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CLIMATOLOGY OF THE HAT CREEK VALLEY REGION

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Vancouver, B. C.

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1. INTRODUCTION

This report, prepared for the British Columbia Hydro and Power Authority (B. C. Hydro), describes the climatology of the Hat Creek Region, the intermontane region of southern British Columbia which surrounds the Hat Creek Valley. This analysis has been carried out as part of the study of potential environmental effects of B. C. Hydro's proposed Hat Creek Project. The project consists of a 2000 MW power plant and an open pit coal mine in the vicinity of Ashcroft, B. C. The mine is expected to be located in the Hat Creek Valley; while the proposed power plant location is at Harry Lake in the nearby Trachyte Hills at an elevation of 4600 ft. (MSL). Figure 1-1 provides a map of the Hat Creek Valley Region and indicates the proposed sites of the mine and the power plant.

The Hat Creek Region is part of the larger Thompson Plateau region which separates the western Coast Range from the Monashee Range of the Rocky Mountains. Despite its characterization as a plateau region, the Thompson Plateau has significant terrain relief due to its erosion by large rivers such as the Fraser and the Thompson, and smaller ones, such as the Hat Creek. The topography of the Hat Creek Valley vicinity is shown in Figure 1-2. The Hat Creek Valley floor varies in elevation from 3500 ft. at Upper Hat Creek to about 1600 ft near the towns of Carquile and Cache Creek. The surrounding ridges and peaks to the south and east of the Hat Creek Valley reach the 5100 to 6600-ft maximum heights of the Trachyte Hills and Cornwall Hills, respectively. The peaks of the Marble Range, to the north, also reach about 6800 ft., while the maximum elevations of the Clear Range, to the west, reach 7200 to 7600 ft. These topographic features have a significant influence upon the climatology of the Hat Creek Valley Region, as will be seen in the analysis which follows.

True climatic averages for meteorological parameters require that consistent records be maintained for long periods. A period of five to ten years is generally considered the minimum period required to establish climatological averages, although 30 to 40 years if preferred for obtaining averages for highly variable or relatively rare events such as snowfall depth, thunderstorm frequency, or temperature range extremes.

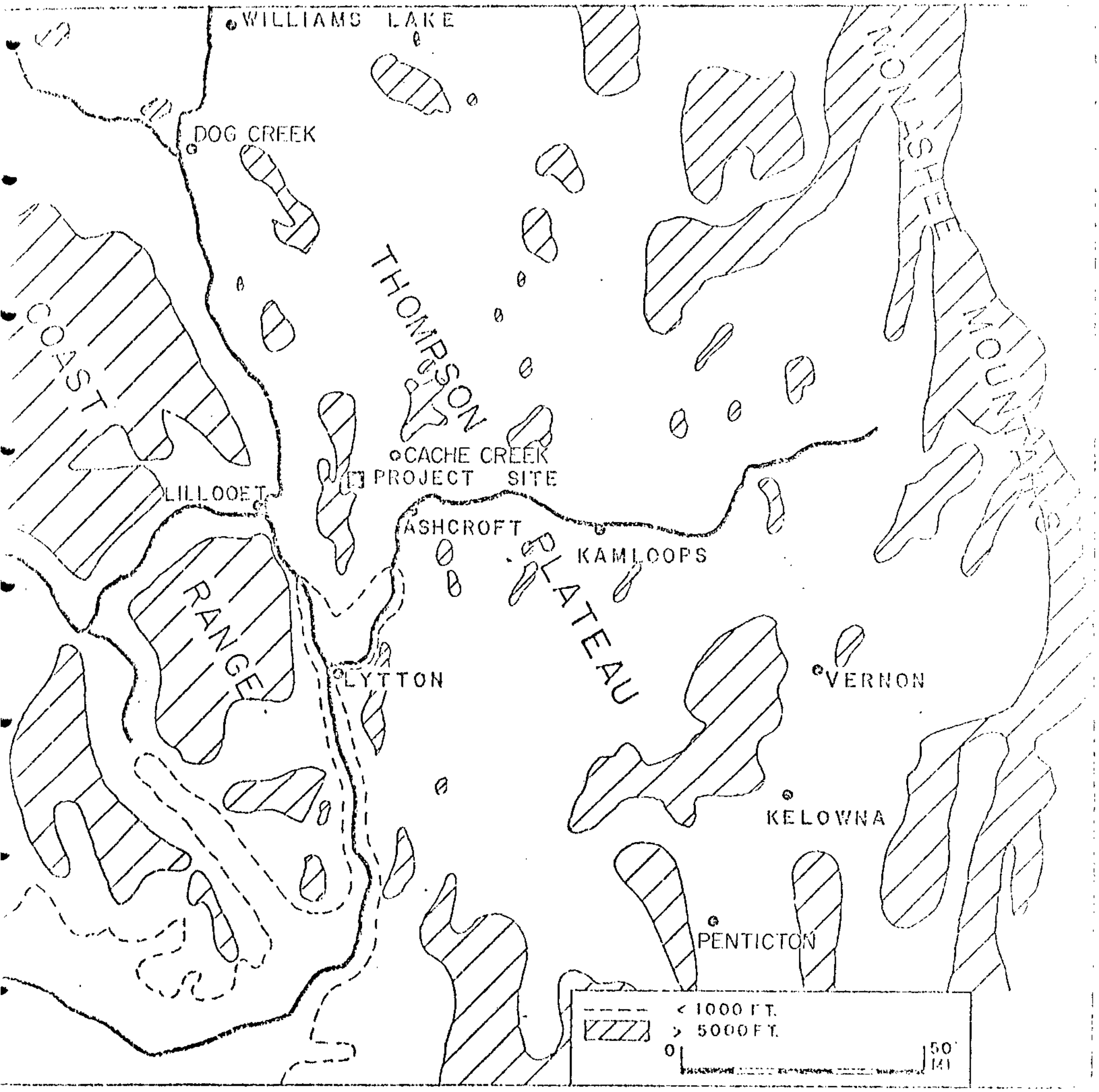


Figure 1-1 Topographic Map of Hat Creek Valley Region Showing Proposed Project Site

0 0 16 MILES

Plant Site

Mine Site

Elevation (feet)

Under 2000

2000-4000

4000-6000

Over 6000

Figure 1-2 Topographic Map of Hat Creek Valley Vicinity

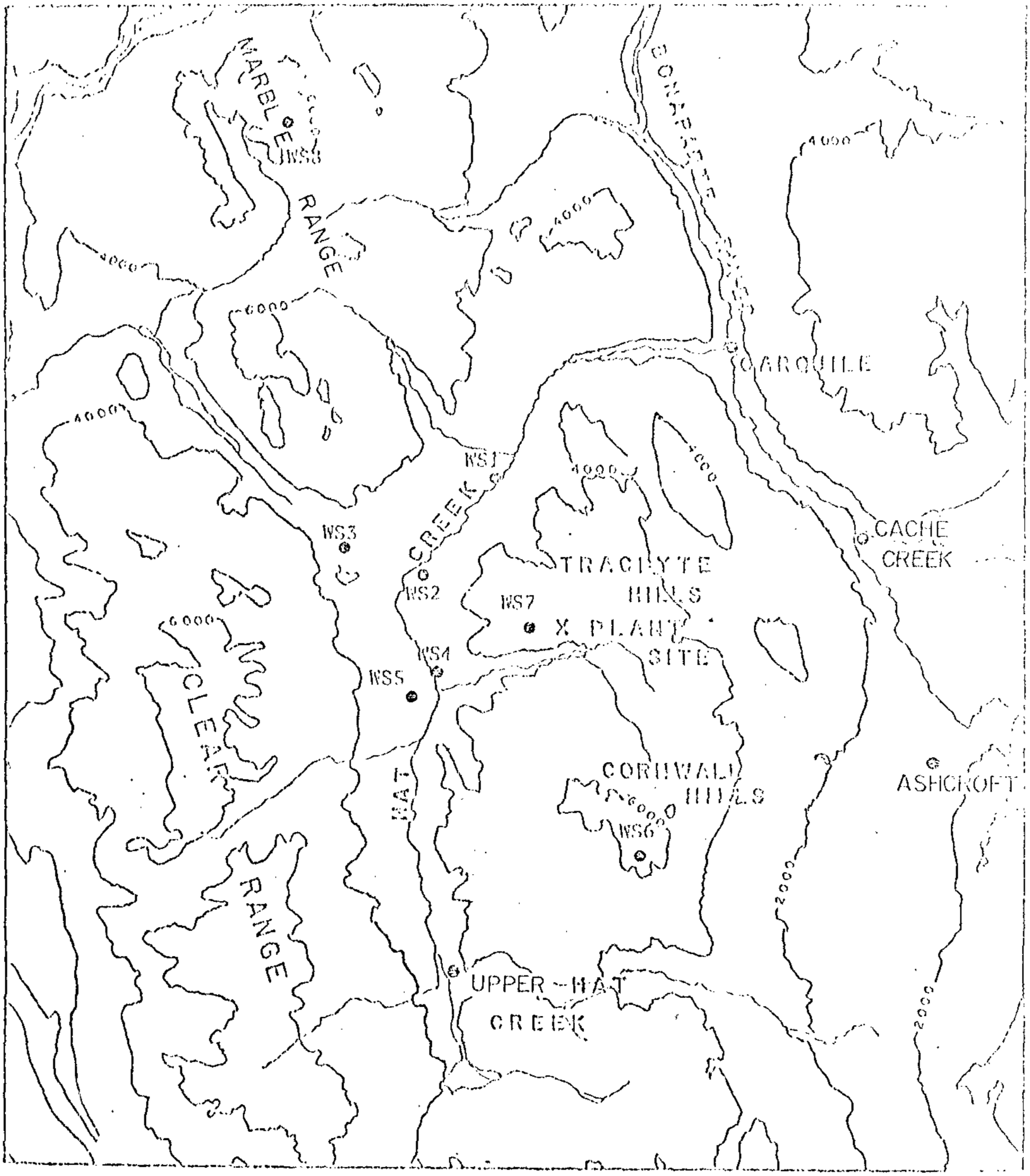
For wind flow data, however, when characteristic patterns are frequently repeated in an area where the topography is a strong influence, a much shorter period can suffice to identify some of the most important climatological features.

The following section identifies the sources of all meteorological data utilized in this analysis of the climatology of the Hat Creek Region. The third section of the report discusses the regional wind flow and patterns of precipitation, temperatures, humidity, sunlight, as well as the occurence of visibility restrictions or conditions associated with high air pollution potential. The last section concentrates upon the more detailed measurements of wind flow, temperature and humidity made over a two-year period by B. C. Hydro in the Hat Creek Valley and its immediate vicinity.

2. DATA SOURCES

Long-term climatological data were obtained principally from the records and periodic reports produced by the Atmospheric Environment Service of Canada (AES), Climatological Service Division, and the U. S. Naval Weather Service World-Wide Airfield Summaries (Vol IV). The two periodic AES publications utilized are the Canadian Weather Review and the Monthly Record: Meteorological Observations in Canada. These data were supplemented considerably by the recent meteorological observations made by B. C. Hydro in the vicinity of its planned generating station in the Hat Creek Valley Region. Table 2-1 lists all the meteorological observation stations providing data for the present analyses. Also given in the table are the directional orientation and distances of all these stations from the proposed generating station site at Harry Lake. The locations of the eight mechanical B. C. Hydro stations referred to in the table are shown in Figure 2-1. Each of these mechanical stations records temperature and humidity, in addition to wind speed and direction. The present analysis covers the first year of the two year period that these eight systems have been operating. Figure 2-1 also shows the sites used for the short-term minisonde studies of the Hat Creek Valley sponsored by B. C. Hydro and reported previously, (Weissman, 1974, 1975). As indicated in Table 2-1 the meteorological measurements received from the Atmospheric Environment Service were initially acquired by B. C. Hydro on computer tapes. These include the hourly surface observations at Ashcroft (1966-71), Kamloops (1974-75), and Lytton (1974-75) as well as the radiosonde upper air observations (RAOB) for Vernon and Prince George, B. C. utilized in this study of the Climatology of the Hat Creek Region.

Other climatic information sources used in this analysis include: the reference texts, The Climate of Canada (1960), The Earth's Problem Climate (1961), and the Climatological Atlas of Canada (1953); and an unpublished report "Mixing Heights, Wind Speeds and Air Pollution Potential for Canada" by R. V. Portelli (1976) of the Atmospheric Dispersion Division of the Atmospheric Environment Service.



WS = Mechanical Weather Station

MS = Minisonde Site

0 4 8

MILES

Figure 2-1 Meteorological Network in the Vicinity of the Hat Creek Project

TABLE 2-1

LOCATIONS OF METEOROLOGICAL OBSERVATION STATIONS
RELATIVE TO PROPOSED GENERATING STATION SITE AT HARRY LAKE

Station	Elevation (ft. MSL)	Direction from Site	Distance (mi)
B. C. Hydro Mechanical Weather Stations			
WS 1	2500	NNW	4
WS 2	2700	W	4
WS 3	2800	W	5
WS 4	3100	WSW	3
WS 5	3300	WSW	4
WS 6	6600	SSE	7
WS 7	4600	N	<1/2
WS 8	6700	NW	16
B. C. Hydro/MEP Co. Minisonde Station			
MS 1	2400	N	5
MS 2	2750	WNW	6
MS 3	2900	W	3
MS 4	3800	SSW	9
Atmospheric Environmental Service Observation Stations			
Surface:			
Alta Lake	2190	SW	72
Ashcroft*	1200	ESE	11
Dog Creek	2150	NNW	60
Kamloops**	1240	E	48
Kelowna	1370	SE	104
Lytton**	850	S	34
Penticton	1120	SE	110
Squamish*	20	SW	96
Williams Lake	3090	NNW	88
Upper Air (RAOB)			
Prince George	2220	NNW	220
Vernon	1820	ESE	100

*Wind data obtained through B. C. Hydro

**Complete surface observations obtained through B. C. Hydro

3. REGIONAL CLIMATOLOGY

3.1 Climatic Scale Wind Flow

The climate of the Hat Creek Region is greatly influenced by the interaction of the large-scale pressure and wind flow patterns with the Coast Range to the west and the Rocky Mountains to the east, as well as the topography within this intermontane region. Seasonal changes in the relative positions of the semi-permanent high pressure region over the northern Pacific Ocean, and the combination of the low pressure region near the Aleutians and the continental high pressure ridge which forms over Alaska in winter, act to control the lower-level wind fields. The latitude at which cyclonic storms track across the Coast Range and the Rocky Mountains is also affected by these seasonal changes.

The Coast Range rises to 10,000-foot elevations and limits the humid and mild maritime air to a narrow band along the coast. As the moist air rises up the mountain slopes, it cools considerably, resulting in widespread condensation and precipitation. The presence of the Coast Range, therefore, causes a dramatic difference between the damp coastal climate and the relatively dry interior of southern British Columbia.

Upper-level winds (above 500 mb or above about 18,000 feet above sea level), which are controlled by global circulations, generally flow from west to east, but are modulated by currents which transport heat between the equator and poles. The north-south waves which appear in the flow streamlines at these levels can alter the prevailing direction sector. These upper wind perturbations are particularly strong at certain times of the year and this is reflected in the nearby passages of surface cyclonic systems. At the latitude of the Hat Creek Region the passage of upper-level waves in spring and fall maximizes the frequencies of occurrence of cyclones (lows) and anticyclones (highs) in the lower levels of the atmosphere. In the winter, the storm track moves to an average which is south of the Hat Creek area (about 45°N); in the summer, these storms take a more northerly path.

At lower levels in the atmosphere (e.g., 850 mb, or about 5,000-6,000 feet above sea level) the wind flow over the Thompson Plateau, is slowed down by the frictional drag of the earth's surface, and its mean direction is somewhat altered. When the surface topography has features which penetrate the flow field at these levels, the flow can be severely distorted. This is the case in the intermontane region of British Columbia. The Coast Range to the west and the Columbia Mountains of the Rockies to the east serve to block the lower-level flows of large scale atmospheric circulations.

Figure 1-1 shows the spatial location of mountains and river valleys in relation to the proposed project site. Solid contours are drawn for terrain of elevation greater than 5,000 feet, and the lower terrain below 1,000 feet is shown by broken contours. The figure shows the Coast Range and the Monashee Mountains which are major factors in determining regional climate by partially blocking both the maritime and continental air flows. The strong westerly winds of the upper levels, averaging 25-35 mph, are slowed and channeled by the mountains into more northerly or southerly directions at the lower levels (depending upon the season). These changes in the winds at the 850 mb level, compared to those at the 500 mb level (about 18,000 feet), are illustrated by the 1975 upper air sounding data for Vernon, British Columbia, summarized in Table 3-1.

As previously noted, by winter the semi-permanent high pressure region over the northern Pacific Ocean has receded to its most southerly position, and most major storm centers pass to the south of the Hat Creek area. During the months from December through February, in conjunction with an upper-level trough of low-pressure channeling these storms to the south, the most predominant 850 mb winds are from the southwest. The Fraser River Valley acts to channel surface-level components of strong winds onto the interior plateau in a south to southwesterly direction over the plateau region. Table 3-1 shows that wind speeds at the 500 mb atmospheric pressure level above the plateau average about 25 mph. At the 850 mb level the dominant southerly winds average about half that speed.

Although surface observations of winds over the area show the winter predominance of southerly winds, they also indicate the strong influences of local mountain valley circulations. At Vernon, these local effects reinforce the southerly flow during the day but counteract it with a northerly drainage wind at night.

TABLE 3-1

WIND DIRECTION AND MEAN SPEEDS FOR SEVERAL LEVELS AT VERNON, B.C.*

Frequency of Occurrence of Wind Direction by Level

Wind Direction	Winter 500mb	Winter 850mb	Winter Surface	Spring 500mb	Spring 850mb	Spring Surface	Summer 500mb	Summer 850mb	Summer Surface	Fall 500mb	Fall 850mb	Fall Surface
N	5	6	23	16	17	21	4	11	28	7	17	21
NNE	2	5	16	6	7	14	2	7	11	6	4	9
NE	0	3	14	3	7	10	1	4	8	2	5	7
ENE	2	2	2	1	2	4	2	5	5	1	1	6
E	1	3	6	5	2	8	4	7	4	0	1	5
ESE	0	1	5	1	2	2	2	1	3	0	2	4
SE	0	8	18	2	7	14	0	2	12	1	7	21
SSE	1	13	14	5	8	15	5	3	15	1	7	14
S	5	19	22	9	13	12	9	9	18	6	35	20
SSW	5	24	14	15	20	6	17	16	12	5	23	17
SW	11	28	10	17	16	23	25	27	25	8	23	19
WSW	10	17	5	22	17	10	34	34	11	18	12	8
W	16	10	13	16	9	17	23	12	15	26	7	5
WNW	16	7	1	18	10	13	19	12	6	20	5	6
NW	9	14	4	13	17	4	18	15	6	19	12	4
NNW	2	11	5	10	22	8	7	13	3	11	12	10
Calm	1	2	8	1	1	3	1	2	2	0	4	6

Monthly Mean Wind Speeds (mph)

	February			May			August			November		
Mean Wind Speed	24.9	11.5	6.1	28.1	10.1	8.7	29.8	8.8	7.7	30.9	17.1	10.0

*Radiosonde Data: AES(1975)

During the transition period in spring, the stream of Pacific cyclones weakens and shifts slightly to the north. The Alaskan ridge moves eastward, causing more frequent northerly components in the lower-level winds. Winds at 500 mb vary due to the effects of storm centers crossing the area, but they are generally from the southwest to northwest, averaging about 30 mph. At 850 mb, winds are either more southerly or more northerly, channeled according to the orientation of the plateau between the Coast Range and the Rockies (Figure 2-1). Occasional outbreaks of the strong springtime Arctic high pressure centers cause cold winds from the north to north-northwest over the plateau. On the average, the winds at 850 mb (5,000 feet) are slightly weaker than those in winter, as shown in Table 3-1.

During the summertime, considerable weakening and retreat of the Arctic high takes place while a semi-permanent Pacific high pressure center builds up at about 43° N, 1,000 miles west of the Oregon coast. Westerly winds dominate the upper flow pattern at 45°-50° N. The track of Pacific storms continues to move north to a maximum average latitude of 54° N by late July. At this time, the amplitude of the waves in the upper air windfields is reduced to its minimum, generating only weak cyclonic circulations over the surface. As a result, occasional brief, heavy showers and thunderstorms take place on the interior plateau during the summer. Summer is the time of year when the weakest synoptic air flow exists at the 850 mb level and below. Winds at the 500 mb level are generally from the west, driven now by the persistent Pacific high pressure system. Resultant wind speeds average almost 30 mph at 500 mb but less than 10 mph at 850 mb. Occasionally the Pacific high will move farther west or south, causing light southwesterly winds to be channeled through the Fraser River gap in the Coast Range.

