UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
HARRISBURG, PENNSYLVANIA

CHEMICAL AND BIOLOGICAL CONDITIONS IN BALD EAGLE CREEK AND PROGNOSIS OF TROPHIC CHARACTERISTICS OF FOSTER JOSEPH SAYERS RESERVOIR, CENTRE COUNTY, PENNSYLVANIA

By

Herbert N. Flippo, Jr.

Prepared in cooperation with the
U.S. Army Corps of Engineers
Baltimore District

OPEN-FILE REPORT 71-109

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ABSTRACT

Foster Joseph Sayers Reservoir will be impounded on moderately fertile soils; however, its water source, Bald Eagle Creek, is a bicarbonate-water stream that is overly-enriched with nutrients. About 650 of the 1,730 acres to be inundated in summer are subject to infestation with aquatic weeds. Nuisance algal "blooms" are expected to occur in summer. The reservoir will stratify in early summer and water released for conservation purposes and acid neutralization will consist mostly of hypolimnetic water. This water will be nearly depleted in dissolved oxygen and will, at times, contain relatively high concentrations of heavy metallic ions and hydrogen sulfide.

INTRODUCTION

Purpose and Scope

The purpose of this report is to present and evaluate hydrologic data relevant to newly-completed Foster Joseph Sayers Reservoir on Bald Eagle Creek in Centre County, Pennsylvania. Historical and recent information on sediment, soils in the impoundment area, water quality, and benthic macroinvertebrates in Bald Eagle Creek are presented to portray the pre-impoundment environmental base.

Because of the complexity of the chemical and ecological balances particular to impoundments, the data presently available do not permit a quantitative prognosis of the chemical and biological characteristics of the reservoir. However, the available information was evaluated, with reference to the results of more intensive studies of other shallow reservoirs, to anticipate and qualitatively assess the more economically significant post-impoundment characteristics of the reservoir.

Background Information

The watershed for Foster Joseph Sayers Reservoir (fig. 1) is the upper 339 square miles of the Bald Eagle Creek basin. This area, which is in the Valley and Ridge Province, is underlain principally by limestone and shale. Surface waters are mostly calcium-bicarbonate types.

The reservoir is designed for recreation and flood control. At its recreational-pool elevation of 630 feet, the reservoir will be 10 miles long, cover 1,730 acres, and contain 28,800 acre-feet of water. The first filling of the reservoir to its recreational level is scheduled for the spring of 1971. The capacity at the level of the flood spillway is 92,700 acre-feet. Conservation releases will dilute and neutralize the acidic flow of Beech Creek, which enters Bald Eagle Creek 2.7 miles downstream from the dam.

Nutrient loading in Bald Eagle Creek has been recognized as potentially hazardous to the recreational utility of the reservoir (U.S. Dept. of Health, Education, and Welfare, 1965, p. 37). About 50,000 of the 65,000 persons residing in the watershed are served by public-sewerage facilities in the Spring Creek basin. Efforts have been made to reduce the nutrient content of treated sewage effluents that are discharged to Spring Creek (U.S. Army Engineer District, Baltimore, 1963, Appendix M); however, nutrient concentrations in Bald Eagle Creek remain excessive.

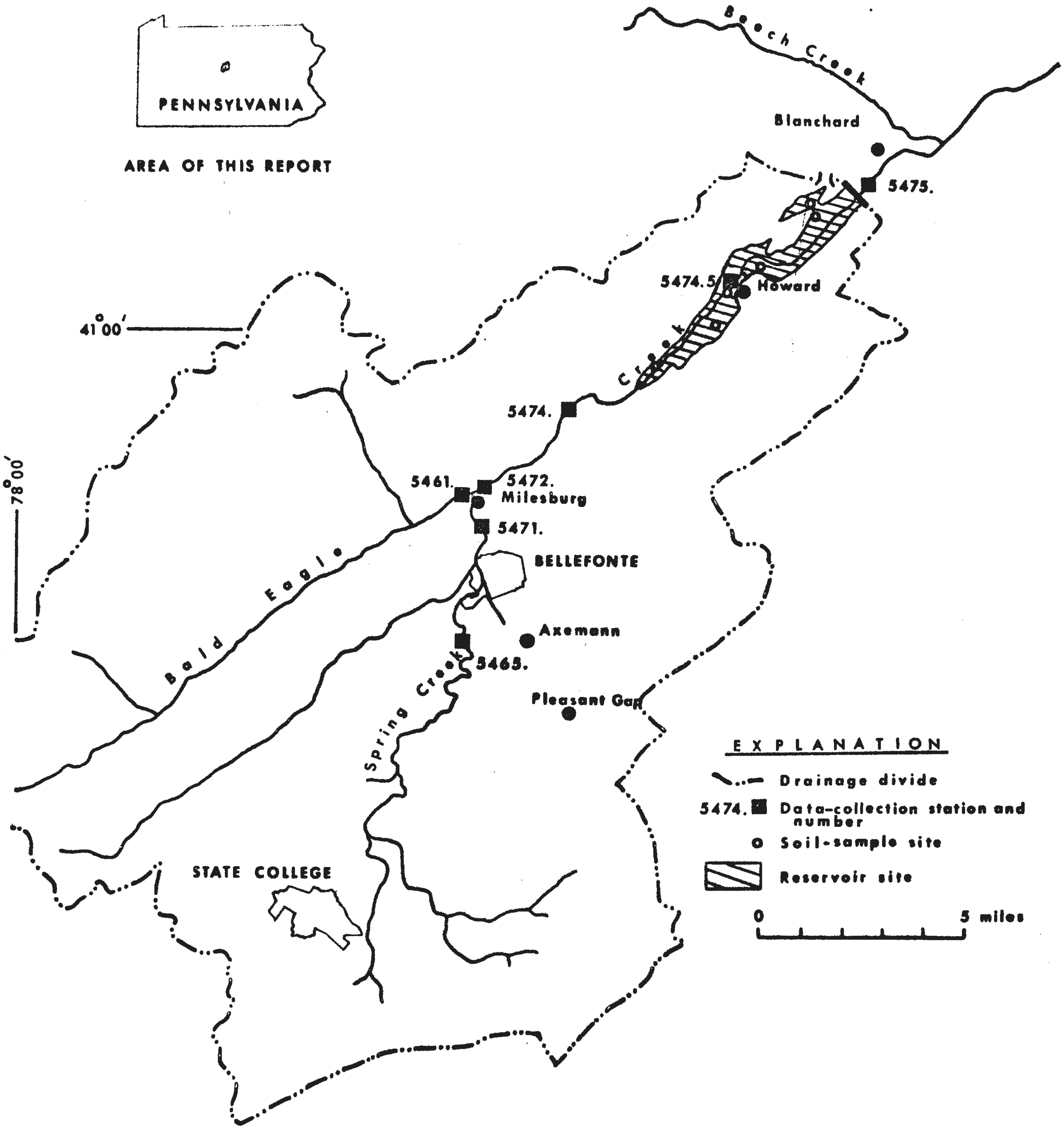

Figure 1.--Map showing data-collection sites and location of Foster Joseph Sayers Reservoir.

Methods of Investigation

The data-collection stations selected for this study are on the principal streams in and near the impoundment area. The locations of these stations are shown in figure 1. The locations of the sites where soil samples were collected are given, by latitude and longitude, in table 1.

Soil compositions were determined by the methods presented by Black (1965). The metallic ions in these samples were extracted with ammonium acetate.

