2.3 Meteorology

The AP1000 is designed for air temperatures, humidity, precipitation, snow, wind, and tornado conditions as specified in Table 2.0-201. The design wind is specified as a basic wind speed of 145 mph with an annual probability of occurrence of 0.02. Wind loads are calculated for exposure C, which is applicable to shorelines in hurricane prone areas. The VEGP site parameters for the design wind are demonstrated to be acceptable by comparison of the wind loads on the structures. Refer to Subsection 2.3.1.3.

This section describes the regional and local climatological and meteorological characteristics applicable to the VEGP site for consideration in the design and operating bases of safety- and/or non-safety related structures, systems and components for proposed VEGP Units 3 and 4. This section also provides site-specific meteorological information for use in evaluating construction-related, routine operational, and hypothetical accidental releases to the atmosphere.

2.3.1 Regional Climatology

The VEGP site is located in the region known as the Upper Coastal Plain, lying between the Appalachian Mountains and the Atlantic Ocean, just south of the Fall Line that separates the Piedmont from the Coastal Plain. Elevation is generally 150 to 250 ft above sea level in this region, which is cut by the valley of the Savannah River. The river valley ranges from 2 to 5 mi wide near the VEGP site.

2.3.1.1 Data Sources

SNC used several sources of data to characterize regional climatological conditions pertinent to the VEGP site. The National Climatic Data Center (NCDC) compiled data from the first-order National Weather Service (NWS) station in Augusta, Georgia, and from nine other nearby locations in its network of cooperative observer stations.

These climatological observing stations are located in Burke, Richmond, Jenkins, Screven, and Jefferson Counties, Georgia, and in Aiken, Barnwell, Orangeburg, and Bamberg Counties, South Carolina. Table 2.3-203 identifies the specific stations and lists their approximate distance and direction from the existing reactors at the VEGP site. Figure 2.3-201 illustrates these station locations relative to the VEGP site.

The objective of selecting nearby, off-site climatological monitoring stations is to demonstrate that the mean and extreme values measured at those locations are reasonably representative of conditions that might be expected to be observed at the VEGP site. The 50-mi radius circle shown in Figure 2.3-201 provides a relative indication of the distance between the climate observing stations and the VEGP site.

However, a 50-km (about 31-mi) grid spacing is considered to be a reasonable fine mesh grid in current regional climate modeling, and this distance was used as a nominal radius for the station selection process. The identification of stations to be included was based on the following considerations:

- Proximity to the site (i.e., within the nominal 50-km radius indicated above, to the extent practicable)
- Coverage in all directions surrounding the site (to the extent possible)

- Where more than one station exists for a given direction relative to the site, a station was chosen if it contributed one or more extreme conditions (e.g., rainfall, snowfall, maximum and/or minimum temperatures) for that general direction.

Nevertheless, if an overall extreme precipitation or temperature condition was identified for a station located within a reasonable distance beyond the nominal 50-km radius and that event was considered to be reasonably representative for the site area, such stations were also included, regardless of directional coverage.

Normals (i.e., 30-year averages), means, and extremes of temperature, rainfall, and snowfall are based on the:

- *2004 Local Climatological Data, Annual Summary with Comparative Data for Augusta, Georgia* (Reference 221)
- *Climatography of the United States, No. 20, 1971-2000, Monthly Station Climate Summaries* (Reference 222)
- *Climatography of the United States, No. 81, 1971-2000, U.S. Monthly Climate Normals* (Reference 211)
- Southeast Regional Climate Center (SERCC), *Historical Climate Summaries and Normals for the Southeast* (Reference 230).
- *Cooperative Summary of the Day, TD3200, Period of Record Through 2001, for the Eastern United States, Puerto Rico and the Virgin Islands* (Reference 213).

First-order NWS stations also record measurements, typically on an hourly basis, of other weather elements, including winds, several indicators of atmospheric moisture content (i.e., relative humidity, dew point, and wet-bulb temperatures), and barometric pressure, as well as other observations when those conditions occur (e.g., fog, thunderstorms). Table 2.3-204, excerpted from the 2004 local climatological data (LCD) summary for the Augusta NWS Station, presents the long-term characteristics of these parameters.

The following data sources were also used in describing climatological characteristics of the VEGP site area and region:

- *Solar and Meteorological Surface Observation Network, 1961-1990, Volume 1, Eastern U.S.* (Reference 227)
- *Hourly United States Weather Observations, 1990-1995* (Reference 210)
- *Integrated Surface Hourly Observations*, 1995-1999 (Reference 215), 2000 (Reference 216), 2001 (Reference 217), 2002 (Reference 218), 2003 (Reference 220), 2004 (Reference 223), 2005 (Reference 226)
- *International Station Meteorological Climate Summary* (Reference 232)
- *Engineering Weather Data, 2000 Interactive Edition, Version 1.0* (Reference 202)
- *Minimum Design Loads for Buildings and Other Structures* (Reference 204)

- *Seasonal Variation of 10-Square-Mile Probable Maximum Precipitation Estimates, United States East of the 105th Meridian,* Hydrometeorological Report No. 53, June 1980 **(NUREG/CR-1486)**
- *Storm Events for Georgia and South Carolina*, Tornado Event Summaries, accessed July 2005 and January 2006 (Reference 224)
- *Historical Hurricane Tracks Storm Query*, 1851 through 2004 (Reference 228)
- *The Climate Atlas of the United States* (Reference 212)
- *Storm Events for Georgia and South Carolina*, Hail Event and Snow and Ice Event Summaries for Burke, Jenkins, Richmond, and Screven Counties in Georgia, and Aiken, Allendale, and Barnwell Counties in South Carolina (Reference 225)
- *Storm Data (and Unusual Weather Phenomena with Late Reports and Corrections)*, January 1959 (Volume 1, Number 1) to January 2004 (Volume 42, Number 1) (Reference 219)
- *Air Stagnation Climatology for the United States (1948-1998)* (Reference 233)
- *Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States* (Reference 209)
- *Climatography of the United States, No. 85, Divisional Normals and Standard Deviations of Temperature, Precipitation, and Heating and Cooling Degree Days 1971-2000 (and previous normals periods)* (Reference 214)

2.3.1.2 General Climate

The general climate in this region is characterized by mild, short winters; long periods of mild sunny weather in the autumn; somewhat more windy but mild weather in spring; and long, hot summers.

The regional climate is predominately influenced by the Azores high-pressure system. Due to the clockwise circulation around the western extent of the Azores High, maritime tropical air mass characteristics prevail much of the year, especially during the summer with the establishment of the Bermuda High and the Gulf High. Together, these systems govern Georgia’s summertime temperature and precipitation patterns. This macro-circulation feature also has an effect on the frequency of high air pollution potential in the VEGP site region. These characteristics and their relationship to the Bermuda High, especially in the late summer and autumn, are addressed in Subsection 2.3.1.6.

This macro-scale circulation feature continues during the transitional seasons and winter months; however, it is regularly disrupted by the passage of synoptic- and meso-scale weather systems. During winter, cold air masses may briefly intrude into the region with the cyclonic (i.e., counter-clockwise) northerly flow that follows the passage of low-pressure systems. These systems frequently originate in the continental interior around Colorado, pick up moisture-laden air due to southwesterly through southeasterly airflow in advance of the system, and result in a variety of precipitation events that include rain, snow, sleet, and freezing rain or mixtures, depending on the temperature characteristics of the weather system itself and the temperature of the underlying air (see Subsection 2.3.1.3.5). Similar cold air intrusion and precipitation patterns may also be associated with secondary low-pressure systems that form in the eastern Gulf of Mexico or along the Atlantic Coast and move northeastward along the coast (also referred to as “nor’easters”).

Larger and relatively more persistent outbreaks of very cold, dry air associated with massive high-pressure systems that move southeastward out of Canada also periodically affect the VEGP site region. These weather conditions are moderated by the Appalachian Mountains to the northwest, which shelter the region in winter from these cold air masses that sweep down through the continental interior. In general, the cold air that does reach the VEGP site area is warmed by its descent to the relatively lower elevations of the region, as well as by modification due to heating as it passes over the land.

Monthly precipitation exhibits a cyclical pattern, with one maximum during the winter into early spring and a second maximum during late spring into summer (see Table 2.3-204). The winter and early spring maximum is associated with low-pressure systems moving eastward and northward through the Gulf States and up the Atlantic Coast, drawing in warm, moist air from the Gulf of Mexico and the Atlantic Ocean. These air masses receive little modification as they move into the region. The late spring and summer maximum is due to thunderstorm activity. Heavy precipitation associated with late summer and early autumn tropical cyclones, as discussed in Subsection 2.3.1.3.3, is not uncommon. The VEGP site is located far enough inland that the strong winds associated with tropical cyclones are much reduced by the time that such systems affect the site area.

2.3.1.3 Severe Weather

2.3.1.3.1 Extreme Winds

Estimating the wind loading on plant structures for design and operating bases considers the "basic" wind speed, which is the "3-second gust speed at 33 ft (10 m) above the ground in Exposure Category C," as defined in Sections 6.2 and 6.3 of the ASCE-SEI design standard, *Minimum Design Loads for Buildings and Other Structures* (Reference 204).

The basic wind speed for the VEGP site is about 97 mph, as estimated by linear interpolation from the plot of basic wind speeds in Figure 6-1 of ASCE (2002) for that portion of the U.S. that includes the VEGP site (Reference 204). This interpolated value is about 7.5 percent higher than the basic wind speed reported in the Engineering Weather Data summary for the Augusta (Bush Field) NWS Station (i.e., 90 mph) (Reference 202), which is located about 20 mi northwest of the VEGP site. The former value is, therefore, considered to be a reasonably conservative indicator of the basic wind speed.

From a probabilistic standpoint, these values are associated with a mean recurrence interval of 50 years. Section C6.0 of the ASCE-SEI design standard provides conversion factors for estimating 3-second-gust wind speeds for other recurrence intervals (Reference 204). Based on this guidance, the 100-year return period value is determined by multiplying the 50-year return period value by a scaling factor of 1.07, which yields a 100-year return period 3-second-gust wind speed for the VEGP site of about 104 mph.

2.3.1.3.2 Tornadoes

The design-basis tornado (DBT) characteristics applicable to structures, systems, and components important to safety at the proposed VEGP site include the following parameters as identified in Draft Regulatory Guide DG-1143, *Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants, Proposed Revision 1 of NRC Regulatory Guide 1.76 (dated April 1974)*, January 2006 (DG-1143) and the predecessor US Atomic Energy Commission (USAEC) guidance document WASH-1300, *Technical Basis for Interim Regional Tornado Criteria* (Reference 231)**,** on which the original version of Regulatory Guide 1.76 is based:

- Tornado strike probability

- Maximum wind speed
- Translational speed
- Maximum rotational wind speed
- Radius of maximum rotational speed
- Pressure drop
- Rate of pressure drop

The tornado strike probability is determined by evaluating certain characteristics of tornadoes that have been observed within a 2-degree latitude and longitude square centered on the VEGP site. These characteristics include the Fujita-scale wind speed classification (or “F-scale”) and the Pearson-scale path length and path width classification (or “P-scale”). As tornado intensity increases, so does the magnitude or the dimensions of these parameters along with the assigned numerical classification, which ranges from 0 to 5.

The 2-degree square area was assumed to be centered on the VEGP Unit 1 reactor, adjacent to the new unit footprint, and located at the following coordinates:

Latitude = 33° 08’ 30” N; Longitude = 81° 45’ 44” W

A searchable database of tornado occurrences by location, date, and time; starting and ending coordinates; F-scale classification; P-scale dimensions; and damage statistics has been compiled by the NCDC beginning with January 1950 (Reference 224). The 2-degree square area for this evaluation includes all or portions of 30 counties in Georgia and all or portions of 18 counties in South Carolina.

Through the nearly 55-year period ending April 30, 2005, the records in the database indicate that a total of 348 tornadoes or portions of a tornado path passed within the 2-degree square area centered on the VEGP site. Tornado F-scale classifications (with corresponding wind speed range) and respective frequencies of occurrence are as follows:

- F5 (wind speed > 117 m/sec) = 0
- F4 (wind speed 93 to 116 m/sec) = 1
- F3 (wind speed 70 to 92 m/sec) = 18
- F2 (wind speed 50 to 69 m/sec) = 62
- F1 (wind speed 33 to 49 m/sec) = 151
- F0 (wind speed 18 to 32 m/sec) = 116

Following the WASH-1300 methodology, the probability that a tornado will strike a particular location during any one year is given as:

PS = n (a / A)

where:

P_S = mean tornado strike probability per year
n = average number of tornadoes per year in the area being considered
a = average individual tornado area
A = total area being considered (i.e., the 2-degree square area)

Based on an average occurrence of 6.29 tornadoes per year (i.e., 348 tornadoes over a 55.33-year period of record), an average individual tornado area of 0.197 sq mi (i.e., an average tornado path length of 3.3 mi and an average tornado path width of 105.3 yds), and a total area of 16,010 sq mi for the 2-degree square under consideration, the tornado strike probability (P_S) for the VEGP site area is estimated to be about 774 x 10^{-7} (about 0.0000774 per year), or a recurrence interval of once every 12,920 years.

WASH-1300 indicates that determination of the DBT characteristics is based on the premise that the probability of occurrence of a tornado that exceeds the DBT should be on the order of 10^{-7} per year per nuclear power plant. DG-1143 retains that threshold criterion.

The estimated recurrence interval for the VEGP site area exceeds this threshold; therefore, it is necessary to determine the DBT parameters listed at the beginning of this section. These parameters are able to be calculated from the area-specific database used to determine PS. However, DG-1143 also provides DBT characteristics for three tornado intensity regions, each with a 10^{-7} probability of occurrence, that are acceptable to the agency.

As indicated in DG-1143, Figure 1, the VEGP site is adjacent to Tornado Intensity Regions I and II. The more conservative DBT parameters for Region I will be used for the design of structures, systems, and components that are important to safety that must take DBT characteristics into account. DG-1143, Table 1, provides the following DBT parameter values for Tornado Intensity Region I:

- Maximum wind speed = 300 mph
- Translational speed = 60 mph
- Maximum rotational wind speed = 240 mph
- Radius of maximum rotational speed = 150 ft
- Pressure drop = 2.0 psi
- Rate of pressure drop = 1.2 psi/sec

2.3.1.3.3 Tropical Cyclones

Tropical cyclones include not only hurricanes and tropical storms, but systems classified as tropical depressions, sub-tropical depressions, and extra-tropical storms, among others. This characterization considers all “tropical cyclones” (rather than systems classified only as hurricanes and tropical storms) because storm classifications are generally downgraded once landfall occurs and the systems weaken, although they may still result in significant rainfall events as they travel through the site region.

NOAA’s Coastal Services Center (NOAA-CSC) provides a comprehensive historical database, extending from 1851 through 2004, of tropical cyclone tracks based on information compiled by the National Hurricane Center. This database indicates that a total of 102 tropical cyclone centers or storm tracks have passed within a 100-nautical mile radius of the VEGP site during this historical period (Reference 228). Storm classifications and respective frequencies of occurrence over this 154-year period of record are as follows:

- Hurricanes – Category 3 (5), Category 2 (4), Category 1 (16)
- Tropical storms – 46
- Tropical depressions – 23
- Sub-tropical storms – 1
- Sub-tropical depressions – 2
- Extra-tropical storms – 5

Tropical cyclones within this 100-nautical-mile radius have occurred as early as May and as late as November, with the highest frequency (36 out of 102 events) recorded during September, including all classifications except sub-tropical depressions. August and October account for 21 and 20 events, respectively, indicating that 75 percent of the tropical cyclones that affect the VEGP site area occur from mid-summer to early autumn. Three of the five Category 3 hurricanes occurred in September, and the other two occurred in August.

Tropical cyclones are responsible for at least 12 separate rainfall records at 8 NWS cooperative observer network stations in the VEGP site area – eight 24-hour (daily) rainfall totals and 3 monthly rainfall totals (see Table 2.3-205). In October 1990, rainfall associated with Tropical Depression Marco (along with a slow-moving cold frontal system) resulted in historical daily maximum totals of 8.60 in. at the Louisville 1E Station, 8.19 in. at the Midville Experiment Station, and 5.50 in. at the Newington 2NE Station, all located in Georgia. Two daily records were established due to Hurricane Gracie in September 1959, at the Blackville 3W (7.53 in.) and Springfield (7.10 in.) stations in South Carolina. In August 1964, a 24-hour rainfall total of 8.02 in. was recorded at the Millen 4N Station (in Georgia) due to Tropical Storm Cleo; and in September 2000, Tropical Depression Helene produced 8.02 in. of rain in a 24-hour period at the Bamberg, South Carolina, observing station. A daily maximum total of 7.30 in. was measured at the Augusta Weather Service Office (WSO) (also in Georgia) in September 1998 during the passage of Tropical Storm Earl **(**Reference 219**,** Reference 225**;** Reference 230**)**.

Monthly station records were established due to contributions from the following tropical cyclones: Tropical Depression Marco in October 1990 (14.82 in. at Augusta WSO and 14.67 in. at Blackville 3W); Tropical Storm Cleo in August 1964 (13.45 in. at Millen 4N); and to some extent, Tropical Depression Jerry in August 1995 (15.26 in. at Bamberg) **(**Reference 215**,** Reference 219**,** Reference 225**)**.

2.3.1.3.4 Precipitation Extremes

Because precipitation is a point measurement, mean and extreme statistics, such as individual storm event, or daily or cumulative monthly totals typically vary from station to station. Assessing the variability of precipitation extremes over the VEGP site area, in an effort to evaluate whether the available long-term data are representative of conditions at the site, is largely dependent on station coverage.

Historical precipitation extremes (rainfall and snowfall) are presented in Table 2.3-205 for the ten nearby climatological observing stations listed in Table 2.3-203. Based on the similarity of the maximum recorded 24-hour and monthly totals among these stations and the areal distribution of these stations around the VEGP site, the data suggest that these statistics are reasonably representative of precipitation extremes that might be expected to be observed at the site.

As indicated in Subsection 2.3.1.3.3, most of the individual station 24-hour rainfall records (and to a lesser extent the monthly record totals) were established as a result of precipitation associated with tropical cyclones that passed within a 100-nautical-mile radius of the VEGP site.

However, the overall highest 24-hour rainfall total in the VEGP site area — 9.68 in. on April 16, 1969, at the Aiken 4NE Station in South Carolina (Reference 222), about 25 mi north-northeast of the VEGP site—was not associated with a low-pressure system or other well-defined synoptic-scale feature. Rather, this appears to have been an embedded, localized event in an otherwise widespread area of disturbed weather that brought precipitation to the entire East Coast (Reference 208).

Similarly, the overall highest monthly rainfall total recorded in the VEGP site area —17.32 in. during June 1973 at the cooperative observing station in Springfield, South Carolina **(**Reference 230**;** Reference 213**)**, 37 mi northeast of the VEGP site — represents the accumulation of 21 days of measurable precipitation during that month (Reference 213) due to both synoptic-scale weather features (e.g., stationary frontal boundaries and stalled low-pressure areas off the Carolina coast) and more regional- to local-scale events (i.e., thunderstorms).

For the most part, when daily or monthly rainfall records were established at a given station, regardless of their cause(s), significant amounts of precipitation were usually measured at the other stations in the VEGP site area (Reference 213).

Although the disruptive effects of any winter storm accompanied by frozen precipitation can be significant in the Upper Coastal Plain of Georgia and South Carolina, storms that produce large measurable amounts of snow occur infrequently. With one exception, all of the 24-hour and monthly record snowfall totals listed in Table 2.3-205 were established during the storm of early February 1973, the highest 24-hour and monthly totals (19.0 and 22.0 in., respectively) being recorded at the Bamberg Station in South Carolina, about 44 mi east-northeast of the VEGP site. Similar amounts, ranging from 14.0 to 17.0 in., were recorded at most of the other stations **(**Reference 222**;** Reference 230**)**.

The stations with lower maximum 24-hour snowfall totals — 8.0 in. at the Augusta WSO on February 9 and 5.0 in. at Newington 2NE on February 10 (both in Georgia) **(**Reference 222**;** Reference 230**)**, and 8.0 in. at Springfield, South Carolina, on February 11 (Reference 230**;**Reference 213) — recorded a comparable amount of snowfall on the preceding or following day, making the 2-day totals for these stations similar to the single-day records at the other stations (except at the Newington 2NE station, the lowest of all the station records).

The record monthly snowfall total at the Millen 4N Station (15.0 in. in February 1968) represents the cumulative amount from two smaller snow events that occurred around February 8 and from February 22 to 24. A review of the daily records for the other stations indicates that except for the Augusta (Georgia) and Blackville 3W (South Carolina) stations, the data are missing for these time periods. (Reference 213)

Estimating the design basis snow load on the roofs of safety-related structures considers two climate-related components: the weight of the 100-year return period ground-level snowpack, and the weight of the 48-hour probable maximum winter precipitation (PMWP). From a probabilistic standpoint, the estimated weight of the 100-year return period ground-level snowpack for the VEGP site area is about 10 lb/ft^2, as determined in accordance with the guidance in Section C7.0 of the ASCE-SEI design standard, *Minimum Design Loads for Buildings and Other Structures* (Reference 204).

The 48-hour PMWP component is derived from plots of 24- and 72-hour, 10-sq mi area, monthly probable maximum precipitation (PMP) as presented in NUREG/CR-1486, *Seasonal Variation of 10-Square-Mile Probable Maximum Precipitation Extremes, United States East of the 105th Meridian,* NOAA Hydrometeorological Report No. 53, June 1980 (NUREG/CR-1486). The highest winter season (i.e., December through February) PMP values for the VEGP site area occur in December. The 48-hour PMWP value is determined by linear interpolation between the 24- and 72-hour PMP values for that month (Figures 35 and 45 of NUREG/CR-1486) and result in a value of 28.3 in. One inch of liquid water is equivalent to 5.2 lb/ft^2; therefore, the estimated weight of the 48-hour PMWP is about 147 lb/ft^2.

The AP1000 safety-related roofs are sloped and designed to handle winter snowpack with margin to handle rainfall on top of the snowpack. The AP1000 design basis snow load of 75 psf (ground) and 63 psf (roof) has sufficient margin to include the weight of rain water adding to a pre-existing snow pack. Using ASCE 7-98 the design snow load 50 psf (ground) converts to 42 psf (roof). Therefore, the AP1000 design includes a 21 psf (63 - 42) margin above the design ASCE 7-98 requirement. This margin could accommodate the equivalent weight of 4" of water within the snow on the roof.

Winter PMP loads in excess of this loading are not considered credible based on the design of the roof. The safety related roofs are constructed of 15" thick reinforced concrete supported by steel beams. The roofs will not deflect enough to hold water under the snow load; therefore, ponding of rain water with pre-existing snow pack conditions will not occur. The physical arrangement of the AP1000 sloped roof is designed such that the 100-year snow pack will not prevent the winter PMP water from draining off the sloped roof system.

In addition the AP1000 roof includes R10 insulation that assures uniform temperatures on the roof surface. This minimizes the potential for ice dams that are typically formed across roofs with a temperature differential.

For the VEGP site, the 100 year snow load is 10 psf which is well within the 63 psf design basis snow load of the AP1000. Thus, for the VEGP site, a 53 psf margin is available to accommodate winter PMP water that may be impounded in the 100-year snow pack as the water flows off of the roof.

2.3.1.3.5 Hail, Snowstorms, and Ice Storms

Frozen precipitation typically occurs in the form of hail, snow, sleet, and freezing rain. The frequency of occurrence of these types of weather events in the VEGP site area is based on the latest version of *The Climate Atlas of the United States* (Reference 212), which has been developed from observations made over the 30-year period of record from 1961 to 1990.

Though hail can occur at any time of the year and is associated with well-developed thunderstorms, it has been observed primarily during the spring and early summer months and least often during the late summer and autumn months. The Climate Atlas indicates that Burke County, Georgia, and adjacent Barnwell County, South Carolina, can expect, on average, hail with diameters 0.75 in. or greater about 1 day per year. The occurrence of hailstorms with hail greater than or equal to 1.0 in. in diameter averages less than 1 day per year in Burke County.

However, the annual mean number of days with hail 0.75 in. and 1.0 in. or greater is slightly higher in nearby Richmond and Columbia Counties, Georgia (just to the northwest of the VEGP site), and in Aiken and Edgefield Counties, South Carolina (just to the north and north-northwest of the VEGP site), ranging from 1 to 2 days per year (0.75 in. diameter or greater) and up to 1 day per year (1.0 in. diameter or greater).

NCDC cautions that hailstorm events are point observations and somewhat dependent on population density. While no hailstorms of note have been recorded in some years, multiple events have been observed in other years, including 16 events on 9 separate dates in 1998 and 8 events on 8 separate dates during 1999 in Aiken County, and 8 events on 6 separate dates during 1998 in Richmond County (Reference 225). Therefore, the slightly higher annual mean number of hail days may be a more representative indicator of frequency for the relatively less-populated VEGP site area.

Despite these long-term statistics, golfball-size hail (about 1.75 in. in diameter) is not a rare occurrence (Reference 219, Reference 225**)**. However, in terms of extreme hailstorm events, the NCDC publication *Storm Data* indicates that baseball-size hail (about 2.75 in. in diameter) was observed at one location in the general VEGP site area (Reference 219) on May 21, 1964, at Hampton, South Carolina, about 43 mi southeast of the VEGP site.

Snow is infrequent in the Upper Coastal Plain of Georgia and South Carolina, where the VEGP site is located, but can occur when a source of moist air from the Atlantic Ocean or the Gulf of Mexico interacts with a very cold air mass that penetrates across the otherwise protective Appalachian mountain range in northern Georgia and northwestern South Carolina. The Climate Atlas (Reference 212) indicates that the occurrence of snowfalls 1 in. or greater in the VEGP site area averages less than 1 day per year.

Heavy snow is a rarity. The greatest snowfall on record in the VEGP site area occurred between February 9 and 11, 1973, depending on the cooperative observing station records. Snowfall totals for the overall event typically ranged between 14 and 22 in., the highest single-day total recorded at the Bamberg Station (19.0 in.) on February 10, which contributed to the highest cumulative monthly total for that station and for the site area. Single-day and cumulative monthly record snowfall totals were also set at nearly all of the other nearby cooperative observing stations as a result of this event. Additional details were given previously in Subsection 2.3.1.3.4 and Table 2.3-205.

Depending on the temperature characteristics of the air mass, snow events are often accompanied by or alternate between sleet and freezing rain as the weather system traverses the VEGP region. The Climate Atlas (Reference 212) indicates that, on average, freezing precipitation occurs only about 1 or 2 days per year in the VEGP site area.

However, the site area appears to be in a transition zone for frequency of occurrence, with the eastern two-thirds of Aiken and Barnwell Counties and all of Allendale County (immediately to the northeast, east, and southeast in South Carolina) and the northeastern quadrant of Screven County, Georgia (just to the southeast of the VEGP site in northeastern Burke County), showing an average frequency of 3 to 5 days of freezing precipitation per year (Reference 212). Therefore, it is not unreasonable to expect a slightly higher annual frequency of occurrence of freezing precipitation events at the VEGP site.

Storm event records from the winters of 2000 through 2005 for the seven-county area surrounding the VEGP site note that ice accumulations of up to 1 in. have occurred, although it is typically less than this thickness (Reference 225).

2.3.1.3.6 Thunderstorms

Thunderstorms can occur in the VEGP site area at any time during the year. Based on a 54-year period of record, Augusta, Georgia, averages about 52 thunderstorm-days (i.e., days on which thunder is heard at an observing station) per year. On average, July has the highest monthly frequency of occurrence — about 12 days. On an annual basis, nearly 60 percent of thunderstorm-days are recorded between late spring and mid-summer (i.e., from June through August). From October through January, a thunderstorm might be expected to occur about 1 day per month. (Reference 221)

The mean frequency of lightning strikes to earth can be estimated using a method attributed to the Electric Power Research Institute, as reported by the US Department of Agriculture Rural Utilities Service in the publication entitled Summary of Items of Engineering Interest Reference 206. This methodology assumes a relationship between the average number of thunderstorm-days per year (T) and the number of lightning strikes to earth per square mile per year (N), where:

$$N = 0.31T$$

Based on the average number of thunderstorm-days per year at Augusta, Georgia (i.e., 52; see Table 2.3-204), the frequency of lightning strokes to earth per square mile is about 16 per year for the VEGP site area. This frequency is essentially equivalent to the mean of the 5-year (1996 to 2000) flash density for the area that includes the VEGP site, as reported by the NWS—4 to 8 flashes per square kilometer per year Reference 229—and, therefore, a reasonable indicator.

The potential reactor area for VEGP Units 3 and 4 is represented in Figure 1.1-202 as an area bounded by a 775-ft-radius circle (or approximately 0.068 mi^2). Given the estimated annual average frequency of lightning strokes to earth in the VEGP site area, the frequency of lightning strokes in the reactor area can be calculated as follows:

$$(16 \text{ lightning strokes}/mi^2/\text{year}) \times (0.068\ mi^2) = 1.09 \text{ lightning strokes/year}$$

or about once each year in the reactor area.

2.3.1.4 Meteorological Data for Evaluating the Ultimate Heat Sink

Unlike the Vogtle 1 and 2 design, the AP1000 design does not use a cooling tower to release heat to the atmosphere following a Loss-of-Coolant Accident (LOCA). Instead, the AP1000 design uses a passive containment cooling system (PCS) to provide the safety-related ultimate heat sink (UHS) for the plant (Reference 234). The PCS uses a high-strength steel containment vessel inside a concrete shield building. The steel containment vessel provides the heat transfer surface that removes heat from inside the containment and transfers it to the atmosphere.

Heat is removed from the containment vessel by continuous, natural circulation of air. In the event of a LOCA, a high-pressure signal activates valves, allowing water to drain by gravity from a storage tank installed on top of the shield building. An air flow path is formed between the shield building and the containment vessel to aid in the evaporation and is exhausted through a chimney at the top of the shield building (Reference 205).

The use of the PCS in the AP1000 design is not significantly influenced by local weather conditions. Therefore, the identification of meteorological conditions that are associated with maximum evaporation and drift loss of water, as well as minimum cooling by the UHS (i.e., periods of maximum wet-bulb temperatures) is not necessary.

A reactor design has been chosen as specified in Section 1.1 that does not use an ultimate heat sink cooling tower to release heat to the atmosphere following a loss of coolant accident; therefore, evaluation of meteorological site characteristics such as maximum evaporation and drift loss and minimum water cooling conditions used to evaluate this design is not necessary.

2.3.1.5 Design Basis Dry- and Wet-Bulb Temperatures

Long-term, engineering-related climatological data summaries, prepared by the AFCCC and the NCDC for the nearby Augusta NWS Station (Reference 202) are used to characterize typical design basis dry- and wet-bulb temperatures for the VEGP site. These characteristics include:

- Maximum ambient threshold dry-bulb (DB) temperatures at annual exceedance probabilities of 2.0 and 0.4 percent, along with the mean coincident wet-bulb (MCWB) temperatures at those values.
- Minimum ambient threshold DB temperatures at annual exceedance probabilities of 1.0 and 0.4 percent.
- Maximum ambient threshold wet-bulb temperature with an annual exceedance probability of 0.4 percent.

Based on the 24-year period of record from 1973 to 1996 for Augusta, Georgia, the maximum DB temperature with a 2.0 percent annual exceedance probability is 92°F, with a MCWB temperature of 75°F. The maximum DB temperature with a 0.4 percent annual exceedance probability is 97°F with a corresponding MCWB temperature value of 76°F. (Reference 202)

For the same period of record, the minimum DB temperatures with 1.0 and 0.4 percent annual exceedance probabilities are 25°F and 21°F, respectively. The maximum wet-bulb temperature with a 0.4 percent annual exceedance probability is 79°F. (Reference 202)

The AFCCC-NCDC data summaries, from which the dry-bulb and mean coincident wet-bulb temperatures, presented above, were obtained, do not include values that represent return intervals of 100 years. Maximum dry-bulb, minimum dry-bulb, and maximum wet-bulb temperatures corresponding to a 100-year return period were derived through linear regression using individual daily maximum and minimum dry-bulb temperatures and maximum daily wet-bulb temperatures for each year over a 30-year period of record from 1966 through 1995 at the Augusta, Georgia, NWS station (Reference 227; Reference 210).

Based on the linear regression analyses of these data sets for a 100-year return period, the maximum dry-bulb temperature is estimated to be about 115°F, the minimum dry-bulb temperature is estimated to be about -8°F, and the maximum wet-bulb temperature is estimated to be about 88°F.

The Westinghouse basis for the determination of maximum design-basis dry- and wet-bulb (WB) temperature values reflected in the AP1000 design (Reference 234, Reference 235) is summarized below:

- <u>Maximum Safety Dry-Bulb and Coincident Wet-Bulb Temperatures</u>. These site parameter values represent a maximum DB temperature that exists for 2 hours or more, combined with the maximum WB temperature that exists in that population of dry-bulb temperatures. Note that this coincident WB temperature is not defined in the same way as the MCWB values presented previously.
- <u>Maximum Safety Wet-Bulb Temperature (Non-Coincident)</u>. This site parameter value represents a maximum WB temperature that exists within a set of hourly data for a duration of 2 hours or more.
- <u>Maximum Normal Dry-Bulb and Coincident Wet-Bulb Temperatures</u>. The DB temperature component of this site parameter pair is represented by a maximum DB temperature that exists for 2 hours or more, excluding the highest 1 percent of the values in an hourly data set. The WB temperature component is similarly represented by the highest WB temperature excluding the highest 1 percent of the data, although there is no minimum 2-hour persistence criterion associated with this WB temperature. The coincident WB temperature is not defined in the same way as the MCWB values presented previously.

- Maximum Normal Wet-Bulb Temperature (Non-Coincident). This site parameter value represents a maximum WB temperature, excluding the highest 1 percent of the values in an hourly data set (i.e., a 1 percent exceedance), that exists for 2 hours or more.

Site characteristic values for the Maximum Safety Dry-Bulb and Coincident Wet-Bulb Temperatures, and the Maximum Safety Wet-Bulb Temperature (Non-Coincident) were estimated, as discussed below, using a conservative approach that reflects 100-year return intervals for these values.

The dry-bulb temperature component of the Maximum Safety Dry-Bulb and Coincident Wet-Bulb Temperature site characteristic pair is represented by the 100-year return period maximum dry-bulb value (i.e., 115°F) reported earlier. Because this 100-year return period dry-bulb value is extrapolated from a regression curve on a single parameter, there is no corresponding MCWB temperature. As a result, the coincident wet-bulb temperature component had to be derived based on a characteristic relationship between concurrent dry- and wet-bulb temperatures—that is, as dry-bulb temperature continues to increase, there is a point at which the concurrent wet-bulb temperature reaches a maximum and thereafter changes little or even decreases. This characteristic is not unique to this location or climatological setting.

This relationship is exhibited by the annual percent frequency distribution of wet-bulb temperature depression for the Augusta, Georgia, NWS station, as reported in the International Station Meteorological Climate Summary (Reference 232), over the 47-year period from 1949 through 1995. This type of summary is a bivariate distribution of dry-bulb temperatures in 2-degree ranges by wet-bulb depression (i.e., the difference between concurrent dry- and wet-bulb observations), also in 2-degree ranges.

For the Augusta NWS station, this threshold dry-bulb temperature occurs at about 85°F. A cubic polynomial curve was fit to the concurrent maximum dry-bulb and maximum wet-bulb temperature pairs extracted from this bivariate distribution at and above this threshold dry-bulb value. The equation of the curve is an estimation of the trend where the maximum coincident wet-bulb temperature can then be determined as a function of the maximum dry-bulb temperature in this upper range of dry-bulb values. Based on a 100-year return period maximum dry-bulb temperature of 115°F, the corresponding wet-bulb temperature is estimated to be 77.7°F. Therefore, this pair of values is used to represent the Maximum Safety Dry-Bulb and Coincident Wet-Bulb Temperature site characteristic values, respectively, for the VEGP Units 3 & 4 site.

The Maximum Safety Wet-Bulb Temperature (Non-Coincident) site characteristic value was developed in a manner similar to the previously reported 100-year return period maximum and minimum dry-bulb temperatures and the maximum wet-bulb temperature in that a regression equation was used to extrapolate the available data to that return interval. However, the wet-bulb temperature data were filtered to include only observed periods of persistence of two hours or more, consistent with the Westinghouse basis.

This persistence criterion introduced the constraint of only being able to analyze data sets with sequential hourly wet-bulb observations. As a result, the period of record utilized to estimate the Maximum Safety Wet-Bulb Temperature (Non-Coincident) associated with a 100-year return period was different than the 100-year return period maximum wet-bulb temperature reported above. A 30-year period of record from 1975 through 2005 (except 1980) for the Augusta NWS station was used to identify the maximum wet-bulb temperature for each year (References 215, 216, 217, 218, 220, 223, and 226).

When applied to the equation of the curve defined by these maximum yearly values, the wet-bulb temperature associated with a return period of 100 years was estimated to be 83.9°F. Therefore, this value is used to represent the Maximum Safety Wet-Bulb Temperature (Non-Coincident) site characteristic for the VEGP Units 3 & 4 site.

The AP1000 DCD maximum and minimum normal temperature site characteristics are 1-percent (99-percent) seasonal exceedance values. According to the ASHRAE 2001 Fundamentals Handbook, these are approximately equivalent to the annual 0.4-percent (99.6-percent) annual exceedance values. Thus, the maximum normal dry bulb temperature (1% seasonal exceedance) is 97° F with a coincident maximum normal wet bulb temperature of 76°F. The maximum normal non-coincident wet bulb temperature is 79°F. Additionally, the minimum normal dry bulb temperature (99% seasonal exceedance) is 21°F.

These values are summarized in Table 2.0-203, *Site Characteristics, Design Parameters, and Site Interface Values*.

2.3.1.6 Restrictive Dispersion Conditions

Atmospheric dispersion can be described as the horizontal and vertical transport and diffusion of pollutants released into the atmosphere. Horizontal and along-wind dispersion is controlled primarily by wind direction variation and wind speed. Subsection 2.3.2.2.1 addresses wind characteristics for the VEGP site vicinity based on measurements from the existing meteorological monitoring program at the VEGP site. The persistence of those wind conditions is also discussed in Subsection 2.3.2.2.1.

In general, lower wind speeds represent less turbulent air flow, which is restrictive to horizontal and vertical dispersion. And, although wind direction tends to be more variable under lower wind speed conditions (which increases horizontal transport), air parcels containing pollutants often re-circulate within a limited area, thereby increasing cumulative exposure.

Major air pollution episodes are usually related to the presence of stagnating high-pressure weather systems (or anti-cyclones) that influence a region with light and variable wind conditions for 4 days or more. An updated air stagnation climatology is available for the continental US based on over 50 years of observations from 1948 through 1998. Although inter-annual frequency varies, the data in Figures 1 and 2 of that report indicate that, on average, the VEGP site area can expect about 20 days per year with stagnation conditions, or about 4 cases per year with the mean duration of each case lasting about 5 days. (Reference 233)

Air stagnation conditions primarily occur during an “extended” summer season that runs from May through October. This is a result of the weaker pressure and temperature gradients, and therefore weaker wind circulations, during this period (as opposed to the winter season). Based on the *Air Stagnation Climatology for the United States (1948-1998)*, Figures 17 to 67, the highest incidence is recorded in the latter half of that period between August and October, typically reaching its peak in September. As the LCD summary for Augusta, Georgia, in Table 2.3-204 indicates, this 3-month period coincides with the lowest monthly mean wind speeds during the year. Within this “extended” summer season, air stagnation is at a relative minimum during July due to the influence of the Bermuda High pressure system. (Reference 233)

The mixing height (or depth) is defined as the height above the surface through which relatively vigorous vertical mixing takes place. Lower mixing heights (and wind speeds), therefore, are a relative indicator of more restrictive dispersion conditions. Holzworth (1972) reports mean seasonal and annual morning and afternoon mixing heights and wind speeds for the contiguous US based on observations over the 5-year period from 1960 to 1964. Out of the network of 62 NWS stations in the 48 contiguous US at which daily surface and upper air sounding measurements were routinely made, one station was located in Athens, Georgia, about 105 mi northwest of the VEGP site. The information in that report indicates that the results from that station should be reasonably representative of conditions at the VEGP site.

Table 2.3-206 summarizes the mean seasonal and annual morning and afternoon mixing heights and wind speeds for Athens, Georgia (Reference 209). From a climatological standpoint, considering all weather conditions, the lowest morning mixing heights occur in the autumn and are highest during the winter although, on average, morning mixing heights are only slightly lower in the spring and summer months than during the winter. Conversely, afternoon mixing heights reach a seasonal minimum in the winter and a maximum during the summer, as might be expected due to more intense summertime heating.

The wind speeds listed in Table 2.3-206 for Athens, Georgia, are consistent with the LCD summary for Augusta, Georgia, in Table 2.3-204 in that the lowest mean wind speeds are shown to occur during summer and autumn. This period of minimum wind speeds likewise coincides with the “extended” summer season described by Wang and Angell (1999) that is characterized by relatively higher air stagnation conditions.

2.3.1.7 Climate Changes

It is a given that climatic conditions change over time and that such changes are cyclical in nature on various time and spatial scales. The timing, magnitude, relative contributions to, and implications of these changes are generally more speculative, even more so for specific areas or locations.

With regard to the expected 40-year operating life for proposed VEGP Units 3 and 4, which could extend until the year 2070 based on a start-up year of 2030 (see Subsection 2.3.1.6), it is reasonable to evaluate the record of readily-available and well-documented climatological observations of temperature and rainfall (normals, means, and extremes) as they have varied over time (i.e., the last 60 to 70 years or so), and the occurrences of severe weather events, in the context of the plant’s design bases.

Trends of temperature and rainfall normals and standard deviations are identified over a 70-year period for successive 30-year intervals, updated every 10 years, beginning in 1931 (e.g., 1931–1960, 1941–1970, etc.) through the most recent normal period (i.e., 1971–2000) in the NCDC publication Climatography of the United States, No. 85 (Reference 214). The report summarizes these observations for the 344 climate divisions in the 48 contiguous states.

A climate division represents a region within a state that is as climatically homogeneous as possible. Division boundaries generally coincide with county boundaries except in the Western US. In Georgia, the VEGP site is located within Climate Division GA-06 (East Central). In South Carolina, Climate Division SC-05 (West Central), whose southern extent includes Aiken County, is nearly adjacent to the VEGP site.

Summaries of successive annual temperature and rainfall normals as well as the composite 70-year average are provided below for these climate divisions (Reference 214).

	Temperature (°F)		Rainfall (inches)	
Period	**GA-06**	**SC-05**	**GA-06**	**SC-05**
1931-2000	64.3	62.2	45.60	46.99
1931-1960	65.0	62.9	43.42	44.88
1941-1970	64.3	62.3	45.35	46.46
1951-1980	63.8	61.8	45.95	47.53
1961-1990	63.6	61.6	46.61	48.46
1971-2000	63.9	61.8	47.06	48.36

These data indicate a slight cooling trend over most of the 70-year period, with a slight increase of about 0.2 to 0.3°F during the most recent normal period. In general, total annual rainfall has increased slightly in these divisions over the period by about 1.5 inches. Similar trends are observable for all of the other climate divisions in Georgia and South Carolina (Reference 214).

The preceding values represent variations of "average" temperature and rainfall conditions over time. The occurrence of extreme temperature and precipitation (rainfall and snowfall) events does not necessarily follow the same trends. However, characteristics about the occurrence of such events over time are indicated by the summaries for observed extremes of temperature and rainfall and snowfall totals recorded in the VEGP site area (see Table 2.3-205).

The data summarized in Table 2.3-205 show that individual station records for maximum temperature have been set between 1952 (including the overall highest value for the site area) and 1999, i.e., there is no discernible trend for these extremes in the site area. Similarly, record-setting 24-hour rainfall totals were established between 1959 and 2000, with station records for total monthly rainfall between 1964 and 1995 – again, no clear trend. Cold air outbreaks that result in overall extreme low temperature records occur infrequently; record-setting snowfalls are even more rare events. The almost singular dates of their occurrence (in 1985 and 1973, respectively) are indicative of this characteristic. Nevertheless, records of these types for individual calendar days span a range of years similar to the maximum temperature, and the maximum 24-hour and monthly total rainfall records (Reference 230).

Characteristics and/or effects of other types of severe weather phenomena have been discussed previously, including tornadoes (see Subsection 2.3.1.3.2 and tropical cyclones (see Subsection 2.3.1.3.3).

The number of recorded tornado events has increased, in general, since detailed records were routinely documented beginning around 1950. However, some of this increase is attributable to a growing population, greater public awareness and interest, and technological advances in detection. These changes are superimposed on normal year-to-year variations. Consequently, the number of observations recorded within a 2-degree latitude and longitude square centered on the VEGP site reflect these effects.

As the frequency distribution in Subsection 2.3.1.3.2 indicates, the most intense tornado recorded in this study area was classified as an "F4" storm. The event occurred in 1973 and is the only tornado classified as such based on the nearly 55-year period of record evaluated. All of the tornadoes classified as "F3" storms (a total of 18) were recorded since 1972. Tornadoes with lower intensity classifications are much more numerous and have been identified throughout the available period of record (Reference 224).

The occurrence of all tropical cyclones within a 100-nautical mile radius of the VEGP site has been fairly steady since about 1950 when considered on a decadal (i.e., 10-year) basis or in terms of 30-year intervals similar to the "normal" periods used to evaluate temperature and rainfall data. Both the frequency and intensity of hurricanes passing within 100 nautical miles of the site have generally decreased over the available 154-year period of record, reaching a peak more than a hundred years ago around the turn of the last century. The frequency of tropical depressions has shown some increase in the last 30 years – storms of this classification have been associated with many of the 24-hour and monthly total rainfall records identified in Table 2.3-205 and discussed in Subsection 2.3.1.3.3 (Reference 228).

