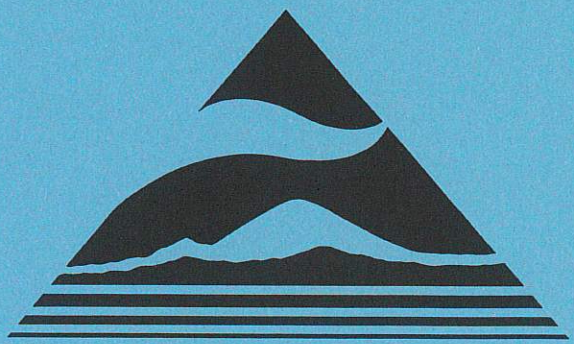
1994 Air Quality Data Summary

for the counties

King
Kitsap
Pierce
Snohomish



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PUGET SOUND AIR POLLUTION CONTROL AGENCY

Serving King, Kitsap, Pierce and Snohomish Counties

1994 AIR QUALITY DATA SUMMARY

Contents

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EXECUTIVE SUMMARY

Introduction

This twenty-third annual data summary reviews 1994 air quality and meteorological 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.

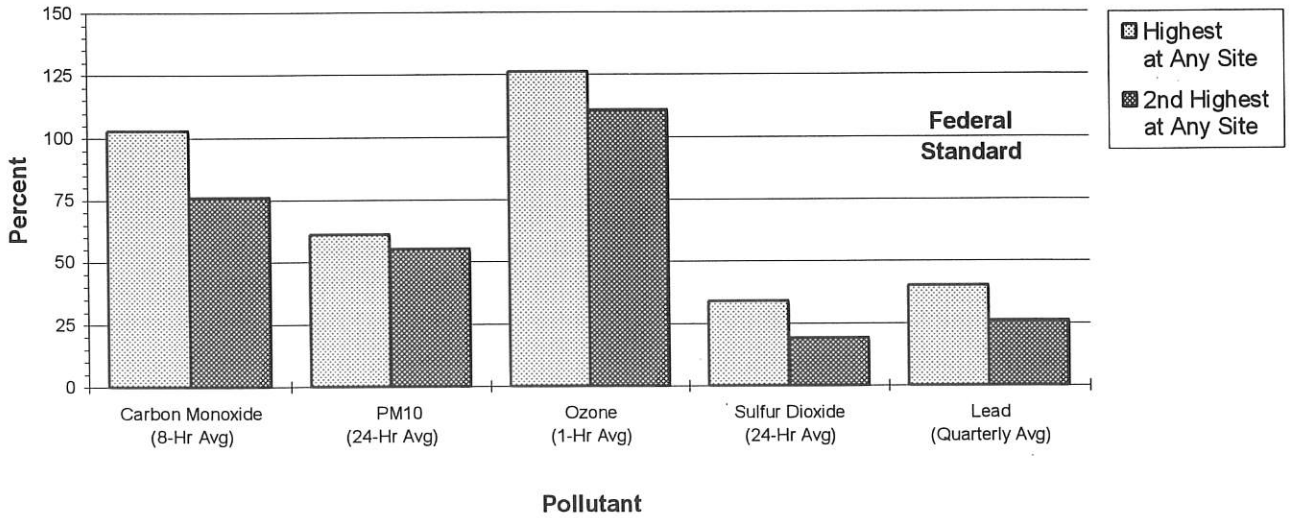
Sections near the back summarize air pollution episodes and "impaired air quality" periods and provide meteorological analyses consisting of wind speed averages and graphs of wind patterns. The last data section presents the Puget Sound Region emission inventory summarized in a variety of ways.

Air pollution is a complex mixture of compounds that each requires specialized equipment for identification and measurement. National ambient air quality standards have been established for the six common pollutants known as *carbon monoxide*, *particulate matter*, *ozone*, *sulfur dioxide*, *lead* and *nitrogen dioxide*. For these pollutants Federal law requires meeting the national primary standards that protect health and establishes deadlines for states to develop and implement plans to achieve and maintain the air quality standards. The Washington State Department of Ecology and the Puget Sound Air Pollution Control Agency have established state and local ambient air quality standards for the same six pollutants that are at least as stringent as the national standards. A discussion of the characteristics and effects of each of these air pollutants and a table of all the ambient air quality standards appear on pages 58 and 59 of this report.

The Puget Sound Region continues in compliance with the standards for sulfur dioxide, lead and nitrogen dioxide. In specific areas during the last seven years, the Region has been out of compliance with the standards for the pollutants carbon monoxide, particulate matter and ozone.

A review of data shows the only cases exceeding the level of an ambient air quality standard in the Puget Sound Region during calendar year 1994 involved ozone. The chart below displays 1994 maximum pollutant concentrations compared to the Federal primary standard. Maximum ozone levels exceeded the level of the standard, but ozone remains in compliance as described on the following page. This chart demonstrates compliance for the pollutants where the concentrations do not exceed the Federal Standard. Further, the Puget Sound Region has complied with all these ambient standards for four years through the end of 1994.

1994 Maximum Pollutant Concentrations Compared to the Federal Standard



Carbon Monoxide

The area that in the past has not complied with the carbon monoxide standard includes Everett, Seattle, Bellevue and Tacoma. During 1994, none of the monitoring sites measured a carbon monoxide value that exceeded the primary (health related) standard of 9 ppm averaged over eight hours. This completes four full years that the Puget Sound Region has complied with the standard. The following table summarizes the highest and second highest 8 hour average carbon monoxide values during 1994 for each carbon monoxide monitoring station.

1994 Carbon Monoxide Summary

Location	Highest 8 hr Avg (ppm)	2nd Highest 8 hr Avg (ppm)
Everett, Broadway	7.0	6.2
Bellevue, Bellevue Way NE	7.6	5.2
Bellevue, NE 8th St & 108th	9.3	6.2
Seattle, NE Northgate Way	7.1	4.9
Seattle, University District	8.2	6.8
Seattle, 1424 4th Ave	6.8	5.2
Seattle, 5th Ave & James	6.1	4.7
Tacoma, 1101 Pacific Ave	7.5	6.0
Bremerton, 2909 Wheaton Way	4.8	4.3

Particulate Matter

The particulate matter standards adopted by the U. S. EPA in July 1987 measure only PM_{10} (particles 10 micrometers or less in diameter). The levels for the national primary and secondary PM_{10} standards are 150 micrograms per cubic meter ($\mu g/m^3$) for a 24 hour average and 50 $\mu g/m^3$ for an annual arithmetic mean. Washington State and Puget Sound Region PM_{10} standards were established at the same level as the national PM_{10} standards.

For 1994, none of the daily or annual average PM_{10} values exceeded the level of the standards. The following table summarizes the maximum daily PM_{10} value and the annual PM_{10} arithmetic average by monitoring location for the year 1994.

1994 PM_{10} Summary

Location	Maximum Daily PM_{10} Value ($\mu g/m^3$)	Annual PM_{10} Arith Avg ($\mu g/m^3$)
Marysville, Jr Hi School	86	20.8
Everett, Hoyt & 26th St	47	19.2
Lynnwood, 59th Place W	62	---
Bellevue, Bellevue Wy NE	45	18.0
Lake Forest Pk, City Hall	78	20.5
Seattle, Harbor Is	60	26.7
Seattle, Duwamish	91	27.7
Seattle, South Park	55	21.9
Kent, James & Central	82	24.3
Puyallup, South Hill	67	19.6
NE Tacoma, 27th & 54th	79	22.8
Tacoma, Taylor Way	68	25.4
Tacoma, Alexander Ave	71	22.7
Tacoma, E 11th St	80	26.4
Kitsap County, Meadowdale	51	19.7
Poulsbo, 6th Ave & Fjord Dr	34	15.2

Under the Federal regulation, the last three years of data must be used to determine compliance with the PM_{10} standards. For these past three calendar years, none of the annual PM_{10} values exceeded the annual PM_{10} standard of 50 $\mu g/m^3$ and none of the daily PM_{10} values exceeded the 24 hour average PM_{10} standard of 150 $\mu g/m^3$. Therefore the Puget Sound Region complies with the PM_{10} standards.

Ozone

Ozone is a photochemical pollutant with highest levels measured during record hot weather from mid May to mid September. In 1987 the Puget Sound Region attained the ozone standard, but monitoring data during the summer of 1990 resulted again in a designation as out of compliance with this standard. If a particular location shows more than one (1.0) daily maximum hour per year, averaged over the last three years, with a concentration greater than 0.12 ppm, then the ozone standard has been violated.

There were two exceedances of the ozone standard at the Enumclaw station and one exceedance at the Pack Forest Station. These exceedances combine with zero exceedances for the two years 1992-1993 to maintain these locations in compliance with the ozone standard. Therefore, all sites in the Puget Sound Region complied with the ozone standard at the end of 1994. The following table summarizes the maximum 1 hour average ozone value during 1994 for each ozone monitoring site.

1994 Ozone Summary

Location	Maximum 1 hr Avg (ppm)
Getchell 8426 99th Ave NE	0.082
Lake Sammamish State Park	0.107
Enumclaw, Highway 410	0.151
La Grande, Pack Forest	0.128

Weather and Air Quality

One of the variables 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. In the Puget Sound Region, poor dispersion exists on about one-third of the days during night to early morning hours, but weather effectively disperses pollutants by afternoon on most of these days.

A few times during the months of January, February, October, November or December, poor dispersion persists for 24 or more hours and may result in the declaration of an "air pollution episode" or local "impaired air quality". During 1994, the Department of Ecology did not declare any stage of an air pollution episode in the Puget Sound Region.

The Washington Clean Air Act established the criteria for determining "impaired air quality". During 1994, the Puget Sound Air Pollution Control Agency did not declare any periods of "impaired air quality" in the Puget Sound Region and therefore no burn bans were required.

Daily Air Quality

The Agency uses the national Pollutant Standards Index to report daily air quality. The report includes the Index value as determined by pollutant levels and a descriptive term for the Index value. This term describes 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. Summarizing from the daily Pollutant Standards Index values, in 1994:

Everett had 294 Good, 71 Moderate, and 0 Unhealthful days;
Seattle had 315 Good, 50 Moderate, and 0 Unhealthful days;
Tacoma had 337 Good, 28 Moderate, and 0 Unhealthful days.

The current daily Pollutant Standards Index is available toll free from the Puget Sound Air Pollution Control Agency by dialing 1-800-433-2215.

1994 SAMPLING NETWORK

Location	*Type of Sampling*		
* 8426 99th Avenue NE, Getchell, Wa (seasonal)			O_3
Marysville JHS, 1605 7th St, Marysville, Wa	PM10	$(PM10)_{eq}$	Wind
Hoyt Ave & 26th St, Everett, Wa	PM10		SO_2, Wind
* Broadway & Hewitt Ave, Everett, Wa		CO	
* NE 8th St & 108th Ave NE, Bellevue, Wa (began May 1, 1994)		CO	
* 622 Bellevue Way NE, Bellevue, Wa		CO	
* 504 Bellevue Way NE, Bellevue, Wa	PM10		
* 20050 SE 56th, Lake Sammamish State Park, Wa (seasonal)			O_3
20935 59th Place West, Lynnwood, Wa (began Oct 14, 1994)	PM10	$(PM10)_{eq}$	Wind
17711 Ballinger Way NE, Lake Forest Park, Wa	PM10	$(PM10)_{eq}$	bsp, Wind
* Northgate, 310 NE Northgate Way, Seattle, Wa		CO	
* Sand Point, 7600 Sand Pt Way NE, Seattle, Wa			Wind, Temp, dT
* 5701 8th Ave NE, Seattle, Wa (ended Jul 31, 1994)			TSP/Pb
* University Dist, 1307 NE 45th St, Seattle, Wa		CO	
* 1424 4th Ave, Seattle, Wa		CO	
* 5th Ave & James St, Seattle, Wa		CO	
* Beacon Hill, 15th S & Charlestown, Seattle, Wa			Wind, Temp
Harbor Island, 2555 13th Ave SW, Seattle, Wa			TSP/Pb
Harbor Island, 3400 13th Ave SW, Seattle, Wa	PM10		

Notes- (1) *Type of Sampling*:

PM10	=	Particulate Matter ≤ 10 micrometers (reference method)	bsp	=	Atmospheric Particles (by nephelometer)
$(PM10)_{eq}$	=	Particulate Matter ≤ 10 micrometers (equivalent method)	O_3	=	Ozone
CO	=	Carbon Monoxide	SO_2	=	Sulfur Dioxide
PM2.5	=	Particulate Matter ≤ 2.5 micrometers	TSP/Pb	=	Total Suspended Particulates and Lead
Wind	=	Wind Direction & Speed	Temp	=	Air Temperature
			dT	=	delta Temperature

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

1994 SAMPLING NETWORK

Location	*Type of Sampling*			
Duwamish, 4752 E Marginal Way S, Seattle, Wa	PM_{10}	$(PM_{10})_{eq}$		$PM_{2.5}$, b_{sp}, SO_2, Wind
South Park, 723 S Concord St, Seattle, Wa	PM_{10}			
James St & Central Ave, Kent, Wa	PM_{10}	$(PM_{10})_{eq}$		$PM_{2.5}$, b_{sp}, Wind
* Highway 410, 2 miles east of Enumclaw, Wa (seasonal)				O_3
* Charles L Pack Forest, La Grande, Wa (seasonal)				O_3
South Hill, 9616 128th St E, Puyallup, Wa	PM_{10}	$(PM_{10})_{eq}$		Wind
* 5225 Tower Drive NE, Northeast Tacoma, Wa				Wind, Temp
27th St NE & 54th Ave NE, Northeast Tacoma, Wa	PM_{10}			SO_2, Wind
2340 Taylor Way, Tacoma, Wa (ended Oct 5, 1994)	PM_{10}			
2301 Alexander Ave, Tacoma, Wa	PM_{10}			SO_2, Wind
Fire Station #12, 2316 E 11th St, Tacoma, Wa	PM_{10}	$(PM_{10})_{eq}$		$PM_{2.5}$, b_{sp}, Wind
* 1101 Pacific Ave, Tacoma, Wa			CO	
* 2909 Wheaton Way, Bremerton, Wa (began Sep 1, 1994)			CO	
Meadowdale, 7252 Blackbird Dr NE, Kitsap Co, Wa	PM_{10}	$(PM_{10})_{eq}$		Wind
Lions Park, 6th Ave NE & Fjord Dr, Poulsbo, Wa	PM_{10}	$(PM_{10})_{eq}$		Wind

Notes- (1) *Type of Sampling*:

PM_{10}	=	Particulate Matter ≤ 10 micrometers (reference method)	b_{sp}	=	Atmospheric Particles (by nephelometer)
$(PM_{10})_{eq}$	=	Particulate Matter ≤ 10 micrometers (equivalent method)	O_3	=	Ozone
CO	=	Carbon Monoxide	SO_2	=	Sulfur Dioxide
$PM_{2.5}$	=	Particulate Matter ≤ 2.5 micrometers	Temp	=	Air Temperature
Wind	=	Wind Direction & Speed			

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

POLLUTANT STANDARDS INDEX

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

Measured pollutant levels during each day convert to a scale that shows if there are potential health effects. This Index scale, ranging from zero to 500, categorizes 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 pollutant concentration and the averaging period associated with each PSI value that is a break-point between Index categories. PSI values for pollutant concentrations between break-points are determined by linear interpolation.

Whenever the PSI is greater than 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.

Every day the concentration of each pollutant within the areas of Everett, Seattle and Tacoma determines an Index value. For each area, the pollutant with the highest Index value determines the PSI on that day. Highest values for these areas usually occur in the vicinity of heavy traffic or an industrial area.

Since high ozone levels occur some distance downwind of Everett, Seattle or Tacoma on hot summer afternoons, the Agency reports the ozone PSI value in a downwind area during the months from May through September. For 1994, three ozone PSI values exceeded 100, with the maximum values of 139 and 116 occurring near Enumclaw on successive days, July 21st and 22nd. At the Pack Forest station near La Grande the ozone PSI value of 110 also occurred on July 21st.

Tables that follow summarize the daily PSI values for Everett, Seattle, and Tacoma. The 1994 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 1980 through 1994 summary table shows for each year the number of days in each air quality category and the number of days each pollutant determined the PSI. For all the Unhealthful days each year (Index values greater than 100), this summary also tabulates the pollutant responsible. The right-hand columns list the highest PSI value for each year.

Pollutant Concentration for Each PSI Break-point Value

PSI Value	CO *8 hr Avg* (*ppm*)	PM10 *24 hr Avg* ($\mu g/m^3$)	SO_2 *24 hr Avg* (*ppm*)	O_3 *1 hr Avg* (*ppm*)
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

1994

EVERETT

Number of Days in Each PSI Interval during Each Month

AIR QUALITY	PSI Interval	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
GOOD	(0 to 50)	25	19	24	24	25	21	23	26	21	29	29	28	294
MODERATE	(51 to 100)	6	9	7	6	6	9	8	5	9	2	1	3	71
UNHEALTHFUL	(101 to 199)	0	0	0	0	0	0	0	0	0	0	0	0	0
VERY UNHEALTHFUL	(200 to 299)	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum PSI each month		67	68	56	67	67	67	58	67	67	56	56	78	78
Date		18th#	6th	7th#	15th	6th	3rd#	5th	3rd	6th#	6th#	17th	30th	Dec 30
Pollutant		CO	PM	CO	CO	CO	CO	SO2	CO	CO	CO	CO	CO	CO

SEATTLE

Number of Days in Each PSI Interval during Each Month

AIR QUALITY	PSI Interval	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
GOOD	(0 to 50)	15	19	27	30	31	30	31	31	28	26	26	21	315
MODERATE	(51 to 100)	16	9	4	0	0	0	0	0	2	5	4	10	50
UNHEALTHFUL	(101 to 199)	0	0	0	0	0	0	0	0	0	0	0	0	0
VERY UNHEALTHFUL	(200 to 299)	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum PSI each month		78	65	60	44	44	44	47	44	56	67	56	89	89
Date		21st	2nd	9th	8th#	3rd#	3rd#	21st	18th#	28th	9th	4th#	23rd	Dec 23
Pollutant		CO	PM	PM	CO	CO	CO	PM	CO	CO	CO	CO	CO	CO

TACOMA

Number of Days in Each PSI Interval during Each Month

AIR QUALITY	PSI Interval	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	ANNUAL
GOOD	(0 to 50)	25	21	29	30	31	30	31	31	28	28	28	25	337
MODERATE	(51 to 100)	6	7	2	0	0	0	0	0	2	3	2	6	28
UNHEALTHFUL	(101 to 199)	0	0	0	0	0	0	0	0	0	0	0	0	0
VERY UNHEALTHFUL	(200 to 299)	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum PSI each month		56	67	57	43	40	33	39	40	56	65	59	89	89
Date		3rd#	1st	9th	20th	12th	3rd#	19th#	26th	22nd	11th	22nd	23rd	Dec 23
Pollutant		CO	CO	PM	PM	PM	PM	PM	PM	CO	PM	PM	CO	CO

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

Earliest date of occurrence

POLLUTANT STANDARDS INDEX

1980 - 1994

EVERETT

	Days in Each Air Quality Category				Pollutant Determining the PSI						Highest Value		
					All Days			Unhealthful Days					
	Good	Moderate	Unhealthful	Very Unhealthful	PM	CO	SO2	PM	CO	SO2	PSI	Date	Pollutant
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
1989	150	213	2	0	26	338	1	0	2	0	133	Feb 10	CO
1990	166	197	2	0	29	335	1	0	2	0	117	Mar 2#	CO
1991	188	176	1	0	32	333	0	0	1	0	117	Dec 16	CO
1992	180	186	0	0	34	332	0	0	0	0	100	Feb 4#	CO
1993	238	127	0	0	56	309	0	0	0	0	79	Jan 11	PM
1994	294	71	0	0	28	336	1	0	0	0	78	Dec 30	CO
Totals	3858	1590	19	0	1906	3329	232	0	19	0			

SEATTLE

	Days in Each Air Quality Category				Pollutant Determining the PSI						Highest Value		
					All Days			Unhealthful Days					
	Good	Moderate	Unhealthful	Very Unhealthful	PM	CO	SO2	PM	CO	SO2	PSI	Date	Pollutant
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
1989	231	134	0	0	129	233	3	0	0	0	100	Jan 19#	CO
1990	239	126	0	0	141	218	6	0	0	0	100	Jan 18	CO
1991	256	109	0	0	141	216	8	0	0	0	100	Dec 15#	CO
1992	238	127	1	0	105	260	1	0	1	0	167	Feb 3	CO
1993	251	114	0	0	119	245	1	0	0	0	88	Jan 11	PM
1994	315	50	0	0	72	292	1	0	0	0	89	Dec 23	CO
Totals	2617	2758	98	6	1674	3751	54	21	83	0			

TACOMA

	Days in Each Air Quality Category				Pollutant Determining the PSI						Highest Value		
					All Days			Unhealthful Days					
	Good	Moderate	Unhealthful	Very Unhealthful	PM	CO	SO2	PM	CO	SO2	PSI	Date	Pollutant
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
1989	260	103	2	0	217	121	27	0	2	0	117	Nov 30#	CO
1990	289	75	1	0	237	87	41	1	0	0	118	May 5	PM
1991	282	82	1	0	268	85	12	0	1	0	117	Jan 31	CO
1992	285	81	0	0	256	83	27	0	0	0	100	Feb 3#	CO
1993	302	63	0	0	260	82	23	0	0	0	89	Feb 1	CO
1994	337	28	0	0	259	75	31	0	0	0	89	Dec 23	CO
Totals	3033	2362	79	5	3575	1689	215	18	66	0			

Earliest date of occurrence

The ambient air quality standard for lead is 1.5 $\mu g/m^3$ averaged over one calendar quarter. The Puget Sound Region fully complies with this standard as shown by 1994 data in the table below. In the past, urban area lead levels violated the standard near high traffic roadways due principally to automobile exhaust. However, the current ambient lead levels near these roadways are now significantly lower as a result of the reduced amount of lead in gasoline. This is shown below for the Puget Sound Region where the freeway site at 5701 8th Ave NE documents that the lead concentration is about 2 percent of the standard in 1994. This compares to a level that was 116 percent of the standard at this site in 1979. Lead emissions come also from stationary industrial sources such as primary and secondary nonferrous smelters. The Harbor Island station in the table below is located just across the street from the site of a secondary lead smelter that ceased operation several years ago. The lead levels at this station reached 40 percent of the standard in 1994 still documenting some effect of past emissions from this closed lead smelter.

LEAD

Micrograms per Standard Cubic Meter
Sampling Method: Standard High Volume Quartz Fiber filters

1994

Location	Monthly Arithmetic Averages												No. of Obs	Year Arith Mean
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
5701 8th Ave NE, Seattle, Wa	.02	.02	.03	.02	.01	.02	.02	(discontinued)					36	.02
Harbor Island, 2555 13th Ave SW, Seattle, Wa	.26	.24	.59	.21	.15	.35	.35	.17	.66	.47	.68	.66	60	.40

Location	Quarterly Arithmetic Averages			
	1st	2nd	3rd	4th
5701 8th Ave NE, Seattle, Wa	.02	.02		
Harbor Island, 2555 13th Ave SW, Seattle, Wa	.36	.24	.39	.60

Summary of Individual 24 Hour Average Lead Values				
Location	Highest Value		Values Higher than .50	
	Value	Date	Value	Date
5701 8th Ave NE, Seattle, Wa	.06	9 Mar		
Harbor Island, 2555 13th Ave SW, Seattle, Wa	2.94	29 Sep	2.94	29 Sep
			1.66	22 Nov
			1.64	28 Dec
			1.33	21 Mar
			1.30	17 Oct
			1.11	1 Jul
			1.04	13 Jun
			1.03	28 Nov
			.77	22 Dec
			.69	15 Mar
			.67	25 Jul
			.66	16 Dec
			.59	1 Feb
			.59	11 Oct
			.55	14 Jan
			.55	7 Jun

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 Total Suspended Particulates (TSP) to only that portion of particulate matter with particle diameters smaller than or equal to 10 micrometers (PM_{10}). The levels for both the national primary and secondary standards are: 150 $\mu g/m^3$ for a 24 hour average and 50 $\mu g/m^3$ annual arithmetic mean. The PM_{10} standards also include calculation formulas to statistically determine if the standards are attained (40 CFR Part 50, Appendix K).

