

**STREAM RECONNAISSANCE FOR NUTRIENTS
AND OTHER WATER - QUALITY PARAMETERS,
GREATER PITTSBURGH REGION,
PENNSYLVANIA**



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COVER--ERTS-1 image (multi-spectral scanner, channel 7)
of southwestern Pennsylvania taken March 24, 1973, from
an altitude of 910 kilometres (560 statute miles).
Nominal scale 1:1,000,000.

Source: EROS Data Center, Sioux Falls, SD

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By Robert M. Beall

U.S. GEOLOGICAL SURVEY

Water-Resources Investigations 50-74



February 1975

UNITED STATES DEPARTMENT OF THE INTERIOR

Rogers C. B. Morton, Secretary

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February 1975

CONTENTS

	Page
Abstract.....	1
Introduction.....	2
Water-quality concerns and complexities.....	2
Why a nutrient reconnaissance?.....	3
Other studies and programs.....	4
Acknowledgments.....	5
Stream-quality observations.....	5
Some features of the sampled basins.....	5
The climatic setting.....	9
Results of the reconnaissance.....	11
Evaluation.....	14
Method.....	14
Commentary on the characteristics.....	14
Temperature.....	16
Dissolved oxygen.....	16
pH.....	18
Alkalinity.....	18
Specific conductance.....	20
Sulfate.....	22
Nitrogen.....	23
Phosphorus.....	26
Total organic carbon.....	27
Chloride.....	27
Summary.....	29
Selected references.....	31

ILLUSTRATIONS

	Page
Plate 1. Map showing location of stream-quality reconnaissance sampling sites, Greater Pittsburgh region, Pennsylvania.....	In pocket
2. Map showing regional distribution of total inorganic nitrogen concentration	In pocket
Figure 1. Index map showing location of the Greater Pittsburgh Region and the general reconnaissance area.....	2
2-7. Graphs showing:	
2. Streamflow conditions during the sampling periods...	10
3. Array of water-temperature values and dissolved- oxygen concentrations.....	17
4. Array of bicarbonate alkalinity concentrations and pH values.....	19
5. Array of specific-conductance values and sulfate concentrations.....	21

CONTENTS

	Page
Figure 6-7. Graphs showing:	
6. Array of total inorganic nitrogen and phosphorus concentrations.....	25
7. Array of total organic carbon and chloride concentrations.....	28

TABLES

	Page
Table 1. Sampling locations, stream-quality reconnaissance.....	6
2. Source and significance of some chemical constituents and properties.....	12
3. Variation in values of selected surface-water constituents....	15
4. Stream-quality-reconnaissance data.....	34

CONVERSION FACTORS

Factors for converting English units to the International System of Units (SI) are given below to four significant figures. However, in the text the metric equivalents are shown only to the number of significant figures consistent with the values for the English units.

<u>English</u>	<u>Multiply by</u>	<u>Metric (SI)</u>
inches (in)	25.40	millimetres (mm)
miles (mi)	1.609	kilometres (km)
square miles (mi ²)	2.590	square kilometres (km ²)
cubic feet per second (ft ³ /s)	.02832	cubic metres per second (m ³ /s)
pounds (lbs)	.4536	kilograms (kg)
pounds per day per square mile	.1751	kilograms per day per square
[(lbs/day)/mi ²]		kilometre [(kg/day)/km ²]

STREAM RECONNAISSANCE FOR NUTRIENTS AND OTHER WATER-QUALITY PARAMETERS,
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ABSTRACT

Eighty-five stream sites in and near the six-county Greater Pittsburgh Region were sampled in mid-June 1971 and again in mid-October 1972. Data are reported for 89 sites because 4 substitute sites were sampled in the second period. Drainage areas of the basins sampled ranged from 4.1 to 19,500 square miles (10.6 to 50,500 square kilometres). The chemical analyses included constituents of three general classes: (1) nutrients, (2) activity indicators, and (3) dominant anions. Modification of the natural chemical and physical characteristics of the surface waters by man's activities is evident in some of the data. However, the activities are so diverse in type and in areal extent that their influence in terms of cause and effect is often obscure.

Nutrient concentrations were high enough to indicate potential problems at about a quarter of the sampling sites. Temperature, dissolved oxygen, and pH values indicated a generally favorable capacity for regeneration or recovery from degradation, although a number of streams east of the Allegheny and Monongahela Rivers are marginal or lacking in that capacity. Regionally, sulfate is the dominant ion and was observed in concentrations of 40 milligrams per litre or more at 90 percent of the sites. Bicarbonate exceeded 100 milligrams per litre at 22 sites. A moderate to high degree of mineralization, as indicated by conductance readings of more than 500 micromhos per centimetre at half of the sampling sites, is a characteristic of the region's surface waters.

INTRODUCTION

Water-Quality Concerns and Complexities

The physical, chemical, and biological quality of rivers and streams is of concern to many government agencies, evincing general public concern. Response to those concerns in Pennsylvania is reflected in a variety of data-collection efforts, basin studies, conferences, and legislation, in addition to the planning and implementation of specific remedial projects and development of a statewide Comprehensive Water Quality Management Planning program (Bartal, 1974). Basic to these activities is an appreciation for the background values and variability of the many factors which may characterize water quality. This study attempts to describe regional values of some water-quality characteristics in southwestern Pennsylvania (fig. 1).

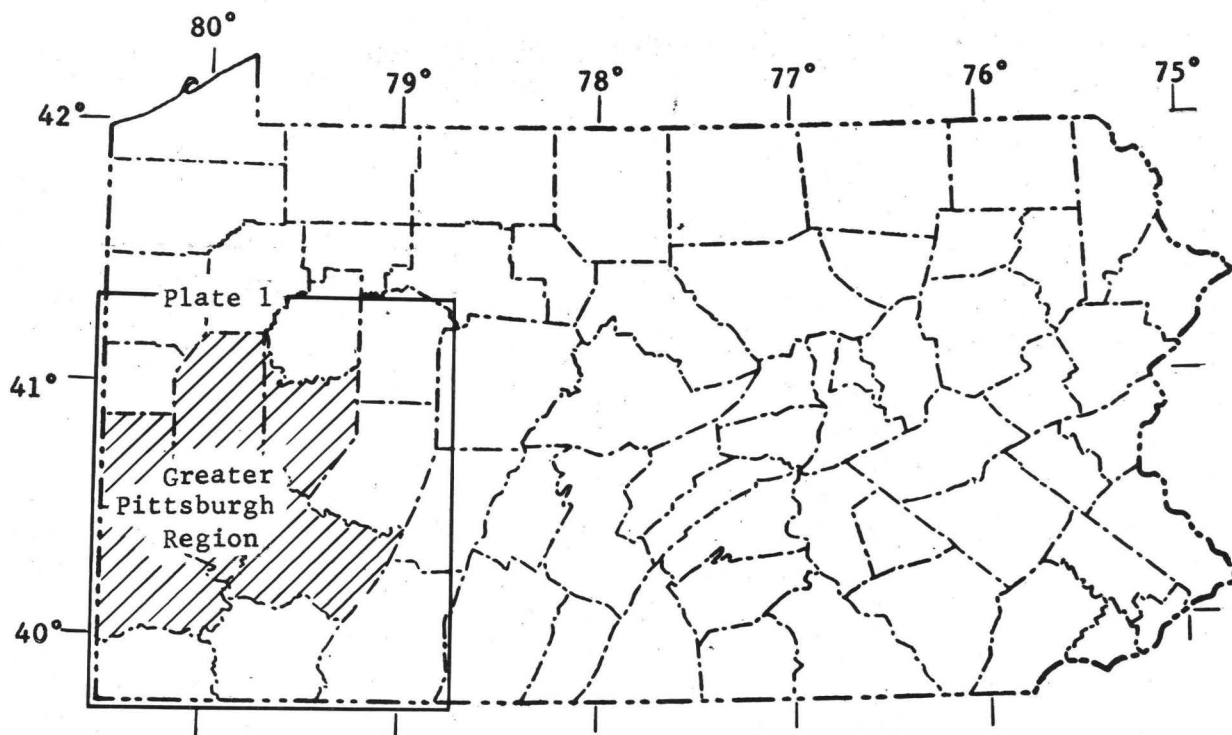


FIGURE 1.--Index map showing location of the Greater Pittsburgh Region and the general reconnaissance area.

The natural chemical and physical characteristics of a particular stream are imparted by the passage of its constituent waters through or over the varied rocks and soils of the contributing basin. Some natural quality characteristics are relatively stable and consistent for a given basin while others are difficult to describe or quantify because they vary as the stream system responds dynamically to daily and seasonal weather occurrences. An additional element of variability is introduced by land-use and waste-disposal practices, whereby characteristics may be altered and constituents added.

The water-quality degradation associated with past coal-mining methods has been so extensive and apparent in some areas, that it has tended to obscure the deterioration resulting from disposal of industrial, domestic, and agricultural wastes. Positive remedial measures are being taken under the administration of the Pennsylvania Department of Environmental Resources (1971), although much remains to be done.

Descriptions or assessments of water quality may be derived from data-collection efforts that vary considerably in scope, intensity, areal extent, and objective. Our reconnaissance was accomplished by sampling in two disparate seasons (June 1971 and October 1972), at 89 stream sites, in and about the Greater Pittsburgh region (Allegheny, Armstrong, Beaver, Butler, Washington, and Westmoreland Counties), southwestern Pennsylvania (pl. 1). In addition to developing regional values for seldom-measured constituents, such as nitrogen, phosphorus, and carbon, values of a few other commonly reported characteristics were obtained at each site to augment the data that numerous public and private organizations have been collecting in recent years.

Why a Nutrient Reconnaissance?

The investigation reported here was conceived as a means of evaluating the regional occurrence of nutrients and a few other constituents and properties common to surface waters. Although nutrients such as phosphorus and nitrogen compounds stimulate undesirable algal growth, algae are certainly not the dominant water problem of the region. However, those factors that contribute to undesirable plant growth will become increasingly important as abatement measures reduce present pollution loads and as the effectiveness of abatement measures is evaluated. In addition, there is a growing need to describe quantitatively the background values of a variety of constituents in order to improve our understanding of their interaction.

The sampling of 89 sites for this report does not describe in detail the distribution of measured constituents or the variation within stream systems. The data, however, do permit a statistical evaluation of the region-wide variation in concentration of certain constituents and are a basic contribution to future studies of those several factors that cause or control the variation in concentration.

There was no particular attempt to sample downstream from domestic or industrial waste sources, although this occurred in some places as a consequence of sampling near the mouth of tributaries and at mainstream sites.

Other Studies and Programs

The general chemical-quality characteristics of surface waters of the Greater Pittsburgh region have been described in a number of reports, most of which deal broadly with basins or regions extending beyond that of the six-county area of interest here. Most of the repetitive data from which these generalizations are derived are for stream-sampling sites on the larger rivers and creeks. Some of these reports are listed in the section entitled "Selected References". The areal scope usually is reflected by the title of the report.

A few basins within the Greater Pittsburgh region have been studied in detail for brief periods, and analyses of samples from hundreds of sites have been made by Federal, State, and local governmental agencies, by consulting firms or individuals under contract to those agencies, and by those in the academic field. Many of these studies are oriented toward assessment of particular problems whereby a very limited number of constituents or properties have been analysed. Additionally, most water utilities, by regulation, amass a considerable amount of analytical data on raw and finished water.

Coal is a dominant mineral resource of the region, and several seams have been and are being mined extensively, both by stripping and underground mining. Water-quality degradation from coal-mine drainage has been a long-standing pollution problem and the subject of intensive field investigation, analysis, and management effort (Federal Water Pollution Control Administration, 1968a, Environmental Protection Agency, 1971b, Biesecker and George, 1966, Environmental Quality Systems, Inc., 1973, Gwin Engineers, Inc., 1970, Pennsylvania Department of Environmental Resources, 1971).

Several water-quality monitoring networks have been or are being maintained in the region. The variety is emphasized not only by the number of sponsoring agencies,¹ but also by the classes of constituents analyzed (chemical, physical, biological, and radiological) and by the frequency of sampling (continuous, daily, monthly, quarterly, seasonally, annually). Some of the data are available in published reports, some appear only in project or in-house documents, and many are found only in agency files or computer storage. Characterization of these data and identification of sampling locations is beyond the scope of this report; but some of this information may be found in a catalog prepared by the U.S. Geological Survey Office of Water Data Coordination (1963b). Although these data are invaluable for a number of purposes and programs, their use also was beyond the scope of this investigation.

¹Including the following:

- Ohio River Valley Water Sanitation Commission
- Pennsylvania Department of Environmental Resources
 - Bureau of Water Quality Management
- U.S. Army Corps of Engineers
- U.S. Environmental Protection Agency
- U.S. Geological Survey
- The several counties

Acknowledgments

The reconnaissance was carried out entirely by personnel of the U.S. Geological Survey. Personnel of the Pittsburgh and Harrisburg offices performed the sample collection and field measurements. Laboratory analyses and services were provided in part by a mobile laboratory, and also by the water quality laboratory then in Harrisburg.

STREAM-QUALITY OBSERVATIONS

Some Features of the Sampled Basins

To provide the broadest possible description of the regional variation in selected water-quality indicators, within given time and sampling frequency constraints, sites near the mouth of widely distributed tributary basins were a first consideration. Additional sites were selected below reservoirs and on the principal streams, so that the influence of regulated storage and basin size could be incorporated in the broad statistical description.

The locations of the sampling sites are shown in plate 1. Station name and coordinate location are given in table 1. Where samples were taken at or near a gaging station, the U.S. Geological Survey station number is given in table 1 in addition to the map reference number. The following table shows the distribution of site numbers by major basin:

Allegheny River basin except Kiskiminetas River	1-14, 25-37
Kiskiminetas River basin	15-24
Monongahela River basin except Youghiogheny River	38-47, 54-56
Youghiogheny River basin	48-53
Ohio River and tributaries except Beaver River	57-73
Beaver River basin	74-85

Most drainage areas listed in table 1 are those for the gaging-station sites (more completely described in: U.S. Geological Survey, 1973a) or the mouths of the named streams, even though the samples may not have been obtained exactly at those sites. For example, the drainage areas given in table 1 for stations 3 and 13 (the most extreme cases), are those for the gaging stations, although the samples were taken at bridges 5.2 and 2.8 mi (8.4 and 4.5 km) downstream respectively. Drainage areas for sites not associated with gaging stations were based on data in a gazetteer by Shaw and Busch (1970). The drainage areas were modified where there was a significant intervening area between sampling sites and stations or mouths. They are qualified as approximate in table 1.