Nevertheless, the regulatory guidance for evaluating the climatological characteristics of a site from a design basis standpoint is not event specific, but rather is statistically based and for several parameters includes expected return periods of 100 years or more and probable maximum event concepts. These return periods exceed the design life of the proposed units. The design-basis characteristics determined previously under Subsection 2.3.1.3 are developed consistent with the intent of that guidance and incorporate the readily-available, historical data records for locations considered to be representative of the site for VEGP Units 3 and 4. These site characteristic values are summarized and compared in Table 2.0-203, *Site Characteristics, Design Parameters, and Site Interface Values*.

2.3.2 Local Meteorology

The potential influence of the construction and operation of VEGP Units 3 and 4 are evaluated using meteorological data representative of local conditions as described below.

2.3.2.1 Data Sources

The primary sources of data used to characterize local meteorological and climatological conditions representative of the VEGP site include summaries for the first-order NWS station at Augusta, Georgia (Bush Field) and nine other nearby cooperative network observing stations, and measurements from the existing VEGP onsite meteorological monitoring program. Table 2.3-203 identifies the offsite observing stations and provides the approximate distance and relative direction of each station to the VEGP site; their locations are shown in Figure 2.3-201. The onsite primary meteorological tower is located about 1 mi south-southwest of the Units 1 and 2 Containment Buildings and about 0.9 mi south of the proposed VEGP units as shown on Figure 1.1-202.

The NWS and cooperative observing station summaries were used to characterize climatological normals, period-of-record means, and extremes of temperature, rainfall, and snowfall in the vicinity of the VEGP site. In addition, first-order NWS stations also record measurements, typically on an hourly basis, of other weather elements, including winds, relative humidity, dew point, and wet-bulb temperatures, as well as other observations (e.g., fog, thunderstorms). This information was based on the following resources:

- *2004 Local Climatological Data, Annual Summary with Comparative Data for Augusta, Georgia* (Reference 221)
- *Climatography of the United States, No. 20, 1971-2000, Monthly Station Climate Summaries* (Reference 222)
- *Climatography of the United States, No. 81, 1971-2000, U.S. Monthly Climate Normals* (Reference 211)
- *SERCC, Historical Climate Summaries and Normals for the Southeast* (Reference 230)
- *Cooperative Summary of the Day, TD3200, Period of Record through 2001 for the Eastern United States, Puerto Rico and the Virgin Islands* (Reference 213)

Wind speed, wind direction, and atmospheric stability data based on the VEGP meteorological monitoring program form the basis for determining and characterizing atmospheric dispersion conditions in the vicinity of the site. These data include measurements taken over the 5-year period of record from 1998 through 2002.

2.3.2.2 Normal, Mean, and Extreme Values of Meteorological Parameters

Historical extremes of temperature, rainfall, and snowfall are listed in Table 2.3-205 for the 10 NWS and cooperative observing stations in the VEGP site area. The normals, means, and extremes of the more extensive set of measurements and observations made at the Augusta NWS Station are summarized in Table 2.3-204. Finally, Table 2.3-207 compares the annual normal (i.e., 30-year average) daily maximum, minimum, and mean temperatures, as well as the normal annual rainfall and snowfall totals for these stations.

2.3.2.2.1 Wind

Average Wind Direction and Wind Speed Conditions

The distribution of wind direction and wind speed is an important consideration when characterizing the dispersion climatology of a site. Long-term average wind motions at the macro- and synoptic scales (i.e., on the order of several thousand down to several hundred kilometers) are influenced by the general circulation patterns of the atmosphere at the macro-scale and by large-scale topographic features (e.g., mountain ranges, land-water interfaces such as coastal areas). These characteristics are addressed in Subsection 2.3.1.2.

Site-specific or micro-scale (i.e., on the order of 2 km or less) wind conditions, while reflecting these larger-scale circulation effects, are influenced primarily by local and, to a lesser extent (generally), by meso- or regional-scale (i.e., up to about 200 km) topographic features. Wind measurements at these smaller scales are available from the existing meteorological monitoring program at the VEGP site and from data recorded at the nearby Augusta NWS Station.

Subsection 2.3.3 provides a summary description of the onsite meteorological monitoring program at the VEGP site. In its current configuration, wind direction and wind speed measurements are made at two levels on an instrumented 60-m tower (i.e., the lower level at 10 m and the upper level at 60 m).

Figures 2.3-202 through 2.3-206 present annual and seasonal wind rose plots (i.e., graphical distributions of the direction from which the wind is blowing and wind speeds for each of sixteen 22.5-degree compass sectors centered on north, north-northeast, northeast, etc.) for the 10-m level based on measurements at the VEGP site over the composite 5-year period from 1998 through 2002.

For the VEGP site, the wind direction distribution at the 10-m level generally follows a southwest-northeast orientation on an annual basis (see Figure 2.3-202). The prevailing wind (i.e., defined as the direction from which the wind blows most often) is from the southwest, with nearly 25 percent of the winds blowing from the southwest through west sectors. Conversely, winds from the northeast through east sectors occur about 20 percent of the time. On a seasonal basis, winds from the southwest quadrant predominate during the spring and summer months (see Figures 2.3-204 and 2.3-205). This is also the case during the winter, although westerly winds prevail and the relative frequency of west-northwest winds during this season is greater (see Figure 2.3-203) due to increased cold frontal passages. Winds from the northeast quadrant predominate during the autumn months (see Figure 2.3-206). Plots of individual monthly wind roses at the 10-m measurement level are presented in Figure 2.3-207 (Sheets 1 to 12).

Wind rose plots based on measurements at the 60-m level are shown in Figures 2.3-208 through 2.3-213. By comparison, wind direction distributions for the 60-m level are fairly similar to the 10-m level wind roses on a composite annual (see Figure 2.3-208) and seasonal basis (see Figures 2.3-209 through 2.3-212). Plots of individual monthly wind roses at the 60-m measurement level are presented in Figure 2.3-213 (Sheets 1 to 12).

Wind information summarized in the LCD for the Augusta NWS Station (see Table 2.3-204) indicates a prevailing west-southwesterly wind direction (Reference 221) that appears to be similar to the 10-m level wind flow at the VEGP site, at least on an annual basis (see Figure 2.3-202).

Table 2.3-208 summarizes seasonal and annual mean wind speeds based on measurements from the upper and lower levels of the existing VEGP site meteorological tower (1998–2002) and from wind instrumentation at the Augusta NWS Station (1971–2000 station normals) (Reference 221). The elevation of the wind instruments at the Augusta NWS Station is nominally 20 ft (about 6.1 m) (Reference 221), comparable to the lower (10-m) level measurements at the VEGP site.

On an annual basis, mean wind speeds at the 10- and 60-m levels are 2.5 m/sec and 4.6 m/sec, respectively, at the VEGP site. The annual mean wind speed at Augusta (i.e., 2.7 m/sec) is similar to the 10-m level at the VEGP site, differing by only 0.2 m/sec; seasonal average wind speeds at Augusta are likewise slightly higher. Seasonal mean wind speeds for both measurement levels at the VEGP site follow the same pattern discussed in Subsection 2.3.1.6 for Augusta and Athens, Georgia, and their relationship to the seasonal variation of relatively higher air stagnation and restrictive dispersion conditions in the site region.

Based on the joint frequency distributions of wind speed and wind direction by atmospheric stability class (see Subsection 2.3.2.2.2), the annual frequencies of calm wind conditions are 0.35 and 0.05 percent of the time for the 10-m and 60-m tower levels, respectively, at the VEGP site.

Wind Direction Persistence

Wind direction persistence is a relative indicator of the duration of atmospheric transport from a specific sector-width to a corresponding downwind sector-width that is 180 degrees opposite. Atmospheric dilution is directly proportional to the wind speed (other factors remaining constant). When combined with wind speed, a wind direction persistence/wind speed distribution further indicates the downwind sectors with relatively more or less dilution potential (i.e., higher or lower wind speeds, respectively) associated with a given transport wind direction.

Tables 2.3-207 and 2.3-208 present wind direction persistence/wind speed distributions based on measurements at the VEGP site for the 5-year period of record from 1998 through 2002. The distributions account for durations ranging from 1 to 48 hours for wind directions from 22.5-degree and 67.5-degree upwind sectors centered on each of the 16 standard compass radials (i.e., north, north-northeast, northeast, etc.). Further, the distributions are provided for wind measurements made at the lower (10-m) and the upper (60-m) tower levels, respectively.

2.3.2.2.2 Atmospheric Stability

Atmospheric stability is a relative indicator for the potential diffusion of pollutants released into the ambient air. Atmospheric stability, as discussed in this SSAR, is determined by the delta-temperature (Δ**T**) method as defined in Table 1 of Proposed Revision 1 to Regulatory Guide 1.23, *Meteorological Programs in Support of Nuclear Power Plants,* September 1980.

The approach classifies stability based on the temperature change with height (i.e., the difference in °C per 100 m). Stability classifications are assigned according to the following criteria:

- Extremely Unstable (Class A) —$\Delta T/\Delta Z \leq$ -1.9°C
- Moderately Unstable (Class B) — -1.9°C < $\Delta T/\Delta Z \leq$ -1.7°C
- Slightly Unstable (Class C) — -1.7°C < $\Delta T/\Delta Z \leq$ -1.5°C
- Neutral Stability (Class D) — -1.5°C < $\Delta T/\Delta Z \leq$ -0.5°C
- Slightly Stable (Class E) — -0.5°C < $\Delta T/\Delta Z \leq$ +1.5°C
- Moderately Stable (Class F) — +1.5°C < $\Delta T/\Delta Z \leq$ +4.0°C
- Extremely Stable (Class G) — +4.0°C < $\Delta T/\Delta Z$

The diffusion capacity is greatest for extremely unstable conditions and decreases progressively through the remaining unstable, neutral stability, and stable classifications.

During the 1998 through 2002 time period at the VEGP site, Δ**T** was determined from the difference between temperature measurements made at the 10-m and 60-m tower levels. Seasonal and annual frequencies of atmospheric stability class and associated 10-m level mean wind speeds for this period of record are presented in Table 2.3-211.

The data indicate a predominance of slightly stable (Class E) and neutral stability (Class D) conditions, ranging from about 50 to 60 percent of the time on a seasonal and annual basis. Extremely unstable conditions (Class A) are more frequent during the spring and summer months due to greater solar insolation. Extremely stable conditions (Class G) are most frequent during the fall and winter months, owing in part to increased radiational cooling at night.

Joint frequency distributions (JFDs) of wind speed and wind direction by atmospheric stability class and for all stability classes combined for the 10-m and 60-m wind measurement levels at the VEGP site are presented in Tables 2.3-210 and 2.3-211, respectively, for the 5-year period of record from 1998 through 2002. The 10-m level JFDs are used to evaluate short-term dispersion estimates for accidental atmospheric releases (see Subsection 2.3.4) and long-term diffusion estimates of routine releases (see Subsection 2.3.5).

2.3.2.2.3 Temperature

Extreme maximum temperatures recorded in the vicinity of the VEGP site have ranged from 105°F to 112°F, with the highest reading observed at the Louisville 1E Station on July 24, 1952. The station record high temperature for the Midville Experiment Station (i.e., 105°F) has been reached on four separate occasions. As Table 2.3-205 shows, individual station extreme maximum temperature records were set at multiple locations on the same or adjacent dates (i.e., Waynesboro 2NE, Louisville 1E, and Millen 4N; Augusta, Midville Experiment Station, and Aiken 4NE; and Waynesboro 2NE, Midville Experiment Station, and Newington 2NE) (Reference 222; Reference 230).

Extreme minimum temperatures in the vicinity of the VEGP site have ranged from 2°F to -4°F, with the lowest reading on record observed at the Aiken 4NE Station on January 21, 1985, the same date on which the record low temperature was set at the nine other nearby stations (Reference 222; Reference 230).

The extreme maximum and minimum temperature data indicate that synoptic-scale conditions responsible for periods of record-setting excessive heat as well as significant cold air outbreaks tend to affect the overall VEGP site area. The similarity of the respective extremes suggests that these statistics are reasonably representative of the temperature extremes that might be expected to be observed at the VEGP site.

Daily mean temperatures (which are based on the average of the daily mean maximum and minimum temperature values) for these stations are similar, ranging from 63.1°F at Waynesboro 2NE to 65.0°F at the Midville Experiment Station (Reference 211). Likewise, the diurnal (day-to-night) temperature ranges, as indicated by the differences between the daily mean maximum and minimum temperatures, are fairly comparable, ranging from 21.9°F at Bamberg to 26.3°F at Aiken 4NE (Reference 211).

2.3.2.2.4 Water Vapor

Based on a 49-year period of record, the LCD summary for the Augusta, Georgia NWS Station (see Table 2.3-204) indicates that the mean annual wet-bulb temperature is 56.7°F, with a seasonal maximum during the summer months (June through August) and a seasonal minimum during the winter months (December through February). The highest monthly mean wet-bulb temperature is 72.7°F in July (only slightly less during August); the lowest monthly mean value (40.3°F) occurs during January. (Reference 221) Wet-bulb temperature characteristics are addressed in Subsection 2.3.1.5 from a design-basis standpoint.

The LCD summary shows a mean annual dew point temperature of 51.9°F, also reaching its seasonal maximum and minimum during the summer and winter, respectively. The highest monthly mean dew point temperature is 69.7°F in July; again, only slightly less during August. The lowest monthly mean dew point temperature (34.4°F) occurs during January. (Reference 221)

The 30-year normal daily relative humidity averages 72 percent on an annual basis, typically reaching its diurnal maximum in the early morning (around 0700 hours) and its diurnal minimum during the early afternoon (around 1300 hours). There is less variability in this day-to-night pattern with the passage of weather systems, persistent cloud cover, and precipitation. Nevertheless, this diurnal pattern is evident throughout the year. The LCD summary shows that average early morning relative humidity levels exceed 90 percent during August, September, and October. (Reference 221)

2.3.2.2.5 Precipitation

With the exception of the Aiken 4NE Station, normal annual rainfall totals are similar for the nine other nearby observing stations listed in Table 2.3-207, differing by only about 4.7 in. (or about 10 percent) and ranging from 43.85 to 48.57 in. The current 30-year average for the Aiken 4NE Station is somewhat higher at 52.43 in. Snowfall is an infrequent occurrence, as discussed in Subsection 2.3.1, with normal annual totals of only 0.1 to 1.4 in. (References 211, 222; 230).

2.3.2.2.6 Fog

The closest station to the VEGP site at which observations of fog are made and routinely recorded is the Augusta NWS Station about 20 mi to the northwest. The 2004 LCD summary for this station (Table 2.3-204) indicates an average of 35.1 days per year of heavy fog conditions based on a 54-year period of record. The NWS defines heavy fog as fog that reduces visibility to 1/4 mi or less.

The frequency of fog conditions at the VEGP site would be expected to be similar to that of Augusta because of their proximity to one another and because of the similarity of topographic features at both locations (i.e., gently rolling terrain, adjacent to the Savannah River, and location within that broad river valley).

2.3.2.3 Potential Influence of the Plant and Related Facilities on Meteorology

The dimensions and operating characteristics of the proposed VEGP Units 3 and 4 and existing VEGP Units 1 and 2 facilities and the associated paved, concrete, or other improved surfaces are considered to be insufficient to generate discernible, long-term effects to local- or micro-scale meteorological conditions.

Wind flow may be altered in areas immediately adjacent to and downwind of larger site structures. However, these effects will likely dissipate within ten structure heights downwind of the intervening structure(s). Similarly, while ambient temperatures immediately above any improved surfaces could increase, these temperature effects will be too limited in their vertical profile and horizontal extent to alter local- or regional-scale ambient temperature patterns.

Units 1 and 2 at the VEGP site use two 550-ft-high natural-draft cooling towers as a means of heat dissipation. Depending on local meteorological conditions, plume rise ranges from 500 to 1,000 ft above those 550-ft-high towers. Because of the elevated release point and plume rise, there is minimal effect on local meteorology or the plant.

Two 600-ft-high natural-draft cooling towers will provide cooling for the proposed VEGP Units 3 and 4. Because the release height of the thermal/water vapor plumes from these cooling towers will be even higher than that of the existing VEGP cooling towers, minimal effect on local meteorology or the plant will be expected.

While there is excavation, landscaping, site leveling, and clearing associated with the construction of the new units, these alterations to the site terrain would be localized and would not represent a significant alteration to the flat-to-gently-rolling topographic character of the area and region around the site. Therefore, the overall meteorological characteristics of the site will not be affected.

2.3.2.4 Current and Projected Site Air Quality

The VEGP site is located within the Augusta (Georgia) – Aiken (South Carolina) Interstate Air Quality Control Region (40 CFR 81.114). The counties within this region are designated as being in attainment or unclassified for all criteria air pollutants (40 CFR 81.311; 40 CFR 81.341). Attainment areas are areas where the ambient air quality levels are better than the EPA-promulgated National Ambient Air Quality Standards (NAAQS). Criteria pollutants are those for which NAAQS have been established: sulfur dioxide, particulate matter (i.e., PM_{10} and $PM_{2.5}$ – particles with nominal aerodynamic diameters less than or equal to 10.0 and 2.5 micons, respectively), carbon monoxide, nitrogen dioxide, ozone, and lead (40 CFR Part 50).

Four pristine areas in the States of Georgia and South Carolina are designated as “Mandatory Class I Federal Areas Where Visibility is an Important Value.” They include the Cohutta Wilderness Area, the Okefenokee Wilderness Area, and the Wolf Island Wilderness Area in Georgia (40 CFR 81.408), and the Cape Romain Wilderness Area in South Carolina (40 CFR 81.426). The two closest of these Class I areas are both about 130 mi away from the VEGP site—the Wolf Island Wilderness Area to the south-southeast and the Cape Romain Wilderness Area to the east-southeast.

The new nuclear steam supply system and other related radiological systems are not sources of criteria pollutants or other air toxics. Supporting equipment (e.g., diesel generators, fire pump engines, auxiliary boilers), emergency station-blackout generators, and other non-radiological emission-generating sources (e.g., storage tanks and related equipment) or activities will not be expected to be a significant source of criteria pollutant emissions.

Emergency equipment will only be operated on an intermittent test or emergency-use basis. Therefore, these emission sources will not be expected to significantly impact ambient air quality levels in the vicinity of the VEGP site, nor will they be anticipated to be a significant factor in the design and operating bases of proposed VEGP Units 3 and 4. Likewise, because of the relatively long distance of separation from the VEGP site, visibility at any of these Class I Federal Areas will not be expected to be significantly impacted by project construction and facility operations.

Nevertheless, these non-radiological emission sources will likely be regulated by the Georgia Department of Natural Resources (DNR) under the Georgia Rules for Air Quality Control (Chapter 391-3-1) and permitted under the State’s Title V Operating Permit Program implemented by the Georgia DNR pursuant to 40 CFR Part 70 either as a separate facility or via a revision to the then current Title V Operating Permit for the existing VEGP site.

2.3.2.5 Topographic Description

The VEGP site (approximately 3,169 acres) is located in Burke County, Georgia, along (west of) the Savannah River. Topographic features within a 5-mi radius of the VEGP site are shown in Figure 2.3-214. Terrain elevation profiles along each of the 16 standard 22.5-degree compass radials out to a distance of 50 mi from the VEGP site are illustrated in Figure 2.3-215 (Sheets 1 through 4).

These profiles indicate that the terrain in the VEGP site area is flat to gently rolling. The only other nearby topographic feature of note is the Savannah River, located adjacent to the VEGP site; the broad river valley represents a depression running northwest to southeast.

2.3.3 Onsite Meteorological Measurements Program

2.3.3.1 Onsite Meteorological Measurements Program

SNC plans to use measurement data from the VEGP onsite meteorological monitoring program to support operation of the proposed VEGP Units 3 and 4.

2.3.3.2 General Program Description

The VEGP onsite meteorological measurements program commenced operation in April 1972. Instruments for measuring pertinent meteorological parameters were installed on a 45-m tower located in a cleared area at site coordinates N 3260 and E 8040. This location is about 3,840 ft (1,170 m) south of the 775-ft-radius circle that encloses the VEGP Units 3 and 4 power block area (see Figure 1.1-202 for general location). The base of the tower is at approximately plant grade.

The onsite meteorological measurements program and equipment were updated in the first quarter of 1984 to meet the intent of NUREG-0654 (*Criteria for Preparation and Evaluation of Radiological Emergency Response Plans and Preparedness in Support of Nuclear Power Plants,* FEMA-REP-1, Revision 1, November 1980). A new meteorological data collection center (MDCC) included a 60-m tower located at site coordinates N 3100 and E 7940 with permanent instrumentation at the 10- and 60-m elevations. The 60-m tower is located about 3,960 ft (1,207 m) south of the 775-ft-radius circle that encloses the VEGP Units 3 and 4 power block area (see Figure 1.1-202 for general location). A 2-kVA uninterruptible power supply was also installed to prevent the loss of meteorological data collection in the event that offsite power is interrupted.

The 60-m tower serves as the primary source of site meteorological data. The 45-m tower is now used as a backup for periods of equipment failure on the 60-m tower and consists of wind speed, wind direction, and ambient temperature measurements at the 10-m elevation only. Table 2.3-214 presents instrument descriptions and accuracies for the backup and primary meteorological monitoring systems. Measurement system accuracies are generally in conformance with Regulatory Guide 1.23.

The instruments are monitored at least once a week by SNC personnel. Preventive maintenance is performed by SNC personnel in accordance with the instrument manuals and is intended to maintain 90 percent data recovery.

Data collection for the MDCC consists of continuous strip chart recorders and digital data collection equipment, both located in the meteorological tower equipment building. These data are transmitted to the power block via a microwave communication link. This microwave link provides instrument data to the Unit 1 Control Room, Technical Support Center, and Emergency Operations Facility via the Unit 1 plant computer. Additionally, the microwave link provides for telephone communication to the tower equipment building and for MDCC trouble alarms. The collected data are compiled in accordance with Regulatory Guide 1.23 and are summarized and edited to provide averages representative of each hour of measurements.

The annual and/or seasonal summaries of onsite meteorological data presented in this report are based on hourly-averaged measurements from instrumentation mounted on the primary tower taken over the 5-year period of record from 1998 through 2002. These data were used to determine the wind roses and joint frequency distributions of wind speed and wind direction by atmospheric stability class presented and discussed in Subsection 2.3.2.

A year-by-year summary of the percent data recoveries for each parameter is shown in Table 2.3-215. Composite data recoveries of 94 percent or greater were achieved in each of those 5 years for the dispersion modeling-related parameters of wind speed and wind direction from the 10-m and 60-m levels, and vertical stability based on the delta-temperature between the 60-m and 10-m levels. The only parameters with annual data recoveries less than the 90 percent target recovery level are dew point temperature (i.e., 89.6 percent) and rainfall (i.e., 78.8 percent) during 2002.

2.3.3.3 Location, Elevation, and Exposure of Instruments

The general location of both the primary and backup meteorological towers is shown in Figure 1.1-202. The towers are located near one another, as discussed later, and the area indicated on Figure 1.1-202 for the meteorological tower encloses the locations of both towers.

The nearest major structures will be the proposed VEGP Units 3 and 4 reactors and the proposed natural-draft cooling towers, which will be located, respectively, about 4,525 ft (mid-point between the two units) and about 3,025 ft (closest point on the Unit 3 cooling tower) to the north of the primary meteorological tower. Regulatory Guide 1.23 indicates that a meteorological tower located at 10-building-heights horizontal distance downwind will not have adverse building wake effects exerted by the structure. Since the height of the proposed AP1000 units will be about 234 ft above grade, the zone of turbulent flow created by the reactor buildings will be limited to about 2,340 ft (or 10 building heights) downwind. Thus, the proposed reactors will not be expected to adversely affect the measurements taken at the primary tower.

The 10-building-height distance of separation guidance is usually applied to square- or rectangular-shaped structures or objects. A round structure will produce a downwind wake zone that is shorter than a square or rectangular structure or object. The downwind region of adverse influence of a hyperbolically-shaped, natural-draft cooling tower is estimated to be about five times the width of the tower at the top of the structure (Reference 207).

The preliminary design indicates that the proposed natural-draft cooling towers will be about 600 ft high, with a base diameter of 550 ft, and a diameter of 330 ft at the top. Based on the EPA guidance for this type of structure and the diameter at its top, the outermost boundary of influence that will be exerted by the proposed cooling towers is estimated to be about 1,650 ft. This distance is much shorter than the physical separation of the proposed cooling towers from the primary meteorological tower (i.e., about 3,025 ft). Therefore, the proposed natural-draft cooling towers will not be expected to adversely affect measurements made at the primary meteorological tower. Similarly, minor structures in the vicinity of the primary meteorological tower have been evaluated as having no adverse effect on the measurements taken at that tower.

The backup meteorological tower is located about 620 ft to the north-northeast of the primary tower; therefore, it will also be located beyond the wake influence zones induced by the proposed reactors and natural-draft cooling towers.

2.3.3.4 VEGP Meteorological Monitoring Program Compliance

The meteorological monitoring program operated in support of VEGP Units 1 and 2 will also support the operation of VEGP Units 3 and 4. Characteristics of this monitoring program, include:

- siting of the meteorological tower with respect to potential obstructions to air flow (e.g., containment structures, cooling towers, tree lines),

- descriptions of the meteorological instrumentation (e.g., performance specifications, methods and equipment for recording sensor output, QA program for sensors and recorders, and data acquisition and reduction procedures), and
- operation, maintenance, and calibration procedures.

The NRC evaluated the meteorological monitoring program as part of the ESPA SSAR safety evaluation site audit on December 6, 2006 and through their review of Subsection 2.3.3.

The current monitoring program and its implementation were determined to meet the guidance in Proposed Revision 1 to Regulatory Guide 1.23 and found to provide an acceptable basis for estimating atmospheric dispersion conditions for accidental and routine releases of radioactive material to the atmosphere.

2.3.4 Short-Term (Accident) Diffusion Estimates

In the absence of a specific site for use in determining values for short-term diffusion, a study was performed to determine the atmospheric dispersion factors (χ/Q values) that would envelope most current plant sites and that could be used to calculate the radiological consequences of design basis accidents. The χ/Q values thus derived for offsite are provided in Table 2.0-201.

This set of offsite χ/Q values is representative of potential sites for construction of the AP1000. The values are appropriate for analyses to determine the radiological consequences of accidents. These values were selected to bound 70 to 80 percent of U.S. sites.

The χ/Q values for the control room air intake or the door leading to the control room are dependent not only on the site meteorology but also on the plant design and layout. These χ/Q values are addressed in Appendix 15A. Separate sets of χ/Q values are identified for each combination of activity release location and receptor location.

This subsection addresses the determination of conservative, short-term atmospheric dispersion estimates due to postulated design-basis, accidental releases of radioactive material to the ambient air for receptors located:

- on the Exclusion Area Boundary (EAB) and the outer boundary of the Low Population Zone (LPZ) (Subsections 2.3.4.1 and 2.3.4.2) to support the evaluation of offsite radiological consequences; and
- at air intake points to the control room (Subsection 2.3.4.3) to support the evaluation of personnel exposures inside the control room and the design of the control room habitability system.

This subsection also briefly addresses the determination of accident-related concentrations at the control room due to onsite and/or offsite airborne releases of hazardous materials such as flammable vapor clouds, toxic chemicals, and smoke from fires (Subsection 2.3.4.4).

In the AP1000 reactor DCD, the terms “site boundary” and “exclusion area boundary” are used interchangeably. Thus, the χ/Q value specified for the site boundary applies whenever a discussion in the DCD refers to the exclusion area boundary. In the Subsections 2.3.4.1 and 2.3.4.2 site specific χ/Q calculations, the term “Dose Calculation EAB” is equivalent to the DCD term “EAB”.

Short-term, dispersion-related site parameters at the site boundary and the LPZ boundary, on which the AP1000 design is based, are identified in DCD Tier 1, Table 5.0-1, Table 2.0-201, and

Table 15A-5. As indicated above, site-specific dispersion characteristics that correspond to these site parameters are presented in Subsections 2.3.4.1 and 2.3.4.2.

Short-term, dispersion-related site parameters at the control room, also incorporated in the AP1000 design, are identified in DCD Tier 1, Table 5.0-1, Table 2.0-201, and Table 15A-6. Site-specific dispersion characteristics that correspond to these site parameters are presented in Subsection 2.3.4.3.

Tables 2.0-201 and 2.0-202 compare the applicable site parameters and corresponding site-specific characteristic values.

2.3.4.1 Basis

To evaluate potential health effects for Westinghouse AP1000 design-basis accidents, a hypothetical accident is postulated to predict upper-limit concentrations and doses that might occur in the event of a containment release to the atmosphere.

Regulatory Guide 4.7, *General Site Suitability Criteria for Nuclear Power Stations*, Revision 2, April 1998, states that for site approval, each applicant should collect at least 1 year of meteorological information that is representative of the site conditions for calculating radiation doses resulting from the release of fission products as a consequence of a postulated accident. Site-specific meteorological data covering the 5-year period of record from 1998 through 2002 (see Subsection 2.3.2.2.2) have been used to quantitatively evaluate such a hypothetical accident at the VEGP site. Onsite data provide representative measurements of local dispersion conditions appropriate to the VEGP site and a 5-year period is considered to be reasonably representative of long-term conditions.

According to 10 CFR Part 100, it is necessary to consider the doses for various time periods immediately following the onset of a postulated containment release at the exclusion distance and for the duration of exposure for the low population zone and population center distances. The relative air concentrations (χ/Qs) are estimated for various time periods ranging from 2 hours to 30 days.

Meteorological data have been used to determine various postulated accident conditions as specified in Regulatory Guide 1.145, *Atmospheric Dispersion Models for Potential Accident Consequence Assessments at Nuclear Power Plants*, Revision 1, November 1982 (Re-issued February 1983). Compared to an elevated release, a ground-level release usually results in higher ground-level concentrations at downwind receptors due to less dilution from shorter traveling distances. Since the ground-level release scenario provides a bounding case, elevated releases are not considered in this ESP application.

The NRC-sponsored PAVAN computer code (NUREG/CR-2858, *PAVAN: An Atmospheric Dispersion Program for Evaluating Design Basis Accidental Releases of Radioactive Materials from Nuclear Power Stations*, PNL-4413, November 1982 [NUREG/CR-2858]) has been used to estimate ground-level χ/Qs at the Exclusion Area Boundary (EAB) and Low Population Zone (LPZ) for potential accidental releases of radioactive material to the atmosphere. Such an assessment is required by 10 CFR Part 100.

As discussed in Subsection 2.1.1.3, the EAB for VEGP Units 3 and 4 is the same as the exclusion area for the existing VEGP units. For the purposes of determining χ/Qs and subsequent radiation dose analyses, an effective EAB, hereafter referred to as the Dose Calculation EAB, was developed for the proposed units. The AP1000 units will be located within the power block area, shown in Figure 1.1-202, which is the perimeter of a 775-ft-radius circle with the centroid at a point between the two AP1000 units. The Dose Calculation EAB is a circle that extends 1/2 mi beyond the power block area (i.e., a circle with a 3,415-ft radius with its centroid at the centroid of the power block circle). The Dose Calculation EAB is completely within the actual plant EAB and, thus, the χ/Qs and the subsequent radiation doses are conservatively higher.

The PAVAN program implements the guidance provided in Regulatory Guide 1.145. Mainly, the code computes χ/Qs at the EAB and LPZ for each combination of wind speed and atmospheric stability class for each of 16 downwind direction sectors (i.e., north, north-northeast, northeast, etc.). The χ/Q values calculated for each direction sector are then ranked in descending order, and an associated cumulative frequency distribution is derived based on the frequency distribution of wind speeds and stabilities for the complementary upwind direction sector. The χ/Q value that is equaled or exceeded 0.5 percent of the total time becomes the maximum sector-dependent χ/Q value.

The χ/Q values calculated above are also ranked independently of wind direction into a cumulative frequency distribution for the entire site. The PAVAN program then selects the χ/Qs that are equaled or exceeded 5 percent of the total time.

The larger of the two values (i.e., the maximum sector-dependent 0.5 percent χ/Q or the overall site 5 percent χ/Q value) is used to represent the χ/Q value for a 0- to 2-hour time period. To determine χ/Qs for longer time periods, the program calculates an annual average χ/Q value using the procedure described in Regulatory Guide 1.111, *Methods for Estimating Atmospheric Transport and Dispersion of Gaseous Effluents in Routine Releases from Light-Water-Cooled Reactors*, Revision 1, July 1977. The program then uses logarithmic interpolation between the 0- to 2-hour χ/Qs for each sector and the corresponding annual average χ/Qs to calculate the values for intermediate time periods (i.e., 8 hours, 16 hours, 72 hours, and 624 hours). As suggested in NUREG/CR-2858, each of the sector-specific 0- to 2-hour χ/Qs provided in the PAVAN output file has been examined for "reasonability" by comparing them with the ordered χ/Qs also presented in the model output.

The PAVAN model has been configured to calculate offsite χ/Q values assuming both wake-credit allowed and wake-credit not allowed. The entire Dose Calculation EAB is located beyond the wake influence zone induced by the Reactor Building. And, because the LPZ is located farther away from the plant site than the Dose Calculation EAB (i.e., a 2-mi-radius [3,218 m] circle centered at the midpoint of the existing reactors bounds the LPZ), the "wake-credit not allowed" scenario of the PAVAN results has been used for the χ/Q analyses at both the Dose Calculation EAB and the LPZ.

The PAVAN model input data are presented below:

- Meteorological data: 5-year (January 1, 1998 to December 31, 2002) composite onsite JFD of wind speed, wind direction, and atmospheric stability.
- Type of release: Ground-level.
- Wind sensor height: 10 m.
- Vertical temperature difference: (10 m-60 m).
- Number of wind speed categories: 11.
- Release height: 10 m (default height).
- Distances from release point to Dose Calculation EAB: 800 m, for all downwind sectors.
- Distances from release point to LPZ: 2,304 m, for all downwind sectors.

The PAVAN model uses building cross-sectional area and containment height to estimate wake-related χ/Q values. Since the Dose Calculation EAB and the LPZ are both located beyond the building wake influence zone, these two input parameters have no effect in calculating the non-wake χ/Q values.

To be conservative, the 1/2 mi (or approximately 800 m) distance between the VEGP Units 3 and 4 power block area circle and the Dose Calculation EAB has been entered as input for each downwind sector to calculate the χ/Q values at the Dose Calculation EAB. Similarly, the shortest distance from the power block area circle to the LPZ has been input for all direction sectors to calculate the χ/Q values at the LPZ. The distance from the center-point of the existing units to the western perimeter of the power block area is about 914 m. Therefore, the minimum distance from the power block area circle to the LPZ is about 2,304 m (or about 1.4 mi).

2.3.4.2 PAVAN Modeling Results

As presented in Table 2.3-216, the maximum 0- to 2-hour, 0.5 percentile, direction-dependent χ/Q value (3.14 x 10^{-4} sec/m^3) is less than the corresponding 5 percentile overall site χ/Q value (3.49 x 10^{-4} sec/m^3) at the Dose Calculation EAB. Therefore, the 5 percentile overall site χ/Qs should be used as the proper χ/Qs at the Dose Calculation EAB.

Similarly, Table 2.3-217 shows that the maximum 0- to 2-hour, 0.5 percentile, direction-dependent χ/Q value (1.17 x 10^{-4} sec/m^3) is less than the corresponding 5 percentile overall site χ/Q value (1.27 x 10^{-4} sec/m^3) at the LPZ. Therefore, the 5 percentile overall site χ/Qs should be used as the proper χ/Qs at the LPZ.

The maximum χ/Qs presented in Tables 2.3-214 and 2.3-215 for the Dose Calculation EAB and the LPZ, respectively, are summarized below for the 0- to 2-hour time period, the annual average time period, and other intermediate time intervals evaluated by the PAVAN model.

Summary of PAVAN χ/Q Results (5% Limiting Case), 1998–2002 Meteorological Data

Source Location	Receptor Location	0-2 hr (Dir, Dist)	0-8 hr (Dir, Dist)	8-24 hr (Dir, Dist)	1-4 days (Dir, Dist)	4-30 days (Dir, Dist)	Annual (Dir, Dist)
ESP PBAC[(a)]	Dose Calculation EAB	3.49E-04	2.41E-04	2.00E-04	1.34E-04	7.56E-05	3.74E-05
ESP PBAC[a]	LPZ	1.27E-04 [(b)]	7.04E-05	5.25E-05	2.77E-05	1.11E-05	3.63E-06

(a) PBAC = Power Block Area Circle
(b) The 0-2 hour χ/Q values are reported here for reference only (not required based on Regulatory Guide 1.145).

Using the same assumptions and methodology as described in Subsection 2.3.4.1 (which relied on DCD Revision 15), the short-term (accidental release) dispersion estimates at the EAB and the LPZ boundary were evaluated using the revised building dimensions provided in DCD Revision 17. That evaluation confirmed that the χ/Q values for the EAB and LPZ remain the same. This result is reasonable given that the designated receptor points at the EAB and the LPZ boundary are beyond the distance that would be influenced by building wake.

2.3.4.3 Radiological Accident Dispersion Estimates at the Control Room

Subsection 2.3.4.3.1 describes the dispersion modeling analysis used to determine short-term, relative concentration estimates associated with a postulated design-basis, accidental release of radioactive material to the atmosphere. The results of this dispersion analysis for receptors at air intake points to the control room are summarized in Subsection 2.3.4.3.2.

2.3.4.3.1 Regulatory Basis and Technical Approach

General Design Criterion 19 (*Control Room*) under 10 CFR Part 50, Appendix A, requires that the control room remain functional so that actions can be taken to operate the nuclear power unit safely under normal conditions and to maintain the plant in a safe state under accident conditions.

Regulatory Guide 1.194, *Atmospheric Relative Concentrations for Control Room Radiological Habitability Assessments at Nuclear Power Plants*, June 2003, provides guidance on utilizing the ARCON96 dispersion model to characterize atmospheric dispersion conditions (χ/Q values) that are input to the evaluation of the consequences of accidental airborne radiological releases on control room habitability. The ARCON96 dispersion model is described in NUREG/CR-6331 (*Atmospheric Relative Concentrations in Building Wakes*, PNNL-10521, Revision 1, May 1997). [Reference 201]

Five consecutive calendar years (from 1998 through 2002) of sequential hourly meteorological data, from the onsite monitoring program operated in support of VEGP Units 1 & 2, were input to ARCON96 in model-required format. As such, the estimated χ/Q values represent the composite 5-year period of record. Wind data from both the 10- and 60-m measurement levels were included. Wind speed units of measure were in meters per second.

Joint data recovery of atmospheric stability class and 10-m level wind speed and wind direction was greater than 94 percent for each of the five years. Data recoveries for 60-m level wind data exceeded 95 percent for wind speed during each year, and ranged from about 93 to 97 percent for wind direction for all years except 1998 (at slightly more than 88 percent). Subsections 2.3.2 and 2.3.3 establish that these data are representative of site dispersion characteristics.

χ/Q values were estimated at two air intake points leading to the control room—at the Heating Ventilation and Air Conditioning (HVAC) system intake and at the annex building access door (i.e., the pathway for outside air to the control room is that due to building ingress/egress). These two air intake points, designated as Receptors 1 and 2, respectively, are illustrated in Figure 15A-1.

These receptors may be contaminated by accidental radiological releases from any of eight potential sources (the two- or four-letter Source Indicator is included in the ARCON96 model):

- plant vent (Source Indicator - PV);
- passive containment cooling system (PCS) air diffuser (Source Indicator - AD);
- fuel building blowout panel (Source Indicator - BP);
- fuel building rail bay door (Source Indicator - BD);
- a steam vent (or line) break (Source Indicator - SV);
- Power Operated Relief Valves (PORV) and safety valves (Source Indicator - PORV);
- condenser air removal stack (Source Indicator - AR); and
- the containment shell (Source Indicator - CS).

These potential release points, designated as Sources 1 to 8, respectively, are also illustrated in Figure 15A-1. Note that Source 4, the fuel building rail bay door in the list above, is referred to as the “Radwaste Building Truck Staging Area Door” in Figure 15A-1.

The receptor locations are also reflected in the ARCON96 model and may be distinguished by the respective two-letter indicators “CR” (i.e., control room HVAC intake) and “AN” (annex building access door).

The release types used in the ARCON96 modeling analyses follow those specified in Chapter 15, Appendix 15A. Figure 15A-1 shows that among the potential release sources, the containment shell is considered to be a diffuse area source. All other releases are considered to be point sources.

The Regulatory Position in Section 3.2.2 of Regulatory Guide 1.194 specifies that the stack release mode in ARCON96 is appropriate for releases from a freestanding, vertical, uncapped stack that is outside the directionally dependent zone of influence of adjacent structures. Furthermore, Regulatory Guide 1.194 states that such a stack should be more than 2-1/2 times the height of adjacent structures. From Table 15A-7, the height of the plant vent is 55.7 m above grade; the condenser air removal stack only 38.4 m above grade. Given that the PCS air diffuser sits atop the containment shield building at an elevation of 69.8 m above grade, the vertical criterion for stack releases is not met. Therefore, modeling these sources in stack release mode was not considered.

The Regulatory Position in Section 3.2.3 of Regulatory Guide 1.194 states that modeling sources using the vent release mode “may not be sufficiently conservative for accident evaluations” and so “should not be used in design basis assessments”. As neither a release from the condenser air removal stack nor the plant vent can be represented as stack releases, both potential sources were considered to be ground-level releases in the ARCON96 modeling analyses.

Different building cross-sectional areas were input to the model depending on the receptor being evaluated. For the annex building access door, a building cross-sectional area of 2,636 m^2 was used. This receptor, at an assumed elevation of 1.5 m, is located in a region where the air flow is under the influence of the combined structural wakes generated by the entire containment shield building, the auxiliary building, and the annex building. However, for this modeling analysis, the wake effects induced by the auxiliary building and the annex building were not considered. By excluding these two structures, the total building cross-sectional area is reduced, which is a relatively conservative assumption in that a smaller cross-sectional area results in higher χ/Q values.

The 2,636 m^2 cross-sectional area is based on an assumed diameter of the containment shield building of 43.3 m and an effective structural height of 60.9 m. The assumed diameter of the containment is slightly smaller than the actual diameter and is conservative since the smaller diameter results in a higher χ/Q. The effective structural height takes into account the fact that the containment shield building is a tapered structure beginning at elevation 170.84 ft above grade. The overall height of this building is 228.75 ft above grade. The effective structural height is taken, then, as the mid-point between the start of the taper and the overall building height—that is, 199.8 ft or 60.9 m.

For the receptor at the control room HVAC system intake, a cross-sectional area of 1,805 m^2 was assumed. This receptor, at an elevation of 19.9 m above grade, is located within the wake generated by that portion of the containment shield building that extends above the roof of the auxiliary building where this receptor is situated. The difference between the effective structural height of the containment shield building (i.e., 60.9 m, as discussed above) and the roof height of this part of the auxiliary building (i.e., 19.2 m above grade) is multiplied by the diameter of the containment shield building (i.e., 43.3 m) to yield the cross-sectional area input to the ARCON96 model for estimating χ/Q values at this receptor.

Specification of initial diffusion coefficients is only applicable to a hypothetical release from the containment shell which was modeled as a diffuse area source, as indicated previously. The Regulatory Positions in Sections 3.2.4.4 and 3.2.4.5 of Regulatory Guide 1.194 indicate that in the absence of site-specific empirical data, as is the case here, the initial horizontal and vertical diffusion coefficients may be estimated as follows:

- Sigma-y_o = Area Source Width ÷ 6; and
- Sigma-z_o = Area Source Height ÷ 6.

Consistent with those regulatory positions, the area source width and height are based on the horizontal and vertical dimensions used to determine the building cross-sectional areas input to the ARCON96 modeling analyses. For the receptor at the annex building access door, Sigma-y_o and Sigma-z_o are estimated to be 7.2 m (i.e., 43.3 m ÷ 6) and 10.2 m (i.e., 60.9 m ÷ 6), respectively. For the receptor at the control room HVAC intake, Sigma-y_o and Sigma-z_o are estimated to be 7.2 m (i.e., 43.3 m ÷ 6) and 7.0 m (i.e., 41.7 m ÷ 6), respectively.

Other parameters input to ARCON96 that are based on the recommendations in Regulatory Guide 1.194, Table A-2 (which are different, in some cases, than the default values in the model user's guidance, Reference 201) include:

- Surface Roughness Length = 0.2 (rather than the model default value of 0.1);
- Averaging Sector Width Constant = 4.3 (rather than the model default value of 4.0);
- Vertical Velocity, Stack Radius, and Stack Flow = 0 (all sources are assumed to be ground-level releases and so vertical velocity and stack radius are not used; stack flow during the course of an accident cannot be demonstrated with reasonable assurance);
- Release Height Elevation Difference = 0 (differences in grade elevations between all sources and receptors are only a few feet or less); and
- Wind Direction Window = 90 (default value in both Regulatory Guide 1.194 and Reference 201).

Finally, Table 15A-7 lists the heights of the two modeled receptors and the eight potential sources of radioactive releases, the straight-line distances between these sources and the respective receptors.

2.3.4.3.2 ARCON96 Modeling Results

The χ/Qs determined by the ARCON96 dispersion model represent 95th-percentile values based on all of the hourly relative concentrations calculated using the 5-year meteorological data set input to the model. χ/Q values at the control room HVAC intake and at the annex building access door for time averaging intervals of 0-2 hours, 2-8 hours, 8-24 hours, 1-4 days, and 4-30 days are summarized in Tables 2.3-201 and 2.3-202, respectively.

