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NATIONAL DAM SAFETY PROGRAM, LAKE ST. LOUIS DAM (MO 10545) MISS-ETC(U)
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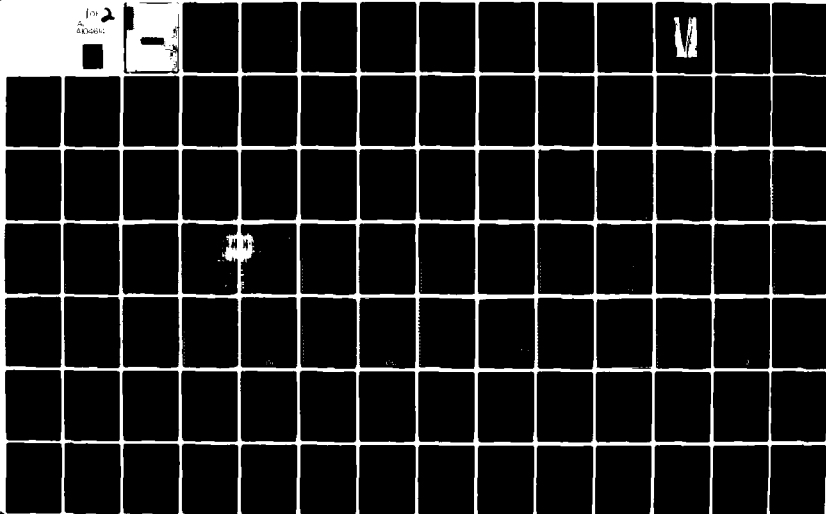
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This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.		

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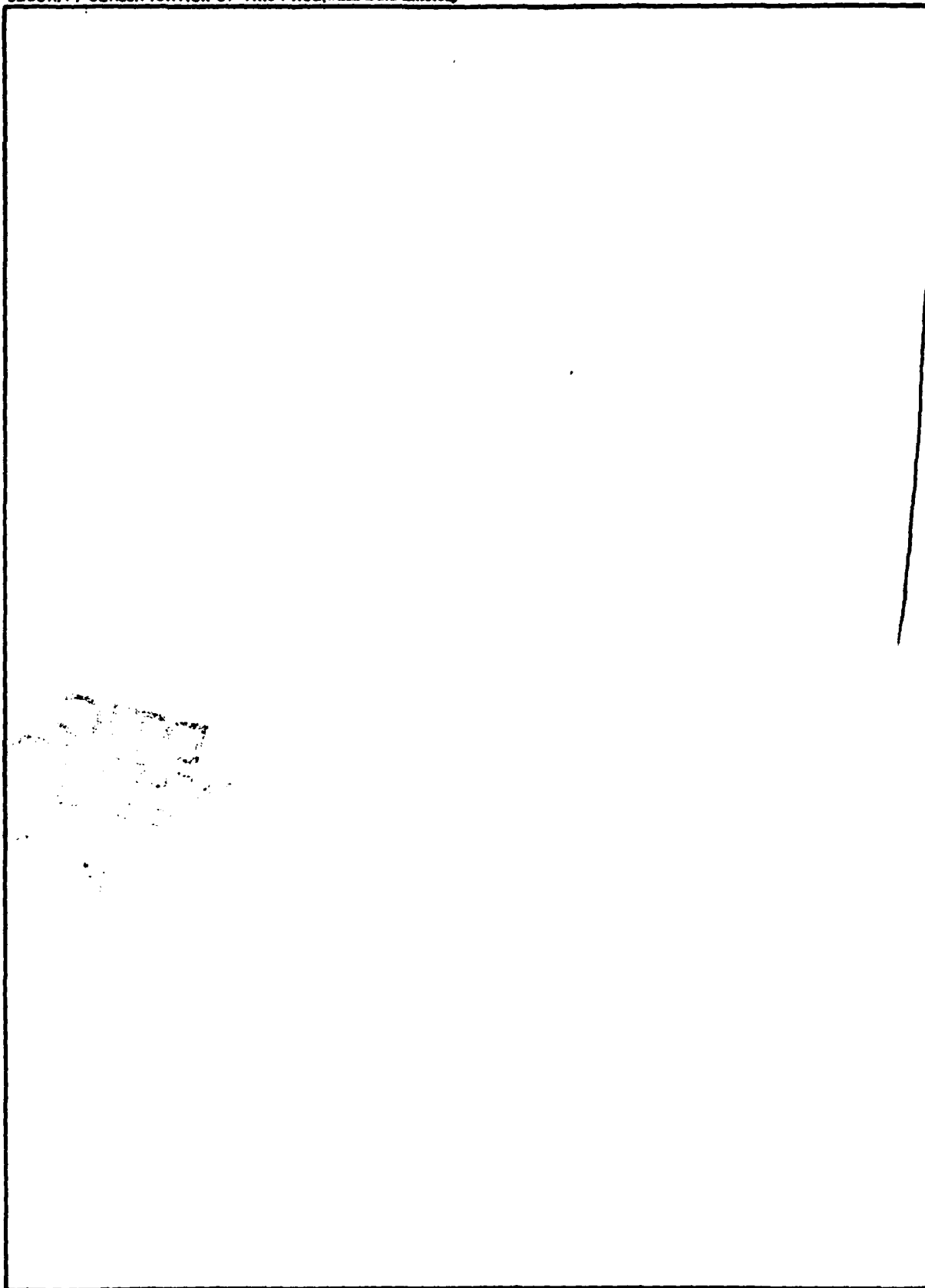
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LAKE ST. LOUIS DAM
ST. CHARLES COUNTY, MISSOURI
MISSOURI INVENTORY NO. 10490

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

MAY 1978

HS-7812



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

IN REPLY REFER TO

SUBJECT: Lake St. Louis Phase I Dam Inspection Report

This report presents the results of field inspection and evaluation of the Lake St. Louis Dam. It was prepared under the National Program of Inspection of Non-Federal Dams.

SUBMITTED BY:

Paul R. Uheim
Chief, Engineering Division

15 June 78
Date

APPROVED BY:

Sam E. Muck
Colonel, CE, District Engineer

15 June 78
Date

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PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam: Lake Saint Louis
State Located: Missouri
County Located: St. Charles
Stream: Peruque Creek
Date of Inspections: 2 February 1978 and 22 March 1978

Based on a visual inspection and a review of performance history, the present general condition of the Lake Saint Louis dam and spillway is considered to be good. 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 and spillway:

- a. Corrosion of the 72-inch steel drawdown pipe along with some loss of section due to flaking at the water line was observed. This condition is not considered serious at this time.
- b. The 72-inch drawdown pipe terminates at a point approximately in line with the downstream toe of the dam slope. There exists a possibility of erosion at the outlet during pipe discharge and the subsequent undermining of the dam.
- c. Erosion of the lakeside spillway outlet channel bank near station 12+90 was observed. This erosion is producing a concentration of flow at this point which could result in undermining of a portion of the spillway overflow section.
- d. Overflow of sewage at the wet well of the sewage lift station was noted at the time the downstream side of the dam was inspected.

There remains, until further investigations are made, some doubt as to the cause of the overflow. One of the reasons for the overflow occurring may be due to a surcharged condition which in turn may be due to excessive infiltration of the sewer line. It is important to verify if excess infiltration is occurring and that such is not the case immediately upstream or downstream or below the dam.

Based on evaluation of hydraulic-hydrologic data, it was found that the spillway outlet channel does not meet the criteria set forth in the guidelines for dam safety inspection work, furnished by the Department of the Army, office of the Chief of Engineers, for a dam of the size and hazard classification designated. The outlet channel, in order to satisfy the specified criteria, would be required to pass a flow of 86,000 cfs, which is equivalent to maximum probable flood (MPF). The spillway channel, as it is believed to presently exist, will pass a flow of 38,300 cfs. Spillway discharges of magnitudes greater than 38,300 cfs will result in a backwater condition developing over the spillway weir crest and a loss of spillway capacity due to weir submergence. Once submergence occurs the lake level will rise progressively until equilibrium of flow to the weir crest and channel outflow is reached, or until the dam is overtopped. The probability of a flood producing lake outflows of 38,300 cfs is believed to be greater than once in one thousand years.

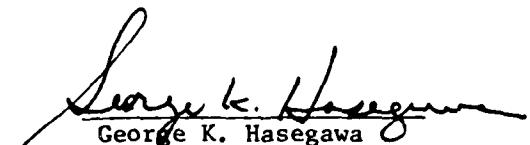
A review of available data did not disclose that seepage and stability analyses of the dam were performed. Portions of the downstream toe of slope were found to be soft and wet. At the time of inspection it could not be concluded if this condition is due to seepage, ground thaw, surface runoff from snow and ice, or a combination thereof.

It was noticed during the inspection of the area in the vicinity of the dam that a number of liquid petroleum tanks have been installed immediately downstream from the Lake Sainte Louise Dam. The proximity of

these tanks to the Lake Saint Louis Dam presents a hazardous condition should failure of this dam occur. The owner is advised to investigate the safety of this dam and, if necessary, based on the results of this investigation, relocate the tanks.

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


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


George K. Hasegawa
P.E. Missouri E-4551



OVERVIEW OF LAKE AND DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
LAKE SAINT LOUIS DAM - ID NO. 10490

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2-14 thru 2-25	Drilling Report and Pressure Test Data - July 1969 (Test Drilling Service Co.)
2-26 thru 2-54	Core Drilling Report for Spillway Design - May, June 1970 and June, July 1971 (Test Drilling Service Co.)
2-55 thru 2-60	Geological Investigations and Reports, Missouri Geological Survey (21 Feb. 1963, 30 Sept. 1966, 6 June 1967, 12 May 1969)

APPENDIX

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
LAKE SAINT LOUIS DAM - 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 inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam 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, published by the Department of the Army, Office of the Chief of Engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances. The Lake Saint Louis dam is an earthfill type dam rising approximately 47 feet above the original stream bed. Lake level is governed by a continuous concrete overflow type spillway approximately 810 feet in length with a side channel outlet. The spillway outlet channel is in rock cut to a point downstream from the dam where the channel transitions to the original drainage course of Peruque Creek. A 72-inch diameter steel pipe with a manually operated sluice gate serves the lake for drawdown purposes. Lake Saint Louis Blvd. traverses the dam crest crossing the side channel spillway at the west end of the dam. A general plan of the dam and spillway is shown on Plate 2.

b. Location. The dam and lake are located on Peruque Creek approximately 6 miles west of O'Fallon, Missouri, in St. Charles County, as shown on the map on Plate 1. The dam is located immediately upstream of the Interstate 70 crossing of Peruque Creek in Section 26, Township 47 North, Range 2 East.

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

d. Hazard Classification. The Lake Saint Louis Dam has a high hazard potential, meaning that the dam is located where failure may cause more than a few lives lost, serious damage to homes, extensive agricultural, industrial and commercial facilities, important public utilities, main highways, or railroads. Further, the flood damage zone downstream of the dam was estimated to be ten miles. Within this damage zone are eight bridges, four of which are major bridges and includes Interstate Highway 70, three additional highways, and seven homes. Eleven additional homes may be subject to backwater flooding. The flood plain is extensively farmed.

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.

(1) A hydrologic and hydraulic study of the proposed dam and lake was made in 1966 by the firm of Spence & Weinel, 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 what the writers termed an Assumption A flood.

The flood for Assumption A is approximately equivalent to one-half the maximum probable flood (MPF). It was also stated in the Spence & Weinel report that if the MPF would not greatly increase the height of the dam it would be desirable to design the dam for this flood.

(2) The design of the dam and spillway was prepared during 1968 by Bernard G. Browning, P.E., Fulton, Missouri, for Lake Saint Louis Estates, Inc., which was then the site developer. Construction of the dam was started with the cut off trench excavated and fill approximately 20 feet in depth placed in the eastern portion of the dam. The 24-inch cast iron sanitary sewer pipe that runs down the center of the lake was installed across the dam site and the 72-inch steel drawdown pipe was also installed. Due to frequent flooding, the contractor was unable to place the impervious fill in the cut off trench in the vicinity of the Peruque Creek channel.

(3) In 1969, at the request of the ultimate developers, the Lake St. Louis Investment Corporation, Horner & Shifrin, Inc., Consulting Engineers, was engaged to review the design of the spillway and subsequently was authorized by the developers to redesign it. The spillway as designed by Horner & Shifrin, Inc., was based on the Assumption A flood.

(4) Horner & Shifrin, Inc. was also engaged to provide inspection services during the remaining construction of the dam and spillway. A steel sheet piling cut off was substituted for about 220 feet of the cut off trench in the vicinity of the creek channel and earth fill placed across the entire dam. The earth fill for the dam was essentially completed during the summer of 1970 with Horner & Shifrin, Inc. inspecting the placement and compaction of the fill. The overflow spillway and outlet channel were completed during the summer of 1973.

h. Normal Operational Procedure. The lake level is regulated by overflow of an uncontrolled spillway.

1.3 PERTINENT DATA

a. Drainage Areas. The areas tributary to the lake are primarily agricultural in use with a small amount of urban development. The watershed above the dam is approximately 17 miles long and the width varies to a maximum of about 5 miles. The total area is approximately 56.4 square miles (36,100 acres). The watershed area is outlined on Plate 1.

b. Discharge at Damsite.

- (1) Estimated known maximum flood at damsite ... 4,500 cfs
- (2) Overflow spillway capacity (including side outlet channel) ...
36,000 cfs
- (3) Gated 72-inch drawdown pipe capacity at normal pool elevation ...
700 cfs

c. Elevation (ft. above MSL).

- (1) Top of dam ... 512.0
- (2) Maximum pool-design surcharge ... 510.3⁽¹⁾
- (3) Normal pool ... 500.5
- (4) Spillway crest, normal pool section ... 500.5
- (5) Spillway crest, flood section ... 501.0
- (6) Streambed at centerline of dam ... 465.6
- (7) Maximum tailwater ... Unknown

d. Reservoir.

- (1) Length of maximum pool (elevation 510.3) ... 5.6 miles⁽¹⁾
- (2) Length of normal pool (elevation 500.5) ... 4.3 miles

e. Storage.

- (1) Normal pool ... 6,300 Ac.Ft.
- (2) Design surcharge (incremental) ... 6,900 Ac.Ft.
- (3) Top of dam (incremental) ... 1,450 Ac.Ft.

(1) For MPF assuming free discharge condition of outlet channel.

f. Reservoir Surface.

- (1) Top of dam ... 880 Acres
- (2) Maximum pool ... 830 Acres⁽¹⁾
- (3) Spillway crest ... 563 Acres
- (4) Normal pool ... 546 Acres

g. Dam.

- (1) Type ... Earthfill, homogenous
- (2) Length (approximate) ... 900 Ft.
- (3) Height ... 47 Ft.
- (4) Top Width ... 55 Ft.
- (5) Side Slopes
 - (a) Upstream ... 1v on 3h
 - (b) Downstream ... 1v on 2.5h
- (6) Cutoff ... Earthfill Trench/Sheet Piling
- (7) Slope Protection
 - (a) Upstream ... Rock rip-rap, dumped
 - (b) Downstream ... Grass

h. Spillway.

- (1) Type ... Concrete
- (2) Approximate length ... 810 Ft.
- (3) Crest elevation (feet above MSL)
 - (a) Normal pool section ... 500.5
 - (b) Flood section ... 501.0
- (4) Upstream Channel ... Lake
- (5) Downstream Side Channel
 - (a) Rock cut, approximate length ... 970 Ft.
 - (b) Bottom width ... 40 Ft. (min.), 70 Ft. (max.)

i. Outlet for Lake Drawdown.

- (1) Type ... Steel pipe, 72-inch diameter
- (2) Length ... 267 Ft.
- (3) Control ... Sluice gate, manually operated

(1) For MPF assuming free discharge condition of outlet channel.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

a. Subsurface Investigations. Available test borings and other data for subsurface investigations for both the dam and spillway are included on Plate 14 and Charts 2-1 through 2-54. Geological investigations and reports prepared prior to the construction of the dam by the Missouri Geological Survey are included on Charts 2-55 through 2-60.

b. Dam. The dam was designed as a homogenous earthfill type embankment. The materials used, clays and silts, were obtained from nearby hillside and valley borrow areas. An impervious earthfill cutoff trench was designed to reduce the underseepage and prevent loss of water from the lake. A 72-inch diameter steel pipe with a manually operated control gate was provided for the purpose of unwatering the lake. Plans indicating the original design requirements of the dam are unavailable.

c. Spillway and Outlet Channel. The fixed crest spillway was designed as a concrete gravity section bearing on rock. The outlet channel was designed as a rock (limestone) cut section to a point about 400 feet downstream from the dam centerline to where the channel transitions to the original drainage course of Peruque Creek. The outlet channel has a bottom width varying from 40 feet at the upstream end to 70 feet at the downstream end. The channel side slopes in rock cut were specified to be 1 horizontal to 4 vertical. Details of the concrete gravity spillway as well as the side channel outlet are shown on the plans titled "Lake Saint Louis Main Dam," dated 17 July 1972, and are included as Plates 10 through 13. Due to flow in the spillway outlet channel, the elevation of the invert based on survey was not obtained. However, it is believed that the channel was not excavated to the full depth shown in the plans but that the invert near the downstream end is about 4.5 feet higher than specified.

2.2 CONSTRUCTION

a. Dam. At the time Horner & Shifrin was engaged by the Lake St. Louis Investment Corporation, the earthfill dam, including cutoff trench, had been under construction for some time. Approximately 20 feet of fill was in place near the east abutment. The 72-inch drawdown pipe as well as the 24-inch sanitary sewer pipe had also been installed beneath the main body of the dam. However, due to flooding of the excavation, the contractor had been unable to place the impervious fill for the cutoff trench in the vicinity of the old creek channel.

Under the surveillance of Horner & Shifrin, a steel sheet piling cutoff was substituted for the earthfill trench section from station 19+14 to station 21+31 in order to proceed with construction of the dam. Placement of the remaining fill was monitored and the compaction effort recorded. The 72-inch drawdown pipe was extended some 34 feet to a point just beyond the downstream toe of slope, a headwall was constructed on the upstream end of the 72-inch pipe, and construction of the gatewell structure was completed.

Plans for modifying the 72-inch pipe, including construction of the gatewell and upstream headwall, as well as cross-sections used to complete construction of the dam are shown on Plates 3 through 9. Photographs of the dam taken during construction are included on Page A-1 of the Appendix.

b. Spillway and Outlet Channel. Construction of the concrete spillway section was accomplished according to plan with the exception of the reach between stations 4+60 and 6+38. Due to poor rock foundation conditions, as indicated by the test borings, it was planned to construct an earthfill embankment section in this area. When excavation of the overburden in this area revealed that the foundation rock could be satisfactorily utilized, and at the request of the developer, it was decided to extend the concrete overflow section through this reach and eliminate the earthfill embankment. Considerable effort was expended removing badly weathered rock, cleaning the earth

filled cavernous rock areas, and filling with concrete the resulting voids within the limits of the overflow section in order to attain a sound, impervious foundation. Photographs taken during construction showing an area of the cavernous rock foundation that has been prepared for filling with concrete, as well as other photographs taken during construction of the spillway overflow section, are included on Pages A-2 through A-5 of the Appendix.

The outlet channel was excavated in limestone by drilling and blasting. Side slopes were maintained at 4 vertical to 1 horizontal. The alignment of the channel was maintained essentially as planned, however it is believed that the invert was constructed higher than the profile grades specified. No evidence of faulting of the bedrock during excavation of the channel was noted.

2.3. OPERATION

Lake level is governed by overflow of the uncontrolled spillway. The gate on the 72-inch outlet pipe is maintained closed and used only for lake drawdown purposes.

2.4 EVALUATION

a. Availability. Engineering data available for assessment of the spillway and outlet channel design was substantial. The data available for assessment of the design of the dam was found lacking with regard to the soil strengths of the foundation and embankment.

b. Adequacy. Since soil strength data is unavailable to make a complete assessment of the design of the dam, it is recommended that the owner engage a qualified engineer to obtain the necessary soil test data and to perform detailed stability and seepage analyses.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of the dam, spillway, outlet channel, the outlet end of the drawdown pipe, and other related features was made by Horner & Shifrin engineering personnel on 2 February 1978 and 22 March 1978. Also inspected was the Highway 40-61 Bridge crossing Peruque Creek at the upstream end of the lake and the various bridges crossing Peruque Creek from the dam downstream to Highway 79. Below Highway 79 the stream emerges onto the flood plain of the Mississippi River and is considered to be the downstream limits subject to damage by flooding should failure of the dam occur. Photographs of the dam, spillway, and the Highway 40-61 Bridges are included on Pages B-1 through B-6 of the Appendix.

b. Dam. The upstream and downstream slopes of the dam were found to be in good condition except for some erosion, caused by surface storm runoff, of the downstream slope where the dam joins the east abutment and of the upstream slope at the east abutment of the Lake Saint Louis Boulevard Bridge.

The downstream toe of slope was found to be soft and wet in several areas. At this time of the year, it cannot be concluded if this condition is due to seepage, ground thaw, surface runoff, or a combination of all the aforementioned.

The downstream flood plain adjacent to the dam was also noticeably wet, with ponded water appearing in several locations, however this condition can be attributed to poor drainage of surface runoff and to overflow of the sewage lift station wetwell. Details of the sewage lift station and wetwell are shown on Plate 15.

c. Drawdown Pipe. The 72-inch uncoated steel pipe provided for unwatering the lake was rusted and showed signs of corrosion at the water line.

Water could be heard entering the upstream end of the pipe, presumably due to leakage about the control gate. A minor quantity of water was noticed flowing from the pipe. Since, at this time, the pipe was two-thirds full of backwater caused by downstream channel obstruction, an internal inspection of the pipe from the outlet to the gate was not undertaken. The exposed elements of the gate operator and gatewell structure appeared to be in good condition.

d. Spillway and Outlet Channel. The fixed crest concrete spillway section appeared to be in good condition. No deterioration of the concrete due to weathering or damage from ice was observed. Leakage at the vertical joints between adjacent sections was not appreciable. A significant amount of erosion of the left bank of the outlet channel between the overflow section and the channel has occurred in the vicinity of channel station 12+40. The erosion is the result of the washing out of the soil fill in the existing solution channel in the limestone bedrock on which the spillway is constructed. A picture of the erosion of the solution channel is shown on Photograph No. 8 of the appendix. At the time of construction of the spillway, the portion of the solution channel occurring below the spillway was thoroughly cleaned of earth and backfilled with concrete. The erosion has partially exposed the concrete fill. The solution channel is about 20 feet wide at the top and is estimated to be about 40 feet in length. It appeared that the erosion has nearly stabilized and that erosion from this time on would be due to weathering of the exposed rock surfaces. Loss of the bank is causing spillway discharge to concentrate at this location. Additional erosion of the bank was noticed along the east side of the paved chute downstream from the normal pool control section. The outlet channel banks, with the exception of the loss of section in the vicinity of station 12+40, were found to be in good condition and maintaining their slopes. Some areas of the channel bottom did have an accumulation of large stones and boulders, apparently due to sloughing of loose rock along the upper regions of the right bank.

e. Highway 40-61 Bridges. The Highway 40-61 Bridges at the upstream end of the lake were visually examined during the inspection of 22 March 1978. No

noticeable adverse effects due to the presence of the lake were detected. The lake at the time of the inspection was approximately 6 inches above normal pool level at the spillway.

f. Downstream Channel. The Peruque Creek channel downstream from the dam is unimproved. The flood plain between the dam and the Highway 79 Bridge, approximately 9 miles downstream, varies in section with the average width being approximately 1,500 feet. The narrowest section, approximately 600 feet in width, occurs at a point approximately 1 mile upstream from the Highway 79 Bridge or roughly 8 miles downstream from the dam. The stream is crossed, beginning at the dam and proceeding downstream by the I-70 South Outer Road Bridge, the I-70 East Bound and West Bound Bridges, the North Outer Road Bridge, the Norfolk & Western Railroad Bridge, Hoff Road Bridge, County Route P Bridge, a private road bridge, County Route M Bridge, and State Highway 79 Bridge. The flood plain is principally farm land; however, it is being developed in some areas with several homes completed and occupied. In addition, primarily along Route M, there are several older residences that lie within the flood plain limits.

3.2 EVALUATION

Deficiencies observed during this inspection and noted herein are not considered significant or of serious potential to warrant immediate remedial action.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

Since the spillway is uncontrolled and the lake drawdown pipe is maintained closed, there are no gated facilities for controlling lake discharge.

4.2 MAINTENANCE OF DAM

A visual inspection of the dam and spillway is normally performed by personnel of the Lakes and Parks Department, Lake Saint Louis Community Association, on a monthly basis. This inspection is done on foot and includes examination of the dam slopes, the area immediately downstream from the dam, the gate structure, the spillway, and the spillway outlet channel. The grass on the dam slopes and downstream berm is mowed on a regular basis. Shrubs and trees are not permitted in these areas. Animal burrows are filled when noticed. No records are kept of these inspections or maintenance performed.

4.3 MAINTENANCE OF SPILLWAY AND OUTLET CHANNEL

To date, it would appear that little maintenance work has been performed in the spillway area as is evident by the erosion of the channel bank in the vicinity of station 12+40 and the accumulation of boulders and large rocks in the outlet channel.

4.4 MAINTENANCE OF LAKE DRAWDOWN CONTROL GATE

The gate on the 72-inch drawdown pipe is the only mechanical item capable of being operated. It has been reported by the Director of the Lakes and

Parks Department that the gate is in operating condition although it leaks moderately in the closed position. The gate operator was well lubricated and appeared to be in good condition.

4.5 DESCRIPTION OF WARNING SYSTEM

There presently is no warning system in effect in case of extreme high water or sudden failure of the dam. With a county maintained road traversing the dam crest and a bridge crossing the spillway outlet channel, there is rather frequent observation of the lake conditions and the overflow of the spillway by many interested residents of the area. Due to the presence of a large number of people in the dam vicinity, it is likely that adequate warning of overtopping of the dam would be given if such a condition was developing.

4.6 EVALUATION

The presence of full-time employees under responsible supervision, as is the case at Lake Saint Louis, to maintain and inspect the dam, is considered beneficial to the safety of the dam. It is recommended that maintenance on a regular basis of the spillway outlet channel be included along with the other normally maintained features. The owner should determine if ponded water on the berm immediately below the dam is due to overflow of the wetwell. Saturation of the berm due to poor drainage is undesirable since it has an adverse effect on the stability of the dam. The owner should provide positive means for draining surface runoff in this area.

In order to insure proper operation of the sluice gate on the lake draw-down pipe, the gate should be periodically opened fully and closed.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. The hydraulic and hydrologic data for the design of the dam and spillway is available. Beginning with the 1966 study by Spence and Weinel and continuing with the investigations by Horner & Shifrin for the design of the spillway, it was concluded that the hydraulics of the spillway and the hydrology of the lake and upstream tributary area have been sufficiently investigated. Data used for hydrologic computations is presented on Page C-1 of the Appendix.

The design of the spillway and outlet channel was based on the Assumption A flood which is approximately equivalent to one-half of the maximum probable flood (MPF). Under the Assumption A flood, the peak inflow to the lake amounts to 44,800 cfs, while for MPF the peak inflow amounts to 90,500 cfs. For a storm with a frequency of once in 300 years the peak inflow to the lake would be 13,600 cfs, and for a frequency of once in 100 years the peak inflow amounts to 10,700 cfs. Hydrographs for lake inflow and outflow for PMF, Assumption A, and 300 year storm are presented on Plate 16. Lake outflow is based on spillway crest length believed to have been constructed.

The limiting factor governing the level of the lake, based on hydraulic investigations, was found to be the capacity of the spillway outlet channel. It is believed that the channel invert was not constructed to the plan elevations specified on the construction drawings prepared by Horner & Shifrin in 1972 but is approximately 4.5 feet higher. Based on the channel invert believed to presently exist, the capacity of the outlet channel was found to be 33,500 cfs without exceeding elevation 508.0 in the lake. Elevation 508.0 was considered to be the maximum lake surface elevation desirable for development of the property about the lake and therefore to be used for spillway design.

A second and smaller lake, Lake Sainte Louise, is located immediately to the west and north of Lake Saint Louis. Its location is shown on Plate 1. The main stem of the lake is roughly parallel to Lake Saint Louis and lies about 2,000 feet south of I-70 highway. The spillway for this lake discharges to an arm of Lake Saint Louis at a point approximately 7,000 feet from the main dam. An earthfill type dam, approximately 50 feet high, serves to impound water for Lake Sainte Louise. The dam lies near the upper end of the aforementioned arm of Lake Saint Louis and any discharges from Lake Sainte Louise due to the failure of the dam would be into a relatively shallow section of Lake Saint Louis and at a point where the lake is not very wide. Based on data obtained from U.S.G.S. topographic maps, the approximate surface area of Lake Sainte Louise is 75 acres and the storage volume at normal pool level is 1,070 acre-feet. The tsunami or tidal wave effect on Lake Saint Louis, should sudden failure of the Lake Sainte Louise dam occur, has not been considered in these investigations. However, failure of the dam will undoubtedly cause considerable damage to much of the development around the arm of Lake Saint Louis immediately downstream from the Lake Sainte Louise dam. Therefore, a Phase I inspection of Lake Sainte Louise is warranted.

b. Experience Data. Since completion of the spillway in September of 1973, the maximum depth of flow over the spillway weir, according to observations made by individuals at Lake Saint Louis, is believed to be 12 to 18 inches. Using a conventional formula for a broad-crested weir, a depth of 18 inches amounts to a flow of about 4,500 cfs.

c. Visual Observations. It was noticed in areas downstream from the dam that relatively low spillway discharges will force the stream out of its natural channel. This, however, is not a new condition or one that has developed since construction of the dam. Estimates of discharge that will be contained within the natural channel vary, but it is believed that flows as low as 1,500 cfs will cause the stream to flood in some areas.

d. Overtopping Potential. The potential for overtopping the dam is believed to be relatively low if the outlet channel can allow flow to discharge

at the rate required. This rate was found to be 33,500 cfs for a lake surface elevation of 508.0, and 38,300 cfs for a lake surface elevation of 512.0 (top of dam). Once the outlet channel capacity is reached, a back-water condition will develop, and additional increases in spillway discharge will result in higher lake levels. The MPF outflow, 86,000 cfs, so greatly exceeds the capacity of the spillway outlet channel that, for a flow of MPF magnitude, it is believed that the dam will be overtopped. A rating curve for the spillway outlet channel indicating the relationship of channel capacity to lake level is presented on Plate 17.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. No evidence of instability of the dam or overflow spillway was noticed during the visual inspection of March 22, 1978. No mention of slides or other signs of instability were reported by the owner.

b. Design and Construction Data. Stability analyses of the dam section and soil shear strengths based on field or laboratory testing are not available for review. A review of the field compaction tests, obtained during placement of the rolled earth fill for the dam, indicated that for a total of 37 tests taken, 5 exceeded 95 percent of maximum dry density at optimum moisture content, per ASTM D-698, and that the average of all tests made was 92.6 percent.

Overturning and sliding stability were investigated during design of the concrete spillway overflow section in accordance with the procedures outlined in Chapter VII of the technical publication "Design of Small Dams" by the Bureau of Reclamation, U.S. Department of the Interior. The 28 day strength of the concrete was assumed to be 3,000 psi and a minimum of 6 sacks of cement per cubic yard of mix was specified. Of 25 test cylinders obtained during construction, the minimum compressive strength of the concrete cylinders tested was found to be 3,519 psi.

c. Operating Records. The dam and spillway have not been monitored in any form during the post construction period. No records have been kept of lake level, spillway discharge, dam settlement, or seepage during this time.

d. Post Construction Changes. Since completion of the dam in 1970 and the spillway in 1973, there have been no changes to these improvements.

e. Seismic Stability. Seismic forces were not considered in the design of the spillway. Since the lake 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 or spillway.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. Based on the present condition of the dam, the physical proportions of the dam, such as the width of the crest (55 ft.) and side slope ratios (1v on 3h upstream, 1v on 2.5h downstream), knowledge of materials placed and methods used during construction, and history of performance, the dam is believed to be capable of withstanding various normal combinations of earth and water forces applied. This capability does not, however, preclude the potential for overtopping of the dam due to storms greater than one-half maximum probable flood magnitude.

b. Adequacy of Information. Soil strength data and properties necessary to assess the overall stability of the dam were unavailable for review.

c. Urgency. The remedial measures recommended herein are not considered to be of imminent necessity. It is recommended, however, that implementation of the actions recommended in paragraph 7-2 be undertaken 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. Since the dam is located in a Zone II seismic design area, an earthquake of the predicted magnitude is not expected to be hazardous to the dam.

7.2 REMEDIAL MEASURES

a. Alternatives.

(1) The spillway side outlet channel should be enlarged in order to increase its capacity for storm runoff of maximum probable flood (MPF) magnitude.

Hydraulically the overflow spillway and dam are considered to be adequate for MPF requirements.

(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. The analysis should include the necessary investigations to determine the need for a sub-drain with a filter system and other drainage devices to prevent toe softening downstream of the dam proper. In addition, investigations should be made to determine if the ponding of water on the berm downstream from the dam is due entirely or in part to overflow of the sewage lift station. Positive drainage of surface runoff in this area should be provided.

(3) A number, approximately 60, of liquid petroleum (LP) tanks are located in an area immediately downstream from the Lake Sainte Louis Dam. These tanks are serviced by O'Fallon Gas Service, Inc., and provide gas for heating of many homes and condominiums within the Lake Saint Louis development. It was calculated that if the entire volume of water in Lake Sainte Louise was allowed to discharge into Lake Saint Louis, the rise in the level of Lake Saint Louis would be on the order of 2 feet. This rise above normal pool level of Lake Saint Louis would not cause any serious damages. However, if failure of the Lake Sainte Louise dam should occur in such a way that a large volume of water would be released suddenly, the mass of water could create a wave of such magnitude that serious damage not only to the LP tank farm but also to the development about the edge of the lower lake would undoubtedly occur. It, therefore, is believed that a very hazardous condition exists and a Phase I investigation of the Lake Sainte Louise Dam is recommended.

(4) Perusal of the available records of the construction of the 24-inch sanitary sewer under the dam did not uncover sufficient information to verify the type of material or type of joints and class of pipe used. Although drawings available showed anti-seep collars were to be constructed on the sanitary sewer, verification of the fact that this was done was not possible at this time. As far as it was determined, there appears no provision on the upstream

side of the dam to isolate the sanitary sewer should failure or other problem occur in the sanitary sewer under the dam.

Due to backwater in the 72-inch lake drawdown pipe at the time of the inspection, visual examination of the interior of the pipe was not made except near its outlet. It was noted at the outlet that a considerable amount of flaking of the interior surface near the water line had occurred. Drawings which were obtained indicated that seep collars were to be constructed on the pipe under the dam. Verification of the actual construction of these collars could not be made. Since these uncertainties occur, further investigation of the structural condition should be made of both pipe lines under the dam as well as the determination of the presence or absence of the seep collars.

b. O & M Maintenance and Procedures.

(1) The 72-inch diameter uncoated steel lake drawdown pipe should be lined or protected by some other means to eliminate the concern of its failure due to loss of section from corrosion on both the inside and outside surfaces.

(2) The lake drawdown pipe should be extended to avoid scour of foundation soils at the existing discharge location and possible undermining of the dam.

(3) If the results of the recommended stability and underseepage analyses so indicate, a subdrain with filter system should be installed in line with and approximately at the location of the downstream toe of slope of the dam. The subdrain system should have an outlet that cannot be contaminated by backflow.

