18033

F

Document P-A688
May 1981

Prepared for
New Hampshire Air Resources Agency
Hazen Drive
Concord, New Hampshire 03301

Air quality analysis for the coal conversion of Schiller generating station units 4, 5, and 6

NTAL RESEARCH & TECHNOLOGY, INC.
ICAGO · CONCORD, MA · FORT COLLINS, CO
S ANGELES · PITTSBURGH · WASHINGTON, DC

Document P-A688
May 1981

Prepared for
New Hampshire Air Resources Agency
Hazen Drive
Concord, New Hampshire 03301

Air quality analysis for the coal conversion of Schiller generating station units 4, 5, and 6

ERT

ENVIRONMENTAL RESEARCH & TECHNOLOGY, INC.
ATLANTA · CHICAGO · CONCORD, MA · FORT COLLINS, CO
HOUSTON · LOS ANGELES · PITTSBURGH · WASHINGTON, DC

ACKNOWLEDGEMENTS

The preparation of this report was financed in part by the Coastal Zone Management Act Of 1972 (as amended), administered by the Office of Coastal Zone Management, Coastal Energy Impact Program, National Oceanic and Atmospheric Administration.

The report was prepared by the Air Quality Studies Division at ERT. Mr. Joseph Curreri was the Project Manager. Mr. John Purdum was the Principal Investigator.

The analyses herein were supported by the New Hampshire Air Resources Agency. We are grateful to Mr. Thomas Noel, Assistant Director, for his cooperation and assistance throughout the course of the project.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

LIST OF ILLUSTRATIONS

LIST OF TABLES

LIST OF TABLES (Continued)

1. INTRODUCTION

1.1 Overview and Study Objectives

This report presents the results of a comprehensive ambient air quality modeling and analysis study performed by Environmental Research & Technology, Inc. (ERT) for the proposed coal conversion of the Public Service Company of New Hampshire's (PSNH) Schiller Station. The Schiller plant is located on the southern bank of the Piscataqua River in the city of Portsmouth, New Hampshire. Presently, Units 4, 5, and 6 each has a maximum rated generating capacity of 50 MW and consists of an oil-fired steam electric generating unit served by a 225-foot stack.

This study predicts and assesses the air quality impacts associated with a potential conversion of Units 4, 5, and 6 from oil to coal. These units now fire 2.0% maximum sulfur content oil. The study determines the complying coal sulfur content in terms of pounds of sulfur per million Btu heat input necessary to meet applicable SO_2 ambient air quality standards and PSD increments. The study also addresses the impacts of total suspended particulates (TSP) from coal combustion and fugitive dusts due to coal handling operations. Impacts of other criteria pollutants emitted in lower amounts (CO,Pb,NO) are evaluated via comparative analyses.

There were two major study objectives. The first was to predict the incremental and total ambient pollutant concentrations resulting from the change in stack emissions due to coal use. The second was to analyze and interpret the predicted changes with respect to federal and state ambient air quality standards (AAQS) and prevention of significant air quality deterioration (PSD) increments. Major source impacts were predicted with the U. S. EPA Industrial Source Complex (ISC) model. Background concentrations of SO_2 and TSP were established from recent monitoring data at locations in Portsmouth and Eliot, Maine. A complete description of the analytical techniques and a summary of the ISC model is given in Section 2.

1.2 Air Quality Standards Addressed

The National Ambient Air Quality Standards (NAAQS), shown in Table 1-1, are regulatory limits that must be attained and maintained throughout the country by appropriate State Implementation Plans (SIP). The New Hampshire State AAQS are the same as the NAAQS. The state of Maine AAQS differ from the NAAQS for SO_2 and TSP, being more stringent in both magnetude and number of allowed exceedances per calendar year. While one exceedance per year per location is allowed by the NAAQS, Maine standards are written never to be exceeded. The NAAQS was established by EPA in accordance with provisions of the 1970 Clean Air Act Amendments to protect the public health and welfare. The Maine standards were established by the State Board of Environmental Protection to preserve or enhance the quality of ambient air and to prevent air pollution. The states and EPA ensure compliance with these standards through enforcement SIPs or specific permit conditions. As documented in this report, the Schiller permit conditions will reflect the necessary emissions limitations to allow maintenance of the NAAQS in both New Hampshire and Maine.

PSD increments, also shown in Table 1-1, were established by Congress in the 1977 Clean Air Amendments. They are restrictive ambient constraints that are equivalent to tertiary ambient standards and apply only in "clean" areas where existing ambient concentrations are below NAAQS. The SO_2 and TSP increments are shown in Table 1-1. The amount of deterioration allowed is determined by area categorization. Currently, the entire region of the impact (within 50 km of Schiller) is categorized as Class II. Presently there are PSD increments for SO_2 and TSP only; however, the other criteria pollutants may be addressed under PSD in the future. For purposes of this analysis, the states of Maine and New Hampshire have verified that the total increments are available within the entire impact region for all possible receptor locations and meteorological conditions. However, the NHARA and Maine DEP jointly enforce the federal guideline of 50% maximum PSD increment consumption by interstate pollution.

TABLE 1-1

AIR QUALITY STANDARDS AND SCHILLER PSD APPLICABILITY

Pollutant	Averaging Period	National and New Hampshire Primary AAQS (μg/m3)	State of Maine Primary AAQS (μg/m3)	Allowable PSD+ Increments (μg/m3)	De Minimis Concentrations (μg/m3)	De Minimis Emissions Rate (ton/yr)	Incremental Schiller Emissions (ton/yr)
SO_2	Annual	80	57	20	1	40	15,850++
	24-Hour	365*	230**	91	5		
	3-Hour	1,300*	1,150**	512	25		
TSP	Annual	75	60	19	1	25	1,258
	24-Hour	260*	150**	37	5		
NO_x	Annual	100	100	-	1	40	2,270
CO	8-Hour	10,000*	10,000*	-	500	100	135
	1-Hour	40,000*	10,000*	-	2000		
Pb	3-month	1.5	1.5	-	-	0.6	0.1

*Not to be exceeded more than once per calendar year
**Not to be exceeded at any time
+For impacts in Maine, New Hampshire sources limited to 50% of increment
++Based on a maximum sulfur in fuel limitation of 2 pounds per million Btu heat input

Also shown in Table 1-1 are the de minimis concentrations and annual emissions below which changes are considered to be insignificant. As indicated in the table, the incremental increase in pollutant emissions due to the Schiller coal conversion are significant for all criteria pollutants except lead (Pb). For this reason, a detailed analysis of ambient Pb impacts was not performed.

1.3 Summary of Results

Table 1-2 presents a summary of the findings of the modeling analyses for complying sulfur emission limits. The results are presented for two regulatory scenarios. The first scenario applies to current regulations. The alternate scenario addresses the federal standards only, as given in Table 1-1, with one exception. Only one exceedance would be allowed in any calendar year, regardless of location. The federal standards allow one exceedance at all locations. As shown in Table 1-2, under the current regulations, the most stringent sulfur limitation would be 0.65 lb.S/mmBtu. This was desived from the highest predicted 24-hour total ambient SO_2 concentrations in Maine. This prediction is a combination of (1) model simulated concentrations due to the Schiller plant operating at maximum load in conjunction with the other major sources, and (2) the highest 24-hour background SO_2 measured in Portsmouth during 1980. This sulfur limit would also ensure compliance with all other applicable AAQS and PSD increments in both New Hampshire and Maine. As shown in the table, the complying sulfur limits on a 3-hour and annual average basis are less stringent than the 24-hour limit. Given the low probability of the highest background SO_2 (1/365) and highest plant impact (1/365) occurring jointly during any year, this limit represents a conservative margin of safety for maintaining all applicable SO_2 standards and PSD increments.

With respect to the federal standards alone, it can be seen that complying sulfur limits would be higher on a 3-hour and 24-hour basis. In this case, the second-highest impacts are the controlling cases, since the highest impacts would be discounted. In all cases, the limiting impacts are 50% PSD increment consumption in Maine.

TABLE 1-2

SUMMARY OF COMPLYING SULFUR EMISSION LIMITS

Scenario	Averaging Period	Emission Limit (lb. S/mm Btu)	Limiting Basis
1:Current Regulations	3-Hour	0.81	Highest predicted 3-Hour PSD Increment Consumption in Maine
	24-Hour	0.65	Highest predicted 24-Hour Ambient Air Quality in Maine
	Annual	1.62	Highest predicted Annual PSD Increment Consumption in Maine
2:Federal Standards Only	3-Hour	1.77	2nd Highest predicted 3-Hour PSD Increment Consumption in Maine
	24-Hour	1.43	2nd Highest predicted 24-Hour PSD Increment Consumption in Maine
	Annual	1.62	Highest predicted Annual PSD Increment Consumption in Maine

Again, the most stringent sulfur limitation is calculated for 24-hour averages. The limit of 1.43 lb.S/mmBtu would ensure no more than 50% PSD increment consumption in the state of Maine and compliance with all other applicable federal SO_2 standards and PSD increments in both New Hampshire and Maine. Obviously, however, this limit would not necessarily ensure compliance with Maine AAQS for SO_2. Based on this limit, the analysis conservatively estimates that no more than 4 exceedances of the 230 $\mu g/m^3$ 24-hour standard would occur in Maine. Each of these exceedances would be predicted at separate locations for different 24-hour periods. However, since this estimate includes an observed background 24-hour SO_2 concentration that occurred only once in 1980, it is more likely that the Maine standard would only be exceeded once, if at all.

Table 1-3 presents a summary of the findings of the analyses for the other criteria pollutants. By comparison to Table 1-1, it is evident that no exceedances of either the PSD increments or the AAQS are predicted for the other pollutants with the exception of TSP. The highest predicted 24-hour increment consumption in Maine is greater than 50% of the 37 $\mu g/m^3$ allowed. The highest predicted 24-hour increment consumption in New Hampshire is 180% of the full PSD increment. However, these impacts occur within a very small area close to Schiller. The predicted impacts are totally dominated by particulate emissions due to fugitive dusts from Schiller's coal handling operations, and as such, contain inherent measures of uncertainty beyond the limits usually associated with standard dispersion models. The maximum short term emissions assumed for modeling all hours throughout the year actually occur only once every two weeks during coal barge unloading activities, or approximately 7% of the time. This significantly decreases the probability that worst-case emissions will occur simultaneously with worst-case meterorological conditions. Other measures of conservatism associated with the modeling of fugitive dusts include:

1. the assumption that maximum emissions occur exclusive of any precipitation

TABLE 1-3

SUMMARY OF ANALYSIS RESULTS FOR TSP, CO, AND NO_2

Pollutant	Averaging Period	Maximum Predicted Concentration ($\mu g/m^3$) PSD Increment	Total Ambient Air
TSP*	24-Hour	66.6 (NH)	138.6 (NH)
		26.4 (Maine)	98.6 (Maine)
	Annual	4.4 (NH)	36.2 (NH)
		2.9 (Maine)	34.6 (Maine)
NO_x	Annual	not applicable	5.0**(Maine)
CO	1-Hour	not applicable	14.0***(Schiller Only)
	8-Hour	not applicable	***

*Dominated by Predicted Fugitive Dust Impacts From Schiller Coal Handling Operations

**Does not include background

***Well below 1 and 8-Hour significance liimits of 2000 and 500 $\mu g/m^3$ respectively

2. the assumption that no deposition occurs for particle impaction on ground vegetation or fallout of larger particles.
3. the assumption that no initial dilution takes place at the source due to the nature of the loading and unloading activities.
4. the assumption of minimum coal surface moisture.

These assumptions lead to conservative estimates of maximum short-term impacts which can only be verified by actual source monitoring.

The highest predicted TSP impacts due only to the point sources modeled are significantly lower than those due to the fugitive dust sources. Table 1-4 lists these impacts. By comparison to Table 1-1, it can be seen that no exceedances of the applicable TSP standards are predicted.

1.4 Report Outline

The remainder of this report is organized into five sections. A description of the modeling procedures and the EPA ISC dispersion model is presented in Section 2 along with source emissions and stack parameters used in the modeling. Section 2 also discusses the sources of monitoring data used to determine background air quality, and other major sources considered in the analysis. Section 3 presents the results of the screening analysis used to determine significant impact areas, building downwash potential, and maximum impact locations. The detailed modeling results for SO_2 and TSP impacts are presented in Sections 4 and 5 respectively. Section 6 discusses the evaluation of other pollutant impacts.

TABLE 1-4

MAXIMUM PREDICTED TSP IMPACTS WITHOUT CONSIDERATION OF FUGITIVE DUST EMISSIONS

Averaging Period	Maximum Predicted Concentrations ($\mu g/m^3$)	
	PSD Increment	Total Ambient Air Quality
24-Hour	13.8 (Maine)	93.7 (Maine)
	36.6 (NH)	109.1 (NH)
Annual	1.5 (Maine)	33.7 (Maine)
	1.2 (NH)	33.2 (NH)

2. TECHNICAL DISCUSSION

2.1 Modeling Procedures

A comprehensive modeling approach was employed to predict the ambient air quality impact of the increase in pollutant emissions due to the potential conversion of Schiller Units 4, 5, and 6 to coal. The modeling analysis was conducted in six phases:

1. establishment of emission parameters
2. detailed screening modeling
3. iterative full-year sequential dispersion modeling
4. critical period modeling
5. analysis of background air quality
6. assessment of complying sulfur emission limits and maintenance of PSD, NAAQS, and Maine AAQS.

The screening analysis was performed for all the existing major SO_2 sources and the proposed Schiller conversion to determine the distances to and relative magnitude of each source's maximum one-hour impact. The meteorological conditions associated with maximum impacts were identified, and the 1-hour concentration estimates were extrapolated to 3-hour and 24-hour impacts using conservative scaling techniques. In addition, the areas of significant annual impact (greater than 1 $\mu g/m^3$) were also determined for each source.

The areas of maximum impacts, their magnitudes, and the meteorological frequency data were then evaluated to determine:

1. Potential for combined (overlapping) impacts of other sources with Schiller,
2. Which sources (if any) would not contribute significantly to Schiller impacts,
3. The area(s) of most frequent significant impacts for locating model receptors, and,
4. the order of importance, in terms of potential for highest impacts, of the five separate years of hourly meteorologly to be used in sequential modeling.

Once the major contributing sources were identified and initial receptor locations chosen, sequential modeling of Schiller was performed for two years of hourly meteorological conditions. Surface meteorological data of wind speed, wind direction, atmospheric stability, and temperature were taken from hourly measurements at Pease Air Force Base for the years 1970 through 1974. The years 1970 and 1974 were used in the sequential modeling. Upper air data for mixing depth calculations was taken from twice daily measurements at Portland, Maine, during the same period. The results of this modeling were used to identify a maximum of 15 critical 3- and 24-hour periods of highest Schiller impact in each year.

The hourly meteorological data was also processed into a five-year stability wind rose representing the joint frequencies of 16 wind directions, six stability classes, and six wind speed classes. This data was employed in climatological modeling of all sources to determine annual average impacts.

Once the critical periods of 3 and 24-hour impacts for Schiller were identified, the other contributing sources were modeled along with Schiller for those periods, using a dense rectangular receptor grid located around the receptor of highest impact for the respective period. The grids consisted of 25 receptors evenly spaced at 1/4 km intervals. In this manner, resolution of maximum impacts was assured.

After the highest source impacts were determined through modeling, an analysis of available monitoring data for SO_2 and TSP was conducted to determine appropriate background concentrations to be added to model predictions. Conservative estimates of the highest background concentrations were utilized to assess the maintenace of ambient air quality standards.

Finally, complying fuel sulfur emissions were established by calculating the necessary reductions in emissions required to maintain the SO_2 PSD increments and ambient air quality standards. Additionally, the maximum impacts of other criteria pollutants were compared to allowable PSD increments and AAQS to demonstrate compliance with those standards.

2.2 Dispersion Model

The EPA ISC dispersion model (EPA 1979a) was used to predict ground-level pollutant concentrations due to emissions from Schiller and the other major sources. The ISC model is a comprehensive collection of various enhanced dispersion model algorithms for analyzing the air quality impact of a wide variety of emission sources associated with an industrial complex. ISC is made up of two separate programs, the ISC short-term (ISCST) model and the climatological long-term model (ISCLT). ISCST is an extension of the single source EPA CRSTER model, designed to calculate concentrations for time periods of 1,2,3,4,5,6,8,12 and 24 hours when used with a year of sequential hourly meteorological data. It is the only EPA model with all of the following capabilities:

1. simulation of aerodynamic building downwash effects on plume dispersion,
2. simulation of plume impacts in areas of elevated terrain
3. multiple-source interactions
4. simultaneous consideration of point, line, area, and volume sources, and,
5. wind-speed dependent emissions scaling.

All of these capabilities were necessary for the present study. The Schiller plant is located near several areas of elevated terrain significant enough to interact with plumes from the various sources modeled. The stacks servicing the Schiller plant are not high enough to totally preclude the effects of building downwash, as is true for another source modeled in the study. A complete description of the stack height analysis is presented in Section 3.1. In addition the physical characteristics of the fugitive dust sources associated with Schiller coal handling operations require the use of an area source model. The above criteria formed the basis for the selection of the ISC model.

2.3 Schiller Emissions Data

This section details the physical source parameters and emissions data used in the dispersion modeling of the Schiller plant. Table 2-1 lists the fixed stack parameters along with the pollutant emission rates for maximum operating conditions. Presently, all units at Schiller fire residual oil with a maximum allowed sulfur content of 2%. Only units 4, 5, and 6 are being proposed for conversion to coal. As shown in Table 2-1, there will be a significant increase in SO_2 emissions due to the switch to coal at an allowable limitation of 2 lb.S/mmBtu. As was summarized in Section 1.3, however, air quality constraints will limit the allowable sulfur emissions to less than this amount. The emission rate presented in the table was used in the modeling to determine what those limits would be. The emissions of the other criteria pollutants do not increase as much as SO_2 on a short-term basis. However, on an annual basis the expected capacity utilization of Units 4, 5, and 6 is much greater than historical utilization of these units when burning oil. This leads to significant increases in total annual emissions due to the conversion to coal. Table 2-2 lists the assumptions used in calculating pollutant emissions from the respective generating units.

In addition to TSP emissions from fuel combustion, there will be emission of TSP related to the fugitive dust created from coal handling. Figure 2-1 depicts the current design of the coal handling operations. Coal will be received from self-unloading barges once every two weeks. It will be transported to the coal pile area via enclosed conveyors, passing through partially or fully enclosed transfer stations. Reclaiming operations will be performed with a front end loader which will transport coal from the storage pile to the reclaim hopper. From there it will be transported via enclosed conveyors to the crusher building and eventually to the unit silos. All of the dust generated between the reclaim hopper and the unit silos will be captured and fed back into the silos via vaccum systems. Table 2-3 lists the significant sources of fugitive dust emissions and the dimensions of the emission releases as simulated in the modeling. Also listed are the various dust control measures,

TABLE 2-1

STACK AND EMISSION PARAMETERS FOR

THE SCHILLER GENERATING STATION

Parameter	Unit 3 (Oil Fired Only)	Units 4, 5, 6 Oil Fired	Units 4, 5, 6 Coal Fired
Location (UTM)	354.71 East 4,773.04 North		
Stack Height (m)	41.76	68.58	
Stack Diameter (m)	2.59	2.44	
Exit Temperature(°k)	652.4	475.2	467.4
Exit Velocity (m/sec)	9.14	22.6	19.3
Maximum Load Emissions (g/sec):			
SO_2	109.40	416.70	734.30*
TSP	8.42	32.02	57.97
NO_x	38.43	146.16	131.4
CO	1.83	6.96	7.30
Annual Capacity Factors	3.9%	22.7%	75%

*Based on initial assumption of 2 lb. S/mm Btu

TABLE 2-2

ASSUMPTIONS USED TO CALCULATE SCHILLER

STACK EMISSION PARAMETERS

1. Flow Rates (ACFM)

   Unit 3 Oil Firing: 102,141
   Units 4-6 Oil Firing: 223,700 per unit
   Units 4-6 Coal Firing: 190,516 per unit

2. Maximum Fuel Rates (lb/hour)

   Unit 3 Oil Firing: 22,852
   Units 4-6 Oil Firing: 29,000 per unit
   Units 4-6 Coal Firing: 38,600 per unit

3. Maximum Heat Input (10^6 Btu/hour)
   Unit 3: 338.66
   Unit 4: 486.00
   Unit 5: 507.60
   Unit 6: 540.00

4. Fuel Sulfur Content:
   Residual Oil: 2% maximum
   Coal: 2 lb Sulfur per million Btu Heat Input

5. Sulfur to Sulfur Dioxide Conversion Rate: 95%

6. Emission Factors

Pollutant	Residual Oil	Bituminous Coal
TSP	23 lb/10^3 gal(1)	0.3 lb/mm Btu(2)
CO	5 lb/10^3 gal(1)	1.0 lb/ton(1)
NO_x	105 lb/10^3 gal(1)	18.0 lb/ton(1)
Pb	.033 - .086%(3) of TSP	.012%(3) of TSP

(1) EPA (1977)
(2) New Hampshire Standard For Existing Coal Fired Utilities
(3) Henry, W. M., Knapp, K. T., (1980).

