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BELTZVILLE LAKE PROJECT WATER QUALITY DATA REPORT (RCS-DAEN-CWE--ETC(U)
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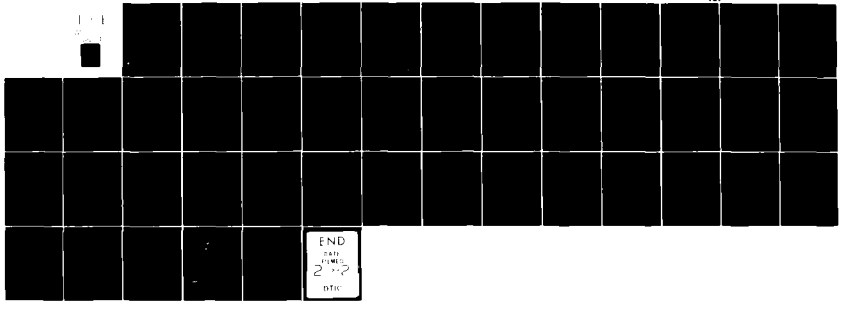

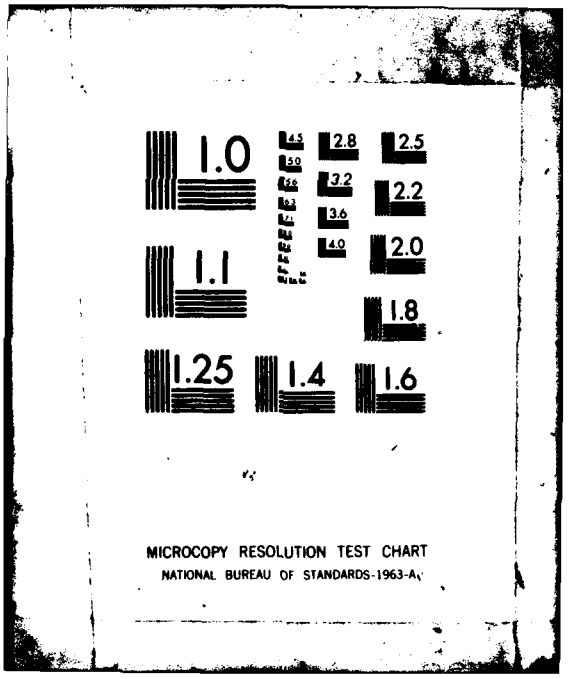
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BELTZVILLE LAKE PROJECT

WATER QUALITY DATA REPORT (RCS DAEN-CWE-15)

Prepared by

U. S. Army Corps of Engineers
Philadelphia District

FOR THE PERIOD
OCTOBER 1, 1980 TO SEPTEMBER 30, 1981

REPORT NO: DAEN/NAP - 01340/WQDR81 - 81/12

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Beltzville Lake, located on the Pohopoco Creek in Carbon County, northwest of Allentown, Pa has been in operation since Oct. 1970. The primary purposes of the project are flood control, water quality control, future water supply, low flow augmentation and recreation. This report which covers the time period 1 Oct. 1979 thru Sept. 1980 deals with the water quality aspect of the project. It includes the general characteristics of the area influenced by the dam, the project itself and the basin draining into the lake.

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The water quality in Beltzville Lake remains within the standards established by Pennsylvania (DER) and U.S. Environmental Protection Agency. In general, following periods of heavy precipation there is a slight increase in ammonia, nitrogen and phosphorous levels with a decrease in the PH. This is associated more with run-off from surrounding areas and is not a direct function of the reservoir.

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SUMMARY

1.01. Summary. Belt ville Lake, located on the Pohopoco Creek in Carbon County, Northwest of Allentown, Pennsylvania, has been in operation since Octoer of 1970. The primary purposes of the project are flood control, water quality control, future water supply, low flow augmentation and recreation. This report, which covers the time period beginning 1 October 1979 through 30 September 1980, deals with the water quality aspect of the project. The drainage basin above Belt ville Dam which was formerly devoted principally to farming is presently undergoing a land pattern change apparently due to the influence of Belt ville Lake. Farm land is being sold for building lots and new homes are being constructed throughout the basin. It appears that in addition to contamination from animal runoff, there may be an increase in septic tank seepage, which may become a concern in future lake management. In general, accumulated data 1/ (APPENDIX A) indicate that stream i flow and the reservoir are of high water quality. The collected data indicated a favorable comparison with untreated water quality for public water supplies as adopted by the Commonwealth of Pennsylvania (DER) and U. S. Environmental Protection Agency. The reservoir exhibits a moderating effect on water quality and the very slight acidic conditions and nutrient loadings associated with ammonia nitrogen and phosphorous have been nicely controlled to prevent any shocks on receiving streams. In general, following periods of heavy precipitation there is a slight increase in ammonia nitrogen and phosphorous and a decrease in pH. This is associated more with runoff from surrounding areas and is not a direct function of the reservoir.

1/ BCM, Water Quality Management Report (1981)

During FY 81, bacteriological testing was continued at all sampling points in addition to testing that was being done for the past several years.

SECTION II - INFORMATION

2-01. Purpose and Scope. This report presents and briefly interprets the water quality data collected through 1981 related to the operation of the Beltzville Lake Project. It includes the general characteristics of the area influenced by the dam, the project itself, and the basin draining into the lake. The report presents data and information useful to the operation of Beltzville Lake for water quality control in the lake and downstream.

2-02. Authority. This report is submitted in accordance with the Corps of Engineers policy as set forth as set forth in ER 1110-2-334, "Water Quality Management at Corps Civil Works Facilities," 1 May 1974.

2-03. Background Information. Beltzville Dam, located in Northeastern Pennsylvania, (Plate 1) was completed in 17 September 1971. The pool was raised to elevation 628.0 in December 1971 and the project has been in operation ever since. The project is one of five flood control dams in the Lehigh and Delaware River Basin. In addition, Beltzville functions for water quality, water supply and recreation.

2-04. Pertinent References. The following references are considered pertinent to this report, (ER 1110-2-1402 and 1130-2-415).

a. U. S. Army Corps of Engineers, Philadelphia District, Stratification Data (APPENDIX B).

b. Water Quality Management Report - Contract DACW61-79-D-0013 APPENDIX A).

SECTION III - AREA AND PROJECT DESCRIPTION

3-01. River Basin Characteristics. Beltzville Lake is located in Carbon County in northeastern Pennsylvania on the Pohopoco Creek, a tributary of Lehigh River (Plate 1). The Pohopoco Creek drainage area is 111 square miles and the portion above the damsite is 93.3 square miles. The drainage area above the dam was particularly devoted to agricultural production prior to the construction of the dam; however, land patterns are changing due to the increase of housing construction. Lands formerly devoted to agricultural pursuits are fast becoming recreation-oriented.

However, with the increase of housing, additional causes of concern arise from septic overflows due to the lack of sewerage systems in the watershed. Periodic nutrient lake loading occurs occasionally but no adverse effects have been noticed on water quality. These effects are counterbalanced by the flushing action caused by early spring and fall rainfall.

3-02. Project Description. The Beltzville project, completed in 1971, provides supplies of water, reduction of flood damage and facilities for public recreation. The dam is built across Pohopoco Creek about one-third of a mile from its juncture with Sawmill Run, and about 4 miles east of Lehighton, PA. The dam extends 4,300 feet across the Pohopoco Valley and rises 170 feet above the creek bed. The water in the lake discharges through a conduit located near the southern end of the dam. The lake, when filled to its normal level is five miles long. The elevation of the lake is 628 feet above sea level. Recreation facilities at the lake were built to provides a recreation capacity for 250,000 visitors annually; however, the Pennsylvania Bureau of State Parks and Corps personnel recently reported 712,200 visitors at Beltzville (calendar year 1980).

The three major recreatonal sites are: Pine Run area, presently developed while the remaining two, Trinity Gorge and Twinflower, are undeveloped.

3-03. Climate. The Lehigh River Basin, including the area drained by Pohopoco Creek, has a temperate northeast Atlantic coast climate that is characterized by frequent changes in temperature and occasional moderate amounts of precipitation. The area is subject to precipitation from normal rainfall, thunderstorms, snowfall, and heavy rains associated with hurricanes. The mean annual temperature in the Lehigh River Basin is about 50°F. Selected climatological data for 1980-81 is found in Table 1.

3-04. Dam and Lake Characteristics.

a. Embankment. The dam is a rock faced earth embankment with an impervious core and random fill outer sections, has a crest length 4,200 feet with a maximum height of 170 feet above the stream bed. The top of the dam is at elevation 672 feet (sea level datum). The embankment has a top width of 30 feet. The top of the dam is surfaced with gravel to serve as a maintenance road. Access to an intake tower is by a service bridge.

b. Spillway. The spillway contains a concrete crest 275 feet wide and approximately 325 feet long approximately centered in an upland channel cut into the right bank. The spillway discharge after leaving the unlined downstream section, will flow in a natural valley into Sawmill Run and Pohopoco Creek.

c. Outlet Works. The outlet works is located near the center of the dam and consists of a control tower and multi-level intake structure located on the upstream side of the dam. The tower leads gated water passages through the dam and a conventional stilling basin is provided at the downstream end to dissipate the energy of the conduit discharge.

d. Access Roads to Dam. Access to the top of the dam is directly from the operations building on the right bank via a bridge crossing the spillway channel.

e. Reservoir. The reservoir when filled to the top of the water supply pool, elevation 628, is approximately seven miles long and 1/2 mile wide at point of maximum width. The average depth of the reservoir is about 60 feet and the maximum of 125 feet. The stream slopes vary from about 310 feet per mile to about 5 feet per mile. The topography includes all land classification types from rolling farmland to sheer rock faces. The flood plain in the reservoir area has been developed as a recreational and farming area.

3-05. Geological History. 1/ The area is located in the middle portion of the Appalachian Valley and Ridge physiographic province. Pohopoco Creek flows parallel to the northeast-southwest trending ridges and is incised in gently sloping Devonian shales, siltstones, and sandstones. The project area contains outcroppings of what is thought to be the Centerfield coral reef. THis formation, which is rich in fossils, dates back to the Devonian period. There is also evidence that changes in the structure of the earth's crust created lagoons during the Mississippian period.

1/ A detailed geological description can be found in the Beltzville Dam and Reservoir Memorandum 3(GDM) and the Recreation-Resource Management DM No. 18A, U. S. Army Corps of Engineers, Philadelphia District.

Some of the marine life that inhabited these lagoons has been identified in fossils found in the project area.

3-06. Topography. The difference in elevation between the valleys and ridges in the project area is about 400 feet. A number of deep narrow gorges, most of which are located on the gently sloping north side of the reservoir site, are aligned generally perpendicular to the creek. A high, steep ridge forms the south side of the valley. The ridge is particularly steep near the dam site and upstream portion of the reservoir site. It recedes slightly to the south near the mid-point of the reservoir, leaving a pocket of relatively flat land on the south side of the project area.

