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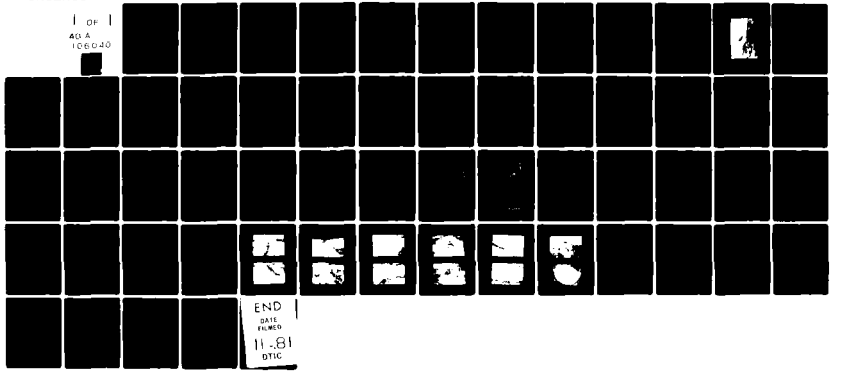

MISSISSIPPI - KASKASKIA - ST. LOUIS BASIN

HIDDEN VALLEY LAKE DAM

STE. GENEVIEVE COUNTY, MISSOURI

MO 31100

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

FEBRUARY 1980

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National Dam Safety Program. Hidden Valley Lake Dam (MO 31100), Mississippi - Kaskaskia - St. Louis Basin, Ste. Genevieve County, Missouri. Phase I Inspection Report.

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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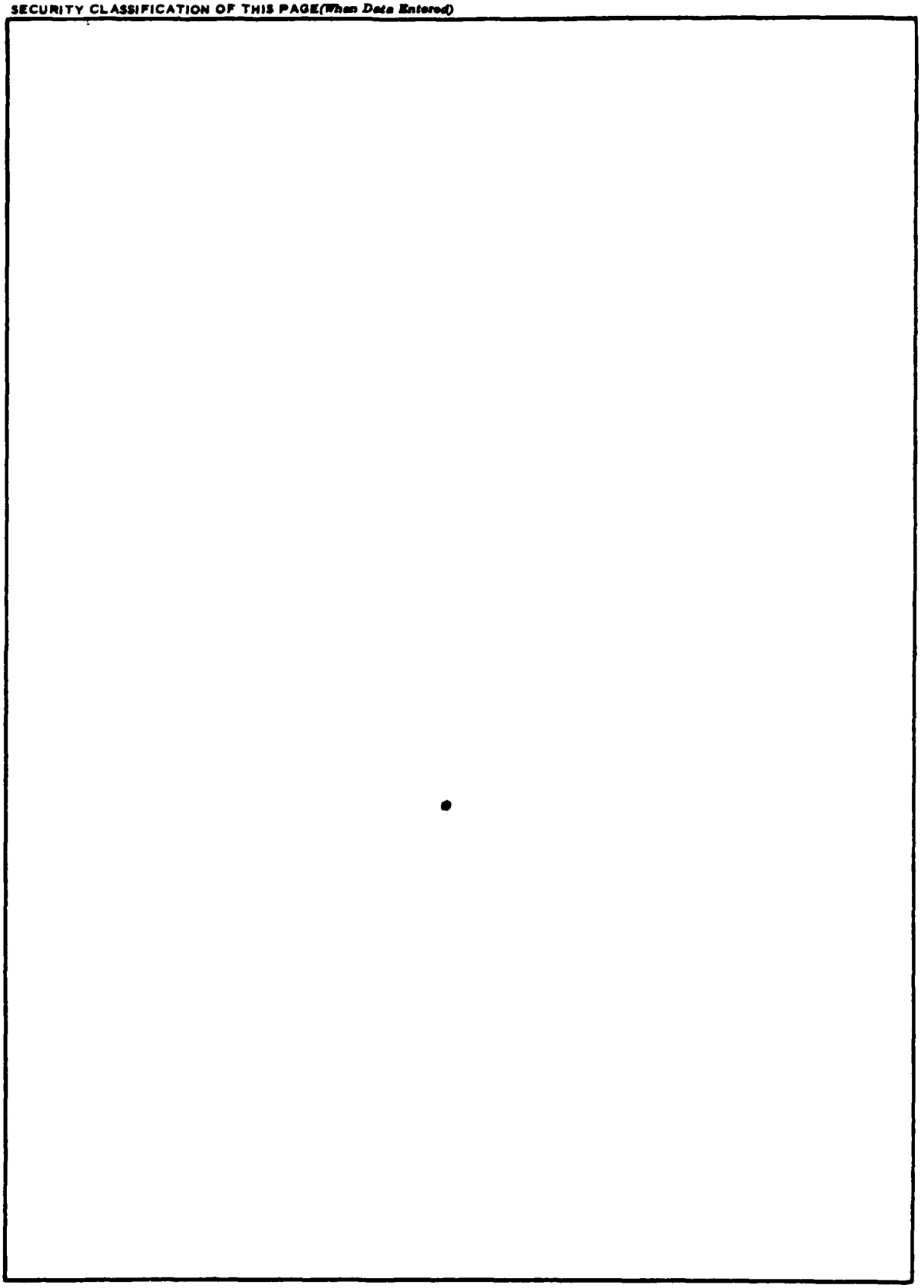

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MISSISSIPPI - KASKASKIA - ST. LOUIS BASIN

HIDDEN VALLEY LAKE DAM

STE. GENEVIEVE COUNTY, MISSOURI

MO 31100

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

FEBRUARY 1980

A

DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: Hidden Valley Lake Dam (Mo. 31100) Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Hidden Valley Lake 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 50 percent of the Probable Maximum Flood.

2. Overtopping of the dam and/or erosion of the spillway 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
31 MAR 1980
Date

APPROVED BY: SIGNED
Colonel, CE, District Engineer
1 APR 1980
Date

HIDDEN VALLEY LAKE DAM

MISSOURI INVENTORY NO. 31100

STE. GENEVIEVE 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

FEBRUARY 1980

HS-7925

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Hidden Valley Lake Dam
State Located:	Missouri
County Located:	Ste. Genevieve
Stream:	Brushy Creek
Date of Inspection:	18 October 1979

The Hidden Valley Lake Dam, 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 a hazard to human life or property.

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, the present general physical condition of the dam proper is considered to be satisfactory. However, the following deficiencies were noticed during the inspection and are considered to have an adverse effect on the overall safety and future operation of the dam:

1. Seepage, as characterized by soft ground, running and standing water, cattails, and willows; was observed at the toe of the center of the dam in the area between the emergency spillway outlet channel and the original creek channel. Uncontrolled seepage could develop into a piping condition that can lead to failure of the dam. Saturation of the soil adjacent to the dam can weaken the foundation and impair the stability of the dam.

2. The earthen banks of the outlet channel for the principal spillway are in an unstable state as evidenced by erosion, sloughing, cracking, and near vertical slopes. In a location at the upper bend in the channel, the left bank of the channel appeared to be on the verge of collapse. Loss of the channel banks could render the spillway outlet ineffective which may result in overtopping and possibly failure of the dam.

3. The crest and outlet channel for the emergency spillway were noticeably eroded. Continued erosion of the spillway could lower the spillway crest resulting in increased lake outflow and conditions promoting greater erosion with the possibility of flooding the downstream area adjacent to the dam.

4. Erosion of the grass covered upstream face of the dam apparently by wave action and/or by fluctuations in the lake surface level has created a near vertical bank approximately 1 to 2 feet high at the normal waterline. A grass covered slope is not considered adequate to prevent erosion by wave action or fluctuations of the lake level.

5. A beaver dam exists within the downstream channel, Brush Creek, just downstream of the junction of the creek with the spillway outlet channels, a distance of approximately 400 feet from the dam. The beaver dam serves to obstruct flow restricting the capacity of the channel which could result in flooding of the area below the dam.

According to the criteria set forth in the recommended guidelines, the magnitude of the spillway design flood for the Hidden Valley Lake Dam, which is classified as small in size and of high hazard potential, is specified to be a minimum of one-half the Probable Maximum Flood (PMF). Considering the fact that a fairly large volume of water is

impounded; the downstream floodplain is relatively narrow and flow in the stream will be deep and with high velocities; and that several dwellings lie within the possible flood damage zone, it is recommended that the spillway for this dam be designed for 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. The PMF is ordinarily accepted as the inflow design flood for dams where failure of the structure would increase the danger to human life.

Results of a hydrologic/hydraulic analysis indicated that both spillways, principal plus emergency, are inadequate to pass lake outflow resulting from a storm of PMF magnitude or from the 1 percent chance (100-year frequency) flood. The spillways are capable however, of passing lake outflow corresponding to about 9 percent of the PMF lake inflow and the lake outflow resulting from the 0.1 percent chance (10-year frequency) flood. 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 3 miles. Accordingly, within the possible damage zone are three dwellings and several farm buildings.

A review of available data did not disclose that seepage or stability analyses of this 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.

Harold B. Lockett

P.E. Missouri E-4189

Albert B. Becker, Jr.

P.E. Missouri E-9168

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

HIDDEN VALLEY LAKE DAM - ID. NO. 31100

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PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

HIDDEN VALLEY LAKE DAM - I.D. NO. 31100

SECTION I - 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 Hidden Valley 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 above dam with respect to safety and, based upon available data and this inspection, determine if the dam poses a hazard to human life or property.

c. Evaluation Criteria. This evaluation was performed in accordance with the "Phase I" investigation procedures as prescribed in "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 Hidden Valley Lake Dam is an earthfill type embankment rising approximately 35 feet above the original streambed. The embankment has an upstream slope (above the waterline) of 1v on 2.3h, a crest width of about 20 feet, and a

downstream slope of 1v on 2.4h. The length of the dam including the spillway sections is approximately 620 feet. A plan and profile of the dam are shown on Plate 3 and a cross-section of the dam is shown on Plate 4. At normal pool elevation the reservoir impounded by the dam occupies approximately 28 acres.

The dam has both a principal and emergency spillway. The principal spillway is cut into the hillside at the right or east abutment. The spillway outlet channel, a badly eroded canyon-like section with near vertical side walls, conducts flow towards a watercourse of the adjacent valley that lies approximately 340 feet downstream and to the east of the dam. Just downstream of the spillway crest the channel drops abruptly through a series of rock ledges into the deep, canyon-like section. The channel then continues by meandering through both earth and rock formations before joining the watercourse east of the dam. This watercourse joins the downstream channel, Brushy Creek, at a point approximately 350 feet below the dam.

The emergency spillway, trapezoidal section, is located at the left or west abutment. The spillway is moderately eroded throughout. A V-shaped section cut into the overburden serves as the spillway outlet channel. The spillway channel joins the downstream channel, Brushy Creek at a point approximately 350 feet below the dam. An earthen berm on the right side that adjoins the dam serves to confine flow to the channel and protect the dam.

b. Location. The dam is located on Brushy Creek, a tributary of Saline Creek, about one-half mile west of State Highway N and approximately 5 miles southwest of the Town of Minnith, Missouri, as shown on the Regional Vicinity Map, Plate 1. The dam is located in Section 19, Township 35 North, Range 9 East, within Ste. Genevieve County.

c. Size Classification. 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. Hazard Classification. Hidden Valley 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 3 miles downstream of the dam. Within the possible damage zone are three dwellings and several farm buildings.

e. Ownership. The lake and dam are owned by the Hidden Valley Sportsman's Club Association, Incorporated, a Missouri corporation of which Mr. Thomas J. Robertson is the current president. The Club's address is Hidden Valley Sportsman's Club, Inc., 902 Tenth Street, Crystal City, Missouri 63019.

f. Purpose of Dam. The dam impounds water for recreational use by individuals who are members of the club.

g. Design and Construction History. According to Mr. Gary Linderer, past president of the Club and familiar with the lake project since its inception, construction of the dam was started in 1974 and completed in 1975, and the builder of the dam was the Vern Bauman Contracting Co. of Ste. Genevieve, Missouri. Mr. Bauman reported that several test borings were made along the dam alignment prior to construction of the dam. However, records of this subsurface investigation as well as any other design and construction data are no longer available. The extent of the engineering investigations performed for design of the dam are unknown.

h. Normal Operational Procedure. The lake level is unregulated. Lake outflow is governed by the capacities of two overflow type spillways.

1.3 PERTINENT DATA

a. Drainage Area. The area tributary to the lake is essentially in a native state and covered with timber. The watershed above the dam amounts to approximately 1,130 acres. The watershed area is outlined on Plate 2.

b. Discharge at Damsite.

(1) Estimated known maximum flood at damsite ... 90 cfs* (W.S. Elev. 631.4)

(2) Spillway capacity (principal + emergency) ... 870 cfs (W.S. Elev. 632.9)

c. Elevation (Ft. above MSL). The following elevations were determined by survey and are based on topographic data shown on the 1959 Parker Lake, Missouri Quadrangle Map, 7.5 Minute Series.

(1) Top of Dam ... 632.9 (min.)

