

1988 Air Quality Data Summary

for the counties of

King
Kitsap
Pierce
Snohomish

PUGET SOUND AIR POLLUTION CONTROL AGENCY

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1988 AIR QUALITY DATA SUMMARY

Contents

	Page
Executive Summary	1
Sampling Network (Addresses)	4
Pollutant Standards Index:	
Description; Index Break-point Table	6
1988 Summary of PSI Values	7
Jan, 1980 - Dec, 1988 Summary of PSI Values	8
Particulate Matter:	
Discussion	9
Particulates 10 micrometers or Smaller in Diameter (PM ₁₀)	
Quarterly and Annual Averages; Max, 2nd High, and Values above 150	10
Quarterly and Annual Averages (TSP)	11
Summary of Observations Greater than 150 (TSP)	12
Summary of Maximum and Second High Observed Concentrations (TSP)	14
Atmospheric Particles -- measured by nephelometer (b _{sp})	15
Lead	16
Arsenic	17
Ozone	18
Sulfur Dioxide	20
Carbon Monoxide:	
Discussion	21
1988 Summary Tables	22
Multi-Year Data Summary and Graphs	24
Quality Assurance	26
Air Pollution Episode and	
Impaired Air Quality Conditions	28
Lower Atmosphere Temperature Soundings	29
Wind Analysis	34
Air Contaminant Emission Inventory	44
National, State and Puget Sound Region Ambient Air Quality Standards	50
Characteristics and Effects of Ambient Air Pollutants	51
Air Quality Units Conversion Table	52

Reference copies of this summary have been placed in public and college libraries within the Puget Sound region. Copies are available at the Puget Sound Air Pollution Control Agency Seattle headquarters office. A single copy picked up at the Seattle office is free, otherwise the price for each copy is:

\$4.00 (plus \$2.00 postage and handling if mailed)

EXECUTIVE SUMMARY

Introduction

This seventeenth annual data summary reviews 1988 air quality, meteorological and air contaminant emission data for the Puget Sound Region. The report begins with sampling network tables providing the address and type of sampling at each location. Summaries of pollutant measurements and information to assist in interpretation appear within the report.

Sections near the back provide a summary of air pollution episode and impaired air quality conditions and meteorological analyses consisting of lower atmosphere temperature soundings, wind speed averages and wind roses. The last data section presents the air contaminant emission inventory by county followed by the four county totals for the Puget Sound Region.

National, Washington State, and Puget Sound Region ambient air quality standards for the six principal air pollutants appear on the last two facing pages of the report. The standards are not yet attained for the pollutants carbon monoxide and particulate matter. The Puget Sound Region was redesignated as attainment for the pollutant ozone early in 1987. The Region is in attainment of the standards for sulfur dioxide, lead and nitrogen dioxide.

Carbon Monoxide

The carbon monoxide nonattainment areas are located in Seattle (downtown and the University district), in Bellevue (downtown), and in Tacoma (downtown). Recent data show a small area in downtown Everett and an area covering the Northgate section in Seattle have also exceeded the standards. Conversely, none of the Seattle downtown locations exceeded the level of the

standard more than once during the last three years. The following table summarizes 1988 carbon monoxide data for locations with measured values exceeding the level of the primary (health related) standard of 9 ppm averaged over eight hours.

<u>Location</u>	<u>Number of Days 8 hr Avg Exceeded 9 ppm</u>	<u>Highest 8 hr Avg (ppm)</u>
Everett, Broadway	8	11
Bellevue, Bellevue Wy	1	11
Seattle, Northgate	2	10
Seattle, 45th & Univ	3	12
Seattle, Univ Hosp	1	10
Seattle, 301 2nd Ave	1	10
Tacoma, 942 Pacific	3	14
Tacoma, 1101 Pacific	4	12
Bremerton, Burwell St	1	10

Particulate Matter

The particulate matter standards adopted by the U. S. EPA in July, 1987, measure only the component of Total Suspended Particulates (TSP) known as PM₁₀ (particles 10 micrometers or less in diameter). The levels for the national primary and secondary PM₁₀ standards are identical, 150 ug/m³ for a 24 hour average and 50 ug/m³ annual arithmetic mean. Washington State and Puget Sound Region PM₁₀ standards have been established at the same level as the national PM₁₀ standards. The following table identifies locations in the Puget

Sound Region during 1988 for which at least one PM₁₀ value exceeded a 24 hour average of 150 ug/m³.

Location	Maximum PM ₁₀ Value (ug/m ³)	Number of PM ₁₀ Values Exceeding 150 ug/m ³
Seattle, Duwamish	178	2
Tacoma, Taylor Way	157	1
Tacoma, Alexander	156	1
Tacoma, E 11th St	184	4

The areas which exceed the Washington State and Puget Sound Region annual TSP standard of 60 ug/m³ are the industrialized Seattle Harbor Island-Duwamish area and the industrialized Tacoma Port area. Of the 29 stations measuring TSP in the Puget Sound area at some time during 1988, 11 locations measured at least one value exceeding the 24 hour standard of 150 ug/m³.

Daily Air Quality

The Agency uses the national Pollutant Standards Index to report daily air quality. The Index value is calculated directly from measurements for each of the pollutants, and the report includes a descriptive term for the daily Index value.

These terms describe the air quality (in progressively more polluted stages) as "Good", "Moderate", "Unhealthful", or "Very Unhealthful". Any pollutant measurement exceeding the short term national primary standard causes the Index value to be in the Unhealthful or a worse category.

The daily Pollutant Standards Index values provide a way to summarize the air quality for the entire year. In 1988:

Everett had 174 Good, 184 Moderate, and 8 Unhealthful days;
 Seattle had 215 Good, 146 Moderate, and 5 Unhealthful days;
 Tacoma had 226 Good, 132 Moderate, and 8 Unhealthful days.

Weather Variables

Finally, another variable that influences the air quality on a given day is the weather. Weather never causes high pollutant levels, but sometimes under stable conditions the pollutants emitted from human activities are not quickly dispersed.

Poor dispersion exists on about one-third of the days during nighttime and early morning hours, but the weather effectively disperses pollutants by afternoon on most of these days. A few times each year poor dispersion persists for 24 or more hours and may result in the declaration of an air pollution episode or local impaired air quality. These cases are often associated with the higher pollutant levels.

During 1988 in western Washington, no air pollution episodes were declared under the Washington Episode Plan; however, the Agency declared a local condition of impaired air quality on five occasions. The dates of impaired air quality were:

- January 25-28,
- February 5-6,
- December 1-2, 4-5 & 16-18.

Emission Inventory

The air contaminant emission inventory is compiled each year by the Agency's Compliance Division from registered source information, notice of construction permit data, published emission factors, census statistics and source test results. Additional data has been received and incorporated from the U. S. EPA's toxic air contaminant reports for selected facilities within the Puget Sound Region. The air contaminants tabulated include: total suspended particulate matter (TSPM), particulate matter less than 10 micrometers (PM10), sulfur oxides (SOx), nitrogen oxides (NOx), volatile organic compounds (VOC), carbon monoxide (CO) and toxic air contaminants (TAC). The Puget Sound Region emission inventory for 1988 is summarized below.

<u>Emissions</u>	
<u>Contaminant</u>	<u>Thsds of Tons</u>
TSPM	224
PM10	109
SOx	28
NOx	138
VOC	189
CO	1,023
TAC	38

Other Information Sources

All data collected are reported to the Washington State Department of Ecology; some of it is forwarded from there to the National Aerometric Data Bank maintained by the U. S. EPA. The Department of Ecology conducts air monitoring within the Puget Sound area in addition to that done by our Agency. The Department publishes an annual summary of data for the entire state.

Requests for the state summary should be directed to the Washington Department of Ecology - PV11, Air Program, Olympia, WA 98504-8711.

Anyone may also obtain the current daily Pollutant Standards Index from the American Lung Association of Washington in Seattle by dialing 441-5100 or by dialing 1-800-732-9339 from outside Seattle.

The current daily Index is also available from the Puget Sound Air Pollution Control Agency by dialing 296-5100 or by dialing 1-800-433-2215 from outside Seattle.

Information on burning restrictions during the heating season, October 15 - March 31, is also obtained on 296-5100 or by dialing 1-800-523-INFO from outside Seattle.

1988 SAMPLING NETWORK

Location	-----Type of Sampling-----		
Tolt River Watershed, King County, Wa	TSP		
*Snohomish FD #22, 9921 84th NE, Arlington, Wa			O ₃
*3402 28th Place NE, Everett, Wa			SO ₂
*Legion Park, W Marine View Dr, Everett, Wa			SO ₂
Medical-Dental Bldg, 2730 Colby, Everett, Wa	PM ₁₀	TSP	b _{sp} , SO ₂ , Wind
*Broadway & Hewitt Ave, Everett, Wa			CO
*622 Bellevue Way NE, Bellevue, Wa			CO
*504 Bellevue Way NE, Bellevue, Wa	PM ₁₀	TSP	
*20050 SE 56th, Lake Sammamish State Park, Wa			O ₃
*Northgate, 310 NE Northgate Way, Seattle, Wa			CO
North 98th St & Stone Ave N, Seattle, Wa	PM ₁₀	TSP	b _{sp} , Pb, Wind
*5701 8th Ave NE, Seattle, Wa		TSP	Pb
*4511 University Way NE, Seattle, Wa			CO
*1960 NE Pacific Ave, Seattle, Wa			CO
*1424 4th Ave, Seattle, Wa			CO
*5th Ave & James St, Seattle, Wa			CO
*Courthouse, 4th Ave & James St, Seattle, Wa			CO
*Fire Station #10, 301 2nd Ave S, Seattle, Wa	PM ₁₀	TSP	CO
*Beacon Hill, 15th S & Charlestown, Seattle, Wa			Wind
Harbor Island, 2555 13th Ave SW, Seattle, Wa		TSP	Pb
Harbor Island, 3400 13th Ave SW, Seattle, Wa	PM ₁₀	TSP	Pb
Duwamish, 4752 E Marginal Way S, Seattle, Wa	PM ₁₀	TSP	PM _{2.5} , b _{sp} , SO ₂ , Wind
*Georgetown, 6431 Corson Ave S, Seattle, Wa		TSP	
South Park, 723 S Concord St, Seattle, Wa	PM ₁₀	TSP	Pb
Duwamish Valley, 12026 42nd Ave S, King Co, Wa		TSP	

Notes- (1) Type of Sampling:

- | | | | |
|-------------------|--|-----------------|--|
| PM ₁₀ | = Particulate Matter
10 micrometers or smaller | b _{sp} | = Atmospheric Particles
(by nephelometer) |
| TSP | = Total Suspended Particulates | O ₃ | = Ozone |
| CO | = Carbon Monoxide | SO ₂ | = Sulfur Dioxide |
| PM _{2.5} | = Particulate Matter smaller
than 2.5 micrometers | Pb | = Lead |
| Wind | = Wind Direction & Speed | | |

(2) * Station operated by Washington State Department of Ecology.

1988 SAMPLING NETWORK

Location	-----Type of Sampling-----		
James St & Central Ave, Kent, Wa	PM10	TSP	b _{sp} , Wind
115 E Main St, Auburn, Wa		TSP	
Pac Coast Coal, 270th Ave SE, Black Diamond, Wa		TSP	
*Highway 410, 2 miles east of Enumclaw, Wa			O ₃
Sumner Jr HS, 1508 Willow St, Sumner, Wa		TSP	O ₃ , Wind
27th St NE & 54th Ave NE, Northeast Tacoma, Wa	PM10	TSP	b _{sp} , SO ₂ , Wind
2340 Taylor Way, Tacoma, Wa	PM10	TSP	
2301 Alexander Ave, Tacoma, Wa	PM10	TSP	SO ₂ , Wind
Fire Station #12, 2316 E 11th St, Tacoma, Wa	PM10	TSP	PM _{2.5} , b _{sp} , Wind
*951 Portland Ave, Tacoma, Wa			SO ₂
Treatment Plant, 1241 Cleveland Wy, Tacoma, Wa		TSP	
Cascadia, 2002 E 28th St, Tacoma, Wa		TSP	
Willard School, S 32nd & S 'D' St, Tacoma, Wa		TSP	
Hess Bldg, 901 Tacoma Ave S, Tacoma, Wa		TSP	
*942 Pacific Ave, Tacoma, Wa			CO
*1101 Pacific Ave, Tacoma, Wa			CO
SW 283rd & 101st Ave SW, Maury Island, Wa		TSP	Pb, As
Ruston School, 5219 N Shirley St, Tacoma, Wa		TSP	Pb, As
North 26th & Pearl Sts, Tacoma, Wa		TSP	SO ₂ , Pb, As, Wind
*Mt Tahoma HS, 6404 S Adams St, Tacoma, Wa		TSP	
City Hall, 239 4th St, Bremerton, Wa		TSP	
*Burwell St & Pacific Ave, Bremerton, Wa			CO
*Pierce Co Fire D #21, 8102 304th, Graham, Wa			O ₃
*Charles L Pack Forest, La Grande, Wa			O ₃
*Mount Rainier National Park, Longmire, Wa			O ₃

Notes- (1) Type of Sampling:

PM ₁₀	= Particulate Matter 10 micrometers or smaller	b _{sp}	= Atmospheric Particles (by nephelometer)
TSP	= Total Suspended Particulates	O ₃	= Ozone
CO	= Carbon Monoxide	SO ₂	= Sulfur Dioxide
PM _{2.5}	= Particulate Matter smaller than 2.5 micrometers	Pb	= Lead
Wind	= Wind Direction & Speed	As	= Arsenic

(2) * Station operated by Washington State Department of Ecology.

POLLUTANT STANDARDS INDEX

The Pollutant Standards Index (PSI) provides a nationally uniform way to report daily air quality levels. In cooperation with the Washington State Department of Ecology, the Agency began reporting the PSI in 1980 for the Everett, Seattle, and Tacoma areas.

Measured pollutant levels during each day are transferred to a scale indicating if there are potential health effects. This PSI scale of zero to 500 classifies air quality by the following descriptions:

- from 0 to 50, Good;
- from 51 to 100, Moderate;
- from 101 to 199, Unhealthful;
- from 200 to 299, Very Unhealthful;
- from 300 to 500, Hazardous.

The table below shows the averaging period and each pollutant concentration for all the category break-points of the Index. Values between break-points are determined by linear interpolation.

Whenever the PSI is above 100, a measured pollutant level has exceeded the national primary air quality standard established to protect health. An index value of 200 means the pollutant concentration has reached the "Alert" level in the Washington Episode Avoidance Plan.

Each day the pollutant levels within the cities of Everett, Seattle and Tacoma are used to calculate the Index. The daily Index value for each city is determined by the pollutant with the highest value on the PSI scale. The highest PSI values normally occur near congested traffic or an industrial area, and the values in suburban residential areas are usually lower.

Tables which follow summarize the daily PSI values for Everett, Seattle, and Tacoma. The higher PSI values tend to occur during the fall and winter months often coinciding with air stagnation periods. The 1988 summary table shows for each month the number of days in each PSI interval, the maximum Index, the date of the maximum and the pollutant determining the maximum value.

A summary table for 1980 through 1988 presents by year the number of days in each air quality category and the number of days each pollutant determined the PSI. For the unhealthful days each year (Index values greater than 100), this summary also tabulates the pollutant responsible.

<u>Pollutant</u>	<u>Averaging Period & Units</u>
Carbon Monoxide (CO)	8 hour average in parts per million
Particulate Matter (PM ₁₀)	24 hour average in micrograms per cubic meter
Sulfur Dioxide (SO ₂)	24 hour average in parts per million
Ozone (O ₃)	1 hour average in parts per million

PSI Break-points and Pollutant Concentrations

<u>PSI value</u>	<u>CO (8 hrs)</u>	<u>PM₁₀ (24 hrs)</u>	<u>SO₂ (24 hrs)</u>	<u>O₃ (1 hr)</u>
50	4.5	50	0.03	0.06
100	9.0	150	0.14	0.12
200	15.0	350	0.30	0.20
300	30.0	420	0.60	0.40
400	40.0	500	0.80	0.50
500	50.0	600	1.00	0.60

POLLUTANT STANDARDS INDEX

1988

EVERETT														
AIR QUALITY	(PSI Interval)	JAN	FEB	Number of Days in Each					PSI Interval during Each Month					ANNUAL
				MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
GOOD	(0 to 50)	17	15	23	17	21	20	13	10	6	8	16	8	174
MODERATE	(51 to 100)	14	14	8	13	10	10	18	21	19	21	14	22	184
UNHEALTHFUL	(101 to 199)	0	0	0	0	0	0	0	0	5	2	0	1	8
VERY UNHEALTHFUL	(200 to 299)	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum PSI each month		100	100	89	89	78	89	100	89	133	117	89	133	133
Date		3rd#	5th	17th#	18th#	11th	14th	19th#	23rd#	13th#	6th#	28th#	27th	Sep 13#
Pollutant		CO	CO	CO	CO	CO	CO	CO	CO	CO	CO	CO	CO	CO
SEATTLE														
AIR QUALITY	(PSI Interval)	JAN	FEB	Number of Days in Each					PSI Interval during Each Month					ANNUAL
				MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
GOOD	(0 to 50)	9	8	19	22	27	25	25	26	22	6	16	10	215
MODERATE	(51 to 100)	21	21	12	8	4	5	6	5	8	24	13	19	146
UNHEALTHFUL	(101 to 199)	1	0	0	0	0	0	0	0	0	1	1	2	5
VERY UNHEALTHFUL	(200 to 299)	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum PSI each month		107	99	89	56	67	56	56	56	67	117	117	150	150
Date		27th	24th	18th	1st#	20th	1st#	19th#	3rd#	2nd#	28th	30th	3rd	Dec 3
Pollutant		PM	PM	CO	CO	CO	CO	CO	CO	CO	CO	CO	CO	CO
TACOMA														
AIR QUALITY	(PSI Interval)	JAN	FEB	Number of Days in Each					PSI Interval during Each Month					ANNUAL
				MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
GOOD	(0 to 50)	10	11	19	24	26	26	23	21	19	11	18	18	226
MODERATE	(51 to 100)	17	17	12	6	5	4	8	10	11	20	11	11	132
UNHEALTHFUL	(101 to 199)	4	1	0	0	0	0	0	0	0	0	1	2	8
VERY UNHEALTHFUL	(200 to 299)	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum PSI each month		183	117	88	67	77	67	70	80	100	100	167	133	183
Date		27th	24th	18th	15th	11th	14th	20th	28th	2nd	28th	30th	1st#	Jan 27
Pollutant		CO	PM	PM	CO	PM	PM	PM	PM	CO	CO	CO	CO	CO

PM = Particulate Matter; CO = Carbon Monoxide; SO2 = Sulfur Dioxide.

