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**LAKE SAINTE LOUISE DAM
ST. CHARLES COUNTY, MISSOURI
MO 10490**



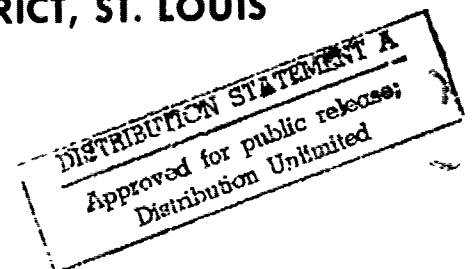
PHASE 1 INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM



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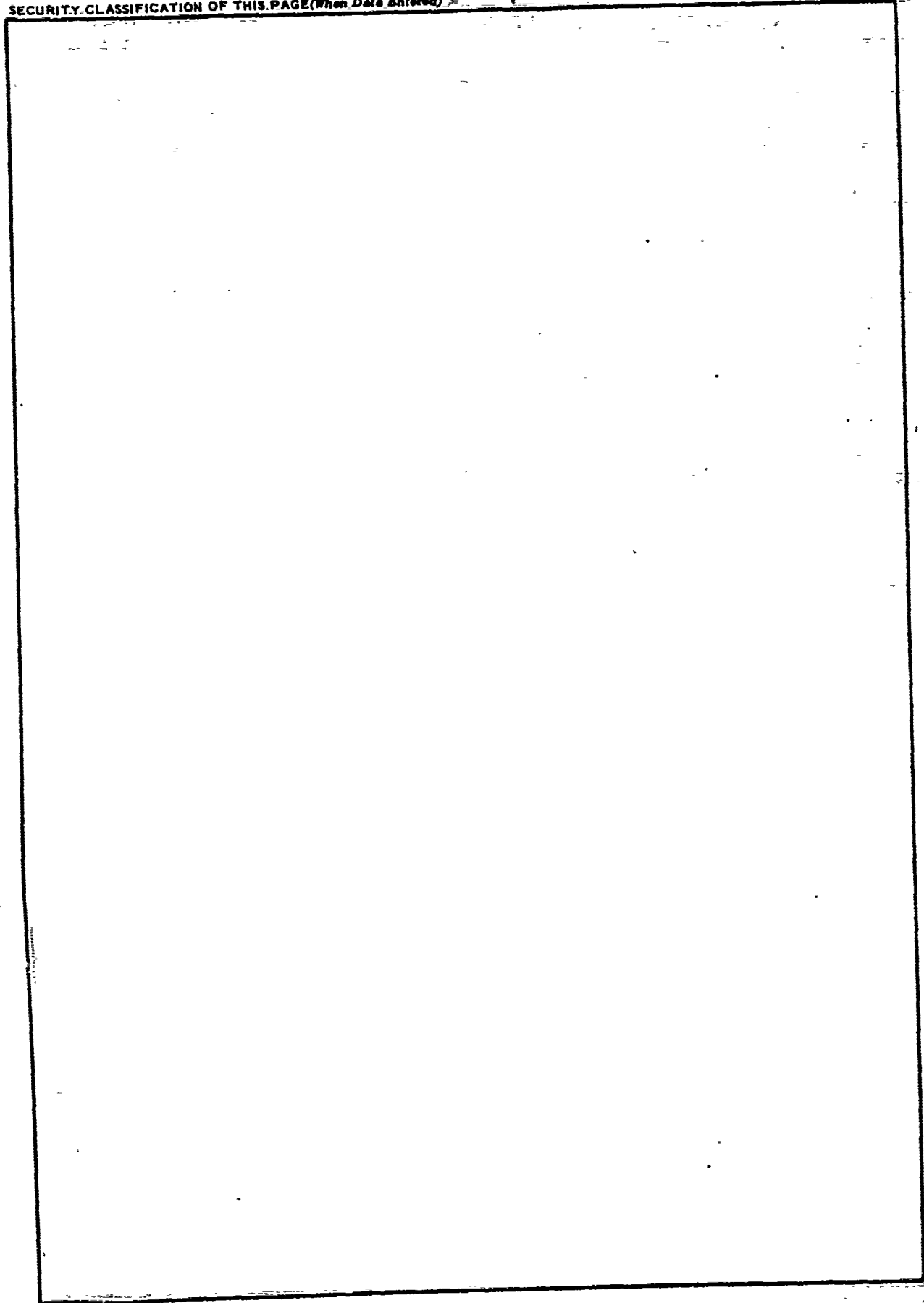
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20. ABSTRACT (Continue on reverse side if necessary and identify by block number) This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.		

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
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SUBJECT: Lake Sainte Louise Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Lake Sainte Louise 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.

SUBMITTED BY: SIGNED
Chief, Engineering Division

25 SEP 1978
Date

APPROVED BY: SIGNED
Colonel, CE, District Engineer

25 SEP 1978
Date

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LAKE SAINTE LOUISE DAM
ST. CHARLES COUNTY, MISSOURI

MISSOURI INVENTORY NO. 10490

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY:

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FOR:

U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS

SEPTEMBER 1976

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PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam: Lake Sainte Louise Dam
State Located: Missouri
County Located: St. Charles
Stream: Tributary of Peruque Creek at Lake Saint Louis
Date of Inspection: 19 June 1978

The Lake Sainte Louise Dam was visually inspected by engineering personnel of the office of Horner & Shifrin, Inc., Consulting Engineers, St. Louis, Missouri. The purpose of the 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.

Based on a visual inspection, the present general condition of the dam is considered to be satisfactory. ^{Various} 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.

- a. Several inches of subsidence or erosion of the downstream slope of the dam, along the alignment of the 12-inch discharge pipe for the 42-inch diameter drop inlet spillway located near the center of the dam, was observed. (It could not be determined at the time of the inspection if this loss of material was due to pipe infiltration, or erosion caused by storm water runoff, or settlement of pipe back-fill, or a combination thereof. If embankment materials are being lost through this pipe, the result may be rapidly increasing internal erosion which could cause a piping failure of the dam. The kind and type of pipe and pipe joints used for the 12-inch pipe should be determined and reviewed to verify their suitability for this installation. As presently used, the 12-inch pipe is subjected to the pressure produced by the lake water surface level on a permanent basis.

- b. ✓ Minor wearing away at the waterline of the upstream face of the dam was noticed. The condition is not considered serious at this time but continued erosion of this slope will reduce the dam cross section.
- c. ✓ At the time of the inspection, it could not be determined if the 10-inch sanitary sewer passing beneath the dam can be isolated if necessary in order to prevent loss of foundation soils, should collapse of the sewer beneath the dam occur. Voids resulting from loss of materials into the sewer will provide a passageway for seepage that may develop into a piping condition and subsequent failure of the dam.

Modifications by the owner to the outlet pipe of the 42-inch drop inlet spillway located near the center of the dam for installation of a lake replenishment pump have negated the use of the pipe as a spillway. These changes include plugging the existing 12-inch pipe outlet with concrete such that it no longer functions as an outlet, and installation of a 10-inch valve and pipe to connect the existing 12-inch outlet pipe to a pump discharge line. The valve is normally maintained closed in order to prevent backflow and loss of water from the lake. When the pump is installed (it was not at the time of the inspection) and operated, the valve is opened and flow is introduced into the lake through the 42-inch vertical riser. At the time of the inspection the valve was closed, although it was leaking at the rate of several gallons per minute.

According to the criteria set forth in the recommended guidelines (see text) the minimum spillway design flood for this dam, which is classified as intermediate in size and of high hazard potential, is specified to be the Probable Maximum Flood (PMF). 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 the existing spillways (drop inlet plus emergency) to be inadequate to pass lake outflow resulting from a storm of PMF magnitude without overtopping the dam; however, they are adequate to pass lake outflow

resulting from the 1 percent chance (100-year frequency) flood. The existing spillways (drop inlet plus emergency) are capable of passing lake outflow corresponding to 22 percent of the PMF. The length of the downstream damage zone, should failure of the dam occur, is estimated to be 11 miles.

It was found by hydraulic analysis that the combined capacity of the two drop inlet spillways, without allowing the lake water level to exceed elevation 547.3 (the crest of the emergency spillway) is about 90 cfs. With lake level to elevation 548.3, the maximum water surface elevation without overtopping the dam, the emergency spillway will permit an overflow of about 547 cfs and the combined capacity of the two drop inlet spillways will increase to about 93 cfs, thus providing a total capacity of 640 cfs. In the investigations for spillway capacity, it was assumed that the 42-inch drop inlet spillway will function as originally intended.

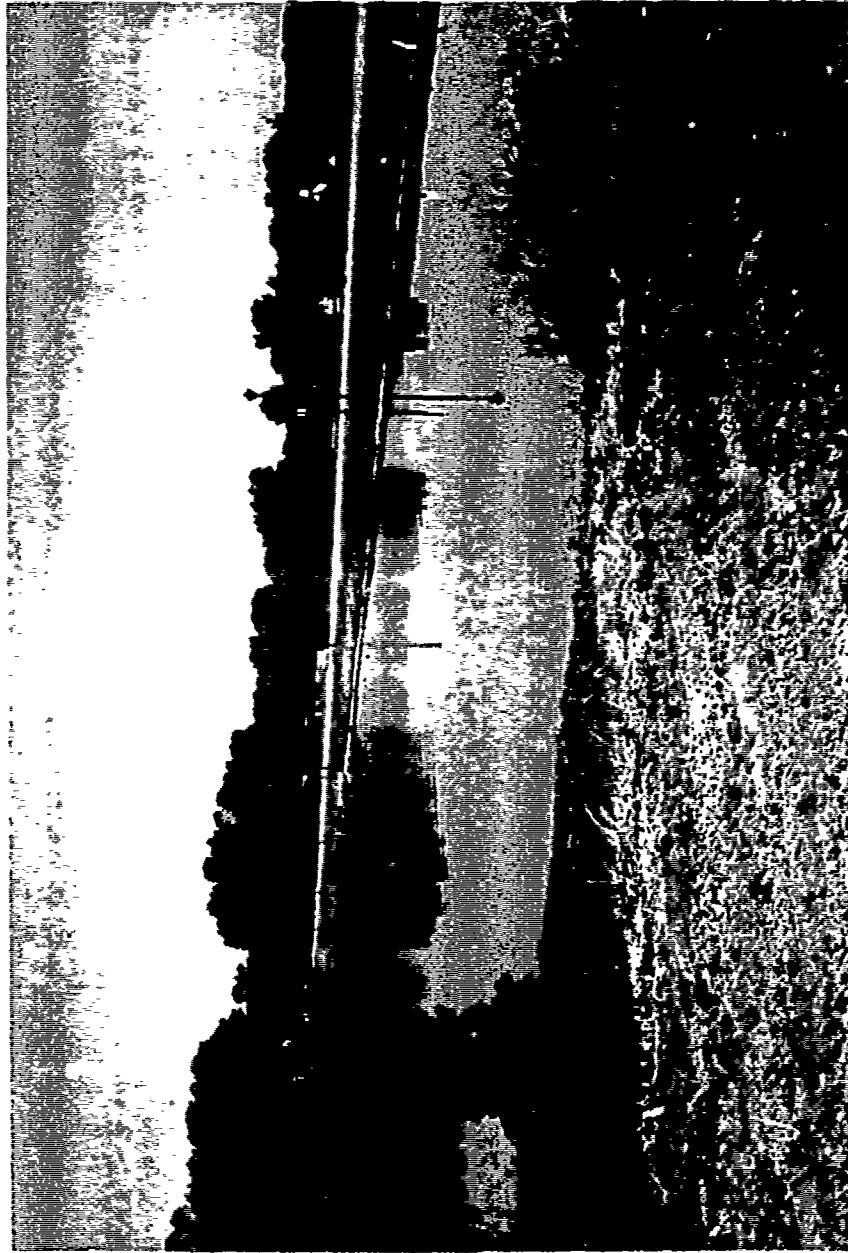
It is believed that the liquid petroleum tanks located on the area adjacent to the downstream toe of slope of the dam presents a hazardous condition should failure of the dam occur. In addition to damages due to the flood wave if the dam fails, the leakage of liquid petroleum will create a possible explosion hazard.

Also present on the downstream area immediately adjacent to the dam is an electric substation. Failure of the dam would undoubtedly damage or destroy this installation. Explosions caused by sparks igniting leaking LP gas may cause damages above the level of the floodwaters.

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

It is recommended that the owner take the necessary action in the near future to correct or control the deficiencies and safety defects reported herein.

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



OVERVIEW OF LAKE AND DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
LAKE SAINTE LOUISE - ID NO. 10490

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
LAKE SAINTE LOUISE - ID NO. 10490

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 and spillway pose 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 Lake Sainte Louise Dam is an earthfill type embankment rising approximately 50 feet above the original stream bed. Lake level is governed by overflow of two drop inlet type spillways with outlets leading to Lake Saint Louis. A paved road, Savoy Drive, traverses the dam crest. The low roadway area east of the right (looking downstream) abutment will function as an emergency spillway should the lake level rise above the roadway at this location. The capacity of this area to serve as a spillway is limited to flow with a depth of about 12-inches before discharge will overflow the dam. A general plan of the dam and appurtenances is shown on Plate 2.

The 12-inch outlet pipe for the 42-inch diameter drop inlet spillway (see Photo 7) located near the center of the dam has been modified to accommodate a pump for replenishing lost water in Lake Sainte Louise by pumping from Lake Saint Louis. These changes include plugging the existing 12-inch pipe outlet with concrete and installation of a 10-inch valve and pipe to connect the 12-inch pipe to a pump. In addition, the operating stem for controlling the valve on the high level lake drawdown pipe, allowing water to flow into the 42-inch spillway, has been disconnected and the valve allowed to remain open. The other spillway, a 48-inch by 102-inch drop inlet (see Photo 3) with a 36-inch outlet pipe is located at the right (looking downstream) abutment of the dam. The overflow level of both drop inlet type spillways is approximately the same. The 36-inch pipe terminates at an open, 4-foot square, manhole (see Photo 4) located approximately 290 feet from the inlet in an area east of the right abutment. At this structure discharge is required to overflow the top of the manhole or continue in a 15-inch pipe for another 28 feet, depending upon the volume of flow. After leaving the manhole, flow continues toward Lake Saint Louis in an unimproved ditch. An electric substation and a liquid petroleum tank farm (see Photos 12 and 13) occupy a portion of the area immediately downstream from the dam.

b. Location. The dam and lake are located on an unnamed tributary of Peruque Creek approximately 6 miles west of O'Fallon, Missouri, in St. Charles County, as shown on the Regional Vicinity Map on Plate 1. The dam is located in U. S. Survey 929, Township 47 North, Range 2 East, on the west side of Lake Saint Louis which is just south of the Interstate 70 crossing of Peruque Creek.

c. Size Classification. The size classification based on the height of the dam and storage capacity is categorized as intermediate. (Per Table 1, Recommended Guidelines for Safety Inspection of Dams.)

d. Hazard Classification. According to the St. Louis District, Corps of Engineers, the Lake Sainte Louise Dam has a high hazard potential, meaning

that the dam is located where failure may cause loss of life, serious damage to homes, extensive agricultural, industrial and commercial facilities, important public utilities, main highways, or railroads. According to the St. Louis District, the estimated damage zone, should failure of the dam occur, extends 11 miles downstream of the dam. The damage zone includes Lake Saint Louis Dam, which would likely fail if Lake Sainte Louise Dam fails. Within the possible damage zone of the two dams are 36 homes, 11 of which could be damaged by backflooding, and 8 bridges, 4 of which are major bridges, including Interstate Highway 70 and 3 additional highways. The floodplain downstream of Lake Saint Louis Dam is extensively farmed. In addition, a liquid petroleum (LP) tank farm with approximately 60 LP tanks and an electric substation are located on the area immediately below the dam and, in all likelihood, would be severely damaged if failure of the dam occurred.

e. Ownership. The dam is owned by the Lake Saint Louis Community Association, 20 Ellerman Road, Lake Saint Louis, Missouri, 63367. The association presently consists of 2,443 home and/or property owners.

f. Purpose of Dam. The dam impounds water for the purpose of recreation for surrounding residential property owners, who are part of the Lake Saint Louis Community Association.

g. Design and Construction History. A hydrologic study of the proposed dam and lake was made about 1965 by the firm of R. W. Booker & Associates, Inc., Consulting Engineers, St. Louis, Missouri, for the potential developers of the Lake Saint Louis subdivision property. This report recommended that the design of the dam and spillway be predicated on the probable maximum flood. The design of the dam and spillway, was prepared during 1966 by Bernard G. Browning, P. E., Fulton, Missouri, for the Lake Saint Louis Investment Corporation, the site developer.

h. Normal Operational Procedure. The lake level is normally regulated by overflow of the 48-inch by 102-inch drop inlet type spillway structure located near the right abutment of the dam. If conditions warrant the 42-inch

drop inlet spillway can also be utilized to relieve lake surcharge. However, the 10-inch valve controlling this spillway outlet is normally closed and must be opened manually for the drop inlet to function as a spillway. During periods of low lake level a pump is installed to replenish lost lake water by pumping from Lake Saint Louis to Lake Sainte Louise. The original outlet pipe for the 42-inch spillway is utilized as a pump discharge line. According to the owner, the capacity of the pump is estimated to be 1,500 gpm.

