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PALISADES METEOROLOGICAL STUDY VOLUME 1  
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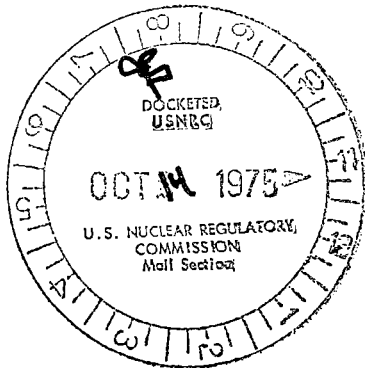
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PALISADES METEOROLOGICAL STUDY

VOLUME 1

FOR

CONSUMERS POWER COMPANY  
1945 West Parnell  
Jackson, Michigan 49201

Under Contract  
issued 2 July 1975

BY

EG&G, ENVIRONMENTAL CONSULTANTS  
9025 East Kenyon Drive  
Denver, Colorado 80237

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PALISADES METEOROLOGICAL STUDY


22 September 1975

CERTIFICATIONS


The data processing, and analyses described in this report represent a true and accurate account of the work performed to obtain the data present.

  
\_\_\_\_\_  
Roger Nelson  
Atmospheric Physicist

The treatment of information contained in this report is appropriate for its stated purpose and consistent with current and accepted techniques in this field.

  
\_\_\_\_\_  
Leroy Meyer  
Scientific Specialist

Approved for Publication

  
\_\_\_\_\_  
August Hansen  
Denver Operations Manager

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## 1.0 INTRODUCTION

### 1.1 BACKGROUND

This Palisades meteorological study has been undertaken by Consumers Power Company because of the apparent inadequacy of the existing program in meeting the meteorological requirements for an operating nuclear power plant. The new Nuclear Regulatory Commission (NRC) regulatory guides reflect stringent requirements for meteorological instrumentation, percent of data recovery, and representativeness of the data for dose calculations and safety considerations.

The study is based primarily on data supplied by Consumers Power from the Palisades meteorological station, data obtained from the University of Michigan P03A station, and data from the National Weather Service station at Muskegon, Michigan. Other regional data were considered, but, for various reasons, were not available in a usable form for the study.

Sources of off-site data that were considered for use in performing X/Q estimates for Palisades were:

- 1) U.S. Coast Guard station near Benton Harbor
- 2) Donald C. Cook nuclear plant, about 25 miles south of the Palisades plant
- 3) Muskegon Airport

The Coast Guard station had only bihourly wind speed and direction data with sky cover as observed by the attendant. Data would have to be copied at the Coast Guard station.

The Donald C. Cook data were not available for the study.

Muskegon Airport data were available from the National Weather Service in the form of the STAR program, which provided the joint wind speed, wind direction in six stability categories. These data appeared to be the most complete off-site data available for the area for the X/Q estimate comparison.

Comparison of the on-site data and data from station P03A is presented in Section 2.0. Comparison of these data with the National Weather Service data is given in Section 3.0.

## 1.2 METEOROLOGICAL PROGRAM HISTORY

The preoperational meteorological program consisted of two stations located within the Palisades plant site boundary. Each station consisted of a self-standing tower with thermistors mounted at the 10- and 55-foot levels for temperature measurement. Also mounted at the 55-foot level on each tower was a Gill-type Propeller Vane for wind speed and direction measurements. All parameters were recorded on strip chart recorders located in the construction office building, with signals transmitted via underground cables. The inland station was located approximately 2400 feet east and 1350 feet north of the containment building at the eastern foot of shoreline sand dunes with a ground level elevation of approximately 610 feet. The shoreline station was located 150 feet east and 40 feet south of the containment building, part way up the western slope of a dune with the 55-foot tower level at the same elevation as the top of the containment building, or about 200 feet above the lake. Figure 1 is a map showing location of key structures on and around the Palisades site.

These preoperational sites were abandoned after plant construction was completed because they were not considered representative nor adequate. They were replaced with the present 55-foot pole located on a sand dune approximately 700 feet east of the containment structure. The instrumentation includes aspirated temperature probes (mounted at 10 and 55 feet), wind direction,

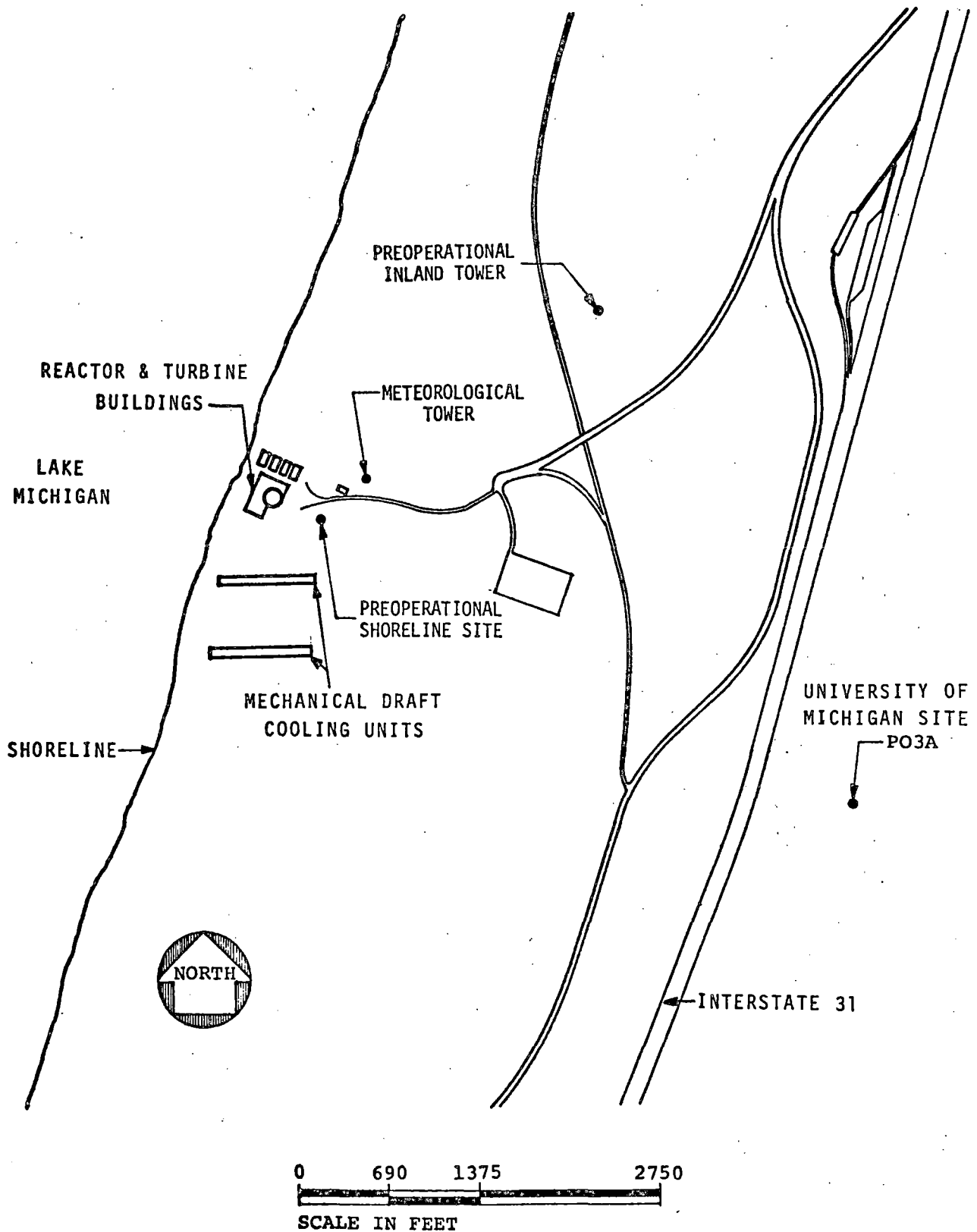


Figure 1. Map of Palisades nuclear plant site.

and wind speed sensors (mounted at 55 feet). The wind direction signal is further conditioned to provide an indication of the horizontal wind direction variation ( $\sigma$ ). The temperature sensors are electronically "bucked" to provide an output signal proportional to the temperature difference between the two sensors. The nonlinearities of the temperature sensors are electronically compensated. The wind speed, wind direction, wind  $\sigma$ , ambient air temperature and temperature difference data were recorded in digital form on a cassette tape recorder at the base of the tower. In addition, a Bendix weather vane mounted adjacent to the above sensors on the 55-foot pole is used with wind speed and wind direction analog recorders located in the reactor control room.

Additional wind data were provided by a small analog system instrumented by the University of Michigan. This P03A site consisted of a 10-foot tower with wind speed and wind direction sensors; data were recorded on strip chart recorders.

### 1.3 SITE DESCRIPTIONS

The Palisades plant is located in the southwest lower climatic district of Michigan on the eastern shore of Lake Michigan. The lake smooths out most climatic extremes, with the most pronounced lake effect occurring during the coldest part of winter when there is an excess of cloudiness and little sunshine. Prevailing winds are from the western sectors during all seasons, but most predominantly in winter. Periods of westerly winds (off Lake Michigan) and localized lake-land breezes probably modify temperatures predominantly during the summer months. The mean wind speed reaches a maximum of about 20 mph in the winter months and falls to 10-15 mph during the remainder of the year. The plant area averages about 80 days per year of snow cover lowering the winter temperature below what would be considered normal and retarding spring warming.

The annual mean monthly temperature ranges from 20°F in February to about 70°F in July. The annual mean monthly precipitation ranges from 1.5 inches in February to about 3.5 inches in September with an annual total of about 29 inches.

The Palisades site is located about five miles south-southwest of South Haven, Michigan. The shoreline at the site is characterized by sand dunes extending inland typically about one-half mile. With the exception of the shoreline (about 100 feet of beach), the inland surface (including sand dunes) is quite heavily wooded with an average tree height of about 30 feet above the surface. This "rough" surface structure probably tends to generate more mechanical turbulence than would normally be anticipated.

Topography for a five-mile radius around the site showing key locations of site structure is given in Section 4.0.

A sketch of the Palisades site is shown in Figure 2. The existing meteorological station is located on the left side of the sketch on the sand dune behind the visitor center.

Locations of various meteorological towers that have been associated with the Palisades program are given below. Distance is from the containment structure and angle is with reference to true north as zero.

Palisades meteorological tower	700 feet at 80.5°
UM P03A site	4533 feet at 120°
Preoperational shoreline tower	155 feet at 105°
Preoperational inland tower	2754 feet at 61°

The University of Michigan P03A site lies inland approximately 1 mile to the east-southeast of the Palisades plant. It is situated in a cleared field relatively free of obstructions. The nearest trees are approximately 300 feet to the east with a much larger (about 1000 feet) distance to any other obstructions to the wind flow.



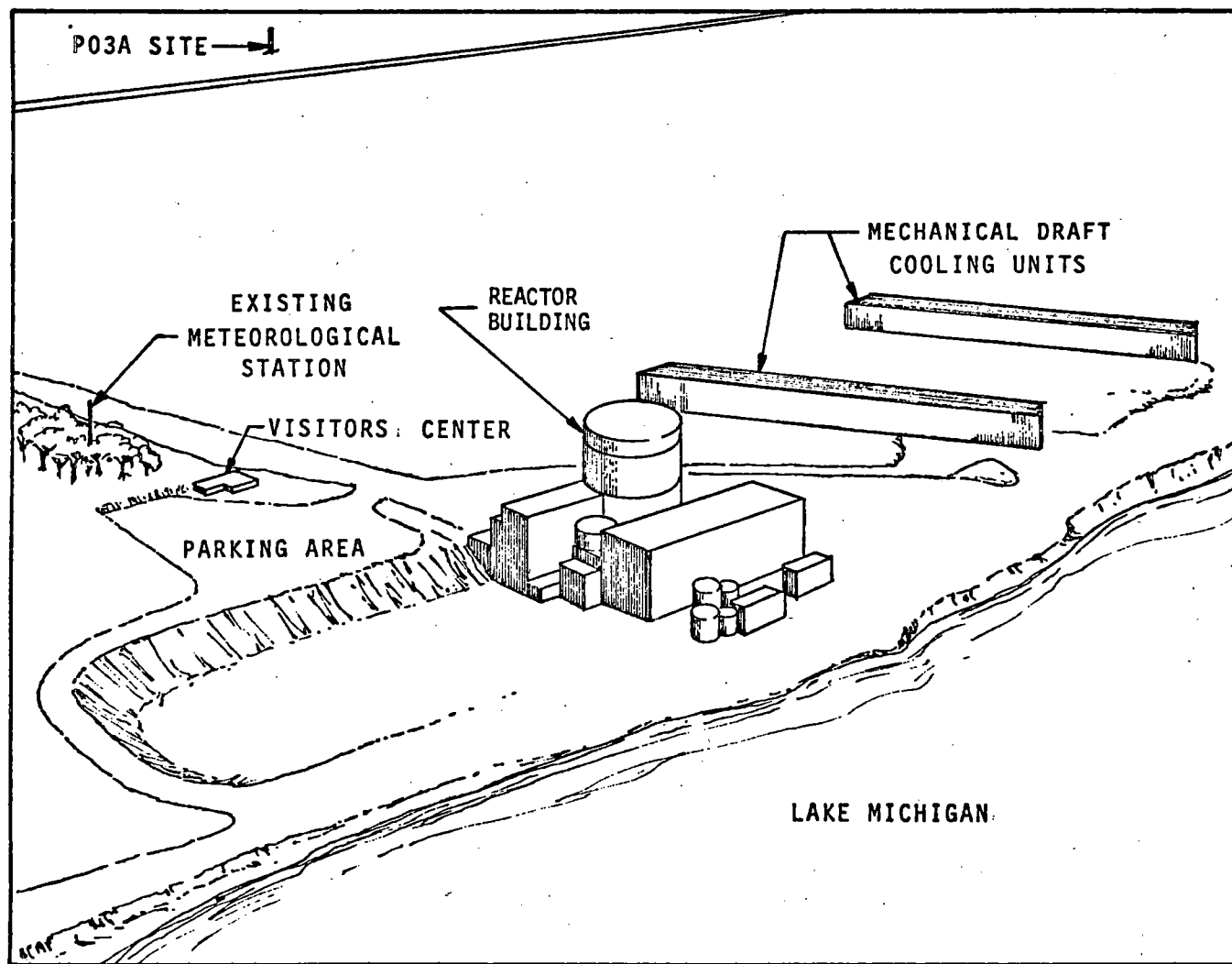


Figure 2. Palisades nuclear plant site showing meteorological station.

The Muskegon Airport is located about 3.5 miles inland and P03A is about 1 mile inland. The sensors are mounted at the standardized NWS height of 10 meters above the surface. The surrounding vegetation is predominantly characterized by a medium to high grass making the roughness parameter about 4 centimeters for all directions. Conversely, the existing Palisades meteorologically instrumented pole is in the midst of a wooded area with trees within 3 meters of the pole in all directions. The wind sensors are mounted about 8 meters above the mean tree-top level, thus effectively making the wind measurement at about 6 meters with a roughness parameter of about 10 centimeters or more.

## 2.0 COMPARISON OF ON-SITE DATA AND UNIVERSITY OF MICHIGAN STATION P03A DATA

### 2.1 DATA SOURCE

Data used in the study were compiled by Consumers Power Company and submitted to EG&G, Environmental Consultants in the form of 1600 BPI nine-track magnetic tape. Included were data from the P03A site from July 1973 to December 1973 and data from the Palisades site covering the period August 1973 through December 1974. The overlapping time periods are from August 1973 to December 1973.

No attempt has been made, from a quality assurance standpoint, to justify the validity and accuracy of the data analyzed. Certain physical considerations, however, lead to the conclusion that a significant portion of the on-site data collected was not correct. Throughout the analyses, several tests on each data point were made to provide a more realistic picture of the site diffusion meteorology. Data failing these tests were not used in the analysis.

### 2.2 WIND PATTERNS

Wind data for Palisades and University of Michigan station P03A have been compared in several ways to determine how well they correlate. Wind rose presentations, by month, for the two sites are given in Appendix A for August through December 1973. The shoreline station, which is approximately 200 feet above lake level, shows a dominant southeasterly and northwesterly wind preference. The southwesterly winds are diminished with the south and west wind enhanced at the shoreline site indicating possible wake or cavity effects at this station from the close proximity to the reactor

building for southwesterly winds. The inland P03A site shows a significantly higher percentage of southwesterly winds and also has a much higher percentage of calms, partially accounted for by the 10-foot height of the sensors. Calms were defined as speeds less than 1 mph. Winds at the shoreline site tended to be stronger even when allowances were made for the tower height difference (see Section 2.4).

The extremely high percentage of calms at the P03A site is partially due to the nearness of the sensors to the ground. A significant number of the calms, however, occur for prevailing wind directions from the east and east-southeast. As discussed in Section 1.3, this direction is associated with the nearest obstructions to the flow in the vicinity of the P03A site. It is conceivable that the wake turbulence generated by these trees (when winds are from the east-southeast) is responsible for the high frequency of calms at the P03A site.

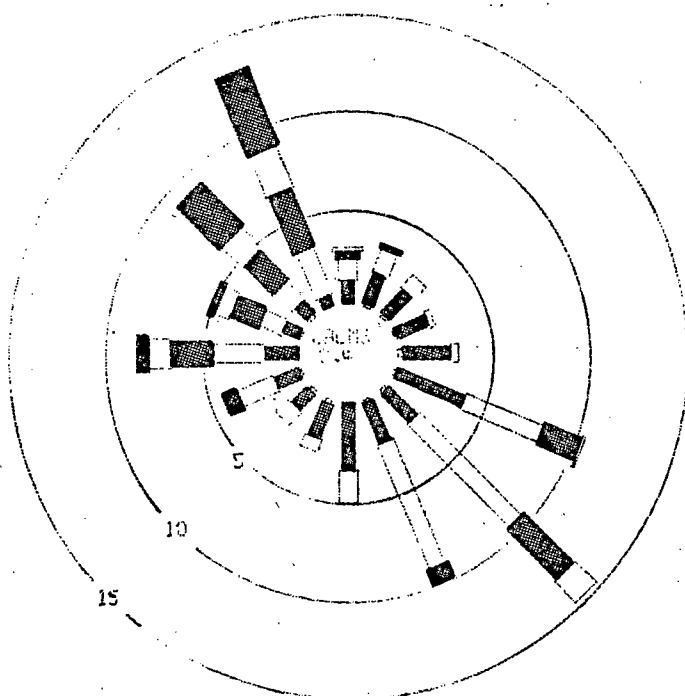
The July 1973 wind rose for the inland site shows a high percentage of southwesterly winds. The shoreline station wind rose for August shows predominant winds out of the west and southeast. The inland station shows predominant winds from the southwest quadrant and a 30.2% incidence of calms. In September, the southeast and northwest quadrants predominated at the shoreline station while the inland station had a much more equal direction distribution (although the northwesterly wind predominated with calms occurring at a frequency of 29.1%). The October wind roses for both stations are similar, with the southeast-northwest winds predominating. The inland station experienced a 24.9% frequency of calm, while 0.3% were observed at the shoreline. At the shoreline station the southeasterly and northwesterly winds predominated during November and December. The wind roses for both stations for December were based on a low percentage of data recovery. The high percentage of calms at the shoreline (17.4%) in December is questionable and was probably caused by a five-day period, 13 to 18 December,

of zero wind speed. Icing conditions may have occurred at the shoreline station since winds of up to 10 mph were recorded at the inland site during this period.

Wind roses for these two stations for the fall 1973 season (September, October, November) are shown in Figure 3. They are representative of the winds recorded at the two sites and display the characteristics discussed above.

The north-northwest winds have a significantly higher velocity than other directions at both the P03A and Palisades sites. One contributing factor for these stronger northwesterly winds is that the fetch over the lake is longer from these directions. There may also be some channeling through the access road, although the magnitude of this effect is questionable. Because the P03A site shows increased northwesterly velocities, the former explanation seems most likely. Additional wind data from Muskegon (60 miles to the north) also show an increase in wind speed associated with north-northwest directions, but the magnitude of the effect is only about a 1-knot increase for these sectors, while the magnitude of the effect at the Palisades site shows a 3-4 mph increase.

The effect of surface roughness on wind speed can be seen in Figure 4. The friction drag on winds at the Palisades site would probably be about that shown for the suburbs with easterly winds and that shown for level country or lakes with westerly winds. The southwesterly winds have a fetch of about 75 to 100 miles across Lake Michigan. The northwest winds have a fetch considerably longer (up to 250 miles). Winds coming off the lake are generally expected to be less turbulent than winds off the land for the same meteorological conditions. As they move inland, the winds should gain somewhat in turbulence in the lower layers due to surface roughness and thermal heating of the land. Dispersion of releases made from reactor building heights, during times of on-shore winds,



should be enhanced by mechanical and thermal turbulence caused by the shore and dunes. Because of the possibility of people fishing on the lake, winds blowing toward the lake are also of interest. These winds should generally arrive at the plant site with marked turbulence. This turbulence would be expected to subside at a considerable distance out over the lake.

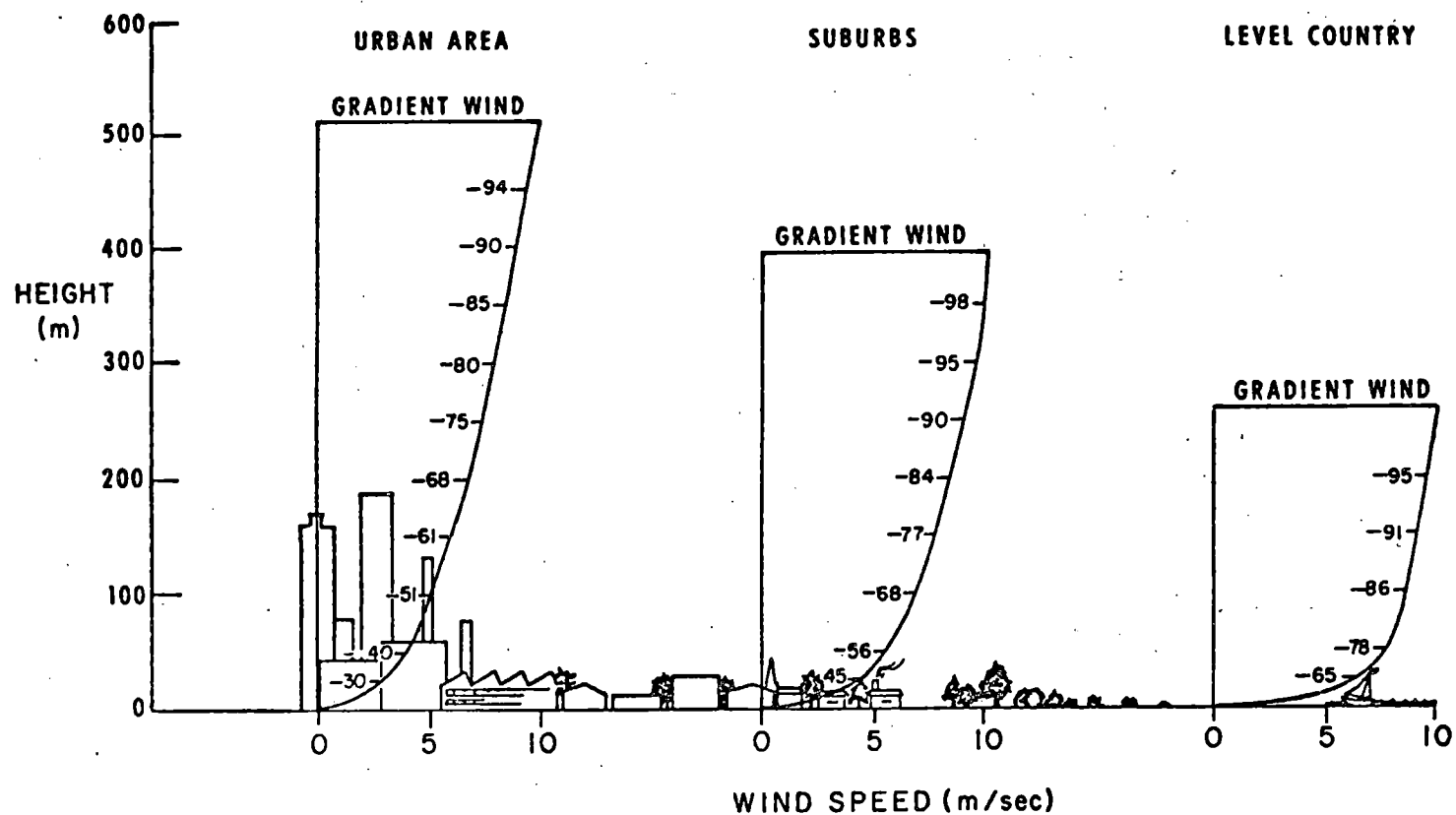


Figure 4. Examples of variation of wind with height over different size roughness elements (figures are percentages of gradient wind); (from Davenport, 1963).



### 2.3 LAKE BREEZE

A lake breeze is an on-shore wind flow fundamentally produced by the temperature difference between a lake surface and an adjacent land mass. When the land is significantly warmer than the water, the density of the air immediately above the land is less than the density above the water. This results in a simple gradient flow from over the water to over the land. Because of the necessary differential heating of the two surfaces required, lake breezes would be expected to be more common and intense in the late spring and early summer, when water temperature and land temperature show the greatest difference. Other conditions conducive to lake breeze circulation is an absence of clouds with light winds during the afternoon. Mass continuity requires a return circulation to the lake at a distance above the lake breeze flow. Differential heating of the two surfaces can be explained by the dynamic mixing (turbulent) of the water convecting incident energy downward to the rest of the lake, while heat transfer down to lower layers of the land relies upon conduction processes only. During nighttime hours, an opposite circulation can be generated due to the more rapid cooling of the land surface with respect to the water surface.

The wind data for both the on-site station and station P03A were studied for lake-land breeze effects by arranging the wind data in four-hour wind rose presentations with each time period analyzed over the fall 1973 season. These four-hour wind roses are presented in Appendix B. The time periods are 1 to 4, 5 to 8, etc., to 20 to 24 hours. The 1 to 4 indicates that the data for the first four hours of the day (midnight to 4 a.m.) is analyzed for each day during the fall season.

During the time period beginning at late evening (about 2000) to noon the next day there was a high percentage of land breeze directions coming from the east-southeast, southeast, and south-southeast at the site. During this time, the lake was warmer than

the land. From noon until about 2000, there was a higher percentage of lake breeze directions from the west, northwest, and north-northwest indicating the land had been warmed during the afternoon. During the afternoon hours (1300 to 1600), the lake breeze effect appears to extend inland to the P03A station with a higher percentage of northwest to southwest winds than during other time periods.

Winds at the shore station from the west through north-northwest have a higher average velocity than from the other directions. Also, there was a higher percentage of southwest and west-southwest winds during the 9 to 12 period at station P03A. The west to north-northwest winds also appear to have higher velocities at the P03A station, with occasional peaks from the southwest. The calms at P03A occur often when southeast winds occur at Palisades.

Most of the calm periods at P03A occurred during nighttime hours when land breeze was blowing toward the lake. Thus, there could be a correlation between calms at site P03A and southeast winds at Palisades. These percentages are presented in Table 1.

Table 1. Percent of calm for four time periods, 1973 fall season.

<u>Time Period</u>	<u>% of Calm P03A</u>	<u>% of Calm Palisades</u>
0100-0400	38.3	0.5
0500-0800	29.9	0.3
0900-1200	2.0	0.8
1300-1600	0.7	0.7
1700-2000	18.5	0.4
2100-2400	44.1	0.4

Although not plotted in graphical form, the four remaining seasons of wind data from the Palisades site (winter, spring, summer, and fall 1973-1974) were analyzed in the same manner to

investigate the behavior of the lake-land breeze circulation with respect to season. All the remaining seasons show evidence of this phenomenon, although the effect is greatly diminished during the winter.

Because the lake has not warmed appreciably by mid-spring, while the land surface has almost reached its maximum insolation, the lake breeze effect should be more apparent in the spring than in the fall when the water has warmed to its maximum temperature and the land is receiving the same amount of heating. The late afternoon temperature difference between air masses of land over water should be greatest in spring. The opposite is true for land breezes. The early morning temperature difference between water and land should be greatest in fall when the lake has attained its maximum temperature and the land has cooled, forming autumn inversions.

This effect of lake breeze predominance during the spring and land breeze predominance during the fall is not apparent from the Palisades data. Throughout spring, summer, and fall, the lake-land breeze diurnal circulation was about equal magnitude.

## 2.4 WIND SPEED CORRELATION

Because the wind rose representations showed very definite differences in wind directions and velocities, scatter diagrams of the wind speeds at each site were used to obtain a better understanding of the velocity differences occurring at the same time period. These scatter diagrams are graphical representations of the behavior of the wind speed at the Palisades site with respect to the wind speed at the P03A site for the fall 1973 season. Each hourly observation at the two sites is plotted on a two-dimensional grid with the wind speed at the Palisades site as the ordinate and the wind speed at the P03A site as the abscissa. Thus the density of points at any position in the graph is statistically representative of the correlation. In these diagrams, letters were used to indicate the number of times that a point on the chart occurred (A = 1, B = 2, ... Z = 26). A star indicates more than 26 occurrences.

If there were perfect correlation between the speeds at the two sites, the scatter diagram would consist of a straight line at  $45^\circ$ . As seen in Figure 5, there is a definite bias in favor of the Palisades site, which has higher wind velocities for most of the record period. These higher wind velocities are partially caused by the difference in tower heights. The solid line plotted is a least squares fit to the linear relationship between speeds at the two sites. Writing this as  $y = ax + b$ ,  $a = 1.259$  and  $b = 2.91$ . Readily apparent in the scatter diagram is the large spread in the data about the least squares linear fit. This is reflected in the coefficient of determination ( $r^2 = 0.44$ ) which can be interpreted as the proportion of total variation about the  $\bar{y}$ , explained by the regression. In other words, the coefficient of determination measures the "goodness of fit" of the regression line. Note that  $0 \leq r^2 \leq 1$ , and a perfect fit implies  $r^2 = 1$ .

The wind speed profile above the surface is extremely dependent upon the roughness of that surface (see Figure 4). In most instances, the wind profile follows a simple logarithmic pattern described by

$$\bar{u} = \frac{U_*}{K} \ln \left( \frac{z}{z_0} \right)$$

where

$U_*$  = the friction velocity,

$K$  = the von Karman constant (about 0.38), and

$z_0$  = the roughness parameter.

The roughness parameter is intimately related to the characteristic size of the roughness elements impeding a smooth surface wind flow. This equation can be used to calculate the mean wind speeds at heights other than those at which the mean wind is actually measured:

$$\frac{\bar{u}_2}{\bar{u}_1} = \frac{\ln (z_2/z_0)}{\ln (z_1/z_0)}$$

The roughness parameter for fields of medium to high grass and widely scattered trees separated by about 100 feet is about 5 centimeters, normalizing the wind speed at 3 meters at the P03A site to the value it should have at 10 meters results in a ratio of

$$\frac{\bar{u}_{10}}{\bar{u}_3} = 1.29.$$

Normalization of the wind speed measured 55 feet above the surface (but only 25 feet above the tops of the surrounding trees) at the Palisades site requires several assumptions whose validity is questionable. Winds coming from the western hemisphere are not subjected to as much surface roughness as winds from the east.

It would be expected that the roughness parameter for the Palisades site is highly direction-dependent.

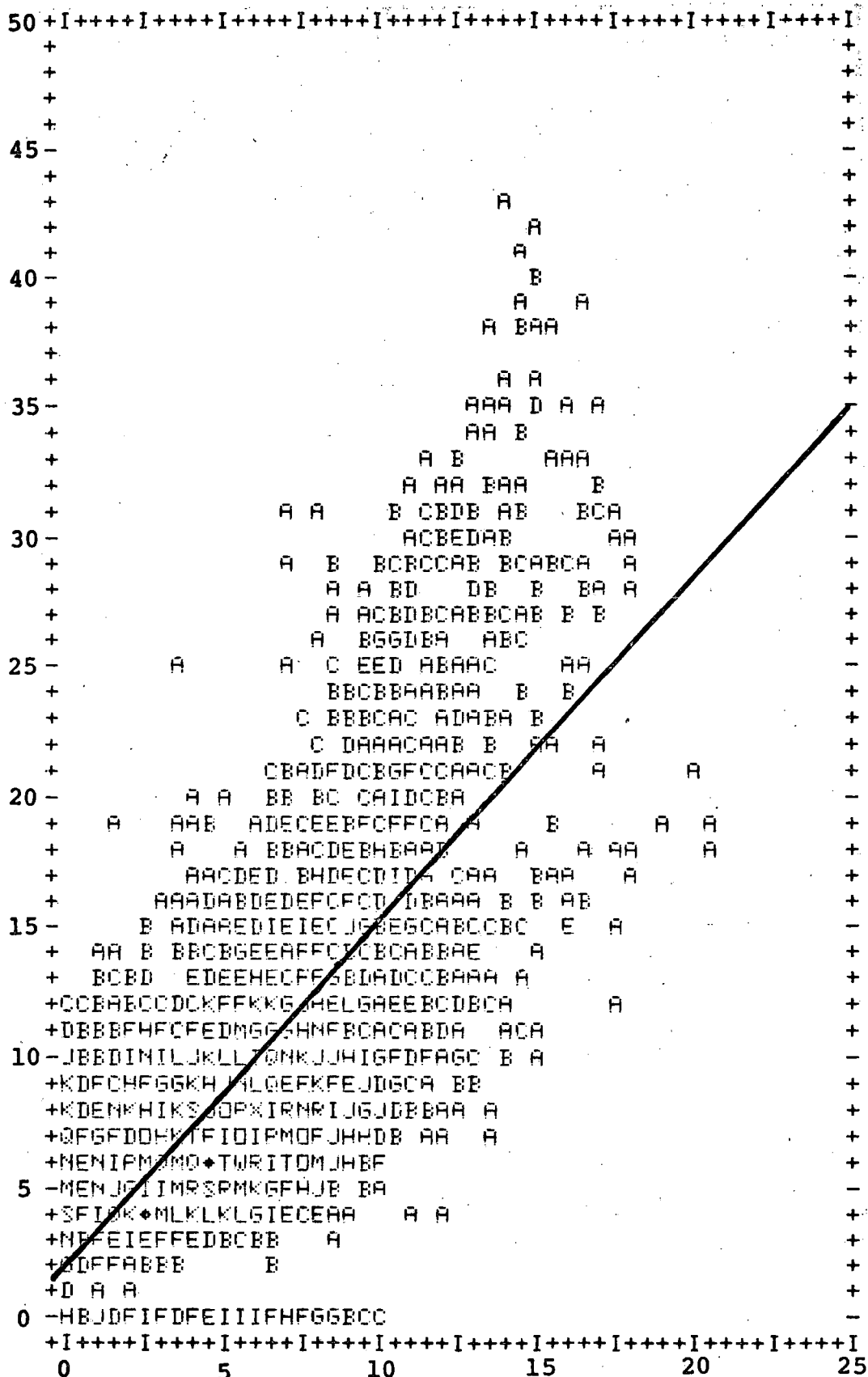
Due to the complexity of the problem, no attempt was made to correlate the roughness parameter with direction. Because of the relatively dense foliage surrounding the Palisades tower, a normalization of the wind speed to 10 meters, assuming that the sensors are 55 feet above the surface, is probably incorrect. The height of the wind sensors above the tree tops varies considerably, but averages about 25 feet (7.62 meters). Therefore, the normalization would probably be more correctly done by using a 25-foot sensor height above the surface and a roughness parameter value similar to that used for the P03A site (tree top heights are relatively similar). This results in:

$$\frac{\bar{U}_{10}}{\bar{U}_{7.62}} = \frac{\ln(10/0.05)}{\ln(7.62/0.05)} = 1.0541$$

The scatter diagram shown in Figure 5 was replotted with the wind speeds at the two sites normalized to their expected values at 10 meters (Figure 6). The solid curve is the least squares linear fit line for the normalized data;  $a = 1.026$  and  $b = 3.057$  indicating that the choice of roughness parameter was good. This statistical evaluation points out that the wind speeds at the two sites are substantially different, and great care should be exercised when using data from either in modeling calculations.

PALISADES

WIND SPEED - MPH



WIND SPEED - MPH  
UNIVERSITY OF MICHIGAN STATION P03A

Figure 5. Scatter diagram comparing Palisades wind speed data with University of Michigan station P03A data (data for fall 1973 time period).

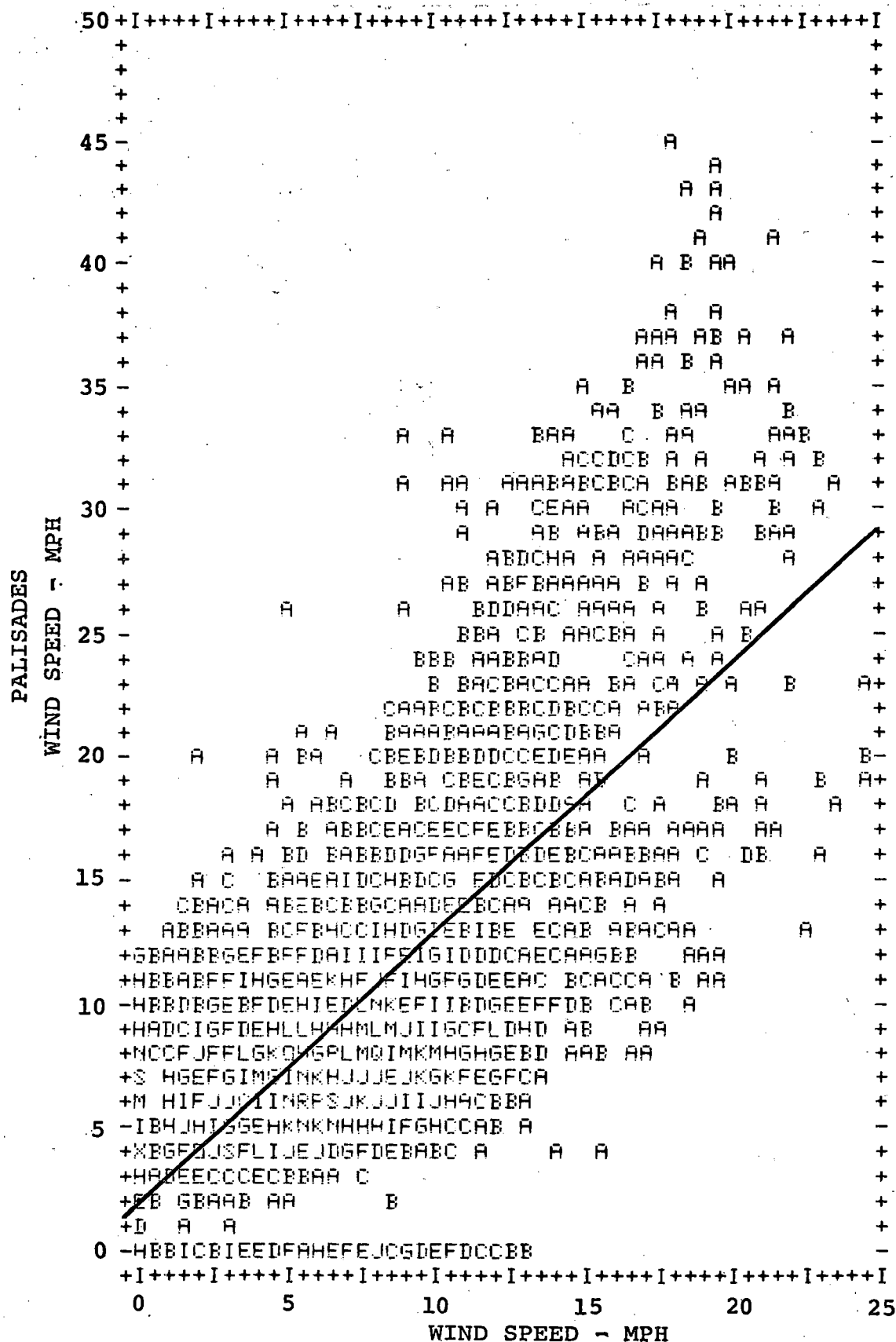


Figure 6. Scatter diagram comparing wind speed data adjusted for tower height for Palisades and University of Michigan station P03A (data for fall 1973 time period).



## 2.5 DIFFERENCE WIND ROSE DATA

In addition to the scatter diagrams and wind rose tables, another method of investigating wind correlations between the two sites was developed. This technique consisted of vectorially subtracting the winds at the P03A site from those at the Palisades site, and categorizing these difference vector winds by direction and speed. The resultant values showing the relative frequency of occurrence of speed and direction of these difference vectors for the fall season are given in Table 2. Note the high percentage of differences in the southeast, south-southeast and northwest directions. These can probably be explained by the stronger influence of the lake-land breeze effect at the Palisades shoreline site than at the P03A site. Conditions conducive to a lake breeze or land breeze circulation require relative light overall winds. Without a northwesterly lake breeze penetrating inland to the P03A site, the difference vector would be relatively unchanged from the actual wind vector at the Palisades site because the P03A winds should be small and variable. The same situation, in reverse, should hold for a southwesterly land breeze. The average vector difference in wind speed was 7.1 mph. If there were perfect correlation between sites, all values in the chart would be zeros.

Table 2. Fall 1973 Difference Wind Rose Data.

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	1.4	1.2	0.0	0.0	0.0	0.0	2.7	3.1
NNE	0.3	0.5	0.0	0.0	0.0	0.0	0.8	3.1
NE	0.4	0.2	0.0	0.0	0.0	0.0	0.6	2.1
ENE	0.5	0.2	0.0	0.0	0.0	0.0	0.7	2.7
E	0.5	1.4	0.7	0.0	0.0	0.0	2.7	4.9
ESE	1.1	3.6	2.5	1.1	0.3	0.0	8.7	7.5
SE	1.3	3.5	4.3	4.0	1.0	0.1	14.2	10.0
SSE	1.5	4.4	5.2	6.3	2.7	0.3	20.5	11.1
S	1.3	2.3	0.7	0.1	0.0	0.0	4.5	4.9
SSW	1.1	1.5	0.1	0.0	0.0	0.0	2.7	3.3
SW	1.2	0.9	0.0	0.0	0.0	0.0	2.2	2.8
WSW	1.2	0.7	0.0	0.0	0.0	0.0	1.8	2.6
W	1.7	2.2	0.3	0.1	0.0	0.0	4.3	3.8
WNW	1.3	4.1	1.5	0.1	0.0	0.0	7.0	5.1
NW	2.0	7.6	8.4	0.6	0.0	0.0	18.6	6.7
NNW	1.5	3.6	0.6	0.0	0.0	0.0	5.7	4.4
TOTAL	18.4	38.0	24.3	12.4	4.1	0.5	97.6	7.1

## 2.6 HOURLY AVERAGES BY HOUR OF DAY

The hourly averages by hour of day for all parameters measured at Palisades and wind speeds at station P03A are given in Appendix E for each month and season of record. Minimum and maximum values are also given. Each hourly data point presented is the mean of the data taken during that particular hour of the day for all days of the month. A composite day defines the maximum, minimum, and mean values for 24 composite hours of a month. The maximum and minimum listed are the individual hourly averages which are greater than or less than, respectively, all other hourly averages.

The average wind speed vs hour of the day is plotted for the Palisades site and University of Michigan station P03A for each month, August 1973 to December 1973, in Figure 7. The diurnal variation in wind speed is quite noticeable in the summer months at P03A and much less evident by December. Winds, on the average, reach their peak velocity at P03A around noon to early afternoon.

At the Palisades site, the diurnal variation is quite different. The August and September plots in Figure 7 reach a slight peak at about 3:00 p.m. In October, the diurnal pattern reaches peak velocity at midnight. There is a minimum velocity at both sites around 2000 hours in August, 1900 hours in September, and 1800 hours in October. By November, there is little diurnal variation in wind speeds at Palisades; in December, the minimum velocity occurs during the morning hours from 0600 to 1200. These diagrams clearly show the effect of Lake Michigan on wind velocity at the Palisades site, where the lake breeze has a definite overall effect on average velocities. The wind speed vs hour of day for fall 1973 is plotted in Figure 8.

A similar plot is shown in Figure 9 for air temperature, temperature difference, and wind sigma for Palisades for fall 1973. The air temperature shows a typical diurnal variation, as expected.

However, temperature difference shows an increased atmospheric stability (inversion) during the period from about 0800 to 1300 hours. This is contrary to what might be expected at an inland site where most inversions should break up by about 1000 hours. It is probably due to the land warming as the sun comes up, creating a lake breeze. The lake breeze carried cold air off the lake across the ground creating the inversion. By mid-afternoon, the lake breeze circulation began to dissipate and more unstable conditions existed. The wind sigma average appears typical of what might be expected with increasing sigmas during the morning hours toward unstable atmospheric conditions during the afternoon, with a reversal in this trend at mid-afternoon. The magnitude of this effect, however, is greatly reduced from that of a typical inland site. This is, again, probably caused by the influence of the lake breeze bringing stable, more laminar flow off the lake.

The 1974 Palisades average wind speed vs hour of day is shown in Figure 10 for January to October. The charts are continued in Figure 11, and also include  $\Delta T$  and air temperature by season. There are some differences noted in the 1974 plots from those for 1973. In 1973, late summer and fall, the Palisades average wind speed vs hour of the day plots showed only a slight peak at 1500 hours. In September of 1974, a more pronounced diurnal variation, similar to that for the 1973 station P03A plot, is observed. In 1974, this diurnal variation is noticeable for April, May, July, August, and September. Thus, the Palisades site data appear to have more diurnal variability than station P03A, with typical inland average diurnal variation modified to varying degrees by the lake-land breeze.

The December average winds do not show a minimum during the morning hours in 1974, as they did in 1973. The seasonal averages for  $\Delta T$  show the same type of pattern for fall 1973 and 1974.

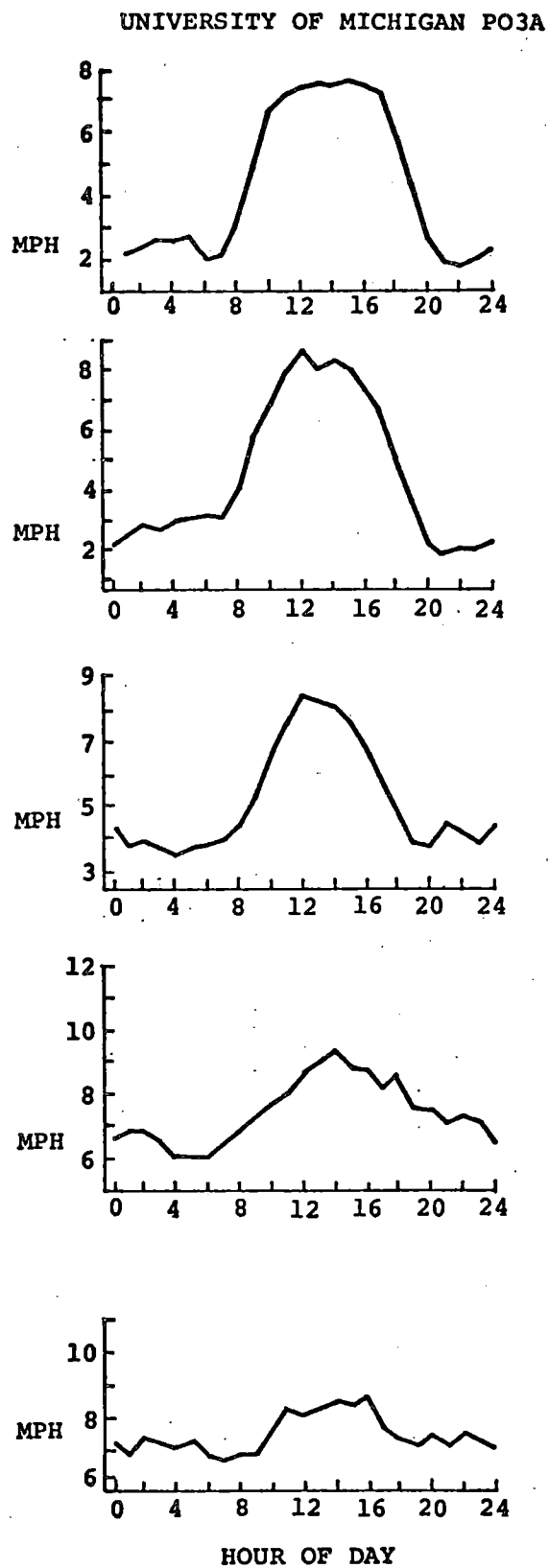
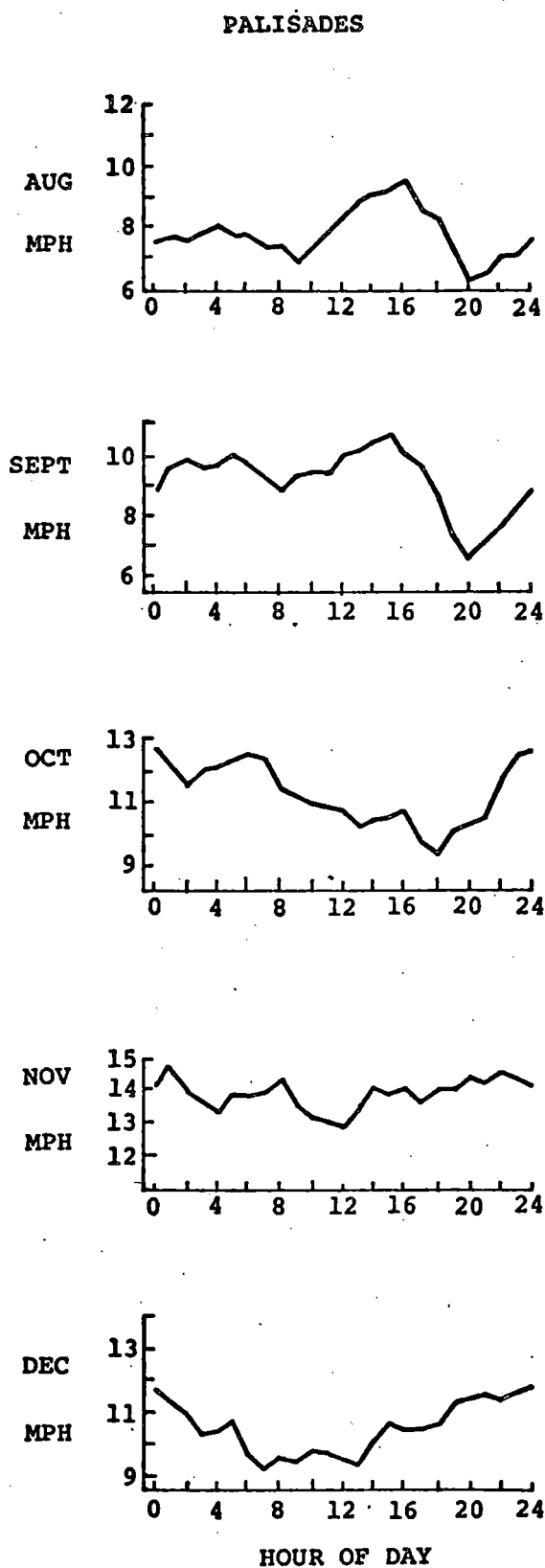


Figure 7. Palisades and University of Michigan station P03A average wind speed vs hour of day for August through December 1973.

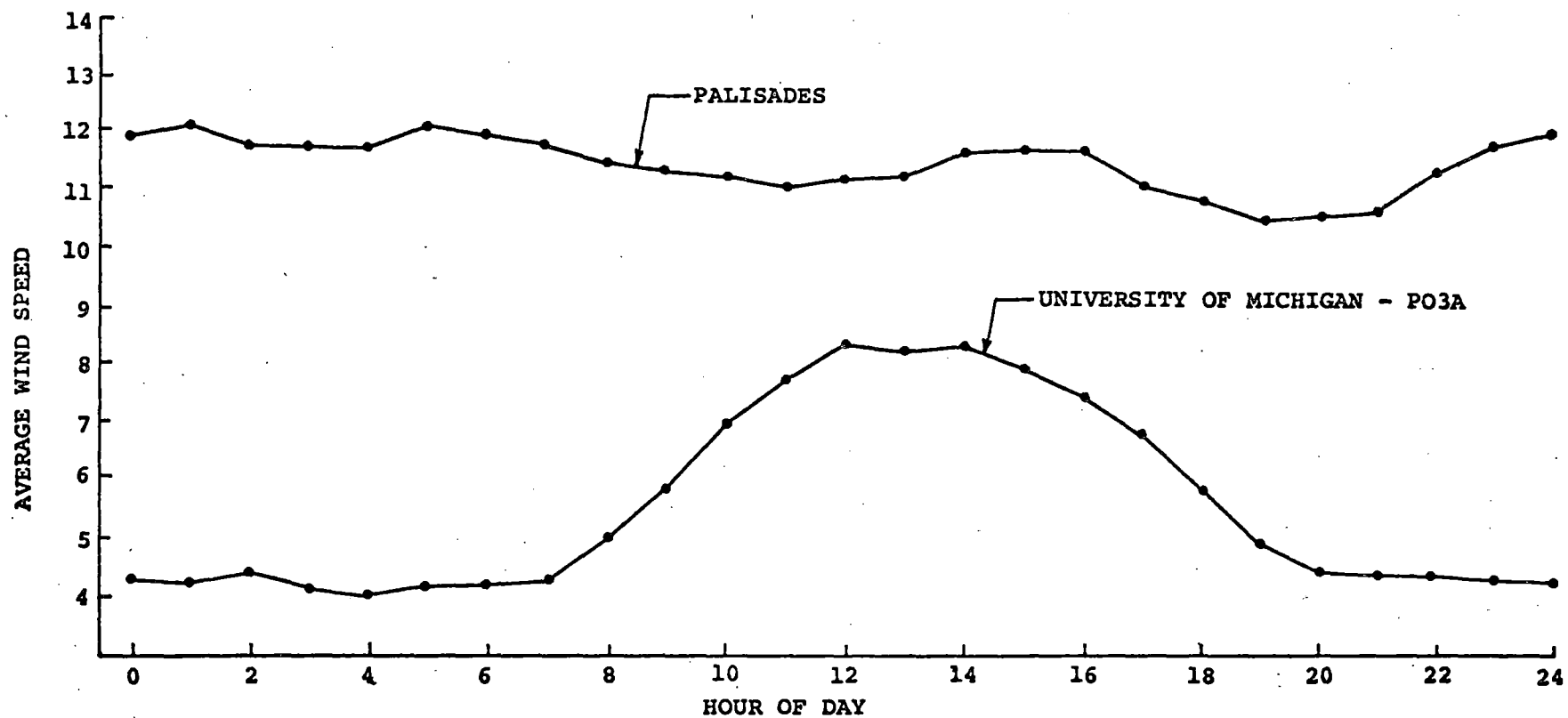


Figure 8. Average wind speed vs hour of day (fall 1973).

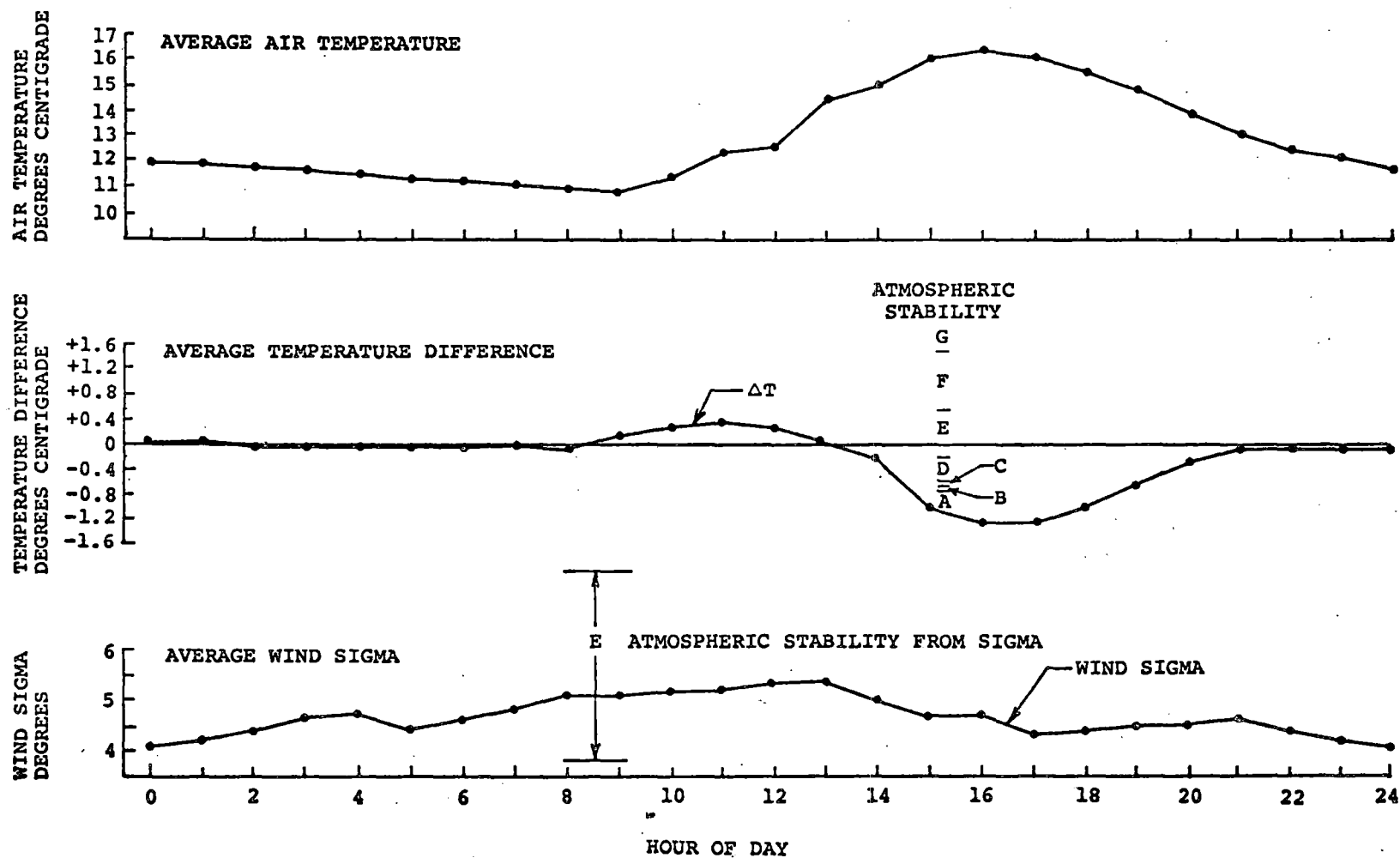


Figure 9. Palisades average air temperature, temperature difference, and wind sigma vs hour of day for fall 1973.

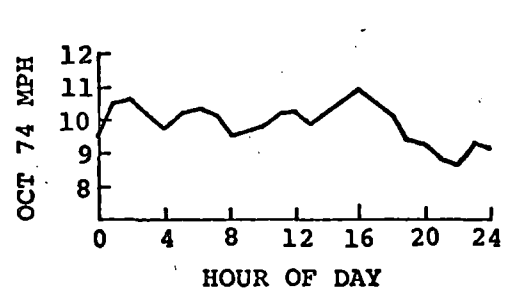
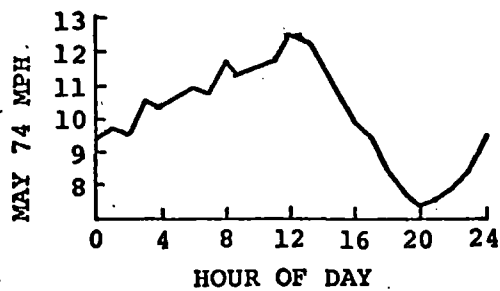
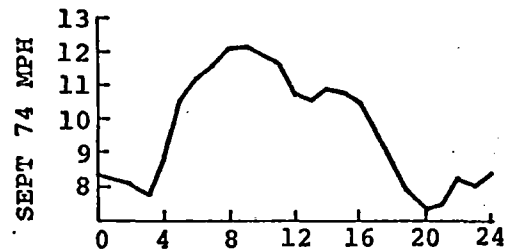
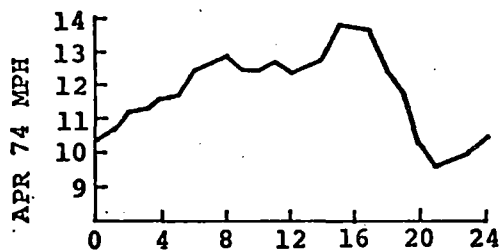
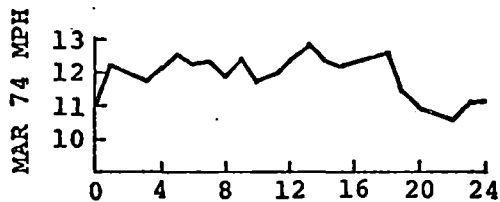
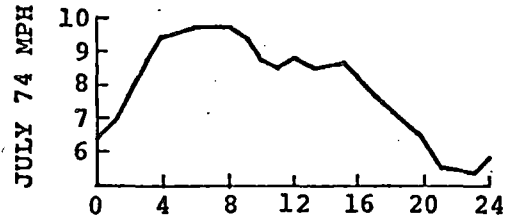
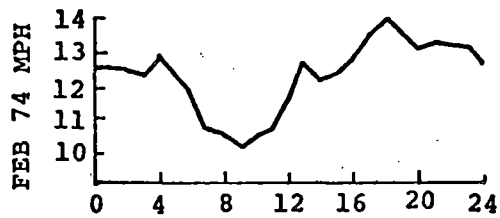
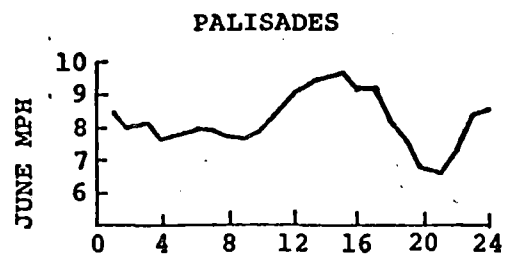
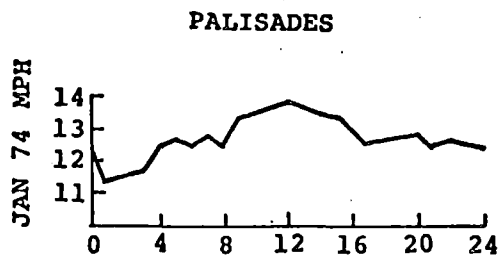


Figure 10. Diurnal variations of average wind speed for January through October 1974.



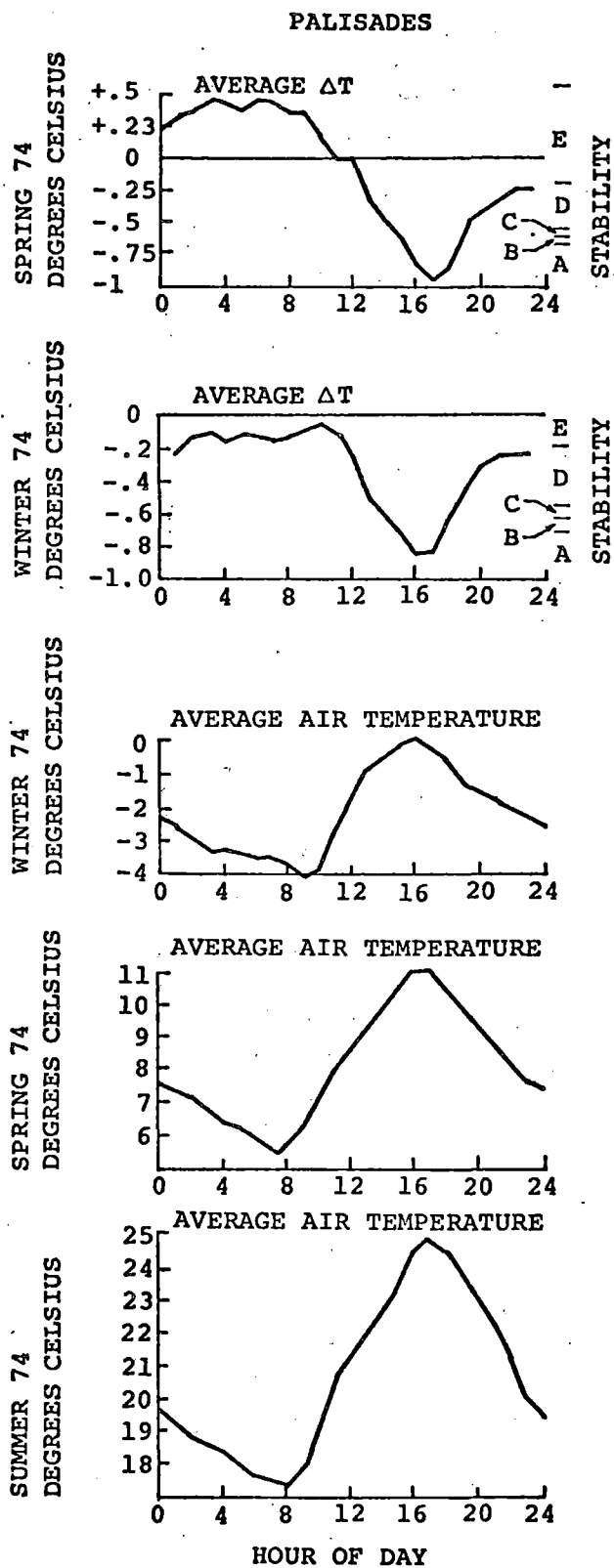
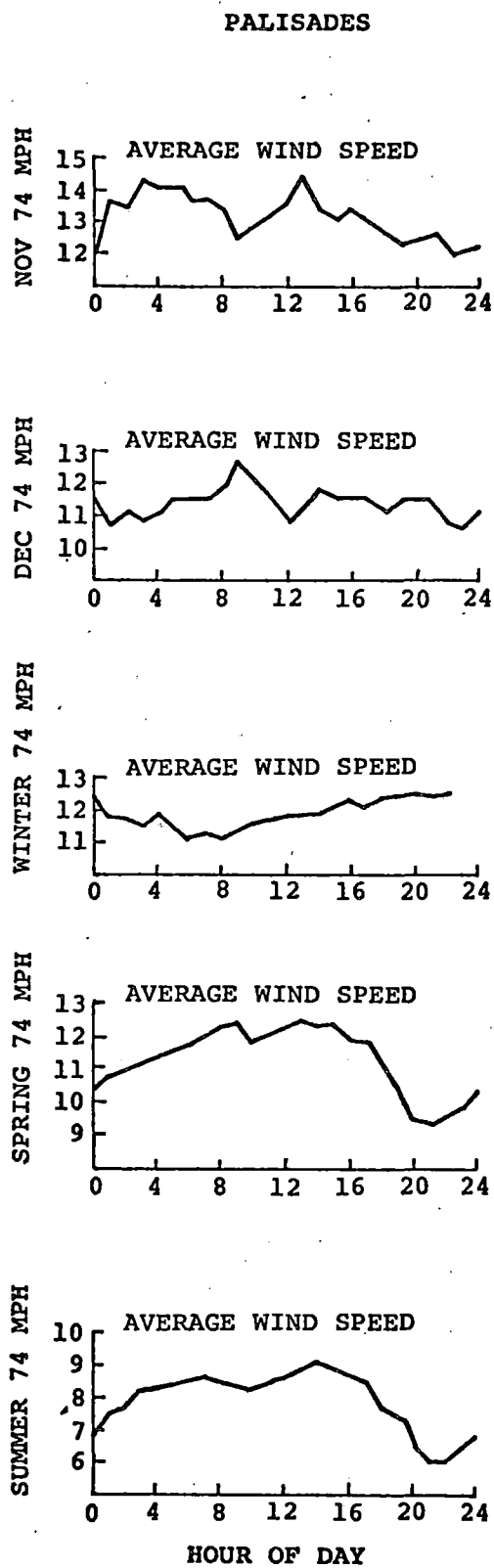


Figure 11. Diurnal variations of wind speed,  $\Delta T$ , and air temperature for Palisades.

## 2.7 WIND PERSISTENCE

The wind direction persistence within a 22-1/2 degree sector using data from the Palisades and University of Michigan station P03A is shown in Figure 12. The wind persistence is calculated by checking the wind direction hourly averages sequentially and determining the length of time any particular series of directions lie within a 22-1/2 degree sector. The average direction of this particular series of data points is then calculated and reported as a function of the average direction. By performing the analysis in this manner, the wind persistence in any arbitrary 22-1/2 degree sector is generated.

The two curves shown in Figure 12 are the least squares log-log fit to the cumulative persistence distribution using data from both sites. Because the graph is presented in log-log form, the analytical form of the relationship between the probability of persistence and the persistence duration is:

$$H = ap^b$$

where

H = the number of hours of persistence

p = the percentage of time the direction persists  
for H hours or longer

a and b = the dimensionless coefficients determined by a  
least squares fit to the data.

Using the data from the fall quarter results in the following values:

<u>Palisades persistence</u>	<u>University of Michigan station P03A persistence</u>
a = 9.57	a = 8.33
b = -0.42	b = -0.35
Coefficient of determination = 0.96	Coefficient of determination = 0.90

which were used to plot the solid curves in Figure 12.

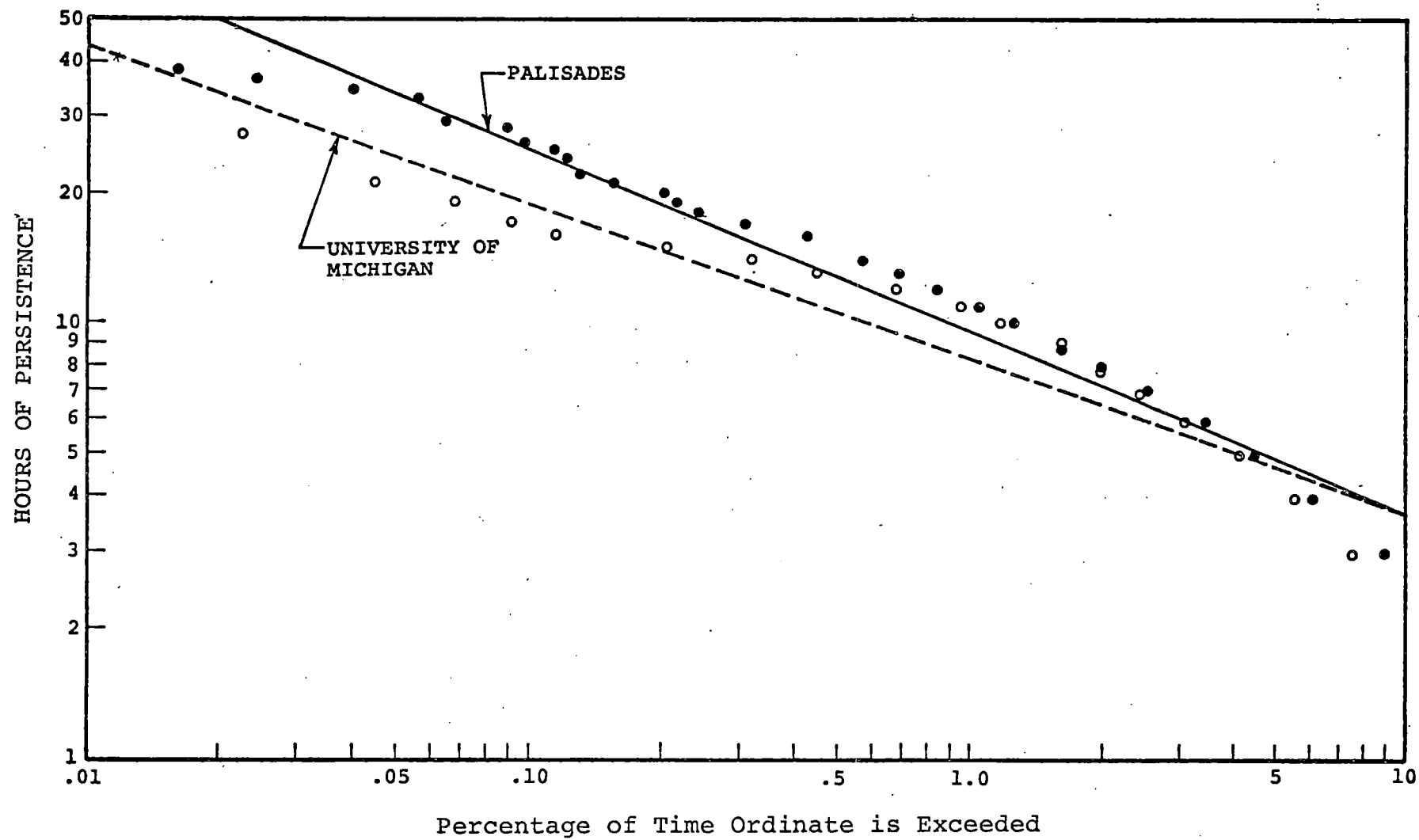


Figure 12. Wind direction persistence in 22-1/2-degree sector.

As an example, in the use of the graph, there is a predicted 0.67% chance that a particular wind direction will persist for ten or more hours at the P03A site, and a 1.03% chance that it will persist for 10 or more hours at Palisades.

The wind persistence is close for the two sites, with P03A having a slightly lower probability for the same hours of wind persistence, indicating more variable winds at P03A.

## 2.8 SUMMARY OF COMPARISON STUDY FOR PALISADES AND UNIVERSITY OF MICHIGAN STATION P03A

This comparison study was conducted to support the operating requirements for the Palisades nuclear plant. The data supplied by Consumers Power were assumed to be valid with the limitations stated in summary statement 5 below. The major findings of this portion of the study are discussed in the following paragraphs:

### 1. Lake breeze and wind patterns

There is a definite lake breeze effect at the Palisades site which is not as apparent in the P03A data. A large percentage of winds occur from the northwest and southeast directions which are perpendicular to the shoreline. Average diurnal wind speed variations were different for the two sites in the fall of 1973. In late fall (October, November) the diurnal average wind speed variations were in opposite daytime hours. A diurnal variation is noticeable for April, May, July, August, and September, 1974. The Palisades site data appear to have more diurnal variability than station P03A, with typical inland average diurnal patterns modified to varying degrees by the lake-land breeze. Average wind velocities at the Palisades site appear to be greater on the average than those at P03A by about 3 mph for the fall season, even when normalized to a 10-meter level. Temperature inversion exists at the Palisades site during the morning hours of all seasons, apparently due to the lake breeze. Little data are available on how far the lake breeze extends inland. During afternoon hours it appears to reach station P03A.

### 2. Wake turbulence

Data comparison indicates that the Palisades meteorological station is influenced by the wake of the reactor containment structure and associated structures when winds are from the south-southwest, southwest, and west-southwest directions.

### 3. Wind persistence

The wind persistence percentage is similar for the two sites, with the Palisades site having a slightly higher probability of longer wind persistence.

### 4. Prevailing winds

Prevailing winds were from the southwest for the duration of the data record. The P03A data show a preference for this direction which was not apparent at the Palisades site, possibly due to the wake factor, sand dune channeling, and sea breeze effects.

### 5. Lack of data representativeness

Neither site in the present configuration can provide data representative of the area suitable for providing unbiased  $\chi/Q$  estimates nor can they meet Regulatory Guide 1.23 requirements. Data from both sites were limited. The University of Michigan station P03A had only wind data available, and wind sensors were located at 10 feet above the surface resulting in an extremely high percentage of calms. The Palisades wind data showed effects of being in the wake of the reactor structures and, perhaps, some channeling by the sand dunes. The temperature difference data appeared to be biased by the close proximity of trees to the lower sensor and the minimal distance between sensors. More data on the vertical temperature and wind structure from both stations would be desirable.

### 6. Site characterization

Present data are inadequate to completely characterize the meteorological conditions at the Palisades site. Studies are continuing to determine the extent inland of the lake breeze. Vertical atmospheric structure data for temperature and winds are needed at the shoreline and at least one inland site to determine atmospheric stability conditions and other atmospheric parameters such as roughness coefficient and unbiased wind speed and direction. While there is correlation between the two sites for wind speeds and persistence, the wind directions and diurnal variations show considerable variance.

### 3.0 COMPARISON OF JOINT FREQUENCY DISTRIBUTIONS AND X/Q ESTIMATES BETWEEN PALISADES SITE DATA AND NWS DATA FROM MUSKEGON, MICHIGAN

#### 3.1 WIND ROSE COMPARISONS

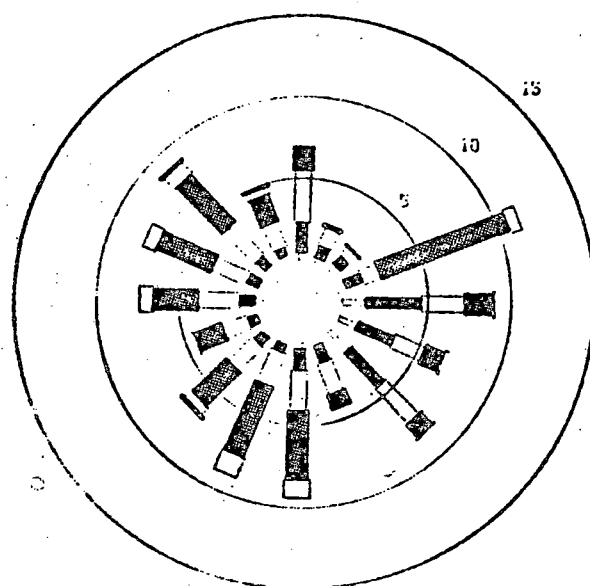
Wind roses for Muskegon, Palisades, and University of Michigan site P03A for the fall season are shown in Figure 13. It can be seen that little, if any, similarity in structure exists. Winds from Muskegon and University of Michigan P03A appear to be evenly distributed in all directions, except north-northeast and northeast. The Muskegon rose shows a large value for winds from east-northeast that is not apparent at station P03A. The Palisades rose shows a definite preference for west to northwest directions and east-southeast and southeast directions. The Muskegon Airport is located about 3.5 miles inland and P03A about 1 mile inland.

#### 3.2 JOINT WIND SPEED, WIND DIRECTION STABILITY FREQUENCY DISTRIBUTIONS, SEASONAL AND ANNUAL

The Palisades joint frequency distributions are given in Appendix F. The data begin with the fall 1973 season and end with summer 1974. The atmospheric stabilities were determined from wind sigma, if wind speeds were greater than 2 mph, and from  $\Delta T$  if wind speeds were less than 2 mph. Data were discarded as invalid if

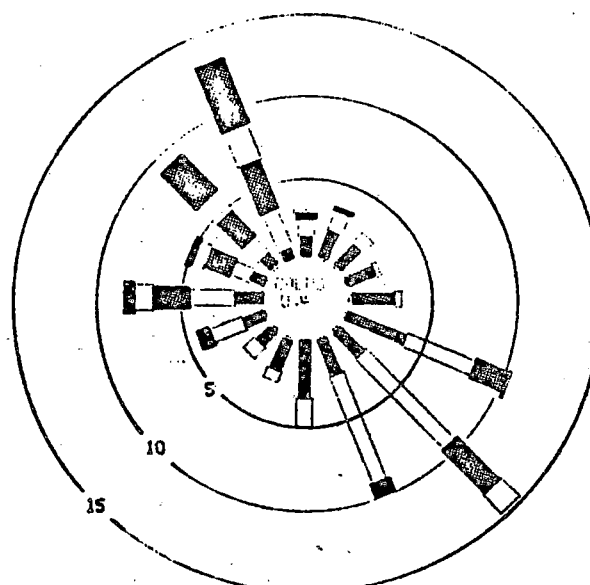
- 1)  $|\Delta T| > 2^{\circ}\text{C}$ , or
- 2)  $WS > 2$  mph and  $\sigma < 0.5$ .

The atmospheric stability in terms of standard deviation of the wind direction ( $\sigma$ ) was classified as follows:



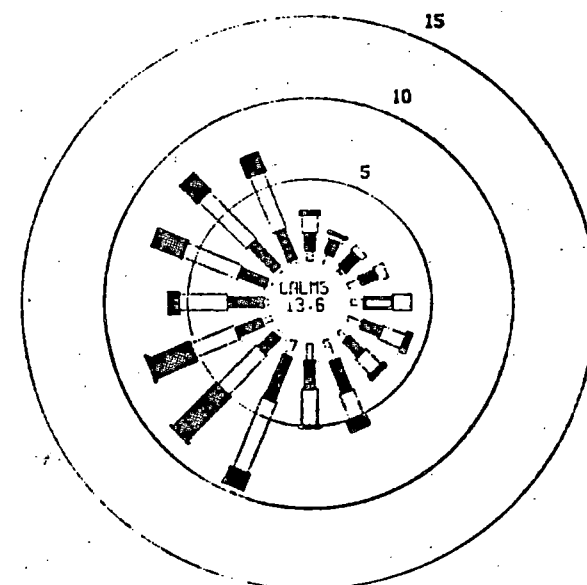
SPEED CLASS (MPH)  
0-2 3-5 6-9 10-15 16-20 21-24

MUSKEGON FALL WIND ROSE (73-74)



SPEED CLASS (MPH)  
1-3 4-6 7-9 10-12 13-15 16-18

PALISADES WIND ROSE FOR FALL 1973



SPEED CLASS (MPH)  
1-3 4-6 7-9 10-12 13-15 16-18

UNIV MICH WIND ROSE FOR FALL 1973

Figure 13. Wind roses for Palisades and University of Michigan, during the fall 1973 season (September, October, November) and for 1973-1974 fall seasons for Muskegon.



<u>Pasquill Category</u>	<u>Range of Standard Deviation (degrees)</u>
A	$\sigma \geq 22.5$
B	$22.5 > \sigma \geq 17.5$
C	$17.5 > \sigma \geq 12.5$
D	$12.5 > \sigma \geq 7.5$
E	$7.5 > \sigma \geq 3.8$
F	$3.8 > \sigma \geq 2.1$
G	$2.1 > \sigma$

The stability classification using the  $\Delta T$  scheme was modified slightly from that normally used for the NRC requirements. Because temperature difference was measured between 16.8 meters and 3 meters above the surface, use of these data projected to a 100-meter difference in height would not resemble the data actually taken over the extended height interval. This is due to the logarithmic behavior of the lapse rate as a function of height above the surface. Thus, given any two temperatures along the curve at known heights, the temperature at any other height can be calculated:

$$T_x = T_2 - (T_2 - T_1) \left\{ \frac{\ln(Z_2/Z_x)}{\ln(Z_2/Z_1)} \right\}$$

This expression can be rearranged to give the temperature difference between any two levels (a and b) as a function of the temperature difference between two other known levels (1 and 2):

$$\Delta T_{ab} = \Delta T_{12} \left\{ \frac{\ln(Z_b/Z_a)}{\ln(Z_2/Z_1)} \right\}$$

To standardize the levels between which the temperature difference should be measured at nuclear power plants, Regulatory Guide 1.23 suggests a lower measurement level of 10 meters and an upper

measurement of about 40 meters. Using the above equation to estimate the temperature difference between the 40- and 10-meter levels, given the measurement between 16.8 and 3.0 meters, results in

$$\Delta T_{40-10} = \Delta T_{16.8-3} * (0.8047)$$

With the above analysis in mind, the atmospheric stability was classified according to the following scheme when wind data indicated speeds less than 2.0 mph:

<u>Pasquill Category</u>	<u>Range of Temperature Difference (16.8 - 3 meters)</u>
A	<-0.71
B	-0.71 to -0.63
C	-0.63 to -0.56
D	-0.56 to -0.19
E	-0.19 to +0.56
F	+0.56 to +1.49
G	>+1.49

The NWS data for Muskegon were obtained in the form of the STAR program for seasonal and annual wind distributions of Pasquill stability classes based on eight observations per day. These data are included as Appendix G. The three-hour data listing was also obtained on magnetic tape. The Muskegon NWS station is located at the Muskegon Airport, approximately 60 miles north of the Palisades site. The atmospheric stabilities calculated in the STAR program were based on net radiation and wind speed. Details of the Pasquill stability classification method are given in Appendix G. This data set is a composite of two full years, 1973 and 1974.

A summary of the percentage of occurrence of stability classes with associated wind speeds is given in Table 3 for the two sets of data.

Table 3. Percentage of Occurrence of Stability Classes with Associated Wind Speeds.

