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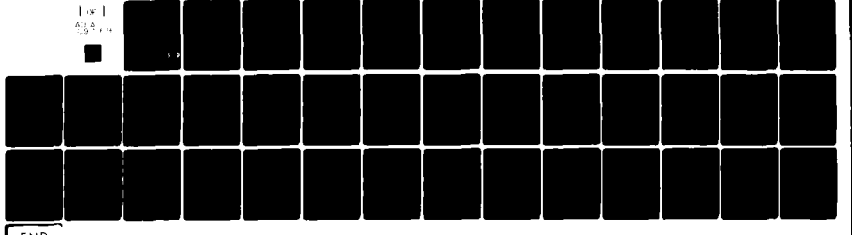

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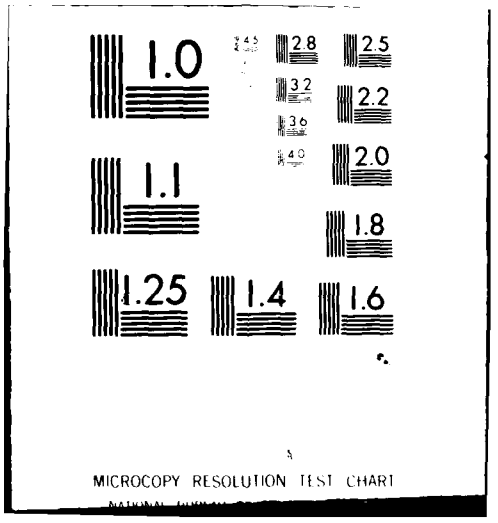
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BLUE MARSH LAKE PROJECT

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

FOR THE PERIOD

OCTOBER 1, 1979 TO SEPTEMBER 30, 1980

Prepared by

U. S. Army Corps of Engineers
Philadelphia District

Rept. no. DAEN/NAP-01780/WQDR80-80/12

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20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

Blue Marsh Lake is located on the Tulpehocken Creek about seven miles northwest of Reading, Pa. The purpose of the report is to present and briefly interpret the water quality data collected to date at Blue Marsh Lake. The analyzed data (Appendix A), meets the standards established by the U.S. Environmental Protection Agency and the Commonwealth of Pennsylvania as outlined in Chapter 93, Water Quality Criteria.

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The fecal coliform standards for swimming beaches is 200 fecal coliforms per 100 ml of sample and this was not exceeded during the current year.

The report characterizes the general design areas as to land use, potential pollution sources contributing to the lake, the project itself and the relationship between potential water quality problems that may occur and possible effects of the lake on the water quality.

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* Appendices A, B, and C are available for inspection in the Philadelphia District office.

SECTION I - SUMMARY

1-01. Summary. The Blue Marsh Dam and Reservoir [1]/ is located on Tulpehocken Creek, a tributary of the Schuylkill River in Berks County about six miles northwest of Reading, Pennsylvania. The primary purposes of the project are flood control, emergency water supply storage, water quality control and recreation. This report deals with the water quality aspect of the project.

The drainage basin above Blue Marsh Lake consists principally of farmland and woodland with scattered housing located along the rural roads and small villages. Stream valleys, within the watershed have moderate to steep slopes, mostly wooded, with adjacent open fields devoted principally to agricultural pursuits. Pollution control in the Watershed is problematic, due to septic tank overflows, lack of sewage systems and drainage from farmlands within the basin.

The pH range for the maintenance of good fish production should be between 6.5 and 8.5. The State pH standards of 6.0 to 8.5 are not being met at all tributaries and the main stream. During the months of March through September 1980, several stations, primarily 1, 3, 6, 7, 10, and 12, reported pH levels higher than 8.5 (see Appendix A for locations). These higher pH levels were found primarily near the water surface level and the pH levels dropped rapidly to within state standards as testing proceeded from the surface down. It is believed that the alkaline conditions are caused by carbonate material that is picked up as the streams travel through limestone beds and from runoff on local agricultural lands. Farmers using lime and alkaline fertilizers

1/ Blue Marsh Dam and Reservoir Location (Plate 1).

contribute to alkaline runoff that flows into the reservoir. It should also be noted here that the high alkalinity is primarily a surface phenomenon and appears to be buffered as depth increases. This may be due to organic decay of leaves and detritus at depths. This natural acidity would buffer the higher alkalinity. Bicarbonate derived from limestone of the upper Tulephocken and Spring Creek basin provides for a high buffering capacity of the water for maintaining a pH on the main stem generally between 7.5 and 8.5. Northkill and Liching Creeks, which flow over shale of the Martinsburg Formation, have a lower buffering capacity and a pH between 7 and 8.

