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NATIONAL DAM SAFETY PROGRAM. FON-DU-LAC (MO 10699), MISSISSIPPI--ETC(U)

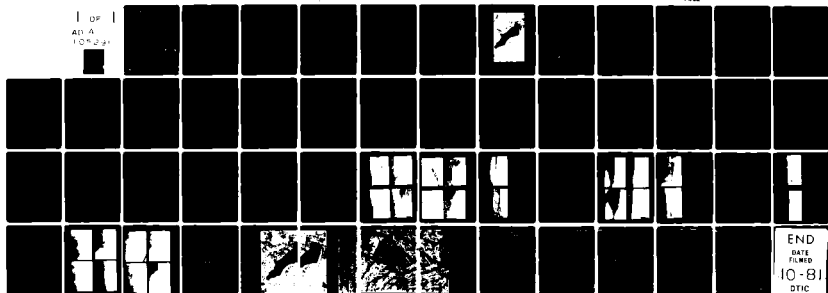
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MISSISSIPPI-KASKASKIA-ST. LOUIS BASIN

FON-DU-LAC

JEFFERSON COUNTY, MISSOURI

MO 10699

**PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM**



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19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Dam Safety, Lake, Dam Inspection, Private Dams		
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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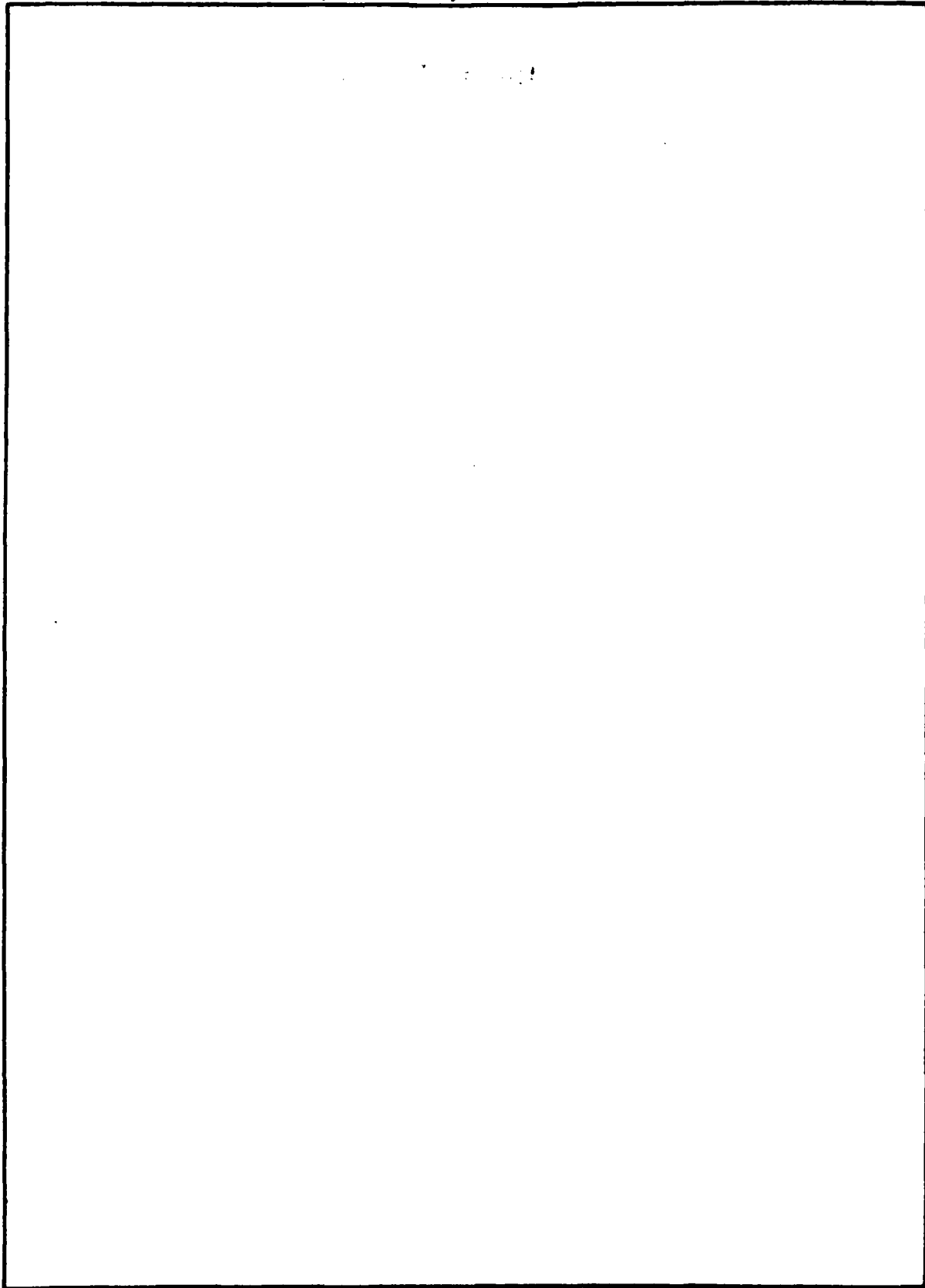
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DEPARTMENT OF THE ARMY
 ST. LOUIS DISTRICT, CORPS OF ENGINEERS
 210 NORTH 12TH STREET
 ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: Fon-du-lac Subdivision Dam, MO ID No. 10699
 Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Fon-du-lac Subdivision Dam.

It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, non-emergency by the St. Louis District as a result of the application of the following criteria:

- (1) Spillway will not pass 20 percent of the Probable Maximum Flood.
- (2) Overtopping could result in dam failure.
- (3) Dam failure significantly increases the hazard to loss of life downstream.
- (4) Control of tree and underbrush growth on the dam is deficient.

SUBMITTED BY: SIGNED 9 FEB 1970
 Chief, Engineering Division Date

APPROVED BY: SIGNED 12 FEB 1979
 Colonel, CE, District Engineer Date

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PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam Fon-du-lac Subdivision Dam
State Located Missouri
County Located Jefferson County
Stream Unnamed branch of Saline Creek
Dates of Inspection 9 and 10 August and 27 October 1978

Fon-du-lac Subdivision Dam was inspected by an interdisciplinary team of engineers, from Reitz & Jens, Inc. under contract with the St. Louis District 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 a small dam with a high downstream hazard potential. The estimated damage zone from failure of the dam extends five miles downstream from the dam.

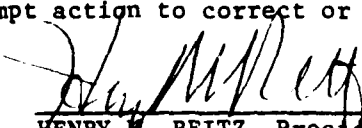
Failure would threaten the life and property of ten families and cause appreciable damage to two county roads.

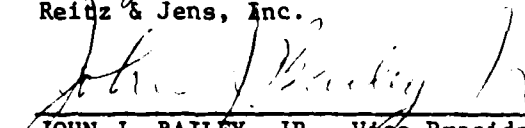
Our inspection and evaluation indicates the dam is deficient in that the spillway is inadequate. The guidelines for a dam having the above size and hazard potential require that the spillway be capable of passing a one-half PMF (Probable Maximum Flood). The Probable Maximum Flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions reasonably possible in the region. Considering the small volume of water impounded, the large floodplain downstream and the three groups of farm buildings downstream, one-half PMF is the appropriate spillway design flood. A 20% PMF will begin to overtop the dam. The lake and spillway are adequate to contain a 1% annual probability flood (100-year flood) without overtopping the dam.

Other deficiencies observed by the inspection team were presence of a chainlink fence across the spillway, tree growth on the downstream face of the dam, the several isolated trees on the upstream slope and lack of seepage and stability analyses.

These deficiencies are further discussed in the attached report.

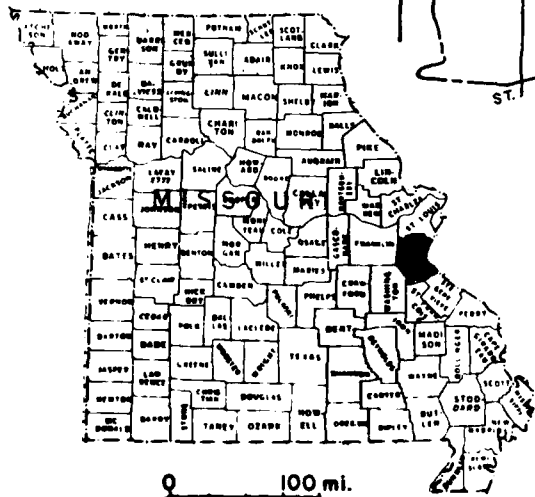
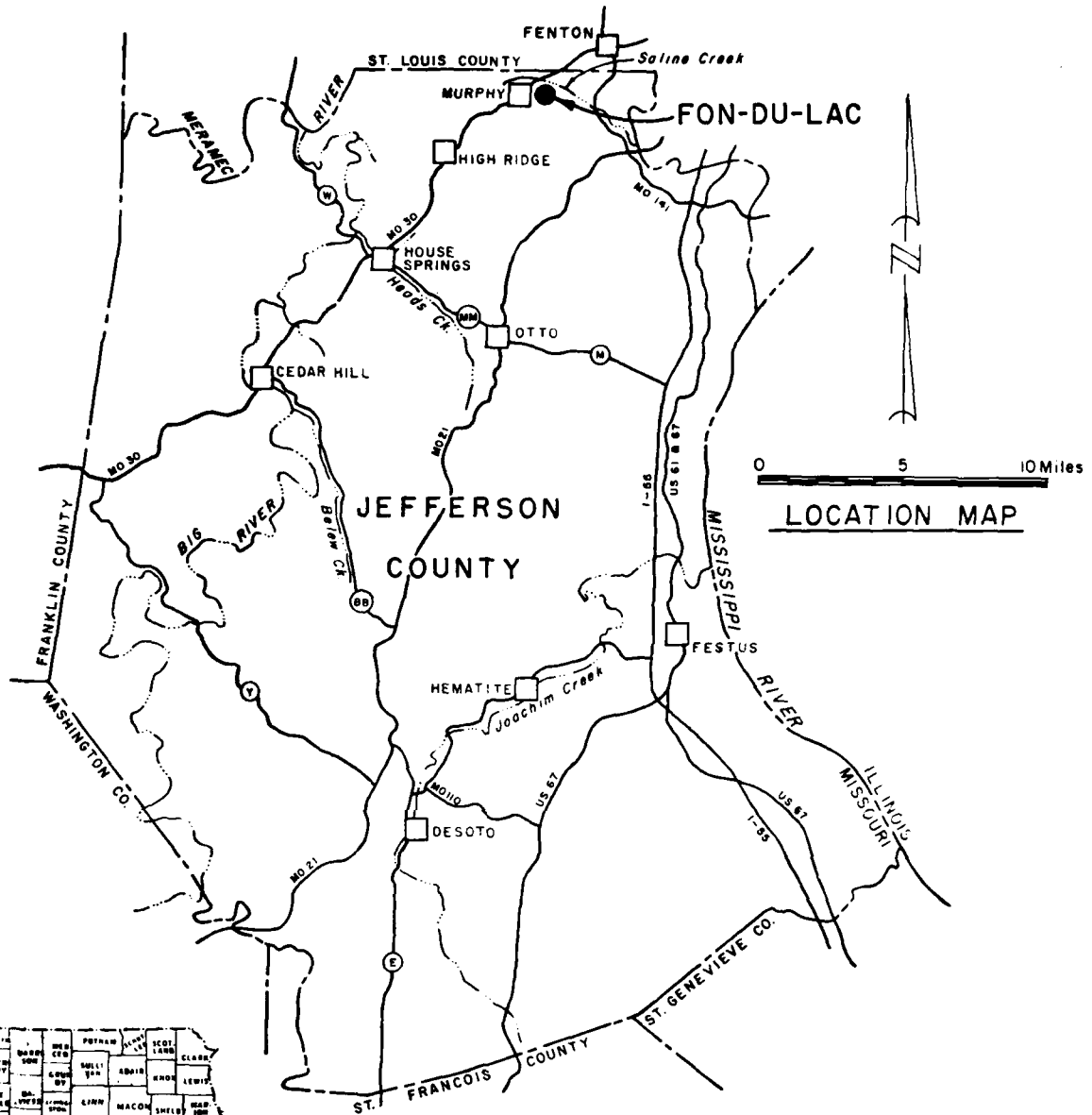
We recommend the owner take prompt action to correct or control the deficiencies described.


HENRY M. REITZ, President
Reitz & Jens, Inc.


JOHN J. BAILEY, JR., Vice President
Chief Engineer
Reitz & Jens, Inc.



OVERVIEW - 10699



PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
Fon-du-lac Subdivision Dam MO. ID No. 10699

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A-1 (5 sheets)	Hydrologic and Hydraulic Computations (HEC-1 Input and Output)

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1	Index of Dam Photos (D-1 through D-10)
2	Index of Panorama Photos (P-1 through P-6)
3	Index of Spillway Photos (S-1 through S-8)
4	Index of Valley Below Dam Photos (V-1 through V-2)

SECTION 1 - 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 St. Louis District, Corps of Engineers, District Engineer contracted with Reitz & Jens, Inc. (Contract DACW43-78-C-0162) for a safety inspection of the Fon-du-lac Subdivision Dam, MO ID No. 10699. In the Federal dam inventory, the spelling is as shown above; the spelling in Jefferson County records is "Fond du Lac" on a plat dated 1953.