The drainage areas of the 89² sampling sites range from 4.5 to 19,500 mi² (10.6 to 50,500 km²), but most, 57 sites, are less than 100 mi² (259 km²). Only 10 sites had drainage areas larger than 1,000 mi² (2,590 km²).

² 85 sites were sampled in each of the two periods. During the second round (October 1972), four new sites were substituted for a similar number sampled in the first round (June 1971).

Table 1.--Sampling locations, stream-quality reconnaissance, Greater Pittsburgh Region, Pennsylvania
June 1971 and October 1972

Site number on Pl. 1	USGS station number	Station name	Drainage area (square miles)	Location
1	03031500	Allegheny River at Parker	7,671	41°06'02"/79°40'53"
2	03036500	Allegheny River at Kittanning	8,973	40°49'13"/79°31'54"
3	03049500	Allegheny River at Natrona	11,410	40°36'55"/79°43'07"
4	03032500	Redbank Creek at St. Charles	528	40°59'40"/79°23'40"
5	03036000	Mahoning Creek at Mahoning Creek Dam	344	40°55'39"/79°17'29"
6	03034000	Mahoning Creek at Punxsutawney	158	40°56'21"/79°00'31"
7	03034500	Little Mahoning Creek at McCormick	87.4	40°50'10"/79°06'37"
8	-	Pine Run at Eddyville	32.5	40°56'49"/79°16'36"
9	-	Scrubgrass Creek near Templeton	10.3	40°55'20"/79°25'18"
10	-	Pine Creek at Mosgrove	51.2	40°52'25"/79°28'16"
11	-	Cowanshannock Creek at Gosford	^a 63	40°50'44"/79°30'05"
12	03039000	Crooked Creek at Crooked Creek Dam	278	40°43'13"/79°30'42"
13	03038000	Crooked Creek at Idaho	191	40°39'17"/79°20'56"
14	03037500	South Branch Plum Creek at Willet	30	40°43'12"/79°13'26"
15	03048500	Kiskiminetas River at Vandergrift	1,825	40°36'16"/79°33'08"
16	03042000	Blacklick Creek at Josephine	192	40°28'24"/79°11'01"
17	03042500	Two Lick Creek at Graceton	171	40°31'02"/79°10'19"
18	03044000	Conemaugh River at Tunnelton	1,358	40°27'16"/79°23'28"
19	03041500	Conemaugh River at Seward	715	40°25'09"/79°01'35"
20	03047000	Loyalhanna Creek at Loyalhanna Dam	292	40°27'53"/79°27'05"
21	03045000	Loyalhanna Creek at Kingston	172	40°17'33"/79°20'27"
22	-	Mill Creek at Oak Grove	^a 30	40°15'22"/79°12'12"
23	-	Four Mile Run near Buttermilk Falls	^a 37.5	40°14'36"/79°17'17"
24	-	Beaver Run below dam near Paulton	^a 43	40°30'50"/79°33'04"
25	-	Little Pucketa Creek at New Kensington	10.7	40°33'14"/79°45'30"
25A	03049630	Pucketa Creek at New Kensington	25.4	40°33'05"/79°45'03"
26	-	Plum Creek at Oakmont	^a 20.5	40°30'40"/79°50'37"
27	-	Bear Creek at Parker	^a 62	41°04'45"/79°41'28"
28	-	Sugar Creek at East Brady	17.5	40°59'30"/79°37'01"
29	-	Huling Run near Wattersonville	10.8	40°58'59"/79°34'30"
30	-	Limestone Run at Tarrtown	10.2	40°51'26"/79°30'32"

Table 1.--Sampling locations, stream-quality reconnaissance--continued

Site number on Pl. 1	USGS station number	Station Name	Drainage area (square miles)	Location
31	-	Glade Run at Cadogan	^a 25	40°45'24"/79°34'25"
32	-	Buffalo Creek at Freeport	^a 170	40°40'35"/79°41'26"
33	-	Little Buffalo Run near Fenelton	^a 14.3	40°51'44"/79°42'26"
34	-	Buffalo Creek at Buffalo Mills	^a 78	40°50'26"/79°38'39"
35	-	Bull Creek at Tarentum	^a 49	40°36'36"/79°45'26"
36	-	Deer Creek at Harmarville	^a 49	40°32'33"/79°50'18"
37	-	Pine Creek at Undercliff	^a 60	40°30'42"/79°56'37"
38	03075000	Monongahela River at Charleroi	5,213	40°08'58"/79°54'06"
39	03085000	Monongahela River at Braddock	7,337	40°23'28"/79°51'30"
40	-	Tenmile Creek at Clarksville	^a 134	39°58'30"/80°02'31"
41	-	Little Tenmile Creek near Marianna	27.2	40°00'54"/80°07'32"
42	-	South Fork Tenmile Creek at Mather	^a 185	39°56'12"/80°03'49"
42A	03073000	South Fork Tenmile Creek at Jefferson	180	39°55'23"/80°04'22"
43	-	Pike Run at California	^a 28.4	40°03'54"/79°55'08"
44	03075040	Pigeon Creek at Monongahela	58.4	40°11'26"/79°55'50"
45	-	Mingo Creek at River View	^a 22	40°12'31"/79°57'53"
46	-	Peters Creek at Clairton	^a 45	40°17'56"/79°53'40"
47	-	Streets Run at Hays	^a 8.2	40°23'12"/79°55'58"
48	03083500	Youghiogheny River at Sutersville	1,715	40°14'24"/79°48'24"
49	03082100	Indian Creek near Melcroft	32.6	40°04'30"/79°21'28"
50	03083100	Jacobs Creek at Jacobs Creek	94.9	40°07'23"/79°44'14"
51	-	Sewickley Creek at Lowber	168	40°14'18"/79°46'30"
52	-	Sewickley Creek near Armbrust	^a 45	40°13'39"/79°33'55"
53	-	Buffalo Run at Hunker	10.2	40°12'05"/79°37'29"
54	03084500	Turtle Creek at Trafford	55.9	40°23'15"/79°45'55"
55	-	Abers Creek near Level Green	10.6	40°24'54"/79°43'20"
56	-	Brush Creek at Cavetttsville	^a 56	40°22'19"/79°45'28"
57	03086000	Ohio River at Sewickley	19,500	40°31'53"/80°11'21"
58	03085500	Chartiers Creek at Carnegie	257	40°24'00"/80°05'54"
59	-	Little Chartiers Creek at Linden	^a 34	40°13'42"/80°08'39"
60	-	Millers Run at Sygan Hill	^a 27.5	40°21'30"/80°07'43"

Table 1.--Sampling locations, stream-quality reconnaissance--continued

Site number on Pl. 1	USGS station number	Station Name	Drainage area (square miles)	Location
61	-	Robinson Run at Ewingsville	41.0	40°23'57"/80°06'13"
62	-	Montour Run at Groveton	^a 36	40°30'18"/80°08'42"
63	03108000	Raccoon Creek at Moffatts Mill	178	40°37'40"/80°20'16"
64	-	Raccoon Creek at Independence	^a 144	40°34'23"/80°16'26"
64A	-	Service Creek at Independence	^a 17.6	40°34'59"/80°19'08"
65	-	Kings Creek at Pleasant Valley, W.Va.	^a 34	40°25'41"/80°32'13"
66	-	Harmon Creek at Dinsmore	^a 4.1	40°22'45"/80°26'08"
66A	-	Harmon Creek at Hanlin Station	^a 9.5	40°22'09"/80°28'01"
67	-	Cross Creek at Jefferson	^a 50	40°17'09"/80°29'30"
68	-	Buffalo Creek near Acheson	^a 70	40°11'08"/80°28'21"
69	-	Enlow Fork at Burdette	^a 40	39°58'06"/80°26'52"
70	03111600	Robinson Fork at West Finley	14.3	40°00'08"/80°28'21"
71	-	Lowries Run at Emsworth	^a 17	40°30'46"/80°05'35"
72	-	Killbuck Run at Glenfield	^a 5	40°31'16"/80°07'50"
73	03086100	Big Sewickley Creek near Ambridge	15.6	40°36'27"/80°09'49"
74	03107500	Beaver River at Beaver Falls	3,106	40°45'48"/80°18'55"
75	-	Connoquenessing Creek at Ellwood City	^a 836	40°51'46"/80°17'28"
76	03106000	Connoquenessing Creek near Zelienople	356	40°49'01"/80°14'33"
77	-	Thorn Creek at McBride	^a 34	40°47'50"/79°55'30"
78	-	Glade Run at Zeno	40.6	40°46'42"/80°00'35"
79	-	Breakneck Creek at Eidenau	42.5	40°47'34"/80°05'38"
80	-	Little Connoquenessing Creek at Harmony Junction	64.5	40°48'16"/80°06'19"
81	03106500	Slippery Rock Creek at Wurtemburg	398	40°53'02"/80°14'02"
82	-	Wolf Creek near Moores Corners	101	41°02'34"/80°06'04"
83	-	Muddy Creek at Muddy Creek	^a 11	40°58'19"/79°58'28"
84	03106300	Muddy Creek near Portersville	51.2	40°57'47"/80°07'41"
85	-	Brady Run at Fallston	25.8	40°42'54"/80°18'20"

a: Approximate. Note.--1 mi² = 2.59 km²

The Climatic Setting

The first series of samples was collected June 21-24, 1971, a period when temperatures were somewhat above normal and evapotranspiration rates were moderate. Daily maximum temperatures in the Southwest Plateau Region, as reported by the National Oceanic and Atmospheric Administration (1971) ranged from 77 to 90°F (25 to 32°C); daily minimums from 52 to 68°F (11 to 20°C), and recorded pan evaporation averaged about 0.2 in (5 mm) per day.

Shower activity began on June 20 in the Johnstown area (about 8 mi or 13 km southeast of Seward in eastern Westmoreland County, pl. 1), spread through most of the region on June 21, and continued as very light showers in the northern half of the region on June 22. Maximum storm totals of 1.5 to 2 in (40 to 50 mm) were observed near Johnstown (total for 2 days), Beaver Falls, and Mercer.

Selected gaging-station hydrographs of daily discharges for June 1-30 (fig. 2) give some idea of antecedent streamflow conditions and also those which prevailed during the sampling period. They also illustrate the necessity for considering the relation between sampling dates and storm runoff in the course of detailed evaluation of sampling results.

For example, the samples collected in eastern Westmoreland County were subject to the influence of direct storm runoff. Those collected in the northern half of the six-county region were affected to a lesser extent because of the sampling sequence. Samples from the southwest quadrant of the region were least affected by direct runoff.

The flooding associated with Tropical Storm Agnes in June 1972 occurred a year after the first sampling period and preceded the second sampling period by 4 months. New record flood peaks in the vicinity of the report area were experienced in Armstrong, Indiana, and Fayette Counties (Miller, 1974). Significant flooding occurred also on the Allegheny, Monongahela, and Ohio Rivers (U.S. Army Corps of Engineers, 1974). Although it is assumed that a flood of this magnitude would have had a marked short-term impact on some water-quality characteristics, these effects were not evident in the reconnaissance data reported here.

The second sampling series took place October 16-19, 1972. In the Southwest Plateau Region, October was a month of below-normal temperatures and seasonally-low evapotranspiration rates. Average daily maximum temperatures (National Oceanic and Atmospheric Administration, 1972) ranged from 39 to 57°F (4 to 14°C), average minimums, from 28 to 40°F (-2 to 4.5°C). Pan evaporation averaged less than 0.1 in (2.5 mm) per day.

Streamflows generally were receding during the first three days of the sampling period, although minor precipitation amounts (less than 0.1 in or 2.5 mm) were recorded in parts of the region on most days. Even though the season's first widespread snowfall occurred on October 18-19 when streams in the northwest quadrant of the region were being sampled, maximum daily precipitation totals in that area were less than 0.3 in (7.6 mm). The light precipitation slowed recessions during the sampling period and caused a minor increase in streamflow in some streams on October 18-19 (fig. 2).

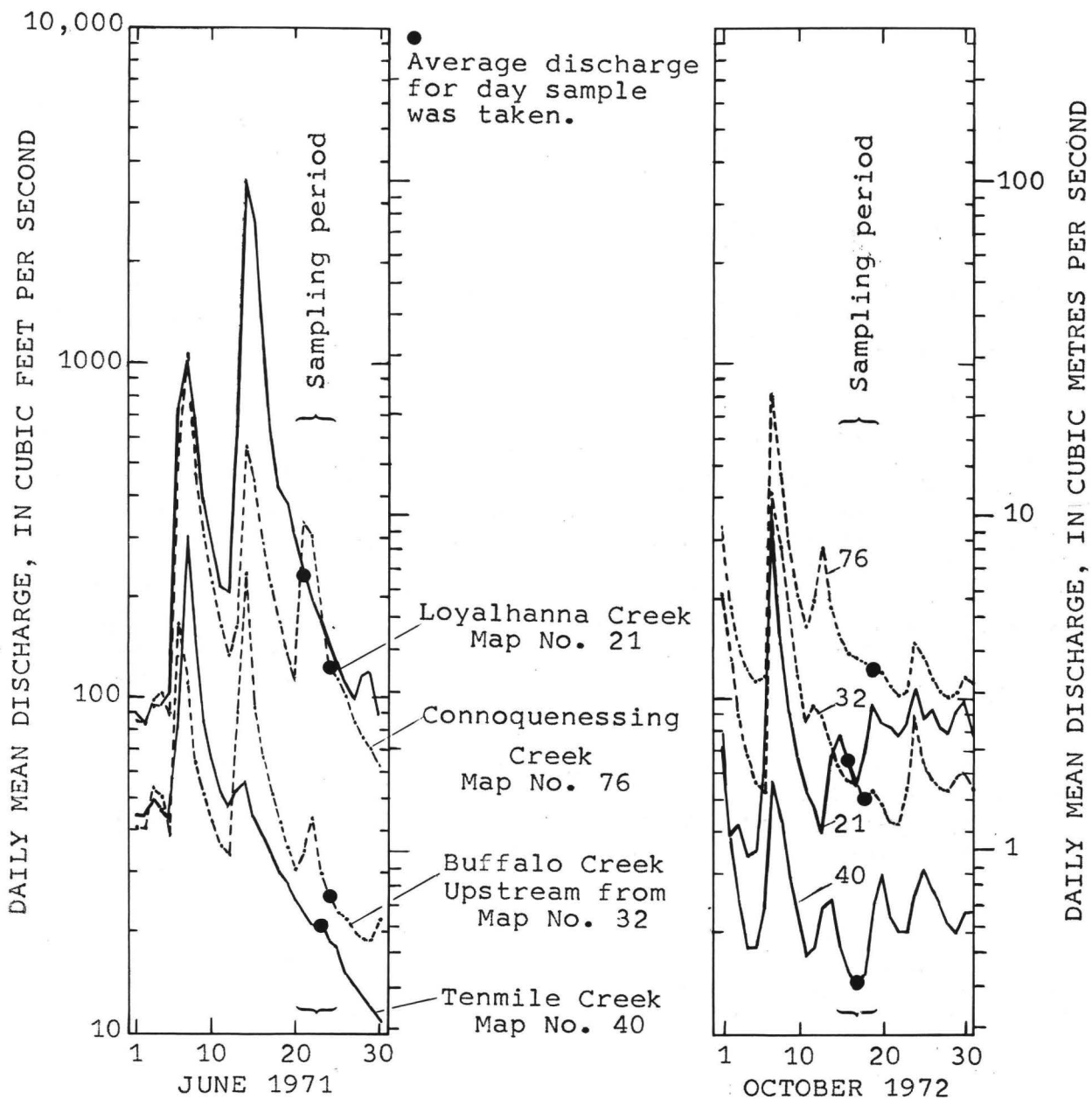


FIGURE 2.--Streamflow conditions during the sampling periods.