Chemical analyses of water were performed according to the methods of Rainwater and Thatcher (1959) and the Federal Water Pollution Control Administration (1969). Samples analyzed for phosphates and trace metals were filtered through a 0.45- micron filter. Dissolved oxygen concentrations were determinated by the modified Winkler method.

Coliform bacteria were determined by membrane-filter techniques. Collections of benthic macroinvertebrates were made, with a Surber square-foot sampler, on the riffles at stream-gaging stations.

SEDIMENTATION

The average annual load of suspended sediment to enter the impoundment is estimated at 32,000 tons. An additional 3,000 tons, based on the estimates of Sheppard (1965, p. 276), will be transported into the reservoir annually as bedload. The total annual sediment load of 35,000 tons is partitioned according to principal source areas as follows:

Source	Drainage area (sq mi)	Load (tons/yr)
Spring Creek basin	144	16,000
Bald Eagle Creek basin above Milesburg (excluding Spring Creek basin)	121	10,000
Bald Eagle Creek basin below Milesburg	74	9,000
	339	35,000

Approximately 70 percent of the annual sediment load of Bald Eagle Creek is transported in the period from December through April. During this time, the reservoir level will usually lie between 610 and 620 feet elevation. Thus, at least three-fourths of the sediment that becomes trapped in the reservoir will be deposited below 610 feet elevation. Particle-size analyses indicate that 34 percent of the suspended sediment is clay, 62 percent is silt, and the remainder is sand. In view of the small particle size of the sediment, and taking into consideration the morphological features of the impoundment area, about two-thirds of the entrapped sediment is expected to deposit rather uniformly on the bottom between 600 and 610 feet elevation. The principal area of deposition will be that part of the reservoir within 2 miles of the causeway at Howard.

The trap efficiency of the reservoir, as determined by the method of Brune (1953, p. 414) is 75 percent. Differences in the sediment content of water samples collected upstream and downstream from the small impoundment maintained during this study indicated a trap efficiency of about 65 percent. On the basis of a 70 percent trap efficiency, silting of the reservoir is calculated as 12 acre-feet annually. As a result of this siltation, the annual loss in storage capacity will be 0.081 percent of the original 14,840 acre-feet of storage below 620 feet elevation. In the principal area of deposition in the vicinity of Howard, where about 8 acre-feet of sediment will be deposited annually, the annual loss in storage capacity will be about 0.2 percent of the original storage below 620 feet elevation.

Sediment concentrations in stream samples collected during this study at stations upstream from the reservoir site were of the same magnitude as those collected under similar flow conditions between 1955 and 1958 when samples were taken daily. Hence, the sediment-discharge characteristics of the major streams in the watershed are believed to have undergone little change, if any, between 1955 and 1970.

SOILS

Samples of the top 3 inches of soils in the impoundment area were collected at six sites on the flood plain of Bald Eagle Creek. These sites were chosen to represent a variety of depositional environments in the reservoir. The soils at all six sites have been farmed.

The results of physical and chemical analyses of these soil samples are presented in table 1. The cation exchange capacities of these samples are more or less typical of those for soils that develop in humid, temperate climates. However, for these six samples, the average exchangeable calcium content and the average percent saturation with metallic ions are about half of the typical values suggested by Lyon and others (1950, p. 115) for a mineral surface soil of a humid, temperate region. Precipitation of calcium carbonate in the impoundment is expected to increase the calcium concentration and the pH of the soil surface in those parts of the reservoir where depths are less than 10 feet in summer.

WATER QUALITY

Inorganic and Physical Characteristics

Chemical analyses by the U. S. Geological Survey that pre-date the current study are available for two of the six data-collection sites shown in figure 1. These stations are Spring Creek near Axemann (5465.) and Bald Eagle Creek at Blanchard (5475.).

Historical and current chemical analyses for Spring Creek near Axemann are presented in table 2. Inspection of these data discloses that there has been little, if any, increase in the concentrations of inorganic constituents in this stream in the last decade. However, the two samples collected in 1944 and 1945 contained significantly lower concentrations of sodium, potassium, sulfate, nitrate, and dissolved solids than did any of the more recent samples.

For the period of quality record there is no detectable change in the general relation between discharge and specific conductance. The constancy of this relation indicates that the inorganic quality characteristics of Bald Eagle Creek did not change appreciably between 1956 and 1970.

The maximum, minimum, and median values for historical chemical analyses of Bald Eagle Creek at Blanchard are given in table 2 in conjunction with the seven most recent analyses. The concentrations of all inorganic constituents, except for iron, in the most recent samples fall within the respective ranges of concentrations observed for samples collected between 1956 and 1969. Prior to 1969, much of the dissolved iron in the unfiltered samples precipitated before the analyses were performed; thus, iron concentrations in these samples tend to be lower than those in the filtered samples collected during this study. On the average, nitrate concentrations were 22 percent greater in samples collected since 1963 than they were in samples collected before 1963. However, the nitrate load of Bald Eagle Creek was only about 10 percent greater in the 1963-69 period than in the 1956-62 period. Nitrate concentrations in Bald Eagle Creek do not exhibit significant seasonal variations.

All of the sewage-treatment facilities and 87 percent of the drainage area in the watershed lie upstream from Bald Eagle Creek near Milesburg (5474.), which is about 2 miles upstream from the inflow end of the summer pool. (See fig. 1.) The quality of the stream at this station represents the quality of the water entering the reservoir. Comparison of the chemical data for this station with those for the station at Howard (5474.5) and the station at Blanchard (5475.) show that in the absence of a large impoundment (the impounded volume was between 335 and 1,650 acre-feet when samples were collected) there is little change in the inorganic quality of Bald Eagle Creek between stations 5474. and 5475. Particularly, there were no losses in bicarbonate content and little loss, if any, in nitrate content as the water flowed through the impoundment.

Organic Characteristics--Nutrient Loading and Pollution

Chemical analyses related to biological productivity and pollution are presented in table 3. Profiles of the values for dissolved oxygen, biochemical oxygen demand, and specific conductance are given in figure 2 for January 27-28, and June 19, 1970, when macroinvertebrate surveys were made. Loads of selected constituents in Bald Eagle Creek near Milesburg (5474.) are given in table 5.

The dissolved oxygen content of all samples collected at six stations (table 3) were in the range of 62 to 106 percent saturation. Spring Creek at station 5465. generally was less saturated with dissolved oxygen than was Bald Eagle Creek.

The observed 5-day biochemical oxygen demand in Spring Creek ranged from 2.1 to 4.5 mg/l (milligrams per liter). In the reach between stations 5465. and 5471., in which Spring Creek receives treated-sewage effluent, the load of biochemical oxygen demand undergoes a negligible increase. The analyses suggest that Spring Creek contributes about 40 percent of the load of biochemical oxygen demand in Bald Eagle Creek near Milesburg (5474.). Observed loads of biochemical oxygen demand at this station (table 5) are roughly proportional to the discharge. The observed loads at Howard (5474.5) were slightly greater than those at station 5474. The load of biochemical oxygen demand in Bald Eagle Creek was reduced in the reservoir by less than 20 percent when there was between 1,250 and 1,650 acre-feet of water, at temperatures less than 10°C, in storage.