	<u>Palisades Percentages (%)</u>							<u>Muskegon Percentages (%)</u>						
	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>E</u>	<u>F</u>	<u>Total</u>	<u>A</u>	<u>B</u>	<u>C</u>	<u>D</u>	<u>E</u>	<u>F</u>	<u>Total</u>
Fall	0.07	0.56	7.67	30.05	45.67	15.98	100	0	0.96	5.63	70.33	9.89	13.19	100
Winter	1.21	2.7	11.44	25.39	41.94	17.85	100	0	0.28	2.5	86.59	6.39	4.24	100
Spring	0	2.37	15.12	28.07	38.78	15.66	100	0.07	1.83	6.9	73.77	9.10	8.29	100
Summer	0.10	1.72	9.78	28.77	33.35	26.27	100	0.14	5.16	19.23	48.98	11.1	15.42	100
Annual	0.28	1.69	10.92	28.25	39.28	19.58	100	0.05	2.1	8.61	69.83	9.13	10.3	100

Associated Average Wind Speeds

	<u>(mph)</u>							<u>(mph)</u>						
Fall	1.8	8.26	8.01	8.58	10.78	11.76	10.04	-	6.45	9.21	13.01	7.60	3.80	10.98
Winter	1.8	12.15	10.43	9.51	11.63	16.37	11.76	-	3.45	6.68	13.36	8.64	4.72	12.44
Spring	-	13.84	10.91	10.31	10.63	10.68	10.67	5.76	5.41	10.59	13.70	8.18	4.15	11.98
Summer	11.95	10.01	8.44	7.4	7.65	8.28	7.86	5.76	6.68	10.02	11.75	7.83	2.88	9.33
Annual	1.62	11.73	9.62	8.78	10.06	10.85	9.81	5.76	6.22	9.75	13.01	7.95	3.57	11.15

The annual average wind speed was slightly higher (about 1.34 mph) at Muskegon during each season. The Muskegon data set has a higher percentage of D stability for all seasons with an annual average occurrence of 69.83%. The wind speeds appear as expected with maximum velocities occurring with D stability and lower wind speeds for the other categories. The minimum average wind speeds correspond with A and F stabilities.

The Palisades data set has a higher percentage of stable categories, E and F, than might be expected. Category G was combined with F to provide a direct comparison with the Muskegon data. The wind speed averages appear about the same for each category for each season. They would, normally, be expected to be lower for extremely stable and unstable stability categories similar to that of the Muskegon data set.

### 3.3 X/Q ESTIMATES

The long-term (routine release) annual X/Q estimates using Palisades data, are presented in Table 4 for distances out to 1000 meters. The same X/Q calculations using the Muskegon data are presented in Table 5. Similar sets are given in Tables 6 and 7 for distances out to 10,000 meters. The annual long-term average X/Q values in the 16 radial sectors were calculated using the annual joint frequency distributions of wind speed, wind direction by stability in:

$$X/Q = \frac{\sqrt{2\pi}}{r\theta} \sum_m \sum_s \frac{f(\theta, m, s)}{\bar{U}_{ms} \sum_{zm} (r)}$$

Table 4. X/Q estimates, Palisades.

LONG TERM ROUTINE MODEL										
CHI/Q ESTIMATES										
DISTANCE FROM SITE -METERS-										
	100	200	300	400	500	600	700	800	900	1000
N	.826E-04	.233E-04	.111E-04	.659E-05	.439E-05	.315E-05	.232E-05	.183E-05	.137E-05	.114E-05
NNE	.374E-04	.103E-04	.487E-05	.285E-05	.189E-05	.135E-05	.993E-06	.780E-06	.409E-06	.340E-06
NE	.421E-04	.117E-04	.557E-05	.328E-05	.218E-05	.156E-05	.113E-05	.896E-06	.592E-06	.493E-06
ENE	.692E-04	.192E-04	.910E-05	.535E-05	.355E-05	.253E-05	.186E-05	.147E-05	.893E-06	.742E-06
E	.137E-03	.392E-04	.188E-04	.112E-04	.748E-05	.538E-05	.395E-05	.313E-05	.241E-05	.201E-05
ESE	.904E-04	.261E-04	.126E-04	.752E-05	.504E-05	.363E-05	.262E-05	.209E-05	.171E-05	.143E-05
SE	.130E-03	.373E-04	.180E-04	.107E-04	.718E-05	.517E-05	.346E-05	.281E-05	.234E-05	.199E-05
SSE	.138E-03	.397E-04	.192E-04	.114E-04	.764E-05	.551E-05	.381E-05	.307E-05	.254E-05	.214E-05
S	.754E-04	.215E-04	.103E-04	.612E-05	.409E-05	.294E-05	.220E-05	.173E-05	.138E-05	.114E-05
SSW	.583E-04	.165E-04	.791E-05	.469E-05	.312E-05	.224E-05	.167E-05	.132E-05	.101E-05	.838E-06
SW	.510E-04	.144E-04	.691E-05	.409E-05	.273E-05	.196E-05	.147E-05	.115E-05	.880E-06	.728E-06
WSW	.544E-04	.154E-04	.733E-05	.434E-05	.289E-05	.207E-05	.152E-05	.120E-05	.910E-06	.756E-06
W	.721E-04	.204E-04	.975E-05	.577E-05	.385E-05	.276E-05	.203E-05	.161E-05	.118E-05	.979E-06
WNW	.141E-03	.403E-04	.194E-04	.115E-04	.770E-05	.554E-05	.406E-05	.322E-05	.260E-05	.216E-05
NW	.175E-03	.506E-04	.245E-04	.146E-04	.981E-05	.708E-05	.512E-05	.408E-05	.334E-05	.280E-05
NNW	.136E-03	.390E-04	.188E-04	.112E-04	.749E-05	.540E-05	.402E-05	.318E-05	.258E-05	.214E-05

Table 5. X/Q estimates, Muskegon.

LONG TERM ROUTINE MODEL										
CHI/Q ESTIMATES										
DISTANCE FROM SITE -METERS-										
	100	200	300	400	500	600	700	800	900	1000
N	.892E-04	.251E-04	.120E-04	.709E-05	.472E-05	.338E-05	.245E-05	.194E-05	.152E-05	.126E-05
NNE	.700E-04	.197E-04	.938E-05	.555E-05	.369E-05	.264E-05	.194E-05	.153E-05	.116E-05	.962E-06
NE	.755E-04	.213E-04	.101E-04	.599E-05	.398E-05	.285E-05	.205E-05	.163E-05	.124E-05	.103E-05
ENE	.584E-04	.165E-04	.785E-05	.464E-05	.309E-05	.221E-05	.161E-05	.127E-05	.954E-06	.795E-06
E	.744E-04	.209E-04	.997E-05	.589E-05	.392E-05	.281E-05	.206E-05	.162E-05	.122E-05	.102E-05
ESE	.695E-04	.195E-04	.931E-05	.550E-05	.366E-05	.262E-05	.193E-05	.152E-05	.115E-05	.954E-06
SE	.655E-04	.184E-04	.879E-05	.520E-05	.346E-05	.248E-05	.181E-05	.143E-05	.112E-05	.930E-06
SSE	.422E-04	.119E-04	.567E-05	.335E-05	.223E-05	.160E-05	.119E-05	.934E-06	.738E-06	.611E-06
S	.763E-04	.216E-04	.104E-04	.614E-05	.409E-05	.294E-05	.212E-05	.168E-05	.134E-05	.112E-05
SSW	.382E-04	.108E-04	.516E-05	.306E-05	.204E-05	.146E-05	.104E-05	.826E-06	.648E-06	.543E-06
SW	.430E-04	.122E-04	.583E-05	.345E-05	.230E-05	.165E-05	.117E-05	.932E-06	.726E-06	.609E-06
WSW	.538E-04	.153E-04	.730E-05	.433E-05	.288E-05	.207E-05	.149E-05	.118E-05	.949E-06	.792E-06
W	.117E-03	.351E-04	.158E-04	.937E-05	.624E-05	.448E-05	.321E-05	.255E-05	.205E-05	.171E-05
WNW	.112E-03	.319E-04	.153E-04	.907E-05	.605E-05	.435E-05	.302E-05	.242E-05	.195E-05	.164E-05
NW	.114E-03	.324E-04	.155E-04	.920E-05	.614E-05	.441E-05	.311E-05	.249E-05	.199E-05	.167E-05
NNW	.506E-04	.143E-04	.685E-05	.406E-05	.270E-05	.194E-05	.138E-05	.110E-05	.862E-06	.722E-06

Table 6. X/Q estimates, Palisades.

LONG TERM ROUTINE MODEL										
CHI/Q ESTIMATES										
DISTANCE FROM SITE -METERS-										
	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
N	.114E-05	.357E-06	.194E-06	.126E-06	.905E-07	.689E-07	.547E-07	.448E-07	.376E-07	.321E-07
NNE	.340E-06	.105E-06	.572E-07	.371E-07	.266E-07	.202E-07	.161E-07	.132E-07	.111E-07	.946E-08
NE	.493E-06	.156E-06	.851E-07	.554E-07	.398E-07	.303E-07	.241E-07	.198E-07	.166E-07	.142E-07
ENE	.742E-06	.232E-06	.126E-06	.816E-07	.584E-07	.444E-07	.352E-07	.288E-07	.242E-07	.206E-07
E	.201E-05	.632E-06	.348E-06	.228E-06	.165E-06	.126E-06	.100E-06	.826E-07	.695E-07	.595E-07
ESE	.143E-05	.464E-06	.253E-06	.170E-06	.123E-06	.948E-07	.759E-07	.626E-07	.528E-07	.453E-07
SE	.199E-05	.699E-06	.391E-06	.259E-06	.188E-06	.145E-06	.116E-06	.962E-07	.813E-07	.699E-07
SSE	.214E-05	.725E-06	.404E-06	.267E-06	.194E-06	.149E-06	.119E-06	.984E-07	.830E-07	.713E-07
S	.114E-05	.351E-06	.192E-06	.125E-06	.897E-07	.684E-07	.544E-07	.446E-07	.375E-07	.320E-07
SSW	.838E-06	.259E-06	.141E-06	.918E-07	.657E-07	.500E-07	.397E-07	.325E-07	.273E-07	.233E-07
SW	.728E-06	.223E-06	.121E-06	.785E-07	.561E-07	.426E-07	.338E-07	.277E-07	.232E-07	.198E-07
WSW	.756E-06	.238E-06	.129E-06	.838E-07	.600E-07	.456E-07	.362E-07	.296E-07	.248E-07	.212E-07
W	.979E-06	.308E-06	.168E-06	.110E-06	.787E-07	.600E-07	.473E-07	.392E-07	.329E-07	.281E-07
WNW	.216E-05	.684E-06	.376E-06	.246E-06	.177E-06	.136E-06	.108E-06	.887E-07	.746E-07	.639E-07
NW	.280E-05	.902E-06	.503E-06	.332E-06	.241E-06	.185E-06	.148E-06	.122E-06	.103E-06	.887E-07
NNW	.214E-05	.665E-06	.366E-06	.240E-06	.173E-06	.132E-06	.105E-06	.867E-07	.729E-07	.625E-07

Table 7. X/Q estimates, Muskegon.

LONG TERM ROUTINE MODEL										
CHI/Q ESTIMATES										
DISTANCE FROM SITE -METERS-										
	1000	2000	3000	4000	5000	6000	7000	8000	9000	10000
N	.126E-05	.402E-06	.218E-06	.141E-06	.101E-06	.767E-07	.608E-07	.497E-07	.417E-07	.356E-07
NNE	.962E-06	.303E-06	.164E-06	.106E-06	.758E-07	.576E-07	.456E-07	.373E-07	.312E-07	.266E-07
NE	.103E-05	.333E-06	.181E-06	.118E-06	.842E-07	.640E-07	.508E-07	.416E-07	.349E-07	.298E-07
ENE	.795E-06	.254E-06	.138E-06	.896E-07	.641E-07	.488E-07	.387E-07	.317E-07	.266E-07	.227E-07
E	.102E-05	.320E-06	.173E-06	.112E-06	.799E-07	.606E-07	.480E-07	.393E-07	.329E-07	.280E-07
ESE	.954E-06	.299E-06	.162E-06	.104E-06	.745E-07	.565E-07	.447E-07	.365E-07	.306E-07	.261E-07
SE	.930E-06	.294E-06	.159E-06	.103E-06	.733E-07	.557E-07	.441E-07	.360E-07	.302E-07	.257E-07
SSE	.611E-06	.189E-06	.102E-06	.654E-07	.466E-07	.353E-07	.279E-07	.228E-07	.190E-07	.162E-07
S	.112E-05	.359E-06	.196E-06	.127E-06	.914E-07	.697E-07	.554E-07	.454E-07	.381E-07	.326E-07
SSW	.543E-06	.178E-06	.976E-07	.637E-07	.457E-07	.349E-07	.278E-07	.228E-07	.192E-07	.164E-07
SW	.609E-06	.202E-06	.111E-06	.724E-07	.521E-07	.398E-07	.317E-07	.261E-07	.219E-07	.188E-07
WSW	.792E-06	.255E-06	.139E-06	.905E-07	.649E-07	.494E-07	.393E-07	.322E-07	.270E-07	.231E-07
W	.171E-05	.552E-06	.300E-06	.195E-06	.140E-06	.106E-06	.845E-07	.692E-07	.580E-07	.496E-07
WNW	.164E-05	.552E-06	.304E-06	.199E-06	.144E-06	.110E-06	.877E-07	.721E-07	.607E-07	.520E-07
NW	.167E-05	.551E-06	.302E-06	.198E-06	.142E-06	.109E-06	.865E-07	.711E-07	.597E-07	.512E-07
NNW	.722E-06	.236E-06	.129E-06	.842E-07	.605E-07	.461E-07	.367E-07	.301E-07	.253E-07	.216E-07



where

$$\Sigma_{rm}(r) = \begin{cases} \left[ \sigma_{zm}^2 + \left( \frac{0.50z}{\pi} \right)^2 \right]^{1/2} & \text{if } \Sigma_{zm}(r) \leq 3\sigma_{zm} \\ 3\sigma_{zm} & \text{Otherwise} \end{cases}$$

$\bar{U}_{ms}$  = average wind speed in s<sup>-th</sup> wind speed class and m<sup>th</sup> stability category (m/sec)

$\sigma_{zm}$  = vertical standard deviation (meters) of the plume of the m<sup>th</sup> stability category at downwind distance r (derived from Meteorology and Atomic Energy, David Slade, 1965)

$f(\theta, m, s)$  = joint frequency distribution between wind speed, direction, and stability

$D_z$  = heights of the containment building, 53.3 meters

$\theta$  = sector width in radians ( $22.5^\circ = 0.3927$ )

$r$  = downwind distance in meters

The NWS data from Muskegon had all calm periods implicitly included in the joint frequency distribution; therefore, no special treatment was made for calms. Data from the Palisades site were treated in the same manner. Because of the low frequency of calms, no overestimates of  $X/Q$  were anticipated. Stability category G was combined with F to provide a more direct comparison with the Muskegon data.

As would be expected from the wind roses, the Palisades data result in higher  $X/Q$  values in the northwest and southeast directions and also higher values on some radials closer to the reactor.

To obtain a more meaningful comparison of the two sets of  $X/Q$  estimates, clearly showing the more conservative values as related to the population exposure, the following method was used.  $X/Q$  values for 1.5, 2.5, 3.5, and 4.5 miles were calculated for each 22.5-degree inland sector. The populations for the increments 1 to 2 miles, 2 to 3 miles, etc., were determined, and a weighted average

X/Q value determined for the populations along each radial out to 5 miles. For example, the Palisades X/Q value for 1.5 miles in the north-northeast direction was 0.246E-06 and the population between 1 and 2 miles was 140. The product of these two plus the product of the next three incremental sets of X/Q estimates and corresponding population along this radial divided by the total radial population of 1867 provided the average population weighted X/Q estimate in this sector. This was performed for all land 22.5-degree sectors. The results are presented in Table 8. The average population weighted X/Q values for all land areas from 1 to 5 miles was 1.205E-07 using Palisades data and 0.7982E-07 using Muskegon data. There is about a 3 to 2 factor in favor of the Palisades data set providing the more conservative X/Q estimates for the populations within a 1- to 5-mile radius of the plant.

#### 3.4 SUMMARY OF PALISADES AND MUSKEGON DATA COMPARISON

The average annual wind speeds were slightly higher at Muskegon because of the high percentage of occurrence of D stability and its associated 13.01 mph wind speed. For stability categories B, E, and F, winds were considerably higher at Palisades. The winds were more evenly distributed in all directions, except north-northeast and northeast at Muskegon and appear to be more representative of inland sites. The long-term X/Q estimates were higher for Palisades data in the northwest and southeast directions as expected from the wind roses. Also, the closer X/Q values tended to be higher for the Palisades data. At 10,000 meters distance there were eight radials at which the Palisades data yielded higher X/Q values. Thus overall, the Palisades data produced more conservative values for the average population X/Q than Muskegon data. This is primarily due to the higher percentage of E and F stability categories than the Palisades data presented. From a meteorological viewpoint, it seems high and could possibly be attributed to wind sigma instrumentation.

Table 8. Comparison of weighted X/Q estimate for Palisades and Muskegon data.

<u>Direction</u>	<u>1- to 5-Mile Radius Population</u>	<u>Palisades Weighted Average X/Q</u>	<u>Muskegon Weighted Average X/Q</u>
NNE	1867	0.253E-07	0.667E-07
NE	929	0.417E-07	0.884E-07
ENE	640	0.657E-07	0.752E-07
E	590	1.738E-07	0.943E-07
ESE	975	2.750E-07	0.936E-07
SE	1095	2.202E-07	0.873E-07
SSE	315	1.660E-07	0.360E-07
S	308	0.789E-07	0.805E-07
SSW	200	0.657E-07	0.809E-07
All Land Directions	6921	1.205E-07	0.798E-07

#### 4.0 TOPOGRAPHIC CROSS SECTIONS

The topographic cross sections through the center of the 22.5-degree cardinal compass point sectors for a distance of five miles are shown in Figure 14 (a through j). The meteorological tower is located on a 720-foot knoll in the east sector, about 700 feet from the containment structure. Other structures, pre-operational towers, and the University of Michigan P03A station, are identified on the various radials. Within the first mile of the reactor building, the topography has peaks and valleys in every on-shore direction. Beyond one mile inland, the terrain levels off or has an increasing slope in all directions except south and south-southwest along the shore, which have continuing sand dunes with peaks and valleys.

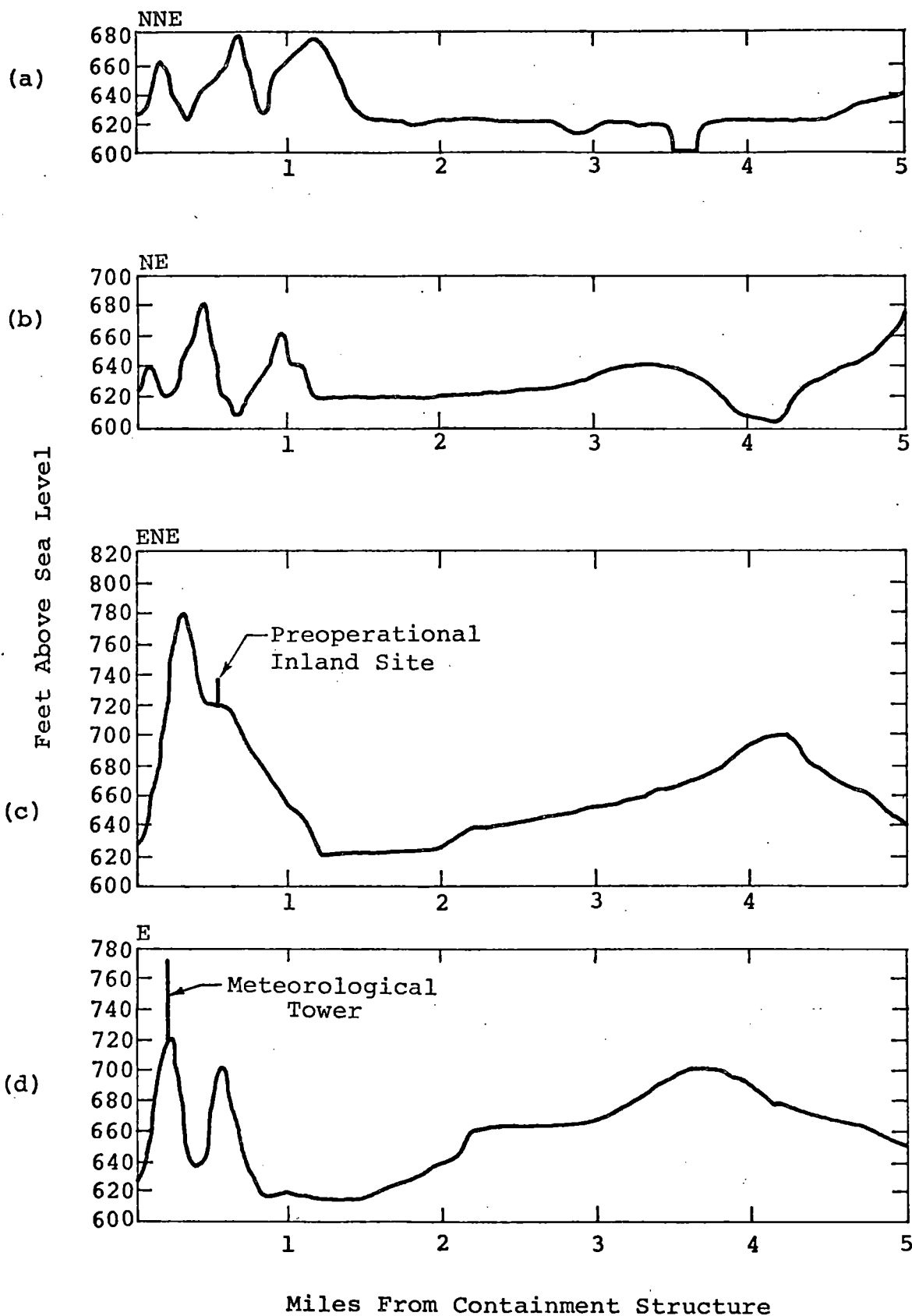


Figure 14. Topographic cross sections (sheet 1).

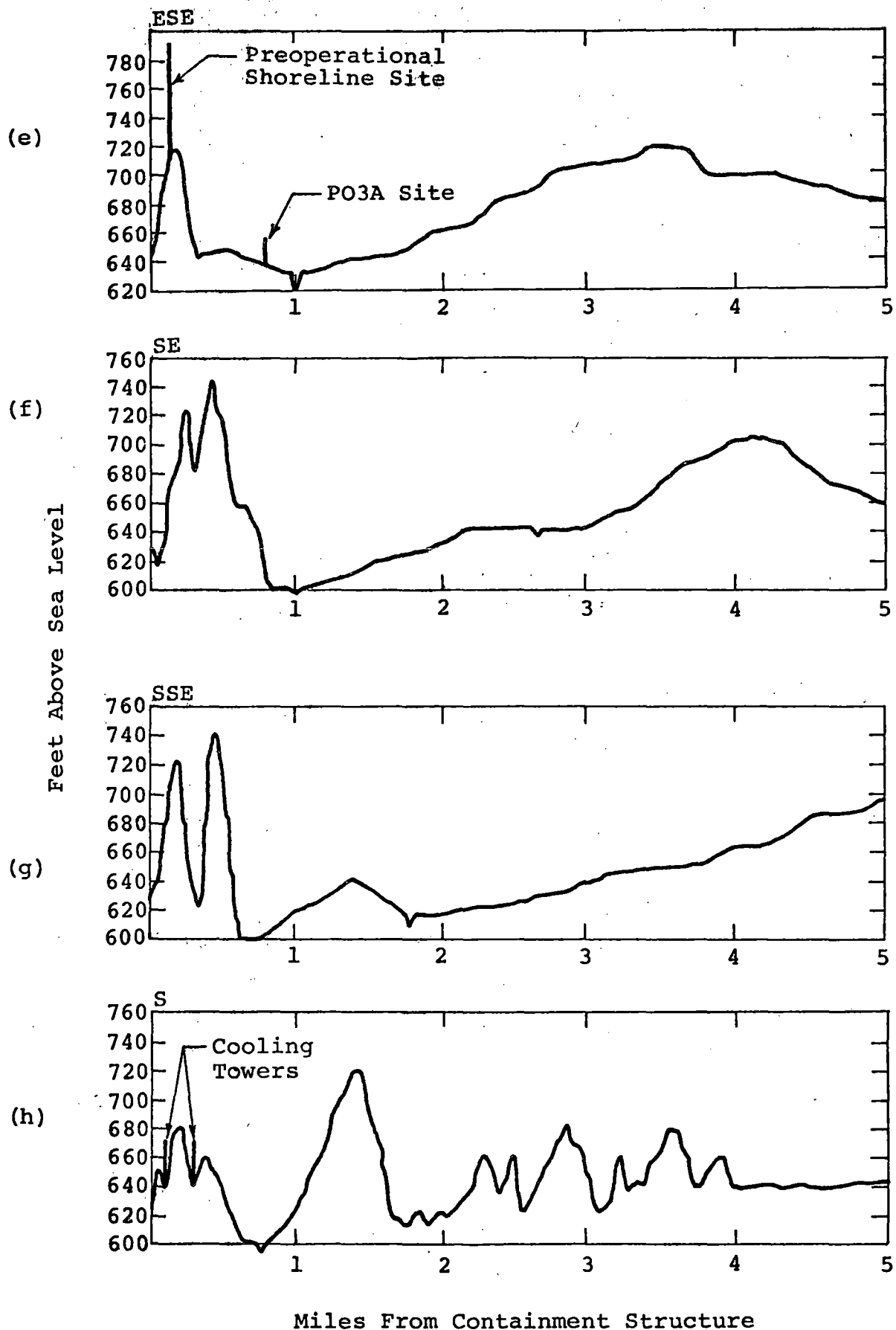
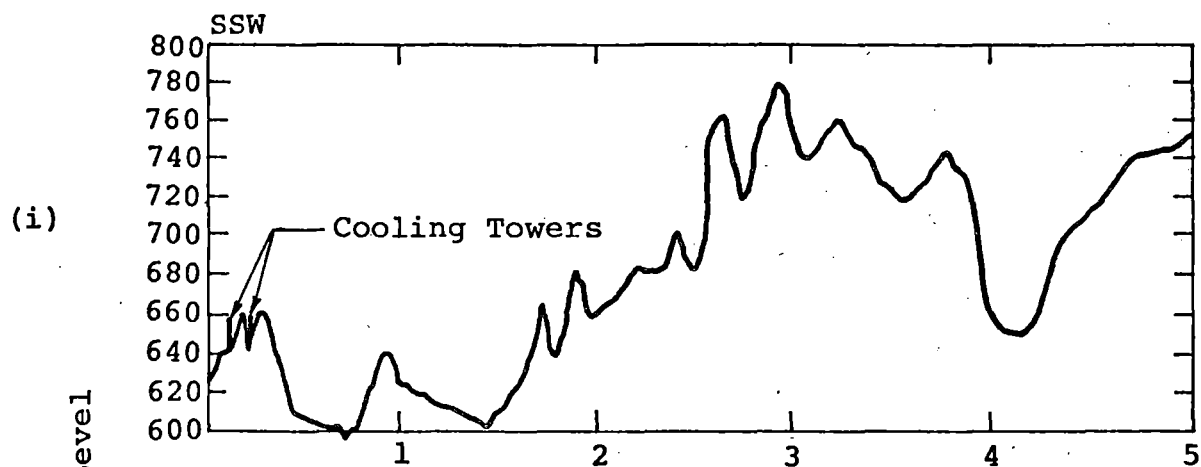


Figure 14. Topographic cross sections (sheet 2).



\* SW, WSW, W, WNW, NW, NNW, N  
all are located on  
Lake Michigan

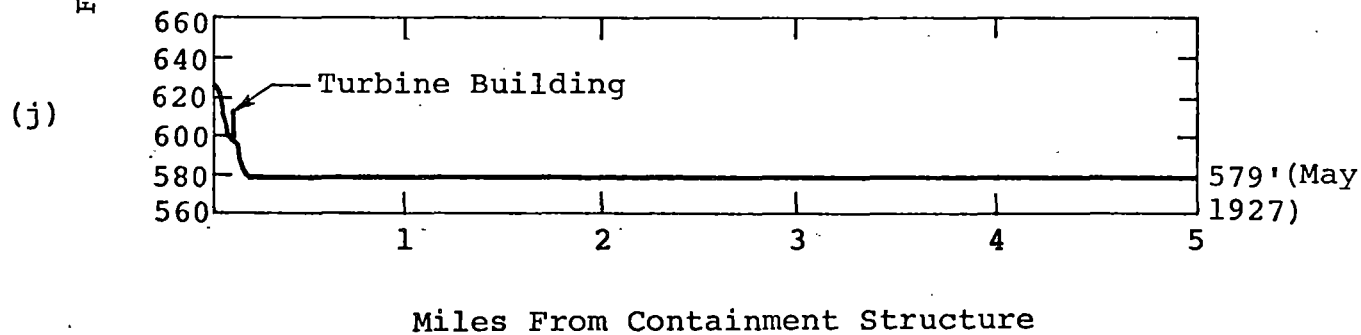


Figure 14. Topographic cross sections (sheet 3).

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ENVIRONMENTAL CONSULTANTS





22 September 1975  
Report No. ECR-75-018A

**PALISADES METEOROLOGICAL STUDY**

**VOLUME 2**

**FOR**

**CONSUMERS POWER COMPANY  
1945 West Parnell  
Jackson, Michigan 49201**

**Under Contract**

**issued 2 July 1975**

**BY**

**EG&G, ENVIRONMENTAL CONSULTANTS  
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## APPENDICES

- A      COMPARISONS OF PALISADES AND UNIVERSITY OF MICHIGAN  
SITE P03A MONTHLY WIND ROSES FOR PERIOD  
JULY THROUGH DECEMBER 1973 INCLUDING  
WIND ROSE DATA PRINTOUT
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FOR PALISADES

APPENDIX A

COMPARISON OF PALISADES AND UNIVERSITY OF MICHIGAN  
SITE P03A MONTHLY WIND ROSES FOR PERIOD  
JULY THROUGH DECEMBER 1973  
INCLUDING WIND ROSE DATA PRINTOUT

A-1

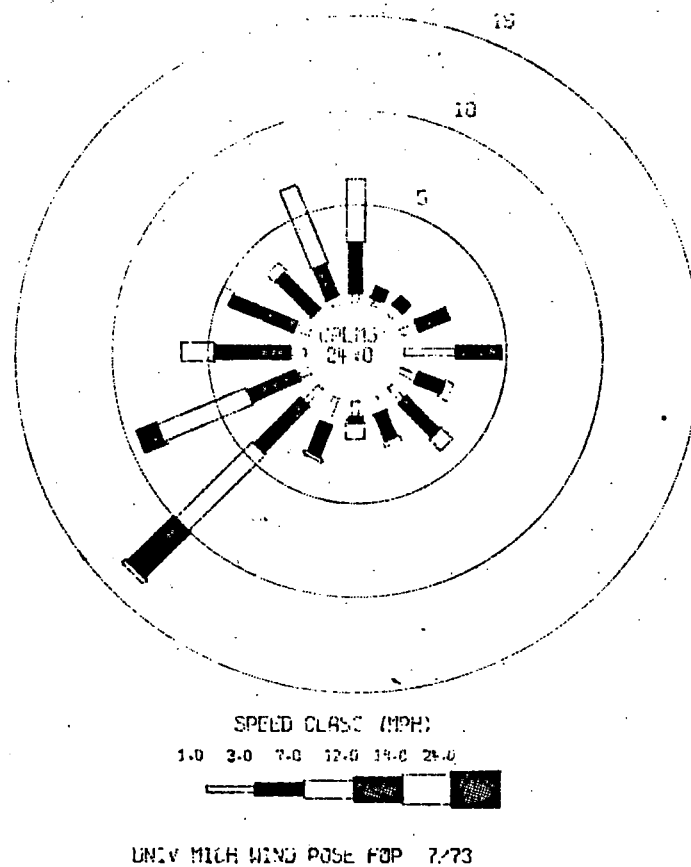
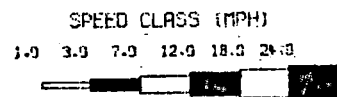
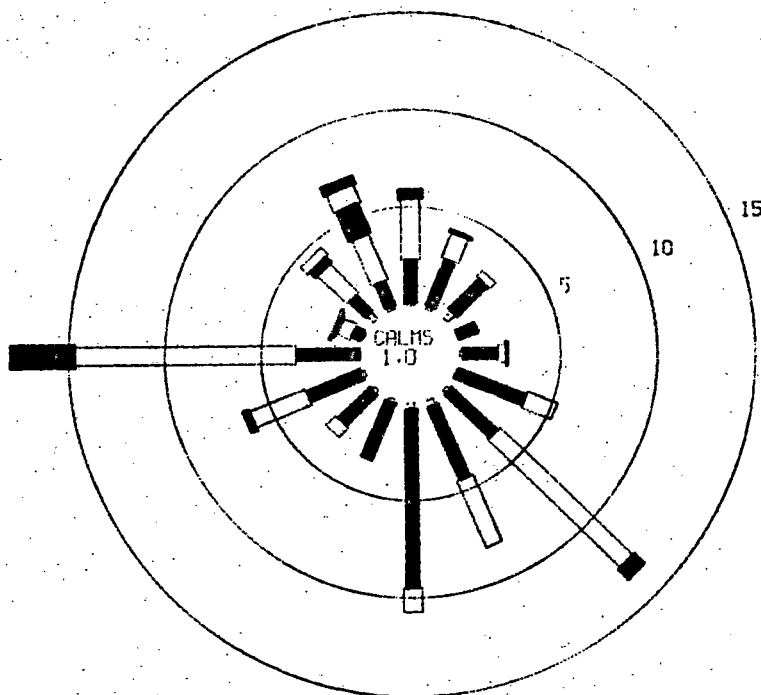
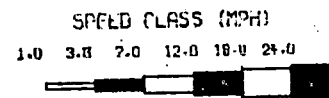
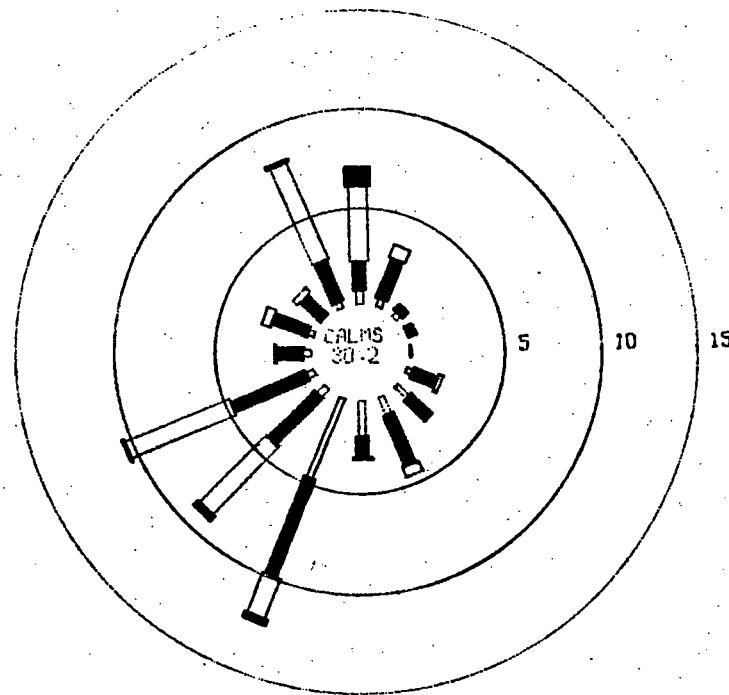


Figure A-1. University of Michigan Site P03A wind rose patterns for July 1973.

A-2



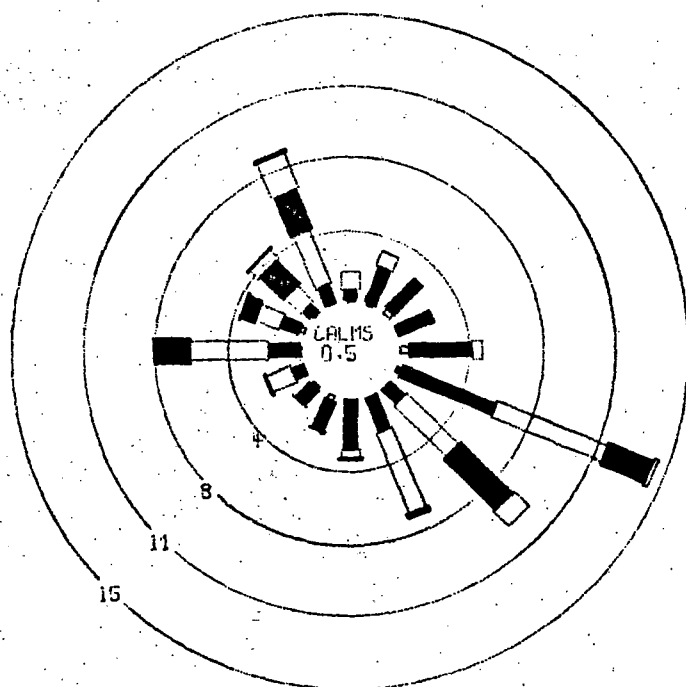
PALISADES WIND ROSE FOR 8/73



UNIV MICH WIND ROSE FOR 8/73

Figure A-2. Comparison of Palisades and University of Michigan Site P03A wind rose patterns for August 1973.

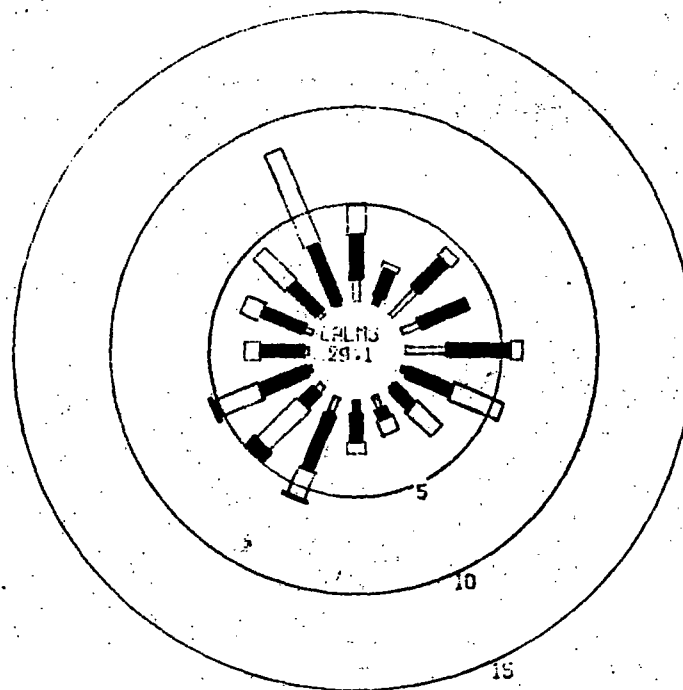
A-3



SPEED CLASS (MPH)  
1-5 6-10 11-15 16-20 21-25 26-30



PALISADES WIND ROSE FOR 9/73



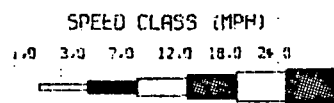
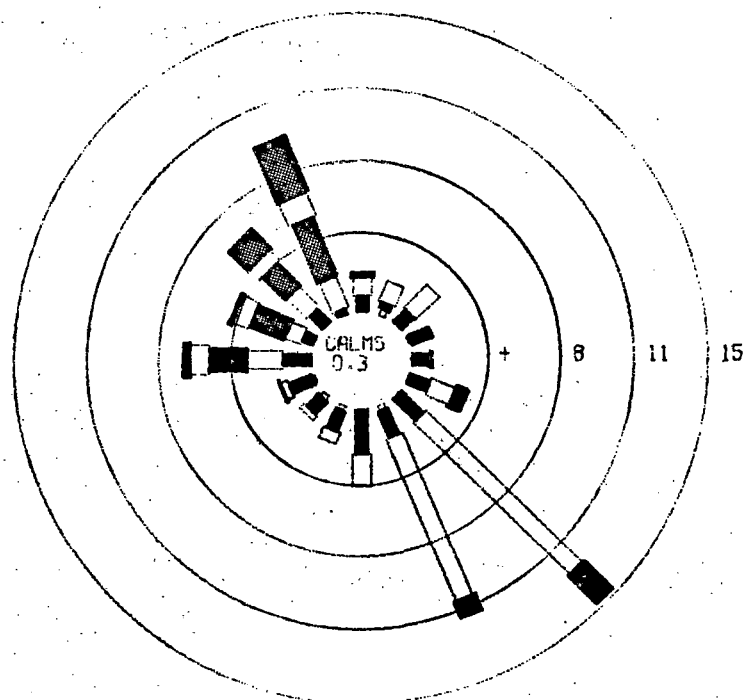
SPEED CLASS (MPH)  
1-5 6-10 11-15 16-20 21-25 26-30



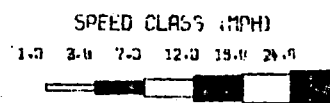
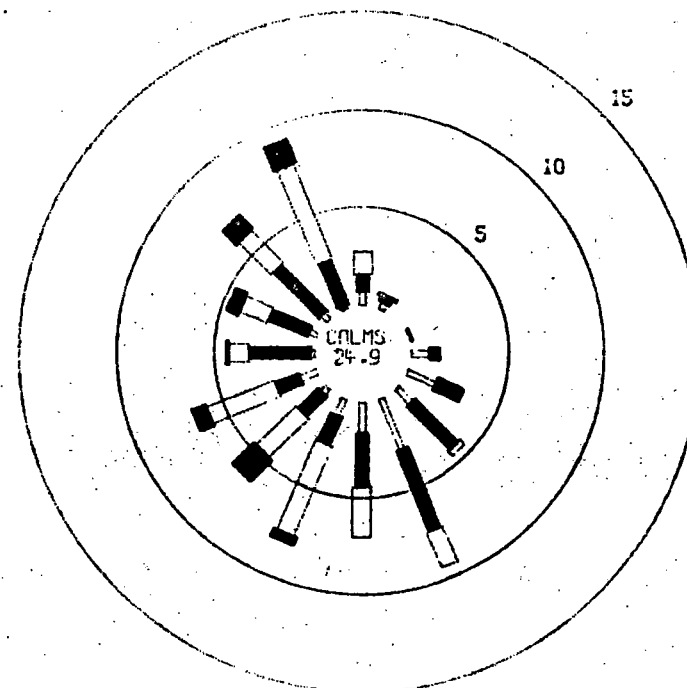
UNIV MICH WIND ROSE FOR 9/73

Figure A-3. Comparison of Palisades and University of Michigan Site P03A wind rose patterns for September 1973.

A-4



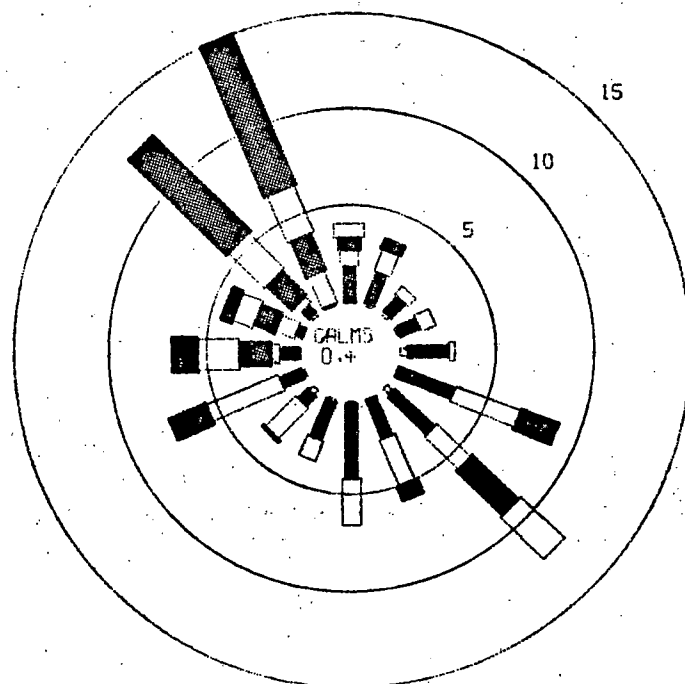
PALISADES WIND ROSE FOR 10/73



UNIV MICH WIND ROSE FOR 10/73

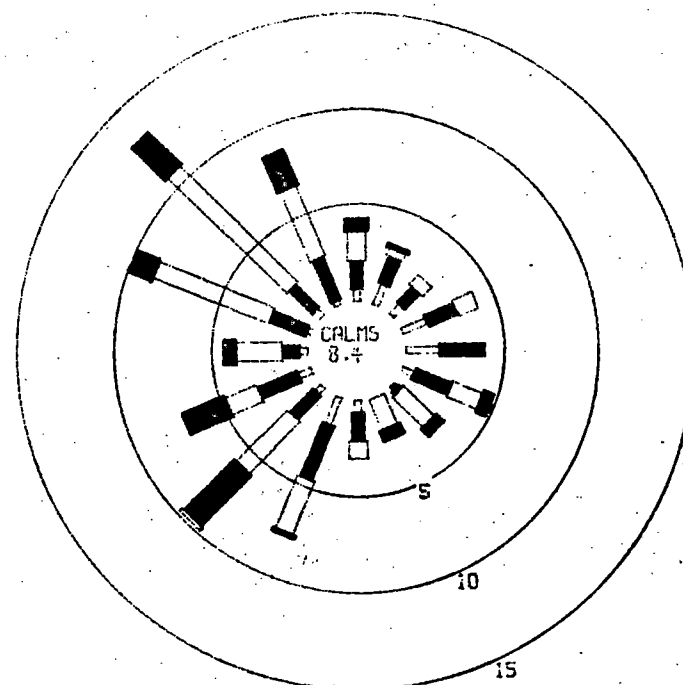
Figure A-4. Comparison of Palisades and University of Michigan Site P03A wind rose patterns for October 1973.

A-5



SPEED CLASS (MPH)  
1.0 3.0 7.0 12.0 18.0 24.0

PALISADES WIND ROSE FOR 11/73



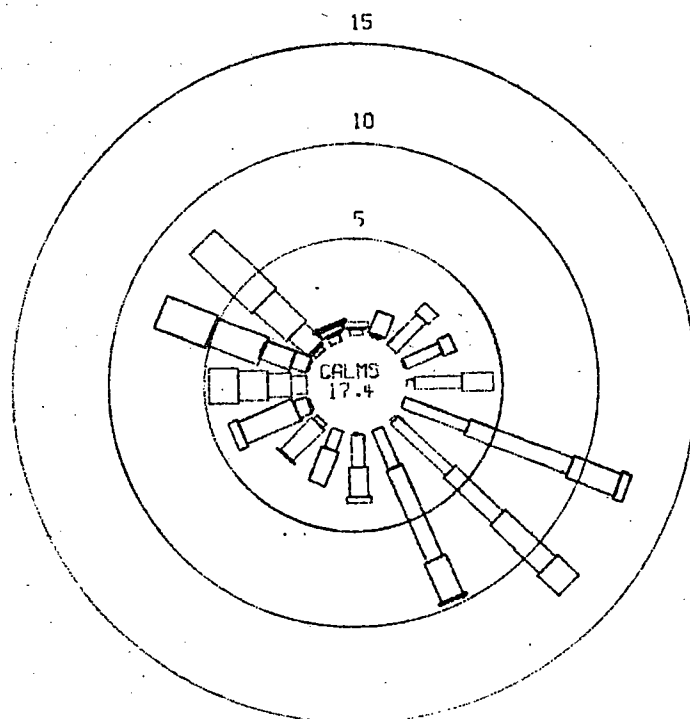
SPEED CLASS (MPH)  
1.0 3.0 7.0 12.0 18.0 24.0

-UNIV MICH WIND ROSE FOR 11/73

Figure A-5. Comparison of Palisades and University of Michigan Site P03A wind rose patterns for November 1973.

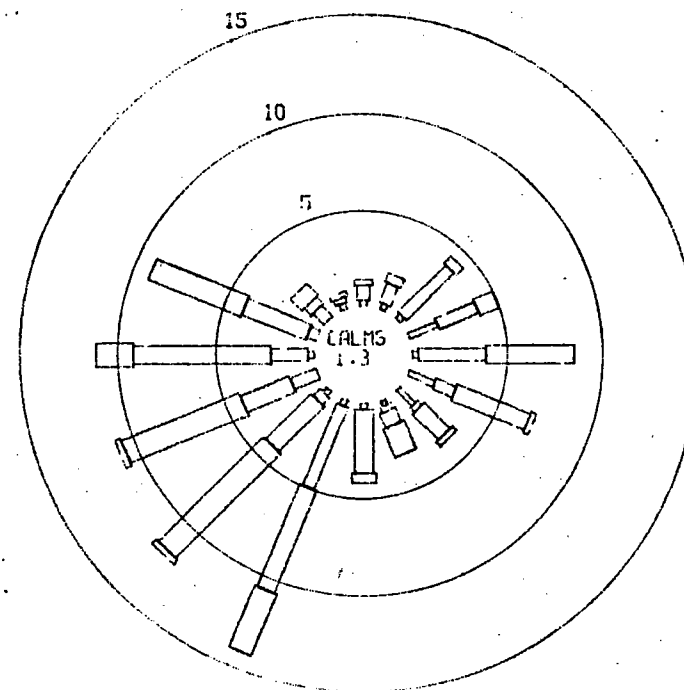


A-6



SPEED CLASS (MPH)  
1-3 3-7 7-12 12-18 18-24

PALISADES WIND ROSE FOR 12/73



SPEED CLASS (MPH)  
1-3 3-7 7-12 12-18 18-24

UNIV MICH WIND ROSE FOR 12/73

Figure A-6. Comparison of Palisades and University of Michigan Site P03A wind rose patterns for December 1973.

## PALISADES WIND ROSE DATA FOR 8/73

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.1	2.3	3.1	0.5	0.0	0.0	6.2	7.9
NNE	0.1	2.6	1.4	0.1	0.0	0.0	4.2	6.2
NE	0.5	2.2	0.4	0.0	0.0	0.0	3.1	5.2
ENE	0.0	1.1	0.0	0.0	0.0	0.0	1.1	4.6
E	0.1	1.8	0.4	0.1	0.0	0.0	2.5	5.7
ESE	0.0	3.7	1.6	0.0	0.0	0.0	5.3	6.7
SE	0.1	3.3	9.4	0.7	0.0	0.0	13.5	8.5
SSE	0.3	4.2	3.7	0.0	0.0	0.0	8.2	6.7
S	0.3	9.3	1.2	0.0	0.0	0.0	10.8	5.7
SSW	0.1	3.3	0.0	0.0	0.0	0.0	3.4	4.5
SW	0.1	2.3	0.7	0.0	0.0	0.0	3.1	5.9
WSW	0.1	3.0	3.1	0.3	0.0	0.0	6.6	7.3
W	0.0	3.3	11.4	3.4	0.0	0.0	18.1	9.3
WNW	0.1	0.5	0.7	0.1	0.1	0.1	1.8	10.2
NW	0.4	1.2	2.1	0.4	0.5	0.0	4.7	9.3
NNW	0.1	1.4	2.6	1.6	1.0	0.4	7.1	12.2
TOTAL	2.7	45.6	41.9	7.4	1.6	0.5	99.7	7.8

## PALISADES WIND ROSE DATA FOR 9/73

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.1	0.7	1.2	0.0	0.0	0.0	2.1	6.6
NNE	0.1	2.5	1.1	0.0	0.0	0.0	3.7	5.7
NE	0.4	2.6	0.0	0.0	0.0	0.0	3.1	4.6
ENE	0.0	2.6	0.0	0.0	0.0	0.0	2.6	5.5
E	0.6	4.3	0.7	0.0	0.0	0.0	5.6	5.1
ESE	0.3	6.9	8.1	3.3	0.3	0.0	18.9	9.0
SE	0.0	1.4	5.0	5.0	1.4	0.0	12.8	12.3
SSE	0.0	2.6	6.0	0.3	0.0	0.0	8.9	7.7
S	0.0	3.5	0.6	0.1	0.0	0.0	4.2	6.1
SSW	0.3	2.2	0.1	0.0	0.0	0.0	2.6	5.1
SW	0.1	1.4	0.1	0.0	0.0	0.0	1.7	4.3
WSW	0.0	0.8	1.8	0.1	0.0	0.0	2.8	8.2
W	0.1	2.1	5.4	2.5	0.0	0.0	10.1	9.6
WNW	0.3	1.4	1.7	1.0	0.1	0.0	4.4	8.9
NW	0.1	0.7	1.5	2.2	0.8	0.1	5.6	12.7
NNW	0.0	1.4	3.9	2.9	2.6	0.1	11.0	13.1
TOTAL	2.5	37.2	37.2	17.5	5.3	0.3	♦♦♦♦	9.1

# PALISADES WIND ROSE DATA FOR 10/73

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.0	1.1	1.3	0.4	0.0	0.0	2.8	8.5
NNE	0.4	0.5	1.5	0.0	0.0	0.0	2.4	7.3
NE	0.0	1.2	2.2	0.0	0.0	0.0	3.4	7.4
ENE	0.1	1.6	0.0	0.0	0.0	0.0	1.7	4.2
E	0.0	1.2	0.1	0.0	0.0	0.0	1.3	5.1
ESE	0.0	1.5	1.7	0.9	0.0	0.0	4.2	8.7
SE	0.0	2.2	14.8	2.7	0.0	0.0	19.6	9.7
SSE	0.3	2.0	12.2	1.2	0.0	0.0	15.7	9.4
S	0.0	3.2	2.2	0.0	0.0	0.0	5.4	6.8
SSW	0.3	1.5	0.9	0.0	0.0	0.0	2.7	6.2
SW	0.3	1.2	0.4	0.0	0.0	0.0	1.9	5.4
WSW	0.1	1.7	0.5	0.1	0.0	0.0	2.6	6.4
W	0.0	2.0	2.4	2.6	1.3	0.5	8.9	12.6
WNW	0.1	0.8	1.1	2.6	1.1	0.3	5.9	14.2
NW	0.0	1.3	1.9	2.3	0.9	2.0	8.5	16.8
NNW	0.0	0.4	2.3	4.4	1.7	4.2	13.0	19.4
TOTAL	1.6	23.5	45.6	17.2	5.1	7.0	♦♦♦♦	11.2

# PALISADES WIND ROSE DATA FOR 11/73

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.0	1.9	0.8	0.7	0.7	0.0	4.2	9.9
NNE	0.1	1.7	1.2	0.6	0.0	0.0	3.6	7.4
NE	0.1	1.1	0.6	0.0	0.0	0.0	1.8	5.9
ENE	0.1	1.1	0.8	0.0	0.0	0.0	2.1	6.0
E	0.4	2.1	0.3	0.0	0.0	0.0	2.8	4.9
ESE	0.0	3.1	3.5	2.1	0.0	0.0	8.6	8.9
SE	0.4	2.8	2.4	3.3	3.1	0.0	11.9	12.6
SSE	0.0	2.2	2.6	0.8	0.0	0.0	5.7	8.8
S	0.1	3.9	2.4	0.0	0.0	0.0	6.4	6.7
SSW	0.1	2.1	1.1	0.0	0.0	0.0	3.3	6.2
SW	0.3	0.7	2.2	0.1	0.0	0.0	3.3	7.9
WSW	0.1	1.2	4.0	2.1	0.0	0.0	7.5	9.7
W	0.0	1.1	0.4	1.7	2.1	1.4	6.7	17.9
WNW	0.0	0.4	1.0	1.2	1.1	0.6	4.3	15.9
NW	0.1	0.6	0.4	1.8	2.6	7.1	12.6	24.6
NNW	0.0	0.1	1.7	2.1	2.6	8.5	15.0	23.4
TOTAL	2.1	26.1	25.4	16.5	12.2	17.5	99.9	13.9

# PALISADES WIND ROSE DATA FOR 12/73

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.0	0.3	0.1	0.3	0.0	0.0	0.7	10.1
NNE	0.1	0.1	1.2	0.0	0.0	0.0	1.5	0.7
NE	0.0	2.2	0.7	0.0	0.0	0.0	2.8	6.2
ENE	0.1	2.0	0.7	0.0	0.0	0.0	2.8	5.5
E	0.4	2.4	1.6	0.0	0.0	0.0	4.4	4.9
ESE	0.0	3.5	5.6	2.6	0.5	0.0	12.2	9.8
SE	0.1	3.9	3.4	3.5	1.5	0.0	12.4	11.1
SSE	0.0	2.2	5.1	2.2	0.1	0.0	9.5	9.6
S	0.1	1.7	1.5	0.3	0.0	0.0	3.6	7.1
SSW	0.0	1.1	1.9	0.0	0.0	0.0	3.0	8.0
SW	0.0	0.3	2.3	0.1	0.0	0.0	2.7	9.1
WSW	0.0	0.1	0.7	3.0	0.5	0.0	4.3	14.6
W	0.0	0.0	0.8	1.2	1.5	1.5	5.0	20.2
WNW	0.0	0.1	0.9	1.6	2.8	2.8	8.3	20.7
NW	0.0	0.3	0.1	1.3	2.3	4.4	8.5	23.3
NNW	0.0	0.4	0.1	0.3	0.1	0.1	1.1	12.2
TOTAL	0.9	20.6	26.7	16.3	9.4	8.9	82.8	10.3

A-11

UNIV MICH WIND ROSE DATA FOR 7/73

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.5	2.6	3.3	0.0	0.0	0.0	6.4	1.7
NNE	0.3	0.6	0.0	0.0	0.0	0.0	0.9	3.3
NE	0.5	0.6	0.0	0.0	0.0	0.0	1.1	3.0
ENE	0.9	1.7	0.0	0.0	0.0	0.0	2.6	4.1
E	2.6	2.4	0.0	0.0	0.0	0.0	5.0	3.2
ESE	0.9	1.4	0.5	0.0	0.0	0.0	2.7	4.1
SE	0.9	2.4	0.8	0.0	0.0	0.0	4.1	4.5
SSE	0.8	1.5	0.2	0.0	0.0	0.0	2.4	4.2
S	0.8	0.3	0.8	0.0	0.0	0.0	1.8	4.6
SSW	1.4	1.7	0.2	0.0	0.0	0.0	3.2	3.5
SW	1.1	3.3	5.6	3.3	0.3	0.0	13.7	9.0
WSW	0.6	2.7	5.0	1.1	0.0	0.0	9.4	7.9
W	0.8	3.9	1.7	0.0	0.0	0.0	6.4	5.7
WNW	0.8	3.6	0.6	0.0	0.0	0.0	5.0	4.6
NW	0.3	2.6	0.6	0.0	0.0	0.0	3.5	5.5
NNW	0.5	1.7	4.4	0.0	0.0	0.0	6.5	8.0
TOTAL	13.4	33.1	23.5	4.4	0.3	0.0	74.7	4.3

# UNIV MICH WIND ROSE DATA FOR 8/73

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.7	1.5	3.9	1.0	0.0	0.0	7.1	1.8
NNE	0.4	2.2	0.7	0.0	0.0	0.0	3.3	4.9
NE	0.3	0.4	0.0	0.0	0.0	0.0	0.7	2.4
ENE	0.0	0.5	0.0	0.0	0.0	0.0	0.5	3.4
E	0.0	0.1	0.0	0.0	0.0	0.0	0.1	3.4
ESE	0.3	1.4	0.1	0.0	0.0	0.0	1.8	4.1
SE	0.8	1.5	0.0	0.0	0.0	0.0	2.3	3.4
SSE	1.0	2.9	0.5	0.0	0.0	0.0	4.3	4.2
S	1.9	1.1	0.1	0.0	0.0	0.0	3.1	2.6
SSW	4.5	5.4	2.2	0.3	0.0	0.0	12.4	4.4
SW	0.5	3.5	4.8	0.3	0.0	0.0	9.1	7.0
WSW	0.4	4.2	5.8	0.1	0.0	0.0	10.6	7.3
W	0.4	1.4	0.1	0.0	0.0	0.0	1.9	5.0
WNW	0.3	2.0	0.4	0.0	0.0	0.0	2.7	5.3
NW	0.0	1.5	0.3	0.0	0.0	0.0	1.8	5.9
NNW	0.3	2.3	5.4	0.1	0.0	0.0	8.2	7.7
TOTAL	11.7	31.9	24.5	1.8	0.0	0.0	69.8	3.7



UNIV MICH WIND ROSE DATA FOR 9/73

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	1.1	2.3	1.5	0.0	0.0	0.0	4.9	1.0
NNE	0.4	1.5	0.3	0.0	0.0	0.0	2.3	4.0
NE	1.8	2.1	0.6	0.0	0.0	0.0	4.5	3.1
ENE	1.0	2.7	0.0	0.0	0.0	0.0	3.7	2.9
E	2.1	3.4	0.6	0.0	0.0	0.0	6.1	3.6
ESE	0.3	2.5	2.8	0.0	0.0	0.0	5.6	6.5
SE	0.1	1.4	1.8	0.0	0.0	0.0	3.4	7.2
SSE	0.6	0.6	0.8	0.0	0.0	0.0	2.0	5.7
S	0.7	1.5	0.6	0.0	0.0	0.0	2.8	4.0
SSW	1.0	3.1	1.5	0.1	0.0	0.0	5.8	5.3
SW	0.3	1.0	3.0	0.6	0.0	0.0	4.8	7.9
WSW	0.1	2.7	2.4	0.1	0.0	0.0	5.4	6.7
W	0.1	2.3	0.8	0.0	0.0	0.0	3.2	6.0
WNW	0.3	2.4	1.0	0.0	0.0	0.0	3.7	5.7
NW	0.1	2.1	2.3	0.0	0.0	0.0	4.5	7.0
NNW	0.1	3.2	5.2	0.0	0.0	0.0	8.6	7.2
TOTAL	10.3	34.8	25.2	0.8	0.0	0.0	71.1	3.8

# UNIV MICH WIND ROSE DATA FOR 10/73

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.7	0.9	1.2	0.0	0.0	0.0	2.8	0.7
NNE	0.3	0.3	0.1	0.0	0.0	0.0	0.7	2.9
NE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.6
ENE	0.0	0.1	0.0	0.0	0.0	0.0	0.1	2.6
E	0.9	0.6	0.0	0.0	0.0	0.0	1.5	2.3
ESE	1.5	1.5	0.0	0.0	0.0	0.0	2.9	2.8
SE	1.0	3.2	0.3	0.0	0.0	0.0	4.5	3.8
SSE	2.8	4.5	2.0	0.0	0.0	0.0	9.4	4.8
S	1.6	2.8	2.6	0.0	0.0	0.0	7.0	5.0
SSW	0.9	1.6	5.1	0.4	0.0	0.0	8.0	7.5
SW	0.3	1.5	2.9	1.5	0.0	0.0	6.1	9.3
WSW	0.9	1.3	3.7	0.7	0.0	0.0	6.6	8.1
W	0.1	3.2	1.0	0.1	0.0	0.0	4.5	5.6
WNW	0.4	2.2	1.5	0.7	0.0	0.0	4.8	7.8
NW	0.3	3.4	2.3	1.0	0.0	0.0	7.0	7.8
NNW	0.1	2.5	5.3	1.3	0.0	0.0	9.2	9.1
TOTAL	11.8	29.5	28.1	5.8	0.0	0.0	75.3	4.8

# UNIV MICH WIND ROSE DATA FOR 11/73

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.6	1.5	1.5	0.7	0.0	0.0	4.2	3.3
NNE	1.1	1.5	0.4	0.2	0.0	0.0	3.1	4.3
NE	0.7	1.1	0.7	0.0	0.0	0.0	2.6	4.9
ENE	1.3	1.7	1.1	0.0	0.0	0.0	4.1	4.7
E	1.7	2.4	0.0	0.0	0.0	0.0	4.1	3.1
ESE	0.6	2.0	1.7	0.6	0.0	0.0	4.8	6.9
SE	0.2	0.2	2.2	0.6	0.0	0.0	3.1	8.8
SSE	0.0	0.0	1.7	0.6	0.0	0.0	2.2	9.8
S	0.6	1.5	0.9	0.0	0.0	0.0	3.0	4.2
SSW	1.5	3.0	3.0	0.2	0.0	0.0	7.6	6.1
SW	0.4	1.7	3.7	3.7	0.2	0.0	9.6	10.8
WSW	0.7	2.2	1.7	2.4	0.0	0.0	7.0	8.8
W	0.4	0.9	2.4	0.6	0.0	0.0	4.2	8.9
WNW	0.2	2.0	6.3	1.3	0.0	0.0	9.8	9.5
NW	0.4	1.7	8.5	2.4	0.0	0.0	12.9	9.9
NNW	0.2	2.4	3.9	2.0	0.0	0.0	8.5	9.1
TOTAL	10.3	25.6	39.5	15.1	0.2	0.0	90.8	7.1

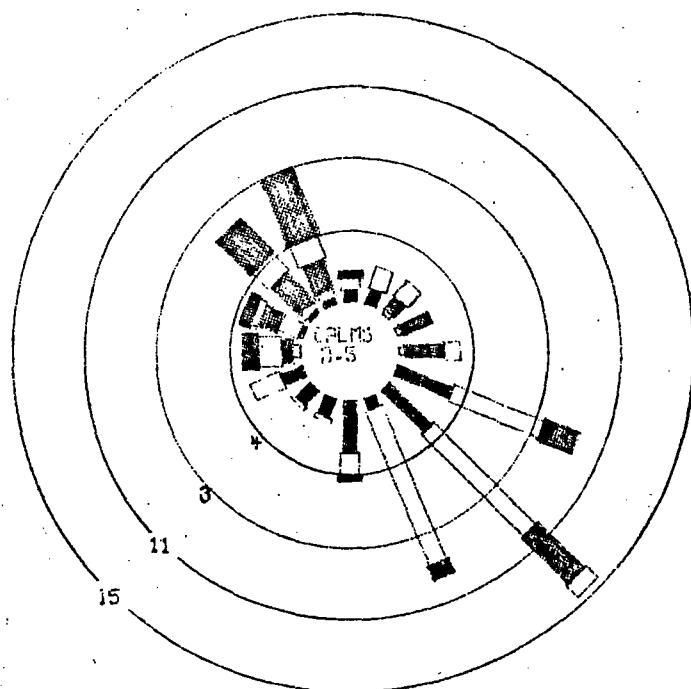
## UNIV MICH WIND ROSE DATA FOR 12/73

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.3	0.8	0.3	0.0	0.0	0.0	1.4	2.5
NNE	0.3	1.1	0.5	0.0	0.0	0.0	1.9	5.7
NE	0.3	3.5	0.5	0.0	0.0	0.0	4.3	5.2
ENE	1.6	2.2	1.1	0.0	0.0	0.0	4.9	5.3
E	0.3	3.5	4.6	0.0	0.0	0.0	8.4	6.8
ESE	1.4	1.1	4.1	0.3	0.0	0.0	6.8	7.7
SE	1.1	0.3	1.9	0.3	0.0	0.0	3.5	7.4
SSE	0.3	0.3	0.8	1.6	0.0	0.0	3.0	11.0
S	0.3	0.0	3.3	0.5	0.0	0.0	4.1	9.4
SSW	0.3	4.6	5.7	3.5	0.0	0.0	14.1	9.0
SW	0.3	0.5	3.3	7.6	0.3	0.0	11.9	13.0
WSW	0.0	1.4	2.7	6.5	0.3	0.0	10.8	13.2
W	0.3	1.9	7.0	1.9	0.0	0.0	11.1	9.3
WNW	0.0	0.5	3.5	5.1	0.0	0.0	9.2	11.9
NW	0.0	0.8	0.5	0.8	0.0	0.0	2.2	9.5
NNW	0.3	0.3	0.3	0.0	0.0	0.0	0.8	5.6
TOTAL	6.8	22.8	40.1	28.2	0.5	0.0	98.4	9.3

APPENDIX B

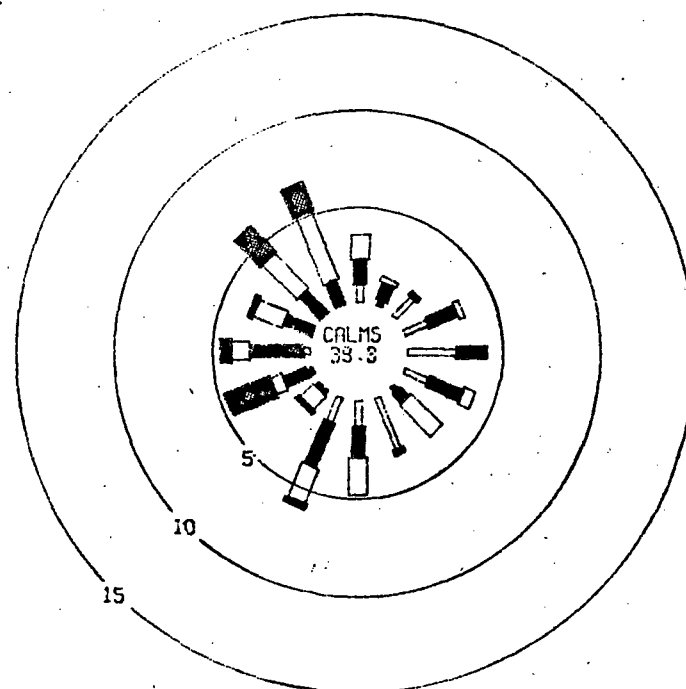
FOUR HOUR WIND ROSES FOR LAKE BREEZE STUDY WITH  
WIND ROSE DATA PRINTOUT FOR PALISADES AND  
UNIVERSITY OF MICHIGAN STATION P03A

B-1



SPEED CLASS (MPH)  
1-3 3-7 7-12 12-18 18-24 24-30

PALISADES FALL WIND FROM 1 TO 4

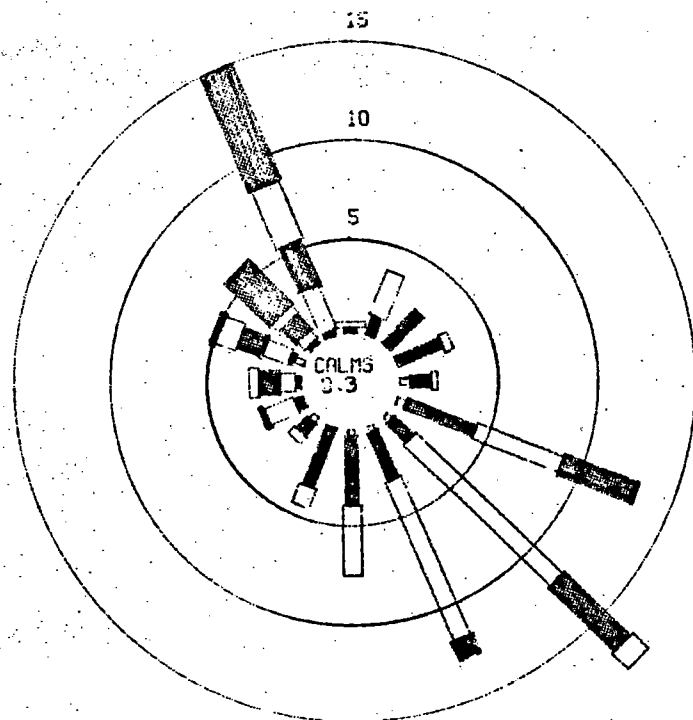


SPEED CLASS (MPH)  
1-3 3-7 7-12 12-18 18-24 24-30

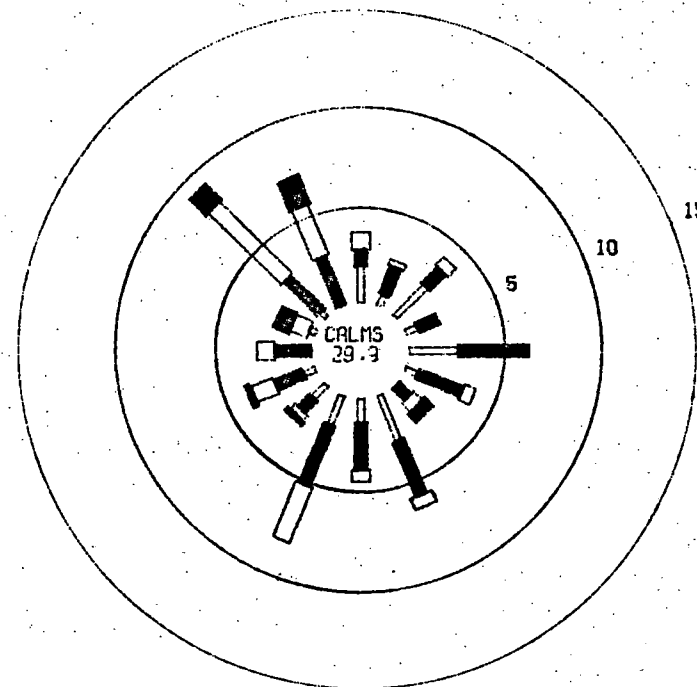
QNV MICH FALL WIND FROM 1 TO 4

Figure B-1. Four-hour wind roses for Palisades and P03A site for time period 0100 to 0400 averaged over the fall 1973 season.

B-2



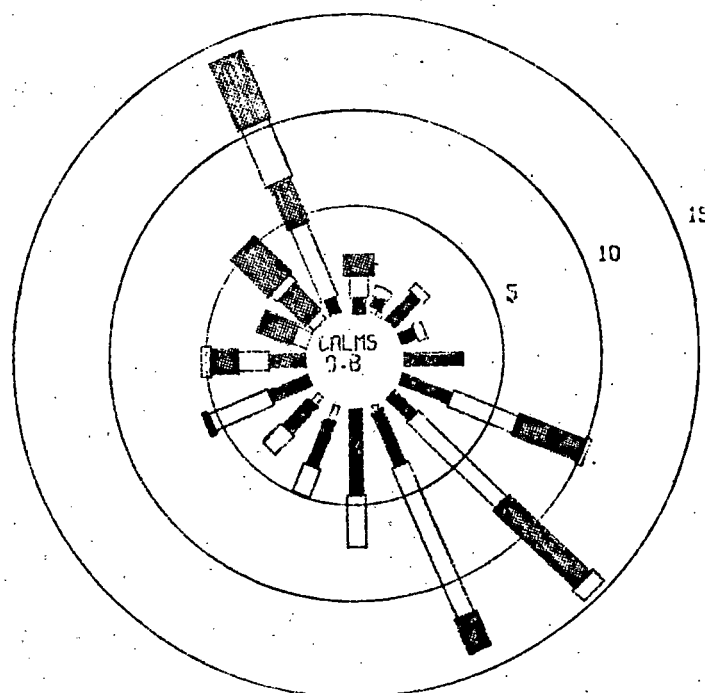
PALISADE FALL WIND FROM 5 TO 8



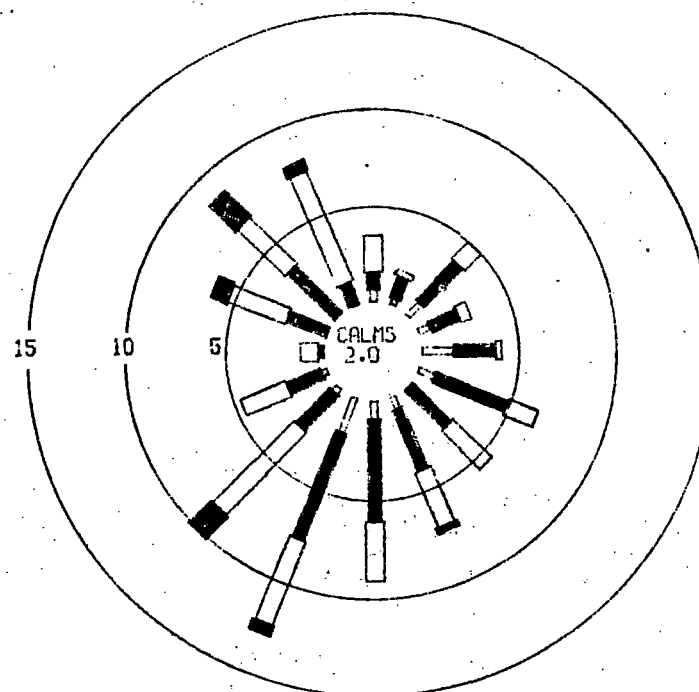
UNV MICH FALL WIND FROM 5 TO 8

Figure B-2. Four-hour wind roses for Palisades and P03A site for time period 0500 to 0800 average over the spring 1973 season.

B-3



SPEED CLASS (MPH)  
1-3 3-6 7-9 12-15 18-24 24+  
PALISADE FALL WIND FROM 9 TO 12

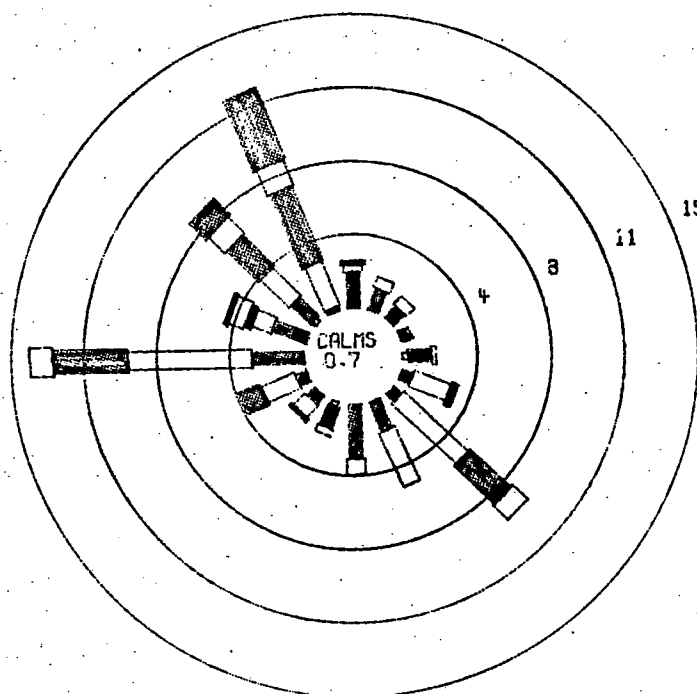


SPEED CLASS (MPH)  
1-3 3-6 7-9 12-15 18-24 24+  
UNV MICH FALL WIND FROM 9 TO 12

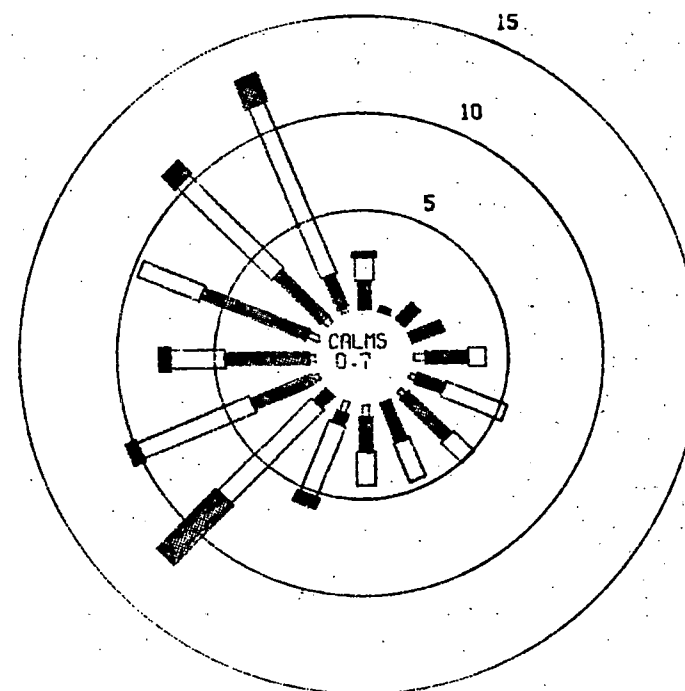
Figure B-3. Four-hour wind roses for Palisades and P03A site for time period 0900 to 1200 averaged over the spring 1973 season.



B-4



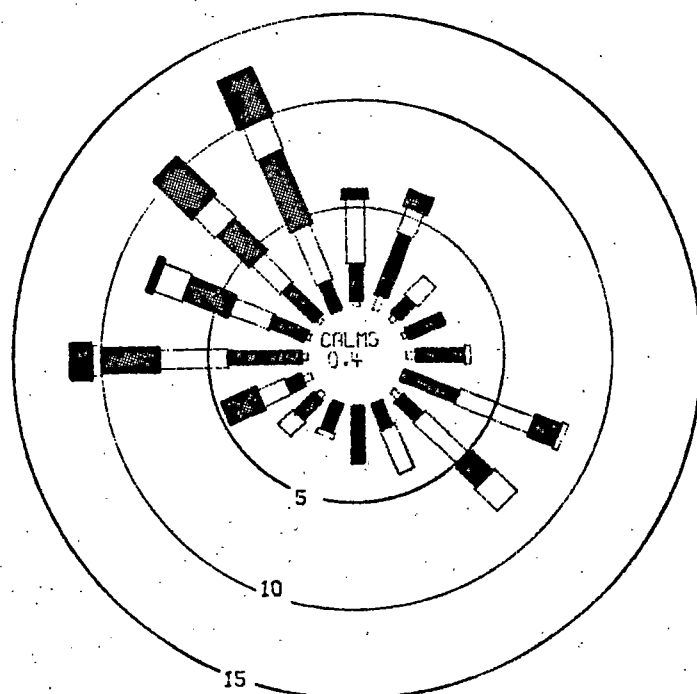
PALISADE FALL WIND FROM 13 TO 15



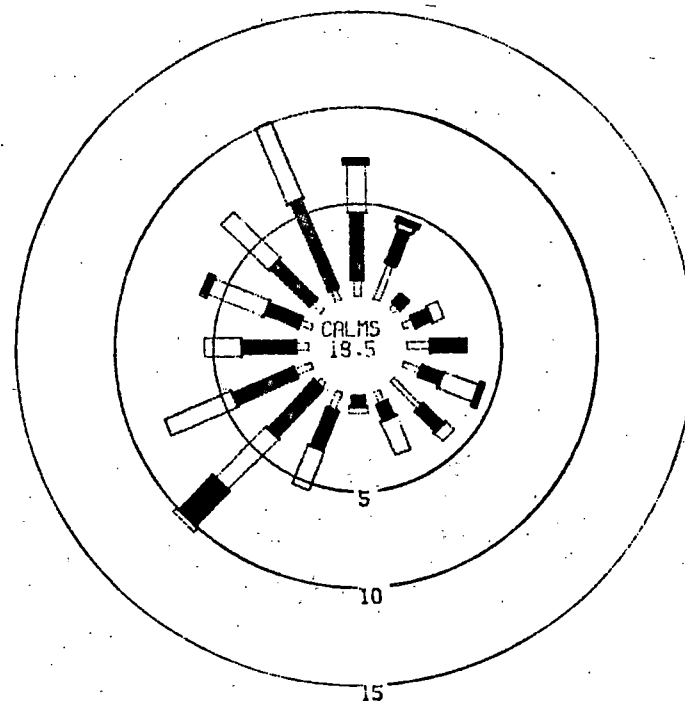
UNV MICH FALL WIND FROM 13 TO 16

Figure B-4. Four-hour wind roses for Palisades and P03A site for time period 1300 to 1600 averaged over the spring 1973 season.

B-5



PALISADE FALL WIND FROM 17 TO 20



UNV MICH FALL WIND FROM 17 TO 20

Figure B-5. Four-hour wind roses for Palisades and P03A site for time period 1700 to 2000 averaged over the spring 1973 season.