Results of the Reconnaissance

Analytical results from samples collected at the 89 sites are listed in table 4 (end of report). At seven of the large stream sites (1, 2, 3, 38, 39, 48, and 57), two or three points in the cross section were sampled to show the possible variation across these wide sections. Insignificant cross-sectional variations in constituent concentrations were observed except for Youghiogheny River at Sutersville (site 48, table 4) where the specific conductance, ammonia nitrogen, sulfate, and chloride determinations of the right center channel sample seemed to reflect the characteristics of Sewickley Creek (site 51), which is a tributary 2.2 mi (3.5 km) upstream.

At active daily gaging stations, discharge at the time of sampling was obtained from the records. At ungaged sites, discharges were estimated from approximations of cross-sectional area and average velocity. A few discharges were extrapolated from active-station data.

Temperature and dissolved oxygen were measured when the samples were collected. Conductance and pH of the June 1971 samples were measured in the field; those for the October 1972 samples were determined in the laboratory.

The several nitrogen ions are particularly subject to reactive change; hence, care was taken to preserve the samples in their initial state and to analyse these constituents as rapidly as possible in a mobile laboratory. During the first sampling period (June 1971), the mobile laboratory was stationed in the region and samples were brought to it each day. During the second sampling period (October 1972), the samples were air-freighted to the same laboratory which was then stationed in Tampa, Florida. The nitrogen and phosphorus analytical results are believed to be comparable in spite of the change in operational procedure.

The source and significance of chemical constituents and physical properties measured during this reconnaissance are shown in table 2.

Table 2.--Source and significance of some

Constituent or property	Source or cause
Temperature (T_w °C)	Atmospheric contact, industrial discharge.
Specific conductance	Dissolved mineral content of the water.
pH	Acids, acid-generating salts, and free carbon dioxide lower the pH. Carbonates, bicarbonates, hydroxides, phosphates, silicates and borates generally raise the pH.
Dissolved oxygen (DO)	Atmospheric contact, enhanced by turbulence. Solubility a function of temperature and pressure. Also a byproduct of photosynthesis.
Nitrogen as: Ammonium-N Nitrite-N Nitrate-N	Domestic, industrial, agricultural and urban wastes. Rural and urban runoff. Precipitation. Decomposition of proteinaceous material.
Phosphorus (P) as: orthophosphate (PO_4) and hydrolyzable	May be dissolved from rock containing apatite and other phosphatic mineral species but more commonly derived from sewage, fertilizer production and use, and certain detergent products.
Sulfate (SO_4)	Dissolved from rock and soils containing gypsum, iron sulfides, and other sulfur compounds. Usually present in mine waters and in some industrial wastes.
Chloride (Cl)	Dissolved in varying amounts in all soils and rocks. Also found in brines, sea water, and most domestic and industrial wastes.
Bicarbonate (HCO_3) and carbonate (CO_3) alkalinity	Action of carbon dioxide in water on carbonate rocks such as limestone and dolomite.
Acidity (+H) and as $CaCO_3$	Chemical reactions of hydrolysis, dissociation of acidic solutions, and oxidation. Related to availability of reactive minerals.
Total organic carbon (TOC)	Decomposition of plant and animal material.

Significance

Reflects but lags air temperatures and may be modified by surface or ground-water storage. Critical in supporting aquatic life and for many industrial processes. Influences solubility of oxygen.

Indicates degree of mineralization. Is a measure of the capacity of the water to conduct an electric current. Varies with concentration and degree of ionization of the constituents. Commonly, the amount of dissolved solids (in milligrams per litre--mg/l) is about 65 percent of the specific conductance (in micromhos). This relation may vary considerably.

A pH of 7.0 indicates neutrality of a solution. Values higher than 7.0 denote increasing alkalinity; values lower than 7.0 indicate increasing acidity. pH is a measure of the activity of the hydrogen ions. Corrosiveness of water generally increases with decreasing pH. However, excessively alkaline waters may also attack metals.

A requirement of all living organisms, varying widely with species, stage of life cycle, temperature, concentration of other substance, and other factors. Depleted by contact with organic material or other oxygen-consuming substance, hence, fosters corrosion.

Transient phases of the nitrogen cycle closely tied to biological activity. Concentrations much greater than the local average suggest pollution. Nitrates may become toxic only under conditions in which they are or may be reduced to nitrites (Wolf and Wasserman, 1972). A proposed revised standard (Environmental Protection Agency, 1971a) recommends a maximum allowable concentration of 10 mg/l expressed as nitrate-nitrogen. Encourages growth of algae and other organisms that produce undesirable tastes and odors.

Phosphorous, like nitrogen, is an essential element in the metabolism of organic matter. Aquatic vegetation depends on both for nutrient supply, although critical and synergistic concentrations are not well defined. Concentrations found in water are not reported to be toxic to man, animals, or fish. A wide range of oxidation states is possible.

Sulfate in water containing calcium forms hard calcium sulfate scale in steam boilers. In large amounts, sulfate in combination with other ions gives bitter taste to water. Some calcium sulfate is considered beneficial in the brewing process. U.S. Public Health Service (1962) standards recommend that the sulfate concentration should not exceed 250 mg/l.

In large amounts in combination with sodium gives salty taste to drinking water. In large quantities increases the corrosiveness of water. U.S. Public Health Service (1962) standards recommend that the chloride concentration should not exceed 250 mg/l.

Bicarbonate and carbonate produce alkalinity. Bicarbonates of calcium and magnesium decompose in steam boilers and hot water facilities to form scale and release corrosive carbon dioxide gas. In combination with calcium and magnesium cause carbonate hardness.

Reflection of the stage of naturally occurring chemical reactions and, thus, the potential for further action. Titrated acidity may be expressed in terms of milligrams or milliequivalents per litre of hydrogen ions or as equivalent concentrations of CaCO_3 or of sulfuric acid.

Total organic carbon is a standard chemical parameter closely related to the levels of organic material present in water and often represents a rapid approximation of BOD values. High TOC concentrations are a warning that streams will not be able to support normal aquatic life as dissolved oxygen in the streams will be used up in the oxidation of the organic material, raising levels of biochemical oxygen demand (BOD).

EVALUATION

Method

To develop a regional concept of prevailing concentrations of certain water-quality parameters, external biases and influences, such as the size, nature, and development of the basin upstream from the sampling sites, were ignored by giving analyses from the 89 sites equal weight. Each property or constituent value was ranked in descending order of magnitude. Results are summarized in table 3; the nature of the array of constituent values is illustrated in figures 3-7. Although most of these constituent distributions show a smooth progression of values in 80 percent or more of the samples, the range in values commonly is large.

Data for two main-stream sites (1 and 39) and for two sites below major impoundments (20 and 24) have been identified on the several graphs (figs. 3-7) to develop a perspective on the general level of constituent concentration at these kinds of sites as compared to minor basin sites. Map reference numbers also have been added to selected extreme-value data points in figures 3-7 as an aid to location in plate 1 or as a reference to the data listed in table 4.

Commentary on the Characteristics

Some findings and speculation relative to the several properties and constituents may be made beyond those which are evident in table 3. Throughout the following discussion, the words June and October refer to results obtained during the sampling periods June 21-24, 1971 and October 16-19, 1972.

Table 3. -- Variation in values of selected surface-water constituents, Greater Pittsburgh Region

Constituent or property	Units	Constituent value for the indicated ranking						
		Upper row: June 1971 -- Lower row: October 1972						
		Upper			Median	Lower		Minimum
		Maximum	10 percent ^a	25 percent ^a		25 percent ^a	10 percent ^a	
Temperature	°C	32 16	26.5 12.5	24.5 11.5	23 8.5	21 6	19 5.5	13 4.5
Specific conductance	μmhos/cm	2,250 3,077	1,350 1,592	980 980	535 510	330 347	218 228	85 131
pH	units	10.2 8.1	8.4 7.9	7.8 7.5	7.4 6.9	6.6 6.3	3.9 3.6	2.9 3.15
Dissolved oxygen-concentration	mg/l	13.5 13.6	11.0 12.2	9.4 11.8	8.7 10.8	8.2 9.6	7.6 7.8	3.6 4.0
Dissolved oxygen-saturation	%	178 115	125 101	110 96	100 92	92 85	85 70	41 37
Total inorganic nitrogen - N	mg/l	5.5 5.8	2.3 3.7	1.3 1.5	.80 .76	.45 .40	.27 .22	.08 0
Orthophosphate: PO ₄ as P	mg/l	1.6	.16	.049	.016	0	0	0
Acid hydrol. + ortho. as P	mg/l	1.5	.23	.043	.011	0	0	0
Sulfate	mg/l	1,400 1,110	750 635	430 399	150 138	72 67	43 40	13 16
Chloride	mg/l	92 530	66 78	34 43	19 21	11 12	6.8 8.4	.6 2.6
Alkalinity-bicarbonate	mg/l	282 355	174 173	84 96	46 47	16 11	0 0	0 0
Total organic carbon	mg/l	110 21	27 7	9 5.5	6 4.5	4 3.5	3 3	2 2.5
Sampling site drainage area distribution								
Drainage area	mi ²	19,500	1,715	185	51.2	27.2	10.8	4.1

^a Approximations; more specifically the values for rank of 8, 21, 65, 78 from the array of 85, appropriately modified for an array of 81 TOC analyses in June 1971, and an array of 89 drainage area values.

Temperature

All perennial streams for which Pennsylvania water-quality standards have been adopted are subject to specific temperature criteria. The least restrictive limits for interstate waters (U.S. Environmental Protection Agency, 1972) specify that the water temperature is not to be raised more than 5°F (~3°C) above ambient temperatures, or to a maximum of 87°F (~30.5°C), whichever is less. A more restrictive limit within the same basic criteria, particularly applied to streams presently or likely to support cold-water fish, is a maximum of 57°F (~14°C).

Most water temperatures did not deviate markedly from those expected to be associated with prevailing air temperatures. In June (see fig. 3), Connoquenessing Creek (site 75), Pucketa Creek (site 25), and Beaver River (site 74) temperatures (29 to 32°C) were somewhat higher than expected. The June Beaver Run (site 24) temperature seems abnormally low, possibly reflecting the release of cool reservoir water.

In October, the Monongahela River temperatures at sites 38 and 39 were the highest (16.5°C) among those observed. They may have been influenced by residual heat storage in the navigation pools, by the southerly origins of the river, or perhaps by warm industrial or power plant discharges. The normal seasonal lag in the air-water temperature relation is evident in the October water temperatures, which were generally several degrees warmer than daily average air temperatures in the region.

Dissolved oxygen

Dissolved oxygen (DO) is a rather variable constituent, both in time and place within stream systems; thus, the single values observed during this reconnaissance have only minor significance. During the June 1971 sampling period, Two Lick Creek in Indiana County (site 17), was the only site where DO was less than 4 mg/l (fig. 3), which is the lowest allowable value among the several criteria listed for DO in the Pennsylvania Water Quality Standards (Environmental Protection Agency, 1972). A value of 4 mg/l was measured at Millers Run (site 60) in October. All other DO values were 6 mg/l or greater in both sampling periods, indicating generally satisfactory concentrations, or at least a fair oxygen recovery in the reach upstream from the sampling site.

At about half of the sites sampled in June the water was supersaturated (DO greater than 100 percent saturation). This is partly related to the prevailing warm water temperatures. As with most gases, the solubility of oxygen in water decreases with increasing temperature; hence, lower concentrations are required to achieve saturation. DO concentrations measured in the October sampling period illustrate this effect; they were commonly 1 or 2 mg/l higher than those in June, whereas the degree of saturation was consistently lower. However, saturation did exceed 80 percent at more than 80 percent of the sites.