Blue Marsh Lake has a wide variety of fish, ranging from bass to game fish such as Tiger muskellunge. Prior to the official opening of the Blue Marsh project, on 15 July 1979; the Pennsylvania Fish Commission began stocking the lake in May and June with 400,000 largemouth bass fry, 25,000 walleyes, 15,000 crappies and 75,000 channel catfish fry. During August, another 5,000 largemouth bass were stocked.

Finally, 7,000 Tiger muskellunge were stocked during October of 1979. The Fish Commission reported that there was a very low fish mortality rate and a prolific growth exhibited in largemouth bass and other fish. Fishing in lake waters was reportedly excellent with similar results for 1980. Most fishermen contacted expressed deep satisfaction with the fishing provided by Blue Marsh Lake.

Monitoring of lake waters was begun in June 1979 by U.S. Geological Service and the Corps in September of the same year. In addition to Corps' testing for pH, dissolved oxygen, temperature, and specific conductance, the U.S.

Geological Survey tested for bacteria, arsenic, chlorphyll a, and nutrient levels. Algae infestation did not manifest itself to the point of a problem. Since the lake is less than two years old, it is difficult to postulate future lake conditions as to algae infestation.

SECTION II - INTRODUCTION

2-01. Purpose and Scope. The purpose of the report is to present and briefly interpret the water quality data collected to date at Blue Marsh Lake. The analyzed data (Appendix A), meets the standards established by the U. S. Environmental Protection Agency and the Commonwealth of Pennsylvania as outlined in Chapter 93, Water Quality Criteria.

The fecal coliform standards for swimming beaches is 200 fecal coliforms per 100 ml of sample and this was not exceeded during the current year.

The report characterizes the general design areas as to land use, potential pollution sources contributing to the lake, the project itself and the relationship between potential water quality problems that may occur and possible effects of the lake on the water quality.

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

2-03. Background Information. Blue Marsh Lake is located on the Tulpehocken Creek about seven miles northwest of Reading. Blue Marsh Dam, spillway and outlet works was essentially completed in the fall of 1978, and dedicated on 15 July 1979. Flood and water quality gates were closed on 23 April 1979; with the water reaching the summer pool (EL 290) on 16 September 1979.

Lake monitoring began on 20 June 1979 by the U. S. Geological Survey, and the district instituted profile monitoring on 13 September 1979. The primary purposes of the reservoir are for flood control, future water supply, water quality and recreation. Blue Marsh Reservoir is one of four flood control structures in the Delaware River Basin.

2-04. Pertinent References. The following references are considered pertinent to this report.

a. (ER 1110-2-1402)
b. (ER 1130-2-415)
c. U. S. Geological Survey, Water Resources Investigations, Water Quality Study of Tulpehocken, Prior to Impoundment of Blue Marsh Lake, (77.55).
d. U. S. Geological Survey Water-Resources Investigations (78-53); Bacteriological Water-Quality of Tulpehocken Creek Basin, Berks and Lebanon Counties, Pennsylvania.
e. Chemical, Bacteriological and Physical Data documented in Appendix A of this report.

SECTION III - AREA AND PROJECT DESCRIPTION

3-01. River Basin Characteristics. The Blue Marsh project is located in Berks County in southeastern Pennsylvania (see Plate 1). The project is on Tulpehocken Creek, which has its source near the city of Lebanon and flows generally eastward towards its confluence with the Schuylkill River, about seven miles below the dam site at Reading. The Tulpehocken Creek watershed covers approximately 215 square miles with more than 80 percent of the drainage area located above the dam site. The general topography of the basin is characterized by hills with rounded tops and steep slopes, mostly of which, are wooded.

The watershed is essentially rural and agriculturally oriented with approximately 24 percent of the project lands forested; primarily occurring on steep slopes and along the bottoms of narrow ravines. Urban and villages lands in Myerstown, Womelsdorf, Robesonia, Wernersville, and numerous smaller communities make up the remainder of the Blue Marsh Lake's drainage basin. Reading, which is the county seat, is located approximately 7 miles downstream of the Blue Marsh Dam at the confluence of the Schuylkill River and Tulpehocken Creek.