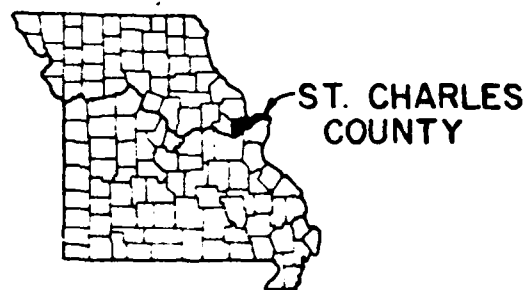
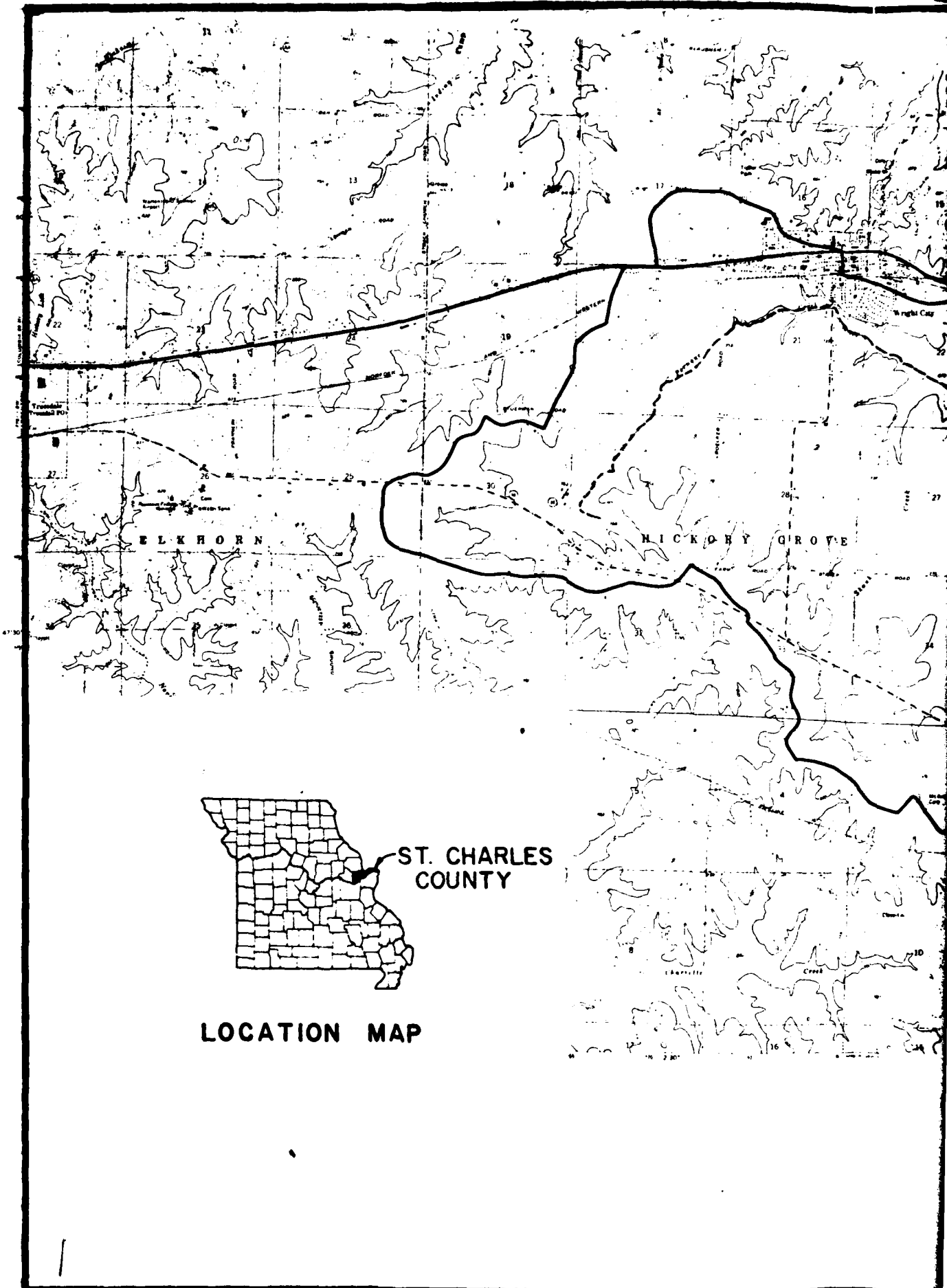
(4) The partially eroded bank of the spillway outlet channel at about station 12+40 should be restored. The overflow spillway foundation should be carefully examined for undercutting when this work is performed and any voids or openings discovered should also be restored.

(5) The eroded area on the east side of the spillway chute for the normal pool control section should be repaired so as to prevent additional erosion of the bank and undercutting of the bay and channel bottom.

(6) The eroded earthen areas of the upstream and downstream faces of the dam should be restored and protected.

(7) The manually operated control gate on the 72-inch lake drawdown pipe should be operated to ensure proper function. At present, this gate leaks moderately, and unless for some reason the leak increases severely, should not impair the performance of the lake from a recreational standpoint.

(8) It is recommended that the lake owners association continue to employ qualified personnel for the purpose of operating and maintaining the dam, spillway, and appurtenant features. Inspection of the dam and spillway should be continued, as at present, on a monthly basis. Records indicating the date of the inspection, the items inspected and their condition, the urgency of any action to be taken in the case where remedial work is deemed necessary, and any additional information considered pertinent should also be included. The names of personnel performing the inspection, should also be a matter of record. A copy of this inspection report should be submitted without delay to the lake owners association for further consideration. It is also recommended, for future reference, that records be kept of all inspections, maintenance work, remedial measures, and improvements.



LOCATION MAP

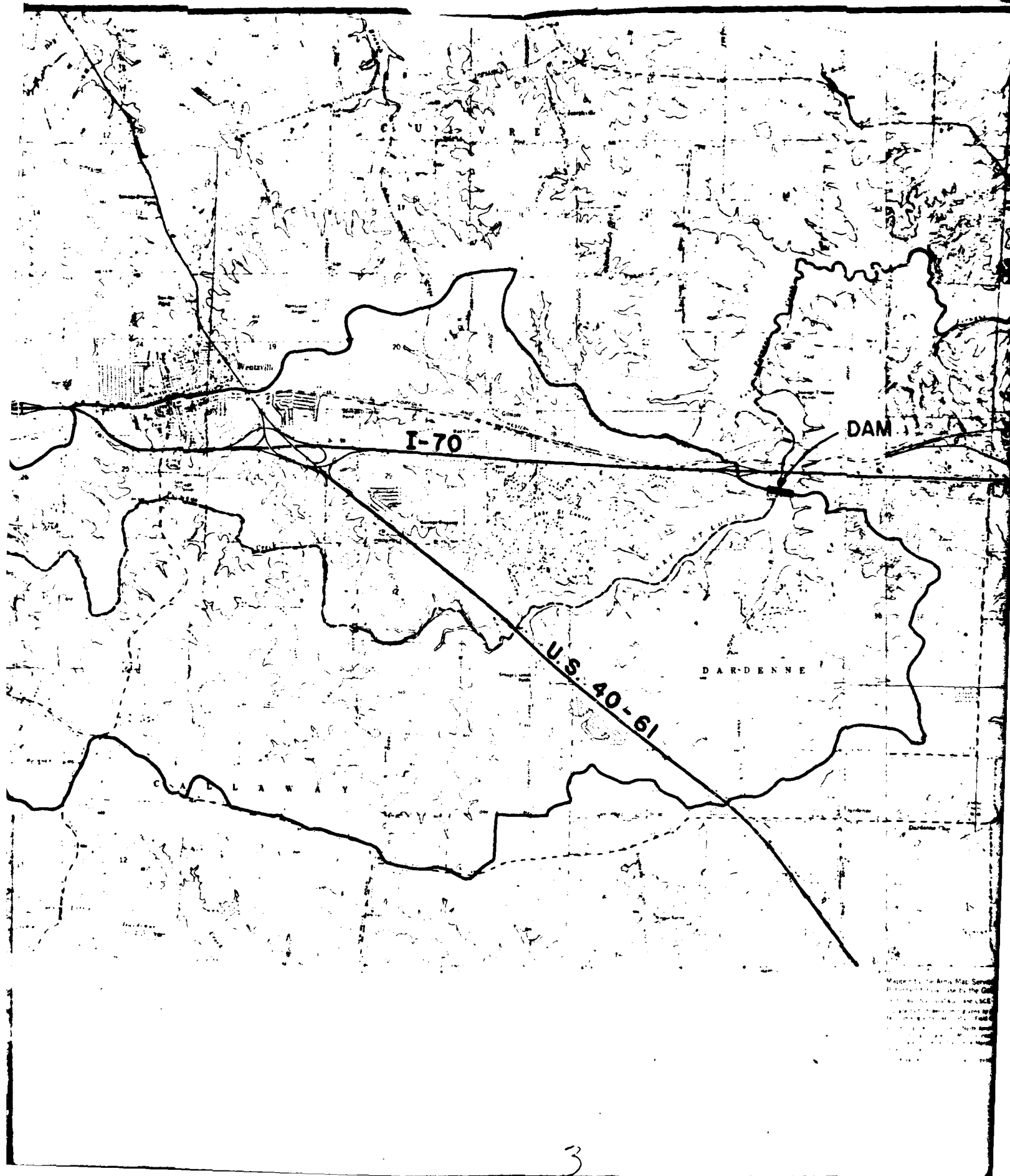
WATERSHED BOUNDARY

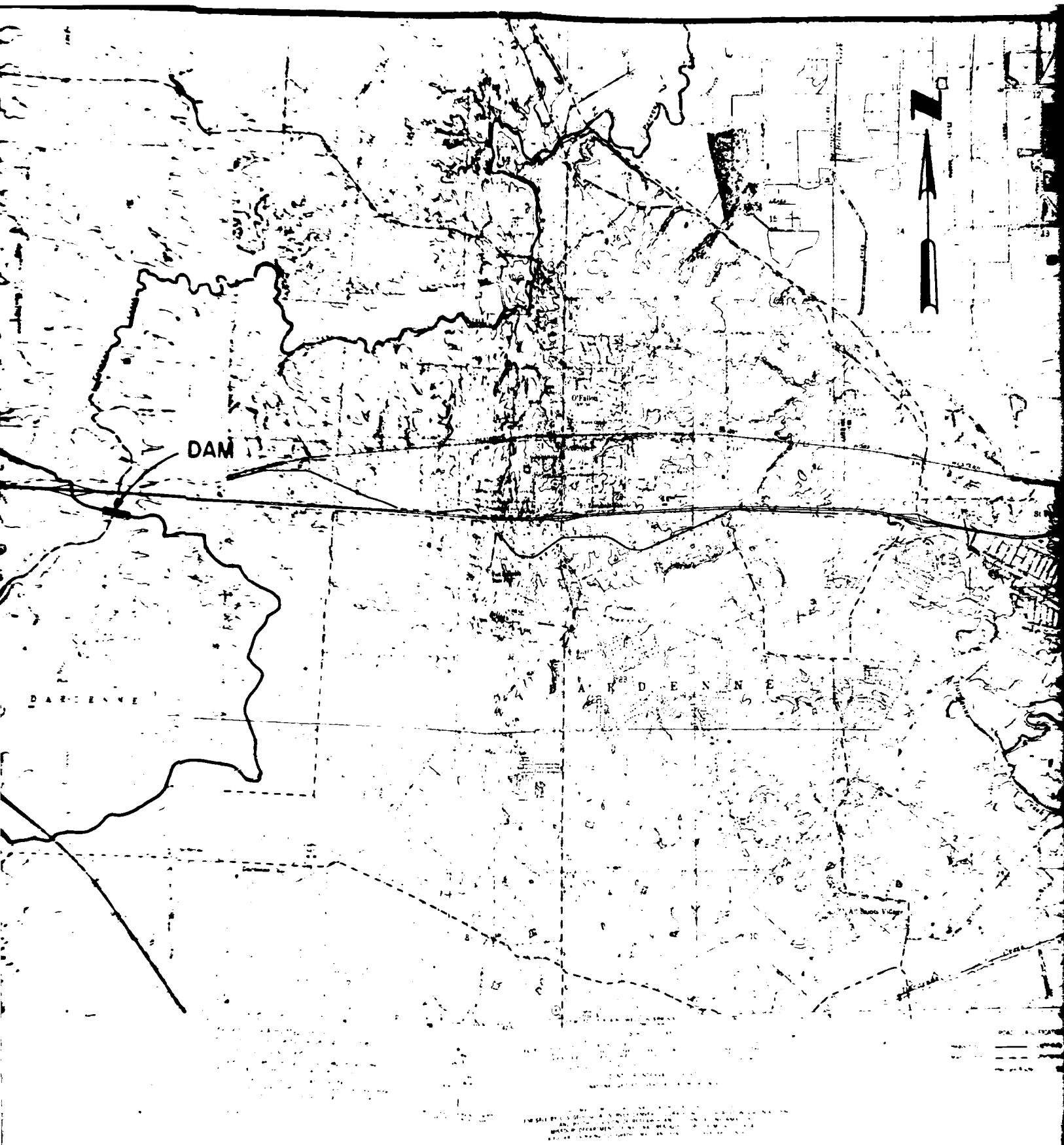
HICKORY

CALAWAY

DRY CREEK

8





REGIONAL VICINITY MAP

4

DIATE

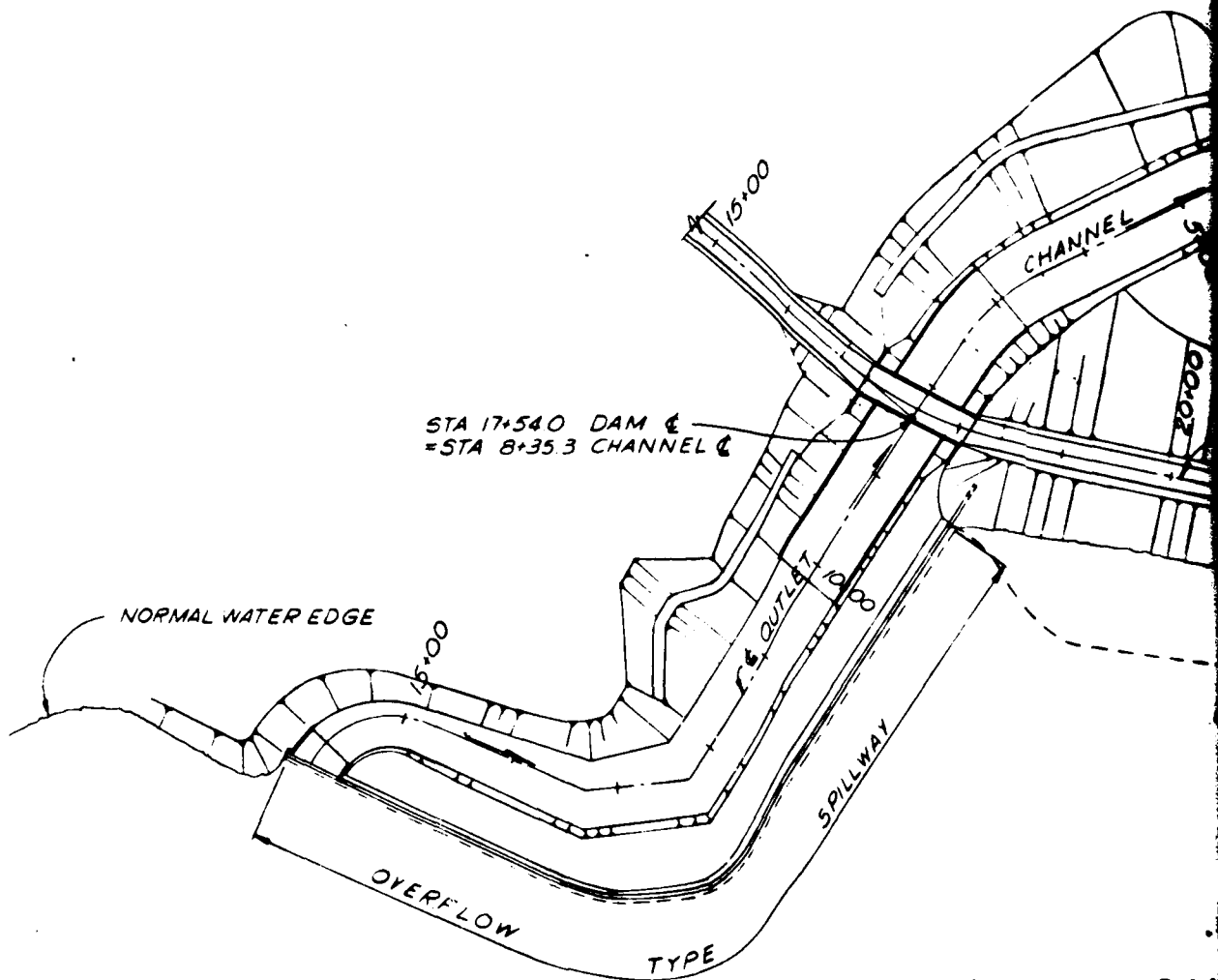
(WESTBOUND LANES)

I-70

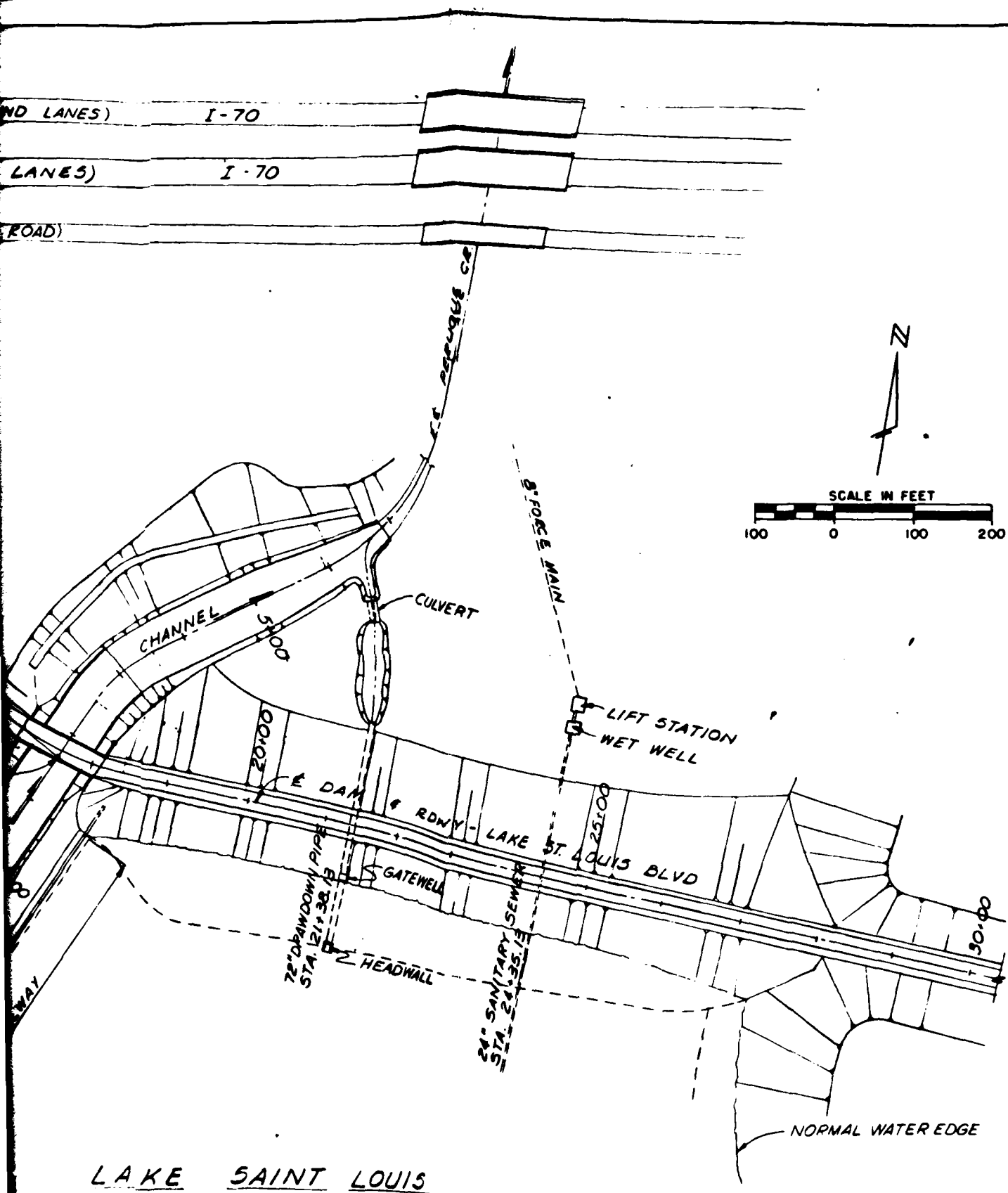
(EASTBOUND LANES)

I-70

(SOUTH OUTER ROAD)



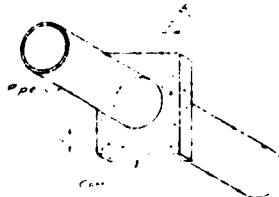
LAKE SAI



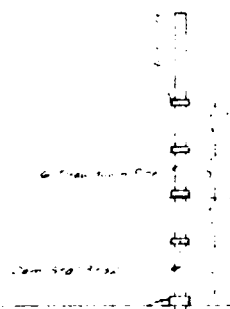
LAKE SAINT LOUIS

GENERAL PLAN OF DAM AND SPILLWAY

PLAN	
NOTE BOOK	NO.



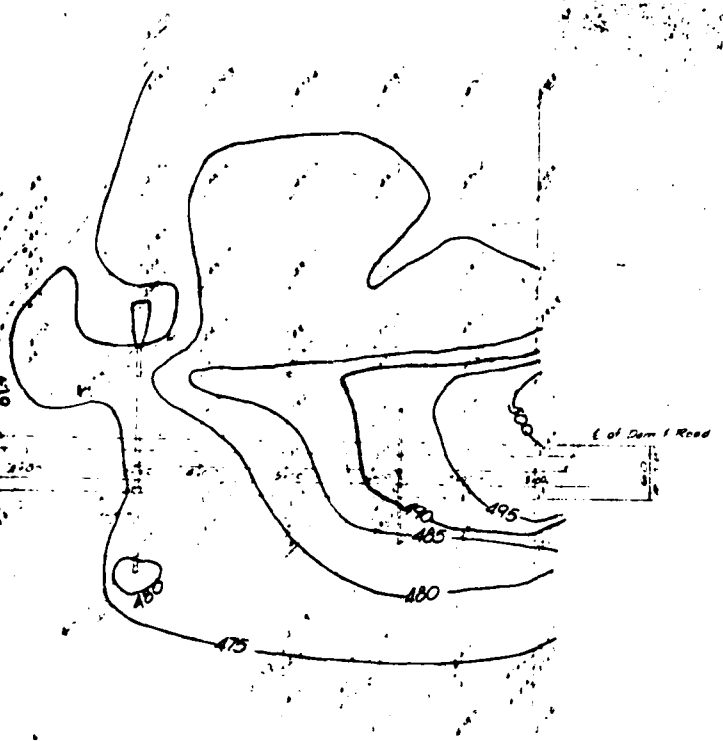
ANTI-SEEP



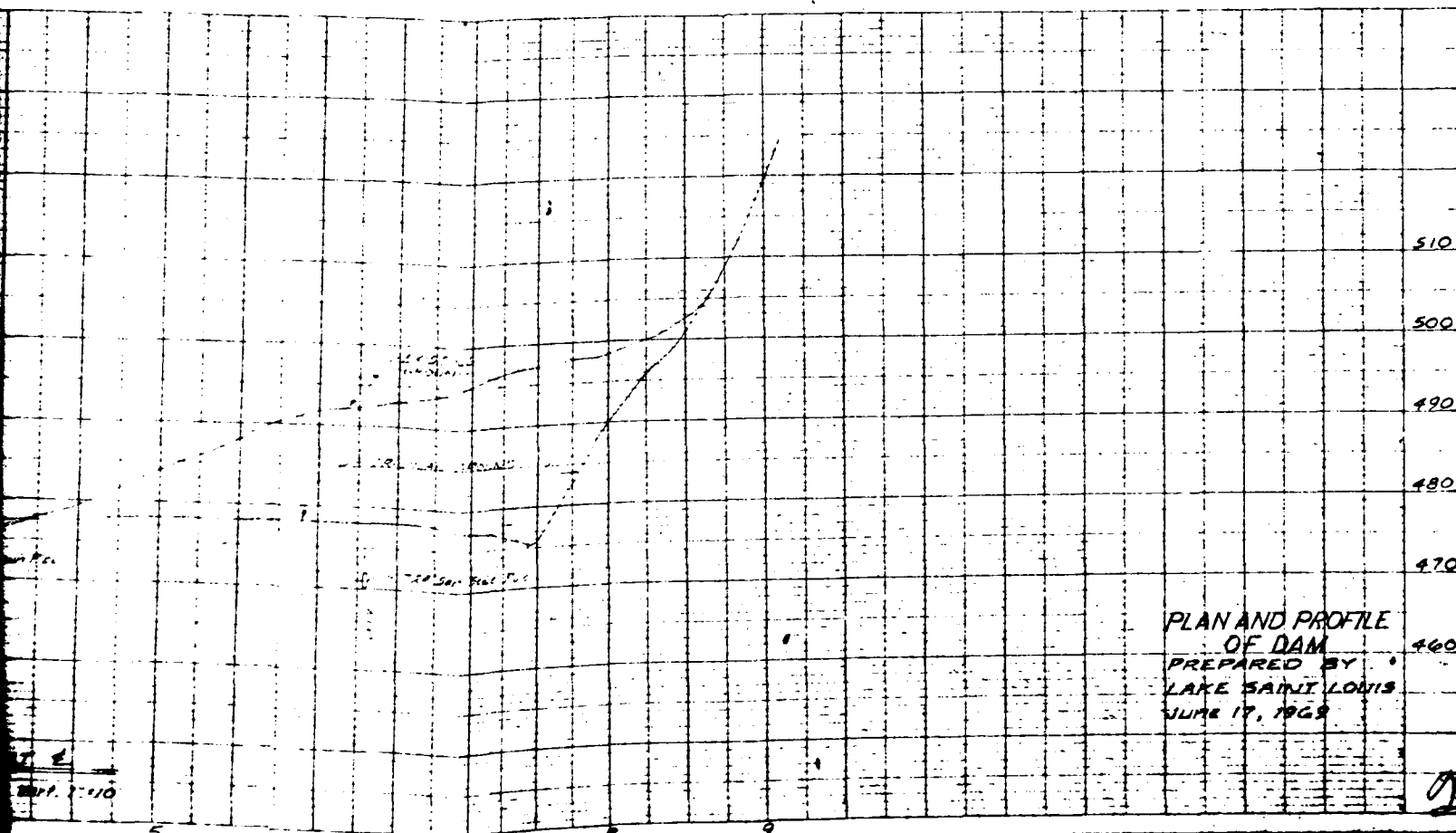
PLAN VIEW OF ANTI-SEEPS

PROFILE	
NOTE BOOK	NO.

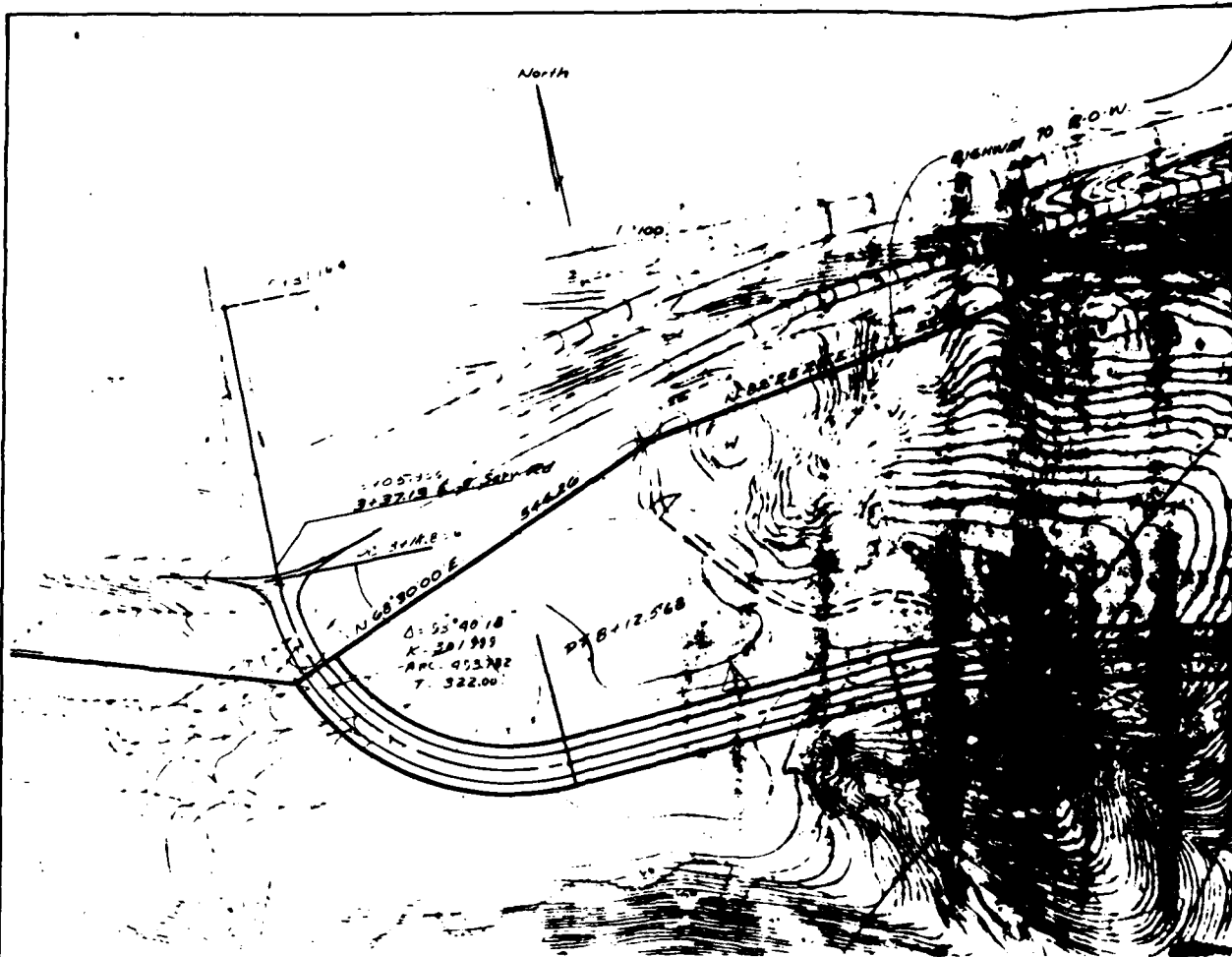




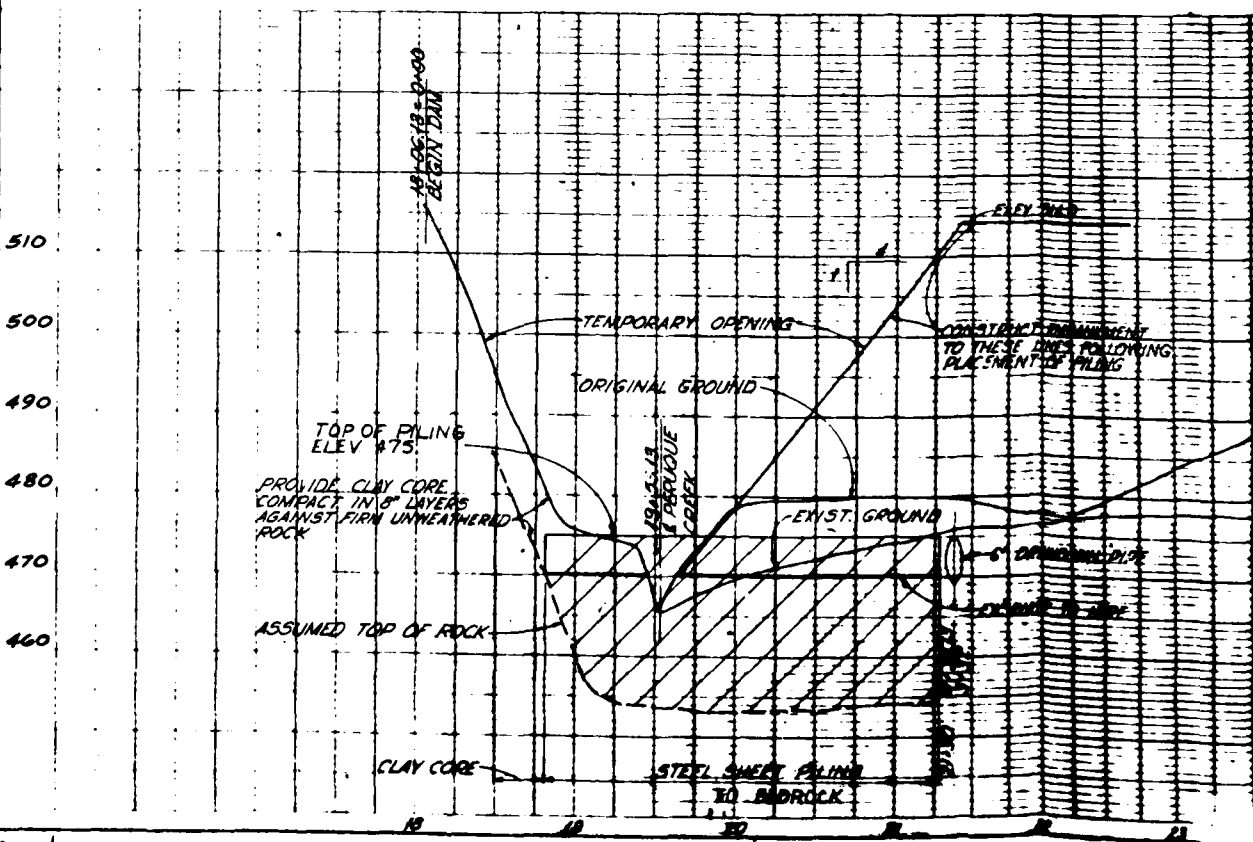
PLAN VIEW OF DAM AREA



PLAN AND PROFILE
OF DAM
PREPARED BY
LAKE SAINT LOUIS
JUNE 17, 1968



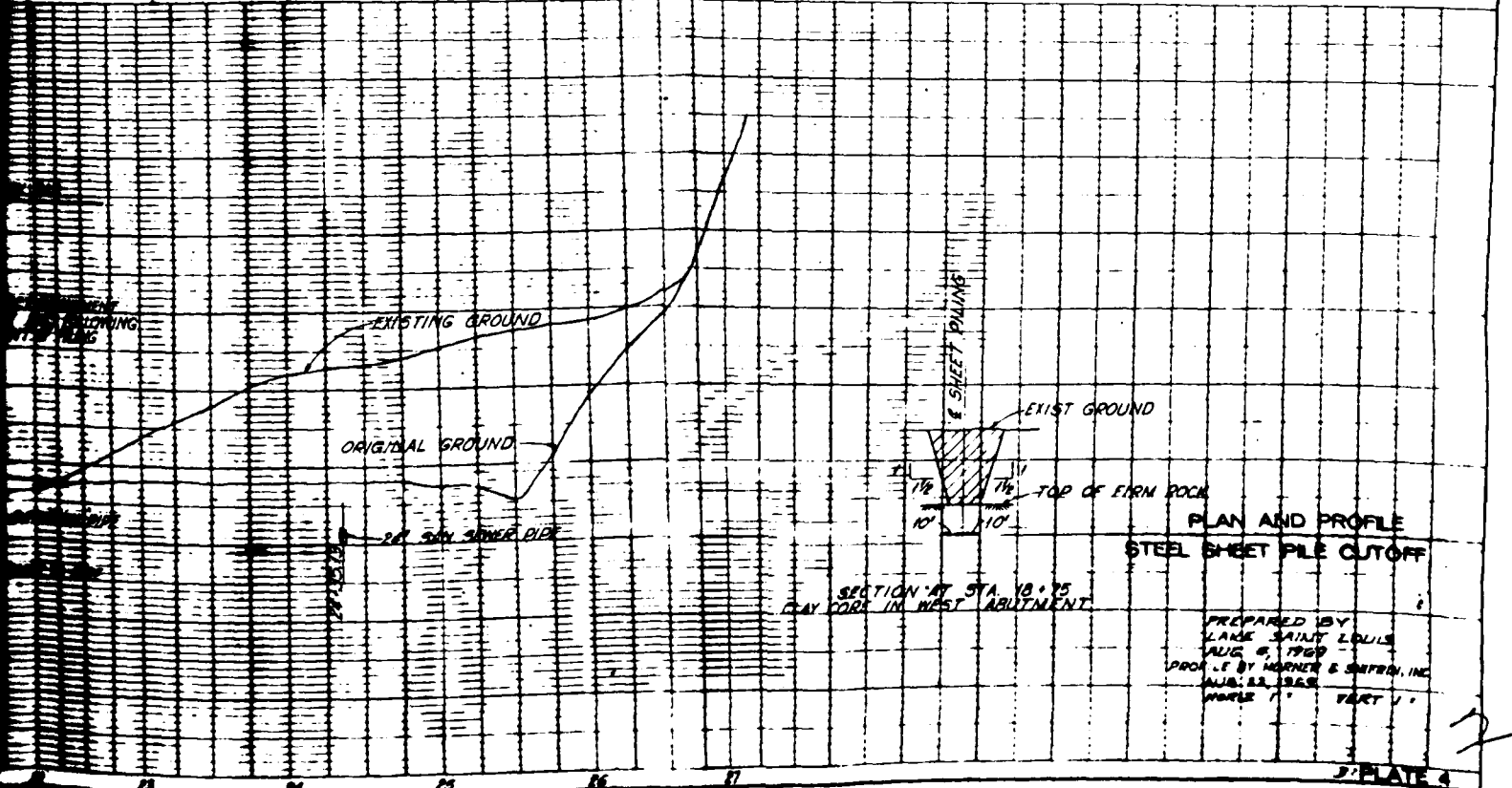
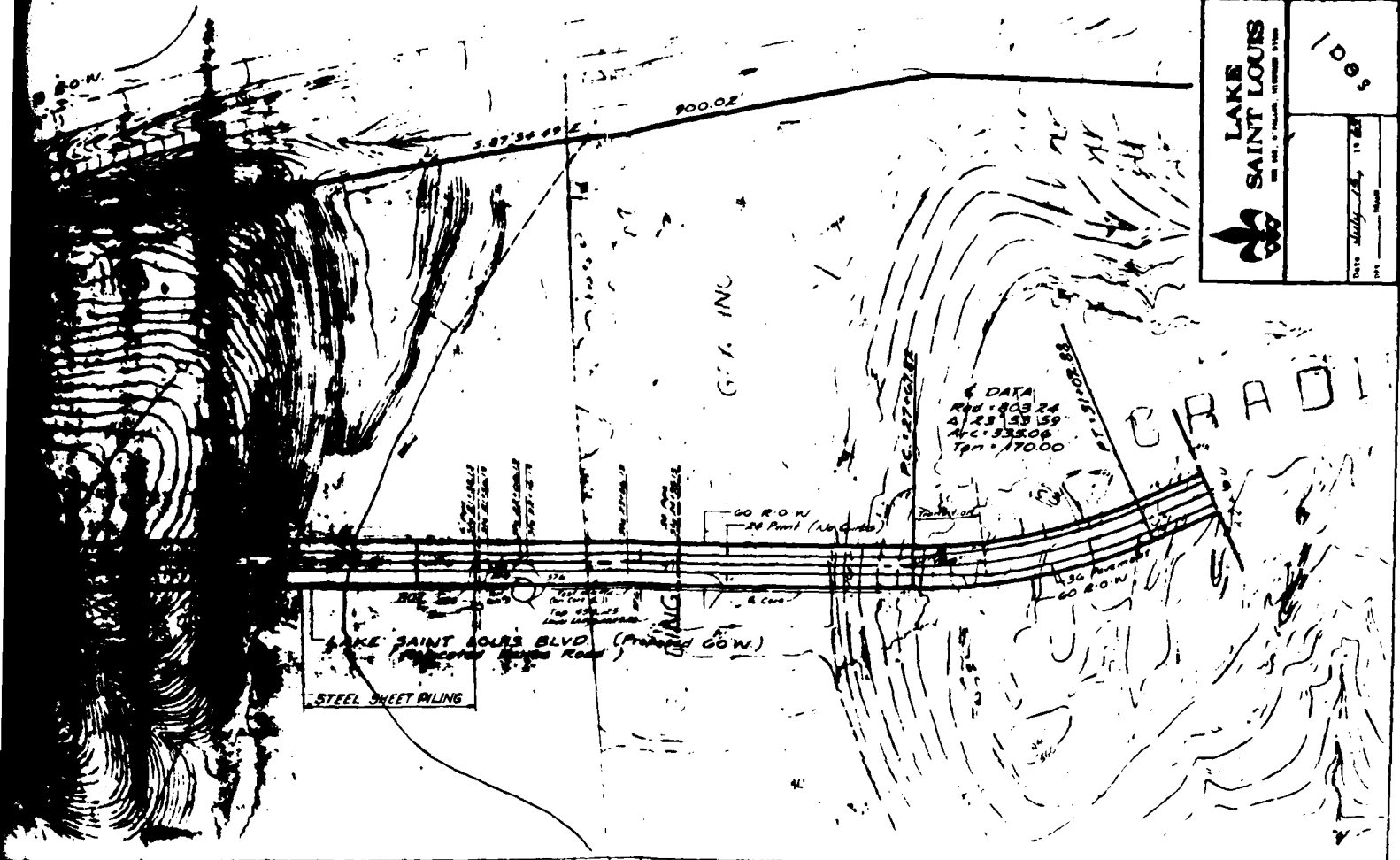
PROFILE



LAKE SAINT LOUIS
INC.