B-6

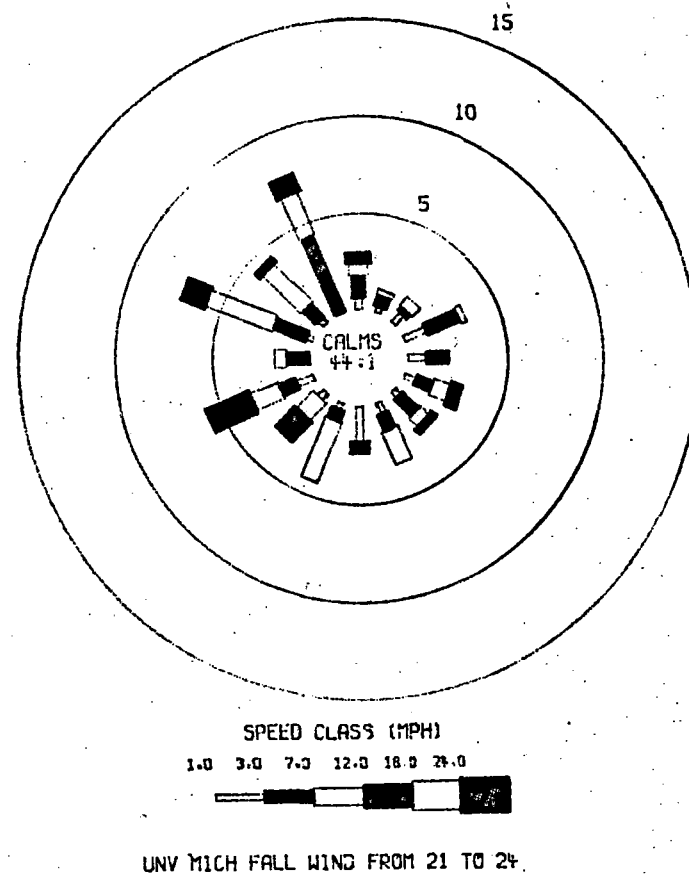
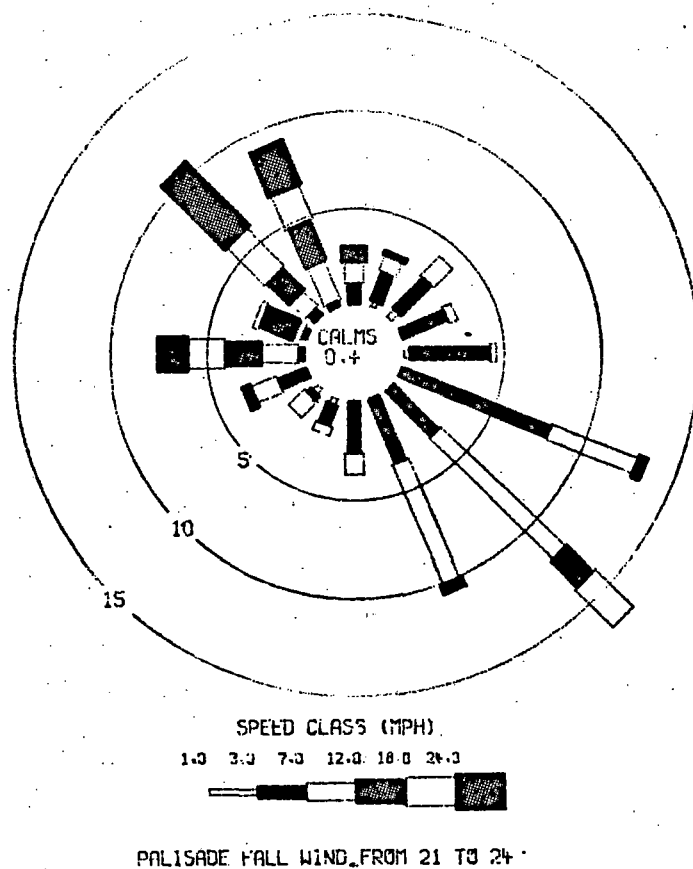


Figure B-6. Four-hour wind rose for Palisades and P03A site for time period 2100 to 2400 averaged over the fall 1973 season.

## UNIV MICH FALL WIND ROSE FOR 1 TO 4

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.9	1.3	1.3	0.0	0.0	0.0	3.5	0.6
NNE	0.3	0.9	0.3	0.0	0.0	0.0	1.6	3.9
NE	1.3	0.3	0.0	0.0	0.0	0.0	1.6	1.6
ENE	1.3	1.6	0.3	0.0	0.0	0.0	3.1	2.8
E	2.5	1.6	0.0	0.0	0.0	0.0	4.1	3.0
ESE	1.3	1.9	0.6	0.0	0.0	0.0	3.8	4.3
SE	0.3	0.6	2.2	0.0	0.0	0.0	3.1	7.4
SSE	2.8	0.3	0.0	0.0	0.0	0.0	3.1	1.7
S	1.3	1.6	1.9	0.0	0.0	0.0	4.7	4.1
SSW	1.3	2.5	1.9	0.3	0.0	0.0	6.0	5.7
SW	0.0	0.3	0.9	0.3	0.0	0.0	1.6	7.7
WSW	0.3	1.3	0.6	2.5	0.0	0.0	4.7	10.3
W	0.3	2.8	0.9	0.6	0.0	0.0	4.7	7.0
WNW	0.0	1.6	1.6	0.3	0.0	0.0	3.5	7.9
NW	0.0	1.6	2.5	1.9	0.0	0.0	6.0	10.1
NNW	0.0	1.3	3.8	1.6	0.0	0.0	6.6	9.7
TOTAL	13.8	21.4	18.9	7.5	0.0	0.0	61.6	3.8

UNIV MICH FALL WIND ROSE FOR 5 TO 8

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	1.9	0.9	0.9	0.0	0.0	0.0	3.7	0.6
NNE	0.6	1.6	0.3	0.0	0.0	0.0	2.5	4.1
NE	2.2	1.2	0.6	0.0	0.0	0.0	4.1	3.0
ENE	0.6	1.2	0.0	0.0	0.0	0.0	1.9	3.7
E	2.5	3.7	0.0	0.0	0.0	0.0	6.2	3.0
ESE	0.6	2.5	0.6	0.0	0.0	0.0	3.7	4.7
SE	0.0	0.9	0.6	0.6	0.0	0.0	2.2	6.6
SSE	2.5	3.1	0.0	0.6	0.0	0.0	6.2	4.5
S	1.2	2.5	0.6	0.0	0.0	0.0	4.4	3.4
SSW	1.6	3.4	3.1	0.0	0.0	0.0	8.1	5.4
SW	0.9	0.9	0.3	0.3	0.0	0.0	2.5	5.2
WSW	0.6	1.6	1.2	0.3	0.0	0.0	3.7	6.6
W	0.0	1.9	0.9	0.0	0.0	0.0	2.8	6.8
WNW	0.3	0.0	0.9	0.9	0.0	0.0	2.2	11.0
NW	0.3	2.5	5.3	1.2	0.0	0.0	9.4	8.8
NNW	0.0	2.8	2.8	1.6	0.0	0.0	7.2	8.8
TOTAL	15.9	30.9	18.4	5.6	0.0	0.0	70.9	4.0

## UNIV MICH FALL WIND ROSE FOR 9 TO 12

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.6	0.9	1.9	0.0	0.0	0.0	3.4	4.8
NNE	0.3	1.2	0.3	0.0	0.0	0.0	1.9	4.7
NE	0.9	2.8	1.2	0.0	0.0	0.0	5.0	5.0
ENE	0.6	1.6	0.6	0.0	0.0	0.0	2.8	4.8
E	1.6	2.2	0.3	0.0	0.0	0.0	4.0	4.3
ESE	0.9	4.0	1.6	0.0	0.0	0.0	6.5	5.0
SE	0.0	2.8	2.8	0.0	0.0	0.0	5.6	7.2
SSE	0.6	3.4	3.1	0.3	0.0	0.0	7.5	6.9
S	0.9	5.3	3.1	0.0	0.0	0.0	9.3	6.0
SSW	1.9	5.9	4.7	0.6	0.0	0.0	13.0	6.6
SW	0.3	2.5	5.9	1.6	0.0	0.0	10.2	8.9
WSW	0.3	1.9	2.5	0.0	0.0	0.0	4.7	7.2
W	0.0	0.3	0.9	0.0	0.0	0.0	1.2	8.0
WNW	0.0	2.2	3.1	0.9	0.0	0.0	6.2	8.9
NW	0.0	3.4	3.4	1.9	0.0	0.0	8.7	8.9
NNW	0.0	1.2	6.2	0.6	0.0	0.0	8.1	9.3
TOTAL	9.0	41.6	41.6	5.9	0.0	0.0	98.1	6.9

## UNIV MICH FALL WIND ROSE FOR 13 TO 16

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.0	1.5	1.2	0.3	0.0	0.0	3.1	7.8
NNE	0.0	0.3	0.0	0.0	0.0	0.0	0.3	4.1
NE	0.0	1.2	0.0	0.0	0.0	0.0	1.2	5.4
ENE	0.0	1.8	0.0	0.0	0.0	0.0	1.8	4.7
E	0.6	2.2	0.9	0.0	0.0	0.0	3.7	5.0
ESE	0.3	1.5	3.4	0.0	0.0	0.0	5.2	7.5
SE	0.3	3.1	1.5	0.0	0.0	0.0	4.9	5.7
SSE	0.0	2.2	2.2	0.0	0.0	0.0	4.3	7.5
S	0.6	1.8	1.8	0.0	0.0	0.0	4.3	5.8
SSW	0.6	0.6	4.0	0.6	0.0	0.0	5.8	8.6
SW	0.0	0.9	6.8	4.3	0.0	0.0	12.0	11.1
WSW	0.3	3.4	6.2	0.6	0.0	0.0	10.5	7.9
W	0.3	4.3	2.8	0.6	0.0	0.0	8.0	7.2
WNW	0.6	5.8	3.4	0.0	0.0	0.0	9.8	6.4
NW	0.3	3.4	6.8	0.9	0.0	0.0	11.4	8.4
NNW	0.3	1.8	9.5	1.5	0.0	0.0	13.2	9.0
TOTAL	4.3	36.0	50.5	8.9	0.0	0.0	99.7	7.9

## UNIV MICH FALL WIND ROSE FOR 17 TO 20

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.9	3.4	2.5	0.3	0.0	0.0	7.1	2.4
NNE	1.9	1.9	0.3	0.3	0.0	0.0	4.3	3.8
NE	0.3	0.6	0.0	0.0	0.0	0.0	0.9	1.8
ENE	0.6	0.9	0.6	0.0	0.0	0.0	2.2	5.1
E	1.2	1.9	0.0	0.0	0.0	0.0	3.1	2.7
ESE	0.9	1.2	1.9	0.3	0.0	0.0	4.3	6.4
SE	1.9	1.5	0.6	0.0	0.0	0.0	4.0	3.9
SSE	0.6	0.9	1.9	0.0	0.0	0.0	3.4	6.2
S	0.0	0.6	0.3	0.0	0.0	0.0	0.9	4.9
SSW	0.9	2.2	2.2	0.0	0.0	0.0	5.2	5.7
SW	0.3	3.4	3.7	2.5	0.3	0.0	10.2	9.2
WSW	0.9	3.4	3.7	0.0	0.0	0.0	8.0	6.4
W	0.6	2.8	1.9	0.0	0.0	0.0	5.2	5.8
WNW	0.6	1.9	3.1	0.3	0.0	0.0	5.9	7.7
NW	0.6	2.8	3.4	0.0	0.0	0.0	6.8	6.7
NNW	0.6	4.9	4.3	0.0	0.0	0.0	9.9	6.5
TOTAL	13.0	34.3	30.2	3.7	0.3	0.0	81.5	4.8



UNIV MICH FALL WIND ROSE FOR 21 TO 24

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.6	1.2	0.6	0.6	0.0	0.0	3.1	0.6
NNE	0.3	0.6	0.3	0.0	0.0	0.0	1.2	3.2
NE	0.6	0.3	0.6	0.0	0.0	0.0	1.5	4.1
ENE	1.2	1.8	0.3	0.0	0.0	0.0	3.4	2.7
E	0.9	1.2	0.0	0.0	0.0	0.0	2.1	1.8
ESE	0.6	0.9	0.9	0.6	0.0	0.0	3.1	6.1
SE	0.3	1.2	0.6	0.3	0.0	0.0	2.4	5.9
SSE	0.6	0.9	1.8	0.0	0.0	0.0	3.4	6.8
S	1.8	0.0	0.6	0.0	0.0	0.0	2.4	2.5
SSW	0.3	0.6	3.4	0.0	0.0	0.0	4.3	6.5
SW	0.3	0.0	1.2	1.5	0.0	0.0	3.1	10.8
WSW	0.9	0.9	1.5	2.4	0.0	0.0	5.8	9.1
W	0.0	1.2	0.6	0.0	0.0	0.0	1.8	5.4
WNW	0.3	1.8	3.7	1.2	0.0	0.0	7.0	9.4
NW	0.3	0.9	2.8	0.3	0.0	0.0	4.3	9.1
NNW	0.0	4.3	2.4	0.9	0.0	0.0	7.6	7.5
TOTAL	9.2	18.0	21.4	8.0	0.0	0.0	56.6	3.7

FALL 1973  
PALISADES WIND ROSE FOR 1 TO 4

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.0	0.8	0.3	0.5	0.0	0.0	2.2	3.5
NNE	0.0	1.1	1.6	0.0	0.0	0.0	2.7	7.5
NE	0.3	1.1	1.4	0.0	0.0	0.0	2.7	6.7
ENE	0.3	2.2	0.0	0.0	0.0	0.0	2.5	4.9
E	0.3	2.7	1.1	0.0	0.0	0.0	4.1	5.5
ESE	0.0	4.1	6.6	2.5	0.0	0.0	13.2	9.1
SE	0.0	4.1	9.9	4.4	1.1	0.0	19.5	10.5
SSE	0.0	0.8	11.5	1.1	0.0	0.0	13.5	9.3
S	0.0	3.6	1.6	0.3	0.0	0.0	5.5	6.9
SSW	0.0	1.4	0.3	0.0	0.0	0.0	1.6	5.0
SW	0.0	1.4	0.3	0.0	0.0	0.0	1.6	5.5
WSW	0.0	1.6	2.2	0.0	0.0	0.0	3.8	7.8
W	0.0	0.5	0.0	0.3	1.6	1.1	4.1	20.0
WNW	0.0	0.3	1.4	1.4	0.5	0.8	4.4	15.7
NW	0.0	0.3	0.5	2.7	1.6	3.3	8.5	22.2
NNW	0.0	0.5	0.5	2.2	1.6	4.9	9.9	21.7
TOTAL	0.8	26.6	39.8	15.9	6.6	10.2	♦♦♦♦	11.8

B-13

FALL 1973  
PALISADES WIND ROSE FOR 5 TO 8

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.0	0.3	0.0	0.0	0.3	0.0	0.5	12.1
NNE	0.0	1.1	2.5	0.0	0.0	0.0	3.6	3.1
NE	0.0	2.5	0.0	0.0	0.0	0.0	2.5	4.5
ENE	0.0	2.5	0.5	0.0	0.0	0.0	3.0	5.1
E	0.5	1.1	0.3	0.0	0.0	0.0	1.9	4.7
ESE	0.5	3.3	4.7	4.1	0.0	0.0	13.2	9.3
SE	0.3	1.4	10.4	4.7	1.1	0.0	17.9	11.1
SSE	0.3	2.7	3.3	1.1	0.0	0.0	12.9	9.2
S	0.3	3.6	3.6	0.0	0.0	0.0	7.4	7.2
SSW	0.0	3.3	1.1	0.0	0.0	0.0	4.4	5.9
SW	0.3	0.8	0.5	0.0	0.0	0.0	1.6	6.6
WSW	0.0	0.5	1.6	0.3	0.0	0.0	2.5	9.0
W	0.0	0.3	0.3	1.1	0.5	0.0	2.7	12.7
WNW	0.5	0.3	1.4	1.4	1.1	0.3	4.9	13.0
NW	0.0	0.3	0.5	1.1	0.5	3.3	5.8	25.3
NNW	0.0	0.3	2.5	2.5	3.3	6.3	14.8	21.0
TOTAL	2.7	24.7	39.3	16.2	6.9	9.9	99.7	11.8

FALL 1973  
PALISADES WIND ROSE FOR 9 TO 12

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.0	0.8	1.1	0.0	1.1	0.0	3.0	12.0
NNE	0.3	0.5	0.5	0.0	0.0	0.0	1.4	6.1
NE	0.0	1.9	0.5	0.0	0.0	0.0	2.5	5.4
ENE	0.0	0.8	0.5	0.0	0.0	0.0	1.4	6.9
E	0.0	3.0	0.0	0.0	0.0	0.0	3.0	4.9
ESE	0.0	2.7	3.6	3.6	0.3	0.0	10.2	10.5
SE	0.0	1.6	6.3	5.8	0.8	0.0	14.6	12.0
SSE	0.3	3.0	8.5	1.9	0.0	0.0	13.7	9.0
S	0.0	4.4	2.7	0.0	0.0	0.0	7.1	6.6
SSW	0.8	2.5	1.6	0.0	0.0	0.0	4.9	5.9
SW	0.5	1.9	1.4	0.0	0.0	0.0	3.8	5.5
WSW	0.0	2.2	3.3	0.3	0.0	0.0	5.8	7.9
W	0.0	1.9	1.6	1.4	0.5	0.0	5.5	10.0
WNW	0.0	0.0	0.8	1.9	0.0	0.0	2.7	13.3
NW	0.0	0.0	0.5	1.9	0.5	2.7	5.8	22.3
NNW	0.0	0.8	4.1	2.5	3.3	3.8	14.6	18.2
TOTAL	1.9	28.3	37.4	19.2	6.6	6.6	♦♦♦♦	11.2

B-15

FALL 1973  
PALISADES WIND ROSE FOR 13 TO 16

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.0	2.5	0.5	0.3	0.0	0.0	3.3	6.2
NNE	0.0	1.6	0.3	0.0	0.0	0.0	2.5	5.9
NE	0.0	1.1	0.8	0.0	0.0	0.0	1.9	6.3
ENE	0.0	0.3	0.0	0.0	0.0	0.0	0.3	5.6
E	0.3	1.6	0.3	0.0	0.0	0.0	2.2	4.8
ESE	0.0	0.3	2.7	0.5	0.0	0.0	4.1	9.3
SE	0.0	0.3	6.0	3.8	1.4	0.0	12.1	12.0
SSE	0.0	2.2	4.1	0.0	0.0	0.0	6.3	7.9
S	0.0	3.8	1.1	0.0	0.0	0.0	4.9	6.2
SSW	0.3	1.6	0.5	0.0	0.0	0.0	2.5	6.7
SW	0.0	0.3	1.1	0.3	0.0	0.0	2.2	7.8
WSW	0.0	0.3	2.5	1.6	0.0	0.0	4.9	10.0
W	0.0	3.6	3.5	5.2	1.6	0.0	19.0	11.0
WNW	0.0	2.5	1.4	0.5	1.1	0.3	5.8	10.8
NW	0.3	1.9	2.7	3.0	1.6	1.6	11.3	14.2
NNW	0.0	0.3	3.3	5.5	1.9	5.2	16.2	19.3
TOTAL	0.8	26.9	36.5	20.9	7.7	7.1	♦♦♦♦	11.5

FALL 1973  
PALISADES WIND ROSE FOR 17 TO 20

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.3	1.9	3.3	0.5	0.0	0.0	6.0	7.8
NNE	0.8	3.3	1.4	0.8	0.0	0.0	5.3	6.3
NE	0.3	1.1	1.4	0.0	0.0	0.0	2.7	7.1
ENE	0.3	1.9	0.0	0.0	0.0	0.0	2.2	3.9
E	0.5	2.5	0.3	0.0	0.0	0.0	3.3	4.9
ESE	0.0	3.0	4.1	1.4	0.3	0.0	8.8	8.6
SE	0.5	1.4	3.3	1.4	1.6	0.0	8.2	11.1
SSE	0.0	1.4	2.5	0.0	0.0	0.0	3.8	8.4
S	0.0	3.0	0.0	0.0	0.0	0.0	3.0	5.4
SSW	0.0	1.6	0.3	0.0	0.0	0.0	1.9	6.2
SW	0.3	1.4	1.1	0.0	0.0	0.0	2.7	6.5
WSW	0.5	0.8	1.6	1.9	0.0	0.0	4.9	9.4
W	0.3	3.3	3.6	3.0	0.5	1.1	12.4	11.3
WNW	0.3	1.9	2.2	2.5	1.6	0.3	8.8	12.6
NW	0.3	2.2	2.2	2.2	1.6	2.7	11.3	16.3
NNW	0.0	1.6	3.0	4.1	1.9	2.7	13.5	15.9
TOTAL	4.4	33.0	30.2	17.9	7.7	6.9	♦♦♦♦	10.7

FALL 1973  
PALISADES WIND ROSE FOR 21 TO 24

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.0	1.1	1.1	0.8	0.0	0.0	3.0	9.4
NNE	0.3	1.6	0.8	0.3	0.0	0.0	3.0	6.4
NE	0.5	2.2	1.4	0.0	0.0	0.0	4.1	6.2
ENE	0.0	2.5	0.5	0.0	0.0	0.0	3.0	6.0
E	0.3	4.1	0.3	0.0	0.0	0.0	4.7	5.1
ESE	0.0	8.2	4.7	0.5	0.0	0.0	13.5	7.2
SE	0.0	3.3	8.8	1.9	2.7	0.0	16.8	10.9
SSE	0.0	3.6	6.6	0.5	0.0	0.0	10.7	8.0
S	0.0	2.7	1.1	0.0	0.0	0.0	3.8	6.2
SSW	0.3	1.1	0.5	0.0	0.0	0.0	1.9	5.3
SW	0.3	0.3	1.1	0.0	0.0	0.0	1.6	6.7
WSW	0.0	1.6	1.4	0.5	0.0	0.0	3.6	7.9
W	0.0	0.3	1.9	1.9	1.9	1.6	7.7	17.8
WNW	0.0	0.3	0.3	1.9	0.3	0.0	2.7	14.6
NW	0.0	0.5	1.1	1.6	2.7	4.7	10.7	22.1
NNW	0.0	0.3	2.2	2.2	1.9	2.5	9.1	19.2
TOTAL	1.6	33.8	33.8	12.4	9.6	8.8	♦♦♦♦	11.4

WINTER 1973-1974  
PALISADES WIND ROSE FOR 1 TO 4

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.0	0.3	0.8	0.0	0.0	0.0	1.1	8.5
NNE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NE	0.0	3.3	0.3	0.0	0.0	0.0	3.6	5.2
ENE	0.0	4.7	0.3	0.0	0.0	0.0	5.6	5.4
E	0.3	3.3	1.7	0.0	0.0	0.0	5.3	6.2
ESE	0.0	2.2	3.6	2.5	1.9	0.0	10.3	12.0
SE	0.0	1.4	6.4	2.8	1.7	0.0	12.2	11.8
SSE	0.3	1.1	1.9	0.0	0.0	0.0	3.3	7.0
S	0.0	1.9	3.3	0.6	0.0	0.0	5.8	8.0
SSW	0.0	3.3	1.7	0.0	0.0	0.0	5.0	6.2
SW	0.0	0.8	3.3	1.4	0.0	0.0	5.6	9.6
WSW	0.0	0.0	3.9	3.6	0.6	0.0	8.1	12.6
W	0.0	0.0	2.2	1.1	0.3	0.6	4.2	14.4
WNW	0.0	0.6	1.4	1.4	3.3	2.8	9.4	19.7
NW	0.0	0.3	0.3	3.3	3.3	1.7	8.9	18.9
NNW	0.0	0.3	0.3	2.2	0.3	3.1	6.1	22.3
TOTAL	0.6	23.6	31.9	18.9	11.4	8.1	94.4	11.6



WINTER 1973-1974  
PALISADES WIND ROSE FOR 5 TO 8

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.0	0.3	0.3	0.0	0.0	0.0	0.6	7.7
NNE	0.3	0.3	0.0	0.0	0.0	0.0	0.6	0.4
NE	0.0	2.2	0.0	0.0	0.0	0.0	2.2	5.6
ENE	0.0	3.6	0.3	0.0	0.0	0.0	3.9	5.2
E	0.0	5.6	1.4	0.0	0.0	0.0	6.9	5.7
ESE	0.0	3.6	5.6	4.2	1.1	0.0	14.4	10.8
SE	0.3	0.3	3.1	3.3	2.8	0.0	9.7	13.9
SSE	0.0	2.2	5.8	0.6	0.0	0.0	8.6	8.7
S	0.3	3.6	2.8	0.3	0.0	0.0	6.9	7.0
SSW	0.0	1.4	2.2	0.0	0.0	0.0	3.6	7.5
SW	0.0	1.4	2.8	0.3	0.0	0.0	4.4	8.6
WSW	0.3	0.3	1.9	4.4	0.8	0.0	7.8	13.5
W	0.0	1.1	1.7	1.1	1.1	0.3	5.3	13.3
WNW	0.0	0.6	0.6	1.1	1.1	3.1	6.4	19.6
NW	0.0	0.0	0.0	2.2	3.9	1.4	7.5	20.6
NNW	0.0	0.0	0.3	0.3	1.7	2.8	5.0	23.1
TOTAL	1.1	26.4	28.6	17.8	12.5	7.5	93.9	11.3

WINTER 1973-1974  
PALISADES WIND ROSE FOR 9 TO 12

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.3	0.3	0.3	0.0	0.0	0.0	0.8	5.0
NNE	0.0	0.0	0.6	0.3	0.0	0.0	0.8	1.5
NE	0.3	1.4	0.6	0.0	0.0	0.0	2.2	6.1
ENE	0.3	1.1	0.0	0.0	0.0	0.0	1.4	4.6
E	0.0	3.9	1.4	0.0	0.0	0.0	5.3	5.2
ESE	0.0	5.0	5.6	5.3	1.1	0.0	16.9	10.9
SE	0.0	3.1	5.0	5.8	0.3	0.0	14.2	11.1
SSE	0.0	1.4	5.0	2.2	0.0	0.0	8.6	10.1
S	0.3	1.7	2.2	0.3	0.0	0.0	4.4	7.1
SSW	0.0	3.1	1.9	0.0	0.0	0.0	5.0	6.9
SW	0.0	0.6	3.1	0.0	0.0	0.0	3.6	9.3
WSW	0.0	0.6	1.1	4.2	0.3	0.0	6.1	12.8
W	0.3	0.3	0.6	2.8	1.7	0.0	5.6	14.9
WNW	0.0	0.0	0.6	1.9	2.5	0.0	5.0	18.2
NW	0.0	0.0	0.0	2.8	3.1	3.6	9.4	22.0
NNW	0.0	0.3	0.8	0.3	1.7	0.8	3.9	20.7
TOTAL	1.4	22.5	28.6	25.8	10.6	4.4	93.3	11.2

WINTER 1973-1974  
PALISADES WIND ROSE FOR 13 TO 16

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.0	1.1	0.0	0.3	0.6	0.6	2.5	14.8
NNE	0.0	0.8	2.5	0.3	0.0	0.0	3.6	3.5
NE	0.0	1.4	0.0	0.0	0.0	0.0	1.4	4.5
ENE	0.3	1.1	0.0	0.0	0.0	0.0	1.4	3.8
E	0.6	1.1	0.8	0.0	0.0	0.0	2.5	5.1
ESE	0.0	3.3	4.2	2.8	1.7	0.0	12.0	11.0
SE	0.0	3.1	7.0	4.7	1.9	0.0	16.7	11.4
SSE	0.0	1.7	3.3	2.2	0.3	0.0	7.5	10.0
S	0.0	1.4	1.7	0.3	0.0	0.0	3.3	8.2
SSW	0.0	0.3	2.5	0.0	0.0	0.0	2.8	9.0
SW	0.0	0.8	0.6	0.6	0.0	0.0	1.9	8.6
WSW	0.0	0.8	3.1	7.5	0.3	0.0	11.7	12.6
W	0.0	0.0	0.8	1.9	1.7	0.3	4.7	17.0
WNW	0.0	0.3	1.7	3.3	1.1	0.3	6.7	14.6
NW	0.0	0.0	1.1	2.2	3.9	3.1	10.3	21.3
NNW	0.0	0.8	0.0	0.8	1.9	1.1	4.7	19.1
TOTAL	0.8	18.1	29.2	27.0	13.4	5.3	93.9	11.8

WINTER 1973-1974  
PALISADES WIND ROSE FOR 17 TO 20

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.0	0.8	0.8	1.1	0.0	0.0	2.8	10.6
NNE	0.0	1.1	1.9	0.0	0.0	0.0	3.1	2.8
NE	0.3	1.4	1.1	0.0	0.0	0.0	2.8	7.0
ENE	0.0	1.1	0.6	0.0	0.0	0.0	1.7	6.6
E	0.3	1.4	3.6	0.0	0.0	0.0	5.3	7.4
ESE	0.3	1.1	5.3	2.5	1.1	0.0	10.3	11.3
SE	0.6	2.8	3.9	3.6	1.1	0.0	11.9	10.6
SSE	0.0	1.9	2.2	0.8	0.0	0.0	5.0	8.7
S	0.0	0.0	3.3	0.0	0.0	0.0	3.3	9.1
SSW	0.0	1.1	1.9	0.6	0.0	0.0	3.6	8.1
SW	0.0	0.6	3.1	0.3	0.0	0.0	3.9	8.2
WSW	0.0	0.0	1.7	3.3	0.6	0.0	5.6	13.0
W	0.0	0.3	1.4	2.2	2.5	1.4	7.8	17.7
WNW	0.0	0.6	1.9	4.7	1.1	0.6	8.9	13.9
NW	0.0	0.6	1.1	2.2	6.7	2.8	13.3	20.0
NNW	0.0	0.6	0.6	0.8	0.8	2.2	5.0	25.5
TOTAL	1.4	15.3	34.4	22.2	13.9	6.9	94.2	12.1

WINTER 1973-1974  
PALISADES WIND ROSE FOR 21 TO 24

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.0	0.0	0.6	0.8	0.0	0.0	1.4	12.1
NNE	0.0	0.6	0.3	0.0	0.0	0.0	0.8	0.9
NE	0.0	1.7	0.6	0.0	0.0	0.0	2.2	6.2
ENE	0.3	2.2	1.1	0.0	0.0	0.0	3.6	6.0
E	0.0	4.4	1.1	0.0	0.0	0.0	5.6	5.8
ESE	0.0	1.1	5.6	2.8	1.1	0.0	10.6	11.7
SE	0.0	3.3	4.7	3.6	0.8	0.0	12.5	10.6
SSE	0.0	1.9	2.5	0.8	0.0	0.0	5.3	8.2
S	0.0	1.9	2.2	0.6	0.0	0.0	4.7	8.0
SSW	0.0	1.1	2.8	0.3	0.0	0.0	4.2	8.3
SW	0.0	1.4	1.9	1.4	0.0	0.0	4.7	9.2
WSW	0.0	1.1	1.7	1.1	0.6	0.0	4.4	11.0
W	0.0	0.0	1.4	2.5	1.7	1.1	6.7	17.5
WNW	0.0	0.0	2.5	1.7	2.2	1.9	8.3	18.5
NW	0.0	0.3	1.1	4.4	4.4	3.3	13.6	19.6
NNW	0.3	0.6	0.3	1.7	0.0	3.1	5.8	23.8
TOTAL	0.6	21.7	30.3	21.7	10.8	9.4	94.4	12.3

B-24

SPRING 1974  
PALISADES WIND ROSE FOR 1 TO 4

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.3	1.7	1.7	0.3	0.0	0.0	3.9	6.4
NNE	0.3	0.8	1.4	0.0	0.0	0.0	2.5	7.8
NE	0.0	1.4	0.0	0.0	0.0	0.0	1.4	4.1
ENE	0.3	2.8	0.0	0.0	0.0	0.0	3.1	4.1
E	0.6	3.1	1.1	0.0	0.0	0.0	4.7	6.0
ESE	0.0	3.9	4.2	2.2	0.6	0.3	11.1	9.1
SE	0.0	0.8	8.3	4.4	1.4	0.3	15.3	12.1
SSE	0.0	1.9	4.2	1.4	0.3	0.0	7.8	9.7
S	0.3	1.4	0.6	0.0	0.0	0.0	2.2	6.3
SSW	0.0	0.6	1.9	0.0	0.0	0.0	2.5	7.9
SW	0.0	0.3	3.1	0.0	0.0	0.0	3.3	9.4
WSW	0.3	3.1	4.7	3.9	0.0	0.0	11.9	9.8
W	0.3	1.1	2.5	3.1	0.0	0.0	6.9	10.7
WNW	0.0	0.3	0.8	2.2	0.0	0.3	3.6	14.0
NW	0.0	0.6	1.7	2.2	2.5	3.3	10.3	19.3
NNW	0.0	1.1	1.4	1.4	2.2	1.9	8.1	16.3
TOTAL	2.2	24.7	37.5	21.1	6.9	6.1	98.6	10.9

B-25

SPRING 1974  
PALISADES WIND ROSE FOR 5 TO 8

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.0	1.4	1.1	1.1	0.0	0.0	3.6	9.2
NNE	0.3	0.6	0.8	0.0	0.0	0.0	1.7	6.4
NE	0.3	2.8	0.6	0.0	0.0	0.0	3.6	5.2
ENE	0.6	1.7	0.0	0.0	0.0	0.0	2.2	4.4
E	0.3	1.1	1.4	0.0	0.0	0.0	2.8	6.9
ESE	0.0	2.5	6.4	4.4	1.7	0.0	15.0	10.6
SE	0.0	0.8	6.1	6.1	1.1	0.0	14.2	12.2
SSE	0.0	1.7	4.7	1.1	0.0	0.0	7.5	10.0
S	0.0	0.6	3.1	0.3	0.0	0.0	3.9	9.6
SSW	0.0	0.8	1.9	0.3	0.0	0.0	3.1	8.8
SW	0.0	0.0	0.3	0.6	0.0	0.0	0.8	10.9
WSW	0.0	0.8	3.3	5.8	0.0	0.0	10.0	12.2
W	0.0	1.1	2.2	3.6	0.6	0.0	7.5	11.4
WNW	0.0	0.3	1.1	2.2	1.4	0.6	5.6	15.4
NW	0.3	0.3	1.1	1.9	2.5	1.7	7.8	18.1
NNW	0.0	0.6	2.5	1.9	3.3	1.4	9.7	17.2
TOTAL	1.7	16.9	36.7	29.4	10.6	3.6	98.9	11.7

SPRING 1974  
PALISADES WIND ROSE FOR 9 TO 12

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.3	0.8	2.8	1.1	0.0	0.0	5.0	9.5
NNE	0.0	1.4	0.8	0.0	0.0	0.0	2.2	6.3
NE	0.3	1.9	0.6	0.0	0.0	0.0	3.3	4.5
ENE	0.0	1.1	0.3	0.0	0.0	0.0	1.4	5.1
E	0.6	1.4	0.8	0.0	0.0	0.0	2.8	5.8
ESE	0.0	1.4	1.9	3.6	2.8	1.1	10.8	13.7
SE	0.0	0.8	3.6	4.4	1.7	1.1	11.7	14.2
SSE	0.0	1.4	4.7	1.9	0.6	0.0	8.6	10.5
S	0.3	0.3	2.5	0.8	0.0	0.0	3.9	10.0
SSW	0.0	1.4	0.6	1.4	0.0	0.0	3.3	10.0
SW	0.0	0.8	0.3	0.3	0.0	0.0	1.4	8.0
WSW	0.0	1.1	2.5	4.2	0.0	0.0	7.8	12.2
W	0.0	1.9	5.0	4.2	1.7	0.3	13.1	12.2
WNW	0.6	1.9	0.6	1.7	0.3	0.0	5.0	9.4
NW	0.6	1.7	0.3	0.8	1.1	0.3	5.3	14.5
NNW	0.3	1.1	3.3	1.7	3.3	3.6	13.3	17.4
TOTAL	3.3	20.6	30.6	26.1	11.4	6.9	99.9	12.0

B-27



SPRING 1974  
PALISADES WIND ROSE FOR 13 TO 16

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.3	1.1	3.3	1.9	0.3	0.0	6.9	10.2
NNE	0.3	0.8	1.1	0.3	0.0	0.0	2.5	7.7
NE	0.0	0.6	0.0	0.0	0.0	0.0	0.6	5.6
ENE	0.0	0.6	0.6	0.3	0.0	0.0	1.4	8.2
E	0.0	0.8	2.8	1.4	0.0	0.0	5.0	9.5
ESE	0.0	1.4	1.4	2.8	0.8	0.0	6.3	10.6
SE	0.3	0.3	4.4	4.4	3.0	0.6	12.9	14.5
SSE	0.0	0.3	1.4	1.9	0.0	0.0	3.6	11.4
S	0.3	0.6	2.5	1.4	0.0	0.0	4.7	9.8
SSW	0.0	0.3	1.4	1.1	0.0	0.0	2.8	10.2
SW	0.0	0.6	0.0	0.8	0.0	0.0	1.4	11.4
WSW	0.0	1.1	1.7	4.7	1.1	0.0	8.5	13.1
W	0.3	1.1	6.3	3.9	0.6	0.3	12.4	11.6
WNW	0.0	1.4	1.4	0.8	0.3	0.0	3.9	9.2
NW	0.0	2.5	3.6	1.9	1.4	1.4	10.7	13.2
NNW	0.0	1.4	5.0	3.3	3.9	2.2	15.7	15.5
TOTAL	1.4	14.6	36.6	30.9	11.3	4.4	99.2	12.1

SPRING 1974  
PALISADES WIND ROSE FOR 17 TO 20

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.3	3.3	5.5	1.7	0.6	0.0	11.3	9.2
NNE	0.3	2.2	3.0	0.3	0.0	0.0	5.8	6.3
NE	0.3	1.4	0.6	0.0	0.0	0.0	2.2	5.0
ENE	0.0	0.6	0.6	0.0	0.0	0.0	1.1	7.2
E	0.0	1.7	3.0	0.0	0.0	0.0	4.7	7.7
ESE	0.0	1.1	3.6	1.9	1.1	0.0	7.7	9.9
SE	0.0	1.4	3.3	0.6	2.8	0.0	8.0	12.7
SSE	0.0	1.1	4.7	0.3	0.0	0.0	6.1	9.0
S	0.0	0.8	1.4	0.0	0.0	0.0	2.2	7.3
SSW	0.0	0.6	1.1	0.6	0.3	0.0	2.5	10.1
SW	0.0	0.6	2.5	1.4	0.0	0.0	4.4	10.0
WSW	0.3	1.1	3.3	3.9	1.1	0.0	9.6	12.4
W	0.3	2.5	1.7	2.2	0.8	0.0	7.4	10.1
WNW	0.8	1.7	0.8	1.1	0.3	0.3	5.0	9.3
NW	0.3	1.9	2.2	0.6	2.2	1.4	8.5	14.7
NNW	0.3	1.9	3.0	3.3	1.9	1.4	11.8	14.1
TOTAL	2.8	23.7	40.2	17.6	11.0	3.0	98.3	10.5

SPRING 1974  
PALISADES WIND ROSE FOR 21 TO 24

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.5	1.6	3.8	0.8	0.0	0.0	6.9	8.0
NNE	0.0	3.8	1.9	0.0	0.0	0.0	5.8	6.4
NE	0.0	2.5	0.0	0.0	0.0	0.0	2.5	4.4
ENE	0.5	2.7	0.3	0.0	0.0	0.0	3.6	4.4
E	0.3	3.0	1.6	0.0	0.0	0.0	4.9	5.8
ESE	0.5	3.6	4.7	1.6	1.6	0.0	12.1	8.9
SE	0.5	2.7	8.0	1.6	1.1	0.0	14.0	9.2
SSE	0.0	0.8	4.1	0.3	0.0	0.0	5.2	8.7
S	0.5	1.6	2.7	0.0	0.0	0.0	4.9	6.9
SSW	0.0	0.8	3.8	0.0	0.0	0.0	4.7	8.8
SW	0.5	0.5	2.7	0.0	0.0	0.0	3.8	7.4
WSW	0.0	3.3	1.6	3.8	0.0	0.0	8.8	9.8
W	0.3	0.8	0.5	2.2	0.3	0.3	4.9	13.8
WNW	0.0	0.0	2.5	0.5	1.1	0.3	4.4	14.0
NW	0.5	0.0	2.7	0.3	0.8	3.0	7.4	17.9
NNW	0.5	0.0	1.1	1.6	0.5	1.1	4.9	15.5
TOTAL	4.9	28.0	42.3	12.9	5.5	5.2	98.9	9.6

SUMMER 1974  
FALISADES WIND ROSE FOR 1 TO 4

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.8	0.8	0.8	0.0	0.0	0.0	2.5	5.2
NNE	0.3	0.8	0.0	0.0	0.0	0.0	1.1	5.0
NE	0.8	2.5	0.0	0.0	0.0	0.0	3.4	4.2
ENE	0.0	3.9	0.0	0.0	0.0	0.0	3.9	4.5
E	0.6	3.1	0.0	0.0	0.0	0.0	3.7	5.0
ESE	0.3	6.2	6.5	0.3	0.0	0.0	13.2	7.3
SE	0.8	1.7	11.8	0.6	0.0	0.0	14.9	8.8
SSE	0.0	4.8	11.8	0.0	0.0	0.0	16.6	8.1
S	0.0	4.5	2.2	0.0	0.0	0.0	6.7	6.5
SSW	0.0	2.2	0.6	0.0	0.0	0.0	2.8	5.9
SW	0.3	2.2	0.6	0.0	0.0	0.0	3.1	5.3
WSW	0.3	1.4	4.8	0.3	0.0	0.0	6.7	8.1
W	0.3	1.7	1.4	3.7	0.0	0.0	7.0	10.3
WNW	0.3	1.7	0.6	0.6	0.0	0.0	3.1	6.9
NW	0.3	1.7	1.4	3.1	0.6	0.0	7.0	11.2
NNW	0.0	2.0	0.3	0.8	0.8	0.3	4.2	12.6
TOTAL	5.1	41.3	42.7	9.3	1.4	0.3	♦♦♦♦	7.9

SUMMER 1974  
PALISADES WIND ROSE FOR 5 TO 8

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.6	0.8	0.3	0.0	0.0	0.0	1.7	4.6
NNE	0.3	0.6	0.3	0.0	0.0	0.0	1.1	4.7
NE	0.3	2.5	0.0	0.0	0.0	0.0	2.8	4.1
ENE	0.8	3.9	0.0	0.0	0.0	0.0	4.8	4.0
E	0.8	5.6	0.0	0.0	0.0	0.0	6.5	4.8
ESE	0.0	2.8	3.9	3.1	0.0	0.0	9.8	9.7
SE	0.0	2.2	11.0	2.0	0.0	0.0	15.2	9.6
SSE	0.0	2.5	12.9	0.3	0.0	0.0	15.7	8.7
S	0.0	5.6	1.7	0.0	0.0	0.0	7.3	6.2
SSW	0.0	1.1	0.3	0.0	0.0	0.0	1.4	5.1
SW	0.0	2.2	0.3	0.0	0.0	0.0	3.1	5.7
WSW	0.3	2.2	3.4	0.3	0.0	0.0	6.2	7.3
W	0.3	1.1	2.5	4.5	0.0	0.0	8.4	11.5
WNW	0.0	0.6	1.7	1.4	0.0	0.0	3.7	11.2
NW	0.6	0.8	1.7	0.6	0.6	0.6	4.8	11.5
NNW	0.6	2.0	1.1	1.1	2.8	0.0	7.6	12.8
TOTAL	4.5	36.8	41.6	13.2	3.4	0.6	♦♦♦♦	8.6

SUMMER 1974  
PALISADES WIND ROSE FOR 9 TO 12

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.3	3.1	0.6	0.0	0.0	0.0	3.9	5.3
NNE	0.6	2.0	0.3	0.0	0.0	0.0	2.8	4.9
NE	0.3	1.1	0.0	0.0	0.0	0.0	1.4	4.2
ENE	0.6	2.5	0.0	0.0	0.0	0.0	3.1	4.1
E	0.3	1.1	0.6	0.0	0.0	0.0	2.0	5.0
ESE	0.0	3.1	3.7	1.4	0.3	0.0	8.4	8.9
SE	0.0	3.1	7.3	2.2	0.3	0.0	12.9	9.1
SSE	0.3	4.8	5.9	1.4	0.0	0.0	12.4	8.2
S	0.3	3.9	0.6	0.0	0.0	0.0	4.8	5.5
SSW	0.0	2.0	0.3	0.0	0.0	0.0	2.2	4.9
SW	0.0	2.8	0.3	0.0	0.0	0.0	3.1	4.9
WSW	0.3	2.5	0.8	0.3	0.0	0.0	3.9	6.2
W	0.0	4.5	9.0	4.2	0.0	0.3	18.0	9.5
WNW	0.3	0.8	1.4	0.6	1.4	0.0	4.5	12.5
NW	0.3	1.1	2.2	1.4	0.6	0.8	6.5	13.1
NNW	0.0	6.2	1.4	0.6	2.0	0.0	10.1	9.6
TOTAL	3.4	44.7	34.3	12.1	4.5	1.1	♦♦♦♦	8.4

SUMMER 1974  
PALISADES WIND ROSE FOR 13 TO 16

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.0	4.2	2.5	0.0	0.0	0.0	6.8	6.4
NNE	0.3	1.4	0.3	0.0	0.0	0.0	2.0	5.5
NE	0.3	0.6	0.0	0.0	0.0	0.0	0.8	4.5
ENE	0.0	1.4	0.0	0.0	0.0	0.0	1.4	4.5
E	0.0	0.8	0.3	0.0	0.0	0.0	1.1	6.0
ESE	0.0	1.4	3.1	0.0	0.0	0.0	4.5	7.6
SE	0.0	0.8	1.4	1.1	0.0	0.0	3.4	9.9
SSE	0.0	0.3	3.1	0.3	0.0	0.0	3.7	10.2
S	0.0	0.6	0.3	0.0	0.0	0.0	0.8	6.2
SSW	0.0	1.4	0.3	0.0	0.0	0.0	1.7	5.9
SW	0.3	0.3	0.3	0.0	0.0	0.0	0.8	5.2
WSW	0.0	0.8	0.0	0.0	0.0	0.0	0.8	5.5
W	0.3	5.1	18.9	4.8	0.8	0.0	29.9	9.9
WNW	0.0	5.1	3.7	0.8	0.3	0.0	9.9	8.0
NW	0.0	6.2	4.8	3.4	0.6	0.3	15.8	10.5
NNW	0.0	7.3	7.0	1.1	0.8	0.3	16.6	8.8
TOTAL	1.1	37.7	45.9	11.5	2.5	1.1	♦♦♦♦	8.9

SUMMER 1974  
PALISADES WIND ROSE FOR 17 TO 20

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.3	7.5	6.1	0.0	0.0	0.0	13.9	6.7
NNE	0.6	5.0	3.1	0.0	0.0	0.0	8.6	6.0
NE	0.6	1.1	0.0	0.0	0.0	0.0	1.7	3.6
ENE	0.3	0.6	0.0	0.0	0.0	0.0	0.8	4.5
E	0.0	0.3	0.0	0.0	0.0	0.0	0.3	4.9
ESE	0.0	1.4	0.8	0.0	0.0	0.0	2.2	6.7
SE	0.3	0.8	2.5	0.8	0.0	0.0	4.5	9.4
SSE	0.0	0.6	1.1	0.6	0.0	0.0	2.2	10.0
S	0.6	1.1	1.1	0.0	0.0	0.0	2.8	5.8
SSW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SW	0.3	0.8	0.0	0.0	0.0	0.0	1.1	4.0
WSW	0.3	1.9	1.1	0.0	0.0	0.0	3.3	6.5
W	0.6	7.0	8.1	1.4	0.3	0.0	17.3	7.9
WNW	0.3	7.0	3.3	0.8	0.0	0.6	12.0	7.9
NW	1.1	4.7	2.5	4.5	1.1	0.0	13.9	9.7
NNW	0.6	8.4	3.9	1.7	0.6	0.0	15.0	7.7
TOTAL	5.6	48.2	33.7	9.7	1.9	0.6	99.7	7.6



SUMMER 1974  
PALISADES WIND ROSE FOR 21 TO 24

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.3	3.1	1.1	0.0	0.0	0.0	4.4	5.8
NNE	1.4	4.7	2.8	0.0	0.0	0.0	8.9	6.0
NE	1.9	4.4	0.8	0.0	0.0	0.0	7.2	4.3
ENE	0.8	5.0	0.0	0.0	0.0	0.0	5.8	4.1
E	0.3	3.9	0.8	0.0	0.0	0.0	5.0	5.4
ESE	0.3	5.3	1.4	0.0	0.0	0.0	6.9	5.6
SE	0.0	3.6	5.8	0.0	0.0	0.0	9.4	7.5
SSE	0.6	4.4	3.9	0.0	0.0	0.0	8.9	6.9
S	0.0	5.0	0.8	0.0	0.0	0.0	5.8	5.4
SSW	0.8	4.2	0.8	0.0	0.0	0.0	5.8	4.9
SW	1.1	1.1	0.3	0.0	0.0	0.0	2.5	4.0
WSW	0.0	3.3	2.5	0.0	0.3	0.0	6.1	7.0
W	0.6	1.9	3.9	0.3	0.0	0.0	6.7	7.7
WNW	0.6	0.6	1.9	0.0	0.0	0.0	3.1	6.3
NW	0.8	1.4	1.1	1.7	0.8	0.3	6.1	10.9
NNW	0.3	2.2	2.5	0.0	0.6	0.3	5.8	9.0
TOTAL	9.7	54.2	30.6	1.9	1.7	0.6	98.6	6.3

FALL 1974  
PALISADES WIND ROSE FOR 1 TO 4

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.0	0.0	0.5	0.3	0.0	0.0	0.8	12.3
NNE	0.0	0.8	0.3	0.0	0.0	0.0	1.1	6.5
NE	0.0	1.9	0.0	0.0	0.0	0.0	1.9	5.2
ENE	0.3	4.9	0.5	0.0	0.0	0.0	5.8	5.4
E	0.5	3.6	0.5	0.0	0.0	0.0	4.7	5.3
ESE	0.3	5.8	2.7	0.3	0.0	0.0	9.1	6.6
SE	0.0	2.2	8.2	0.3	0.0	0.0	10.7	8.7
SSE	0.0	1.1	10.4	0.3	0.0	0.0	11.8	9.0
S	0.0	1.4	8.8	0.0	0.0	0.0	10.2	8.0
SSW	0.0	1.4	4.4	0.0	0.0	0.0	5.8	7.9
SW	0.0	1.9	1.4	0.0	0.0	0.0	3.3	6.6
WSW	0.0	1.4	1.6	2.2	0.0	0.0	5.2	10.4
W	0.0	0.0	3.3	2.7	0.5	1.1	7.7	14.7
WNW	0.0	0.3	1.1	1.4	2.7	1.4	6.9	18.3
NW	0.0	0.0	1.4	2.7	0.8	1.9	6.9	18.0
NNW	0.0	0.3	1.9	1.6	1.4	3.0	8.2	20.8
TOTAL	1.1	26.9	47.3	11.8	5.5	7.4	♦♦♦♦	10.8

FALL 1974  
PALISADES WIND ROSE FOR 5 TO 8

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.0	1.6	1.1	0.0	0.0	0.0	2.7	7.6
NNE	0.0	0.5	0.3	0.0	0.0	0.0	0.8	5.5
NE	0.3	2.2	0.3	0.0	0.0	0.0	2.7	5.1
ENE	0.0	3.8	0.0	0.0	0.0	0.0	3.8	5.1
E	0.0	1.6	0.5	0.0	0.0	0.0	2.2	5.8
ESE	0.3	4.4	1.4	1.9	0.0	0.0	8.0	7.3
SE	0.0	1.9	8.8	1.1	0.0	0.0	11.8	9.1
SSE	0.5	1.9	9.3	1.4	0.0	0.0	13.2	8.8
S	0.0	2.7	6.9	0.0	0.0	0.0	9.6	7.7
SSW	0.0	2.7	2.2	0.0	0.0	0.0	4.9	7.1
SW	0.0	1.6	1.1	0.0	0.0	0.0	2.7	6.9
WSW	0.0	1.6	2.5	1.1	0.0	0.0	5.2	8.5
W	0.0	1.4	1.1	2.5	1.4	0.3	6.6	14.4
WNW	0.0	0.5	2.5	1.4	1.4	1.9	7.7	17.4
NW	0.0	0.0	1.4	2.7	2.7	3.6	10.4	20.5
NNW	0.0	0.0	0.3	1.1	2.2	3.8	7.4	26.7
TOTAL	1.1	28.8	39.6	13.2	7.7	9.6	♦♦♦♦	11.7

FALL 1974  
PALISADES WIND ROSE FOR 9 TO 12

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.3	0.8	1.1	0.0	0.0	0.0	2.2	6.3
NNE	0.3	1.1	0.8	0.0	0.0	0.0	2.2	6.3
NE	0.3	1.4	0.0	0.0	0.0	0.0	1.6	4.8
ENE	0.0	1.4	0.0	0.0	0.0	0.0	1.4	4.7
E	0.5	3.0	0.3	0.0	0.0	0.0	3.8	4.6
ESE	0.0	4.4	3.3	0.5	0.0	0.0	8.2	7.1
SE	0.3	1.6	7.4	1.1	0.0	0.0	10.4	9.0
SSE	0.0	4.4	6.3	0.8	0.0	0.0	11.5	8.0
S	0.0	3.6	3.8	0.3	0.0	0.0	7.7	7.5
SSW	0.3	4.4	2.7	0.0	0.0	0.0	7.4	6.3
SW	0.0	0.8	1.4	0.0	0.0	0.0	2.2	7.9
WSW	0.3	1.9	4.9	0.8	0.0	0.0	8.0	8.4
W	0.0	0.3	4.7	2.7	0.8	0.3	8.8	12.3
WNW	0.3	0.0	2.2	1.4	3.3	1.6	8.8	18.3
NW	0.0	0.3	0.8	1.4	1.1	3.0	6.6	21.6
NNW	0.0	0.0	0.5	0.5	1.6	6.3	9.1	27.8
TOTAL	2.5	29.4	40.4	9.6	6.9	11.3	♦♦♦♦	11.6

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FALL 1974  
PALISADES WIND ROSE FOR 13 TO 16

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.0	1.9	2.7	1.1	0.0	0.0	5.8	2.5
NNE	0.0	1.1	1.1	0.0	0.0	0.0	2.2	7.0
NE	0.3	1.6	0.5	0.0	0.0	0.0	2.5	5.4
ENE	1.1	1.1	0.0	0.0	0.0	0.0	2.2	3.6
E	0.8	1.9	0.0	0.0	0.0	0.0	2.7	3.8
ESE	0.0	1.4	0.5	1.1	0.0	0.0	3.0	9.6
SE	0.0	1.6	2.2	1.4	0.0	0.0	5.2	9.3
SSE	0.0	1.4	4.9	0.3	0.0	0.0	6.6	8.4
S	0.0	1.4	3.6	0.0	0.0	0.0	4.9	7.6
SSW	0.0	1.4	0.8	0.0	0.0	0.0	2.2	6.4
SW	0.0	1.1	2.5	0.0	0.0	0.0	3.6	7.5
WSW	0.0	0.8	3.0	0.5	0.0	0.0	4.4	9.0
W	0.0	1.6	12.6	7.4	0.8	0.3	22.8	11.3
WNW	0.0	1.6	1.9	2.2	1.9	1.9	9.6	15.8
NW	0.0	0.8	1.1	0.5	2.7	1.9	7.1	20.4
NNW	0.0	2.5	4.4	2.2	1.6	4.4	15.1	17.0
TOTAL	2.2	23.4	42.0	16.8	7.1	8.5	♦♦♦♦	11.6

FALL 1974  
PALISADES WIND ROSE FOR 17 TO 20

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.0	3.3	3.0	0.5	0.3	0.0	7.1	8.0
NNE	0.5	1.9	1.9	1.1	0.0	0.0	5.5	8.0
NE	1.1	1.4	0.0	0.0	0.0	0.0	2.5	4.2
ENE	0.3	1.6	0.0	0.0	0.0	0.0	1.9	4.6
E	0.0	1.6	0.0	0.0	0.0	0.0	1.6	4.8
ESE	0.5	2.7	1.6	0.3	0.0	0.0	5.2	7.2
SE	0.3	1.6	2.5	1.9	0.0	0.0	6.3	9.7
SSE	0.0	3.3	2.2	0.3	0.0	0.0	5.8	7.1
S	0.0	4.7	2.2	0.0	0.0	0.0	6.9	6.8
SSW	0.0	3.3	2.2	0.0	0.0	0.0	5.5	6.6
SW	0.5	1.4	0.8	0.0	0.0	0.0	2.7	5.7
WSW	1.1	1.6	3.8	0.5	0.0	0.0	7.1	7.3
W	0.0	3.3	5.5	2.5	0.3	0.0	12.1	9.5
WNW	0.5	2.2	0.8	0.0	0.5	1.6	5.3	13.0
NW	0.0	0.8	1.6	1.4	2.2	4.7	10.7	20.9
NNW	0.5	1.1	5.2	1.9	0.8	3.3	12.9	14.7
TOTAL	5.5	36.5	33.5	10.4	4.1	9.6	99.7	10.2

FALL 1974  
PALISADES WIND ROSE FOR 21 TO 24

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.0	0.0	2.7	1.4	0.0	0.0	4.1	10.6
NNE	0.0	0.8	1.4	0.0	0.0	0.0	2.2	7.3
NE	0.0	2.2	1.4	0.0	0.0	0.0	3.6	7.0
ENE	0.3	4.1	0.3	0.0	0.0	0.0	4.7	5.2
E	0.0	4.4	0.5	0.0	0.0	0.0	4.9	5.3
ESE	1.1	6.0	3.3	0.3	0.0	0.0	10.7	6.2
SE	0.0	2.7	4.9	1.9	0.3	0.0	9.9	9.4
SSE	0.5	3.6	9.9	0.5	0.0	0.0	14.6	8.0
S	0.0	4.9	6.0	0.0	0.0	0.0	11.0	7.3
SSW	0.3	2.7	1.9	0.0	0.0	0.0	4.9	6.2
SW	0.3	1.9	0.8	0.0	0.0	0.0	3.0	6.5
WSW	0.0	0.8	3.6	0.5	0.0	0.0	4.9	9.0
W	0.0	0.3	0.8	2.5	1.1	0.0	4.7	14.2
WNW	0.0	0.0	0.0	0.3	2.2	0.8	3.3	22.4
NW	0.0	0.0	0.0	1.1	1.1	3.0	5.2	23.5
NNW	0.0	0.3	1.6	1.6	1.6	3.0	8.2	21.4
TOTAL	2.5	34.9	39.3	10.2	6.3	6.9	♦♦♦♦	10.2

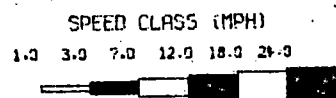
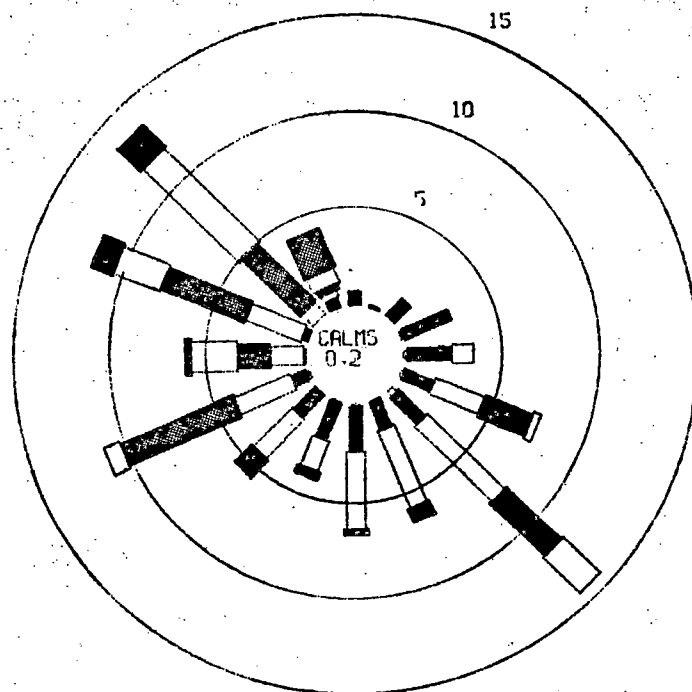
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APPENDIX C

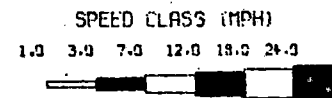
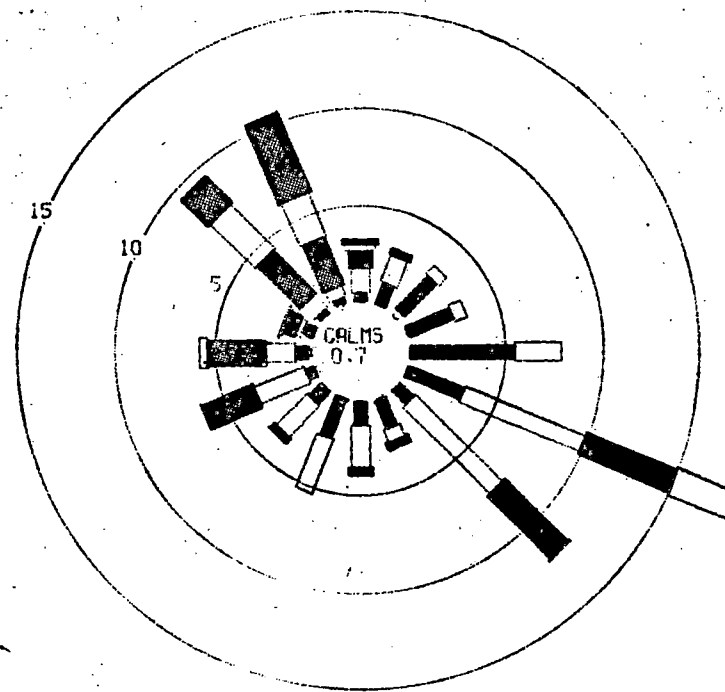
MONTHLY PALISADES WIND ROSE PATTERN FOR 1974  
WITH COMPUTER PRINTOUT



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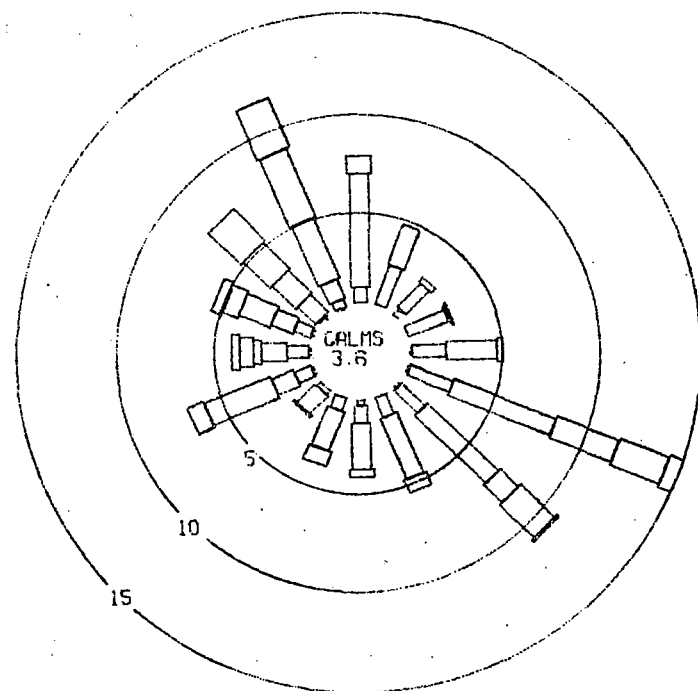
PALISADES WIND ROSE FOR 1/74



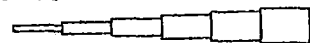
PALISADES WIND ROSE FOR 2/74

Figure C-1. Wind rose patterns averaged over January and February 1974.

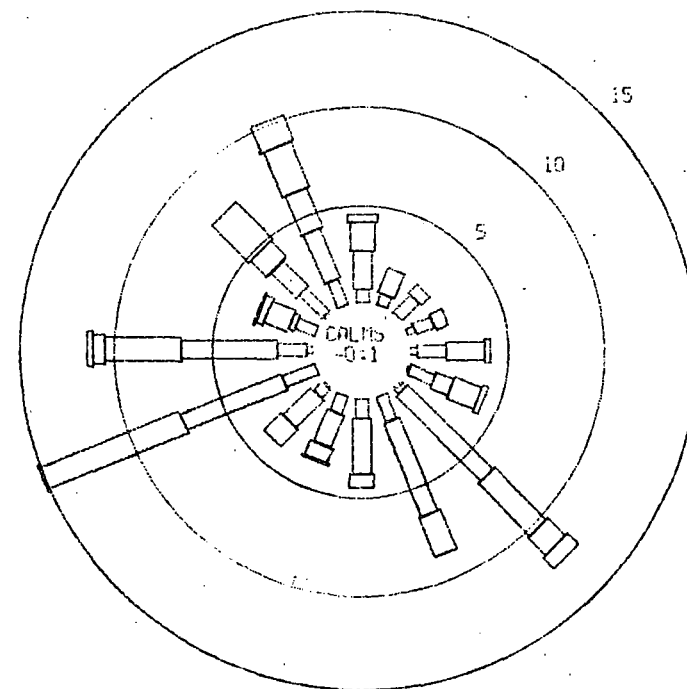
C-2



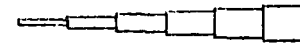
SPEED CLASS (MPH)  
1.0 3.0 7.0 12.0 18.0 24.0



PALISADES WIND ROSE FOR 3/74



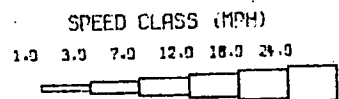
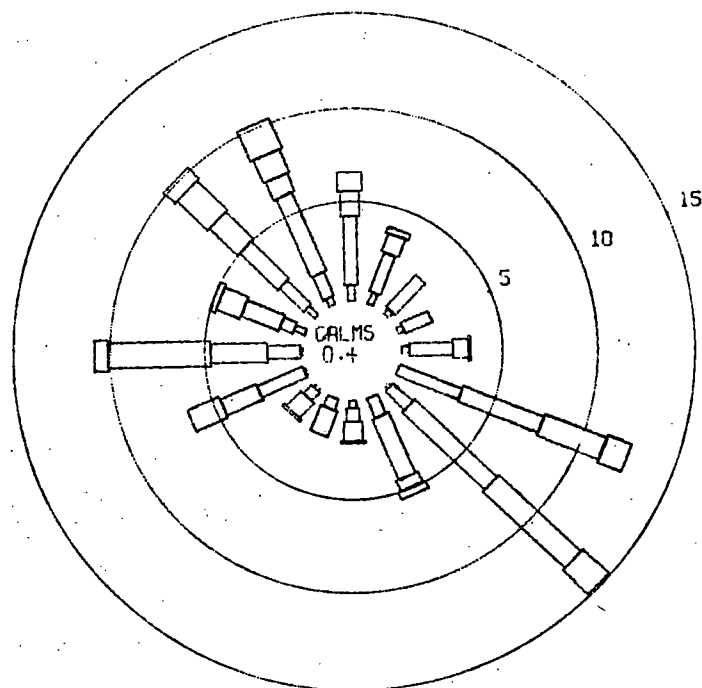
SPEED CLASS (MPH)  
1.0 3.0 7.0 12.0 18.0 24.0



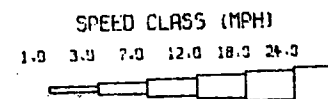
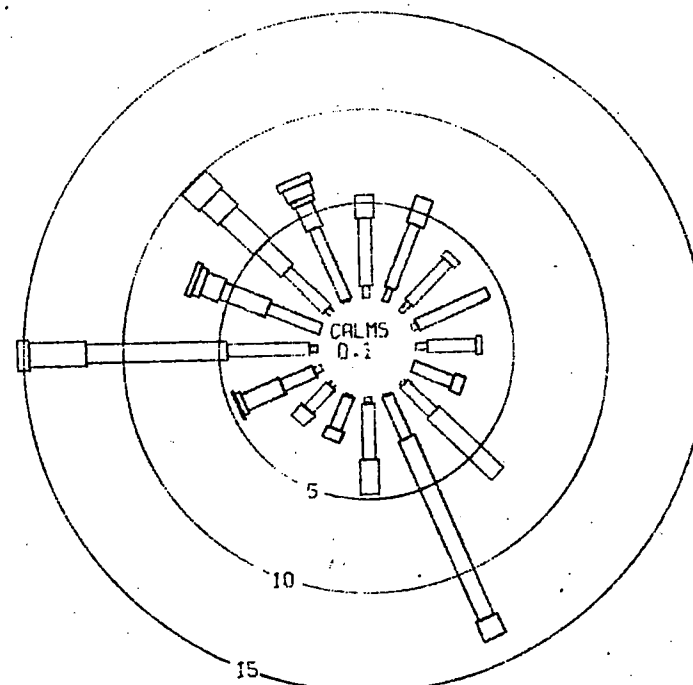
PALISADES WIND ROSE FOR 4/74

Figure C-2. Wind rose patterns averaged over March and April 1974.

C-3



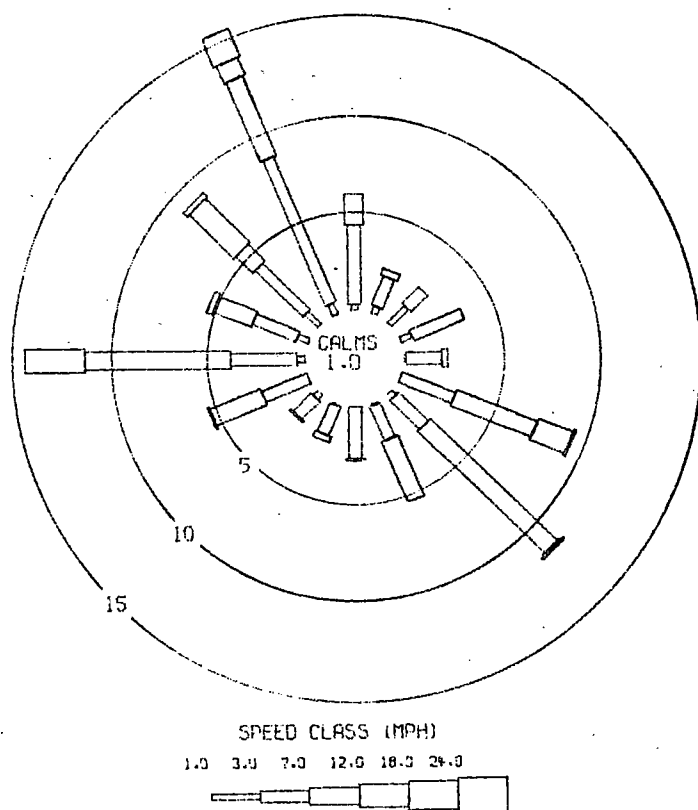
PALISADES WIND ROSE FOR 5/74



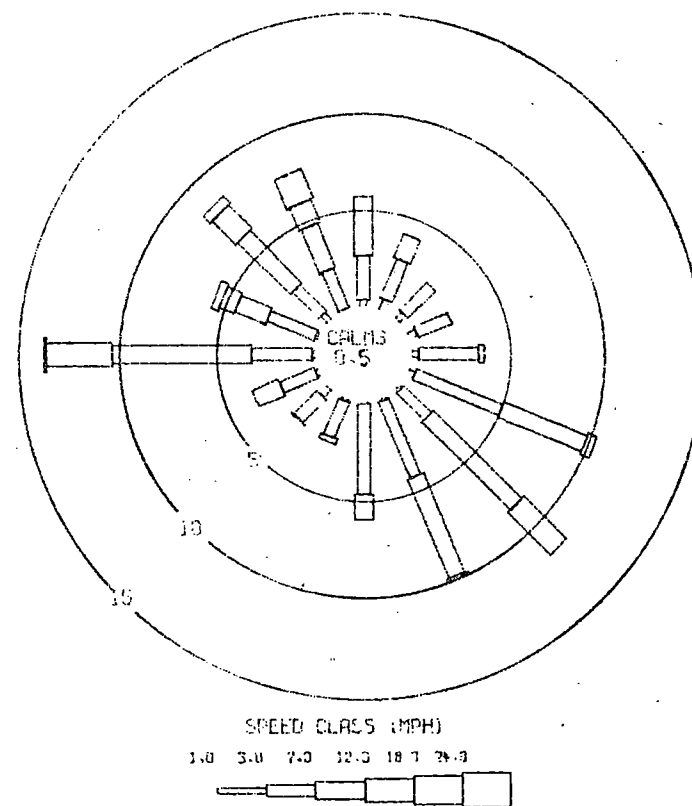
PALISADES WIND ROSE FOR 6/74

Figure C-3. Wind rose patterns averaged over May and June 1974.

C-4



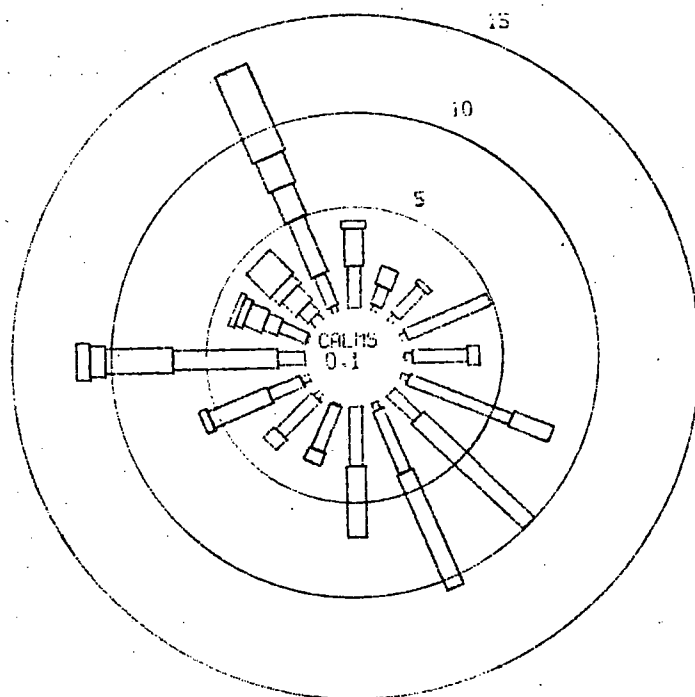
PALISADES WIND ROSE FOR 7/74



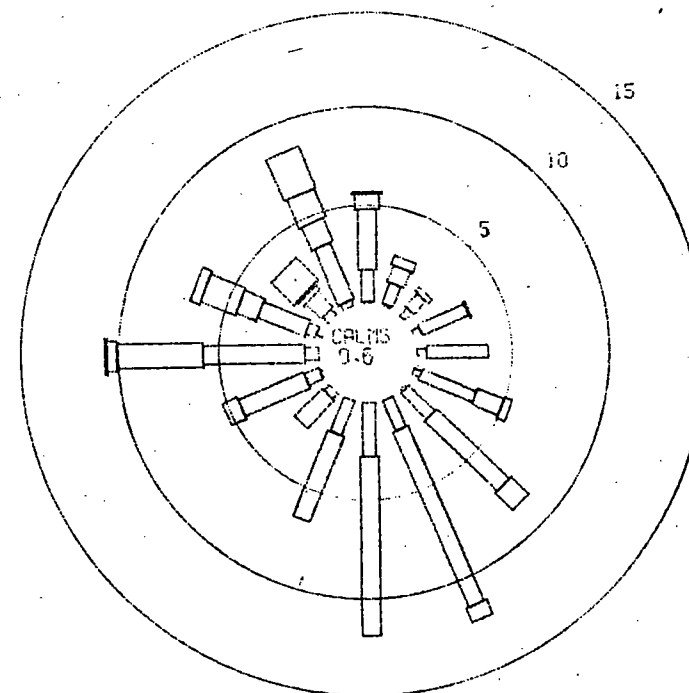
PALISADES WIND ROSE FOR 8/74

Figure C-4. Wind rose patterns averaged over July and August 1974.

C-5



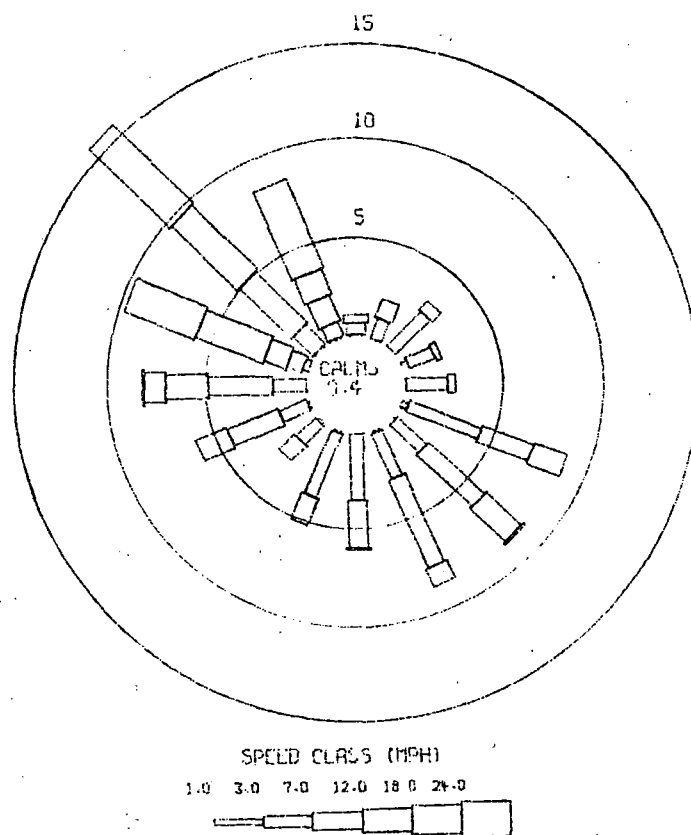
PALISADES WIND ROSE FOR 9/74



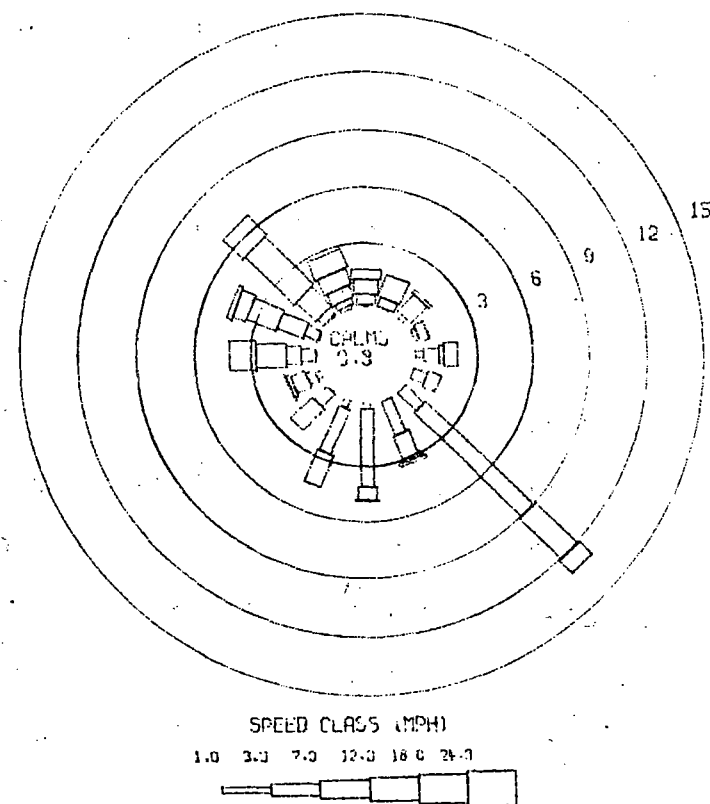
PALISADES WIND ROSE FOR 10/74

Figure C-5. Wind rose patterns averaged over September and October 1974.

C-6



PALISADES WIND ROSE FOR 11/74



PALISADES WIND ROSE FOR 12/74

Figure C-6. Wind rose patterns averaged over November and December 1974.