2.3.4.4 Dispersion Estimates Associated with Accidental Onsite and Offsite Hazardous Material Releases

Potential control room habitability effects and personnel exposures at VEGP Units 3 & 4 due to:

- postulated accidental releases of chemicals and other hazardous materials stored onsite, and at offsite locations within 5 miles of the units;
- for toxic or flammable materials carried over nearby transportation routes (e.g., roadways, railways, and waterways); and

- explosions

were addressed in Subsection 2.2.3 and in Section 2.2.

Concentrations at the control room HVAC intake and at the annex building access door due to accidental hazardous chemical releases were determined and evaluated in consideration of the guidance in Regulatory Guide 1.78, *Evaluating the Habitability of a Nuclear Power Plant Control Room During a Postulated Hazardous Chemical Release*, Revision 1, December 2001.

2.3.5 Long-Term (Routine) Diffusion Estimates

The long-term diffusion estimates are site specific. The site boundary annual average χ/Q shown in Table 2.0-201 is used to calculate release concentrations at the site boundary for comparison with the activity release limits defined in 10 CFR 20. The value specified is expected to bound atmospheric conditions at most U.S. sites. If a selected site has a χ/Q value that exceeds this reference site value, the release concentrations reported in Section 11.3 would be adjusted proportionate to the change in χ/Q.

2.3.5.1 Basis

The NRC-sponsored XOQDOQ computer program (NUREG/CR-2919, *XOQDOQ: Computer Program for the Meteorological Evaluation of Routine Effluent Releases at Nuclear Power Stations*, PNL-4380, September 1982 [NUREG/CR-2919]) was used to estimate χ/Q values due to routine releases of gaseous effluents to the atmosphere. The XOQDOQ computer code has the primary function of calculating annual average χ/Q values and annual average relative deposition (D/Q) values at receptors of interest (e.g., the Dose Calculation EAB and the LPZ boundaries, the nearest milk cow, residence, garden, meat animal). χ/Q and D/Q values due to intermittent releases, which occur during routine operation, may also be evaluated using the XOQDOQ model.

The XOQDOQ dispersion model implements the assumptions outlined in Regulatory Guide 1.111. The program assumes that the material released to the atmosphere follows a Gaussian distribution around the plume centerline. In estimating concentrations for longer time periods, the Gaussian distribution is assumed to be evenly distributed within a given directional sector. A straight-line trajectory is assumed between the release point and all receptors.

The following input data and assumptions have been used in the XOQDOQ modeling analysis:

- Meteorological Data: 5-year (January 1, 1998 to December 31, 2002) composite onsite JFD of wind speed, wind direction, and atmospheric stability.
- Type of release: Ground-level.
- Wind sensor height: 10 m.
- Vertical temperature difference: (10 m – 60 m).
- Number of wind speed categories: 11.
- Release height: 10 m (default height).
- Minimum building cross-sectional area: 2,926 m^2.
- Containment structure equivalent height: 65.6 m.

- Distances from the release point to the nearest residence, nearest site boundary, vegetable garden, and meat animal.

The AP1000 reactor design has been used to calculate the minimum building cross-sectional area as called for in NUREG/CR-2919 for evaluating building downwash effects on dispersion. The containment building minimum cross-sectional area contains two parts: the reactor enclosure building plus a PCS water tank on the top of that structure. The height of the entire contiguous building is assumed to be 234.4 ft (71.4 m), while the bottom (W_B) and the top (W_T) widths of the building are 146.3 ft (44.6 m) and 89 ft (27.1 m), respectively. The height of the PCS is 39.1 ft (11.9 m).

The total calculated cross-sectional area of the structure (A_T) is 31,498 ft^2 (2,926 m^2). Using this total area, and dividing by the actual width of the bottom of the reactor enclosure building (i.e., 146.3 ft), the equivalent structural height is calculated ($H_e = A_T / W_B$) to be 215.2 ft (65.6 m), which assumes that the structure width is uniform in the vertical direction.

These calculated values were input into the XOQDOQ model to predict the required annual average χ/Q and D/Q values.

Distances from the midpoint between the VEGP Unit 1 and Unit 2 reactors to various receptors of interest (i.e., nearest residence, meat animal, site boundary, and vegetable garden) for each directional sector are provided in AREOR (2004). The distance to the nearest residence (i.e., 0.67 mi) was conservatively used in all the directional sectors for all types of sensitive receptors (meat animal, vegetable garden, and residence). The results are presented in Table 2.3-218.

2.3.5.2 XOQDOQ Modeling Results

Table 2.3-219 summarizes the maximum relative concentration and relative deposition (i.e., χ/Q and D/Q values predicted by the XOQDOQ model for identified sensitive receptors in the vicinity of the VEGP site due to routine releases of gaseous effluents. The listed maximum χ/Q values reflect several plume depletion scenarios that account for radioactive decay (i.e., no decay, and the default half-life decay periods of 2.26 and 8 days).

The overall maximum annual average χ/Q value (with no decay) is 5.5 x 10^{-6} sec/m^3 and occurs at the Dose Calculation EAB at a distance of 0.5 mi to the northeast of the VEGP site. The maximum annual average χ/Q values (along with the direction and distance of the receptor locations relative to the VEGP site) for the other sensitive receptor types are:

- 3.4 x 10^{-6} sec/m^3 for the nearest residence occurring in the northeast sector at a distance of 0.67 mi.

- Because the same shortest distance (0.67 mi) was used to estimate χ/Q values for the nearest vegetable garden and meat animal, the same χ/Q value (3.4 x 10^{-6} sec/m^3) was obtained at these receptors.

Finally, Table 2.3-220 summarizes annual average χ/Q values (for no decay) and D/Q values at the XOQDOQ model's 22 standard radial distances between 0.25 and 50 mi and for the model's 10 distance-segment boundaries between 0.5 and 50 mi downwind along each of the 16 standard direction radials (i.e., separated by 22.5 degrees).

In the AP1000 reactor DCD, the terms "site boundary" and "exclusion area boundary" (EAB) are used interchangeably. Thus, the χ/Q specified for the site boundary applies whenever a discussion in the DCD refers to the exclusion area boundary. In Subsection 2.3.5 site specific χ/Q calculations, the term "Dose Calculation EAB" is equivalent to the DCD term "EAB".

Using the same assumptions and methodology as described earlier in this subsection (which relied on DCD Revision 15), along with the building dimensions provided in DCD Revision 17, the long-term (routine release) dispersion and deposition estimates were evaluated at the Dose Calculation EAB and at the various receptor locations. This evaluation confirmed that the χ/Q values for the EAB and the various receptor locations are within approximately 3.3% of those previously calculated. This result is reasonable given that the designated receptor points at the EAB and the various receptor locations are beyond the distance that would be appreciably influenced by building wake.

2.3.6 Combined License Information

2.3.6.1 Regional Climatology

Site-specific information related to regional climatology is addressed in Subsection 2.3.1.

2.3.6.2 Local Meteorology

Site-specific local meteorology information is addressed in Subsection 2.3.2.

2.3.6.3 Onsite Meteorological Measurements Program

The site-specific onsite meteorological measurements program is addressed in Subsections 2.3.3.4 and 2.3.3.

2.3.6.4 Short-Term Diffusion Estimates

Site-specific χ/Q values are addressed in Subsections 2.3.4, 15.6.5.3.7.3, and Appendix 15A.3.3.

2.3.6.5 Long-Term Diffusion Estimates

Long-term diffusion estimates and χ/Q values are addressed in Subsection 2.3.5.

2.3.7 References

201. NUREG/CR-6331, *Atmospheric Relative Concentrations in Building Wakes*, PNNL-10521, Revision 1, May 1997.

202. **(AFCCC-NCDC 1999)** Air Force Combat Climatology Center (AFCCC) and National Climatic Data Center (NCDC), *Engineering Weather Data, 2000 Interactive Edition*, Version 1.0 (CD-ROM), developed by the AFCCC and published by the NCDC, December 1999.

203. **(AREOR 2004)** *Vogtle Electric Generating Plant, Annual Radiological Environmental Operating Report for 2004*, Southern Company.

204. **(ASCE 2002)** ASCE Standard ASCE/SEI 7-02, *Minimum Design Loads for Buildings and Other Structures*, Revision of ASCE 7-98, American Society of Civil Engineers (ASCE) and Structural Engineering Institute, January 2002.

205. **(Cummins, et al. 2003)** Cummins, W.E., M. M. Corletti, and T.L. Schulz, Westinghouse Electric Company, LLC, Proceedings of ICAPP, Cordoba, Spain, May 2003.

206. **(DOA-RUS 1998)** U.S. Department of Agriculture - Rural Utilities Service, *Summary of Items of Engineering Interest*, Page 8, August 1998.

207. **(EPA 1981)** *Guideline for Determination of Good Engineering Practice Stack Height*, Technical Support Document for the Stack Height Regulations, U.S. Environmental Protection Agency (EPA), EPA-450/4-80-023, July 1981.

208. **(ESSA 1969)** Environmental Science Services Administration, *Daily Weather Maps, Weekly Series, April 14-20, 1969*, U.S. Department of Commerce, Environmental Data Service, April 1969.

209. **(Holzworth 1972)** Holzworth, G.C., *Mixing Heights, Wind Speeds, and Potential for Urban Air Pollution Throughout the Contiguous United States*, EPA, Publication No. AP-101, January 1972.

210. **(NCDC 1997)** National Climatic Data Center, *Hourly United States Weather Observations, 1990-1995*, CD-ROM, NCDC, National Oceanic and Atmospheric Administration (NOAA), October 1997.

211. **(NCDC 2002a)** National Climatic Data Center, *Climatography of the United States, No. 81, 1971-2000, U.S. Monthly Climate Normals*, CD-ROM, NCDC, National Environmental Satellite, Data and Information Service (NESDIS), NOAA, February 2002.

212. **(NCDC 2002b)** National Climatic Data Center, *The Climate Atlas of the United States*, Version 2.0 (CD-ROM), NCDC, Climate Services Division, NOAA, September 2002.

213. **(NCDC 2002c)** National Climatic Data Center, *Cooperative Summary of the Day, TD3200, Period of Record through 2001 (Includes Daily Weather Data from the Eastern United States, Puerto Rico, and the Virgin Islands)*, Version 1.0 (CD-ROM), data listings for Waynesboro 2NE, Augusta, Millen 4N, Midville Experiment Station, Newington 2NE in Georgia, and Aiken 4NE, Blackville 3W, Springfield in South Carolina, NCDC, NOAA, data released November 2002.

214. **(NCDC 2002d)** National Climatic Data Center, *Climatography of the United States, No. 85, Divisional Normals and Standard Deviations of Temperature, Precipitation, and Heating and Cooling Degree Days 1971-2000 (and previous normals periods)*, Section 1 (Temperature) and Section 2 (Precipitation), NCDC, NESDIS, NOAA, June 15, 2002.

215. **(NCDC 2002e)** National Climatic Data Center, *Integrated Surface Hourly Data, 1995-1999,* CD-ROM, Volume 7, Eastern United States of America, NCDC, NESDIS, NOAA, September 2002.

216. **(NCDC 2002f)** National Climatic Data Center, *Integrated Surface Hourly Observations, 2000,* CD-ROM, Volume 15, United States of America (World Meteorological Organization #69, 72, 74), NCDC, NESDIS, NOAA, September 2002.

217. **(NCDC 2003a)** National Climatic Data Center, *Integrated Surface Hourly Observations, 2001,* CD-ROM, Volume 19, United States, NCDC, NESDIS, NOAA, January 2003.

218. **(NCDC 2003b)** National Climatic Data Center, *Integrated Surface Hourly Observations, 2002,* CD-ROM, Volume 23, United States, NCDC, NESDIS, NOAA, August 2003.

219. **(NCDC 2004a)** National Climatic Data Center, *Storm Data (and Unusual Weather Phenomena with Late Reports and Corrections), January 1959 (Volume 1, Number 1) to January 2004 (Volume 42, Number 1),* complete set of monthly hardcopy issues purchased as PDF files on CD-ROM from NCDC, June 2004, NCDC, NESDIS, NOAA.

220. **(NCDC 2004b)** National Climatic Data Center, *Integrated Surface Hourly Observations, 2003,* DVD-ROM, Global Data Set, NCDC, NESDIS, NOAA, October 2004.

221. **(NCDC 2005a)** National Climatic Data Center, *2004 Local Climatological Data, Annual Summary with Comparative Data, Augusta, Georgia,* NCDC, NESDIS, NOAA.

222. **(NCDC 2005b)** National Climatic Data Center, *Climatography of the United States, No. 20, 1971-2000, Monthly Station Climate Summaries,* for Waynesboro 2NE, Augusta, Midville Experiment Station, Newington 2NE in Georgia, and Aiken 4NE, Blackville 3W in South Carolina, CD-ROM, NCDC, NESDIS, NOAA, July 2005.

223. **(NCDC 2005c)** National Climatic Data Center, *Integrated Surface Hourly Observations, 2004,* DVD-ROM, Global Data Set, NCDC, NESDIS, NOAA, June 2005.

224. **(NCDC 2006a)** National Climatic Data Center, *Storm Events for Georgia and South Carolina,* Tornado Event summaries, NCDC, NOAA, http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms, accessed July 2005 and January 2006.

225. **(NCDC 2006b)** National Climatic Data Center, *Storm Events for Georgia and South Carolina,* Hail Event, and Snow and Ice Event summaries for Burke, Jenkins, Richmond and Screven Counties in Georgia, and Aiken, Allendale and Barnwell Counties in South Carolina, NCDC, NOAA, http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwEvent~Storms, accessed various dates through January 17, 2006.

226. **(NCDC 2006c)** National Climatic Data Center, *Integrated Surface Hourly Observations, 2005,* DVD-ROM, Global Data Set, NCDC, NESDIS, NOAA, August 2006.

227. **(NCDC-NREL 1993)** National Climatic Data Center in conjunction with the National Renewable Energy Laboratory, *Solar and Meteorological Surface Observation Network, 1961-1990, Volume 1, Eastern U.S.*, Version 1.0 (CD-ROM), NCDC, NREL, September 1993.

228. **(NOAA-CSC 2005)** National Oceanic and Atmospheric Administration - Coastal Services Center, *Historical Hurricane Tracks Storm Query*, 1851 through 2004, http://hurricane.csc.noaa.gov/hurricanes/viewer.html, National Ocean Service, NOAA, accessed July 14 and 15, 2005.

229. **(NWS 2002)** National Weather Service, *5-Year Flash Density Map – U.S. (1996-2000)*, NOAA, NWS, Office of Climate, Water, and Weather Services, provided by Vaisala-GAI (formerly Global Atmospherics), Tucson, Arizona, February 2002.

230. **(SERCC 2006)** Southeast Regional Climate Center (SERCC) in association with the Land, Water and Conservation Division of the South Carolina Department of Environmental Resources under the direction of NCDC, NESDIS, NOAA, *Historical Climate Summaries and Normals for the Southeast*, data summaries for Waynesboro 2NE, Augusta, Millen 4N, Midville Experiment Station, Newington 2NE in Georgia, and Aiken 4NE, Blackville 3W, Springfield in South Carolina, http://www.sercc.com/climateinfo/historical/historical.html, accessed various dates through February 22, 2006.

231. **(USAEC 1974) W**ASH-1300, *Technical Basis for Interim Regional Tornado Criteria*, U.S. Atomic Energy Commission, Office of Regulation, May 1974.

232. **(USN-NCDC-USAF 1996)** U.S. Navy, National Climatic Data Center, U.S. Air Force, *International Station Meteorological Climate Summary,* jointly produced by the Fleet Numerical Meteorology and Oceanography Detachment, NCDC, and USAFETAC OL-A under authority of the Commander, Naval Meteorology and Oceanography Command, Department of the Navy, Department of Commerce, Department of the Air Force, CD-ROM, Version 4.0, September 1996.

233. **(Wang and Angell 1999)** Wang, J. X. L., and J. K. Angell, *Air Stagnation Climatology for the United States (1948-1998)*, NOAA Air Resources Laboratory Atlas No. 1, Air Resources Laboratory, Environmental Research Laboratories, Office of Oceanic and Atmospheric Research, Silver Spring, MD, April 1999.

234. **(Westinghouse 2005)** AP1000 Design Control Document, Revision 15, Westinghouse Electric Company, 2005.

235. **(Westinghouse 2007)** Westinghouse letter DCP/NUS0463, dated March 23, 2007.

Table 2.3-201
ARCON96 X/Q Values at the Control Room HVAC Intake

Release Point	0 – 2 hours	2 – 8 hours	8 – 24 hours	1 – 4 days	4 – 30 days
Plant Vent	2.02E-03	1.58E-03	6.37E-04	5.12E-04	3.82E-04
PCS Air Diffuser	1.68E-03	1.29E-03	5.47E-04	4.55E-04	3.34E-04
Fuel Building Blowout Panel	1.54E-03	1.11E-03	4.42E-04	3.57E-04	2.59E-04
Fuel Building Rail Bay Door	1.15E-03	8.29E-04	3.35E-04	2.62E-04	1.86E-04
Steam Line Break	1.48E-02	1.20E-02	5.41E-03	3.93E-03	3.26E-03
PORV & Safety Valves	1.31E-02	1.02E-02	4.62E-03	3.29E-03	2.77E-03
Condenser Air Removal Stack	1.54E-03	1.17E-03	5.36E-04	3.94E-04	2.78E-04
Containment Shell (As Diffuse Area Source)	3.20E-03	1.82E-03	8.27E-04	7.22E-04	5.70E-04

Table 2.3-202
ARCON96 X/Q Values at the Annex Building Access Door

Release Point	0 – 2 hours	2 – 8 hours	8 – 24 hours	1 – 4 days	4 – 30 days
Plant Vent	4.32E-04	3.52E-04	1.44E-04	1.15E-04	8.47E-05
PCS Air Diffuser	4.48E-04	3.38E-04	1.44E-04	1.17E-04	8.77E-05
Fuel Building Blowout Panel	3.77E-04	2.84E-04	1.18E-04	9.50E-05	6.83E-05
Fuel Building Rail Bay Door	3.48E-04	2.60E-04	1.09E-04	8.75E-05	6.16E-05
Steam Line Break	9.23E-04	7.31E-04	2.98E-04	2.37E-04	1.75E-04
PORV & Safety Valves	9.81E-04	7.69E-04	3.12E-04	2.49E-04	1.87E-04
Condenser Air Removal Stack	4.00E-03	3.15E-03	1.35E-03	1.04E-03	8.05E-04
Containment Shell (As Diffuse Area Source)	3.93E-04	3.16E-04	1.32E-04	1.07E-04	8.14E-05

Table 2.3-203
NWS and Cooperative Observing Stations Near the VEGP Site

Station[a]	State	County	Approximate Distance (miles)	Direction Relative to Site	Elevation (feet)
Waynesboro 2NE	GA	Burke	16	WSW	270
Augusta WSO (Bush Field)	GA	Richmond	20	NW	132
Millen 4N	GA	Jenkins	22	SSW	195
Midville Experiment Station	GA	Burke	32	SW	280
Louisville 1E	GA	Jefferson	37	WSW	322
Newington 2NE	GA	Screven	41	SSE	209
Aiken 4NE	SC	Aiken	25	NNE	502
Blackville 3W	SC	Barnwell	29	ENE	324
Springfield	SC	Orangeburg	37	NE	300
Bamberg	SC	Bamberg	44	ENE	165

Notes:

a – Numeric and letter designators following a station name (e.g., Waynesboro 2NE) indicate the station's approximate distance in miles (e.g., 2) and direction (e.g., northeast) relative to the place name (e.g., Waynesboro)

Table 2.3-204
Local Climatological Data Summary for Augusta, Georgia

NORMALS, MEANS, AND EXTREMES

AUGUSTA, GA (AGS)

LATITUDE: 33° 22' 11" N   **LONGITUDE:** 81° 57' 53" W   **ELEVATION (FT):** GRND: 160 BARO: 163   **TIME ZONE:** EASTERN (UTC +5)   **WBAN:** 03820

	ELEMENT	POR	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	YEAR
TEMPERATURE °F	NORMAL DAILY MAXIMUM	30	56.5	61.3	69.2	76.7	83.9	89.6	92.0	90.2	85.3	76.5	67.8	59.1	75.7
	MEAN DAILY MAXIMUM	48	56.4	60.6	68.3	76.8	84.0	89.4	91.9	90.6	85.6	76.9	68.3	59.1	75.7
	HIGHEST DAILY MAXIMUM	54	82	86	89	96	99	105	107	108	101	97	90	82	108
	YEAR OF OCCURRENCE		2002	1962	1995	1986	2000	1952	1980	1983	1999	1954	1961	1998	AUG 1983
	MEAN OF EXTREME MAXS.	56	74.4	76.0	80.7	88.8	93.4	98.1	99.0	97.9	94.5	88.3	81.5	76.1	87.4
	NORMAL DAILY MINIMUM	30	33.1	35.5	42.5	48.1	57.2	65.4	69.6	68.4	62.4	49.6	40.9	34.7	50.6
	MEAN DAILY MINIMUM	48	32.7	34.7	40.4	48.9	58.0	66.0	70.1	69.1	63.3	50.7	41.5	34.3	50.8
	LOWEST DAILY MINIMUM	54	-1	0	0	26	35	47	55	52	36	22	15	5	-1
	YEAR OF OCCURRENCE		1985	1998	1998	1982	1971	1984	1951	2004	1967	1952	1970	1981	JAN 1985
	MEAN OF EXTREME MINS.	56	16.6	19.0	25.0	33.4	43.5	54.7	62.5	60.4	49.7	34.4	24.9	18.5	36.9
	NORMAL DRY BULB	30	44.8	48.4	55.9	62.4	70.5	77.5	80.8	79.3	73.8	63.1	54.4	46.9	63.1
	MEAN DRY BULB	56	45.2	48.4	55.3	63.0	71.2	77.9	81.0	80.1	74.6	64.1	54.5	46.9	63.5
	MEAN WET BULB	49	40.3	42.8	48.4	55.5	63.4	69.8	72.7	72.3	67.4	57.4	48.5	41.7	56.7
	MEAN DEW POINT	49	34.4	36.0	41.5	49.4	58.9	66.0	69.7	69.4	64.3	53.4	43.2	36.1	51.9
	NORMAL NO. DAYS WITH:														
	MAXIMUM ≥ 90°	30	0.0	0.0	0.0	0.6	5.9	16.0	23.5	19.4	9.4	0.6	0.0	0.0	75.4
	MAXIMUM ≤ 32°	30	0.4	0.2	*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.7
	MINIMUM ≤ 32°	30	15.0	11.5	4.6	0.9	0.0	0.0	0.0	0.0	0.0	0.6	6.5	13.1	52.2
	MINIMUM ≤ 0°	30	*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
H/C	NORMAL HEATING DEG. DAYS	30	617	469	301	129	21	1	0	0	5	118	317	547	2525
	NORMAL COLLING DEG. DAYS	30	1	2	15	52	191	385	506	459	285	74	15	1	1986
RH	NORMAL (PERCENT)	30	70	67	66	66	70	72	74	77	77	75	74	72	72
	HOUR 01 LST	30	80	77	77	80	86	87	88	91	90	89	86	82	84
	HOUR 07 LST	30	84	84	85	86	87	87	89	92	92	91	89	85	88
	HOUR 13 LST	30	55	50	48	45	48	52	54	56	55	50	51	54	52
	HOUR 19 LST	30	68	61	57	55	60	63	67	72	77	78	74	71	67
S	PERCENT POSSIBLE SUNSHINE														
W/O	MEAN NO. DAYS WITH:														
	HEAVY FOG (VISBY ≤ 1/4 MI)	54	3.5	2.7	2.1	2.5	2.5	1.4	1.6	3.1	3.8	3.9	4.0	4.0	35.1
	THUNDERSTORMS	54	0.9	1.8	2.7	3.6	6.0	9.4	11.9	9.3	3.4	1.3	0.8	0.7	51.8
CLOUDINESS	MEAN:														
	SUNRISE-SUNSET (OKTAS)	1			7.2		3.2	4.0	5.6	4.8		5.6		4.0	
	MIDNIGHT-MIDNIGHT (OKTAS)	1			6.4		4.0	4.0	4.8	4.0					
	MEAN NO. DAYS WITH:														
	CLEAR	1	2.0	2.0	9.0		14.0	7.0	2.0	6.0	3.0	7.0	5.0	10.0	
	PARTLY CLOUDY	1		2.0	1.0		2.0	8.0	2.0	2.0	2.0	4.0	1.0	1.0	
	CLOUDY	1	2.5	3.0	12.0		3.0	4.0		6.0	7.0	3.0	1.0	7.0	
PR	MEAN STATION PRESSURE (IN)	31	29.97	29.93	29.89	29.86	29.83	29.84	29.87	29.88	29.89	29.93	29.96	29.98	29.90
	MEAN SEA-LEVEL PRES. (IN)	47	30.14	30.09	30.04	30.02	30.00	29.99	30.03	30.01	30.04	30.08	30.11	30.15	30.06
WINDS	MEAN SPEED (MPH)	28	6.7	7.1	7.4	6.9	6.1	5.7	5.6	5.0	5.3	5.2	5.5	6.2	6.1
	PREVAIL. DIR (TENS OF DEGS)	29	27	29	29	18	14	14	24	14	04	04	29	29	24
	MAXIMUM 2-MINUTE:														
	SPEED (MPH)	10	40	37	40	37	49	45	36	38	36	38	38	35	49
	DIR. (TENS OF DEGREES)		26	30	29	28	23	34	21	01	02	34	18	28	23
	YEAR OF OCCURRENCE		1997	2003	1999	2001	2004	1998	1995	2002	1997	1995	2001	2000	MAY 2004
	MAXIMUM 5-SECOND:														
	SPEED (MPH)	10	54	45	51	55	74	53	47	49	45	52	49	43	74
	DIR. (TENS OF DEGREES)		25	31	29	34	23	33	21	01	01	33	03	28	23
	YEAR OF OCCURRENCE		1997	2003	1999	1997	2004	1998	1998	2002	1997	1995	1995	2000	MAY 2004
PRECIPITATION	NORMAL (IN)	30	4.50	4.11	4.61	2.94	3.07	4.19	4.07	4.48	3.59	3.20	2.68	3.14	44.58
	MAXIMUM MONTHLY (IN)	54	8.91	7.67	11.92	8.43	9.61	10.57	11.43	11.34	9.51	14.82	7.76	8.65	14.82
	YEAR OF OCCURRENCE		1987	1961	1980	1961	1979	2004	1967	1986	1975	1990	1985	1981	OCT 1990
	MINIMUM MONTHLY (IN)	54	0.75	0.69	0.88	0.60	0.36	0.68	1.02	0.65	0.31	T	0.09	0.32	T
	YEAR OF OCCURRENCE		1981	1968	1968	1970	2000	1984	1987	1980	1984	1953	1960	1955	OCT 1953
	MAXIMUM IN 24 HOURS (IN)	54	3.61	3.69	5.31	3.96	4.44	5.08	3.71	5.98	7.30	8.57	3.82	3.12	8.57
	YEAR OF OCCURRENCE		1960	1985	1967	1955	1981	1981	1979	1964	1998	1990	1985	1970	OCT 1990
	NORMAL NO. DAYS WITH:														
	PRECIPITATION ≥ 0.01	30	11.0	8.7	9.8	7.4	9.0	10.1	11.2	10.9	7.8	6.2	7.2	9.5	108.8
	PRECIPITATION ≥ 1.00	30	1.2	1.2	1.3	0.8	0.8	1.4	1.1	1.4	0.9	1.0	0.8	0.7	12.6
SNOWFALL	NORMAL (IN)	30	0.3	1.0	0.*	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.4
	MAXIMUM MONTHLY (IN)	50	2.6	14.0	1.1	T	0.0	T	0.0	0.0	0.0	0.0	T	1.0	14.0
	YEAR OF OCCURRENCE		1992	1973	1980	1992		1994					1968	1993	FEB 1973
	MAXIMUM IN 24 HOURS (IN)	50	2.6	13.7	1.1	T	0.0	T	0.0	0.0	0.0	0.0	T	1.0	13.7
	YEAR OF OCCURRENCE		1992	1973	1980	1992		1994					1968	1993	FEB 1973
	MAXIMUM SNOW DEPTH (IN)	48	2	13	1	0	0	0	0	0	0	0	0	1	13
	YEAR OF OCCURRENCE		1988	1973	1980									1958	FEB 1973
	NORMAL NO. DAYS WITH:														
	SNOWFALL ≥ 1.0	30	0.1	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.3

Note: Source: NCDC, 2005a

Table 2.3-205
Climatological Extremes at Selected NWS and Cooperative Observing Stations in the VEGP Site Area

Parameter	Waynesboro 2NE	Augusta WSO	Millen 4N	Midville Exp Station	Louisville 1E	Newington 2NE	Aiken 4NE	Blackville 3W	Springfield	Bamberg
Maximum Temperature	108 °F [a, b] (7/25/52); (7/14/80)	108 °F [a] (8/21/83)	109 °F [b] (7/24/52)	105 °F [a, b] (7/13/80); (8/21/83) (7/19/86); (7/21/86)	112 °F [a] (7/24/52)	110 °F [a] (7/13/80)	109 °F [a] (8/22/83)	108 °F [a] (8/1/99)	NA [d]	109 °F [a] (7/24/52)
Minimum Temperature	-1 °F [a, b] (1/20/85); (1/21/85)	-1 °F [a] (1/21/85)	0 °F [b] (1/21/85)	-1 °F [a] (1/21/85)	-2 °F [a] (1/21/85)	-1 °F [a] (1/21/85)	-4 °F [a] (1/21/85)	-1 °F [a] (1/21/85)	NA [d]	2 °F [a] (1/21/85)
Maximum 24-hr Rainfall	7.40 in. [a] (10/3/94)	7.30 in. [a] (9/3/98)	8.02 in. [b] (8/29/64)	8.19 in. [a] (10/12/90)	8.60 in. [a] (10/12/90)	5.50 in. [a] (10/10/90)	9.68 in. [a] (4/16/69)	7.53 in. [a] (9/30/59)	7.10 in. [b, c] (9/30/59)	8.02 in. [a, c] (9/23/00)
Maximum Monthly Rainfall	16.99 in. [a, b] (10/94)	14.82 in. [a, b] (10/90)	13.45 in. [b] (8/64)	15.97 in. [b, c] (8/70)	14.76 in. [b, c] (8/91)	15.29 in. [a, b] (7/89)	14.45 in. [a, b] (3/80)	14.67 in. [a, b] (10/90)	17.32 in. [b, c] (6/73)	15.26 in. [a, b] (8/95)
Maximum 24-hr Snowfall	16.0 in. [a, b] (2/10/73)	8.0 in. [a, b] (2/9/73)	14.0 in. [b] (2/10/73)	14.0 in. [b, c] (2/10/73)	14.8 in. [a, b] (2/10/73)	5.0 in. [a, b] (2/10/73)	15.0 in. [a, b] (2/10/73)	17.0 in. [b, c] (2/10/73)	8.0 in. [b, c] (2/11/73)	19.0 in. [a, b] (2/10/73)
Maximum Monthly Snowfall	16.0 in. [a, b] (2/73)	14.0 in. [a, b] (2/73)	15.0 in. [b] (2/68)	14.0 in. [b, c] (2/73)	14.8 in. [a, b] (2/73)	8.0 in. [a, b] (2/73)	15.0 in. [a, b] (2/73)	17.0 in. [b, c] (2/73)	15.0 in. [b, c] (2/73)	22.0 in. [a, b] (2/73)

Sources:
a – NCDC 2005b
b – SERCC 2006
c – NCDC 2002c
d – NA = Measurements not made at this station

Table 2.3-206
Mean Seasonal and Annual Morning and Afternoon Mixing Heights and Wind Speeds for Athens, Georgia

Parameter	Winter	Spring	Summer	Autumn	Annual
Mixing Height – AM (m)	407	383	390	314	374
Wind Speed – AM (m/sec)	6.0	5.3	3.8	4.4	4.9
Mixing Height – PM (m)	1042	1754	1918	1455	1542
Wind Speed – PM (m/sec)	7.0	7.2	4.9	5.7	6.2

Note: Mean wind speed values represent the arithmetic average of speeds observed at the surface and aloft within the mixed layer.
Source: Reference 209

Table 2.3-207
Climatological Normals (Means) at Selected NWS and Cooperative Observing Stations in the VEGP Site Area

Station	Normal Annual Temperatures (°F)[a]			Normal Annual Precipitation	
	Daily Maximum	Daily Minimum	Daily Mean	Rainfall[a] (inches)	Snowfall (inches)
Waynesboro 2NE	75.2	51.0	63.1	47.20	1.0 [a]
Augusta	75.7	50.6	63.2	44.58	1.4 [b]
Millen 4N	76.1	50.6	63.4	43.85	0.5 [c]
Midville Exp Station	76.9	52.9	65.0	44.90	0.1 [b]
Louisville 1E	75.6	51.7	63.7	45.92	0.9 [b]
Newington 2NE	76.2	52.5	64.4	47.81	0.8 [b]
Aiken 4NE	77.2	50.9	64.1	52.43	1.4 [b]
Blackville 3W	77.6	51.6	64.6	47.23	0.7 [b]
Springfield	NA [e]	NA [e]	NA [e]	46.28	0.7 [d]
Bamberg	75.0	53.1	64.1	48.57	1.3 [b]

Sources:
a – Reference 211
b – Reference 212
c – Reference 230, based on available Period of Record (1930-1998)
d – Reference 230, based on available Period of Record (1948-2005)
e – NA = Measurements not made at this station

Table 2.3-208
Seasonal and Annual Mean Wind Speeds for the VEGP Site (1998–2002) and the Augusta, Georgia, NWS Station (1971–2000, Normals)

Primary Tower Elevation	Location	Winter	Spring	Summer	Autumn	Annual
Upper Level (60 m) (m/sec)	Plant Vogtle	5.0	5.0	4.1	4.4	4.6
Lower Level (10 m) (m/sec)	Plant Vogtle	2.6	2.8	2.4	2.3	2.5
Single Level (6.1 m) (m/sec)	Augusta WSO [a]	3.0	3.0	2.4	2.4	2.7

Notes:
Winter = December, January, February
Spring = March, April, May
Summer = June, July, August
Autumn = September, October, November
Source: a - Reference 221

Table 2.3-209 (Sheet 1 of 6)
Wind Direction Persistence/Wind Speed Distributions for the VEGP Site – 10-m Level

1998 TO 2002 WIND PERSISTENCE
VEGP METEOROLOGICAL TOWER – 10-M LEVEL
22.5° SECTOR WIDTH
START AND END OF PERIOD 98010101 - 02123124

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 22.5 DEGREES)

Speed Greater than or Equal to 5.0 mph

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	1180	1133	1919	2028	1392	822	948	863	906	1298	1541	1478	1804	1444	856	894
2	439	376	919	983	538	231	353	294	305	493	621	526	830	639	266	310
4	99	75	343	326	139	27	88	58	56	102	164	105	246	197	51	52
8	6	4	97	65	13	4	5	2	3	4	14	4	28	30	3	0
12	0	0	36	10	0	0	0	0	0	0	0	0	2	9	0	0
18	0	0	9	0	0	0	0	0	0	0	0	0	0	3	0	0
24	0	0	3	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 22.5 DEGREES)

Speed Greater than or Equal to 10.0 mph

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	136	126	323	415	149	58	116	85	74	167	246	250	362	361	150	59
2	42	51	129	197	39	16	37	27	24	57	106	91	156	167	46	22
4	7	9	40	63	5	3	8	5	3	9	25	21	47	45	11	6
8	0	0	11	7	0	0	0	0	0	0	0	1	4	5	0	0
12	0	0	2	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.3-209 (Sheet 2 of 6)
Wind Direction Persistence/Wind Speed Distributions for the VEGP Site – 10-m Level

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 22.5 DEGREES)

Speed Greater than or Equal to 15.0 mph

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	3	9	13	25	8	1	6	3	4	14	21	17	40	43	19	2
2	0	3	2	10	0	0	0	0	0	4	6	5	13	14	5	1
4	0	0	0	5	0	0	0	0	0	0	3	0	0	2	0	0
8	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 22.5 DEGREES)

Speed Greater than or Equal to 20.0 mph

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	1	0	0	4	0	0	0	0	0	2	0	1	3	5	0	0
2	0	0	0	3	0	0	0	0	0	0	0	0	0	1	0	0
4	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.3-209 (Sheet 3 of 6)
Wind Direction Persistence/Wind Speed Distributions for the VEGP Site – 10-m Level

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 22.5 DEGREES)

Speed Greater than or Equal to 25.0 mph

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.3-209 (Sheet 4 of 6)
Wind Direction Persistence/Wind Speed Distributions for the VEGP Site – 10-m Level

1998 TO 2002 WIND PERSISTENCE
VEGP METEOROLOGICAL TOWER - 10-M LEVEL
67.5° SECTOR WIDTH

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 67.5 DEGREES)

Speed Greater than or Equal to 5.0 mph

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	3207	4232	5080	5339	4242	3162	2633	2717	3067	3745	4317	4823	4726	4104	3194	2930
2	1885	2649	3569	3875	2751	1762	1438	1539	1694	2224	2686	3187	3226	2738	1881	1630
4	901	1461	2358	2587	1495	830	666	740	733	1031	1363	1765	1941	1635	908	738
8	310	653	1331	1443	570	271	219	248	208	250	455	623	824	749	297	216
12	129	358	828	880	237	96	78	116	68	73	168	209	361	376	119	80
18	54	187	466	471	87	23	19	29	4	15	57	64	134	148	41	20
24	32	107	283	287	32	0	3	6	0	3	20	15	52	67	17	2
30	17	69	164	178	2	0	0	0	0	0	6	2	22	33	2	0
36	11	48	96	117	0	0	0	0	0	0	0	0	4	20	0	0
48	0	27	33	38	0	0	0	0	0	0	0	0	0	8	0	0

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 67.5 DEGREES)

Speed Greater than or Equal to 10.0 mph

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	321	585	864	887	622	323	259	275	326	487	663	858	973	873	570	345
2	160	271	484	515	328	114	115	127	143	243	354	489	592	549	332	143
4	74	115	212	243	128	26	42	49	40	71	135	218	299	313	168	59
8	33	44	69	74	24	0	12	15	0	2	15	36	81	115	55	16
12	19	21	26	20	4	0	2	3	0	0	0	2	30	43	18	4
18	5	6	3	1	0	0	0	0	0	0	0	0	6	13	4	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	2	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.3-209 (Sheet 5 of 6)
Wind Direction Persistence/Wind Speed Distributions for the VEGP Site – 10-m Level

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 67.5 DEGREES)

Speed Greater than or Equal to 15.0 mph

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	14	25	47	46	34	15	10	13	21	39	52	78	100	102	64	24
2	5	6	20	17	10	0	0	0	4	14	23	29	49	56	29	7
4	0	0	7	7	5	0	0	0	0	5	5	6	16	21	9	0
8	0	0	1	1	1	0	0	0	0	0	0	0	3	3	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 67.5 DEGREES)

Speed Greater than or Equal to 20.0 mph

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	1	1	4	4	4	0	0	0	2	2	3	4	9	8	5	1
2	0	0	3	3	3	0	0	0	0	0	0	0	3	3	1	0
4	0	0	1	1	1	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.3-209 (Sheet 6 of 6)
Wind Direction Persistence/Wind Speed Distributions for the VEGP Site – 10-m Level

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 67.5 DEGREES)

Speed Greater than or Equal to 25.0 mph

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.3-210 (Sheet 1 of 6)
Wind Direction Persistence/Wind Speed Distributions for the VEGP Site – 60-m Level

1998 TO 2002 WIND PERSISTENCE
VEGP METEOROLOGICAL TOWER - 60-M LEVEL
22.5° SECTOR WIDTH

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 22.5 DEGREES)

Speed Greater than or Equal to 5.0 mph

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	1610	1940	3083	2713	2037	1558	1645	2015	2294	2694	3397	3268	3052	2001	1615	1488
2	641	889	1687	1343	946	666	734	986	1057	1266	1739	1594	1576	910	663	575
4	168	245	736	446	273	167	218	319	290	346	569	492	586	293	146	131
8	20	33	192	70	43	19	20	56	35	27	73	51	122	67	6	3
12	4	7	67	7	15	1	4	15	0	0	5	13	17	16	0	0
18	0	0	20	0	5	0	0	0	0	0	0	0	0	0	0	0
24	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 22.5 DEGREES)

Speed Greater than or Equal to 10.0 mph

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	616	954	1922	1457	984	747	802	713	1006	1597	2138	2098	2036	1247	775	615
2	240	435	1107	710	442	303	339	305	433	750	1106	1066	1106	619	322	231
4	68	116	515	219	114	77	100	82	118	207	366	359	444	233	73	59
8	14	16	161	33	23	10	13	6	12	13	43	44	101	60	4	2
12	4	6	63	5	12	0	1	0	0	0	3	13	13	15	0	0
18	0	0	20	0	2	0	0	0	0	0	0	0	0	0	0	0
24	0	0	13	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	7	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.3-210 (Sheet 2 of 6)
Wind Direction Persistence/Wind Speed Distributions for the VEGP Site – 60-m Level

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 22.5 DEGREES)

Speed Greater than or Equal to 15.0 mph

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	131	211	522	254	106	66	112	75	171	364	628	721	732	436	147	123
2	53	87	264	94	31	11	33	15	52	123	277	314	362	211	49	39
4	23	27	117	29	6	0	10	2	8	26	81	94	140	89	15	9
8	12	10	44	8	0	0	3	0	0	0	3	9	34	21	2	1
12	4	6	24	4	0	0	0	0	0	0	0	3	1	2	0	0
18	0	0	17	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	11	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	5	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 22.5 DEGREES)

Speed Greater than or Equal to 20.0 mph

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	24	21	44	25	12	8	16	4	19	48	97	135	183	118	36	12
2	13	6	20	10	4	0	5	0	3	14	21	48	87	54	16	4
4	7	1	7	5	0	0	3	0	0	2	0	12	30	19	7	2
8	3	0	0	1	0	0	0	0	0	0	0	0	6	1	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	1	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.3-210 (Sheet 3 of 6)
Wind Direction Persistence/Wind Speed Distributions for the VEGP Site – 60-m Level

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 22.5 DEGREES)

Speed Greater than or Equal to 25.0 mph

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	2	0	5	5	1	0	0	0	2	6	15	26	37	21	5	3
2	0	0	1	3	0	0	0	0	0	2	2	12	16	7	1	2
4	0	0	0	1	0	0	0	0	0	0	0	6	6	2	0	0
8	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.3-210 (Sheet 4 of 6)
Wind Direction Persistence/Wind Speed Distributions for the VEGP Site – 60-m Level

1998 TO 2002 WIND PERSISTENCE
VEGP METEOROLOGICAL TOWER - 60-M LEVEL
67.5° SECTOR WIDTH

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 67.5 DEGREES)

Speed Greater than or Equal to 5.0 mph

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	5038	6633	7736	7833	6308	5240	5218	5954	7003	8385	9359	9717	8321	6668	5104	4713
2	3401	4871	6139	6199	4565	3663	3670	4240	5098	6291	7318	7740	6402	4858	3475	3173
4	1887	3216	4448	4396	2827	2165	2126	2561	3130	4099	5024	5525	4399	3100	1942	1745
8	842	1778	2685	2516	1215	905	847	1122	1331	1939	2694	3133	2539	1549	726	666
12	459	1095	1746	1561	527	398	376	556	576	953	1523	1874	1606	876	295	286
18	225	581	1046	836	152	127	134	198	184	370	671	934	842	425	112	121
24	123	355	665	449	61	52	44	77	69	151	331	511	460	223	51	71
30	82	241	417	251	19	28	14	46	24	57	146	308	217	110	17	49
36	52	162	253	145	11	16	4	28	5	13	58	186	84	54	3	38
48	18	66	95	49	0	0	0	1	0	0	4	80	9	11	0	26

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 67.5 DEGREES)

Speed Greater than or Equal to 10.0 mph

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	2185	3492	4333	4363	3188	2533	2262	2521	3316	4741	5833	6272	5381	4058	2637	2006
2	1281	2389	3217	3156	2011	1548	1344	1406	2029	3291	4248	4711	4052	2884	1663	1170
4	627	1465	2159	1982	998	757	620	620	959	1932	2698	3182	2793	1848	876	557
8	245	751	1218	993	313	228	183	188	223	775	1306	1701	1607	984	325	207
12	139	460	754	570	119	74	69	76	50	330	700	985	1007	555	125	109
18	84	230	449	296	26	8	14	21	0	118	275	496	503	264	24	52
24	45	131	285	165	5	0	1	4	0	48	104	273	252	130	2	32
30	26	76	176	97	0	0	0	0	0	19	30	170	108	56	0	20
36	12	45	108	62	0	0	0	0	0	1	6	106	35	29	0	14
48	0	13	44	19	0	0	0	0	0	0	0	41	0	10	0	2

Table 2.3-210 (Sheet 5 of 6)
Wind Direction Persistence/Wind Speed Distributions for the VEGP Site – 60-m Level

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 67.5 DEGREES)

Speed Greater than or Equal to 15.0 mph

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	465	864	987	882	426	284	253	358	610	1163	1713	2081	1889	1315	706	401
2	223	470	549	462	163	104	90	126	243	606	1005	1322	1217	814	369	189
4	100	233	276	207	46	32	29	32	63	239	482	731	711	456	173	92
8	51	106	121	79	11	5	8	8	1	41	111	257	304	206	59	48
12	37	59	75	47	7	0	0	0	0	8	31	97	145	95	8	33
18	19	24	44	29	1	0	0	0	0	0	5	12	37	40	0	21
24	10	11	26	19	0	0	0	0	0	0	0	0	18	25	0	10
30	4	5	14	13	0	0	0	0	0	0	0	0	11	18	0	4
36	0	0	6	7	0	0	0	0	0	0	0	0	5	12	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 67.5 DEGREES)

Speed Greater than or Equal to 20.0 mph

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	57	89	90	81	45	36	28	39	71	164	280	415	436	337	166	72
2	26	43	44	38	15	10	5	9	21	55	122	210	240	194	88	38
4	14	16	17	15	5	3	3	3	3	12	38	82	107	92	41	23
8	5	3	1	1	1	0	0	0	0	1	2	16	18	19	7	10
12	0	0	0	0	0	0	0	0	0	0	0	1	1	1	0	2
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.3-210 (Sheet 6 of 6)
Wind Direction Persistence/Wind Speed Distributions for the VEGP Site – 60-m Level

PERSISTENCIES FROM 98010101 TO 02123124 (SECTOR WIDTH = 67.5 DEGREES)

Speed Greater than or Equal to 25.0 mph

Hours	N	NNE	NE	ENE	E	ESE	SE	SSE	S	SSW	SW	WSW	W	WNW	NW	NNW
1	5	7	10	11	6	1	0	2	8	23	47	78	84	63	29	10
2	2	1	5	5	3	0	0	0	2	6	21	36	40	30	12	3
4	0	0	1	1	1	0	0	0	0	1	9	16	17	12	3	0
8	0	0	0	0	0	0	0	0	0	0	1	1	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
30	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
36	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
48	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Table 2.3-211
Seasonal and Annual Vertical Stability Class and Mean 10-Meter Level Wind Speed Distributions for the VEGP Site (1998–2002)

Period	Vertical Stability Categories[a]						
	A	B	C	D	E	F	G
Winter							
Frequency (%)	2.23	2.94	6.40	31.25	28.96	14.06	14.14
Wind Speed (m/sec)	3.4	3.9	3.6	3.1	2.6	1.7	1.4
Spring							
Frequency (%)	11.49	5.29	7.04	25.18	27.10	13.94	9.95
Wind Speed (m/sec)	3.6	3.7	3.6	3.3	2.5	1.8	1.4
Summer							
Frequency (%)	8.27	6.12	7.60	24.73	33.00	14.22	6.04
Wind Speed (m/sec)	3.4	3.1	2.9	2.7	2.1	1.5	1.4
Autumn							
Frequency (%)	3.76	3.79	8.36	28.90	26.92	13.65	14.62
Wind Speed (m/sec)	3.2	3.3	3.2	2.8	2.2	1.7	1.2
Annual							
Frequency (%)	6.48	4.54	7.34	27.50	28.99	13.97	11.17
Wind Speed (m/sec)	3.5	3.5	3.3	3.0	2.4	1.7	1.3

Note: a – Vertical stability based on temperature difference (DT) between 10-m and 60-m measurement levels.

