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NATIONAL DAM SAFETY PROGRAM. DONALD STRAUS LAKE DAM (MO 30275),--ETC(U)
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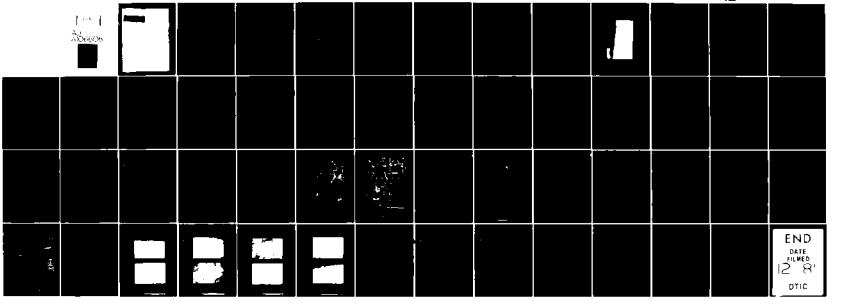

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Dam Safety, Lake, Dam Inspection, Private Dams

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

IN REPLY REFER TO

SUBJECT: Donald Straus Lake Dam (MO 30275)

This report presents the results of field inspection and evaluation of the Donald Straus 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 could result in dam failure
3) Dam failure significantly increases the hazard to loss of life downstream
4) Extensive erosion of the spillway channel has occurred along the toe of the downstream embankment slope

SUBMITTED BY: SIGNED
Chief, Engineering Division
20 SEP 1979
Date

APPROVED BY: SIGNED
Colonel, CE District Engineer
20 SEP 1979
Date

MISSISSIPPI - KASKASKIA - ST. LOUIS BASIN

DONALD STRAUS LAKE DAM

ST. FRANCOIS COUNTY, MISSOURI

MO 30275

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY INSPECTION

United States Army
Corps of Engineers
...Serving the Army
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St. Louis District

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

FOR: STATE OF MISSOURI

AUGUST 1979

DONALD STRAUS LAKE DAM - MISSOURI INVENTORY NO. 30275

ST. FRANCOIS 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

AUGUST 1979

HS-7925

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Donald Straus Lake Dam
State Located:	Missouri
County Located:	St. Francois
Stream:	Tributary Flat River
Date of Inspection:	17 July 1979

The Donald Straus 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 is considered to be unsatisfactory. 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. The upstream face of the dam has a grass cover to protect the slope from erosion. A grass covered slope is not considered adequate to prevent erosion by wave action or by fluctuations of the water level.
2. A dense cover of vegetation (brush, small trees, and tall grass) that may contain animal burrows exists on the upstream and downstream faces of the dams. Tree roots and

animal burrows can provide passageways for seepage that could develop into a piping condition that can lead to failure of the dam.

3. Underseepage, as evidenced by wet and soft ground, cattails and ponded water, was observed in the vicinity of the downstream toe of slope junction with the right abutment. Seepage was also noticed emerging from the right (dam side) bank of the spillway outlet channel, beginning at a point approximately one-third of the way down from the top of the dam. Uncontrolled seepage could develop into a piping condition that can lead to failure of the dam.
4. The banks of the spillway outlet channel are severly eroded in several locations and the channel has cut into the embankment at the base of the dam. Since the location of the spillway channel encroaches on the dam, continued erosion of the embankment by spillway flow could lead to instability of the slope and possible failure of the dam.
5. A wire mesh type fence is located in the lake just upstream of the spillway pipes. The fence could act as a barrier upon which lake carried debris can lodge and prevent lake outflow from reaching the spillway pipes resulting in flooding of the lake and possible overtopping of the dam.

According to the criteria set forth in the recommended guidelines, the magnitude of the spillway design flood for the Donald Straus 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 railroad crosses the downstream channel at a point approximately 800 feet below the dam, 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. Results of a hydrologic/hydraulic analysis indicated that the existing spillways are inadequate to pass lake outflow

resulting from a storm of PMF magnitude. The principal spillway is adequate to pass lake outflow resulting from the 1 percent chance (100 year frequency) flood. Both spillways, principal plus emergency, are capable of passing lake outflow corresponding to about 37 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 one mile. Accordingly, within the possible damage zone are two roads, a railroad, three dwellings, and several other 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.

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

Karl L. Freese
P.E. Missouri E-16182

OVERVIEW DONALD STRAUS LAKE DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

DONALD STRAUS LAKE DAM - ID. NO. 30275

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

DONALD STRAUS LAKE DAM - ID NO. 30275

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. National Dam Inspection Act, Public Law 92-367, dated 8 August 1972.

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 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 of the Chief of Engineers on the National Program of Dams," dated May 1975.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances. The Donald Straus Lake Dam is an earthfill type embankment rising approximately 37 feet above the original stream bed. The embankment has an upstream slope (above the waterline) of 1v on 3h, a crest width of about 14 feet, and a downstream slope of 1v on 2h. The length of the dam including the spillway section is approximately 610 feet. An unpaved road traverses the dam crest. 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 9 acres.

The principal spillway, three 30-inch diameter pipes approximately 37 feet long, passes through the dam at the east or left abutment. An emergency spillway, a trapezoidal section crossing the dam crest, is also located at the left abutment directly above the spillway pipes. A common outlet channel serves both the principal and emergency spillways. The spillway discharge channel, and unimproved trapezoidal section of variable width, follows closely the intersection of the downstream toe of the dam and the left abutment until it reaches the area below the dam. At a point just below the dam, spillway releases are no longer confined by a channel and must spread over a wide area before joining the downstream channel. A paved county road lies approximately 100 feet below the dam where a 2-foot high by 4-foot wide culvert allows flow in the channel to continue downstream. A profile of the outlet channel through the spillway pipes is shown on Plate 4.

b. Location. The dam and lake are located on an unnamed tributary of Flat River, approximately 5 miles southwest of Flat River, Missouri, as shown on the Regional Vicinity Map, Plate 1. The dam is located in Section 21, Township 36 North, Range 4 East, in St. Francois 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. The Donald Straus 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, extensive 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 one mile downstream of the dam. Within the

possible damage zone are two roads, a railroad, three dwellings and several other buildings.

e. Ownership. The lake and dam are owned by Donald Straus. Mr. Straus's address is: 504 Taylor Avenue, Flat River, Missouri - 63601.

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

g. Design and Construction History. According to the Owner, the dam was constructed in 1965 and the builder of the dam was a Mr. E. Paul Black, an excavating and grading contractor, from Elvins, Missouri. According to both the Owner and Mr. Black, the dam was constructed without the benefit of formal engineering design data or plans.

h. Normal Operational Procedure. The lake level is unregulated.

1.3 PERTINENT DATA

a. Drainage Area. The area tributary to the lake is essentially undeveloped and in a native state covered with timber. There are several dwellings and other buildings adjacent to the county road at the east side of the drainage area. The watershed above the dam amounts to approximately 141 acres. The watershed area is outlined on Plate 2.

b. Discharge at Damsite.

(1) Estimated known maximum flood at damsite ... 3 cfs*

(2) Spillway capacity (principal) ... 114 cfs (W.S. = Elev. 918.2)

(3) Spillway capacity (principal + emergency) ... 244 cfs (W.S. = Elev. 919.4)

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

c. Elevation (ft. above MSL). The following elevations were determined by survey and are based on topographic data shown on the 1958 USGS Flat River, Missouri Quadrangle Map, 7.5 Minute Series.

(1) Top of dam ... 919.4 (min.)

(2) Normal pool (spillway crest) ... 913.3

(3) Streambed at centerline of dam ... 882±

(4) Maximum tailwater ... Unknown

d. Reservoir.

(1) Length at normal pool (elevation 913.3) ... 1,000 ft.

(2) Length at maximum pool (elevation 919.4) ... 1,500 ft

e. Storage.

(1) Normal pool ... 111 ac. ft.

(2) Top of dam (incremental) ... 68 ac. ft.

f. Reservoir.

(1) Normal Pool ... 9 acres

(2) Top of dam (Incremental) ... 3 acres

g. Dam.

(1) Type ... Earthfill, homogeneous*

(2) Length ... 610 ft.

(3) Height ... 37 ft.

(4) Top width ... 14 ft.

(5) Side slopes

a. Upstream ... 1v on 3h

b. Downstream ... 1v on 2h

(6) Cutoff ... Clay core*

(7) Slope protection

a. Upstream ... Grass

b. Downstream ... Grass

*Per builder of dam.

h. Principal Spillway.

(1) Type ... Uncontrolled, three 30-inch diameter steel pipes

(2) Length of pipes ... 37 ft.

(3) Crest elevation ... 913.3

(4) Approach channel ... Lake

(5) Exit channel ... Earth cut, trapezoidal section

i. Emergency Spillway.

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

(2) Crest ... Elevation 918.2

(3) Approach channel ... Lake

(4) Exit channel ... Same as principal spillway

j. Lake Drawdown Facility. ... None

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

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

2.2 CONSTRUCTION

No formal records were kept during construction of the dam. Both Mr. Straus, the Owner, and Mr. Black, the contractor who built the dam, reported that a core trench about 6 or 7 feet deep and approximately 20 feet wide, was excavated along the centerline of the dam. According to Mr. Black, the trench, however, was not carried to rock throughout its entire length. The material used to backfill the trench and construct the embankment, a stoney red clay, was obtained from the area to be occupied by the lake. The Owner recalled that compaction of the fill was obtained using a sheepsfoot roller.

2.3 OPERATION

The lake level is uncontrolled and governed by the upstream invert elevation of the 30-inch diameter pipes located at the left abutment. An emergency spillway, with a crest elevation approximately 4.9 feet higher than the crest elevation of the pipe spillway and about 1.2 feet lower than the top of the dam at its lowest point, is also located at the left abutment. The Owner reported that the dam has never been overtopped and that the highest lake level observed to date produced a depth of flow at the spillway pipes estimated to be about 3 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 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.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of the Donald Straus Lake Dam was made by Horner & Shifrin engineering personnel, K.L. Freese, Civil Engineer and Hydrologist, A.B. Becker, Jr., Civil and Soils Engineer, on 17 July 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-4 of Appendix A.

b. Area Geology. The dam site is located on the northern flank of the Ozark Uplift on nearly flat-lying Cambrian age sedimentary rock. The uniform bedrock structure is intersected by the northwest-southeast trending Simms Mountain Fault System which passes through the area approximately 1,500 feet south of the dam site. The Cambrian age Potosi and Derby-Doerun formations are exposed north of the fault zone and the older Cambrian-Bonneterre and Lamotte and Precambrian rhyolite porphyry are exposed south of the fault.

