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NATIONAL DAM SAFETY PROGRAM. HIDEOUT LAKE DAM (MO 30424), UPPER--ETC(U)
MAR 81 R E SAUTHOFF, A B BECKER DACW43-81-C-0002

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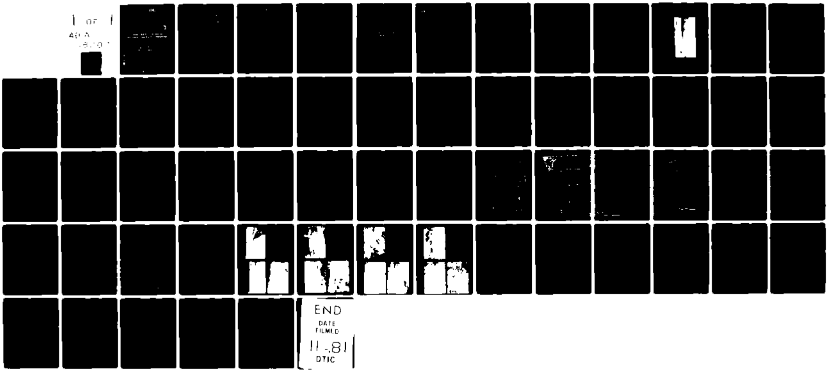

LEVEL II

1

UPPER MISSISSIPPI - KASKASKIA - ST. LOUIS BASIN

HIDEOUT LAKE DAM

JEFFERSON COUNTY, MISSOURI

MO 30424

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

United States Army
Corps of Engineers
Serving the Army
Serving the Nation

St. Louis District

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

MARCH 1981

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REPORT DOCUMENTATION PAGE

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1. REPORT NUMBER

2. GOVT ACCESSION NO.

3. RECIPIENT'S CATALOG NUMBER

4. TITLE (and Subtitle)
Phase I Dam Inspection Report
National Dam Safety Program
Hideout Lake Dam (MO 30424)
Jefferson County, Missouri

5. TYPE OF REPORT & PERIOD COVERED
9 Final [illegible]

6. PERFORMING ORG. REPORT NUMBER

7. AUTHOR(s)
Horner & Shifrin, Inc.

8. CONTRACT OR GRANT NUMBER(s)
15
DACW43-81-C-[illegible]2

9. PERFORMING ORGANIZATION NAME AND ADDRESS
U.S. Army Engineer District, St. Louis
Dam Inventory and Inspection Section, LMSED-PD
210 Tucker Blvd., North, St. Louis, Mo. 63101

10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS

11. CONTROLLING OFFICE NAME AND ADDRESS
U.S. Army Engineer District, St. Louis
Dam Inventory and Inspection Section, LMSED-PD
210 Tucker Blvd., North, St. Louis, Mo. 63101

11

12. REPORT DATE
~~March 1981~~ (12)

13. NUMBER OF PAGES
Approximately 60

14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)
10 Ralph E. /Sauthoff
Albert B. /Becker, Jr

15. SECURITY CLASS. (of this report)
UNCLASSIFIED

15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

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17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

6 National Dam Safety Program. Hideout Lake Dam (MO 30424), Upper Mississippi - Kaskaskia - St. Louis Basin, Jefferson County, Missouri. Phase I Inspection Report.

18. SUPPLEMENTARY NOTES

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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UPPER MISSISSIPPI - KASKASKIA - ST. LOUIS BASIN

HIDEOUT LAKE DAM

JEFFERSON COUNTY, MISSOURI

MO 30424

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

United States Army
Corps of Engineers
...Serving the Army
...Serving the Nation

St. Louis District

PREPARED BY: U.S. ARMY ENGINEER DISTRICT, ST. LOUIS

FOR: STATE OF MISSOURI

MARCH 1981

DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 TUCKER BOULEVARD, NORTH
ST. LOUIS, MISSOURI 63101

REPLY TO
ATTENTION OF

LMSED-P

SUBJECT: Hideout Lake Dam, Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Hideout Lake Dam (MO 30424):

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 50 percent of the Probable Maximum Flood without overtopping the dam.

2) Overtopping of the dam could result in failure of the dam.

3) Dam failure significantly increases the hazard to loss of life downstream.

SUBMITTED BY: SIGNED
Chief, Engineering Division

15 APR 1981
Date

APPROVED BY: SIGNED
Colonel, CE, District Engineer

15 APR 1981
Date

HIDEOUT LAKE DAM

MISSOURI INVENTORY NO. 30424

JEFFERSON COUNTY, MISSOURI

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

PREPARED BY:

HORNER & SHIFRIN, INC.
5200 OAKLAND AVENUE
ST. LOUIS, MISSOURI 63110

FOR:

U. S. ARMY ENGINEER DISTRICT, ST. LOUIS

CORPS OF ENGINEERS

MARCH 1981

HS-8088

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Hideout Lake Dam
State Located:	Missouri
County Located:	Jefferson
Stream:	Tributary of Sandy Creek
Date of Inspection:	6 November 1980

The Hideout Lake Dam, which according to the St. Louis District, Corps of Engineers, is of high hazard potential, was visually inspected by engineering personnel of Horner & Shifrin, Inc., Consulting Engineers, St. Louis, Missouri. The purpose of this inspection was to assess the general condition of the dam with respect to safety and, based upon this inspection and available data, determine if the dam poses an inordinate danger to human life or property. Evaluation of the dam was performed in accordance with the "Phase I" investigation procedures prescribed in "Recommended Guidelines for Safety Inspection of Dams", dated May 1975.

The following summarizes the findings of the visual inspection and the results of certain hydrologic/hydraulic investigations performed under the direction of the inspection team. Based on the visual inspection and the results of these hydrologic/hydraulic investigations, the present general condition of the dam is considered to be less than satisfactory. Several items were noticed during the inspection which are considered to have an adverse effect on the overall safety and future operation of the dam. These items include trees and areas of dense brush on the downstream face of the embankment, seepage, an undercut spillway apron and obstructions within the spillway outlet channel, as well as conditions conducive to erosion of the dam as a result of badly deteriorated spillway retaining walls.

According to the criteria set forth in the recommended guidelines, the magnitude of the spillway design flood for the Hideout Lake Dam, which, according to Table 1 of the guidelines, is classified as small in size, is specified, according to Table 3 of the guidelines for a dam of high hazard potential and small size, to be a minimum of one-half the Probable Maximum Flood (PMF). Considering the fact that a relatively small volume of water is impounded by the dam, that the flood plain downstream of the dam is fairly broad, and that there are but five dwellings within the estimated flood damage zone, it is recommended that the spillway for this dam be designed for one-half the PMF. The Probable Maximum Flood (PMF) is the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

Results of a hydrologic/hydraulic analysis indicated that the spillway is inadequate to pass lake outflow resulting from a storm of one-half PMF magnitude without overtopping the dam. The spillway is capable of passing lake outflow resulting from the one percent chance (100-year frequency) flood and the outflow corresponding to about 23 percent of the PMF lake inflow. According to the St. Louis District, Corps of Engineers, the length of the downstream damage zone, should failure of the dam occur, is estimated to be four miles. Within the potential flood damage zone are five dwellings, including three mobile homes, a Knights of Columbus Hall, State Highway 21, and a covered bridge at Lemay Ferry Road.

A review of available data did not disclose that seepage or stability analyses of the dam were performed. This is considered a deficiency and should be rectified.

It is recommended that the Owner take the necessary action in the near future to correct or control the deficiencies and safety defects reported herein. The item concerning increasing spillway capacity should be pursued on a high priority basis.

Ralph E. Sauthoff

Ralph E. Sauthoff
P. E. Missouri E-19090

Albert B. Becker, Jr.

Albert B. Becker, Jr.
P. E. Missouri E-9168

OVERVIEW HIDEOUT LAKE DAM

PHASE 1 INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

HIDEOUT LAKE DAM - MO 30424

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PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

HIDEOUT LAKE DAM - MO 304[illegible]

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, dated 8 August 1972, 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, directed that a safety inspection of the Hideout Lake Dam be made.

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

c. Evaluation Criteria. This evaluation was performed in accordance with the "Phase I" investigation procedures as prescribed in the "Recommended Guidelines for Safety Inspection of Dams", Appendix D to "Report to the Chief of Engineers on the National Program of Inspection of Non-Federal Dams", dated May 1975.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances. The Hideout Lake Dam is an earthfill type embankment rising approximately 33 feet above the natural streambed at the downstream toe of the barrier. The embankment has an upstream slope (above the waterline) of approximately 1v on 1.7h, a crest width of about 10 feet, and a somewhat irregular downstream slope that varies between 1v on 2.0h and 1v on 2.5h. The length of the dam is approximately 740 feet and the dam is curved away from the lake between abutments, with the curvature near the right, or south, end of the dam most pronounced. A combination of stone, concrete rubble, and [illegible] riprap serves to protect the upstream face from erosion. A plan and profile of the dam is shown on Plate [illegible], and a cross-section of the dam, at about the location of the original stream on which the dam was constructed, is shown on Plate [illegible]. At normal pool elevation, the reservoir impounded by the dam occupies approximately 8 acres. There is no lake drawdown facility to dewater the lake. An overview photo of the Hideout Lake Dam is shown following the preface at the beginning of the report.

The spillway, an excavated earth, rectangular section with a combination bedrock and concrete paved invert, is located at the left, or north, abutment. Concrete block type retaining walls serve to confine flow to the spillway section at the dam. The invert of the spillway exit section is also paved with concrete. The spillway outlet channel, an irregular trapezoidal section, joins a natural draw of the adjacent watershed at a point about 80 feet downstream of the spillway crest. The natural draw, in turn, joins the original stream on which the dam was constructed at a point about 150 feet downstream of the center of the dam. A profile of the spillway channel and a cross-section of the spillway at the crest location are shown on Plate 5.

b. <u>Location</u>. The dam is located on an unnamed tributary of Sandy Creek approximately 1.0 mile northeast of the intersection of New Highway A and State Highway 21, and about 2.5 miles northeast of the City of Hillsboro, Missouri, as shown on the Regional Vicinity Map, Plate 1. The dam is located within the southeast one-quarter of Section [illegible], Township 41 North, Range 4 East, in Jefferson County.

c. <u>Size Classification</u>. The size classification based on the height of the dam and storage capacity, is categorized as small (per Table 1, Recommended Guidelines for Safety Inspection of Dams).

d. <u>Hazard Classification</u>. The Hideout Lake Dam, according to the St. Louis District, Corps of Engineers, has a high hazard potential, meaning that if the dam should fail, there may be loss of life, serious damage to homes, or extensive damage to agricultural, industrial and commercial facilities, important public utilities, main highways, or railroads. The estimated flood damage zone, should failure of the dam occur, as determined by the St. Louis District, extends four miles downstream of the dam. Within the possible damage zone are five dwellings, including three mobile homes, a Knights of Columbus Hall, State Highway 21, and a covered bridge at Lemay Ferry Road. Those features lying within the downstream damage zone as reported by the St. Louis District, Corps of Engineers, were verified by the inspection team.

e. Ownership. The lake and dam are owned by George Ogilvey. Mr. Ogilvey's address is: Route 5, Box 248, Hillsboro, Missouri 63050.

f. Purpose of Dam. The dam impounds water for recreational use.

g. Design and Construction History. According to Mr. George Ogilvey, the present Owner, the dam was constructed by Paul Shy, a local excavating contractor and builder of earthen dams, for Mr. Ray Sondag (deceased), the owner of the property at the time the dam was built. According to Mr. Shy, the contractor, the dam was built about 1945; however, no records of the design or construction exist. Mr. Ogilvey reported that he acquired the property from a Mrs. Moehler, the interim owner, in 1972, but that he was familiar with the lake and dam since 1958, having acted as a supervisor of the property for the previous owner since that time.

h. Normal Operational Procedure. The lake level is unregulated. Lake outflow is governed by the capacity of an excavated earth type spillway.

1.3 PERTINENT DATA

A. Drainage Area. The area tributary to the lake is approximately two-thirds meadowland and one-third woodland . The watershed above the dam amounts to approximately 129 acres. The watershed area is outlined on Plate 2.

b. Discharge at Damsite.

1. Estimated known maximum flood at damsite ... 56 cfs* (W.S. Elev. 646.0)
2. Spillway capacity ... 263 cfs (W.S. Elev. 647.6)

*Based on an estimate of depth of flow at the spillway as observed by the Owner.

c. Elevation (Ft. above MSL). Unless otherwise indicated, the following elevations were determined by survey and are based on topographic data shown on the 1954 U.S.G.S. Belew Creek, Missouri, Quadrangle Map, 7.5 Minute Series, photorevised 1968 and 1974.

1. Observed pool ... 642.8
2. Normal pool ... 645.0
3. Spillway crest ... 645.0
4. Maximum experienced pool ... 646.0* (Approx.)
5. Top of dam ... 647.6 (Min.)
6. Streambed at centerline of dam ... 617± (Est.)
7. Maximum tailwater ... Unknown
8. Observed tailwater ... None

d. Reservoir.

