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NATIONAL DAM SAFETY PROGRAM, MO NONAME 819 DAM (MO 30211), MISS--ETC(U)
APR 80 J L ANDERSON, H L SMITH, R O SMITH

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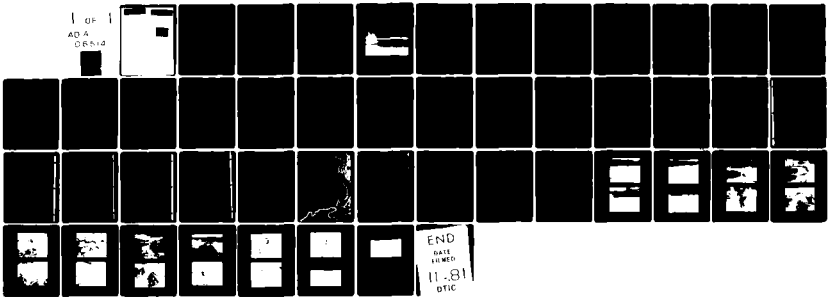

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20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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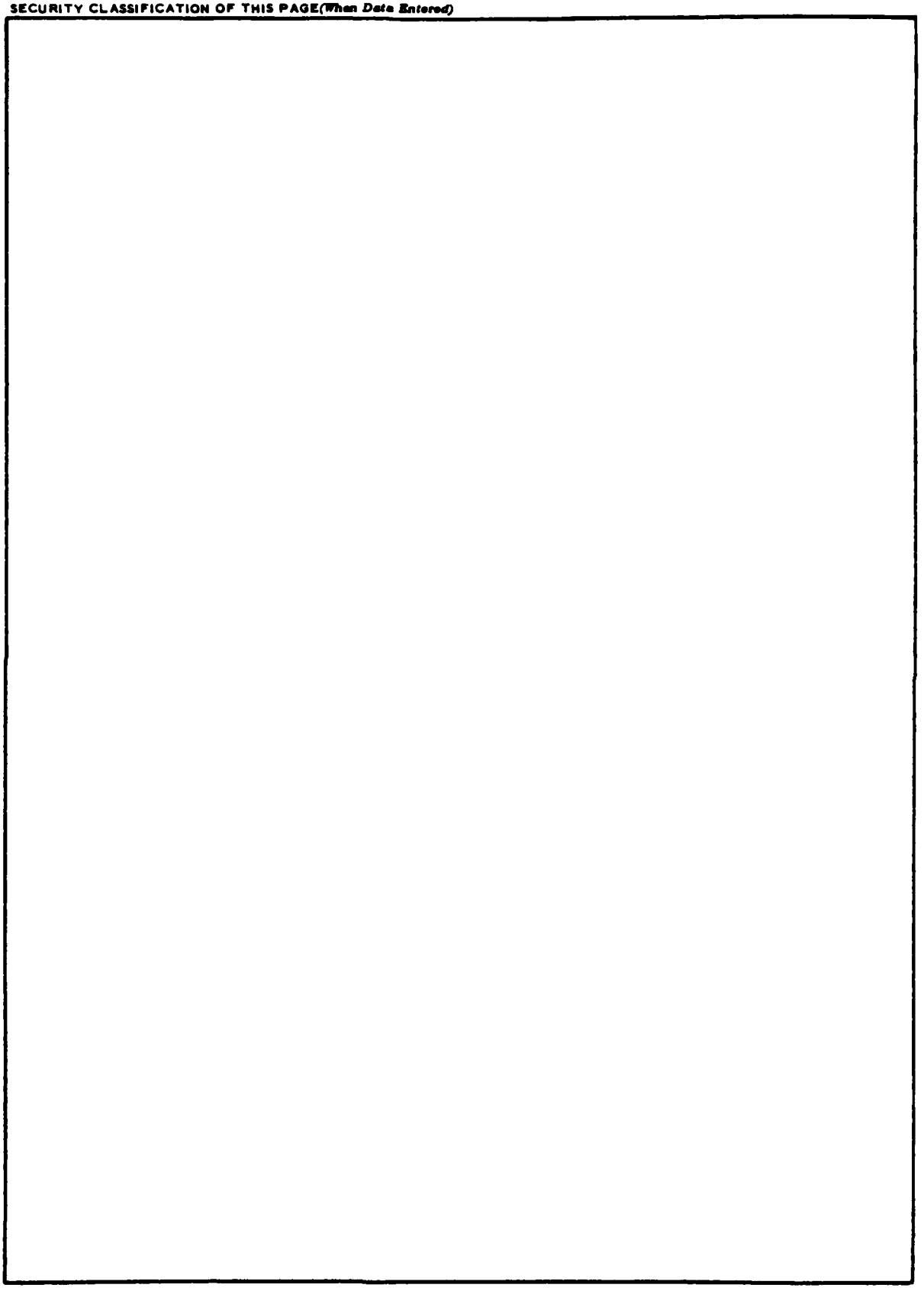

MONONAME 819 DAM
CAPE GIRARDEAU COUNTY, MISSOURI

MISSOURI INVENTORY NO. 30211

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY: ST. LOUIS DISTRICT CORPS OF ENGINEERS
FOR: GOVERNOR OF MISSOURI

MAY 1980

Overview of Mononame 819 Dam

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
MONONAME 819 DAM - ID NO. 30211

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Name of Dam	Mononame 819
State Located	Missouri
County Located	Cape Girardeau
Stream	Unnamed tributary to Indian Creek
Date of Inspection	15 May 1979

The Mononame 819 Dam was inspected by an interdisciplinary team of engineers from the Memphis District, U. S. Army Corps of Engineers. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers and developed with the help of several Federal and state agencies, professional engineering organizations, and private engineers. Based on these guidelines, this dam is classified as an intermediate size dam with a high downstream hazard potential. Failure would threaten the life and property of five families downstream of the dam and cause appreciable damage to Highway J bridge located approximately 0.3 mile downstream.

The inspection and evaluation indicate that the spillway does not meet the criteria set forth in the guidelines for a dam having the above mentioned size classification and hazard potential. For its size and hazard category, this dam is required by the guidelines to pass the PMF. The emergency spillway will only pass 30 percent of the PMF before the dam embankment is overtopped. Because the spillway will not pass 1/2 of the PMF without overtopping but will pass the 10-year frequency flood, the dam is classified as "unsafe non-emergency". The spillway will pass the 100-year flood without overtopping, which is a flood that has a 1 percent chance of being exceeded in any given year. There are no other hydrologic or hydraulic deficiencies.

Other deficiencies visually observed by the inspection team were trees growing on the upstream slope; erosion gulleys in both abutments; and erosion at the outlet of the emergency spillway due to the discharge from the emergency spillway being directed onto the downstream slope of the dam. Another deficiency found was the lack of seepage and stability analysis records.

It is recommended that the owner take action to correct or control the deficiencies described. Corrective works should be in accordance with analyses and design performed by an engineer experienced in the design and construction of dams.

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SUBMITTED BY: SIGNED 15 JUL 1980

Chief, Engineering Division — Date

APPROVED BY: SIGNED 15 JUL 1980

Colonel, CE, District Engineer — Date

SECTION I - PROJECT INFORMATION

1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the District Engineer for the St. Louis District, Corps of Engineers, directed that a safety inspection of Mononame 819 Dam be made.

b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams." These guidelines were developed with the help of several Federal agencies and many state agencies, professional engineering organizations, and private engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances.

(1) The dam is an earthen embankment built between two gently rolling hills in the uplands which border the Mississippi Embayment. Topography adjacent to the valley is rolling to steep. Soils in the area are formed of silty clays with fragments of chert. Topography in the vicinity of the dam is shown on Plate 2.