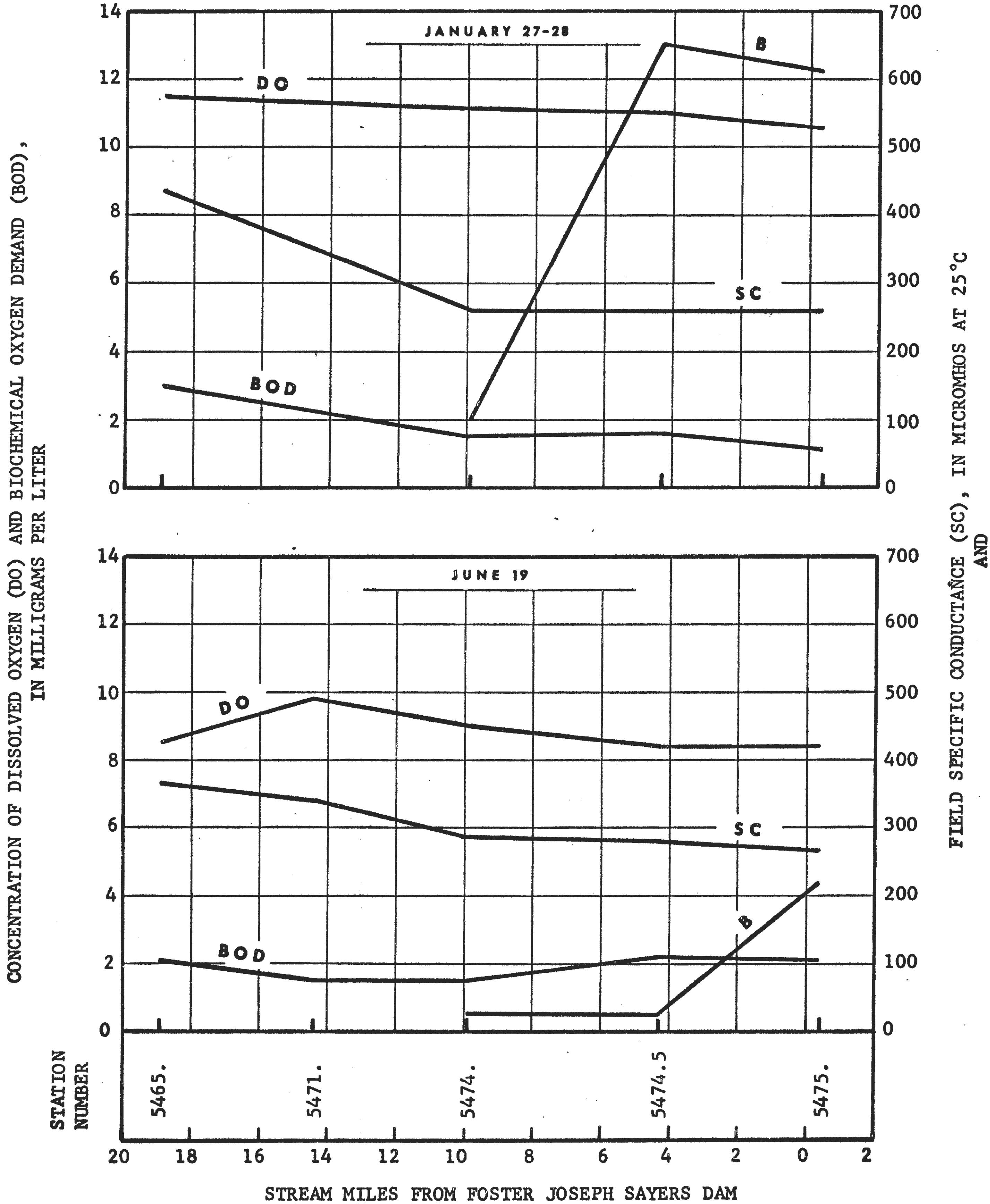

Figure 2.--Profiles of dissolved oxygen, biochemical oxygen demand, specific conductance, and biomass in Spring and Bald Eagle Creeks.

About half of the nutrients in Bald Eagle Creek at Milesburg come from the upper part of the Spring Creek basin. As shown in table 5, about 40 percent of the observed loads of calcium, magnesium, bicarbonate, and nitrate, as compared to 20 percent of the discharge, in Bald Eagle Creek near Milesburg (5474.) were transported by Spring Creek near Axemann (5465.). Nearly 60 percent of the observed loads of phosphate in Bald Eagle Creek originated in the Spring Creek basin.

The maximum observed concentrations of copper and zinc ions in Bald Eagle Creek were 0.01 mg/l. The principal sources of these metals are apparently in the lower part of the Spring Creek basin and the Bald Eagle Creek basin upstream from Milesburg.

BIOLOGY

Coliform Bacteria

The results of tests for total and fecal coliform bacteria are given in table 3. Spring Creek contained the highest densities of coliform bacteria observed; however, the densities of fecal coliform bacteria observed for Bald Eagle Creek upstream from Milesburg (station 5461.) are evidence that this stream is polluted above its confluence with Spring Creek.

Total coliforms in Bald Eagle Creek near Milesburg (5474.) exceeded 2,000 per 100 ml (milliliters), except when extremely high flows prevailed. The maximum density--24,000 per 100 ml--was observed at a high base flow of 320 cfs (cubic feet per second) and a water temperature of 18°C. Presumably, densities of total coliforms are commonly greater than 20,000 per 100 ml in the summer when streamflow is low. Observed fecal-coliform densities for this station were in the range of 5 to 2,700 per 100 ml. The highest fecal-coliform densities were coincident with the highest total-coliform densities; this coincidence was also observed for the other data-collection stations.

Densities of both total- and fecal-coliform bacteria tended to decrease in a downstream direction from station 5474. However, below the reservoir at the Blanchard station (5475.), 5 of 6 samples contained more than 1,000 total coliforms per 100 ml; densities of fecal coliforms ranged from 40 to 3,600 per 100 ml. The data indicate that even during winter and spring, coliform densities in Bald Eagle Creek exceed Pennsylvania Department of Health bathing-water standards.[1/]

The densities of fecal coliforms observed for Spring and Bald Eagle Creeks show these streams to be continually polluted by fecal matter. Although most of the sewage pollution in Bald Eagle Creek enters above the upper end of the impoundment, some of the biochemical oxygen demand and coliform data suggest that sewage sporadically enters the creek between Milesburg and Howard.

1/ Pennsylvania Department of Health bathing-water standards require an average of not more than 1,000 total coliform bacteria per 100 ml, with no more than 20 percent of the samples having counts of 1,000 to 2,400 organisms per 100 ml.

Macroinvertebrates

Macroinvertebrates were collected in January and June at three stations on Bald Eagle Creek--5474., 5474.5., and 5475. The results of these collections are summarized in table 4 and profiles of the calculated biomass are shown in figure 2.

At station 5474., near Milesburg, nearly all the organisms collected in both samplings were facultative and pollution-tolerant types, consisting mainly of caddis flies, sludge worms, and other aquatic earthworms. The only clean-water form collected was a single stone fly, which probably had been washed into the creek from a nearby tributary. The biomass in each sampling was low for a nutrient-enriched carbonate-water stream. The assemblages and numbers of organisms collected show that the stream at this site is recovering from organic pollution, but conditions unfavorable to pollution-sensitive organisms exist.

The samples collected in January at station 5474.5, at Howard, contained a diverse assemblage of macroinvertebrates, but most of the specimens were caddis flies. This assemblage indicates that the quality of the stream improves slightly between Milesburg and Howard. The June sampling contained considerably fewer families and individual organisms, particularly clean-water forms, than were observed in the previous sample. Although many bottom-dwelling organisms were probably washed away in April by floods, the families represented in the second sampling indicated that stream quality deteriorated slightly in the period between the samplings. The observed concentrations of biochemical oxygen demand and coliform bacteria support this interpretation.