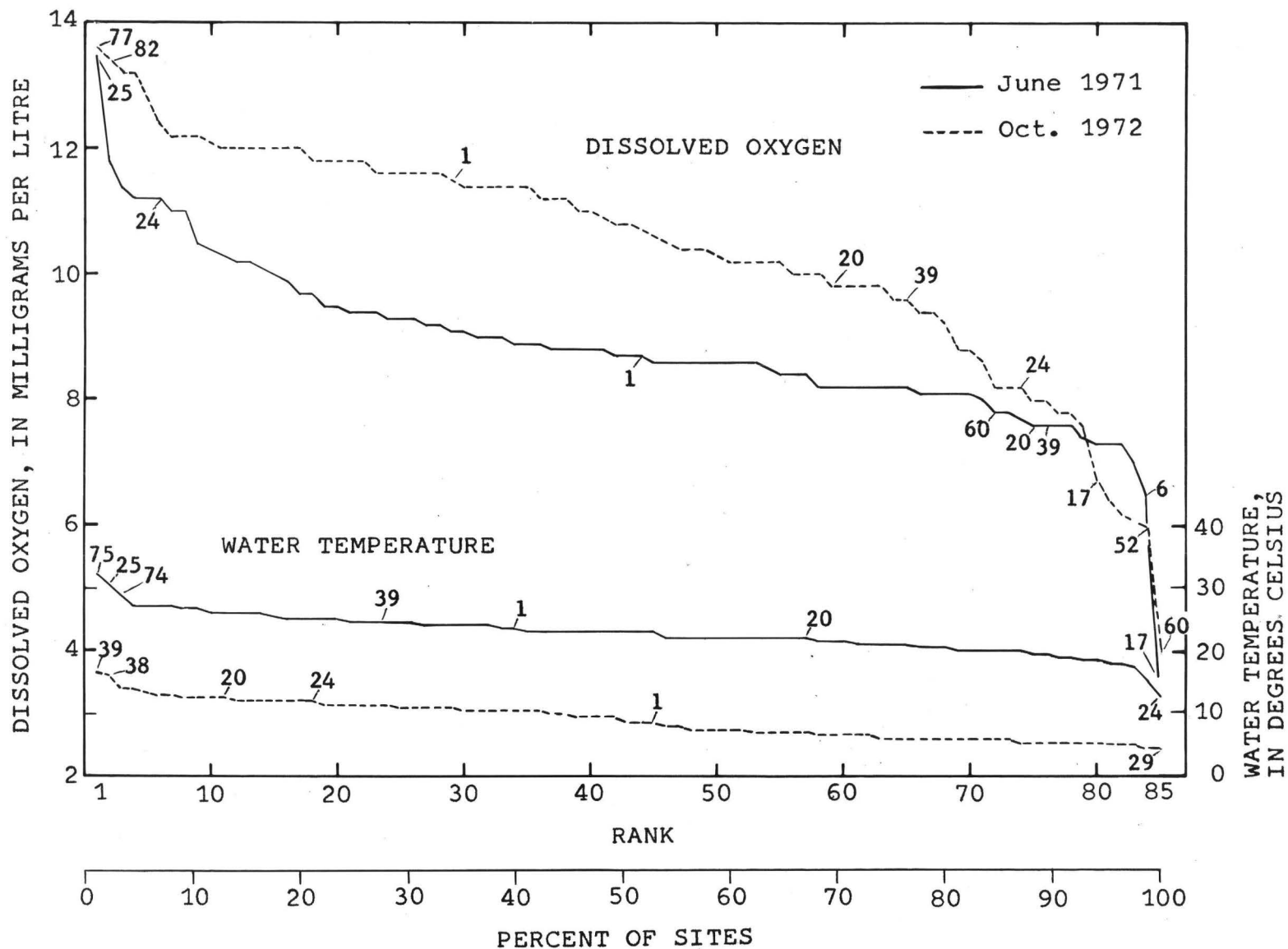


FIGURE 3.--Array of water-temperature values and dissolved-oxygen concentrations. Numbers are selected site locations (plate 1).

pH

The pH of natural waters is usually in the range of 6.0 to 9.0 while that of untreated acid mine drainage commonly ranges from 2.0 to 6.0 (Federal Water Pollution Control Administration, 1968a, p. 23). The pH of receiving streams will vary according to the proportion of the acid discharge relative to the stream discharge, treatment (if any) of the discharge, and the opportunity for natural oxidation or mixing with water of different pH.

Little Pucketa Creek (site 25), inadvertently sampled only in June 1971, was the only site at which a pH greater than 9 was measured (fig. 4). Here the water temperature, dissolved oxygen, and carbonate alkalinity also were anomalously high. At 14 of the 85 sites in both of the sampling periods, values were less than pH 6, the desirable minimum in several standards. The majority of these 14 sites were in Armstrong, Indiana, and Westmoreland Counties, although at a few sites in Allegheny County pH values between 4.0 and 6.0 were measured.

In general, the pH values were higher than one might assume, reflecting the possibility of reaction and mixing within stream systems. It is possible also that treatment of mine water discharges raised the pH at some sampling points above that of the natural drainage system.

Most pH values of the October samples were lower than those of the June samples. Differences generally were less than 1.0 pH unit but larger than the apparent average difference in the ranked arrays of data (fig. 4). The method of determination (field, June, versus lab, October) may have been a factor. In reference to pH changes resulting from delayed analysis, Hem (1970, p. 95) has stated: "Besides gains or losses of carbon dioxide, the solution may be influenced by reactions such as oxidation of ferrous iron, and the laboratory pH can be a full unit different from the value at the time of sampling."

Free acidity (as H⁺) was measured at 10 sites in June and at 13 sites in October where the pH ranged from 2.9 to 4.5. The free-acidity concentrations ranged as high as 6.3 mg/l (Blacklick Creek, site 16); the equivalent acidity as calcium carbonate at that site was 313 mg/l.

Alkalinity

Bicarbonate alkalinity concentrations of 50 mg/l or more were found at nearly half of the sampled sites in each of the periods. (See fig. 4.) This suggests that considerable neutralizing capacity exists and also that a significant amount of neutralization has taken place. There is a marked areal variation in alkalinity concentrations in which the higher concentrations generally were found in streams west of the Monongahela and Allegheny Rivers. The exceptions seem to be in areas where strip mining has taken place. As with some pH values, alkalinity concentrations at some sites may be unnaturally high because of deliberate neutralization of waste water from active mining operations.

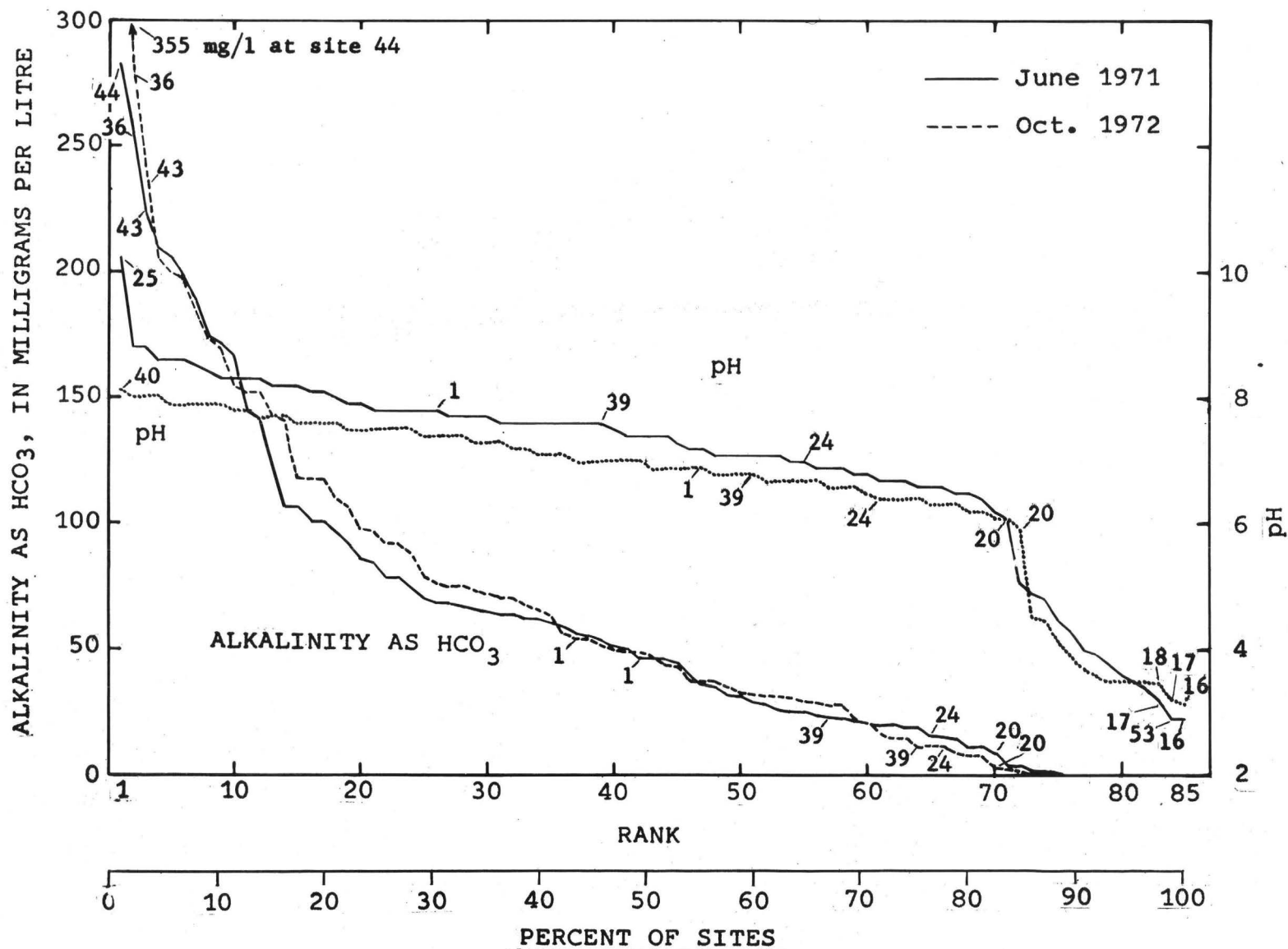


FIGURE 4.--Array of bicarbonate alkalinity concentrations and pH values.
Numbers are selected site locations (plate 1).

(Alkalinity....con.)

Highest alkalinity values, about 200 mg/l or higher, were found in a group of small basins extending across central Washington County (sites 43, 44, 45, 59, and 68), and atypically in one Allegheny River tributary, Deer Creek (site 36). Hem (1960, p. 158) suggests that the higher bicarbonate concentrations are common in ground waters, especially where sulfate reduction processes are releasing carbon dioxide. Samples from sites 43-45, on streams that drain eastward across areas of extensive deep mining had high sulfate concentrations (greater than 300 mg/l), but samples from the upper Chartiers Creek basin (site 59) and Buffalo Creek (site 68) had relatively low sulfate values (less than 100 mg/l). Samples from other southern and western Washington County sites had substantial bicarbonate alkalinity concentrations, and also had a wide sulfate variation, which was related to mining activity.

At the six high-alkalinity sites, sulfate, bicarbonate, and chloride constituted about 90 percent of the dissolved solids during the June sampling period but only about 70 percent in October. The constituents and processes accounting for this seasonal variation were not identified.

Specific Conductance

The relatively high degree of mineralization measured at many sites in the region was not unexpected. At about 20 percent of the sites sampled, as shown in figure 5, the dissolved solids (roughly calculated, in milligrams per litre, as 0.7 of the measured specific conductance in micromhos) exceeded one of Pennsylvania's basic water-quality criteria limits, which is: 750 mg/l at any time or 500 mg/l as a monthly average (Environmental Protection Agency, 1972).

Dissolved solids at the sampling sites, as indicated by specific conductance values, ranged from 50 to 2,000 mg/l and had a median value of about 350 mg/l. In general, dissolved solids concentrations would be expected to increase during periods when the streamflows are less than those during this reconnaissance. Such streamflows occur, on the average, in about a third of the days in a year. This inverse relation between discharge and conductance is complicated by a number of factors and, for example, might not apply in some basins or parts of basins where the high-flow periods might coincide with times of maximum flushing of highly mineralized water from mined-out areas.

Those streams most highly mineralized are affected by mine drainage. They include Blacklick Creek (site 16) in Indiana County, Buffalo Run (site 53) in Westmoreland County, Harmon Creek (sites 66 and 66A) in Washington County, and Deer Creek (site 36) in Allegheny County. The constituent variability at the sampling sites is shown by the data for sites 16 and 43, one highly acid, the other alkaline, and both high in sulfate.

The least mineralized waters sampled were those in the headwaters of Loyalhanna Creek (sites 21, 22, 23) and Indian Creek (site 49), and on the main stem of the Allegheny River upstream from the Kiskiminetas River (sites 1, 2).

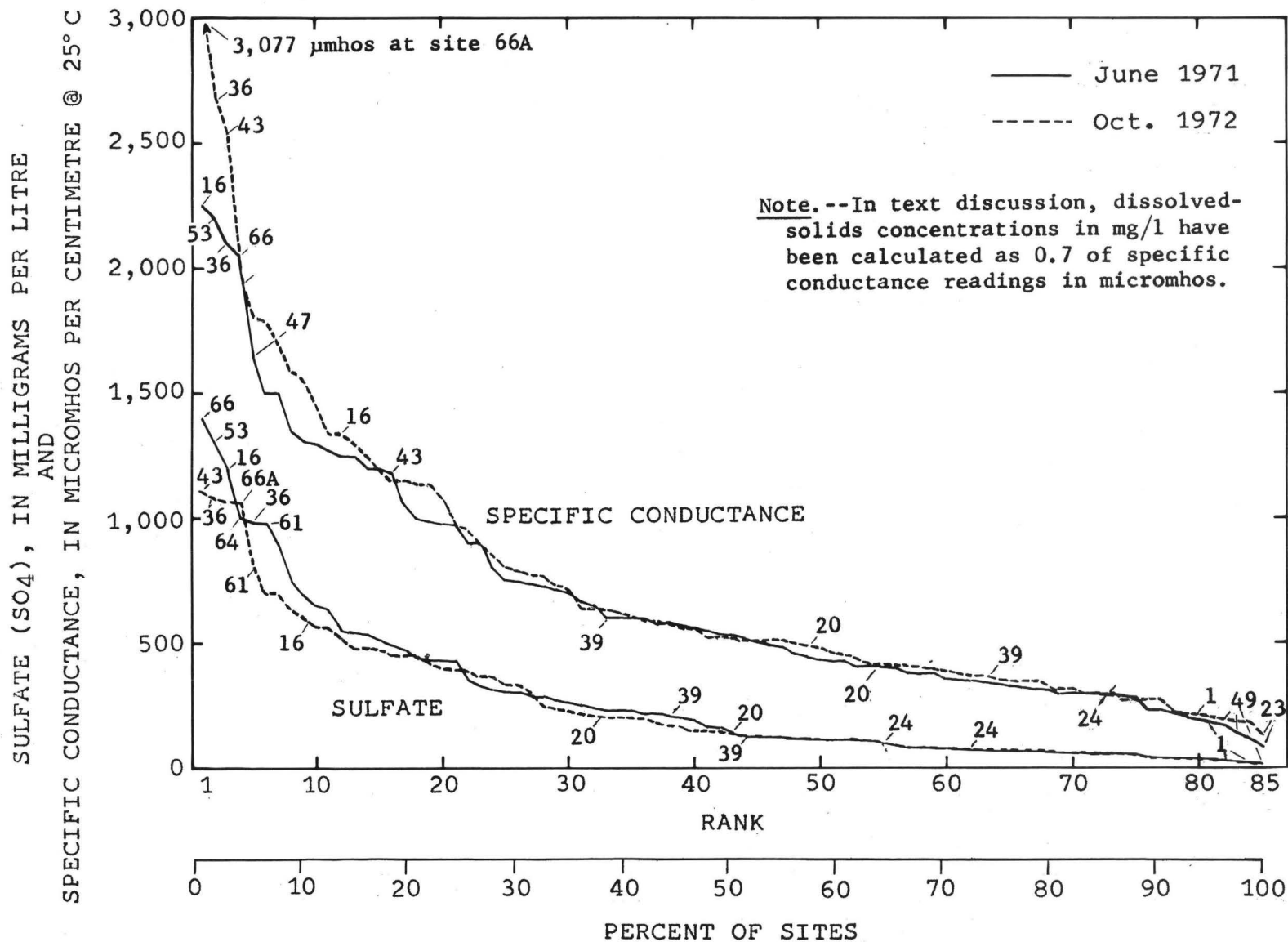


FIGURE 5.--Array of specific conductance values and sulfate concentrations. Numbers are selected site locations (plate 1).