(2) An uncontrolled 48-inch bituminous coated corrugated metal pipe (CMP) with a hooded inlet extending horizontally through the embankment and junctioned with a 48-inch bituminous coated CMP passing through the embankment on 1V to 3H slope is the primary means of discharge. The overall horizontal length of the primary discharge system is 163 feet. The emergency spillway consists of three 24-inch diameter bituminous coated CMP pipes extending horizontally through the embankment for a distance of 48 feet.

(3) Pertinent physical data are given in paragraph 1.3 below.

b. Location. The dam is located in the north central portion of Cape Girardeau County, Missouri, as shown on Plate 1. The lake formed by the dam (as presented on Plate 2) is shown on the Cape Girardeau, Missouri, Quadrangle sheet in Section 11; Township 32 North, Range 13 East.

c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. Based on these criteria, this dam is in the intermediate size catergory.

d. Hazard Classification. Guidelines for determining hazard classification are presented in the same guidelines as referenced in paragraph c above. Based on referenced guidelines, this dam is in a High Hazard Classification.

e. Ownership. The dam is owned by Mr. Adrian Geisler of 2103 Themis in Cape Girardeau, Missouri.

f. Purpose of Dam. The dam forms a 44-acre recreational lake for the Cape Lake Development.

g. Design and Construction History. Through conversation with the owner, it was determined that no design information was available on Mononame 819 Dam. Construction of the dam was begun in the summer of 1970 and completed in the summer of 1971. Mr. Adrian Geisler, the owner, constructed the dam and help was received from Mr. Tom Dean, state geologist, during construction of the cutoff trench. The dam was constructed of silty clays containing fragments of chert excavated from the hills on each side of the dam. The material was placed in lifts by bottom dump scrapers and paddle-wheel scrapers and then compacted by several passes of the scrapers and a dozer. A cutoff trench to rock was reported as part of the design. The cutoff trench was reported to be 20 feet wide and 22 feet deep with side slopes of approximately 1V on 2.5H.

h. Normal Operating Procedures. Normal rainfall, runoff, transpiration and evaporation all combine with uregulated discharges to maintain a relatively stable water surface.

1.3 PERTINENT DATA

a. Drainage Area. - 345 acres (Topographic Quadrangle)

b. Discharge at Damsite.

(1) Discharge can take place through a horizontal inlet pipe and three culverts which act as an emergency spillway.

(2) Estimated experienced maximum flood at damsite - unknown.

c. Elevation (Feet above N.G.V.D.)

(1) Observed Pool - 460.0
(2) Normal Pool - 459.5
(3) Spillway Crest - 461.6
(4) Maximum Experienced Pool - Unknown
(5) Top of Dam - 464.5
(6) Maximum Pool (PMF) - 466.3
(7) Invert of Discharge Pipe at Stilling Basin - 416.7
(8) Stream bed at centerline of dam - 420.0
(9) Maximum Tailwater - Unknown

d. Reservoir. Length of maximum pool - 2300^{+} feet.

e. Storage. (Acre - feet)

(1) Observed Pool - 691
(2) Normal Pool - 670
(3) Spillway Crest - 764
(4) Maximum Experienced Pool - Unknown
(5) Top of Dam - 906
(6) Maximum Pool (PMF) - 1003

f. Reservoir Surface Area (Acres)

(1) Observed Pool - 43.90
(2) Normal Pool - 43.22
(3) Spillway Crest - 47.05
(4) Maximum Experienced Pool - Unknown
(5) Top of Dam - 52.75
(6) Maximum Pool (PMF) - 56.29

g. Dam

(1) Type - earth embankment
(2) Length - 700± feet
(3) Height - 44.5 feet Maximum
(4) Top Width - 25± feet
(5) Side Slopes

(a) Downstream - 1V on 3.05H
(b) Upstream - 1V on 3.42H

(6) Zoning - Unknown
(7) Impervious Core - Unknown
(8) Cutoff - (Reported as):

Bottom Width - 20 feet
Depth - 22 feet
Side Slopes - Approximately 1V on 2.5H

(9) Grout Curtain - None

h. Diversion and Regulating Tunnel. None.

i. Primary Discharge System

(1) Type - An uncontrolled 48-inch bituminous coated CMP with a hooded inlet extending horizontally for an estimated distance of 40 feet through the embankment junctioned with a 48-inch bituminous coated CMP sloping through the embankment on 1V to 3H for a horizontal distance of 123 feet. The location of the junction was estimated based upon the topography of the dam and horizontal measurements from the inlet end to the outlet end.

(2) Length of the initial horizontal section of the 48-inch diameter pipe - 40 feet.

(3) Horizontal length of sloping 48-inch diameter pipe - 123 feet (est).

(4) Overall horizontal length of 48-inch diameter pipe - 163 feet.

(5) Invert elevation of inlet end - 459.5 N.G.V.D.

(6) Invert elevation of outlet end at stilling basin - 416.7 N.G.V.D.

j. Emergency Spillway

(1) Type - Three uncontrolled 24-inch bituminous CMP pipe.

(2) Length of each 24-inch diameter pipe - 48 feet.

(3) Invert elevation at inlet end - 461.6 N.G.V.D. (avg).

(4) Invert elevation at outlet end - 461.2 N.G.V.D. (avg).

k. Regulating Outlet. None.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No design data are known to exist.

2.2 CONSTRUCTION

The dam was constructed by the present owner from the summer of 1970 to the summer of 1971. The dam was constructed of silty clay with fragments of chert excavated from the hills on each side of the dam. The material was placed in lifts by bottom dump scrapers and paddle-wheel scrapers and then compacted by several passes of the scrapers and a dozer. A cutoff trench to rock was constructed by a dragline. The cutoff trench was reported to be 20 feet wide and 22 feet deep with side slopes of approximately 1V on 2.5H.

2.3 OPERATION

The emergency spillway was reportedly used only once, but the date of usage was unknown. The emergency spillway was used during an 11.5 inch rain. The maximum depth of flow that occurred in the emergency spillway is unknown.

2.4 EVALUATION

a. Availability. The only engineering data available were mentioned in paragraphs 2.1 - 2.3 above.

b. Adequacy. The field and visual inspections presented herein are considered adequate to support the conclusion of the report. There were no design data available to evaluate the adequacy of the hydrologic and hydraulic design. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

c. Validity. Not applicable.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. Visual inspection of Mononame 819 Dam was performed on 15 May 1979. Personnel making the inspection were employees of the Memphis District, Corps of Engineers, and included a geological engineer, a hydraulic engineer, and a soils engineer. Specific observations are discussed below.

b. Dam. No detrimental settlement, cracking, slides, or animal burrows were observed in or near the earth embankment (see Photo 1). A typical existing cross-section of the embankment is shown on Plate 4. A dam plan view is shown on Plate 3. The existing upstream slope is 1V on 3.42H, and the existing downstream slope is 1V on 3.05H. The crest width was measured to be approximately 25 feet.

The upstream slope is protected by riprap to within 10 feet of the crown of the dam. The upstream slope above the riprap is well covered with grass. Small trees are growing along the water's edge (see Photos 3 and 5). Only slight erosion exists on the upstream slope and one erosion gulley has been repaired with riprap at Station 8+85 (see Photo 6). No wavewash was present on the upstream slope. In the right abutment a concrete boat ramp has been constructed.

The crest of the dam is well maintained and is covered by 16 feet of asphalt pavement (see Photo 1). The downstream slope is well maintained and has good grass protection (see Photos 1, 4 and 20). Erosion on the downstream slope has been controlled except for erosion gulleys which exist in each abutment (see Photos 16, 17 and Plate 3). No seepage was observed on the downstream embankment, however, a wet area exists at the toe of the dam near the right abutment (see Photo 19 and Plate 3). Small crayfish holes exist at the intersection of the dam and valley slope of the right abutment. At the toe of the dam, two sewage lagoons have been constructed. The dimensions of the sewage lagoons are 335 feet by 190 feet for the large lagoon and 221 feet by 93 feet for the small lagoon (see Photos 20, 21, and Plate 3).

c. Appurtenant Structures. An uncontrolled 48-inch bituminous coated corrugated metal pipe (CMP) with a hooded inlet extending horizontally through the embankment and junctioned with a 48-inch bituminous coated CMP passing through the embankment on 1V on 3H slope is the primary means of discharge. The overall horizontal length of the primary discharge system is 163 feet. The inlet invert elevation is 459.5 N.G.V.D. A small trash screen has been constructed around the inlet. Also, the area around the inlet has been concreted to prevent erosion (see Photo 7). The outlet invert elevation is 416.7 N.G.V.D. The outlet discharges into a stilling basin whose approximate dimensions are 15 feet by 10 feet and which is approximately 4 feet deep (see Photo 8). The inlet and discharge pipe appear to be in relatively good condition. The stilling basin appears to be stable.