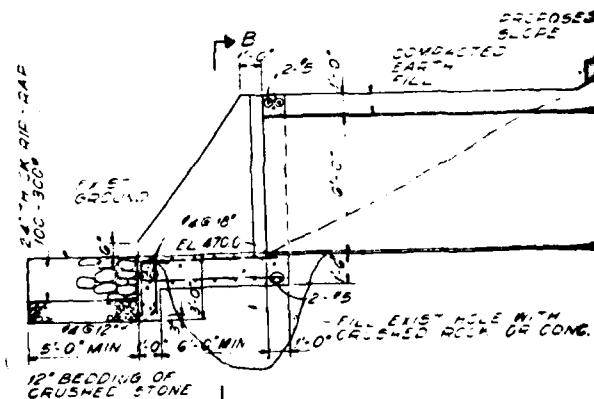
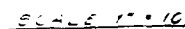
1065

Date July 22, 1969
BY [Signature]
1065



PREPARED BY
LAKE SAINT LOUIS
AUG. 6, 1969
PROJECT BY MORRIS & SMITH, INC.
AUG. 22, 1969
SCALE 1" = 10'

••



DETAILS OF INTAKE ON EXD
SCALE 4" = 1'

WELD TO PIPE AND
WITH CH COAL TAR ENAMEL
BY HOPKINS COMPANY
BITUMASTIC NPS 80

1/2 IN. SOLID 30 IN. ANNEALED
COPPER WIRE Laid IN TRENCH
3/4 IN. G N L L NOT BE PERMITTED

72" STEEL PIPE

WEL AND DE 1/2 IN.
WELDING DATA
1/2 IN. STEEL WEL
TAMPED

REGISTERED
HOLE

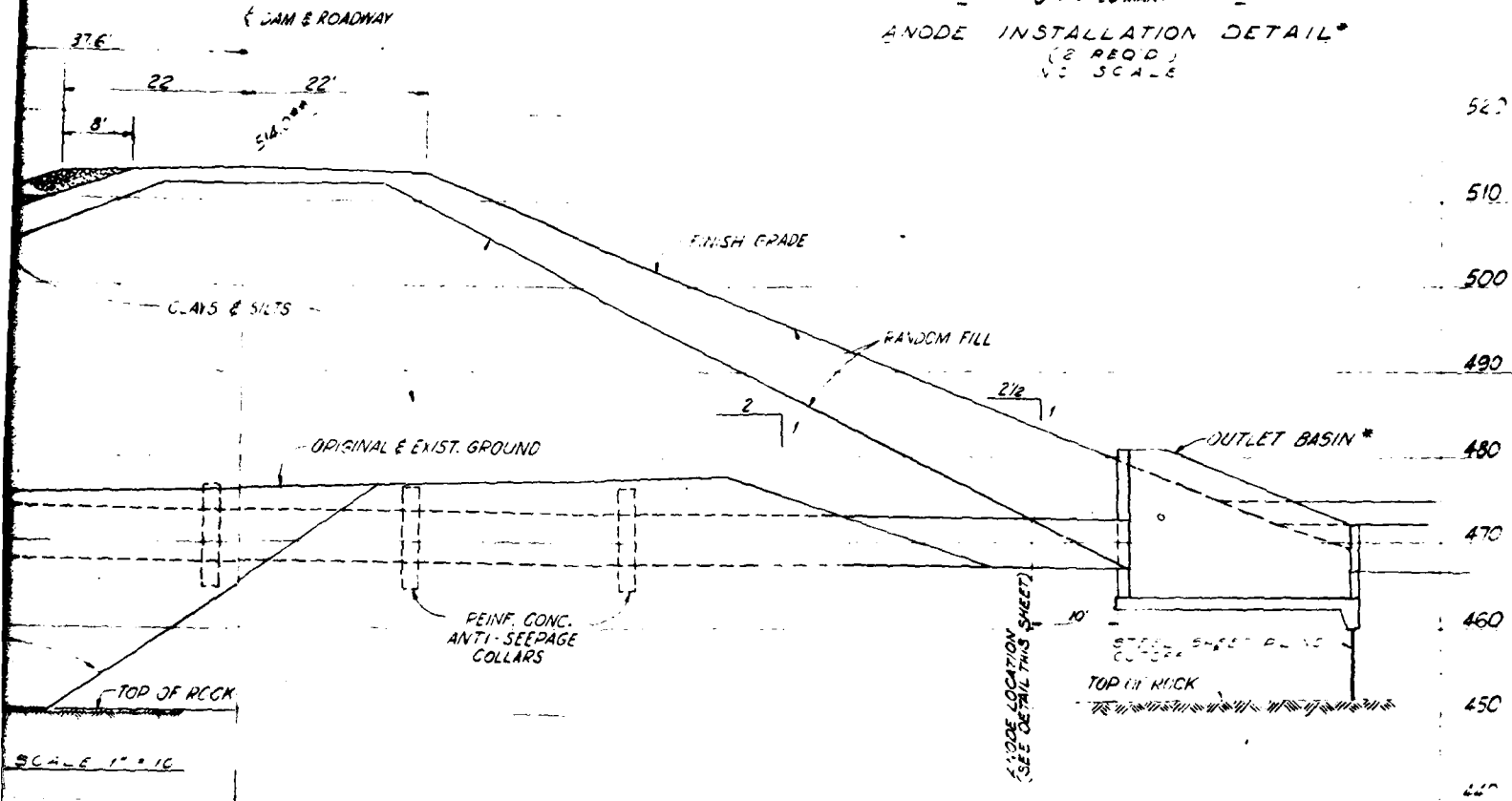
TOP OF ANODE =
E PIPE

1. MAGNIFIED MAGNESIUM
ANODE 4" X 4" X 1/4"
2. 3-STRAND BACKFILL
3. 1/2" BAG AS NAIL
4. LINED BY HARGO CORP.
5. 1/2" CLEVELAND OHIO
OR APPROVED EQUAL

DOWNSTREAM

5' MAX. 20 MAX.

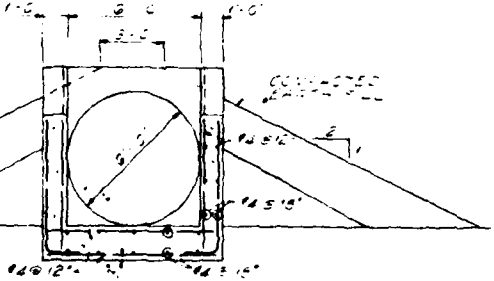
ANODE INSTALLATION DETAIL*
(2 RECD)
VC SCALE



SCALE 1" = 10'

COMPACTED
EARTH
FILL

1/2" HOLE WITH
EO ROCK OR CONC



NOTE: REIN. 1/2\"/>

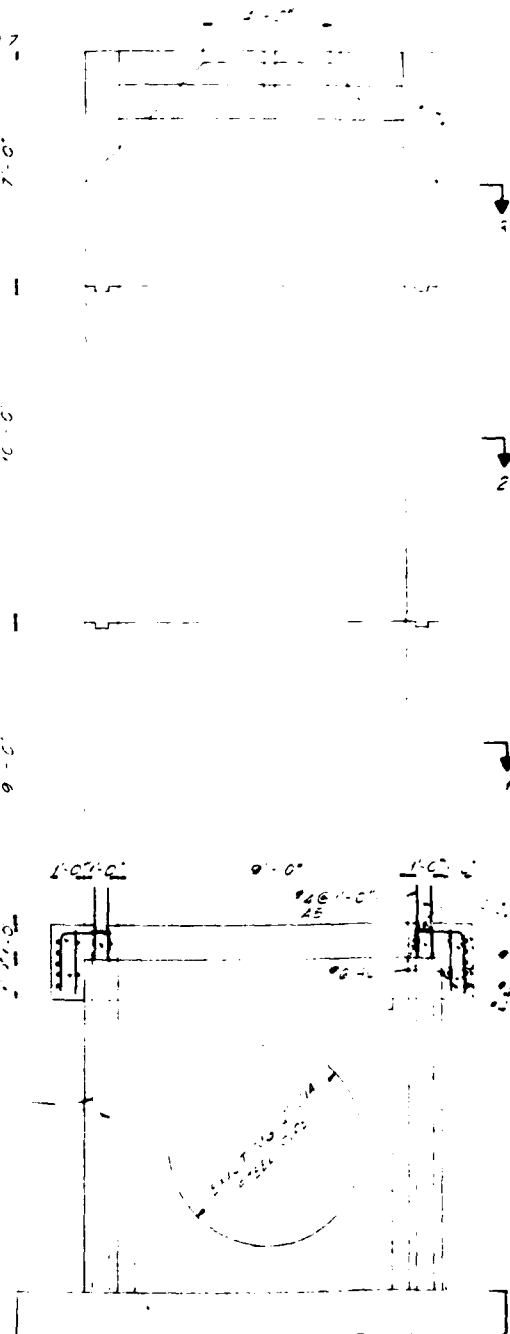
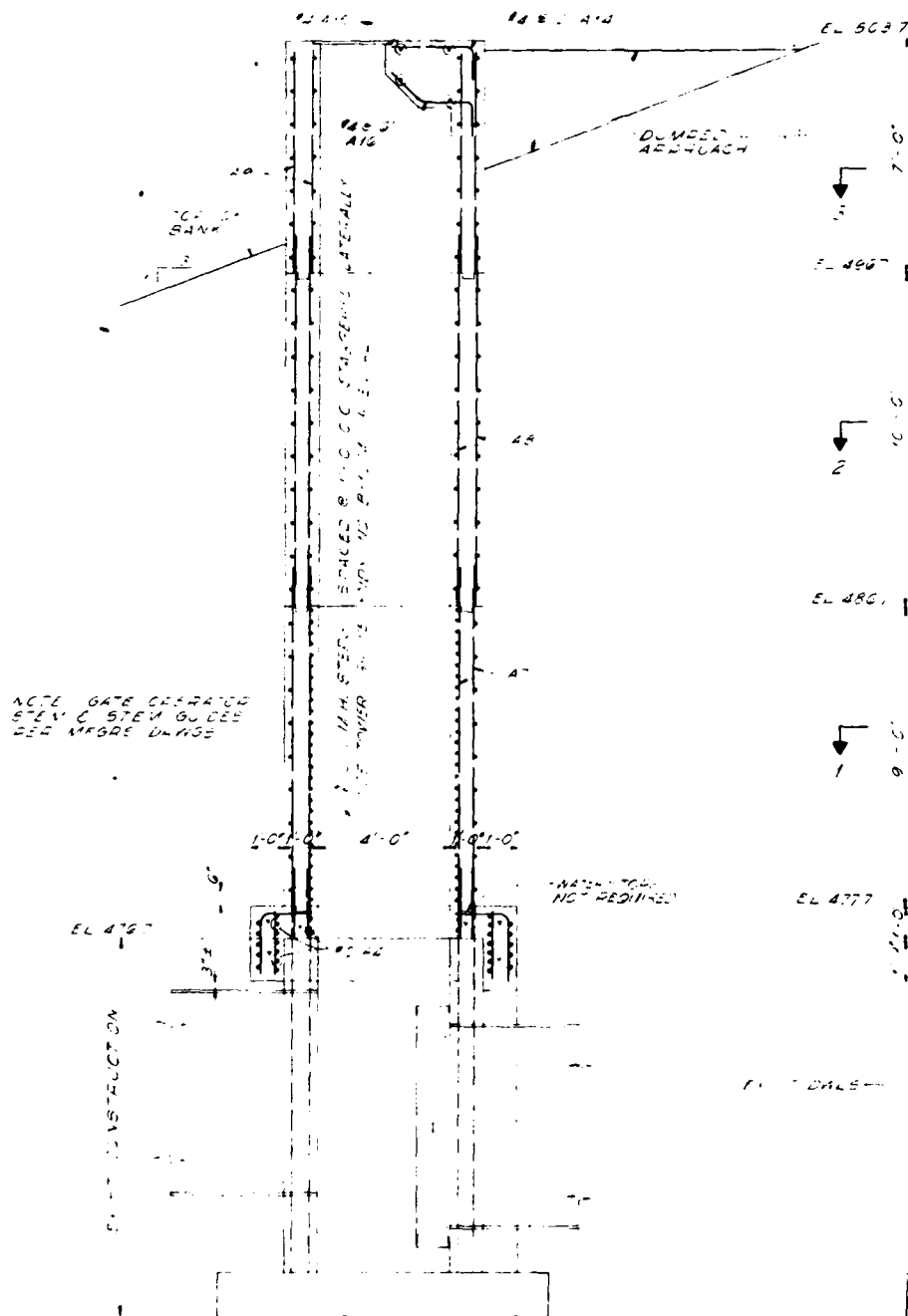
SECTION B-B

* ITEM NOT CONSTRUCTED
** ITEM CONSTRUCTED TO AN ELEVATION
OTHER THAN SHOWN

10/26/63 REV. DATE ANODE DETAIL ADDED DESCRIPTION D.C.L. BY

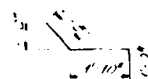
LAKE ST. LOUIS INVESTMENT CORPORATION			
LAKE ST. LOUIS			
MAIN DAM			
PROFILE ALONG 72" STEEL PIPE			
SCALE AS SHOWN	HORNOR & SHIFFRIN, INC. CONSULTING ENGINEERS ST. LOUIS, MISSOURI	DATE SEPT 1968	
DRAWN BY J.E.B.		DRAWING	
CHECKED BY D.E.E.		SHEET NUMBER	TOTAL SHEETS
DESIGNED BY D.C.L.		1	3
NO. 8042			

LAKE ON EXIST. 72" STEEL PIPE
SCALE 1/4" = 1'-0"

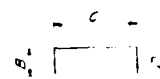


BAR SCHEDULE							
MARKS	QTY	QTY	LENGTH	TYPE	C	B	D
A1	4	12	1	17	12-8	3-9	3-4
A2	4	42	1	17	1-11	1-8	-
A3	4	42	1-11	1	-	-	-
A4	4	18	12-8	1	-	-	-
A5	4	60	2-2	1	-	-	-
A6	6	6	7-8	1	-	-	-
A7	4	60	10-2	1	-	-	-
A8	4	60	11-2	1	-	-	-
A9	4	60	6-10	1	-	-	-
A10	6	52	5-8	1	-	-	-
A11	6	36	10-8	1	-	-	-
A12	6	34	10-8	1	-	-	-
A13	5	16	6-10	1	-	-	-
A14	4	17	3-6	17	1-0	2-6	-
A15	4	4	10-6	1	-	-	-
A16	4	17	4-5	-	-	-	-
A17	6	52	18-2	17	10-8	3-9	3-9

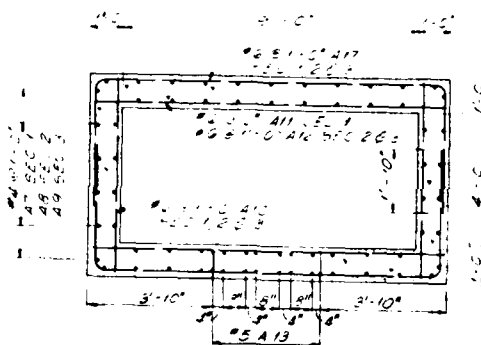
NOTE - TYPE 1 BARS ARE STRAIGHT BARS



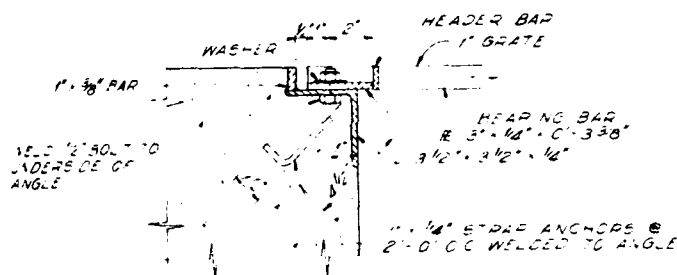
Nº 525



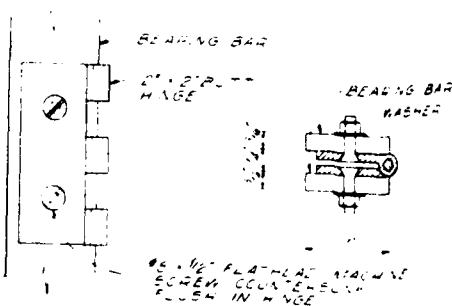
TYPE 17



TYPICAL SHAFT SECTIONS
SCALE 3/8" = 1'-0"

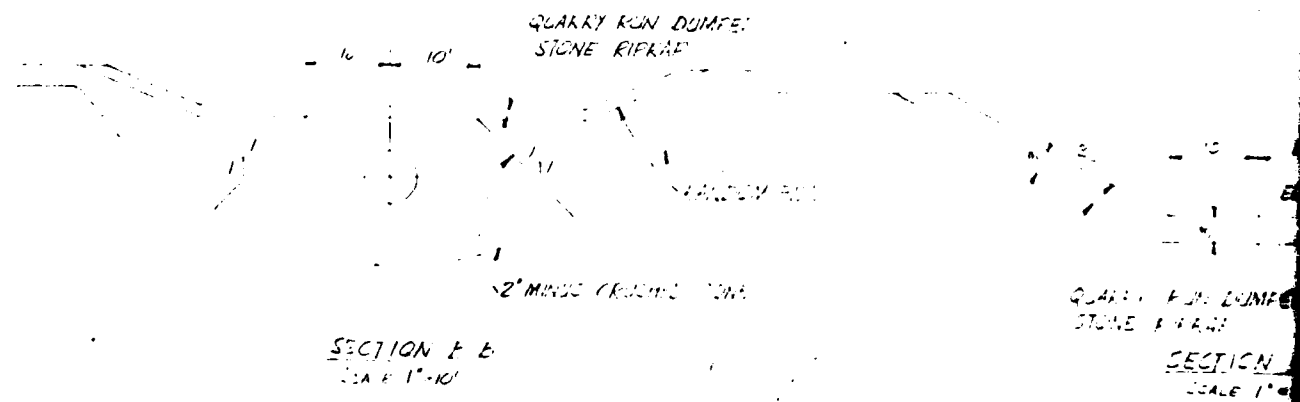
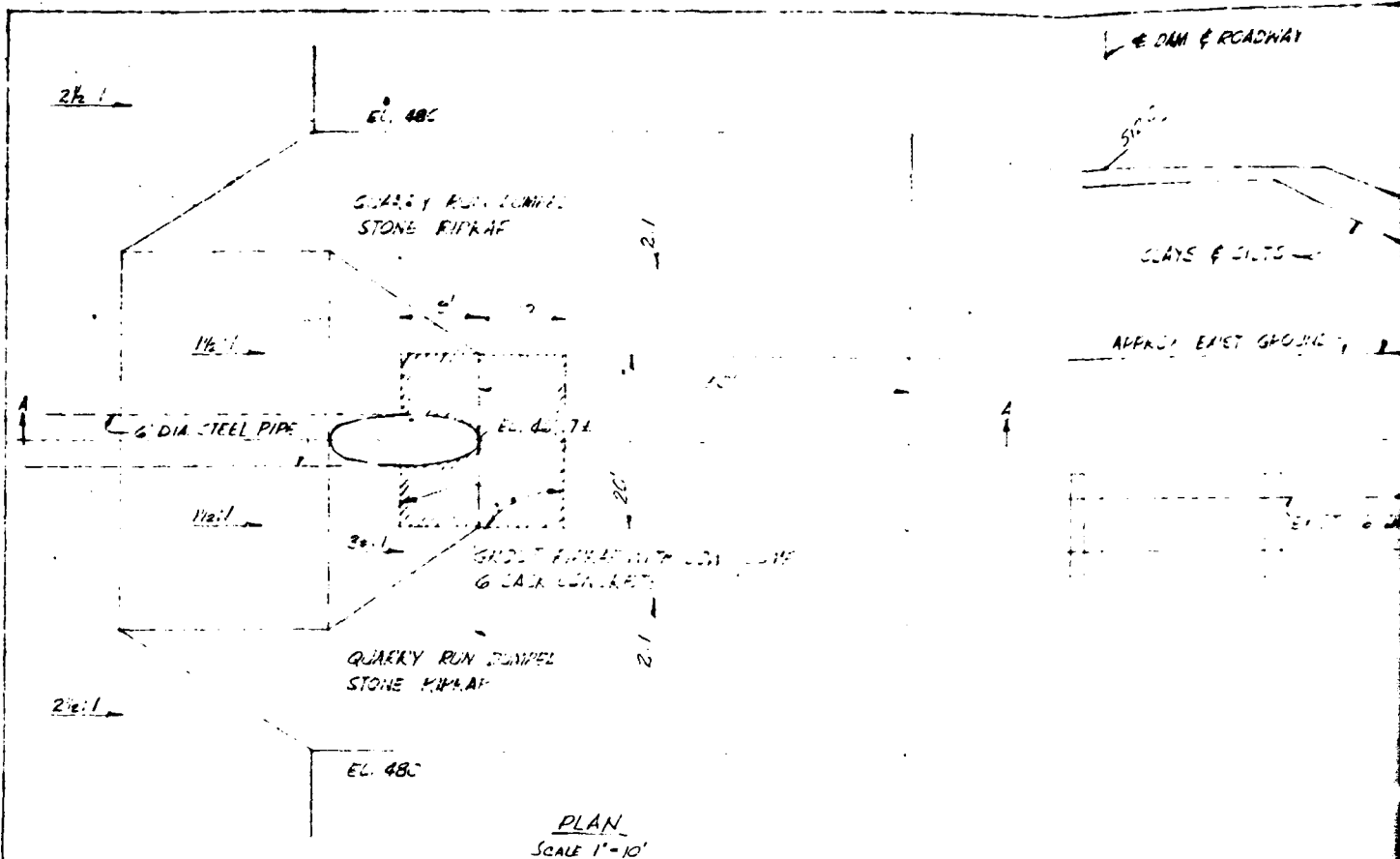


DETAIL OF GRATE CLAMP
& ANGLE SEAT
SCALE 3" = 1'-0"



GRATE HINGE
FULL SIZE

3/15/69	BAR SCHEDULE REVISION A5, A11, A13	DRAWING
REV. DATE	DESCRIPTION	BY
LAKE ST LOUIS INVESTMENT CORPORATION LAKE ST. LOUIS MAIN DAM DETAILS-GATEWELL STRUCTURE		
SCALE AS SHOWN	MORFITT & SHIFRIN, INC. CONSULTING ENGINEERS ST. LOUIS, MISSOURI	DATE SEPT 1968 DRAWING
DESIGNED BY JBB DRAWN BY DEE CHECKED BY DCL		SHEET NUMBER 2
		TOTAL SHEETS 3
HS NO 0042		



DAM & ROADWAY

C.

CLAYS & SILTS

EXIST GROUND

FRANCONIA FILL

2' MIN. CRUSHED STONE

EXIST 6" DIA. STEEL PIPE

EXIST 6" DIA. STEEL PIPE

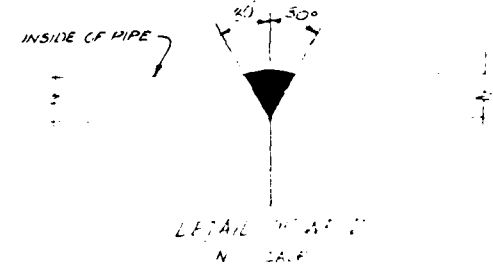
EXIST 6" DIA. STEEL PIPE

RECONNECT BEVELLED END SECTION AT THIS LOCATION.

QUARRY & DUMPS STONE RIBBON

SECTION A-A
SCALE 1" = 10'

CUT END OF PIPE AND GRIND AS REQUIRED TO 30° BEVEL PROVIDE DOUBLE BEVEL WELD FULL PENETRATION.



CLAYS & SILTS
STONE RIBBON

SECTION C-C
SCALE 1" = 10'