Although the biomass of the samples collected at the Blanchard station (5475.) in June was less than that observed in January, the differences in the assemblages of families and the numbers of organisms in the two samplings were minor. The compositions of these samplings, together with other biological data (table 3), show that the stream has not, at least as far downstream as station 5475., attained healthful characteristics.

The average macroinvertebrate-diversity indices (Wilhm, p. 222) for the samplings are, in downstream order, 1.36, 1.64, and 0.81. These values are of the same magnitudes as those observed by Wilhm for polluted streams. Unpolluted streams generally have macroinvertebrate-diversity indices of 3 to 4.

To summarize, the macroinvertebrate collections show the ecosystem of Bald Eagle Creek in the reach from Milesburg to Blanchard to be disrupted by sewage pollution. The quality of this stream is expected to be poorest in late summer when flows are low and water temperatures are high.

Aquatic Plants

No survey of aquatic plants was made during this study; however, a dense growth of marsh smartweed (*Polygonum coccineum*), which covered about 4 acres, was noted about 1 mile above the dam. Curly-leaf pondweed (*Potamogeton crispus*) and water milfoil (*Myriophyllum spicatum*) were observed in Spring and Bald Eagle Creeks.

SIGNIFICANCE OF THE FINDINGS

Sedimentation in the Reservoir

For the foreseeable future, sedimentation in the reservoir is not expected to significantly reduce the storage capacity or to restrict recreational use of the reservoir.

Throughout most of the area below 630 feet elevation, the layer of sediment that develops within the first few years of impoundment probably will be insufficient in thickness to materially reduce the rates at which chemical equilibria are reached between substrate and the water. Thus, nutrients in the substrate are subject to solution and utilization by vegetation. Some particulate phosphatic matter is expected to be deposited with sediment and by precipitation of phosphatic lime. Most of these phosphates probably will be dissolved following the autumn overturn.

Soil Fertility and Nutrients

The chemical compositions of soil samples collected in the impoundment area (table 1) and the known capabilities of these and other soils in the area for growing grain crops (U.S. Department of Agriculture, v. I, 1968) show the soils to be mostly of medium to medium-high fertility. These soils, which have loamy textures, will provide a substrate well suited to aquatic vascular plants. The littoral area of the impoundment, which involves about 650 acres or roughly one-third of the area inundated in summer, will be subject to infestation by aquatic weeds.

The loads of nutrients, particularly phosphorus and nitrogen compounds, that Bald Eagle Creek will carry into the reservoir during the spring and summer of each year are roughly equivalent to the pre-impoundment content of nutrients in the upper 3 inches of soil. The available phosphorus and nitrogen contents of this layer of soil, in the elevation interval of 620 to 630 feet, are approximately 5 and 500 tons, respectively. The dissolved loads of these elements that will be brought into the reservoir by Bald Eagle Creek in the period from mid-March to mid-September of each year are approximately 20 and 330 tons, respectively. Although the bulk of these and other water-borne nutrients will pass through the reservoir without being assimilated by plants, they will constitute an abundant and continuously replenished source of food for rooted aquatic plants and algae. Concentrations of total phosphorus and nitrogen in the shallows of the reservoir are expected to be at least 0.2 and 2 mg/l, respectively, in early summer. These concentrations are in the optimum ranges, as observed by Chu (1943), for the growth of planktonic algae. Thus, "blooms" of algae are expected to occur shortly after the reservoir is filled.

Prognosis of Physical, Chemical, and Biological Characteristics of the Reservoir

The physical, chemical, and biological data collected during this pre-impoundment investigation were evaluated to make a prognosis of the salient characteristics of the reservoir. The morphology of the impoundment area and the observed characteristics of similar bicarbonate-water impoundments in the northern states (Symons, 1969) provided the base for this evaluation. Although pre-impoundment conditions for two or more reservoirs may, outwardly, appear similar, it cannot be safely concluded that these reservoirs eventually will have similar chemical characteristics or ecosystems. Thus, prognoses of reservoir characteristics based on comparative conditions must be either qualitative or, at best, semi-quantitative. It should be kept in mind that the following prognoses of reservoir characteristics are crude estimates.

Aquatic vascular plants are expected to become established in all shallow areas of the reservoir. Turbidity will probably limit the depth of the trophogenic zone to about 10 feet. Nearly one-third of this zone, or about 200 acres, will be in the shallow inflow end of the reservoir.

Most of the aquatic vascular plants are expected to be submersed types. Initially, the predominant plant species in the upper end of the reservoir may be curly-leaf pondweed, which is already well established in Spring Creek and in Bald Eagle Creek in the vicinity of Milesburg. Other plants that prefer turbulent bicarbonate waters, such as *Potamogeton filiformis* and *Myriophyllum spicatum*, are expected to occupy the swifter water. As the reservoir ages, plants suited to silt substrates of high organic content may become the principal forms in the upper end of the impoundment; such plants include *Elodea canadensis*, *Potamogeton pectinatus*, and *Potamogeton natans* (Sculthorpe, p. 59).

In other parts of the reservoir plant growth may be more dependent on soil characteristics than on water quality; however, many types of aquatic plants are suited to the environment of the trophogenic zone. Judging from the predominant species in Conewago Lake in York County, Pennsylvania, (Barker, J. L., and Ott, A. N., oral commun., 1970) *Potamogeton crispus*, *Najas flexilis*, *Ceratophyllum demersum*, and *Myriophyllum spicatum* may be some of the principal species in the reservoir. Dense stands of these plants may develop where light and the substrate are suitable.

The predominant algae are expected to be those suited to phosphate-enriched bicarbonate waters. Blue-green types will probably be the dominant forms in the epilimnion in summer. Stoneworts (*Chara* spp.) should grow well in the shallows. By late summer, algal growths may reach nuisance proportions, but they may also serve to control submersed aquatic plants in the deeper parts of the trophogenic zone by increasing the turbidity.

Foster Joseph Sayers Reservoir is expected to be thermally and chemically stratified in summer, as are most reservoirs in the temperate zone. Each year, filling of the reservoir will begin about the middle of March. In most years, streamflow is adequate, with allowance for conservation releases, to fill the reservoir to its summer level of 630 feet elevation by the middle of June. The density of the warm inflow in late spring is expected to be sufficiently lower than that of the cooler impounded water to cause this inflow to occur as an "overflow" in the reservoir, thereby initiating stratification. At this time the thickness of the epilimnion may be 10 feet or less, but by late summer the thickness of the epilimnion is expected to be about 15 feet. Along the principal path of flow, which is expected to follow the present course of Bald Eagle Creek at least as far downstream as Howard, the metalimnion may be less distinct and thicker than it is elsewhere; however, nowhere in the reservoir is the metalimnion expected to extend to a depth of more than 25 feet. Thus, the hypolimnion will always include the water below 605 feet elevation when the stratified reservoir is filled to 630 feet elevation. This process of stratification is similar to that observed in other impoundments in Pennsylvania (Barker, J. L., oral commun., 1970).

The average temperature of the epilimnion will probably be about 20°C when stratification becomes established. By mid-summer, surface temperatures are expected to approach a maximum of 30°C. The hypolimnion probably will remain below 15°C throughout the summer. No thermally definable hypolimnion is expected to develop in re-entrants created by tributary valleys or in the embayment upstream from Howard created by the abandoned railroad and highway embankments.

