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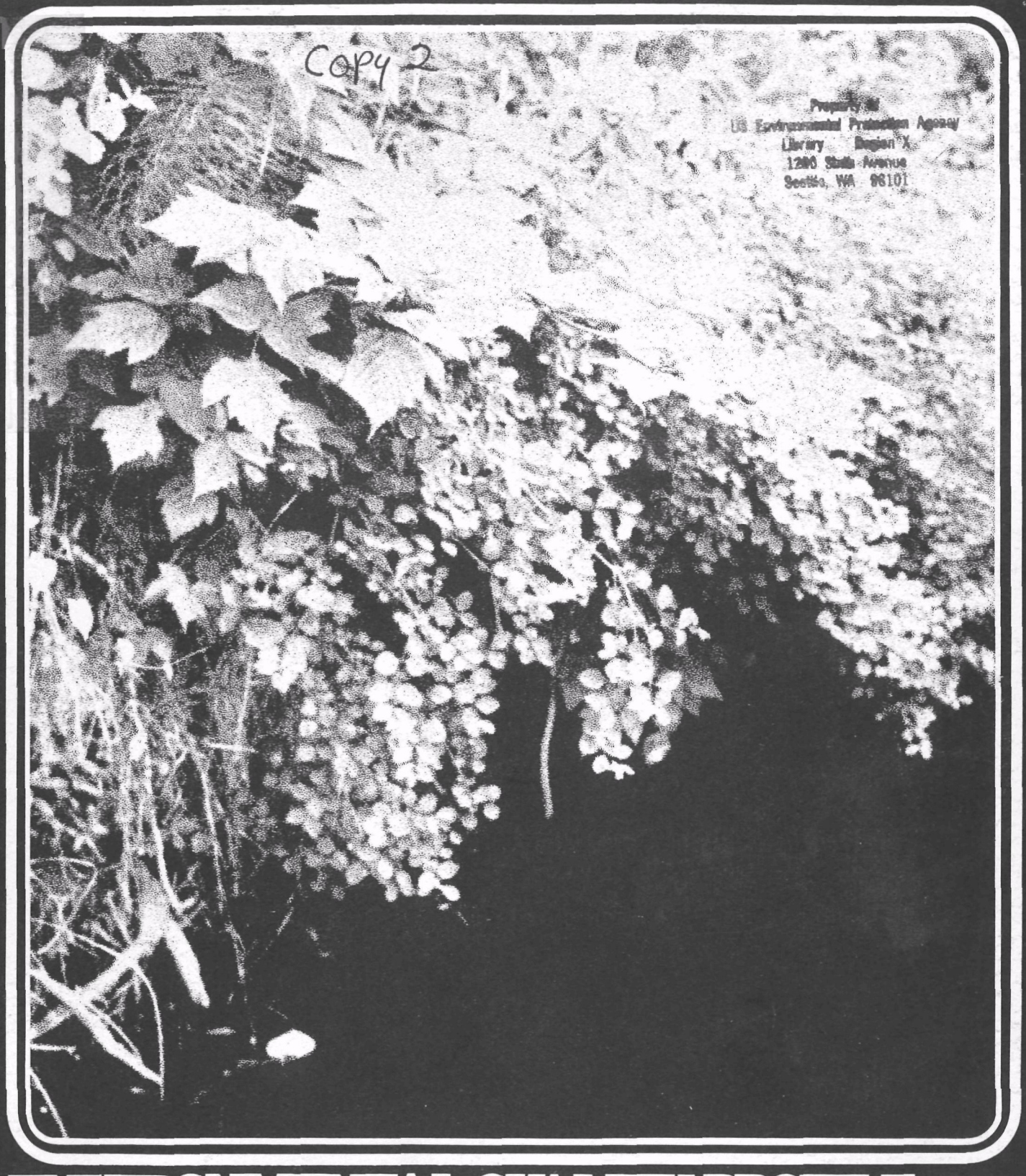

ENVIRONMENTAL QUALITY PROFILE 1976
technical supplement

ALASKA

SUPPLEMENT

1976 ENVIRONMENTAL QUALITY PROFILE

FOR ALASKA

This report has been reviewed by EPA Region X and is approved for publication. Approval does not necessarily signify that the contents reflect the views or policies of the Environmental Protection Agency, nor does mention of trade names or commercial products constitute endorsement or recommendation for use.

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INTRODUCTION

State, federal, and local environmental quality control agencies maintain monitoring networks to scientifically measure the quality of our environment. These monitoring networks are invaluable in determining where pollution problems exist and to measure the success or failure of abatement and pollution prevention programs.

The Seattle Regional Office of the Environmental Protection Agency annually evaluates all data collected by northwest pollution control agencies and submitted to the EPA computer data storage systems. We feel the public should be made aware of the results of these evaluations. This document and similar future documents are designed to report on the present status of northwest air and water quality, trends in that quality, an analysis of the causes and effects of observed pollution problems and our view of the near term outlook for solving these problems. This report is a technical supplement to the 1976 Regional Environmental Quality Profile and is designed to inform the reader about the general status of the environment within the state.

The reader may find a few inconsistencies between this supplement and the 1976 Regional Environmental Quality Profile due to the continual profile upgrading process which includes improvement of evaluation and presentation techniques. These changes are the result of our readers comments and suggestions. Formulating useful and accurate indices of environmental quality is a difficult task. Additional suggestions for improving the information presented in this document would be appreciated. Please direct your comments to the Office of the Regional Administrator, U. S. Environmental Protection Agency, 1200 Sixth Avenue, Seattle, Washington 98101.

REGIONAL AIR QUALITY PROFILE

OVERVIEW

Air pollution--as pollutant concentrations in excess of those established by National health-related air quality standards--occurs in every State in Federal Administrative Region X. Standards for four of the most widespread pollutants were exceeded in the State of Washington for the three year period ending in 1974. Alaska and Idaho exceeded standards for two of the four. Three standards were exceeded in Oregon. Frequency of excessive pollutant concentrations, as measured by number of violation-days, was greatest in sparsely populated Idaho, least in Oregon. (A violation-day, for the purposes of this report, was established whenever a standard was exceeded in a county.) More serious "alert level" pollutant concentrations were recorded most often in Alaska, least often in Oregon.