LAKE SAINT LOUIS INVESTMENT CORPORATION
**LAKE ST. LOUIS
MAIN DAM**
MODIFICATION TO 6" PIPE OUTLET

SCALE AS NOTED
DESIGNED
DRAWN BY
CHECKED BY
HS NO 8842

HORNER & SHIFRIN, INC
CONSULTING ENGINEERS
ST. LOUIS, MISSOURI

DATE JUNE, 1970
DRAWING SHEET TOTAL
NUMBER SHEETS
24 29

PLATE

520

510

500

490

480

470

460

520

510

500

490

480

470

460

520

510

500

490

480

470

UPSTREAM

FINISHED GRADE

STONE RIPRAP &
GRANULAR BEDDING

COFFERDAM

FINISHED GRADE

COMPACT FILL WITH
HAND OPERATED
TAMMERS

STEEL SHEET
PIILING

2.10.120

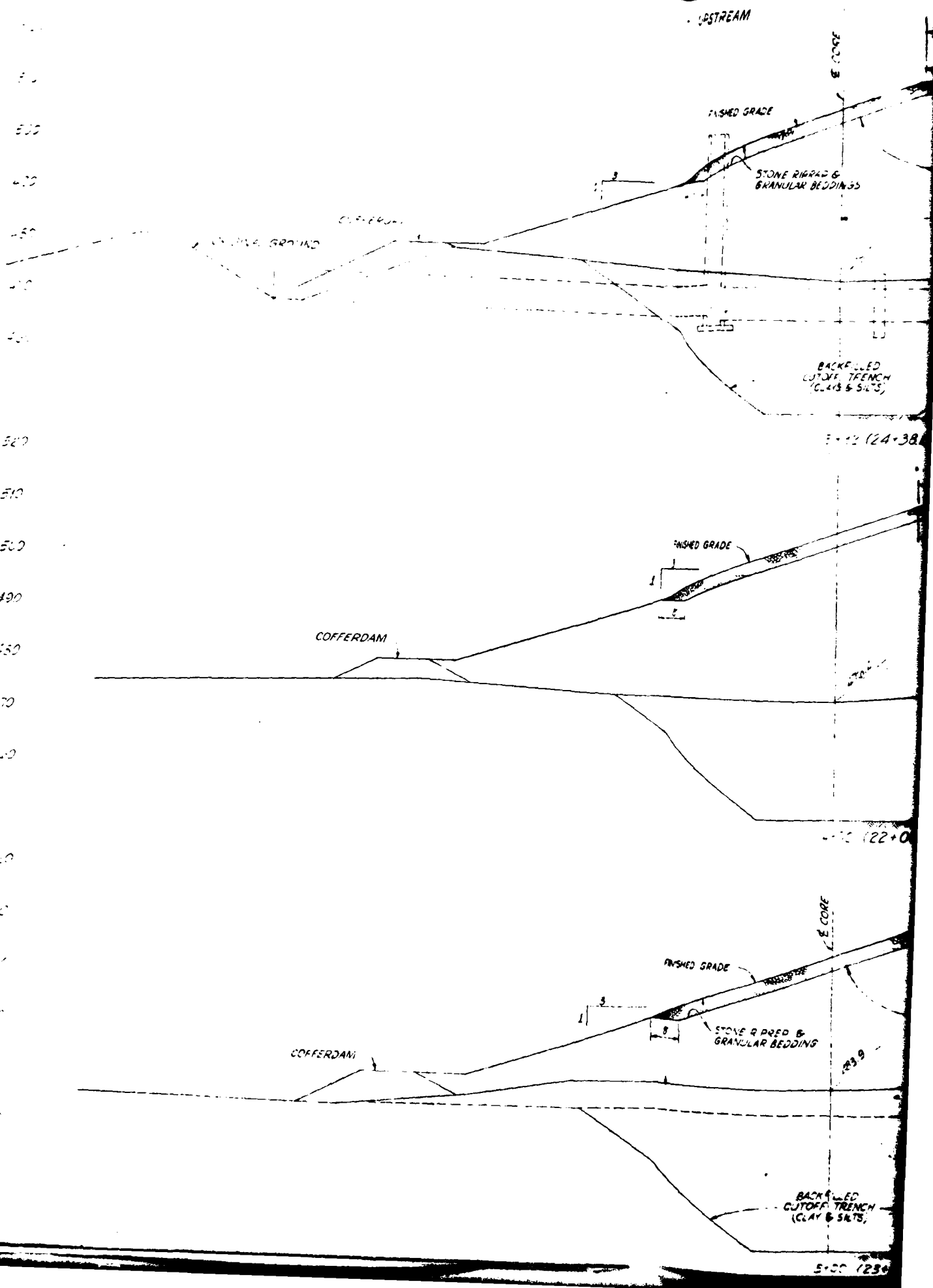
FINISHED GRADE

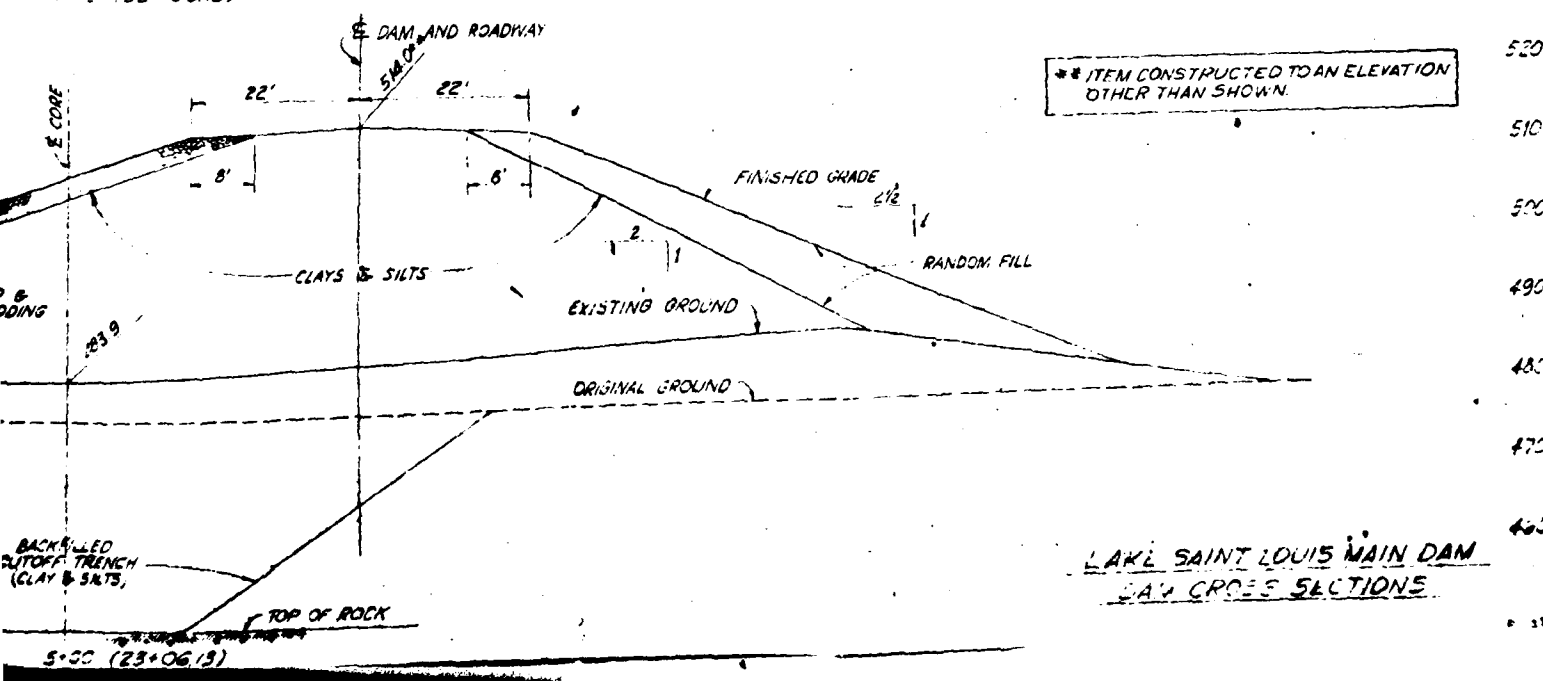
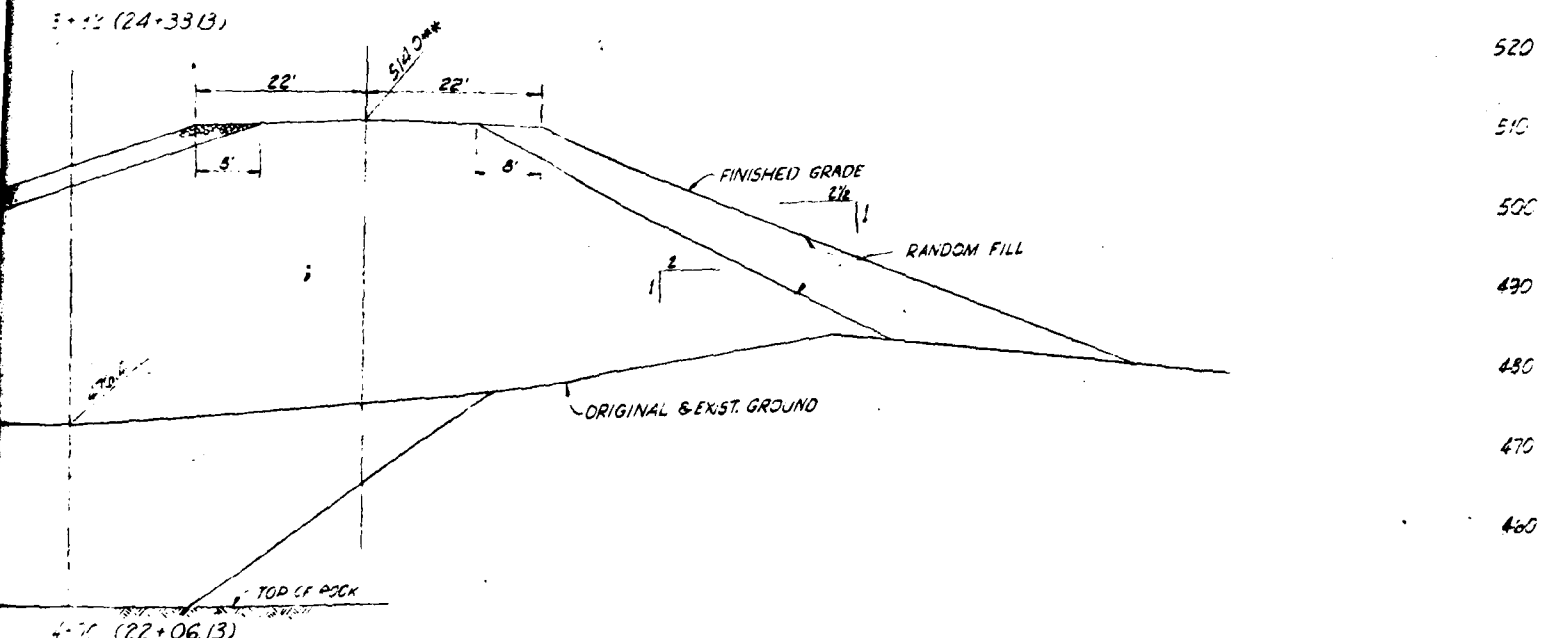
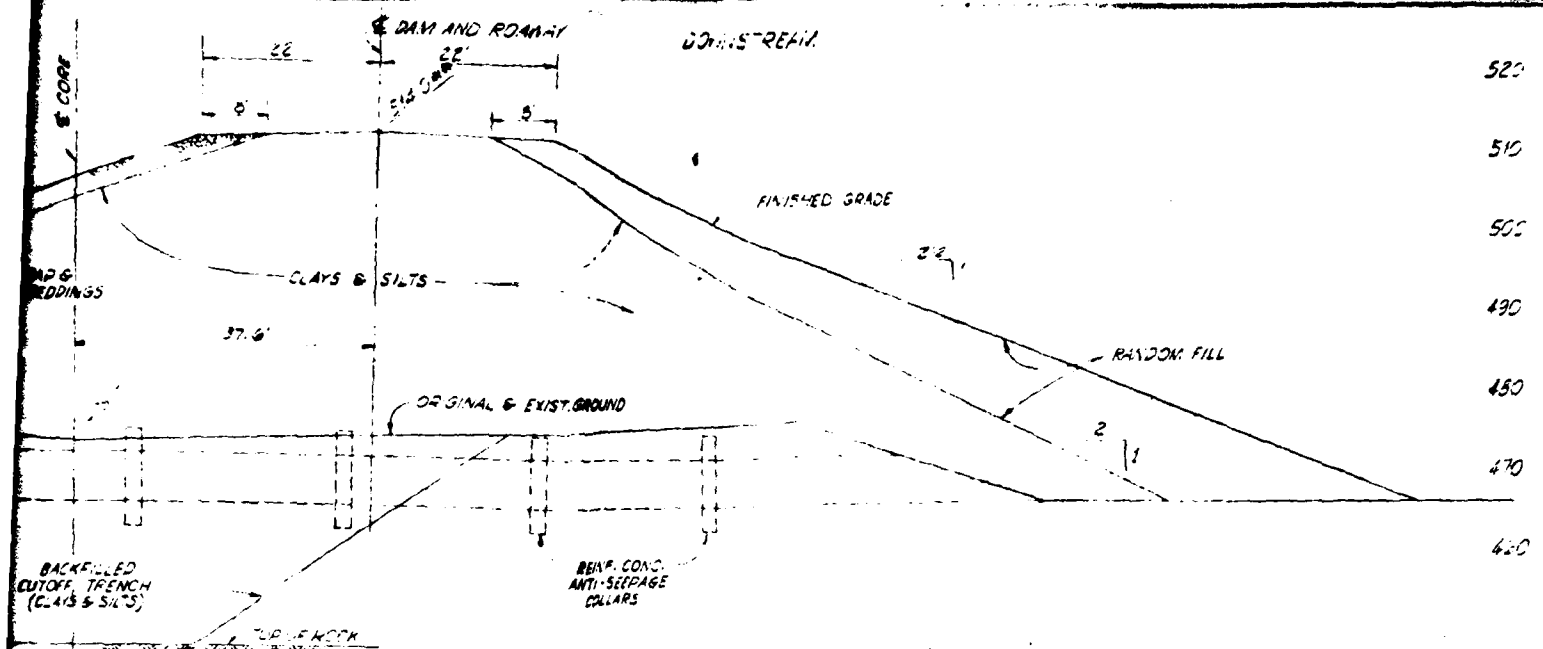
STONE RIPRAP &
GRANULAR BEDDING

COFFERDAM

EXCAVATE AND
BACKFILL WITH
CLAYS AND SILTS
FROM BORROW AREA

COMPACT WITH HAND
OPERATED TAMPING
EQUIPMENT

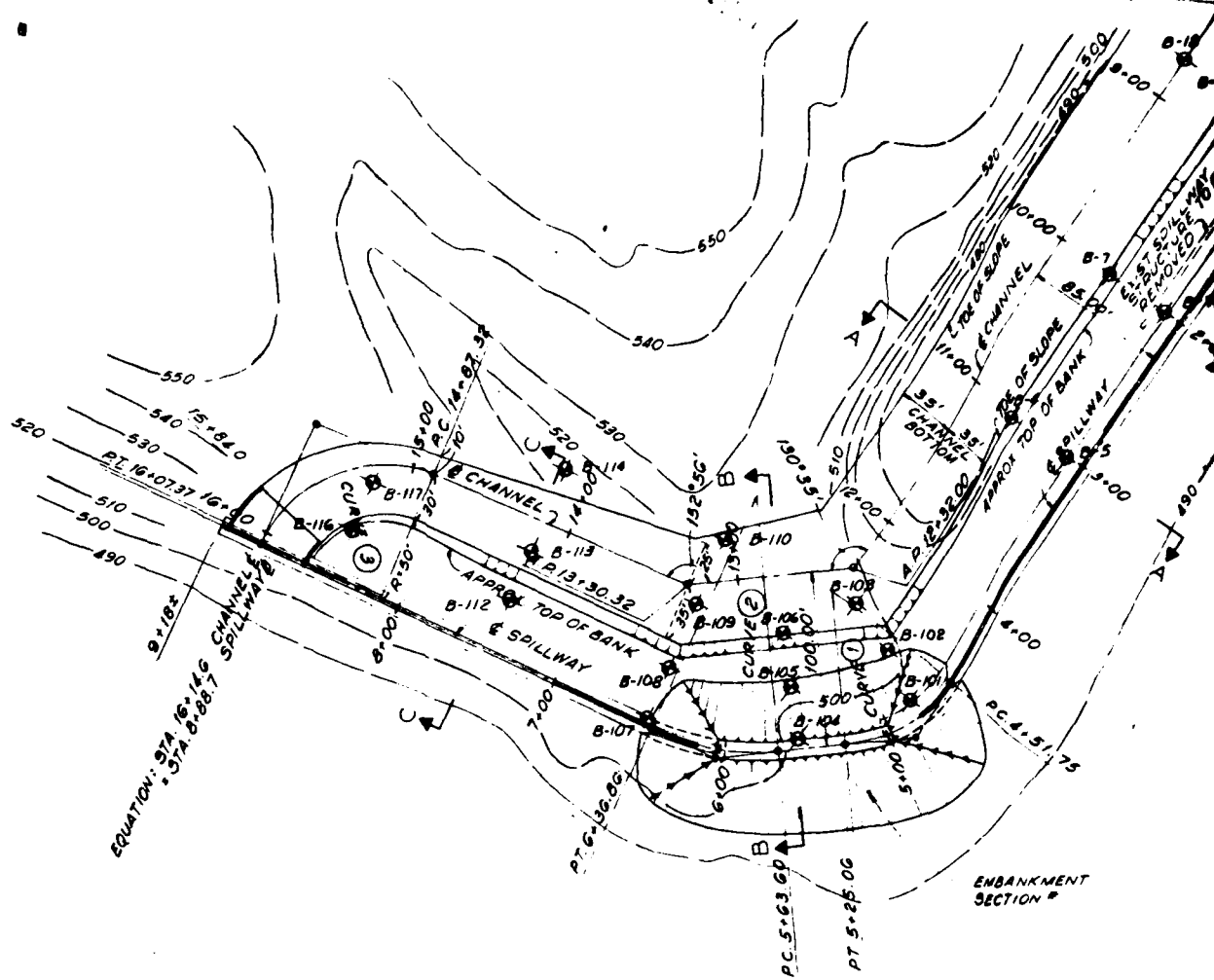




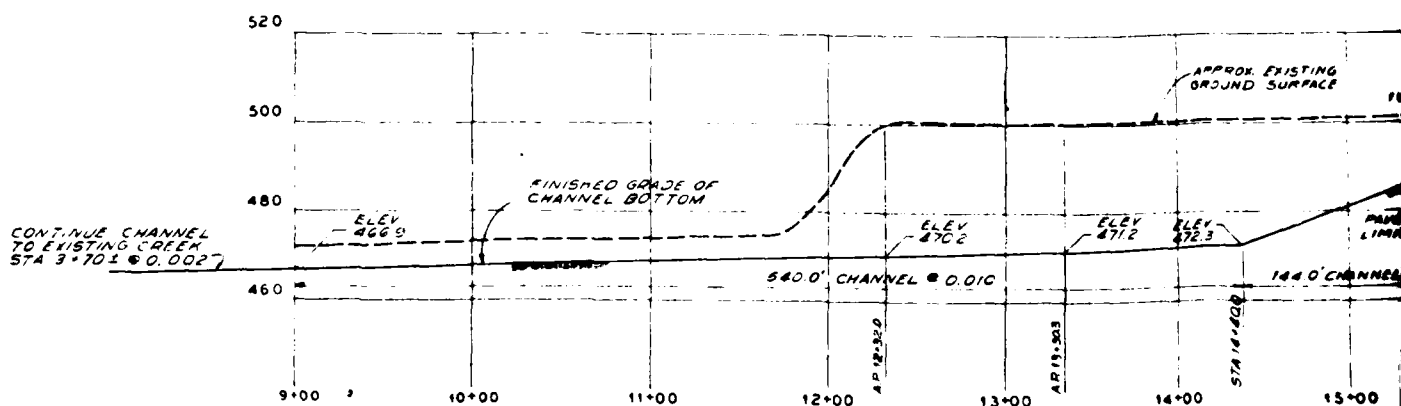
ITEM CONSTRUCTED TO AN ELEVATION OTHER THAN SHOWN.

LAKE SAINT LOUIS MAIN DAM
DAY CROSS SECTIONS

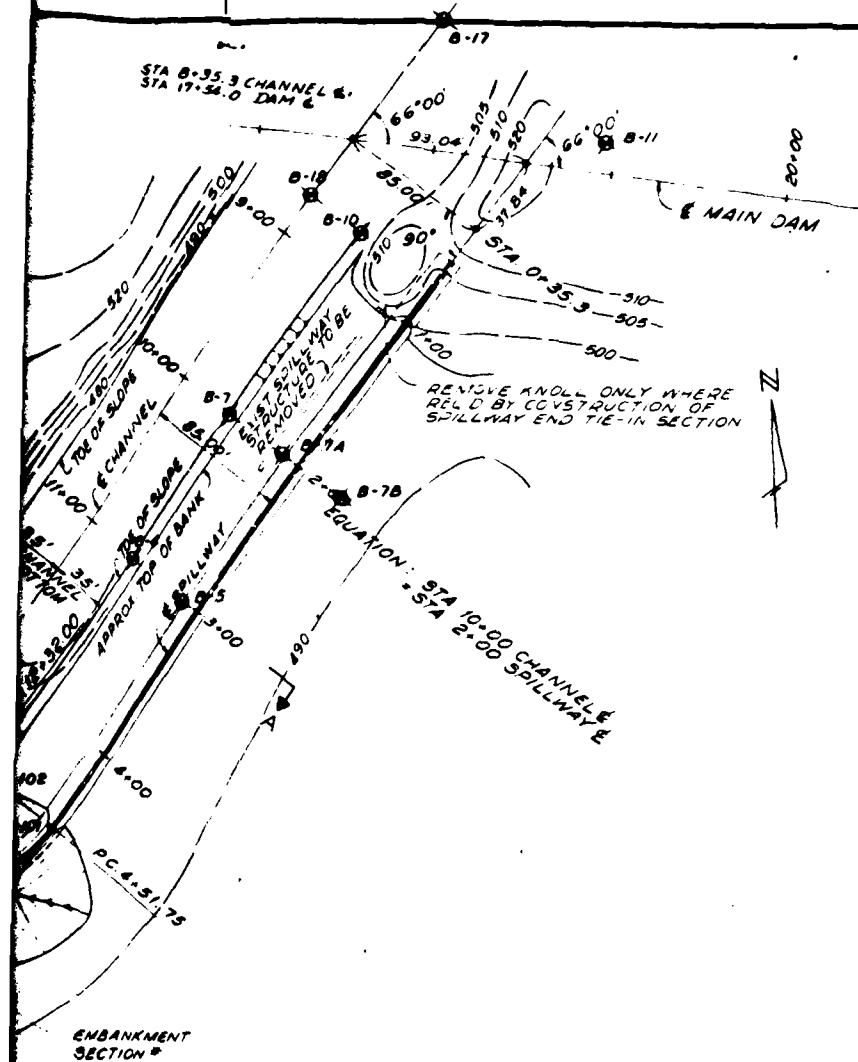
CURVE (3)
 $\Delta = 88^{\circ}11'10''$
 $R = 78.00'$
 $T = 75.57'$
 $L = 120.05'$



SITE PLAN OF SPILLWAY



PROFILE OF SPILLWAY CHANNEL
SCALE: 1"=20' VERT. 1"=50' HORIZ.



GENERAL NOTES

A. GENERAL

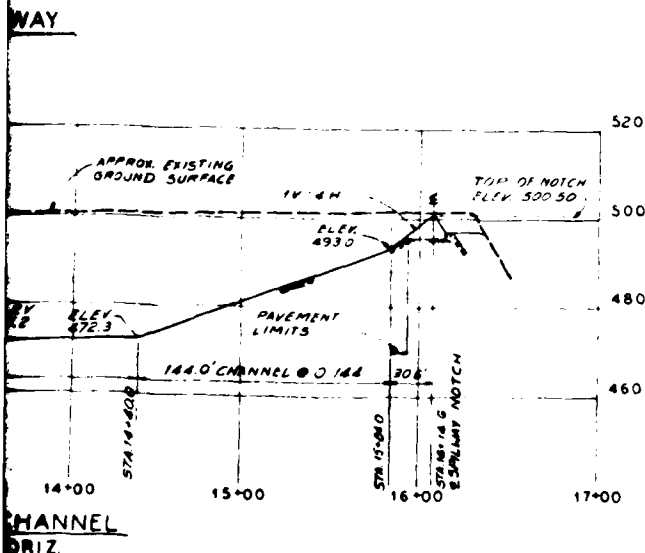
1. Excavation for 12-inch minimum embedment of spillway base and embankment cutoff trench in sound limestone rock shall be performed such that adjacent rock remains intact and undisturbed.
2. Impervious fill shall be clays and/or silty clays obtained from hillside borrow areas approved by the Engineer.
3. Impervious fill shall be compacted in 8-inch maximum lifts unless otherwise specified to 95 per cent maximum density at optimum moisture content per ASTM Test D-698, "Standard Proctor Method."
4. All fill placed within 2 feet of spillway walls or base sections shall be mechanically compacted in 6-inch maximum lifts to 95 per cent maximum density per ASTM D-698. Backfill shall be uniformly and symmetrically placed.
5. Spillway monoliths and end tie-in sections shall be placed in alternate sections with a minimum elapsed period of 120 hours between placement of adjacent sections.
6. Riprap shall be sound durable quarry-run limestone with a maximum size of 250 lbs.
7. Bedding shall be well-graded sound durable limestone with a maximum size of 3 inches.
8. Surfacing shall be crushed limestone similar to bedding.

B. CONCRETE

1. All detailing, fabrication, and placing of reinforcing bars shall comply with the ACI "Manual of Standard Practice for Detailing for Reinforced Concrete Structures," ACI-315.
2. All concrete shall have a minimum compressive strength in 28 days of 3,000 psi; shall contain a minimum of 6 sacks of Type II, ASTM C-150 portland cement per cubic yard, and shall not contain more than 5.25 gallons of water (total moisture) per sack of cement. An air-entraining agent, conforming to the requirements of ASTM C-260 shall also be included in the mix. The maximum allowable slump for base sections shall be 3 inches and for walls, 3 inches. Concrete aggregates shall conform to ASTM C-33. Coarse aggregate shall be well graded crushed limestone with a maximum size of 1-1/2 inches. The mix shall be approved by the Engineer prior to construction.
3. All exposed concrete shall be cured with wet burlap coverings for a period of not less than 120 hours. Forms in contact with the concrete shall be kept wet for a period of not less than 120 hours. If forms are removed during the curing period the exposed concrete surface shall be cured, as specified above, for the balance of the curing period. In lieu of moist curing, all concrete may be membrane cured using "Mornure 40W" (white) curing compound applied at a coverage rate of 200 sq. ft. per gallon.
4. Reinforcing bars, including anchors, shall conform to ASTM A-615, Grade 60.
5. Reinforcing bars shall have a clear concrete cover of 2 inches unless otherwise shown on the drawings.
6. Waterstops shall be 6 inches wide by 3/8 inch thick, 2 bulb type PVC waterstops, manufactured in accordance with CRD-C572.
7. All exposed edges of concrete walls shall have a 3/4-inch chamfer. The upstream and downstream corners of the overflow spillway crest shall be rounded to a 3-inch radius.
8. All exposed unformed concrete surfaces shall have a wood float finish.

NOTES:

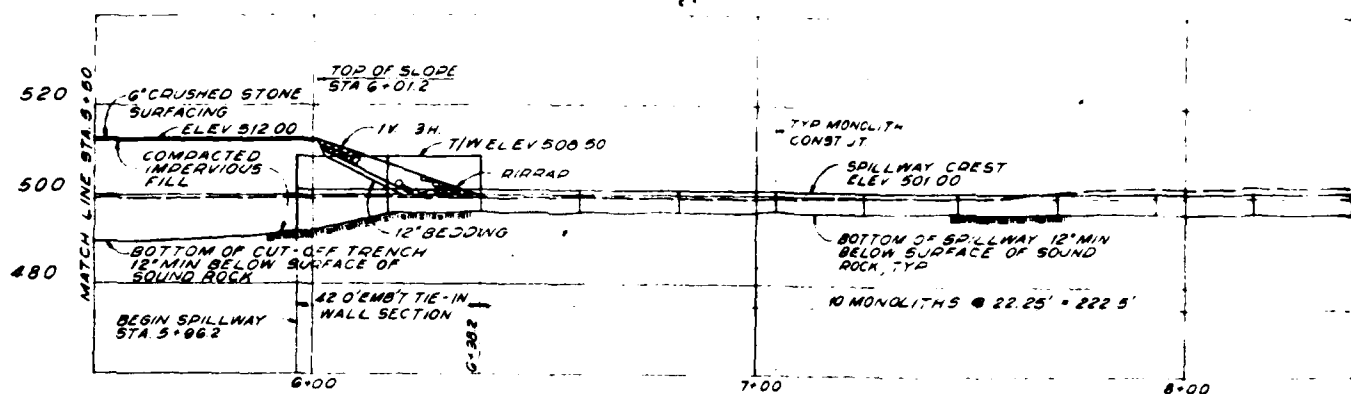
1. TEST BORINGS B-4 THRU B-18 DRILLED MAY & JUNE, 1970.
2. TEST BORINGS B-101 THRU B-117 DRILLED JUNE & JULY, 1971



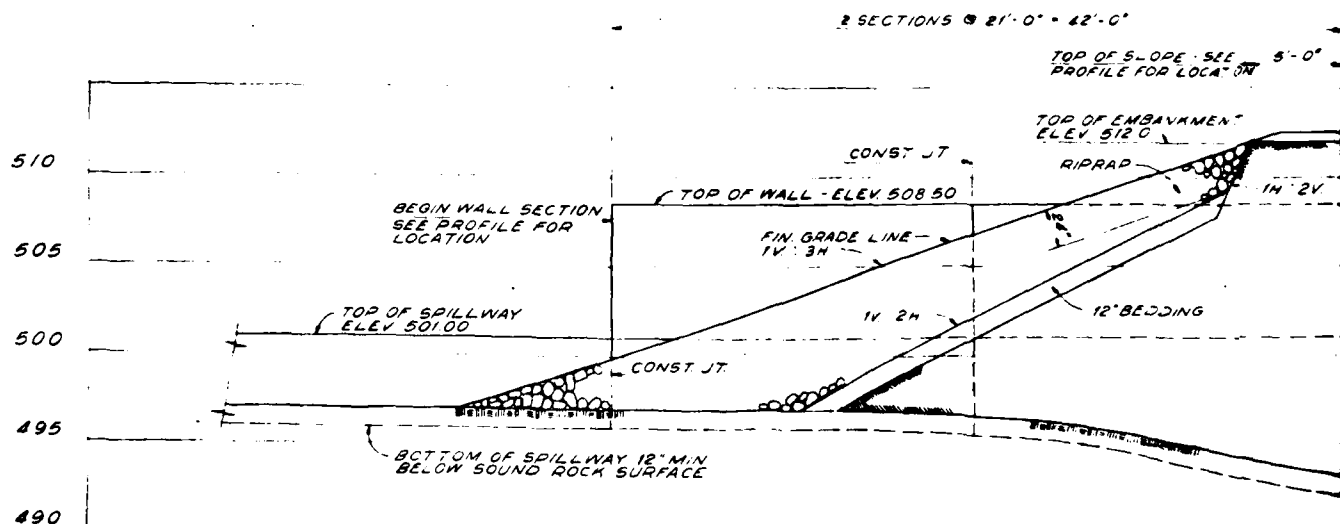
* ITEM NOT CONSTRUCTED.



REV.	DATE	DESCRIPTION
LAKE SAINT LOUIS INVESTMENT CORPORATION		
LAKE SAINT LOUIS		
MAIN DAM		
SITE PLAN OF SPILLWAY		
PROFILE OF CHANNEL		
SCALE: 1" = 50'	DESIGNED BY A.B.D. DRAWN BY E.L.H. CHECKED BY D.C.L.	DATE: 11/1/71 DRAWN BY: [blank] SHEET NUMBER: 1 OF: 1
NS NO. 72.48	HORNER & SHIFRIN, INC. CONSULTING ENGINEERS ST. LOUIS, MISSOURI	

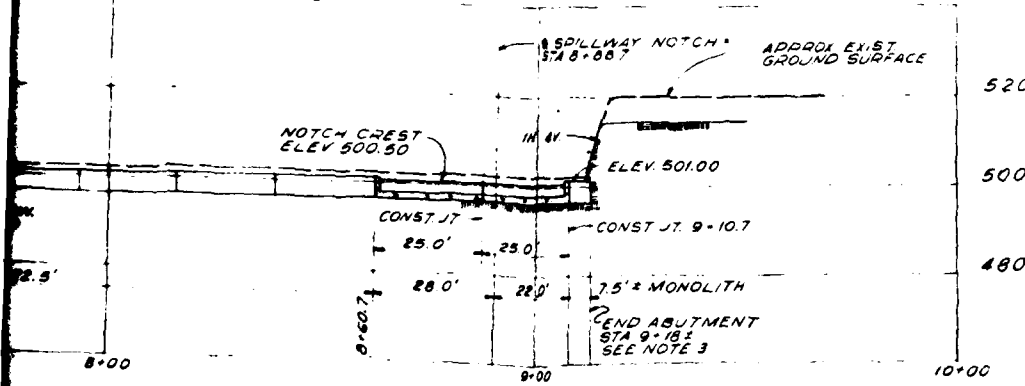
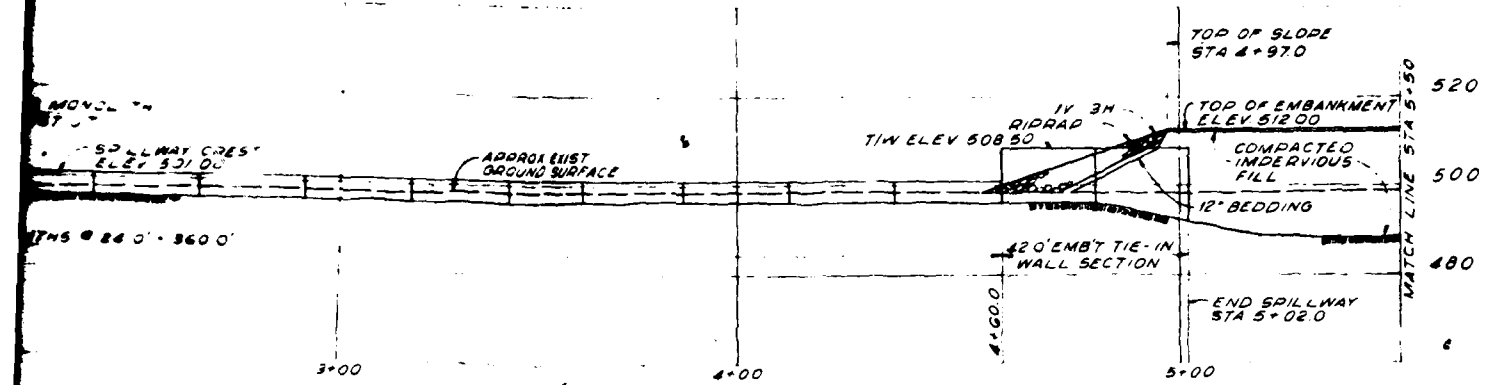


Scale: 1" = 20'

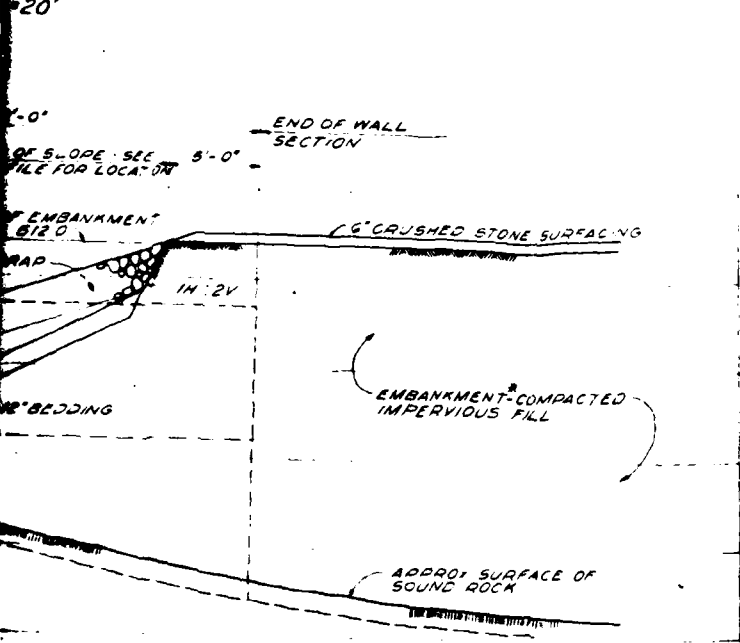


ELEVATION TYPICAL SPILLWAY END WALL AT EM

Scale: 1" = 5'



W SPILLWAY



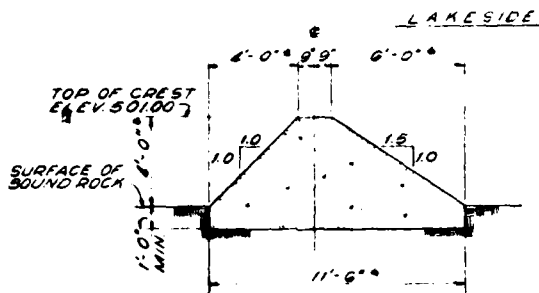
D WALL AT EMBANKMENT

- NOTES:
1. CONSTRUCT END WALL TIE-IN AT MAIN DAM SIMILAR TO THAT SHOWN FOR END WALL TIE-IN AT EMBANKMENT. PROVIDE CONSTRUCTION JOINT AT MID-POINT OF WALL LONGITUDINAL REINF. TO EXTEND THRU JOINT.
 2. END WALL TIE-IN SECTION AT EMBANKMENT TO FOLLOW E ALIGNMENT OR MAY BE CONSTRUCTED IN CHORDS NOT EXCEEDING 1'-0" IN LENGTH.
 3. OVERFLOW SPILLWAY END ABUTMENT TO KEY 1'-0" MIN INTO SOUND ROCK.

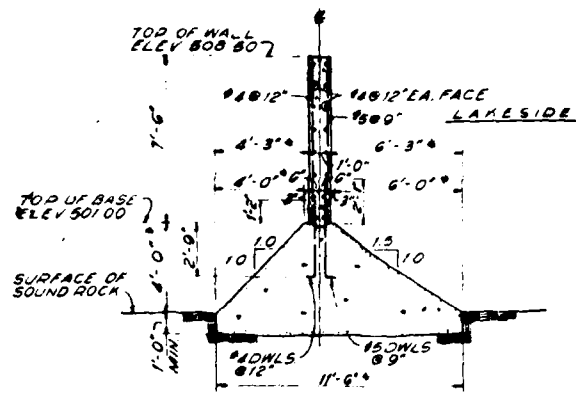
* ITEM NOT CONSTRUCTED



REV.	DATE	DESCRIPTION	BY
LAKE SAINT LOUIS INVESTMENT CORPORATION			
LAKE SAINT LOUIS MAIN DAM			
PROFILE OVERFLOW SPILLWAY ELEVATION TYP. SPILLWAY END WALL			
SCALE AS SHOWN		DATE JULY 17, 1972	
DESIGNED BY: A.B.B.		DRAWING	
DRAWN BY: D.C.E.		SHEET NUMBER	
CHECKED BY: D.C.E.		TOTAL SHEETS	
WS NO. 1248		2 4	
HORNER & SHIFRIN, INC. CONSULTING ENGINEERS ST. LOUIS, MISSOURI			



TYPICAL OVERFLOW SECTION



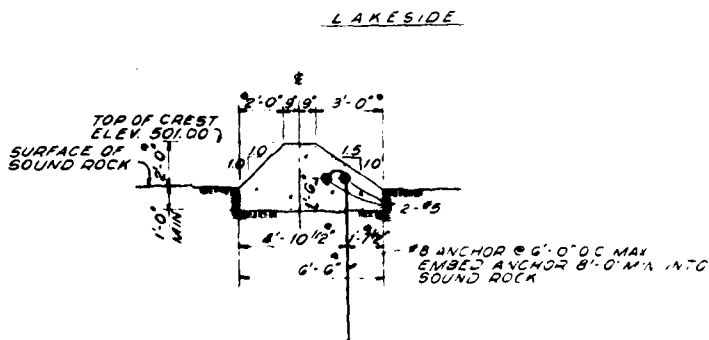
TYPICAL END TIE-IN SECTION

DETAILS OF MINIMUM GRAVITY SPILLWAY SECTIONS

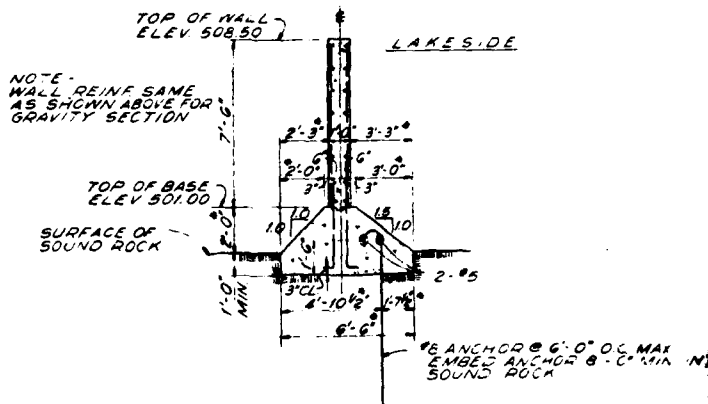
Scale: 1/4" = 1'-0"

SPECIAL NOTE

DIMENSIONS MARKED WITH ASTERISK(*) ARE VARIABLE AND DEPEND ON ELEVATIONS OF SOUND ROCK. HOWEVER THESE DIMENSIONS ARE MINIMUM FOR BOTH THE GRAVITY AND NON-GRAVITY SECTIONS SHOWN



TYPICAL OVERFLOW SECTION

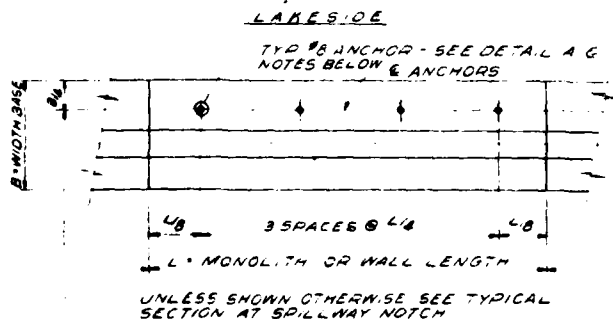


TYPICAL END TIE-IN SECTION

DETAILS OF MINIMUM NON-GRAVITY SPILLWAY SECTIONS

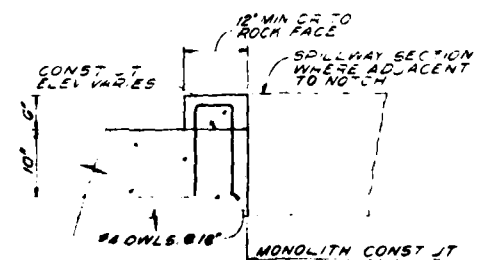
Scale: 1/4" = 1'-0"

NOTES:
1. #5 BARS TO BE CONTINUOUS THRU CONSTRUCTION JOINTS WITH 15" LAP SPLICES, STAGGERED, AT ANCHOR LOCATIONS



TYPICAL ANCHOR LOCATION PLAN

NOTES:
1. GROUT #8 ANCHOR IN 3" HOLE WITH 1" GROUT. USE #4 1/2" DIA. THICK PASTE CONSISTENCY.
2. HOLES TO BE DRILLED WITH A ROLLER BIT AND FLUSHED CLEAN PRIOR TO GROUTING

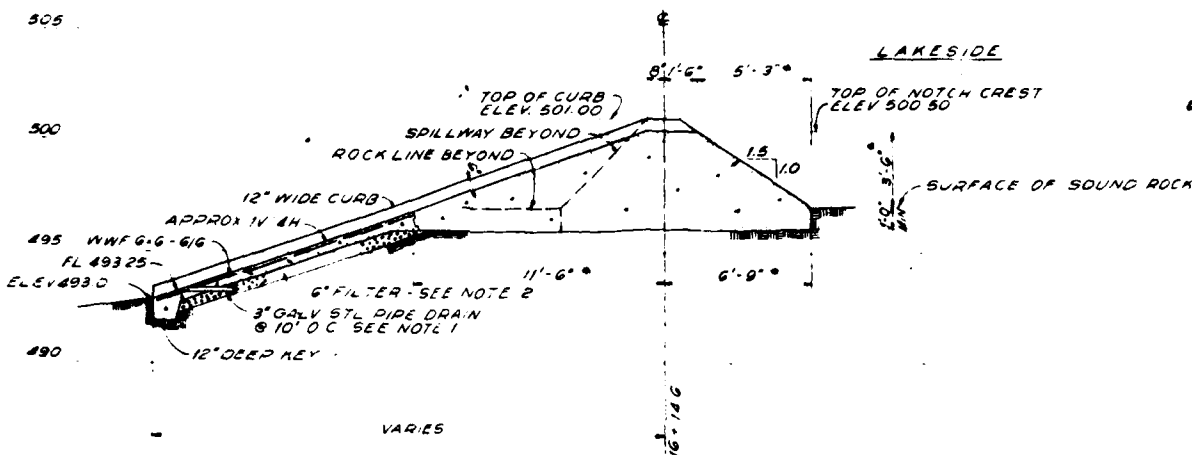


TYPICAL DETAIL NOTCH CURB

Scale: 1/4" = 1'-0"