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", Appendix D. 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) Dam The dam is an earth structure built across a draw in the rolling ground tributary to Saline Creek. The general soils classification in the watershed is Union Silt Loam, a type soil the analysis of which is insensitive to antecedent moisture conditions. The slopes average 12%. A trailer court of about 40 acres in extent is in the upper reaches of the watershed. About 50 acres are in woods and pasture, the remainder is low density residential development. Including the 26-acre lake it is estimated the watershed is 20% impervious. Development of the remaining area of woods and pasture will have only slight effect on the hydrology of the watershed.

The axis of the dam runs in a generally north/south direction. Lakewood Drive, a circulation road in the subdivision, crosses the valley below the dam and continues completely around the reservoir. This asphaltic concrete paved road is close to the toe of the dam.

(2) Spillway The spillway is at the south end of the dam. It is an unlined earth channel extending about 110 feet downstream from the centerline of the dam to three 36-inch galvanized corrugated metal pipe culverts where Lakewood Drive crosses the spillway. The channel is side hill construction.

The upslope side and the bottom appear to be excavated in virgin ground. The downslope side toward the valley appears to be an earth fill spur dike or levee with a top width of about 10 feet and about 5-foot height above original ground. The channel has a top width of about 35 feet, a maximum depth of about 5 feet and a fairly smooth "U"-shaped cross-section. The crest of the berm has a fairly uniform slope from the top of dam to the road and can be considered to be an extension of the dam crest but extending downstream at a 90-degree angle

to the axis of the major portion of the dam. The spillway flowline slopes down about one-half foot in its 60-foot length to the triple pipe culvert under the road.

The culvert pipes are all set parallel and at about 6-foot center to center distances. Flowline elevations vary slightly but are all within a range of 0.5 foot. Flowline slopes are about 6%. At the upstream end of the pipes, a vertical headwall has been constructed to retain the roadway fill. The asphaltic pavement of the road is about 2 feet above the top of the pipes.

(3) Downstream Channel Downstream, the channel bottom has been paved with concrete for a short distance. A slab was constructed over the channel downstream to provide additional roadway width. It is supported by the downstream headwall and two round concrete posts positioned between the pipe outlets. Downstream from the culverts the channel makes an abrupt turn and flows northwardly, parallel to Lakewood Dr., in an eroded channel in the natural ground surface to the original creek bottom of the valley, approximately 300 feet to the north.

(4) Reservoir Residential development almost completely encircles the reservoir. About 35 homes have their rear lot lines at the lakeshore. About 500 feet of the reservoir shore immediately west of the north end of the dam is used for a swimming beach and for access to the lake by subdivision property owners who do not own lake-front lots.

(5) Topography in the vicinity of the dam is shown on Plate 3.

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

b. Location The dam is located in northeastern Jefferson County about two miles southwest of Fenton as shown on Plate 2. The dam and lake are situated in U.S. Surveys 1331 and 3011 in T48N, R5E, and are shown on the Missouri, Jefferson and St. Louis County USGS Maxville Quadrangle Sheet, 1968 Edition. The dam is not shown on the 1954 edition of this sheet. Access to Fon-du-lac Subdivision is south off Highway 30 on Dolores Road.

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

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

e. Ownership The dam is owned by the Trustees of Fon-du-lac Subdivision. Mr. Kenneth Crawford, 101 E. Lake Drive, Fenton, Mo., 63026, is Vice President of the Board of Trustees.

f. Purpose of Dam The dam forms a 26.5-acre recreational lake.

g. Design and Construction History The inspection team was unable to find any design data on this dam. It was reported that construction of the dam

started about 1953. The dam, lake and spillway are shown on the Plat of Subdivision No. Three of Fon-du-lac dated 11 January 1954. This states that Weber Realty Company sold the site to Jefferson County Land Office, Inc. It was reported that Mr. Glenn Weber was one of the owners of the former company and was responsible for construction of the dam. The name of the contractor, if any, is unknown.

h. Normal Operating Procedure Normal rainfall, runoff, transpiration, and evaporation all combine to maintain a relatively stable water surface elevation. The maximum water depth ever experienced at the spillway is unknown.

1.3 PERTINENT DATA

a. Drainage Area - 346 acres

b. Discharge at Damsite

(1) All discharge at the damsite is through an uncontrolled spillway.

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

(3) Estimated ungated spillway capacity at maximum pool elevation is 146 cfs.

c. Elevation (Feet Above M.S.L.)

(1) Top of dam - 513.5 to 516.4 ± (see Plate 3).

(2) Spillway crest - 509.6

(3) Streambed at centerline of dam - 485 (est.)

(4) Maximum tailwater - unknown

d. Reservoir Length of maximum pool - 3,000 feet ±. Length of pool at spillway crest - 2,200 feet.

e. Storage (Acre-Feet)

(1) Top of dam - 398 acre feet

(2) Spillway elevation - 296 acre feet

f. Reservoir Surface (Acres)

(1) Top of dam - 32.6 estimated from USGS map.

(2) Spillway crest - 26.5 from aerial photo.

g. Dam

(1) Type - earth embankment.

- (2) Length - 800 feet
- (3) Height - 28.5 feet maximum(at Station 2+80 from inspection survey)
- (4) Top width -
 - (a) Main dam - 15 to 24 feet
 - (b) Spillway spur - 10 feet
- (5) Side Slopes -
 - (a) Downstream - 1V on 2.4H (determined from section at Station 2+80; 1V on 2.5H (determined from section at Station 6+00). See Plate 3.
 - (b) Upstream - 1V on 1.5H to water surface (riprap). Below water surface unknown.
- (6) Zoning - unknown
- (7) Impervious core - unknown
- (8) Cutoff - unknown
- (9) Grout Curtain - unknown

h. Diversion and Regulating Tunnel - None

i. Spillways One spillway side hill channel 100 feet long at the south end of the dam with triple 36-inch diameter pipe culvert at lower end. Channel has 35-foot + top width and is 5 feet deep with "U" shaped cross-section. Spillway is at right angles to dam centerline. The spur dike along the north side of the spillway channel is effectively, from a hydraulic standpoint, part of the dam. Until the spur dike overtops the hydraulic control for spillway discharges will be at the entrance to the 36-inch pipe culverts.

j. Regulating Outlets - None

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No design data were found.

2.2 CONSTRUCTION

The dam was constructed prior to 1954. No construction records were found. See paragraph 1.2.g.

2.3 OPERATION

The maximum loading on the dam is unknown. The lake level seems to remain stable during average precipitation of 38 inches per year. No mechanical facilities requiring operation exist. No records of operation of the dam have been kept by the Board of Trustees.

It appears, from absence of any plant growth other than sparse weeds, that the spillway, at frequent times since completion, has discharged storm runoff.

2.4 EVALUATION

a. Availability No engineering data were found.

b. Adequacy No engineering data were available to make an assessment of design, construction and operation. Seepage and stability analyses comparable to the requirements of "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.

However, for the size of dam, materials used and measurements taken, a defensible evaluation of the hydrologic/hydraulic characteristics of the development indicated deficient spillway capacity. Also, for the section and presence of the primary spillway plus the visual inspection of a dam with reservoir of at least 25 years of age, the generally good condition of the dam, when considered by the experienced engineers, indicated that even though a detailed assessment of the design and construction in an analytical sense was not possible, a defensible evaluation of the dam as a structure, was feasible.

c. Validity This report is primarily for safety through maintenance and operation and the conclusions and evaluation for this Phase I Inspection are considered adequate for the definitive statement in this report.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General A visual inspection of the Fon-du-lac Subdivision Dam was made on 27 October 1978. This followed two days of field measurements by a survey party on 9 and 10 August 1978. The training and experience of personnel in these two inspections included hydrologic, hydraulic engineering, soils materials engineering, structural engineering and surveying, two of whom were John J. Bailey and Henry M. Reitz. This dam and reservoir are over 25 years old. While many people live around the lake and there is and has been a Board of Trustees for this subdivision, detailed records of the construction of the lake and specific experiences during its life were not available.

b. Dam This dam is an earth dam. Top width is 15 to 24 feet (see photos D-2, D-3, D-9). Downstream slope is 1V on 2.4H; length approximately 800 feet. The elevation of top of dam varies approximately 2-1/2 feet. The lowest point is near the natural bottom of the valley. A probable cause of the low portion of the top of dam is post construction settlement of the dam embankment. The north half of the dam is higher and nearly level. The reservoir slope of the dam is armor-protected with rock of mixed sizes, generally ranging downward from cobbles to sand sizes (D-1, D-6, D-9, D-10). This armor-coating zone is functioning as intended and no signs of areas of wave-wash, excessive erosion or slides on the dam were visible. There are several willows similar to low bush-trees on the reservoir side of the dam. The downstream side of the dam has fairly heavy growth of saplings and brush (D-1 thru D-10). The reservoir side of the dam was examined in detail. On the downstream slope, the growth prevented examination. No discontinuities in the surface of the dam other than the lower top portion mentioned or signs of animal activity were observed.

Inspection of the downstream slope of the dam and contiguous areas beyond the toe of the dam found no growth of hydrophilic plants, soft, wet areas, nor the even greater degree of free water at the surface. The absence of these suggests no seepage problems in the dam. The asphaltic concrete paved road is closely adjacent to and paralleling the toe of the dam. Between the edge of the pavement closest to the dam and the toe of the dam is a shallow weed-choked swale which collects runoff from the pavement and stormwater runoff coming down the face of the dam. This accumulated surface water is carried under the road by an 18-inch concrete pipe culvert shown on D-5.

c. Spillway The lake level is controlled by a spillway at the south end of the dam. With a distance of about 110 feet from the centerline of the dam to the crossing under the road in which the lesser flows in the spillway are carried in three parallel 36-inch 18-foot long culvert pipes, the remainder would overtop either the dike along the north side of the open channel spillway between the dam and pipe culverts or the road pavement over the pipe culvert. A low chainlink fence paralleling the center of the dam crosses the open channel spillway. After the waters in the spillway cross the alignment of the street paralleling the axis of the dam and downstream therefrom, the resistance to downward erosion furnished by the triple pipe culvert is removed and significant erosion of the soil is visible and very poor housekeeping has resulted in dumping almost all kinds of debris into this eroded channel downstream from the triple pipe culvert (S-6). Part of the alignment of the open channel spillway appears to be virgin ground. A dike has been built along the north edge of the alignment between the dam and Lakewood Drive which is intended to

direct the spillway discharges into the triple pipe culvert beneath Lakewood Drive rather than allow the water to flow northwardly over the surface between Lakewood and the toe of the dam. This would be the first portion of the dam to be overtopped by extreme flood flows.

Manholes on sanitary sewers at each end of the dam are far enough from the lake and dam section so that the sewer alignments they indicate are not potentially hazardous to the development.

d. Reservoir The Fon-du-lac reservoir has shorelines either in public use areas or well-landscaped private backyards (P-1 thru P-6). There is no erosion along the dam due to the armor-coat (D-2,D-3,D-9). There is between a one- and two-foot vertical zone along the north shore away from the dam where the turf has been undercut. At the entrance to the spillway at the south end of the dam there is a very gradual earth slope with some weed growth but no signs of erosion. At the inspection on 27 October, the water surface in the lake was below the control elevation on the spillway. However, antecedent precipitation had been very low and the amount by which the lake level was below the control elevation appeared to result more from evaporation than from loss due to seepage.

The shoreline along the lake, in almost all its length, had well maintained lawn or grass cover. A vertical increment of approximately one foot from the edge of the grass down to the water surface, without any vegetative cover, was visible. Esthetically, it is felt that this existing condition is more acceptable than trying to prevent this barren earth zone where the water surface can fluctuate several feet.

e. Downstream Channel Immediately downstream from the toe of dam is Lakewood Dr., an asphaltic concrete two-lane drive. Between the west edge of Lakewood Dr. and the toe of dam is a shallow swale to collect stormwater off the top and downstream slope of the dam and convey it to an 18-inch pipe culvert under Lakewood Dr. at Station 2+80, which carries it downstream into the valley. This appears to be functioning well. Flow from the spillway at the south end of the dam, after crossing Lakewood Dr., moves downslope in a northeasterly direction to the low point in the valley. The valley is of moderate width but there is a distinct alignment for the channel downslope from the dam. Approximately 3,000 feet downstream from the dam, the sub-watershed enters the Saline Creek valley just below the Saline Road crossing. Saline Creek, within the next 1-1/4 miles, is crossed by a private road (Schlect Rd.) then flows under Missouri Highway 141.

3.2 EVALUATION

Remedial measures discussed are required in the near future to prevent development of a serious potential for failure. Removal of the trees and bushes and continued annual attention to growth on the slopes of the dam is advisable. Heavy vegetation on the slopes of the dam provides habitat and shelter for burrowing animals whose activity could endanger the integrity of the embankment. The chainlink fence across the spillway could clog with leaves and debris and seriously reduce discharge capacity. This fence should be removed. Maintenance of the spillway channel down the slope east of Lakewood Dr. is needed but this is not a deficiency which would endanger the dam.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

There are no controlled outlet works for this dam; therefore, no regulating procedures exist. The pool is controlled by rainfall, runoff, evaporation and capacity of the uncontrolled spillway.