1. Length at normal pool (Elev. 645.0) ... 850 ft.
2. Length at maximum pool (Elev. 647.6) ... 950 ft.

e. Storage.

1. Normal pool ... 69 ac. ft.
2. Top of dam (incremental) ... 23 ac. ft.

f. Reservoir Surface.

1. Normal pool ... 8 acres
2. Top of dam (incremental) ... 2 acres

g. Dam. The height of the dam is defined to be the overall vertical distance from the lowest point of foundation surface at the downstream toe of the barrier, to the top of the dam.

*Based on an estimate of depth of flow at the spillway as observed by the Owner.

1. Type ... Earthfill
2. Length ... 740 ft.
3. Height ... 33 ft.
4. Top width ... 10 ft.
5. Side slopes
    a. Upstream ... 1v on 1.7h (above waterline)
    b. Downstream ... Irregular, 1v on 2.0h (max.)
6. Cutoff ... Core trench*
7. Slope protection
    a. Upstream ... Riprap (stone, concrete rubble, masonry)
    b. Downstream ... Grass

h. Principal Spillway.

1. Type ... Uncontrolled, excavated earth, rectangular section
2. Location ... Left abutment
3. Crest ... Elevation 645.0
4. Width ... 22 ft.
5. Side slopes ... Vertical
6. Approach channel ... Lake
7. Outlet channel ... Excavated earth, irregular trapezoidal section

i. Emergency Spillway ... None

j. Lake Drawdown Facility ... None

*Per Paul Shy, contractor and builder of dam.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No data relating to the design of the dam are known to exist.

2.2 CONSTRUCTION

As previously stated, the dam was constructed about 1945 by Paul Shy, a local excavating contractor and builder of earth dams. Mr. Shy was contacted and reported that a core trench was excavated to rock or to firm clay along the alignment of the dam and that the material used to backfill the trench and construct the dam was good clay obtained from the area to be occupied by the lake. Mr. Shy also indicated that the fill material was compacted by rubber-tired earth scrapers that were used to haul and place the earthfill. When asked about the proportions of the dam, Mr. Shy stated that this dam was constructed similar to other earth dams that he had built and that the upstream face probably had a slope of 1v on 3h and the downstream face a slope of 1v on 2h. According to the contractor, the size of the spillway was based on judgement and experience; however, Mr. Shy reported that the concrete block type retaining walls on either side of the spillway were not constructed by his company.

2.3 OPERATION

The lake level is uncontrolled and governed by the elevation of the crest of the excavated earth type spillway. There is no emergency spillway or lake drawdown facility. No indication was found during the inspection that the dam had been overtopped. According to the Owner who is familiar with the operation of the lake since 1958, the dam has never been overtopped. The Owner reported that the highest lake level he has observed occurred in April of 1979 when a storm produced a depth of flow at the spillway estimated to be on the order of 12 inches.

2.4 EVALUATION

a. Availability. Engineering data for assessing the design of the dam and spillway were unavailable.

b. Adequacy. No data available. 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. According to survey data obtained during the inspection, the upstream face of the dam above the observed waterline has a slope of 1v on 1.7h, which is steeper than the 1v on 3h slope reported by the builder of the dam; however the slope of the downstream face did agree with the reported slope in so far as it was found to be no steeper than 1v on 2h.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of the Hideout Lake Dam was made by Horner & Shifrin engineering personnel, R. E. Sauthoff, Civil Engineer, H. B. Lockett, Hydrologist, and A. B. Becker, Jr., Civil and Soils Engineer, on 6 November 1980. An examination of the dam site was also made by an engineering geologist, Jerry D. Higgins, Ph.D., a consultant retained by Horner & Shifrin for the purpose of assessing the area geology. Also examined at the time of the inspection were the areas and features below the dam within the potential flood damage zone. Photographs of the dam taken at the time of the inspection are included on pages A-1 through A-4 of Appendix A. The locations of the photographs taken during the inspection are indicated on Plate 3.

b. Site Geology. Hideout Lake is located on a northward-flowing tributary to Sandy Creek approximately 0.3 mile north of Route A on the Belew Creek, Missouri Quadrangle Map. The topography around the lake site is moderately sloping, with relief between the lake and surrounding drainage divides ranging up to approximately 235 feet. The area is included within the northeastern part of the Ozark Plateaus Physiographic Province, and the regional dip of the bedrock is to the northeast.

The bedrock at the site consists of the Ordovician-age Jefferson City-Cotter formation. Bedrock exposures were noted at several locations around the shoreline and in the right abutment. No faulting was observed in the immediate vicinity of the lake.

The Jefferson City-Cotter formation consists of a light brown, medium-to-finely crystalline dolomite or argillaceous dolomite. It is thin-to medium-bedded, often argillaceous, and cherty. Solution enlargement of joints and bedding planes frequently occurs in the dolomite, and the contact between bedrock and the overlying surficial materials is usually an irregular surface. These solution features are commonly the cause of reservoir leakage when the soil cover is thin.

The soils at the site consist primarily of a buff- to tan-colored, stony clay (CL, Unified Soil Classification) derived from weathering of the dolomite bedrock. The soils do not appear to be excessively permeable or susceptible to severe erosion. The soil is thin around the shoreline, probably a result of construction of the dam embankment, but appears to be of sufficient thickness under the reservoir to avoid any severe leakage. These soils tend to form stable slopes and embankments.

The most significant geologic condition at the site is the permeable bedrock and its susceptibility to solution weathering. The soil appears to be of sufficient thickness to prohibit excessive water loss from the lake. No other geologic conditions were observed that would adversely affect the performance or stability of the dam embankment.

c. Dam. The visible portions of the upstream and downstream faces of the dam, as well as the dam crest (see Photos 1, 2 and 3), were examined and found to be in sound condition. No undue settlement of the dam, sloughing of the embankment slopes, or erosion of the dam at the junction with the abutments, was noted. Riprap, consisting of a combination of limestone, average size about 12 inches, concrete rubble, and brick masonry, was found across almost the entire upstream face of the dam. The riprap extended from below the waterline to near the top of the dam, and no significant erosion of the upstream slope was noticed. Trees up to about 12 inches in diameter and dense brush covered almost the entire downstream face of the dam, and although no animal burrows were observed, because of the trees and undergrowth on the downstream side, it cannot be stated that none exist. At the time of the inspection, the grass, a fescue, on the dam crest was about 4 inches high. Examination of a soil sample obtained from the downstream face of the embankment near the center of the dam indicated the surficial material of the dam to be a brown, slightly silty, lean clay (CL) of low-to-medium plasticity.

Except for the concerete block type retaining walls adjacent to the spillway crest, the excavated earth spillway was inspected and found to be in reasonably good condition, although the crest section was overgrown with brush (see Photo 4), and the paved concrete apron that serves to protect the exit section from erosion was undercut up to 12 inches (see Photo 5) at the downstream end of the apron. A tree approximately 8 inches in diameter was found within the channel at the downstream end of the paved section. The concrete block retaining walls that serve to confine flow to the spillway were examined and found to be in poor condition. The downstream end of both walls were collapsed (see Photos 7 and 8), and the upstream wingwall of the retaining wall on the dam side of the channel (see Photo 9) was in a deteriorated condition with open and cracked joints. In addition, the earth fill behind the retaining wall on the left side of the channel had been badly eroded, apparently by lake outflow, up to a depth of about 2.7 feet and most of the back side of the wall was visible. The outlet channel of the spillway appeared to be in satisfactory condition with the exception that several fallen trees (see Photo 6) were found lying within the channel just downstream of the paved exit section.

A marshy area about 30 feet wide, as indicated by horsetails (genus Equisetum), cattails, and soft, wet ground with pockets of standing water, was observed just downstream of the left side of the dam (see Photo 10) extending from about station 1+00 to approximately station 3+00. A second marshy area on the order of 60 feet wide and 100 feet in length was noticed in the vicinity of the original stream (see Photo 11) at about station 5+10. Numerous pockets of standing water (see Photo 12) that appeared to be seepage from the lake were evident in this area. Many of the pockets displayed a reddish residue, and the water had an oil-like film on the surface. At the downstream end of the marsh, at the point where the drainage from the area adjacent to the toe of the dam entered the original stream channel, water entering the channel and presumed to be seepage was estimated to be flowing at a rate of 5 gpm. At this point in the channel, which is approximately 125 feet beyond the toe of the dam, two 6-foot long sections of 10-inch diameter vitrified clay pipe were found. The purpose of the pipe could not be determined.

d. Appurtenant Structures. No appurtenant structures were observed at this dam site.

e. Downstream Channel. Except at road and highway crossings, the channel downstream of the dam within the potential flood damage zone is unimproved. The channel section is irregular and for the most part, lined with trees. The tributary stream joins Sandy Creek at a point about two miles downstream of the dam.

f. Reservoir. Except for the area adjacent to the right side of the lake, the lake banks are covered with trees. The area at the right side of the lake is covered with grass, although a road surfaced with crushed stone and several farm buildings are located in this general area. No significant erosion of the lake banks was noted. At the time of the inspection, the lake water was clear and about 2.2 feet below the normal pool level. The amount of sediment within the lake could not be determined during the inspection; however, due to the fact that the drainage area is well covered with vegetation, it is not expected to be significant.

3.2 EVALUATION

The deficiencies observed during this inspection and noted herein are not considered of significant importance to warrant immediate remedial action.

The riprap protection across the upstream face of the dam appeared to be adequate to prevent erosion of the embankment by wave action or by fluctuations of the lake level.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The spillway is uncontrolled. The lake surface level is governed by precipitation runoff, evaporation, seepage, and the capacity of the uncontrolled spillway.

4.2 MAINTENANCE OF DAM

According to the Owner, the dam receives periodic routine maintenance such as mowing of the grass on the dam crest during the growing season and removal of muskrats by trapping during the winter. The Owner also reported that the dam has not experienced any problems with excessive leakage, settlement, erosion, cracking, or sloughing of the slopes. The Owner indicated that the trees and undergrowth on the downstream face of the dam have not been removed; however, the vegetation near the top of the slope was killed this past summer by spraying with a herbicide.

4.3 MAINTENANCE OF OUTLET OPERATING FACILITIES

No outlet facilities requiring operation exist at this dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEMS IN EFFECT

The Owner reported that telephone numbers of the local police and fire departments were readily available in the case of an emergency, such as the imminent failure of the dam. The inspection did not reveal the existence of any other type of dam failure warning system. The Owner does not reside at the dam site, but does live nearby.

4.5 EVALUATION

It is recommended that maintenance of the dam also include periodic removal of trees and brush on the downstream face of the dam. Maintenance of the spillway, including restoration of eroded areas and repair of retaining walls, as well as clearing of the spillway outlet channel to insure that the section is free of flow impeding obstructions, such as the tree within the channel at the downstream end of the paved exit section and fallen trees and brush, should also be regularly performed. It is also recommended that a detailed inspection of the dam be instituted on a regular basis by an engineer experienced in the design and construction of dams and that records be kept of all inspections made and remedial measures taken.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. Design data are not available.

b. Experience Data. The drainage area and lake surface area were determined from the 1954 USGS Belew Creek, Missouri, Quadrangle Map (photorevised 1968 and 1974). The proportions and dimensions of the spillway and dam were developed from surveys made during the inspection. Records of rainfall, streamflow, or flood data for the watershed were not available.

Due to the fact that the watershed for this reservoir is relatively small and since there is no history of excessive reservoir leakage that would adversely affect the normal operational level of the lake, the lake level was assumed to be normal pool as a result of antecedent storms prior to occurrence of the PMF and the probabilistic storm.

According to the St. Louis District, Corps of Engineers, the estimated flood damage zone, should failure of the dam occur, extends four miles downstream of the dam.

c. Visual Observations.

(1) The spillway, a broad-crested, rectangular section with concrete block walls and a paved concrete and rock invert, is located at the left abutment.

(2) The retaining walls that serve to confine flow to the spillway section are badly deteriorated and it is possible, considering the condition of these walls, that damage to the dam could occur during periods of lake outflow within the capacity of the spillway.

(3) There is no emergency spillway or lake drawdown facility.

d. Overtopping Potential. The spillway is inadequate to pass the probable maximum flood, or one-half the probable maximum flood, without overtopping the dam. The spillway is adequate, however to pass the 1 percent chance (100-year frequency) flood without overtopping the dam. The results of the dam overtopping analyses are as follows:

(Note: The data appearing in the following table were extracted from the computer output data appearing in Appendix B. Decimal values have been rounded to the nearest one-tenth in order to prevent assumption of unwarranted accuracy.)

