Puget Sound
Air Pollution Control Agency

1983 AIR QUALITY DATA SUMMARY

Counties Of

King
Kitsap
Pierce
Snohomish

Puget Sound Air Pollution Control Agency

Serving King, Kitsap, Pierce and Snohomish Counties

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1983
AIR QUALITY
DATA SUMMARY

measured and compiled by the

Technical Services Division

PUGET SOUND
AIR POLLUTION CONTROL AGENCY
200 West Mercer Street
P.O. Box 9863
Seattle, Washington 98109

1983 AIR QUALITY DATA SUMMARY

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PUBLISHED JUNE, 1984
TECHNICAL SERVICES DIVISION
(206) 344-7326

INTRODUCTION

This twelfth annual data summary presents air quality and meteorological data measured in the Puget Sound Region during 1983. The report begins with a table outlining the sampling network (with addresses) and a map of the network. Within the report are summaries of pollutant measurements together with interpretive comments. The last sections present meteorological data consisting of lower atmosphere temperature soundings, wind roses, and stability wind roses. The outside back cover outlines the National, Washington State, and Puget Sound Region ambient air quality standards. Summaries within the report show whether the actual pollutant levels in the Puget Sound Region meet or exceed these standards.

The year 1983 was notably free of any Air Stagnation Advisories. In particular the fall season was completed with unusually good dispersion on almost every day as compared to recent years. This fact should be kept in mind during any review or determination of trends in the measured air quality levels.

A section summarizing air quality using the nationally uniform Pollutant Standards Index (PSI) begins on page 6. The PSI provides a daily index of air quality using a simple reference scale. This reference scale is designed around the short term standard for each of the pollutants which is set to protect health. Each daily PSI value during 1983 for Everett, Seattle and Tacoma is displayed on a graph and summarized in a table. New this year is a four year summary of PSI values covering the years 1980 through 1983. Every weekday the Agency reports the current PSI to the news media and the public. Anyone may obtain the current PSI also from the Washington Lung Association in Seattle by dialing 282-5565 or by dialing 1-800-732-9339 toll-free from outside Seattle.

In March, 1984 the U.S. Environmental Protection Agency proposed revisions to the national ambient air quality standards for particulate matter. Along with other changes the proposal would define a size specific method of measuring particulate matter. This report presents a summary of suspended particulates smaller than 10 micrometers measured with a Size Selective Inlet (SSI) high volume sampler at seven stations. Summaries for five of these stations also present data for the fraction smaller than 2.5 micrometers, termed "fine particulates", which is measured using a cyclone inlet sampler. Various particulate matter ratios and correlation analyses are also computed and presented. These summaries appear on pages 21 through 25.

New this year are reports containing arsenic data measured at five stations around the Tacoma Smelter. These reports are presented on page 27.

It is important that air quality measurements be precise and accurate. Nationally uniform requirements establish the procedures to audit and document the Precision and Accuracy of air quality data. A section beginning on page 34, titled Quality Assurance, summarizes the program and presents the Precision and Accuracy audit results.

All data collected are reported quarterly to the Washington Department of Ecology; some of it is forwarded from there to the National Aerometric Data Bank maintained by the U.S. Environmental Protection Agency. The Department of Ecology conducts air monitoring within the region in addition to that done by the Agency. The Department publishes an annual summary of data for the entire state. Inquiries concerning the statewide data should be directed to the Washington State Department of Ecology-PV11, Office of Hazardous Substances and Air Quality Control, Olympia, Washington 98504.

PUGET SOUND AIR POLLUTION CONTROL AGENCY

Atmospheric Sampling Network

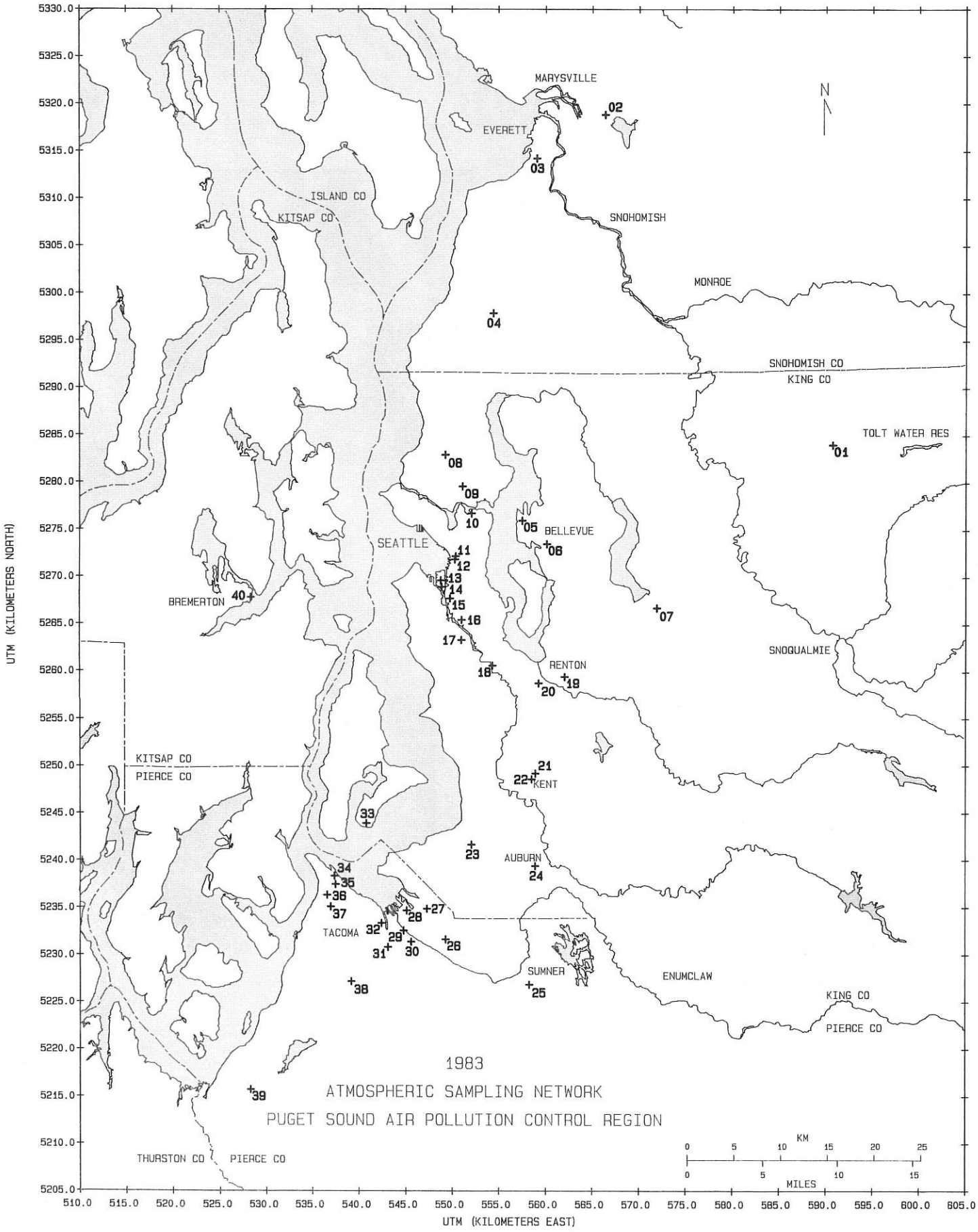
1983

	Location	Type of Sampling[a] A	B	C	D	E	F	G	H	I
01	Tolt River Watershed, King County, Wa	A								
*02	Highway 9 & 28th St NE, Lake Stevens, Wa	A								
03	Medical-Dental Bldg, 2730 Colby, Everett, Wa	A	B	C	D					
*04	Lynnwood HS, 3001 184th St SW, Lynnwood, Wa	A								
*05	Evergreen Point Bridge Toll Plaza, Medina, Wa							G		
*06	504 Bellevue Way NE, Bellevue, Wa	A						G		
*07	20050 SE 56th, Lake Sammamish State Park, Wa	A				E				
08	North 98th St & Stone Ave N, Seattle, Wa	A	B	C	D		F	G		I
*09	5701 8th Ave NE, Seattle, Wa	A						G		
*10	Portage Bay, 2725 Montlake Blvd E, Seattle, Wa	A			D			G		
11	Public Safety Bldg, 604 3rd Ave, Seattle, Wa	A								
*12	Fire Station #10, 301 2nd Ave S, Seattle, Wa	A								
13	Harbor Island, 2555 13th Ave SW, Seattle, Wa	A						G		I
14	Harbor Island, 3400 13th Ave SW, Seattle, Wa	A						G		
15	Duwamish, 4401 E Marginal Way S, Seattle, Wa	A	B	C	D		F			I
*16	Georgetown, 6431 Corson Ave S, Seattle, Wa	A								
17	South Park, 723 S Concord St, Seattle, Wa	A								I
18	Duwamish Valley, 12026 42nd Ave S, King Co, Wa	A								
19	SE Dist Health Ctr, 3001 NE 4th St, Renton, Wa	A								
20	200 South 2nd St, Renton, Wa	A								
21	22916 86th Ave S, Kent, Wa	A			D	E	F			
22	Memorial Park, 850 N Central Ave, Kent, Wa	A								I
23	Federal Way HS, 1401 S 304 St, Federal Way, Wa	A	B		D					
24	115 E Main St, Auburn, Wa	A								
25	Sumner Jr HS, 1508 Willow St, Sumner, Wa	A			D	E				
26	Fife Sr High School, 5616 20th E, Fife, Wa	A								
27	2340 Taylor Way, Tacoma, Wa	A								I
28	Fire Station #12, 2316 E 11th St, Tacoma, Wa	A		C	D		F			I
29	Treatment Plant, 1241 Cleveland Wy, Tacoma, Wa	A								
30	Cascadia, 2002 E 28th St, Tacoma, Wa	A								
31	Willard School, S 32nd & S 'D' St, Tacoma, Wa	A		C	D					
32	Hess Bldg, 901 Tacoma Ave S, Tacoma, Wa	A								
33	SW 283rd & 101st Ave SW, Maury Island, Wa	A	B		D			G	H	
34	Ruston School, 5219 N Shirley St, Tacoma, Wa	A						G	H	
35	4716 North Baltimore St, Tacoma, Wa	A						G	H	
36	North 37th & Vassault Sts, Tacoma, Wa		B		D					
37	North 26th & Pearl Sts, Tacoma, Wa	A	B		D			G	H	
*38	Mt Tahoma HS, 6404 S Adams St, Tacoma, Wa	A								
*39	City Water Supply Pump House, Dupont, Wa	A						G	H	
40	City Hall, 239 4th St, Bremerton, Wa	A								

* Station operated by Washington State Department of Ecology (Additional Ozone and all Nitrogen Dioxide and Carbon Monoxide sampling is performed by the Department of Ecology. Summaries of these data are included in this publication).

[a] Type of Sampling

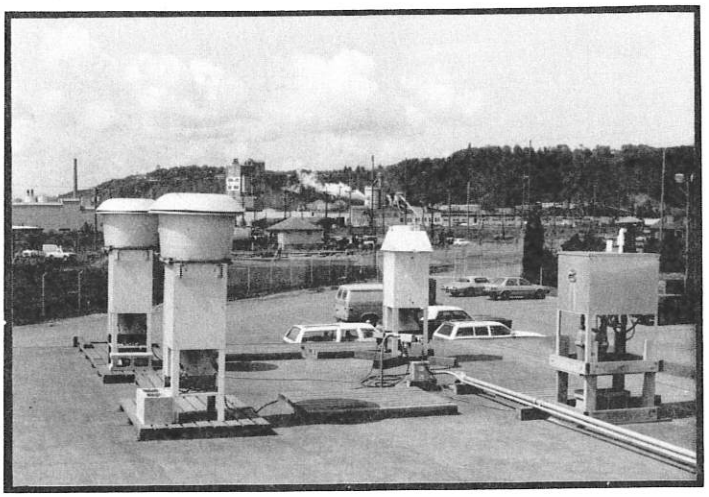
A Suspended Particulates (Total)
B Sulfur Dioxide (SO2)
C Suspended Particulates-COH'S
D Wind Direction & Speed
E Ozone (O3)
F Atmospheric Particles (b - scattering)
G Lead
H Arsenic
I Suspended Particulates (size selective sampling)

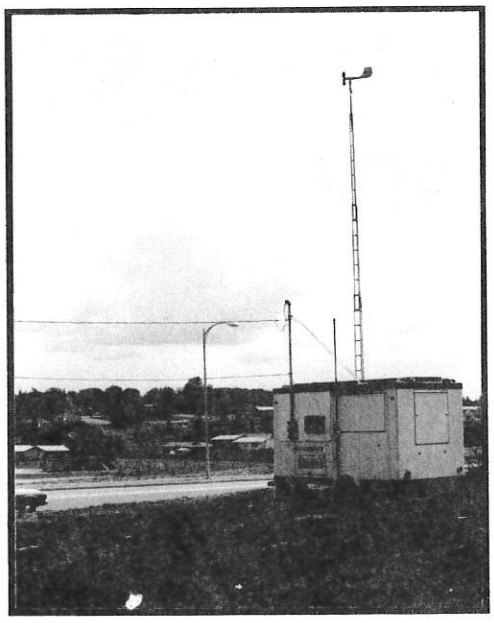

1983
ATMOSPHERIC SAMPLING NETWORK
PUGET SOUND AIR POLLUTION CONTROL REGION
MARYSVILLE
EVERETT
ISLAND CO
KITSAP CO
SNOHOMISH
MONROE
SNOHOMISH CO
KING CO
TOLT WATER RES
SEATTLE
BELLEVUE
BREMERTON
RENTON
SNOQUALMIE
KITSAP CO
PIERCE CO
KENT
AUBURN
TACOMA
SUMNER
ENUMCLAW
KING CO
PIERCE CO
THURSTON CO
PIERCE CO
N
KM
MILES
UTM (KILOMETERS NORTH)
UTM (KILOMETERS EAST)

AIR QUALITY AND METEOROLOGICAL SAMPLING SYSTEM

Pictures on this and the facing page show some of the sampling sites and the equipment used for sampling. Actual sampling at each station is documented in the table on page 2.

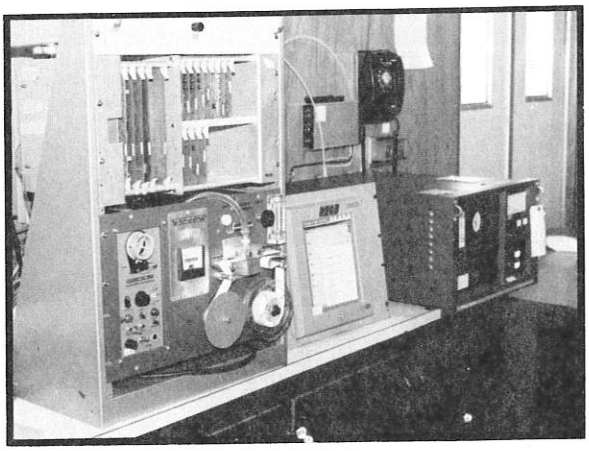
Sampling at 2340 Taylor Way, Tacoma measures three different fractions of Particulate Matter. To the left in the adjacent picture are two high volume samplers with Size Selective Inlets which collect the particulate fraction smaller than or equal to 10 micrometers diameter (PM10). In the center is a standard high volume sampler which measures Total Suspended Particulates (TSP). To the right is a cyclone inlet sampler collecting the particulate fraction smaller than 2.5 micrometers (Fine Particulates). All of these samplers collect particulate matter on a filter for the period of sampling, usually a 24-hour midnight to midnight time period every sixth day.



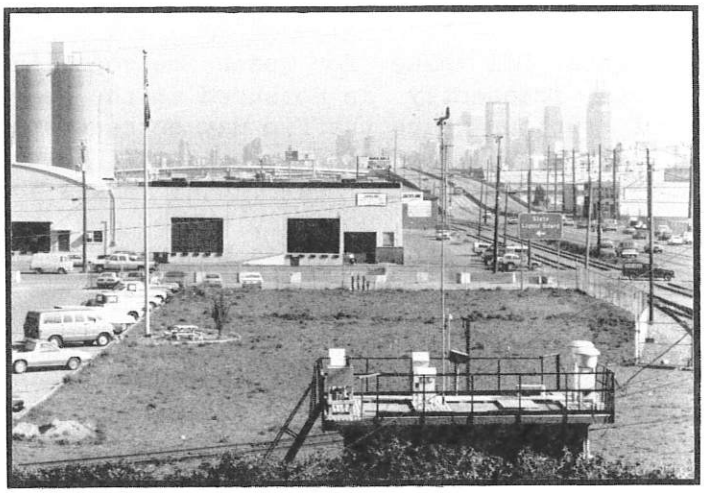


North 37th & Vassault Sts, Tacoma

The Wind Direction and Speed sensor is mounted on a 10 meter tower. A sampling probe immediately left of the tower obtains an ambient air sample for analysis by instruments inside the station.



Inside a station are the telemetry electronics which translate the instrument signals for transmission over phone lines at the command of the central control station computer. A tape sampler analyzes Suspended Particulates measured as COHs. An analyzer operating on the principle of ultraviolet fluorescence measures Sulfur Dioxide. This measurement is also recorded at the site on a strip chart recorder.

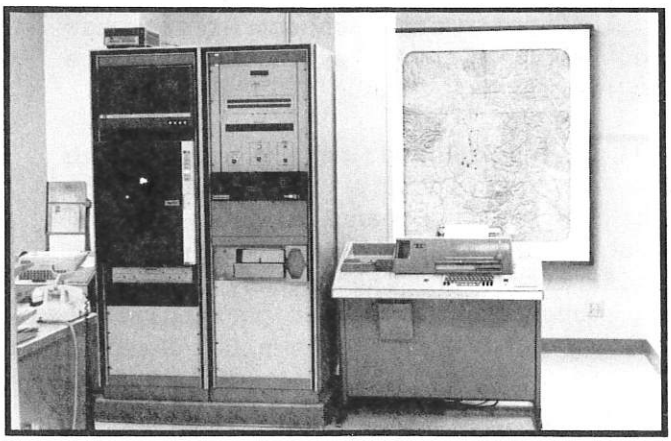


Station in Duwamish Valley
4401 E Marginal Way S, Seattle

On the roof, several standard high volume samplers enable every day sampling of Total Suspended Particulates. Two high volume samplers with a Size Selective Inlet (circular, dome shaped top) collect the PM10 fraction of particulate matter. A cyclone inlet sampler measures Fine Particulates. Separate sampling probes near the wind mast provide continuous sampling for analysis by a nephelometer, a tape sampler, and a sulfur dioxide analyzer all within the station.

Most data from all remote stations is immediately telemetered to the central station computer via phone lines.

Central station computer controls the entire network. It processes all incoming data, and computes 15-minute, 1-hour, and 24-hour averages for immediate printout on a continous schedule around the clock every day of the year.



- Values for TSP, PM10, and Fine Particulates collected by each specific sampler are computed after each sampled filter is removed and transported to the laboratory where it is conditioned and weighed.
- All data is checked for validity by air quality specialists.
- After validation, the data is stored in permanent computer files and summarized at least monthly and annually. Once stored in final computer files, the data is readily available to meet a variety of needs.
- The data is used to document air quality levels throughout the region and thereby determine areas in which air quality standards are exceeded; to report the Pollutant Standards Index to the public; to maintain continuous surveillance for real-time episode avoidance; and to evaluate the effect of control and enforcement activities.

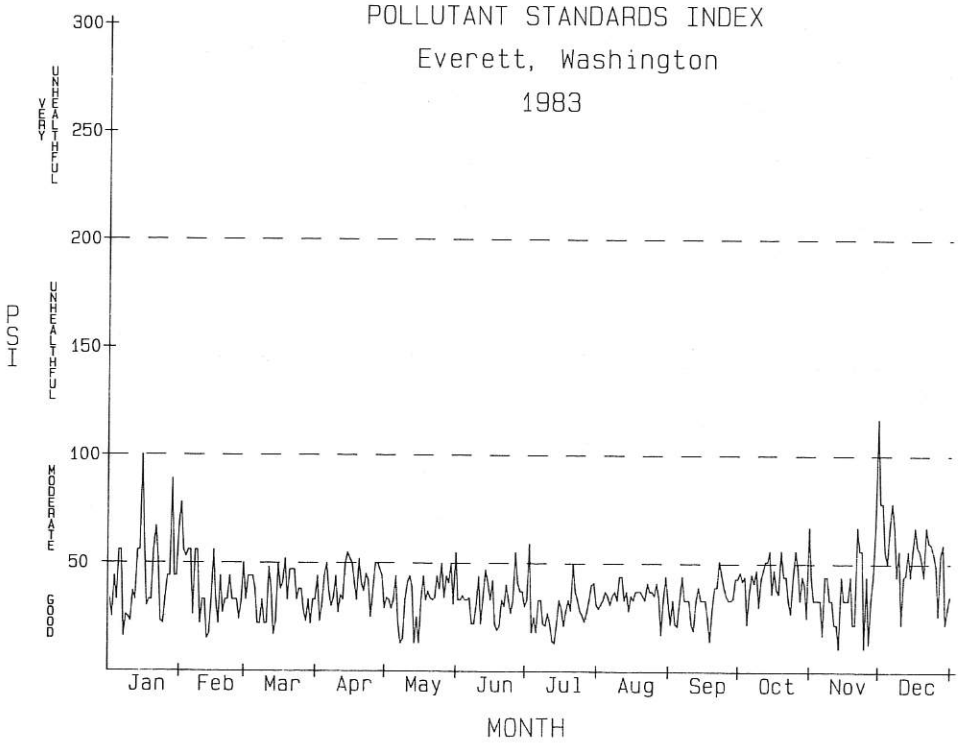
The Pollutant Standards Index (PSI) is a nationally uniform index for daily air quality reporting. In cooperation with the State Department of Ecology, the Agency began reporting the PSI in 1980 for the Everett, Seattle, and Tacoma areas.