## PALISADES WIND ROSE DATA FOR 1/74

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.0	0.7	0.0	0.0	0.0	0.0	0.7	5.3
NNE	0.0	0.1	0.0	0.0	0.0	0.0	0.1	4.9
NE	0.0	1.2	0.0	0.0	0.0	0.0	1.2	5.0
ENE	0.1	2.6	0.0	0.0	0.0	0.0	2.7	4.7
E	0.1	2.3	1.1	0.0	0.0	0.0	3.5	6.2
ESE	0.1	1.6	2.7	2.6	0.4	0.0	7.4	11.0
SE	0.3	1.9	5.5	3.9	2.6	0.0	14.1	12.0
SSE	0.0	1.5	4.3	0.7	0.0	0.0	6.5	8.8
S	0.1	2.3	4.0	0.3	0.0	0.0	6.7	7.6
SSW	0.0	2.0	1.7	0.4	0.0	0.0	4.2	7.6
SW	0.0	1.6	2.8	1.3	0.0	0.0	5.8	9.1
WSW	0.1	0.8	3.2	6.2	0.9	0.0	11.3	12.6
W	0.0	0.1	1.7	1.7	2.4	0.3	6.3	16.0
WNW	0.0	0.3	3.0	4.7	2.6	1.2	11.7	15.7
NW	0.0	0.0	0.8	4.2	7.0	1.6	13.6	19.4
NNW	0.0	0.5	0.4	0.3	0.8	2.2	4.2	23.4
TOTAL	0.9	19.5	31.3	26.2	16.7	5.2	99.9	12.8

# PALISADES WIND ROSE DATA FOR 2/74

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.1	0.4	1.3	0.9	0.3	0.3	3.4	12.5
NNE	0.0	1.2	1.5	0.3	0.0	0.0	3.0	8.2
NE	0.3	2.4	0.6	0.0	0.0	0.0	3.3	5.7
ENE	0.1	2.4	0.7	0.0	0.0	0.0	3.3	5.9
E	0.0	5.4	2.4	0.0	0.0	0.0	7.7	6.5
ESE	0.0	3.1	6.7	5.1	3.3	0.0	18.2	12.4
SE	0.0	1.0	6.3	4.6	0.1	0.0	12.1	11.3
SSE	0.1	1.5	0.7	0.4	0.0	0.0	2.8	7.4
S	0.0	1.2	2.2	0.4	0.0	0.0	3.9	8.8
SSW	0.0	2.1	3.0	0.0	0.0	0.0	5.1	7.1
SW	0.0	0.9	2.2	0.4	0.0	0.0	3.6	8.7
WSW	0.0	0.4	2.8	2.8	0.0	0.0	6.1	11.3
W	0.1	0.7	1.5	3.0	0.4	0.0	5.8	12.1
WNW	0.0	0.6	0.3	0.6	0.1	0.1	1.8	12.0
NW	0.0	0.3	0.9	3.1	3.3	1.8	9.4	18.8
NNW	0.1	0.3	0.6	2.7	2.4	4.5	10.6	23.4
TOTAL	1.0	24.0	33.8	24.4	10.0	6.7	♦♦♦♦	12.2



# PALISADES WIND ROSE DATA FOR 3/74

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.0	0.8	5.9	0.9	0.0	0.0	7.7	9.5
NNE	0.0	2.2	2.2	0.0	0.0	0.0	4.3	6.7
NE	0.4	1.7	0.3	0.0	0.0	0.0	2.4	4.7
ENE	0.0	2.2	0.1	0.1	0.0	0.0	2.4	5.1
E	0.1	1.7	2.6	0.3	0.0	0.0	4.7	7.7
ESE	0.1	2.3	5.6	3.4	2.7	0.7	14.8	10.5
SE	0.1	1.7	5.0	1.3	2.4	0.1	10.8	11.6
SSE	0.0	1.1	3.4	0.7	0.0	0.0	5.1	9.1
S	0.3	0.9	2.4	0.4	0.0	0.0	4.0	8.0
SSW	0.0	0.7	2.2	0.8	0.0	0.0	3.6	9.0
SW	0.0	0.3	1.3	0.1	0.0	0.0	1.7	9.3
WSW	0.1	0.9	1.2	3.6	0.9	0.0	6.9	13.0
W	0.1	1.1	1.3	0.4	0.7	0.4	4.0	12.5
WNW	0.1	0.9	1.2	1.7	0.9	0.5	5.5	13.9
NW	0.1	0.1	1.3	1.7	1.9	2.3	7.5	19.8
NNW	0.1	0.4	1.1	3.4	3.8	2.7	11.4	19.1
TOTAL	1.7	19.1	37.1	19.0	13.3	6.7	96.9	11.5

# PALISADES WIND ROSE DATA FOR 4/74

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.0	0.7	2.0	1.5	0.4	0.0	4.6	11.0
NNE	0.0	0.6	1.4	0.0	0.0	0.0	2.0	8.4
NE	0.0	1.3	0.6	0.0	0.0	0.0	1.8	6.0
ENE	0.4	1.0	0.7	0.0	0.0	0.0	2.1	5.7
E	0.3	1.5	2.0	0.3	0.0	0.0	4.1	7.3
ESE	0.1	1.3	1.0	1.5	0.3	0.0	4.2	10.5
SE	0.1	0.3	6.2	3.8	1.3	0.8	12.4	13.5
SSE	0.0	1.4	5.2	2.2	0.0	0.0	8.8	10.2
S	0.0	1.0	2.9	0.7	0.0	0.0	4.6	9.8
SSW	0.0	1.0	1.8	0.8	0.1	0.0	3.8	10.1
SW	0.1	0.6	2.0	1.3	0.0	0.0	3.9	10.0
WSW	0.0	1.8	5.5	7.7	0.1	0.0	15.1	11.9
W	0.3	1.5	4.9	3.9	0.6	0.3	11.5	11.4
WNW	0.0	1.1	0.3	1.3	0.4	0.1	3.2	12.1
NW	0.1	1.7	1.8	0.1	1.1	2.7	7.6	16.5
NNW	0.0	1.4	2.8	2.2	2.5	1.4	10.3	15.6
TOTAL	1.5	18.0	40.8	27.4	6.9	5.3	♦♦♦♦	11.8

## PALISADES WIND ROSE DATA FOR 5/74

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N.	0.8	3.5	1.3	1.0	0.0	0.0	6.6	6.7
NNE	0.6	2.1	1.0	0.3	0.0	0.0	3.9	6.3
NE	0.3	2.2	0.0	0.0	0.0	0.0	2.5	4.0
ENE	0.3	1.5	0.0	0.0	0.0	0.0	1.8	4.2
E	0.4	2.2	0.8	0.1	0.0	0.0	3.7	6.1
ESE	0.0	3.4	4.4	3.4	1.3	0.0	12.4	10.3
SE	0.1	1.4	5.8	5.8	1.8	0.0	14.9	12.0
SSE	0.0	1.1	3.4	0.6	0.4	0.0	5.5	10.0
S	0.4	0.7	1.0	0.1	0.0	0.0	2.2	6.9
SSW	0.0	0.6	1.4	0.0	0.0	0.0	2.0	8.2
SW	0.1	0.6	1.1	0.1	0.0	0.0	2.0	7.5
WSW	0.1	2.5	2.0	1.8	0.0	0.0	6.5	8.9
W	0.1	1.7	2.9	5.3	0.7	0.0	10.8	11.5
WNW	0.6	0.7	2.1	1.3	0.3	0.0	4.9	9.4
NW	0.6	1.7	2.7	2.0	2.2	0.8	10.0	13.3
NNW	0.4	1.3	4.4	1.0	1.3	1.7	10.0	13.0
TOTAL	4.9	27.2	34.1	22.8	8.0	2.5	99.6	10.1

C-11

## PALISADES WIND ROSE DATA FOR 6/74

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.6	3.5	1.2	0.0	0.0	0.0	5.3	6.0
NNE	0.7	3.5	1.5	0.0	0.0	0.0	5.7	5.8
NE	0.6	2.9	0.4	0.0	0.0	0.0	3.9	4.7
ENE	0.3	4.0	0.0	0.0	0.0	0.0	4.3	4.4
E	0.6	2.5	0.3	0.0	0.0	0.0	3.3	5.1
ESE	0.0	2.2	0.6	0.0	0.0	0.0	2.8	5.8
SE	0.1	2.1	4.6	0.0	0.0	0.0	6.8	7.9
SSE	0.1	2.4	10.3	1.1	0.0	0.0	13.9	9.1
S	0.3	2.9	1.8	0.0	0.0	0.0	5.0	6.3
SSW	0.1	1.8	0.6	0.0	0.0	0.0	2.5	5.7
SW	0.1	1.7	0.8	0.0	0.0	0.0	2.6	6.0
WSW	0.4	1.8	2.1	0.3	0.1	0.0	4.7	7.3
W	0.4	4.2	7.2	2.9	0.6	0.0	15.3	9.5
WNW	0.0	2.9	2.5	1.0	0.4	0.3	7.1	9.6
NW	0.3	2.8	1.8	2.4	1.2	1.2	9.7	12.9
NNW	0.1	4.0	1.4	0.3	0.7	0.4	6.9	9.4
TOTAL	4.7	45.1	37.1	7.9	3.1	1.9	99.9	8.2

## PALISADES WIND ROSE DATA FOR 7/74

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.3	4.1	1.6	0.0	0.0	0.0	6.0	5.7
NNE	0.4	1.6	0.4	0.0	0.0	0.0	2.5	4.9
NE	1.2	1.2	0.0	0.0	0.0	0.0	2.4	3.2
ENE	0.6	2.8	0.0	0.0	0.0	0.0	3.4	3.9
E	0.1	1.8	0.3	0.0	0.0	0.0	2.2	5.3
ESE	0.0	2.9	4.4	1.9	0.1	0.0	9.4	9.2
SE	0.3	2.1	9.0	0.1	0.1	0.0	11.6	8.8
SSE	0.1	1.9	3.4	0.0	0.0	0.0	5.4	8.1
S	0.0	2.7	0.1	0.0	0.0	0.0	2.8	5.4
SSW	0.1	1.6	0.3	0.0	0.0	0.0	2.1	5.1
SW	0.3	1.3	0.1	0.0	0.0	0.0	1.8	4.6
WSW	0.0	2.5	2.8	0.1	0.0	0.0	5.4	7.2
W	0.4	3.4	7.5	3.1	0.0	0.0	14.4	9.3
WNW	0.6	2.4	2.1	0.3	0.0	0.0	5.3	6.7
NW	0.9	3.4	1.2	3.2	0.3	0.0	9.0	9.4
NNW	0.6	8.1	4.4	1.0	1.5	0.0	15.6	8.4
TOTAL	6.0	43.7	37.7	9.9	2.1	0.0	99.4	7.7

## PALISADES WIND ROSE DATA FOR 8/74

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.3	2.3	3.0	0.0	0.0	0.0	5.5	6.8
NNE	0.5	2.2	1.3	0.0	0.0	0.0	4.0	6.0
NE	0.4	2.0	0.0	0.0	0.0	0.0	2.4	4.3
ENE	0.4	1.9	0.0	0.0	0.0	0.0	2.3	4.1
E	0.3	3.1	0.3	0.0	0.0	0.0	3.6	5.0
ESE	0.3	4.8	4.7	0.5	0.0	0.0	10.3	7.2
SE	0.1	2.0	6.5	3.1	0.0	0.0	11.7	9.6
SSE	0.1	4.3	5.5	0.1	0.0	0.0	10.1	7.3
S	0.1	4.7	1.3	0.0	0.0	0.0	6.2	5.8
SSW	0.1	2.0	0.3	0.0	0.0	0.0	2.4	4.9
SW	0.5	1.7	0.1	0.0	0.0	0.0	2.4	4.3
WSW	0.1	1.9	1.5	0.0	0.0	0.0	3.5	6.7
W	0.1	3.1	7.1	3.4	0.0	0.1	13.8	9.6
WNW	0.1	2.6	1.7	0.8	0.4	0.0	5.6	9.1
NW	0.4	1.9	3.8	1.7	0.5	0.0	8.3	9.9
NNW	0.0	2.2	2.4	1.3	1.6	0.0	7.5	11.5
TOTAL	4.0	42.6	39.5	11.0	2.6	0.1	99.9	8.0

## PALISADES WIND ROSE DATA FOR 9/74

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.0	2.1	1.9	0.4	0.0	0.0	4.4	7.5
NNE	0.3	1.0	1.0	0.0	0.0	0.0	2.2	6.7
NE	0.4	1.9	0.3	0.0	0.0	0.0	2.6	5.0
ENE	0.3	4.6	0.0	0.0	0.0	0.0	4.9	4.9
E	0.4	2.8	0.6	0.0	0.0	0.0	3.7	5.3
ESE	0.4	5.6	2.2	0.0	0.0	0.0	8.2	6.1
SE	0.0	1.9	7.9	0.0	0.0	0.0	9.9	8.2
SSE	0.4	3.5	6.5	0.0	0.0	0.0	10.4	7.4
S	0.0	3.1	3.7	0.0	0.0	0.0	6.8	6.9
SSW	0.1	2.5	0.7	0.0	0.0	0.0	3.3	5.9
SW	0.3	2.6	0.8	0.0	0.0	0.0	3.8	5.9
WSW	0.4	1.8	3.3	0.4	0.0	0.0	6.0	8.0
W	0.0	1.4	5.4	3.5	0.8	0.7	11.8	12.2
WNW	0.1	1.5	0.8	1.0	0.4	0.3	4.2	11.1
NW	0.0	0.4	0.7	1.0	0.6	1.7	4.3	18.3
NNW	0.3	1.7	3.1	1.8	1.7	4.9	13.3	18.6
TOTAL	3.5	38.3	39.0	8.1	3.5	7.5	99.9	9.7

# PALISADES WIND ROSE DATA FOR 10/74

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.1	1.6	3.1	0.8	0.1	0.0	5.8	8.9
NNE	0.1	1.1	0.9	0.5	0.0	0.0	2.7	7.5
NE	0.5	0.9	0.3	0.0	0.0	0.0	1.7	5.2
ENE	0.4	2.6	0.1	0.0	0.0	0.0	3.1	4.7
E	0.5	3.2	0.0	0.0	0.0	0.0	3.8	4.1
ESE	0.4	3.0	1.5	0.4	0.0	0.0	5.2	6.5
SE	0.1	1.9	5.2	1.3	0.0	0.0	8.6	9.5
SSE	0.0	1.7	9.9	0.8	0.0	0.0	12.5	8.9
S	0.0	2.8	9.3	0.0	0.0	0.0	12.1	8.1
SSW	0.0	1.9	4.8	0.0	0.0	0.0	6.7	7.7
SW	0.0	0.4	2.0	0.0	0.0	0.0	2.4	8.4
WSW	0.1	0.8	3.6	0.8	0.0	0.0	5.4	8.8
W	0.0	0.7	5.2	4.4	0.5	0.1	11.0	12.1
WNW	0.3	0.5	2.6	1.1	1.9	0.5	6.9	13.9
NW	0.0	0.4	1.1	0.3	0.1	1.6	3.5	19.2
NNW	0.0	0.3	3.1	1.3	1.6	2.3	8.6	17.9
TOTAL	2.7	23.8	52.8	11.8	4.3	4.6	♦♦♦♦	10.1



# PALISADES WIND ROSE DATA FOR 11/74

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.0	0.1	0.6	0.4	0.0	0.0	1.1	10.8
NNE	0.0	1.1	1.0	0.0	0.0	0.0	2.1	7.3
NE	0.0	2.5	0.6	0.0	0.0	0.0	3.1	6.0
ENE	0.3	1.4	0.3	0.0	0.0	0.0	1.9	5.5
E	0.0	2.1	0.4	0.0	0.0	0.0	2.5	5.7
ESE	0.3	3.9	2.8	1.8	0.0	0.0	8.7	8.2
SE	0.1	2.1	3.9	2.5	0.1	0.0	8.7	9.9
SSE	0.1	2.6	5.0	1.0	0.0	0.0	8.7	8.5
S	0.0	3.5	2.5	0.1	0.0	0.0	6.1	6.8
SSW	0.1	3.6	1.5	0.0	0.0	0.0	5.3	6.1
SW	0.1	1.4	1.1	0.0	0.0	0.0	2.6	6.6
WSW	0.1	1.5	2.8	1.7	0.0	0.0	6.1	9.2
W	0.0	1.7	3.3	2.2	1.1	0.1	8.5	11.9
WNW	0.0	0.3	0.8	1.2	3.7	3.9	10.0	21.9
NW	0.0	0.1	1.4	3.7	4.7	5.8	15.8	21.7
NNW	0.0	0.1	0.8	1.4	1.4	4.9	8.6	25.7
TOTAL	1.2	28.1	28.7	16.1	11.1	14.7	♦♦♦♦	13.4

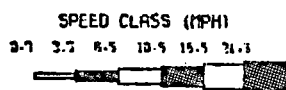
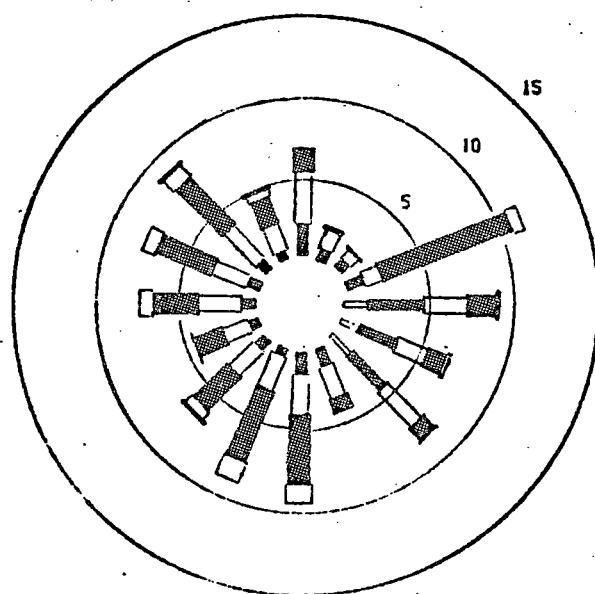
# PALISADES WIND ROSE DATA FOR 12/74

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.1	0.1	0.9	1.2	0.9	0.0	3.4	13.9
NNE	0.1	0.0	0.8	2.0	0.0	0.0	3.0	12.4
NE	0.4	0.0	2.0	0.3	0.0	0.0	2.7	8.4
ENE	0.1	0.4	0.9	0.0	0.0	0.0	1.5	7.9
E	0.7	1.3	0.4	1.2	0.0	0.0	3.6	8.0
ESE	0.0	1.2	1.2	0.0	0.0	0.0	2.4	7.1
SE	0.0	2.2	13.0	5.1	1.5	0.0	21.8	10.9
SSE	0.0	3.2	2.2	0.3	0.3	0.0	5.9	7.5
S	0.4	6.9	1.2	0.1	0.0	0.0	8.6	5.7
SSW	0.7	4.3	3.0	0.0	0.0	0.0	7.9	6.1
SW	0.1	1.5	2.7	0.0	0.0	0.0	4.3	7.1
WSW	0.4	0.8	1.3	0.3	0.1	0.0	3.0	8.0
W	0.1	1.2	1.3	2.6	2.2	0.0	7.4	13.7
WNW	0.1	1.2	2.4	2.7	1.2	0.4	8.1	13.1
NW	0.1	0.1	0.7	2.3	5.9	2.3	11.4	19.7
NNW	0.0	0.3	0.5	1.1	1.5	1.7	5.1	20.6
TOTAL	3.5	24.7	34.7	19.1	13.6	4.4	♦♦♦♦	11.3

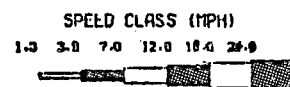
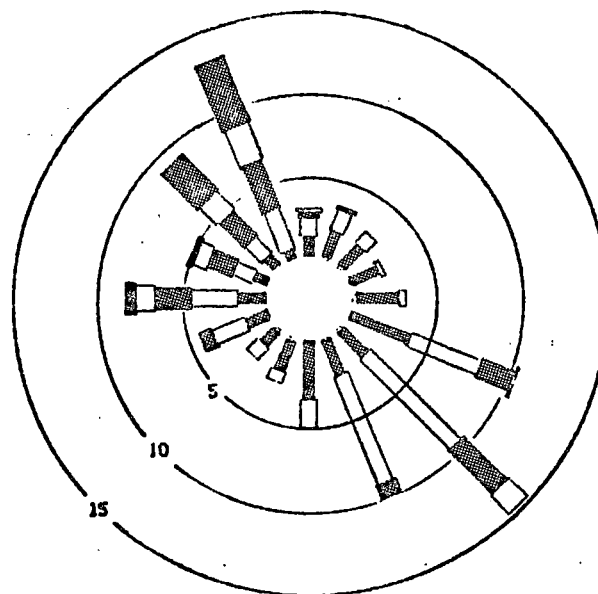
APPENDIX D

COMPARISON OF PALISADES, MUSKEGON AND  
UNIVERSITY OF MICHIGAN STATION P03A  
SEASONAL AND ANNUAL WIND ROSES WITH DATA PRINTOUT

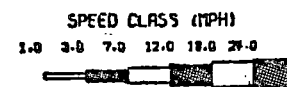
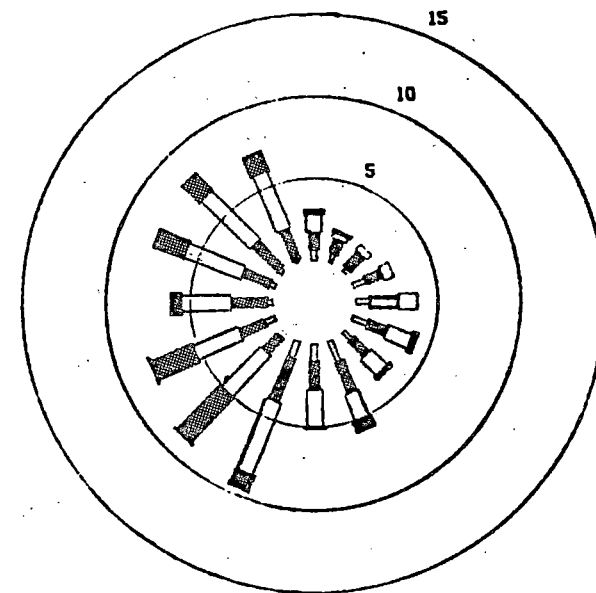
D-1



NUS FALL WIND ROSE 1973-1974

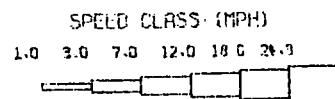
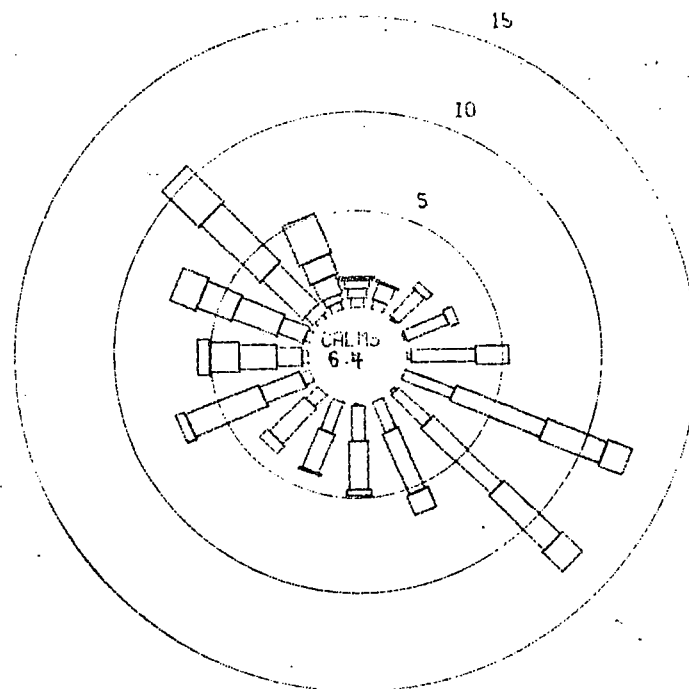


PALISADES WIND ROSE 1973

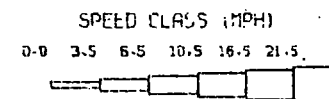
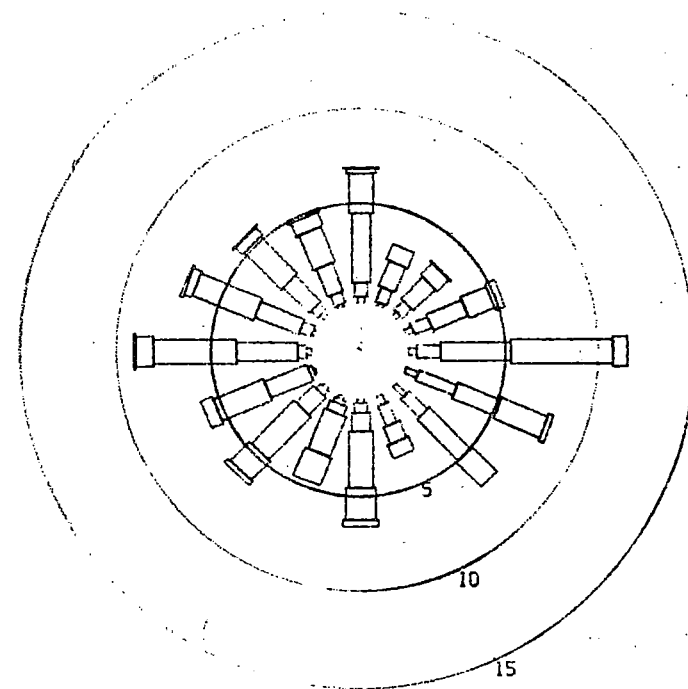


UNIV MICH WIND ROSE 1973

Figure D-1. Wind roses for September, October, November.

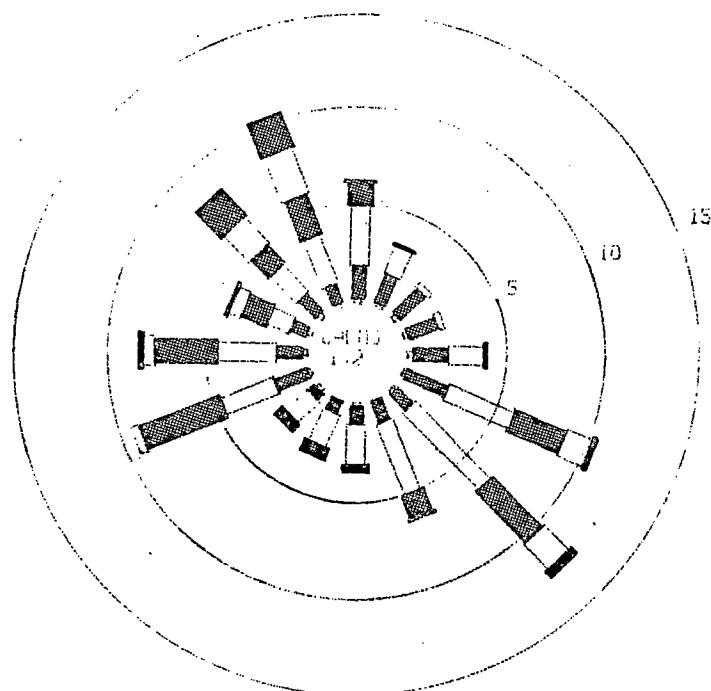


PALISADES WIND ROSE

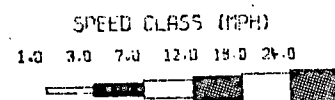
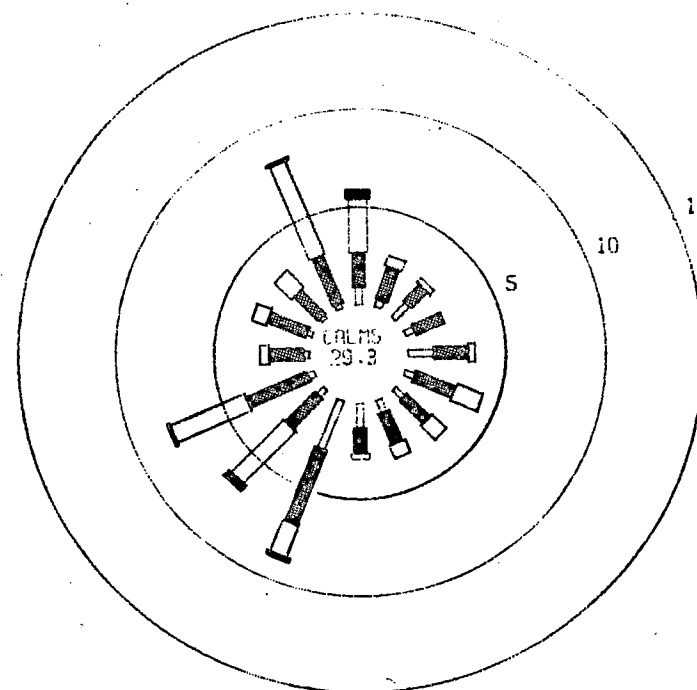


NWS WINTER WIND ROSE (73-74)

Figure D-2. Wind roses for December, January, February 1973-1974.



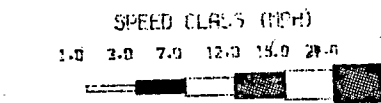
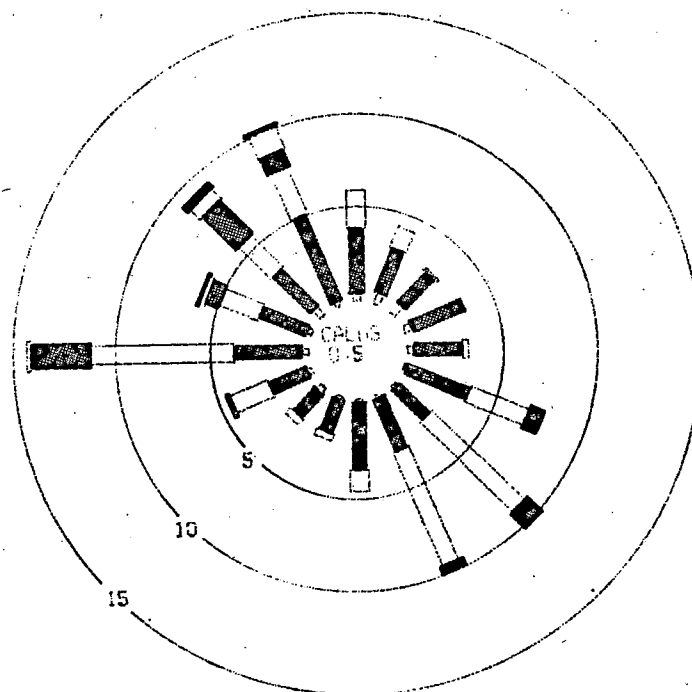
D-4



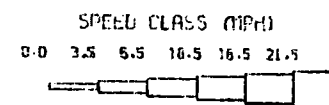
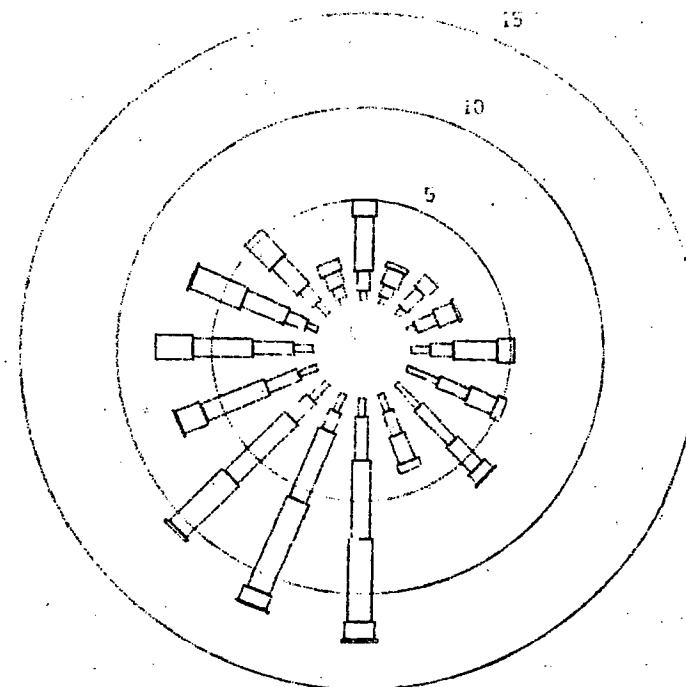
UNIV HIGH WIND ROSE

Figure D-4. Wind rose for July, August 1973.

D-5



PALISADES WIND ROSE 1974



NWS SUMMER WIND ROSE (73-74)

Figure D-5. Wind roses for June, July, August.



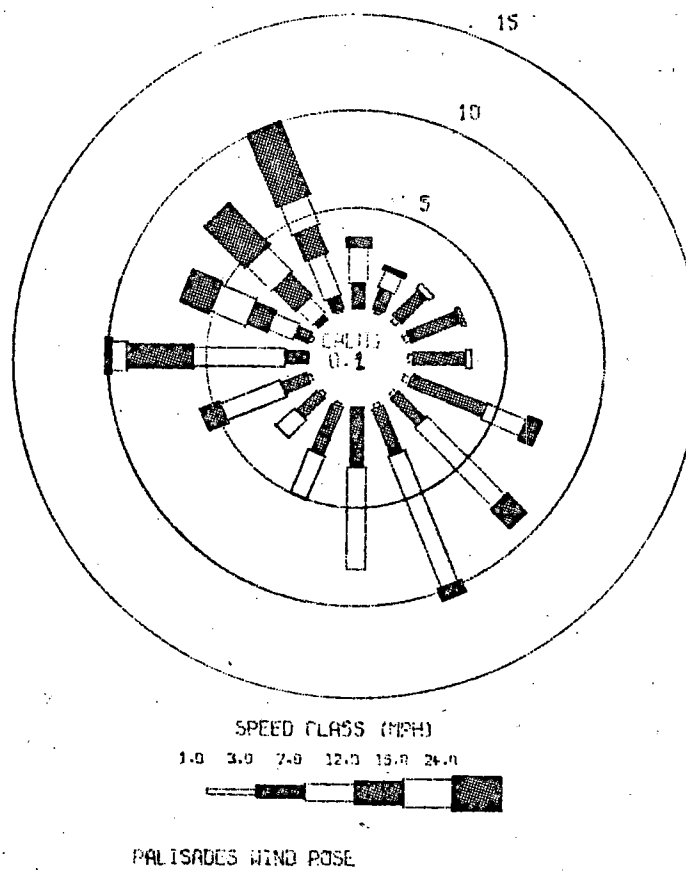


Figure D-6. Wind rose for September, October, November 1974.

D-7

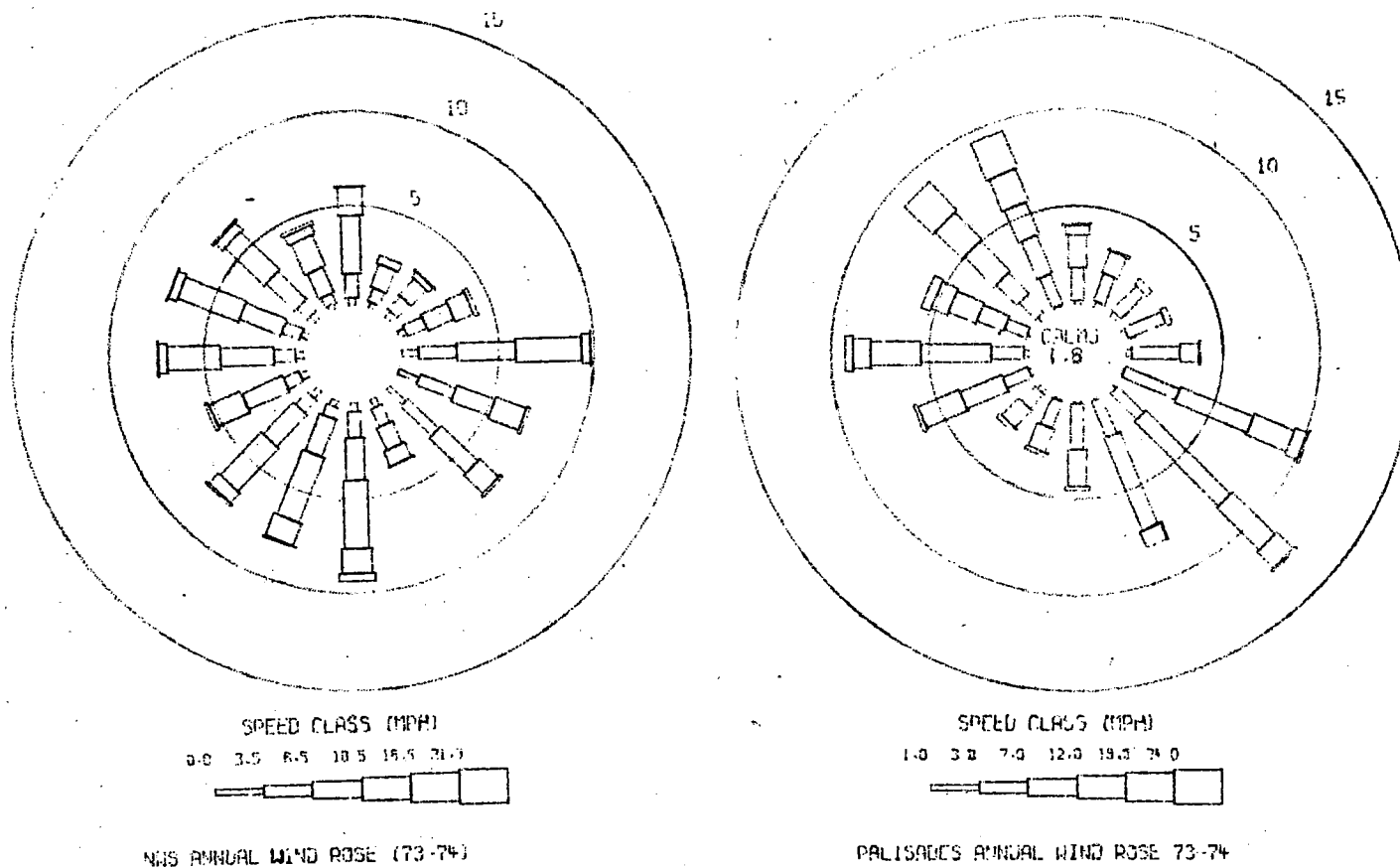


Figure D-7. Wind roses for Annual, 1973-1974.

# PALISADES WIND ROSE DATA FOR FALL 1973

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.0	1.2	1.1	0.4	0.2	0.0	3.0	8.7
NNE	0.2	1.6	1.3	0.2	0.0	0.0	3.3	6.7
NE	0.2	1.6	0.9	0.0	0.0	0.0	2.7	6.1
ENE	0.1	1.8	0.3	0.0	0.0	0.0	2.2	5.3
E	0.3	2.5	0.4	0.0	0.0	0.0	3.2	5.1
ESE	0.1	3.8	4.4	2.1	0.1	0.0	10.5	8.9
SE	0.1	2.1	7.5	3.7	1.5	0.0	14.8	11.2
SSE	0.1	2.3	7.0	0.8	0.0	0.0	10.2	8.8
S	0.0	3.5	1.7	0.0	0.0	0.0	5.3	6.6
SSW	0.2	1.9	0.7	0.0	0.0	0.0	2.9	5.9
SW	0.2	1.1	0.9	0.0	0.0	0.0	2.3	6.3
WSW	0.1	1.3	2.1	0.8	0.0	0.0	4.3	8.7
W	0.0	1.7	2.7	2.2	1.1	0.6	8.6	12.8
WNW	0.1	0.9	1.2	1.6	0.8	0.3	4.9	13.1
NW	0.1	0.9	1.3	2.1	1.5	3.1	8.9	19.6
NNW	0.0	0.6	2.6	3.2	2.3	4.3	13.0	19.1
TOTAL	2.1	28.9	36.2	17.1	7.5	8.2	♦♦♦♦	11.4

# PALISADES WIND ROSE DATA FOR WINTER 1973-1974

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.0	0.5	0.5	0.4	0.1	0.1	1.5	11.0
NNE	0.0	0.5	0.9	0.1	0.0	0.0	1.5	1.7
NE	0.1	1.9	0.4	0.0	0.0	0.0	2.4	5.8
ENE	0.1	2.3	0.5	0.0	0.0	0.0	2.9	5.4
E	0.2	3.3	1.7	0.0	0.0	0.0	5.1	5.9
ESE	0.0	2.7	5.0	3.3	1.3	0.0	12.4	11.2
SE	0.1	2.3	5.0	4.0	1.4	0.0	12.9	11.5
SSE	0.0	1.7	3.5	1.1	0.0	0.0	6.4	9.0
S	0.1	1.8	2.6	0.3	0.0	0.0	4.8	7.8
SSW	0.0	1.7	2.2	0.1	0.0	0.0	4.0	7.5
SW	0.0	0.9	2.5	0.6	0.0	0.0	4.0	9.0
WSW	0.0	0.5	2.2	4.0	0.5	0.0	7.3	12.7
W	0.0	0.3	1.3	1.9	1.5	0.6	5.7	16.0
WNW	0.0	0.3	1.4	2.4	1.9	1.4	7.5	17.4
NW	0.0	0.2	0.6	2.9	4.2	2.6	10.5	20.3
NNW	0.0	0.4	0.4	1.0	1.1	2.2	5.1	22.6
TOTAL	1.0	21.3	30.5	22.2	12.1	6.9	94.0	11.7

## PALISADES WIND ROSE DATA FOR SPRING 1974

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.3	1.7	3.1	1.2	0.1	0.0	6.3	8.9
NNE	0.2	1.6	1.5	0.1	0.0	0.0	3.4	6.9
NE	0.2	1.8	0.3	0.0	0.0	0.0	2.3	4.8
ENE	0.2	1.6	0.3	0.0	0.0	0.0	2.1	5.0
E	0.3	1.8	1.8	0.2	0.0	0.0	4.1	7.1
ESE	0.1	2.3	3.7	2.8	1.4	0.2	10.5	10.4
SE	0.1	1.2	5.6	3.6	1.8	0.3	12.7	12.4
SSE	0.0	1.2	4.0	1.2	0.1	0.0	6.4	9.8
S	0.2	0.9	2.1	0.4	0.0	0.0	3.6	8.5
SSW	0.0	0.7	1.8	0.6	0.0	0.0	3.1	9.2
SW	0.1	0.5	1.5	0.5	0.0	0.0	2.5	9.2
WSW	0.1	1.8	2.9	4.4	0.4	0.0	9.4	11.5
W	0.2	1.4	3.0	3.2	0.6	0.2	8.7	11.6
WNW	0.2	0.9	1.2	1.4	0.6	0.2	4.6	11.9
NW	0.3	1.2	1.9	1.3	1.8	1.9	8.3	16.3
NNW	0.2	1.0	2.7	2.2	2.5	1.9	10.6	16.1
TOTAL	2.7	21.4	37.4	23.0	9.4	4.9	98.8	11.1

# PALISADES WIND ROSE DATA FOR SUMMER 1974

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.4	3.3	2.0	0.0	0.0	0.0	5.6	6.2
NNE	0.6	2.4	1.1	0.0	0.0	0.0	4.1	5.7
NE	0.7	2.1	0.1	0.0	0.0	0.0	2.9	4.2
ENE	0.4	2.9	0.0	0.0	0.0	0.0	3.3	4.2
E	0.3	2.5	0.3	0.0	0.0	0.0	3.1	5.1
ESE	0.1	3.4	3.2	0.8	0.0	0.0	7.5	7.8
SE	0.2	2.1	6.6	1.1	0.0	0.0	10.0	8.9
SSE	0.1	2.9	6.4	0.4	0.0	0.0	9.9	8.3
S	0.1	3.5	1.1	0.0	0.0	0.0	4.7	5.9
SSW	0.1	1.8	0.4	0.0	0.0	0.0	2.3	5.2
SW	0.3	1.6	0.4	0.0	0.0	0.0	2.3	5.1
WSW	0.2	2.1	2.1	0.1	0.0	0.0	4.5	7.1
W	0.3	3.5	7.3	3.1	0.2	0.0	14.5	9.5
WNW	0.2	2.6	2.1	0.7	0.3	0.1	6.0	8.6
NW	0.5	2.7	2.3	2.4	0.7	0.4	9.0	10.8
NNW	0.2	4.7	2.7	0.9	1.3	0.1	9.9	9.5
TOTAL	4.9	43.8	38.1	9.6	2.6	0.7	99.7	7.9

# PALISADES WIND ROSE DATA FOR FALL 1974

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.0	1.3	1.9	0.5	0.0	0.0	3.8	8.6
NNE	0.1	1.1	1.0	0.2	0.0	0.0	2.3	7.2
NE	0.3	1.8	0.4	0.0	0.0	0.0	2.5	5.4
ENE	0.3	2.8	0.1	0.0	0.0	0.0	3.3	5.0
E	0.3	2.7	0.3	0.0	0.0	0.0	3.3	5.0
ESE	0.4	4.1	2.2	0.7	0.0	0.0	7.4	7.0
SE	0.1	2.0	5.7	1.3	0.0	0.0	9.1	9.2
SSE	0.2	2.6	7.2	0.6	0.0	0.0	10.6	8.3
S	0.0	3.1	5.2	0.0	0.0	0.0	8.4	7.5
SSW	0.1	2.7	2.4	0.0	0.0	0.0	5.1	6.8
SW	0.1	1.5	1.3	0.0	0.0	0.0	2.9	6.8
WSW	0.2	1.4	3.3	1.0	0.0	0.0	5.8	8.7
W	0.0	1.2	4.7	3.4	0.8	0.3	10.4	12.1
WNW	0.1	0.8	1.4	1.1	2.0	1.6	7.0	17.1
NW	0.0	0.3	1.1	1.6	1.8	3.0	7.8	20.7
NNW	0.1	0.7	2.3	1.5	1.6	4.0	10.2	20.4
TOTAL	2.5	30.0	40.3	12.0	6.3	8.9	◆◆◆◆	11.0

# UNIV MICH WIND ROSE DATA FOR SUMMER 1973

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.9	1.8	2.7	0.5	0.0	0.0	5.9	1.5
NNE	0.4	1.8	0.5	0.0	0.0	0.0	2.7	4.5
NE	1.0	1.2	0.3	0.0	0.0	0.0	2.5	3.0
ENE	0.5	1.6	0.0	0.0	0.0	0.0	2.0	3.0
E	1.3	1.8	0.3	0.0	0.0	0.0	3.3	3.4
ESE	0.5	2.2	1.4	0.0	0.0	0.0	4.2	5.4
SE	0.6	1.7	1.0	0.0	0.0	0.0	3.3	5.3
SSE	0.7	1.7	0.7	0.0	0.0	0.0	3.1	4.6
S	1.3	1.3	0.3	0.0	0.0	0.0	2.9	3.3
SSW	2.7	4.2	1.8	0.2	0.0	0.0	9.0	4.7
SW	0.4	2.2	3.8	0.4	0.0	0.0	6.9	7.3
WSW	0.3	3.4	4.1	0.1	0.0	0.0	7.9	7.1
W	0.3	1.8	0.5	0.0	0.0	0.0	2.5	5.6
WNW	0.3	2.2	0.7	0.0	0.0	0.0	3.1	5.5
NW	0.1	1.8	1.2	0.0	0.0	0.0	3.1	6.7
NNW	0.2	2.7	5.2	0.1	0.0	0.0	8.2	7.4
TOTAL	11.5	33.5	24.5	1.3	0.0	0.0	70.7	3.7



# UNIV MICH WIND ROSE DATA FOR FALL 1973

DIR.	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG. WIND SPEED (MPH)
N	0.6	1.1	1.1	0.3	0.0	0.0	3.0	1.4
NNE	0.6	0.9	0.3	0.1	0.0	0.0	1.8	4.3
NE	0.3	1.2	0.4	0.0	0.0	0.0	1.9	5.1
ENE	0.8	1.1	0.6	0.0	0.0	0.0	2.6	4.8
E	0.8	1.8	1.1	0.0	0.0	0.0	3.7	4.9
ESE	0.9	1.3	1.5	0.3	0.0	0.0	3.9	6.4
SE	0.6	1.3	1.3	0.3	0.0	0.0	3.4	6.1
SSE	1.3	2.0	1.7	0.6	0.0	0.0	5.5	6.3
S	1.0	1.7	2.2	0.1	0.0	0.0	5.0	5.6
SSW	1.0	2.8	4.6	1.1	0.0	0.0	9.4	7.6
SW	0.3	1.3	3.3	3.7	0.1	0.0	8.8	11.1
WSW	0.6	1.7	2.8	2.7	0.1	0.0	7.8	10.0
W	0.3	2.2	2.9	0.7	0.0	0.0	6.0	8.0
WNW	0.3	1.8	3.6	2.0	0.0	0.0	7.6	9.7
NW	0.3	2.2	4.1	1.5	0.0	0.0	8.0	9.1
NNW	0.2	2.0	3.7	1.3	0.0	0.0	7.1	9.0
TOTAL	9.7	26.4	35.2	14.4	0.2	0.0	85.9	6.7

## APPENDIX E

### HOURLY MINIMUM AVERAGE AND MAXIMUM PARAMETER VALUES FOR EACH MONTH AND SEASON FOR PALISADES AND UNIVERSITY OF MICHIGAN P03A SITE

Parameter 1	Wind Speed
Parameter 2	Wind Direction (not included in minimum average or maximum listings)
Parameter 3	Wind Sigma
Parameter 4	Air Temperature
Parameter 5	Temperature Difference

University of Michigan station data for period July through December 1973, Palisades data period August 1973 through December 1974.

b. University of Michigan

MONTH 7 YEAR 73 DAYS ANALYZED 31 PARAMETER # 1

HOUR	MIN	AVG	MAX
1	0.00	2.30	15.60
2	0.00	2.56	14.70
3	0.00	2.24	13.00
4	0.00	2.49	11.90
5	0.00	2.43	10.90
6	0.00	2.42	10.10
7	0.00	2.98	11.00
8	0.00	4.40	12.60
9	0.50	5.36	13.10
10	0.90	6.49	13.00
11	2.50	7.26	13.90
12	3.60	8.02	14.60
13	3.40	8.41	15.70
14	3.30	8.38	17.60
15	2.50	8.35	19.30
16	0.00	8.03	18.60
17	2.90	7.60	17.20
18	1.30	6.37	15.80
19	0.70	5.17	15.50
20	0.00	4.20	14.50
21	0.00	2.79	13.60
22	0.00	2.37	13.90
23	0.00	2.48	14.90
24	0.00	2.61	15.90

SUMMARY 0.00 4.82 19.30

NUMBER OF OBSERVATIONS 674

a. Palisades

MONTH 8 YEAR 73 DAYS ANALYZED 31 PARAMETER # 1

HOUR	MIN	AVG	MAX
1	2.00	7.76	15.20
2	2.90	7.60	15.20
3	2.50	7.89	14.10
4	2.90	8.00	18.30
5	2.50	7.62	15.20
6	2.90	7.62	13.80
7	3.30	7.37	13.40
8	3.30	7.34	13.20
9	2.00	6.90	13.40
10	3.30	7.23	14.10
11	3.10	7.94	25.70
12	3.80	8.43	19.60
13	4.20	8.05	12.50
14	4.00	9.11	18.10
15	2.70	9.29	19.60
16	4.00	9.61	21.70
17	2.00	8.68	19.40
18	2.00	8.22	21.00
19	1.10	7.20	23.40
20	0.20	6.32	24.60
21	1.30	6.55	25.20
22	3.30	7.05	26.30
23	3.10	7.14	21.40
24	3.60	7.71	18.10

SUMMARY 0.20 7.78 26.30

NUMBER OF OBSERVATIONS 731

b. University of Michigan

MONTH 8 YEAR 73 DAYS ANALYZED 31 PARAMETER # 1

HOUR	MIN	AVG	MAX
1	0.00	2.20	10.90
2	0.00	2.23	10.00
3	0.00	2.58	9.50
4	0.00	2.59	9.20
5	0.00	2.61	9.30
6	0.00	2.00	8.30
7	0.00	2.11	8.20
8	0.00	3.09	10.30
9	0.00	5.05	11.20
10	1.20	6.79	13.00
11	3.00	7.18	11.70
12	3.70	7.36	12.00
13	3.40	7.65	12.30
14	3.10	7.59	12.30
15	1.20	7.62	13.60
16	0.00	7.42	13.60
17	1.50	7.15	13.90
18	0.70	5.85	13.80
19	0.00	4.16	13.40
20	0.00	2.90	11.80
21	0.00	1.95	9.60
22	0.00	1.82	9.90
23	0.00	2.04	11.50
24	0.00	2.23	11.30

SUMMARY 0.00 4.34 13.90

NUMBER OF OBSERVATIONS 744

a. Palisades

MONTH 8 YEAR 73 DAYS ANALYZED 31 PARAMETER # 3

HOUR	MIN	AVG	MAX
1	1.80	9.18	18.10
2	1.20	9.17	16.60
3	0.70	8.53	15.60
4	0.60	8.36	17.00
5	0.50	8.15	14.80
6	1.30	8.13	14.90
7	1.40	7.81	17.20
8	0.60	8.04	14.30
9	1.20	8.09	15.90
10	2.60	8.85	14.90
11	2.80	9.10	18.20
12	3.00	8.47	14.60
13	3.00	8.20	14.40
14	2.70	7.14	11.80
15	2.30	7.26	13.70
16	1.80	7.02	16.70
17	2.30	7.31	19.80
18	1.70	7.86	18.20
19	0.80	8.64	16.40
20	0.30	9.02	19.00
21	0.60	8.54	17.50
22	0.40	8.87	19.00
23	0.40	9.14	18.50
24	1.70	8.82	18.00

SUMMARY 0.30 8.32 19.80

NUMBER OF OBSERVATIONS 731

a. Palisades

MONTH 8 YEAR 73 DAYS ANALYZED 31 PARAMETER # 4

HOUR	MIN	AVG	MAX
1	13.10	20.87	28.00
2	12.90	20.44	27.40
3	13.00	20.20	26.60
4	12.10	19.97	26.10
5	11.40	19.62	26.00
6	10.80	19.40	25.30
7	10.20	19.14	24.90
8	10.00	19.01	25.00
9	11.60	19.55	25.30
10	13.10	20.92	26.00
11	13.30	22.39	27.30
12	14.10	23.33	29.40
13	16.20	24.16	29.70
14	17.80	24.67	30.10
15	18.60	25.20	31.30
16	17.70	26.43	32.80
17	16.70	26.82	33.90
18	16.10	26.00	33.30
19	14.50	25.29	31.90
20	14.10	24.73	30.70
21	14.00	23.55	29.80
22	13.60	22.51	29.80
23	13.70	21.87	29.10
24	13.80	21.39	28.50

SUMMARY 10.00 22.42 33.90

NUMBER OF OBSERVATIONS 731

a. Palisades

MONTH 8 YEAR 73 DAYS ANALYZED 31 PARAMETER # 5

HOUR	MIN	AVG	MAX
1	-0.29	0.23	1.35
2	-0.29	0.30	1.70
3	-0.28	0.28	2.52
4	-0.37	0.29	1.85
5	-0.30	0.30	1.75
6	-0.29	0.36	1.72
7	-0.40	0.41	1.68
8	-0.58	0.45	1.93
9	-0.25	0.78	2.51
10	-0.29	1.02	2.74
11	-0.32	0.90	2.87
12	-0.48	0.90	2.37
13	-0.28	0.82	1.90
14	-0.69	0.37	1.85
15	-0.84	0.01	0.81
16	-1.61	-0.81	1.06
17	-2.86	-1.12	-0.06
18	-1.17	-0.43	0.25
19	-0.70	-0.14	0.63
20	-1.05	-0.29	0.91
21	-0.97	-0.22	1.03
22	-0.26	0.11	1.23
23	-0.28	0.19	1.60
24	-0.18	0.24	1.14

SUMMARY	-2.86	0.20	2.87
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NUMBER OF OBSERVATIONS 731

## a. Palisades

MONTH 9 YEAR 73 DAYS ANALYZED 30 PARAMETER # 1

E-5

HOUR	MIN	AVG	MAX
1	3.10	9.48	21.00
2	2.50	9.52	24.80
3	3.60	9.34	23.70
4	2.90	9.57	21.70
5	3.10	9.81	25.70
6	2.20	9.59	21.40
7	2.00	9.04	19.00
8	2.50	8.97	18.10
9	3.80	9.22	18.50
10	2.70	9.27	20.50
11	3.30	9.17	19.00
12	3.30	9.91	21.40
13	3.80	10.00	20.30
14	3.80	10.27	19.40
15	4.50	10.40	17.40
16	3.80	9.96	20.30
17	3.10	9.65	19.90
18	2.90	8.74	18.50
19	1.80	7.37	17.00
20	2.00	6.84	20.50
21	2.00	7.09	19.00
22	2.70	7.47	20.30
23	2.70	8.07	19.60
24	2.90	8.96	20.30

SUMMARY 1.80 9.07 25.70

NUMBER OF OBSERVATIONS 720

## b. University of Michigan

MONTH 9 YEAR 73 DAYS ANALYZED 30 PARAMETER # 1

HOUR	MIN	AVG	MAX
1	0.00	2.24	10.60
2	0.00	2.66	13.00
3	0.00	2.53	9.40
4	0.00	2.72	10.60
5	0.00	2.88	8.70
6	0.00	2.94	8.00
7	0.00	2.87	12.30
8	0.00	3.90	8.40
9	1.10	5.30	10.10
10	2.30	6.43	9.90
11	2.80	7.58	11.40
12	3.40	8.02	13.40
13	4.10	7.55	14.10
14	3.70	7.63	12.70
15	2.60	7.42	10.80
16	1.60	6.82	11.40
17	2.00	6.34	10.10
18	0.00	4.83	8.90
19	0.00	3.41	11.70
20	0.00	2.08	10.90
21	0.00	1.90	11.50
22	0.00	1.92	10.60
23	0.00	1.98	8.90
24	0.00	2.11	8.00

SUMMARY 0.00 4.32 14.10

NUMBER OF OBSERVATIONS 717

## a. Palisades

MONTH 9 YEAR 73 DAYS ANALYZED 30 PARAMETER # 3

HOUR	MIN	AVG	MAX
1	1.40	6.92	15.40
2	1.90	6.87	14.40
3	2.70	7.65	16.20
4	1.30	7.87	15.80
5	1.10	7.36	16.80
6	2.80	7.34	17.20
7	0.70	7.59	17.00
8	1.60	7.71	18.30
9	2.00	7.61	17.00
10	2.20	7.97	15.20
11	2.40	8.23	16.50
12	2.20	8.48	17.90
13	1.90	8.11	16.60
14	2.10	7.63	15.70
15	2.50	6.93	14.00
16	3.40	7.18	13.30
17	2.90	6.66	16.10
18	2.50	7.07	15.10
19	1.80	7.58	14.50
20	2.60	7.91	14.70
21	3.10	8.16	13.40
22	2.90	7.79	13.60
23	2.90	7.34	13.40
24	0.90	7.24	15.20

SUMMARY 0.70 7.55 18.30

NUMBER OF OBSERVATIONS 714

## a. Palisades

MONTH 9 YEAR 73 DAYS ANALYZED 30 PARAMETER # 4

HOUR	MIN	AVG	MAX
1	5.60	16.76	25.20
2	5.90	16.61	24.60
3	5.50	16.42	24.10
4	5.40	16.25	23.70
5	5.00	15.99	23.10
6	5.00	15.85	23.90
7	5.40	15.70	23.90
8	4.40	15.62	23.80
9	4.80	15.74	23.60
10	7.00	16.51	24.80
11	9.20	17.79	27.50
12	9.60	19.06	29.10
13	9.60	19.81	29.80
14	9.00	20.65	30.00
15	8.90	21.87	31.00
16	8.90	22.70	31.60
17	8.30	22.32	32.70
18	7.80	21.84	33.00
19	7.60	20.85	32.70
20	7.50	19.80	30.50
21	7.30	18.52	28.40
22	7.20	17.72	27.30
23	6.80	17.22	26.40
24	5.80	16.72	25.60

SUMMARY 4.40 18.27 33.00

NUMBER OF OBSERVATIONS 714



a. Palisades

MONTH 9 YEAR 73 DAYS ANALYZED 30 PARAMETER # 5

HOUR	MIN	AVG	MAX
1	-0.43	0.24	1.19
2	-0.51	0.20	1.53
3	-0.62	0.16	1.45
4	-0.41	0.08	0.90
5	-0.84	0.09	1.38
6	-0.76	0.09	1.26
7	-0.55	0.06	1.27
8	-0.62	0.12	1.39
9	-0.50	0.32	2.41
10	-0.44	0.51	2.22
11	-0.04	0.73	2.08
12	-0.44	0.73	2.19
13	-0.72	0.50	1.59
14	-0.95	0.00	0.86
15	-2.79	-1.03	0.40
16	-3.46	-1.48	0.33
17	-3.31	-1.45	0.40
18	-2.80	-1.22	0.29
19	-2.03	-0.68	0.88
20	-1.24	-0.43	1.34
21	-0.74	-0.27	1.17
22	-0.55	-0.02	1.09
23	-0.41	0.10	1.03
24	-0.47	0.18	1.02

SUMMARY -3.46 -0.10 2.41

NUMBER OF OBSERVATIONS 714

a. Palisades

MONTH 10 YEAR 73 DAYS ANALYZED 31 PARAMETER # 1

HOUR	MIN	AVG	MAX
1	3.30	12.05	35.90
2	2.50	11.65	31.20
3	4.00	12.02	29.70
4	3.80	12.15	31.50
5	3.80	12.40	32.10
6	2.70	12.44	33.30
7	3.80	12.33	35.90
8	1.80	11.27	36.40
9	1.60	11.17	34.80
10	2.70	11.11	35.70
11	3.60	10.84	35.70
12	2.70	10.76	33.90
13	3.80	10.22	31.70
14	4.70	10.49	30.10
15	3.30	10.67	31.00
16	4.00	10.86	31.50
17	3.80	9.89	28.60
18	2.70	9.52	29.90
19	2.00	10.08	27.90
20	2.90	10.38	32.40
21	2.20	10.58	35.50
22	3.80	11.85	42.00
23	4.90	12.53	40.80
24	4.70	12.67	39.70

SUMMARY 1.60 11.25 42.00

NUMBER OF OBSERVATIONS 744

b. University of Michigan

MONTH 10 YEAR 73 DAYS ANALYZED 31 PARAMETER # 1

HOUR	MIN	AVG	MAX
1	0.00	3.76	15.30
2	0.00	3.84	15.10
3	0.00	3.62	14.90
4	0.00	3.42	13.50
5	0.00	3.69	14.50
6	0.00	3.78	13.60
7	0.00	3.95	15.00
8	0.00	4.34	14.10
9	0.00	5.32	13.40
10	2.50	6.82	13.70
11	2.00	7.43	13.40
12	2.80	8.27	14.90
13	3.50	8.23	15.40
14	3.40	8.17	17.50
15	1.40	7.57	13.60
16	0.00	6.75	13.00
17	0.00	5.84	12.10
18	0.00	4.77	11.00
19	0.00	3.80	11.20
20	0.00	3.84	14.40
21	0.00	4.36	17.10
22	0.00	4.17	15.30
23	0.00	3.95	15.10
24	0.00	4.26	16.20

SUMMARY 0.00 5.15 17.50

NUMBER OF OBSERVATIONS 690

a. Palisades

MONTH 10 YEAR 73 DAYS ANALYZED 31 PARAMETER # 3

HOUR	MIN	AVG	MAX
1	0.00	4.99	11.70
2	0.00	5.39	14.40
3	0.00	5.14	16.30
4	0.00	4.93	14.40
5	0.00	4.92	14.80
6	0.00	5.18	16.10
7	0.00	5.35	16.00
8	0.00	5.97	19.20
9	0.00	5.83	19.70
10	0.00	6.09	16.40
11	0.00	6.57	18.50
12	0.00	6.50	18.00
13	0.00	6.69	17.10
14	0.00	6.03	16.60
15	0.00	5.81	16.80
16	0.00	5.74	17.60
17	0.00	5.39	17.70
18	0.00	5.23	15.60
19	0.00	4.78	15.90
20	0.00	4.65	13.10
21	0.00	4.64	10.90
22	0.00	4.60	11.10
23	0.00	4.29	13.40
24	0.00	4.47	12.60

SUMMARY 0.00 5.38 19.70

NUMBER OF OBSERVATIONS 744

a. Palisades

MONTH 10 YEAR 73 DAYS ANALYZED 31 PARAMETER # 4

HOUR	MIN	AVG	MAX
1	3.80	13.51	19.70
2	3.80	13.25	19.70
3	3.70	13.07	19.80
4	3.30	12.83	19.30
5	3.20	12.44	18.60
6	3.40	12.36	18.50
7	3.40	12.34	19.30
8	4.00	12.16	20.10
9	4.80	11.99	20.00
10	5.70	12.31	18.70
11	6.40	13.31	20.00
12	7.20	14.68	22.00
13	7.90	15.88	24.50
14	8.00	16.87	26.70
15	8.30	18.39	29.60
16	8.40	18.85	30.40
17	8.40	18.62	30.30
18	8.60	18.14	29.70
19	8.60	17.15	26.90
20	8.00	15.47	23.90
21	7.90	14.62	22.30
22	7.50	14.26	21.30
23	5.50	13.90	20.50
24	4.30	13.59	20.00

SUMMARY 3.20 14.58 30.40

NUMBER OF OBSERVATIONS 744

a. Palisades

MONTH 10 YEAR 73 DAYS ANALYZED 31 PARAMETER # 5

HOOR	MIN	AVG	MAX
1	-0.65	-0.02	1.10
2	-0.87	-0.01	0.83
3	-1.02	0.01	0.95
4	-0.80	-0.03	1.19
5	-0.48	-0.00	1.06
6	-0.65	-0.01	1.01
7	-0.74	-0.04	0.99
8	-0.68	-0.05	0.54
9	-0.72	0.02	0.52
10	-0.77	0.22	1.13
11	-0.79	0.38	1.99
12	-0.83	0.31	1.75
13	-1.64	-0.02	0.68
14	-1.57	-0.34	0.25
15	-4.23	-1.32	0.07
16	-4.63	-1.60	-0.10
17	-4.51	-1.64	-0.21
18	-4.77	-1.48	0.01
19	-3.83	-1.06	0.01
20	-1.17	-0.37	0.37
21	-0.62	-0.04	1.14
22	-0.66	0.03	1.48
23	-0.76	0.05	1.46
24	-0.51	0.05	1.34

SUMMARY -4.77 -0.29 1.99

NUMBER OF OBSERVATIONS 744

a. Palisades

MONTH 11 YEAR 73 DAYS ANALYZED 30 PARAMETER # 1

HOUR	MIN	AVG	MAX
1	4.00	14.81	38.80
2	3.80	14.06	38.40
3	3.10	13.86	38.40
4	3.80	13.46	43.10
5	0.90	13.92	41.10
6	2.50	13.89	39.70
7	2.00	13.94	40.60
8	2.70	14.22	38.60
9	2.70	13.51	36.20
10	2.70	13.28	34.40
11	3.60	13.01	33.30
12	3.10	12.95	32.40
13	2.70	13.61	31.90
14	3.60	14.11	33.50
15	2.70	13.89	33.90
16	2.90	14.02	32.40
17	1.10	13.67	31.90
18	2.70	14.01	34.60
19	2.70	14.07	35.00
20	2.50	14.40	35.70
21	4.50	14.36	34.60
22	4.70	14.63	38.40
23	4.50	14.47	30.40
24	4.50	14.19	31.00
SUMMARY	0.90	13.93	43.10
NUMBER OF OBSERVATIONS 720			

b. University of Michigan

MONTH 11 YEAR 73 DAYS ANALYZED 30 PARAMETER # 1

HOUR	MIN	AVG	MAX
1	0.00	6.85	15.40
2	0.00	6.84	15.40
3	0.00	6.59	15.80
4	0.00	6.10	14.00
5	0.00	6.10	14.60
6	0.00	6.06	16.80
7	0.00	6.30	15.40
8	0.00	6.80	20.90
9	0.00	7.25	20.90
10	1.30	7.72	20.20
11	1.70	8.16	19.20
12	0.70	8.59	17.30
13	1.40	9.02	16.80
14	2.30	9.29	16.90
15	2.50	8.83	15.70
16	1.40	8.73	17.10
17	0.00	8.11	17.90
18	0.00	7.82	18.10
19	0.00	7.57	17.30
20	0.00	7.47	17.20
21	0.00	7.19	16.80
22	0.00	7.32	16.70
23	0.00	7.23	15.20
24	0.00	6.66	16.00
SUMMARY	0.00	7.44	20.90
NUMBER OF OBSERVATIONS 720			

a. Palisades

MONTH 11 YEAR 73 DAYS ANALYZED 30 PARAMETER # 3

HOUR	MIN	AVG	MAX
1	0.00	0.74	9.00
2	0.00	0.96	10.90
3	0.00	1.21	13.30
4	0.00	1.25	13.80
5	0.00	1.04	12.70
6	0.00	1.17	15.50
7	0.00	1.35	15.30
8	0.00	1.52	15.30
9	0.00	1.72	15.40
10	0.00	1.41	12.00
11	0.00	0.98	13.00
12	0.00	1.03	12.30
13	0.00	1.29	15.40
14	0.00	0.99	11.90
15	0.00	0.78	9.40
16	0.00	0.66	8.40
17	0.00	0.71	7.50
18	0.00	0.84	9.70
19	0.00	0.75	8.00
20	0.00	0.64	5.80
21	0.00	0.78	7.80
22	0.00	0.60	5.00
23	0.00	0.73	8.30
24	0.00	0.64	6.20

SUMMARY 0.00 0.99 15.50

NUMBER OF OBSERVATIONS 715

a. Palisades

MONTH 11 YEAR 73 DAYS ANALYZED 30 PARAMETER # 4

HOUR	MIN	AVG	MAX
1	0.10	5.81	11.90
2	-0.40	5.75	12.00
3	-0.60	5.64	12.30
4	-0.80	5.38	11.60
5	-0.90	5.33	11.70
6	-1.00	5.19	12.30
7	-1.30	5.04	13.20
8	-1.80	4.99	14.20
9	-1.50	4.93	14.50
10	-1.10	5.12	14.70
11	-0.80	5.95	15.30
12	-0.40	6.92	15.30
13	-0.10	7.70	17.10
14	0.60	7.97	16.50
15	0.40	8.07	17.90
16	0.30	7.83	17.20
17	0.30	7.46	15.00
18	0.30	6.94	14.00
19	0.70	6.58	14.10
20	0.70	6.17	13.50
21	0.20	6.02	13.30
22	0.00	5.87	12.90
23	-0.10	5.69	13.00
24	0.00+	5.70	12.70

SUMMARY -1.80 6.17 17.90

NUMBER OF OBSERVATIONS 715

a. Palisades

MONTH 11 YEAR 73 DAYS ANALYZED 30 PARAMETER # 5

HOUR	MIN	AVG	MAX
1	-0.69	-0.22	0.19
2	-0.74	-0.23	0.30
3	-0.74	-0.22	0.28
4	-1.03	-0.24	0.59
5	-1.08	-0.20	1.82
6	-1.09	-0.20	0.91
7	-0.86	-0.16	0.92
8	-0.77	-0.18	0.52
9	-0.83	-0.19	0.48
10	-0.91	-0.11	1.10
11	-0.86	-0.06	1.35
12	-0.88	-0.24	0.68
13	-1.60	-0.49	0.48
14	-2.70	-0.60	0.11
15	-2.81	-0.70	0.04
16	-2.43	-0.68	0.10
17	-2.08	-0.56	0.11
18	-1.53	-0.40	0.37
19	-0.84	-0.28	0.15
20	-1.09	-0.19	0.46
21	-1.05	-0.19	0.48
22	-1.02	-0.21	0.48
23	-0.72	-0.20	0.33
24	-0.86	-0.26	0.25

SUMMARY -2.81 -0.29 1.82

NUMBER OF OBSERVATIONS 715

a. Palisades

MONTH 12 YEAR 73 DAYS ANALYZED 31 PARAMETER # 1

HR	MIN	AVG	MAX
1	0.00	11.35	32.40
2	0.00	11.00	31.00
3	0.00	10.38	29.90
4	0.00	10.27	28.80
5	0.00	10.65	27.90
6	0.00	9.77	25.90
7	0.00	9.30	29.00
8	0.00	9.68	27.70
9	0.00	9.55	26.60
10	0.00	9.81	26.10
11	0.00	9.71	26.60
12	0.00	9.55	26.10
13	0.00	9.46	30.40
14	0.00	10.00	30.60
15	0.00	10.74	31.90
16	0.00	10.67	31.20
17	0.00	10.50	29.20
18	0.00	10.68	28.80
19	0.00	11.22	30.10
20	0.00	11.26	31.90
21	0.00	11.60	32.80
22	0.00	11.41	29.90
23	0.00	11.52	31.70
24	0.00	11.77	32.40

SUMMARY 0.00 10.49 32.80

NUMBER OF OBSERVATIONS 744

b. University of Michigan

MONTH 12 YEAR 73 DAYS ANALYZED 31 PARAMETER # 1

HR	MIN	AVG	MAX
1	0.00	6.79	17.20
2	0.00	7.31	16.90
3	0.00	7.11	18.30
4	0.00	7.07	18.00
5	0.00	7.13	16.50
6	0.00	6.82	16.20
7	0.00	6.69	16.40
8	0.00	6.88	16.30
9	0.00	6.89	14.70
10	0.60	7.44	14.10
11	2.90	8.26	16.00
12	2.70	8.07	16.10
13	2.70	8.29	16.00
14	2.50	8.44	14.70
15	1.80	8.35	14.80
16	1.90	8.68	17.30
17	1.20	7.72	17.80
18	0.00	7.22	17.90
19	0.00	7.01	17.00
20	0.00	7.27	16.90
21	0.60	7.13	18.00
22	1.30	7.46	18.20
23	1.30	7.40	17.70
24	0.90	7.01	17.20

SUMMARY 0.00 7.44 18.30

NUMBER OF OBSERVATIONS 657



a. Palisades

MONTH 12 YEAR 73 DAYS ANALYZED 31 PARAMETER # 3

HOURL	MIN	AVG	MAX
1	0.00	1.00	9.10
2	0.00	1.09	8.80
3	0.00	1.18	10.20
4	0.00	1.20	7.80
5	0.00	1.08	7.90
6	0.00	1.30	8.10
7	0.00	1.23	8.50
8	0.00	1.33	16.30
9	0.00	1.48	11.10
10	0.00	1.34	9.50
11	0.00	1.52	12.40
12	0.00	1.35	8.90
13	0.00	1.56	8.10
14	0.00	1.20	7.90
15	0.00	1.19	8.50
16	0.00	1.20	11.80
17	0.00	1.16	10.40
18	0.00	1.04	9.20
19	0.00	0.98	9.90
20	0.00	0.94	12.70
21	0.00	0.87	15.00
22	0.00	0.96	17.40
23	0.00	1.27	13.20
24	0.00	1.20	10.90

SUMMARY 0.00 1.19 17.40

NUMBER OF OBSERVATIONS 744

a. Palisades

MONTH 12 YEAR 73 DAYS ANALYZED 31 PARAMETER # 4

HOURL	MIN	AVG	MAX
1	-13.20	-2.12	13.30
2	-13.60	-2.41	12.10
3	-14.10	-2.50	11.80
4	-14.70	-2.54	11.50
5	-15.20	-2.66	10.90
6	-16.00	-2.85	10.70
7	-16.00	-3.12	10.80
8	-16.80	-3.39	11.00
9	-17.30	-3.57	11.10
10	-15.90	-3.20	12.10
11	-12.70	-2.38	12.20
12	-9.80	-1.22	11.90
13	-7.90	-0.25	12.00
14	-7.60	0.15	12.20
15	-7.10	0.32	14.40
16	-6.70	0.53	14.60
17	-6.40	0.25	14.00
18	-8.70	-0.70	12.80
19	-11.30	-1.35	12.20
20	-10.80	-1.43	11.30
21	-11.40	-1.43	12.50
22	-12.20	-1.61	13.10
23	-12.00	-1.88	13.00
24	-12.60	-2.15	13.10

SUMMARY -17.30 -1.73 14.60

NUMBER OF OBSERVATIONS 744

a. Palisades

MONTH 12 YEAR 73 DAYS ANALYZED 31 PARAMETER # 5

HOUR	MIN	AVG	MAX
1	-1.02	-0.22	0.32
2	-1.01	-0.23	0.30
3	-1.06	-0.23	0.83
4	-1.08	-0.25	0.80
5	-1.13	-0.24	0.46
6	-1.12	-0.25	0.44
7	-1.08	-0.20	0.52
8	-1.12	-0.18	0.52
9	-1.12	-0.15	0.80
10	-1.08	-0.08	0.95
11	-1.09	-0.14	0.90
12	-1.12	-0.29	0.33
13	-2.43	-0.56	0.29
14	-2.70	-0.63	0.23
15	-2.77	-0.61	0.28
16	-2.94	-0.71	0.32
17	-2.70	-0.69	0.18
18	-1.16	-0.39	0.28
19	-1.05	-0.17	0.72
20	-1.05	-0.18	0.55
21	-1.06	-0.21	0.39
22	-1.06	-0.26	0.39
23	-1.06	-0.24	0.33
24	-1.06	-0.26	0.17

SUMMARY -2.94 -0.31 0.95

NUMBER OF OBSERVATIONS 744

a. Palisades

FALL YEAR 73 DAYS ANALYZED 91 PARAMETER # 1

HOUR	MIN	AVG	MAX
1	3.10	12.11	38.80
2	2.50	11.74	38.40
3	3.10	11.74	38.40
4	2.90	11.73	43.10
5	0.90	12.05	41.10
6	2.20	11.98	39.70
7	2.00	11.78	40.60
8	1.80	11.49	38.60
9	1.60	11.30	36.20
10	2.70	11.22	35.70
11	3.30	11.01	35.70
12	2.70	11.20	33.90
13	2.70	11.26	31.90
14	3.60	11.61	33.50
15	2.70	11.64	33.90
16	2.90	11.60	32.40
17	1.10	11.06	31.90
18	2.70	10.74	34.60
19	1.80	10.50	35.00
20	2.00	10.54	35.70
21	2.00	10.68	35.50
22	2.70	11.32	42.00
23	2.70	11.70	40.80
24	2.90	11.95	39.70

SUMMARY 0.90 11.42 43.10

NUMBER OF OBSERVATIONS2184

b. University of Michigan

FALL YEAR 73 DAYS ANALYZED 91 PARAMETER # 1

HOUR	MIN	AVG	MAX
1	0.00	4.29	15.40
2	0.00	4.45	15.40
3	0.00	4.25	15.80
4	0.00	4.09	14.00
5	0.00	4.23	14.60
6	0.00	4.26	16.80
7	0.00	4.38	15.40
8	0.00	5.02	20.90
9	0.00	5.97	20.90
10	1.30	7.00	20.20
11	1.70	7.73	19.20
12	0.70	8.30	17.30
13	1.40	8.27	16.80
14	2.30	8.37	17.50
15	1.40	7.95	15.70
16	0.00	7.45	17.10
17	0.00	6.78	17.90
18	0.00	5.81	18.10
19	0.00	4.94	17.30
20	0.00	4.47	17.20
21	0.00	4.48	17.10
22	0.00	4.47	16.70
23	0.00	4.39	15.20
24	0.00	4.35	16.20

SUMMARY 0.00 5.65 20.90

NUMBER OF OBSERVATIONS2127

## a. Palisades

FALL YEAR 73 DAYS ANALYZED 91 PARAMETER # 3

HOUR	MIN	AVG	MAX
1	0.00	4.20	15.40
2	0.00	4.39	14.40
3	0.00	4.67	16.30
4	0.00	4.69	15.80
5	0.00	4.44	16.80
6	0.00	4.57	17.20
7	0.00	4.77	17.00
8	0.00	5.08	19.20
9	0.00	5.06	19.70
10	0.00	5.17	16.40
11	0.00	5.27	18.50
12	0.00	5.35	18.00
13	0.00	5.38	17.10
14	0.00	4.90	16.60
15	0.00	4.52	16.80
16	0.00	4.54	17.60
17	0.00	4.27	17.70
18	0.00	4.39	15.60
19	0.00	4.42	15.90
20	0.00	4.44	14.70
21	0.00	4.53	13.40
22	0.00	4.34	13.60
23	0.00	4.13	13.40
24	0.00	4.09	15.20

SUMMARY 0.00 4.65 19.70

NUMBER OF OBSERVATIONS2173

## a. Palisades

FALL YEAR 73 DAYS ANALYZED 91 PARAMETER # 4

HOUR	MIN	AVG	MAX
1	0.10	11.99	25.20
2	-0.40	11.84	24.60
3	-0.60	11.72	24.10
4	-0.80	11.50	23.70
5	-0.90	11.27	23.10
6	-1.00	11.15	23.90
7	-1.30	11.04	23.90
8	-1.80	10.94	23.80
9	-1.50	10.90	23.60
10	-1.10	11.32	24.80
11	-0.80	12.36	27.50
12	-0.40	13.57	29.10
13	-0.10	14.48	29.80
14	0.60	15.18	30.00
15	0.40	16.14	31.00
16	0.30	16.48	31.60
17	0.30	16.16	32.70
18	0.30	15.67	33.00
19	0.70	14.98	32.70
20	0.70	13.92	30.50
21	0.20	13.09	28.40
22	0.00	12.65	27.30
23	-0.10	12.31	26.40
24	0.00	11.97	25.60

SUMMARY -1.80 13.03 33.00

NUMBER OF OBSERVATIONS2173

a. Palisades

FALL YEAR 73 DAYS ANALYZED 91 PARAMETER # 5

HOUR	MIN	AVG	MAX
1	-0.69	-0.00	1.19
2	-0.87	-0.02	1.53
3	-1.02	-0.02	1.45
4	-1.03	-0.06	1.19
5	-1.08	-0.04	1.82
6	-1.09	-0.04	1.26
7	-0.86	-0.05	1.27
8	-0.77	-0.04	1.39
9	-0.83	0.05	2.41
10	-0.91	0.21	2.22
11	-0.86	0.35	2.08
12	-0.88	0.27	2.19
13	-1.64	-0.00	1.59
14	-2.70	-0.31	0.86
15	-4.23	-1.02	0.40
16	-4.63	-1.26	0.33
17	-4.51	-1.22	0.40
18	-4.77	-1.04	0.37
19	-3.83	-0.68	0.88
20	-1.24	-0.33	1.34
21	-1.05	-0.16	1.17
22	-1.02	-0.06	1.48
23	-0.76	-0.02	1.46
24	-0.86	-0.01	1.34

SUMMARY -4.77 -0.23 2.41

NUMBER OF OBSERVATIONS 2173

Palisades

MONTH 1 YEAR 74 DAYS ANALYZED 31 PARAMETER # 1

HOUR	MIN	AVG	MAX
1	3.80	11.42	33.00
2	4.00	11.59	33.00
3	2.70	11.67	31.50
4	3.80	12.59	32.60
5	4.50	12.79	32.60
6	2.50	12.61	26.60
7	1.80	12.93	26.80
8	2.50	12.78	25.90
9	3.30	13.33	34.60
10	5.10	13.57	43.50
11	4.20	13.72	36.60
12	3.10	13.86	40.00
13	4.00	13.52	38.40
14	1.80	13.43	33.00
15	3.10	13.32	27.70
16	4.00	13.00	23.40
17	2.50	12.41	22.80
18	0.70	12.56	23.70
19	4.70	12.71	23.70
20	4.70	12.81	23.00
21	3.60	12.44	25.00
22	4.70	12.53	29.80
23	3.30	12.43	35.00
24	3.30	12.34	33.50

SUMMARY	0.70	12.76	43.50
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NUMBER OF OBSERVATIONS 744

## Palisades

MONTH 1 YEAR 74 DAYS ANALYZED 31 PARAMETER # 3

HOUR	MIN	AVG	MAX
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1	0.00	7.37	18.60
2	0.00	7.55	19.00
3	0.00	7.68	19.80
4	0.00	7.72	18.80
5	0.00	7.51	16.60
6	0.00	7.39	17.20
7	0.00	6.78	18.10
8	0.00	6.71	18.40
9	0.00	7.02	18.10
10	0.00	7.09	16.70
11	0.00	7.34	18.40
12	0.00	6.74	17.50
13	0.00	6.25	16.60
14	0.00	6.29	16.50
15	0.00	6.55	17.30
16	0.00	6.45	18.30
17	0.00	6.66	18.90
18	0.00	6.29	19.70
19	0.00	5.97	18.70
20	0.00	6.54	19.20
21	0.00	6.33	19.20
22	0.00	6.72	20.80
23	0.00	6.94	19.50
24	0.00	7.01	20.60

SUMMARY 0.00 6.87 20.80

NUMBER OF OBSERVATIONS 744

## Palisades

MONTH 1 YEAR 74 DAYS ANALYZED 31 PARAMETER # 4

HOUR	MIN	AVG	MAX
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1	-15.30	-2.50	8.30
2	-14.50	-2.78	8.90
3	-16.00	-3.07	8.20
4	-15.90	-3.09	9.30
5	-16.10	-3.22	8.20
6	-15.50	-3.42	6.10
7	-15.90	-3.39	5.70
8	-16.80	-3.44	5.30
9	-17.10	-3.39	4.70
10	-16.50	-3.11	5.20
11	-14.00	-2.32	6.20
12	-12.80	-1.51	8.00
13	-11.10	-0.77	10.10
14	-9.80	-0.42	11.40
15	-8.80	-0.18	12.60
16	-8.70	-0.20	13.40
17	-9.30	-0.56	12.40
18	-9.50	-0.86	11.80
19	-10.00	-1.23	10.00
20	-10.20	-1.37	10.10
21	-10.20	-1.51	9.60
22	-10.40	-1.72	10.60
23	-14.30	-1.94	11.20
24	-15.00	-2.04	9.10

SUMMARY -17.10 -2.00 13.40

NUMBER OF OBSERVATIONS 744

Palisades

MONTH 1 YEAR 74 DAYS ANALYZED 31 PARAMETER # 5

HOUR	MIN	AVG	MAX
1	-1.17	-0.21	0.83
2	-1.17	-0.16	0.76
3	-1.17	-0.17	0.58
4	-1.09	-0.18	0.58
5	-0.98	-0.20	0.48
6	-0.95	-0.16	0.58
7	-0.94	-0.20	0.50
8	-1.02	-0.25	0.33
9	-1.08	-0.20	0.52
10	-1.10	-0.20	0.57
11	-1.13	-0.27	0.39
12	-1.59	-0.41	0.21
13	-2.12	-0.63	0.18
14	-2.23	-0.69	0.14
15	-2.59	-0.74	0.15
16	-2.65	-0.77	0.15
17	-2.23	-0.70	0.23
18	-1.85	-0.51	0.73
19	-1.06	-0.36	0.43
20	-1.21	-0.36	0.39
21	-1.20	-0.29	1.02
22	-1.21	-0.25	1.05
23	-1.16	-0.22	1.06
24	-1.17	-0.23	0.90

SUMMARY	-2.65	-0.35	1.06
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NUMBER OF OBSERVATIONS 744



# Palisades

MONTH 2 YEAR 74 DAYS ANALYZED 28 PARAMETER # 1

HOUR	MIN	AVG	MAX
1	4.20	12.48	32.60
2	4.90	12.41	31.70
3	2.00	12.23	29.50
4	3.80	12.66	27.20
5	5.60	12.15	25.70
6	5.60	11.73	26.60
7	4.00	10.77	25.00
8	4.50	10.66	23.20
9	2.90	10.05	23.90
10	1.80	10.37	24.10
11	2.90	10.69	23.40
12	3.80	11.65	21.90
13	4.00	12.74	26.80
14	3.80	12.11	25.70
15	4.90	12.29	29.90
16	4.20	12.80	35.00
17	4.50	13.43	43.30
18	5.40	14.00	47.10
19	2.70	13.42	45.80
20	3.30	13.07	43.50
21	1.60	13.13	44.40
22	4.00	13.10	41.70
23	4.90	13.03	36.80
24	4.00	12.66	34.80

SUMMARY 1.60 12.23 47.10

NUMBER OF OBSERVATIONS 671

Palisades

MONTH 2 YEAR 74 DAYS ANALYZED 28 PARAMETER # 3

HOUR	MIN	AVG	MAX
1	0.00	2.01	16.80
2	0.00	1.95	16.10
3	0.00	1.77	16.30
4	0.00	2.04	16.90
5	0.00	2.19	16.60
6	0.00	2.37	16.10
7	0.00	2.40	15.80
8	0.00	2.71	16.90
9	0.00	2.87	17.30
10	0.00	2.18	18.10
11	0.00	2.36	18.80
12	0.00	2.37	17.80
13	0.00	3.19	15.90
14	0.00	3.85	15.80
15	0.00	4.01	14.50
16	0.00	4.04	13.50
17	0.00	3.67	14.50
18	0.00	3.36	14.00
19	0.00	3.24	13.90
20	0.00	2.43	12.60
21	0.00	2.19	14.60
22	0.00	1.93	13.30
23	0.00	1.83	15.20
24	0.00	2.04	18.50

SUMMARY 0.00 2.62 18.80

NUMBER OF OBSERVATIONS 671

Palisades

MONTH 2 YEAR 74 DAYS ANALYZED 28 PARAMETER # 4

HOUR	MIN	AVG	MAX
1	-11.90	-3.66	8.30
2	-12.70	-4.12	8.80
3	-12.80	-4.54	8.90
4	-12.60	-4.49	9.20
5	-12.90	-4.54	9.20
6	-13.40	-4.56	9.20
7	-13.80	-4.77	7.90
8	-14.00	-5.05	6.30
9	-14.40	-5.28	5.40
10	-14.70	-5.15	4.10
11	-13.40	-4.31	4.20
12	-9.80	-3.24	5.90
13	-9.30	-1.79	8.10
14	-8.80	-1.05	8.80
15	-8.60	-0.22	9.70
16	-8.20	0.09	9.40
17	-8.30	-0.06	9.60
18	-8.30	-0.46	9.00
19	-8.40	-1.13	7.90
20	-8.90	-2.06	6.80
21	-9.70	-2.58	7.10
22	-9.90	-2.78	6.40
23	-10.10	-2.98	6.40
24	-10.80	-3.18	7.70