4.2 MAINTENANCE OF DAM

Based on the amount of brush and size of trees on the downstream slope, it appears that it has been some time since this slope has been mowed. Maintenance of the spillway channel below the culverts, where it runs parallel to Lakewood Dr., appears to have been limited to dumping tree trimmings into the channel in an apparent attempt to control erosion by creating high flow resistance in the channel. Mowing of the spillway channel above the culverts seems to be done at sufficient intervals to control high weed growth. The stone armor on the wetted slope of the dam appears to be kept in good condition. Most of the shoreline around the reservoir is mowed by the individual lot owners.

4.3 MAINTENANCE OF OPERATING FACILITIES

No operating facilities exist at this dam.

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 uncontrolled vegetation on the downstream slope is allowed to continue, a serious potential for failure may develop.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data No design data were available.

b. Experience Data The drainage area is developed from USGS Maxville Missouri Quadrangle. Also available are 1"=2000' aerial stereo pairs taken 8 April 1977, by Surdex Corporation. Lake area is measured on a 1"=200' enlargement of a portion of one of these photographs and shown on Plate 1. The spillway and dam layout are from surveys made during the inspection.

c. Visual Observations

(1) The spillway is located at the south end of the dam (see paragraphs 1.2.a(2) and 3.1.c).

(2) The unlined spillway channel above the pipe culverts and the culverts themselves are in good condition. The chainlink fence across the spillway channel could clog with leaves and grass clippings or other trash and seriously reduce spillway capacity.

(3) No drawdown facilities are available to evacuate the pool.

(4) Maximum spillway releases may endanger the integrity of the dam (see paragraph 3.1.c).

d. Overtopping Potential Hydrologic and hydraulic calculations are reproduced in Appendix A.

The spillway is too small to pass the minimum required flood of one-half the probable maximum without overtopping. The probable maximum flood is defined as the flood discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. The dam will start to be overtopped by a flood equal to 20% of the PMF. The one-half PMF will overtop the dam to a maximum depth of about 2.2 feet. The depth will vary to zero across the dam because of the sloping crest. A width of 450 feet of dam crest will be subject to some overtopping flow. Maximum rate of flow over the dam crest will be about 1800 cubic feet per second. Overtopping flow will have a duration of about 7 hours. Erosion of the downstream face will occur during continuing overtopping flows. The existing lake and principal spillway will contain a 100-year frequency flood without overtopping the dam.

Future development of the remainder of the watershed not now used for residential purposes would not have a significant impact on the hydrologic or hydraulic analysis.

The effect from rupture of the dam could extend approximately 5 miles downstream of the dam. There are 10 inhabited homes downstream of the dam which could be severely damaged and lives of the inhabitants could be endangered should failure of the dam occur.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations Visual observations concerning the structural stability of this dam are discussed in Section 3, paragraph 3.1.b.

b. Design and Construction Data No design or construction data relating to seepage or the structural stability of the dam are known to exist.

c. Operating Records No appurtenant structures requiring operation exist at this dam. No operating records of the dam have been made.

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

e. Seismic Stability A detailed seismic analysis is beyond the scope of a Phase I Inspection. Considering the seismic zone (2) in which this dam is located and the physical characteristics of the development and area, a detailed seismic analysis is not recommended.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety The spillway is not adequate to pass the required one-half Probable Maximum Flood (PMF). Seepage and stability analyses are not on record.

Several items were noted during the visual inspection by the inspection team which should be corrected or controlled. The heavy growth of trees and shrubs on the downstream slope and the several trees on the upstream slope of the dam are safety deficiencies. The chainlink fence across the spillway could clog with leaves and seriously reduce rates of discharge. Erosion protection for the spillway channel east of Lakewood Dr. is needed but this is not a deficiency which would endanger the integrity of the dam.

b. Adequacy of Information Due to 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 these data sufficient to support the conclusions herein. 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. If the safety deficiencies listed in paragraph 7.1.a are not corrected in the near future, they will continue to deteriorate and lead to a serious potential of failure.

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 in Seismic Zone 2. A detailed seismic analysis is not recommended.

7.2 REMEDIAL MEASURES

a. Alternatives Spillway size and/or height of dam should be increased to pass the one-half PMF. In either case, the spillway should be protected to prevent erosion. The owner should obtain the services of an engineer experienced in design and construction of dams to design and observe construction of remedial measures.

b. Stability and Seepage Analyses The owner should have an engineer experienced in the design and construction of dams prepare seepage and stability analyses.

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

(1) Remove the chainlink fence across the spillway channel.

(2) Remove uncontrolled vegetation growth on the downstream slope of the dam. The several trees in the upstream slope should be removed. Clearing should be performed under the direction of a professional engineer experienced in design and construction of earth dams. Indiscriminate clearing methods could create an unstable condition.

(3) After removal of existing tree growth, vegetation on the dam should be periodically cut.

(4) Erosion protection for the spillway downstream of the pipe culverts should be improved.

(5) After completion of the remedial measures, detailed inspections of the dam should be made periodically by an engineer experienced in design and construction of dams.

(6) The owner should keep a record of all future repairs and maintenance.

APPENDIX A
HYDROLOGIC COMPUTATIONS

HYDROLOGIC AND HYDRAULIC ANALYSIS METHODOLOGY

1. The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for a reservoir routing. The Probable Maximum Precipitation for those dams in the high hazard potential category is derived and determined from regional charts prepared by the National Weather Service in "Hydrometeorological Report No. 33". Reduction factors have not been applied. A 24-hour storm duration is assumed with the 24-hour rainfall depths distributed over 6-hour periods in accordance with procedures outlined in EM 1110-2-1411 (SPF Determination). The maximum 6-hour rainfall period is then distributed to hourly increments by the same criteria. Within-the-hour distribution is based upon NOAA Technical Memorandum NWS HYDRO-35. The non-peak 6-hour rainfall periods are distributed uniformly. All distributed values are arranged in a critical sequence by the SPF criteria. The final inflow hydrograph is produced by deduction of infiltration losses appropriate to the soil, land use and antecedent moisture conditions.

2. The reservoir routing is accomplished by using Modified Puls routing techniques wherein the flood hydrograph is routed through lake storage. Hydraulic capacities of the spillway and crest of dam are used as outlet controls in the routing. Storage in the pool area is defined by an elevation-area curve. The hydraulic capacity of the spillways is defined by an elevation-discharge curve. The hydraulic capacity of the sloping top of dam is defined by a triangular broad-crested weir equation.

3. Dam overtopping analysis has been conducted by hydrologic methods for this dam and lake. This computation determined the percentage of the PMF hydrograph that the reservoir can contain without the dam being overtopped. An output summary in the hydrologic appendix displays this information as well as other characteristics of the simulated dam overtopping.

4. The above methodology has been accomplished for this report using the systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. The numeric parameters estimated for this site are listed on Plate 1A. Definitions of these variables are contained in the "User's Manual" for the computer program.

5. Flow through the triple pipe culvert was estimated using the TRB Hydraulic Engineering Manual #5, Chart #5 for corrugated metal pipe culverts with inlet control, Condition (1) for a square headwall. Capacity of the pipes at 6% slope was not a consideration; entrance losses to the pipe culvert were. Using the headwater depth thus determined, the additional frictional losses in the channel were calculated to establish the level in the pool at the spillway channel entrance. Only for flows less than 12 cfs, does the spillway crest control.

6. The berm along the spillway channel was included as part of the dam for calculating the discharge over the top of the dam. The average longitudinal slope of top of dam was determined by plotting length of crest subject to overflow for incremental increases in lake elevation above the lowest crest elevation. The "Z" value thus obtained (increase in lineal feet of crest subject to overflow per foot of rise in the lake) was then used in the triangular broad-crested weir equation: $Q = C*0.4*Z*H^{2.5}$.