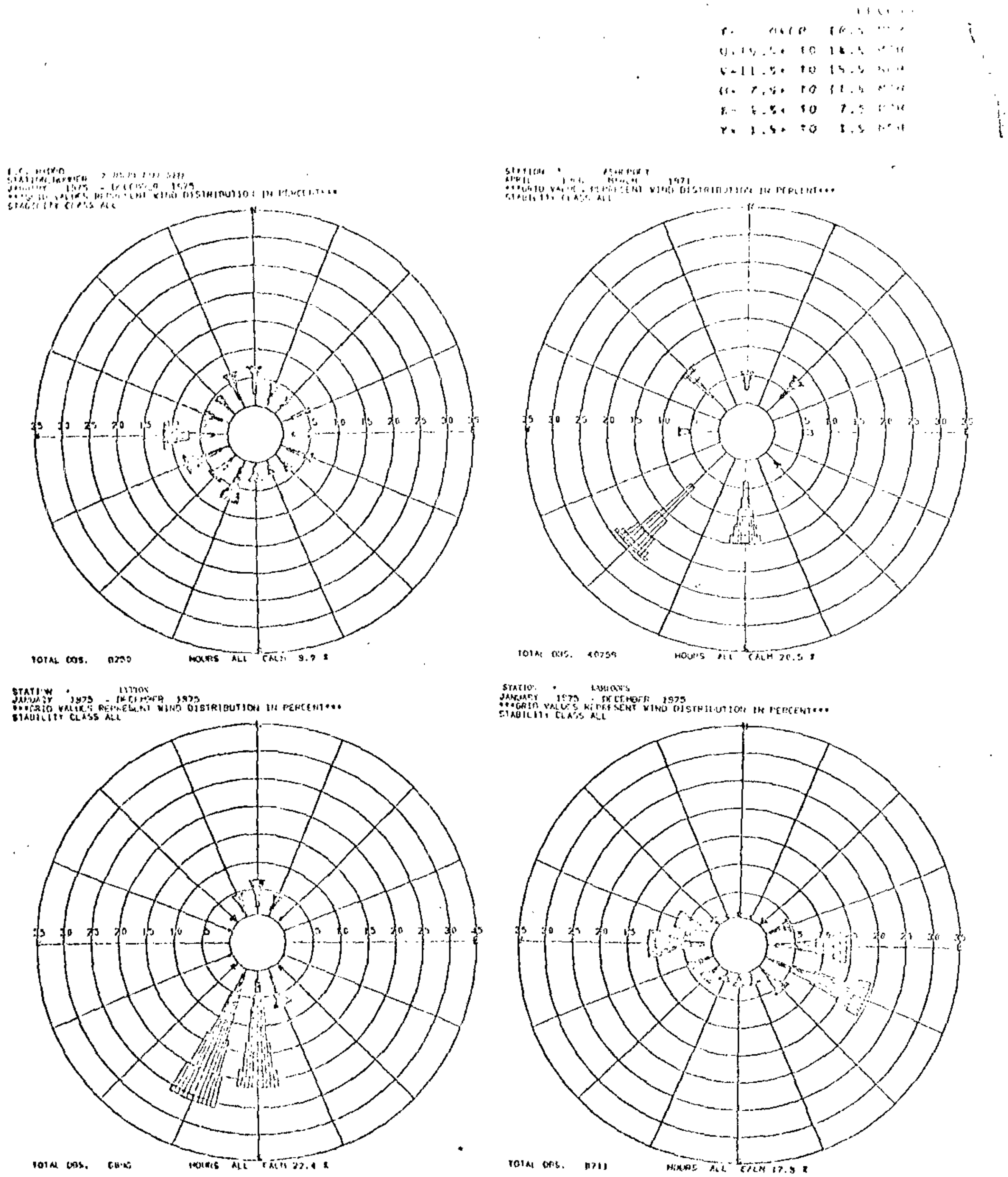
Summer synoptic circulations do not produce a strong response in surface wind fields, due to the dominance of summer heating and mountain valley circulations. At Vernon, the north to north-northeast and south to south-southeast surface flow is a strong reflection of the valley orientation. As will be seen in the next section, the frequency distributions of wind directions at all of the stations in the Hat Creek Valley and its vicinity demonstrate frequent maxima along terrain orientations in the summer. In fact, most observations at the surface are dominated by terrain-induced flow patterns throughout the year.

The fall, like the spring, is a period of transition between the weak westerly winds of summer and the slightly stronger westerly flow of winter. As the Pacific high weakens and retreats south, in the fall, the storm track passes southward over the Hat Creek area, producing perturbations in the wind flow, resulting in mean 500 and 850 mb winds that vary between the northwest and southwest. Wind speeds increase at both levels, averaging more than 30 mph at 500 mb and more than 15 mph at 850 mb. These stronger winds and the increasing dominance of southerly flows near the surface lead to maximum surface wind speeds for the year in fall at locations like Vernon, where the orientation of its valley enhances the coupling between surface and upper-level flows.

3.2 Surface Wind Observations

The location of the proposed power generating station at Harry Lake, above the Hat Creek Valley, has been indicated in Figure 1-1. The towns of Ashcroft, Kamloops, Lytton, Kelowna, Penticton, and Williams Lake, from which surface wind data are routinely obtained by the Atmospheric Environment Service, are also located in the figure. Figure 2-1 shows the location of the eight mechanical weather stations which measure surface winds for B. C. Hydro in the vicinity of Hat Creek valley. An annual wind rose for Mechanical Station No. 7, the one representative of the Harry Lake Site, is compared with those representing Ashcroft, Lytton, and Kamloops in Figure 3-1. The wind speed and direction frequencies for the same four stations presented in Figure 3-1 are also tabulated in Tables 3-2 through 3-5 to aid quantitative comparisons. (A comparison of the Harry Lake Site wind rose with those derived for the other seven B. C. Hydro mechanical weather stations is given in Section 4). The wind roses for Lytton and Kamloops are based upon two years of data (1974-75), and the wind rose for Ashcroft is based upon five years of observations. At Ashcroft, however, wind direction observations are classified in 8 sectors; instead of the 16 used at all the other stations discussed in this report. It is clear that the predominant wind directions are principally determined by the orientation of the valley, in or near which each site is located.

These wind roses reveal that the wind directions associated with orographically-induced wind flow are characterized by low wind speeds.



*Source: Atmospheric Environment Service Data

Figure 3-1 Annual Wind Roses for Harry Lake Site, Ashcroft, Lytton, and Kamloops, B.C.

TABLE 3-2

ANNUAL WIND DIRECTIONS AND SPEEDS AT HARRY LAKE SITE

% FREQUENCY OF WIND DIRECTIONS WITHIN VARIOUS WIND SPEED CATEGORIES *

B.C. HYDRO. HARRY LAKE SITE
STABILITY ALL JANUARY 1975 - DECEMBER 1975

	WIND SPEED CATEGORY(MPH)							
DIR.	0.0-1.5	1.5-3.5	3.5-7.5	7.5-11.5	11.5-15.5	15.5-18.5	>18.5	TOTAL
N	0.6	2.0	3.7	0.8	0.2	0.1	0.0	7.6
NNE	1.0	1.3	1.8	1.0	0.3	0.1	0.0	5.5
NE	0.7	1.4	1.9	0.3	0.0	0.0	0.0	4.4
ENE	1.0	2.1	3.0	0.3	0.0	0.0	0.0	6.4
E	0.5	1.6	2.9	0.4	0.0	0.0	0.0	5.4
ESE	0.7	1.3	3.3	1.2	0.1	0.0	0.0	6.6
SE	0.3	1.0	1.5	0.9	0.1	0.0	0.0	3.8
SSE	0.3	0.9	1.1	0.3	0.2	0.0	0.0	2.8
S	0.3	0.5	1.0	0.7	0.5	0.3	0.3	3.5
SSW	0.4	1.0	2.0	1.3	1.1	0.8	1.2	7.8
SW	0.6	0.7	1.6	1.6	1.0	0.3	0.3	6.0
WSW	0.7	1.5	2.9	2.0	1.6	0.3	0.1	9.1
W	0.9	2.6	4.5	2.2	1.7	0.5	0.2	12.3
WNW	0.5	1.2	1.9	1.0	0.6	0.1	0.0	5.3
NW	0.5	1.4	1.6	0.8	0.4	0.1	0.0	4.9
NNW	0.7	1.7	2.7	1.5	0.5	0.2	0.1	7.4
VAR	0.1	0.4	0.6	0.0	0.0	0.0	0.0	1.1

*TOTAL OBSERVATIONS = 8201 % Data Capture = 93.62

TABLE 3-3

ANNUAL WIND DIRECTIONS AND SPEEDS AT KAMLOOPS

% FREQUENCY OF WIND DIRECTIONS WITHIN VARIOUS WIND SPEED CATEGORIES *

KAMLOOPS

STABILITY ALL JANUARY 1974 - DECEMBER 1975

	WIND SPEED CATEGORY (MPH)							
DIR.	0.0-1.5	1.5-3.5	3.5-7.5	7.5-11.5	11.5-15.5	15.5-18.5	>18.5	TOTAL
N	17.8	0.2	0.4	0.1	0.1	0.0	0.0	18.7
NNE	0.0	0.3	0.3	0.1	0.1	0.1	0.0	0.9
NE	0.0	0.4	0.5	0.2	0.2	0.1	0.0	1.5
ENE	0.0	0.9	2.0	1.2	0.7	0.2	0.1	5.0
E	0.0	1.4	4.4	3.3	3.0	1.2	0.9	14.3
ESE	0.0	1.3	4.1	4.4	5.1	2.6	2.0	19.5
SE	0.0	0.7	1.7	1.3	1.3	0.4	0.4	5.8
SSE	0.0	0.6	0.8	0.2	0.2	0.1	0.1	2.1
S	0.0	0.5	0.7	0.2	0.2	0.1	0.2	2.0
SSW	0.0	0.4	0.7	0.2	0.3	0.2	0.3	2.2
SW	0.0	0.5	1.0	0.5	0.6	0.4	0.7	3.6
WSW	0.0	0.8	1.8	1.1	0.7	0.3	0.2	4.6
W	0.0	1.1	2.5	2.0	2.2	1.3	1.5	10.6
WNW	0.0	0.7	1.3	1.0	1.3	0.9	1.0	6.3
NW	0.0	0.4	0.6	0.2	0.2	0.1	0.1	1.7
NNW	0.0	0.4	0.4	0.1	0.0	0.0	0.1	0.9
VAR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

*TOTAL OBSERVATIONS = 17422

* % Data Capture 99.44

TABLE 3-4

ANNUAL WIND DIRECTIONS AND SPEEDS AT LYTTON

% FREQUENCY OF WIND DIRECTIONS WITHIN VARIOUS WIND SPEED CATEGORIES *

LYTTON

STABILITY ALL JANUARY 1974 - DECEMBER 1975

DIR.	WIND SPEED CATEGORY (MPH) 0.0-1.5	1.5-3.5	3.5-7.5	7.5-11.5	11.5-15.5	15.5-18.5	>18.5	TOTAL
N	19.1	1.4	2.6	1.4	0.6	0.1	0.0	25.4
NNE	0.2	1.2	2.0	0.7	0.2	0.0	0.0	4.2
NE	0.1	0.6	0.7	0.1	0.0	0.0	0.0	1.5
ENE	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.5
E	0.0	0.1	0.1	0.0	0.0	0.0	0.0	0.3
ESE	0.0	0.2	0.2	0.1	0.0	0.0	0.0	0.4
SE	0.1	0.5	0.8	0.3	0.0	0.0	0.0	1.7
SSE	0.2	1.3	2.6	1.3	1.0	0.3	0.4	7.2
S	0.3	1.3	3.2	2.8	7.7	4.4	2.7	22.4
SSW	0.2	1.0	2.4	2.7	10.7	6.4	4.9	28.2
SW	0.1	0.3	0.2	0.2	0.4	0.1	0.0	1.0
WSW	0.1	0.3	0.2	0.0	0.0	0.0	0.0	0.7
W	0.1	0.3	0.1	0.0	0.0	0.0	0.0	0.5
WNW	0.0	0.2	0.2	0.0	0.0	0.0	0.0	0.5
NW	-0.1	0.4	0.4	0.1	0.1	0.0	0.0	1.1
NNW	0.1	0.8	1.6	0.9	0.5	0.1	0.0	4.1
VAR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

*TOTAL OBSERVATIONS = 14271   % Data Capture = 81.46

TABLE 3-5

ANNUAL WIND DIRECTIONS AND SPEEDS AT ASHCROFT

% FREQUENCY OF WIND DIRECTIONS WITHIN VARIOUS WIND SPEED CATEGORIES *

ASHCROFT

STABILITY ALL APRIL 1966 - MARCH 1971

DIR.	WIND SPEED CATEGORY (MPH) 0.0-1.5	1.5-3.5	3.5-7.5	7.5-11.5	11.5-15.5	15.5-18.5	>18.5	TOTAL
N	5.3	2.4	1.7	1.0	0.5	0.1	0.1	11.0
NNE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NE	1.7	3.4	2.9	1.1	0.5	0.1	0.0	9.7
ENE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
E	2.9	5.0	1.6	0.1	0.0	0.0	0.0	9.7
ESE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SE	0.9	2.1	1.0	0.1	0.0	0.0	0.0	4.2
SSE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
S	1.9	3.6	3.0	1.9	2.8	1.9	1.4	16.6
SSW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SW	3.5	8.1	7.8	4.1	2.6	0.9	0.5	27.5
WSW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
W	3.0	5.1	1.6	0.3	0.1	0.0	0.0	10.2
WNW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
NW	1.1	3.4	4.1	1.7	0.7	0.1	0.1	11.2
NNW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
VAR	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

*TOTAL OBSERVATIONS = 40729

% Data Capture = 92.99

The highest wind speeds occur when the local flow becomes coupled with the higher-level winds. Except for this speed enhancement effect, the dominance of local circulations makes it difficult to infer the major climatic flow patterns from these surface data, even when the wind roses are broken down into separate seasons, as in Figures 3-2 through 3-5. Comparisons of these wind roses do show the increased importance of southerly winds (which amplify the frequency of ESE winds at Kamloops) in the winter, and somewhat weaker westerly winds in the summer. Diurnally varying mountain/valley flows are strongest in summer and winter when heating and cooling effects upon wind directions are the most evident. However, the comparison of wind roses of the sites illustrates that the specific geometry of the topography surrounding any of the stations is more important than their distance from a location of interest. For that reason, the surface wind data collected by B.C. Hydro, supplemented by the upper-air sounding data routinely taken at Vernon, is seen as essential to the documentation of the climatic wind flow patterns in the Hat Creek Valley (see Section 4.1). In this case, a relatively short data record inside Hat Creek Valley is more representative of long-term circulation patterns than a much longer record at any station outside the valley--even at Ashcroft which is only about 15 miles from Harry Lake. An important aspect of the comparative wind analysis is the frequency of calm conditions in all of these valley locations. For the present analysis, calm is defined as any wind speed less than 1.5 mph, rather than just a report of zero. For many standard observation stations the wind instruments are not sensitive enough to give accurate wind speed or direction data below this threshold. Table 3-6 presents a summary of the seasonal and annual frequencies of calms to indicate typical variations for these valley stations. In valleys which are sheltered from southerly synoptic winds, the winter season is characterized by calm conditions - about 35 percent of the time in the Hat Creek Valley.

3.3 Precipitation

Table 3-7 presents seasonal and annual averages of total precipitation and thunderstorm frequency for seven stations in the Hat Creek

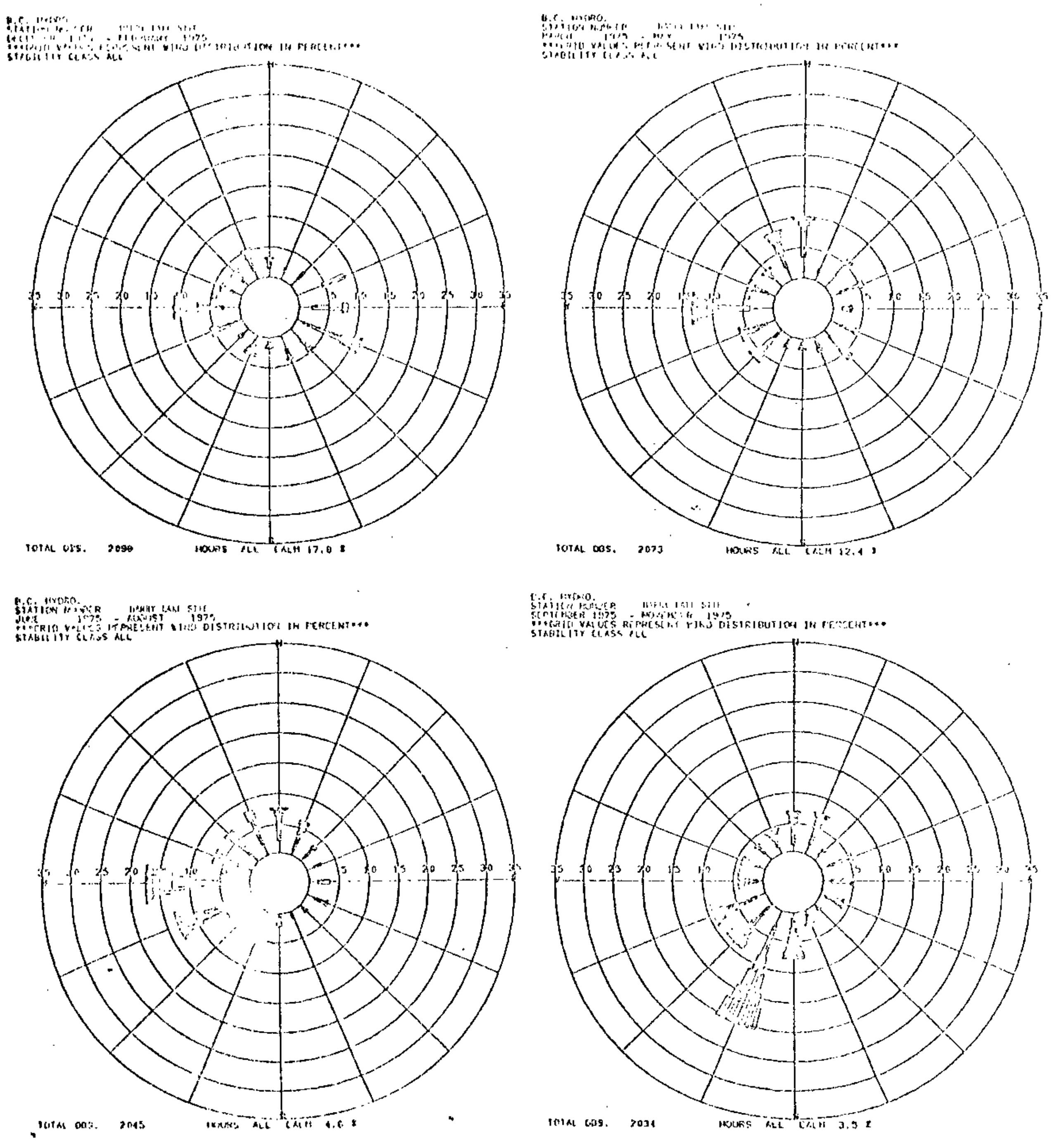


Figure 3-2 Seasonal Wind Roses for Harry Lake Site
(Mechanical Station No. 7)

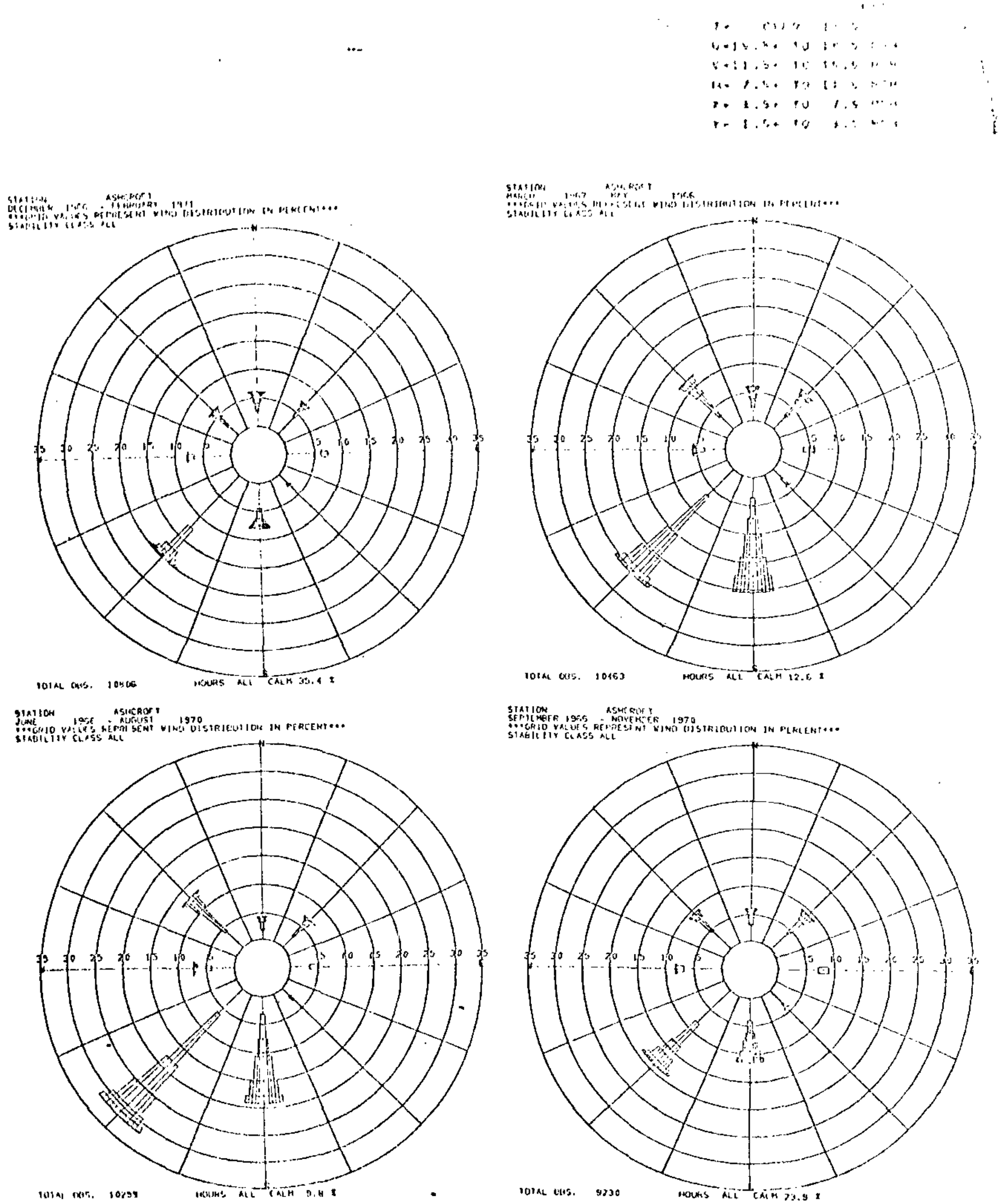


Figure 3-3 Seasonal Wind Roses for Ashcroft, B.C.