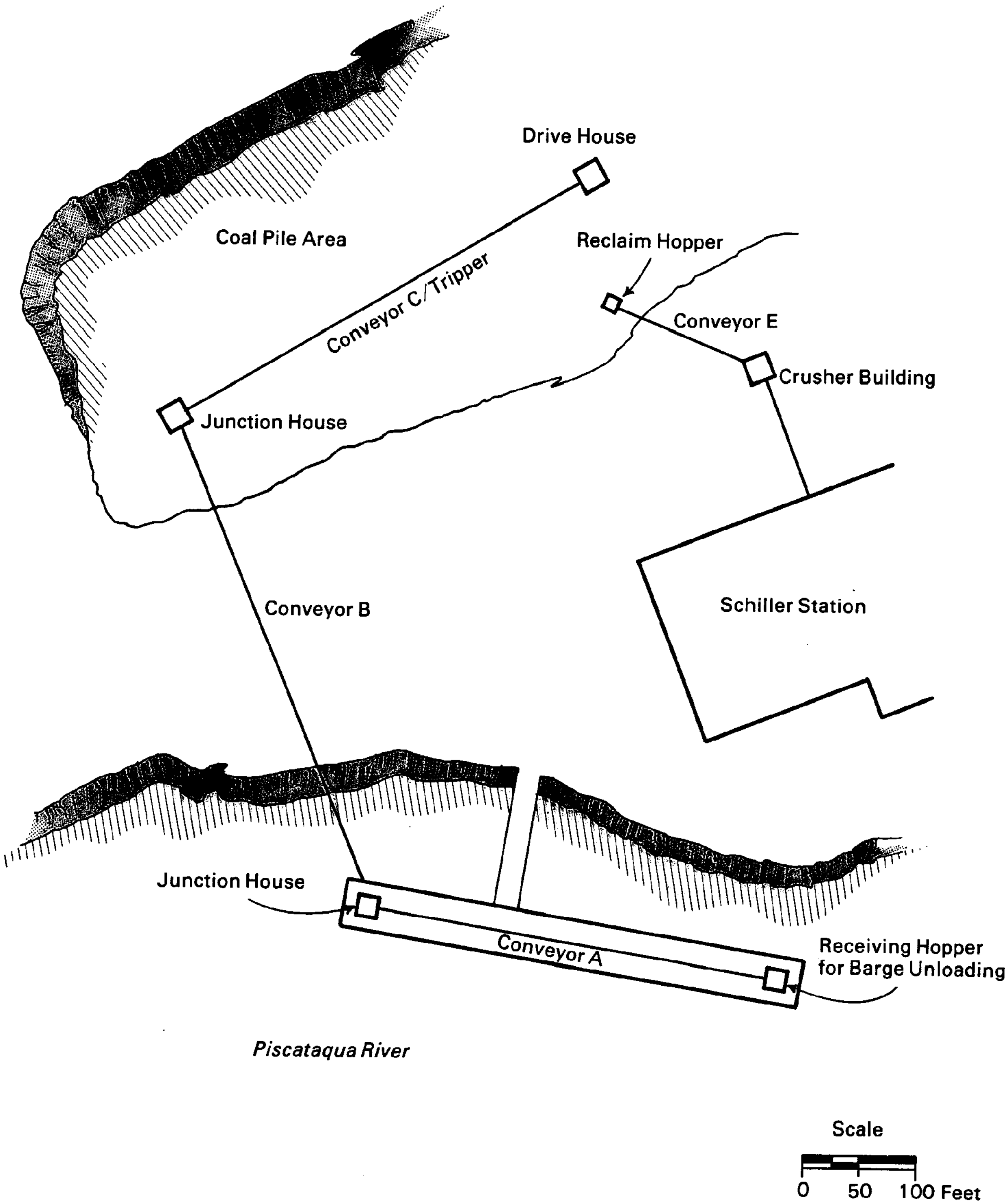


Figure 2-1 Schiller Coal Handling System

8104121

TABLE 2-3

FUGITIVE DUST SOURCE PARAMETERS FOR

SCHILLER COAL HANDLING OPERATIONS

	Dimensions (ft)			Controls		TSP Emissions (g/sec)(1)	
Source	Height	Width	Length	Technique	Efficiency(3)	24-Hour	Annual
Barge Unloading	10.0	20.0	20.0	Wet-Spray Surfactant	70% 90%	$7.41(u) \times 10^{-4}$	$5.29(u) \times 10^{-5}$
Conveyor A-B Transfer House	10.0	20.0	20.0	Semi-Enclosed Enclosed Chute Wet-Spray Surfactant	70% 75% 70% 90%	$5.69(u) \times 20^{-5}$	$4.06(u) \times 10^{-6}$
Conveyor C/ Tripper	30.0	40.0	400.0	Telescopic Chute Surfactant	75% 90%	$1.85(u) \times 10^{-3}$	$1.32(u) \times 10^{-4}$
Reclaim Hopper	10.0	20.0	20.0	Surfactant	90%	$1.98(u) \times 10^{-4}$	$1.41(u) \times 10^{-4}$
Storage Pile Maintenance/ Traffic	27.0	250.0	500.0	Surfactant	90%	1.66×10^{-1}	8.73×10^{-2}
Storage Pile Wind Erosion(2)	27.0	250.0	500.0	Surfactant	90%	9.87×10^{-1}	6.06×10^{-1}

(1) where (u) appears in the emission rate indicates wind speed (mph)
(2) emissions occur only when u exceeds 12 mph
(3) EPA (1978)

their expected control efficiencies, and the resulting emission rates of TSP. All of the coal will be treated with a petroleum based resin (surfactant) which has an associated control efficiency as high was 98%. However, 90% was assumed for this study, as a margin of safety, since control efficiencies for this treatment are not yet fully understood. Other control measures are used, where feasible, for the specific operations themselves. Maximum short-term emission rates associated with coal receiving are significantly higher than annual estimates on a grams per second basis. This is due to the bi-weekly shipments of coal which occur on one day. Also shown in the table is the dependency of emissions on wind speed. This was accounted for in the modeling by scaling these emissions by the hourly wind speed according to six wind speed classes. Table 2-4 lists the assumptions used in calculating TSP emission rates. The emission factors used represent the latest recommendations of EPA. These emission factors are primarily designed to predict annual average emissions. However, for the purpose of addressing short-term air quality standards, an attempt was made to employ conservative estimates of short term emissions based on maximum daily throughput rates, hourly wind speeds, and minimal climatological effects such as precipitation events.

2.4 Other Major Sources

The estimates of total ambient concentrations of the different pollutants require estimates of the concurrent impact of other major sources and an estimate of background concentrations which represent the impact of minor sources in the region. Six existing major sources of SO_2 were identified by the NHARA within 50 km of the Schiller plant. In addition, a new source not yet operating but for which a permit is pending was also identified by the NHARA. The location of these sources is depicted in Figure 2-2. The Eastern Grains Refinery is the new source. In addition to contributing to total ambient concentrations, this source will also consume PSD increment in the study region. It's impacts were added to the incremental impacts of Schiller for assessment of PSD increment consumption. As will be demonstrated in Section 3, the Great Falls Bleachery and the

TABLE 2-4

ASSUMPTIONS USED TO CALCULATE FUGITIVE DUST EMISSIONS FROM SCHILLER COAL HANDLING OPERATIONS

1. Emission Factors (EPA 1979b)

a) Barge Unloading, Conveyor Transfer Stations, Conveyor C tripper (continuous load out)

$$\frac{.0018\ (\frac{S}{5})(\frac{u}{5})(\frac{h}{5})}{(\frac{m}{2})^{2}} \quad \text{lb/ton throughput}$$

where:

s is silt content (%)

u is wind speed (mph)

h is drop height

m is moisture content (%)

b) Reclaim Hopper (batch load-out)

$$\frac{.0018\ (\frac{s}{5})(\frac{u}{5})(\frac{h}{5})}{(\frac{m}{2})^{2}\ (\frac{Y}{6})^{1/3}} \quad \text{lb/ton throughput}$$

where:

Y is dumping device capacity (yd^3)
previous definitions apply for s,u,h,m

c) Storage Pile Maintenance & Traffic

$$0.10K\ (\frac{s}{1.5})\ (\frac{d}{235}) \quad \text{lb/ton throughput}$$

TABLE 2-4 (continued)

where:

K = activity factor

s = silt content (%)

d = number of dry days per year (less than .01 inch precipitation)

d) Storage Pile Wind Erosion

$$.05 \left(\frac{s}{1.5}\right) \left(\frac{d}{235}\right) \left(\frac{f}{15}\right) \left(\frac{D}{90}\right) \quad \text{lb/ton throughput}$$

where:

previous definitions apply for s,d

f = % of time wind speed exceeds 12 mph

D = duration of material in storage

2. Correction Parameters

s, silt content:	4.9% (medium volatility coal)
m, moisture content:	3.0% (minimum expected)
h, drop heights:	10 ft. barge unloading, conveyor transfer stations, reclaim hopper
	30 ft. conveyor C tripper
y, dumping device capacity:	6 yd^3 front end loader
K, activity correction:	0.5 (1 front end loader)
d, number of dry days:	set equal to 365 for short-term, 225 for annual average (EPA 1977)
D, duration of material in storage:	83.33 days
f, % of time wind speed(u) exceeds 12 mph:	set equal to 100 for any hour when u exceeds 12mph, 0 otherwise.

TABLE 2-4 (continued)

3. Throughput Rates (ton/hour)

Source	Maximum 24-Hour	Annual Average
Barge Unloading	625	45
Conveyor A-B transfer station	625	45
Conveyor B-C transfer station	625	45
Conveyor C tripper	625	45
Reclaim Hopper	50	35.7
Storage Pile Maintenance and Traffic	52	44.6
Storage Pile Wind Erosion	50	50

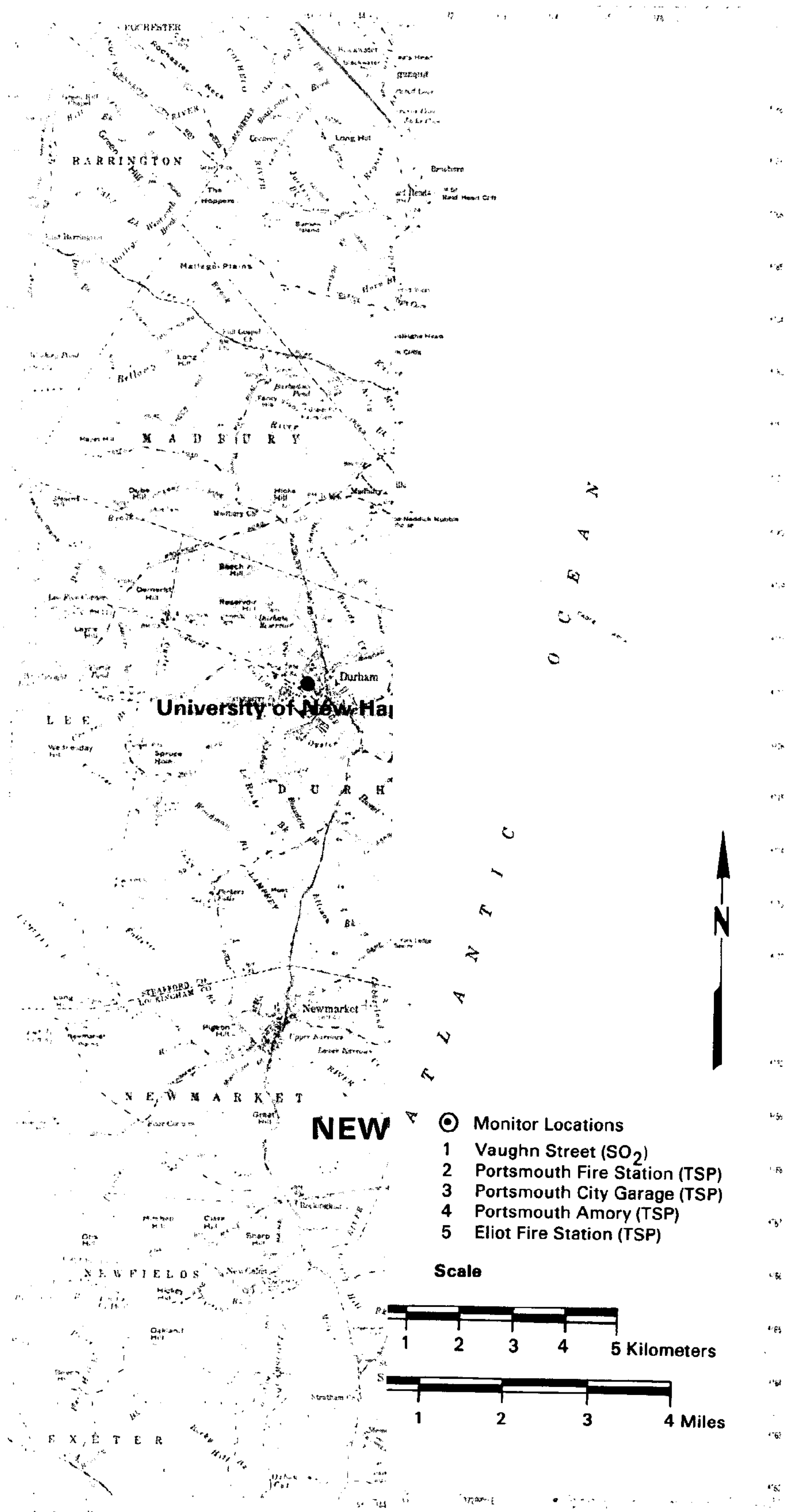


Figure 2-2 Location of Major SO_2 and TSP Sources

715-1 8104124

University of New Hampshire do not contribute significantly to any Schiller impacts and were therefore eliminated from consideration. All the other sources, however, did show the potential for combined impacts and were therefore included in the detailed modeling analysis. Table 2-5 lists the sources along with their physical stack parameters and emission rates. All of the sources were modeled at annual average emissions with the exception of Newington, which was modeled at maximum operating conditions for short-term estimates only. This was agreed to jointly by the NHARA and the Maine DEP. The annual average capacity of Newington is 49.3%. Also shown in Figure 2-2 are the locations of monitoring stations which were evaluated for use in determining background concentrations.

2.5 Background Air Quality Data

The monitoring locations depicted in Figure 2-2 were evaluated to determine their usefulness for estimating background concentrations of SO_2 and TSP. The Vaughn Street monitor was the only available recent site of ambient SO_2 data. Hourly measurements taken from February 1, 1980 through January 31, 1981 were analyzed to determine the highest 3- and 24-hour averages along with the annual average. Meteorological data from Pease AFB was analyzed for the same time period to assess the likelihood that measurements reflected impact from the sources being modeled. As it turned out, the highest measurements were recorded when winds were southerly, indicating little, if any, impact from the modeled sources. Although some source impact would be expected on an annual basis, the annual average at this monitor was used as a conservative estimate of annual background SO_2.

Four monitoring sites were available for estimating background TSP concentrations. Three sites are located in downtown Portsmouth. The other site, Eliot Fire Station, is located in a more rural area. Table 2-6 presents a summary of the monitoring data. As shown in the table, the downtown Portsmouth monitors recorded relatively high TSP levels. These concentrations were most likely due to the effects of very localized sources within the downtown area and are not

TABLE 2-5

OTHER MAJOR SOURCES CONSIDERED FOR

DISPERSION MODELING WITH SCHILLER

Source	Location (UTM)	Stack Height (m)	Stack Diameter (m)	Exit Temp. (°K)	Exit Velocity (m/sec)	Emissions(g/sec) SO_2	TSP	NO_x
Newington	354.22E 4773.04N	124.97	6.32	538.6	21.34	1282.8	17.34	428.96
Gold Bond	356.00E 4771.80N							
Rock Dryer		23.47	0.63	366.3	5.22	0.58	0.022	0.23
Kiln 1-4		19.81	0.76	499.7	8.26	0.81	0.030	0.31
Kiln 5		19.81	0.76	377.4	2.06	0.24	0.009	0.09
Kiln 6		19.81	0.76	360.8	1.07	0.09	0.004	0.04
Calciners		17.83	0.76	421.9	23.16	2.04	0.016	0.68
Pease AFB	353.00E 4772.00N							
CB Boilers		9.14	0.51	463.5	3.66	0.06	0.002	0.02
CE Boilers		25.91	1.83	533.0	4.11	12.70	0.980	4.25
UNH:	342.60E 4777.70N							
Boilers 1-4		60.96	1.24	533.0	22.60	7.90	0.610	2.64
Boiler 5		14.02	1.30	477.44	8.17	2.63	0.203	0.88
Eastern Grains	354.8E 4772.5N							
Boiler		30.48	0.91	449.7	21.05	7.04	2.33	5.13
Process 1		20.74	0.76	288.7	11.38	-	0.285	-
Process 2		20.74	0.46	352.6	2.87	-	0.055	-
Process 3		19.82	0.46	288.7	1.72	-	0.012	-
Process 4		19.82	0.46	288.7	2.34	-	0.058	-
Process 5		22.87	1.22	380.4	12.13	-	0.570	-
Portsmouth Shipyard	358.4E 4771.2N	50.90	1.17	477.4	21.05	69.73	4.98	18.65
Great Falls Bleachery	348.8E 4791.0N	18.29	0.76	560.8	10.36	3.18	0.25	1.06

TABLE 2-6

SUMMARY OF SO_2 AND TSP MONITORING DATA

Site	Pollutant	Measurement Period	Concentrations ($\mu g/m^3$) Maximum 3-Hour	Maximum 24-Hour	Annual Average
Vaughn St	SO_2	2/1/80-1/31/81	115.0	89.0	18.0
Portsmouth City Garage	TSP	1/4/80-12/19/80	-	94.0	55.0
Portsmouth Fire Station	TSP	1/4/80-12/29/80	-	111.0	53.0
Portsmouth Armory	TSP	1/4/80-12/29/80	-	83.0	39.0
Eliot Fire Station	TSP	1/19/71-9/3/71	-	72.0	31.3

representative of background throughout the characteristically rural impact area. For these reasons, the NHARA and Maine DEP agreed to employ the measurements from the Eliot fire station for estimating rural background TSP concentrations.

3. RESULTS OF SCREENING ANALYSES

3.1 GEP Stack Height Analysis

A "good engineering practice" (GEP) stack height analysis was performed for the Schiller and Newington plants. The purpose of the analysis was to determine the potential for building downwash of the plumes emanting from the stacks. The GEP stack heights were calculated according to EPA guidance (EPA 1978b). The GEP stack height associated with any simple rectangular structure is calculated by the formula:

$$H_{GEP} = H_B + 1.5L$$

where:

H_{GEP} = Good engineering practice stack height

H_B = Height of the structure

L = Lesser dimension (height or width) of the structure, as projected on to a plane perpendicular to the direction of the wind.

For each plant, design drawings were examined to determine the physical dimensions of the structural building tiers which could create aerodynamic downwash effects. The stack height required to avoid any significant downwash was calculated for each building tier to determine the maximum GEP stack heights. These were then compared to the actual stack heights to assess the potential for plume downwash.

Table 3-1 summarizes the GEP stack height analysis of the Schiller station. Basically, there are three tiers of significant structural dimension, each of which has an associated GEP stack height. As shown in the table, the third tier is the determining structure. The maximum GEP stack height based on this tier's dimensions is equal to 238.75 feet. The height of the stacks

TABLE 3-1

SCHILLER GEP STACK HEIGHT SUMMARY

Tier 1:

Height	= 34.5	feet
Width	= 135	feet
Length	= 201	feet
Diagonal	= 244	feet

$H_s(GEP)_{max}$ = 34.5 + 1.5 min (34.5,135) = 86.25'.

Tier 2:

Height	= 62.5	feet
Width	= 135	feet
Length	= 175	feet
Diagonal	= 221	feet

$H_s(GEP)_{max}$ = 62.5 + 1.5 min (62.5, 135) = 156.25'.

Tier 3:

Height	= 95.5	feet
Width	= 85	feet
Length	= 114	feet
Diagonal	= 221	feet

$H_s(GEP)_{max}$ = 95.5 + 1.5 min (95.5, 114) = 238.75'.

servicing units 4, 5, and 6 is 225 feet, thereby indicating a minor potential for building downwash. The stack servicing unit 3, however, is only 137 feet high, indicating a significant potential for building downwash.

Table 3-2 depicts similar results for the Newington station. There are two tiers with the potential to create downwash. The maximum GEP stack height, determined by the second tier, is 431.5 feet. Since the height of the stack is 410 feet, again, there exists the potential for downwash. On the basis of these results, the decision was made to employ the building downwash option of the ISC dispersion model in the detailed sequential modeling analysis which is presented in Section 4.