The project is located in the temperate northeast Atlantic Coast climatic zone, an area of frequent changing temperatures and moderate, year-round precipitation. Precipitation is relatively uniform throughout the year, averaging between about 6.4 and 10.3 percent per month of the yearly total.

Snowfall averages about 30 inches per year over the entire Tulpehocken watershed. Temperatures at Blue Marsh Lake area, during July and August have a daily maximum temperature above 80 degrees. From May through September, the daily average temperature approaches 70°F. These temperatures in conjunction with high humidity result in very hot summers.

3-02. Project Description. The principal features of the project are: a dam embankment, a spillway, an outlet works, a service building, an overlook, and two residences for the dam operator's use. Most of the Blue Marsh Lake projects approximately 5,500 acres of Federal land and water and 460 acres of state-owned land will be available for recreation and related uses. The dam is a rock-faced, earth-filled structure across the valley of the Tulpehocken Creek. The dam is about 1,775 feet long with a 30 foot graveled maintenance road along the entire length. The top of the dam is at elevation 332, twenty-five feet above the spillway crest, with 5.6 feet of freeboard above the peak spillway design flood pool. The spillway is an unlined channel through a natural saddle about 1,500 feet south of the dam. The channel is 300 feet wide and approximately 1,360 feet along the centerline. The sill is 300 feet wide, 30 feet long and extends from the crest elevation of 307 to elevation 323.

The outlet works consists of an approach channel, intake tower and service bridge, conduit, stilling basin and exit channel. The intake tower contains the operating house, intakes, gates to regulate intake flow and conduits to convey withdrawals through the dam embankment.

The reservoir, when filled to the recreation pool, elevation 290, is approximately 8.8 miles long and slightly over a mile at its widest point just north of the dam. The average depth is about 25 feet and a maximum depth of 56 feet (summer season pool) near the dam.

The recreation areas are located along the north bank of the reservoir which provide a bathing beach, change house with sanitary facilities, picnic areas and a boat launch area. A second boat launch area is located on the south bank near state hill. The recreation areas were built, maintained and operated by the Army Corps of Engineers. The service building, located on the east embankment near the dam structure, provides office space for management personnel and garage space for project vehicles and equipment.

3-03. Climate. 1/ The project is located in the temperate northeast Atlantic climatic zone, and is characterized by frequent changing temperatues and moderate amounts of precipitations. The area is subject to precipitation from normal rainfall, thunderstorms, and heavy rains associated

1/ Climatological Data, Blue Marsh Lake - 1980 - TABLE 1.

TABLE 1

BLUE MARSH LAKE

CLIMATOLOGICAL DATA 1/ - JAN - JUNE 1980

MONTH	Precp. (inches)	Total Snow (inches)	Avg. Temp. (°F)	Highest Temp. (°F)	Lowest Temp. (°F)	Days with Precp.
JAN	3.23	0	29.5	57	8	3
FEB	1.17	0	27.2	56	3	4
MAR	5.48	0	37.4	66	6	17
APR	5.53	0	51.9	77	26	2
MAY	3.01	0	62.9	88	31	10
JUNE	3.78	0	67.7	92	39	11

1/ Extracted from the Monthly Summary Report - NOAA - Data collected at the Reading Station.

with hurricanes and snowfall. Based on records compiled by NOAA at Allentown, which is physiographically similar to the Blue Marsh Lake area; July and August have daily maximum temperatures above 80 degrees (F). From May through September average highs of 70°F have been recorded. Snowfall averages about 30 inches per year over the entire Tulpehocken watershed.

3-04. Dam and Lake Characteristics.

a. Embankment. The dam is a rock-faced, earth-filled structure across the valley of the Tulpehocken Creek, about 7 miles northwest of Reading. The top of the dam is surfaced with gravel to serve as a maintenance road. The top of the dam is at elevation 332 with the spillway located through a saddle about 1500 feet south of the dam. The spillway is an ungated structure with crest at elevation 307.

b. Outlet Works. The outlet works consists of an approach channel, intake tower and service bridge, conduit, stilling basin and exit channel. The intake tower contains the operating house, intakes, gates to regulate intake flow and conduits to convey withdrawals through the embankment.

c. Reservoir. The reservoir when filled to the recreation pool (El. 290), is approximately 8.8 miles long and slightly over a mile at the point of maximum width. The average depth is about 25 feet, and the maximum is 56 feet.