(2) Normal pool (spillway crest) ... 630.0

(3) Streambed at centerline of dam ... 598±

(4) Maximum tailwater ... Unknown

(5) Tailwater at time of inspection ... 601.5

d. Reservoir.

(1) Length at normal pool (elevation 630.0) ... 2,000 ft.

(2) Length at maximum pool (elevation 632.9) ... 2,200 ft.

e. Storage.

(1) Normal pool ... 305 ac. ft.

(2) Top of dam (incremental) ... 87 ac. ft.

f. Reservoir Surface.

(1) Normal pool ... 28 acres

(2) Top of dam (incremental) ... 5 acres

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

g. Dam.

(1) Type ... Earth fill, homogeneous*

(2) Length ... 620 ft.

(3) Height ... 35 ft.

(4) Top width ... 20 ft.

(5) Side slopes

a. Upstream ... 1v on 2.3h (above waterline)

b. Downstream ... 1v on 2.4h

(6) Cutoff ... Clay core*

(7) Slope protection

a. Upstream ... Grass

b. Downstream ... Grass

h. Principal Spillway.

(1) Type ... Uncontrolled, broad-crested, trapezoidal section

(2) Location ... Right abutment

(3) Crest ... Elevation 630.0

(4) Approach channel ... Lake

(5) Exit channel ... Earth and rock cut, U-shaped section

i. Emergency Spillway.

(1) Type ... Uncontrolled, earth, trapezoidal section.

(2) Location ... Left abutment

(3) Crest ... Elevation 630.9

(4) Approach channel ... Lake

(5) Exit channel ... V-shaped, earth section

j. Lake Drawdown Facility.

(1) Size ... 6-Inch pipe (intake), 4-inch pipe (outlet)

(2) Control ... 6-Inch x 4-inch reducing valve (near outlet)

(3) Elevation (Ft. above MSL) ... 603.8 (outlet end)

*Per dam builder.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

It was reported by the past president of the club, Mr. Gary Linderer, and by Mr. Vernon Bauman, the Contractor who constructed the dam, that a minimum of four test borings were advanced along the centerline of the dam. However, records of these borings or other engineering data used as a basis for design of the dam were not available.

2.2 CONSTRUCTION

As previously indicated, the dam was constructed by the Vernon Bauman Excavating Company of Ste. Genevieve, Missouri. According to Mr. Bauman, no formal records were kept during construction of the dam. However, the Contractor reported that considerable blasting was performed in order to construct a core trench and to anchor the right abutment into sound rock. It was reported that this core trench was 4 to 8 feet deep and about 8 feet wide; that several layers of gravel and clay-seamed ledge rock were excavated; that the trench was backfilled with clay, and that the material placed within the trench was compacted using a sheepsfoot roller. Mr. Bauman stated that most of the remaining embankment material was compacted with rubber-tired equipment, although a sheepsfoot roller was used to compact fill in critical areas. The Contractor mentioned that the embankment at the right abutment was anchored 20 to 25 feet into rock at the hillside while at the left abutment the embankment was secured into the clay covered hillside.

2.3 OPERATION

The lake level is uncontrolled and governed by the crest elevation of the principal spillway located at the right abutment. An emergency spillway, with a crest elevation approximately 0.9 feet higher than the crest of the principal spillway and about 2.0 feet lower than the top of

the dam at its lowest point, is located at the left abutment. A representative of the Owner, reported that the dam has not been overtopped and that the highest lake level observed occurred sometime during the spring of 1979 when the depth of flow at the emergency spillway was estimated to be about 6 inches.

2.4 EVALUATION

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

b. Adequacy. No data available. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety" 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.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of the Hidden Valley Lake Dam was made by Horner & Shifrin engineering personnel, H. B. Lockett, Civil Engineer and Hydrologist, T. K. Deddens, Geological Engineer, and A. B. Becker, Jr., Civil and Soils Engineer, on 18 October 1979. An examination of the dam site was also made by an engineering geologist, Jerry D. Higgins, a consultant retained by Horner & Shifrin for the purpose of assessing the area geology. Also examined at the time of the inspection, was the area 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-6 of Appendix A. The locations of the photographs taken during the inspection are indicated on Plate 3.

b. Area Geology. The dam site is located on the eastern flank of the Ozark Uplift on gently dipping Ordovician-age sedimentary rock in the area of the dam, the Gasconade formation is exposed at the surface. The Gasconade is predominantly a light brownish gray, crystalline and cherty dolomite with a few thin, irregular sandstone lenses. Cryptozoan, cellular and ropey cherts are also common. The residuum, formed by deep in situ weathering of the overlying Roubidoux consists of a thick, cherty clay soil containing boulder-size chert overlying an irregular bedrock surface of cryptozoan chert (reef) and dolomite. The residuum is relatively permeable and erodible. Bedrock exposures are primarily limited to the main spillway in the right abutment.

The right abutment is moderately sloping, composed of thick, cherty clay residuum overlying cryptozoan chert and dolomite. The spillway cut through the abutment hillside exposes a thick section of residuum and cryptozoan chert. The spillway channel has been eroded to a deep, steep-walled section with numerous potholes formed in the irregular bedrock surface.

The left abutment is gently sloping, composed of thick cherty clay residuum cut by a small emergency spillway. The spillway has undergone moderate erosion, and some small potholes have formed along its channel.

c. Dam. The visible portions of the upstream and downstream faces of the dam (See Photos 1 and 2) appeared to be in sound condition, although erosion of the unprotected upstream slope has created a near vertical face about 1 to 2 feet high at the normal pool waterline. No cracking or sloughing of the embankment, or misalignment of the dam crest was evident. The downstream slope and the upstream slope above normal pool were well covered by a thick stand of fescue and lespedeza type grasses that were about 12 inches high. No trees were present on either face of the embankment. The gravel surfaced road on the crest of the dam was found to be in good condition and appeared to be well maintained.

A marshy area (see Photo 9) as evidenced by cattails, willows, soft ground, and standing and flowing water, was observed just downstream of the center of the dam. Seepage flow from this area was difficult to estimate because of the fact that it extended over an area approximately 150 feet wide and 350 feet long. However, seepage flow near the dam appeared to be less than 5 gpm. Flooding of the old creek channel, believed primarily due to the fact that the valve on the lake drawdown pipe (see Photo 12) was open and discharging flow to the channel, and the presence of a beaver dam (see Photo 11) across the channel at a point approximately 350 feet downstream of the dam, had created a pool (see Photo 10) which abutted the base of the dam. Due to the presence of the pool it could not be determined if the dam was experiencing underseepage at the location of the old stream.

The crest area of the principal spillway (see Photo 3) appeared to be in sound condition, although the earthen bank at the interface of the dam and spillway had only a sparse cover of grass to prevent erosion of the embankment. It was also noted that an accumulation of miscellaneous debris littered the upstream area. Downstream of the crest the spillway

outlet channel was found to be badly eroded (see Photos 4 through 6) with several potholes formed in the bedrock surface of the invert and evidence of recent sloughing of the steep-walled earthen banks. At a location approximately 125 feet downstream of the crest, a vertical crack had severed a portion of the channel bank (see Photo 5) leaving it unstable and on the verge of collapse. The hillside to the right of the channel was also badly eroded, apparently by storm water runoff, with the surface cut by numerous small channels. Recent minor sloughing of the hillside adjacent to the channel was also evident.

The emergency spillway was moderately eroded with approximately 6 to 12 inches of foundation material (see Photo 7) missing throughout most of the crest area. Erosion of the overburden had created a V-shaped channel section (see Photo 8) up to about 3 feet in depth along the entire length of the outlet. Seepage, estimated to be on the order of 1 to 2 gpm, was noticed emerging in the channel invert beginning at a location approximately 200 feet below the crest. The berm adjacent to the right side of the channel and the hillside adjoining the left side were well covered by various varieties of grass and no significant erosion of these areas was noticed.

d. Downstream Channel. The channel, Brushy Creek, downstream of the dam is unimproved, although a low earth and gravel berm that appeared to be material excavated from the channel was noticed along the right bank in the vicinity of the dam. At a point approximately 350 feet from the dam the stream is joined by the principal and emergency spillway outlet channels. A low beaver dam crosses the stream just below the confluence of the spillway channels. Flow passing the beaver dam was attributed mostly to discharge from the lake drawdown valve which was open at the time of the inspection.

e. Reservoir. The area adjacent to the lake is in a natural state covered with a dense growth of trees. Except for those areas normally inundated by the lake, the shoreline about the lake was free [illegible]

grass covered. The amount of sediment within the lake could not be determined at the time of the inspection; however, it is believed not to be significant.

3.2 EVALUATION

The deficiencies observed during this inspection and noted herein are not considered significant to warrant immediate remedial action. It is advisable, however, that the Owner address the problem of erosion at both the principal and emergency spillways within the near future.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The spillways are uncontrolled. The water surface level is determined by precipitation runoff, evaporation, seepage, and the capacities of the uncontrolled principal and emergency spillways.

4.2 MAINTENANCE OF DAM

The embankment and areas immediately adjacent thereto appeared relatively well maintained as no trees or brush were observed on the slopes and the area was uniformly covered with grass that was approximately 12 inches high at the time of the inspection. However, judging by the badly eroded and deteriorating conditions observed at the outlet channel for the principal spillway as well as the generally eroded condition of the emergency spillway it is apparent that no attempt has been made to remedy either situation. It also appears that there is little concern for problems associated with seepage or drainage of the low-lying marshy areas adjacent to the dam.

4.3 MAINTENANCE OF OUTLET OPERATING FACILITIES

No outlet operating facilities exist at this dam.

4.4 DESCRIPTION OF ANY WARNING SYSTEMS IN EFFECT

The inspection did not reveal the existence of a dam warning system.

4.5 EVALUATION

Lack of or inadequate maintenance is considered detrimental to the safety of the dam. It is recommended that maintenance of the dam and spillways be undertaken on a regular basis and that records be kept of all maintenance work performed.

5.1 EVALUATION OF FEATURES

a. Design Data. Design data are not available.

b. Experience Data. The drainage area and lake surface area were developed from the USGS Parker Lake, Missouri, Quadrangle Map. The proportions and dimensions of the spillways and dam were developed from surveys made during the inspection. Records of rainfall, streamflow or flood data for the watershed are not available.

c. Visual Observations.

(1) The principal spillway, a broad-crested trapezoidal section with a width of about 15 feet at the crest, is cut into the hillside at the right (east) abutment.

(2) At the spillway crest the spillway is defined by a grass covered earth berm on the left and by a nearly vertical excavated rock face on the right.

(3) Just downstream of the crest, the spillway drops abruptly through a series of rock ledges into a narrow, steep walled and badly eroded canyon-like channel.

(4) The spillway channel joins a watercourse from the adjacent valley at a point approximately 340 feet downstream of the crest.

(5) The spillway channel conducts flow away from the dam and releases within the capacity of the spillway should not endanger the dam.

(6) The emergency spillway, a shallow broad-crested trapezoidal section is located in the gently sloping hillside of the left (west) abutment. The spillway is moderately eroded throughout.

(7) An earthen berm that joins the dam parallels the spillway outlet and serves to confine flow to the channel and protect the dam.

(8) A 6-inch pipe that reduces to a 4-inch pipe at the control valve is provided to dewater the lake. The valve is located near the downstream toe of the dam.

(9) The original stream channel abuts the dam.

d. Overtopping Potential. The spillways (principal and emergency) are inadequate to pass the probable maximum flood, or 1/2 the probable maximum flood, or the 1 percent chance (100-yr. frequency) flood without overtopping the dam. The spillways are adequate, however to pass the 0.1 percent chance (10-yr. frequency) flood without overtopping the dam. The results of the dam overtopping analysis are as follows:

Ratio of PMF	Q-Peak Outflow (cfs)	Max. Lake W.S. Elev.	Max. Depth (Ft.) of Flow over Dam (Elev. 632.9)	Duration of Overtopping of Dam (Hrs.)
0.09	907	632.9	0.0	0.0
0.50	7,726	636.2	3.3	6.2
1.00	16,462	637.9	5.0	7.4
100-Yr. Flood	2,250	634.1	1.2	1.2
10-Yr. Flood	851	632.9	0.0	0.0

Elevation 632.9 was found to be the lowest point in the dam crest. The flow safely passing the spillway just prior to overtopping amounts to about 907 cfs, which is equivalent to about 9 percent of the probable maximum flood inflow. During peak flow of the probable maximum flood, the greatest depth of flow over the dam is projected to be 5.0 feet and overtopping will extend across the entire length of the dam.

e. Evaluation. Experience with embankments constructed of similar material (a gravelly red clay) to that used to construct this dam have shown evidence that the material under certain conditions such as high velocity flow, can be very erodible. Examples of such erosion are apparent at each of the spillways. 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 5.0 feet, and the duration of flow over the dam, 7.4 hours, are substantial, damage by erosion to the crest and downstream face of the dam is expected. The extent of these damages is not predictable, however, there is a possibility that they could result in failure of the dam.