3.2 Maximum Short-Term Impact Areas

Using the SO_2 emission rates for each of the sources identified in Section 2.4, the EPA screening model PTPLU was used to predict the magnitude of, distance to, and meteorological conditions of maximum 1-hour concentrations. The objective of this analysis was to evaluate the potential for overlapping impact areas and identify the areas of most probable maximum impacts. The results of this analysis are depicted in Table 3-3 and Figure 3-1. The results are presented in terms of maximum 3-hour impacts. These were conservatively estimated by applying the factor of 0.9 to the 1-hour concentrations. As shown in the table, maximum 3-hour impacts are predicted to occur under very unstable (Class A) to slightly unstable (Class C) conditions and light wind speeds. The impacts are constrained to very close distances from the individual sources. The relationship of these impact areas to one another are depicted in Figure 3-1. By comparing the areas of maximum impact shown in Figure 3-1 with the magnitude of the concentrations presented in Table 3-3, it is possible to infer the relative significance of one source's contribution to another's maximum impact. From this comparison, it is immediately evident that UNH, GFB, and PAFB would not significantly contribute to the maximum 3-hour impacts of Schiller.

TABLE 3-2

NEWINGTON GEP STACK HEIGHT SUMMARY

Tier 1:

Height	=	92 feet
Width	=	204 feet
Length	=	222 feet
Diagonal	=	302 feet

$$H_s(GEP)_{max} = 92 + 1.5 \min(92,204) = 230.0.$$

Tier 2:

Height	=	184 feet
Width	=	104 feet
Length	=	128 feet
Diagonal	=	165 feet

$$H_s(GEP)_{max} = 184 + 1.5 \min(184,165) = 431.5.$$

TABLE 3-3

RESULTS OF WORST-CASE SCREENING ANALYSIS

Source	Maximum 3-Hour SO_2 Concentration $\mu g/m^3$	Distance (km)	Meteorological Conditions Stability Class	Wind Speed (m/sec)
Schiller (4-6)	1257	0.60	A	3.6
Newington	473	0.88	A	3.9
PNS	194	0.56	A	2.4
PAFB	100	0.34	A	3.3
Gold Bond	80	0.18-0.42	A-C	0.5-7.0
UNH	20-40	0.18-0.61	A-C	0.2-0.6
Eastern Grains	73	0.31	A	3.3
GFB	60	0.38	C	5.0

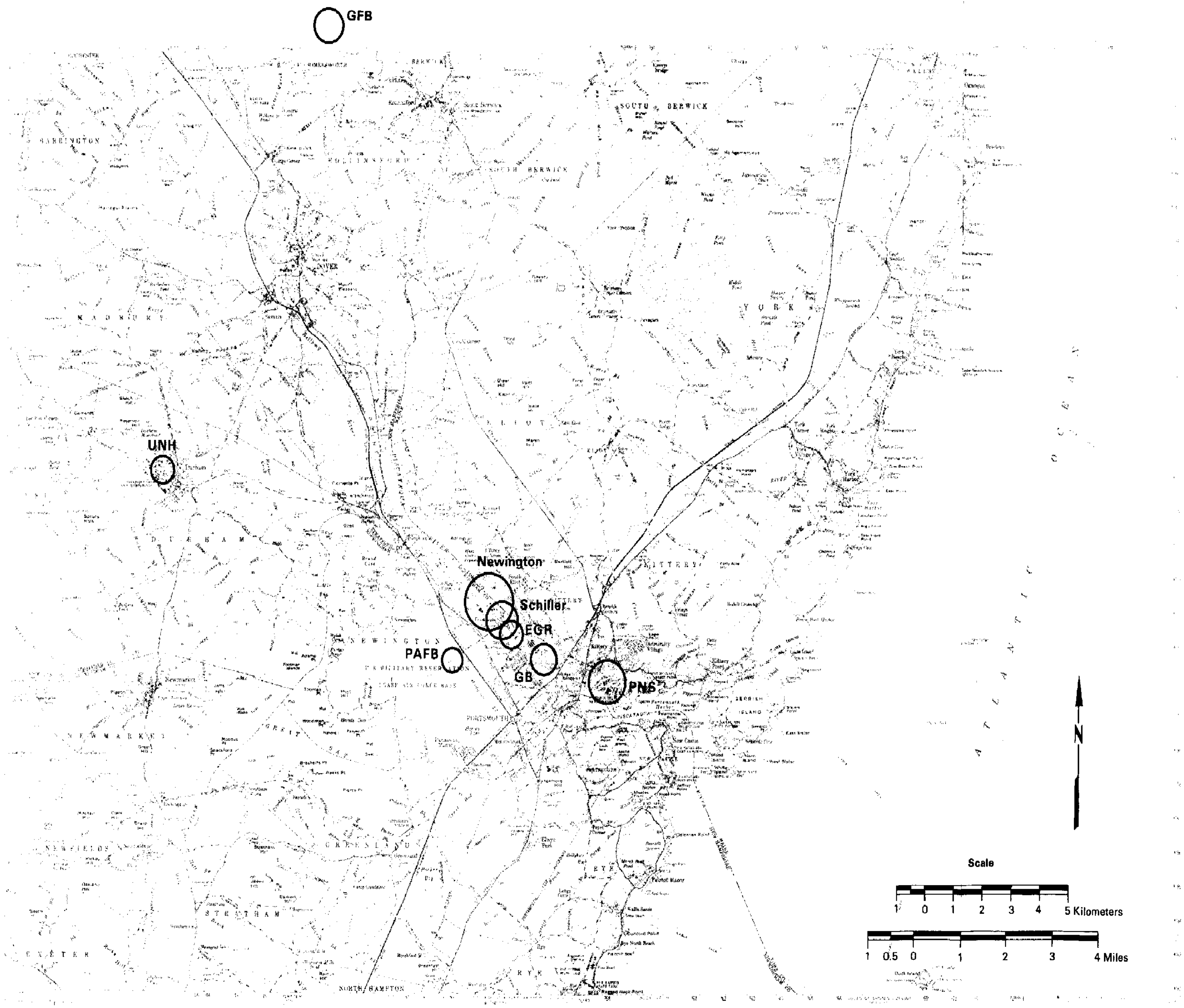


Figure 3-1 Distance to Maximum 3-Hour Impacts

715-1 8104127

Maximum 24-hour impacts due to point sources, however, are often associated with the persistence of neutral (Class D) conditions and moderate wind speeds. To assess the potential for combined impacts under these conditions, a similar analysis using PTPLU was conducted. Table 3-4 lists the estimated maximum 24-hour impacts under neutral conditions. These were conservatively estimated by applying the factor of 0.4 to the maximum 1-hour concentrations predicted by PTPLU for neutral conditions. As shown in Table 3-4, the estimated concentrations are lower, as expected, but occur at greater distances and under higher wind speeds than those under unstable conditions. The relationship of these impact areas to one another is depicted in Figure 3-2. Again, it is clear that neither UNH nor GFB would significantly contribute to Schiller maximum impacts. It is also evident that Newington maximum impacts would not combine with Schiller's. There does appear to be the potential for combined impacts with the other sources, however. As a means of further assessing this potential, a worst-case "line-up" modeling analysis was performed with the EPA PTMTP model. The downwind profile of ground-level 24-hour SO_2 concentrations was determined for all sources under neutral stability and moderate wind speeds, assuming a hypothetical "worst-case" situation of all sources being colinear with the wind direction. The results of that analysis are presented in Figure 3-3. As is clearly indicated, the Schiller station would dominate the short-term impacts within its area of influence.

3.3 Areas of Significant Annual Average Impact

The ISCLT model was employed with the 1970-1974 meteorological frequency data to estimate the significant annual average impact areas for each source along with the areas of most frequent combined impacts. The results are depicted in Figure 3-4. The areas of annual average SO_2 concentrations greater than the significance level of 1 $\mu g/m^3$ are depicted for each source. Schiller's significant impact area covers the largest portion of the study region as indicated by the isopleth which extends from the western region of the study area easterly, to beyond the coast line. Again, the impact

TABLE 3-4

WORST-CASE 24-HOUR IMPACTS AND DISTANCES

UNDER NEUTRAL STABILITY

Source	Maximum 24-Hour SO_2 Concentration $\mu g/m^3$	Distance (km)	Wind Speed (m/sec)
Schiller (4-6)	127	3.7	12-15
Newington	24	9.4	28.2
PNS	37	2.3	7.0
PAFB	33	1.0	7.0
Gold Bond	30	0.7	0.8-7.0
UNH	3-15	0.5-3.0	7.9-12.0
Eastern Grains	26	0.9	6.2
GFB	22	0.7	5.8

Figure 3-2 Distance to Maximum 24-Hour Impact Stability Class D

715-1 810125

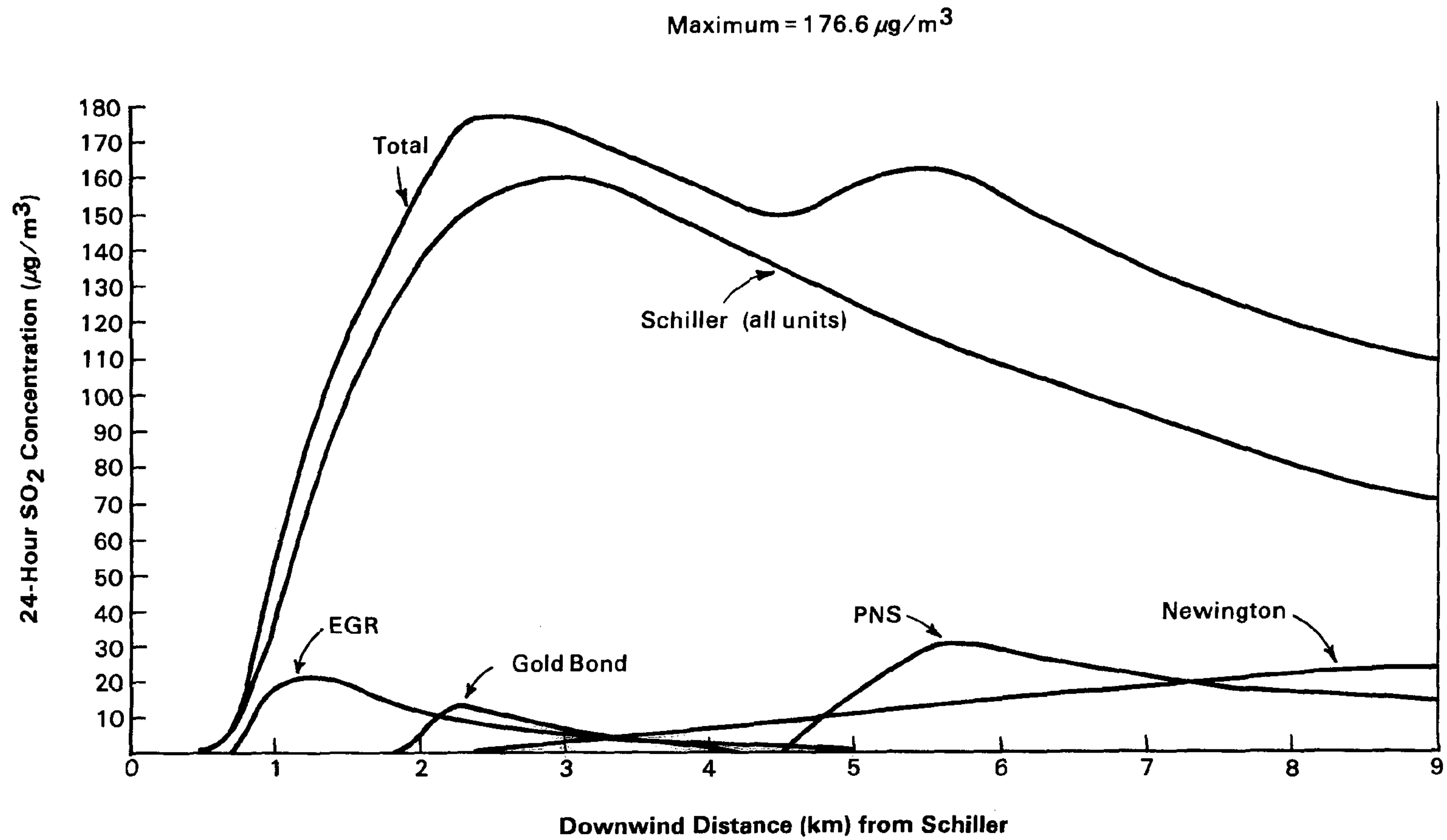


Figure 3-3 Hypothetical Worst-Case Line-up of All Sources Maximum 24-Hour SO_2 Under Neutral Stability

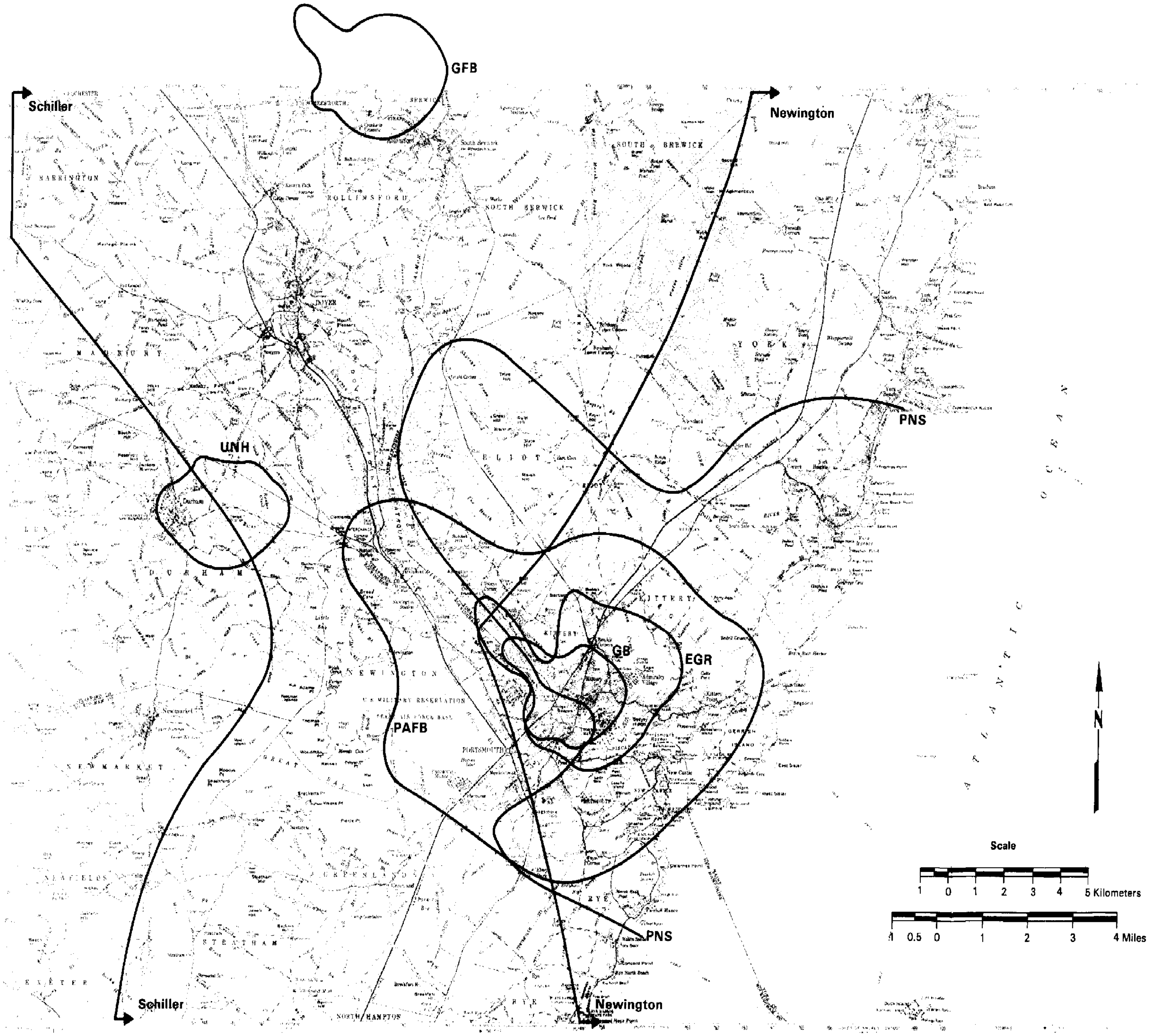


Figure 3-4 Area of Significant Impact Annual $SO_2 \geq 1$ μg/m^3

areas of UNH and GFB are relatively isolated. The impact areas of all the other sources overlap on an annual average basis in the area of Kittery and northeast Portsmouth. This can be expected due to the locations of the other sources and the predominant wind directions. Figure 3-5 is a plot of the frequency of wind directions over the 5 year period 1970-1974 as measured at Pease Air Force Base. The predominance of West to Northwest winds is clearly evidenced. The next section describes how the results of these screening analyses were incorporated into the detailed sequential modeling.

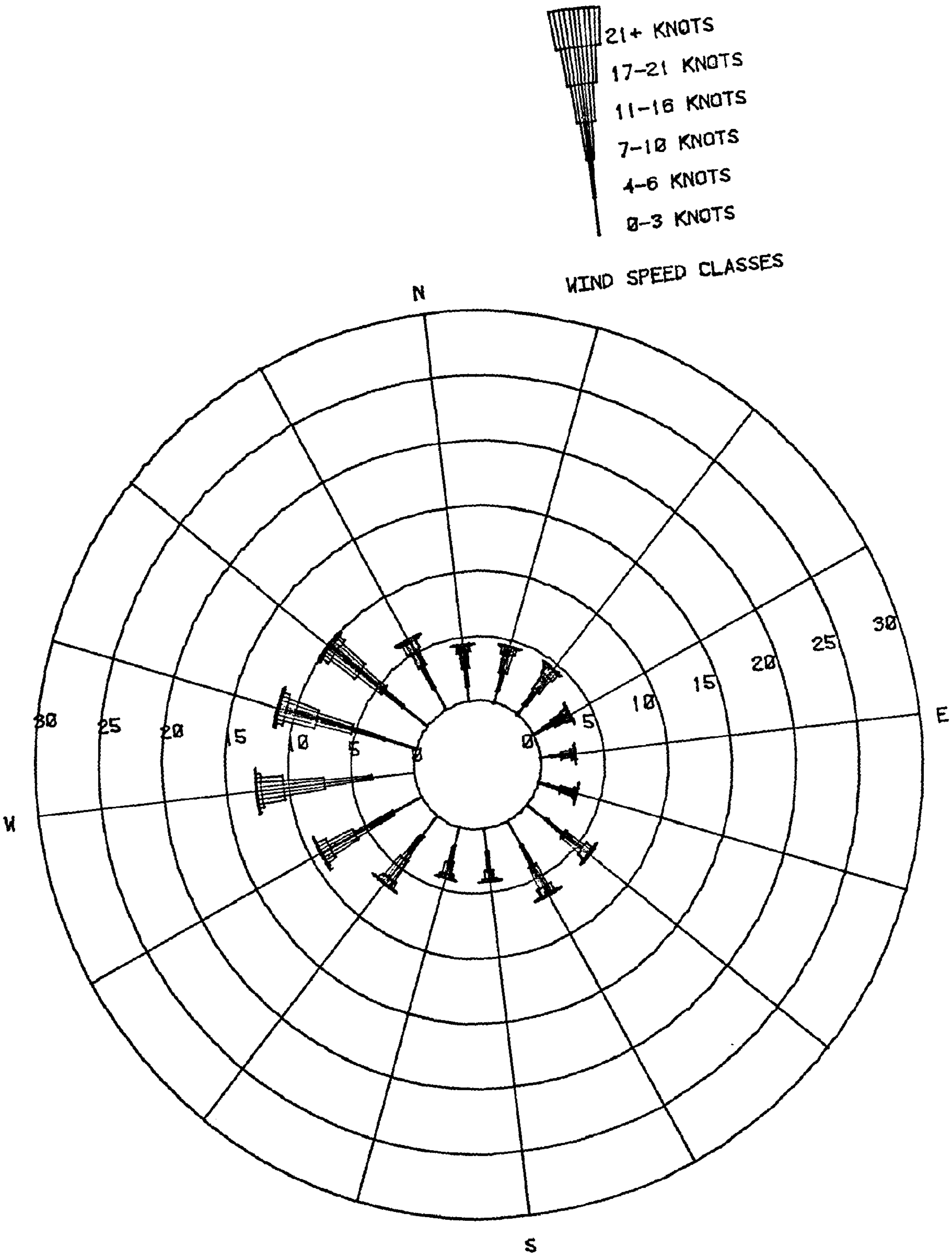


Figure 3-5 Star Wind Rose - All Stabilities 1970-1974 Pease AFB, Portsmouth, NH

4. RESULTS OF DETAILED SEQUENTIAL MODELING OF SO_2 IMPACTS

4.1 Overview of Modeling Approach

The following critical considerations were derived from the results of the screening analysis for the design of the detailed sequential modeling analysis.

