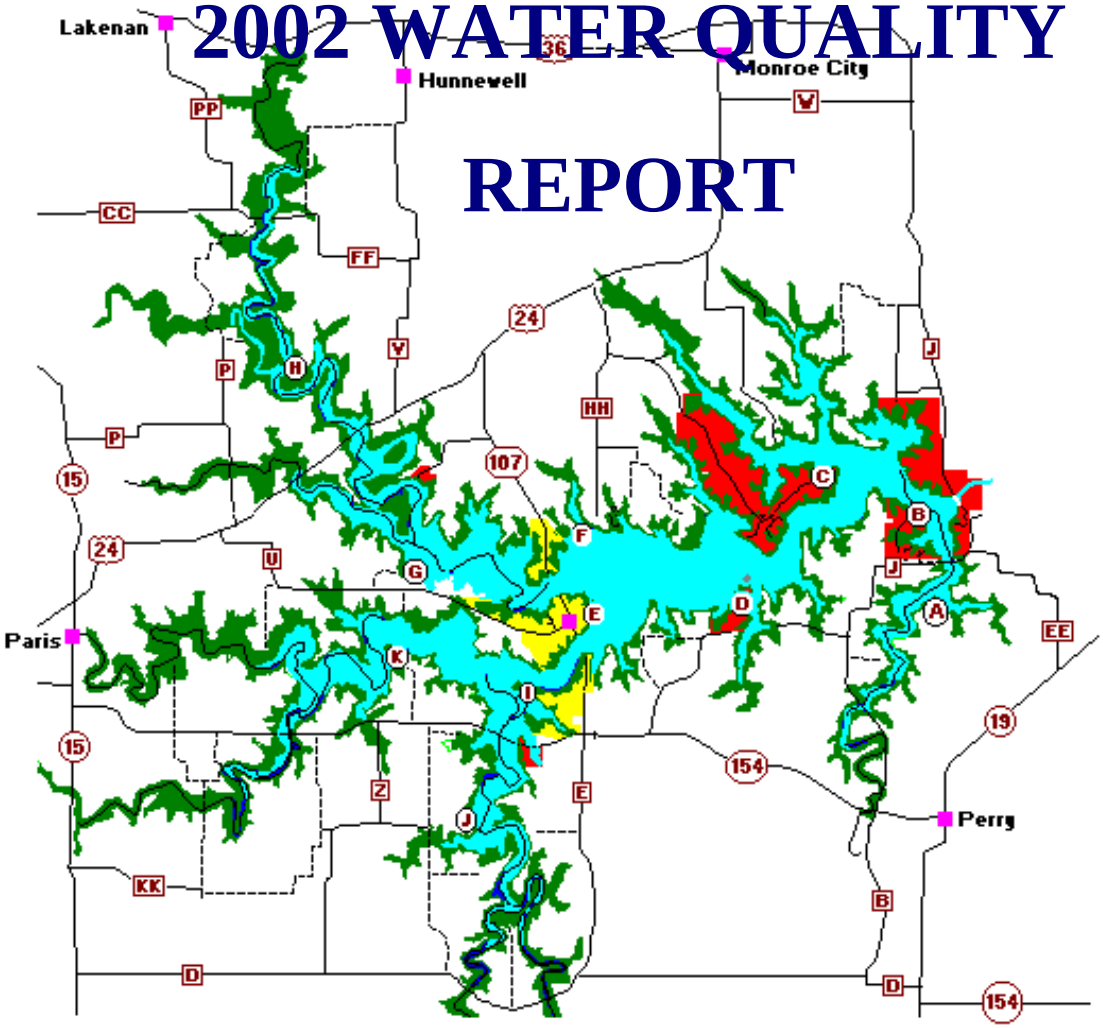
MARK TWAIN LAKE

2002 WATER QUALITY REPORT



U.S. ARMY CORPS OF ENGINEERS, ST. LOUIS DISTRICT
ENVIRONMENTAL QUALITY SECTION - Water Quality

Billy Arthur,Section Chief
Ted Postol, Environmental Engineer
Rick Archeski, Environmental Engineer
Kevin Slattery, Hydrologist
Ron Frerker, Chemist