E. References. Procedures and data for determining the probable maximum flood, the 100-year frequency flood, the 10-year frequency flood, and the discharge rating curve for flow over the spillways and the dam crest are presented on Pages B-1 and B-2 of the Appendix. A listing of the HEC-1 (Dam Safety Version) input data is shown on Pages B-3 thru B-5 of the Appendix. A copy of the computer output tables entitled "Summary of Dam Safety Analysis" for ratios of the PMF, the 100-year flood, and the 10-year flood, are presented on Page B-6. The inflow and outflow hydrographs for the probable maximum flood are shown on Page B-7 of the Appendix. Area-storage curves for the reservoir are shown on Plate 5 and the spillway rating curves are shown on Plate 6 of the report.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Visual observations 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. It was reported that records of test borings taken at the dam site prior to construction are no longer 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. Operating Records. With the exception of the valve on the lake drawdown pipe, no appurtenant structures or facilities requiring operation exist at this dam. According to a representative of the Owner, no records are kept of the lake level, spillway discharge, dam settlement, or seepage.

d. Post Construction Changes. The Owner's representative also reported that 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 and an earthquake of the magnitude predicted for this area is not expected to produce a hazardous condition to the dam, provided that static stability conditions are satisfactory and conventional safety margins exist.

7.1 DAM ASSESSMENT

a. Safety. A hydraulic analysis indicated that the spillways (principal plus emergency) are capable of passing lake outflow of about 870 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 probable maximum flood magnitude, the lake outflow would be about 16,460 cfs, and that for the 1 percent chance (100-year frequency) flood, the lake outflow would be about 2,250 cfs. A similar analysis indicated that for the 0.1 percent (10-year frequency) flood, the lake outflow would be approximately 850 cfs.

Several items were noticed during the inspection that could adversely affect the safety of the dam. These items include seepage, the deteriorating condition of the spillway outlets, and the lack of adequate erosion protection along the upstream face of the dam.

Seepage and stability 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.

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 capacities of the spillways were based on a hydrologic/hydraulic 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 items concerning the safety of the dam noted in paragraph 7.1a and the remedial measures recommended in paragraph 7.2 should be accomplished within a reasonable time. It is recommended, however, that priority be given to remedying the problem of erosion at both the principal and emergency spillways and to increasing the capacity of the spillway outlets which are considered to be seriously inadequate.

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 and an earthquake of the magnitude predicted for this area is not expected to produce a hazardous condition to the dam, provided that static stability conditions are satisfactory and conventional safety margins exist.

7.2 REMEDIAL MEASURES

a. Recommendations. The following actions are recommended:

(1) Based upon criteria set forth in the recommended guidelines, alterations to the design of the dam should be made in order to pass lake outflow resulting from a storm of probable maximum flood magnitude.

(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) Provide some means of controlling seepage evident in the area adjacent to the downstream toe near the center of the dam. 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 area 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.

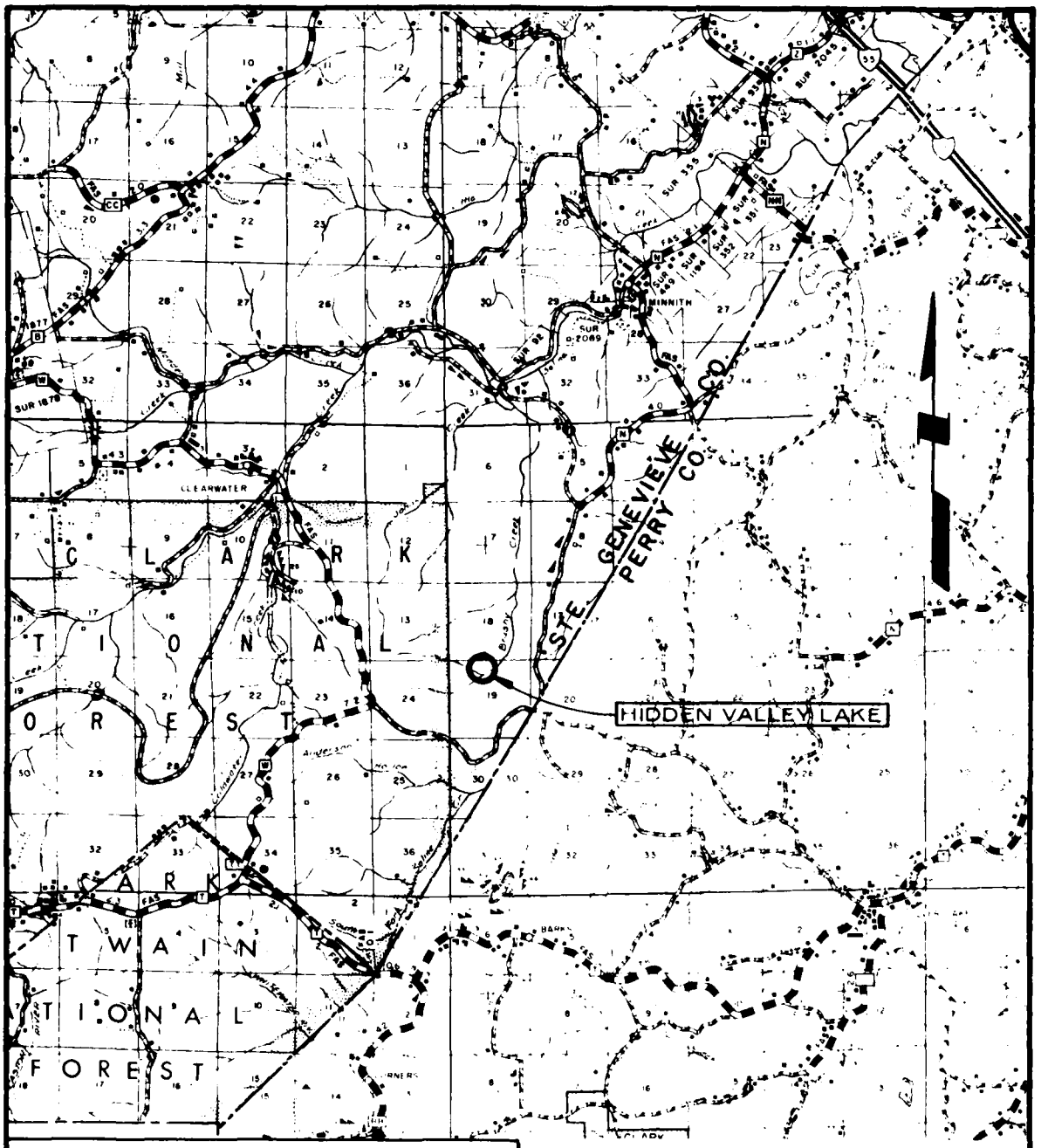
(2) Provide some form of protection at the spillways in order to prevent erosion by lake outflow or overland drainage. In the case of the principal spillway measures should be undertaken to insure the stability of the channel banks, which are considered to be overly steep. Failure of the channel banks could result in blockage of the spillway outlet which could lead to overtopping and possibly failure of the dam. Continued erosion of the emergency spillway could lower the crest and promote progressive erosion.

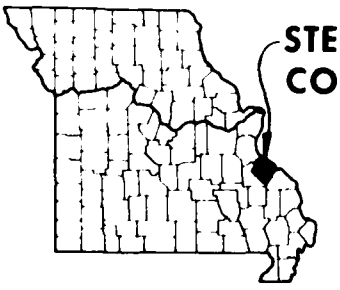
(3) Provide some form of protection other than grass for the upstream face of the dam at and above the normal waterline in order to prevent erosion. A grass covered slope is not considered adequate protection to prevent erosion by wave action or by a fluctuating lake level.

(4) Remove the beaver dam that obstructs the downstream channel. Obstructions within the channel will restrict the capacity of the outlet which could result in flooding of the area below the dam and conditions unfavorable to the structural stability of the dam.

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

(6) 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.





LOCATION MAP

HIDDEN VALLEY LAKE

1 0 1 2 3 4

SCALE (MILES)