3-05. Geological Patterns. The rocks underlying the Blue Marsh Lake project were deposited as sediment nearly half a billion years ago. After consolidating into solid rock, they underwent folding, and in recent times, the folded strata was exposed by erosion.

Two major layers of sediment crop out beneath the soils of the Blue Marsh project. The Beekmantown limestone group is the older of the two, having been deposited during the lower Ordovician period some 480 to 500 million years ago. The younger rocks are collectively termed the Martinsburg Formation which were deposited during the middle and upper Ordovician period, about 440 to 440 million years ago.

The Beekmantown limestone has been exposed by the erosion of overlying shales in only one place within the project. At the crest of an anticline, the outcrop forms a 5,600 by 1,500 foot oval about 1,800 feet north of the dam. The bedrock in this exposure is encountered within 20 feet of the surface.

The Martinsburg Formation has two divisions; the lower shaly member which underlies most of the project, and the upper sandy member, which rests atop the lower section and underlies only the northwestern portion of the project. The rocks in both divisions occur in numerous layers. Most of the layers are composed of some kind of shale, but beds of sandstone, limestone and conglomerates also occur. The depth to Martinsburg bedrock varies, but generally averages only 2 to 3 feet. The overburden is somewhat thinner on the ridges and steep slopes but may reach depths as high as 6 feet or more in a few level areas.

3-06. Soils. [1/] The majority of the project's soils are of three series and types. Weikert-Berks shaly silt loam covers about 40 percent of project lands above elevation 290, Litz shaly silt loam covers about 20 percent, and Berks shaly silt loam, about 15 percent. All tend to be somewhat dry, to contain many shale fragments and to be relatively shallow over bedrock.

3-07. Vegetation. Nearly all relatively flat lands and slopes under 15 percent have been cleared and farmed - principally for grass, hay, grain and corn to sustain dairy operations. Woodlands presently account for about 1,400 acres or 24 percent of project lands. They occur primarily on steep slopes and along the bottoms of narrow ravines. The dominant tree species are red oak and white oak. Other major components include black oak, chestnut oak, several hickory species, beech, tulip, hemlock, flowering dogwood, black cherry, white ash, black locust, sassafras, juneberry and red maple.

3-08. Land Use. The Blue Marsh Lake Park comprising of 5,500 acres of Federal Land and water will provide public use areas to accommodate 250,000 recreationists annually. The public use areas presently in use are for picnicking, boating, swmming and hiking. The park and its public use areas were constructed by the U. S. Army Corps of Engineers in 1978 and dedicated in July 1979. The park is managed, operated and maintained by Corps personnel.

The Pennsylvania Fish Commission stocked the lake with various types of game fish and are also responsible for lake management. Management of adjacent lands are under the jurisdiction of the Corps. Most of remaining lands in the watershed are devoted to farming and other closely related pursuits such as orcharding and timbering.

SECTION IV - WATER QUALITY DATA

4-01. Purpose of Sampling Program. The purpose of taking water samples is to establish a base line inventory of water quality parameters within the areas influencing and influenced by the lake.

The data that will be collected and documented will be useful in determining the kind of pollutants that may occur in the watershed and within the lake environment. From this date, the Corps through the Pennsylvania (DER), can initiate corrective action to control or minimize these sources of pollution. It is the Corps' intent to develop a meaningful water quality program and to conform with the Pennsylvania (DER) standards as outlined in Chapter 93, Water Quality Criteria.

4-02. Testing Procedures and Equipment. The U. S. Geological Survey has conducted pre-impoundment studies [1/] [2/] at the Blue Marsh Project for the Corps. Those investigations dealt with the Biological, Chemical and Physical aspects of the proposed project.

Beginning with the spring of 1979, and filling of the lake, the U. S. Geological Survey initiated a program of collecting lake water samples at prescribed levels at four points within the lake and two points downstream of the dam. These samples were analyzed for chemical, biological, bacteriological constituents; - sediment and bed material, for heavy metals.

1/ Water-Quality Study of Tulpehocken Creek - Water Resources Investigations, 77-55, Bacteriological Water-Quality of Tulpehocken Creek Basin Water
2/ Resources Investigations, 78-53, April 1978.

The Philadelphia District continued lake stratification testing in 1980. The parameters tested for were dissolved oxygen, pH, temperature and specific conductance. The [illegible] results are tabulated in (Appendix A) of this report.