505

PAGE
LAKESIDE



SECTION

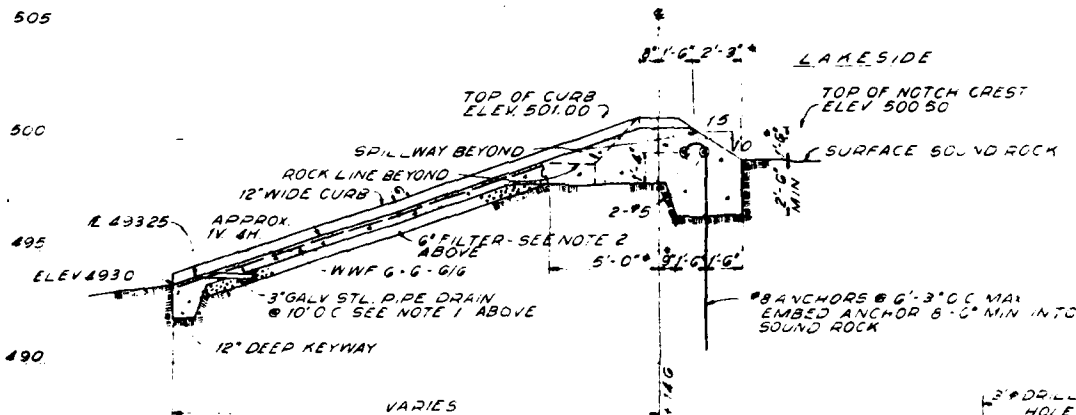
SPILLWAY SECTIONS

TYPICAL SECTION AT NOTCH

- NOTES
1. COVER END OF DRAIN PIPE WITH #4 HARDWARE CLOTH AND SECURE SLOPE PIPE TO DRAIN
2. FILTER MATERIAL TO CONSIST OF 3/4" UNIFORM SIZE CRUSHED ROCK

505

LAKESIDE



ANCHOR 6'-0" O.C. MAX. EMBED ANCHOR 6'-0" MIN. INTO SOUND ROCK

SECTION

TYPICAL SPILLWAY SECTIONS*

TYPICAL SECTION AT NOTCH

2" DRILLED HOLE



3'-6" x 6" x 120" SECURE ABOUT 18" FROM HOLE PER ANCHOR SETS ONE SET TOP & ONE SET BOT. OF CM OF HOLE

GROUT 18 REIN BAR ANCHOR

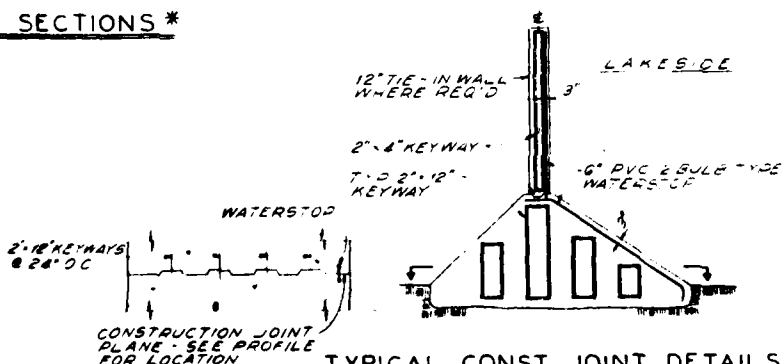
PLAN-ANCHOR HOLE & BAR SETTING DETAIL A

Scale: Half Size

SPILLWAY SECTION
ADJACENT
NOTCH

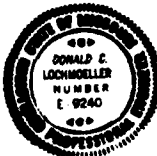
IN CONST. JT

12" CURB



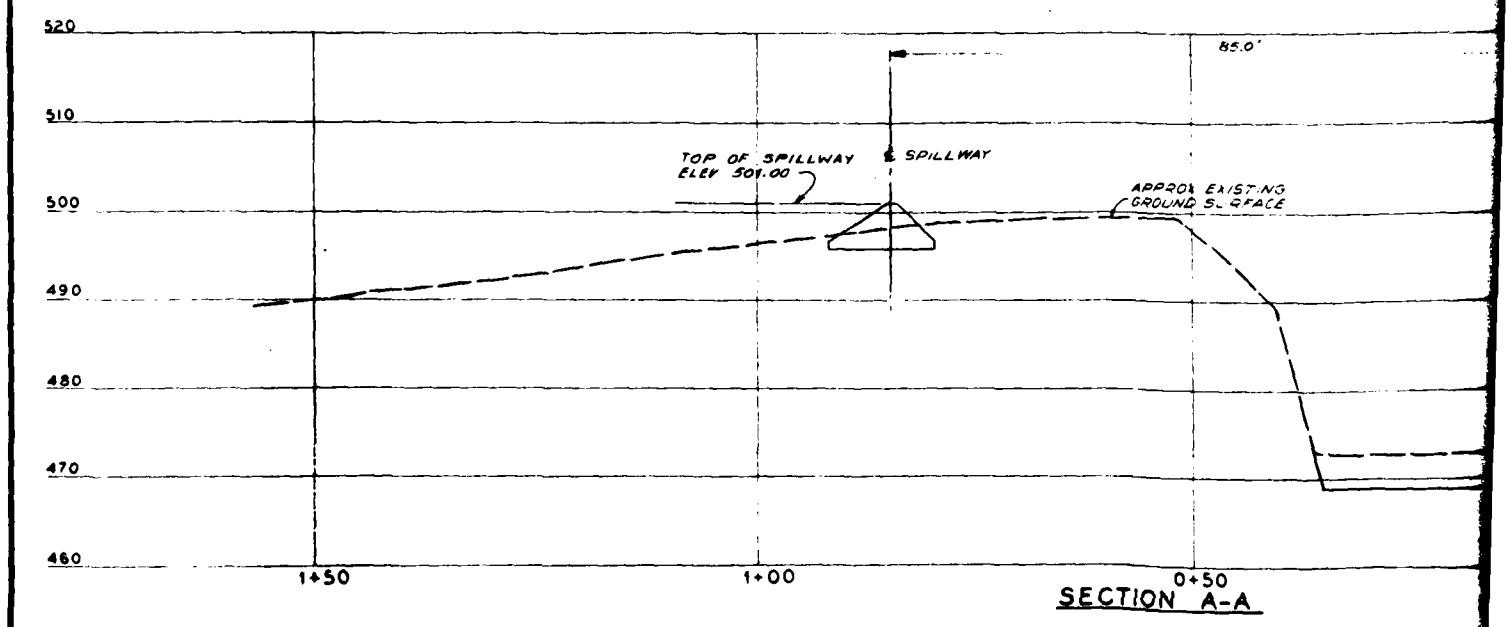
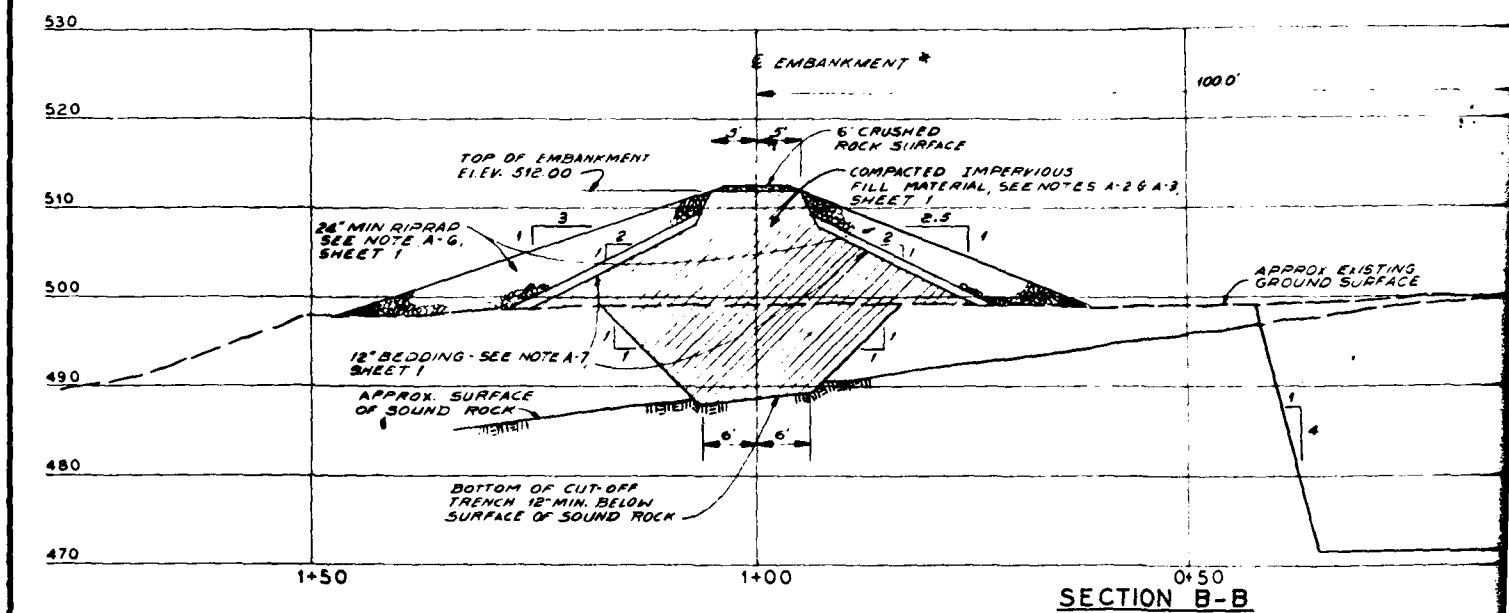
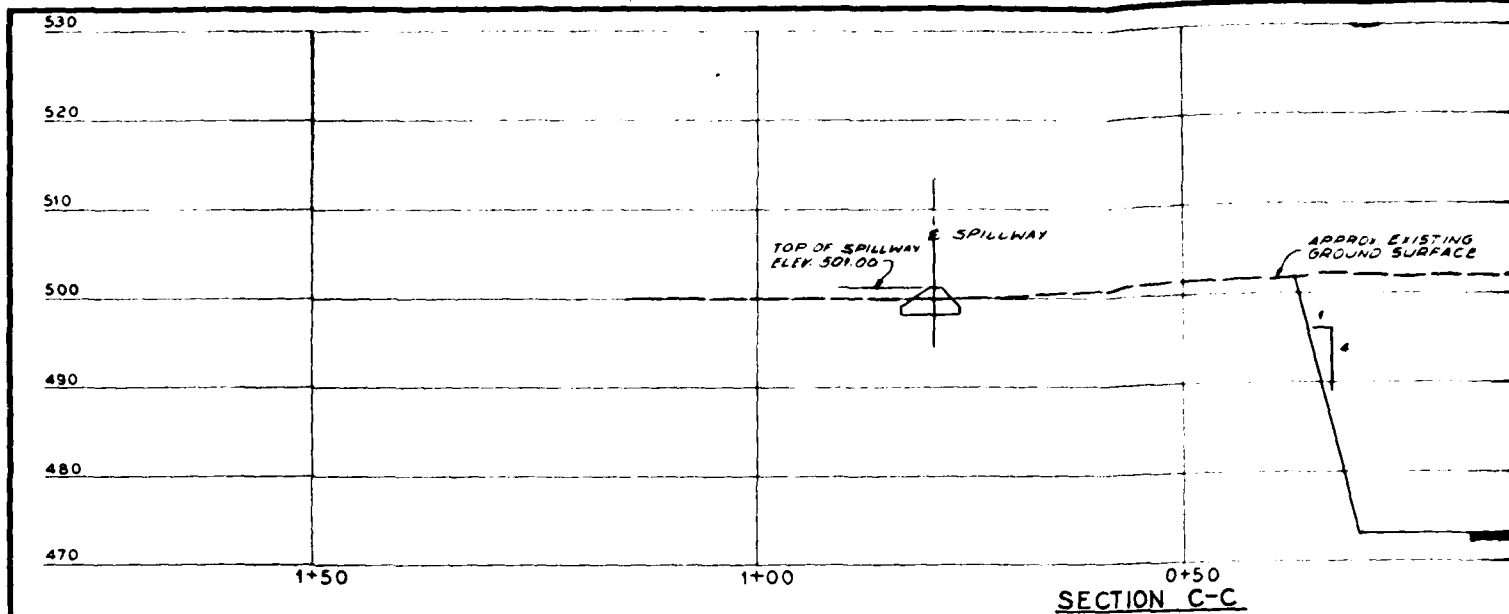
TYPICAL CONST. JOINT DETAILS

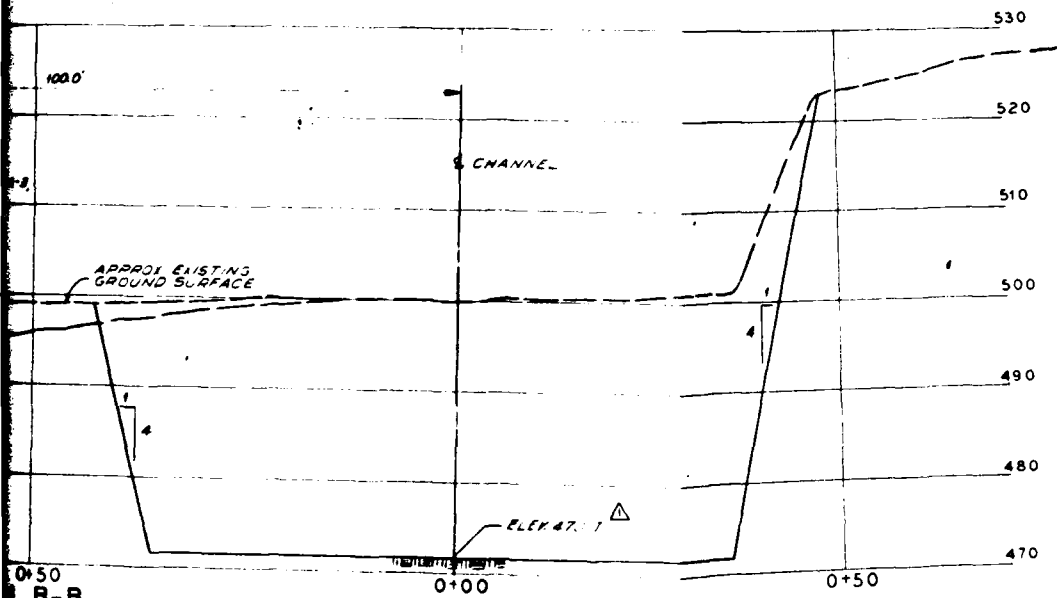
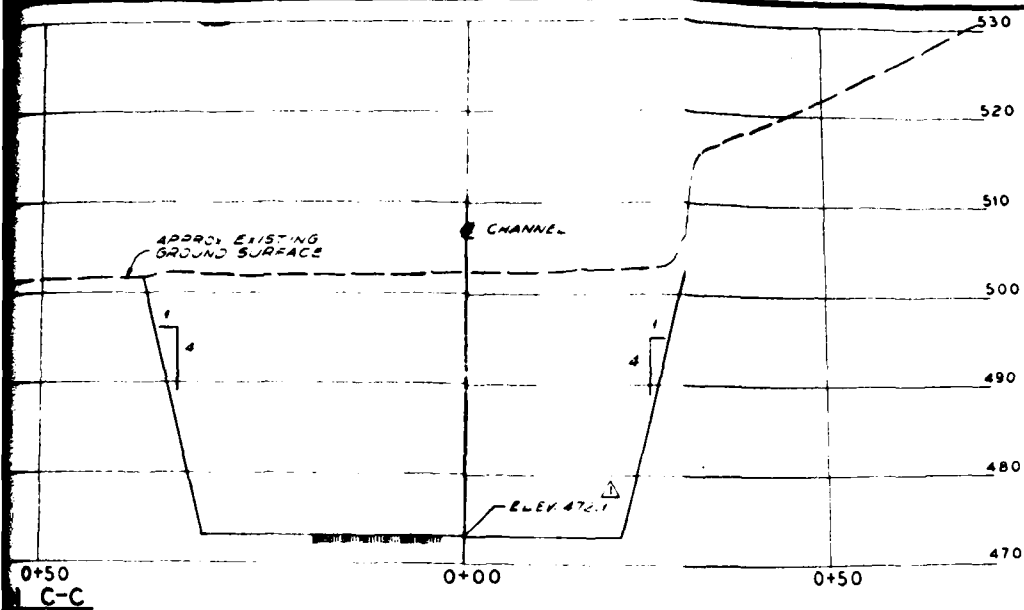
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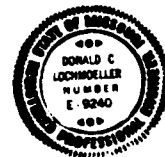
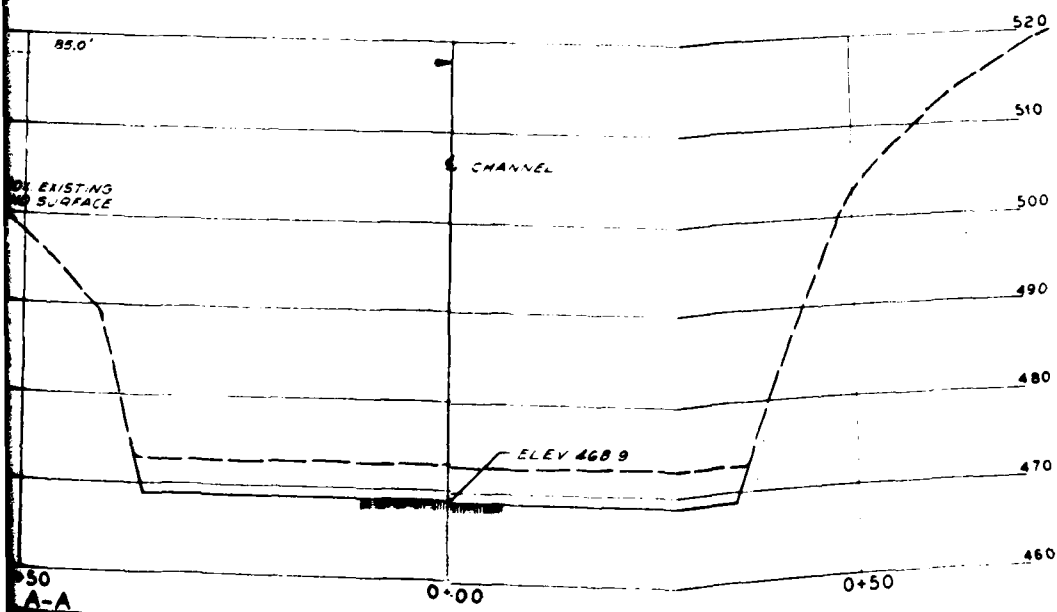
REV.	DATE	DESCRIPTION
1		LAKE SAINT LOUIS INVESTMENT CORPORATION
2		LAKE SAINT LOUIS MAIN DAM
3		OVERFLOW SPILLWAY SECTIONS AND DETAILS

SCALE AS NOTED	DESIGNED BY: A.B.D.	HORNER & SHIFRIN, INC. CONSULTING ENGINEERS ST. LOUIS, MISSOURI	DATE JULY 1971
DRAWN BY: D.E.E.	CHECKED BY: J.D.		DRAWN BY: J.D.
HS NO 7248			SHEET NUMBER 3

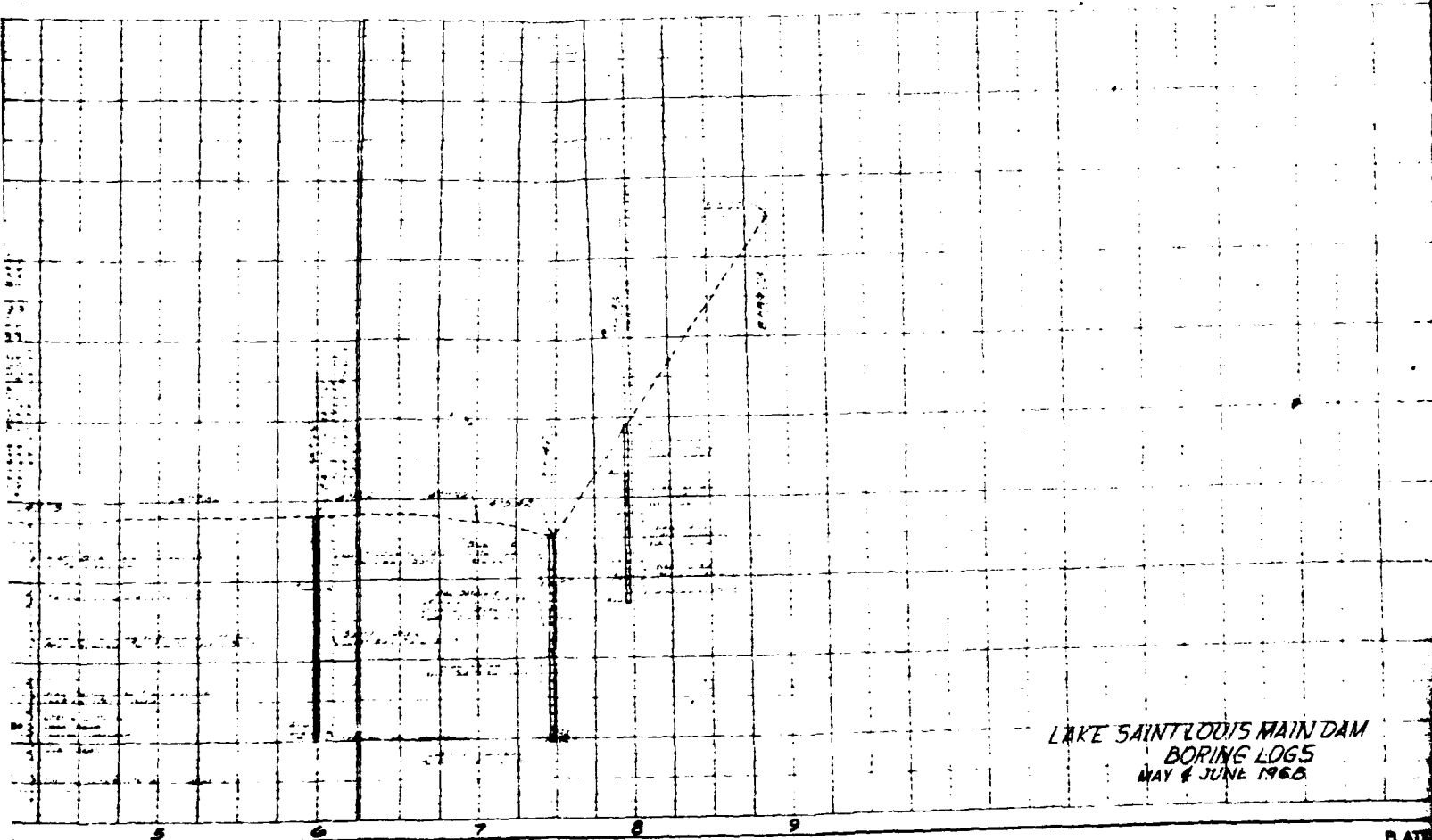




ITEM NOT CONSTRUCTED



A-B-B Channel Flowline Corrected REV DATE DESCRIPTION BY	
LAKE SAINT LOUIS INVESTMENT CORPORATION LAKE SAINT LOUIS MAIN DAM SPILLWAY CROSS SECTIONS	
SCALE 1"=10' DESIGNED BY ABB DRAWN BY HEW CHECKED BY DCL HS NO 1248	DATE JULY 17, 1978 HORNER & SHIFRIN, INC. CONSULTING ENGINEERS ST LOUIS, MISSOURI
DRAWING SHEET NUMBER 4	TOTAL SHEETS 4

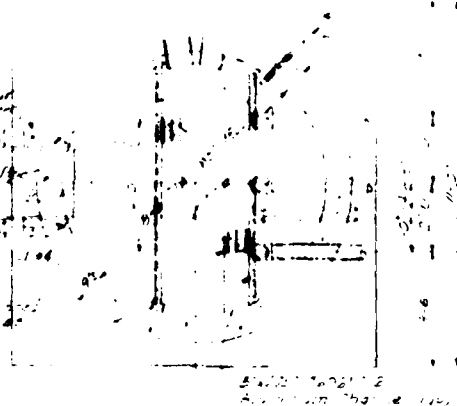


LAKE SAINT LOUIS MAIN DAM
BORING LOGS
MAY & JUNE 1963

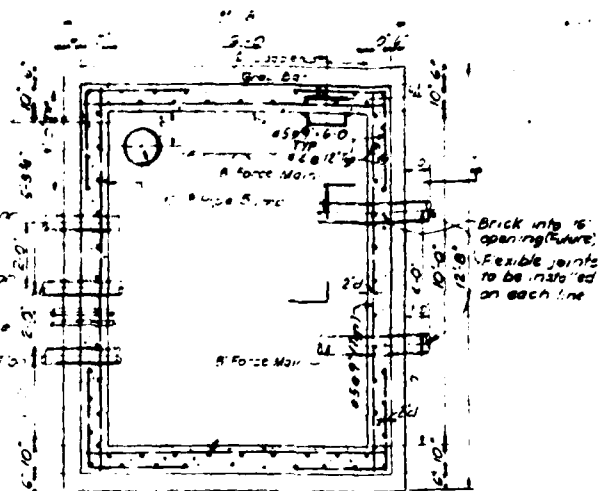
1-5'-0" x 2'-6'-0" Sections of 46" R.C. Column 17'-0" High

1-5'-0" x 2'-6'-0" Sections of 46" R.C. Column 17'-0" High

1-5'-0" x 2'-6'-0" Sections of 46" R.C. Column 17'-0" High

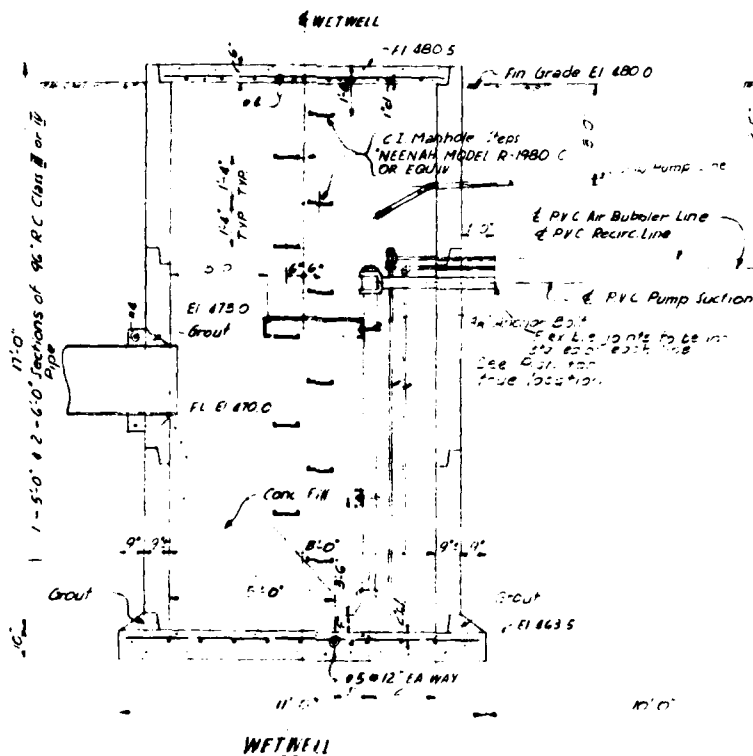


PLAN - WETWELL
Scale: 1/4" = 1'-0"

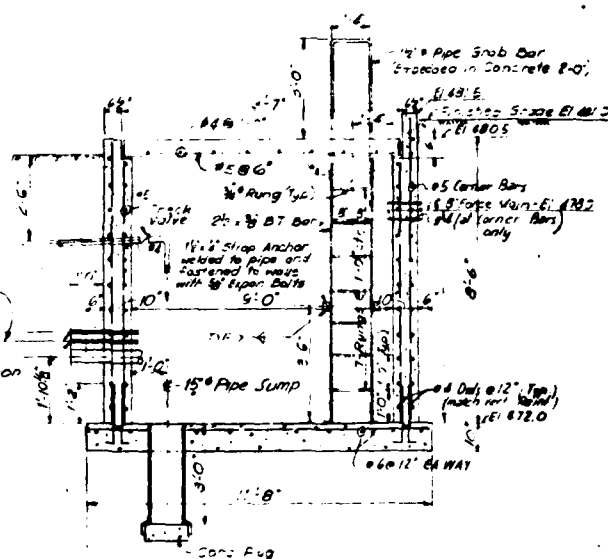


PLAN

Note Slope Base Slab to drain toward pump



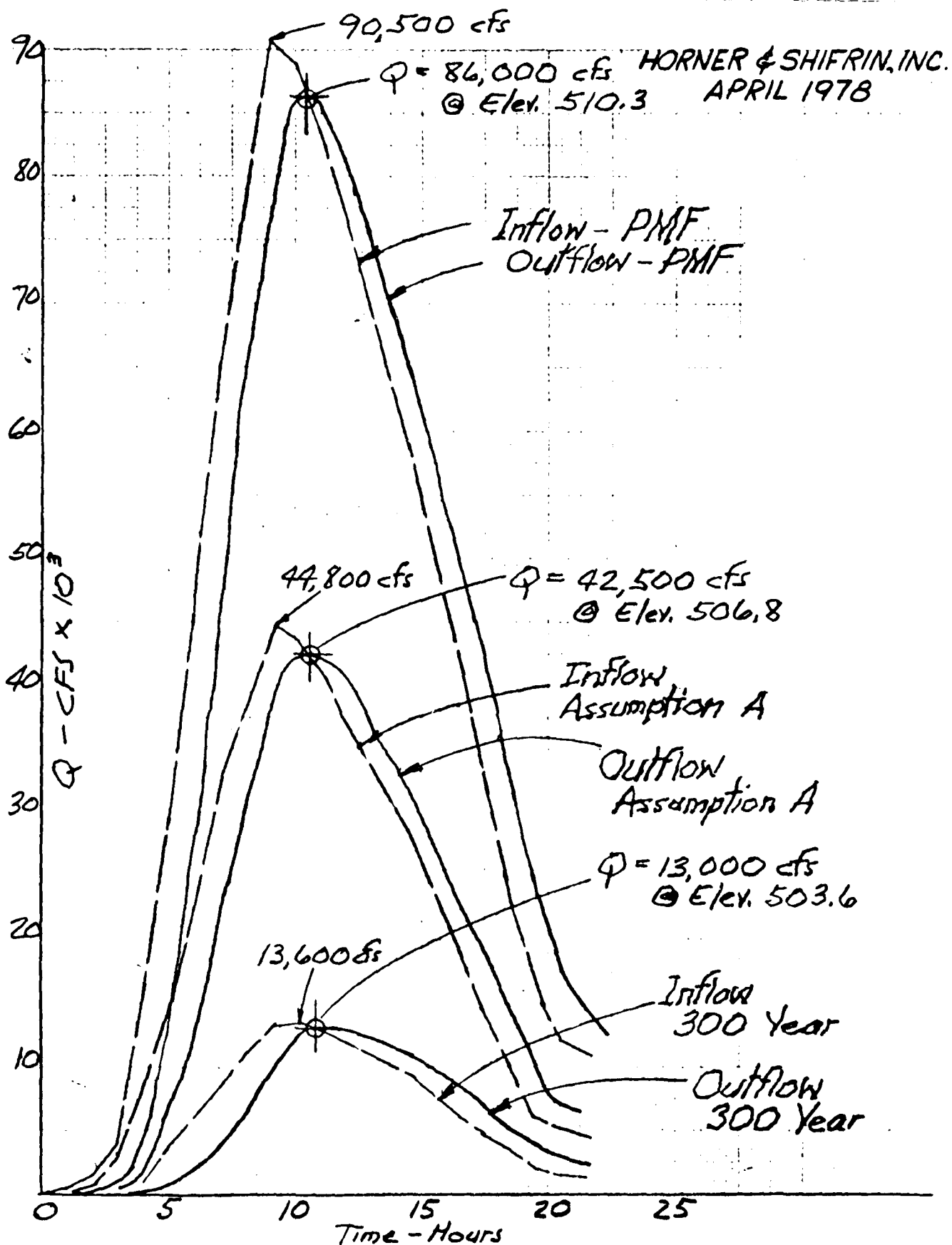
SECTION A-A
Scale: 1/4" = 1'-0"



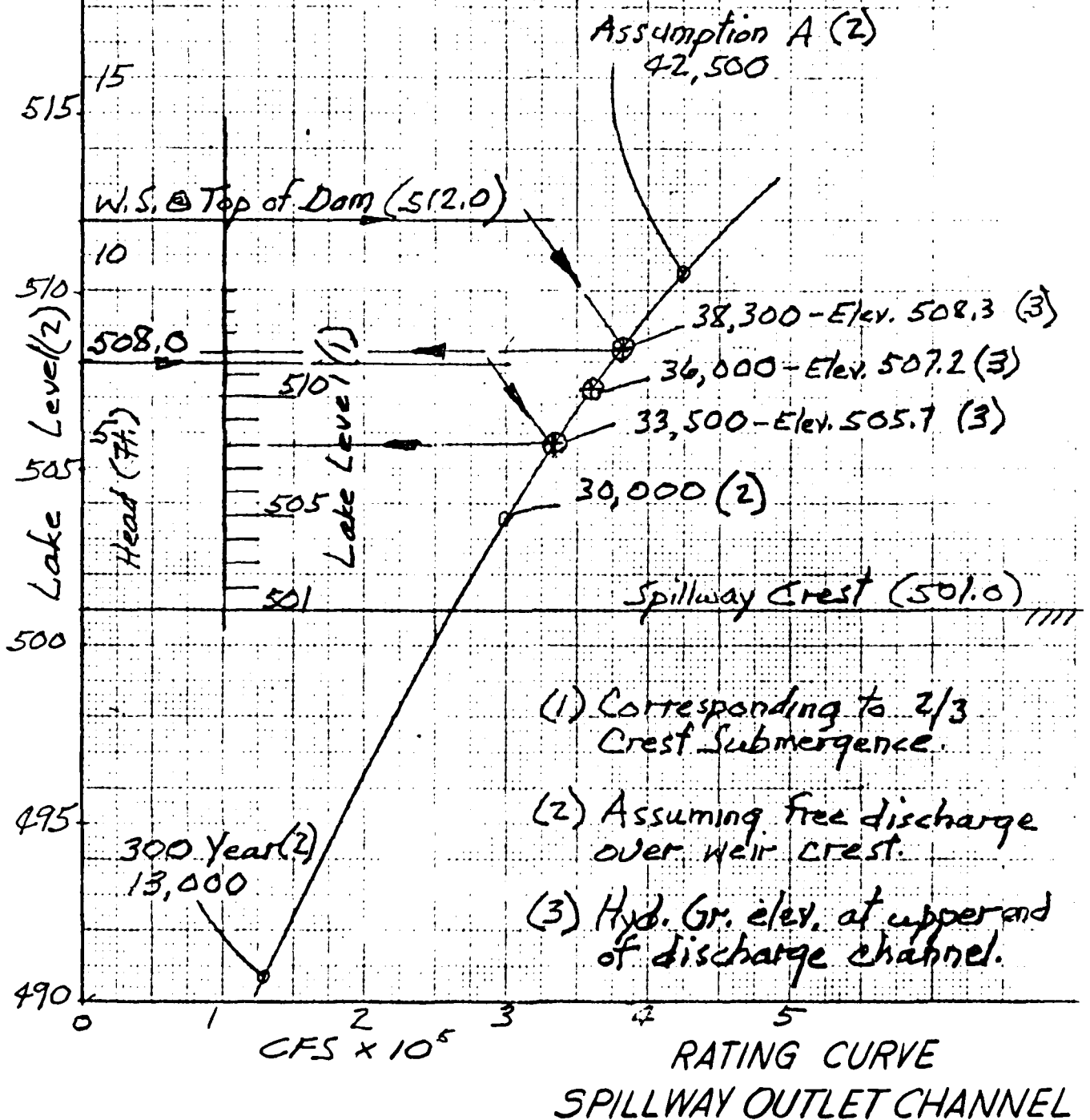
SECTION A-A
DETAILS OF LIFT STATION
Scale: 1/4" = 1'-0"

NOTES

1. Structural design and the ACP Code
2. Backfill against walls 3,000 p.s.i. 28-day
3. For location of p. see Dwg NS 4368-1
4. Design of walls without surcharge
5. Reinforcing bars grade for new be conforming to All
6. All exposed edges
7. Structural steel American Institute of Steel Construction and
8. Structural steel
9. All structural steel
10. 2" Fasteners for
11. Entire Ladder after 100' cells
12. All holes for
13. Fasteners for Ladder 100' No 3000



LAKE INFLOW-OUTFLOW HYDROGRAPHS



PROPOSED DAM SITE

SUBSURFACE INVESTIGATION
&
LABORATORY ANALYSIS

FOR

LAKE SAINT LOUIS ESTATES, INC.
R.P. 2, - O'FALLON, MISSOURI

BY

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

CHART 2-1

Room 2, Div. 54 North
FULTON, MISSOURI 65251
(314) 442-5719

Water Level 3.51 at 0 hrs.