REGIONAL VICINITY MAP

PLATE 1

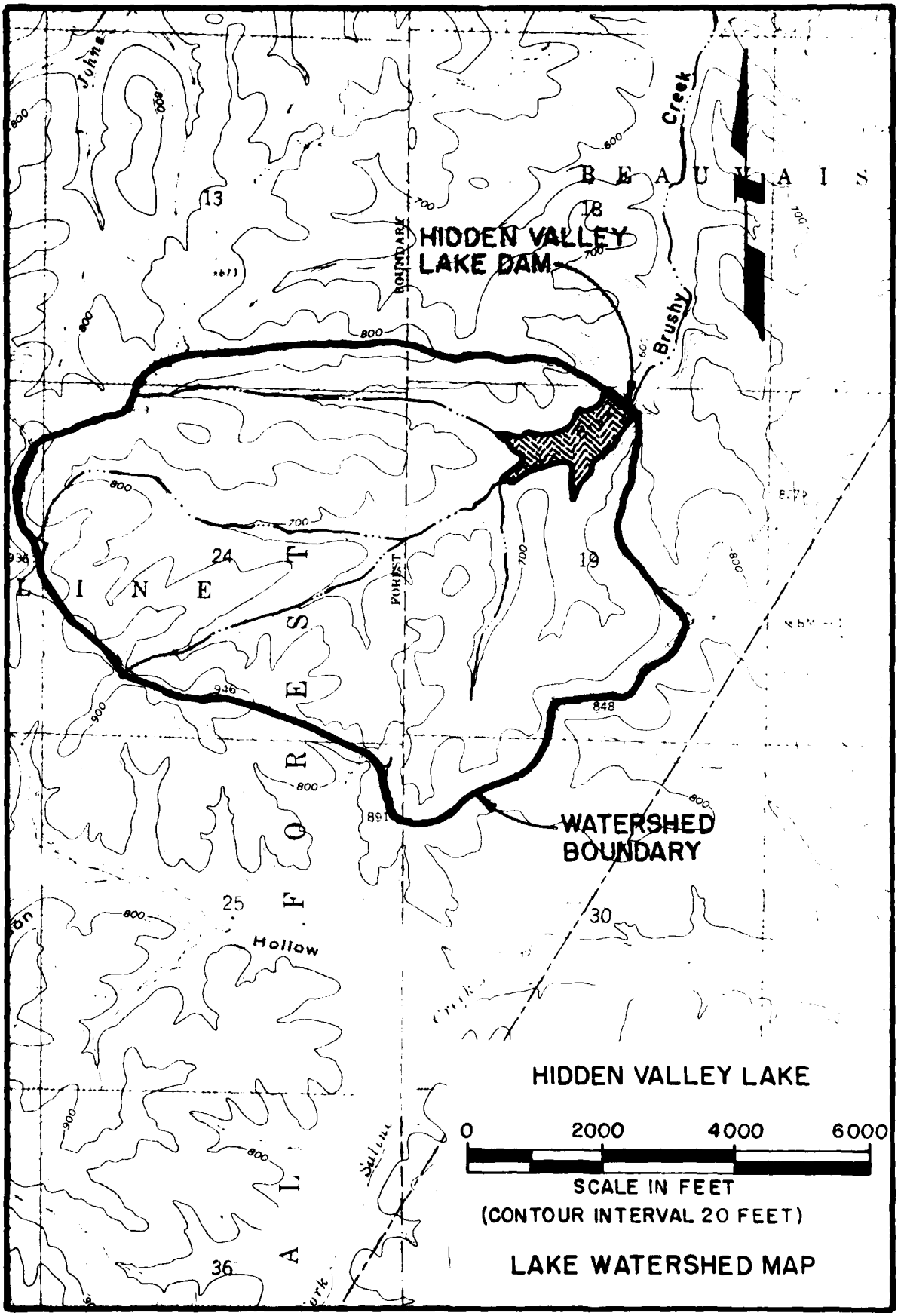
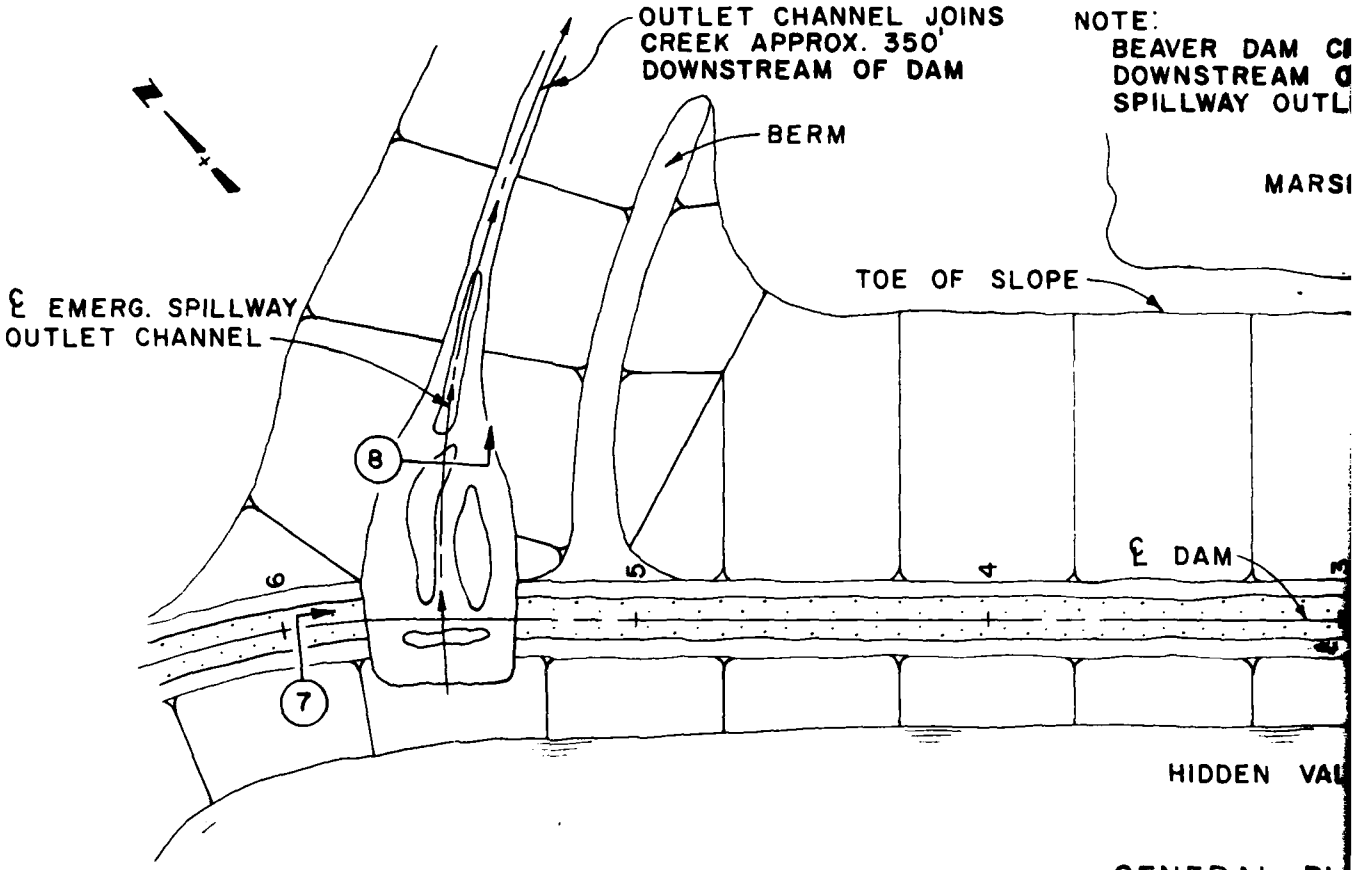
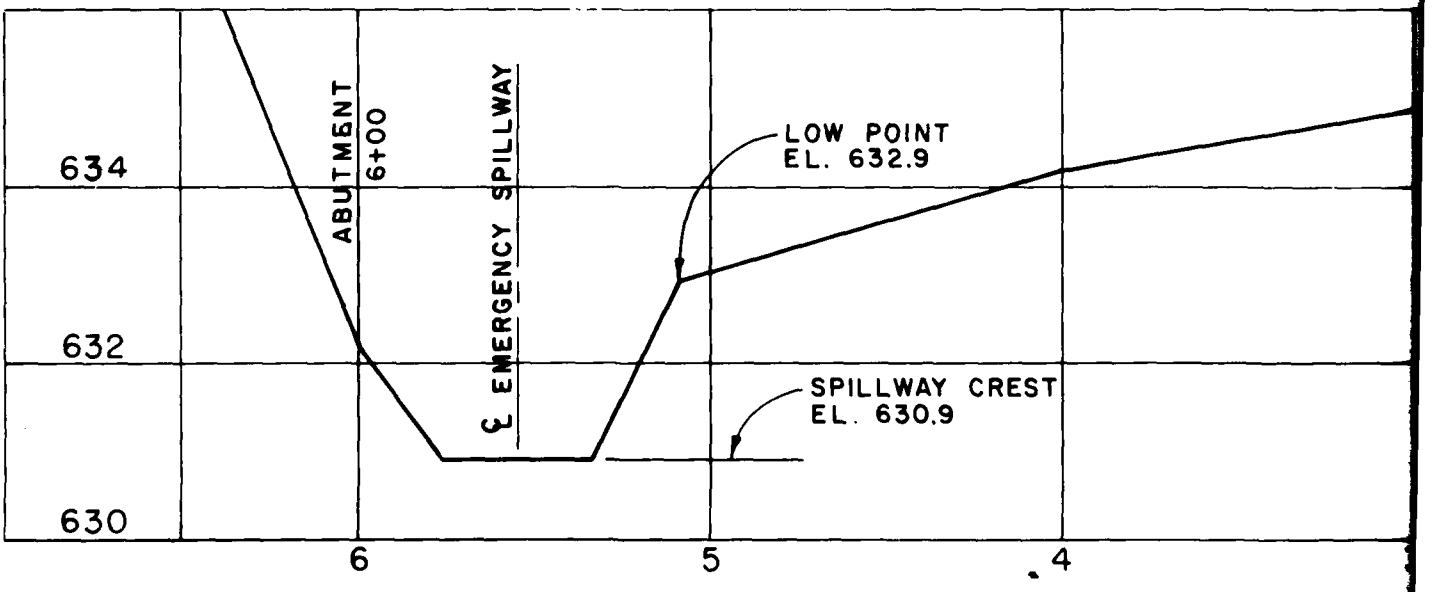

HIDDEN VALLEY
LAKE DAM
WATERSHED
BOUNDARY
BEAUVAIS
LINE
FOREST
BOUNDARY
Brushy
Creek
Hollow
13
18
24
19
25
30
36
HIDDEN VALLEY LAKE
0
2000
4000
6000
SCALE IN FEET
(CONTOUR INTERVAL 20 FEET)
LAKE WATERSHED MAP

PLATE 2



GENERAL PL

SCALE:

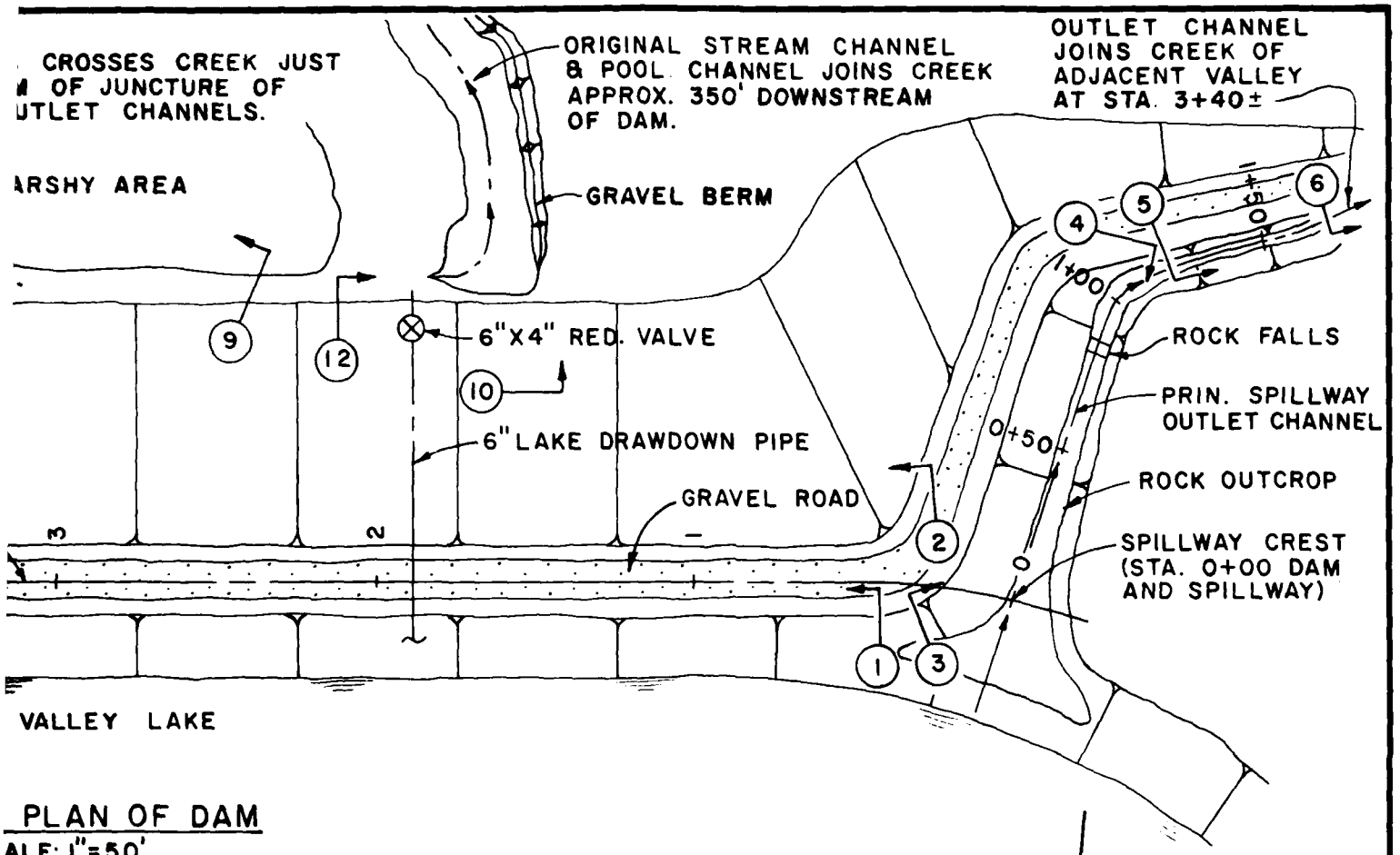


PROFILE

SCALES: 1"

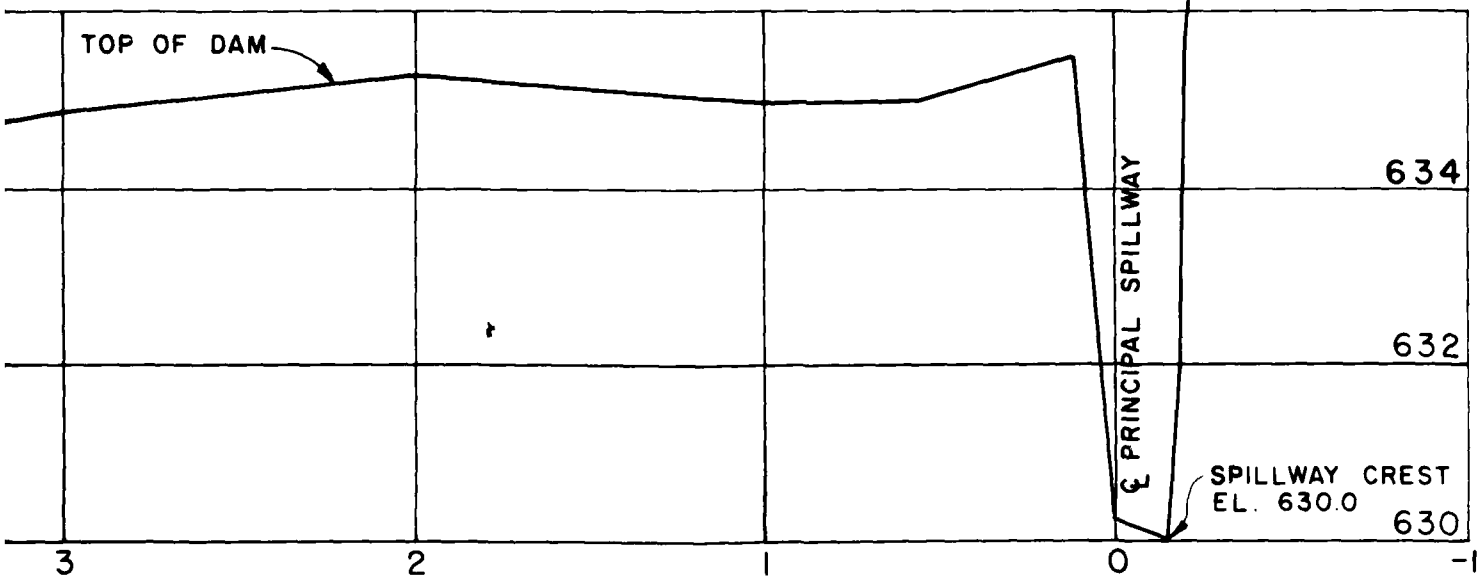
6 PHOTO LOCATION & KEY (SEE APPENDIX A)

NOTE: LOCATION OF PHOTO NO. 11 (NOT SHOWN) BEYOND LIMITS OF PLAN VIEW.



PLAN OF DAM

ALE: 1"=50'



E DAM CREST

:1"=2'V.,1"=50'H.