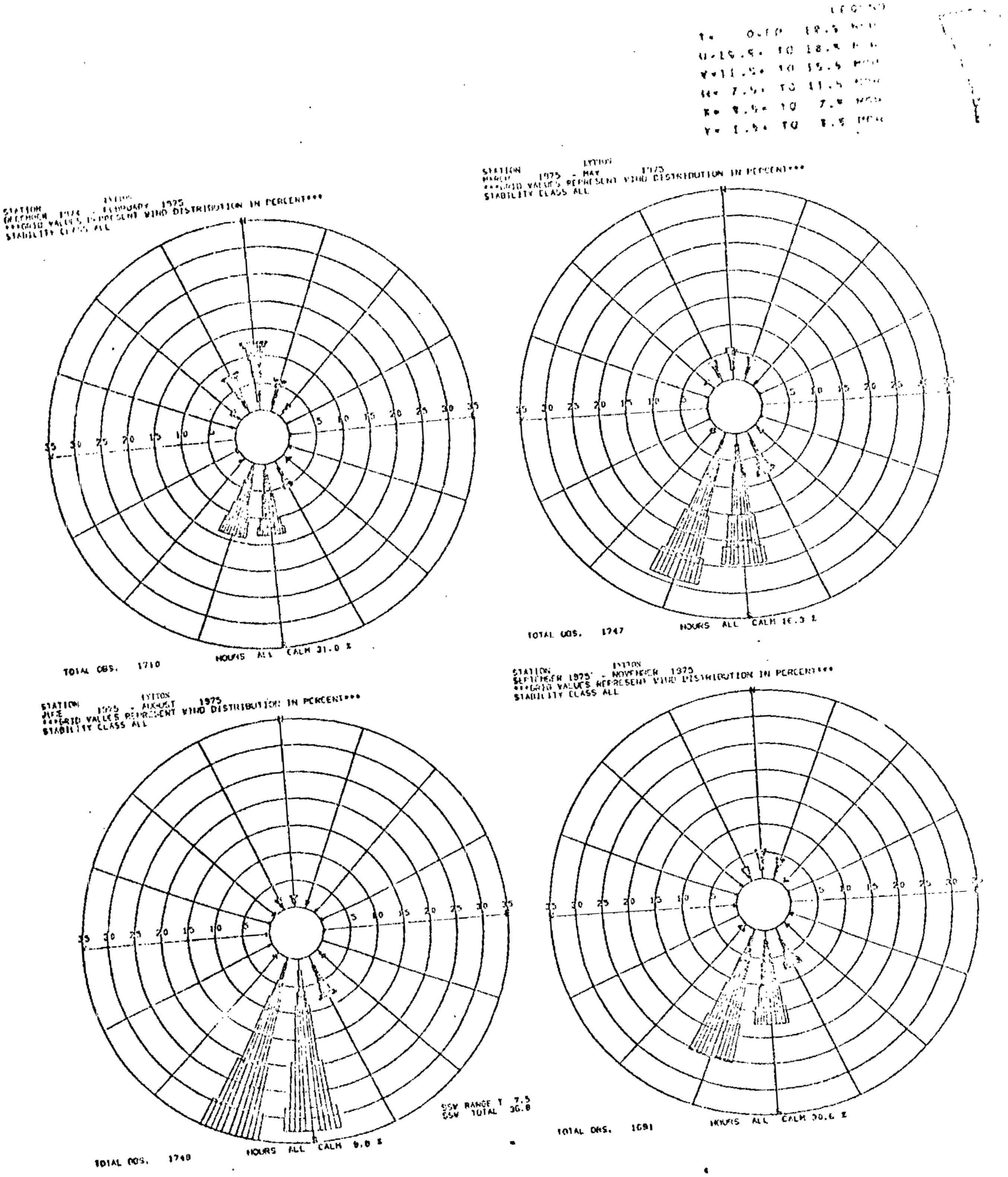


Figure 3-4 Seasonal Wind Roses for Lytton, B.C.

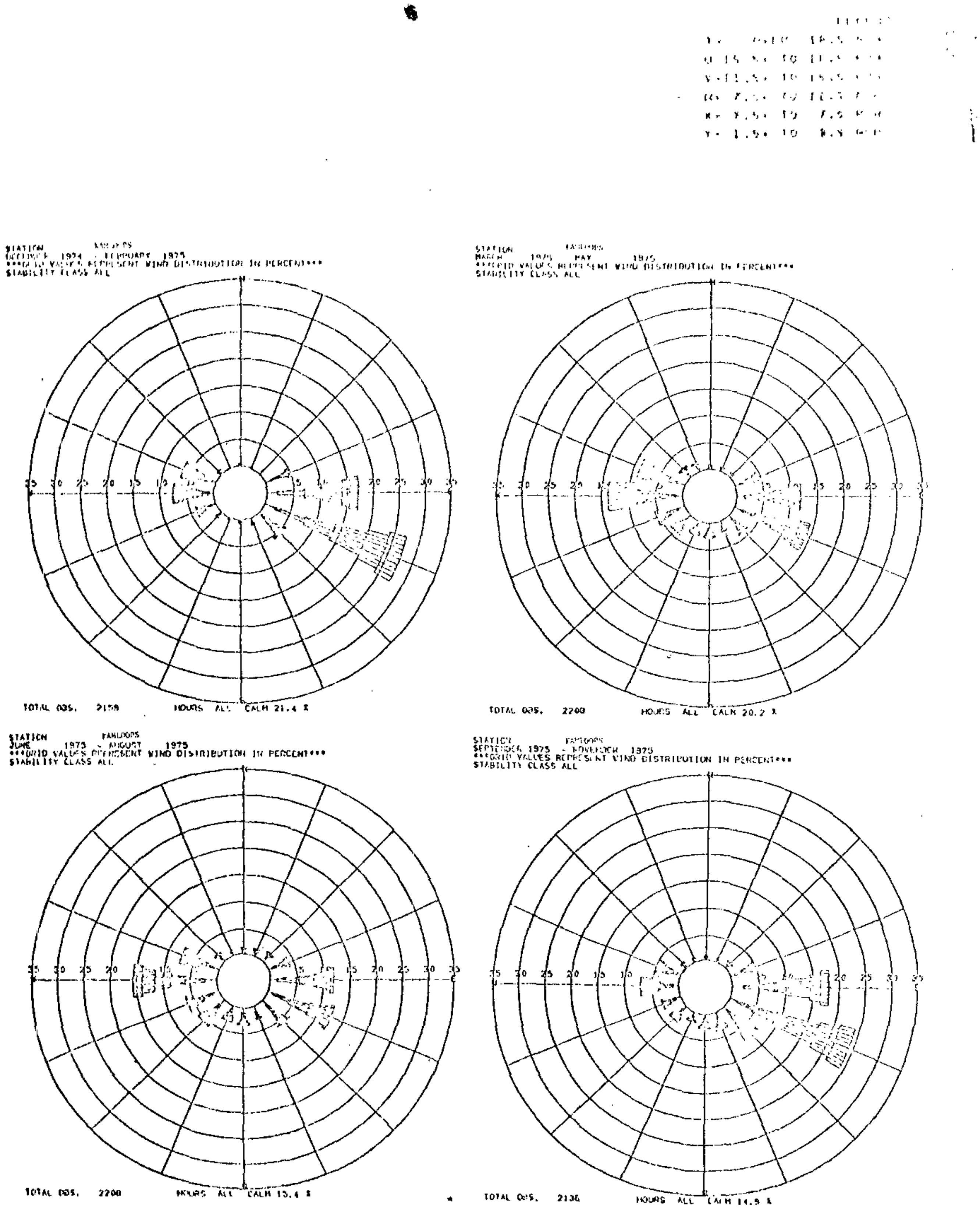


Figure 3-5 Seasonal Wind Roses for Kamloops, B.C.

TABLE 3-6

FREQUENCY (%) OF CALMS IN HAT CREEK REGION*

Station	Annual	Winter	Spring	Summer	Fall
	Frequency of Calms				
Ashcroft (April 1966-March 71)	20.46	35.38	12.57	9.76	23.86
Kamloops (Jan 1974-Dec 75)	18.10	21.40	17.50	17.39	17.63
Lytton (Jan 74-Dec 75)	20.72	30.99	14.11	8.18	32.76
Mechanical Sites 1-5 (Jan 75-Dec 75)	22.53	34.79	21.10	15.07	22.47
Mechanical Sites 6 and 8 (Jan 75-Dec 75)	0.81	0.66	1.29	0.30	1.35
Harry Lake Site Mechanical Site 7 (Jan 75-Dec 75)	9.66	17.78	12.45	4.65	3.49

*Source: Analysis of AES date for Ashcroft, Kamloops, and Lytton; analysis of B. C. Hydro data for all mechanical station sites.

TABLE 3-7

TOTAL PRECIPITATION IN THE HAT CREEK REGION*

Season	Ashcroft	Dog Creek	Kamloops	Kelowna	Lytton	Penticton	Williams Lake**
			Mean Total Precipitation (in) per Station				
Winter	2.81	3.50	2.70	3.72	5.61	2.84	3.76
Spring	1.38	2.09	1.70	2.18	2.46	2.40	2.64
Summer	2.94	5.21	3.40	2.90	2.15	2.86	5.93
Fall	2.29	2.89	2.40	3.39	4.24	2.75	3.50
Annual	9.4	13.7	10.2	12.2	14.5	10.8	15.8
			Frequency (days) of Precipitation > 0.1 in				
Winter	9.1	11.7	8.6	11.8	21.9	9.1	28.0
Spring	4.3	6.0	5.3	6.9	7.7	7.7	16.8
Summer	9.3	15.5	10.2	9.1	7.0	8.9	16.5
Fall	8.1	7.8	8.4	10.3	11.6	9.1	20.3
Annual	30.7	41.0	32.5	38.1	48.2	34.8	81.5
			Thunderstorm Frequency (days) per Station				
Winter	0	0	0	0	0	0	***
Spring	2	2	1	2	0	2	***
Summer	5	8	6	12	2	12	***
Fall	0	0	1	1	0	1	***
Annual	7	10	8	15	2	15	***
Period of Record (yrs)	9	6	73	40	22	32	4

*Source: World-Wide Airfield Summaries, USNWS (1967)

**Source: Monthly Record, AES (1972-75)

***Williams Lake data not available

region. The 9- to 16-inch range of total annual precipitation shows the efficacy of the Coast Range in blocking the influx of moist maritime air from the Pacific Ocean. Though Dog Creek and Williams Lake are both farther from the Hat Creek Valley than Ashcroft, they probably are more representative of the seasonal distribution of precipitation to be found at the Harry Lake site, since they are closer to the same elevation and are located in similar terrain. Ashcroft and Kamloops are expected to be the most similar of all the stations to sites in the Lower Hat Creek Valley. In spite of the higher frequency of summer thunderstorms at Kelowna and Penticton, the summer climate is not markedly wetter at these stations. The thunderstorms form in relatively dry air masses when they are in the lee of the coast range. The increased exposure of Kelowna and Lytton to southerly synoptic scale storms in the late fall and winter explains the maximum precipitation that occurs during these seasons.

Mean seasonal and annual figures for snowfall are listed in Table 3-8. The stations at higher elevations (Dog Creek and Williams Lake) are the only ones which have significant spring snowfall. However, a similar seasonal distribution of snowfall and an annual total of 50 to 60 inches should also be anticipated for the elevated Harry Lake site. The middle and lower Hat Creek Valley can expect 30 to 40 inches of snowfall each year. The Williams Lake station is only about 100 miles north of Ashcroft, but it has a noticeably colder and wetter climate.

3.4 Normal and Extreme Temperatures

The normal temperatures for the Hat Creek Region are presented in Table 3-9. The absolute extremes and mean daily temperature ranges are given in Tables 3-10 and 3-11, respectively. These tables illustrate that all of the valley sites in the region have quite similar temperature ranges, except for Lytton, which is about 4°F warmer at all times. Long-term temperature statistics at Dog Creek are expected to be representative of those at the Harry Lake site. B. C. Hydro measurements of temperatures in the Hat Creek Valley Vicinity are discussed in Section 4.2.

3.5 Dew Point and Relative Humidity

The dew-point and relative humidity data summarized in Table 3-12 show the relatively dry spring and summer conditions in this region.

TABLE 3-8

SNOWFALL IN THE HAT CREEK REGION*

Month/ Season	Mean Snowfall (in) per Station: Ashcroft	Dog Creek	Kamloops	Kelowna	Lytton	Penticton	Williams Lake**
Dec.	7.4	12.4	8.0	11.0	17.7	7.1	16.7
Jan.	11.0	8.8	9.0	10.7	14.2	7.2	25.8
Feb.	6.4	11.4	6.0	6.4	6.7	4.5	15.1
Winter	24.8	32.6	23.0	28.1	38.6	18.8	57.5
Mar.	1.8	9.2	1.0	3.2	2.2	2.5	9.7
Apr.	0.5	5.6	0.5	0.1	0.3	0	2.1
May	0	0.9	0.5	0	0	0	1.0
Spring	2.3	15.7	2.0	3.3	2.5	2.5	12.8
June	0	0	0	0	0	0	0
July	0	0	0	0	0	0	0
Aug.	0	0	0	0	0	0	0
Summer	0	0	0	0	0	0	0
Sept.	0	0	0.5	0	0	0	0
Oct.	0.9	0.3	0.5	0.3	0.1	0.2	1.7
Nov.	4.2	3.1	5.0	4.0	2.8	2.5	20.6
Fall	5.1	3.4	6.0	4.3	2.9	2.7	22.3
Annual	32.3	51.7	31.0	35.7	44.0	24.0	92.6
Days with Snowfall > 1.5 in.	6.1	12.4	5.5	7.0	9.0	4.4	***
Period of Record (yrs)	9	6	73	40	22	32	4

*Source: World-wide Airfield Summaries, USNWS (1967)
**Source: Monthly Record, AES (1972-1975)
***Williams Lake data not available

TABLE 3-9

NORMAL TEMPERATURES IN THE HAT CREEK REGION*

Season	Kamloops	Kelowna	Lytton	Penticton	Williams Lake
	Seasonal Mean Temperature (°F) per Station				
Winter	26.0	25.7	30.3	30.3	19.0
Spring	47.3	45.3	50.3	45.7	39.3
Summer	67.3	63.7	69.3	66.0	58.3
Fall	47.0	44.7	50.0	48.0	40.0
Annual	46.9	44.8	50.0	47.5	39.2

*Source: Canadian Weather Review, AES (1974)

TABLE 3-10

SEASONAL EXTREME TEMPERATURES IN THE HAT CREEK REGION*

Season	Ashcroft	Dog Creek	Kamloops	Kelowna	Lytton	Penticton
Absolute Maximum Temperature (°F) per Station						
Winter	59	56	64	63	65	64
Spring	95	86	100	93	104	94
Summer	102	94	107	102	112	105
Fall	93	84	95	93	97	94
Annual	102	94	107	102	112	105
Absolute Minimum Temperature (°F) per Station						
Winter	-35	-41	-37	-24	-25	-16
Spring	-21	-32	-13	-8	-6	0
Summer	34	29	33	30	40	38
Fall	-13	-24	-22	-9	0	-2
Annual	-35	-41	-37	-24	-25	-16
Period of Record (yrs)	20	10	65	60	40	50

*Source: World-wide Airfield Summaries, USNWS (1967)

TABLE 3-11

CLIMATOLOGICAL AVERAGES OF DAILY TEMPERATURE RANGES IN THE HAT CREEK REGION*

	Mean Maximum/Minimum Temperatures (°F) per Station					
Month	Ashcroft	Dog Creek	Kamloops	Kelowna	Lytton	Penticton
December	30/18	28/16	33/23	34/24	34/23	35/26
January	24/9	21/10	28/16	31/19	31/21	32/21
February	34/17	27/14	34/20	35/20	40/24	38/23
March	45/27	38/23	48/29	47/28	52/34	50/30
April	58/35	50/32	62/38	58/34	64/40	61/35
May	71/44	62/40	71/46	68/42	73/47	70/42
June	74/50	65/46	77/52	74/49	77/54	77/49
July	82/54	74/50	84/56	81/53	84/58	84/53
August	80/53	70/47	82/54	78/51	83/57	81/52
September	73/45	63/43	71/47	68/44	73/50	71/45
October	56/36	49/24	56/38	56/36	60/42	59/38
November	40/26	32/19	41/30	43/30	45/32	44/31
Annual	56/35	48/31	57/37	56/36	60/40	59/37
Period of Record (yrs)	9	6	61	40	13	32

*Source: World-wide Airfield Summaries, USNWS (1967)

TABLE 3-12

DEW POINT AND RELATIVE HUMIDITY IN THE HAT CREEK REGION*

Season	Ashcroft	Dog Creek	Kamloops	Kelowna	Lytton	Penticton
Mean Dew Point (°F) per Station						
Winter	12.3	14.0	20.7	24.3	24.3	24.3
Spring	33.0	28.7	35.0	34.7	37.0	34.7
Summer	46.0	45.3	50.0	51.0	50.0	51.0
Fall	34.3	32.0	38.0	39.3	40.0	39.3
Annual	32.7	30.0	35.9	37.3	37.8	37.3
Mean Relative Humidity (%) per Station						
Winter	83.7	82.7	79.3	79.3	82.0	79.3
Spring	57.7	61.7	57.7	61.3	61.0	61.3
Summer	49.0	62.3	53.7	60.0	50.7	60.0
Fall	66.3	73.0	71.7	71.3	72.0	71.3
Annual	64.2	69.9	65.6	68.0	66.4	68.0
Period of Record (yrs)	6	6	10	10	6	10

*Source: World-wide Airfield Summaries, USNWS (1967)

These data indicate that the maximum probability of cooling tower impacts upon visibility or precipitation should occur in the fall and winter seasons. Ashcroft and Dog Creek have the lowest dew points during these seasons, but about the same mean relative humidity as the other stations listed. These two locations appear to be somewhat colder and drier than the other stations in the region.

3.6 Visibility

Table 3-13 presents three years of statistics related to restricted visibility for the five stations discussed in most of the other regional comparisons in this report. More detailed annual and seasonal distributions of visual ranges versus frequencies of their reported occurrence are given for Lytton and Kamloops in Table 3-14a, b, and c. These latter distributions were derived from hourly observations at each site, rather than the four observations per day summarized in Table 3-13. The earlier table is useful, however, for examining the variation of visibility restriction cases with location and time. It can be seen that fogs causing visual ranges less than 1/2 miles are relatively rare in these semi-arid areas. Some increase from 1973 to 1975 in the frequency of restricted visibility in winter, particularly in the mildly restricted ranges (5/8 to 5 miles), is suggested by the Table 3-13 data. However, a comparable pattern of decreases in the fall frequencies in Table 3-13 suggests that the particular climatic pattern associated with periods of frequent fogs may have been delayed in its time of arrival over this region. That is why it is important that visibility data be recorded and analyzed for as long a period as possible before the installation of a new industrial facility, so that the baseline climate can be clearly established.

Tables 3-14b and c show that for 1975, about 5 percent of the reported winter hours at Lytton had visibilities of less than 2 miles, while more than 5 percent of the hours at Kamloops had visibilities less than 1 mile. The Monthly Record: Meteorological Observations in Canada, shows that the majority of the observations of severely limited visual range occurred at the 4 AM observation time.

TABLE 3-13

OBSERVATIONS OF LIMITED VISIBILITY IN THE HAT CREEK REGION

Number** of Observations of Limited Visual Range (miles)*

Location	1973		1974		1975	
	0-1/2 mi	5/8-5 mi	0-1/2 mi	5/8-5 mi	0-1/2 mi	5/8-5 mi
1. Kamloops						
Winter	2	22	6	37	7	46
Spring	1	1	1	2	0	0
Summer	0	0	0	0	0	1
Fall	2	19	0	4	0	7
2. Kelowna						
Winter	8	25	2	32	6	30
Spring	0	3	1	7	0	8
Summer	0	0	0	0	0	0
Fall	4	22	0	8	1	7
3. Lytton						
Winter	3	13	1	39	3	34
Spring	1	2	0	3	1	10
Summer	0	0	0	2	1	1
Fall	1	24	16	17	0	15
4. Penticton						
Winter	0	12	1	15	3	38
Spring	0	1	0	1	1	7
Summer	0	0	0	0	0	0
Fall	1	16	0	4	1	4
5. Williams Lake						
Winter	6	28	8	44	8	53
Spring	3	14	1	16	2	14
Summer	3	7	0	5	1	11
Fall	12	46	11	29	4	26

Source: *Monthly Record, AES (1973-5)

**Possible number of observations each year: Winter = 360, Spring = 368, Summer = 368, Fall = 364

TABLE 3-14(a)

ANNUAL FREQUENCY DISTRIBUTION OF VISIBLE RANGE LIMITS FOR KAMLOOPS AND LYTTON IN 1974 - 1975 *

STATION KAMLOOPS

HOURLY AVERAGE VISUAL RANGE (MI)
JANUARY 1974 - DECEMBER 1975

UPPER LIMIT OF INTERVAL	PERCENT OCCURRENCE	CUMULATIVE PERCENT
0.0	0.769	0.769
1.000	0.878	1.647
2.000	0.448	2.095
3.000	0.522	2.617
4.000	0.488	3.105
≥ 5.000	96.895	100.000

NUMBER OF VALUES = 17423

STATION LYTTON

HOURLY AVERAGE VISUAL RANGE (MI)
JANUARY 1974 - DECEMBER 1975

UPPER LIMIT OF INTERVAL	PERCENT OCCURRENCE	CUMULATIVE PERCENT
0.0	1.128	1.128
1.000	0.771	1.899
2.000	0.385	2.284
3.000	1.205	3.489
4.000	0.673	4.162
5.000	95.838	100.000

NUMBER OF VALUES = 14272

* Source: Analysis of AES data

TABLE 3-14(b)

SEASONAL FREQUENCY DISTRIBUTION OF VISIBLE RANGE LIMITS FOR

KAMLOOPS IN 1974 - 1975*

STATION KAMLOOPS
HOURLY AVERAGE VISUAL RANGE (MI)
DECEMBER 1974 - FEBRUARY 1975

UPPER LIMIT OF INTERVAL	PERCENT OCCURRENCE	CUMULATIVE PERCENT
0.0	2.663	2.663
1.000	3.010	5.673
2.000	1.505	7.178
3.000	1.852	9.030
4.000	1.667	10.697
≥ 5.000	89.303	100.000

NUMBER OF VALUES = 4319

STATION KAMLOOPS
HOURLY AVERAGE VISUAL RANGE (MI)
MARCH 1974 - MAY 1975

UPPER LIMIT OF INTERVAL	PERCENT OCCURRENCE	CUMULATIVE PERCENT
0.0	0.159	0.159
1.000	0.113	0.272
2.000	0.068	0.340
3.000	0.136	0.476
4.000	0.136	0.611
≥ 5.000	99.389	100.000

NUMBER OF VALUES = 4416

STATION KAMLOOPS
HOURLY AVERAGE VISUAL RANGE (MI)
JUNE 1974 - AUGUST 1975

UPPER LIMIT OF INTERVAL	PERCENT OCCURRENCE	CUMULATIVE PERCENT
0.0	0.0	0.0
1.000	0.0	0.0
2.000	0.0	0.0
3.000	0.0	0.0
4.000	0.0	0.0
≥ 5.000	100.000	100.000