Rip No. C/E-55

Casing used -

Surface Flow

Job No. 228

Date 5-20-68

Suber 1 of 9

BORING NO. 1 (7-47) FOR Lake St. Louis										WEATHER Partly Cloudy		TEMP. 65°	ABBREVIATIONS			
Sample No.	Depth		From Elevation	To Elevation	Distance	Method	Penetration Record				Site:	Proposed Dam Site R.R. 2, O'Fallon, Missouri	SAMPLE DESCRIPTION Color - Moisture - Material - Consistency	F.T. - Flash Tell W.O. - Wash Out S.T. - Shelby Tube S.S. - Split Spoon D.B. - Diamond Bit C. - Core R.B. - Rock Bit A. - Auger		
	From	To					Hydraulic Pressure Psi	Time Interval Sec	Number of Blows	Length Recovered Feet						
	0.0	4.0	475.5		4.0	A					Brown, wet, silty clay, very soft,					
	4.0	6.0			2.0	ST					" " " " "					
	6.0	9.0			3.0	A					Gray, saturated sandy silt, soft- with sticks of decaying wood and plant life,					
	9.0	11.0			2.0	ST					Gray, saturated sandy silt, soft- with sticks of decaying wood & plant life,					
	11.0	25.0			14.0	A					Gray sandy silt with scattered gravel.					
	25.0	25.5		450.0	0.5	A					Scattered cobbles, bottom on limestone.					

CHART 2-2

Revised, Hwy. 54 North
FULTON, MISSOURI 65251
(314) 411-25719

Water Level 9.4' at 2 hrs.

Rif No. 004E-58

Surface Elev. _____ SS Size _____ Wt of Hammer _____

Job No. 228

85-02-5 - 2190

Steel 2 of 9

Wilf of Hammer

Size SS

1

1

Surface

FOR LA:3 St. Louis

[illegible]

CHART 2-3

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

Job No. 228

Date 5-21-68

Sheet 3 of 9

Water Level at Hrs.

Casing used 25.0'

Rig No. CME-55

Surface Elev. SS Size Wt of Hammer

BORING NO. 3 (4500') FOR Lake St. Louis										WEATHER	TEMP.	ABBREVIATIONS
Sample No.	Depth		From Elevation	To Elevation	Distance	Method	Penetration Record				Site:	Color - Moisture - Material - Consistency
	From	To					Hydraulic Pressure	Time Interval	Number of Blows	Length Recovered		
	0.0	4.0	477.3		4.0	A					Proposed Dam Site	P.T.-Flash Test W.O.-Wash Out S.T.-Shelby Tube S.S.-Spill Spoon D.B.-Diamond Bit C.-Core R.B.-Rock Bit A.-Auger
	4.0	6.0			2.0	ST				2.0	" " " " " "	Lt. brown, lt. gray, moist silty clay, soft
	6.0	9.0			3.0	A					" " " " " "	" " " " " "
	9.0	10.0			1.0	ST				0.6	Sandy silty clay, wet, soft.	
	10.0	14.0			4.0	A					Gray silty clay with sand stringers, and decayed plant life, wet, soft.	
	14.0	16.0			2.0	ST				2.0	" " " " " "	" " " " " "
	16.0	19.0			3.0	A					" " " " " "	" " " " " "
	19.0	20.0			1.0	ST				0.6	" " " " " "	" " " " " "
	20.0	23.5			3.5	A					Gray sandy clay and limestone cobbles, wet, hard.	
	23.5	25.0		452.0	1.5	RB					Cherty limestone	

CHART 2-4

Job No. 228

Date

Sheet 4 of 9

Water Level at ft.

Casing used

SS Size Wt of Hammer

Rig No.

Surface Elev.

BORING NO. 3 CONT.		FOR		Penetration Record				Site:		WEATHER	TEMP.	ABBREVIATIONS
Sample No.	Depth		From Elevation	To Elevation	Distance Feet	Method	Hydraulic Pressure Psi	Time Interval Sec	Number of Blows	Length Recovered Feet	Color - Moisture - Material - Consistency	F.T. - Fish Tail W.O. - Wash Out S.T. - Shelby Tube S.S. - Split Spoon D.B. - Diamond Bit C. - Core R.D. - Rock Bit A. - Auger
	From	To										
	25.0	25.5			0.5	RB					Open seam.	
	25.5	26.0			0.6	RB					Cherty limestone.	
	26.0	28.5			2.5	RB					Open seam.	
	28.5	35.0		442.0	6.5	RB					Cherty limestone with seams.	
											Pressure test at 10.0' - 40 gal. 3 min.	
											Pressure test at 30.0' - 45 gal. 3 min.	
											(set 25 ft. casing)	

CHART 2-

Rig No. CME-55 Job No. 228
 Surface Elev. _____ Date 5-21-68
 Water Level _____ at _____ Hrs.
 Casing used 25'
 SS Size _____ Wt of Hammer _____ Sheet 5 of 9

BORING NO. 4 (3400) FOR Lake St. Louis										WEATHER clear		TEMP. 70°	ABBREVIATIONS		
Sample No.	Depth		From Elevation	To Elevation	Distance	Method	Penetration Record				Site:	Proposed Dam Site R.R. 2, O'Fallon, Missouri SAMPLE DESCRIPTION Color - Moisture - Material - Consistency	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		
	From	To					Hydraulic Pressure Psi	Time Interval Sec	Number of Blows	Length Recovered Feet					
	0.0	4.0	479.38		4.0	A									Lt. brown-lt. gray mottled silty clay, moist soft.
	4.0	6.0			2.0	ST					" "			" "	" "
	6.0	9.0			3.0	A					" "	" "	" "		
	9.0	11.0			1.0	ST					" "	" "	" "		
	11.0	13.0			1.0	A					" "	" "	" "		
	13.0	14.0			1.0	A					Gray, sandy silt, decayed plant, wet, soft.				
	14.0	15.0			2.0	ST					" "	" "	" "		
	16.0	25.0		454.38	9.0	A					Gray, sandy silt, cobbles, wet, soft.				
	25.0	30.0			5.0	RB					Lt. brown, weathered limestone with chert.				
											Bottom on cherty limestone.				
											Pressure test 10.0' - 45 gal. 2 min.				
											Pressure test 28.0' - 30 gal. 2 min.				

MISSOURI SUPPLY
FULTON, MISSOURI 65251
(314) 2-5719

MISSOURI SUPPLY

Job No. 228

Water Level 11.5 at 12 hrs.

Rig No. CKE-55

Casing used

Date 5-28-68

Surface Elev.

SS Size Wt of Hammer

Sheet 6 of 9

BORING NO. 5 (2-25) FOR Lake St. Louis				Penetration Record			Distance Feet	To Elevation	From Elevation	Depth		Weather	TEMP.	ABBREVIATIONS
Sample No.	From	To		Hydraulic Pressure Psi	Time Interval Sec	Number of Blows	Length Recovered Feet							
	0.0	4.0	479.61					4.0	A					
	4.0	6.0					2.0	2.0	ST					
	6.0	9.0						3.0	A					
	9.0	11.0					2.0	2.0	ST					
	11.0	14.0						3.0	A					
	14.0	16.0					1.0	2.0	ST					
	16.0	26.0						10.0	A					
	26.0	28.0						2.0	RB					
	28.0	34.0						6.0	RB					
CHART 2-														

Site:
Proposed Dam Site
R.R. 2,
O'Fallon, Missouri
SAMPLE DESCRIPTION
Color - Moisture - Material - Consistency

Lt. Brown, lt. gray mottled, silty loam,
wet, soft.
"
"
"
"
Lt. brown, sand and silt, wet, soft.
"
"
Lt. brown, sand and gravel, weathered
limestone, wet.
"
"
Lt. brown, weathered limestone with seams
to 28.0 ft. and limestone and chert to 34.0
"
Pressure test 12.0' - 45 gal. 3 min.

ALL INFORMATION CONTAINED HEREIN IS UNCLASSIFIED

Water Level $\frac{44}{}$ at $\frac{0}{}$ Hrs.

Ref. No. C15-55

Surface Elev. _____ Wt of Hammer _____
 SS Size _____ Sheet 1 of 9

[illegible]

CHART 2-8

FULTON, MISSOURI 65251
(314) MI 2-5719

Water Level _____ at _____ Mrs.

Job No. 228

Rig No. C1:E-55

Casing used 4.0'

Date 6-5-68

Surface Eval.

SS size _____ Wt of Hg. per c. _____

Sheet 8 of 9

[illegible]

CHART 2-9

Route 2, Hwy. 54 North
FULTON, MISSOURI 65251
(314) 412-5719

Water level _____ at _____ hrs.

Rig No. CHE-55

Casing used 61

Surface Elev.

SS Size _____ Wt of Hammer _____

Job No. 228

Date 6-11-68

Sheet 9 of 9

[illegible]

CHART 2-10

Water Level _____ at _____ Hrs.

Casing used.

Fig No. C/E-55

Surface Finish _____ SS Size _____ Wt of Hammer _____ Sheet 1 of 2

[illegible]

CHART 2-11

Route 2, Hwy. 55 North
FULTON, MISSOURI 65251
(314) 312-5719

Job No. 228
Date 6-12-68
Sheet 2 of 2

Water Level at _____ fms.
Casing used _____
SS Size _____ Wt of Hammer _____

Rig No. CHE-55

Surface Elev. _____

BORING NO. 1, 2, and 3 FOR LOCK & ST. LOUIS				WEATHER Clear			TEMP. 80° +			ABBREVIATIONS		
Sample No.	Depth		From Elevation	To Elevation	Distance Feet	Method	Penetration Record			Site: Borrow Area East Proposed Dam Site R.R. 2, - O'Fallon, Missouri	SAMPLE DESCRIPTION Color - Moisture - Material - Consistency	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
	From	To					Hydraulic Pressure Psi	Time Interval Sec	Number of Blows	Length Recovered Feet		
1	0.0	2.5			A						Lt. brown, silty clay, soft, moist.	
	2.5	5.0			A						Reddish brown, silty clay, stiff, moist.	
2	0.0	3.0			A						Lt. brown, silty clay, soft, moist.	
	3.0	9.0			A						Reddish brown, silty clay, boulders, stiff, moist.	
	9.0				A						Bottom on Limestone.	
3	0.0	3.0			A						Lt. brown, silty clay, soft, moist.	
	3.0	7.5			A						Reddish-brown, silty clay, boulders, stiff, moist.	
	7.5				A						Bottom on Limestone.	

BROWNING TESTING LABORATORIES, INC.
Route 2, Hwy. 54 North
Pulaski, Missouri 65251
(314) 642-5719

DATA SUMMARY SHEET

JOB NO. 228

LABORATORY TESTS

DATE 6-18-68

Borrow Area West
Lake St. Louis

ATTERBERG LIMITS:

HOLE NO.

DEPTH FT.

6 - 28

0 - 6

LIQUID LIMIT

50%

28%

PLASTIC LIMIT

22%

20%

PLASTIC INDEX

28

8

SHRINKAGE LIMIT

8

18

NATURAL MOISTURE

37%

18%

AASHTO
SOIL CLASSIFICATION

A-7-6

A-6

FAA
SOIL CLASSIFICATION

E-8

E-7

UNIFIED
SOIL CLASSIFICATION

CH

CL

REMARKS:

CHART 2-13



Soil Sampling
Core Drilling
Site Explorations
Pressure Grouting
Geological Investigations

5121 NO. LINDBERGH BLVD. • BRIDGETON, MO. 63042 • 314-731-1111

23 July 1969

Horner & Shifrin, Inc.
Consulting Engineers
1221 Locust Street
St. Louis, Missouri 63103

Attention: Mr. Don Lochmoeller

RE: Test Drilling Report
and Pressure Test Data
For Lake St. Louis
Project, St. Charles
County, Missouri

Dear Don:

Per your instructions we have completed the test drilling along the center line of the proposed dam and spillway section. Results of this investigation are enclosed for your review. Testing procedure was performed under your instruction letter of July 3, 1969. It was quite apparent throughout the duration of the water pressure tests that the bedrock appears quite sound and continuous. In addition to your instructions we initiated the use of a water meter to verify that the formation was not taking water, during the constant pressure test. It should be noted that before the test section time that all pressures were held for a period of ten minutes before the initial readings were taken. In all cases the pressure readings held constant or increased slightly, within the accuracy of the pressure test gauge.

For your information our diamond setting for NXM series coring is 2 7/8" O.D.. The cores taken on this project will be held in our warehouse until notice is given to deliver to your preference.

Per your request we are at this time working-up a bid on a per cubic yard basis, with an estimated 35,000 cubic yards of limestone excavation. We are bidding on the basis of drilling and shooting with the removal of the material shot, by others.

Thank you for calling on Test Drilling Service Company for work. If you have any questions concerning the enclosed data, please contact us at your convenience. With best

Very truly yours,

TEST DRILLING SERVICE COMPANY

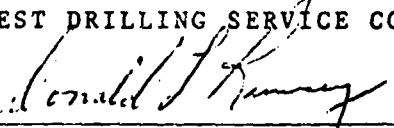

Donald L. Ramsey, Geologist

CHART 2-14

DRILLING SERVICE COMPANY

PHONE: 314-731-1111

5121 NO. LINDBERGH BLVD.

BRIDGETON, MO. 63042

ST. LOUIS COUNTY

FIELD BORING LOG

Project LAKE ST. LOUIS

Job No. 247

Boring 2 Location PER CLIENT INSTRUCTION Surface El. 510 : 514.6

Drilling Co. TEST DRILLING SERVICE CO. Boring Type NXM CORE

Date 7-14-69

Rig 63

Inspector TED LEAR

CORE RUN		Total Run	Core Recovery	Percent Recovery	CLASSIFICATION	PRESSURE TEST		
From	To					Pac. Loc. (ft.)	Pressure (Psi)	Inflow (Gpm)
					0.0 - 7.0'			
					Red Residual Stiff Clay W/Heavy Gravel & Boulders			
507.6	7.0	10.0	3.0	1.9	63.5			
					7.0 - 9.0'			
504.6	10.0	15.0	5.0	4.0	80.0			
					Medium Gray, Hard Dense, Medium Bedded Fine to Medium Crystalline Limestone w/chert Nodules			
499.6	15.0	20.0	5.0	5.0	100			
					9.0' - 11.0'			
494.6	20.0	25.0	5.0	5.0	100			
					Red Gravelly Clay			
489.6	25.0	30.0	5.0	5.0	100			
					11.0 - 18.8'			
479.6	35.0	40.0	5.0	5.0	100			
					Medium Gray Hard Dense Medium Bedded, Medium Crystalline Limestone with Numerous Chert Band & Nodules up to 8" in Dimension			
474.6	40.0	45.0	5.0	5.0	100			
					18.8 - 24.0'			
469.6	45.0	50.0	5.0	5.0	100			
					Lt. Gray, Medium to Massive Bedded, Coarsely Crystalline, Hard Fossiliferous Limestone w/Styolitic Partings			
					24.0 - 35.5'			
					Light Gray, Thin to Medium Bedded, Coarsely Crystalline, Hard Fossiliferous Limestone w/Numerous Chert Bands & Nodules up to 10" Dimension			
					35.5 - 39.0'			
					Lt. Gray, Medium to Massive Bedded, Coarsely Crystalline, Hard Fossiliferous Limestone w/Styolitic Partings			
					39.0 - 50.0'			
					Light Gray, Thin to Medium Bedded, Coarsely Crystalline, Hard Fossiliferous Limestone w/Numerous Chert Bands & Nodules up to 6" Dimension & Numerous Buff Weathered Portions			
					50.0' Bottom of Test Hole Per Client Instruction			

Drilling Fluid CLEAR WATER Casing 12.0' Press. Gage Loc. @ Gr. Surf.

Ground Water Depth 27.0' Date 7-17-69 Method Det. STEEL TAPE

Remarks SEE ATTACHED PRESSURE TEST SHEETS NO. 2 THRU 6

CHART 2 'S

DATE 3 OF 6
PAGE 7-17-69

DAM SITE LAKE ST. LOUIS OVER PERDUQUE CK 2 43
LOCATION OF HOLE PER CLIENT INSTRUCTION
CONTRACTOR TEST DRILLING SERVICE CO. DRILLING C. STEVENS 510

[illegible]

* UNABLE TO OBTAIN ANY GAGE PRESSURE AT START OF TEST

[illegible]

D. L. RAMSEY

CHART 2-17

4 6
7-17-69

DAM SITE LAKE ST. LOUIS RIVER PERQUEE CK. DIST. NO. 2 DIST. NO. 43
LOCATION OF HOLE PER CLIENT INSTRUCTION
CONTRACTOR TEST DRILLING SERVICE CO. DRILLER J. STEVENS TOP OF HOLE 510±

[illegible]

* UNABLE TO OBTAIN ANY GAGE PRESSURE AT START OF TEST

[illegible]

D. L. RAMSEY

CHART 2-18

Page 5 of 6
7-17-69

DAM SITE LAKE ST. LOUIS RIVER PEROUKE CK
LOCATION OF HOLE PER CLIENT INSTRUCTION
CONTRACTOR TEST DRILLING SERVICE CO. DRILLER C. STEVENS
REV. 100 OF 100 510±

[illegible]

* UNABLE TO OBTAIN ANY GAGE PRESSURE AT START OF TEST

[illegible]

CLASSIFIED BY D. L. RAMSEY

CHART 2-19

7-17-69

DAM SITE LAKE ST. LOUIS RIVER PERDUE CK. HOLE NO. 2 HOLE NO. 43
LOCATION OF HOLE PER CLIENT INSTRUCTION
CONTRACTOR TEST DRILLING SERVICE CO. DRILLER C. STEVENS TEST OF HOLE 510±

[illegible]

W UNABLE TO OBTAIN ANY GAGE PRESSURE AT START OF TEST

[illegible]

D. L. RAMSEY

CHART 2-20

DRILLING SERVICE COMPANY

PHONE: 314-731-1111

5121 NO. LINDBERGH BLVD.

BRIDGETON, MO. 63042

ST. LOUIS COUNTY

FIELD BORING LOG

Project LAKE ST. LOUIS

Job No. 247

Boring 3 Location PER CLIENT INSTRUCTIONS

Surface El. 476.7

Drilling Co. TEST DRILLING SERVICE CO.

Boring Type NXM CORE

Date 7-8-69

Rig 63

Inspector DON RAMSEY

CORE RUN		Total Run	Core Recovery	Percent Recovery	CLASSIFICATION	PRESSURE TEST			
From	To					Pac. Loc. (Ft.)	Bot. Hole (Ft.)	Pressure (Psi)	Int'l (Cp)
					0.0-13.0'				
					Fill Control Section				
					13.0-27.0'				
27.0	29.5	2.5	2.3	92	Alluvial Deposit - Stratified Sands, Gravels w/ Silt & Clayey Silt Matrix				
					27.0-34.6'				
29.5	37.0	7.5	7.5	100	Medium Gray, Medium To Massive Bedded Hard, Dense Medium to Coarsely Crystalline Fossiliferous Limestone w/ Scattered Few Chert Nodules Up to 2" Dimension				
					34.6-35.3'				
					Solid Chert Band				
					35.3-37.0'				
					Medium Gray, Fresh, Medium Crystalline, Hard, Dense Medium Bedded, Styolitic Limestone - Fossiliferous				
					37.0' Bottom of Boring Per Client Instruction				

Drilling Fluid CLEAR WATER

Casing 27.0' Press. Gage Loc. @ Gr. Surf.

Ground Water Depth 13.0'

Date 7-8-69

Method Det. STEEL TAPE

Remarks SEE WATER PRESSURE TEST SHEETS 2 THRU 3

CHART 2-21

SHEET 1 of 3

Sheet 2 of 3
Date 7-17-69

DAM SITE LAKE ST. LOUIS RIVER PERUQUE CK HOLE NO. 3 HOLE NO. 43
LOCATION OF HOLE PER CLIENT INSTRUCTION
CONTRACTOR TEST DRILLING SERVICE CO. DRILLER C. STEVENS REVIEW TOP OF HOLE

[illegible]

* UNABLE TO OBTAIN ANY GAGE PRESSURE AT START OF TEST

[illegible]

OBSERVED BY D. L. RAMSEY

CHART 2-22

3 on 3
7-17-69

DAM SITE LAKE ST. LOUIS RIVER PERUQUE CK

LOCATION OF HOLE PER CLIENT INSTRUCTION

CONTRACTOR TEST DRILLING SERVICE CO. PHILLIP C. STEVENS

[illegible]

ELEV TOP ROCK -
BOTTOM HOLE -

* UNABLE TO OBTAIN ANY GAGE PRESSURE AT START OF TEST

[illegible]

Dist. by the

D. L. RAMSEY

CHART 2-23

7-20-69

4 43

CONTRACTOR TEST DRILLING SERVICE CO. DRILLER C. STEVENSON

[illegible]

ELEV TOP ROCK -
BOTTOM HOLE -

X UNABLE TO OBTAIN ANY GAGE PRESSURE AT START OF TEST

[illegible]

DISCOVERED BY D. L. RAMSEY

CHART 2-25

ST. LOUIS COUNTY

FIELD BORING LOG

Project LAKE ST. LOUIS Job No. 247
Boring 4 Location PER CLIENT INSTRUCTION Surface El. 487.7
Drilling Co. TEST DRILLING SERVICE CO. Boring Type NXM CORE
Date 7-9-69 Rig 63 Inspector DON RAMSEY

[illegible]

Drilling Fluid CLEAR WATER Casing 37' Press. Gage Loc. Gr. Surface
Ground Water Depth 23.0' Date 7-9-69 Method Det. STEEL TAPE
Remarks SEE WATER PRESSURE TESTING SHEET 2 of 2

CHART 2-24

SHEET 1 of 2



5121 NO. LINDBERGH BLVD. • BRIDGETON, MO. 63042 • 314-731-1111

Soil Sampling
Core Drilling
Site Explorations
Pressure Grouting
Geological Investigations

July 1, 1970

Horner & Shifrin, Inc.
5200 Oakland
St. Louis, Missouri 63110

Attention: Mr. Donald C. Lochmoeller

RE: Core Drilling Report
For Spillway Design
Lake St. Louis
St. Charles County

Gentlemen:

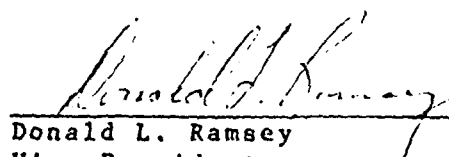
We are submitting three (3) copies of our core boring report pertaining to the subject project site.

A total of eleven (11) detailed core borings were drilled at your direction and are shown on the site plan, Figure 1. Our boring logs, Figure 2 thru 12 present the detailed description of the material encountered and the core recovery records. Special notes on loss of drill water circulation are reported for each boring drilled.

We hope the information enclosed is as complete as you desire. If you have any questions concerning this information, please contact us at your convenience and we will be more than happy to meet with you. Thank you for calling on Test Drilling Service Company for this work.

With Best Regards,

TEST DRILLING SERVICE COMPANY


Donald L. Ramsey
Vice-President

DLR/bh

Enc.-

TEST DRILLING REPORT
DRILLING SERVICE CO.

5121 NO. LINDBERGH BLVD. • 314-731-1111 • BRIDGETON, MO. 63042

Client Horner & Shifrin

Date of Report 7-1-70

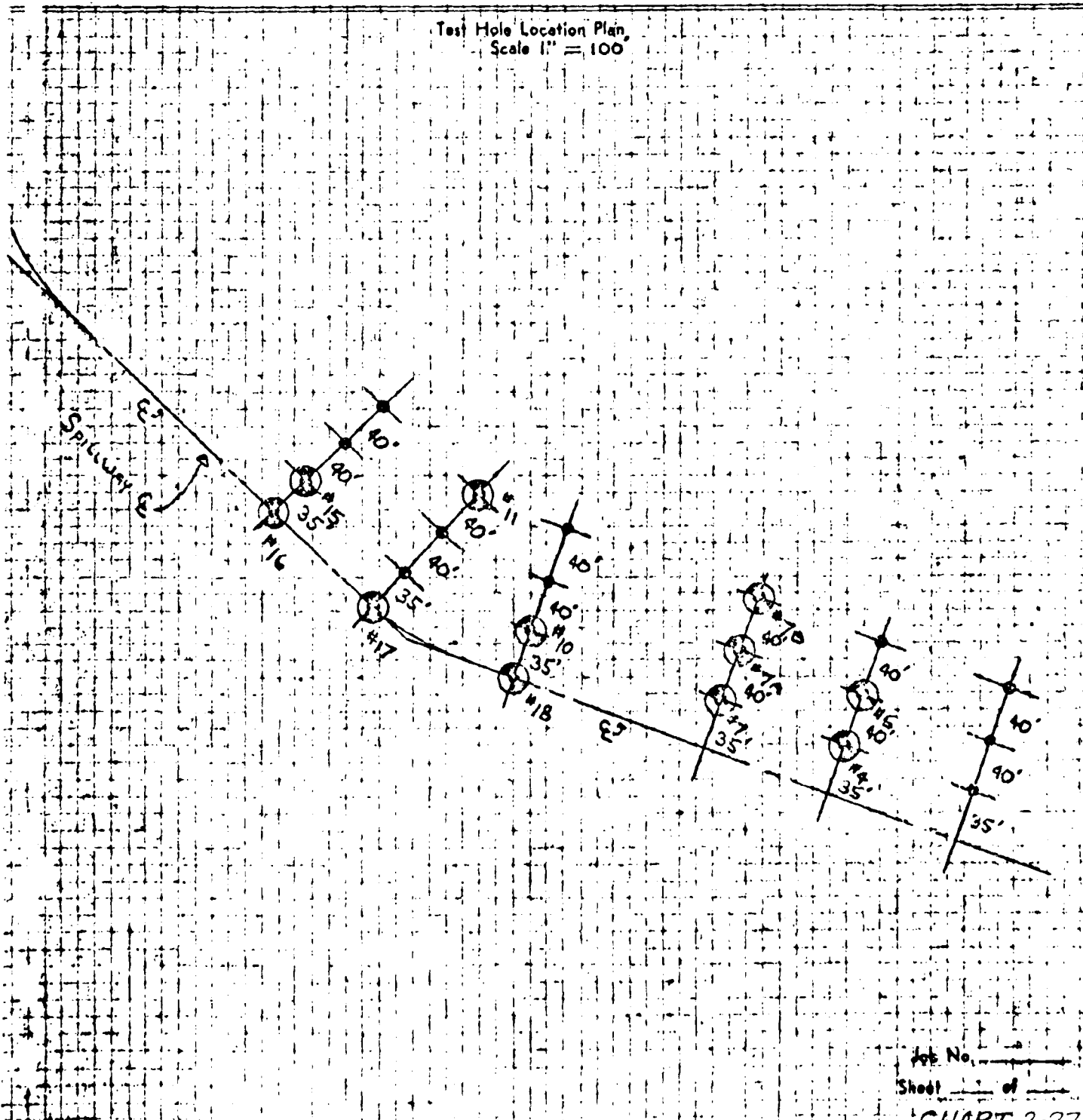
Address 5200 Oakland, St. Louis, Missouri 63110

We Have Completed Exploratory Test Drilling Work For You at

Lake St. Louis Spillway

As Outlined Below. Detailed Results of All Boring Is Attached Hereto.

Test Hole Location Plan
Scale 1" = 100'



Job No. _____

Sheet _____ of _____

CHART 2-27

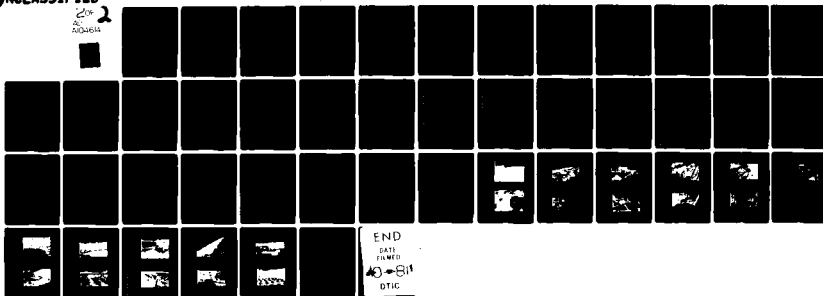
10-A104 614

HORNER AND SHIFRIN INC ST LOUIS MO F/8 13/13
NATIONAL DAM SAFETY PROGRAM. LAKE ST. LOUIS DAM (MO 10545) MISS-ETC(U)
MAY 78 DACW43-79-C-0047

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UNCLASSIFIED

2
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ST. LOUIS COUNTY

FIELD BORING LOG

Project LAKE ST. LOUIS - SPILLWAY CORING Job No. 70-62
Boring 1 Location 11+00, 35' LEFT Surface El. 499.73'
Drilling Co. TEST DRILLING SERVICE CO. Boring Type AY CORE
Date 6-5-70 Rig CME NO. 59 Inspector E.L.B.

CORE RUN (50-53)		Total Run	Core Recovery	Percent Recovery	CLASSIFICATION	PRESSURE TEST		
From	To					Pac. Loc. (Ft.)	Pot. Hole(Ft.)	Pressure (Psi)
3-4	5-5	28"	20"	71	0100"-3112" Broken rock			
5-5	13-4	92"	87"	93	3112"-10110" Gray limestone w/ trace chert & oolite. 1" decomposed zone			
13-4	23-4	120"	102"	91	10110"-23116" Gray limestone w/ chert inclusions up to 3" thick			
23-4	33-4	120"	112"	92	23116"-31112" Gray to gray buff, slightly saturated, silt, limestone w/ oolite, chert inclusions up to 2" thick			
33-4	29-2	77"	66"	78	31112"-22119" Gray limestone w/ chert inclusions up to 3" thick & oolite. thin, decomposed zone			
					32119" Bottom of boring			

Drilling Fluid CLEAR WATER Casing 3 1/4" Press. Gage Loc. _____
Ground Water Depth _____ Date _____ Method Det. _____
Remarks No drill water circulation loss throughout coring operations.

CHART 2-28

FIG. 2

ST. LOUIS COUNTY

FIELD BORING LOG

Project LAKE ST. LOUIS - SPILLWAY CORING Job No. 72-62
Boring 5 Location 11+00, 72' LEFT Surface El. 498.5'
Drilling Co. TEST DRILLING SERVICE CO. Boring Type AM CONC
Date 6-1-70 Rig CME NO. 59 Inspector D.L.R.

[illegible]

Drilling Fluid CLEAR WATER Casing NONE Press. Gage Loc. _____
Ground Water Depth _____ Date _____ Method Det. _____
Remarks No drill water circulation loss throughout drilling operations.

CHART 2-29

ETG 3

ST. LOUIS COUNTY

FIELD BORING LOG

Project LAKE ST. LOUIS - SPIRWAY CORING Job No. 70-69
Boring 7 Location 10+00, 35' LEFT Surface El 169.0'
Drilling Co. TEST DRILLING SERVICE CO. Boring Type AX CORZ
Date 5-27-70 Rig CME NO. 59 Inspector D.L.R.

[illegible]

Drilling Fluid CLEAR WATER Casing None Press. Gage Loc. _____
Ground Water Depth _____ Date _____ Method Det. _____
Remarks _____

CHART 2-30
FIG. 4

DRILLING SERVICE COMPANY

PHONE: 314-731-1111

5121 NO. LINDBERGH BLVD.

BRIDGETON, MO. 63042

ST. LOUIS COUNTY

FIELD BORING LOG

Project LAKE ST. LOUIS - SPILLWAY CORING Job No. 70-69
 Boring 7-A Location 10+00, 75' LEFT Surface El 198.7'
 Drilling Co. TESS DRILLING SERVICE CO. Boring Type IX & AX CORE
 Date 5-12-70 & 6-2-70 Rig CME NO. 59 Inspector D.L.R.

CORE RUN (Feet-In)		Total Run	Core Recovery	Percent Recovery	CLASSIFICATION	PRESSURE TEST		
From	To					Loc. (Feet)	Pressure (Psi)	Inflow (Gpm)
0-6	5-0	54"	100"	82	010"-016" Overburden - Broken rock & clay			
5-0	9-6	54"	54"	100	016"-111" Gray limestone w/ trace chert			
9-6	15-7	73"	73"	100	111"-1110" Decomposed limestone			
15-7	25-7	120"	70"	53	1110"-2110" Gray limestone w/ occas. thin chert inclusions			
25-7	32-10	37"	10"	57	2110"-2117" Gray limestone w/ chert inclusions up to 1/4" thick w/ soft decomposed strata below			
32-10	39-0	74"	54"	73	2117"-2117" Gray limestone w/ chert inclusions up to 1/4" thick w/ decomposed strata below			
					2117"-3910" Buff to buff gray, slightly weathered silty limestone w/ chert inclusions up to 1/4" thick w/ decomposed strata below			
					3910"-3912" Bottom of boring			

Drilling Fluid CLEAR WATER Casing NONE Press. Gage Loc. _____
 Ground Water Depth _____ Date _____ Method Det. _____
 Remarks Used "X" Core to 15'7" on 5-12-70, then changed to AX Core to 39'0" on 6-2-70.

No drill water circulation loss throughout coring operations. CHART 23

DRILLING SERVICE COMPANY

PHONE: 314-731-1111

5121 NO. LINDBERGH BLVD.

BRIDGETON, MO. 63042

ST. LOUIS COUNTY

FIELD BORING LOG

Project LAKE ST. LOUIS - SPILLWAY CORING Job No. 70-60
 Boring 7-B Location 10+00, 115' LEFT Surface El. 425.7'
 Drilling Co. TECH DRILLING SERVICE CO. Boring Type 4" CORE
 Date 5-28-70 Rig CME NO. 52 Inspector D.L.B.

CORE RUN (ft-in)		Total Run	Core Recovery	Percent Recovery	CLASSIFICATION	PRESSURE TEST		
From	To					Fac. Loc. (ft)	Pressure (Psi)	Inflow (Gpm)
1-0	11-7	121"	74"	53	0-10" Overburden - Shot rock			
11-7	21-9	120"	100"	82	11-6" - 11-9" Gray limestone w/ trace chert 7 soft decomposed seams below			
21-9	29-1	92"	1-2"	13	21-9" - 27-1"			
27-1	35-9	70"	60"	85	27-1" - 35-9"			
					11-6" - 21-9" Gray limestone w/ chert inclusions up to 6" thick & soft decomposed seams below			
					21-9" - 27-1"			
					27-1" - 35-9"			
					35-9" Bottom of boring			

Drilling Fluid CLEAR WATER Casing 1 1/2" Press. Gage Loc. _____
 Ground Water Depth _____ Date _____ Method Det. _____
 Remarks No drill water circulation loss throughout the coring operations.

CHART 2-32

FIG. 6

ST. LOUIS COUNTY

FIELD BORING LOG

Project LAKE ST. LOUIS - SPILLWAY CORING Job No. 70-67
Boring 10 Location R+75, 25' LEFT Surface El. 107.81
Drilling Co. TEST DRILLING SERVICE CO. Boring Type AY CORE
Date 5-26-70 Rig CHE NO. 52 Inspector D.L.B.

CORE RUN (11-12)		Total Run	Core Recovery	Percent Recovery	CLASSIFICATION	PRESSURE TEST		
From	To					Loc. Loc. (ft.)	Pressure (Psi)	Inflow (Gpm)
1-0	1-1	11"	11"	100	010"-110" Overburden - loose shot rock			
1-1	2-1	60"	58"	97	110"-111" Gray limestone w/ trace chert			
2-1	12-3	100"	100"	100	111"-251" Gray limestone w/ numerous chert inclusions up to 8" thick			
10-3	25-5	26"	26"	100	251"-321" buff gray to buff, slightly weathered, silty limestone w/ chert inclusions up to 2" thick			
25-5	31-2	58"	53"	100	321"-381" Gray limestone w/ chert inclusions 1, 2 to 3" thick			
31-2	38-0	58"	56"	97	381" Bottom of boring			
					NOTE: No water circulation loss throughout coring operations			

Drilling Fluid CLEAR WATER Casing NONE Press. Gage Loc. _____
Ground Water Depth _____ Date _____ Method Det. _____
Remarks _____

CHART 2-33

FIG. 7

ST. LOUIS COUNTY

FIELD BORING LOG

Project LAKE ST. LOUIS - SPIRITWAY CORING Job No. 70-69
Boring 11 Location 7+50, 115' LEFT Surface El. 518.5'
Drilling Co. TEST DRILLING SERVICE CO. Boring Type AY CORE
Date 6-22-70 Rig CME NO. 59 Inspector D.L.R.