Table 2.3-212 (Sheet 1 of 8)
Joint Frequency Distribution of Wind Speed and Wind Direction (10-m Level) by Atmospheric Stability Class for the VEGP Site (1998–2002)

Hours at Each Wind Speed and Direction

Period of Record: 01/01/98 1:00 - 12/31/02 23:00 Total Period

Elevation: **Speed:** SP10M **Direction:** DI10M **Lapse:** DT60M

Stability Class: A Delta Temperature Extremely Unstable

Wind Speed (m/s)

Wind Direction (from)	0.23 - 0.50	0.51 - 0.75	0.76 - 1.0	1.1 - 1.5	1.6 - 2.0	2.1 - 3.0	3.1 - 5.0	5.1 - 7.0	7.1 - 10.0	10.1 - 13.0	13.1 - 18.0	> 18.0	Total
N	0	0	0	3	7	38	63	4	0	0	0	0	115
NNE	0	0	2	3	17	48	33	13	0	0	0	0	116
NE	0	0	0	7	6	36	79	17	0	0	0	0	145
ENE	0	0	1	3	13	75	127	30	0	0	0	0	249
E	0	0	0	5	15	77	133	10	0	0	0	0	240
ESE	0	0	1	4	17	66	55	0	0	0	0	0	143
SE	0	1	1	4	11	41	49	5	0	0	0	0	112
SSE	0	0	1	9	2	32	36	2	1	0	0	0	83
S	0	1	0	10	22	42	51	5	0	0	0	0	131
SSW	0	0	2	6	19	59	97	12	0	0	0	0	195
SW	0	0	2	8	18	71	117	20	3	0	0	0	239
WSW	0	0	2	6	23	74	167	26	3	0	0	0	301
W	0	2	0	4	17	79	156	26	2	0	0	0	286
WNW	0	0	0	5	9	39	88	16	3	0	0	0	160
NW	0	0	0	6	9	28	57	14	3	0	0	0	117
NNW	1	0	1	2	6	23	59	1	0	0	0	0	93
Totals	1	4	13	85	211	828	1367	201	15	0	0	0	2725

Number of Calm Hours for this Table	0
Number of Variable Direction Hours for this Table	11
Number of Invalid Hours	1633
Number of Valid Hours for this Table	2725
Total Hours for the Period	43823

Note: Stability class based on temperature difference (ΔT or lapse) between 10-m and 60-m measurement levels.

Table 2.3-212 (Sheet 2 of 8)
Joint Frequency Distribution of Wind Speed and Wind Direction (10-m Level) by Atmospheric Stability Class for the VEGP Site (1998–2002)

Hours at Each Wind Speed and Direction

Period of Record: 01/01/98 1:00 - 12/31/02 23:00 Total Period

Elevation: **Speed:** SP10M **Direction:** DI10M **Lapse:** DT60M

Stability Class: B Delta Temperature Moderately Unstable

Wind Speed (m/s)

Wind Direction (from)	0.23 - 0.50	0.51 - 0.75	0.76 - 1.0	1.1 - 1.5	1.6 - 2.0	2.1 - 3.0	3.1 - 5.0	5.1 - 7.0	7.1 - 10.0	10.1 - 13.0	13.1 - 18.0	> 18.0	Total
N	0	0	1	3	9	39	64	5	0	1	0	0	122
NNE	0	0	0	5	13	38	36	8	2	0	0	0	102
NE	0	1	0	4	7	40	48	7	0	0	0	0	107
ENE	1	0	0	1	11	54	69	23	0	0	0	0	159
E	0	0	0	5	4	44	65	8	0	0	0	0	126
ESE	0	0	1	6	6	31	22	3	0	0	0	0	69
SE	0	0	4	7	8	23	22	1	0	0	0	0	65
SSE	0	0	0	7	14	21	18	1	0	0	0	0	61
S	0	1	0	2	12	30	27	4	0	0	0	0	76
SSW	0	0	0	3	17	53	51	5	2	0	0	0	131
SW	0	0	1	9	18	51	75	19	2	0	0	0	175
WSW	0	0	0	4	7	58	64	18	1	0	0	0	152
W	0	0	0	2	8	60	96	22	3	0	0	0	191
WNW	0	0	0	2	7	37	75	28	4	1	0	0	154
NW	0	0	0	3	5	33	42	12	2	0	0	0	97
NNW	0	0	0	1	11	37	70	4	0	0	0	0	123
Totals	1	2	7	64	157	649	844	168	16	2	0	0	1910

Number of Calm Hours for this Table	1
Number of Variable Direction Hours for this Table	44
Number of Invalid Hours	1633
Number of Valid Hours for this Table	1910
Total Hours for the Period	43823

Note: Stability class based on temperature difference (ΔT or lapse) between 10-m and 60-m measurement levels.

Table 2.3-212 (Sheet 3 of 8) Joint Frequency Distribution of Wind Speed and Wind Direction (10-m Level) by Atmospheric Stability Class for the VEGP Site (1998–2002)

Hours at Each Wind Speed and Direction

Period of Record: 01/01/98 1:00 - 12/31/02 23:00 Total Period

Elevation: **Speed:** SP10M **Direction:** DI10M **Lapse:** DT60M

Stability Class: C Delta Temperature Slightly Unstable

Wind Speed (m/s)

Wind Direction (from)	0.23 - 0.50	0.51 - 0.75	0.76 - 1.0	1.1 - 1.5	1.6 - 2.0	2.1 - 3.0	3.1 - 5.0	5.1 - 7.0	7.1 - 10.0	10.1 - 13.0	13.1 - 18.0	> 18.0	Total
N	0	1	1	8	24	81	84	5	1	0	0	0	205
NNE	0	0	4	6	17	72	72	3	0	0	0	0	174
NE	0	0	0	5	15	60	72	13	0	0	0	0	165
ENE	0	0	3	6	19	74	115	17	0	0	0	0	234
E	0	0	1	9	21	58	105	1	1	0	0	0	196
ESE	0	0	2	9	15	52	44	1	0	0	0	0	123
SE	0	1	2	11	19	43	35	5	1	0	0	0	117
SSE	0	0	2	10	9	28	45	10	1	0	0	0	105
S	0	0	3	8	29	70	47	4	0	0	0	0	161
SSW	0	1	0	7	26	70	84	8	1	0	0	0	197
SW	0	0	0	11	22	74	127	21	3	0	0	0	258
WSW	0	1	0	11	24	94	101	23	1	0	0	0	255
W	0	0	3	10	27	110	138	41	5	0	0	0	334
WNW	0	0	0	8	22	53	71	43	7	0	0	0	204
NW	0	2	1	3	24	68	66	14	4	0	0	0	182
NNW	2	1	2	4	20	81	67	1	0	0	0	0	178
Totals	2	7	24	126	333	1088	1273	210	25	0	0	0	3088

Number of Calm Hours for this Table	1
Number of Variable Direction Hours for this Table	114
Number of Invalid Hours	1633
Number of Valid Hours for this Table	3088
Total Hours for the Period	43823

Note: Stability class based on temperature difference (ΔT or lapse) between 10-m and 60-m measurement levels.

Table 2.3-212 (Sheet 4 of 8) Joint Frequency Distribution of Wind Speed and Wind Direction (10-m Level) by Atmospheric Stability Class for the VEGP Site (1998–2002)

Hours at Each Wind Speed and Direction

Period of Record: 01/01/98 1:00 - 12/31/02 23:00 Total Period

Elevation: **Speed:** SP10M **Direction:** DI10M **Lapse:** DT60M

Stability Class: D Delta Temperature Neutral

Wind Speed (m/s)

Wind Direction (from)	0.23 - 0.50	0.51 - 0.75	0.76 - 1.0	1.1 - 1.5	1.6 - 2.0	2.1 - 3.0	3.1 - 5.0	5.1 - 7.0	7.1 - 10.0	10.1 - 13.0	13.1 - 18.0	> 18.0	Total
N	0	7	13	78	137	345	215	29	0	0	0	0	824
NNE	2	6	8	72	106	278	209	32	2	0	0	0	715
NE	3	4	15	57	99	342	507	75	1	0	0	0	1103
ENE	1	2	12	61	95	303	454	87	4	1	0	0	1020
E	1	10	18	67	114	268	215	21	3	0	0	0	717
ESE	3	5	14	49	71	165	124	9	0	0	0	0	440
SE	1	16	9	48	80	138	149	39	2	0	0	0	482
SSE	4	9	17	65	96	186	152	18	0	0	0	0	547
S	2	9	14	78	114	240	125	10	0	0	0	0	592
SSW	1	9	21	47	96	229	219	38	3	0	0	0	663
SW	3	3	14	83	117	269	238	40	7	0	0	0	774
WSW	1	8	18	68	141	294	246	53	2	1	0	0	832
W	1	4	11	72	123	269	334	81	16	0	0	0	911
WNW	6	3	19	59	109	222	287	83	14	0	0	0	802
NW	2	4	11	69	97	212	123	31	4	0	0	0	553
NNW	0	3	12	60	98	244	154	17	0	0	0	0	588
Totals	31	102	226	1033	1693	4004	3751	663	58	2	0	0	11563

Number of Calm Hours for this Table	4
Number of Variable Direction Hours for this Table	543
Number of Invalid Hours	1633
Number of Valid Hours for this Table	11563
Total Hours for the Period	43823

Note: Stability class based on temperature difference (ΔT or lapse) between 10-m and 60-m measurement levels.

Table 2.3-212 (Sheet 5 of 8) Joint Frequency Distribution of Wind Speed and Wind Direction (10-m Level) by Atmospheric Stability Class for the VEGP Site (1998–2002)

Hours at Each Wind Speed and Direction

Period of Record: 01/01/98 1:00 - 12/31/02 23:00 Total Period

Elevation: **Speed:** SP10M **Direction:** DI10M **Lapse:** DT60M

Stability Class: E Delta Temperature Slightly Stable

Wind Speed (m/s)

Wind Direction (from)	0.23 - 0.50	0.51 - 0.75	0.76 - 1.0	1.1 - 1.5	1.6 - 2.0	2.1 - 3.0	3.1 - 5.0	5.1 - 7.0	7.1 - 10.0	10.1 - 13.0	13.1 - 18.0	> 18.0	Total
N	9	16	26	87	94	154	108	12	1	0	0	0	507
NNE	9	11	37	89	93	224	112	13	1	0	0	0	589
NE	9	20	26	88	124	338	272	23	3	0	0	0	903
ENE	12	14	33	94	149	327	206	29	6	1	0	0	871
E	7	23	38	95	164	330	114	19	2	0	0	0	792
ESE	12	8	50	123	184	246	86	14	0	0	0	0	723
SE	13	21	45	110	184	293	160	9	0	0	0	0	835
SSE	13	25	47	167	250	322	101	8	0	0	0	0	933
S	10	21	60	239	233	271	76	9	1	0	0	0	920
SSW	3	21	43	151	200	272	135	17	1	0	0	0	843
SW	8	18	53	167	245	335	170	13	1	0	0	0	1010
WSW	9	18	40	191	223	266	82	10	1	0	0	0	840
W	5	13	59	127	156	281	169	15	0	0	0	0	825
WNW	9	11	22	113	122	216	185	29	1	0	0	0	708
NW	8	14	27	102	107	147	84	9	1	0	0	0	499
NNW	7	8	21	57	85	128	75	6	2	0	0	0	389
Totals	143	262	627	2000	2613	4150	2135	235	21	1	0	0	12187

Number of Calm Hours for this Table	35
Number of Variable Direction Hours for this Table	396
Number of Invalid Hours	1633
Number of Valid Hours for this Table	12187
Total Hours for the Period	43823

Note: Stability class based on temperature difference (ΔT or lapse) between 10-m and 60-m measurement levels.

Table 2.3-212 (Sheet 6 of 8) Joint Frequency Distribution of Wind Speed and Wind Direction (10-m Level) by Atmospheric Stability Class for the VEGP Site (1998–2002)

Hours at Each Wind Speed and Direction

Period of Record: 01/01/98 1:00 - 12/31/02 23:00 Total Period

Elevation: **Speed:** SP10M **Direction:** DI10M **Lapse:** DT60M

Stability Class: F Delta Temperature Moderately Stable

Wind Speed (m/s)

Wind Direction (from)	0.23 - 0.50	0.51 - 0.75	0.76 - 1.0	1.1 - 1.5	1.6 - 2.0	2.1 - 3.0	3.1 - 5.0	5.1 - 7.0	7.1 - 10.0	10.1 - 13.0	13.1 - 18.0	> 18.0	Total
N	11	20	20	56	61	65	15	0	0	0	0	0	248
NNE	16	21	30	62	44	61	25	0	0	0	0	0	259
NE	22	15	24	70	71	97	19	0	0	0	0	0	318
ENE	17	29	27	77	86	162	24	1	0	0	0	0	423
E	16	28	45	103	128	117	5	0	0	0	0	0	442
ESE	16	25	37	94	112	69	2	0	0	0	0	0	355
SE	21	17	35	85	112	52	6	0	0	0	0	0	328
SSE	15	28	30	88	106	65	7	0	0	0	0	0	339
S	12	22	47	143	111	55	0	1	0	0	0	0	391
SSW	20	14	36	138	135	88	10	0	0	0	0	0	441
SW	19	24	36	148	224	99	7	0	0	0	0	0	557
WSW	12	19	47	183	228	110	1	0	0	0	0	0	600
W	10	18	50	169	129	64	9	1	0	0	0	0	450
WNW	10	24	30	103	110	45	11	3	0	0	0	0	336
NW	6	16	21	66	57	34	3	0	0	0	0	0	203
NNW	12	14	18	44	49	38	7	0	0	0	0	0	182
Totals	235	334	533	1629	1763	1221	151	6	0	0	0	0	5872

Number of Calm Hours for this Table	39
Number of Variable Direction Hours for this Table	230
Number of Invalid Hours	1633
Number of Valid Hours for this Table	5872
Total Hours for the Period	43823

Note: Stability class based on temperature difference (ΔT or lapse) between 10-m and 60-m measurement levels.

Table 2.3-212 (Sheet 7 of 8)
Joint Frequency Distribution of Wind Speed and Wind Direction (10-m Level) by Atmospheric Stability Class for the VEGP Site (1998–2002)

Hours at Each Wind Speed and Direction

Period of Record: 01/01/98 1:00 - 12/31/02 23:00 Total Period

Elevation: **Speed:** SP10M **Direction:** DI10M **Lapse:** DT60M

Stability Class: G Delta Temperature Extremely Stable

Wind Speed (m/s)

Wind Direction (from)	0.23 - 0.50	0.51 - 0.75	0.76 - 1.0	1.1 - 1.5	1.6 - 2.0	2.1 - 3.0	3.1 - 5.0	5.1 - 7.0	7.1 - 10.0	10.1 - 13.0	13.1 - 18.0	> 18.0	Total
N	26	31	49	75	46	18	5	0	0	0	0	0	250
NNE	25	26	34	33	13	16	1	0	1	0	0	0	149
NE	45	30	35	58	24	16	0	0	0	0	0	0	208
ENE	29	26	42	73	61	36	2	0	0	0	0	0	269
E	28	33	55	101	78	30	3	0	0	0	0	0	328
ESE	28	33	56	110	40	17	1	0	0	0	0	0	285
SE	21	31	39	48	48	20	3	0	0	0	0	0	210
SSE	20	34	43	46	36	14	2	0	0	0	0	0	195
S	15	20	41	58	47	22	1	0	1	0	0	0	205
SSW	24	22	56	104	111	49	5	0	0	0	0	0	371
SW	32	34	56	150	203	68	2	0	0	0	0	0	545
WSW	19	38	61	207	170	50	2	0	0	0	0	0	547
W	25	36	78	178	133	42	0	0	0	0	0	0	492
WNW	26	34	43	83	56	14	2	1	0	0	0	0	259
NW	35	32	32	41	21	6	0	0	0	0	0	0	167
NNW	22	25	45	81	28	16	1	0	0	0	0	0	218
Totals	420	486	765	1446	1115	434	30	1	2	0	0	0	4698

Number of Calm Hours for this Table	67
Number of Variable Direction Hours for this Table	432
Number of Invalid Hours	1633
Number of Valid Hours for this Table	4698
Total Hours for the Period	43823

Note: Stability class based on temperature difference (∆T or lapse) between 10-m and 60-m measurement levels.

Table 2.3-212 (Sheet 8 of 8)
Joint Frequency Distribution of Wind Speed and Wind Direction (10-m Level) by Atmospheric Stability Class for the VEGP Site (1998–2002)

Hours at Each Wind Speed and Direction

Period of Record: 01/01/98 1:00 - 12/31/02 23:00 Total Period

Elevation: **Speed:** SP10M **Direction:** DI10M **Lapse:** DT60M

Summary of All Stability Classes Delta Temperature

Wind Speed (m/s)

Wind Direction (from)	0.23 - 0.50	0.51 - 0.75	0.76 - 1.0	1.1 - 1.5	1.6 - 2.0	2.1 - 3.0	3.1 - 5.0	5.1 - 7.0	7.1 - 10.0	10.1 - 13.0	13.1 - 18.0	> 18.0	Total
N	46	75	110	310	378	740	554	55	2	1	0	0	2271
NNE	52	64	115	270	303	737	488	69	6	0	0	0	2104
NE	79	70	100	289	346	929	997	135	4	0	0	0	2949
ENE	60	71	118	315	434	1031	997	187	10	2	0	0	3225
E	52	94	157	385	524	924	640	59	6	0	0	0	2841
ESE	59	71	161	395	445	646	334	27	0	0	0	0	2138
SE	56	87	135	313	462	610	424	59	3	0	0	0	2149
SSE	52	96	140	392	513	668	361	39	2	0	0	0	2263
S	39	74	165	538	568	730	327	33	2	0	0	0	2476
SSW	48	67	158	456	604	820	601	80	7	0	0	0	2841
SW	62	79	162	576	847	967	736	113	16	0	0	0	3558
WSW	41	84	168	670	816	946	663	130	8	1	0	0	3527
W	41	73	201	562	593	905	902	186	26	0	0	0	3489
WNW	51	72	114	373	435	626	719	203	29	1	0	0	2623
NW	51	68	92	290	320	528	375	80	14	0	0	0	1818
NNW	44	51	99	249	297	567	433	29	2	0	0	0	1771
Totals	833	1196	2195	6383	7885	12374	9551	1484	137	5	0	0	42043

Number of Calm Hours for this Table	147
Number of Variable Direction Hours for this Table	1770
Number of Invalid Hours	1633
Number of Valid Hours for this Table	42043
Total Hours for the Period	43823

Note: Stability class based on temperature difference (ΔT or lapse) between 10-m and 60-m measurement levels.

Table 2.3-213 (Sheet 1 of 8)
Joint Frequency Distribution of Wind Speed and Wind Direction (60-m Level) by Atmospheric Stability Class for the VEGP Site (1998–2002)

Hours at Each Wind Speed and Direction

Period of Record: 01/01/98 1:00 - 12/31/02 23:00 Total Period

Elevation: **Speed:** SP60M **Direction:** DI60M **Lapse:** DT60M

Stability Class: A Delta Temperature Extremely Unstable

Wind Speed (m/s)

Wind Direction (from)	0.23 - 0.50	0.51 - 0.75	0.76 - 1.0	1.1 - 1.5	1.6 - 2.0	2.1 - 3.0	3.1 - 5.0	5.1 - 7.0	7.1 - 10.0	10.1 - 13.0	13.1 - 18.0	> 18.0	Total
N	0	0	0	4	5	22	36	33	6	0	0	0	106
NNE	0	0	0	1	6	24	34	21	9	1	0	0	96
NE	0	0	0	0	4	23	84	88	28	0	0	0	227
ENE	0	0	1	3	7	35	141	71	15	1	0	0	274
E	0	0	0	1	2	31	86	26	2	0	0	0	148
ESE	1	0	0	4	3	19	52	21	1	0	0	0	101
SE	0	0	0	2	2	10	31	7	0	0	0	0	52
SSE	0	0	1	2	4	27	49	14	1	0	0	0	98
S	0	0	2	4	6	15	51	32	8	0	0	0	118
SSW	0	0	0	2	11	27	80	51	23	3	0	0	197
SW	0	0	0	3	14	33	98	110	60	13	0	0	331
WSW	0	1	1	2	9	26	96	104	76	15	5	9	335
W	0	1	0	2	9	34	57	48	46	5	0	0	202
WNW	0	0	1	2	1	12	37	37	12	7	0	0	109
NW	0	0	0	2	10	19	46	30	4	1	2	0	114
NNW	0	0	1	0	5	22	47	33	2	0	0	0	110
Totals	1	2	7	34	98	379	1025	726	293	46	7	0	2618

Number of Calm Hours for this Table	0
Number of Variable Direction Hours for this Table	6
Number of Invalid Hours	3217
Number of Valid Hours for this Table	2618
Total Hours for the Period	43823

Note: Stability class based on temperature difference (ΔT or lapse) between 10-m and 60-m measurement levels.

Table 2.3-213 (Sheet 2 of 8)
Joint Frequency Distribution of Wind Speed and Wind Direction (60-m Level) by Atmospheric Stability Class for the VEGP Site (1998–2002)

Hours at Each Wind Speed and Direction

Period of Record: 01/01/98 1:00 - 12/31/02 23:00 Total Period

Elevation: **Speed:** SP60M **Direction:** DI60M **Lapse:** DT60M

Stability Class: B Delta Temperature Moderately Unstable

Wind Speed (m/s)

Wind Direction (from)	0.23 - 0.50	0.51 - 0.75	0.76 - 1.0	1.1 - 1.5	1.6 - 2.0	2.1 - 3.0	3.1 - 5.0	5.1 - 7.0	7.1 - 10.0	10.1 - 13.0	13.1 - 18.0	> 18.0	Total
N	0	0	1	4	4	17	48	20	8	0	0	0	102
NNE	0	0	0	1	5	15	33	22	5	0	0	0	81
NE	0	1	0	4	1	20	60	46	12	0	0	0	144
ENE	0	0	0	2	3	23	67	35	4	0	0	0	134
E	0	0	0	2	3	18	43	21	1	0	0	0	88
ESE	0	0	0	1	2	18	27	10	0	0	0	0	58
SE	0	0	1	0	3	12	20	10	0	0	0	0	46
SSE	0	0	0	3	1	15	19	5	0	0	0	0	43
S	0	0	0	1	4	15	29	11	8	0	0	0	68
SSW	0	0	1	1	1	17	48	22	18	1	1	0	110
SW	0	0	0	0	8	28	80	46	35	4	1	0	202
WSW	0	0	0	1	6	26	73	49	35	7	1	0	198
W	0	0	0	1	6	17	67	48	29	12	0	0	180
WNW	0	0	0	0	3	14	45	26	17	7	2	0	115
NW	0	0	0	2	4	17	52	27	8	1	0	0	111
NNW	0	0	0	0	5	18	53	28	2	0	0	0	106
Totals	0	1	3	23	59	290	765	426	182	32	5	0	1786

Number of Calm Hours for this Table	0
Number of Variable Direction Hours for this Table	26
Number of Invalid Hours	3217
Number of Valid Hours for this Table	1786
Total Hours for the Period	43823

Note: Stability class based on temperature difference (ΔT or lapse) between 10-m and 60-m measurement levels.

Table 2.3-213 (Sheet 3 of 8)
Joint Frequency Distribution of Wind Speed and Wind Direction (60-m Level) by Atmospheric Stability Class for the VEGP Site (1998–2002)

Hours at Each Wind Speed and Direction

Period of Record: 01/01/98 1:00 - 12/31/02 23:00 Total Period

Elevation: **Speed:** SP60M **Direction:** DI60M **Lapse:** DT60M

Stability Class: C Delta Temperature Slightly Unstable

Wind Speed (m/s)

Wind Direction (from)	0.23 - 0.50	0.51 - 0.75	0.76 - 1.0	1.1 - 1.5	1.6 - 2.0	2.1 - 3.0	3.1 - 5.0	5.1 - 7.0	7.1 - 10.0	10.1 - 13.0	13.1 - 18.0	> 18.0	Total
N	0	0	0	2	12	54	80	27	4	0	0	0	179
NNE	1	1	1	3	10	34	62	24	8	0	0	0	144
NE	0	2	0	6	7	36	99	48	6	0	0	0	204
ENE	0	0	2	5	8	45	97	49	8	0	0	0	214
E	0	0	0	6	11	44	100	16	2	1	0	0	180
ESE	0	0	1	6	5	18	34	11	0	1	0	0	76
SE	0	0	1	1	7	19	41	14	2	0	0	0	85
SSE	0	0	0	6	5	26	51	13	6	1	0	0	108
S	0	0	0	4	13	38	63	21	10	0	0	0	149
SSW	0	0	0	4	9	37	85	38	13	3	0	0	189
SW	0	0	2	3	4	49	102	73	34	7	0	0	274
WSW	0	1	0	5	9	52	122	60	41	6	1	0	297
W	0	1	1	1	12	47	111	54	44	11	1	0	283
WNW	0	0	0	4	5	34	69	43	26	12	2	0	195
NW	0	0	1	5	12	40	92	30	5	2	0	0	187
NNW	0	1	3	5	4	46	89	22	5	0	0	0	175
Totals	1	6	12	66	133	619	1297	543	214	44	4	0	2939

Number of Calm Hours for this Table	0
Number of Variable Direction Hours for this Table	60
Number of Invalid Hours	3217
Number of Valid Hours for this Table	2939
Total Hours for the Period	43823

Note: Stability class based on temperature difference (ΔT or lapse) between 10-m and 60-m measurement levels.

Table 2.3-213 (Sheet 4 of 8) Joint Frequency Distribution of Wind Speed and Wind Direction (60-m Level) by Atmospheric Stability Class for the VEGP Site (1998–2002)

Hours at Each Wind Speed and Direction

Period of Record: 01/01/98 1:00 - 12/31/02 23:00 Total Period

Elevation: **Speed:** SP60M **Direction:** DI60M **Lapse:** DT60M

Stability Class: D Delta Temperature Neutral

Wind Speed (m/s)

Wind Direction (from)	0.23 - 0.50	0.51 - 0.75	0.76 - 1.0	1.1 - 1.5	1.6 - 2.0	2.1 - 3.0	3.1 - 5.0	5.1 - 7.0	7.1 - 10.0	10.1 - 13.0	13.1 - 18.0	> 18.0	Total
N	2	2	1	24	47	152	291	114	39	2	0	0	674
NNE	0	4	9	24	49	129	319	182	62	2	0	0	780
NE	0	3	5	25	42	147	425	382	125	1	0	0	1155
ENE	1	1	8	27	59	158	352	199	47	3	2	0	857
E	1	4	6	24	40	115	237	91	27	1	0	0	546
ESE	2	0	6	21	32	76	134	50	12	2	0	0	335
SE	2	2	9	20	38	72	170	100	41	1	0	0	455
SSE	1	5	7	23	43	114	210	109	22	0	0	0	534
S	1	4	4	29	59	148	233	100	22	3	0	0	603
SSW	2	3	7	19	36	102	231	138	57	12	1	0	608
SW	1	3	6	22	48	135	307	186	111	13	1	0	833
WSW	2	3	6	23	37	149	299	253	155	22	2	0	951
W	0	4	9	24	45	143	286	212	166	46	8	0	943
WNW	0	5	6	26	33	93	189	139	93	21	0	0	605
NW	0	2	11	18	34	122	206	109	31	5	0	0	538
NNW	2	2	5	22	42	158	258	109	45	1	0	0	644
Totals	17	47	105	371	684	2013	4147	2473	1055	135	14	0	11061

Number of Calm Hours for this Table	0
Number of Variable Direction Hours for this Table	257
Number of Invalid Hours	3217
Number of Valid Hours for this Table	11061
Total Hours for the Period	43823

Note: Stability class based on temperature difference (ΔT or lapse) between 10-m and 60-m measurement levels.

Table 2.3-213 (Sheet 5 of 8)
Joint Frequency Distribution of Wind Speed and Wind Direction (60-m Level) by Atmospheric Stability Class for the VEGP Site (1998–2002)

Hours at Each Wind Speed and Direction

Period of Record: 01/01/98 1:00 - 12/31/02 23:00 Total Period

Elevation: **Speed:** SP60M **Direction:** DI60M **Lapse:** DT60M

Stability Class: E Delta Temperature Slightly Stable

Wind Speed (m/s)

Wind Direction (from)	0.23 - 0.50	0.51 - 0.75	0.76 - 1.0	1.1 - 1.5	1.6 - 2.0	2.1 - 3.0	3.1 - 5.0	5.1 - 7.0	7.1 - 10.0	10.1 - 13.0	13.1 - 18.0	> 18.0	Total
N	3	2	7	18	17	91	205	107	21	8	0	0	479
NNE	0	0	3	20	25	93	248	212	58	0	0	0	659
NE	2	1	4	12	32	87	331	373	122	4	0	0	968
ENE	1	1	4	19	31	89	347	277	50	4	3	0	826
E	1	2	4	15	21	82	312	204	27	3	0	0	671
ESE	1	2	6	16	24	71	289	221	24	1	0	0	655
SE	0	1	6	9	16	81	345	215	18	0	0	0	691
SSE	0	4	6	31	48	196	513	163	11	1	0	0	973
S	0	3	5	25	41	179	421	222	29	2	1	0	928
SSW	1	3	6	13	21	90	371	336	57	3	0	0	901
SW	1	4	3	18	27	71	419	368	98	7	0	0	1016
WSW	2	2	2	11	25	64	310	288	106	9	0	0	819
W	3	3	5	13	26	48	253	364	146	10	1	0	872
WNW	5	1	6	11	15	61	170	204	112	9	0	0	591
NW	1	3	3	16	14	60	169	147	41	2	0	0	456
NNW	1	0	8	15	25	61	131	91	17	3	1	0	353
Totals	19	32	78	262	408	1424	4834	3792	937	66	6	0	11858

Number of Calm Hours for this Table	8
Number of Variable Direction Hours for this Table	83
Number of Invalid Hours	3217
Number of Valid Hours for this Table	11858
Total Hours for the Period	43823

Note: Stability class based on temperature difference (ΔT or lapse) between 10-m and 60-m measurement levels.

Table 2.3-213 (Sheet 6 of 8) Joint Frequency Distribution of Wind Speed and Wind Direction (60-m Level) by Atmospheric Stability Class for the VEGP Site (1998–2002)

Hours at Each Wind Speed and Direction

Period of Record: 01/01/98 1:00 - 12/31/02 23:00 Total Period

Elevation: **Speed:** SP60M **Direction:** DI60M **Lapse:** DT60M

Stability Class: F Delta Temperature Moderately Stable

Wind Speed (m/s)

Wind Direction (from)	0.23 - 0.50	0.51 - 0.75	0.76 - 1.0	1.1 - 1.5	1.6 - 2.0	2.1 - 3.0	3.1 - 5.0	5.1 - 7.0	7.1 - 10.0	10.1 - 13.0	13.1 - 18.0	> 18.0	Total
N	1	3	1	8	9	39	78	43	8	0	0	0	190
NNE	0	0	1	3	13	39	117	68	15	0	0	0	256
NE	1	2	0	8	9	39	100	156	33	0	0	0	348
ENE	2	1	1	8	16	27	150	174	26	0	0	0	405
E	1	1	2	8	7	30	163	142	2	0	0	0	356
ESE	3	2	1	13	14	44	157	89	3	0	0	0	326
SE	1	1	3	6	15	41	157	85	6	0	0	0	315
SSE	1	2	4	18	27	94	142	94	5	0	0	0	387
S	1	1	11	25	30	80	156	149	8	0	0	0	461
SSW	1	5	3	4	8	47	187	212	28	0	0	0	495
SW	3	1	5	10	15	40	156	280	44	0	0	0	554
WSW	0	0	3	8	11	26	150	242	37	1	0	0	478
W	2	1	4	6	14	29	133	216	49	0	0	0	454
WNW	1	0	2	7	13	31	89	142	31	0	0	0	316
NW	0	0	3	5	8	30	87	80	5	0	0	0	218
NNW	2	2	2	4	9	27	75	51	7	0	0	0	179
Totals	20	22	46	141	218	663	2097	2223	307	1	0	0	5738

Number of Calm Hours for this Table	4
Number of Variable Direction Hours for this Table	14
Number of Invalid Hours	3217
Number of Valid Hours for this Table	5738
Total Hours for the Period	43823

Note: Stability class based on temperature difference (ΔT or lapse) between 10-m and 60-m measurement levels.

Table 2.3-213 (Sheet 7 of 8) Joint Frequency Distribution of Wind Speed and Wind Direction (60-m Level) by Atmospheric Stability Class for the VEGP Site (1998–2002)

Hours at Each Wind Speed and Direction

Period of Record: 01/01/98 1:00 - 12/31/02 23:00 Total Period

Elevation: **Speed:** SP60M **Direction:** DI60M **Lapse:** DT60M

Stability Class: G Delta Temperature Extremely Stable

Wind Speed (m/s)

Wind Direction (from)	0.23 - 0.50	0.51 - 0.75	0.76 - 1.0	1.1 - 1.5	1.6 - 2.0	2.1 - 3.0	3.1 - 5.0	5.1 - 7.0	7.1 - 10.0	10.1 - 13.0	13.1 - 18.0	> 18.0	Total
N	2	2	4	10	16	32	69	17	0	0	1	0	153
NNE	2	2	2	12	15	56	86	17	1	0	0	0	193
NE	1	1	7	15	22	37	90	55	7	0	0	0	235
ENE	0	3	8	13	12	40	118	88	20	0	0	0	302
E	0	4	3	9	13	24	123	97	10	0	0	0	283
ESE	2	2	5	7	8	28	111	72	1	0	0	0	236
SE	1	1	4	9	20	38	90	43	2	0	0	0	208
SSE	1	2	7	17	29	76	82	39	4	0	0	0	257
S	1	1	7	18	33	70	113	94	27	0	0	0	364
SSW	1	3	5	13	12	34	135	172	45	0	0	0	420
SW	1	0	2	9	13	43	147	171	58	0	0	0	444
WSW	4	1	2	7	15	41	103	216	37	0	0	0	426
W	4	5	3	12	15	47	126	159	33	0	0	0	404
WNW	1	3	3	8	10	41	102	90	11	0	0	0	269
NW	1	1	6	11	12	47	98	50	4	0	0	0	230
NNW	0	0	3	8	16	44	57	31	2	0	0	0	161
Totals	22	31	71	178	261	698	1650	1411	262	0	1	0	4585

Number of Calm Hours for this Table	9
Number of Variable Direction Hours for this Table	42
Number of Invalid Hours	3217
Number of Valid Hours for this Table	4585
Total Hours for the Period	43823

Note: Stability class based on temperature difference (ΔT or lapse) between 10-m and 60-m measurement levels.

Table 2.3-213 (Sheet 8 of 8)
Joint Frequency Distribution of Wind Speed and Wind Direction (60-m Level) by Atmospheric Stability Class for the VEGP Site (1998–2002)

Hours at Each Wind Speed and Direction

Period of Record: 01/01/98 1:00 - 12/31/02 23:00 Total Period

Elevation: **Speed:** SP60M **Direction:** DI60M **Lapse:** DT60M

Summary of All Stability Classes Delta Temperature

Wind Speed (m/s)

Wind Direction (from)	0.23 - 0.50	0.51 - 0.75	0.76 - 1.0	1.1 - 1.5	1.6 - 2.0	2.1 - 3.0	3.1 - 5.0	5.1 - 7.0	7.1 - 10.0	10.1 - 13.0	13.1 - 18.0	> 18.0	Total
N	8	9	14	70	110	407	807	361	86	10	1	0	1883
NNE	3	7	16	64	123	390	899	546	158	3	0	0	2209
NE	4	10	16	70	117	389	1189	1148	333	5	0	0	3281
ENE	4	6	24	77	136	417	1272	893	170	8	5	0	3012
E	3	11	15	65	97	344	1064	597	71	5	0	0	2272
ESE	9	6	19	68	88	274	804	474	41	4	0	0	1787
SE	4	5	24	47	101	273	854	474	69	1	0	0	1852
SSE	3	13	25	100	157	548	1066	437	49	2	0	0	2400
S	3	9	29	106	186	545	1066	629	112	5	1	0	2691
SSW	5	14	22	56	98	354	1137	969	241	22	2	0	2920
SW	6	8	18	65	129	399	1309	1234	440	44	2	0	3654
WSW	8	8	14	57	112	384	1153	1212	487	60	9	0	3504
W	9	15	22	59	127	365	1033	1101	513	84	10	0	3338
WNW	4	9	18	58	80	286	702	681	302	56	4	0	2200
NW	2	6	24	59	94	335	750	473	98	11	2	0	1854
NNW	5	5	22	54	106	376	710	365	80	4	1	0	1728
Totals	80	141	322	1075	1861	6086	15815	11594	3250	324	37	0	40585

Number of Calm Hours for this Table	21
Number of Variable Direction Hours for this Table	488
Number of Invalid Hours	3217
Number of Valid Hours for this Table	40585
Total Hours for the Period	43823

Note: Stability class based on temperature difference (ΔT or lapse) between 10-m and 60-m measurement levels.

Table 2.3-214
VEGP Onsite Weather Instruments

Sensed Parameter	Range	System Accuracy	Starting Threshold	Distance Constant	Damping Ratio	Elevation
			45-m Tower Instruments			
Wind Speed	0-100 mph (0-56 m/sec)	±0.5 mph (±0.22 m/sec)	1.0 mph (0.45 m/sec)	-----	-----	10 m
Wind Direction	0°-540°	±5°	1.0 mph (0.45 m/sec)	6.56 ft 2 m	0.4-0.6 with deflection of 15° and delay distance of ≤ 2 m	10 m
Ambient Temperature	-10°F to 120°F (-23° to 49°C)	±0.9°F (±0.5°C)	-----	-----	-----	10 m
Sigma-Theta	0°-100°	-----	-----	-----	See wind direction	10 m
			60-m Tower Instruments			
Wind Speed	0-100 mph (0-56 m/sec)	±0.5 mph (±0.22 m/sec)	1.0 mph (0.45 m/sec)	-----	-----	10 m; 60 m
Wind Direction	0°-540°	±5°	1.0 mph (0.45 m/sec)	6.56 ft 2 m	0.4-0.6 with deflection of 15° and delay distance of ≤ 2 m	10 m; 60 m
Ambient Temperature	-10°F to 120°F (-23° to 49°C)	±0.9°F (±0.5°C)	-----	-----	-----	10 m
Differential Temperature	-5°F to 10°F (-20°C to -12°C)	±0.27°F (±0.15°C) per 50-m height	-----	-----	-----	10 m – 60 m
Dew Point	-10°F to 120°F (-23°C to 49°C)	±2.7°F (±1.5°C)	-----	-----	-----	10 m
Precipitation	0-100 events/reset	±10% of the total accumulated catch	Resolution of 0.01 in. (0.25 mm)	-----	-----	Tower base
Sigma-Theta	0°-100°	-----	-----	-----	See wind direction	10 m; 60 m

Table 2.3-215
Annual Data Recovery Statistics - VEGP Primary Meteorological Tower (1998-2002)

Parameter	**1998**	**1999**	**2000**	**2001**	**2002**
Wind Speed (10m)	99.0	99.0	97.8	95.1	97.1
Wind Speed (60 m)	98.4	98.1	97.7	95.2	96.7
Wind Direction (10 m)	99.1	98.9	98.4	95.2	96.4
Wind Direction (60 m)	88.2	93.3	96.6	95.3	97.6
Δ -Temperature (60m – 10m)[a]	96.6	98.6	97.2	94.9	99.3 [b]
Temperature (10 m)	99.2	98.9	97.8	95.0	97.6 [b]
Dewpoint (10 m)	99.0	98.3	85.5	95.1	89.6
Rainfall	99.5	99.3	99.1	96.3	78.8
Composite Parameters					
WS/WD (10m), ΔT (60m-10m) [a]	96.4	98.3	96.5	94.9	95.3
WS/WD (60m), ΔT (60m-10m) [a]	85.6	91.9	94.8	94.9	96.1

Notes:

a – Temperature difference (ΔT) between 10-m and 60-m levels.

b – Data recovery for Δ-Temperature is greater than the 10-m temperature parameter recovery rate due to data substitution by SNC in the 2002 data set for the ΔT parameter only.

Table 2.3-216
PAVAN Output – χ/Q Values at the Dose Calculation EAB

/ PLANT NAME: Vogtle COL
DATA PERIOD: 1998–2002 JFD
TYPE OF RELEASE: Ground-Level Release
SOURCE OF DATA: Onsite
COMMENTS: Accidental Releases
PROGRAM: PAVAN, 10/76, 8/79 REVISION, IMPLEMENTATION OF REGULATORY GUIDE 1.145

METEOROLOGICAL INSTRUMENTATION
WIND SENSORS HEIGHT: 10 m
DELTA-T HEIGHTS: 10 m – 60 m

0 RELATIVE CONCENTRATION (X/Q) VALUES (SEC/CUBIC METER) VERSUS AVERAGING TIME

DOWNWIND SECTOR	DISTANCE (METERS)	0–2 HOURS	0–8 HOURS	8–24 HOURS	1–4 DAYS	4–30 DAYS	ANNUAL AVERAGE	HOURS PER YEAR MAX 0–2 HR X/Q IS EXCEEDED IN SECTOR	DOWNWIND SECTOR
S	800.	2.53E–04	1.69E–04	1.38E–04	8.89E–05	4.73E–05	2.19E–05	29.9	S
SSW	800.	2.22E–04	1.49E–04	1.21E–04	7.84E–05	4.18E–05	1.94E–05	530.6	SSW
SW	800.	2.59E–04	1.77E–04	1.46E–04	9.61E–05	5.29E–05	2.54E–05	34.4	SW
WSW	800.	2.67E–04	1.82E–04	1.50E–04	9.95E–05	5.49E–05	2.65E–05	32.5	WSW
W	800.	2.88E–04	1.97E–04	1.63E–04	1.08E–04	5.94E–05	2.88E–05	36.9	W
WNW	800.	2.85E–04	1.92E–04	1.57E–04	1.02E–04	5.52E–05	2.59E–05	36.4	WNW
NW	800.	2.47E–04	1.67E–04	1.37E–04	8.97E–05	4.87E–05	2.30E–05	30.0	NW
NNW	800.	2.45E–04	1.67E–04	1.38E–04	9.16E–05	5.06E–05	2.45E–05	29.3	NNW
N	800.	2.42E–04	1.67E–04	1.39E–04	9.26E–05	5.20E–05	2.57E–05	25.6	N
NNE	800.	2.78E–04	1.92E–04	1.59E–04	1.06E–04	5.92E–05	2.91E–05	34.1	NNE
NE	800.	3.14E–04	2.21E–04	1.85E–04	1.26E–04	7.30E–05	3.73E–05	43.7	NE
ENE	800.	2.95E–04	2.10E–04	1.77E–04	1.22E–04	7.18E–05	3.74E–05	36.7	ENE
E	800.	3.03E–04	2.11E–04	1.77E–04	1.19E–04	6.82E–05	3.43E–05	40.1	E
ESE	800.	2.59E–04	1.75E–04	1.44E–04	9.45E–05	5.14E–05	2.44E–05	31.2	ESE
SE	800.	2.11E–04	1.42E–04	1.16E–04	7.51E–05	4.03E–05	1.88E–05	26.5	SE
SSE	800.	2.39E–04	1.56E–04	1.26E–04	7.91E–05	4.07E–05	1.80E–05	26.6	SSE
MAX X/Q		3.14E–04				TOTAL HOURS AROUND SITE:		*****	
SRP 2.3.4	800.	1.86E–03	9.75E–04	7.06E–04	3.50E–04	1.28E–04	3.74E–05		
SITE LIMIT		3.49E–04	2.41E–04	2.00E–04	1.34E–04	7.56E–05	3.74E–05		

0THE FIVE-PERCENT-FOR-THE-ENTIRE-SITE X/Q IS LIMITING.