Flow in the lower part of the reservoir, from about 1 mile downstream from Howard to the dam, will probably be almost uniformly distributed over the width of the impoundment. Flow entering the outlet works of the dam will be regulated, for quality-control purposes, by the manipulation of two tiers of 7×10-foot leaf gates. Any combination of leaf-gate sections may be removed to permit discharge from selected 10-foot strata. In addition, flow may be restricted to the upper half of one 10-foot zone by the insertion of a half-sized gate. During most of the summer, two open gates will provide sufficient release to maintain the reservoir at the recreational-pool elevation. Thus, water may be discharged from at least two levels throughout the summer.

Stratification is not expected to develop in winter. In the period from December through February, the maximum depth of the reservoir will be approximately 20 feet and an ice cover will exist most of the time. The volume of inflow will generally be sufficient to exchange the water in storage, on a volume-for-volume basis, every 9 days. Thus, the retention time of water in the reservoir in winter is expected to be sufficiently short to prevent stratification.

Chemical stratification is expected to accompany thermal stratification. The processes of chemical stratification probably will include the following phenomena:

1) A reduction of nitrate and dissolved phosphorus in the epilimnion in response to the growth of algae and aquatic vascular plants;
2) Maintenance, by photosynthesis, of near-saturation dissolved oxygen concentrations in the epilimnion during the day;
3) A slight reduction in the bicarbonate ion content of the epilimnion as this ion is broken down in photosynthesis and is consumed in nitrification;
4) Precipitation of calcium carbonate in shoreward parts of the epilimnion, occasionally with co-precipitation of iron, manganese and phosphate;
5) A general increase in the pH of the epilimnion, to a maximum of about 9.2, as the summer progresses;

6) A depletion of the dissolved oxygen in the hypolimnion caused by the biochemical oxygen demands of the water used to fill the reservoir, particulate organic matter that settles from the epilimnion and metalimnion, and the inundated soils (In most years, the hypolimnion probably will be nearly devoid of dissolved oxygen within 30 days after thermal stratification develops.);

7) An increase, to levels much greater than those in the inflow, in concentrations of heavy metals (particularly iron, manganese, and copper) in the hypolimnion caused by reduction and leaching of the substrate and metallic precipitates;

8) Generation of hydrogen sulfide gas in the hypolimnion, as a result of organic decay during summer and autumn;

9) A progressive reduction in turbidity in a downstream direction caused by settling of suspended sediment (The least turbid waters are expected to be in border areas removed from the central path of flow.); and,

10) A slight accumulation of bicarbonate in the hypolimnion, created by the combination of carbon dioxide with precipitated calcium carbonate.

The estimatable characteristics of the three zones of stratification (which are important to recreational usage and the ecology of the reservoir) in late summer are summarized as follows:

EPILIMNION--

Elevation range: 632-615 feet

Temperature range: 25-30°C

Plants: algae, mostly blue-green varieties, appearing as dense "blooms" in areas of still water; prolific growths of aquatic vascular plants in shallows--especially in the upper end of the reservoir

Coliform bacteria: total coliform group usually more than 20,000 per 100 ml and fecal coliforms often more than 5,000 per 100 ml in Bald Eagle Creek; density of coliforms expected to be sharply reduced in the reservoir, but excessive concentrations may persist in bathing areas

Chemical:

pH range: 8.5 to 9.2

Dissolved oxygen: at or near saturation

Five-day biochemical oxygen demand: less than 1 mg/1

Iron and manganese: both less than 0.02 mg/1

Copper and zinc: both less than 0.01 mg/1

Bicarbonate ion: 130 (±20) mg/1

Nitrogen and phosphorus: concentrations, although indeterminate, will be adequate to support a heavy growth of aquatic plants

METALIMNION

Elevation range: somewhat variable, depending on degree of development and location in the reservoir; generally between elevations of 625 feet and 605 feet along the central path of flow

Temperature range: 12-20°C

Chemical:

- pH range: 7.5 to 8.5
- Dissolved oxygen: less than 5 mg/l most of the time
- Five-day biochemical oxygen demand: 1 to 3 mg/l
- Metallic ions, bicarbonate ion, and compounds of nitrogen and phosphorus: concentrations similar to those prevailing in Bald Eagle Creek

HYPOLIMNION--

Elevation of upper limit: probably no greater than 615 feet and no less than 605 feet where present

Temperature range: 12 (±3)°C

Chemical:

- pH range: 7.5 to 8
- Dissolved oxygen: 0 to 3 mg/l
- Five-day biochemical oxygen demand: up to 3 mg/l
- Iron and manganese: up to 1 mg/l, or more
- Copper and zinc: both less than 0.1 mg/l
- Bicarbonate ion: 140 (±20) mg/l
- Nitrate: greater than 5 mg/l
- Total phosphate: approximately 0.4 mg/l
- Dissolved hydrogen sulfide: present in lower part of reservoir in late summer and autumn

Effects of the Reservoir on Water Quality Below the Dam

The quality of Bald Eagle Creek below the reservoir will be poorest in late summer and autumn. Conservation releases during this part of the year will be of low oxygen content because much of the water released will come from the metalimnion and hypolimnion. This water will undoubtedly undergo some re-aeration in the stilling basin, but fishlife and benthic macroinvertebrates may be adversely affected for several miles below the dam.

Drainage of the reservoir to its winter-pool level before the onset of the autumn overturn, which is expected to occur early in November, will serve to flush heavy metallic ions and nutrients from the hypolimnion. Such flushing, which will help prevent the gradual and undesirable accumulation of minerals in the impoundment, may prove somewhat deleterious to fish and benthic macroinvertebrates.

SUMMARY AND CONCLUSIONS

The results of this investigation show Bald Eagle Creek to be sufficiently over-enriched to promote nuisance growths of algae and aquatic weeds in the reservoir. Excessive growths of aquatic vegetation and high densities of coliform bacteria are expected to reduce the recreational utility of the reservoir in summer.

The reservoir is expected to stratify in early summer. Bottom waters, the release of which will be regulated for quality-control purposes, will be depleted of dissolved oxygen in summer and early autumn.

In autumn, when oxygen-depleted waters are released for conservation purposes, fishlife in Bald Eagle Creek may be adversely affected for several miles downstream from the dam.

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APPENDIX

Table 1.--Physical and chemical analyses of soils in the impoundment area

Soil type	Site	Location	Elevation feet	Sand	Silt	Clay	Carbon (C)	Nitrogen (N)	C/N	Phosphorus (P) Total	Phosphorus (P) Available
				percent			percent			milligrams per 100 grams	
Melvin silt loam	1	40°59'13"N 77°42'11"	628	46	36	18	1.79	0.14	12.8	42.5	1.0
Chagrin loam	2	41°00'57"N 77°40'00"	613	50	32	18	1.42	.13	10.9	49.0	2.0
Dunning silty-clay loam	3	41°00'18"N 77°40'18"	622	18	46	36	2.72	.21	13.0	56.5	<1.0
Pope loam	4	41°01'19"N 77°38'59"	615	42	36	22	2.40	.19	12.6	100	4.3
Berks channery silt loam	5	41°02'42"N 77°37'37"	610	24	48	28	2.22	.21	10.6	80.0	1.6
Hublersburg silt loam	6	41°02'33"N 77°37'23"	603	26	46	28	1.37	.22	6.2	86.5	1.5

Table 1.--Physical and chemical analyses of soils in the impoundment area (continued)