CORE RUN (1-1)		Total Run	Core Recovery	Percent Recovery	CLASSIFICATION	PRESSURE TEST		
From	To					Prc. Loc. (Ft.)	Bot. Hole (Ft.)	Pressure (Psi)
					0'0"-34'3" Overburden			
54-3	144-3	120"	50"	1/2	34'3"-144'3" Gray to buff gray limestone w/ numerous decomposed horizons			
					144'3"-Bottom of boring per client instruction			

Drilling Fluid CLEAR WATER Casing 3 1/2" Press. Gage Loc. _____
Ground Water Depth _____ Date _____ Method Det. _____
Remarks _____

CHART 2-34

ITC

DRILLING SERVICE COMPANY

PHONE: 314-731-1111

5121 NO. LINDBERGH BLVD. BRIDGETON, MO. 63042

ST. LOUIS COUNTY

FIELD BORING LOG

Project LAKE ST. LOUIS - SPILLWAY CORING Job No. 70-69
 Boring 15 Location 6+50, 35' LEFT Surface El. 425.3'
 Drilling Co. TEST DRILLING SERVICE CO. Boring Type AX CORE
 Date 5-25-70 Rig CME NO. 59 Inspector D.L.R.

COPE RUN (Feet)		Total Run	Core Recovery	Percent Recovery	CLASSIFICATION	PRESSURE TEST		
From	To					Sec. Loc. (Feet)	Pressure (Psi)	Inflow (Gpm)
2-2	1-2	26"	20"	77	0-10" - 2-10" Overburden			
1-2	0-1	6"	52"	87	2-10" - 2-110" Gray limestone - Trace chert 1/2" thin, buff partings			
0-1	0-0	70"	70"	100	2-110" - 3-12" Soft, decomposed limestone - lost water circulation			
0-0	0-0	60"	35"	58	3-12" - 4-18" Gray limestone - Trace chert 1/2" thin, buff partings			
0-0	0-0	60"	60"	100	(NOTE - Set IR casing to 4'12")			
0-0	0-0	56"	56"	100	4-18" - 5-11" Soft, decomposed limestone - no water loss			
0-0	0-0	16"	16"	100	5-11" - 5-18" Gray limestone - Trace chert 1/2" thin, buff partings			
					5-18" - 6-12" Soft, decomposed limestone - no water loss			
					6-12" - 25-17" Gray limestone w/ chert inclusions up to 8" thick			
					25-17" - 27-10" Buff, weathered, silty limestone - lost 30" water return			
					27-10" - 31-12" Gray limestone w/ chert inclusions up to 10" thick - Vertical fracture throughout section			
					31-12" - 35-0" Buff, gray limestone w/ chert inclusions to 6" thick			
					35-0" Bottom of boring			

Drilling Fluid Clear water Casing 4-12" Press. Gage Loc. _____
 Ground Water Depth _____ Date _____ Method Det. _____
 Remarks: # Bearings on core barrel were damaged on this run - Formation
 cored solid w/ poor recovery due to grinding core
 No drill water circulation loss throughout coring operations. CHART 2-35

DRILLING SERVICE COMPANY

PHONE: 314-731-1111

5121 NO. LINDBERGH BLVD. BRIDGETON, MO. 63042

ST. LOUIS COUNTY

FIELD BORING LOG

Project LAKE ST. LOUIS - SPILLWAY CORING Job No. 70-69
 Boring 16 Location 6+50 ON CENTERLINE Surface El. 495.71
 Drilling Co. TEST DRILLING SERVICE CO. Boring Type AY CORZ
 Date 5-25-70 Rig CUE NO. 59 Inspector D.J.B.

CORE RUN (Feet)		Total Run	Core Recovery	Percent Recovery	CLASSIFICATION	PRESSURE TEST		
From	To					Pressure (Psi)	Inflow (Gpm)	
0-0	1-5	17"	56"	94	110"-117" Gray limestone w/ trace chert (light matrix)			
1-5	2-9	14"	60"	100	117"-2117" Gray limestone w/ chert inclusions up to 3" thick - light matrix			
2-9	31-7	22"	22"	100	2117"-3110" Buff gray to buff slightly weathered limestone w/ numerous small inclusions to 1/4" thick & occa. thin vertical fractures (10' water circulation loss)			
31-7	41-9	10"	57"	95	3110"-3519" Bottom of boring			
41-9	51-9	10"	60"	100				
51-9	61-9	10"	60"	100				
61-9	71-9	10"	60"	100				
71-9	81-9	10"	60"	100				
81-9	91-9	10"	60"	100				
91-9	101-9	10"	60"	100				
101-9	111-9	10"	60"	100				
111-9	121-9	10"	60"	100				
121-9	131-9	10"	60"	100				
131-9	141-9	10"	60"	100				
141-9	151-9	10"	60"	100				
151-9	161-9	10"	60"	100				
161-9	171-9	10"	60"	100				
171-9	181-9	10"	60"	100				
181-9	191-9	10"	60"	100				
191-9	201-9	10"	60"	100				
201-9	211-9	10"	60"	100				
211-9	221-9	10"	60"	100				
221-9	231-9	10"	60"	100				
231-9	241-9	10"	60"	100				
241-9	251-9	10"	60"	100				
251-9	261-9	10"	60"	100				
261-9	271-9	10"	60"	100				
271-9	281-9	10"	60"	100				
281-9	291-9	10"	60"	100				
291-9	301-9	10"	60"	100				
301-9	311-9	10"	60"	100				
311-9	321-9	10"	60"	100				
321-9	331-9	10"	60"	100				
331-9	341-9	10"	60"	100				
341-9	351-9	10"	60"	100				
351-9	361-9	10"	60"	100				
361-9	371-9	10"	60"	100				
371-9	381-9	10"	60"	100				
381-9	391-9	10"	60"	100				
391-9	401-9	10"	60"	100				
401-9	411-9	10"	60"	100				
411-9	421-9	10"	60"	100				
421-9	431-9	10"	60"	100				
431-9	441-9	10"	60"	100				
441-9	451-9	10"	60"	100				
451-9	461-9	10"	60"	100				
461-9	471-9	10"	60"	100				
471-9	481-9	10"	60"	100				
481-9	491-9	10"	60"	100				
491-9	501-9	10"	60"	100				
501-9	511-9	10"	60"	100				
511-9	521-9	10"	60"	100				
521-9	531-9	10"	60"	100				
531-9	541-9	10"	60"	100				
541-9	551-9	10"	60"	100				
551-9	561-9	10"	60"	100				
561-9	571-9	10"	60"	100				
571-9	581-9	10"	60"	100				
581-9	591-9	10"	60"	100				
591-9	601-9	10"	60"	100				
601-9	611-9	10"	60"	100				
611-9	621-9	10"	60"	100				
621-9	631-9	10"	60"	100				
631-9	641-9	10"	60"	100				
641-9	651-9	10"	60"	100				
651-9	661-9	10"	60"	100				
661-9	671-9	10"	60"	100				
671-9	681-9	10"	60"	100				
681-9	691-9	10"	60"	100				
691-9	701-9	10"	60"	100				
701-9	711-9	10"	60"	100				
711-9	721-9	10"	60"	100				
721-9	731-9	10"	60"	100				
731-9	741-9	10"	60"	100				
741-9	751-9	10"	60"	100				
751-9	761-9	10"	60"	100				
761-9	771-9	10"	60"	100				
771-9	781-9	10"	60"	100				
781-9	791-9	10"	60"	100				
791-9	801-9	10"	60"	100				
801-9	811-9	10"	60"	100				
811-9	821-9	10"	60"	100				
821-9	831-9	10"	60"	100				
831-9	841-9	10"	60"	100				
841-9	851-9	10"	60"	100				
851-9	861-9	10"	60"	100				
861-9	871-9	10"	60"	100				
871-9	881-9	10"	60"	100				
881-9	891-9	10"	60"	100				
891-9	901-9	10"	60"	100				
901-9	911-9	10"	60"	100				
911-9	921-9	10"	60"	100				
921-9	931-9	10"	60"	100				
931-9	941-9	10"	60"	100				
941-9	951-9	10"	60"	100				
951-9	961-9	10"	60"	100				
961-9	971-9	10"	60"	100				
971-9	981-9	10"	60"	100				
981-9	991-9	10"	60"	100				
991-9	1001-9	10"	60"	100				

Drilling Fluid CLEAR WATER Casing NONE Press. Gage Loc. _____
 Ground Water Depth _____ Date _____ Method Det. _____
 Remarks No drill water circulation loss throughout coring operations.

CHART 2-36

FIG. 10

ST. LOUIS COUNTY

FIELD BORING LOG

Project LAKE ST. LOUIS - SPILLWAY CORING Job No. 70-62
Boring 17 Location 7+50 ON CENTERLINE Surface El. 197.6'
Drilling Co. TEST DRILLING SERVICE CO. Boring Type AY CORE
Date 5-12-70 Rig CME NO. 59 Inspector D.I.R.

[illegible]

Drilling Fluid CLEAN WATER Casing 11012 Press. Gage Loc. _____
Ground Water Depth _____ Date _____ Method Dot. _____
Remarks _____

CHART 2-37

ETA 11

DRILLING SERVICE COMPANY

PHONE: 314-731-1111

5121 NO. LINDBERGH BLVD. BRIDGETON, MO. 63042

ST. LOUIS COUNTY

FIELD BORING LOG

Project LAKE ST. LOUIS - SPIRITWAY CORING Job No. 70-69
 Boring 12 Location B-75 ON CENTERLINE Surface El. 103.1'
 Drilling Co. TB32 DRILLING SERVICE CO. Boring Type AY CORE
 Date 6-2-70 Rig CME NO. 59 Inspector D.L.R.

CORE RUN (50' - 51')		Total Run	Core Recovery	Percent Recovery	CLASSIFICATION	PRESSURE TEST		
From	To					Per. Loc. (Ft.) Est. Hole (Ft.)	Pressure (Psi)	Inflow (Gpm)
1-7	11-0	22"	27"	93	11'7"-11'7" Broken shot rock			
11-0	11-0	34"	31"	91	11'7"-11'0" Gray limestone w/ occas. thin chert string			
11-0	19-9	105"	8"	8	11'0"-12'0" Buff, weathered, decomposed limestone w/ numerous chert inclusions			
19-9	29-9	120"	104"	87	12'0"-29'9" Gray to buff, gray limestone w/ chert inclusions up to 5" thick and decomposed seen betw. 28'0" to 29'10"			
29-9	38-2	101"	94"	93	29'9"-38'2" Bottom of boring per client instruction			

Drilling Fluid CLEAR WATER Casing 1.7" Press. Gage Loc. _____
 Ground Water Depth _____ Date _____ Method Det. _____
 Remarks No drill water circulation loss throughout coring operations.

CHART 2-38

FIG. 12

LOGGING NO. 101

LOGGING COMPANY
LOGGING COMPANY
LOGGING COMPANY

PHONE: (314) 201-1111
2000 CALLING SERVICE DR.
ST. LOUIS COUNTY
MARYLAND HEIGHTS, MO. 63043

JOB NO. 71-23
CONTRACT NO. 498.4

PROJECT: Lake St. Louis

SOUNDING LOCATION: Sullivan, Emerson

DATE	START	END	TIME	DATE	TIME	FROM	TO	RECOVERY
DEPTH	CLASSIFICATION	DATE	TIME	FROM	TO	RECOVERY	TOTAL	RECOVERY
0.0	0.5	Residual Red Clay & Chert Spinel		0.5'	5.5'	5.0'	5.0'	100
5.5	10.0'	Light Green, Hard, Dense Siliceous Material		5.5'	10.5'	5.0'	5.0'	100
		Chert Inclusions		10.5'	15.5'	5.0'	5.0'	100
		Between 15.5' & 20.5' W/5uff Weathered		15.5'	20.5'	5.0'	5.0'	100
		Portions		20.5'	24.5'	4.0'	4.0'	100
		Between 24.5' & 29.7' W/5uff Weathered		24.5'	29.7'	5.2'	5.2'	100
		Portions		29.7'	35.7'	6.0'	6.0'	100
40.0'		Bottom of Boring		35.7'	40.0'	4.3'	4.3'	100

REMARKS: No water was seen during drilling

LOG OF BORING NO. 100

PROJECT: ST. LOUIS COUNTY
 LOCATION: 2500 DRILLING SERVICE DR.
 ST. LOUIS COUNTY

DATE: 10-11-11
 PHONE: (314) 221-1111

DEPTH: 100
 SURFACE: 501.6

BORING LOCATION: 2500 DRILLING SERVICE DR.

DATE	START	END	TIME	DATE	TIME	FROM	TO	RECOVERY
DEPTH	CONCENTRATION							
FROM	TO							
0.0'	1.0'	Broken Weathered Limestone				1.0'	5.0'	1.5'
1.0'	2.0'	White Cryst. Sand, Dense, Limestone fragments				5.0'	9.8'	4.0'
2.0'	3.0'	White Cryst. Sand, Dense, Limestone fragments				9.8'	14.5'	4.0'
3.0'	4.0'	White Cryst. Sand, Dense, Limestone fragments				14.5'	20.2'	5.7'
4.0'	5.0'	Bottom of boring				20.2'	21.5'	1.3'
5.0'	6.0'					21.5'	31.3'	9.8'
6.0'	7.0'					31.3'	33.4'	2.1'
7.0'	8.0'					33.4'	40.0'	6.6'
8.0'	9.0'					40.0'	47.0'	7.0'
9.0'	10.0'							
10.0'	11.0'							
11.0'	12.0'							
12.0'	13.0'							
13.0'	14.0'							
14.0'	15.0'							
15.0'	16.0'							
16.0'	17.0'							
17.0'	18.0'							
18.0'	19.0'							
19.0'	20.0'							
20.0'	21.0'							
21.0'	22.0'							
22.0'	23.0'							
23.0'	24.0'							
24.0'	25.0'							
25.0'	26.0'							
26.0'	27.0'							
27.0'	28.0'							
28.0'	29.0'							
29.0'	30.0'							
30.0'	31.0'							
31.0'	32.0'							
32.0'	33.0'							
33.0'	34.0'							
34.0'	35.0'							
35.0'	36.0'							
36.0'	37.0'							
37.0'	38.0'							
38.0'	39.0'							
39.0'	40.0'							
40.0'	41.0'							
41.0'	42.0'							
42.0'	43.0'							
43.0'	44.0'							
44.0'	45.0'							
45.0'	46.0'							
46.0'	47.0'							
47.0'	48.0'							
48.0'	49.0'							
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69.0'	70.0'							
70.0'	71.0'							
71.0'	72.0'							
72.0'	73.0'							
73.0'	74.0'							
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80.0'	81.0'							
81.0'	82.0'							
82.0'	83.0'							
83.0'	84.0'							
84.0'	85.0'							
85.0'	86.0'							
86.0'	87.0'							
87.0'	88.0'							
88.0'	89.0'							
89.0'	90.0'							
90.0'	91.0'							
91.0'	92.0'							
92.0'	93.0'							
93.0'	94.0'							
94.0'	95.0'							
95.0'	96.0'							
96.0'	97.0'							
97.0'	98.0'							
98.0'	99.0'							
99.0'	100.0'							

REMARKS: Chart shows some core grinding.
 No water loss while drilling

[illegible]

501.6

[illegible]

STANDARD
No water loss while drilling.
Drilling 6100 feet below
that passed under 1940.

LOG OF BORING NO. 122

TROT DRILLING COMPANY CO.

PHONE: (314) 201-1111 2000 DRILLING SERVICE DR. MARYLAND HEIGHTS, MO. 63043
ST. LOUIS COUNTY

PROJECT: Lake St. Louis

USDA NO. 71-63

SURFACE ELEV. 500.0

BORING LOCATION: Williamson Station

DATE	START	STOP	TIME	DATE	TIME	CORE RUN FROM TO	TOTAL RUN	RECOVERY TOTAL	%
6-11-71	6-11-71	6-15-71	719						
DEPTH	CLASSIFICATION								
0.0	10.0'	Residual Red Clay & Chert Gravel W/Several				10.0'	15.0'	5.0'	3.0' 60
		Large Boulders or Stratified Layers of Chert				15.0'	16.5'	1.5'	1.0' 67
		& Limestone Below 5.0'				16.5'	18.0'	1.5'	1.3' 87
4.0	4.5'	15. Gravel, thin bedded Limestone W/numerous				15.0'	26.0'	8.0'	3.0' 37
10.0	34.7'	Clay layers & chert inclusions (chert fall				26.0'	28.5'	2.5'	4.3' 12
		in from seams caused core grinding)				28.5'	34.7'	6.2'	1.7' 27
34.7		Lost Diamond Bit in Hole-							
		Sharp Chert Cut off Outer							
		Partial							
	34.7	Bottom of Boring.							

REMARKS: No water loss during drilling.

CHART 2-43

SECRET

PHONE: (314) 291-1111
2500 DRILLING SERVICE DR.
MARYLAND HEIGHTS, MO. 63043
ST. LOUIS COUNTY

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0.03	0.03
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0.33	0.33
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0.35	0.35
0.36	0.36
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0.38	0.38
0.39	0.39
0.40	0.40
0.41	0.41
0.42	0.42
0.43	0.43
0.44	0.44
0.45	0.45
0.46	0.46
0.47	0.47
0.48	0.48
0.49	0.49
0.50	0.50
0.51	0.51
0.52	0.52
0.53	0.53
0.54	0.54
0.55	0.55
0.56	0.56
0.57	0.57
0.58	0.58
0.59	0.59
0.60	0.60
0.61	0.61
0.62	0.62
0.63	0.63
0.64	0.64
0.65	0.65
0.66	0.66
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PHONE: (314) 231-1111
2500 DRILLING SERVICE DR.
MARYLAND HEIGHTS, MO. 63043
ST. LOUIS COUNTY

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504.4

DATE	DESCRIPTION	AMOUNT	BALANCE
1901-1-1	Balance		100.00
1901-1-15	Interest	5.00	105.00
1901-2-1	Interest	5.00	110.00
1901-2-15	Interest	5.00	115.00
1901-3-1	Interest	5.00	120.00
1901-3-15	Interest	5.00	125.00
1901-4-1	Interest	5.00	130.00
1901-4-15	Interest	5.00	135.00
1901-5-1	Interest	5.00	140.00
1901-5-15	Interest	5.00	145.00
1901-6-1	Interest	5.00	150.00
1901-6-15	Interest	5.00	155.00
1901-7-1	Interest	5.00	160.00
1901-7-15	Interest	5.00	165.00
1901-8-1	Interest	5.00	170.00
1901-8-15	Interest	5.00	175.00
1901-9-1	Interest	5.00	180.00
1901-9-15	Interest	5.00	185.00
1901-10-1	Interest	5.00	190.00
1901-10-15	Interest	5.00	195.00
1901-11-1	Interest	5.00	200.00
1901-11-15	Interest	5.00	205.00
1901-12-1	Interest	5.00	210.00
1901-12-15	Interest	5.00	215.00
1902-1-1	Interest	5.00	220.00
1902-1-15	Interest	5.00	225.00
1902-2-1	Interest	5.00	230.00
1902-2-15	Interest	5.00	235.00
1902-3-1	Interest	5.00	240.00
1902-3-15	Interest	5.00	245.00
1902-4-1	Interest	5.00	250.00
1902-4-15	Interest	5.00	255.00
1902-5-1	Interest	5.00	260.00
1902-5-15	Interest	5.00	265.00
1902-6-1	Interest	5.00	270.00
1902-6-15	Interest	5.00	275.00
1902-7-1	Interest	5.00	280.00
1902-7-15	Interest	5.00	285.00
1902-8-1	Interest	5.00	290.00
1902-8-15	Interest	5.00	295.00
1902-9-1	Interest	5.00	300.00
1902-9-15	Interest	5.00	305.00
1902-10-1	Interest	5.00	310.00
1902-10-15	Interest	5.00	315.00
1902-11-1	Interest	5.00	320.00
1902-11-15	Interest	5.00	325.00
1902-12-1	Interest	5.00	330.00
1902-12-15	Interest	5.00	335.00
1903-1-1	Interest	5.00	340.00
1903-1-15	Interest	5.00	345.00
1903-2-1	Interest	5.00	350.00
1903-2-15	Interest	5.00	355.00
1903-3-1	Interest	5.00	360.00
1903-3-15	Interest	5.00	365.00
1903-4-1	Interest	5.00	370.00
1903-4-15	Interest	5.00	375.00
1903-5-1	Interest	5.00	380.00
1903-5-15	Interest	5.00	385.00
1903-6-1	Interest	5.00	390.00
1903-6-15	Interest	5.00	395.00
1903-7-1	Interest	5.00	400.00
1903-7-15	Interest	5.00	405.00
1903-8-1	Interest	5.00	410.00
1903-8-15	Interest	5.00	415.00
1903-9-1	Interest	5.00	420.00
1903-9-15	Interest	5.00	425.00
1903-10-1	Interest	5.00	430.00
1903-10-15	Interest	5.00	435.00
1903-11-1	Interest	5.00	440.00
1903-11-15	Interest	5.00	445.00
1903-12-1	Interest	5.00	450.00
1903-12-15	Interest	5.00	455.00
1904-1-1	Interest	5.00	460.00
1904-1-15	Interest	5.00	465.00
1904-2-1	Interest	5.00	470.00
1904-2-15	Interest	5.00	475.00
1904-3-1	Interest	5.00	480.00
1904-3-15	Interest	5.00	485.00
1904-4-1	Interest	5.00	490.00
1904-4-15	Interest	5.00	495.

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DEPTH FROM TO	CLASSIFICATION	DATE	TIME	CORE RUN		TOTAL RUN	RECOVERY	
				FROM	TO		TOTAL	%
0.0' 0.5'	Reddish Red Clay & Chert Gravel			6.4'	10.2'	3.8'	3.8'	100
0.5' 1.5'	Limestone Gravel			10.2'	10.9'	0.7'	0.7'	100
1.5' 5.0'	Yellow Clay w/ Chert Gravel			10.8'	12.7'	1.9'	1.9'	100
5.0' 6.4'	Broken Cherty Limestone			12.7'	17.7'	5.0'	5.0'	100
6.4' 22.7'	Light Grey, Hard, Dense			17.7'	22.7'	5.0'	5.0'	100
	Limestone w/ Porphyrous Chert			22.7'	27.7'	5.0'	5.0'	100
	Limestone			27.7'	32.7'	5.0'	5.0'	100
	Bottom of boring			32.7'	37.7'	5.0'	5.0'	100
25.0'				37.7'	42.7'	5.0'	5.0'	100
				42.7'	45.0'	2.3'	2.3'	100

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PHONE: (314) 291-1111
2500 DRILLING SERVICE DR.
MARYLAND HEIGHTS, MO. 63043
ST. LOUIS COUNTY

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REMARKS:

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1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31 32 33 34 35 36 37 38 39 40 41 42 43 44 45 46 47 48 49 50 51 52 53 54 55 56 57 58 59 60 61 62 63 64 65 66 67 68 69 70 71 72 73 74 75 76 77 78 79 80 81 82 83 84 85 86 87 88 89 90 91 92 93 94 95 96 97 98 99 100 101 102 103 104 105 106 107 108 109 110 111 112 113 114 115 116 117 118 119 120 121 122 123 124 125 126 127 128 129 130 131 132 133 134 135 136 137 138 139 140 141 142 143 144 145 146 147 148 149 150 151 152 153 154 155 156 157 158 159 160 161 162 163 164 165 166 167 168 169 170 171 172 173 174 175 176 177 178 179 180 181 182 183 184 185 186 187 188 189 190 191 192 193 194 195 196 197 198 199 200 201 202 203 204 205 206 207 208 209 210 211 212 213 214 215 216 217 218 219 220 221 222 223 224 225 226 227 228 229 230 231 232 233 234 235 236 237 238 239 240 241 242 243 244 245 246 247 248 249 250 251 252 253 254 255 256 257 258 259 260 261 262 263 264 265 266 267 268 269 270 271 272 273 274 275 276 277 278 279 280 281 282 283 284 285 286 287 288 289 290 291 292 293 294 295 296 297 298 299 300 301 302 303 304 305 306 307 308 309 310 311 312 313 314 315 316 317 318 319 320 321 322 323 324 325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344 345 346 347 348 349 350 351 352 353 354 355 356 357 358 359 360 361 362 363 364 365 366 367 368 369 370 371 372 373 374 375 376 377 378 379 380 381 382 383 384 385 386 387 388 389 390 391 392 393 394 395 396 397 398 399 400 401 402 403 404 405 406 407 408 409 410 411 412 413 414 415 416 417 418 419 420 421 422 423 424 425 426 427 428 429 430 431 432 433 434 435 436 437 438 439 440 441 442 443 444 445 446 447 448 449 450 451 452 453 454 455 456 457 458 459 460 461 462 463 464 465 466 467 468 469 470 471 472 473 474 475 476 477 478 479 480 481 482 483 484 485 486 487 488 489 490 491 492 493 494 495 496 497 498 499 500 501 502 503 504 505 506 507 508 509 510 511 512 513 514 515 516 517 518 519 520 521 522 523 524 525 526 527 528 529 530 531 532 533 534 535 536 537 538 539 540 541 542 543 544 545 546 547 548 549 550 551 552 553 554 555 556 557 558 559 560 561 562 563 564 565 566 567 568 569 570 571 572 573 574 575 576 577 578 579 580 581 582 583 584 585 586 587 588 589 590 591 592 593 594 595 596 597 598 599 600 601 602 603 604 605 606 607 608 609 610 611 612 613 614 615 616 617 618 619 620 621 622 623 624 625 626 627 628 629 630 631 632 633 634 635 636 637 638 639 640 641 642 643 644 645 646 647 648 649 650 651 652 653 654 655 656 657 658 659 660 661 662 663 664 665 666 667 668 669 670 671 672 673 674 675 676 677 678 679 680 681 682 683 684 685 686 687 688 689 690 691 692 693 694 695 696 697 698 699 700 701 702 703 704 705 706 707 708 709 710 711 712 713 714 715 716 717 718 719 720 721 722 723 724 725 726 727 728 729 730 731 732 733 734 735 736 737 738 739 740 741 742 743 744 745 746 747 748 749 750 751 752 753 754 755 756 757 758 759 760 761 762 763 764 765 766 767 768 769 770 771 772 773 774 775 776 777 778 779 780 781 782 783 784 785 786 787 788 789 790 791 792 793 794 795 796 797 798 799 800 801 802 803 804 805 806 807 808 809 810 811 812 813 814 815 816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833 834 835 836 837 838 839 840 841 842 843 844 845 846 847 848 849 850 851 852 853 854 855 856 857 858 859 860 861 862 863 864 865 866 867 868 869 870 871 872 873 874 875 876 877 878 879 880 881 882 883 884 885 886 887 888 889 890 891 892 893 894 895 896 897 898 899 900 901 902 903 904 905 906 907 908 909 910 911 912 913 914 915 916 917 918 919 920 921 922 923 924 925 926 927 928 929 930 931 932 933 934 935 936 937 938 939 940 941 942 943 944 945 946 947 948 949 950 951 952 953 954 955 956 957 958 959 960 961 962 963 964 965 966 967 968 969 970 971 972 973 974 975 976 977 978 979 980 981 982 983 984 985 986 987 988 989 990 991 992 993 994 995 996 997 998 999 1000 1001 1002 1003 1004 1005 1006 1007 1008 1009 1010 1011 1012 1013 1014 1015 1016 1017 1018 1019 1020 1021 1022 1023 1024 1025 1026 1027 1028 1029 1030 1031 1032 1033 1034 1035 1036 1037 1038 1039 1040 1

LOGS OF BORINGS NO. 105

7207 DRILLING COMPANY, INC.

PHONE: (314) 291-1111 2500 DRILLING SERVICE DR. MARYLAND HEIGHTS, MO. 63043
ST. LOUIS COUNTY

PROJECT Lake St. Louis

LOG NO. 71-63

BORING LOCATION Shellmound Section

CORRECTION 514.4

DEPTH FROM TO	CLASSIFICATION	DATE	TIME	CORE RUN		TOTAL RUN	TOTAL RECOVERY
				FROM	TO		
0.0	UNSATURATED SAND, SILT, CLAY			9.2'	24.2'	5.0'	100
5.2	Light Gray. Hard. Sand.			24.2'	29.2'	5.0'	100
53.0'	Limestone w/numerous Chert Inclusions			29.2'	33.0'	3.8'	100
				33.0'	38.0'	5.0'	100
53.0'	Bottom of Boring			38.0'	43.0'	5.0'	100
				43.0'	48.0'	5.0'	100
				48.0'	53.0'	5.0'	100
				53.0'	58.0'	5.0'	100
				58.0'	63.0'	5.0'	100
				63.0'	68.0'	5.0'	100
				68.0'	73.0'	5.0'	100
				73.0'	78.0'	5.0'	100
				78.0'	83.0'	5.0'	100
				83.0'	88.0'	5.0'	100
				88.0'	93.0'	5.0'	100
				93.0'	98.0'	5.0'	100
				98.0'	103.0'	5.0'	100
				103.0'	108.0'	5.0'	100
				108.0'	113.0'	5.0'	100
				113.0'	118.0'	5.0'	100
				118.0'	123.0'	5.0'	100
				123.0'	128.0'	5.0'	100
				128.0'	133.0'	5.0'	100
				133.0'	138.0'	5.0'	100
				138.0'	143.0'	5.0'	100
				143.0'	148.0'	5.0'	100
				148.0'	153.0'	5.0'	100
				153.0'	158.0'	5.0'	100
				158.0'	163.0'	5.0'	100
				163.0'	168.0'	5.0'	100
				168.0'	173.0'	5.0'	100
				173.0'	178.0'	5.0'	100
				178.0'	183.0'	5.0'	100
				183.0'	188.0'	5.0'	100
				188.0'	193.0'	5.0'	100
				193.0'	198.0'	5.0'	100
				198.0'	203.0'	5.0'	100
				203.0'	208.0'	5.0'	100
				208.0'	213.0'	5.0'	100
				213.0'	218.0'	5.0'	100
				218.0'	223.0'	5.0'	100
				223.0'	228.0'	5.0'	100
				228.0'	233.0'	5.0'	100
				233.0'	238.0'	5.0'	100
				238.0'	243.0'	5.0'	100
				243.0'	248.0'	5.0'	100
				248.0'	253.0'	5.0'	100
				253.0'	258.0'	5.0'	100
				258.0'	263.0'	5.0'	100
				263.0'	268.0'	5.0'	100
				268.0'	273.0'	5.0'	100
				273.0'	278.0'	5.0'	100
				278.0'	283.0'	5.0'	100
				283.0'	288.0'	5.0'	100
				288.0'	293.0'	5.0'	100
				293.0'	298.0'	5.0'	100
				298.0'	303.0'	5.0'	100
				303.0'	308.0'	5.0'	100
				308.0'	313.0'	5.0'	100
				313.0'	318.0'	5.0'	100
				318.0'	323.0'	5.0'	100
				323.0'	328.0'	5.0'	100
				328.0'	333.0'	5.0'	100
				333.0'	338.0'	5.0'	100
				338.0'	343.0'	5.0'	100
				343.0'	348.0'	5.0'	100
				348.0'	353.0'	5.0'	100
				353.0'	358.0'	5.0'	100
				358.0'	363.0'	5.0'	100
				363.0'	368.0'	5.0'	100
				368.0'	373.0'	5.0'	100
				373.0'	378.0'	5.0'	100
				378.0'	383.0'	5.0'	100
				383.0'	388.0'	5.0'	100
				388.0'	393.0'	5.0'	100
				393.0'	398.0'	5.0'	100
				398.0'	403.0'	5.0'	100
				403.0'	408.0'	5.0'	100
				408.0'	413.0'	5.0'	100
				413.0'	418.0'	5.0'	100
				418.0'	423.0'	5.0'	100
				423.0'	428.0'	5.0'	100
				428.0'	433.0'	5.0'	100
				433.0'	438.0'	5.0'	100
				438.0'	443.0'	5.0'	100
				443.0'	448.0'	5.0'	100
				448.0'	453.0'	5.0'	100
				453.0'	458.0'	5.0'	100
				458.0'	463.0'	5.0'	100
				463.0'	468.0'	5.0'	100
				468.0'	473.0'	5.0'	100
				473.0'	478.0'	5.0'	100
				478.0'	483.0'	5.0'	100
				483.0'	488.0'	5.0'	100
				488.0'	493.0'	5.0'	100
				493.0'	498.0'	5.0'	100
				498.0'	503.0'	5.0'	100
				503.0'	508.0'	5.0'	100
				508.0'	513.0'	5.0'	100
				513.0'	518.0'	5.0'	100
				518.0'	523.0'	5.0'	100
				523.0'	528.0'	5.0'	100
				528.0'	533.0'	5.0'	100
				533.0'	538.0'	5.0'	100
				538.0'	543.0'	5.0'	100
				543.0'	548.0'	5.0'	100
				548.0'	553.0'	5.0'	100
				553.0'	558.0'	5.0'	100
				558.0'	563.0'	5.0'	100
				563.0'	568.0'	5.0'	100
				568.0'	573.0'	5.0'	100
				573.0'	578.0'	5.0'	100
				578.0'	583.0'	5.0'	100
				583.0'	588.0'	5.0'	100
				588.0'	593.0'	5.0'	100
				593.0'	598.0'	5.0'	100
				598.0'	603.0'	5.0'	100
				603.0'	608.0'	5.0'	100
				608.0'	613.0'	5.0'	100
				613.0'	618.0'	5.0'	100
				618.0'	623.0'	5.0'	100
				623.0'	628.0'	5.0'	100
				628.0'	633.0'	5.0'	100
				633.0'	638.0'	5.0'	100
				638.0'	643.0'	5.0'	100
				643.0'	648.0'	5.0'	100
				648.0'	653.0'	5.0'	100
				653.0'	658.0'	5.0'	100
				658.0'	663.0'	5.0'	100
				663.0'	668.0'	5.0'	100
				668.0'	673.0'	5.0'	100
				673.0'	678.0'	5.0'	100
				678.0'	683.0'	5.0'	100
				683.0'	688.0'	5.0'	100
				688.0'	693.0'	5.0'	100
				693.0'	698.0'	5.0'	100
				698.0'	703.0'	5.0'	100
				703.0'	708.0'	5.0'	100
				708.0'	713.0'	5.0'	100
				713.0'	718.0'	5.0'	100
				718.0'	723.0'	5.0'	100
				723.0'	728.0'	5.0'	100
				728.0'	733.0'	5.0'	100
				733.0'	738.0'	5.0'	100
				738.0'	743.0'	5.0'	100
				743.0'	748.0'	5.0'	100
				748.0'	753.0'	5.0'	100
				753.0'	758.0'	5.0'	100
				758.0'	763.0'	5.0'	100
				763.0'	768.0'	5.0'	100
				768.0'	773.0'	5.0'	100
				773.0'	778.0'	5.0'	100
				778.0'	783.0'	5.0'	100
				783.0'	788.0'	5.0'	100
				788.0'	793.0'	5.0'	100
				793.0'	798.0'	5.0'	100
				798.0'	803.0'	5.0'	100
				803.0'	808.0'	5.0'	100
				808.0'	813.0'	5.0'	100
				813.0'	818.0'	5.0'	100
				818.0'	823.0'	5.0'	100
				823.0'	828.0'	5.0'	100
				828.0'	833.0'	5.0'	100
				833.0'	838.0'	5.0'	100
				838.0'	843.0'	5.0'	100
				843.0'	848.0'	5.0'	100
				848.0'	853.0'	5.0'	100
				853.0'	858.0'	5.0'	100
				858.0'	863.0'	5.0'	100
				863.0'	868.0'	5.0'	100
				868.0'	873.0'	5.0'	100
				873.0'	878.0'	5.0'	100
				878.0'	883.0'	5.0'	100
				883.0'	888.0'	5.0'	100
				888.0'	893.0'	5.0'	100
				893.0'	898.0'	5.0'	100
				898.0'	903.0'	5.0'	100
				903.0'	908.0'	5.0'	100
				908.0'	913.0'	5.0'	100
				913.0'	918.0'	5.0'	100
				918.0'	923.0'	5.0'	100
				923.0'	928.0'	5.0'	100
				928.0'	933.0'	5.0'	100
				933.0'	938.0'	5.0'	100
				938.0'	943.0'	5.0'	100
				943.0'	948.0'	5.0'	100
				948.0'	953.0'	5.0'	100
				953.0'	958.0'	5.0'	100
				958.0'	963.0'	5.0'	100
				963.0'	968.0'	5.0'	100
				968.0'	973.0'	5.0'	100
				973.0'	978.0'	5.0'	100
				978.0'	983.0'	5.0'	100
				983.0'	988.0'	5.0'	100
				988.0'	993.0'	5.0'	100
				993.0'	998.0'	5.0'	100
				998.0'	1003.0'	5.0'	100

REMARKS: No water loss during drilling. Water at 17' after 20 hrs.