The lake and dam are founded on weathered residuum from the Potosi dolomite which reportedly overlies 20 to 40 feet of unweathered Potosi bedrock. The weathered residuum is a red, blocky clay with abundant chert and quartz druse. Although there were no bedrock exposures found in the reservoir and dam area, it is known that the Potosi is a masssive, thickly-bedded, medium-to-fine-grained dolomite with abundant quartz druse and chert. The dam appears to have been built entirely of Potosi residuum.

Severe erosion of Potosi residuum and the materials comprising the toe of the dam has occurred along the spillway from near the

left abutment to near the center of the dam. This erosion appears to be the result of the high velocities of flow through the spillway and the fact that the spillway is located on thick residuum with no bedrock near the surface to retard erosion, rather than a result of a highly erodible soil type.

The Simms Mountain Fault System does not cross the dam site or reservoir and is considered to be inactive.

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 right bank of the spillway outlet channel (see Photo 5) has removed embankment materials from the downstream toe of the dam along an area extending from near the left abutment to about the center of the dam. Loss of embankment fill appeared to be a depth of several feet in some locations. Both the upstream and downstream faces of the dam have a substantial cover of vegetation that includes decorative plants, tall grass, brush, and small trees. No animal burrows were seen but due to the dense cover of vegetation in some areas, it could not be concluded that none exist. Some minor surface erosion of the unprotected upstream face at the waterline was noticed. No cracking of the surface or misalignment of the crest of the dam was noticed.

Seepage was observed in the vicinity of the downstream toe of slope junction with the right abutment (see Photo 6). Seepage flow at this location was estimated to be about 2 gpm. Seepage was also noticed emerging from the right (dam side) bank of the spillway outlet channel beginning at a location about 12 feet below the top of the dam and again at about 18 feet below the top of the dam. The total quantity of seepage entering the spillway channel from the bank was estimated at less than 1 gpm.

The three 30-inch diameter steel spillway pipes (see Photos 3 and 4) appeared to be in sound condition with only a light coating of rust due to corrosion. At the upstream end of the pipes, some erosion of the unprotected earth bank has occurred. A wire mesh type fence exists in the lake just upstream of the spillway pipes. Erosion of the bank at the downstream end of the spillway pipes has

..dercut the pipes about 2.5 feet. Riprap, consisting mostly of stones less than 8 inches across, serves to protect the spillway outlet channel in the area just below the spillway pipes. The riprap, however, is not uniformly distributed and covers only portions of the channel invert. The spillway channel banks, except for the area adjacent to the pipe outlets, are unprotected. The right bank of the spillway channel, as previously stated, is extensively eroded and there has been a loss of materials that make up the embankment at the toe of the dam. The affected channel extends from a point near the left abutment to a location near the center of the dam.

The crest portion of the emergency spillway, which is located in the dam at the spillway pipes, appeared to be in satisfatory condition, although, as indicated above, the lake approach side of the spillway pipes is unprotected and some erosion has occurred. The downstream side at the spillway pipes is also eroded, however, there is a light covering of riprap to protect the slope.

d. Downstream Channel. The channel downstream of the dam is unimproved and extends for approximately 1,000 feet before joining the Flat River. At a distance of about 800 feet, a 6-foot wide by 5-foot high concrete arch culvert allows the stream to pass beneath railroad tracks belonging to the Missouri Illinois Railroad. Flow in the culvert at the time of the inspection was estimated to be about 2 to 3 gpm, approximately the same flow observed, and believed to be seepage from the lake.

e. Reservoir. The area adjacent to the lake is for the most part in a natural state and wooded. The lake shoreline opposite the dam (see Photo 8) is without plant cover and appeared to be experiencing some erosion. 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.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The spillway is uncontrolled. The water surface level is governed by precipitation runoff, evaporation, seepage, and the capacity of the uncontrolled principal and emergency spillways.

4.2 MAINTENANCE OF DAM AND SPILLWAY

Based on the substantial cover of small trees and brush on the upstream and downstream slopes of the dam and the eroded condition of the spillway outlet channel, it is apparent that these areas receive little attention. The Owner did report that spraying is done periodically to control the growth of vegetation.

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

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 performed.

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 developed from the USGS Flat River, Missouri, Quadrangle Map. The proportions and dimensions of the spillway and dam were developed from surveys made during the inspection.

c. Visual Observations.

(1) The principal spillway consists of three 30-inch welded steel pipes approximately 37 feet long.

(2) The spillway is located within the embankment near the left (east) abutment.

(3) The spillway outlet channel follows closely the intersection of the embankment and the abutment. The upper reach of the channel, at the pipe discharge, is protected from erosion by stone riprap. The lower reaches of the channel are defined by deep erosion near and at the toe of the existing embankment. The small amount of gravel in the base of the channel section is the result of sedimentation from the upper reaches and the stoney native soils. Since the spillway channel encroaches on the embankment, it is possible that spillway releases will continue to cause damage to the dam unless certain alterations to the outlet channel and/or embankment are made. A profile of the spillway channel invert is shown on Plate 4.

(4) An emergency spillway, a broad-crested approximately trapezoidal section is also located near the left abutment and directly above the spillway pipes. The outlet channel for the principal (pipe) spillway also serves the emergency spillway.

(5) No lake level drawdown facilities are provided.

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

Ratio of PMF	Q-Peak Outflow (cfs)	Max. Lake W.S. Elev.	Maximum Depth of Flow Over Dam (Elev. 919.4)	Duration of Overtopping Of Dam (Hours)
0.37	244	919.4	0.0	0.0
0.50	1,014	920.1	0.7	1.9
1.00	2,808	920.7	1.3	4.8
100-Yr. Flood	77	916.2	0.0	0.0

Elevation 919.4 was found to be the lowest point in the dam crest. The flow safely passing the spillways just prior to overtopping was determined to be 244 cfs, which amounts to 37 percent of the probable maximum flood inflow. This inflow is greater that the outflow from the 1 percent chance (100-year frequency) flood. During peak flow of the probable maximum flood, the greatest depth over the dam would be 1.3 feet and the overflow would extend for about 550 feet across the center of the dam.

e. Evaluation. Observations made of the existing spillway channel indicate that the embankment material (gravelly, red clay) can under certain circumstances be very erodible. When large spillway releases pass through the channel, flow velocities increase, resulting in a very erosive condition along the sides of the channel, especially at the outside of bends or changes in the course of the channel or where the channel encroaches on the dam and fill ground is encountered. Erosion from high velocity flow could lead to instability of the embankment and possibly failure of the dam. Since it is known that the materials used to construct the dam

can be eroded by high velocity flows, it is likely that for the PMF condition, where the depth of flow overtopping the dam (1.3 feet maximum) and the duration of flow over the dam (4.8 hours) are appreciable, damage to the downstream face of the dam will occur. The extent of these damages are not predictable, however, they could result in failure of the dam.

f. References. Procedures and data for determing the probable maximum flood, the 100-year frequency flood, and the discharge rating curve for flow passing 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 and B-4 of the Appendix. A copy of the computer output table entitled "Summary of Dam Safety Analysis" is presented on Page B-5 and the inflow and outflow hydrographs for the probable maximum flood are shown on Page B-6 of the Appendix. Area-storage curves for the reservoir are presented on Plate 5 and spillway discharge 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. Desgn and Construction Data. No design or construction data relating to the structural stability of the dam are known to exist. Lack of seepage and stability analyses is considered a deficiency.

c. Operating Records. No appurtenant structures or facilities requiring operation exist at this dam. According to the Owner, no records are kept of the lake level, spillway discharge, dam settlement, or seepage.

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

e. Seismic Stability. Since the dam is located within a Zone II seismic probability area, and since the known geologic faults that lie within the nearby surrounding area are considered inactive, an earthquake of the magnitude predicted is not expected to produce a hazardous condition to the dam, provided that static stability conditions are satisfactory and conventional safety margins exist.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. A hydraulic analysis indicates the spillways (principal plus emergency) are capable of passing lake outflow of about 244 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, indicated that for storm runoff of probable maximum flood magnitude, the lake outflow would be on the order of 2,808 cfs, and that for the 1 percent chance (100-year frequency) flood, the lake outflow would be about 77 cfs.

Several items were noticed during the inspection that could adversely affect the safety of the dam. These items include seepage, brush and trees on the upstream and downstream faces of the dam, lack of adequate slope protection on the upstream face of the dam, a wire fence that lies within the lake just upstream of the spillway pipes, and damage to the downstream toe of the dam due to erosion of the spillway outlet channel.

Stability and seepage 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 assessment of the hydrology of the watershed and capacity of the spillways were based on a hydrologic/hydraulic study as indicated in Section 5. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

c. Urgency. The 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 advised that priority be given to restoring the eroded areas of the spillway channel which has resulted in damage to the downstream toe of the dam, a condition considered to be detrimental to the stability of the embankment.

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

e. Seismic Stability. Since the dam is located within a Zone II seismic probability area, and since the known geologic faults that lie within the nearby surrounding area are considered inactive, an earthquake of the magnitude predicted 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 stability and seepage 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 dams.

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

(1) Restore where required the upstream face of the dam and

provide some form of protection for the dam face at and above the normal waterline in order to prevent erosion by wave action.

(2) Remove the trees and brush that may conceal animal burrows from the upstream and downstream slopes of the dam. Tree roots and animal burrows provide a passageway for seepage that can lead to a piping condition and subsequent failure of the dam. The existing turf cover should be restored if destroyed or missing. Maintain the turf cover on the slopes at a height that will not hinder inspection of the slope or provide cover for burrowing animals. The removal of trees should be performed under the direction of an engineer experienced in the design and construction of earth dams.