An emergency spillway exists near the left abutment of the dam. The emergency spillway consists of three uncontrolled 24-inch bituminous coated CMP which extend horizontally through the dam embankment for approximately 48 feet. The inlet invert elevation of the culverts is 461.6 N.G.V.D. and the outlet invert elevation is 461.2 N.G.V.D. The three culverts appear to be in relatively good condition (see Photo 11).

Erosion exists below the outlets (see Photos 12 and 14). The erosion gulley is approximately 10 feet long and 2 feet deep. The erosion is the result of discharge from the emergency spillway being directed onto the downstream face of the dam. There is no existing outfall channel for flow from the culverts of the emergency spillway (see Photo 13).

d. Reservoir Area. No wave wash, excessive erosion or slides were observed along the shore of the reservoir.

e. Downstream Channel. The downstream channel is overgrown with trees and brush (see Photo 9).

3.2 EVALUATION

None of the conditions observed are significant enough to indicate a need for immediate remedial action or a serious potential of failure. Trees on the upstream slope, erosion at the outlets of the three culverts of the emergency spillway and erosion gulleys in both abutments are deficiencies which, left uncontrolled or uncorrected could lead to the development of potential problems.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The primary discharge system and emergency spillway are uncontrolled; therefore, no regulating procedures exist for those structures. The pool elevation is controlled by rainfall, runoff, evaporation, and the capacity of the uncontrolled discharge structures.

4.2 MAINTENANCE OF DAM

The upstream and downstream slope and crest appear to be well maintained except for the deficiencies discussed in paragraph 3.1b.

4.3 MAINTENANCE OF OPERATING FACILITIES

No operating facilities exist. The uncontrolled discharge structures provide the only means of discharge from the lake.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

The inspection team is not aware of any existing warning system for this dam.

4.5 EVALUATION

If the trees and brush on the upstream slope, the erosion gulleys in both abutments of the downstream slope and the erosion gulley below the emergency spillway in the downstream face of the dam are allowed to continue, potential problems could develop.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. No hydraulic and hydrologic design was available to assess.

b. Experience Data. The drainage area was developed using USGS Cape Girardeau NE, MO Quadrangle. The spillway and dam layout are made from surveys conducted by the inspecting team.

c. Visual Observations.

(1) The inlet pipe structure and the three culverts which comprise the emergency spillway are in good condition.

(2) The principal inlet pipe structure is located at Station 3+65 and the culverts which comprise the emergency spillway are located in the left abutment.

d. Overtopping Potential. The spillway will safely pass 30 percent of the Probable Maximum Flood (PMF) at a discharge of 175 cfs without overtopping. The Probable Maximum Flood is defined as the flood discharge that may be discharged from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The PMF will overtop the embankment for a period of 8 hours at a depth of 1.8 feet with a discharge of 3600 cfs. The 1/2 PMF will also overtop the embankment for a period of 5 hours at a depth of 1.1 feet with a discharge of 1200 cfs. The 100-year frequency flood will not overtop the embankments. For its size and hazard category, this dam is required by the guidelines to pass the PMF. However, considering the high-hazard potential to life and property of approximately five families downstream of the dam, the PMF is considered the appropriate spillway design. Because the spillway will not pass 1/2 PMF without overtopping but will pass the 10-year frequency flood, the dam is classified as unsafe non-emergency. The data utilized in the preparation of the estimates was various Federal reports, data from field inspection and survey, and output from OCE program HEC-1, Dam Safety Version. More specific details will be found in Appendix A.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observation. Visual observation of the dam and appurtenant structures are discussed and evaluated in SECTIONS 3 and 5.

b. Design and Construction Data. The design and construction data were limited to that information discussed in SECTION 2.

c. Operation Records. There have been no known operations which have affected the structural stability of the dam.

d. Post Construction Changes. No post construction changes exist which will affect the structural stability of the dam.

e. Seismic Stability. The lake is located on the dividing line between Seismic Risk Zones 2 and 3. Because of its location in these Seismic Risk Zones, there is a possibility of liquefication of the foundation material which could cause failure of the dam during an earthquake.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. A few items were noted during the visual inspection which should be corrected or controlled. These items are trees and brush on the upstream embankment face; and erosion in both abutments of the downstream slope; and erosion below the emergency spillway due to the discharge from the emergency spillway flowing over the downstream face of the dam. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record. Also these analyses should be utilized to detail the corrective actions called for in paragraph 7.2. The Probable Maximum Flood (the spillway design flood) and one-half the Probable Maximum Flood will both overtop the dam. Because the spillway will not pass one-half the PMF without overtopping the dam, but will pass the 10-year frequency flood, the dam is classified as "unsafe non-emergency."

b. Adequacy of Information. Due to the lack of engineering design and construction data, the conclusions in this report were based on performance history and external visual conditions. The inspection team considers that these data are sufficient to support the conclusions herein. However, seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available which is considered a deficiency.

c. Urgency. The remedial measures recommended in paragraph 7.2 should be accomplished in the near future. The item recommended in para 7.2a should be pursued on a high priority basis. The stability and seepage analyses should be given priority by the owner and accomplished without delay in order to determine if corrective measures are necessary. If the safety deficiencies listed in paragraph 7.1a are not corrected in a timely manner, they could lead to the development of potential problems.

d. Necessity for Phase II. Based on the results of the Phase I inspection, no Phase II inspection is recommended.

e. Seismic Stability. This dam is located on the boundary between Seismic Zones 2 and 3. Because of its location it is possible that an earthquake could occur of sufficient intensity to cause severe damage or failure of the dam.

7.2 REMEDIAL MEASURES

a. Alternatives. The spillway size and/or height of the dam should be increased to pass the Probable Maximum Flood without overtopping the dam.

b. Seepage and stability analyses should be performed to assess the safety concerns raised by the presence of a wet area at the downstream toe of the dam. The results of these analyses should be used to effect appropriate corrective measures.

c. O & M Maintenance and Procedures. The following O & M maintenance and procedures are recommended:

(1) Remove trees and brush on the upstream embankment slope. Care should be taken during removal not to destroy the existing conditions of the upstream embankment.

(2) The downstream face of the dam below the three culverts which comprise the emergency spillway should be repaired. To prevent future erosion which could threaten the integrity of the dam, some form of erosion protection should be placed on the face of the dam below the emergency spillway or the emergency spillway should be relocated in the abutment of the dam so that discharge from the spillway can be directed away from the face of the dam.

(3) Repair the erosion gulleys in both abutments of the downstream slope.

(4) A detailed inspection of the dam should be make periodically by an engineer experienced in the design and construction of dams.

APPENDIX A

Hydrology and Hydraulic

1. Narrative. The methods and sources of data were primarily those suggested by the Hydraulics Branch, St. Louis District Corps of Engineers. Specific references and methods will be discussed below. A field inspection survey was made to determine the outlet structures and the topographic characteristics of the dam. HEC-1, Dam Safety Version was used in conjunction with appropriate input parameters to compute the inflow hydrographs, determine storage, and route through the structure.

a. Rainfall. The PMF was developed using Hydrometeorological Report No. 33. The "Hop Brook" reduction factor was not used to adjust the rainfall for this study. The distribution of rainfall was developed using the criteria as described by EM 1110-2-1411 (Standard Project Storm).