Earliest date of occurrence

POLLUTANT STANDARDS INDEX

1980 - 1988

EVERETT

	Days in Each Air Quality Category				Pollutant Determining the PSI						Highest Value		
	Good	Moderate	Unhealthful	Very	All Days			Unhealthful Days			PSI	Date	Pollutant
				Unhealthful	PM	CO	SO2	PM	CO	SO2			
1980	340	19	0	0	356	-	3	0	-	0	60	Jan 23	PM
1981	350	11	0	0	340	-	21	0	-	0	62	Jan 16	PM
1982	334	30	1	0	277	70	18	0	1	0	117	Dec 30	CO
1983	308	56	1	0	191	150	24	0	1	0	117	Nov 30	CO
1984	309	57	0	0	105	217	44	0	0	0	92	Sep 28	PM
1985	300	64	1	0	152	166	47	0	1	0	117	Dec 11	CO
1986	324	41	0	0	169	148	48	0	0	0	89	Jan 25	CO
1987	203	158	3	0	96	250	18	0	3	0	117	Jun 26#	CO
1988	174	184	8	0	15	345	6	0	8	0	133	Sep 13#	CO
Totals	2642	620	14	0	1701	1346	229	0	14	0			

SEATTLE

	Days in Each Air Quality Category				Pollutant Determining the PSI						Highest Value		
	Good	Moderate	Unhealthful	Very	All Days			Unhealthful Days			PSI	Date	Pollutant
				Unhealthful	PM	CO	SO2	PM	CO	SO2			
1980	73	275	18	0	95	270	1	1	17	0	194	Jan 23	PM
1981	69	267	28	1	109	254	2	5	24	0	213	Jan 15	CO
1982	86	268	10	1	96	264	5	1	10	0	214	Feb 6	PM
1983	98	258	9	0	101	261	3	0	9	0	183	Jan 28	CO
1984	146	218	2	0	111	242	13	2	0	0	103	Dec 6	PM
1985	150	202	10	3	156	206	3	6	7	0	204	Dec 12	PM
1986	130	226	8	1	113	246	6	1	8	0	206	Jan 7	PM
1987	120	238	7	0	119	246	0	3	4	0	184	Feb 6	PM
1988	215	146	5	0	67	298	1	2	3	0	150	Dec 3	CO
Totals	1087	2098	97	6	967	2287	34	21	82	0			

TACOMA

	Days in Each Air Quality Category				Pollutant Determining the PSI						Highest Value		
	Good	Moderate	Unhealthful	Very	All Days			Unhealthful Days			PSI	Date	Pollutant
				Unhealthful	PM	CO	SO2	PM	CO	SO2			
1980	83	271	12	0	256	107	3	4	8	0	160	Apr 12	PM
1981	74	278	10	3	222	137	6	1	12	0	227	Jan 12	CO
1982	119	242	4	0	255	101	9	0	4	0	167	Dec 30	CO
1983	140	222	3	0	228	128	9	1	2	0	137	Dec 23	PM
1984	162	198	6	0	207	149	10	0	6	0	117	Jan 19#	CO
1985	140	213	12	0	252	109	4	1	11	0	165	Dec 13	PM
1986	161	197	7	0	247	114	4	2	5	0	167	Oct 23	CO
1987	173	177	13	2	227	136	2	5	10	0	220	Feb 5	CO
1988	226	132	8	0	184	175	7	3	5	0	183	Jan 27	CO
Totals	1278	1930	75	5	2078	1156	54	17	63	0			

Earliest date of occurrence

PARTICULATE MATTER

Introduction

Particulate Matter as a general term includes small particles of dust, soot, organic matter and compounds containing sulfur, nitrogen, and metals. In July, 1987, the U. S. EPA changed the national particulate matter standards from the measurement of Total Suspended Particulates (TSP) to the measurement of only that fraction of particulate matter with particle diameters smaller than or equal to 10 micrometers (PM₁₀). The levels for the national primary and secondary standards are identical, 150 ug/m³ for a 24 hour average and 50 ug/m³ annual arithmetic mean. The PM₁₀ standards also include calculation formulas for statistically determining whether the standards are attained.

Particulate Sources and Air Quality

Particulates directly enter the air from industrial operations, from fuel combustion including wood stoves and fireplaces, from auto and truck traffic, from construction, and from other sources. These emissions change from day to day due to intermittent industrial operations, equipment upset or breakdown, traffic cycles and building heating requirements. Gaseous transformation products like sulfates, nitrates, and some organics are also a component of particulate matter. In the air particulate matter disperses and is transported by the wind. Ambient levels change from day to day in response to what enters the air and to different weather conditions.

Manual Sampling Methods

The approved U. S. EPA reference methods to measure PM₁₀ all draw outside air first through an inlet which traps particulates larger than 10 micrometers and then through a filter which collects the remaining particulate matter (PM₁₀). A PM₁₀ inlet installed on a high volume sampler is sometimes called a size selective inlet. Sampling for a single measurement continues for 24 hours usually from midnight to midnight. After sampling, the pre-weighed filter is manually removed and, following

conditioning in a controlled atmosphere to remove moisture effects, the filter is weighed on a precise balance to determine the net weight of particulate matter collected. The volume of air sampled, corrected to standard temperature and pressure conditions, is calculated from the flow rate and sampling time. The ambient PM₁₀ concentration is the weight (mass) of the particulate collected divided by the volume of air sampled, and is reported in micrograms per standard cubic meter.

The TSP method measures the total particulate concentration following a procedure essentially like the PM₁₀ reference method except that the inlet is not size selective. For TSP, outside air reaches the collection filter after being drawn under the edge of the roof covering a small rectangular shelter containing the high volume sampler.

Continuous Sampling

An instrument called an integrating nephelometer continuously measures the light scattering extinction coefficient. A component of the scattering coefficient, (b_{sp}), is a measure of atmospheric particles. This dry particle scattering coefficient has shown high correlation to PM₁₀ levels. The particulate level measured by this method is reported as a scattering coefficient per meter times 10⁻⁴.

When operated at a site along with the reference method sampling, it is possible to develop a relationship between the two methods for that site. Each relationship (multiple regression equation) enables use of the continuous nephelometer measurement to provide a satisfactory real-time prediction of the manual reference PM₁₀ value.

Data Summaries

The following tables summarize PM₁₀, TSP, and nephelometer measurements during 1988. The areas documented as exceeding both the PM₁₀ and TSP standards are the industrialized Seattle Harbor Island-Duwamish area, the Kent area and the industrialized Tacoma Port area.

PARTICULATE MATTER (PM10)
Micrograms per Standard Cubic Meter

Sampled by Size Selective Inlet - Hi Vol SA1200 Quartz Fiber filters

1988

Location	Number of Values	Quarterly Arithmetic Averages				Year Arith Mean
		1st	2nd	3rd	4th	
Medical-Dental Bldg, 2730 Colby, Everett, Wa	60	25.2	22.9	23.0	28.3	24.9
504 Bellevue Way NE, Bellevue, Wa	107	35.4	22.3	22.4	26.1	26.6
North 98th St & Stone Ave N, Seattle, Wa	60	24.7	20.0	20.4	27.7	23.2
Fire Station #10, 301 2nd Ave S, Seattle, Wa	57	32.1	28.3	23.2	33.7	29.3
Harbor Island, 3400 13th Ave SW, Seattle, Wa	54	45.2	32.4	29.3	43.3	37.6
Duwamish, 4752 E Marginal Way S, Seattle, Wa	356	50.4	30.0	30.2	46.0	39.2
South Park, 723 S Concord St, Seattle, Wa	61	32.3	25.5	28.7	37.5	31.0
James St & Central Ave, Kent, Wa	59	42.2	29.1	31.1	43.4	36.5
27th St NE & 54th Ave NE, Northeast Tacoma, Wa	61	35.3	33.4	36.7	35.4	35.2
2340 Taylor Way, Tacoma, Wa	60	43.5	39.3	41.7	36.8	40.3
2301 Alexander Ave, Tacoma, Wa	150	49.1	29.8	31.1	41.0	37.8
Fire Station #12, 2316 E 11th St, Tacoma, Wa	355	59.2	31.5	36.6	44.0	42.8

Notes

- (1) Nationally scheduled particulate matter sampling occurs each sixth day. Quarterly averages are shown only when at least one data value exists for 75 percent or more of the six day intervals.
- (2) Annual averages are shown only if there are at least three quarterly averages.

Summary of Maximum and 2nd High Observed Concentrations

Location	Jan 4	Jan 7	Jan 26	Jan 27	Feb 21	Feb 24	Mar 16	Nov 29	Dec 1	Dec 17
	Mon	Thu	Tue	Wed	Sun	Wed	Wed	Tue	Thu	Sat
Medical-Dental Bldg, 2730 Colby, Everett, Wa	71	--	--	--	--	--	--	--	--	68
504 Bellevue Way NE, Bellevue, Wa	--	--	--	--	117	--	--	--	--	65
North 98th St & Stone Ave N, Seattle, Wa	--	--	--	--	52	--	--	--	--	62
Fire Station #10, 301 2nd Ave S, Seattle, Wa	--	--	--	--	--	--	56	--	--	92
Harbor Island, 3400 13th Ave SW, Seattle, Wa	--	--	--	--	--	--	66	66	--	89
Duwamish, 4752 E Marginal Way S, Seattle, Wa	--	--	163	--	--	--	--	--	178	--
South Park, 723 S Concord St, Seattle, Wa	--	--	--	62	--	62	--	--	--	90
James St & Central Ave, Kent, Wa	87	--	--	--	--	--	--	--	--	98
27th St NE & 54th Ave NE, Northeast Tacoma, Wa	108	--	--	--	--	--	--	--	--	94
2340 Taylor Way, Tacoma, Wa	157	--	--	--	--	--	--	--	--	85
2301 Alexander Ave, Tacoma, Wa	--	156	139	--	--	--	--	--	--	--
Fire Station #12, 2316 E 11th St, Tacoma, Wa	175	--	--	--	184	--	--	--	--	--

Summary of Observations Greater Than 150

Location	Jan 4	Jan 7	Jan 26	Jan 27	Feb 24	Dec 1
	Mon	Thu	Tue	Wed	Wed	Thu
Duwamish, 4752 E Marginal Way S, Seattle, Wa	--	--	163	--	178	--
2340 Taylor Way, Tacoma, Wa	157	--	--	--	--	--
2301 Alexander Ave, Tacoma, Wa	--	156	--	--	--	--
Fire Station #12, 2316 E 11th St, Tacoma, Wa	175	160	154	--	184	--

-- Indicates no sample on specified day

SUSPENDED PARTICULATES (TSP)
Micrograms per Standard Cubic Meter

Sampled by Standard High Volume Quartz Fiber filters

1988

Location	Number of Values	Quarterly Arithmetic Averages				Year Arith Mean	Year Geom Mean
		1st	2nd	3rd	4th		
Tolt River Watershed, King County, Wa	55	6.0	13.3	17.6	9.7	11.7	9.4
Medical-Dental Bldg, 2730 Colby, Everett, Wa	44	38.9	41.5	43.1		41.2	35.8
504 Bellevue Way NE, Bellevue, Wa	42	55.8	55.2	46.3		52.4	48.3
North 98th St & Stone Ave N, Seattle, Wa	61	39.3	40.6	47.7	36.4	41.0	37.6
5701 8th Ave NE, Seattle, Wa	39	60.5	48.8	-	-	-	-
Fire Station #10, 301 2nd Ave S, Seattle, Wa	41	61.1	45.2	44.4		50.2	46.5
Harbor Island, 2555 13th Ave SW, Seattle, Wa	64	57.2	43.5	51.4	57.6	52.4	48.1
Harbor Island, 3400 13th Ave SW, Seattle, Wa	44	85.2	64.3	65.4		71.6	66.5
Duwamish, 4752 E Marginal Way S, Seattle, Wa	353	104.3	71.7	71.3	81.3	82.2	72.6
Georgetown, 6431 Corson Ave S, Seattle, Wa	60	56.3	61.3	78.1	60.5	64.1	55.5
South Park, 723 S Concord St, Seattle, Wa	46	49.7	46.4	59.1		51.7	44.6
Duwamish Valley, 12026 42nd Ave S, King Co, Wa	61	47.3	36.3	44.3	51.1	44.8	39.5
James St & Central Ave, Kent, Wa	46	77.5	57.9	68.5		68.0	60.4
115 E Main St, Auburn, Wa	61	58.7	38.2	48.1	45.2	47.6	41.3
Pac Coast Coal, 270th Av SE, Black Diamond, Wa	54	16.9	19.8	46.9	20.8	26.1	19.7
Sumner Jr HS, 1508 Willow St, Sumner, Wa	57	48.9	42.5	43.6	45.0	45.0	38.1
27th St NE & 54th Ave NE, Northeast Tacoma, Wa	90	66.1	65.9	85.4		72.5	59.4
2340 Taylor Way, Tacoma, Wa	45	77.6	87.7	101.7		89.0	70.9
2301 Alexander Ave, Tacoma, Wa	112	80.1	60.5	67.5		69.4	56.9
Fire Station #12, 2316 E 11th St, Tacoma, Wa	300	106.7	74.3	85.5	68.3	83.7	68.6
Treatment Plant, 1241 Cleveland Wy, Tacoma, Wa	59	76.5	76.4	91.1	58.6	75.7	65.3
Cascadia, 2002 E 28th St, Tacoma, Wa	61	54.4	54.5	72.3	41.9	55.8	43.8
Willard School, S 32nd & S 'D' St, Tacoma, Wa	59	53.8	43.9	57.7	44.2	49.9	40.7
Hess Bldg, 901 Tacoma Ave S, Tacoma, Wa	46	46.8	31.5	35.6		38.0	33.0
SW 283rd & 101st Ave SW, Maury Island, Wa	61	28.3	18.9	20.5	27.1	23.7	20.6
Ruston School, 5219 N Shirley St, Tacoma, Wa	61	39.3	25.7	29.0	36.3	32.6	28.3
North 26th & Pearl Sts, Tacoma, Wa	46	38.1	22.1	25.8		28.7	24.2
Mt Tahoma HS, 6404 S Adams St, Tacoma, Wa	46	64.9	48.1	-	-	-	-
City Hall, 239 4th St, Bremerton, Wa	57	33.9	30.1	28.4	27.0	29.9	27.7

Notes

- (1) Nationally scheduled particulate matter sampling occurs each sixth day. Quarterly averages are shown only when at least one data value exists for 75 percent or more of the six day intervals.
- (2) Annual averages are shown only if there are at least three quarterly averages.

SUSPENDED PARTICULATES (TSP)
Micrograms per Standard Cubic Meter

Sampled by Standard High Volume Quartz Fiber filters

Jan - Feb, 1988

Summary of Observations Greater Than 150

Location	Jan	Feb																	
	4	5	6	7	18	21	25	26	27	2	4	5	19	22	23	24	25	26	26
	Mon	Tue	Wed	Thu	Mon	Thu	Mon	Tue	Wed	Tue	Thu	Fri	Fri	Mon	Tue	Wed	Thu	Fri	Fri
Duwamish, 4752 E Marginal Way S, Seattle, Wa	--	184	171	173		181	216	226	259	206		264			177	293	191	160	
Georgetown, 6431 Corson Ave S, Seattle, Wa		--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
James St & Central Ave, Kent, Wa	170	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
115 E Main St, Auburn, Wa	208	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
27th St NE & 54th Ave NE, Northeast Tacoma, Wa	153	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2340 Taylor Way, Tacoma, Wa	256	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
2301 Alexander Ave, Tacoma, Wa	--	160	--	218	--	164	--	191	--	--	--	--	--	--	--	--	157	--	--
Fire Station #12, 2316 E 11th St, Tacoma, Wa	--	177	182	250	171	219	214	211	--	--	154	175	198	179	250	302	219	241	--
Treatment Plant, 1241 Cleveland Wy, Tacoma, Wa	232	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cascadia, 2002 E 28th St, Tacoma, Wa	176	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Willard School, S 32nd & S 'D' St, Tacoma, Wa	162	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

Mar - Jul, 1988

Summary of Observations Greater Than 150

Location	Mar	Mar	Mar	Mar	Mar	Apr	Apr	Apr	May	May	May	Jun	Jun	Jul	Jul	Jul	Jul	Jul	Jul
	14	15	16	17	18	12	15	27	10	11	12	13	14	19	20	22	25	26	26
	Mon	Tue	Wed	Thu	Fri	Tue	Fri	Wed	Tue	Wed	Thu	Mon	Tue	Tue	Wed	Fri	Mon	Tue	Tue
Duwamish, 4752 E Marginal Way S, Seattle, Wa	157		187	209	250														
Georgetown, 6431 Corson Ave S, Seattle, Wa	--	--	152	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
James St & Central Ave, Kent, Wa	--	--	152	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
115 E Main St, Auburn, Wa	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
27th St NE & 54th Ave NE, Northeast Tacoma, Wa	--	--	153	--	--	154	159	--	--	--	--	--	--	--	--	--	--	--	--
2340 Taylor Way, Tacoma, Wa	--	--	188	--	--	--	--	160	--	--	--	--	200	--	167	--	--	163	--
2301 Alexander Ave, Tacoma, Wa	--	154	--	153	--	--	--	--	--	--	--	--	--	157	--	--	--	--	--
Fire Station #12, 2316 E 11th St, Tacoma, Wa	228	239	181	168	261	--	--	169	246	167	157	193	158	--	160	202	152	--	--
Treatment Plant, 1241 Cleveland Wy, Tacoma, Wa	--	--	155	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Cascadia, 2002 E 28th St, Tacoma, Wa	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Willard School, S 32nd & S 'D' St, Tacoma, Wa	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

-- Indicates no sample on specified day

SUSPENDED PARTICULATES (TSP)
Micrograms per Standard Cubic Meter

Sampled by Standard High Volume Quartz Fiber filters

Aug - Dec, 1988

Summary of Observations Greater Than 150

Location	Aug 3 Wed	Aug 26 Fri	Aug 27 Sat	Sep 1 Thu	Sep 2 Fri	Sep 6 Tue	Sep 9 Fri	Sep 12 Mon	Sep 14 Wed	Oct 3 Mon	Oct 28 Fri	Nov 30 Wed	Dec 1 Thu	Dec 16 Fri	Dec 28 Wed
Duwamish, 4752 E Marginal Way S, Seattle, Wa	--	--	--	--	--	--	--	--	165	--	164	224	314	--	164
Georgetown, 6431 Corson Ave S, Seattle, Wa	--	--	--	--	--	224	--	--	--	--	--	--	--	--	--
James St & Central Ave, Kent, Wa	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
115 E Main St, Auburn, Wa	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
27th St NE & 54th Ave NE, Northeast Tacoma, Wa	174	--	--	190	--	--	--	--	--	--	--	--	--	--	--
2340 Taylor Way, Tacoma, Wa	--	--	--	--	--	191	--	151	--	--	--	--	--	--	--
2301 Alexander Ave, Tacoma, Wa	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Fire Station #12, 2316 E 11th St, Tacoma, Wa	--	171	176	--	154	--	157	--	211	--	162	215	196	--	--
Treatment Plant, 1241 Cleveland Wy, Tacoma, Wa	--	--	--	--	--	173	--	--	--	--	--	--	--	--	--
Cascadia, 2002 E 28th St, Tacoma, Wa	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Willard School, S 32nd & S 'D' St, Tacoma, Wa	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--

-- Indicates no sample on specified day

SUSPENDED PARTICULATES (TSP)
Micrograms per Standard Cubic Meter

Sampled by Standard High Volume Quartz Fiber filters

1988

Summary of Maximum and 2nd High Observed Concentrations

Location	Jan	Jan	Jan	Feb	Feb	Feb	Mar	Mar	Apr	Apr	Jun	Jul	Jul	Aug	Sep	Sep	Sep	Oct	Dec	Dec
	4	7	26	21	24	27	16	18	15	27	14	20	26	3	1	6	12	12	1	17
	Mon	Thu	Tue	Sun	Wed	Sat	Wed	Fri	Fri	Wed	Tue	Wed	Tue	Wed	Thu	Tue	Mon	Wed	Thu	Sat
Tolt River Watershed, King County, Wa	--	--	--	--	--	--	--	--	--	--	--	--	30	--	--	--	--	30	--	--
Medical-Dental Bldg, 2730 Colby, Everett, Wa	112	--	--	--	--	--	90	--	--	--	--	--	--	--	--	--	--	--	--	--
504 Bellevue Way NE, Bellevue, Wa	--	--	--	--	--	--	125	--	--	112	--	--	--	--	--	--	--	--	--	--
North 98th St & Stone Ave N, Seattle, Wa	--	--	--	--	--	--	--	--	82	77	--	--	--	--	--	--	--	--	--	--
5701 8th Ave NE, Seattle, Wa	--	--	--	--	--	--	103	--	--	--	--	--	--	--	--	--	--	--	--	100
Fire Station #10, 301 2nd Ave S, Seattle, Wa	--	--	--	94	--	--	123	--	--	--	--	--	--	--	--	--	--	--	--	--
Harbor Island, 2555 13th Ave SW, Seattle, Wa	105	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	108
Harbor Island, 3400 13th Ave SW, Seattle, Wa	131	--	--	--	--	--	130	--	--	--	--	--	--	--	--	--	--	--	--	--
Duwamish, 4752 E Marginal Way S, Seattle, Wa	--	--	--	--	293	--	--	--	--	--	--	--	--	--	--	--	--	314	--	--
Georgetown, 6431 Corson Ave S, Seattle, Wa	--	--	--	--	--	--	152	--	--	--	--	--	--	--	224	--	--	--	--	--
South Park, 723 S Concord St, Seattle, Wa	--	--	--	--	--	--	119	--	--	--	117	--	--	--	--	--	--	--	--	--
Duwamish Valley, 12026 42nd Ave S, King Co, Wa	--	--	--	--	--	--	105	--	--	--	--	--	--	--	--	--	--	--	--	95
James St & Central Ave, Kent, Wa	170	--	--	--	--	--	152	--	--	--	--	--	--	--	--	--	--	--	--	--
115 E Main St, Auburn, Wa	208	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	103
Pac Coast Coal, 270th Av SE, Black Diamond, Wa	--	--	--	--	--	--	--	--	--	--	--	76	--	--	--	--	75	--	--	--
Sumner Jr HS, 1508 Willow St, Sumner, Wa	147	--	--	--	--	94	--	--	--	--	--	--	--	--	--	--	--	--	--	--
27th St NE & 54th Ave NE, Northeast Tacoma, Wa	--	--	--	--	--	--	--	--	--	--	--	174	190	--	--	--	--	--	--	--
2340 Taylor Way, Tacoma, Wa	256	--	--	--	--	--	--	--	--	200	--	--	--	--	--	--	--	--	--	--
2301 Alexander Ave, Tacoma, Wa	--	218	191	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Fire Station #12, 2316 E 11th St, Tacoma, Wa	--	--	--	--	302	--	--	261	--	--	--	--	--	--	--	--	--	--	--	--
Treatment Plant, 1241 Cleveland Wy, Tacoma, Wa	232	--	--	--	--	--	--	--	--	--	--	--	--	--	173	--	--	--	--	--
Cascadia, 2002 E 28th St, Tacoma, Wa	176	--	--	--	--	--	132	--	--	--	--	--	--	--	--	--	--	--	--	--
Willard School, S 32nd & S 'D' St, Tacoma, Wa	162	--	--	--	--	--	120	--	--	--	--	--	--	--	--	--	--	--	--	--
Hess Bldg, 901 Tacoma Ave S, Tacoma, Wa	142	--	--	--	--	--	89	--	--	--	--	--	--	--	--	--	--	--	--	--
SW 283rd & 101st Ave SW, Maury Island, Wa	--	--	--	--	--	57	--	--	--	--	--	--	--	--	--	--	--	--	--	69
Ruston School, 5219 N Shirley St, Tacoma, Wa	122	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	83
North 26th & Pearl Sts, Tacoma, Wa	107	--	--	--	--	--	73	--	--	--	--	--	--	--	--	--	--	--	--	--
Mt Tahoma HS, 6404 S Adams St, Tacoma, Wa	135	--	--	--	--	--	119	--	--	--	--	--	--	--	--	--	--	--	--	--
City Hall, 239 4th St, Bremerton, Wa	68	--	--	--	--	--	--	--	--	55	--	--	--	--	--	--	--	--	--	--