Particulate Sources and Air Quality

Particulates directly enter the air from industrial operations, from auto, bus and truck traffic, from fuel combustion including wood stoves and fireplaces, from construction, and from other sources. These emissions into the air change daily due to intermittent industrial operations, equipment upset or breakdown, traffic cycles and building heating requirements. Gaseous transformation products in the air like sulfates, nitrates, and some organics are also components of particulate matter. The wind acts to disperse and transport airborne particulate matter. Ambient particulate levels change from day to day in response both to what enters the air and to the variations in weather.

Sampling Methods

Reference methods designated by the U. S. EPA to measure PM_{10} all draw outside air first through an inlet that removes particulates larger than 10 micrometers and then through a filter that collects the remaining particulate matter (PM_{10}). Sampling for a single measurement continues for 24 hours under time clock control and the required sampling period occurs from midnight to midnight.

After the sampling has completed as scheduled, the pre-weighed, sampled filter must be manually removed. Following conditioning in a controlled environment for 24 hours to remove moisture effects, the sampled filter is weighed again on a precision balance and the weight of particulate matter collected during the sample period is calculated. The volume of air sampled, corrected to standard temperature and pressure conditions, is calculated from the flow rate and sampling time. The ambient PM_{10} concentration for the specific location and sampling time is calculated by dividing the weight (mass) of collected particulate by the volume of air sampled. The PM_{10} concentration is reported in micrograms per standard cubic meter.

The U. S. EPA has designated three methods as *equivalent methods* for the measurement of PM_{10}; two use a measurement principle based on beta-ray attenuation; one uses a Tapered Element Oscillating Microbalance (TEOM). All three equivalent methods are automated and continuous so that PM_{10} values may be immediately determined and transmitted to a central computer. These methods also measure consecutive daily values without the need for manual servicing after each sampling day.

By the end of 1994, the Puget Sound Air Pollution Control Agency had five equivalent method PM_{10} beta attenuation instruments and five TEOM instruments in operation. Three beta instruments and all five TEOM instruments are placed at wood smoke sites. Two of the beta attenuation instruments are located at industrial sites. A TEOM was installed at Lynnwood that began operation in mid October. Each beta attenuation and each TEOM instrument is collocated with one or more manual, reference method instrument(s) to enable data comparison. The Marysville station features collocation of both a beta attenuation instrument and TEOM along with the reference method.

The dichotomous sampler is one of the manual samplers designated as a *reference method* for the measurement of PM_{10}. This sampler is different from the more commonly used high volume sampler in that it further separates the PM_{10} at a particle diameter of 2.5 micrometers. The dichotomous sampler collects the small size particulates known as $PM_{2.5}$ on one filter and the coarse fraction containing particulates of size 2.5 to 10 micrometers on another filter. The Agency has collocated dichotomous

samplers with other particulate matter sampling at the Duwamish and Tacoma port industrial sites and also at the Kent station.

The integrating nephelometer continuously measures the light scattering extinction coefficient. A component of the scattering coefficient due to dry particles, (b_{sp}), generally shows good correlation to PM_{10} values and to visibility. The b_{sp} values are reported as a scattering coefficient per meter times 10^{-4}. Operating a nephelometer at a site concurrent with a reference method enables development of a relationship between the two methods for that site.

Summary of Data

During 1994, PM_{10} data in the Puget Sound Region was measured at sixteen locations, but seven of these sites were equipped only with a single manual reference method sampler. PM_{10} sampling usually occurred each sixth day at these seven locations for a total of about sixty PM_{10} values during the year at each of those sites.

Continuous PM_{10} data was obtained at nine locations that were equipped with additional reference method samplers and/or equivalent method monitors. Two of these continuous sites are industrial locations and six of the sites are primarily wood smoke monitoring locations. The industrial locations have operated since the PM_{10} standard was adopted and the wood smoke area monitoring began more recently.

Since adoption of the PM_{10} standard in 1987, none of the annual PM_{10} values have exceeded the annual PM_{10} standard. This means the Puget Sound Region is in compliance with the annual PM_{10} standard.

Under the Federal regulation, (40 CFR Part 50, Appendix K), the last three years of data must be used to determine compliance with the 24 hour average PM_{10} standard. This regulation requires attainment to be determined by statistically adjusting for days without data and then calculating the average number of days per year exceeding the standard at a particular location for the last three years. If this "expected" number of days above the standard exceeds one, then the PM_{10} standard has not been attained; the location is out of compliance with the 24 hour average PM_{10} standard.

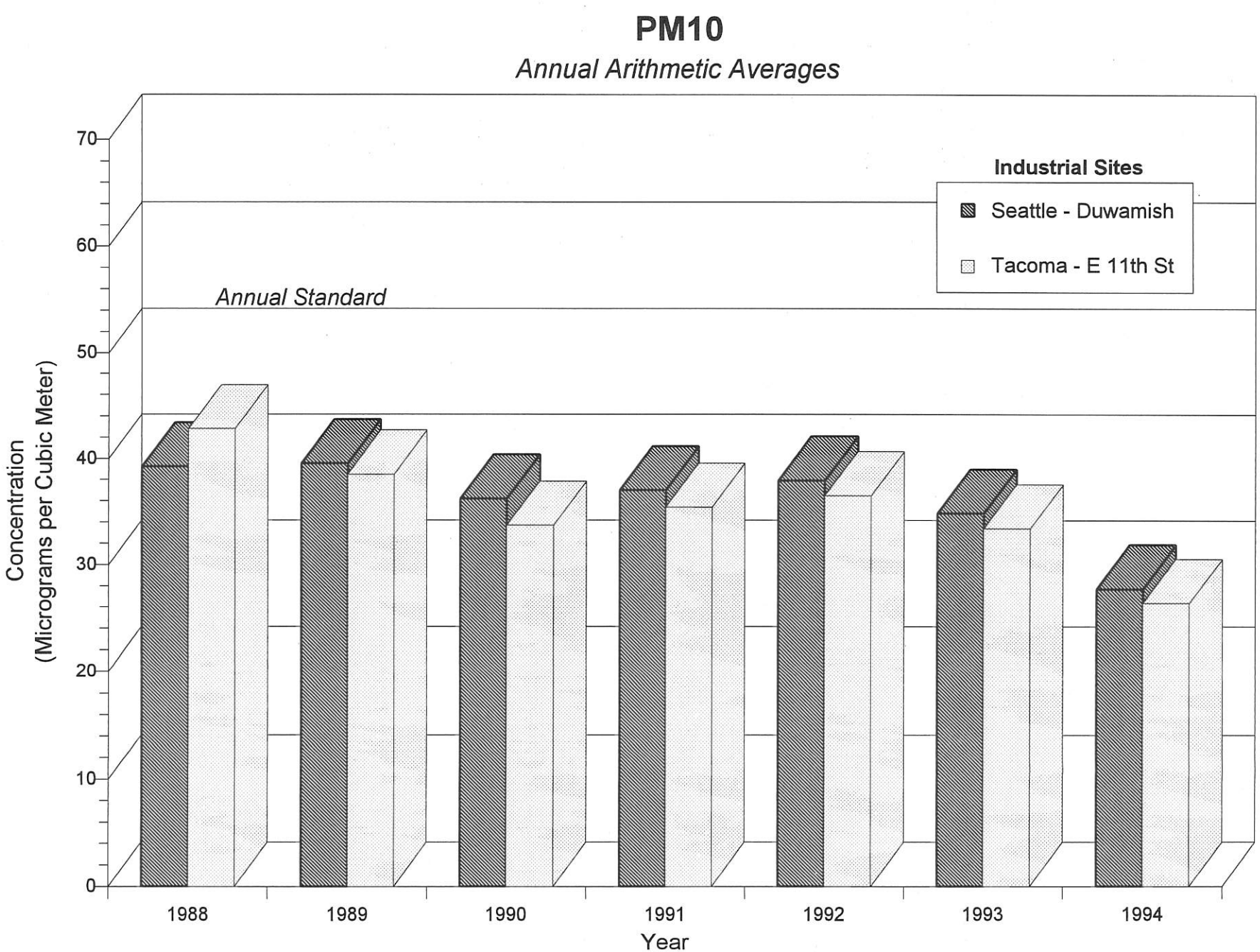
The 24 hour average PM_{10} standard has been met everywhere in the Puget Sound Region for the last six calendar years. A single daily value at a Tacoma port area station during 1990 exceeded the level of the 150 $\mu g/m^3$ daily standard, but this was not a violation of the standard because measurements occur each day at this site and none of the other values exceeded the level of the standard. With respect to the daily (24 hour average) PM_{10} standard, the last three years of data establish the Region is in compliance with this standard.

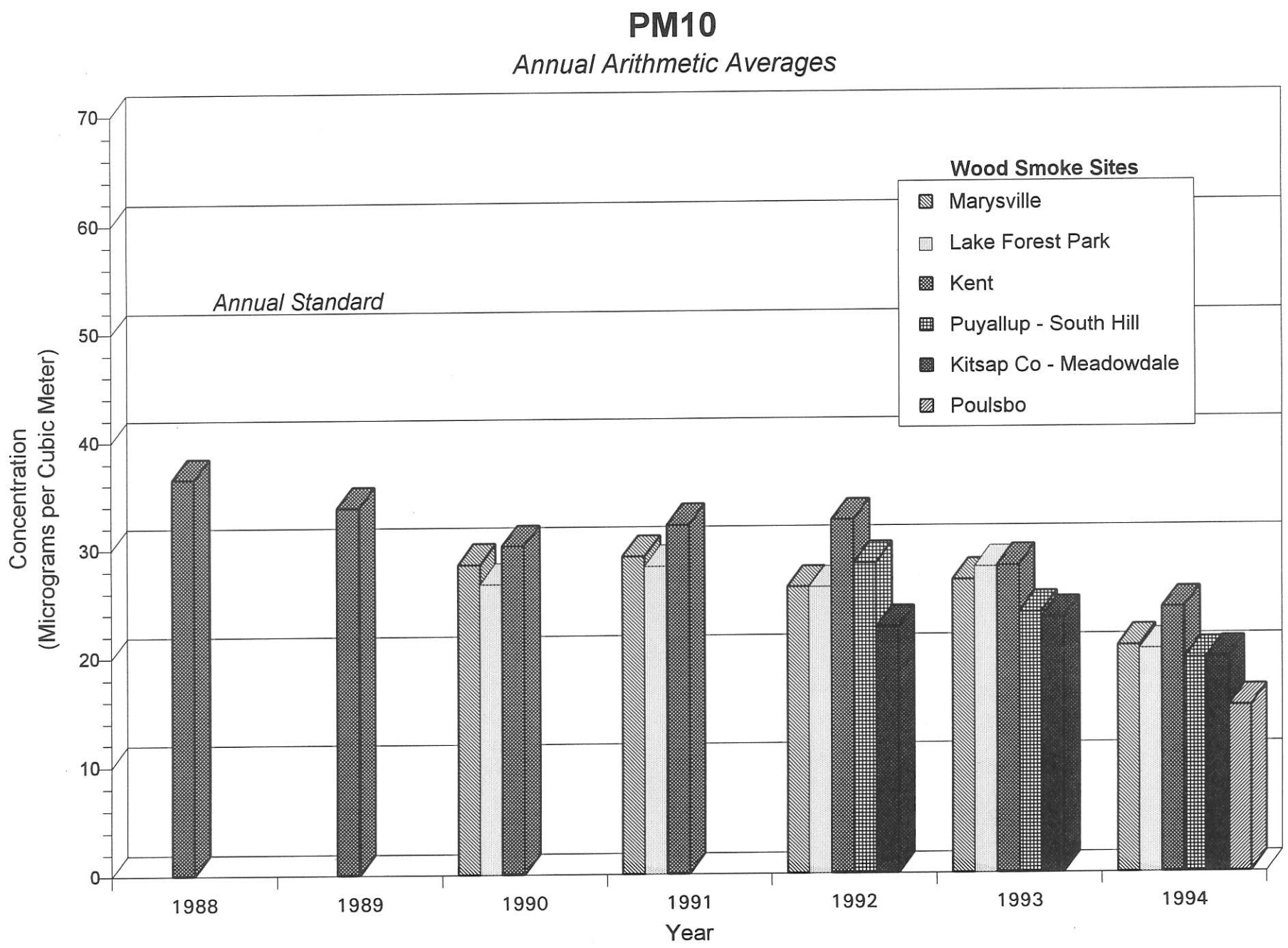
Charts on the following pages summarize PM_{10} data beginning in the first year following the PM_{10} standard adoption. Column graphs for the eight stations with continuous data present a PM_{10} history starting either in 1988 or with the beginning of data at each site. The new site in Lynnwood is not included in these charts since it operated only for the last three months of 1994.

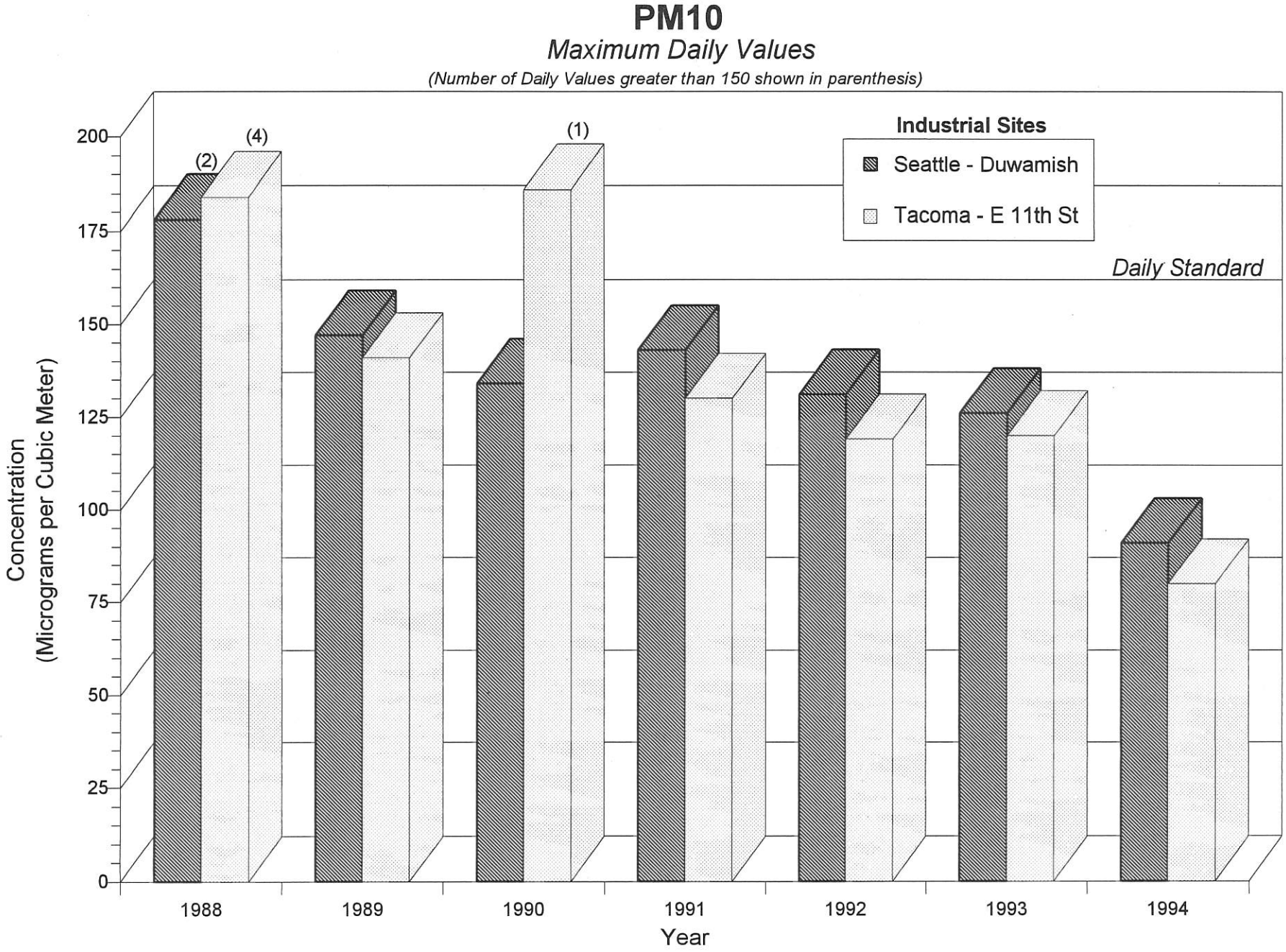
Separate charts for industrial sites and wood smoke sites show the annual arithmetic averages and maximum daily values. These charts show compliance with both the annual and 24 hour average PM_{10} standards for both types of monitoring locations. One can see the PM_{10} levels in the industrial areas have been and continue to be higher than those in the wood smoke areas.

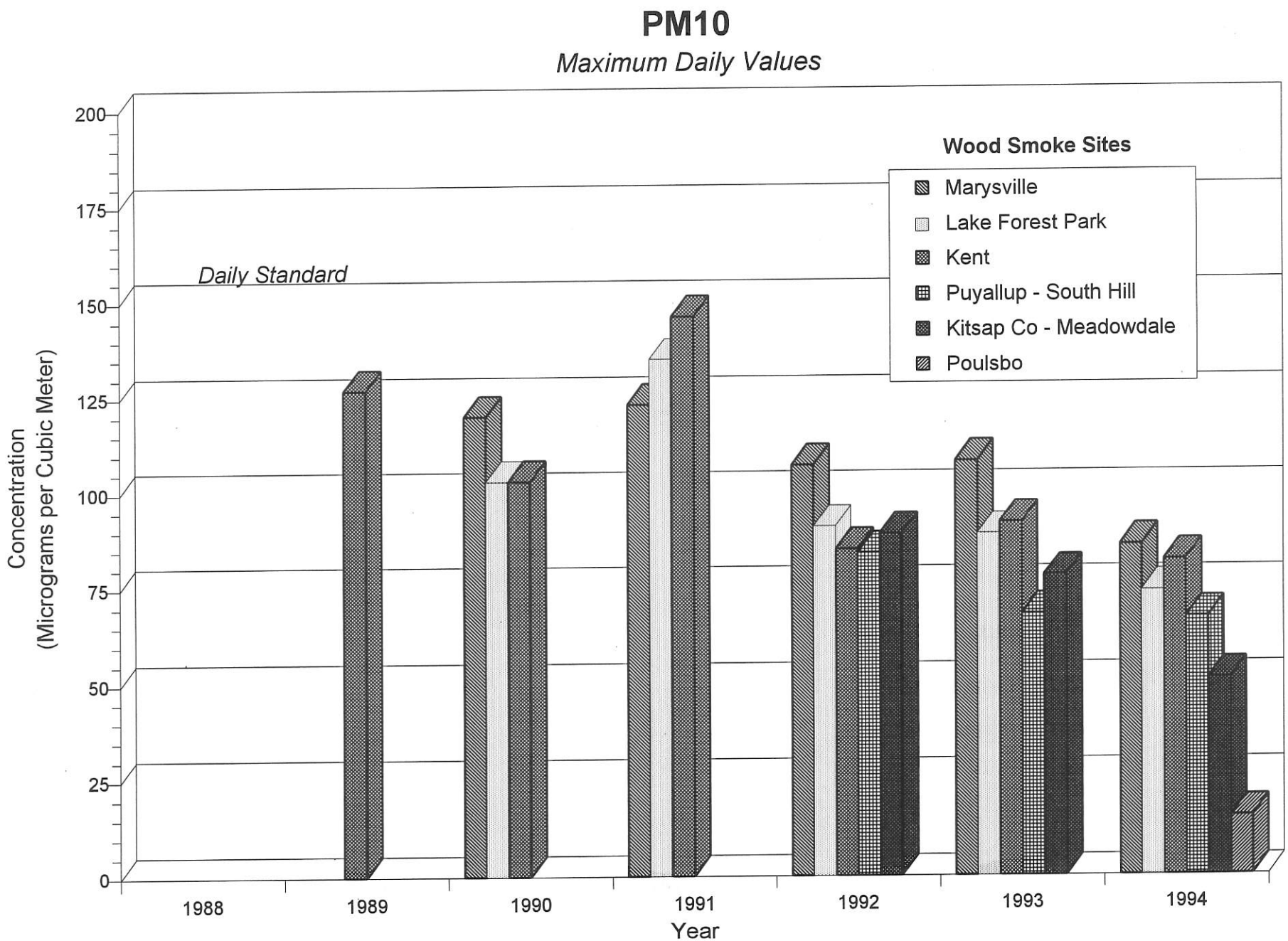
An additional set of charts shows the number of days when each of these stations exceeded the 75 $\mu g/m^3$ "impaired air quality" trigger level established in Washington State law. During the heating season beginning the last part of October and continuing into March, certain indoor burning in fireplaces and wood stoves is prohibited upon formal declaration that a period of "impaired air quality" is in effect.

Tables following the charts summarize for each station the 1994 PM_{10} data from both reference and equivalent methods, $PM_{2.5}$ data from dichotomous samplers and b_{sp} values from nephelometer measurements.


PM10
Annual Arithmetic Averages
Industrial Sites
Seattle - Duwamish
Tacoma - E 11th St
Annual Standard
Concentration
(Micrograms per Cubic Meter)
70
60
50
40
30
20
10
0
1988
1989
1990
1991
1992
1993
1994
Year

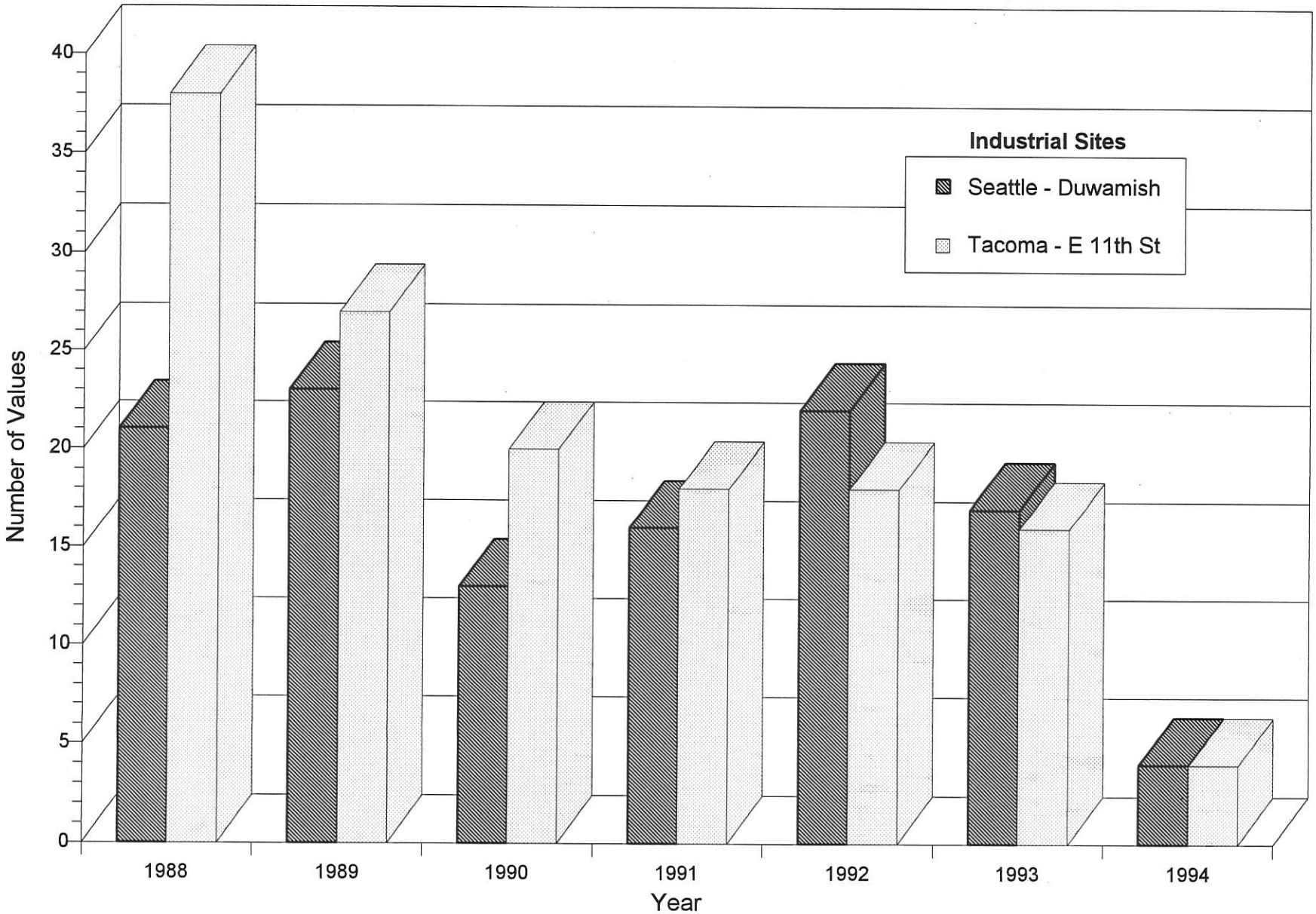

PM10
Annual Arithmetic Averages
Annual Standard
Wood Smoke Sites
Marysville
Lake Forest Park
Kent
Puyallup - South Hill
Kitsap Co - Meadowdale
Poulsbo
Concentration
(Micrograms per Cubic Meter)
0
10
20
30
40
50
60
70
1988
1989
1990
1991
1992
1993
1994
Year