1.3 PERTINENT DATA

a. Drainage Area. The areas tributary to the lake are primarily suburban residential and agricultural in use. The watershed above the dam is approximately 2.1 miles long and the width varies to a maximum of about 0.7 of a mile. The total area is approximately 664 acres. The watershed area is outlined on Plate 1.

b. Discharge at Damsite.

- (1) During maximum flood experienced at damsite ... 88 \pm cfs⁽¹⁾
- (2) Spillway capacity
 - a. Drop inlets (total) ... 90 cfs⁽²⁾
 - b. Drop inlets and emergency (total) ... 640 cfs⁽³⁾

c. Elevation (ft. above MSL).

- (1) Top of dam ... 548.3 (min.)
- (2) Normal pool (spillway crest) ... 545.3
- (3) Streambed at centerline of dam ... 497.0 \pm
- (4) Maximum known tailwater (Lake Saint Louis) ... 502.0

d. Reservoir.

- (1) Length of maximum pool (elevation 548.3) ... 4,900 ft.
- (2) Length of normal pool (elevation 545.3) ... 4,500 ft.

- (1) Computed value for water surface at elevation 547.0 and based upon high water mark indicated by a resident living adjacent to the lake.
- (2) Water surface at elevation 547.3.
- (3) Water surface at elevation 548.3.

e. Storage.

- (1) Normal pool ... 1,170 ac. ft.
- (2) Top of dam (incremental) ... 2 . ac. ft.

f. Reservoir Surface.

- (1) Top of dam ... 84 acres
- (2) Normal pool ... 72 acres

g. Dam. Data tabulated below per survey made on date of inspection unless otherwise indicated.

- (1) Type ... Earthfill, homogeneous
- (2) Length ... 790 ft.
- (3) Height ... 52 ft.
- (4) Top width ... 58 ft.
- (5) Side Slopes
 - a. Upstream ... 1v on 2.5h
 - b. Downstream ... 1v on 2.5h
- (6) Cutoff ... Core trench⁽¹⁾
- (7) Zoning ... None
- (8) Core wall ... None
- (9) Slope Protection
 - a. Upstream ... Grass
 - b. Downstream ... Grass

h. Spillways.

- (1) Type ... Drop inlet
 - a. 42" diameter shaft with 10" pipe outlet and valve⁽²⁾
 - b. 48" x 102" rectangular shaft with 36" pipe outlet
- (2) Lip elevation ... 545.3 (both)
- (3) Upstream channel ... Lake

(1) Per report by Bernard G. Browning, 19 October 1969.
(2) Original 12-inch outlet pipe plugged with concrete and presently unusable.

i. Emergency Spillway.

- (1) Type ... Paved road control section
- (2) Approximate length ... 410 ft. (at elevation 548.3)
- (3) Crest elevation ... 547.3 (min.)

j. Outlet for Lake Drawdown ... Partial drawdown only, estimated to be about 4 feet below normal pool, however, not operable at present time.

k. Sanitary Sewer ... Passing beneath dam near center of structure.

- (1) Size ... 10-inch
- (2) Type of pipe ... Unknown
- (3) Invert ... Elevation 497.2 (manhole at junction of sewer lines near downstream toe of dam)

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

a. Subsurface Investigations. Available test boring logs and other data for subsurface investigations obtained by the Browning Test Laboratories, Inc., including a report prepared by the Missouri Geological Survey, are presented on Charts 2-1 thru 2-25. Borings 1 thru 7 and 11 were taken at the dam site while borings 8 thru 10 and 12 thru 14 were taken in borrow areas in the vicinity of the dam, as noted.

b. Dam. Review of the preliminary engineering report prepared by Bernard G. Browning, P.E., indicates that the dam was designed as a homogeneous earthfill type embankment with an impervious fill seepage cutoff core trench to bedrock. No additional design data was readily available.

c. Spillway. No detailed hydraulic or structural design data was found to be available. Data included in the R. W. Booker hydrologic investigation report was found to be of limited value due to differences between the recommendations included in the report and the improvements actually constructed as observed at the time of the inspection.

2.2 CONSTRUCTION

The dam was constructed during 1966 - 1967 by the developer of Lake Saint Louis. No additional construction data was obtainable.

2.3 OPERATION

The maximum loading on the dam according to an owner living adjacent to the lake was a storm that produced a high water mark equivalent to about elevation 547.0.

2.4 EVALUATION

a. Availability. The only engineering data obtained was the material contained in the preliminary engineering report prepared by Mr. Browning. Other data is believed to exist, however, attempts to obtain this information were not successful.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of the dam and appurtenances was made by Horner & Shifrin engineering personnel on 19 June 1978. The possible flood damage zone between the dam and the Highway 79 Bridge crossing Peruque Creek downstream from the dam was also visually examined. Photographs of the dam and appurtenant structures taken during the time of inspection are presented on Pages A-1 through A-7 of the Appendix.

b. Dam. The upstream and downstream faces of the dam (see Photo 1 and 2) were found to be in satisfactory condition although some erosion of the unprotected upstream slope at the waterline was noticed. The upstream slope is grass-covered above the eroded section. Some surface erosion or subsidence, to a depth of several inches along the alignment of the center spillway outlet pipe, was noticed in the downstream slope near the toe. The downstream slope was well covered with grass and at the time of the inspection it was about 24 inches high. The dam crest appeared in good condition with only some minor surface shrinkage cracks in several areas adjacent to and parallel to the roadway where the grass cover was sparse. These cracks were, for the most part, less than 12-inches in length, about 1/8-inch in width, and appeared to be about 6-inches in depth.

At the surface and where exposed, the material used to construct the dam appeared to be either a silty clay or a clayey silt. No holes or animal burrows were detected in the face or crest of the dam. No indication of seepage through the dam at the downstream toe of slope or at the abutments was noticed.

A liquid petroleum (LP) tank farm (see Photo 12) with about 60 LP tanks is located on an area at the west side near the downstream toe of slope and an electrical substation (see Photo 13) is located on an area at the east side adjacent to the downstream toe of slope of the dam.

A facility for installation of a pump (see Photo 8) has been constructed on the area near the center of the dam immediately adjacent to the downstream toe of slope. This pump is used to replenish Lake Sainte Louise by pumping water from Lake Saint Louis. The 12-inch outlet pipe for the 42-inch diameter drop inlet spillway at this location has been modified to function as a pump discharge line. A 10-inch cast-iron pipe that serves as the discharge line for the pump is connected to the 12-inch spillway outlet pipe. At the connection to the 12-inch pipe, a gate valve (see Photo 9) has been installed. This valve is normally maintained closed in order to prevent backflow from Lake Sainte Louise. Also, according to the Director of the Lakes and Parks Department, Lake Saint Louis Community Association, the spillway outlet pipe downstream of the pump line connection has been plugged with concrete in order to allow pumpage to flow to Lake Sainte Louise. The location of the pump base and connecting pipe lines is shown on Plate 2. At the time of the inspection, the pump was not installed and water, although the valve was closed, was flowing from the pump discharge connecting line at a rate of about 1-2 gpm. This leakage was collecting in a small pool (see Photo 10) adjacent to the pump base and entering the ground at a point adjacent to the nearby sanitary sewer manhole where it appeared that some of the flow entered the manhole through an open joint in the masonry wall. Although, according to the Director, the valve is normally maintained closed, it has been opened at times by non-authorized individuals living nearby. During these periods when the valve is open, high discharges at the 10-inch pipe have occurred and the flow has eroded to a depth of several feet, (see Photo 11) the normal bank at the point where it enters Lake Saint Louis. The location of the eroded bank at Lake Saint Louis is also shown on Plate 2.

c. 42-Inch Diameter Spillway. The 42-inch diameter drop inlet type spillway (see Photo 7) located near the center of the dam appeared to be in good condition although it did have an accumulation of small stones and/or debris lying in the bottom of the inlet. An anti-vortex baffle plate and a screen to prevent trash from entering the inlet had been installed above the open top of the inlet. Both the plate and screen appeared to be in good condition. The operating stem for the gate on a pipe line located out in the

lake and leading to the inlet was disconnected and not operable. Water was standing in the inlet to the same level as the lake. The outlet pipe for this spillway had been modified as indicated in the preceding paragraph. The condition of this pipe could not be determined since only the top of the pipe at one location (near the 10-inch valve) could be seen.

d. 48-Inch by 102-Inch Rectangular Spillway. The 48-inch by 102-inch drop inlet type spillway (see Photo 3) located at the east end of the dam appeared to be in good condition. The 2-foot high section of stop-log planks on the lake side of the inlet were leaking a negligible amount. An anti-vortex plate and a screen to prevent trash from entering the inlet had been installed above the open top of the inlet. Both the plate and screen appeared to be in good condition. A 36-inch diameter corrugated metal pipe serves as an outlet for this inlet. The 36-inch pipe appeared to be in good condition although the type of joints used could not be determined. The pipe discharges into an open concrete manhole (see Photo 4) located approximately 150 feet from the centerline of the dam near the right abutment. A 15-inch diameter pipe extends approximately 28 feet from the manhole and terminates at an unimproved ditch (see Photo 5). An accumulation of construction debris was observed at the upstream end of the ditch. The ditch continues for about 420 feet before it joins Lake Saint Louis (see Photo 6). The ditch at the upstream and downstream (Lake Saint Louis) ends was extensively eroded, apparently by flow being discharged from the 36-inch diameter outlet pipe.

e. Sanitary Sewer. The sanitary sewer manhole located at about the center of the dam on the area near the downstream toe of slope was visually inspected. Depth of flow in the manhole was on the order of 3 to 4 inches, at 8:00 a.m. on the date of the inspection. As previously mentioned, some water leakage at the valve on the 10-inch pipe installed for a pump connection was observed entering the manhole through joint openings in the masonry wall.

3.2 DEFICIENCIES

Deficiencies observed during the inspection are not of serious potential to warrant immediate remedial action. Recommendations regarding correction of deficiencies reported herein are presented in Section 7 of this report.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

At present, according to the Director of the Lakes and Parks Department, lake surcharge is controlled by overflow of the 48-inch by 102-inch drop inlet spillway located near the east end of the dam. The stop-log planks along the lake side of the inlet are normally kept in place and apparently used only when it is desired to lower the lake level 2 feet or less.

During periods of dry weather and low lake level, according to the Director of Parks and Lakes, a pump, estimated to have a capacity of 1,500 gpm, is installed on the base located on the berm just below the dam and water is pumped from Lake Saint Louis to Lake Sainte Louise to raise the lake level. As indicated in Section 3, the 12-inch outlet pipe for the 42-inch diameter drop inlet spillway is utilized as the pump discharge line.

4.2 MAINTENANCE OF DAM

The grass on the upstream slope of the dam is cut frequently during the growing season. The grass on the downstream slope, according to the Director, is cut occasionally because of the steepness of the slope. The roadway traversing the dam crest has an asphalt surface and is well maintained. Curb inlets for the collection of surface runoff are located at intervals along the roadway. Runoff collected by this drainage system is discharged to Lake Sainte Louise.

4.3 MAINTENANCE OF SPILLWAYS

It was reported by the Director that both drop inlet type spillways are periodically cleaned of debris. The outlet channel downstream of the 36-inch

outlet pipe for the 48-inch by 102-inch spillway is unimproved and not maintained. The valve on the 10-inch pump discharge line of the modified outlet pipe for the 42-inch spillway is, according to the Director, in operating condition although it leaks moderately when in the closed position.

4.4 WARNING SYSTEM

There is no warning system in effect in case of extreme high water and possible overtopping of the dam. With a very frequently traveled road traversing the dam and the presence of numerous home owners in the dam vicinity, it is likely that adequate warning of overtopping of the dam would be given if such a condition was developing.

4.5 EVALUATION

Revisions to the outlet pipe of the 42-inch diameter drop inlet spillway have rendered its reliability as an outlet questionable since discharge depends on opening the valve that is located on the berm below the dam. Since this outlet provides only about 10 percent of the total capacity of both drop inlet spillways, and since this quantity is considerably less than that required for spillway design flood, the potential loss of this spillway outlet is not considered significant.

The presence of full time employees under responsible supervision, as is the case at Lake Sainte Louise, to maintain and inspect the dam and appurtenances, is considered beneficial to the safety of the dam.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. No detailed design data was available for review. The preliminary hydrologic/hydraulic design by R. W. Booker & Associates, Inc., recommended a 50 acre lake, with normal lake level at elevation 541.0, top of dam at elevation 552.4, and a 50-foot long spillway designed to pass the probable maximum flood (PMF).

However, surveys made at the time of the visual inspection indicated that the lake, dam and spillways as constructed were considerably different from those contemplated in the preliminary design report. The lake has a surface area of about 72-acres at normal pool, elevation 545.3.

Two drop inlet type spillways (48-inch by 102-inch rectangular with a 36-inch pipe outlet, and 42-inch circular with a 12-inch pipe outlet) were provided. The overflow level of both drop inlets is about elevation 545.3. The low point in the roadway just east of the right abutment is about elevation 547.3 and will function as an emergency spillway to about elevation 548.3, the elevation at which lake outflow will overtop the dam in the vicinity of the right abutment.

b. Experience Data. The drainage area and lake surface area were developed from the USGS Wentzville, Missouri Quadrangle Map. The dam and spillway layouts were obtained from Lake Saint Louis study drawings and surveys made during the inspection.

c. Visual Observations.

(1) The drop inlet spillways and outlet pipes are in satisfactory condition. According to the Director of the Lakes and Parks Department, channel

improvements downstream of the outlet manhole on the 36-inch pipe outlet, consisting of the installation of a pipe to carry frequent low volume lake outflows, are planned by the owner.

(2) Drawdown facilities to completely dewater the lake are not provided. A pipe extending into the lake and leading to the 42-inch spillway is believed to have been capable at one time of allowing the lake to be lowered about 4 feet below normal pool level. However, modifications to this spillway and present operating methods no longer allow this outlet to function as originally intended. The lake can be lowered about 2 feet by removal of the stop-log planks at the 48-inch by 12-inch spillway.

(3) The 48-inch by 102-inch drop inlet spillway and 36-inch pipe outlet are located at the east end of the dam. The 42-inch diameter drop inlet spillway and 12-inch pipe outlet are located near the center of the dam. Spillway releases within the capacity of the spillways will not endanger the integrity of the dam.

(4) The low area east of the right abutment, when required, will function as an emergency spillway to about elevation 548.3 before lake outflow begins to overtop the dam. However, flow over this spillway will undoubtedly cause damages to a few lots, including homes on these lots, if present. Although this spillway outlet area appears, from the inspection, to be in undisturbed ground, discharges within the capacity of the emergency spillway are expected to cause damage to the area by erosion in excess of that presently experienced from discharge of the 36-inch outlet.

d. Overtopping Potential. The total capacity of the two drop inlet spillways and the emergency spillway is too small to pass the outflow from the Probable Maximum Flood or the 1/2 Probable Maximum Flood, but will pass outflow from the 1 percent chance (100-year frequency) flood without overtopping the dam. The results of a dam overtopping analysis are as follows:

<u>Ratio of PMF</u>	<u>Q - Peak Outflow (cfs)</u>	<u>Max. Lake Water Surface Elev.</u>	<u>Max. Depth of Flow Over Dam (Elev. 548.3)</u>	<u>Duration of Overtopping of Dam (Hours)</u>
0.22	640	548.3	0	0
0.50	3,250	549.4	1.1	4.3
1.0	7,400	550.2	1.9	7.0
100-Year Flood	540	548.2	0	0

The flow safely passing the drop inlet and emergency spillways just prior to overtopping amounts to about 640 cfs, which is the outflow equivalent to about 22 percent of the Probable Maximum Flood, but exceeds the 1 percent chance (100-year frequency) flood.