(Specific Conductance....con.)

Within the six-county region, the subbasins of higher mineralization and, hence, probable lower "quality," are found generally in a broad swath from northeast to southwest encompassing much of Armstrong County, most of Allegheny County, western Westmoreland County, and much of Washington County.

Sulfate

The sedimentary rocks of the region are well supplied with sulfuritic material. The natural and continual processes of weathering and leaching provide the mechanisms for the formation of sulfate and its movement into the ground-water system from which it is discharged to surface streams. Coal mining often exposes sulfides to oxidation and thus markedly enhances the production of sulfate ions. In some basins sulfate formation is reduced if mining removes a significant fraction of the deposits in which the sulfides are concentrated. This is more likely in well managed strip mining than in deep mining where some surface waste piles may expose considerable sulfuritic material.

Biesecker and George (1966) used a sulfate concentration of 20 parts per million (20 mg/l) as the value above which the effect of mine drainage on stream quality was evident.³ By this criterion, only Indian Creek (site 49, tables 3,4, and fig. 5), having sulfate concentrations of 13 and 16 mg/l, could be considered to be unaffected. This is obviously an overstatement, as a number of streams in the region have not been affected by mining. A sulfate concentration of more than 50 mg/l might be used as a descriptive value, but any discrete number would likely be misleading in view of widespread opportunity for sulfate formation through natural processes.

At about half of the sites (fig. 5) sulfate concentrations were less than about 150 mg/l., a level that would be satisfactory for a number of purposes including public water supply. Concentrations exceeded drinking water standards (Environmental Protection Agency, 1971a; U.S. Public Health Service, 1962) at about one third of the sites.

³ The same value was cited by the Federal Water Pollution Control Administration (1968a, p. 25).

Nitrogen

Municipal, industrial, and rural wastewaters are the principal contributors of nutrients (nitrogen and phosphorus) to surface-water systems. The compounds of these elements promote excessive growth of algae and other aquatic vegetation. In domestic wastewaters (Shindala, 1972), the nitrogen is found in organic form (40-45 percent), and in the several inorganic forms (ammonia nitrogen, 55-60 percent, nitrite and nitrate nitrogen, 0-5 percent). Wastewaters were sampled only by chance in the present reconnaissance. Their sources were not sought. Organic nitrogen was not determined.

The samples were analysed for ammonia, nitrite, and nitrate. The nitrogen component of each was calculated and then totalled for presentation in table 3, on figure 6, and plate 2. A relatively low level of contamination, probably organic pollution, is prevalent through the region. The original data for the June 1971 sampling period showed ammonia concentrations of more than 0.1 mg/l at nearly 80 percent of the sites (maximum, 3.3 mg/l), and nitrate concentrations of more than 5 mg/l at more than 10 percent of the sites (maximum, 19 mg/l). Median concentrations of ammonia, nitrite, and nitrate were 0.2, 2, and 2.3 mg/l, respectively.

The maximum allowable nitrate nitrogen concentration (Environmental Protection Agency, 1971a), is 10 mg/l. The maximum values of elemental nitrogen of this particular form were 4.3 mg/l in Peters Creek (site 56) and Raccoon Creek (site 64) in June, and 5.1 mg/l in Buffalo Creek (site 53) in October.

Concentrations of total inorganic nitrogen in this region appear to be too low in most streams to be a widespread significant factor in nutrient enrichment. Concentrations greater than 2.5 mg/l were found at less than 10 percent of the sampling sites in June and at about 15 percent of the sites in October. The maximums were 5.5 mg/l in June and 5.8 mg/l in October.

On the basis of the highest measured nitrogen concentrations, potential problem basins included Peters Creek (site 46), Raccoon Creek (sites 63 and 64), Abers Creek (site 55), Plum Creek (site 26), Conemaugh River (site 19), Streets Run (site 47), Buffalo Run (site 53), Chartiers Creek (site 58), and Robinson Run (site 61), which apparently receive inordinate wastewater loads. Plate 2 shows the regional distribution of concentrations.

Organic-nitrogen concentrations probably are similarly low, as indicated by data published by the Environmental Protection Agency (1971d) for sampling sites on the lower Allegheny and Monongahela Rivers. The average concentration of more than 60 samples collected over a 7-year period was 0.5 mg/l at both sites. The maximum measured was 2.6 mg/l.

(Nitrogen....con.)

Constituent load contributions can be computed and compared for discrete stream reaches and their subbasin areas where reliable discharge data are available under relatively stable flow conditions for favorably distributed sampling sites. This analytical approach was suggested by A. N. Ott (written commun., 1973). With the simplifying assumption that the instantaneous values of concentration and discharge were representative of daily averages, total inorganic nitrogen loads for 1 day in each of the sampling periods were computed for three sites on the Allegheny River as shown in the table below. Here load, in pounds per day, (column 2, lbN/day) was obtained by multiplying the nitrogen concentration, in milligrams per litre, times the discharge, in cubic feet per second, times a conversion factor of 5.4. Thus using the data for site 1 (Allegheny River at Parker) from table 4:

$$\text{Load} = (0.27)(4,890)(5.4) = 7,100 \text{ lbN/day (rounded) or about } 3,200 \text{ kgN/day}$$

The nitrogen concentration is the total of the three forms (NH₃-N plus NO₂-N plus NO₃-N), averaged where two or three samples were obtained when the site was visited.

(1)	(2)	(3)	(4)	(5)	(6)
Site No.	Load (lbN/day)	Load per unit of drainage area $\left[\frac{\text{lbN/day}}{\text{mi}^2}\right]$	Incremental increase in load (lbN/day)	Incremental increase in drainage area (mi ²)	Incremental increase in load per unit of drainage area $\left[\frac{\text{lbN/day}}{\text{mi}^2}\right]$
<u>June 1971 Sampling Period</u>					
1	7,100	0.93	5,200	1,302	3.99
2	12,300	1.37	18,100	2,437	7.43
3	30,400	2.66			
<u>October 1972 Sampling Period</u>					
1	5,100	0.66	7,500	1,302	5.76
2	12,600	1.40	17,700	2,437	7.26
3	30,300	2.66			

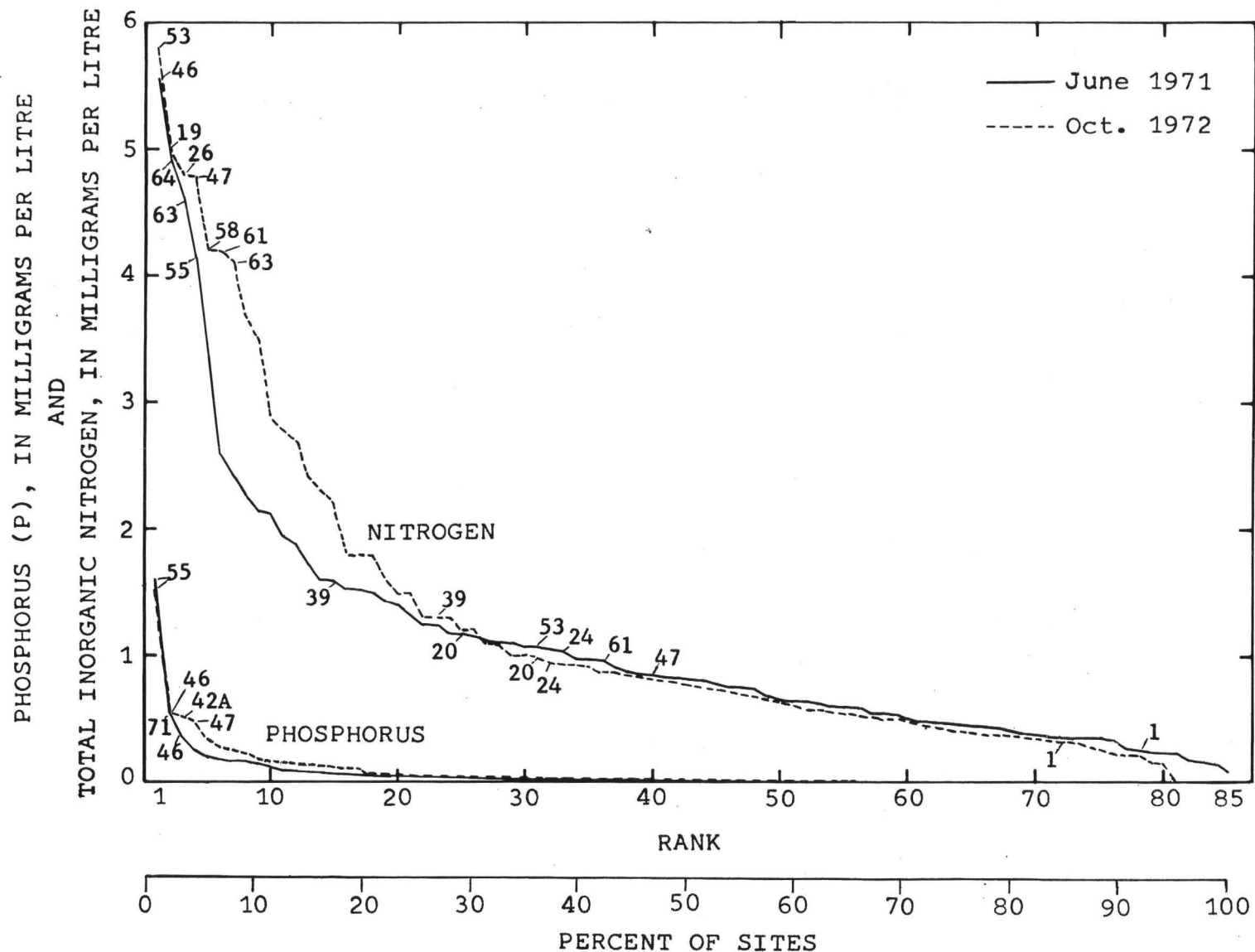


FIGURE 6.--Array of total inorganic nitrogen and phosphorus concentrations.
Numbers are selected site locations (plate 1).

(Nitrogen....con.)

Allegheny River at Parker (site 1) is a major point of inflow to the Greater Pittsburgh region. Nitrogen load contribution from the basin above that point, when considered on a unit drainage area basis, was relatively low in both sampling periods $\sqrt{0.93}$ and $0.66(\text{lbN/day})/\text{mi}^2$, or 0.16 and $0.12(\text{kgN/day})/\text{km}^2$ as given in column 37. Nitrogen loads increase downstream owing to proportionally larger contributions from the intervening areas. The incremental increase in load from these intervening areas was similarly calculated on a unit drainage area basis (columns 4-6). The apparent loading from the reach between Parker and Kittanning (site 2) was four times that of the basin above Parker ($3.99 \div 0.93$) in June and almost nine times that of the upper basin in October ($5.76 \div 0.66$). The increase in nitrogen loading attributable to the intervening area between Kittanning and Natrona (site 3) was even larger than that of the Parker-Kittanning reach, and is comparable to unit load data (not shown here) which can be computed from the data in table 4 for Kiskiminetas River at Vandergrift(site 15).

These computations have been described to illustrate areal variations taking the liberty of assuming instantaneous values equal to daily averages. Temporal variations need to be considered when evaluating load implications. Some data ranges are evident in nitrate data presented by McCarren (1967) for the Allegheny River at Warren (p. 27-29), at Kittanning (p. 49), at Sharpsburg (p. 62, 63), and at Nadine (p. 65).

Phosphorus

As a nutrient constituent, phosphorus does not appear to be a regional problem. Concentrations of more than 0.2 mg/l were found at less than 10 percent of the sampling sites. Abers Creek (site 55), the only basin in which a concentration of more than 0.6 mg/l was noted, was the point of maximum phosphorus concentration in both sampling periods (fig. 6).

Even though nitrogen and phosphorus concentrations were found to be relatively low throughout the region and, hence, indirectly suggest a correspondingly low level of pollution from domestic wastes, Biesecker and George (1961, p. 7, 8) comment that this also suggests a native deficiency of some key nutrients that fertilize aquatic plants. "This deficiency may provide a poorer environment for many types of aquatic insects and fish, which, in turn, can exert some limitation on recreational development of the water."

The standard list of specific criteria in the Pennsylvania water quality standards summary (Environmental Protection Agency, 1972) refers to the maximum allowable concentrations of total soluble phosphorus as 0.10 mg/l , 0.30 mg/l , and 0.40 mg/l (or natural levels whichever is greater), for three classes of waters. However, no phosphorus criteria have been adopted for interstate streams in the Greater Pittsburgh region.

Total organic carbon

At most sites in both sampling periods, concentrations of total organic carbon (TOC) were below 10 mg/l, a common background level. At 10 sites in June and 1 in October, however (fig. 7), TOC concentrations of more than 20 mg/l were measured, indicating introduction of decomposed organic material.

Industrial wastewater loading may cause high TOC values, which may be transient in nature. Several sites where the higher TOC values were measured are subject to this type of loading. The unusually high TOC (110 mg/l) found in Cross Creek in the June sampling period is likely a chance sampling of uncommon event. Although not necessarily industrial in origin, it illustrates what can be experienced. Weather records do not indicate that overland runoff was a significant component of the discharge at sites of higher TOC values.

If total organic carbon, as suggested by Hem (1970, p. 223), is a comprehensive indication of organic pollution loads, then the following sites merit special mention even though a relatively high TOC concentration was observed in only one sampling period:

Allegheny County

Plum and Chartiers Creeks (sites 26 and 58)

Beaver County

Connoquenessing Creek (site 76)

Butler County

Bear Creek and Little Buffalo Run (sites 27 and 33)

Washington County

Cross Creek (site 67)

Westmoreland County

Youghiogheny River, Jacobs and Sewickley Creeks,
Buffalo Run (sites 48, 50-53).