PM10
Maximum Daily Values
(Number of Daily Values greater than 150 shown in parenthesis)
Industrial Sites
Seattle - Duwamish
Tacoma - E 11th St
Daily Standard
(2)
(4)
(1)
200
175
150
125
100
75
50
25
0
Concentration
(Micrograms per Cubic Meter)
1988
1989
1990
1991
1992
1993
1994
Year


PM10
Maximum Daily Values
Wood Smoke Sites
Marysville
Lake Forest Park
Kent
Puyallup - South Hill
Kitsap Co - Meadowdale
Poulsbo
Daily Standard
Concentration
(Micrograms per Cubic Meter)
200
175
150
125
100
75
50
25
0
1988
1989
1990
1991
1992
1993
1994
Year

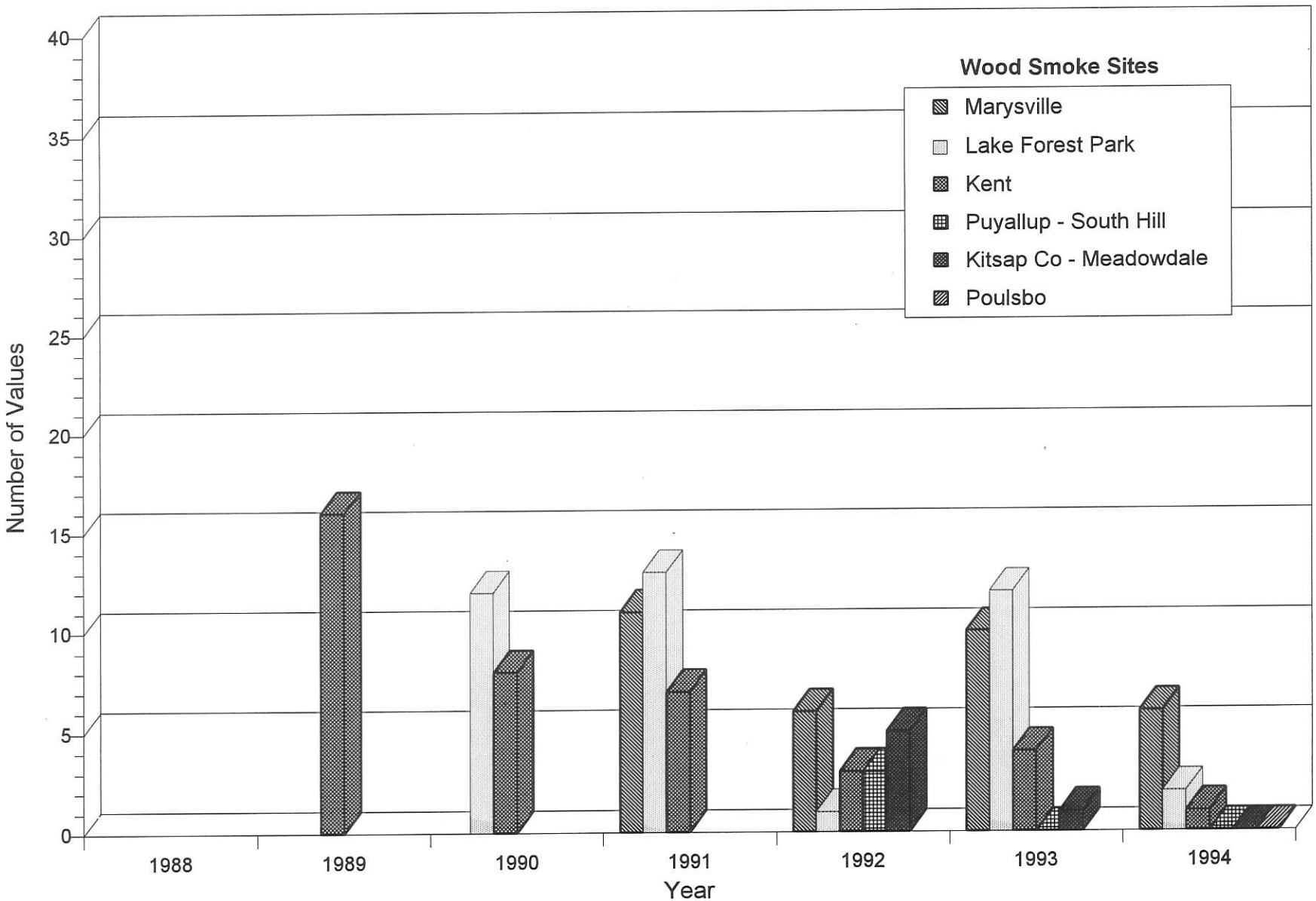
PM10

Number of Daily Values Greater than or Equal to 75 micrograms per cubic meter



PM10

Number of Daily Values Greater than or Equal to 75 micrograms per cubic meter



PARTICULATE MATTER (PM_{10})

Micrograms per Standard Cubic Meter

Sampling Method: Reference - **Hi Vol ANDERSEN/GMW 1200** Quartz Fiber filters

1994

Location	Number of Values	Quarterly Arithmetic Averages				Year Arith Mean
		1st	2nd	3rd	4th	
Marysville JHS, 1605 7th St, Marysville, Wa	206	25.6	16.8	18.6	22.2	20.8
Hoyt Ave & 26th St, Everett, Wa	61	22.1	18.1	18.3	18.1	19.2
20935 59th Place West, Lynnwood, Wa	13				22.2	
504 Bellevue Way NE, Bellevue, Wa	61	21.1	15.4	17.2	18.3	18.0
17711 Ballinger Way NE, Lake Forest Park, Wa	297	25.9	15.6	15.9	24.4	20.5
Harbor Island, 3400 13th Ave SW, Seattle, Wa	60	32.0	20.1	24.1	30.6	26.7
Duwamish, 4752 E Marginal Way S, Seattle, Wa	350	33.1	22.6	25.6	29.5	27.7
South Park, 723 S Concord St, Seattle, Wa	61	25.5	15.8	20.6	25.6	21.9
James St & Central Ave, Kent, Wa	301	24.8	20.1	27.7	24.5	24.3
South Hill, 9616 128th St E, Puyallup, Wa	61	22.2	12.7	19.1	24.3	19.6
27th St NE & 54th Ave NE, Northeast Tacoma, Wa	60	22.1	18.9	22.2	28.0	22.8
2340 Taylor Way, Tacoma, Wa	45	30.1	18.7	27.3		25.4
2301 Alexander Ave, Tacoma, Wa	144	25.8	19.0	22.3	23.5	22.7
Fire Station #12, 2316 E 11th St, Tacoma, Wa	352	30.2	21.8	24.5	29.1	26.4
Meadowdale, 7252 Blackbird Dr NE, KitsapCo, Wa	61	22.9	13.5	14.1	28.1	19.7
Lions Park, 6th Ave NE & Fjord Dr, Poulsbo, Wa	61	16.1	12.2	13.1	19.5	15.2

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 20 Thu	Jan 29 Sat	Feb 1 Tue	Feb 2 Wed	Feb 4 Fri	Feb 5 Sat	Feb 6 Sun	Feb 7 Mon	Mar 9 Wed	Sep 23 Fri	Oct 11 Tue	Oct 17 Mon	Oct 23 Sun	Dec 4 Sun	Dec 23 Fri
Marysville JHS, 1605 7th St, Marysville, Wa				83		-	86								-
Hoyt Ave & 26th St, Everett, Wa		-	46	-	-	-	-		47						-
20935 59th Place West, Lynnwood, Wa	-	-	-	-	-	-	-	-	-	-	-		30	45	-
504 Bellevue Way NE, Bellevue, Wa		41	45	-	-	-	-		-						-
17711 Ballinger Way NE, Lake Forest Park, Wa					69	74	-						-		
Harbor Island, 3400 13th Ave SW, Seattle, Wa	60	-	60	-	-	-	-		-						-
Duwamish, 4752 E Marginal Way S, Seattle, Wa				80											91
South Park, 723 S Concord St, Seattle, Wa		-	50	-	-	-	-			55					-
James St & Central Ave, Kent, Wa			70			71	-								
South Hill, 9616 128th St E, Puyallup, Wa		-	62	-	-	-	-							51	-
27th St NE & 54th Ave NE, Northeast Tacoma, Wa		-		-	-	-	-			54	79				-
2340 Taylor Way, Tacoma, Wa		-	68	-	-	-	-		63		-	-	-	-	-
2301 Alexander Ave, Tacoma, Wa			71	-	-	69	-	-	-	-					-
Fire Station #12, 2316 E 11th St, Tacoma, Wa				79				76							
Meadowdale, 7252 Blackbird Dr NE, KitsapCo, Wa		-	51	-	-	-	-							41	-
Lions Park, 6th Ave NE & Fjord Dr, Poulsbo, Wa	28	-	32	-	-	-	-					28			-

- Indicates no sample on specified day

Summary of Observations Equal To or Greater Than 75

Location	Feb 1 Tue	Feb 2 Wed	Feb 3 Thu	Feb 4 Fri	Feb 5 Sat	Feb 6 Sun	Feb 7 Mon	Oct 11 Tue	Dec 13 Tue	Dec 23 Fri	Dec 30 Fri
Marysville JHS, 1605 7th St, Marysville, Wa		83	-	78	-	86			79	-	78
17711 Ballinger Way NE, Lake Forest Park, Wa											
Harbor Island, 3400 13th Ave SW, Seattle, Wa											
Duwamish, 4752 E Marginal Way S, Seattle, Wa		80			75		75		-	91	-
South Park, 723 S Concord St, Seattle, Wa											
James St & Central Ave, Kent, Wa											
27th St NE & 54th Ave NE, Tacoma, Wa		-	-	-	-	-		79	-	-	-
2340 Taylor Way, Tacoma, Wa											
2301 Alexander Ave, Tacoma, Wa											
Fire Station #12, 2316 E 11th St, Tacoma, Wa	75	79	75				76				-

- Indicates no sample on specified day

PARTICULATE MATTER (PM_{10})

Micrograms per Standard Cubic Meter

Sampling Method: Equivalent - **BetaAtten ANDERSEN FH62I-N** Glass Fiber strip

1994

Location	Number of Values	Quarterly Arithmetic Averages				Year Arith Mean
		1st	2nd	3rd	4th	
Marysville JHS, 1605 7th St, Marysville, Wa	365	24.2	17.3	19.7	23.7	21.2
17711 Ballinger Way NE, Lake Forest Park, Wa	365	28.2	14.4	15.5	22.1	20.1
Duwamish, 4752 E Marginal Way S, Seattle, Wa	365	31.2	23.5	26.7	28.7	27.5
James St & Central Ave, Kent, Wa	365	27.1	18.9	26.4	21.5	23.5
Fire Station #12, 2316 E 11th St, Tacoma, Wa	365	29.2	21.3	25.5	28.9	26.2

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	Feb 1 Tue	Feb 2 Wed	Feb 3 Thu	Feb 4 Fri	Feb 5 Sat	Feb 6 Sun	Dec 23 Fri
Marysville JHS, 1605 7th St, Marysville, Wa					77	76	
17711 Ballinger Way NE, Lake Forest Park, Wa				75	78		
Duwamish, 4752 E Marginal Way S, Seattle, Wa		73					82
James St & Central Ave, Kent, Wa	73					82	
Fire Station #12, 2316 E 11th St, Tacoma, Wa		76	80				

Summary of Observations Equal To or Greater Than 75

Location	Feb 2 Wed	Feb 3 Thu	Feb 4 Fri	Feb 5 Sat	Feb 6 Sun	Dec 23 Fri
Marysville JHS, 1605 7th St, Marysville, Wa				77	76	
17711 Ballinger Way NE, Lake Forest Park, Wa			75	78		
Duwamish, 4752 E Marginal Way S, Seattle, Wa						82
James St & Central Ave, Kent, Wa					82	
Fire Station #12, 2316 E 11th St, Tacoma, Wa	76	80				

PARTICULATE MATTER (PM_{10})

Micrograms per Standard Cubic Meter

Sampling Method: Equiv - **Mass Transducer R&P TEOM 1400a** Tef-coat Glass Fiber

1994

Location	Number of Values	Quarterly Arithmetic Averages				Year Arith Mean
		1st	2nd	3rd	4th	
Marysville JHS, 1605 7th St, Marysville, Wa	340	21.7	16.1	18.8	19.5	19.0
20935 59th Pl W, Lynnwood, Wa	75				17.7	
South Hill, 9616 128th St E, Puyallup, Wa	354	18.4	13.5	17.1	16.8	16.5
Meadowdale, 7252 Blackbird Dr NE, KitsapCo, Wa	350	20.5	11.8	13.5	18.5	16.1
Lions Park, 6th Ave NE & Fjord Dr, Poulsbo, Wa	364	16.1	13.2	14.0	15.2	14.6

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 16 Sun	Jan 29 Sat	Feb 1 Tue	Feb 5 Sat	Feb 6 Sun	Feb 10 Thu	Mar 9 Wed	Dec 13 Tue	Dec 30 Fri	Dec 31 Sat
Marysville JHS, 1605 7th St, Marysville, Wa								74	71	
20935 59th Pl W, Lynnwood, Wa	-	-	-	-	-	-	-	62		52
South Hill, 9616 128th St E, Puyallup, Wa				62	67					
Meadowdale, 7252 Blackbird Dr NE, KitsapCo, Wa	44	45	44							
Lions Park, 6th Ave NE & Fjord Dr, Poulsbo, Wa	32			32		34	32			

- Indicates no sample on specified day

PARTICULATE MATTER ($PM_{2.5}$)

Micrograms per Standard Cubic Meter

Sampling Method: **Dichotomous Sampler - SA244E** Teflon filters

1994

Location	Number of Values	Quarterly Arithmetic Averages				Year Arith Mean
		1st	2nd	3rd	4th	
Duwamish, 4752 E Marginal Way S, Seattle, Wa	115	18.0	13.9	12.0	16.3	15.1
James St & Central Ave, Kent, Wa	124	12.7	9.4	10.5	14.9	11.9
Fire Station #12, 2316 E 11th St, Tacoma, Wa	121	16.1	9.8	11.2	16.3	13.4

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	Feb 1 Tue	Feb 3 Thu	Dec 13 Tue
Duwamish, 4752 E Marginal Way S, Seattle, Wa		46	43
James St & Central Ave, Kent, Wa	35		42
Fire Station #12, 2316 E 11th St, Tacoma, Wa	42	40	

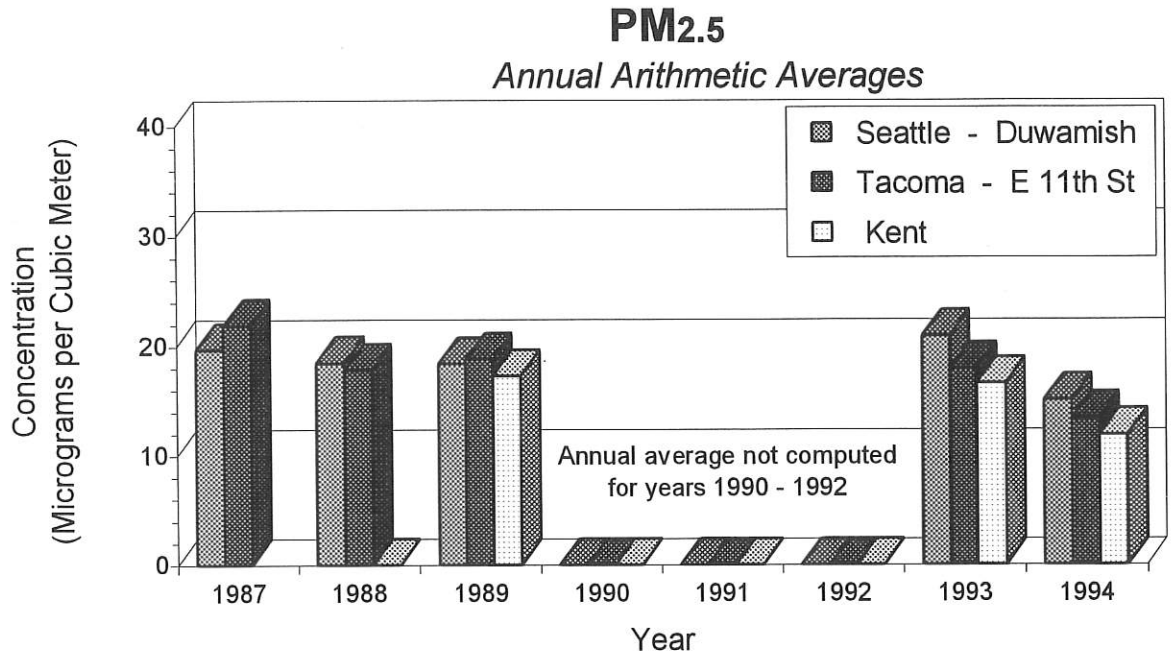
Summary of Observations Equal To or Greater Than 35

Location	Jan 29 Sat	Feb 1 Tue	Feb 3 Thu	Dec 10 Sat	Dec 13 Tue
Duwamish, 4752 E Marginal Way S, Seattle, Wa		39	46		43
James St & Central Ave, Kent, Wa		35			42
Fire Station #12, 2316 E 11th St, Tacoma, Wa	35	42	40	35	37

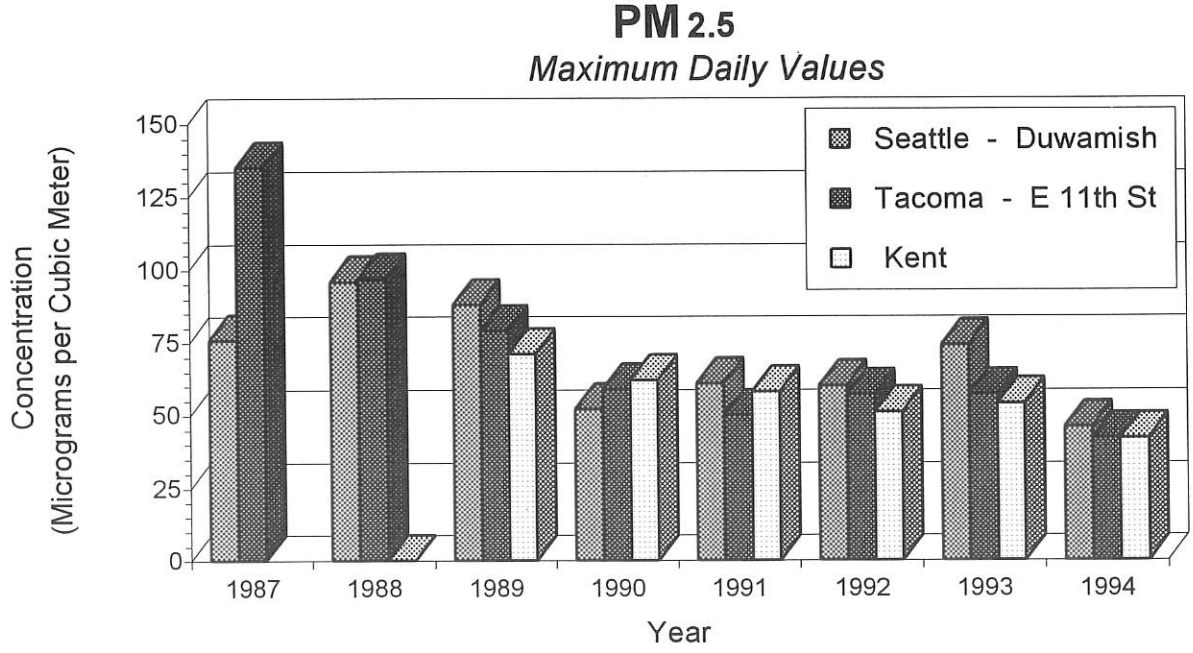
PARTICULATE MATTER ($PM_{2.5}$)

Particulate Matter ≤ 2.5 Micrometers

Sampling Method: Dichotomous Sampler - SA244E Teflon filters



Note: In years 1990 - 1992 no sampling occurred during months April through September



ATMOSPHERIC PARTICLES

($b_{sp} \times 10^{-4}/M$)

1994

Location	Monthly Arithmetic Averages												No of 1 Hour Samples	Year Arith Mean
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
17711 Ballinger Way NE, Lake Forest Park, Wa	.74	.78	.45	.36	.27	.20	.28	.26	.36	.62	.59	.66	8676	.46
Duwamish, 4752 E Marginal Way S, Seattle, Wa	.66	.64	.40	.35	.30	.22	.29	.28	.38	.52	.43	.50	8641	.41
James St & Central Ave, Kent, Wa	.72	.78	.42	.38	.35	.23	.41	.32	.45	.56	.47	.58	8643	.47

Statistical Summary

Location	No. of 1 hour Samples	Frequency Distribution - Percent												1 Hour Max	Arith Mean	Arith Std Dev
		5	10	20	30	40	50	60	70	80	90	95	99			
17711 Ballinger Way NE, Lake Forest Park, Wa	8676	.1	.1	.2	.2	.2	.3	.3	.4	.6	1.0	1.5	3.0	5.11	.46	.54
Duwamish, 4752 E Marginal Way S, Seattle, Wa	8641	.1	.1	.2	.2	.3	.3	.4	.4	.5	.8	1.2	2.2	3.17	.41	.39
James St & Central Ave, Kent, Wa	8643	.1	.1	.2	.2	.3	.3	.4	.5	.7	1.0	1.4	2.5	4.21	.47	.47

SULFUR DIOXIDE

Sulfur dioxide is a common air pollutant regulated under a national standard. Local sulfur dioxide standards have been in effect since 1968. The national, state and local sulfur dioxide standards are summarized on page 59. 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 Region, 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. Reactions in the air partially convert sulfur dioxide to other sulfur compounds such as sulfuric acid and various sulfate salts. Early on the morning of July 5, high sulfur dioxide concentrations were measured at the Everett station at Hoyt Avenue and 26th Street. The highest concentration of 0.738 ppm for the hour ending at 4 a.m. local time violated the PSAPCA 0.40 ppm hour average standard, but not the State standard, since one such occurrence is allowed per year under the State rule. There is no federal one hour standard. This case of high ambient sulfur dioxide was caused by emissions from the paper company located on the waterfront just to the west of the monitoring station. The tables below summarize sulfur dioxide data collected during 1994 and show that the Puget Sound Region continues to comply with all federal sulfur dioxide standards.

SULFUR DIOXIDE
(Parts per Million)
1994

Monthly and Annual Arithmetic Averages

Location	Monthly Arithmetic Averages												No. of 1 Hour Samples	Year Arith Mean
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Hoyt Ave & 26th St, Everett, Wa	.005	.004	.005	.004	.005	.004	.008		.007	.006	.004	.003	7519	.005
Duwamish, 4752 E Marginal Way S, Seattle, Wa	.008	.008	.009	.008	.007	.006	.007	.008	.008	.008	.006	.006	8430	.007
27th St NE & 54th Ave NE, Northeast Tacoma, Wa	.010	.010	.007	.006	.006	.005	.005	.006	.008	.008	.008	.007	8554	.007
2301 Alexander Ave, Tacoma, Wa	.009	.008	.008	.006	.007	.005	.008	.006	.007	.007	.006	.007	8651	.007

Maximum and Second Highest Concentrations for Various Averaging Periods

Location / Continuous Sampling Periods(s)	1 Hour Average			3 Hour Average			24 Hour Average		
	Value	Date	End Time	Value	Date	End Time	Value	Date	End Time
Hoyt Ave & 26th St, Everett, Wa	.738	5 Jul	0300	.327	5 Jul	0300	.047	5 Jul	2400
1 Jan-31 Dec	.230	5 Jul	0200	.091	1 Aug	1700	.027	20 Jul	2200
Duwamish, 4752 E Marginal Way S, Seattle, Wa	.074	12 Aug	0900	.053	12 Apr	0100	.024	1 Nov	1000
1 Jan-31 Dec	.074	14 Sep	1500	.053	23 Nov	0800	.021	12 Apr	0700
27th St NE & 54th Ave NE, Northeast Tacoma, Wa	.235	20 Jul	0700	.108	20 Jul	0900	.027	24 Dec	0600
1 Jan-31 Dec	.092	2 Feb	0200	.067	2 Feb	0300	.026	6 Feb	0200
2301 Alexander Ave, Tacoma, Wa	.100	21 Aug	0200	.062	16 Feb	0500	.020	22 Jan	0700
1 Jan-31 Dec	.083	16 Feb	0300	.046	23 Apr	1000	.019	3 Feb	0300

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 sulfur dioxide was measured using the continuous ultraviolet fluorescence method.