Procedures and data for determining the Probable Maximum Flood, the 100-year frequency flood, and the discharge rating curve for flow over the spillways and dam crest are presented on Pages B-1 and B-2 of the Appendix. A listing of the HEC-1DB input data is shown on Pages B-3 through B-5 of the Appendix.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. No evidence of instability of the dam or seepage at or near the downstream toe of dam, the abutments, or elsewhere was evident during the visual inspection. No mention of slides or other signs of instability were reported by the owner.

b. Design and Construction Data. Design or construction data relating to the structural stability of the dam was not available for review.

c. Operating Records. No appurtenant structures requiring operation presently exist at this dam. The pipe allowing the lake to be lowered about 4 feet no longer functions as intended due to changes to the 42-inch spillway outlet pipe and method of operation. No records have been kept of lake level, spillway discharge, dam settlement, or seepage during the post construction period.

d. Post Construction Changes. According to the Director of the Parks and Lakes Department and to the best of his knowledge, since completion of the dam and appurtenances, the only significant change has been the modifications made to the outlet pipe of the 42-inch diameter drop inlet spillway.

e. Seismic Stability. Since this dam is located within a Zone II seismic probability area, 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 hydrologic/hydraulic analysis indicated that, for floods requiring lake outflow greater than 640 cfs (outflow for maximum probable flood would be approximately 7,430 cfs and for the 1 percent chance [100-year frequency] flood would be approximately 540 cfs), the dam and part of the east abutment will be overtopped.

Data available at this time did not reveal that stability or seepage analyses of the dam had been performed.

b. Adequacy of Information. Due to the lack of engineering design and construction data, the assessments reported herein were based on performance, history and external conditions as determined during the visual inspection. This information is believed adequate to support the conclusions herein. Those recommendations with regard to the hydrology of the lake and the hydraulic capacity of the spillways are based on a study of the area and the outlets as indicated in Section 5.

c. Urgency. The safety deficiency stated in Paragraph 7.1a pertaining to overtopping of the dam should be investigated without delay. The stability and seepage analysis are not considered to be of urgent necessity since the dam has already experienced near maximum surcharge (lake level below dam crest by 1.3 feet) conditions without showing signs of instability. The remedial measures recommended in Paragraph 7.2 should be accomplished in the near future.

d. Necessity for Phase II. Based on the findings and assessment of the safety of the dam developed during this investigation, a Phase II study is not recommended.

e. Seismic Stability. The Lake Sainte Louise dam is located in seismic Zone II. An earthquake of the magnitude predicted for this zone is not expected to be hazardous to the dam provided static stability conditions are satisfactory and conventional safety margins exist.

7.2 REMEDIAL MEASURES

a. Recommendations. The following actions are recommended:

(1) Spillway capacity and/or height of dam should be increased to pass the probable maximum flood without overtopping the dam. It may be that, if and when the probable maximum flood occurs, the flow over the spillway would cause damages to several homes located on the opposite bank of Lake Saint Louis. This possibility should be investigated. Further, it is advised that the lake replenishment system (pump, suction and discharge lines) be independent of the spillway(s).

(2) Obtain the necessary soil data and perform seepage and stability analyses to assess the stability of the dam for conditions which the dam has not experienced.

(3) A review of the available records for the sanitary sewer line under the dam did not reveal the kind of pipe material used or the type of joints required. Further, it could not be determined if collars were constructed along the line beneath the dam to provide obstruction to seepage flow. Also, there appears to be no provision on the upstream side of the dam to isolate the sanitary sewer should failure or other problems occur in the sewer beneath the dam. The owner should address these deficiencies and take the necessary corrective measures.

(4) Determine the nature of the subsidence and/or erosion on the downstream slope of the dam along the alignment of the 12-inch outlet pipe for the 42-inch diameter spillway and take the necessary corrective action. The kind

and type of pipe and pipe joints used for the 12-inch pipe should be determined and their suitability for this installation investigated.

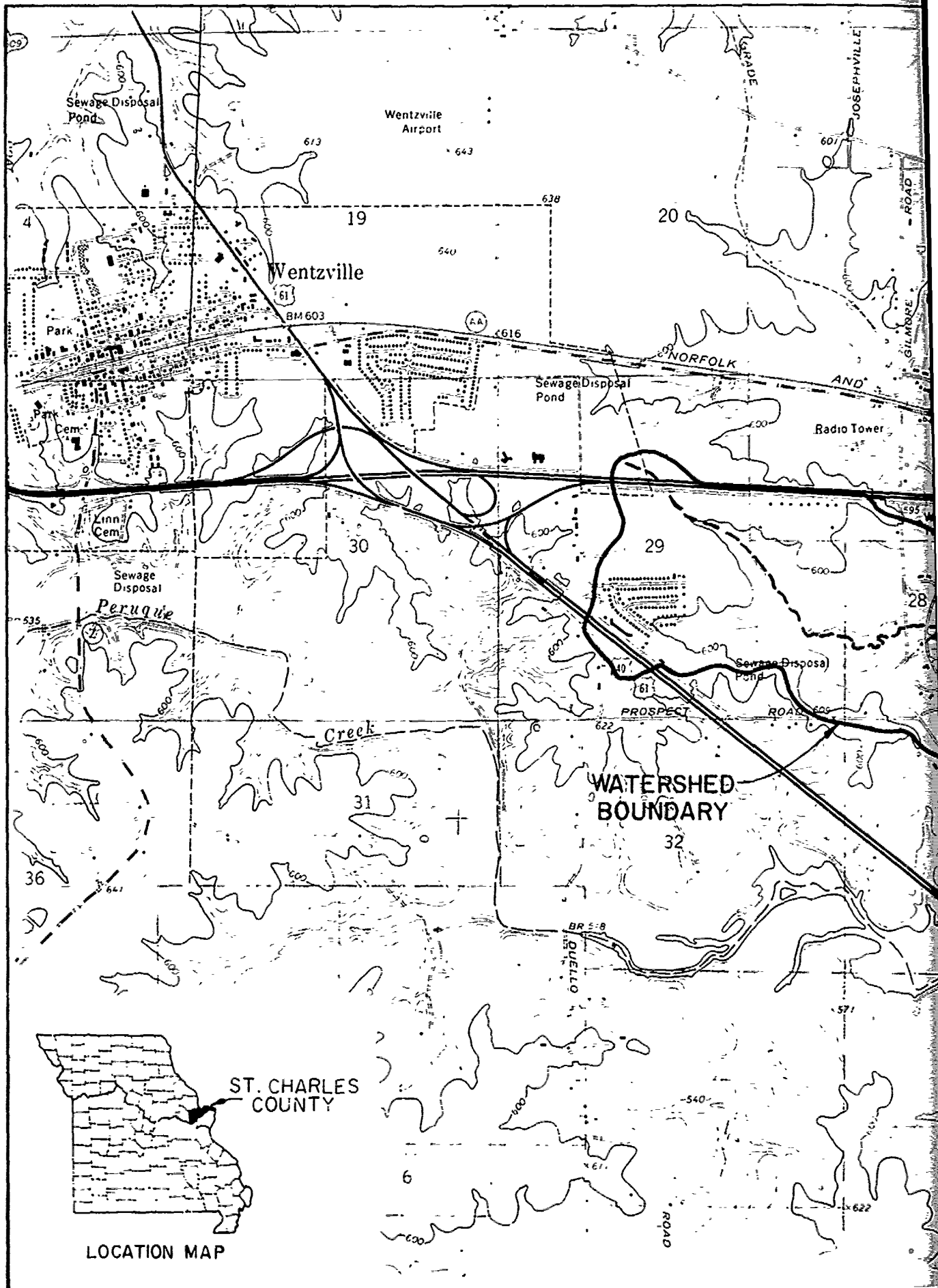
b. O & M Maintenance and Procedures. The following O & M maintenance and procedures are recommended:

(1) Provide some form of slope protection on the upstream face of the dam to prevent erosion of the slope at the waterline due to wave action or fluctuations in the water surface level.

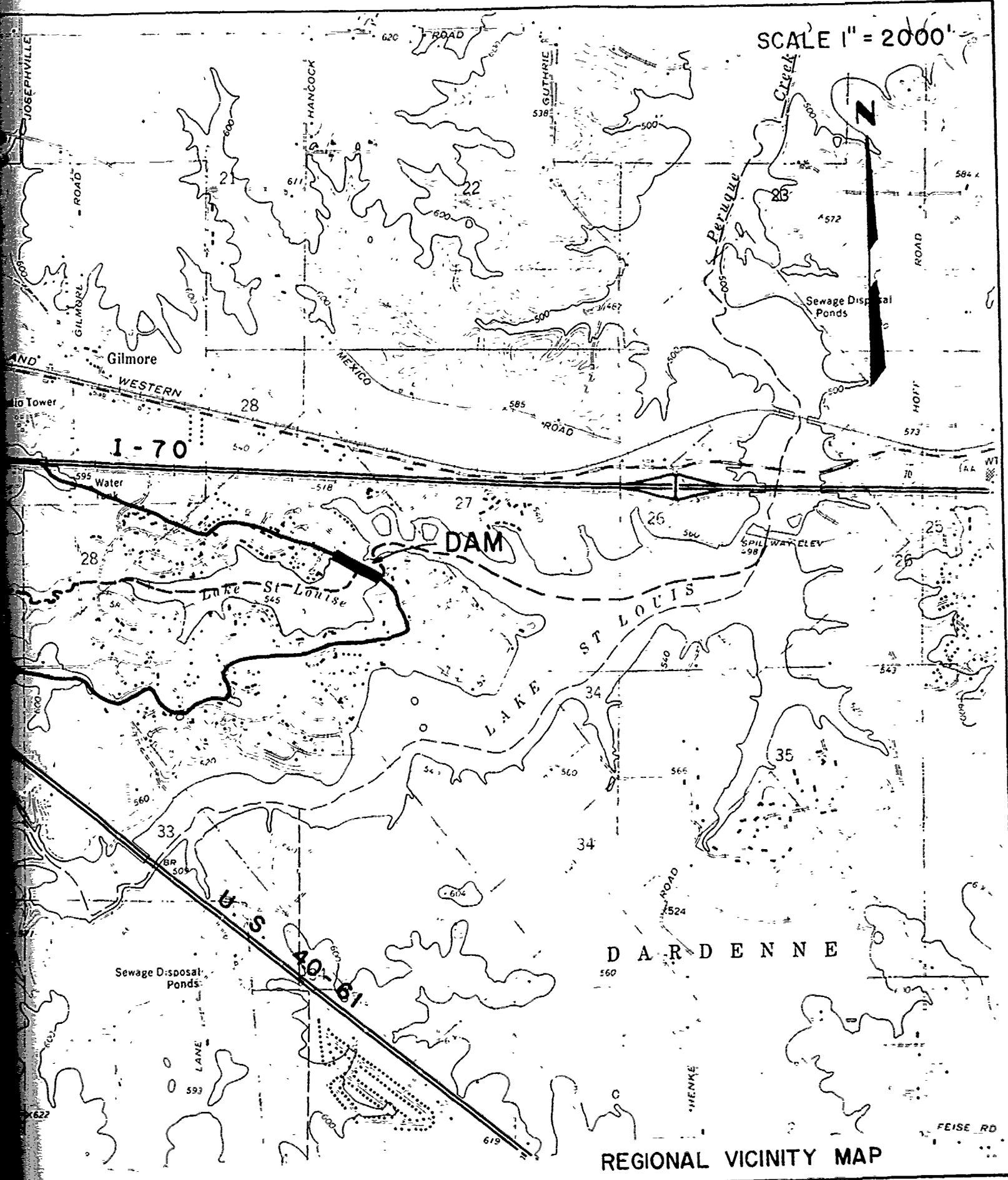
(2) Cut grass on downstream slope of dam more frequently. Grass should not be allowed to grow to a height that hinders inspection of the dam and provides cover for burrowing animals.

(3) Provide protection at the shore line of lake Saint Louis and elsewhere to prevent erosion by spillway discharges from Lake Sainte Louise.

(4) Restore the 42-inch spillway to its original condition by closing the valve on the lake inlet pipe and unblocking the outlet pipe. This will allow the spillway to function as originally intended (as long as the valve on the pump connecting line is closed or the line blocked) and will eliminate the condition of having the 12-inch outlet pipe under permanent head. The purpose of this recommendation is to eliminate a condition considered undesirable under any circumstances and will not increase spillway capacity as recommended in paragraph 7.2a(1). It will, however, improve the reliability of this spillway since it will not be necessary to open the valve on the pump connecting line in order to allow the outlet pipe to be serviceable.



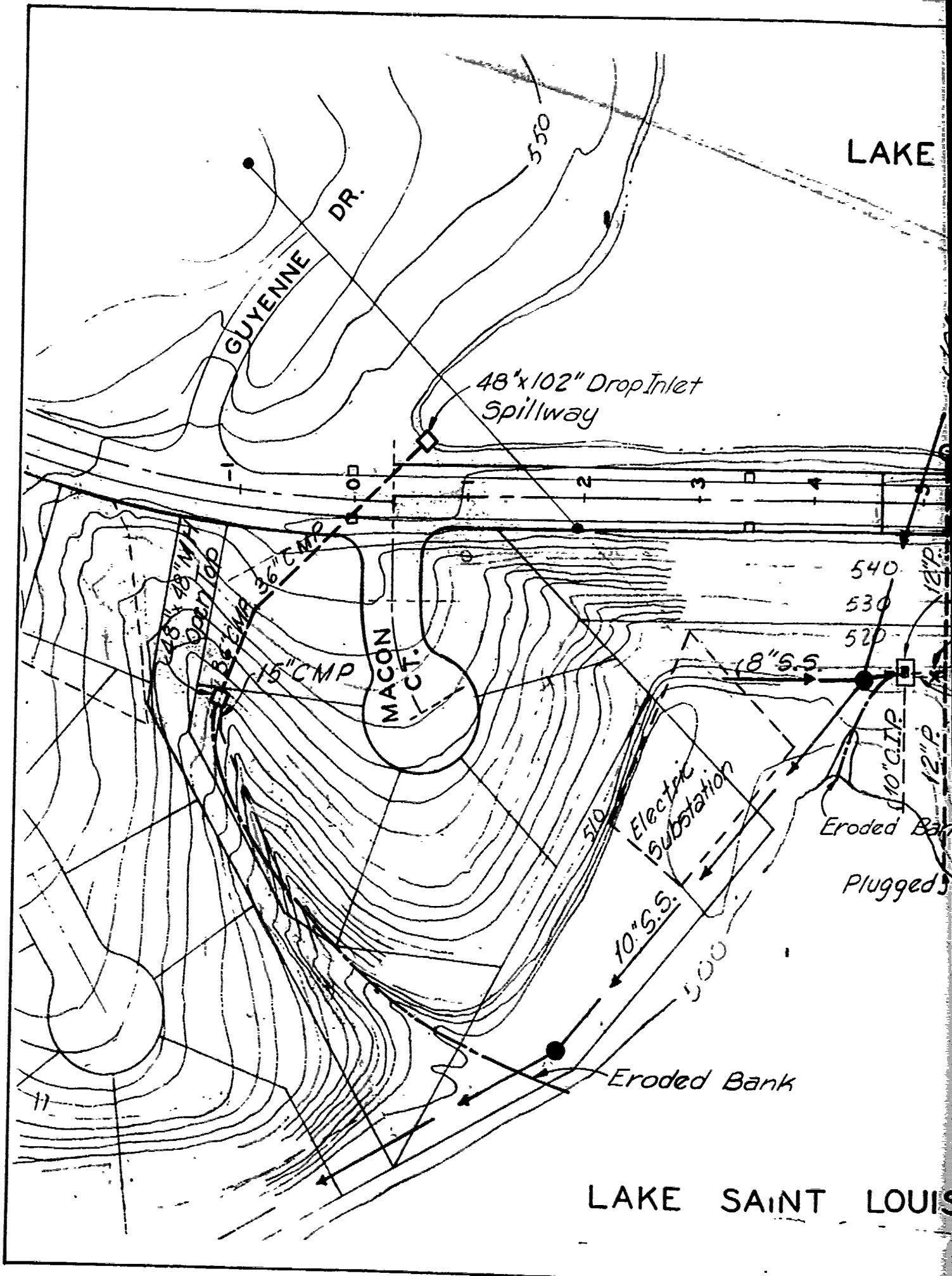
SCALE 1" = 2000'



REGIONAL VICINITY MAP

PLATE I

2



SCALE: 1" = 100'

N

LAKE SAINTE LOUISE

CHANTILLY CT.