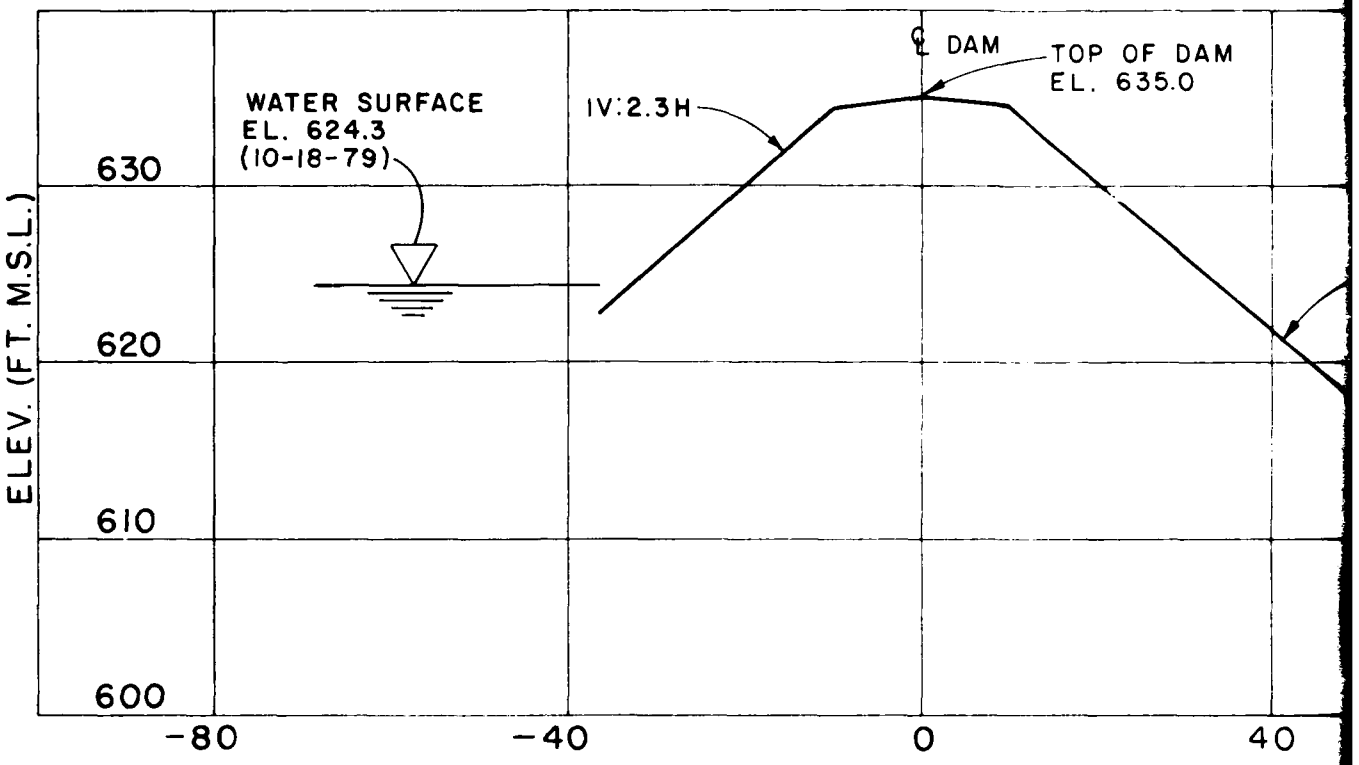
HIDDEN VALLEY LAKE

DAM PLAN & PROFILE

Horner & Shifrin, Inc. Nov. 1979

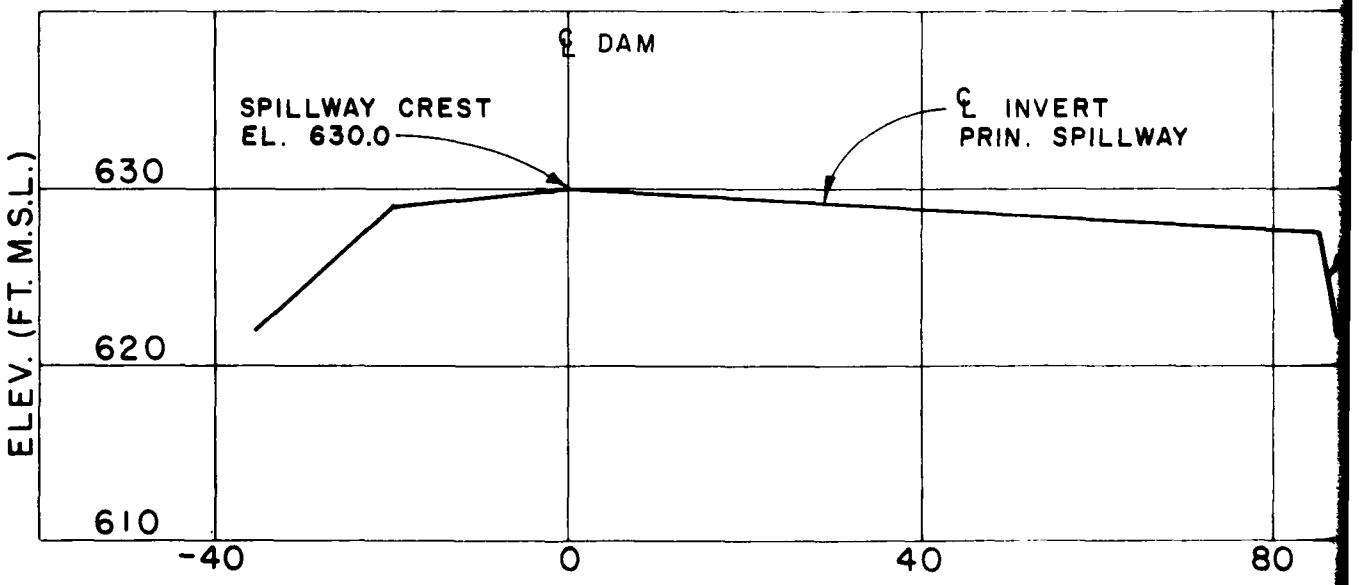
12

PLATE 3



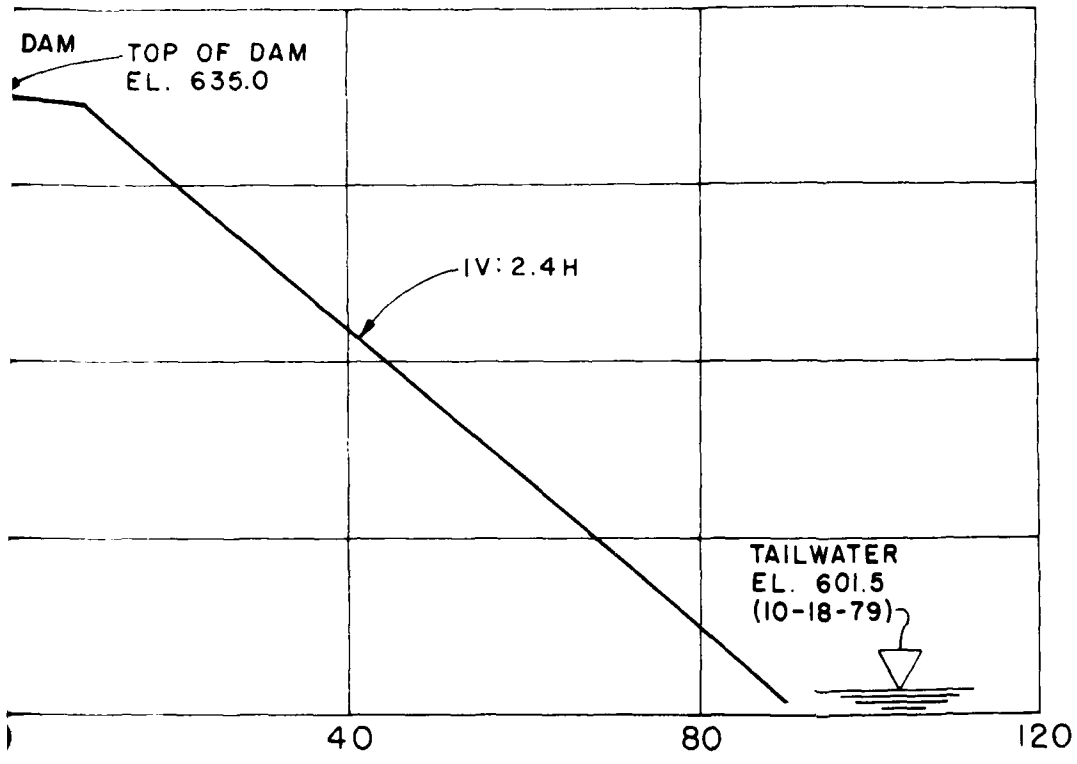
DAM CROSS-SECTION STA. 1+62

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



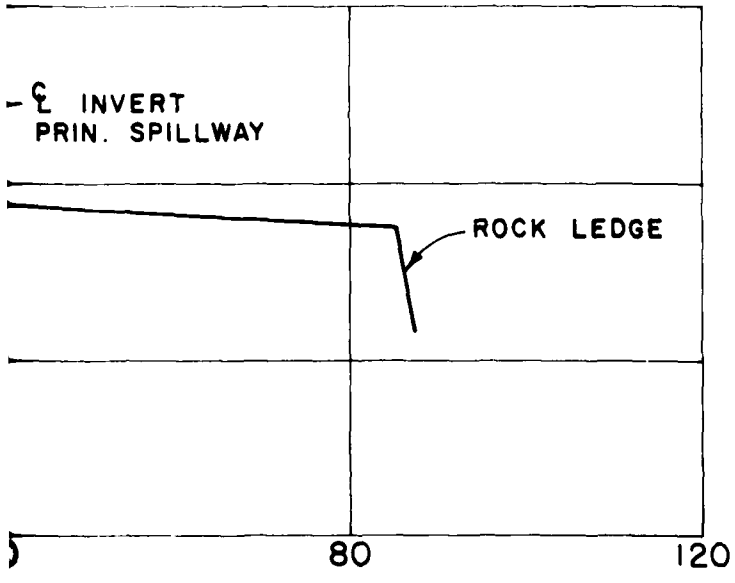
PROFILE SPILLWAY CHANNEL

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



SECTION STA. 1+62

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



WAY CHANNEL

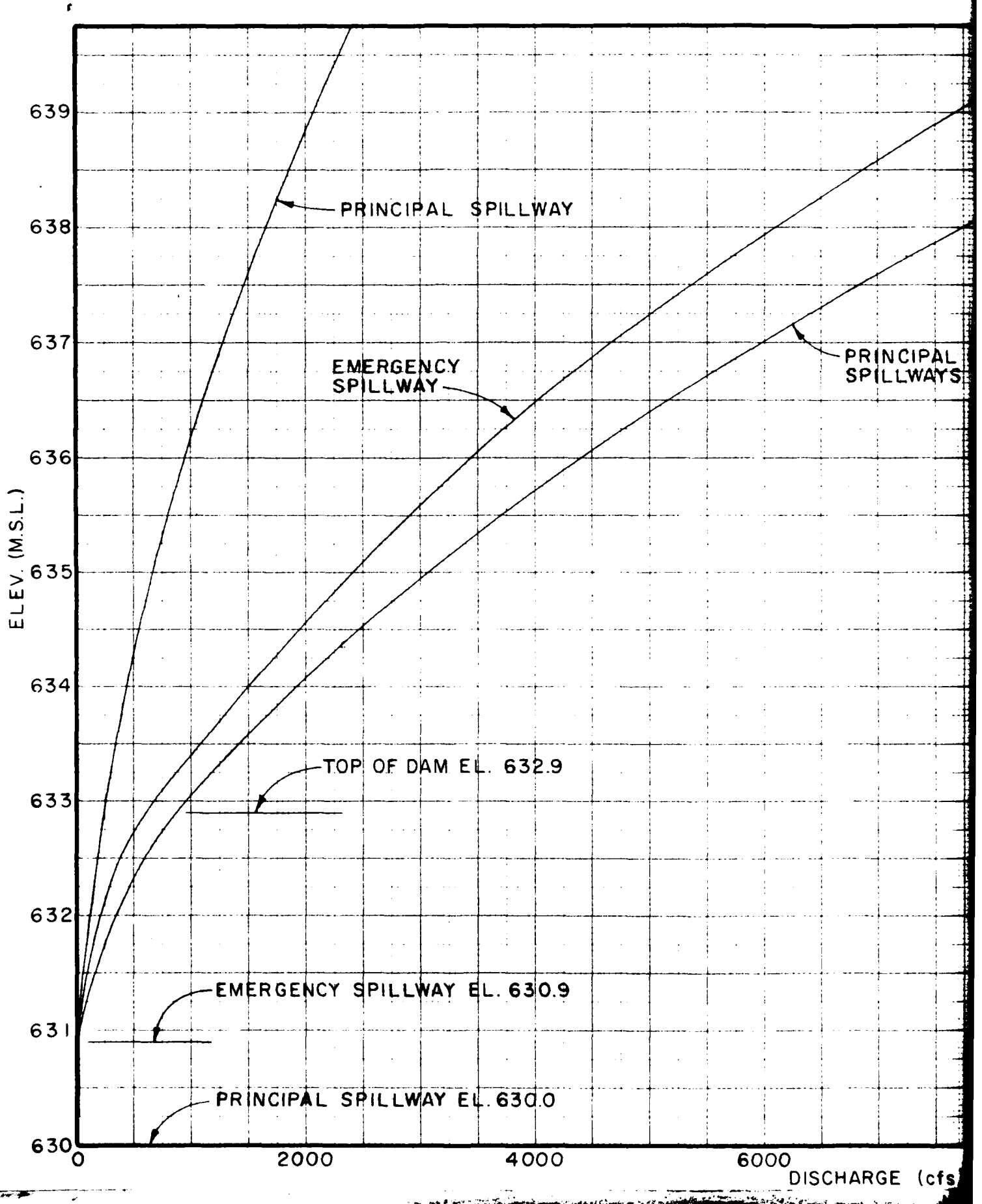
0'V., 1"=20'H.