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*****
FLOOD HYDROGRAPH PACKAGE (MFC-1)
NAM SAFETY VERSION      JULY 197A
LAST MODIFICATION      3 AUG 7A
*****
1 A ***** ID #10699 FOM-DH-LAC SURDIVISION * AND 41A FOR USGS FLEW
2 A ***** NAM SAFETY PROGRAM - U. S. CORPS OF ENGINEERS *****
3 A ***** OF IT7 M JENS, INC. - AUGUST 197A *****
4 4 PAR 0 5 -0 -0 -0 -0 -4 -0
5 1 5
6 1 1 6
7 1 0.15 0.20 0.25 0.30 0.50 1.00
8 X 1
9 I ***** INFLOW HYDROGRAPH - SCS METHOD *****
10 M 1 25.3 101 120 130
11 0
12 T 0.20
13 J -0.10 2.0
14 X
15 1 03
16 I ***** OFSEAVOID ROUTING - RATING CURVE SUPPLIED - SIMPLING NAM *****
17 Y 1
18 Y1 1
19 Y4 99.4 100.0 100.2 100.7 101.2 101.7 101.7 102.2 102.7 103.7 103.7
20 Y4 104.2 104.8 105.4 106.0 106.7
21 Y5 0 2.6 5.6 15.6 30.7 52.3 78 102 135 154
22 Y5 210 200 420 540 675
23 $A 0 26.5 44.1 60.6
24 $F 66.5 100 120
25 $S 100.0
26 $N 103.5 3.0 2.5 82.8
27 K

```

 FLOOD HYDROGRAPH PACKAGE (HFC-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 3 AUG 78

011N DATE0 10/02/78.
 TIME0 11.16.03.

* ***** IN #10699 FOM-NU-LAC SURVIVISION * ADD 410 FOR USGS FLEV
 ***** DAM SAFETY PROGRAM - U. S. CORPS OF ENGINEERS *****
 ***** REIT7 W JFNS, INC. - AUGUST 1978 *****

JOB SPECIFICATION									
NQ	NHR	NMTN	TRAY	IMR	TMIN	MTBC	IPLT	IPRT	NSTAN
288	0	5	-0	-0	-0	-0	-0	-4	-0
			.INDP	NWT	LRPT	TRAC			
		5		-0	-0	-0			

MULTI-PLAN ANALYSES TO BE PERFORMED
 NPLAN= 1 NRTIO= 6 LRPTIO= 1
 RTIO= .15 .20 .25 .30 .50 1.00

***** SUR-AREA RUNOFF COMPUTATION *****

***** INFLOW HYDROGRAPH - SSC METHOD *****
 TSTAQ TCOMP IFCON ITAPE JPLT JPRY INAME ISTAGE TAUIN

THY06	IUMG	TARFA	SNAP	TRSDA	TRSPC	PATIO	TSNOW	TSAME	LOCAL
1	2	.54	-0.00	.54	1.00	-0.000	-0	1	-0

PRECIP DATA
 SPPF PMS R6 R12 R24 R48 R72 R96
 -0.00 25.30 101.00 120.00 130.00 -0.00 -0.00 -0.00

LOSS DATA
 IPRPT STPKR DLTKR RTIOL ERAIN STRKS RTIOK STRIL CNSTL ALSMX RTIMP
 -0 -0.00 -0.00 1.00 -0.00 -0.00 1.00 -1.00 -0.00 -0.00 .20

CURVE NO = 88.00 WETNESS = -1.00 EFFECT CN = 88.00

UNIT HYDROGRAPH DATA
 TC= -0.00 LAG= .20

PERCESSION DATA
 STPTO= -0.00 ORCSN= -.10 RTTOR= 2.00

UNIT HYDROGRAPH 14 END OF PERIOD ORDINATES, TC= -0.00 HOURS, LAGE .20 VOL= 1.00 29.
 244. 1079. 862. 470. 274. 156. 51.
 16. 6. 2.

0.00 HR.MN PERIOD RAIN EXCS LOSS END-OF-PERIOD FLOW 0.00 HR.MN PERIOD RAIN EXCS LOSS COMP 0

NO.	HR.MN	PERIOD	RAIN	EXCS.	LOSS	COMP O	END-OF-PERIOD FLOW	HR.MN	PERIOD	RAIN	EXCS.	LOSS	COMP O