PMF Rainfall	26.5 in
PMF Percentages	6 hr - 102
	12 hr - 120
	24 hr - 130
	48 hr - 140

b. Unit Hydrograph Coefficients. The unit hydrograph for the drainage basin was developed using the Snyder Method as outlined in HEC-1, Dam Safety Version. Two methods of determining time of concentration were used, namely the Snyder's method and Kirpich method for comparison purposes.

The variables used for the appropriate method are listed below.

Snyder's	$t_p = C_t (L L_{cg})^{0.3}$; L and L_{cg} in miles
	L = 6900 feet = 1.31 miles
	L_{cg} = 3600 feet = 0.68 miles
	Stream Slope = 97 ft/mi. = .018 ft/ft
	C_t = .56
	tp = .56 hr
	t_c = .63 hr

Kirpich $$t_c = .00013\left(\frac{L, ft}{\sqrt{SLOPE, ft/ft}}\right)^{.77}$$

$$t_c = .55 \text{ hr}$$

Where

L = length of the main stream channel from the outlet to the divide

L_{cg} = length along the main channel to a point opposite the watershed centeroid

C_t = coefficient used in Snyder's method

t_p = time to peak (hr)

t_c = time of concentration (hr)

Consequently, since the time of concentrations agreed so closely, a value for t_p was chosen to be .50 hr or 30 minutes which necessitated developing a 10-minute unit hydrograph and applying a 48 hr rainfall to develop the inflow hydrographs.

The general soils map of Cape Girardeau County indicates that Mononame 819 Dam lies in an area where the soil is of the Menfro-Clarkville Association which is moderately sloping to steep, well and somewhat excessively drained, silty soils formed in loess and loamy and cherty soils formed in cherty limestone residum.

Listed below are the remaining parameters necessary to develop the unit hydrograph of 10-minute duration.

$$C_p = .646$$

Drainage Area = .539 sq. mi.

The unit hydrograph ordinates are found in the computer printout.

c. Loss Rates. A loss rate of .5 in. initially and .05 in./hr. was chosen based on engineering experience.

d. Base Flow and Antecedent Flood Conditions. A base flow of 1 cfs was selected. Since the primary discharge structure was a 48-inch CMP, the starting water surface elevation was chosen as 459.5 N.G.V.D.

e. Hydrograph Routing. HEC-1, Dam Safety Version uses the single routing step of the "Modified Puls" method. Routing through the emergency spillway was computed as outlined below while routing over the top of the embankment was accomplished using the non-level dam top option of the HEC-1, Dam Safety Version (see Plate 3) coupled with critical energy consideration of the flow.

The routing through the primary discharge structure and the emergency spillway consisted of a combination of inlet control (critical energy consideration) and pipe full-flow conditions. From the geometry of the primary discharge structure it was felt that only the short horizontal section should be considered for pipe full-flow conditions. Listed below are the pertinent parameters for the pipe full-flow conditions. Also, the respective elevation of inlet control change to pipe full-flow conditions will be listed.

(1) Primary Discharge Structure

(a) Invert Elevation = 459.5 N.G.V.D.

(b) Inlet control and pipe full-flow condition equated at water surface elevation 464.5 N.G.V.D.

(c) Pipe full-flow condition

Horizontal Pipe

D = 48-inch bituminous CMP
L = 40 feet (estimated)
N = .024

Head Losses: $h_{ent} = 1/2 \frac{V^2}{2g}$

$h_{ext} = \frac{V^2}{2g}$

h_f = friction loss (Mannings Equation)

$Q = .6117\ A_{48} \sqrt{2g}\ H^{1/2}$

The invert elevation from which to calculate H, height of head is 462.9 msl.

(2) Emergency Spillway

(a) No. of culverts = 3

(b) Invert elevation = 461.6 (average)

(c) Inlet control and pipe full-flow condition equated at water surface elevation 463.83 N.G.V.D.

(d) Pipe full-flow condition

Horizontal Pipe

D = 24-inch bituminous CMP
L = 48 feet
n = .024

Head Losses: $h_{ent} = 1/2 \frac{V^2}{2g}$

$h_{exit} = \frac{V^2}{2g}$

h_f = friction loss (Mannings Equation)

$Q = .5321\ A_{24} \sqrt{2g}\ H^{1/2}$

The invert elevation from which to calculate H, height of head is 462.2 N.G.V.D.

(f) Quantities of flow were calculated for various elevations depending on either critical flow inlet control or pipe full-flow conditions. Then the flows for each

respective elevation were combined to determine the relationship between elevation and total discharge of the primary discharge system and the emergency spillway culverts. The elevation and discharge values were then input into the computer program on respective Y4 and Y5 cards. These values can be found on the computer input section.

f. Storage. The storage was calculated with the HEC-1, Dam Safety Version with input consisting of elevations and respective surface area which were determined using the USGS Cape Girardeau NE, MO Quadrangle.

```
**************************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION        JULY 1978
  LAST MODIFICATION  01 APR 80
**************************************

RUN  DATE: 10 JUN 80
     TIME: 12.52.18

                              NON-FEDERAL DAM INSPECTION
                                   DAM #30211
                                  MONONAME 819

                                JOB SPECIFICATION
        NQ      NHR     NMIN    IDAY     IHR    IMIN   METRC    IPLT    IPRT   NSTAN
       300        0       10      -0      -0      -0      -0      -0      -0      -0
                                JOPER     NWT   LROPT   TRACE
                                    5      -0      -0      -0

                           MULTI-PLAN ANALYSES TO BE PERFORMED
                             NPLAN= 1 NRTIO= 9 LRTIO= 1
          RTIOS=    .10    .15    .20    .25    .30    .35    .40    .50   1.00

 **********     **********     **********     **********     **********

                              SUB-AREA RUNOFF COMPUTATION

                      PROBABLE MAXIMUM PRECIPITATION-48 HR DURATION

                  ISTAQ   ICOMP   IECON   ITAPE    JPLT    JPRT   INAME  ISTAGE   IAUTO
                      1       0      -0      -0      -0      -0       1      -0      -0

                                    HYDROGRAPH DATA
       IHYDG    IUHG   TAREA    SNAP   TRSDA   TRSPC   RATIO   ISNOW   ISAME   LOCAL
           1       1     .54     -0.     .54    1.00     -0.      -0      -0      -0

                                     PRECIP DATA
              SPFE     PMS      R6     R12     R24     R48     R72     R96
               -0.   26.50  102.00  120.00  130.00  140.00     -0.     -0.

                                      LOSS DATA
   LROPT   STRKR   DLTKR   RTIOL   ERAIN   STRKS   RTIOK   STRTL   CNSTL   ALSMX   RTIMP
      -0     -0.     -0.    1.00     -0.     -0.    1.00     .50     .05     -0.     -0.

                                 UNIT HYDROGRAPH DATA
                             TP=   .50     CP= .65     NTA= -0

                                    RECESSION DATA
                      STRTQ=    1.00    QRCSN=    1.00    RTIOR= 2.00
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 3.75 AND R= 2.25 INTERVALS

          UNIT HYDROGRAPH 14 END-OF-PERIOD ORDINATES, LAG=    .50 HOURS, CP=  .65  VOL= 1.00
       74.       255.       419.       438.       327.       208.       133.        84.        54.        34.
       22.        14.         9.         6.

                                            END-OF-PERIOD FLOW
       0
   MO.DA  HR.MN  PERIOD    RAIN    EXCS    LOSS    COMP Q       MO.DA  HR.MN  PERIOD    RAIN    EXCS    LOSS    COMP Q
```

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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  01 APR 80
**********