TABLE 1 - REGION X STATES

	Concentrations Exceeding Standard				Violation-Days	
	Carbon Monoxide	Photo Oxidants	Particulate Matter	Sulfur Dioxide	Standard Exceeded	Alert Level
Alaska	X		X		412	174
Idaho			X	X	446	149
Oregon	X	X	X		301	40
Washington	X	X	X	X	368	48

Excessive pollutant levels were concentrated in nine Region X communities that together accounted for 72 percent of all violation-days and 74 percent of all alert level violation-days. The core cities of the Region's seven standard metropolitan statistical areas were responsible for just under half of all violation-days and just under two-fifths of all alert level violation-days. But two fairly small communities, Fairbanks, Alaska and Kellogg-Wallace, Idaho, exceeded any of the larger cities in numbers of times excessive pollutant concentrations were recorded, and were responsible for almost half of all recorded pollutant concentrations above the alert level.

TABLE 2 - PRINCIPAL CITIES

	Concentrations Exceeding Standard				Violation-Days	
	Carbon Monoxide	Photo Oxidants	Particulate Matter	Sulfur Dioxide	Standard Exceeded	Alert Level
Seattle	X	X	X		149	16
Portland	X	X	X		165	30
Spokane	X		X		82	3
Tacoma	X	X	X		43	5
Anchorage	X		X		142	90
Boise			X		11	6
Eugene	X	X	X		56	2
Salem	X	X			23	1
Fairbanks	X		X		203	73
Kellogg-Wallace			X	X	217	69

A great deal of Region X's air pollution can be attributed to the automobile. Just under half of Alaska's violation-days can be traced to the automobile and the bulk of Oregon's and Washington's problems (in violation-days) can be traced to the automobile. The bulk of Oregon's and Washington's standards violation problems were due to carbon monoxide and photochemical oxidant concentrations that occurred around the largest cities of the two States. Those pollutants could be traced almost entirely (i.e., 80 to 90 percent) to automobile exhausts. Because well over half of the Region's population lives in and around the six cities in which such pollution occurs, population exposure to risk as a consequence of automobile emissions is a significant public health problem of the Pacific Northwest and Alaska.

TABLE 3 - AUTO-RELATED VIOLATION DAYS

Alaska	42.2%
Anchorage	16.9%
Fairbanks	77.8%
Idaho	No Data
Oregon	85.0%
Portland	97.6%
Eugene	85.7%
Salem	100.0%
Washington	66.8%
Seattle	99.3%
Spokane	82.9%
Tacoma	46.5%
Region X	45.1%

AIR QUALITY IN ALASKA

Under the Clean Air Act of 1970, the Environmental Protection Agency has established National standards that specify maximum permissable levels of pollutant materials in air.

Standards for the principal and most widespread pollutants--total suspended particulate matter, sulfur dioxide, carbon monoxide, photochemical oxidants, and oxides of nitrogen--are divided into two categories. Primary standards are set at levels intended to protect human health. Secondary standards are set at levels intended to protect against other forms of damage caused by air pollution.

The material that follows is an attempt to describe simply what is known about air quality in the State of Alaska in terms of its adherence to National primary air quality standards. Those standards have been established to protect against the following specific health effects that have been demonstrated to stem from the particular pollutant:

Total suspended particulates--aggravation of asthma and chronic lung diseases, increased cough, chest discomfort, restricted activity, aggravation of heart and lung disease symptoms in the elderly, increased death rate;

Sulfur dioxide--aggravation of asthma, aggravation of heart and lung disease symptoms in the elderly, increased lung illness, increased death rate;

Carbon monoxide--interference with mental and physical activity, reduced capacity in persons suffering from heart and other circulatory disorders;

Photochemical oxidants--aggravation of asthma and chronic lung disease, irritation of the eye and of the respiratory tract, decreased vision, reduced heart and lung capacity;

Oxides of nitrogen--increased chronic bronchitis.

The material is presented in graphic form. It is intended to depict:

1) where, and how often, primary standards were exceeded in 1974,

2) location and frequency of severe concentrations of health damaging pollutants in 1974,

3) indicated trend of pollutant concentrations in the period 1972 to 1974, and

4) sources of the principal pollutants found to be in excess of the primary standard in 1974.

POLLUTANTS IN EXCESS OF HEALTH STANDARDS

During the three year period ending in 1974, eight of Alaska's twenty-nine census divisions experienced recorded concentrations of pollutants that exceeded the allowable maxima specified by primary air quality standards. The census divisions are ranked in the chart (Figure 1) according to the average number of days per year in which a standard was exceeded.

Particulate matter was the most widespread cause of an exceeded standard. Concentrations above the primary standard occurred in seven census divisions, and the total number of days in which the particulate standard was exceeded among all census divisions summed to 226.

Carbon monoxide standards were not consistently met in either Anchorage or Fairbanks. Total violation-days for the two communities amounted to 182; and in Fairbanks, the primary standard was exceeded on 158 days, or almost 45% of the entire year.

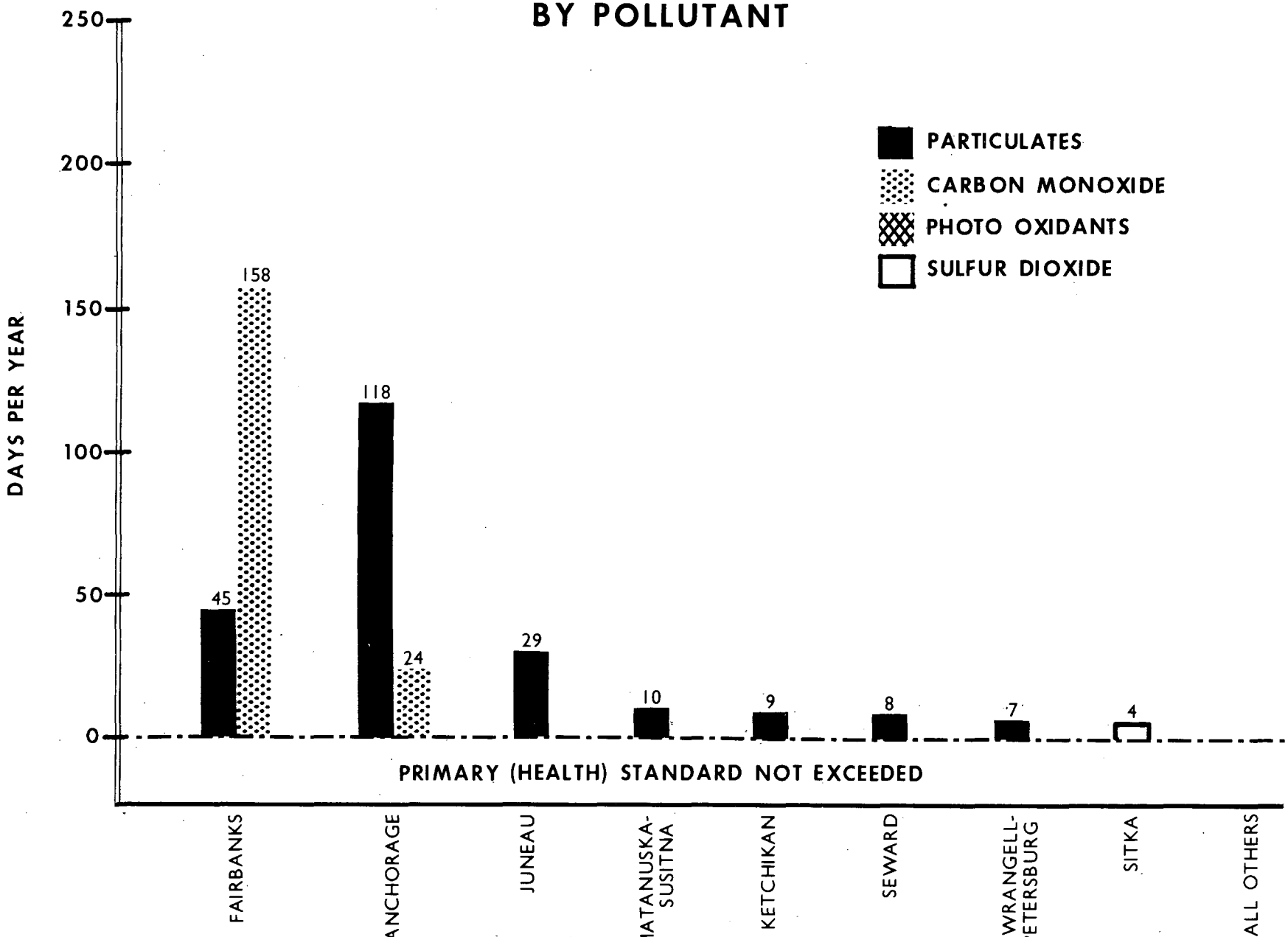
Sulfur dioxide concentrations in excess of the standard were confined to Sitka, and occurred on four days.