Introduction

As a group, motor vehicles emit more carbon monoxide than any other source. For Puget Sound Region cities, motor vehicles contribute significantly in all cases of high carbon monoxide ambient levels.

The occasions with high ambient levels of carbon monoxide occur mainly during autumn and winter months near congested motor vehicle traffic. Traffic congestion occurs with afternoon commuting and increased shopping during holidays. Stable weather and light wind often exist during periods when levels are high. This weather condition temporarily reduces the means to disperse carbon monoxide that is 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. 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 an 8 hour average of 15 ppm and meteorological conditions are such that this concentration can be expected to remain at or above that level for 12 or more hours, or to recur within 24 hours unless control actions are taken. If needed, the Plan includes more severe stages of Warning (30 ppm for an 8 hour average) and Emergency (40 ppm).

Summary of 1994 Data

The table in this section summarizes the six highest 1 hour and 8 hour average carbon monoxide levels at each station during 1994 as obtained from Department of Ecology data summaries. The Federal regulation, (40 CFR Part 50), directs that comparison of the data with the standards (in ppm) be made in terms of integers with fractional parts of 0.5 or greater rounding up. Further, the ambient concentration at a site shall not exceed the level of the standard more than once per year.

For the second year in a row in the Puget Sound Region, no station measured carbon monoxide values that exceeded the level of the 8 hour average standard. The highest 8 hour average at any location during 1994 occurred at the NE 8th Street station in Bellevue where a value of 9.3 ppm was measured on December 23-24. The 1 hour standard continues to be easily achieved everywhere.

Multi-Year Summary

Multi-year graphs for carbon monoxide present column charts to show the historical trend. For the longest term sampling sites in the cities of Seattle, Everett, Bellevue and Tacoma, one chart shows the number of days on which the 8 hour average exceeded 9 ppm for each year from 1979 to 1994. A companion chart graphs the value that was the second high 8 hour average for each of those years. If the second high 8 hour average equals or exceeds 9.5 ppm, this violates the standard.

For all cities, the data acquired since 1979 show that carbon monoxide values have improved, though there is some variability from year to year. As documented in previous annual data summaries, the first complete year of carbon monoxide data for the Seattle 5th Avenue and James Street station was 1972. The results at this station have improved from exceeding the primary standard 112 days in 1972 and 130 days in 1973, to zero exceedances during 1987 through 1994. The charts show that for the last four years, 1991 through 1994, the carbon monoxide levels throughout the Puget Sound Region have achieved the standards.

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 regular testing of vehicle emissions to assure compliance with these standards. Since November 1992, the requirement that only oxygenated gasoline be dispensed during the four months from November through February has also reduced carbon monoxide emissions.

CARBON MONOXIDE

(Parts per Million)

1994

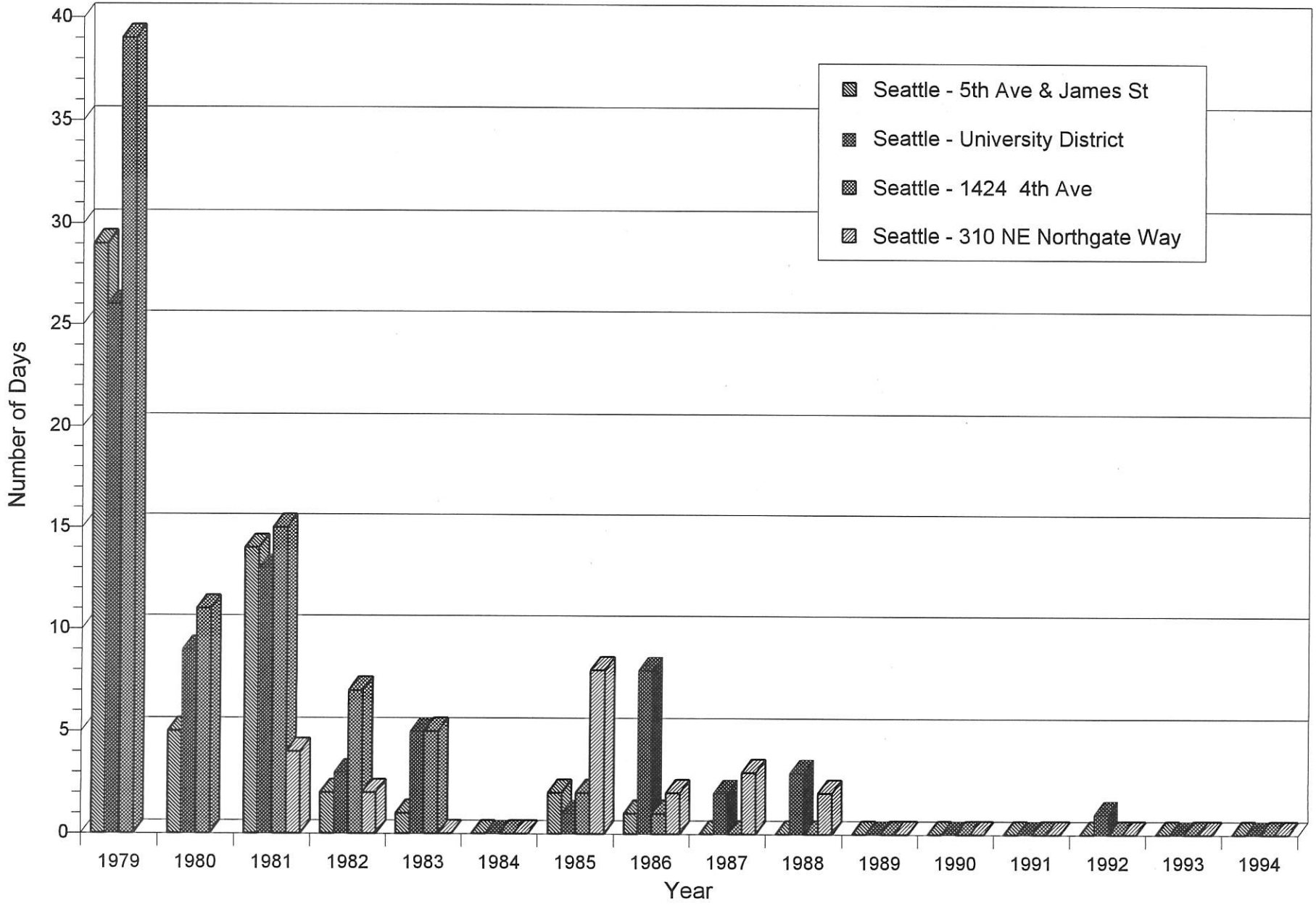
Location / Continuous Sampling Period(s)	Six Highest Concentrations						Number of 8 Hour Averages Exceeding 9 ppm	Number of Days 8 Hour Average Exceeded 9 ppm
	1 Hour Average			8 Hour Average				
	Value	Date	End Time	Value	Date	End Time		
Broadway & Hewitt Ave, Everett, Wa	12.4	30 Dec	1900	7.0	30 Dec	2400	0	0
1 Jan-31 Dec	11.6	30 Dec	2000	6.2	6 Sep	1700		
	9.9	13 Dec	1900	6.0	23 Sep	1800		
	9.2	17 Jan	1900	5.9	15 Apr	1800		
	9.2	17 Nov	1800	5.9	13 Dec	2100		
	9.1	13 Dec	1800	5.8	18 Jan	2000		
622 Bellevue Way NE, Bellevue, Wa	8.7	23 Dec	2000	7.6	24 Dec	0100	0	0
1 Jan-31 Dec	8.6	23 Dec	1900	5.2	14 Dec	0100		
	7.9	23 Dec	1800	5.0	6 Feb	0100		
	7.7	23 Dec	2100	4.8	3 Feb	0100		
	7.3	13 Dec	2100	4.4	21 Jan	2200		
	7.3	23 Dec	2200	4.1	20 Jan	2400		
NE 8th St & 108th Ave NE	10.8	23 Dec	2400	9.3	24 Dec	0100	0	0
Bellevue, Wa	10.6	23 Dec	1800	6.2	13 Dec	2400		
1 May-31 Dec	9.5	24 Dec	0100	5.5	23 Dec	1700		
	9.4	23 Dec	1900	4.7	10 Nov	2400		
	9.4	23 Dec	2000	4.7	22 Dec	2200		
	9.3	23 Dec	2300	4.3	18 Oct	2300		
Northgate, 310 NE Northgate Way	10.8	1 Feb	0900	7.1	24 Dec	0100	0	0
Seattle, Wa	8.8	4 Oct	0800	4.9	21 Jan	1900		
1 Jan-31 Dec	8.7	23 Dec	2000	4.5	1 Feb	1400		
	8.3	23 Dec	2100	4.5	4 Oct	1300		
	8.2	23 Dec	1900	4.5	23 Dec	1700		
	7.6	31 Jan	0800	4.3	13 Dec	2300		
University District, 1307 NE 45th St	13.6	27 Feb	2300	8.2	24 Dec	0300	0	0
Seattle, Wa	11.2	25 Jul	1000	6.8	21 Jan	1900		
1 Jan-31 Dec	10.5	31 Jan	0100	6.4	23 Dec	1900		
	10.4	23 Dec	2400	6.2	31 Jan	0300		
	9.7	23 Dec	2200	5.8	6 Jan	2100		
	8.4	24 Dec	0200	5.8	9 Oct	1700		
1424 4th Ave, Seattle, Wa	7.7	20 Jan	1800	6.8	24 Dec	0300	0	0
1 Jan-31 Dec	7.5	23 Dec	2100	5.2	21 Jan	1900		
	7.4	23 Dec	2000	4.5	20 Jan	2200		
	7.4	23 Dec	2200	4.0	31 Jan	0300		
	7.3	24 Dec	0300	4.0	12 Dec	1500		
	7.0	23 Dec	2300	4.0	23 Dec	1900		
5th Ave & James St, Seattle, Wa	7.9	21 Jan	1800	6.1	21 Jan	1900	0	0
1 Jan-31 Dec	6.8	9 Mar	1800	4.7	20 Jan	2300		
	6.7	21 Jan	1500	4.2	31 Jan	1400		
	6.5	21 Jan	1900	4.1	19 Jan	1900		
	6.3	20 Jul	1700	4.1	20 Jul	1900		
	6.1	20 Jan	1800	4.0	23 Sep	1700		
1101 Pacific Ave, Tacoma, Wa	10.4	5 Dec	1200	7.5	23 Dec	2400	0	0
1 Jan-31 Dec	9.9	23 Dec	2300	6.0	1 Feb	2400		
	8.5	23 Dec	2400	5.8	21 Dec	2400		
	8.0	23 Dec	2200	5.7	5 Dec	1900		
	7.9	1 Feb	1800	5.4	24 Oct	2300		
	7.7	23 Dec	2000	5.3	14 Dec	1800		
2909 Wheaton Way, Bremerton, Wa	6.4	5 Dec	1800	4.8	23 Dec	2100	0	0
1 Sep-31 Dec	6.4	23 Dec	1600	4.3	4 Nov	2400		
	6.1	24 Oct	0700	4.3	10 Nov	2400		
	6.0	2 Dec	1700	3.9	3 Nov	0100		
	5.9	21 Nov	0800	3.6	9 Nov	2300		
	5.6	4 Nov	2100	3.6	12 Dec	1300		

Notes

(1) All carbon monoxide stations 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 carbon monoxide was measured using the continuous nondispersive infrared method.

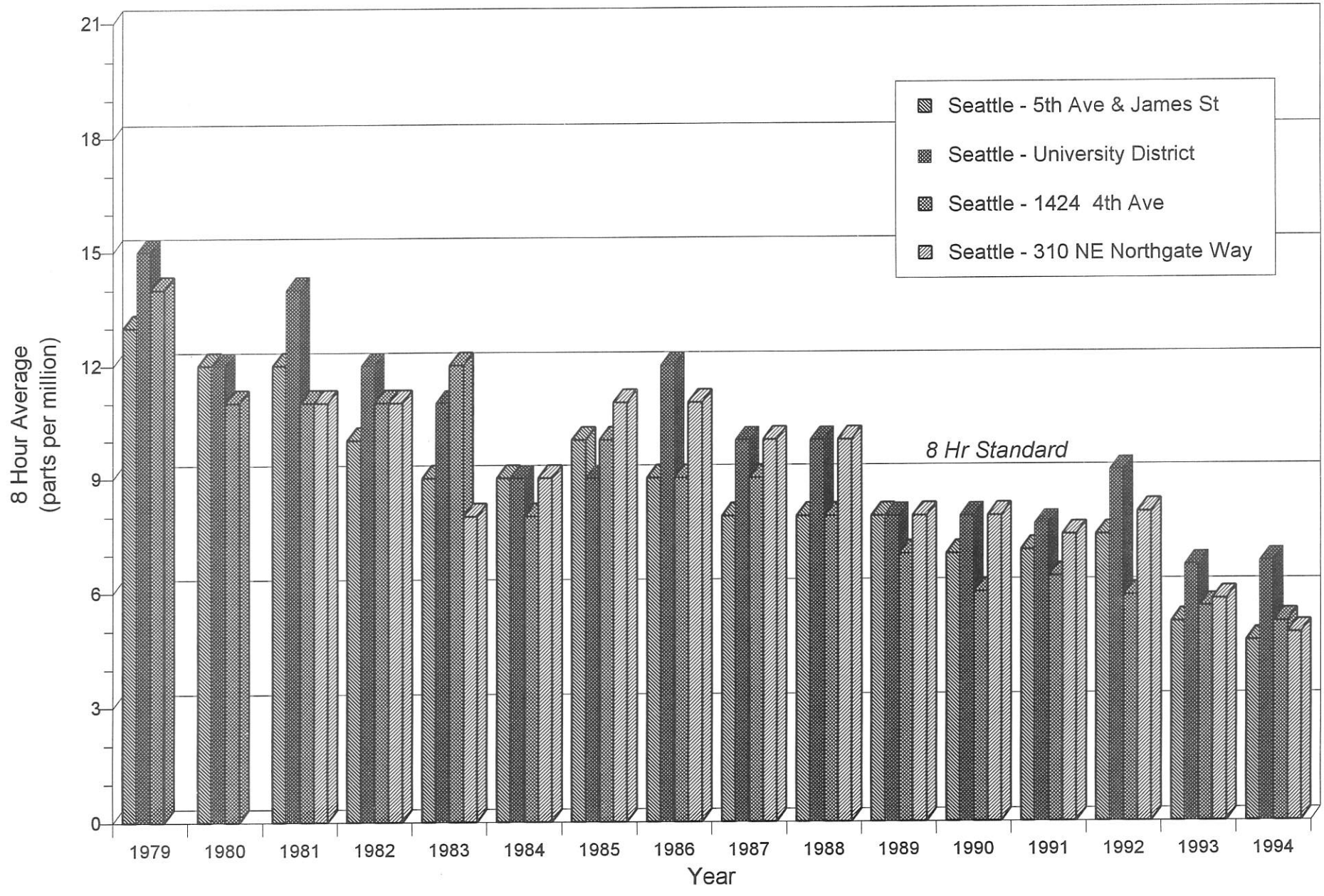
CARBON MONOXIDE

Number of Days 8 Hour Average Exceeded 9 ppm



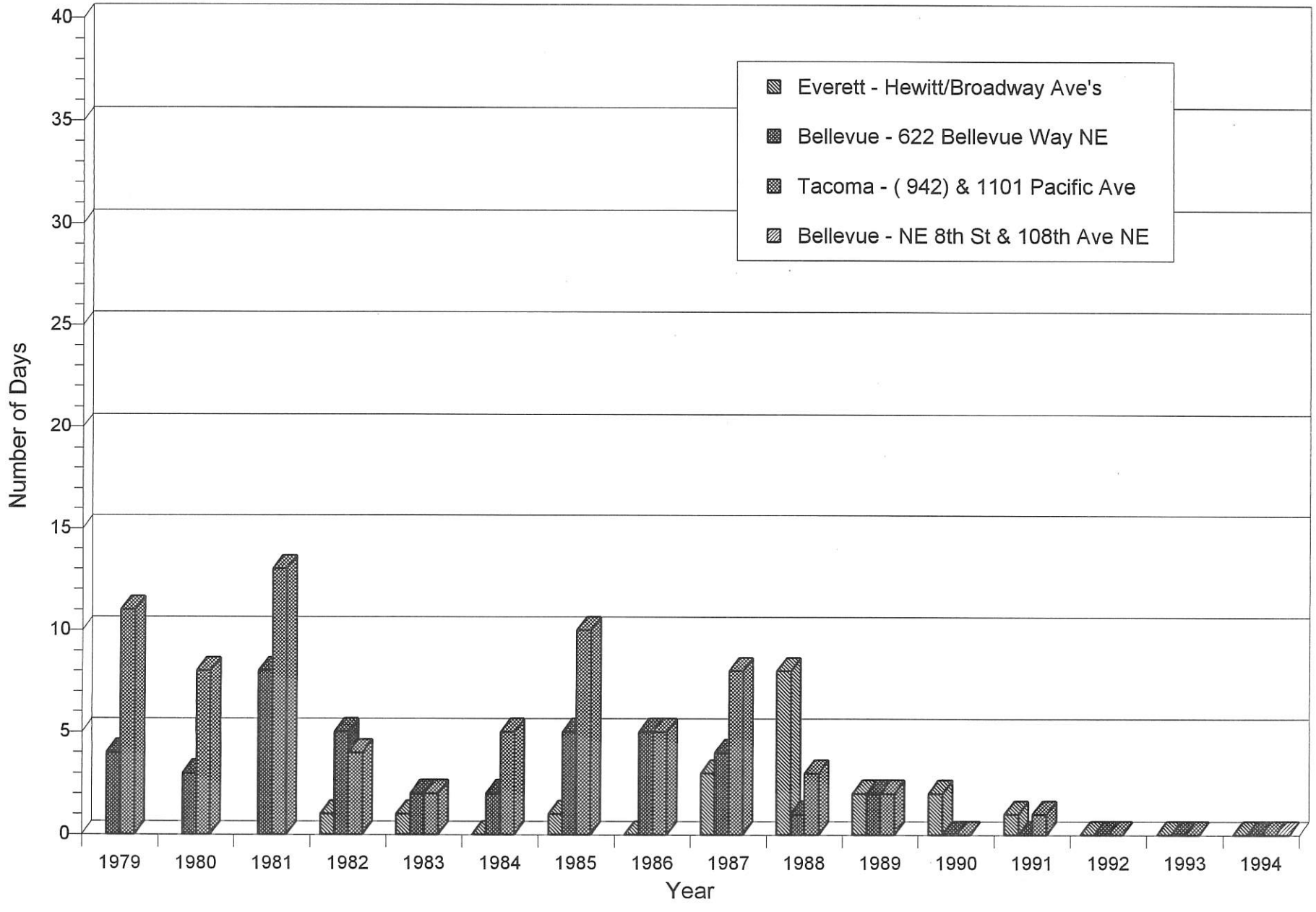
CARBON MONOXIDE

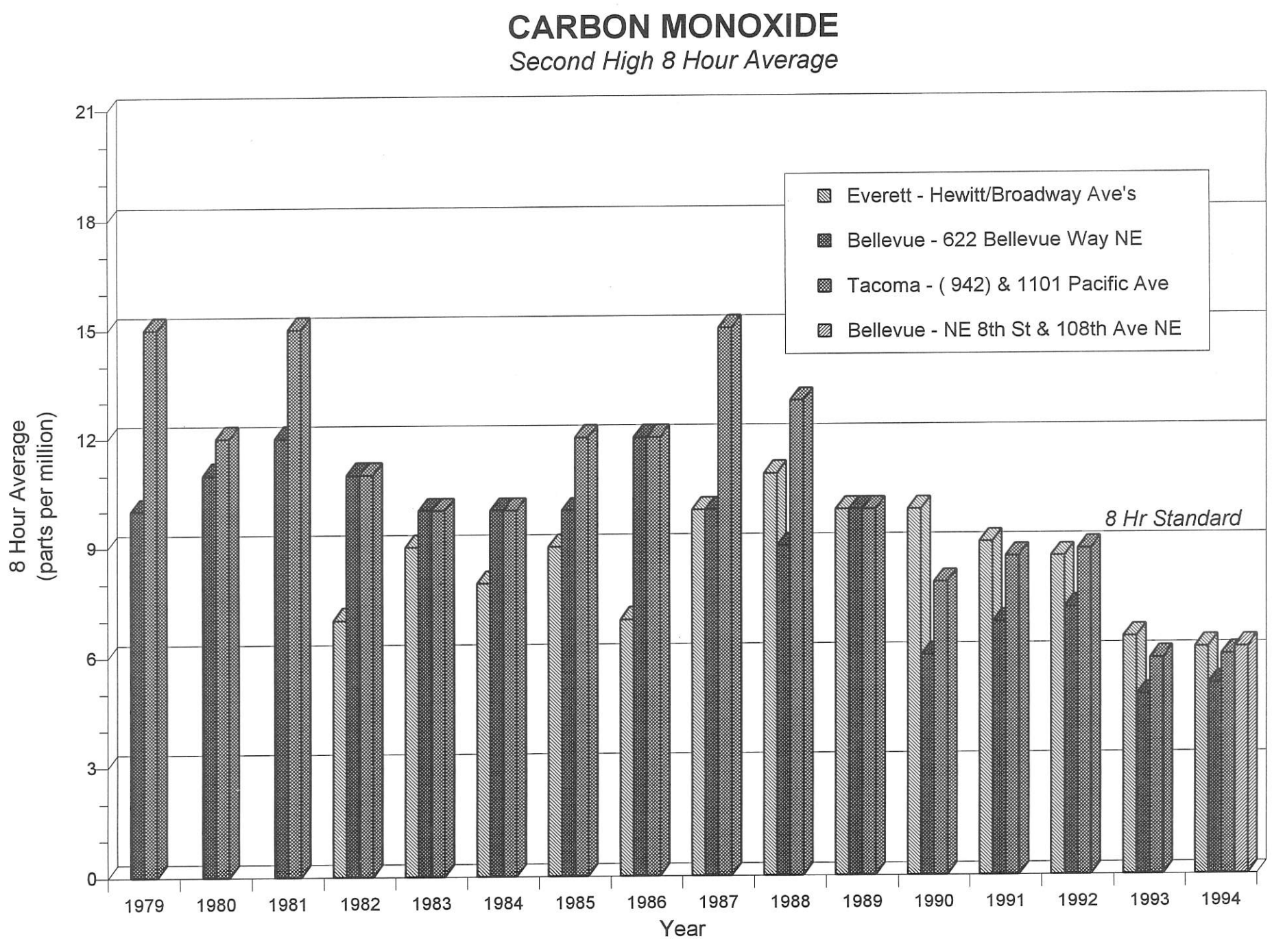
Second High 8 Hour Average



CARBON MONOXIDE

Number of Days 8 Hour Average Exceeded 9 ppm




CARBON MONOXIDE
Second High 8 Hour Average
8 Hour Average
(parts per million)
21
18
15
12
9
6
3
0
Everett - Hewitt/Broadway Ave's
Bellevue - 622 Bellevue Way NE
Tacoma - (942) & 1101 Pacific Ave
Bellevue - NE 8th St & 108th Ave NE
8 Hr Standard
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
Year

Introduction

The principal oxidant found in photochemical smog is ozone, a very reactive form of oxygen. Most photochemical oxidants result from chemical reactions in the ambient air between nitrogen oxides and volatile organic compounds (VOC) that take place under intense sunlight. The highest ozone levels occur on hot summer afternoons, since this is the period of most intense radiant energy from 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 continue for several hours and generally produce maximum ozone levels between noon and early evening at locations miles away from the sources of nitrogen oxides and VOC. Each day after nightfall the high ozone levels diminish because the photochemical effect ends.

In the Puget Sound Region the highest ozone levels occur from mid May to mid September on the few hot 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.