4-03. Data Collected. Considerable data has been collected and documented for future use in project [illegible], pollution detection and to initiate protective measures for stream inflows and lake waters to conform with Pennsylvania (DER) Regulations, Chapter 93. A water quality management program was conducted through contract services, with lake stratification testing conducted by the Philadelphia District, supplemented by Bacteriological Analysis conducted by [illegible] services. This data is available at the Philadelphia District office.

Stratification testing indicated anaerobic conditions throughout the lake extending from 4 meters to 14 meters below the surface waters, with 0.0 dissolved oxygen readings observed. This condition improved toward September. This condition is typical of new lakes and should stabilize with time. The analysis of water samples suggest the Tulpehocken Creek basin to be a highly fertile environment, evidently caused by runoff which contain large volumes of dissolved fertilizer and animal matter.

Major stream inflows will be included in future sampling and will be analyzed for dissolved oxygen, conductivity, pH, phosphorous, total dissolved solids, nitrate, nitrite, ammonia, temperature and bacteria.

On the basis of this accumulated data, the Philadelphia District will evaluate and apply this information in the future management of Blue Marsh Lake.

The Environmental Branch will continue coordination efforts with the Pennsylvania (DER) for the purpose of continuing their assistance in conducting Biological and Chemical Surveys of stream inflows and lake waters at the Blue Marsh Project.

Fecal coliform samples were collected at the beach waters by the U. S. Geological Survey and analyzed at their facilities. The current fecal coliform standards for swimming beaches is 200 fecal coliforms per 100/ml of sample and this was not exceeded during the 1980 testing period at Blue Marsh Lake.

Since Blue Marsh Lake is relatively new and the water quality data documented to date insufficient, it is problematic to draw precise conclusions regarding water quality conditions at this time. The indications are that minor problems were encountered in algae proliferation in the upper lake area and anerobic conditions were recorded at bottom depths.

4-04. WATER CHEMISTRY

a. Nitrogen and Phosphorous: The concentrations of nitrogen and phosphorous necessary at the beginning of the growing season to produce nuisance populations of algae were suggested by Sawyer (1974) to be 0.30 and 0.015 mg/l respectively.

In Tulpehocken Creek concentrations of nitrogen and phosphorous exceeded Sawyer's critical values in all of the samples collected within the lake site (fig. 1 and 2). Median concentrations of nitrate-nitrogen and total phosphorous near the dam site were 4.5 and 0.13 mg/l, respectively. Nutrient concentrations were higher during periods of runoff.

The load of nitrogen and phosphorous at various discharges is plotted in figures 3 and 5. Based upon flow duration, the annual input of nitrogen to the lake is about 1,400 tons (1,270 metric tons) or 8 tons (7.3 metric tons) per square mile, and the annual input of phosphorous is 46 tons (41.7 metric tons) or 0.26 tons (0.24 metric tons per square mile).

b. Dissolved Oxygen. The concentration of dissolved oxygen in water in equilibrium with the atmosphere, depends on temperature and dissolved-solids content of the water. The solubility of dissolved oxygen increases as temperature and dissolved solids decreases. The State has established the minimum dissolved-oxygen concentration necessary for maintaining healthy aquatic life in Tulpehocken Creek as 5.0 mg/l and a daily mean not less than 6.0 mg/l. Minimum values at all five stations (Figure 4) exceeded these standards, and although it is probable that the daylight sampling program has not disclosed the true minimum values, the criteria are undoubtedly met at all five sampling sites.

An analysis of the dissolved oxygen saturation curves for Tulpehocken near Blue Marsh Dam site discloses that saturation was succeeded a large percent of the time, indicating high rate of photosynthesis of aquatic plants and a low biochemical oxygen demand (BOD).

Stratification monitoring 1/ which began in June 1979 revealed that anerobic conditions existed from approximately 4 meters to lake bottom throughout the lake until the middle of October. This condition improved during October as indicated by a higher dissolved oxygen readings at the lake bottom near the dam and throughout the lake. Dissolved oxygen readings showed a marked improvement at all four test sites and met the standards as published in Chapter 93, Water Quality Criteria, Pennsylvania DER.

c. pH. The pH range for the maintenance of good game fish production should be between 6.5 and 8.5. Our testing program (Appendix A) indicated that the criteria established by Pennsylvania DER were met at all lake stations during 1980. This could be contributed by the bicarbonate derived from limestone of the upper Tulephocken and Spring Creek basin and is responsible for the high buffering capacity of the water and for maintaining a pH generally between 7.5 and 8.5 throughout the lake.

d. Total Dissolved Solids (TDS) and Specific Conductance. Specific conductance is a measure of the ability of a unit volume of material to conduct electric current. In water, this ability is directly related to the concentration of ions and therefore to the concentration of dissolved solids.