Site	pH	Milliequivalents per 100 grams						Percent saturation with metallic ions	Milligrams per 100 grams					
		Cation exchange capacity	Hydrogen (H)	Sodium (Na)	Potassium (K)	Calcium (Ca)	Magnesium (Mg)		Iron (Fe)	Manganese (Mn)	Copper (Cu)	Zinc (Zn)	Available Potassium (K)	Available Magnesium (Mg)
1	6.3	14.00	8.77	0.03	0.30	3.80	1.10	38	0.55	5.3	0.36	0.80	8.3	19.2
2	7.1	12.78	6.60	.00	.30	3.80	2.08	48	.60	3.5	.42	.50	8.7	34.5
3	5.2	21.92	16.74	.04	.31	3.25	1.58	24	.65	1.1	.40	.34	6.8	13.0
4	7.1	19.28	13.01	.03	.40	4.80	1.04	33	.57	1.2	.40	.30	12.7	44.4
5	7.2	18.78	12.33	.03	.47	5.50	.45	52	.70	2.8	.38	.33	14.1	4.5
6	6.0	17.13	11.54	.00	.94	3.50	1.15	33	.67	5.3	.45	.34	23.5	10.0

Table 2.--Chemical analyses of streams

(Chemical data in milligrams per liter, except as noted)

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe) 1/	Manganese (Mn) 1/	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Specific conductance (micromhos at 25°C)	pH: field	pH: laboratory	Color (cobalt-platinum scale)
1-5465. Spring Creek near Axemann, Pa. (lat 40°53'25"N, long 77°47'40")																				
8-10-44	54	3.3	0.02	----	44	18		1.0	197	12	3.2	0.0	9.4	198	184	22	339	---	8.4	--
4-18-45	115	3.8	.05	0.00	45	16		1.3	190	13	2.8	.0	9.6	182	178	22	337	---	7.8	--
10-17-63	25	----	----	----	---	----	12	---	219	17	11	---	18	---	200	21	420	---	7.7	--
3- 6-67	169	35	.00	.00	48	10	12	3.2	142	26	19	.8	18	259	161	45	359	---	7.9	9
3-27-67	153	6.2	.00	.00	50	16	3.8	1.6	184	23	8.5	.0	11	218	191	40	361	---	8.2	2
9-26-67	37	4.7	.00	.00	55	19	8.0	2.5	225	19	13	.0	17	261	215	31	431	---	8.2	1
1- 6-70	48	14	.27	.04	60	18	8.8	2.5	215	21	16	.0	13	266	224	48	469	7.4	7.7	3
1-27-70	41	----	----	----	62	18	18		208	27	42	---	12	---	229	58	541	7.5	8.3	1
2-24-70	99	----	.03	.03	---	----	----	---	---	--	--	---	14	---	---	--	470	7.4	---	2

Table 2.--Chemical analyses of streams--Continued

(Chemical data in milligrams per liter, except as noted)

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe) 1/	Manganese (Mn) 1/	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$		Specific conductance (micromhos at 25°C)	pH		Color (cobalt-platinum scale)
															Calcium, magnesium	Noncarbonate		field	laboratory	
1-5465. Spring Creek near Axemann, Pa.--Continued																				
3-26-70	148	----	0.03	0.03	61	16	6.9		213	22	17	---	14	---	218	44	447	7.7	7.7	2
4-29-70	203	----	.01	.03	--	----	----	---	---	--	----	---	13	---	---	--	375	7.6	---	--
5-27-70	95	----	.05	.04	50	18	3.0		190	23	12	---	11	---	199	44	400	7.8	7.4	6
1-5474. Bald Eagle Creek near Milesburg, Pa. (lat 40°58'31", long 77°44'35")																				
1- 6-70	222	5.5	.21	.02	31	11	5.4	1.6	114	23	10	0.0	8.1	171	123	29	285	7.3	7.9	1
1-28-70	213	5.8	.20	.02	36	11	8.2	1.7	124	26	18	.0	9.4	194	135	34	328	8.2	8.0	1
2-25-70	a/975	----	.05	.02	25	7.5	7.1		83	21	10	---	6.5	---	94	26	246	7.2	7.4	1
3-26-70	a/1,080	----	.05	.02	21	6.4	12		78	25	8.6	---	5.0	---	79	15	223	7.7	7.6	2
4-29-70	a/1,360	----	.04	.03	25	8.5	3.7		85	22	6.9	---	4.3	---	98	28	218	7.5	7.6	12
5-27-70	310	----	.03	.02	34	12	3.4		123	21	9.1	---	7.2	---	135	34	280	8.2	7.8	6
6-19-70	320	----	.04	.02	--	----	----	---	---	--	----	---	7.7	---	---	--	285	8.1	---	--

Table 2.--Chemical analyses of streams--Continued

(Chemical data in milligrams per liter, except as noted)

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe) 1/	Manganese (Mn) 1/	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Specific conductance (micromhos at 25°C)	pH: field	pH: laboratory	Color (cobalt-platinum scale)
1-5474.5 Bald Eagle Creek at Howard, Pa. (lat 41°01'04", long 77°39'54")																				
10- 3-69	a/190	----	----	----	14	8.8	30		---	47	12	---	8.6	---	71	9	256	7.3	9.4	6
1- 6-70	251	4.7	0.62	0.03	34	10	5.6	1.7	115	25	10	0.0	6.0	169	126	32	289	7.2	7.9	1
1-28-70	a/235	---	----	----	30	11	17		121	27	16	---	8.5	---	120	21	317	8.2	8.1	1
2-25-70	1,060	---	.05	.02	25	6.8	9.7		79	27	9.7	---	6.7	---	91	26	240	7.3	7.8	1
3-26-70	1,180	---	.08	.02	25	7.1	11		80	31	8.5	---	6.2	---	92	26	234	7.8	7.6	2
4-29-70	1,490	---	.04	.04	25	8.0	6.0		84	26	6.7	---	3.6	---	96	27	224	7.5	7.4	6
5-27-70	340	---	----	----	--	----	----		---	--	----	---	6.6	---	---	--	300	---	8.6	--

Table 2.--Chemical analyses of streams--Continued

(Chemical data in milligrams per liter, except as noted)

Date of collection	Mean discharge (cfs)	Silica (SiO_2)	Iron (Fe) 1/	Manganese (Mn) 1/	Calcium (Ca)	Magnesium (Mg)	Sodium (Na)	Potassium (K)	Bicarbonate (HCO_3)	Sulfate (SO_4)	Chloride (Cl)	Fluoride (F)	Nitrate (NO_3)	Dissolved solids (residue at 180°C)	Hardness as $CaCO_3$: Calcium, magnesium	Hardness as $CaCO_3$: Noncarbonate	Specific conductance (micromhos at 25°C)	pH: field	pH: laboratory	Color (cobalt-platinum scale)
1-5475. Bald Eagle Creek at Blanchard (lat 41°03'05", long 77°36'10")																				
1- 7-70	246	4.4	0.23	0.04	36	10	5.8	1.6	118	27	11	0.0	6.6	176	131	35	298	7.9	8.0	2
1-27-70	239	5.3	.23	.04	36	11	7.3	1.8	124	27	15	.0	7.6	192	135	34	315	7.9	8.0	1
2-25-70	704	---	.07	.02	26	7.5	9.7		83	28	10	---	7.5	---	96	28	241	7.3	7.6	2
3-26-70	1,000	---	.09	.03	25	7.4	11		83	30	9.7	---	5.1	---	93	25	239	7.8	7.8	2
4-29-70	1,040	---	.01	.07	26	9.0	4.4		91	23	6.9	---	4.1	---	102	28	227	7.8	7.5	4
5-27-70	415	---	.02	.06	36	13	2.8		126	25	9.2	---	8.5	---	144	40	291	8.0	7.6	6
6-19-70	425	---	----	----	--	----	----		---	--	---	---	6.5	---	---	--	265	8.0	---	--
1-5475. (Summary of historical chemical analyses--1956, 1959-69)																				
Minimum	-----	1.8	.00	.00	15	4.1	2.1	.5	43	11	2.5	.0	1.0	88	57	12	142	---	6.6	1
Maximum	-----	35	.13	.10	49	18	12	3.2	195	35	16	.2	16	248	208	46	393	---	8.6	15
Median	-----	6.6	.01	.01	39	13	5.6	1.8	154	22	8.0	.1	6.1	191	155	27	325	---	7.7	3
No. of analyses		61	46	45	74	74	73	60	105	105	105	47	104	81	105	105	105		105	100

1/ Dissolved (total for analyses prior to 1969).
a/ Estimated.