Chloride

The chloride concentrations at the sampling sites (except at site 66A on Harmon Creek) are well below the U.S. Public Health Service (1962) drinking water standards limitation of 250 mg/l (fig. 7). The anomalously high chloride value (530 mg/l) measured on Harmon Creek in October 1972 is considered to have been a transient occurrence, likely the result of a brine flush from a water-treatment plant. The dozen or more sites where chloride concentrations of 51 to 109 mg/l were found, are in developed basins; hence, the samples probably reflect the impact of domestic and(or) industrial wastewater discharge. Brine discharge from water softening units, uncontrolled discharge of deep oil and gas wells, and leaching of unprotected road salt storage piles also could produce high concentrations at some sites.

Chloride variation does not appear to be related to drainage area size. Concentrations as much as 100 mg/l occur randomly in all areas less than 270 mi² (700 km²). At sampling sites greater than 270 mi² (700 km²), average concentrations were less than 20 mg/l except for Connoquenessing Creek (sites 75,76) and Beaver River (site 74), where individual chloride concentrations ranged from 23 to 44 mg/l.

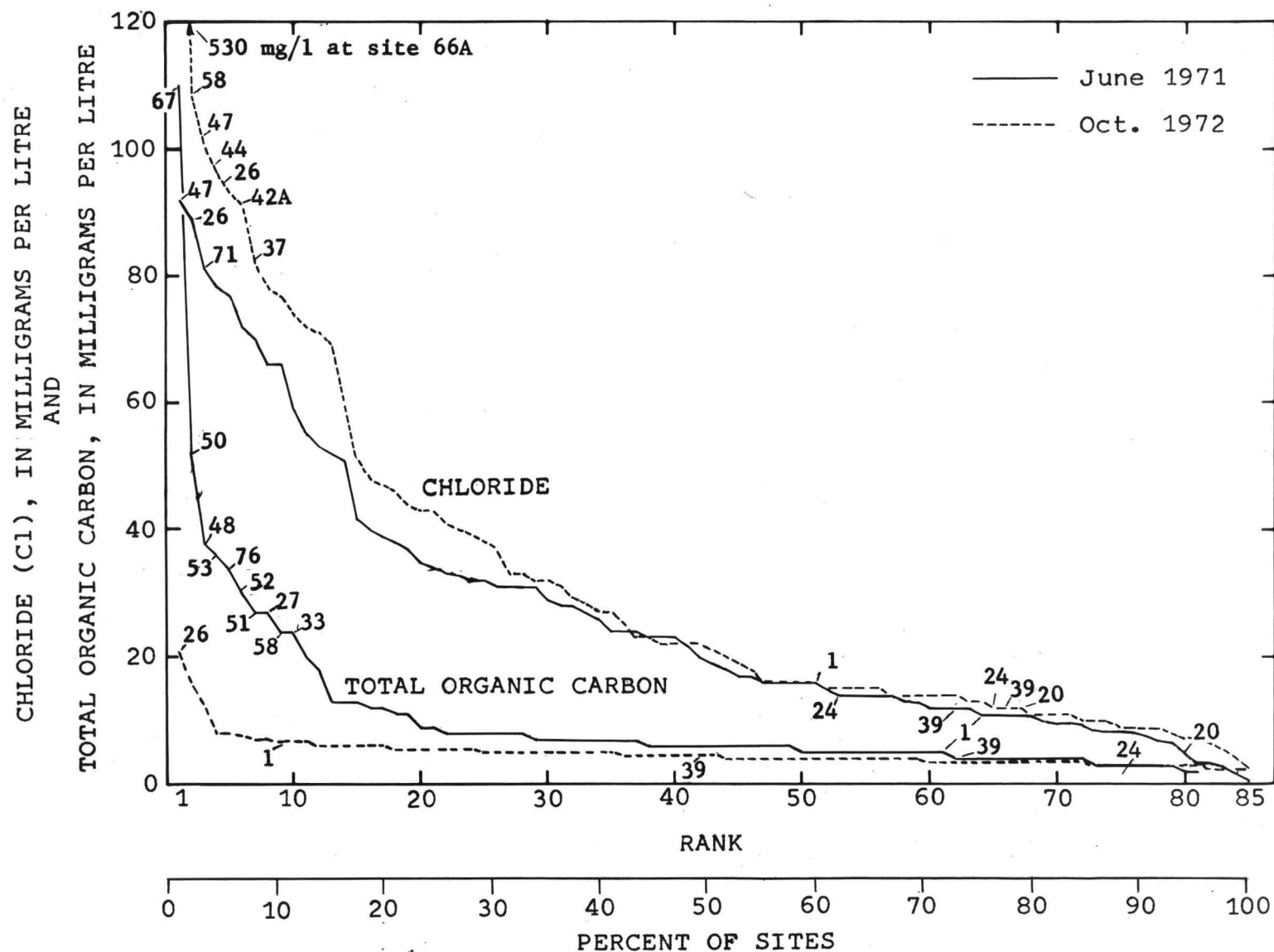


FIGURE 7.--Array of total organic carbon and chloride concentrations.
Numbers are selected site locations (plate 1).

SUMMARY

A reconnaissance sampling was conducted in mid-June 1971 at 85 stream sites in basins of varied size in and near the six-county Greater Pittsburgh region. The sampling at 81 sites was repeated in mid-October 1972, and 4 alternate sites were visited. The chemical analysis included a limited number of constituents of three general classes: nutrients, activity indicators, and dominant anions.

Some forms of nitrogen, phosphorus, and carbon are present in the biological life of most stream systems and as a group and individually, are indicators of the relative health of the systems. The forms selected for analysis in this reconnaissance are also indicators of organic waste pollution from domestic, agricultural, and industrial sources.

The reconnaissance data indicate that surface waters throughout the region are contaminated to some degree. This is neither unusual nor necessarily alarming in view of the urban, rural, and agricultural development that characterize most of the sampled basins. However, it does demonstrate the need for continuing pollution abatement and surveillance programs. At about one-quarter of the sites sampled, constituent values of either total inorganic nitrogen, or phosphorus, or total organic carbon were higher than values to be expected from the trend array of regional data.

The sampling sites where highest values of two or more of these nutrient constituents were measured in one or both of the sampling periods were:

<u>Site number</u>	<u>Name</u>
26	Plum Creek at Oakmont
46	Peters Creek at Clairton
47	Streets Run at Hays
53	Buffalo Creek at Hunker
55	Abers Creek near Level Green
58	Chartiers Creek at Carnegie
63	Raccoon Creek at Moffatts Mills

In most cases, the data represent conditions at only one site in most basins and at one or two specific points in time. Many minor basins throughout the region were not sampled; thus, the reconnaissance data should be considered only as a representation of possible levels of concentration of specific constituents.

In addition to the previously mentioned constituents most directly associated with the life processes of plants and animals, several properties and other constituents were measured to help characterize the degree or state of chemical activity. Some of these, like temperature, pH, dissolved oxygen, acidity, and alkalinity, are important indices of existing states of reaction within and among the solutes. The dynamic nature of river systems precludes definitive assessment on the basis of two observations. However, the prevalence at a majority of sampling sites of

(1) reasonable or at least expected water temperature, (2) hydrogen ion concentration (pH) in the range found in most natural water, and (3) dissolved oxygen concentrations sufficient to support life processes, indicates a generally favorable capacity for regeneration or recovery from degrading stresses. A number of streams east of the Allegheny and Monongahela Rivers are marginal or lacking in that capacity, as evidenced by low alkalinity and pH values. High alkalinity values characterize sampling sites in the southwestern part of the region.

Water temperatures directly, and sometimes subtly, influence aquatic life, chemical and biological reactions, toxicity of contaminants, and the usability for domestic and industrial purposes. Normal maximum summertime air temperatures in the region are such that water temperatures critical to some fish species and to some industrial uses can be anticipated annually in the lower reaches of most tributary streams. From mid-summer to early fall, streamflows normally approach their annual minimums. Water is shallow and slow moving and water temperatures closely approximate air temperatures. The moderating effect of cooler ground-water discharges is largely absent except in the Allegheny and Ohio Rivers.

Major anions (sulfate, chloride, and bicarbonate) were included in the suite of reconnaissance analyses to enlarge the data base of some of the constituents that reflect the influence of the rocks, soils, climate, and land use of the region on water chemistry. Measurements of conductance also were obtained to provide a general indication of total ion concentration and, thus, estimates of dissolved-solids concentration.

The data indicate that sulfate is the dominant anion in about three-quarters of the basins sampled. This emphasizes not only the abundance of sulfuritic material in some of the rocks of the region but also the effect of natural weathering processes and the impact of man's developmental activity in exposing this material to oxidation. The sulfur-bearing material is found principally in coal seams and adjacent shale and sandstone strata and, hence, is exposed extensively in the course of mining. In addition, the sulfides exposed during more than a century of rail and highway construction and urban and suburban development must significantly influence distribution and concentration of the sulfate ion in drainage systems throughout the region. Sulfate concentrations of more than 40 mg/l were observed at 90 percent of the sites.

Bicarbonate and carbonate ions measured in this reconnaissance are largely a contribution from the carbon dioxide in the atmosphere rather than from the rocks of the region except where perhaps influenced by mine-water-treatment practices. However, the bicarbonate anion was dominant at about 20 minor basin sampling sites in the region, most of which were situated in the southern parts of Butler, Washington, and Westmoreland Counties. Sulfate concentrations in these basins were all well below the regional median and averaged about 50 mg/l, indicating minor, if any, acid-mine drainage influence, or conversely, indicating the existence of alkaline mine drainage.

A moderate to high degree of mineralization, as indicated by conductance readings of 500 $\mu\text{mhos}/\text{cm}$ or more at half of the sampling sites, is a characteristic of the region. This might be considered better than expected in view of the opportunity for contamination from domestic and industrial wastewater sources and the opportunity for mineralization from mining and other earth-disturbance practices. The relatively abundant and seasonally well distributed precipitation that the region receives is both a positive factor in the dilution it provides and also a negative one in the solution activity it promotes.

Certainly there is not widespread, hopeless degradation. Periodic monitoring at some main stream sites shows a trend of improvement in several water-quality parameters. Many sources of physical, chemical, and biological contamination can be and are being brought under control. In carrying out these programs, however, it is important to use existing physical and chemical water characteristics to complement treatment processes and in such a way that water quality downstream will not be adversely affected.

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TABLE 4

STREAM-QUALITY-RECONNAISSANCE DATA

follows

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Table 4. --Stream-quality-reconnaissance data,
(Analyses in milligrams per litre; e: estimated, RB: right bank)

Site number on Pl. 1	Location in cross section	Date of collection	Time	Discharge (ft^3/s)	Water temper- ature ($^{\circ}\text{C}$)	Specific conduct- ance (micro- mhos at 25°C)	pH	Dissolved oxygen	
								O_2	(% sat.)
1	LC	June 22, 1971	1130	4,890	23	180	7.6	8.6	99
	RC	do.	do.	do.	24	165	8.0	8.7	102
	LC	Oct. 19, 1972	1115	2,960	8	210	6.7	11.2	94
	RC	do.	do.	do.	8.5	202	7.1	11.8	100
2	C	June 22, 1971	1730	5,830	24	195	7.6	9.4	111
	LC	Oct. 18, 1972	1130	6,140	11.5	226	7.1	11.0	100
	C	do.	do.	do.	11.5	229	7.2	11.0	100
	RC	do.	do.	do.	11.5	229	7.2	10.8	99
3	LC	June 21, 1971	-----	7,300	27	245	6.8	9.2	114
	C	do.	-----	do.	26	250	6.7	9.2	112
	RC	do.	-----	do.	26	365	6.2	9.2	112
	LC	Oct. 18, 1972	1020	6,090	10	314	7.0	10.4	92
	C	do.	do.	do.	10	315	7.0	11.2	99
	RC	do.	do.	do.	9.5	316	6.7	10.4	91
4	C	June 22, 1971	1000	195	22	335	7.0	8.4	95
	C	Oct. 18, 1972	1155	93	7.5	346	6.7	12.0	100
5	C	June 22, 1971	1200	325	21.5	340	6.5	8.7	98
	C	Oct. 18, 1972	1100	33	11	272	7.0	11.2	101
6	C	June 22, 1971	1040	50	20	430	7.1	6.5	71
	C	Oct. 16, 1972	1430	64	9.5	431	6.3	10.4	91
7	C	June 22, 1971	1200	18	23	230	7.7	8.2	94
	C	Oct. 16, 1972	1530	50	9.5	178	6.8	10.6	93
8	C	June 22, 1971	1130	e28	20	750	3.5	8.2	90
	C	Oct. 18, 1972	1030	e13	5	766	3.60	11.6	91
9	C	June 22, 1971	1430	e2.0	23	660	8.5	8.4	97
	C	Oct. 18, 1972	1400	e2.4	6	504	6.3	11.4	91
10	C	June 22, 1971	1515	e20	25	375	7.2	9.3	111
	C	Oct. 18, 1972	1500	e30	6	294	6.8	12.0	96
11	C	June 22, 1971	1600	e9	25	730	6.9	9.3	111
	C	Oct. 18, 1972	1610	e35	6	393	6.9	11.6	93

Greater Pittsburgh Region, Pennsylvania, June 1971 and October 1972

C: center of channel, LC: center of left half, RC: center of right half)

Site number on Pl. 1	Ammo- nia nitro- gen NH ₃ -N	Ni- trite nitro- gen NO ₂ -N	Ni- trate nitro- gen NO ₃ -N	Phos- phorus P	Sul- fate SO ₄	Chlo- ride Cl	Alka- lin- ity as CO ₃ /HCO ₃	Acid- ity as H+	Acid- ity as CaCO ₃	Total organ- ic carbon
1	0.00	0.000	0.27	0.000	25	10	44			5
	.00	.000	.27	.000	19	12	47			5
	.01	.000	.29	.011	39	16	50			7
	.03	.000	.31	.011	25	16	58			6.5
2	.05	.000	.34	.000	43	11	29			7
	----	-----	---	----	58	14	33			6
	.02	.000	.36	.006	58	14	32			7
	.02	.000	.36	.011	58	15	33			6.5
3	.30	.009	.43	.000	79	11	20			4
	.30	.009	.43	.000	80	9.7	18			7
	.30	.009	.52	.000	83	10	20			6
	.38	.000	.51	.000	110	14	15			7
	.38	.000	.52	.000	109	14	16			5
	.42	.000	.55	.000	113	14	15			5
4	.10	.000	.50	.000	110	14	14			--
	.05	.000	.28	.006	127	14	11			5.5
5	.20	.009	.52	.000	93	16	40			4
	.06	.000	.64	.006	73	16	28			4
6	.25	.009	.34	.065	130	17	62			4
	.34	.005	.34	.11	131	20	51			5
7	.05	.000	.41	.000	44	16	36			3
	.03	.000	.58	.000	42	10	21			4
8	.20	.000	.36	.000	330	8.2	0	1.4	70	5
	.20	.000	.30	.000	363	8.4	0	1.15	57	4.5
9	.05	.000	.32	.000	250	16	2/92			8
	.06	.000	.35	.000	182	14	49			5
10	.05	.000	.43	.000	80	31	50			3
	.08	.000	.40	.000	75	16	37			5.5
11	.10	.000	.56	.000	220	24	46			6
	.06	.000	.49	.000	128	14	35			4