-- Indicates no sample on specified day

ATMOSPHERIC PARTICLES
(bsp (X 10 Exp-4)/M)
1988

Location	Monthly Arithmetic Averages												No. of Year 1 Hour Arith Samples	Mean
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Medical-Dental Bldg, 2730 Colby, Everett, Wa	.86	.99	.59	.56	.35	.32	.36		.64	1.24	.39	.82	8509	.63
North 98th St & Stone Ave N, Seattle, Wa	.98	.95	.58	.42	.30	.26	.24	.35	.54	1.17	.52	1.00	8753	.61
Duwamish, 4752 E Marginal Way S, Seattle, Wa	1.24	1.03	.66	.48	.36	.30	.29	.41	.59	1.25	.67	1.12	8634	.70
James St & Central Ave, Kent, Wa	1.83	1.39	.89	.58	.39	.31	.36	.47	.65	1.56	.70		8276	.88
27th St NE & 54th Ave NE, Northeast Tacoma, Wa	1.25	.89	.55	.39	.36	.31	.32	.43	.59	1.20	.49	.97	8753	.65
Fire Station #12, 2316 E 11th St, Tacoma, Wa	2.06	1.20	.73	.42	.39	.30	.33	.42	.58	1.31	.65	1.43	8736	.82

Statistical Summary

Location	No. of 1 Hour Samples	Frequency Distribution - Percent												Arith Mean	Geom Mean	Geom Std Dev	Arith Std Dev
		5	10	20	30	40	50	60	70	80	90	95	99				
Medical-Dental Bldg, 2730 Colby, Everett, Wa	8509	.1	.2	.2	.3	.3	.4	.5	.7	.9	1.4	1.9	2.8	.63	.45	2.25	.58
North 98th St & Stone Ave N, Seattle, Wa	8753	.1	.1	.2	.2	.3	.4	.5	.6	.9	1.4	1.9	3.4	.61	.40	2.49	.67
Duwamish, 4752 E Marginal Way S, Seattle, Wa	8634	.1	.2	.2	.3	.4	.4	.6	.7	1.0	1.5	2.2	3.7	.70	.47	2.36	.74
James St & Central Ave, Kent, Wa	8276	.1	.1	.2	.3	.4	.5	.7	.9	1.3	2.2	3.1	4.9	.88	.52	2.80	1.02
27th St NE & 54th Ave NE, Northeast Tacoma, Wa	8753	.1	.1	.2	.2	.3	.4	.5	.7	1.0	1.5	2.0	3.5	.65	.42	2.48	.71
Fire Station #12, 2316 E 11th St, Tacoma, Wa	8736	.1	.1	.2	.3	.3	.4	.5	.7	1.1	2.1	3.1	5.2	.82	.47	2.78	1.05

LEAD

The ambient air quality standard for lead is 1.5 micrograms per cubic meter averaged over one calendar quarter. Lead emissions to the air across urban areas come principally from automobile exhaust. In some places localized industrial emissions of lead come from stationary sources such as primary and secondary nonferrous smelters.

The tables below present the results of lead sampling in the Puget Sound area during 1988. Lead concentrations measured at all stations were lower than the ambient standard. The lead levels

shown for the Harbor Island station at 2555 13th Ave SW still document some effect from the nearby site of a secondary lead smelter which ceased operation several years ago.

These current ambient lead levels compared to levels prior to 1980 show significant improvement due primarily to the phase down of lead in gasoline. Since the improvement in lead levels is well documented and permanent, much of the lead sampling ended on September 30, 1988.

LEAD
Micrograms per Standard Cubic Meter

Sampled by Standard High Volume Quartz Fiber filters

1988

Location	Monthly Arithmetic Averages												No. Of Obs.	Year Arith Mean
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
North 98th St & Stone Ave N, Seattle, Wa	.06	.03	.04	.04	.06	.02	.03	.03	.02	.05	.05	.05	61	.04
Marshall School, 520 NE Ravenna, Seattle, Wa	.17	.07	.09										15	.11
5701 8th Ave NE, Seattle, Wa	.14	.08	.08	.12	.08	.05	.06		.06			.07	35	.08
Harbor Island, 2555 13th Ave SW, Seattle, Wa	.65	.56	.62	.34	.41	.16	.15	.13	.27	.15	1.75	.46	61	.47
Harbor Island, 3400 13th Ave SW, Seattle, Wa	.15	.03	.13	.36	.11	.28	.13	.12	.14				44	.16
South Park, 723 S Concord St, Seattle, Wa	.07	.02	.06	.07	.07	.06	.07	.05	.05				46	.06
SW 283rd & 101st Ave SW, Maury Island, Wa	.03	.03	.02	.02	.02	.01	.01	.02	.01				46	.02
Ruston School, 5219 N Shirley St, Tacoma, Wa	.05	.04	.03	.03	.03	.03	.03	.03	.03	.04	.04	.03	61	.03
North 26th & Pearl Sts, Tacoma, Wa	.06	.04	.03	.02	.05	.02	.02	.02	.02				46	.03

Location	Quarterly Arithmetic Averages			
	1st	2nd	3rd	4th
North 98th St & Stone Ave N, Seattle, Wa	.04	.04	.03	.05
Marshall School, 520 NE Ravenna, Seattle, Wa	.11			
5701 8th Ave NE, Seattle, Wa	.10	.08	.06	
Harbor Island, 2555 13th Ave SW, Seattle, Wa	.61	.30	.18	.79
Harbor Island, 3400 13th Ave SW, Seattle, Wa	.10	.25	.13	
South Park, 723 S Concord St, Seattle, Wa	.05	.07	.06	
SW 283rd & 101st Ave SW, Maury Island, Wa	.03	.02	.01	
Ruston School, 5219 N Shirley St, Tacoma, Wa	.04	.03	.03	.04
North 26th & Pearl Sts, Tacoma, Wa	.04	.03	.02	

ARSENIC

Under the federal Clean Air Act the U.S. EPA has designated inorganic arsenic as a hazardous air pollutant. The principal source of arsenic in the Puget Sound area is the closed Tacoma Smelter site at Ruston. Smelting ceased in March, 1985 and arsenic processing ended in January, 1986. Site dismantling and reclamation followed under U. S. EPA supervision.

The Washington Department of Ecology has set community exposure standards for arsenic as follows:

Maximum 24 hour concentration -
2.0 micrograms per cubic meter

Maximum annual arithmetic mean -
0.3 micrograms per cubic meter

Arsenic sampling for 1988 is summarized below. The Ruston School is across the street just west of the Tacoma Smelter site. Arsenic levels no longer show values exceeding the exposure standards. As a result, all arsenic measurements except those at the Ruston School ended on September 30, 1988.

ARSENIC
Micrograms per Standard Cubic Meter

Sampled by Standard High Volume Quartz Fiber filters

1988

Location	Monthly Arithmetic Averages												No. Obs.	Year Arith Mean	
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
SW 283rd & 101st Ave SW, Maury Island, Wa	.02	.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01				46	.01
Ruston School, 5219 N Shirley St, Tacoma, Wa	.06	.04	.01	.01	.01	.02	.01	.02	.02	.01	.01	.01		61	.02
North 26th & Pearl Sts, Tacoma, Wa	.01	.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01	<.01				46	<.01

Yearly arithmetic mean calculated using .0025 as a substitute for each <.01 value.

Location	Summary of Individual 24 Hour Average Arsenic Values			
	Highest Value		Values Higher than .50	
	Value	Date	Value	Date
SW 283rd & 101st Ave SW, Maury Island, Wa	.07	22 Jan		
Ruston School, 5219 N Shirley St, Tacoma, Wa	.20	3 Feb		
North 26th & Pearl Sts, Tacoma, Wa	.02	4 Jan		

OZONE

Introduction

The principal oxidant found in photochemical smog is ozone, a very reactive form of oxygen. Most photochemical oxidants result from sunlight driven chemical reactions in the ambient air between nitrogen oxides and volatile organic compounds (VOC). The highest ozone levels occur on hot summer afternoons since this is the period of most intense radiant energy from the sunlight. However, even with strong sunlight, ozone levels would be low without the precursor nitrogen oxide and VOC pollutants emitted from human activities.

On any given day the photochemical reactions proceed for several hours and generally produce maximum ozone levels between noon and early evening at locations several miles away from the sources of nitrogen oxides and VOC. Each day after nightfall the high ozone levels diminish because the photochemical effect ends. However, the photochemical smog is such a complex mixture that significant ozone levels sometimes continue for hours into the night.

In the Puget Sound area the highest ozone levels occur from mid May to mid September on the few days favorable for significant photochemical activity. These high values develop when urban area emissions are trapped beneath a nighttime and morning temperature inversion followed during the day by very high temperatures. Light northerly winds often develop on these hot days. As a result, the highest ozone values normally occur south to southeast of the major cities or source areas.

Ozone Standard and Summary of Data

The U. S. EPA has set the level of the ozone standard at a value of 0.12 ppm. The federal regulation says the standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is equal to or less than one.

If an "exceedance" means a day on which the maximum 1 hour average is higher than 0.12 ppm, the standard is attained when the expected number of exceedances is equal to or less than one. If no data are missing, the expected number of exceedances is the average number of measured exceedances per year at a particular location for the last three years.

When some data for a given year are missing, the number of exceedances in that year must be adjusted to estimate the true number. The estimate is calculated using the number of measured exceedances, the number of required monitoring days, the number of days with a measured maximum value and the number of days determined to be less than the level of the standard.

For each year the estimated number of exceedances is always equal to or greater than the measured number of exceedances. For stations where no exceedances are measured, the estimate is zero. The expected number of exceedances is then the average of the annual estimates for the last three years.

The 1988 ozone summary table on the following page lists the four highest daily maximum 1 hour averages for each monitoring location. For the three year period ending with 1988, the average number of ozone exceedances is less than 1.0 for all locations. On January 2, 1987, the U. S. EPA formally designated the Puget Sound Region as in attainment of the ozone standard.

Pollutant Standards Index

A one hour average ozone level of 0.12 ppm is equivalent to 100 on the Pollutant Standards Index scale. Since the high ozone levels occur some distance downwind of major cities, ozone never determines the Index for Everett, Seattle or Tacoma, but may occasionally cause unhealthy air quality for outlying locations such as Lake Sammamish, Enumclaw or Graham.

OZONE
(Parts per Million)
1988

Location / Continuous Sampling Period(s)	Four Highest Daily Maximum 1 Hour Averages			Estimated No. of Days Daily Maximum 1 Hour Average Exceeded .12 ppm			No. of Days Daily Maximum 1 Hour Average Expected To Exceed .12 ppm
	Value	Date	End Time	1986	1987	1988	
Snohomish FD #22, 9921 84th NE, Arlington, Wa* 1 Apr-11 May; 25 May-26 Sep	.09	14 Sep	1600	0.0	0.0	0.0	0.0
	.08	3 Sep	1500				
	.07	21 Jun	1200				
	.07	20 Jul	1400				
20050 SE 56th, Lake Sammamish State Park, Wa* 1 Mar-19 Mar; 1 Apr-31 Oct	.14	3 Sep	1600	1.0	0.0	1.0	0.7
	.11	2 Sep	1500				
	.10	20 Jul	1400				
	.08	15 Jun	1600				
Highway 410, 2 miles east of Enumclaw, Wa* 18 May-7 Jun; 27 Jun-30 Jun; 16 Jul-17 Jul; 29 Jul-31 Jul; 8 Sep-30 Oct	.11	21 May	1900	0.0	1.5	0.0	0.5
	.08	14 Sep	1500				
	.06	13 Sep	1600				
	.06	2 Oct	1600				
Sumner Jr HS, 1508 Willow St, Sumner, Wa 1 Apr-23 Jul; 5 Aug-31 Oct	.11	3 Sep	1400	0.0	0.0	0.0	0.0
	.10	21 May	1700				
	.10	2 Sep	1700				
	.08	19 Jul	1400				
Pierce Co Fire D #21, 8102 304th, Graham, Wa* 13 Apr-20 Oct	.11	20 Jul	1300	0.0	0.0	0.0	0.0
	.11	3 Sep	1400				
	.10	19 Jul	1600				
	.10	2 Sep	1600				
Charles L Pack Forest, La Grande, Wa* 14 Apr-19 Apr; 1 May-6 Nov	.11	2 Sep	1400	1.1	0.0	0.0	0.4
	.11	3 Sep	1600				
	.10	21 May	1700				
	.10	19 Jul	1700				
Mount Rainier National Park, Longmire, Wa* 28 May-9 Jul; 29 Jul-6 Nov	.11	3 Sep	1700	0.0	0.0	0.0	0.0
	.09	8 Jul	1700				
	.09	4 Aug	1800				
	.08	29 Jul	1700				

Notes

- (1) * Station operated by the Washington State Department of Ecology.
- (2) Ending times are reported in Pacific Standard Time.
- (3) For equal concentration values the date and time refer to the earliest occurrences.
- (4) Continuous sampling periods are those with fewer than 10 consecutive days of missing data.
- (5) At all stations ozone was measured using the continuous ultraviolet photometric detection method.

SULFUR DIOXIDE

Sulfur dioxide is a common air pollutant for which standards have been established nation-wide. A summary of the national, state and local sulfur dioxide standards appears on page 50. Sulfur dioxide enters the air mainly from industrial processes and from the combustion of sulfur-containing fuels such as coal and oil. In the Puget Sound area, the four main industrial areas with sulfur dioxide point sources

are the Everett Port area, Seattle Harbor Island-Duwamish Valley area, Tacoma Port area and the Bremerton Naval Shipyard. In the air, reactions occur to partially convert sulfur dioxide to other sulfur compounds such as sulfuric acid and various sulfate salts. Local sulfur dioxide standards have been in effect since 1968. The tables below summarize sulfur dioxide data collected during 1988.

SULFUR DIOXIDE
(Parts per Million)
1988

Location	Monthly Arithmetic Averages												No. of 1 Hour Samples	Year Arith Mean
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Medical-Dental Bldg, 2730 Colby, Everett, Wa	.008	.009		.009	.009	.013	.013	.011	.010	.007	.005	.006	8452	.009
Duwamish, 4752 E Marginal Way S, Seattle, Wa	.007	.012	.010	.008	.009	.007	.007	.006	.007	.007	.006	.010	8691	.008
27th St NE & 54th Ave NE, Northeast Tacoma, Wa	.011	.009	.008	.006	.007		.007	.008	.009	.009		.011	7744	.008
2301 Alexander Ave, Tacoma, Wa	.010	.008	.007	.006	.005	.005	.007	.006	.008	.007		.007	8204	.007
North 26th & Pearl Sts, Tacoma, Wa	.007	.006	.005	.004	.003	.003	.003	.003	.004				6051	.004

Summary of Maximum and Second Highest Concentrations
for Various Averaging Periods

Location / Continuous Sampling Period(s)	5 Minute Average			1 Hour Average			3 Hour Average			24 Hour Average		
	Value	Date	End Time	Value	Date	End Time	Value	Date	End Time	Value	Date	End Time
Medical-Dental Bldg, 2730 Colby, Everett, Wa 1 Jan-31 Dec				.13	14 Jul	1900	.083	9 Apr	1800	.035	11 Apr	1500
				.13	22 Aug	1000	.083	10 Apr	1900	.034	23 Jun	1700
Duwamish, 4752 E Marginal Way S, Seattle, Wa 1 Jan-31 Dec				.13	7 Feb	1500	.097	7 Feb	1500	.044	15 Feb	2000
				.13	15 Feb	0600	.097	15 Feb	0600	.029	2 Dec	0200
27th St NE & 54th Ave NE, Northeast Tacoma, Wa 1 Jan-2 Jun; 23 Jun-15 Nov; 30 Nov-31 Dec				.14	24 Feb	0600	.107	24 Feb	0800	.040	27 Jan	2200
				.12	14 Sep	0400	.083	13 Sep	1000	.039	4 Dec	1200
2301 Alexander Ave, Tacoma, Wa 1 Jan-19 Nov; 5 Dec-31 Dec				.10	16 Jul	0800	.073	16 Jul	1000	.024	25 Feb	0100
				.10	16 Jul	0900	.067	15 May	1000	.023	22 Jan	1000
North 26th & Pearl Sts, Tacoma, Wa 1 Jan-30 Sep				.05	12 Mar	0400	.037	12 Mar	0500	.019	27 Jan	2000
				.04	27 Jan	0400	.030	27 Jan	0600	.014	26 Jan	1800

Notes

- (1) 5 minute average reported only for concentrations exceeding 1.00 ppm.
- (2) Ending times are reported in Pacific Standard Time.
- (3) For equal concentration values the date and time refer to the earliest occurrences.
- (4) Continuous sampling periods are those with fewer than 10 consecutive days of missing data.
- (5) At all stations sulfur dioxide was measured using the continuous ultraviolet fluorescence method.

CARBON MONOXIDE

Introduction

As a group, motor vehicles emit more carbon monoxide than any other source. For Puget Sound area cities, motor vehicles are the principal source of carbon monoxide causing the ambient levels to exceed air quality standards. The occasions with high ambient levels of carbon monoxide occur mainly during autumn and winter months. The highest levels are measured in the vicinity of congested motor vehicle traffic present during late afternoon commuting and around shopping centers particularly during holiday shopping. A contributing factor during some periods when levels are high is the existence of stable weather and light wind, thus temporarily reducing the means to disperse carbon monoxide emitted into the air.

Pollutant Standards Index and Washington State Episode Levels

The level of the 8 hour average standard is 9 parts per million (ppm), and this is equivalent to 100 on the Pollutant Standards Index scale. PSI values exceeding 100 are termed "Unhealthful". An 8 hour average of 15 ppm equals 200 on the PSI scale. Pollutant Standards Index values of 200 to 299 are described as "Very Unhealthful".

Episode criteria are specified in the Washington Episode Plan (Washington Administrative Code 173-435). The Alert stage is reached when the ambient carbon monoxide concentration reaches 15 ppm for an 8 hour average, and meteorological conditions are such that the carbon monoxide concentration can be expected to remain at or above that level for 12 or more hours, or to recur unless control actions are taken. Correspondingly, the carbon monoxide concentration for the Warning stage is 30 ppm for an 8 hour average, and for the Emergency stage is 40 ppm for an 8 hour average.