1) Full Year Sequential Modeling

This was performed for Schiller emissions only to identify the critical 3 and 24-hour periods of highest impact. The ISCST model was applied on a sequential basis for each hour of the meteorological year. Based on the highest frequency of west to northwest winds, the year 1974 was chosen to be modeled first. For each hour of meteorology, the impact of the conversion from oil to coal for Schiller was predicted by modeling SO_2 emissions of Units 4, 5, and 6 when coal fired and Unit 3, which remains on oil. The predicted hourly concentrations were then averaged together in block periods of 3 and 24-hours to determine 3 and 24-hour critical impact periods.

For the modeling of impacts due to the point source emissions alone, a coarse grid of 288 model receptors was employed. The highest receptor resolution was input for the area immediately surrounding the Schiller plant, with care to locate an adequate number of receptors in the Kittery and Northeast Portsmouth areas. Figure 4-1 illustrates the receptor coverage.

For all modeling with ISC, the terrain elevations were input for each receptor location. Additional receptors were located at the highest elevations within the study area, as shown in Figure 4-1. Finally, as discussed in Section 3, the structural dimensions which could create aerodynamic building downwash effects for Schiller were also included in the full year modeling.

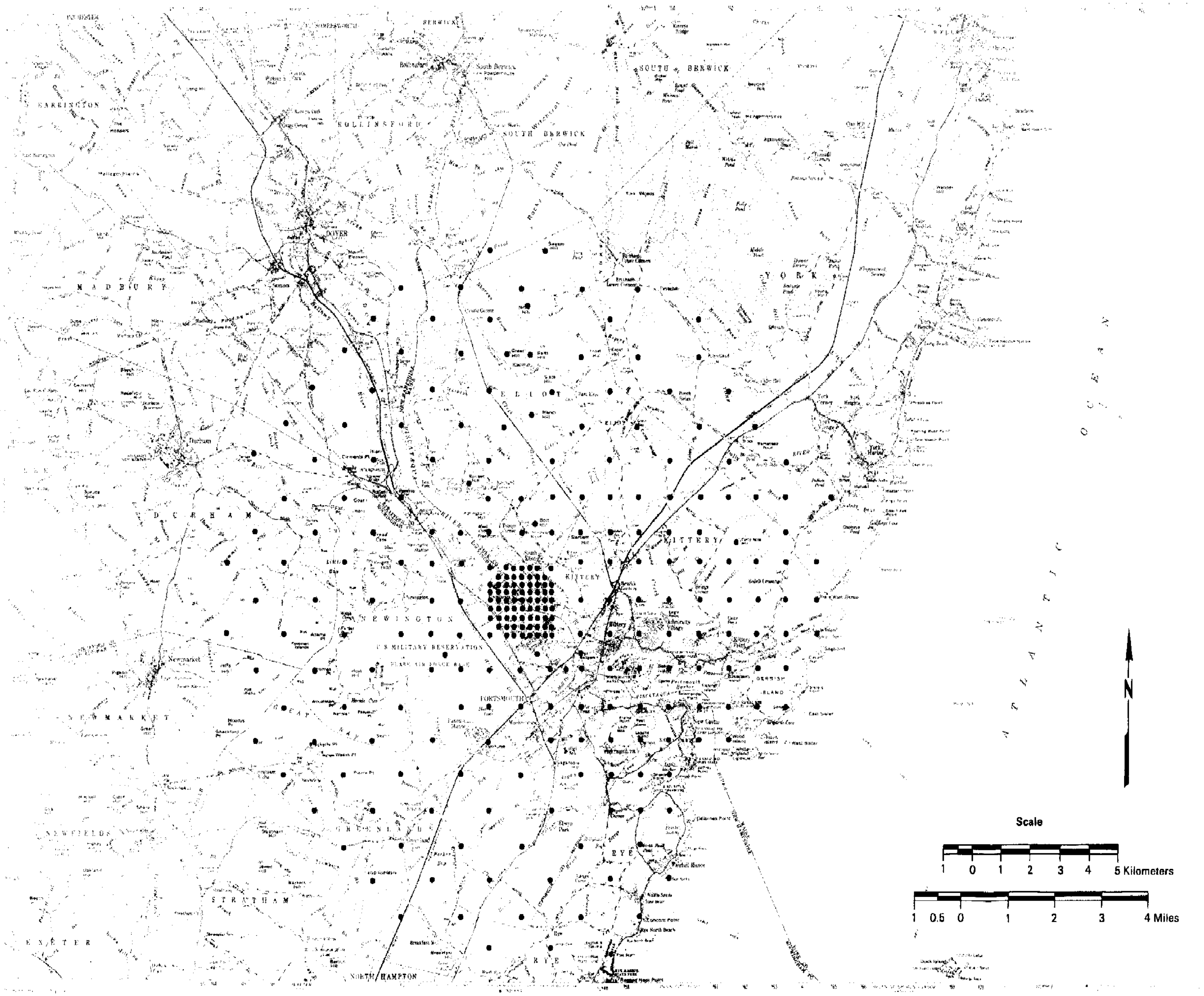


Figure 4-1 Receptor Grid used in Full Year Sequential Modeling

2) Critical Period Modeling

From the sequential modeling results for 1974, a total of 30 critical periods were identified based on the 15 highest predicted 3 and 24-hour SO_2 concentrations from Schiller alone. These periods were re-modeled with all the other significant sources included. UNH and GFB were eliminated from further consideration based on the screening analysis results discussed in Section 3. For each critical period, a dense grid of 25 receptors was input for the area surrounding the coarse grid receptor identified in the sequential modeling. These receptors were located so as to cover the area about the initial receptor which was not covered as densely in the coarse grid. Distances between receptors ranged from 100 to 250 meters depending on the location of the original receptor.

The results of the critical period SO_2 modeling were then analyzed to identify any exceedances of the applicable PSD increments or ambient air quality standards. For each period for which an exceedance was predicted, the necessary reduction in SO_2 emissions from Schiller units 4, 5, and 6, when coal fired, was calculated by the following formulas:

1) PSD Increment Consumption

$$\frac{CFS}{MFS}(S_c) - (S_o) + EGR = \text{Available Increment}$$

2) Total Ambient Air Quality

$$\frac{CFS}{MFS}(S_c) + OS + BKG = \text{Ambient Standard}$$

where: CFS = Complying Fuel Sulfur Content in (lb.S/mm Btu)
MFS = Modeled Fuel Sulfur Content at 2lb.S/mm Btu
S_c = Schiller Units 4, 5, 6 impacts when coal fired (future case)

S_o = Schiller Units 4, 5, 6 impacts when oil fired (current case)

EGR = Impact of Eastern Grains Refinery (increment consuming source)

OS = all source impacts <u>other</u> than Schiller Units 4, 5, 6

BKG = background concentration

Once a complying sulfur limit for Schiller was determined based on 1974 modeling results, the sequential modeling was repeated for 1970 meteorology. Additional 3 and 24-hour critical periods were identified which could potentially result in a lower complying fuel sulfur content. These were analyzed in the same manner as the critical periods for 1974.

4.2 Limiting 3-Hour SO_2 Impacts

Table 4-1 presents the results of the 1974 critical period modeling for 3-hour SO_2 PSD increment consumption. The periods are ranked according to total increment consumed. The day, hour ending, and receptor location of the maximum predicted concentrations are listed for each period. The locations are given in terms of the distance from Schiller, based on Cartesian coordinates in kilometers, with the origin at Schiller. The available increment is a function of receptor location. For receptors in Maine, half of the allowable increment is assumed. In New Hampshire it is assumed that the full increment is available. The complying fuel in terms of lb.S/mmBtu is listed for each period, as calculated from the formula described in Section 4.1. The most limiting situation is predicted to occur in Maine (Day 170, hour ending 21) where only half of the allowable increment is available. A limit of 1.57 lb.S/mmBtu would be required in order not to exceed half of the allowable increment of 512 $\mu g/m^3$.

Table 4-2 lists similar results for 1970 meteorology. Seven 3-hour periods were identified with higher total predicted increment consumption than the 15th ranked period of 1974. As can be seen from these results, the most stringent 3-hour SO_2 limit would be 0.81 lb.S/mmBtu.

TABLE 4-1

1974 CRITICAL PERIOD MODELING RESULTS FOR 3-HOUR

SO_2 PSD INCREMENT CONSUMPTION

Rank*	Day	Hour Ending	Location (km)** X	Location (km)** Y	3-Hour SO_2 Concentrations ($\mu g/m^3$) Available Increment	Schiller Units 4-6 (coal)	Schiller Units 4-6 (oil)	EGR	Complying Fuel (lbS/mmBtu)
1	203	12	- .25	-1.0	512	532	14	6	1.95
2	170	21	- .37	7.09	256	819	407	20	1.57
3	191	15	1.5	- .75	512	762	381	0	2.34
4	155	12	- .75	1.25	256	610	303	6	1.81
5	211	18	-2.25	0	512	655	366	16	2.63
6	244	12	1.25	-1.0	512	586	287	1	2.72
7	187	15	1.0	- .75	512	555	262	0	2.79
8	192	12	0.5	-1.25	512	504	239	17	2.91
9	185	12	1.5	0.5	256	575	297	1	1.92
10	365	12	2.25	0	256	508	238	0	1.94
11	278	12	1.75	0	256	497	237	1	1.98
12	156	9	1.5	0	256	497	256	1	2.06
13	98	24	-2.75	-1.75	512	282	78	1	4.18
14	124	12	0.75	-0.75	512	263	84	0	4.53
15	19	15	4.75	-2.75	256	261	134	2	2.97

*Based on total increment consumption
**Based on cartesian coordinate system with origin at Schiller

TABLE 4-2

1970 CRITICAL PERIOD MODELING RESULTS FOR 3-HOUR

SO_2 PSD INCREMENT CONSUMPTION

			Location (km)**		3-Hour SO_2 Concentrations ($\mu g/m^3$)				
Rank*	Day	Hour Ending	X	Y	Available Increment	Schiller Units 4-6 (coal)	Schiller Units 4-6 (oil)	EGR	Complying Fuel (lbS/mmBtu)
1	150	12	- .25	.75	256	817	80	6	0.81
2	215	12	1.25	0	256	652	321	0	1.77
3	17	3	6.3	8.0	256	613	301	11	1.78
4	278	12	1.0	-1.0	512	553	259	2	2.78
5	174	18	2.0	0	256	529	247	0	1.90
6	216	15	1.0	-1.0	512	515	245	6	2.92
7	74	12	1.75	0	256	499	240	0	1.99

*See Table 4-1

**See Table 4-1

Tables 4-3 and 4-4 present the critical period modeling results for 3-hour total ambient SO_2 concentrations for 1974 and 1970, respectively. It is immediately apparent that no exceedances of either the Maine or N.H. ambient standards are predicted if Schiller is limited to 2 lbS./mmBtu.

4.3 Limiting 24-Hour SO_2 Impacts

Tables 4-5 through 4-8 present the critical period modeling results for 24-hour SO_2 PSD increment consumption and total ambient air quality. The most stringent SO_2 emission limit arises from the prediction of total ambient air quality shown in Table 4-7. On day 216 at a receptor located in Maine, a sulfur limit of 0.65 lb/mmBtu would be required in order not to exceed the Maine 24-hour SO_2 standard of 230 $\mu g/m^3$.

4.4 Limiting Annual Average SO_2 Impacts

Table 4-9 presents the modeling results for annual average SO_2 impacts. These results are based on modeling of all sources at their annual average emission rates with ISCLT for the 1970-1974 meteorological frequency data. For Schiller and Newington, the annual emissions were based on the annual capacity factors which were presented in Sections 2.3 and 2.4. The highest impacts for both increment consumption and total air quality are predicted to occur in Maine. This would be expected due to the predominance of westerly winds on an annual basis. As shown in the table, PSD increment consumption would be the determining factor in terms of complying SO_2 emissions. A sulfur limit of 1.62 lb/mmBtu would be required in order not to exceed the available increment of 10 $\mu g/m^3$.

4.5 Limiting SO_2 Impacts Based On Federal Standards Only

As discussed in Section 1.3, an alternate regulatory scenario was examined for determining complying sulfur emissions. This scenario assumes that only Federal Standards apply in the state of Maine for

TABLE 4-3

1974 CRITICAL PERIOD MODELING RESULTS FOR 3-HOUR

SO_2 TOTAL AMBIENT AIR QUALITY

Rank*	Day	Hour Ending	Location (km)** X	Location (km)** Y	3-Hour SO_2 Concentrations ($\mu g/m^3$) Applicable Standard	Schiller Units 4-6 (coal)	Schiller Unit 3	Other Sources	Background	Complying Fuel (lbS/mmBtu)
1	170	21	- .37	7.09	1150	819	165	23	115	2.07
2	191	15	1.5	- .75	1300	762	170	28	"	2.59
3	211	18	-2.25	0	1300	655	123	34	"	3.14
4	155	12	-0.75	1.25	1150	610	128	37	"	2.85
5	244	12	1.25	-1.0	1300	586	130	22	"	3.60
6	187	15	1.0	- .75	1300	575	123	28	"	3.60
7	185	12	1.5	0.5	1150	555	129	5	"	3.25
8	192	12	0.5	-1.25	1300	504	145	19	"	4.05
9	365	12	2.5	0	1150	521	120	1	"	3.51
10	156	9	1.5	0	1150	497	139	1	"	3.60
11	278	12	1.75	0	1150	497	130	4	"	3.63
12	203	12	- .25	-1.0	1300	532	86	5	"	4.11
13	98	24	-2.5	-1.5	1300	376	132	68	"	5.24
14	124	18	1.5	-1.5	1300	287	107	41	"	7.23
15	71	24	5.25	-2.75	1150	230	58	68	"	7.90

*Based on total air quality
**See Table 4-1

TABLE 4-4

1970 CRITICAL PERIOD MODELING RESULTS FOR 3-HOUR

SO_2 TOTAL AMBIENT AIR QUALITY

					3-Hour SO_2 Concentrations ($\mu g/m^3$)					
Rank*	Day	Hour Ending	Location (km)** X	Y	Applicable Standard	Schiller Units 4-6 (coal)	Schiller Unit 3	Other Sources	Background	Complying Fuel (lbS/mmBtu)
1	150	12	-2.5	.75	1150	817	153	6	115	2.14
2	17	3	6.3	8.0	1150	613	212	29	"	2.59
3	215	12	1.25	0	1150	652	140	57	"	2.57
4	278	12	1.0	-1.0	1300	553	128	7	"	3.80
5	174	18	2.25	0	1150	537	125	15	"	3.33
6	216	15	1.0	-1.0	1300	515	123	17	"	4.06
7	74	12	1.75	0	1150	499	131	9	"	3.59

*Based on total air quality
**See Table 4-1

TABLE 4-5

1974 CRITICAL PERIOD MODELING RESULTS FOR 24-HOUR

SO_2 PSD INCREMENT CONSUMPTION

				24-Hour SO_2 Concentrations ($\mu g/m^3$)				
Rank*	Day	Location (km)** X	Y	Available Increment	Schiller Units 4-6 (coal)	Schiller Units 4-6 (oil)	EGR	Complying Fuel (lbS/mmBtu)
1	118	1.75	1.25	45.5	157	52	7.6	1.15
2	216	2.75	1.75	45.5	165	76	3.6	1.43
3	330	2.75	-1.75	45.5	158	77	3.1	1.51
4	185	1.5	-0.5	45.5	147	74	0.6	1.62
5	151	-1.25	2.5	45.5	124	56	5.1	1.55
6	36	3.5	-2.25	45.5	125	61	3.6	1.65
7	166	-1.5	0.75	91.0	123	58	2.5	2.38
8	159	1.0	1.0	45.5	127	61	1.2	1.66
9	99	-1.75	-1.75	91.0	120	58	0.8	2.47
10	199	1.75	1.0	45.5	116	56	1.7	1.72
11	72	3.25	-2.0	45.5	116	56	1.7	1.72
12	176	-2.5	-1.75	91.0	103	46	3.2	2.60
13	265	4.75	-2.0	45.5	104	52	2.8	1.82
14	170	- .37	7.09	45.5	102	51	2.5	1.84
15	139	0.5	-1.5	91.0	62	22	6.1	3.45

*See Table 4-1
**See Table 4-1

TABLE 4-6

1970 CRITICAL PERIOD MODELING RESULTS FOR 24-HOUR

SO_2 PSD INCREMENT CONSUMPTION

				24-Hour SO_2 Concentrations ($\mu g/m^3$)				
Rank*	Day	Location (km)** X	Y	Available Increment	Schiller Units 4-6 (coal)	Schiller Units 4-6 (oil)	EGR	Complying Fuel (lbS/mmBtu)
1	150	- .25	.75	45.5	107	12	2.0	1.04
2	215	1.25	0	45.5	145	68	1.7	1.54
3	162	1.5	.25	45.5	1623	79	0.7	1.53
4	121	2.0	3.25	45.5	156	75	3.4	1.53
5	216	1.0	-1.0	91	128	59	1.4	2.32
6	41	-3.0	0	91	111	44	0.4	2.43
7	174	2.0	- .25	45.5	136	70	1.0	1.68
8	262	1.75	-1.75	91	122	59	2.6	2.42
9	346	-1.25	-5.25	91	115	54	4.1	2.45
10	82	-2.25	-1.5	91	114	53	1.1	2.51
11	193	-5.0	-1.25	91	101	48	4.1	2.67
12	364	4.25	-1.5	45.5	101	48	2.0	1.81
13	14	3.5	-1.75	45.5	101	49	2.0	1.83
14	160	6.3	8.0	45.5	95	46	2.2	1.88

*See Table 4-1
**See Table 4-1

TABLE 4-7

1974 CRITICAL PERIOD MODELING RESULTS FOR 24-HOUR SO_2 TOTAL AMBIENT AIR QUALITY

Rank*	Day	Location (km)** X	Location (km)** Y	24-Hour SO_2 Concentrations ($\mu g/m^3$) Applicable Standard	Schiller Units 4-6 (coal)	Schiller Unit 3	Other Sources	Background	Complying Fuel (lbS/mmBtu)
1	216	2.75	1.75	230	165	66	21	89	0.65
2	330	2.75	-1.75	230	158	55	5.6	"	1.02
3	118	1.75	1.25	230	157	49	12	"	1.02
4	151	-1.25	2.5	230	124	46	13	"	1.32
5	185	1.5	0.5	230	147	33	2.3	"	1.44
6	36	3.5	-2.25	230	125	39	8.3	"	1.50
7	99	-1.75	-1.75	365	120	45	5.5	"	3.76
8	166	-1.5	0.75	365	123	37	8.9	"	3.74
9	265	4.75	-2.0	230	104	29	36	"	1.46
10	176	-2.5	-1.75	365	103	39	22	"	4.17
11	159	1.0	1.0	230	127	31	4.1	"	1.67
12	72	3.25	-2.0	230	117	38	3.9	"	1.69
13	199	1.75	1.0	230	116	34	5.4	"	1.75
14	170	- .37	7.09	230	102	21	3.0	"	2.29
15	139	0.5	-1.5	365	86	22	5.1	"	5.79

*Based on total air quality
**See Table 4-1

TABLE 4-8

1970 CRITICAL PERIOD MODELING RESULTS FOR 24-HOUR

SO_2 TOTAL AMBIENT AIR QUALITY

				24-Hour SO_2 Concentrations ($\mu g/m^3$)					
Rank*	Day	Location (km)** X	Y	Applicable Standard	Schiller Units 4-6 (coal)	Schiller Unit 3	Other Sources	Background	Complying Fuel (lbS/mmBtu)
1	215	1.25	0	230	145	40	20	89	1.12
2	162	1.5	.25	230	162	42	14	"	1.05
3	121	2.0	3.25	230	156	49	13	"	1.01
4	174	2.0	- .25	230	136	31	11	"	1.46
5	216	1.5	-1.5	365	124	31	35	"	3.39
6	262	1.75	-1.75	365	122	28	21	"	3.72
7	82	-2.75	-1.75	365	112	34	21	"	3.95
8	14	5.0	-2.5	230	98	28	33	"	1.63
9	346	1.25	-5.25	365	115	34	6.0	"	4.10
10	41	-2.25	0	365	108	40	1.6	"	4.34
11	193	.5	-1.25	365	101	32	7.1	"	4.69
12	150	-.25	.75	230	107	28	7.6	"	1.97
13	364	4.25	-1.5	230	101	37	4.8	"	1.96
14	160	6.3	8.0	230	95	24	25	"	1.94

*Based on total air quality
**See Table 4-1

TABLE 4-9

MODELING RESULTS FOR ANNUAL AVERAGE SO_2

Case 1: Maximum PSD Increment Consumption

Location: 3 km East, 2 km North of Schiller

Available Increment: 10 $\mu g/m^3$

Predicted SO_2 ($\mu g/m^3$):

1) Schiller Units 4-6 coal fired = 13.3

2) Schiller Units 4-6 oil fired = -1.9

3) Eastern Grain Refinery = 1.1

Complying Fuel: 1.62 lb.S/mmBtu

Case 2: Maximum Total Ambient Air Quality

Location: 3 km East, 2 km North of Schiller

Applicable Standard: 57 $\mu g/m^3$

Predicted SO_2 ($\mu g/m^3$):

1) Schiller Units 4-6 coal fired = 13.3

2) Schiller Unit 3 = 0.4

3) Other Sources = 6.8

Background: 18 $\mu g/m^3$

Complying Fuel: 4.78 lb.S/mmBtu

impacts of New Hampshire sources. In order to evaluate this scenario the critical periods presented in the previous sections were re-examined. For PSD increment consumption, it was assumed that only one exceedance of the available 3 or 24-hour increment would be allowed per year over the entire impact area. Therefore, the second lowest complying sulfur limit would be the controlling case in each year, This results in a 3-hour limit for PSD of 1.77 lb/mmBtu, based on the second-lowest limit derived from the 1970 critical periods (Table 4-2). The 24-hour sulfur limit for PSD would be 1.43 lb/mmBtu based on the second-lowest limit derived from 1970 critical periods (Table 4-6). For the annual average case, the results do not change since the Federal Standards also do not allow any exceedances.