RUN  DATE: 10 JUN 80
     TIME: 12,52,18
```

NON-FEDERAL DAM INSPECTION
DAM #30211
MONONAME 819

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	10	=0	=0	=0	=0	=0	=0	=0
			JOPER	NWT	LROPT	TRACE			
			5	=0	=0	=0			

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 9 LRTIO= 1

RTIOS=	.10	.15	.20	.25	.30	.35	.40	.50	1.00

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

PROBABLE MAXIMUM PRECIPITATION-48 HR DURATION

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	=0	=0	=0	=0	1	=0	=0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.54	=0.	.54	1.00	=0.	=0	=0	=0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
=0.	26.50	102.00	120.00	130.00	140.00	=0.	=0.

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
=0	=0.	=0.	1.00	=0.	=0.	1.00	.50	.05	=0.	=0.

UNIT HYDROGRAPH DATA
TP= .50 CP= .65 NTA= =0

RECESSION DATA
STRTQ= 1.00 QRCSN= 1.00 RTIOR= 2.00
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 3.75 AND R= 4.25 INTERVALS

UNIT HYDROGRAPH 14 END-OF-PERIOD ORDINATES, LAG= .50 HOURS, CP= .65 VOL= 1.00

74.	255.	419.	438.	327.	208.	133.	84.	54.	34.
22.	14.	9.	6.						

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
0													