Summary of 1988 Data

The tables on the next two pages summarize the six highest 1 hour and

8 hour average carbon monoxide levels at each station during 1988. These data were obtained from Department of Ecology data summaries.

Measurements at five stations exceeded an 8 hour average of 9 ppm at least twice. Therefore, all of these five stations, one located in Everett, two located in Seattle, and two located in Tacoma, violated the 8 hour average standard. Further, because there were four cases in 1987 exceeding the level of the standard at the Bellevue station, this location also continues in violation of the standard.

Multi-Year Summary

A multi-year summary following the 1988 tables presents data and column graphs to show the long term historical trend. For the longest term sampling sites in the cities of Seattle, Everett, Bellevue, and Tacoma, the summary charts show by year the number of days on which the 8 hour average exceeded 9 ppm. The bottom row lists the value which was the 2nd high 8 hour average for each year.

The first complete year of carbon monoxide data for one Seattle station was 1972. The results at this station have improved from over 100 days exceeding the primary standard in 1972 and 1973, to none exceeding the standard in 1987-88. Two other Seattle stations which began in 1978 confirm the same trend.

The data acquired since 1979 shows the decrease (improvement) in carbon monoxide values has leveled off. To show the standard has been attained for any station, the U. S. EPA requires that the number of cases exceeding the standard averaged over a two year period not exceed one per year.

The significant improvement from levels in the mid 1970's is due mainly to the federal emission standards for new motor vehicles and to the program requiring an annual test of vehicle emissions to assure compliance with these standards.

CARBON MONOXIDE
(Parts per Million)
1988

Location / Continuous Sampling Period(s)	Six Highest Concentrations						Number of 8 Hour Averages Exceeding 9 ppm	Number of Days 8 Hour Average Exceeded 9 ppm
	1 Hour Average			8 Hour Average				
	Value	Date	End Time	Value	Date	End Time		
Broadway & Hewitt Ave, Everett, Wa 1 Jan-31 Dec	19	3 Jan	1800	11	13 Sep	1700	8	8
	18	3 Jan	1900	11	14 Sep	1700		
	17	5 Jan	2000	11	27 Dec	2200		
	17	27 Dec	1900	10	1 Sep	1700		
	15	5 Jan	1900	10	12 Sep	1700		
	15	1 Sep	1600	10	21 Sep	1800		
622 Bellevue Way NE, Bellevue, Wa 1 Jan-31 Dec	15	27 Jan	2000	11	1 Dec	0100	1	1
	13	27 Jan	1800	9	27 Jan	2100		
	12	30 Nov	1900	9	3 Dec	2300		
	12	30 Nov	2000	8	24 Feb	2400		
	12	30 Nov	2200	8	1 Dec	2000		
	12	1 Dec	1800	7	25 Jan	2300		
Northgate, 310 NE Northgate Way, Seattle, Wa 1 Jan-31 Dec	15	25 Jan	0900	10	30 Nov	2000	2	2
	14	30 Nov	1800	10	3 Dec	2400		
	13	25 Jan	0800	9	25 Jan	1200		
	13	25 Jan	1000	8	18 Jan	2100		
	13	30 Nov	1900	8	1 Dec	1100		
	13	3 Dec	2100	8	17 Dec	2000		
4511 University Way NE, Seattle, Wa 1 Jan-31 Dec	17	28 Oct	2100	12	4 Dec	0100	3	3
	15	28 Oct	2000	10	28 Oct	2200		
	15	3 Dec	1900	10	30 Nov	2400		
	15	3 Dec	2000	8	23 Feb	2300		
	14	3 Dec	2100	8	24 Feb	2200		
	13	23 Feb	2100	8	18 Mar	2400		
1960 NE Pacific Ave, Seattle, Wa 1 Jan-2 Jun; 13 Jul-31 Dec	12	30 Nov	2100	10	30 Nov	2300	1	1
	11	30 Nov	1800	8	25 Feb	0200		
	11	30 Nov	2000	8	3 Dec	2300		
	11	30 Nov	2200	7	21 Jan	2400		
	11	3 Dec	2200	7	27 Jan	1900		
	10	24 Feb	2200	7	28 Oct	2300		
1424 4th Ave, Seattle, Wa 1 Jan-9 Mar; 28 Mar-31Mar; 21 Apr-22 Aug; 7 Sep-31 Dec	11	7 Jan	1800	8	4 Dec	0300	0	0
	11	25 Jan	1800	8	16 Dec	1700		
	11	30 Nov	1900	7	30 Nov	2100		
	11	30 Nov	2000	7	2 Dec	1800		
	11	4 Dec	0300	6	7 Jan	1700		
	10	2 Dec	1800	6	8 Jan	1800		

Notes

- (1) Ending times are reported in Pacific Standard Time.
- (2) For equal concentration values the date and time refer to the earliest occurrences.
- (3) Continuous sampling periods are those with fewer than 10 consecutive days of missing data.
- (4) At all stations carbon monoxide was measured using the continuous nondispersive infrared method.

CARBON MONOXIDE
(Parts per Million)
1988

Location / Continuous Sampling Period(s)	Six Highest Concentrations						Number of 8 Hour Averages Exceeding 9 ppm	Number of Days 8 Hour Average Exceeded 9 ppm
	1 Hour Average			8 Hour Average				
	Value	Date	End Time	Value	Date	End Time		
5th Ave & James St, Seattle, Wa 1 Jan-31 May; 1 Jul-31 Dec	13	30 Nov	1800	8	30 Nov	2100	0	0
	12	30 Nov	1900	8	4 Dec	0400		
	11	18 Mar	1800	7	23 Feb	2100		
	11	3 Dec	2400	6	4 Feb	1400		
	10	17 Feb	1700	6	24 Feb	1300		
	10	2 Sep	1600	6	24 Feb	2100		
Courthouse, 4th Ave & James St, Seattle, Wa 1 Jan-4 May; 18 May-31 Dec	13	28 Nov	1700	9	4 Dec	0400	0	0
	13	30 Nov	1900	8	30 Nov	2000		
	12	30 Oct	1700	7	25 Jan	1500		
	12	28 Nov	1600	7	28 Nov	1800		
	12	3 Dec	2400	6	27 Jan	1800		
	11	2 Sep	1500	6	24 Feb	1000		
Fire Station #10, 301 2nd Ave S, Seattle, Wa 1 Jan-31 Dec	15	3 Dec	2300	10	30 Nov	2300	1	1
	14	30 Nov	1800	9	4 Dec	0300		
	14	30 Nov	1900	6	26 Jan	2400		
	14	3 Dec	2400	6	27 Jan	1200		
	11	30 Nov	2000	6	24 Feb	0100		
	10	7 Jan	1800	6	1 Dec	0700		
942 Pacific Ave, Tacoma, Wa 1 Jan-30 Jun; 13 Jul-2 Aug; 15 Aug-30 Nov	25	27 Jan	1800	14	27 Jan	2100	3	3
	23	27 Jan	1700	13	30 Nov	2300		
	21	30 Nov	1800	10	4 Jan	1800		
	18	27 Jan	1900	9	7 Jan	1000		
	16	4 Jan	1800	9	24 Feb	2200		
	15	7 Jan	0900	8	6 Jan	2400		
1101 Pacific Ave, Tacoma, Wa 1 Jan-31 Dec	21	27 Jan	1700	12	27 Jan	2000	4	4
	17	1 Dec	1800	12	30 Nov	2400		
	17	16 Dec	1900	11	1 Dec	1800		
	16	27 Jan	1800	11	16 Dec	2000		
	16	27 Jan	1900	9	4 Jan	1800		
	16	30 Nov	1800	9	2 Sep	1600		
Burwell St & Pacific Ave, Bremerton, Wa 1 Jan-31 Dec	20	15 Apr	2200	10	17 Apr	0100	1	1
	19	22 Apr	2200	9	15 Apr	2400		
	18	16 Apr	2400	8	8 May	0100		
	18	22 Apr	2300	8	24 Jul	0200		
	18	7 May	2400	8	31 Jul	0100		
	17	16 Apr	2300	7	22 Apr	2300		

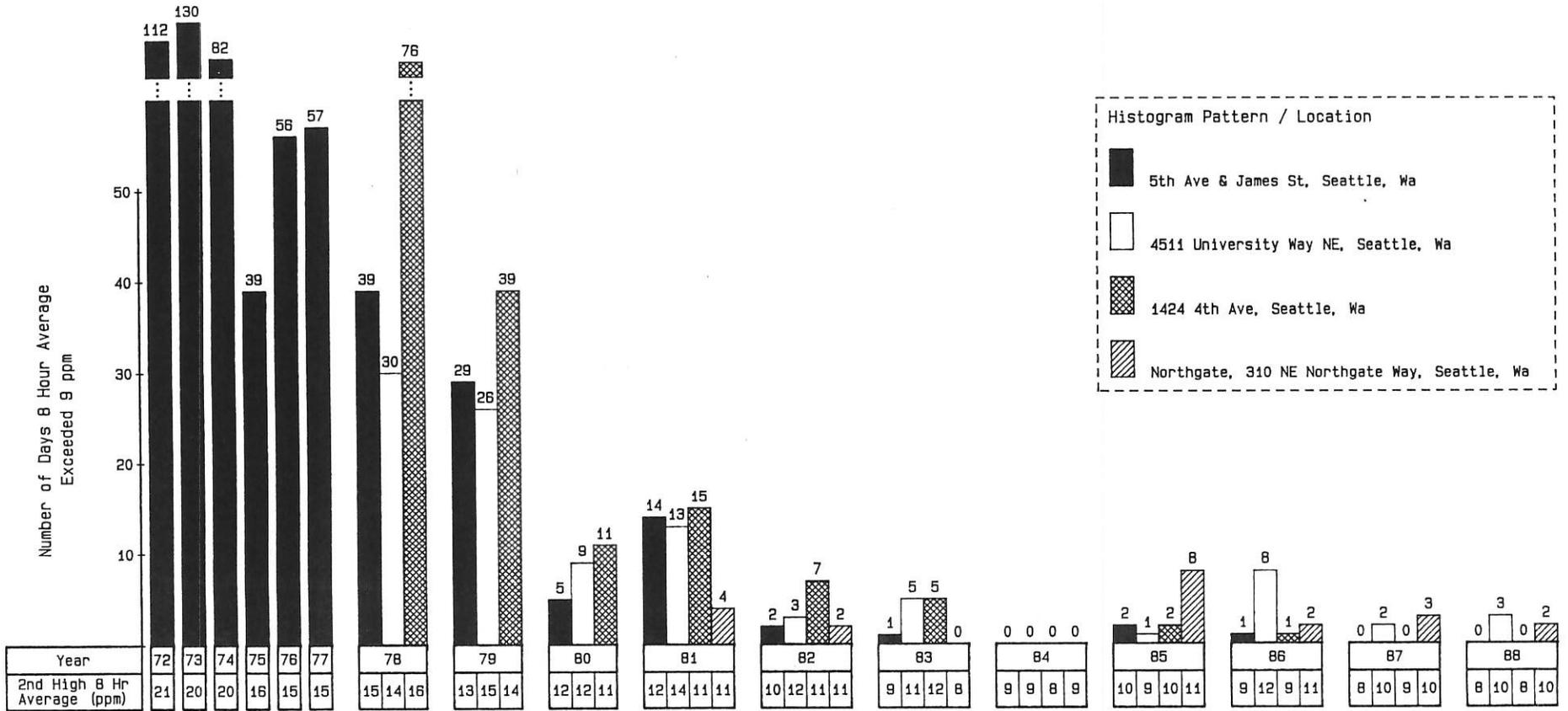
Notes

- (1) Ending times are reported in Pacific Standard Time.
- (2) For equal concentration values the date and time refer to the earliest occurrences.
- (3) Continuous sampling periods are those with fewer than 10 consecutive days of missing data.
- (4) At all stations carbon monoxide was measured using the continuous nondispersive infrared method.

CARBON MONOXIDE

Multi-Year Summary

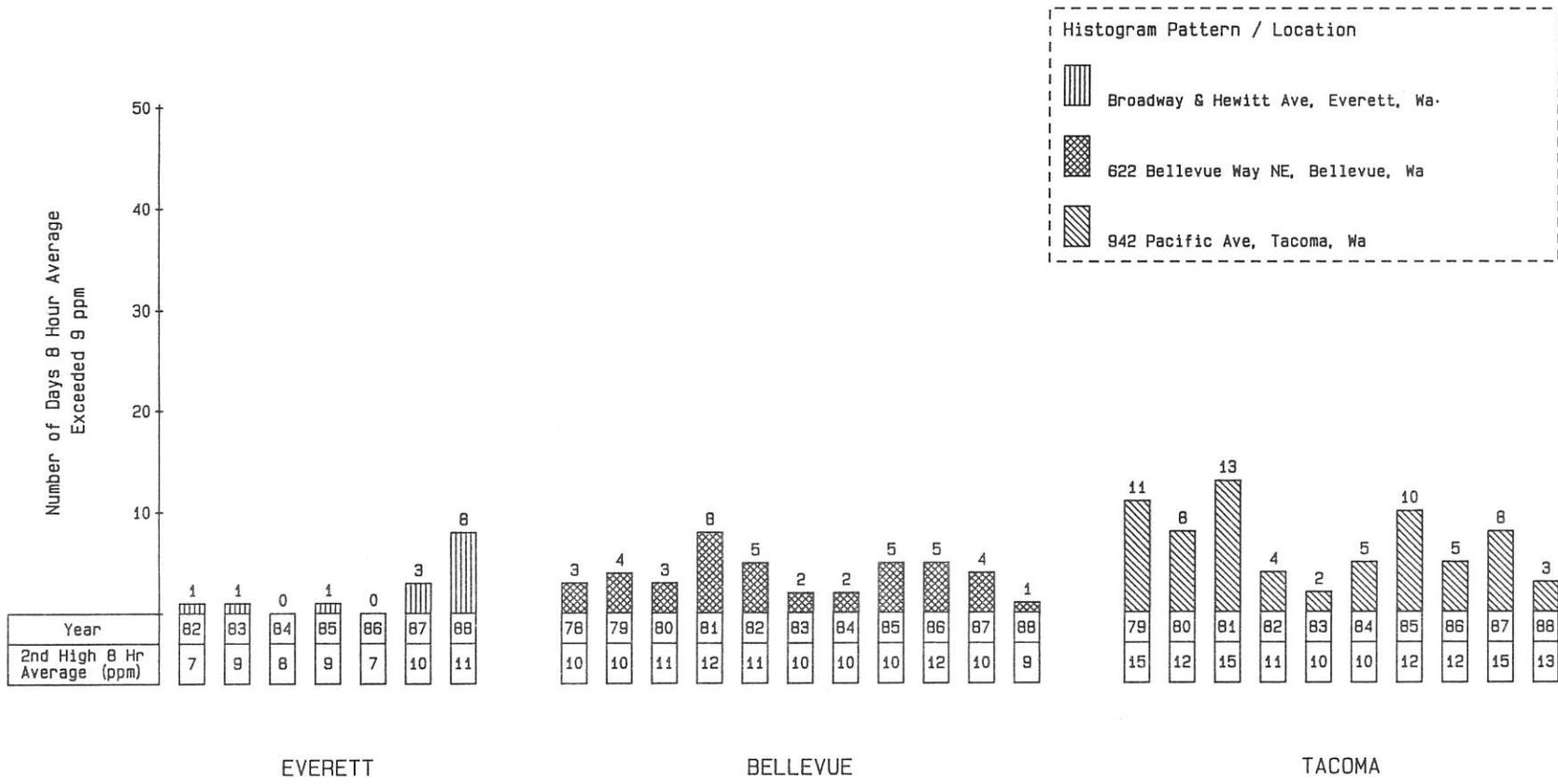
24



SEATTLE

CARBON MONOXIDE

Multi-Year Summary



QUALITY ASSURANCE

Introduction

Quality Assurance (QA) includes all activities involved with obtaining valid data and documenting the quality of the data. Quality Assurance is an integral part of all monitoring activities. Some specific QA activities are: selection of methods and analyzers; installation of equipment; calibration; zero and span checks and adjustments; control checks, limits, and corrective actions; maintenance; recording and validating data; and documentation of quality control information.

The Agency participates in audit programs conducted independently by the U.S. Environmental Protection Agency and the Washington State Department of Ecology. For the EPA, this consists of (1) on-site audits of some Agency instruments by EPA or their designated representative, and (2) Agency participation in EPA's national performance audits as they are announced. The Department of Ecology also independently selects and audits some of the Agency instruments on-site each quarter.

Precision and Accuracy Audits

The documentation for the QA program is established in Title 40, Code of Federal Regulations, Part 58, published May 10, 1979, and amended November 9, 1979, September 3, 1981, March 19, 1986, and July 1, 1987. The important QA characteristics which the regulations require to be developed and reported are precision and accuracy. In simple terms, precision means the ability to repeat a measurement of the same, known sample at a different time; accuracy means the agreement between a measurement and the true value.

Each instrument measuring a pollutant at a location must be audited for precision at least every two weeks and for accuracy at least once per year. For each audit, the percentage difference between the instrument indicated

concentration and the true concentration of the reference sample is calculated. For each calendar quarter the average and the standard deviation of these percentage differences are calculated. These two statistics are then pooled for all audits involving the same pollutant.

Probability Limits

The federal regulation requires summary of the precision and accuracy audit results by computing the 95 Percent Probability Limits for each pollutant from the weighted average percent difference, D , and the pooled standard deviation, S_a , as follows:

$$\text{Upper 95 Percent Probability Limit} = D + 1.96(S_a)$$

$$\text{Lower 95 Percent Probability Limit} = D - 1.96(S_a)$$

These upper and lower limits reflect data quality by establishing that, with 95 percent probability, the pollutant measurements during the audit period are within the limits. As an example, if the average of the percent differences is zero and the standard deviation of the percent differences is 4.1 percent, the upper and lower 95 percent probability limits are respectively +8 and -8 percent.

Agency Precision and Accuracy

For many Agency monitoring locations precision audits are performed each week and accuracy audits are completed each month or each quarter. The table following this page summarizes the precision and accuracy probability limits by quarter for all air quality data which the Agency originated in 1988. For each pollutant the type of audit (accuracy or precision) is followed by a brief phrase description of the audit method. The number of audits and the lower and upper probability limits are presented for each quarter.

DATA QUALITY ASSESSMENT
1988

Lower and Upper 95 Percent Probability Limits
of Percent Differences

Pollutant & Type of Audit	Number of Stations	Audit Results by Quarter											
		1st			2nd			3rd			4th		
		No. of Audits	Prob. Limits Lwr	Prob. Limits Upr	No. of Audits	Prob. Limits Lwr	Prob. Limits Upr	No. of Audits	Prob. Limits Lwr	Prob. Limits Upr	No. of Audits	Prob. Limits Lwr	Prob. Limits Upr
Particulate Matter (TSP, Hi-Vol)	24												
Accuracy													
Flow Rate		10	-6	+9	33	-7	+4	2	+2	+4	15	-7	+4
Precision													
Collocated Samples		41	-5	+15	42	-3	+15	42	-5	+10	38	-5	+13
Particulate Matter (PM10, SSI Hi Vol)	10												
Accuracy													
Flow Rate		29	-6	+4	52	-4	+1	29	-7	+3	63	-6	+2
Precision													
Collocated Samples		22	-7	+7	22	-8	+4	24	-4	+6	24	-8	+6
Sulfur Dioxide	5												
Accuracy													
Level 1		11	-4	+14	13	-17	+14	8	-1	+13	10	-13	+12
Level 2		11	-6	+12	13	-14	+12	8	+1	+9	10	-12	+13
Level 3		11	-6	+11	13	-15	+13	8	-3	+10	10	-14	+12
Level 4		2	-8	+9	3	-19	+15	2	+1	+2	2	-17	+13
Precision													
One point check		58	-7	+8	54	-8	+8	61	-5	+10	39	-8	+12
Ozone	1												
Accuracy													
Level 1								2	-8	+2			
Level 2								2	-6	-1			
Level 3								2	-4	-2			
Precision													
One point check					12	-3	+7	11	-3	+6	5	-6	-2
Atmospheric Particles (Nephelometer)	6												
Precision													
One point check		40	-6	+6	39	-8	+7	41	-5	+3	47	-6	+7

**AIR POLLUTION EPISODE and
IMPAIRED AIR QUALITY CONDITIONS**

Air Pollution Episodes

The Washington Clean Air Act defines air pollution episodes and the policy for establishing an avoidance plan in RCW 70.94.710 through 70.94.730. The Washington State Department of Ecology has adopted WAC 173-435 which implements an episode avoidance plan.