42" ϕ Drop Inlet Spillway

SAVOY DR.

Pump Base

10" Valve

10" C.I.P.

LP Tank Farm

540
530
520

10" C.I.P.

12" P.

Eroded Bank

Plugged

DETOUR DR.

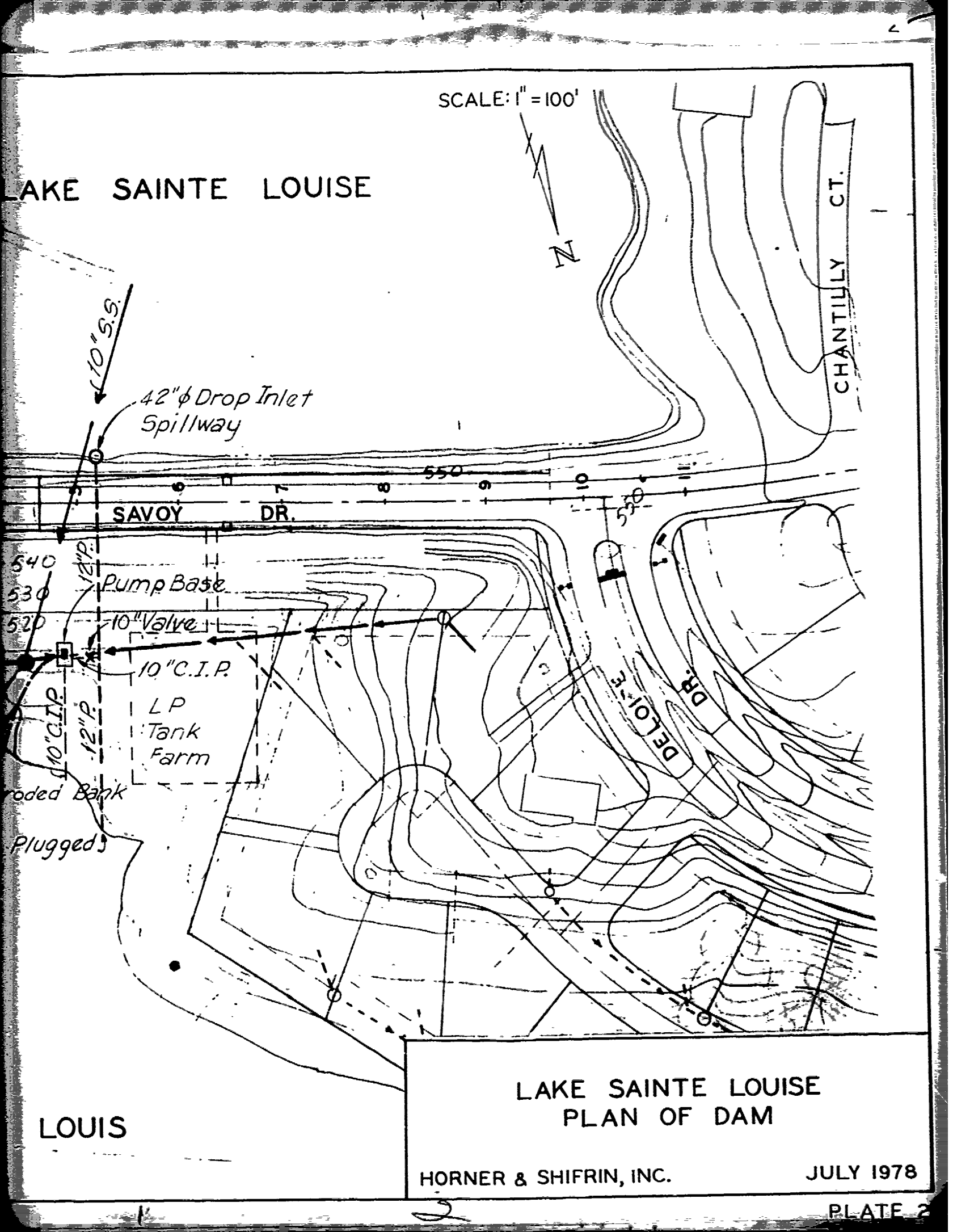
LOUIS

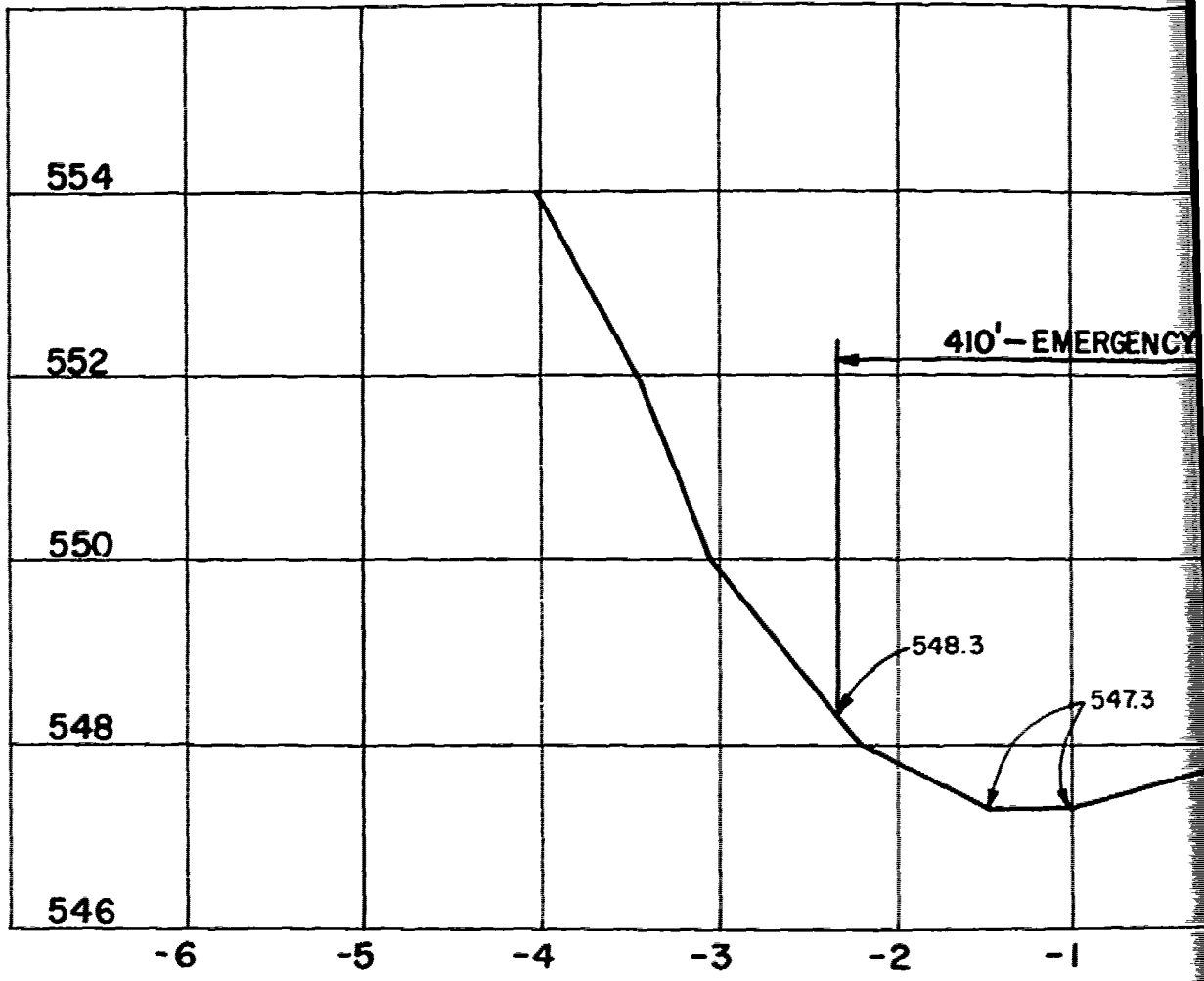
LAKE SAINTE LOUISE PLAN OF DAM

HORNER & SHIFRIN, INC.