NUMBER OF VALUES = 4416

STATION KAMLOOPS
HOURLY AVERAGE VISUAL RANGE (MI)
SEPTEMBER 1974 - NOVEMBER 1975

UPPER LIMIT OF INTERVAL	PERCENT OCCURRENCE	CUMULATIVE PERCENT
0.0	0.281	0.281
1.000	0.421	0.702
2.000	0.234	0.936
3.000	0.117	1.053
4.000	0.164	1.217
≥ 5.000	98.783	100.000

NUMBER OF VALUES = 4272

* Source: Analysis of AES data

TABLE 3-14(c)

SEASONAL FREQUENCY DISTRIBUTION OF VISIBLE RANGE LIMITS FOR

LYTTON IN 1974 - 1975 *

STATION LYTTON

HOURLY AVERAGE VISUAL RANGE (MI)
DECEMBER 1974 - FEBRUARY 1975

UPPER LIMIT OF INTERVAL	PERCENT OCCURRENCE	CUMULATIVE PERCENT
0.0	1.911	1.911
1.000	1.965	3.876
2.000	1.050	4.926
3.000	2.826	7.752
4.000	1.373	9.125
5.000	90.875	100.000

NUMBER OF VALUES = 3715

STATION LYTTON

HOURLY AVERAGE VISUAL RANGE (MI)
MARCH 1974 - MAY 1975

UPPER LIMIT OF INTERVAL	PERCENT OCCURRENCE	CUMULATIVE PERCENT
0.0	0.326	0.326
1.000	0.299	0.625
2.000	0.109	0.734
3.000	0.408	1.142
4.000	0.353	1.495
5.000	98.505	100.000

NUMBER OF VALUES = 3679

STATION LYTTON

HOURLY AVERAGE VISUAL RANGE (MI)
JUNE 1974 - AUGUST 1975

UPPER LIMIT OF INTERVAL	PERCENT OCCURRENCE	CUMULATIVE PERCENT
0.0	0.086	0.086
1.000	0.0	0.086
2.000	0.0	0.086
3.000	0.0	0.086
4.000	0.114	0.200
5.000	99.800	100.000

NUMBER OF VALUES = 3496

STATION LYTTON

HOURLY AVERAGE VISUAL RANGE (MI)
SEPTEMBER 1974 - NOVEMBER 1975

UPPER LIMIT OF INTERVAL	PERCENT OCCURRENCE	CUMULATIVE PERCENT
0.0	2.218	2.218
1.000	0.769	2.986
2.000	0.355	3.341
3.000	1.538	4.879
4.000	0.828	5.707
5.000	94.293	100.000

NUMBER OF VALUES = 3382

* Source: Analysis of AES data

TABLE 3-15

ANNUAL CLOUD COVER STATISTICS

FOR KAMLOOPS AND LYTTON FOR 1974 - 1975*

STATION KAMLOOPS
HOURLY AVERAGE CLOUD COVER (0,0 TO 1,0)
JANUARY 1974 - DECEMBER 1975
HOUR ALL STABILITY ALL

UPPER LIMIT OF INTERVAL	PERCENT OCCURRENCE	CUMULATIVE PERCENT
0,0	12,834	12,834
0,100	6,859	19,692
0,200	5,688	25,380
0,300	5,441	30,821
0,400	4,442	35,264
0,500	3,800	39,063
0,600	4,689	43,752
0,700	6,445	50,198
0,800	9,631	59,829
0,900	13,293	73,122
≥ 1,000	26,878	100,000

AVERAGE = 0,60998 STANDARD DEVIATION = 0,37270
GEOMETRIC AVG, = 0,58694 GEOMETRIC STD, DEV, = 2,00967
NUMBER OF VALUES = 17423

STATION LYTTON
HOURLY AVERAGE CLOUD COVER (0,0 TO 1,0)
JANUARY 1974 - DECEMBER 1975
HOUR ALL STABILITY ALL

UPPER LIMIT OF INTERVAL	PERCENT OCCURRENCE	CUMULATIVE PERCENT
0,0	14,763	14,763
0,100	6,341	21,104
0,200	5,059	26,163
0,300	4,659	30,823
0,400	3,903	34,725
0,500	3,819	38,544
0,600	4,463	43,007
0,700	5,633	48,641
0,800	7,378	56,019
0,900	16,165	72,183
≥ 1,000	27,817	100,000

AVERAGE = 0,61396 STANDARD DEVIATION = 0,38162
GEOMETRIC AVG, = 0,60942 GEOMETRIC STD, DEV, = 1,98577
NUMBER OF VALUES = 14272

* Source: Analysis of AES data

3.7 Cloud Cover, Cloud Ceiling, and Insolation

Frequency distributions of hourly observations of cloud cover are given for Lytton and Kamloops in Table 3-15. Comparable distributions for hourly reports of cloud ceiling are shown in Table 3-16. Both distributions at the two stations are quite similar for the two-year period analyzed. The totals of bright sunlight hours at stations in the Hat Creek Region are given in Table 3-17. These average values represent direct observation reports.

3.8 Regional Mixing Depths and Air Pollution Potential

Following the examples set by Holzworth (1972) and Munn (1970), Portelli (1976) has recently calculated climatological averages of annual and seasonal mixing depths for all of Canada. The average mixing depths for Hat Creek Valley, presented in Table 3-18, have been interpolated from Portelli's graphs of mixing depth isopleths. These isopleths were based upon four years (July 1965 through June 1969) of upper air soundings taken at Canadian and northern U. S. rawinsonde stations, including Prince George and Port Hardy, B. C., and Spokane, Washington. The corresponding mean mixing depths for these latter three stations are also presented in Table 3-18. Rawinsonde data from Vernon, B. C., were not used by Portelli. Data from Vernon are used as the basis for the more precise mixing depth analyses for Hat Creek Valley given in Section 4.5. The analysis which led to Table 3-18 does not consider the effects of valley-trapping of pools of cold air, or mountain/valley circulations, either of which can significantly affect the effective maximum afternoon mixing depths in complex terrain.

The air pollution potential for a region is a qualitative measure of the average dispersal capacity of the atmosphere over large areas in which detailed analysis has not been carried out. To determine the relative degree of this dispersal capacity, or alternatively, the air pollution risk, ventilation coefficients are the product of the mean mixing depths and the mean wind speed for each region surrounding a radiosonde observation station. These coefficients are given in Table 3-19 for the same stations presented in Table 3-18. Values of $<6,000\ m^2/sec$ are considered to be indicative of high air pollution potential in the U. S. air pollution forecast program (Gross, 1970).

TABLE 3-16

ANNUAL CLOUD CEILING STATISTICS FOR KAMLOOPS AND LYTTON FOR 1974 - 1975 *

STATION KAMLOOPS
HOURLY AVERAGE CLOUD CEILING (100FT)
JANUARY 1974 - DECEMBER 1975

UPPER LIMIT OF INTERVAL	PERCENT OCCURRENCE	CUMULATIVE PERCENT
0.0	0.029	0.029
29.000	5.912	5.940
40.000	4.023	9.964
60.000	9.241	19.204
80.000	8.816	28.020
100.000	8.569	36.590
120.000	5.504	42.094
140.000	2.101	44.194
160.000	1.527	45.721
180.000	0.316	46.037
200.000	1.119	47.156
220.000	1.314	48.470
240.000	0.316	48.785
260.000	2.221	51.007
280.000	0.080	51.088
300.000	0.264	51.352
	48.648	100.000

GEOMETRIC AVG. = 252.61632 GEOMETRIC STD. DEV. = 4.28024
NUMBER OF VALUES = 17423

STATION LYTTON
HOURLY AVERAGE CLOUD CEILING (100FT)
JANUARY 1974 - DECEMBER 1975

UPPER LIMIT OF INTERVAL	PERCENT OCCURRENCE	CUMULATIVE PERCENT
0.0	0.112	0.112
20.000	5.788	5.900
40.000	8.772	14.672
60.000	8.856	23.529
80.000	7.266	30.795
100.000	5.872	36.666
120.000	2.845	39.511
140.000	1.184	40.695
160.000	1.177	41.872
180.000	0.694	42.566
200.000	1.920	44.486
220.000	1.338	45.824
240.000	0.764	46.588
260.000	1.345	47.933
280.000	0.084	48.017
300.000	0.021	48.038
	51.962	100.000

GEOMETRIC AVG. = 256.30933 GEOMETRIC STD. DEV. = 4.61971
NUMBER OF VALUES = 14272

* Source: Analysis of AES data

TABLE 3-17

TOTAL HOURS OF BRIGHT SUNSHINE IN THE HAT CREEK REGION*

Station	Annual	Winter	Spring	Summer	Fall
		Number of Hours of Sunshine			
Kamloops	2,080	217	574	895	394
Kelowna	2,088	160	574	903	451
Lytton	1,990	185	607	829	369
Penticton	2,076	174	599	880	423
Williams Lake	2,168	251	621	912	384

*3-1/2 year average, (1972-1975)

Source: Canadian Weather Review

TABLE 3-18

MEAN AFTERNOON MIXING DEPTHS FOR
SOUTHERN BRITISH COLUMBIA (1965-69)*

Season	Mean Mixing Depth (m) Port Hardy (coastal station)	Prince George	Spokane, Wash	Hat Creek Valley Vicinity**
Winter	400	350	400	350
Spring	<1000	1600	1300	1400
Summer	800	1800	2250	1800
Fall	400	750	950	750
Annual	650	1100	1350	1100

*Source: Portelli (1976).

**Interpolated from Portelli (1976) graphs.

TABLE 3-19

VENTILATION COEFFICIENTS FOR
SOUTHERN BRITISH COLUMBIA (1965-1969)*

Season	Port Hardy (coastal station)	Prince George	Spokane, Wash	Hat Creek Valley Vicinity**
	Mean Ventilation Coefficients (m^2/sec)			
Winter	<3,000	2,000	~3,000	<3,000
Spring	<3,000	4,500	6,000	4,500
Summer	4,000	8,500	12,500	8,500
Fall	<3,000	4,500	6,000	4,500

*Source: Portelli (1976)

**Interpolated from Portelli (1976) graphs.

The annual average ventilation between 6,000 and 7,000 m^2/sec was found by Portelli to represent the entire section of the Fraser River Valley, extending south from Prince George, past Lillooet and Lytton, to Hope, B. C. Portelli's results show that almost all of Canada has a winter average ventilation coefficient which is less than 6,000 m^2/sec. In addition to low winter mixing depths, the prevalence of light winds in mountains and intermontane regions leads to winter coefficients that are less than 3,000 m^2/sec over the region extending from this section of the Fraser River Valley to the Pacific Coast at Port Hardy. The other major ingredients in U. S. pollution potential forecasts, quasi-stationary anticyclones and mean wind speeds less than 4 m/sec, are also prevalent conditions in the Hat Creek Valley in both winter and summer.

The Atmospheric Environment Service has not verified that the forecast criter is used in the U. S. are valid for predicting pollution potential in Canada, but the numeric values have been temporarily adopted for Portelli's comparative analysis. A pollution potential forecasting method appropriate for Canada is presently under development (Portelli, 1977).

4. HAT CREEK VALLEY VICINITY CLIMATOLOGY

4.1 Wind Flow

Annual wind roses for all eight mechanical stations operated by B. C. Hydro in the Hat Creek Valley and its vicinity are presented in Figure 4-1 for comparison of prevalent wind directions and speeds. The relation of each of the site locations to topographic features provides strong documentation of the importance of basic mountain/valley flow patterns. In fact, it is possible to accurately guess the topographic setting for each valley station (Nos. 1-5) by examining both the orientation of the dominant winds and their speeds. The three ridge sites (Nos. 6-8) are the only ones which show evidence of the frequent southerly and westerly wind directions which result from synoptic and larger scale wind patterns (Section 3-1). The Harry Lake site (Station No. 7) is somewhat more sheltered than either the Cornwall Hills site (No. 6) or the Marble Range site (No. 8), but the highest wind speeds ($\geq$7.5 mph) have the same general directional distribution at all three of these sites.

Figure 4-2 presents a diurnal breakdown (6 AM to 6 PM = daytime) of the annual wind roses for valley wind stations Nos. 1, 2, 3, and 5, as well as the Harry Lake station. For the lower valley stations (Nos. 1, 2, and 3) the daytime wind pattern is dominant because 33 percent to 50 percent of the night hours are calm or near calm (winds <1.5 mph). The prevalence of the south-southwest flow for Station No. 5 and west to south-southwest winds at Station No. 7, with a significant occurrence of northerly winds at both of these sites, is seen to result from the combined influence of nocturnal valley drainage flows and channeling of synoptic higher-level winds.

Cumulative frequency plots of wind direction persistence are presented in Figures 4-3, 4-4, and 4-5 for Harry Lake station, station No. 1, and station No 4, respectively. From these graphs it is apparent that calms and the winds which follow the valleys are the most persistent, but persistence of any of these flow conditions is rarely more than 16 hours.

Variation in wind direction and speed distributions with atmospheric stability class is demonstrated by the wind roses given in Figures 4-6 and 4-7. Annual wind roses stratified by stability in Figure 4-6 may be

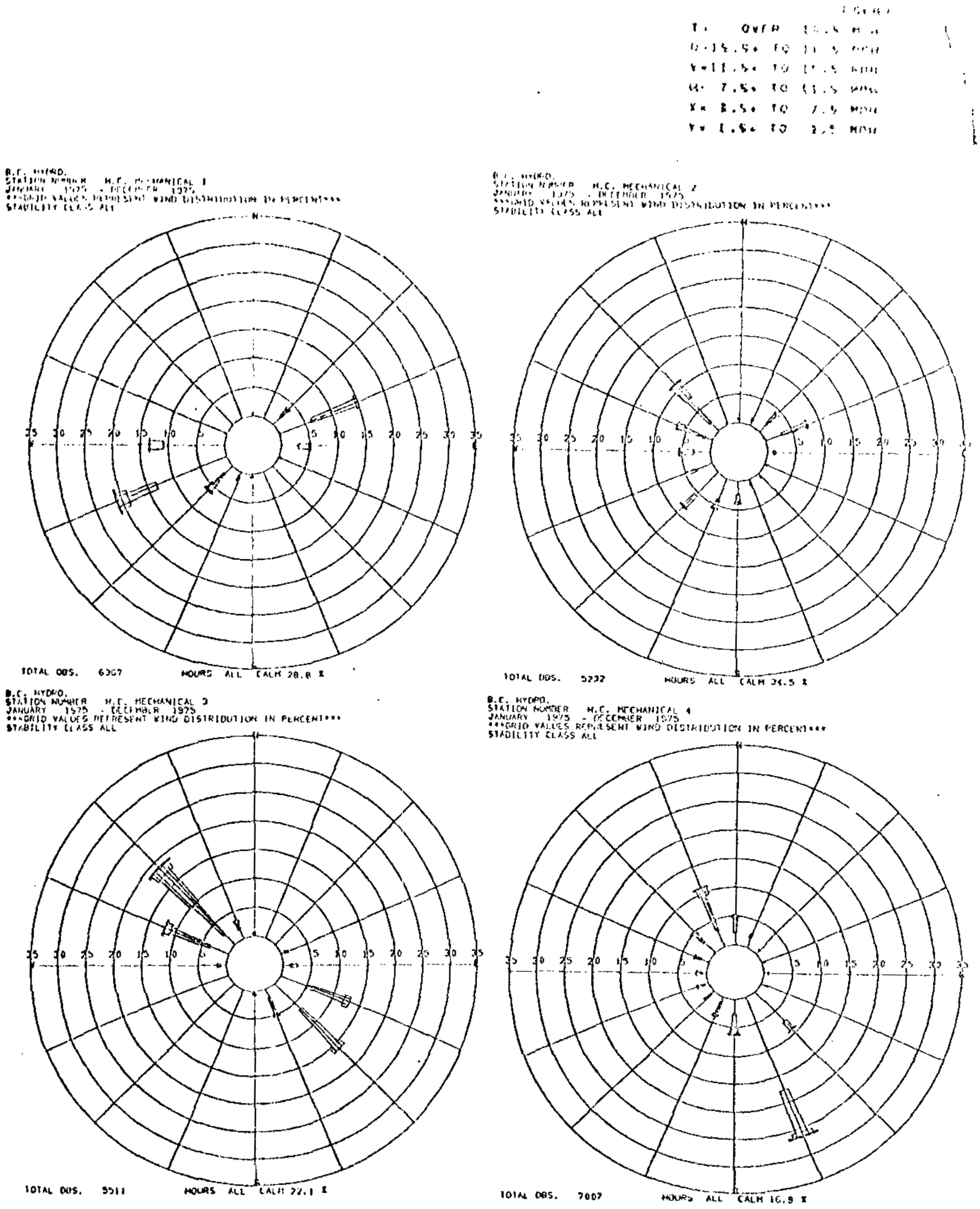


Figure 4-1 Comparison of Annual Wind Roses for All Hours at Eight Mechanical Weather Stations

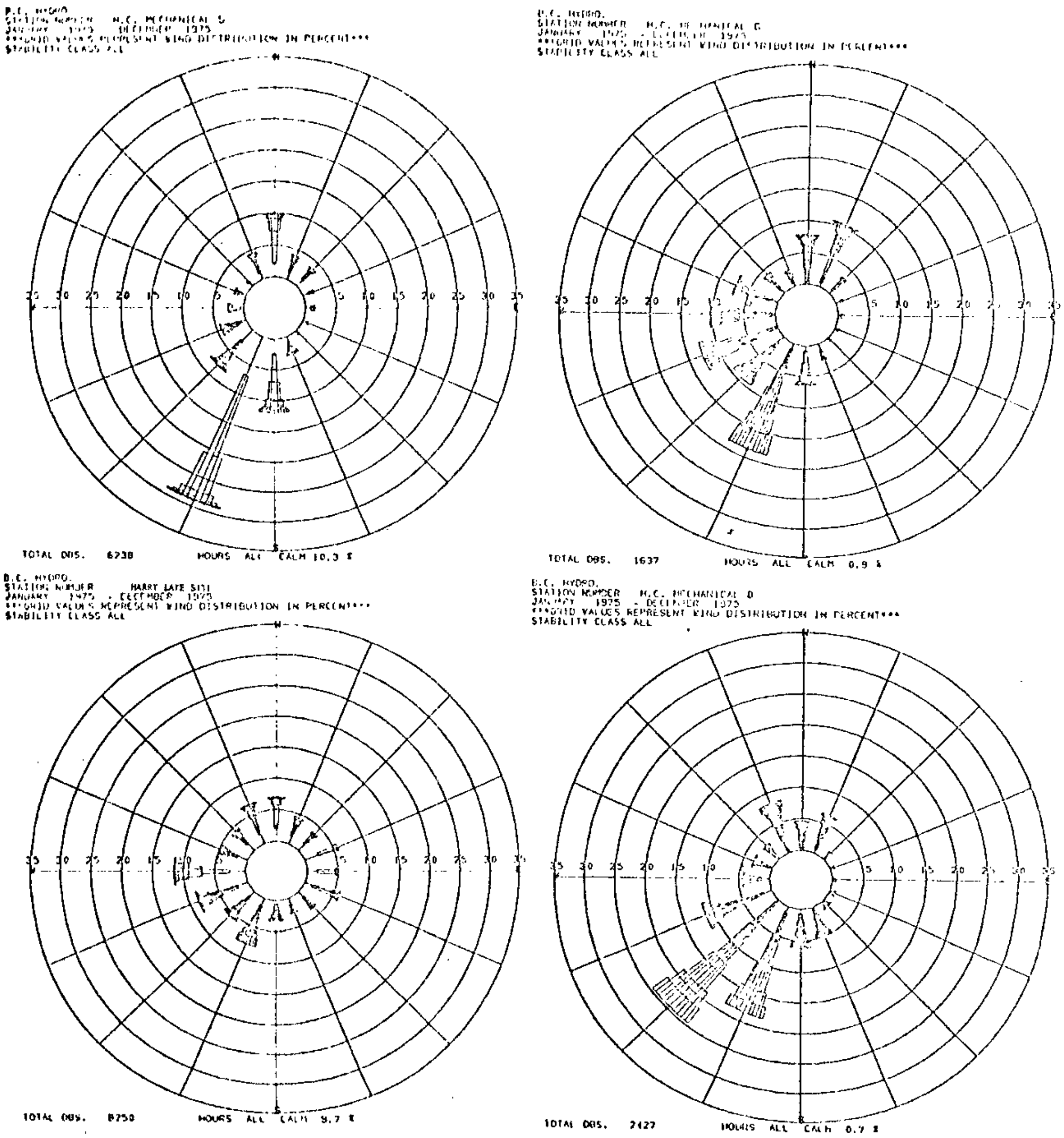
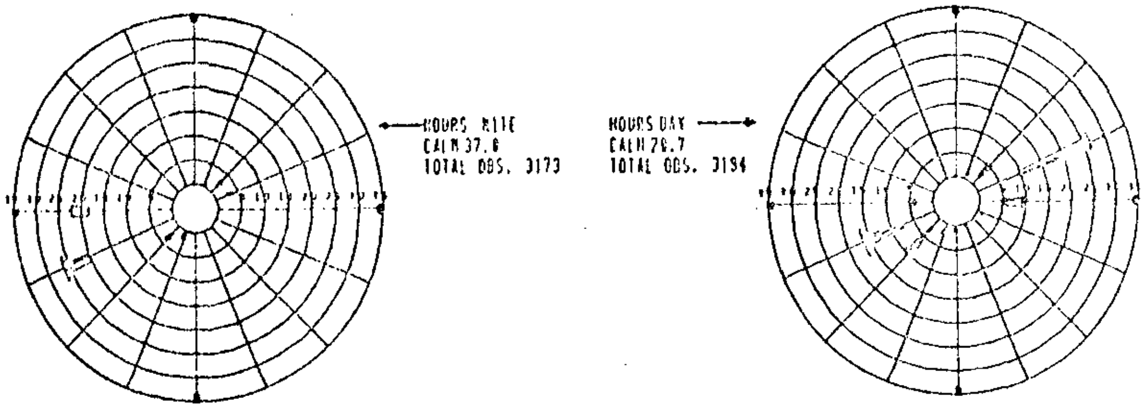
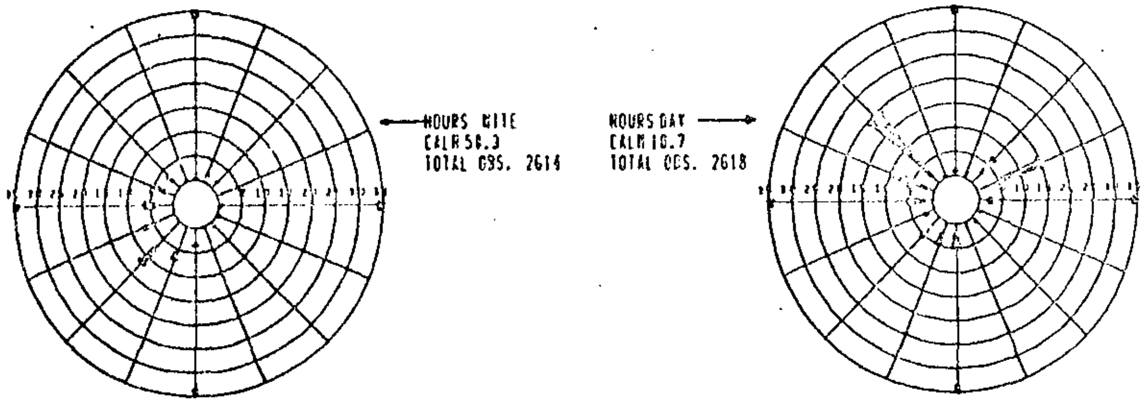