```
*********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  01 APR 80
*********************************
          A                    NON-FEDERAL DAM INSPECTION
          A                           DAM #30211
          A                          MONONAME 819
          B     300       0      10      -0      -0      -0      -0      -0      -0      -0
          B1      5
          J       1       9       1
          J1     .1     .15      .2     .25      .3     .35      .4      .5      1.
          K       0       1                                       1
          K1              PROBABLE MAXIMUM PRECIPITATION-48 HR DURATION
          M       1       1   .5391           .5391      1.
          P            26.5     102     120     130     140
          T                                                      .5     .05
          W      .5    .646
          X       1       1       2
          K       1       2                                       1
          K1            ROUTED FLOWS THROUGH MONONAME 819 DAM
          Y                               1       1
          Y1      1                                         -459.50      -1
          Y4459.50  459.83  460.17  460.51  460.85  461.20  461.60  461.94  462.29  462.63
          Y4462.99  463.38  463.85  464.45  465.50  466.50  467.50  468.50  469.50
          Y5      0     .76    3.01    6.69   11.73   18.10   25.73   36.72   50.87   68.38
          Y5  89.60  114.99  145.55  171.54  201.01  225.49  247.49  267.70  286.46
          $A      0  16.463  43.902  83.230
          $E    420     440     460     480
          $$  461.6
          $D  464.5
          $L      0      25      75     190     415     675     750     840     908
          $V  464.5   464.5   464.6   465.0   465.0   465.3   466.9   470.0   471.5
          K      99
```

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS								
				RATIO 1 .10	RATIO 2 .15	RATIO 3 .20	RATIO 4 .25	RATIO 5 .30	RATIO 6 .35	RATIO 7 .40	RATIO 8 .50	RATIO 9 1.00
HYDROGRAPH AT	1	.54	1	387.	581.	775.	968.	1162.	1355.	1549.	1936.	3873.
	(	1.40)	(	10.97)(	16.45)(	21.93)(	27.42)(	32.90)(	38.38)(	43.87)(	54.83)(	109.67)
ROUTED TO	2	.54	1	24.	54.	98.	146.	175.	324.	554.	1208.	3554.
	(	1.40)	(	.67)(	1.53)(	2.78)(	4.12)(	4.95)(	9.17)(	15.70)(	34.20)(	100.64)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	459.50	461.60	464.50