The "First" or "Forecast" stage of the Episode Plan may be declared by the Department of Ecology when an "Air Stagnation Advisory" is issued by the National Weather Service or there is equivalent indication of stagnant atmospheric conditions and conditions are forecast to persist for 24 hours.

Outdoor fires are prohibited during any declared stage of the Washington Episode Plan. Further, a new section added to the Washington Clean Air Act by the 1987 Legislature, RCW 70.94.473, states that any person who has an adequate source of heat without burning wood shall not burn wood in any solid fuel heating device during any declared stage of the Washington Episode Plan.

For the Puget Sound region, the year 1988 passed with no air pollution episodes declared under the Washington Episode Plan.

Impaired Air Quality Periods

Under RCW 70.94.473 and WAC 173-433, "Impaired Air Quality" means a condition declared by the Department of Ecology or an air pollution control agency whenever meteorological conditions are conducive to an accumulation of air contamination concurrent with PM₁₀ at an ambient level of 90 ug/m³ measured on a 24 hour average. (Note: TSP at a level of 125 ug/m³ for a 24 hour average or carbon monoxide at a level of 8 ppm for an 8 hour average are also included in the regulation, but these measurements are rarely used to determine "impaired air quality".)

During an "impaired air quality" condition, any person who has an adequate source of heat without burning wood shall not burn wood in any solid fuel heating device except wood stoves certified under WAC 173-433-100. The PSAPCA Board of Directors adopted regulations implementing the curtailment restrictions of WAC 173-433 and also prohibiting outdoor fires during any period of "impaired air quality".

During 1988 a condition of "impaired air quality" was in effect during the following times in the four counties of King, Kitsap, Pierce and Snohomish unless otherwise noted.

8:30 am, Monday, January 25 -

8:30 am, Thursday, January 28

4:30 pm, Friday, February 5 -

9:30 am, Saturday, February 6

2:30 pm, Thursday, December 1 -

8:00 am, Friday, December 2
(King and Pierce only)

2:30 pm, Sunday, December 4 -

2:00 pm, Monday, December 5

2:30 pm, Friday, December 16 -

2:30 pm, Saturday, December 17
(King and Pierce only)

2:30 pm, Saturday, December 17 -

2:30 pm, Sunday, December 18
(revised to add Kitsap and
Snohomish -- in effect for
all four counties)

LOWER ATMOSPHERE TEMPERATURE SOUNDINGS

The Washington State Department of Ecology operates a lower atmosphere sounding unit on the east shore of Portage Bay in Seattle. Normal operation provides one sounding to 700 millibars about 7 am local time each Monday through Friday except holidays.

This sounding provides the primary lower atmosphere data in the Puget Sound region and is an essential basis for many forecasts including the determination of air pollution episode and impaired air quality conditions. The Agency regularly uses the sounding to evaluate and interpret air quality data and also enters the sounding in a computerized data base.

Some important features may be determined from each sounding and these are important to the determination of air stagnation. Temperature increasing with height is termed a "Temperature Inversion". A temperature inversion limits the height to which pollutants are mixed or dispersed vertically. The "Mixing Depth" is the height from the surface to the temperature inversion base. The mixing depth continuously

changes in response to diurnal surface temperature changes and to other processes.

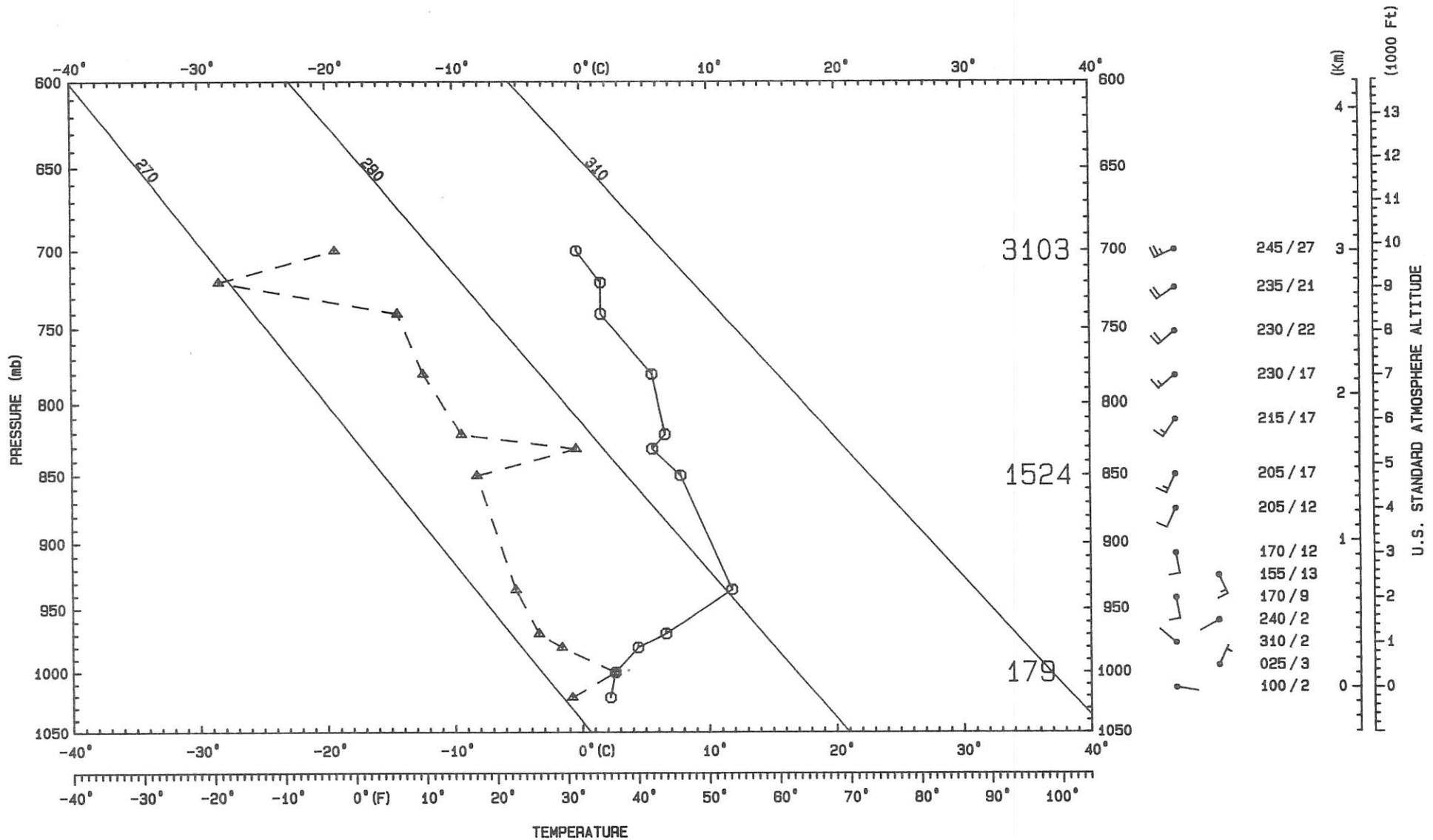
On days with no temperature inversion the mixing depth is unlimited, and this contributes to rapid pollutant dispersion and good air quality. In contrast, a temperature inversion near the surface too great in depth or too warm to be reversed during the daytime significantly restricts vertical dispersion. This stable condition is associated with higher pollutant levels.

Several soundings from 1988 are included on the following pages. These soundings all reveal stagnant conditions on days when some pollutant values exceeded the level of an ambient standard. On each sounding, temperature is represented by a solid line connecting actual circular data points. The dewpoint temperature is represented by a dashed line connecting actual triangular data points. The wind at regular altitude intervals is plotted and also printed in degrees/knots to the right of the temperature sounding.

PSEUDO-ADIABATIC CHART

0700 PST Jan 26, 1988

Portage Bay, 2725 Montlake Blvd E, Seattle, WA



3103

1524

179

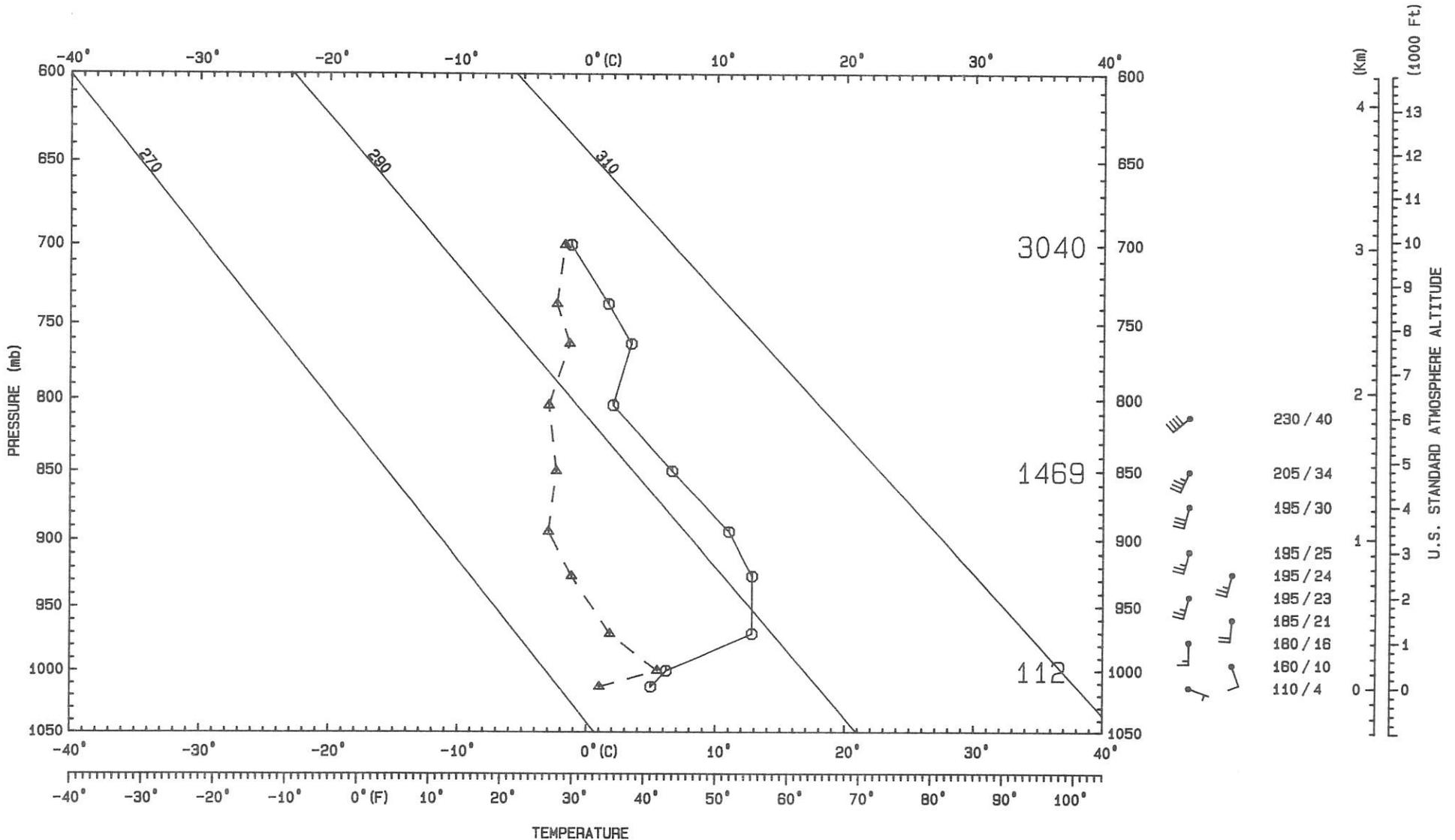
- 245 / 27
- 235 / 21
- 230 / 22
- 230 / 17
- 215 / 17
- 205 / 17
- 205 / 12
- 170 / 12
- 155 / 13
- 170 / 9
- 240 / 2
- 310 / 2
- 025 / 3
- 100 / 2

U.S. STANDARD ATMOSPHERE ALTITUDE

PSEUDO-ADIABATIC CHART

0700 PST Jan 27, 1988

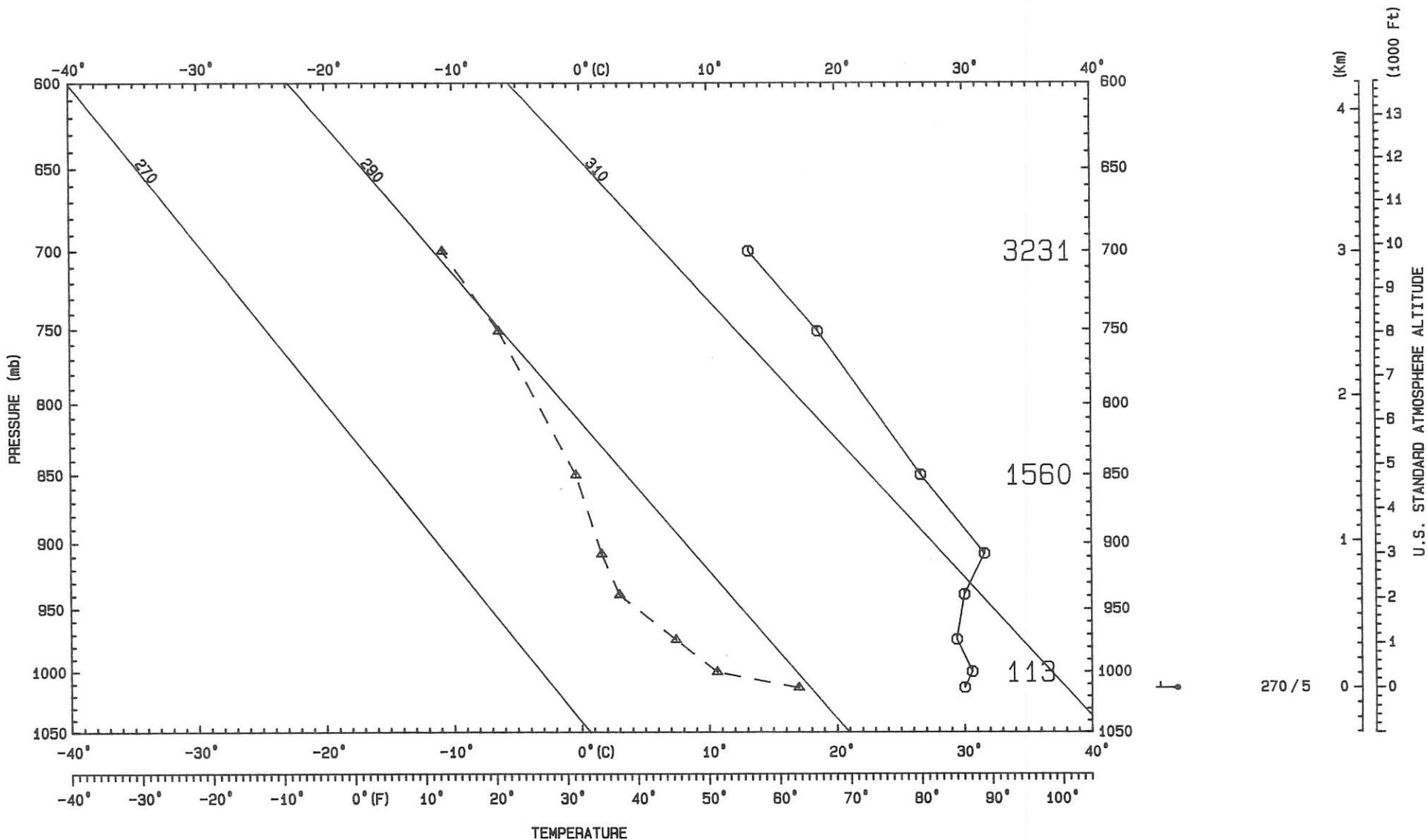
Portage Bay, 2725 Montlake Blvd E, Seattle, WA



PSEUDO-ADIABATIC CHART

1600 PST Sep 3, 1988

Portage Bay, 2725 Montlake Blvd E, Seattle, WA

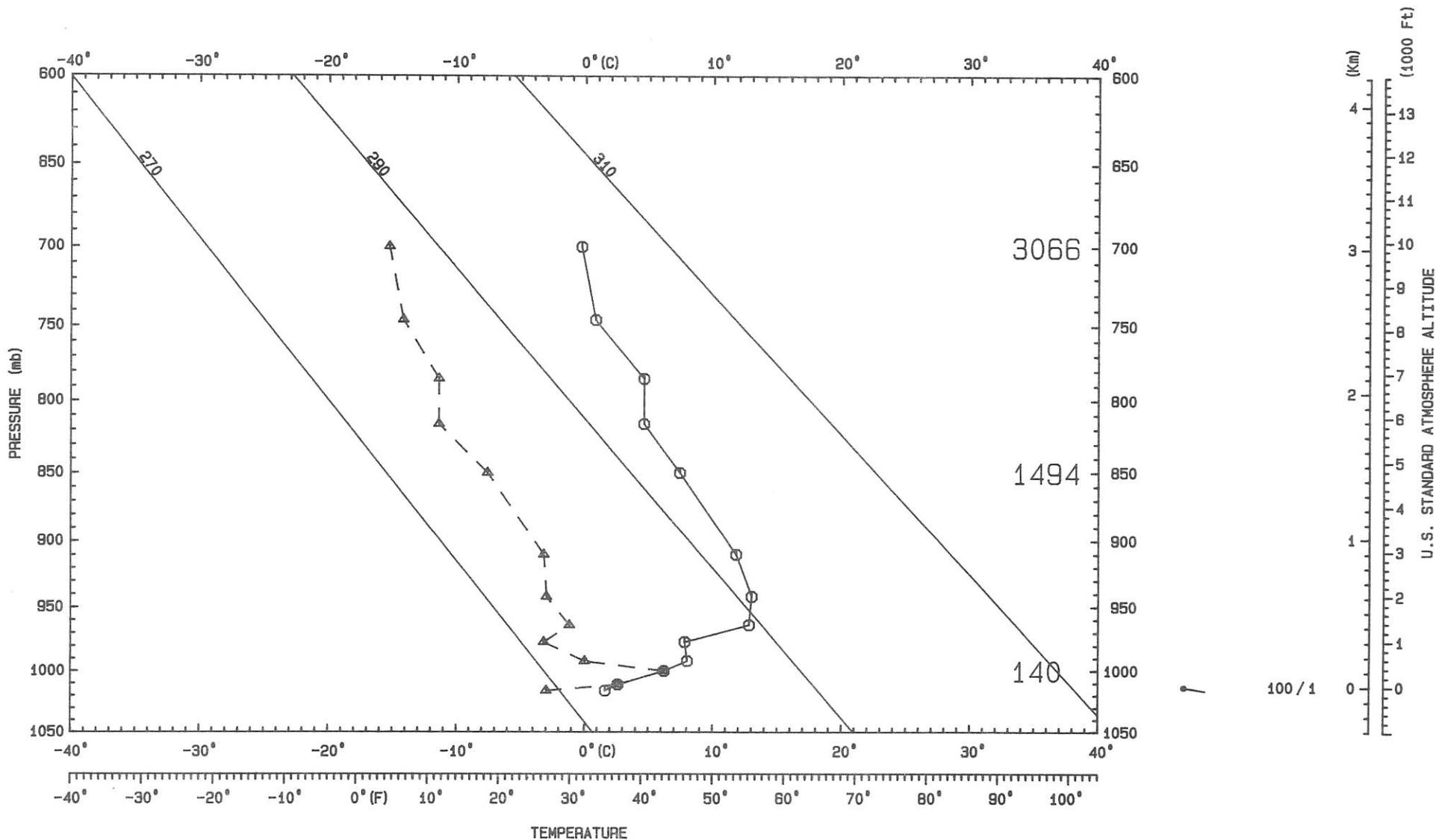


PSEUDO-ADIABATIC CHART

0700 PST Dec 1, 1988

Portage Bay, 2725 Montlake Blvd E, Seattle, WA

33



WIND ANALYSIS

Wind Data

Everyone has a qualitative sense of surface wind and some effects produced by the wind. The wind direction helps identify the sources or source areas affecting a specific location.