Ratio of PMF	Q-Peak Outflow (cfs)	Max. Lake W.S. Elev.	Max. Depth (Ft.) of Flow over Dam (Elev. 647.6)	Duration of Overtopping of Dam (Hours)
0.50	1,212	648.5	0.9	1.6
1.00	2,547	648.9	1.3	5.5
1% Chance Flood	213	647.3	0.0	0.0

Since the spillway crest and exit section are protected from erosion by lake outflow, the top of the embankment was considered to be the lowest point, elevation 647.6, of the dam crest. The flow safely passing the spillway just prior to overtopping was determined to be approximately 263 cfs, which is the routed outflow corresponding to about 23 percent of the probable maximum flood inflow. This flow is greater than the outflow from the 1 percent chance (100-year frequency) flood, but less than the outflow of one-half the PMF, which is the recommended spillway design flood for this dam. During peak flow of the probable maximum flood the greatest depth of flow over the dam is projected to be 1.3 feet and overtopping will extend across the entire length of the dam.

e. Evaluation. Experience with embankments constructed of similar material (a slightly silty lean clay of low-to-medium plasticity) to that used to construct this dam has shown evidence that under certain conditions, such as high velocity flow, the material can be very erodible. Such a condition exists during the PMF when large lake outflow, accompanied by high flow velocities, occurs. For the PMF condition where the depth of flow over the dam crest, a maximum of 1.3 feet, and the duration of flow over the dam, 5.5 hours, are considerable, damage by erosion to the crest and downstream face of the dam is expected. The extent of these damages is not pedictable; however, there is a possibility that they could result in failure by erosion of the dam. A similar condition, but not nearly as severe, also exists during occurrence of one-half the PMF.

f. References. Procedures and data for determining the probable maximum flood, the 100-year frequency flood, and the discharge rating curve for flow passing the spillway and dam crest are presented on pages B-1 and B-2 of the Appendix. Listings of the HEC-1 (Dam Safety Version) input data for both the probable maximum flood and the 100-year frequency flood are shown on pages B-3 through B-5. Computer output data, including unit hydrograph ordinates, tabulation of PMF rainfall, loss and inflow data are shown on pages B-6 through B-9; tabulation of lake surface area, elevation and storage volume is shown on page B-10 and tabulations titled "Summary of Dam Safety Analysis" for the PMF and 1 percent chance (100-year frequency) flood are also shown on page B-10.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Visual observations of conditions which adversely affect the structural stability of the dam are discussed in Section 3, paragraph 3.1c.

b. Design and Construction Data. No design or construction data relating to the structural stability of the dam are known to exist. 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. Operating Records. No appurtenant structures or facilities requiring operation exist at this dam. According to the Owner, no records of the lake level, spillway discharge, dam settlement, or lake seepage have been kept.

d. Post Construction Changes. According to the Owner, no post construction changes have been made or have occurred which would affect the structural stability of the dam.

e. Seismic Stability. The dam is located within a Zone II seismic probability area. An earthquake of the magnitude that might occur in this area would not be expected to cause structural damage to a well constructed earthen dam of this size provided that static stability conditions are satisfactory and conventional safety margins exist. However, it is recommended that the prescribed seismic loading for this zone be applied in any stability analyses performed for this dam.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. A hydraulic analysis indicated that the spillway is capable of passing lake outflow of about 263 cfs without the level of the lake exceeding the low point in the top of the dam. A hydrologic analysis of the lake watershed area, as discussed in Section 5, paragraph 5.1d, indicates that for storm runoff of one-half probable maximum flood magnitude, the lake outflow would be about 1,212 cfs, and that for the 1 percent chance (100-year frequency) flood, the lake outflow would be about 213 cfs. Since the existing spillway is inadequate to pass lake outflow resulting from a storm of one-half probable maximum flood magnitude (the recommended spillway design flood for this dam) without overtopping the dam, the possibility exists that overtopping could result in failure by erosion of the dam during this flood event. A description of the features within the potential flood damage zone should failure of the dam occur is presented in Section 1, paragraph 1.2d.

Seepage and stabilty analyses of the dam were not available for review, and therefore, no judgment could be made with respect to the structural stability of the dam.

Several items were noticed during the inspection that could adversely affect the safety of the dam. These items include trees and dense brush on the downstream slope of the embankment, seepage, an undercut spillway apron and obstructions within the spillway outlet channel, as well as conditions conducive to erosion of the dam as a result of badly deteriorated spillway retaining walls.

b. Adequacy of Information. Due to lack of design and construction data, the assessments reported herein were based on external conditions as determined during the visual inspection. The assessments of the hydrology of the watershed and capacity of the spillway were based on a hydraulic/hydrologic study as indicated in Section 5. Seepage and stability analyses comparable to the requirements of "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 for the items concerning the safety of the dam noted in paragraph 7.1a should be accomplished within the near future. The item concerning increasing spillway capacity should be pursued on a high priority basis.

d. Necessity for Phase II. Based on the results of the Phase I inspection, a Phase II investigation is not recommended.

e. Seismic Stability. The dam is located within a Zone II seismic probability area. An earthquake of the magnitude that might occur in this area would not be expected to cause structural damage to a well constructed earthen dam of this size provided that static stability conditions are satisfactory and conventional safety margins exist. However, it is recommended that the prescribed seismic loading for this zone be applied in any stability analyses performed for this dam.

7.2 REMEDIAL MEASURES

A. Recommendations. The following actions are recommended.

(1) Based upon criteria set forth in the recommended guidelines, spillway size and/or height of dam should be increased in order to pass lake outflow resulting from a storm of one-half probable maximum flood magnitude. In either case, the spillway should be protected to prevent erosion.

(2) Obtain the necessary soil data and perform dam seepage and stability analyses in order to determine the structural stability of the dam for all operational conditions. Seepage and stability analyses should be performed by a qualified professional engineer experienced in the design and construction of earthen dams.

b. Operations and Maintenance (O &M) Procedures. The following O & M Procedures are recommended:

(1) Remove the trees and brush from the dam proper and the areas adjacent to the downstream toe of slope. The removal of trees should be

performed under the direction and guidance of an engineer experienced in the design and construction of earthen dams, since indiscriminate clearing can jeopardize the safety of the dam. The existing turf cover should be restored if destroyed or missing. Maintain the turf cover at a height that will not hinder inspection of the embankment or provide cover for burrowing animals. Holes from tree roots and voids created by burrowing animals can provide passageways for lake seepage that could lead to a piping condition (progressive internal erosion) and potential failure of the dam.

(2) Provide some means of controlling seepage evident in the areas adjacent to the downstream toe near the left side of the dam and along the course of the original stream. Uncontrolled seepage can lead to a piping condition which could result in failure of the dam. Drainage of the areas affected by seepage including elimination of the marshy areas just downstream of the dam should be one of the objectives of the seepage control measures since saturation of the soil weakens the foundation which could impair the stability of the dam.

(3) Repair the retaining walls at the spillway and restore as required the dam and abutment areas adjacent to these walls. These walls, which are badly deteriorated, present conditions conducive to erosion of the dam since failure of the wall on the right side of the spillway will expose the embankment to lake outflow and velocities that can erode fill material. An example of such erosion has occurred on the fill side of the wall on the left side of the spillway where the earth backfill is missing.

(4) Restore the eroded undercut areas at the downstream end of the paved concrete apron of the spillway exit section. Lack of foundation material can result in failure of the pavement due to loss of support, a condition that will promote erosion of the spillway.

(5) Remove the fallen trees that lie within the spillway outlet channel. Obstructions, such as trees, can impede flow and reduce the carrying capacity of the channel which could result in flooding of the area adjacent to the downstream toe of the dam and/or flow impinging upon the toe of the dam, both of which are conditions unfavorable to the structural stability of the dam.

(6) Provide maintenance of all areas of the dam and spillway on a regularly scheduled basis in order to insure features of being in satisfactory operational condition.

(7) A detailed inspection of the dam should be instituted on a regular basis by an engineer experienced in the design and construction of dams. It is also recommended, for future reference, that records be kept of all inspections made and remedial measures taken.