3-07. Soil Condition. Glacial frost action south of the Wisconsin terminal moraine produced a channery condition of the soil surface layer. Channery soils are predominant in the project area. They contain thin flat fragments of sandstone, limestone, or shale as much as six inches in length along the longer axis. These fragments are thickly interspersed throughout a silt loam.

3-08. Vegetation. Nearly all relatively flat lands have been cleared and farmed for many years. Uncleared land contains an abundance of second growth hardwoods including species such as red maple, various oaks, ash, hickory, birch, dogwood, sassafras and hawthorn. The slopes of both gorges and ridges are forested with dense stands of hemlock and rhododendron and a scattering of other conifers and hardwood species.

3-09. Land Use. Government lands are recreationally oriented and are divided into picnicking, swimming, boating, hunting, sightseeing, waterskiing, and fishing.

Pennsylvania Bureau of Parks manages the recreational areas, the Pennsylvania Fish Commission manages the lake waters and the Game Commission is responsible for the management of the game lands.

The area north and east of the lake were formerly devoted to Agricultural production, however, for the past several years, land patterns have changed drastically. Dairy farm operations are being phased out ans the land is being developed for homes and recreational businesses.

The land to the south of the lake is a pine-hemlock-hardwood forest which in turn is bordered to the south by more farm and forested lands.

SECTION IV - WATER QUALITY DATA

4-01. Purpose of Sampling Program. The purpose of taking water samples at Beltzville Lake is to acquire an inventory of water quality paramenter within the areas influencing an influenced by the lake. This data will be used to evaluate water quality conditions and to determine where, what and if any pollution problems exist in the watershed. It is further anticipated that positive action will be initiated to contain, control or eliminate any point or non-point sources of pollution or contamination. Additionally, it is the intent of the Corps to develop a meaningful program to characterize the lake with respect to standards of the Pennsylvania Department of Environmental Resources under provisions of the Clean Streams Law, Act of June 22, 1937, P.L. 1987.

4-02. Testing Procedures. Water samples are being collected on a year round basis under contract with the Corps of Engineers.

These samples are being analyzed by a certified laboratory (under contract) for pH, dissolved oxygen, dissolved solids, ammonia, specific conductance, nitrite, nitrate, and phosphorous, biochemical oxygen demand, temperature, and coliform. Stratification testing procedures (APPENDIX B) are being continued on the basis of twice per month from April through November. Temperature readings, specific conductance, dissolved oxygen and pH are taken at prescribed depths and documented. Coliform samples 1/ are also collected at the same time as the water quality samples and processed within twenty-four hours by a certified laboratory under contract to the Philadelphia District. The fecal coliform samples were collected and analyzed by contracted laboratories. The current fecal coliforms standards for swimming beaches in 200 fecal col/100ml of sample and this was exceeded once during 1981. Water samples collected from Corps Headquarters are fully in conformance with Pennsylvania Drinking Water Standards.

4-03. Data Available. Considerable data, collected as a basis for project regulation, are available for analysis. Water quality data, temperature, dissolved oxygen, conductivity, pH, phosphorous, total dissolved solids, nitrate, nitrite, ammonia, and total coliform, has been collected and documented on a regular basis for the past year. Additional data is available from other sources such as the Pennsylvania Department of Environmetal Resources, U. S. Geological Survey, Pennsylvania Fish Commission and information collected and cataloged by the Philadelphia District, Corps of Engineers. The Environmental Branch is encouraging the Water Quality Department to assist in the collection and testing of additional water samples to cover other parameters which are presently not being analyzed.

1/ APPENDIX A - Water Quality Management Report (BCM)

The Corps is also requesting Pennsylvania DER to expand their program to include biological, algal biomass, and chlorophyl studies.

4-04. Low Flow Augmentation. Beltzville Lake is regulated for downstream water quality, low flow augmentation, and recreational purposes. Regulation of this project for water supply purposes is also a factor. The following paragraphs describe the necesary regulation requirement and objectives for each of the designated purposes.

a. Pohopoco Creek. A minimum release requirement of 35 cfs has been established to meet downstream requirements of Pohopoco Creek. Of this total release, 3 cfs is required to meet the established future requirements of the Palmerton Water Company, municipal and industrial water supplies in the vicinity of Palmerton, PA. The aditional 4 cfs will provide adequate stream flow between the water supply intakes and the mouth of Pohopoco Creek. These releases will be made through the water quality outlet system.

b. Lehigh River. A desirable minimum flow of 400 cfs at Bethlehem, PA was established in House Document 522, 87th Congress, 2nd Session. At present, until other goals are established along the Lehigh River, it will be the task of Beltzville Lake and F. E. Walter Dam to augment all deficient flows as necessary to bring the flow at the Bethlehem gage to 400 cfs.

(1) During drought conditions when F. E. Walter Dam is below conservation pool (elev. 1,30.0), Beltzville Lake will have to supply all flows necessary to augment the Bethlehem goal.

(2) All low flow augmentation releases will be made through the water quality outlet system. The minimum release limit wil be 35 cfs and the maximum approximately 400 cfs (normal pool elev. 628.0).

(c) Delaware River. The Delaware River Basin Commission presently in coordination with other interested agencies is evaluating low flow goals at Trenton, New Jersey.

Until such time as a new goal may be established, a goal of 3,000 cfs at Trenton wil be used. Beltzville Lake releases may at times be based on amounts reuested by the (USGS) Delaware River Master Office at Milford, PA.

Flows required in excess of 400 cfs (approximate capacity of the water quality outlet system) will have to be requested and approved by the Delaware River Basin Commission and the District Engineer. These excess releases will necessitate the use of the flood control outlet system.

During FY 81 the Philadelphia District was operating Beltzville Lake for drought contingency water supply purposes. Normal pool elevation if 628.0. The total water supply storage available was 12.98 billion gallons. Due to drought conditions, the pool was drawn down siginificantly and water quality and water supply storage was used. Due to repairs, the release schedule was ad hoc from 19 Jan 81 to 27 Feb 81. The releases were completely shut down on 21 Jan and 23 for approximately 1.5 hours each day.

(d) Water Quality. The 27,880 acre-feet allocated for future water supply storage at Beltzville Lake has been contracted to the Government to the Delaware River Basin Commission. All releases are being made through the water quality outlet system. The range of releases will vary from a minimum of 35 cfs to a mzximum of approximately 400 cfs.

First use of a portion of this water supply shortage was made on 18 October, 1980. This was in addition to the water quality shortage which was also used on combatting low flow (drought) conditions in the Delaware River Basin.

The U. S. Fish and Wildlife Service in conjunction with the Pennsylvania Fish Commission have indicated preferences in regard to the temperatures of release from Beltzville Lake. Fish will be stocked below the dam in the tailwater, as well as in the lake. The fishing below the dam will be primarily for trout. The interested agencies have requested that releases for the summer months have temperatures that range between 50-65 degrees Fahrenheit. During other times of the year a temperature as close as possible to this optimum will be desired.

Bi-monthly stratification monitoring data, will provide an indication as to the location of water in storage having specific temperatures, dissolved oxygen and pH readings; it also provides a guide for selecting the most desirable combination of intake ports to satisfy downstream water quality requirements.

SECTION V - INTERPRETATION OF DATA

5-01. General Post-Impoundment Conditions. Analysis of data collected by USGS indicated that the water quality generally is good with little or no effect caused by the outflow from Beltzville Lake. The problems of algae growths and coliforms in the lake are insignificant.

Water samples have beem taken by the park superintendent and tested for coliforms on a weekly at two beach locations in the park.

The analysis indicates that the coliform bacteriological test results are within the allowable limits of water quality standards for swimming areas under provisions of the Clean Streams Law, reference Title 25, Chapter 193 of Public Law 177. Commonwealth of Pennsylvania.

Bi-monthly stratification monitoring data will provide an indication as to the location of water in storage having specific temperatures, dissolved oxygen and pH readings; it also provides a guide for selecting the most desirable combination of intake ports to satisfy downstream water quality requirements.

It has been observed that the lake each summer has been anerobic in the deep portions. Releases, however, have not been deficient in dissolved oxygen. Reaeration of water as it passes through the flood control conduit and stilling basin has been sufficient to elevate dissolved oxygen (DO) levels to near saturation. (See APPENDIX A).

a. Water Quality.

(1) Nitrogen. The nitrogen concentrations in Beltzville Reservoir react as expected: the highest levels are at station B-5 where the effect of runoff is least modified. Stations B-1 and B-3 show the moderating effects of the reservoir and station B-4 reflects the effect of the Wild Creek Reservoir. Station B-1 reflects the concentrating effect of the reservoir since the peaks and valleys are higher than the stations in the reservoir. Runoff appears to be the major source of nitrogen in the lake. This is particularly noticeable in the spring and fall when large quantities of nitrogen based fertilizers are used by farmers in the area drained by the Pohopoco Creek.

The ammonia nitrogen concentrations are more readily affected by rainfall than the other forms of nitrogen. Nitrate nitrogen concentrations exceed those mentioned by some sources as being necessary for excessive algae populations. Whether these high concentrations exist throughout the lake or only on the surface is not known. However, nuisance algae blooms have not been a continuing problem since the lake was filled. The effect of the lake stratifying is reflected in the ammonia nitrogen curves for station B-1 during the summer. Since nitrate and nitrite nitrogen are reduced to ammonia nitrogen when oxygen is limited, the downstream discharges should be highest in ammonia when the lake is stratified. This held true during the summer. The spring and fall overturns will also bring ammonia compounds from the hypolimnion to the epilimnion. This may be the source of the ammonia peaks in mid-April and early September. However, historical data is lacking to confirm this opinion.

Generally the nitrogen levels in the reservoir are elevated. The lack of severe algae blooms indicates that nitrogen may not be a problem but algae data has not been collected for this lake. Although there may not be a problem, a present build-up of nitrogen in the benthos may create a problem.

(2) Phosphates. The phosphate concentrations found below the dam stayed relatively low and constant, with the exception of a peak during the month of April. The peaks tended to be highest at stations B-4 and B-5; Wild Creek and tributaries and Pohopoco Creek and tributaries. The upper reaches of Pine Run showed low concentrations of phosphates with very little fluctuation. The occasional high readings at station B-4 may be the result of phosphate laden water being released from the Bethlehem Water Supply Reservoirs. The wide fluctuation in the peaks of the curves tend to support this conclusion since water is released only when the supply of water exceeds the demand.