From an air pollution standpoint, low wind speed poorly dilutes pollutants and is therefore associated with higher air pollutant concentrations. During a stable, temperature inversion condition, the wind is often light or calm. When this condition persists, the natural process which effectively disperses pollutants is greatly diminished, and pollutant levels are higher near the source areas.

Wind Speed Averages

The table below presents monthly and annual average wind speed computed from hour average surface wind speed at wind monitoring locations. These average values are sometimes used to compare locations and different months or to provide data for calculations needing average speed values. Individual air stagnation episodes are not exposed by

this analysis unless episode conditions predominate during most of a month.

Wind Roses

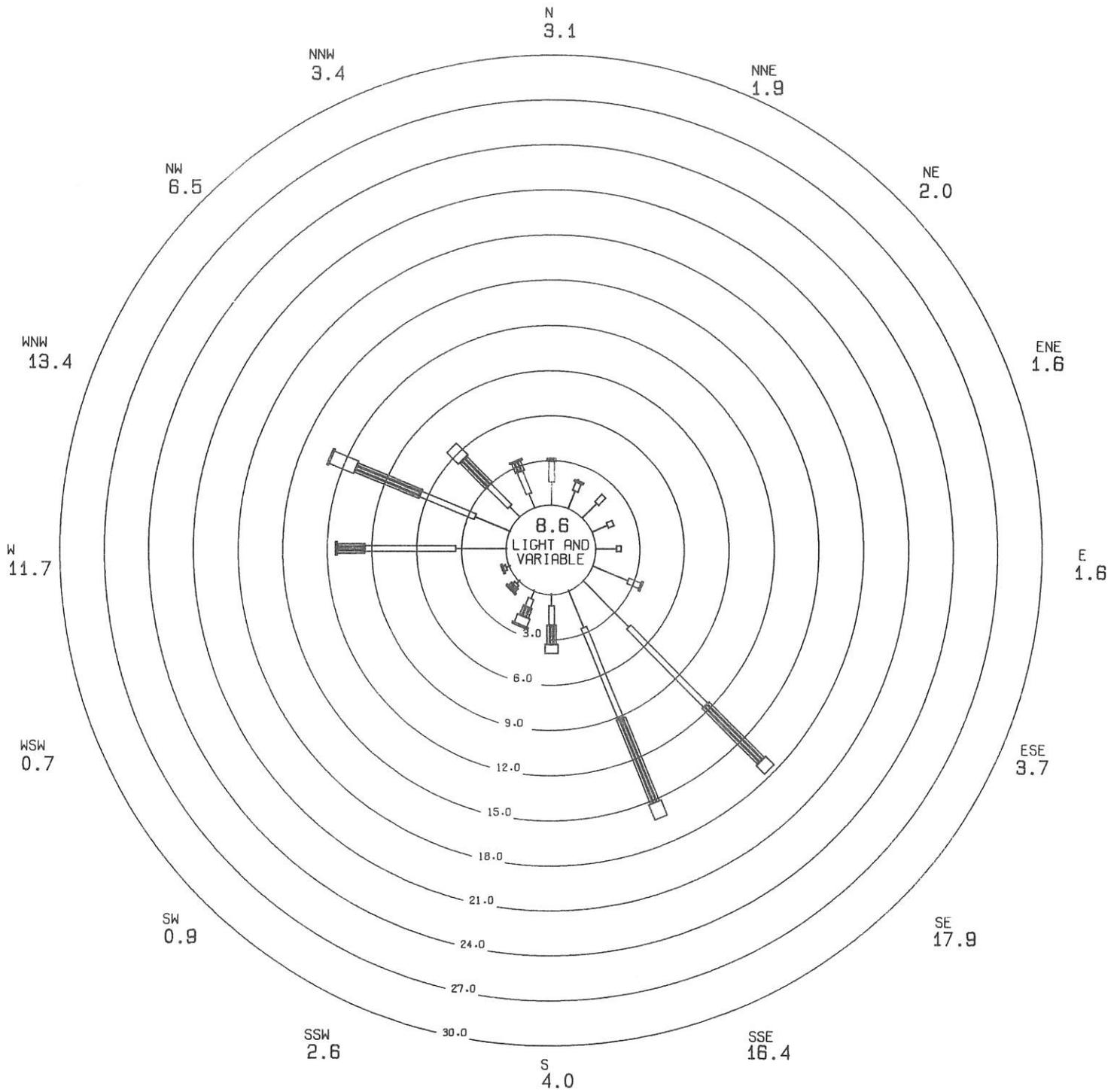
A wind rose is a quantitative graphical summary of the wind direction and speed for a given time period. It is a count, expressed on the following graphs as a percentage frequency, of the number of observations or hours which had a particular direction and speed during the summary period.

The wind rose spokes or arms represent 16 points of the compass and are labeled by wind direction. The percentage frequency of winds from a given direction (without regard to speed) is expressed numerically beneath that direction on the perimeter of each rose.

The length of each segment of a spoke represents the frequency of wind within a speed category. From this frequency and the total observations, the number of hours within each speed category may be determined. The percentage frequency of light and variable winds (winds less than 1.5 knots) is printed in the center of the rose.

WIND SPEED (Knots) 1988

Location	Monthly Arithmetic Averages												No. of 1 Hour Arith Samples	Year Mean
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Medical-Dental Bldg, 2730 Colby, Everett, Wa	5.8	5.2	6.0	5.5	6.0	6.1	6.1	4.9	4.7	4.7	6.8	5.4	8748	5.6
North 98th St & Stone Ave N, Seattle, Wa	2.6	3.0	3.5	3.4	3.5	2.9	3.0	2.5	2.3	2.2	3.6	2.6	8748	2.9
Duwamish, 4752 E Marginal Way S, Seattle, Wa	3.7	4.2	4.7	4.6	4.3	3.8	3.8	3.3	3.1	3.1	4.7	3.7	8746	3.9
James St & Central Ave, Kent, Wa	2.8	3.2	3.6	3.3	3.0	3.3	3.3	2.8	2.4	2.0	3.2		8359	2.9
Sumner Jr HS, 1508 Willow St, Sumner, Wa					2.5	2.4	2.5	2.2	2.4	1.7	3.6	2.3	6269	2.5
27th St NE & 54th Ave NE, Northeast Tacoma, Wa	2.9	3.4	3.5	3.2	2.6	2.8	2.8	2.8	2.6	2.4	3.7	3.0	8731	3.0
2301 Alexander Ave, Tacoma, Wa	3.0	3.7	4.6	4.2	4.0	4.1	3.9	3.6	3.5	2.8	4.1	3.0	8748	3.7
Fire Station #12, 2316 E 11th St, Tacoma, Wa	3.2	3.9	4.7	4.2	3.9	4.1	4.1	3.7	3.6	2.9	4.6	3.4	8738	3.9
North 26th & Pearl Sts, Tacoma, Wa	3.6	4.3	4.4	4.3	3.7	3.7	3.7	3.5	3.5				6538	3.9



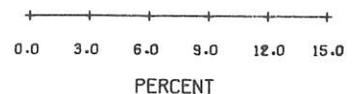
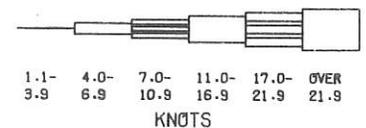
HOUR AVERAGE SURFACE WINDS

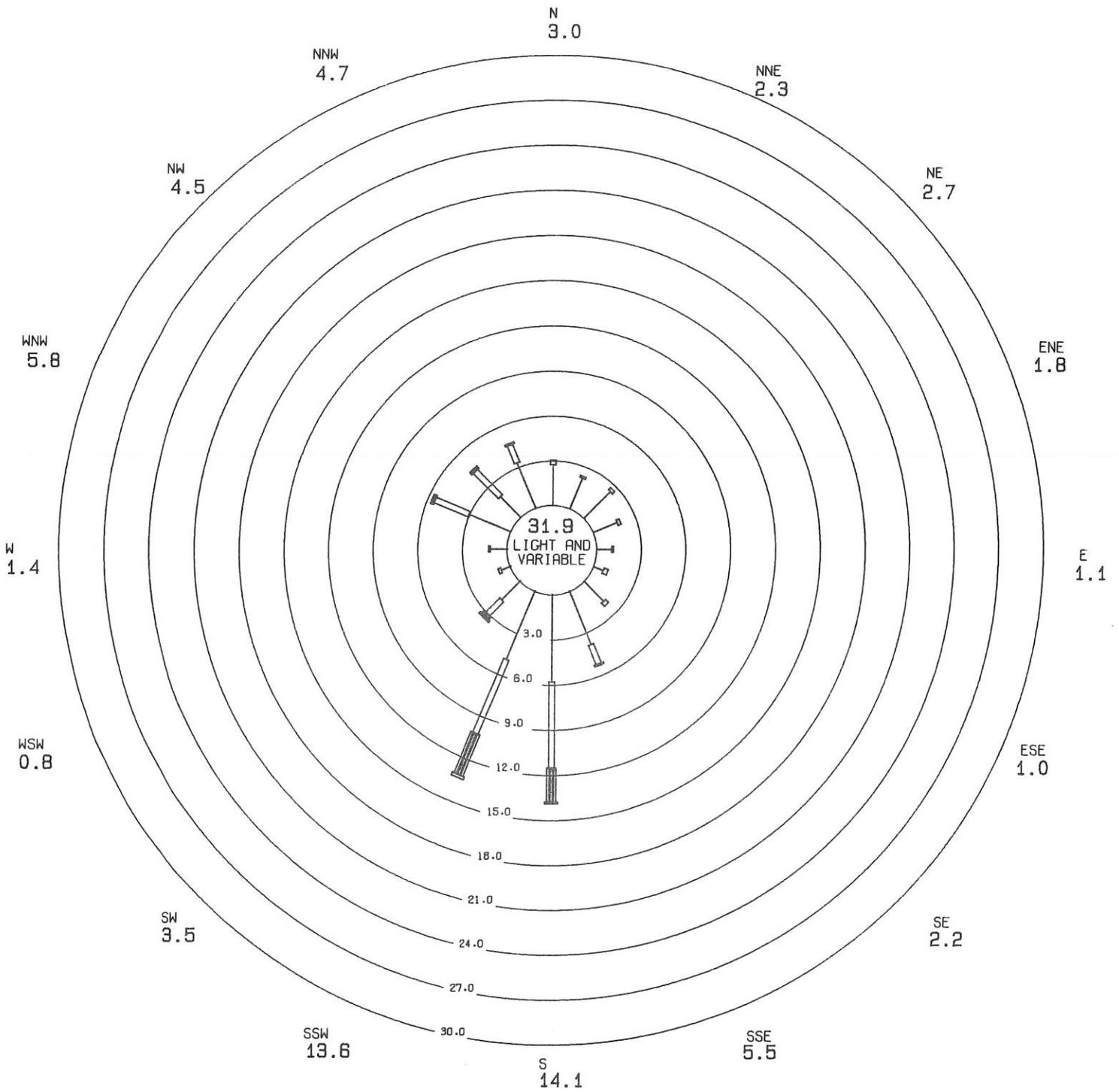
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY
Medical-Dental Bldg, 2730 Colby, Everett, Wa

INCLUSIVE DATES- ALL MONTHS 1988

TOTAL OBSERVATIONS- 8,748





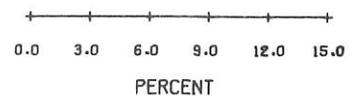
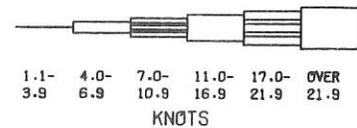
HOUR AVERAGE SURFACE WINDS

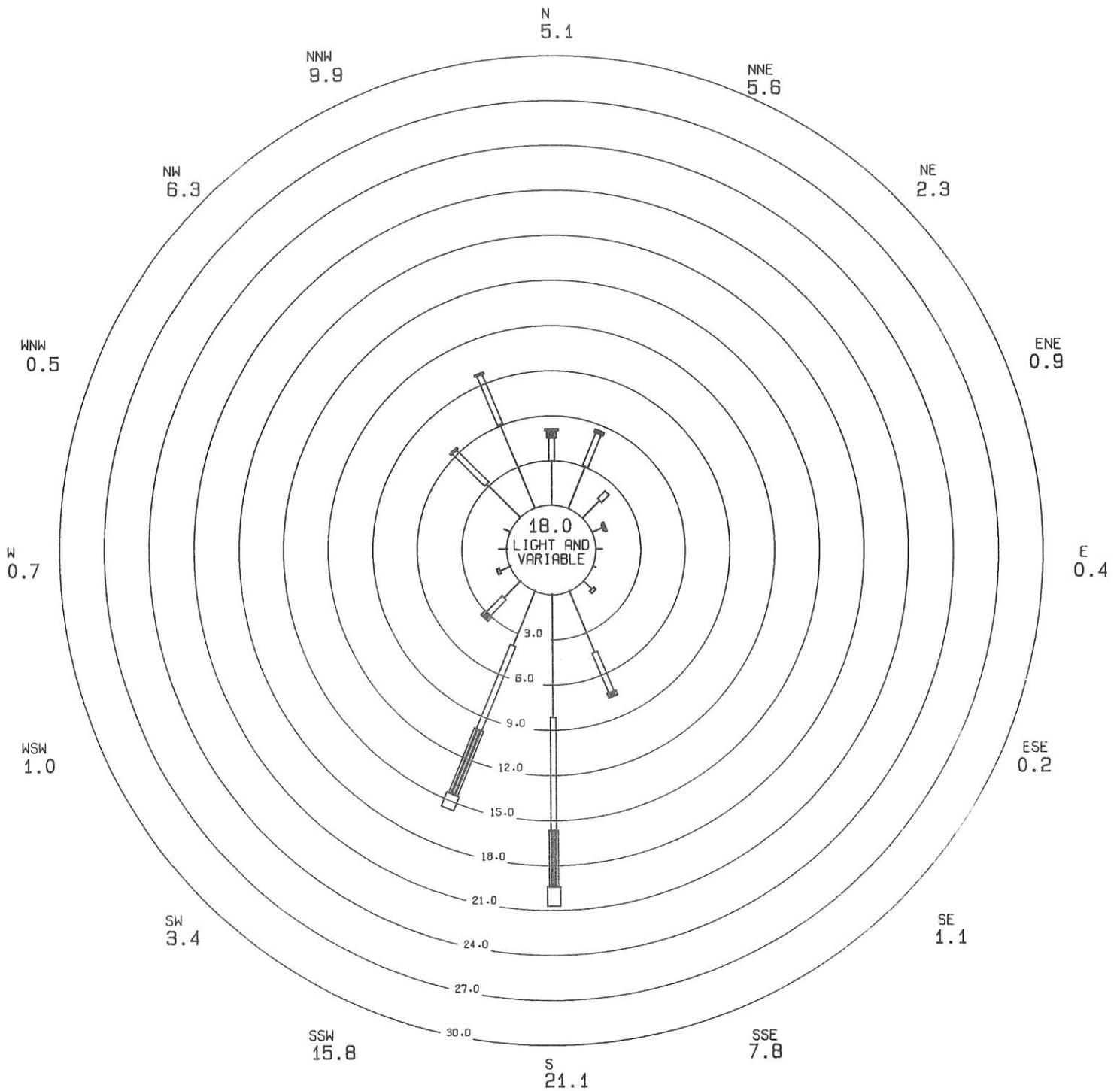
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY
North 98th St & Stone Ave N, Seattle, Wa

INCLUSIVE DATES- ALL MONTHS 1988

TOTAL OBSERVATIONS- 8,748





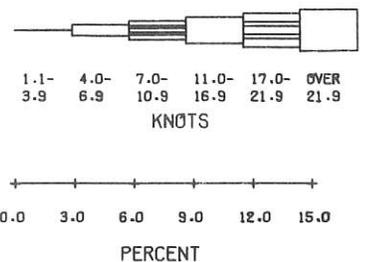
HOUR AVERAGE SURFACE WINDS

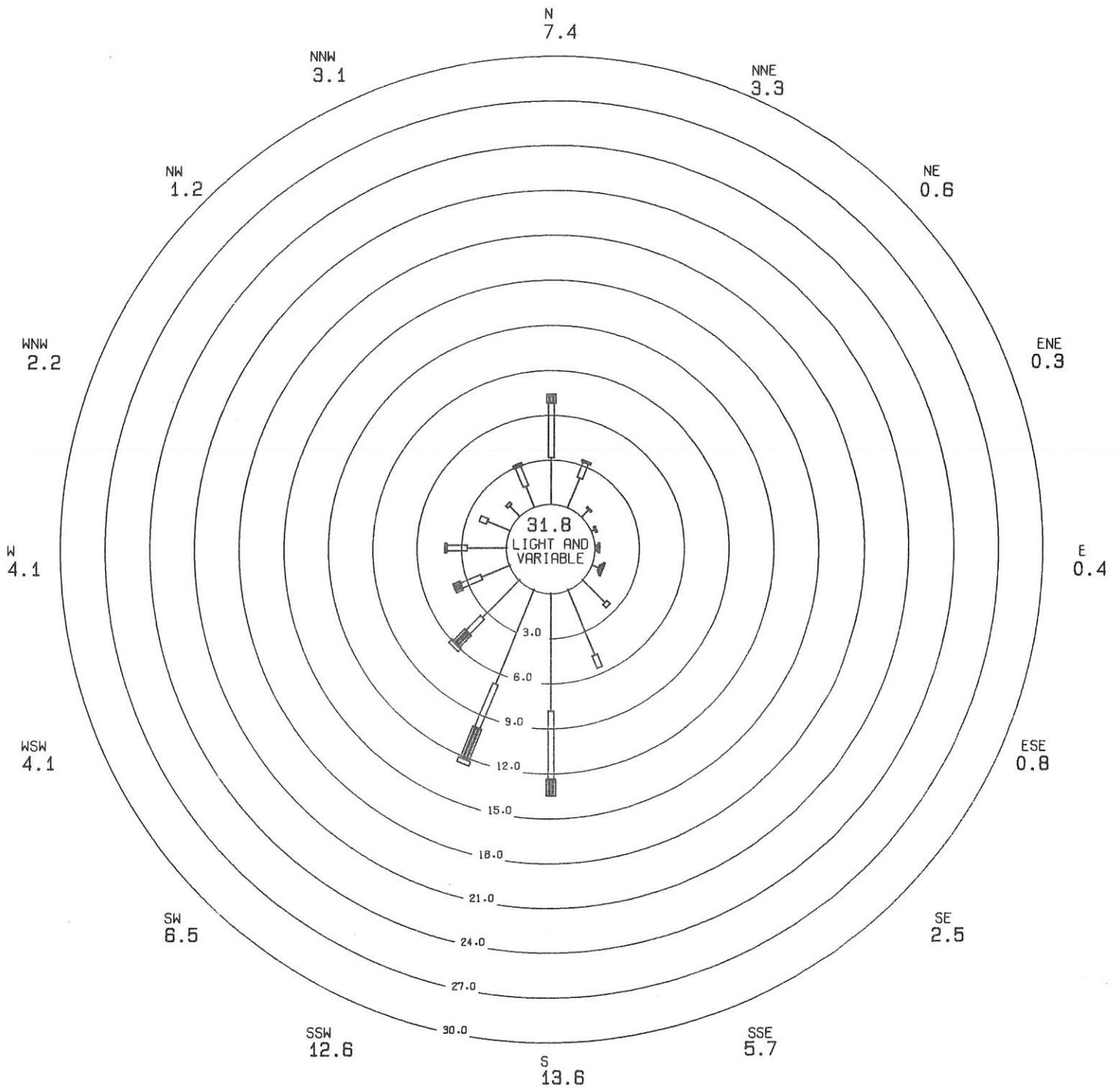
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY
Duwamish, 4752 E Marginal Way S, Seattle, Wa

INCLUSIVE DATES- ALL MONTHS 1988

TOTAL OBSERVATIONS- 8,746





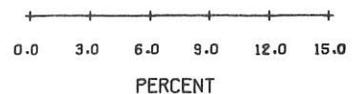
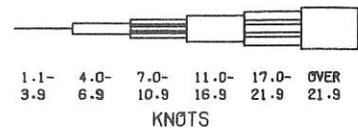
HOUR AVERAGE SURFACE WINDS