JULY 1978

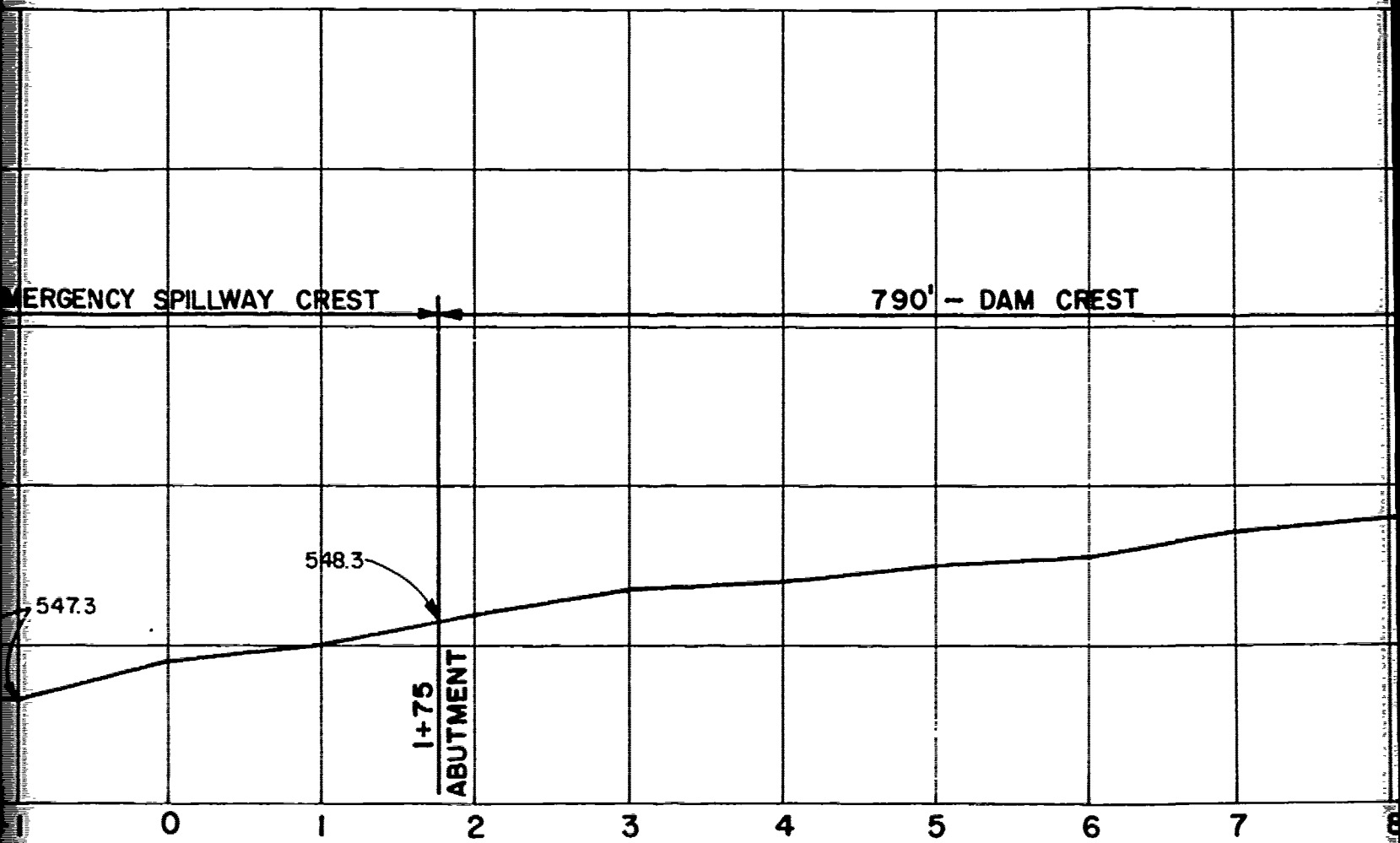
PLATE 2





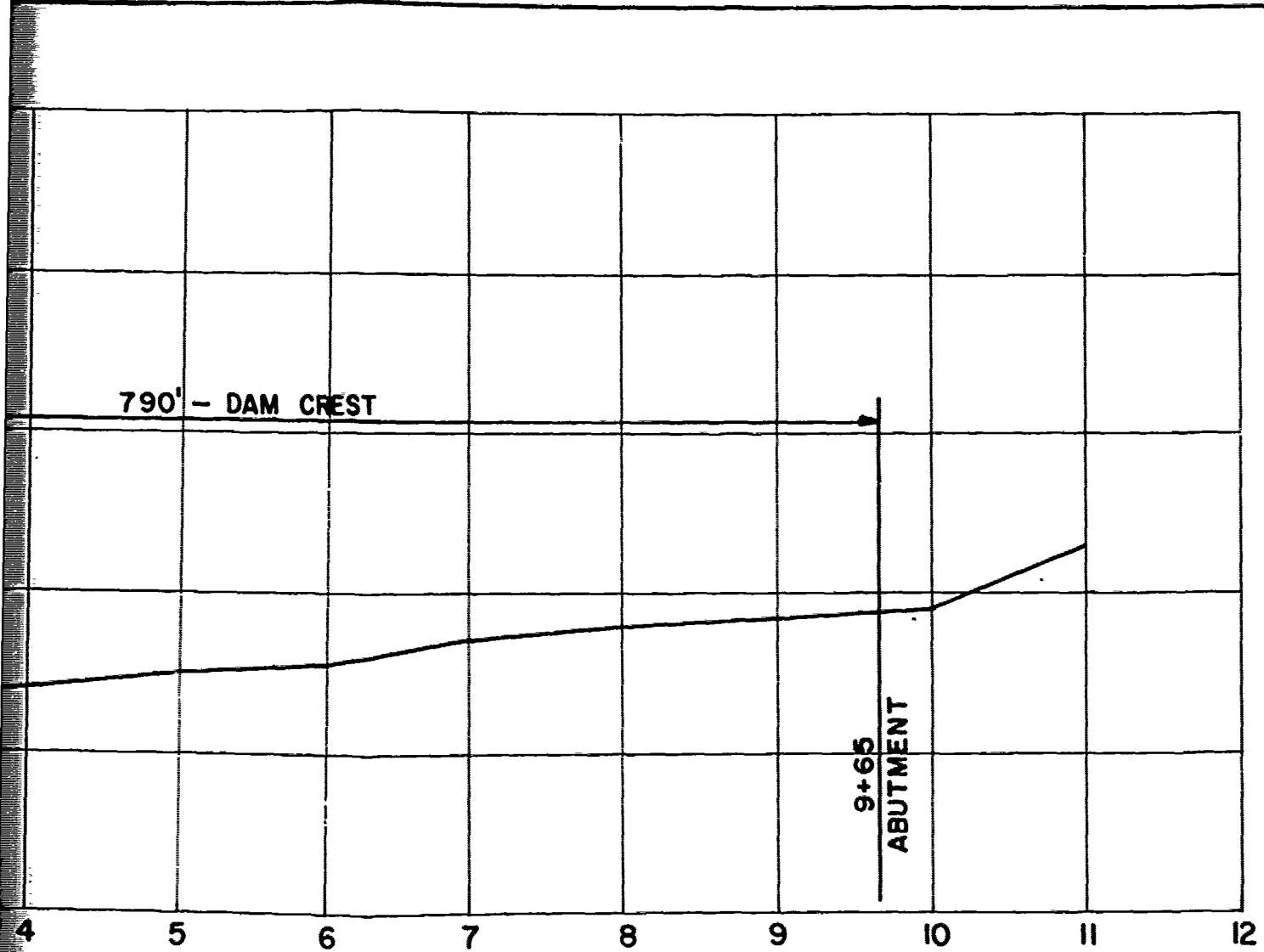
EMERGENCY SPILLWAY CREST

790' - DAM CREST

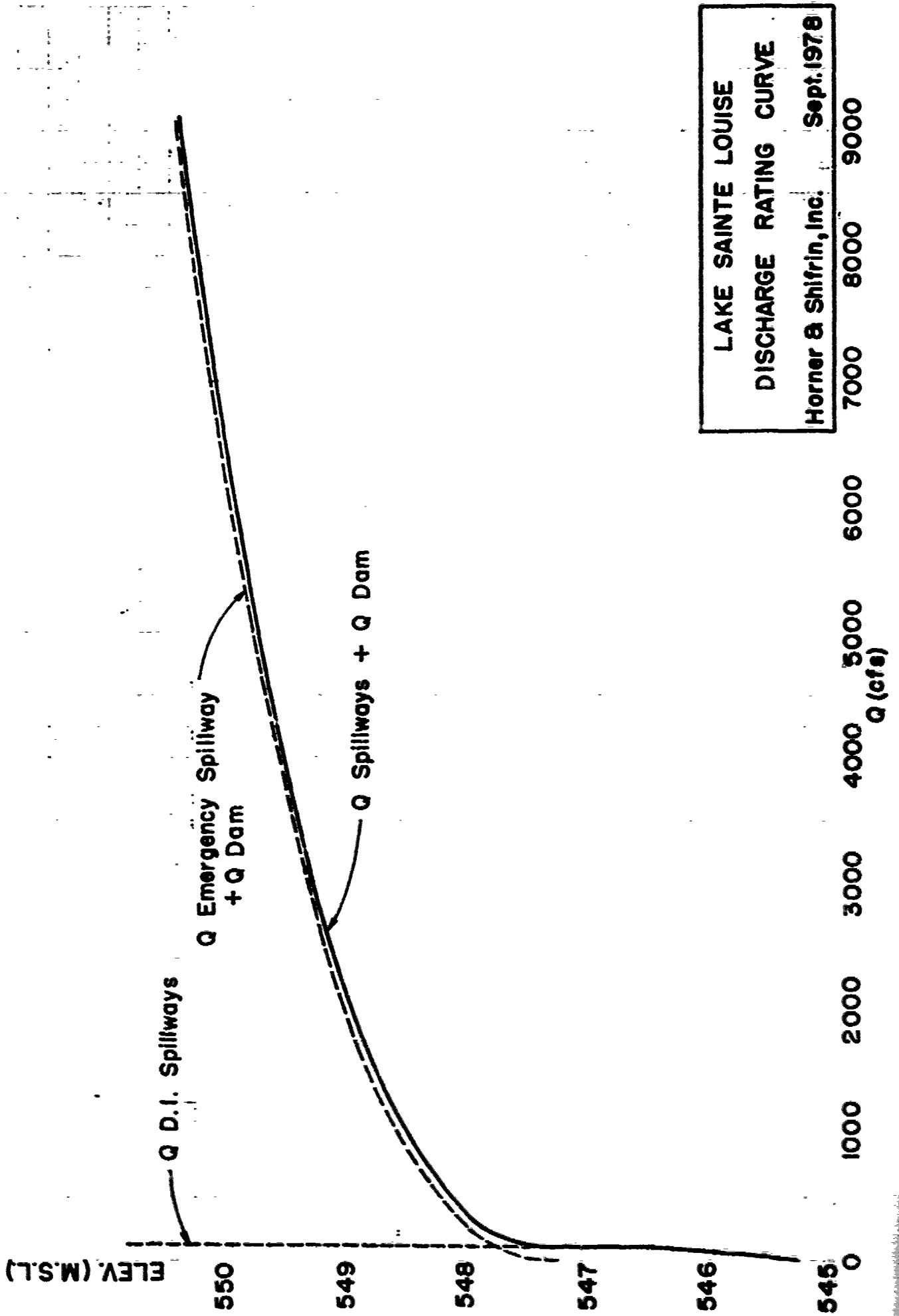


PROFILE

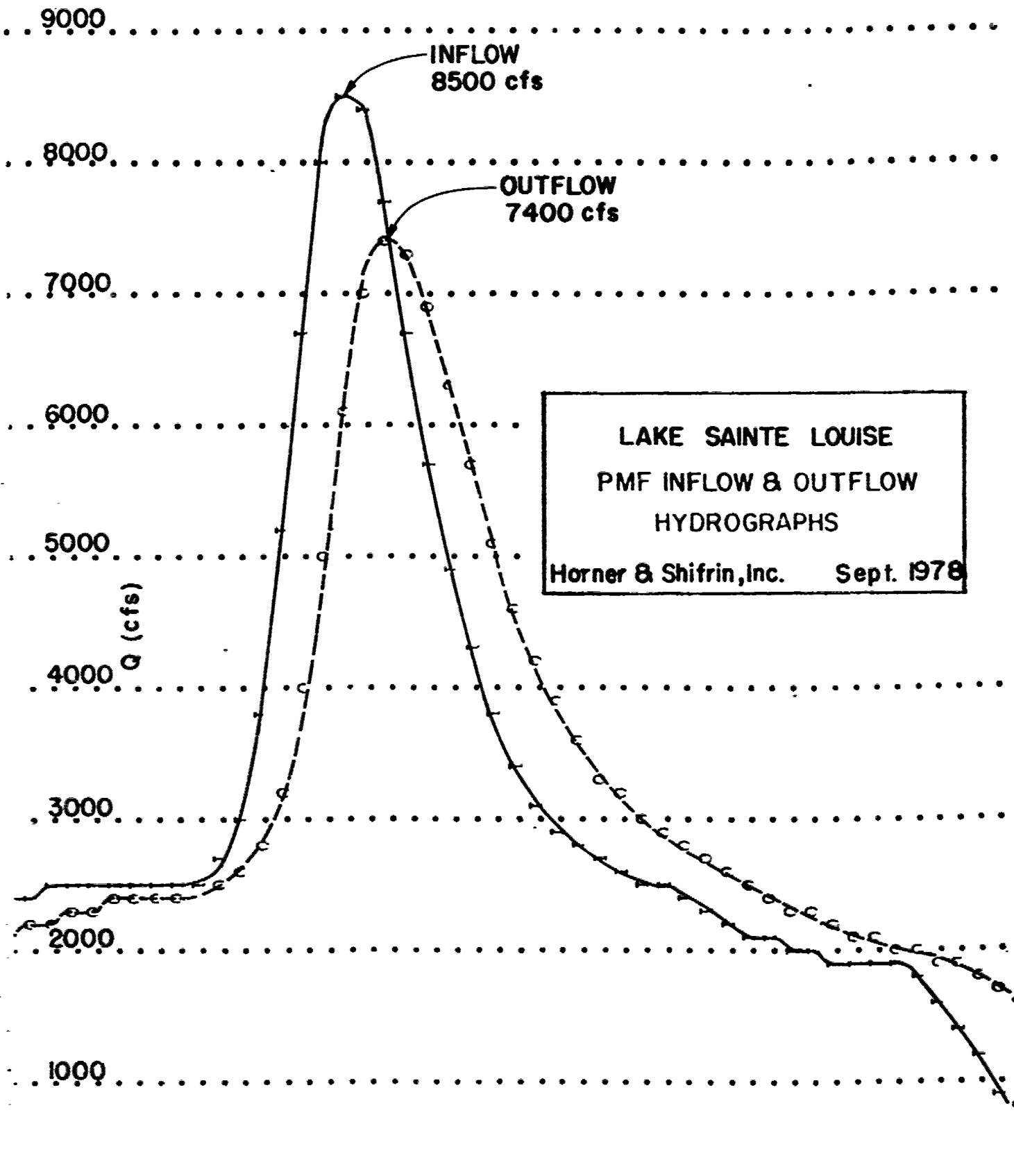
SCALES: 1" = 2' V., 1" = 100' H.



LAKE SAINTE LOUISE
DAM & EMERGENCY SPILLWAY PROFILE
 Horner & Shifrin, Inc. Sept. 1978



LAKE SAINTE LOUISE
DISCHARGE RATING CURVE
Horner & Shifrin, Inc. Sept. 1978



LAKE SAINTE LOUISE
PMF INFLOW & OUTFLOW
HYDROGRAPHS
 Horner & Shifrin, Inc. Sept. 1978

TIME (Hr./Min.) FROM BEGIN OF RAINFALL
14.40
14.45
14.50
14.55
15.00
15.05
15.10
15.15
15.20
15.25
15.30
15.35
15.40
15.45
15.50
15.55
16.00
16.05
16.10
16.15
16.20
16.25
16.30
16.35
16.40
16.45
16.50
16.55
17.00
17.05
17.10
17.15
17.20
17.25
17.30
17.35
17.40
17.45
17.50
17.55
18.00
18.05
18.10
18.15
18.20
18.25
18.30

SUBSURFACE INVESTIGATION
AND
LABORATORY ANALYSIS

FOR

PETITE LAKE ST. LOUIS DAM PROJECT
OF
LAKE ST. LOUIS INVESTMENT CORP.
OF FALLON, MISSOURI

BY

BROWNING TESTING LABORATORIES, INC.
ROUTE #2, HWY. 54 NORTH
FULTON, MISSOURI 65251
PHONE (314) 642-5719

BROWNING TESTING LABORATORIES, INC.

ROUTE 2, HWY. 54 NORTH - - PHONE MI 2-5719

FULTON, MISSOURI 65251

Manager
GARY N. CLARK

President
BERNARD G. BROWNING

October 13, 1966

Lake St. Louis Investment
Corporation
Route 1?
O'Fallon, Missouri

Re: Subsurface investigation and Laboratory Analysis of Lake St. Louis Dam Site.

Gentlemen:

We have completed the subsurface investigation and laboratory analysis of the work referenced.

Enclosed, you will find copies of the drilling logs and explanations of the method of classification, a plot showing the depths and location of borings along the center line of the dam, and laboratory data sheets showing compaction data and atterberg limits.

The soil type at the dam site is Huntington, generally a smooth brown silt loam to a silty clay and containing some chert, gravel and sand.

The geological location is of the Keokuk formation as is indicated in the Geologic Report presented by Mr. James H. Williams, and incorporated in this report.

The soil type from the borrow area above the dam site is Union, generally a reddish to brownish silty clay to clay with residual chert scattered throughout.

Samples of the boring are maintained on file until the job is completed or abandoned, feel free to see them at any time.

Respectfully yours,

Gary N. Clark
Gary N. Clark, Manager

SNQ:ajb

cc: James H. Williams

Chart 2-2:

BERNARD G. BROWNING
PROFESSIONAL ENGINEER & LAND SURVEYOR
ROUTE 2, HWY. 54 NORTH - - PHONE MI 2-5719
FULTON, MISSOURI 65251

Member
N.S.P.E.
M.S.P.E.
M.A.R.L.S.
A.C.S.M.

Missouri
Registration
E-7793
I.S-359

October 19, 1966

Lake St. L. Investment, Corp.
Route #2
O'Fallon, Missouri

Gentlemen:

The following is a preliminary Engineering Report of your Petite Lake St. Louis Dam Project.

The Geological Report, Drill Logs, and field investigation all indicate that you have a feasible project.

It is suggested that if fishing is anticipated in the fall of 1967 that construction proceed this fall with a target completion date of Oct. 20, 1966.

Good construction will be the key to success for this project. The core trench excavation will require hand work and possibly some blasting at the juncture of the soil and bedrock. This is the critical area.

In general the preliminary design criteria is as follows:

Top width of dam	50 feet
Top elevation of dam	548.0 -
Side slopes of dam upstream	2.5 to 1.0
Side slopes of dam downstream	2.5 to 1.0
Core trench, bottom width	20.0 ft.
Core trench, side slopes	1.0 to 1.0
Principal spillway elevation	543.0

The laboratory tests show that the soil classified as silt loam has a liquid limit of 23 percent moisture. This means that this fill material is to be used with caution. It can be used in the down stream section above the Big Lake St. Louis waterline.

We are awaiting your decision about going ahead on the final design.

Very truly yours,

Bernard G. Browning

Chart 2-3

2681a/b

GEOLOGIC REPORT ON THE ST. LOUIS LAKE (BROWNING), ST. CHARLES COUNTY

The proposed lake site is located in the SW $\frac{1}{4}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 27, T.47 N., R.2 E. (Troy Quad.). Geologically the location is excellent for water impoundment. The bedrock formation, Keokuk Limestone, is present in the valley area but crops out in very few exposures along the steeper portions of the valley slopes. The Keokuk has limestone beds that are thin to medium in thickness (4" to 2') and interlayered with persistent thick nodules of chert that are in 2" to 6" beds. Most of the valley is covered by a thick mantle of silty clay mixed with chert fragments.

While geologically the area is suitable and there are no major hazards, particular attention must be given to the abutments and valley floor at the dam site. Weathered bedrock exposed near the abutments indicate that seepage could occur along horizontal openings if these are not intercepted by the core trench. Location of the centerline so that small side valley draws can be utilized as part of the abutment core trench will facilitate excavation into fresh unweathered bedrock. Similarly excavation along the floor of the valley should be carried through the weathered bedrock zone. The bedrock excavation may require the use of a rear mounted ripper. It is most important that all weathered bedrock layers in the core be removed even if it should require some drilling and blasting.

During the field examination it was considered that the dam site should be shifted upstream so that the side valley draws could be utilized. This upstream relocation also placed the dam on a more shallow thickness of alluvium than at the originally proposed downstream site. This will further enhance the suitability of the site since it will be easier to complete the core trench excavations. Greater thickness of alluvium such as the downstream site generally involve the problems of more permeable zones consisting of gravels and boulders.

Since subsurface exploration has outlined the nature of the subsoil and bedrock so that major seepage hazards have been noted and a positive cutoff core is planned borrow may be obtained from areas most convenient from an engineering design viewpoint.

James H. Williams
by j

James H. Williams
Chief, Eng. Geol. Section
Missouri Geological Survey
September 30, 1966

Table 1--Percentage of Sand Sizes in Soil in Terms of Subsoils
Loamy Sand and Sandy Loam Basic Textural Classes
as Defined by the U.S. Department of Agriculture

Subsoil	Soil separates				
	Very coarse sand, 2.0-1.0 mm.	Coarse sand, 1.0-0.5 mm.	Medium sand, 0.5-0.25 mm.	Fine sand, 0.25-0.1 mm.	Very fine sand, 0.1-0.05 mm.
Coarse sand	25% or more		Less than 50%	Less than 50%	Less than 50%
Sand		25% or more		Less than 50%	Less than 50%
Fine sand			— or —	50% or more	Less than 50%
Very fine sand		Less than 25%			Less than 50%
Loamy coarse sand	25% or more		Less than 50%		Less than 50%
Loamy sand		25% or more		Less than 50%	Less than 50%
Loamy fine sand			— or —	50% or more	Less than 50%
Loamy very fine sand		Less than 25%			50% or more
Coarse sandy loam	25% or more		Less than 50%		Less than 50%
Sandy loam	Less than 25%	30% or more	— and —	Less than 30%	Less than 50%
Fine sandy loam		— or —		30% or more	Less than 30%
Very fine sandy loam		Less than 15%	— or —	More than 40%	30% or more

all of fine sand and very fine sand must be very fine sand.

Chart 2-5

Sandy loam: Consists largely of sand that has a small amount of silt and clay present to give it a small amount of stability. Under heavy pressure it can be seen and felt readily. Squeezed in the hand when dry, it will fall apart when the pressure is released. Squeezed when moist, it will form a cast that will not only hold its shape when the pressure is released but will withstand careful handling without breaking. The stability of the moist cast differentiates this soil from sand.