The Ozone Standard and Pollutant Standards Index

The U. S. EPA has set the level of the ozone standard at a value of 0.12 ppm. A 1 hour average ozone value of 0.12 ppm is equivalent to 100 on the Pollutant Standards Index scale. According to the Federal regulation (40 CFR Part 50, Appendix H), the standard is attained when the expected number of days per calendar year with a maximum hourly average concentration above 0.12 ppm is one day or less. Compliance is established for a monitoring site by averaging the number of days with an hour average above 0.12 ppm over the past three years to determine if this is less than or equal to one day.

The required ozone monitoring season in Washington state is the period from April 1 through October 31. If any data at a site during this season are missing and there are any days where the maximum hour average exceeds 0.12 ppm, the number of exceedance days must be increased by a fraction using the procedure in Appendix H.

As indicated, the higher ozone levels occur some distance downwind rather than in Everett, Seattle or Tacoma. For 1994, the maximum ozone Index value of 139, described as "unhealthful" on the Index, occurred July 21 at Enumclaw.

Summary of Data

The 1994 ozone summary table on the following page lists the six highest daily maximum 1 hour averages for each monitoring location. There were two exceedances of the ozone standard at Enumclaw and one exceedance at La Grande. These exceedances combine with zero exceedances for the two previous years to maintain these locations in compliance with the ozone standard. Therefore, all sites in the Puget Sound Region complied with the ozone standard at the end of 1994.

Graphs of ozone data for the years from 1979 through 1994 show the history. One column chart presents the number of days on which the 1 hour average exceeded 0.12 ppm for each year at the longer term monitoring sites in Snohomish, King and Pierce Counties. This chart shows two or more exceedances for the years 1979, 1981, 1990 and 1994. Eight of the other years in this period show zero exceedances. Four years (1985 - 1988) recorded just one exceedance at a site plus, in some cases, an added fraction due to missing data.

A companion chart shows the maximum 1 hour average at these locations. The highest 1 hour average of 0.16 ppm occurred at two sites in 1979 and values reached 0.15 ppm at one site in 1981, 1990 and 1994. These charts suggest that short periods favorable for producing ozone existed during the summers of 1979, 1981, 1990 and 1994; during the remaining twelve years the standard was less in jeopardy. There is no clear trend in the numbers; however, there is a risk of exceeding the level of the standard during any summer that experiences record hot temperatures that accelerate and drive the ozone producing photochemical reactions.

OZONE

(Parts per Million)
1994

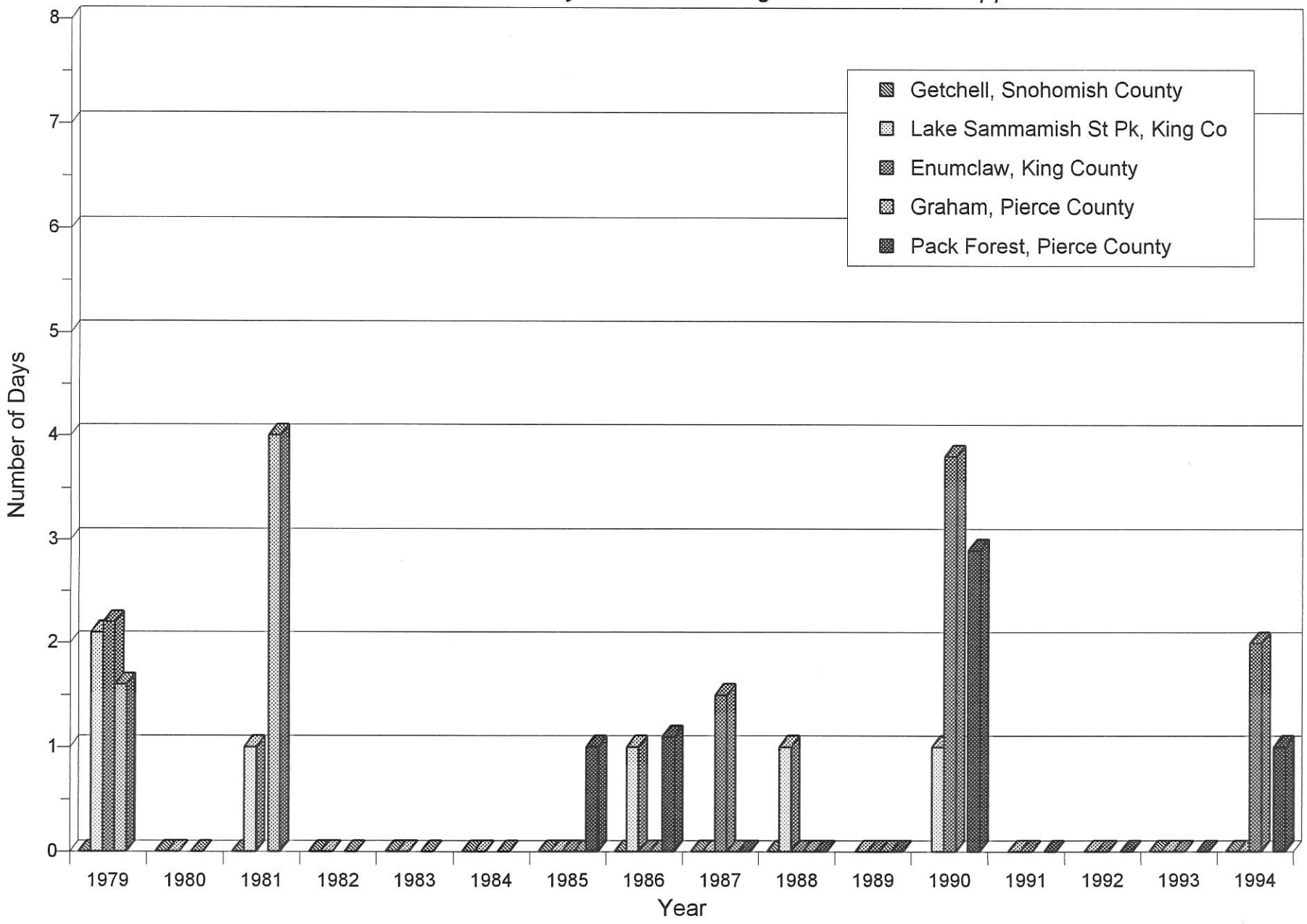
Location / Continuous Sampling Period(s)	Six Highest Daily Maximum 1 Hour Averages			Estimated No. of Days Daily Maximum 1 Hour Average Exceeded .12 ppm			No. of Days Daily Maximum 1 Hour Average Expected to Exceed .12 ppm
	Value	Date	End Time	1992	1993	1994	
Fire Station #22, 8426 99th Ave NE	.082	20 Jul	1800		0.0	0.0	0.0
Getchell, Wa	.076	21 Jul	1900				
1 Apr-31 Oct	.067	19 Jul	1600				
	.064	30 Aug	1600				
	.061	7 May	1700				
	.061	27 Jul	1700				
20050 SE 56th	.107	22 Jul	1400	0.0	0.0	0.0	0.0
Lake Sammamish State Park, Wa	.106	21 Jul	1600				
1 Apr-31 Oct	.086	20 Jul	1400				
	.076	19 Jul	1700				
	.068	13 Aug	1500				
	.067	24 Jul	1500				
Highway 410	.151	21 Jul	1600	0.0	0.0	2.0	0.7
2 miles east of Enumclaw, Wa	.133	22 Jul	1600				
1 Apr-31 Oct	.112	20 Jul	1600				
	.084	19 Jul	1800				
	.083	24 Sep	1500				
	.077	24 Jul	1500				
Charles L Pack Forest	.128	21 Jul	1600	0.0	0.0	1.0	0.3
La Grande, Wa	.112	22 Jul	1500				
1 Apr-31 Oct	.105	20 Jul	1500				
	.092	27 Jul	1600				
	.089	19 Jul	1800				
	.088	23 Sep	1500				

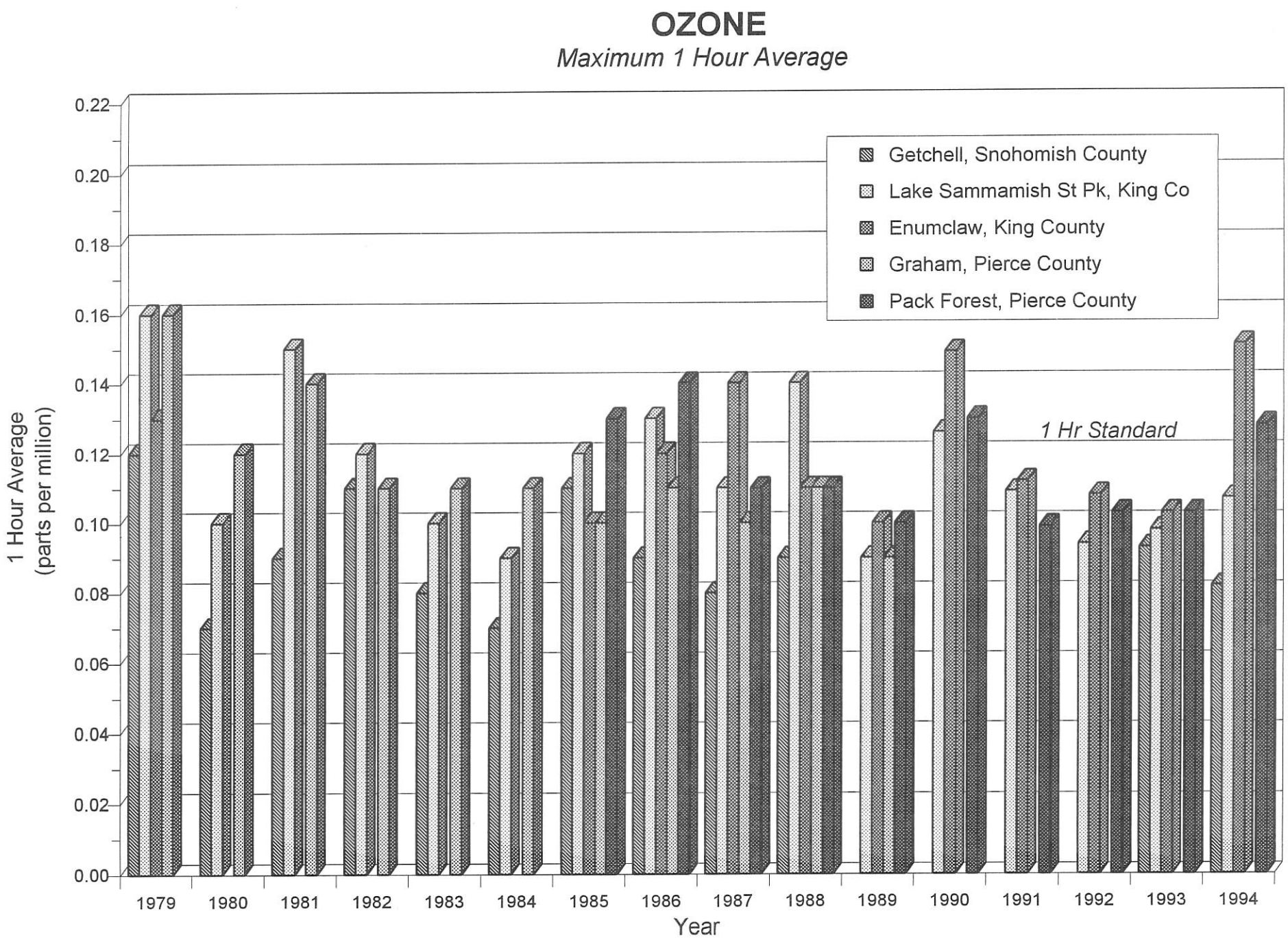
Notes

(1) All ozone stations 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.

OZONE

Number of Days 1 Hour Average Exceeded 0.12 ppm




OZONE
Maximum 1 Hour Average
1 Hour Average (parts per million)
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
Getchell, Snohomish County
Lake Sammamish St Pk, King Co
Enumclaw, King County
Graham, Pierce County
Pack Forest, Pierce County
1 Hr Standard
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
1991
1992
1993
1994
Year

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) Agency participation in EPA's national performance audits, and (2) occasional on-site audits of some Agency monitoring equipment by EPA or a designated representative. Each quarter the Department of Ecology also independently performs audits on Agency monitoring equipment at various locations.

Precision and Accuracy Audits

The QA program requirements are established in Title 40, Code of Federal Regulations, Part 58. The important QA characteristics that 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.

At a minimum, 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 is calculated.

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 parameter.

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 percentage 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 data values during the audit period fall within these limits. As an example, if the average of the percentage differences is zero and the standard deviation of the percentage differences is 4.1 percent, the upper and lower 95 percent probability limits are respectively +8 and -8 percent.

Agency Precision and Accuracy

For most Puget Sound Air Pollution Control 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 monitoring data that the Agency originated in 1994.

For each parameter, the type of audit, (accuracy or precision), is followed by a brief phrase description of the audit process or the actual measurement point that is audited. The number of audits and the lower and upper probability limits (of percentage differences) are presented for each quarter.

Wind sensor audits report the quarterly audit of the direction system for the cardinal points and the speed system at two controlled rates of shaft rotation. The propeller turned by the wind at the specific rate (revolutions per minute) should report the wind speed (miles per hour) as shown.

DATA QUALITY ASSESSMENT
1994

Lower and Upper 95 Percent Probability Limits of Percent Differences

Parameter & Type of Audit	Number of Stations	*Audit Results by Quarter*											
		1st			*2nd*			*3rd*			*4th*		
		Number of Audits	Prob. Limits Lwr (%)	Upr (%)	Number of Audits	Prob. Limits Lwr (%)	Upr (%)	Number of Audits	Prob. Limits Lwr (%)	Upr (%)	Number of Audits	Prob. Limits Lwr (%)	Upr (%)
Particulate Matter (PM10) (Reference Method)	14												
Accuracy													
Flow Rate		105	-5	3	100	-6	3	106	-7	3	98	-4	2
Precision													
Collocated Samples		23	-8	6	18	-7	0	25	-6	5	23	-8	3
Particulate Matter (PM10) (Equivalent Method)	8												
Accuracy													
Flow Rate		27	-4	5	27	-3	6	30	-2	5	29	-3	4
Particulate Matter (PM2.5) (Dichotomous Method)	3												
Accuracy													
Flow Rate		3	-6	6	5	-7	12	3	-9	6	3	0	12
Sulfur Dioxide	4												
Accuracy													
Level 1		10	-1	11	16	-7	12	17	-8	14	17	-6	8
Level 2		10	-6	9	16	-7	10	17	-7	13	17	-7	8
Level 3		10	-6	8	16	-9	8	17	-8	13	17	-9	8
Level 4		3	-3	11	3	-8	4	6	-8	12	5	-7	4
Precision													
One point check		54	-6	5	55	-7	6	49	-5	6	54	-4	5
Atmospheric Particles (Nephelometer)	3												
Precision													
One point check		41	-3	4	40	-3	4	43	-3	3	40	-2	3
Wind	11												
Direction													
Accuracy													
90 degrees (E)		11	-1	1	13	-1	1	11	-1	1	11	-1	1
180 degrees (S)		11	-1	1	13	-1	1	11	0	0	11	-1	1
270 degrees (W)		11	-1	1	13	-1	1	11	0	0	11	0	1
360 degrees (N)		11	0	0	13	0	0	11	0	0	11	0	0
Speed													
Accuracy													
11.0 mph (1000 rpm)		11	-1	1	13	-1	1	11	-1	1	11	-1	1
32.9 mph (3000 rpm)		11	-1	1	13	-1	1	11	-1	1	11	-1	1

AIR POLLUTION EPISODES and IMPAIRED AIR QUALITY PERIODS

Introduction

The policy and rules for air pollution episode avoidance and for restrictions on the use of solid fuel burning devices during periods of "impaired air quality" are established by the Washington Clean Air Act and implemented by state and local regulations. Legislative amendments significantly revised these rules effective in mid 1990.

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. During 1994, the Department of Ecology did not declare any stage of an air pollution episode in the Puget Sound Region.

Impaired Air Quality Periods

The Washington Clean Air Act defines two stages of "impaired air quality" in RCW 70.94.473. A *first stage* of "impaired air quality" is reached when PM_{10} is at an ambient level of 75 $\mu g/m^3$ measured on a 24 hour average or when carbon monoxide is at an ambient level of 8 ppm measured on an 8 hour average.

During a first stage of "impaired air quality", any person in a residence or commercial establishment which has an adequate source of heat without burning wood shall not burn wood in any solid fuel burning device except those certified as described in RCW 70.94.473 or a pellet stove either certified or issued an exemption by the U. S. Environmental Protection Agency.

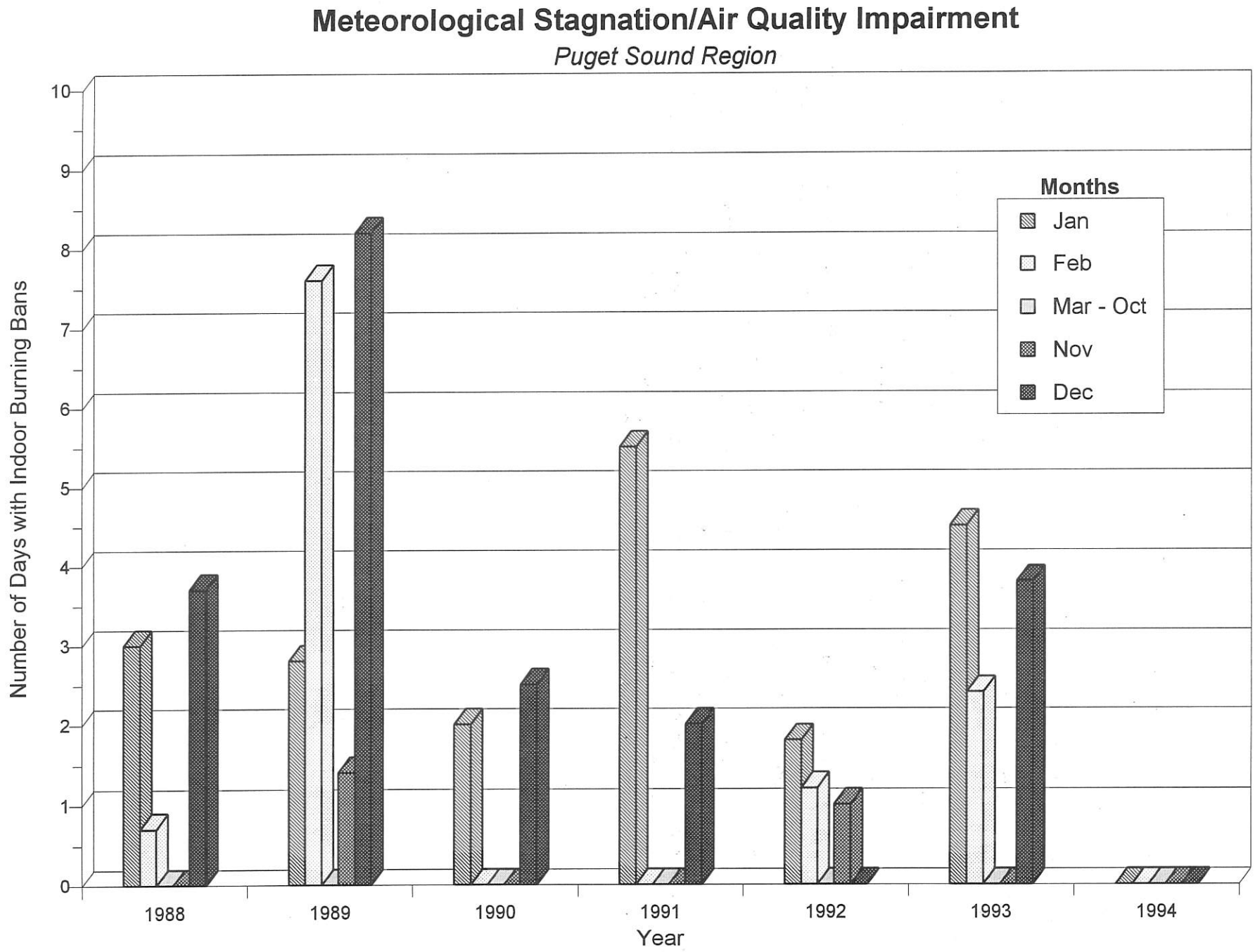
A *second stage* of "impaired air quality" is reached when PM_{10} is at an ambient level of 105 $\mu g/m^3$ measured on a 24 hour average. When a second stage of "impaired air quality" is in effect, any person in a residence or commercial establishment which has an adequate source of heat without burning wood shall not burn wood in any solid fuel burning device.

Along with the restrictions on the use of solid fuel burning devices as outlined above, all outdoor fires are prohibited during any period of "impaired air quality".

No "impaired air quality" periods were declared during 1994 and therefore no burn bans were required.

Air Quality Impairment Chart

The following graph displays occurrences of air quality impairment beginning in January 1988 when indoor burning restrictions were first applied. The number of days is determined from the total number of hours of prohibited indoor burning divided by 24. Results for January, February, November and December are displayed individually. The March - October category shows that no burn bans have ever occurred during those spring through fall months.


Meteorological Stagnation/Air Quality Impairment
Puget Sound Region
Number of Days with Indoor Burning Bans
0
1
2
3
4
5
6
7
8
9
10
1988
1989
1990
1991
1992
1993
1994
Year
Months
Jan
Feb
Mar - Oct
Nov
Dec

WIND ANALYSIS

Wind Data

Everyone has a qualitative sense of surface wind and some effects produced by the wind. The wind direction helps to locate 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 ambient pollutant concentrations. During a stable, temperature inversion condition, the wind is often light or calm. When this condition persists, the natural process that 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 wind speed at various locations. These average values are sometimes used to compare locations or different months. Air stagnation episodes are not exposed by this analysis unless episode conditions predominate during most of a month.

Wind Roses

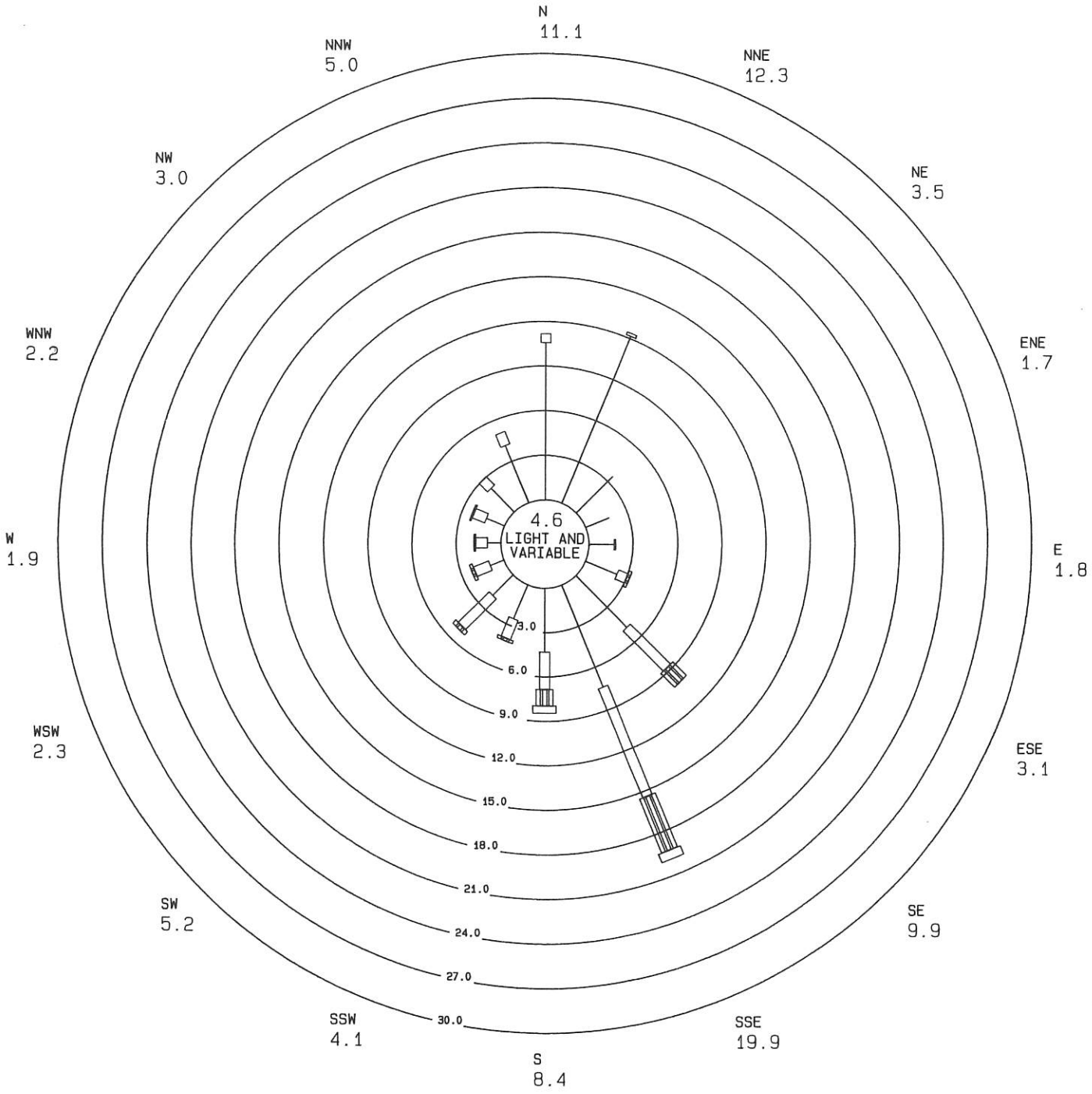
A wind rose is a quantitative graphical summary of the wind direction and speed for a given time. The following wind rose graphs show the number of observations or hours, expressed as a percentage, that had a particular direction and speed during the summary period.