1.01	0.05	1	.01	.00	.01	1.	1.01	12.05	145	.21	.21	.01	308.
1.01	1.10	2	.01	.00	.01	3.	1.01	12.10	146	.21	.21	.01	471.
1.01	1.15	3	.01	.00	.01	6.	1.01	12.15	147	.21	.21	.01	585.
1.01	1.20	4	.01	.00	.01	9.	1.01	12.20	148	.21	.21	.01	708.
1.01	1.25	5	.01	.00	.01	10.	1.01	12.25	149	.21	.21	.01	777.
1.01	1.30	6	.01	.00	.01	11.	1.01	12.30	150	.21	.21	.00	817.
1.01	1.35	7	.01	.00	.01	11.	1.01	12.35	151	.21	.21	.00	840.
1.01	1.40	8	.01	.00	.01	12.	1.01	12.40	152	.21	.21	.00	854.
1.01	1.45	9	.01	.00	.01	12.	1.01	12.45	153	.21	.21	.00	863.
1.01	1.50	10	.01	.00	.01	12.	1.01	12.50	154	.21	.21	.00	868.
1.01	1.55	11	.01	.00	.01	12.	1.01	12.55	155	.21	.21	.00	871.
1.01	1.00	12	.01	.00	.01	12.	1.01	13.00	156	.21	.21	.00	873.
1.01	1.05	13	.01	.00	.01	12.	1.01	13.05	157	.26	.25	.00	886.
1.01	1.10	14	.01	.00	.01	12.	1.01	13.10	158	.26	.25	.00	886.
1.01	1.15	15	.01	.00	.01	12.	1.01	13.15	159	.26	.25	.00	923.
1.01	1.20	16	.01	.00	.01	12.	1.01	13.20	160	.26	.25	.00	969.
1.01	1.25	17	.01	.00	.01	12.	1.01	13.25	161	.26	.25	.00	1027.
1.01	1.30	18	.01	.00	.01	12.	1.01	13.30	162	.26	.25	.00	1049.
1.01	1.35	19	.01	.00	.01	12.	1.01	13.35	163	.26	.25	.00	1047.
1.01	1.40	20	.01	.00	.01	12.	1.01	13.40	164	.26	.25	.00	1051.
1.01	1.45	21	.01	.00	.01	12.	1.01	13.45	165	.26	.25	.00	1054.
1.01	1.50	22	.01	.00	.01	12.	1.01	13.50	166	.26	.25	.00	1056.
1.01	1.55	23	.01	.00	.01	13.	1.01	13.55	167	.26	.25	.00	1057.
1.01	2.00	24	.01	.00	.01	13.	1.01	14.00	168	.26	.25	.00	1058.
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1.01	3.05	37	.01	.00	.01	23.	1.01	15.05	181	.19	.19	.00	1296.
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1.01	3.35	43	.01	.00	.01	27.	1.01	15.35	187	2.72	2.71	.01	3759.
1.01	3.40	44	.01	.00	.01	27.	1.01	15.40	188	1.07	1.07	.00	5490.
1.01	3.45	45	.01	.00	.01	28.	1.01	15.45	189	.68	.68	.00	6051.
1.01	3.50	46	.01	.00	.01	28.	1.01	15.50	190	.58	.58	.00	5761.
1.01	3.55	47	.01	.00	.01	29.	1.01	15.55	191	.39	.39	.00	4205.
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1.01	4.55	59	.01	.00	.01	34.	1.01	16.55	203	.30	.30	.00	1248.
1.01	5.00	60	.01	.00	.01	34.	1.01	17.00	204	.30	.30	.00	1247.

1.01	5.00	60	.01	.01	34.	1.01	17.00	204	.30	.30	1247.
1.01	5.05	61	.01	.01	35.	1.01	17.05	205	.23	.00	1229.
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1.01	5.20	64	.01	.01	36.	1.01	17.20	208	.23	.00	1050.