Loam: Consists of an even mixture of the different sizes of sand and of silt and clay. It is easily crumbled when dry and has a slightly gritty, yet fairly smooth feel. It is slightly plastic. Squeezed in the hand when dry, it will form a cast that will withstand careful handling. The cast formed of moist soil can be handled freely without breaking.

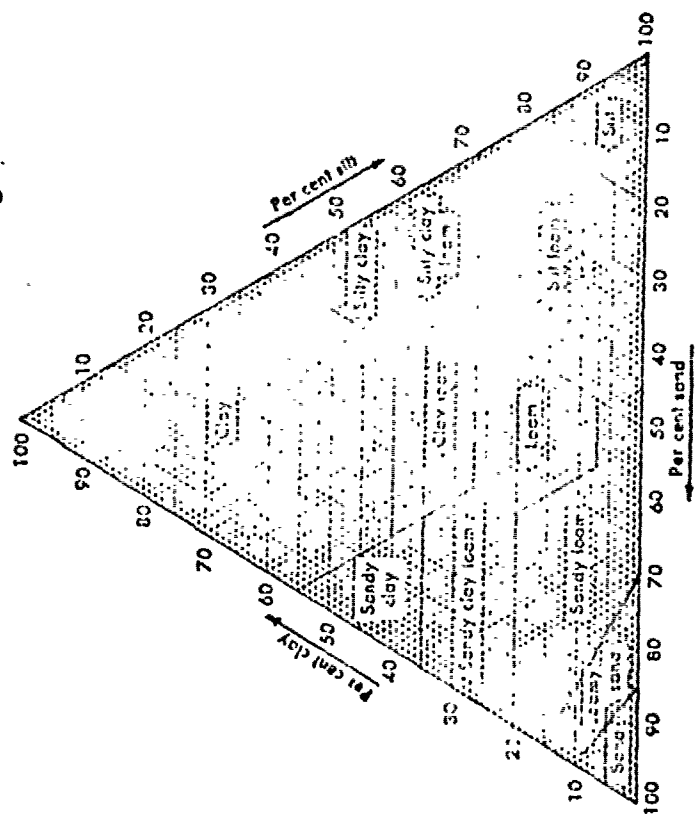


Fig. 2. U.S. Department of Agriculture (textural) classification chart for 2-micron clay.

Silt loam: Consists of a moderate amount of fine grades of sand, a small amount of clay and a large quantity of silt particles. Lumps in a dry, undisturbed state appear quite cloddy but they can be pulverized readily; the soil then feels soft and floury. When wet, silt loam runs together

Copied From Soil Primer
Ash, Soil Primer

BROWNING TESTING LABORATORIES, INC.

Route 2, Hwy. 54 North
FULTON, MISSOURI 65251
(314) MI 2-5719

DATA SUMMARY SHEET

#157

LABORATORY TESTS

ATTERBERG LIMITS:	%	%	%
HOLE NO.	12	12	13-14
DEPTH FT.	0-10.0	10.0-15.0	0-7.0
LIQUID LIMIT	28	49	55
PLASTIC LIMIT	20	17	24
PLASTIC INDEX	8	32	31
SHRINKAGE LIMIT			

BROWNING TESTING LABORATORIES, INC.

Route 2, Hwy. 54 North
 FULTON, MISSOURI 65231
 (314) MI 2-5719

GENERAL EXPLANATION OF FIELD BORING LOGS

consistency	number of blows	estimated unconfined compression P.S.F.	field identification
very soft	0 - 2	0 - 500	easily penetrated several inches by fist
soft	2 - 4	500 - 1000	easily penetrated several inches by thumb
medium	5 - 8	1000 - 2000	can be penetrated several inches with moderate effort
stiff	9 - 15	2000 - 4000	readily indented by thumb but penetrated only with great effort
very stiff	16 - 30	4000 - 5000	readily indented by thumbnail
hard	30+	5000+	indented with difficulty by thumb nail

- Silt:** Soil material that contains 60 per cent or more silt and less than 12 per cent clay.
- Sandy clay loam:** Soil material that contains 20 to 35 per cent clay, less than 28 per cent silt and 45 per cent or more sand.
- Clay loam:** Soil material that contains 27 to 40 per cent clay and 20 to 45 per cent sand.
- Silty clay loam:** Soil material that contains 27 to 40 per cent clay and less than 20 per cent sand.
- Sandy clay:** Soil material that contains 35 per cent or more clay and 45 per cent or more sand.
- Silty clay:** Soil material that contains 40 per cent or more clay and 40 per cent or more silt.
- Clay:** Soil material that contains 40 per cent or more clay, less than 45 per cent sand and less than 40 per cent silt.

Field identification of texture

Identification of the texture of a soil in the field by feel and appearance requires training and experience. Many engineers acquire this knowledge in the soil laboratory where they conduct the tests for grain size of a soil, plot the results on a triaxial chart and determine the appropriate texture; and then return to the soil tested, mold it in their hands and rub it, both wet and dry, between their fingers while studying its appearance and feel.

To permit approximate textural classification, many practical shortcuts can be devised to determine the amount of silt and clay in a soil. However, since the range in clay content for the textural groups is not large, accurate weighing of samples is needed, which requires some laboratory facilities.

The following brief comments on the feel and appearance of the textural groups given previously illustrate the factors used in determining the texture of a soil in the field and will also assist in field classification work. Note that forming a cast of soil, dry and moist, in the hand and pressing a moist ball of soil between the thumb and finger constitute two major field tests used to judge soil texture.

Sand: Individual grains can be seen and felt readily. Squeezed in the hand when dry, it will fall apart when the pressure is released. Squeezed when moist, it will form a cast that will hold its shape when the pressure is released but will crumble when touched.

Particle size—mm	Sieve sizes	United Soil Classification (Corps of Engineers, Department of the Army, and Bureau of Reclamation)	Civil Aeronautics Administration Soil Classification	U.S. Department of Agriculture Soil Classification	American Association of State Highway Officials Soil Classification	American Society for Testing Materials for Testing Materials
.001		Fines (silt or clay)**	Clay	Clay	Clay	Clay
.002						
.003		Fines sand	Silt	Silt	Silt	Silt
.004						
.005		Fines sand	Fines sand	Very fine sand	Fine sand	Fine sand
.008						
.01		Fines sand	Fines sand	Med. fine sand	Coarse sand	Coarse sand
.02						
.03		Fines sand	Fines sand	Med. coarse sand	Fine gravel	Fine gravel
.04						
.06	270	Fines sand	Fines sand	Very coarse sand	Coarse gravel	Coarse gravel
.08	200					
.1	140	Fines sand	Fines sand	Very coarse sand	Coarse gravel	Coarse gravel
.15						
.2	100	Fines sand	Fines sand	Med. coarse sand	Fine gravel	Fine gravel
.3	75					
.4	40	Fines sand	Fines sand	Med. coarse sand	Coarse gravel	Coarse gravel
.6						
.8	20	Fines sand	Fines sand	Very coarse sand	Coarse gravel	Coarse gravel
1.0						
2.0	10	Fines sand	Fines sand	Very coarse sand	Coarse gravel	Coarse gravel
3.0						
4.0	4	Fines sand	Fines sand	Very coarse sand	Coarse gravel	Coarse gravel
6.0						
8.0		Fines sand	Fines sand	Very coarse sand	Coarse gravel	Coarse gravel
10						
20	1/2"	Fines sand	Fines sand	Very coarse sand	Coarse gravel	Coarse gravel
30						
40		Fines sand	Fines sand	Very coarse sand	Coarse gravel	Coarse gravel
60						
80		Fines sand	Fines sand	Very coarse sand	Coarse gravel	Coarse gravel
100	3"					

United Soil Classification (Corps of Engineers, Department of the Army, and Bureau of Reclamation)

Civil Aeronautics Administration Soil Classification

U.S. Department of Agriculture Soil Classification

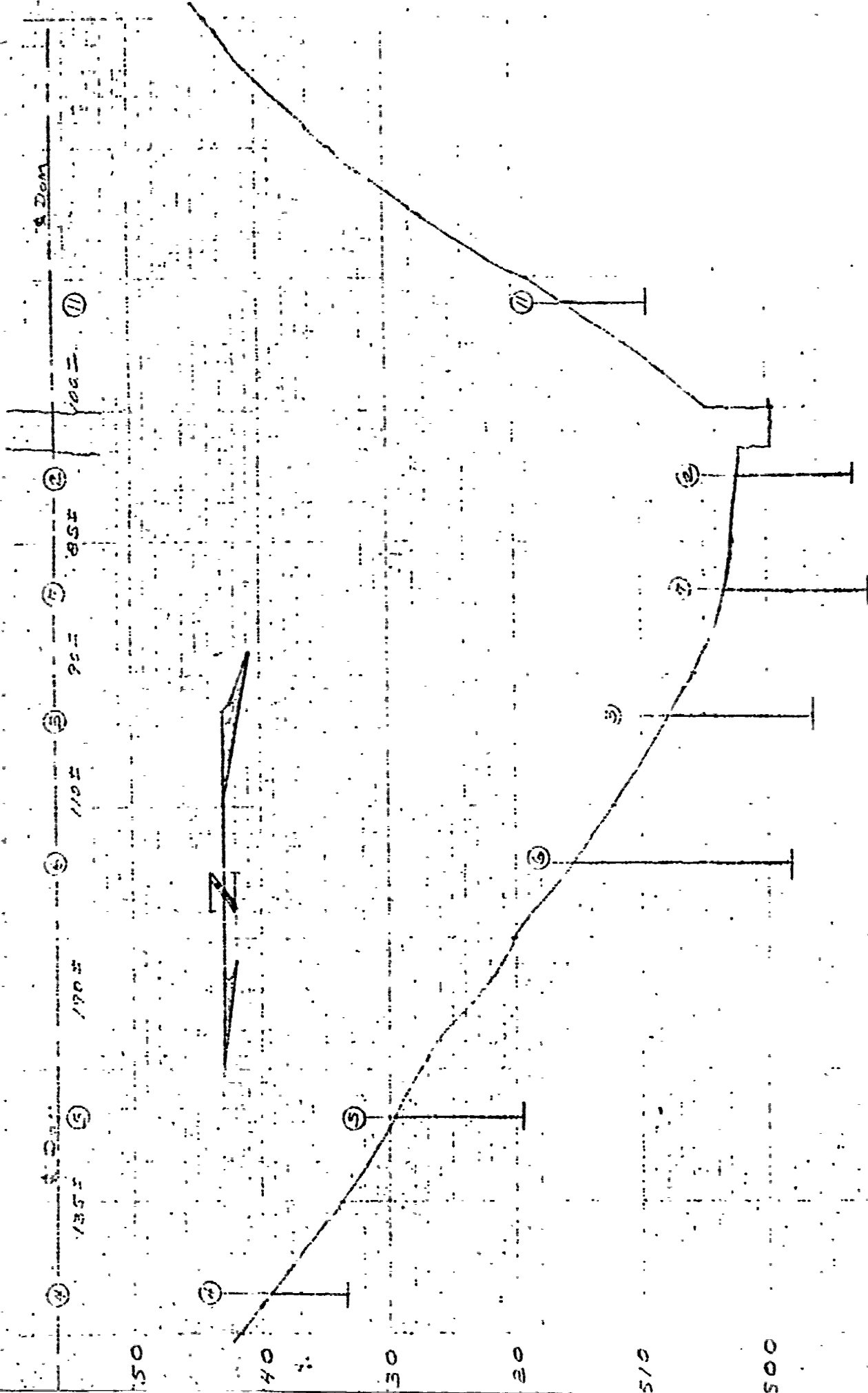
American Association of State Highway Officials Soil Classification

American Society for Testing Materials for Testing Materials

Fig. 1. Soil texture classification limits of ASTM, CMAA, Corps of Engineers and USBR.

*Cobles included in clay fraction in test reports. **The LL and PL of SM plot below the "A" line on the plasticity chart, Table 4 and the LL and PL for "Clay" plot above the "A" line.

Soil Primer
Soil Primer
Soil Primer



LAKE ST. LIGHTS, FERRY, CONN.
 Profile of Center line of
 Dam and location and
 Depth of Test Borings

Job No 157
Date 3-21-66

Rig No at Weight of 11's

Surface Elev. SS Elev Casing Used SS Elev

Sheet of

BORING NO.		Depth	From	To	Elevation	Distance	Method	Penetration Record				Weather	TTMP	ABBREVIATIONS		
Sample No	Pressure							Time	Interval	Number	Length					
																F.T. - Fish Tail W.O. - Wash Out S.T. - Shelby Tube S.S. - Split Spoon D.B. - Diamond Bit C. - Core R.B. - Rock Bit A. - Auger
												Site <u>at</u>				
												<u>24</u>				
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Job No. 177
 Date 6-21-57

Sheet of

Water Level
 Coating used
 SS Size
 Wt of Hammer

Sample No.	Depth		From Elevation	To Elevation	Distance Feet	Method	Penetration Record				Site	WEATHERED, TEMP SOIL	ABBREVIATIONS
	From	To					Hydraulic Pressure Psi	Time Interval Sec	Number of Blows	Length Recovered Feet			
	10.7	10.4									Can site Lake St. Lewis Route 72 M.F.A. 101, Missis.	F.T.-Fish Tail W.O.-Wash Tub S.T.-Stebby Tube S.S.-Soft Spore P.D.-Diamond Bit C.-Core R.D.-Rock Bit A.-Auger	

Job No 177
Date 5-22-33

Water Level 61.00
Casing used

Sheet of

BORING NO	Depth		From Elevation	To Elevation	Distance	Method	Penetration Record				Sieve	WEATHER	TEMP	ABBREVIATIONS	
	From	To					Time Interval	Pressure	Number of Blows	Length					
1	0.5	2.5												F.T. - Fish Tail W.O. - Wash Out S.T. - Shelby Tube S.S. - Split Spoon D.B. - Diamond Bit C - Core R.B. - Rock Bit A - Auger	
	2.5	5.0													
	5.0	7.0													
	7.0	9.0													
	9.0	11.0													
	11.0	13.0													
	13.0	15.0													
	15.0	17.0													
	17.0	19.0													
	19.0	21.0													
	21.0	23.0													
	23.0	25.0													
	25.0	27.0													
	27.0	29.0													
	29.0	31.0													
	31.0	33.0													
	33.0	35.0													
	35.0	37.0													
	37.0	39.0													
	39.0	41.0													
	41.0	43.0													
	43.0	45.0													
	45.0	47.0													
	47.0	49.0													
	49.0	51.0													
	51.0	53.0													
	53.0	55.0													
	55.0	57.0													
	57.0	59.0													
	59.0	61.0													
	61.0	63.0													

Site: Dan site
Lake St. Louis
Ruta #2
Coffman, Missouri

SAMPLE DESCRIPTION
Color - Moisture - Material - Consistency
Brown-silty / sandstone

Soiler

Brown-silty claystone

Intermediate

Yellowish

Job No. 107

Date 10/20/57

Sheet 1 of 1

Water Level at 10:00 AM

Casing used 4 1/2" diameter

SS Size 20 mesh

BORING NO. 107 FOR LOGS CO. LOGS CORP. - MISSOURI

Site: 2075th, Leola, Route 43, Jefferson, Missouri

Penetration Record

Sample No.	Depth		From Elevation	To Elevation	Distance	Method	Hydraulic Pressure	Time Interval	Number of Blows	Length Recovered	APPRECIATIONS
	From	To									

SAMPLE DESCRIPTION
Color - Moisture - Material - Consistency

1st to 10th feet at 10:00 AM
penetration maintained 100 blows, 10:00 AM
11:00 AM to 12:00 PM
was out on to ground water level
1st 10 feet ground coru.

12:00 PM to 1:00 PM
1st 10 feet ground coru.

1:00 PM to 2:00 PM
cutting from the tank water level on.