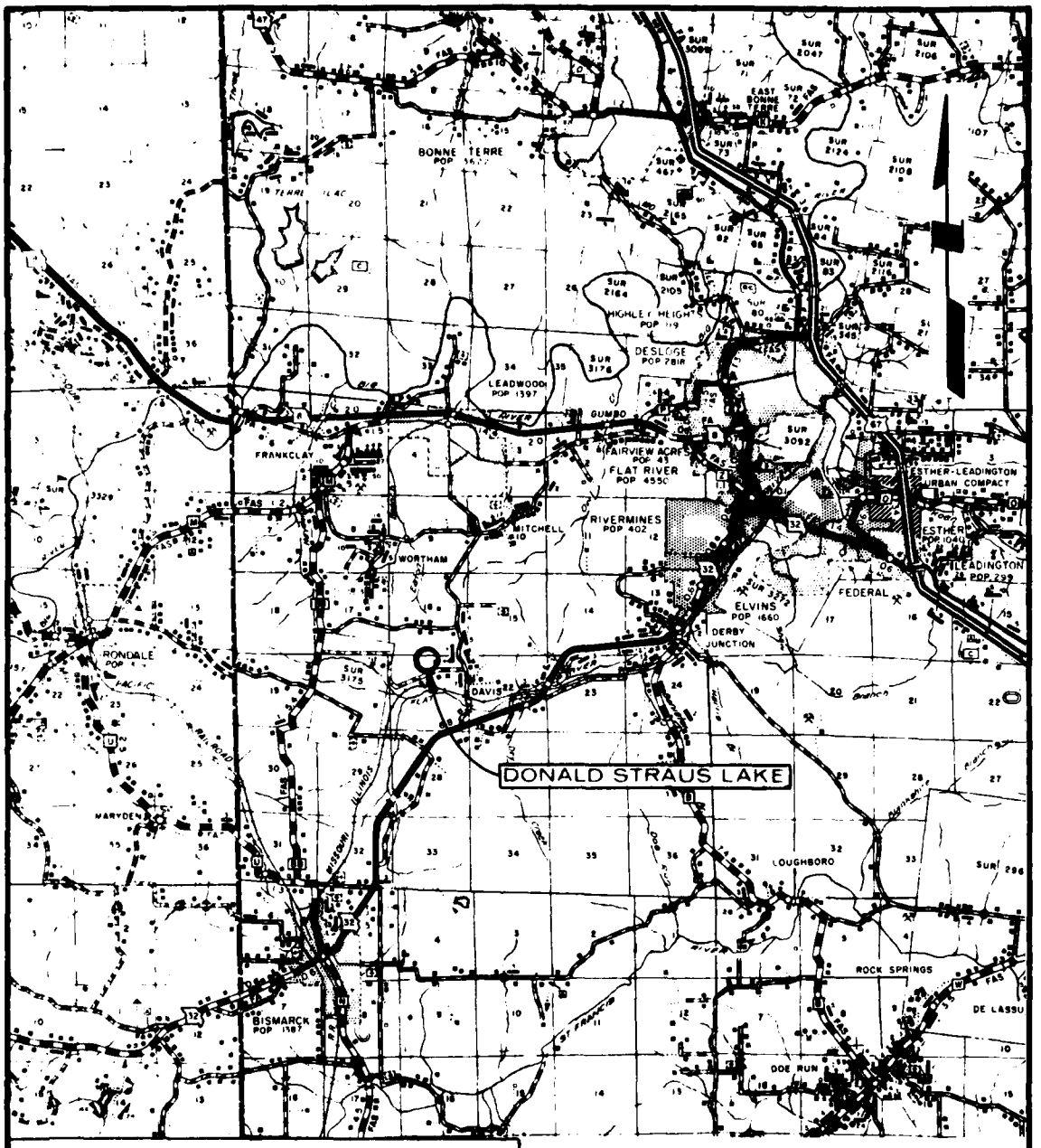
(3) Restore the eroded areas of the spillway channel and provide some form of protection particularly along the dam side of the channel in order to prevent future erosion of embankment materials by spillway flows. Since the location of the spillway channel encroaches on the dam, continued erosion of the embankment could lead to instability of the slope and possible failure of the dam.

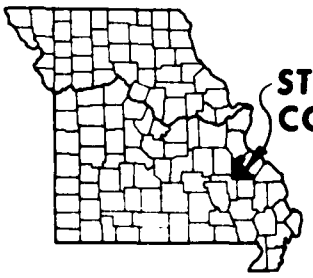
(4) Provide some means of preventing piping (progressive internal erosion) due to seepage at the right abutment area and within the spillway discharge channel.

(5) Remove the wire mesh fence that could restrict lake outflow from entering the spillway pipes. A reduction in spillway capacity could result in unwarranted flooding of the lake and overtopping of the embankment.

(6) Provide maintenance of all areas of the dam and spillways on a regularly scheduled basis in order to insure features of the dam 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.





LOCATION MAP

DONALD STRAUS LAKE

1 0 1 2 3 4

SCALE (MILES)

REGIONAL VICINITY MAP

PLATE 1

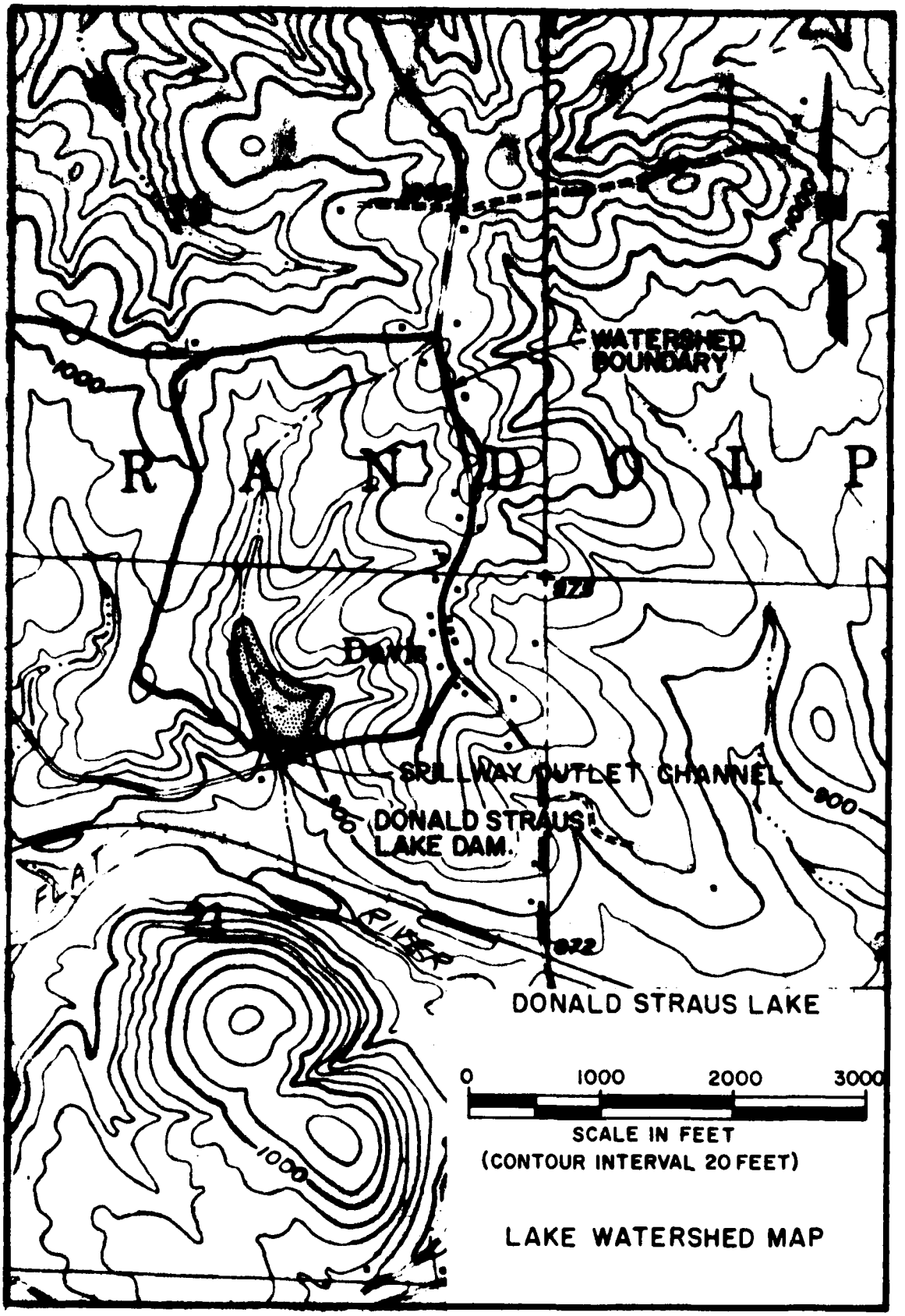
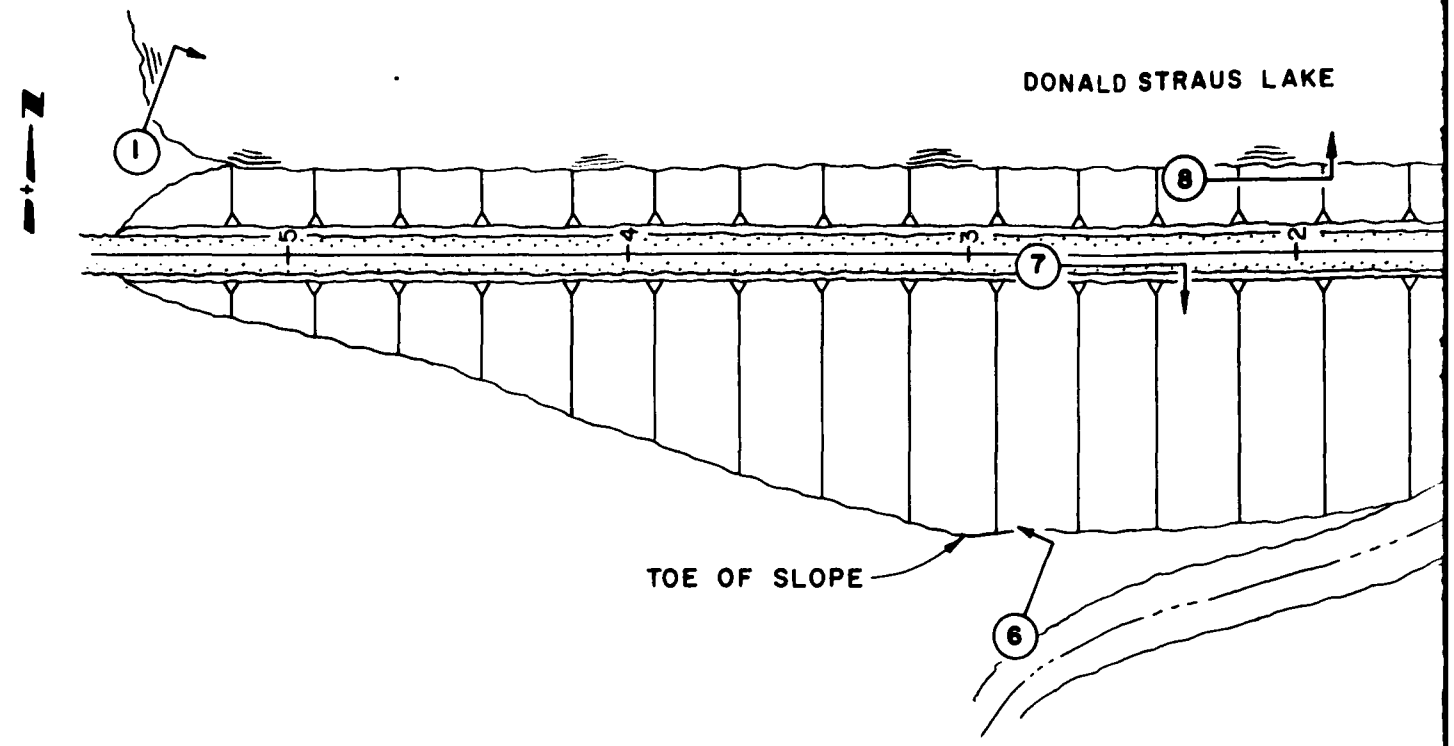
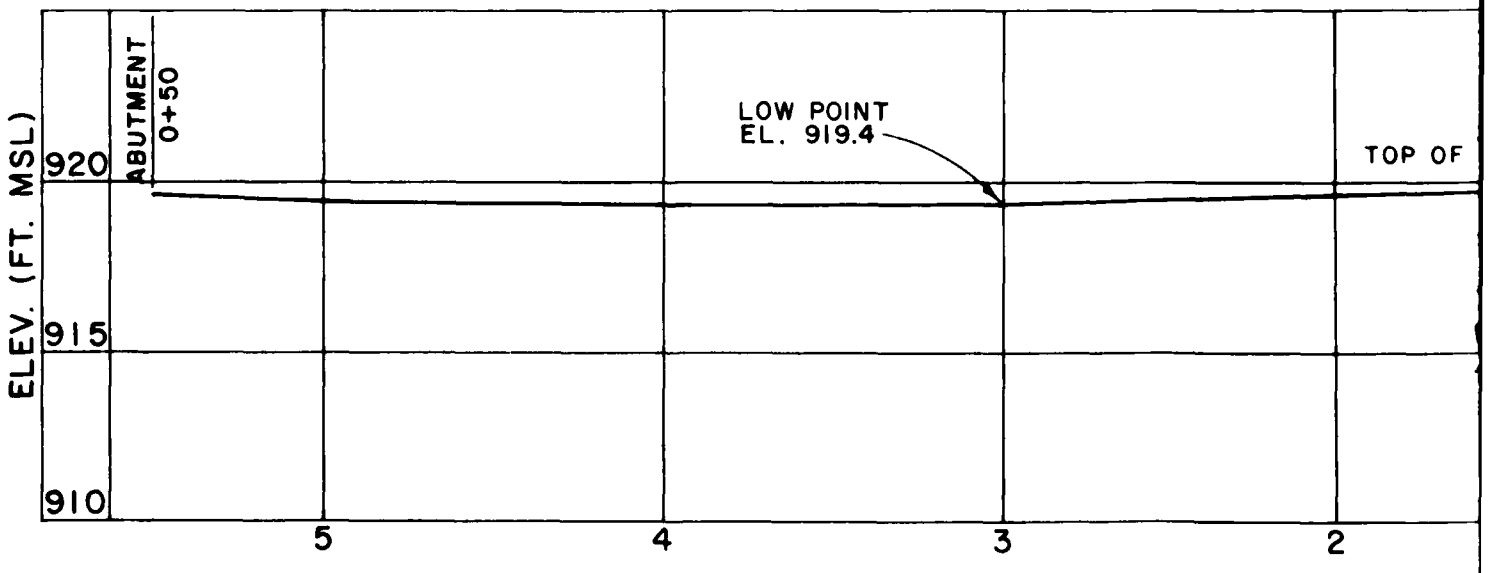