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

For a particular wind direction the length of each segment of a spoke represents the percentage of time the wind speed was within a specific speed interval. If summed for all wind directions, the result would provide the percentage of all hours the wind speed was measured within a particular interval. The percentage of time during which the wind was light and variable shows in the center of the rose.

WIND SPEED
(Miles per Hour)
1994

Location	Monthly Arithmetic Averages												No. of 1 Hour	Year Arith
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Samples	Mean
Marysville JHS, 1605 7th St, Marysville, Wa	3.0	4.7	4.2	3.9	4.0			3.6	3.2	3.3	4.4	4.6	7400	3.9
Hoyt Ave & 26th St, Everett, Wa	4.2	5.6	5.0	4.6	4.7	4.7	4.6	4.4	3.9	4.4	5.4	5.5	8674	4.8
20935 59th Place W, Lynnwood, Wa											2.5	2.7	1881	2.5
17711 Ballinger Way NE, Lake Forest Park, Wa	2.2	3.5	3.2	3.2	3.0	3.2	2.5	2.5	2.5	2.6	3.3	2.9	8747	2.9
Duwamish, 4752 E Marginal Way S, Seattle, Wa	4.4	6.0	5.5	5.5	5.0	5.4	4.8	4.5	4.4	4.7	5.6	5.6	8746	5.1
James St & Central Ave, Kent, Wa	3.3	4.3	4.4	4.1	3.8	4.1	3.6	3.5	3.3	3.6	4.0	4.5	8746	3.9
South Hill, 9616 128th St E, Puyallup, Wa	2.3	3.2	2.6	2.6	2.2	2.4	2.0	1.9	1.9	2.5	3.3	3.0	8729	2.5
27th St NE & 54th Ave NE, Northeast Tacoma, Wa	3.1	3.8	4.5	3.4	3.3	3.3	3.1	3.1	3.3	3.3	3.4	4.0	8745	3.5
2301 Alexander Ave, Tacoma, Wa	4.0	5.4		5.9	5.3	5.8	5.3	5.2	4.5	5.1	5.1		7620	5.1
Fire Station #12, 2316 E 11th St, Tacoma, Wa	3.9	5.4	5.8	5.4	5.2	5.8	5.3	5.0	4.5	5.1	5.3	5.0	8741	5.1
Meadowdale, 7252 Blackbird Dr NE, KitsapCo, Wa	1.6							1.7	1.8	1.8	2.2	2.5	4747	1.9
Lions Park, 6th Ave NE & Fjord Dr, Poulsbo, Wa	4.0	6.8	6.0	5.0	4.7	5.1	4.1	3.7	4.3	4.7	6.3	6.8	8742	5.1



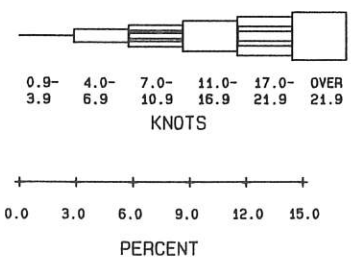
HOUR AVERAGE SURFACE WINDS

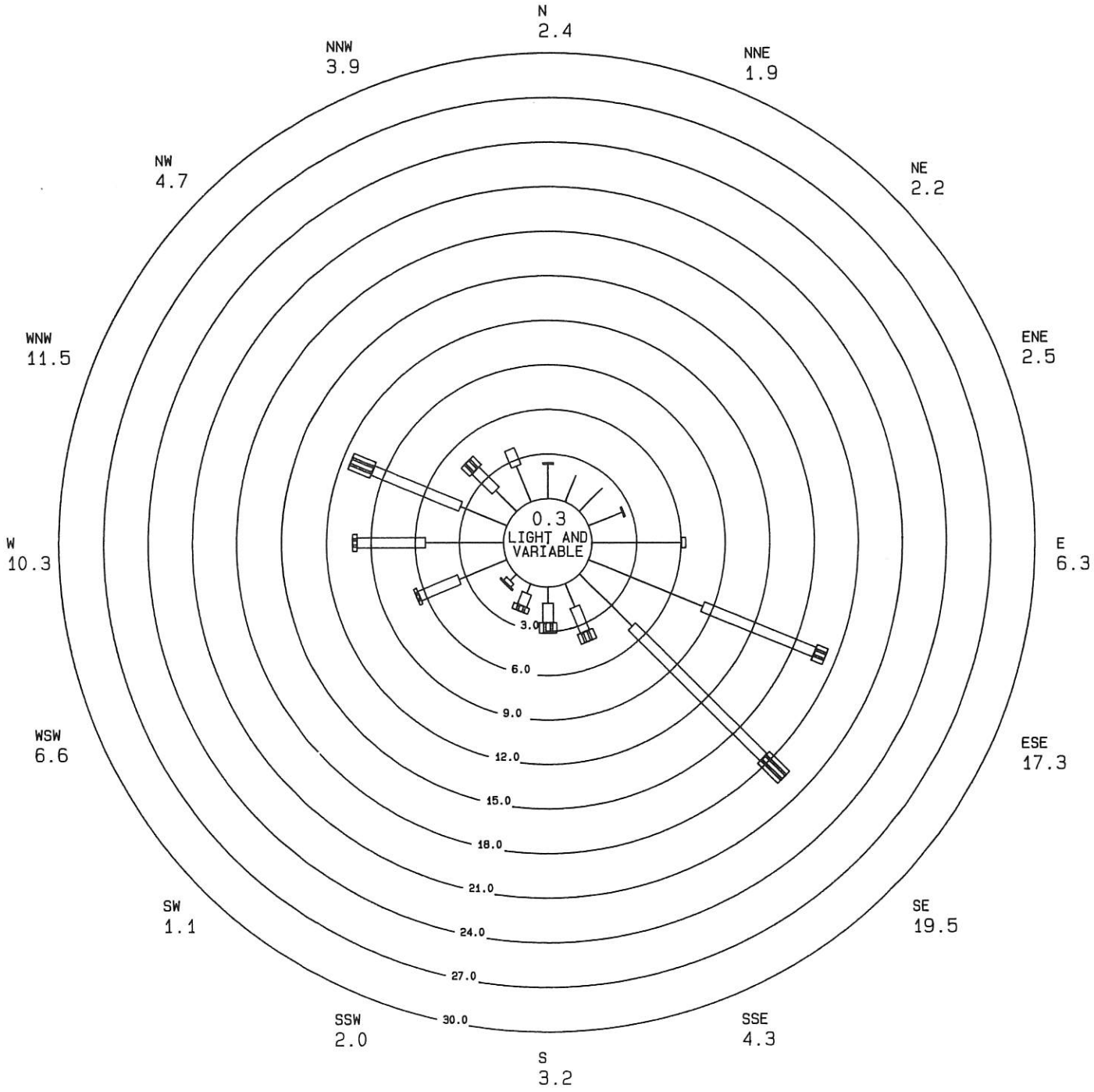
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY
Marysville JHS, 1605 7th St, Marysville, Wa

INCLUSIVE DATES- ALL MONTHS 1994

TOTAL OBSERVATIONS- 7,400





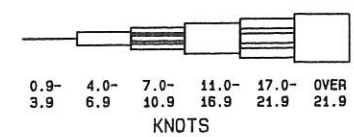
HOUR AVERAGE SURFACE WINDS

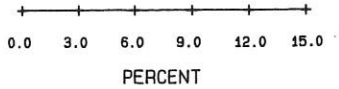
PERCENTAGE FREQUENCY OF OCCURRENCE

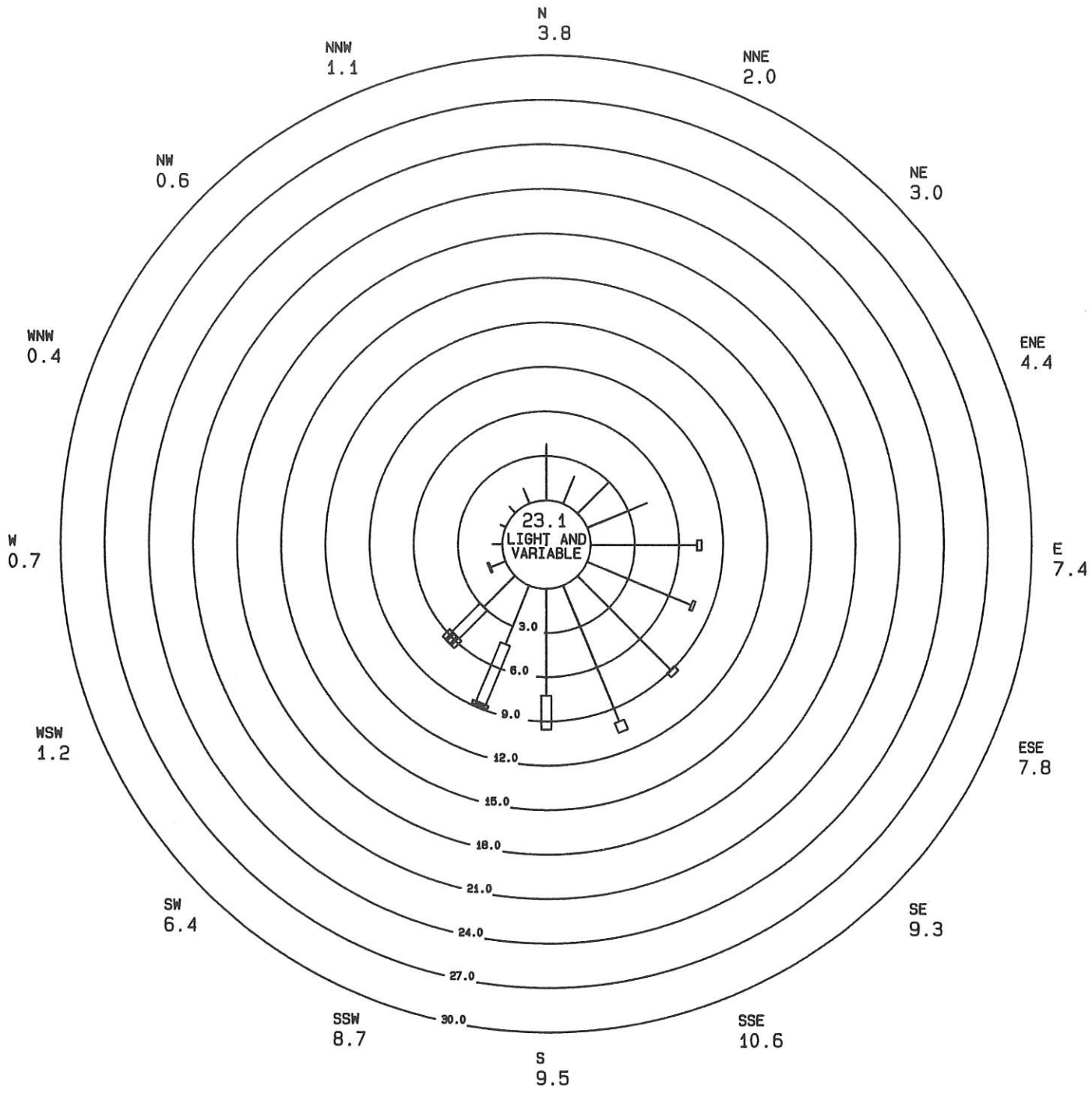
STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY
Hoyt Ave & 26th St, Everett, Wa

INCLUSIVE DATES- ALL MONTHS 1994

TOTAL OBSERVATIONS- 8,674







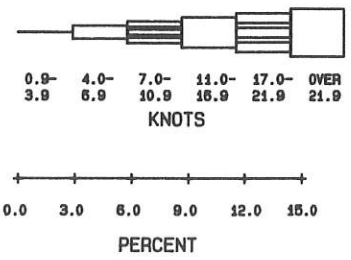
HOUR AVERAGE SURFACE WINDS

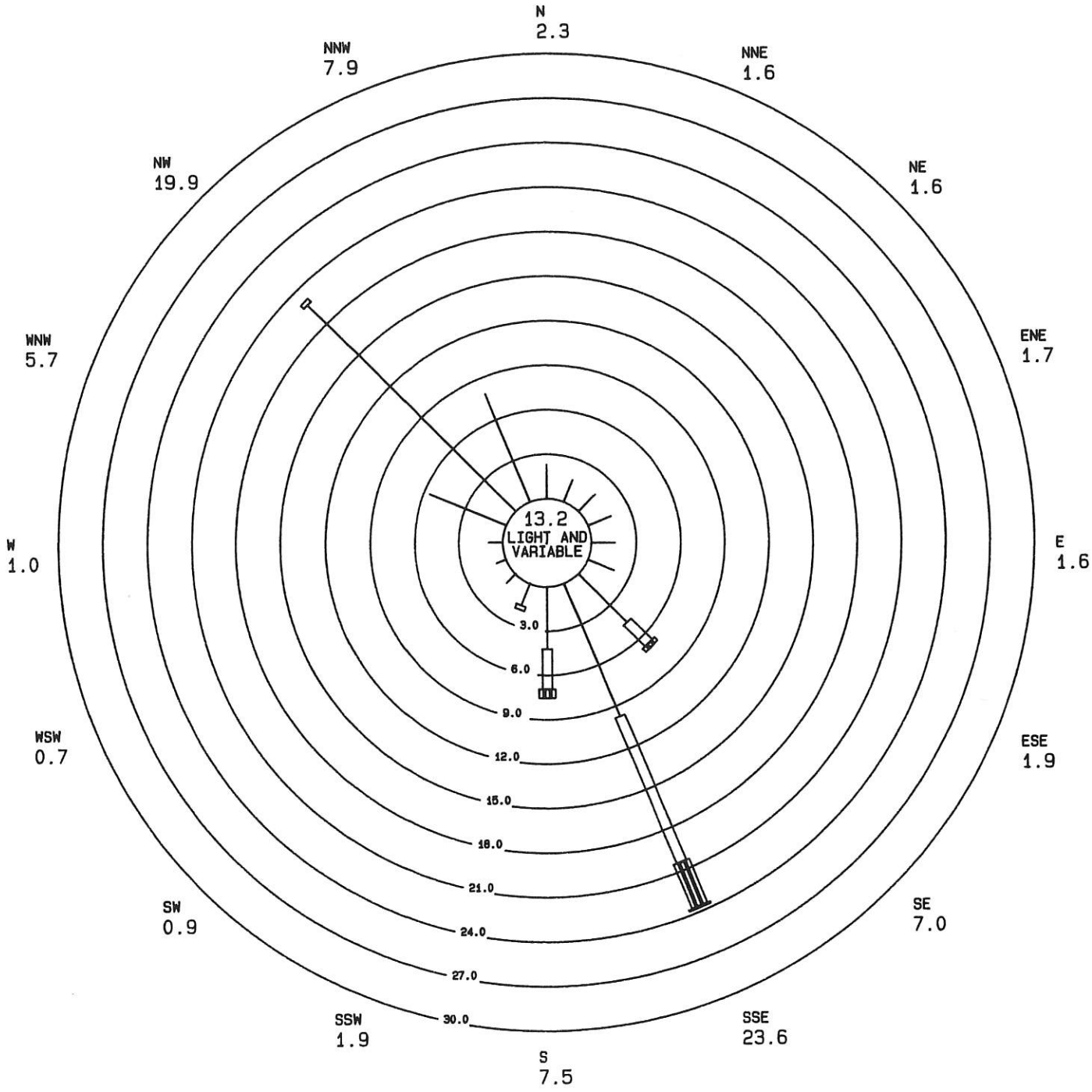
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY
20935 59th Place West, Lynnwood, Wa

INCLUSIVE DATES- OCT, NOV, DEC, 1994

TOTAL OBSERVATIONS- 1,881





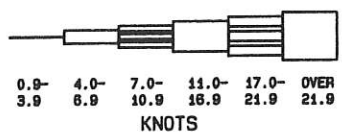
HOUR AVERAGE SURFACE WINDS

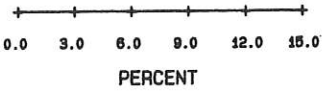
PERCENTAGE FREQUENCY OF OCCURRENCE

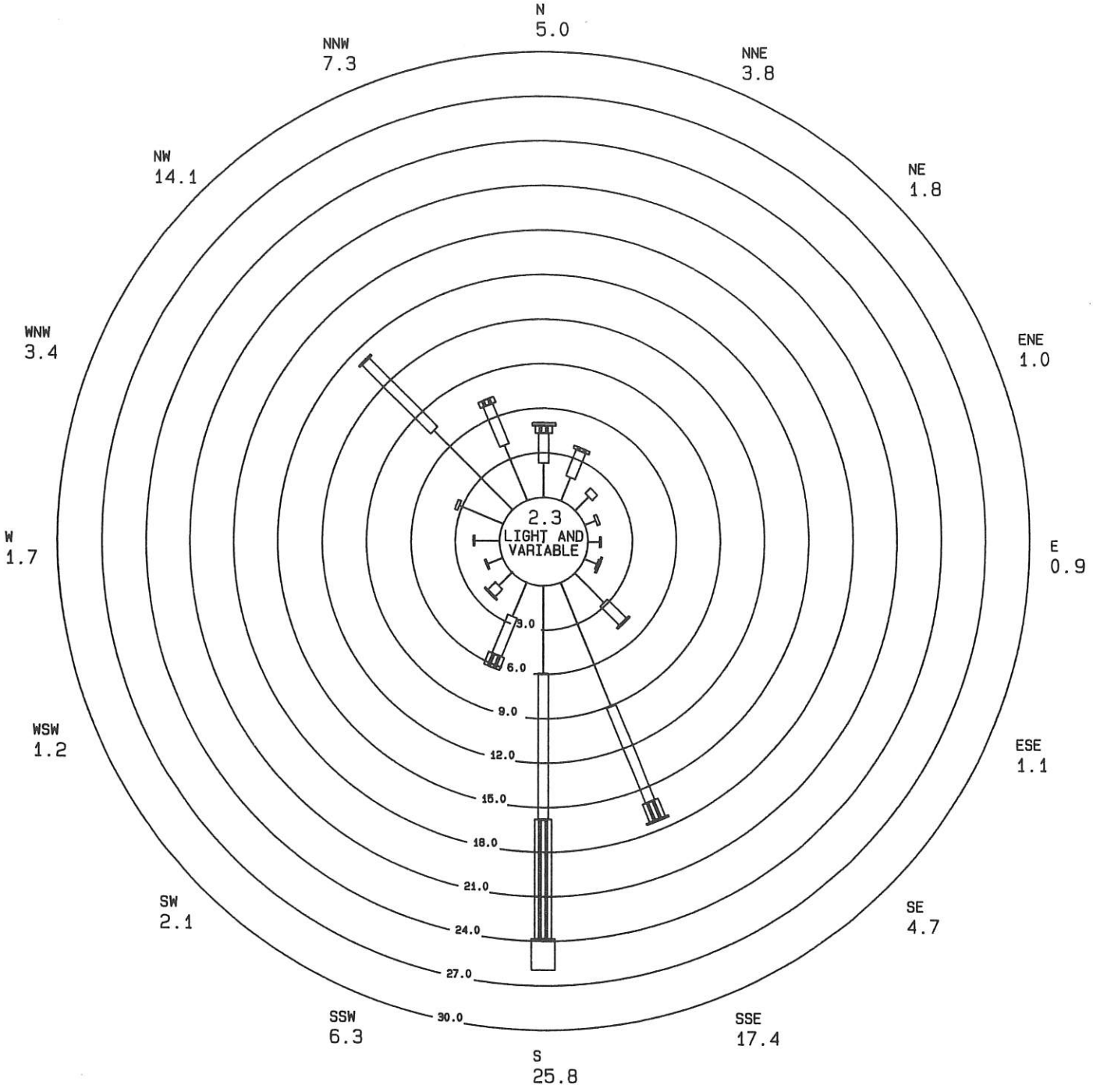
STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY
17711 Ballinger Way NE, Lake Forest Park, Wa