Figure 4-1 (Continued) Comparison of Annual Wind Roses for All Hours at Eight Mechanical Weather Stations

B.C. HYDRO.
STATION NUMBER H.C. MECHANICAL 1
JANUARY 1975 - DECEMBER 1975
GRID VALUES REPRESENT WIND DISTRIBUTION IN PERCENT
STABILITY CLASS ALL



B.C. HYDRO.
STATION NUMBER H.C. MECHANICAL 2
JANUARY 1975 - DECEMBER 1975
GRID VALUES REPRESENT WIND DISTRIBUTION IN PERCENT
STABILITY CLASS ALL



B.C. HYDRO.
STATION NUMBER H.C. MECHANICAL 3
JANUARY 1975 - DECEMBER 1975
GRID VALUES REPRESENT WIND DISTRIBUTION IN PERCENT
STABILITY CLASS ALL

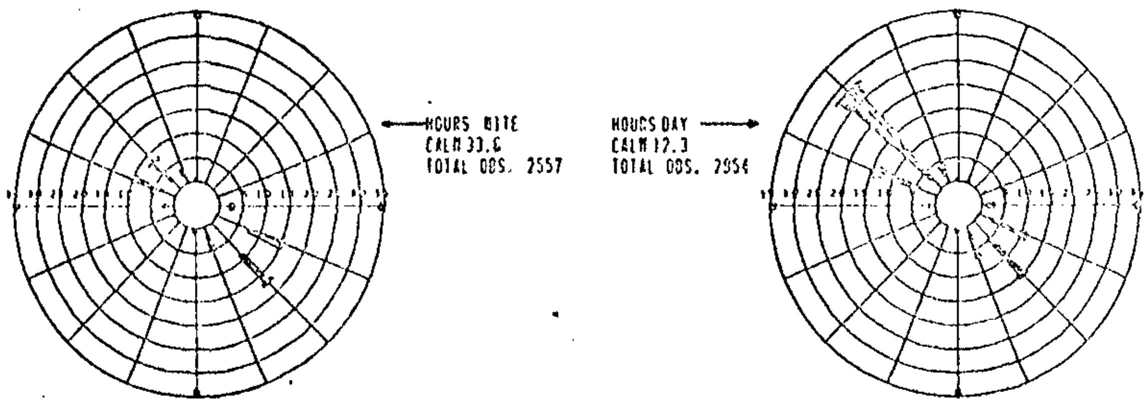


Figure 4-2(a) Comparison of Annual Day/Night Wind Roses for Lower Hat Creek Valley Mechanical Weather Stations

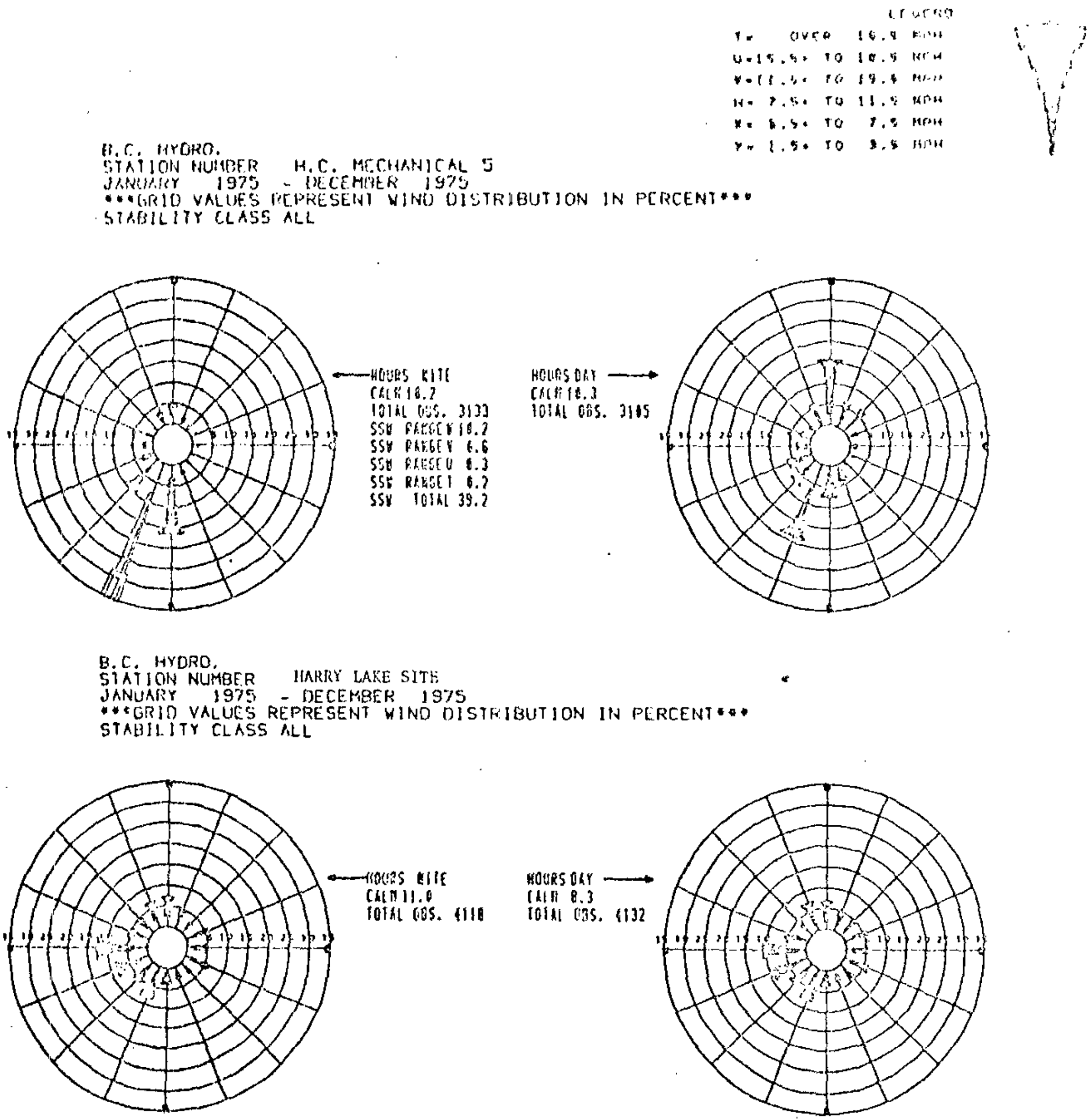


Figure 4-2(b) Comparison of Annual Day/Night Wind Roses for Upper Hat Creek Valley and Harry Lake Site Mechanical Weather Stations

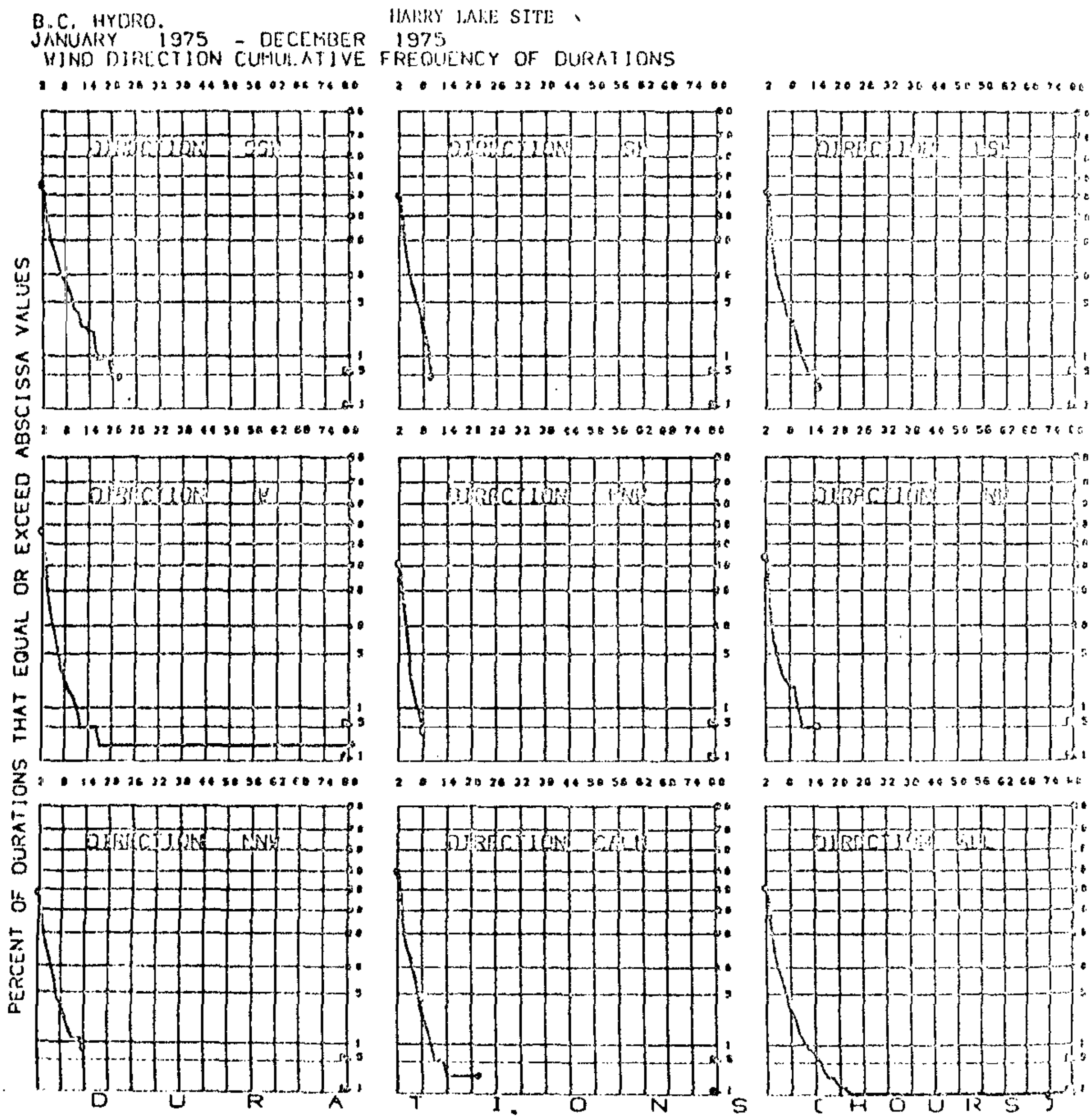


Figure 4-3 Plots of Wind Direction Persistence vs. Frequency for Harry Lake Site (Mechanical Station No.7)

B.C. HYDRO. STATION HARRY LAKE SITE
JANUARY 1975 - DECEMBER 1975
WIND DIRECTION CUMULATIVE FREQUENCY OF DURATIONS

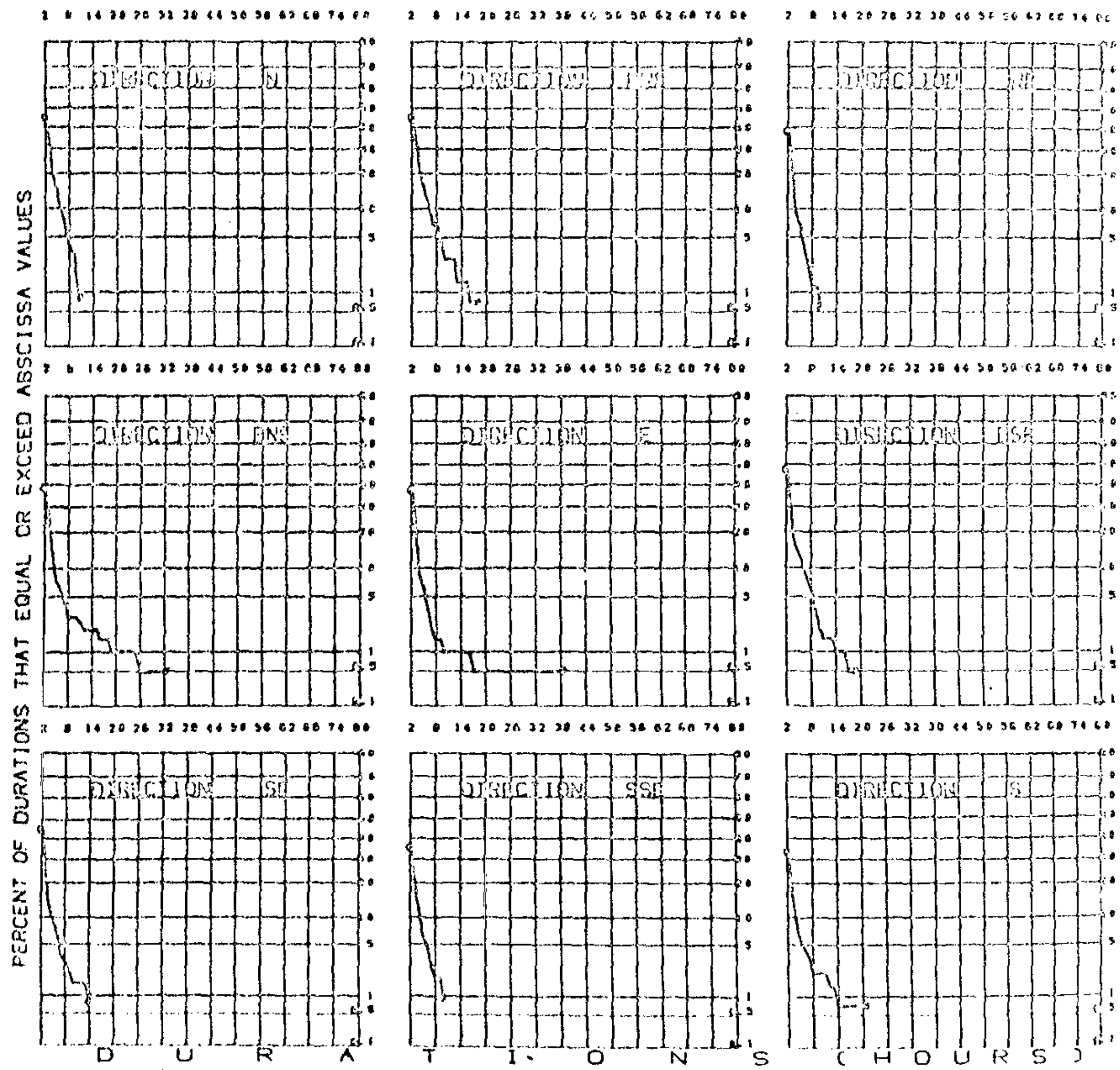


Figure 4-3 (Continued) Plots of Wind Direction Persistence vs. Frequency for Harry Lake Site (Mechanical Station No. 7)

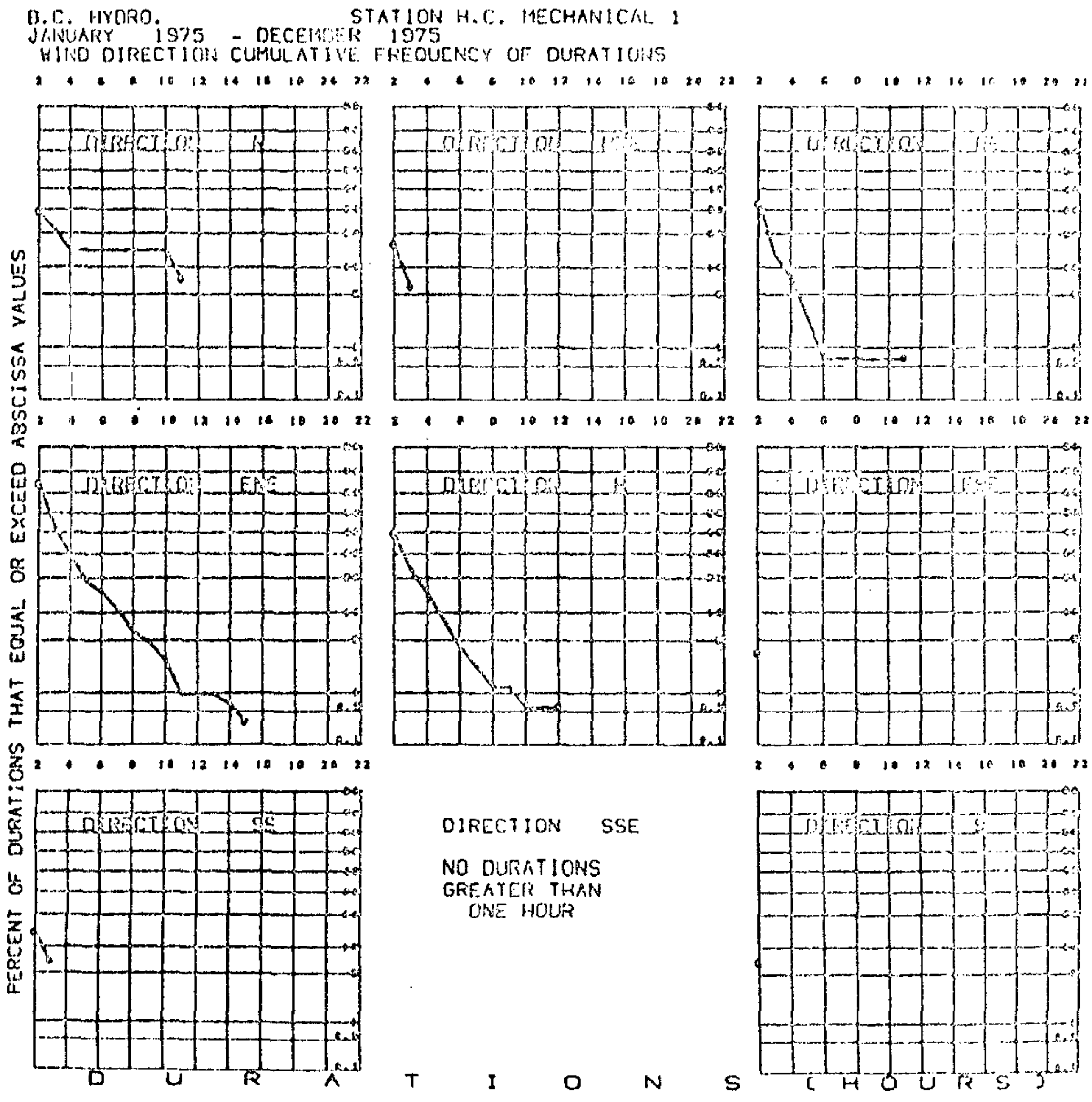


Figure 4-4 Plots of Wind Direction Persistence vs. Frequency for Mine Site in Lower Hat Creek Valley (Mechanical Station No. 1)

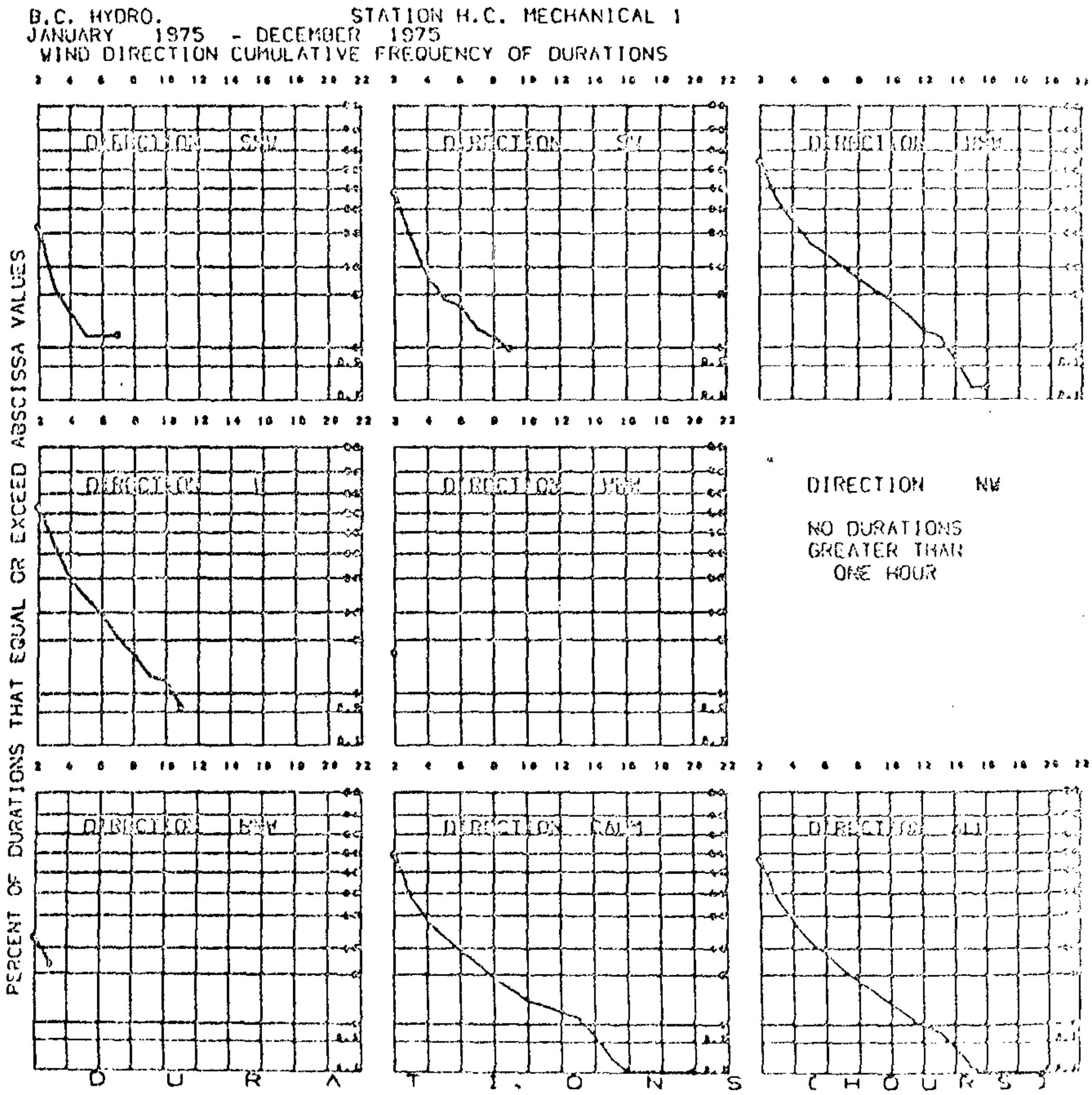


Figure 4-4 (Continued) Plots of Wind Direction Persistence vs. Frequency for Mine Site in Lower Hat Creek Valley (Mechanical Station No. 1)