WATERSHED BOUNDARY
R A N D O L P
1000
975
Dam
SPILLWAY OUTLET CHANNEL
900
DONALD STRAUS LAKE DAM.
FLAT
RIVER
972
DONALD STRAUS LAKE
1000
0 1000 2000 3000
SCALE IN FEET
(CONTOUR INTERVAL 20 FEET)
LAKE WATERSHED MAP

PLATE 2

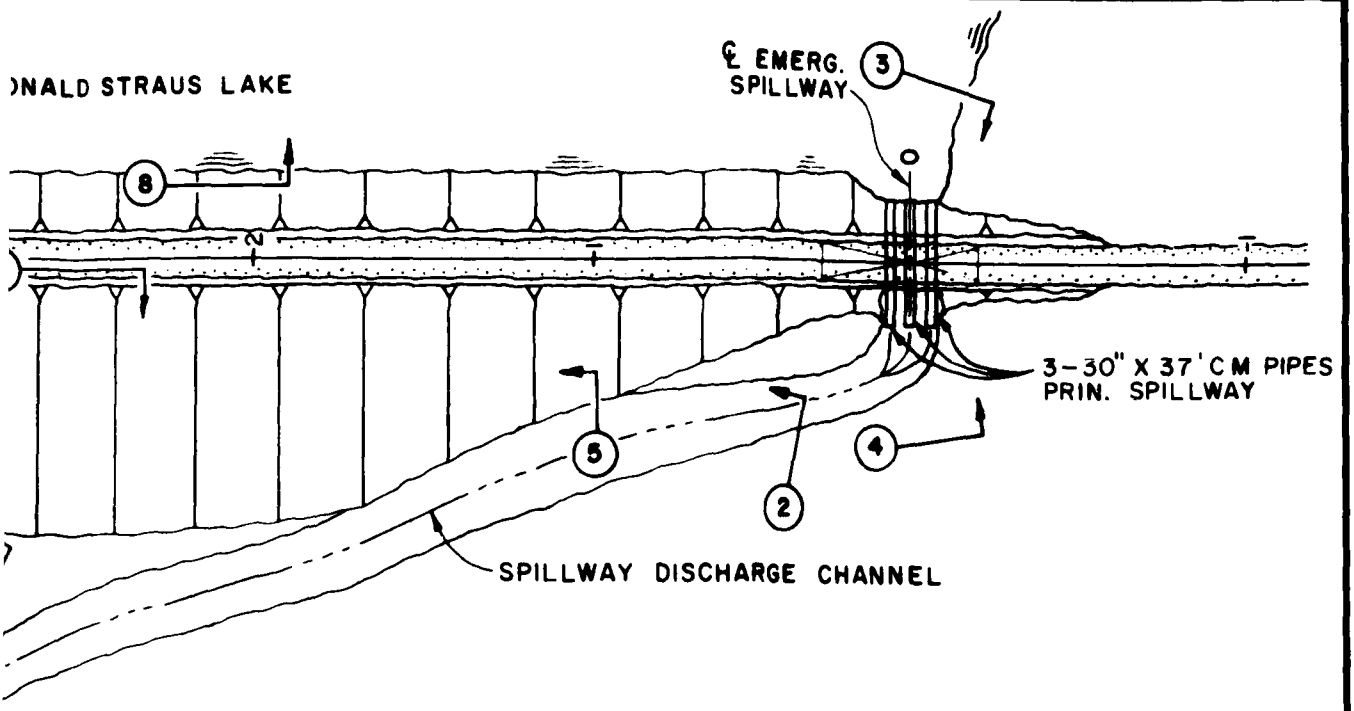


GENERAL PLAN OF DAM
SCALE: 1"=50'



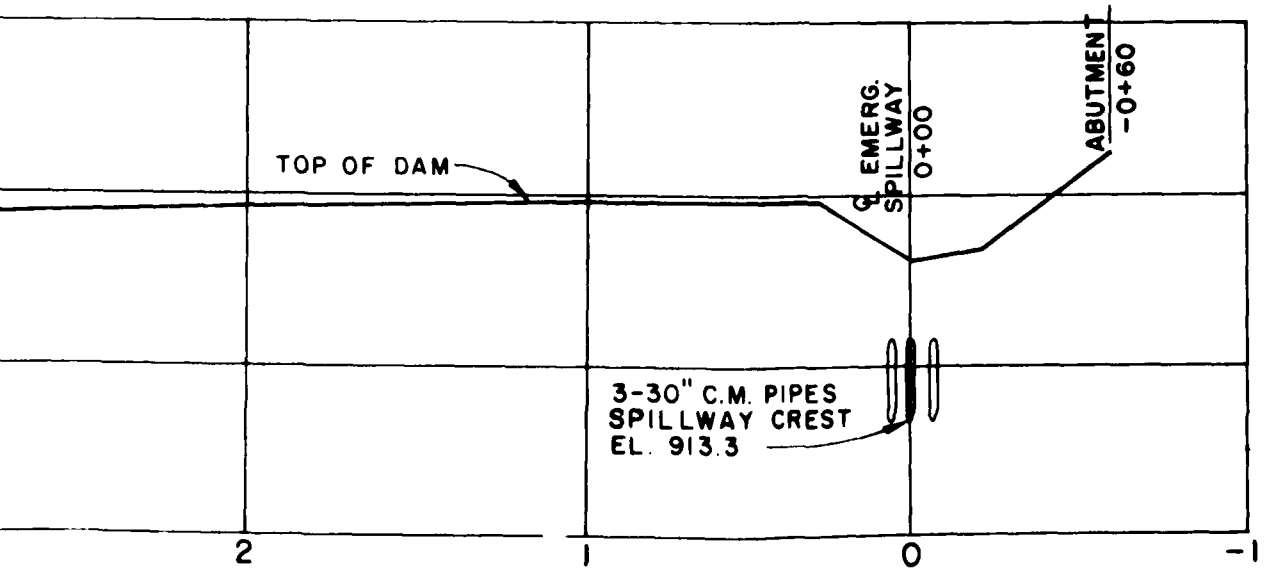
PROFILE DAM CREST
SCALES: 1"=5'V., 1"=50'H.