(3) Dissolved Oyxgen. 1/ Dissolved Oxygen is adequate in all feeder streams and in the reserovir itself. During the summer the D.O. readings while the lake was stratified dropped to 5.9 ppm D.O. at the surface in late June but rebounded and stayed high the rest of the year.

Generally the dissolved oxygen levels are adequate for aquatic life at all levels during the year. The stratification does not eliminate oxygen completely and concentrations return to acceptable levels with the fall rains and operation of the water quality gates to draw water from the hypolimnion.

(4) pH. pH essentially remains ton the range normally found in surface waters in Northeastern Pennsylvania. These tend to be in the 5-7 range.

(5) Total Dissolved Solids (TDS) and Specific Conductance. The TDS and Specific Conductance curves follow rainfall for the in-lake stations, these curves below show a lag time allowing for flow into the reservoir. Station B-4 shows the influence of Wild Creek and Penn Forest Reservoirs by reducing peaks and valleys. This is particularly noticeable in the spring and fall when water is being impounded for drinking. Station B-5 fluctuates the most since most of the land area above this station is under cultivation and the effect of the reservoir is most noticeable at station B-3 when the peaks and valleys of the concentration curve are of a longer duration. The peak in early September is probably due to the fall overturn but not enough data is available to confirm this.

(6) Coliform Sampling. The coliform counts at Beltzville Reservoir remained within the limits established by the Pennsylvania Department of

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1/ BCM Contract Water Quality (APPENDIX A)

Environmental Resources of no more than a geometric mean of 200 colonies or milliliters of sample on five different days for fecal coliform and no more than 5,000 per 100 milliliters of sample for total coliform. The highest counts follow a period of rain, particularly after a prolonged dry spell. This indicated that most of the coliform load is the result of runoff carrying material into the water rather than a point source. Fecal Streptococcus testing results indicated medium to high readings during July. The coliform counts from the swimming area remain within the limits the Department of Environmental Resources has established for public swimming areas.

5-02. Fishery. Pohopoco Creek is considered one of the best trout streams in the State. Trout fishing in the impoundment area of the Creek has decreased due to the habitat change resulting from the lake. However, the Pennsylvania Fish Commission has stocked the lake five times since the impoundment opened in 1972 and intends to continue the program at the lake. Beltzville Reservoir will provide the best fishing if managed as a salmonid-walleye-smallmouth bass lake since dissolved oxygen conditions are suitable for these fish while steep slopes limit other species. Walleye populations are excellent, with yellow perch providing the principle forage. Successful salmonid fishing might be dependent upon development of a suitable forage base. Small-mouth bass populations should improve naturally. Although this lake was noted for its muskellunge, this was probably primarily a result of the great potential for growth provided by new impoundments. Muskellunge will probably not play as important a role in the future.

FY 1981 PENNA. FISH STOCKING AT BELTZVILLE LAKE

18,00 cm Brown Trout, fingerling Aug 31

SECTION VI - RECOMMENDATIONS AND PROPOSED STUDIES.

6-01. General. The following recommendations are made relative to the Water Quality Control Management Program at Beltzville Lake.

a. Maintain present sampling frequency to maintain a meaning for surveillance over the water quality in the lake.

b. Continue to correlate data collected from other agencies and establish their sampling locations, procedures and equipment used for testing.

c. Continue cooperation with the Pennsylvania Fish Commission in the management of the lake and to improve fish habitat both in the lake and downstream from the dam.

d. Enlist the services of the Pennsylvania DER's Water Quality Section and laboratory facilities to expand our present sampling points and test for additional chemical, bacteriological and biological parameters.

e. Maintain and improve a permanent record system of data on hand and other data obtained from all other sources. Such data can become a useful management tool and provide a means for evaluating water quality trends.

6-02. Findings and Conclusions. The sampling program will continue essentially unchanged for FY 1982 at Beltzville Lake. From the data collected during the past year, the quality of the water in Beltzville Lake remains within the standards established by Pennsylvania (DER) and the U. S. Environmental Protection Agency and has changed little in the past year. In general, following periods of heavy precipitation, there is a slight increase in ammonia nitrogen and phosphorous levels with a decrease in th pH.

This is associated more with run-off from surrounding areas and is not a direct function of the reservoir. Bacteriological data recorded at stream inflows exceeded the standards once, as established by Pennsylvania DER. Recorded bacteriological data from the beach area by Pennsylvania DER did not exceed the criteria established by that agency. This indicates that the bacteria both died off by the time the water reached the swim area and no problems were encountered in this regard.

APPENDIX A

WATER QUALITY MANAGMENT REPORT

BELTZVILLE LAKE WATER QUALITY SAMPLING

INTRODUCTION

The Philadelphia District of the Corps of Engineers has established a Water Quality Monitoring Program at a numerous lakes within their jurisdiction, in order to ensure that good water quality is maintained and that the Pennsylvania Water Quality Standards outlined in Chapter 93 are being met. Betz•Converse•Murdoch•Inc. (BCM), under contract to the Philadelphia District, has conducted a water chemistry testing program at Beltzville Lake for water year 1981 (October 1980 to September 1981). The following report presents the results of the testing program and an analysis of the data.

SAMPLING PROCEDURES

The Beltzville Dam and Reservoir are located on Pohopoco Creek, a tributary to the Lehigh River in Carbon County, northwest of Allentown, Pennsylvania. The following five stations were sampled 17 times during water year 1981; once a month during December, January, February, March, April and September, and twice a month during the summer months:

B-1 Downstream of Dam
B-2 Pine Run
B-3 Boat Launch
B-4 Wild Creek
B-5 Pohopoco Creek - upstream of lake

At each station, water samples were collected just below the surface, iced, and delivered to the BCM analytical laboratory within 24 hours. They were analyzed for biochemical oxygen demand (BOD_5), total phosphorus, ammonia nitrogen, nitrate nitrogen, nitrite nitrogen and total dissolved solids. All analysis were performed in accordance with the current procedures approved by the U. S. Environmental Protection Agency. Dissolved oxygen, pH, temperature and conductivity were measured in the field. In addition, lake samples were collected in sterile bottles five times during the year for bacteriological analysis. The drinking water source at Beltzville is sampled in April, June and August at the COE headquarters building for bacteriological analysis.

PENNSYLVANIA WATER QUALITY STANDARDS

The Beltzville impoundment is listed as having the protected use for Cold Water Fisheries (CWF) in Pennsylvania Chapter 93 Water Quality Standards. Table 1 presents the Pennsylvania Water Quality Standards for the Beltzville impoundment for the parameters analyzed in the 1981 water year sampling program.

WATER QUALITY RESULTS

Table 2 presents the water quality data collected at the Beltzville impoundment during water year 1981. The following figures present plots of BOD_5, total phosphorus, ammonia, nitrate, total dissolved solids, dissolved oxygen, temperature and conductivity for the five stations. The following is a discussion by parameter of the sampling results.

Biochemical Oxygen Demand (BOD) and Dissolved Oxygen

Dissolved oxygen levels were above the 5.0 mg/l State standards for all sampling dates. Dissolved oxygen levels are inversely related to temperature and dissolved solids concentrations resulting in a decrease of oxygen levels during the summer months. Biochemical oxygen demand (BOD_5) values were generally <5 mg/l, except for a one high level of 10 mg/l at Station B-1 which is downstream of the dam. The upstream station (B-5) had a BOD_5 value of 8 mg/l on March 26.

Nutrients

The concentrations of phosphorus and nitrogen compounds found in the lake are critical to the eutrophication process. High levels of nutrients speed-up the aging process of the lake by excessive growths of algae and/or macrophytes. The concentrations of nitrogen and phosphorus necessary at the beginnning of the growing season to produce new populations of algae were suggested by Sawyer (1947) to be 0.30 and 0.015 mg/l, respectively. Vollenweider (1968) states that .02 mg/l of total phosphorus is the eutrophication danger level. About one-third (30 of 85) phosphorus values recorded during water year 1981 are less than or equal to 0.02 mg/l with an arithmetic mean of 0.06 mg/l. The mean nitrate level recorded as nitrogen was 1.2 mg/l with none of the values exceeding 10 mg/l (which is the state standard). The maximum value was 5.5 mg/l recorded July 7, 1981 at the uppermost end of the lake (Station B-5).

Ammonia concentrations are important in lake dynamics not only because they serve as a nutrient source, but because un-ionized ammonia can be toxic to aquatic organisms. Although there is no state standard for ammonia in the Beltzville impoundment, ammonia levels do not exceed 0.5 mg/l.

Total Dissolved Solids and Conductibity

Specific conductance is a measure of the ability of the unit volume of material to conduct electric current. In water this ability is directly related to the concentrations of ions, and therefore is related to the concentration of dissolved solids. Water quality criteria for the Beltzville impoundment require that the monthly average total dissolved solids not exceed 500 mg/l or that it exceeds 750 mg/l at any one time. The data show that these standards were exceeded once on March 26, 1981. However, the exceedingly high value recorded on this date (3,340 mg/l) may be a sampling anomaly especially since the conductivity level remained low on that date.

pH

The pH values range from 5.1 to 8.1. The state standards require a minimum of 6.0. The pH fell below this standard 11 times at various sites, reflecting the acidic nature of the watershed.

Bacteria

Samples were collected at all four stations above the dam on March 26, May 27, June 23, July 22, and August 11 for analysis of fecal coliform, total coliform and fecal streptococcus. The state bacteria standard only applies to fecal coliform which is 200 per 100 milliliters during the swimming season. This standard was exceeded once at B-5 which is the Pohopoco Creek above the lake. Fecal coliform to fecal streptococcus ratios are commonly used as an indicator of the bacterial source. Ratios greater than 4 are said to indicate human pollution while those less than 0.7 indicate animal contamination. Coliform/streptococcus ratios vary considerably at the Beltzville impoundment, but the higher ratios may indicate some human sources of contamination towards the upper end of the lake. The drinking water samples yielded no evidence of bacterial contamination.

SUMMARY

The Beltzville impoundment shows relatively good water quality based on analysis during water year 1981.

RECOMMENDATIONS

It is recommended that the following studies be done to make the COE lake studies more meaningful:

- Precipitation data should be reviewed and used to calculate nutrient loadings at particular times. The data can also be used to explain anomolies in other parameters.
- The previously collected of water quality data should be stored in a computerized data management system so that annual trends can be assessed and a more meaningful analysis conducted.
- Additional bacterial sampling should be instituted to trace the source of possible human contamination in Pohopoco Creek above the lake.

Literature Cited:

Sawyer C. N 1947. Fertilization of Lakes by agricultural and urban drainage. New England Water Works Association. 61: 109-127.

Vollenweider, R. A. 1968. The scientific basis of lake and stream eutrophication, with particular reference to phosphorus and nitrogen as eutrophication factors. Tech. Rep. OECD, Paris DAS/DSI/68; 27: 1-182.