Pollutant concentrations in excess of the health standards were concentrated in the two principal cities. Together, Anchorage and Fairbanks produced 345 standard violation-days, the rest of the State of Alaska only 67.

Figure 1

ALASKA

DAYS EXCEEDING HEALTH STANDARD BY POLLUTANT



SEVERITY OF POLLUTION

Primary air quality standards include three degrees of risk, according to level of pollutant concentrations. The nature of potential health damage is the same at each level, but the probability of damage and the proportion of the population that is predisposed to health impairment increases as the amount of pollutants in air increases. There are distinct thresholds that indicate the degree of risk that is believed to be associated with certain pollutant concentrations, and these are recognized in the primary air quality standards. As the higher concentrations occur, the enhanced danger of the consequent pollution is designated by an air quality standard category. "Alert" level pollutant concentrations are thought to be significantly more serious than lower concentrations exceeding the primary standard. "Warning" levels are thought to be significantly more serious than alert.

TABLE 4

Threshold Pollutant Concentrations (per cubic meter of air)

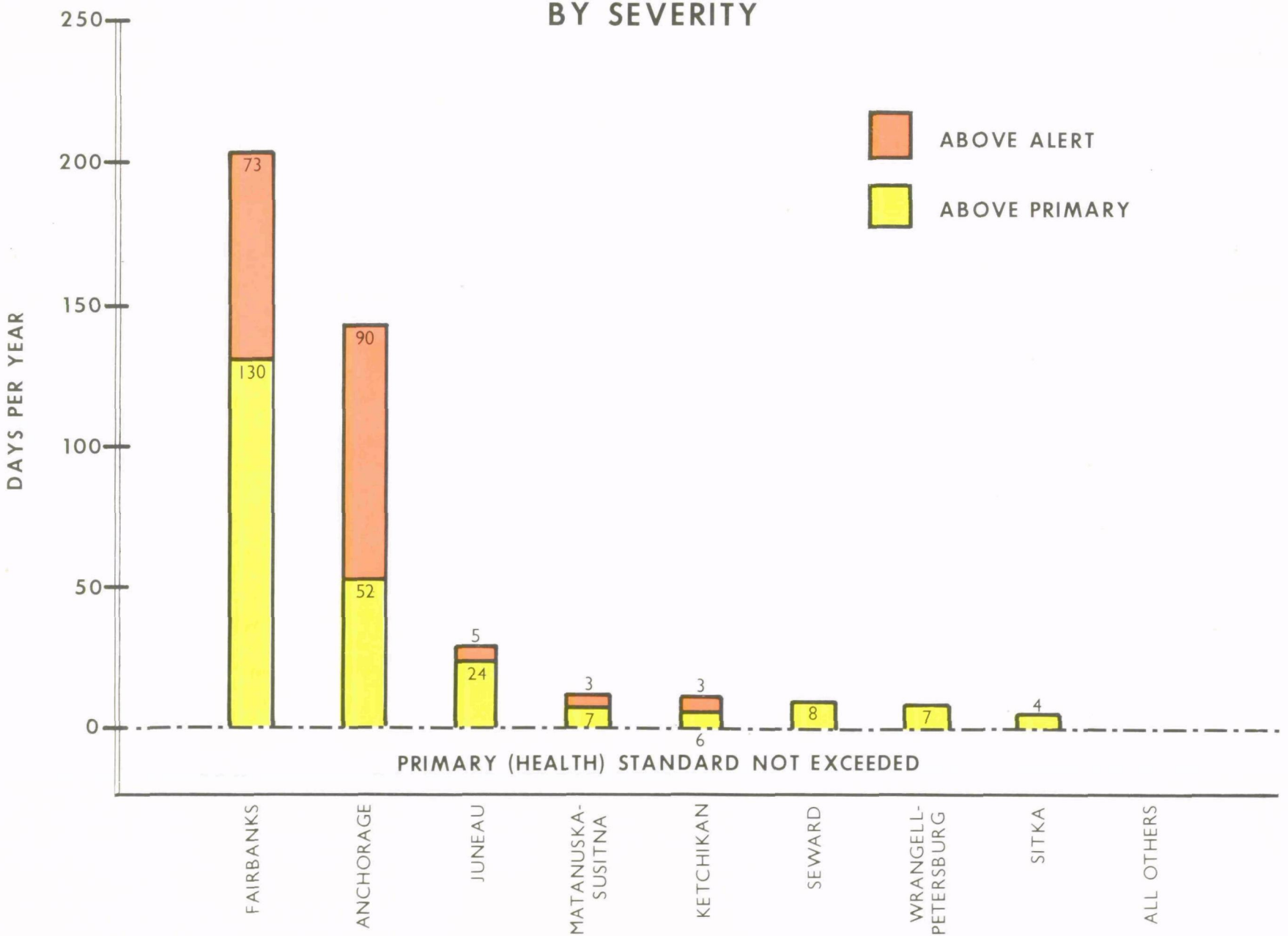
Pollutant	Standard	Alert	Warning
Particulates (24 hour)	260 micrograms	375	625
Sulfur dioxide (24 hour)	365 micrograms	800	1,600
Carbon monoxide (8 hour)	10 milligrams	17	34
Oxidants (1 hour)	160 micrograms	200	800

In 1974 (Figure 2), at least 174 of the 412 instances in which health standards were exceeded in Alaska involved concentrations at or above the alert level. The proportion of alert level, or higher, concentrations in cases in which primary standards were exceeded must have been among the greatest--if not actually the greatest--in the nation.