1.01	5.25	65	.01	.01	36.	1.01	17.25	209	.23	.00	1020.
1.01	5.30	66	.01	.01	36.	1.01	17.30	210	.23	.00	1002.
1.01	5.35	67	.01	.01	37.	1.01	17.35	211	.23	.00	992.
1.01	5.40	68	.01	.01	37.	1.01	17.40	212	.23	.00	987.
1.01	5.45	69	.01	.00	38.	1.01	17.45	213	.23	.00	983.
1.01	5.50	70	.01	.00	38.	1.01	17.50	214	.23	.00	981.
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1.01	6.00	72	.01	.00	48.	1.01	18.00	216	.23	.00	980.
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1.01	6.10	74	.07	.05	79.	1.01	18.10	219	.02	.00	738.
1.01	6.15	75	.07	.05	119.	1.01	18.15	219	.02	.00	588.
1.01	6.20	76	.07	.05	153.	1.01	18.20	220	.02	.00	549.
1.01	6.25	77	.07	.05	174.	1.01	18.25	221	.02	.00	512.
1.01	6.30	78	.07	.05	188.	1.01	18.30	222	.02	.00	478.
1.01	6.35	79	.07	.05	197.	1.01	18.35	223	.02	.00	444.
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1.01	7.00	84	.07	.05	221.	1.01	19.00	229	.02	.00	315.
1.01	7.05	85	.07	.06	224.	1.01	19.05	229	.02	.00	294.
1.01	7.10	86	.07	.06	227.	1.01	19.10	230	.02	.00	274.
1.01	7.15	87	.07	.06	229.	1.01	19.15	231	.02	.00	256.
1.01	7.20	88	.07	.06	232.	1.01	19.20	232	.02	.00	239.
1.01	7.25	89	.07	.06	234.	1.01	19.25	233	.02	.00	223.
1.01	7.30	90	.07	.06	236.	1.01	19.30	234	.02	.00	208.
1.01	7.35	91	.07	.06	239.	1.01	19.35	235	.02	.00	194.
1.01	7.40	92	.07	.06	239.	1.01	19.40	236	.02	.00	181.
1.01	7.45	93	.07	.06	241.	1.01	19.45	237	.02	.00	169.
1.01	7.50	94	.07	.06	242.	1.01	19.50	238	.02	.00	159.
1.01	7.55	95	.07	.06	244.	1.01	19.55	239	.02	.00	147.
1.01	8.00	96	.07	.06	245.	1.01	20.00	240	.02	.00	137.
1.01	8.05	97	.07	.06	247.	1.01	20.05	241	.02	.00	128.
1.01	8.10	98	.07	.06	248.	1.01	20.10	242	.02	.00	119.
1.01	8.15	99	.07	.06	249.	1.01	20.15	243	.02	.00	111.
1.01	8.20	100	.07	.06	250.	1.01	20.20	244	.02	.00	104.
1.01	8.25	101	.07	.06	251.	1.01	20.25	245	.02	.00	97.
1.01	8.30	102	.07	.06	252.	1.01	20.30	246	.02	.00	91.
1.01	8.35	103	.07	.06	253.	1.01	20.35	247	.02	.00	88.
1.01	8.40	104	.07	.06	254.	1.01	20.40	248	.02	.00	84.
1.01	8.45	105	.07	.06	255.	1.01	20.45	249	.02	.00	80.
1.01	8.50	106	.07	.06	255.	1.01	20.50	250	.02	.00	80.
1.01	8.55	107	.07	.06	256.	1.01	20.55	251	.02	.00	80.
1.01	9.00	108	.07	.06	257.	1.01	21.00	252	.02	.00	80.
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1.01	9.55	119	.07	.06	263.	1.01	21.55	263	.02	.00	80.
1.01	10.00	120	.07	.06	263.	1.01	22.00	264	.02	.00	80.