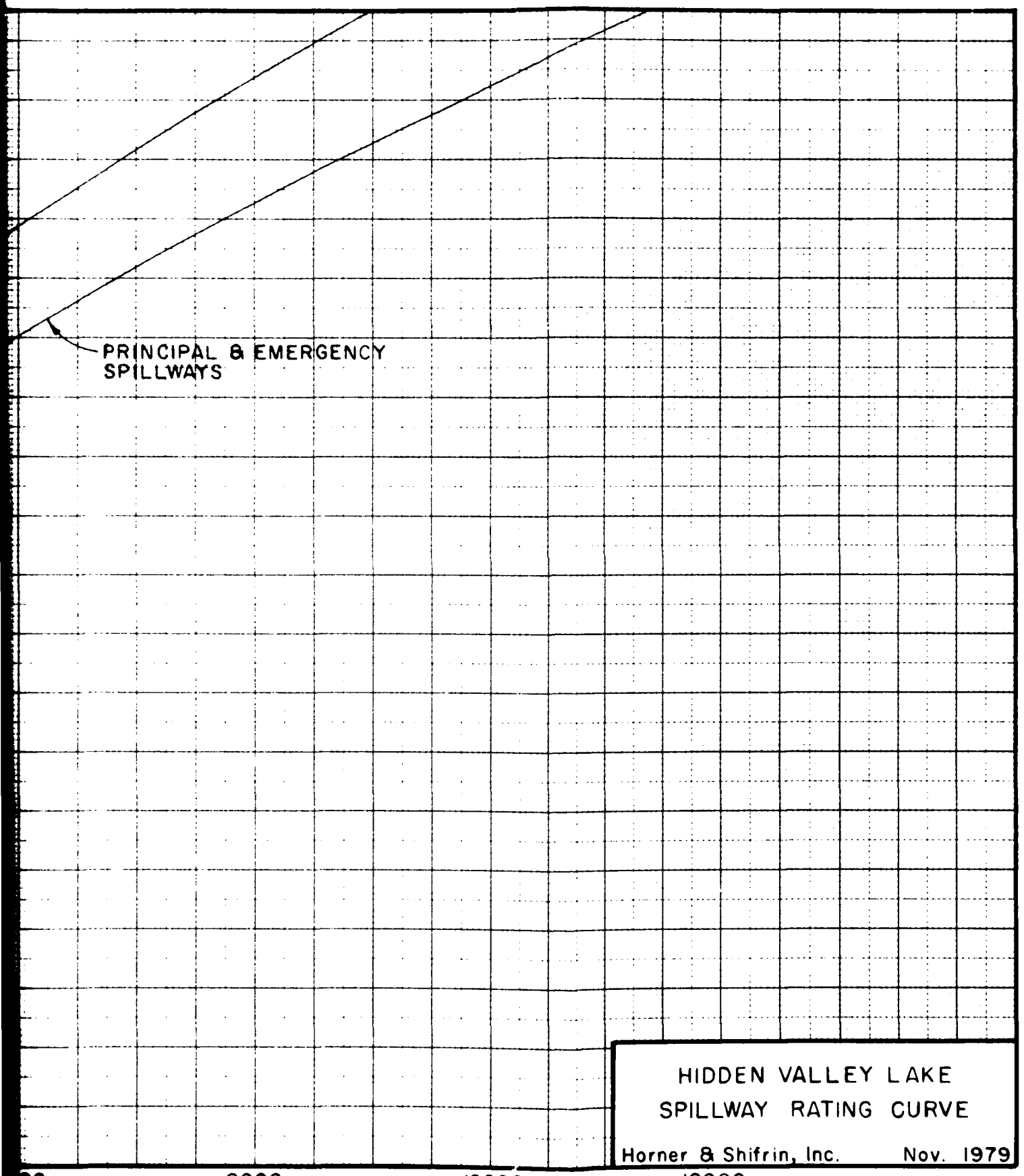
HIDDEN VALLEY LAKE
DAM CROSS-SECTION &
SPILLWAY PROFILE

Horner & Shifrin, Inc. Nov. 1979

PLATE 4

12

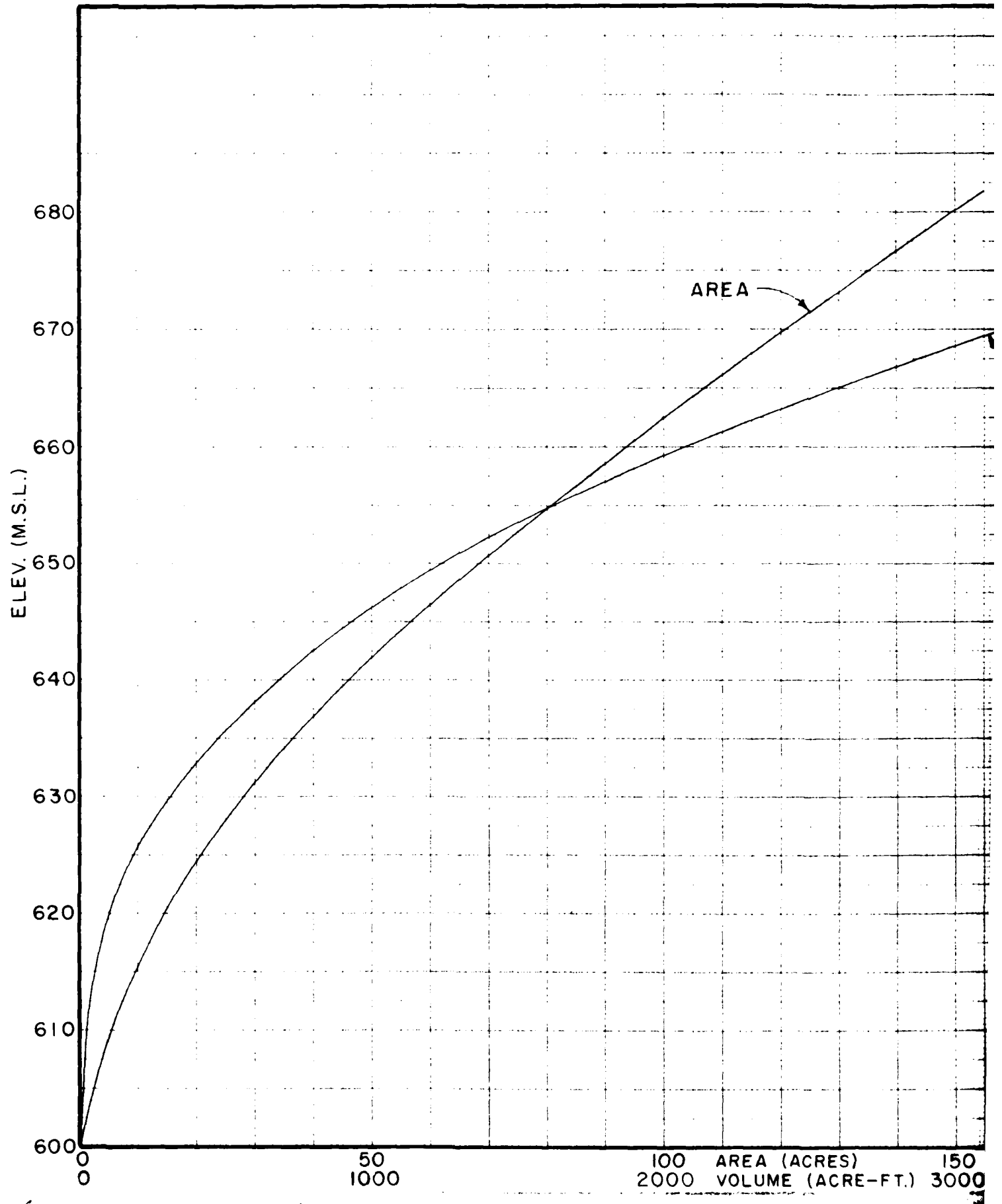

639
638
637
636
635
634
633
632
631
630
ELEV. (M.S.L.)
PRINCIPAL SPILLWAY
EMERGENCY SPILLWAY
PRINCIPAL SPILLWAYS
TOP OF DAM EL. 632.9
EMERGENCY SPILLWAY EL. 630.9
PRINCIPAL SPILLWAY EL. 630.0
0
2000
4000
6000
DISCHARGE (cfs)

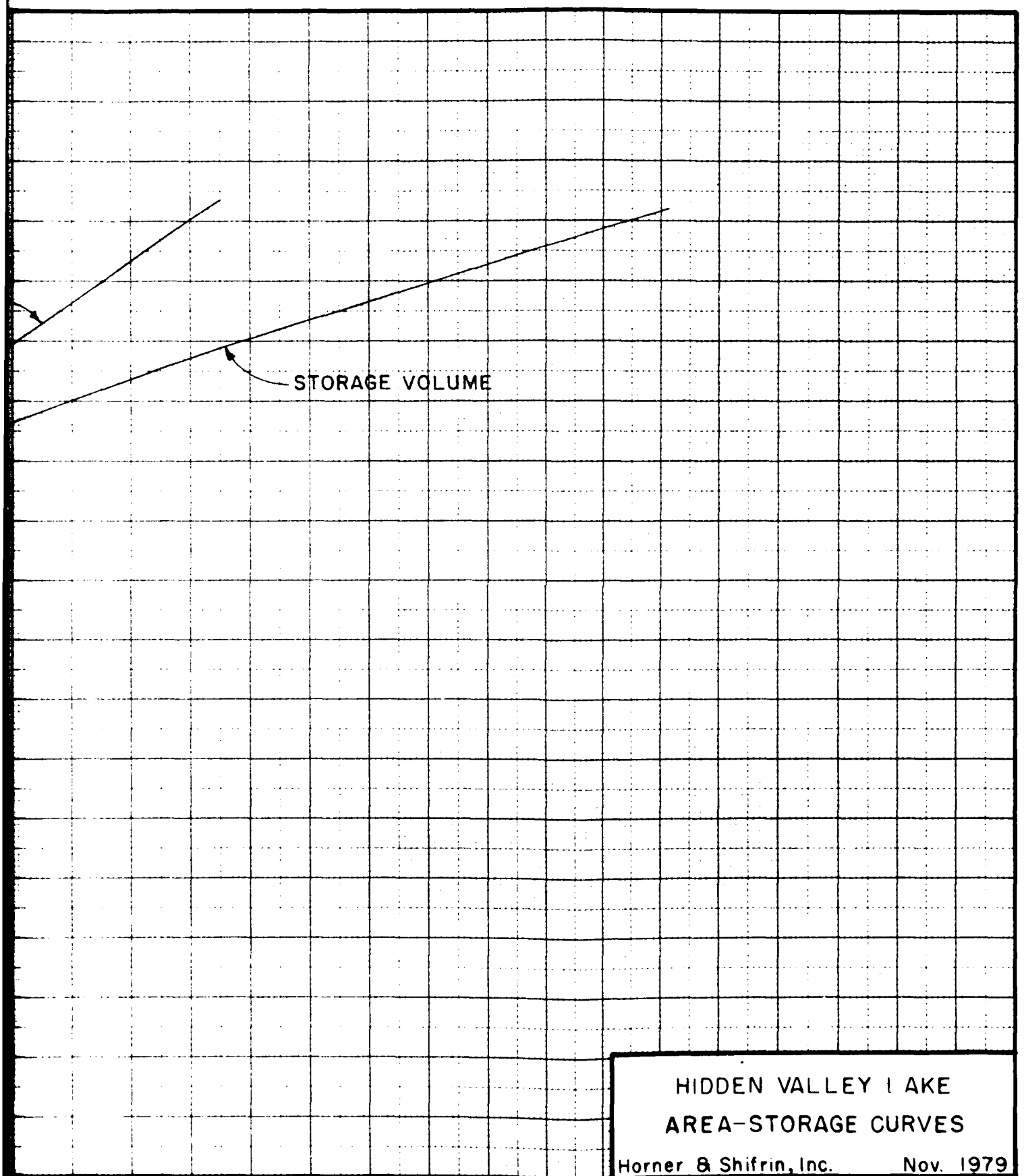


HIDDEN VALLEY LAKE
SPILLWAY RATING CURVE

Horner & Shifrin, Inc. Nov. 1979

PLATE 5


680
670
660
650
640
630
620
610
600
ELEV. (M.S.L.)
AREA
0
0
50
1000
100
2000
150
3000
AREA (ACRES)
VOLUME (ACRE-FT.)