TABLE 1

PENNSYLVANIA WATER QUALITY STANDARDS

Beltzville Impoundment

Dissolved Oxygen - Minimum daily average 6.0 mg/l; no value less than 5.0 mg/l. For the lakes, ponds and impoundments only, no value less than 5.0 mg/l at any point.

Bacteria - During the swimming season (May 1 through September 30), the fecal coliform level shall not exceed a geometric mean of 200 per 100 milliliters (ml), based on five consecutive samples, each sample collected on different days; for the remainder of the year, the fecal coliform level shall not exceed a geometric mean of 2,000 per 100 ml based on five consecutive samples collected on different days.

Nitrite plus Nitrate - Not to exceed 10 mg/l as nitrogen

pH - Not less than 6.0 and not more than 9.0

Temperature - No rise when ambient temperature is 58°F or above; not more than a 5°F rise above ambient temperature until stream temperature reaches 58°F; not to be changed by more than 2°F during any one-hour period.

Total Dissolved Solids - Not more than 500 mg/l as a monthly average value; not more than 750 mg/l at any one time.

Source: PA Chapter 93 Water Quality Standards, Title 25, Part 1, Subpart C. Adopted August 21, 1979.

Table 2

BELTZVILLE LAKE WATER QUALITY SAMPLING WATER YEAR 1981

MM/DD/YY	SITE	BOD	TP-P	NH3-N	NO3-N	NO2-N	DS	DO	pH	TEMP	COND	FC	TC	FS
10/29/80	1	<3	0.02	0.07	0.52	<0.10	36	11.0	8.1	9.0	54			
10/29/80	2	<3	0.02	0.07	0.52	<0.10	33	10.2	6.7	10.0	50			
10/29/80	3	<3	0.02	0.07	1.08	<0.10	29	10.0	6.9	10.0	52			
10/29/80	4	<3	0.03	0.07	0.47	<0.10	36	10.8	6.8	9.0	48			
10/29/80	5	<3	0.02	0.07	1.08	<0.10	59	11.0	6.7	8.0	48			
11/12/80	1	4	<0.01	0.22	0.61	<0.10	30	10.0	6.3	8.0	63			
11/12/80	2	3	0.01	0.33	0.62	<0.10	28	10.3	6.8	9.5	54			
11/12/80	3	4	0.01	0.19	<0.10	<0.10	16	12.1	5.8	4.5	65			
11/12/80	4	<2	0.08	0.24	0.50	<0.10	31	11.2	6.0	7.0	58			
11/12/80	5	<2	0.06	0.18	0.35	<0.10	46	12.0	5.6	5.2	62			
11/25/80	1	<3	0.02	0.18	0.90	<0.10	35	11.6	6.2	2.0	60			
11/25/80	2	<3	0.02	0.19	0.64	<0.10	33	10.4	6.6	5.0	55			
11/25/80	3	<3	0.02	0.15	0.35	<0.10	29	11.0	6.0	2.0	62			
11/25/80	4	<3	0.02	0.12	0.25	<0.10	38	11.6	6.8	4.0	52			
11/25/80	5	<3	0.05	0.16	2.02	<0.10	68	12.2	5.8	3.0	60			
12/30/80	1	3	0.07	0.04	0.45	<0.10	68	12.5	6.6	3.0	53			
12/30/80	2	2	0.07	0.09	0.40	<0.10	74	10.5	6.7	1.0	53			
12/30/80	3	4	0.05	0.05	0.45	<0.10	76	13.5	6.2	3.0	53			
12/30/80	4	3	0.06	0.05	0.45	<0.10	51	12.2	7.0	3.0	53			
12/30/80	5	4	0.05	0.06	0.50	<0.10	59	12.0	7.2	4.0	54			
01/14/81	1	10	0.12	0.03	4.56	<0.10	75	13.0	7.2	2.0	56			
01/14/81	2	No data or samples taken because lake was completely frozen												
01/14/81	3	4	0.04	<0.01	0.77	<0.10	36	13.5	7.2	2.0	28			
01/14/81	4	5	0.05	0.03	1.15	<0.10	51	13.0	7.0	3.0	52			
01/14/81	5	3	0.01	0.01	0.66	<0.10	37	13.4	7.2	2.0	29			
02/25/81	1	<2	0.08	0.09	0.57	<0.10	60	12.2	7.0	4.0	90			
02/25/81	2	3	0.14	0.06	0.50	<0.10	84	9.0	6.7	5.5	65	15	300	
02/25/81	3	2	0.12	<0.01	0.67	<0.10	44	12.0	7.7	3.0	40	130	360	
02/25/81	4	2	0.11	<0.01	0.85	<0.10	52	13.4	6.2	4.0	70	10	50	
02/25/81	5	2	0.09	<0.01	0.81	<0.10	50	12.4	6.8	4.0	72	10	60	
03/26/81	1	<2	0.04	0.01	0.91	<0.10	61	10.2	6.8	8.0	45			
03/26/81	2	5	0.04	<0.01	0.20	<0.10	3340	11.4	6.8	7.0	38	0	50	0
03/26/81	3	<2	0.08	0.04	1.05	<0.10	101	11.2	6.9	5.0	40	0	3	0
03/26/81	4	<2	0.07	<0.01	0.84	<0.10	56	12.8	7.0	8.0	40	0	10	3
03/26/81	5	8	0.03	<0.01	1.21	<0.10	60	13.8	7.1	4.0	40	0	1200	0
04/28/81	1	<3	0.06	<0.01	0.86	<0.10	70	12.4	6.6	12.0	40			
04/28/81	2	<3	0.03	<0.01	0.12	<0.10	44	12.2	6.6	12.0	35			
04/28/81	3	<3	0.04	<0.01	0.89	<0.10	55	11.4	6.2	14.0	50			
04/28/81	4	<3	0.10	<0.01	0.56	<0.10	44	11.3	7.0	14.0	50			
04/28/81	5	<3	0.03	<0.01	0.86	<0.10	65	11.3	6.3	13.0	65			
05/12/81	1	<3	0.02	<0.01	0.85	<0.10	64	12.6	5.9	11.0	64			
05/12/81	2	<3	0.05	<0.01	0.08	<0.10	53	10.4	5.6	13.0	65			
05/12/81	3	<3	0.08	<0.01	0.80	<0.10	60	10.5	6.0	16.0	64			
05/12/81	4	<3	0.07	<0.01	1.04	<0.10	60	11.6	6.0	13.0	60			
05/12/81	5	<3	0.10	<0.01	0.96	<0.10	92	10.0	5.8	15.0	60			
05/27/81	1	<3	0.02	0.03	3.70	<0.10	39	11.4	6.4	14.0	66			
05/27/81	2	<3	0.01	0.02	0.40	<0.10	07	10.7	6.6	15.0	50	0	500	3
05/27/81	3	3	0.01	0.02	2.40	<0.10	19	9.7	6.7	22.0	66	9	100	2
05/27/81	4	<3	<0.01	0.02	2.40	<0.10	06	10.2	6.3	17.0	62	14	300	2
05/27/81	5	<3	0.02	0.01	3.20	<0.10	14	10.1	6.6	19.0	53	7	460	3

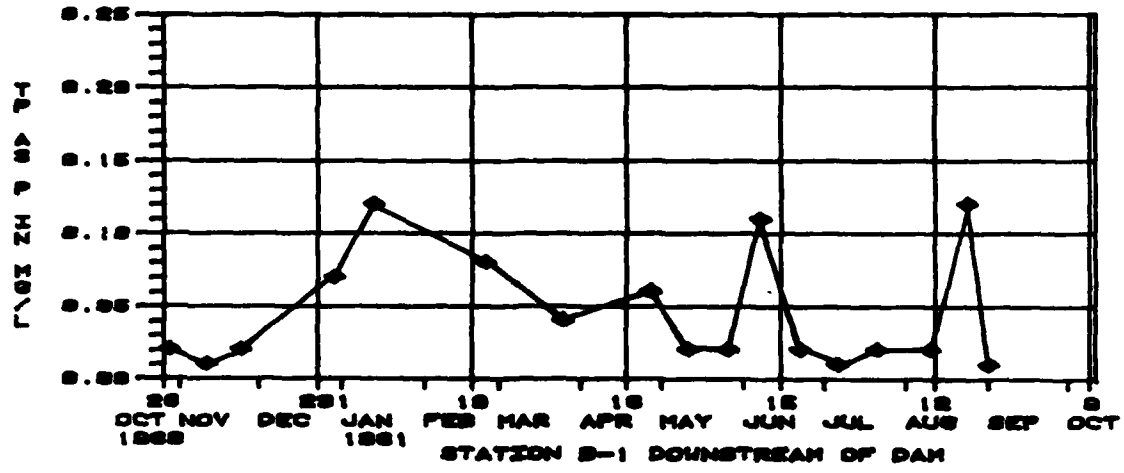
Continued on next page

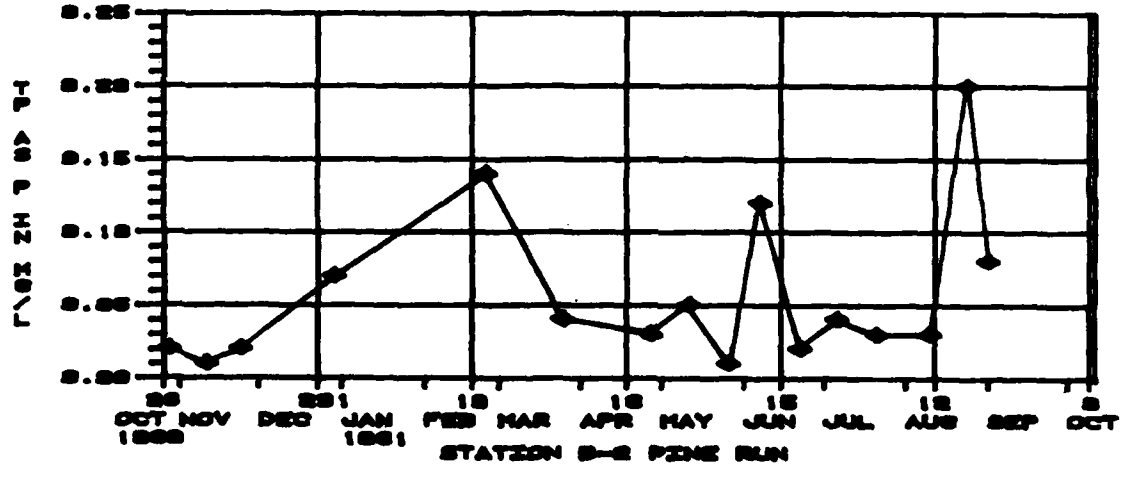
BELTZVILLE LAKE WATER QUALITY SAMPLING (Continued)