1.01	10.00	126	.07	.06	.00	263.	1.01	22.00	264	.02	.00	RR.
1.01	10.05	121	.07	.06	.00	264.	1.01	22.05	245	.02	.00	RR.
1.01	10.10	122	.07	.06	.00	264.	1.01	22.10	266	.02	.00	RR.
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1.01	10.25	125	.07	.06	.00	265.	1.01	22.25	269	.02	.00	RR.
1.01	10.30	124	.07	.06	.00	266.	1.01	22.30	270	.02	.00	RR.
1.01	10.35	127	.07	.06	.00	266.	1.01	22.35	271	.02	.00	RR.
1.01	10.40	128	.07	.06	.00	266.	1.01	22.40	272	.02	.00	RR.
1.01	10.45	129	.07	.06	.00	267.	1.01	22.45	273	.02	.00	RR.
1.01	10.50	130	.07	.06	.00	267.	1.01	22.50	274	.02	.00	RR.
1.01	11.00	131	.07	.06	.00	267.	1.01	22.55	275	.02	.00	RR.
1.01	11.05	132	.07	.06	.00	268.	1.01	23.00	276	.02	.00	RR.
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1.01	11.40	139	.07	.06	.00	269.	1.01	23.35	283	.02	.00	RR.
1.01	11.45	140	.07	.06	.00	269.	1.01	23.40	284	.02	.00	RR.
1.01	11.50	141	.07	.06	.00	270.	1.01	23.45	285	.02	.00	RR.
1.01	11.55	142	.07	.06	.00	270.	1.01	23.50	286	.02	.00	RR.
1.01	12.00	143	.07	.06	.00	270.	1.01	23.55	287	.02	.00	RR.
1.01	12.00	144	.07	.06	.00	270.	1.02	0.00	288	.02	.00	RR.

SUM 32.89 31.62 1.27 176265.
 (835.11 803.11 32.11 3858.60)

PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
6051.	1462.	473.	473.	136225.
171.	41.	13.	13.	3857.
	25.14	72.53	72.53	826.33
	638.53	826.33	826.33	938.
	725.	938.	938.	1157.
	894.	1157.	1157.	

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1	RATIO OF PNE	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	INITIAL VALUE		
									ELEVATION STORAGE OUTFLOW	SOFTWAY CREST	TOP OF DAM
	.15	103.11	0.00	384.	129.	0.00	18.08	0.00	100.00	103.50	103.50
	.20	103.49	.39	411.	190.	3.75	17.59	0.00	398.	398.	398.
	.25	104.33	.83	426.	388.	4.58	16.33	0.00	3.	146.	146.
	.30	104.75	1.25	440.	729.	5.00	16.08	0.00			
	.50	105.65	2.15	471.	2167.	7.25	15.92	0.00			
	1.00	106.62	3.12	507.	4915.	10.50	15.83	0.00			

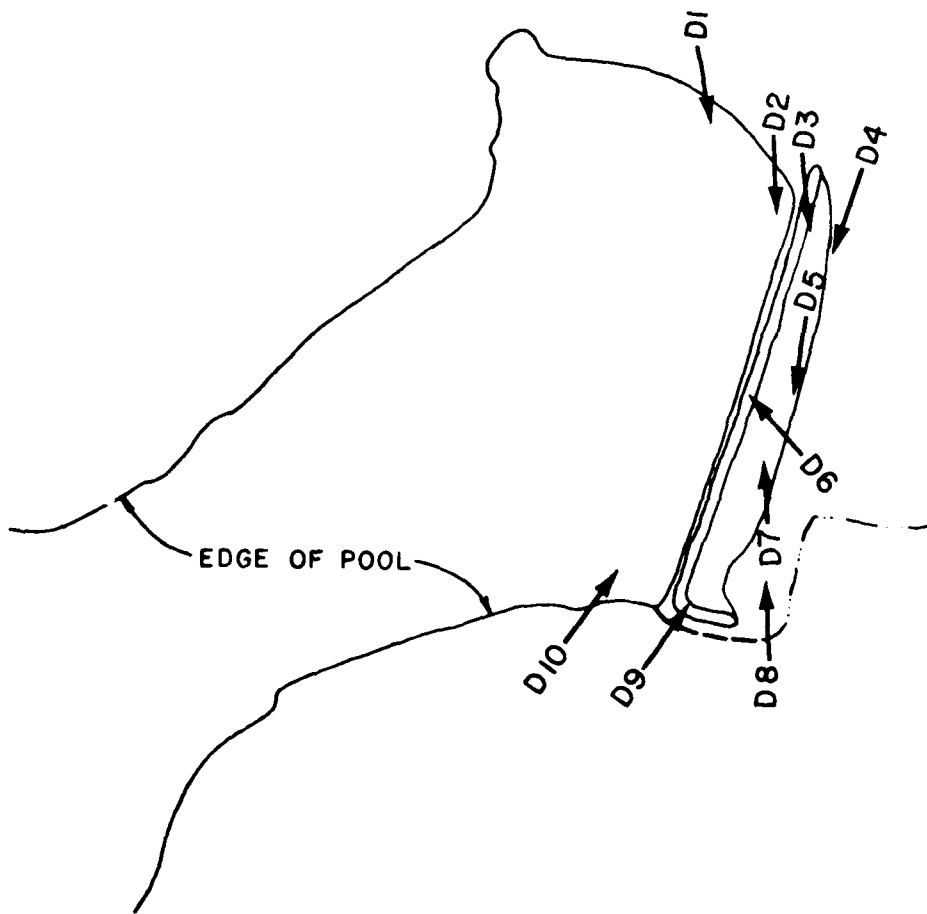
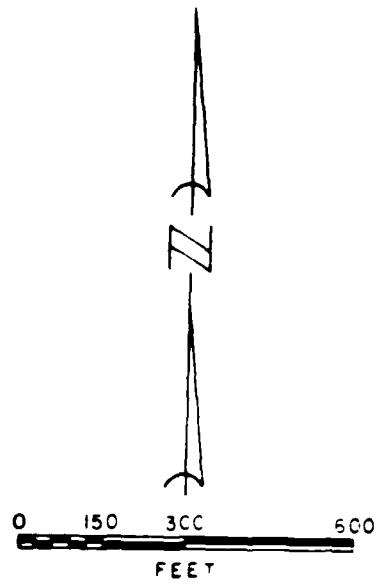
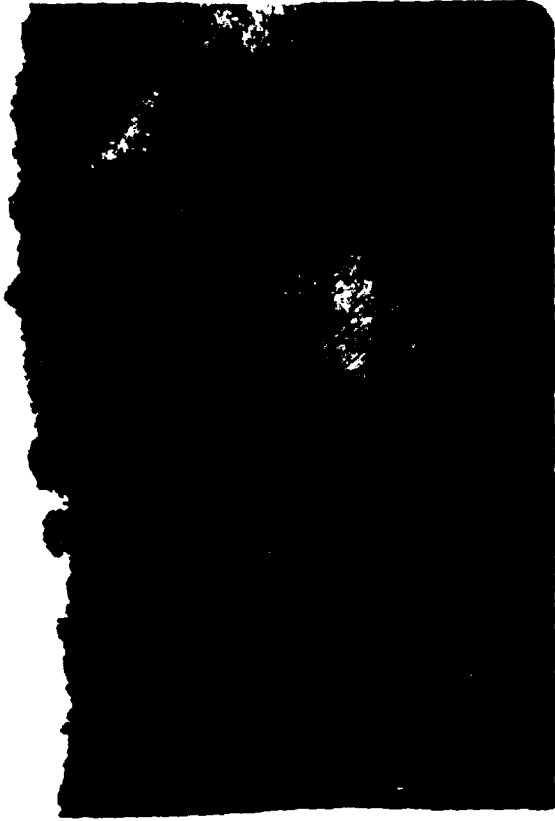


PHOTO INDEX I
FOR
DAM

PREPARED BY
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FON-DU-LAC
JEFFERSON COUNTY, MO.
OCTOBER 1978

D2



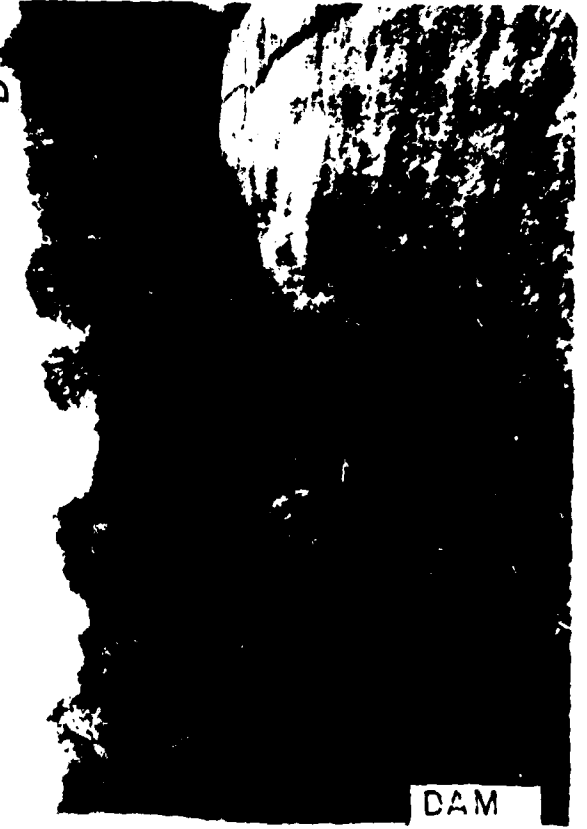
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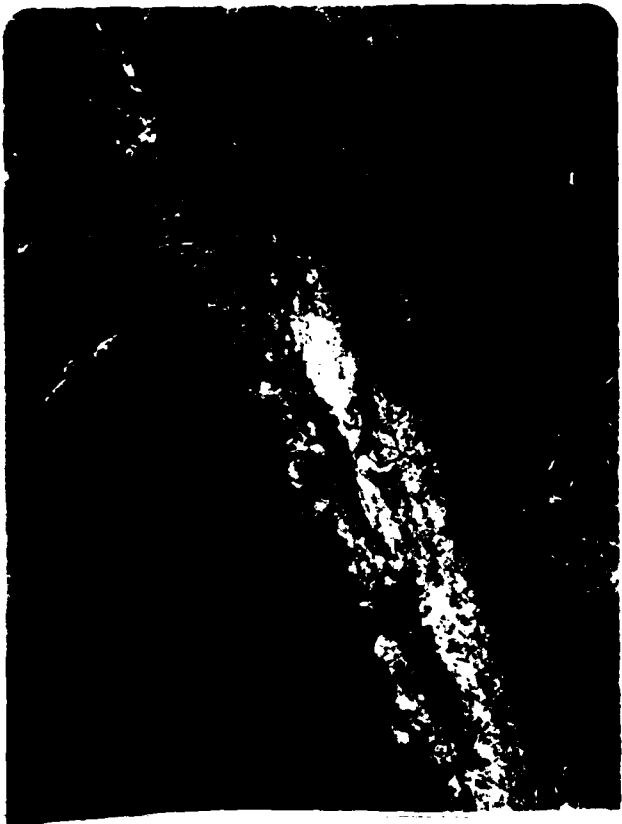


D1



D3





D 10



D 9



DAM

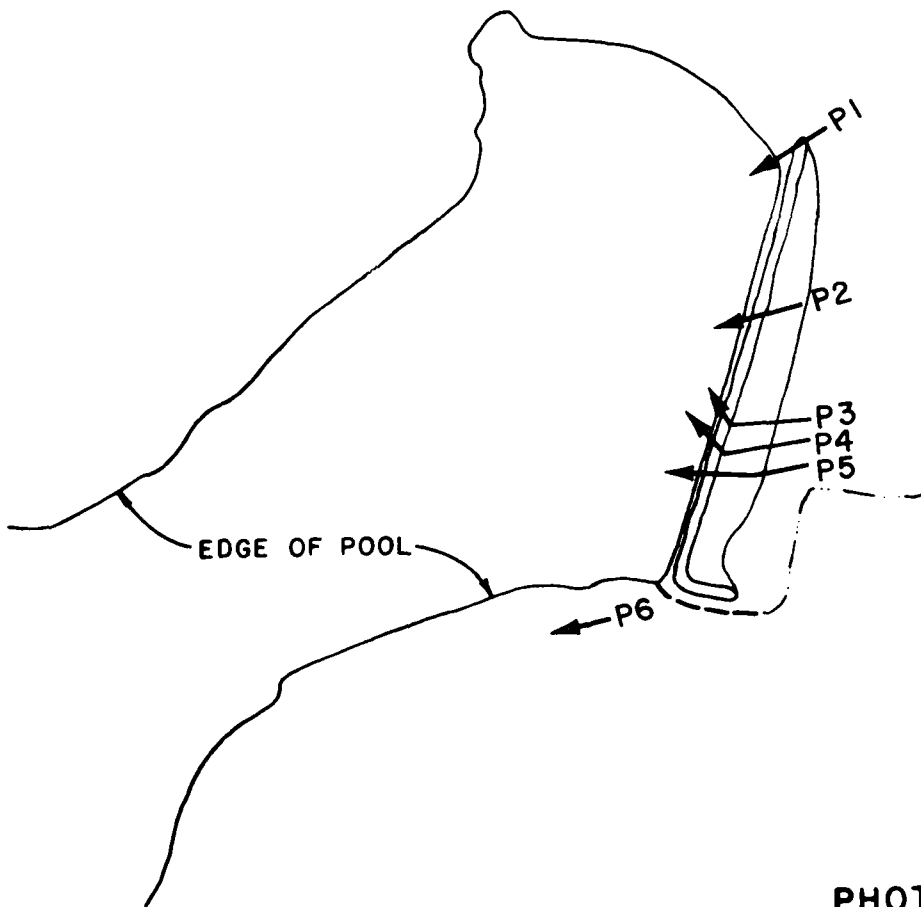