For total ambient air quality, impacts were assessed against the NAAQS of 1300 $\mu g/m^3$ for 3-hour SO_2, 365 $\mu g/m^3$ for 24-hour SO_2, and 80 $\mu g/m^3$ for annual average SO_2, with one 3 and 24-hour exceedance allowed as explained above. This results in a 3-hour sulfur limit of 2.59 lb/mmBtu based on the second-lowest limit derived from 1974 critical periods (Table 4-3). The 24-hour sulfur limit would be 2.72 lb/mmBtu based on the second-lowest limit derived from 1970 critical periods (Table 4-8). The annual average sulfur limit would be 8.24 lb/mmBtu.

5. RESULTS OF DETAILED SEQUENTIAL MODELING OF TSP IMPACTS

5.1 Overview of Modeling Approach

The analysis of TSP impacts included both point source particulate emissions and fugitive dust emissions due to Schiller coal handling operations. The dispersion modeling was conducted in two phases. Initially, critical period modeling was performed for the same critical 24-hour periods identified in the SO_2 full year modeling for point source impacts. These results were then compared to the applicable PSD increments and Ambient Air Quality Standards (AAQS). However, since the fugitive dust emissions occur at or near ground level and have no initial buoyancy or vertical momentum, their maximum impacts would not necessarily occur under the same meteorological conditions or locations that produce the critical point source impacts. For this reason, full year sequential modeling of the Schiller fugitive dust sources alone was performed for 1974 meteorology. A revised receptor grid was employed to obtain maximum resolution in the immediate area of the Schiller plant. This reflects the assumption that maximum impacts from non-buoyant ground-level sources typically occur at receptors closest to the sources themselves. The receptor grid used in the full year modeling of fugitive dust impacts is shown in Figure 5-1.

Based on this analysis, eight additional critical periods were selected; the four highest impacts in Maine and New Hampshire respectively. These were then re-modeled with a dense grid of 25 receptors at 100 meter spacing. All other sources were included and the results were again compared to the applicable PSD increments and AAQS.

For annual average impacts the fugitive dust sources were included with the point souirces in the ISCLT climatological model for 1970-1974 meteorology. The analysis was performed for both the original receptor grid used in the SO_2 modeling (Figure 4-1) and the grid shown in Figure 5-1.

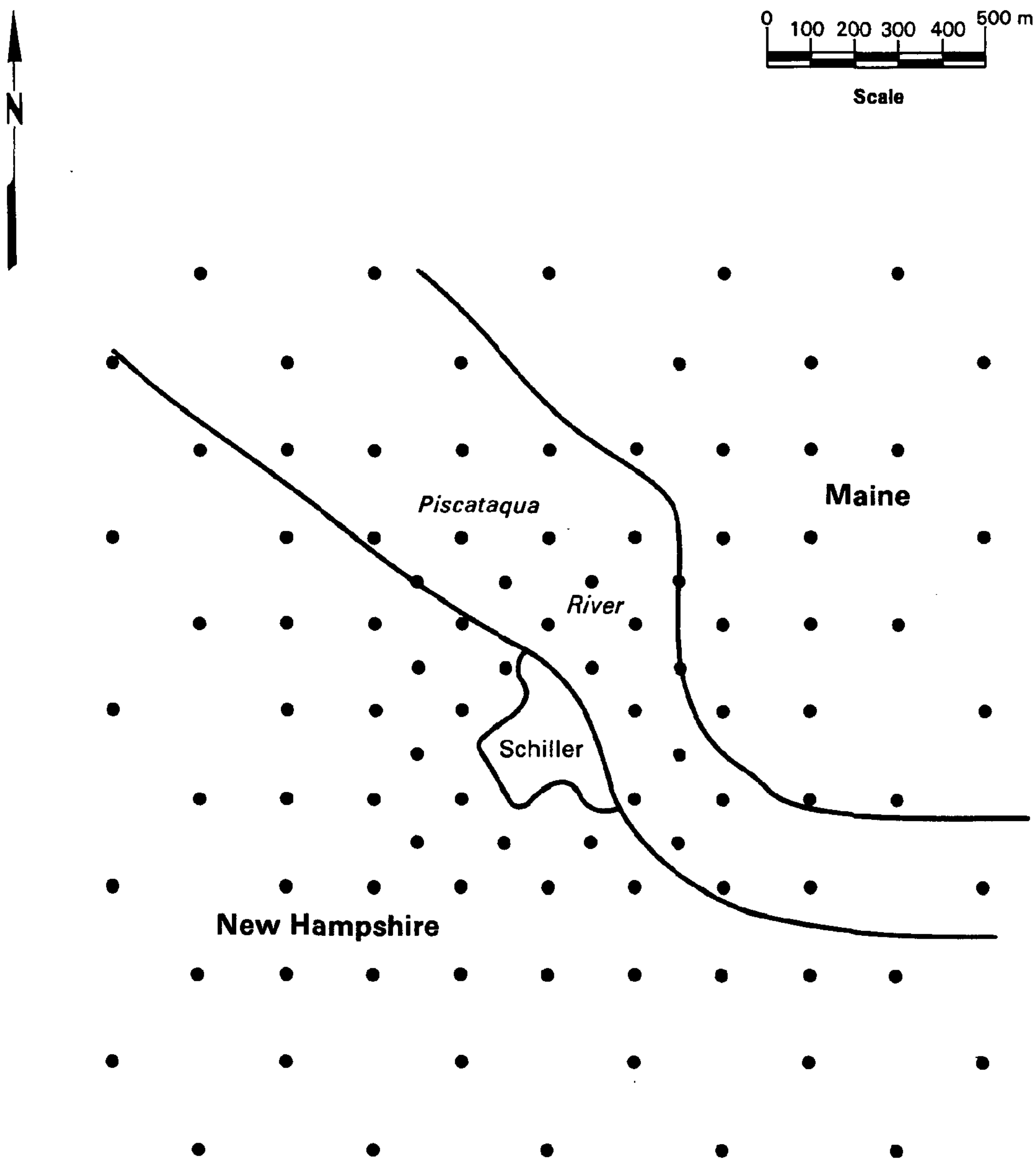


Figure 5-1 Receptor Grid for Full Year Sequential Modeling of Fugitive Dust Sources

8104122

5.2 Maximum 24-Hour TSP Impacts

Table 5-1 presents the TSP modeling results for PSD increment consumption based on the critical 24-hour periods of point source impacts. The periods are ranked according to total increment consumption. For each period, the contribution of Schiller fugitive dust emissions, Shiller point source emissions, and EGR emissions are listed separately. The maximum 24-hour increment consumption occurs in New Hampshire at a receptor located 0.75 kilometers south of the Schiller plant. The value of 38.4 $\mu g/m^3$ is almost totally due to EGR. Schiller's stacks contribute nothing to this concentration but fugutive dust sources account for approximately 4.7% of the total increment consumed. Although total increment consumption is above the PSD increment of 37 $\mu g/m^3$, New Hampshire allows one exceedance per year. As shown in the table, all other periods are below 37 $\mu g/m^3$. The highest increment consumption in Maine is predicted at 1.25 kilometers north of Schiller. The total predicted increment of 15.3 $\mu g/m^3$ is below the 50% interstate guideline of 18.5 $\mu g/m^3$.

The modeling results for total ambient TSP concentrations from critical point source impacts are presented in Table 5-2. All of the impacts in New Hampshire are well below the 24-hour 260 $\mu g/m^3$ primary standard. The maximum predicted 24-hour impact in Maine is 94.9 $\mu g/m^3$ which is well below the 150 $\mu g/m^3$ state standard.

It is obvious from the results presented in Tables 5-1 and 5-2 that Schiller's fugitive dust sources contribute little, if any, impact to the maximum point source concentrations. As discussed in Section 5.1, this would be expected due to the very different source emission characteristics.

Table 5-3 presents the modeling results for TSP increment consumption based on critical fugitive dust impact periods. The four highest periods of 24-hour increment consumption are listed for Maine and New Hampshire. The highest impacts are predicted in New Hampshire at receptors immediately adjacent to Schiller. As shown in the table, these are well above the allowable 37 $\mu g/m^3$ PSD increment. But as previously discussed, New Hampshire allows one exceedance per year of the allowable increment at each receptor. The highest predicted

TABLE 5-1

RESULTS OF 24-HOUR CRITICAL PERIOD MODELING FOR TSP INCREMENT CONSUMPTION BASED ON CRITICAL PERIODS OF POINT SOURCE IMPACT

Rank	Year	Day	Location (km)**		TSP Increment Consumption ($\mu g/m^3$)			
			X	Y	Schiller Fugitive Dust Sources	Schiller Units 4-6	EGR	Total
1	1970	346	0	-.75	1.8	0	36.6	38.4
2	1970	215	.25	-.5	0	0	30.9	30.9
3	1974	176	-.25	-.75	0.4	0	24.0	24.4
4	1970	216	.25	-.75	2.8	0.9	19.8	23.5
5	1974	265	.5	-.75	0	0	22.1	22.1
6	1970	14	.5	-.75	0.2	0	21.3	21.5
7	1970	262	.25	-.75	4.2	0.8	16.3	21.3
8	1974	166	-.5	.5	19.7	0.1	0.4	20.2
9	1974	199	.25	-.25	0.9	0	18.9	19.8
10	1970	193	.25	-1.0	1.6	4.0	13.3	18.9
11	1970	82	.25	-.75	0	0	17.9	17.9
12 *	1970	162	1.25	0	2.6	5.5	7.2	15.3
13	1970	346	-.25	-.1.75	1.0	0.9	13.3	15.2
14	1970	41	-.25	-.5	1.2	0	13.8	15.0
15	1974	69	-.25	-.75	0.6	0	13.8	14.4
16 *	1970	215	1.5	0	1.2	5.9	6.8	13.9
17 *	1970	174	0.5	.25	0.3	0	13.6	13.9
18 *	1974	185	1.5	-.25	0	0.3	13.5	13.8
19	1970	14	1.0	-1.0	0.4	0.1	11.6	12.1
20	1974	139	.25	-.75	0.5	1.6	8.0	10.1
21 *	1974	216	2.75	1.75	0.5	7.2	2.2	9.9
22 *	1970	121	1.5	2.5	0.5	6.3	3.0	9.8
23 *	1970	150	-.25	.75	0.3	7.7	1.4	9.4
24 *	1974	330	3.0	-2.0	0.4	6.3	2.1	8.8
25 *	1974	118	2.75	2.0	0.2	7.2	1.2	8.6
26 *	1974	265	2.5	-1.0	0.6	4.5	3.3	8.4
27 *	1974	36	3.0	-2.0	0.3	5.0	2.2	7.5
28 *	1974	151	-1.65	3.28	0.2	5.3	1.8	7.3
29 *	1974	72	2.75	-2.0	0.3	3.8	3.1	7.2
30 *	1970	364	2.5	-1.25	0.3	1.2	4.9	6.4

**Based on cartesian coordinate system with Schiller at origin

* Receptor located in Maine

TABLE 5-2

RESULTS OF 24-HOUR CRITICAL PERIOD MODELING FOR TOTAL AMBIENT TSP BASED ON CRITICAL PERIODS OF POINT SOURCE IMPACT

Rank	Year	Day	Location (km)**		Total Ambient TSP Concentrations ($\mu g/m^3$)				
			X	Y	Schiller Fugitive Dust Sources	Schiller Units 4-6	Other Sources	Background	Total
1	1970	346	0	-.75	1.8	0	37.1	72	110.9
2	1970	215	.25	-.5	0	0	31.7	72	103.7
3	1970	193	.25	1.0	1.6	7.0	16.2	72	96.8
4	1970	216	.25	-.75	2.8	1.5	20.4	72	96.7
5	1974	176	-.25	-.75	0.4	0	24.1	72	96.5
6	1974	166	-.75	.5	1.1	2.3	19.9	72	95.3
7	1970	262	.25	-.75	4.2	1.1	17.8	72	95.1
8 *	1970	215	1.5	0	1.2	11.4	10.3	72	94.9
9 *	1970	162	1.5	.25	1.1	12.8	8.7	72	94.6
10	1974	265	.5	-.75	0	0	22.1	72	94.1
11 *	1974	216	2.75	1.75	0.5	13.0	8.2	72	93.7
12	1970	14	.5	-.75	0.2	0	21.3	72	93.5
13	1974	199	.25	-.25	0.9	0	19.4	72	92.3
14 *	1970	121	1.5	2.5	0.5	11.4	7.8	72	91.7
15	1970	346	-.25	-1.75	1.0	1.3	16.5	72	90.8
16 *	1974	330	2.75	-1.75	0.4	12.4	6.4	72	91.2
17	1970	82	.25	-.75	0	0	18.0	72	90.0
18 *	1974	265	2.5	-1.0	0.6	8.3	6.9	72	87.8
19 *	1970	174	1.75	-.25	1.2	10.0	4.4	72	87.6
20 *	1974	118	2.75	2.0	0.2	10.9	4.3	72	87.4
21 *	1974	36	3.0	-2.0	0.3	9.3	5.6	72	87.2
22	1970	41	-.25	-.5	1.2	0	13.8	72	87.0
23 *	1974	151	-1.65	3.28	0.2	9.9	4.3	72	86.4
24	1974	69	.25	-.75	0.6	0	14.2	72	86.2
25 *	1974	185	1.5	-.25	0	0.6	14.1	72	86.7
26	1974	99	-1.25	-1.25	0.5	7.6	6.2	72	86.3
27	1970	82	-2.25	-1.5	0.3	9.1	4.6	72	86.0
28 *	1974	72	3.0	-2.0	0.3	8.5	4.9	72	85.7
29 *	1974	159	1.25	1.25	0.2	10.2	3.3	72	85.7
30	1970	14	5.0	-2.5	0.2	7.7	5.6	72	85.5

**See Table 5-1

* See Table 5-1

TABLE 5-3

RESULTS OF ADDITIONAL CRITICAL PERIOD MODELING FOR 24-HOUR TSP INCREMENT CONSUMPTION BASED ON CRITICAL PERIODS OF FUGITIVE DUST IMPACTS

State	Rank	Day	Location (km)**		TSP Increment Consumption (μg/m^3)		
			X	Y	Schiller Fugitive Dust Sources	Other PSD* Sources	Total
Maine	1	339	0.3	-0.1	25.2	1.2	26.4
	2	352	0.3	-0.1	25.0	0	25.0
	3	133	0.3	-0.1	24.6	0	24.6
	4	219	0.4	-0.2	7.9	14.2	22.1
New Hampshire	1	204	-0.1	0.1	49.4	17.2	66.6
	2	312	-0.1	-0.3	57.8	0	57.8
	3	114	-0.1	-0.3	54.6	0	54.6
	4	265	0.1	-0.2	42.1	0	42.1

**See Table 5-1

* Schiller Units 4-6, EGR

increments in Maine are much lower than those in New Hampshire, mainly due to the distance from Schiller. However, these impacts exceed the 50% interstate guideline of 18.5 $\mu g/m^3$. Most of these impacts are predicted at receptors located over the Piscataqua river and not on land in Maine. The area of land for which maximum predicted TSP impacts due to fugitive dusts exceed the 50% guideline in Maine is constrained to the Spinney Creek peninsula extending no further than approximately 0.75 kilometers from Schiller. The area of land for which the second-highest predicted TSP impacts due to fugitive dusts exceed the 37 $\mu g/m^3$ PSD increment in New Hampshire extends no further than approximately 0.2 kilometers from the Schiller property line.

It is important to note that these modeling results contain inherent measures of uncertainty not normally associated with standard model applications. These uncertanties were delineated in Section 1.3 and should be taken into consideration when interpreting these results.

Table 5-4 presents the modeling results for total 24-hour ambient TSP concentrations based on critical fugitive dust impacts. The four highest predicted impacts in Maine are all well below the state standard of 150 $\mu g/m^3$. Again, the highest predicted impacts occur immediately adjacent to Schiller in New Hampshire, but are all well below the 260 $\mu g/m^3$ primary standard.

5.3 Annual Average TSP Impacts

As was discused in Section 5.1, annual average modeling of TSP concentrations was performed with the ISCLT model using 1970-1974 meteorology. Modeling was performed for the primary receptor grid reflective of maximum point source impacts and the secondary grid established to reflect maximum fugitive dust impacts. The modeling results for annual TSP at the location of maximum point source impacts are presented in Table 5-5. As was the case for SO_2, the highest impact from the point sources is predicted to occur in Maine at a receptor located approximately 3.6 kilometers east-northeast of Schiller. The maximum predicted annual increment at this receptor is 1.54 $\mu g/m^3$, which is well below the 50% interstate guideline of 9.5 $\mu g/m^3$. The predicted total ambient air quality at this

TABLE 5-4

RESULTS OF ADDITIONAL CRITICAL PERIOD MODELING FOR TOTAL 24-HOUR AMBIENT TSP BASED ON CRITICAL PERIODS OF FUGITIVE DUST IMPACTS

State	Rank	Day	Location (km)**		Total Ambient TSP Concentrations (μg/m³)			
			X	Y	Schiller Fugitive Dust Sources	Other Sources	Background	Total
Maine	1	339	0.3	-0.1	25.2	1.4	72	98.6
	2	352	0.3	-0.1	25.0	0.9	72	97.9
	3	133	0.3	-0.1	24.6	1.3	72	97.9
	4	219	0.4	-0.2	7.9	14.2	72	94.1
New Hampshire	1	204	-0.1	0.1	49.4	17.2	72	138.6
	2	312	-0.1	-0.3	57.8	2.7	72	132.5
	3	114	-0.1	-0.3	54.6	2.8	72	129.4
	4	265	0.1	-0.2	42.1	0	72	114.1

**See Table 5-1

TABLE 5-5

MODELING RESULTS FOR ANNUAL AVERAGE TSP IMPACTS
BASED ON LOCATION OF MAXIMUM POINT SOURCE IMPACTS

Case 1: Maximum PSD Increment Consumption

Location: 3 km East, 2 km North of Schiller

Available Increment: 9.5 $\mu g/m^3$

Predicted TSP ($\mu g/m^3$):

1)	Schiller Units 4-6 coal fired =	1.10
2)	Schiller Units 4-6 oil fired =	-0.10
3)	Eastern Grains Refinery =	0.50
4)	Schiller Fugitive Dust Sources =	0.04
	Total =	1.54

Case 2: Maximum Total Ambient Air Quality

Location: 3 km East, 2 km North of Schiller

Applicable Standard: 60 $\mu g/m^3$

Predicted TSP ($\mu g/m^3$):

1)	Schiller Units 4-6 =	1.10
2)	Schiller Fugitive Dust Sources =	0.04
3)	All other sources =	1.30
4)	Background =	31.30
	Total =	33.74

location is 33.74 $\mu g/m^3$ compared to the state standard of 60 $\mu g/m^3$. As vas evident in the modeling results for short-term impacts, fugitive dust source contributions at this distance are insignificant. However, at receptors immediately adjacent to the Schiller plant the fugitive dust sources again lead to the highest predicted impacts. These results are presented in Table 5-6. The four highest annual average impacts are predicted in New Hampshire at very short distances from Schiller. The maximum annual average TSP increment of 4.4 $\mu g/m^3$ is well below the allowable 19 $\mu g/m^3$ PSD increment. Total predicted ambient concentrations are also below the federal standard of 75 $\mu g/m^3$. The highest predicted increment in Maine is 2.9 $\mu g/m^3$ compared to the 50% interstate guideline of 9.5 $\mu g/m^3$. The highest predicted total ambient TSP in Maine is 34.6 $\mu g/m^3$ compared to the state standard of 60 $\mu g/m^3$.