SUMMARY -14.70 -3.00 9.60

NUMBER OF OBSERVATIONS 671

E-24

Palisades

MONTH 2 YEAR 74 DAYS ANALYZED 28 PARAMETER # 5

HOUR	MIN	AVG	MAX
1	-1.82	-0.22	0.58
2	-0.81	-0.15	0.66
3	-1.08	-0.09	0.91
4	-1.10	-0.12	0.77
5	-0.90	-0.10	0.79
6	-0.99	-0.13	0.92
7	-0.87	-0.16	0.68
8	-0.88	-0.10	0.69
9	-0.88	0.01	1.63
10	-1.01	0.0	1.89
11	-0.87	0.09	1.16
12	-0.92	-0.11	0.86
13	-1.27	-0.34	0.98
14	-2.33	-0.58	0.18
15	-3.39	-0.90	0.17
16	-3.92	-1.05	0.03
17	-3.67	-1.14	0.21
18	-3.13	-1.07	0.21
19	-3.48	-0.84	0.37
20	-1.39	-0.46	0.74
21	-1.06	-0.27	0.68
22	-0.99	-0.27	0.91
23	-1.19	-0.27	0.81
24	-1.49	-0.28	0.73
SUMMARY	-3.92	-0.35	1.89
NUMBER OF OBSERVATIONS 671			

Palisades

MONTH 3 YEAR 74 DAYS ANALYZED 31 PARAMETER # 1

HOUR	MIN	AVG	MAX
1	0.00	12.14	31.50
2	0.00	11.95	29.20
3	0.00	11.65	29.70
4	0.00	12.03	32.10
5	0.00	12.43	29.20
6	0.00	12.10	28.10
7	0.00	12.12	28.10
8	0.00	11.80	27.20
9	0.00	12.32	35.30
10	0.00	11.77	35.00
11	0.00	11.89	33.30
12	3.30	12.09	32.10
13	3.60	12.83	31.50
14	0.00	12.25	30.60
15	0.00	12.09	28.10
16	0.00	12.14	26.60
17	0.00	12.33	29.00
18	0.00	12.43	31.70
19	0.00	11.44	29.70
20	0.00	10.94	28.80
21	0.00	10.68	29.50
22	0.00	10.59	30.60
23	0.00	11.10	30.40
24	0.00	11.09	30.10

SUMMARY 0.00 11.84 35.30

NUMBER OF OBSERVATIONS 744

## Palisades

MONTH 3 YEAR 74 DAYS ANALYZED 31 PARAMETER # 3

HR	MIN	AVG	MAX
1	0.00	3.93	18.80
2	0.00	4.08	17.60
3	0.00	3.71	18.00
4	0.00	3.88	18.30
5	0.00	3.99	18.20
6	0.00	4.22	17.00
7	0.00	4.23	15.30
8	0.00	4.47	16.20
9	0.00	4.51	17.30
10	0.00	4.51	19.20
11	0.00	4.90	20.40
12	0.00	5.45	21.90
13	0.00	5.25	20.10
14	0.00	5.11	18.70
15	0.00	4.86	19.10
16	0.00	4.93	19.50
17	0.00	4.57	18.90
18	0.00	4.24	17.70
19	0.00	4.48	15.00
20	0.00	4.74	15.30
21	0.00	4.71	16.30
22	0.00	4.21	16.90
23	0.00	3.86	15.00
24	0.00	3.60	15.50

SUMMARY 0.00 4.44 21.90

NUMBER OF OBSERVATIONS 744

## Palisades

MONTH 3 YEAR 74 DAYS ANALYZED 31 PARAMETER # 4

HR	MIN	AVG	MAX
1	-8.80	2.05	16.10
2	-8.20	1.95	16.10
3	-11.60	1.58	16.50
4	-12.50	1.40	16.40
5	-13.30	1.13	16.50
6	-13.60	0.89	16.50
7	-13.50	0.75	16.80
8	-13.70	0.57	16.70
9	-12.90	0.47	16.40
10	-11.10	0.76	16.60
11	-10.00	1.35	17.80
12	-10.60	1.99	19.00
13	-10.80	2.98	20.80
14	-10.90	3.72	20.50
15	-11.10	4.45	20.50
16	-10.80	4.80	19.10
17	-10.60	5.02	18.80
18	-10.30	4.50	16.90
19	-10.40	3.96	17.60
20	-10.40	3.38	16.60
21	-10.50	2.64	15.90
22	-10.10	2.41	15.00
23	-9.40	2.20	14.70
24	-9.10	2.07	14.70

SUMMARY -13.70 2.38 20.80

NUMBER OF OBSERVATIONS 744

# Palisades

MONTH 3 YEAR 74 DAYS ANALYZED 31 PARAMETER # 5

HOUR	MIN	AVG	MAX
1	-0.92	-0.11	1.50
2	-1.74	-0.21	1.16
3	-0.90	-0.13	1.35
4	-0.95	-0.14	0.94
5	-0.87	-0.14	0.70
6	-0.91	-0.14	0.58
7	-1.01	-0.12	0.81
8	-0.92	-0.10	0.59
9	-0.91	-0.13	0.69
10	-1.19	-0.15	0.73
11	-1.31	-0.18	0.66
12	-1.37	-0.14	1.86
13	-1.48	-0.49	0.25
14	-1.93	-0.72	0.19
15	-2.17	-0.86	0.29
16	-2.32	-0.89	0.80
17	-2.33	-1.02	0.21
18	-2.22	-0.88	0.14
19	-1.89	-0.59	0.17
20	-1.21	-0.39	0.18
21	-0.84	-0.17	0.40
22	-0.86	-0.10	0.41
23	-1.01	-0.12	0.54
24	-0.88	-0.10	0.94

SUMMARY	-2.33	-0.33	1.86
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NUMBER OF OBSERVATIONS 744

# Palisades

MONTH 4 YEAR 74 DAYS ANALYZED 30 PARAMETER # 1

HOUR	MIN	AVG	MAX
1	2.70	10.62	27.70
2	3.60	11.07	25.20
3	1.60	11.13	25.20
4	3.30	11.40	25.00
5	4.70	11.56	27.20
6	3.30	12.22	24.10
7	1.60	12.70	30.80
8	1.30	12.85	34.40
9	2.70	12.27	32.80
10	3.10	12.27	29.90
11	3.80	12.41	29.90
12	4.00	12.21	27.90
13	5.10	12.36	27.90
14	3.30	12.97	29.50
15	3.10	13.95	28.10
16	4.00	13.76	31.20
17	4.00	13.67	33.50
18	4.50	12.38	31.20
19	4.20	11.65	34.40
20	3.30	10.12	33.30
21	2.00	9.51	30.40
22	2.00	9.71	28.60
23	2.70	9.91	25.70
24	3.80	10.28	25.90

SUMMARY 1.30 11.79 34.40

NUMBER OF OBSERVATIONS 715

## Palisades

MONTH 4 YEAR 74 DAYS ANALYZED 30 PARAMETER # 3

HOUR	MIN	AVG	MAX
1	0.00	6.36	18.30
2	0.00	6.26	19.60
3	0.00	6.49	17.40
4	0.00	6.40	18.00
5	0.00	6.12	19.00
6	0.00	5.84	18.90
7	0.00	5.04	17.70
8	0.00	4.89	17.20
9	0.00	5.05	15.90
10	0.00	5.64	14.80
11	0.00	5.98	16.70
12	0.00	6.45	17.60
13	0.00	6.57	19.10
14	0.00	6.95	19.20
15	0.00	6.35	15.20
16	0.00	6.20	15.60
17	0.00	6.85	19.00
18	0.00	7.23	18.00
19	0.00	7.12	18.60
20	0.00	6.91	16.60
21	0.00	7.05	17.40
22	0.00	6.61	16.00
23	0.00	6.21	16.30
24	0.00	6.05	18.80

SUMMARY 0.00 6.28 19.60

NUMBER OF OBSERVATIONS 720

## Palisades

MONTH 4 YEAR 74 DAYS ANALYZED 30 PARAMETER # 4

HOUR	MIN	AVG	MAX
1	-3.50	8.62	22.30
2	-3.60	8.35	21.40
3	-4.40	8.01	20.30
4	-5.20	7.82	21.10
5	-5.10	7.71	21.10
6	-5.30	7.42	21.00
7	-5.90	6.82	20.50
8	-6.60	6.56	19.80
9	-4.00	7.25	19.80
10	-1.70	8.74	19.90
11	-0.10	9.51	22.00
12	0.40	9.81	23.30
13	1.30	10.30	24.30
14	1.90	11.52	25.20
15	2.10	12.14	26.00
16	2.40	12.58	26.40
17	2.10	12.62	26.00
18	2.50	12.77	27.90
19	2.10	12.05	26.00
20	1.40	11.41	24.60
21	-0.10	10.49	24.10
22	-1.70	9.66	23.30
23	-1.10	9.22	22.40
24	-1.70	8.96	22.40

SUMMARY -6.60 9.60 27.90

NUMBER OF OBSERVATIONS 720

E-30



Palisades

MONTH 4 YEAR 74 DAYS ANALYZED 30 PARAMETER # 5

HOUR	MIN	AVG	MAX
1	-0.87	0.12	1.81
2	-0.86	0.14	1.57
3	-0.86	0.18	1.97
4	-0.80	0.16	1.46
5	-0.90	0.12	1.21
6	-0.73	0.17	1.43
7	-0.79	0.17	1.53
8	-0.58	0.28	1.90
9	-0.57	0.30	1.68
10	-0.87	-0.07	0.77
11	-1.20	-0.14	0.63
12	-0.81	0.06	1.05
13	-1.12	-0.20	0.65
14	-1.60	-0.44	0.44
15	-2.06	-0.68	0.40
16	-2.58	-0.78	0.26
17	-2.74	-0.77	0.39
18	-2.63	-0.68	0.48
19	-2.22	-0.45	0.50
20	-1.43	-0.31	0.70
21	-0.84	-0.06	0.66
22	-0.80	0.16	1.19
23	-1.08	0.12	1.28
24	-1.38	0.13	1.64

SUMMARY -2.74 -0.10 1.97

NUMBER OF OBSERVATIONS 720

# Palisades

MONTH 5 YEAR 74 DAYS ANALYZED 31 PARAMETER # 1

HOUR	MIN	AVG	MAX
1	2.90	9.73	26.30
2	3.10	9.62	26.10
3	2.90	10.51	24.30
4	2.00	10.45	27.20
5	2.20	10.76	23.20
6	3.60	10.93	21.70
7	3.60	10.87	21.00
8	1.30	11.74	27.50
9	0.90	12.27	28.80
10	2.20	11.59	24.30
11	2.90	11.96	22.30
12	2.50	12.48	25.70
13	1.60	12.23	27.50
14	3.60	11.47	28.10
15	2.70	10.67	28.80
16	2.50	9.80	23.00
17	0.40	9.38	22.30
18	1.80	8.36	26.10
19	2.20	7.84	19.90
20	0.90	7.28	21.00
21	1.30	7.47	24.60
22	2.00	7.94	23.90
23	1.10	8.38	24.80
24	2.70	9.28	26.60

SUMMARY 0.40 10.12 28.80

NUMBER OF OBSERVATIONS 712

## Palisades

MONTH 5 YEAR 74 DAYS ANALYZED 31 PARAMETER # 3

HOUR	MIN	AVG	MAX
1	0.00	5.93	16.20
2	0.00	5.72	16.60
3	0.00	5.20	13.70
4	0.00	4.68	12.30
5	0.00	4.68	12.70
6	0.00	4.62	18.40
7	0.00	4.67	16.50
8	0.00	5.21	18.20
9	0.00	4.97	18.80
10	0.00	5.15	17.50
11	0.00	4.89	14.90
12	0.00	4.94	14.40
13	0.00	5.67	15.70
14	0.00	5.89	15.70
15	0.00	5.83	16.30
16	0.00	6.38	16.20
17	0.00	6.02	16.70
18	0.00	6.40	16.50
19	0.00	5.95	16.00
20	0.00	5.38	15.30
21	0.00	5.33	16.00
22	0.00	5.77	17.40
23	0.00	6.62	19.40
24	0.00	6.34	16.00

SUMMARY 0.00 5.51 19.40

NUMBER OF OBSERVATIONS 712

## Palisades

MONTH 5 YEAR 74 DAYS ANALYZED 31 PARAMETER # 4

HOUR	MIN	AVG	MAX
1	3.10	11.50	20.10
2	3.00	11.20	18.80
3	3.00	10.90	19.60
4	2.80	10.01	18.50
5	2.40	9.78	18.70
6	2.30	9.74	20.00
7	1.10	9.59	19.80
8	-0.80	9.75	19.00
9	2.00	10.60	20.00
10	2.80	11.96	21.00
11	3.10	13.08	25.70
12	3.30	13.30	27.50
13	4.20	14.02	27.80
14	4.40	14.30	23.90
15	4.50	14.94	25.60
16	4.40	15.83	27.80
17	4.60	15.81	28.80
18	4.60	15.17	25.80
19	4.40	14.57	26.60
20	4.40	14.13	25.50
21	4.30	13.40	24.70
22	4.00	12.44	23.50
23	3.60	12.27	23.60
24	3.50	12.12	22.30

SUMMARY -0.80 12.54 28.80

NUMBER OF OBSERVATIONS 712

Palisades

MONTH 5 YEAR 74 DAYS ANALYZED 31 PARAMETER # 5

HOUR	MIN	AVG	MAX
1	-2.54	1.01	2.95
2	-5.14	1.13	2.95
3	-0.59	1.28	2.77
4	-0.21	1.32	2.90
5	-2.40	1.22	3.06
6	-1.02	1.29	3.59
7	-1.42	1.22	3.68
8	-5.16	0.81	4.18
9	-5.16	0.74	4.40
10	-5.16	0.56	3.26
11	-5.16	0.14	2.51
12	-5.16	-0.06	2.34
13	-5.16	-0.38	1.79
14	-5.16	-0.40	2.06
15	-5.16	-0.52	1.94
16	-5.16	-0.97	1.43
17	-5.16	-1.10	2.15
18	-5.16	-0.92	2.87
19	-5.16	-0.54	2.79
20	-5.16	-0.66	2.08
21	-5.16	-0.60	2.26
22	-5.16	-0.15	2.79
23	-5.16	-0.01	2.80
24	-5.16	0.24	3.19

SUMMARY -5.16 0.18 4.40

NUMBER OF OBSERVATIONS 712

Palisades

MONTH 6 YEAR 74 DAYS ANALYZED 30 PARAMETER # 1

HOUR	MIN	AVG	MAX
1	1.80	8.21	25.70
2	2.00	7.99	21.40
3	1.10	8.02	23.00
4	2.70	7.63	23.20
5	1.10	7.68	23.70
6	2.50	7.95	21.40
7	2.00	7.90	24.60
8	2.70	7.86	26.10
9	2.70	7.77	25.70
10	2.20	7.90	22.80
11	3.10	8.53	25.40
12	2.90	9.00	28.30
13	4.20	9.35	26.30
14	3.60	9.45	26.30
15	4.90	9.61	26.10
16	3.10	9.18	24.10
17	4.20	9.16	21.40
18	1.30	8.09	25.40
19	1.80	7.55	25.70
20	2.00	6.72	20.10
21	0.90	6.54	20.30
22	1.30	7.19	25.40
23	1.80	8.33	26.60
24	2.50	8.48	23.20

SUMMARY	0.90	8.17	28.30
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NUMBER OF OBSERVATIONS 720

## Palisades

MONTH 6 YEAR 74 DAYS ANALYZED 30 PARAMETER # 3

HOUR	MIN	AVG	MAX
1	0.10	4.69	19.50
2	0.10	5.26	21.00
3	0.00	5.16	23.40
4	0.00	5.53	22.60
5	0.10	5.45	19.20
6	0.10	5.59	18.80
7	0.10	5.06	14.90
8	0.10	4.50	13.80
9	0.10	4.72	16.20
10	0.10	4.96	15.40
11	0.20	5.17	14.00
12	0.10	4.76	14.00
13	0.10	4.90	14.00
14	0.10	4.89	12.10
15	0.10	4.84	14.20
16	0.10	5.00	12.40
17	0.10	4.99	12.80
18	0.10	5.05	13.10
19	0.10	5.40	13.50
20	0.10	5.40	13.80
21	0.10	5.27	14.80
22	0.00	5.51	14.30
23	0.00	5.80	15.00
24	0.10	5.23	15.10

SUMMARY 0.00 5.13 23.40

NUMBER OF OBSERVATIONS 720

## Palisades

MONTH 6 YEAR 74 DAYS ANALYZED 30 PARAMETER # 4

HOUR	MIN	AVG	MAX
1	11.30	16.07	23.20
2	10.90	15.93	23.40
3	10.40	15.85	23.90
4	10.40	15.75	24.30
5	10.30	15.36	23.30
6	10.20	15.04	22.50
7	9.30	14.66	21.20
8	9.40	14.75	21.60
9	10.70	15.57	22.20
10	11.40	16.81	22.80
11	11.60	18.03	24.30
12	11.00	18.87	25.90
13	10.90	19.47	26.90
14	11.10	19.95	27.70
15	10.70	20.41	29.20
16	10.60	21.79	32.30
17	10.80	21.58	30.50
18	10.80	20.72	30.90
19	10.70	19.99	30.60
20	11.00	19.48	29.70
21	11.30	18.81	28.30
22	11.40	17.90	27.70
23	11.50	16.88	24.20
24	11.80	16.60	24.80

SUMMARY 9.30 17.76 32.30

NUMBER OF OBSERVATIONS 720

# Palisades

MONTH 6 YEAR 74 DAYS ANALYZED 30 PARAMETER # 5

HOUR	MIN	AVG	MAX
1	-5.16	-5.16	-5.16
2	-5.16	-5.16	-5.16
3	-5.16	-5.16	-5.16
4	-5.16	-5.16	-5.14
5	-5.16	-5.16	-5.16
6	-5.16	-5.16	-5.14
7	-5.16	-5.16	-5.14
8	-5.16	-5.16	-5.14
9	-5.16	-5.16	-5.16
10	-5.16	-5.16	-5.16
11	-5.16	-5.16	-5.16
12	-5.16	-5.16	-5.14
13	-5.17	-5.16	-5.16
14	-5.17	-5.16	-5.16
15	-5.17	-5.16	-5.16
16	-5.17	-5.16	-5.14
17	-5.17	-5.16	-5.16
18	-5.17	-5.16	-5.16
19	-5.17	-5.16	-5.16
20	-5.17	-5.16	-5.16
21	-5.17	-5.16	-5.16
22	-5.17	-5.16	-5.16
23	-5.16	-5.16	-5.16
24	-5.16	-5.16	-5.16

SUMMARY -5.17 -5.16 -5.14

NUMBER OF OBSERVATIONS 720

# Palisades

MONTH 7 YEAR 74 DAYS ANALYZED 31 PARAMETER # 1

HOUR	MIN	AVG	MAX
1	2.70	6.92	13.20
2	2.90	7.70	12.10
3	3.30	8.69	15.60
4	2.70	9.24	17.60
5	2.50	9.46	18.30
6	1.30	9.55	19.40
7	2.00	9.64	22.50
8	2.50	9.39	19.90
9	2.90	8.81	21.20
10	2.90	8.58	21.40
11	3.10	8.72	21.20
12	2.90	8.48	21.00
13	2.50	8.41	19.20
14	2.70	8.66	20.10
15	3.30	8.17	16.50
16	3.80	7.68	13.60
17	2.50	7.11	13.60
18	2.20	6.82	13.80
19	1.60	6.18	13.40
20	0.40	5.39	12.90
21	0.40	5.32	12.70
22	0.40	5.18	11.20
23	3.30	5.74	9.20
24	2.20	6.21	11.40

SUMMARY 0.40 7.73 22.50

NUMBER OF OBSERVATIONS 679



Palisades

MONTH 7 YEAR 74 DAYS ANALYZED 31 PARAMETER # 3

HOUR	MIN	AVG	MAX
1	0.30	6.83	19.70
2	0.30	6.60	20.00
3	0.60	6.75	19.20
4	1.70	7.05	18.10
5	1.40	7.03	18.30
6	1.80	7.63	18.70
7	0.80	6.88	18.40
8	0.90	6.58	15.60
9	1.20	7.33	17.10
10	2.20	7.72	18.60
11	2.20	7.48	16.00
12	2.20	7.49	16.00
13	2.10	7.01	14.90
14	1.30	6.85	15.10
15	1.90	6.70	16.40
16	1.70	6.43	13.00
17	2.00	6.53	13.70
18	1.90	6.42	12.50
19	1.60	6.67	18.20
20	0.40	6.60	17.40
21	0.70	6.12	18.10
22	0.30	5.54	15.60
23	0.40	5.90	17.10
24	0.50	6.01	18.40

SUMMARY 0.30 6.75 20.00

NUMBER OF OBSERVATIONS 679

Palisades

MONTH 7 YEAR 74 DAYS ANALYZED 31 PARAMETER # 4

HOUR	MIN	AVG	MAX
1	15.70	21.03	29.40
2	15.10	20.53	29.10
3	14.80	20.29	27.40
4	14.30	20.15	27.10
5	13.60	19.91	26.80
6	12.70	19.59	26.40
7	11.80	19.21	25.90
8	11.80	19.05	25.70
9	13.60	19.78	25.80
10	16.70	21.16	27.10
11	17.40	22.55	27.50
12	17.60	23.02	27.60
13	17.70	23.73	28.20
14	18.20	24.18	29.70
15	17.50	24.79	31.20
16	17.50	26.53	32.70
17	17.40	27.19	33.40
18	3.20	25.26	34.80
19	17.60	25.32	33.80
20	17.90	24.80	32.90
21	18.00	23.84	31.80
22	17.80	22.42	31.00
23	16.70	21.63	30.20
24	16.00	21.21	29.60

SUMMARY 3.20 22.39 34.80

NUMBER OF OBSERVATIONS 679

Palisades

MONTH 7 YEAR 74 DAYS ANALYZED 31 PARAMETER # 5

HOUR	MIN	AVG	MAX
1	-5.17	-5.16	-5.16
2	-5.17	-5.16	-5.16
3	-5.17	-5.16	-5.16
4	-5.17	-5.16	-5.16
5	-5.17	-5.16	-5.16
6	-5.16	-5.16	-5.16
7	-5.16	-5.16	-5.16
8	-5.16	-5.16	-5.16
9	-5.16	-5.16	-5.16
10	-5.17	-5.16	-5.16
11	-5.17	-5.16	-5.16
12	-5.17	-5.16	-5.16
13	-5.17	-5.16	-5.16
14	-5.17	-5.16	-5.16
15	-5.17	-5.16	-5.16
16	-5.17	-5.17	-5.16
17	-5.17	-5.17	-5.16
18	-5.17	-5.16	-5.14
19	-5.17	-5.16	-5.16
20	-5.17	-5.16	-5.16
21	-5.17	-5.16	-5.16
22	-5.17	-5.16	-5.16
23	-5.17	-5.16	-5.16
24	-5.17	-5.16	-5.16

SUMMARY -5.17 -5.16 -5.14

NUMBER OF OBSERVATIONS 679

Palisades

MONTH 8 YEAR 74 DAYS ANALYZED 31 PARAMETER # 1

HOUR	MIN	AVG	MAX
1	3.30	6.91	13.40
2	2.90	7.48	12.50
3	1.80	8.02	14.50
4	2.90	7.91	16.50
5	2.50	8.24	19.60
6	1.80	8.47	22.80
7	3.10	8.64	21.00
8	3.60	8.26	18.50
9	3.10	8.18	19.00
10	2.00	8.47	22.80
11	2.20	8.10	24.10
12	3.30	8.50	22.10
13	3.60	9.06	23.00
14	4.20	9.03	21.20
15	3.80	8.99	20.80
16	3.60	8.92	17.60
17	4.90	9.09	16.50
18	3.60	8.55	21.90
19	1.30	8.68	22.10
20	2.00	7.83	19.90
21	2.70	6.26	20.30
22	1.30	5.79	18.10
23	0.70	5.46	11.80
24	2.70	6.15	10.30

SUMMARY	0.70	7.96	24.10
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NUMBER OF OBSERVATIONS 744

Palisades

MONTH 8 YEAR 74 DAYS ANALYZED 31 PARAMETER # 3

HOUR	MIN	AVG	MAX
1	0.00	6.86	19.90
2	0.00	6.95	18.80
3	0.00	6.97	17.40
4	0.00	7.01	17.70
5	0.00	6.86	16.40
6	0.00	6.72	15.30
7	0.00	6.62	13.90
8	0.00	6.69	13.20
9	0.00	7.01	14.50
10	0.00	6.64	13.80
11	0.00	7.32	17.60
12	0.00	7.56	17.90
13	0.00	6.93	16.80
14	0.00	7.08	17.20
15	0.00	6.41	17.40
16	0.00	6.45	17.00
17	0.00	6.73	16.10
18	0.00	6.87	14.00
19	0.00	7.38	16.40
20	0.00	7.52	16.70
21	0.00	7.17	15.30
22	0.00	7.22	17.50
23	0.00	7.52	19.50
24	0.00	7.06	20.20

SUMMARY 0.00 6.98 20.20

NUMBER OF OBSERVATIONS 744

Palisades

MONTH 8 YEAR 74 DAYS ANALYZED 31 PARAMETER # 4

HOUR	MIN	AVG	MAX
1	14.40	20.54	25.90
2	14.90	20.03	26.20
3	14.30	19.67	26.20
4	13.60	19.22	25.10
5	13.40	18.85	24.70
6	13.10	18.47	24.30
7	12.90	18.18	23.90
8	12.50	18.03	23.20
9	12.30	17.85	22.60
10	12.50	18.20	22.30
11	13.70	19.61	22.90
12	16.00	21.43	25.50
13	17.80	22.52	27.10
14	18.60	23.40	27.50
15	19.10	24.19	28.10
16	20.60	25.15	29.20
17	19.80	25.90	30.90
18	20.20	26.90	33.40
19	17.00	25.80	31.00
20	11.40	24.28	30.30
21	18.50	23.90	30.10
22	18.00	22.96	28.90
23	17.50	21.59	27.90
24	15.20	20.85	26.90

SUMMARY 11.40 21.56 33.40

NUMBER OF OBSERVATIONS 744

# Palisades

MONTH 8 YEAR 74 DAYS ANALYZED 31 PARAMETER # 5

HOUR	MIN	AVG	MAX
1	-5.16	-5.16	-5.16
2	-5.16	-5.16	-5.16
3	-5.16	-5.16	-5.16
4	-5.16	-5.16	-5.16
5	-5.16	-5.16	-5.16
6	-5.16	-5.16	-5.16
7	-5.16	-5.16	-5.16
8	-5.16	-5.16	-5.16
9	-5.16	-5.16	-5.16
10	-5.16	-5.16	-5.16
11	-5.16	-5.16	-5.16
12	-5.16	-5.16	-5.16
13	-5.17	-5.16	-5.16
14	-5.17	-5.16	-5.16
15	-5.17	-5.16	-5.16
16	-5.17	-5.16	-5.16
17	-5.17	-5.17	-5.16
18	-5.17	-5.17	-5.16
19	-5.17	-5.07	-2.32
20	-5.17	-4.97	0.72
21	-5.17	-5.15	-4.92
22	-5.17	-5.16	-5.16
23	-5.17	-5.16	-5.16
24	-5.17	-5.16	-5.16

SUMMARY -5.17 -5.15 0.72

NUMBER OF OBSERVATIONS 744

Palisades

MONTH 9 YEAR 74 DAYS ANALYZED 30 PARAMETER # 1

HOUR	MIN	AVG	MAX
1	3.60	8.11	24.30
2	3.60	8.04	24.30
3	2.90	7.80	24.30
4	3.60	8.74	25.40
5	2.50	10.62	33.90
6	3.10	11.07	37.90
7	2.70	11.61	38.40
8	3.60	12.01	39.50
9	4.00	12.01	41.70
10	3.30	11.99	39.10
11	2.70	11.66	37.30
12	2.50	10.95	34.80
13	2.00	10.64	32.80
14	3.30	10.96	31.20
15	2.00	10.82	29.50
16	2.20	10.40	26.30
17	0.70	9.65	25.00
18	2.20	8.76	24.60
19	2.00	7.91	26.10
20	1.60	7.21	24.60
21	2.00	7.32	25.20
22	4.00	8.13	24.60
23	2.50	8.11	23.00
24	3.60	8.23	26.10

SUMMARY 0.70 9.70 41.70

NUMBER OF OBSERVATIONS 720

## Palisades

MONTH 9 YEAR 74 DAYS ANALYZED 30 PARAMETER # 3

HOUR	MIN	AVG	MAX
1	0.00	1.73	12.90
2	0.00	1.58	11.70
3	0.00	1.36	10.40
4	0.00	1.00	11.50
5	0.00	1.21	13.30
6	0.00	1.19	13.20
7	0.00	1.28	14.20
8	0.00	1.08	12.30
9	0.00	1.07	11.70
10	0.00	1.01	11.20
11	0.00	1.01	11.50
12	0.00	1.04	12.10
13	0.00	1.14	11.50
14	0.00	1.11	10.80
15	0.00	1.04	11.40
16	0.00	1.21	13.30
17	0.00	1.25	12.50
18	0.00	1.35	13.00
19	0.00	1.70	14.60
20	0.00	2.05	17.00
21	0.00	2.15	17.60
22	0.00	2.05	16.30
23	0.00	2.28	18.90
24	0.00	1.84	12.50

SUMMARY 0.00 1.40 18.90

NUMBER OF OBSERVATIONS 720

## Palisades

MONTH 9 YEAR 74 DAYS ANALYZED 30 PARAMETER # 4

HOUR	MIN	AVG	MAX
1	7.30	14.57	22.20
2	5.70	14.10	21.60
3	5.30	13.82	21.40
4	5.10	13.67	21.00
5	4.80	13.68	21.20
6	4.10	13.40	22.00
7	4.10	13.06	22.30
8	4.20	12.87	22.30
9	4.10	12.85	21.50
10	4.90	13.72	22.20
11	6.50	15.23	23.70
12	8.30	16.38	24.60
13	9.70	17.37	25.80
14	9.70	18.62	28.90
15	9.70	20.07	30.80
16	9.70	20.91	30.40
17	9.80	21.33	31.40
18	9.80	20.65	28.00
19	9.60	19.12	26.90
20	8.80	17.91	26.10
21	7.70	16.28	24.90
22	6.30	15.25	24.00
23	6.40	14.96	23.40
24	7.90	14.68	23.10

SUMMARY 4.10 16.02 31.40

NUMBER OF OBSERVATIONS 720

Palisades

MONTH 9 YEAR 74 DAYS ANALYZED 30 PARAMETER # 5

HOUR	MIN	AVG	MAX
1	-5.16	-5.16	-5.14
2	-5.16	-5.16	-5.14
3	-5.16	-5.16	-5.14
4	-5.16	-5.16	-5.14
5	-5.16	-5.15	-5.14
6	-5.16	-5.15	-5.14
7	-5.16	-5.15	-5.14
8	-5.16	-5.15	-5.14
9	-5.16	-5.15	-5.14
10	-5.16	-5.16	-5.14
11	-5.16	-5.16	-5.14
12	-5.16	-5.16	-5.14
13	-5.17	-5.16	-5.14
14	-5.17	-5.16	-5.14
15	-5.17	-5.16	-5.14
16	-5.17	-5.16	-5.14
17	-5.17	-5.16	-5.14
18	-5.17	-5.16	-5.14
19	-5.17	-5.16	-5.14
20	-5.16	-5.16	-5.14
21	-5.16	-5.16	-5.14
22	-5.16	-5.16	-5.14
23	-5.16	-5.16	-5.14
24	-5.16	-5.16	-5.14

SUMMARY -5.17 -5.16 -5.14

NUMBER OF OBSERVATIONS 720



# Palisades

MONTH 10 YEAR 74 DAYS ANALYZED 31 PARAMETER # 1

HOUR	MIN	AVG	MAX
1	3.10	10.50	33.90
2	2.20	10.57	30.10
3	2.50	10.15	26.80
4	2.90	9.84	25.00
5	3.60	10.08	22.50
6	3.80	10.26	25.40
7	3.60	10.06	25.90
8	3.80	9.59	23.40
9	3.60	9.73	30.40
10	2.50	9.91	35.50
11	2.70	10.20	35.90
12	2.00	10.25	24.30
13	2.90	9.98	23.40
14	2.50	10.20	25.90
15	2.20	10.90	28.80
16	1.60	10.99	32.80
17	2.90	10.55	35.50
18	2.20	10.13	35.00
19	2.20	9.38	29.50
20	1.80	9.21	30.80
21	2.70	8.91	29.50
22	3.60	9.75	32.40
23	2.50	10.21	32.80
24	2.90	10.13	35.30

SUMMARY 1.60 10.06 35.90

NUMBER OF OBSERVATIONS 744

Palisades

MONTH 10 YEAR 74 DAYS ANALYZED 31 PARAMETER # 3

HOUR	MIN	AVG	MAX
1	0.00	0.31	4.20
2	0.00	0.25	3.80
3	0.00	0.28	4.10
4	0.00	0.25	3.10
5	0.00	0.24	2.30
6	0.00	0.20	2.40
7	0.00	0.19	2.30
8	0.00	0.19	1.90
9	0.00	0.21	2.10
10	0.00	0.21	2.60
11	0.00	0.28	2.30
12	0.00	0.43	3.60
13	0.00	0.32	2.60
14	0.00	0.28	3.00
15	0.00	0.23	2.60
16	0.00	0.21	1.80
17	0.00	0.22	1.50
18	0.00	0.17	1.40
19	0.00	0.17	1.40
20	0.00	0.24	2.00
21	0.00	0.18	1.20
22	0.00	0.25	2.50
23	0.00	0.20	2.00
24	0.00	0.25	2.40

SUMMARY 0.00 0.24 4.20

NUMBER OF OBSERVATIONS 744

Palisades

MONTH 10 YEAR 74 DAYS ANALYZED 31 PARAMETER # 4

HOUR	MIN	AVG	MAX
1	-0.60	10.63	19.30
2	-1.00	10.33	18.80
3	-1.60	10.12	18.30
4	-1.80	10.02	18.40
5	-1.70	9.76	18.30
6	-1.10	9.58	18.30
7	-0.90	9.40	18.50
8	-1.30	9.14	18.50
9	-1.20	8.97	17.90
10	-0.40	9.67	18.10
11	0.80	11.12	19.20
12	2.20	12.59	21.10
13	3.80	13.73	22.60
14	3.90	14.81	24.80
15	1.90	15.60	26.20
16	0.90	16.00	26.40
17	1.40	15.86	26.10
18	1.70	15.12	25.20
19	1.70	14.06	23.70
20	1.50	12.83	22.80
21	1.30	12.23	21.90
22	1.30	11.79	21.70
23	1.40	11.45	21.90
24	0.40	11.18	22.30

SUMMARY -1.80 11.92 26.40

NUMBER OF OBSERVATIONS 744

Palisades

MONTH 10 YEAR 74 DAYS ANALYZED 31 PARAMETER # 5

HOUR	MIN	AVG	MAX
1	-5.16	-5.15	-5.14
2	-5.16	-5.15	-5.14
3	-5.16	-5.15	-5.14
4	-5.16	-5.15	-5.14
5	-5.16	-5.15	-5.14
6	-5.16	-5.15	-5.14
7	-5.16	-5.15	-5.14
8	-5.16	-5.15	-5.14
9	-5.16	-5.15	-5.14
10	-5.16	-5.15	-5.14
11	-5.16	-5.15	-5.14
12	-5.16	-5.15	-5.14
13	-5.16	-5.16	-5.14
14	-5.16	-5.16	-5.14
15	-5.17	-5.16	-5.14
16	-5.17	-5.16	-5.14
17	-5.17	-5.16	-5.14
18	-5.16	-5.16	-5.14
19	-5.16	-5.16	-5.14
20	-5.16	-5.15	-5.14
21	-5.16	-5.15	-5.14
22	-5.16	-5.15	-5.14
23	-5.16	-5.15	-5.14
24	-5.16	-5.15	-5.14

SUMMARY -5.17 -5.15 -5.14

NUMBER OF OBSERVATIONS 744

# Palisades

MONTH 11 YEAR 74 DAYS ANALYZED 30 PARAMETER # 1

HOUR	MIN	AVG	MAX
1	3.80	13.82	40.00
2	3.60	13.57	38.80
3	3.60	14.38	38.40
4	4.00	14.06	39.10
5	4.50	14.07	39.30
6	3.60	13.86	40.40
7	4.00	13.83	38.60
8	2.70	13.22	37.70
9	2.90	12.40	36.40
10	3.30	12.97	37.70
11	2.70	13.25	37.30
12	4.50	13.73	37.10
13	3.60	14.48	37.10
14	3.30	13.43	38.40
15	3.30	13.13	36.80
16	2.20	13.38	38.20
17	2.70	13.06	38.60
18	3.10	12.78	38.40
19	1.80	12.32	39.70
20	2.50	12.42	40.40
21	2.50	12.69	40.60
22	3.30	13.15	38.40
23	3.80	13.17	40.80
24	4.50	13.22	38.80

SUMMARY	1.80	13.35	40.80
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NUMBER OF OBSERVATIONS 720

## Palisades

MONTH 11 YEAR 74 DAYS ANALYZED 30 PARAMETER # 3

HOUR	MIN	AVG	MAX
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1	0.00	0.05	0.80
2	0.00	0.05	0.80
3	0.00	0.07	1.00
4	0.00	0.06	0.60
5	0.00	0.06	0.70
6	0.00	0.06	0.60
7	0.00	0.12	1.50
8	0.00	0.17	2.70
9	0.00	0.15	2.80
10	0.00	0.10	2.40
11	0.00	0.17	4.30
12	0.00	0.20	5.10
13	0.00	0.32	4.70
14	0.00	0.27	6.70
15	0.00	0.36	9.30
16	0.00	0.35	9.10
17	0.00	0.24	6.10
18	0.00	0.21	5.30
19	0.00	0.24	6.60
20	0.00	0.29	8.20
21	0.00	0.35	10.10
22	0.00	0.37	10.90
23	0.00	0.43	12.40
24	0.00	0.22	5.80

SUMMARY 0.00 0.20 12.40

NUMBER OF OBSERVATIONS 720

## Palisades

MONTH 11 YEAR 74 DAYS ANALYZED 30 PARAMETER # 4

HOUR	MIN	AVG	MAX
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1	-7.00	6.40	22.60
2	-7.60	6.24	22.40
3	-7.90	6.14	22.80
4	-8.40	5.76	20.60
5	-9.00	5.45	20.50
6	-9.40	5.28	18.90
7	-10.00	5.16	18.30
8	-10.20	4.98	17.30
9	-9.10	4.94	16.50
10	-7.70	5.22	16.90
11	-5.30	6.06	17.70
12	-2.70	7.13	18.40
13	-1.10	7.61	19.60
14	-0.70	7.81	21.40
15	0.30	8.01	22.20
16	0.00	8.01	22.10
17	-0.30	7.79	22.90
18	-0.80	7.13	22.40
19	-1.30	6.47	20.20
20	-1.90	6.12	19.50
21	-2.90	5.91	19.10
22	-3.30	5.81	18.40
23	-4.40	5.68	17.00
24	-6.20	5.65	17.30

SUMMARY -10.20 6.28 22.90

NUMBER OF OBSERVATIONS 720

Palisades

MONTH 11 YEAR 74 DAYS ANALYZED 30 PARAMETER # 5

HOUR	MIN	AVG	MAX
1	-5.16	-5.14	-5.13
2	-5.16	-5.14	-5.13
3	-5.16	-5.14	-5.13
4	-5.16	-5.14	-5.13
5	-5.16	-5.14	-5.13
6	-5.16	-5.14	-5.13
7	-5.16	-5.14	-5.13
8	-5.16	-5.14	-5.13
9	-5.16	-5.14	-5.13
10	-5.16	-5.14	-5.13
11	-5.16	-5.15	-5.14
12	-5.16	-5.15	-5.14
13	-5.16	-5.15	-5.14
14	-5.16	-5.15	-5.14
15	-5.16	-5.15	-5.14
16	-5.16	-5.15	-5.14
17	-5.16	-5.15	-5.14
18	-5.16	-5.15	-5.14
19	-5.16	-5.14	-5.14
20	-5.16	-5.14	-5.14
21	-5.16	-5.14	-5.14
22	-5.16	-5.14	-5.14
23	-5.16	-5.14	-5.14
24	-5.16	-5.14	-5.14
SUMMARY	-5.16	-5.14	-5.13

NUMBER OF OBSERVATIONS 720

# Palisades

MONTH 12 YEAR 74 DAYS ANALYZED 31 PARAMETER # 1

HOUR	MIN	AVG	MAX
1	2.20	10.88	25.40
2	2.90	11.12	25.90
3	2.50	10.92	26.10
4	2.90	11.18	27.50
5	4.00	11.51	25.90
6	2.50	11.42	23.00
7	2.50	11.49	24.60
8	4.00	11.83	25.40
9	3.80	12.50	24.10
10	3.10	11.97	23.70
11	2.20	11.35	24.10
12	2.20	10.85	25.00
13	2.90	11.25	24.60
14	2.90	11.84	29.20
15	3.60	11.50	31.00
16	2.50	11.54	37.30
17	2.50	11.33	37.30
18	2.50	11.03	36.40
19	2.00	11.46	35.70
20	3.30	11.48	33.00
21	2.00	11.27	27.70
22	2.50	10.76	25.00
23	1.60	10.64	25.40
24	3.10	11.18	26.10

SUMMARY 1.60 11.35 37.30

NUMBER OF OBSERVATIONS 744

## Palisades

MONTH 12 YEAR 74 DAYS ANALYZED 31 PARAMETER # 3

HOUR	MIN	AVG	MAX
1	0.00	0.00	0.00
2	0.00	0.00	0.00
3	0.00	0.00	0.00
4	0.00	0.00	0.00
5	0.00	0.00	0.00
6	0.00	0.00	0.00
7	0.00	0.00	0.00
8	0.00	0.00	0.00
9	0.00	0.00	0.00
10	0.00	0.00	0.00
11	0.00	0.00	0.00
12	0.00	0.00	0.00
13	0.00	0.03	0.80
14	0.00	0.00	0.00
15	0.00	0.00	0.00
16	0.00	0.00	0.00
17	0.00	0.00	0.00
18	0.00	0.00	0.00
19	0.00	0.00	0.00
20	0.00	0.00	0.00
21	0.00	0.00	0.00
22	0.00	0.00	0.00
23	0.00	0.00	0.00
24	0.00	0.00	0.00

SUMMARY 0.00 0.00 0.80

NUMBER OF OBSERVATIONS 744

## Palisades

MONTH 12 YEAR 74 DAYS ANALYZED 31 PARAMETER # 4

HOUR	MIN	AVG	MAX
1	-3.40	0.55	5.50
2	-3.20	0.63	6.20
3	-2.90	0.60	7.30
4	-3.20	0.50	6.90
5	-4.20	0.51	5.90
6	-4.50	0.45	5.80
7	-5.00	0.13	5.30
8	-6.10	-0.03	4.50
9	-7.20	-0.03	4.70
10	-6.10	0.20	5.10
11	-5.10	0.64	5.30
12	-4.10	1.26	6.30
13	-4.10	1.92	7.40
14	-3.90	2.33	8.50
15	-3.40	2.42	9.00
16	-4.10	2.19	8.30
17	-4.30	1.97	7.40
18	-4.40	1.49	5.50
19	-4.40	1.21	5.00
20	-4.20	1.12	4.80
21	-3.70	1.01	5.00
22	-3.80	0.86	4.70
23	-6.20	0.65	4.10
24	-5.10	0.61	3.90

SUMMARY -7.20 0.97 9.00

NUMBER OF OBSERVATIONS 744



# Palisades

MONTH 12 YEAR 74 DAYS ANALYZED 31 PARAMETER # 5

HOUR	MIN	AVG	MAX
1	-5.14	-5.14	-5.14
2	-5.14	-5.14	-5.14
3	-5.14	-5.14	-5.14
4	-5.14	-5.14	-5.14
5	-5.14	-5.14	-5.14
6	-5.14	-5.14	-5.14
7	-5.14	-5.14	-5.14
8	-5.14	-5.14	-5.14
9	-5.14	-5.14	-5.13
10	-5.14	-5.14	-5.14
11	-5.14	-5.14	-5.14
12	-5.14	-5.14	-5.14
13	-5.14	-5.14	-5.14
14	-5.14	-5.14	-5.14
15	-5.14	-5.14	-5.14
16	-5.14	-5.14	-5.14
17	-5.14	-5.14	-5.14
18	-5.14	-5.14	-5.14
19	-5.14	-5.14	-5.14
20	-5.14	-5.14	-5.14
21	-5.14	-5.14	-5.14
22	-5.14	-5.14	-5.14
23	-5.14	-5.14	-5.14
24	-5.14	-5.14	-5.14

SUMMARY -5.14 -5.14 -5.13

NUMBER OF OBSERVATIONS 744

Palisades

WINTER YEAR 74 DAYS ANALYZED 90 PARAMETER # 1

HOUR	MIN	AVG	MAX
1	0.00	11.73	33.00
2	0.00	11.64	33.00
3	0.00	11.40	31.50
4	0.00	11.81	32.60
5	0.00	11.85	32.60
6	0.00	11.36	26.60
7	0.00	11.01	29.00
8	0.00	11.05	27.70
9	0.00	11.01	34.60
10	0.00	11.28	43.50
11	0.00	11.40	36.60
12	0.00	11.69	40.00
13	0.00	11.87	38.40
14	0.00	11.84	33.00
15	0.00	12.11	31.90
16	0.00	12.14	35.00
17	0.00	12.07	43.30
18	0.00	12.36	47.10
19	0.00	12.42	45.80
20	0.00	12.35	43.50
21	0.00	12.36	44.40
22	0.00	12.32	41.70
23	0.00	12.30	36.80
24	0.00	12.24	34.80

SUMMARY 0.00 11.82 47.10

NUMBER OF OBSERVATIONS 2159

## Palisades

WINTER YEAR 74 DAYS ANALYZED 90 PARAMETER # 3

HOUR	MIN	AVG	MAX
1	0.00	3.51	18.60
2	0.00	3.58	19.00
3	0.00	3.60	19.80
4	0.00	3.71	18.80
5	0.00	3.64	16.60
6	0.00	3.73	17.20
7	0.00	3.50	18.10
8	0.00	3.61	18.40
9	0.00	3.82	18.10
10	0.00	3.58	18.10
11	0.00	3.78	18.80
12	0.00	3.53	17.80
13	0.00	3.69	16.60
14	0.00	3.78	16.50
15	0.00	3.91	17.30
16	0.00	3.89	18.30
17	0.00	3.84	18.90
18	0.00	3.57	19.70
19	0.00	3.40	18.70
20	0.00	3.33	19.20
21	0.00	3.16	19.20
22	0.00	3.25	20.80
23	0.00	3.40	19.50
24	0.00	3.46	20.60

SUMMARY 0.00 3.59 20.80

NUMBER OF OBSERVATIONS2159

## Palisades

WINTER YEAR 74 DAYS ANALYZED 90 PARAMETER # 4

HOUR	MIN	AVG	MAX
1	-15.30	-2.73	13.30
2	-14.50	-3.07	12.10
3	-16.00	-3.33	11.80
4	-15.90	-3.33	11.50
5	-16.10	-3.44	10.90
6	-16.00	-3.58	10.70
7	-16.00	-3.72	10.80
8	-16.80	-3.92	11.00
9	-17.30	-4.04	11.10
10	-16.50	-3.78	12.10
11	-14.00	-2.96	12.20
12	-12.80	-1.95	11.90
13	-11.10	-0.90	12.00
14	-9.80	-0.42	12.20
15	-8.80	-0.02	14.40
16	-8.70	0.14	14.60
17	-9.30	-0.13	14.00
18	-9.50	-0.68	12.80
19	-11.30	-1.24	12.20
20	-10.80	-1.62	11.30
21	-11.40	-1.82	12.50
22	-12.20	-2.01	13.10
23	-14.30	-2.24	13.00
24	-15.00	-2.43	13.10

SUMMARY -17.30 -2.22 14.60

NUMBER OF OBSERVATIONS2159

Palisades

WINTER YEAR 74 DAYS ANALYZED 90 PARAMETER # 5

HOUR	MIN	AVG	MAX
1	-1.82	-0.22	0.83
2	-1.17	-0.18	0.76
3	-1.17	-0.17	0.91
4	-1.10	-0.19	0.80
5	-1.13	-0.18	0.79
6	-1.12	-0.18	0.92
7	-1.08	-0.19	0.68
8	-1.12	-0.18	0.69
9	-1.12	-0.12	1.63
10	-1.10	-0.07	1.89
11	-1.13	-0.11	1.16
12	-1.59	-0.28	0.86
13	-2.43	-0.52	0.88
14	-2.70	-0.63	0.23
15	-3.39	-0.74	0.28
16	-3.92	-0.84	0.32
17	-3.67	-0.83	0.23
18	-3.13	-0.64	0.73
19	-3.48	-0.45	0.72
20	-1.39	-0.33	0.74
21	-1.20	-0.26	1.02
22	-1.21	-0.26	1.05
23	-1.19	-0.24	1.06
24	-1.49	-0.25	0.90

SUMMARY -3.92 -0.34 1.89

NUMBER OF OBSERVATIONS2159

Palisades  
SPRING

YEAR 74 DAYS ANALYZED 92 PARAMETER # 1

HOUR	MIN	AVG	MAX
1	0.00	10.86	31.50
2	0.00	10.91	29.20
3	0.00	11.11	29.70
4	0.00	11.31	32.10
5	0.00	11.60	29.20
6	0.00	11.76	28.10
7	0.00	11.91	30.80
8	0.00	12.13	34.40
9	0.00	12.29	35.30
10	0.00	11.87	35.00
11	0.00	12.08	33.30
12	2.50	12.26	32.10
13	1.60	12.48	31.50
14	0.00	12.23	30.60
15	0.00	12.24	28.80
16	0.00	11.90	31.20
17	0.00	11.80	33.50
18	0.00	11.07	31.70
19	0.00	10.32	34.40
20	0.00	9.46	33.30
21	0.00	9.24	30.40
22	0.00	9.43	30.60
23	0.00	9.81	30.40
24	0.00	10.23	30.10

SUMMARY 0.00 11.26 35.30

NUMBER OF OBSERVATIONS 2171

## Palisades

SPRING YEAR 74 DAYS ANALYZED 92 PARAMETER # 3

HOUR	MIN	AVG	MAX
1	0.00	5.39	18.80
2	0.00	5.33	19.60
3	0.00	5.12	18.00
4	0.00	4.97	18.30
5	0.00	4.92	19.00
6	0.00	4.89	18.90
7	0.00	4.64	17.70
8	0.00	4.85	18.20
9	0.00	4.84	18.80
10	0.00	5.09	19.20
11	0.00	5.25	20.40
12	0.00	5.61	21.90
13	0.00	5.83	20.10
14	0.00	5.97	19.20
15	0.00	5.67	19.10
16	0.00	5.83	19.50
17	0.00	5.80	19.00
18	0.00	5.94	18.00
19	0.00	5.84	18.60
20	0.00	5.66	16.60
21	0.00	5.69	17.40
22	0.00	5.51	17.40
23	0.00	5.55	19.40
24	0.00	5.31	18.80

SUMMARY 0.00 5.40 21.90

NUMBER OF OBSERVATIONS2176

## Palisades

SPRING YEAR 74 DAYS ANALYZED 92 PARAMETER # 4

HOUR	MIN	AVG	MAX
1	-8.80	7.29	22.30
2	-8.20	7.06	21.40
3	-11.60	6.73	20.30
4	-12.50	6.32	21.10
5	-13.30	6.11	21.10
6	-13.60	5.92	21.00
7	-13.50	5.62	20.50
8	-13.70	5.52	19.80
9	-12.90	6.05	20.00
10	-11.10	7.08	21.00
11	-10.00	7.91	25.70
12	-10.60	8.30	27.50
13	-10.80	9.04	27.80
14	-10.90	9.78	25.20
15	-11.10	10.44	26.00
16	-10.80	11.00	27.80
17	-10.60	11.08	28.80
18	-10.30	10.75	27.90
19	-10.40	10.13	26.60
20	-10.40	9.57	25.50
21	-10.50	8.77	24.70
22	-10.10	8.11	23.50
23	-9.40	7.83	23.60
24	-9.10	7.66	22.40

SUMMARY -13.70 8.09 28.80

NUMBER OF OBSERVATIONS2176

Palisades

SPRING YEAR 74 DAYS ANALYZED 92 PARAMETER # 5

HOUR	MIN	AVG	MAX
1	-2.54	0.33	2.95
2	-5.14	0.34	2.95
3	-0.90	0.43	2.77
4	-0.95	0.43	2.90
5	-2.40	0.38	3.06
6	-1.02	0.42	3.59
7	-1.42	0.41	3.68
8	-5.16	0.32	4.18
9	-5.16	0.30	4.40
10	-5.16	0.11	3.26
11	-5.16	-0.06	2.51
12	-5.16	-0.05	2.34
13	-5.16	-0.36	1.79
14	-5.16	-0.52	2.06
15	-5.16	-0.69	1.94
16	-5.16	-0.88	1.43
17	-5.16	-0.96	2.15
18	-5.16	-0.83	2.87
19	-5.16	-0.53	2.79
20	-5.16	-0.45	2.08
21	-5.16	-0.27	2.26
22	-5.16	-0.03	2.79
23	-5.16	-0.01	2.80
24	-5.16	0.09	3.19

SUMMARY -5.16 -0.09 4.40

NUMBER OF OBSERVATIONS 2176

Palisades

SUMMER YEAR 74 DAYS ANALYZED 92 PARAMETER # 1

HOUR	MIN	AVG	MAX
1	1.80	7.35	25.70
2	2.00	7.72	21.40
3	1.10	8.23	23.00
4	2.70	8.23	23.20
5	1.10	8.43	23.70
6	1.30	8.63	22.80
7	2.00	8.70	24.60
8	2.50	8.48	26.10
9	2.70	8.24	25.70
10	2.00	8.31	22.80
11	2.20	8.44	25.40
12	2.90	8.66	28.30
13	2.50	8.95	26.30
14	2.70	9.06	26.30
15	3.30	8.94	26.10
16	3.10	8.62	24.10
17	2.50	8.49	21.40
18	1.30	7.84	25.40
19	1.30	7.49	25.70
20	0.40	6.67	20.10
21	0.40	6.05	20.30
22	0.40	6.06	25.40
23	0.70	6.50	26.60
24	2.20	6.95	23.20

SUMMARY 0.40 7.96 28.30

NUMBER OF OBSERVATIONS 2143



## Palisades

SUMMER YEAR 74 DAYS ANALYZED 92 PARAMETER # 3

HOUR	MIN	AVG	MAX
1	0.00	6.12	19.90
2	0.00	6.27	21.00
3	0.00	6.29	23.40
4	0.00	6.52	22.60
5	0.00	6.43	19.20
6	0.00	6.62	19.80
7	0.00	6.17	18.40
8	0.00	5.92	15.60
9	0.00	6.34	17.10
10	0.00	6.41	18.60
11	0.00	6.65	17.60
12	0.00	6.59	17.90
13	0.00	6.27	16.80
14	0.00	6.27	17.20
15	0.00	5.97	17.40
16	0.00	5.95	17.00
17	0.00	6.08	16.10
18	0.00	6.12	14.00
19	0.00	6.49	18.20
20	0.00	6.52	17.40
21	0.00	6.20	18.10
22	0.00	6.11	17.50
23	0.00	6.42	19.50
24	0.00	6.12	20.20

SUMMARY 0.00 6.29 23.40

NUMBER OF OBSERVATIONS2143

## Palisades

SUMMER YEAR 74 DAYS ANALYZED 92 PARAMETER # 4

HOUR	MIN	AVG	MAX
1	11.30	19.18	29.40
2	10.90	18.80	29.10
3	10.40	18.58	27.40
4	10.40	18.34	27.10
5	10.30	18.01	26.80
6	10.20	17.66	26.40
7	9.30	17.32	25.80
8	9.40	17.25	25.70
9	10.70	17.69	25.80
10	11.40	18.66	27.10
11	11.60	20.00	27.50
12	11.00	21.07	27.60
13	10.90	21.87	28.20
14	11.10	22.48	29.70
15	10.70	23.10	31.20
16	10.60	24.45	32.70
17	10.80	24.85	33.40
18	3.20	24.31	34.80
19	10.70	23.71	33.80
20	11.00	22.85	32.90
21	11.30	22.18	31.80
22	11.40	21.10	31.00
23	11.50	20.03	30.20
24	11.80	19.55	29.60

SUMMARY 3.20 20.55 34.80

NUMBER OF OBSERVATIONS2143

Palisades

SUMMER - YEAR 74 DAYS ANALYZED 92 PARAMETER # 5

HOUR	MIN	AVG	MAX
1	-5.17	-5.16	-5.16
2	-5.17	-5.16	-5.16
3	-5.17	-5.16	-5.16
4	-5.17	-5.16	-5.14
5	-5.17	-5.16	-5.16
6	-5.16	-5.16	-5.14
7	-5.16	-5.16	-5.14
8	-5.16	-5.16	-5.14
9	-5.16	-5.16	-5.16
10	-5.17	-5.16	-5.16
11	-5.17	-5.16	-5.16
12	-5.17	-5.16	-5.14
13	-5.17	-5.16	-5.16
14	-5.17	-5.16	-5.16
15	-5.17	-5.16	-5.16
16	-5.17	-5.16	-5.14
17	-5.17	-5.16	-5.16
18	-5.17	-5.16	-5.14
19	-5.17	-5.13	-2.32
20	-5.17	-5.10	0.72
21	-5.17	-5.16	-4.92
22	-5.17	-5.16	-5.16
23	-5.17	-5.16	-5.16
24	-5.17	-5.16	-5.16

SUMMARY -5.17 -5.16 0.72

NUMBER OF OBSERVATIONS2143

Palisades

FALL YEAR 74 DAYS ANALYZED 91 PARAMETER # 1

HOUR	MIN	AVG	MAX
1	3.10	10.80	40.00
2	2.20	10.73	38.80
3	2.50	10.77	38.40
4	2.90	10.87	39.10
5	2.50	11.57	39.30
6	3.10	11.71	40.40
7	2.70	11.82	38.60
8	2.70	11.58	39.50
9	2.90	11.36	41.70
10	2.50	11.61	39.10
11	2.70	11.69	37.30
12	2.00	11.63	37.10
13	2.00	11.68	37.10
14	2.50	11.52	38.40
15	2.00	11.61	36.80
16	1.60	11.58	38.20
17	0.70	11.08	38.60
18	2.20	10.55	38.40
19	1.80	9.86	39.70
20	1.60	9.61	40.40
21	2.00	9.63	40.60
22	3.30	10.34	38.40
23	2.50	10.49	40.80
24	2.90	10.52	38.80

SUMMARY 0.70 11.03 41.70

NUMBER OF OBSERVATIONS 2184

## Palisades

FALL YEAR 74 DAYS ANALYZED 91 PARAMETER # 3

HOUR	MIN	AVG	MAX
1	0.00	0.69	12.90
2	0.00	0.63	11.70
3	0.00	0.57	10.40
4	0.00	0.44	11.50
5	0.00	0.50	13.30
6	0.00	0.48	13.20
7	0.00	0.53	14.20
8	0.00	0.48	12.30
9	0.00	0.47	11.70
10	0.00	0.44	11.20
11	0.00	0.48	11.50
12	0.00	0.56	12.10
13	0.00	0.59	11.50
14	0.00	0.55	10.80
15	0.00	0.54	11.40
16	0.00	0.59	13.30
17	0.00	0.56	12.50
18	0.00	0.57	13.00
19	0.00	0.70	14.60
20	0.00	0.85	17.00
21	0.00	0.88	17.60
22	0.00	0.88	16.30
23	0.00	0.96	18.90
24	0.00	0.76	12.50

SUMMARY 0.00 0.61 18.90

NUMBER OF OBSERVATIONS2184

## Palisades

FALL YEAR 74 DAYS ANALYZED 91 PARAMETER # 4

HOUR	MIN	AVG	MAX
1	-7.00	10.53	22.60
2	-7.60	10.22	22.40
3	-7.90	10.02	22.80
4	-8.40	9.82	21.00
5	-9.00	9.63	21.20
6	-9.40	9.42	22.00
7	-10.00	9.21	22.30
8	-10.20	9.00	22.30
9	-9.10	8.92	21.50
10	-7.70	9.54	22.20
11	-5.30	10.81	23.70
12	-2.70	12.04	24.60
13	-1.10	12.91	25.80
14	-0.70	13.76	28.90
15	0.30	14.57	30.80
16	0.00	14.98	30.40
17	-0.30	15.00	31.40
18	-0.80	14.31	28.00
19	-1.30	13.23	26.90
20	-1.90	12.29	26.10
21	-2.90	11.48	24.90
22	-3.30	10.96	24.00
23	-4.40	10.70	23.40
24	-6.20	10.51	23.10

SUMMARY -10.20 11.41 31.40

NUMBER OF OBSERVATIONS2184

Palisades

FALL YEAR 74 DAYS ANALYZED 91 PARAMETER # 5

HOUR	MIN	AVG	MAX
1	-5.16	-5.15	-5.13
2	-5.16	-5.15	-5.13
3	-5.16	-5.15	-5.13
4	-5.16	-5.15	-5.13
5	-5.16	-5.15	-5.13
6	-5.16	-5.15	-5.13
7	-5.16	-5.15	-5.13
8	-5.16	-5.15	-5.13
9	-5.16	-5.15	-5.13
10	-5.16	-5.15	-5.13
11	-5.16	-5.15	-5.14
12	-5.16	-5.15	-5.14
13	-5.17	-5.15	-5.14
14	-5.17	-5.15	-5.14
15	-5.17	-5.15	-5.14
16	-5.17	-5.15	-5.14
17	-5.17	-5.15	-5.14
18	-5.17	-5.15	-5.14
19	-5.17	-5.15	-5.14
20	-5.16	-5.15	-5.14
21	-5.16	-5.15	-5.14
22	-5.16	-5.15	-5.14
23	-5.16	-5.15	-5.14
24	-5.16	-5.15	-5.14

SUMMARY -5.17 -5.15 -5.13

NUMBER OF OBSERVATIONS 2184

APPENDIX F

JOINT WIND SPEED, WIND DIRECTION  
AND ATMOSPHERIC STABILITY DISTRIBUTION  
BY SEASON AND ANNUAL FOR PALISADES

THE PERCENTAGE OF OCCURENCE OF WIND SPEED CLASS AND WIND DIRECTION  
FOR STABILITY INDEX A

PERIOD OF RECORD-FALL

	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG SPD MPH
N	0.07	0.00	0.00	0.00	0.00	0.00	0.07	1.80
NNE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ENE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ESE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SSE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SSW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WSW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
W	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.07	0.00	0.00	0.00	0.00	0.00	0.07	1.80
AVG SPD	1.80	0.00	0.00	0.00	0.00	0.00	1.80	1.80

NUMBER OF CALM HOURS - 0  
NUMBER OF MISSING HOURS - 763  
NUMBER OF HOURS OF DATA - 1421

THE PERCENTAGE OF OCCURENCE OF WIND SPEED CLASS AND WIND DIRECTION  
FOR STABILITY INDEX B

PERIOD OF RECORD-FALL

	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG SPD MPH
N	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ENE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ESE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SSE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SSW	0.00	0.00	0.21	0.00	0.00	0.00	0.21	8.80
SW	0.00	0.07	0.07	0.00	0.00	0.00	0.14	6.90
WSW	0.00	0.00	0.21	0.00	0.00	0.00	0.21	8.63
W	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.00	0.07	0.49	0.00	0.00	0.00	0.56	8.26
AVG SPD	0.00	6.70	8.49	0.00	0.00	0.00	8.26	8.26

NUMBER OF CALM HOURS - 0  
NUMBER OF MISSING HOURS - 763  
NUMBER OF HOURS OF DATA - 1421



THE PERCENTAGE OF OCCURENCE OF WIND SPEED CLASS AND WIND DIRECTION  
FOR STABILITY INDEX C

PERIOD OF RECORD-FALL

	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG SPD MPH
N	0.00	0.00	0.00	0.00	0.14	0.00	0.14	19.10
NNE	0.00	0.14	0.70	0.00	0.00	0.00	0.84	8.32
NE	0.00	0.35	0.00	0.00	0.00	0.00	0.35	6.26
ENE	0.00	0.42	0.07	0.00	0.00	0.00	0.49	6.54
E	0.00	0.56	0.14	0.00	0.00	0.00	0.70	6.36
ESE	0.00	0.07	0.28	0.00	0.00	0.00	0.35	9.02
SE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SSE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S	0.00	0.42	0.49	0.07	0.00	0.00	0.99	8.18
SSW	0.00	1.13	0.28	0.00	0.00	0.00	1.41	6.43
SW	0.00	0.21	0.28	0.00	0.00	0.00	0.49	7.17
WSW	0.00	0.35	0.77	0.07	0.00	0.00	1.20	8.59
W	0.00	0.00	0.42	0.28	0.00	0.00	0.70	10.98
WNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.00	3.66	3.45	0.42	0.14	0.00	7.67	8.01
AVG SPD	0.00	6.18	8.88	13.02	19.10	0.00	8.01	8.01

NUMBER OF CALM HOURS - 0  
NUMBER OF MISSING HOURS - 763  
NUMBER OF HOURS OF DATA - 1421

THE PERCENTAGE OF OCCURENCE OF WIND SPEED CLASS AND WIND DIRECTION  
FOR STABILITY INDEX D

PERIOD OF RECORD-FALL

	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG SPD MPH
N	0.00	0.42	1.13	0.14	0.07	0.00	1.76	8.96
NNE	0.00	1.06	0.49	0.00	0.00	0.00	1.55	6.03
NE	0.07	1.13	0.00	0.00	0.00	0.00	1.20	4.68
ENE	0.00	1.41	0.07	0.00	0.00	0.00	1.48	5.20
E	0.07	1.69	0.00	0.00	0.00	0.00	1.76	4.45
ESE	0.00	2.18	1.41	0.70	0.00	0.00	4.29	8.13
SE	0.00	0.00	0.28	0.35	0.35	0.00	0.99	15.34
SSE	0.00	0.56	3.80	0.49	0.00	0.00	4.86	9.60
S	0.00	2.18	0.70	0.00	0.00	0.00	2.89	6.31
SSW	0.07	0.49	0.00	0.00	0.00	0.00	0.63	3.63
SW	0.00	0.56	0.00	0.00	0.00	0.00	0.56	4.19
WSW	0.07	0.63	0.14	0.00	0.00	0.00	0.84	5.46
W	0.00	0.56	1.76	1.34	0.07	0.00	3.73	10.74
WNW	0.00	0.00	0.28	0.28	0.21	0.07	0.84	16.33
NW	0.00	0.07	0.07	0.07	0.35	0.00	0.56	17.05
NNW	0.00	0.14	1.27	0.56	0.00	0.14	2.11	11.42
TOTAL	0.28	13.09	11.40	3.94	1.06	0.21	30.05	8.58
AVG SPD	2.35	5.24	9.32	14.11	20.16	25.77	8.58	8.58

NUMBER OF CALM HOURS - 1  
NUMBER OF MISSING HOURS - 763  
NUMBER OF HOURS OF DATA - 1421

THE PERCENTAGE OF OCCURENCE OF WIND SPEED CLASS AND WIND DIRECTION  
FOR STABILITY INDEX E

PERIOD OF RECORD-FALL

	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG SPD MPH
N	0.00	0.42	0.00	0.00	0.00	0.00	0.42	4.53
NNE	0.07	0.28	0.00	0.00	0.00	0.00	0.35	3.44
NE	0.21	0.14	0.00	0.00	0.00	0.00	0.35	3.00
ENE	0.07	0.21	0.00	0.00	0.00	0.00	0.28	3.40
E	0.28	0.63	0.21	0.00	0.00	0.00	1.13	5.00
ESE	0.14	1.27	3.10	1.55	0.14	0.00	6.19	9.88
SE	0.00	0.70	8.16	3.87	0.70	0.00	13.44	11.29
SSE	0.14	1.34	5.14	0.00	0.00	0.00	6.62	8.22
S	0.00	0.49	0.14	0.00	0.00	0.00	0.63	5.52
SSW	0.07	0.28	0.00	0.00	0.00	0.00	0.35	3.84
SW	0.28	0.35	0.00	0.00	0.00	0.00	0.63	3.40
WSW	0.07	0.14	0.07	0.00	0.00	0.00	0.28	4.53
W	0.00	1.20	1.55	0.84	0.70	0.28	4.57	12.04
WNW	0.00	0.63	0.84	1.13	0.42	0.00	3.03	11.91
NW	0.00	0.21	0.28	0.91	0.28	0.07	1.76	14.29
NNW	0.00	0.56	1.27	1.90	1.13	0.77	5.63	15.93
TOTAL	1.34	8.87	20.76	10.20	3.38	1.13	45.67	10.78
AVG SPD	2.49	5.17	9.38	14.58	19.76	29.14	10.78	10.78

NUMBER OF CALM HOURS - 0  
NUMBER OF MISSING HOURS - 763  
NUMBER OF HOURS OF DATA - 1421

THE PERCENTAGE OF OCCURENCE OF WIND SPEED CLASS AND WIND DIRECTION  
FOR STABILITY INDEX F

PERIOD OF RECORD-FALL

	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG SPD MPH
N	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNE	0.14	0.00	0.00	0.00	0.00	0.00	0.14	2.45
NE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ENE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E	0.00	0.07	0.00	0.00	0.00	0.00	0.07	6.70
ESE	0.00	0.35	0.35	0.14	0.00	0.00	0.84	8.18
SE	0.00	0.56	1.90	0.14	0.00	0.00	2.60	8.89
SSE	0.00	0.28	0.07	0.00	0.00	0.00	0.35	5.38
S	0.07	0.07	0.00	0.00	0.00	0.00	0.14	2.80
SSW	0.07	0.00	0.00	0.00	0.00	0.00	0.07	2.90
SW	0.07	0.00	0.00	0.00	0.00	0.00	0.07	2.70
WSW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
W	0.07	0.35	0.07	0.00	0.00	0.00	0.49	4.56
WNW	0.00	0.42	0.07	0.00	0.00	0.00	0.49	5.64
NW	0.07	0.49	1.13	0.99	0.28	0.70	3.66	14.81
NNW	0.00	0.21	0.49	0.99	0.91	1.13	3.73	19.63
TOTAL	0.49	2.81	4.08	2.25	1.20	1.83	12.67	13.10
AVG SPD	2.59	5.05	9.31	14.42	20.11	30.61	13.10	13.10

NUMBER OF CALM HOURS - 0  
NUMBER OF MISSING HOURS - 763  
NUMBER OF HOURS OF DATA - 1421

THE PERCENTAGE OF OCCURENCE OF WIND SPEED CLASS AND WIND DIRECTION  
FOR STABILITY INDEX 6

PERIOD OF RECORD-FALL

	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG SPD MPH
N	0.00	0.07	0.00	0.00	0.00	0.00	0.07	3.60
NNE	0.07	0.00	0.00	0.00	0.00	0.00	0.07	2.20
NE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ENE	0.00	0.07	0.00	0.00	0.00	0.00	0.07	6.50
E	0.00	0.07	0.00	0.00	0.00	0.00	0.07	6.50
ESE	0.00	0.21	0.00	0.00	0.00	0.00	0.21	5.87
SE	0.21	0.49	0.42	0.00	0.00	0.00	1.13	5.99
SSE	0.00	0.14	0.00	0.00	0.00	0.00	0.14	4.25
S	0.00	0.14	0.00	0.00	0.00	0.00	0.14	3.80
SSW	0.07	0.00	0.00	0.00	0.00	0.00	0.07	2.00
SW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WSW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
W	0.00	0.07	0.00	0.00	0.00	0.00	0.07	5.40
WNW	0.21	0.21	0.00	0.00	0.00	0.00	0.42	3.23
NW	0.00	0.35	0.07	0.21	0.00	0.00	0.63	8.83
NNW	0.00	0.00	0.07	0.07	0.07	0.00	0.21	16.93
TOTAL	0.56	1.83	0.56	0.28	0.07	0.00	3.31	6.50
AVG SPD	2.46	5.11	8.68	15.55	21.40	0.00	6.50	6.50

NUMBER OF CALM HOURS - 0  
NUMBER OF MISSING HOURS - 763  
NUMBER OF HOURS OF DATA - 1421

THE PERCENTAGE OF OCCURENCE OF WIND SPEED CLASS AND WIND DIRECTION  
FOR STABILITY INDEX A

PERIOD OF RECORD-12/1/73-2/28/74

	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG SPD MPH
N	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNE	0.00	0.00	0.00	0.00	0.00	0.00	1.13	0.00
NE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ENE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ESE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SSE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S	0.09	0.00	0.00	0.00	0.00	0.00	0.09	1.80
SSW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WSW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
W	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.09	0.00	0.00	0.00	0.00	0.00	1.21	0.13
AVG SPD	1.80	0.00	0.00	0.00	0.00	0.00	0.13	0.13

NUMBER OF CALM HOURS - 13  
NUMBER OF MISSING HOURS - 1006  
NUMBER OF HOURS OF DATA - 1154

THE PERCENTAGE OF OCCURENCE OF WIND SPEED CLASS AND WIND DIRECTION  
FOR STABILITY INDEX B

PERIOD OF RECORD-12/1/73-2/28/74

	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG SPD MPH
N	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ENE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ESE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SSE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SSW	0.00	0.00	0.26	0.26	0.00	0.00	0.52	11.42
SW	0.00	0.00	0.61	0.87	0.00	0.00	1.47	12.00
WSW	0.00	0.00	0.00	0.09	0.09	0.00	0.17	15.65
W	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.00	0.00	0.87	1.21	0.09	0.00	2.17	12.15
AVG SPD	0.00	0.00	10.32	12.97	19.00	0.00	12.15	12.15

NUMBER OF CALM HOURS - 0  
NUMBER OF MISSING HOURS - 1006  
NUMBER OF HOURS OF DATA - 1154

THE PERCENTAGE OF OCCURENCE OF WIND SPEED CLASS AND WIND DIRECTION  
FOR STABILITY INDEX C

PERIOD OF RECORD-12/1/73-2/28/74

	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG SPD MPH
N	0.00	0.00	0.00	0.00	0.17	0.00	0.17	19.50
NNE	0.00	0.00	0.00	0.09	0.00	0.00	0.17	8.60
NE	0.00	0.09	0.00	0.00	0.00	0.00	0.09	5.80
ENE	0.00	0.17	0.00	0.00	0.00	0.00	0.17	6.25
E	0.00	0.35	0.43	0.00	0.00	0.00	0.78	7.08
ESE	0.00	0.00	0.09	0.00	0.00	0.00	0.09	11.80
SE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SSE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S	0.09	0.00	0.43	0.26	0.00	0.00	0.78	10.22
SSW	0.00	0.69	1.39	0.00	0.00	0.00	2.08	7.81
SW	0.00	0.61	1.65	0.17	0.00	0.00	2.43	8.79
WSW	0.00	0.00	1.39	3.12	0.09	0.00	4.59	13.08
W	0.00	0.00	0.09	0.00	0.00	0.00	0.09	7.80
WNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.09	1.91	5.46	3.64	0.26	0.00	11.44	10.43
AVG SPD	1.10	6.25	9.30	14.12	19.83	0.00	10.43	10.43

NUMBER OF CALM HOURS - 1  
NUMBER OF MISSING HOURS - 1006  
NUMBER OF HOURS OF DATA - 1154



THE PERCENTAGE OF OCCURENCE OF WIND SPEED CLASS AND WIND DIRECTION  
FOR STABILITY INDEX D

PERIOD OF RECORD-12/1/73-2/28/74

	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG SPD MPH
N	0.00	0.26	0.09	0.00	0.00	0.17	0.52	14.10
NNE	0.00	0.17	0.00	0.00	0.00	0.00	3.47	0.25
NE	0.00	0.95	0.09	0.00	0.00	0.00	1.04	5.69
ENE	0.09	1.47	0.00	0.00	0.00	0.00	1.56	4.47
E	0.09	1.21	0.52	0.00	0.00	0.00	1.99	5.45
ESE	0.00	0.52	1.30	0.78	0.35	0.00	2.95	11.50
SE	0.00	0.00	0.00	0.35	0.00	0.00	0.35	15.88
SSE	0.00	0.00	0.26	0.95	0.09	0.00	1.30	14.29
S	0.00	0.69	2.60	0.26	0.00	0.00	3.55	8.45
SSW	0.00	0.52	0.17	0.00	0.00	0.00	0.69	5.73
SW	0.00	0.52	0.00	0.00	0.00	0.00	0.61	4.11
WSW	0.00	0.09	1.21	1.32	0.43	0.00	3.55	13.22
W	0.00	0.00	0.35	0.43	0.78	0.09	1.65	17.14
WNW	0.00	0.00	0.09	0.87	0.69	0.35	1.99	18.24
NW	0.00	0.00	0.00	0.00	0.17	0.00	0.17	19.50
NNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.17	6.41	6.67	5.46	2.51	0.61	25.39	9.51
AVG SPD	1.80	5.30	9.10	14.77	19.71	26.43	9.51	9.51

NUMBER OF CALM HOURS - 41  
NUMBER OF MISSING HOURS - 1006  
NUMBER OF HOURS OF DATA - 1154

THE PERCENTAGE OF OCCURENCE OF WIND SPEED CLASS AND WIND DIRECTION  
FOR STABILITY INDEX E

PERIOD OF RECORD-12/1/73-2/28/74

	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG SPD MPH
N	0.00	0.52	0.09	0.00	0.00	0.00	0.61	5.70
NNE	0.09	0.00	0.00	0.00	0.00	0.00	4.77	0.05
NE	0.09	0.17	0.00	0.00	0.00	0.00	0.35	4.02
ENE	0.00	0.17	0.09	0.00	0.00	0.00	0.35	4.60
E	0.09	0.26	0.00	0.00	0.00	0.00	0.87	1.74
ESE	0.09	1.13	1.04	1.56	0.52	0.00	4.33	11.79
SE	0.00	0.69	2.51	3.29	2.17	0.00	8.67	14.16
SSE	0.00	1.47	2.69	0.43	0.00	0.00	4.59	8.40
S	0.00	0.69	0.43	0.00	0.00	0.00	1.13	6.46
SSW	0.00	0.43	0.00	0.00	0.00	0.00	0.43	4.14
SW	0.00	0.09	0.17	0.00	0.00	0.00	0.26	7.67
WSW	0.00	0.43	0.26	0.26	0.00	0.00	0.95	8.33
W	0.09	0.09	0.95	1.47	1.21	0.09	3.90	15.44
WNW	0.00	0.09	1.73	2.60	1.39	0.87	6.67	16.39
NW	0.00	0.00	0.09	1.04	1.39	0.78	3.29	20.76
NNW	0.09	0.17	0.17	0.26	0.00	0.09	0.78	13.38
TOTAL	0.52	6.41	10.23	10.92	6.67	1.82	41.94	11.63
AVG SPD	2.30	5.35	9.64	14.80	20.92	28.90	11.63	11.63

NUMBER OF CALM HOURS - 62  
NUMBER OF MISSING HOURS - 1006  
NUMBER OF HOURS OF DATA - 1154

THE PERCENTAGE OF OCCURENCE OF WIND SPEED CLASS AND WIND DIRECTION  
FOR STABILITY INDEX F

PERIOD OF RECORD-12/1/73-2/28/74

	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG SPD MPH
N	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNE	0.00	0.00	0.00	0.00	0.00	0.00	0.26	0.00
NE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ENE	0.00	0.09	0.00	0.00	0.00	0.00	0.09	6.70
E	0.00	0.09	0.09	0.00	0.00	0.00	0.17	6.80
ESE	0.00	0.43	0.00	0.00	0.00	0.00	0.43	4.38
SE	0.00	0.69	0.78	0.00	0.00	0.00	1.47	7.38
SSE	0.09	0.09	0.09	0.00	0.00	0.00	0.26	4.47
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SSW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WSW	0.00	0.09	0.00	0.00	0.00	0.00	0.09	3.30
W	0.00	0.09	0.26	0.00	0.00	0.00	0.35	7.90
WNW	0.00	0.17	0.09	0.00	0.00	0.00	0.26	4.90
NW	0.00	0.00	0.17	1.73	3.81	1.65	7.37	21.08
NNW	0.00	0.26	0.26	0.69	0.78	1.39	3.38	22.97
TOTAL	0.09	1.99	1.73	2.43	4.59	3.03	14.12	17.90
AVG SPD	2.00	4.63	8.95	15.45	21.16	30.74	17.90	17.90

NUMBER OF CALM HOURS - 3  
NUMBER OF MISSING HOURS - 1006  
NUMBER OF HOURS OF DATA - 1154

THE PERCENTAGE OF OCCURENCE OF WIND SPEED CLASS AND WIND DIRECTION  
FOR STABILITY INDEX 6

PERIOD OF RECORD-12/1/73-2/28/74

	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG SPD MPH
N	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NE	0.00	0.09	0.00	0.00	0.00	0.00	0.09	5.10
ENE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E	0.00	0.26	0.00	0.00	0.00	0.00	0.26	6.10
ESE	0.00	0.00	0.17	0.00	0.00	0.00	0.17	9.60
SE	0.17	0.52	0.17	0.00	0.00	0.00	0.87	5.50
SSE	0.00	0.00	0.09	0.00	0.00	0.00	0.09	7.40
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SSW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SW	0.00	0.00	0.17	0.00	0.00	0.00	0.17	9.80
WSW	0.09	0.00	0.09	0.00	0.00	0.00	0.17	6.70
W	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WNW	0.00	0.00	0.00	0.00	0.00	0.09	0.09	32.40
NW	0.00	0.09	0.61	0.26	0.43	0.17	1.56	14.77
NNW	0.00	0.17	0.09	0.00	0.00	0.00	0.26	5.20
TOTAL	0.26	1.13	1.39	0.26	0.43	0.26	3.73	10.51
AVG SPD	2.57	5.22	9.19	14.60	20.14	28.27	10.51	10.51

NUMBER OF CALM HOURS - 0  
NUMBER OF MISSING HOURS - 1006  
NUMBER OF HOURS OF DATA - 1154

THE PERCENTAGE OF OCCURENCE OF WIND SPEED CLASS AND WIND DIRECTION  
FOR STABILITY INDEX A

PERIOD OF RECORD-3/1/74-5/31/74

	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG SPD MPH
N	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ENE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ESE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SSE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SSW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WSW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
W	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.00	0.00	0.00	0.00	0.00	0.00	0.00	+++++
AVG SPD	0.00	0.00	0.00	0.00	0.00	0.00	+++++	+++++

NUMBER OF CALM HOURS - 0  
NUMBER OF MISSING HOURS - 733  
NUMBER OF HOURS OF DATA - 1475

THE PERCENTAGE OF OCCURENCE OF WIND SPEED CLASS AND WIND DIRECTION  
FOR STABILITY INDEX B

PERIOD OF RECORD-3/ 1/74-5/31/74

	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG SPD MPH
N	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ENE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ESE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SSE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SSW	0.00	0.00	0.41	0.54	0.00	0.00	0.95	12.69
SW	0.00	0.00	0.47	0.27	0.00	0.00	0.75	11.97
WSW	0.00	0.00	0.14	0.20	0.34	0.00	0.68	17.50
W	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.00	0.00	1.02	1.02	0.34	0.00	2.37	13.84
AVG SPD	0.00	0.00	10.51	14.53	21.74	0.00	13.84	13.84

NUMBER OF CALM HOURS - 0  
NUMBER OF MISSING HOURS - 733  
NUMBER OF HOURS OF DATA - 1475

THE PERCENTAGE OF OCCURENCE OF WIND SPEED CLASS AND WIND DIRECTION  
FOR STABILITY INDEX C

PERIOD OF RECORD-3/1/74-5/31/74

	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG SPD MPH
N	0.00	0.00	0.34	0.14	0.00	0.00	0.47	11.66
NNE	0.00	0.00	0.14	0.00	0.00	0.00	0.14	10.25
NE	0.00	0.07	0.20	0.00	0.00	0.00	0.27	7.20
ENE	0.00	0.20	0.41	0.00	0.00	0.00	0.61	7.36
E	0.00	0.14	1.49	0.27	0.00	0.00	1.90	9.78
ESE	0.00	0.00	0.34	0.07	0.00	0.00	0.41	10.40
SE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SSE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S	0.00	0.00	0.68	0.34	0.00	0.00	1.02	11.10
SSW	0.00	0.34	1.36	0.14	0.00	0.00	1.83	8.28
SW	0.00	0.07	1.02	0.07	0.00	0.00	1.15	9.08
WSW	0.00	0.34	2.10	3.59	0.14	0.00	6.17	12.74
W	0.00	0.00	0.68	0.41	0.07	0.00	1.15	11.53
WNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.00	1.15	8.75	5.02	0.20	0.00	15.12	10.91
AVG SPD	0.00	6.35	9.31	14.35	20.83	0.00	10.91	10.91