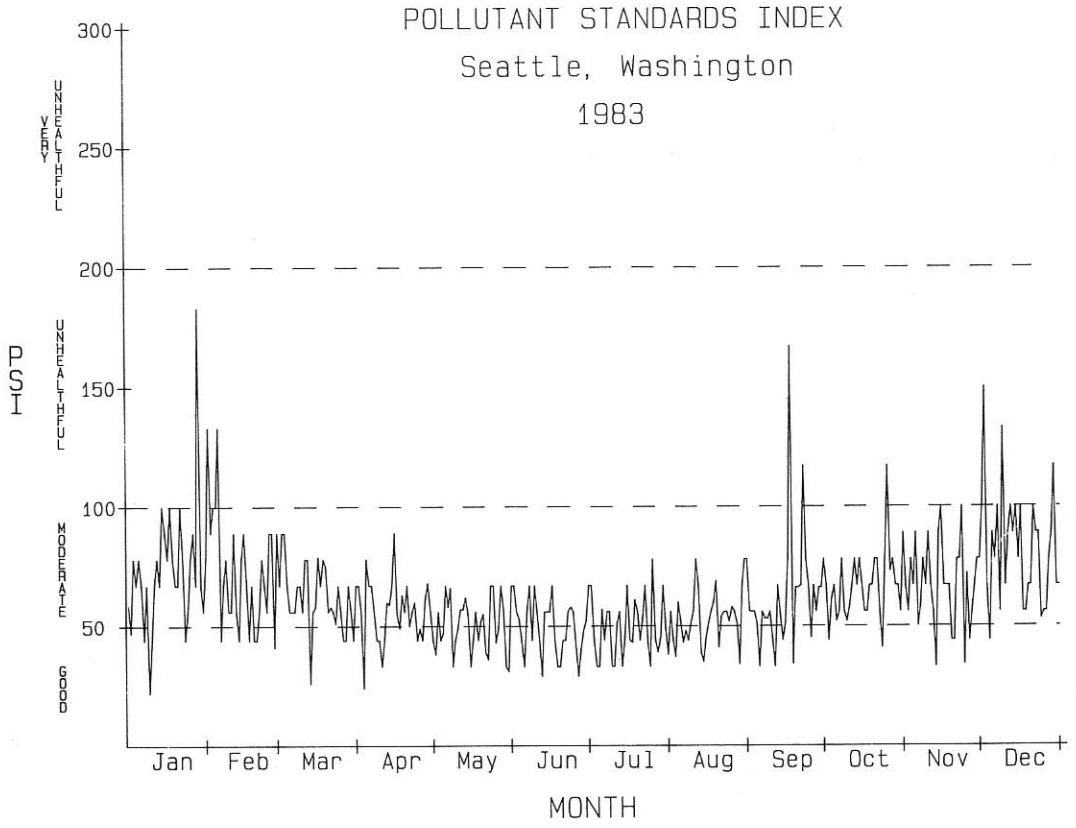
The PSI associates pollutant levels during a 24 hour period with potential health effects. The PSI is a range of values between zero and 500, with 0 to 50 indicating "Good" air quality, 51 to 100 being "Moderate", 101 to 199 considered "Unhealthful", 200 to 299 being "Very Unhealthful", and 300 and above "Hazardous". Whenever the PSI is above 100, a primary air quality standard has been exceeded. An index value of 200 means the pollutant concentration has reached the "Alert" level listed in the Washington Episode Plan.

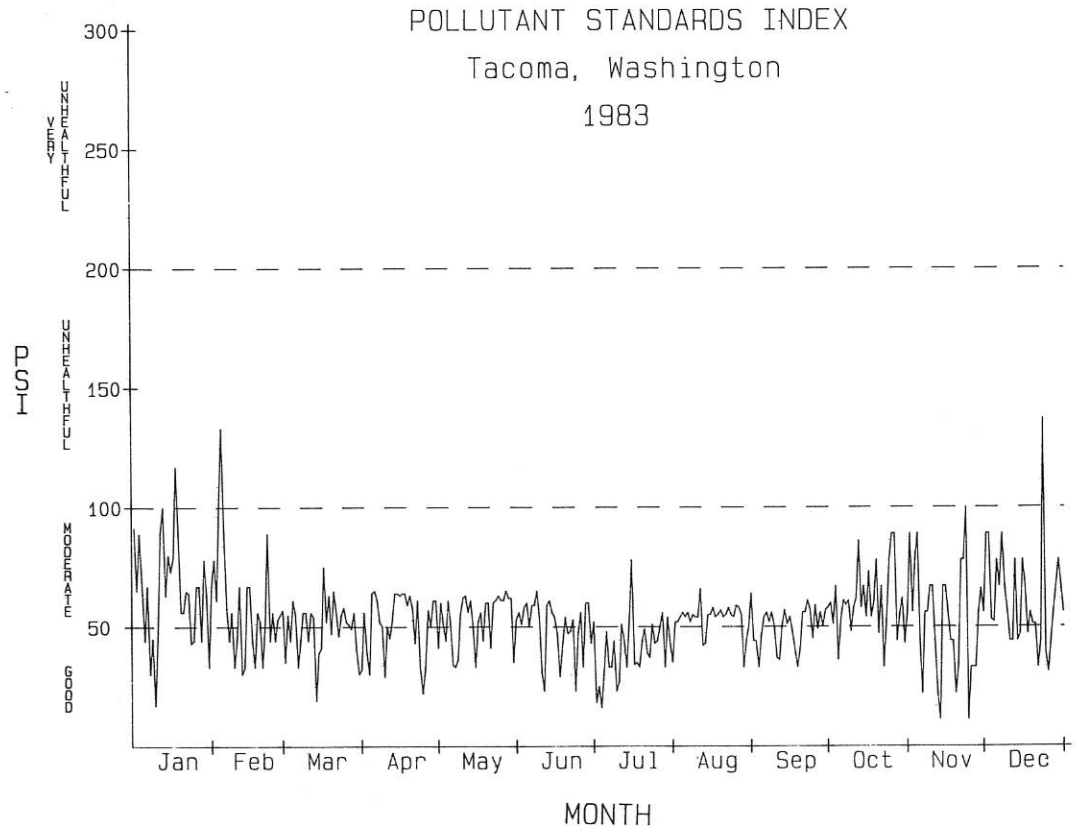
The PSI is designed to report upon five major air pollutants of concern for health: suspended particulates, sulfur dioxide, carbon monoxide, ozone, and nitrogen dioxide. The Agency reviews carbon monoxide, suspended particulates, and sulfur dioxide in the Everett, Seattle and Tacoma areas to calculate the index. The index value for each day in each area is determined by the pollutant with the highest value on the PSI scale. Since the highest PSI value for each metropolitan area frequently is measured in the heart of downtown where traffic may be congested or in a heavy industrial area, the values in many suburban residential areas are generally lower. However, there are not enough monitoring stations to specifically report for local neighborhoods.

The accompanying graphs plot each daily PSI for Everett, Seattle, and Tacoma during 1983. The higher PSI values tend to occur during the fall and winter months often coinciding with air stagnation periods. A 1983 summary table shows the number of days in each PSI interval by month and also lists the maximum index for each month, the date of occurrence, and the pollutant determining that index value. A four year (1980-1983) summary table presents by year the number of days in each air quality category as well as the number of days each pollutant determined the PSI. A summary specifically of the unhealthful days is also included.

Air quality in Bellevue is principally determined by levels of carbon monoxide. During 1983 the air quality in Bellevue was unhealthful due to carbon monoxide on 2 days. The PSI for Bellevue reached 117 on Jan 28 and Dec 1.




POLLUTANT STANDARDS INDEX
Seattle, Washington
1983
PSI
300
250
200
150
100
50
VERY UNHEALTHFUL
UNHEALTHFUL
MODERATE
GOOD
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
MONTH


POLLUTANT STANDARDS INDEX
Tacoma, Washington
1983
PSI
300
250
200
150
100
50
VERY UNHEALTHFUL
UNHEALTHFUL
MODERATE
GOOD
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
MONTH

POLLUTANT STANDARDS INDEX

1983

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)	20	20	30	27	30	29	30	31	29	25	25	12	308
MODERATE	(51 to 100)	11	8	1	3	1	1	1	0	1	6	4	19	56
UNHEALTHFUL	(101 to 199)	0	0	0	0	0	0	0	0	0	0	1	0	1
VERY UNHEALTHFUL	(200 to 299)	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum PSI each month		100	78	52	55	55	55	59	44	51	67	117	78	117
Date		15th	1st	18th	14th	31st	26th	2nd	10th	22nd	31st	30th	1st	Nov 30
Pollutant		CO	CO	TSP	SO2	SO2	SO2	SO2	CO	TSP	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)	5	6	4	11	15	14	18	10	6	2	6	1	98
MODERATE	(51 to 100)	25	20	27	19	16	16	13	21	22	28	24	27	258
UNHEALTHFUL	(101 to 199)	1	2	0	0	0	0	0	0	2	1	0	3	9
VERY UNHEALTHFUL	(200 to 299)	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum PSI each month		183	133	89	89	67	67	78	78	167	117	100	150	183
Date		28th	1st	2nd	15th	5th	1st	25th	11th	17th	25th	15th	2nd	Jan 28
Pollutant		CO	CO	CO	CO	CO	CO	CO	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)	9	10	14	12	9	12	25	5	15	6	13	10	140
MODERATE	(51 to 100)	21	17	17	18	22	18	6	26	15	25	17	20	222
UNHEALTHFUL	(101 to 199)	1	1	0	0	0	0	0	0	0	0	0	1	3
VERY UNHEALTHFUL	(200 to 299)	0	0	0	0	0	0	0	0	0	0	0	0	0
Maximum PSI each month		117	133	75	65	65	65	78	66	61	89	100	137	137
Date		17th	4th	16th	5th	27th	8th	15th	11th	22nd	25th	23rd	23rd	Dec 23
Pollutant		CO	CO	TSP	TSP	TSP	TSP	CO	CO	TSP	CO	CO	TSP	TSP

TSP = Total Suspended Particulates; CO = Carbon Monoxide; SO2 = Sulfur Dioxide.

POLLUTANT STANDARDS INDEX

1980 - 1983

EVERETT

	Days in Each Air Quality Category				Pollutant Determining the PSI						Highest Value		
					All Days			Unhealthful Days					
	Good	Moderate	Unhealthful	Very Unhealthful	TSP	CO	SO2	TSP	CO	SO2	PSI	Date	Pollutant
1980	340	19	0	0	356	-	3	0	-	0	60	Jan 23	TSP
1981	350	11	0	0	340	-	21	0	-	0	62	Jan 16	TSP
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
Totals	1332	116	2	0	1164	220	66	0	2	0			

SEATTLE

	Days in Each Air Quality Category				Pollutant Determining the PSI						Highest Value		
					All Days			Unhealthful Days					
	Good	Moderate	Unhealthful	Very Unhealthful	TSP	CO	SO2	TSP	CO	SO2	PSI	Date	Pollutant
1980	73	275	18	0	95	270	1	1	17	0	194	Jan 23	TSP
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	TSP
1983	98	258	9	0	101	261	3	0	9	0	183	Jan 28	CO
Totals	326	1068	65	2	401	1049	11	7	60	0			

TACOMA

	Days in Each Air Quality Category				Pollutant Determining the PSI						Highest Value		
					All Days			Unhealthful Days					
	Good	Moderate	Unhealthful	Very Unhealthful	TSP	CO	SO2	TSP	CO	SO2	PSI	Date	Pollutant
1980	83	271	12	0	256	107	3	4	8	0	160	Apr 12	TSP
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	TSP
Totals	416	1013	29	3	961	473	27	6	26	0			

SUSPENDED PARTICULATES

Introduction

Suspended Particulates is a general term for small particles of dust, soot, organic matter, and compounds containing sulfur, nitrogen, and metals. Particulates, when sampled by the standard high volume federal reference method are called Total Suspended Particulates (TSP). Total Suspended Particulate samplers effectively collect particulate matter up to diameters in the range of 25 to 45 micrometers.

In March, 1984 the U.S. Environmental Protection Agency proposed revisions to the national ambient air quality standards for particulate matter. The proposal would: (1) define a size specific method of measuring particulate matter; (2) establish new numerical levels for the standards; and (3) revise the statistical form of the standards. For the primary standard the measurement method would collect only those particulates smaller than or equal to 10 micrometers diameter (PM10). It is noted that the fraction of particulate matter with diameters smaller than 2.5 micrometers is generally referred to by the term "fine particulates".

During 1983, the Agency measured the PM10 fraction of suspended particulates at seven stations using the Size Selective Inlet (SSI) high volume sampler. A cyclone inlet sampler measured the fine particulate fraction concurrently at five of these stations. Data from this size selective sampling is summarized in this section along with the analysis of TSP from a continuing more extensive network.

Particulate Sources and Measured Levels

Particulates directly enter the air from industrial operations, from fuel combustion, from auto and truck traffic, from construction, and from other sources. These emissions may change from day to day due to intermittent industrial operations, equipment upset or breakdown and traffic variations. The fine particulate fraction includes gaseous transformation products such as sulfates, nitrates, and some organics.

Once present in the air, particulates are dispersed and transported by the wind. Valleys, hills, and large bodies of water affect the local direction and speed of the wind. Lower atmosphere stability influences how quickly particulates are dispersed. Measured 24 hour particulate levels may differ significantly from day to day responding to how much enters the air and how quickly meteorological processes disperse the particulates. Tables in this section summarize 24 hour measurements and document that high 24 hour levels are often recorded at many stations on the same day.

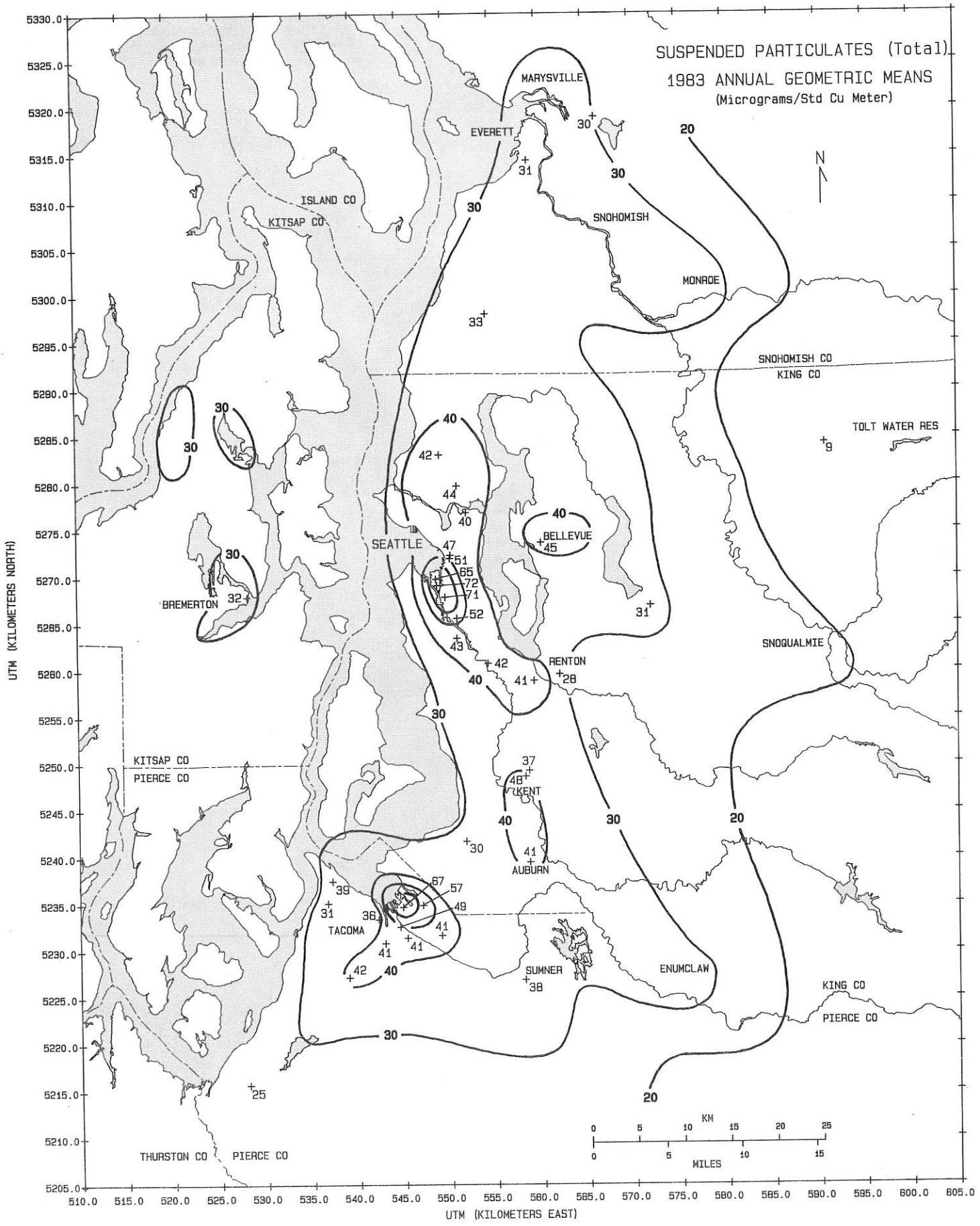
Annual Average TSP Map

A map of annual geometric mean TSP values throughout the region for calendar year 1983 follows this page. The actual values at each sampling station, together with a particulate emission inventory, local wind patterns and topography, provide the basis for the map.

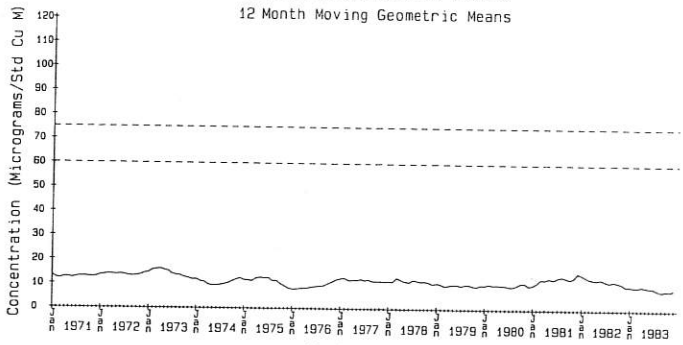
The annual concentration of TSP at a location may be determined by interpolating between adjacent isopleths (lines connecting points of equal concentration). The Tacoma Port area and the Harbor Island-Duwamish Valley area of Seattle record the highest concentrations in the Puget Sound area. At the end of 1983 the annual primary standard has been met, however the long history of readings exceeding the primary standard in these two industrial areas suggests continuing potential for the standard to be exceeded.

Suspended Particulate Trends

Graphic plots of moving TSP geometric means permit quick visual review of long term trends, but to depict any trend such plots require many years of data. Plotted moving geometric mean charts for several stations follow the map. A 12 month moving geometric mean compares directly to the annual primary and secondary standards which are shown by reference lines on the charts. One station near the Tolt Water Reservoir presents a steady unchanging low TSP value apparently unaffected by the urbanized areas. Other stations in the industrialized Seattle Duwamish Valley and Tacoma Port area show values exceeding the annual primary standard for many past years, but during 1982 and 1983 these values decreased to just about the level of the primary standard.

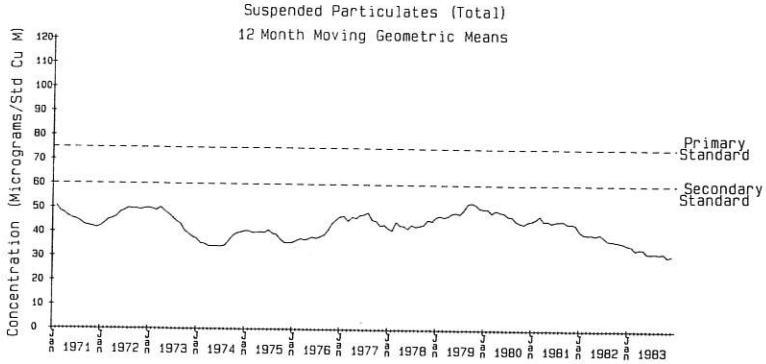

SUSPENDED PARTICULATES (Total)
1983 ANNUAL GEOMETRIC MEANS
(Micrograms/Std Cu Meter)
N
MARYSVILLE
EVERETT
ISLAND CO
KITSAP CO
SNOHOMISH
MONROE
SNOHOMISH CO
KING CO
TOLT WATER RES
SEATTLE
BELLEVUE
BREMERTON
RENTON
SNOQUALMIE
KITSAP CO
PIERCE CO
KENT
AUBURN
TACOMA
SUMNER
ENUMCLAW
KING CO
PIERCE CO
THURSTON CO
PIERCE CO
KM
MILES
UTM (KILOMETERS NORTH)
UTM (KILOMETERS EAST)

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means



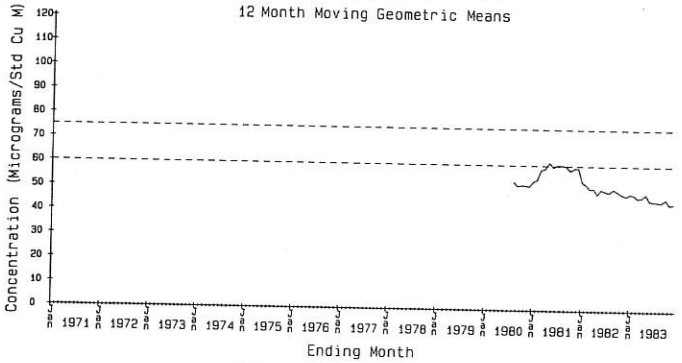
TOLT RIVER WATERSHED, KING COUNTY, WA

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means



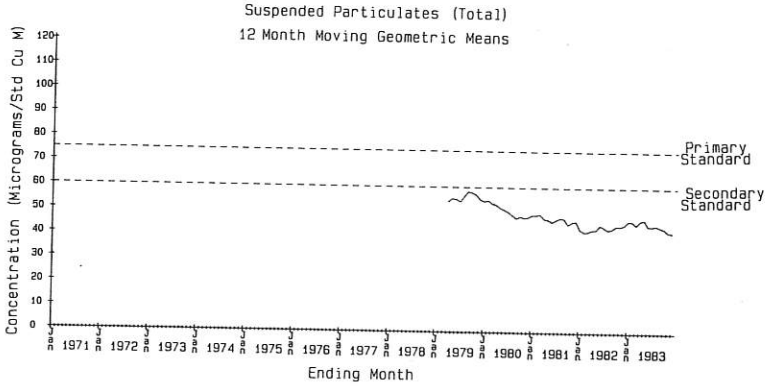
MEDICAL-DENTAL BLDG, 2730 COLBY, EVERETT, WA

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means



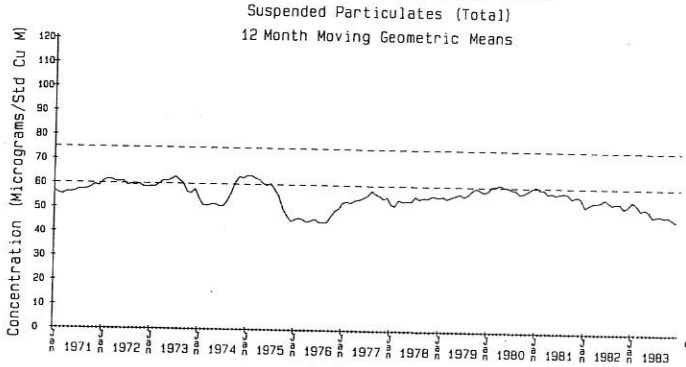
504 BELLEVUE WAY NE, BELLEVUE, WA

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means



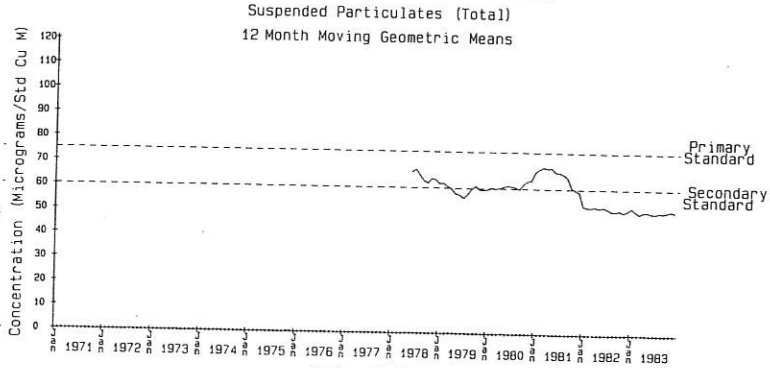
NORTH 98TH ST & STONE AVE N, SEATTLE, WA