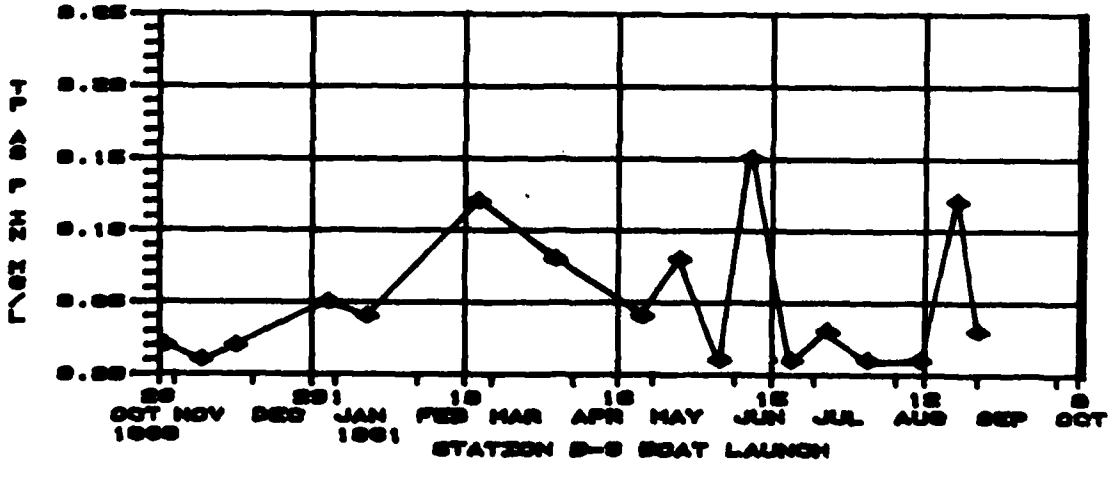
MM/DD/YY	SITE	BOD	TP-P	NH3-N	NO3-N	NO2-N	DS	DO	pH	TEMP	COND	FC	TC	FS
06/08/81	1	<3	0.11	<0.01	3.17	<0.10	48	11.4	6.0	15.0	65			
06/08/81	2	<3	0.12	<0.01	0.61	<0.10	38	9.9	6.1	17.0	50			
06/08/81	3	3	0.15	<0.01	2.90	<0.10	57	10.4	5.7	23.0	64			
06/08/81	4	<3	0.12	<0.03	3.00	<0.10	45	9.2	5.1	16.0	55			
06/08/81	5	3	0.17	<0.05	4.30	<0.10	58	10.4	5.8	20.0	57			
06/23/81	1	<3	0.02	0.02	3.20	<0.10	45	10.1	6.2	16.0	66			
06/23/81	2	<3	0.02	<0.01	0.40	<0.10	24	10.2	6.5	16.0	55	160	1590	40
06/23/81	3	<3	0.01	<0.01	2.80	<0.10	35	8.9	6.6	23.0	66	31	100	07
06/23/81	4	<3	0.04	<0.01	1.80	<0.10	39	9.6	6.2	16.0	65	44	900	30
06/23/81	5	3	0.02	<0.01	4.20	<0.10	61	5.9	6.3	20.0	64	160	240	13
07/07/81	1	<3	0.01	0.07	3.10	<0.10	49	10.0	6.0	15.0	64			
07/07/81	2	<3	0.04	0.02	0.82	<0.10	48	10.0	6.6	18.0	53			
07/07/81	3	<3	0.03	0.02	4.60	<0.10	52	9.3	6.4	24.0	64			
07/07/81	4	<3	0.05	0.10	3.10	<0.10	35	12.1	6.3	10.0	35			
07/07/81	5	<3	0.08	0.03	5.50	<0.10	41	9.4	6.3	22.0	63			
07/22/81	1	3	0.02	0.07	0.75	<0.10	38	12.0	6.1	16.0	70			
07/22/81	2	3	0.03	0.06	<0.10	<0.10	24	13.6	6.4	18.0	60	70	100	50
07/22/81	3	4	<0.01	0.03	0.40	<0.10	38	11.2	6.2	26.0	70	100	1400	50
07/22/81	4	5	0.04	0.03	0.67	<0.10	26	12.2	6.0	17.0	64	20	100	0
07/22/81	5	5	0.02	0.04	0.68	<0.10	37	11.2	6.2	21.0	60	340	500	10
08/11/81	1	<3	0.02	<0.01	0.46	<0.10	61	10.0	5.8	18.0	52			
08/11/81	2	<3	0.03	0.03	0.10	<0.10	83	9.9	6.2	16.0	40	10	120	20
08/11/81	3	<3	0.01	0.02	0.10	<0.10	42	8.2	6.5	26.0	44	40	100	40
08/11/81	4	<3	0.04	<0.01	0.20	<0.10	85	10.4	6.5	16.0	36	30	60	40
08/11/81	5	3	0.04	0.02	0.30	<0.10	46	9.0	6.4	24.0	40	40	40	10
08/25/81	1	<3	0.12	0.01	1.12	<0.10	22	8.2	6.2	20.0	55			
08/25/81	2	<3	0.20	0.01	0.03	<0.10	25	8.8	5.8	19.0	44			
08/25/81	3	<3	0.12	<0.01	1.17	<0.10	24	6.6	6.5	24.0	50			
08/25/81	4	<3	0.18	0.01	0.46	<0.10	29	10.2	6.1	16.0	42			
08/25/81	5	<3	0.12	0.01	0.69	<0.10	29	8.2	5.8	22.0	50			
09/02/81	1	<3	<0.01	0.01	1.17	<0.10	46	9.2	7.4	16.0	51			
09/02/81	2	<3	0.08	0.01	0.19	<0.10	39	9.2	7.0	16.0	60			
09/02/81	3	<3	0.03	0.01	0.67	<0.10	45	8.4	7.4	21.0	50			
09/02/81	4	<3	0.18	0.01	0.83	<0.10	47	9.5	7.2	15.0	48			
09/02/81	5	<3	<0.01	0.01	1.47	<0.10	120	8.2	7.4	18.0	50			
MAXIMUM		10.0	0.20	0.33	5.50		3340	13.8	8.1	26.0	90			
MINIMUM		2.0	0.01	0.01	0.03		6	5.9	5.1	1.0	28			
RANGE		8.0	0.19	0.32	5.47		3334	7.9	3.0	25.0	62			
MEAN		3.2	0.06	0.05	1.20		86	10.8	6.5	12.5	55			
STAN DEV		1.1	0.05	0.06	1.24		360	1.6	0.5	7.1	11			

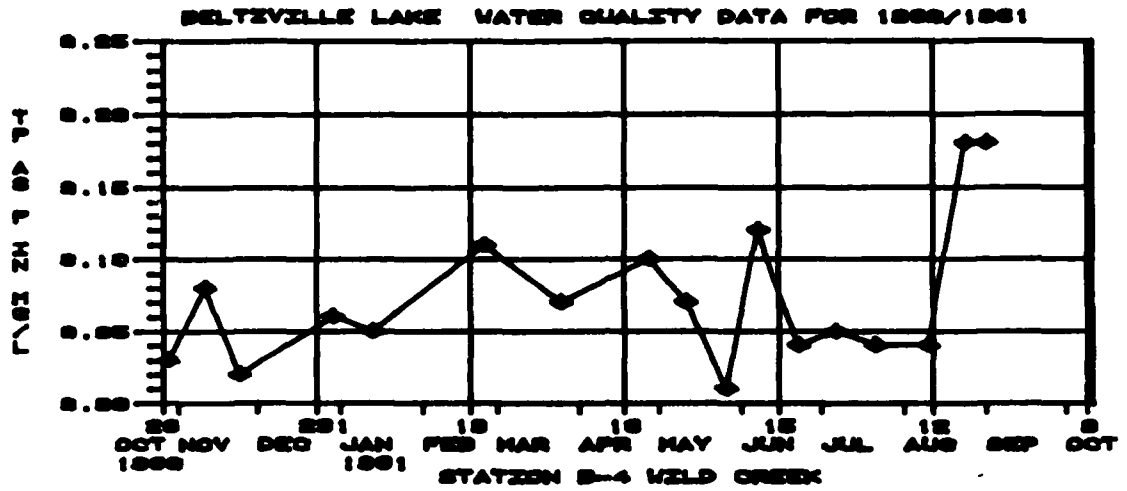
All units are mg/l except: pH in standard units, Temp in degrees centigrade, Conductivity in umhos/cm and the bacteriological results in #/100 ml.