Table of Contents

LIST OF APPENDICES

LIST OF TABLES

LIST OF GRAPHS

WATER QUALITY MONITORING PROGRAM

Mark Twain Lake, Monroe City, Missouri

1.0 GENERAL OVERVIEW

Mark Twain Lake is located in northeast Missouri. The land surrounding the lake is used predominately for agriculture. The main agricultural contaminants into the watershed include pesticides and fertilizers. Also a concern is the high sediment loading into the lake and the colloidal characteristic of the sediments as well as low dissolved oxygen levels related to turbine generation. The lake is also susceptible to fish kills due to algal decay in the lake arms.

The operating purposes for Mark Twain Lake are fish/wildlife, hydroelectric power, flood control, recreation, navigation and water supply. The water quality management program for the lake includes monitoring of baseline parameters, ecological trends and investigation of problem areas to keep the lake within state and federal standards.

The water quality monitoring program was conducted during 1998 at four lake sites, six tributaries and 2 outflows to assure that safe conditions were maintained for human recreation, wildlife and aquatic life. A special study of the North, Middle and South Fork Tributaries was conducted in FY98 in an effort to determine contaminate levels as they enter the lake from a primary tributary. Four sampling events took place between March and October 1998. The location of the twelve sampling locations (four lake, 6 tributaries and two outflow streams) are depicted on the lake area map in Appendix A.

2.0 WATER QUALITY ASSESSMENT CRITERIA

The water quality assessment criteria are based on the State of Missouri regulatory limits for certain contaminants and generally accepted criteria for sustaining adequate aquatic plant and animal growth.

The following parameters were analyzed in FY98 sampling at Mark Twain Lake: alachlor, atrazine, chlorophyll, pheophytin-a, fecal coliform and fecal streptococcus bacteria, iron, manganese, nitrate-nitrogen, nitrate/nitrite-nitrogen, dissolved ammonia-nitrogen, alkalinity, total organic carbon (TOC), orthophosphate-phosphorus, total phosphate-phosphorus, total dissolved solids (TDS), total suspended solids (TSS), volatile suspended solids (VSS), biological oxygen demand (BOD), silica, chloride, pH, dissolved oxygen, specific conductance, temperature and oxidation-reduction potential.

The Missouri Department of Natural Resources, Code of State Regulations, Division 20, Chapter 7 classifies water quality criteria based on designated usage. These standards are used to determine the water quality of the lake. Table 2.1 provides a listing of the regulatory limits for the parameters analyzed where a limit has been established.

TABLE 2.1 State of Missouri Water Quality Standards	
PARAMETER	**LIMIT**
Nitrate-Nitrogen	10 mg/l
Iron	0.30 mg/l
Manganese	0.05 mg/l
Fecal Coliform	< 200 colonies/100 ml
Chloride, Chronic	230 mg/l
Chloride, Acute	860 mg/l
pH	Range: 6.5 to 9.0
DO	> 5.0 mg/l
Atrazine	0.003 mg/l (Drinking Water Standard)
Alachlor	0.002 mg/l (Drinking Water Standard)

Monitoring of the alkalinity provides the measurement of the buffering capacity of lake water as well as the effect on the toxicity of certain pollutants in the water (i.e., algae blooms and decay). Ammonia nitrogen is monitored so that the effects on fish spawning, hatching, growth rate and pathologic changes in gills, liver and kidney tissue can be related to the detected levels of ammonia nitrogen. Nitrate-nitrogen degrades to nitrite or produces ammonia which has a detrimental effect on aquatic life and therefore is monitored to assure levels are below the regulatory "safe" limit. The metals manganese and iron are nutrients for both plants and animals. Phosphate is analyzed as phosphorus and is monitored due to the potential for uptake by nuisance algae. Levels of phosphate can indicate the potential for rapid growth of algae (algae bloom) which can cause serious oxygen depletion during the algae decay process. Serious oxygen depletion has a major effect on aquatic life. Photosynthetic activity can be hindered by the levels of total suspended solids. Total suspended solids concentrations which cause the photosynthetic activity to be reduced by more than 10% from the seasonably established norm, would have a detrimental effect on aquatic life. Silica, chlorophyll and pheophytin-a are monitored to provide indicators of algae growth and therefore potential oxygen depletion activity. Total volatile solids indicate the presence of organics in suspension and therefore additional demand levels of oxygen. Fecal coliform bacteria is monitored for the protection of human health as it relates to full body contact of lake waters. Chloride, pH and dissolved oxygen are monitored for the protection of aquatic life. Atrazine and Alachlor herbicides are commonly used agricultural chemicals which can be readily transported by rainfall runoff. Both compounds are suspected of causing cancer and therefore are monitored for the protection of human and aquatic health.