Figure 2

ALASKA

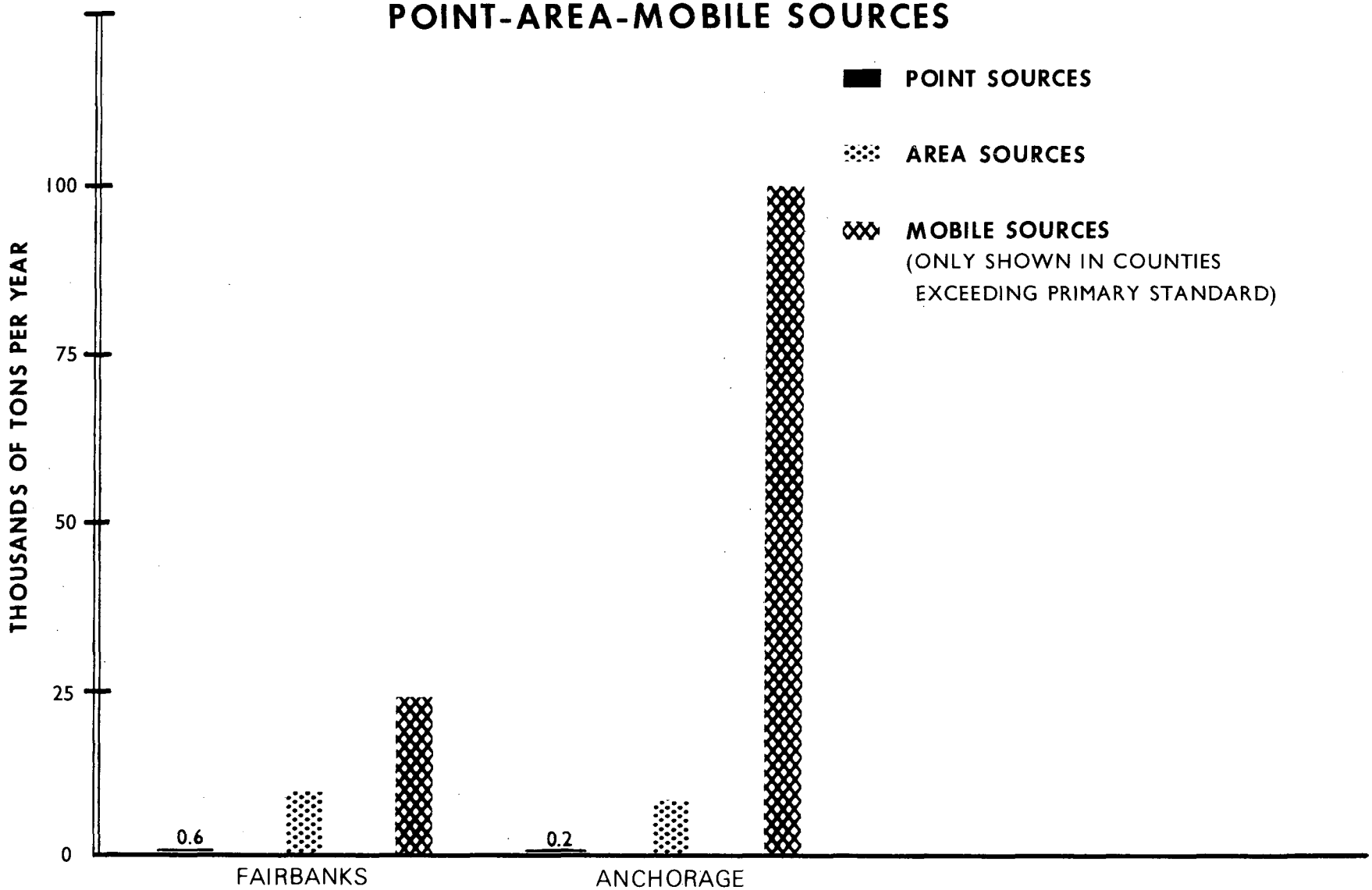
DAYS EXCEEDING HEALTH STANDARD BY SEVERITY



POLLUTANT SOURCES: CARBON MONOXIDE

The graph in Figure 3 indicates the estimated distribution of sources of carbon monoxide in Fairbanks and Anchorage, where the primary standard for carbon monoxide was exceeded on a number of occasions in 1974. Although point sources were of minor significance, area sources produced almost all of the recorded carbon monoxide. Automobiles and other kinds of transportation equipment--designated mobile sources on the graph--were estimated to produce 92% of all carbon monoxide generated in Anchorage, and 70% of that occuring in Fairbanks.

Figure 3
ALASKA
CARBON MONOXIDE EMISSIONS
POINT-AREA-MOBILE SOURCES



POLLUTANT SOURCES: PARTICULATE AND SULFUR DIOXIDE

Figure 4 indicates the estimated distribution of sources of particulate matter in those Alaskan census districts in which a primary air quality standard was exceeded in 1974.

Point sources--large, recognizable features such as factories--were responsible for less than half of aggregate particulate production in the eight census districts not meeting primary standards. In total, point source particulate emissions amounted to about 6,500 tons of the more than 14,000 tons of particulate matter produced in 1974.