Water-quality criteria for Blue Marsh Lake, (Pennsylvania DER Standards, Chapter 93), require that the monthly average must not exceed 500 mg/l dissolved solids and must not exceed 750 mg/l at any time. Specific conductance data (Appendix A) indicate that these criteria are being met at all four testing sites within the lake.

1/ APPENDIX A - Blue Marsh Lake Stratification Testing - Philadelphia District.

4-05. COLIFORM SAMPLING. The coliform counts at Blue Marsh remained within the limits established by the Pennsylvania (DER) of no more than a geometric mean of 200 colonies per 100 millimeters of sample for total coliform. The highest count follows a period of rain, particularly after a prolonged dry spell, indicating that runoff carries material into the water rather than from point sources. The following test results of bacteria were recorded from 19 August and through 22 September 1980 at Blue Marsh Swimming Beach.

BLUE MARSH LAKE SWIMMING BEACH

F.C./100 ml	Time	Date
4	1100	19 August 80
9	1500	21 August 80
9	1030	25 August 80
9	1300	29 August 80
0	1030	1 September 80
4	*	14 September 80
0	*	22 September 80

(*-- not reported)

Fecal coliform standards of 200 per 100 ml for bathing waters was not exceeded at the beach area during 1980. It appears that the Fecal and Fecal Strep data as cited above indicates that tremendous die off of bacteria occurs between the inflow and the beach area, a distance of approximately 8 miles.

4-06. ALGAE. The potential for algae bloom remains in the upper reaches of the lake.

Concentrations of nitrogen and phosphorous was highest after storm runoff. Based upon estimates from flow duration curves, the annual input of nitorgen and phosphorous to the lake is about 1,400 tons and 46 tons respectively.

SECTION V - INTERPRETATION OF DATA

5-01. General Post-Impoundment Conditions. Blue Marsh Lake does not have an acid problem. The bicarbonate derived from limestone of the upper Tulpehocken and Spring Creek basin, is responsible for the high buffering capacity of the water. As a result, pH readings between 7.5 and 8.5 are found throughout the lake.

Analysis of data 1/ collected by the Philadelphia District and U.S. Geological Survey indicates that the water quality of lake waters meets the standards as set forth in the Clean Streams Law, ref. Title 25, Chapter 93. Documented data indicates that generally throughout the summer season, water quality remained good and is acceptable for recreational pursuits.

5-02. Fishery. Blue Marsh Lake is expected to be primarily a walleye-bass lake with crappies, the principal forage fish.

Tiger muskellunge, which were also stocked, will provide excellent future sport fishing opportunities throughout the lake. Fishermen contacted expressed deep satisfaction with the quantity and size of fish that were taken.

The Pennsylvania Fish Commission is responsible for the stocking management and patrol of the Blue Marsh Lake. The Commission's fish stocking program began in May 1979 and has progressed quite satisfactorily this year.

1/ Appendix A - Stratification Data.

1980 - PENNSYLVANIA FISH STOCKING PROGRAM

Walleye Fry	500,000	29 April 1980
Largemouth Bass Fry	375,000	28 May 1980
Walleye, 1-2"	35,000	27 June 1980
Largemouth Bass, 4-6"	27,000	2 Sept 1980
Tiger Muskellunge, 6-10"	4,000	19 Sept 1980
Channel Catfish, 2-3"	60,000	29 Sept 1980

5-03. Coordination Efforts With Other Federal and State Agencies. The Philadelphia District requested the U.S. Geological Survey to perform Chemical, Biological, Bacteriological, Physical and Sedimentation Studies for Blue Marsh Lake for FY 1980. Data 1/ has been recorded and the balance of the study has been submitted to the Corps.

Pennsylvania (DER), Bureau of Water Quality, has been contacted in an attempt to secure their services to collect and analyze water samples from the major tributaries of the Blue Marsh Lake. An attempt will also be made to initiate a macroinvertebrate and benthic invertebrate study on these same streams.

1/ Due to its volume, this data is retained in Corps' (NAPEN-E) files.

SECTION VI - RECOMMENDATIONS AND PROPOSED STUDIES

6-01. General. The following recommendations and proposals are made relative to the water quality management and control at Blue Marsh Lake.