Table 2.3-217
PAVAN Output – χ/Q Values at the LPZ

/ PLANT NAME: Vogtle COL
DATA PERIOD: 1998–2002 JFD
TYPE OF RELEASE: Ground-Level Release
SOURCE OF DATA: Onsite
COMMENTS: Accidental Release
PROGRAM: PAVAN, 10/76, 8/79 REVISION, IMPLEMENTATION OF REGULATORY GUIDE 1.145

METEOROLOGICAL INSTRUMENTATION
WIND SENSORS HEIGHT: 10 m
DELTA-T HEIGHTS: 10 m – 60 m

0 RELATIVE CONCENTRATION (X/Q) VALUES (SEC/CUBIC METER) VERSUS AVERAGING TIME

DOWNWIND SECTOR	DISTANCE (METERS)	0–2 HOURS	0–8 HOURS	8–24 HOURS	1–4 DAYS	4–30 DAYS	ANNUAL AVERAGE	HOURS PER YEAR MAX 0–2 HR X/Q IS EXCEEDED IN SECTOR	DOWNWIND SECTOR
S	2304.	8.95E–05	4.82E–05	3.54E–05	1.81E–05	6.89E–06	2.12E–06	29.6	S
SSW	2304.	7.42E–05	4.04E–05	2.98E–05	1.54E–05	5.97E–06	1.87E–06	502.4	SSW
SW	2304.	8.94E–05	4.94E–05	3.67E–05	1.93E–05	7.64E–06	2.47E–06	32.2	SW
WSW	2304.	9.17E–05	5.08E–05	3.78E–05	1.99E–05	7.92E–06	2.57E–06	29.5	WSW
W	2304.	1.02E–04	5.61E–05	4.17E–05	2.19E–05	8.66E–06	2.79E–06	34.5	W
WNW	2304.	1.03E–04	5.56E–05	4.09E–05	2.10E–05	8.10E–06	2.52E–06	34.9	WNW
NW	2304.	8.52E–05	4.67E–05	3.45E–05	1.80E–05	7.04E–06	2.24E–06	28.3	NW
NNW	2304.	8.53E–05	4.72E–05	3.51E–05	1.85E–05	7.36E–06	2.38E–06	28.5	NNW
N	2304.	8.32E–05	4.66E–05	3.48E–05	1.86E–05	7.52E–06	2.49E–06	24.1	N
NNE	2304.	1.00E–04	5.55E–05	4.13E–05	2.18E–05	8.68E–06	2.82E–06	32.8	NNE
NE	2304.	1.11E–04	6.28E–05	4.73E–05	2.56E–05	1.06E–05	3.61E–06	39.5	NE
ENE	2304.	1.17E–04	6.59E–05	4.95E–05	2.65E–05	1.08E–05	3.63E–06	43.7	ENE
E	2304.	1.15E–04	6.40E–05	4.78E–05	2.53E–05	1.01E–05	3.32E–06	42.3	E
ESE	2304.	9.13E–05	4.99E–05	3.69E–05	1.92E–05	7.48E–06	2.36E–06	29.4	ESE
SE	2304.	7.34E–05	3.98E–05	2.94E–05	1.51E–05	5.83E–06	1.82E–06	25.8	SE
SSE	2304.	8.49E–05	4.47E–05	3.24E–05	1.61E–05	5.92E–06	1.74E–06	26.6	SSE
MAX X/Q		1.17E–04				TOTAL HOURS AROUND SITE:		984.3	
SRP 2.3.4	2304.	3.47E–04	1.63E–04	1.12E–04	4.94E–05	1.53E–05	3.63E–06		
SITE LIMIT		1.27E–04	7.04E–05	5.25E–05	2.77E–05	1.11E–05	3.63E–06		

0THE FIVE-PERCENT-FOR-THE-ENTIRE-SITE X/Q IS LIMITING.

Table 2.3-218
Shortest Distances Between the VEGP Units 3 and 4 Power Block Area and Receptors of Interest by Downwind Direction Sector[a]

Direction	Meat Animal	Residence	Vegetable Garden	EAB[b]
N	1,071	1,071	1,071	800
NNE	1,071	1,071	1,071	800
NE	1,071	1,071	1,071	800
ENE	1,071	1,071	1,071	800
E	1,071	1,071	1,071	800
ESE	1,071	1,071	1,071	800
SE	1,071	1,071	1,071	800
SSE	1,071	1,071	1,071	800
S	1,071	1,071	1,071	800
SSW	1,071	1,071	1,071	800
SW	1,071	1,071	1,071	800
WSW	1,071	1,071	1,071	800
W	1,071	1,071	1,071	800
WNW	1,071	1,071	1,071	800
NW	1,071	1,071	1,071	800
NNW	1,071	1,071	1,071	800

Notes:
a – Distances shown are in meters
b – EAB = Exclusion Area Boundary
c – There are no milk-giving animals (i.e., cows, goats) within a 5-mile radius of the VEGP Units 3 and 4 Site.

Table 2.3-219
XOQDOQ-Predicted Maximum χ/Q and D/Q Values at Receptors of Interest

Type of Location	Direction from Site	Distance meters/ (miles)	χ/Q (sec/m^3) (No Decay) (Undepleted)	χ/Q (sec/m^3) (2.26 Day Decay) (Undepleted)	χ/Q (sec/m^3) (8 Day Decay) (Depleted)	D/Q ($1/m^2$)
Residence	NE	1,071 (0.67)	3.4E-06	3.4E-06	3.0E-06	1.0E-08[a]
Dose Calculation EAB	NE	800 (0.5)	5.5E-06	5.5E-06	5.0E-06	1.7E-08[b]
Meat Animal	NE	1,071 (0.67)	3.4E-06	3.4E-06	3.0E-06	1.0E-08[a]
Vegetable Garden	NE	1,071 (0.67)	3.4E-06	3.4E-06	3.0E-06	1.0E-08[a]

Notes:
a – NE, ENE, and E
b – NE and ENE

Table 2.3-220 (Sheet 1 of 4)
XOQDOQ-Predicted Annual Average χ/Q and D/Q Values at the Standard Radial Distances and Distance-Segment Boundaries

No Decay X/Qs at Various Distances

EXIT ONE - GROUND LEVEL RELEASE - NO PURGE RELEASES
NO DECAY, UNDEPLETED

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) — DISTANCE IN MILES FROM THE SITE

SECTOR	0.250	0.500	0.750	1.000	1.500	2.000	2.500	3.000	3.500	4.000	4.500
S	1.097E-05	3.306E-06	1.697E-06	1.088E-06	6.032E-07	3.998E-07	2.971E-07	2.339E-07	1.912E-07	1.606E-07	1.377E-07
SSW	9.903E-06	2.986E-06	1.546E-06	9.958E-07	5.570E-07	3.707E-07	2.750E-07	2.160E-07	1.762E-07	1.478E-07	1.265E-07
SW	1.326E-05	3.993E-06	2.063E-06	1.328E-06	7.408E-07	4.926E-07	3.660E-07	2.881E-07	2.353E-07	1.976E-07	1.694E-07
WSW	1.342E-05	4.026E-06	2.076E-06	1.336E-06	7.479E-07	4.982E-07	3.702E-07	2.912E-07	2.378E-07	1.996E-07	1.711E-07
W	1.421E-05	4.237E-06	2.168E-06	1.392E-06	7.796E-07	5.201E-07	3.877E-07	3.059E-07	2.504E-07	2.106E-07	1.808E-07
WNW	1.282E-05	3.803E-06	1.947E-06	1.251E-06	7.014E-07	4.684E-07	3.498E-07	2.764E-07	2.266E-07	1.908E-07	1.639E-07
NW	1.157E-05	3.450E-06	1.790E-06	1.156E-06	6.516E-07	4.357E-07	3.241E-07	2.552E-07	2.086E-07	1.751E-07	1.502E-07
NNW	1.210E-05	3.626E-06	1.899E-06	1.231E-06	6.940E-07	4.637E-07	3.443E-07	2.706E-07	2.208E-07	1.852E-07	1.586E-07
N	1.239E-05	3.719E-06	1.951E-06	1.266E-06	7.147E-07	4.779E-07	3.543E-07	2.781E-07	2.266E-07	1.898E-07	1.624E-07
NNE	1.424E-05	4.240E-06	2.171E-06	1.395E-06	7.821E-07	5.221E-07	3.892E-07	3.071E-07	2.515E-07	2.115E-07	1.816E-07
NE	1.832E-05	5.438E-06	2.773E-06	1.778E-06	9.945E-07	6.633E-07	4.952E-07	3.914E-07	3.208E-07	2.702E-07	2.322E-07
ENE	1.781E-05	5.295E-06	2.696E-06	1.728E-06	9.670E-07	6.451E-07	4.816E-07	3.805E-07	3.119E-07	2.626E-07	2.257E-07
E	1.645E-05	4.895E-06	2.488E-06	1.591E-06	8.856E-07	5.890E-07	4.395E-07	3.473E-07	2.847E-07	2.397E-07	2.060E-07
ESE	1.211E-05	3.630E-06	1.865E-06	1.198E-06	6.685E-07	4.449E-07	3.310E-07	2.607E-07	2.132E-07	1.791E-07	1.537E-07
SE	9.657E-06	2.893E-06	1.486E-06	9.531E-07	5.289E-07	3.509E-07	2.611E-07	2.058E-07	1.684E-07	1.415E-07	1.215E-07
SSE	9.037E-06	2.711E-06	1.382E-06	8.836E-07	4.892E-07	3.242E-07	2.413E-07	1.903E-07	1.558E-07	1.310E-07	1.125E-07

ANNUAL AVERAGE CHI/Q (SEC/METER CUBED) — DISTANCE IN MILES FROM THE SITE

SECTOR	5.000	7.500	10.000	15.000	20.000	25.000	30.000	35.000	40.000	45.000	50.000
S	1.201E-07	7.112E-08	4.917E-08	2.936E-08	2.045E-08	1.546E-08	1.232E-08	1.018E-08	8.626E-09	7.459E-09	6.552E-09
SSW	1.102E-07	6.491E-08	4.471E-08	2.655E-08	1.841E-08	1.388E-08	1.103E-08	9.093E-09	7.694E-09	6.642E-09	5.826E-09
SW	1.477E-07	8.727E-08	6.025E-08	3.589E-08	2.493E-08	1.883E-08	1.498E-08	1.236E-08	1.046E-08	9.039E-09	7.932E-09
WSW	1.492E-07	8.812E-08	6.081E-08	3.621E-08	2.515E-08	1.899E-08	1.511E-08	1.246E-08	1.055E-08	9.113E-09	7.996E-09
W	1.579E-07	9.376E-08	6.494E-08	3.885E-08	2.707E-08	2.048E-08	1.632E-08	1.348E-08	1.143E-08	9.884E-09	8.682E-09
WNW	1.432E-07	8.529E-08	5.918E-08	3.548E-08	2.475E-08	1.875E-08	1.495E-08	1.236E-08	1.048E-08	9.067E-09	7.967E-09
NW	1.309E-07	7.737E-08	5.339E-08	3.178E-08	2.206E-08	1.664E-08	1.323E-08	1.091E-08	9.232E-09	7.971E-09	6.992E-09
NNW	1.381E-07	8.131E-08	5.597E-08	3.318E-08	2.297E-08	1.730E-08	1.373E-08	1.130E-08	9.553E-09	8.239E-09	7.221E-09
N	1.413E-07	8.295E-08	5.697E-08	3.369E-08	2.328E-08	1.751E-08	1.388E-08	1.142E-08	9.644E-09	8.313E-09	7.281E-09
NNE	1.585E-07	9.419E-08	6.524E-08	3.904E-08	2.720E-08	2.058E-08	1.640E-08	1.355E-08	1.149E-08	9.932E-09	8.724E-09
NE	2.029E-07	1.209E-07	8.394E-08	5.038E-08	3.517E-08	2.666E-08	2.127E-08	1.759E-08	1.492E-08	1.291E-08	1.135E-08
ENE	1.971E-07	1.174E-07	8.150E-08	4.889E-08	3.413E-08	2.586E-08	2.064E-08	1.706E-08	1.447E-08	1.253E-08	1.101E-08
E	1.800E-07	1.073E-07	7.453E-08	4.477E-08	3.129E-08	2.373E-08	1.895E-08	1.568E-08	1.331E-08	1.152E-08	1.013E-08
ESE	1.341E-07	7.943E-08	5.492E-08	3.279E-08	2.282E-08	1.725E-08	1.374E-08	1.134E-08	9.613E-09	8.310E-09	7.297E-09
SE	1.060E-07	6.292E-08	4.357E-08	2.607E-08	1.818E-08	1.376E-08	1.097E-08	9.066E-09	7.689E-09	6.652E-09	5.845E-09
SSE	9.818E-08	5.836E-08	4.046E-08	2.425E-08	1.693E-08	1.283E-08	1.024E-08	8.467E-09	7.186E-09	6.220E-09	5.468E-09

Table 2.3-220 (Sheet 2 of 4)
XOQDOQ-Predicted Annual Average χ/Q and D/Q Values at the Standard Radial Distances and Distance-Segment Boundaries

No Decay X/Qs at Various Segments

EXIT ONE - GROUND LEVEL RELEASE - NO PURGE RELEASES
NO DECAY, UNDEPLETED
CHI/Q (SEC/METER CUBED) FOR EACH SEGMENT

DIRECTION FROM SITE	SEGMENT BOUNDARIES IN MILES FROM THE SITE .5-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50
S	1.784E-06	6.205E-07	2.992E-07	1.917E-07	1.380E-07	7.225E-08	2.980E-08	1.554E-08	1.020E-08	7.469E-09
SSW	1.621E-06	5.717E-07	2.769E-07	1.767E-07	1.268E-07	6.600E-08	2.697E-08	1.395E-08	9.115E-09	6.651E-09
SW	2.165E-06	7.609E-07	3.686E-07	2.360E-07	1.697E-07	8.868E-08	3.643E-08	1.892E-08	1.238E-08	9.051E-09
WSW	2.181E-06	7.677E-07	3.727E-07	2.385E-07	1.714E-07	8.955E-08	3.676E-08	1.908E-08	1.249E-08	9.125E-09
W	2.283E-06	8.003E-07	3.903E-07	2.511E-07	1.812E-07	9.519E-08	3.941E-08	2.057E-08	1.351E-08	9.897E-09
WNW	2.050E-06	7.200E-07	3.521E-07	2.272E-07	1.642E-07	8.656E-08	3.598E-08	1.883E-08	1.238E-08	9.079E-09
NW	1.877E-06	6.678E-07	3.263E-07	2.092E-07	1.504E-07	7.861E-08	3.226E-08	1.672E-08	1.093E-08	7.982E-09
NNW	1.986E-06	7.111E-07	3.467E-07	2.215E-07	1.589E-07	8.267E-08	3.371E-08	1.738E-08	1.133E-08	8.251E-09
N	2.039E-06	7.319E-07	3.568E-07	2.273E-07	1.627E-07	8.438E-08	3.424E-08	1.760E-08	1.145E-08	8.325E-09
NNE	2.286E-06	8.027E-07	3.918E-07	2.521E-07	1.819E-07	9.562E-08	3.960E-08	2.068E-08	1.358E-08	9.945E-09
NE	2.923E-06	1.021E-06	4.985E-07	3.217E-07	2.326E-07	1.227E-07	5.108E-08	2.677E-08	1.763E-08	1.293E-08
ENE	2.843E-06	9.930E-07	4.847E-07	3.127E-07	2.260E-07	1.192E-07	4.958E-08	2.598E-08	1.710E-08	1.254E-08
E	2.624E-06	9.106E-07	4.425E-07	2.854E-07	2.064E-07	1.089E-07	4.539E-08	2.383E-08	1.571E-08	1.154E-08
ESE	1.961E-06	6.867E-07	3.333E-07	2.138E-07	1.540E-07	8.068E-08	3.328E-08	1.733E-08	1.137E-08	8.321E-09
SE	1.562E-06	5.440E-07	2.629E-07	1.688E-07	1.217E-07	6.390E-08	2.645E-08	1.382E-08	9.086E-09	6.660E-09
SSE	1.456E-06	5.035E-07	2.430E-07	1.562E-07	1.127E-07	5.925E-08	2.460E-08	1.289E-08	8.486E-09	6.228E-09

Table 2.3-220 (Sheet 3 of 4)
XOQDOQ-Predicted Annual Average χ/Q and D/Q Values at the Standard Radial Distances and Distance-Segment Boundaries

D/Qs at Various Distances

EXIT ONE - GROUND LEVEL RELEASE - NO PURGE RELEASES

******************** RELATIVE DEPOSITION PER UNIT AREA (M**-2) AT FIXED POINTS BY DOWNWIND SECTORS ********************

DIRECTION	DISTANCES IN MILES										
FROM SITE	0.25	0.50	0.75	1.00	1.50	2.00	2.50	3.00	3.50	4.00	4.50
S	3.128E-08	1.058E-08	5.431E-09	3.335E-09	1.663E-09	1.008E-09	6.817E-10	4.940E-10	3.756E-10	2.959E-10	2.396E-10
SSW	2.900E-08	9.807E-09	5.035E-09	3.092E-09	1.541E-09	9.348E-10	6.321E-10	4.580E-10	3.483E-10	2.744E-10	2.221E-10
SW	4.066E-08	1.375E-08	7.059E-09	4.334E-09	2.161E-09	1.311E-09	8.861E-10	6.421E-10	4.882E-10	3.847E-10	3.114E-10
WSW	4.440E-08	1.502E-08	7.710E-09	4.734E-09	2.360E-09	1.431E-09	9.678E-10	7.013E-10	5.333E-10	4.201E-10	3.401E-10
W	3.911E-08	1.323E-08	6.791E-09	4.170E-09	2.079E-09	1.261E-09	8.525E-10	6.177E-10	4.697E-10	3.701E-10	2.996E-10
WNW	2.948E-08	9.971E-09	5.119E-09	3.143E-09	1.567E-09	9.505E-10	6.426E-10	4.657E-10	3.541E-10	2.790E-10	2.258E-10
NW	2.963E-08	1.002E-08	5.145E-09	3.159E-09	1.575E-09	9.552E-10	6.458E-10	4.680E-10	3.559E-10	2.804E-10	2.270E-10
NNW	3.119E-08	1.055E-08	5.415E-09	3.325E-09	1.658E-09	1.005E-09	6.797E-10	4.925E-10	3.745E-10	2.951E-10	2.389E-10
N	3.408E-08	1.152E-08	5.917E-09	3.633E-09	1.811E-09	1.099E-09	7.427E-10	5.382E-10	4.092E-10	3.224E-10	2.610E-10
NNE	3.910E-08	1.322E-08	6.789E-09	4.169E-09	2.078E-09	1.260E-09	8.522E-10	6.175E-10	4.696E-10	3.699E-10	2.995E-10
NE	4.897E-08	1.656E-08	8.503E-09	5.221E-09	2.603E-09	1.579E-09	1.067E-09	7.735E-10	5.882E-10	4.634E-10	3.751E-10
ENE	4.850E-08	1.640E-08	8.422E-09	5.171E-09	2.578E-09	1.564E-09	1.057E-09	7.661E-10	5.825E-10	4.589E-10	3.715E-10
E	4.798E-08	1.622E-08	8.330E-09	5.115E-09	2.550E-09	1.547E-09	1.046E-09	7.578E-10	5.762E-10	4.539E-10	3.675E-10
ESE	3.612E-08	1.221E-08	6.271E-09	3.851E-09	1.920E-09	1.164E-09	7.872E-10	5.704E-10	4.338E-10	3.417E-10	2.766E-10
SE	2.507E-08	8.478E-09	4.353E-09	2.673E-09	1.333E-09	8.082E-10	5.464E-10	3.960E-10	3.011E-10	2.372E-10	1.920E-10
SSE	2.440E-08	8.252E-09	4.237E-09	2.602E-09	1.297E-09	7.867E-10	5.319E-10	3.854E-10	2.931E-10	2.309E-10	1.869E-10

DIRECTION	DISTANCES IN MILES										
FROM SITE	5.00	7.50	10.00	15.00	20.00	25.00	30.00	35.00	40.00	45.00	50.00
S	1.982E-10	9.712E-11	6.094E-11	3.080E-11	1.864E-11	1.250E-11	8.956E-12	6.725E-12	5.229E-12	4.177E-12	3.409E-12
SSW	1.837E-10	9.004E-11	5.650E-11	2.856E-11	1.728E-11	1.159E-11	8.304E-12	6.235E-12	4.848E-12	3.873E-12	3.161E-12
SW	2.576E-10	1.262E-10	7.920E-11	4.003E-11	2.423E-11	1.625E-11	1.164E-11	8.741E-12	6.796E-12	5.429E-12	4.431E-12
WSW	2.813E-10	1.379E-10	8.651E-11	4.372E-11	2.646E-11	1.774E-11	1.271E-11	9.547E-12	7.423E-12	5.930E-12	4.840E-12
W	2.478E-10	1.214E-10	7.620E-11	3.851E-11	2.331E-11	1.563E-11	1.120E-11	8.409E-12	6.538E-12	5.223E-12	4.263E-12
WNW	1.868E-10	9.155E-11	5.744E-11	2.903E-11	1.757E-11	1.178E-11	8.442E-12	6.339E-12	4.929E-12	3.937E-12	3.214E-12
NW	1.877E-10	9.200E-11	5.773E-11	2.918E-11	1.766E-11	1.184E-11	8.484E-12	6.371E-12	4.954E-12	3.957E-12	3.230E-12
NNW	1.976E-10	9.683E-11	6.075E-11	3.071E-11	1.859E-11	1.246E-11	8.929E-12	6.705E-12	5.213E-12	4.164E-12	3.399E-12
N	2.159E-10	1.058E-10	6.639E-11	3.356E-11	2.031E-11	1.362E-11	9.757E-12	7.327E-12	5.697E-12	4.551E-12	3.714E-12
NNE	2.477E-10	1.214E-10	7.617E-11	3.850E-11	2.330E-11	1.562E-11	1.120E-11	8.406E-12	6.536E-12	5.221E-12	4.262E-12
NE	3.103E-10	1.521E-10	9.541E-11	4.823E-11	2.919E-11	1.957E-11	1.402E-11	1.053E-11	8.187E-12	6.540E-12	5.338E-12
ENE	3.073E-10	1.506E-10	9.450E-11	4.776E-11	2.891E-11	1.938E-11	1.389E-11	1.043E-11	8.109E-12	6.477E-12	5.287E-12
E	3.040E-10	1.490E-10	9.347E-11	4.724E-11	2.859E-11	1.917E-11	1.374E-11	1.032E-11	8.021E-12	6.407E-12	5.229E-12
ESE	2.288E-10	1.121E-10	7.036E-11	3.557E-11	2.153E-11	1.443E-11	1.034E-11	7.766E-12	6.038E-12	4.823E-12	3.937E-12
SE	1.588E-10	7.784E-11	4.884E-11	2.469E-11	1.494E-11	1.002E-11	7.178E-12	5.390E-12	4.191E-12	3.348E-12	2.733E-12
SSE	1.546E-10	7.577E-11	4.754E-11	2.403E-11	1.454E-11	9.752E-12	6.988E-12	5.247E-12	4.080E-12	3.259E-12	2.660E-12

Table 2.3-220 (Sheet 4 of 4)
XOQDOQ-Predicted Annual Average χ/Q and D/Q Values at the Standard Radial Distances and Distance-Segment Boundaries

D/Qs at Various Segments

EXIT ONE - GROUND LEVEL RELEASE - NO PURGE RELEASES

************************ RELATIVE DEPOSITION PER UNIT AREA (M**-2) BY DOWNWIND SECTORS ************************

SEGMENT BOUNDARIES IN MILES

DIRECTION FROM SITE	.5-1	1-2	2-3	3-4	4-5	5-10	10-20	20-30	30-40	40-50
S	5.643E-09	1.743E-09	6.937E-10	3.791E-10	2.409E-10	1.035E-10	3.209E-11	1.272E-11	6.793E-12	4.204E-12
SSW	5.232E-09	1.616E-09	6.432E-10	3.515E-10	2.234E-10	9.595E-11	2.975E-11	1.179E-11	6.298E-12	3.898E-12
SW	7.335E-09	2.266E-09	9.017E-10	4.927E-10	3.132E-10	1.345E-10	4.171E-11	1.653E-11	8.829E-12	5.465E-12
WSW	8.011E-09	2.475E-09	9.848E-10	5.382E-10	3.420E-10	1.469E-10	4.556E-11	1.806E-11	9.643E-12	5.968E-12
W	7.056E-09	2.180E-09	8.675E-10	4.740E-10	3.013E-10	1.294E-10	4.013E-11	1.591E-11	8.494E-12	5.257E-12
WNW	5.319E-09	1.643E-09	6.539E-10	3.574E-10	2.271E-10	9.756E-11	3.025E-11	1.199E-11	6.403E-12	3.963E-12
NW	5.346E-09	1.652E-09	6.572E-10	3.591E-10	2.283E-10	9.804E-11	3.040E-11	1.205E-11	6.435E-12	3.983E-12
NNW	5.626E-09	1.738E-09	6.917E-10	3.780E-10	2.402E-10	1.032E-10	3.200E-11	1.268E-11	6.772E-12	4.192E-12
N	6.148E-09	1.899E-09	7.558E-10	4.130E-10	2.625E-10	1.128E-10	3.496E-11	1.386E-11	7.400E-12	4.580E-12
NNE	7.054E-09	2.179E-09	8.672E-10	4.739E-10	3.012E-10	1.294E-10	4.012E-11	1.590E-11	8.491E-12	5.255E-12
NE	8.835E-09	2.730E-09	1.086E-09	5.936E-10	3.773E-10	1.620E-10	5.025E-11	1.992E-11	1.064E-11	6.583E-12
ENE	8.751E-09	2.703E-09	1.076E-09	5.879E-10	3.736E-10	1.605E-10	4.977E-11	1.972E-11	1.053E-11	6.520E-12
E	8.656E-09	2.674E-09	1.064E-09	5.815E-10	3.696E-10	1.587E-10	4.923E-11	1.951E-11	1.042E-11	6.449E-12
ESE	6.516E-09	2.013E-09	8.011E-10	4.377E-10	2.782E-10	1.195E-10	3.706E-11	1.469E-11	7.843E-12	4.855E-12
SE	4.523E-09	1.397E-09	5.560E-10	3.039E-10	1.931E-10	8.295E-11	2.572E-11	1.020E-11	5.444E-12	3.370E-12
SSE	4.403E-09	1.360E-09	5.413E-10	2.958E-10	1.880E-10	8.075E-11	2.504E-11	9.924E-12	5.300E-12	3.280E-12

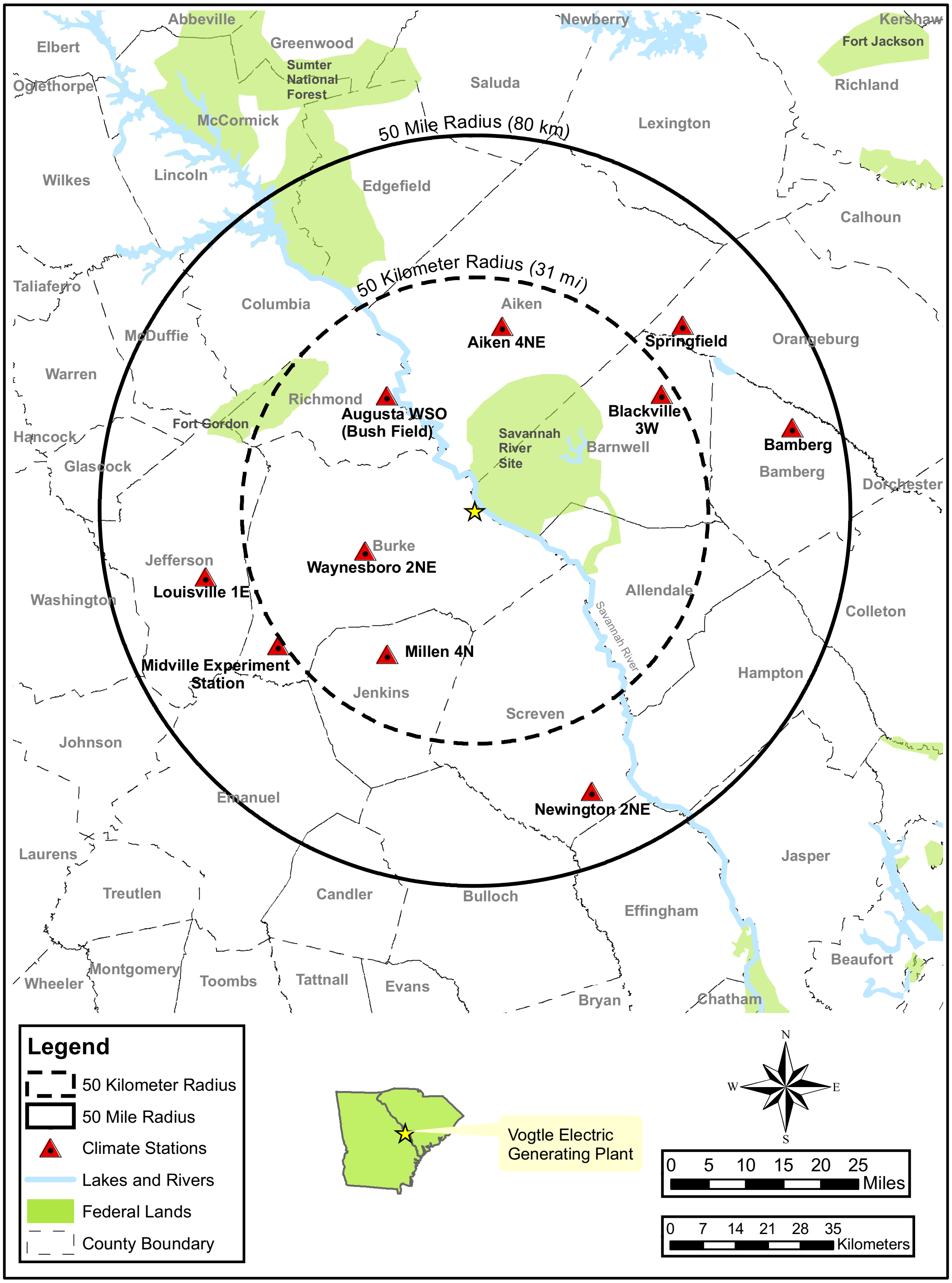

Figure 2.3-201
Climatological Observing Stations Near the VEGP Site

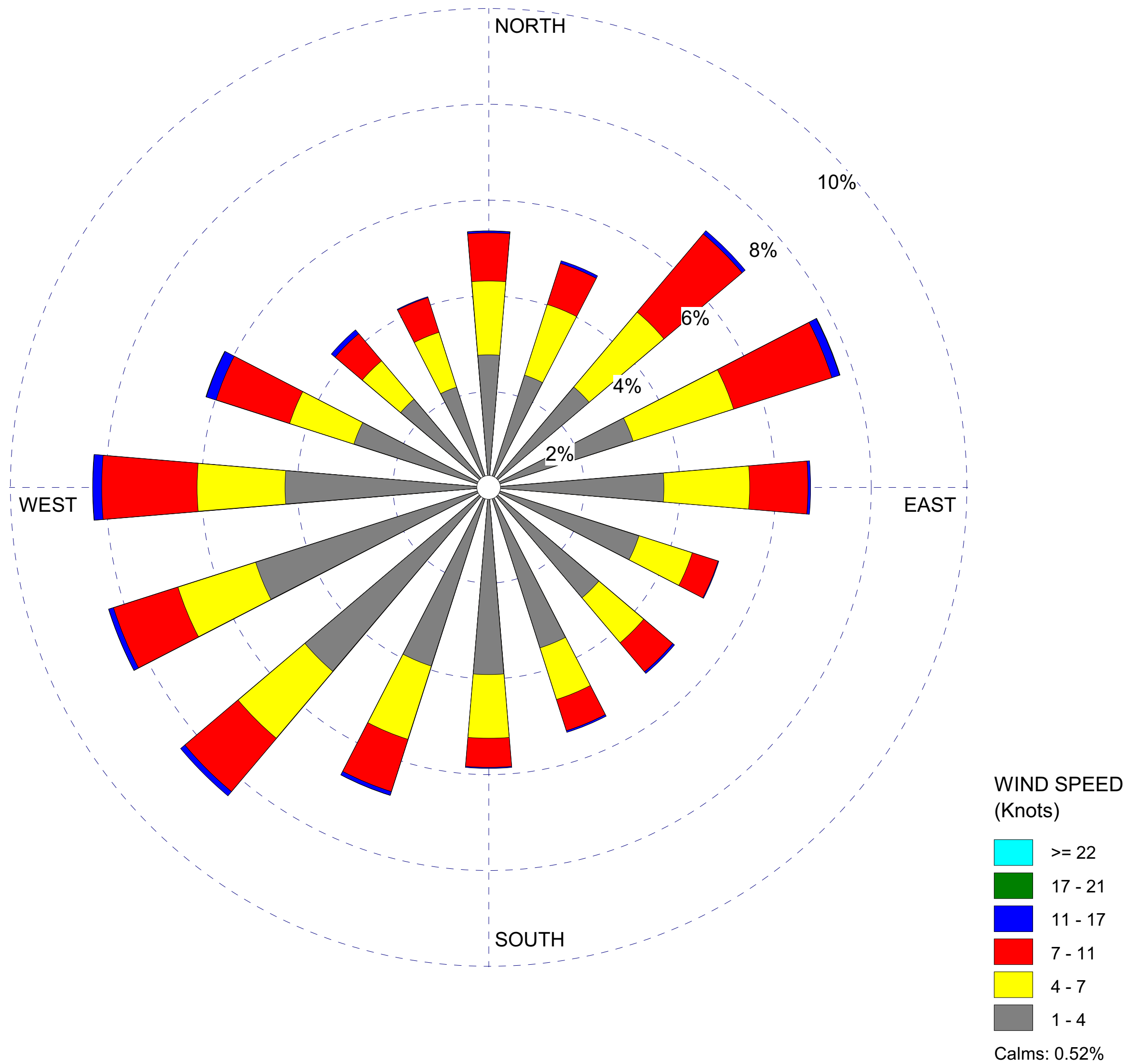

Figure 2.3-202
VEGP 10-m Level Annual Wind Rose (1998-2002)

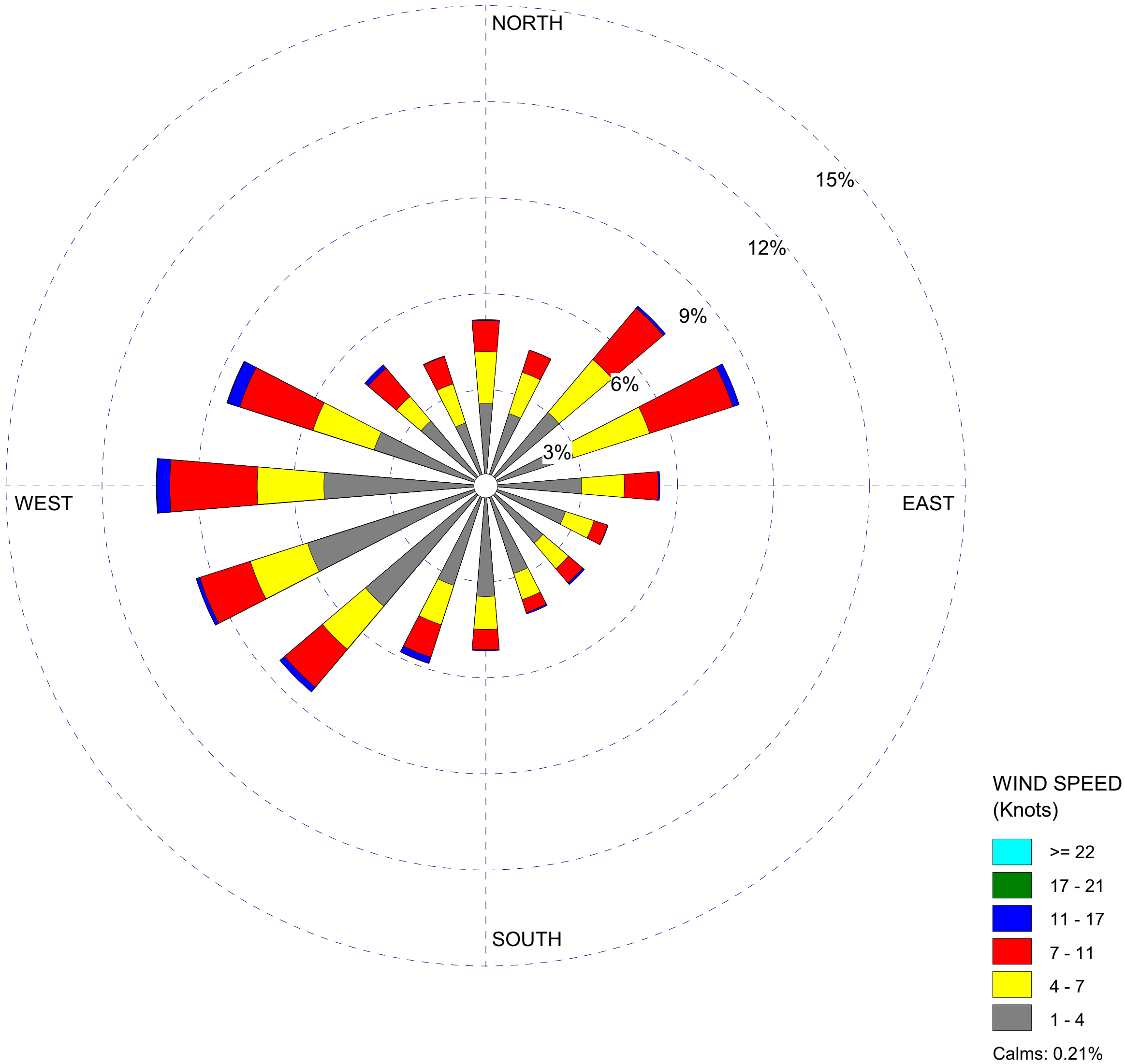

Figure 2.3-203
VEGP 10-m Level Winter Wind Rose (1998-2002)

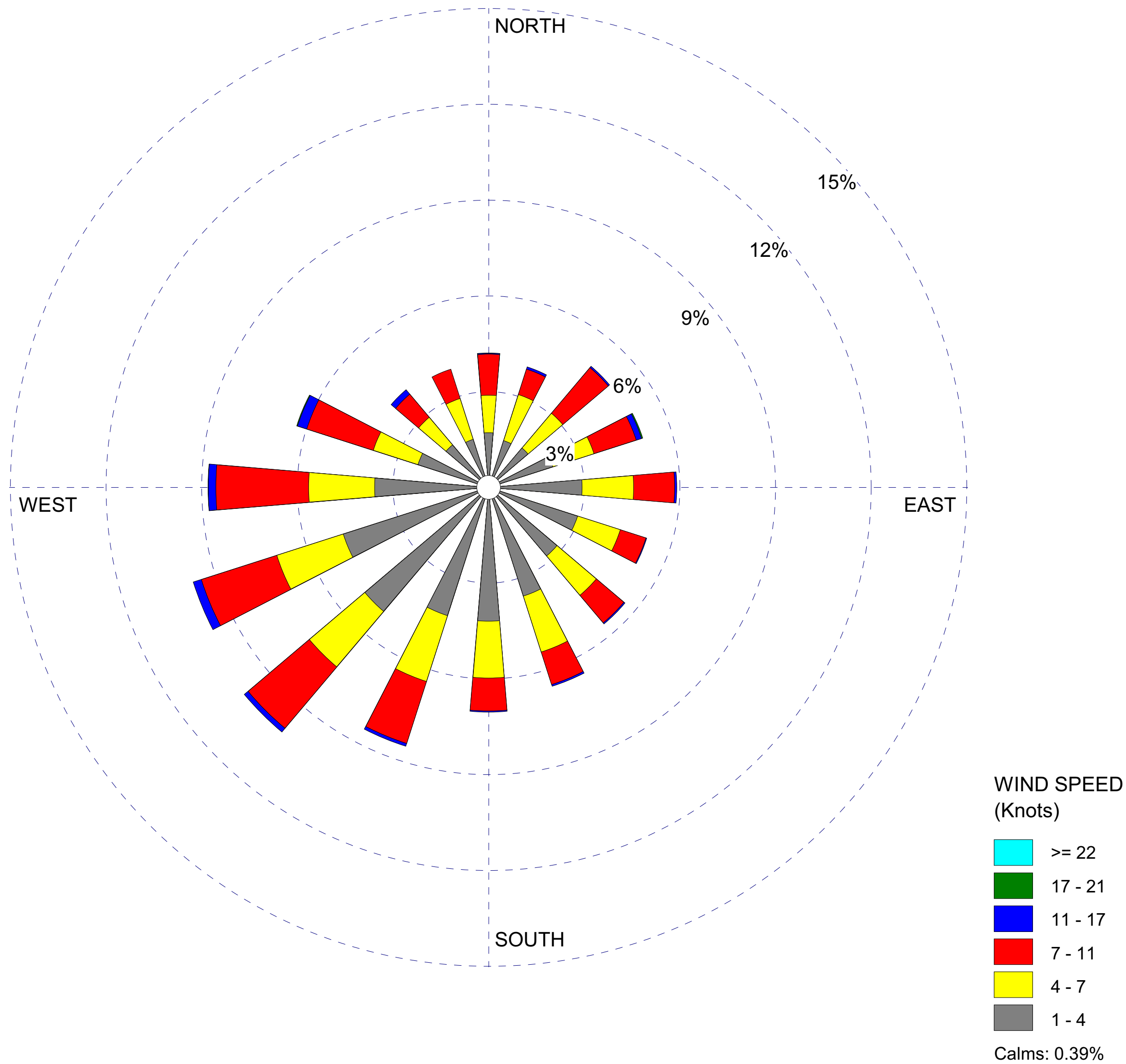

Figure 2.3-204
VEGP 10-m Level Spring Wind Rose (1998-2002)

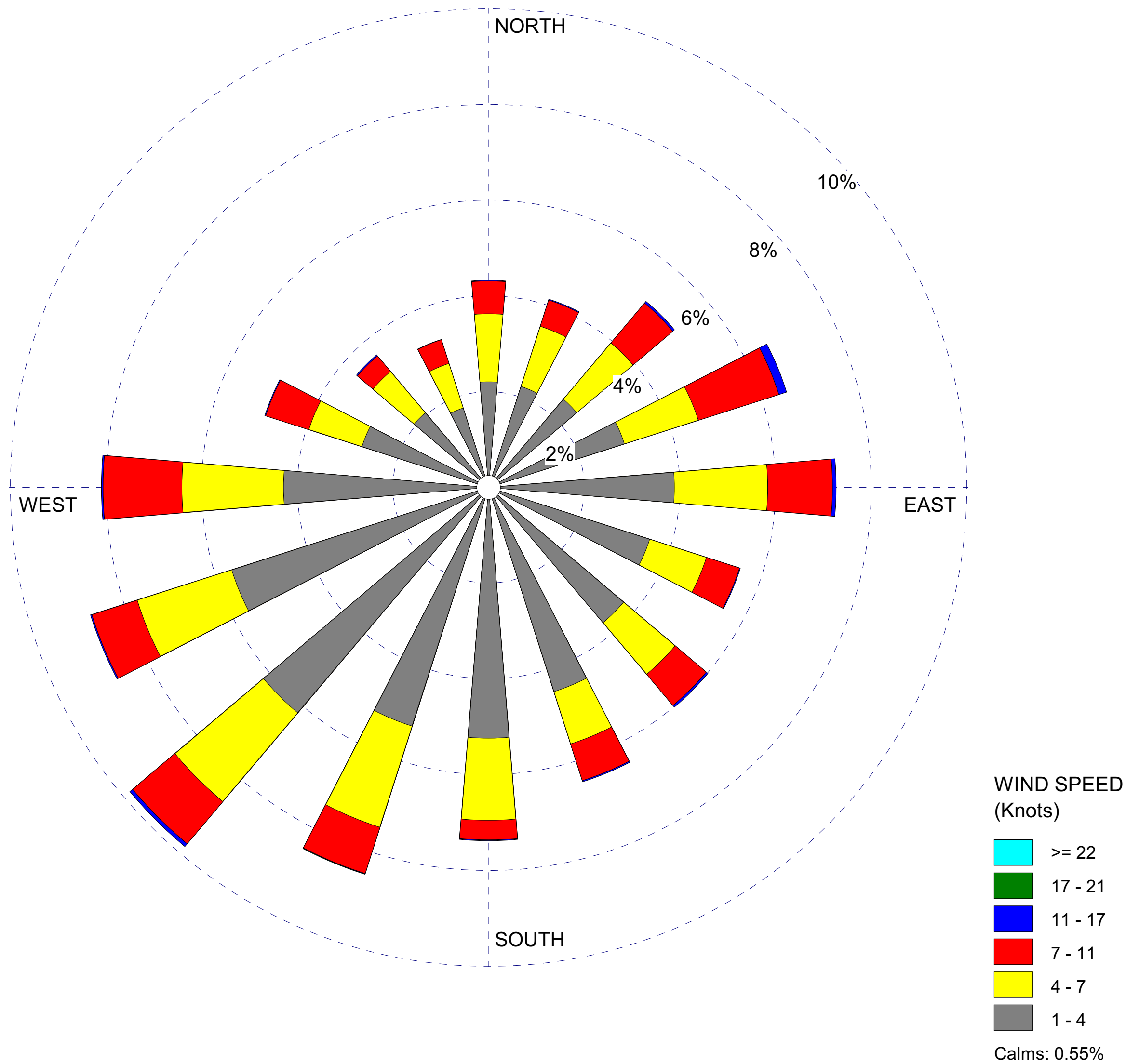

Figure 2.3-205
VEGP 10-m Level Summer Wind Rose (1998-2002)