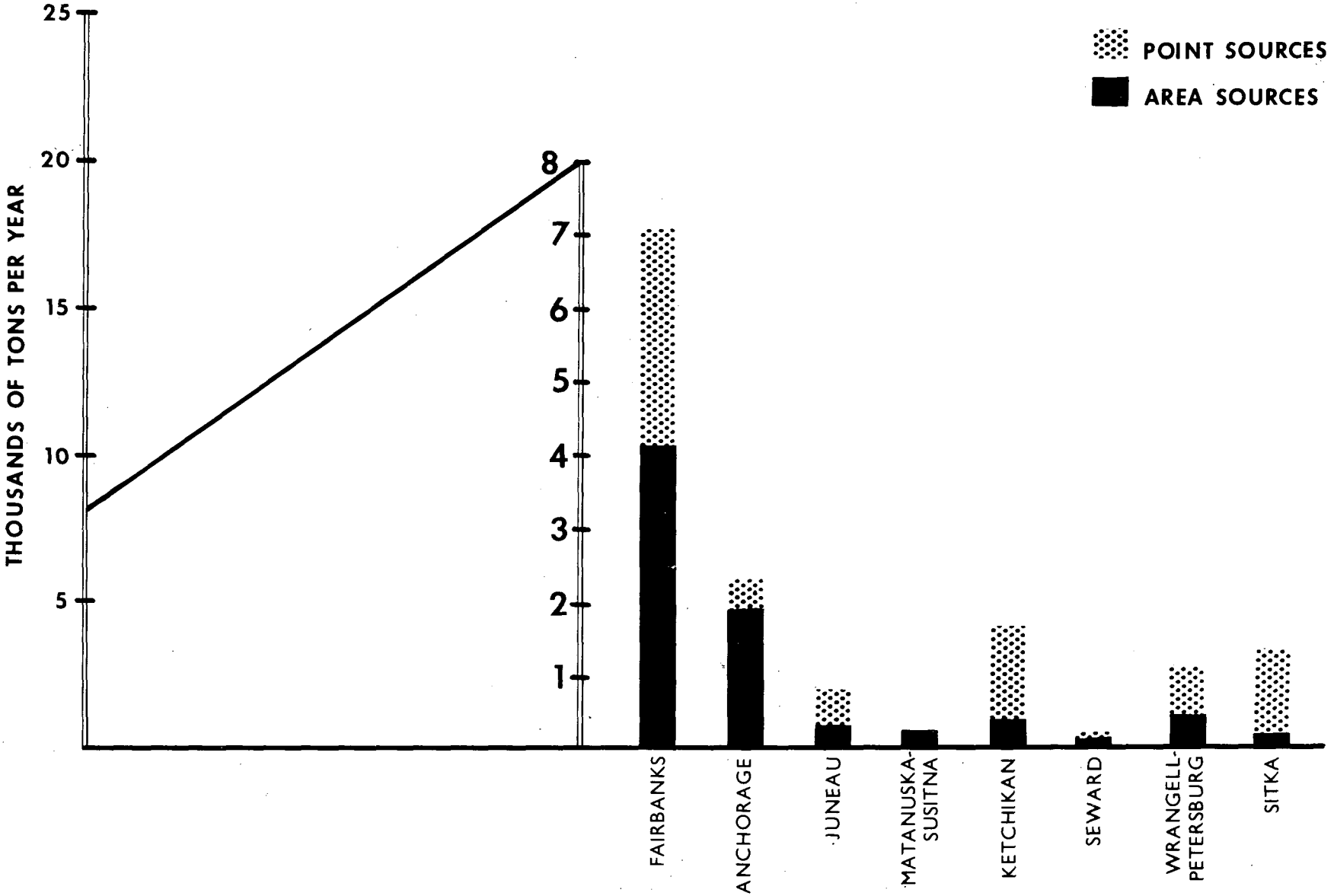
Area sources--space heating, transportation devices, brush burning, wind blown dust, etc.: the variety of small, intermittent sources of pollutants too numerous, changeable, and insignificant in themselves to be cataloged--though in combination they may generate large volumes of pollutants--were responsible for more than 7,500 tons of particulate matter. Most of that production occurred in Anchorage and Fairbanks, where the bulk of days exceeding the particulate standard were registered.

Sulfur dioxide concentrations in excess of the primary standard in Sitka were entirely attributable to a point source.

Figure 4

ALASKA

POINT AND AREA SOURCE PARTICULATE EMISSIONS



AIR POLLUTION TRENDS

The chart in Figure 5 shows indicated trends of pollutant concentrations in Alaska census divisions, as those trends may be derived from the air monitoring record for the period 1972 through 1974.

Blue boxes indicate that there is no evidence that the specified air quality standard has been exceeded. Where the circles occur within the box, the presumed compliance with standards is not based on measurements, but is derived from judgment and a knowledge of pollutant sources.

Yellow boxes indicate that a standard has been exceeded, without concentrations reaching the alert level. An upward pointing arrow indicates that measured concentrations of the specified pollutant appear to be increasing--that the propensity for pollution to occur is rising. A downward pointing arrow indicates that concentrations appear to be receding.

Red boxes are used where a pollutant concentration has exceeded the alert level. Again, the arrow within the box indicates the apparent direction of the pollutant's concentration.

The period 1972-1974 seems to have been marked by conflicting trends. In general, particulate levels were--with a couple of exceptions--declining. On the other hand, carbon monoxide problems in both Anchorage and Fairbanks seem to have been growing worse; and in a couple of instances, sulfur dioxide concentrations show signs of evolving into problems. Because of the enormous influence of meteorological conditions, apparent trends based on only three years of air quality data may be deceptive; but the Alaskan situation seems less optimistic than that of other Region X States.

While the central feature of the display is its preponderance of blue, the intensity and duration of pollutant concentrations exceeding primary standards is worrisome, particularly in view of the small population that causes those relatively serious effects, and the rapid rate of growth of that population. There is evidence that the severe climate creates atmospheric conditions that will make it more than usually difficult to relieve existing air pollution in Alaska, as well as make it difficult to protect against the future degradation of the State's generally good quality air.

Figure 5

ATTAINMENT STATUS AND TRENDS IN AIR POLLUTION

ALASKA

ELECTION DISTRICT	PARTICULATES	CARBON MONOXIDE	PHOTO OXIDANTS	SULFUR DIOXIDE
ALEUTIAN ISLANDS	○	○	○	○
ANCHORAGE	⇩		○	
ANGOON	○	○	○	○
BARROW	○	○	○	○
BRISTOL BAY BOROUGH	○	○	○	○
BRISTOL BAY	○	○	○	○
CORDOVA-McCARTHY	○	○	○	○
FAIRBANKS	⇩	⇨	○	⇧
HAINES	○	○	○	○
JUNEAU		○	○	○
KENAI-COOK INLET	⇩	○	○	○
KETCHIKAN		○	○	
KOBUK	○	○	○	○
KODIAK	○	○	○	○
KUSKOKWIM	○	○	○	○
MATANUSKA-SUSITNA		○	○	○
NOME	○	○	○	○
OUTER KETCHIKAN	○	○	○	○
PRINCE OF WALES	○	○	○	○
SEWARD		○	○	○
SITKA		○	○	
SKAGWAY-YAKUTAT	○	○	○	○