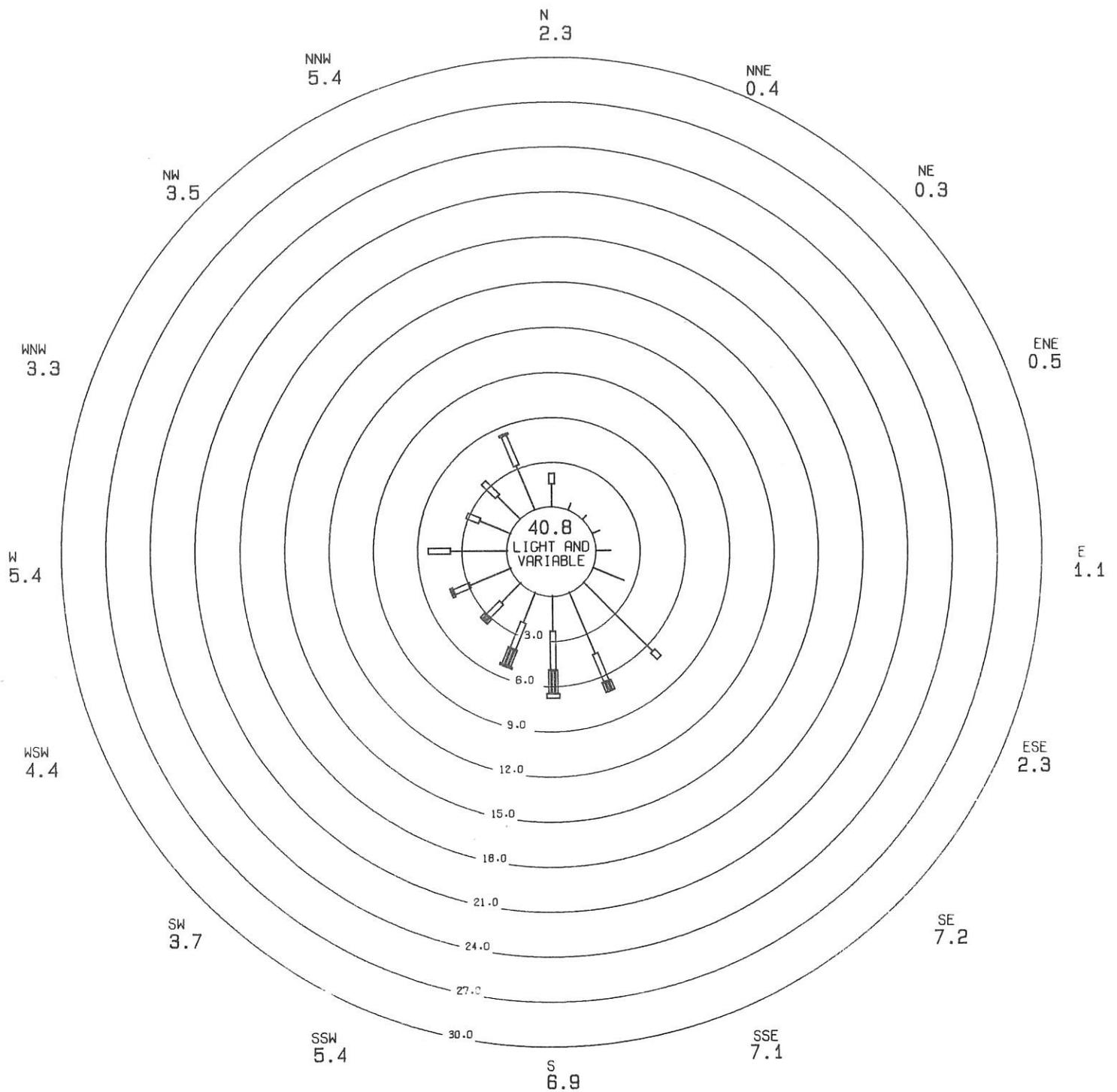
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY
James St & Central Ave, Kent, Wa

INCLUSIVE DATES- ALL MONTHS 1988

TOTAL OBSERVATIONS- 8,359





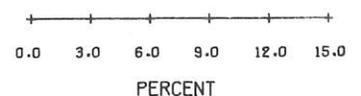
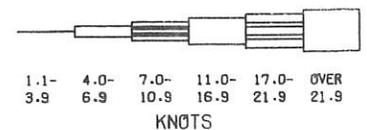
HOUR AVERAGE SURFACE WINDS

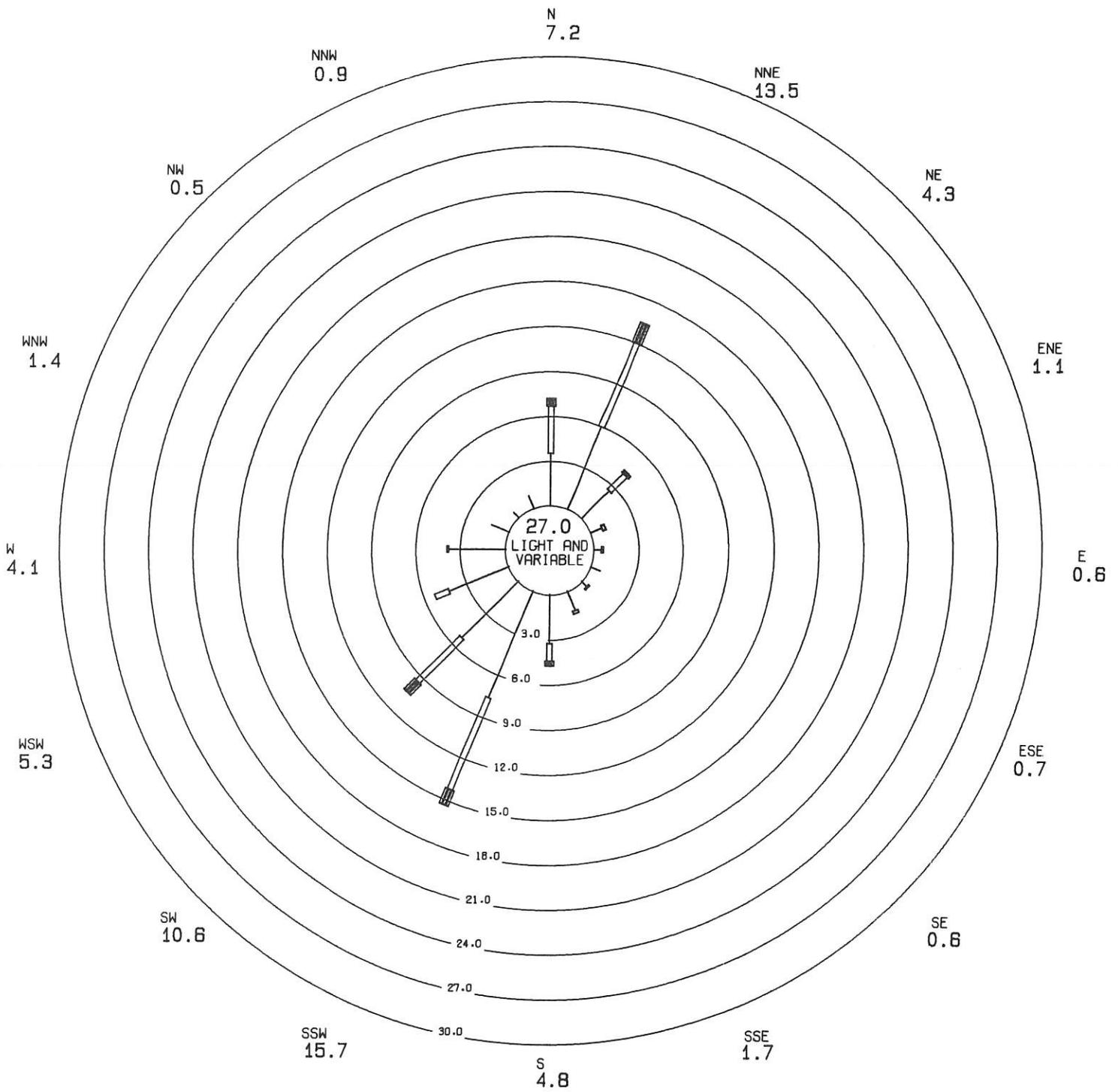
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY
 Summer Jr HS, 1508 Willow St, Sumner, Wa

INCLUSIVE DATES- APR - DEC, 1988

TOTAL OBSERVATIONS- 6,269





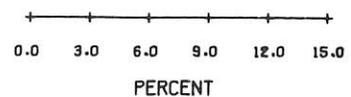
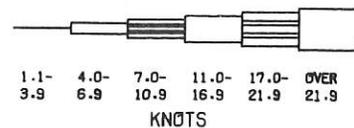
HOUR AVERAGE SURFACE WINDS

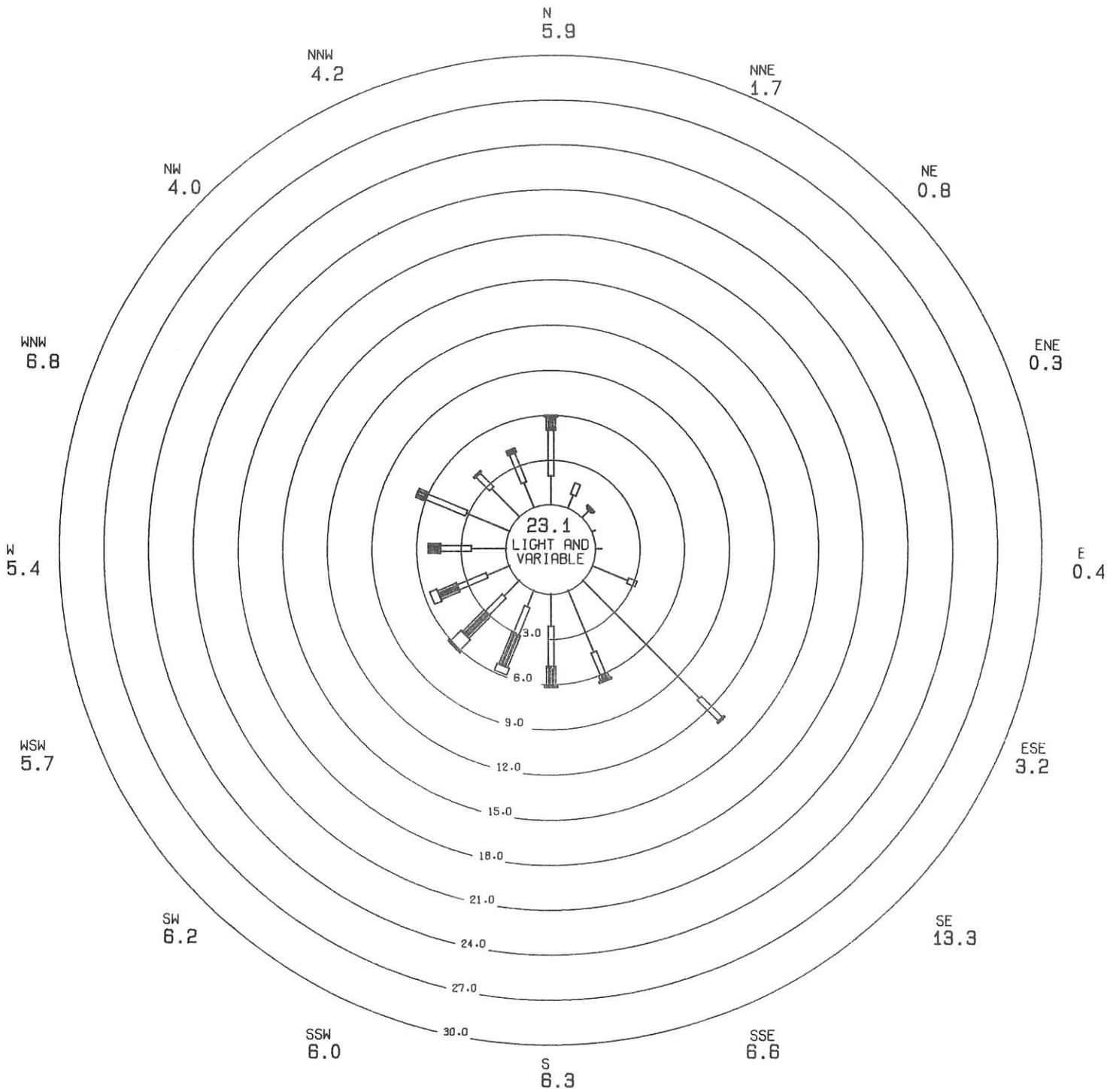
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY
27th St NE & 54th Ave NE, Northeast Tacoma, Wa

INCLUSIVE DATES- ALL MONTHS 1988

TOTAL OBSERVATIONS- 8,731





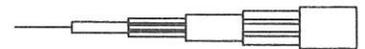
HOUR AVERAGE SURFACE WINDS

PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY
 2301 Alexander Ave, Tacoma, Wa

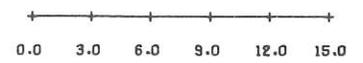
INCLUSIVE DATES- ALL MONTHS 1988

TOTAL OBSERVATIONS- 8,748

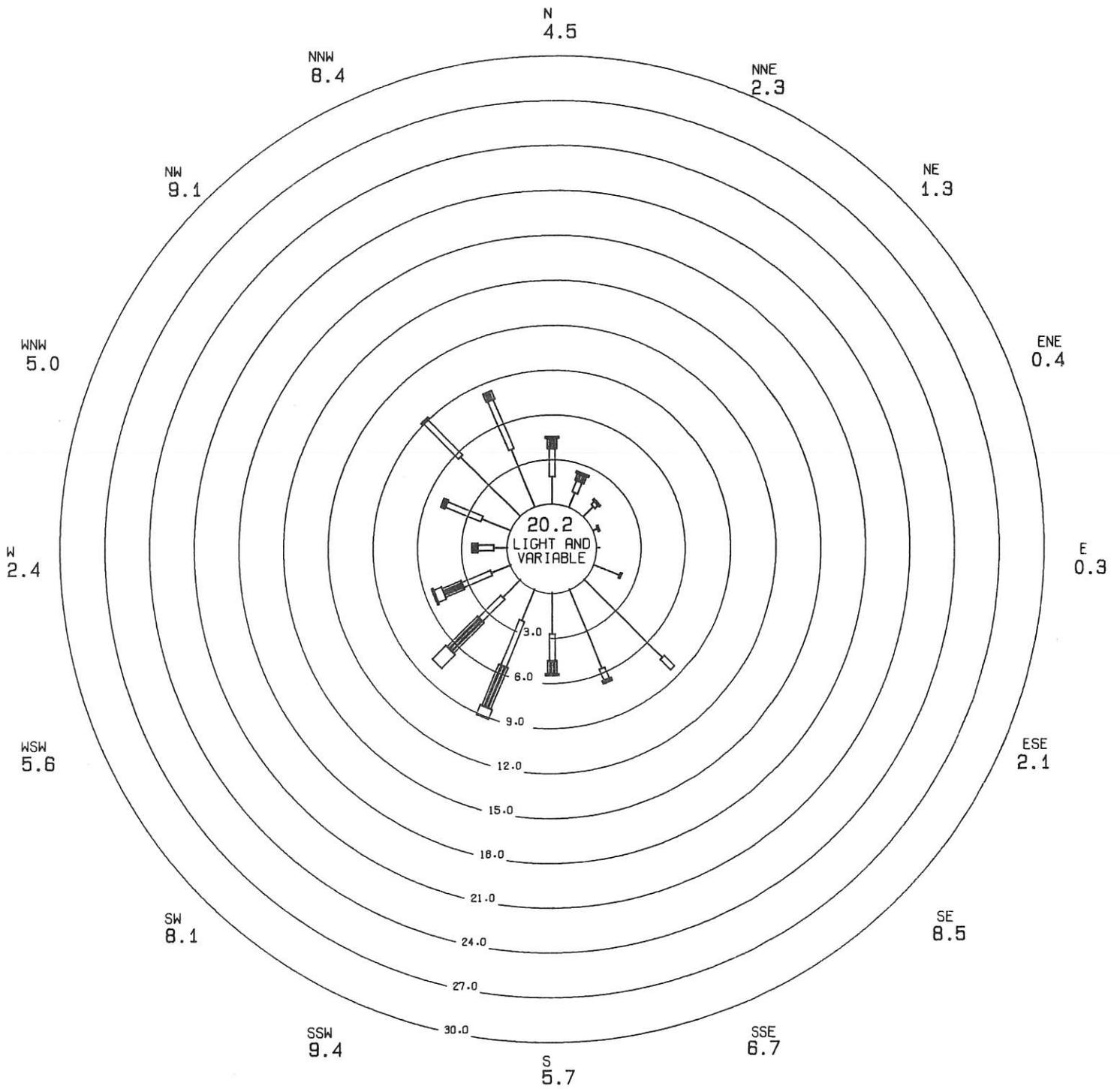


1.1-	4.0-	7.0-	11.0-	17.0-	OVER
3.9	6.9	10.9	16.9	21.9	21.9

KNOTS



PERCENT



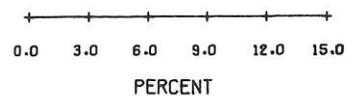
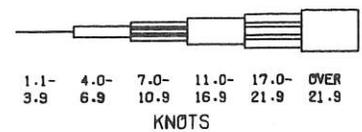
HOUR AVERAGE SURFACE WINDS

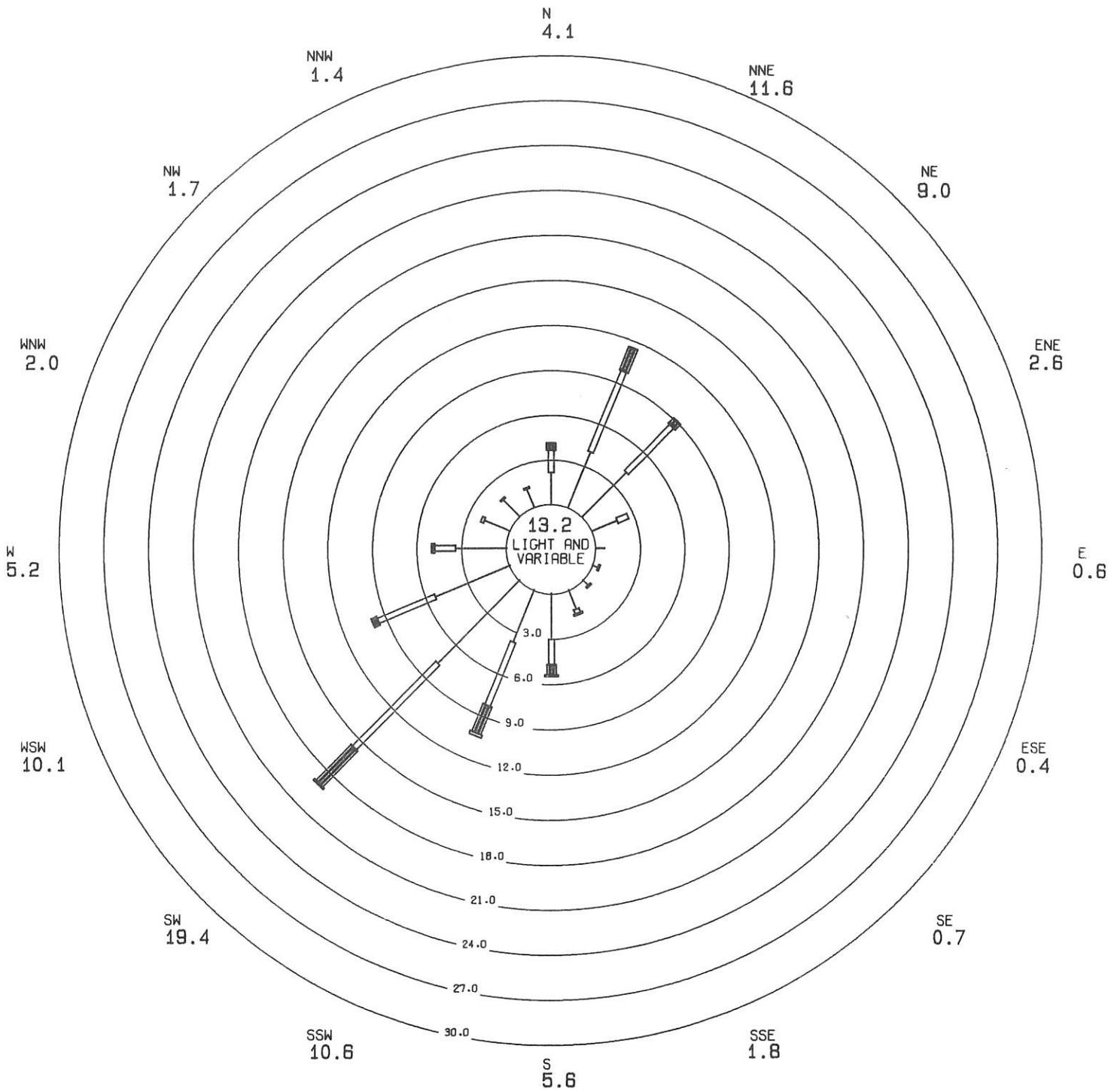
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY
Fire Station #12, 2316 E 11th St, Tacoma, Wa

INCLUSIVE DATES- ALL MONTHS 1988

TOTAL OBSERVATIONS- 8,738





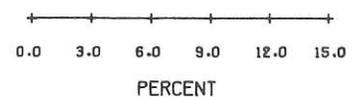
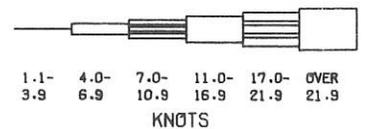
HOUR AVERAGE SURFACE WINDS

PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY
North 26th & Pearl Sts, Tacoma, Wa

INCLUSIVE DATES- JAN - SEP, 1988

TOTAL OBSERVATIONS- 6,538



AIR CONTAMINANT EMISSION INVENTORY

Introduction

Registered facilities within the Puget Sound Agency's control region are required to report annually their air contaminant emissions and process quantities. These data enable calculation of air contaminant emissions from published emission factors. The resulting emission quantities have been tabulated by county and by source category in the pages which follow.