HIDDEN VALLEY LAKE

AREA-STORAGE CURVES

Horner & Shifrin, Inc. Nov. 1979

PLATE 6

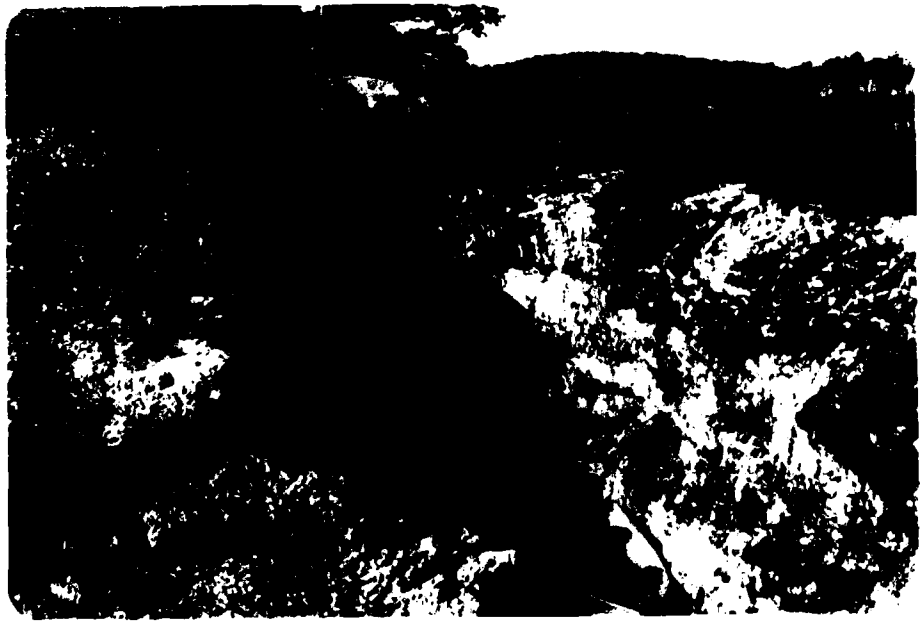
APPENDIX A

INSPECTION PHOTOGRAPHS

NO. 1: UPSTREAM FACE OF DAM

NO. 2: DOWNSTREAM FACE OF DAM

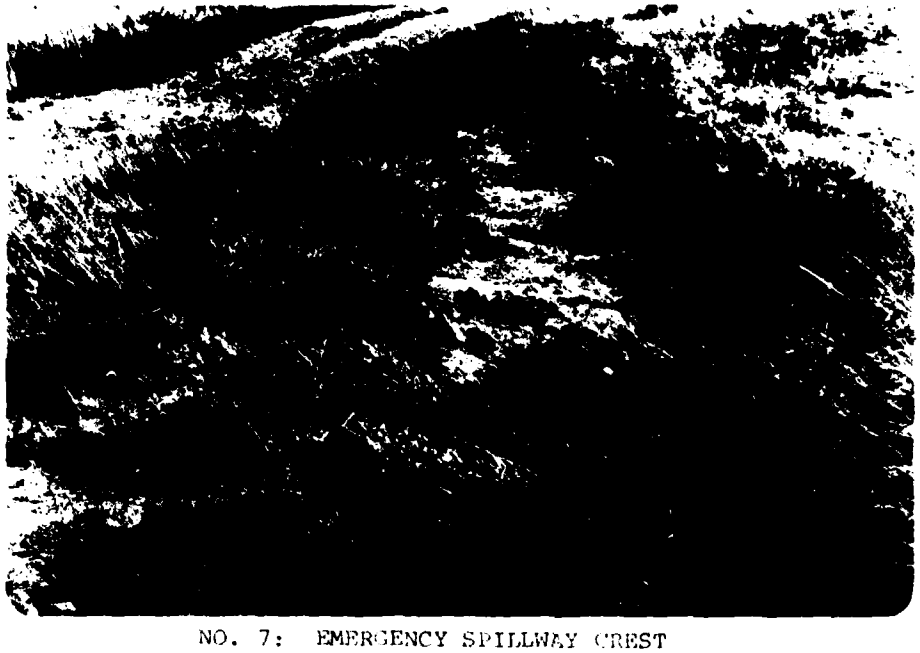
NO. 3: PRINCIPAL SPILLWAY CREST (LOOKING DOWNSTREAM)



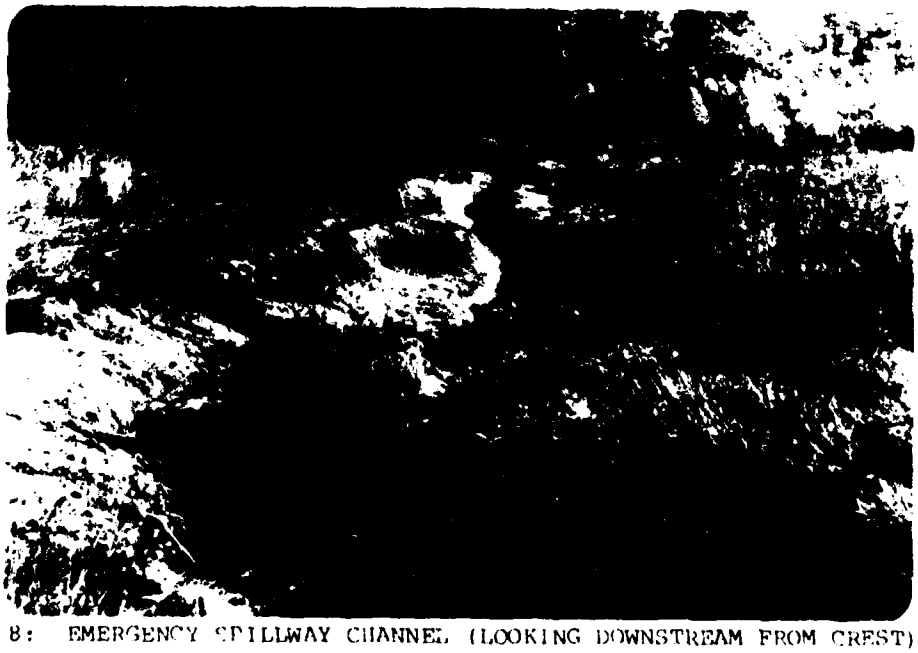
NO. 4: ROCK FALLS AT PRINCIPAL SPILLWAY OUTLET CHANNEL

NO. 5: SLOUGHING AND CRACKING OF SPILLWAY CHANNEL BANK

NO. 6: DOWNSTREAM SECTION OF SPILLWAY CHANNEL



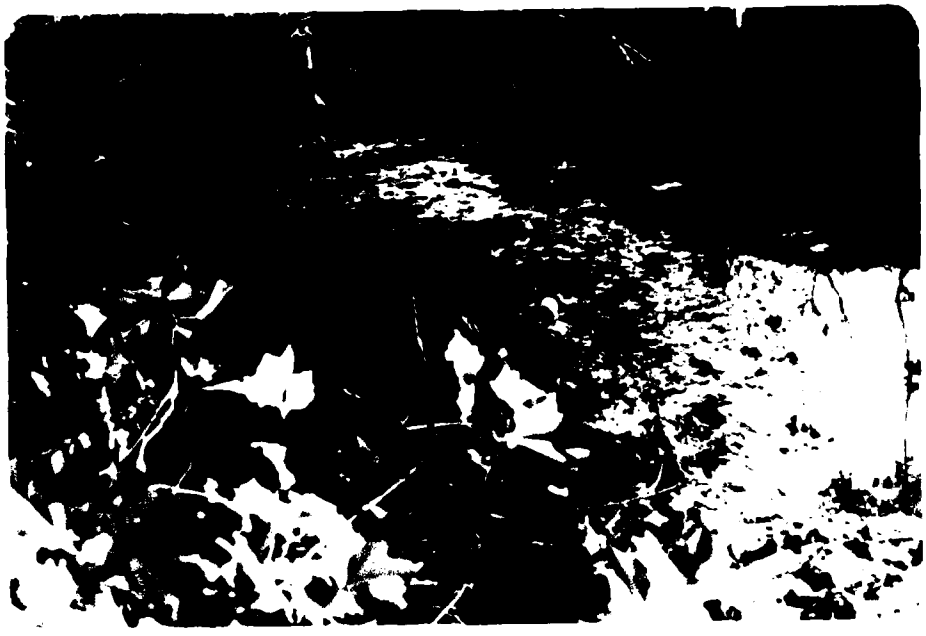
NO. 7: EMERGENCY SPILLWAY CREST



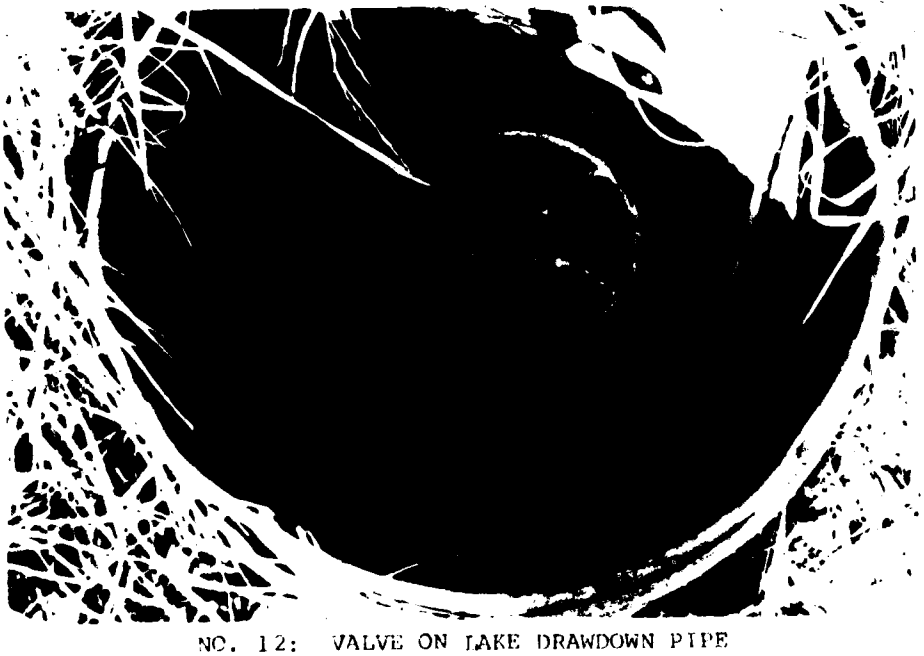
NO. 8: EMERGENCY SPILLWAY CHANNEL (LOOKING DOWNSTREAM FROM CREST)

NO. 9: SEEPAGE AREA AT BASE OF DAM

NO. 10: POOL IN ORIGINAL STREAM CHANNEL AT TOE OF DAM



NO. 11: BEAVER DAM ACROSS DOWNSTREAM CHANNEL



NO. 12: VALVE ON LAKE DRAWDOWN PIPE

APPENDIX F

HYDROLOGIC AND HYDRAULIC ANALYSIS

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 26.3 inches) from Hydrometeorological Report No. 33. The precipitation data used in the analysis of the 1 percent (100-year frequency) flood and the 0.1 percent (10-year frequency) flood was provided by the St. Louis District, Corps of Engineers.

b. Drainage area = 1.76 square miles = 1,130 acres.

c. SCS parameters:

Soil Group C = 100 percent
Soil type CN = 88 (AMC III, PMF condition)
= 75 (AMC II, 100-yr. and 10-year flood conditions)
Time of Concentration (Tc) = $\left(\frac{11.9L^3}{H}\right)^{0.385}$
Lag Time = 0.60 Tc = 0.28 hours

Where; T_c = Travel time of water from hydraulically most distant point to point of interest, hours.
L = Length of longest watercourse, miles.
H = Elevation difference, feet.

2. The principal and emergency spillway sections consist essentially of broad-crested, trapezoidal sections for which conventional weir formulas do not apply.

Spillway release rates for these sections were determined as follows:

a. Spillway crest section properties (area, "a" and top width, "t") were computed for various depths, "d."

b. It was assumed that flow over the spillway crest would occur at critical depth. Flow at critical depth was computed as $Qc = (\frac{a^3 g}{t})^{0.5}$ for the various depths, "d." Corresponding velocities (v_c) and velocity heads (H_{vc}) were determined using conventional formulas.

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

d. The discharges for the principal and emergency spillways for equal elevations were summated for entry on the Y4 and Y5 cards.