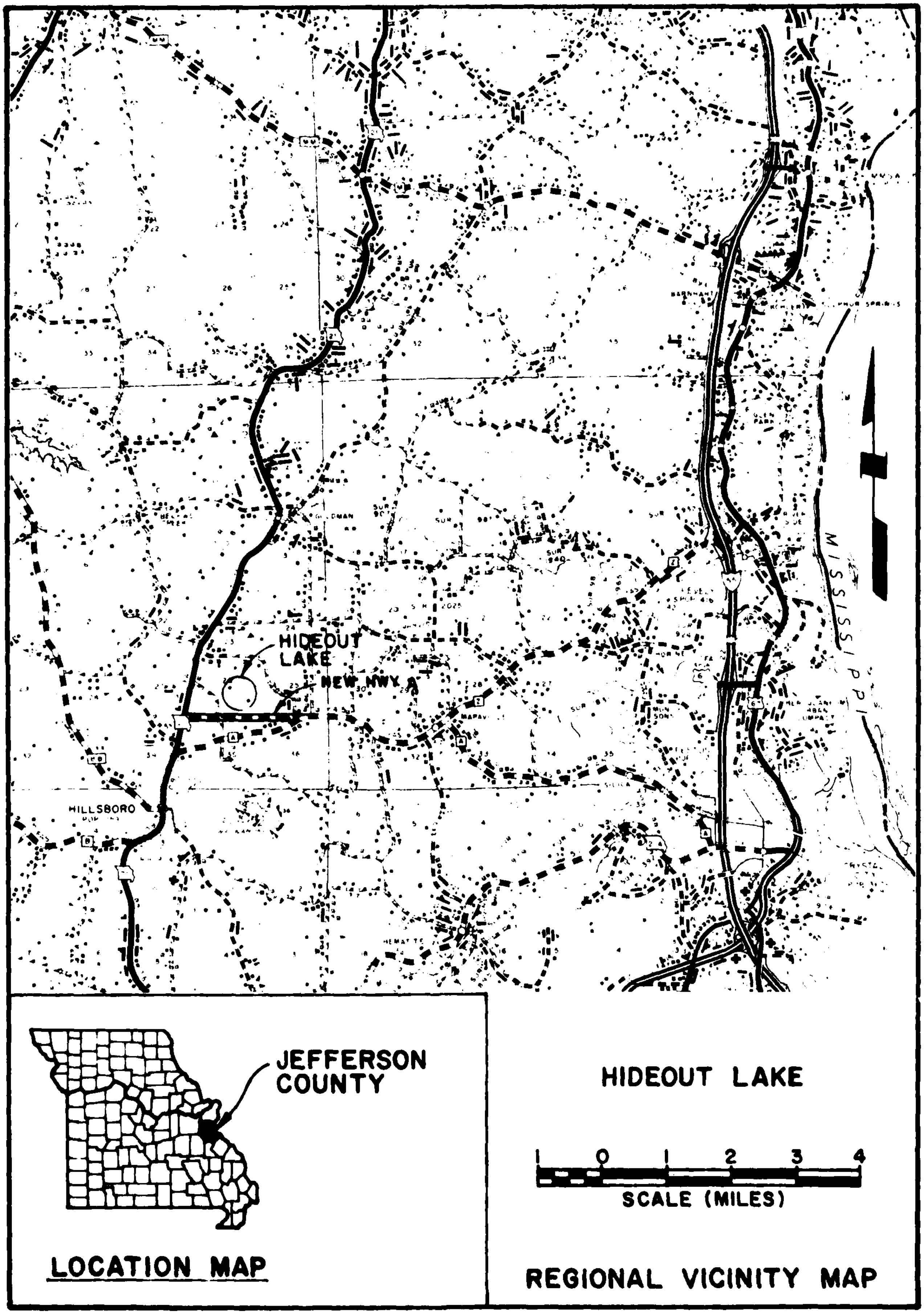
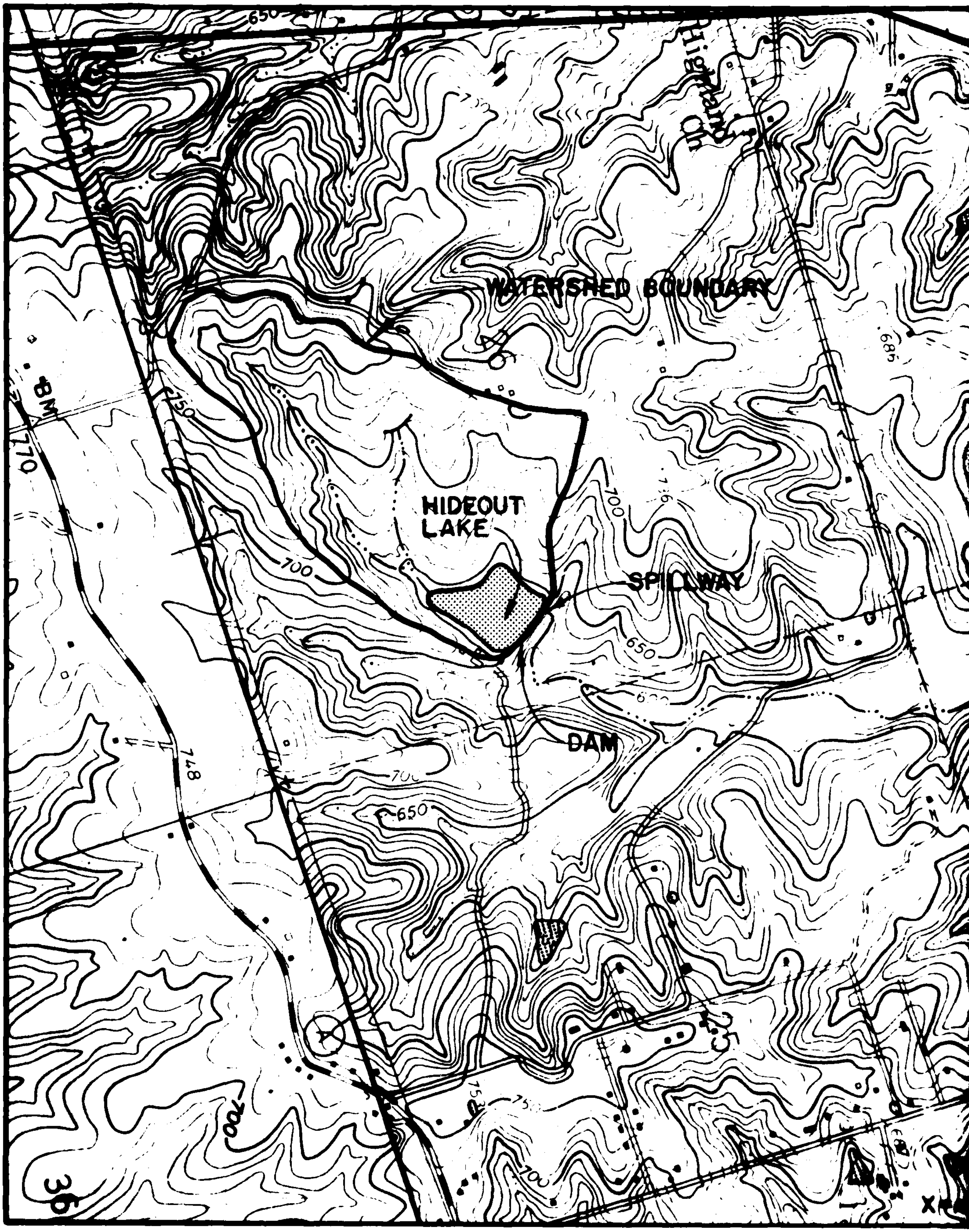
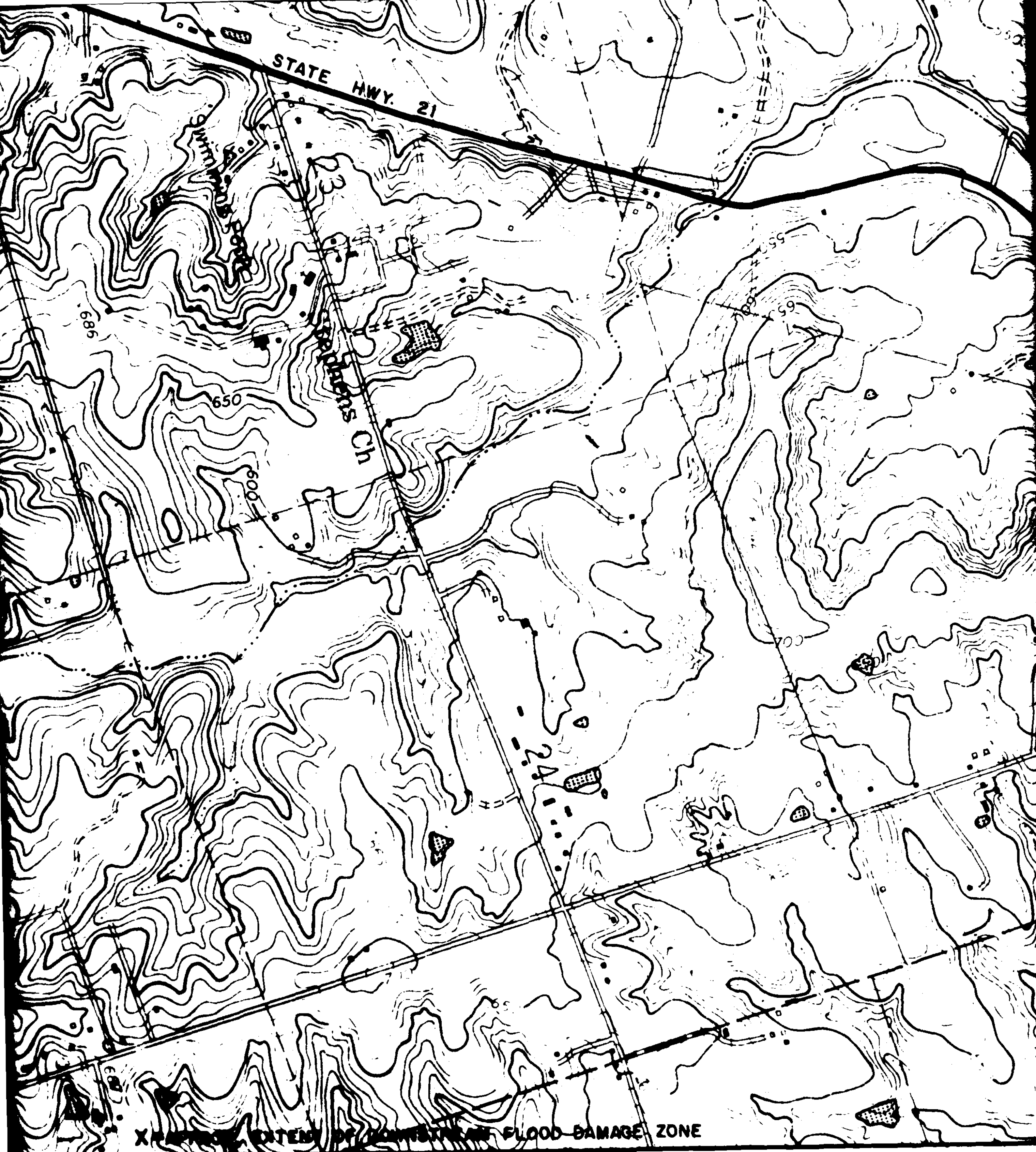

HIDEOUT
LAKE
NEW HWY A
HILLSBORO
MISSISSIPPI
JEFFERSON
COUNTY
LOCATION MAP
HIDEOUT LAKE
1 0 1 2 3 4
SCALE (MILES)
REGIONAL VICINITY MAP

PLATE I


WATERSHED BOUNDARY
HIDEOUT LAKE
SPILLWAY
DAM



.2

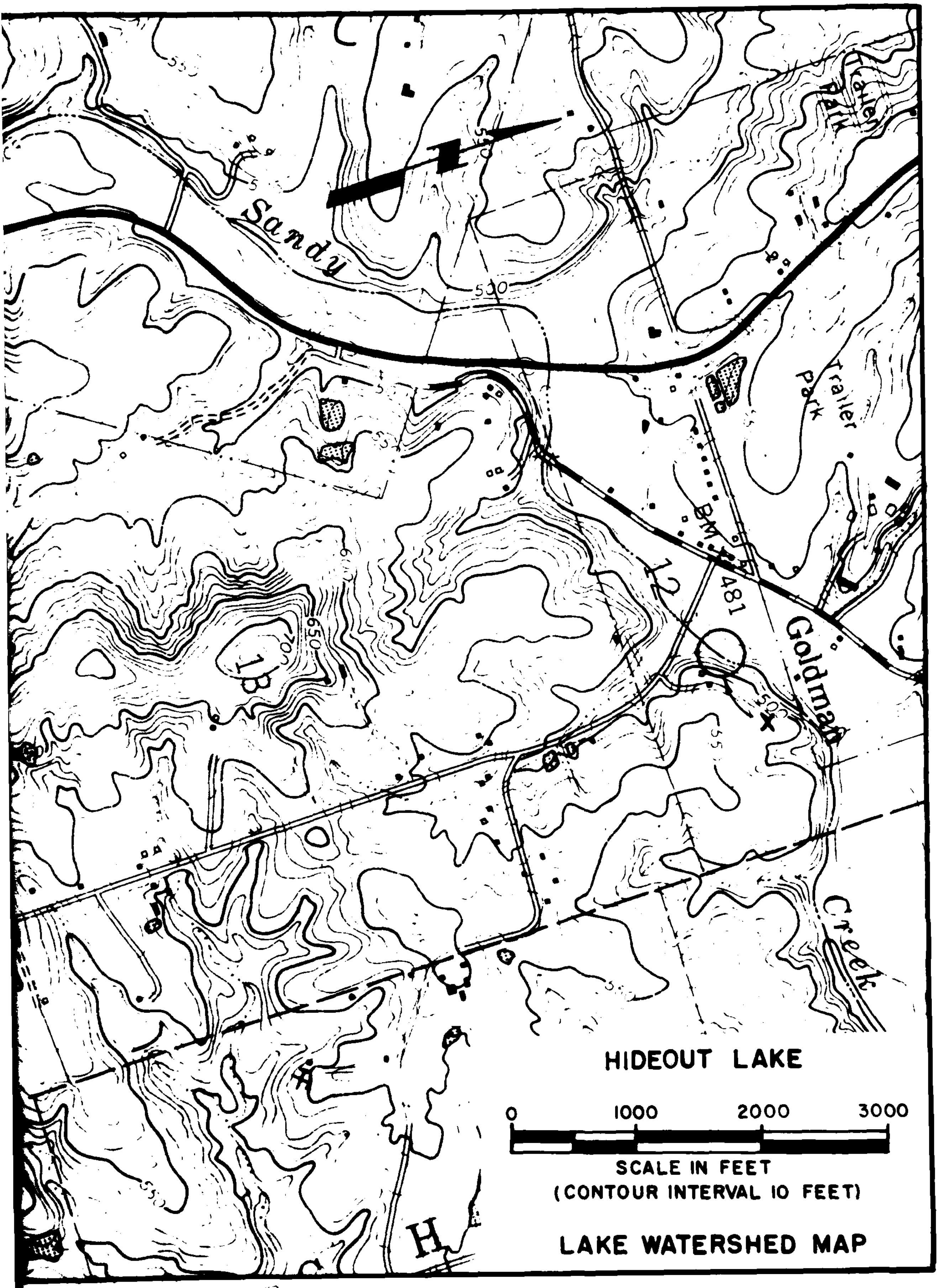
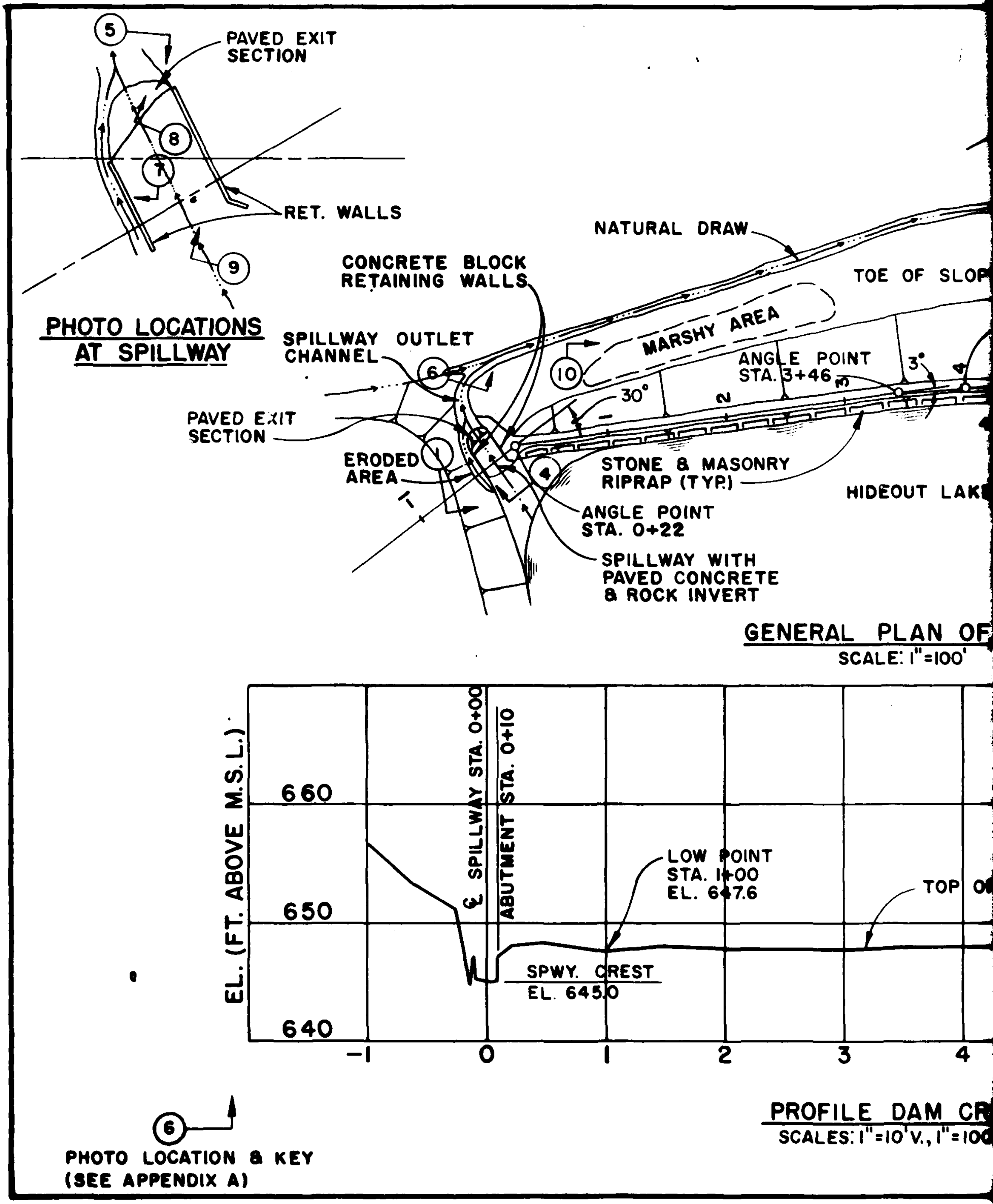
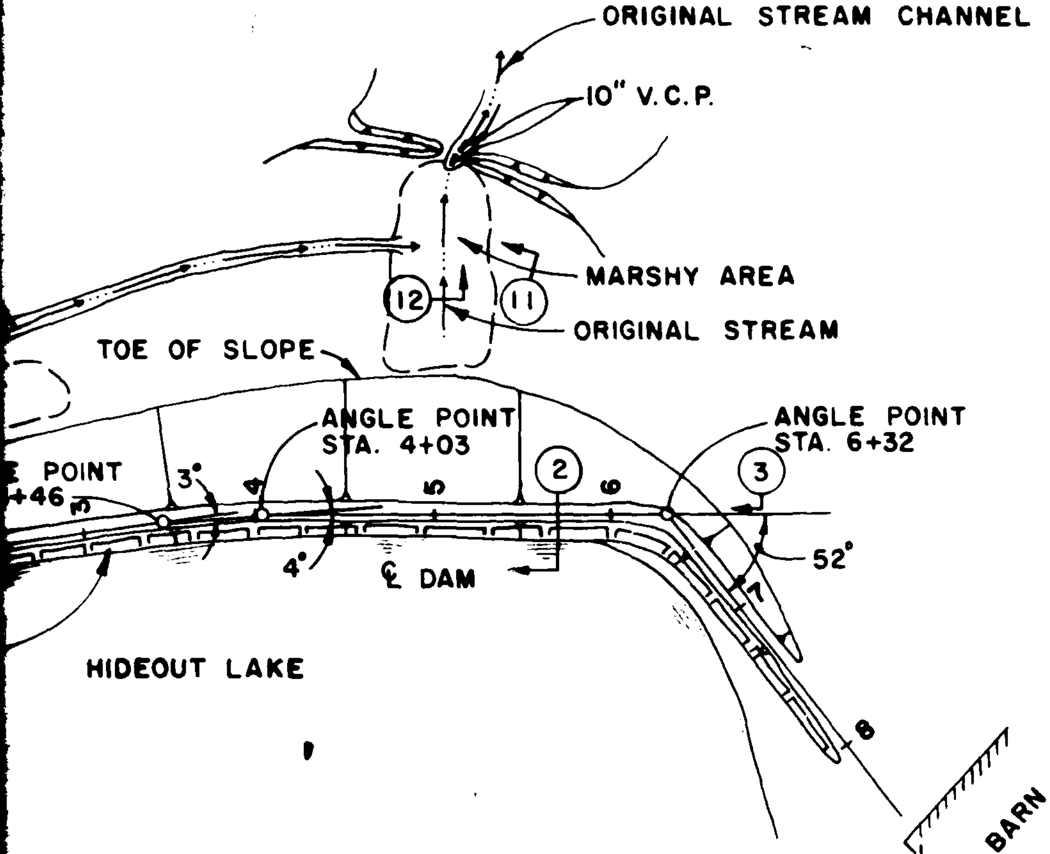