Table 3.--Chemical analyses related to biological productivity and pollutional conditions in Bald Eagle Creek basin--1970

(Chemical data in milligrams per liter, except as noted)

Date 2/	Time (EST)	Discharge (cfs)	Temperature (°C)	Dissolved oxygen	Oxygen saturation (%)	Biochemical oxygen demand (5-day)	Total coliforms (no/100 ml)	Fecal coliforms (no/100 ml)	Copper (Cu)	Zinc (Zn)	Bicarbonate (HCO_3)	Nitrate (NO_3)	Total organic nitrogen (N)	Ammonium nitrogen (N)	Dissolved orthophosphate (PO_4)	Total phosphate 1/ (PO_4)	Specific conductance in field (micromhos at 25°C)
1-5461. Bald Eagle Creek above Spring Creek at Milesburg, Pa.																	
5-27-70	8:15 a.m.	a/110	14.5	7.7	75	1.0	5,000	530	0.01	0.00	---	0.5	0.00	0.02	0.07	1.2	100
6-19-70	5:35 a.m.	a/ 90	19.0	8.9	95	1.0	23,000	1,100	----	----	---	1.8	.14	.10	.1	.1	135
1-5465. Spring Creek near Axemann, Pa.																	
1- 6-70	7:50 a.m.	48	2.5	8.5	62	---	------	-----	----	----	215	13	----	----	1.7	2.5	355
1-27-70	12:30 p.m.	41	4.0	11.5	84	3.0	------	-----	----	----	208	12	----	----	2.0	2.8	435
2-24-70	2:15 p.m.	99	6.5	11.6	94	4.4	------	-----	----	----	---	14	----	----	1.2	1.2	520
3-26-70	7:10 a.m.	148	8.0	10.1	85	3.7	------	-----	----	----	213	14	----	----	.76	.88	420
4-29-70	7:00 a.m.	203	14.0	8.3	80	4.5	------	-----	.00	.00	---	13	----	----	1.2	1.2	375
5-27-70	6:15 a.m.	95	15.0	8.6	85	2.9	26,000	480	.00	.00	190	11	.48	.25	.99	1.3	420
6-19-70	4:55 a.m.	103	17.0	8.5	87	2.1	21,000	1,300	----	----	---	13	.40	.22	1.1	1.1	365

Table 3.--Chemical analyses related to biological productivity and pollutional conditions in Bald Eagle Creek basin--1970

Continued

(Chemical data in milligrams per liter, except as noted)

Date 2/	Time (EST)	Discharge (cfs)	Temperature (°C)	Dissolved oxygen	Oxygen saturation (%)	Biochemical oxygen demand (5-day)	Total coliforms (no/100 ml)	Fecal coliforms (no/100 ml)	Copper (Cu)	Zinc (Zn)	Bicarbonate (HCO_3)	Nitrate (NO_3)	Total organic nitrogen (N)	Ammonium nitrogen (N)	Dissolved orthophosphate (PO_4)	Total phosphate 1/ (PO_4)	Specific conductance in field (micromhos at 25°C)
			1-5471. Spring Creek at Milesburg, Pa.														
5-27-70	7:30 a.m.	204	13.0	8.2	77	1.4	12,000	2,200	0.01	0.01	---	12	0.33	0.08	0.48	0.71	410
6-19-70	5:20 a.m.	231	15.0	9.8	97	1.5	30,000	3,800	----	----	---	--	----	----	----	----	340
			1-5474. Bald Eagle Creek near Milesburg, Pa.														
1- 6-70	11:30 a.m.	222	5.5	10.9	86	---	1,800	-----	----	----	114	8.1	----	----	.46	.53	240
1-28-70	8:30 a.m.	213	5.5	11.1	88	1.5	2,700	300	----	----	124	9.4	----	----	.74	.74	260
2-25-70	8:30 a.m.	a/975	4.0	12.4	94	1.4	3,900	260	----	----	83	6.5	----	----	.24	.29	240
3-26-70	8:20 a.m.	a/1,080	6.0	11.9	95	1.3	------	200	----	----	78	5.0	----	----	.14	.25	205
4-29-70	8:30 a.m.	a/1,360	14.0	9.1	88	2.3	230	5	.01	.01	85	4.3	----	----	.39	.39	210
5-27-70	9:15 a.m.	310	15.0	10.2	100	1.2	13,000	660	.00	.01	123	7.2	.00	.09	.21	.41	280
6-19-70	6:00 a.m.	320	18.0	9.0	94	1.5	24,000	2,700	.00	.00	---	7.7	.55	.24	.42	.42	285

Table 3.--Chemical analyses related to biological productivity and pollutional conditions in Bald Eagle Creek basin--1970

Continued

(Chemical data in milligrams per liter, except as noted)

Date 2/	Time (EST)	Discharge (cfs)	Temperature (°C)	Dissolved oxygen	Oxygen saturation (%)	Biochemical oxygen demand (5-day)	Total coliforms (no/100 ml)	Fecal coliforms (no/100 ml)	Copper (Cu)	Zinc (Zn)	Bicarbonate (HCO_3)	Nitrate (NO_3)	Total organic nitrogen (N)	Ammonium nitrogen (N)	Dissolved orthophosphate (PO_4)	Total phosphate 1/ (PO_4)	Specific conductance in field (micromhos at 25°C)
							1-5474.5 Bald Eagle Creek at Howard, Pa.										
10- 3-69	9:00 a.m.	a/190	18.0	7.6	79	---	16,000	5,700	----	----	----	8.6	----	----	----	1.0	360
1- 6-70	3:00 p.m.	251	4.5	10.9	84	---	1,000	-----	----	----	115	6.0	----	----	0.50	.57	235
1-28-70	2:45 p.m.	a/235	5.5	11.0	87	1.6	560	10	----	----	121	8.5	----	----	.74	.74	260
2-25-70	12:30 p.m.	1,060	4.0	12.9	98	1.6	450	52	----	----	79	6.7	----	----	.22	.36	240
3-26-70	11:10 a.m.	1,180	7.0	13.0	106	1.3	------	-----	----	----	80	6.2	----	----	.16	.29	230
4-29-70	10:00 a.m.	1,490	14.5	8.8	86	2.3	150	0	----	----	84	3.6	----	----	.46	.46	220
5-27-70	12:30 p.m.	340	15.5	10.1	100	1.2	18,000	240	----	----	---	6.6	0.03	0.03	.25	.34	300
6-19-70	6:40 a.m.	a/355	19.0	8.4	90	2.2	22,000	5,900	----	----	---	---	----	----	----	----	280