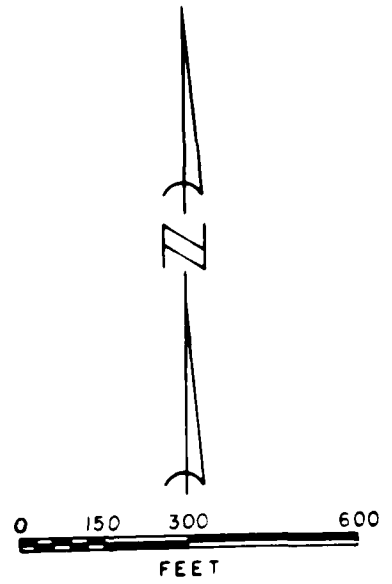
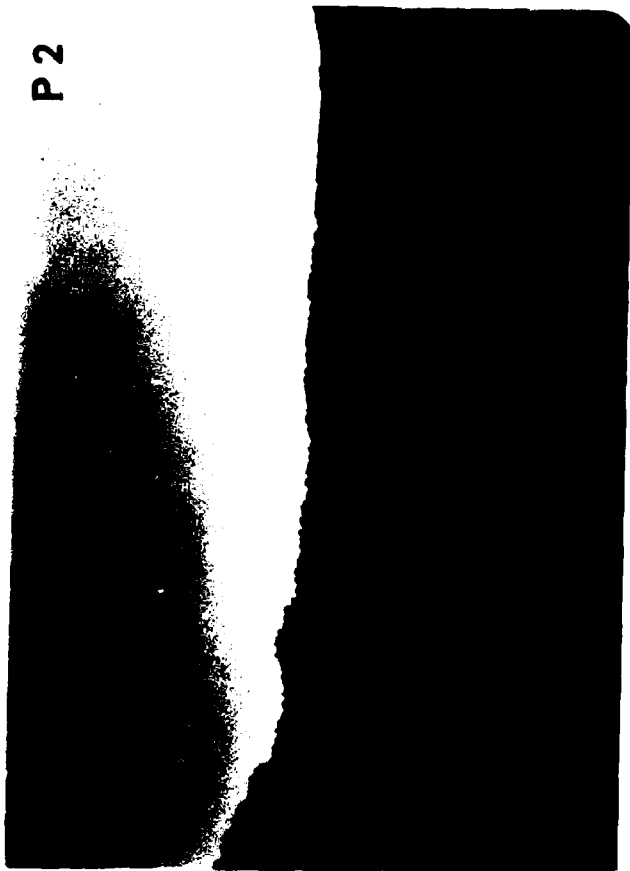


PHOTO INDEX 2
FOR
PANORAMA

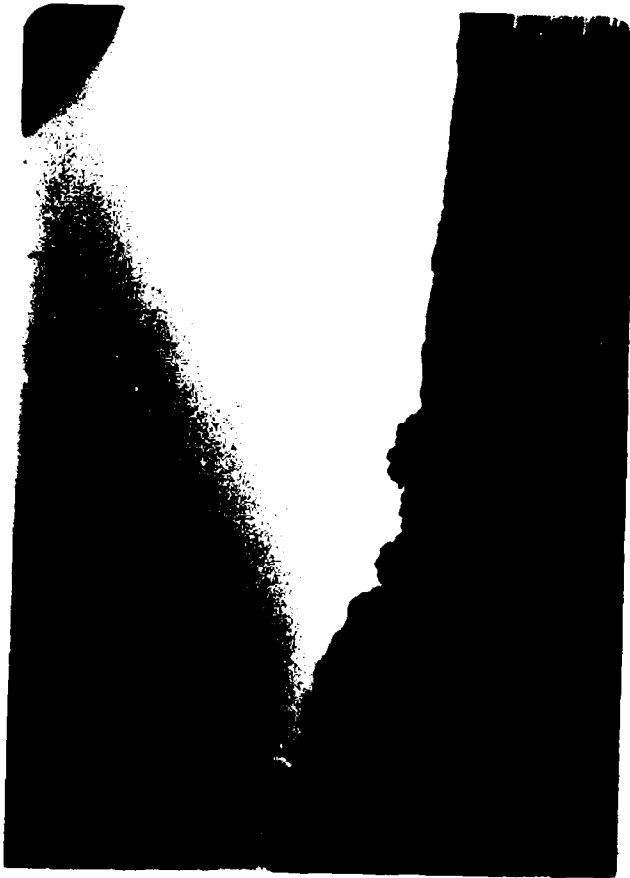
FON-DU-LAC
JEFFERSON COUNTY, MO.
OCTOBER 1978

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P 2



P 4



P 3



PANORAMA

P6



P5



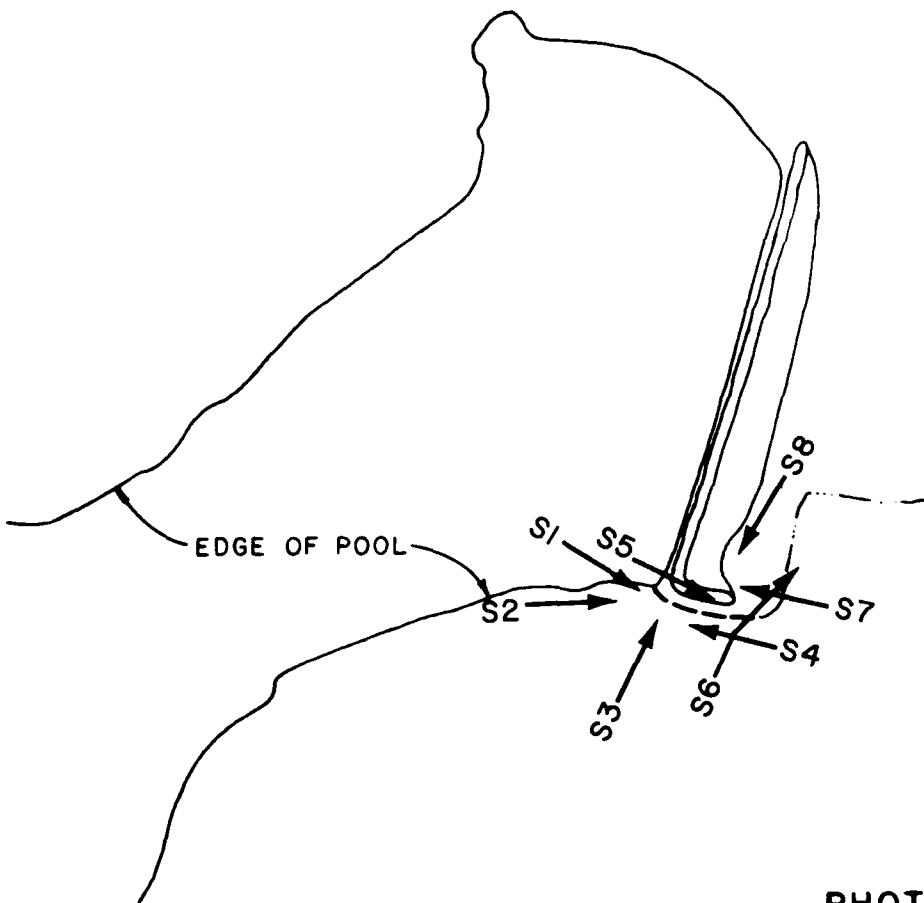
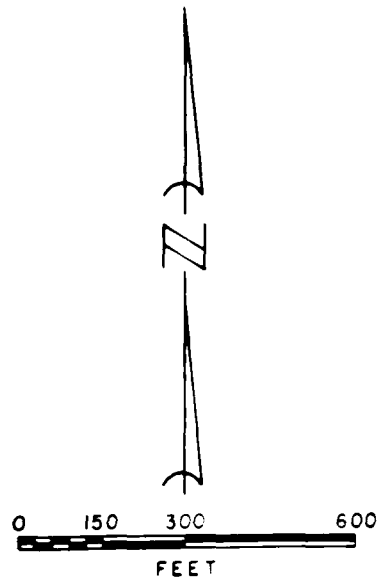
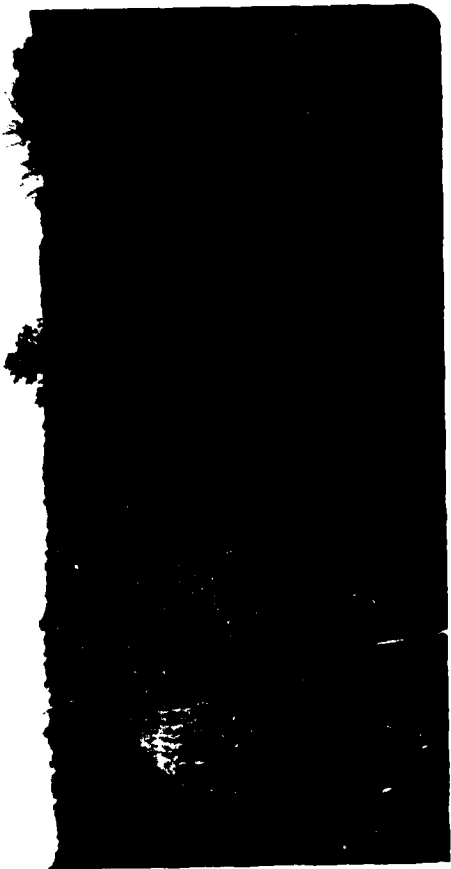


PHOTO INDEX 3
FOR
SPILLWAY

FON-DU-LAC
JEFFERSON COUNTY, MO.
OCTOBER 1978

PREPARED BY
REITZ & JENS, INC

V 2



V 1



VALLEY BELOW DAM

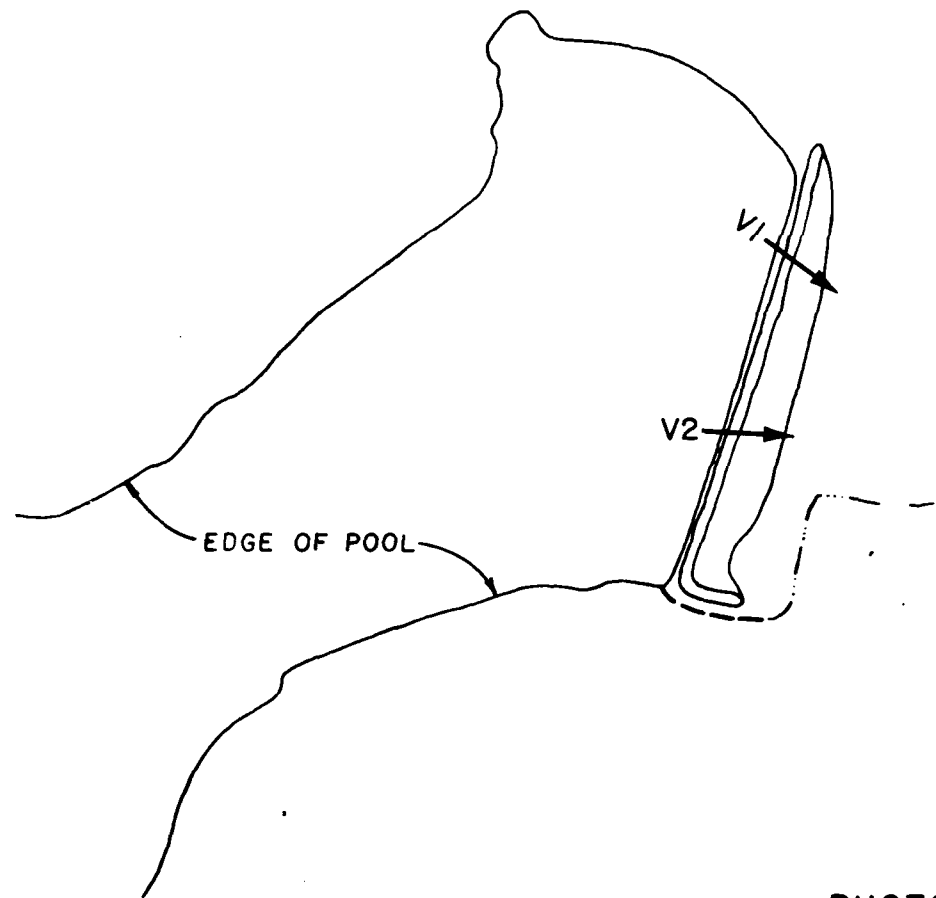
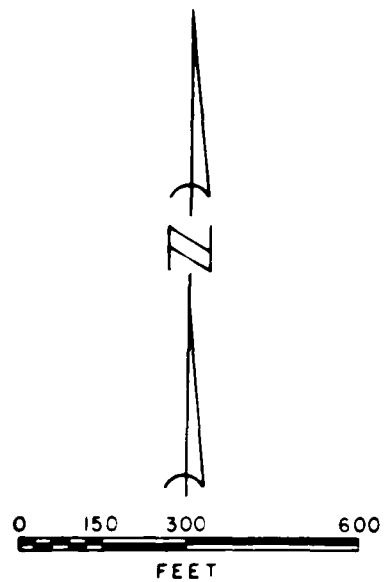


PHOTO INDEX 4
FOR
VALLEY BELOW DAM

PREPARED BY
REITZ & JENS, INC

FON-DU-LAC
JEFFERSON COUNTY, MO.
OCTOBER 1978



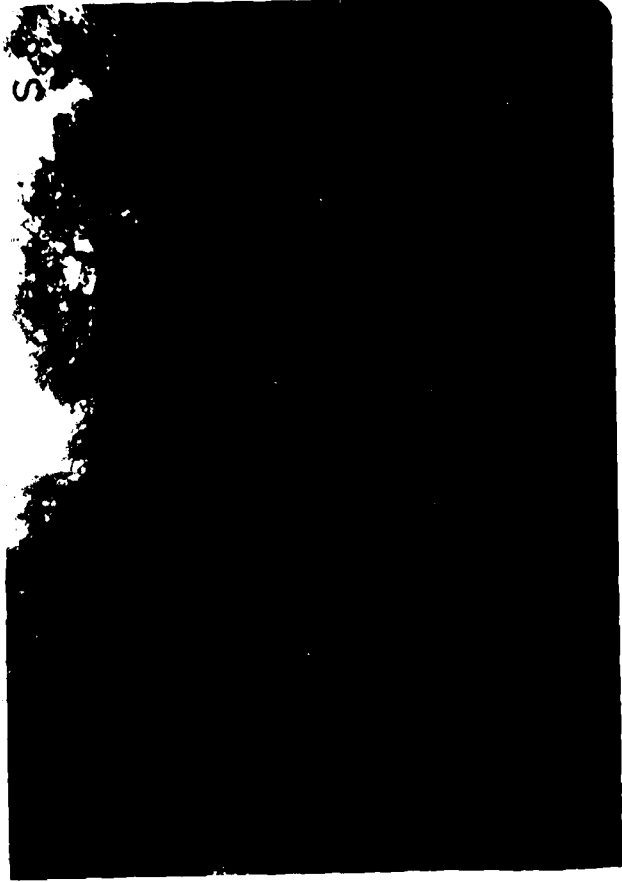
S 4



S 3



SPILLWAYS



S



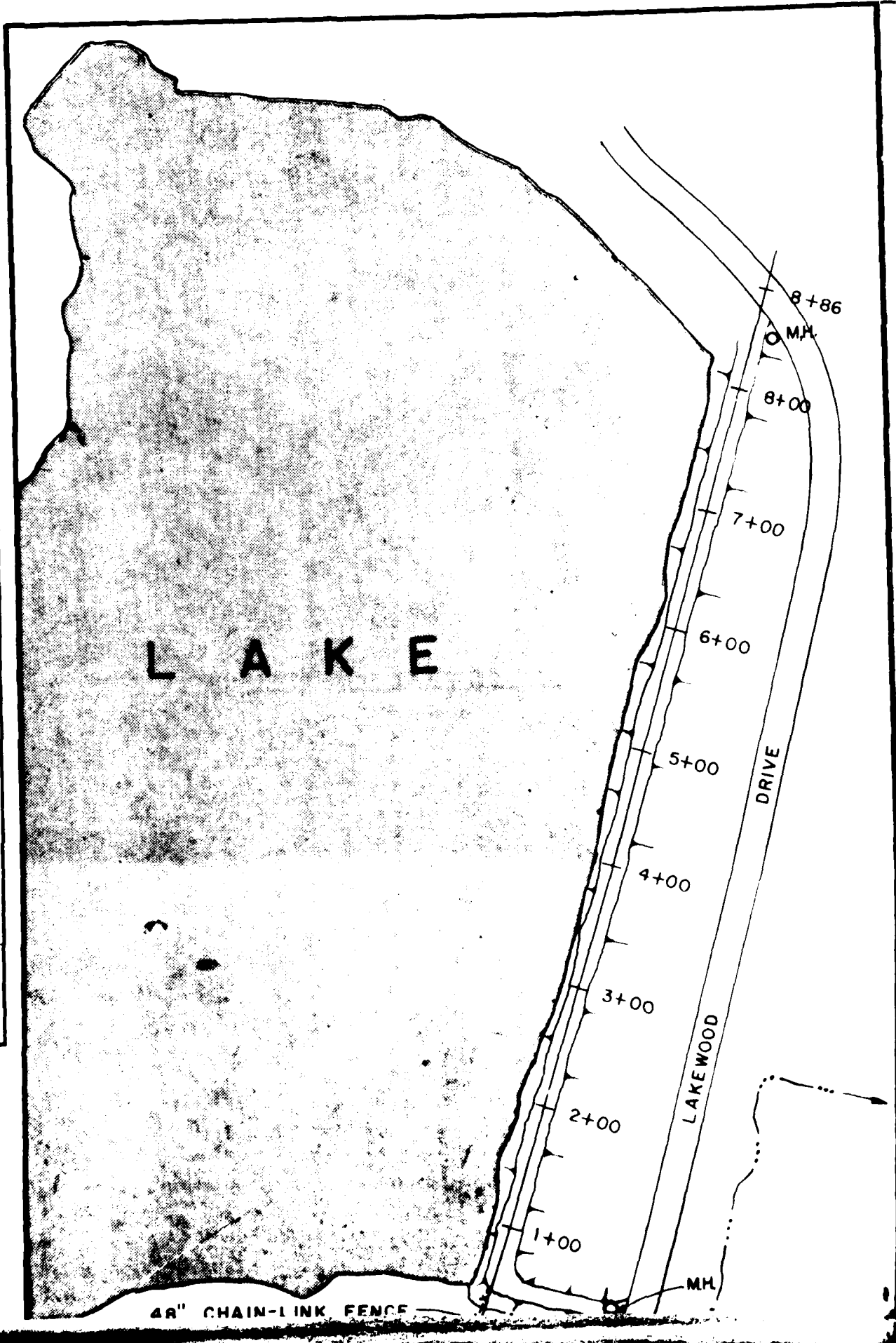
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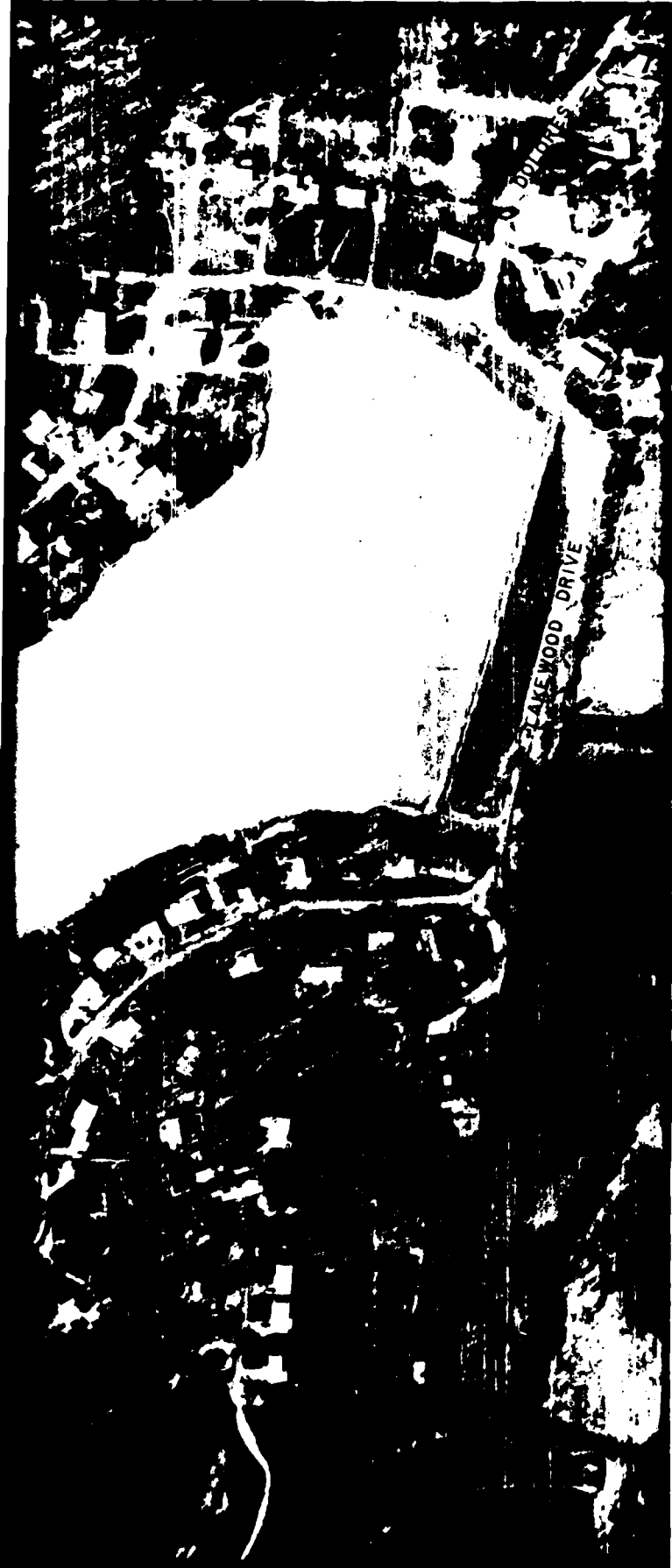
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STOP

FINAL SURVEY	SURVEYED	BY	DATE
	PLOTTED		
NOTE BOOK NO	TEMPLATE		
	AREAS		
	AREAS CHECKED		

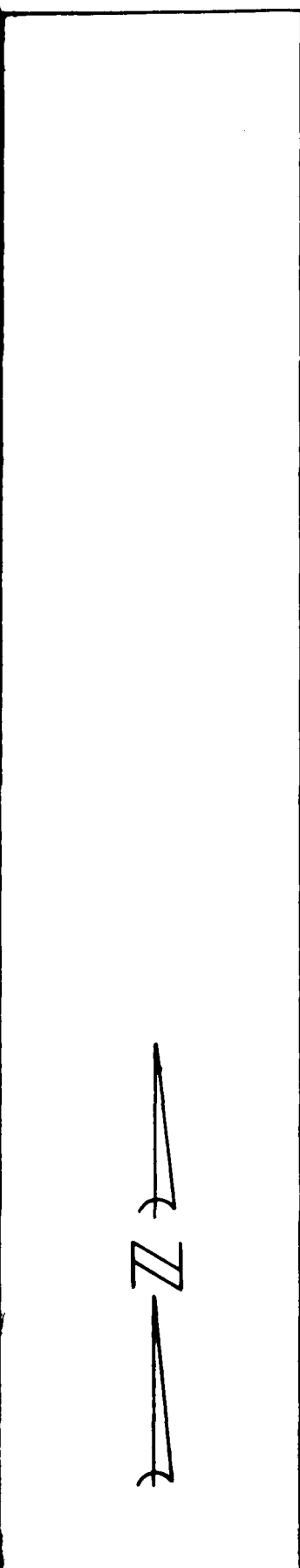






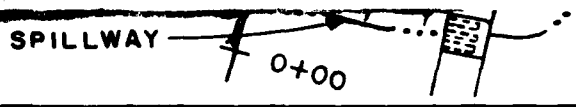
OF LAKE 13





ANEL

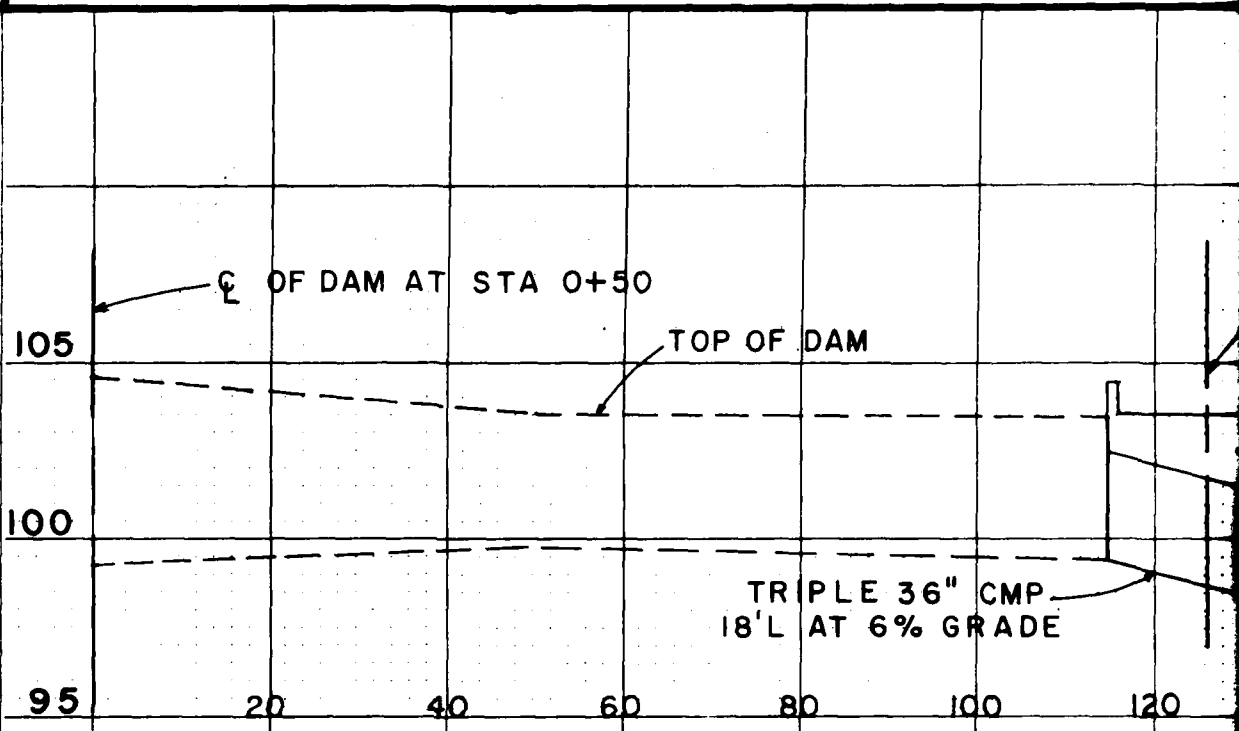
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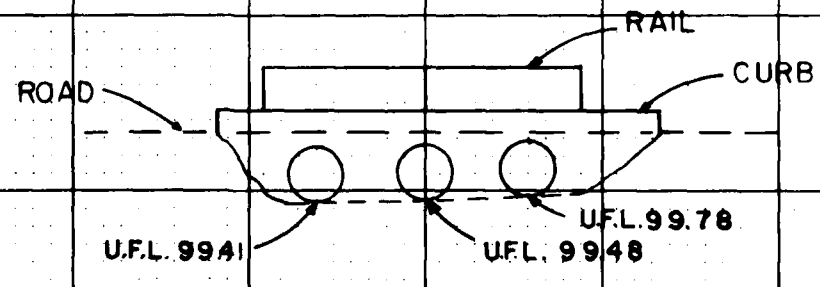
PLAN OF DAM AND SPILLWAY



ORIGINAL SURVEY	SURVEYED	DATE
	BY	
NOTE BOOK NO.	PLOTTED	
	TEMPLATE	
	AREAS CHECKED	



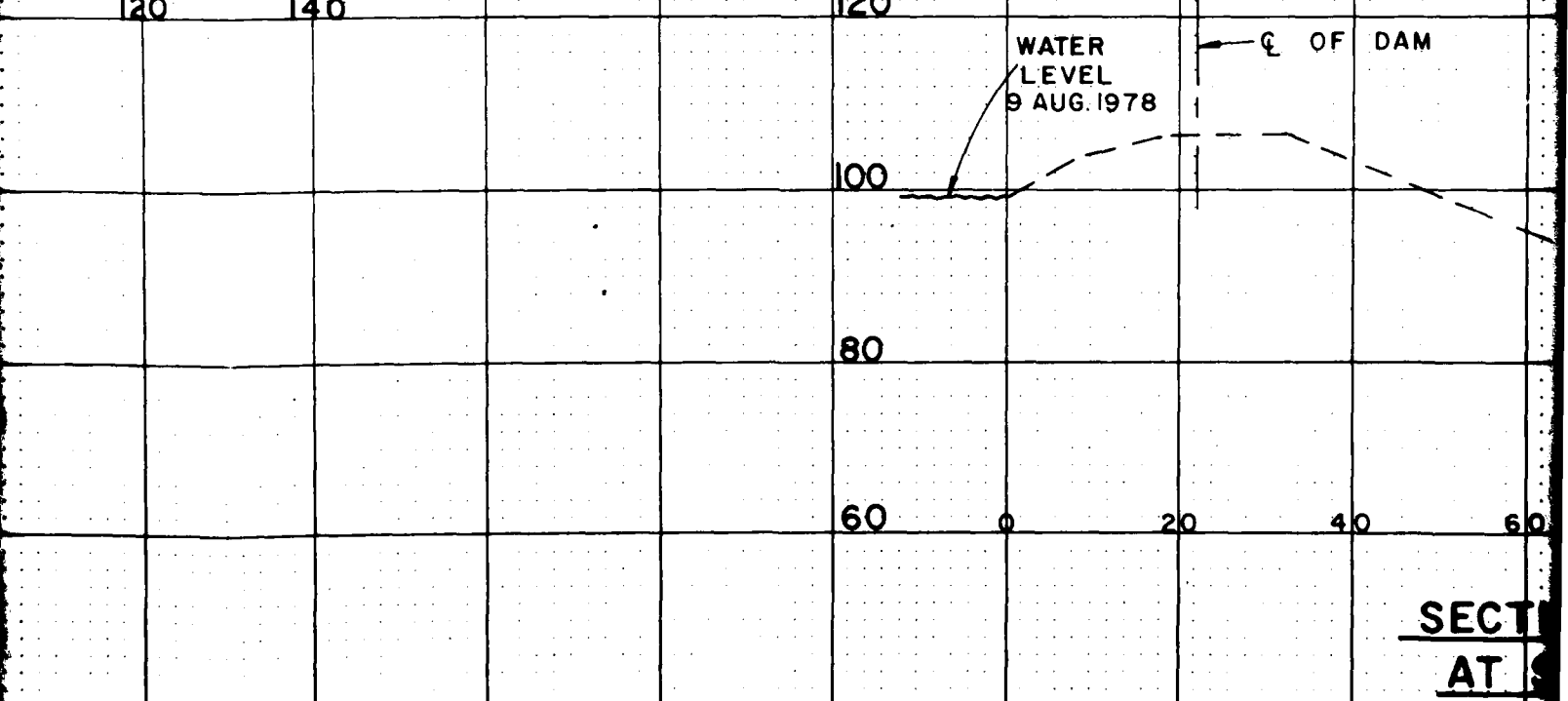
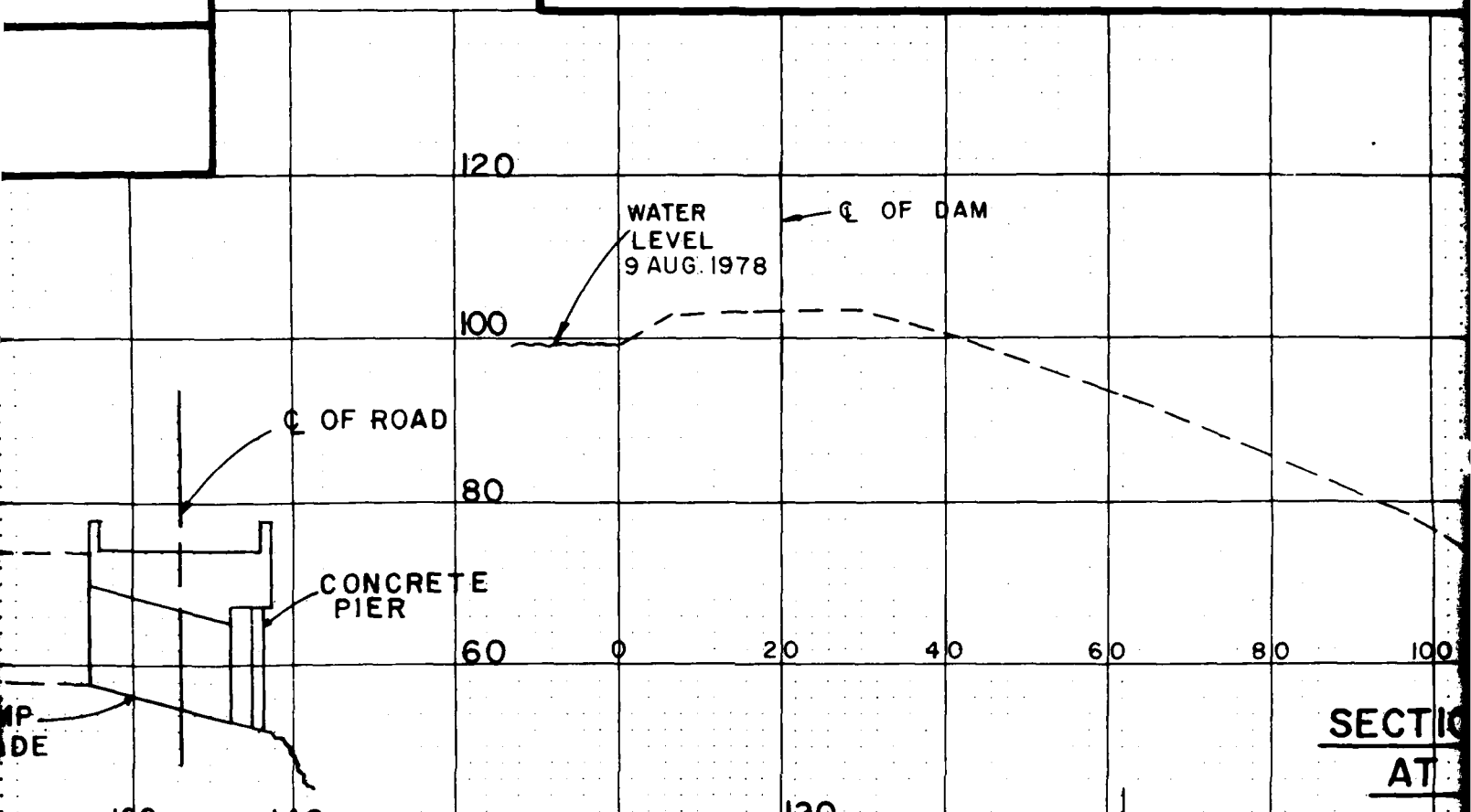
PROFILE OF SPILLWAY AT CENTERLINE



DETAIL OF PIPES IN SPILLWAY

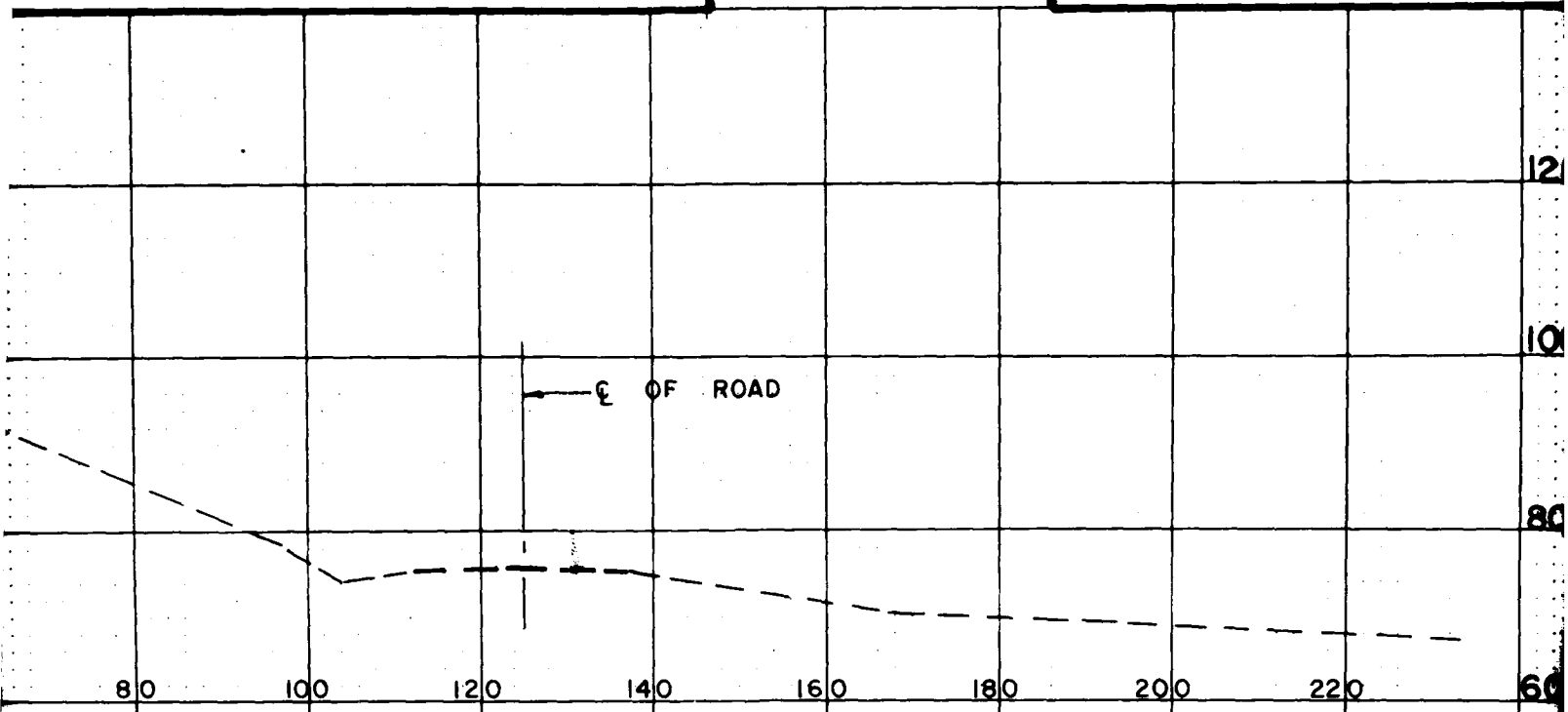
SCALE 1" = 10'

6

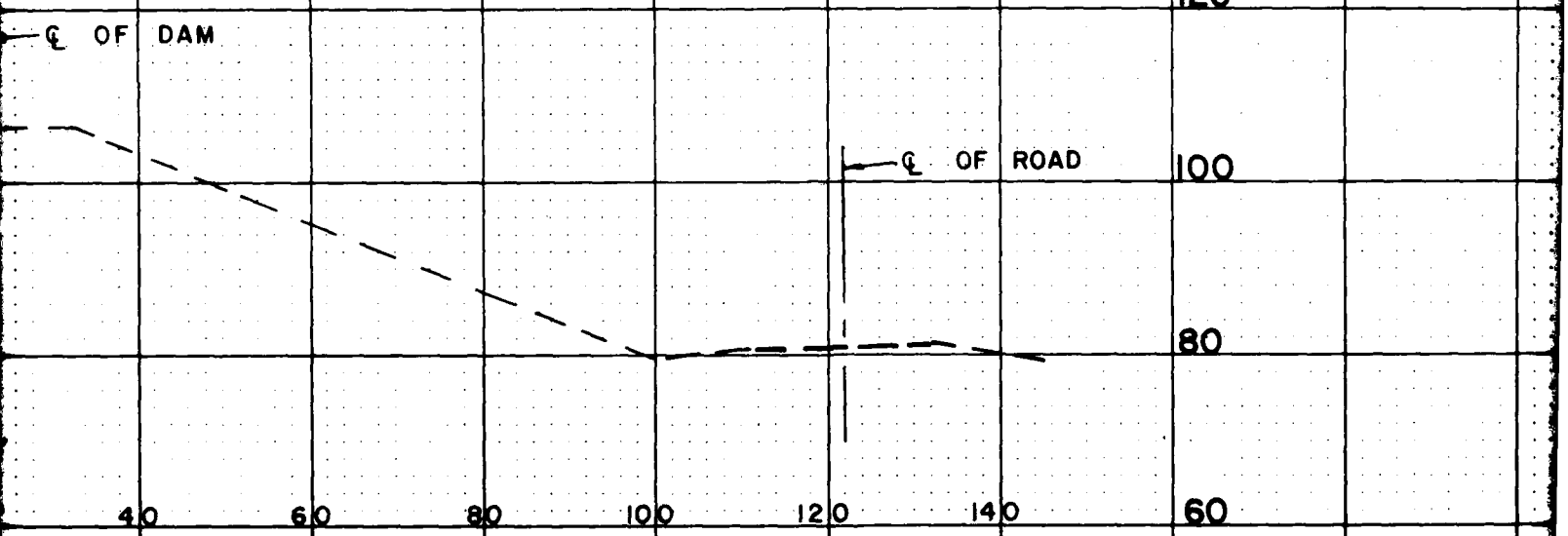


AY

600 900 FT.



SECTION OF DAM
AT STA. 2+80



SECTION OF DAM
AT STA. 6+00



120

110

SPILLWAY

100

105

80

100

0+00

1+00

2+00

3+00

4+00

5+00

220

60

95

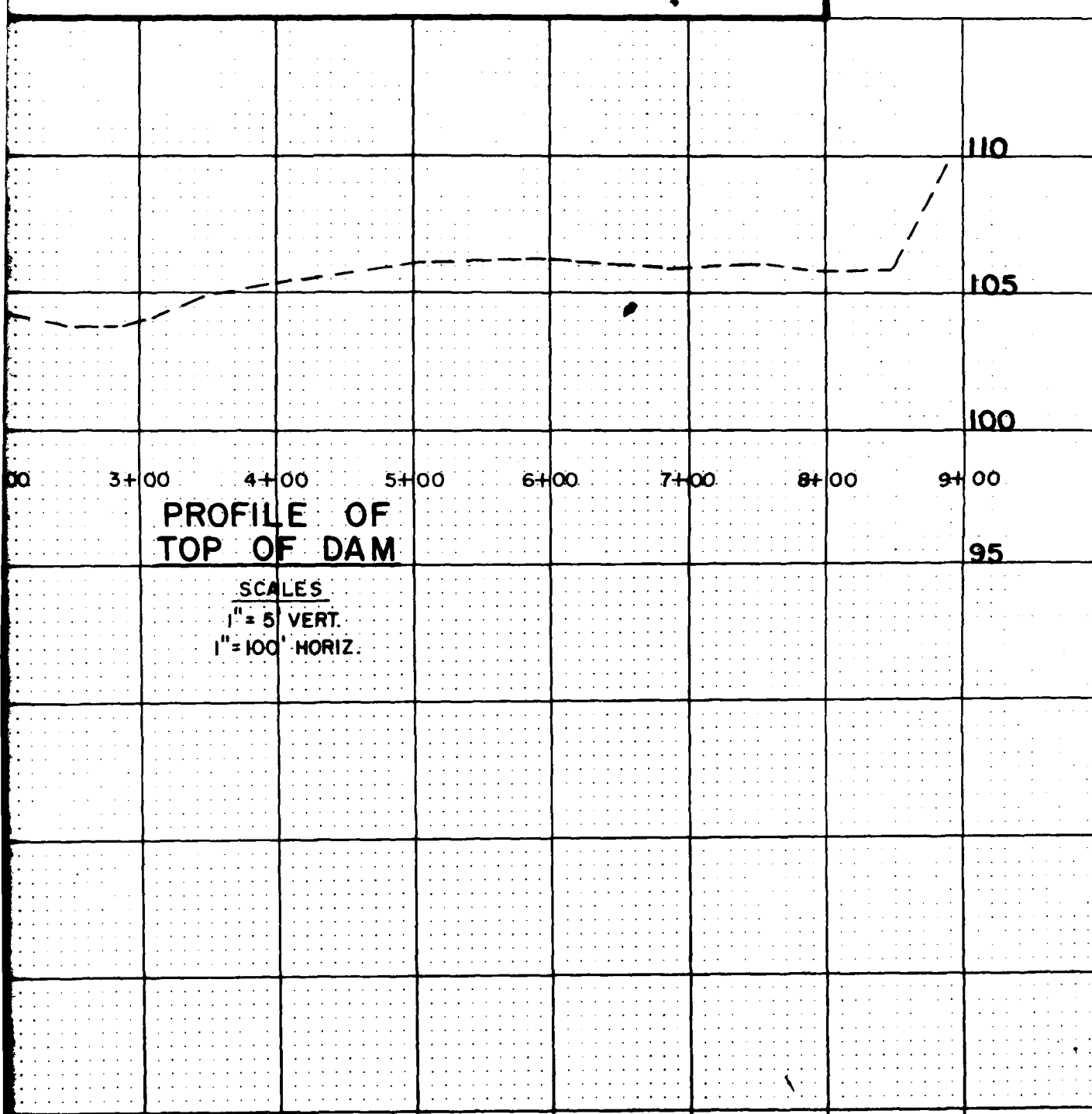
PROFILE OF
TOP OF DAM

SCALES
1" = 5' VERT.
1" = 100' HORIZ.

ADD 410' TO ELEVATIONS SHOWN
TO OBTAIN APPROX. USGS DATUM

FON-DU-LAC

000 6000 FT.



**PROFILE OF
TOP OF DAM**

SCALES
1" = 5' VERT.
1" = 100' HORIZ.

PHASE I - INSPECTION
COUNTY I. D. NO. 099
JEFFERSON COUNTY, MISSOURI
INVENTORY NO. I. D. 10699

DU-LAC

FOR ST. LOUIS DISTRICT, CORPS OF ENGINEERS
 REITZ & JENS, INC.
 CONSULTING ENGINEERS
 ST. LOUIS, MISSOURI
 NOVEMBER 1978

ND
ATE