Sandy
Trailer Park
Trailer Park
BM 481
Goldman
Creek
12
18
650
500
HIDEOUT LAKE
0
1000
2000
3000
SCALE IN FEET
(CONTOUR INTERVAL 10 FEET)
LAKE WATERSHED MAP

PLATE 2

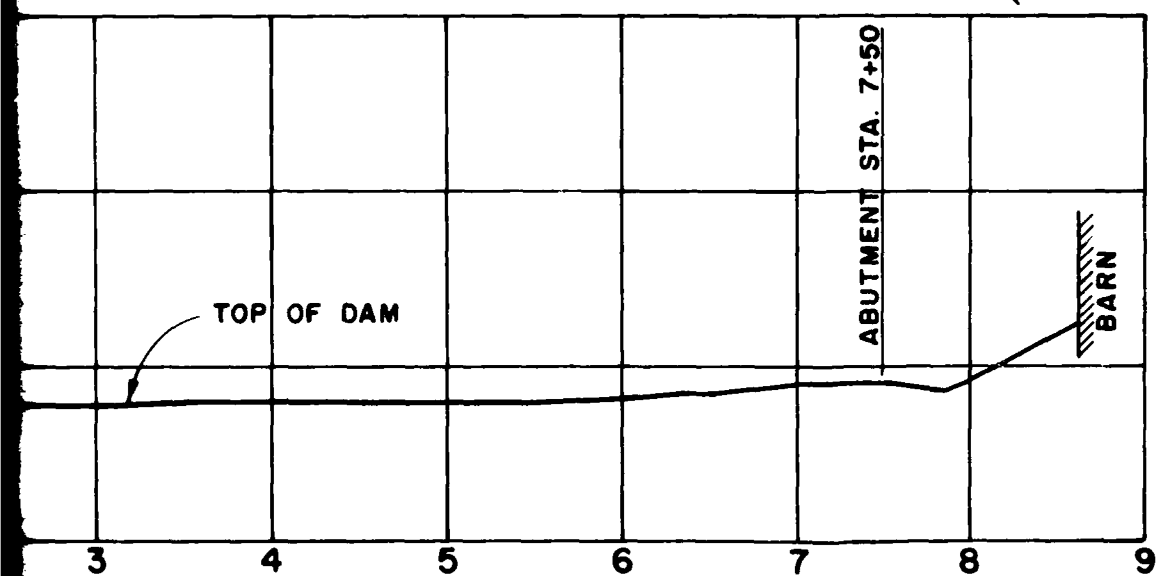


PAVED EXIT SECTION
RET. WALLS
PHOTO LOCATIONS AT SPILLWAY
NATURAL DRAW
CONCRETE BLOCK RETAINING WALLS
TOE OF SLOP
MARSHY AREA
SPILLWAY OUTLET CHANNEL
ANGLE POINT STA. 3+46
30°
3°
PAVED EXIT SECTION
ERODED AREA
STONE & MASONRY RIPRAP (TYP.)
HIDEOUT LAK
ANGLE POINT STA. 0+22
SPILLWAY WITH PAVED CONCRETE & ROCK INVERT
GENERAL PLAN OF
SCALE: 1"=100'
EL. (FT. ABOVE M.S.L.)
660
650
640
℄ SPILLWAY STA. 0+00
ABUTMENT STA. 0+10
LOW POINT STA. 1+00 EL. 647.6
TOP O
SPWY. CREST EL. 645.0
-1
0
1
2
3
4
PROFILE DAM CR
SCALES: 1"=10' V., 1"=100
PHOTO LOCATION & KEY (SEE APPENDIX A)



ERAL PLAN OF DAM

SCALE: 1"=100'



OFILE DAM CREST

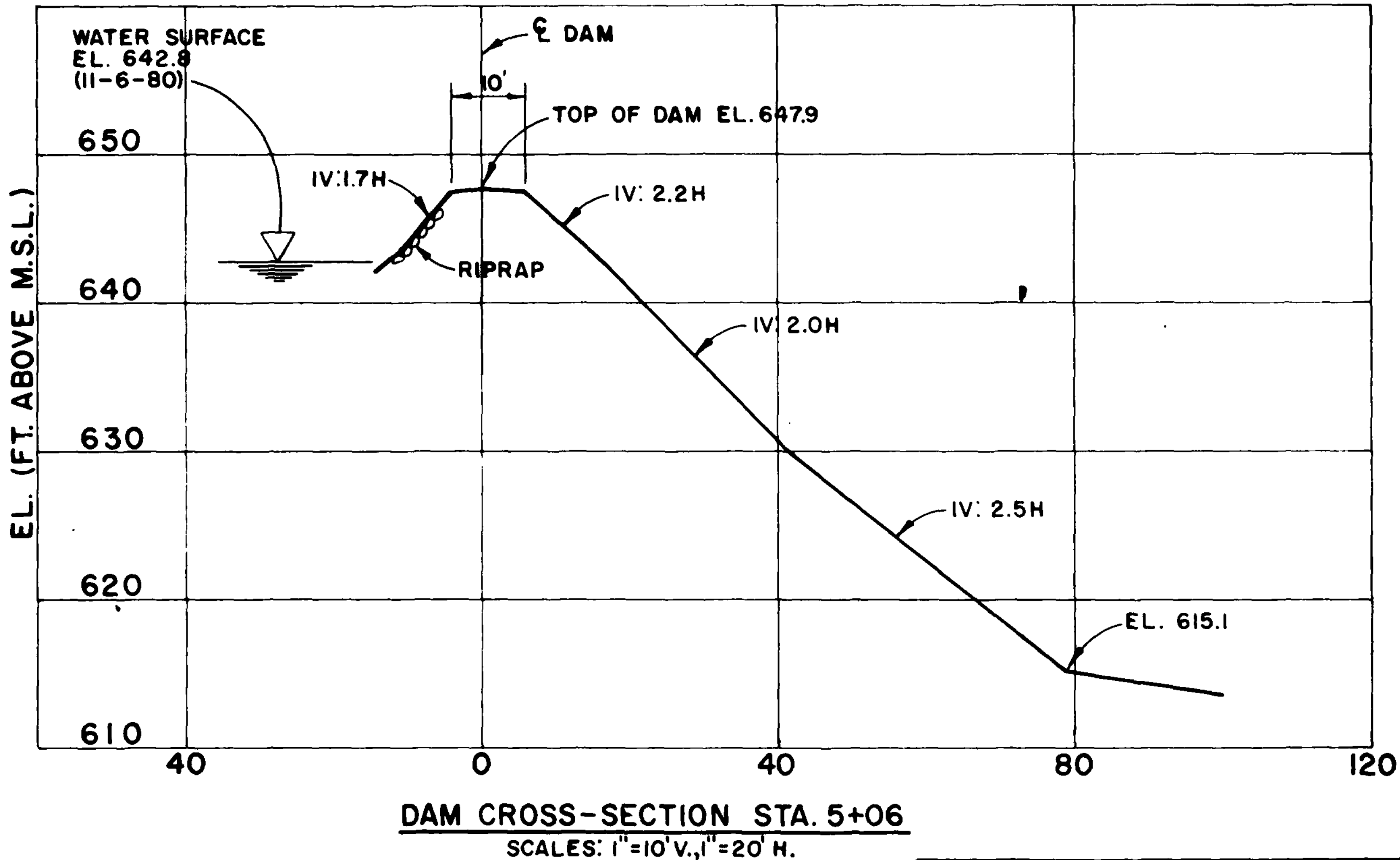
ALES: 1"=10' V., 1"=100' H.