6
PHOTO LOCATION & KEY
(SEE APPENDIX A)



RAL PLAN OF DAM

SCALE 1"=50'



OFILE DAM CREST

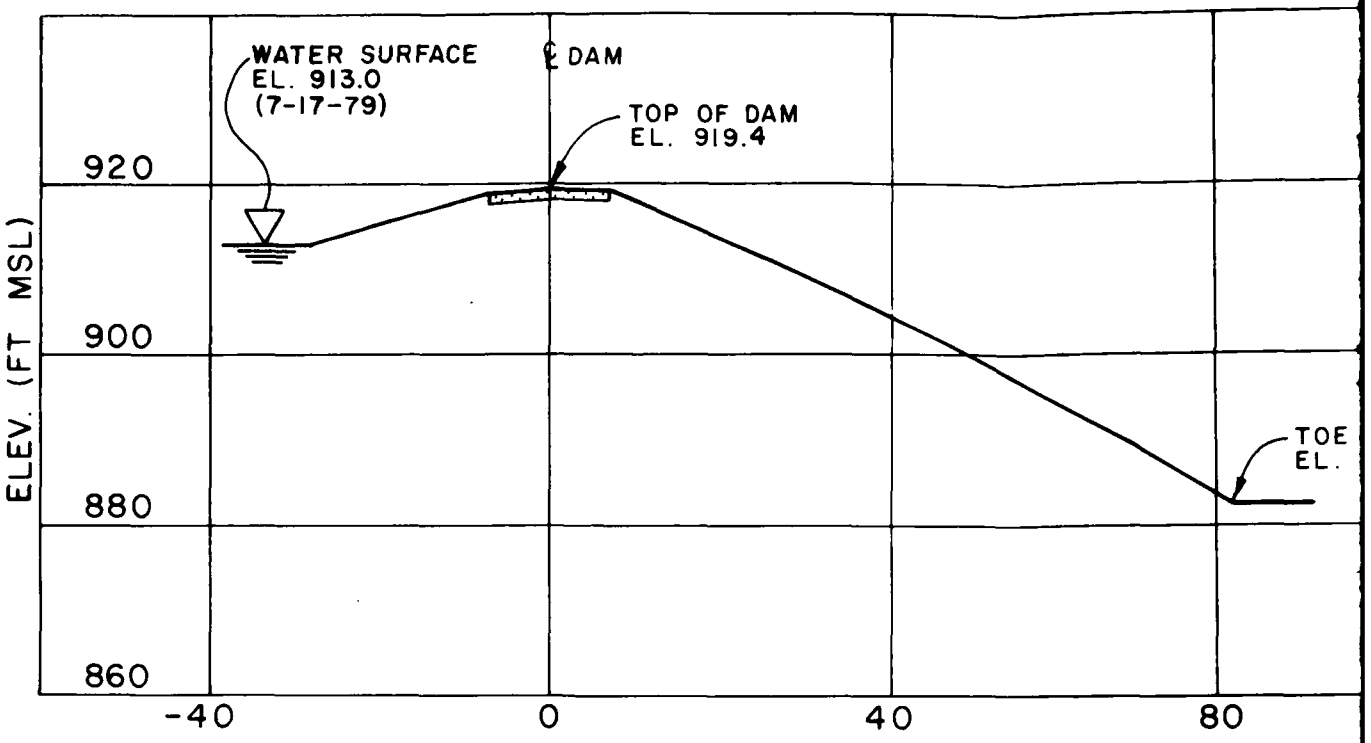
CALES: 1"=5' V., 1"=50' H.

2

DONALD STRAUS LAKE
DAM PLAN & PROFILE

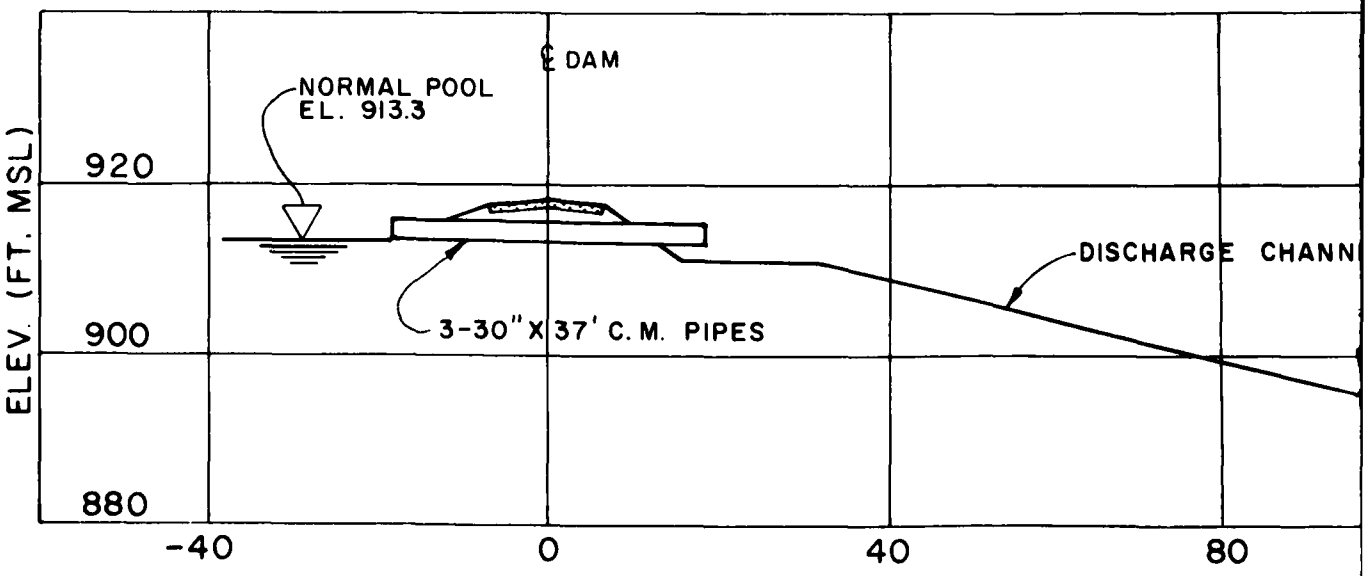
Horner & Shifrin, Inc. Aug. 1979

PLATE 3



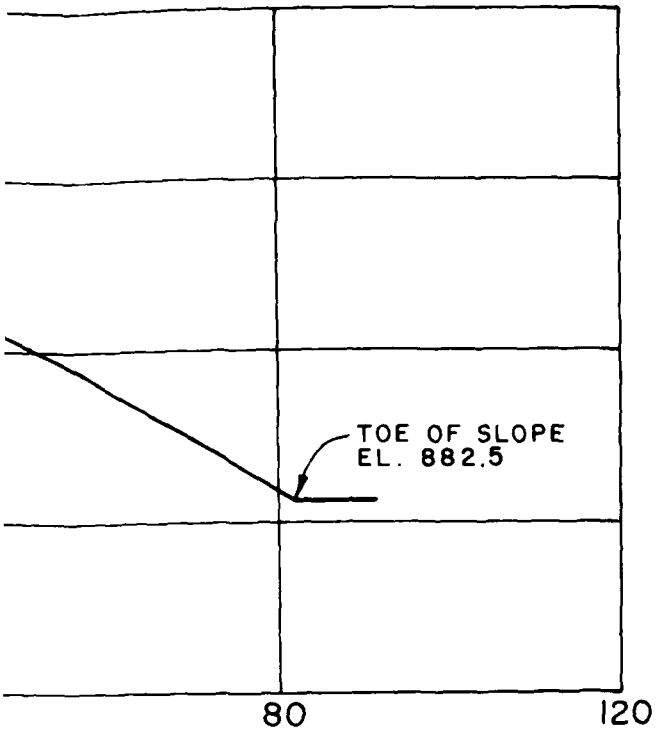
DAM CROSS SECTION STA. 3+00

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

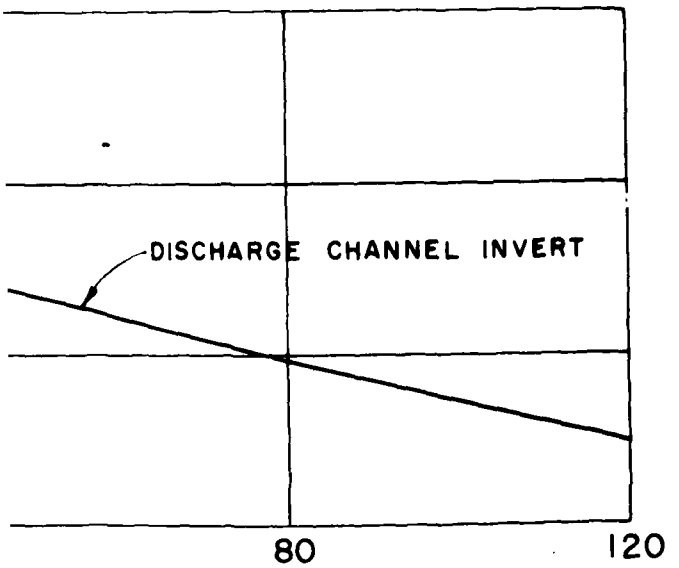


PROFILE SPILLWAY ℄

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



STA. 3+00
0'H.