TABLE 5-6

MODELING RESULTS FOR MAXIMUM ANNUAL AVERAGE

TSP INCREMENT CONSUMPTION AND TOTAL AMBIENT AIR QUALITY

Rank	Location (km)*		TSP Concentrations (μg/m³)						
	X	Y	Schiller Fugitive Dust Sources	Schiller Units 4-6	EGR	Total Increment	Existing Sources	Background	Total Ambient
1	0.2	-0.2	4.3	neg.***	0.1	4.4	0.5	31.3	36.2
2	0.1	-0.3	4.0	neg.	neg.	4.0	0.6	31.3	35.9
3	0.2	0.0	2.8	neg.	0.2	3.0	0.4	31.3	34.7
4	-0.1	-0.3	2.5	neg.	0.5	3.0	0.5	31.3	34.8
5	0.3	-0.1**	2.7	neg.	0.2	2.9	0.4	31.3	34.6

* See Table 5-1

** Receptor in Maine

***Impacts insignificant (0.1)

6. ANALYSIS OF OTHER CRITERIA POLLUTANTS

6.1 Lead (Pb)

Based on data presented in the literature, lead emissions were derived by the average proportion of Pb in fly ash emissions (TSP) from oil and coal combustion. At maximum firing rates, approximately 0.086% of fly ash emissions from oil combustion are lead particulates while only 0.012% of coal combustion fly emissions are lead. Therefore, on an hourly or daily basis, coal combustion Pb emissions from Schiller will be lower than those from oil. However, the annual average capacity of Schiller on coal is expected to be much higher than on oil (75% vs. 23%). Therefore, on an annual basis, lead emissions could be greater. At these capacity figures, the net increase in Pb emissions will be approximately 0.1 tons per year. The federal significance limit for lead emissions is 0.6 tons per year (Table 1-1). Therefore the expected annual increase in Pb emmissions due to the coal conversion is less than 17% of the significance limit. By scaling the maximum annual average TSP impact of Schiller Units 4-6 on coal to 0.012% for Pb, the estimated annual average Pb impact would be 0.00013 $\mu g/m^3$ which is less than .01% of the 1.5 $\mu g/m^3$ quaterly lead standard.

6.2 Carbon Monoxide (CO)

Fossil fuel combustion produces very little carbon monoxide as compared to vehicular exhaust emissions. The significant limit for CO emissions is 100 tons per year. The conversion of Schiller to coal will cause an increase of only 135 tons per year of CO. A worst-case 1-hour CO concentration attributable to Schiller for coal firing can be estimated from the SO_2 screening results presented in Section 3.2. The highest 3-hour average SO_2 concentration from the screening results (Table 3-3) was 1257 $\mu g/m^3$. Since this was derived from multiplying the 1-hour concentration by the factor 0.9, the associated 1-hour SO_2 would be 1397 $\mu g/m^3$. CO emissions from Schiller are approximately 1% of SO_2 emissions (Table 2-1).

Scaling 1397 $\mu g/m^3$ of SO_2 to an equivalent CO concentration results in approximately 14 $\mu g/m^3$ which is negligible when compared to the CO significance limits of 2000 $\mu g/m^3$ 1-hour and 500 $\mu g/m^3$ 8-hour (Table 1-1).

6.3 Nitrogen Dioxide (NO_2)

An estimate of maximum annual average NO_2 impact was made by scaling the modeling results for annual SO_2 by the ratio of each sources SO_2 to NO_x emissions. Although not all NO_x emissions are converted to NO_2, this provides a conservative estimate. The maximum annual NO_2 concentration after the conversion to coal is estimated to be approximately 5 $\mu g/m^3$ which is only 5% of the 100 $\mu g/m^3$ state and federal standards. No background data for NO_2 was available for this study which prevents an estimate of total ambient NO_2 concentrations. However, it is unlikely that background concentrations approach 95 $\mu g/m^3$ and therefore unlikely that the standard of 100 $\mu g/m^3$ would be exceeded.

REFERENCES

Environmental Protection Agency, 1979a. Industrial Source Complex (ISC) Dispersion Model User's Guide, Volumes I and II. EPA Report No. EPA-450/4-79-031, U.S. EPA, Research Triangle Park, North Carolina.

Environmental Protection Agency, 1978a. Fugitive Emissions From Integrated Iron and Steel Plants. EPA Report No. EPA-600/2-78-050, U.S. EPA, Research Triangle Park, North Carolina.

Environmental Protection Agency, 1979b. Particulate Emission Factors Applicable to the Iron and Steel Industry. EPA Report No. EPA-450/4-79-028, U.S. EPA, Research Triangle Park, North Carolina.

Environmental Protection Agency, 1977. Compilation of Air Pollutant Emission Factors. Third Edition. EPA Report No. AP-42; U.S. EPA, Research Triangle Park, North Carolina.

Henry, W. M., Knapp, K. T., 1980. Compound Forms of Fossil Fuel Fly Ash Emissions. Environmental Science & Technology, Volume 14, Number 4, April 1980.

Environmental Protection Agency, 1978b. Technical Support Document For Determination of Good Engineering Practice Stack Height, Draft, U.S. EPA, OAQPS, Research Triangle Park, North Carolina.

APPENDIX A
CRITICAL PERIOD METEOROLOGY

APPENDIX A

CRITICAL PERIOD METEOROLOGY

This appendix presents the hourly meteorological conditions which produced the limiting SO_2 and TSP impacts for 3 and 24-hour averaging periods. A total of 12 days are presented. For each hour of the day, seven variables are listed. The flow vector indicates the observed direction the wind was blowing towards which is reported to the nearest 10 degrees clockwise from north (360). The random flow vector, used in the calculations, represents the statistically random wind direction within 10 degrees of the reported wind direction. The other parameters, in order, are wind speed in meters per second, mixing depth in meters, ambient temperature, and stability class. The adjusted stability classes are, for the most part, equal to the reported stability classes. The only exceptions are cases where the reported stability class changes by more than 1 category. The ISC model does not allow this rapid change, restraining any hourly change to 1 category.

TABLE A-1

*** Schiller Coal Conversion - NHARA - Critical Periods - 1970 ***

* METEOROLOGICAL DATA FOR DAY 150 *

HOUR	FLOW VECTOR (DEGREES)	RANDOM FLOW VECTOR (DEGREES)	WIND SPEED (MPS)	MIXING HEIGHT (METERS)	TEMP. (DEG. K)	INPUT STABILITY CATEGORY	ADJUSTED STABILITY CATEGORY
1	50.0	46.0	1.00	1409.1	278.7	6	6
2	40.0	38.0	2.06	1337.6	278.7	6	6
3	60.0	60.0	2.57	1266.2	278.2	6	6
4	60.0	59.0	1.00	1194.7	278.2	6	6
5	10.0	11.0	1.03	22.4	278.2	6	6
6	40.0	43.0	1.03	73.3	280.4	5	5
7	50.0	55.0	2.57	124.1	283.2	4	4
8	50.0	51.0	2.57	175.0	286.5	3	3
9	90.0	92.0	2.06	225.8	288.2	2	2
10	10.0	11.0	3.09	276.6	290.4	2	2
11	340.0	339.0	2.06	327.5	292.0	1	1
12	340.0	336.0	6.69	378.3	292.0	2	2
13	340.0	336.0	7.72	429.2	292.6	3	3
14	350.0	355.0	6.17	480.0	293.2	4	4
15	350.0	346.0	7.20	480.0	292.6	4	4
16	50.0	47.0	5.66	480.0	295.4	4	4
17	40.0	36.0	4.63	480.0	294.8	4	4
18	40.0	36.0	5.66	480.0	293.7	4	4
19	30.0	35.0	3.60	480.0	292.0	4	4
20	30.0	32.0	3.60	500.2	289.3	4	4
21	50.0	52.0	5.14	537.5	288.7	5	5
22	50.0	50.0	4.12	574.9	287.0	5	5
23	50.0	48.0	4.12	612.3	286.5	5	5
24	60.0	63.0	3.60	649.7	285.4	5	5

TABLE A-2

*** Schiller Coal Conversion - NHARA - Critical Periods - 1970 ***

* METEOROLOGICAL DATA FOR DAY 215 *

HOUR	FLOW VECTOR (DEGREES)	RANDOM FLOW VECTOR (DEGREES)	WIND SPEED (MPS)	MIXING HEIGHT (METERS)	TEMP. (DEG. K)	INPUT STABILITY CATEGORY	ADJUSTED STABILITY CATEGORY
1	80.0	80.0	3.09	1269.8	294.8	6	6
2	80.0	77.0	3.60	1295.1	293.2	5	5
3	70.0	70.0	3.60	1320.5	292.0	5	5
4	70.0	70.0	3.09	1345.8	290.9	6	6
5	70.0	69.0	3.60	.4	289.8	5	5
6	80.0	81.0	3.09	178.0	290.9	4	4
7	80.0	79.0	3.09	355.7	292.0	3	3
8	60.0	57.0	2.57	533.3	295.4	3	3
9	90.0	95.0	3.09	710.9	297.6	2	2
10	90.0	89.0	3.09	888.5	299.3	2	2
11	100.0	96.0	4.63	1066.1	299.8	2	2
12	90.0	94.0	4.63	1243.8	300.9	2	2
13	80.0	80.0	5.14	1421.4	300.9	3	3
14	90.0	89.0	4.12	1599.0	302.6	3	3
15	80.0	80.0	3.60	1599.0	301.5	2	2
16	70.0	73.0	4.63	1599.0	301.5	3	3
17	50.0	52.0	2.57	1599.0	300.9	3	3
18	70.0	75.0	2.06	1599.0	299.8	4	4
19	70.0	74.0	1.00	1599.0	298.7	3	3
20	70.0	71.0	1.00	1615.1	297.6	4	4
21	20.0	17.0	2.06	1638.7	296.5	5	5
22	360.0	357.0	3.09	1662.4	294.3	6	6
23	90.0	87.0	2.06	1686.1	293.7	6	6
24	100.0	100.0	2.57	1709.7	292.6	6	6

TABLE A-3

*** Schiller Coal Conversion - NHARA - Critical Periods - 1970 ***

* METEOROLOGICAL DATA FOR DAY 216 *

HOUR	FLOW VECTOR (DEGREES)	RANDOM FLOW VECTOR (DEGREES)	WIND SPEED (MPS)	MIXING HEIGHT (METERS)	TEMP. (DEG. K)	INPUT STABILITY CATEGORY	ADJUSTED STABILITY CATEGORY
1	100.0	96.0	2.57	1733.7	292.0	6	6
2	130.0	129.0	2.06	1757.4	292.0	5	5
3	120.0	117.0	1.03	1781.0	292.0	6	6
4	80.0	78.0	1.00	1804.6	291.5	6	6
5	70.0	69.0	2.06	1828.3	290.9	6	6
6	120.0	122.0	3.09	223.8	291.5	5	5
7	160.0	157.0	2.06	450.9	293.2	4	4
8	130.0	133.0	1.54	678.1	294.3	3	3
9	140.0	138.0	4.12	905.2	297.0	3	3
10	170.0	174.0	4.12	1132.4	297.6	3	3
11	160.0	157.0	4.63	1359.5	298.7	2	2
12	130.0	128.0	4.12	1586.7	299.3	2	2
13	140.0	139.0	6.69	1813.8	299.8	3	3
14	130.0	127.0	2.57	2041.0	299.8	2	2
15	130.0	133.0	3.09	2041.0	299.8	2	2
16	130.0	128.0	5.14	2041.0	298.7	3	3
17	140.0	138.0	4.12	2041.0	297.6	3	3
18	130.0	132.0	4.12	2041.0	297.0	4	4
19	130.0	132.0	2.06	2041.0	294.8	4	4
20	130.0	132.0	1.54	2002.6	293.2	5	5
21	150.0	155.0	2.57	1947.6	292.6	6	6
22	180.0	185.0	3.09	1892.6	292.6	6	6
23	180.0	183.0	1.00	1837.6	289.3	6	6
24	180.0	179.0	1.00	1782.7	288.7	6	6

TABLE A-4

*** Schiller Coal Conversion - NHARA - Critical Periods - 1970 ***

* METEOROLOGICAL DATA FOR DAY 346 *

HOUR	FLOW VECTOR (DEGREES)	RANDOM FLOW VECTOR (DEGREES)	WIND SPEED (MPS)	MIXING HEIGHT (METERS)	TEMP. (DEG. K)	INPUT STABILITY CATEGORY	ADJUSTED STABILITY CATEGORY
1	200.0	198.0	2.57	622.6	269.3	4	4
2	200.0	197.0	5.66	617.3	268.1	4	4
3	190.0	193.0	4.63	612.0	267.6	4	4
4	190.0	192.0	4.12	606.8	266.5	4	4
5	190.0	195.0	6.17	601.5	265.9	4	4
6	190.0	194.0	5.14	596.2	265.9	4	4
7	190.0	193.0	5.14	590.9	265.4	4	4
8	200.0	203.0	5.14	585.7	265.9	4	4
9	190.0	195.0	5.14	580.4	265.9	4	4
10	190.0	189.0	5.14	575.1	265.9	4	4
11	200.0	201.0	4.12	569.8	266.5	4	4
12	190.0	189.0	6.17	564.6	268.1	4	4
13	210.0	208.0	4.12	559.3	267.6	4	4
14	220.0	225.0	3.60	554.0	267.6	4	4
15	190.0	195.0	3.60	554.0	267.6	4	4
16	180.0	185.0	5.66	554.0	267.6	4	4
17	190.0	186.0	4.12	547.7	267.0	4	4
18	190.0	191.0	5.66	537.2	267.0	4	4
19	190.0	188.0	4.12	526.6	267.0	4	4
20	200.0	199.0	4.12	516.1	267.0	4	4
21	190.0	186.0	4.12	505.6	267.0	4	4
22	190.0	195.0	4.63	495.1	267.0	4	4
23	180.0	178.0	3.09	484.6	266.5	4	4
24	180.0	177.0	3.09	474.1	266.5	4	4

TABLE A-5

*** Schiller Coal Conversion - NHARA - Critical Periods - 1974 ***

* METEOROLOGICAL DATA FOR DAY 118 *

HOUR	FLOW VECTOR (DEGREES)	RANDOM FLOW VECTOR (DEGREES)	WIND SPEED (MPS)	MIXING HEIGHT (METERS)	TEMP. (DEG. K)	INPUT STABILITY CATEGORY	ADJUSTED STABILITY CATEGORY
1	50.0	52.0	3.60	1401.7	283.2	5	5
2	40.0	41.0	3.09	1317.8	282.6	6	6
3	70.0	70.0	3.60	1234.0	282.6	5	5
4	80.0	84.0	3.09	1150.2	282.0	6	6
5	70.0	75.0	2.57	1066.4	281.5	5	5
6	60.0	62.0	3.09	30.9	282.0	4	4
7	70.0	67.0	4.12	66.0	284.8	4	4
8	60.0	62.0	3.09	101.1	286.5	4	4
9	60.0	58.0	5.14	136.3	288.7	3	3
10	50.0	54.0	3.60	171.4	291.5	3	3
11	60.0	58.0	5.14	206.6	293.7	3	3
12	40.0	43.0	5.14	241.7	295.9	3	3
13	50.0	47.0	5.14	276.9	298.7	4	4
14	40.0	37.0	6.69	312.0	299.8	4	4
15	30.0	35.0	5.66	312.0	300.4	3	3
16	40.0	44.0	7.20	312.0	299.8	4	4
17	40.0	39.0	7.72	312.0	298.7	4	4
18	40.0	36.0	6.17	312.0	296.5	4	4
19	30.0	35.0	5.14	315.0	294.3	4	4
20	30.0	27.0	5.14	344.8	293.2	4	4
21	30.0	30.0	6.17	374.7	291.5	4	4
22	50.0	55.0	4.63	404.5	290.9	4	4
23	40.0	41.0	4.63	434.4	290.4	4	4
24	50.0	53.0	5.14	464.2	289.3	4	4

TABLE A-6

*** Schiller Coal Conversion - NHARA - Critical Periods - 1974 ***

* METEOROLOGICAL DATA FOR DAY 170 *

HOUR	FLOW VECTOR (DEGREES)	RANDOM FLOW VECTOR (DEGREES)	WIND SPEED (MPS)	MIXING HEIGHT (METERS)	TEMP. (DEG. K)	INPUT STABILITY CATEGORY	ADJUSTED STABILITY CATEGORY
1	60.0	62.0	1.00	1041.2	288.7	6	6
2	90.0	95.0	1.03	1087.3	288.2	6	6
3	90.0	88.0	1.03	1133.5	287.0	6	6
4	90.0	88.0	1.54	1179.6	287.0	6	6
5	90.0	94.0	1.03	89.6	286.5	6	6
6	90.0	86.0	1.54	262.0	288.2	5	5
7	80.0	83.0	3.09	434.4	289.8	4	4
8	100.0	96.0	1.54	606.7	292.6	3	3
9	90.0	93.0	1.54	779.1	294.8	2	2
10	90.0	94.0	1.54	951.5	297.0	2	2
11	60.0	62.0	1.54	1123.9	298.2	1	1
12	40.0	36.0	4.12	1296.2	298.7	2	2
13	330.0	326.0	4.12	1468.6	298.7	3	3
14	320.0	322.0	3.60	1641.0	298.7	2	2
15	320.0	316.0	5.14	1641.0	297.6	3	3
16	320.0	320.0	5.09	1641.0	296.5	3	3
17	310.0	315.0	2.06	1641.0	297.0	4	4
18	320.0	321.0	2.57	1641.0	295.9	4	4
19	340.0	344.0	2.06	1641.0	294.8	4	4
20	360.0	358.0	1.54	1635.7	293.7	5	5
21	360.0	356.0	2.06	1619.9	293.2	5	5
22	40.0	36.0	3.60	1604.1	293.7	4	4
23	50.0	54.0	3.09	1588.2	293.7	5	5
24	20.0	18.0	1.54	1572.4	292.6	6	6

TABLE A-7

*** Schiller Coal Conversion - NHARA - Critical Periods - 1974 ***

* METEOROLOGICAL DATA FOR DAY 185 *

HOUR	FLOW VECTOR (DEGREES)	RANDOM FLOW VECTOR (DEGREES)	WIND SPEED (MPS)	MIXING HEIGHT (METERS)	TEMP. (DEG. K)	INPUT STABILITY CATEGORY	ADJUSTED STABILITY CATEGORY
1	80.0	85.0	2.57	1070.5	295.4	5	5
2	80.0	79.0	1.00	1042.8	294.3	6	6
3	80.0	80.0	1.00	1015.0	293.7	6	6
4	80.0	81.0	1.03	987.3	293.7	6	6
5	80.0	76.0	1.00	32.5	293.2	5	5
6	40.0	45.0	2.06	107.8	294.8	4	4
7	80.0	81.0	2.57	183.1	297.0	3	3
8	80.0	79.0	1.54	258.3	299.3	2	2
9	80.0	77.0	3.60	333.6	300.9	2	2
10	70.0	70.0	3.09	408.9	301.5	2	2
11	80.0	81.0	2.57	484.2	302.0	1	1
12	70.0	72.0	3.09	559.4	303.7	2	2
13	60.0	64.0	4.12	634.7	304.3	2	2
14	40.0	39.0	5.14	710.0	305.4	3	3
15	40.0	43.0	4.12	710.0	304.3	3	3
16	70.0	75.0	4.63	710.0	305.4	3	3
17	70.0	68.0	4.12	710.0	304.8	3	3
18	80.0	84.0	2.06	710.0	304.3	4	4
19	240.0	240.0	2.06	710.0	297.6	4	4
20	160.0	157.0	7.20	710.0	297.6	4	4
21	220.0	225.0	3.09	710.0	294.8	5	5
22	210.0	214.0	2.06	710.0	294.8	5	5
23	210.0	207.0	1.54	710.0	293.7	6	6
24	230.0	231.0	3.09	710.0	291.5	5	5