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means

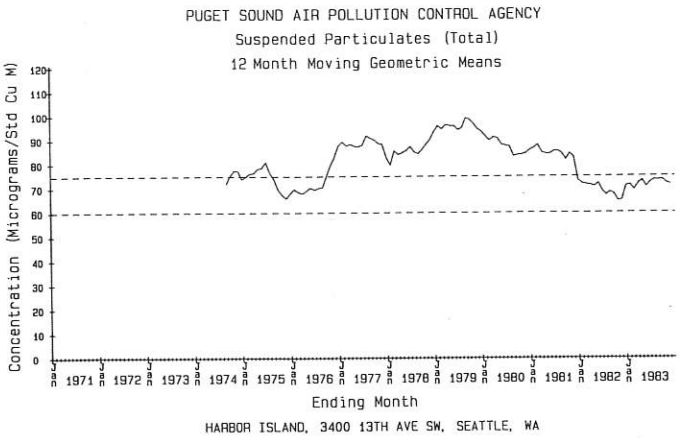


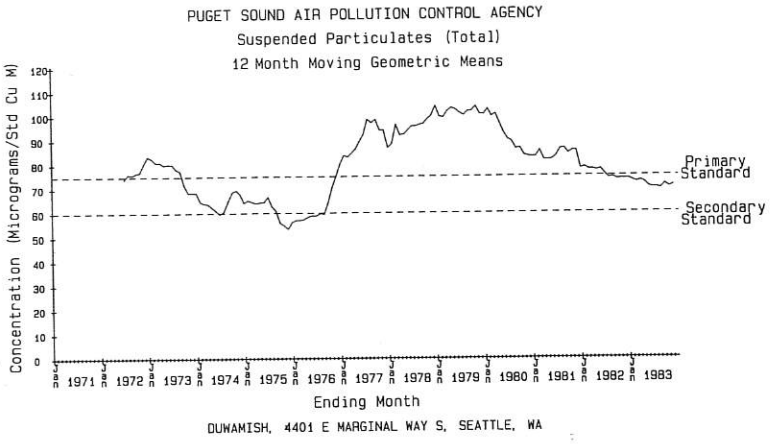
PUBLIC SAFETY BLDG, 604 3RD AVE, SEATTLE, WA

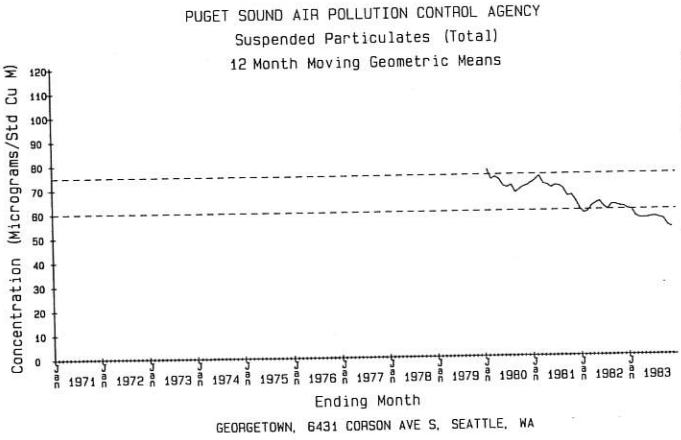
PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means

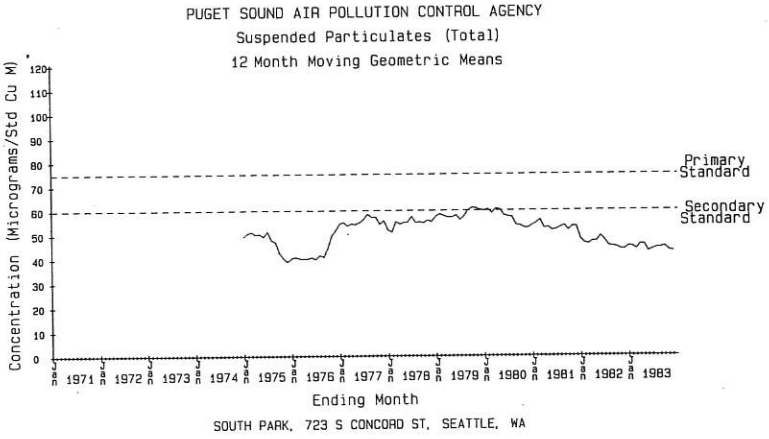


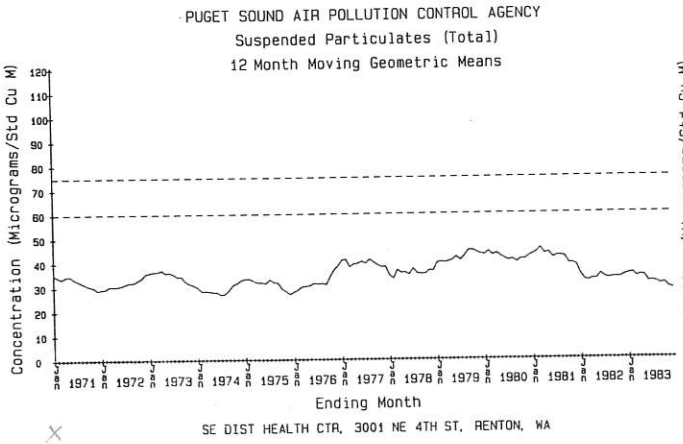
FIRE STATION #10, 301 2ND AVE S, SEATTLE, WA

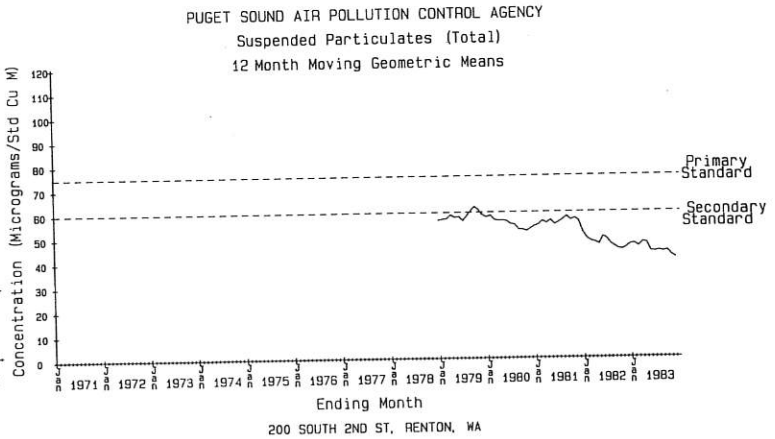

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means
Concentration (Micrograms/Std Cu M)
Ending Month
HARBOR ISLAND, 3400 13TH AVE SW, SEATTLE, WA


PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means
Concentration (Micrograms/Std Cu M)
Primary Standard
Secondary Standard
Ending Month
DUWAMISH, 4401 E MARGINAL WAY S, SEATTLE, WA

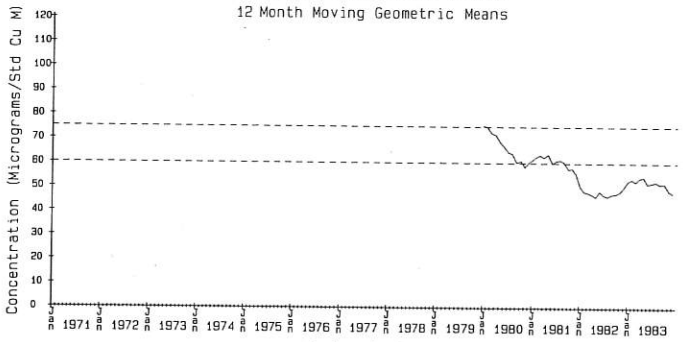

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means
Concentration (Micrograms/Std Cu M)
Ending Month
GEORGETOWN, 6431 CORSON AVE S, SEATTLE, WA


PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means
Concentration (Micrograms/Std Cu M)
Primary Standard
Secondary Standard
Ending Month
SOUTH PARK, 723 S CONCORD ST, SEATTLE, WA


PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means
Concentration (Micrograms/Std Cu M)
Ending Month
SE DIST HEALTH CTR, 3001 NE 4TH ST, RENTON, WA

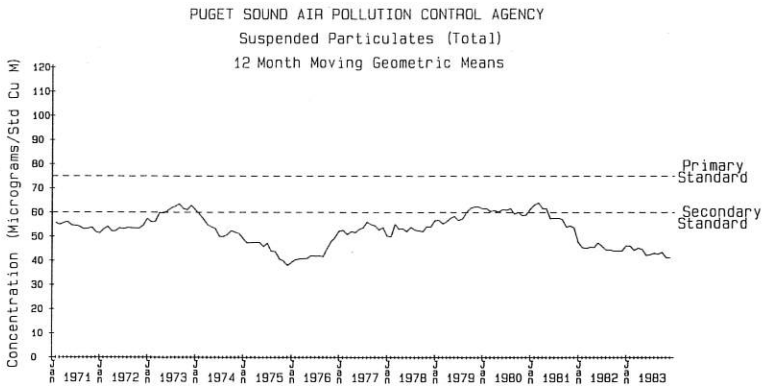

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means
Concentration (Micrograms/Std Cu M)
Primary Standard
Secondary Standard
Ending Month
200 SOUTH 2ND ST, RENTON, WA

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means



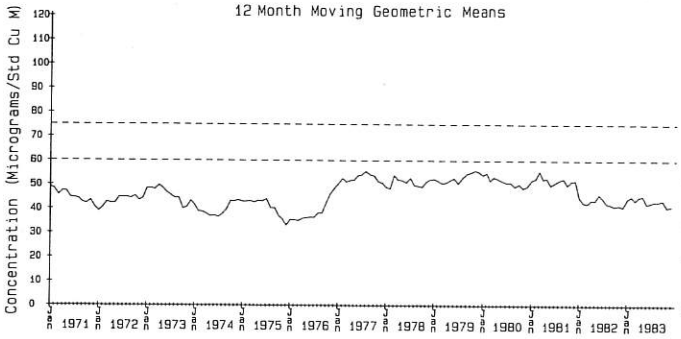
MEMORIAL PARK, 850 N CENTRAL AVE, KENT, WA

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means



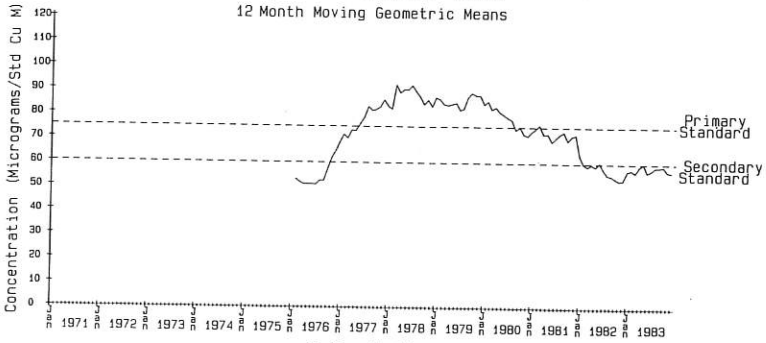
115 E MAIN ST, AUBURN, WA

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means



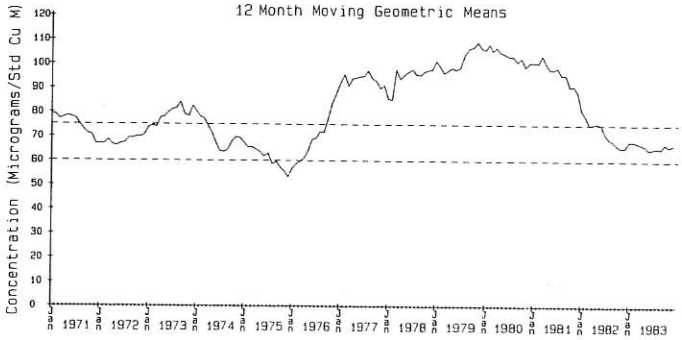
FIFE SR HIGH SCHOOL, 5616 20TH E, FIFE, WA

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means



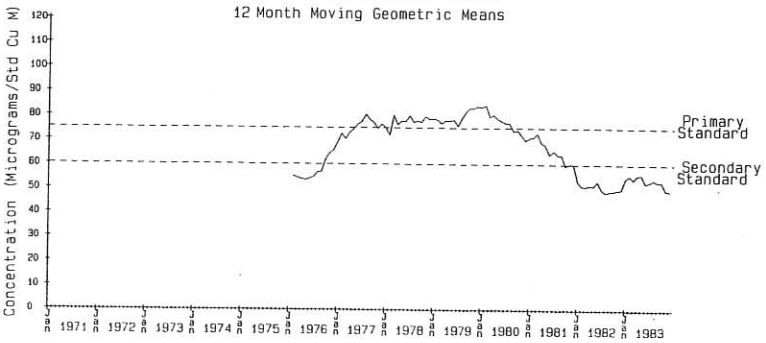
2340 TAYLOR WAY, TACOMA, WA

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means



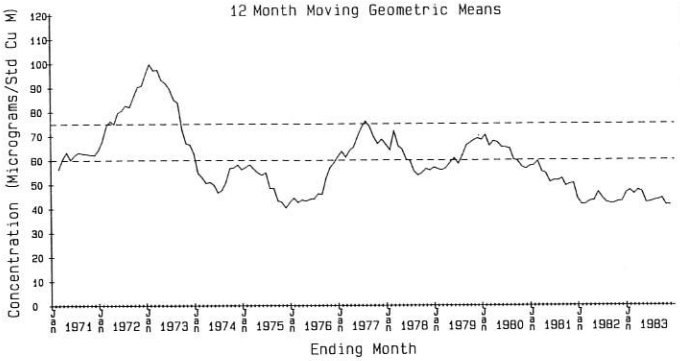
FIRE STATION #12, 2316 E 11TH ST, TACOMA, WA

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means



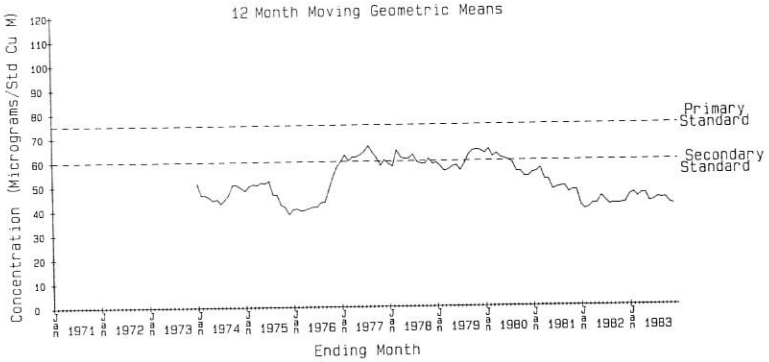
TREATMENT PLANT, 1241 CLEVELAND WY, TACOMA, WA

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means



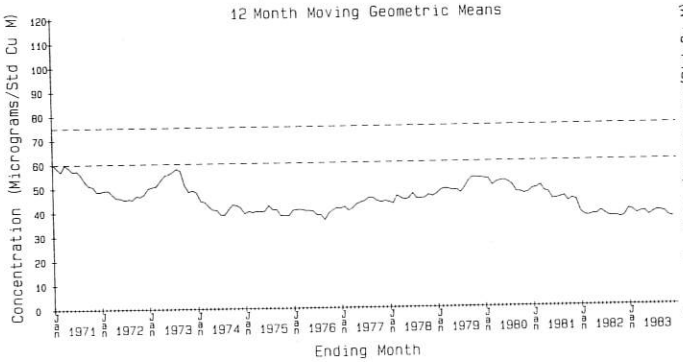
CASCADIA, 2002 E 28TH ST, TACOMA, WA

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means



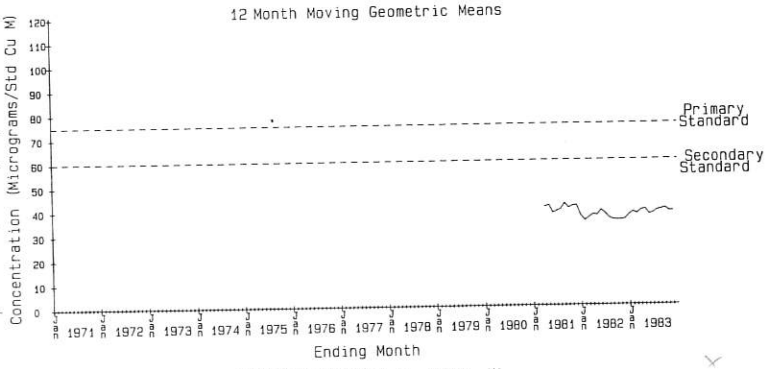
WILLARD SCHOOL, S 32ND & S 'D' ST, TACOMA, WA

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means



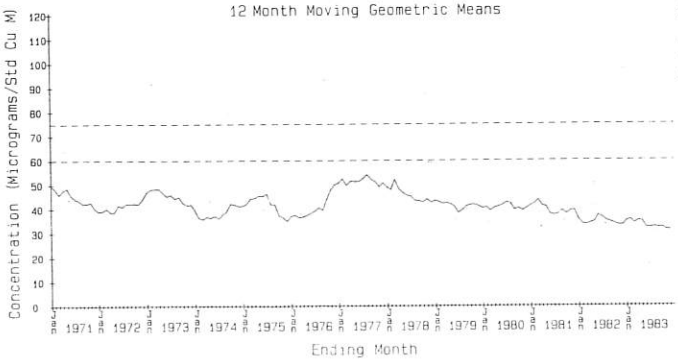
HESS BLDG, 901 TACOMA AVE S, TACOMA, WA

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means



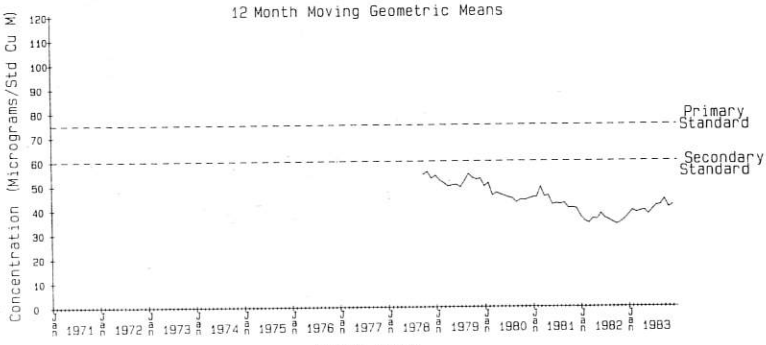
4716 NORTH BALTIMORE ST, TACOMA, WA

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means



NORTH 26TH & PEARL STS, TACOMA, WA

PUGET SOUND AIR POLLUTION CONTROL AGENCY
Suspended Particulates (Total)
12 Month Moving Geometric Means



MT TAHOMA HS, 6404 S ADAMS ST, TACOMA, WA

SUSPENDED PARTICULATES (Total)
Micrograms per Standard Cubic Meter

Sampled by Standard High Volume Glass Fiber filters

1983

Location	Monthly Arithmetic Averages												No. Of Obs.	Year Arith Mean	Year Geom Mean
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
Tolt River Watershed, King County, Wa	6	6	11	18		16	16		11	15	3	4	48	11	9
Highway 9 & 28th St NE, Lake Stevens, Wa	28	43	35	40	32	22	26	42	37	50	19	45	57	34	30
Medical-Dental Bldg, 2730 Colby, Everett, Wa	24	32	31	48	38	25	35	43	43	41	19	35	57	34	31
Lynnwood HS, 3001 184th St SW, Lynnwood, Wa	39	40	41	45	31	21	31	46	38	40	24	38	59	36	33
504 Bellevue Way NE, Bellevue, Wa	40	41	45	55	59	33	55	63	62	57	25	45	57	48	45
20050 SE 56th, Lake Sammamish State Park, Wa	24	51	31	37	33	23	35		53	43	16	32	55	35	31
North 98th St & Stone Ave N, Seattle, Wa	40	43	42	60	47	34	41	61	44	46	31	47	60	45	42
5701 8th Ave NE, Seattle, Wa	50	70	51	57	40	35	35	46	42	48	32	66	54	47	44
Portage Bay, 2725 Montlake Blvd E, Seattle, Wa	48	60	47	49	35	30	35	43	38	52	36	45	59	43	40
Public Safety Bldg, 604 3rd Ave, Seattle, Wa	54	62	45	62	46	41	43	54	46	62	35	47	59	49	47
Fire Station #10, 301 2nd Ave S, Seattle, Wa	58	61	55	61	45	49	45	53	48	67			49	54	51
Harbor Island, 2555 13th Ave SW, Seattle, Wa	77	91	65	86	71	64	63	59	57	85	73	61	60	71	65
Harbor Island, 3400 13th Ave SW, Seattle, Wa	74	99	71	108	84	56	67	82	77	84	62	67	59	77	72
Duwamish, 4401 E Marginal Way S, Seattle, Wa	81	85	83	84	66	62	62	77	80	98	71	88	348	78	71
Georgetown, 6431 Corson Ave S, Seattle, Wa	53	74	54		61	64		68	65	65	38	40	52	58	52
South Park, 723 S Concord St, Seattle, Wa	43	57	43	66	49	27	42	49	52	57	35	43	59	47	43
Duwamish Valley, 12026 42nd Ave S, King Co, Wa	45	59	41	57	42	27	39	45	49	55	35	50	60	45	42
SE Dist Health Ctr, 3001 NE 4th St, Renton, Wa	26	29	26	38	33	22	33	44	30	43	18	32	60	31	28
200 South 2nd St, Renton, Wa	43	42	39	60	46	35	41	50	39	53	30	41	60	43	41
22916 86th Ave S, Kent, Wa	36	40	34	45	47	33	44	55	40	54	26	40	59	41	37
Memorial Park, 850 N Central Ave, Kent, Wa	54	58	50	63	55	36	51	68	43	56	32	48	60	51	48
Federal Way HS, 1401 S 304 St, Federal Way, Wa	29	35	32	41	31	23	31	39	32	41	21	32	60	32	30
115 E Main St, Auburn, Wa	49	53	38	54	40	28	41	57	40	56	33	50	59	45	41
Sumner Jr HS, 1508 Willow St, Sumner, Wa	43	58	31	51	43	23	36	49	39	47	31	51	60	41	38
Fife Sr High School, 5616 20th E, Fife, Wa	49	64	35	60	60	25	43	55	47	52	32	46	60	47	41
2340 Taylor Way, Tacoma, Wa	48	71	47	89	72	34	63	83	72	70	46	62	58	63	57
Fire Station #12, 2316 E 11th St, Tacoma, Wa	77	74	70	75	75	63	67	85	70	101	60	86	119	75	67
Treatment Plant, 1241 Cleveland Wy, Tacoma, Wa	81	79	45	70	61	30	46	67	59	57	32	52	58	55	49
Cascadia, 2002 E 28th St, Tacoma, Wa	47	62	40	65	49	25	41	55	58	56	29	49	60	48	41
Willard School, S 32nd & S 'D' St, Tacoma, Wa	52	79	38	55	47	22	41	50	57	55	33	45	57	47	41
Hess Bldg, 901 Tacoma Ave S, Tacoma, Wa	53	32	31	39	41	22	36	43	42	46	31	54	55	39	36
SW 283rd & 101st Ave SW, Maury Island, Wa[a]										31	20	23	14		
Ruston School, 5219 N Shirley St, Tacoma, Wa[b]										38	31	41	16		
4716 North Baltimore St, Tacoma, Wa	36	56	39	51	46	21	37	46	49	53	36	48	60	43	39
North 26th & Pearl Sts, Tacoma, Wa	35	44	26	42	39	21	29	37	32	39	28	44	60	34	31
Mt Tahoma HS, 6404 S Adams St, Tacoma, Wa	29	69	38	45	48	28	58	69	47	74	27	69	53	49	42
City Water Supply Pump House, Dupont, Wa	20	31	18	35	36	25	38	70	56	15		22	53	33	25
City Hall, 239 4th St, Bremerton, Wa	36	45	33	38	29	24	29	33	32	39	27	39	60	33	32