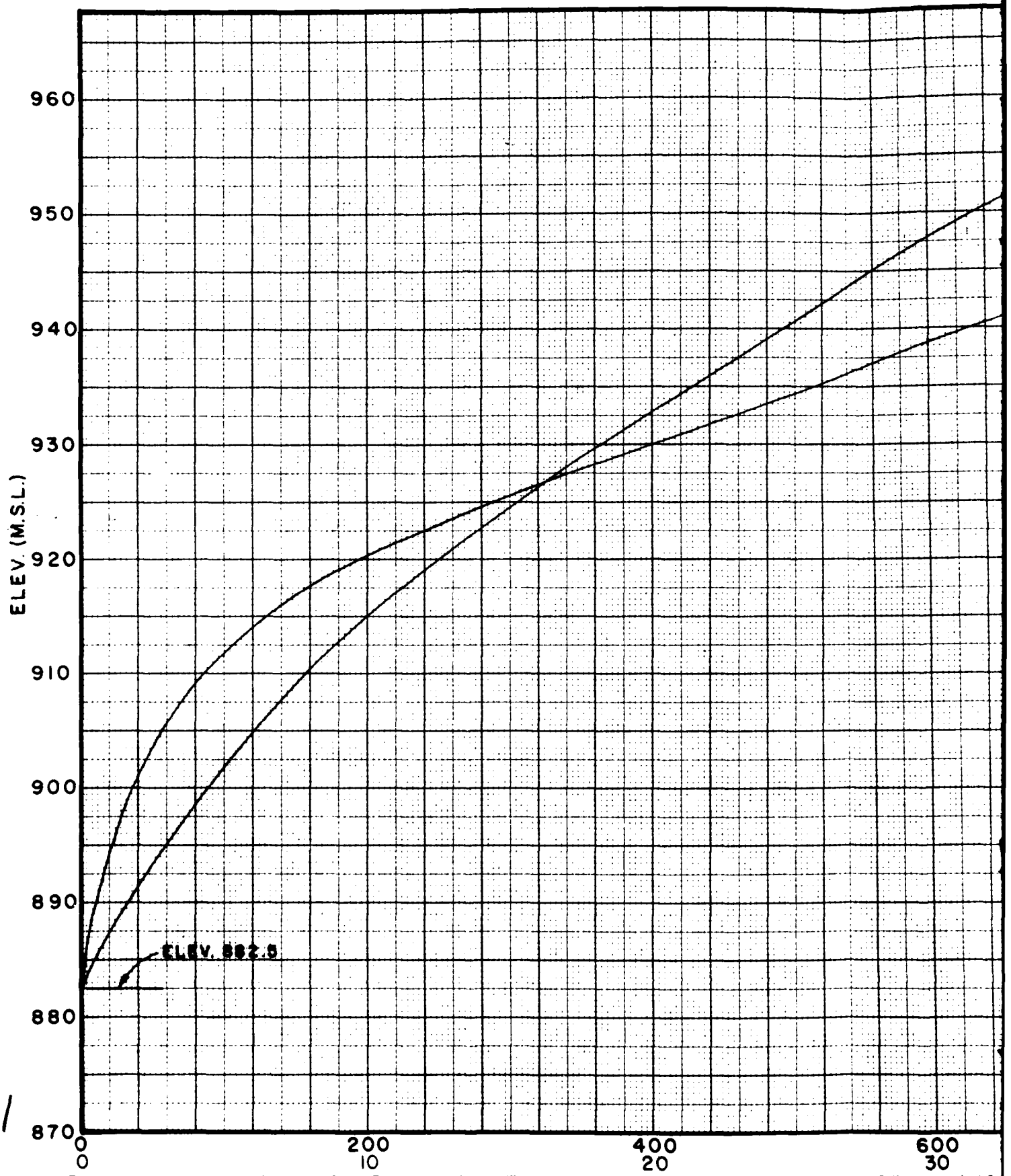


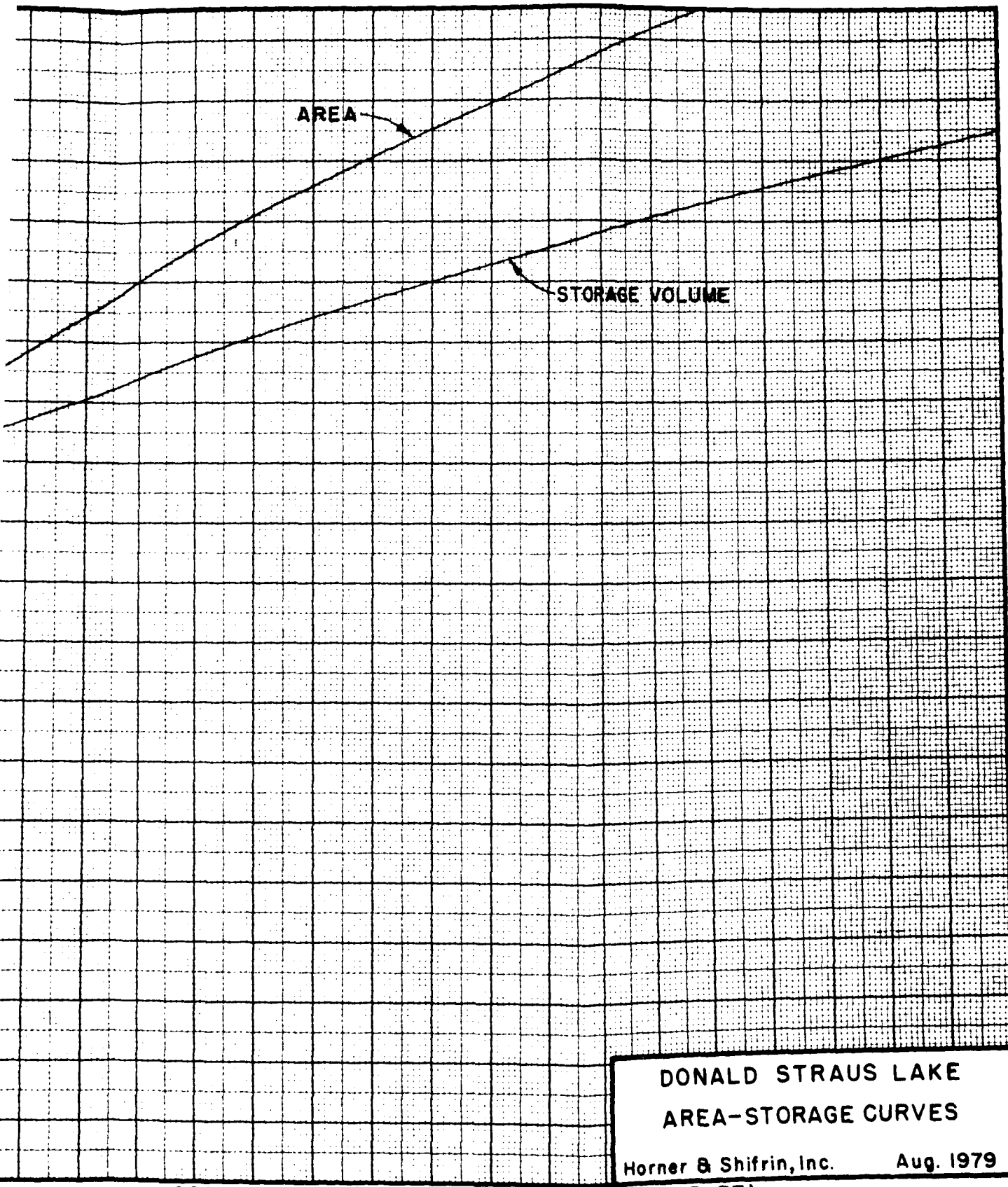
℄
'H.

2

DONALD STRAUS LAKE
DAM CROSS SECTION &
SPILLWAY PROFILE
Horner & Shifrin, Inc. Aug. 1979