INCLUSIVE DATES- ALL MONTHS 1994

TOTAL OBSERVATIONS- 8,747







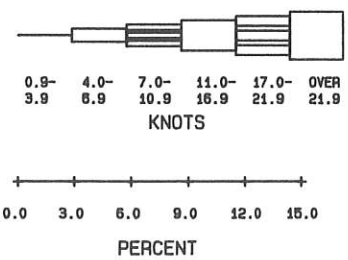
HOUR AVERAGE SURFACE WINDS

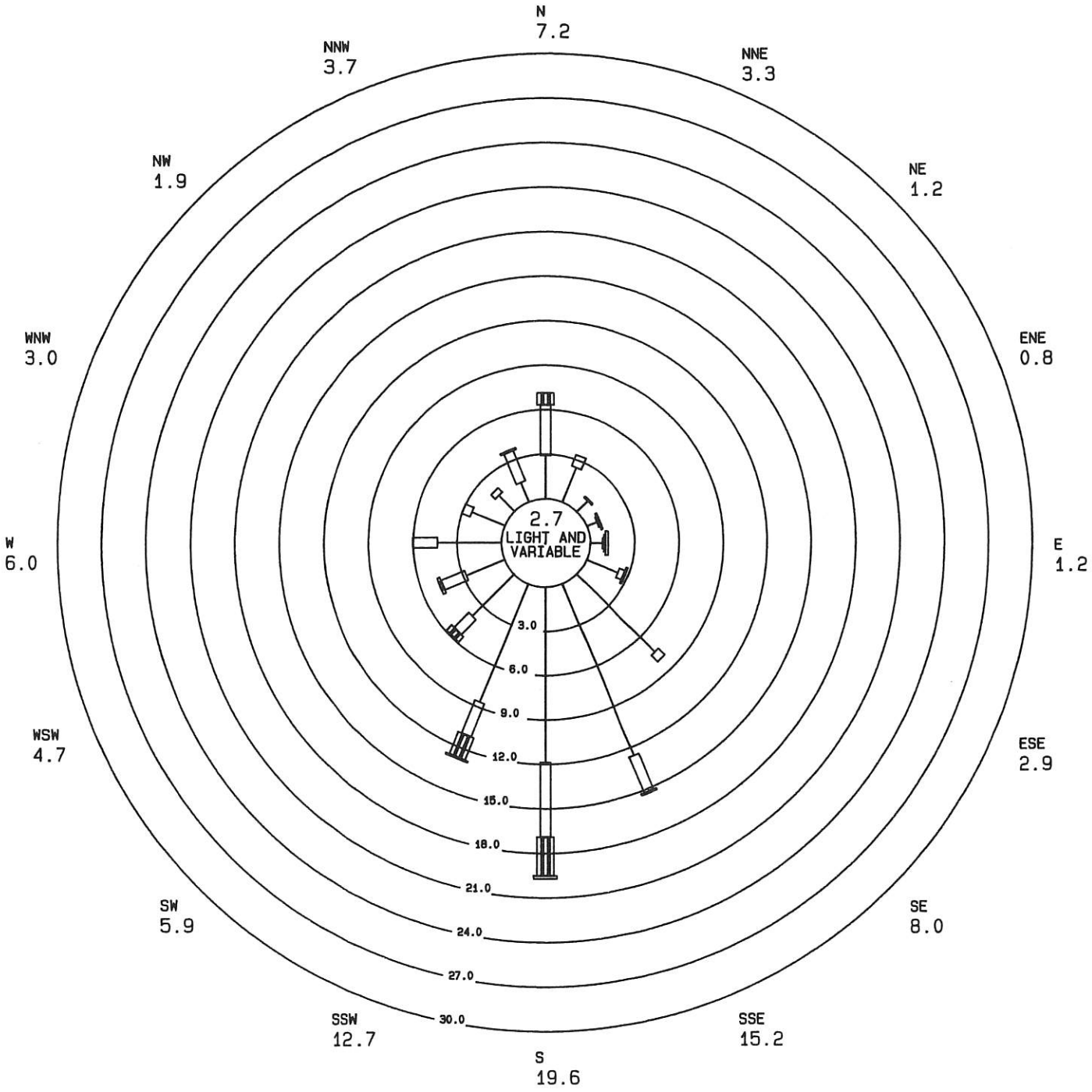
PERCENTAGE FREQUENCY OF OCCURRENCE

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

INCLUSIVE DATES- ALL MONTHS 1994

TOTAL OBSERVATIONS- 8,746





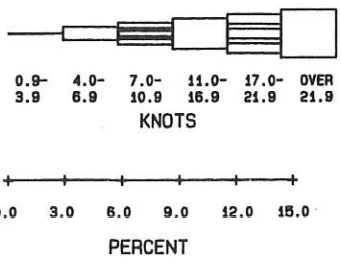
HOUR AVERAGE SURFACE WINDS

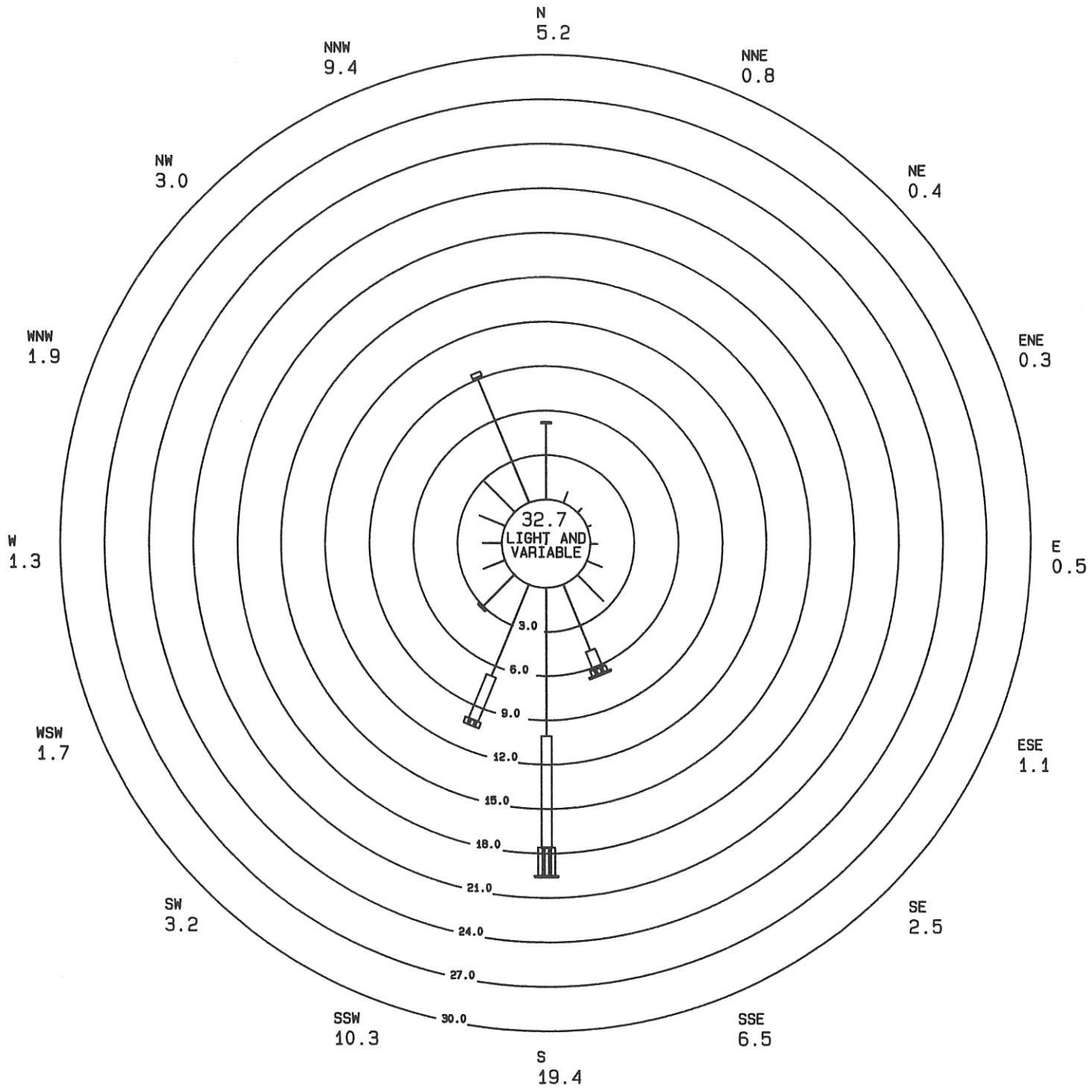
PERCENTAGE FREQUENCY OF OCCURRENCE

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

INCLUSIVE DATES- ALL MONTHS 1994

TOTAL OBSERVATIONS- 8,746





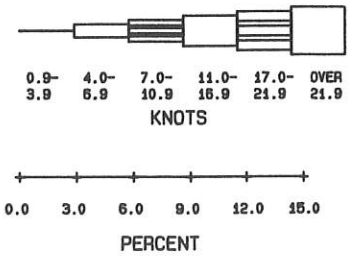
HOUR AVERAGE SURFACE WINDS

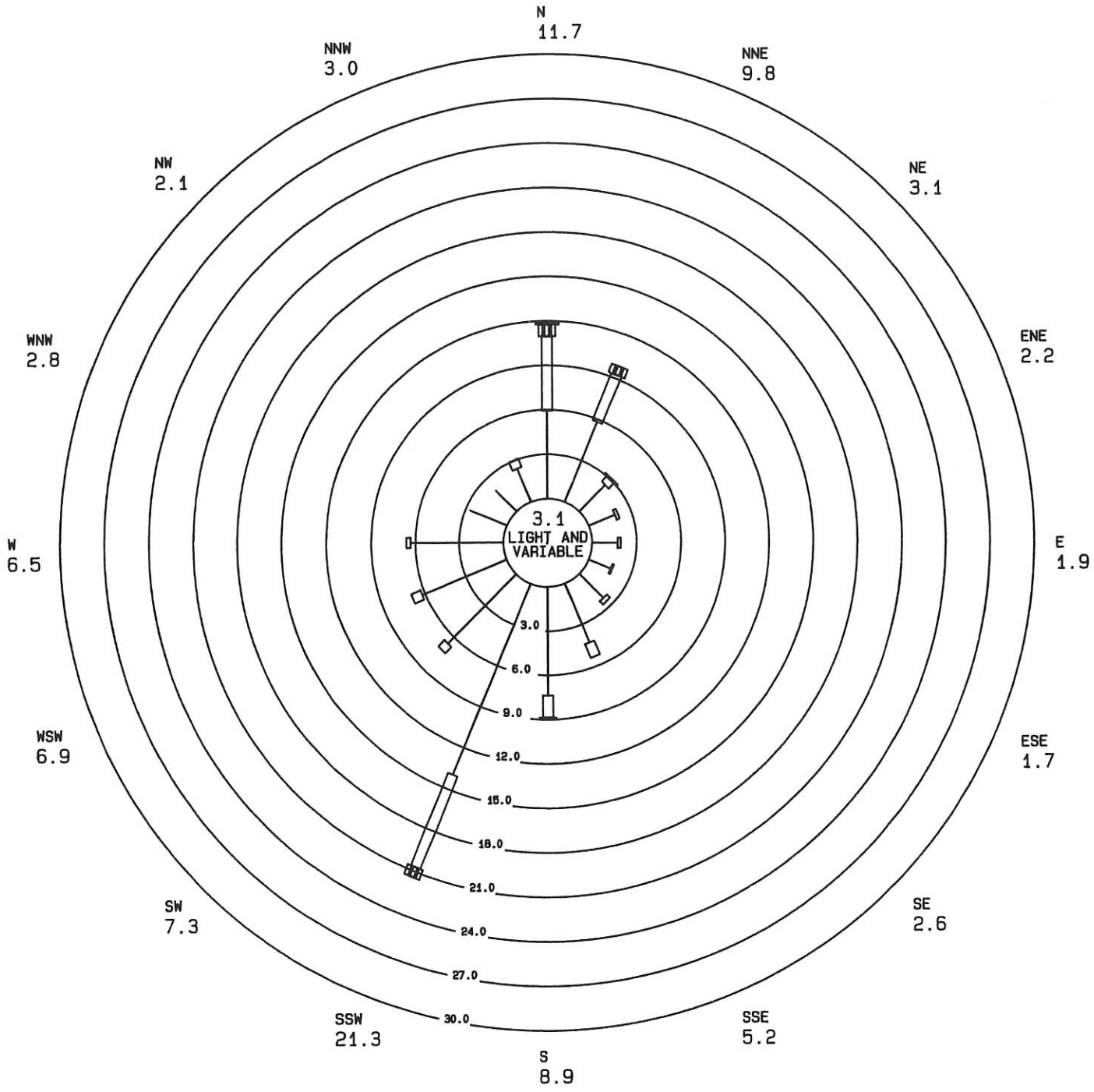
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY
South Hill, 9616 128th St E, Puyallup, Wa

INCLUSIVE DATES- ALL MONTHS 1994

TOTAL OBSERVATIONS- 8,729





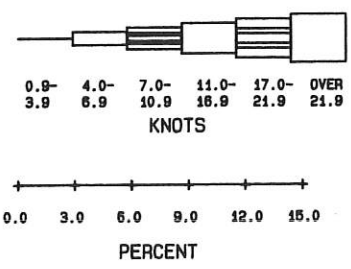
HOUR AVERAGE SURFACE WINDS

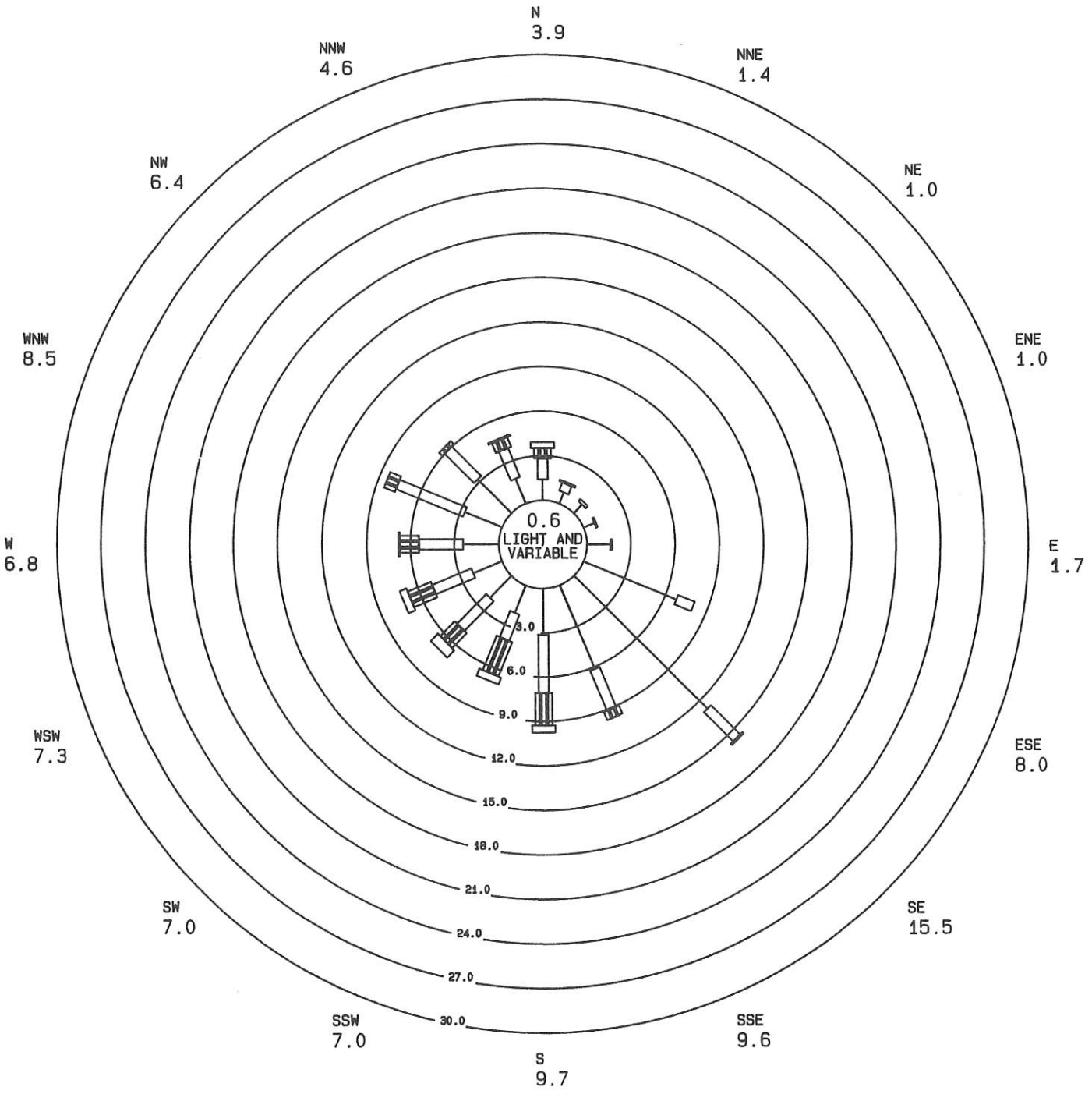
PERCENTAGE FREQUENCY OF OCCURRENCE

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

INCLUSIVE DATES- ALL MONTHS 1994

TOTAL OBSERVATIONS- 8,745





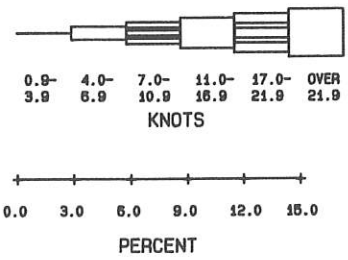
HOUR AVERAGE SURFACE WINDS

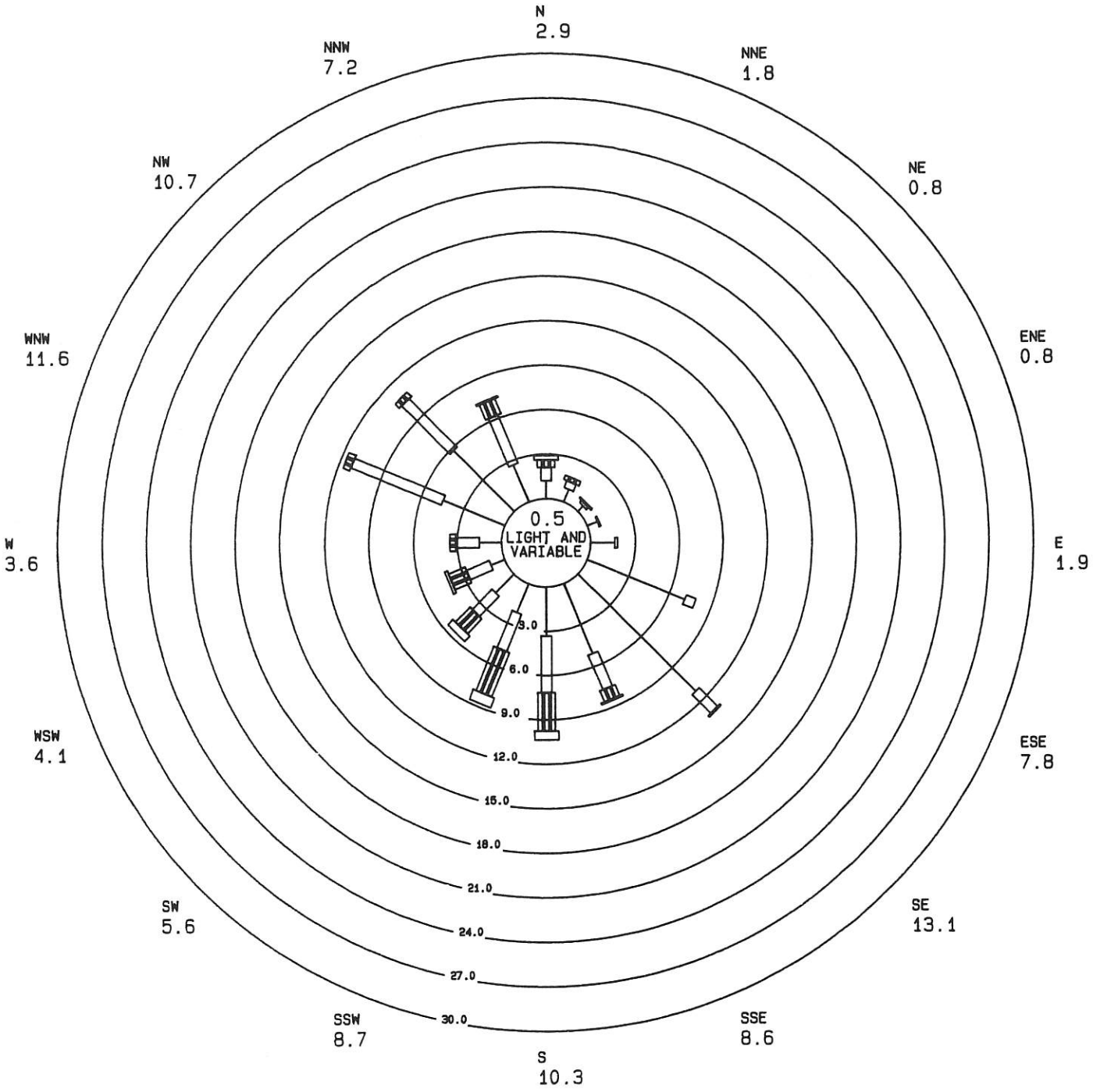
PERCENTAGE FREQUENCY OF OCCURRENCE

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

INCLUSIVE DATES- ALL MONTHS 1994

TOTAL OBSERVATIONS- 7,620





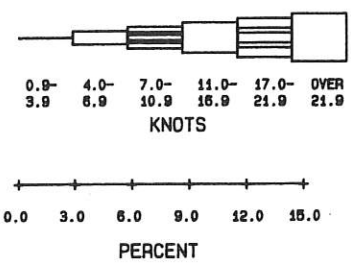
HOUR AVERAGE SURFACE WINDS

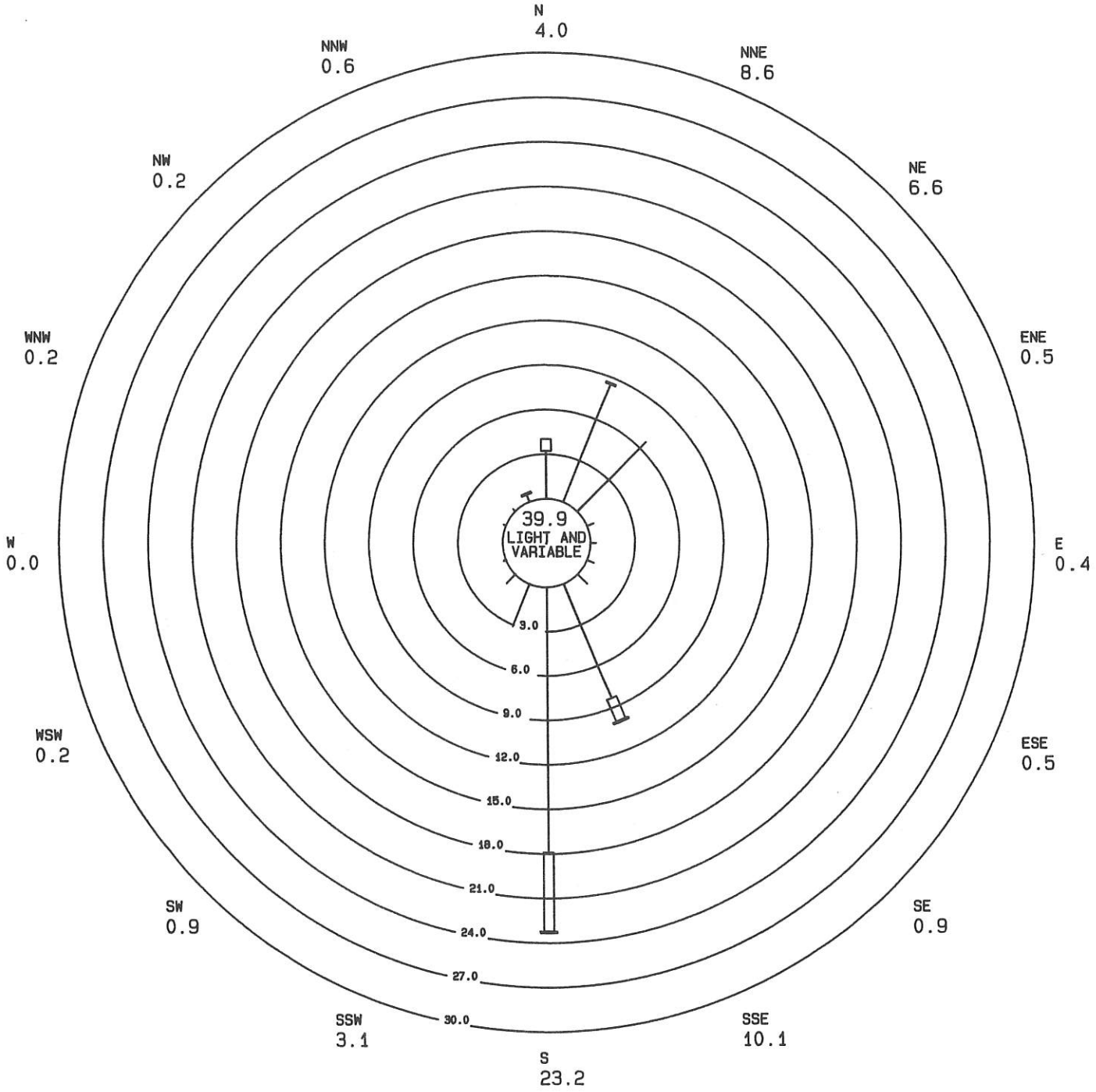
PERCENTAGE FREQUENCY OF OCCURRENCE

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

INCLUSIVE DATES- ALL MONTHS 1994

TOTAL OBSERVATIONS- 8,741





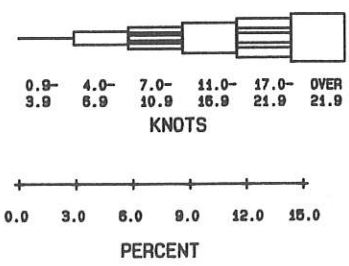
HOUR AVERAGE SURFACE WINDS

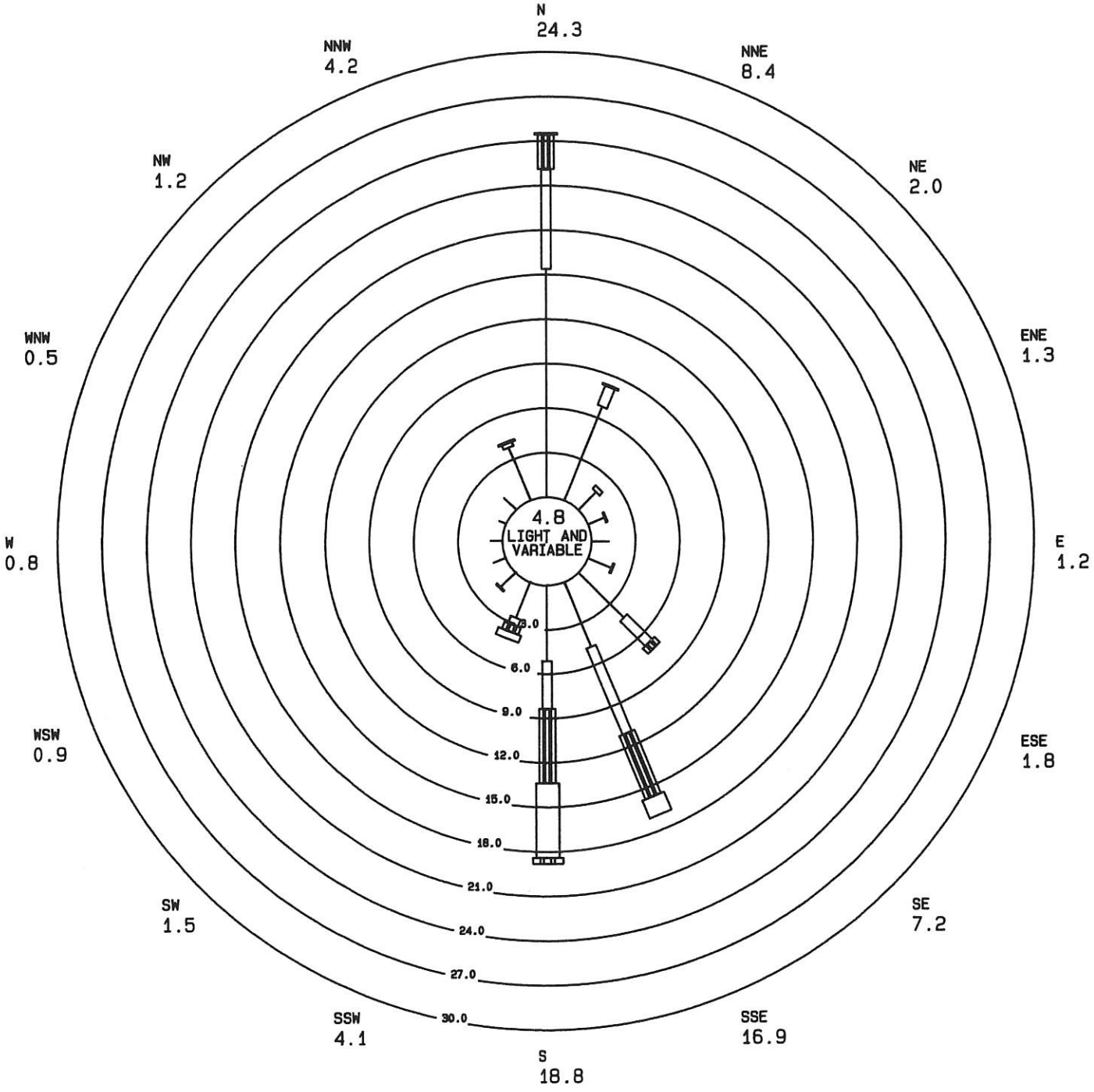
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY
Meadowdale, 7252 Blackbird Dr NE, KitsapCo, Wa

INCLUSIVE DATES- ALL MONTHS 1994

TOTAL OBSERVATIONS- 4,747





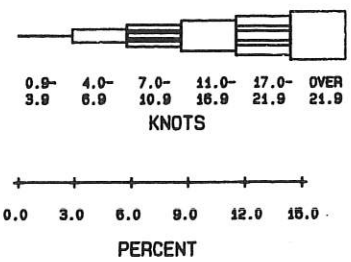
HOUR AVERAGE SURFACE WINDS

PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY
Lions Park, 6th Ave NE & Fjord Dr, Poulsbo, Wa

INCLUSIVE DATES- ALL MONTHS 1994

TOTAL OBSERVATIONS- 8,742



EMISSION INVENTORY

Emissions from air pollution sources in the Puget Sound Region are inventoried to assess their relative contribution to the air quality of our region. Emission inventories can also be used to evaluate the effectiveness of applying different emission control strategies.