2:00 PM to 3:00 PM
penetration 100 blows 10:00 AM

3:00 PM to 4:00 PM
penetration 100 blows 10:00 AM

Job No. 1000
 Date 10-2-54

Water Level at 10:00 AM
 Casing used SS Vize

Surface Elev. 1000.00 Wt of Hammer 10 lbs
 Penetration Record

Boring No.	Depth		From Elevation	To Elevation	Distance Feet	Method	Penetration Record				Remarks	
	From	To					Hydraulic Pressure Psi	Time Sec	Number of blows	Length Percussed Feet		
	0	0.2			0.2	A						Site: Pop Silo Lake St, Louis Rolls #2 O'Fallon, Missouri
	0.2	0.7			0.5	A						Color - Moisture - Material - Consistency
	0.7	1.0			0.3	A						Color - Moisture - Material - Consistency
	1.0	1.5			0.5	A						Color - Moisture - Material - Consistency
	1.5	2.0			0.5	A						Color - Moisture - Material - Consistency
	2.0	2.5			0.5	A						Color - Moisture - Material - Consistency
	2.5	3.0			0.5	A						Color - Moisture - Material - Consistency
	3.0	3.5			0.5	A						Color - Moisture - Material - Consistency
	3.5	4.0			0.5	A						Color - Moisture - Material - Consistency
	4.0	4.5			0.5	A						Color - Moisture - Material - Consistency
	4.5	5.0			0.5	A						Color - Moisture - Material - Consistency
	5.0	5.5			0.5	A						Color - Moisture - Material - Consistency
	5.5	6.0			0.5	A						Color - Moisture - Material - Consistency
	6.0	6.5			0.5	A						Color - Moisture - Material - Consistency
	6.5	7.0			0.5	A						Color - Moisture - Material - Consistency
	7.0	7.5			0.5	A						Color - Moisture - Material - Consistency
	7.5	8.0			0.5	A						Color - Moisture - Material - Consistency
	8.0	8.5			0.5	A						Color - Moisture - Material - Consistency
	8.5	9.0			0.5	A						Color - Moisture - Material - Consistency
	9.0	9.5			0.5	A						Color - Moisture - Material - Consistency
	9.5	10.0			0.5	A						Color - Moisture - Material - Consistency

Job No. 157
Date 9-25-33

Water level ... ft
Casing used ...
SS Size ...
Wt of Hammer ...

Sheet ... of

Boring No.	Depth		From Elevation	To Elevation	Distance	Method	Penetration Record				Site:	WEATHERING	TEMP.	ABBREVIATIONS	
	From	To					Pressure	Time	Number	Length					Feet
Sample No.	From	To													
	2.0	2.1										17th St, Louis Route #2 Stanton, Missouri			F.T.-Flas Tall W.O.-Wash Out S.T.-Shabby Tube S.S.-Split Spoon D.B.-Diamond Bit C. - Core R.D.-Rock Bit A. - Auger
	2.7	2.9			2.7	A									Prognality 1st - Rocky - dry - stiff
	2.9	5.7													Overlimestone - small amount of cherty clay directly above
	5.7	7.7													Brown-cherty - silty clay - moist - medium directly above

Job No. 157
 Date 9-25-64
 Sheet of
 Water Level at Hrs.
 Casing used
 SS Size Wt of Hammer

Sample No.	Depth		From Elevation	To Elevation	Distance Feet	Method	Penetration Record				Site:	WEATHER/soil	TEMP. Soil	ABBREVIATIONS
	From	To					Hydraulic Pressure Pst	Time Interval Sec	Number of Blows	Length Feet				
	0	2.0			2.0	A					FOR Lake St, Louis Investment Corporation			F.T.-Fish Tail W.O.-Wash Out S.T.-Shotsy Tube S.S.-Spill Spoon D.B.-Diamond Bit C.-Core R.B.-Rock Bit A.-Auger
	2.0	4.0			2.0	A					Dom Site Lake St, Louis Bents #2 Or Fallon, Missouri			
	4.0	5.5			1.5	A								
	5.5	6.5			1.0	A								
	6.5	10.0			3.5	A								
	10.0	10.5			0.5	A								
	10.5	12.5			2.0	A								
<p>Color - Moisture - Material - Consistency Brown-silty loam clay - medium Brown-cherty silty clay - moist-medium Reddish-cherty clay - moist-medium Brownish-cherty clay - moist-medium Reddish - sandy clay - moist-medium Limestone and shale with weathered clay Description: Section 4000 ft. to 1000 ft. above crystalline limestone is a silty clay of clay. Several intervals of thin between layers from 10 in. to 4 inches in thickness. Portions of core appeared somewhat weathered. Cored 2.4 ft. and recovered 2.4 ft.</p>														

Rig No. 244 at 157 Hrs
 Water Level
 Casing used
 SS Size Wt. of Hammer
 Surface Elev. Sheet of

Boring No.	Depth		From Elevation	To Elevation	Distance Feet	Method	Penetration Record				Length Recovered Feet	WEATHER CONDITIONS	TEMP. Cool	ABBREVIATIONS					
	From	To					Hydraulic Pressure Psi	Time Interval Sec	Number of Blows	Penetration Record									
	0	2.0			2.0	A													
	2.0	5.0			3.0	A													
	5.0	5.5			0.5	A													
	5.5	10.5			5.0	M													
	10.5	15.5			5.0	A													
	15.5	15.0			0.5	A													
	15.0	15.0			0	-													

Site: Dam site
Lake St. Louis
ROUTE 42
Jefferson, Missouri

SAMPLE DESCRIPTION
 Color - Moisture - Material - Consistency
Brown-silty loam-medium
medium-silty clay-medium
low-moisture silty clay-to-medium
reddish brown-silty clay-to-medium

- ABBREVIATIONS
- P.T. - Fish Tail
 - W.O. - Wash Out
 - S.T. - Shelby Tube
 - S.S. - Spill Spoon
 - D.B. - Diamond Bit
 - C. - Core
 - R.S. - Rock Bit
 - A. - Auger

Job No. 157

Date 02-07-04

Water Level at 11.5

Casing used

Sheet 1 of 1

Site: Elm St. Louis
Route #2
Circulation, Missouri

Color - Moisture - Material - Consistency

Abbreviations:
F.T.-Fish Tail
W.O.-Wash Out
S.T.-Shelly Tube
S.S.-Split Spoon
D.B.-Diamond Bit
C.-Cone
R.B.-Rock Bit
A.-Auger

Boring No. 7	Depth		From Elevation	To Elevation	Distance	Method	Penetration Record				Length Recovered	Weather Cloud	TEMP. 0001	ABBREVIATIONS	
	From	To					Hydraulic Pressure	Time Interval	Number of Blows	Feet					
	0.0	1.0			1.0	A									
	1.5	2.0			1.0	GT									
	2.0	3.0			2.0	A									
	4.0	5.0			0.5	GT									
	5.0	6.0			0.5	GT									
	6.0	7.0			0.5	A									
	7.0	8.0			0.5	GT									
	11.5	11.5			0.0	A									

Job No. 157 Date 2-27-55 Sheet 1 of

Water Level at _____ Mts
Casing used _____
SS Size _____ Wt of Hammer _____

Boring No.	Depth		From Elevation	To Elevation	Distance Feet	Method	Penetration Record				Weather	TEMP. Cool	ABBREVIATIONS		
	From	To					Hydraulic Pressure Psi	Time Interval Sec	Number of Blows	Length Recovered Feet					
	0	3.5			3.5	1							Site: borrow area below Lake St. Louis Route #2 OFICTION, Missouri	F.T.-Fish Tail W.C.-Wash Out S.T.-Shelby Tube S.S.-Soft Spoon D.B.-Diamond Bit C.-Core R.B.-Rock Bit A.-Anker	
	3.5	7.0				1								Color - Moisture - Material - Consistency Brown-silt loam-medium to stiff	
	7.0	9.0				1								Brown-rocky-gravelly-dry-stiff	
	9.0	11.0				1								Brown-rocky-cherty-silty clay-medium to stiff	
	11.0	13.7				1								Brown-cherty-silty-medium stiff	
	13.7	15.7				1								Water refusal	

Job No. 157

Date 5-27-55

Water Level at _____ (fts.)

Casing used _____

SS Size _____ Wt of Hammer _____

Sheet _____ of _____

BOHING NO.		FOR LAKE ST., LOUISIANA INVESTMENT CORPORATION				WEATHER STATION		TEMP.	COOL	ADDITIONS
Sample No.	Depth	From Elevation	To Elevation	Distance	Method	Penetration Record			Site	Color - Moisture - Material - Consistency
						Hydraulic Pressure	Time Interval	Number of Blows		
				Feet		Psi	Sec			Feet Recovered
	2.0			2.0 A					LAKE ST., LOUISIANA INVESTMENT CORPORATION	
	3.0	12.0		7.0 A					ROUTE #2	
	10.0	12.0		2.0 A					ORIFLION, MISSOURI	
	12.0	12.0		5.0 A						
	17.0	17.0		2.0 A						
	17.0	17.0		-						

Job No. 157

Date 7-27-65

Water Level --- at --- Mrs.

Dr. No. --- of ---
 Surface Elev. --- Wt of Hammer ---
 SS Size ---

Sample No.	Depth		From Elevation	To Elevation	Distance	Method	Penetration Record				Length Feet Recovered	WEATHER Site: borrow area below dam Lake St, Louis Route 42 Jefferson, Missouri	ABBREVIATIONS F.T.-Fish Tail W.O.-Wash Out S.T.-Shells Tube S.S.-Split Spoon D.B.-Diamond Bit C - Cone R.B.-Rock Bit A - Auger
	From	To					Hydraulic Pressure Psi	Time Interval Sec	Number of Blows	Feet			
	0	2.0			2.0	A							Color - Moisture - Material - Consistency Brown-silt loam-silty-silt
	2.0	4.4			4.1	A							Color - Moisture - Material - Consistency Brown-rocky-silt loam-silty-silt
	4.4	6.0			2.0	A							Color - Moisture - Material - Consistency Brown-rocky-silt loam-silty-silt
	6.0	7.0			2.0	A							Color - Moisture - Material - Consistency Brown-silty loam-silt
	7.0	12.0			3.0	A							Color - Moisture - Material - Consistency Brown-silty loam-silt
	12.0	17.0			3.0	A							Color - Moisture - Material - Consistency Brown-silty loam-silt
	17.0	17.5			0.5	A							Color - Moisture - Material - Consistency Penetration into limestone
	17.5	17.5			-	-							Auger refusal

Job No. _____
Date _____

Sheet _____ of _____

3: of Hammer

Surf. Elev.

Sample No.	Depth		From Elevation	To Elevation	Distance	Method	Hydraulic Pressure (psi)	Penetration Test			Weather	TEMP. COR.	APPRECIATIONS						
	From	To						Time (Sec)	Number of Blows	Length of Penetration									
																		P.T. - Fish Tail W.O. - Wash Out S.T. - Shelby Tube S.S. - Split Spoon D.B. - Diamond Bit C. - Core R.B. - Rock Bit A. - Auger	

214 S. 10th St., St. Louis, Mo.
 Phone 2-2146
 CULTON, MISSOURI 65251
 (314) MI 2-5719

Job No. 157
 Date 02-28-53

Water Level 11.0 at 11.0 ft
 Casing used 1 1/2" No. of Blows 11

Rig No. 512 Sheet 1 of 1
 Surface Elev. _____

Sample No.	Depth		From Elevation	To Elevation	Distance	Method	Penetration Record				Length Recovered	WEATHER RECORD	TEMP. COOL	ABBREVIATIONS	
	From	To					Hydraulic Pressure	Time Interval	Number of Blows	Feet					
	0.0	1.0			1.0										
	1.0	15.0													
	15.0	27.0													
	27.0	31.0													

Site: BORROW CRAG BELOW W.M. MARK ST., LOUIS
 ROUTE #2
 (11th St., West of)
 SAMPLE DESCRIPTION
 Color - Moisture - Material - Consistency
 Brown-silt from silty claystone, silty
 green-cherty silt & siltstone
 or somewhat silty claystone with some
 Auger refusal

WEATHER RECORD

FOR LOG NO. 72

MISSOURI STATE UNIVERSITY
 Route 2, Hwy. 54 North
 FULTON, MISSOURI 65251
 (314) 472-5719

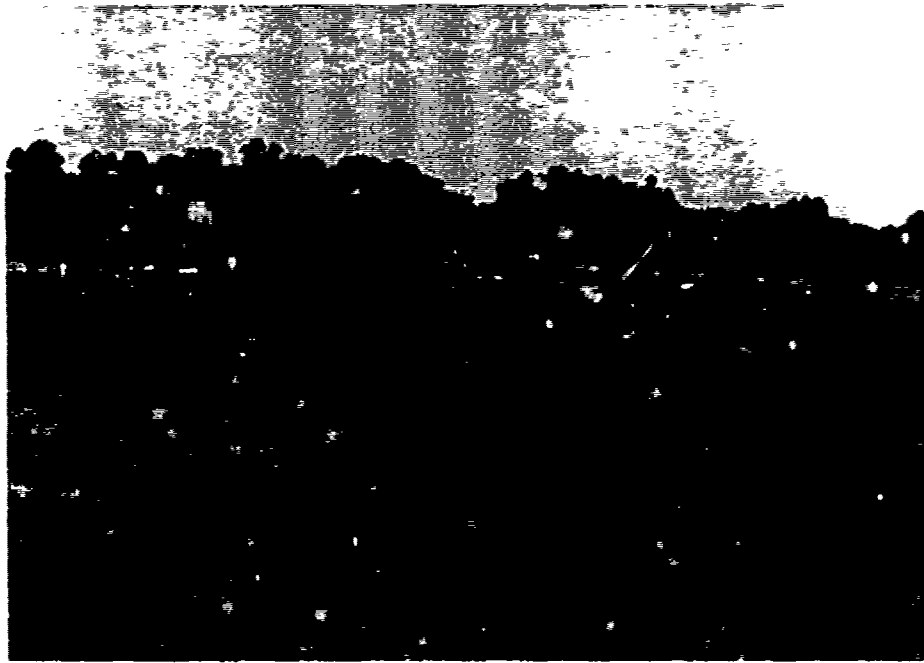
Job No. 157
 Date 9-29-56

Water Level _____ at _____ Hrs. _____
 Casing used _____

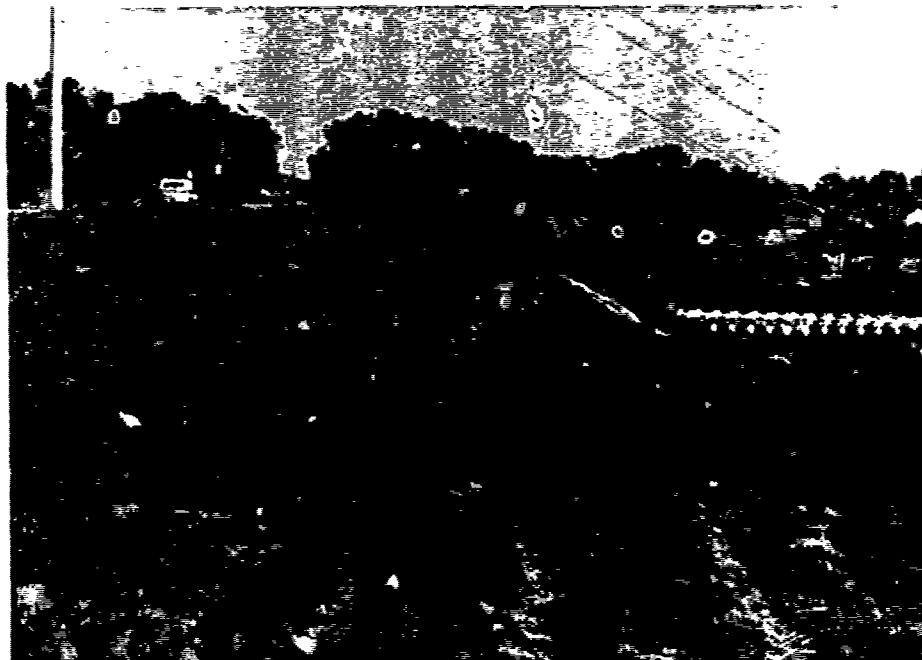
Rig No. _____ Surface Elev. _____ SS Size _____ Wt of Hammer _____ Sheet _____ of _____