TABLE A-8

*** Schiller Coal Conversion - NHARA - Critical Periods - 1974 ***

* METEOROLOGICAL DATA FOR DAY 191 *

HOUR	FLOW VECTOR (DEGREES)	RANDOM FLOW VECTOR (DEGREES)	WIND SPEED (MPS)	MIXING HEIGHT (METERS)	TEMP. (DEG. K)	INPUT STABILITY CATEGORY	ADJUSTED STABILITY CATEGORY
1	50.0	55.0	1.03	856.9	293.2	6	6
2	130.0	131.0	1.03	911.4	294.8	6	6
3	80.0	82.0	3.09	966.0	296.5	5	5
4	80.0	84.0	3.60	1020.5	295.4	4	4
5	80.0	81.0	4.12	1075.1	295.4	4	4
6	90.0	89.0	4.12	1129.6	295.9	4	4
7	100.0	105.0	5.66	1184.2	297.6	4	4
8	110.0	110.0	7.20	1238.7	299.3	4	4
9	130.0	128.0	5.66	1293.3	300.4	3	3
10	130.0	134.0	6.17	1347.8	302.0	4	4
11	130.0	135.0	6.17	1402.4	302.0	3	3
12	110.0	112.0	5.14	1456.9	302.6	3	3
13	110.0	113.0	5.66	1511.5	303.2	3	3
14	110.0	115.0	5.14	1566.0	304.3	3	3
15	120.0	116.0	5.66	1566.0	303.7	3	3
16	140.0	140.0	7.20	1566.0	303.2	4	4
17	120.0	122.0	6.17	1566.0	303.2	4	4
18	120.0	119.0	5.14	1566.0	301.5	4	4
19	140.0	142.0	5.14	1566.0	299.3	4	4
20	150.0	154.0	8.75	1578.5	297.0	4	4
21	150.0	154.0	7.72	1614.0	295.4	4	4
22	150.0	149.0	6.17	1649.5	294.3	4	4
23	130.0	131.0	7.20	1685.1	293.2	4	4
24	140.0	144.0	3.09	1720.6	290.4	5	5

TABLE A-9

*** Schiller Coal Conversion - NHARA - Critical Periods - 1974 ***

* METEOROLOGICAL DATA FOR DAY 204 *

HOUR	FLOW VECTOR (DEGREES)	RANDOM FLOW VECTOR (DEGREES)	WIND SPEED (MPS)	MIXING HEIGHT (METERS)	TEMP. (DEG. K)	INPUT STABILITY CATEGORY	ADJUSTED STABILITY CATEGORY
1	330.0	329.0	2.06	992.4	288.2	6	6
2	330.0	329.0	1.54	965.0	288.2	6	6
3	330.0	328.0	1.00	937.6	287.6	6	6
4	330.0	327.0	1.00	910.2	287.0	6	6
5	330.0	334.0	1.00	12.8	284.3	6	6
6	330.0	328.0	1.00	82.1	287.6	5	5
7	40.0	45.0	2.57	151.3	289.8	4	4
8	10.0	12.0	2.06	220.5	291.5	3	3
9	10.0	8.0	3.09	289.8	294.3	2	2
10	360.0	4.0	3.09	359.0	295.9	3	3
11	340.0	344.0	5.14	428.3	297.0	4	4
12	350.0	347.0	6.17	497.5	298.2	4	4
13	350.0	355.0	7.72	566.8	298.2	4	4
14	340.0	345.0	8.75	636.0	297.0	4	4
15	340.0	344.0	7.72	636.0	295.9	4	4
16	340.0	345.0	8.23	636.0	295.4	4	4
17	340.0	341.0	6.69	636.0	294.3	4	4
18	340.0	345.0	7.20	636.0	293.2	4	4
19	340.0	339.0	4.63	636.0	291.5	4	4
20	360.0	359.0	3.60	641.1	290.4	4	4
21	360.0	359.0	2.06	651.6	289.3	5	5
22	350.0	349.0	2.06	662.0	288.2	5	5
23	350.0	353.0	1.00	672.4	287.6	6	6
24	350.0	350.0	1.00	682.9	288.2	6	6

TABLE A-10

*** Schiller Coal Conversion - NHARA - Critical Periods - 1974 ***

* METEOROLOGICAL DATA FOR DAY 215 *

HOUR	FLOW VECTOR (DEGREES)	RANDOM FLOW VECTOR (DEGREES)	WIND SPEED (MPS)	MIXING HEIGHT (METERS)	TEMP. (DEG. K)	INPUT STABILITY CATEGORY	ADJUSTED STABILITY CATEGORY
1	30.0	30.0	1.00	1434.9	294.8	6	6
2	30.0	27.0	1.00	1450.9	294.8	6	6
3	340.0	340.0	2.57	1466.9	294.3	5	5
4	350.0	350.0	1.03	1482.9	294.8	4	4
5	330.0	329.0	2.06	1498.9	294.8	4	4
6	340.0	341.0	2.06	1514.9	294.8	4	4
7	340.0	339.0	3.09	1531.0	295.4	4	4
8	60.0	57.0	3.60	1547.0	297.0	4	4
9	60.0	65.0	5.66	1563.0	298.7	4	4
10	70.0	69.0	5.14	1579.0	299.8	3	3
11	70.0	66.0	4.12	1595.0	300.4	3	3
12	70.0	74.0	6.17	1611.0	302.0	4	4
13	60.0	60.0	5.14	1627.0	301.5	3	3
14	70.0	69.0	5.14	1643.0	303.2	3	3
15	70.0	70.0	5.14	1643.0	303.7	3	3
16	70.0	73.0	5.66	1643.0	303.2	3	3
17	70.0	72.0	6.17	1643.0	302.0	4	4
18	60.0	65.0	4.12	1643.0	301.5	4	4
19	60.0	64.0	3.09	1643.0	300.4	4	4
20	50.0	51.0	3.09	1613.5	299.3	5	5
21	30.0	27.0	3.09	1570.1	298.7	5	5
22	40.0	37.0	5.14	1526.7	298.7	4	4
23	40.0	37.0	5.14	1483.3	298.7	4	4
24	50.0	50.0	4.63	1439.8	298.2	4	4

TABLE A-11

*** Schiller Coal Conversion - NHARA - Critical Periods - 1974 ***

* METEOROLOGICAL DATA FOR DAY 216 *

HOUR	FLOW VECTOR (DEGREES)	RANDOM FLOW VECTOR (DEGREES)	WIND SPEED (MPS)	MIXING HEIGHT (METERS)	TEMP. (DEG. K)	INPUT STABILITY CATEGORY	ADJUSTED STABILITY CATEGORY
1	60.0	56.0	3.60	1395.8	297.6	4	4
2	60.0	59.0	3.09	1352.4	297.6	5	5
3	50.0	47.0	4.12	1309.1	297.0	4	4
4	60.0	58.0	3.09	1265.7	297.0	5	5
5	50.0	49.0	3.60	1222.3	296.5	4	4
6	60.0	62.0	2.57	1179.0	296.5	4	4
7	60.0	57.0	4.63	1135.6	298.2	4	4
8	70.0	73.0	4.63	1092.2	299.8	4	4
9	70.0	68.0	6.17	1048.9	300.9	4	4
10	60.0	64.0	8.23	1005.5	302.0	4	4
11	70.0	67.0	4.63	962.1	303.7	3	3
12	60.0	58.0	5.14	918.7	304.3	4	4
13	60.0	59.0	10.29	875.4	304.8	3	3
14	60.0	57.0	6.69	832.0	304.8	4	4
15	40.0	43.0	5.14	832.0	301.5	4	4
16	60.0	58.0	4.63	832.0	299.8	4	4
17	50.0	48.0	4.12	832.0	300.4	4	4
18	50.0	52.0	7.20	832.0	300.4	4	4
19	40.0	42.0	5.14	832.0	297.6	4	4
20	50.0	52.0	7.72	866.3	297.6	4	4
21	60.0	65.0	7.20	915.2	297.0	4	4
22	50.0	55.0	6.69	964.2	296.5	4	4
23	30.0	33.0	4.63	1013.2	295.9	4	4
24	30.0	29.0	4.63	1062.2	295.9	4	4

TABLE A-12

*** Schiller Coal Conversion - NHARA - Critical Periods - 1974 ***

* METEOROLOGICAL DATA FOR DAY 339 *

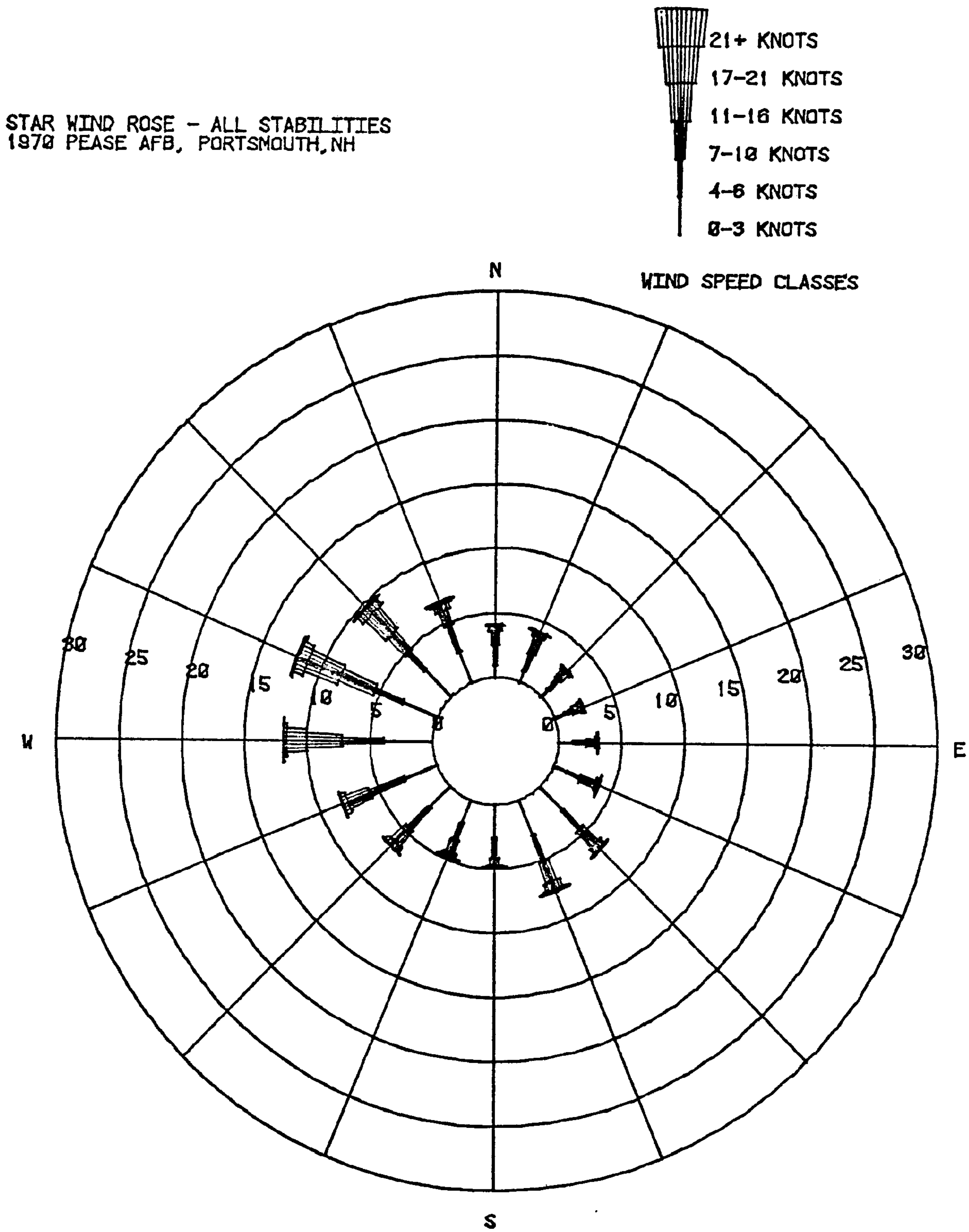
HOUR	FLOW VECTOR (DEGREES)	RANDOM FLOW VECTOR (DEGREES)	WIND SPEED (MPS)	MIXING HEIGHT (METERS)	TEMP. (DEG. K)	INPUT STABILITY CATEGORY	ADJUSTED STABILITY CATEGORY
1	90.0	88.0	1.54	892.7	266.5	6	6
2	90.0	93.0	1.54	882.2	266.5	6	6
3	100.0	104.0	2.06	871.6	266.5	6	6
4	100.0	101.0	2.06	861.1	265.4	6	6
5	100.0	98.0	3.09	850.6	265.9	6	6
6	100.0	103.0	1.54	840.1	265.9	6	6
7	100.0	102.0	2.06	829.6	265.4	6	6
8	90.0	95.0	1.54	68.0	266.5	5	5
9	100.0	102.0	2.57	182.7	269.3	4	4
10	110.0	107.0	2.06	297.4	270.4	3	3
11	110.0	113.0	1.00	412.0	272.0	2	2
12	80.0	82.0	2.57	526.7	273.1	3	3
13	90.0	88.0	1.03	641.3	273.7	2	2
14	70.0	70.0	2.06	756.0	274.8	3	3
15	80.0	84.0	2.06	756.0	274.8	4	4
16	30.0	26.0	2.06	756.0	273.7	4	4
17	60.0	58.0	1.54	767.0	272.0	5	5
18	90.0	87.0	1.54	785.6	272.6	6	6
19	80.0	85.0	2.57	804.3	271.5	6	6
20	90.0	91.0	1.54	822.9	270.9	6	6
21	100.0	105.0	2.06	841.5	270.4	5	5
22	90.0	86.0	2.57	860.1	270.9	5	5
23	90.0	86.0	2.06	878.7	270.4	5	5
24	90.0	90.0	1.03	897.4	269.8	6	6

APPENDIX B

METEOROLOGICAL FREQUENCY DATA

APPENDIX B
METEOROLOGICAL FREQUENCY DATA

This appendix contains the meteorological frequency data employed in the ISCLT modeling. For each meteorological year (1970-1974) a wind rose plot is presented which graphically depicts the joint frequency of occurrence of wind direction and wind speed. Each plot is followed by a table listing the numerical frequencies of each stability class by compass point wind directions. Stability classes are numbered 1 through 5 which represent very unstable to stable categories respectively. Class 4 represents neutral stability. Wind directions are listed in numerical order clockwise from north in 22.5° increments.



STAR WIND ROSE - ALL STABILITIES
1970 PEASE AFB, PORTSMOUTH,NH
21+ KNOTS
17-21 KNOTS
11-16 KNOTS
7-10 KNOTS
4-6 KNOTS
0-3 KNOTS
WIND SPEED CLASSES
N
S
E
W
0
5
10
15
20
25
30

Figure B-1

TABLE B-1

1970 STABILITY ROSE

DIRECTION	STABILITY					
	1	2	3	4	5	TOTAL
1	.0002	.0010	.0019	.0296	.0084	.0412
2	.0002	.0006	.0011	.0330	.0075	.0425
3	.0001	.0007	.0011	.0227	.0051	.0298
4	.0003	.0009	.0019	.0186	.0032	.0250
5	.0000	.0017	.0050	.0200	.0051	.0318
6	.0006	.0037	.0079	.0212	.0055	.0388
7	.0005	.0042	.0113	.0395	.0122	.0677
8	.0005	.0033	.0110	.0402	.0209	.0758
9	.0006	.0019	.0053	.0216	.0188	.0482
10	.0003	.0018	.0047	.0236	.0171	.0476
11	.0006	.0041	.0092	.0240	.0287	.0666
12	.0010	.0071	.0107	.0260	.0365	.0814
13	.0008	.0057	.0156	.0460	.0508	.1189
14	.0001	.0030	.0096	.0634	.0449	.1209
15	.0001	.0035	.0099	.0523	.0307	.0966
16	.0005	.0046	.0080	.0344	.0199	.0672
TOTAL	.0064	.0478	.1144	.5160	.3154	1.0000

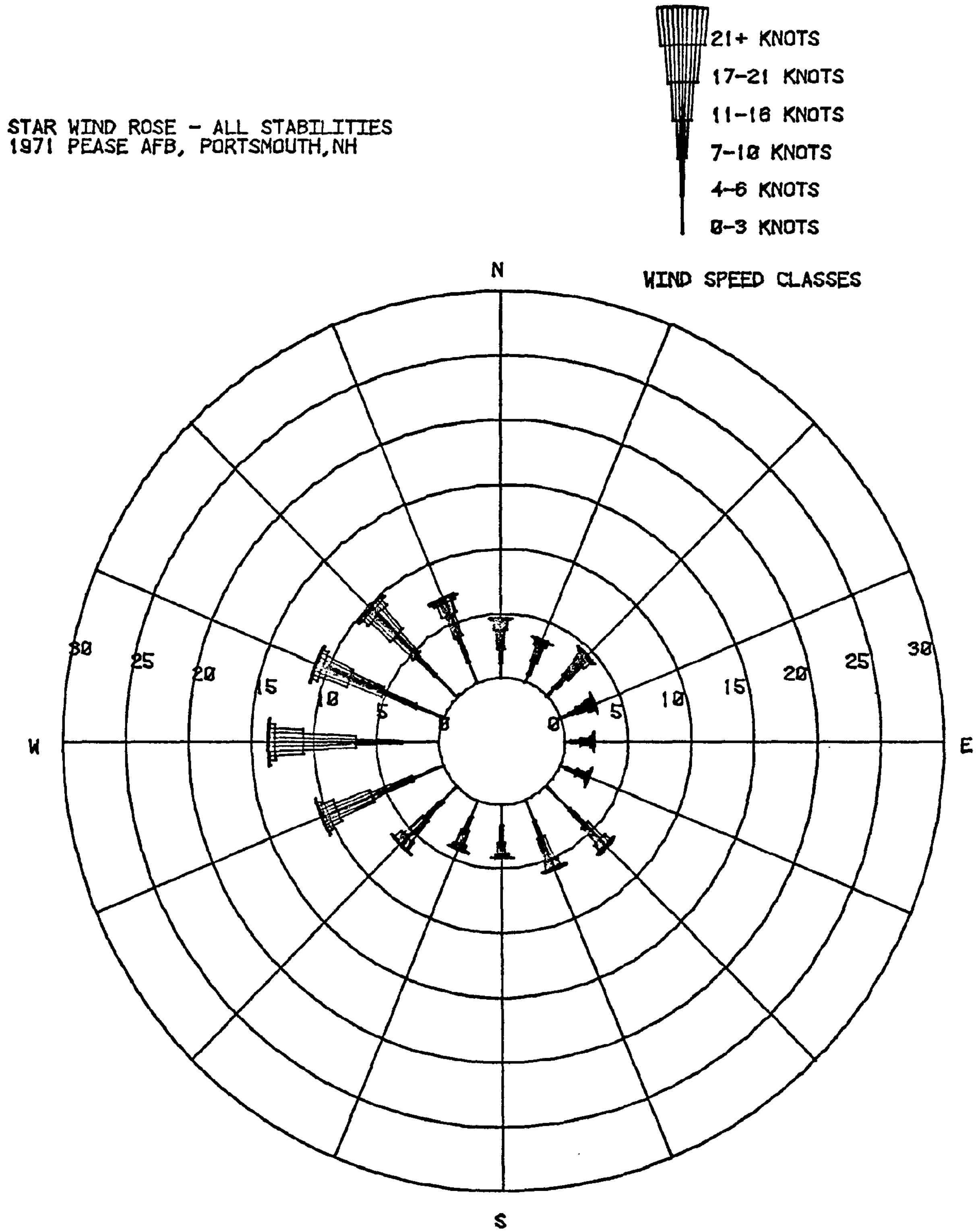

STAR WIND ROSE - ALL STABILITIES
1971 PEASE AFB, PORTSMOUTH,NH
21+ KNOTS
17-21 KNOTS
11-16 KNOTS
7-10 KNOTS
4-6 KNOTS
0-3 KNOTS
WIND SPEED CLASSES
N
S
E
W
30
25
20
15
10
5
0
0
5
10
15
20
25
30

Figure B-2

TABLE B-2

1971 STABILITY ROSE

DIRECTION	STABILITY					
	1	2	3	4	5	TOTAL
1	.0000	.0015	.0027	.0323	.0104	.0469
2	.0000	.0005	.0024	.0253	.0078	.0360
3	.0003	.0008	.0033	.0341	.0076	.0462
4	.0000	.0003	.0035	.0218	.0040	.0297
5	.0001	.0026	.0041	.0143	.0025	.0236
6	.0007	.0025	.0062	.0131	.0022	.0247
7	.0003	.0040	.0113	.0346	.0164	.0667
8	.0001	.0030	.0103	.0308	.0139	.0581
9	.0000	.0008	.0038	.0197	.0172	.0416
10	.0000	.0023	.0053	.0216	.0123	.0414
11	.0006	.0025	.0082	.0257	.0274	.0644
12	.0007	.0039	.0132	.0426	.0453	.1057
13	.0005	.0042	.0176	.0618	.0526	.1366
14	.0005	.0029	.0103	.0547	.0419	.1102
15	.0000	.0027	.0107	.0511	.0328	.0974
16	.0000	.0029	.0076	.0394	.0210	.0709
TOTAL	.0038	.0373	.1205	.5229	.3154	1.0000