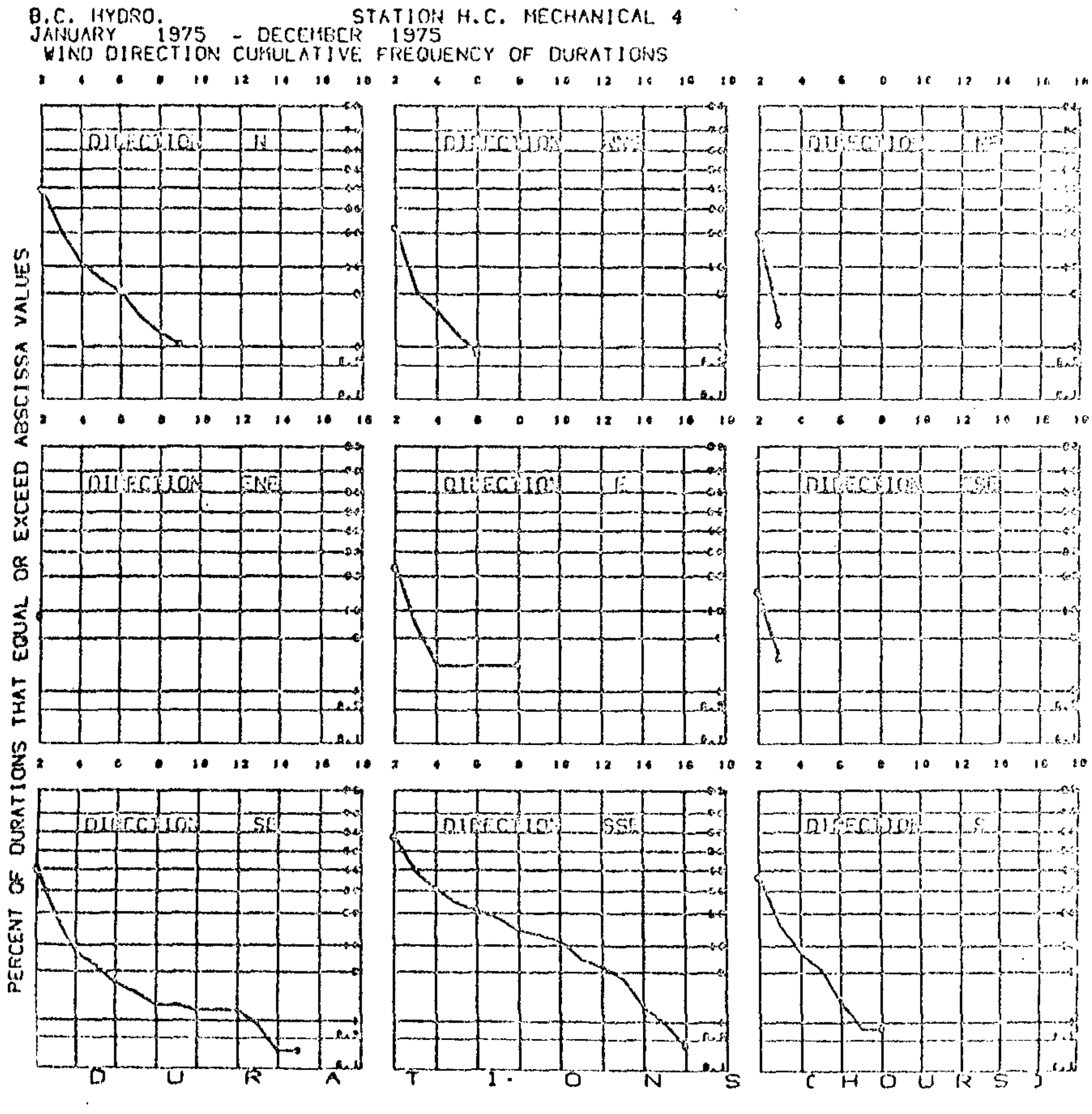


Figure 4-5 Plots of Wind Direction Persestence vs. Frequency for Middle Hat Creek Valley (Mechanical Station No. 4)

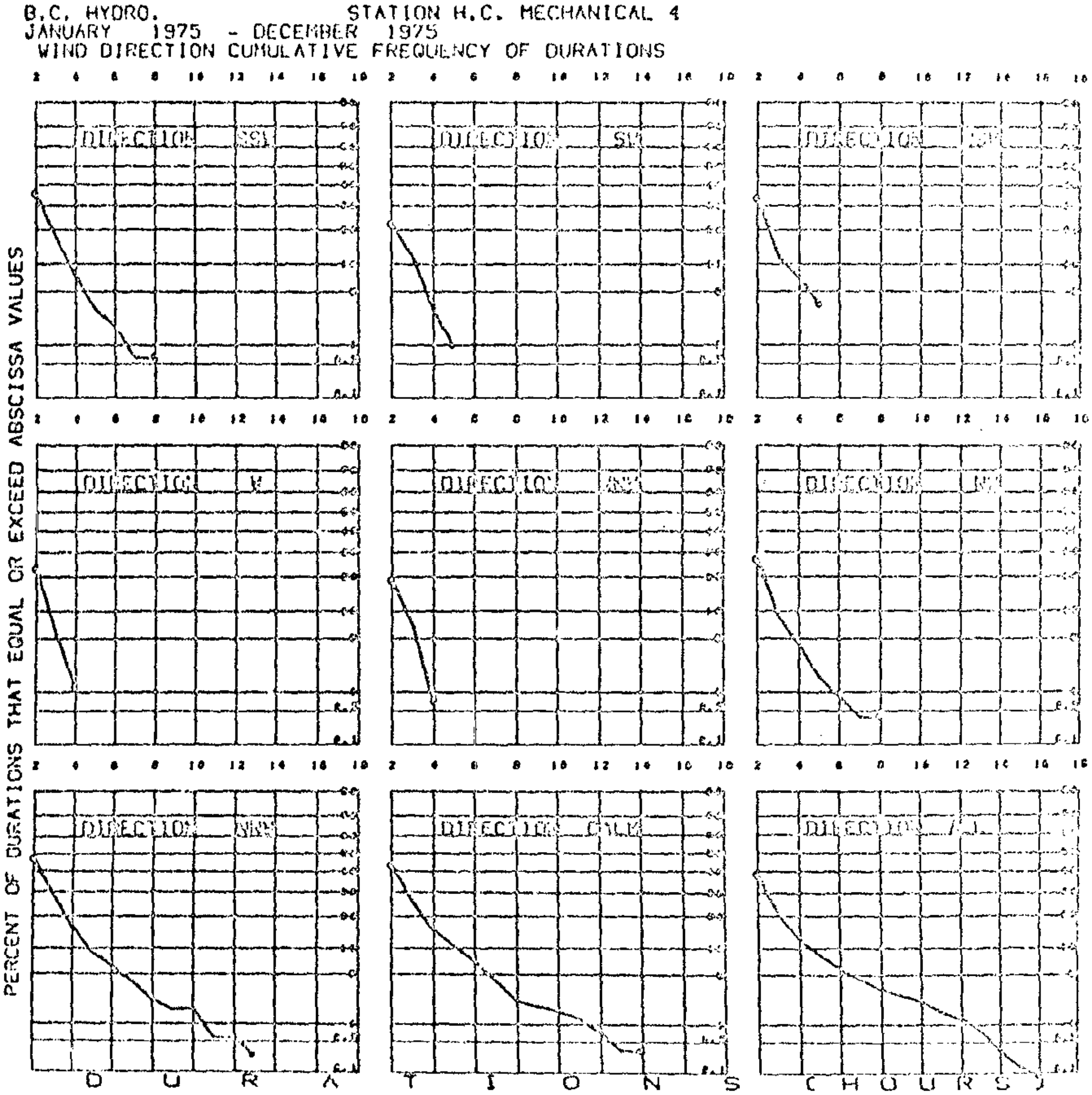


Figure 4-5 (Continued) Plots of Wind Direction Persistence vs. Frequency for Middle Hat Creek Valley (Mechanical Station No. 4)

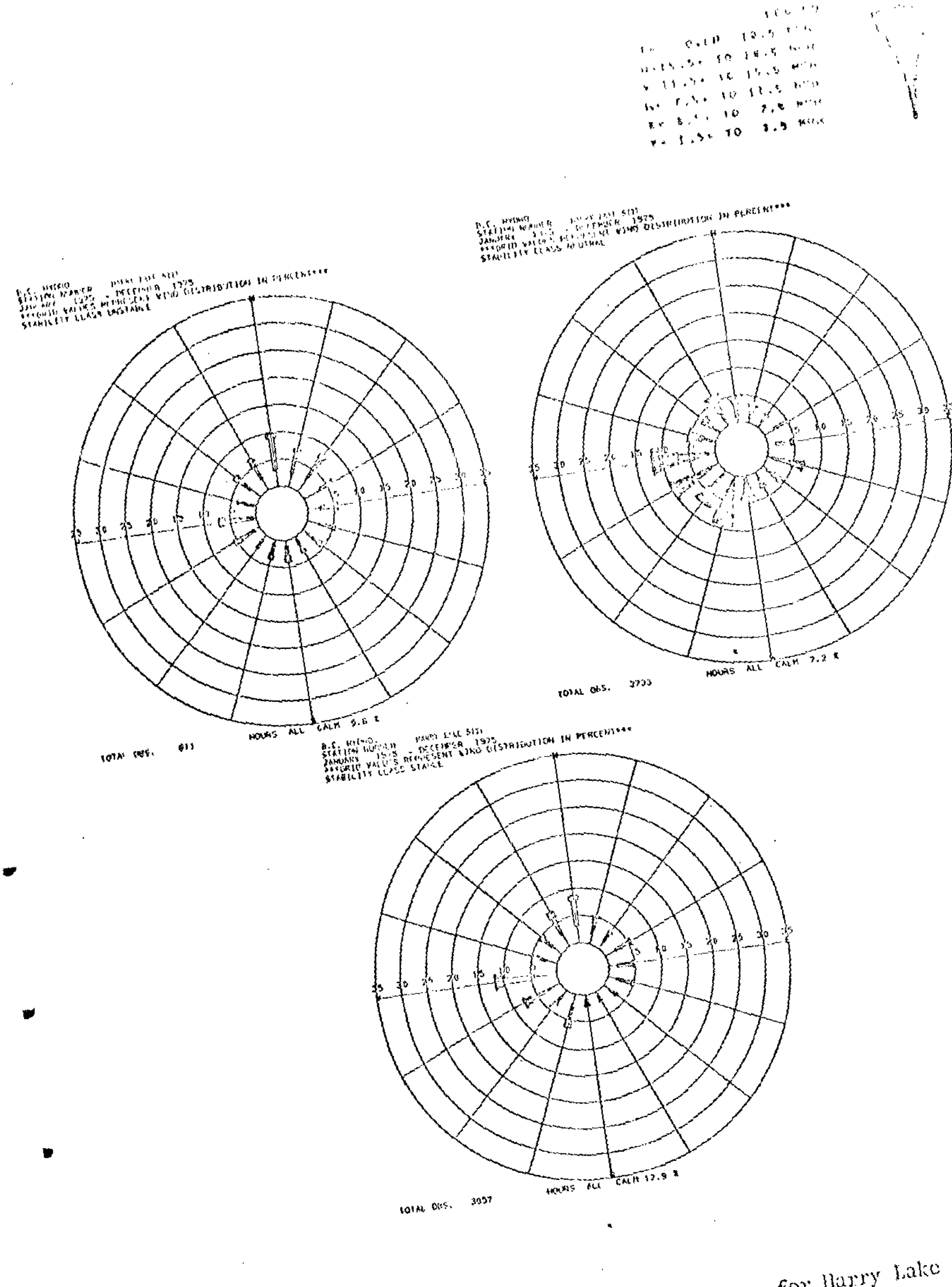


Figure 4-6 Annual Stability Wind Rose for Harry Lake Site (Mechanical Station No. 7)

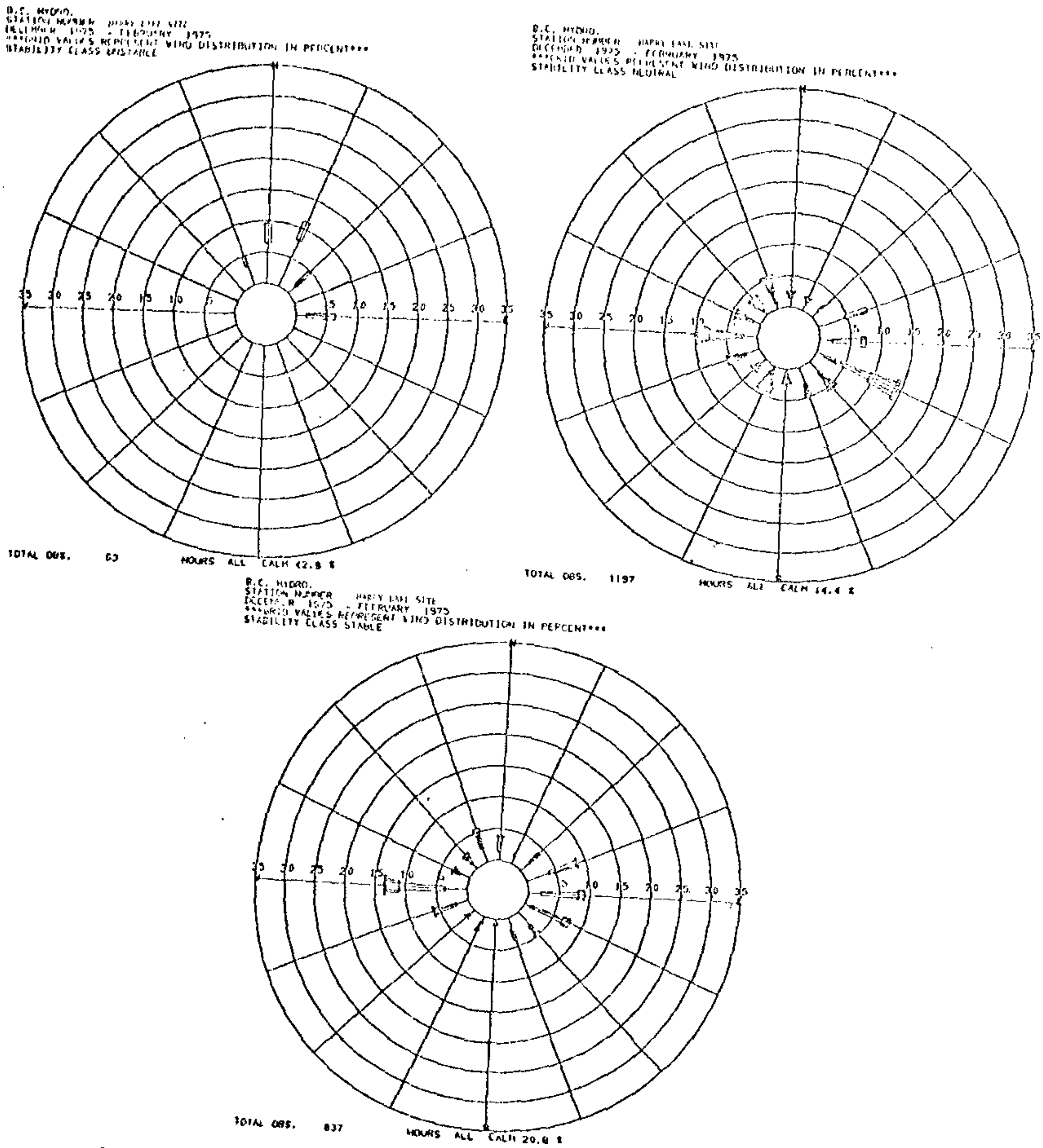


Figure 4-7(a) Winter Stability Wind Rose for Harry Lake Site (Mechanical Station No. 7)

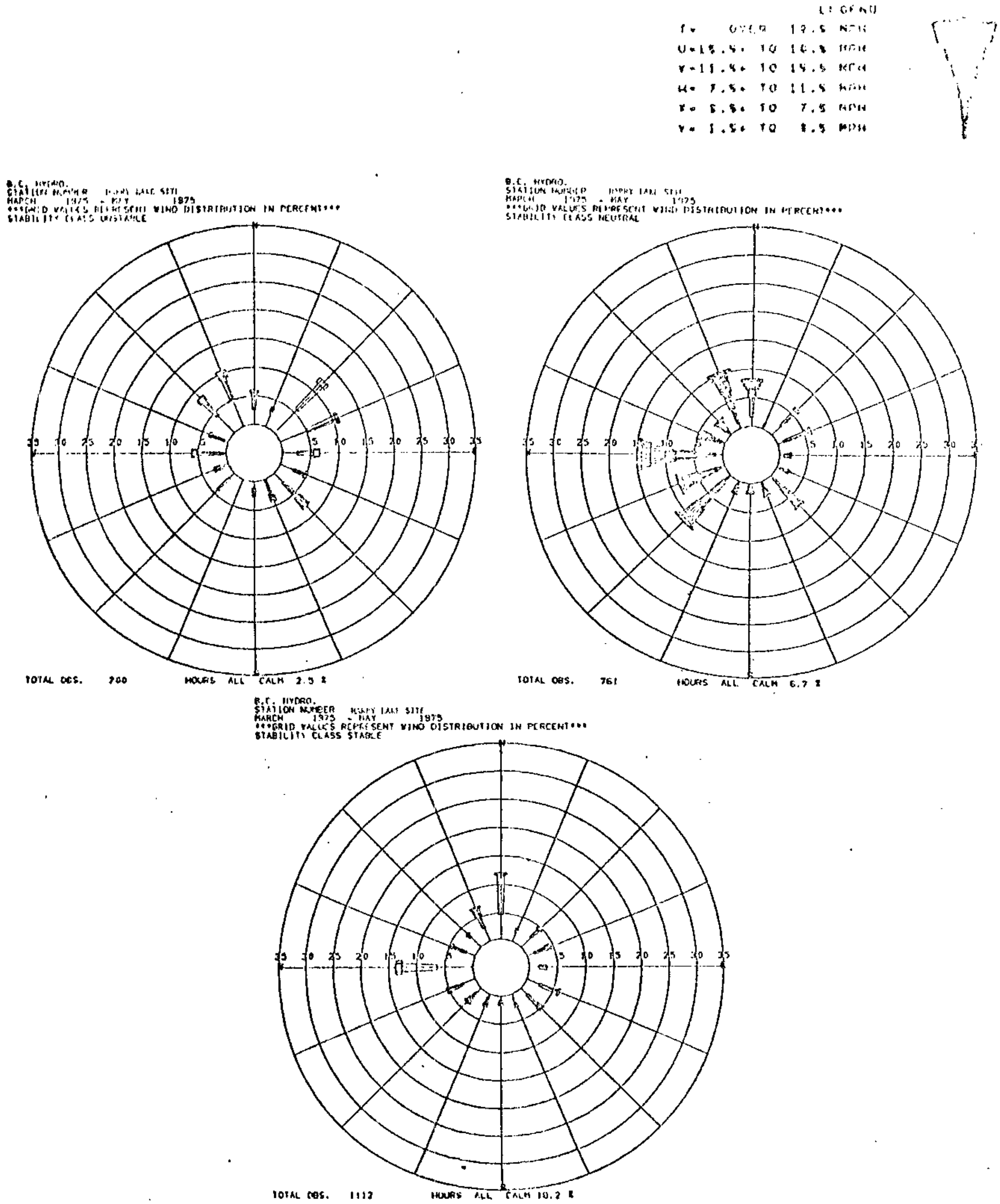


Figure 4-7(b) Spring Stability Wind Rose for Harry Lake Site (Mechanical Station No. 7)