NUMBER OF CALM HOURS - 0  
NUMBER OF MISSING HOURS - 733  
NUMBER OF HOURS OF DATA - 1475

THE PERCENTAGE OF OCCURENCE OF WIND SPEED CLASS AND WIND DIRECTION  
FOR STABILITY INDEX D

PERIOD OF RECORD-3/1/74-5/31/74

	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG SPD MPH
N	0.00	0.27	2.37	0.95	0.20	0.00	3.80	10.81
NNE	0.00	1.08	1.02	0.00	0.00	0.00	2.10	6.85
NE	0.07	1.02	0.07	0.00	0.00	0.00	1.15	4.85
ENE	0.00	0.47	0.00	0.07	0.00	0.00	0.54	6.14
E	0.07	0.75	0.61	0.00	0.00	0.00	1.42	6.19
ESE	0.00	0.95	1.42	1.08	0.07	0.00	3.53	9.96
SE	0.00	0.07	0.00	0.20	0.41	0.00	0.68	17.71
SSE	0.00	0.00	1.36	0.75	0.20	0.00	2.31	12.41
S	0.00	0.75	1.69	0.07	0.00	0.00	2.51	8.35
SSW	0.00	0.14	0.14	0.00	0.00	0.00	0.27	7.93
SW	0.00	0.54	0.00	0.00	0.00	0.00	0.54	4.76
WSW	0.00	0.75	1.36	1.69	0.00	0.00	3.80	10.75
W	0.00	0.20	1.15	2.31	0.20	0.07	3.93	12.91
WNW	0.00	0.00	0.14	0.34	0.20	0.00	0.68	14.86
NW	0.00	0.00	0.00	0.07	0.34	0.00	0.41	20.10
NNW	0.00	0.00	0.20	0.20	0.00	0.00	0.41	12.53
TOTAL	0.14	6.98	11.53	7.73	1.63	0.07	28.07	10.31
AVG SPD	2.10	5.36	9.37	14.10	20.39	24.60	10.31	10.31

NUMBER OF CALM HOURS - 0  
NUMBER OF MISSING HOURS - 733  
NUMBER OF HOURS OF DATA - 1475



THE PERCENTAGE OF OCCURENCE OF WIND SPEED CLASS AND WIND DIRECTION  
FOR STABILITY INDEX E

PERIOD OF RECORD-3/1/74-5/31/74

	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG SPD MPH
N	0.34	0.81	0.41	0.07	0.00	0.00	1.63	5.51
NNE	0.14	0.54	0.00	0.00	0.00	0.00	0.68	3.85
NE	0.14	0.14	0.00	0.00	0.00	0.00	0.27	2.95
ENE	0.14	0.14	0.00	0.00	0.00	0.00	0.27	3.80
E	0.07	0.61	0.00	0.07	0.00	0.00	0.75	6.27
ESE	0.07	0.68	1.29	1.42	0.88	0.20	6.03	9.76
SE	0.07	0.75	4.61	3.39	1.69	0.07	10.58	12.51
SSE	0.00	1.22	2.24	0.14	0.00	0.00	3.59	8.06
S	0.20	0.47	0.07	0.00	0.00	0.00	0.75	4.75
SSW	0.00	0.27	0.00	0.00	0.07	0.00	0.41	6.37
SW	0.07	0.00	0.07	0.00	0.00	0.00	0.14	5.45
WSW	0.00	0.41	0.07	0.00	0.00	0.00	0.47	6.16
W	0.07	0.68	1.76	1.69	0.27	0.07	4.54	11.62
WNW	0.00	0.54	1.02	1.22	0.07	0.07	2.92	11.40
NW	0.00	0.61	0.47	0.75	0.27	0.68	2.78	15.62
NNW	0.00	0.61	1.22	0.54	0.61	0.00	2.98	11.69
TOTAL	1.29	8.47	13.22	9.29	3.86	1.08	38.78	10.63
AVG SPD	2.42	5.34	9.37	14.29	20.06	27.48	10.63	10.63

NUMBER OF CALM HOURS - 23  
NUMBER OF MISSING HOURS - 733  
NUMBER OF HOURS OF DATA - 1475

THE PERCENTAGE OF OCCURENCE OF WIND SPEED CLASS AND WIND DIRECTION  
FOR STABILITY INDEX F

PERIOD OF RECORD-3/ 1/74-5/31/74

	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG SPD MPH
N	0.07	0.27	0.00	0.00	0.00	0.00	0.34	3.62
NNE	0.00	0.00	0.07	0.00	0.00	0.00	0.07	8.30
NE	0.00	0.07	0.00	0.00	0.00	0.00	0.07	3.30
ENE	0.14	0.07	0.00	0.00	0.00	0.00	0.20	2.37
E	0.14	0.07	0.00	0.00	0.00	0.00	0.20	2.07
ESE	0.07	0.14	0.34	0.00	0.00	0.00	0.54	6.80
SE	0.00	0.20	0.47	0.07	0.00	0.00	0.75	8.80
SSE	0.00	0.14	0.07	0.00	0.00	0.00	0.20	5.83
S	0.14	0.00	0.00	0.00	0.00	0.00	0.14	2.45
SSW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SW	0.07	0.00	0.00	0.00	0.00	0.00	0.07	2.50
WSW	0.07	0.20	0.00	0.00	0.00	0.00	0.27	3.40
W	0.07	0.47	0.20	0.07	0.00	0.00	0.81	6.28
WNW	0.14	0.47	0.07	0.14	0.00	0.00	0.81	6.84
NW	0.14	0.88	1.42	0.47	0.95	0.88	4.75	14.46
NNW	0.07	0.61	1.08	0.38	1.42	0.00	4.07	13.97
TOTAL	1.08	3.59	3.73	1.63	2.37	0.88	13.29	11.43
AVG SPD	2.24	4.92	9.11	14.88	21.06	26.84	11.43	11.43

NUMBER OF CALM HOURS - 0  
NUMBER OF MISSING HOURS - 733  
NUMBER OF HOURS OF DATA - 1475

THE PERCENTAGE OF OCCURENCE OF WIND SPEED CLASS AND WIND DIRECTION  
FOR STABILITY INDEX G

PERIOD OF RECORD-3/1/74-5/31/74

	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG SPD MPH
N	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNE	0.14	0.00	0.00	0.00	0.00	0.00	0.14	2.55
NE	0.07	0.07	0.00	0.00	0.00	0.00	0.14	4.10
ENE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E	0.00	0.07	0.00	0.00	0.00	0.00	0.07	6.30
ESE	0.00	0.07	0.07	0.00	0.00	0.00	0.14	6.95
SE	0.07	0.00	0.07	0.00	0.07	0.00	0.20	9.60
SSE	0.00	0.00	0.07	0.00	0.00	0.00	0.07	7.10
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SSW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WSW	0.00	0.07	0.00	0.00	0.00	0.00	0.07	4.70
W	0.07	0.34	0.00	0.00	0.00	0.00	0.41	3.62
WNW	0.20	0.07	0.00	0.00	0.00	0.00	0.27	2.68
NW	0.14	0.07	0.14	0.07	0.00	0.00	0.41	7.42
NNW	0.07	0.07	0.07	0.07	0.14	0.00	0.47	11.14
TOTAL	0.75	0.81	0.41	0.14	0.20	0.00	2.37	6.54
AVG SPD	2.50	4.42	8.82	16.20	20.77	0.00	6.54	6.54

NUMBER OF CALM HOURS - 1  
NUMBER OF MISSING HOURS - 733  
NUMBER OF HOURS OF DATA - 1475

THE PERCENTAGE OF OCCURENCE OF WIND SPEED CLASS AND WIND DIRECTION  
FOR STABILITY INDEX A

PERIOD OF RECORD-6/1/74-8/31/74

	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG SPD MPH
N	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ENE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ESE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SSE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SSW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SW	0.00	0.00	0.05	0.00	0.00	0.00	0.05	10.30
WSW	0.00	0.00	0.00	0.05	0.00	0.00	0.05	13.60
W	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.00	0.00	0.05	0.05	0.00	0.00	0.10	11.95
AVG SPD	0.00	0.00	10.30	13.60	0.00	0.00	11.95	11.95

NUMBER OF CALM HOURS - 0  
NUMBER OF MISSING HOURS - 286  
NUMBER OF HOURS OF DATA - 1922

THE PERCENTAGE OF OCCURENCE OF WIND SPEED CLASS AND WIND DIRECTION  
FOR STABILITY INDEX B

PERIOD OF RECORD-6/1/74-8/31/74

	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG SPD MPH
N	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ENE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ESE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SSE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SSW	0.00	0.00	0.16	0.00	0.00	0.00	0.16	8.30
SW	0.00	0.16	0.16	0.00	0.00	0.00	0.31	7.10
WSW	0.00	0.05	0.68	0.05	0.00	0.00	0.78	9.50
W	0.00	0.00	0.10	0.36	0.00	0.00	0.47	13.38
WNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.00	0.21	1.09	0.42	0.00	0.00	1.72	10.01
AVG SPD	0.00	6.48	9.21	13.87	0.00	0.00	10.01	10.01

NUMBER OF CALM HOURS - 0  
NUMBER OF MISSING HOURS - 286  
NUMBER OF HOURS OF DATA - 1922

THE PERCENTAGE OF OCCURENCE OF WIND SPEED CLASS AND WIND DIRECTION  
FOR STABILITY INDEX C

PERIOD OF RECORD-6/1/74-8/31/74

	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG SPD MPH
N	0.00	0.00	0.31	0.00	0.00	0.00	0.31	9.83
NNE	0.00	0.16	0.52	0.00	0.00	0.00	0.68	8.74
NE	0.00	0.42	0.16	0.00	0.00	0.00	0.57	6.25
ENE	0.00	0.42	0.00	0.00	0.00	0.00	0.42	5.30
E	0.00	0.47	0.16	0.00	0.00	0.00	0.62	5.97
ESE	0.00	0.05	0.00	0.00	0.00	0.00	0.05	6.30
SE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SSE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S	0.00	0.42	0.31	0.00	0.00	0.00	0.73	7.19
SSW	0.00	1.14	0.10	0.00	0.00	0.00	1.25	5.59
SW	0.00	0.57	0.05	0.00	0.00	0.00	0.62	5.68
WSW	0.00	0.31	1.04	0.00	0.00	0.00	1.35	8.14
W	0.00	0.10	1.61	1.46	0.00	0.00	3.17	11.65
WNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.00	4.06	4.27	1.46	0.00	0.00	9.78	8.44
AVG SPD	0.00	5.61	9.34	13.70	0.00	0.00	8.44	8.44

NUMBER OF CALM HOURS - 0  
NUMBER OF MISSING HOURS - 286  
NUMBER OF HOURS OF DATA - 1922

THE PERCENTAGE OF OCCURENCE OF WIND SPEED CLASS AND WIND DIRECTION  
FOR STABILITY INDEX D

PERIOD OF RECORD-6/1/74-8/31/74

	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG SPD MPH
N	0.00	1.61	1.66	0.00	0.00	0.00	3.28	7.01
NNE	0.00	1.87	0.73	0.00	0.00	0.00	2.60	6.33
NE	0.26	1.46	0.00	0.00	0.00	0.00	1.72	4.31
ENE	0.10	2.08	0.00	0.00	0.00	0.00	2.19	4.48
E	0.21	0.88	0.00	0.00	0.00	0.00	1.09	4.37
ESE	0.05	1.35	1.51	0.16	0.00	0.00	3.07	7.54
SE	0.00	0.00	0.42	0.42	0.00	0.00	0.83	11.66
SSE	0.00	0.78	3.07	0.36	0.00	0.00	4.21	9.22
S	0.00	1.35	0.57	0.00	0.00	0.00	1.93	6.33
SSW	0.00	0.31	0.05	0.00	0.00	0.00	0.36	4.70
SW	0.05	0.42	0.00	0.00	0.00	0.00	0.47	4.17
WSW	0.00	0.83	0.00	0.00	0.05	0.00	0.88	5.63
W	0.00	0.73	2.45	0.73	0.00	0.00	3.90	9.42
WNW	0.00	0.10	0.21	0.16	0.05	0.00	0.52	11.43
NW	0.00	0.05	0.10	0.10	0.10	0.00	0.36	14.57
NNW	0.00	0.73	0.47	0.16	0.00	0.00	1.35	8.07
TOTAL	0.68	14.57	11.24	2.08	0.21	0.00	28.77	7.40
AVG SPD	2.82	5.31	8.95	13.76	21.00	0.00	7.40	7.40

NUMBER OF CALM HOURS - 0  
NUMBER OF MISSING HOURS - 286  
NUMBER OF HOURS OF DATA - 1922

THE PERCENTAGE OF OCCURENCE OF WIND SPEED CLASS AND WIND DIRECTION  
FOR STABILITY INDEX E

PERIOD OF RECORD-6/1/74-8/31/74

	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG SPD MPH
N	0.10	1.87	0.16	0.00	0.00	0.00	2.13	4.97
NNE	0.42	0.47	0.00	0.00	0.00	0.00	0.88	3.26
NE	0.42	0.21	0.00	0.00	0.00	0.00	0.62	2.96
ENE	0.05	0.57	0.00	0.00	0.00	0.00	0.62	3.68
E	0.00	0.94	0.10	0.00	0.00	0.00	1.04	5.43
ESE	0.00	0.62	1.25	0.73	0.05	0.00	2.65	9.77
SE	0.05	0.62	3.49	0.68	0.05	0.00	4.89	9.60
SSE	0.00	1.35	2.60	0.00	0.00	0.00	3.95	7.90
S	0.05	0.88	0.16	0.00	0.00	0.00	1.09	5.16
SSW	0.00	0.21	0.00	0.00	0.00	0.00	0.21	4.07
SW	0.10	0.16	0.00	0.00	0.00	0.00	0.26	3.70
WSW	0.05	0.42	0.00	0.00	0.00	0.00	0.47	4.17
W	0.10	2.03	1.77	0.26	0.00	0.05	4.21	7.68
WNW	0.05	1.72	1.46	0.31	0.10	0.00	3.64	8.17
NW	0.10	1.35	0.78	0.31	0.05	0.00	2.60	7.87
NNW	0.00	2.19	0.99	0.47	0.42	0.00	4.06	8.77
TOTAL	1.51	15.61	12.75	2.76	0.68	0.05	33.35	7.65
AVG SPD	2.66	5.21	9.14	13.95	19.85	24.10	7.65	7.65

NUMBER OF CALM HOURS - 0  
NUMBER OF MISSING HOURS - 286  
NUMBER OF HOURS OF DATA - 1922



THE PERCENTAGE OF OCCURENCE OF WIND SPEED CLASS AND WIND DIRECTION  
FOR STABILITY INDEX F

PERIOD OF RECORD-6/1/74-8/31/74

	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG SPD MPH
N	0.00	0.05	0.00	0.00	0.00	0.00	0.05	4.70
NNE	0.05	0.00	0.00	0.00	0.00	0.00	0.05	2.50
NE	0.00	0.10	0.00	0.00	0.00	0.00	0.10	4.10
ENE	0.10	0.05	0.00	0.00	0.00	0.00	0.16	3.27
E	0.05	0.21	0.05	0.00	0.00	0.00	0.31	5.00
ESE	0.00	0.57	0.47	0.00	0.00	0.00	1.04	7.04
SE	0.00	0.52	1.35	0.10	0.00	0.00	1.98	8.63
SSE	0.05	0.31	0.00	0.00	0.00	0.00	0.36	5.10
S	0.00	0.36	0.10	0.00	0.00	0.00	0.47	5.87
SSW	0.00	0.10	0.10	0.00	0.00	0.00	0.21	7.57
SW	0.05	0.21	0.16	0.00	0.00	0.00	0.42	5.55
WSW	0.00	0.16	0.26	0.05	0.00	0.00	0.47	8.22
W	0.05	0.21	0.26	0.21	0.00	0.00	0.73	8.81
WNW	0.05	0.57	0.26	0.00	0.00	0.00	0.88	5.37
NW	0.05	0.94	1.25	1.40	0.16	0.00	3.80	10.70
NNW	0.00	1.30	1.04	0.26	0.73	0.00	3.33	10.83
TOTAL	0.47	5.67	5.31	2.03	0.88	0.00	14.36	8.88
AVG SPD	2.59	5.10	9.28	14.65	20.72	0.00	8.88	8.88

NUMBER OF CALM HOURS - 0  
NUMBER OF MISSING HOURS - 286  
NUMBER OF HOURS OF DATA - 1922

THE PERCENTAGE OF OCCURENCE OF WIND SPEED CLASS AND WIND DIRECTION  
FOR STABILITY INDEX G

PERIOD OF RECORD-6/1/74-8/31/74

	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG SPD MPH
N	0.16	0.00	0.00	0.00	0.00	0.00	0.16	2.40
NNE	0.05	0.05	0.00	0.00	0.00	0.00	0.10	3.00
NE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ENE	0.05	0.00	0.00	0.00	0.00	0.00	0.05	2.50
E	0.10	0.16	0.00	0.00	0.00	0.00	0.26	4.28
ESE	0.05	0.57	0.21	0.00	0.00	0.00	0.83	5.69
SE	0.05	0.68	1.51	0.00	0.00	0.00	2.24	7.64
SSE	0.10	0.26	0.73	0.10	0.00	0.00	1.20	8.49
S	0.10	0.52	0.10	0.00	0.00	0.00	0.73	5.47
SSW	0.00	0.16	0.00	0.00	0.00	0.00	0.16	4.80
SW	0.05	0.16	0.00	0.00	0.00	0.00	0.21	4.30
WSW	0.05	0.47	0.36	0.00	0.00	0.00	0.88	6.28
W	0.05	0.31	1.14	0.31	0.16	0.00	1.98	10.42
WNW	0.10	0.26	0.05	0.16	0.00	0.10	0.68	10.28
NW	0.26	0.52	0.16	0.16	0.21	0.00	1.30	8.10
NNW	0.10	0.57	0.42	0.05	0.00	0.00	1.14	6.74
TOTAL	1.30	4.68	4.68	0.78	0.36	0.10	11.91	7.63
AVG SPD	2.52	5.00	9.17	14.29	20.43	25.55	7.63	7.63

NUMBER OF CALM HOURS - 0  
NUMBER OF MISSING HOURS - 286  
NUMBER OF HOURS OF DATA - 1922

THE PERCENTAGE OF OCCURENCE OF WIND SPEED CLASS AND WIND DIRECTION  
FOR STABILITY INDEX A

PERIOD OF RECORD-ANNUAL

	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG SPD MPH
N	0.02	0.00	0.00	0.00	0.00	0.00	0.02	1.80
NNE	0.00	0.00	0.00	0.00	0.00	0.00	0.22	0.00
NE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ENE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ESE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SSE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S	0.02	0.00	0.00	0.00	0.00	0.00	0.02	1.80
SSW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SW	0.00	0.00	0.02	0.00	0.00	0.00	0.02	10.30
WSW	0.00	0.00	0.00	0.02	0.00	0.00	0.02	13.60
W	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
WNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.03	0.00	0.02	0.02	0.00	0.00	0.28	1.62
AVG SPD	1.80	0.00	10.30	13.60	0.00	0.00	1.62	1.62

NUMBER OF CALM HOURS - 13  
NUMBER OF MISSING HOURS - 2788  
NUMBER OF HOURS OF DATA - 5972

THE PERCENTAGE OF OCCURENCE OF WIND SPEED CLASS AND WIND DIRECTION  
FOR STABILITY INDEX B

PERIOD OF RECORD-ANNUAL

	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG SPD MPH
N	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ENE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
E	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
ESE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SSE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SSW	0.00	0.00	0.25	0.18	0.00	0.00	0.44	11.44
SW	0.00	0.07	0.30	0.23	0.00	0.00	0.60	10.89
WSW	0.00	0.02	0.30	0.08	0.10	0.00	0.50	12.49
W	0.00	0.00	0.03	0.12	0.00	0.00	0.15	13.38
WNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.00	0.08	0.89	0.62	0.10	0.00	1.69	11.73
AVG SPD	0.00	6.52	9.69	13.80	21.28	0.00	11.73	11.73

NUMBER OF CALM HOURS - 0  
NUMBER OF MISSING HOURS - 2788  
NUMBER OF HOURS OF DATA - 5972

THE PERCENTAGE OF OCCURENCE OF WIND SPEED CLASS AND WIND DIRECTION  
FOR STABILITY INDEX C

PERIOD OF RECORD-ANNUAL

	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG SPD MPH
N	0.00	0.00	0.18	0.03	0.07	0.00	0.28	12.81
NNE	0.00	0.08	0.37	0.02	0.00	0.00	0.49	8.66
NE	0.00	0.25	0.10	0.00	0.00	0.00	0.35	6.41
ENE	0.00	0.32	0.12	0.00	0.00	0.00	0.44	6.42
E	0.00	0.39	0.54	0.07	0.00	0.00	0.99	8.01
ESE	0.00	0.03	0.17	0.02	0.00	0.00	0.22	9.66
SE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
SSE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
S	0.02	0.23	0.47	0.15	0.00	0.00	0.87	9.11
SSW	0.00	0.85	0.70	0.03	0.00	0.00	1.59	7.09
SW	0.00	0.37	0.65	0.05	0.00	0.00	1.07	8.11
WSW	0.00	0.27	1.31	1.51	0.05	0.00	3.13	11.82
W	0.00	0.03	0.80	0.64	0.02	0.00	1.49	11.51
WNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NNW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
TOTAL	0.02	2.83	5.41	2.51	0.13	0.00	10.92	9.62
AVG SPD	1.10	5.94	9.25	14.11	20.02	0.00	9.62	9.62

NUMBER OF CALM HOURS - 1  
NUMBER OF MISSING HOURS - 2788  
NUMBER OF HOURS OF DATA - 5972

THE PERCENTAGE OF OCCURENCE OF WIND SPEED CLASS AND WIND DIRECTION  
FOR STABILITY INDEX D

PERIOD OF RECORD-ANNUAL

	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG SPD MPH
N	0.00	0.74	1.41	0.27	0.07	0.03	2.51	9.04
NNE	0.00	1.16	0.60	0.00	0.00	0.00	2.39	4.69
NE	0.12	1.17	0.03	0.00	0.00	0.00	1.32	4.72
ENE	0.05	1.41	0.02	0.02	0.00	0.00	1.49	4.79
E	0.12	1.11	0.25	0.00	0.00	0.00	1.51	5.09
ESE	0.02	1.29	1.42	0.64	0.08	0.00	3.45	8.98
SE	0.00	0.02	0.20	0.33	0.18	0.00	0.74	14.59
SSE	0.00	0.39	2.28	0.60	0.07	0.00	3.33	10.28
S	0.00	1.27	1.27	0.07	0.00	0.00	2.61	7.36
SSW	0.02	0.35	0.08	0.00	0.00	0.00	0.47	5.11
SW	0.02	0.50	0.00	0.00	0.00	0.00	0.54	4.31
WSW	0.02	0.62	0.60	0.77	0.10	0.00	2.11	10.36
W	0.00	0.42	1.56	1.21	0.22	0.03	3.43	11.46
WNW	0.00	0.03	0.18	0.37	0.25	0.08	0.92	15.97
NW	0.00	0.03	0.05	0.07	0.23	0.00	0.39	17.30
NNW	0.00	0.27	0.50	0.23	0.00	0.03	1.04	10.13
TOTAL	0.35	10.77	10.47	4.57	1.21	0.18	28.25	8.78
AVG SPD	2.57	5.30	9.18	14.21	20.10	26.08	8.78	8.78

NUMBER OF CALM HOURS - 42  
NUMBER OF MISSING HOURS - 2788  
NUMBER OF HOURS OF DATA - 5972

THE PERCENTAGE OF OCCURENCE OF WIND SPEED CLASS AND WIND DIRECTION  
FOR STABILITY INDEX E

PERIOD OF RECORD-ANNUAL

	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG SPD MPH
N	0.12	1.00	0.17	0.02	0.00	0.00	1.31	5.17
NNE	0.20	0.35	0.00	0.00	0.00	0.00	1.46	1.31
NE	0.23	0.17	0.00	0.00	0.00	0.00	0.42	3.14
ENE	0.07	0.30	0.02	0.00	0.00	0.00	0.40	3.81
E	0.10	0.65	0.08	0.02	0.00	0.00	0.95	4.82
ESE	0.07	0.89	1.66	1.26	0.37	0.05	4.66	10.16
SE	0.03	0.69	4.69	2.61	1.02	0.02	9.06	11.88
SSE	0.03	1.34	3.13	0.12	0.00	0.00	4.62	8.14
S	0.07	0.65	0.18	0.00	0.00	0.00	0.90	5.45
SSW	0.02	0.28	0.00	0.00	0.02	0.00	0.33	4.72
SW	0.12	0.15	0.05	0.00	0.00	0.00	0.32	4.37
WSW	0.03	0.35	0.08	0.05	0.00	0.00	0.52	6.14
W	0.07	1.12	1.56	0.99	0.47	0.12	4.32	11.15
WNW	0.02	0.85	1.26	1.17	0.42	0.18	3.90	12.17
NW	0.03	0.64	0.45	0.70	0.42	0.33	2.58	14.16
NNW	0.02	1.02	0.95	0.79	0.55	0.20	3.53	12.29
TOTAL	1.22	10.47	14.28	7.72	3.27	0.90	39.28	10.06
AVG SPD	2.52	5.24	9.35	14.48	20.31	28.46	10.06	10.06

NUMBER OF CALM HOURS - 85  
NUMBER OF MISSING HOURS - 2788  
NUMBER OF HOURS OF DATA - 5972

THE PERCENTAGE OF OCCURENCE OF WIND SPEED CLASS AND WIND DIRECTION  
FOR STABILITY INDEX F

PERIOD OF RECORD-ANNUAL

	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG SPD MPH
N	0.02	0.08	0.00	0.00	0.00	0.00	0.10	3.80
NNE	0.05	0.00	0.02	0.00	0.00	0.00	0.12	2.24
NE	0.00	0.05	0.00	0.00	0.00	0.00	0.05	3.83
ENE	0.07	0.05	0.00	0.00	0.00	0.00	0.12	3.37
E	0.05	0.12	0.03	0.00	0.00	0.00	0.20	4.71
ESE	0.02	0.39	0.32	0.03	0.00	0.00	0.75	7.01
SE	0.00	0.49	1.16	0.08	0.00	0.00	1.72	8.53
SSE	0.03	0.22	0.05	0.00	0.00	0.00	0.30	5.19
S	0.05	0.13	0.03	0.00	0.00	0.00	0.22	4.87
SSW	0.02	0.03	0.03	0.00	0.00	0.00	0.08	6.64
SW	0.05	0.07	0.05	0.00	0.00	0.00	0.17	4.96
WSW	0.02	0.12	0.08	0.02	0.00	0.00	0.23	6.49
W	0.05	0.28	0.20	0.08	0.00	0.00	0.62	7.09
WNW	0.05	0.44	0.13	0.03	0.00	0.00	0.65	5.84
NW	0.07	0.64	1.05	1.14	1.09	0.70	4.69	15.55
NNW	0.02	0.67	0.77	0.67	0.95	0.54	3.62	16.05
TOTAL	0.55	3.77	3.94	2.06	2.04	1.24	13.65	12.23
AVG SPD	2.40	5.00	9.22	14.82	20.92	30.01	12.23	12.23

NUMBER OF CALM HOURS - 3  
NUMBER OF MISSING HOURS - 2788  
NUMBER OF HOURS OF DATA - 5972



THE PERCENTAGE OF OCCURENCE OF WIND SPEED CLASS AND WIND DIRECTION  
FOR STABILITY INDEX 6

PERIOD OF RECORD-ANNUAL

	1-3	3-7	7-12	12-18	18-24	24-UP	TOTAL	AVG SPD MPH
N	0.05	0.02	0.00	0.00	0.00	0.00	0.07	2.70
NNE	0.07	0.02	0.00	0.00	0.00	0.00	0.08	2.66
NE	0.02	0.03	0.00	0.00	0.00	0.00	0.05	4.43
ENE	0.02	0.02	0.00	0.00	0.00	0.00	0.03	4.50
E	0.03	0.13	0.00	0.00	0.00	0.00	0.17	5.25
ESE	0.02	0.25	0.12	0.00	0.00	0.00	0.39	6.16
SE	0.12	0.44	0.64	0.00	0.02	0.00	1.21	7.06
SSE	0.03	0.12	0.27	0.03	0.00	0.00	0.45	8.08
S	0.03	0.20	0.03	0.00	0.00	0.00	0.27	5.26
SSW	0.02	0.05	0.00	0.00	0.00	0.00	0.07	4.10
SW	0.02	0.05	0.03	0.00	0.00	0.00	0.10	6.13
WSW	0.03	0.17	0.13	0.00	0.00	0.00	0.33	6.25
W	0.03	0.20	0.37	0.10	0.05	0.00	0.75	9.40
WNW	0.13	0.15	0.02	0.05	0.00	0.05	0.40	8.17
NW	0.12	0.28	0.22	0.17	0.15	0.03	0.97	10.22
NNW	0.05	0.23	0.18	0.05	0.05	0.00	0.59	8.36
TOTAL	0.79	2.36	2.01	0.40	0.27	0.08	5.93	7.72
AVG SPD	2.51	4.99	9.12	14.70	20.46	27.18	7.72	7.72

NUMBER OF CALM HOURS - 1  
NUMBER OF MISSING HOURS - 2788  
NUMBER OF HOURS OF DATA - 5972

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ENVIRONMENTAL CONSULTANTS



22 September 1975  
Report No. ECR-75-018 A

PALISADES METEOROLOGICAL STUDY  
VOLUME 3

FOR  
CONSUMERS POWER COMPANY  
1945 West Parnell  
Jackson, Michigan 49201

Under Contract  
issued 2 July 1975

BY  
EG&G, ENVIRONMENTAL CONSULTANTS  
9025 East Kenyon Drive  
Denver, Colorado 80237

APPENDIX G

SEASON AND ANNUAL WIND DISTRIBUTION OF  
PASQUILL STABILITY CLASSES (6) STAR PROGRAM FOR  
MUSKEGON, MICHIGAN

JOB NO.: 51388

SEASONAL & ANNUAL  
WIND DIRECTION BY PASQUILL STABILITY CLASSES (STAR PROGRAM)  
6 Classes

Page 1 of 3

Station: #14840 Muskegon, MI

Period of Record: 1/73-12/74 (8 Obs/Day)

Data are presented by stability classes and also combined for the period indicated; first, as a bivariate frequency distribution of wind direction vs. wind speed, and second, as normalized values (i.e., relative frequency). Stability classes are based on Pasquill's class structure (see Journal of Applied Meteorology, February 1964), as follows:

Stability Class (Regular STAR)	Identified in lower left corner in this tabulation as:	Definition
1	A	Extremely Unstable
2	B	Unstable
3	C	Slightly Unstable
4	D	Neutral
5	E	Slightly Stable
6	F	Stable
7	G	Extremely Stable

Stability Class (Day/Night STAR)	Identified in lower left corner in this tabulation as:	Definition
1	A	Extremely Unstable
2	B	Unstable
3	C	Slightly Unstable
4	D	Neutral/Day
5	E	Neutral/Night
6	F	Slightly Stable
7	G	Stable
8	H	Extremely Stable

Tabulations can also be prepared for the Regular STAR in 5 classes (E, F, G combined), 6 classes (F, G combined), or 7 classes

The Day/Night STAR can be prepared for 6 classes (F, G, H combined), 7 classes (G, H combined), or 8 classes. The Day/Night STAR is normally used in the climatological display model (CDM)

Average wind speed in knots, to tenths, for each direction and each speed class. Overall average wind speed is computed by:  $\frac{\text{Sum of Wind Speed}}{\text{Number of Occurrences}}$

NUMBER OF OCCURRENCES: Number of DIR/SPD observations, plus number of calms (winds are tabulated to 16 points; speeds are in knots.)

RELATIVE FREQUENCY OF OCCURRENCES:  $\frac{\text{Number of occurrences/stability class}}{\text{Total number of observations}}$

TOTAL NUMBER OF OBSERVATIONS: Number of observations in each month, season, annual or period.

TOTAL RELATIVE FREQUENCY OF OBSERVATIONS:  $\frac{\text{Total number of observations}}{\text{Total number of observations}} = 1.00000$

This normalized (relative frequency) table is self explanatory, except that calm values have been distributed in the 0-3 speed category based on the number of observations in speed categories 1-3 and 4-6 as shown below.

Because of the importance of calm winds in air pollution studies, their occurrences are distributed into 0-3 speed category of the percentage frequency (normalized) tables using a ratio based on the number of observations of speeds of 1-6 knots in each direction category.

Example:

Season:	MAM
R Total Obs for Season (all Stabilities):	3680
S Stability Class:	"C"
T Total Obs. Class "C" - Speeds 1-3	21
U Total Obs. Class "C" - Speeds 4-6	142
V Total Calms - Class "C" (Season: MAM)	8

To find the distribution of calms into a direction category we must also know the number of observations in that direction that had speeds of 1-3 and 4-6 knots. In our example let us assume we want to find how the calms were distributed into the south direction.

W Total Obs. S Direction (Season: MAM) "C" Stability  
Speeds 1-3 3

X Total Obs. S Direction (Season: MAM) "C" Stability  
Speeds 4-6 6

Symbolically the Distribution Factor =

$$\left(\frac{V}{R}\right) \left(\frac{W+X}{T+U}\right) + \left(\frac{W}{R}\right)$$

In our example then: Z Frequency South Spd 0-3 "C" =  $\left(\frac{8}{3680}\right) \left(\frac{3+6}{21+142}\right) + \left(\frac{3}{3680}\right) = (.002174) (.55215) + (.000815) = .000935$

Percentages for Monthly or Annual tables may be determined in a like manner by substituting the proper values.

TABLE A-1. STABILITY CLASS AS A FUNCTION OF NET RADIATION AND WIND SPEED

WIND SPEED (KNOTS)	NET RADIATION INDEX						
	4	3	2	1	0	-1	-2
0, 1	1	1	2	3	4	6	7
2, 3	1	2	2	3	4	6	7
4, 5	1	2	3	4	4	5	6
6	2	2	3	4	4	5	6
7	2	2	3	4	4	4	5
8, 9	2	3	3	4	4	4	5
10	3	3	4	4	4	4	5
11	3	3	4	4	4	4	4
≥12	3	4	4	4	4	4	4

TABLE A-2. INSOLATION AS A FUNCTION OF SOLAR ALTITUDE

SOLAR ALTITUDE (a)	INSOLATION	INSOLATION CLASS NUMBER
60° < a	Strong	4
35° < a ≤ 60°	Moderate	3
15° < a ≤ 35°	Slight	2
a ≤ 15°	Weak	1

JOB NO.

## A STABILITY CLASSIFICATION BASED ON HOURLY AIRPORT OBSERVATIONS

The following explanation of the Pasquill Stability classification has been extracted from an article by D. Bruce Turner in the February 1964 Journal of Applied Meteorology.

This system of classifying stability on an hourly basis for research in air pollution is based upon work accomplished by Dr. F. Pasquill of the British Meteorological Office (1961). Stability near the ground is dependent primarily upon net radiation and wind speed. Without the influence of clouds, insolation (incoming radiation) during the day is dependent upon solar altitude, which is a function of time of day and time of year. When clouds exist their cover and thickness decrease incoming and outgoing radiation. In this system insolation is estimated by solar altitude and modified for existing conditions of total cloud cover and cloud ceiling height. At night estimates of outgoing radiation are made by considering cloud cover. This stability classification system has been made completely objective so that an electronic computer can be used to compute stability classes. The stability classes are as follows: 1) Extremely unstable, 2) Unstable, 3) Slightly unstable, 4) Neutral, 5) Slightly stable, 6) Stable, 7) Extremely stable. Table A-1 gives the stability class as a function of wind speed and net radiation. The net radiation index ranges from 4, highest positive net radiation (directed toward the ground), to -2, highest negative net radiation (directed away from the earth). Instability occurs with high positive net radiation and low wind speed, stability with high negative net radiation and light winds, and neutral conditions with cloudy skies or high wind speeds.

The net radiation index used with wind speed to obtain stability class is determined by the following procedure:

- 1) If the total cloud cover is 10/10 and the ceiling is less than 7000 feet, use net radiation index equal to 0 (whether day or night).
- 2) For night-time (night is defined as the period from one hour before sunset to one hour after sunrise):
  - a) If total cloud cover  $\leq 4/10$ , use net radiation index equal to -2.
  - b) If total cloud cover  $> 4/10$ , use net radiation index equal to -1.
- 3) For daytime:
  - a) Determine the insolation class number as a function of solar altitude from Table A-2.
  - b) If total cloud cover  $\leq 5/10$ , use the net radiation index in Table A-1 corresponding to the insolation class number.
  - c) If cloud cover  $> 5/10$ , modify the insolation class number by following these six steps:
    - 1) Ceiling  $< 7000$  ft, subtract 2.
    - 2) Ceiling  $\geq 7000$  ft but  $< 16,000$  ft, subtract 1.
    - 3) Total cloud cover equal 10/10, subtract 1. (This will only apply to ceilings  $\geq 7000$  ft since cases with 10/10 coverage below 7000 ft are considered in item 1 above.)
    - 4) If insolation class number has not been modified by steps (1), (2), or (3) above, assume modified class number equal to insolation class number.
    - 5) If modified insolation class number is less than 1, let it equal 1.
    - 6) Use the net radiation index in Table A-1 corresponding to the modified insolation class number.

Since urban areas do not become as stable in the lower layers as non-urban areas, stability classes 5, 6 and 7 computed using the STAR program may be combined into a single class (5), or classes 6 and 7 may be combined and identified as class 6.

THIS TABULATION WAS PREPARED USING THE FOLLOWING HEADER CARD INFORMATION

STATION NUMBER = 14840

STATION NAME = MUSKEGON MI 8 OBS 1973-74

LATITUDE = 43.167

LONGITUDE = 86.233

TIME ZONE = 75.0

THIS IS A REGULAR STAR RUN

HEMISPHERE = WESTERN

NUMBER OF STABILITY CLASSES = 6

INPUT = MAGNETIC TAPE DECK FAMILY 14 DSREF = 6

OUTPUT = SEASONAL AND ANNUAL

PERIOD OF RECORD = 7301 7412

NUMBER OF HOURS USED = 8 OBSERVATIONS PER DAY BEGINNING WITH HOUR 01

A TAPE CONTAINING INDIVIDUAL STABILITY OBSERVATIONS WAS PREPARED ON DSREF 7





SEA D.E

## RELATIVE FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI A OBS 1973-74

## SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NNE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ENE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
E	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ESE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
SE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
SSE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
S	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
SSW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
SW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
WSW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
W	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
WNW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NNW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
TOTAL	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF A STABILITY = 0.000000

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH A STABILITY = 0.000000

SEA= DJF

## FREQUENCY DISTRIBUTION

STATION =14840 MUSKEGON MI

8 OBS

1973-74

## SPEED(KTS)

DIRECTION	1 - 3	4 - 6	7 - 10	11-16	17-21	GREATER THAN 21	AVG SPD	TOTAL
N	0	0	0	0	0	0	0.0	0
NNE	1	0	0	0	0	0	3.0	1
NE	0	0	0	0	0	0	0.0	0
ENE	0	0	0	0	0	0	0.0	0
E	1	0	0	0	0	0	3.0	1
ESE	0	1	0	0	0	0	6.0	1
SE	0	0	0	0	0	0	0.0	0
SSE	0	0	0	0	0	0	0.0	0
S	0	0	0	0	0	0	0.0	0
SSH	0	0	0	0	0	0	0.0	0
SW	0	0	0	0	0	0	0.0	0
WSW	0	0	0	0	0	0	0.0	0
W	0	0	0	0	0	0	0.0	0
WNW	0	0	0	0	0	0	0.0	0
NW	0	0	0	0	0	0	0.0	0
NNW	0	0	0	0	0	0	0.0	0
AVG	3.0	6.0	0.0	0.0	0.0	0.0	3.0	
TOTAL	2	1	0	0	0	0		
NUMBER OF OCCURRENCES OF B STABILITY	4							
NUMBER OF CALMS WITH B STABILITY	1							

G-7

SEA= DJF

## RELATIVE FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI 8 OBS 1973-74

## SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NNE	0.000926	0.000000	0.000000	0.000000	0.000000	0.000000	0.000926
NE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ENE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
E	0.000926	0.000000	0.000000	0.000000	0.000000	0.000000	0.000926
ESE	0.000231	0.000694	0.000000	0.000000	0.000000	0.000000	0.000926
SE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
SSE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
S	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
SSW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
SW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
WSW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
W	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
WNW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NNW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
TOTAL	0.002083	0.000694	0.000000	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF B STABILITY = 0.002778

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH B STABILITY = 0.000694

SEA = DJF

## FREQUENCY DISTRIBUTION

STATION = 14840 MUSKEGON MI 8 OBS 1973-74

## SPEED(KTS)

DIRECTION	1 - 3	4 - 6	7 - 10	11-16	17-21	GREATER THAN 21	AVG SPD	TOTAL
N	0	0	2	0	0	0	8.5	2
NNE	0	0	0	0	0	0	0.0	0
NE	0	1	5	0	0	0	7.0	6
ENE	0	0	1	0	0	0	8.0	1
E	0	0	2	0	0	0	8.0	2
ESE	1	0	0	0	0	0	3.0	1
SE	0	2	0	0	0	0	4.5	2
SSE	1	1	0	0	0	0	3.5	2
S	0	0	1	0	0	0	8.0	1
SSW	0	0	1	1	0	0	9.5	2
SW	0	0	0	0	0	0	0.0	0
WSW	1	0	3	0	0	0	6.8	4
W	1	0	3	0	0	0	7.3	4
WNW	0	0	0	0	0	0	0.0	0
NW	0	0	2	0	0	0	9.0	2
NNW	0	0	1	0	0	0	7.0	1
AVG	3.0	4.3	8.1	11.0	0.0	0.0	5.8	
TOTAL	4	4	21	1	0	0		
NUMBER OF OCCURRENCES OF C STABILITY = 36								
NUMBER OF CALMS WITH C STABILITY = 6								

SEA DJF

## RELATIVE FREQUENCY DISTRIBUTION

STATION #14860 MUSKEGON MI

8 OBS

1973-74

## SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000000	0.000000	0.001389	0.000000	0.000000	0.000000	0.001389
NNE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NE	0.000521	0.000694	0.003472	0.000000	0.000000	0.000000	0.004688
ENE	0.000000	0.000000	0.000694	0.000000	0.000000	0.000000	0.000694
E	0.000000	0.000000	0.001389	0.000000	0.000000	0.000000	0.001389
ESE	0.001215	0.000000	0.000000	0.000000	0.000000	0.000000	0.001215
SE	0.001042	0.001389	0.000000	0.000000	0.000000	0.000000	0.002431
SSE	0.001736	0.000694	0.000000	0.000000	0.000000	0.000000	0.002431
S	0.000000	0.000000	0.000694	0.000000	0.000000	0.000000	0.000694
SSW	0.000000	0.000000	0.000694	0.000694	0.000000	0.000000	0.001389
SW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
WSW	0.001215	0.000000	0.002083	0.000000	0.000000	0.000000	0.003299
W	0.001215	0.000000	0.002083	0.000000	0.000000	0.000000	0.003299
WNW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NW	0.000000	0.000000	0.001389	0.000000	0.000000	0.000000	0.001389
NNW	0.000000	0.000000	0.000694	0.000000	0.000000	0.000000	0.000694
TOTAL	0.006944	0.002778	0.014583	0.000694	0.000000	0.000000	
RELATIVE FREQUENCY OF OCCURRENCE OF C STABILITY = 0.025000							
RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH C STABILITY = 0.004167							

SEA = DJF

## FREQUENCY DISTRIBUTION

STATION = 14840 MUSKEGON MI

8 OBS

1973-74

## SPEED(KTS)

DIRECTION	1 - 3	4 - 6	7 - 10	11-16	17-21	GREATER THAN 21	AVG SPD	TOTAL
N	1	8	38	30	3	1	10.1	81
NNE	0	8	13	13	0	0	9.6	34
NE	1	9	16	12	1	0	9.1	39
ENE	4	6	23	21	8	0	10.6	62
E	1	17	46	77	11	0	11.2	152
ESE	2	18	23	37	4	0	10.4	84
SE	6	7	40	26	0	0	8.9	79
SSE	2	10	11	11	0	0	8.6	34
S	2	5	12	43	24	5	14.1	91
SSW	0	3	6	31	23	0	14.8	63
SW	0	1	11	45	20	4	14.3	81
WSW	0	3	28	40	9	0	12.0	80
W	1	4	42	61	13	1	12.1	122
WNW	1	4	32	49	6	2	12.1	94
NW	3	5	24	39	7	1	11.7	79
NNW	1	6	18	28	11	2	12.6	66
AVG	3.0	5.2	8.6	13.4	18.4	23.1	11.6	
TOTAL	25	114	383	563	140	16		

NUMBER OF OCCURRENCES OF D STABILITY = 1247

NUMBER OF CALMS WITH D STABILITY = 6

SEA= DJF

## RELATIVE FREQUENCY DISTRIBUTION

STATION =14840 MUSKEGON MI

8 OBS 1973-74

## SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000964	0.005556	0.026389	0.020833	0.002083	0.000694	0.056520
NNE	0.000240	0.005556	0.009028	0.009028	0.000000	0.000000	0.023851
NE	0.000994	0.006250	0.011111	0.008333	0.000694	0.000000	0.027383
ENE	0.003078	0.004167	0.015972	0.014583	0.005556	0.000000	0.043355
E	0.001234	0.011806	0.031944	0.053472	0.007639	0.000000	0.106095
ESE	0.001988	0.012500	0.015972	0.025694	0.002778	0.000000	0.058933
SE	0.004556	0.004861	0.027778	0.018056	0.000000	0.000000	0.055251
SSE	0.001749	0.006944	0.007639	0.007639	0.000000	0.000000	0.023971
S	0.001599	0.003472	0.008333	0.029861	0.016667	0.003472	0.063404
SSW	0.000090	0.002083	0.004167	0.021528	0.015972	0.000000	0.043840
SW	0.000030	0.000694	0.007639	0.021250	0.013889	0.002778	0.056280
WSW	0.000090	0.002083	0.019444	0.027778	0.006250	0.000000	0.055645
W	0.000844	0.002778	0.029167	0.042361	0.009028	0.000694	0.084872
WNW	0.000844	0.002778	0.022222	0.034028	0.004167	0.001389	0.065428
NW	0.002323	0.003472	0.016667	0.027083	0.004861	0.000694	0.055101
NNW	0.000904	0.004167	0.012500	0.019444	0.007639	0.001389	0.046043
TOTAL	0.021528	0.079167	0.265972	0.390972	0.097222	0.011111	

RELATIVE FREQUENCY OF OCCURRENCE OF D STABILITY = 0.865972

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH D STABILITY = 0.004167



SEA= DJF

FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI 8 OBS 1973-74

## SPEED(KTS)

DIRECTION	1 - 3	4 - 6	7 - 10	11-16	17-21	GREATER THAN 21	AVG SPD	TOTAL
N	0	2	11	0	0	0	7.8	13
NNE	0	0	7	0	0	0	8.3	7
NE	0	0	2	0	0	0	9.0	2
ENE	0	4	5	0	0	0	6.7	9
E	0	1	5	0	0	0	8.3	6
ESE	0	5	12	0	0	0	7.5	17
SE	0	4	4	0	0	0	6.6	8
SSE	0	3	2	0	0	0	7.0	5
S	0	0	1	0	0	0	7.0	1
SSW	0	1	0	0	0	0	4.0	1
SW	0	0	7	0	0	0	8.4	7
WSW	0	0	3	0	0	0	8.3	3
W	0	0	1	0	0	0	10.0	1
WNW	0	1	3	0	0	0	8.0	4
NW	0	2	1	0	0	0	5.3	3
NNW	0	2	3	0	0	0	7.2	5
AVG	0.0	5.0	8.5	0.0	0.0	0.0	7.5	
TOTAL	0	25	67	0	0	0		
NUMBER OF OCCURRENCES OF E STABILITY =	92							
NUMBER OF CALMS WITH E STABILITY =	0							

SEA = DJF

RELATIVE FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI

8 OBS 1973-74

## SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000000	0.001389	0.007639	0.000000	0.000000	0.000000	0.009028
NNE	0.000000	0.000000	0.004861	0.000000	0.000000	0.000000	0.004861
NE	0.000000	0.000000	0.001389	0.000000	0.000000	0.000000	0.001389
ENE	0.000000	0.002778	0.003472	0.000000	0.000000	0.000000	0.006250
E	0.000000	0.000694	0.003472	0.000000	0.000000	0.000000	0.004167
ESE	0.000000	0.003472	0.008333	0.000000	0.000000	0.000000	0.011806
SE	0.000000	0.002778	0.002778	0.000000	0.000000	0.000000	0.005556
SSE	0.000000	0.002083	0.001389	0.000000	0.000000	0.000000	0.003472
S	0.000000	0.000000	0.000694	0.000000	0.000000	0.000000	0.000694
SSW	0.000000	0.000694	0.000000	0.000000	0.000000	0.000000	0.000694
SW	0.000000	0.000000	0.004861	0.000000	0.000000	0.000000	0.004861
WSW	0.000000	0.000000	0.002083	0.000000	0.000000	0.000000	0.002083
W	0.000000	0.000000	0.000694	0.000000	0.000000	0.000000	0.000694
WNW	0.000000	0.000694	0.002083	0.000000	0.000000	0.000000	0.002778
NW	0.000000	0.001389	0.000694	0.000000	0.000000	0.000000	0.002083
NNW	0.000000	0.001389	0.002083	0.000000	0.000000	0.000000	0.003472
TOTAL	0.000000	0.017361	0.046528	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF E STABILITY = 0.063889

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH E STABILITY = 0.000000

SEA DJF

## FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI R OBS 1973-74

## SPEED(KTS)

DIRECTION	1 - 3	4 - 6	7 - 10	11-16	17-21	GREATER THAN 21	AVG SPD	TOTAL
N	2	1	0	0	0	0	3.3	3
NNE	0	4	0	0	0	0	6.0	4
NE	1	0	0	0	0	0	3.0	1
ENE	0	4	0	0	0	0	5.3	4
E	2	0	0	0	0	0	3.0	2
ESE	3	7	0	0	0	0	4.8	10
SE	2	6	0	0	0	0	4.8	8
SSE	2	2	0	0	0	0	3.5	4
S	0	2	0	0	0	0	5.5	2
SSW	2	0	0	0	0	0	3.0	2
SW	1	4	0	0	0	0	5.4	5
WSW	0	0	0	0	0	0	0.0	0
W	1	2	0	0	0	0	4.7	3
WNW	0	4	0	0	0	0	5.8	4
NW	0	0	0	0	0	0	0.0	0
NNW	0	1	0	0	0	0	4.0	1
AVG	3.0	5.4	0.0	0.0	0.0	0.0	4.1	
TOTAL	16	37	0	0	0	0		
NUMBER OF OCCURRENCES OF F STABILITY	61							
NUMBER OF CALMS WITH F STABILITY	8							

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SEA= DIF

## RELATIVE FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI

8 OBS

1973-74

## SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.001703	0.000694	0.000000	0.000000	0.000000	0.000000	0.002398
NNE	0.000419	0.002778	0.000000	0.000000	0.000000	0.000000	0.003197
NE	0.000799	0.000000	0.000000	0.000000	0.000000	0.000000	0.000799
ENE	0.000419	0.002778	0.000000	0.000000	0.000000	0.000000	0.003197
E	0.001599	0.000000	0.000000	0.000000	0.000000	0.000000	0.001599
ESE	0.003132	0.004861	0.000000	0.000000	0.000000	0.000000	0.007993
SE	0.002227	0.004167	0.000000	0.000000	0.000000	0.000000	0.006394
SSE	0.001808	0.001389	0.000000	0.000000	0.000000	0.000000	0.003197
S	0.000210	0.001389	0.000000	0.000000	0.000000	0.000000	0.001599
SSH	0.001599	0.000000	0.000000	0.000000	0.000000	0.000000	0.001599
SW	0.001219	0.002778	0.000000	0.000000	0.000000	0.000000	0.003996
WSW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
W	0.001009	0.001389	0.000000	0.000000	0.000000	0.000000	0.002398
WNW	0.000419	0.002778	0.000000	0.000000	0.000000	0.000000	0.003197
NW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NNW	0.000105	0.000694	0.000000	0.000000	0.000000	0.000000	0.000799
TOTAL	0.016667	0.025694	0.000000	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF F STABILITY = 0.042361

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH F STABILITY = 0.005556

SEA = DJF

## FREQUENCY DISTRIBUTION

STATION = 14840 MUSKEGON MI 8 OBS 1973-74

## SPEED(KTS)

DIRECTION	1 - 3	4 - 6	7 - 10	11-16	17-21	GREATER THAN 21	AVG SPD	TOTAL
N	3	11	51	30	3	1	9.6	99
NNE	1	12	20	13	0	0	8.9	46
NE	2	10	23	12	1	0	8.7	48
ENE	4	14	29	21	8	0	9.8	76
E	4	18	53	77	11	0	10.9	163
ESE	6	31	35	37	4	0	9.3	113
SE	8	19	44	26	0	0	8.3	97
SSE	5	16	13	11	0	0	7.8	45
S	2	7	14	43	24	5	13.8	95
SSW	2	4	7	32	23	0	14.1	68
SW	1	5	18	45	20	4	13.3	93
WSW	1	3	34	40	9	0	11.6	87
W	3	6	46	61	13	1	11.8	130
WNW	1	9	35	49	6	2	11.7	102
NW	3	7	27	39	7	1	11.4	84
NNW	1	9	22	28	11	2	12.0	73
AVG	3.0	5.2	8.5	13.4	18.4	23.1	10.8	
TOTAL	47	181	471	564	140	16		
TOTAL NUMBER OF OBSERVATIONS = 1440								
TOTAL NUMBER OF CALMS = 21								

G-17

SEA DJF

RELATIVE FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI 8 OBS 1973-74

## SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.002979	0.007639	0.035417	0.020833	0.002083	0.000694	0.069645
NNE	0.001526	0.008333	0.013889	0.009028	0.000000	0.000000	0.022776
NE	0.002156	0.006944	0.015972	0.008333	0.000694	0.000000	0.024101
ENE	0.003929	0.009722	0.020139	0.014583	0.005556	0.000000	0.053929
E	0.004185	0.012500	0.036806	0.053472	0.007639	0.000000	0.114602
ESE	0.006533	0.021528	0.024306	0.025694	0.002778	0.000000	0.080839
SE	0.007283	0.013194	0.030556	0.018056	0.000000	0.000000	0.069088
SSE	0.004815	0.011111	0.009028	0.007639	0.000000	0.000000	0.022593
S	0.001965	0.004861	0.009722	0.029861	0.016667	0.003472	0.066548
SSW	0.001773	0.002778	0.004861	0.022222	0.015972	0.000000	0.047606
SW	0.001078	0.003472	0.012500	0.031250	0.013889	0.002778	0.064967
WSW	0.000950	0.002083	0.023611	0.027778	0.006250	0.000000	0.060673
W	0.002659	0.004167	0.031944	0.042361	0.009028	0.000694	0.090853
WNW	0.001334	0.006250	0.024306	0.034028	0.004167	0.001389	0.071473
NW	0.002723	0.004861	0.018750	0.027083	0.004861	0.000694	0.058973
NNW	0.001334	0.006250	0.015278	0.019444	0.007639	0.001389	0.051334
TOTAL	0.047222	0.125694	0.327083	0.391666	0.097222	0.011111	

TOTAL RELATIVE FREQUENCY OF OBSERVATIONS = 1.000001

TOTAL RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE = 0.014583

SEA = MAM

## FREQUENCY DISTRIBUTION

STATION = 14840 MUSKEGON MI

8 OBS

1973-74

## SPEED(KTS)

DIRECTION	1 - 3	4 - 6	7 - 10	11-16	17-21	GREATER THAN 21	AVG SPD	TOTAL
N	0	0	0	0	0	0	0.0	0
NNE	0	0	0	0	0	0	0.0	0
NE	0	0	0	0	0	0	0.0	0
ENE	0	0	0	0	0	0	0.0	0
E	0	1	0	0	0	0	5.0	1
ESE	0	0	0	0	0	0	0.0	0
SE	0	0	0	0	0	0	0.0	0
SSE	0	0	0	0	0	0	0.0	0
S	0	0	0	0	0	0	0.0	0
SSW	0	0	0	0	0	0	0.0	0
SW	0	0	0	0	0	0	0.0	0
WSW	0	0	0	0	0	0	0.0	0
W	0	0	0	0	0	0	0.0	0
WNW	0	0	0	0	0	0	0.0	0
NW	0	0	0	0	0	0	0.0	0
NNW	0	0	0	0	0	0	0.0	0
AVG	0.0	5.0	0.0	0.0	0.0	0.0	5.0	
TOTAL	0	1	0	0	0	0		
NUMBER OF OCCURRENCES OF A STABILITY = 1								
NUMBER OF CALMS WITH A STABILITY = 0								

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SEA# MAM

## RELATIVE FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI 8 OBS 1973-74

## SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NNE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ENE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
E	0.000000	0.000679	0.000000	0.000000	0.000000	0.000000	0.000679
ESE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
SE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
SSE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
S	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
SSW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
SW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
WSW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
W	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
WNW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NNW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
TOTAL	0.000000	0.000679	0.000000	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF A STABILITY = 0.000679

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH A STABILITY = 0.000000



SEA = MAN

## FREQUENCY DISTRIBUTION

STATION = 14840 MUSKEGON MI 8 OBS 1973-74

## SPEED(KTS)

DIRECTION	1 - 3	4 - 6	7 - 10	11-16	17-21	GREATER THAN 21	AVG SPD	TOTAL
N	0	1	1	0	0	0	6.0	2
NNE	1	1	0	0	0	0	3.5	2
NE	0	1	0	0	0	0	5.0	1
ENE	1	0	1	0	0	0	5.0	2
E	0	4	0	0	0	0	5.5	4
ESE	0	0	0	0	0	0	0.0	0
SE	0	1	2	0	0	0	6.0	3
SSE	0	0	0	0	0	0	0.0	0
S	0	0	0	0	0	0	0.0	0
SSH	0	0	1	0	0	0	7.0	1
SW	0	1	0	0	0	0	5.0	1
WSW	0	0	1	0	0	0	9.0	1
W	0	1	0	0	0	0	4.0	1
WNW	0	1	0	0	0	0	6.0	1
NW	0	0	0	0	0	0	0.0	0
NNW	1	1	2	0	0	0	5.5	4
AVG	3.0	5.0	7.3	0.0	0.0	0.0	4.7	
TOTAL	3	12	8	0	0	0		

NUMBER OF OCCURRENCES OF B STABILITY = 27

NUMBER OF CALMS WITH B STABILITY = 4

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SEA= MAM

## RELATIVE FREQUENCY DISTRIBUTION

STATION = 14840 MUSKEGON MI 8 DBS 1973-74

## SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000181	0.000679	0.000679	0.000000	0.000000	0.000000	0.001540
NNE	0.001042	0.000679	0.000000	0.000000	0.000000	0.000000	0.001721
NE	0.000181	0.000679	0.000000	0.000000	0.000000	0.000000	0.000861
ENE	0.000861	0.000000	0.000679	0.000000	0.000000	0.000000	0.001540
E	0.000725	0.002717	0.000000	0.000000	0.000000	0.000000	0.003442
ESE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
SE	0.000181	0.000679	0.001359	0.000000	0.000000	0.000000	0.002219
SSE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
S	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
SSW	0.000000	0.000000	0.000679	0.000000	0.000000	0.000000	0.000679
SW	0.000181	0.000679	0.000000	0.000000	0.000000	0.000000	0.000861
WSW	0.000000	0.000000	0.000679	0.000000	0.000000	0.000000	0.000679
W	0.000181	0.000679	0.000000	0.000000	0.000000	0.000000	0.000861
WNW	0.000181	0.000679	0.000000	0.000000	0.000000	0.000000	0.000861
NW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NNW	0.001042	0.000679	0.001359	0.000000	0.000000	0.000000	0.003080
TOTAL	0.004755	0.008152	0.005435	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF B STABILITY = 0.018342

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH B STABILITY = 0.002717

SEA = MAM

## FREQUENCY DISTRIBUTION

STATION = 14840 MUSKEGON MI 8 OBS 1973-74

## SPEED(KTS)

DIRECTION	1 - 3	4 - 6	7 - 10	11-16	17-21	GREATER THAN 21	AVG SPD	TOTAL
N	0	0	3	0	1	0	12.0	4
NNE	0	0	2	0	0	0	9.0	2
NE	0	1	3	0	0	0	7.8	4
ENE	0	1	0	1	0	0	8.5	2
E	1	2	3	2	0	0	8.5	8
ESE	0	1	3	2	0	0	8.8	6
SE	0	1	3	0	0	0	7.8	4
SSE	0	0	2	1	0	0	10.0	3
S	0	1	4	0	0	0	7.8	5
SSW	0	0	3	2	0	0	9.6	5
SW	0	1	6	1	0	0	9.4	8
WSW	0	0	7	0	0	0	8.6	7
W	0	0	9	5	0	0	9.6	14
WNW	0	3	8	8	2	0	10.7	21
NW	0	1	2	1	0	0	9.0	4
NNW	0	0	2	1	0	0	10.0	3
AVG	3.0	5.7	8.7	12.2	18.7	0.0	9.2	
TOTAL	1	12	60	24	3	0		

NUMBER OF OCCURRENCES OF C STABILITY = 102

NUMBER OF CALMS WITH C STABILITY = 2

SEA MAM

RELATIVE FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI

R OBS 1973-74

## SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000000	0.000000	0.002038	0.000000	0.000679	0.000000	0.002717
NNE	0.000000	0.000000	0.001359	0.000000	0.000000	0.000000	0.001359
NE	0.000105	0.000679	0.002038	0.000000	0.000000	0.000000	0.002822
ENE	0.000105	0.000679	0.000000	0.000679	0.000000	0.000000	0.001453
E	0.000993	0.001359	0.002038	0.001359	0.000000	0.000000	0.005748
ESE	0.000105	0.000679	0.002038	0.001359	0.000000	0.000000	0.004181
SE	0.000105	0.000679	0.002038	0.000000	0.000000	0.000000	0.002822
SSE	0.000000	0.000000	0.001359	0.000679	0.000000	0.000000	0.002038
S	0.000105	0.000679	0.002717	0.000000	0.000000	0.000000	0.003501
SSW	0.000000	0.000000	0.002038	0.001359	0.000000	0.000000	0.003397
SW	0.000105	0.000679	0.004076	0.000679	0.000000	0.000000	0.005539
WSW	0.000000	0.000000	0.004755	0.000000	0.000000	0.000000	0.004755
W	0.000000	0.000000	0.006114	0.003397	0.000000	0.000000	0.009511
WNW	0.000314	0.002038	0.005435	0.005435	0.001359	0.000000	0.014580
NW	0.000105	0.000679	0.001359	0.000679	0.000000	0.000000	0.002822
NNW	0.000000	0.000000	0.001359	0.000679	0.000000	0.000000	0.002038
TOTAL	0.002038	0.008192	0.040761	0.016304	0.002038	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF C STABILITY = 0.069293

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH C STABILITY = 0.001359

SEA- MAM

FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI 8 OBS 1973-74

## SPEED(KTS)

DIRECTION	1 - 3	4 - 6	7 - 10	11-16	17-21	GREATER THAN 21	AVG SPD	TOTAL
N	1	5	19	21	0	0	10.2	46
NNE	0	6	14	5	0	0	8.6	25
NE	1	4	13	7	1	0	9.1	26
ENE	0	9	19	25	5	0	10.8	58
E	1	14	47	83	12	2	11.8	159
ESE	0	7	30	35	3	1	10.8	76
SE	0	17	29	31	4	1	10.2	82
SSE	1	5	7	17	2	0	10.5	32
S	2	10	14	40	23	15	14.7	104
SSW	0	5	16	34	18	4	13.8	77
SW	1	8	12	31	12	1	12.8	65
WSW	1	5	13	18	0	0	10.5	37
W	0	9	23	26	3	1	10.7	62
WNW	0	9	17	47	6	0	12.2	79
NW	2	4	18	41	10	4	12.9	79
NNW	0	4	12	39	11	6	13.9	72
AVG	3.0	5.3	8.5	13.5	18.6	24.3	11.9	
TOTAL	10	121	303	500	110	35		
NUMBER OF OCCURRENCES OF D STABILITY = 1086								
NUMBER OF CALMS WITH D STABILITY = 7								

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SEA - MAM

## RELATIVE FREQUENCY DISTRIBUTION

STATION - 14840 MUSKEGON MI 8 OBS 1972-74

## SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000897	0.003397	0.012908	0.014266	0.000000	0.000000	0.031468
NNE	0.000218	0.004076	0.009511	0.003397	0.000000	0.000000	0.017201
NE	0.000861	0.002717	0.008832	0.004755	0.000679	0.000000	0.017845
ENE	0.000327	0.006114	0.012908	0.016984	0.003397	0.000000	0.039729
E	0.001224	0.009511	0.031929	0.056286	0.008152	0.001359	0.108561
ESE	0.000254	0.004755	0.020380	0.023777	0.002038	0.000679	0.051885
SE	0.000617	0.011549	0.019701	0.021060	0.002717	0.000679	0.056324
SSE	0.000897	0.003397	0.004755	0.011549	0.001359	0.000000	0.021957
S	0.001794	0.006793	0.009511	0.027174	0.015625	0.010190	0.071088
SSW	0.000182	0.003397	0.010870	0.023098	0.012228	0.002717	0.052491
SW	0.001006	0.005435	0.008152	0.021060	0.008152	0.000679	0.044484
WSW	0.000897	0.003397	0.008832	0.012228	0.000600	0.000000	0.025354
W	0.000327	0.006114	0.015625	0.017663	0.002038	0.000679	0.042446
WNW	0.000327	0.006114	0.011549	0.031929	0.004076	0.000000	0.053995
NW	0.001577	0.002717	0.012228	0.027853	0.006793	0.002717	0.053886
NNW	0.000145	0.002717	0.008152	0.026495	0.007473	0.004076	0.049058
TOTAL	0.011549	0.082201	0.205842	0.339674	0.074728	0.023777	

RELATIVE FREQUENCY OF OCCURRENCE OF D STABILITY = 0.737772

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH D STABILITY = 0.004755

SEA = MAM

## FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI

8 OBS 1973-74

## SPEED(KTS)

DIRECTION	1 - 3	4 - 6	7 - 10	11-16	17-21	GREATER THAN 21	AVG SPD	TOTAL
N	0	4	11	0	0	0	7.4	15
NNE	0	0	6	0	0	0	7.7	6
NE	0	4	5	0	0	0	7.2	9
ENE	0	3	3	0	0	0	6.7	6
E	0	5	4	0	0	0	6.8	9
ESE	0	10	5	0	0	0	6.0	15
SE	0	6	7	0	0	0	7.2	13
SSE	0	3	2	0	0	0	6.0	5
S	0	3	3	0	0	0	6.3	6
SSW	0	0	5	0	0	0	8.4	5
SW	0	1	5	0	0	0	7.7	6
WSW	0	2	5	0	0	0	7.3	7
W	0	4	2	0	0	0	6.3	6
WNW	0	5	5	0	0	0	7.1	10
NW	0	3	5	0	0	0	7.0	8
NNW	0	0	8	0	0	0	8.5	8
AVG	0.0	5.2	8.3	0.0	0.0	0.0	7.1	
TOTAL	0	53	81	0	0	0		

NUMBER OF OCCURRENCES OF E STABILITY = 134

NUMBER OF CALMS WITH E STABILITY = 0

SEA= MAH

## RELATIVE FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI 8 OBS 1973-74

## SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000000	0.002717	0.007473	0.000000	0.000000	0.000000	0.010190
NNE	0.000000	0.000000	0.004076	0.000000	0.000000	0.000000	0.004076
NE	0.000000	0.002717	0.003397	0.000000	0.000000	0.000000	0.006114
ENE	0.000000	0.002038	0.002038	0.000000	0.000000	0.000000	0.004076
E	0.000000	0.003397	0.002717	0.000000	0.000000	0.000000	0.006114
ESE	0.000000	0.006793	0.003397	0.000000	0.000000	0.000000	0.010190
SE	0.000000	0.004076	0.004755	0.000000	0.000000	0.000000	0.008832
SSE	0.000000	0.002038	0.001359	0.000000	0.000000	0.000000	0.003397
S	0.000000	0.002038	0.002038	0.000000	0.000000	0.000000	0.004076
SSW	0.000000	0.000000	0.003397	0.000000	0.000000	0.000000	0.003397
SW	0.000000	0.006793	0.003397	0.000000	0.000000	0.000000	0.004076
WSW	0.000000	0.001359	0.003397	0.000000	0.000000	0.000000	0.004755
W	0.000000	0.002717	0.001359	0.000000	0.000000	0.000000	0.004076
WNW	0.000000	0.003397	0.003397	0.000000	0.000000	0.000000	0.006793
NW	0.000000	0.002038	0.003397	0.000000	0.000000	0.000000	0.005435
NNW	0.000000	0.000000	0.005435	0.000000	0.000000	0.000000	0.005435
TOTAL	0.000000	0.036005	0.055027	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF E STABILITY = 0.091033

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH E STABILITY = 0.000000



SEA- MAM

## FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI 8 DBS 1973-74

## SPEED(KTS)

DIRECTION	1 - 3	4 - 6	7 - 10	11-16	17-21	GREATER THAN 21	AVG SPD	TOTAL
N	0	11	0	0	0	0	5.5	11
NNE	1	6	0	0	0	0	5.6	7
NE	2	7	0	0	0	0	5.0	9
ENE	1	5	0	0	0	0	4.7	6
E	1	2	0	0	0	0	4.3	3
ESE	6	6	0	0	0	0	3.8	12
SE	3	6	0	0	0	0	4.0	9
SSE	0	0	0	0	0	0	0.0	0
S	1	6	0	0	0	0	4.9	7
SSW	0	4	0	0	0	0	6.0	4
SW	3	3	0	0	0	0	3.8	6
WSW	2	5	0	0	0	0	4.6	7
W	1	1	0	0	0	0	4.5	2
WNW	1	3	0	0	0	0	5.0	4
NW	0	3	0	0	0	0	5.3	3
NNW	0	2	0	0	0	0	5.5	2
AVG	3.0	5.3	0.0	0.0	0.0	0.0	2.6	
TOTAL	22	70	0	0	0	0		

NUMBER OF OCCURRENCES OF F STABILITY = 122

NUMBER OF CALMS WITH F STABILITY = 30

SEA- MAM

RELATIVE FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI R OBS 1973-74

## SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.002437	0.007473	0.000000	0.000000	0.000000	0.000000	0.009910
NNE	0.002230	0.004076	0.000000	0.000000	0.000000	0.000000	0.006306
NE	0.003352	0.004755	0.000000	0.000000	0.000000	0.000000	0.008108
ENE	0.002009	0.003397	0.000000	0.000000	0.000000	0.000000	0.005405
E	0.001344	0.001359	0.000000	0.000000	0.000000	0.000000	0.002703
ESE	0.006734	0.004076	0.000000	0.000000	0.000000	0.000000	0.010810
SE	0.004032	0.004076	0.000000	0.000000	0.000000	0.000000	0.008108
SSE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
S	0.002230	0.004076	0.000000	0.000000	0.000000	0.000000	0.006306
SSW	0.000886	0.002717	0.000000	0.000000	0.000000	0.000000	0.003603
SW	0.003367	0.002038	0.000000	0.000000	0.000000	0.000000	0.005405
WSW	0.002909	0.003397	0.000000	0.000000	0.000000	0.000000	0.006306
W	0.001122	0.000679	0.000000	0.000000	0.000000	0.000000	0.001802
WNW	0.001565	0.002038	0.000000	0.000000	0.000000	0.000000	0.003603
NW	0.000665	0.002038	0.000000	0.000000	0.000000	0.000000	0.002703
NNW	0.000443	0.001359	0.000000	0.000000	0.000000	0.000000	0.001802
TOTAL	0.035326	0.047554	0.000000	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF F STABILITY = 0.082880

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH F STABILITY = 0.020380

SEA MAM

## FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI

8 OBS

1973-74

## SPEED(KTS)

DIRECTION	1 - 3	4 - 6	7 - 10	11-16	17-21	GREATER THAN 21	AVG SPD	TOTAL
N	1	21	34	21	1	0	9.0	78
NNE	2	13	22	5	0	0	7.7	42
NE	3	17	21	7	1	0	7.8	49
ENE	2	18	23	26	5	0	9.8	74
E	3	28	54	85	12	2	11.1	184
ESE	6	24	38	37	3	1	9.2	109
SE	3	31	41	31	4	1	9.1	111
SSE	1	8	11	18	2	0	9.9	40
S	3	20	21	40	23	15	12.4	122
SSW	0	9	25	36	18	4	12.8	92
SW	4	14	23	32	12	1	11.4	86
WSW	3	12	26	18	0	0	9.2	59
W	1	15	34	31	3	1	10.0	85
WNW	1	21	30	55	8	0	11.1	115
NW	2	11	25	42	10	4	12.0	94
NNW	1	7	24	40	11	6	12.7	89
AVG	3.0	5.3	8.5	13.4	18.6	24.3	10.4	
TOTAL	36	269	452	524	113	35		
TOTAL NUMBER OF OBSERVATIONS = 1472								
TOTAL NUMBER OF CALMS = 43								

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SEA MAM

## RELATIVE FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI R OBS 1973-74

## SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.002786	0.014266	0.023098	0.014266	0.000679	0.000000	0.055096
NNE	0.002795	0.008932	0.014946	0.003397	0.000000	0.000000	0.029969
NE	0.003954	0.011549	0.014266	0.004755	0.000679	0.000000	0.035204
ENE	0.003274	0.012228	0.015625	0.017663	0.003397	0.000000	0.052187
E	0.005007	0.019022	0.036685	0.057745	0.008152	0.001359	0.127969
ESE	0.006949	0.016304	0.025815	0.025136	0.002038	0.000679	0.076922
SE	0.005294	0.021060	0.027853	0.021060	0.002717	0.000679	0.078664
SSE	0.001541	0.005435	0.007473	0.012228	0.001359	0.000000	0.028036
S	0.004241	0.013587	0.014266	0.027174	0.015625	0.010190	0.085083
SSW	0.000862	0.006114	0.016984	0.024457	0.012228	0.002717	0.063362
SW	0.004441	0.009511	0.015625	0.021739	0.008152	0.000679	0.060148
WSW	0.003475	0.008152	0.017663	0.012228	0.000000	0.000000	0.041518
W	0.002212	0.010190	0.023098	0.021060	0.002038	0.000679	0.059277
WNW	0.002786	0.014266	0.020380	0.037364	0.005435	0.000000	0.080232
NW	0.002604	0.007473	0.016984	0.028533	0.006793	0.002717	0.065104
NNW	0.001446	0.004755	0.016304	0.027174	0.007473	0.004076	0.061228
TOTAL	0.053668	0.182744	0.307065	0.355978	0.076766	0.023777	

TOTAL RELATIVE FREQUENCY OF OBSERVATIONS = 1.000001

TOTAL RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE = 0.029212

B OBS 1973-74

## SPEED(KTS)

NUMBER OF CALMS WITH A STABILITY : 0

SEA= JJA

## RELATIVE FREQUENCY DISTRIBUTION

STATION =14840 MUSKEGON MI

8 OBS 1973-74

## SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NNE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ENE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
E	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ESE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
SE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
SSE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
S	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
SSW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
SW	0.000000	0.000679	0.000000	0.000000	0.000000	0.000000	0.000679
WSW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
W	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
WNW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NW	0.000000	0.000679	0.000000	0.000000	0.000000	0.000000	0.000679
NNW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
TOTAL	0.000000	0.001359	0.000000	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF A STABILITY = 0.001359

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH A STABILITY = 0.000000

SEA= JJA

## FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI 8 OBS 1973-74

## SPEED(KTS)

DIRECTION	1 - 3	4 - 6	7 - 10	11-16	17-21	GREATER THAN 21	AVG SPD	TOTAL
N	0	3	2	0	0	0	5.8	5
NNE	0	1	0	0	0	0	5.0	1
NE	0	0	0	0	0	0	0.0	0
ENE	0	1	0	0	0	0	6.0	1
E	1	2	1	0	0	0	5.0	4
ESE	1	0	2	0	0	0	5.7	3
SE	2	1	3	0	0	0	5.3	6
SSE	1	0	0	0	0	0	3.0	1
S	1	3	2	0	0	0	6.0	6
SSW	1	0	4	0	0	0	6.2	5
SW	0	1	7	0	0	0	7.6	8
WSW	0	2	8	0	0	0	7.4	10
W	0	2	6	0	0	0	7.4	8
WNW	0	0	3	0	0	0	8.3	3
NW	1	3	2	0	0	0	5.5	6
NNW	1	0	1	0	0	0	5.0	2
AVG	3.0	5.3	7.7	0.0	0.0	0.0	5.8	
TOTAL	9	19	41	0	0	0		
NUMBER OF OCCURRENCES OF B STABILITY = 76								
NUMBER OF CALMS WITH B STABILITY = 7								

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SEA = JJA

## RELATIVE FREQUENCY DISTRIBUTION

STATION = 14840 MUSKEGON MI 8 OBS 1973-74

## SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000510	0.002038	0.001359	0.000000	0.000000	0.000000	0.003906
NNE	0.000170	0.000679	0.000000	0.000000	0.000000	0.000000	0.000849
NE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ENE	0.000170	0.000679	0.000000	0.000000	0.000000	0.000000	0.000849
E	0.001189	0.001359	0.000679	0.000000	0.000000	0.000000	0.003227
ESE	0.000849	0.000000	0.001359	0.000000	0.000000	0.000000	0.002208
SE	0.001868	0.000679	0.002038	0.000000	0.000000	0.000000	0.004586
SSE	0.000849	0.000000	0.000000	0.000000	0.000000	0.000000	0.000849
S	0.001359	0.002038	0.001359	0.000000	0.000000	0.000000	0.004755
SSW	0.000849	0.000000	0.002717	0.000000	0.000000	0.000000	0.003567
SW	0.000170	0.000679	0.004755	0.000000	0.000000	0.000000	0.005603
WSW	0.000340	0.001359	0.005435	0.000000	0.000000	0.000000	0.007133
W	0.000340	0.001359	0.004076	0.000000	0.000000	0.000000	0.005774
WNW	0.000000	0.000000	0.002038	0.000000	0.000000	0.000000	0.002038
NW	0.001359	0.002038	0.001359	0.000000	0.000000	0.000000	0.004755
NNW	0.000849	0.000000	0.000679	0.000000	0.000000	0.000000	0.001529
TOTAL	0.010870	0.012908	0.027853	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF B STABILITY = 0.051630

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH B STABILITY = 0.004755



SEA JJA

## FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI 8 OBS 1973-74

## SPEED(KTS)

DIRECTION	1 - 3	4 - 6	7 - 10	11-16	17-21	GREATER THAN 21	AVG SPD	TOTAL
N	1	2	7	0	0	0	8.0	10
NNE	1	1	2	3	0	0	8.1	7
NE	0	3	5	0	0	0	7.4	8
ENE	0	2	3	0	0	0	6.4	5
E	0	1	1	1	0	0	8.0	3
ESE	1	1	8	0	0	0	7.8	10
SE	2	6	4	0	0	0	5.6	12
SSE	0	3	3	0	0	0	7.0	6
S	0	3	13	6	3	0	10.6	25
SSW	0	4	21	14	1	0	10.2	40
SW	2	2	24	12	0	0	9.6	40
WSW	2	4	19	4	0	0	8.6	29
W	1	1	19	9	0	0	9.2	30
WNW	0	3	9	17	0	0	10.2	29
NW	2	0	7	3	0	0	8.8	12
NNW	0	3	1	0	0	0	6.5	4
AVG	3.0	5.3	8.8	12.2	18.0	0.0	8.7	
TOTAL	12	39	146	69	4	0		

NUMBER OF OCCURRENCES OF C STABILITY = 283

NUMBER OF CALMS WITH C STABILITY = 13

SEAS JJA

## RELATIVE FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI 8 OBS 1973-74

## SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.001199	0.001359	0.004755	0.000000	0.000000	0.000000	0.007313
NNE	0.001026	0.000679	0.001359	0.002038	0.000000	0.000000	0.005102
NE	0.000520	0.002038	0.003397	0.000000	0.000000	0.000000	0.005954
ENE	0.000346	0.001359	0.002038	0.000000	0.000000	0.000000	0.003743
E	0.000173	0.000679	0.000679	0.000679	0.000000	0.000000	0.002211
ESE	0.001026	0.000679	0.003435	0.000000	0.000000	0.000000	0.007140
SE	0.002744	0.004076	0.002717	0.000000	0.000000	0.000000	0.009538
SSE	0.000520	0.002038	0.002038	0.000000	0.000000	0.000000	0.004596
S	0.000520	0.002038	0.008832	0.004076	0.002038	0.000000	0.017503
SSW	0.000693	0.002717	0.014266	0.009511	0.000679	0.000000	0.027867
SW	0.002051	0.001359	0.016304	0.008152	0.000000	0.000000	0.027867
WSW	0.002398	0.002717	0.012908	0.002717	0.000000	0.000000	0.020740
W	0.001026	0.000679	0.012908	0.006114	0.000000	0.000000	0.020727
WNW	0.000520	0.002038	0.006114	0.011549	0.000000	0.000000	0.020221
NW	0.001705	0.000000	0.004755	0.002038	0.000000	0.000000	0.008499
NNW	0.000520	0.002038	0.000679	0.000000	0.000000	0.000000	0.003237
TOTAL	0.016984	0.026495	0.099185	0.046875	0.002717	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF C STABILITY = 0.192255

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH C STABILITY = 0.008832

SEA= JJA

## FREQUENCY DISTRIBUTION

STATION =14840 MUSKEGON MI 9 OBS 1973-74

## SPEED(KTS)

DIRECTION	1 - 3	4 - 6	7 - 10	11-16	17-21	GREATER THAN 21	AVG SPD	TOTAL
N	0	0	15	13	0	0	10.4	28
NNE	0	1	8	1	0	0	8.0	10
NE	0	3	5	0	0	0	6.5	8
ENE	0	6	7	2	0	0	7.9	15
E	0	8	25	12	0	0	8.9	45
ESE	2	8	11	7	0	0	7.8	28
SE	3	6	17	9	1	0	8.7	36
SSE	0	5	18	6	0	0	6.4	29
S	0	10	40	58	10	2	11.6	120
SSW	3	7	18	62	11	1	12.3	102
SW	0	8	24	45	3	0	11.2	80
WSW	0	11	15	16	1	0	9.4	43
W	0	18	16	19	0	0	8.8	53
WNW	2	6	19	24	1	0	10.6	52
NW	0	4	16	23	0	0	10.7	43
NNW	0	4	8	9	0	0	10.2	21
AVG	3.0	5.1	8.5	13.0	18.1	23.3	10.2	
TOTAL	10	105	262	306	27	3		

NUMBER OF OCCURRENCES OF D STABILITY = 721

NUMBER OF CALMS WITH D STABILITY = 8

SEA- JJA

RELATIVE FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI 8 OBS 1973-74

## SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000000	0.000000	0.010190	0.008832	0.000000	0.000000	0.019022
NNE	0.000047	0.000679	0.005435	0.000679	0.000000	0.000000	0.006841
NE	0.000142	0.002038	0.003397	0.000000	0.000000	0.000000	0.005577
ENE	0.000284	0.004076	0.004755	0.001359	0.000000	0.000000	0.010474
E	0.000378	0.005435	0.016984	0.008152	0.000000	0.000000	0.020949
ESE	0.001831	0.005435	0.007473	0.004755	0.000000	0.000000	0.019494
SE	0.002463	0.004076	0.011549	0.006114	0.000679	0.000000	0.024882
SSE	0.000236	0.003397	0.012228	0.004076	0.000000	0.000000	0.019937
S	0.000473	0.006793	0.027174	0.039402	0.006793	0.001359	0.081994
SSW	0.002511	0.004755	0.012228	0.042120	0.007473	0.000679	0.069766
SW	0.000378	0.005435	0.016304	0.030571	0.002038	0.000000	0.054726
WSW	0.000520	0.007473	0.010190	0.010870	0.000679	0.000000	0.029732
W	0.000851	0.012228	0.010870	0.012908	0.000000	0.000000	0.036856
WNW	0.001737	0.004076	0.012908	0.016304	0.000679	0.000000	0.035704
NW	0.000189	0.002717	0.010870	0.015625	0.000000	0.000000	0.029401
NNW	0.000189	0.002717	0.005435	0.006114	0.000000	0.000000	0.014455
TOTAL	0.012228	0.071332	0.177989	0.207880	0.018342	0.002038	