ELECTION DISTRICT	PARTICULATES	CARBON MONOXIDE	PHOTO OXIDANTS	SULFUR DIOXIDE
SOUTHEAST FAIRBANKS	○	○	○	○
UPPER YUKON	○	○	○	○
VALDEZ-CHITINA WHITTIER	○		○	○
WADE HAMPTON	○	○	○	○
WRANGELL-PETERSBURG		○	○	○
YUKON-KOYUKUK	○	○	○	○

- NO EVIDENCE PRIMARY STANDARD EXCEEDED
- EXCEEDS PRIMARY LEVEL
- EXCEEDS ALERT LEVEL
- ○ DESIGNATION BASED ON JUDGMENT
- ⇩ DECREASING STANDARDS VIOLATIONS
- ⇨ LEVEL OR NO APPARENT TREND
- ⇧ INCREASING STANDARDS VIOLATIONS

NEAR TERM OUTLOOK

Paradoxically, some areas of Alaska--a virtual frontier with the lowest population density among the fifty States--appears to have the worst air pollution problems in Federal Administrative Region X. Air quality trends are currently favorable with respect to particulates, unfavorable with respect to carbon monoxide, and uncertain for sulfur dioxide. And the combination of rapid rates of population and industrial growth with a physical environment that seems, because of the severe winter inversion phenomenon, particularly vulnerable to air pollution makes it most difficult to project air quality conditions for Alaska.

Particulates, the broadest form of pollutants in excess of the standards, would appear to offer the best prospects for immediate improvement. Though excessive particulates are widespread, the frequency and duration of concentrations in excess of the standard are slight, except in Fairbanks and Anchorage. Point sources predominate outside of the two principal cities; and the combination of source identification with the availability of control technology indicates that abatement of pollutional conditions is likely.

Sulfur dioxide, a potential problem for Alaska, does not seem to be an imminent one. Availability of point source controls and the near complete absence of concentrations in excess of standards seem sufficient to override the disadvantage of extended periods of inversion. But the pace of industrialization indicates that careful monitoring is necessary.

Carbon monoxide excursions beyond the standard present distinctly less optimistic prospects. The private automobile is responsible for a significant share of carbon monoxide production in both Fairbanks and Anchorage; and the extreme inversion conditions make other area sources of carbon monoxide highly significant. Thus the very number of sources to be controlled presents a formidable barrier to standards attainment. Moreover, there are no feasible techniques available for control of carbon monoxide originating from area sources other than the mobile ones. Carbon monoxide reduction devices are, of course, an integral component of all recent model year autos, but their effectiveness in an artic climate remains to be proven. If they work as designed, reductions of carbon monoxide from mobile sources is essentially a matter of gradual replacement of the existing stock of autos with newer units that incorporate the control technology --a long term probabilistic process that is retarded by growth in total automobile usage. In view of rapid growth, particularly in Fairbanks, and the significance of other area sources of carbon monoxide, there must be some question as to the capability of auto exhaust controls alone to effectuate a sufficient improvement in carbon monoxide concentrations to satisfy public health requirements within the next three to five years.

REGIONAL WATER QUALITY PROFILE

OVERVIEW

Relative pollution of the non-marine waters of major Pacific Northwest rivers is indicated on the accompanying graphs. Figure 6 depicts the degree of pollution in each major regional river reach and Figure 7 shows the location of the river reaches. Similar determinations are not available for Alaskan waters due to a lack of necessary data. EPA and the State of Alaska are currently working together toward the development of a water quality monitoring program that will provide the same depth of information that is available in other Region X States.

The basis of comparison between waters of the Pacific Northwest is an eleven part Water Quality Index (WQI) that compares measured water quality conditions during the last five years with National criteria recommended by the National Academy of Sciences.[1/] Measured water quality constituents from various Federal, State and local agencies are stored in EPA's data storage and retrieval system called STORET. The National water quality criteria are recommended threshold concentrations in water which are considered suitable for propagation of fish, the use by wildlife, and for recreation. The eleven criteria groups considered in the index are listed in Table 5.

The index number for any river segment is calculated by multiplying the frequency of criteria violations for each constituent by a severity weighting function which is based on the magnitude of violation. Individual river segment index numbers are multiplied by a ratio of segment river miles to total river miles, then summed to obtain average WQI for the total river. The WQI number spans a scale that may run from 0.0 (no measured evidence of pollution) to 110.0 (severe pollution in all criteria groups at all times); however, most Pacific Northwest streams fall into a category below the scale of 20.0. General, national criteria were employed for the particular index construction rather than the specific State and Federal water quality standards that apply to the various waterbodies. State water quality standards reflect local natural conditions whereas federal criteria are based upon field and laboratory studies which have been shown nationally to correlate with biological, recreational, and health problems. Federal criteria are in some cases more stringent than state standards. Index values computed from federal criteria will therefore tend to present a more conservative estimate of water quality than if actual state standards were applied.