HIDEOUT LAKE
DAM PLAN & PROFILE

Horner & Shifrin, Inc. Dec. 1980

1 2

PLATE 3

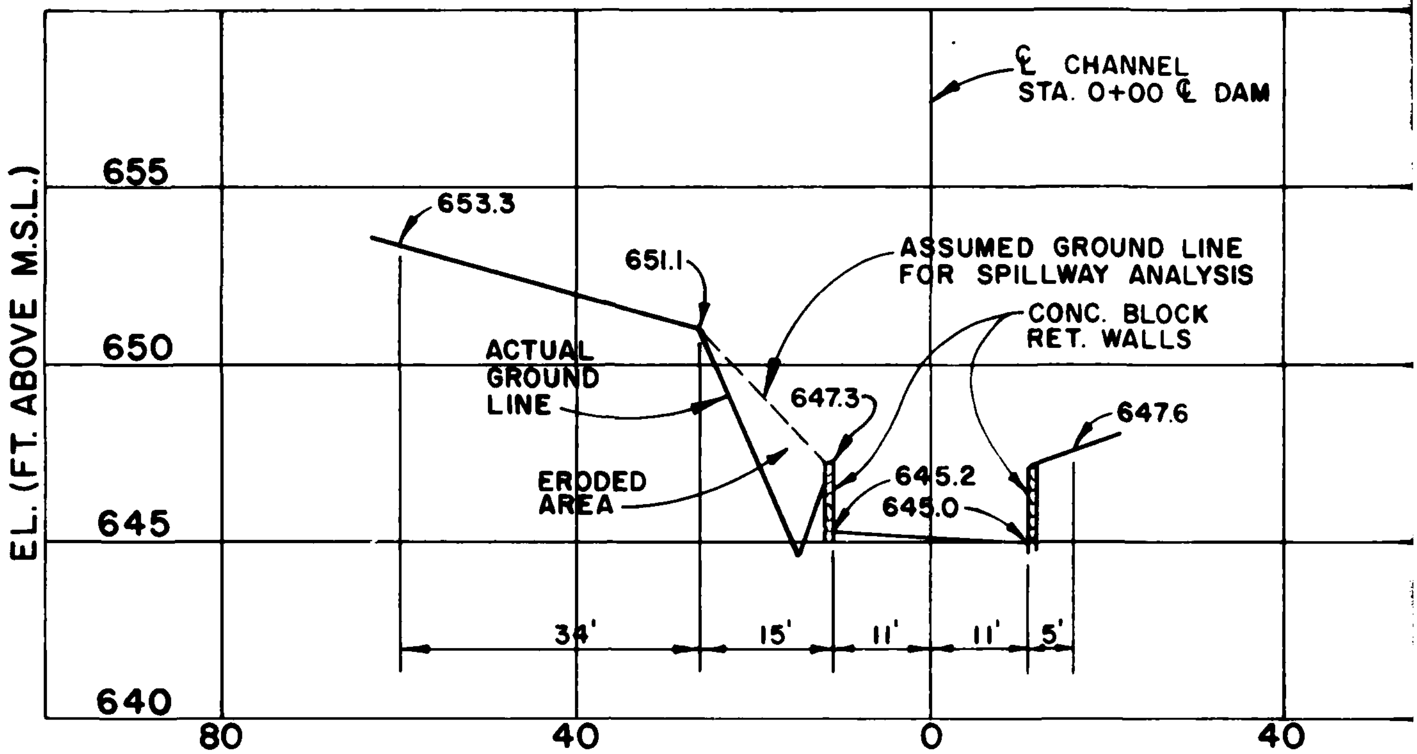


DAM CROSS-SECTION STA. 5+06

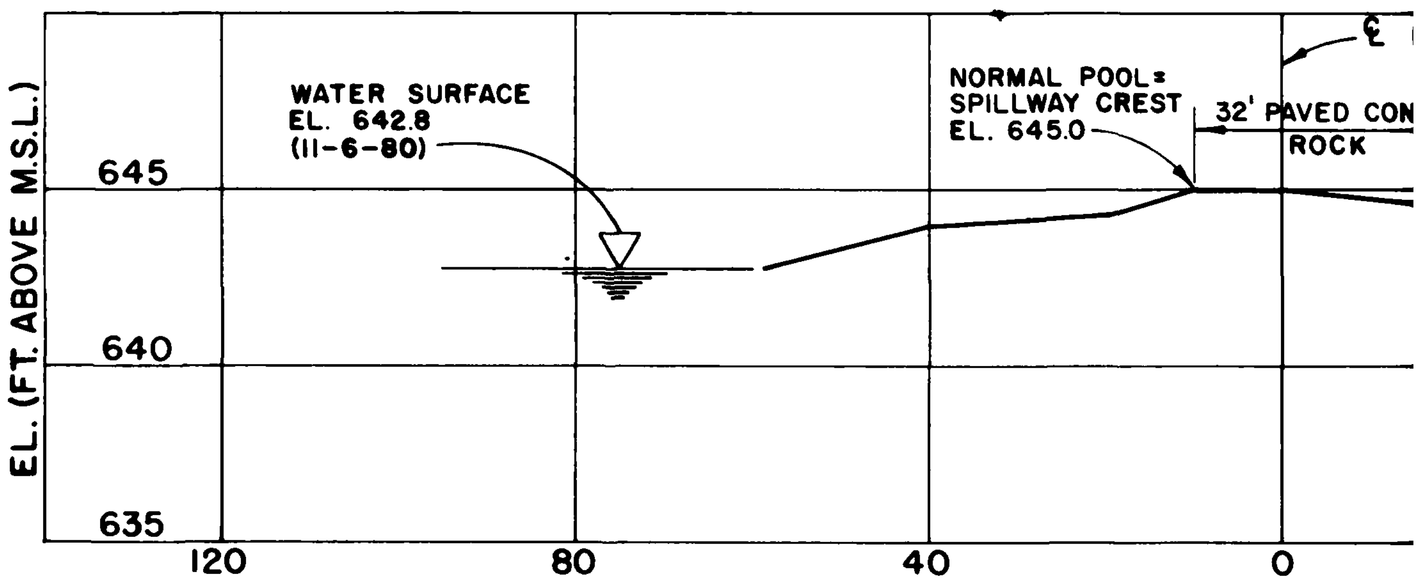
SCALES: 1"=10' V., 1"=20' H.

HIDEOUT LAKE
DAM CROSS-SECTION

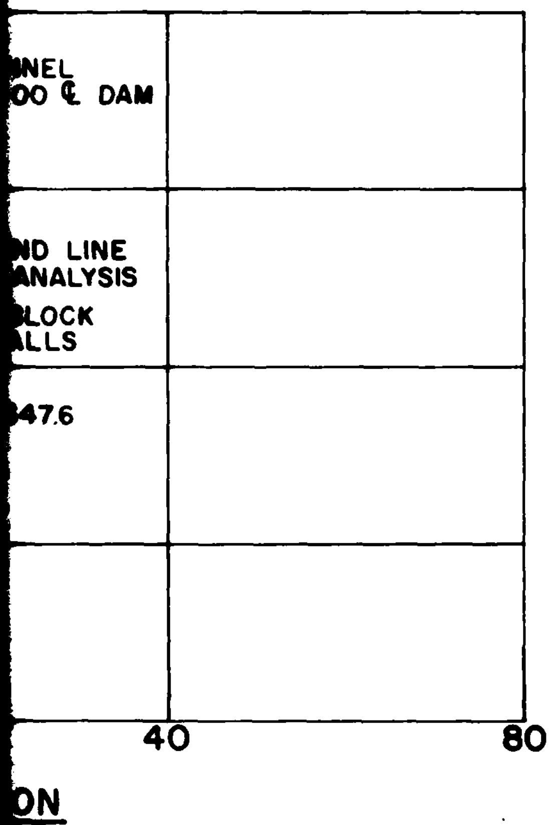
Horner & Shifrin, Inc. Dec. 1980

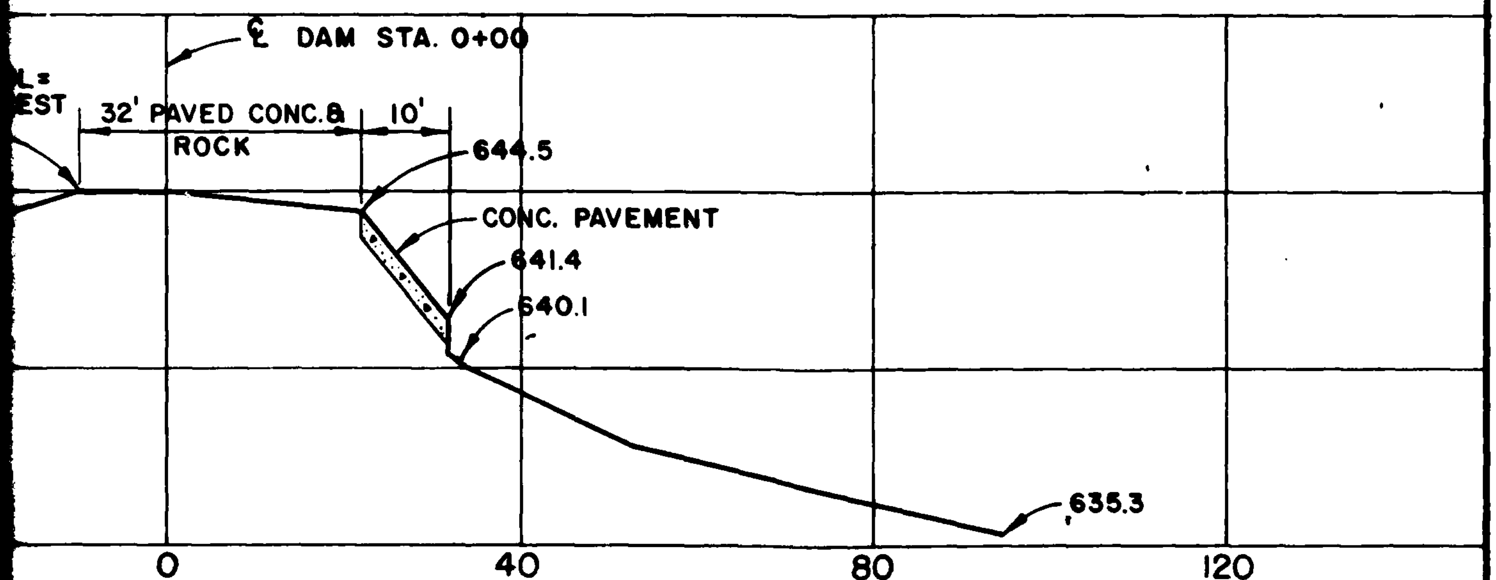


SPILLWAY CROSS-SECTION
SCALES: 1" = 5' V., 1" = 20' H.



SPILLWAY PROFI
SCALES: 1" = 5' V., 1" = 2





PILLWAY PROFILE
CALES: 1" = 5' V., 1" = 20' H.

HIDEOUT LAKE
SPILLWAY PROFILE &
CROSS-SECTION
Horner & Shifrin, Inc. Dec. 1980

2

PLATE 5

APPENDIX A

INSPECTION PHOTOGRAPHS

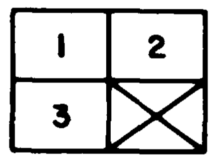


PHOTO KEY

NO.	DESCRIPTION
1	DAM OVERVIEW
2	UPSTREAM FACE OF DAM
3	DOWNSTREAM FACE OF DAM

4	5
6	

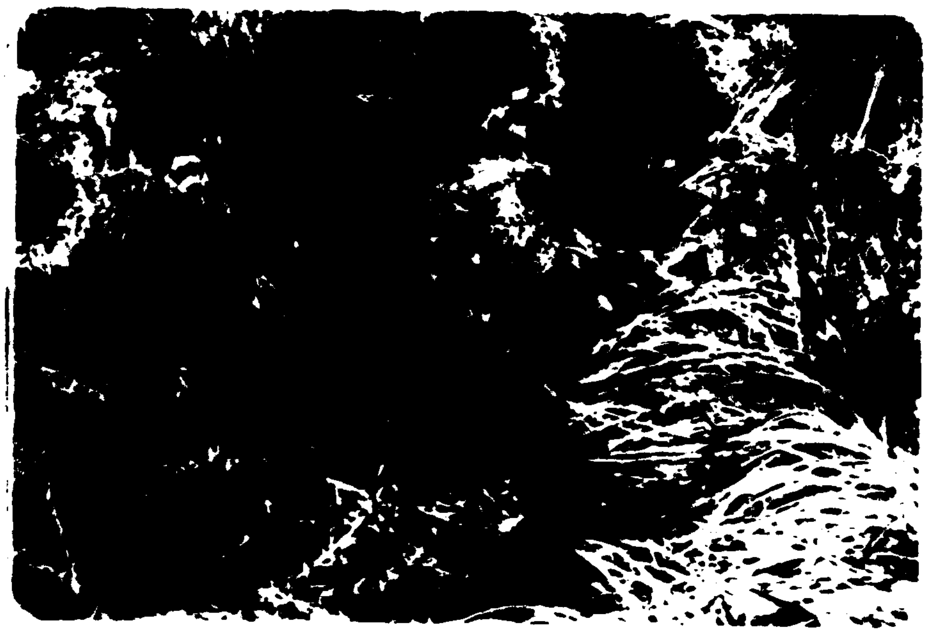
PHOTO KEY

NO.	DESCRIPTION
4	SPILLWAY CREST SECTION
5	PAVED SPILLWAY CHANNEL EXIT SECTION
6	SPILLWAY OUTLET CHANNEL

7	8
9	

PHOTO KEY

NO.	DESCRIPTION
7	SPILLWAY RET. WALL - DOWNSTREAM END AT LEFT
8	SPILLWAY RET. WALL - DOWNSTREAM END AT RIGHT
9	SPILLWAY RET. WALL - UPSTREAM END AT RIGHT



10	11
12	

PHOTO KEY

NO.	DESCRIPTION
10	MARSHY AREA AT LEFT SIDE OF DAM
11	MARSHY AREA AT ORIGINAL STREAM
12	SEEPAGE POCKET

APPENDIX B

HYDROLOGIC AND HYDRAULIC ANALYSES

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

1. The HEC-1 Dam Safety Version (July 1978, Modified 26 February 1979) program was used to develop inflow and outflow hydrographs and dam overtopping analyses, with hydrologic inputs as follows:

a. Probable maximum precipitation (200 sq. mile, 24-hour value equals 25.7 inches) from Hydrometeorological Report No. 33. The precipitation data used in the analysis of the 1 percent (100-year frequency) flood was provided by the St. Louis District, Corps of Engineers.

b. Storm duration = 24 hours, unit hydrograph duration = 5 minutes.

c. Drainage area = 0.202 square miles = 129 acres.

d. SCS parameters:

Time of Concentration (T_C) = $\left(\frac{11.9L^3}{H}\right)^{0.385}$ = 0.225 hours

Where: T_C = Travel time of water from hydraulically most distant point to point of interest, hours.