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

b. Establish tributary and downstream sampling and monitoring for dissolved oxygen, pH, nitrate, nitrite, ammonia, total dissolved solids, ions, total phosphate, specific conductance and bacteria.

c. Coordinate Corps Monitoring activities with Pennsylvania DER's and attempt to secure PA. DER's Water Quality Section to initiate Macroinvertebrate and Benthic Invertebrate studies in the tributaries of the Blue Marsh Lake.

d. Correlate data collected from other agencies and establish their sampling points, procedures and equipment used for testing.

e. Continue close cooperation with the Pennsylvania Fish Commission in the management of Blue Marsh Lake and initiate improvement of fish habitat both in the lakes and downstream from the dam sites.

f. Maintain a permanent record system of data on hand and other data obtained from all other sources. Such data will be used as a management tool and provide a means for evaluating water quality trends.

6-02. Findings and Conclusions. The water sampling program will continue to be expanded to include tributary and downstream monitoring.

Bacteriological monitoring will be continued for FY 1981, particularly at the beach area, for compliance with Pennsylvania DER standards for public bathing areas.

Documented data 1/ collected on water quality for Blue Marsh Lake from April through November 1980 indicates that the quality of water remains within the standards established by Pennsylvania DER. During periods of heavy precipitation, there is slight increase in nutrient enrichment and bacteria counts, but this condition dissipates rather quickly with no apparent detrimental effect on water quality.

Previous studies indicate that bicarbonate derived from limestone of the upper Tulpehocken and Spring Creek basin is responsible for a high buffering capacity of the water and for monitoring a pH of 7.5 and 8.5 in the Blue Marsh Lake. In some cases, the Corps testing program indicated pH readings of 9.0 and higher.

Water Quality Analysis, by USGS (Appendix B) indicated moderate growth of algae and weeds, apparently due to the nutrient enrichment of lake waters caused by runoff.

1/ Appendix A - Stratification Testing

6-02.(a). FUTURE TRENDS.

Blue Marsh is rather new, therefore, it is difficult to predict future water quality trends since the lake has not stabilized and there is insufficient recorded data for predictive analysis.

The Philadelphia District began its water quality testing program in June 1979. This program will continue and will be expanded to include other parameters presently not included. It has also added bacteriological testing at the beach area and plans to add tributaries to the lake waters. Samples for chemical and bacteriological analysis will be collected from various depths at random times during the year and analyzed at Pennsylvania's (DER) laboratories in Harrisburg.

It appears, according to 1980 observations of lake water, that algae and pond weeds may become a future lake problem. Future management efforts should address this problem and recommend proper control methods to minimize these conditions.

6-02.(b). Water Supply. The Delaware River Basin Commission (DRBC) and the United States of America agreed to a contract for certain Water Storage space in the Blue Marsh Reservoir. Western Berks Water Authority is presently under contract with the DRBC to take water from the stream until such time as the Authority may elect to connect into the water supply system at the Blue Marsh Dam. The Authority is presently securing its water from the stream, which meets the quality standards as established by Pennsylvania DER, Chapter 93, Water Quality Criteria.

The forty-eight inch water supply pipe is presently not available for direct withdrawal. This unfavorable feature results in a partial water release tower capacity and can cause anoxic conditions at lower lake depths. To aid in limiting this condition, it is suggested to uncap the 48" water supply pipe, install a small auxiliary basin and an energy dissipation device. Either or both sides of the outlet works could then be used to meet reservoir regulation.

6-02.(c). Conclusion. The data recorded from the 1980 water quality testing program at Blue Marsh Lake suggest that the lake exhibits a nutrient rich environment. Nitrogen and phosphate levels were moderately elevated; but the long term effect of this is not known since sufficient data is lacking at this time to draw predictive conclusions.

The testing program revealed very low to zero dissolved oxygen levels at several stations, primarily station nos. 1, 3 and 6 during the months of July, August and early September. The depths of low oxygen levels fluxuated in the 4.6 meter to 12.2 meter depth range. Lake turnover took place in October and as a result dissolved oxygen readings improved substantially.

The proliferation of algae and pond weeds may become a future problem with time. Close monitoring of this condition will be necessary to determine timing and the application of proper control measures. Any control measures will have to be coordinated with the Pennsylvania Fish Commission and the Pennsylvania Bureau of Water Quality.