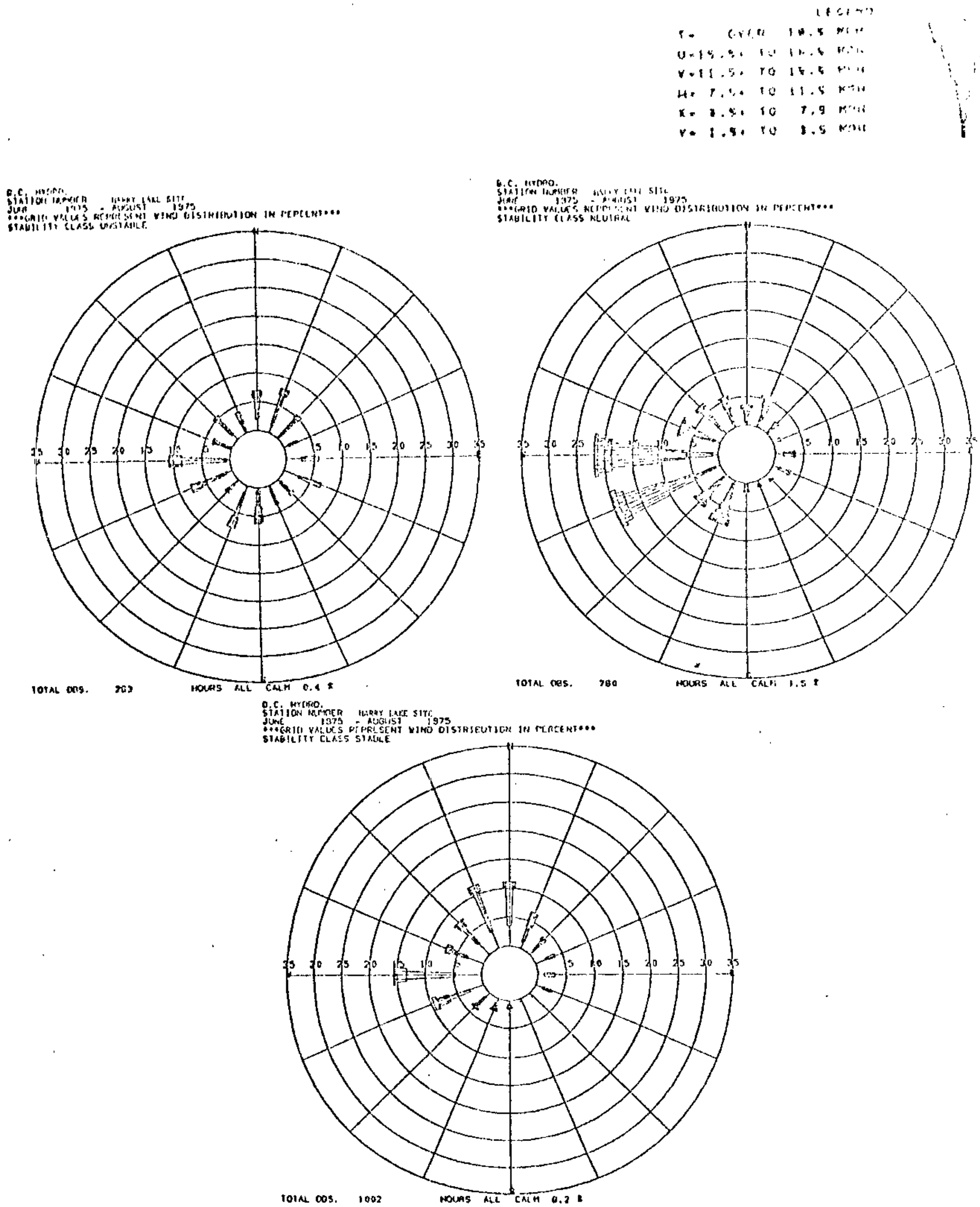


Figure 4-7(c) Summer Stability Wind Rose for Harry Lake Site (Mechanical Station No. 7)

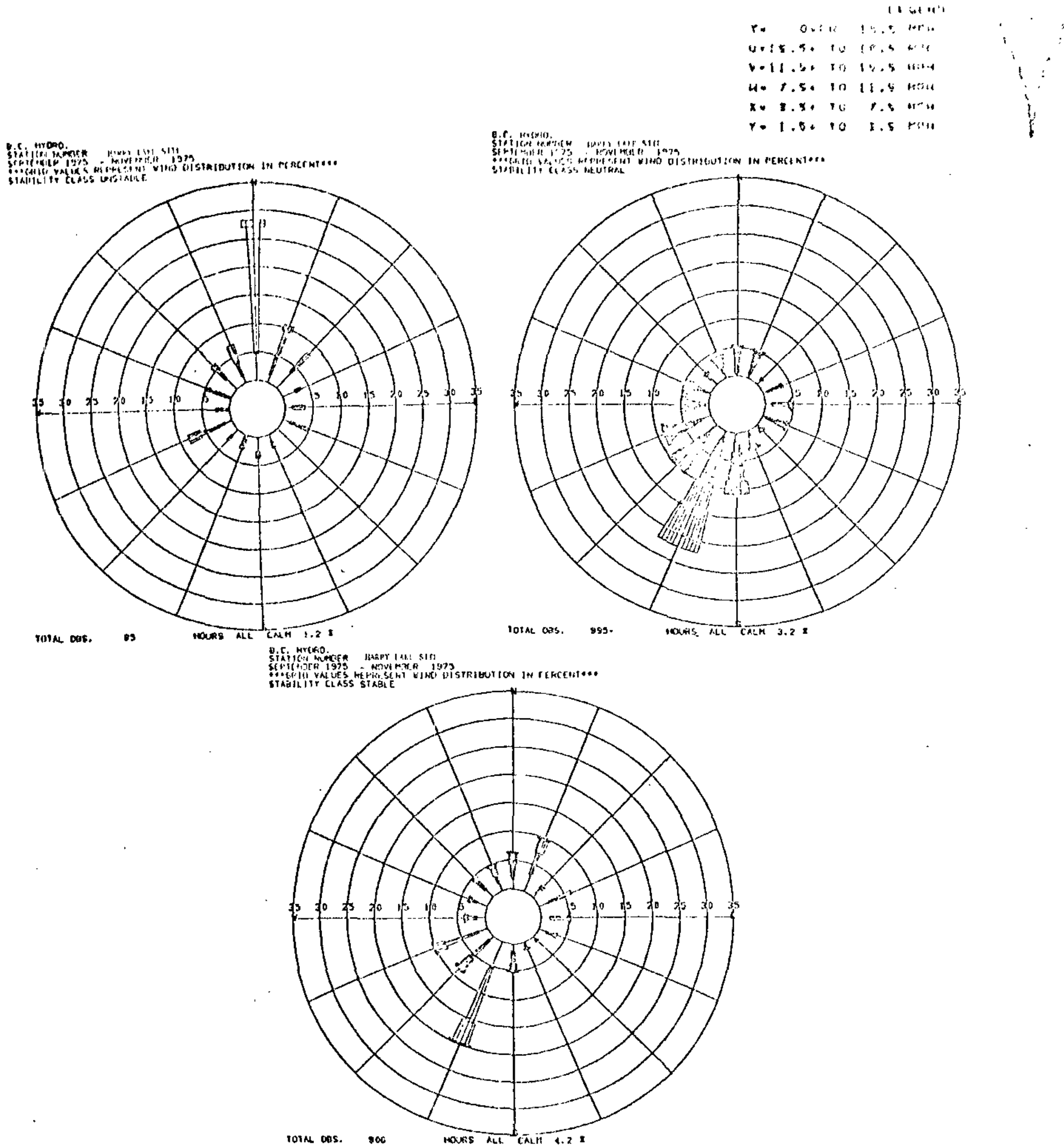


Figure 4-7(d)   Fall Stability Wind Rose for Harry Lake Site
(Mechanical Station No. 7)

compared with Figure 4-7, which presents seasonal wind roses by stability, to examine the seasonal variations in the speed and prevalence of local circulations at the Harry Lake Site. Table 4-1 presents the seasonal wind rose data for the proposed plant site, without stability stratification. The relative frequency and intensities of a long-valley and cross-valley wind flow patterns measured in the MEP/B. C. Hydro field studies (Weisman, 1975, 1976) appear to be generally consistent with the seasonal wind roses derived for the B. C. Hydro Mechanical Station Network. However, it is only through their agreement with long-term measurement results that such short-term field studies can be said to represent climatological patterns of mountain/valley flows.

4.2 Temperatures

Hourly temperature measurements have been recorded at each of the eight mechanical weather stations for a one-year period (Dec. 1974-Nov. 1975). The diurnal patterns of the seasonal mean temperatures for each hour of the day at each station are given in Table 4-2. Hourly mean temperature data for Kamloops and Lytton are also given in Table 4-2, to allow comparisons to be made between the measurements taken in the Hat Creek Valley and on its surrounding ridges, with those taken at stations which are outside the valley. In winter the Harry Lake site averages about 5°F warmer, over the entire day, than Kamloops and about 3°F warmer than Lytton. Hat Creek Valley stations (Nos. 1-5), on the other hand, are 2° to 10° cooler during the middle of the day and 10° (at Nos. 4 and 5) to 20° (at Nos. 1-3) colder in the night and the early morning than Kamloops and Lytton. The winter diurnal temperature range is minimal at Lytton (6°) and Kamloops (6°), and at Stations No. 7 and No. 8 above Hat Creek Valley. In the valley this diurnal range is much larger, 10° to 20°.

In summer, the nighttime temperatures at Kamloops and Lytton are about 10° warmer than at all of the Hat Creek Valley mechanical stations. However, in the afternoon Kamloops and Lytton are only about 5° to 10° higher than the lower valley sites (Nos. 1-4), but about 15° warmer than the uppermost Hat Creek Valley site (No. 5) and the three elevated locations (Nos. 6-8). Seasonal analysis of these diurnal average ranges indicates that an observation station which is more exposed to the

TABLE 4-1

SEASONAL WIND DIRECTIONS AND SPEEDS AT THE HARRY LAKE SITE

% FREQUENCY OF WIND DIRECTIONS WITHIN VARIOUS WIND SPEED CATEGORIES *

B.C. HYDRO, HARRY LAKE SITE
STABILITY ALL DECEMBER 1975 * FEBRUARY 1975

DIR.	0.0-1.5	1.5-3.5	3.5-7.5	7.5-11.5	11.5-15.5	15.5-18.5	>18.5	(TOTAL)
	WIND SPEED CATEGORY(MPH)							
N	1.0	1.4	1.5	0.1	0.2	0.0	0.0	4.2
NNE	2.7	1.0	0.6	0.1	0.1	0.0	0.0	4.9
NE	1.2	1.6	1.5	0.0	0.0	0.0	0.0	4.4
ENE	2.2	4.6	4.1	0.1	0.0	0.0	0.0	10.8
E	0.9	2.0	5.2	0.9	0.0	0.0	0.0	9.0
ESE	1.4	1.1	6.0	3.1	1.3	0.0	0.0	12.8
SE	0.9	2.3	1.7	0.0	0.2	0.0	0.0	6.0
SSE	0.7	2.2	1.7	0.7	0.0	0.0	0.0	4.8
S	0.6	0.4	0.7	0.3	0.2	0.0	0.0	2.3
SSW	0.6	0.6	0.8	0.5	0.3	0.5	0.6	4.0
SW	1.3	0.9	0.4	0.5	0.1	0.1	0.0	3.3
WSW	1.3	2.0	2.0	0.9	0.6	0.0	0.0	6.8
W	0.8	2.6	4.2	2.7	1.2	0.1	0.0	11.7
WNW	0.7	1.3	1.2	0.8	0.3	0.0	0.0	4.4
NW	0.5	1.6	0.7	0.7	0.9	0.2	0.0	3.8
NNW	0.8	1.5	2.2	1.1	0.4	0.1	0.0	6.2
VAR	0.1	0.2	0.3	0.0	0.0	0.0	0.0	0.6

*TOTAL OBSERVATIONS = 2097 % Data Capture = 97.08

% FREQUENCY OF WIND DIRECTIONS WITHIN VARIOUS WIND SPEED CATEGORIES *

B.C. HYDRO, HARRY LAKE SITE
STABILITY ALL MARCH 1975 * MAY 1975

DIR.	0.0-1.5	1.5-3.5	3.5-7.5	7.5-11.5	11.5-15.5	15.5-18.5	>18.5	(TOTAL)
	WIND SPEED CATEGORY(MPH)							
N	0.7	3.3	5.3	0.8	0.2	0.3	0.2	10.8
NNE	0.6	1.3	0.7	0.0	0.0	0.0	0.0	2.7
NE	1.4	2.6	2.9	0.4	0.0	0.0	0.0	[illegible]
ENE	0.8	1.6	3.2	0.9	0.0	0.0	0.0	[illegible]
E	0.5	1.4	1.0	0.2	0.0	0.0	0.0	3.6
ESE	1.1	1.6	2.5	0.5	0.0	0.0	0.0	5.6
SE	0.3	1.1	2.7	2.2	0.1	0.0	0.0	6.5
SSE	0.2	0.4	1.6	0.7	0.1	0.0	0.0	2.8
S	0.3	0.5	0.5	0.4	0.2	0.0	0.0	2.6
SSW	0.3	0.0	0.7	0.6	0.0	0.0	0.0	2.1
SW	0.6	0.5	1.5	2.7	1.0	0.2	0.0	6.9
WSW	0.7	1.3	1.4	1.7	1.2	0.1	0.0	6.8
W	2.3	3.7	5.1	2.0	1.6	0.6	0.3	15.6
WNW	0.6	1.0	1.7	0.9	0.8	0.1	0.0	5.1
NW	0.7	1.8	0.9	0.6	0.2	0.1	0.0	4.0
NNW	0.9	2.2	2.6	2.2	1.1	0.3	0.1	9.5
VAR	0.1	0.6	0.4	0.1	0.0	0.0	0.0	1.4

*TOTAL OBSERVATIONS = 2073 % Data Capture = 93.89

% FREQUENCY OF WIND DIRECTIONS WITHIN VARIOUS WIND SPEED CATEGORIES *

B.C. HYDRO, HARRY LAKE SITE
STABILITY ALL JUNE 1975 * AUGUST 1975

DIR.	0.0-1.5	1.5-3.5	3.5-7.5	7.5-11.5	11.5-15.5	15.5-18.5	>18.5	(TOTAL)
	WIND SPEED CATEGORY(MPH)							
N	0.4	2.1	4.4	0.9	0.1	0.2	0.0	8.1
NNE	0.3	0.8	2.9	1.9	0.5	0.1	0.0	6.7
NE	0.1	0.5	2.2	0.6	0.0	0.0	0.0	3.5
ENE	0.4	1.2	1.4	0.1	0.0	0.0	0.0	3.0
E	0.2	1.4	2.0	0.1	0.0	0.0	0.0	3.7
ESE	0.1	1.4	2.1	0.1	0.0	0.0	0.0	3.7
SE	0.1	0.3	0.8	0.2	0.0	0.0	0.0	1.5
SSE	0.0	0.5	0.6	0.0	0.0	0.0	0.0	1.1
S	0.0	0.4	0.9	0.8	0.0	0.0	0.0	2.1
SSW	0.4	0.6	1.6	1.4	0.7	0.3	0.4	5.4
SW	0.2	0.6	1.6	1.3	0.8	0.2	0.0	4.8
WSW	0.3	1.5	4.1	3.5	3.2	0.5	0.3	13.3
W	0.4	2.5	7.0	3.2	3.2	1.0	0.2	17.6
WNW	0.5	1.7	2.7	1.2	0.8	0.1	0.0	7.0
NW	0.3	1.7	3.1	1.7	0.5	0.0	0.0	7.3
NNW	0.7	1.8	4.7	1.7	0.0	0.0	0.0	9.0
VAR	0.0	0.6	1.5	0.0	0.0	0.0	0.0	2.2

*TOTAL OBSERVATIONS = 2045 % Data Capture = 92.62

% FREQUENCY OF WIND DIRECTIONS WITHIN VARIOUS WIND SPEED CATEGORIES *

B.C. HYDRO, HARRY LAKE SITE
STABILITY ALL SEPTEMBER 1979 * NOVEMBER 1979

DIR.	0.0-1.5	1.5-3.5	3.5-7.5	7.5-11.5	11.5-15.5	15.5-18.5	>18.5	(TOTAL)
	WIND SPEED CATEGORY(MPH)							
N	0.4	1.2	3.6	1.4	0.6	0.0	0.0	7.2
NNE	0.1	1.6	3.0	2.1	0.6	0.7	0.0	7.7
NE	0.2	0.9	1.0	0.4	0.0	0.0	0.0	2.5
ENE	0.5	1.6	3.2	0.2	0.0	0.0	0.0	5.2
E	0.3	1.0	3.1	0.3	0.1	0.1	0.0	[illegible]
ESE	0.2	0.4	1.8	1.1	0.2	0.0	0.0	[illegible]
SE	0.0	0.3	0.6	0.2	0.1	0.0	0.0	1.1
SSE	0.1	0.6	0.7	0.3	0.6	0.1	0.2	2.6
S	0.1	0.6	1.6	1.5	1.6	1.6	1.2	[illegible]
SSW	0.2	2.6	6.2	2.6	3.3	2.5	3.0	20.8
SW	0.3	0.7	2.4	1.9	1.5	0.0	1.3	9.1
WSW	0.3	1.5	3.4	2.1	1.6	0.4	0.2	[illegible]
W	0.0	0.6	1.4	0.7	0.7	0.3	0.3	4.1
WNW	0.5	0.4	1.7	1.0	0.6	0.1	0.1	[illegible]
NW	0.4	1.5	1.7	0.0	0.1	0.0	0.0	[illegible]
NNW	0.2	1.1	1.6	1.0	0.6	0.3	[illegible]	[illegible]
VAR	0.0	0.1	0.2	0.0	0.0	0.0	0.0	[illegible]

*TOTAL OBSERVATIONS = 1986 % Data Capture = 90.93

TABLE 4-2

SEASONAL DIURNAL MEAN TEMPERATURES IN THE HAT CREEK VALLEY VICINITY

DIURNAL AVERAGE FOR DECEMBER 1974 - FEBRUARY 1975
DRY BULB TEMP (DEGF) TEMP

HOUR	KAMLOOPS	LYTTON	H.C. MECHANICAL 1	H.C. MECHANICAL 2	H.C. MECHANICAL 3
	3	3	3	3	3
01	22.352	999.000	8.759	9.065	8.760
02	22.200	999.000	8.276	8.630	7.917
03	22.211	999.000	8.669	8.500	7.792
04	22.200	999.000	7.966	8.391	7.917
05	21.989	26.633	7.655	8.022	7.792
06	21.889	26.333	7.000	8.130	7.826
07	21.789	26.011	6.690	7.761	8.522
08	21.611	25.867	7.867	8.326	8.609
09	21.433	25.778	12.828	10.370	9.565
10	22.272	26.167	18.793	14.870	13.652
11	23.711	26.767	22.714	18.778	17.417
12	25.033	28.511	25.107	21.778	18.680
13	26.256	30.022	26.621	23.711	19.250
14	27.267	31.233	26.733	24.133	18.680
15	27.600	31.989	25.900	23.867	19.042
16	27.678	31.978	23.000	21.733	17.667
17	27.022	31.344	19.323	18.269	15.615
18	25.833	30.467	16.250	15.467	13.885
19	25.067	29.433	14.323	13.000	11.400
20	24.389	29.422	13.097	11.467	10.600
21	24.044	28.933	11.871	10.511	9.760
22	23.233	28.400	10.800	9.911	8.708
23	23.222	27.933	10.100	9.533	8.625
24	22.800	999.000	9.733	9.067	8.750

DIURNAL AVERAGE FOR DECEMBER 1974 - FEBRUARY 1975
DRY BULB TEMP (DEGF) TEMP

HOUR	H.C. MECHANICAL 4	H.C. MECHANICAL 5	H.C. MECHANICAL 6	H.C. MECHANICAL 7	H.C. MECHANICAL 8
	3	3	3	3	3
01	11.340	12.532	999.000	28.829	27.067
02	10.979	12.313	999.000	28.789	26.800
03	10.872	12.392	999.000	28.711	26.600
04	10.915	12.304	999.000	28.697	26.600
05	11.106	12.367	999.000	28.553	26.667
06	10.936	12.278	999.000	28.553	26.733
07	10.660	12.025	999.000	28.382	26.933
08	10.255	11.608	999.000	28.355	27.071
09	11.085	12.228	999.000	28.701	27.786
10	14.043	14.494	999.000	30.167	28.357
11	17.638	17.557	999.000	31.885	29.000
12	20.936	20.291	999.000	33.695	29.643
13	22.913	21.671	999.000	34.545	29.800
14	24.298	22.050	999.000	34.844	29.800
15	24.936	21.094	999.000	34.701	29.333
16	23.915	20.000	999.000	33.705	28.533
17	21.340	18.063	999.000	32.090	27.533
18	17.750	16.400	999.000	30.462	26.933
19	15.313	15.050	999.000	29.718	26.867
20	14.108	14.225	999.000	29.306	26.867
21	13.208	13.620	999.000	29.156	26.667
22	12.500	13.354	999.000	28.961	26.733
23	12.000	12.975	999.000	28.988	26.667
24	11.875	12.734	999.000	28.899	26.933

TABLE 4-2 (Continued)

SEASONAL DIURNAL MEAN TEMPERATURES IN THE HAT CREEK VALLEY VICINITY

DIURNAL AVERAGE FOR MARCH 1975 - MAY 1975
DRY BULB TEMP (DEGF) TEMP

HOUR	KAMLOOPS	LYTTON	H.C. MECHANICAL 1	H.C. MECHANICAL 2	H.C. MECHANICAL 3
01	40.707	999.000	31.649	24.932	27.470
02	39.957	999.000	30.036	24.324	26.529
03	38.957	999.000	29.872	23.406	25.671
04	37.902	999.000	28.354	22.693	24.829
05	37.380	39.804	27.422	21.960	24.209
06	36.739	38.957	27.333	20.966	24.127
07	37.522	38.609	28.476	22.603	25.583
08	39.309	39.196	31.975	26.726	29.514
09	41.435	41.293	36.871	32.471	34.347
10	44.011	43.957	41.795	36.453	38.274
11	46.500	46.503	45.217	39.921	41.635
12	48.967	49.380	47.379	42.840	43.458
13	51.348	51.902	49.045	44.635	44.486
14	53.087	53.924	50.102	45.547	45.236
15	54.293	54.783	50.609	46.224	45.274
16	54.739	55.109	50.655	45.934	44.500
17	54.891	55.011	50.233	44.040	42.667
18	53.946	53.489	48.170	42.092	40.041
19	52.565	51.576	46.195	39.151	37.072
20	49.891	49.494	42.738	35.712	34.917
21	47.641	47.978	39.226	32.822	32.966
22	45.565	46.826	36.267	30.400	31.132
23	43.913	45.826	34.847	28.095	29.486
24	42.239	999.000	33.235	26.521	28.348

DIURNAL AVERAGE FOR MARCH 1975 - MAY 1975
DRY BULB TEMP (DEGF) TEMP

HOUR	H.C. MECHANICAL 4	H.C. MECHANICAL 5	H.C. MECHANICAL 6	H.C. MECHANICAL 7	H.C. MECHANICAL 8
01	25.851	24.486	22.111	35.123	27.706
02	24.925	23.743	22.000	35.246	27.471
03	24.294	23.356	21.333	34.588	27.438
04	23.597	22.479	20.889	34.371	27.400
05	22.985	22.208	21.111	33.757	27.333
06	22.522	22.929	21.111	33.000	27.813
07	23.924	25.536	20.667	34.537	27.250
08	28.014	29.786	21.222	35.984	29.462
09	33.403	33.828	23.667	40.358	30.214
10	37.723	36.721	26.111	43.016	31.941
11	40.153	39.528	28.500	46.410	32.900
12	42.899	41.700	30.500	48.556	33.750
13	44.183	42.013	31.200	49.292	33.739
14	45.514	42.253	31.900	49.470	33.905
15	46.029	42.268	30.600	49.294	33.762
16	44.556	40.838	29.300	48.409	32.444
17	43.535	39.211	27.300	46.092	30.667
18	40.929	36.397	24.900	43.515	29.110
19	37.567	33.930	23.000	40.838	28.684
20	34.569	31.836	22.556	39.300	28.222
21	32.343	29.743	22.333	37.909	28.105
22	30.357	28.389	22.000	35.935	28.053
23	28.536	26.792	22.000	35.609	28.158
24	26.868	25.851	21.889	35.176	28.053