CHART 2-47

LOG CLOSING NO. 100

ST. LOUIS COUNTY
 PHONE: (314) 291-1111
 2500 DRILLING SERVICE DR.
 ST. LOUIS COUNTY

MARYLAND HEIGHTS, MO. 63043

PROJECT Lake St. Louis

LOG NO. 71-62

SINKING LOCATION 5-111111-0000

SURFACE EL. 506.0

DATE: 6-22-71 (FINISH) 6-22-71

INSTRUMENT

DEPTH FROM TO	CLASSIFICATION	DATE	TIME	CORE RUN		TOTAL RUN	RECOVERY	
				FROM	TO		TOTAL	%
0.0	RESIDUAL RED CLAY & CHERT GRAVEL			10.8'	13.5'	3.0'	2.0'	7
	W/ Boulders and cobbles			14.0'	15.2'	1.2'	1.2'	100
	SECTION 4.5'			15.2'	19.1'	3.9'	2.8'	100
5.0	BRICKEN LIMESTONE & CHERT			19.1'	23.1'	5.0'	5.0'	100
				23.1'	29.1'	5.0'	5.0'	100
10.0	Light, Gray, Hard, Dense, Limestone, w/ numerous chert inclusions			29.1'	33.1'	5.0'	5.0'	100
				33.1'	39.1'	5.0'	5.0'	100
				39.1'	43.1'	5.0'	5.0'	100
15.0	Bottom of casing			43.1'	45.0'	1.9'	1.0'	100

REMARKS: Set casing at 10' core to 10' - chert, no recovery, pulled casing.

rained to 14', reset casing.

No water loss while drilling - water at 16' after 15 hours.

CHART 2-48

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PHONE: (314) 231-1111
2200 DRILLING SERVICE DR.
MARYLAND HEIGHTS, MO. 63043
ST. LOUIS COUNTY

SUBSIDIARY

~~CONFIDENTIAL~~

100-443887-100

520.2

DATE:		(8-15-71)	7-12-71	(8-15-71)	7-12-71	DATE:	TIME	CORE RUN		TOTAL	RECOVERY	
DEPTH		CLASSIFICATION				DATE	TIME	FROM	TO	FEET	%	
15.0'	15.0'	SANDSTONE AND GRAVELLY SANDSTONE						15.0'	19.0'	4.0'	3.0'	75
		SANDSTONE AND GRAVELLY SANDSTONE						19.0'	25.8'	6.8'	6.9'	100
		SANDSTONE AND GRAVELLY SANDSTONE						25.8'	30.8'	5.0'	4.7'	95
		SANDSTONE AND GRAVELLY SANDSTONE						30.8'	37.6'	6.8'	5.8'	100
		SANDSTONE AND GRAVELLY SANDSTONE						37.6'	43.3'	5.7'	5.7'	100
		SANDSTONE AND GRAVELLY SANDSTONE						43.3'	49.6'	6.3'	6.3'	100
55.0'	55.0'	LIGHT GRAY, HARD, DENSE						49.6'	55.0'	5.4'	5.4'	100
		SANDSTONE AND GRAVELLY SANDSTONE										
		SANDSTONE										
		SANDSTONE AND GRAVELLY SANDSTONE										

REMARKS:

WILLIAM LIVINGSTON SOL MORALES

LOGGING NO. 112

COLUMBIA UNIVERSITY

PHONE: (314) 231-1111 2000 BILLING SERVICE DR. MARYLAND HEIGHTS, MO. 63043
ST. LOUIS COUNTY

PROJECT 213 St. Louis

LOG NO. 71-63

CORE LOCATION

SURFACE NO. 5276

DATE 12-1-71

PERIOD 7-5-71

RIG 119

INSPECTOR

DEPTH FROM TO	CLASSIFICATION	DATE	TIME	CORE RUN		TOTAL RUN	TOTAL RECOVERY
				FROM	TO		
0.0	RESERVE RED GRAY & WHITE GRAVEL			10.0'	15.0'	5.0'	3.7'
5.0	INTERBEDded GRAY Limestone			15.0'	19.7'	4.7'	3.5'
10.0	INTERBEDded RED GRAY SANDS			19.7'	22.8'	3.1'	3.0'
15.0	Light Gray, Sand, Tanes			22.8'	26.2'	3.4'	2.5'
20.0	Limestone w/ many nodules			26.2'	29.2'	3.0'	3.0'
25.0	Chert nodules Sand			29.2'	39.2'	10.0'	10.0'
30.0	Gray nodules water			39.2'	41.9'	2.7'	2.7'
35.0	Weathered Blue Limestone Horizons			41.9'	51.9'	10.0'	9.5'
40.0	Light Gray, Sand, Tanes			51.9'	55.9'	4.0'	2.0'
45.0	Limestone w/ Nodules			55.9'	59.9'	4.0'	3.7'
50.0	Chert nodules			59.9'	60.0'	0.1'	2.7'
55.0	Bottom of boring						

REMARKS: No water loss while drilling. Water at 60' at completion.

Core Grinding Due to Chert Fall In

PHONE: (314) 251-1111
FAX: (314) 251-1111
ST. LOUIS COUNTY
RECORDING DIVISION
ST. LOUIS COUNTY

PHONE: (314) 291-1111
2000 MILLING SERVICE DR.
ST. LOUIS COUNTY
MARYLAND HEIGHTS, MO. 63043

100

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5298

[illegible][illegible]

FEEL ARIS: "A nation's future is in the hands of its children"

LOG OF BORING NO. 116

TEST DRILLING COMPANY CO.

PHONE: (314) 291-1111 2500 DRILLING SERVICE DR. MARYLAND HEIGHTS, MO. 63043
ST. LOUIS COUNTY

PROJECT: 24th St., Louis

JOB NO. 71-63

BORING LOCATION: 24th St., Louis

DATE: 5/2/9

INSTRUCTIONS:

DATE: 5-24-71

(FINISH) 5-24-71

(START) 5-23-71

TIME: 2:09

DEPTH	CLASSIFICATION	DATE	TIME	CORE RUN FROM	CORE RUN TO	TOTAL RUN	RECOVERY TOTAL
0.0							
5.0				10.5'	12.3'	1.8'	1.0'
10.5				12.3'	17.3'	5.0'	5.0'
				17.3'	22.3'	5.0'	5.0'
20.5				22.3'	27.3'	5.0'	5.0'
				27.3'	32.3'	5.0'	5.0'
				32.3'	37.3'	5.0'	5.0'
				37.3'	42.3'	5.0'	5.0'
				42.3'	47.3'	5.0'	5.0'
				47.3'	52.3'	5.0'	5.0'
				52.3'	57.3'	5.0'	5.0'
				57.3'	62.3'	5.0'	5.0'
				62.3'	67.3'	5.0'	5.0'
				67.3'	72.3'	5.0'	5.0'
				72.3'	77.3'	5.0'	5.0'
				77.3'	82.3'	5.0'	5.0'
				82.3'	87.3'	5.0'	5.0'
				87.3'	92.3'	5.0'	5.0'
				92.3'	97.3'	5.0'	5.0'
				97.3'	102.3'	5.0'	5.0'
				102.3'	107.3'	5.0'	5.0'
				107.3'	112.3'	5.0'	5.0'
				112.3'	117.3'	5.0'	5.0'
				117.3'	122.3'	5.0'	5.0'
				122.3'	127.3'	5.0'	5.0'
				127.3'	132.3'	5.0'	5.0'
				132.3'	137.3'	5.0'	5.0'
				137.3'	142.3'	5.0'	5.0'
				142.3'	147.3'	5.0'	5.0'
				147.3'	152.3'	5.0'	5.0'
				152.3'	157.3'	5.0'	5.0'
				157.3'	162.3'	5.0'	5.0'
				162.3'	167.3'	5.0'	5.0'
				167.3'	172.3'	5.0'	5.0'
				172.3'	177.3'	5.0'	5.0'
				177.3'	182.3'	5.0'	5.0'
				182.3'	187.3'	5.0'	5.0'
				187.3'	192.3'	5.0'	5.0'
				192.3'	197.3'	5.0'	5.0'
				197.3'	202.3'	5.0'	5.0'
				202.3'	207.3'	5.0'	5.0'
				207.3'	212.3'	5.0'	5.0'
				212.3'	217.3'	5.0'	5.0'
				217.3'	222.3'	5.0'	5.0'
				222.3'	227.3'	5.0'	5.0'
				227.3'	232.3'	5.0'	5.0'
				232.3'	237.3'	5.0'	5.0'
				237.3'	242.3'	5.0'	5.0'
				242.3'	247.3'	5.0'	5.0'
				247.3'	252.3'	5.0'	5.0'
				252.3'	257.3'	5.0'	5.0'
				257.3'	262.3'	5.0'	5.0'
				262.3'	267.3'	5.0'	5.0'
				267.3'	272.3'	5.0'	5.0'
				272.3'	277.3'	5.0'	5.0'
				277.3'	282.3'	5.0'	5.0'
				282.3'	287.3'	5.0'	5.0'
				287.3'	292.3'	5.0'	5.0'
				292.3'	297.3'	5.0'	5.0'
				297.3'	302.3'	5.0'	5.0'
				302.3'	307.3'	5.0'	5.0'
				307.3'	312.3'	5.0'	5.0'
				312.3'	317.3'	5.0'	5.0'
				317.3'	322.3'	5.0'	5.0'
				322.3'	327.3'	5.0'	5.0'
				327.3'	332.3'	5.0'	5.0'
				332.3'	337.3'	5.0'	5.0'
				337.3'	342.3'	5.0'	5.0'
				342.3'	347.3'	5.0'	5.0'
				347.3'	352.3'	5.0'	5.0'
				352.3'	357.3'	5.0'	5.0'
				357.3'	362.3'	5.0'	5.0'
				362.3'	367.3'	5.0'	5.0'
				367.3'	372.3'	5.0'	5.0'
				372.3'	377.3'	5.0'	5.0'
				377.3'	382.3'	5.0'	5.0'
				382.3'	387.3'	5.0'	5.0'
				387.3'	392.3'	5.0'	5.0'
				392.3'	397.3'	5.0'	5.0'
				397.3'	402.3'	5.0'	5.0'
				402.3'	407.3'	5.0'	5.0'
				407.3'	412.3'	5.0'	5.0'
				412.3'	417.3'	5.0'	5.0'
				417.3'	422.3'	5.0'	5.0'
				422.3'	427.3'	5.0'	5.0'
				427.3'	432.3'	5.0'	5.0'
				432.3'	437.3'	5.0'	5.0'
				437.3'	442.3'	5.0'	5.0'
				442.3'	447.3'	5.0'	5.0'
				447.3'	452.3'	5.0'	5.0'
				452.3'	457.3'	5.0'	5.0'
				457.3'	462.3'	5.0'	5.0'
				462.3'	467.3'	5.0'	5.0'
				467.3'	472.3'	5.0'	5.0'
				472.3'	477.3'	5.0'	5.0'
				477.3'	482.3'	5.0'	5.0'
				482.3'	487.3'	5.0'	5.0'
				487.3'	492.3'	5.0'	5.0'
				492.3'	497.3'	5.0'	5.0'
				497.3'	502.3'	5.0'	5.0'
				502.3'	507.3'	5.0'	5.0'
				507.3'	512.3'	5.0'	5.0'
				512.3'	517.3'	5.0'	5.0'
				517.3'	522.3'	5.0'	5.0'
				522.3'	527.3'	5.0'	5.0'
				527.3'	532.3'	5.0'	5.0'
				532.3'	537.3'	5.0'	5.0'
				537.3'	542.3'	5.0'	5.0'
				542.3'	547.3'	5.0'	5.0'
				547.3'	552.3'	5.0'	5.0'
				552.3'	557.3'	5.0'	5.0'
				557.3'	562.3'	5.0'	5.0'
				562.3'	567.3'	5.0'	5.0'
				567.3'	572.3'	5.0'	5.0'
				572.3'	577.3'	5.0'	5.0'
				577.3'	582.3'	5.0'	5.0'
				582.3'	587.3'	5.0'	5.0'
				587.3'	592.3'	5.0'	5.0'
				592.3'	597.3'	5.0'	5.0'
				597.3'	602.3'	5.0'	5.0'
				602.3'	607.3'	5.0'	5.0'
				607.3'	612.3'	5.0'	5.0'
				612.3'	617.3'	5.0'	5.0'
				617.3'	622.3'	5.0'	5.0'
				622.3'	627.3'	5.0'	5.0'
				627.3'	632.3'	5.0'	5.0'
				632.3'	637.3'	5.0'	5.0'
				637.3'	642.3'	5.0'	5.0'
				642.3'	647.3'	5.0'	5.0'
				647.3'	652.3'	5.0'	5.0'
				652.3'	657.3'	5.0'	5.0'
				657.3'	662.3'	5.0'	5.0'
				662.3'	667.3'	5.0'	5.0'
				667.3'	672.3'	5.0'	5.0'
				672.3'	677.3'	5.0'	5.0'
				677.3'	682.3'	5.0'	5.0'
				682.3'	687.3'	5.0'	5.0'
				687.3'	692.3'	5.0'	5.0'
				692.3'	697.3'	5.0'	5.0'
				697.3'	702.3'	5.0'	5.0'
				702.3'	707.3'	5.0'	5.0'
				707.3'	712.3'	5.0'	5.0'
				712.3'	717.3'	5.0'	5.0'
				717.3'	722.3'	5.0'	5.0'
				722.3'	727.3'	5.0'	5.0'
				727.3'	732.3'	5.0'	5.0'
				732.3'	737.3'	5.0'	5.0'
				737.3'	742.3'	5.0'	5.0'
				742.3'	747.3'	5.0'	5.0'
				747.3'	752.3'	5.0'	5.0'
				752.3'	757.3'	5.0'	5.0'
				757.3'	762.3'	5.0'	5.0'
				762.3'	767.3'	5.0'	5.0'
				767.3'	772.3'	5.0'	5.0'
				772.3'	777.3'	5.0'	5.0'
				777.3'	782.3'	5.0'	5.0'
				782.3'	787.3'	5.0'	5.0'
				787.3'	792.3'	5.0'	5.0'
				792.3'	797.3'	5.0'	5.0'
				797.3'	802.3'	5.0'	5.0'
				802.3'	807.3'	5.0'	5.0'
				807.3'	812.3'	5.0'	5.0'
				812.3'	817.3'	5.0'	5.0'
				817.3'	822.3'	5.0'	5.0'
				822.3'	827.3'	5.0'	5.0'
				827.3'	832.3'	5.0'	5.0'
				832.3'	837.3'	5.0'	5.0'
				837.3'	842.3'	5.0'	5.0'
				842.3'	847.3'	5.0'	5.0'
				847.3'	852.3'	5.0'	5.0'
				852.3'	857.3'	5.0'	5.0'
				857.3'	862.3'	5.0'	5.0'
				862.3'	867.3'	5.0'	5.0'
				867.3'	872.3'	5.0'	5.0'
				872.3'	877.3'	5.0'	5.0'
				877.3'	882.3'	5.0'	5.0'
				882.3'	887.3'	5.0'	5.0'
				887.3'	892.3'	5.0'	5.0'
				892.3'	897.3'	5.0'	5.0'
				897.3'	902.3'	5.0'	5.0'
				902.3'	907.3'	5.0'	5.0'
				907.3'	912.3'	5.0'	5.0'
				912.3'	917.3'	5.0'	5.0'
				917.3'	922.3'	5.0'	5.0'
				922.3'	927.3'	5.0'	5.0'
				927.3'	932.3'	5.0'	5.0'
				932.3'	937.3'	5.0'	5.0'
				937.3'	942.3'	5.0'	5.0'
				942.3'	947.3'	5.0'	5.0'
				947.3'	952.3'	5.0'	5.0'
				952.3'	957.3'	5.0'	5.0'
				957.3'	962.3'	5.0'	5.0'
				962.3'	967.3'	5.0'	5.0'
				967.3'	972.3'	5.0'	5.0'
				972.3'	977.3'	5.0'	5.0'
				977.3'	982.3'	5.0'	5.0'
				982.3'	987.3'	5.0'	5.0'
				987.3'	992.3'	5.0'	5.0'
				992.3'	997.3'	5.0'	5.0'
				997.3'	1002.3'	5.0'	5.0'

REMARKS: No water loss during drilling.

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PHONE: (314) 231-1111
2000 DRILLING SERVICE DR.
MARYLAND HEIGHTS, MO. 63043
ST. LOUIS COUNTY

[illegible]

100-443887

DEPTH FROM TO	CLASSIFICATION	DATE	TIME	CORE RUN		TOTAL RUN	RECOVERY TOTAL %
				FROM	TO		
12.0 13.0	Bedded Red Clay to Buff, thin			12.0'	15.5'	3.5'	3.5' 100
13.0 14.0	Bedded Reddish Cherty Limestone			15.5'	16.7'	1.2'	0.7' 59
14.0 15.0	Bedded Reddish Cherty Limestone			16.7'	17.7'	1.0'	1.0' 100
	Bedded Reddish Cherty Limestone			17.7'	24.5'	6.8'	2.3' 34
	Green Silt			24.5'	25.5'	1.0'	1.0' 100
12.0 14.0	Light Gray to Buff, thin			25.5'	29.2'	3.7'	3.7' 100
	Bedded Cherty Limestone			29.2'	39.2'	10.0'	10.0' 100
14.0 15.0	W/ numerous clay seams			39.2'	49.2'	10.0'	10.0' 100
15.0 16.0	Bedded Green, hard, porous, limestone			49.2'	55.0'	5.8'	5.8' 100
	W/ numerous chert inclusions						
16.0 17.0	Bedded Green, hard, porous, limestone						
17.0 18.0	Bedded Green, hard, porous, limestone						
18.0 19.0	Bedded Green, hard, porous, limestone						
19.0 20.0	Bedded Green, hard, porous, limestone						
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94.0 95.0	Bedded Green, hard, porous, limestone						
95.0 96.0	Bedded Green, hard, porous, limestone						
96.0 97.0	Bedded Green, hard, porous, limestone						
97.0 98.0	Bedded Green, hard, porous, limestone						
98.0 99.0	Bedded Green, hard, porous, limestone						
99.0 100.0	Bedded Green, hard, porous, limestone						

המחלקה הכלכלית והמנהלית

CHART 2-53

[illegible]

PHONE: (314) 231-1111 2000 DRILLING SERVICE DR. MARYLAND HEIGHTS, MO. 63043
ST. LOUIS COUNTY

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[illegible]

542.0

p.c: 719

TX-6-1 (continued)

11-11-11

RECEIVED
JAN 10 1964

1937

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W/ ccsg Cribling & Bunting

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Texas - No other citation fees

REMARKS: Carried out to 500. No further hole carrying.

17.0' - 30.0' Light Gray to Buff Thin Bedded Cherty Limestone

~~W/CRY course - Core Criminology due to physical fall in~~

Stations for USAC Part I 10:04 10:09

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*Ira Nathan
Danny*

GEOLOGIC INVESTIGATION OF PROPOSED LAKE SITE ON PERUQUE CREEK
ST. CHARLES COUNTY

The proposed lake site on Peruque Creek with a dam located in the center of sec. 26, T. 47 N., R. 2 E., will impound waters in a region of limestone bedrock. Rock exposures are soil covered for the most part except for the slopes at the dam site. The thin veneer of soil and rock fragments on the abutments indicates that the earthen fill must be keyed into bedrock.

The limestone bedrock, referred to as the Burlington formation, is firm, massive, and contains a high percentage of chert. The Burlington normally is fissured and open to some extent. The several springs present within the lake area verify this generality. As is customary with limestone bedrock, suitable precautions are necessary so that impounded lake waters are not lost through openings in the limestone. Therefore, the springs which will be in the lower part of the lake such as the spring in the NW $\frac{1}{4}$ SW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 26, T. 47 N., R. 2 E., should be cleaned of loose rock and soil debris and then padded. The padding should consist of compacted coarse rock covered by two feet of relatively impermeable clay. The lake will probably not have sufficient hydrostatic pressure to reverse the springs, and the failure to pad all the springs should have no adverse affects. However, springs near the dam site, such as the above mentioned outlet should be covered. Springs at or slightly below the water line need not be disturbed.

The rock abutments will consist of firm limestone bedrock except for a several foot thick surficial covering of loose and open layered rock. Therefore, the core trench must be excavated into

each abutment a sufficient depth so that the clay core can be compacted against firm rock. This may increase construction costs, but failure to key the earthen core into firm rock on the abutments can result in high water loss and possible instability of the earthen dam.

An excavated rock core trench may not be necessary along the base of the earthen dam. If sufficient relatively tight alluvial material and compacted clay padding cover the present stream channel are extended upstream from the base of the dam, then there will be a limited possibility of water loss along the base of the dam. However, all loose rock material should be cleaned from the bottom of the core trench so that the clay core can be compacted on firm bedrock. If bedrock is at excessive depth then it may be necessary to bottom the core trench on suitable alluvial soil.

An earthen structure of the size contemplated for Peruque Creek should not be undertaken without a thorough knowledge as to the character of the rock. Surface exposures give only a partial indication as to the water tightness of the bedrock. Therefore, additional information as to possible water loss should be obtained by core drilling and pressure testing. Each abutment should be cored and pressure tested with the holes located at the approximate elevation of the pool level. The holes should be deepened to the average level of bedrock surface in the Peruque Valley floodplain. A third hole located along the center line should be covered and pressure tested at least 10 feet into solid rock. If these holes indicate that the rock is open and water loss is excessive, then additional holes will be needed to determine the seriousness of the adverse rock characteristics. Since the lake is not planned

to be excessively deep, the core hole exploration would not be necessary if borrow areas were located near or above water level. However, the need to obtain most of the borrow from the floodplain indicates that the bedrock should be relatively watertight. Some water loss can be tolerated with the high drainage to lake ratios, but if many open caves are noted in the drilling program, then it will be necessary to leave much of the floodplain soil deposits in place. Borrow will have to be obtained at or above water line.

The most apparent construction problem of the lake site may be core trench excavation in the valley alluvium. The floodplain sediments at Peruque Creek may flood much of the earthen excavation. The problem may exist in some borrow areas also. The general groundwater level appears to be at or above floodplain level and this will tend to recharge the alluvium of the floodplain. Therefore, adequate auger exploration should also be accomplished with particular attention given to the water table level in the floodplain. Over all features of the lake site indicate that it is well situated from the geologic aspect. No major hazards were apparent. However, the relatively simple additional exploration should not be ignored when construction of lakes and dams of this magnitude are considered.

James H. Williams
Engineering Geologist
Missouri Geological Survey
February 21, 1963

Eng. Sect.
lhb

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

Eng. Geol.
Division

ADDENDUM TO GEOLOGIC REPORT ON LAKE ST. LOUIS, ST. CHARLES COUNTY

Preliminary seismic exploration in the valley of Perdue Creek indicates that depth to bedrock varies from about 20 feet to at least 32 feet. On the right portion of the valley floodplain, it appears that alluvial silt loam with normal soil moisture has a thickness of 20 to 23 feet. The alluvium is underlain by dense firm limestones consisting of the Keokuk Formation. Toward the center of the valley it appears that about 12 to 16 feet of moist silt loam is underlain by a 12 to 16 foot layer of water saturated sands and gravels. This is in turn underlain at a depth of 30 to 32 feet by limestone. There is no evidence that the limestone surface is extremely pinnacled although it would not be unusual to find variations in relief of 5 to 8 feet in this type of bedrock. However, from a general indication of the type of erosion common to a stream of this size and the preliminary studies by the seismic it would appear that the bedrock surface across the valley floor is relatively uniform.

Velocities in the limestone indicate that it is firm and fresh material. The limestone does not appear to have major caves or extensive soft weathered zones.

The seismic data only outlines the major features of the valley. Subsurface drilling of the bedrock and possible pressure testing are needed to more accurately outline valley conditions.

James H. Williams
Chief, Eng. Geol. Section
Missouri Geological Survey
June 6, 1967

4 64
ADDENDUM TO LAKE ST. LOUIS, ST. CHARLES COUNTY

Several geologic examinations were made during the work in the core trench. The core for the dam is being completed so that leakage or stability problems associated with geologic features will not affect the dam or lake.

The present plans to investigate in detail the foundation in the area of a spring by drilling, dye studies, and possibly geophysical reconnaissance will provide adequate geological information as to the foundation characteristics near this spring.

The spring flows from a limestone crevice, and is considered to have a bedrock source that is not connected with Peruque Creek. Water temperature of the spring measured on 15 April 1969 was 51°F. Water temperature of Peruque was 63°. The 51°F temperature indicates that warm water contamination is not associated with the spring source. Additional temperature measurements and dye studies should be made for comparison.

Plans to cut off the spring water flow by grouting are those techniques that are customarily used for sealing off water movement in bedrock crevices. This will be a matter of several bore holes in the water loss area followed by emplacement of the grout.

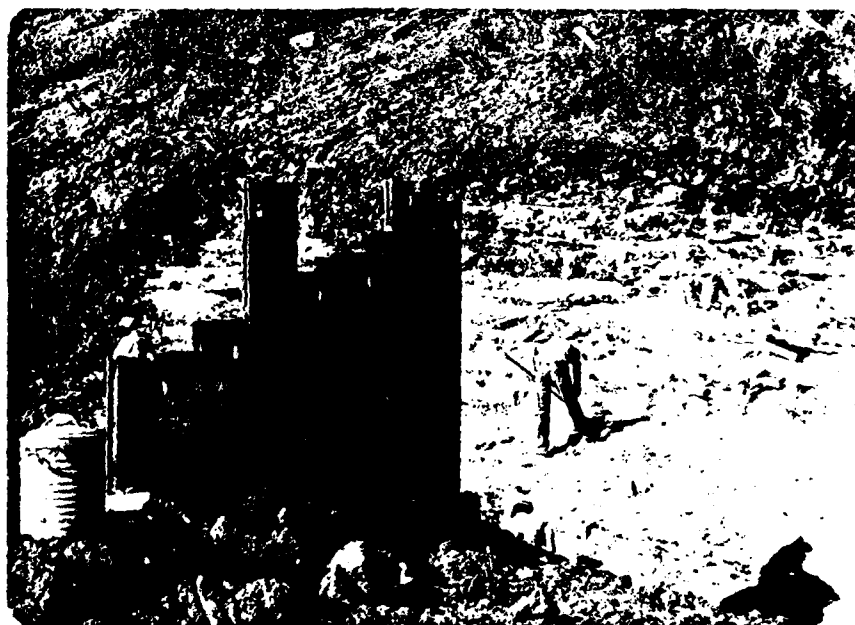
The localized water loss from Peruque Creek channel into the core trench is not considered to be related to the major source of water coming from this limestone fissure. It is thought that the stream channel loss followed along a more deeply weathered surface of the bedrock. Dewatering of the alluvium and the core trench led to the surface alluvial sinks. Such a phenomena is not unusual when dewatering changes the foundation characteristics of alluvium.

James H. Williams
Chief, Eng. Geol. Section
Missouri Geological Survey
May 12, 1969

APPENDIX



NO. 1: PLACING EARTH FILL AT DAM



NO. 2: SHEET PILE CUTOFF AT DAM



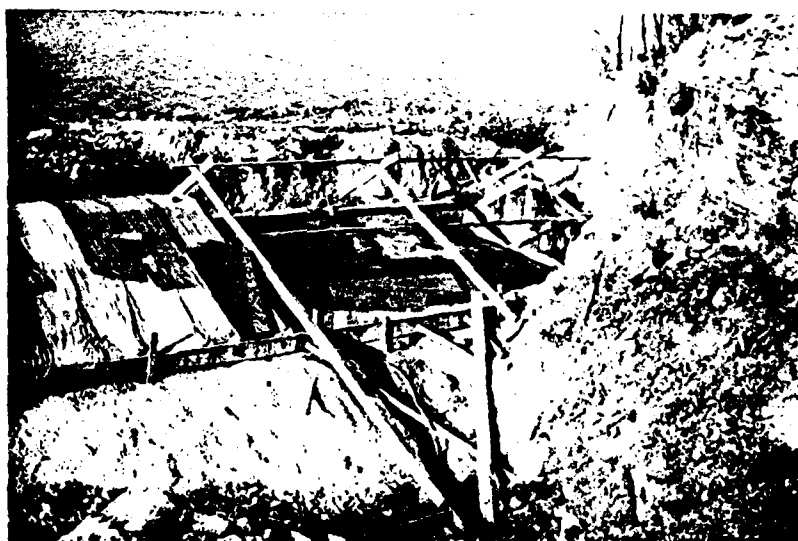
NO. 3: SPILLWAY - STA. 1+72 TO STA. 2+92



NO. 4: CHANNEL - STA. 9+00 TO STA. 12+00



NO. 5: CURING SPILLWAY MONOLITHS



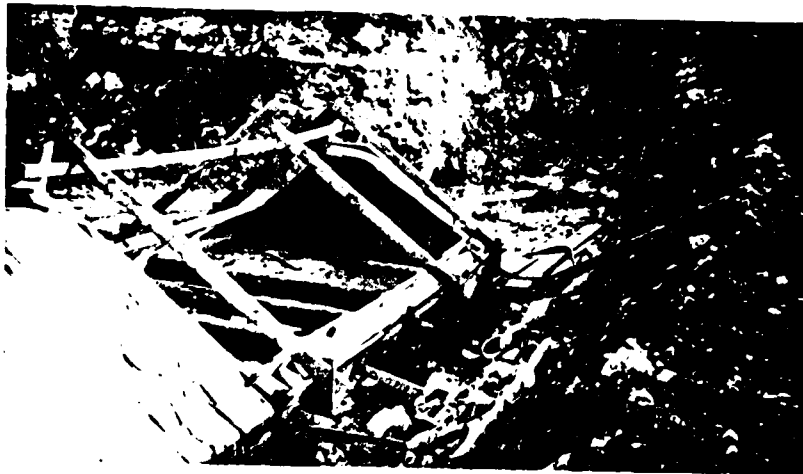
NO. 6: NORMAL POOL SPILLWAY SECTION



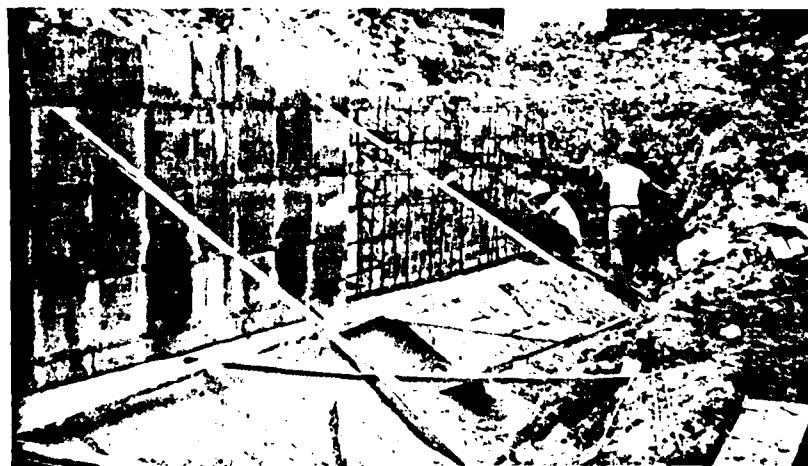
NO. 7: CLEANING CAVITY IN SPILLWAY FOUNDATION - STA. 5+75+



NO. 8: SPILLWAY FOUNDATION - STA. 5+56 TO STA. 5+89



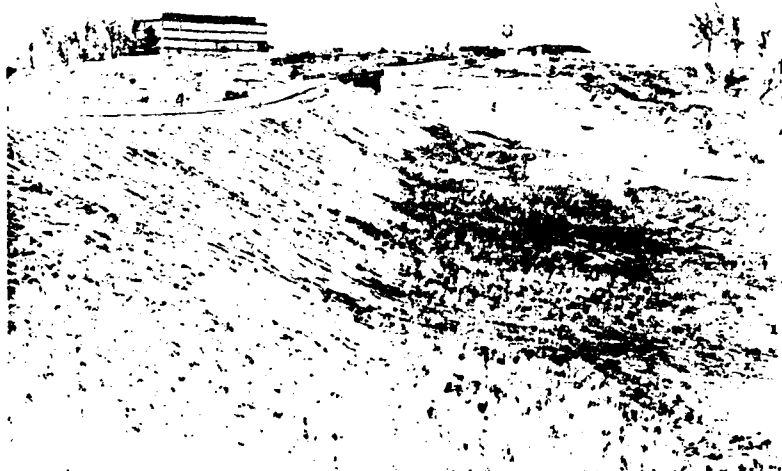
NO. 9: SPILLWAY MONOLITH - STA. 1+24 TO STA. 1+48



NO. 10: SPILLWAY TIE-IN AT DAM



NO. 11: UPSTREAM FACE OF DAM



NO. 12: DOWNSTREAM FACE OF DAM



NO. 13: 72" LAKE DRAWDOWN PIPE



NO. 14: SEWAGE LIFT STATION



NO. 15: I-70 BRIDGES FROM DAM CREST



NO. 16: OUTLET CHANNEL FROM DAM CREST



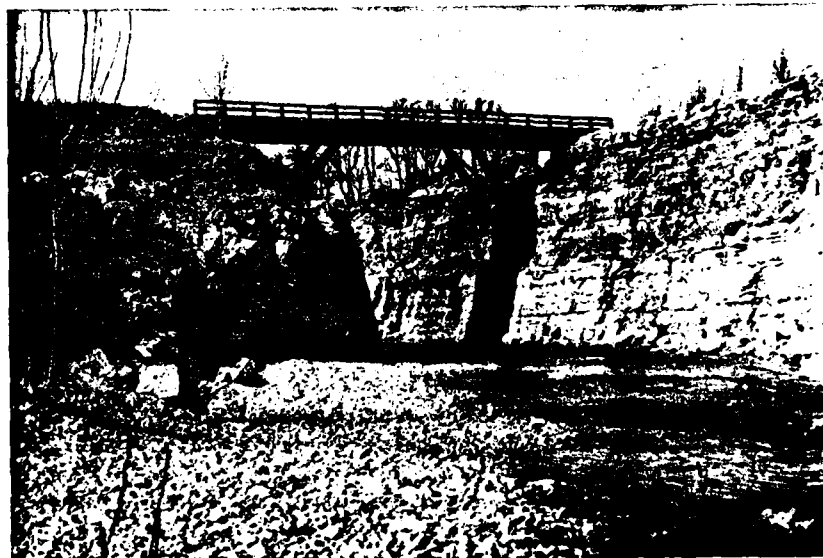
NO. 17: UPSTREAM END OUTLET CHANNEL



NO. 18: CHANNEL BANK - STA. 12+40₊



NO. 19: SPILLWAY, NOTE 3-8" PIPES



NO. 20: OUTLET CHANNEL BELOW DAM



NO. 21: HIGHWAY 40-61 BRIDGE



NO. 22: DOWNSTREAM FACE LAKE SAINT LOUISE DAM

HYDROLOGIC COMPUTATIONS

1. Triangular unit hydrographs and the Soil Conservation Service method of runoff determination as described in the Bureau of Reclamation publication "Design of Small Dams" were used to develop the inflow hydrographs (see Plate 16) with hydrologic inputs as follows:

- a. Rainfall from USWB TP40
 - (1) 24 hour, probable maximum precipitation rainfall
 - (2) 24 hour, Assumption A rainfall
 - (3) 24 hour, 300 year rainfall (extrapolated)
- b. Drainage area = 56.4 square miles.
- c. Time of concentration = 9.5 hours.
- d. Antecedent moisture condition = II.
- e. Soil Type CN = 80.

2. Spillway release rates were based on the broad-crested weir equation:

$$Q = CLH^{\frac{3}{2}} \quad (C = 3.7, L = 817 \text{ feet}), \text{ where } H \text{ is the head on the weir crest.}$$

3. Floods were routed through the spillway and outlet channel to determine the capacity of the spillway discharge system. Outflow hydrographs (assuming free discharge from the spillway) are shown on Plate 16.

4. Correlation of flood routing and spillway outlet channel is shown on Plate 17.