L = Length of longest watercourse = 0.606 miles.

H = Elevation difference = 127 feet.

The time of concentration (T_C) was obtained using Method C as described in Figure 30, "Design of Small Dams", by the United States Department of the Interior, Bureau of Reclamation, and was verified using average channel velocity estimates and watercourse lengths.

Lag time = 0.135 hours (0.60 Tc)

Hydrologic soil group = 100% D (Gasconade series, approximately 2/3 meadow and 1/3 wooded, per Mo. General Soil Map and field investigation)

Soil type CN = 78 (AMC II, 100-yr flood condition)

= 90 (AMC III, PMF condition)

2. The spillway section consists of a broad-crested, rectangular section for which conventional weir formulas are unsuitable for this application. Spillway release rates were determined as follows:

a. Spillway crest section properties (area, "a" and top width, "t") were computed for various depths, "d". The eroded area on the fill side of the retaining wall at the left side of the spillway was assumed to have been restored in the computations for determination of spillway capacity.

b. It was assumed that flow over the spillway crest would occur at critical depth. Flow at critical depth was computed as $Qc = \left(\frac{a^3 g}{t}\right)^{0.5}$ for the various depths, "d". Corresponding velocities (v_c) and velocity heads (H_{vc}) were determined using conventional formulas.* Reference, "Handbook of Hydraulics", Fifth Edition, by King and Brater, page 8-7.

c. Static lake levels corresponding to the various flow values passing the spillway were computed as critical depths plus critical velocity heads ($d_c + H_{vc}$), and the relationship between lake level and spillway discharge was thus obtained. The procedure neglects the minor insignificant friction losses across the length of the spillway.

d. Discharge quantities and corresponding elevations were entered on the Y4 and Y5 cards.

3. The profile of the dam crest is irregular and flow over the dam cannot be determined by application of conventional weir formulas. Crest length and elevation data for the dam crest proper were entered into the HEC-1 Program on the $L and the $V cards. The program assumes that flow over the dam crest section occurs at critical depth and computes internally the flow over the dam crest and adds this flow to the flow over the spillway as entered on the Y4 and Y5 cards.

* $v_c = \frac{Qc}{a}$; $Hvc = \frac{v^2}{2g}$

```
A1      ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
A2      HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF HIDEOUT LAKE DAM
A3      RATIOS OF PMF ROUTED THROUGH RESERVOIR
B    288       0       5       0       0       0       0       0       0       0
B1     5
J      1       4       1
J1  0.23    0.24    0.50    1.00
K      0   INFLOW                                          1
K1      INFLOW HYDROGRAPH
M      1       2   0.202                        1.0                          1
P      0    25.7     102     120     130
T                                                         -1      -50
W2          0.135
X   -1.0    -.10     2.0
K      1     DAM                                           1
K1      RESERVOIR ROUTING BY MODIFIED PULS
Y                                1       1
Y1     1
Y4 645.0  645.25  [illegible]  646.45  647.[illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
Y4649.92  650.57  651.1[illegible]  651.92  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
Y5     0       4      4[illegible]     104     [illegible]  [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
Y5   795    1011    124[illegible]    151[illegible]    1[illegible]    [illegible]  [illegible]  [illegible]  [illegible]
$A     0     [illegible]    11.[illegible]    [illegible]    [illegible].5
$E   61[illegible]     645    [illegible]    [illegible]    [illegible]
$$ 645.0
$D 647.6
$L     0     14[illegible]     [illegible]     404     [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
$V 647.6   647.0   647.[illegible]   648.0   [illegible]  [illegible]  [illegible]  [illegible]  [illegible]
K     [illegible]
```

```
1A1      ANALYSIS OF DAM OVERTOPPING USING 1 PERCENT CHANCE FLOOD
A2      HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF [illegible] LAKE DAM
A3      1 PERCENT CHANCE FLOOD ROUTED THROUGH RESERVOIR
B     288       0       5                                               4
B1      5
J       1       1       1
J1   1.00
K       0  INFLOW                                     1
K1      INFLOW HYDROGRAPH
M       0       2   0.202                       1.0                     1
O     288   6.974
O1   .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
O1   .007    .007    .007    .007    .007    .007    [illegible]    .007    .007    .007
O1   .007    .007    .007    .007    .007    .007    [illegible]    .007    .007    .007
O1   .007    .007    .007    .007    .007    [illegible]    .007    .007    .007    .007
O1   .007    .007    .007    .007    .007    [illegible]    [illegible]    .007    .007    .007
O1   .007    .007    .007    .007    .007    [illegible]    [illegible]    [illegible]    [illegible]    [illegible]
O1   .007    .007    .007    .007    .007    [illegible]    [illegible]    .007    .007    [illegible]
O1   .007    .007    .012    .012    .012    .012    [illegible]    .012    .012    [illegible]
O1   .012    .012    .012    .012    .012    .012    .012    .012    .012    .012
O1   .012    .012    .012    .012    .012    .012    [illegible]    .012    .012    .012
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O1   .030    .030    .048    .048    .048    [illegible]    [illegible]    .048    .134    .134
O1   .134    .255    .255    .546    .817    [illegible]    .255    .134    .134    .134
O1   .049    .049    .049    .048    .048    .048    .030    .030    .030    .030
O1   .030    .030    .023    .023    .023    .023    .023    .023    .023    .023
O1   .023    .023    .023    .023    .023    .023    .023    .023    .023    .023
```

1 PERCENT CHANCE FLOOD (Cont'd)

01	.012	.012	.012	.012	.012	.012	.012	.012	.012	.012
01	.012	.012	.012	.012	.012	.012	.012	.012	.012	.012
01	.012	.012	.012	.012	.012	.012	.012	.012	.012	.012
01	.012	.012	.012	.012	.012	.012	.007	.007	.007	.007
01	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007
01	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007
01	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007
01	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007
01	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007
01	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007
01	.007	.007	.007	.007	.007	.007	.007	.007		

[illegible]

Y5	[illegible]	4	[illegible]	[illegible]	151	270	371	[illegible]	[illegible]	[illegible]
X5	[illegible]	[illegible]	[illegible]	[illegible]	1792	2111	[illegible]	[illegible]	[illegible]	
$A	0	[illegible]	[illegible]	17.5	[illegible]					
$F	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]					
$I	645.0									
$G	[illegible]									
$L	0	[illegible]	[illegible]	484	474	726	[illegible]	[illegible]	[illegible]	
$V	647.4	[illegible]	[illegible]	[illegible]	648.4	647.0	649.1	652.4	[illegible]	

ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF HIDEOUT LAKE DAM
RATIOS OF PMF ROUTED THROUGH RESERVOIR

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	5	0	0	[illegible]	[illegible]	0	[illegible]	0

JOPER	NWT	LROPT	TRACE
5	0	[illegible]	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 4 LRTIO= 1
RTIOS= .23 .24 .50 1.00

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

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
INFLOW	0	0	[illegible]	[illegible]		1	0	

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	.20	0.00	.20	1.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	25.70	102.00	120.00	130.00	0.00	0.00	0.00

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	-1.00	-90.00	[illegible]	[illegible]

CURVE NO = -90.00 WETNESS = -1.00 EFFECT CN = 90.00

UNIT HYDROGRAPH DATA
TC= 0.00 LAG= .14

RECESSION DATA
STRTQ= -1.00 QRCSN= -.10 RTIOR= 2.00

TIME INCREMENT TOO LARGE--(NHQ IS GT LAG/2)

UNIT HYDROGRAPH 10 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= .14 VOL= 1.00

236.	552.	425.	180.	89.	41.	19.	[illegible]	4.	2.

0

END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.05	1	.01	0.00	.01	0.	1.01	12.05	145	.22	.21	.01	133.
1.01	.10	2	.01	0.00	.01	0.	1.01	12.10	146	.22	.21	.01	216.
1.01	.15	3	.01	0.00	.01	0.	1.01	12.15	147	.22	.21	.01	280.
1.01	.20	4	.01	0.00	.01	0.	1.01	12.20	148	.22	.21	.01	303.
1.01	.25	5	.01	0.00	.01	0.	1.01	12.25	149	.22	.21	.00	322.
1.01	.30	6	.01	0.00	.01	0.	1.01	12.30	150	.22	.21	.00	329.
1.01	.35	7	.01	0.00	.01	0.	1.01	12.35	151	.22	.21	.00	332.
1.01	.40	8	.01	0.00	.01	0.	1.01	12.40	152	.22	.21	.00	334.
1.01	.45	9	.01	0.00	.01	0.	1.01	12.45	153	.22	.21	.00	335.
1.01	.50	10	.01	0.00	.01	0.	1.01	12.50	154	.22	.21	.00	335.
1.01	.55	11	.01	0.00	.01	0.	1.01	12.55	155	.22	.21	.00	336.
1.01	1.00	12	.01	0.00	.01	0.	1.01	13.00	156	.22	.22	.00	336.
1.01	1.05	13	.01	0.00	.01	0.	1.01	13.05	157	.26	.26	.00	346.
1.01	1.10	14	.01	0.00	.01	0.	1.01	13.10	158	.26	.26	.00	370.
1.01	1.15	15	.01	0.00	.01	0.	1.01	13.15	159	.26	.26	.00	389.
1.01	1.20	16	.01	.00	.01	0.	1.01	13.20	160	.26	.26	.00	397.
1.01	1.25	17	.01	.00	.01	0.	1.01	13.25	161	.26	.26	.00	401.
1.01	1.30	18	.01	.00	.01	0.	1.01	13.30	162	.26	.26	.00	403.
1.01	1.35	19	.01	.00	.01	1.	1.01	13.35	163	.26	.26	.00	405.
1.01	1.40	20	.01	.00	.01	1.	1.01	13.40	164	.26	.26	.00	405.
1.01	1.45	21	.01	.00	.01	2.	1.01	13.45	165	.26	.26	.00	406.
1.01	1.50	22	.01	.00	.01	2.	1.01	13.50	166	.26	.26	.00	406.
1.01	1.55	23	.01	.00	.01	3.	1.01	13.55	167	.26	.26	.00	406.
1.01	2.00	24	.01	.00	.01	3.	1.01	14.00	168	.26	.26	.00	406.
1.01	2.05	25	.01	.00	.01	4.	1.01	14.05	169	.33	.33	.00	422.
1.01	2.10	26	.01	.00	.01	4.	1.01	14.10	170	.33	.33	.00	458.
1.01	2.15	27	.01	.00	.01	4.	1.01	14.15	171	.33	.33	.00	485.
1.01	2.20	28	.01	.00	.01	5.	1.01	14.20	172	.33	.33	.00	498.
1.01	2.25	29	.01	.00	.01	5.	1.01	14.25	173	.33	.33	.00	504.
1.01	2.30	30	.01	.00	.01	6.	1.01	14.30	174	.33	.33	.00	507.
1.01	2.35	31	.01	.00	.01	6.	1.01	14.35	175	.33	.33	.00	508.
1.01	2.40	32	.01	.00	.01	6.	1.01	14.40	176	.33	.33	.00	509.
1.01	2.45	33	.01	.00	.01	7.	1.01	14.45	177	.33	.33	.00	509.
1.01	2.50	34	.01	.00	.01	7.	1.01	14.50	178	.33	.33	.00	509.
1.01	2.55	35	.01	.01	.01	7.	1.01	14.55	179	.33	.33	.00	510.
1.01	3.00	36	.01	.01	.01	8.	1.01	15.00	180	.33	.33	.00	510.
1.01	3.05	37	.01	.01	.01	8.	1.01	15.05	181	.20	.20	.00	430.
1.01	3.10	38	.01	.01	.01	8.	1.01	15.10	182	.40	.40	.00	456.
1.01	3.15	39	.01	.01	.01	9.	1.01	15.15	183	.40	.40	.00	511.
1.01	3.20	40	.01	.01	.01	9.	1.01	15.20	184	.60	.60	.00	616.
1.01	3.25	41	.01	.01	.01	9.	1.01	15.25	185	.70	.69	.00	777.
1.01	3.30	42	.01	.01	.01	9.	1.01	15.30	186	1.69	1.69	.01	1163.
1.01	3.35	43	.01	.01	.01	10.	1.01	15.35	187	2.79	2.78	.01	2054.
1.01	3.40	44	.01	.01	.01	10.	1.01	15.40	188	1.10	1.09	.00	2721.
1.01	3.45	45	.01	.01	.01	10.	1.01	15.45	189	.70	.70	.00	2364.
1.01	3.50	46	.01	.01	.01	10.	1.01	15.50	190	.60	.60	.00	1706.
1.01	3.55	47	.01	.01	.01	11.	1.01	15.55	191	.40	.40	.00	1260.
1.01	4.00	48	.01	.01	.01	11.	1.01	16.00	192	.40	.40	.00	949.
1.01	4.05	49	.01	.01	.01	11.	1.01	16.05	193	.31	.31	.00	751.
1.01	4.10	50	.01	.01	.01	11.	1.01	16.10	194	.31	.31	.00	619.