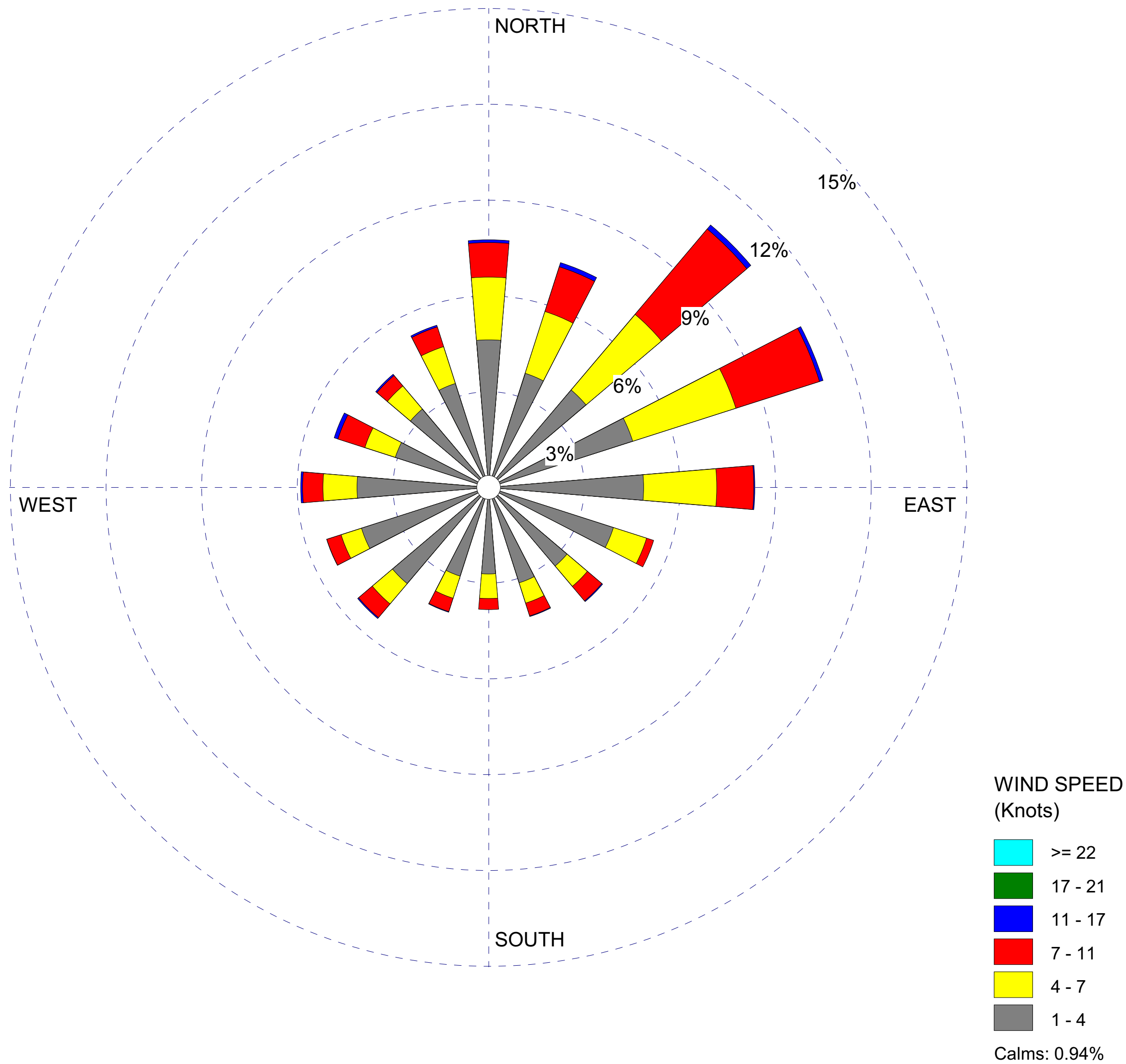

Figure 2.3-206
VEGP 10-m Level Autumn Wind Rose (1998-2002)

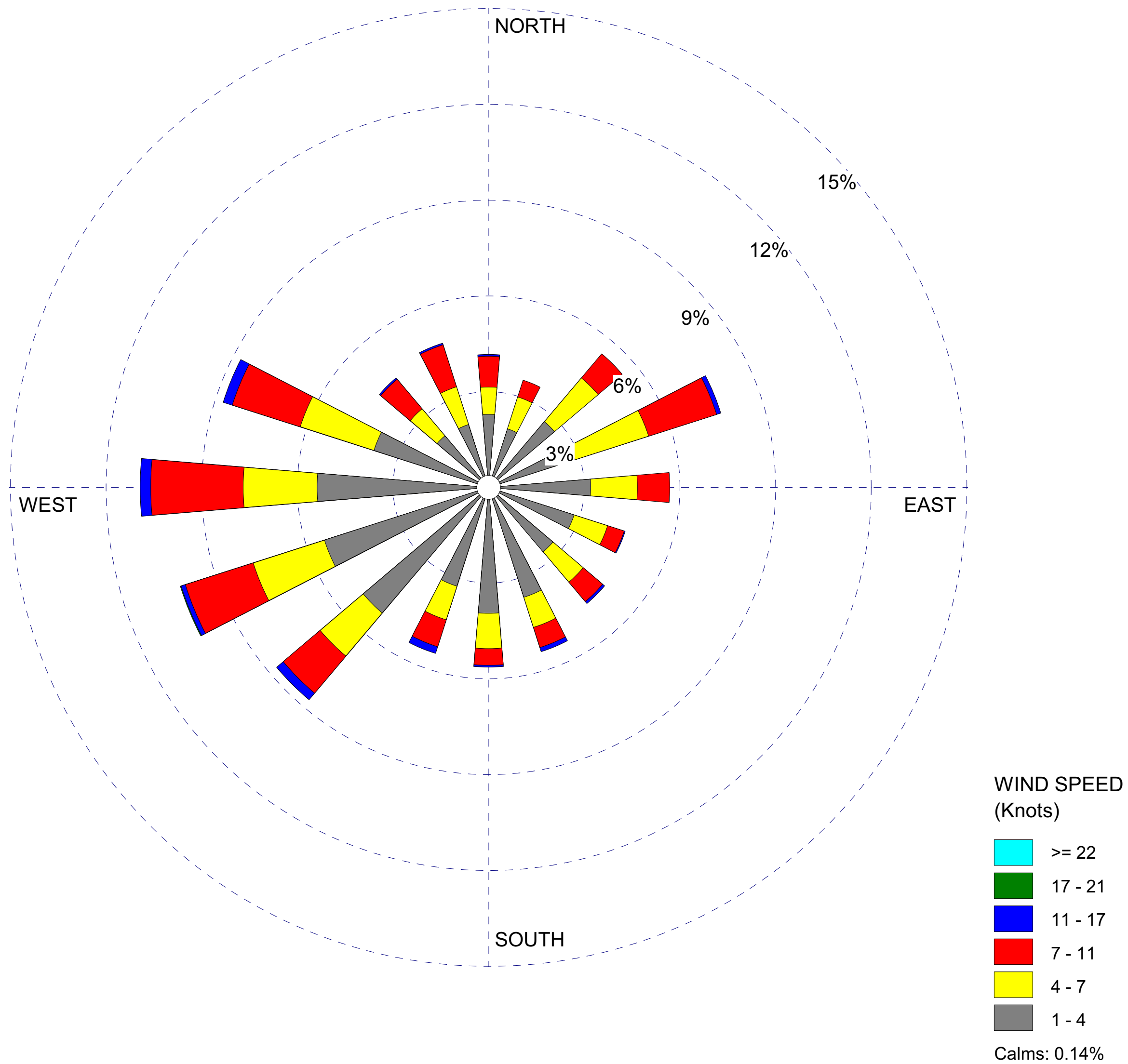

Figure 2.3-207 (Sheet 1 of 12)
VEGP 10-m Level January Wind Rose (1998–2002)

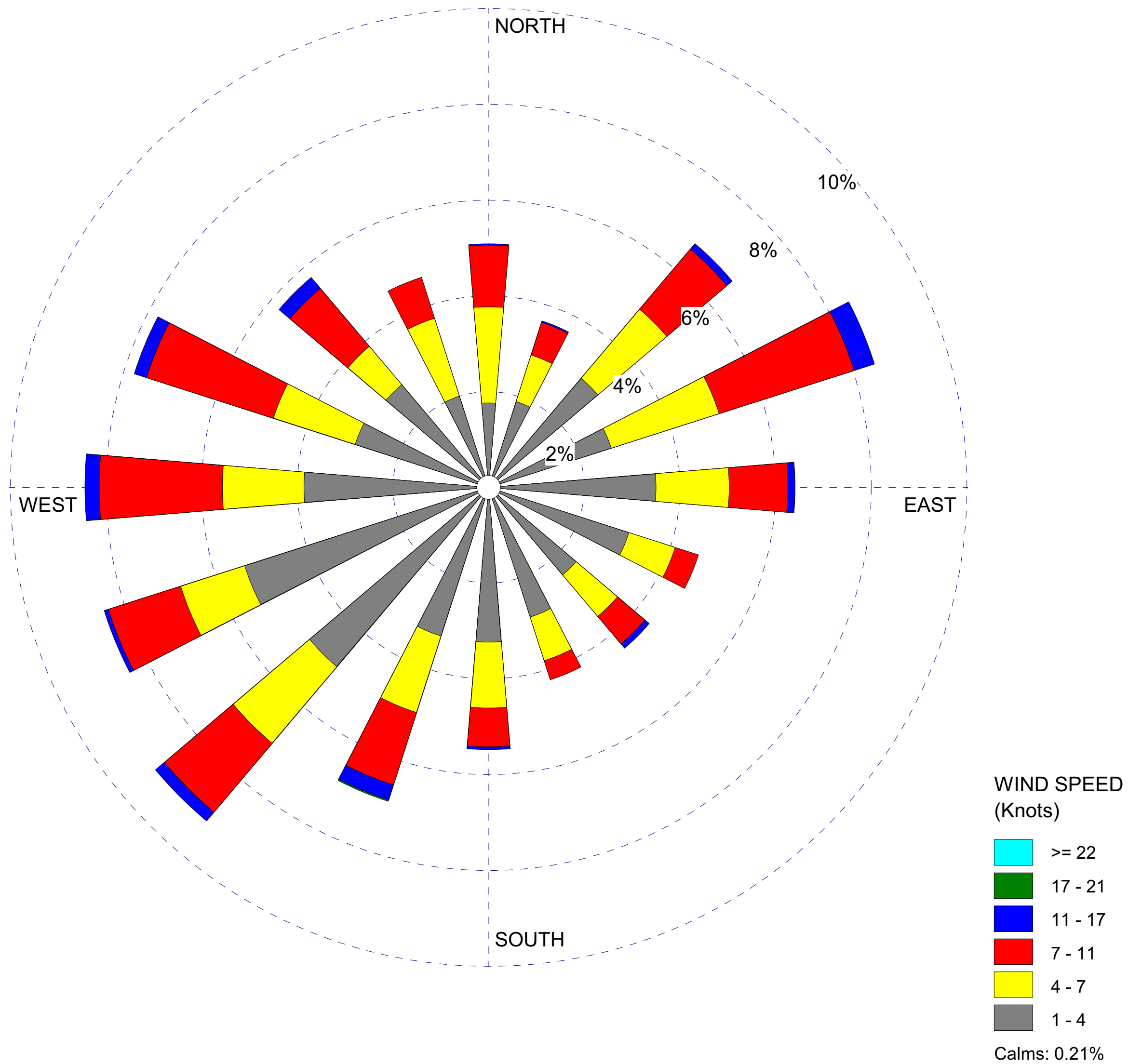

Figure 2.3-207 (Sheet 2 of 12)
VEGP 10-m Level February Wind Rose (1998–2002)

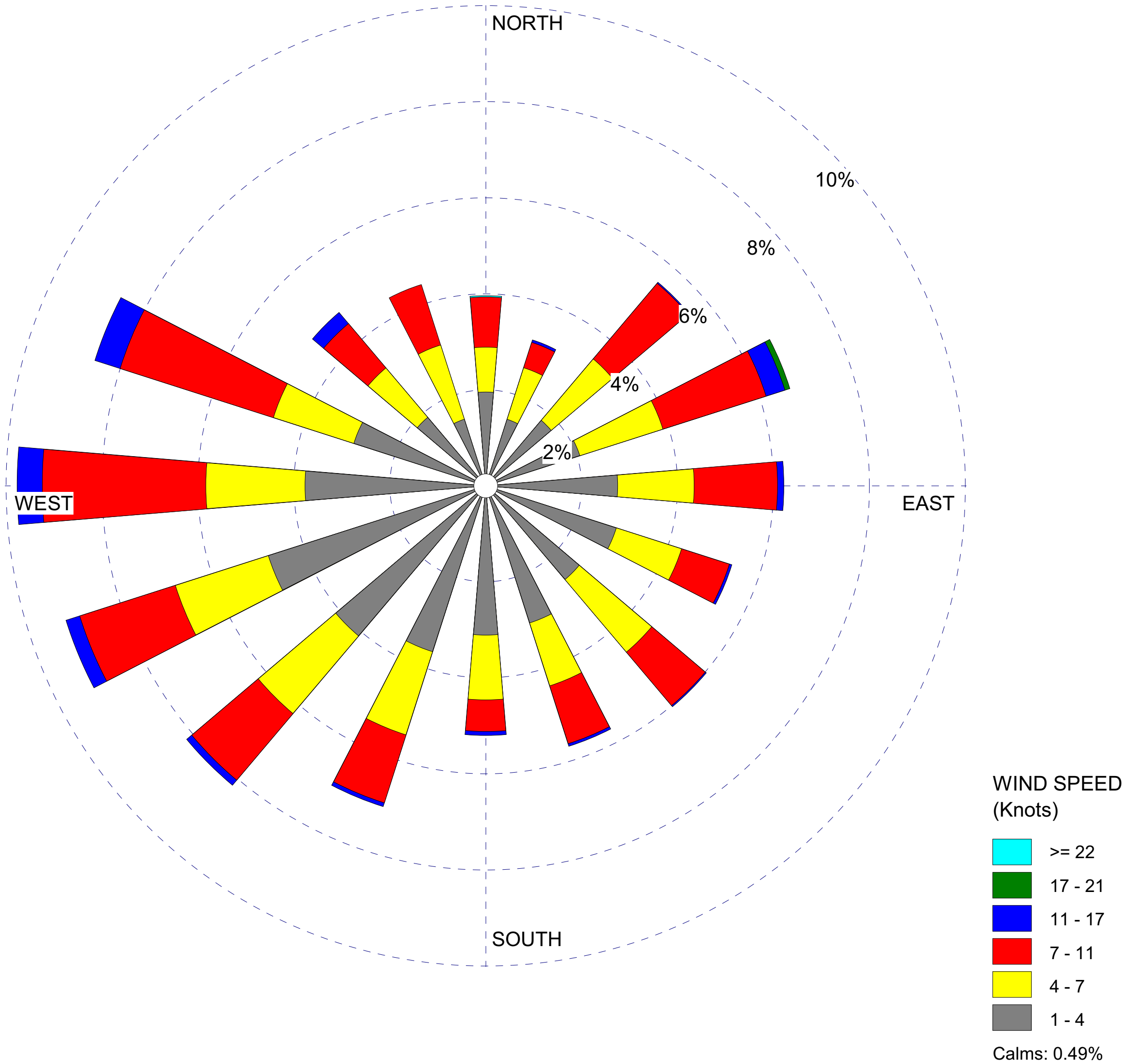

Figure 2.3-207 (Sheet 3 of 12)
VEGP 10-m Level March Wind Rose (1998–2002)

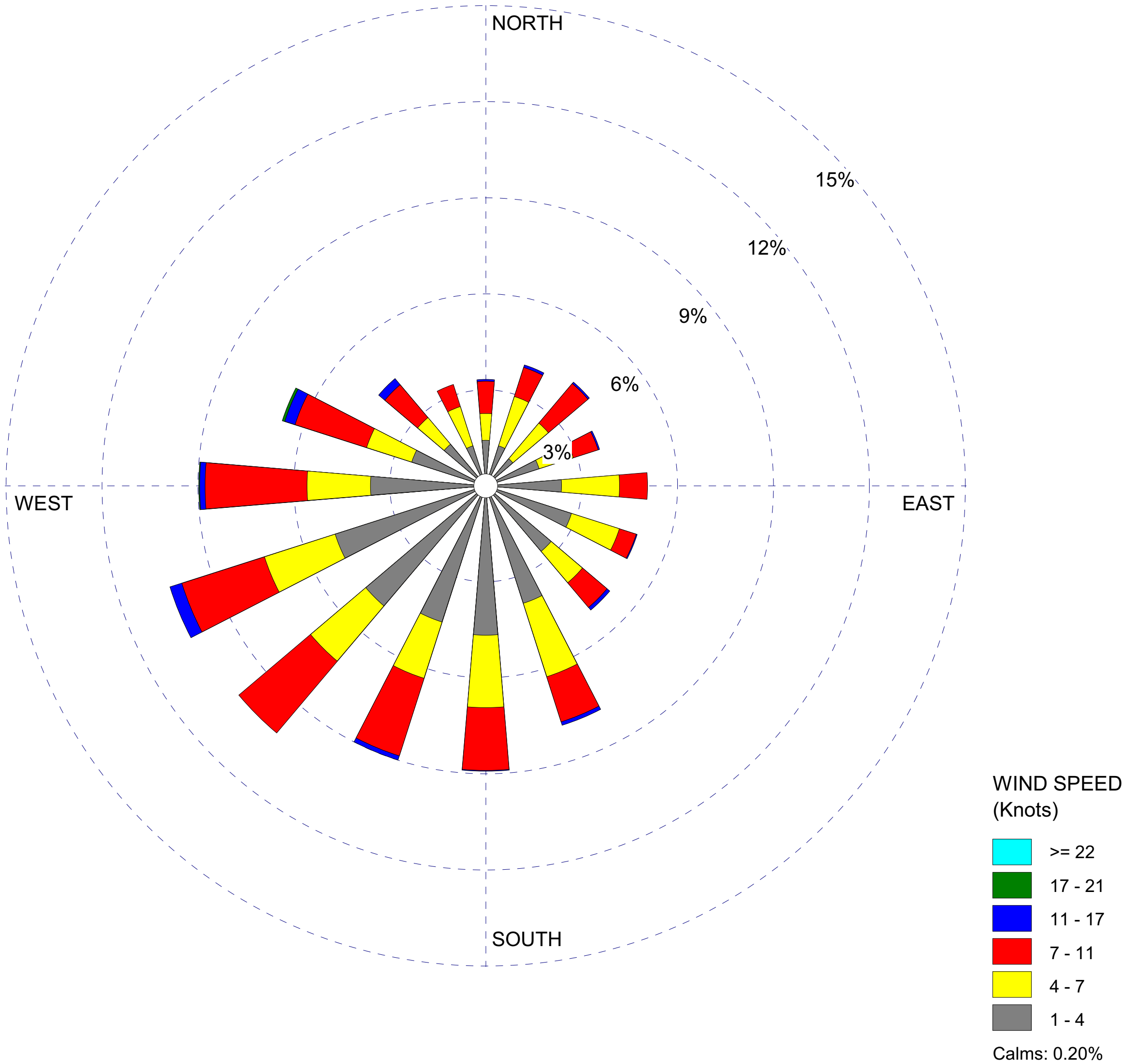

Figure 2.3-207 (Sheet 4 of 12)
VEGP 10-m Level April Wind Rose (1998–2002)

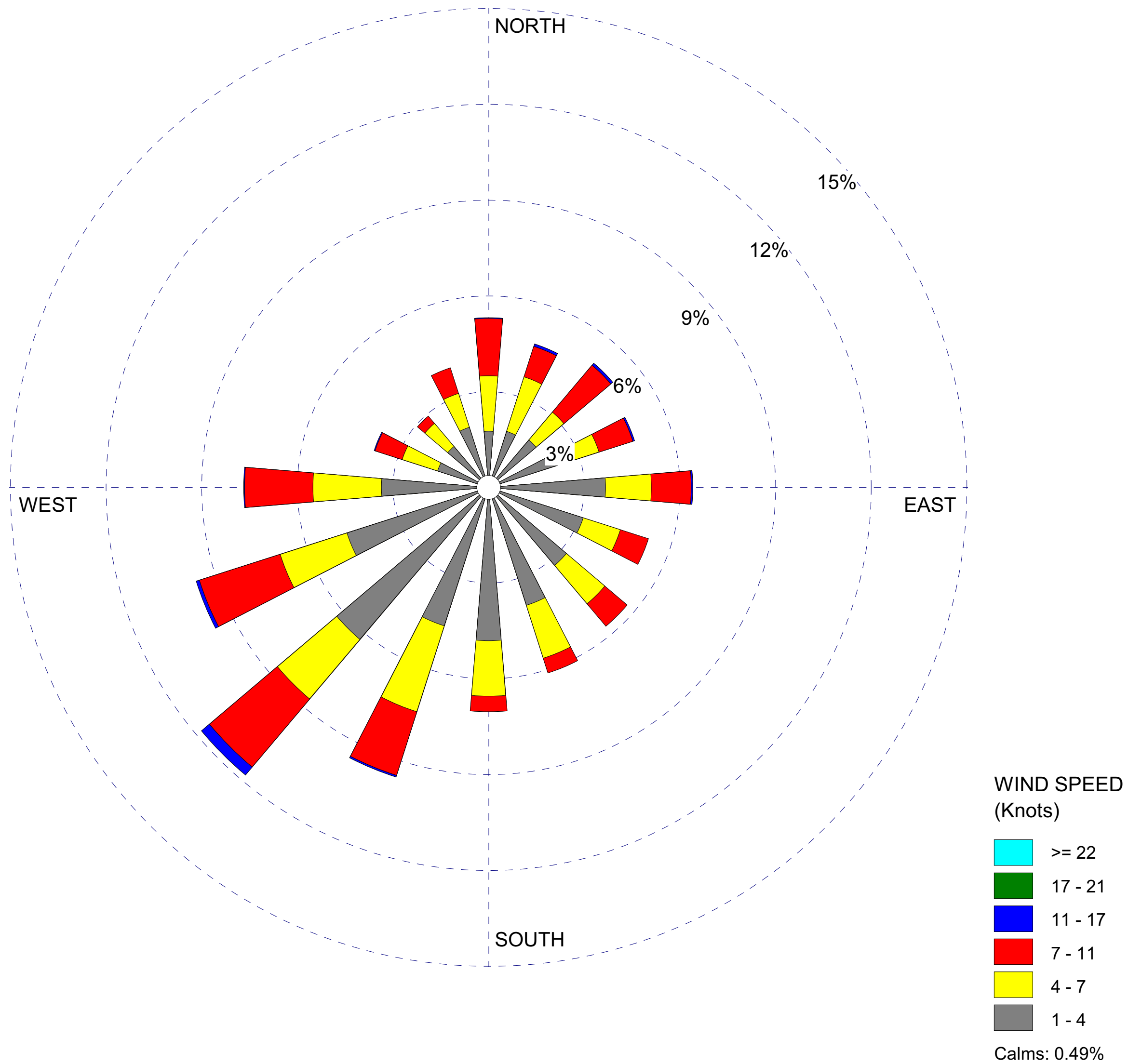

Figure 2.3-207 (Sheet 5 of 12)
VEGP 10-m Level May Wind Rose (1998–2002)

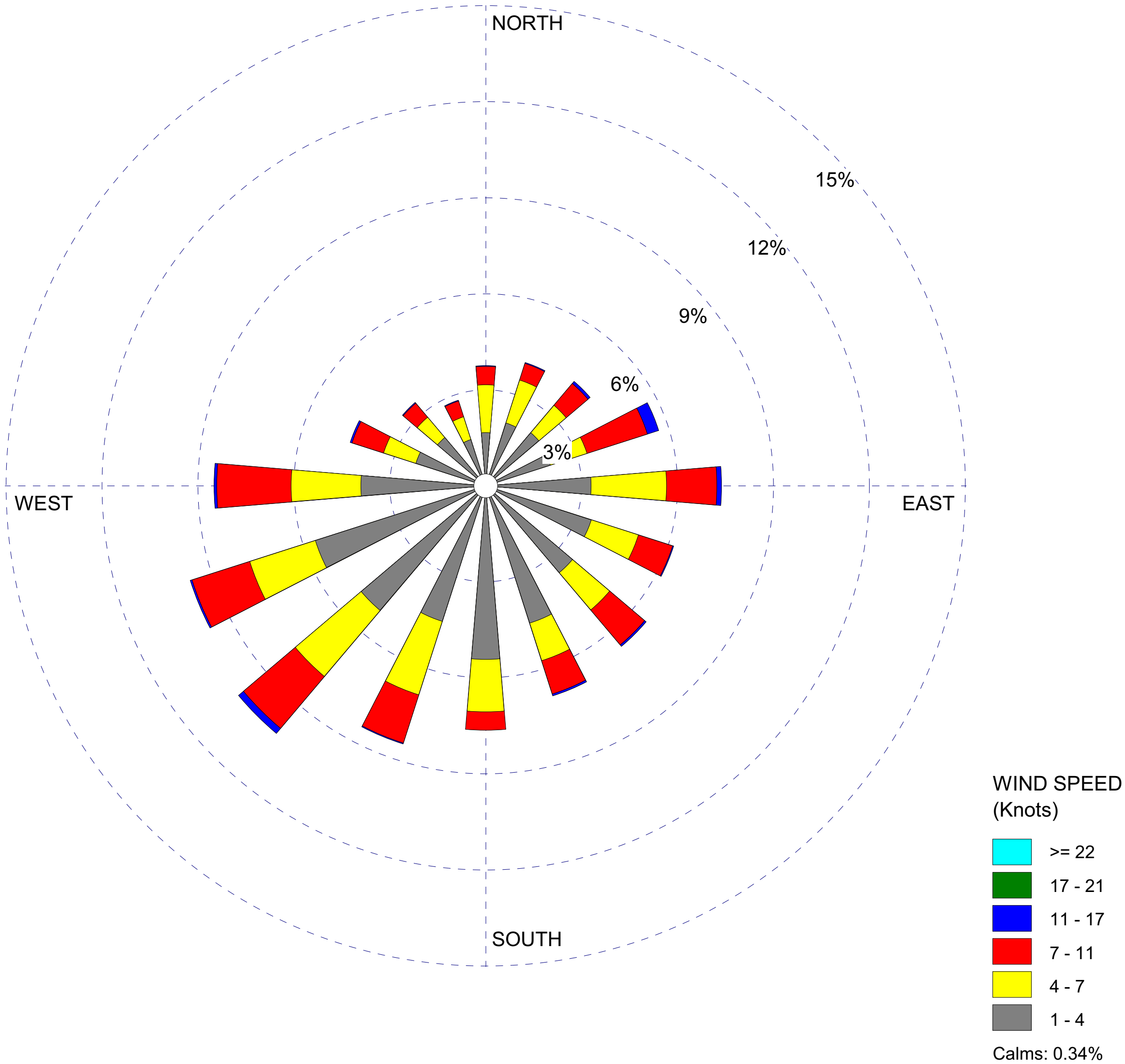

Figure 2.3-207 (Sheet 6 of 12)
VEGP 10-m Level June Wind Rose (1998–2002)

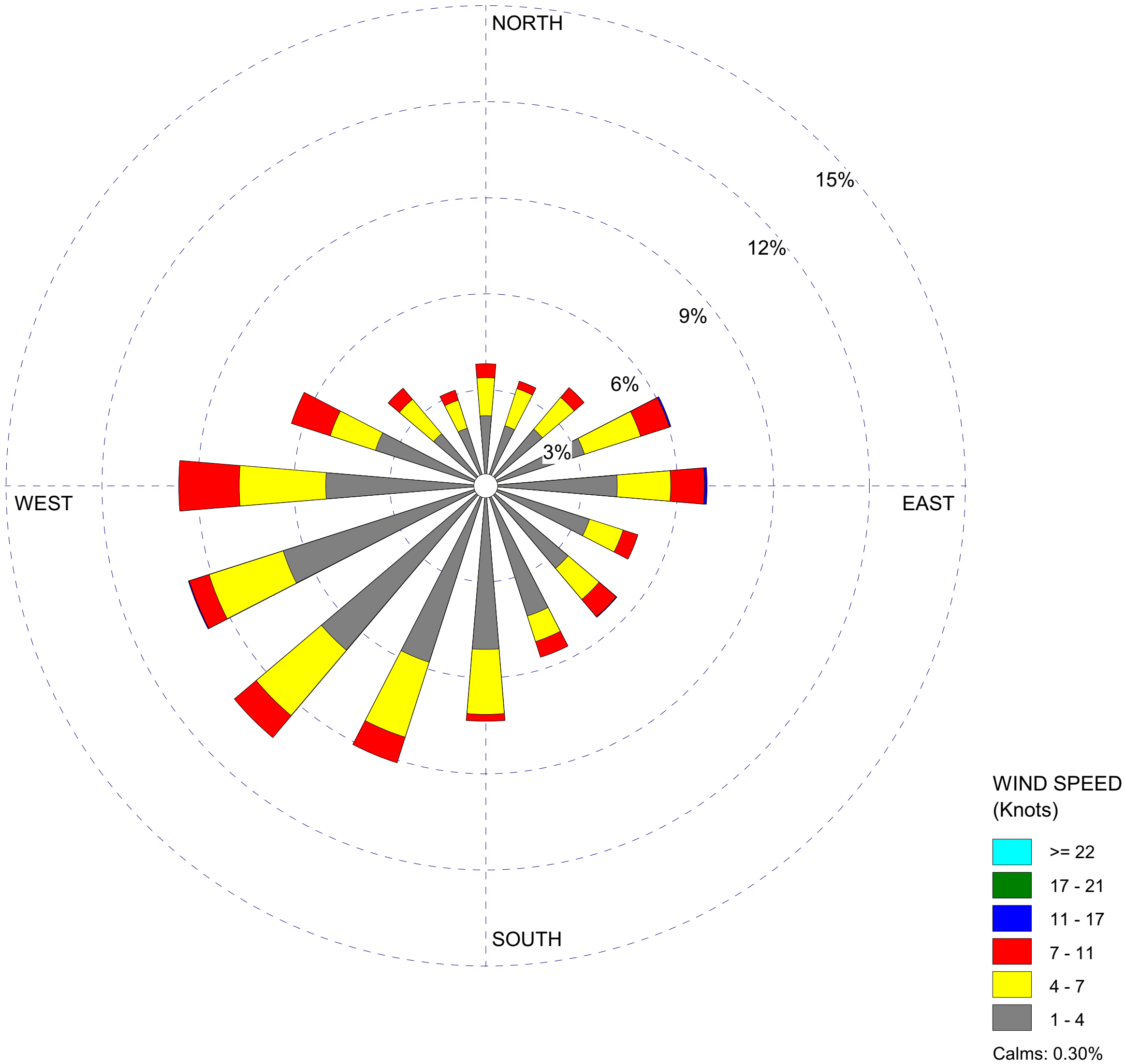

Figure 2.3-207 (Sheet 7 of 12)
VEGP 10-m Level July Wind Rose (1998–2002)

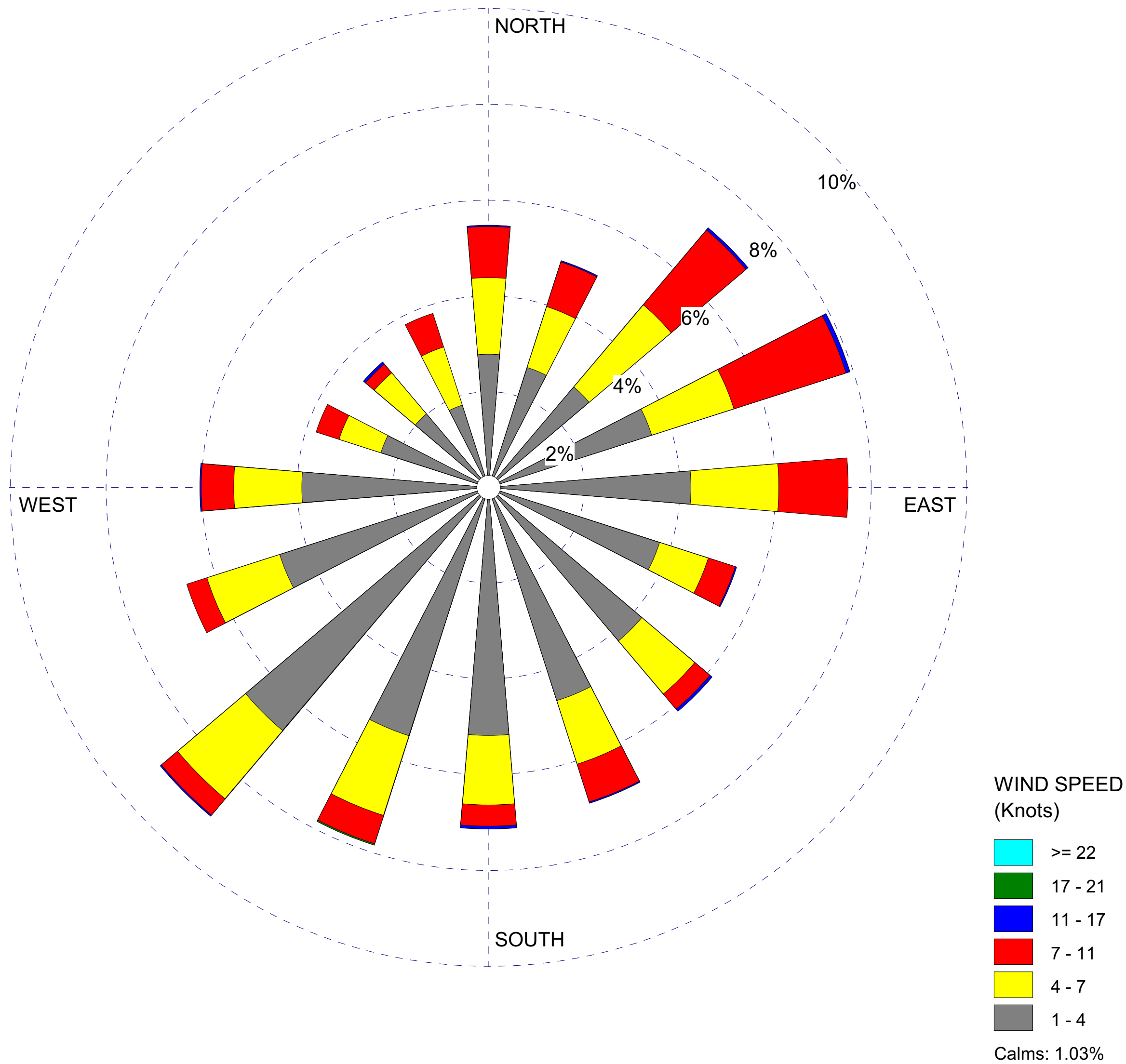

Figure 2.3-207 (Sheet 8 of 12)
VEGP 10-m Level August Wind Rose (1998–2002)

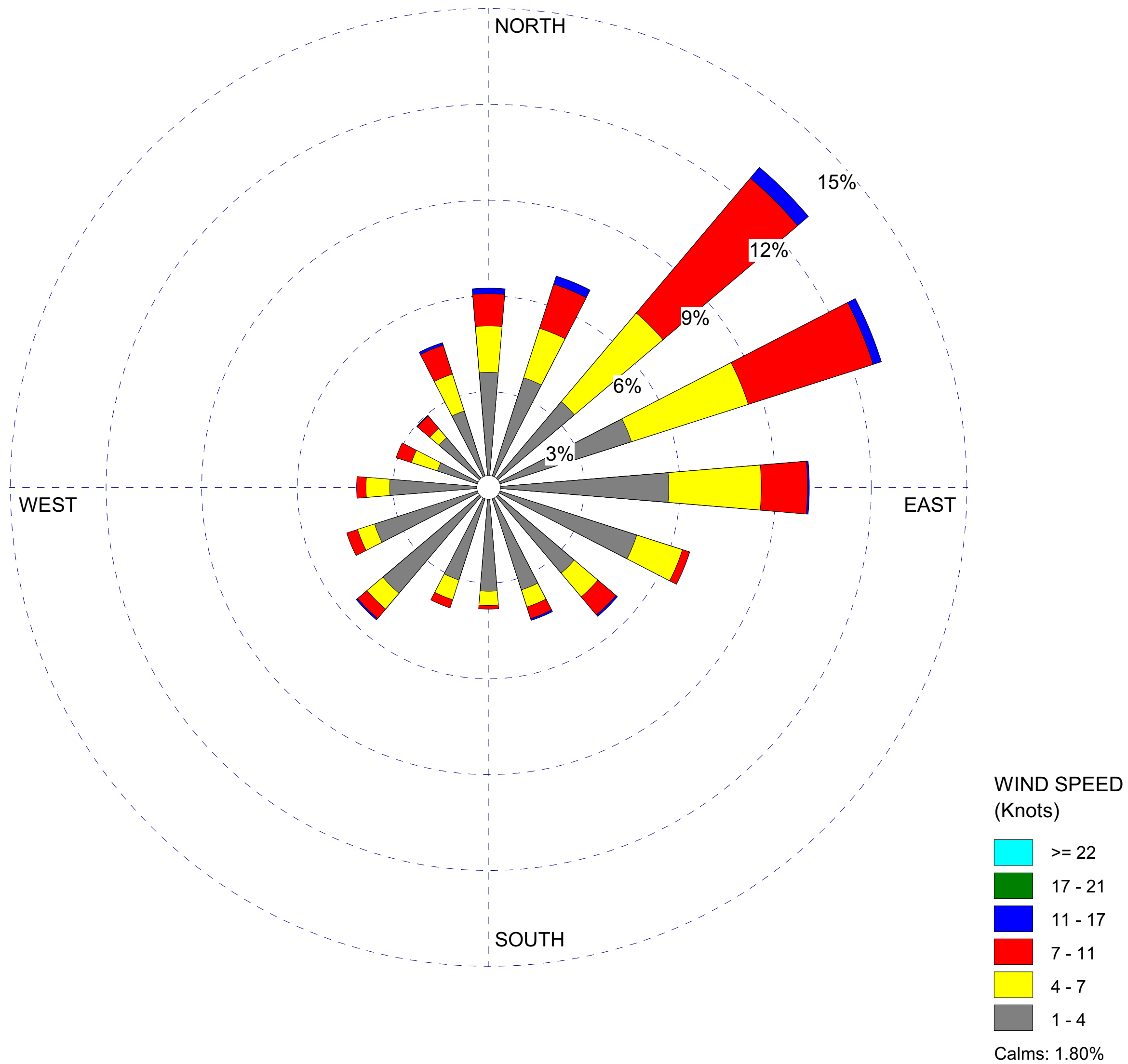

Figure 2.3-207 (Sheet 9 of 12)
VEGP 10-m Level September Wind Rose (1998–2002)

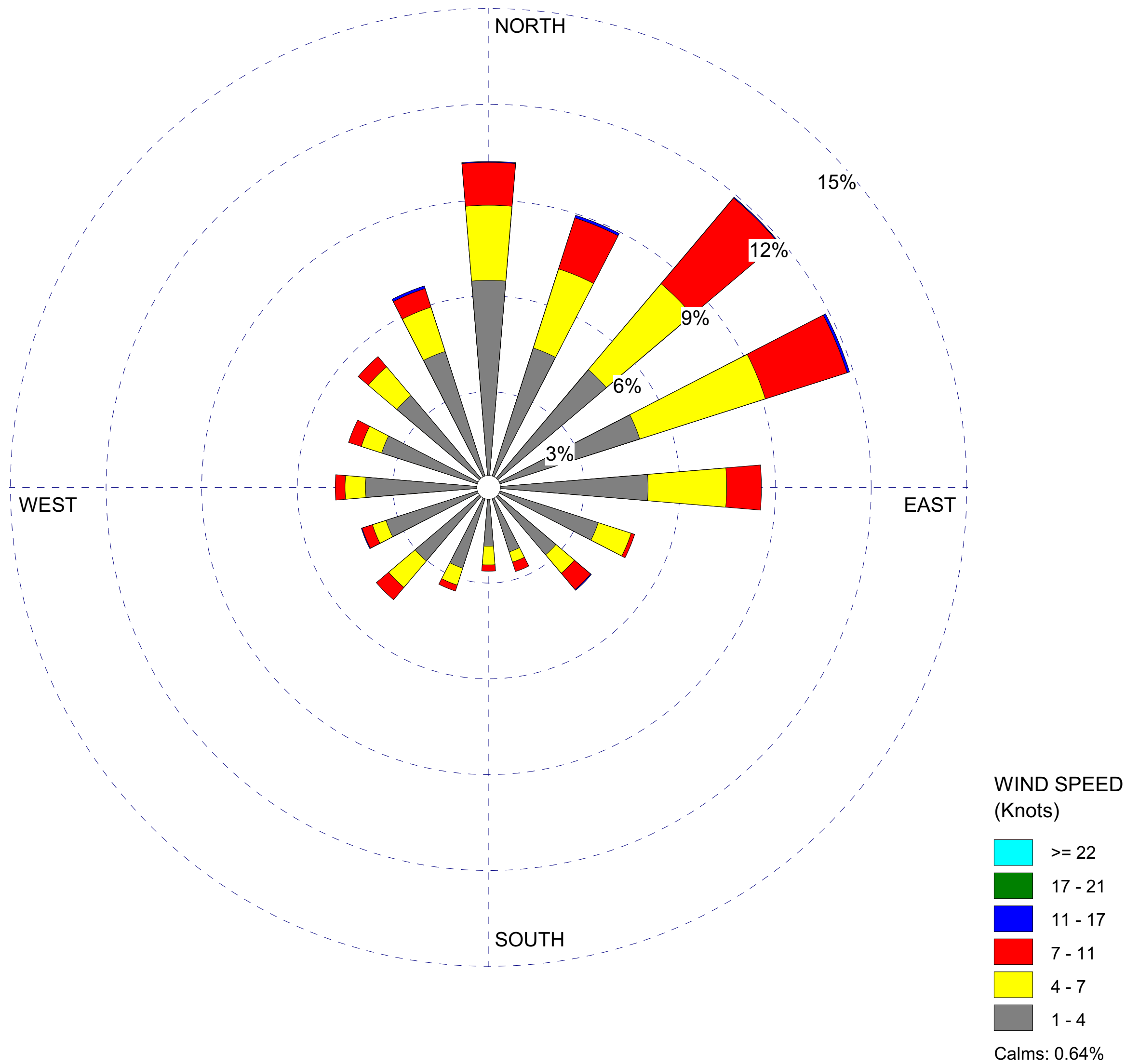

Figure 2.3-207 (Sheet 10 of 12)
VEGP 10-m Level October Wind Rose (1998–2002)