[a] Sampling started 10/03/83 [b] Sampling started 9/27/83

SUSPENDED PARTICULATES (Total)
Micrograms per Standard Cubic Meter

Sampled by Standard High Volume Glass Fiber filters

1983

Statistical Summary

Location	No. Of Obs.	Frequency Distribution - Percent										Arith Mean	Geom Mean	Geom Std Dev	Arith Std Dev
		10	20	30	40	50	60	70	80	90	95				
Tolt River Watershed, King County, Wa	48	3	4	6	10	10	11	13	17	20	25	11	9	2.17	7.40
Highway 9 & 28th St NE, Lake Stevens, Wa	57	17	19	22	23	31	37	41	48	59	64	34	30	1.63	16.85
Medical-Dental Bldg, 2730 Colby, Everett, Wa	57	19	22	25	26	28	32	43	50	54	58	34	31	1.52	14.09
Lynnwood HS, 3001 184th St SW, Lynnwood, Wa	59	20	23	26	28	31	35	40	46	62	67	36	33	1.51	16.04
504 Bellevue Way NE, Bellevue, Wa	57	26	30	36	40	48	49	56	63	70	80	48	45	1.47	17.97
20050 SE 56th, Lake Sammamish State Park, Wa	55	15	18	22	27	32	35	40	47	55	71	35	31	1.66	17.81
North 98th St & Stone Ave N, Seattle, Wa	60	26	31	34	36	39	42	49	59	71	74	45	42	1.43	17.14
5701 8th Ave NE, Seattle, Wa	54	30	32	35	38	41	46	52	58	71	76	47	44	1.43	20.89
Portage Bay, 2725 Montlake Blvd E, Seattle, Wa	59	29	31	33	34	39	42	48	52	57	67	43	40	1.37	16.33
Public Safety Bldg, 604 3rd Ave, Seattle, Wa	59	31	35	38	42	45	47	53	62	66	79	49	47	1.38	17.89
Fire Station #10, 301 2nd Ave S, Seattle, Wa	49	33	36	41	45	50	52	60	65	75	98	54	51	1.42	21.97
Harbor Island, 2555 13th Ave SW, Seattle, Wa	60	35	42	52	61	65	69	84	89	111	117	71	65	1.50	28.63
Harbor Island, 3400 13th Ave SW, Seattle, Wa	59	42	50	60	64	66	72	86	100	119	139	77	72	1.45	29.58
Duwamish, 4401 E Marginal Way S, Seattle, Wa	348	41	49	56	62	71	79	91	108	124	147	78	71	1.57	34.36
Georgetown, 6431 Corson Ave S, Seattle, Wa	52	31	35	39	44	47	57	67	76	95	103	58	52	1.55	28.90
South Park, 723 S Concord St, Seattle, Wa	59	26	27	34	38	42	46	51	62	79	89	47	43	1.51	20.42
Duwamish Valley, 12026 42nd Ave S, King Co, Wa	60	26	30	34	36	41	44	53	60	69	71	45	42	1.44	17.41
SE Dist Health Ctr, 3001 NE 4th St, Renton, Wa	60	15	19	23	25	26	31	37	45	52	54	31	28	1.58	13.43
200 South 2nd St, Renton, Wa	60	27	31	33	34	39	42	49	58	63	68	43	41	1.40	15.54
22916 86th Ave S, Kent, Wa	59	21	24	30	32	37	46	49	54	61	72	41	37	1.53	16.63
Memorial Park, 850 N Central Ave, Kent, Wa	60	28	33	37	41	48	55	59	64	76	84	51	48	1.46	19.57
Federal Way HS, 1401 S 304 St, Federal Way, Wa	60	19	21	24	28	30	33	39	41	47	53	32	30	1.42	11.27
115 E Main St, Auburn, Wa	59	25	28	32	35	37	45	53	58	63	78	45	41	1.48	19.23
Sumner Jr HS, 1508 Willow St, Sumner, Wa	60	21	25	28	34	38	43	50	52	62	69	41	38	1.55	19.68
Fife Sr High School, 5616 20th E, Fife, Wa	60	19	24	28	34	43	48	58	63	74	84	47	41	1.67	24.93
2340 Taylor Way, Tacoma, Wa	58	31	35	39	45	55	66	77	88	98	124	63	57	1.61	31.04
Fire Station #12, 2316 E 11th St, Tacoma, Wa	119	33	46	52	62	68	75	82	100	124	134	75	67	1.63	39.62
Treatment Plant, 1241 Cleveland Wy, Tacoma, Wa	58	27	31	37	40	44	57	63	74	81	110	55	49	1.60	28.76
Cascadia, 2002 E 28th St, Tacoma, Wa	60	19	24	29	36	42	49	58	65	79	85	48	41	1.72	25.48
Willard School, S 32nd & S 'D' St, Tacoma, Wa	57	23	25	28	34	42	49	55	61	76	81	47	41	1.64	26.10
Hess Bldg, 901 Tacoma Ave S, Tacoma, Wa	55	22	25	29	32	37	40	47	48	56	60	39	36	1.49	17.00
SW 283rd & 101st Ave SW, Maury Island, Wa	14	18	18	19	21	23	24	25	28	34	34			1.29	6.62
Ruston School, 5219 N Shirley St, Tacoma, Wa	16	23	24	27	27	34	38	40	46	47	58			1.40	12.36
4716 North Baltimore St, Tacoma, Wa	60	21	25	29	33	41	44	49	58	70	80	43	39	1.60	21.96
North 26th & Pearl Sts, Tacoma, Wa	60	18	21	25	27	31	36	39	42	51	61	34	31	1.55	16.52
Mt Tahoma HS, 6404 S Adams St, Tacoma, Wa	53	20	22	28	33	43	51	57	70	83	100	49	42	1.79	30.10
City Water Supply Pump House, Dupont, Wa	53	11	14	18	21	29	30	39	46	65	71	33	25	2.20	23.64
City Hall, 239 4th St, Bremerton, Wa	60	22	24	25	28	30	32	35	40	47	52	33	32	1.37	13.32

SUSPENDED PARTICULATES (Total)
Micrograms per Standard Cubic Meter

Sampled by Standard High Volume Glass Fiber filters

1983

Summary of Maximum and 2nd High Observed Concentrations

Location	Jan 12 Wed	Jan 14 Fri	Feb 1 Tue	Feb 3 Thu	Feb 5 Sat	Feb 23 Wed	Mar 16 Wed	Mar 17 Thu	Mar 19 Sat	Apr 6 Wed	Apr 12 Tue	Apr 18 Mon	May 24 Tue	Jun 29 Wed	Jul 23 Sat
Tolt River Watershed, King County, Wa		--	--	--			--	--				33	--		26
Highway 9 & 28th St NE, Lake Stevens, Wa		--	--	--		86	--	--							
Medical-Dental Bldg, 2730 Colby, Everett, Wa		--	--	--			--	--				--		--	
Lynnwood HS, 3001 184th St SW, Lynnwood, Wa		--	--	--	79		--	--	82						
504 Bellevue Way NE, Bellevue, Wa		--	--	--			--	--							
20050 SE 56th, Lake Sammamish State Park, Wa	--	89	--	--	90		--	--							
North 98th St & Stone Ave N, Seattle, Wa		--	--	--	85		--	--							
5701 8th Ave NE, Seattle, Wa		--	--	--	152		--	--							
Portage Bay, 2725 Montlake Blvd E, Seattle, Wa		--	--	--	129		--	--	74						
Public Safety Bldg, 604 3rd Ave, Seattle, Wa	99	--	--	--	120		--	--							
Fire Station #10, 301 2nd Ave S, Seattle, Wa	133	--	--	--	127		--	--							
Harbor Island, 2555 13th Ave SW, Seattle, Wa	165	--	--	158			--								
Harbor Island, 3400 13th Ave SW, Seattle, Wa	144	--	--	--	161		--	--							
Duwamish, 4401 E Marginal Way S, Seattle, Wa			191				182								
Georgetown, 6431 Corson Ave S, Seattle, Wa		--	--	--	150		--	--		--	--	--		157	--
South Park, 723 S Concord St, Seattle, Wa		--	--	128			--	120							
Duwamish Valley, 12026 42nd Ave S, King Co, Wa		--	--	--	112		--	--			75				
SE Dist Health Ctr, 3001 NE 4th St, Renton, Wa	60	--	--	--			--	--							
200 South 2nd St, Renton, Wa	92	--	--	--			--	--				82			
22916 86th Ave S, Kent, Wa	77	--	--	--			--	--				--	84		
Memorial Park, 850 N Central Ave, Kent, Wa	106	--	--	--	107		--	--							
Federal Way HS, 1401 S 304 St, Federal Way, Wa		--	--	--	63		--	--				57			
115 E Main St, Auburn, Wa	100	--	--	--	113		--	--							
Sumner Jr HS, 1508 Willow St, Sumner, Wa		--	--	--	136		--	--				80			
Fife Sr High School, 5616 20th E, Fife, Wa		--	--	--	147		--	--					110		
2340 Taylor Way, Tacoma, Wa	--	--	--	161	165		--								
Fire Station #12, 2316 E 11th St, Tacoma, Wa		--	--												
Treatment Plant, 1241 Cleveland Wy, Tacoma, Wa	119	--	--	--	173		--	--							
Cascadia, 2002 E 28th St, Tacoma, Wa		--	--	--	140		--	--				105			
Willard School, S 32nd & S 'D' St, Tacoma, Wa		--	--	--	174	--	--	--		94					
Hess Bldg, 901 Tacoma Ave S, Tacoma, Wa	117	--	--	--	--		--	--		--			76		
SW 283rd & 101st Ave SW, Maury Island, Wa	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
Ruston School, 5219 N Shirley St, Tacoma, Wa	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--
4716 North Baltimore St, Tacoma, Wa		--	--	--	143		--	--							
North 26th & Pearl Sts, Tacoma, Wa		--	--	--	110		--	--							
Mt Tahoma HS, 6404 S Adams St, Tacoma, Wa	--	--	--	--	163		--	--							
City Water Supply Pump House, Dupont, Wa		--	--	--			--	--							
City Hall, 239 4th St, Bremerton, Wa		--	--	--	107		--	--	57						

-- Indicates no sample on specified day

SUSPENDED PARTICULATES (Total)
Micrograms per Standard Cubic Meter

Sampled by Standard High Volume Glass Fiber filters

1983

Summary of Maximum and 2nd High Observed Concentrations

Location	Jul 29 Fri	Aug 4 Thu	Aug 10 Wed	Aug 22 Mon	Sep 21 Wed	Oct 3 Mon	Oct 9 Sun	Oct 12 Wed	Oct 21 Fri	Dec 2 Fri	Dec 20 Tue	Dec 23 Fri	Dec 26 Mon
Tolt River Watershed, King County, Wa	--	--	--	--				--			--	--	
Highway 9 & 28th St NE, Lake Stevens, Wa			--				69	--				--	
Medical-Dental Bldg, 2730 Colby, Everett, Wa	60			67				--				--	
Lynnwood HS, 3001 184th St SW, Lynnwood, Wa			--					--				--	
504 Bellevue Way NE, Bellevue, Wa		83	--		97			--				--	
20050 SE 56th, Lake Sammamish State Park, Wa		--	--	--				--				--	
North 98th St & Stone Ave N, Seattle, Wa				102				--				--	
5701 8th Ave NE, Seattle, Wa			--					--			89	--	
Portage Bay, 2725 Montlake Blvd E, Seattle, Wa								--				--	
Public Safety Bldg, 604 3rd Ave, Seattle, Wa								--		--	--	--	--
Fire Station #10, 301 2nd Ave S, Seattle, Wa								--				--	
Harbor Island, 2555 13th Ave SW, Seattle, Wa								--				--	
Harbor Island, 3400 13th Ave SW, Seattle, Wa												--	
Duwamish, 4401 E Marginal Way S, Seattle, Wa								--			--	--	
Georgetown, 6431 Corson Ave S, Seattle, Wa								--			--	--	
South Park, 723 S Concord St, Seattle, Wa								--				--	
Duwamish Valley, 12026 42nd Ave S, King Co, Wa				63				--				--	
SE Dist Health Ctr, 3001 NE 4th St, Renton, Wa								--				--	
200 South 2nd St, Renton, Wa								--				--	
22916 86th Ave S, Kent, Wa								--				--	
Memorial Park, 850 N Central Ave, Kent, Wa								--				--	
Federal Way HS, 1401 S 304 St, Federal Way, Wa								--				--	
115 E Main St, Auburn, Wa	--							--				--	
Sumner Jr HS, 1508 Willow St, Sumner, Wa								--				--	
Fife Sr High School, 5616 20th E, Fife, Wa								--				--	
2340 Taylor Way, Tacoma, Wa								207				302	
Fire Station #12, 2316 E 11th St, Tacoma, Wa								--				--	
Treatment Plant, 1241 Cleveland Wy, Tacoma, Wa								--				--	
Cascadia, 2002 E 28th St, Tacoma, Wa								--				--	
Willard School, S 32nd & S 'D' St, Tacoma, Wa								--				--	
Hess Bldg, 901 Tacoma Ave S, Tacoma, Wa								67	39				
SW 283rd & 101st Ave SW, Maury Island, Wa	--	--	--	--	--			--		58		--	61
Ruston School, 5219 N Shirley St, Tacoma, Wa	--	--	--	--	--			122					
4716 North Baltimore St, Tacoma, Wa								--		71		--	
North 26th & Pearl Sts, Tacoma, Wa								--				--	
Mt Tahoma HS, 6404 S Adams St, Tacoma, Wa					--	112		--				--	
City Water Supply Pump House, Dupont, Wa			95	117				--				--	
City Hall, 239 4th St, Bremerton, Wa								--				--	

-- Indicates no sample on specified day

SUSPENDED PARTICULATES (Total)
Micrograms per Standard Cubic Meter

Sampled by Standard High Volume Glass Fiber filters

1983

Summary of Observations Greater Than 150

Location	Jan 12 Wed	Jan 14 Fri	Jan 15 Sat	Jan 16 Sun	Jan 28 Fri	Jan 31 Mon	Feb 1 Tue	Feb 3 Thu	Feb 4 Fri	Feb 5 Sat	Mar 16 Wed	Mar 19 Sat	Jun 29 Wed	Sep 22 Thu	Oct 12 Wed	Oct 25 Tue	Oct 26 Wed	Nov 25 Fri	Dec 23 Fri
5701 8th Ave NE, Seattle, Wa		--	--	--	--	--	--	--	--	152	--			--	--	--	--	--	--
Harbor Island, 2555 13th Ave SW, Seattle, Wa	165	--	--	--	--	--	--	158	--		--			--	--	--	--	--	--
Harbor Island, 3400 13th Ave SW, Seattle, Wa		--	--	--	--	--	--	--	--	161	--			--	--	--	--	--	--
Duwamish, 4401 E Marginal Way S, Seattle, Wa		177	167	151	152	162	191	166	180		182	169		164		168	159	156	--
Georgetown, 6431 Corson Ave S, Seattle, Wa		--	--	--	--	--	--	--	--		--		157	--	--	--	--	--	--
2340 Taylor Way, Tacoma, Wa	--	--	--	--	--	--	--	161	--	165	--			--	--	--	--	--	--
Fire Station #12, 2316 E 11th St, Tacoma, Wa		--	161	--	--	--	--	154	--		167			--	207	--	--	--	302
Treatment Plant, 1241 Cleveland Wy, Tacoma, Wa		--	--	--	--	--	--	--	--	173	--			--	--	--	--	--	--
Willard School, S 32nd & S 'D' St, Tacoma, Wa		--	--	--	--	--	--	--	--	174	--			--	--	--	--	--	--
Mt Tahoma HS, 6404 S Adams St, Tacoma, Wa	--	--	--	--	--	--	--	--	--	163	--				--	--	--	--	--

-- Indicates no sample on specified day

SUSPENDED PARTICULATES (Smaller than 10 micrometers)
Micrograms per Standard Cubic Meter

Sampled by Size Selective Inlet - High Volume Glass Fiber filters

1983

Location	Monthly Arithmetic Averages												No. Of Obs.	Year Arith Mean	Year Geom Mean
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
North 98th St & Stone Ave N, Seattle, Wa[a]						18	21	34	27	38	27	41	36	29	27
Harbor Island, 2555 13th Ave SW, Seattle, Wa	44	62	46	52	42	38	36	38	42	58	46	42	58	45	42
Duwamish, 4401 E Marginal Way S, Seattle, Wa	37	63	52	56	40	40	44	46	48	61	44	56	115	49	46
South Park, 723 S Concord St, Seattle, Wa	30	48	32	43	31	20	29	31	35	48	32	39	60	35	32
Memorial Park, 850 N Central Ave, Kent, Wa[b]						19	30	38	29	45	26	36	36	32	30
2340 Taylor Way, Tacoma, Wa	42	58	33	56	47	25	41	49	48	49	32	42	60	43	40
Fire Station #12, 2316 E 11th St, Tacoma, Wa	41	68	37	64	53	34	47	48	48	52	30	51	58	48	43

[a]Sampling started 5/24/83 [b]Sampling started 5/24/83

Statistical Summary

Location	No. Of Obs.	Frequency Distribution - Percent										Arith Mean	Geom Mean	Geom Std Dev	Arith Std Dev
		10	20	30	40	50	60	70	80	90	95				
North 98th St & Stone Ave N, Seattle, Wa	36	18	20	21	23	25	31	35	36	39	51	29	27	1.45	11.55
Harbor Island, 2555 13th Ave SW, Seattle, Wa	58	23	30	38	40	42	48	54	59	66	70	45	42	1.48	16.89
Duwamish, 4401 E Marginal Way S, Seattle, Wa	115	28	34	38	42	47	51	56	64	76	79	49	46	1.45	18.50
South Park, 723 S Concord St, Seattle, Wa	60	19	22	25	27	31	36	41	46	55	60	35	32	1.51	15.25
Memorial Park, 850 N Central Ave, Kent, Wa	36	17	19	23	27	29	33	36	45	47	51	32	30	1.48	12.34
2340 Taylor Way, Tacoma, Wa	60	23	26	30	36	39	44	50	56	64	85	43	40	1.54	20.14
Fire Station #12, 2316 E 11th St, Tacoma, Wa	58	25	27	35	37	45	51	53	60	71	88	48	43	1.57	22.20

Summary of Maximum and 2nd High Observed Concentrations

Location	Feb 3 Thu	Feb 5 Sat	Aug 22 Mon	Oct 9 Sun	Oct 25 Tue	Dec 2 Fri	Dec 26 Mon
North 98th St & Stone Ave N, Seattle, Wa	--	--	53		--	66	
Harbor Island, 2555 13th Ave SW, Seattle, Wa	117	101		--	--		
Duwamish, 4401 E Marginal Way S, Seattle, Wa	120	--			108		
South Park, 723 S Concord St, Seattle, Wa	105	91			--		
Memorial Park, 850 N Central Ave, Kent, Wa	--	--	--	55	--		63
2340 Taylor Way, Tacoma, Wa	114	124			--		
Fire Station #12, 2316 E 11th St, Tacoma, Wa	135	134		--	--		

-- Indicates no sample on specified day

SUSPENDED PARTICULATES (Smaller than 2.5 micrometers)
Micrograms per Standard Cubic Meter

Sampled by Cyclone Inlet Teflon filters

1983

Location	Monthly Arithmetic Averages												No. Of Obs.	Year Arith Mean	Year Geom Mean
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec			
Harbor Island, 2555 13th Ave SW, Seattle, Wa	20	37	21	20	17	14	10	15	16	27	21	19	57	19	17
Duwamish, 4401 E Marginal Way S, Seattle, Wa	24	34	19	22	15	11	12	15	16	28	17	23	91	19	17
South Park, 723 S Concord St, Seattle, Wa		31	20	20	13	10	11	14	13	25	17	21	56	18	16
2340 Taylor Way, Tacoma, Wa	28	33	19	22	11	10	14	16	16	26	14	19	58	19	16
Fire Station #12, 2316 E 11th St, Tacoma, Wa	21	40	19	22	16	10	11	16	17	23	14	23	55	20	17

Statistical Summary

Location	No. Of Obs.	Frequency Distribution - Percent										Arith Mean	Geom Mean	Geom Std Dev	Arith Std Dev
		10	20	30	40	50	60	70	80	90	95				
Harbor Island, 2555 13th Ave SW, Seattle, Wa	57	9	10	12	15	18	21	24	27	31	35	19	17	1.69	10.64
Duwamish, 4401 E Marginal Way S, Seattle, Wa	91	9	12	13	14	16	18	21	26	30	31	19	17	1.60	10.88
South Park, 723 S Concord St, Seattle, Wa	56	8	10	12	13	15	19	22	25	28	29	18	16	1.66	10.50
2340 Taylor Way, Tacoma, Wa	58	9	10	12	14	17	19	21	24	30	33	19	16	1.66	12.02
Fire Station #12, 2316 E 11th St, Tacoma, Wa	55	8	11	13	14	17	18	21	23	30	34	20	17	1.70	14.84

Summary of Maximum and 2nd High Observed Concentrations

Location	Feb 3 Thu	Feb 5 Sat
Harbor Island, 2555 13th Ave SW, Seattle, Wa	56	68
Duwamish, 4401 E Marginal Way S, Seattle, Wa	63	79
South Park, 723 S Concord St, Seattle, Wa	64	73
2340 Taylor Way, Tacoma, Wa	88	85
Fire Station #12, 2316 E 11th St, Tacoma, Wa	78	110

PARTICULATE MATTER RATIOS
(Smaller than 10 micrometers)/(Total)

1983

Particulate Matter Fraction	Method	Filter Medium
Smaller than 10 micrometers DIVIDED BY Total	Size Selective Inlet - High Volume	Glass Fiber
	Standard High Volume	Glass Fiber

Location	Average Monthly Ratios												No. of Obs	Year Ratio
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
North 98th St & Stone Ave N, Seattle, Wa						.53	.52	.56	.61	.84	.88	.88	34	.688
Harbor Island, 2555 13th Ave SW, Seattle, Wa	.76	.70	.69	.59	.59	.61	.59	.64	.75	.66	.64	.69	70	.658
Duwamish, 4401 E Marginal Way S, Seattle, Wa	.74	.65	.64	.56	.56	.65	.62	.55	.56	.64	.69	.66	115	.626
South Park, 723 S Concord St, Seattle, Wa	.92	.78	.74	.64	.62	.76	.70	.62	.69	.84	.94	.90	69	.763
Memorial Park, 850 N Central Ave, Kent, Wa						.54	.60	.56	.68	.78	.79	.75	34	.671
2340 Taylor Way, Tacoma, Wa	.67	.73	.71	.61	.65	.73	.67	.60	.69	.72	.74	.68	70	.684
Fire Station #12, 2316 E 11th St, Tacoma, Wa	.94	.87	.74	.79	.69	.81	.71	.66	.71	.71	.81	.84	67	.774

PARTICULATE MATTER RATIOS
(Smaller than 2.5 micrometers)/(Smaller than 10 micrometers)

1983

Particulate Matter Fraction	Method	Filter Medium
Smaller than 2.5 micrometers DIVIDED BY Smaller than 10 micrometers	Cyclone Inlet	Teflon
	Size Selective Inlet - High Volume	Glass Fiber

Location	Average Monthly Ratios												No. of Obs	Year Ratio
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Harbor Island, 2555 13th Ave SW, Seattle, Wa	.46	.51	.45	.40	.39	.36	.29	.38	.38	.47	.45	.43	66	.414
Duwamish, 4401 E Marginal Way S, Seattle, Wa	.51	.46	.40	.41	.35	.29	.29	.45	.39	.53	.47	.55	87	.425
South Park, 723 S Concord St, Seattle, Wa	.52	.55	.56	.47	.43	.50	.36	.41	.40	.52	.54	.54	68	.485
2340 Taylor Way, Tacoma, Wa	.52	.56	.55	.43	.27	.39	.35	.34	.36	.48	.44	.46	68	.428
Fire Station #12, 2316 E 11th St, Tacoma, Wa	.52	.53	.48	.35	.25	.29	.25	.37	.36	.44	.48	.46	66	.398

PARTICULATE MATTER RATIOS
(Smaller than 2.5 micrometers)/(Light scattering extinction coefficient)

1983

Particulate Matter Fraction	Method	Filter Medium
Smaller than 2.5 micrometers DIVIDED BY Light scattering extinction coefficient;	Cyclone Inlet	Teflon
	Integrating Nephelometer-heated probe;	Units are bsp (X 10 Exp-4)/M

Location	Average Monthly Ratios												No. of Obs	Year Ratio
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Duwamish, 4401 E Marginal Way S, Seattle, Wa	39.2	38.3	35.3	23.6	43.5	34.0	32.2	35.2	32.4	27.3	35.0	32.5	85	34.05
Fire Station #12, 2316 E 11th St, Tacoma, Wa	33.1	30.2	33.6	25.4	25.9	36.2	25.2	30.6	29.0	27.7	30.6	28.4	66	29.65

SUSPENDED PARTICULATES
Description of Methods

Coefficient of Haze (COH) represents a measure of suspended particulates derived from the decrease in light transmission through a cellulose filter tape as particulates accumulate on the tape. Ambient air is drawn through the cellulose filter tape continuously for 28 minutes; the decrease in light transmission due to particulate loading is measured; the instrument then sequences to a clean section of cellulose tape and the sampling cycle repeats again and again providing continuous sampling. The calculated concentration measured by this method is reported in COH-units per thousand linear feet of sampled air.