RELATIVE FREQUENCY OF OCCURRENCE OF D STABILITY = 0.489810

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH D STABILITY = 0.005435

SEA= JJA

## FREQUENCY DISTRIBUTION

STATION =14840 MUSKEGON MI 8 OBS 1973-74

## SPEED(KTS)

DIRECTION	1 - 3	4 - 6	7 - 10	11-16	17-21	GREATER THAN 21	AVG SPD	TOTAL
N	0	3	17	0	0	0	8.0	20
NNE	0	1	3	0	0	0	7.0	4
NE	0	5	2	0	0	0	6.0	7
ENE	0	3	6	0	0	0	6.8	9
E	0	2	7	0	0	0	7.2	9
ESE	0	6	1	0	0	0	5.6	7
SE	0	13	3	0	0	0	5.3	16
SSE	0	5	1	0	0	0	5.8	6
S	0	7	5	0	0	0	6.4	12
SSW	0	3	14	0	0	0	7.6	17
SW	0	4	8	0	0	0	7.4	12
WSW	0	5	9	0	0	0	7.6	14
W	0	8	4	0	0	0	6.4	12
WNW	0	5	4	0	0	0	6.1	9
NW	0	3	3	0	0	0	6.7	6
NNW	0	2	1	0	0	0	6.7	3
AVG	0.0	5.0	8.3	0.0	0.0	0.0	6.8	
TOTAL	0	75	88	0	0	0		
NUMBER OF OCCURRENCES OF E STABILITY	163							
NUMBER OF CALMS WITH E STABILITY	0							

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SEA- JJA

## RELATIVE FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI

8 OBS 1973-74

## SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000000	0.002038	0.011549	0.000000	0.000000	0.000000	0.013587
NNE	0.000000	0.000679	0.002038	0.000000	0.000000	0.000000	0.002717
NE	0.000000	0.003397	0.001359	0.000000	0.000000	0.000000	0.004755
ENE	0.000000	0.002038	0.004076	0.000000	0.000000	0.000000	0.006114
E	0.000000	0.001359	0.004755	0.000000	0.000000	0.000000	0.006114
ESE	0.000000	0.004076	0.000679	0.000000	0.000000	0.000000	0.004755
SE	0.000000	0.008832	0.002038	0.000000	0.000000	0.000000	0.010870
SSE	0.000000	0.003397	0.000679	0.000000	0.000000	0.000000	0.004076
S	0.000000	0.004755	0.003397	0.000000	0.000000	0.000000	0.008152
SSW	0.000000	0.002038	0.009511	0.000000	0.000000	0.000000	0.011549
SW	0.000000	0.002717	0.005435	0.000000	0.000000	0.000000	0.008152
WSW	0.000000	0.003397	0.006114	0.000000	0.000000	0.000000	0.009511
W	0.000000	0.005435	0.002717	0.000000	0.000000	0.000000	0.008152
WNW	0.000000	0.003397	0.002717	0.000000	0.000000	0.000000	0.006114
NW	0.000000	0.002038	0.002038	0.000000	0.000000	0.000000	0.004076
NNW	0.000000	0.001359	0.000679	0.000000	0.000000	0.000000	0.002038
TOTAL	0.000000	0.050951	0.059783	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF E STABILITY = 0.110734

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH E STABILITY = 0.000000

SEA JJA

## FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI

8 OBS 1973-74

## SPEED(KTS)

DIRECTION	1 - 3	4 - 6	7 - 10	11-16	17-21	GREATER THAN 21	AVG SPD	TOTAL
N	1	7	0	0	0	0	5.0	8
NNE	1	5	0	0	0	0	5.0	6
NE	0	8	0	0	0	0	5.3	8
ENE	1	5	0	0	0	0	4.2	6
E	6	5	0	0	0	0	3.9	11
ESE	10	10	0	0	0	0	3.8	20
SE	3	11	0	0	0	0	4.3	14
SSE	5	6	0	0	0	0	4.4	11
S	2	10	0	0	0	0	4.4	12
SSW	3	2	0	0	0	0	3.6	5
SW	6	5	0	0	0	0	3.5	11
WSW	3	4	0	0	0	0	4.6	7
W	3	2	0	0	0	0	3.6	5
WNW	1	2	0	0	0	0	3.7	3
NW	2	4	0	0	0	0	4.3	6
NNW	0	0	0	0	0	0	0.0	0
AVG	3.0	4.9	0.0	0.0	0.0	0.0	2.5	
TOTAL	47	86	0	0	0	0		
NUMBER OF OCCURRENCES OF F STABILITY	227							
NUMBER OF CALMS WITH F STABILITY	94							

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8085 1973-74

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.004520	0.004755	0.000000	0.000000	0.000000	0.000000	0.009276
NNE	0.003560	0.003397	0.000000	0.000000	0.000000	0.000000	0.006957
NE	0.003841	0.003435	0.000000	0.000000	0.000000	0.000000	0.009276
ENE	0.003560	0.003397	0.000000	0.000000	0.000000	0.000000	0.006957
E	0.009358	0.003397	0.000000	0.000000	0.000000	0.000000	0.012754
ESE	0.016396	0.006793	0.000000	0.000000	0.000000	0.000000	0.023190
SE	0.008760	0.007473	0.000000	0.000000	0.000000	0.000000	0.016233
SSE	0.008678	0.004076	0.000000	0.000000	0.000000	0.000000	0.012754
S	0.007120	0.006793	0.000000	0.000000	0.000000	0.000000	0.013914
SSW	0.004439	0.001359	0.000000	0.000000	0.000000	0.000000	0.005797
SW	0.009358	0.003397	0.000000	0.000000	0.000000	0.000000	0.012754
WSW	0.005399	0.002717	0.000000	0.000000	0.000000	0.000000	0.008116
W	0.004439	0.001359	0.000000	0.000000	0.000000	0.000000	0.005797
WNW	0.002120	0.001359	0.000000	0.000000	0.000000	0.000000	0.003478
NW	0.004240	0.002717	0.000000	0.000000	0.000000	0.000000	0.006957
NNW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
TOTAL	0.095788	0.038424	0.000000	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH F STABILITY = 0.063859

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SEA = JJA

## FREQUENCY DISTRIBUTION

STATION = 14840 MUSKEGON MI 8 DBS 1973-74

## SPEED(KTS)

DIRECTION	1 - 3	4 - 6	7 - 10	11-16	17-21	GREATER THAN 21	AVG SPD	TOTAL
N	2	15	41	13	0	0	8.4	71
NNE	2	9	13	4	0	0	7.1	28
NE	0	19	12	0	0	0	6.3	31
ENE	1	17	16	2	0	0	6.8	36
E	7	18	34	13	0	0	7.7	72
ESE	14	25	22	7	0	0	6.3	68
SE	10	37	27	9	1	0	6.6	84
SSE	6	19	22	6	0	0	7.0	53
S	3	33	60	64	13	2	10.4	175
SSW	7	16	57	76	12	1	10.9	169
SW	8	21	63	57	3	0	9.7	152
WSW	5	26	51	20	1	0	8.4	103
W	4	31	45	28	0	0	8.3	108
WNW	3	16	35	41	1	0	9.8	96
NW	5	15	28	26	0	0	9.1	74
NNW	1	9	11	9	0	0	9.0	30
AVG	3.0	5.0	8.5	12.9	18.1	23.3	8.1	
TOTAL	78	326	537	375	31	3		
TOTAL NUMBER OF OBSERVATIONS = 1472								
TOTAL NUMBER OF CALMS = 122								

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SEA= JJA

## RELATIVE FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI 8 DBS 1973-74

## SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.004846	0.010190	0.027853	0.008832	0.000000	0.000000	0.051721
NNE	0.003615	0.006114	0.008832	0.002717	0.000000	0.000000	0.021278
NE	0.003898	0.012908	0.008152	0.000000	0.000000	0.000000	0.024958
ENE	0.004372	0.011549	0.010870	0.001359	0.000000	0.000000	0.028149
E	0.009884	0.012228	0.023098	0.008832	0.000000	0.000000	0.054042
ESE	0.017512	0.016984	0.014946	0.004755	0.000000	0.000000	0.054196
SE	0.016436	0.025136	0.018342	0.006114	0.000679	0.000000	0.066707
SSE	0.009205	0.012908	0.014946	0.004076	0.000000	0.000000	0.041134
S	0.009423	0.022418	0.040761	0.043478	0.008832	0.001359	0.126271
SSW	0.009474	0.010870	0.038723	0.051630	0.008152	0.000679	0.119528
SW	0.011384	0.014266	0.042799	0.038723	0.002038	0.000000	0.109210
WSW	0.009756	0.017663	0.034647	0.013587	0.000679	0.000000	0.076332
W	0.009898	0.021060	0.030571	0.019022	0.000000	0.000000	0.080550
WNW	0.005936	0.010870	0.023777	0.027853	0.000679	0.000000	0.069115
NW	0.007500	0.010190	0.019022	0.017663	0.000000	0.000000	0.054375
NNW	0.002731	0.006114	0.007473	0.006114	0.000000	0.000000	0.022432
TOTAL	0.135869	0.221467	0.364809	0.254755	0.021060	0.002038	

TOTAL RELATIVE FREQUENCY OF OBSERVATIONS = 1.000001

TOTAL RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE = 0.082880

SEA = SDN

FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI 8 OBS 1973-74

## SPEED(KTS)

DIRECTION	1 - 3	4 - 6	7 - 10	11-16	17-21	GREATER THAN 21	AVG SPD	TOTAL
N	0	0	0	0	0	0	0.0	0
NNE	0	0	0	0	0	0	0.0	0
NE	0	0	0	0	0	0	0.0	0
ENE	0	0	0	0	0	0	0.0	0
E	0	0	0	0	0	0	0.0	0
ESE	0	0	0	0	0	0	0.0	0
SE	0	0	0	0	0	0	0.0	0
SSE	0	0	0	0	0	0	0.0	0
S	0	0	0	0	0	0	0.0	0
SSW	0	0	0	0	0	0	0.0	0
SW	0	0	0	0	0	0	0.0	0
WSW	0	0	0	0	0	0	0.0	0
W	0	0	0	0	0	0	0.0	0
WNW	0	0	0	0	0	0	0.0	0
NW	0	0	0	0	0	0	0.0	0
NNW	0	0	0	0	0	0	0.0	0
AVG	0.0	0.0	0.0	0.0	0.0	0.0	0.0	
TOTAL	0	0	0	0	0	0		

NUMBER OF OCCURRENCES OF A STABILITY = 0

NUMBER OF CALMS WITH A STABILITY = 0

SEA# SON

RELATIVE FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI A OBS 1973-74

## SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NNE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ENE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
E	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ESE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
SE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
SSE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
S	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
SSW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
SW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
WSW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
W	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
WNW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NNW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
TOTAL	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF A STABILITY = 0.000000

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH A STABILITY = 0.000000

SEA SON

FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI

8 OBS 1973-74

## SPEED(KTS)

DIRECTION	1 - 3	4 - 6	7 - 10	11-16	17-21	GREATER THAN 21	AVG SPD	TOTAL
N	0	1	1	0	0	0	6.0	2
NNE	0	0	0	0	0	0	0.0	0
NE	0	0	1	0	0	0	7.0	1
ENE	0	2	0	0	0	0	5.5	2
E	0	0	0	0	0	0	0.0	0
ESE	1	0	1	0	0	0	5.0	2
SE	0	0	0	0	0	0	0.0	0
SSE	0	1	0	0	0	0	5.0	1
S	0	1	0	0	0	0	6.0	1
SSH	0	0	1	0	0	0	7.0	1
SW	1	0	0	0	0	0	3.0	1
WSW	0	1	0	0	0	0	6.0	1
W	0	0	0	0	0	0	0.0	0
WNW	0	0	1	0	0	0	7.0	1
NW	0	0	0	0	0	0	0.0	0
NNW	0	1	0	0	0	0	4.0	1
AVG	3.0	5.3	7.0	0.0	0.0	0.0	5.6	
TOTAL	2	7	5	0	0	0		

NUMBER OF OCCURRENCES OF B STABILITY = 14

NUMBER OF CALMS WITH B STABILITY = 0

SEA = SMN

## RELATIVE FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI 8 DBS 1973-74

## SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000000	0.000687	0.000687	0.000000	0.000000	0.000000	0.001374
NNE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NE	0.000000	0.000000	0.000687	0.000000	0.000000	0.000000	0.000687
ENE	0.000000	0.001374	0.000000	0.000000	0.000000	0.000000	0.001374
E	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ESE	0.000687	0.000000	0.000687	0.000000	0.000000	0.000000	0.001374
SE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
SSE	0.000000	0.000687	0.000000	0.000000	0.000000	0.000000	0.000687
S	0.000000	0.000687	0.000000	0.000000	0.000000	0.000000	0.000687
SSH	0.000000	0.000000	0.000687	0.000000	0.000000	0.000000	0.000687
SW	0.000687	0.000000	0.000000	0.000000	0.000000	0.000000	0.000687
WSW	0.000000	0.000687	0.000000	0.000000	0.000000	0.000000	0.000687
W	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
WNW	0.000000	0.000000	0.000687	0.000000	0.000000	0.000000	0.000687
NW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NNW	0.000000	0.000687	0.000000	0.000000	0.000000	0.000000	0.000687
TOTAL	0.001374	0.004808	0.003434	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF B STABILITY = 0.009615

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH B STABILITY = 0.000000

G-50

SEA = SON

FREQUENCY DISTRIBUTION

STATION = 14840 MUSKEGON MI 8 OBS 1973-74

## SPEED(KTS)

DIRECTION	1 - 3	4 - 6	7 - 10	11-16	17-21	GREATER THAN 21	AVG SPD	TOTAL
N	0	0	3	0	0	0	8.7	3
NNE	1	0	4	0	0	0	7.2	5
NE	0	1	1	0	0	0	8.0	2
ENE	0	1	0	0	0	0	6.0	1
E	0	3	2	0	0	0	6.6	5
ESE	0	2	4	1	0	0	7.1	7
SE	0	1	1	0	0	0	6.0	2
SSE	0	1	7	0	0	0	7.4	8
S	0	2	7	1	0	0	8.5	10
SSW	0	1	4	2	0	0	8.3	7
SW	0	1	5	0	0	0	8.2	6
WSW	0	0	3	0	0	0	8.0	3
W	0	1	8	0	0	0	8.1	9
WNW	0	0	5	1	0	0	9.3	6
NW	0	0	6	0	0	0	9.0	6
NNW	0	0	1	1	0	0	9.5	2
AVG	3.0	5.5	8.4	11.0	0.0	0.0	8.0	
TOTAL	1	14	61	6	0	0		
NUMBER OF OCCURRENCES OF C STABILITY = 82								
NUMBER OF CALMS WITH C STABILITY = 0								

G-51

SEA= SDN

RELATIVE FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI

8 DBS

1973-74

## SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000000	0.000000	0.002060	0.000000	0.000000	0.000000	0.002060
NNE	0.000687	0.000000	0.002747	0.000000	0.000000	0.000000	0.003434
NE	0.000000	0.000687	0.000687	0.000000	0.000000	0.000000	0.001374
ENE	0.000000	0.000687	0.000000	0.000000	0.000000	0.000000	0.000687
E	0.000000	0.002060	0.001374	0.000000	0.000000	0.000000	0.003434
ESE	0.000000	0.001374	0.002747	0.000687	0.000000	0.000000	0.004808
SE	0.000000	0.000687	0.000687	0.000000	0.000000	0.000000	0.001374
SSE	0.000000	0.000687	0.004808	0.000000	0.000000	0.000000	0.005495
S	0.000000	0.001374	0.004808	0.000687	0.000000	0.000000	0.006868
SSW	0.000000	0.000687	0.002747	0.001374	0.000000	0.000000	0.004808
SW	0.000000	0.000687	0.003434	0.000000	0.000000	0.000000	0.004121
WSW	0.000000	0.000000	0.002060	0.000000	0.000000	0.000000	0.002060
W	0.000000	0.000687	0.005495	0.000000	0.000000	0.000000	0.006181
WNW	0.000000	0.000000	0.003434	0.000687	0.000000	0.000000	0.004121
NW	0.000000	0.000000	0.004121	0.000000	0.000000	0.000000	0.004121
NNW	0.000000	0.000000	0.000687	0.000687	0.000000	0.000000	0.001374
TOTAL	0.000687	0.009615	0.041896	0.004121	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF C STABILITY = 0.056319

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH C STABILITY = 0.000000



SEA- SON

FREQUENCY DISTRIBUTION

STATION =14840 MUSKEGON MI 8 OBS 1973-74

## SPEED(KTS)

DIRECTION	1 - 3	4 - 6	7 - 10	11-16	17-21	GREATER THAN 21	AVG SPD	TOTAL
N	2	13	37	21	0	0	8.8	73
NNE	1	4	12	3	0	0	8.4	20
NE	1	4	8	1	0	0	7.2	14
ENE	1	0	15	12	1	0	10.6	29
E	1	16	28	24	2	0	9.4	71
ESE	1	7	19	17	2	0	9.6	46
SE	2	11	34	14	1	0	8.8	62
SSE	0	4	18	13	0	0	9.5	35
S	0	6	20	60	16	0	13.0	102
SSW	1	1	18	64	19	0	13.5	103
SW	1	6	22	42	8	2	12.3	81
WSW	1	3	14	26	1	0	11.4	45
W	1	3	22	40	12	0	12.5	78
WNW	0	6	25	51	12	0	12.2	94
NW	0	4	26	38	14	1	12.7	103
NNW	2	3	20	25	6	2	11.7	58
AVG	3.0	5.1	8.7	13.3	18.2	22.6	11.3	
TOTAL	15	91	338	471	94	5		

NUMBER OF OCCURRENCES OF D STABILITY = 1024

NUMBER OF CALMS WITH D STABILITY = 10

SEA SON

RELATIVE FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI

8 OBS 1973-74

## SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.002346	0.008929	0.025412	0.014423	0.000000	0.000000	0.051109
NNE	0.001011	0.002747	0.008242	0.002060	0.000000	0.000000	0.014060
NE	0.001011	0.002747	0.005495	0.000697	0.000000	0.000000	0.009939
ENE	0.000752	0.000000	0.010302	0.008242	0.000687	0.000000	0.019982
E	0.001788	0.010989	0.019231	0.016484	0.001374	0.000000	0.049865
ESE	0.001205	0.004808	0.013049	0.011676	0.001374	0.000000	0.032112
SE	0.002216	0.007555	0.023352	0.009615	0.000687	0.000000	0.043425
SSE	0.000259	0.002747	0.012363	0.008929	0.000000	0.000000	0.024298
S	0.000389	0.004121	0.013736	0.041209	0.010989	0.000000	0.070444
SSH	0.000816	0.000687	0.012363	0.043956	0.013049	0.000000	0.070871
SW	0.001140	0.004121	0.015110	0.028846	0.005495	0.001374	0.056085
WSW	0.000946	0.002060	0.009615	0.017857	0.000687	0.000000	0.031166
W	0.000946	0.002060	0.015110	0.027473	0.008242	0.000000	0.053631
WNW	0.000389	0.004121	0.017170	0.035027	0.008242	0.000000	0.064949
NW	0.000259	0.002747	0.017857	0.039835	0.009615	0.000687	0.071001
NNW	0.001698	0.002060	0.013736	0.017170	0.004121	0.001374	0.040159
TOTAL	0.017170	0.062500	0.232143	0.323489	0.064560	0.003434	

RELATIVE FREQUENCY OF OCCURRENCE OF D STABILITY = 0.702297

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH D STABILITY = 0.006868

SEA = SON		FREQUENCY DISTRIBUTION				STATION = 14840 MUSKEGON MI		8 OBS 1973-74	
SPEED(KTS)									
DIRECTION	1 - 3	4 - 6	7 - 10	11-16	17-21	GREATER THAN 21	AVG SPD	TOTAL	
N	0	5	6	0	0	0	6.9	11	
NNE	0	3	1	0	0	0	5.5	4	
NE	0	4	0	0	0	0	5.0	4	
ENE	0	7	1	0	0	0	5.1	8	
E	0	13	8	0	0	0	6.1	21	
ESE	0	6	4	0	0	0	5.8	10	
SE	0	14	7	0	0	0	6.0	21	
SSE	0	4	4	0	0	0	6.9	8	
S	0	3	8	0	0	0	7.4	11	
SSW	0	2	8	0	0	0	7.5	10	
SW	0	1	2	0	0	0	7.0	3	
WSW	0	2	6	0	0	0	6.6	8	
W	0	3	6	0	0	0	7.2	9	
WNW	0	1	2	0	0	0	7.7	3	
NW	0	1	7	0	0	0	7.9	8	
NNW	0	2	3	0	0	0	7.4	5	
AVG	0.0	5.0	6.1	0.0	0.0	0.0	6.6		
TOTAL	0	71	73	0	0	0			
NUMBER OF OCCURRENCES OF E STABILITY = 144									
NUMBER OF CALMS WITH E STABILITY = 0									

NUMBER OF OCCURRENCES OF E STABILITY ■ 144

NUMBER OF CALMS WITH E STABILITY : 0

SEA = SDN

## RELATIVE FREQUENCY DISTRIBUTION

STATION = 14860 MUSKEGON MI R OBS 1973-74

## SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000000	0.003434	0.004121	0.000000	0.000000	0.000000	0.007555
NNE	0.000000	0.002060	0.000687	0.000000	0.000000	0.000000	0.002747
NE	0.000000	0.002747	0.000000	0.000000	0.000000	0.000000	0.002747
ENE	0.000000	0.004808	0.000687	0.000000	0.000000	0.000000	0.005495
E	0.000000	0.008929	0.005495	0.000000	0.000000	0.000000	0.014423
ESE	0.000000	0.004121	0.002747	0.000000	0.000000	0.000000	0.006868
SE	0.000000	0.009615	0.004808	0.000000	0.000000	0.000000	0.014423
SSE	0.000000	0.002747	0.002747	0.000000	0.000000	0.000000	0.005495
S	0.000000	0.002060	0.005495	0.000000	0.000000	0.000000	0.007555
SSW	0.000000	0.001374	0.005495	0.000000	0.000000	0.000000	0.006868
SW	0.000000	0.000687	0.001374	0.000000	0.000000	0.000000	0.002060
WSW	0.000000	0.001374	0.004121	0.000000	0.000000	0.000000	0.005495
W	0.000000	0.002060	0.004121	0.000000	0.000000	0.000000	0.006181
WNW	0.000000	0.000687	0.001374	0.000000	0.000000	0.000000	0.002060
NW	0.000000	0.000687	0.004808	0.000000	0.000000	0.000000	0.005495
NNW	0.000000	0.001374	0.002060	0.000000	0.000000	0.000000	0.003434
TOTAL	0.000000	0.048764	0.050137	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF E STABILITY = 0.098901

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH E STABILITY = 0.000000

SEA= SDN

## FREQUENCY DISTRIBUTION

STATION =14840 MUSKEGON MI 8 OBS 1973-74

## SPEED(KTS)

DIRECTION	1 - 3	4 - 6	7 - 10	11-16	17-21	GREATER THAN 21	AVG SPD	TOTAL
N	0	8	0	0	0	0	5.0	8
NNE	0	4	0	0	0	0	5.8	4
NE	4	0	0	0	0	0	3.0	4
ENE	1	5	0	0	0	0	4.3	6
E	10	16	0	0	0	0	4.0	26
ESE	8	19	0	0	0	0	4.4	27
SE	12	15	0	0	0	0	3.9	27
SSE	1	6	0	0	0	0	4.3	7
S	2	6	0	0	0	0	4.4	8
SSW	1	3	0	0	0	0	3.8	4
SW	1	2	0	0	0	0	3.7	3
WSW	0	3	0	0	0	0	4.7	3
W	0	6	0	0	0	0	4.8	6
WNW	0	4	0	0	0	0	4.5	4
NW	2	6	0	0	0	0	5.0	8
NNW	1	2	0	0	0	0	4.3	3
AVG	3.0	4.8	0.0	0.0	0.0	0.0	3.3	
TOTAL	43	105	0	0	0	0		

NUMBER OF OCCURRENCES OF F STABILITY = 192

NUMBER OF CALMS WITH F STABILITY = 44

SEA = SDN

## RELATIVE FREQUENCY DISTRIBUTION

STATION = 14840 MUSKEGON MI

8 DAS 1973-74

## SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.001634	0.003495	0.000000	0.000000	0.000000	0.000000	0.007128
NNE	0.000817	0.002747	0.000000	0.000000	0.000000	0.000000	0.003564
NE	0.003564	0.000000	0.000000	0.000000	0.000000	0.000000	0.003564
ENE	0.001912	0.003434	0.000000	0.000000	0.000000	0.000000	0.005346
E	0.012177	0.010989	0.000000	0.000000	0.000000	0.000000	0.023166
ESE	0.011008	0.013049	0.000000	0.000000	0.000000	0.000000	0.024057
SE	0.013755	0.010302	0.000000	0.000000	0.000000	0.000000	0.024057
SSE	0.002116	0.004121	0.000000	0.000000	0.000000	0.000000	0.006237
S	0.003007	0.004121	0.000000	0.000000	0.000000	0.000000	0.007128
SSW	0.001504	0.002060	0.000000	0.000000	0.000000	0.000000	0.003564
SW	0.001299	0.001374	0.000000	0.000000	0.000000	0.000000	0.002673
WSW	0.000613	0.002060	0.000000	0.000000	0.000000	0.000000	0.002673
W	0.001225	0.004121	0.000000	0.000000	0.000000	0.000000	0.005346
WNW	0.000817	0.002747	0.000000	0.000000	0.000000	0.000000	0.003564
NW	0.003007	0.004121	0.000000	0.000000	0.000000	0.000000	0.007128
NNW	0.001299	0.001374	0.000000	0.000000	0.000000	0.000000	0.002673
TOTAL	0.059753	0.072115	0.000000	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF F STABILITY = 0.131868

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH F STABILITY = 0.030220

SEA SON

FREQUENCY DISTRIBUTION

STATION =14840 MUSKEGON MI 8 OBS 1973-74

## SPEED(KTS)

DIRECTION	1 - 3	4 - 6	7 - 10	11-16	17-21	GREATER THAN 21	AVG SPD	TOTAL
N	2	27	47	21	0	0	8.2	97
NNE	2	11	17	3	0	0	7.5	33
NE	5	9	10	1	0	0	6.2	25
ENE	2	15	16	12	1	0	8.5	46
E	11	48	38	24	2	0	7.6	123
ESE	10	34	28	18	2	0	7.4	92
SE	14	41	42	14	1	0	7.0	112
SSE	1	16	29	13	0	0	8.2	59
S	2	18	35	61	16	0	11.6	132
SSW	2	7	31	66	19	0	12.4	125
SW	3	10	29	42	8	2	11.5	94
WSW	1	9	23	26	1	0	10.2	60
W	1	13	36	40	12	0	11.2	102
WNW	0	11	33	52	12	0	11.5	108
NW	2	11	39	58	14	1	11.7	125
NNW	3	8	24	26	6	2	10.9	69
AVG	3.0	5.0	8.5	13.3	18.2	22.6	9.5	
TOTAL	61	288	477	477	94	5		
TOTAL NUMBER OF OBSERVATIONS = 1456								
TOTAL NUMBER OF CALMS = 54								

SEA: SDN

## RELATIVE FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI 8 OBS 1973-74

## SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.004455	0.018544	0.032280	0.014423	0.000000	0.000000	0.069703
NNE	0.002755	0.007555	0.011676	0.002060	0.000000	0.000000	0.024046
NE	0.004922	0.006181	0.006868	0.000687	0.000000	0.000000	0.018658
ENE	0.003180	0.010302	0.010989	0.008242	0.000687	0.000000	0.033400
E	0.013825	0.032967	0.026099	0.016484	0.001374	0.000000	0.090748
ESE	0.011544	0.023352	0.019231	0.012363	0.001374	0.000000	0.067863
SE	0.015460	0.028159	0.028846	0.009615	0.000687	0.000000	0.082768
SSE	0.002493	0.010989	0.019918	0.008929	0.000000	0.000000	0.042329
S	0.003499	0.012363	0.024038	0.041896	0.010989	0.000000	0.092785
SSW	0.002330	0.004868	0.021291	0.045330	0.013049	0.000000	0.086808
SW	0.003442	0.006868	0.019918	0.028846	0.005495	0.001374	0.065942
WSW	0.001750	0.006181	0.015797	0.017857	0.000687	0.000000	0.042271
W	0.002175	0.008929	0.024725	0.027473	0.008242	0.000000	0.071543
WNW	0.001169	0.007555	0.022665	0.035714	0.008242	0.000000	0.075345
NW	0.002755	0.007555	0.026786	0.039835	0.009615	0.000687	0.087233
NNW	0.003229	0.005495	0.016484	0.017857	0.004121	0.001374	0.048559
TOTAL	0.078983	0.197802	0.327610	0.327610	0.064560	0.003434	

TOTAL RELATIVE FREQUENCY OF OBSERVATIONS = 1.000001

TOTAL RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE = 0.037088



ANNUAL

FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI

8 OBS

1973-74

SPEED(KTS)

DIRECTION	1 - 3	4 - 6	7 - 10	11-16	17-21	GREATER THAN 21	AVG SPD	TOTAL
N	0	0	0	0	0	0	0.0	0
NNE	0	0	0	0	0	0	0.0	0
NE	0	0	0	0	0	0	0.0	0
ENE	0	0	0	0	0	0	0.0	0
E	0	1	0	0	0	0	5.0	1
ESE	0	0	0	0	0	0	0.0	0
SE	0	0	0	0	0	0	0.0	0
SSE	0	0	0	0	0	0	0.0	0
S	0	0	0	0	0	0	0.0	0
SSW	0	0	0	0	0	0	0.0	0
SW	0	1	0	0	0	0	5.0	1
WSW	0	0	0	0	0	0	0.0	0
W	0	0	0	0	0	0	0.0	0
WNW	0	0	0	0	0	0	0.0	0
NW	0	1	0	0	0	0	5.0	1
NNW	0	0	0	0	0	0	0.0	0
AVG	0.0	5.0	0.0	0.0	0.0	0.0	5.0	
TOTAL	0	3	0	0	0	0		

NUMBER OF OCCURRENCES UP A STABILITY = 3

NUMBER OF CALMS WITH A STABILITY = 0

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ANNUAL

RELATIVE FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI 8 DBS 1973-74

## SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NNE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
ENE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
E	0.000000	0.000171	0.000000	0.000000	0.000000	0.000000	0.000171
ESE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
SE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
SSE	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
S	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
SSW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
SW	0.000000	0.000171	0.000000	0.000000	0.000000	0.000000	0.000171
WSW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
W	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
WNW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
NW	0.000000	0.000171	0.000000	0.000000	0.000000	0.000000	0.000171
NNW	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
TOTAL	0.000000	0.000514	0.000000	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF A STABILITY = 0.000514

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH A STABILITY = 0.000000

ANNUAL

FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI 8 GBS 1973-74

## SPEED(KTS)

DIRECTION	1 - 3	4 - 6	7 - 10	11-16	17-21	GREATER THAN 21	AVG SPD	TOTAL
N	0	5	4	0	0	0	5.9	9
NNE	2	2	0	0	0	0	3.8	4
NE	0	1	1	0	0	0	6.0	2
ENE	1	3	1	0	0	0	5.4	5
E	2	6	1	0	0	0	5.0	9
ESE	2	1	3	0	0	0	5.5	6
SE	2	2	5	0	0	0	5.6	9
SSE	1	1	0	0	0	0	4.0	2
S	1	4	2	0	0	0	6.0	7
SSW	1	0	6	0	0	0	6.4	7
SW	1	2	7	0	0	0	6.9	10
WSW	0	3	9	0	0	0	7.4	12
W	0	3	6	0	0	0	7.0	9
WNW	0	1	4	0	0	0	7.6	5
NW	1	3	2	0	0	0	5.5	6
NNW	2	2	3	0	0	0	5.1	7
AVG	3.0	5.2	7.5	0.0	0.0	0.0	5.4	
TOTAL	16	39	54	0	0	0		

NUMBER OF OCCURRENCES OF B STABILITY = 121

NUMBER OF CALMS WITH B STABILITY = 12

ANNUAL

RELATIVE FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI

8 OBS 1973-74

## SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000187	0.000856	0.000685	0.000000	0.000000	0.000000	0.001728
NNE	0.000492	0.000342	0.000000	0.000000	0.000000	0.000000	0.000834
NE	0.000037	0.000171	0.000171	0.000000	0.000000	0.000000	0.000380
ENE	0.000321	0.000514	0.000171	0.000000	0.000000	0.000000	0.001006
E	0.000641	0.001027	0.000171	0.000000	0.000000	0.000000	0.001840
ESE	0.000455	0.000171	0.000514	0.000000	0.000000	0.000000	0.001139
SE	0.000492	0.000342	0.000856	0.000000	0.000000	0.000000	0.001691
SSE	0.000246	0.000171	0.000000	0.000000	0.000000	0.000000	0.000417
S	0.000358	0.000685	0.000342	0.000000	0.000000	0.000000	0.001385
SSW	0.000209	0.000000	0.001027	0.000000	0.000000	0.000000	0.001236
SW	0.000283	0.000342	0.001199	0.000000	0.000000	0.000000	0.001824
WSW	0.000112	0.000514	0.001541	0.000000	0.000000	0.000000	0.002167
W	0.000112	0.000514	0.001027	0.000000	0.000000	0.000000	0.001653
WNW	0.000037	0.000171	0.000685	0.000000	0.000000	0.000000	0.000894
NW	0.000321	0.000514	0.000342	0.000000	0.000000	0.000000	0.001177
NNW	0.000492	0.000342	0.000514	0.000000	0.000000	0.000000	0.001348
TOTAL	0.004795	0.006678	0.009247	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF B STABILITY = 0.020719

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH B STABILITY = 0.002055

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ANNUAL		FREQUENCY DISTRIBUTION					STATION #14840 MUSKEGON MI		8 OBS 1973-74	
SPEED(KTS)										
DIRECTION	1 - 3	4 - 6	7 - 10	11-16	17-21	GREATER THAN 21	AVG SPD	TOTAL		
N	1	2	15	0	1	0	9.0	19		
NNE	2	1	8	3	0	0	7.9	14		
NE	0	6	14	0	0	0	7.4	20		
ENE	0	4	4	1	0	0	7.0	9		
E	1	6	8	3	0	0	7.8	18		
ESE	2	4	15	3	0	0	7.7	24		
SE	2	10	8	0	0	0	6.0	20		
SSE	1	5	12	1	0	0	7.3	19		
S	0	6	25	7	3	0	9.7	41		
SSW	0	5	29	19	1	0	9.8	54		
SW	2	4	35	13	0	0	9.4	54		
WSW	3	4	32	4	0	0	8.4	43		
W	2	2	39	14	0	0	9.0	57		
WNW	0	6	22	26	2	0	10.3	56		
NW	2	1	17	4	0	0	8.9	24		
NNW	0	3	5	2	0	0	8.2	10		
AVG	3.0	5.3	8.7	12.1	18.3	0.0	8.5			
TOTAL	18	69	288	100	7	0				
NUMBER OF OCCURRENCES OF C STABILITY = 503										
NUMBER OF CALMS WITH C STABILITY = 21										

ANNUAL

RELATIVE FREQUENCY DISTRIBUTION

STATION #14340 MUSKEGON MI

A DBS 1973-74

## SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000295	0.000342	0.002568	0.000000	0.000171	0.000000	0.003377
NNE	0.000466	0.000171	0.001370	0.000514	0.000000	0.000000	0.002521
NE	0.000248	0.001027	0.002397	0.000000	0.000000	0.000000	0.003673
ENE	0.000165	0.000685	0.000685	0.000171	0.000000	0.000000	0.001706
E	0.000461	0.001027	0.001370	0.000514	0.000000	0.000000	0.003372
ESE	0.000590	0.000685	0.002568	0.000514	0.000000	0.000000	0.004358
SE	0.000838	0.001712	0.001370	0.000000	0.000000	0.000000	0.003921
SSE	0.000419	0.000836	0.002055	0.000171	0.000000	0.000000	0.003501
S	0.000248	0.001027	0.004281	0.001199	0.000514	0.000000	0.007269
SSW	0.000207	0.000836	0.004966	0.003253	0.000171	0.000000	0.009453
SW	0.000590	0.000685	0.005993	0.002226	0.000000	0.000000	0.009495
WSW	0.000803	0.000685	0.005479	0.000685	0.000000	0.000000	0.007652
W	0.000508	0.000342	0.006678	0.002397	0.000000	0.000000	0.009926
WNW	0.000248	0.001027	0.003767	0.004432	0.000342	0.000000	0.009837
NW	0.000466	0.000171	0.002911	0.000685	0.000000	0.000000	0.004234
NNW	0.000124	0.000314	0.000856	0.000342	0.000000	0.000000	0.001836
TOTAL	0.006678	0.011815	0.049315	0.017123	0.001199	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF C STABILITY = 0.086130

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH C STABILITY = 0.003596

## ANNUAL

## FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI 8 OBS 1973-74

## SPEED(KTS)

DIRECTION	1 - 3	4 - 6	7 - 10	11-16	17-21	GREATER THAN 21	AVG SPD	TOTAL
N	4	26	109	85	3	1	9.8	228
NNE	1	19	47	22	0	0	8.8	89
NE	3	20	42	20	2	0	8.6	87
ENE	5	21	64	60	14	0	10.4	164
E	3	55	146	196	25	2	10.9	427
ESE	5	40	83	96	9	1	10.1	234
SE	11	41	120	80	6	1	9.3	259
SSE	3	24	54	47	2	0	9.3	130
S	4	31	86	201	73	22	13.3	417
SSW	4	16	58	191	71	5	13.4	345
SW	2	23	69	163	43	7	12.6	307
WSW	2	22	70	100	11	0	11.0	205
W	2	34	103	146	28	2	11.4	315
WNW	3	25	93	171	25	2	11.9	319
NW	5	17	84	161	31	6	12.2	304
NNW	3	17	58	101	28	10	12.6	217
AVG	3.0	5.2	8.6	13.3	18.4	23.8	11.3	
TOTAL	60	431	1286	1840	371	59		
NUMBER OF OCCURRENCES OF D STABILITY = 4078								
NUMBER OF CALMS WITH D STABILITY = 31								

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ANNUAL

RELATIVE FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI

A OBS 1973-74

## SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.001009	0.004452	0.018664	0.014555	0.000514	0.000171	0.039365
NNE	0.000387	0.003253	0.008048	0.003767	0.000000	0.000000	0.015456
NE	0.000762	0.003425	0.007192	0.003425	0.000342	0.000000	0.015146
ENE	0.001137	0.003596	0.010259	0.010274	0.002397	0.000000	0.028363
E	0.001141	0.009418	0.025000	0.033562	0.004281	0.000342	0.073743
ESE	0.001343	0.006849	0.014212	0.016438	0.001541	0.000171	0.040555
SE	0.002446	0.007021	0.020548	0.013699	0.001027	0.000171	0.044911
SSE	0.000806	0.004110	0.009247	0.008048	0.000342	0.000000	0.022552
S	0.001063	0.005308	0.014726	0.034418	0.012500	0.003767	0.071782
SSW	0.000901	0.002740	0.009932	0.032705	0.012158	0.000856	0.059292
SW	0.000613	0.003938	0.011815	0.027911	0.007363	0.001199	0.052839
WSW	0.000602	0.003767	0.011986	0.017123	0.001884	0.000000	0.035362
W	0.000732	0.005822	0.017637	0.025000	0.004795	0.000342	0.054328
WNW	0.000816	0.004281	0.015925	0.029281	0.004281	0.000342	0.054926
NW	0.001094	0.002911	0.014384	0.027568	0.005308	0.001027	0.052293
NNW	0.000730	0.002911	0.009932	0.017295	0.004795	0.001712	0.037374
TOTAL	0.015582	0.073801	0.220205	0.313068	0.063527	0.010103	

RELATIVE FREQUENCY OF OCCURRENCE OF D STABILITY = 0.698288

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH D STABILITY = 0.005308



ANNUAL

FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI

8 OBS 1973-74

## SPEED(KTS)

DIRECTION	1 - 3	4 - 6	7 - 10	11-16	17-21	GREATER THAN 21	AVG SPD	TOTAL
N	0	14	45	0	0	0	7.6	59
NNE	0	4	17	0	0	0	7.3	21
NE	0	13	9	0	0	0	6.5	22
ENE	0	17	15	0	0	0	6.3	32
E	0	21	24	0	0	0	6.8	45
ESE	0	27	22	0	0	0	6.4	49
SE	0	37	21	0	0	0	6.1	58
SSE	0	15	9	0	0	0	6.5	24
S	0	13	17	0	0	0	6.8	30
SSW	0	6	27	0	0	0	7.6	33
SW	0	6	22	0	0	0	7.7	28
WSW	0	9	23	0	0	0	7.3	32
W	0	15	13	0	0	0	6.8	28
WNW	0	12	14	0	0	0	7.0	26
NW	0	9	16	0	0	0	7.0	25
NNW	0	6	15	0	0	0	7.7	21
AVG	0.0	5.0	8.3	0.0	0.0	0.0	6.9	
TOTAL	0	224	309	0	0	0		
NUMBER OF OCCURRENCES OF E STABILITY = 533								
NUMBER OF CALMS WITH E STABILITY = 0								

ANNUAL

RELATIVE FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI

8 OBS 1973-74

SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.000000	0.002397	0.007705	0.000000	0.000000	0.000000	0.010103
NNE	0.000000	0.000685	0.002911	0.000000	0.000000	0.000000	0.003596
NE	0.000000	0.002226	0.001541	0.000000	0.000000	0.000000	0.003767
ENE	0.000000	0.002911	0.002568	0.000000	0.000000	0.000000	0.005479
E	0.000000	0.003596	0.004110	0.000000	0.000000	0.000000	0.007705
ESE	0.000000	0.004623	0.003767	0.000000	0.000000	0.000000	0.008390
SE	0.000000	0.006336	0.003596	0.000000	0.000000	0.000000	0.009932
SSE	0.000000	0.002568	0.001541	0.000000	0.000000	0.000000	0.004110
S	0.000000	0.002226	0.002911	0.000000	0.000000	0.000000	0.005137
SSW	0.000000	0.001027	0.004623	0.000000	0.000000	0.000000	0.005651
SW	0.000000	0.001027	0.003767	0.000000	0.000000	0.000000	0.004795
WSW	0.000000	0.001541	0.003938	0.000000	0.000000	0.000000	0.005479
W	0.000000	0.002568	0.002226	0.000000	0.000000	0.000000	0.004795
WNW	0.000000	0.002035	0.002397	0.000000	0.000000	0.000000	0.004432
NW	0.000000	0.001541	0.002740	0.000000	0.000000	0.000000	0.004281
NNW	0.000000	0.001027	0.002568	0.000000	0.000000	0.000000	0.003596
TOTAL	0.000000	0.028356	0.052911	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF E STABILITY = 0.091267

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH E STABILITY = 0.000000

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## ANNUAL

## FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI

R OBS 1973-74

## SPEED(KTS)

DIRECTION	1 - 3	4 - 6	7 - 10	11-16	17-21	GREATER THAN 21	AVG SPD	TOTAL
N	3	27	0	0	0	0	5.0	30
NNE	2	19	0	0	0	0	5.5	21
NE	7	15	0	0	0	0	4.6	22
ENE	3	19	0	0	0	0	4.5	22
E	19	23	0	0	0	0	4.0	42
ESE	27	42	0	0	0	0	4.2	69
SE	20	38	0	0	0	0	4.1	58
SSE	9	14	0	0	0	0	4.2	22
S	5	24	0	0	0	0	4.6	29
SSW	6	9	0	0	0	0	4.2	15
SW	11	14	0	0	0	0	4.0	25
WSW	5	12	0	0	0	0	4.6	17
W	5	11	0	0	0	0	4.4	16
WNW	2	13	0	0	0	0	4.8	15
NW	4	13	0	0	0	0	4.5	17
NNW	1	5	0	0	0	0	4.7	6
AVG	3.0	5.0	0.0	0.0	0.0	0.0	3.1	
TOTAL	128	298	0	0	0	0		

NUMBER OF OCCURRENCES OF F STABILITY = 602

NUMBER OF CALMS WITH F STABILITY = 176

ANNUAL

RELATIVE FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI

8 OBS 1973-74

## SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.002636	0.004623	0.000000	0.000000	0.000000	0.000000	0.007259
NNE	0.001828	0.003253	0.000000	0.000000	0.000000	0.000000	0.005082
NE	0.002755	0.002568	0.000000	0.000000	0.000000	0.000000	0.005323
ENE	0.002070	0.003253	0.000000	0.000000	0.000000	0.000000	0.005323
E	0.006225	0.003938	0.000000	0.000000	0.000000	0.000000	0.010163
ESE	0.003505	0.007192	0.000000	0.000000	0.000000	0.000000	0.010696
SE	0.007528	0.006507	0.000000	0.000000	0.000000	0.000000	0.014035
SSE	0.002926	0.002397	0.000000	0.000000	0.000000	0.000000	0.005323
S	0.002908	0.004110	0.000000	0.000000	0.000000	0.000000	0.007017
SSW	0.002089	0.001541	0.000000	0.000000	0.000000	0.000000	0.003630
SW	0.003652	0.002397	0.000000	0.000000	0.000000	0.000000	0.006049
WSW	0.002059	0.002055	0.000000	0.000000	0.000000	0.000000	0.004114
W	0.001988	0.001884	0.000000	0.000000	0.000000	0.000000	0.003872
WNW	0.001404	0.002226	0.000000	0.000000	0.000000	0.000000	0.003630
NW	0.001888	0.002226	0.000000	0.000000	0.000000	0.000000	0.004114
NNW	0.000596	0.000856	0.000000	0.000000	0.000000	0.000000	0.001452
TOTAL	0.052055	0.051027	0.000000	0.000000	0.000000	0.000000	

RELATIVE FREQUENCY OF OCCURRENCE OF F STABILITY = 0.103082

RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE WITH F STABILITY = 0.030137

ANNUAL		FREQUENCY DISTRIBUTION					STATION #14840 MUSKEGON MI		8 OBS 1973-74	
		SPEED(KTS)								
DIRECTION	1 - 3	4 - 6	7 - 10	11-16	17-21	GREATER THAN 21	AVG SPD	TOTAL		
N	8	74	173	85	4	1	8.8	345		
NNE	7	45	72	25	0	0	7.9	149		
NE	10	55	66	20	2	0	7.5	153		
ENE	9	64	84	61	14	0	9.1	232		
E	25	112	179	199	25	2	9.8	542		
ESE	36	114	123	99	9	1	8.3	382		
SE	35	128	154	80	6	1	7.8	404		
SSE	13	59	75	48	2	0	8.1	197		
S	10	78	130	208	76	22	12.0	524		
SSW	11	36	120	210	72	5	12.2	454		
SW	16	50	133	176	43	7	11.2	425		
WSW	10	50	134	104	11	0	9.8	309		
W	9	65	161	160	28	2	10.4	425		
WNW	5	57	133	197	27	2	11.1	421		
NW	12	44	119	165	31	6	11.2	377		
NNW	6	33	81	103	28	10	11.6	261		
AVG	3.0	5.1	8.5	13.3	18.4	23.8	9.7			
TOTAL	222	1064	1937	1940	378	59				
TOTAL NUMBER OF OBSERVATIONS =		5840								
TOTAL NUMBER OF CALMS =		240								

TOTAL NUMBER OF CALMS ■ 240

ANNUAL

RELATIVE FREQUENCY DISTRIBUTION

STATION #14840 MUSKEGON MI 8 OBS 1973-74

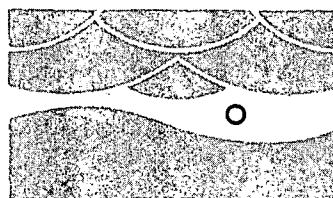
## SPEED(KTS)

DIRECTION	0 - 3	4 - 6	7 - 10	11 - 16	17 - 21	GREATER THAN 21	TOTAL
N	0.003990	0.012671	0.029623	0.014555	0.000685	0.000171	0.061696
NNE	0.002860	0.007705	0.012329	0.004281	0.000000	0.000000	0.027175
NE	0.003789	0.009418	0.011301	0.003425	0.000342	0.000000	0.028276
ENE	0.003874	0.010959	0.014384	0.010445	0.002397	0.000000	0.042059
E	0.008659	0.019178	0.030651	0.034075	0.004281	0.000342	0.097186
ESE	0.010958	0.019521	0.021062	0.016952	0.001541	0.000171	0.070204
SE	0.011202	0.021918	0.026370	0.013699	0.001027	0.000171	0.074387
SSE	0.004527	0.010103	0.012842	0.008219	0.000342	0.000000	0.036034
S	0.004524	0.013356	0.022260	0.035616	0.013014	0.003767	0.092538
SSW	0.003386	0.006154	0.020548	0.035959	0.012329	0.000856	0.079242
SW	0.004849	0.008562	0.022774	0.030137	0.007363	0.001199	0.074893
WSW	0.003630	0.008562	0.022945	0.017808	0.001884	0.000000	0.054828
W	0.003906	0.011130	0.027568	0.027397	0.004795	0.000342	0.075139
WNW	0.002837	0.009760	0.022774	0.033733	0.004623	0.000342	0.074070
NW	0.003844	0.007534	0.020377	0.028253	0.005308	0.001027	0.066344
NNW	0.002274	0.005651	0.013870	0.017637	0.004795	0.001712	0.045938
TOTAL	0.079109	0.182191	0.331678	0.332191	0.064726	0.010103	

TOTAL RELATIVE FREQUENCY OF OBSERVATIONS = 1.000001

TOTAL RELATIVE FREQUENCY OF CALMS DISTRIBUTED ABOVE = 0.041096

DEPARTMENT OF ATMOSPHERIC & OCEANIC SCIENCE



The University of Michigan  
College of Engineering  
Space Research Building  
2455 Hayward  
Ann Arbor, Michigan 48105  
313/764-3335

September 24, 1975

Mr. Walt Strod1  
Consumers Power Company  
212 West Michigan Avenue  
Jackson, Michigan 49201

Dear Walt,

Enclosed are copies of figures which we have made in an analysis of wind data for locations near the Palisades plant. Data presented here are for the 55 foot tower (labeled TOWER or PTWR in the figures) and our station #3 (labeled P03A in the figures), for the months August through December 1973. We performed the same analyses for all 4 of the wind stations in our two meteorological networks, although only the P03A data is included here since it is the most representative of the four stations for the Palisades site. Except as noted in the following discussion, the results for station P03A are very similar to results for all of the stations in our networks.

Figures 1-5 are monthly wind roses for the Palisades tower. They are computer-drawn and produced by the same program which produced the wind rose plots published in our second data report. The fact that there is no number in the center of any of the plots indicates that calms were recorded at the tower zero percent of the time (to the nearest whole percent) in any particular month. We found only two hours of calm at the tower (both in August) during the entire 5 months. An apparent  $5\frac{1}{2}$  day period of calm in December was due to a frozen instrument and was discarded as missing data.

A word regarding our data processing techniques is appropriate here to aid in interpreting the percentage of calms reported at P03A for the same 5 months. The percentage frequency tables and wind roses published in our data reports are based on hours when both wind direction and wind speed sensors were operating. However, in an attempt to recover as much data as possible, a "calm" indication by either sensor was used as data for both wind speed and direction, even when the other was inoperative. This procedure tended to weight the recovered data with calms. In producing the percentage frequency tables, an hour of data was considered "calm" if the average wind speed for that hour was less than 1 mile per hour, and/or if the wind direction trace slowly meandered across the span of the chart with little or no

flucation. In all other stages of processing, however, data were "calm" if the average wind speed was less than 0.5 mph.

We have recently improved our processing techniques so that they eliminate the inconsistencies mentioned above. In the future, when wind speed data are significantly more complete than wind direction data for a particular month, two estimates of the percentage of calms will be given: 1) an estimate based only on the hours of joint data from both sensors, and 2) an estimate based on operation of the wind speed sensor by itself. Table I compares our published calm percentages at station PO3A to calm percentages based solely on operation of the wind speed sensor.

The differences for August through October are due to the re-definition of "calm," since the hours of data are nearly the same. The larger November and December differences are due to the larger data base.

Figures 6-10 show the diurnal variation of three variables for each of the five months. The bottom graph plots average wind speed (mph) at the two stations. All points are plotted at the end of the averaging hour (e.g. points plotted at 0400 are averages for the period 0300-0400). The middle graph shows the normalized number of calms. The number of calm observations was multiplied by the ratio of  $30/N$ , where  $N$  = total number of observations for a particular hour. For most months  $30/N$  was close to 1.0, since  $N$  was always greater than or equal to 27. The use of normalizing factor facilitates comparisons when there are a few missing observations. The graph at the top of each figure shows the vector resultant wind direction for each hour of the day. The vector resultant wind is arrived at by breaking down every observation of wind speed and direction into north and east components, summing over all observations, dividing by the number of observations, and finally recomputing the resultant vector from the two components. Only the direction of the resultant vector is plotted in this graph.

Figures 11-15 show the number of hours of calm at PO3A as a function of the tower wind direction. A brief discussion of figures 6-15 follows.

August PO3A wind speed shows a marked diurnal variation with a maximum at 1300 and minimum at 2200. Tower wind speed shows a bimodal variation with maxima at 1600 and 0300 and minima at 2000 and 0900. The plot of number of calms shows that nearly all the calms at PO3A occurred between the hours of 2000 and 0800, and that those calms occurred on about half of the nights in the month. The "calm rose" (figure 11) for August shows that those calms at PO3A occurred mostly with winds from the SE quadrant at the tower. The plot



of resultant wind direction shows nighttime SE winds at the tower, shifting through SW to NW during the day. Because of the many calms at PO3A, the nighttime resultant wind directions are based on a smaller sample of wind directions. Data from our other stations (which had fewer calms) follow the PO3A data closely between 0900 and 1900 and follow the tower data closely between 2200 and 0700.

September Data for September are very similar to those for August. PO3A wind speed has a maximum at 1200 and minimum at 2100. Tower maxima are at 1400 and 0500 and minima at 2000 and 0700. The plot of calms again shows that calms occur at night, although there are fewer from 0400-sunrise in September. The calm rose shows the same characteristic as the one for August, i.e., calm conditions at PO3A are associated with nighttime SE winds at the tower. The plot of resultant wind direction shows the same shift from off-shore winds at night to onshore winds during the day at the tower. In September the shift begins between 1100 and 1200, two hours later than in August. The change in direction is fairly steady at both stations and continues right through NW and N to E at 1900-2000. Because of the large number of calms, PO3A direction at night is quite variable.

October This is a transition month. The overall PO3A wind speed is greater than in the two previous months, and the difference between the daytime maximum and nighttime minimum is less pronounced. The absolute maximum occurs at 1200 and the absolute minimum occurs at 0400. A localized secondary maximum occurs at 2400 and a secondary minimum occurs at 1900-2000. The tower, which had been having the absolute maximum in the afternoon, now has the absolute maximum at 2400 with the absolute minimum at 1800. The variation exhibited by PO3A (and our other operating station this month) is not evident in the tower data. Calms at PO3A are fewer in number than in the two previous months, but tend to begin earlier and/or end later. The calm rose again shows that these calms occur with winds at the tower from the SE quadrant. The two directions SE and SSE are highly preferred. The plot of resultant wind direction shows an almost constant 40° difference from 1100-2400, with PO3A generally W and the tower NW. The nighttime variability of tower resultant wind direction is apparently due to a large number of moderate NW and SE winds which occurred on different nights and tended to cancel each other in the vector calculations.


November Wintertime characteristics of wind speed and direction are evident this month. Average wind speed at PO3A

has increased and the amplitude of the night-day difference is reduced considerably. Maximum is at 1400 and minimum at 0400-0600. Tower wind speed shows general informity throughout the day with the maximum at 0100 and minimum at 1100. The number of calms is much smaller than in previous months and are at a maximum near sunrise. The calm rose again shows that calms at PO3A are associated with SE winds at the tower. No calms occurred with winds from WNW through NE. There is little variation of wind direction throughout the day at either station, with PO3A averaging about 40° counter-clockwise of the tower. Except for the 0700-1000 period, the resultant direction for PO3A was nearly identical to that for the other stations in our network.

December This month is similar to November in many ways. Both stations show a small diurnal variation in wind speed with the PO3A maximum at 1600 and minimum at 0700. The tower minimum is also at 0700 with the maximum at 2400. The number of calms is quite small and again reaches a maximum near sunrise. December calms at PO3A occurred only with NE, E, ESE, SE, SSE, and S winds at the tower. The variation of resultant wind direction is generally reversed from that of August, i.e., in December onshore winds occur at night and offshore winds occur during the day. The amplitude of the variation is greater at the tower than at PO3A.

We hope that these graphs and description are useful to you. Please contact Ed Ryznar or myself if you have any questions.

Sincerely,



Michael R. Weber

MRW:ss

Table I  
Comparison of Calm Percentages

Month	Published (Calm <1.0 mph)		Based on WS only (Calm <0.5 mph)	
	Hours of Data	Calm %	Hours of Data	Calm %
August 73	744	30.4	744	28.2
September	716	29.3	717	24.8
October	692	25.0	690	22.9
November	576	13.0	720	8.1
December	402	10.4	657	4.9

Fig. 1

# WIND ROSE - AUGUST 1973

PALISADES NUCLEAR PLANT - STATION PTWR

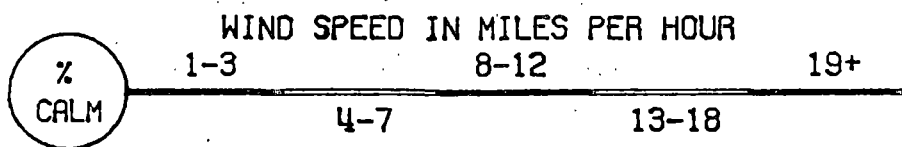
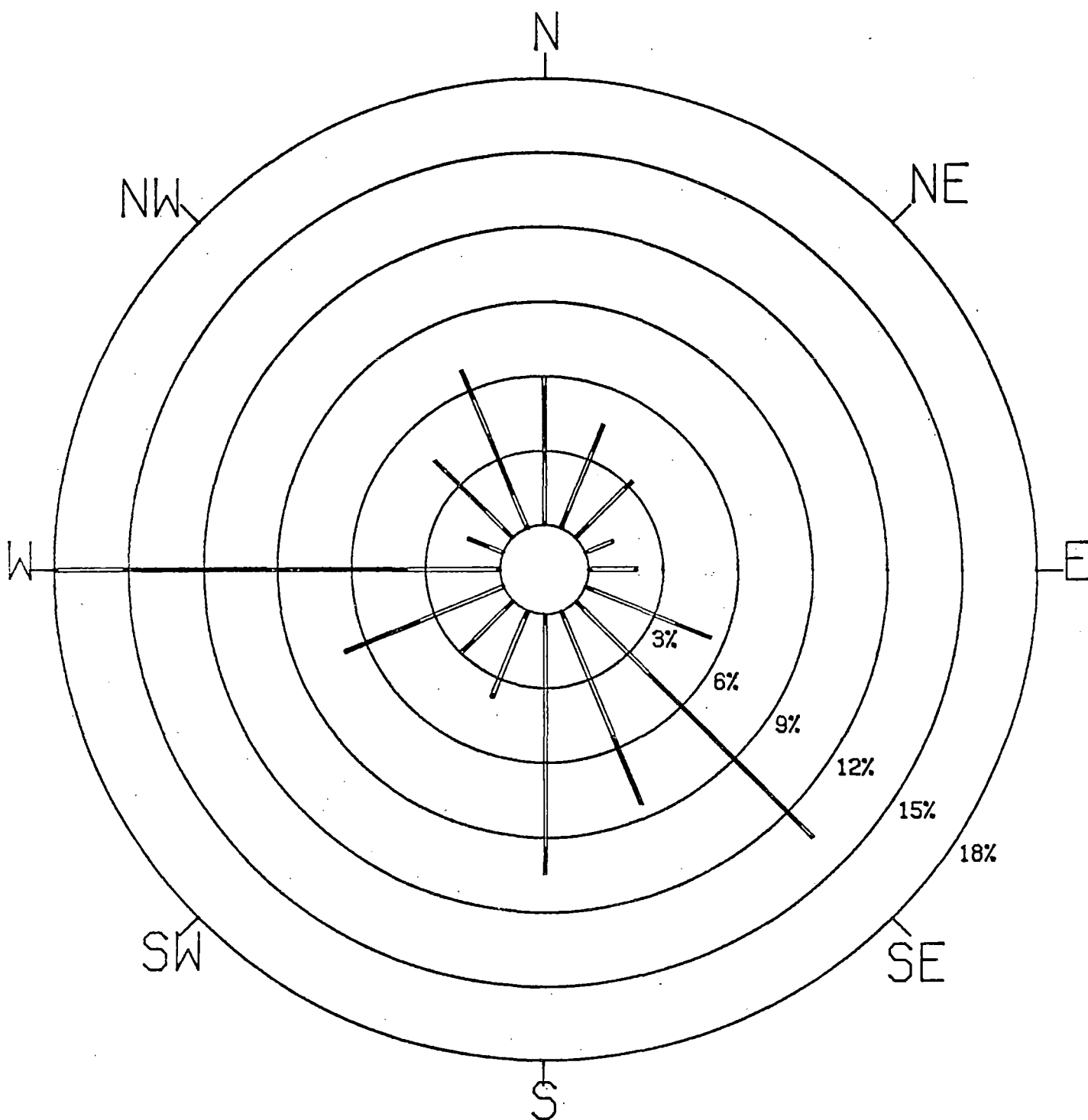


Fig. 2

# WIND ROSE - SEPTEMBER 1973

## PALISADES NUCLEAR PLANT - STATION PTWR

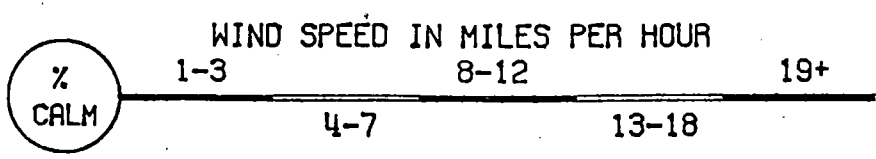
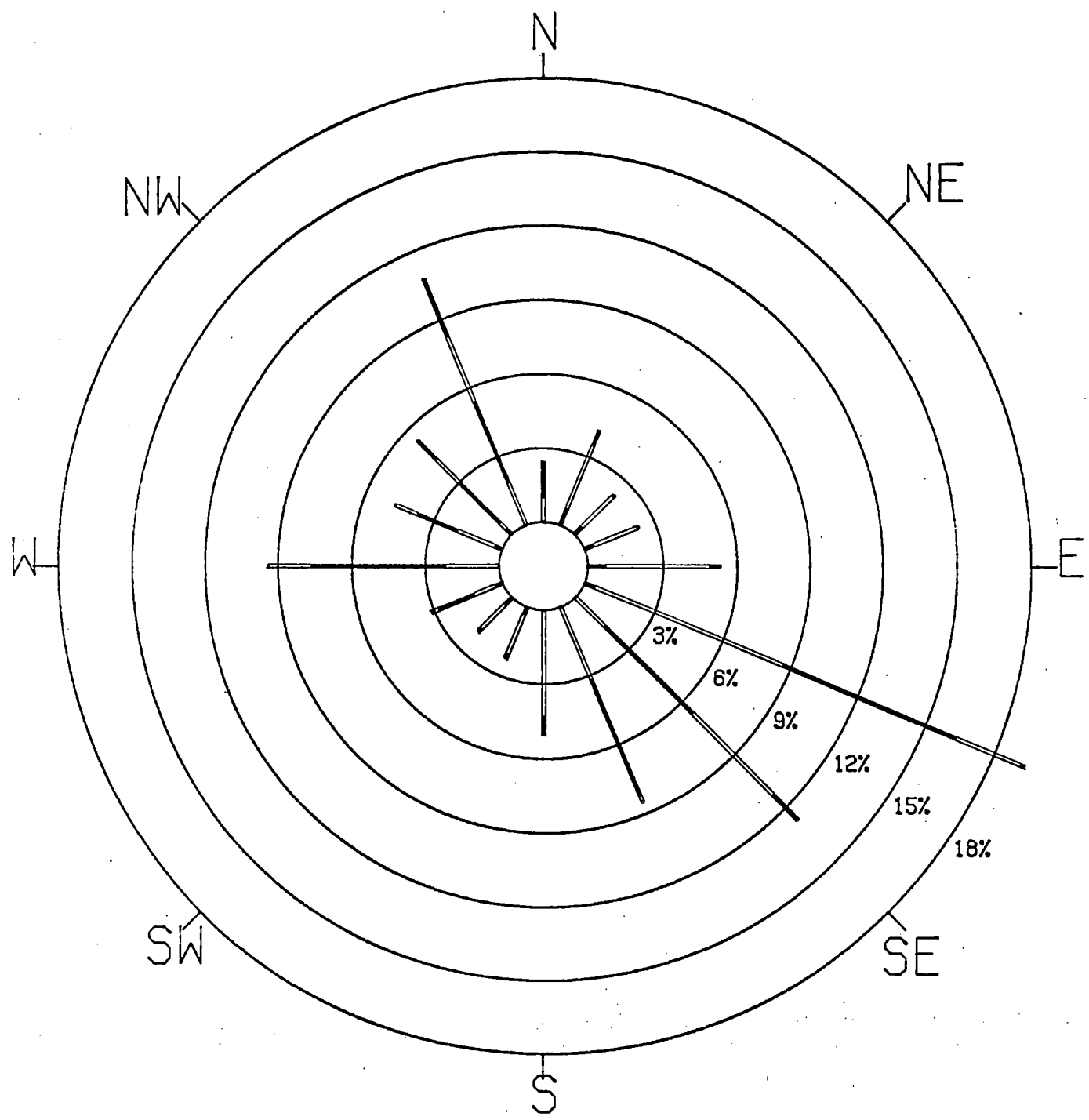


Fig 3

# WIND ROSE - OCTOBER 1973

PALISADES NUCLEAR PLANT - STATION PTWR

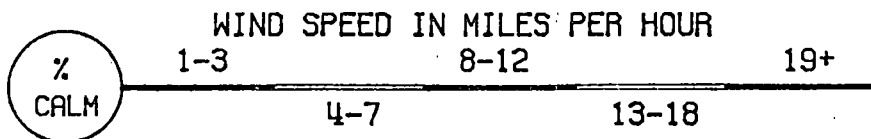
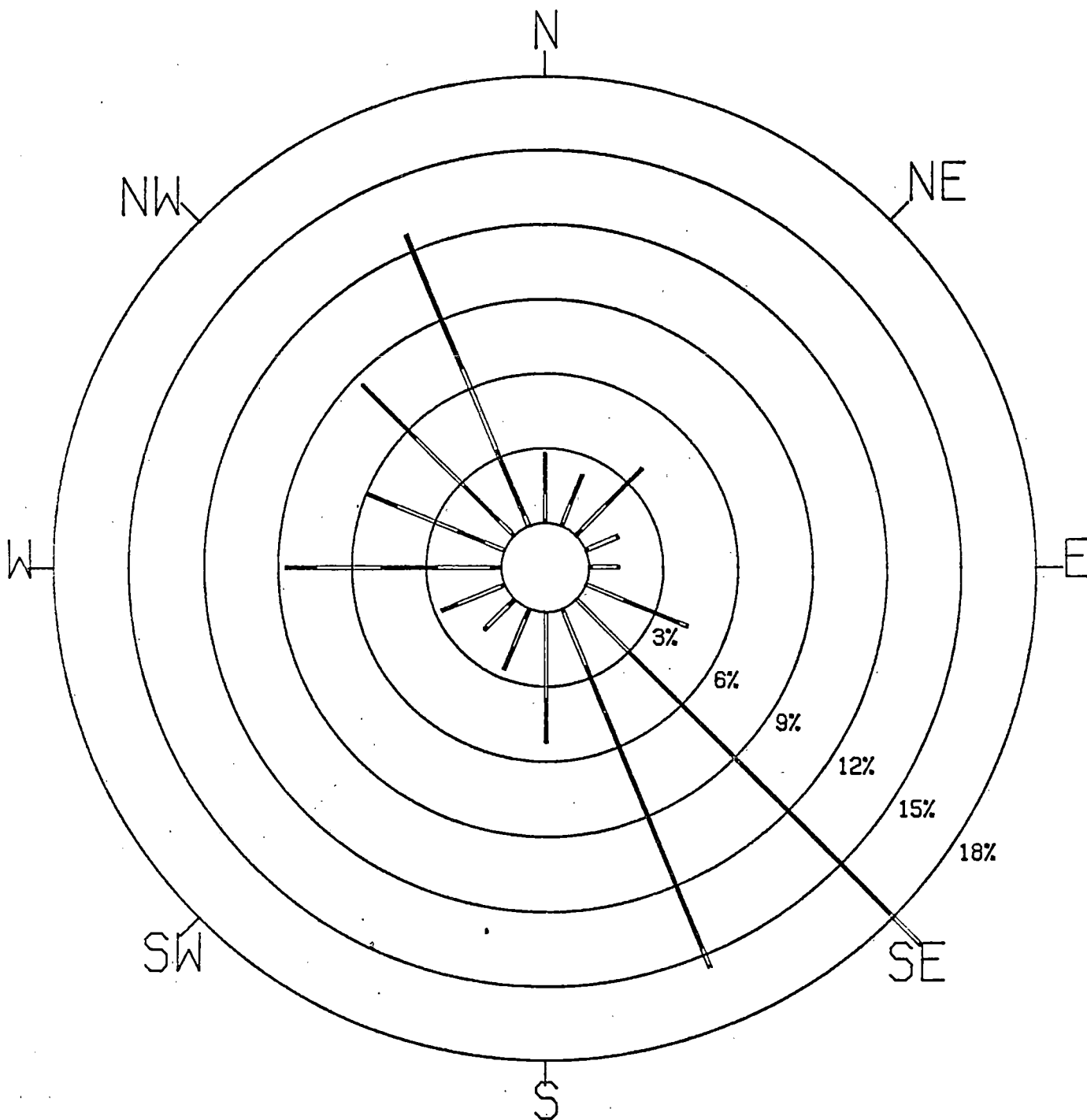


Fig 4

# WIND ROSE - NOVEMBER 1973

## PALISADES NUCLEAR PLANT - STATION PTWR

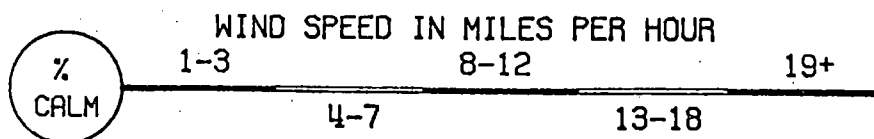
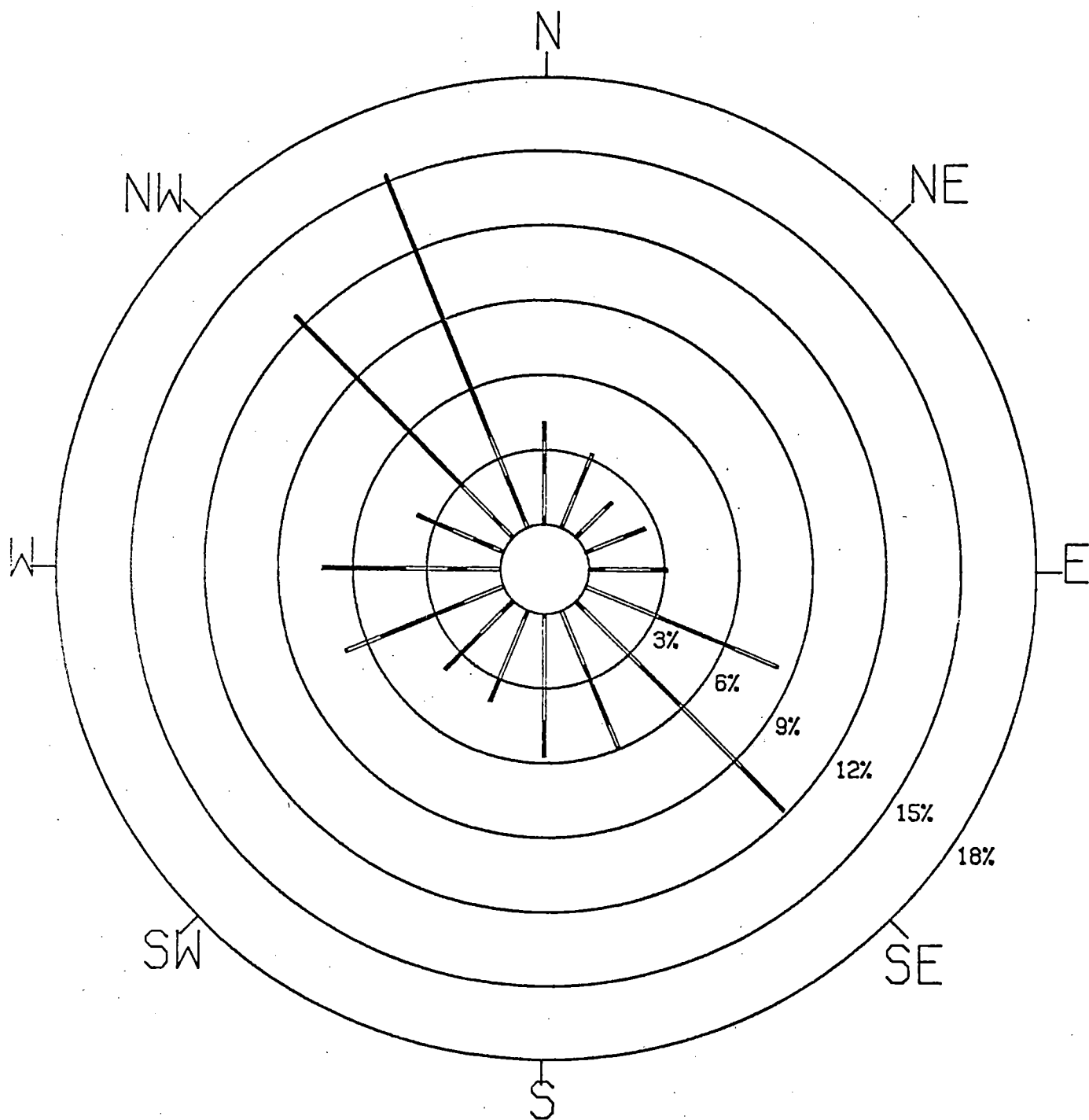


Fig 5

# WIND ROSE - DECEMBER 1973

PALISADES NUCLEAR PLANT - STATION PTWR

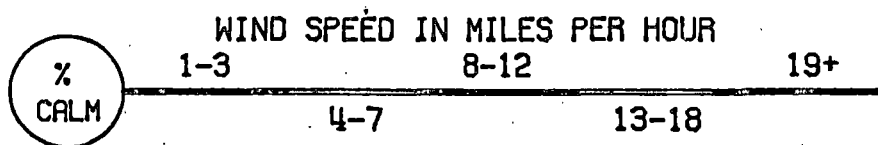
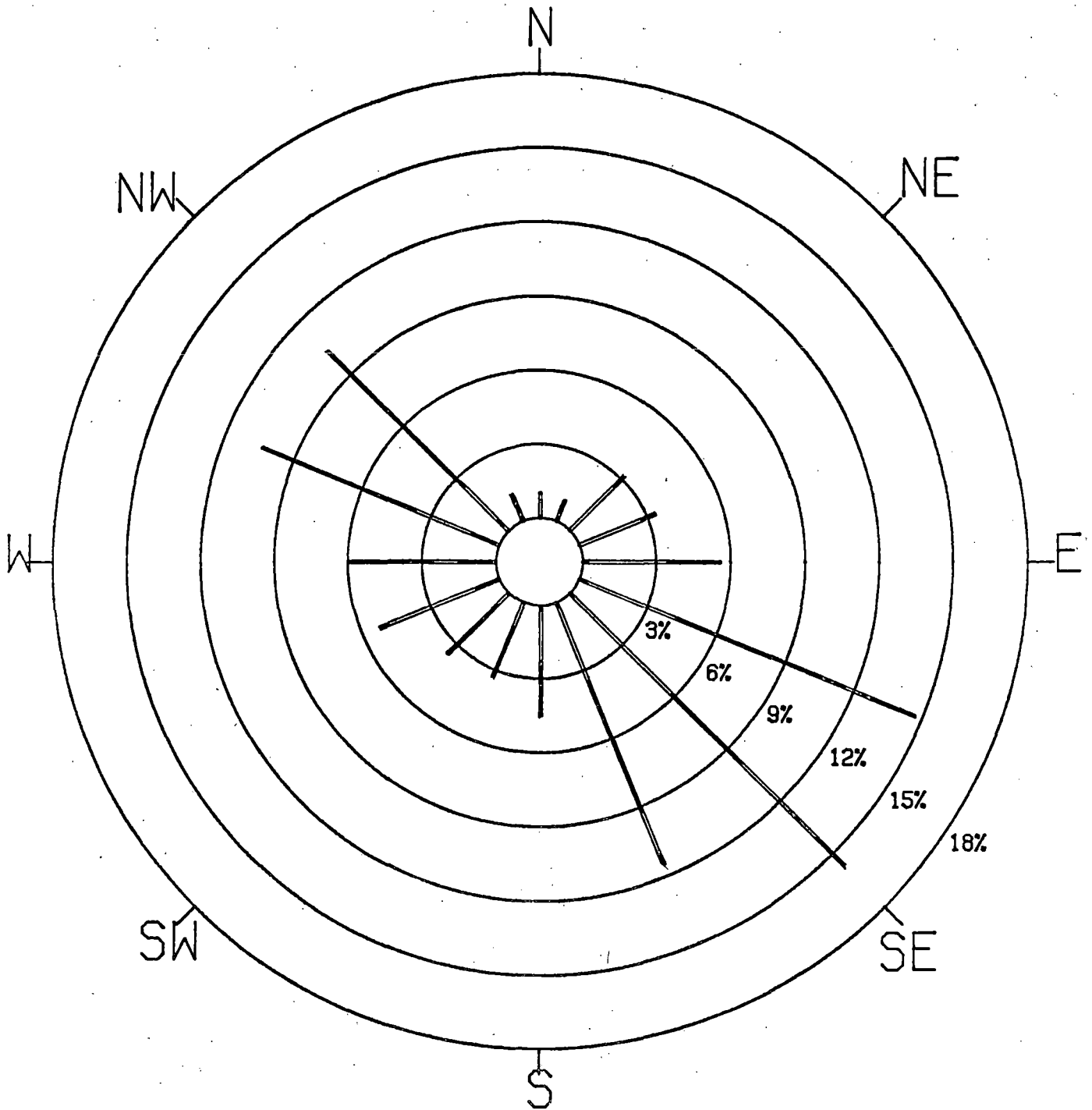
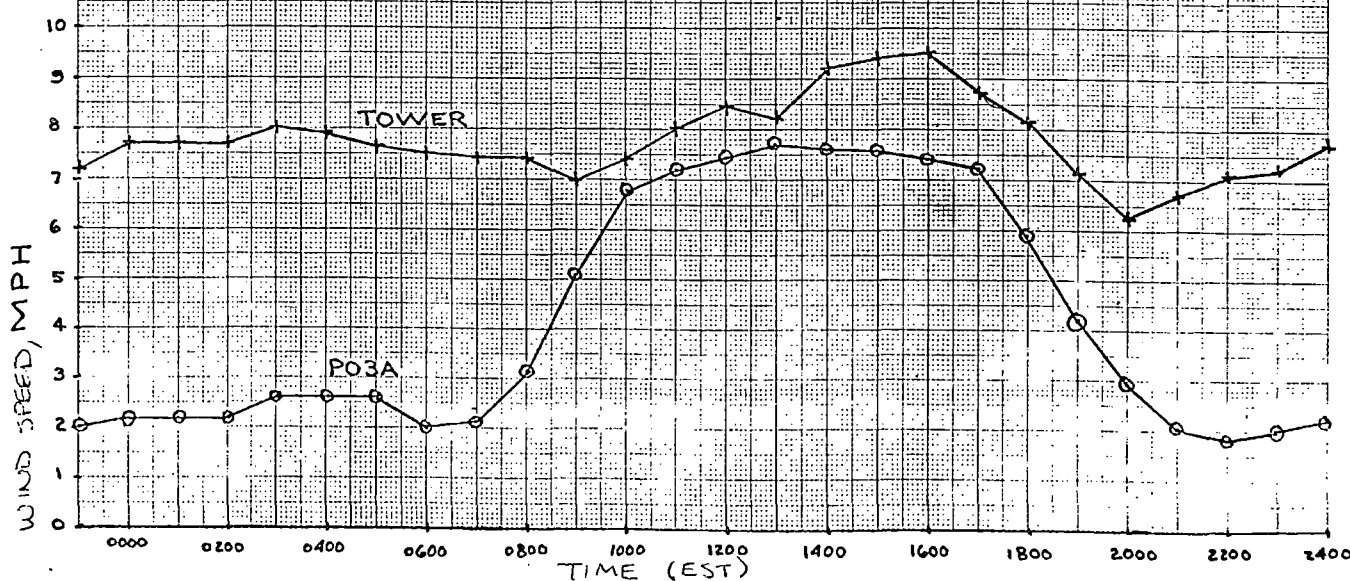
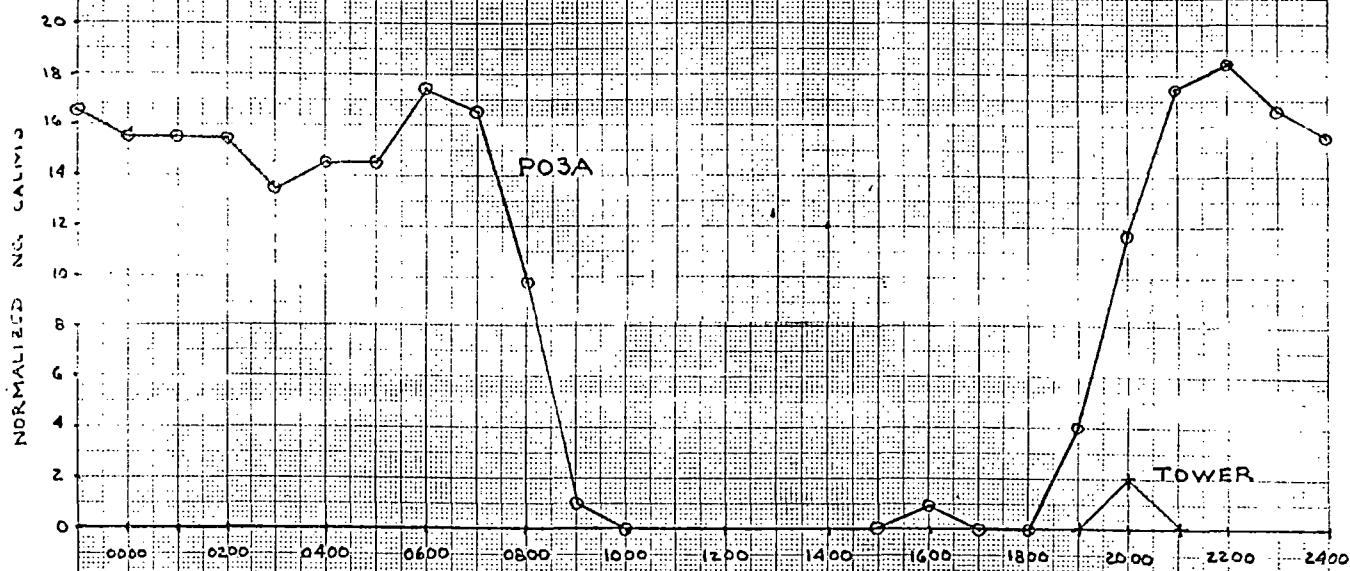
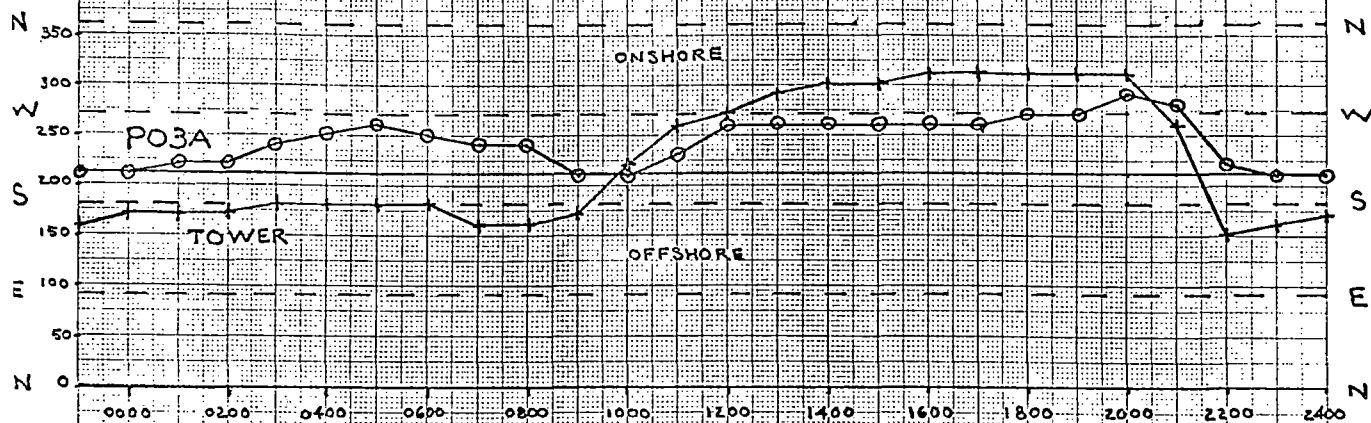