PLATE 4


960
950
940
930
920
910
900
890
880
870
ELEV. (M.S.L.)
ELEV. 882.5
0
0
200
10
400
20
600
30



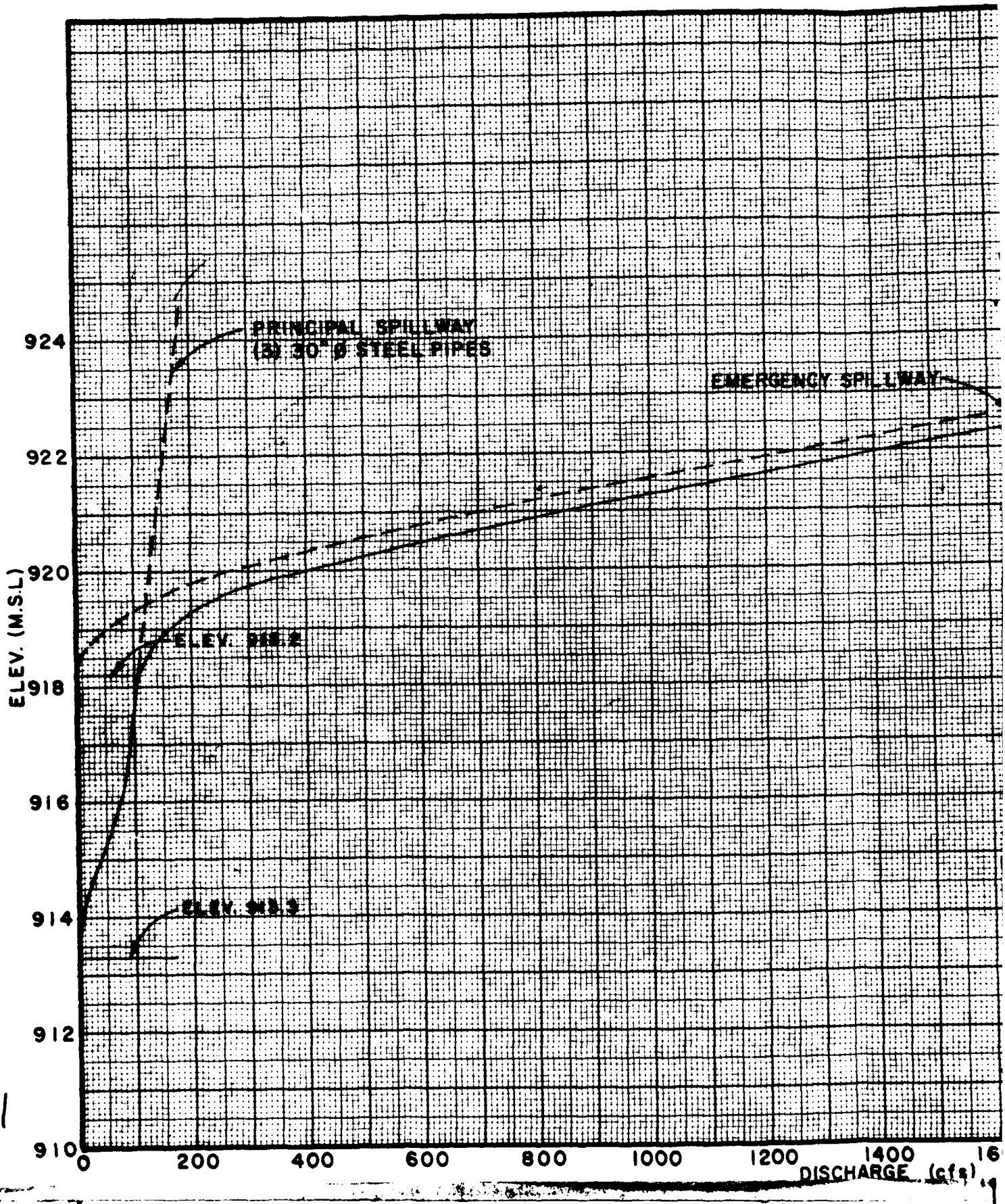
DONALD STRAUS LAKE

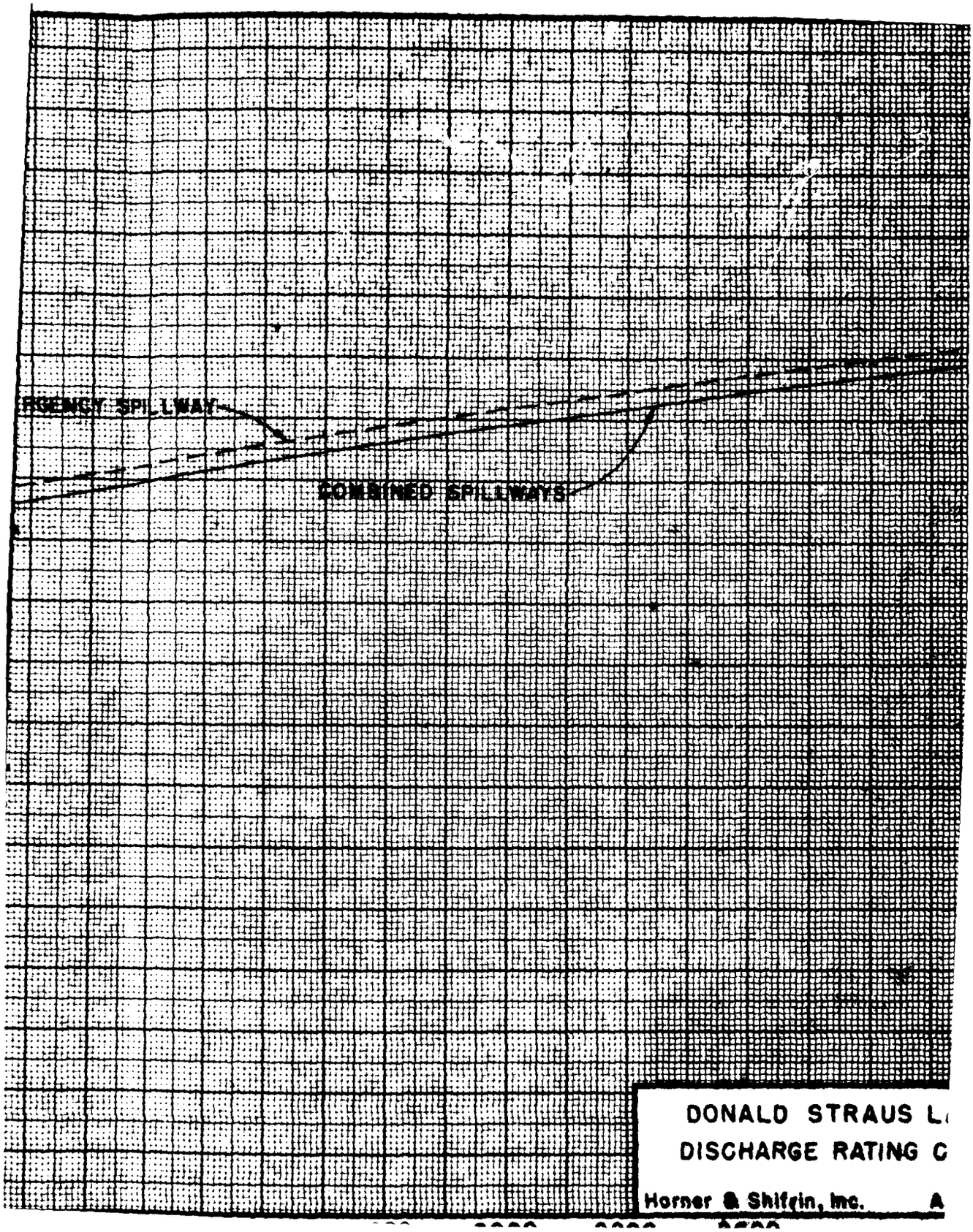
AREA-STORAGE CURVES

Horner & Shifrin, Inc. Aug. 1979

600 800 VOLUME (ACRE-FT.)
30 40 AREA (ACRES)

PLATE 5


PRINCIPAL SPILLWAY
(3) 30" ø STEEL PIPES
EMERGENCY SPILLWAY
ELEV. 918.2
ELEV. 913.3
ELEV. (M.S.L.)
924
922
920
918
916
914
912
910
0
200
400
600
800
1000
1200
1400
DISCHARGE (cfs)



DONALD STRAUS L
DISCHARGE RATING C

Horner & Shifrin, Inc. A

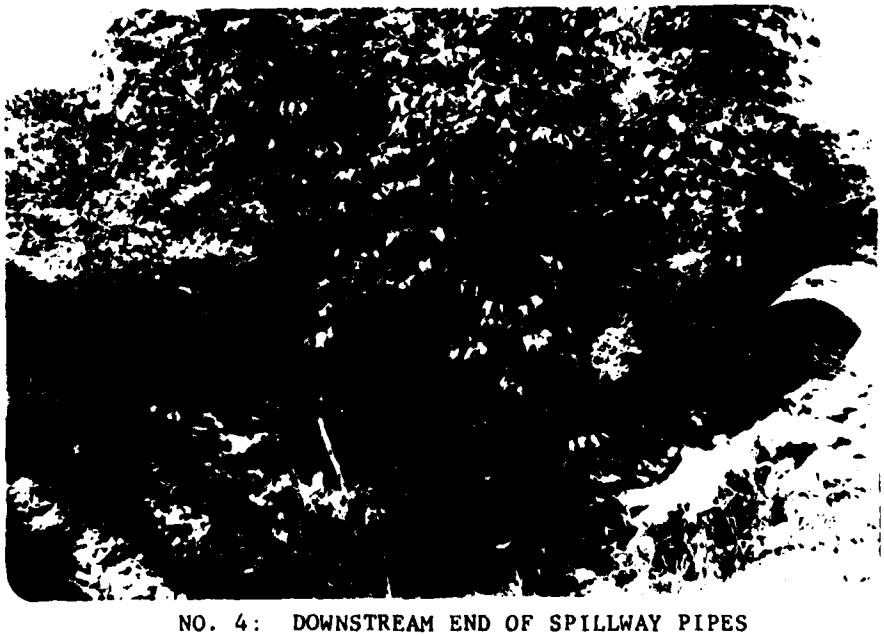
APPENDIX A

INSPECTION PHOTOGRAPHS

NO. 1: UPSTREAM FACE OF DAM

NO. 2: DOWNSTREAM FACE OF DAM

NO. 3: UPSTREAM END OF SPILLWAY PIPES



NO. 4: DOWNSTREAM END OF SPILLWAY PIPES

NO. 5: EROSION OF SPILLWAY CHANNEL BANK

NO. 6: SEEPAGE FLOW FROM RIGHT ABUTMENT AREA

NO. 7: DOWNSTREAM CHANNEL BELOW DAM

NO. 8: EROSION OF LAKE SHORELINE

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 26.5 inches) from Hydrometeorological Report No. 33.

b. Drainage area = 0.22 square miles = 141 acres.

c. SCS parameters:

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

Lag time = 0.11 hours (0.60 Tc)

*Soil type CN = 64 (AMC II), 81 (AMC III)

2. Spillway releases for the principal spillway were computed utilizing the U.S. Bureau of Public Roads' Inlet and Outlet Control Nomographs for Corrugated Metal Pipe Circular Culverts. The variable parameters for the spillway pipe are as follows:

Entrance type - Projecting
Length - 37 feet
Slope - 0.006 (ft./foot)
Discharge Conditions - Free
Entrance head loss coefficient (K) = 0.9
Pipe roughness coefficient (N) = 0.013

*Based on estimated clay content of samples obtained on site.

3. The emergency spillway section consists of a broad-crested, trapezoidal excavated earth section for which conventional weir formulas do not apply.

Spillway release rates 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 Q_c was computed as $Q_c = (\frac{a^3 g}{t})^{0.5}$ for the various depth, 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 over 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. The procedure neglects the minor insignificant friction losses across the length of the spillway.