The light scattering extinction coefficient (bsp) represents a measure of atmospheric particles. The light scattering extinction coefficient is inversely related to visibility and has been shown highly correlated to fine particulate mass concentration. Values of bsp summarized in this book were continuously measured using an integrating nephelometer. The sample air stream was heated 6 to 12 degrees C above ambient air temperature to dry the particles. The particulate concentration measured by this method is reported as a scattering coefficient per meter that must be multiplied by 10 to the exponent, -4.

The Federal reference method using standard high volume sampling measures Total Suspended Particulates (TSP). High volume sampling with a Size Selective Inlet measures the Particulate Matter fraction with diameters smaller than or equal to 10 micrometers (PM10). Sampling with a cyclone inlet sampler measures the Fine Particulate fraction with diameters smaller than 2.5 micrometers (FP2.5). These methods integrate a sample for the duration of sampling on a filter, usually a 24 hour midnight to midnight time period. The concentration of suspended particulates is reported in micrograms per standard cubic meter of air.

SUSPENDED PARTICULATES
1983

Correlation between Continuous Sampling Methods

	Jan Feb Mar	Apr May Jun	Jul Aug Sep	Oct Nov Dec	Annual
North 98th St & Stone Ave N, Seattle, Wa					
1 Hour COH Vs 1 Hour bsp					
Correlation Coefficient	.85	.77	.67	.86	.85
Number of 1 Hour Samples	1998	2167	2181	2090	8436
24 Hour COH Vs 24 Hour bsp					
Correlation Coefficient	.92	.82	.76	.87	.89
Number of 24 Hour Samples	80	90	91	86	347
Duwamish, 4401 E Marginal Way S, Seattle, Wa					
1 Hour COH Vs 1 Hour bsp					
Correlation Coefficient	.71	.79	.62	.68	.72
Number of 1 Hour Samples	2142	1661	2183	2099	8085
24 Hour COH Vs 24 Hour bsp					
Correlation Coefficient	.77	.83	.70	.69	.77
Number of 24 Hour Samples	90	67	92	87	336
Fire Station #12, 2316 E 11th St, Tacoma, Wa					
1 Hour COH Vs 1 Hour bsp					
Correlation Coefficient	.80	.77	.64	.81	.80
Number of 1 Hour Samples	1772	2105	2154	2101	8132
24 Hour COH Vs 24 Hour bsp					
Correlation Coefficient	.90	.83	.69	.89	.89
Number of 24 Hour Samples	72	87	89	85	333

Note: 24 Hour averages computed for calendar day midnight to midnight time period.

SUSPENDED PARTICULATES
1983

Correlation between Continuous and Integrated Sampling Methods

	Jan Feb Mar	Apr May Jun	Jul Aug Sep	Oct Nov Dec	Annual
Medical-Dental Bldg, 2730 Colby, Everett, Wa					
24 Hour COH Vs TSP Corr. Coeff.	.79	.66	.86	.78	.67
Number of Common Samples	15	12	15	14	56
North 98th St & Stone Ave N, Seattle, Wa					
24 Hour COH Vs TSP Corr. Coeff.	.78	.69	.39	.94	.46
24 Hour bsp Vs TSP Corr. Coeff.	.84	.69	.44	.96	.58
Number of Common Samples	14	14	15	13	56
North 98th St & Stone Ave N, Seattle, Wa					
24 Hour COH Vs PM10 Corr. Coeff.		.88	.62	.94	.86
24 Hour bsp Vs PM10 Corr. Coeff.		.72	.62	.99	.87
Number of Common Samples		7	15	12	34
Duwamish, 4401 E Marginal Way S, Seattle, Wa					
24 Hour COH Vs TSP Corr. Coeff.	.72	.78	.73	.63	.68
24 Hour bsp Vs TSP Corr. Coeff.	.63	.74	.62	.58	.62
Number of Common Samples	86	66	88	81	321
Duwamish, 4401 E Marginal Way S, Seattle, Wa					
24 Hour COH Vs PM10 Corr. Coeff.	.56	.84	.67	.78	.67
24 Hour bsp Vs PM10 Corr. Coeff.	.72	.66	.69	.77	.67
Number of Common Samples	25	22	30	28	105
Duwamish, 4401 E Marginal Way S, Seattle, Wa					
24 Hour COH Vs FP2.5 Corr. Coeff.	.73	.90	.31	.64	.76
24 Hour bsp Vs FP2.5 Corr. Coeff.	.88	.83	.67	.94	.88
Number of Common Samples	27	22	22	10	81
22916 86th Ave S, Kent, Wa					
24 Hour bsp Vs TSP Corr. Coeff.	.90	.57	.76	.72	.63
Number of Common Samples	15	13	15	15	58
Fire Station #12, 2316 E 11th St, Tacoma, Wa					
24 Hour COH Vs TSP Corr. Coeff.	.78	.86	.64	.47	.60
24 Hour bsp Vs TSP Corr. Coeff.	.79	.77	.66	.54	.61
Number of Common Samples	30	28	29	25	112
Fire Station #12, 2316 E 11th St, Tacoma, Wa					
24 Hour COH Vs PM10 Corr. Coeff.	.91	.89	.71	.65	.78
24 Hour bsp Vs PM10 Corr. Coeff.	.92	.92	.69	.56	.81
Number of Common Samples	20	13	14	12	59
Fire Station #12, 2316 E 11th St, Tacoma, Wa					
24 Hour COH Vs FP2.5 Corr. Coeff.	.87	.91	.83	.88	.86
24 Hour bsp Vs FP2.5 Corr. Coeff.	.99	.94	.86	.96	.98
Number of Common Samples	20	11	12	13	56
Willard School, S 32nd & S 'D' St, Tacoma, Wa					
24 Hour COH Vs TSP Corr. Coeff.	.95	.94	.90	.53	.86
Number of Common Samples	14	14	13	13	54

Note: 24 Hour averages computed for calendar day midnight to midnight time period.

SUSPENDED PARTICULATES
(COH's/1000 Lin Ft)
1983

Statistical Summary

Location	No. of 1 Hour Samples	Frequency Distribution - Percent												Arith Mean	Geom Mean	Geom Std Dev	Arith Std Dev
		5	10	20	30	40	50	60	70	80	90	95	99				
Medical-Dental Bldg, 2730 Colby, Everett, Wa	8667	.1	.1	.2	.2	.3	.4	.5	.6	.8	1.1	1.3	1.9	.51	.36	2.41	.41
North 98th St & Stone Ave N, Seattle, Wa	8610	.1	.2	.2	.3	.3	.4	.5	.7	.9	1.3	1.7	2.5	.60	.44	2.16	.51
Duwamish, 4401 E Marginal Way S, Seattle, Wa	8576	.1	.1	.2	.3	.4	.5	.7	.9	1.2	1.6	2.0	2.7	.73	.49	2.64	.63
Fire Station #12, 2316 E 11th St, Tacoma, Wa	8218	.2	.2	.3	.5	.6	.7	.9	1.2	1.5	2.1	2.6	3.7	.98	.70	2.35	.81
Willard School, S 32nd & S 'D' St, Tacoma, Wa	8483	.1	.1	.2	.3	.3	.4	.6	.8	1.0	1.4	1.8	2.5	.63	.42	2.66	.56

Location	Monthly Arithmetic Averages												No. of 1 Hour Samples	Year Arith Mean
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Medical-Dental Bldg, 2730 Colby, Everett, Wa	.57	.48	.45	.52	.31	.33	.35	.43	.55	.83	.43	.83	8667	.51
North 98th St & Stone Ave N, Seattle, Wa	.94	.71	.60	.53	.32	.28	.31	.37	.53	.95	.66	1.00	8610	.60
Duwamish, 4401 E Marginal Way S, Seattle, Wa	1.08	.96	.76	.67	.42	.32	.40	.55	.68	1.09	.91	1.02	8576	.73
Fire Station #12, 2316 E 11th St, Tacoma, Wa	1.73	1.24		.81	.64	.53	.58	.74	.88	1.39	1.05	1.36	8218	.98
Willard School, S 32nd & S 'D' St, Tacoma, Wa	.99	.81	.62	.57	.38	.31	.28	.50	.60	1.04	.75	.70	8483	.63

ATMOSPHERIC PARTICLES
(bsp (X 10 Exp-4)/M)
1983

Statistical Summary

Location	No. of 1 Hour Samples	Frequency Distribution - Percent												Arith Mean	Geom Mean	Geom Std Dev	Arith Std Dev
		5	10	20	30	40	50	60	70	80	90	95	99				
North 98th St & Stone Ave N, Seattle, Wa	8586	.1	.1	.2	.3	.3	.4	.5	.6	.9	1.4	2.1	4.1	.66	.42	2.51	.79
Duwamish, 4401 E Marginal Way S, Seattle, Wa	8252	.1	.2	.2	.3	.4	.5	.6	.7	1.0	1.5	2.0	3.8	.70	.49	2.28	.70
22916 86th Ave S, Kent, Wa	8543	.1	.2	.2	.3	.4	.4	.6	.8	1.1	1.6	2.3	4.4	.73	.48	2.51	.82
Fire Station #12, 2316 E 11th St, Tacoma, Wa	8665	.1	.2	.2	.3	.4	.5	.6	.8	1.2	2.0	2.8	5.6	.86	.53	2.57	1.05

Location	Monthly Arithmetic Averages												No. of 1 Hour Samples	Year Arith Mean
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
North 98th St & Stone Ave N, Seattle, Wa	1.04	.69	.52	.51	.32	.27	.34	.49	.62	1.38	.58	1.10	8586	.66
Duwamish, 4401 E Marginal Way S, Seattle, Wa	1.07	.77	.62	.67		.34	.37	.54	.60	1.36	.63	.90	8252	.70
22916 86th Ave S, Kent, Wa	1.23	.78	.58	.71	.47	.37	.37	.62	.57	1.44	.64	1.02	8543	.73
Fire Station #12, 2316 E 11th St, Tacoma, Wa	1.77	1.09	.69	.77	.51	.33	.41	.64	.62	1.49	.75	1.18	8665	.86

ARSENIC
(Micrograms per Standard Cubic Meter)

1983

Location	Monthly Arithmetic Averages												No. of Samples	Arith Mean
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
SW 283rd & 101st Ave SW, Maury Island, Wa										.09	.13	.05	19	.09
Ruston School, 5219 N Shirley St, Tacoma, Wa										.24	.61	.51	15	.45
4716 North Baltimore St, Tacoma, Wa	.23	.33	.67	.31	.93	.12	.38	.46	1.03	.28	.10	.61	85	.45
North 26th & Pearl Sts, Tacoma, Wa	.08	.11	.09	.12	.12	.05	.17	.16	.29	.09	.01	.05	60	.11
City Water Supply Pump House, Dupont, Wa	**	.02	**	**	.01	.01	.03	.02	.01	.01		.01	53	.01

(1) Missing monthly averages indicate that arsenic analysis was not available.
(2) ** Indicates value less than .01 micrograms per standard cubic meter.

Summary of Individual 24 Hour Average Samples

Location	Highest Value		Values Higher than .80	
	Arsenic	Date	Arsenic	Date
SW 283rd & 101st Ave SW, Maury Island, Wa (sampling started 10/3/83)	.33	26 Nov		
Ruston School, 5219 N Shirley St, Tacoma, Wa (sampling started 9/27/83)	1.60	8 Nov	1.60	8 Nov
			1.07	2 Nov
4716 North Baltimore St, Tacoma, Wa	4.01	21 Sep	4.01	21 Sep
			3.03	20 Dec
			2.92	18 Sep
			2.47	24 May
			2.08	13 Mar
			1.60	1 Mar
			1.59	18 May
			1.56	17 Dec
			1.20	29 Jul
			1.03	30 Sep
			1.00	31 Aug
			0.85	19 Aug
			0.85	13 Sep
North 26th & Pearl Sts, Tacoma, Wa (Individual sample analysis after 7/01/83)	1.00	15 Sep	1.00	15 Sep
City Water Supply Pump House, Dupont, Wa (Individual sample analysis after 7/01/83)	0.13	29 Jul		

Under the federal Clean Air Act the U.S. EPA has designated inorganic arsenic as a hazardous air pollutant. The principal source emitting arsenic in the Puget Sound area is the Tacoma Smelter. The Department of Ecology has adopted community exposure standards for arsenic as follows:

Maximum 24 hour concentration - 2.0 micrograms per cubic meter

Maximum annual arithmetic mean - 0.3 micrograms per cubic meter

The adjacent tables summarize arsenic measurements during 1983 from five stations in the vicinity of the Tacoma Smelter.

SULFUR DIOXIDE

Sulfur dioxide is a common air pollutant for which standards have been established nationwide. Sulfur dioxide enters the air primarily from industrial processes or from the combustion of sulfur-containing fuels such as coal and oil. In the Puget Sound area about 85 percent of the sulfur dioxide released into the air each year comes from the Tacoma Smelter. Once emitted into the air, reactions occur to partially convert it to other sulfur compounds such as sulfuric acid and various sulfate salts. Local sulfur dioxide standards have been in effect since 1968. The tables below summarize sulfur dioxide data collected during 1983. There were no violations of the national standards, but there were several incidents where measured 5 minute averages exceeded 1.00 ppm and where measured 1 hour averages exceeded 0.25 ppm and in some cases 0.40 ppm. The tables do not specifically enumerate which of these occurrences were violations of the local standards but do suggest how often and at what locations such sulfur dioxide incidents occur.

365
× 24
1460
730
8760

.75 × 8760 = 6570
.97 × 8760 = 8497

SULFUR DIOXIDE
(Parts per Million)
1983

Location	Monthly Arithmetic Averages												No. of 1 Hour Samples	Year Arith Mean
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
Medical-Dental Bldg, 2730 Colby, Everett, Wa	.008	.010	.011	.014	.013	.013	.009	.009	.008	.008	.004	.005	8459	.009
North 98th St & Stone Ave N, Seattle, Wa	.009	.008	.008	.005	.004	.005	.005	.005			.008	.010	7480	.007
Duwamish, 4401 E Marginal Way S, Seattle, Wa	.014	.014	.012	.012	.011	.015	.012	.010	.013	.016	.016	.013	8412	.013
Federal Way HS, 1401 S 304 St, Federal Way, Wa	.004	.004	.005	.006	.006	.005	.007	.010	.006	.009	.004	.003	8602	.006
SW 283rd & 101st Ave SW, Maury Island, Wa	.008	.008	.008	.009	.008	.008	.005	.008	.006	.010	.010	.005	8169	.008
North 37th & Vassault Sts, Tacoma, Wa	.017	.014	.014	.013	.013	.012	.009	.011	.013	.018	.010	.012	8499	.013
North 26th & Pearl Sts, Tacoma, Wa	.009	.009	.007	.011	.009	.007	.004	.010	.007	.009	.005	.008	8442	.008

Number of Concentrations Exceeding Selected Values
for Various Averaging Periods

Location	5 Minute Average	1 Hour Average		3 Hour Average	24 Hour Average	
	1.00 ppm	0.40 ppm	0.25 ppm	0.50 ppm	0.10 ppm	0.14 ppm
Medical-Dental Bldg, 2730 Colby, Everett, Wa	6	1	1	0	0	0
North 98th St & Stone Ave N, Seattle, Wa	0	0	0	0	0	0
Duwamish, 4401 E Marginal Way S, Seattle, Wa	0	0	0	0	0	0
Federal Way HS, 1401 S 304 St, Federal Way, Wa	0	0	1	0	0	0
SW 283rd & 101st Ave SW, Maury Island, Wa	0	1	3	0	0	0
North 37th & Vassault Sts, Tacoma, Wa	2	4	11	0	0	0
North 26th & Pearl Sts, Tacoma, Wa	2	2	6	0	0	0

SULFUR DIOXIDE
(Parts per Million)
1983

Summary of Maximum and Second Highest Concentrations
for Various Averaging Periods

Location	5 Minute Average			1 Hour Average			3 Hour Average			24 Hour Average		
	Value	Date	End Time	Value	Date	End Time	Value	Date	End Time	Value	Date	End Time
Medical-Dental Bldg, 2730 Colby, Everett, Wa	1.80	2 Jul	1735	.81	2 Jul	1815	.330	2 Jul	1900	.050	2 Jul	2000
	1.35	2 Jul	1730	.19	4 May	1800	.133	4 May	2000	.042	26 Jun	2400
North 98th St & Stone Ave N, Seattle, Wa				.15	22 Jun	1100	.070	22 Jun	1100	.029	24 Dec	1100
				.08	22 Mar	2100	.053	23 Mar	0500	.025	22 Dec	2100
Duwamish, 4401 E Marginal Way S, Seattle, Wa				.19	6 Apr	1500	.133	6 Apr	1700	.057	7 Nov	1800
				.19	6 Apr	1700	.123	3 Oct	1900	.052	18 Jun	2000
Federal Way HS, 1401 S 304 St, Federal Way, Wa				.26	8 Aug	2153	.123	8 Aug	2200	.038	26 Oct	1400
				.20	25 Oct	1600	.113	25 Oct	1800	.028	23 Aug	0500
SW 283rd & 101st Ave SW, Maury Island, Wa				.53	16 Jun	0935	.253	16 Jun	1100	.037	16 Jun	1800
				.26	9 Oct	1204	.157	20 Nov	0100	.032	12 Jan	1700
North 37th & Vassault Sts, Tacoma, Wa	1.94	15 Mar	2003	.75	16 Oct	0748	.330	16 Oct	0900	.090	29 Jan	0800
	1.12	16 Oct	0716	.45	15 Mar	2021	.197	28 Jan	2300	.078	16 Oct	2100
North 26th & Pearl Sts, Tacoma, Wa	1.32	3 Aug	2051	.53	11 May	0658	.240	11 May	0800	.046	12 May	0500
	1.28	3 Aug	2046	.47	3 Aug	2112	.190	3 Aug	2200	.043	20 Dec	1100

(1) 5 minute average reported only for concentrations exceeding 1.00 ppm.
(2) Ending times are reported in Pacific Standard Time.
(3) For equal, high concentration values, the reported date and time refer to the earliest occurrences during the year.
(4) At all stations, Sulfur Dioxide was continuously measured using the method of ultraviolet fluorescence.

Photochemical Oxidants

The oxidant found in largest amounts in photochemical smog is ozone, a very reactive form of oxygen. Most oxidants are not emitted directly into the atmosphere but instead result from a series of chemical reactions between nitrogen oxides and reactive hydrocarbons in the presence of sunlight. This series of "photochemical" reactions proceeds for several hours generally producing maximum ozone levels between noon and early evening.

In the Puget Sound region the highest ozone concentrations occur during summer months when urban area emissions are trapped beneath a temperature inversion during nighttime and morning hours followed by hot afternoon temperatures. Light northerly winds often develop on these hot days. As a result, the highest ozone concentrations normally occur 5 to 15 miles south to southeast of the major urban centers.

Ozone Standard

The level of the ozone standard is 0.12 ppm. The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is equal to or less than one.

If an "exceedence" is defined to be a day with the maximum 1 hour average greater than 0.12 ppm, the standard is attained when the expected number of exceedences is equal to or less than one. In the case of a complete data set, the expected number of exceedences is simply the average number of observed exceedences during the most recent 3 years.

An incomplete data set for a given year requires an estimate of the number of exceedences in that year. This estimate is based upon the observed number of exceedences, the number of required monitoring days, the number of days upon which a valid maximum was recorded, and the number of days assumed to be less than the standard level.

The estimated number of exceedences is always equal to or greater than the observed number of exceedences. However, for stations where no exceedences are observed, the estimate is zero.

The expected number of exceedences is then calculated as the three year average of the estimated number of exceedences. A shorter sampling period may shorten the averaging period to a minimum of one year.

1983 Ozone Summary

The 1983 ozone table summarizes the four highest daily maximum 1 hour ozone averages and shows whether the standard was attained in 1983. The rightmost column documents that 1 of 6 stations had a value for expected number of exceedences greater than 1.0, and thus exceeded the ozone standard for the three year period ending in 1983.

NITROGEN OXIDES

Nitric oxide (NO) and nitrogen dioxide (NO2) are released to the atmosphere as the result of high temperature fuel combustion. Motor vehicles and power plants are the most common fuel combustion sources emitting oxides of nitrogen.

Nitric oxide oxidizes rather quickly to nitrogen dioxide. Nitrogen dioxide plays an important role in the photochemical reactions which produce ozone. The nitrogen dioxide standard is an annual arithmetic average of 0.05 ppm.