Table 3.--Chemical analyses related to biological productivity and pollutional conditions in Bald Eagle Creek basin--1970

Continued

(Chemical data in milligrams per liter, except as noted)

Date 2/	Time (EST)	Discharge (cfs)	Temperature (°C)	Dissolved oxygen	Oxygen saturation (%)	Biochemical oxygen demand (5-day)	Total coliforms (no/100 ml)	Fecal coliforms (no/100 ml)	Copper (Cu)	Zinc (Zn)	Bicarbonate (HCO_3)	Nitrate (NO_3)	Total organic nitrogen (N)	Ammonium nitrogen (N)	Dissolved orthophosphate (PO_4)	Total phosphate 1/ (PO_4)	Specific conductance in field (micromhos at 25°C)
							1-5475. Bald Eagle Creek at Blanchard, Pa.										
1- 7-70	8:45 a.m.	246	3.0	11.1	82	---	1,400	-----	----	----	118	6.6	----	----	0.44	0.53	235
1-27-70	2:50 p.m.	239	3.5	10.5	78	1.1	2,100	160	----	----	124	7.6	----	----	.60	.68	260
2-25-70	2:30 p.m.	704	3.5	13.4	100	1.3	1,600	180	----	----	83	7.5	----	----	.21	.54	250
3-26-70	1:00 p.m.	1,000	8.0	11.9	100	1.1	------	85	----	----	83	5.1	----	----	.15	.27	235
4-29-70	3:00 p.m.	1,250	17.5	9.4	97	2.5	920	40	----	----	91	4.1	----	----	.64	.64	225
5-27-70	2:30 p.m.	415	18.0	9.0	94	1.6	7,600	400	0.01	0.01	126	8.5	0.32	0.04	.21	.53	300
6-19-70	7:30 a.m.	425	21.5	8.4	94	2.1	17,000	3,600	----	----	---	6.5	.22	.18	.29	.29	265

1/ Dissolved orthophosphate and acid-persulfate hydrolyzable phosphorus compounds.
2/ Coliform determinations made on previous day.
a/ Estimated.

Table 4.--Macroinvertebrate collections in Bald Eagle Creek--January and June 1970

Phylum	Class	Order	Family	Common name	1/	Milesburg		Howard		Blanchard	
					Station number	5474.		5474.5		5475.	
					Date	1-28	6-18	1-28	6-18	1-28	6-19
						Number of individuals in 3 square feet					
Arthropoda	Insecta	Tricoptera	Hydropsychidae	caddis flies	F	113	25	1,186	63	1,054	897
			Rhyacophilidae	-----do.------	F	---	--	34	--	2	6
		Ephemeroptera	Baetidae	mayflies	C	---	--	2	1	-----	---
			Ephemeridae	-----do.------	F	---	--	1	--	-----	---
			Heptageniidae	-----do.------	C	---	--	6	--	-----	---
		Plecoptera	Nemouridae	stoneflies	C	1	--	-----	--	-----	---
			Perlodidae	-----do.------	C	---	--	1	--	-----	---
		Lepidoptera	Pyralididae	aquatic caterpillars	C	---	--	-----	--	3	---
		Megaloptera	Corydalidae	fishflies	C	---	--	-----	--	3	---
		Coleoptera	Elmidae	beetles	C	---	--	36	1	3	2
			Hydrophilidae	-----do.------	F	---	2	-----	1	-----	---
			Psephenidae	-----do.------	F	---	--	4	--	-----	---
		Diptera	Anthomyiidae	anthomyiids	F	---	--	21	--	1	---
			Ceratopogonidae	biting midges	F	---	--	7	--	25	---
			Culicidae	phantom midges	F	---	2	-----	1	-----	---
			Ephydridae	shore flies	F	---	1	3	--	-----	3
			Ptychopteridae	phantom crane flies	F	---	--	1	--	-----	---
			Simuliidae	black flies	F	---	--	29	--	15	---
			Tendipedidae	midges	F	---	6	51	24	12	329
			Tipulidae	crane flies	F	1	1	95	--	5	---

Table 4.--Macroinvertebrate collections in Bald Eagle Creek--January and June 1970--Continued

Phylum	Class	Order	Family	Common name	1/	Milesburg 5474. 1-28	Milesburg 5474. 6-18	Howard 5474.5 1-28	Howard 5474.5 6-18	Blanchard 5475. 1-28	Blanchard 5475. 6-19
						Number of individuals in 3 square feet					
Arthropoda	Insecta	Zygpoptera	Coenagrionidae	damselflies	F	---	3	1	--	--	2
	Crustacea	Isopoda	Ascellidae	sow bugs	F	---	--	3	2	--	4
		Amphipoda	Haustoriidae	scuds	F	---	--	--	--	--	2
Mollusca	Gastropoda	-----------	Physidae	snails	F	---	--	12	3	4	--
			Planorbidae	-----do.------	F	---	1	--	--	--	---
	Pelecypoda	-----------	Spaeriidae	clams	F	---	--	--	-	1	4
			Unionidae	mussels	F	---	--	--	--	--	1
Annelida	Oligochaeta	-----------	Tubificidae	sludge worms	P	8	40	2	1	2	--
			(others)	aquatic earth-worms	P	2	2	--	8	--	3
	Hirudinea	Arhynchobdellida	Erpobdellidae	leeches	P	---	--	7	--	1	--
		Rhynchobdellida	Glossiphoniidae	-----do.------	P	---	--	1	--	2	--
			Total individuals			125	83	1,503	105	1,133	1,253
			No. of families			6	11	22	12	15	11
			Biomass 2/ (kilograms per hectare)			100	26	650	24	610	220
			Percent clean-water organisms (C)			.8	0	29.9	1.9	.8	.2
			Percent facultative organisms (F)			91.2	49.4	69.4	89.5	98.8	99.5
			Percent pollution-tolerant organisms (P)			8.0	50.6	.7	8.6	.4	.3

1/ Pollution status of organisms (C, clean water; F, facultative; P, pollution tolerant): After Surber, 1960.

2/ Does not include Gastropoda or Pelecypoda.

Table 5.--Loads of constituents--Bald Eagle Creek near Milesburg, Pa.

(Results in tons per day, based on indicated discharge)

Date	Discharge (cfs)	Dissolved oxygen (DO)	Biochemical oxygen demand (BOD)	Calcium (Ca)	Magnesium (Mg)	Sodium + Potassium (Na+K)	Bicarbonate (HCO_3)	Nitrate-nitrogen (N)	Ammonium nitrogen (N)	Total phosphorus 1/ (P)	Dissolved Orthophosphate phosphorus (P)
1-6-70	222	6.5	----	19	6.6	4.2	68	1.1	----	0.10	0.09
1-28	213	6.4	0.86	21	6.3	5.7	71	1.2	----	.14	.14
2-25	975	33	3.7	66	20	19	220	3.9	----	.25	.21
3-26	1,080	35	3.8	61	19	35	230	3.3	----	.24	.13
4-29	1,360	33	8.4	92	31	14	310	3.6	----	.47	.47
5-27	310	8.5	1.0	28	10	2.8	100	1.4	0.08	.11	.06
6-19	320	7.8	1.3	--	----	----	----	1.5	.21	.12	.12
Average percentage that was carried by Spring Creek at station 5465. on sampling dates	20	18	28	40	37	24	39	37	----	60	62

1/ Phosphorus in dissolved orthophosphate and acid-persulfate hydrolyzable phosphorus compounds.