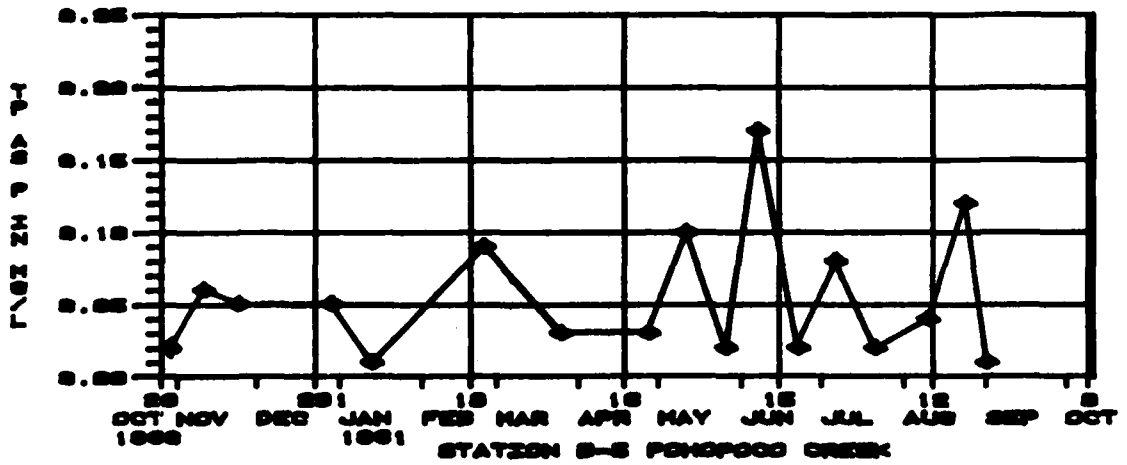
BELTZVILLE LAKE WATER QUALITY DATA FOR 1960/1961








BELTZVILLE LAKE WATER QUALITY DATA FOR 1980/1981
OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT
1980 1981
STATION B-4 WILD CREEK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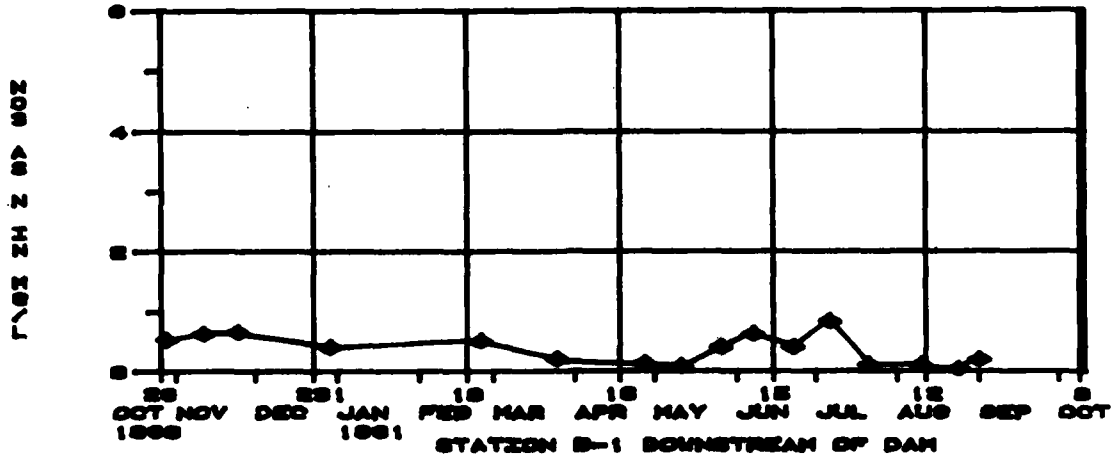
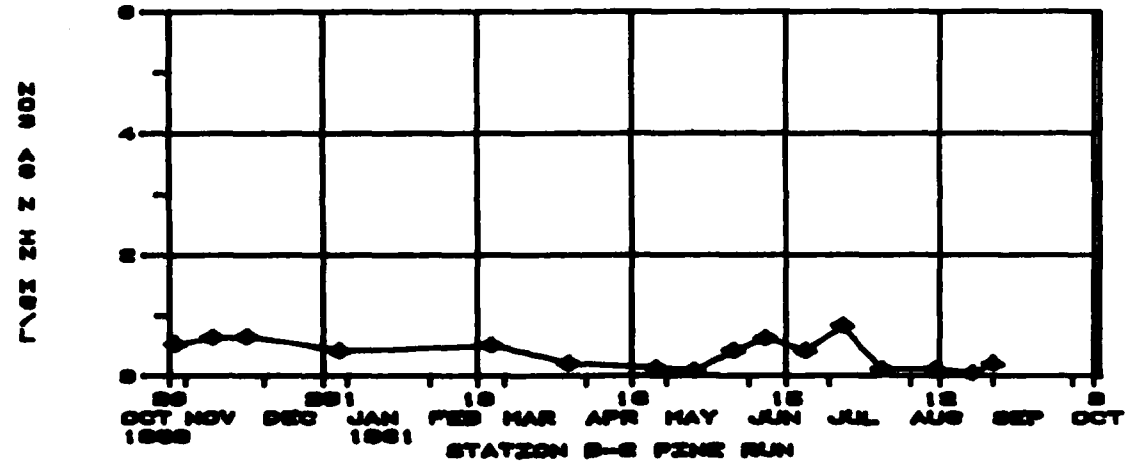
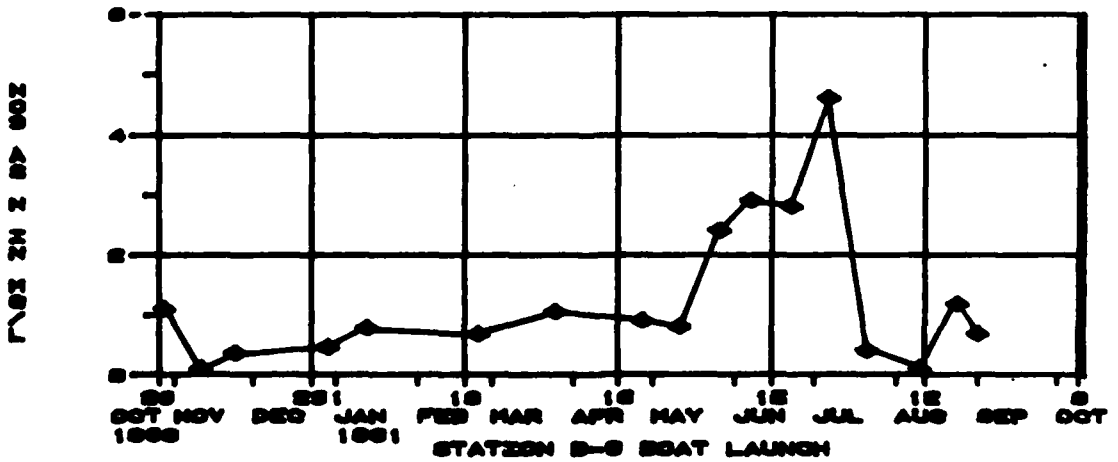
1980 1981
STATION B-5 POHOPOCO CREEK