Table 4. --Stream-quality-reconnaissance data,
(Analyses in milligrams per litre; e: estimated, RB: right bank,

Site number	Location in cross section	Date of collection	Time	Discharge (ft^3/s)	Water temper- ature ($^{\circ}\text{C}$)	Specific conduct- ance (micro- mhos at 25°C)	pH	Dissolved oxygen O ₂ (% sat.)	
12	C	June 22, 1971	1540	60	27	540	4.8	8.2	101
	C	Oct. 17, 1972	1230	98	12.5	345	6.7	9.8	91
13	C	June 22, 1972	1430	67	24	580	4.9	8.9	105
	C	Oct. 16, 1972	1730	91	12	605	3.90	8.0	74
14	C	June 22, 1972	1315	e1.5	24.5	218	7.6	8.8	104
	C	Oct. 16, 1972	1645	e15	10	182	6.2	10.2	90
15	C	June 21, 1971	1915	1,530	23	600	3.8	8.4	96
	C	Oct. 17, 1972	1100	1,090	11.5	795	3.50	6.4	58
16	C	June 21, 1971	1300	87	23	2,250	2.9	8.1	92
	C	Oct. 16, 1972	1245	141	10.5	1,333	3.15	10.0	89
17	C	June 21, 1971	1405	76	22	990	3.2	3.6	41
	C	Oct. 16, 1972	1315	178	12	762	3.20	6.8	63
18	C	June 21, 1971	1630	940	26	705	3.4	8.2	100
	C	Oct. 17, 1972	0900	797	12	807	3.47	9.8	91
19	C	June 21, 1971	1100	816	23	560	3.95	7.6	87
	C	Oct. 16, 1972	1150	380	14	736	3.70	8.0	77
20	C	June 21, 1971	1710	98	22	405	6.1	7.6	86
	C	Oct. 17, 1972	0945	216	12.5	494	5.9	9.8	92
21	C	June 21, 1971	1230	294	19	115	7.6	10.2	110
	C	Oct. 16, 1972	1245	61	9.5	195	6.6	11.0	96
22	C	June 21, 1971	1200	e60	18.5	165	7.4	10.2	108
	C	Oct. 16, 1972	1120	e40	8.5	210	6.7	8.2	70
23	C	June 21, 1971	1035	e35	20	85	7.2	10.0	109
	C	Oct. 16, 1972	1200	e20	9.5	131	7.0	11.2	98
24	C	June 21, 1971	1830	e4	13	290	7.0	11.2	106
	C	Oct. 17, 1972	1015	e5	12	300	6.4	8.2	76
25	C	June 23, 1971	1330	e3.5	30.5	375	10.2	13.5	178
25A	C	Oct. 18, 1972	1140	e4	6.5	515	6.9	10.8	87

Greater Pittsburgh Region, Pennsylvania, June 1971 and October 1972--continued

C: center of channel, LC: center of left half, RC: center of right half)

Site number on Pl. 1	Ammono- nitro- gen NH ₃ -N	Ni- trite nitro- gen NO ₂ -N	Ni- trate nitro- gen NO ₃ -N	Phos- phorous P	Sul- fate SO ₄	Chlo- ride Cl	Alka- lin- ity as CO ₃ /HCO ₃	Acid- ity as H ⁺	Acid- ity as CaCO ₃	Total organ- ic carbon
12	0.20 .12	0.000 .000	0.56 .74	0.000 .000	230 119	24 15	1 7.6			---- 5.5
13	.30 .19	.000 .000	.54 .69	.000 .000	270 200	17 22	1 0	0.45	22	4 3.5
14	.10 .04	.000 .000	.70 .59	.016 .016	53 43	8.3 7.6	78 23			4 6
15	.70 1.7	.000 .000	.72 .64	.000 .000	230 334	9.3 15	0 0	.8 .68	40 33	3 5
16	.78 .52	.000 .000	.29 .56	.033 .000	1,200 605	7.8 11	0 0	6.3 2.96	313 146	18 5
17	.60 .44	.000 .000	.45 .49	.049 .043	430 248	13 9.8	0 0	3.8 1.85	189 92	5 3.5
18	1.2 2.1	.000 .016	.97 .60	.000 .000	300 366	12 13	0 0	1.2 1.45	60 72	---- 4
19	1.8 4.4	.000 .000	.79 .61	.000 .031	230 338	12 19	0 0	.8 1.10	40 55	2 4.5
20	.55 .38	.020 .000	.61 .61	.000 .000	150 203	4.3 12	9 3.6			2 3.5
21	.10 .02	.009 .000	.54 .46	.000 .031	25 39	1.9 7.9	25 37			3 5.5
22	.05 .01	.000 .000	.41 .36	.016 .016	56 54	.6 4.1	22 32			3 3.5
23	.20 .00	.000 .000	.41 .22	.000 .000	22 20	3.3 8.5	20 29			3 4
24	.20 .51	.020 .000	.79 .44	.000 .000	80 100	14 12	16 11			3 3
25	.04	.038	.08	.196	80	33	28/19			13
25A	.02	.000	.42	.000	145	21	91			4

Table 4.--Stream-quality-reconnaissance data,
(Analyses in milligrams per litre; e: estimated, RB: right bank,

Site number	Location in cross section	Date of collection	Time	Discharge (ft ³ /s)	Water temperature (°C)	Specific conductance (micro-mhos at 25°C)	pH	Dissolved oxygen	
Pl. 1								O ₂	(% sat.)
26	C	June 22, 1971	1350	e8	24.5	1,200	5.1	7.8	92
	C	Oct. 18, 1972	1215	e9	8.5	1,196	6.1	10.2	87
27	C	June 22, 1971	1245	e60	22	1,200	7.1	8.6	98
	C	Oct. 19, 1972	1200	e80	5.5	1,129	6.5	11.2	89
28	C	June 22, 1971	1400	e8	24	520	8.1	9.0	106
	C	Oct. 19, 1972	1250	e8	5.5	642	7.4	13.2	104
29	C	June 24, 1971	1130	e1.8	19	570	3.6	8.0	85
	C	Oct. 19, 1972	1345	e3	4.5	522	4.15	12.2	94
30	C	June 24, 1971	1230	e3	21	980	7.8	9.5	106
	C	Oct. 18, 1972	1640	e7	5.5	955	6.4	11.8	93
31	C	June 22, 1971	1715	e5	25	1,050	6.8	8.6	102
	C	Oct. 18, 1972	1250	e9	6.5	857	6.6	11.8	96
32	C	June 24, 1971	1530	e35	26	400	8.3	9.0	109
	C	Oct. 18, 1972	0945	e60	7.5	404	7.0	11.4	95
33	C	June 24, 1971	1430	e3.5	20	350	7.9	9.5	103
	C	Oct. 18, 1972	1800	e6	5.5	351	7.1	11.4	90
34	C	June 24, 1971	1345	e6	23	410	7.8	9.9	114
	C	Oct. 18, 1972	1730	e13	6	400	7.0	11.6	93
35	C	June 23, 1971	1245	e12	26.5	600	8.6	9.1	112
	C	Oct. 18, 1972	0920	e9	6	593	7.4	12.0	96
36	C	June 22, 1971	1430	e6	27	2,100	7.6	8.1	100
	C	Oct. 18, 1972	1115	e25	8.5	2,678	7.5	10.8	92
37	C	June 23, 1971	1145	e15	26	800	7.4	8.8	105
	C	Oct. 18, 1972	1300	e18	7.5	900	8.0	12.8	106
38	LC	June 23, 1971	0930	3,450	24	430	6.6	9.3	109
	RC	do.	do.	do.	24	430	6.6	9.6	113
	LC	Oct. 17, 1972	1000	4,320	16.5	505	7.0	9.4	95
	RC	do.	1010	do.	16	503	6.4	9.4	94

Greater Pittsburgh Region, Pennsylvania, June 1971 and October 1972--continued

C: center of channel, LC: center of left half, RC: center of right half)

Site Number on Pl. 1	Ammo- nia nitro- gen NH ₃ -N	Ni- trite nitro- gen NO ₂ -N	Ni- trate nitro- gen NO ₃ -N	Phos- phorous P	Sul- fate SO ₄	Chlo- ride Cl	Alka- lin- ity as CO ₃ /HCO ₃	Acid- ity as H ⁺	Acid- ity as CaCO ₃	Total organ- ic carbon
26	1.5	0.067	1.8	0.065	470	89	3			6
	1.2	.085	3.5	.000	456	93	2			21
27	.35	.047	.23	.039	430	72	62			27
	.05	.000	.11	.090	388	74	50			16
28	.05	.000	.50	.016	200	18	64			4
	.04	.000	.35	.000	211	23	64			2.5
29	.16	.000	.22	.010	290	14	0	1.4	70	4
	.07	.000	.29	.000	234	7.2	0	.45	22	4
30	.12	.000	.10	.000	530	9.7	53			9
	.08	.000	.20	.011	474	5.7	44			5
31	.40	.000	.43	.016	490	23	28			5
	.10	.000	.61	.011	399	16	28			3
32	.16	.000	.20	.007	110	27	68			6
	.00	.000	.79	.006	109	22	49			4
33	.13	.000	.27	.007	97	26	51			24
	.01	.000	.67	.006	75	26	47			3.5
34	.16	.000	.20	.016	110	31	65			8
	.08	.008	.65	.014	108	23	37			3.5
35	.78	.009	.61	.007	170	31	1/64			5
	.00	.000	.81	.014	163	33	75			3.5
36	1.0	.020	.48	.000	980	53	257			12
	.51	.022	.50	.014	1,080	71	277			4
37	.10	.020	1.1	.033	240	66	84			8
	.03	.018	1.3	.18	201	82	152			7
38	.66	.000	.45	.000	210	7.8	11			3
	.68	.000	.48	.000	200	5.8	11			8
	.72	.000	.43	.000	202	8.1	2.0			3.5
	.72	.000	.43	.000	203	8.9	3.2			3

Table 4. --Stream-quality-reconnaissance data,
(Analyses in milligrams per litre; e: estimated, RB: right bank,

Site number on Pl. 1	Location in cross section	Date of collection	Time	Discharge (f3/s)	Water temper- ature (°C)	Specific conduct- ance (micro- mhos at 25°C)	pH	Dissolved oxygen	
								O ₂	(% sat.)
39	LC	June 23, 1971	0700	e4,500	24.5	600	7.7	7.8	92
	RC	do.	do.	do.	24.5	610	7.6	7.5	89
	LC	Oct. 17, 1972	1515	2,980	16.5	362	6.5	10.2	104
	RC	do.	do.	do.	16.5	361	6.6	9.0	91
40	C	June 23, 1971	1430	e25	27	900	8.6	11.0	136
	C	Oct. 17, 1972	1335	e15	13	1,080	8.1	12.2	115
41	C	June 23, 1971	1430	e2.5	24.5	440	8.3	8.9	105
	C	Oct. 17, 1972	1430	e2	11.5	552	8.0	10.2	93
42	C	June 23, 1971	1340	e18	26.5	535	8.8	10.5	129
42A	C	Oct. 17, 1972	1255	10	12.5	707	7.3	10.0	93
43	C	June 23, 1971	1220	e4	21.5	1,185	8.3	11.2	126
	C	Oct. 17, 1972	1120	e9	11.0	2,528	8.0	12.0	108
44	C	June 23, 1971	1030	e3	22	1,000	7.3	9.7	110
	C	Oct. 17, 1972	0910	e12	11	1,799	7.6	8.6	77
45	C	June 23, 1971	1100	e2	21	985	7.6	9.7	108
	C	Oct. 17, 1972	0830	e7	10.5	1,470	7.7	9.6	86
46	C	June 23, 1971	0900	e18	21.5	1,350	6.5	7.4	83
	C	Oct. 17, 1972	1400	e40	13.5	1,300	7.1	8.8	84
47	C	June 23, 1971	0805	e1.5	17.5	1,650	6.4	8.9	93
	C	Oct. 17, 1972	1615	e7	14	1,705	6.8	7.6	73
48	LC	June 21, 1971	1600	1,920	25	255	7.0	8.5	101
	C	do.	do.	do.	25	275	7.0	8.3	99
	RC	do.	do.	do.	25	610	6.8	7.7	92
	LC	Oct. 16, 1972	1650	1,250	13	330	7.2	10.8	102
	C	do.	do.	do.	13	307	7.2	10.4	98
	RC	do.	do.	do.	12.5	698	6.7	9.6	90
49	C	June 21, 1971	1020	e7	15.5	135	6.6	8.6	85
	C	Oct. 16, 1972	1100	e8	8	190	7.2	11.0	92

Greater Pittsburgh Region, Pennsylvania, June 1971 and October 1972--continued

C: center of channel, LC: center of left half, RC: center of right half)