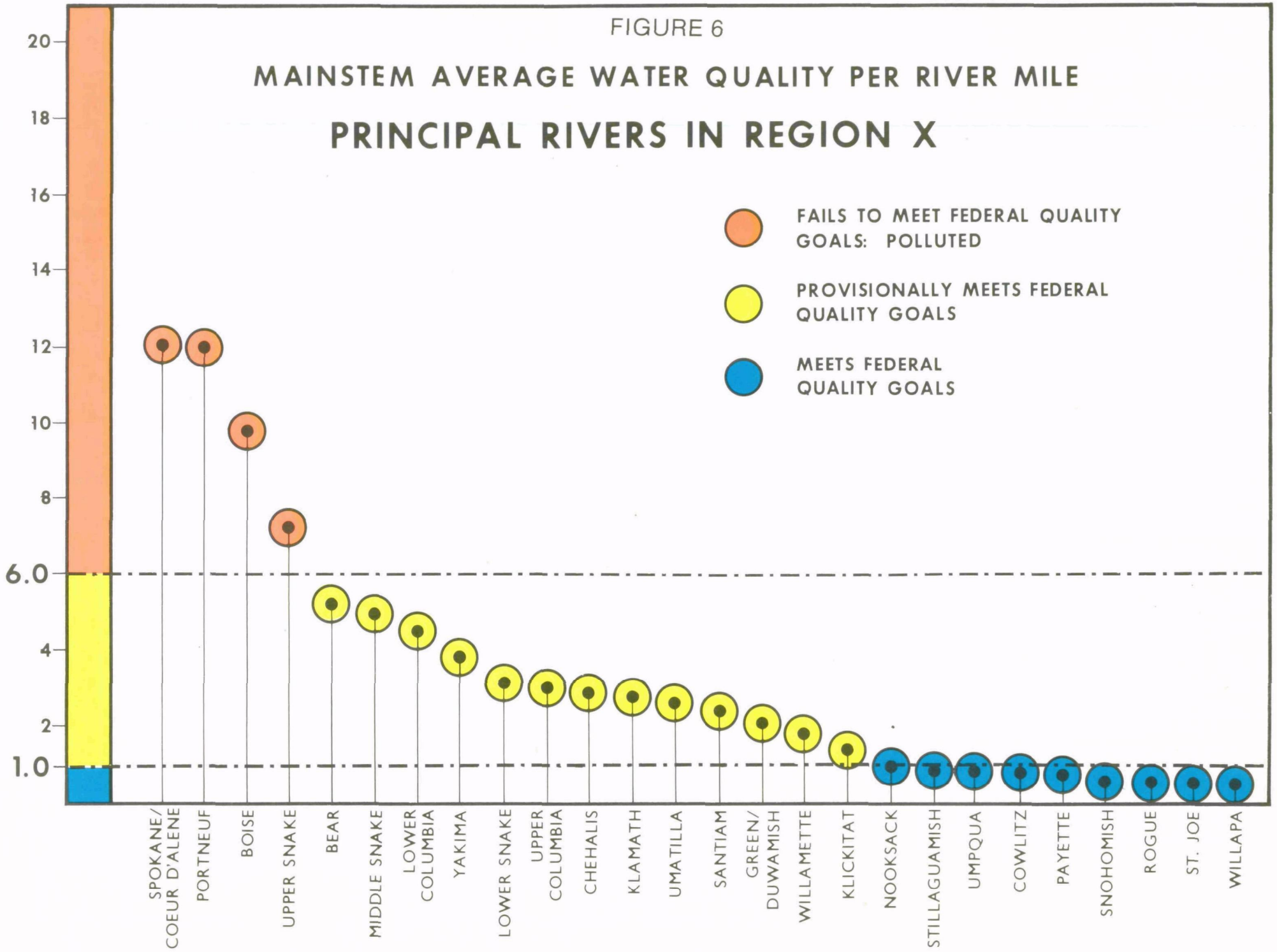
The graphs of water quality indices are divided into three segments that reflect professional judgment as to the significance of the values. An index number greater than 6.0 is considered to be characteristic of streams or stream segments that do not meet the goals of the Federal

1/ EPA R3.033 Ecological Research Series, Water Quality Criteria 1972, U.S. Government Printing Office, March 1973.

FIGURE 6

MAINSTEM AVERAGE WATER QUALITY PER RIVER MILE

PRINCIPAL RIVERS IN REGION X



Water Pollution Control Act--bodies of water that are, by Federal standards, definitely polluted. An index number less than 1.0 is considered to be equivalent to unpolluted natural conditions. The area between 1.0 and 6.0, where most Pacific Northwest rivers fall, is generally consistent with the goals of the Federal Water Pollution Control Act, but with local or seasonal deviations.

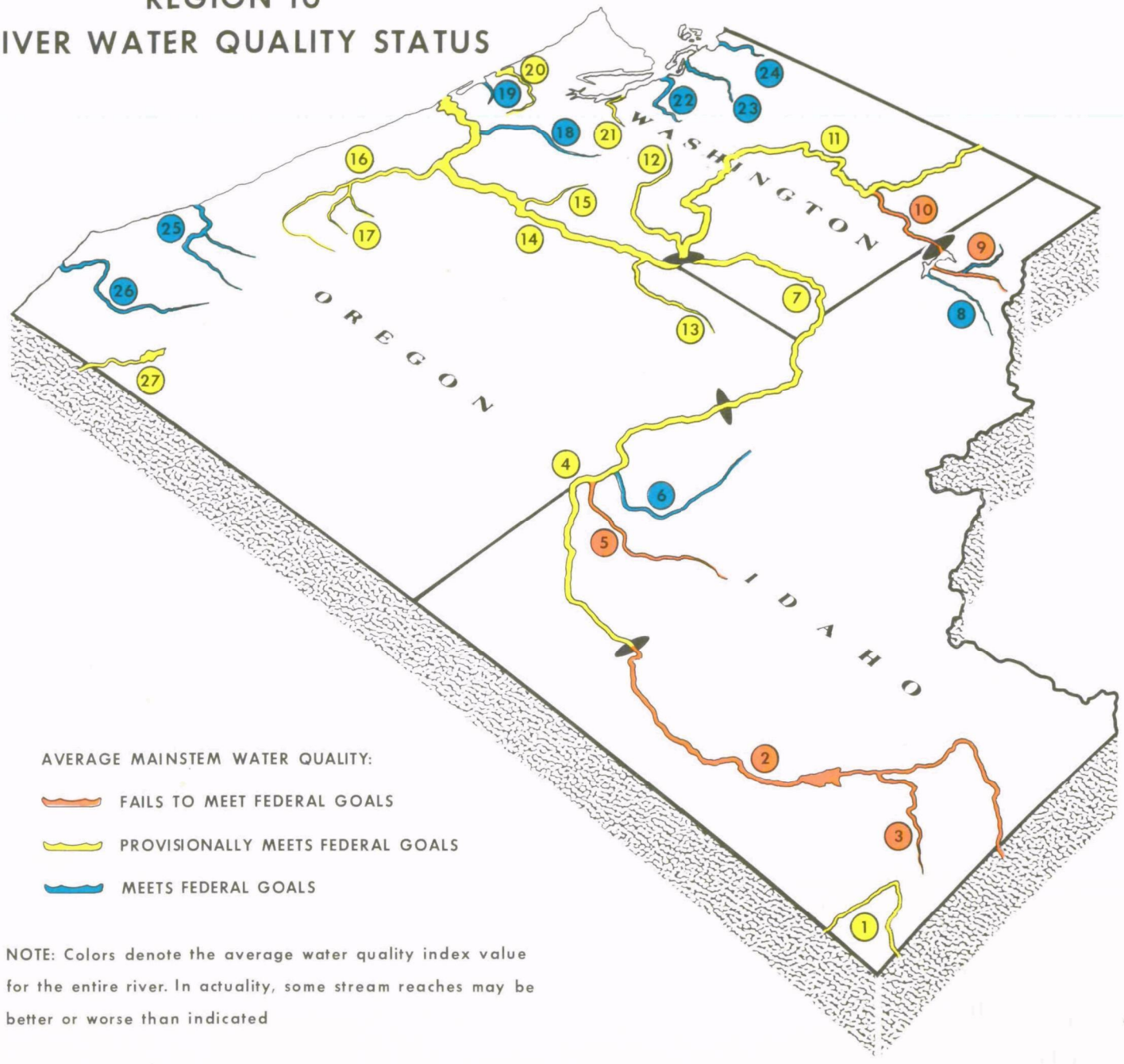
The water quality index is used in this report for the purpose of comparing twenty-six Pacific Northwest rivers within the States of Idaho, Oregon, and Washington. In each major river discussed in this section, the WQI is a summation of the significant individual stream segments that make up each river. The resultant river WQI is the weighted average of the individual WQIs within the river and may not reflect local pollution problems existing in some of the individual segments. For ease of presentation, colors on Figure 7 represent the average WQI range for the mainstem of each river; however, the actual WQI could change throughout each river segment.