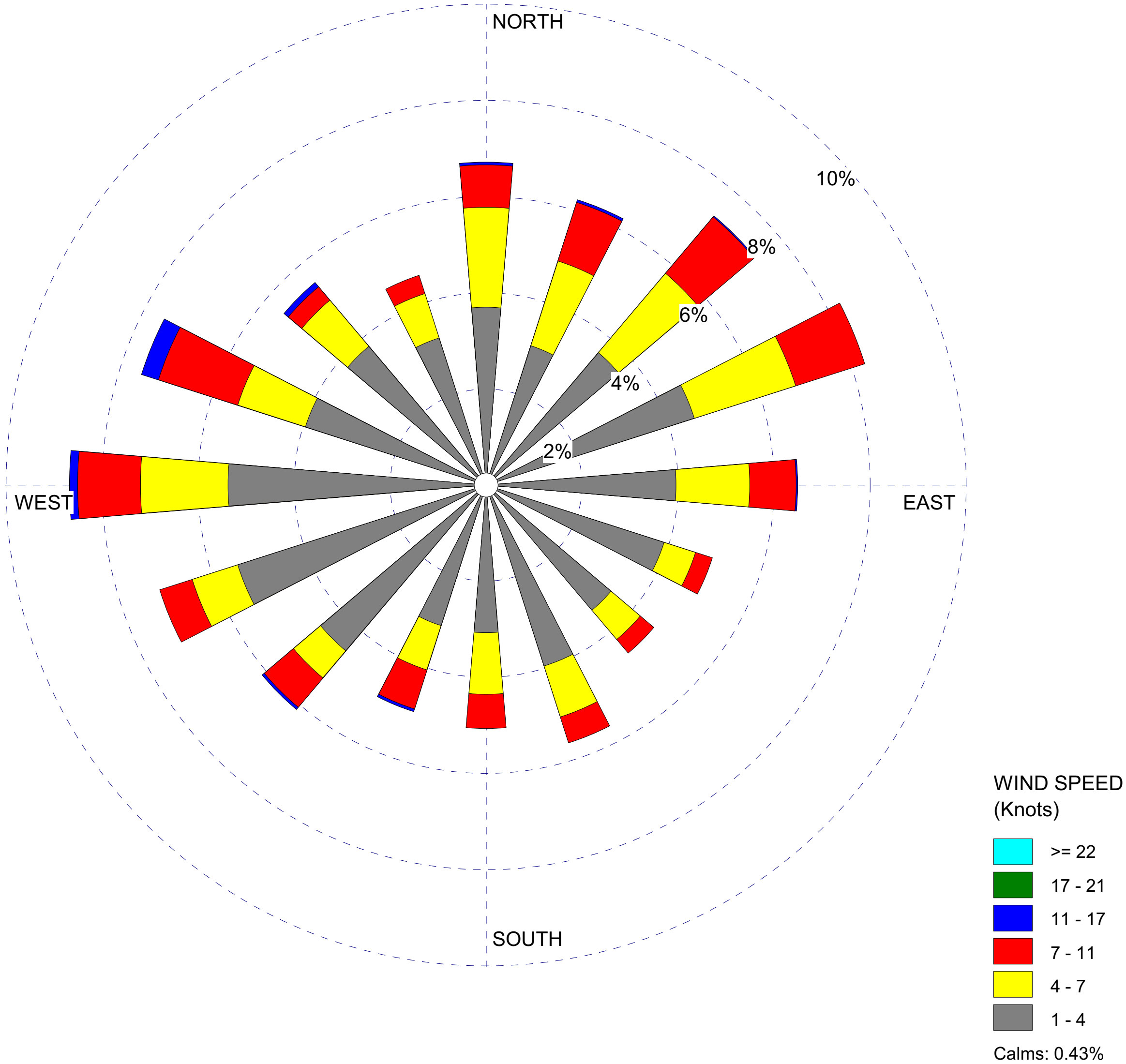

Figure 2.3-207 (Sheet 11 of 12)
VEGP 10-m Level November Wind Rose (1998–2002)

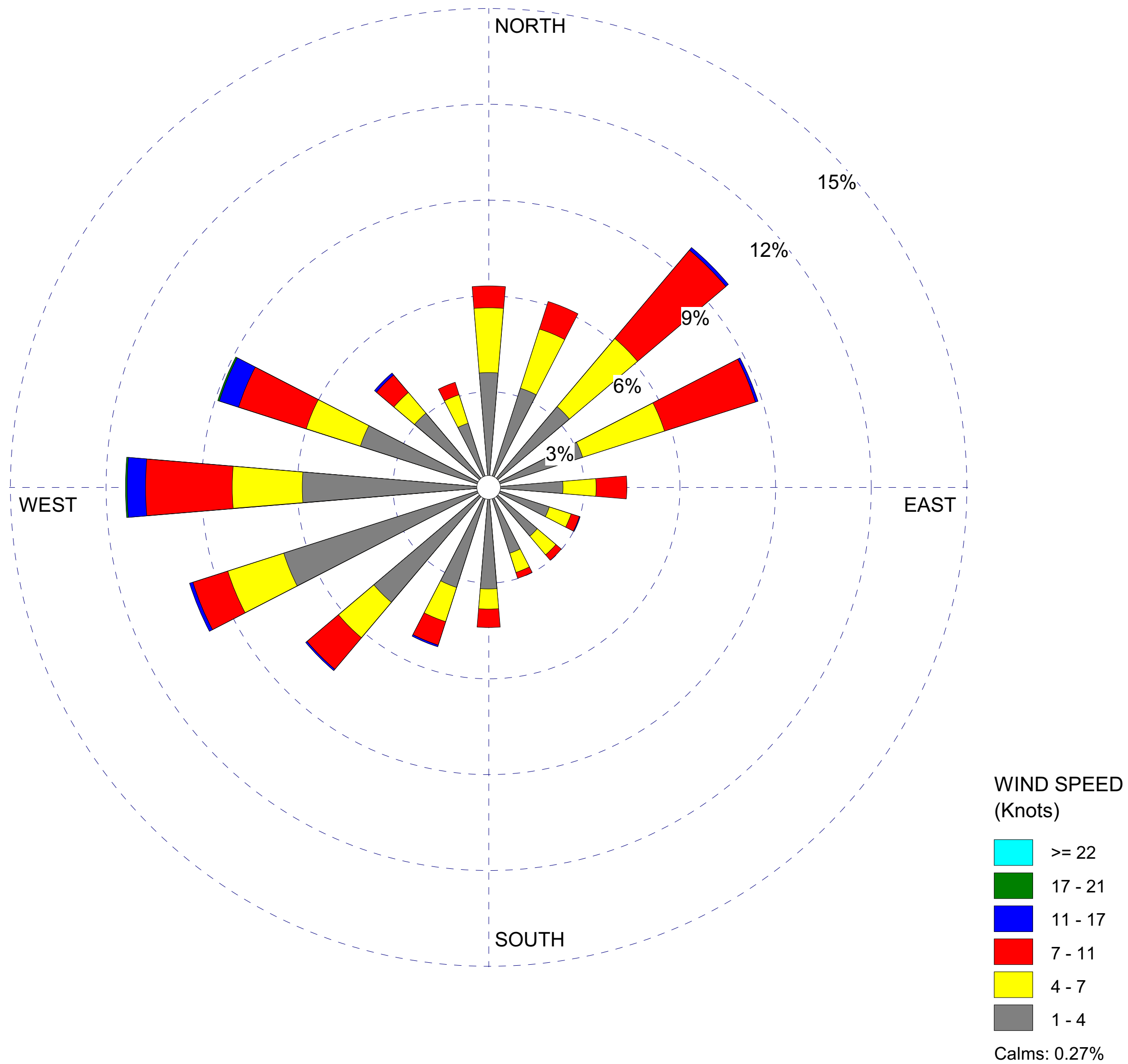

Figure 2.3-207 (Sheet 12 of 12)
VEGP 10-m Level December Wind Rose (1998–2002)

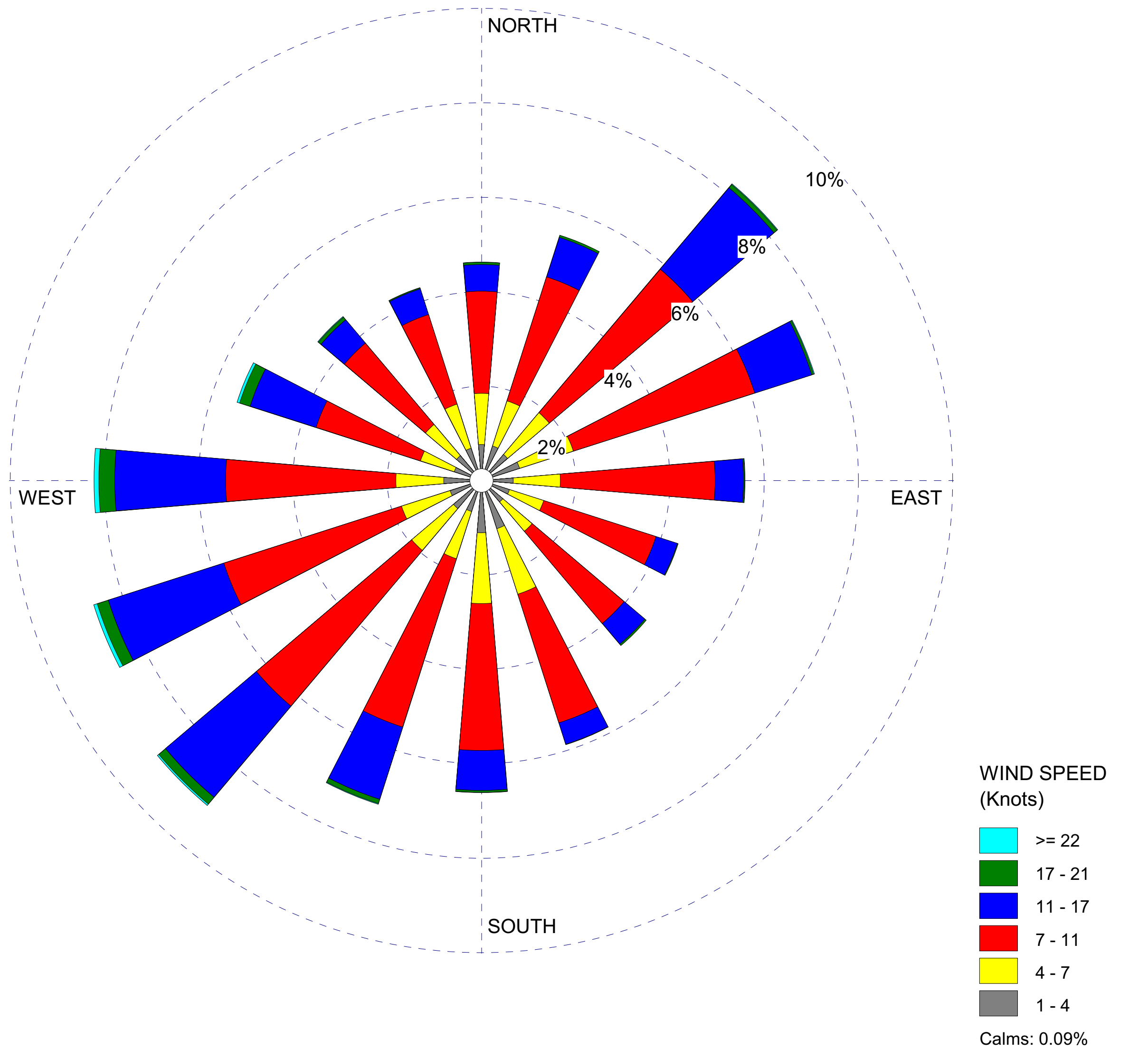

Figure 2.3-208
VEGP 60-m Level Annual Wind Rose (1998-2002)

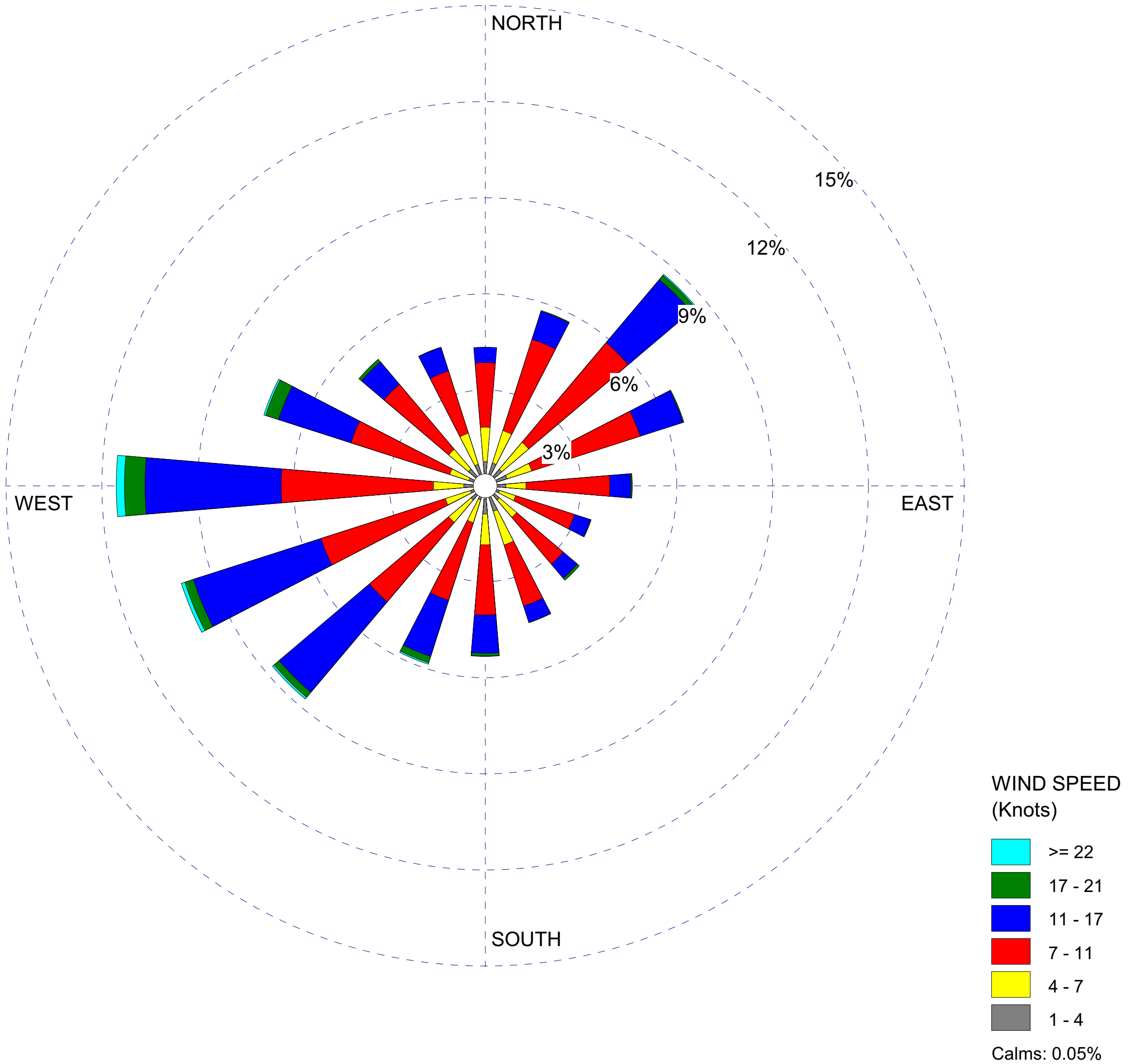

Figure 2.3-209
VEGP 60-m Level Winter Wind Rose (1998-2002)

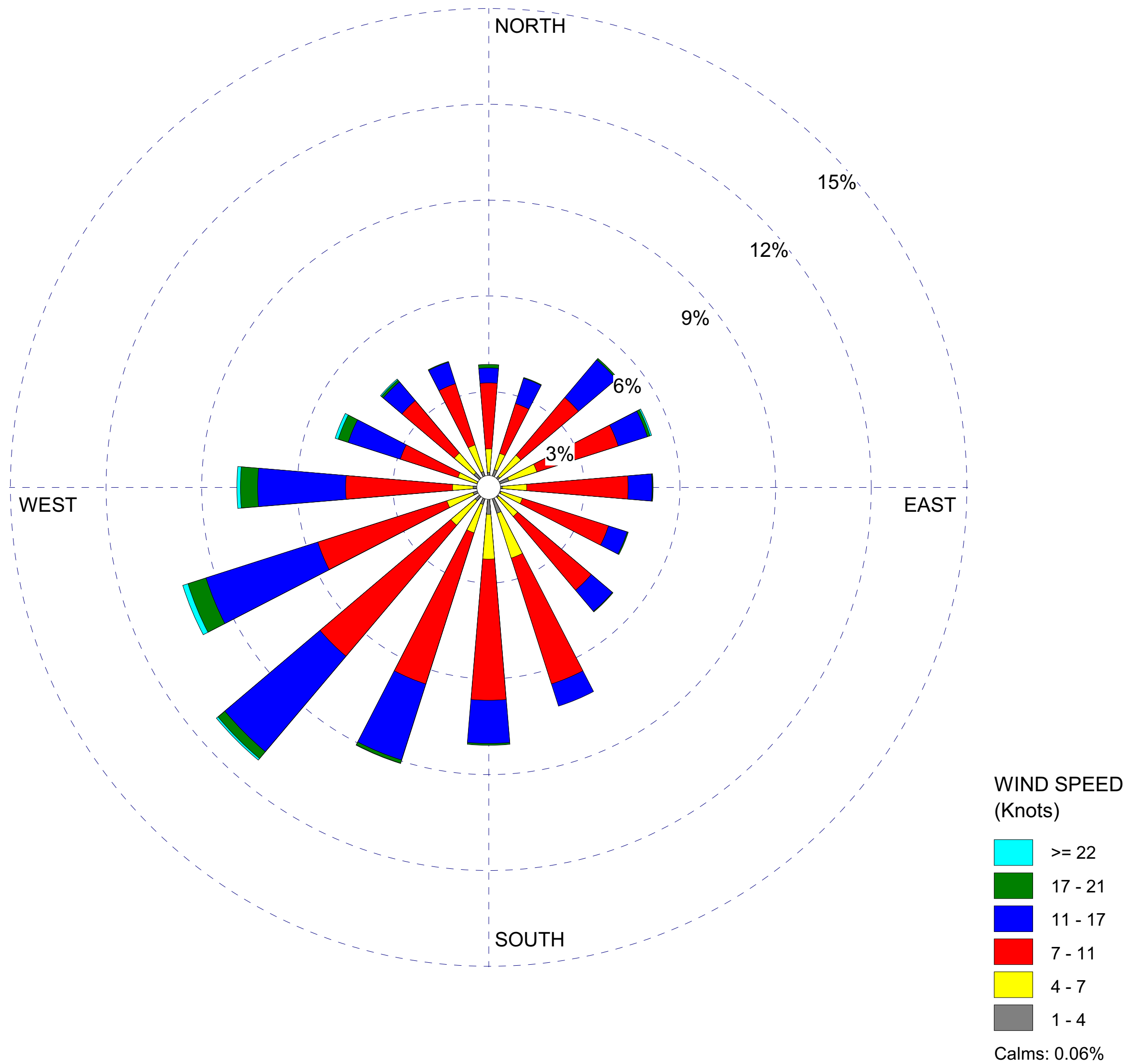

Figure 2.3-210
VEGP 60-m Level Spring Wind Rose (1998-2002)

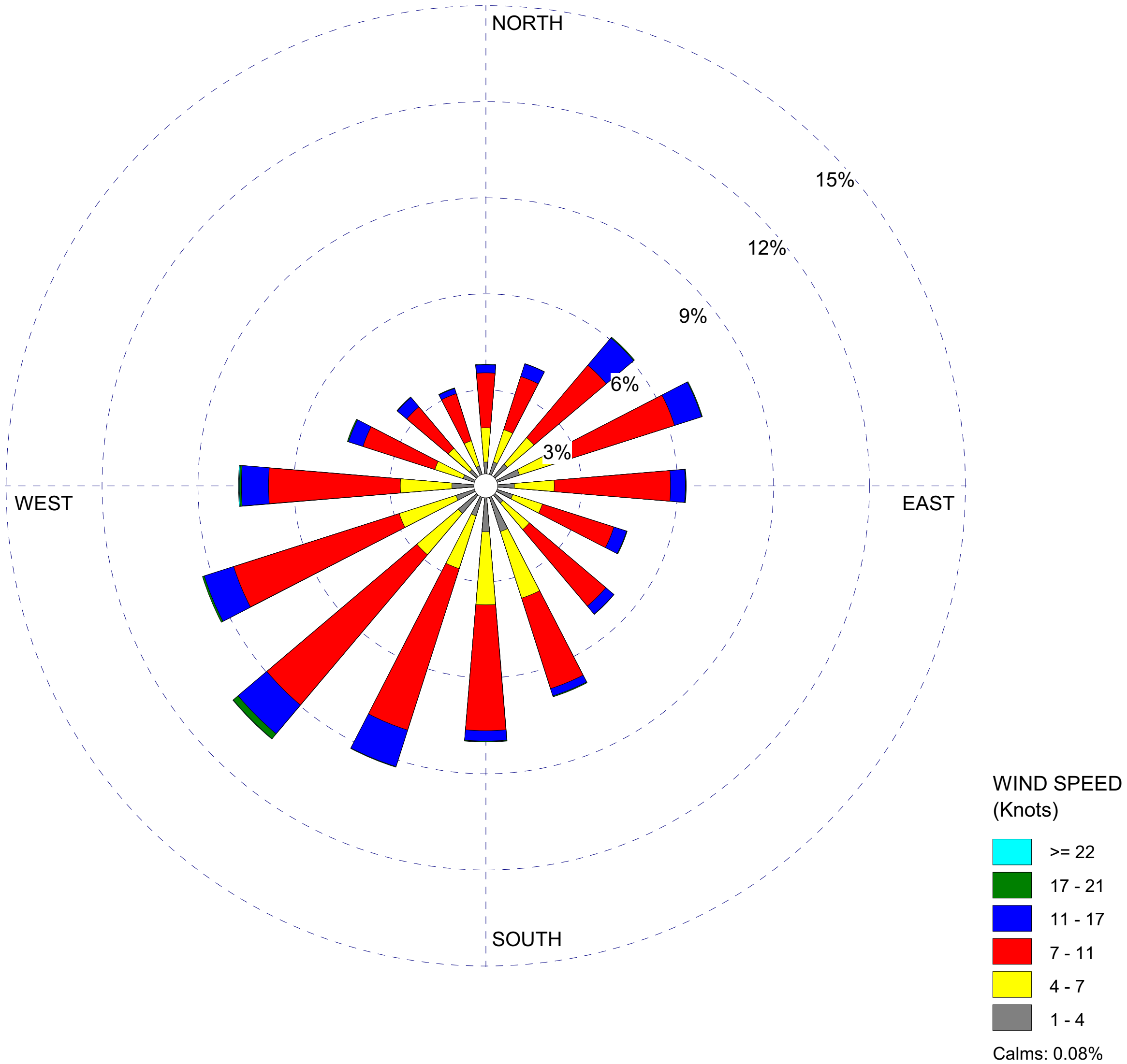

Figure 2.3-211
VEGP 60-m Level Summer Wind Rose (1998-2002)

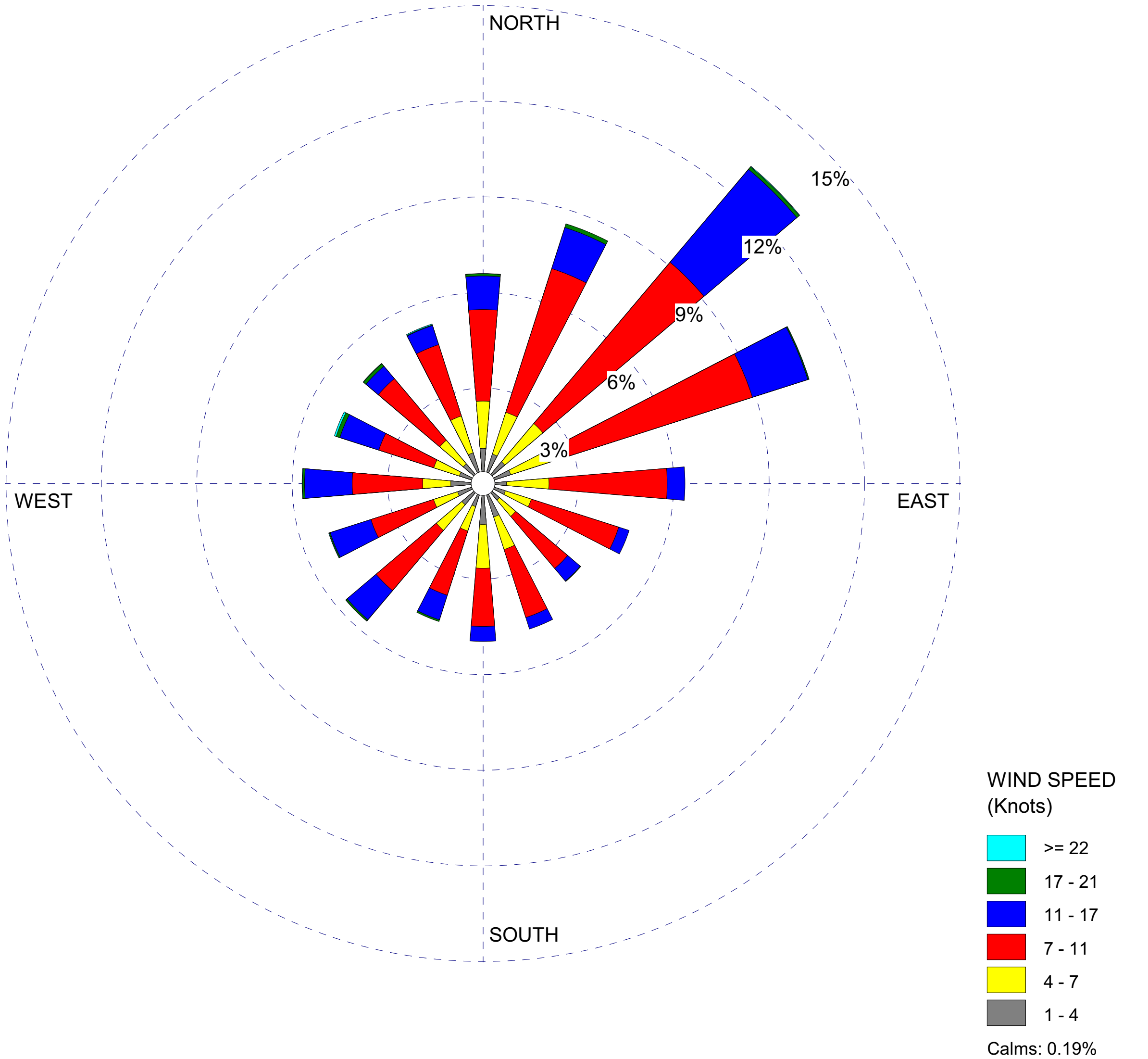

Figure 2.3-212
VEGP 60-m Level Autumn Wind Rose (1998-2002)

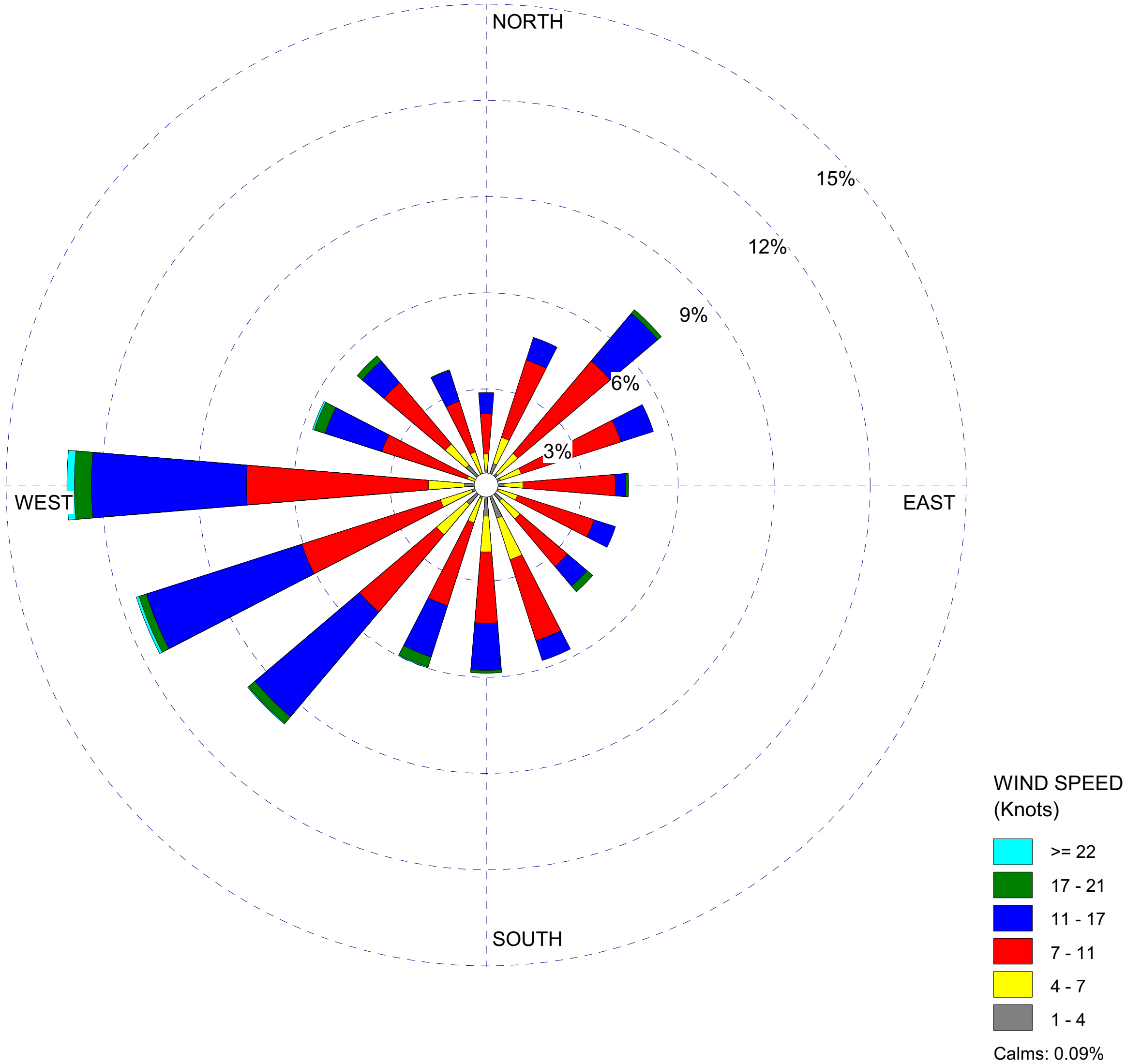

Figure 2.3-213 (Sheet 1 of 12)
VEGP 60-m Level January Wind Rose (1998–2002)

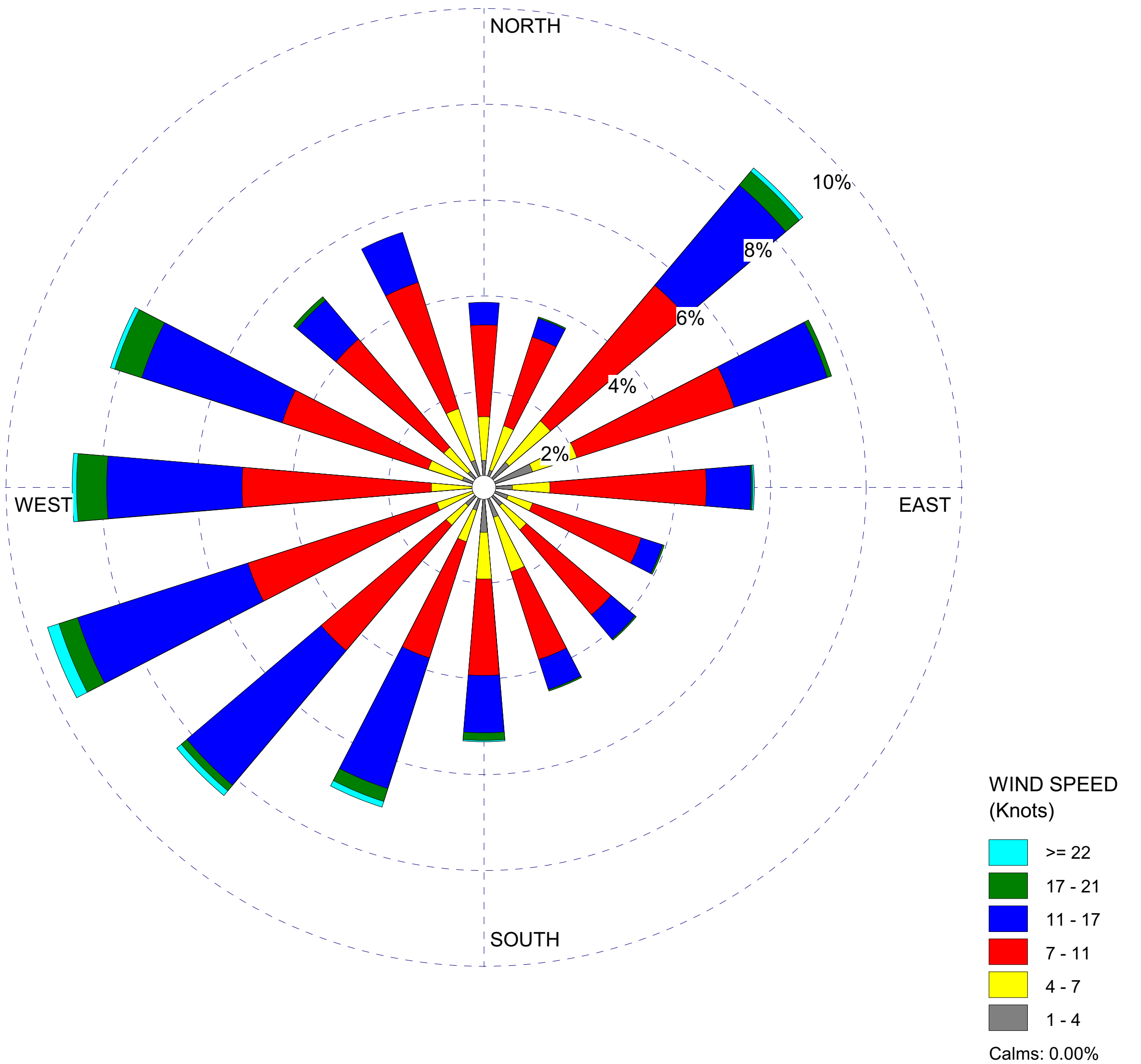

Figure 2.3-213 (Sheet 2 of 12)
VEGP 60-m Level February Wind Rose (1998–2002)

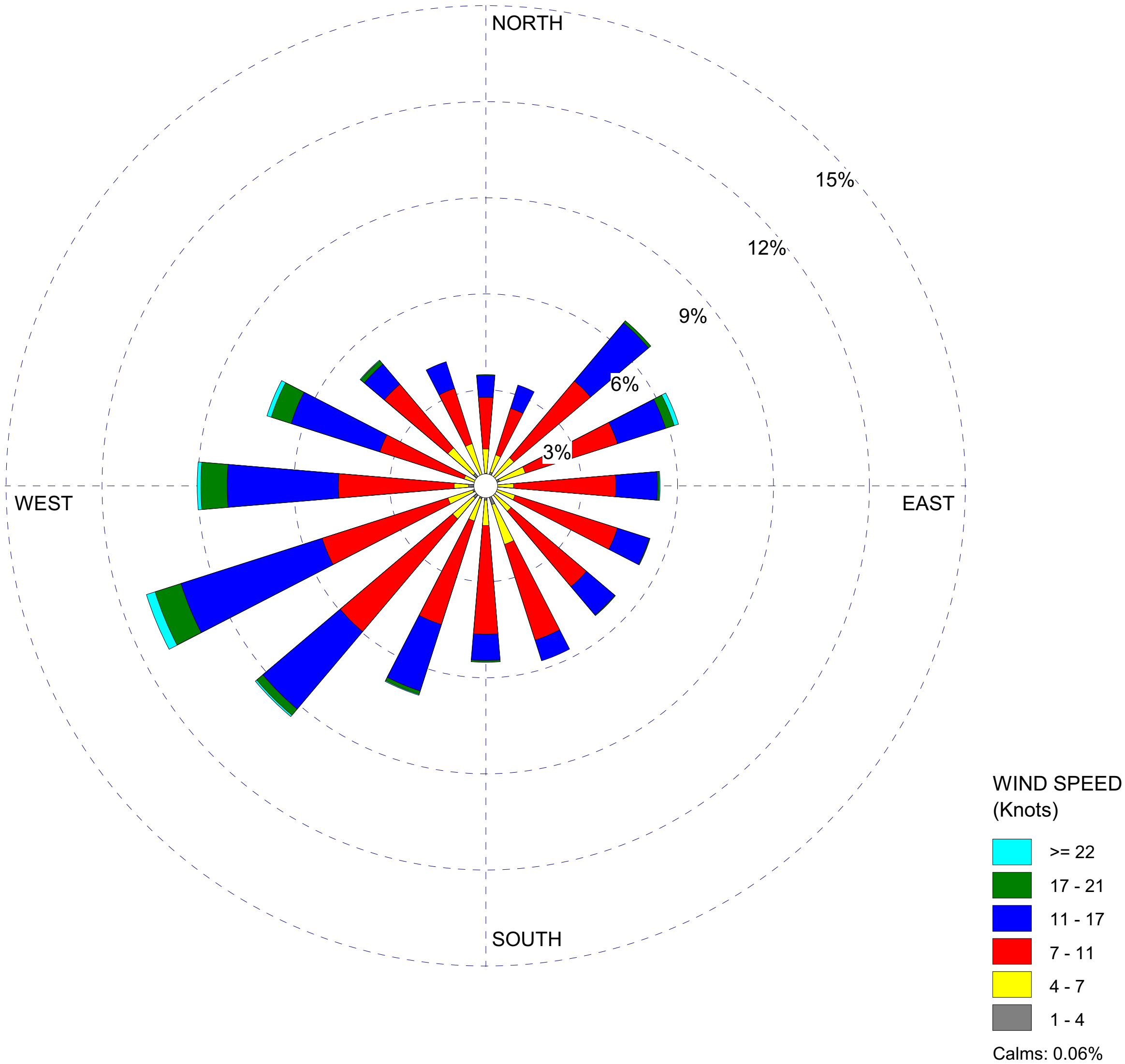

Figure 2.3-213 (Sheet 3 of 12)
VEGP 60-m Level March Wind Rose (1998–2002)

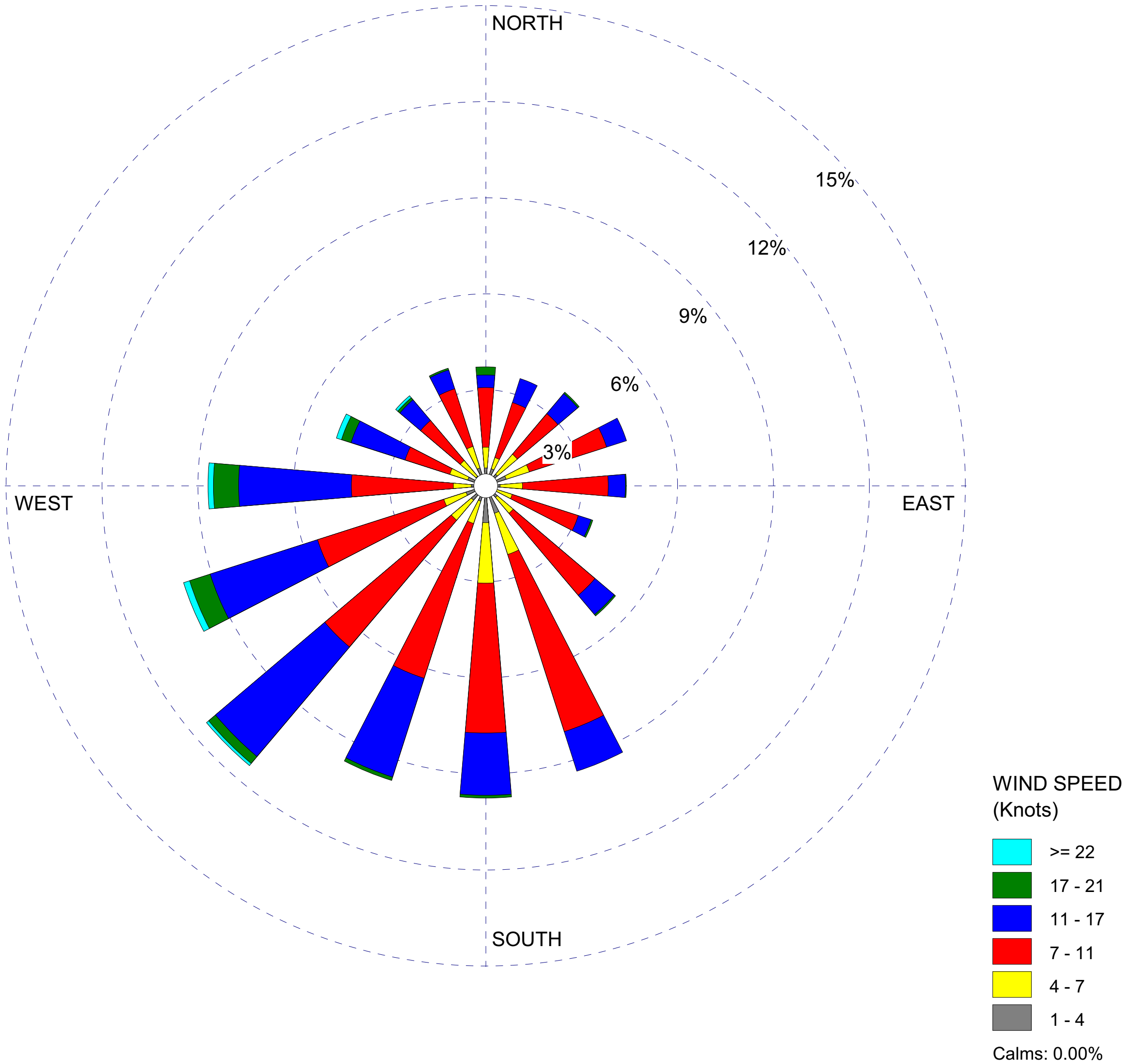

Figure 2.3-213 (Sheet 4 of 12)
VEGP 60-m Level April Wind Rose (1998–2002)

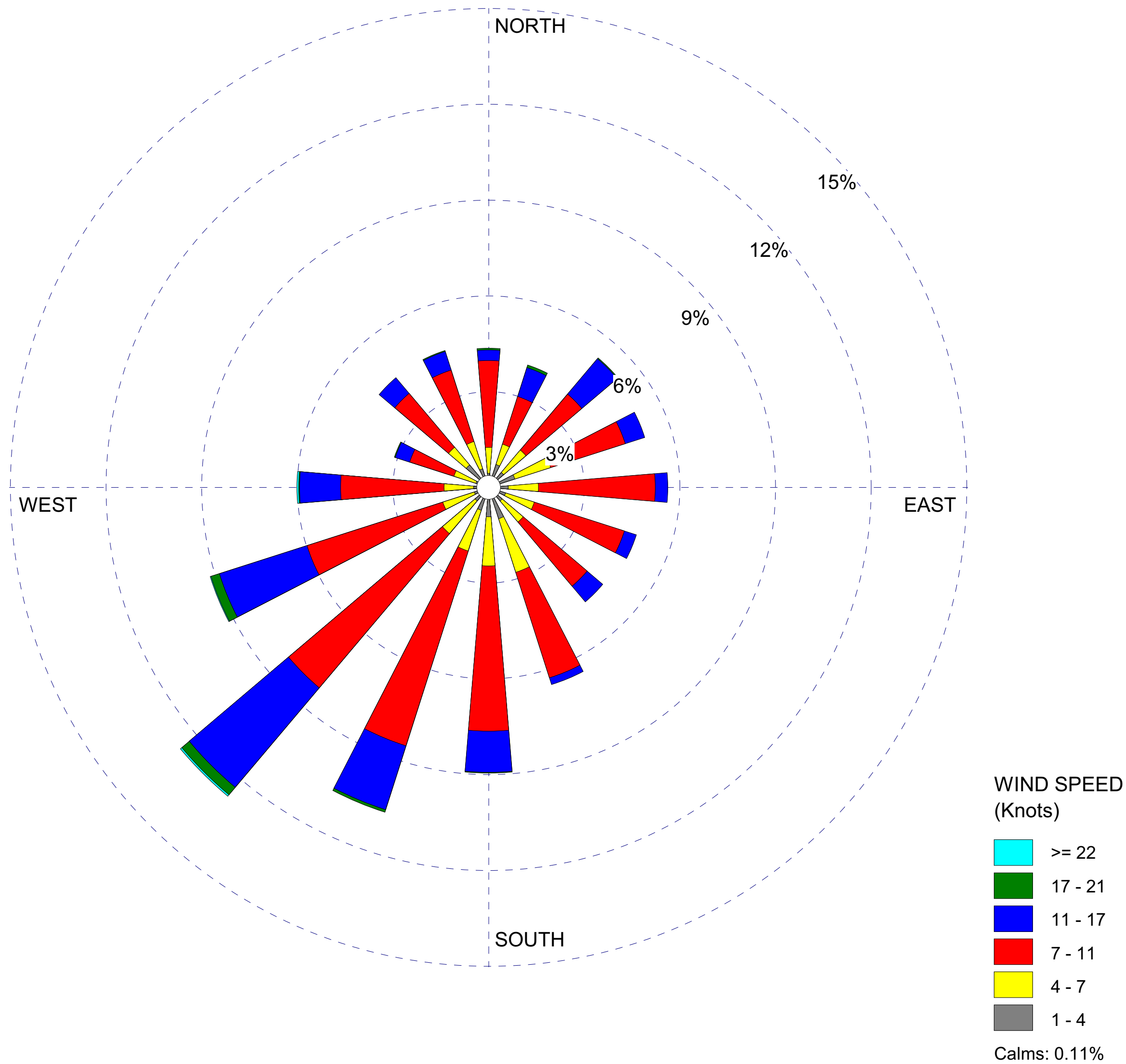

Figure 2.3-213 (Sheet 5 of 12)
VEGP 60-m Level May Wind Rose (1998–2002)