OZONE
(Parts per Million)
1983

Location / Period of Sampling	Four Highest Daily Maximum 1 Hour Averages			Estimated No. of Days Daily Maximum 1 Hour Average Exceeded .12 ppm			No. of Days Daily Maximum 1 Hour Average Expected To Exceed .12 ppm
	Value	Date	End Time	1981	1982	1983	
Snohomish FD#22, 9921 84th NE, Arlington, Wa*	.08	29 May	1400	0.0	0.0	0.0	0.0
13 May - 24 Aug; 2 Sep - 31 Oct	.06	13 May	1600				
	.06	27 May	1800				
	.06	28 May	1500				
20050 SE 56th, Lake Sammamish State Park, Wa*	.10	24 May	1400	1.0	0.0	0.0	0.3
1 Jan - 31 Dec	.10	28 May	1400				
	.09	30 Jul	1600				
	.08	27 May	1500				
22916 86th Ave S, Kent, Wa	.08	28 May	1400	0.0	0.0	0.0	0.0
1 Jan - 31 Dec	.07	30 Jul	1500				
	.07	7 Aug	1500				
	.07	13 Aug	1600				
Sumner Jr HS, 1508 Willow St, Sumner, Wa	.12	28 May	1500	3.1	0.0	0.0	1.0
1 Jan - 31 Dec	.10	30 Jul	1600				
	.08	24 May	1300				
	.08	22 Jul	1500				
Pierce Co Firwood FS, 4418 Freemn Rd, Fife, Wa*	.08	28 May	1400	1.2	0.0	0.0	0.4
1 Jan - 12 Aug; 14 Nov - 31 Dec	.07	27 May	1600				
	.07	22 Jul	1400				
	.06	15 Apr	1500				
Pierce Co, Fire D #21, 8102 304th, Graham, Wa*	.11	30 Jul	1700	4.0	0.0	0.0	1.3
7 Jun - 30 Oct	.09	6 Aug	1600				
	.09	13 Aug	1500				
	.08	16 Aug	1700				

(1) * Station operated by Washington State Department of Ecology.
(2) Ending times are reported in Pacific Standard Time.
(3) For equal, high concentration values, the reported date and time refer to the earliest occurrences during the year.
(4) At all stations, Ozone was continuously measured using ultraviolet photometric detection.

NITROGEN DIOXIDE
(Parts per Million)
1983

Location	Monthly Arithmetic Averages												No. of 1 Hour Samples	Year Arith Mean
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec		
4th Ave South & Jackson St, Seattle, Wa*	.032	.035	.032		.032	.031	.026	.031			.032		6320	.031
15th Ave S & Charlestown St, Seattle, Wa*		.009	.012	.013	.010	.008	.009	.007	.008	.005	.009		7598	.009

(1) * Station operated by the Washington State Department of Ecology.
(2) Monthly averages are shown only for months with 75 percent or higher data completeness.
(3) Year averages are calculated from all valid samples; the number of samples shows how completely the year mean represents the full year.
(4) At all stations, Nitrogen Dioxide was continuously measured using gas phase chemiluminescence.

CARBON MONOXIDE

Introduction

The Department of Ecology has statewide jurisdiction over motor vehicle emissions. Motor vehicles are the largest source of carbon monoxide and are the principal contributor to the carbon monoxide levels which exceed standards in the cities of the Puget Sound area.

The high ambient levels of carbon monoxide occur most often near congested, slow-moving motor vehicle traffic when low level winds are light and stable meteorological conditions exist. The highest hour average concentrations frequently coincide with the weekday evening traffic peaks. The lower hour average values normally occur during low traffic periods after midnight and on many hours of the weekends.

Pollutant Standards Index and 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 PSI scale. PSI values exceeding 100 are considered "Unhealthful". An 8 hour average of 15 ppm equals 200 on the PSI scale. PSI values of 200 to 299 are termed "Very Unhealthful".

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

1983 Summary

The following tables summarize the six highest 1 hour and 8 hour average carbon monoxide levels at each station. These data were obtained from Department of Ecology data summaries. The Tacoma station at South 11th & A Streets is a new site. All other stations operated during previous years.

Review of the data shows that five of the twelve stations exceeded an 8 hour average of 9 ppm at least twice. Therefore all of these five stations violated the 8 hour average standard. Since the maximum 1 hour average recorded at any of the stations was 22 ppm, the 1 hour standard of 35 ppm was not exceeded.

CARBON MONOXIDE
(Parts Per Million)
1983

Location / Period of Sampling	Six Highest Concentrations: 1 Hour Average Value	1 Hour Average Date	1 Hour Average End Time	8 Hour Average Value	8 Hour Average Date	8 Hour Average End Time	Number of 8 Hour Averages Exceeding 9 ppm	Number of Days 8 Hour Average Exceeded 9 ppm
2005 Hewitt Avenue, Everett, Wa	18	30 Nov	1900	10	30 Nov	2300	1	1
21 Jan - 31 Dec	16	30 Nov	1800	9	15 Jan	2300		
	16	30 Nov	2000	8	28 Jan	2100		
	16	6 Dec	1800	7	1 Feb	2200		
	14	15 Jan	1900	7	1 Dec	2200		
	14	1 Feb	2000	7	2 Dec	1900		
622 Bellevue Way NE, Bellevue, Wa	17	28 Jan	1900	10	28 Jan	2100	2	2
1 Jan - 14 Oct; 4 Nov - 31 Dec	15	28 Jan	2000	10	1 Dec	2300		
	15	1 Dec	1800	9	21 Nov	2200		
	14	28 Jan	1800	9	27 Dec	2300		
	13	14 Jan	1900	8	17 Jan	2200		
	13	1 Dec	1800	8	1 Feb	2300		

(11/01/84) Bellevue 1
Seattle 9
Tacoma 3
14

CARBON MONOXIDE
(Parts Per Million)
1983

Location / Period of Sampling	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		
Northgate, 310 NE Northgate Way, Seattle, Wa	17	1 Feb	900	9	21 Jan	1300	0	0
1 Jan - 31 Dec	15	21 Jan	900	8	24 Jan	2400		
	15	16 Mar	800	8	4 Feb	2400		
	14	14 Jan	900	8	11 Feb	1900		
	14	4 Feb	900	8	23 Nov	1800		
	13	14 Jan	1000	8	1 Dec	2200		
4511 University Way NE, Seattle, Wa	21	5 Feb	2000	13	17 Sep	2300	5	5
1 Jan - 31 Dec	20	17 Sep	2000	11	1 Feb	2300		
	20	17 Sep	2100	11	5 Feb	2100		
	20	17 Sep	2200	10	22 Sep	2200		
	16	25 Oct	2100	10	25 Oct	2400		
	15	19 Feb	1900	9	4 Feb	2300		
3921 Linden Ave N, Seattle, Wa	12	17 Jan	1900	6	17 Jan	1900	0	0
1 Jan - 31 Dec	11	17 Jan	1800	6	28 Jan	2100		
	9	21 Jan	900	6	25 Oct	2400		
	9	28 Jan	1800	5	1 Dec	2300		
	8	28 Jan	1700	4	12 Jan	1300		
	8	28 Jan	1900	4	14 Jan	1200		
1424 4th Ave, Seattle, Wa	22	28 Jan	1800	14	28 Jan	2300	6	5
1 Jan - 31 Dec	17	28 Jan	1900	12	2 Dec	1800		
	16	14 Nov	1800	11	9 Dec	1800		
	15	28 Jan	1600	10	1 Feb	1600		
	15	23 Nov	1800	10	29 Dec	1700		
	15	2 Dec	1400	9	14 Jan	1500		
2nd Ave & University St, Seattle, Wa	13	23 Nov	1700	10	28 Jan	2400	1	1
1 Jan - 31 Dec	13	23 Nov	1800	8	23 Nov	1800		
	12	28 Jan	1900	6	15 Jan	1700		
	11	28 Jan	1800	6	17 Jan	1600		
	11	2 Dec	1800	6	21 Jan	1300		
	10	28 Jan	2000	6	1 Feb	1100		
5th Ave & James St, Seattle, Wa	17	17 Jan	1800	12	28 Jan	2100	2	1
1 Jan - 31 Dec	16	28 Jan	1700	9	17 Jan	1800		
	15	28 Jan	1800	9	1 Feb	1200		
	15	1 Feb	1800	9	9 Dec	1700		
	14	28 Jan	2100	8	3 Feb	1400		
	14	1 Feb	1700	8	4 Feb	2200		
Fire Station #10, 301 2nd Ave S, Seattle, Wa	12	3 Dec	2400	5	25 Oct	2400	0	0
1 Jan - 7 Jan; 7 Apr - 31 Dec	10	27 Nov	1800	5	21 Nov	2200		
	10	24 Dec	1700	5	23 Nov	1800		
	8	26 Oct	800	5	27 Nov	2100		
	7	2 Jan	1700	5	1 Dec	1900		
	7	1 Oct	1900	5	7 Dec	1800		
2809 26th Ave S, Seattle, Wa	18	3 Feb	900	9	28 Jan	2400	0	0
1 Jan - 31 Dec	15	4 Feb	900	7	1 Feb	2400		
	14	8 Nov	900	7	3 Feb	1400		
	13	31 Jan	900	7	4 Feb	900		
	13	1 Feb	900	6	3 Jan	1800		
	11	17 Jan	1800	6	4 Jan	1900		
942 Pacific Ave, Tacoma, Wa	21	17 Jan	1800	11	4 Feb	2400	2	2
1 Jan - 7 Jun; 5 Jul - 31 Dec	16	12 Jan	900	10	17 Jan	1800		
	15	1 Feb	900	9	12 Jan	1500		
	15	3 Feb	1000	9	3 Feb	1200		
	15	4 Feb	900	8	3 Jan	1800		
	15	26 Oct	700	8	11 Jan	2300		
South 11th & A Streets, Tacoma, Wa	13	23 Nov	800	9	23 Nov	1300	0	0
7 Oct - 31 Dec	13	29 Dec	1800	8	20 Oct	300		
	12	25 Oct	700	8	25 Oct	1200		
	12	25 Oct	1700	8	25 Oct	2000		
	12	23 Nov	1800	8	23 Nov	2100		
	12	1 Dec	800	8	1 Dec	1200		

(1) Ending times are reported in Pacific Standard Time.
(2) For equal, high concentration values, the reported date and time refer to the earliest occurrences during the year.
(3) At all stations, Carbon Monoxide was continuously measured using the nondispersive infrared method.

QUALITY ASSURANCE

Introduction

Quality Assurance (QA) includes all the activities which focus attention on obtaining valid data and documenting the quality of the data. The QA process 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.

Independent Audits

The Agency participates in audit programs conducted independently by the U.S. Environmental Protection Agency and the State Department of Ecology. For the EPA, this consists of (1) an annual onsite audit of some Agency analyzers by EPA or their designated representative, and (2) Agency participation in EPA's national performance audits as they are announced. The Department of Ecology also independently selects and audits Agency analyzers onsite such that a part of the network is audited each quarter.

Precision and Accuracy Audits

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

Each pollutant measuring instrument must be audited for precision at least every two weeks and for accuracy at least once per year. For each audit, the percentage difference between the instrument indicated concentration and the true concentration of the reference sample is calculated. At the end of a calendar quarter the average and the standard deviation of the percentage differences for each instrument are calculated. These two statistics are then pooled for all analyzers monitoring the same pollutant.

Probability Limits for Precision and Accuracy

The Federal Regulation requires summary of the precision and accuracy audit results by computing the 95 Percent Probability Limits for each pollutant from the pooled average percent differences, D, and the pooled standard deviation, Sa, as follows.

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

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

These calculated limits mean that with 95 percent probability all air quality data compiled during the audit period agree with the true value by a percentage within the limits. As an example, if the average of the percent differences is zero and the standard deviation of the percent differences is 4.1 percent, the upper and lower 95 percent probability limits are respectively +8 and -8 percent.

Agency Precision and Accuracy

The following two tables summarize the Precision and Accuracy statistics for all air quality data which the Agency originated in 1983. Audits for the integrating nephelometer, which measures atmospheric particles, are presented only in the Precision table since separate accuracy audits are not applicable for the nephelometer measurement. There are only two ozone stations, so the accuracy audits are combined for a single annual average.

PRECISION OF AIR QUALITY DATA
1983

Upper and Lower 95 Percent Probability Limits
of Percent Differences

Pollutant	Probability Limit	Quarter 1st	2nd	3rd	4th	Annual Average
Suspended Particulates (Total, Hi Vol)	Upper	+9.7	+10.1	+7.4	+7.8	+8.8
	Lower	-10.3	-17.1	-7.6	-5.2	-10.1
Suspended Particulates (PM10, SSI Hi Vol)	Upper	+8.0	+24.0	+7.4	+14.0	+13.4
	Lower	-16.4	-9.8	-5.6	+1.0	-7.7
Sulfur Dioxide	Upper	+9.0	+9.4	+9.2	+9.6	+9.3
	Lower	-9.0	-9.4	-8.0	-8.8	-8.8
Ozone	Upper	+12.4	+7.1	+15.4	+10.0	+11.2
	Lower	-8.8	-4.3	-5.8	+3.0	-4.0
Atmospheric Particles (Nephelometer)	Upper	+6.0	+2.7	+6.1	+6.1	+5.2
	Lower	-5.4	-3.1	-5.7	-6.9	-5.3

ACCURACY OF AIR QUALITY DATA
1983

Upper and Lower 95 Percent Probability Limits
of Percent Differences

Pollutant	Probability Limit	Quarter 1st	2nd	3rd	4th	Annual Average
Suspended Particulates (Total, Hi Vol)	Upper	+7.3	+9.5	+6.9	+4.2	+7.0
	Lower	-8.7	-9.3	-9.1	-13.4	-10.1
Suspended Particulates (PM10, SSI Hi Vol)	Upper	+5.7	+0.2	+4.9	+1.0	+3.0
	Lower	-12.3	-8.4	-5.3	-4.8	-7.7
Sulfur Dioxide	Upper	+6.5	+5.6	+4.5	+10.9	+6.9
	Lower	-9.3	-15.5	-6.1	-3.1	-8.5
Ozone	Upper					+1.0
	Lower					-1.7

LOWER ATMOSPHERE TEMPERATURE SOUNDINGS

A lower atmosphere sounding unit began operating on the east shore of Portage Bay in Seattle during 1971. The Department of Ecology operates the station. Normal operation provides one slow ascent sounding to 700 millibars about 0700 local time each Monday through Friday except on holidays. This sounding is the primary source of lower atmosphere data in the Puget Sound region and is an essential basis for many forecasts including air stagnation forecasts. Each sounding is reasonably representative of the lower atmosphere in the entire Puget Sound area. The Agency makes regular use of the sounding in evaluating and interpreting air quality data and also enters the sounding in a computerized data base.

The figure below illustrates some key concepts. Temperature increasing with height is termed a TEMPERATURE INVERSION. A temperature inversion limits the height to which pollutants are mixed or dispersed vertically. The MIXING DEPTH is simply the height from the surface to the temperature inversion base. The mixing depth continuously changes in response to diurnal surface temperature changes and to other processes.

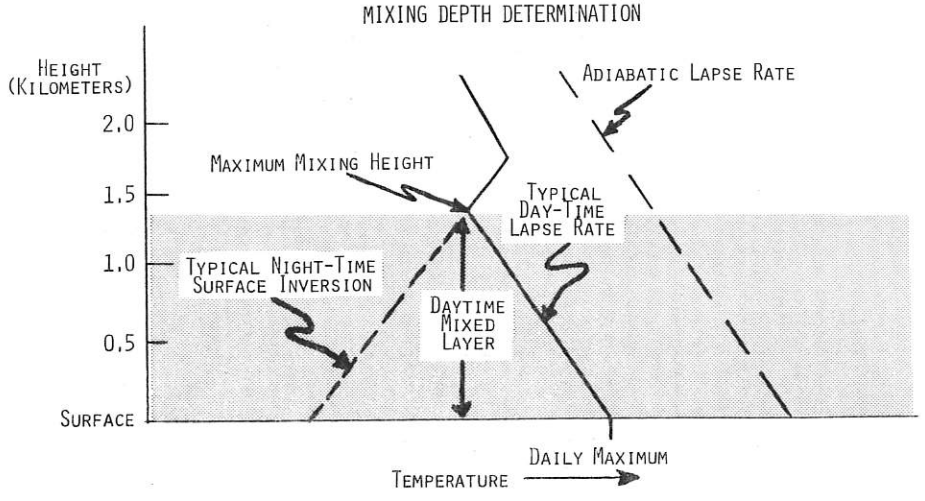
On days with no temperature inversion, the mixing depth is unlimited and this contributes to rapid pollutant dispersion and good air quality. In contrast, a temperature inversion near the surface thick enough so that the daytime mixing depth will not exceed the depth of the inversion significantly restricts vertical dispersion. This stable condition is associated with higher pollutant levels.

Two soundings from 1983 are presented on the following page. Temperature is represented by a solid line connecting actual data values enclosed by circles. The dewpoint temperature is represented by a dashed line connecting actual data values enclosed by triangles. The wind at regular altitude intervals is plotted and also printed in degrees/knots to the right of the sounding. Wind data above the surface is not always available.

The soundings for JANUARY 28 and FEBRUARY 4 provide a meteorological picture on the mornings of two days when Suspended Particulate and Carbon Monoxide levels reached high values exceeding standards at several stations. The Suspended Particulate, Carbon Monoxide, and Pollutant Standards Index summaries present actual values. For some locations the highest levels for the year were measured on one of these two days.

(30)

MIXING DEPTH DETERMINATION

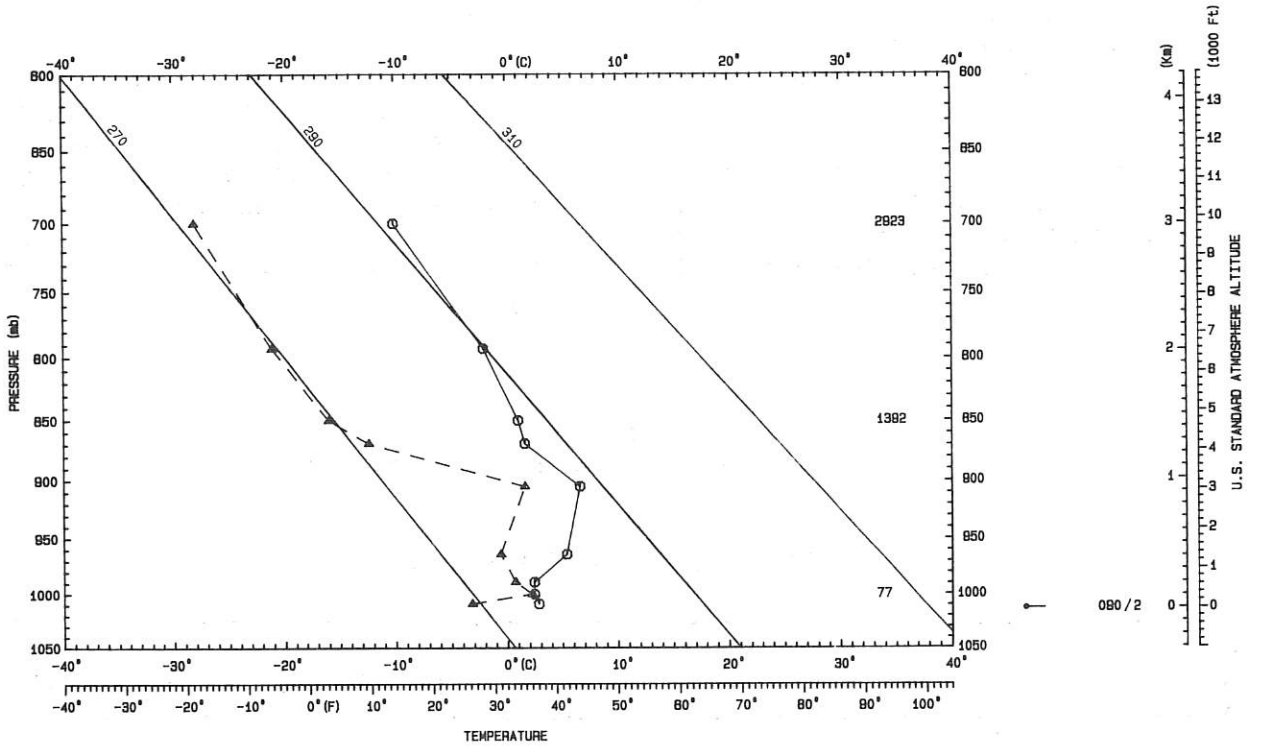


PUGET SOUND AIR POLLUTION CONTROL AGENCY

PSEUDO-ADIABATIC CHART

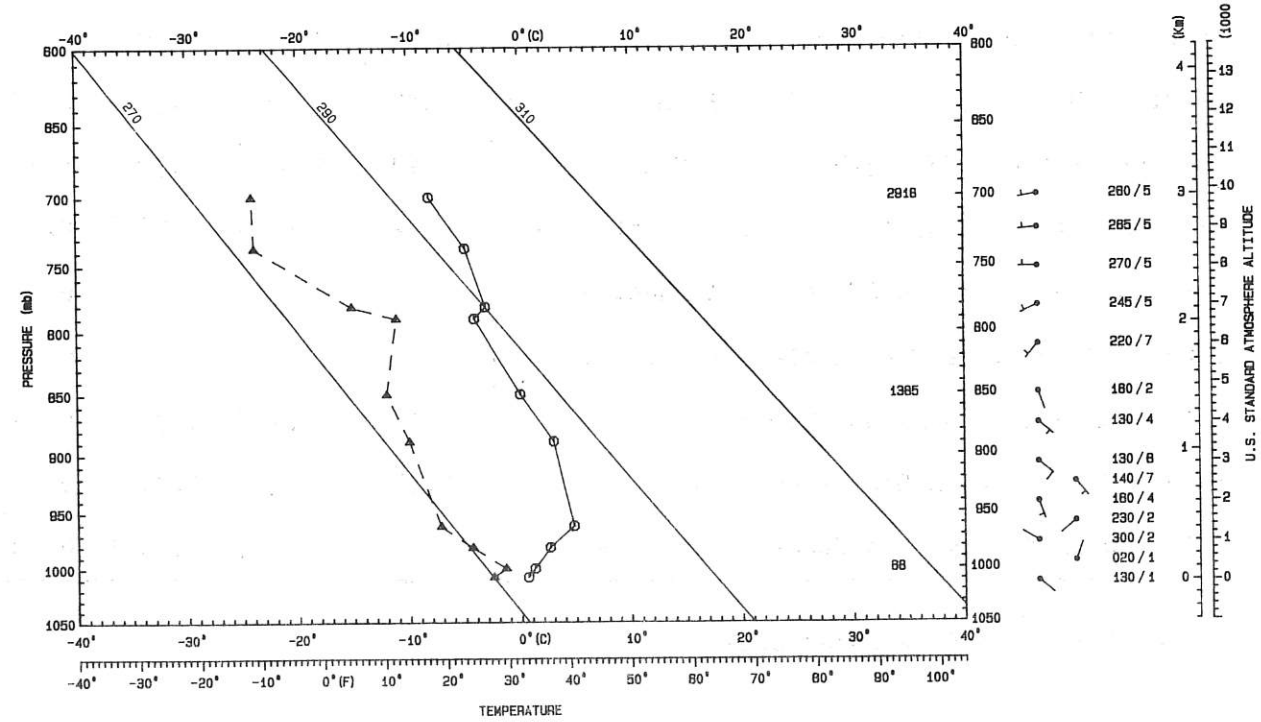
0700 PST Jan 28, 1983

Portage Bay, 2725 Montlake Blvd E, Seattle, WA



0700 PST Feb 4, 1983

Portage Bay, 2725 Montlake Blvd E, Seattle, WA



The ambient air quality standard for lead is 1.5 micrograms per cubic meter averaged over one calendar quarter. About 90 percent of the lead emitted into the air comes from automobile exhaust. The remainder comes from stationary sources such as primary and secondary nonferrous smelters.