STORAGE	670.	764.	906.
OUTFLOW	0.	26.	173.

RATIO OF PMF	MAXIMUM RESERVOIR W.S. ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.10	461.44	0.	759.	24.	0.	43.00	0.
.15	462.35	0.	799.	54.	0.	42.83	0.
.20	463.12	0.	837.	98.	0.	42.67	0.
.25	463.83	0.	872.	146.	0.	42.67	0.
.30	464.54	.04	904.	179.	.83	42.67	0.
.35	465.05	.55	935.	324.	3.83	42.33	0.
.40	465.25	.75	945.	554.	4.67	41.33	0.
.50	465.57	1.07	963.	1208.	5.17	40.50	0.
1.00	466.32	1.82	1003.	3554.	6.33	40.33	0.

APPENDIX B

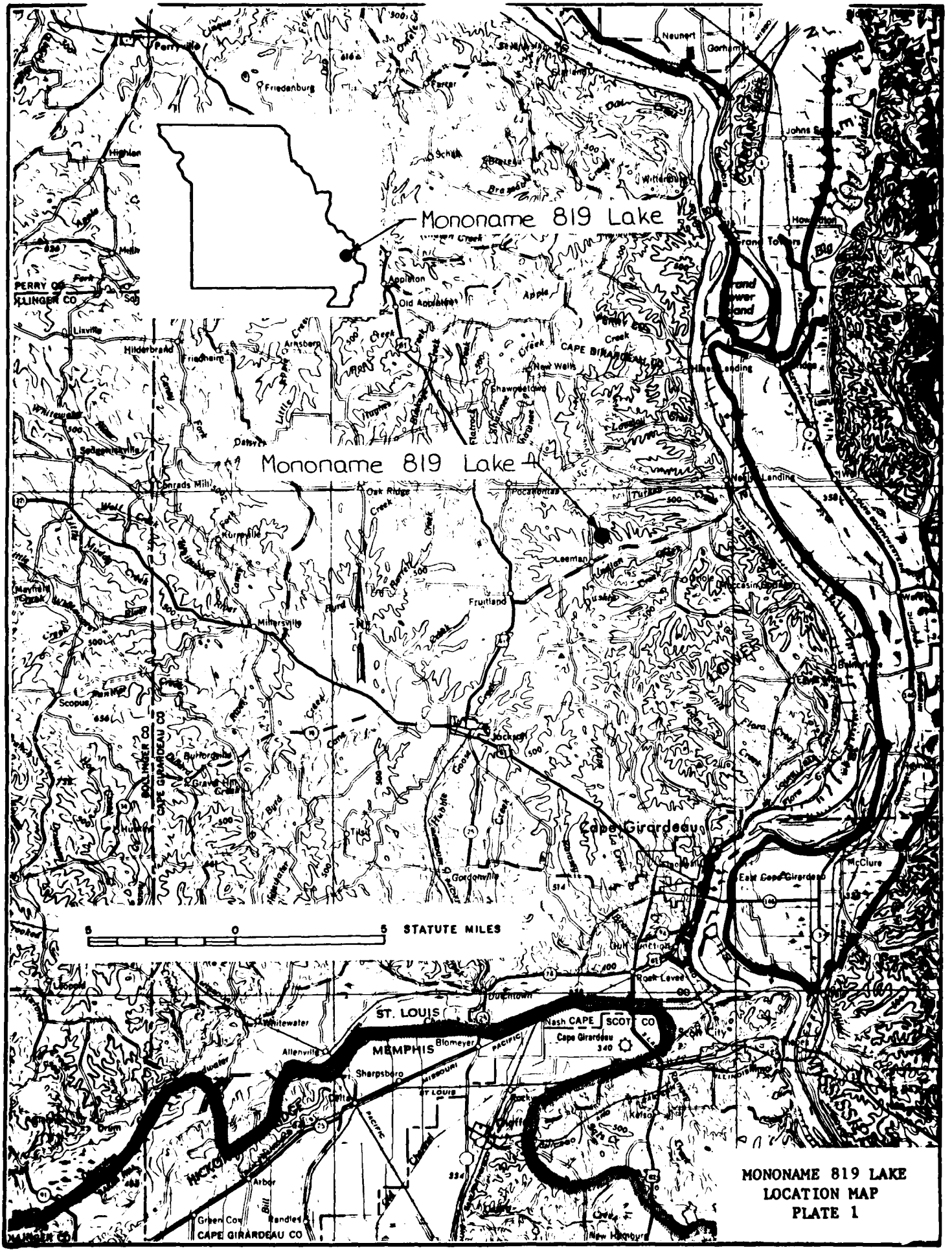
Geology of Damsite

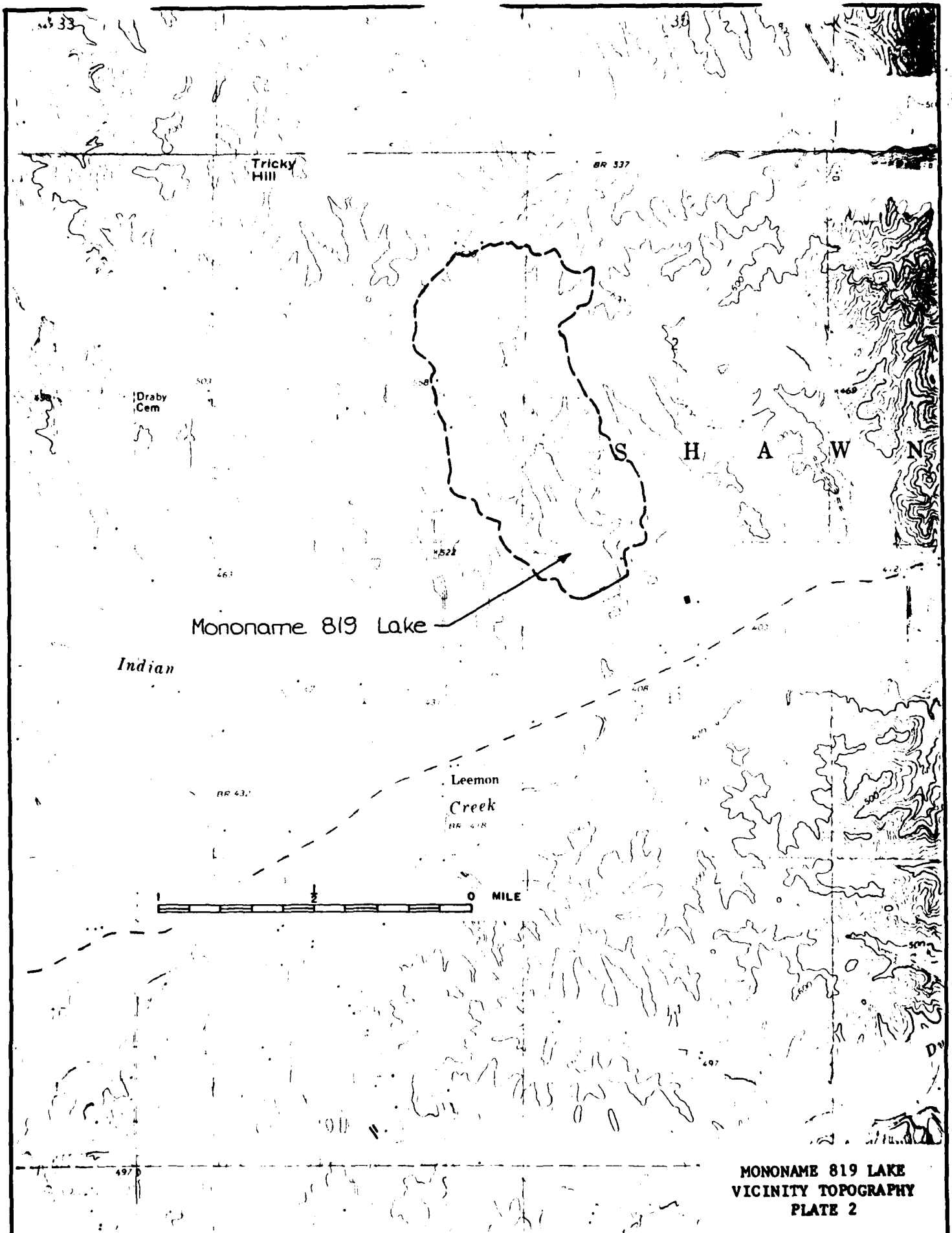
General Geology. The following geographic information was obtained from a search of the very limited available literature and one field inspection of the site.

Regional structure of the area is controlled by the Mississippi Embayment, a southerly plunging syncline whose axis is basically outlined by the course of the Mississippi River. The regional dip of the beds is about 1 to 2 degrees toward the Mississippi Embayment.

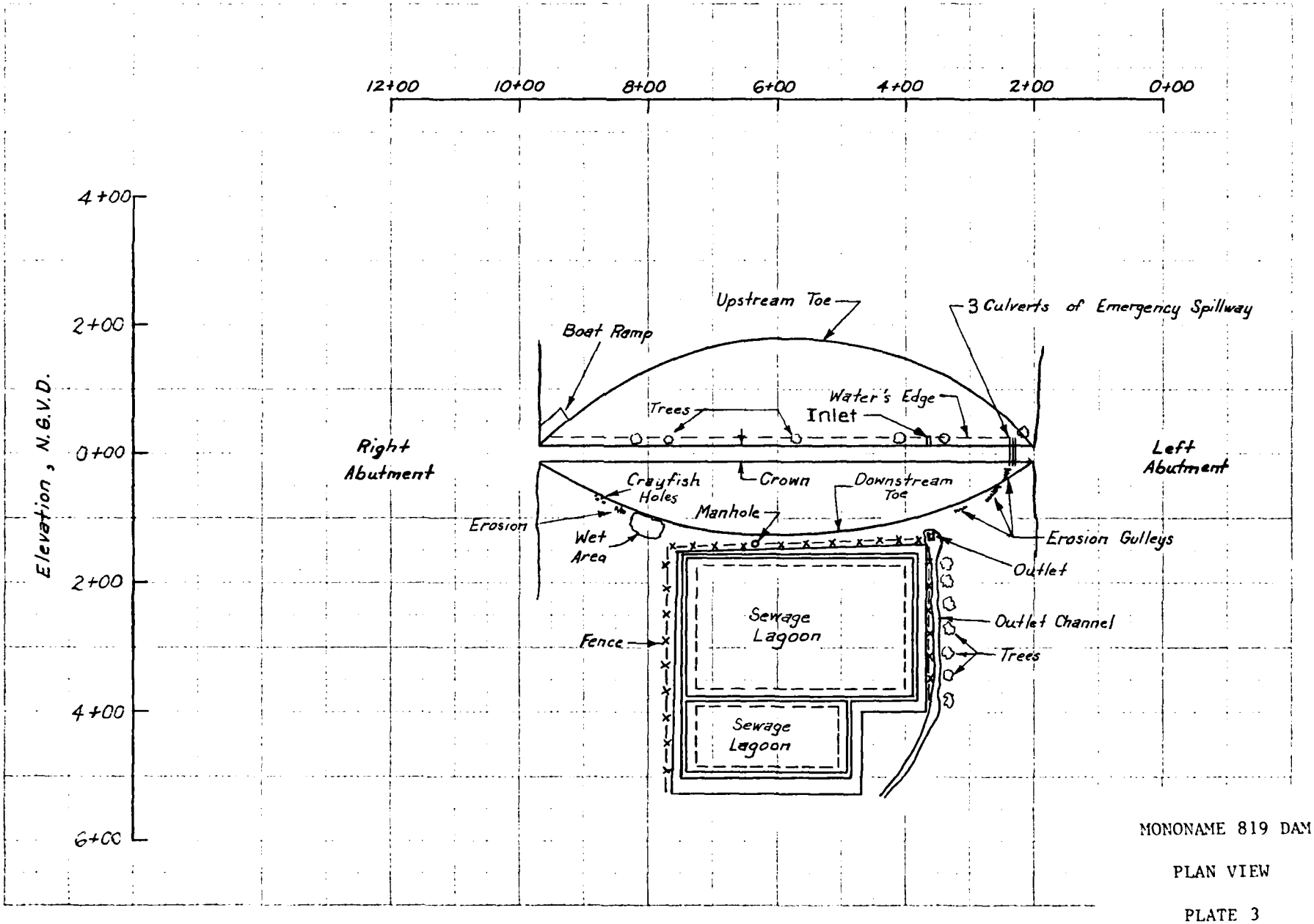
Two major joint systems are present in this area. One system runs northwest to southeast and a second northeast to southwest with vertical fractures. A minor joint system exists in the North-South and East-West directions. The topography and stream patterns of the area are greatly influenced by these joints. Solution zones were found to exist along joints and bedding planes.

Site Description. The dam is situated in a relatively narrow valley surrounded by hills with steep slopes. The valley drainage served as a minor tributary to Indian Creek prior to dam construction. The embankment, abutment and foundation material are predominately the same material, consisting of residuum which is composed of red clay with sand and rock fragments of cherty dolomite and limestone. On top of the left abutment (looking downstream), a large block of gray, medium to fine crystalline cherty limestone was found at the surface. Below the dam along the left abutment in the outlet channel, the limestone was interbedded with shale and chert layers. The shale was friable and easily eroded where exposed to weathering. This outcrop is believed to be the Sexton Creek formation of the Silurian System. No hazardous features such as soft seams, expansive clays or other geologic irregularities were noted. However, the lake is located on the dividing line between Seismic Risk Zones 2 and 3. Because of its location in these Seismic Risk Zones coupled with steep natural topography, there is a possibility of a sudden landslide into the lake during an earthquake.