3.0 SPECIAL STUDIES

The collection of sediments at four lake sites and from three tributaries was continued in 1998. This study is being conducted to establish baseline levels. Presently, there are no regulations for sediments. The composition of sediments vary for different areas. The

data may provide supplemental information as to the relative amount of contaminants transported by sediments versus contaminants dissolved in the water column. This study will provide useful information into what contaminants bottom fish and other aquatic life are ingesting. It would also give an indication into what reactions take place during lake turnover. Lake turnover can have an effect on the oxidizing of metals. Trend analysis of this data will be performed every five years. The parameters analyzed include: fourteen (14) priority pollutant metals, total phosphate (TPO_4), Kjeldahl nitrogen, nitrate-N (NO_3), total solids, total organic carbon (TOC), chlorinated pesticides and PCB's. The results for chlorinated pesticides and PCB analysis were below the detectable limits for 1998.

4.0 WATER QUALITY MONITORING RESULTS

The laboratory analytical results for water samples are summarized in Table C-1, Appendix C. Analytical results of detected levels are plotted in graphical form on Graphs C-1a through C-1h, Appendix C.

Field collected analytical results are summarized in Table D-1 through D-4, Appendix D. A graphical presentation of field results are presented in Graphs D-1a through D-4, Appendix D.

Laboratory results for sediment samples are summarized in Table E-1, Appendix E.

5.0 SUMMARY OF MONITORING RESULTS

The seasonal change brought on a gradual lake stratification during the summer months. The stratification was less dramatic than previous years and therefore overall sudden detrimental water quality changes such as algae blooms and dramatic dissolved oxygen reductions were not experienced in the lake system.

Bacteria levels were elevated in the early spring and could be attributed to surface water runoff carrying additional wildlife wastes into the lake during a time of seasonably increasing temperatures. Bacteria levels decreased to within acceptable limits throughout the remainder of the year.

The metals manganese and iron were seen at slightly elevated levels within the lake waters but no evidence exists that demonstrate the levels are detrimental to the overall lake system at this time.

Atrazine was detected at levels above the regulatory limit for drinking water standards. Treatment of water for the removal of atrazine is an expensive process and therefore elimination of the contaminant prior to water supply intake is the most cost effective approach. Management of agricultural application of the compound along with runoff management could reduce the influx into the lake system and therefore reduce the requirements for pretreatment of drinking water supplies originating from the lake.

The monitoring program for Mark Twain Lake during FY98 revealed a good water quality when compared to limits established by the MDNR for general use, secondary contact and indigenous aquatic life. Herbicide contamination and other agricultural nutrient runoffs are primary concerns for the lake water quality. Better land management practices, erosion control and buffering zones are methods to reduce these contaminants from entering the lake. The St. Louis District personnel will continue working with lake personnel, area communities and agencies in implementation of educational and implementation planning to bring about the use of better management techniques which will improve the lake water quality.

6.0 PLANNED 1999 STUDIES

Water quality monitoring at Mark Twain Lake was modified for FY98 from previous years monitoring programs. A special study of the North, Middle and South Fork Tributaries was conducted in FY98 in an effort to determine contaminate levels as they enter the lake from a primary tributary. This work was conducted in cooperation with the Natural Resources Conservation Service (NRCS). FY99 monitoring is planned on the North, South and Middle Forks along with normal lake sampling. The parameter list has been expanded to include additional herbicides such as triazene and possibly others which are currently applied on upland agricultural properties. Cooperation and coordination of the project with the NRCS will continue during FY98.