As Figures 6 and 7 indicate, all but four of the major rivers of the Pacific Northwest generally meet the goals of the Federal Water Pollution Control Act; however, three rivers have index numbers that are perilously close to the 6.0 that indicates unequivocal pollution. It is apparent that the more arid and agriculture oriented parts of the Region have the worst pollution. The Upper Snake River and its tributaries--the Boise and Portneuf Rivers--are three of the four worst polluted rivers in the Region. The fourth river, Spokane/Coeur d'Alene, is located in an intensive mining and smelting area. Other streams that flow through major agriculture areas include the Middle Snake, Yakima, and Bear Rivers. These streams have higher index numbers than most of the remaining rivers within the Region. Major coastal and Puget Sound rivers, with a few exceptions, have relatively good water quality. The exceptions, Green/Duwamish and Chehalis Rivers, flow through major populated areas.

The most prevalent of the eleven classes of pollution (see Table 5 below) that make up the index are excessive bacterial populations which indicate the possible presence of disease-related bacteria and viruses (Pathogenic indicators), excessive concentrations of phosphorus and nitrogen which have been documented to be the major nutrients responsible for eutrophication in the Region (Trophic potential), and excessive presence of suspended materials or oil and grease (Aesthetics). Each of these three classes of pollution was found to occur in half or more of the twenty-six Pacific Northwest rivers that were analyzed for this report; and each at this time appears to be associated predominantly with runoff rather than waste discharges. High concentrations of toxic organic compounds such as pesticides, dissolved oxygen deficiencies, and elevated temperatures are also common. (The latter two are associated predominantly with reservoir conditions.) Supersaturation of dissolved gasses, heavy metals in toxic concentrations (toxic inorganics), salinity (dissolved minerals), and excessive acidity are also found, though they are rarer forms of pollution in the Pacific Northwest. No excessive concentrations of radioactivity were measured or suspected in the Northwest waters.

FIGURE 7

REGION 10
RIVER WATER QUALITY STATUS



AVERAGE MAINSTEM WATER QUALITY:

- FAILS TO MEET FEDERAL GOALS
- PROVISIONALLY MEETS FEDERAL GOALS
- MEETS FEDERAL GOALS

NOTE: Colors denote the average water quality index value for the entire river. In actuality, some stream reaches may be better or worse than indicated

STREAMS/REACHES

1. BEAR RIVER
2. UPPER SNAKE RIVER
3. PORTNEUF RIVER
4. MIDDLE SNAKE RIVER
5. BOISE RIVER
6. PAYETTE RIVER
7. LOWER SNAKE RIVER
8. ST. JOE RIVER
9. COEUR D'ALENE RIVER
10. SPOKANE RIVER
11. UPPER COLUMBIA RIVER
12. YAKIMA RIVER
13. UMATILLA RIVER
14. LOWER COLUMBIA RIVER
15. KLICKITAT RIVER
16. WILLAMETTE RIVER
17. SANTIAM RIVER
18. COWLITZ RIVER
19. WILLAPA RIVER
20. CHEHALIS RIVER
21. GREEN/DUWAMISH RIVER
22. SNOHOMISH RIVER
23. STILLAGUAMISH RIVER
24. NOOKSACK RIVER
25. UMPQUA RIVER
26. ROGUE RIVER
27. KLAMATH RIVER

Selected stream/reach limits

Table 5 - Percent of Regional Rivers
Not Meeting Water Quality Criteria

Class	Criteria Group	Idaho	Oregon	Washington	Regional Avg.
1	Bacteria	50%	86%	77%	71%
2	Trophic potential	88%	86%	38%	64%
3	Aesthetics	38%	71%	46%	50%
4	Toxic organics	25%	71%	38%	43%
5	Dissolved oxygen	38%	29%	31%	32%
6	Temperature	25%	29%	15%	21%
7	Dissolved gasses	-	14%	23%	14%
8	Toxic inorganics	25%	-	15%	14%
9	Dissolved minerals	50%	14%	-	18%
10	Acidity/Alkalinity	13%	-	-	4%
11	Radioactivity	-	-	-	-

A pattern of change appears to be evolving in the nature of Pacific Northwest water pollution; though variations in flow, climate, and monitoring make any conclusions with respect to short term trends provisional. As seen on Table 6 below, those pollutants that have historically been associated with waste discharges--bacteria, nutrients, acidity, oxygen consuming substances, heavy metals from industrial operations--appear to be progressively less prevalent in Regional rivers. Conversely, pollutants that are associated with runoff, fallout, intense land use, reservoirs, and in-stream chemical reactions--toxic organic compounds, dissolved gasses, total dissolved solids--would appear to be increasing in prevalence and concentrations. Some of this apparent deterioration may be due to improved analytical capability in recent years.

Table 6 - Water Quality Trends of Regional Rivers

Class	Criteria Group	Improving*	Deteriorating*	No Change*
1	Bacteria	21%	11%	68%
2	Trophic potential	11%	7%	82%
3	Aesthetic	7%	7%	86%
4	Toxic organics	-	25%	-
5	Dissolved oxygen	7%	7%	86%
6	Temperature	-	-	-
7	Dissolved gasses	-	7%	-
8	Toxic inorganics	4%	-	-
9	Dissolved minerals	4%	7%	89%
10	Acidity/Alkalinity	4%	-	-

* Figure represents the precent of streams within the three states which are improving or deteriorating by criteria group. One stream may be improving with respect to one criteria group and deteriorating in another; therefore, it would be included in each listing. If 7% of the rivers in one criteria group are improving and 7% are deteriorating in the same group, then 86% experience no change at all.

The impression that may be derived from the data is that contemporary water pollution strategies based on waste treatment are proving effective with traditional pollutant sources but the more complex and resistant kinds of pollution that stem from intensive use of land and water may be offsetting some part of that improvement.

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