Mononame 819 Lake
Mononame 819 Lake
Perryville
Friedenburg
Neunert
Gorham
Johns
Schlib
Brazeau
Wittenburg
Howdershell
Appleton
Old Appleton
Apple
Creek
CAPE BIRARDEAU
New Wells
Shawneetown
Lisville
Hilderbrand
Friedheim
Arnsberg
Sedgewickville
Conrads Mill
Oak Ridge
Pocahontas
Kurrpville
Leeman
Fruitland
Millersville
Scopus
Jackson
Burfordville
Gravel Hill
Cape Girardeau
Gordonville
McClure
East Cape Girardeau
PERRY CO
BOLLINGER CO
CAPE GIRARDEAU CO
5 0 5 STATUTE MILES
ST. LOUIS
MEMPHIS
Whitewater
Allenville
Blomeyer
Sharpsboro
Nash
CAPE
SCOT CO
Cape Girardeau
340
Rock Levee
Dutchtown
Arbor
Green Cov
Randles
New Hamburg
MONONAME 819 LAKE
LOCATION MAP
PLATE 1



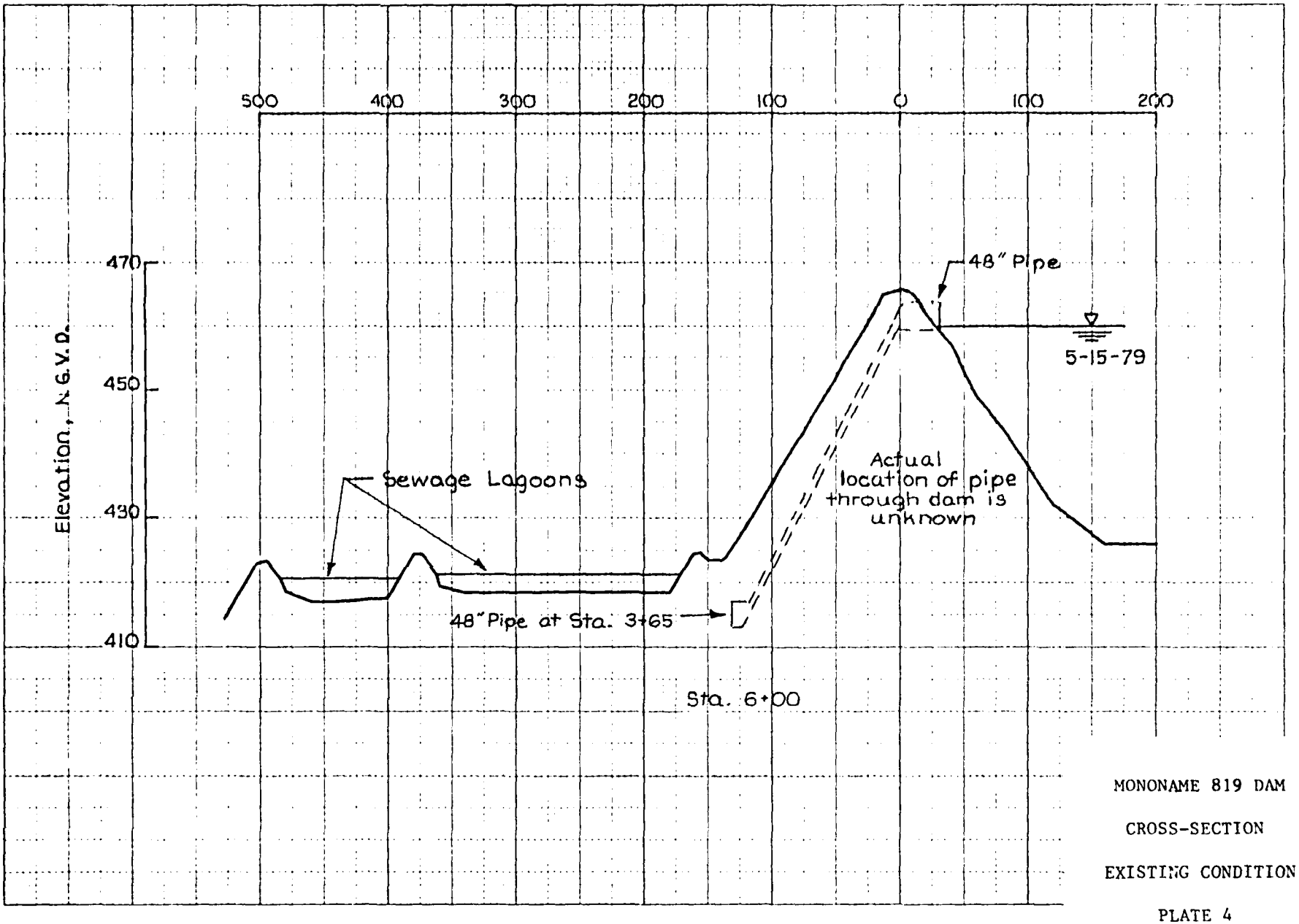
MONONAME 819 LAKE
VICINITY TOPOGRAPHY
PLATE 2



MONONAME 819 DAM

PLAN VIEW

PLATE 3

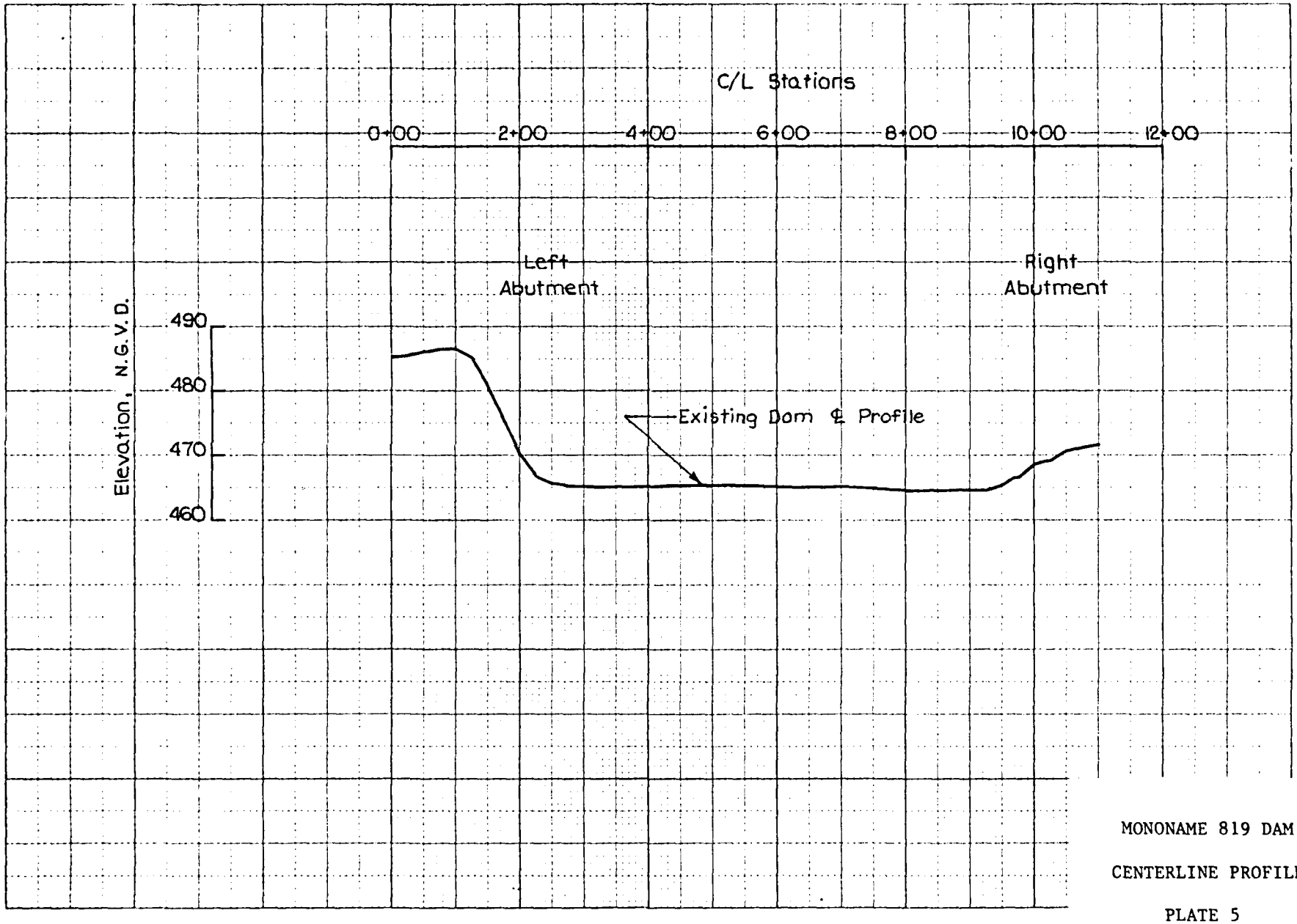


MONONAME 819 DAM

CROSS-SECTION

EXISTING CONDITION

PLATE 4



MONONAME 819 DAM

CENTERLINE PROFILE

PLATE 5

PHOTO 1: Overview of Dam

PHOTO 2: Overview of Lake

PHOTO 3: Upstream Slope

PHOTO 4: Downstream Slope

PHOTO 5: Growth on Upstream Slope

PHOTO 6: Erosion Repair on Upstream Slope near Right Abutment

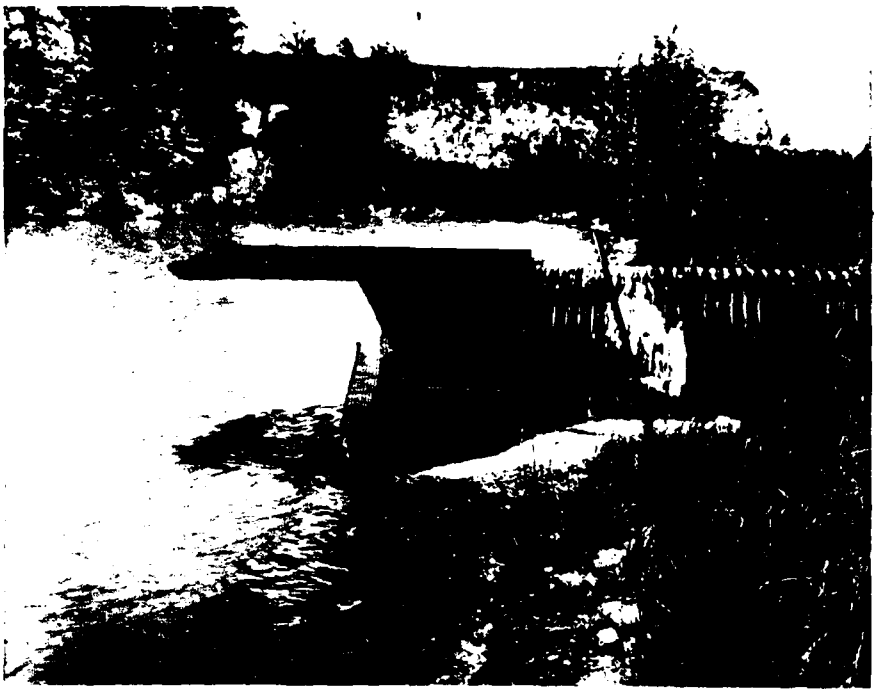


PHOTO 7: Hooded Inlet Structure

PHOTO 8: Outlet Structure and Stilling Basin

PHOTO 9: Growth in Outlet Ditch

PHOTO 10: Erosion in Outlet Ditch

PHOTO 11: Inlets of the Culverts Composing the Emergency Spillway

PHOTO 12: Outlets of the Culverts Composing the Emergency Spillway

PHOTO 13: Emergency Spillway Outfall

PHOTO 14: Erosion at Outlet of Emergency Spillway

PHOTO 15: Boat Ramp in Right Abutment

PHOTO 16: Wash Area on Downstream Slope of Left Abutment

PHOTO 17: Wash Area on Downstream Slope of Left Abutment

PHOTO 18: Wet Area at Downstream Toe of Dam near Right Abutment

PHOTO 19: Crayfish Holes in Downstream Slope of Right Abutment

PHOTO 20: Sewage Lagoons at Downstream Toe of Dam

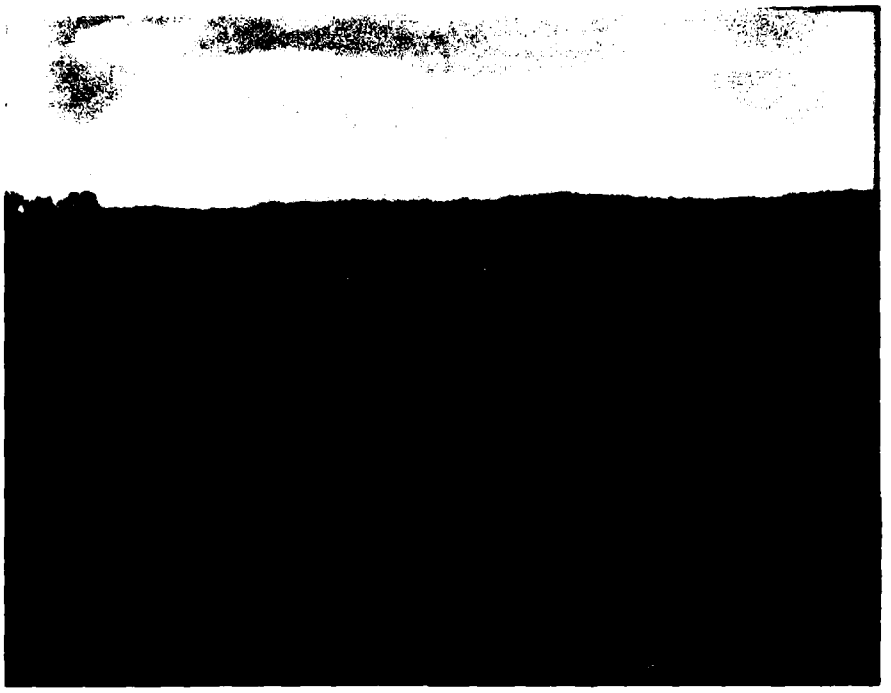


PHOTO 21: Houses in Floodplain