STAR WIND ROSE - ALL STABILITIES
1972 PEASE AFB, PORTSMOUTH,NH

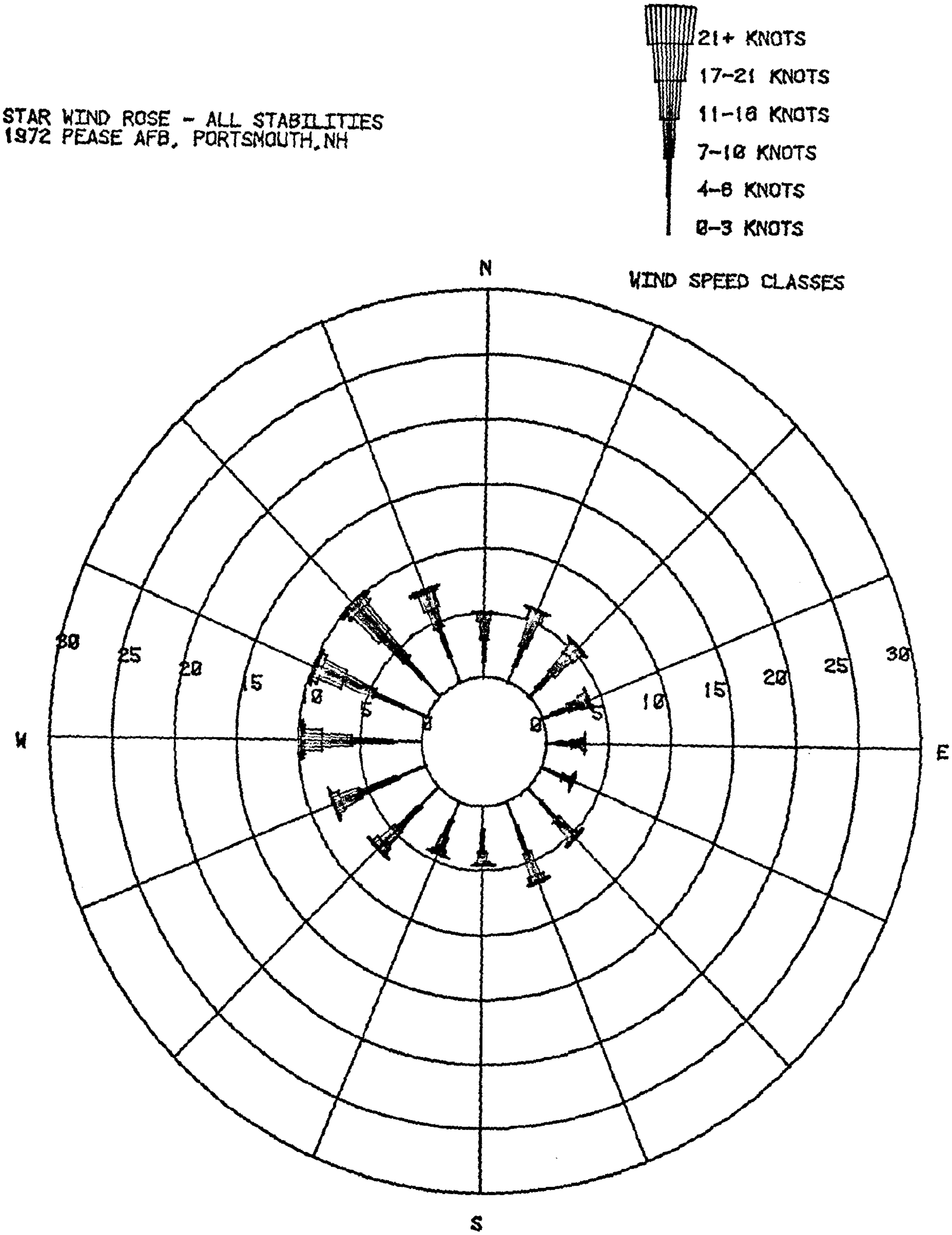


Figure B-3

TABLE B-3

1972 STABILITY ROSE

DIRECTION	STABILITY 1	2	3	4	5	TOTAL
1	.0000	.0023	.0038	.0335	.0112	.0507
2	.0002	.0011	.0024	.0476	.0100	.0614
3	.0000	.0003	.0020	.0483	.0055	.0561
4	.0000	.0011	.0022	.0322	.0052	.0408
5	.0000	.0019	.0046	.0217	.0034	.0316
6	.0002	.0026	.0048	.0171	.0028	.0276
7	.0007	.0054	.0091	.0299	.0088	.0538
8	.0001	.0039	.0088	.0378	.0161	.0666
9	.0001	.0008	.0041	.0244	.0161	.0454
10	.0000	.0016	.0031	.0227	.0168	.0442
11	.0007	.0033	.0077	.0307	.0262	.0686
12	.0002	.0048	.0102	.0322	.0329	.0804
13	.0007	.0047	.0133	.0414	.0375	.0976
14	.0006	.0031	.0106	.0466	.0370	.0980
15	.0005	.0023	.0093	.0570	.0312	.1003
16	.0001	.0014	.0061	.0457	.0217	.0770
TOTAL	.0041	.0405	.1041	.5690	.2823	1.0000

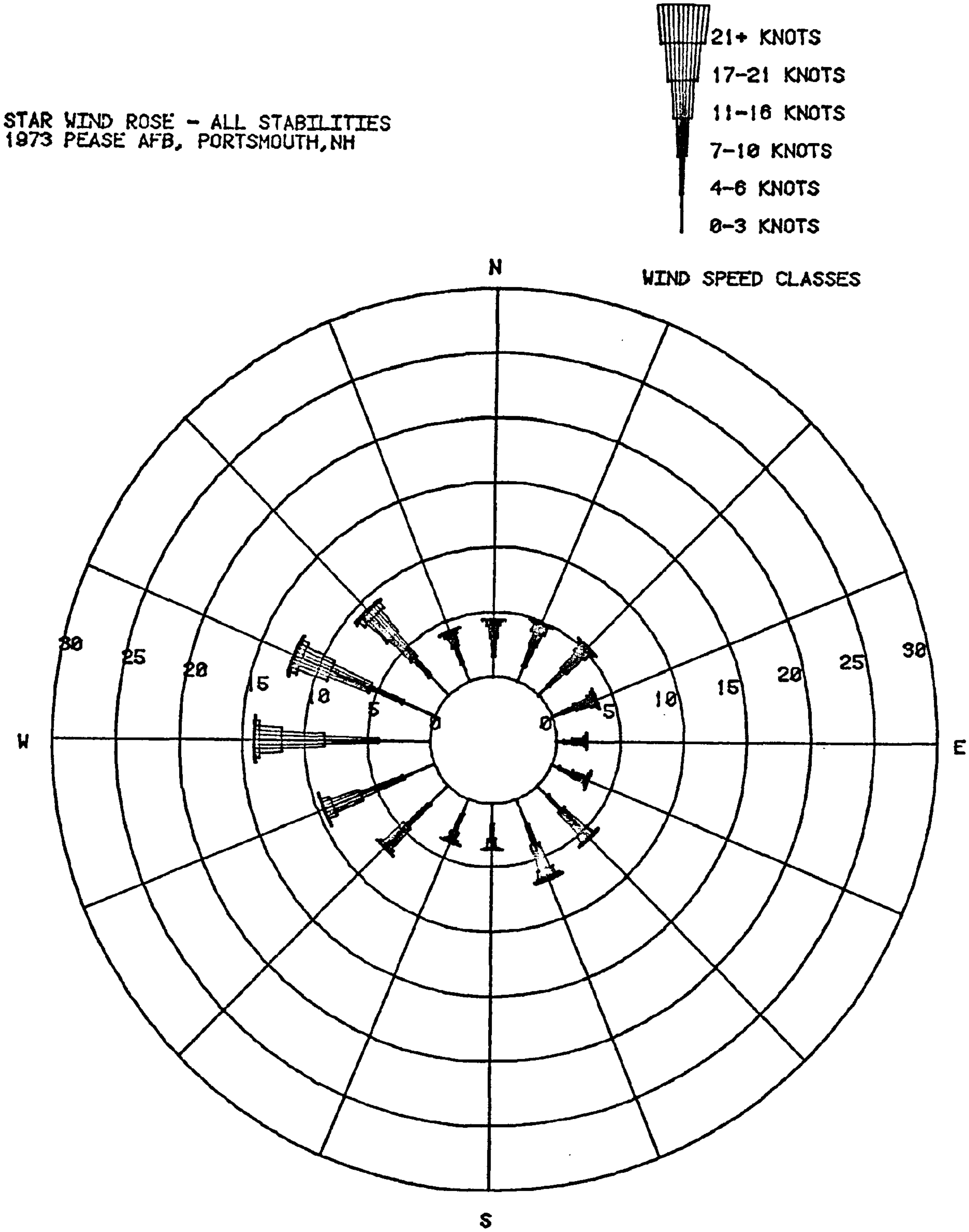
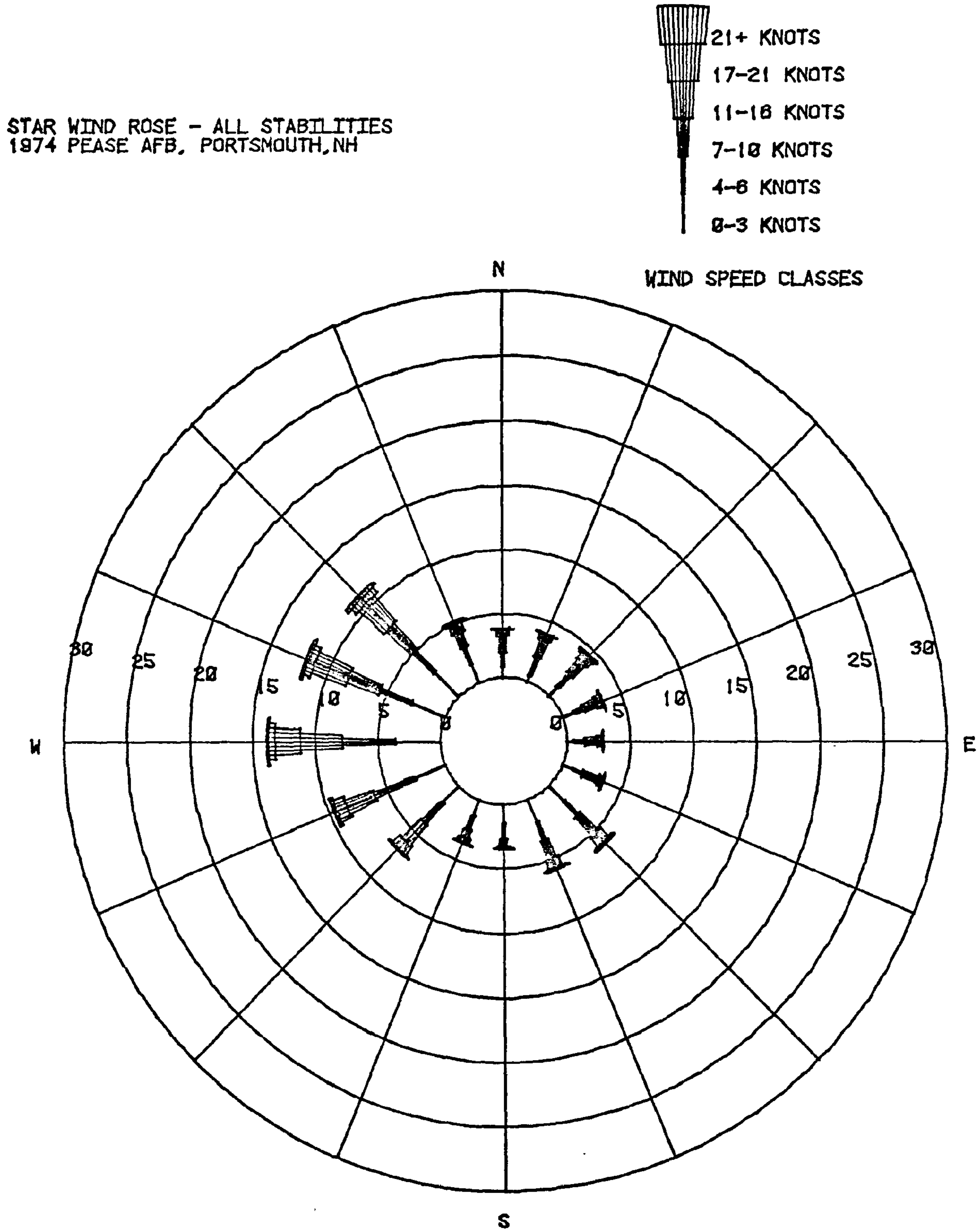

STAR WIND ROSE - ALL STABILITIES
1973 PEASE AFB, PORTSMOUTH,NH
21+ KNOTS
17-21 KNOTS
11-16 KNOTS
7-10 KNOTS
4-6 KNOTS
0-3 KNOTS
WIND SPEED CLASSES
N
E
S
W
0
5
10
15
20
25
30

Figure B-4

TABLE B-4

1973 STABILITY ROSE

DIRECTION	STABILITY 1	2	3	4	5	TOTAL
1	.0001	.0025	.0027	.0268	.0118	.0439
2	.0001	.0015	.0016	.0380	.0078	.0490
3	.0001	.0006	.0027	.0437	.0071	.0542
4	.0000	.0010	.0027	.0293	.0046	.0377
5	.0001	.0011	.0040	.0161	.0026	.0240
6	.0002	.0025	.0068	.0188	.0029	.0313
7	.0000	.0031	.0111	.0356	.0081	.0579
8	.0002	.0019	.0086	.0393	.0175	.0675
9	.0000	.0007	.0024	.0188	.0144	.0363
10	.0000	.0003	.0027	.0175	.0160	.0365
11	.0002	.0032	.0078	.0349	.0241	.0702
12	.0006	.0057	.0134	.0355	.0398	.0950
13	.0005	.0071	.0178	.0564	.0584	.1402
14	.0002	.0045	.0097	.0634	.0443	.1220
15	.0003	.0027	.0108	.0516	.0267	.0922
16	.0001	.0023	.0056	.0194	.0147	.0421
TOTAL	.0029	.0408	.1105	.5452	.3007	1.0000



STAR WIND ROSE - ALL STABILITIES
1974 PEASE AFB, PORTSMOUTH, NH
21+ KNOTS
17-21 KNOTS
11-16 KNOTS
7-10 KNOTS
4-6 KNOTS
0-3 KNOTS
WIND SPEED CLASSES
N
S
E
W
0
5
10
15
20
25
30

Figure B-5

TABLE B-5

1974 STABILITY ROSE

DIRECTION	STABILITY 1	2	3	4	5	TOTAL
1	.0001	.0006	.0022	.0272	.0086	.0386
2	.0001	.0008	.0021	.0320	.0059	.0409
3	.0000	.0006	.0023	.0380	.0051	.0460
4	.0000	.0008	.0039	.0261	.0038	.0346
5	.0001	.0013	.0031	.0209	.0037	.0290
6	.0000	.0022	.0070	.0203	.0049	.0344
7	.0001	.0019	.0124	.0358	.0123	.0627
8	.0000	.0022	.0072	.0312	.0172	.0578
9	.0000	.0013	.0030	.0142	.0158	.0341
10	.0001	.0009	.0022	.0178	.0147	.0357
11	.0006	.0030	.0064	.0330	.0261	.0691
12	.0005	.0033	.0150	.0368	.0409	.0963
13	.0005	.0071	.0180	.0579	.0548	.1382
14	.0001	.0025	.0094	.0637	.0438	.1195
15	.0000	.0019	.0092	.0654	.0352	.1118
16	.0001	.0024	.0057	.0295	.0137	.0514
TOTAL	.0023	.0326	.1089	.5497	.3065	1.0000

STAR WIND ROSE - ALL STABILITIES
1970 - 1974 PEASE AFB, PORTSMOUTH, NH

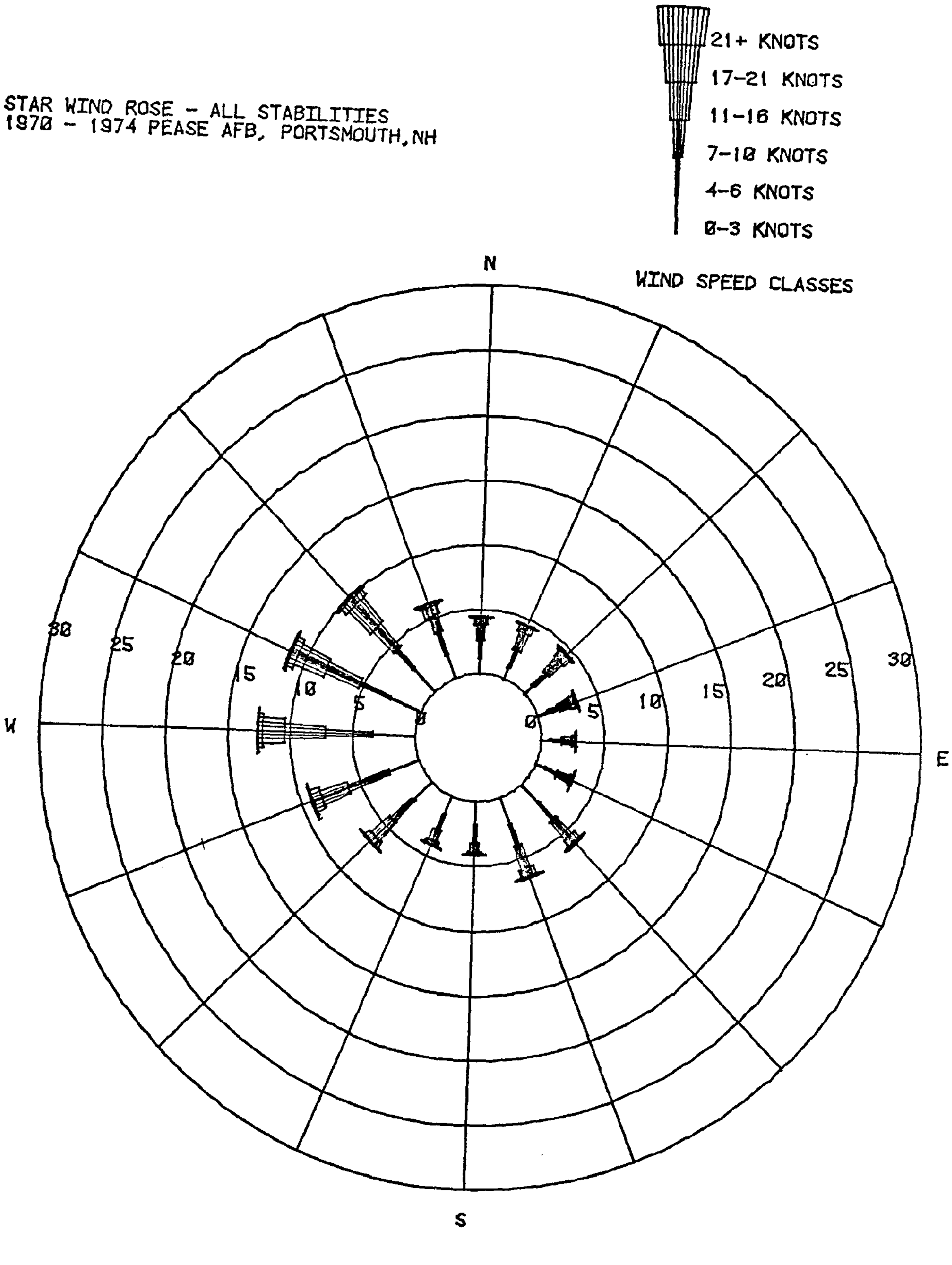


Figure B-6

TABLE B-6

1970-1974 STABILITY ROSE

DIRFCTION	STABILITY 1	2	3	4	5	TOTAL
1	.0001	.0016	.0027	.0299	.0101	.0443
2	.0001	.0009	.0019	.0352	.0078	.0459
3	.0001	.0006	.0023	.0374	.0061	.0465
4	.0001	.0008	.0029	.0256	.0041	.0335
5	.0001	.0017	.0042	.0186	.0035	.0280
6	.0003	.0027	.0065	.0181	.0036	.0313
7	.0003	.0037	.0110	.0351	.0116	.0617
8	.0002	.0028	.0091	.0358	.0171	.0651
9	.0001	.0011	.0037	.0197	.0164	.0411
10	.0001	.0014	.0036	.0206	.0154	.0411
11	.0005	.0032	.0079	.0297	.0265	.0678
12	.0006	.0049	.0125	.0346	.0391	.0918
13	.0006	.0058	.0165	.0527	.0508	.1263
14	.0003	.0032	.0099	.0584	.0424	.1141
15	.0002	.0026	.0100	.0555	.0313	.0997
16	.0002	.0027	.0070	.0337	.0182	.0617
TOTAL	.0039	.0398	.1116	.5406	.3040	.0000

.9999

ERT
ENVIRONMENTAL RESEARCH & TECHNOLOGY, INC.
696 VIRGINIA ROAD, CONCORD, MASSACHUSETTS 01742, USA

CONCORD, MA (617) 369-8910 **FORT COLLINS, CO** (303) 493-8878
PITTSBURGH (412) 261-2910 **WASHINGTON, DC** (202) 659-8913
HOUSTON (713) 977-6611 **LOS ANGELES** (213) 889-5313
ATLANTA (404) 955-3121 **CHICAGO** (312) 620-5900