Site number on Pl. 1	Ammonia nitro- gen	Ni- trite nitro- gen	Ni- trate nitro- gen	Phos- phorous	Sul- fate	Chlo- ride	Alka- lin- ity as CO ₃ /HCO ₃	Acid- ity as H+	Acid- ity as CaCO ₃	Total organ- ic carbon
	NH ₃ -N	NO ₂ -N	NO ₃ -N	P	SO ₄	Cl				
39	0.86	0.020	0.70	0.026	210	12	23			5
	.86	.020	.72	.026	210	13	23			4
	.68	.022	.60	.031	128	11	12			4
	.74	.022	.60	.031	132	12	9.8			5.5
40	.08	.000	.16	.013	290	51	3/171			7
	.00	.000	.00	.000	303	60	173			4
41	.00	.058	.27	.033	66	16	188			6
	.00	.000	.00	.000	67	28	184			5
42	.12	.000	.02	.16	110	52	3/123			8
42A	.03	.032	.97	.52	96	91	143			8
43	.08	.000	.41	.072	510	22	2/224			7
	.00	.000	.52	.068	1,110	48	235			2.5
44	.16	.000	.32	.016	300	77	282			8
	.16	.000	.06	.016	418	96	355			5
45	.10	.000	.29	.000	430	42	206			6
	.08	.000	.30	.000	401	46	200			3.5
46	.76	.47	4.3	.36	550	70	31			9
	1.3	.34	2.1	.55	485	72	92			6
47	.20	.020	.61	.016	750	92	12/70			5
	4.4	.081	.32	.48	558	101	110			12.5
48	.10	.000	.56	.000	92	4.8	14			37
	.10	.000	.61	.000	100	4.8	13			--
	.45	.009	.72	.000	300	16	5			40
	.04	.000	.56	.000	121	8.8	17			4.5
	.04	.000	.57	.008	108	7.7	16			3.5
	.41	.000	.58	.000	275	17	13			3.5
49	.10	.000	.81	.000	13	19	20			13
	.00	.000	.76	.042	16	29	32			2.5

Table 4.--Stream-quality-reconnaissance data,
(Analyses in milligrams per litre; e: estimated, RB: right bank,

Site number on Pl. 1	Location in cross section	Date of collection	Time	Discharge (f3/s)	Water temper- ature (°C)	Specific conduct- ance (micro- mhos at 25°C)	pH	Dissolved oxygen	
								O ₂	(% sat.)
50	C	June 21, 1971	1230	e5	22	315	6.8	8.6	98
	C	Oct. 16, 1972	1230	e.2	10.5	386	7.1	7.8	70
51	C	June 21, 1972	1530	e70	22	1,250	6.7	7.7	88
	C	Oct. 16, 1972	1535	e80	12	1,333	4.45	7.8	72
52	C	June 21, 1971	1430	e20	21	750	6.7	8.2	91
	C	Oct. 16, 1972	1425	e18	11.5	980	6.2	6.0	55
53	C	June 21, 1971	1345	e2.2	21	2,200	2.9	8.1	90
	C	Oct. 16, 1972	1330	e8	10.5	1,960	3.45	8.8	79
54	C	June 21, 1971	1430	e60	24	600	7.1	8.8	104
	C	Oct. 16, 1972	1455	e35	10.5	647	6.1	10.2	91
55	C	June 21, 1971	1630	e16	24.5	580	7.6	7.3	86
	C	Oct. 16, 1972	1410	e14	10.5	649	6.8	6.2	55
56	C	June 21, 1971	1515	e40	22	900	6.2	8.2	93
	C	Oct. 16, 1972	1540	e30	11.5	1,254	3.50	9.2	84
57	LC	June 22, 1971	0945	11,100	24.5	340	7.4	7.3	86
	C	do.	do.	do.	24.5	335	7.5	7.3	86
	RC	do.	do.	do.	24	370	7.4	7.4	87
	LC	Oct. 19, 1972	0935	13,000	12.5	374	6.1	9.8	92
	C	do.	do.	do.	12.5	372	6.3	9.2	86
	RC	do.	do.	do.	12.5	372	6.4	9.2	84
58	C	June 23, 1971	0915	144	20.5	1,250	6.9	7.0	77
	C	Oct. 17, 1972	0905	e120	11	1,784	6.7	8.2	74
59	C	June 23, 1971	1215	e12	22	510	8.0	7.3	83
	C	Oct. 17, 1972	1530	e10	11.5	619	7.6	9.8	90
60	C	June 23, 1971	1100	e12	19.5	1,275	6.7	7.8	84
	C	Oct. 17, 1972	1110	e18	12	1,592	3.50	4.0	37
61	C	June 23, 1971	1010	e25	21	1,500	4.0	9.2	102
	C	Oct. 17, 1972	1000	e24	10.5	1,558	4.50	9.8	87
62	C	June 22, 1971	1050	e3	22	1,300	7.6	9.1	104
	C	Oct. 19, 1972	1000	e11	6	1,147	6.4	11.8	94

Greater Pittsburgh Region, Pennsylvania, June 1971 and October 1972--continued

C: center of channel, LC: center of left half, RC: center of right half)

Site number on Pl. 1	Ammo- nia nitro- gen NH ₃ -N	Ni- trite nitro- gen NO ₂ -N	Ni- trate nitro- gen NO ₃ -N	Phos- phorous P	Sul- fate SO ₄	Chlo- ride Cl	Alka- lin- ity as CO ₃ /HCO ₃	Acid- ity as H+	Acid- ity as CaCO ₃	Total organ- ic carbon
50	0.10 .00	0.009 .000	0.99 .83	0.000 .022	110 66	13 8.4	24 117			52 3
51	.93 1.1	.020 .011	.93 .65	.000 .000	540 635	28 33	3 0	0.65	32	27 5
52	.50 .52	.020 .000	.99 .65	.000 .015	360 517	11 15	59 56			30 3.5
53	.70 .71	.009 .015	.38 5.1	.000 .012	1,300 1,060	15 14	0 0	4.7 .63	233 31	36 3
54	1.3 1.4	.11 .10	.84 .65	.033 .030	220 240	32 32	35 8.4			5 4.5
55	2.6 2.3	.47 .34	1.1 .86	1.6 1.5	120 138	55 51	101 97			7 4.5
56	.65 .84	.067 .13	1.2 1.4	.000 .000	450 560	31 32	21 0	1.05	52	5 4.5
57	.60 .60 .60 .76 .86 .85	.009 .020 .020 .012 .014 .014	.70 .70 .70 .69 .59 .62	.065 .065 .052 .10 .15 .14	120 120 120 116 115 112	17 16 16 17 17 16	25 25 24 17 15 18			-- 5 6 4.5 5 5
58	1.0 2.6	.009 .098	1.4 1.5	.000 .030	690 693	78 109	100 117			24 7.5
59	.12 .00	.009 .000	.68 .24	.033 .006	72 74	28 38	209 205			11 5.5
60	.68 .72	.000 .006	.30 .38	.049 .006	650 695	66 78	15 0	1.0	50	4 6
61	.68 3.6	.29 .011	.00 .54	.049 .051	980 840	37 43	0 0	3.3 .6	164 32	7 6
62	.15 .58	.029 .080	.70 .87	.016 .12	630 456	39 41	23 79			5 6

Table 4. --Stream-quality-reconnaissance data,
(Analyses in milligrams per litre; e: estimated, RB: right bank,

Site number on Pl.	Location in cross section	Date of collection	Time	Discharge (f^3/s)	Water temper- ature (°C)	Specific conduct- ance (micro- mhos at 25°C)	pH	Dissolved oxygen O ₂ (% sat.)	
63	C	June 24, 1971	1030	37	23	1,310	4.5	8.8	101
	C	Oct. 19, 1972	1000	77	5.5	1,127	6.4	11.6	92
64	C	June 24, 1971	1115	e7	24	1,500	4.3	7.6	89
64A	C	Oct. 19, 1972	0900	e6	5	269	6.9	11.8	92
65	C	June 23, 1971	1515	e13	25.5	740	8.8	10.4	125
	C	Oct. 18, 1972	1445	e12	6	585	7.5	12.4	99
66	C	June 23, 1971	1430	e2	27	2,050	8.1	11.4	141
66A	C	Oct. 18, 1972	1330	e3	6.5	3,077	7.0	10.4	84
67	C	June 23, 1971	1300	e25	22	710	7.8	11.0	125
	C	Oct. 18, 1972	1230	e20	6.5	1,147	7.8	12.0	97
68	C	June 23, 1971	1215	e14	23	460	8.2	11.8	136
	C	Oct. 18, 1972	1200	e14	7	492	7.9	10.2	84
69	C	June 23, 1971	1000	e6	20	308	7.7	9.4	102
	C	Oct. 18, 1972	1015	e5	7	347	7.9	10.5	86
70	C	June 23, 1971	1100	e2.5	19.5	293	8.2	10.1	109
	C	Oct. 18, 1972	1030	e2	6	316	7.9	11.8	94
71	C	June 22, 1971	0725	e3.5	18	650	8.2	8.5	89
	C	Oct. 19, 1972	0655	e6	6	556	7.8	11.4	91
72	C	June 22, 1971	0800	e2	18.5	550	8.6	8.6	91
	C	Oct. 19, 1972	0725	e5	5.5	503	7.9	11.6	92
73	C	June 22, 1971	0850	6.6	18	320	8.3	9.3	98
	C	Oct. 19, 1972	0815	10	5.5	377	7.9	11.4	90
74	RB	June 24, 1971	1300	1,560	29	410	7.1	8.6	110
	C	Oct. 19, 1972	1130	1,510	12	503	7.3	6.1	56
75	C	June 24, 1972	1410	e410	32	295	8.4	8.7	118
	C	Oct. 19, 1972	1040	e300	7	479	7.3	11.6	95

Greater Pittsburgh Region, Pennsylvania, June 1971 and October 1972--continued

C: center of channel, LC: center of left half, RC: center of right half)

Site number on Pl. 1	Ammono- nia nitro- gen NH ₃ -N	Ni- trite nitro- gen NO ₂ -N	Ni- trate nitro- gen NO ₃ -N	Phos- phorous P	Sul- fate SO ₄	Chlo- ride Cl	Alka- lin- ity as CO ₃ /HCO ₃	Acid- ity as H+	Acid- ity as CaCO ₃	Total organ- ic carbon
63	1.0 .89	0.000 .000	3.6 3.2	0.026 .017	890 477	35 47	0.4 7.6			5 4
64	.62	.000	4.3	.000	1,000	33	0	1.9	94	4
64A	.01	.000	.28	.006	28	12	76			3
65	.08 .00	.000 .000	.20 .17	.026 .006	310 208	8.1 11	67 96			-- 2.5
66	.18	.000	.05	.091	1,400	6.6	106			7
66A	.37	.007	.18	.000	1,060	530	70			8
67	.08 .05	.000 .000	.43 .18	.000 .000	260 443	11 22	174 169			110 4
68	.10 .00	.000 .000	.34 .00	.026 .000	94 55	20 22	198 197			6 4.5
69	.08 .00	.000 .000	.10 .00	.020 .000	38 34	3.3 6.2	145 155			8 6.5
70	.06 .00	.000 .000	.02 .00	.020 .017	42 38	2.9 2.6	142 141			7 3
71	.10 .00	.210 .000	1.4 1.6	.554 .052	70 79	81 69	106 106			5 3.5
72	.10 .00	.009 .000	.52 .58	.098 .000	72 82	34 31	167 152			5 3.5
73	.10 .01	.000 .000	.45 .49	.033 .090	50 51	24 43	55 70			4 3
74	.56 1.2	.24 .25	1.3 1.4	.163 .15	96 110	29 39	78 75			12 6.5
75	.09 .00	.009 .018	.88 1.8	.085 .15	90 53	23 27	56 67			7 4.5

Table 4.--Stream-quality-reconnaissance data,

(Analyses in milligrams per litre; e: estimated, RB: right bank,

Site number on Pl. 1	Location in cross section	Date of collection	Time	Discharge (ft^3/s)	Water temper- ature ($^{\circ}\text{C}$)	Specific conduct- ance (micro- mhos at 25°C)	Dissolved oxygen		
							pH	O ₂	(% sat.)
76	C	June 24, 1971	1030	125	23	495	7.7	8.1	93
	C	Oct. 19, 1972	0845	117	7	576	7.4	10.4	85
77	C	June 24, 1972	1400	e5	25	450	7.8	8.6	102
	C	Oct. 18, 1972	1420	e11	7.5	457	7.5	13.6	113
78	C	June 24, 1971	1230	e11	22	285	7.8	10.3	117
	C	Oct. 18, 1972	1530	e 6	6.5	299	7.6	13.2	107
79	C	June 24, 1971	1115	e12	20	355	7.7	9.0	98
	C	Oct. 18, 1972	1620	e12	6.5	406	7.5	11.4	92
80	C	June 24, 1971	1145	e13	23	485	7.9	11.2	129
	C	Oct. 18, 1972	1700	e25	7.5	510	7.5	12.0	100
81	C	June 24, 1971	0930	248	20.5	330	7.1	8.8	97
	C	Oct. 19, 1972	0945	170	6.5	410	7.6	12.2	99
82	C	June 24, 1971	1230	e15	23.5	300	7.4	8.2	95
	C	Oct. 19, 1972	1340	e16	5	413	7.7	13.4	105
83	C	June 24, 1971	1135	e14	20.5	205	7.5	8.6	94
	C	Oct. 19, 1972	1245	e8	4.5	268	7.7	12.0	93
84	C	June 24, 1971	1400	38	26	235	7.6	8.1	99
	C	Oct. 19, 1972	1145	25	11	268	7.5	10.0	90
85	C	June 24, 1971	1215	e6	23	300	7.1	8.7	100
	C	Oct. 19, 1972	1030	e15	7	323	7.4	12.1	99

Greater Pittsburgh Region, Pennsylvania, June 1971 and October 1972--continued

C: center of channel, LC: center of left half, RC: center of right half)

Site number on Pl. 1	Ammono- nitro- gen NH ₃ -N	Ni- trite nitro- gen NO ₂ -N	Ni- trate nitro- gen NO ₃ -N	Phos- phorous P	Sul- fate SO ₄	Chlo- ride Cl	Alka- lin- ity as CO ₃ /HCO ₃	Acid- ity as H ⁺	Acid- ity as CaCO ₃	Total organ- ic carbon
76	0.06 .02	0.029 .017	1.5 2.9	0.14 .28	100 145	38 44	66 65			34 4
77	.12 .02	.067 .011	1.3 1.8	.072 .12	52 40	59 77	86 54			7 4
78	.10 .00	.020 .000	1.1 .80	.033 .000	42 53	23 25	68 73			6 5
79	.16 .21	.058 .017	.95 1.1	.17 .36	56 61	32 37	74 88			11 5.5
80	.06 .02	.000 .000	.36 .56	.003 .006	130 144	40 40	45 43			4 4
81	.06 .00	.000 .000	.56 .51	.016 .035	86 108	14 15	60 72			13 3.5
82	.08 .00	.029 .006	.63 .87	.12 .24	62 76	12 15	97 118			20 5
83	.12 .00	.000 .000	.27 .40	.010 .012	60 62	9.7 13	32 29			6 3.5
84	.10 .17	.000 .000	.99 .25	.000 .012	72 65	11 10	26 31			8 5.5
85	.16 .07	.067 .031	.84 .81	.26 .23	78 82	14 18	46 31			6 3