3. The profile of the dam crest between the principal spillway and emergency spillway is irregular and flow over the dam crest cannot be determined by 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 computes internally the flow over the dam crest and adds this flow to the flow over the principal and emergency spillways as entered on the Y4 and Y5 cards.

```
A1       ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
A2       HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF RICCO VALLEY LAKE DAM
A3       RATIOS OF PMF ROUTED THROUGH RESERVOIR
B     288          0         5                                                    0
B1      5
J       1          5         1
J1   .08       .08       .10       .50       1.0
K         INFLOW                                                    1
K1       INFLOW HYDROGRAPH
M         1         2      1.76                                1.0
P         C      26.3       102       120       130                             1
T                                                          -1       -80
K2                0.28
K    -1.0       -.10       2.0
K         1       DAM                                              1
K1       RESERVOIR ROUTING BY MODIFIED PULS
Y                                    1         1
Y1        1                                                  304.9        -1
Y4  630.0     630.3     631.5     632.0     632.5     633.0     633.5     634.0     634.5     635.0
Y4  635.5     636.0     636.5     637.0     637.5     638.0     638.5
Y5        0        30       170       330       505       640      1435      1945      2497      3070
Y5   3710      4395      5110      5835      6805      7750      8705
$A        C      27.8      46.0      93.0     149.4
$E   597.1       630       640       660       680
$$      630
$D   632.9
$L        1       100       200       272       474       498
$V   632.5     634.2     634.6     635.0     635.3     635.5
K        99
```

```
A1       ANALYSIS OF DAM OVERTOPPING USING 100YR FLOOD
A2       HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF HIDDEN VALLEY LAKE DAM
A3       100YR FLOOD ROUTED THROUGH RESERVOIR
B     288        0        5                                                    0
B1      5
J       1        1        1
J1    1.0
K       0   INFLOW                                         1
K1          INFLOW HYDROGRAPH
M       0        2     1.76                       1.0                          1
O     288
C1   .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
C1   .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
C1   .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
C1   .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
C1   .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
C1   .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
C1   .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
C1   .007     .007     .013     .013     .013     .013     .013     .013     .013     .013
C1   .013     .013     .013     .013     .013     .013     .013     .013     .013     .013
C1   .013     .013     .013     .013     .013     .013     .013     .013     .013     .013
C1   .013     .013     .013     .013     .013     .013     .013     .013     .013     .013
C1   .013     .013     .013     .013     .013     .013     .013     .013     .013     .013
C1   .013     .013     .013     .013     .013     .013     .013     .013     .013     .013
C1   .013     .013     .013     .013     .013     .013     .013     .013     .013     .013
C1   .013     .013     .013     .013     .024     .024     .024     .024     .024     .024
C1   .024     .024     .024     .024     .024     .024     .024     .024     .024     .024
C1   .024     .024     .031     .031     .031     .031     .031     .031     .049     .049
C1   .049     .049     .049     .049     .138     .138     .138     .262     .262     .544
C1   .813     .379     .262     .138     .138     .138     .049     .049     .049     .049
C1   .049     .049     .031     .031     .031     .031     .031     .031     .024     .024
C1   .024     .024     .024     .024     .024     .024     .024     .024     .024     .024
C1   .024     .024     .024     .024     .024     .024     .007     .007     .007     .007
C1   .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
C1   .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
C1   .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
C1   .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
C1   .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
C1   .007     .007     .007     .007     .007     .007     .007     .007     .007     .007
C1   .007     .007     .007     .007     .007     .007     .007     .007
T                                                              -1       -70
W2                0.28
X    -1.0         -.10      2.0
K       1        DAM                                          1
K1          RESERVOIR ROUTING BY MODIFIED PULS
Y                                             1        1
Y1      1                                                           304.9       -1
Y4  630.0    630.9    631.5    632.0    632.5    633.0    633.5    634.0    634.5    635.0
Y4  635.5    636.0    636.5    637.0    637.5    638.0    638.5
Y5      0       30      178      330      595      940     1435     1945     2457     3070
Y5   3710     4385     5110     5935     6805     7750     8705
$A      0     27.8     46.0     93.0    149.4
$E  597.1      620      640      660      680
$S    630
$D  632.9
$L      1      109      209      272      474      492
$V  632.9    634.2    634.9    635.0    635.3    635.5
K      99
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A1       ANALYSIS OF DAM OVERTOPPING USING 100YR FLOOD
A2       HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF HIDDEN VALLEY LAKE DAM
A3       100YR FLOOD ROUTED THROUGH RESERVOIR
P     288        0        5                                                  0
P1      5
J       1        1        1
J1    1.0
K       0   INFLOW                                           1
K1        INFLOW HYDROGRAPH
M       0        2     1.76                       1.0                        1
O     288
O1   .005     .005     .005     .005     .005     .005     .005     .005     .005     .005
O1   .005     .005     .005     .005     .005     .005     .005     .005     .005     .005
O1   .005     .005     .005     .005     .005     .005     .005     .005     .005     .005
O1   .005     .005     .005     .005     .005     .005     .005     .005     .005     .005
O1   .005     .005     .005     .005     .005     .005     .005     .005     .005     .005
O1   .005     .005     .005     .005     .005     .005     .005     .005     .005     .005
O1   .005     .005     .005     .005     .005     .005     .005     .005     .005     .005
O1   .005     .005     .010     .010     .010     .010     .010     .010     .010     .010
O1   .010     .010     .010     .010     .010     .010     .010     .010     .010     .010
O1   .010     .010     .010     .010     .010     .010     .010     .010     .010     .010
O1   .010     .010     .010     .010     .010     .010     .010     .010     .010     .010
O1   .010     .010     .010     .010     .010     .010     .010     .010     .010     .010
O1   .010     .010     .010     .010     .010     .010     .010     .010     .010     .010
O1   .010     .010     .010     .010     .010     .010     .010     .010     .010     .010
O1   .010     .010     .010     .010     .015     .015     .015     .015     .015     .015
O1   .015     .015     .015     .015     .015     .015     .015     .015     .015     .015
O1   .015     .015     .027     .027     .027     .027     .027     .027     .040     .040
O1   .040     .040     .040     .040     .091     .091     .091     .172     .172     .377
O1   .580     .262     .172     .091     .091     .091     .040     .040     .040     .040
O1   .040     .040     .027     .027     .027     .027     .027     .027     .015     .015
O1   .015     .015     .015     .015     .015     .015     .015     .015     .015     .015
O1   .015     .015     .015     .015     .015     .015     .005     .005     .005     .005
O1   .005     .005     .005     .005     .005     .005     .005     .005     .005     .005
O1   .005     .005     .005     .005     .005     .005     .005     .005     .005     .005
O1   .005     .005     .005     .005     .005     .005     .005     .005     .005     .005
O1   .005     .005     .005     .005     .005     .005     .005     .005     .005     .005
O1   .005     .005     .005     .005     .005     .005     .005     .005     .005     .005
O1   .005     .005     .005     .005     .005     .005     .005     .005     .005     .005
O1   .005     .005     .005     .005     .005     .005     .005     .005
T                                                                 -1      -70
W2              0.28
X    -1.0     -.10      2.0
K       1      DAM                                                1
K1       RESERVOIR ROUTING BY MODIFIED PULS
Y                                           1        1
Y1      1                                                     304.9       -1
Y4  630.0    630.9    631.5    632.0    632.5    633.0    633.5    634.0    634.5    635.0
Y4  635.5    636.0    636.5    637.0    637.5    638.0    638.5
Y5      0       30      178      330      565      940     1435     1945     2497     3070
Y5   3710     4385     5110     5935     6805     7750     8705
$A      0     27.9     46.0     93.0    149.4
$E  597.1      630      640      660      680
$$    630
$D  632.9
$L      1      109      209      272      474      492
$V  632.9    634.2    634.9    635.0    635.3    635.5
K      99
```

SUMMARY OF DAM SAFETY ANALYSIS
RATIOS OF PMF

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	630.00	630.00	632.90
STORAGE	305.	305.	392.
OUTFLOW	0.	0.	871.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.08	632.77	0.00	388.	782.	0.00	16.17	0.00
.00	632.95	.05	394.	907.	.25	16.17	0.00
.10	633.11	.21	399.	1055.	.58	16.08	0.00
.50	634.10	1.25	509.	7726.	6.17	15.92	0.00
1.00	637.88	4.98	577.	16462.	7.42	15.92	0.00

SUMMARY OF DAM SAFETY ANALYSIS
100-YR. FLOOD

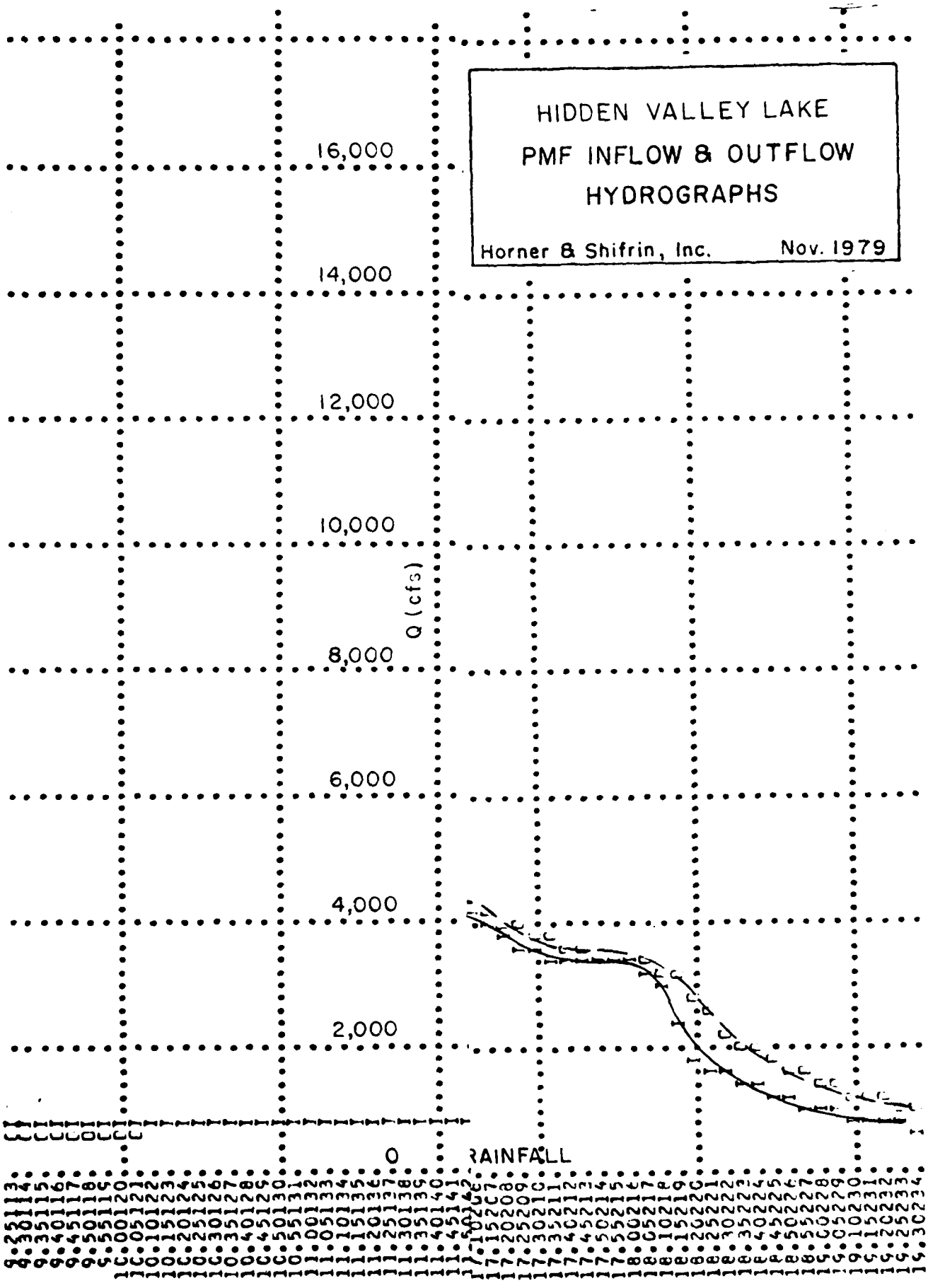
	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	630.00	630.00	632.00
STORAGE	305.	305.	392.
OUTFLOW	0.	0.	871.

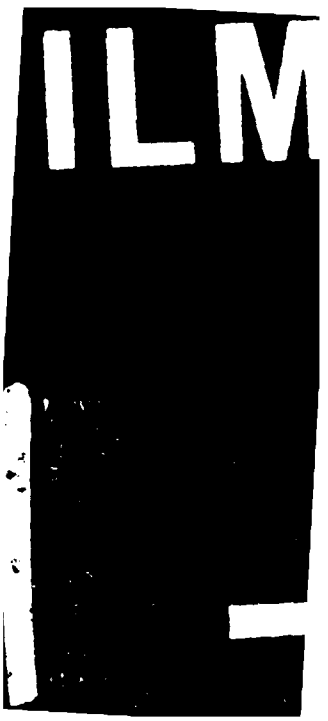
RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	634.13	1.23	434.	2250.	1.17	15.17	0.00

SUMMARY OF DAM SAFETY ANALYSIS-
10-YR. FLOOD

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	630.00	630.00	632.90
STORAGE	305.	305.	392.
OUTFLOW	0.	0.	871.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	632.87	0.00	391.	851.	0.00	15.83	0.00


HIDDEN VALLEY LAKE
PMF INFLOW & OUTFLOW
HYDROGRAPHS
Horner & Shifrin, Inc. Nov. 1979
16,000
14,000
12,000
10,000
8,000
6,000
4,000
2,000
0
Q (cfs)
RAINFALL


ILM