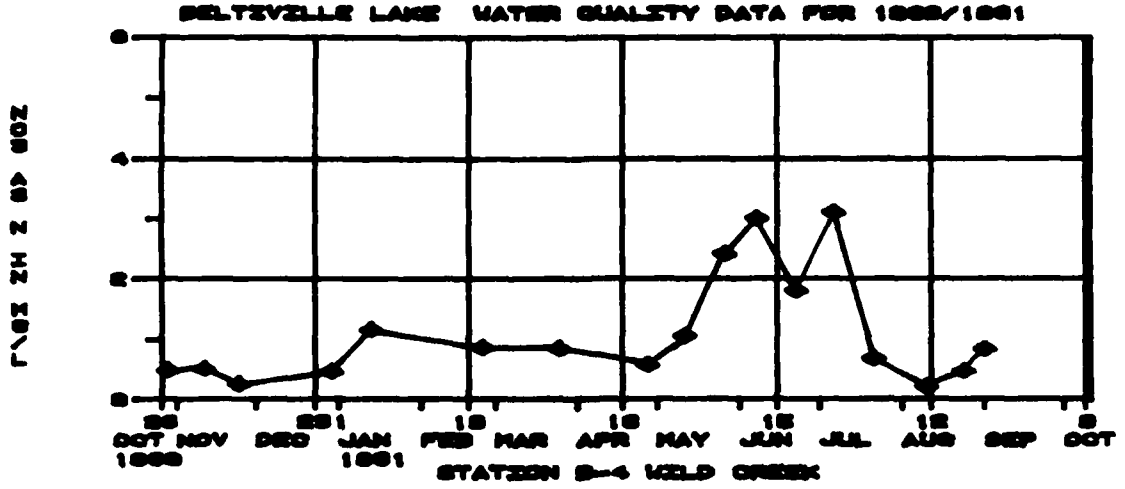
BELTZVILLE LAKE WATER QUALITY DATA FOR 1980/1981



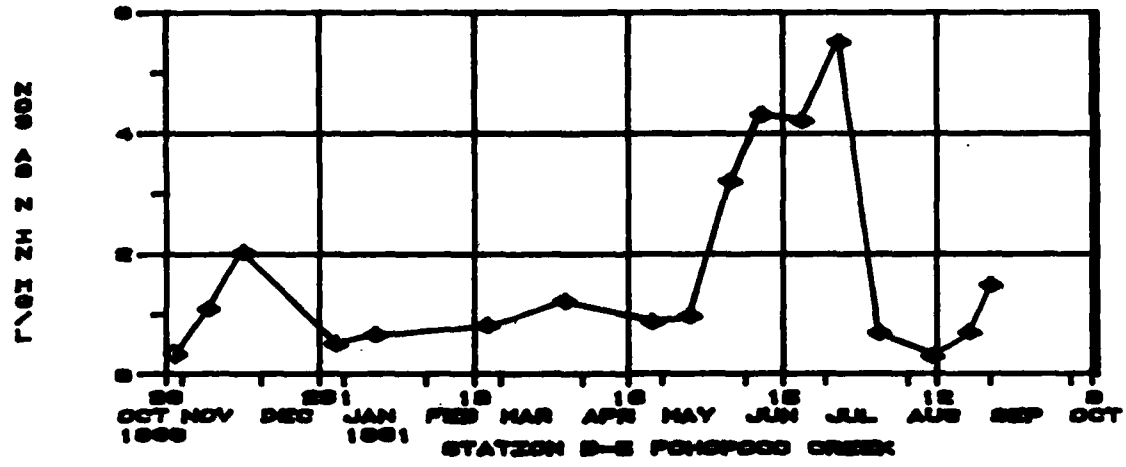




BELTSVILLE LAKE WATER QUALITY DATA FOR 1980/1981

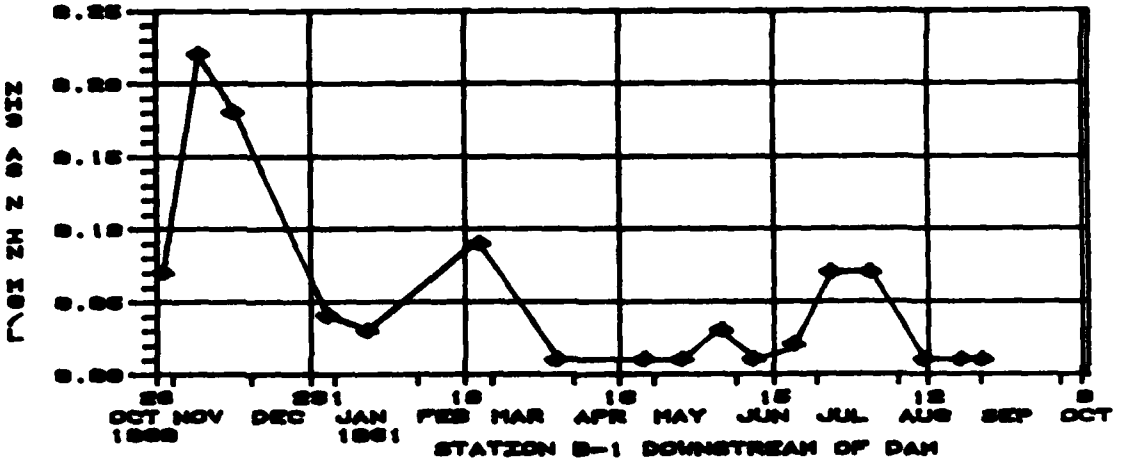


STATION B-4 WILD CREEK

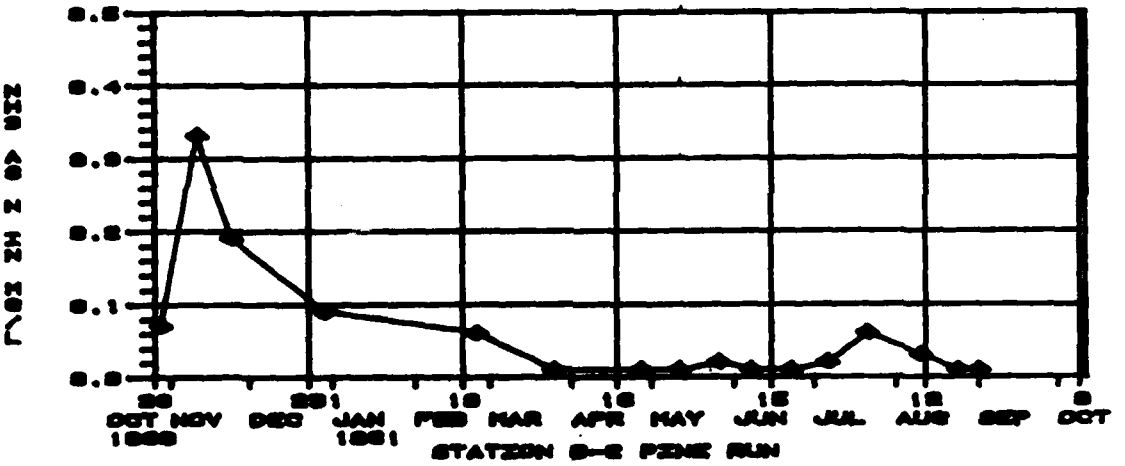


STATION B-5 PONDPOOD CREEK

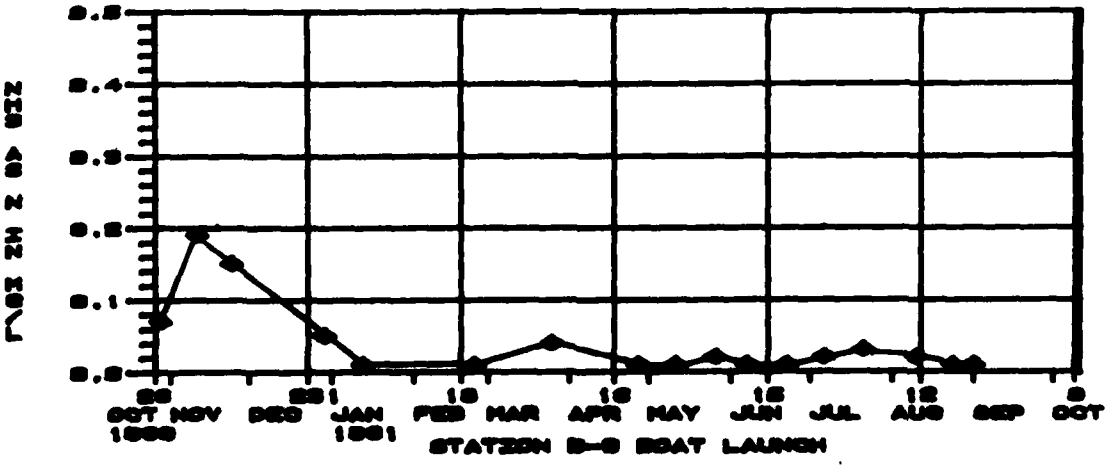
BELTZVILLE LAKE WATER QUALITY DATA FOR 1980/1981



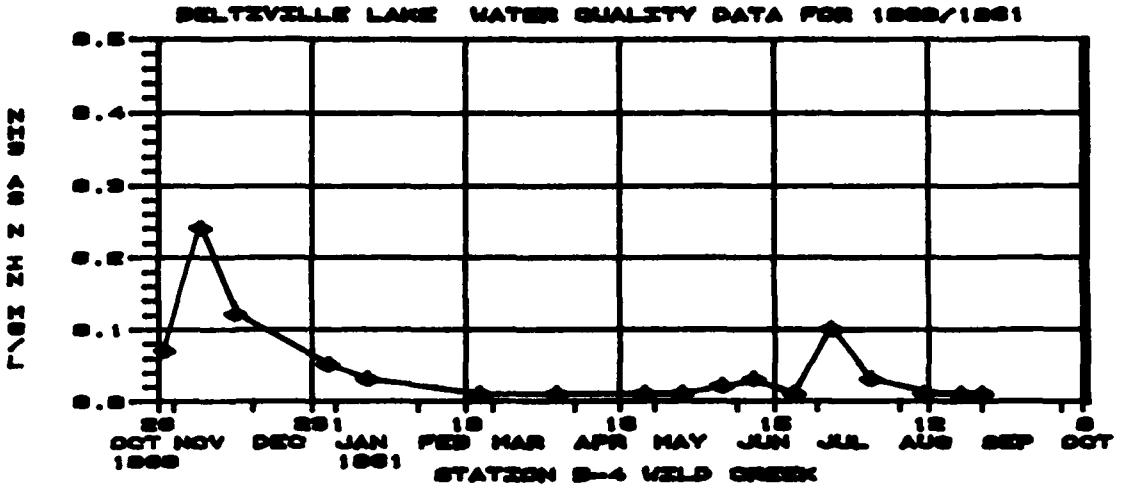
STATION B-1 DOWNSTREAM OF DAM

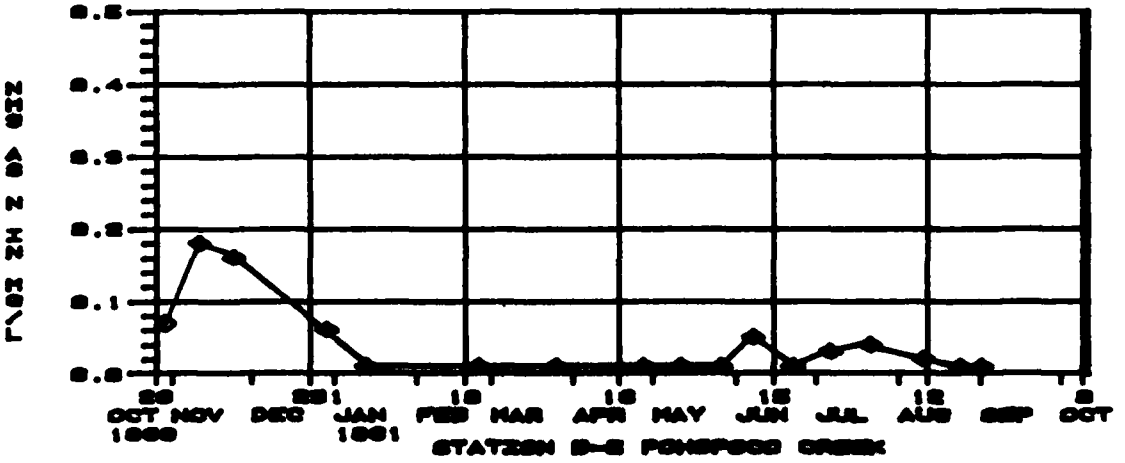


STATION B-2 PINE RUN

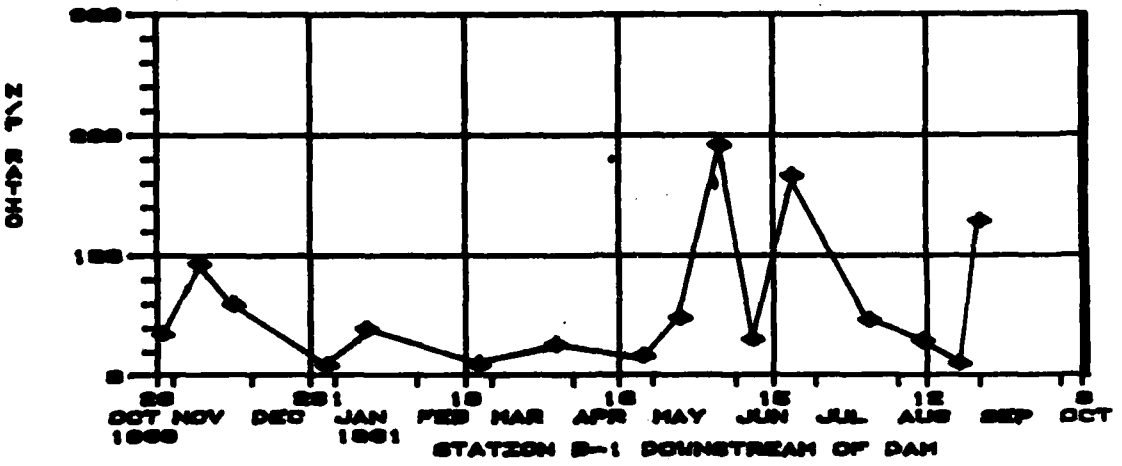


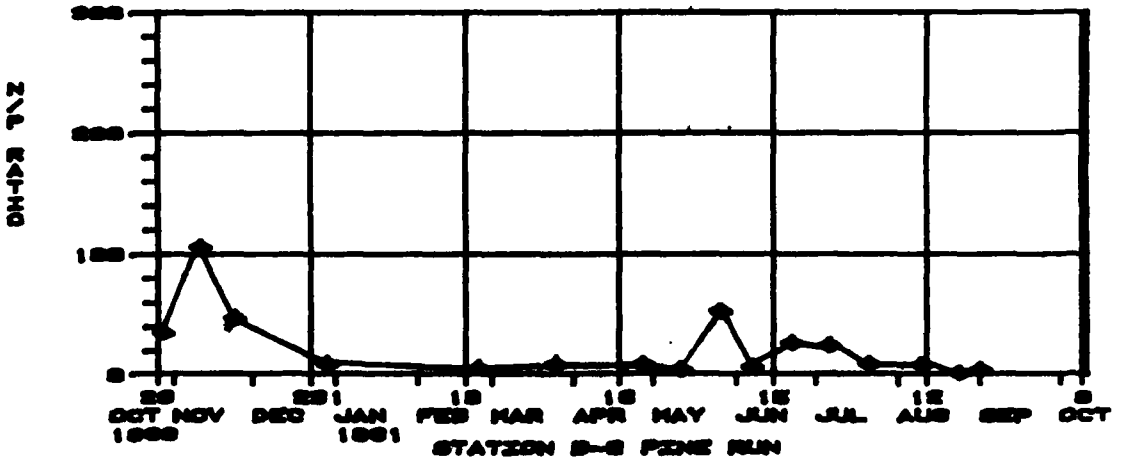
STATION B-3 BOAT LAUNCH

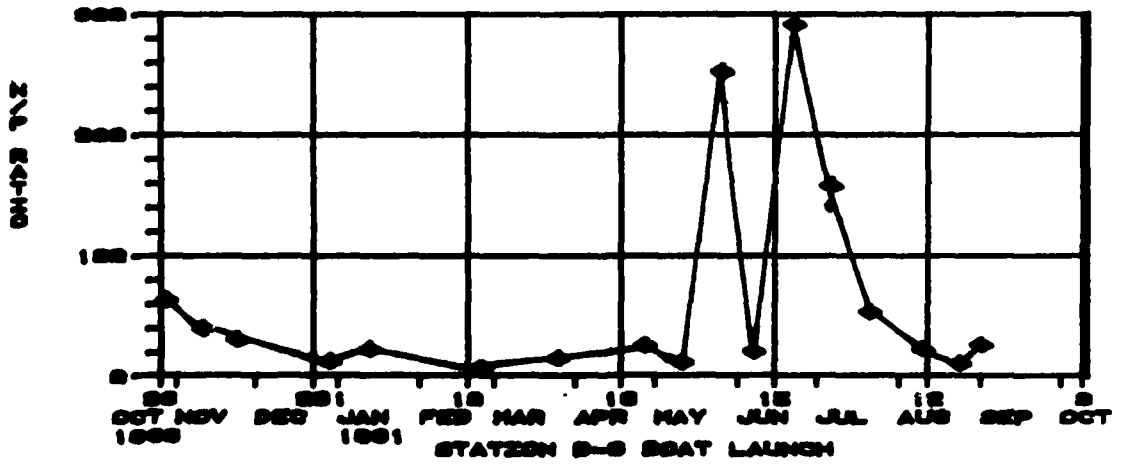

BELTZVILLE LAKE WATER QUALITY DATA FOR 1980/1981
0.5
0.4
0.3
0.2
0.1
0.0
20
OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT
1980
1981
STATION B-4 WELD CREEK