The most recent data available for the Puget Sound Air Pollution Control Agency's four-county jurisdiction are presented in the following pages. The tables presented in this section include the following for King, Kitsap, Pierce, and Snohomish counties:

Table 1: 1994 Large Stationary Source Emissions

Table 2: 1994 Small Stationary Source Emissions

Table 3: 1994 On-road Mobile Source Emissions

Table 4: 1994 Non-road Mobile Source Emissions

Table 5: 1994 Emissions Summary

For reference, some terms used in these inventories are defined below:

Term	**Definition**
Biogenics	Emissions from trees, crops and vegetation
CO	Carbon monoxide
NOx	Nitrogen oxides including nitrogen dioxide
NR	Organic compounds which have negligible reactivity in low level ozone formation
PM10	Particulate matter less than or equal to 10 microns
PSAPCA	Puget Sound Air Pollution Control Agency
SOx	Sulfur oxides including sulfur dioxide
Stationary Source	Non-mobile emission source: Large source - emission of 25 tons or more per year of PM10, SOx, NOx or CO; or - emission of 5 tons or more per year of VOC, NR, or TAC. Small source - emission of these same pollutants, but less than the amount which describes a 'large source'.
tpy	Tons per year
TAC	Toxic air contaminant listed in PSAPCA Reg III, Appendix A
VOC	Volatile organic compounds excluding any NR compounds

Table 1
1994 Large Stationary Source Emissions (Tons/year)

(PM10, SOx, CO, NOx ≥ 25 tpy; VOC, NR, TAC ≥ 5 tpy)

Source	City	County	Tons of Pollutant						
			PM10	SOx	CO	NOx	VOC	NR	TAC
A B C Cabinet	Tacoma	Pierce					22	2	24
Ace Tank & Equipment	Seattle	King					26	12	30
Aero-Lac Inc	Seattle	King					80		57
Aerocell	Marysville	Snohomish					31	2	33
Alliant Techsystems	Mulkiteo	Snohomish					1	4	5
Alliedsignal Avionics	Redmond	King					6		6
American Millwork	Kirkland	King					82	4	83
American National Can	Kent	King				9	200		158
American Reinforced Plastics	Tacoma	Pierce					10	2	12
ARCO Petroleum Products	Seattle	King					41		15
Arima Marine International	Auburn	King					6	2	5
Art Brass Plating	Seattle	King					11		11
Artisan Finishing Systems	Marysville	Snohomish					9		8
Ash Grove Cement	Seattle	King	74	109	1208	837			
Bakker's Fine Drycleaning	Bellevue	King					21		21
Ball Glass Container	Seattle	King	58	95		378			
Barmon Door	Lk Stevens	Snohomish					25		17
Bell Industries Illuminated	Redmond	King					6		
Bert - Wells Industries	Kent	King					1	17	17
Birmingham Steel	Seattle	King	161	61	4557	218	36		88
Boeing Comm (NBF)	Seattle	King		1	3	12	37	10	43
Boeing Comm (Plant 2)	Seattle	King	1		8	30	12	14	25
Boeing Comm Airplane	Renton	King	4	19	12	133	145	41	184
Boeing Commercial	Auburn	King	2	4	21	264	108	50	134
Boeing Commercial	Frederickson	Pierce			4	14	30	1	28
Boeing Commercial	Everett	Snohomish	2	3	28	100	406	96	488
Boeing Defense & Electronics	Renton	King	0	0	1	3	5	1	5
Boeing Defense & Space	Kent	King	2	5	10	43	19	6	24
Boeing Miliary Aircraft DC	Seattle	King	1		5	19	18	12	22
Boeing Support Services	Bellevue	King	3	4	8	32	1		
Buffelen Woodworking	Tacoma	Pierce	17		6	11	12		4
Calvert Industries	Snohomish	Snohomish					31		32
Capital Industries	Seattle	King					55		54
Cascade Cabinet	Woodinville	King					80	3	43
Cello Bag Company	Tukwila	King					36		36
Chevron USA (Asphalt)	Edmonds	Snohomish	7	69	5	29	22		
Chevron(Pt Wells), closed	Edmonds	Snohomish					60		1
Coastal Manufacturing	Mulkiteo	Snohomish					19		19
Continental Baking	Seattle	King					49		49
Continental Lime	Tacoma	Pierce	95				0		0
Craftsman Press	Seattle	King					15		3
Crain Industries	Kent	King					3	164	167
Crest Cabinet	Everett	Snohomish					30		14
Delta Prefinishing Corp	Tacoma	Pierce					42	2	34
Domtar Gypsum	Tacoma	Pierce	37		14	58			
Dyno Overlays	Tacoma	Pierce					5	5	9

Table 1 (*continued*)
1994 Large Stationary Source Emissions (Tons/year)

(PM10, SOx, CO, NOx ≥ 25 tpy; VOC, NR, TAC ≥ 5 tpy)

			Tons of Pollutant						
Source	City	County	PM10	SOx	CO	NOx	VOC	NR	TAC
Final Phase Finishing	Redmond	King					14		14
Finishing Unlimited	Redmond	King					10		10
G A T X (Harbor Island)	Seattle	King				1	40		1
G M Nameplate	Seattle	King					15		13
Gai's Seattle French Baking	Seattle	King					112		112
General Plastics Mfg	Tacoma	Pierce					2	17	18
Genie Industries	Redmond	King					12	4	15
Girard Custom Coaters	Tacoma	Pierce					181	4	135
Great Northwest Cabinet	Woodinville	King					86	9	86
Guardsman Products	Seattle	King					36	1	31
Haworth (Lundstead)	Kent	King					32	3	31
Heath Tecna Aero (Struct)	Kent	King			1	5	21	4	23
Heath Tecna Aerospace	Auburn	King					6	17	21
Holnam Inc. (Ideal)	Seattle	King	93	805	221	2360			1
Huntsman Packaging	Kent	King					152		151
Hytek Finishes	Kent	King			1	3	19	0	15
J. L. Darling	Tacoma	Pierce					58		10
James Hardie Gypsum	Seattle	King	4		9	35	1		
James River (Ridgeway)	Redmond	King					51		33
Jeld - Wen of Everett	Everett	Snohomish	57		81	12	1		
Jorgensen Forge	Seattle	King		2	54	25	1		
K - 2 Corporation	Vashon Isld	King					23	25	48
Kaiser Al & Chem (Port)	Tacoma	Pierce	32						
Kaiser Al & Chem (Smelter) *	Tacoma	Pierce	119	1368	9677	1	58		
Kenworth Truck (Paccar)	Tukwila	King			3	10	136	2	103
Kenworth Truck (Paccar)	Renton	King			1	6	94	0	75
King Pub Wks (Cedar Hill)	Maple Valley	King		21	13	63	0		13
Langendorf Baking	Seattle	King				3	132		132
Leathercare	Seattle	King					5		5
Lianga Pacific Inc.	Tacoma	Pierce					33		33
Livingston Molded Prod.	Auburn	King					33	9	41
Long Painting	Seattle	King	2				17		17
Master Millwork	Puyallup	Pierce					5	2	7
Matsushita Semiconductor	Puyallup	Pierce	6		1	6	20	24	76
Meltec (Div of Young)	Seattle	King	50						
Metro (West Point)	Seattle	King	2	4	33	170	11		
Mutual Materials	Newcastle	King	93						
Norcore Plastics Inc.	Tacoma	Pierce					5	12	17
Northlake Cabinet	Woodinville	King					15		13
NW Composites	Marysville	Snohomish					11	1	12
NW Pipeline (Echo Lake)	Snohomish	Snohomish	2	5	191	520	41		8
O'Brien International	Redmond	King					6	2	7
Occidental Chemical	Tacoma	Pierce	1	1	7	146	1	11	12
Olympic Boat	Arlington	Snohomish					2	3	5
Oroweat Foods	Seattle	King					12		12
Pacific Coast Showcase	Kent	King					9		9

Table 1 (*continued*)
1994 Large Stationary Source Emissions (Tons/year)

(PM10, SOx, CO, NOx ≥ 25 tpy; VOC, NR, TAC ≥ 5 tpy)

Source	City	County	Tons of Pollutant						
			PM10	SOx	CO	NOx	VOC	NR	TAC
Pacific Coast Showcase	Tacoma	Pierce					14	2	15
Pacific NW Baking	Sumner	Pierce					52		52
Pacific Sound Resources	Seattle	King		1	1	4	15		5
Pasquier Panel Products	Puyallup	Pierce					32		27
Pioneer Industries	Seattle	King					17		4
Premier Industries WIC/PZ	Kent	King					104		104
Professional Coatings	Seattle	King					25		26
Protective Coatings	Kent	King					20	3	22
Puget Sound Coatings	Seattle	King	7				31		28
Rainier Brewery	Seattle	King	2		3	13	16		18
Rainier Plywood	Tacoma	Pierce					18		18
Rainier Veneer	Spanaway	Pierce	18		60	7	7		
Rainy River Forest Prod.	Steillacoom	Pierce	94	10	163	254	57		
Red Dot Corporation	Tukwila	King					39		39
Reynolds Metals (Can Plt)	Kent	King					177		157
Rudd Company	Seattle	King					27	1	24
S. Seattle Auto Auction	Kent	King					8		5
Safeway Stores (Bakery)	Bellevue	King					25		25
Sauder Door	Kirkland	King					13		12
Scott Paper *	Everett	Snohomish	62	644	5352	1339	191		
Seattle Disposal (NW)	Seattle	King					14		1
Seattle Steam	Seattle	King	3	12	28	230	1		
Seattle Times	Bothell	King					36		
Seattle Times	Seattle	King					5		
Simpson Tacoma Kraft *	Tacoma	Pierce	254	2219	3715	693	85		
Skills Inc	Seattle	King					6		5
Smith, A. O Water Prod	Seattle	King				1	4	3	7
Sound Refining (Crysen)	Tacoma	Pierce	10	73	15	57	12		
Southgate Press	Seattle	King					6		5
Strasser Wooden Works	Woodinville	King					12		12
Superior Oil (Time Oil)	Tacoma	Pierce					16		1
Surftech Finishes	Kent	King					36	0	7
T A M Engineering	Tacoma	Pierce					10		
T C Systems	Everett	Snohomish					18		18
T. B. M. Door & Millwork	Kirkland	King					22	2	23
Tacoma Fixtures	Tacoma	Pierce					37	1	38
Tacoma City Light	Tacoma	Pierce	20	153	24	171			
Tempress	Seattle	King					20	20	40
Texaco Refining & Mktg	Seattle	King					20		
Tiz's Door Sales	Everett	Snohomish					34	1	32
Todd Pacific Shipyards	Seattle	King	1		1	5	19	0	18
Tosco Corporation	Renton	King					23		1
Tosco Corporation	Tacoma	Pierce					29		1
Tramco Inc. (South)	Everett	Snohomish					137	22	109
Tucci and Sons	McChord	Pierce	10	15	12	43	12		12
Tucci and Sons	Frederickson	Pierce	15	15	17	43	12		12

Table 1 (*continued*)
1994 Large Stationary Source Emissions (Tons/year)

(PM10, SOx, CO, NOx ≥ 25 tpy; VOC, NR, TAC ≥ 5 tpy)

Source	City	County	Tons of Pollutant						
			PM10	SOx	CO	NOx	VOC	NR	TAC
Tucci and Sons	Tacoma(Taylor)	Pierce	12	22	14	30	28		28
Tucci and Sons	Glacier	Pierce	15	15	17	43	12		12
U S Air Force Base	McChord	Pierce	2	10	5	20	11		5
U S Army Base	Fort Lewis	Pierce	19	141	67	137	65	24	44
U S Marine	Arlington	Snohomish					51	15	66
U S Navy Shipyard	Bremerton	Kitsap	32	90	102	292	170	29	125
U S Navy Submarine Base	Bangor	Kitsap	3	80	7	62	23		12
U S Navy Undersea War	Keyport	Kitsap	2	1	5	24	14	6	16
U S Oil & Refining	Tacoma	Pierce	25	145	36	160	317		29
U S G Interiors	Tacoma	Pierce	51		1	3	2		
United Graphics	Kent	King					21		3
Univ of WA Power Plant	Seattle	King	3	19	29	397	5		
Unocal (Tacoma)	Tacoma	Pierce					7		
Wescor Graphics	Seattle	King					9		9
Western Pneumatic Tube	Kirkland	King					18		18
Westmark Products	Tacoma	Pierce					8	5	14
Weyerhauser (Snoq)	Snoqualmie	King	93	7	379	59	39		
Wholesale Door	Snohomish	Snohomish					17		15
Wilkins Distributing (Gull)	Port Orchard	Kitsap					32		
TOTAL			**1214**	**5878**	**20346**	**7453**	**3882**	**284**	**2684**

* *Data from US EPA's AIRS database; no NR and TAC emission data was available*

1994 Large Stationary Source Emissions by County (Tons/year)

County	Tons of Pollutant						
	PM10	SOx	CO	NOx	VOC	NR	TAC
King	659	1169	6610	5368	3033	441	2930
Kitsap	37	171	114	378	239	35	153
Pierce	852	4187	13855	1897	1327	114	727
Snohomish	130	721	5657	2000	1137	144	882
4-County Total	**1678**	**6248**	**26236**	**9643**	**5736**	**734**	**4692**

PM10 -- Particulate Matter less than 10 microns
SOx -- Oxides of Sulfur
CO -- Carbon Monoxide
NOx -- Oxides of Nitrogen
VOC -- Volatile Organic Compounds
NR -- Negligibly Reactive Organic Compounds
TAC -- Toxic Air Contaminants

Table 2

1994 Small Stationary Source Emissions (Tons/year)

Source Category	Tons of Pollutant		
	CO	NOx	VOC
External Combustion:			
Commercial/Institutional Fuel	309	1458	51
Industrial Fuel	527	2295	39
Residential Fuel	959	2466	110
Residential Wood	79730	947	9382
Solid Waste Disposal:			
Land Clearing	4303	118	484
Residential Garbage	2729	193	963
Residential Yard Waste	19297	861	4824
Stationary Internal Combustion:			
Jet Engine Testing	348	9	12
Evaporation Loss:			
Architectural Coatings			6776
Automotive Refinishing			4198
Automotive Surface Cleaning			852
Cutback Asphalt Paving			383
Dry Cleaning			223
Graphic Arts			1324
Industrial Coatings			8126
Industrial Surface Cleaning			2747
Miscellaneous Solvents			9428
Publicly Owned Treatment Works			53
Temporary Storage & Disposal Facilities			8
Traffic Coatings			737
Petroleum Industry:			
Aircraft Refueling			56
Gasoline Distribution			9358
Petroleum Vessel Loading/Unloading			274
Storage Tanks:			
Leaking Underground Tanks			67
Food and Agricultural Industries:			
Agricultural Burning	35	1	6
Baking			1075
Breweries			22
Pesticide Application			109
Miscellaneous:			
Controlled (Slash) Burning	738	16	61
Forest Wildfires	59	1	2
Structure Burning	1468	34	269
TOTAL	**110502**	**8399**	**62019**

Table 3
1994 On-road Mobile Emissions (Tons/year)

Source Category	Tons of Pollutant		
	CO	NOx	VOC
Light Duty Gasoline Vehicles (LDGV)	354843	33452	53595
Light Duty Diesel Vehicles (LDDV)	437	432	197
Light Duty Gasoline Trucks (LDGT)	182066	15025	28078
Light Duty Diesel Trucks (LDDT)	1882	1827	1052
Heavy Duty Gasoline Vehicles (HDGV)	56243	2993	6560
Heavy Duty Diesel Vehicles (HDDV)	13764	19625	3353
Motorcycles (MC)	1270	47	472
TOTAL	**610505**	**73401**	**93307**

Table 4
1994 Non-road Mobile Emissions (Tons/year)

Source Category	Tons of Pollutant		
	CO	NOx	VOC
Aircraft & Aircraft Equipment	13009	3141	2164
Commercial Vessels	4682	32047	1959
Commercial/Industrial Equipment	36194	1900	2176
Construction Equipment	10949	10578	1728
Farm Equipment	921	895	195
Lawn & Garden Equipment	63117	181	6438
Logging Equipment	1900	1007	262
Railroad Equipment	172	1261	58
Recreational Boats	15145	368	5817
Recreational Equipment	24506	74	12753
TOTAL	**170595**	**51452**	**33550**

Table 5
1994 Emissions Summary (Tons/year)

Source Category	Tons of Pollutant						
	PM10	SOx	CO	NOx	VOC	NR	TAC
1. Large Stationary Sources	1678	6248	26236	9643	5736	734	4692
2. Small Stationary Sources			110502	8399	62019		
3. On-road Mobile Sources			610505	73401	93307		
4. Non-road Mobile Sources			170595	51452	33550		
5. Biogenics			0	0	81394		
TOTAL	*	*	**917838**	**142895**	**276006**	*	*

* PM10, SOx, NR, TAC emissions are available only for Large Stationary Sources

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. The automobile internal combustion engine is a principal source of carbon monoxide. Carbon monoxide chemically combines with the hemoglobin in the red blood cells to decrease the oxygen-carrying capacity of the blood. It also weakens the contractions of the heart, thus reducing the amount of blood pumped throughout the body. Additionally it can affect the functioning of the lungs and brain. People with heart disease and pregnant women are particularly at risk because of the effects of carbon monoxide.

Particulate Matter (PM_{10})

Particulate matter consists of small discrete solid or aerosol particles dispersed in the air. Particulate matter with an aerodynamic diameter of less than or equal to 10 micrometers is referred to as PM_{10}. Transportation, industrial activity and wood burning are major sources of particulate matter. Particulates one micrometer or less in diameter are especially associated with a variety of adverse effects on public health and welfare. The small particles can be breathed deeply into the lungs. 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. Particulate matter causes welfare effects through soiling of buildings and other property and by scattering and absorbing visible light thereby reducing visibility.

Ozone

Ozone is a pungent-smelling, colorless gas produced in the atmosphere when nitrogen oxides and volatile organic compounds 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. In contrast, ozone is beneficial when it occurs naturally, very high in the atmosphere, miles above the earth, where it protects us from harmful ultraviolet radiation.

Sulfur Dioxide

Sulfur dioxide is a colorless, corrosive gas, that has a bitter taste, but no appreciable smell between 0.3 and 1.0 ppm. Industrial sites 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 more significant. Inhalation of sulfur dioxide can cause increased airway resistance by constricting lung passages.

Lead

Particles of lead or its compounds enter the air from vehicle exhaust and from industries that smelt or process 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 from one to five years old 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 that, along with 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 photochemical reactions that produce ozone.

AMBIENT AIR QUALITY STANDARDS

POLLUTANT	NATIONAL Primary	NATIONAL Secondary	WASHINGTON STATE	PUGET SOUND REGION
CARBON MONOXIDE				
8 Hour Average [a]	9 ppm		9 ppm	9 ppm
1 Hour Average [a]	35 ppm		35 ppm	35 ppm
PARTICULATE MATTER (PM10)				
Annual Arithmetic Average [b]	50 $\mu g/m^3$	50 $\mu g/m^3$	50 $\mu g/m^3$	50 $\mu g/m^3$
24 Hour Average [c]	150 $\mu g/m^3$	150 $\mu g/m^3$	150 $\mu g/m^3$	150 $\mu g/m^3$
OZONE				
1 Hour Average [d]	0.12 ppm	0.12 ppm	0.12 ppm	0.12 ppm
SULFUR DIOXIDE				
Annual Average [e]	0.03 ppm		0.02 ppm	0.02 ppm
24 Hour Average	0.14 ppm [a]		0.10 ppm [a]	0.10 ppm [e]
3 Hour Average [a]		0.50 ppm		
1 Hour Average [f]			0.25 ppm	0.25 ppm
1 Hour Average			0.40 ppm [a]	0.40 ppm [e]
LEAD				
Calendar Quarter Average [e]	1.5 $\mu g/m^3$	1.5 $\mu g/m^3$		1.5 $\mu g/m^3$
NITROGEN DIOXIDE				
Annual Average [e]	0.053 ppm	0.053 ppm	0.053 ppm	0.053 ppm

Notes

(1) ppm = parts per million.

(2) $\mu g/m^3$ = micrograms per cubic meter.

a -Not to be exceeded more than once per year.

b - Standard attained when the expected annual arithmetic mean concentration, as determined in accordance with 40 CFR Part 50, Appendix K, is less than or equal to 50 $\mu g/m^3$.

c -Standard attained when the expected number of days per calendar year with a 24-hour average concentration above 150 $\mu g/m^3$, as determined in accordance with 40 CFR Part 50, Appendix K, is equal to or less than one.

d -Standard 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, as determined by 40 CFR Part 50, Appendix H.

e - Never to be exceeded.

f - Not to be exceeded more than twice in seven consecutive days.

AIR QUALITY UNITS CONVERSION TABLE

Air quality standards for gases are defined in terms of micrograms (μg) 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 μg/cubic meter or mg/cubic meter. These conversion factors from the Federal Register assume a pressure of 760 millimeters Hg and a temperature of 25 degrees C.

Pollutant	*Multiply ppm by*	*To Obtain*
Carbon Monoxide	1.145	mg/cubic meter
Ozone	1961	μg/cubic meter
Sulfur Dioxide	2619	μg/cubic meter
Nitrogen Dioxide	1880	μg/cubic meter