Limited testing for bacteria levels indicate fluxuation of infestation undoubtedly caused by heavy runoff. It appears that the travel time of water from the upper reaches to the beach area was instrumental and the cause of bacterial dieoff. According to bacteriological data recorded from waters at the beach area; the coliform counts were within the limits established by Pennsylvania (DER) for public bathing areas.

APPENDIX A

BLUE MARSH LAKE STRATIFICATION TESTING

APPENDIX A

Summary - Blue Marsh Stratification Testing

DATE OF TESTING	STATIONS TESTED	COMMENTS/INTERPRETATION
5-18-80	Tower New Bridge - upstream	
5-15-80	1, 3, 6, 7, 10, 12	
5-28-80	1, 3, 6, 7, 10, 12	
6-24-80	1, 3, 6, 7, 10, 12	D.O. levels fell below 2 at depths of >9.1 meters (sta 1)
7-9-80	1, 3, 6, 7, 10, 12	zero D.O. levels noted at stations 1, 3, 6, 7 below 7.6 m
7-15-80	1, 3, 6, 7, 10, 12	zero D.O. level noted [illegible]
7-31-80	1, 3, 6, 7, 10, 12	"pocket" of zero D.O. noted from 4.6 - 6.1 m
8-14-80	1, 3, 6, 7, 10, 12	zero D.O. pocket located from 4.6 - 7.6m (sta 3)
8-26-80	1, 3, 6, 7, 10, 12 tower - wetwell	zero D.O. pocket (tower) located from 7.6 - 12.2m
9-3-80	1, 3, 6, 7, 10, 12	zero D.O. pocket located throughout lake (depth 4.6 - 6.1m)
9-18-80	1, 3, 6, 7, 10, 12	
9-30-80	1, 3, 6, 7, 10, 12	
10-14-80	1, 3, 6, 7, 10, 12	PH levels all into 8 - 9 range
10-29-80	1, 3, 6, 7, 10, 12	PH levels dropped to 7 - 8 range

As shown by stratification testing, the lake stratified beginning around June, continued to experience pockets of low dissolved oxygen at lower depths until September when the fall "turnover" replenished depleted oxygen levels.

BLUE MARSH LAKE, WATER QUALITY

ANALYSIS, USGS

APPENDIX B

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BUTT MARSH [illegible]

BACTERIOLOGICAL ANALYSIS

APPENDIX C

APPENDIX C

1. Blue Marsh Lake Swimming Beach

DATES TESTED

8-19-80

8-21-80

8-25-80

8-29-80 ALL COLIFORM COUNTS WITHIN STATE STANDARDS

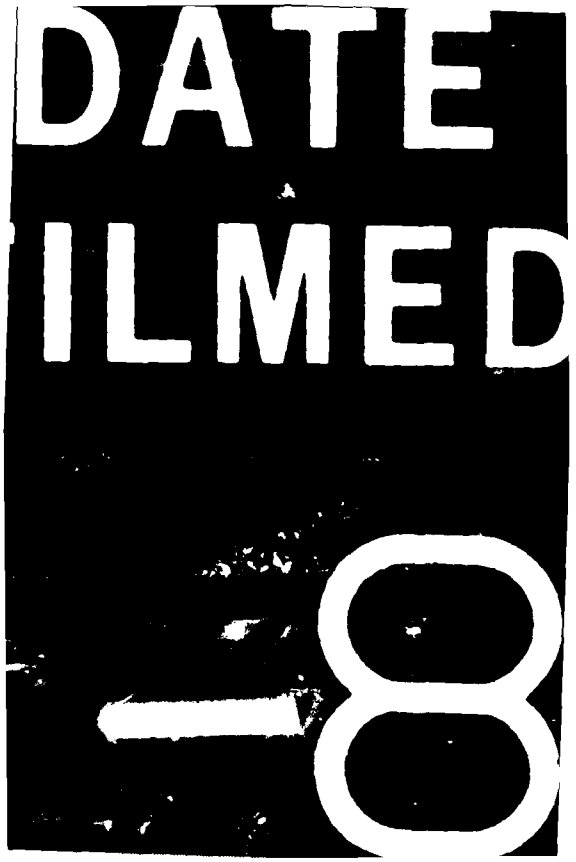
9-1-80

9-14-80

9-22-80

2. Bacteriological samples taken [illegible]
4 USGS stations in pool and one at outlet [illegible] all within standards

3. Phytoplankton distribution of dominant algae genera - 8-26-80 thru 9-24-80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