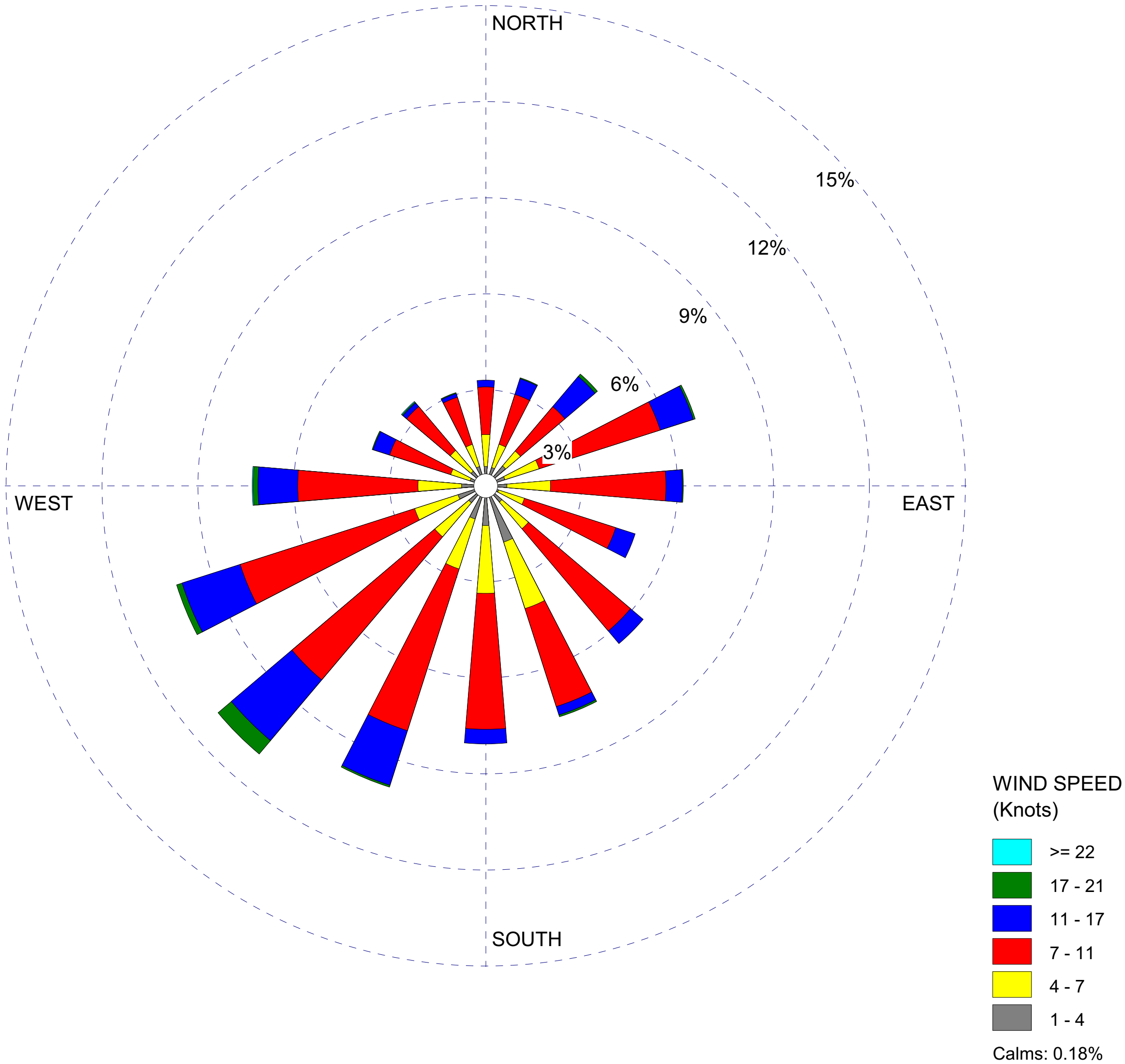

Figure 2.3-213 (Sheet 6 of 12)
VEGP 60-m Level June Wind Rose (1998–2002)

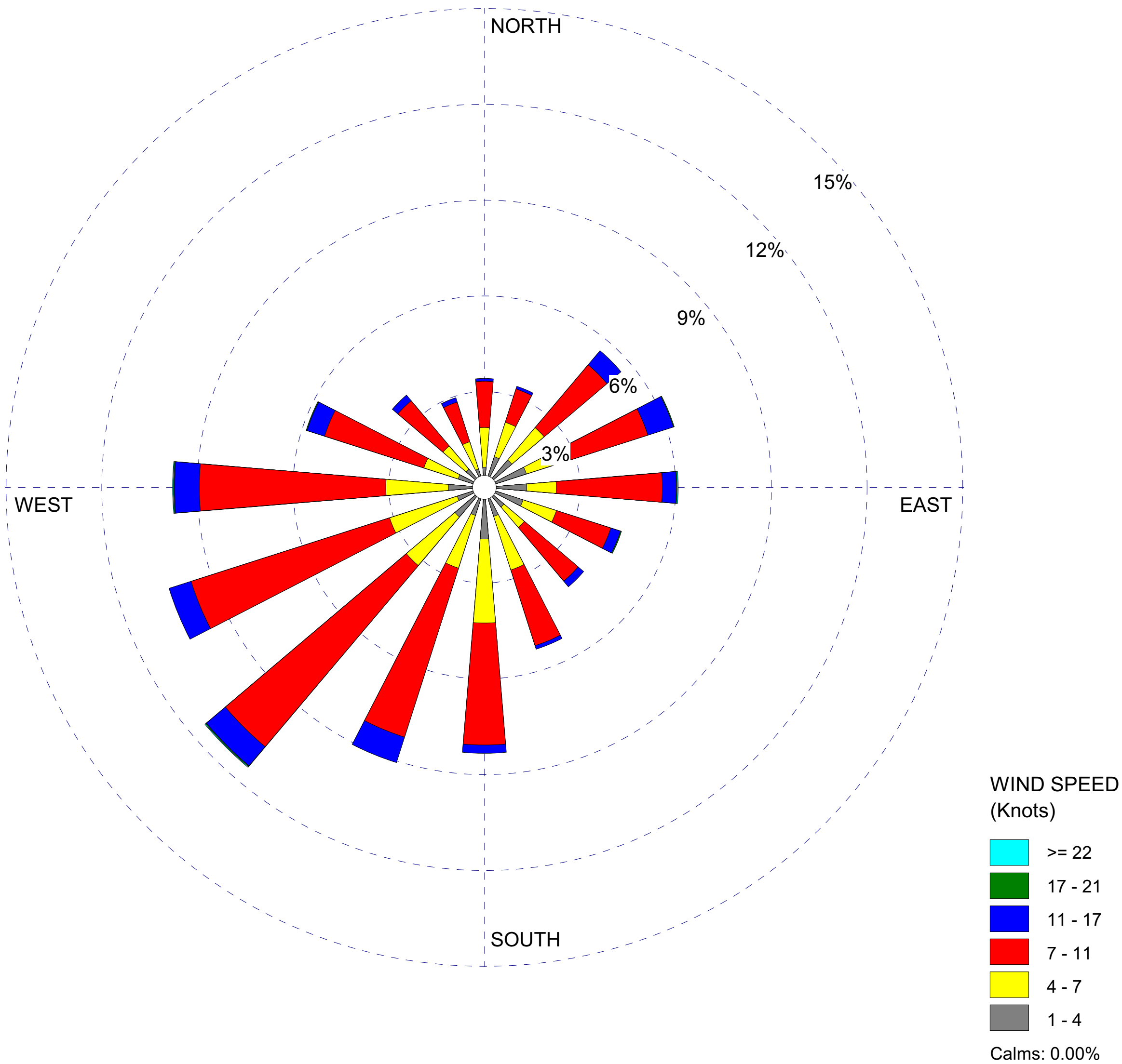

Figure 2.3-213 (Sheet 7 of 12)
VEGP 60-m Level July Wind Rose (1998–2002)

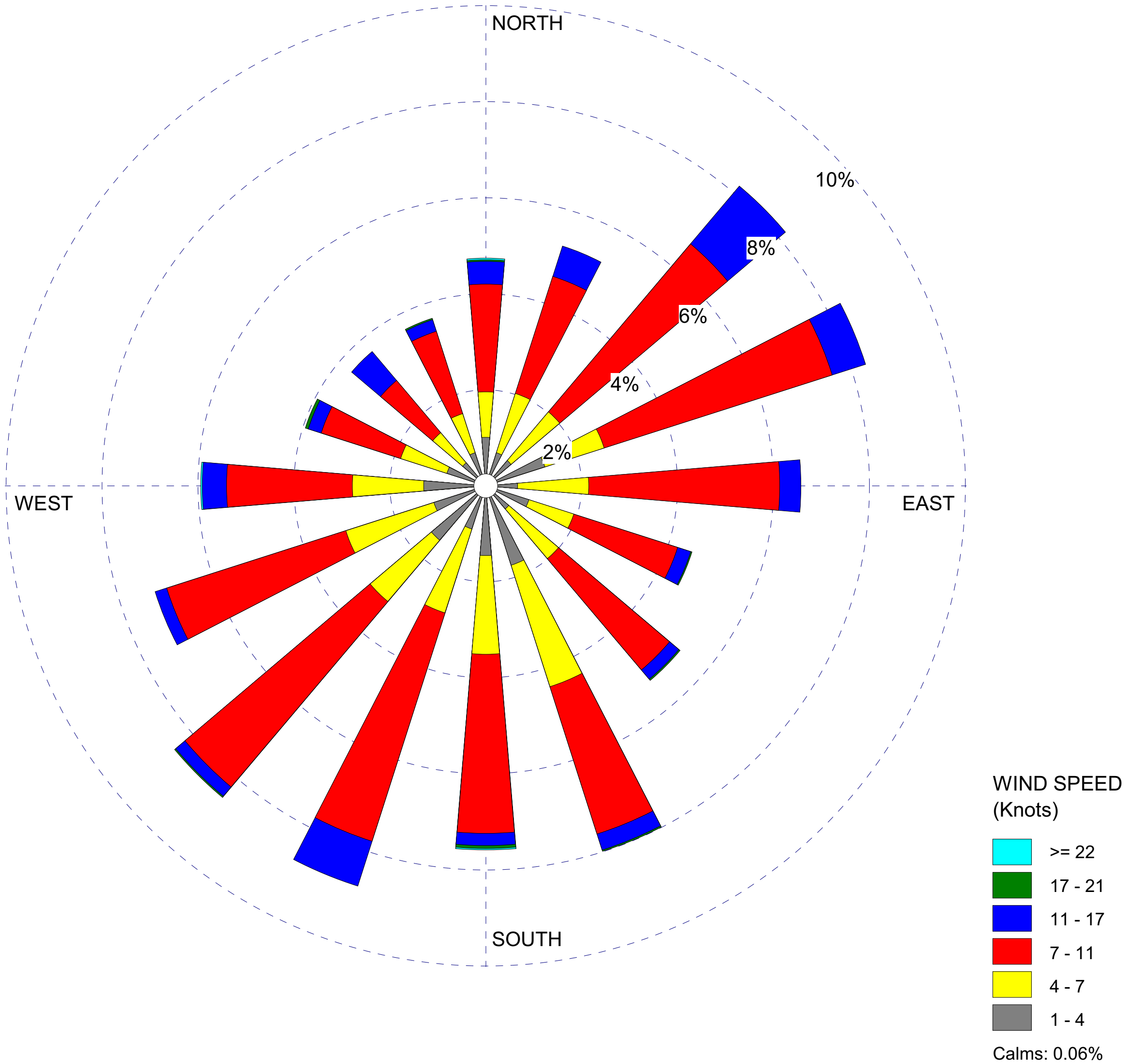

Figure 2.3-213 (Sheet 8 of 12)
VEGP 60-m Level August Wind Rose (1998–2002)

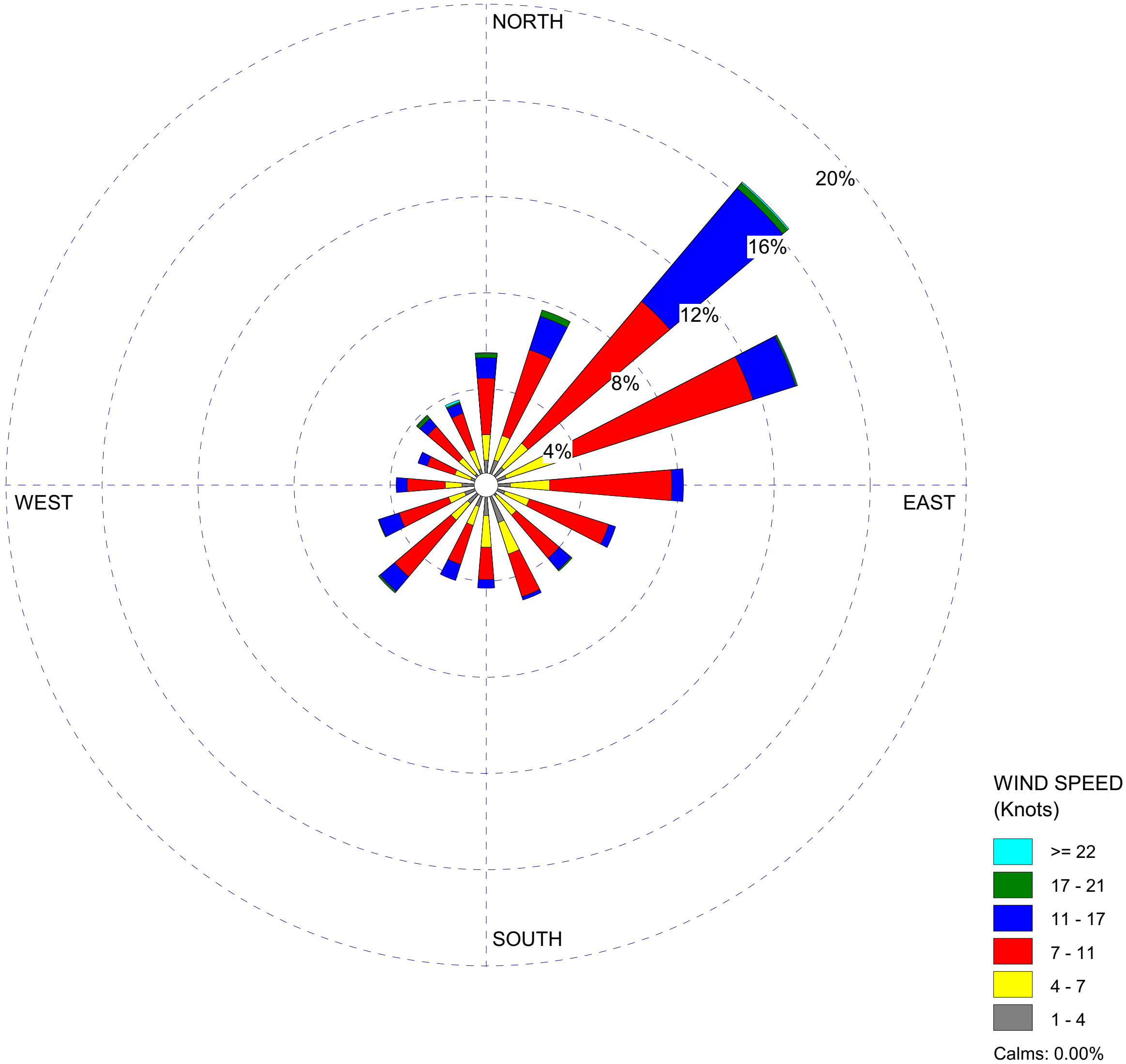

Figure 2.3-213 (Sheet 9 of 12)
VEGP 60-m Level September Wind Rose (1998–2002)

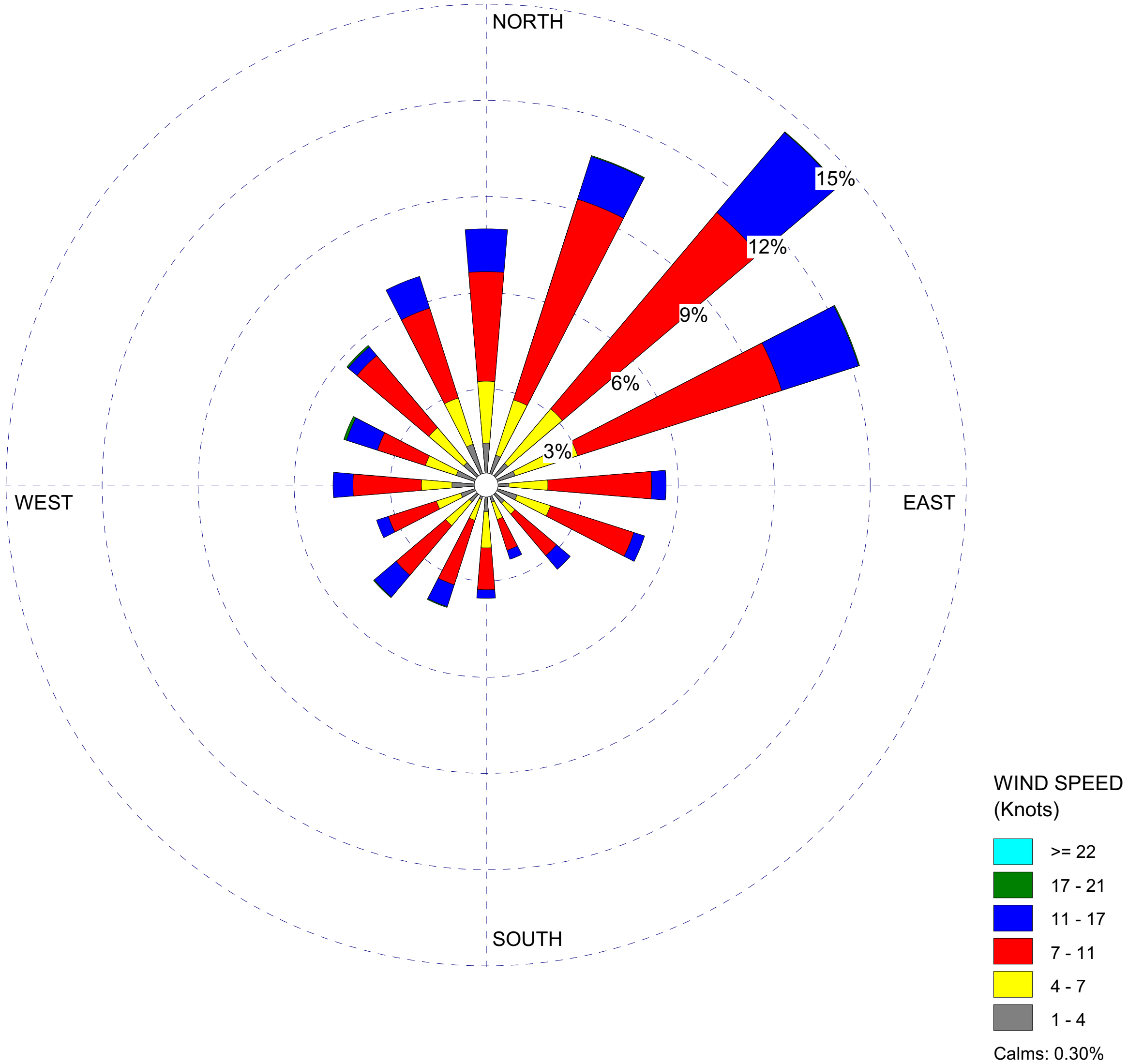

Figure 2.3-213 (Sheet 10 of 12)
VEGP 60-m Level October Wind Rose (1998–2002)

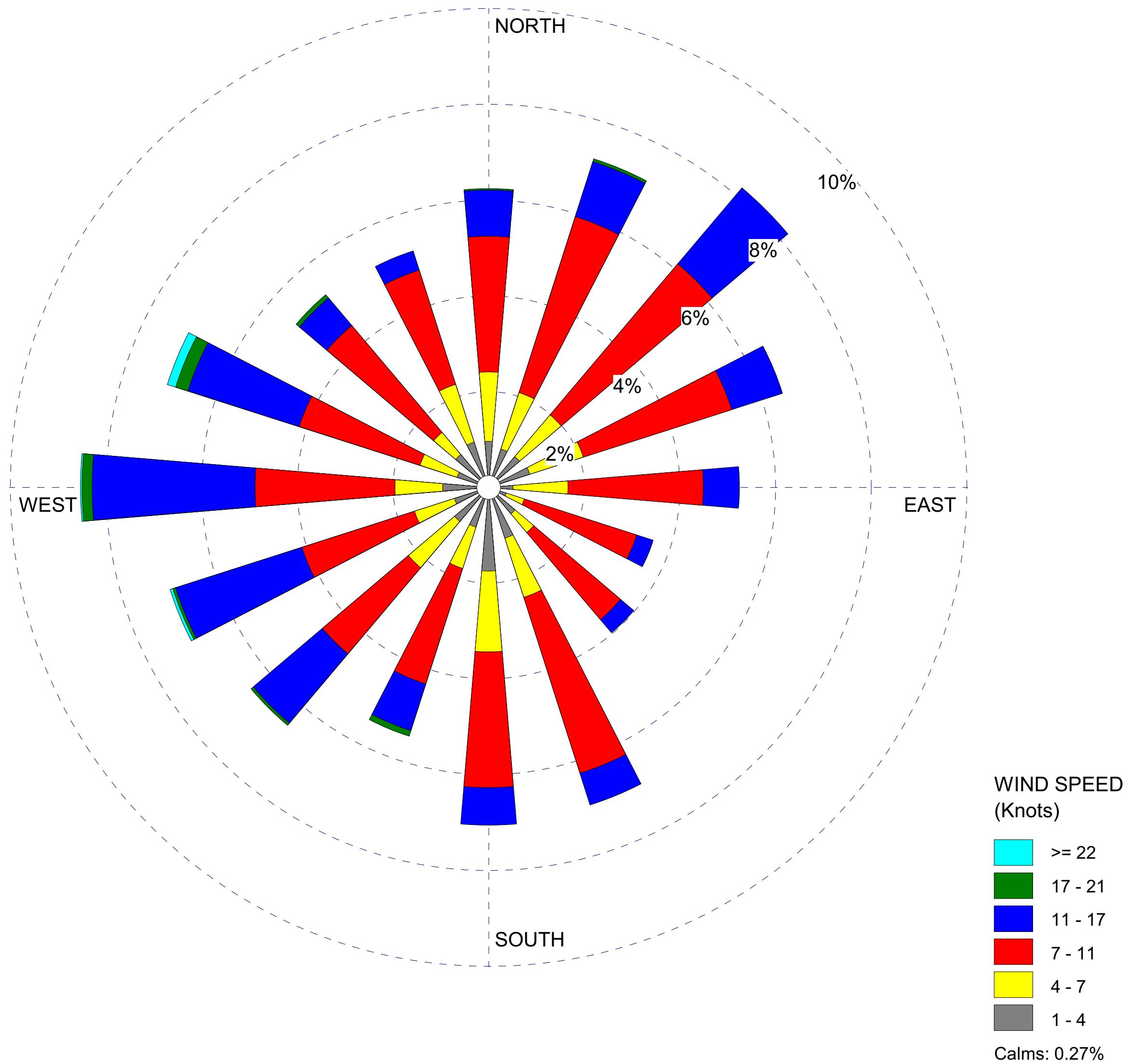

Figure 2.3-213 (Sheet 11 of 12)
VEGP 60-m Level November Wind Rose (1998–2002)

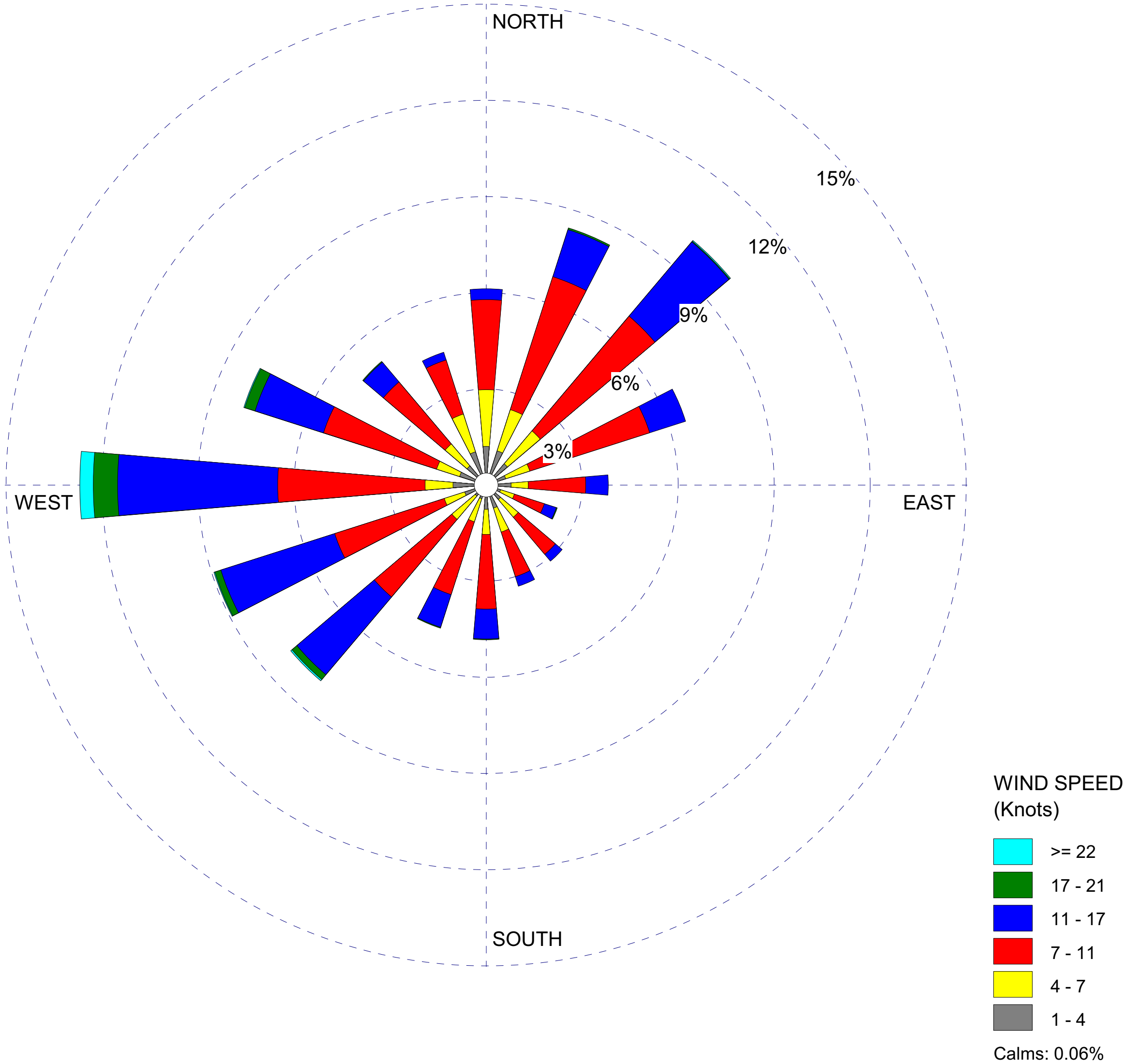

Figure 2.3-213 (Sheet 12 of 12)
VEGP 60-m Level December Wind Rose (1998–2002)

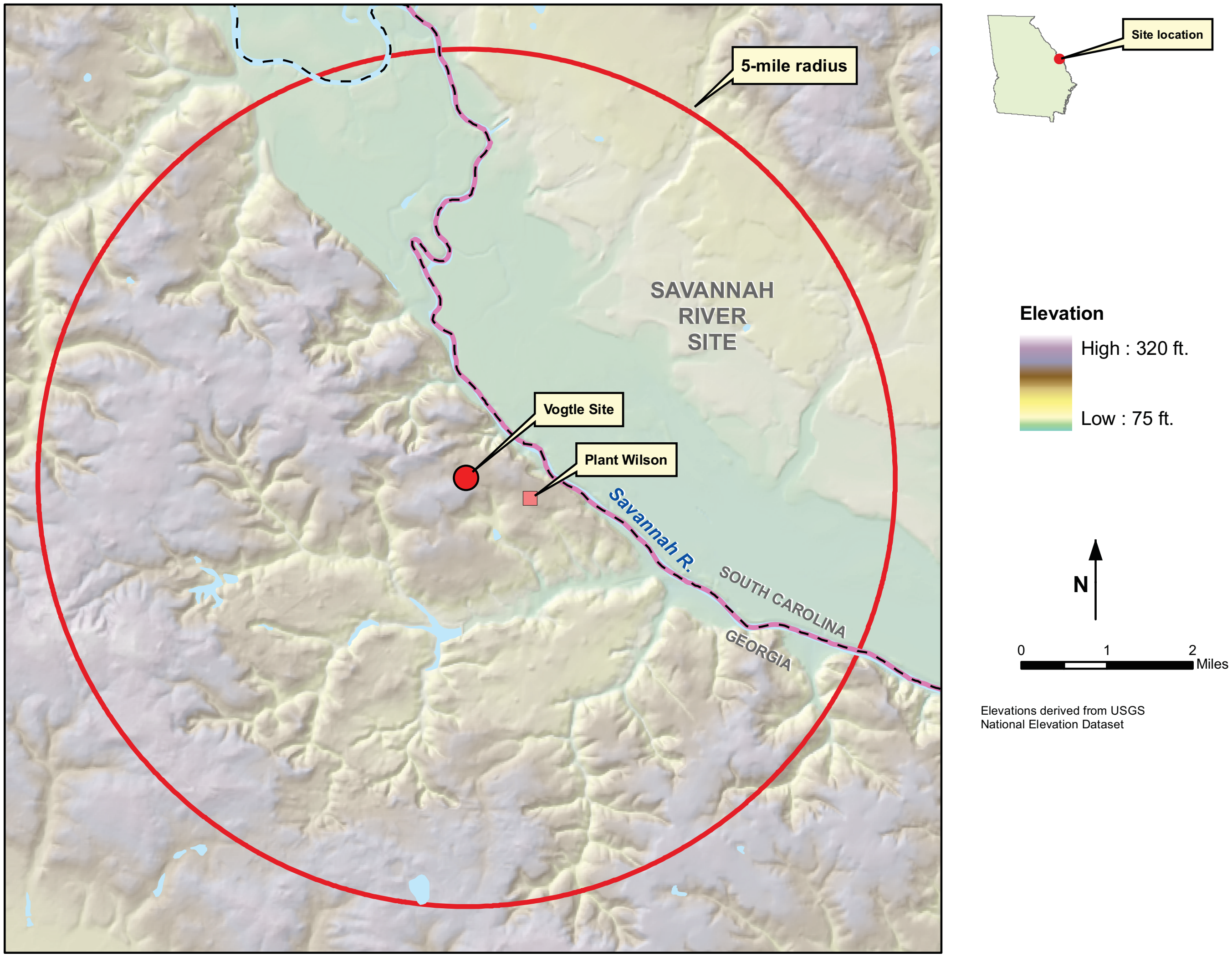

Figure 2.3-214
Topographic Features Within a 5-Mile Radius of the VEGP Site

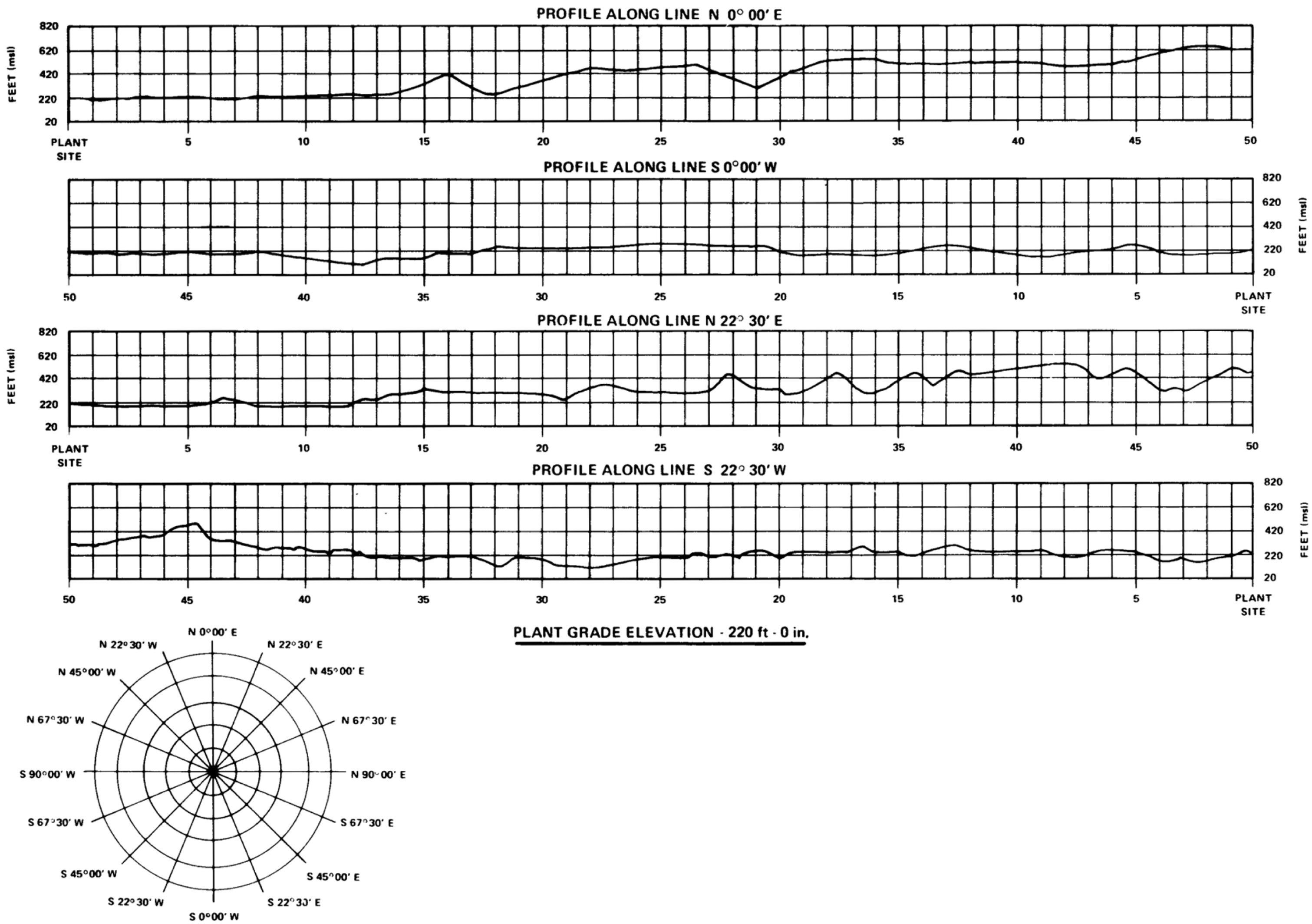

Figure 2.3-215 (Sheet 1 of 4)
Terrain Elevation Profiles Within 50 Miles of the VEGP Site

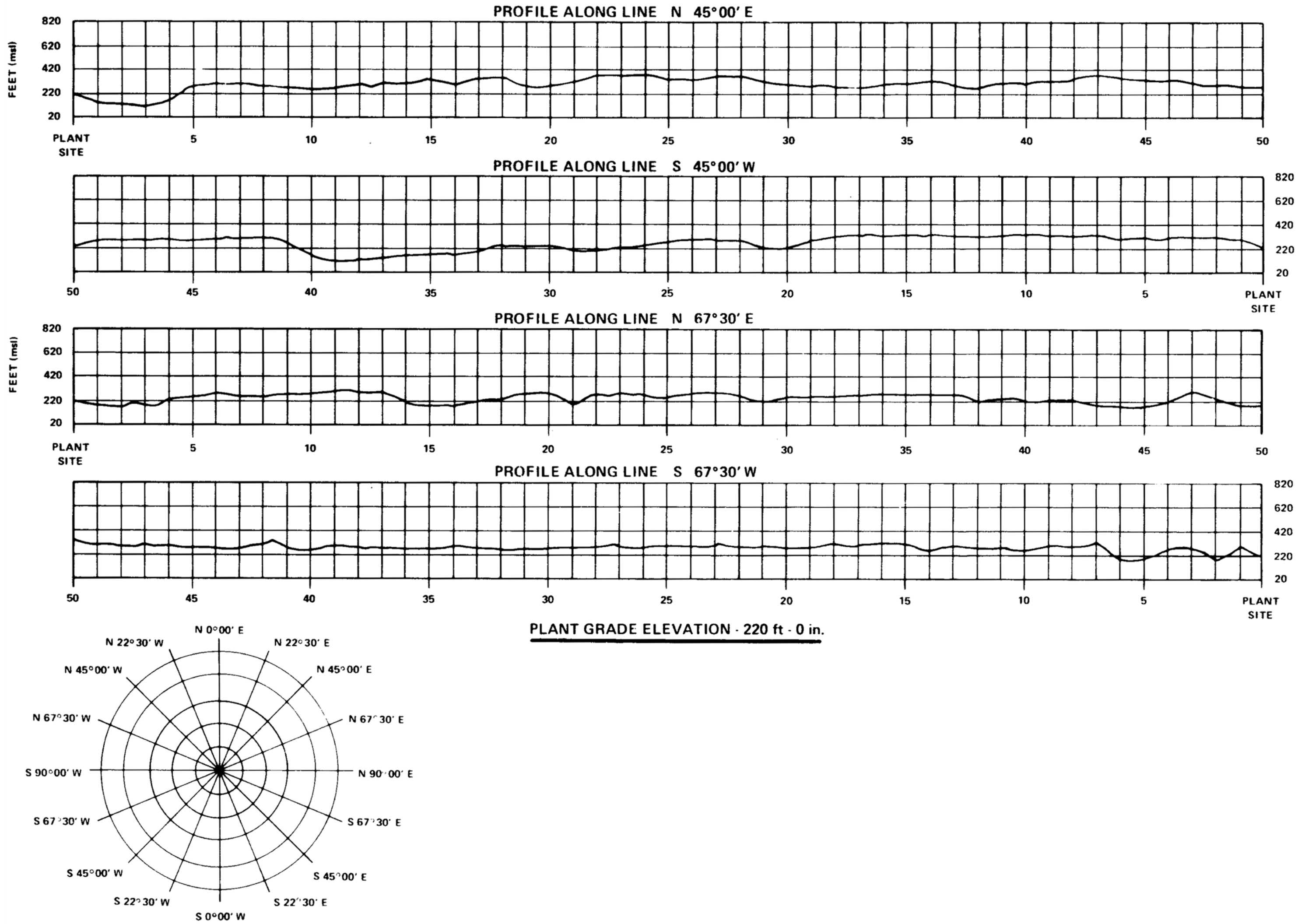

Figure 2.3-215 (Sheet 2 of 4)
Terrain Elevation Profiles Within 50 Miles of the VEGP Site

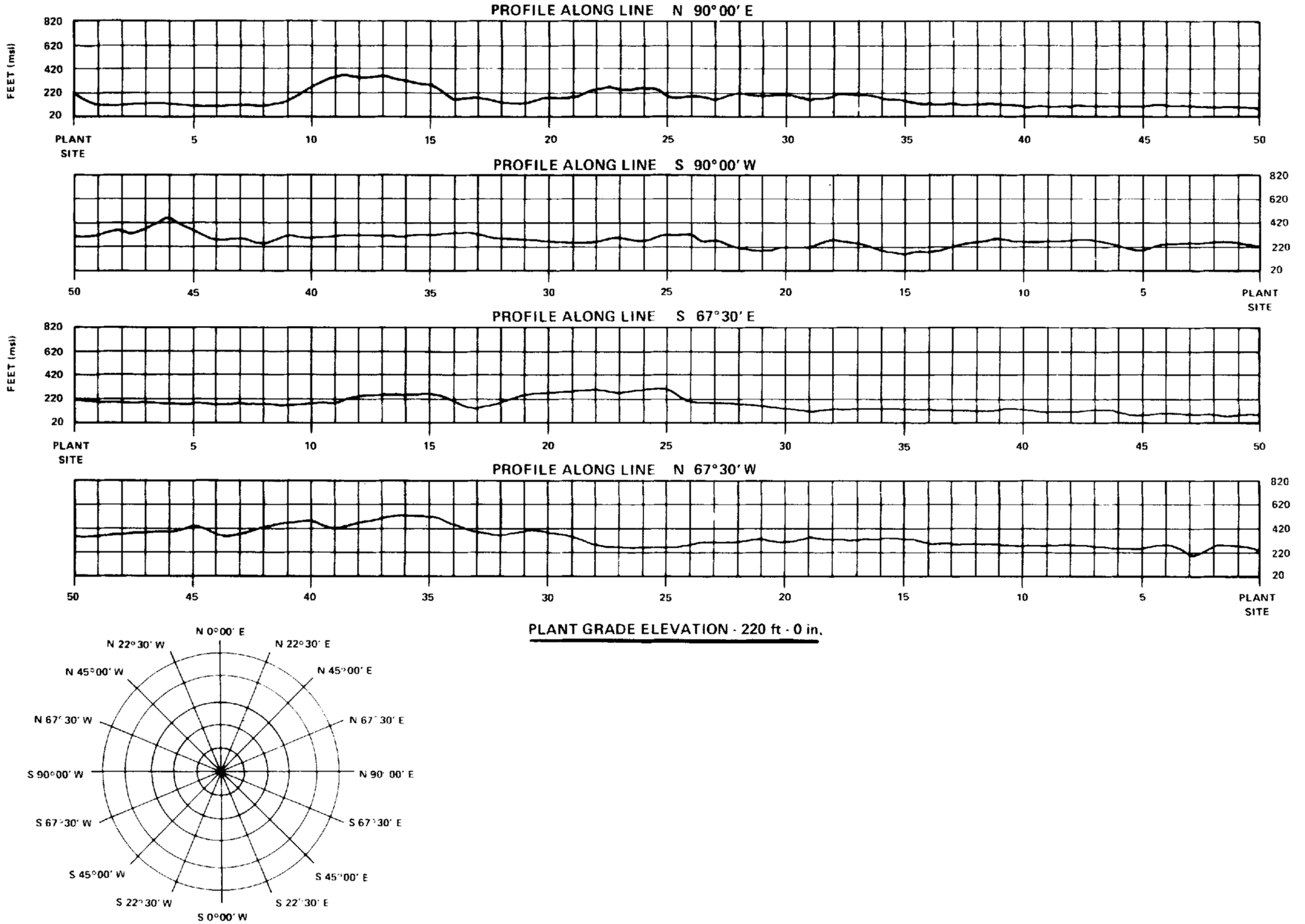

Figure 2.3-215 (Sheet 3 of 4)
Terrain Elevation Profiles Within 50 Miles of the VEGP Site

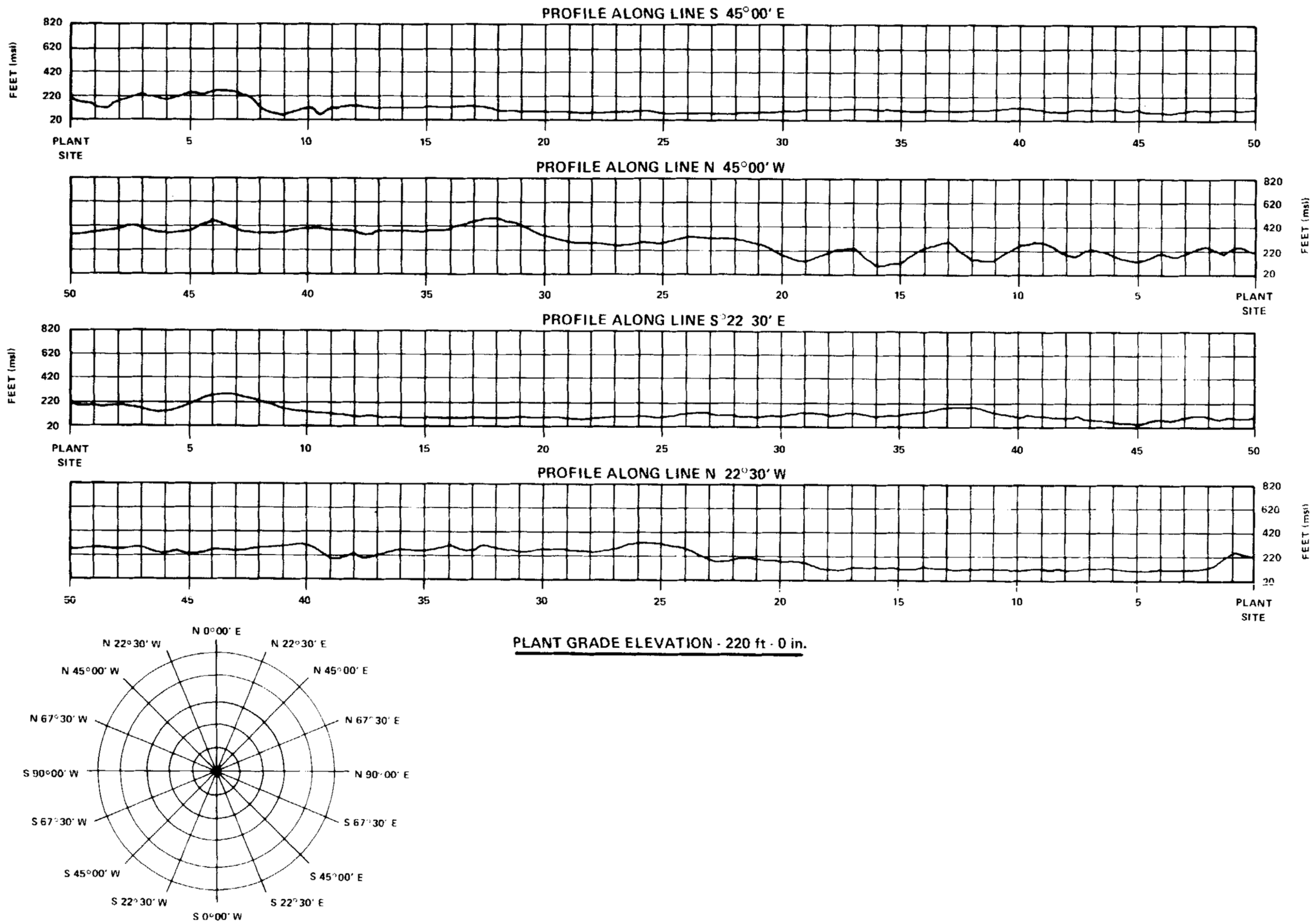

Figure 2.3-215 (Sheet 4 of 4)
Terrain Elevation Profiles Within 50 Miles of the VEGP Site