BORING NO.	Depth		From Elevation	To Elevation	Distance Feet	Method	Penetration Record				Weather	TEMP. Soil	ABBREVIATIONS		
	From	To					Hydraulic Pressure Psi	Time Interval Sec	Number of Blows	Length Recovered Feet				Site	
	0	7.5													F.T.-Fish Tail W.O.-Wash Out S.T.-Shooby Tube S.S.-Split Spoon D.B.-Diamond Bit C - Core R.B.-Rock Bit A - Auger
	7.5	7.0													Color - Moisture - Material - Consistency Particle - Consistency - size to min
	7.0	7.0													Color - Moisture - Material - Consistency

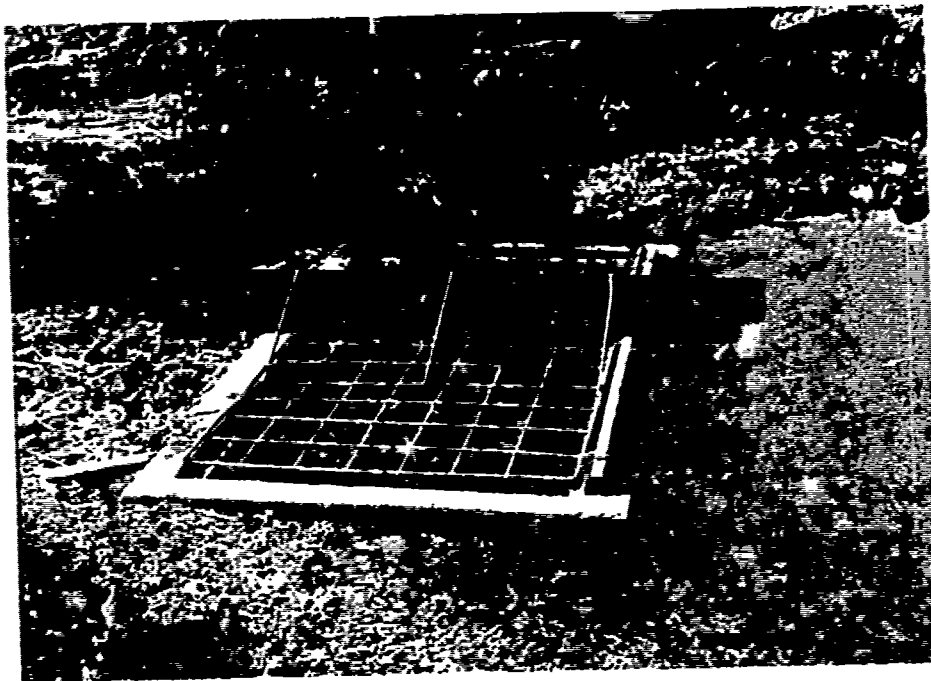
APPENDIX



NO. 1: UPSTREAM FACE OF DAM



NO. 2: DOWNSTREAM FACE OF DAM



NO. 3: 48"x102" DROP INLET SPILLWAY



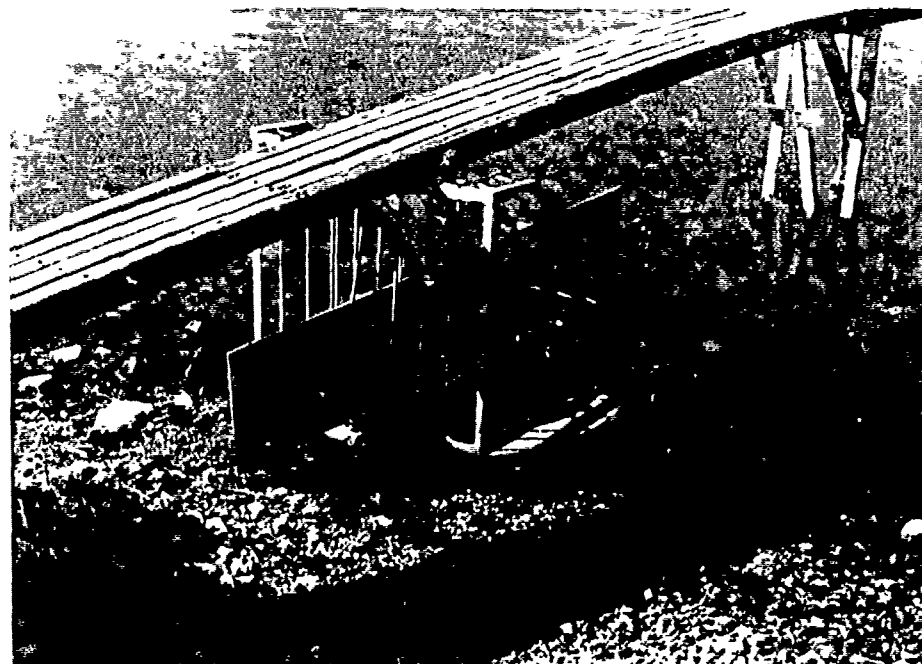
NO. 4: MANHOLE AT END OF 36" OUTLET PIPE



NO. 5: OUTLET DITCH DOWNSTREAM OF MANHOLE



NO. 6: OUTLET DITCH NEAR LAKE SAINT LOUIS



No. 7: 42" DIAMETER DROP INLET SPILLWAY



NO. 8: PUMP BASE



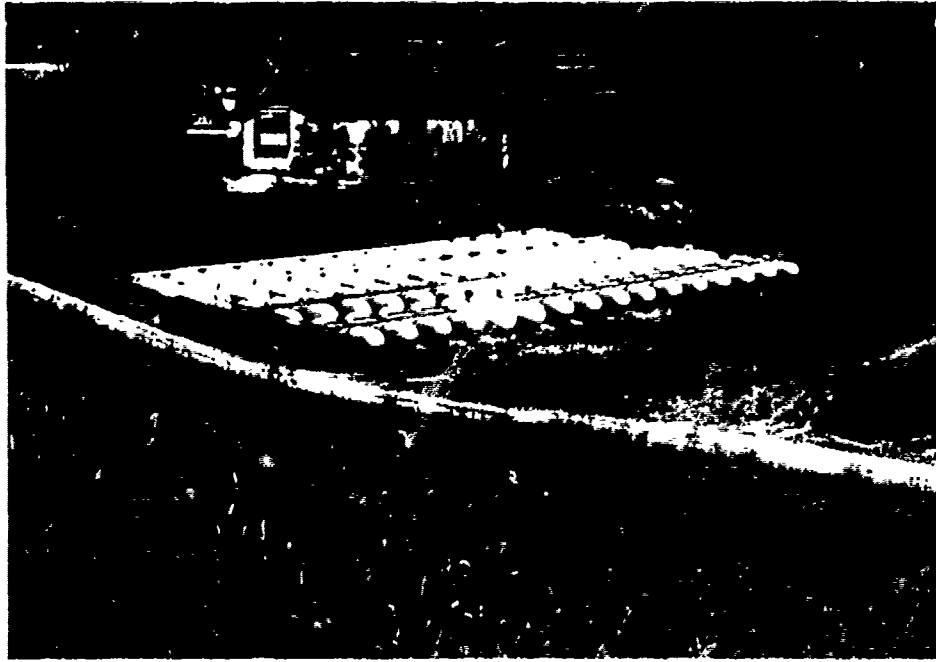
NO. 9: 10" VALVE ON PUMP DISCHARGE LINE



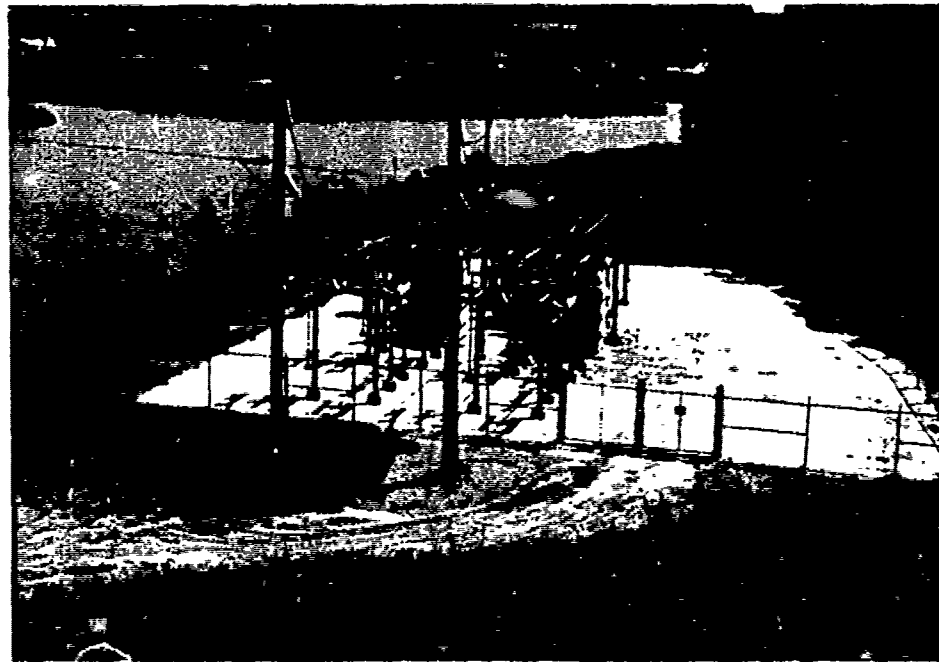
NO. 10: PONDED WATER ON BERM



No. 11: EROSION FROM DISCHARGE OF
12" OUTLET PIPE



NO. 12: LP TANK FARM



NO. 13: ELECTRIC SUBSTATION

HYDROLOGIC COMPUTATIONS

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

a. Probable maximum precipitation (200 sq. mile, 24-hour value equals 25.0 inches) from Hydrometeorological Report No. 33. One hundred year frequency (one square mile precipitation, 24-hour value equals 7.22 inches) from U.S. Weather Bureau Technical Paper No. 40.

b. Drainage area = 1.04 square miles
= 664 acres

c. SCS parameters
Lag time = 0.39 hours
Soil Type CN = 95

2. Drop inlet spillway release rates were based on the broad-crested weir equation and limited, where applicable, by the capacity of their respective outlet pipes.

$$Q = CLH^{\frac{3}{2}} \quad (C = 3.0 \text{ for drop inlet spillways, } L = 25 \text{ feet for } 48'' \times 102'' \text{ spillway, } L = 11 \text{ feet for } 42'' \text{ diameter spillway),}$$

where H is the head on the weir crest.

3. The emergency spillway section and dam crest consist of broad-crested, approximately V-shaped sections for which conventional weir formulas do not apply.

Release rates were determined as follows:

(1) Crest section properties (area, a and top width, t) were computed for various depths, d .

(2) It was assumed that flow leaving the crest would occur at critical depth. Flow at critical depth (Q_c) was computed as $Q_c = \frac{a^3}{t} g^{0.5}$ for the various depth, d .

Corresponding velocities (v_c) and velocity heads (H_{vc}) were determined using conventional formulas.

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

4. The combined outflow rating curve for flow over the drop inlet spillways and the emergency spillway and dam crest was obtained by adding corresponding discharges for given elevations. This rating curve is shown on Plate 4. Inflow-outflow hydrographs for the PMF are shown on Plate 5.

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

1 ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
 2 HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF LAKE STE LOUISE DAM
 3 RATIOS OF PMF ROUTED THROUGH RESERVOIR
 4 PRR 0 5 -0 -0 -0 -0 -0
 5
 6 J 1 3
 7 J1 0.22 0.50 1.00
 8 K 0 INFLOW
 9 K1 INFLOW HYDROGRAPH 3 1
 10 M 1 1.04 1.0
 11 P 0 25.0 102 120 130
 12 T
 13 W2 0.39
 14 X -1.0 2.0
 15 K 1 DAM
 16 K1 RESERVOIR ROUTING BY MODIFIED PULS 2 3 1
 17 Y 1 1
 18 Y1 1
 19 Y4 545.3 545.8 546.35 547.3 547.6 547.8 548.3 548.6 549
 20 Y4 549.3 549.5 549.8 550 550.2 550.4
 21 Y5 0 35 90 130 190
 22 Y5 2860 3660 5100 6200 7500 8900
 23 SA 0 72 91 140
 24 SF 496.55 545.3 550
 25 SS 545.3
 26 SD 548.3
 27 K 99

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

ANALYSIS OF DAM OVERTOPPING USING 100 YR FLOOD
 HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF LAKE STE LOUISE DAM
 100 YR FLOOD ROUTED THROUGH RESERVOIR

	0	5	-0	-0	-0	-0	-0	-0	-0
A1									
A2									
A3									
H	288	5							
H1	5								
J	1	1							
J1	1.0								
K	0								
K1									
V	0								
C	288	1.04							
01	.007	.007	.007	.007	.007	.007	.007	.007	.007
02	.007	.007	.007	.007	.007	.007	.007	.007	.007
03	.007	.007	.007	.007	.007	.007	.007	.007	.007
04	.007	.007	.007	.007	.007	.007	.007	.007	.007
05	.007	.007	.007	.007	.007	.007	.007	.007	.007
06	.007	.007	.007	.007	.007	.007	.007	.007	.007
07	.007	.007	.007	.007	.007	.007	.007	.007	.007
08	.007	.007	.007	.007	.007	.007	.007	.007	.007
09	.007	.007	.007	.007	.007	.007	.007	.007	.007
10	.007	.007	.007	.007	.007	.007	.007	.007	.007
11	.007	.007	.007	.007	.007	.007	.007	.007	.007
12	.007	.007	.007	.007	.007	.007	.007	.007	.007
13	.007	.007	.007	.007	.007	.007	.007	.007	.007
14	.007	.007	.007	.007	.007	.007	.007	.007	.007
15	.007	.007	.007	.007	.007	.007	.007	.007	.007
16	.007	.007	.007	.007	.007	.007	.007	.007	.007
17	.007	.007	.007	.007	.007	.007	.007	.007	.007
18	.007	.007	.007	.007	.007	.007	.007	.007	.007
19	.007	.007	.007	.007	.007	.007	.007	.007	.007
20	.007	.007	.007	.007	.007	.007	.007	.007	.007
21	.007	.007	.007	.007	.007	.007	.007	.007	.007
22	.007	.007	.007	.007	.007	.007	.007	.007	.007
23	.007	.007	.007	.007	.007	.007	.007	.007	.007
24	.007	.007	.007	.007	.007	.007	.007	.007	.007
25	.007	.007	.007	.007	.007	.007	.007	.007	.007
26	.007	.007	.007	.007	.007	.007	.007	.007	.007
27	.007	.007	.007	.007	.007	.007	.007	.007	.007
28	.007	.007	.007	.007	.007	.007	.007	.007	.007
29	.007	.007	.007	.007	.007	.007	.007	.007	.007
30	.007	.007	.007	.007	.007	.007	.007	.007	.007
31	.007	.007	.007	.007	.007	.007	.007	.007	.007
32	.007	.007	.007	.007	.007	.007	.007	.007	.007
33	.007	.007	.007	.007	.007	.007	.007	.007	.007
34	.007	.007	.007	.007	.007	.007	.007	.007	.007
35	.007	.007	.007	.007	.007	.007	.007	.007	.007
36	.007	.007	.007	.007	.007	.007	.007	.007	.007
37	.007	.007	.007	.007	.007	.007	.007	.007	.007
38	.007	.007	.007	.007	.007	.007	.007	.007	.007
39	.007	.007	.007	.007	.007	.007	.007	.007	.007

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39	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007
40	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007	.007
41	T																			
42	4P	0.39																		
43	X	-1.0	2.0																	
44	K	1																		
45	K1	RESERVOIR ROUTING BY MODIFIED PULS																		
46	Y																			
47	Y1	1																		
48	Y4	545.7	545.8	546.35	547.4	547.6	547.8	548.3	548.6	549.2	549.4	549.6	549.8	550.2	550.4	550.6	550.8	551.2	551.4	551.6
49	Y4	549.7	549.5	549.8	550	550.2	550.4	550.6	550.8	551.2	551.4	551.6	551.8	552.2	552.4	552.6	552.8	553.2	553.4	553.6
50	Y5	0	35	90	90	130	130	190	190	310	310	640	640	1100	1100	1100	1100	1100	1100	1100
51	Y5	2860	3660	5100	6200	7500	8900													
52	5A	0	72	91	140	560														
53	5E	494.55	545.3	550	560															
54	48	545.7																		
55	5D	548.7																		
56	K	99																		