TABLE 4-2 (Continued)

SEASONAL DIURNAL MEAN TEMPERATURES IN THE HAT CREEK VALLEY VICINITY

DIURNAL AVERAGE FOR JUNE 1975 - AUGUST 1975
DRY BULB TEMP (DEGF) TEMP

HOUR	KAMLOOPS 3	LYTTON 3	H.C. MECHANICAL 1 3	H.C. MECHANICAL 2 3	H.C. MECHANICAL 3 3
01	61.717	999.000	50.804	50.041	47.011
02	60.087	999.000	49.661	49.456	45.767
03	58.663	999.000	48.732	48.367	44.478
04	57.620	999.000	47.893	47.410	43.411
05	56.522	58.728	47.236	47.921	42.933
06	56.272	57.826	48.125	49.265	43.156
07	58.060	57.554	51.857	53.762	46.180
08	60.170	56.924	56.210	57.962	52.440
09	62.663	61.511	59.911	61.023	54.363
10	65.272	64.283	63.462	64.606	57.527
11	67.739	66.670	66.179	66.975	59.965
12	70.446	69.630	67.679	68.610	61.802
13	73.022	72.087	68.786	69.734	62.956
14	74.967	73.815	69.250	70.286	63.656
15	76.011	75.207	69.273	71.192	64.070
16	76.435	75.402	69.352	71.463	65.107
17	76.587	75.315	68.618	70.654	64.700
18	76.033	74.554	67.143	69.386	63.989
19	74.659	73.207	64.786	67.013	62.306
20	72.652	70.800	61.696	64.231	59.767
21	69.554	68.522	58.607	60.923	56.662
22	67.630	66.486	55.500	57.154	52.787
23	65.380	65.576	53.375	54.500	50.451
24	63.337	999.000	51.679	52.397	48.429

DIURNAL AVERAGE FOR JUNE 1975 - AUGUST 1975
DRY BULB TEMP (DEGF) TEMP

HOUR	H.C. MECHANICAL 4 3	H.C. MECHANICAL 5 3	H.C. MECHANICAL 6 3	H.C. MECHANICAL 7 3	H.C. MECHANICAL 8 3
01	48.217	44.857	44.158	49.034	48.250
02	46.674	43.914	43.605	47.966	47.886
03	45.435	42.786	43.368	47.017	47.766
04	44.565	41.943	43.158	46.271	47.033
05	44.055	41.768	42.711	45.814	48.625
06	44.250	43.163	42.316	46.800	49.561
07	47.418	46.329	42.526	48.278	50.537
08	51.685	49.371	43.638	50.458	52.950
09	55.446	52.103	45.158	52.525	53.951
10	58.391	54.800	46.175	55.466	55.341
11	60.707	56.786	46.452	55.921	55.395
12	62.565	58.232	47.333	51.905	55.558
13	63.509	58.684	48.300	57.750	56.023
14	64.791	59.926	49.000	59.048	56.791
15	65.396	60.275	49.810	59.698	57.262
16	65.725	60.706	50.093	59.554	56.341
17	65.402	59.870	50.256	59.525	56.183
18	64.376	58.710	50.040	58.916	55.605
19	62.413	56.760	49.262	57.063	54.633
20	60.033	54.357	48.195	54.964	53.870
21	56.902	51.571	46.707	52.635	51.159
22	53.826	49.280	45.625	51.767	50.265
23	51.598	47.688	44.825	50.300	49.550
24	49.696	46.083	44.553	49.526	48.114

TABLE 4-2 (Continued)

SEASONAL DIURNAL MEAN TEMPERATURES IN THE HAT CREEK VALLEY VICINITY

DIURNAL AVERAGE FOR SEPTEMBER 1975 - NOVEMBER 1975
DRY BULB TEMP (DEGF) TEMP

HOUR	H.C. MECHANICAL 4	H.C. MECHANICAL 5	H.C. MECHANICAL 6	H.C. MECHANICAL 7	H.C. MECHANICAL 8
01	33.256	35.781	33.955	24.000	41.227
02	32.607	35.108	33.636	24.122	41.000
03	32.024	34.775	33.455	24.119	40.333
04	31.395	34.239	32.952	23.786	40.095
05	31.012	33.616	32.952	24.093	39.682
06	30.088	32.903	32.714	24.000	39.524
07	30.000	32.535	33.000	23.605	39.571
08	50.141	33.072	34.190	23.628	40.333
09	33.602	36.629	35.810	24.442	42.286
10	38.512	41.071	36.773	25.976	42.955
11	41.330	44.101	37.826	28.333	43.208
12	43.988	46.290	36.696	29.553	45.217
13	46.286	47.167	38.957	29.857	46.364
14	47.381	48.068	40.826	31.133	48.810
15	47.927	48.667	39.917	31.111	47.958
16	46.616	48.718	38.640	30.289	49.000
17	45.506	47.859	37.480	28.733	47.708
18	44.108	46.719	36.720	28.370	47.000
19	41.951	43.740	36.280	27.356	45.833
20	39.219	41.444	35.875	26.556	44.320
21	37.024	39.319	35.304	24.837	43.636
22	35.357	38.237	34.300	24.581	42.864
23	34.373	37.129	34.455	24.581	41.826
24	33.580	36.248	34.048	24.698	41.727

DIURNAL AVERAGE FOR SEPTEMBER 1975 - NOVEMBER 1975
DRY BULB TEMP (DEGF) TEMP

HOUR	KAMLOOPS	LYTTON	H.C. MECHANICAL 1	H.C. MECHANICAL 2	H.C. MECHANICAL 3
01	44.876	999.000	31.125	29.920	38.600
02	43.888	999.000	30.329	30.040	37.686
03	43.348	999.000	29.598	29.083	37.086
04	42.697	999.000	28.964	28.696	35.887
05	42.067	44.809	28.198	28.304	35.729
06	41.281	44.258	27.815	28.000	35.014
07	40.753	43.697	27.387	28.318	34.971
08	41.910	43.674	27.684	28.182	34.871
09	44.191	44.551	30.902	29.714	36.500
10	46.494	46.494	36.263	35.775	42.070
11	48.944	48.798	40.637	38.333	46.676
12	51.270	51.292	43.061	41.200	49.620
13	53.573	53.337	45.457	42.833	51.822
14	55.360	55.202	47.325	44.348	52.649
15	56.458	56.303	48.532	44.000	53.663
16	56.843	56.517	47.000	42.462	53.110
17	56.274	56.213	45.470	42.417	51.722
18	55.000	54.464	43.024	38.846	49.986
19	52.697	52.820	40.317	36.000	47.225
20	50.843	51.382	37.650	33.800	45.225
21	49.562	50.270	35.193	32.462	42.958
22	48.101	49.135	33.744	31.346	42.229
23	46.762	48.270	32.684	30.231	40.296
24	45.360	999.000	31.580	29.458	39.310

direction of predominant synoptic wind flow in a particular season, has a smaller mean diurnal range for that season. The pattern noted for each of the B. C. Hydro network stations is consistent with the synoptic wind direction variation with season which was discussed in Section 3.1, as long as elevation, channeling, and sheltering effects of terrain are accounted for.

4.3 Humidity

Seasonal means of relative humidity for each hour of the day are presented in Table 4-3 for Kamloops, Lytton, and the eight B. C. Hydro mechanical stations, in the same format that was used for the mean dry-bulb temperatures (Section 4.2). As may be expected from the diurnal variations in temperature already discussed, the diurnal range of relative humidity is extremely large at the lower Hat Creek Valley stations (Nos. 1-4). This range is approximately 40% during the spring and summer seasons. It decreases to ~30% in the fall and ~20% in the winter. During all seasons the highest nocturnal mean relative humidity at these lower-valley stations is about 78 ± 4%. Kamloops is noticeably (~8-12%) drier than the valley at night, but has approximately the same relative humidity in the daytime. The Harry Lake site has about the same nocturnal relative humidity as Kamloops for all the seasons but winter; in winter the humidity of this site resembles that at all the valley stations except Station No. 5, which is drier at night.

For all seasons, daytime mean relative humidities at the Harry Lake site are 5 to 10% higher than Kamloops or the Hat Creek Valley stations Nos. 1-5. The fact that the mechanical stations at the highest elevations experience the highest daytime relative humidities is at least partly explained by their lower mean daytime temperatures. The planned use of cooling towers at the proposed power generating station has made it essential to have the detailed measurements of Valley humidity profiles and frequencies that can be compiled from the humidity observations acquired by the Mechanical Station Network.*

*This discussion of humidity measurement is based upon currently available calibrations of the B. C. Hydro Mechanical Weather Station humidity sensors. Discussions with the instrument manufacturer indicate that some future revisions of these values may be necessary.

TABLE 4-3

SEASONAL MEAN RELATIVE HUMIDITY IN THE HAT CREEK REGION

DIURNAL AVERAGE FOR DECEMBER 1974 - FEBRUARY 1975
HUMIDITY (XRH) HUM

HOUR	KAMLOOPS	LYTTON	H.C. MECHANICAL 1	H.C. MECHANICAL 2	H.C. MECHANICAL 3
01	69,090	999,000	74,552	75,674	77,120
02	69,978	999,000	74,586	75,500	77,917
03	70,056	999,000	75,379	75,500	76,250
04	70,333	999,000	75,448	75,348	78,208
05	69,878	79,733	75,379	75,457	78,083
06	69,422	79,933	75,586	75,503	77,913
07	69,189	79,567	75,897	75,630	78,304
08	68,878	79,478	74,793	74,435	78,300
09	68,756	78,956	66,862	71,644	75,826
10	67,511	77,278	55,759	65,933	71,522
11	65,600	76,389	49,683	50,644	63,750
12	64,789	72,589	45,429	53,044	58,080
13	63,200	70,533	43,483	49,244	57,240
14	62,567	68,456	43,033	48,333	57,560
15	62,733	66,533	44,333	49,469	60,000
16	62,972	68,156	48,900	54,261	61,667
17	63,900	69,278	57,710	60,689	65,917
18	65,178	71,978	65,613	66,756	70,600
19	65,033	72,900	70,129	70,267	73,840
20	66,956	74,211	72,256	72,733	75,720
21	67,733	74,778	73,733	73,533	76,667
22	66,478	76,078	74,033	74,636	77,583
23	68,433	76,799	75,000	75,341	77,875
24	68,856	999,000	75,200	75,636	78,167

DIURNAL AVERAGE FOR DECEMBER 1974 - FEBRUARY 1975
HUMIDITY (%RH) HUM

HOUR	H.C. MECHANICAL 4	H.C. MECHANICAL 5	H.C. MECHANICAL 6	H.C. MECHANICAL 7	H.C. MECHANICAL 8
01	76,872	65,392	999,000	76,947	81,000
02	76,596	65,162	999,000	77,132	81,429
03	76,894	65,450	999,000	77,500	78,800
04	76,809	65,462	999,000	77,605	79,933
05	76,106	65,387	999,000	77,276	80,600
06	74,979	65,100	999,000	76,658	80,667
07	74,638	65,000	999,000	76,645	80,733
08	74,596	64,950	999,000	76,868	80,219
09	73,638	64,950	999,000	76,565	79,500
10	69,298	64,087	999,000	73,513	77,714
11	61,936	61,037	999,000	69,410	76,643
12	55,043	56,287	999,000	64,776	75,786
13	50,652	52,762	999,000	61,382	74,286
14	47,979	51,086	999,000	59,623	72,929
15	47,340	51,500	999,000	60,455	72,071
16	48,596	52,175	999,000	63,038	73,429
17	53,957	54,778	999,000	67,769	76,643
18	61,854	57,765	999,000	72,308	78,357
19	67,833	60,370	999,000	75,103	80,071
20	71,625	62,198	999,000	76,262	81,500
21	74,771	63,537	999,000	76,779	81,571
22	76,021	64,550	999,000	77,299	81,286
23	76,958	64,887	999,000	77,234	80,929
24	77,167	65,300	999,000	77,051	80,857

TABLE 4-3 (Continued)

SEASONAL MEAN RELATIVE HUMIDITY IN THE HAT CREEK VALLEY VICINITY

DIURNAL AVERAGE FOR MARCH 1975 - MAY 1975
HUMIDITY (%RH) HUM

HOUR	KAMLOOPS	LYTTON	H.C. MECHANICAL 1	H.C. MECHANICAL 2	H.C. MECHANICAL 3
01	61.772	999.000	73.352	73.461	76.425
02	62.982	999.000	74.716	74.013	77.027
03	64.772	999.000	75.875	74.592	77.665
04	66.293	999.000	77.511	75.263	77.878
05	66.756	73.011	78.182	75.724	76.932
06	68.424	73.446	79.023	77.145	78.473
07	67.348	74.293	78.193	75.605	76.784
08	63.870	72.478	73.648	68.987	71.784
09	59.478	68.530	63.989	60.447	62.797
10	55.576	62.130	54.795	52.724	54.189
11	50.946	55.750	47.932	46.224	46.243
12	47.587	50.370	42.352	40.603	40.944
13	43.891	45.576	37.787	37.400	37.375
14	40.891	41.630	35.068	34.289	34.708
15	39.141	39.986	33.114	31.789	33.288
16	38.402	39.565	31.618	31.237	34.250
17	38.239	40.185	31.820	32.787	39.042
18	39.902	42.859	33.652	37.421	47.260
19	42.370	45.739	40.080	46.355	55.699
20	46.685	49.648	49.112	55.039	61.079
21	50.033	53.196	57.978	60.711	67.205
22	53.283	56.165	64.258	66.104	71.630
23	56.663	58.489	68.000	69.505	73.726
24	59.287	999.000	70.618	71.948	75.699

DIURNAL AVERAGE FOR MARCH 1975 - MAY 1975
HUMIDITY (%RH) HUM

HOUR	H.C. MECHANICAL 4	H.C. MECHANICAL 5	H.C. MECHANICAL 6	H.C. MECHANICAL 7	H.C. MECHANICAL 8
01	69.781	66.095	69.000	65.814	73.792
02	71.370	67.867	68.000	67.343	75.958
03	72.918	68.735	69.222	69.071	77.913
04	73.781	69.707	70.889	70.314	78.174
05	74.616	70.600	72.333	71.100	77.826
06	75.507	71.493	73.222	71.855	78.000
07	75.000	70.840	73.889	71.319	77.913
08	68.740	66.813	73.222	68.203	75.609
09	58.425	60.960	72.111	62.971	71.783
10	50.329	55.649	70.869	57.681	65.957
11	41.616	48.172	65.400	52.319	60.870
12	35.171	42.203	62.000	47.536	58.364
13	31.233	38.853	59.600	44.443	51.739
14	28.397	36.347	58.200	42.471	50.007
15	26.685	36.253	55.500	41.306	49.348
16	26.945	36.147	56.400	42.000	53.583
17	29.589	38.413	57.089	45.143	60.833
18	46.753	41.973	60.778	49.786	66.583
19	44.000	47.213	66.889	54.000	68.708
20	51.006	51.293	68.667	56.729	69.792
21	56.712	55.960	69.556	59.286	70.708
22	60.945	59.105	70.000	61.686	73.250
23	65.192	62.132	69.667	63.329	72.875
24	67.022	64.132	69.556	64.714	72.125

TABLE 4-3 (Continued)

SEASONAL MEAN RELATIVE HUMIDITY IN THE HAT CREEK VALLEY VICINITY

DIURNAL AVERAGE FOR JUNE 1975 - AUGUST 1975
HUMIDITY (%RH) HUM

HOUR	KAMLOOPS	LYTTON	H.C. MECHANICAL 1	H.C. MECHANICAL 2	H.C. MECHANICAL 3
01	58.543	999.000	75.893	75.266	76.767
02	62.163	999.000	78.607	78.165	79.256
03	65.239	999.000	81.036	79.974	81.211
04	66.967	999.000	82.357	81.595	82.367
05	68.793	66.989	83.679	81.577	83.169
06	69.587	69.370	83.768	78.595	83.822
07	67.793	70.098	79.811	72.321	80.191
08	63.098	67.348	71.518	64.392	73.264
09	58.337	61.837	63.929	56.010	64.615
10	53.478	56.043	55.679	50.582	57.912
11	49.207	51.772	48.893	46.038	51.978
12	44.880	46.554	45.018	43.228	47.780
13	41.163	42.924	41.732	41.354	45.266
14	37.957	40.663	39.286	40.208	42.944
15	36.565	38.163	38.554	39.038	40.933
16	36.587	37.337	37.648	38.065	39.773
17	35.902	37.678	37.891	38.538	40.176
18	36.804	38.380	39.964	40.282	41.341
19	38.293	39.891	43.357	44.628	44.154
20	41.870	43.533	49.071	49.577	49.633
21	45.717	47.489	56.250	55.449	56.033
22	48.391	50.326	63.250	62.538	62.747
23	52.489	53.278	68.589	68.013	68.165
24	55.407	999.000	72.946	72.192	72.758

DIURNAL AVERAGE FOR JUNE 1975 - AUGUST 1975
HUMIDITY (%RH) HUM

HOUR	H.C. MECHANICAL 4	H.C. MECHANICAL 5	H.C. MECHANICAL 6	H.C. MECHANICAL 7	H.C. MECHANICAL 8
01	72.946	59.957	71.095	68.629	70.023
02	76.272	62.271	73.579	69.607	70.364
03	78.511	64.103	74.211	70.733	71.818
04	80.043	65.900	75.000	72.377	71.591
05	80.868	67.557	74.763	72.933	71.953
06	81.364	68.486	75.000	72.917	70.116
07	79.198	68.743	75.447	72.797	68.810
08	72.315	65.071	73.872	69.167	66.860
09	63.446	60.843	73.632	66.476	66.182
10	56.500	55.871	69.825	61.574	63.000
11	50.674	50.586	69.929	58.219	59.550
12	46.043	46.290	68.057	55.438	58.482
13	44.440	44.101	66.250	54.540	57.545
14	42.275	41.856	62.475	51.492	55.186
15	40.008	39.876	61.119	50.286	54.929
16	39.011	37.647	60.163	49.803	54.578
17	39.130	37.580	58.233	49.328	54.767
18	40.413	37.565	58.907	50.046	55.381
19	42.804	39.162	59.690	51.835	57.444
20	47.859	42.014	61.756	56.738	60.600
21	53.533	46.286	63.561	60.394	63.267
22	60.120	50.700	66.575	62.754	65.600
23	65.074	54.300	68.950	64.813	67.432
24	69.641	57.483	70.395	67.673	68.977

SEASONAL MEAN RELATIVE HUMIDITY IN THE HAT CREEK VALLEY VICINITY

DIURNAL AVERAGE FOR SEPTEMBER 1975 - NOVEMBER 1975
HUMIDITY (%RH) HUM

HOUR	KAMLOOPS	LYTTON	H.C. MECHANICAL 1	H.C. MECHANICAL 2	H.C. MECHANICAL 3
01	64.079	999.000	75.560	75.866	80.669
02	65.371	999.000	77.000	75.520	81.486
03	66.090	999.000	78.048	75.583	82.500
04	67.742	999.000	78.988	76.167	82.931
05	68.921	79.101	80.071	76.958	83.502
06	69.685	79.798	80.422	77.333	83.319
07	70.011	80.629	80.590	77.333	83.167
08	68.944	80.798	80.466	77.042	82.958
09	64.629	78.978	76.494	76.042	81.625
10	61.382	74.665	69.512	69.348	75.930
11	57.708	70.281	60.012	60.640	65.859
12	54.000	65.679	53.679	54.360	58.197
13	50.348	62.191	48.536	48.840	53.219
14	47.315	59.236	45.217	47.360	49.479
15	45.607	57.573	42.241	47.023	47.808
16	45.247	56.011	42.369	47.315	48.425
17	46.270	58.955	45.476	50.615	50.444
18	47.609	61.494	49.619	54.269	54.306
19	50.292	63.798	54.143	60.846	60.083
20	52.506	66.090	60.702	65.346	65.639
21	55.225	67.820	65.631	68.462	70.369
22	57.697	70.292	68.726	70.731	73.625
23	60.404	71.663	71.345	72.962	75.708
24	62.618	999.000	73.464	75.692	78.194

DIURNAL AVERAGE FOR SEPTEMBER 1975 - NOVEMBER 1975
HUMIDITY (%RH) HUM

HOUR	H.C. MECHANICAL 4	H.C. MECHANICAL 5	H.C. MECHANICAL 6	H.C. MECHANICAL 7	H.C. MECHANICAL 8
01	74.773	54.689	85.360	65.710	75.522
02	75.716	55.730	84.800	65.190	77.304
03	76.682	57.162	85.040	64.929	78.478
04	77.636	58.108	85.000	65.929	78.565
05	78.216	58.770	84.200	66.047	78.876
06	78.943	59.753	83.920	66.233	80.609
07	78.955	60.575	83.480	66.744	81.261
08	78.591	61.562	82.375	67.326	80.826
09	76.148	62.082	80.250	66.395	78.783
10	67.807	60.329	78.000	65.651	76.292
11	59.875	55.324	77.875	63.477	73.680
12	53.773	50.446	77.304	60.205	70.800
13	49.568	45.051	78.667	58.930	65.833
14	46.080	42.203	77.167	55.911	65.880
15	45.409	40.533	76.840	55.970	60.680
16	46.820	39.653	76.680	57.500	59.640
17	49.466	39.600	79.080	61.200	57.292
18	52.955	40.507	80.000	62.152	57.680
19	56.693	41.680	81.200	63.267	60.375
20	61.983	44.378	82.080	65.089	64.480
21	66.375	47.135	83.120	66.000	68.217
22	69.198	49.878	88.560	66.488	70.217
23	71.477	51.649	84.720	66.279	71.783
24	73.705	53.568	85.720	65.819	73.783

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