Fig. 6

# AUGUST 1973

DAYS OF DATA: TOWER 30.5  
PO3A 31



# SEPTEMBER 1973

DAYS OF DATA: TOWER 30  
PO3A 30  
OFFSHORE 30

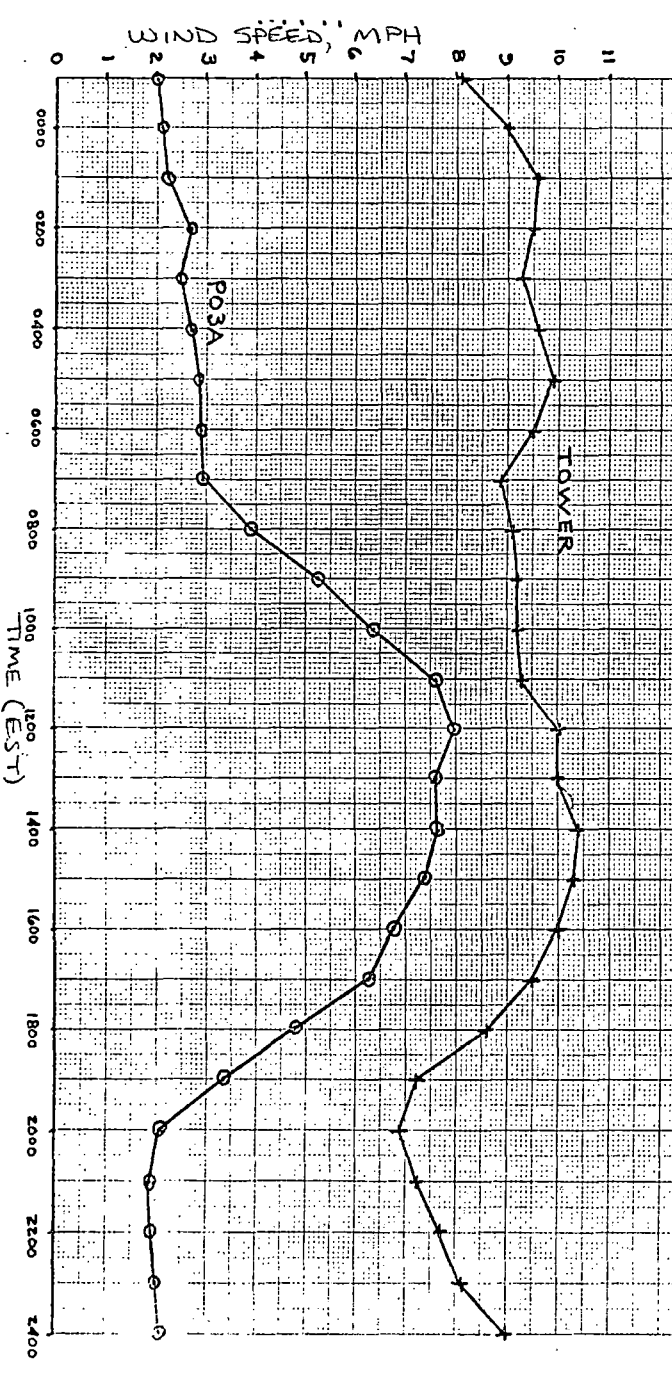
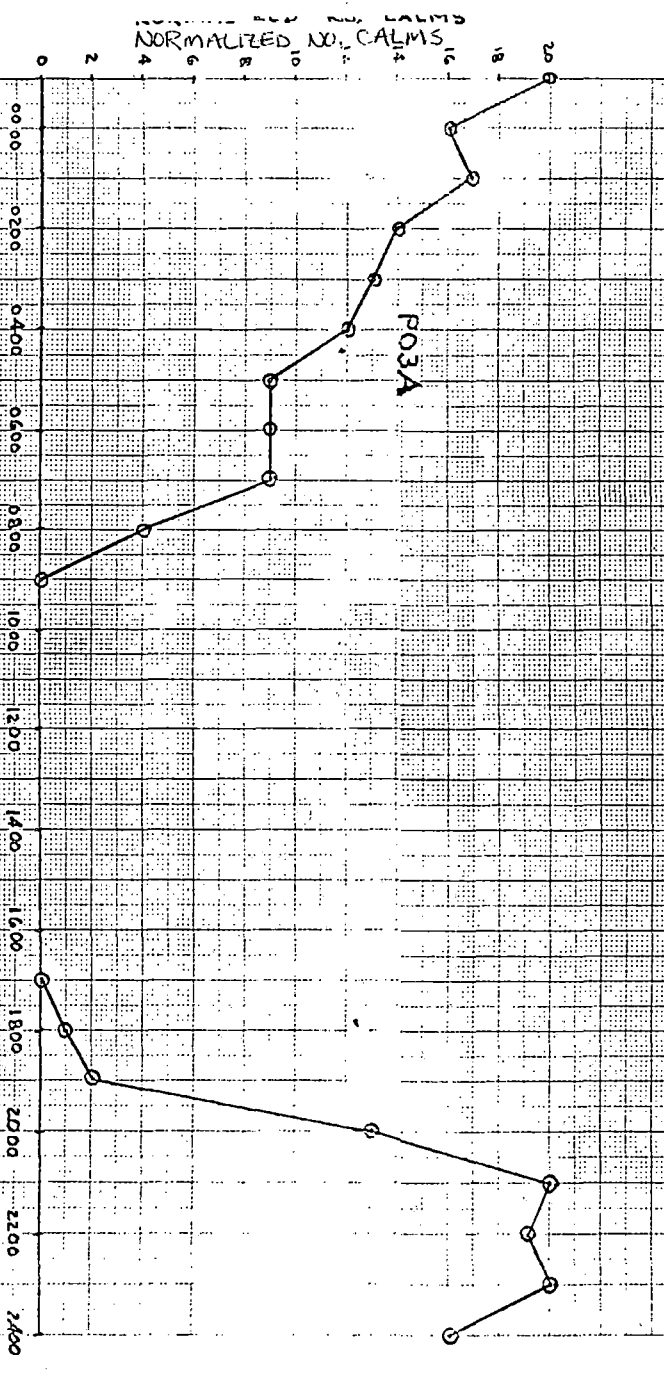
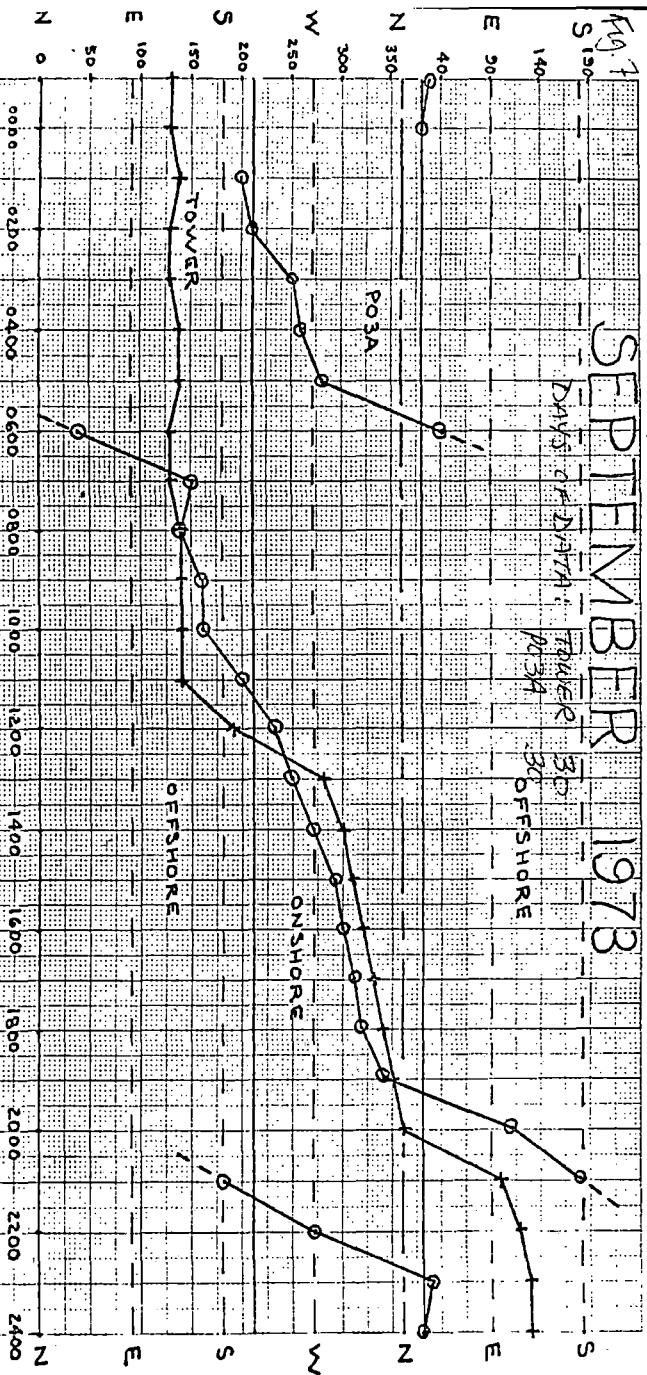
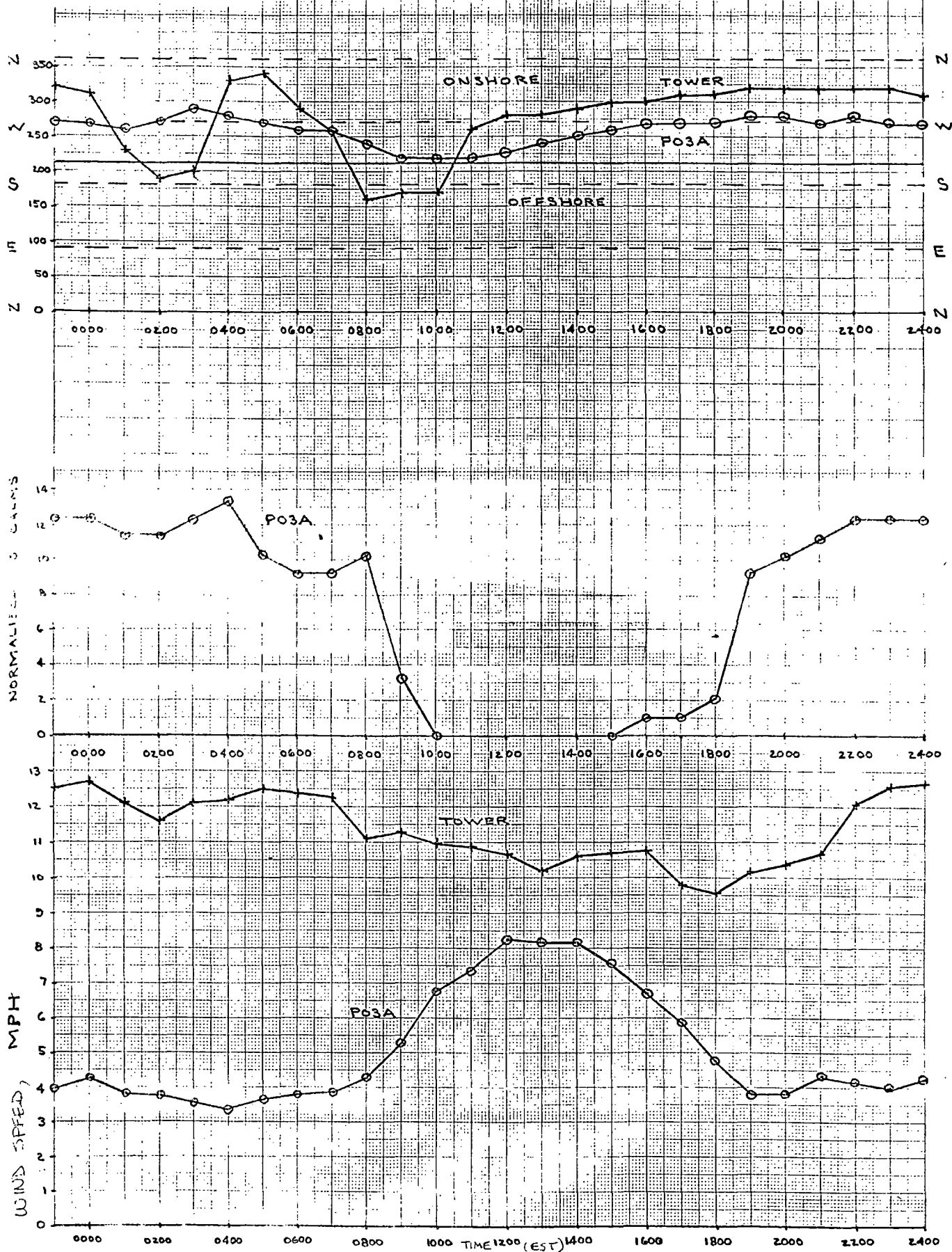


Fig. 8

# OCTOBER 1973

DAYS OF DATA: TOWER 31  
P03A 29



# NOVEMBER 1973

DATA OF DATA TOWER 30  
PO3A 30 (05 WIND DIRECTION)

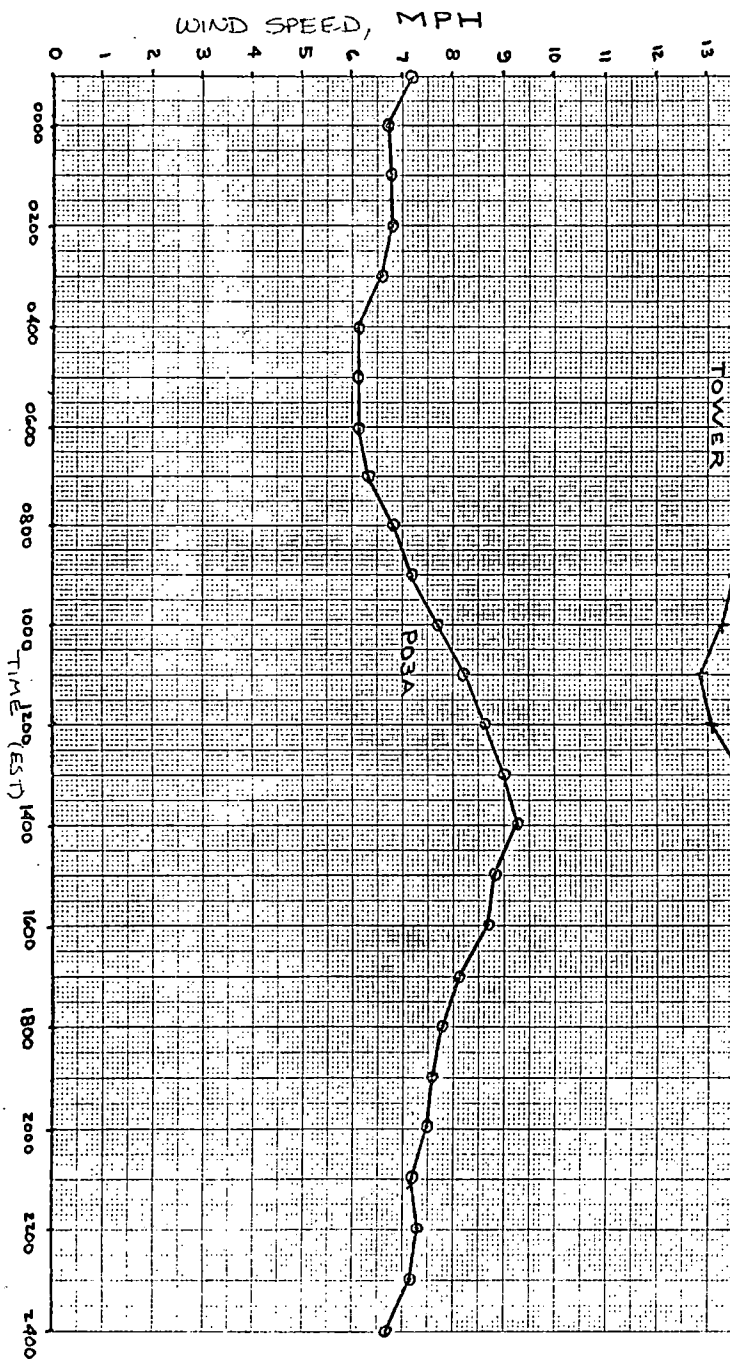
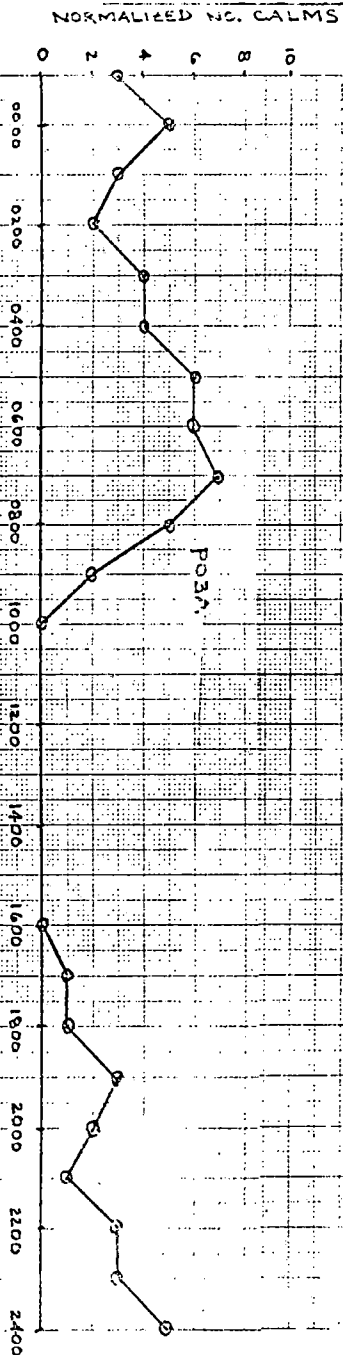
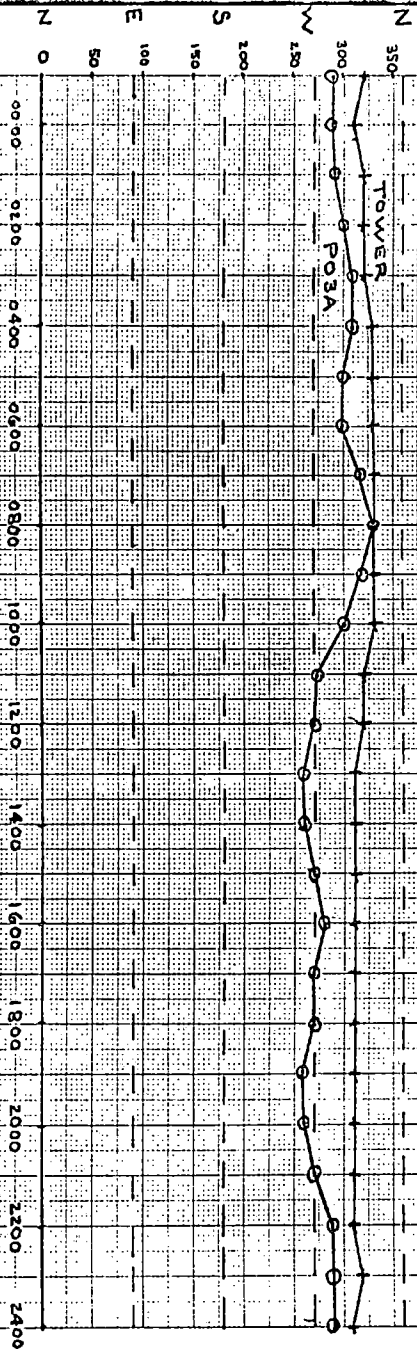




Fig.  
10

DECEMBER 1973

DAYS OF DATA: TOWER 25.5  
PO3A 27.5 (19 WIND DIRECTION)

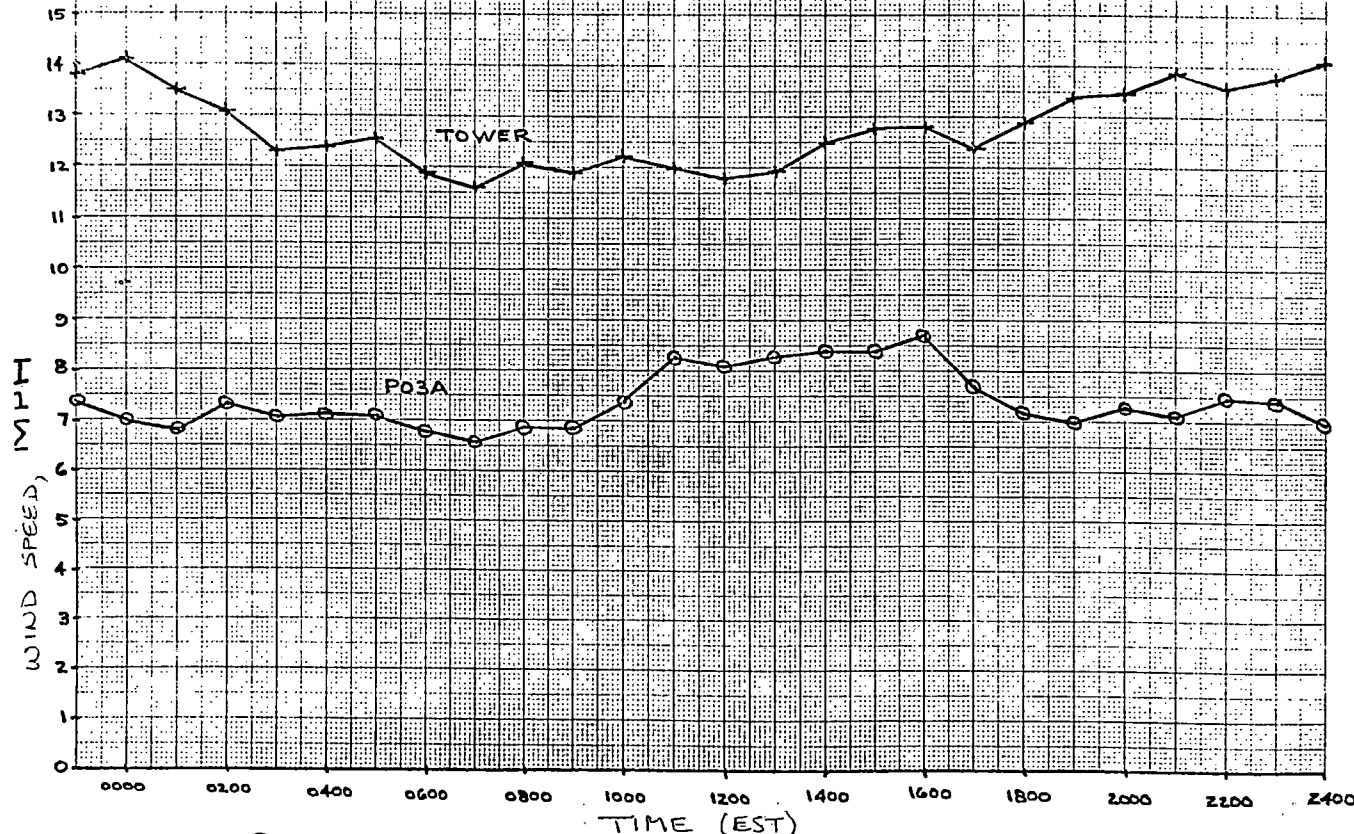
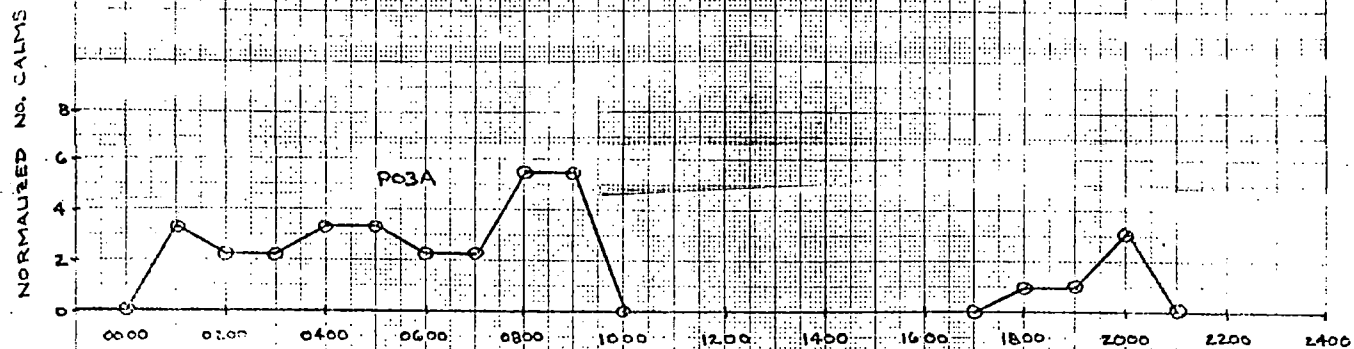
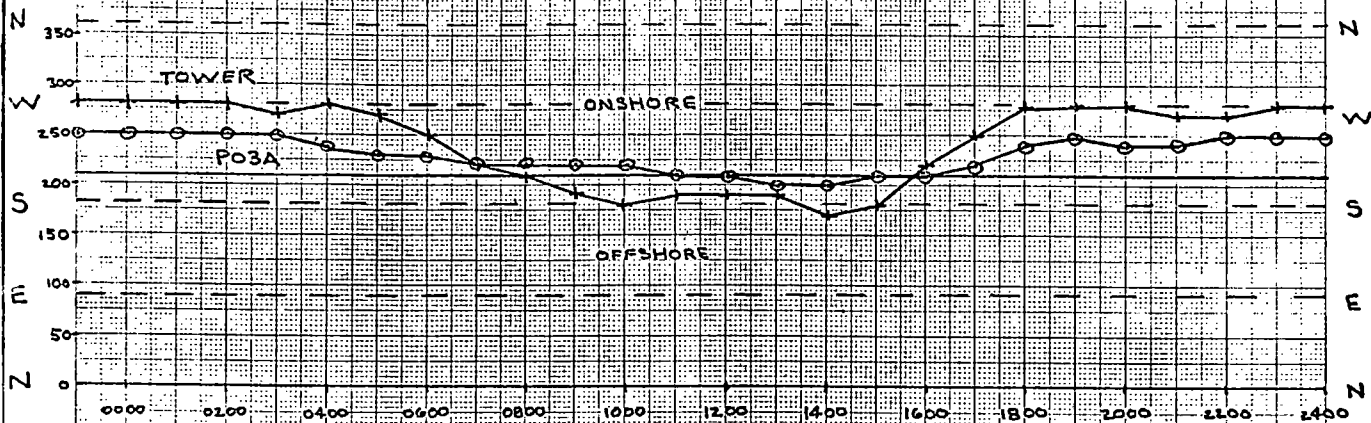


Fig. 11

# CALMS AT POBA  
FOR GIVEN  
PTWR WIND DIRECTION

AUGUST 1973

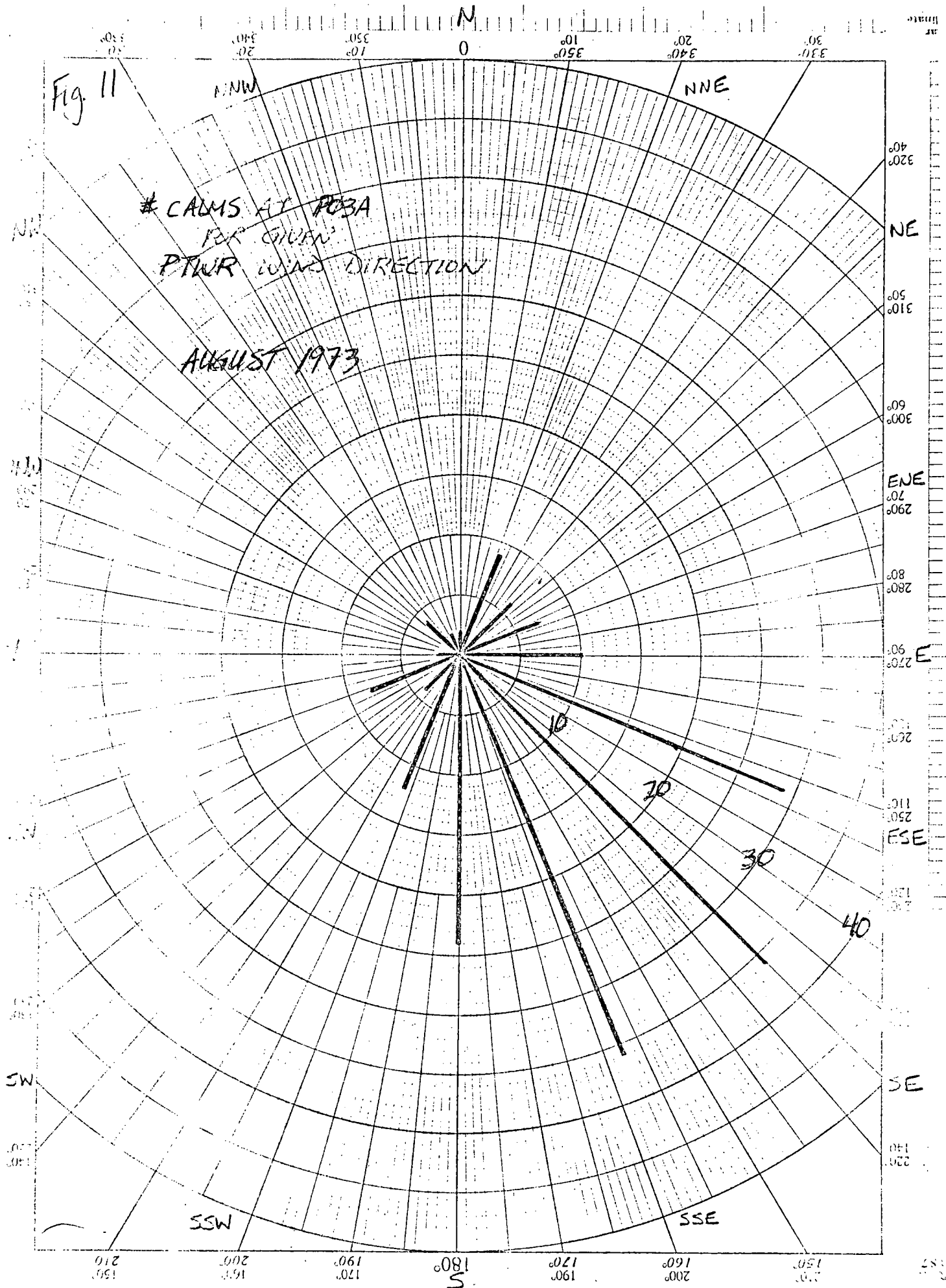
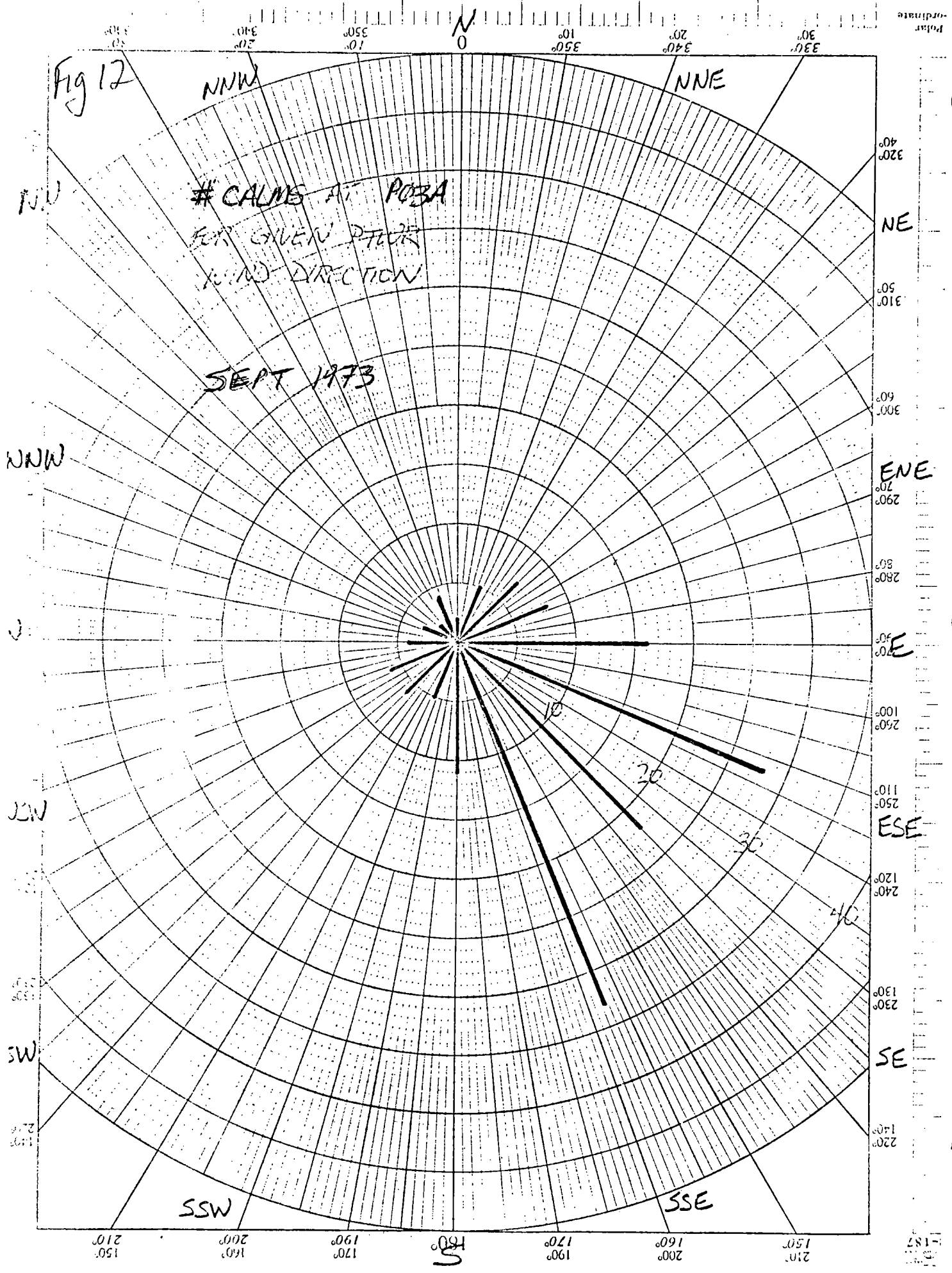
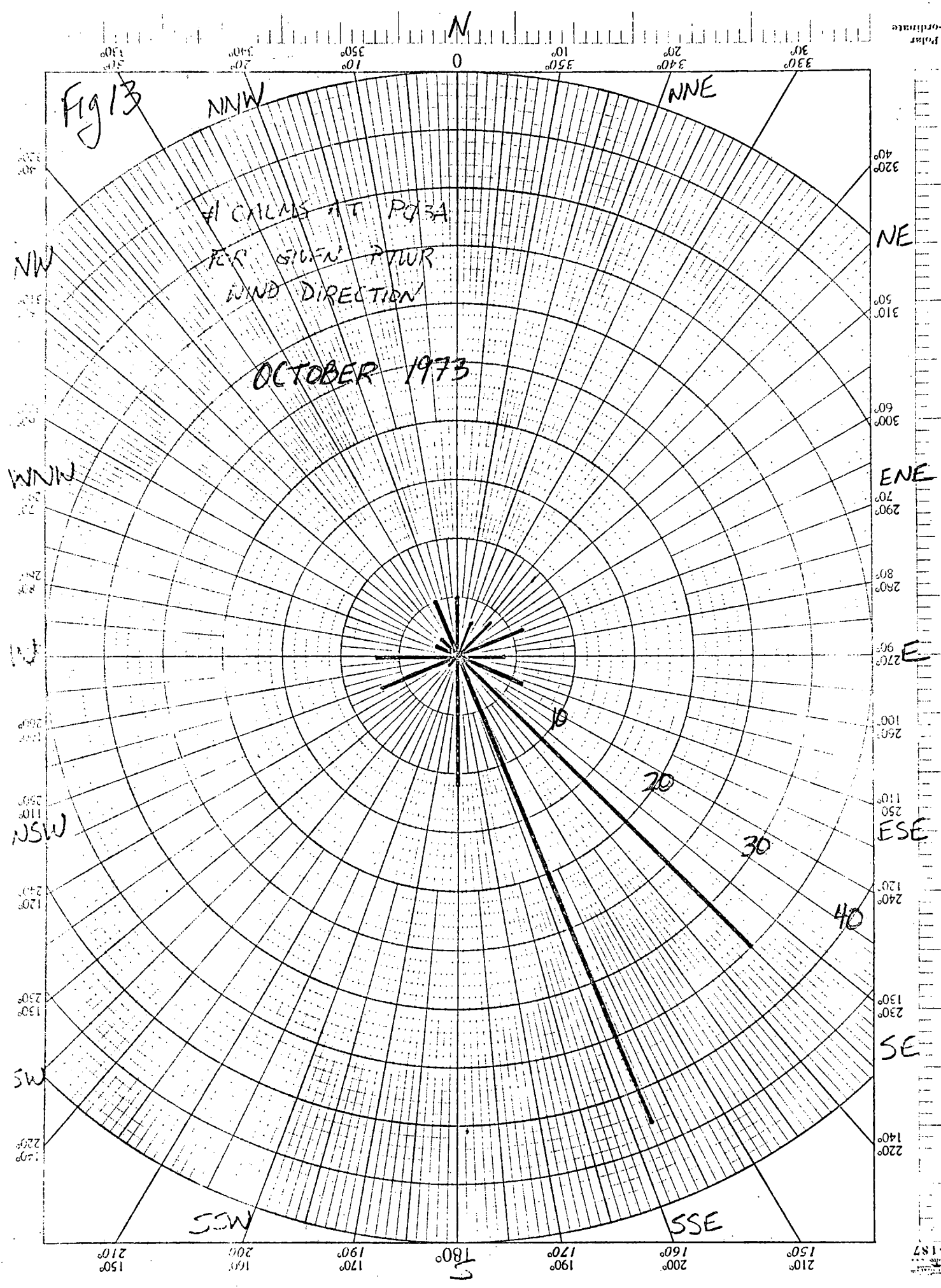


Fig 12

# CALMS AT POBA  
FOR GIVEN PTOOR  
WIND DIRECTION

SEPT 1973







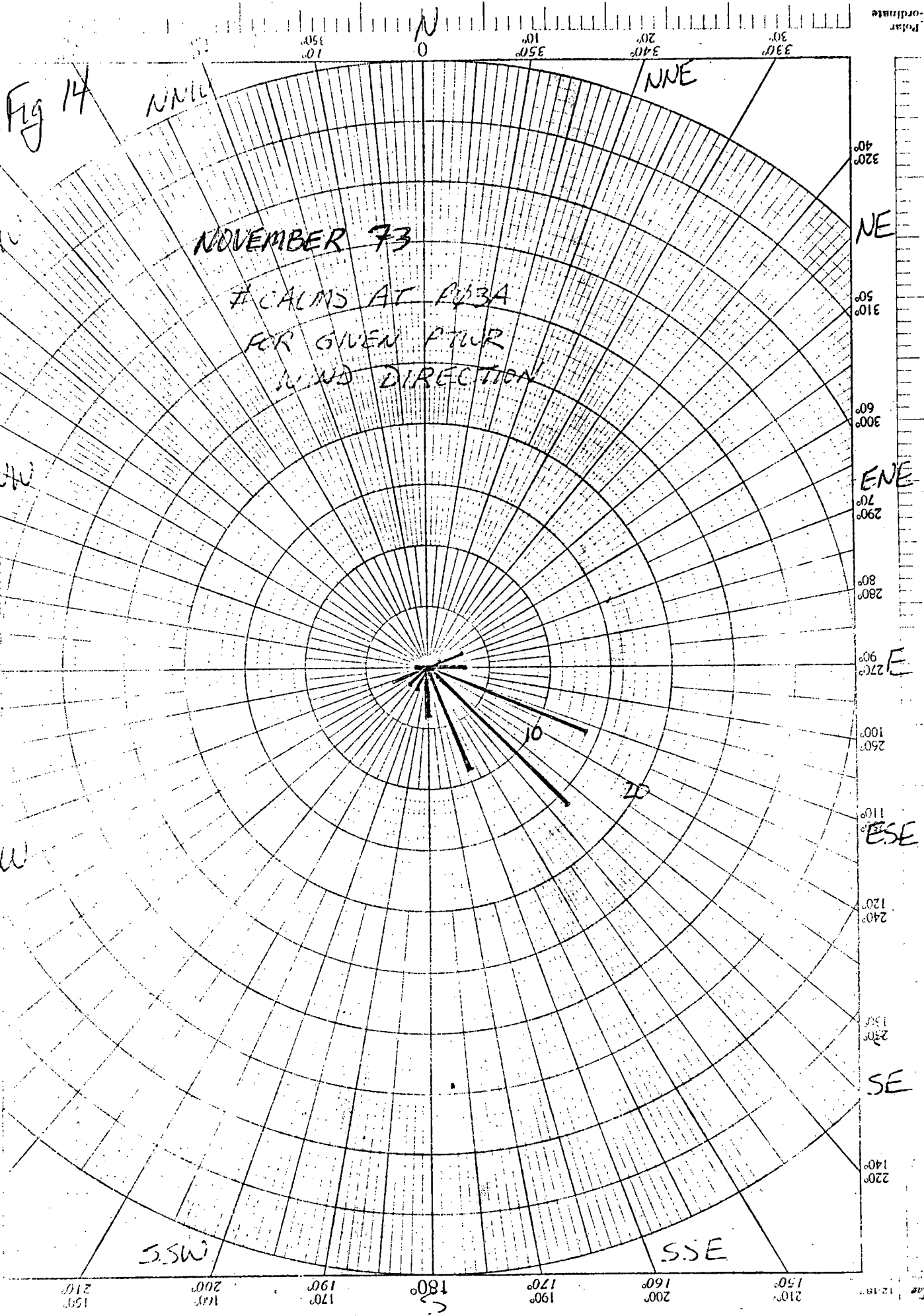


Fig 14

NOVEMBER 73

# CALMS AT P03A  
FOR GIVEN FTWR  
AND DIRECTION

Polar coordinate

320°

NE

310°

300°

ENE

290°

280°

E

270°

260°

110°

ESE

120°

SE

130°

140°

150°

160°

170°

180°

190°

200°

210°

220°

230°

240°

250°

260°

270°

280°

290°

300°

310°

320°

330°

340°

350°

360°

0°

10°

20°

30°

40°

50°

60°

70°

80°

90°

100°

110°

120°

130°

140°

150°

160°

170°

180°

190°

200°

210°

220°

230°

240°

250°

260°

270°

280°

290°

300°

310°

320°

330°

340°

350°

360°

0°

10°

20°

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40°

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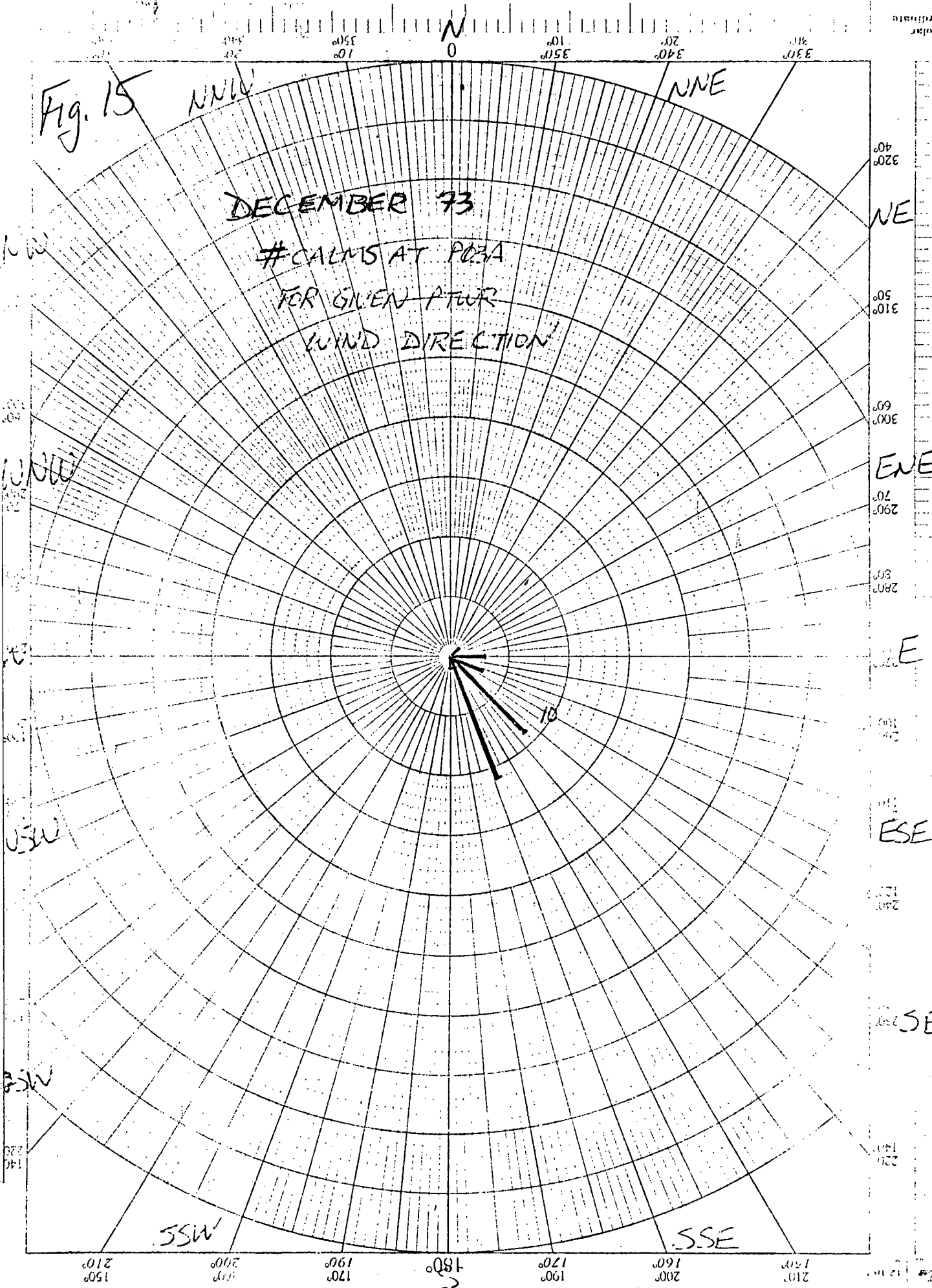
Fig. 15

DECEMBER 73

# CALMS AT PO3A

FOR GILVEN ATUR

WIND DIRECTION



RETURN TO REGULATORY CENTRAL FILES  
ROOM 016

CONSUMERS POWER COMPANY  
BULK POWER OPERATIONS - NUCLEAR  
QUALITY ASSURANCE POLICY MANUAL  
FOR OPERATIONAL NUCLEAR POWER PLANTS

RETURN TO REGULATORY CENTRAL FILES  
ROOM 016

Rev 0  
8/14/72  
DMN/map

RECORD OF REVISIONS

<u>Rev No</u>	<u>Pages</u>	<u>Description</u>	<u>Date</u>	<u>QA Initial</u>
0	Various	To show new organiza- tional changes only.	8/14/72	DMN

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### FOREWARD

This manual sets forth quality assurance (QA) criteria applicable to Consumers Power Company's operating nuclear power plants. This standard has been developed by the staff of the Bulk Power Production Department of Consumers Power Company. It is intended to apply to members of the Nuclear Plant Staff and activities under their control and the Bulk Power Production General Office staff and activities under their control as they relate to the operation and maintenance of nuclear power plants once the plants have become the responsibility of the Bulk Power Operations Department.

This QA Manual uses, as a basis, criteria published by the United States Atomic Energy Commission (AEC) in the Federal Register. Specifically, the criteria used as bases are those published in the Federal Register, Volume 35, No 125, as an Amendment B to 10 CFR 50, June 27, 1970, entitled "Quality Assurance Criteria for Nuclear Power Plants." Consumers Power Company recognizes that Appendix B of 10 CFR 50 applies to all activities affecting safety-related functions of structures, systems and components including designing, purchasing, fabricating, handling, shipping, storing, cleaning, erecting, installing, inspecting, testing, operating, maintaining, repairing, refueling and modifying. This manual is intended to outline QA requirements for Consumers Power Company nuclear plants which are under the control of the Bulk Power Operations Department of Consumers Power Company. This manual is intended as a policy manual only. Plant and General Office procedures covering QA activities will be written, approved, and implemented which comply with the spirit and intent of this manual.



## 1. INTRODUCTION

### 1.1 Purpose

The purpose of this QA Manual is to provide a unified general plan for the establishment and execution of quality assurance activities for Consumers Power Company's operating nuclear power plants.

### 1.2 Scope

This manual provides requirements and guidelines for operation and maintenance of structures, systems and components whose satisfactory performance is required: (1) to prevent accidents that could cause undue risk to the health and safety of the public and (2) to mitigate the consequences of such accidents if they were to occur. The requirements apply to activities affecting quality of items including designing, purchasing, fabricating, handling, shipping, storing, cleaning, erecting, installing, inspecting, testing, operating, maintaining, repairing, refueling and modifying. This manual applies to the Bulk Power Production Department of Consumers Power Company in carrying out its responsibilities for safe operation of its nuclear power plants. Each plant will designate systems, positions of systems, equipment and activities which are within the scope of this manual.

### 1.3 Responsibility

It is the responsibility of Consumers Power Company's Bulk Power Production Department to establish an effective quality assurance program for the operating nuclear plants consistent with the provisions of this manual. This responsibility may be delegated in part to other third party organizations, but primary responsibility shall be retained by Consumers Power Company. This requirement shall in no way relieve or diminish the responsibility of any vendor or contractor furnishing goods or services under the terms of the quality assurance program for execution of his assumed portion of the quality assurance program.

### 1.4 Definitions

The following definitions are provided to assure a uniform understanding of select terms as they are used in this manual.

Contractor - Any organization under contract for furnishing items and services to Consumers Power Company in compliance with this manual (synonymous terms are "vendor" and "supplier").

Deviation - A characteristic of a structure, system or component failing to conform to a specified requirement; an action of a person failing to conform to detailed procedures.

Characteristic - Any property or attribute of an item, process or service that is distinct, describable and measurable as conforming or nonconforming to specified requirements.

Documentation - Any written or pictorial information describing, defining, specifying, reporting or certifying activities, requirements, procedures or results.

Nonconformance - A characteristic of an item that does not conform to a specified requirement.

Operation - (Nuclear Plant Operation) - Activity on the part of members of the Bulk Power Production Department of Consumers Power Company or its representatives to produce power, put plant systems in order to produce power or bring the plant to shutdown status from a power-producing condition.

Quality Assurance - Quality assurance is a planned, systematic audit and control of the quality program to insure that adequate quality control program elements are being implemented to provide confidence that plant systems and components operate reliably and safely.

Quality Control - Quality control is the detailed and systematic inspection testing and documentation to insure that a material, process, component, system or facility is in accordance with predetermined quality and design requirements.

Repair - The process of restoring a nonconforming item characteristic to an acceptable condition, although it may not conform to a specified requirement.

Rework - The process by which a nonconforming item is made to conform to specified requirements.

Maintenance - The process of performing repair, rework or actions necessary to negate need for repair or rework (ie, preventive maintenance).

Objective Evidence - Any information regarding the quality of an item which can be verified. Evidence must be expressed in terms of specific quality requirements or characteristics pertinent to the acceptability of the material. The quality characteristics are identified in the drawings and specifications which describe the product.

## 2. QUALITY ASSURANCE PROGRAM

### 2.1 Purpose, Scope

This Quality Assurance Manual establishes a plan to comply with applicable codes such as the ASME Boiler and Pressure Vessel Code. The program includes provisions for application of methods and techniques of assuring quality that are contained in standards such as proposed standard ANS 3.2 (Administrative Control for Nuclear Power Plants).

Written policies, procedures and instructions shall document the activities comprising the quality assurance program and identify the individuals or groups responsible for their planning and implementation. Written procedures shall identify the items and services covered by the quality assurance program.

This manual establishes the policy that activities affecting quality are to be accomplished under suitably controlled conditions. The need for special control, job skills, tools and test equipment is recognized. The program recognizes the need for proper training and indoctrination of persons performing duties affecting quality.

The Management of Consumers Power Company Bulk Power Production Department will periodically review the manual and the overall quality assurance program. If corrections or modifications are needed, they will be authorized by upper Management personnel.

Items within each nuclear plant differ in relative safety, reliability, performance and importance. Various methods or levels of control and verification will be utilized to assure adequate quality methods or levels of control and verification shall be in accord with applicable codes, standards and other requirements and, in addition, should consider the following factors:

1. The importance of malfunction or failure of the item to plant safety or reliability.
2. The design and fabrication complexity or uniqueness of the item.
3. The demonstrated quality capability of the organization performing the work.
4. The degree to which functional compliance can be demonstrated by inspection or test.
5. The quality history and degree of standardization of the item.

### 3. ORGANIZATION OF PERSONNEL FOR IMPLEMENTING QA MANUAL

#### 3.1 Purpose, Scope

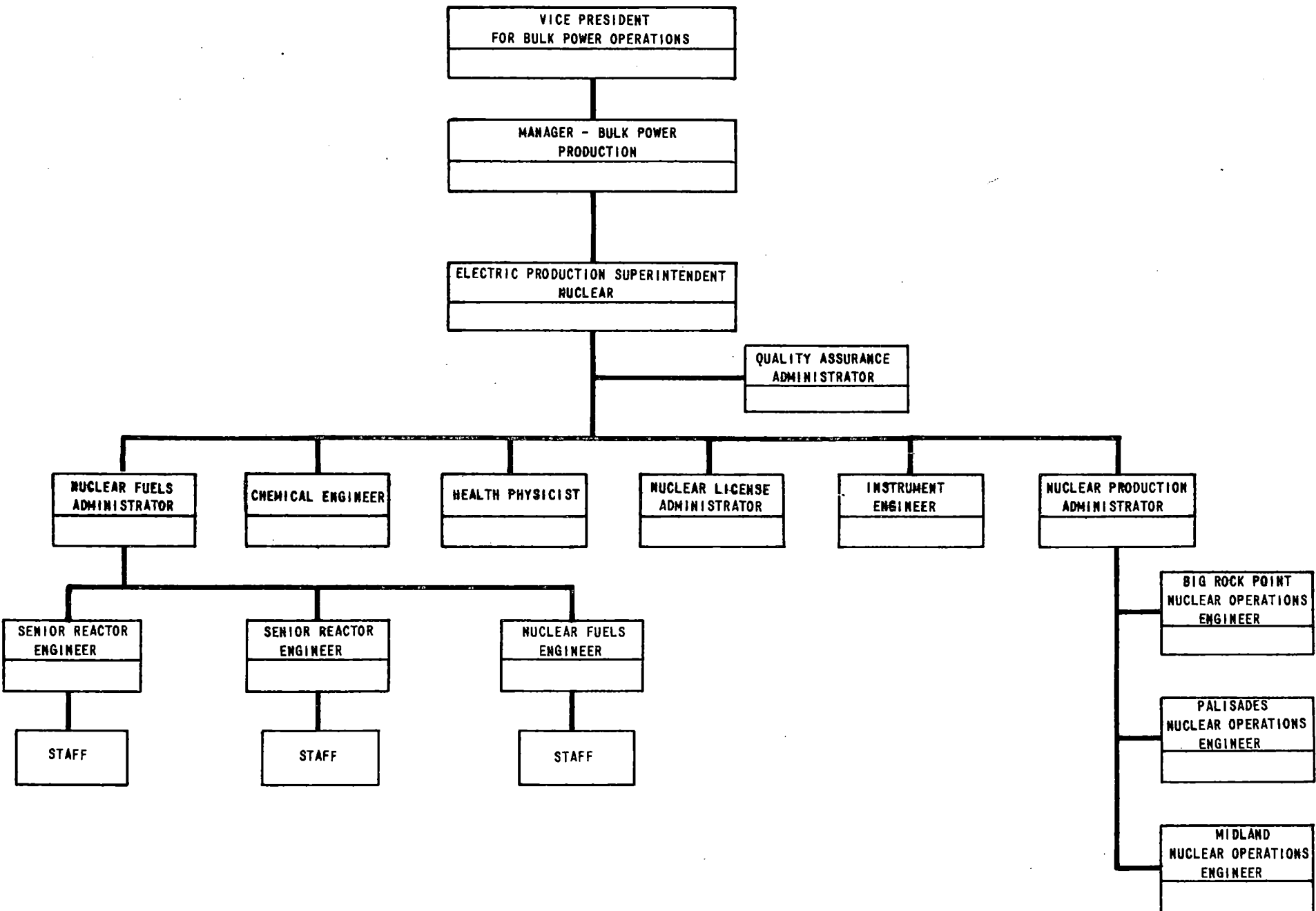
Proper administrative controls must be in effect and adhered to at all times to assure that decisions related to the operation of nuclear power plants are made at the proper level of responsibility and with the necessary technical advice. Many of these administrative controls exist in Plant Operating Instructions and the Plant Technical Specifications. Other procedures will be developed as necessary to comply with requirements of this manual. Industry standards such as ANS 3.2 are to be used to properly structure, implement and maintain administrative control. The purpose of this manual is to delineate policies and individual authority and duties of persons and organizations performing quality assurance functions with respect to the operation of Consumers Power's Nuclear Power Plants.

#### 3.2 Responsibility

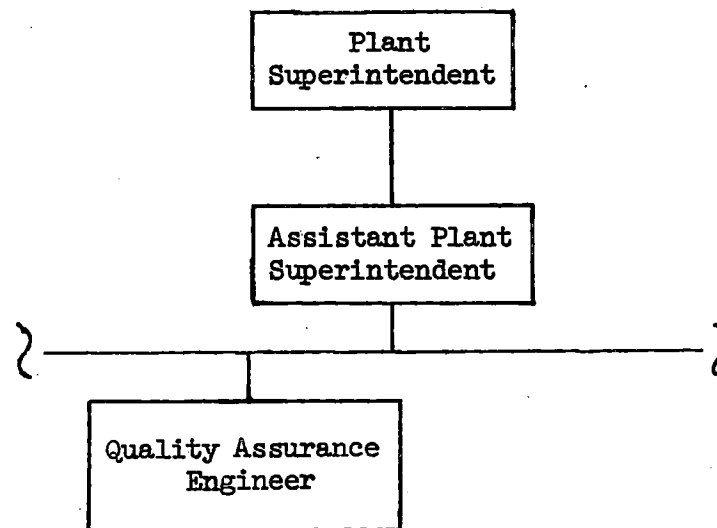
It is intended that each individual participating in the QA program clearly understands his duties and responsibilities. In order to accomplish this, the attached General Office and Nuclear Plant Organizational Charts are presented to delineate the authority and responsibility of key persons and organizations performing quality assurance functions.

A description of the responsibilities of jobs shown on the organizational charts is as follows:

BULK POWER OPERATIONS - BULK POWER PRODUCTION - GENERAL OFFICE NUCLEAR ORGANIZATION CHART



NUCLEAR PLANT ORGANIZATIONAL CHART



Electric Production Superintendent - Nuclear - The Electric Production Superintendent - Nuclear has the responsibility for all nuclear activities within the Bulk Power Production Department. His department is responsible for implementing the quality assurance program outlined in this manual.

Nuclear Fuels Administrator - The Nuclear Fuels Administrator is responsible for the technical direction of the operation of Consumers Power's nuclear reactors with respect to reactor core parameters and the administration of the Company's nuclear fuel resources.

Nuclear Operations Engineer - The Nuclear Operations Engineer (for the plant involved) will provide support to the Electric Production Superintendent - Nuclear concerning plant operation and operation's license supporting requirements. The Nuclear Operations Engineer (for the plant involved) will coordinate all plant operations and maintenance with other electric production functions.

Senior Reactor Engineer - The Senior Reactor Engineer is responsible for physics design, review of plant operations (reactor core), physics support for licensing and for development methods, codes and verifications pertaining to physics. He is also responsible for assisting the Quality Assurance Administrator in implementing the quality assurance program outlined in this manual which relates to nuclear and hydraulic operating parameters.

Nuclear Fuels Engineer - The Nuclear Fuels Engineer is responsible for the preparation of technical specifications for nuclear fuel including fabrication, mechanical and thermal-hydraulic design, evaluating nuclear fuel bids, maintaining appropriate relationships with fuel suppliers during contract performance and evaluating performance of nuclear fuel. He will assist the Quality Assurance Administrator in implementing the quality assurance program outlined in this manual as they relate to mechanical and thermal-hydraulic performance of the fuel. The Quality Assurance Administrator will assist the Nuclear Fuels Engineer in conducting the nuclear fuel quality assurance program as outlined in the Nuclear Fuel Quality Assurance Manual.

Health Physicist - The Health Physicist will provide support to the Electric Production Superintendent - Nuclear concerning health physics. He will assist the Quality Assurance Administrator in implementing the quality assurance program which relates to health physics operations in the plants.

Quality Assurance Administrator - An experienced well-qualified engineer will be assigned the duties of General Office QA Administrator by the Electric Production Superintendent - Nuclear. The General Office QA Administrator shall report to the Electric Production Superintendent - Nuclear. The QA Administrator is responsible for maintaining the quality assurance program on operational nuclear power plants. He will deal on a functional basis with those assigned the duties of nuclear plant Quality Assurance Engineers.

Nuclear Plant Superintendent - The Nuclear Plant Superintendent has the responsibility for all activities occurring in his operational nuclear plant. He or his designated alternate shall undertake this responsibility. This responsibility shall include that of maintaining an effective in-plant quality assurance program per the requirements of this manual.

Assistant Plant Superintendent - The Assistant Plant Superintendent assists the Plant Superintendent in maintaining the in-plant quality assurance program. He can act as the superintendent's representative in carrying out his responsibilities to the quality assurance program.

Plant Quality Assurance Engineer - An experienced well-qualified engineer will be assigned the duties of Plant QA Engineer by the Plant Superintendent. The QA Engineer (Plant) reports directly to the Plant Superintendent. He has the authority, delegated by the Plant Superintendent, to conduct the in-plant quality assurance program. He deals on a functional basis with the General Office QA Administrator.

The Plant QA Engineer will be supported in implementing the program by the plant supervisory staff as described in Appendix A of the Plant Operations Manual.



#### 4. DESIGN CONTROL

##### 4.1 General

Measures shall be established to assure that the applicable specified design requirements, such as design bases, regulatory requirements, codes and standards that served as bases for original plant design, construction and licensing, are maintained when the Bulk Power Production Department assumes responsible operations control. The original design and licensing bases as translated into specifications, drawings, procedures and instructions shall be maintained and kept current with appropriate revisions where necessary. Where changes or deviations or quality standards are justified, they shall be adequately identified, documented and controlled.

##### 4.2 Interface Control

Interface control measures are to be established with cognizant parties in the process of design review and control. The parties involved are the Nuclear Plant Operating Staff, the General Office Bulk Power Production Staff, and equipment manufacturers, designers or consultants.

##### 4.3 Design Verification

Design control measures shall provide for verifying or checking the adequacy of design in cases where equipment purchased differs from original plant equipment or such equipment is not designed per specific accepted code requirements. Control of design can be accomplished by design reviews, by the use of alternate calculational methods or by the performance of a suitable testing program. The verification will be performed by persons other than those responsible for the original design. The results of design verification are to be documented.

##### 4.4 Change Control

Design changes modifying a base design (including field changes) shall be subject to design control measures.

## 5. PROCUREMENT DOCUMENT CONTROL

### 5.1 Purpose, Scope, Responsibility

Measures shall be established to assure that applicable regulatory requirements, design bases and other requirements which are necessary to assure adequate quality are included or referenced in the documents for procurement of items and services. In accomplishing this task, procurement documents will normally be initiated by the Plant Staff. Their content, with respect to applicable regulatory requirements and design bases, will be reviewed by both Plant Staff and General Office Personnel before they are approved for submission to Consumers Power Company Purchasing Department for purchase of the requested equipment.

Procurement documents should include provisions for the following as applicable:

1. Basic technical requirements such as drawings, specifications, codes, tests and inspection requirements and special packaging and shipping instructions.

2. Source Surveillance and Inspection - The procurement documents should include provisions for access to the plant facilities and records for source surveillance and inspection when the need for such surveillance or inspection has been determined. The surveillance and inspection can be performed by Consumers Power Company or its agent.

3. Supplier Quality Assurance Program - Where applicable, the procurement documents should request that the supplier furnish his Quality Assurance Manual and indicate the portion or portions of this manual applicable to the items or services being purchased.

4. Documentation - The supplier shall be informed of records to be prepared, maintained, submitted and made available for review, such as drawings, specifications, welding procedures, procurement documents, inspections and test records, personnel and procedure qualifications and material, chemical and physical test results.

## 6. INSTRUCTIONS, PROCEDURES AND DRAWINGS

### 6.1 Purpose, Scope

Activities significantly affecting the safety of operation and maintenance of nuclear plants are to be governed by documented instructions, procedures and drawings of a type appropriate to the circumstances. Such activities will be accomplished in accordance with these instructions, procedures and drawings. Instructions, procedures or drawings shall include appropriate quantitative or qualitative criteria for determining that significant activities have been satisfactorily accomplished.

Significant activities affecting quality of operation and maintenance shall be described in documents such as:

1. Operating Instructions
2. Test Procedures
3. Maintenance Procedures
4. Equipment Instruction Books
5. Shop and Field Construction Drawings
6. Procedure Manuals (ie, Company Welding Procedures)

### 6.2 Responsibility

The Nuclear Plant Superintendent is responsible for assuring that the work forces under his control have adequate instructional material to satisfy principles set forth in Section VI, Paragraph 6.1 of this manual. The Plant Superintendent, or his designated representative, has the authority to supersede written instructional material provided such changes are based on sound principles and reasonable judgment. The Nuclear Plant Superintendent is responsible to the Electric Production Superintendent - Nuclear insofar as maintaining and following proper instructions, procedures and drawings.

## 7. DOCUMENT CONTROL

### 7.1 Purpose, Scope

Administrative measures shall be established to control the issuance of documents such as instructions, procedures and drawings, including changes thereto, which prescribe activities significantly affecting quality of operation and maintenance.

These measures as a minimum are intended to insure that documents, including changes, are reviewed for adequacy and approved for release by authorized personnel and are distributed to appropriate people who have need for such documents at the location (nuclear plant) where the work is being performed and in the General Office where some of the work effort is reviewed and audited. Changes to documents shall be reviewed and approved by the same organizations that performed the original review and approval unless another responsible organization is specifically designated by the Electric Production Superintendent - Nuclear. Those reviewing the documents shall have access to pertinent background information upon which to base their approval and shall have adequate understanding of the requirements and intent of the original document.

### 7.2 Responsibility

Document control measures should provide for:

1. Identification of individuals or organizations responsible for preparing, reviewing, approving and issuing documents and revisions thereto.
2. Means for identifying the proper documents to be used in performing the activity.
3. Means for coordination and control of documents that interface operations and maintenance activities.
4. Means for ascertaining that proper documents are being used.

The Nuclear Plant Superintendent is responsible for assuring that his plant work force has properly reviewed and approved documents of current issue for use in performing activities affecting quality. Where documented review and approval by General Office Personnel is required, the Electric Production Superintendent - Nuclear shall assure that such documents are properly processed and forwarded to the Plant Superintendent for further review and approval or use.

## 8. CONTROL OF PURCHASED MATERIAL, EQUIPMENT AND SERVICES

### 8.1 Purpose, Scope

Measures shall be established to assure that purchased items (items and services which affect the safety and/or reliability of the nuclear plant) and services, whether purchased directly or through contractors, conform to the purchase documents. Means of accomplishing the above include source selection, inspection and evaluation, objective evidence of quality (ie, success of prior dealings with a given vendor) and examination of goods upon delivery.

Source surveillance may be performed when one or more of the following conditions applies:

1. Quality cannot be verified subsequent to assembly or shipment.
2. Consequences of failure to meet specified requirements would have a significant effect on safety or reliability.
3. The importance or complexity of the product justifies special attention.

Documentary evidence that items conform to the procurement requirements shall be available at the nuclear plant site or at vendor's facilities prior to the installation of such items. Documentary evidence shall be retained at the plant site and shall be sufficient to identify that the specific requirements such as codes, standards and specifications are met by the purchased item. Where not precluded by other requirements, such documentary evidence may take the form of written certifications of conformance which identify the requirements met by the items.

### 8.2 Responsibility

The Electric Production Superintendent - Nuclear shall be responsible for insuring that proper control of purchased material, equipment and services is maintained. He is supported in this task by the Nuclear Plant Superintendent. Purchase documents are to be prepared by the General Office Staff or the Nuclear Plant Staff. Each group shall review the purchase documents for proper reference to applicable codes, standards, drawings and procedures. General Office Staff, Nuclear Plant Staff or both shall take part in source inspection and evaluation and receiving inspection.

## 9. IDENTIFICATION AND CONTROL OF MATERIALS, PARTS AND COMPONENTS

### 9.1 Purpose, Scope

Measures shall be established for the identification and control of materials, parts and components affecting the safety of operation of nuclear power plants. Such measures will operate to control purchased material, parts and components as they are received at operational nuclear power plants. Measures such as physical identification, physical separation or procedural control or combination thereof shall be used as appropriate. Identification may be on the items or on records traceable to the item as appropriate.

Where identification marking is employed, the marking shall be clear, unambiguous and indelible. Markings should be transferred to each part of an item when subdivided and shall not be obliterated or hidden by surface treatment or coatings unless other means of identification are substituted.

These identification and control measures shall provide for comparing an item received at a nuclear plant to an applicable drawing, specification or other technical document. In addition, when codes, standards or purchase specifications require traceability of materials, parts or components to specific inspection or test records, the program shall be designed to provide such traceability. In the absence of specific requirements, the identification and control requirements of this standard will be satisfied by any program which assures that acceptable materials and processes have been used in the finished product and the item finds its proper place in the nuclear plant operation or maintenance system.

### 9.2 Responsibility

The Nuclear Power Plant Superintendent shall be responsible for devising, implementing and maintaining the identification and control program.

## 10. CONTROL OF SPECIAL PROCESSES

### 10.1 Purpose, Scope

Measures shall be established to assure that special processes, including welding, heat treating and nondestructive examination, are accomplished under appropriate conditions in accordance with applicable codes, standards, specifications, drawings, criteria and other special requirements using qualified personnel and procedures. Personnel shall be qualified under currently applicable AEC, ASME, ANS, IEEE, ASCE and ANSI Codes and Standards. Documentation shall be maintained for currently qualified personnel, processes and equipment.

### 10.2 Responsibility

If the General Office Staff is responsible for the special process used, the Electric Production Superintendent - Nuclear shall be responsible for assuring the control of special processes. If the special process being applied is the responsibility of the Plant Staff, the Nuclear Plant Superintendent shall be responsible for assuring that the special process being applied is properly controlled.

## 11. INSPECTION

A program for inspection of materials, equipment, processes or services purchased shall be established and executed during manufacturing, construction and/or installation by or for the organization responsible for furnishing the item or services to assure the item conforms to applicable drawings, specifications, instructions and procedures. The inspection shall be performed by individuals other than those who perform the activity being inspected. The inspection program applied to purchased materials shall be sufficient to assure the appropriate level of quality.

If mandatory inspection hold points are necessary, which require witnessing or inspection by the purchaser or his designated representative, the specific hold points shall be indicated in the appropriate purchase document. Such consent shall be documented prior to the continuation of work beyond the designated hold points.

A program for in-service, nondestructive inspection of completed systems, structures and components shall be planned and executed by Consumers Power Company. This inspection program shall comply with the requirements of the ASME Code, Section 11, and/or the plant technical specifications.

In situations where it is warranted, the equipment received at a Consumers Power Company nuclear plant shall be visually and/or dimensionally inspected. The purpose of such inspection will be to search for shipping damage.

Where it is warranted, Consumers Power Company may visit supplier's facilities for the purpose of inspecting equipment in process of fabrication. The inspection shall be performed by Consumers Power Company or its agent.



## 12. TEST CONTROL

### 12.1 Purpose, Scope

A test program shall be established to assure that all testing required to demonstrate that the item will perform satisfactorily in service is identified and performed in accordance with approved written test procedures. The test procedures used shall take account of the intended function of the item, acceptance limits, and design criteria. Test programs shall include as appropriate prototype qualification tests, proof tests prior to installation or service, preoperational tests as well as operational tests to verify continued satisfactory performance during operation.

Test procedures shall be sufficiently detailed to determine that prerequisites for a given test have been met, that adequate instrumentation is available and used and that necessary monitoring is performed.

Test results shall be documented and evaluated to assure that test requirements have been satisfied.

### 12.2 Responsibility

The Nuclear Plant Superintendent is responsible for assuring that test procedures are developed and available as needed. He shall also assure that approved test procedures are used appropriately and properly evaluated. The Superintendent or his representative shall approve all test procedures.

Test procedures and testing schedules shall be those documented in Plant Technical Specifications, Operating Procedures Manuals and Test Procedures Manuals.

### 13. CONTROL OF MEASURING AND TEST EQUIPMENT AND INSTRUMENTATION

#### 13.1 Purpose, Scope

Measures shall be established to assure that inspection and test measurement equipment is kept in proper order. Inspection and test devices used shall be properly controlled, calibrated, maintained and adjusted at specified intervals consistent with normal use periods and equipment requirements.

Control measures shall include provisions for test equipment identification and for determining calibration status by marking on the equipment or records traceable to the equipment.

Procedures shall be provided for periodic calibration and testing of plant instrumentation. Examples of instruments are interlocks, alarm devices, sensors, signal conditions, and protective circuits. The procedures shall have provisions for meeting surveillance schedules and for assuring measurement accuracies adequate to keep safety parameters within operational safety limits.

#### 13.2 Responsibility

The Nuclear Plant Superintendent shall be responsible for implementing and controlling an effective program of measurement and test equipment usage.

14. HANDLING, STORAGE AND SHIPMENT

14.1 Purpose, Scope

Measures shall be established to control handling, storage, shipping, cleaning, packaging and preservation of material and equipment that has a significant effect on the quality and safety of plant operation and maintenance. The intent is to prevent damage, deterioration and loss.

Specific written procedures for handling, storage, packaging, shipping and preservation of critical items should be used. Special attention should be given to providing adequate marking and labeling for packaging, shipment and storage of articles and materials.

Reasonable engineering judgment based on past successful experience shall be used when special handling, storage, packaging and shipping situations are encountered (such as the need for special inert, protective environments).

14.2 Responsibility

The Nuclear Plant Superintendent shall be responsible for implementing and maintaining an effective program for handling, storage and shipment of quality related items.

15. INSPECTION, TEST AND OPERATING STATUS

15.1 Purpose, Scope

Measures shall be established to identify inspection and test status. These measures shall provide means of positive identification of status to assure that required inspections and tests are performed and evaluated before proceeding with further operation or use of a system, component or item of material. The inspection and test status shall be maintained on the system, component, or material or on records traceable to them.

Measures shall also be established for indicating the operating status of systems and components of the nuclear power plant, such as tagging valves and switches to prevent inadvertent operation.

15.2 Responsibility

The Nuclear Plant Superintendent shall be responsible for establishment and maintenance of an inspection, test and operating status monitoring system. This system shall be documented in the form of operating and test procedures approved by the Plant Superintendent. The system may be augmented by written administrative procedures.

## 16. NONCONFORMING ITEMS

### 16.1 Purpose, Scope

Measures shall be established to control items or services which do not conform to requirements in order to prevent their inadvertent use or installation. These measures shall include, as necessary, procedures for identification, documentation, segregation, disposition and notification to affected organizations. Nonconforming items shall be reviewed and accepted, rejected, repaired or reworked in accordance with documented procedures. Repaired or reworked items shall be reinspected in accordance with applicable procedures.

Measures which prevent further processing, delivery, installation or operation of a defective item pending a decision on its disposition shall be established and maintained. Nonconforming items shall be resolved by acceptance "as is" by scrapping or repairing the defective item or by rework to complete or correct to a drawing specification. Measures for identifying and controlling nonconforming items shall provide for documentation verifying the resolution of nonconforming items. Control of nonconforming items by tagging, marking or other means of identification is acceptable where physical separation is not practical.

### 16.2 Responsibility

The Nuclear Power Plant Superintendent shall establish and maintain measures to assure proper identification and control of nonconforming items significantly affecting quality and safety of plant operation and maintenance.

17. CORRECTIVE ACTION

17.1 Purpose, Scope, Responsibility

Measures shall be established to assure that conditions adverse to quality such as failures, malfunctions, deficiencies, deviations, defective material and equipment and nonconformities are promptly identified and corrected. Where significant conditions adverse to quality exist, measures shall be taken to assure that the cause of the condition is determined and corrective action is taken to preclude repetition. All such action shall be documented. Consumers Power Company Nuclear Plant Review Committee and Consumers Power Company Safety Audit and Review Board serve as the two groups responsible for reviewing such conditions adverse to quality and proper, safe and reliable operating performance.

## 18. QUALITY ASSURANCE RECORDS

### 18.1 Purpose, Scope

Sufficient records shall be prepared as work is performed to furnish documentary evidence of the quality of items and of activities affecting quality. The records shall be adequate for use in the implementation of the quality assurance program as outlined in this manual.

The records shall include as a minimum the results of reviews, inspections, tests and audits. The records shall also include appropriate supporting documentation (such as qualifications of personnel). Inspection and test records shall, as a minimum, identify the inspector or data recorder, the type of observation, the results, the acceptability and the action taken in connection with any deficiencies noted.

Consumers Power Company shall collect, record and store quality assurance data in a convenient form. Required records shall be identifiable and retrievable.

Requirements concerning appropriate review of quality assurance records generated at the Plant and General Office level shall be established. Review requirements shall be established to assure that management is adequately aware of situations with possible influence on the quality, safety and reliability of operating systems.

Insofar as possible, records which correctly identify the as-built condition of items in the plant should be maintained for the life of the plant by Consumers Power Company or its agent. These records shall be filed and maintained in facilities that provide adequate prevention against their damage or loss.

### 18.2 Responsibility

The Nuclear Plant Superintendent is responsible for maintaining adequate quality assurance records. The General Office Quality Assurance Administrator and the Plant Quality Assurance Engineer will assist in this regard.

## 19. QUALITY AUDITS

### 19.1 Purpose, Scope

Planned audits shall be carried out to verify compliance with all aspects of the quality assurance program. Audit results shall be documented and reviewed by management having responsibility in the area audited. Responsible management shall take necessary action to correct the deficiencies revealed by the audit. Consumers Power Company shall perform quality audits:

1. To provide an objective evaluation of compliance with established requirements, methods and procedures.
2. To assess progress of assigned tasks.
3. To determine adequacy of quality assurance program performance.
4. To verify implementation of recommended corrective action.

Audits should include an evaluation of the implementation of the quality assurance program as well as surveillance of actual work areas, activities and work in processes related to the performance of activities affecting quality. The audits should also include review of pertinent documents and records.

Quality audits should be conducted periodically or on a random unscheduled basis, or both. It is desirable to conduct audits when one or more of the following conditions exist:

1. When it is necessary to determine the capability of a sub-contractor's quality assurance program prior to awarding of contracts or purchase orders.
2. When, after award of contract, sufficient time has elapsed for implementation of the quality assurance program and it is appropriate to determine that the organization is performing the function as defined in the quality assurance program description, codes, standards and other contract documents.
3. When extensive changes are made in functional areas of the quality assurance program including major reorganization and procedure revisions.



4. When it is suspected that safety, performance or reliability of the item are in jeopardy due to deficiencies and nonconformances in the quality assurance program.

5. When a systematic independent assessment of program effectiveness or item quality or both is considered necessary.

6. When it is considered necessary to verify implementation of required corrected actions.

#### 19.2 Responsibility

Consumers Power Company personnel responsible for auditing quality assurance and quality control activities - Nuclear power plants - shall be designated by the Electric Production Superintendent - Nuclear, or the Nuclear Power Plant Superintendent. Results of audits should be submitted to the Electric Production Superintendent - Nuclear and the Nuclear Power Plant Superintendent for their review. These persons will be responsible for assuring that corrective action is taken regarding deficiencies revealed during the audit.

## 20. OPERATIONAL CONTROL

### 20.1 Purpose, Scope

Measures shall be established to assure that nuclear plants and their attendant equipment are operated, maintained and modified in accordance with the requirements and limitations of applicable codes, standards, specifications, plant licenses, technical specifications and predetermined safety restrictions. Planning of operational activities shall include procedures which generally include schedules, charts or diagrams which outline checks, tests and inspections required to place and maintain the plant in operation.

A maintenance and testing program shall be developed that identifies systems or components which are essential to the safe, efficient and reliable operation of nuclear power plants. Administrative controls and check points for maintenance activity review evaluation, corrective action and feedback shall be included in the maintenance program.

Modifications to plant or plant equipment affecting plant safety and reliability shall be accomplished under the terms of this manual and attendant-written procedures. Procedures shall be developed and implemented for testing modified components, systems and subsystems. Testing shall establish component, subsystem or system integrity and shall provide for preoperational evaluation of performance prior to system operation.

Maximum use will be made of industry approved standards such as ANS 3.2, Standard for Administrative Controls for Nuclear Power Plants, in maintaining adequate control of operations and maintenance. Consumers Power Company operations and maintenance procedures shall be formulated and implemented as needed.

### 20.2 Responsibility

The Electric Production Superintendent - Nuclear shall have overall responsibility for operational control. He shall rely on his General Office Staff and individual Plant Superintendents to develop and implement operational control programs in nuclear power plants.

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Rev 0  
8/14/72

This document has been reviewed and approved by:

CONSUMERS POWER COMPANY

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- BU-002 Training
- BU-003 Licensing
- BU-004 Plant Maintenance, Plant Operations  
and Testing Programs
- BU-005 Plant Chemistry
- BU-006 Quality Assurance
- BU-007 Health Physics
- BU-008 Nuclear Plant Instrument and Control
- BU-009 Reactor Engineering

Section 6: PROCUREMENT

- A. Plant Equipment Identification and Control
- C. Identification and Marking of Procured  
Material
- D. Index of Plant Systems and Equipment (QA01B)

- E. Nuclear Materials Requisition Procedures
- F. Nuclear Materials Purchasing Procedures
- G. Nuclear Materials Receiving Procedures

Section 7: STORAGE AND HANDLING OF NUCLEAR MATERIALS

- A. Identification of Stored Materials
- C. Handling, Shipping and Storage
- E. Welding Material Control Procedures

Section 8: MAINTENANCE

- A. Maintenance Planning
- B. Maintenance Preparation and Performance
- C. Preventive Maintenance

Section 9: PLANT OPERATIONS

- A. Station Operating Procedures
- B. Control of Measuring and Test Equipment

Section 10: INSERVICE INSPECTION

- A. Inservice Inspection