Data from a coordinated network operated by the Department of Ecology and the Agency previously identified two areas in the Puget Sound region which exceeded the lead standard. One area was a strip bordering Interstate 5 through Seattle from Spokane Street to Northgate. The other area was the Harbor Island industrial region.

The table below presents the results of sampling during 1983. A single station on Harbor Island located near a secondary lead smelter recorded quarterly averages exceeding the lead standard. Lead concentrations measured at all other stations were lower than the standard requires.

LEAD
(Micrograms per Standard Cubic Meter)

1983
Quarterly Arithmetic Averages

Location	1st	2nd	3rd	4th
Evergreen Point Bridge Toll Plaza, Medina, Wa	0.40	0.35	0.60	0.45
504 Bellevue Way NE, Bellevue, Wa	0.29	0.22	0.29	0.24
North 98th St & Stone Ave N, Seattle, Wa	0.29	0.17	0.20	0.26
5701 8th Ave NE, Seattle, Wa	0.66	0.57	0.57	0.50
Portage Bay,2725 Montlake Blvd E, Seattle, Wa	0.45	0.26	0.32	0.38
Harbor Island, 2555 13th Ave SW, Seattle, Wa	4.14	7.57	4.39	4.21
Harbor Island, 3400 13th Ave SW, Seattle, Wa	0.42	0.53	0.68	0.60
SW 283rd & 101st Ave SW, Maury Island, Wa				0.12
Ruston School, 5219 N Shirley St, Tacoma, Wa				0.26
4716 North Baltimore St, Tacoma, Wa	0.54	0.29	0.31	0.34
North 26th & Pearl Sts, Tacoma, Wa	0.24	0.13	0.20	0.23
City Water Supply Pump House, Dupont, Wa			0.13	0.08 [a]

a October and December only

AIR STAGNATION ADVISORIES

An "Air Stagnation Advisory" is issued by the National Weather Service when poor atmospheric dispersion conditions exist and these conditions are forecast to persist for 24 hours or more.

There were no Air Stagnation Advisories issued during 1983. An Advisory which began December 30, 1982 ended at 12 Noon on Saturday, January 1, 1983.

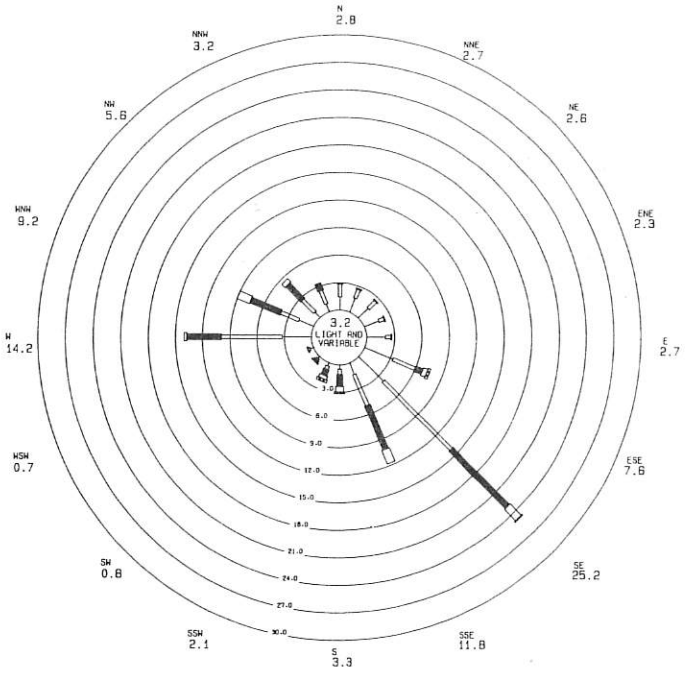
WIND ROSES

The measurement of local area wind speed and direction is important in the evaluation of air pollution. Low wind speed results in slowing the dispersion of pollutants and is therefore associated with higher air pollutant concentrations, particularly near major urban or industrialized areas. Wind direction data suggests which sources or source areas affect a specific location.

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

The wind rose spokes or arms represent 16 points of the compass, each pointing to a wind direction compass point. The percentage frequency of winds FROM a given direction (without regard to speed) is expressed numerically beneath that direction on the perimeter of each rose.

The length of each segment of a spoke represents the frequency of winds within each speed category. Using the percent scale located to the lower right of each rose, these lengths may be converted to the number of observations or hours during which a wind speed within the category occurred. The percentage frequency of light and variable winds (winds less than 1.5 knots) is printed in the center of the rose.



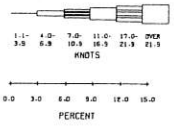
HOUR AVERAGE SURFACE WINDS

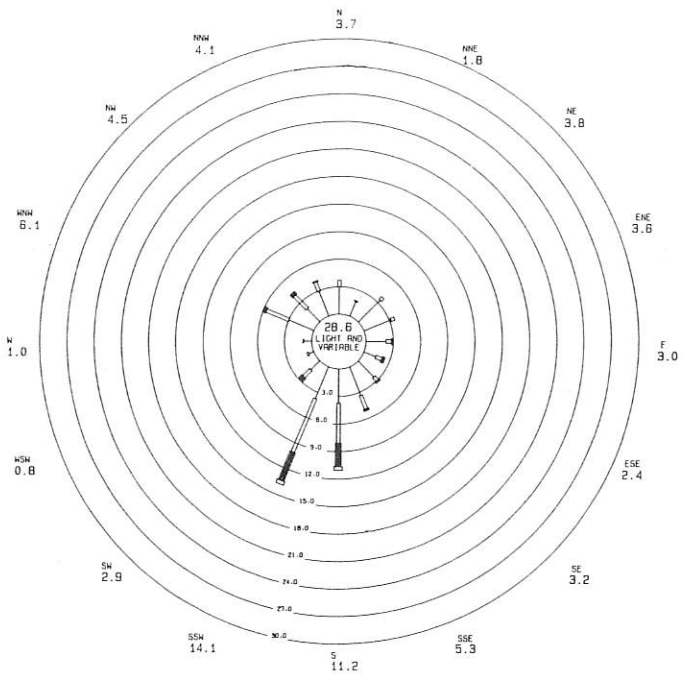
PERCENTAGE FREQUENCY OF OCCURRENCE

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

INCLUSIVE DATES- ALL MONTHS 1983

TOTAL OBSERVATIONS- 8,702





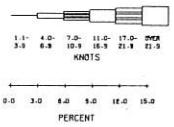
HOUR AVERAGE SURFACE WINDS

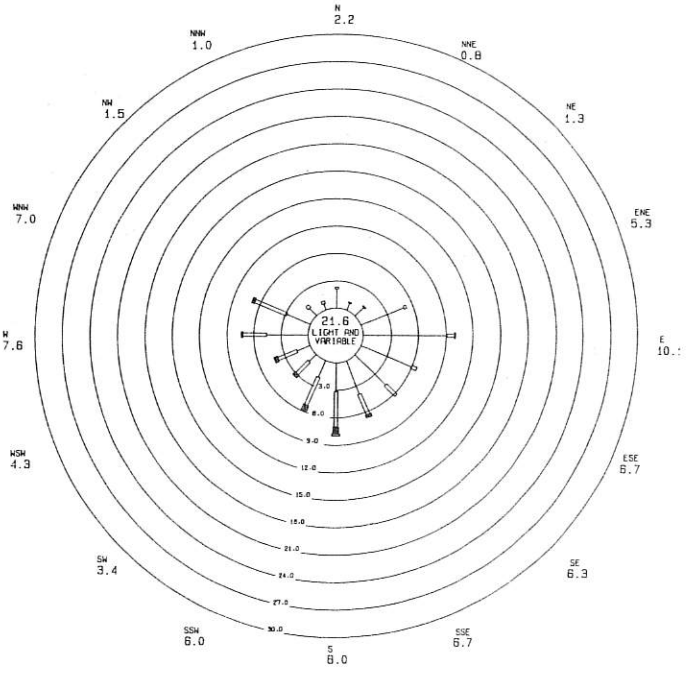
PERCENTAGE FREQUENCY OF OCCURRENCE

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

INCLUSIVE DATES- ALL MONTHS 1983

TOTAL OBSERVATIONS- 8,649





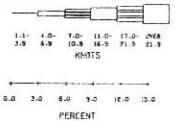
HOUR AVERAGE SURFACE WINDS

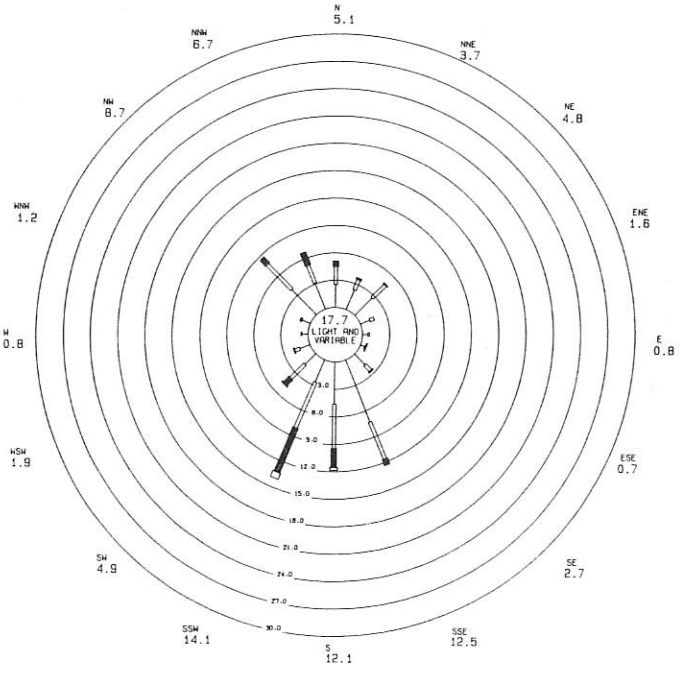
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY
Portage Bay, 2725 Montlake Blvd E, Seattle, Wa

INCLUSIVE DATES- ALL MONTHS 1983

TOTAL OBSERVATIONS- 8,183





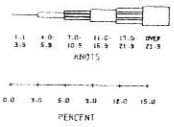
HOUR AVERAGE SURFACE WINDS

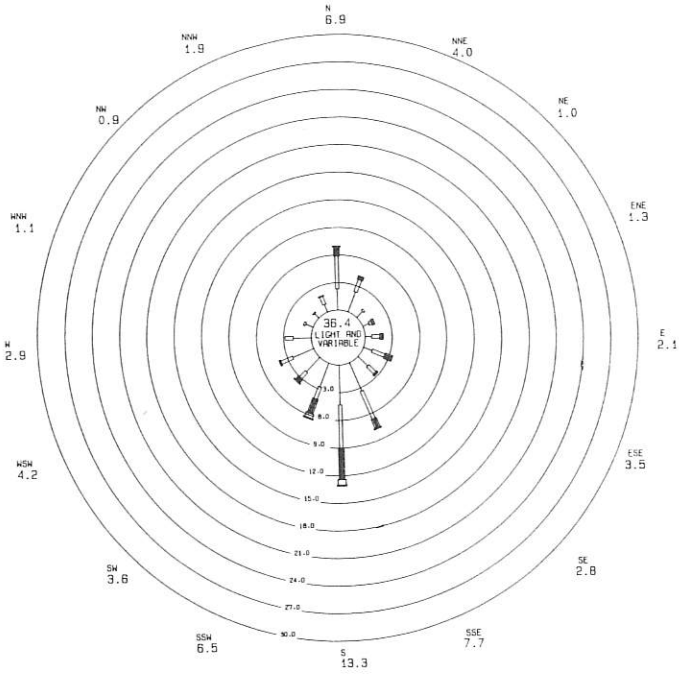
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY
Duwamish, 4401 E Marginal Way S, Seattle, Wa

INCLUSIVE DATES- ALL MONTHS 1983

TOTAL OBSERVATIONS- 8,600





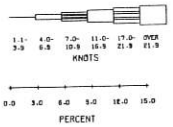
HOUR AVERAGE SURFACE WINDS

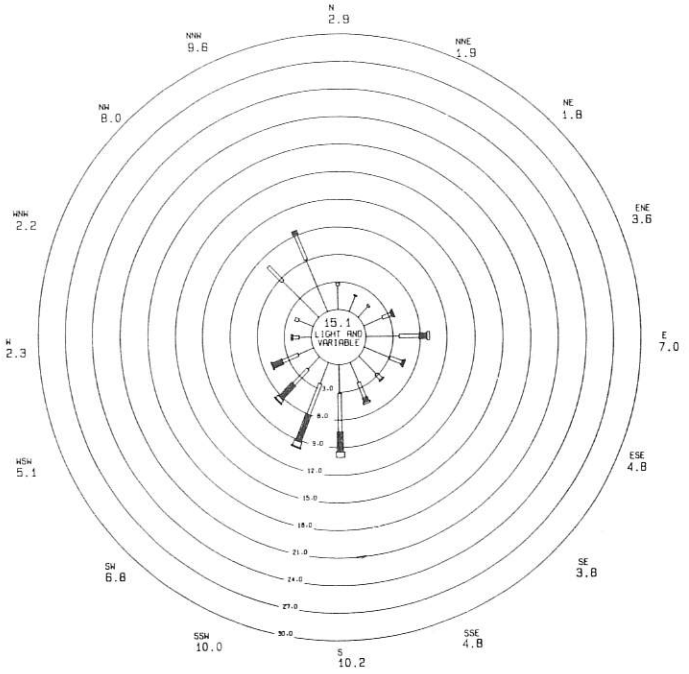
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY
22916 86th Ave S, Kent, Wa

INCLUSIVE DATES- ALL MONTHS 1983

TOTAL OBSERVATIONS- 8,697





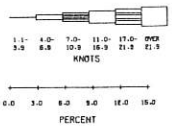
HOUR AVERAGE SURFACE WINDS

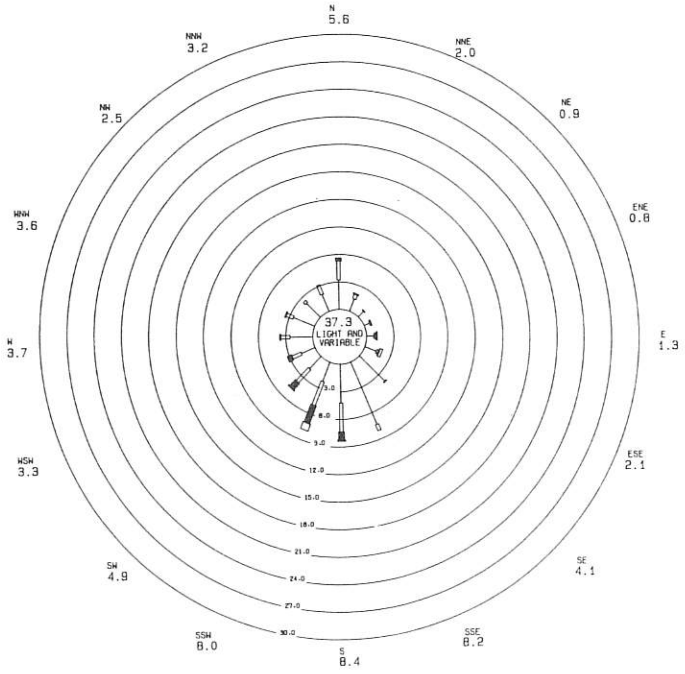
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY
Federal Way HS, 1401 S 304 St, Federal Way, Wa

INCLUSIVE DATES- ALL MONTHS 1983

TOTAL OBSERVATIONS- 8,632





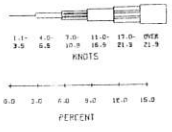
HOUR AVERAGE SURFACE WINDS

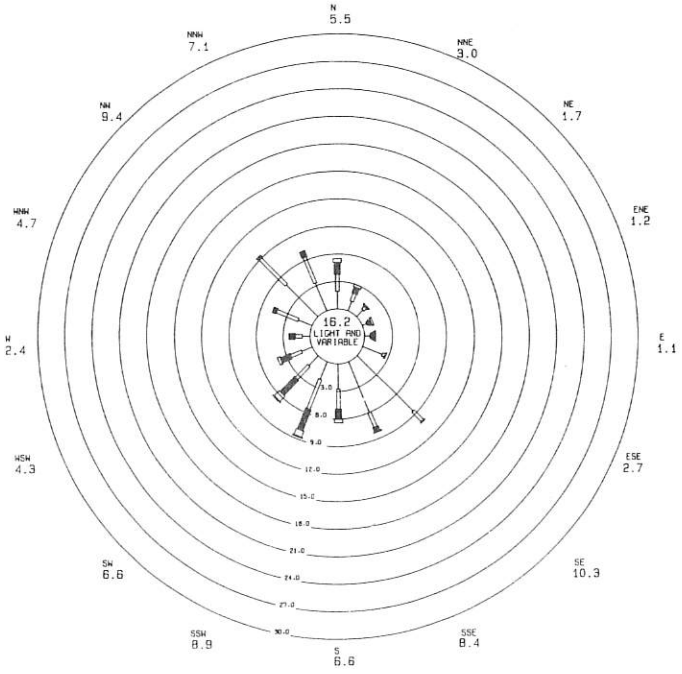
PERCENTAGE FREQUENCY OF OCCURRENCE

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

INCLUSIVE DATES- ALL MONTHS 1983

TOTAL OBSERVATIONS- 8,707





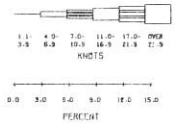
HOUR AVERAGE SURFACE WINDS

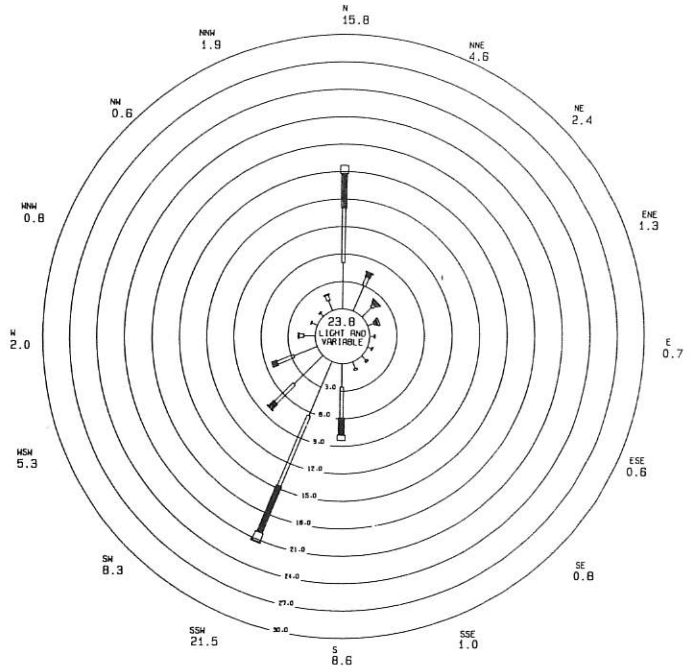
PERCENTAGE FREQUENCY OF OCCURRENCE

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

INCLUSIVE DATES- ALL MONTHS 1983

TOTAL OBSERVATIONS- 8,696





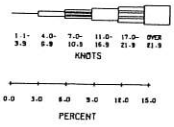
HOUR AVERAGE SURFACE WINDS

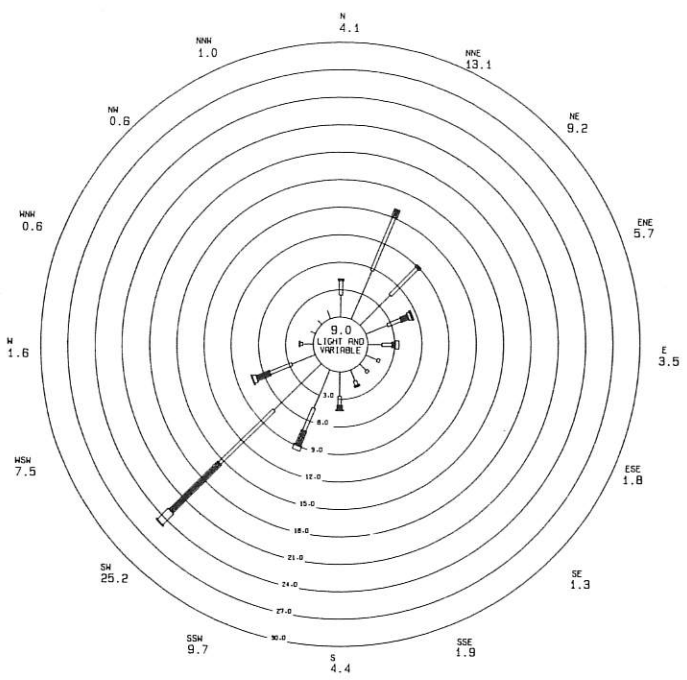
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY
Willard School, S 32nd & S 'D' St, Tacoma, Wa

INCLUSIVE DATES- ALL MONTHS 1983

TOTAL OBSERVATIONS- 8,589





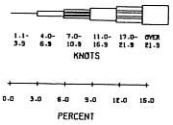
HOUR AVERAGE SURFACE WINDS

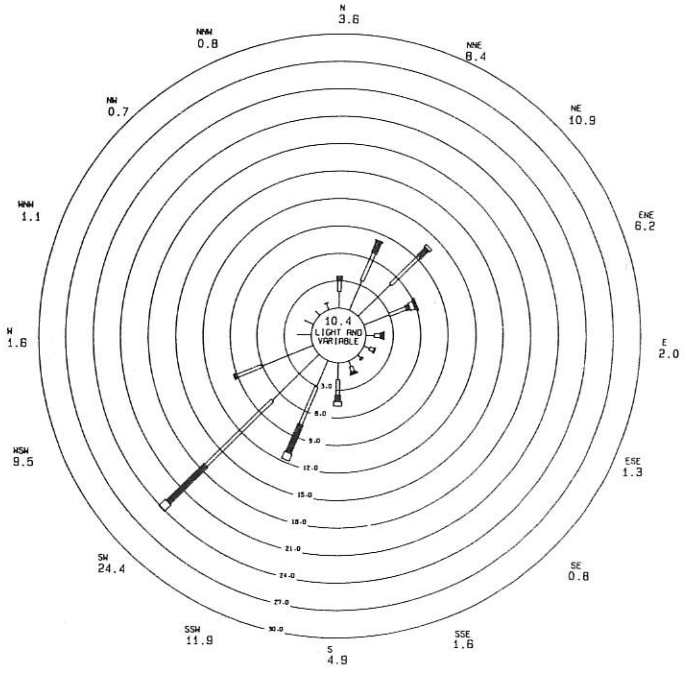
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY
SW 283rd & 101st Ave SW, Maury Island, Wa

INCLUSIVE DATES- ALL MONTHS 1983

TOTAL OBSERVATIONS- 8,587





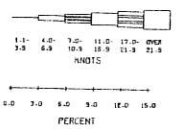
HOUR AVERAGE SURFACE WINDS

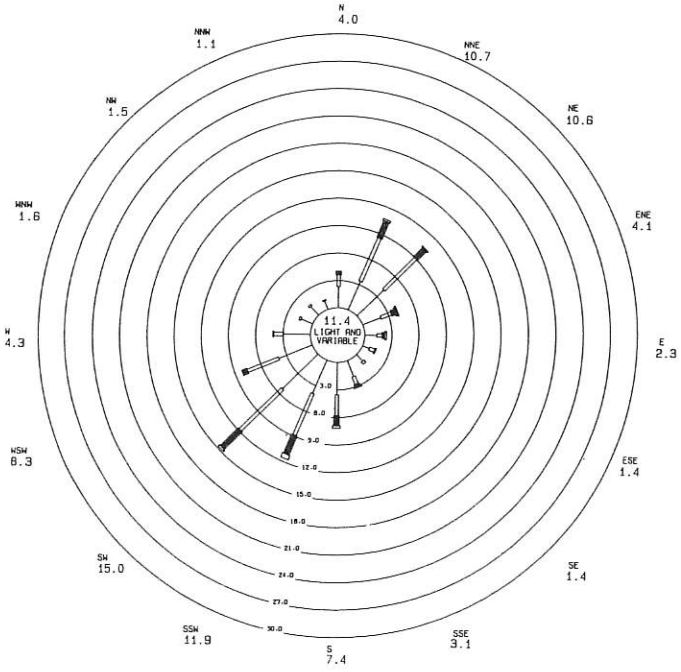
PERCENTAGE FREQUENCY OF OCCURRENCE

STATION LOCATION- PUGET SOUND AIR POLLUTION CONTROL AGENCY
North 37th & Vassault Sts, Tacoma, Wa

INCLUSIVE DATES- ALL MONTHS 1983

TOTAL OBSERVATIONS- 8,710





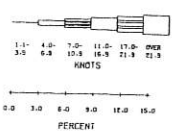
HOUR AVERAGE SURFACE WINDS

PERCENTAGE FREQUENCY OF OCCURRENCE

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

INCLUSIVE DATES- ALL MONTHS 1983

TOTAL OBSERVATIONS- 8,702



Introduction

The stability wind rose summarizes individual observations of wind direction and wind speed plus an objective calculation of low level stability existing at the same time. Each hourly observation is added to a three dimensional table at the position indicated by the wind direction assigned to the nearest of 16 compass points, by the wind speed assigned to one of 6 separate intervals, and by the low level stability category. The graphical presentation is similar to the wind rose except that separate wind roses are constructed for each stability category.