0.5
0.4
0.3
0.2
0.1
0.0
20
OCT NOV DEC JAN FEB MAR APR MAY JUN JUL AUG SEP OCT
1980
1981

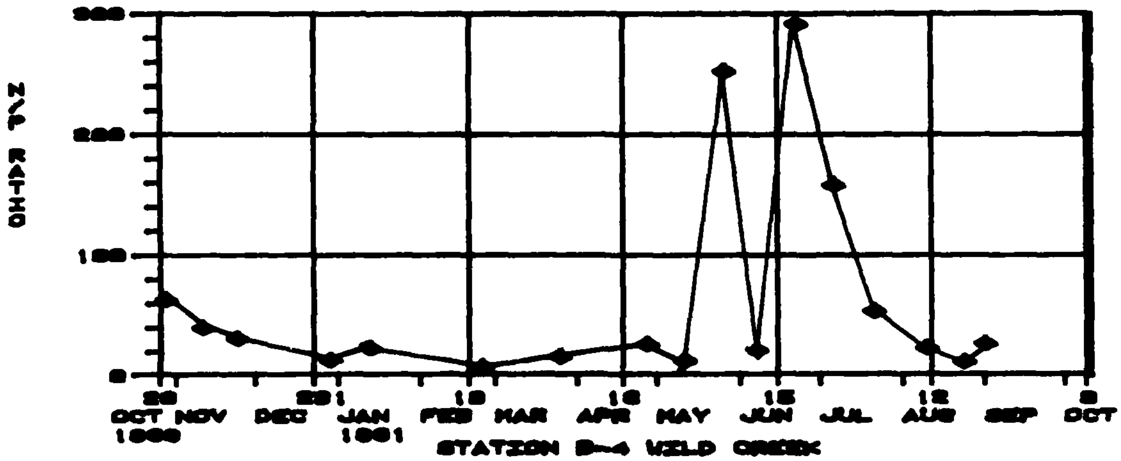
BELTZVILLE LAKE WATER QUALITY DATA FOR 1980/1981



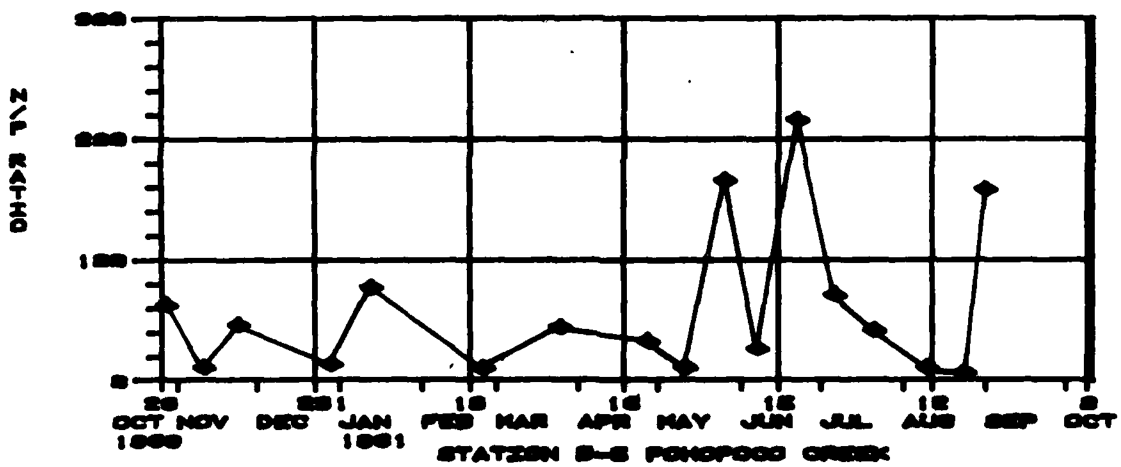




BELTZVILLE LAKE WATER QUALITY DATA FOR 1980/1981



STATION B-4 WILD CREEK



STATION B-6 POHOPOCO CREEK

APPENDIX B

BI-MONTHLY STRATIFICATION DATA - PHILADELPHIA DISTRICT
(Available in District Files)

TABLE 1

BELTZVILLE LAKE - CLIMATOLOGICAL DATA - 1980-81

TABLE 1

BELTZVILLE LAKE

CLIMATOLOGICAL DATA - Oct 1980 - Sept 1981

MONTH	Precp. (inches)	Snow (inches)	Avg. Temp. (oF)	Highest Temp. (oF)	Lowest Temp. (oF)	Days with Precp.
October data not available						
NOV.	3.28	-	35.9	63	13	8
DEC.	.78	11.0	23.7	63	-12	3
JAN.	.71	-	18.0	45	-20	2
FEB.	7.42	33	31.3	68	0	19
MAR.	.89	4.0	34.3	72	8	3
APRIL	4.21	0	49.0	77	20	14
MAY	4.51	0	57.9	86	29	10
JUNE	5.88	0	65.6	92	40	19

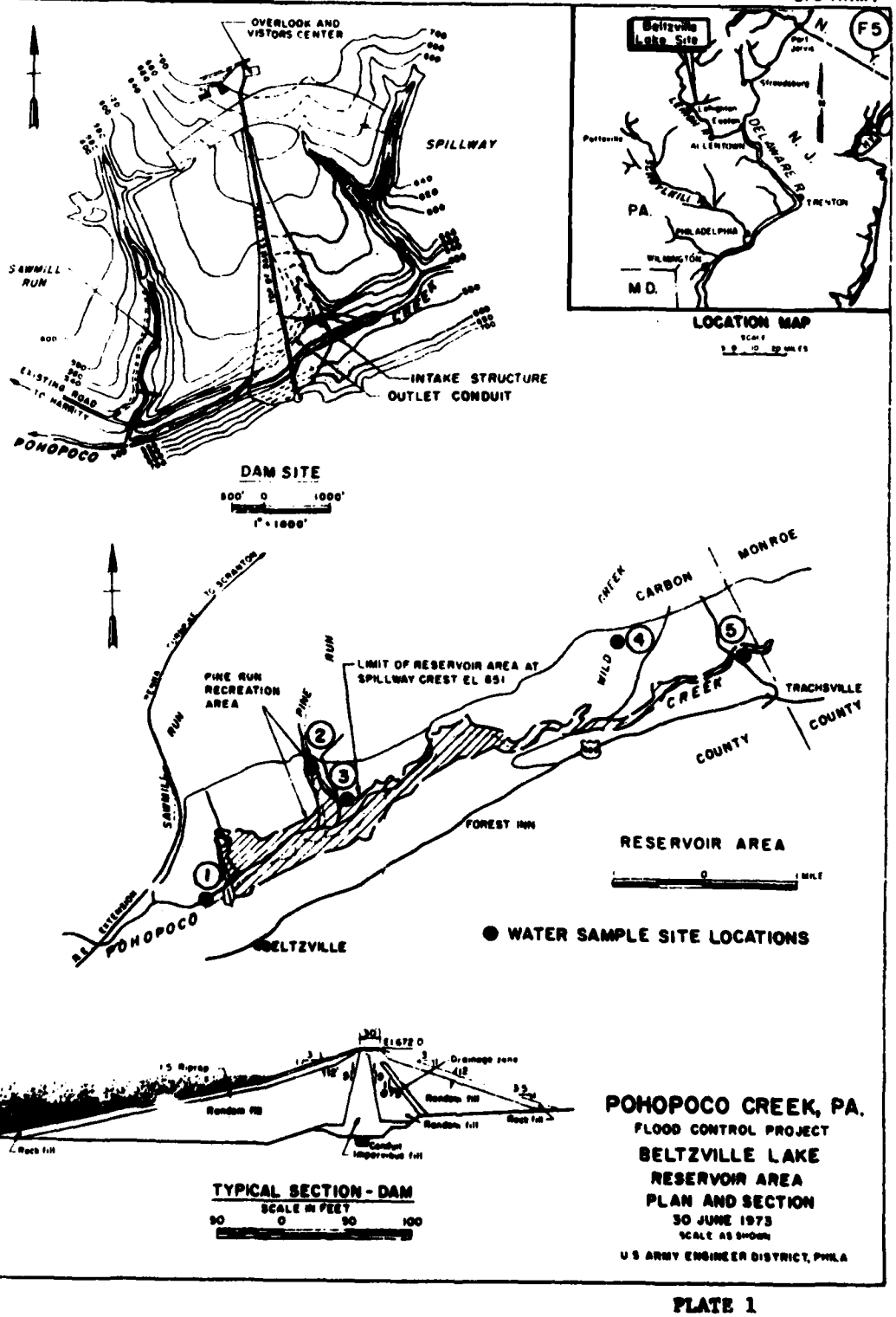
Data for July-Sept not available at time of report preparation.

PLATE 1

LOCATION MAP AND WATER SAMPLE
TEST SITE LOCATIONS

CORPS OF ENGINEERS

U.S ARMY



POHOPOCO CREEK, PA.

FLOOD CONTROL PROJECT

BELTZVILLE LAKE

RESERVOIR AREA

PLAN AND SECTION

30 JUNE 1973

SCALE AS SHOWN

U S ARMY ENGINEER DISTRICT, PHILA

PLATE 1

PLATE 2

POOL ELEVATION DRAWDOWN
(Available in NAPEN-E Files)

END

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