This year major refinements were made in estimating some area sources which generally increased the estimate of those emissions. On road vehicle emissions were computed by the EPA Mobile 4 program.

Definitions

Area sources: County-wide categories of sources.

Emission factor: A value derived from source tests, material balance, engineering comparison with similar processes or other published data which is used to estimate annual emissions from process quantities.

Off road transportation: Farm vehicles, construction/industrial vehicles, logging/governmental vehicles, small marine craft, railroads, vessels, tugs, and ferries.

On road transportation: Motor vehicle fuel combustion by-products and resuspended roadway particulate matter.

Other area sources: Architectural surface coating, automobile surface coating, cold solvent degreasing, commercial/consumer solvents, cutback asphalt, dry cleaning, graphic arts, waste incineration, fireplaces without inserts, stationary diesel engines, and small utility engines.

Point sources: Facilities which have an air contaminant annual emission exceeding twenty-five tons.

Process quantity: An indicator of air contaminant emitting activities used to calculate emissions, such as

amount of fuel burned, materials handled, coatings applied, etc.

Registered facility: The sum total of all the pollutant emitting activities located on one or more contiguous or adjacent properties, which is owned or operated by the same person and includes buildings, structures, equipment, control apparatus and storage piles.

Residential heating: Natural gas and distillate fuel oil combustion in homes; wood combustion in stoves and fireplaces with inserts.

Slash burns: Prescribed burning on private, state and federal land.

Small boilers: Commercial natural gas and distillate fuel oil combustion.

Volatile organic compound (VOC): A hydrocarbon or derivative with a vapor pressure exceeding 0.002 pounds per square inch (psi) at 20° C and 14.7 psi excluding methane, ethane, trichlorotrifluoroethane (CFC-113), methylene chloride, 1,1,1-trichloroethane, chlorodifluoromethane (CFC-22), dichlorodifluoromethane (CFC-12), trifluoromethane (FC-23), dichlorotetrafluoroethane (CFC-114), trichlorofluoromethane (CFC-11) and chloropentafluoroethane (CFC-115).

Comments

It should be noted that the air contaminant categories are not necessarily mutually exclusive. Toxic air contaminants may also be tabulated under TSPM, PM₁₀ or VOC; and PM₁₀ is a subset of TSPM. Estimates for toxic air contaminants have come primarily from source calculated emissions or evaporation estimates of substances which were reported as hazardous ingredients on material safety data sheets. Toxic air contaminants represent a wide range of toxicity.

PUGET SOUND AIR POLLUTION CONTROL AGENCY
AIR CONTAMINANT EMISSION INVENTORY SUMMARY

All Counties
Tons per 1988

	TSPM	PM10	SOx	NOx	VOC	CO	TAC
POINT SOURCES							
1-INDUSTRIAL BOILERS	1510	1342	4371	2682	536	9709	587
2-FOREST PRODUCTS							
A-PULP MILLS	940	578	2132	2029	473	3181	631
B-WOOD PRODUCTS	256	169			4		
3-PRIMARY METALS							
A-ALUMINUM	497	20					
B-COPPER				3		1	
C-OTHER	279	173		19		5794	
4-PETROLEUM REFINERIES	6	6	76	122	299	28	
5-ELECTRIC UTILITIES	1	1	4	1			
6-CHEMICAL PRODUCTION					6		8
7-CEMENT PRODUCTION	208	142	319	539		66	2
8-OTHER POINTS							
A-POLLUTANT >25 T/Y	3424	1018	2190	2361	6964	20808	8404
B-POLLUTANT <25 T/Y	627	332	38	102	658	31	974
POINT SOURCE TOTAL	7748	3781	9130	7858	8940	39618	10606
AREA SOURCES							
1-TRANSPORTATION							
A-ON ROAD	176468	68891	4742	52195	84392	646730	3872
B-OFF ROAD	1467	1389	8854	68886	22760	88295	1581
2-SMALL BOILERS	90	67	2014	1851	77	393	21
3-SLASH BURNS	461	356		68	433	3851	
4-RESIDENTIAL HEATING	16238	13530	2846	3336	14941	132362	2326
5-OTHER AREA SOURCES	21034	21034	113	3420	57166	111666	19181
AREA SOURCE TOTAL	215758	105267	18569	129756	179769	983297	26981
GRAND TOTAL	223506	109048	27699	137614	188709	1022915	37587

Notes

- | | |
|---|--------------------------------|
| (1) TSPM=Total Suspended Particulate Matter | NOx=Nitrogen Oxides |
| PM10=Particulate Matter <10 Micrometers | VOC=Volatile Organic Compounds |
| SOx =Sulfur Oxides | CO =Carbon Monoxide |
| TAC =Toxic Air Contaminants | |
- (2) Unit Conversion: 1 Ton=907.18 kg

11/30/1989

PUGET SOUND AIR POLLUTION CONTROL AGENCY
AIR CONTAMINANT EMISSION INVENTORY SUMMARY

King County
Tons per 1988

	TSPM	PM10	SOx	NOx	VOC	CO	TAC
POINT SOURCES							
1-INDUSTRIAL BOILERS	253	220	657	707	89	1567	208
2-FOREST PRODUCTS A-PULP MILLS B-WOOD PRODUCTS	67	64			2		
3-PRIMARY METALS A-ALUMINUM B-COPPER C-OTHER	279	173		1 19	0	0 5794	0
4-PETROLEUM REFINERIES							
5-ELECTRIC UTILITIES	1	1	4	1	0	0	0
6-CHEMICAL PRODUCTION					6		7
7-CEMENT PRODUCTION	208	142	319	539	0	66	2
8-OTHER POINTS A-POLLUTANT >25 T/Y B-POLLUTANT <25 T/Y	1480 283	381 139	247 2	1604 23	4002 542	221 10	3915 660
POINT SOURCE TOTAL	2571	1120	1229	2894	4641	7658	4792
AREA SOURCES							
1-TRANSPORTATION A-ON ROAD B-OFF ROAD	104569 740	40823 697	2810 2914	30929 20702	48378 9963	369668 44743	2280 872
2-SMALL BOILERS	58	45	1241	1272	55	268	15
3-SLASH BURNS	29	22	0	4	27	238	
4-RESIDENTIAL HEATING	5952	4957	1654	1804	5476	48378	855
5-OTHER AREA SOURCES	8736	8736	46	1608	27437	49207	10002
AREA SOURCE TOTAL	120084	55280	8665	56319	91336	512502	14024
GRAND TOTAL	122655	56400	9894	59213	95977	520160	18816

Notes

- (1) TSPM=Total Suspended Particulate Matter
PM10=Particulate Matter <10 Micrometers
SOx =Sulfur Oxides
TAC =Toxic Air Contaminants
NOx=Nitrogen Oxides
VOC=Volatile Organic Compounds
CO =Carbon Monoxide
- (2) Unit Conversion: 1 Ton=907.18 kg

11/30/1989

PUGET SOUND AIR POLLUTION CONTROL AGENCY
AIR CONTAMINANT EMISSION INVENTORY SUMMARY

Kitsap County
Tons per 1988

	TSPM	PM10	SOx	NOx	VOC	CO	TAC
POINT SOURCES							
1-INDUSTRIAL BOILERS	11	11	375	118	2	30	3
2-FOREST PRODUCTS A-PULP MILLS B-WOOD PRODUCTS	35	18					
3-PRIMARY METALS A-ALUMINUM B-COPPER C-OTHER							
4-PETROLEUM REFINERIES							
5-ELECTRIC UTILITIES							
6-CHEMICAL PRODUCTION							
7-CEMENT PRODUCTION							
8-OTHER POINTS A-POLLUTANT >25 T/Y B-POLLUTANT <25 T/Y	120 2	27 2	88 0	57 53	433 20	20 13	245 18
POINT SOURCE TOTAL	168	58	463	228	455	63	266
AREA SOURCES							
1-TRANSPORTATION A-ON ROAD B-OFF ROAD	10759 103	4200 98	289 3989	3183 32115	5254 5011	41821 14886	232 104
2-SMALL BOILERS	5	3	142	67	2	15	0
3-SLASH BURNS	1	1	0	0	1	11	
4-RESIDENTIAL HEATING	1980	1650	222	261	1822	16171	283
5-OTHER AREA SOURCES	2415	2415	13	302	5456	12253	1493
AREA SOURCE TOTAL	15263	8367	4655	35928	17546	85157	2112
GRAND TOTAL	15431	8425	5118	36156	18001	85220	2378

Notes

(1) TSPM=Total Suspended Particulate Matter
PM10=Particulate Matter <10 Micrometers
SOx =Sulfur Oxides
TAC =Toxic Air Contaminants

NOx=Nitrogen Oxides
VOC=Volatile Organic Compounds
CO =Carbon Monoxide

(2) Unit Conversion: 1 Ton=907.18 kg

11/30/1989

PUGET SOUND AIR POLLUTION CONTROL AGENCY
AIR CONTAMINANT EMISSION INVENTORY SUMMARY

Pierce County
Tons per 1988

	TSPM	PM10	SOx	NOx	VOC	CO	TAC
POINT SOURCES							
1-INDUSTRIAL BOILERS	669	619	1873	1069	247	4506	342
2-FOREST PRODUCTS							
A-PULP MILLS	440	342	1502	981	473	2222	444
B-WOOD PRODUCTS	41	30			2		
3-PRIMARY METALS							
A-ALUMINUM	332	13					
B-COPPER				2	0	1	
C-OTHER							
4-PETROLEUM REFINERIES	6	6	76	122	299	28	0
5-ELECTRIC UTILITIES							
6-CHEMICAL PRODUCTION					0		1
7-CEMENT PRODUCTION							
8-OTHER POINTS							
A-POLLUTANT >25 T/Y	1468	523	1791	401	888	11159	2112
B-POLLUTANT <25 T/Y	319	171	33	21	77	4	178
POINT SOURCE TOTAL	3275	1704	5275	2596	1986	17920	3077
AREA SOURCES							
1-TRANSPORTATION							
A-ON ROAD	34643	13524	931	10247	17349	134616	762
B-OFF ROAD	353	342	861	6623	4869	14913	335
2-SMALL BOILERS	18	13	434	337	13	73	4
3-SLASH BURNS	428	331	0	64	402	3575	
4-RESIDENTIAL HEATING	4139	3449	614	723	3807	33760	592
5-OTHER AREA SOURCES	5651	5651	32	834	13915	28954	4390
AREA SOURCE TOTAL	45232	23310	2872	18828	40355	215891	6083
GRAND TOTAL	48507	25014	8147	21424	42341	233811	9160

Notes

(1) TSPM=Total Suspended Particulate Matter
 PM10=Particulate Matter <10 Micrometers
 SOx =Sulfur Oxides
 TAC =Toxic Air Contaminants

NOx=Nitrogen Oxides
 VOC=Volatile Organic Compounds
 CO =Carbon Monoxide

(2) Unit Conversion: 1 Ton=907.18 kg

11/30/1989

PUGET SOUND AIR POLLUTION CONTROL AGENCY
AIR CONTAMINANT EMISSION INVENTORY SUMMARY

Snohomish County
Tons per 1988

	TSPM	PM10	SOx	NOx	VOC	CO	TAC
POINT SOURCES							
1-INDUSTRIAL BOILERS	577	492	1466	788	198	3606	34
2-FOREST PRODUCTS							
A-PULP MILLS	500	236	630	1048		959	187
B-WOOD PRODUCTS	113	57					
3-PRIMARY METALS							
A-ALUMINUM	165	7					
B-COPPER							
C-OTHER							
4-PETROLEUM REFINERIES							
5-ELECTRIC UTILITIES							
6-CHEMICAL PRODUCTION							
7-CEMENT PRODUCTION							
8-OTHER POINTS							
A-POLLUTANT >25 T/Y	356	87	64	299	1641	9408	2132
B-POLLUTANT <25 T/Y	23	20	3	5	19	4	118
POINT SOURCE TOTAL	1734	899	2163	2140	1858	13977	2471
AREA SOURCES							
1-TRANSPORTATION							
A-ON ROAD	26497	10344	712	7836	13411	100625	598
B-OFF ROAD	271	252	1090	9446	2917	13753	270
2-SMALL BOILERS	9	6	197	175	7	37	2
3-SLASH BURNS	3	2	0	0	3	27	
4-RESIDENTIAL HEATING	4167	3474	356	548	3836	34053	596
5-OTHER AREA SOURCES	4232	4232	22	676	10358	21252	3296
AREA SOURCE TOTAL	35179	18310	2377	18681	30532	169747	4762
GRAND TOTAL	36913	19209	4540	20821	32390	183724	7233

Notes

- (1) TSPM=Total Suspended Particulate Matter
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11/30/1989

AMBIENT AIR QUALITY STANDARDS

POLLUTANT	NATIONAL		WASHINGTON STATE	PUGET SOUND REGION
	Primary	Secondary		
CARBON MONOXIDE 8 Hour Average 1 Hour Average	9 ppm 35 ppm		9 ppm 35 ppm	9 ppm 35 ppm
PARTICULATE MATTER (PM ₁₀) Annual Arithmetic Average 24 Hour Average ^a	50 ug/m ³ 150 ug/m ³			
TOTAL SUSPENDED PARTICULATES Annual Geometric Average 24 Hour Average			60 ug/m ³ 150 ug/m ³	60 ug/m ³ 150 ug/m ³
OZONE 1 Hour Average ^b	0.12 ppm	0.12 ppm	0.12 ppm	0.12 ppm
SULFUR DIOXIDE Annual Average 30 Day Average 24 Hour Average 3 Hour Average 1 Hour Average ^d 1 Hour Average 5 Minute Average ^e	0.03 ppm 0.14 ppm	0.50 ppm	0.02 ppm 0.10 ppm 0.25 ppm 0.40 ppm	0.02 ppm 0.04 ppm 0.10 ppm ^c 0.25 ppm 0.40 ppm ^c 1.00 ppm
LEAD Calendar Quarter Average	1.5 ug/m ³	1.5 ug/m ³		1.5 ug/m ³
NITROGEN DIOXIDE Annual Average	0.05 ppm	0.05 ppm	0.05 ppm	0.05 ppm

Notes

- (1) ppm = parts per million
- (2) ug/m³ = micrograms per cubic meter
- (3) Annual, Quarter and 30 Day standards never to be exceeded, shorter term standards not to be exceeded more than once per year unless noted.

- a - Standard attained when expected number of days per year with a 24 hour concentration above 150 ug/m³ is equal to one or less.
- b - Standard attained when expected number of days per year with an hourly average above 0.12 ppm is equal to one or less.
- c - Sulfur Dioxide short-term standard never to be exceeded.
- d - Not to be exceeded more than twice in seven days.
- e - Not to be exceeded more than once in eight hours.

CHARACTERISTICS AND EFFECTS OF AMBIENT AIR POLLUTANTS

Carbon Monoxide

Carbon monoxide is a colorless, odorless, toxic gas commonly formed when carbon-containing fuel is not burned completely. It chemically combines with the hemoglobin in the red blood cells to decrease the oxygen-carrying capacity of the blood. Carbon monoxide also weakens the contractions of the heart, thus reducing the amount of blood pumped throughout the body. People with heart disease and pregnant women are particularly at risk because of the effects of carbon monoxide.

Particulate Matter (PM₁₀ and TSP)

Particulate matter with an aerodynamic diameter of less than or equal to 10 micrometers (PM₁₀) and Total Suspended Particulates (TSP) are small discrete masses of solid or liquid matter dispersed in the atmosphere. Slash and wood burning, and transportation and industrial activity are the major sources of particulate matter. Those particulates one micrometer or less in diameter are especially associated with a variety of adverse effects on public health and welfare. Particulate in the respiratory tract may produce injury by itself, or it may act in conjunction with gases to increase the effect on the body. The elderly, those suffering from respiratory illness, and young children are especially prone to the deleterious effects of particulates. Soiling of buildings and other property, and reduced visibility are further results of high particulate matter levels.

Ozone

Ozone is a pungent-smelling, colorless gas produced in the atmosphere when nitrogen oxides and some hydrocarbons chemically react under the effect of strong sunlight. It is a pulmonary irritant that affects lung tissues and respiratory functions. Ozone impairs the normal function of the lung and, at concentrations between 0.15 and 0.25 ppm, causes lung tightness, coughing and wheezing. Other oxidants that often accompany ozone cause eye irritation. Persons with chronic

respiratory problems, such as asthma, seem most sensitive to increases in ozone concentration.

Sulfur Dioxide

Sulfur dioxide is a colorless, corrosive gas, that has a bitter taste, but no appreciable smell between 0.3 - 1.0 ppm. Industrial sites which use coal and oil for fuel - such as smelters, paper mills, power plants and steel manufacturing plants - are the main sources of sulfur dioxide pollution. The presence of sulfur dioxide in the ambient air has been associated with a variety of respiratory diseases and increased mortality rates. When sulfur dioxide is inhaled with small particles, the effect on health is increased. Inhalation of sulfur dioxide can cause increased airway resistance by constricting lung passages.

Lead

Lead particles or its compounds enter the air from vehicle exhaust and from industries that smelt, process and/or handle the metal. Lead affects humans in numerous ways, but the greatest impacts appear to be on the blood-forming system, the nervous system, and the kidneys. It affects some people more than others. Young children (ages 1 - 5) are particularly sensitive to lead exposure. The standard for lead in air is intended to prevent most children from exceeding blood lead levels of 30 micrograms per deciliter of blood.

Nitrogen Dioxide

Nitrogen dioxide is a poisonous, brownish gas which, in addition to being a strong oxidizing agent, quickly reacts with water vapor to form corrosive nitric acid. Nitrogen dioxide is formed as the result of high temperature fuel combustion and subsequent atmospheric reactions. The presence of nitrogen dioxide in ambient air has been connected with a range of respiratory diseases. Further, nitrogen dioxide plays an essential role in the production of ozone.

AIR QUALITY UNITS CONVERSION TABLE

Air quality standards for gases are defined in terms of micrograms (ug) or milligrams (mg) per cubic meter as well as in parts per million (ppm). As this data summary expresses measurements for gaseous pollutants in terms of ppm, the following conversion table is for the

convenience of those who wish to interpret our results in terms of ug/cubic meter or mg/cubic meter. These conversion factors from the Federal Register assume a pressure of 760 mm Hg and a temperature of 25 degrees C.

<u>Pollutant</u>	<u>Multiply ppm by</u>	<u>To Obtain</u>
Carbon Monoxide	1.145	mg/cubic meter
Nitrogen Dioxide	1880	ug/cubic meter
Ozone	1961	ug/cubic meter
Sulfur Dioxide	2619	ug/cubic meter