Determination of Stability

The low level stability is calculated following an objective procedure documented by D. Bruce Turner in the "Journal of Applied Meteorology", February, 1964. Low level stability depends primarily upon net radiation and wind speed. In this technique the estimate of daytime incoming radiation is developed from solar altitude for time of day and time of year at the particular location. Incoming radiation is then decreased for increased cloud cover and lower cloud ceiling height. The estimate of nighttime outgoing radiation is also decreased for increased total cloud cover.

Stability Classes

A. EXTREMELY UNSTABLE. Daytime occurrence with high positive net radiation and wind speed 5 knots or less.

B. UNSTABLE. Daytime occurrence with wind speed less than 10 knots.

C. SLIGHTLY UNSTABLE. Daytime occurrence.

D. NEUTRAL. Characterized by low or zero net radiation. Separated into daytime or nighttime occurrence by local daily sunrise and sunset times.

E. STABLE. Nighttime occurrence in conjunction with lighter wind speeds. All stable conditions are combined within this class since urban areas do not become as stable in the lower layers as rural areas.

Discussion of Local Stability Wind Roses

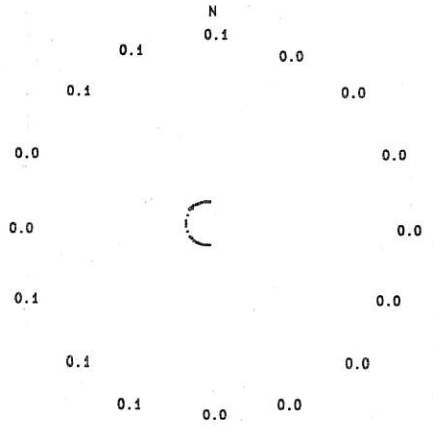
The local area stability wind roses are developed using 3 hour interval cloud data recorded for Seattle Tacoma International Airport. Persistence in cloud data is assumed for the hour preceding and the hour following the observation. This cloud data extended to 1 hour intervals is then used with the 1 hour average wind data measured at the location for which the stability wind rose is constructed.

Stability wind roses for three locations in the Puget Sound region follow this discussion. The wind rose for each stability class may be interpreted by reviewing the discussion in the preceding section on wind roses. There are two main differences. First, percent frequencies refer to the total of all observations. Thus the sum of the frequency of winds from 16 compass points displayed around each wind rose equals the frequency of occurrence for that stability class. Second, light and variable wind cases are distributed within the lowest wind speed class based upon actual occurrences in the lowest two wind speed classes.

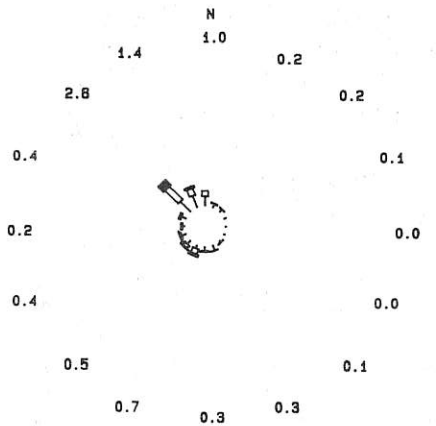
The stability wind rose summaries are required for air quality modeling. The Climatological Dispersion Model uses the frequency tables from which the accompanying stability wind roses were plotted.

Clearly the wind pattern represents the most significant difference between locations. Each stability class occurs a similar percentage of time at each station. During 1983 neutral stability existed 48 to 49 percent of the time. Stable nighttime conditions occurred about 32 percent of the time. The wind rose associated with these stable conditions is probably the most important in describing poor pollutant dispersion and is generally different than that occurring during any other stability class.

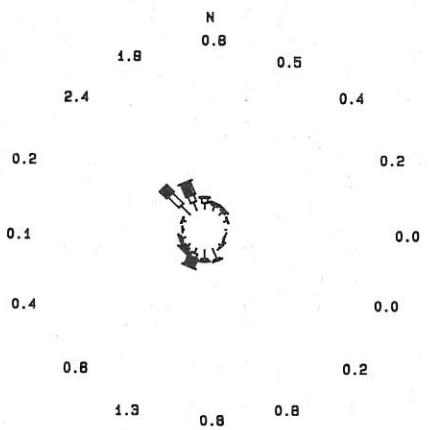
PUGET SOUND AIR POLLUTION CONTROL AGENCY



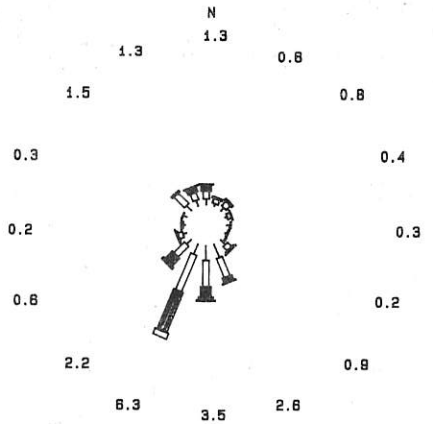
Extremely Unstable
0.6 %



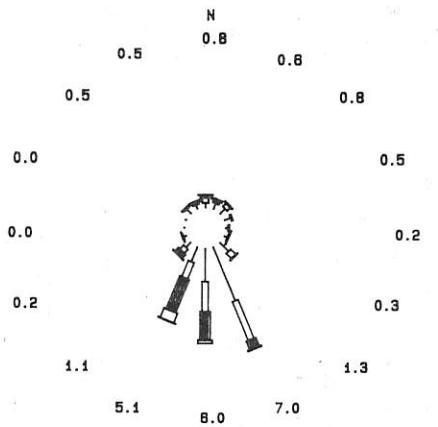
Unstable
8.5 %



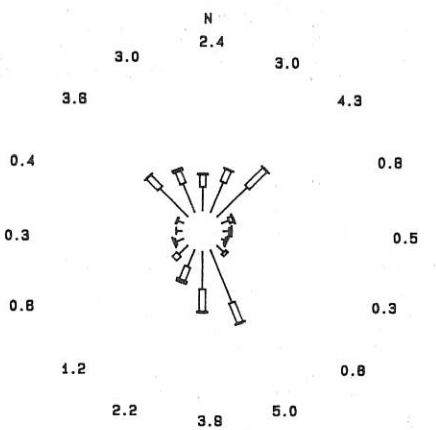
Slightly Unstable
10.7%



Neutral Daytime
23.0%



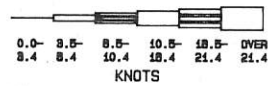
Neutral Nighttime
24.9%

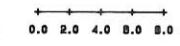


Stable
32.3%

STABILITY WIND ROSES

DUWAMISH, 4401 E MARGINAL WAY S, SEATTLE, WA





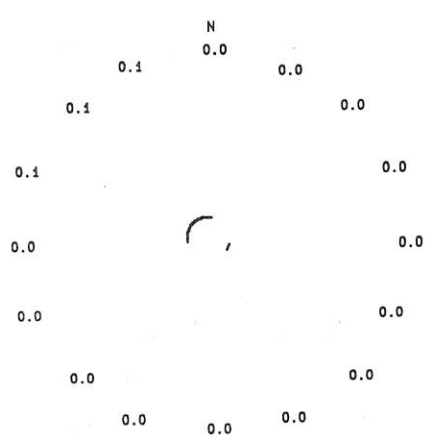
Period of Record: JAN - DEC, 1983

1 Hr Wind Location: DUWAMISH, 4401 E MARGINAL WAY S, SEATTLE, WA

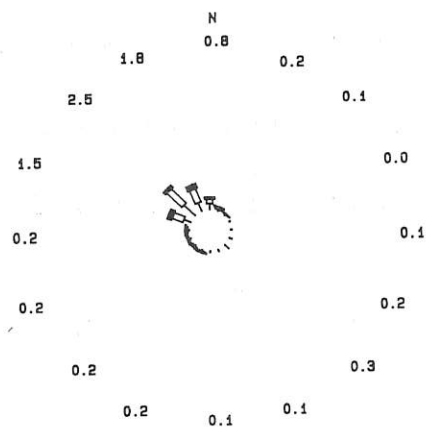
3 Hr Cloud Location: SEATTLE TACOMA INTERNATIONAL AIRPORT, WA

Percentage Frequency of Occurrence

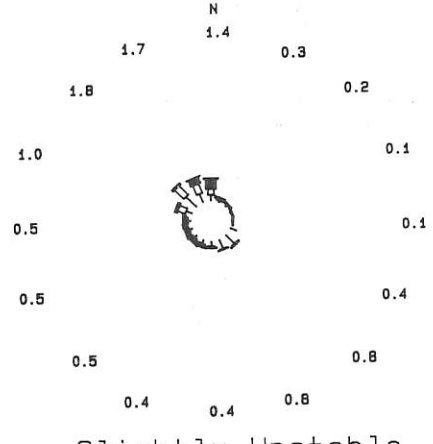
PUGET SOUND AIR POLLUTION CONTROL AGENCY



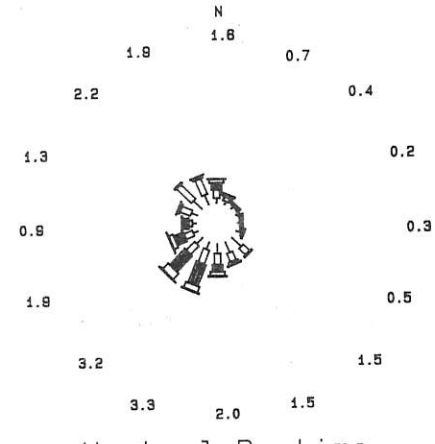
Extremely Unstable
0.3 %



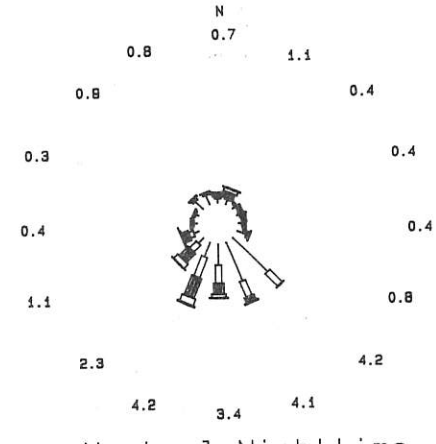
Unstable
8.5 %



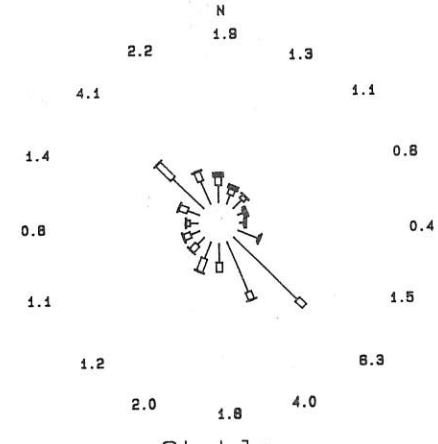
Slightly Unstable
10.5%



Neutral Daytime
23.3%



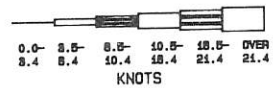
Neutral Nighttime
25.7%

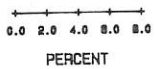


Stable
31.6%

STABILITY WIND ROSES

FIRE STATION #12, 2316 E 11TH ST, TACOMA, WA





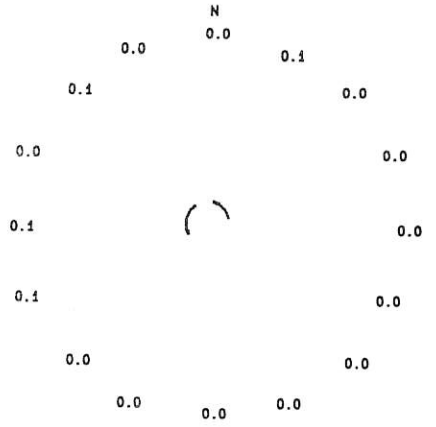
Period of Record: JAN - DEC, 1983

1 Hr Wind Location: FIRE STATION #12, 2316 E 11TH ST, TACOMA, WA

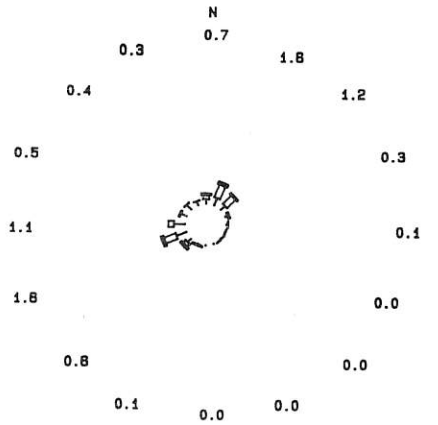
3 Hr Cloud Location: SEATTLE TACOMA INTERNATIONAL AIRPORT, WA

Percentage Frequency of Occurrence

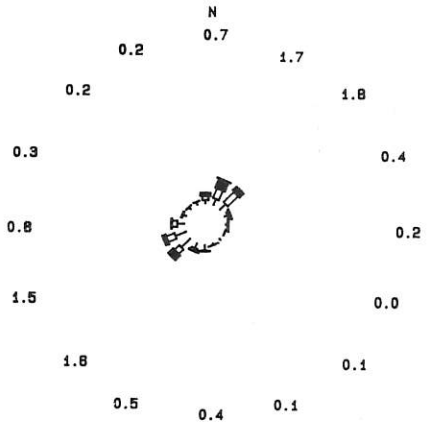
PUGET SOUND AIR POLLUTION CONTROL AGENCY



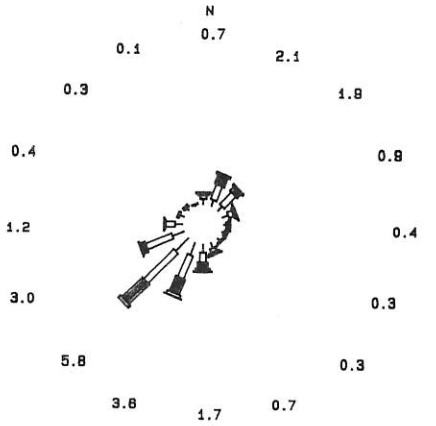
Extremely Unstable
0.5 %



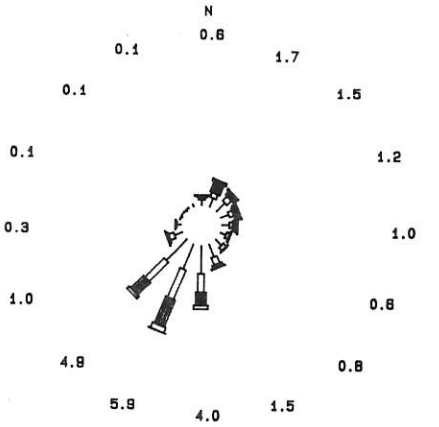
Unstable
8.5 %



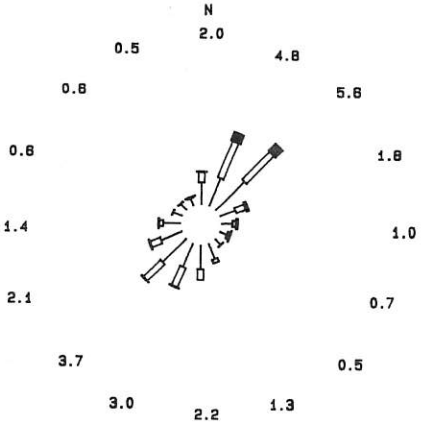
Slightly Unstable
10.4%



Neutral Daytime
23.4%



Neutral Nighttime
25.4%

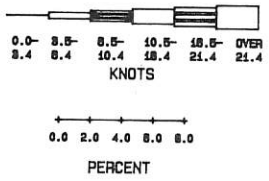


Stable
31.8%

STABILITY WIND ROSES

NORTH 26TH & PEARL STS, TACOMA, WA

Percentage Frequency of Occurrence



Period of Record: JAN - DEC, 1983

1 Hr Wind Location: NORTH 26TH & PEARL STS, TACOMA, WA

3 Hr Cloud Location: SEATTLE TACOMA INTERNATIONAL AIRPORT, WA

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 of our readers who wish to interpret our results in terms of $\mu g/m^3$ or mg/m^3. Conversion factors, extracted from the Federal Register, assume a pressure of 760 mm Hg and a temperature of $25^{o}C$.

Pollutant	Multiply PPM by	To Obtain
CO	1.145	mg/m^3
NO_2	1880	$\mu g/m^3$
O_3	1961	$\mu g/m^3$
SO_2	2619	$\mu g/m^3$

AMBIENT AIR QUALITY STANDARDS

SULFUR OXIDES

The presence of sulfur oxides in the ambient air has been associated with a variety of respiratory diseases and increased mortality rates. They represent a significant economic burden and have a nuisance impact. When sulfur oxides are inhaled with small particles, the effect on health is increased. Inhalation of sulfur dioxide can cause increased airway resistance by constricting lung passages.

PARTICULATES

Small discrete masses of solid or liquid matter dispersed in the atmosphere, especially those of one micron or less in diameter, are associated with a variety of adverse effects on public health and welfare. Particulate matter in the respiratory tract may produce injury by itself, or it may act in conjunction with gases to increase the effect on the body. Small particles suspended in the air are chiefly responsible for reduced visibility in the Puget Sound area. Soiling of buildings and other property is a common effect of high particulate levels.

CARBON MONOXIDE

Carbon monoxide reacts with the hemoglobin in red blood cells to decrease the oxygen-carrying capacity of the blood. The national primary standard for carbon monoxide was based on evidence that levels of carboxyhemoglobin in human blood as low as 2.5% may be associated with impairment of ability to discriminate time intervals. The national ambient air quality standards for carbon monoxide are intended to protect against the occurrence of carboxyhemoglobin levels above 2%. Smoking 2 packs of cigarettes a day raises carboxyhemoglobin levels to 5%.

	NATIONAL			WASHINGTON STATE		PUGET SOUND REGION	
	PRIMARY	SECONDARY					
SULFUR OXIDES	ppm	ppm	*	ppm	*	ppm	*
Annual Average	0.03		a	0.02	a	0.02	a
30 day Average						0.04	a
24 hour Average	0.14		b	0.10	b	0.10	a
3 hour Average		0.50	b				
1 hour Average				0.25	c	0.25	c
1 hour Average				0.40	b	0.40	a
5 min Average						1.00	d
SUSPENDED PARTICULATES	ug/cubic meter	ug/cubic meter		ug/cubic meter		ug/cubic meter	
Annual Geometric Mean	75	60	a	60	a	60	a
24 hour Average	260	150	b	150	b	150	b
CARBON MONOXIDE	ppm	ppm		ppm		ppm	
8 hour Average	9	9	b	9	b	9	b
1 hour Average	35	35	b	35	b	35	b
OZONE	ppm	ppm		ppm		ppm	
1 hour Average	0.12	0.12	e	0.12	e	0.12	e
NITROGEN DIOXIDE	ppm	ppm		ppm		ppm	
Annual Average	0.05	0.05	a	0.05	a	0.05	a
LEAD	ug/cubic meter	ug/cubic meter				ug/cubic meter	
Calendar Quarter Average	1.5	1.5	a			1.5	a

ppm = parts per million

ug/cubic meter = micrograms per cubic meter

*

a Never to be exceeded
b Not to be exceeded more than once per year
c Not to be exceeded more than twice in seven days
d Not to be exceeded more than once in eight hours
e Standard attained when expected number of days per year with maximum hourly average above 0.12 ppm is equal to or less than one

OZONE

Oxidants are produced in the atmosphere when nitrogen oxides and some hydrocarbons are exposed to sunlight. Ozone is the oxidant found in largest amounts. 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, produced in smaller amounts than ozone, cause eye irritation. Persons with chronic respiratory problems such as asthma seem most sensitive to changes in ozone concentration.

NITROGEN DIOXIDE

Nitric oxide results from the fixation of nitrogen and oxygen at high temperatures as in fuel combustion. There are several atmospheric reactions which lead to the oxidation of nitric oxide to nitrogen dioxide, and the presence of nitrogen dioxide in ambient air is essential to the production of photochemical oxidants. The presence of nitrogen dioxide in ambient air has been associated with a variety of respiratory diseases.

LEAD

Lead affects humans in numerous ways, but the greatest effects appear to be on the blood-forming system, the nervous system, and the kidneys. It affects some persons more than others. Young children (ages 1-5) are particularly sensitive to lead exposure. The standard for lead in air is intended to prevent most children from exceeding blood lead levels of 30 micrograms per deciliter of blood.

PSAPCA 4/83