4. The profile of the dam crest is irregular and flow over the dam crest cannot be determined by conventional weir formulas. Flow quantities overtopping the dam crest were computed as described in the preceding paragraph and corresponding flow over the dam and spillways for given elevations were added to obtain the combined outflow rating curve for the dam and spillways.

```
A1       ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
A2       HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF DONALD STRAUS LAKE DAM
A3       RATIOS OF PMF ROUTED THROUGH RESERVOIR
B     238          C         5
B1      5
J       1                  8         1
J1   0.35       0.36      0.37      0.38      0.39      0.40      0.50      1.0
K       0  INFLOW                                                    1
K1       INFLOW HYDROGRAPH
M       1          2      0.22                                  1.0
P       0       26.5       102       120       130
T                                                                  -1       -81
W2                0.11
X    -1.0       -.10       2.0
K       1        DAM                                               1
K1       RESERVOIR ROUTING BY MODIFIED PULS
Y                                    1         1
Y1      1                                                      110.7        -1
Y4  913.3      913.8     914.6     915.3     915.8     916.8     918.2     918.5     919.3     919.9
Y4  920.4      922.3     923.2
Y5    0.0        8.3      25.5      49.8      69.7      90.0     114.0     124.8     205.6     373.5
Y5  555.1     1646.8    2789.0
SA      0        9.0      14.0      23.9      40.4
SE  876.2      913.3     920.0     940.0     960.0
SS  913.3
SD  919.4
SL  100.0      235.0     350.0     458.0     537.0     574.5     674.5
SV919.37   919.47    919.67    919.87    920.0     922.0     924.0
K      99
```

```
A1       ANALYSIS OF DAM OVERTOPPING USING 100YR FLOOD
A2       HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF DONALD STRAUS LAKE DAM
A3       100YR FLOOD ROUTED THROUGH RESERVOIR
B     288          0         5                                                  0
B1      5
J       1          1         1
J1    1.0        .10       .15       .20       .25       .30      0.40       .50      1.00
K       0  INFLOW                                                    1
K1       INFLOW HYDROGRAPH
M       0          2     0.22                             1.0                  1
C     288
Q1   .007      .007      .007      .007      .007      .007      .007      .007      .007      .007
Q1   .007      .007      .007      .007      .007      .007      .007      .007      .007      .007
Q1   .007      .007      .007      .007      .007      .007      .007      .007      .007      .007
Q1   .007      .007      .007      .007      .007      .007      .007      .007      .007      .007
Q1   .007      .007      .007      .007      .007      .007      .007      .007      .007      .007
Q1   .007      .007      .007      .007      .007      .007      .007      .007      .007      .007
Q1   .007      .007      .007      .007      .007      .007      .007      .007      .007      .007
Q1   .007      .007      .013      .013      .013      .013      .013      .013      .013      .013
Q1   .013      .013      .013      .013      .013      .013      .013      .013      .013      .013
Q1   .013      .013      .013      .013      .013      .013      .013      .013      .013      .013
Q1   .013      .013      .013      .013      .013      .013      .013      .013      .013      .013
Q1   .013      .013      .013      .013      .013      .013      .013      .013      .013      .013
Q1   .013      .013      .013      .013      .013      .013      .013      .013      .013      .013
Q1   .013      .013      .013      .013      .024      .024      .024      .024      .024      .024
Q1   .024      .024      .024      .024      .024      .024      .024      .024      .024      .024
Q1   .024      .024      .031      .031      .031      .031      .031      .031      .049      .049
Q1   .049      .049      .049      .049      .138      .138      .139      .262      .262      .544
Q1   .813      .378      .262      .139      .138      .138      .049      .049      .049      .049
Q1   .049      .049      .031      .031      .031      .031      .031      .031      .024      .024
Q1   .024      .024      .024      .024      .024      .024      .024      .024      .024      .024
Q1   .024      .024      .024      .024      .024      .024      .007      .007      .007      .007
Q1   .007      .007      .007      .007      .007      .007      .007      .007      .007      .007
Q1   .007      .007      .007      .007      .007      .007      .007      .007      .007      .007
Q1   .007      .007      .007      .007      .007      .007      .007      .007      .007      .007
Q1   .007      .007      .007      .007      .007      .007      .007      .007      .007      .007
Q1   .007      .007      .007      .007      .007      .007      .007      .007      .007      .007
Q1   .007      .007      .007      .007      .007      .007      .007      .007
T                                                              -1       -68
W2              0.11
X    -1.0       -.10       2.0
K       1         DAM                                                  1
K1       RESERVOIR ROUTING BY MODIFIED PULS
Y                                          1         1
Y1      1                                                    110.7        -1
Y4  913.3      913.8     914.6     915.3     915.8     916.8     918.2     918.5     919.3     919.9
Y4  920.4      922.3     923.0
Y5    0.0        8.3      25.5      49.8      69.7      90.0     114.0     124.8     205.6     373.5
Y5  555.1     1646.8    2789.0
SA      0        9.0      14.0      23.9      40.4
SE  876.2      913.3     920.0     940.0     960.0
SS  913.3
SD  919.4
SL  100.0      235.0     350.0     458.0     537.0     574.5     674.5
SV  919.4     919.47    919.67    919.87    920.0     922.0     924.0
```

SUMMARY OF DAM SAFETY ANALYSIS
RATIOS OF PMF

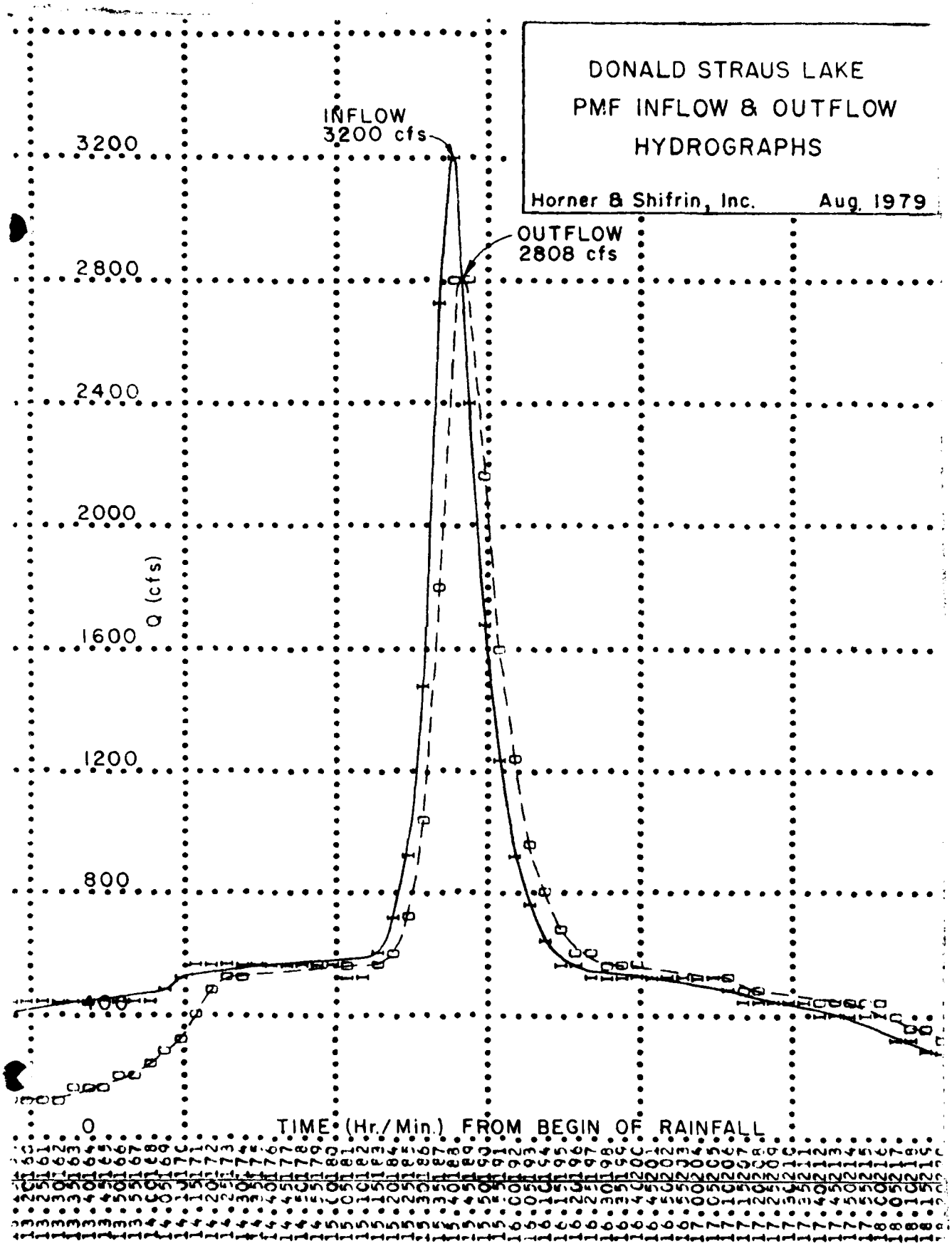
	ELEVATION	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	STORAGE	913.10 110.	913.30 111.	919.40 179.
	OUTFLOW	0.	0.	235.

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
.35	919.21	0.00	177.	197.	0.00	16.25	0.00
.36	919.33	0.00	178.	213.	0.00	16.25	0.00
.37	919.42	.02	180.	245.	.25	16.17	0.00
.38	919.50	.10	181.	287.	.67	16.08	0.00
.39	919.57	.17	182.	335.	.75	16.00	0.00
.40	919.63	.23	183.	369.	1.00	16.00	0.00
.50	920.06	.66	189.	1014.	1.92	15.83	0.00
1.00	923.73	1.33	198.	2808.	4.75	15.75	0.00

SUMMARY OF DAM SAFETY ANALYSIS
100 YR. FLOOD

	ELEVATION	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	STORAGE	913.10 110.	913.30 111.	919.40 179.
	OUTFLOW	0.	0.	234.

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	915.70	0.00	135.	66.	0.00	15.92	0.00


DONALD STRAUS LAKE
PMF INFLOW & OUTFLOW
HYDROGRAPHS
Horner & Shifrin, Inc. Aug. 1979
INFLOW
3200 cfs
OUTFLOW
2808 cfs
3200
2800
2400
2000
1600
1200
800
400
0
Q (cfs)
TIME (Hr./Min.) FROM BEGIN OF RAINFALL

END

DATE
FILMED

12-81

DTIC