END-OF-PERIOD FLOW (Cont'd)

1.01	4.15	51	.01	.01	.01	11.	1.01	16.15	195	.31	.31	.00	542.
1.01	4.20	52	.01	.01	.01	12.	1.01	16.20	196	.31	.31	.00	506.
1.01	4.25	53	.01	.01	.01	12.	1.01	16.25	197	.31	.31	.00	488.
1.01	4.30	54	.01	.01	.01	12.	1.01	16.30	198	.31	.31	.00	482.
1.01	4.35	55	.01	.01	.01	12.	1.01	16.35	199	.31	.31	.00	479.
1.01	4.40	56	.01	.01	.01	12.	1.01	16.40	200	.31	.31	.00	478.
1.01	4.45	57	.01	.01	.01	12.	1.01	16.45	201	.31	.31	.00	478.
1.01	4.50	58	.01	.01	.01	13.	1.01	16.50	202	.31	.31	.00	477.
1.01	4.55	59	.01	.01	.01	13.	1.01	16.55	203	.31	.31	.00	477.
1.01	5.00	60	.01	.01	.01	13.	1.01	17.00	204	.31	.31	.00	477.
1.01	5.05	61	.01	.01	.01	13.	1.01	17.05	205	.24	.24	.00	462.
1.01	5.10	62	.01	.01	.01	13.	1.01	17.10	206	.24	.24	.00	426.
1.01	5.15	63	.01	.01	.01	13.	1.01	17.15	207	.24	.24	.00	398.
1.01	5.20	64	.01	.01	.01	14.	1.01	17.20	208	.24	.24	.00	386.
1.01	5.25	65	.01	.01	.01	14.	1.01	17.25	209	.24	.24	.00	380.
1.01	5.30	66	.01	.01	.01	14.	1.01	17.30	210	.24	.24	.00	377.
1.01	5.35	67	.01	.01	.01	14.	1.01	17.35	211	.24	.24	.00	376.
1.01	5.40	68	.01	.01	.01	14.	1.01	17.40	212	.24	.24	.00	376.
1.01	5.45	69	.01	.01	.01	14.	1.01	17.45	213	.24	.24	.00	375.
1.01	5.50	70	.01	.01	.00	14.	1.01	17.50	214	.24	.24	.00	375.
1.01	5.55	71	.01	.01	.00	14.	1.01	17.55	215	.24	.24	.00	375.
1.01	6.00	72	.01	.01	.00	15.	1.01	18.00	216	.24	.24	.00	375.
1.01	6.05	73	.02	.04	.02	28.	1.01	18.05	217	.02	.02	.00	324.
1.01	6.10	74	.06	.04	.02	42.	1.01	18.10	218	.02	.02	.00	262.
1.01	6.15	75	.06	.05	.02	57.	1.01	18.15	219	.02	.02	.00	244.
1.01	6.20	76	.06	.05	.02	65.	1.01	18.20	220	.02	.02	.00	228.
1.01	6.25	77	.06	.05	.02	70.	1.01	18.25	221	.02	.02	.00	213.
1.01	6.30	78	.06	.05	.02	73.	1.01	18.30	222	.02	.02	.00	198.
1.01	6.35	79	.06	.05	.01	75.	1.01	18.35	223	.02	.02	.00	185.
1.01	6.40	80	.06	.05	.01	76.	1.01	18.40	224	.02	.02	.00	173.
1.01	6.45	81	.06	.05	.01	78.	1.01	18.45	225	.02	.02	.00	161.
1.01	6.50	82	.06	.05	.01	79.	1.01	18.50	226	.02	.02	.00	150.
1.01	6.55	83	.06	.05	.01	80.	1.01	18.55	227	.02	.02	.00	140.
1.01	7.00	84	.06	.05	.01	81.	1.01	19.00	228	.02	.02	.00	131.
1.01	7.05	85	.06	.05	.01	82.	1.01	19.05	229	.02	.02	.00	122.
1.01	7.10	86	.06	.05	.01	83.	1.01	19.10	230	.02	.02	.00	114.
1.01	7.15	87	.06	.05	.01	84.	1.01	19.15	231	.02	.02	.00	106.
1.01	7.20	88	.06	.05	.01	85.	1.01	19.20	232	.02	.02	.00	99.
1.01	7.25	89	.06	.06	.01	85.	1.01	19.25	233	.02	.02	.00	93.
1.01	7.30	90	.06	.06	.01	86.	1.01	19.30	234	.02	.02	.00	86.
1.01	7.35	91	.06	.06	.01	87.	1.01	19.35	235	.02	.02	.00	81.
1.01	7.40	92	.06	.06	.01	87.	1.01	19.40	236	.02	.02	.00	75.
1.01	7.45	93	.06	.06	.01	88.	1.01	19.45	237	.02	.02	.00	70.
1.01	7.50	94	.06	.06	.01	88.	1.01	19.50	238	.02	.02	.00	65.
1.01	7.55	95	.06	.06	.01	89.	1.01	19.55	239	.02	.02	.00	61.
1.01	8.00	96	.06	.06	.01	89.	1.01	20.00	240	.02	.02	.00	57.
1.01	8.05	97	.06	.06	.01	90.	1.01	20.05	241	.02	.02	.00	53.
1.01	8.10	98	.06	.06	.01	90.	1.01	20.10	242	.02	.02	.00	50.
1.01	8.15	99	.06	.06	.01	90.	1.01	20.15	243	.02	.02	.00	46.
1.01	8.20	100	.06	.06	.01	91.	1.01	20.20	244	.02	.02	.00	43.
1.01	8.25	101	.06	.06	.01	91.	1.01	20.25	245	.02	.02	.00	40.
1.01	8.30	102	.06	.06	.01	91.	1.01	20.30	246	.02	.02	.00	38.

END-OF-PERIOD FLOW (CONT'D)

1.01	8.35	103	.06	.06	.01	92.	1.01	20.35	247	.02	.02	.00	35.
1.01	8.40	104	.06	.06	.01	92.	1.01	20.40	248	.02	.02	.00	33.
1.01	8.45	105	.06	.06	.00	92.	1.01	20.45	249	.02	.02	.00	33.
1.01	8.50	106	.06	.06	.00	93.	1.01	20.50	250	.02	.02	.00	33.
1.01	8.55	107	.06	.06	.00	93.	1.01	20.55	251	.02	.02	.00	33.
1.01	9.00	108	.06	.06	.00	93.	1.01	21.00	252	.02	.02	.00	33.
1.01	9.05	109	.06	.06	.00	93.	1.01	21.05	253	.02	.02	.00	33.
1.01	9.10	110	.06	.06	.00	93.	1.01	21.10	254	.02	.02	.00	33.
1.01	9.15	111	.06	.06	.00	94.	1.01	21.15	255	.02	.02	.00	33.
1.01	9.20	112	.06	.06	.00	94.	1.01	21.20	256	.02	.02	.00	33.
1.01	9.25	113	.06	.06	.00	94.	1.01	21.25	257	.02	.02	.00	33.
1.01	9.30	114	.06	.06	.00	94.	1.01	21.30	258	.02	.02	.00	33.
1.01	9.35	115	.06	.06	.00	94.	1.01	21.35	259	.02	.02	.00	33.
1.01	9.40	116	.06	.06	.00	95.	1.01	21.40	260	.02	.02	.00	33.
1.01	9.45	117	.06	.06	.00	95.	1.01	21.45	261	.02	.02	.00	33.
1.01	9.50	118	.06	.06	.00	95.	1.01	21.50	262	.02	.02	.00	33.
1.01	9.55	119	.06	.06	.00	95.	1.01	21.55	263	.02	.02	.00	33.
1.01	10.00	120	.06	[illegible]	.00	[illegible]	1.01	22.00	264	.02	.02	.00	33.
1.01	10.05	121	.06	[illegible]	.00	[illegible]	1.01	22.05	265	.02	.02	.00	33.
1.01	10.10	122	.06	[illegible]	.00	[illegible]	1.01	22.10	266	.02	.02	.00	33.
1.01	10.15	123	.06	.06	.00	[illegible]	1.01	22.15	267	.02	.02	.00	33.
1.01	10.20	124	.06	.06	.00	96.	1.01	22.20	268	.02	.02	.00	33.
1.01	10.25	125	.06	.06	.00	96.	1.01	22.25	269	.02	.02	.00	33.
1.01	10.30	126	.06	.06	.00	[illegible]	1.01	22.30	270	.02	.02	.00	33.
1.01	10.35	127	.06	.06	.00	[illegible]	1.01	22.35	271	.02	.02	.00	33.
1.01	10.40	128	.06	.06	.00	96.	1.01	22.40	272	.02	.02	.00	33.
1.01	10.45	129	.06	.06	.00	96.	1.01	22.45	273	.02	.02	.00	33.
1.01	10.50	130	.06	.06	.00	96.	1.01	22.50	274	.02	.02	.00	33.
1.01	10.55	131	.06	.06	.00	96.	1.01	22.55	275	.02	.02	.00	33.
1.01	11.00	132	.06	.06	.00	97.	1.01	23.00	276	.02	.02	.00	33.
1.01	11.05	133	.06	.06	.00	97.	1.01	23.05	277	.02	.02	.00	33.
1.01	11.10	134	.06	.06	.00	97.	1.01	23.10	278	.02	.02	.00	33.
1.01	11.15	135	.06	.06	.00	97.	1.01	23.15	279	.02	.02	.00	33.
1.01	11.20	136	.06	.06	.00	97.	1.01	23.20	280	.02	.02	.00	33.
1.01	11.25	137	.06	.06	.00	97.	1.01	23.25	281	.02	.02	.00	33.
1.01	11.30	138	.06	.06	.00	97.	1.01	23.30	282	.02	.02	.00	33.
1.01	11.35	139	.06	.06	.00	97.	1.01	23.35	283	.02	[illegible]	.00	33.
1.01	11.40	140	.06	.06	.00	97.	1.01	23.40	284	.02	.02	.00	33.
1.01	11.45	141	.06	.06	.00	97.	1.01	23.45	285	.02	.02	.00	33.
1.01	11.50	142	.06	.06	.00	97.	1.01	23.50	286	[illegible]	[illegible]	[illegible]	33.
1.01	11.55	143	.06	.06	.00	97.	1.01	23.55	[illegible]	[illegible]	.02	[illegible]	33.
1.01	12.00	144	.06	.06	.00	97.	1.02	0.00	288	.02	[illegible]	[illegible]	33.

SUM 33.41 32.11 1.30 52236.
([illegible])([illegible])([illegible])(1479.16)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2721.	562.	181.	181.	52236.
CMS	77.	16.	5.	5.	1479.
INCHES		25.89	33.41	33.41	33.41
MM		657.62	848.67	848.67	848.67
AC-FT		279.	360.	360.	360.
THOUS CU M		344.	444.	444.	444.

SURFACE AREA=	0.	8.	12.	20.	29.
CAPACITY=	0.	69.	110.	272.	516.
ELEVATION=	619.	645.	650.	660.	670.

SUMMARY OF DAM SAFETY ANALYSIS

PMF

....		INITIAL VALUE	SPILLWAY [illegible]	[illegible]
	ELEVATION	645.00	645.	[illegible]
	STORAGE	69.	69.	[illegible]
	OUTFLOW	0.	[illegible]	[illegible]

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	[illegible]	[illegible]	TIME OF FAILURE HOURS
.23	647.55	[illegible].00	92.	[illegible]	[illegible]	[illegible]	[illegible]
.24	647.[illegible]	.03	93.	[illegible]	[illegible]	[illegible]	[illegible]
.50	648.4[illegible]	.87	101.	[illegible]	[illegible]	[illegible]	[illegible]
1.00	648.[illegible]	1.33	106.	[illegible]	[illegible]	[illegible]	[illegible]

SUMMARY OF DAM SAFETY ANALYSIS

1% Chance Flood

....		INITIAL VALUE	SPILLWAY [illegible]	[illegible]
	ELEVATION	645.00	645.	[illegible]
	STORAGE	69.	[illegible]	[illegible]
	OUTFLOW	0.	[illegible]	[illegible]

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	[illegible]	[illegible] MAX OUTFLOW [illegible]	[illegible] FAILURE [illegible]
1.00	647.26	0.00	89.	21[illegible].	[illegible].00	[illegible]	0.[illegible]