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NATIONAL DAM SAFETY PROGRAM. MOECKEL DAM (MO 30476), MISSISSIPP--ETC(U)
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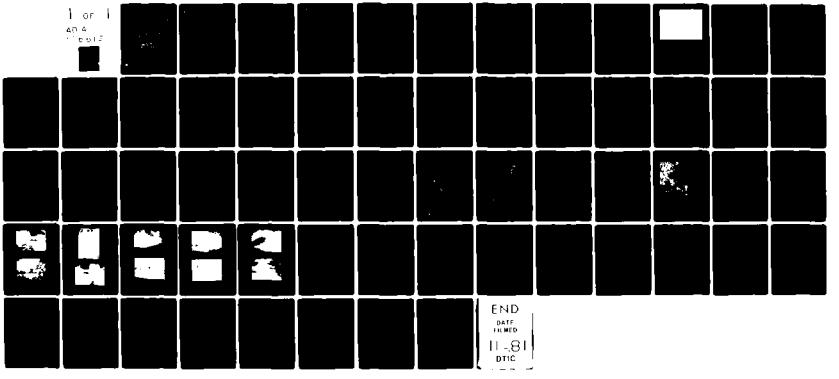

MISSISSIPPI-KASKASKIA-ST. LOUIS BASIN

MOECKEL DAM
WASHINGTON COUNTY, MISSOURI
MO 30476

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY INSPECTION

United States Army
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St. Louis District

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

FOR: STATE OF MISSOURI

DECEMBER 1980

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20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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

REPLY TO ATTENTION OF

LMSED-P

SUBJECT: Moeckel Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Moeckel Dam (MO 30476).

It was prepared under the National Program of Inspection of Non-Federal Dams.

This dam has been classified as unsafe, non-emergency by the St Louis District as a result of the application of the following criteria:

a. This dam will retain less than 50 percent of the Probable Maximum Flood without overtopping the dam at a low area on the dam crest.

b. Overtopping of the dam could result in failure of the dam.

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

SUBMITTED BY: SIGNED 14 JAN 1981
Chief, Engineering Division Date

APPROVED BY: SIGNED 16 JAN 1981
Colonel, CE, District Engineer Date

MOECKEL DAM

Washington County, Missouri

Missouri Inventory No. 30476

Phase I Inspection Report

National Dam Safety Program

Prepared by

Woodward-Clyde Consultants

Chicago, Illinois

Under Direction of

St Louis District, Corps of Engineers

for

Governor of Missouri

December 1980

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams for Phase I Investigations. Copies of these guidelines may be obtained from the Office of the Chief of Engineers, Washington, D. C., 20314. The purpose of a Phase I investigation is not to provide a complete evaluation of the safety of the structure nor to provide a guarantee on its future integrity. Rather the purpose of the program is to identify potentially hazardous conditions to the extent they can be identified by a visual examination. The assessment of the general condition of the dam is based upon available data (if any) and visual inspections. Detailed investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify the need for more detailed studies. In view of the limited nature of the Phase I studies no assurance can be given that all deficiencies have been identified.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with any data which may be available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action removes the normal load on the structure, as well as the reservoir head along with seepage pressures, and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected, so that corrective action can be taken. Likewise continued care and maintenance are necessary to minimize the possibility of development of unsafe conditions.

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam	Moeckel Dam
State Located	Missouri
County Located	Washington
Stream	Unnamed Tributary of Mine `a Breton Creek
Date of Inspection	16 August 1980

The Moeckel Dam, Missouri Inventory Number 30476, (formerly Mononame 266), was inspected by Richard Berggreen (engineering geologist), Leonard Krazynski (geotechnical engineer), and Sean Tseng (hydrologist). The dam is an abandoned barite tailings dam.

The Phase I dam inspection was made following the guidelines presented in the "Recommended Guidelines for Safety Inspection of Dams". These guidelines were developed by the Chief of Engineers, U.S. Army, Washington, D.C., with the help of federal and state agencies, professional engineering organizations, and private engineers. The resulting guidelines represent a consensus of the engineering profession. These guidelines are intended to provide for an expeditious identification, based on available data and a visual inspection, of those dams which may pose hazards to human life or property. In view of the limited nature of the Phase I study, no assurance can be given that all deficiencies have been identified.

The St Louis District, Corps of Engineers (SLD), has classified this dam as having a high hazard potential; we concur with this classification. The downstream hazard zone length, estimated by the St Louis District, extends approximately 16 miles downstream of the dam. Within this zone are several occupied dwellings, the Missouri-Pacific Railroad and several Missouri State Highways.

The Moeckel Dam is classified intermediate size based on its 85 ft height and storage capacity of about 1340 ac-ft. The intermediate size classification includes dams between 40 and 100 ft in height, or having storage capacities between 1000 and 50,000 ac-ft.

The results of the visual inspection and review of available data indicate the dam is in generally poor condition. There is no designed spillway at this facility. Overflow at the low area on the left abutment could cause significant erosion during severe flood

events. Significant erosion could also occur at the toe of the dam due to obstructions and diversion of the discharge channel. The moderately to highly erodible nature of the embankment materials and the extreme steepness of the downstream slope (1.3H to 1V) indicate that significant erosion could pose a hazard to the safety of the dam.

Dense vegetation is present in the informal spillway and discharge channel. This vegetation could cause obstructions to flow during severe flooding. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" are not on record, which is considered a deficiency.

The dam is currently abandoned and there is apparently no inspection or monitoring program at this dam. This is considered a deficiency.

Hydraulic and hydrologic analyses of the dam and reservoir indicate the dam will contain the 10 percent probability-of-occurrence event without overtopping the low area which forms the informal spillway. A flood with a 1 percent probability-of-occurrence (100-yr flood) will overtop the informal spillway by about 0.8 ft. These analyses also indicate that a flood greater than 13 percent of the Probable Maximum Flood (PMF) will overtop the embankment at the informal spillway. The PMF is defined as the flood event that may be expected to occur from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

It is recommended that further studies be made without undue delay in order that a spillway and discharge channel be constructed, which will meet the following objectives:

1. Minimize storage behind the dam.

2. Allow passage of the PMF event without overtopping the dam.

3. Provide erosion control or direct the discharge channel so erosion of the toe of the embankment will not occur. The discharge channel should be cleared to minimize obstruction to flow and potential diversion of flood water.

It is recommended that static and seismic stability analyses be performed on the existing structure by an engineer experienced in the design and construction of dams.

These analyses should also include a seepage analysis to meet the criteria of the recommended guidelines.

It is recommended that an evaluation be made of the necessity and feasbility of removing large trees from the face of the embankment. Removal of large trees should be performed under the guidance of a professional engineer experienced in the design and construciton of dams. Indiscriminate clearing of large trees could jeopardize the safety of the dam.

It is recommended that a program of periodic inspections and monitoring be initiated at this facility. This program should include:

1. Inspection of the embankment crest and slopes to identify evidence of instability such as cracking or slumping.

2. Inspection of the spillway, discharge channel and toe of dam for evidence of significant erosion following heavy precipitation events.

3. Monitoring seepage at the toe of the dam to identify changes in the volume of flow or turbidity in the seepage water.

It is recommended the owner takes action on these recommendations without undue delay.

WOODWARD-CLYDE CONSULTANTS

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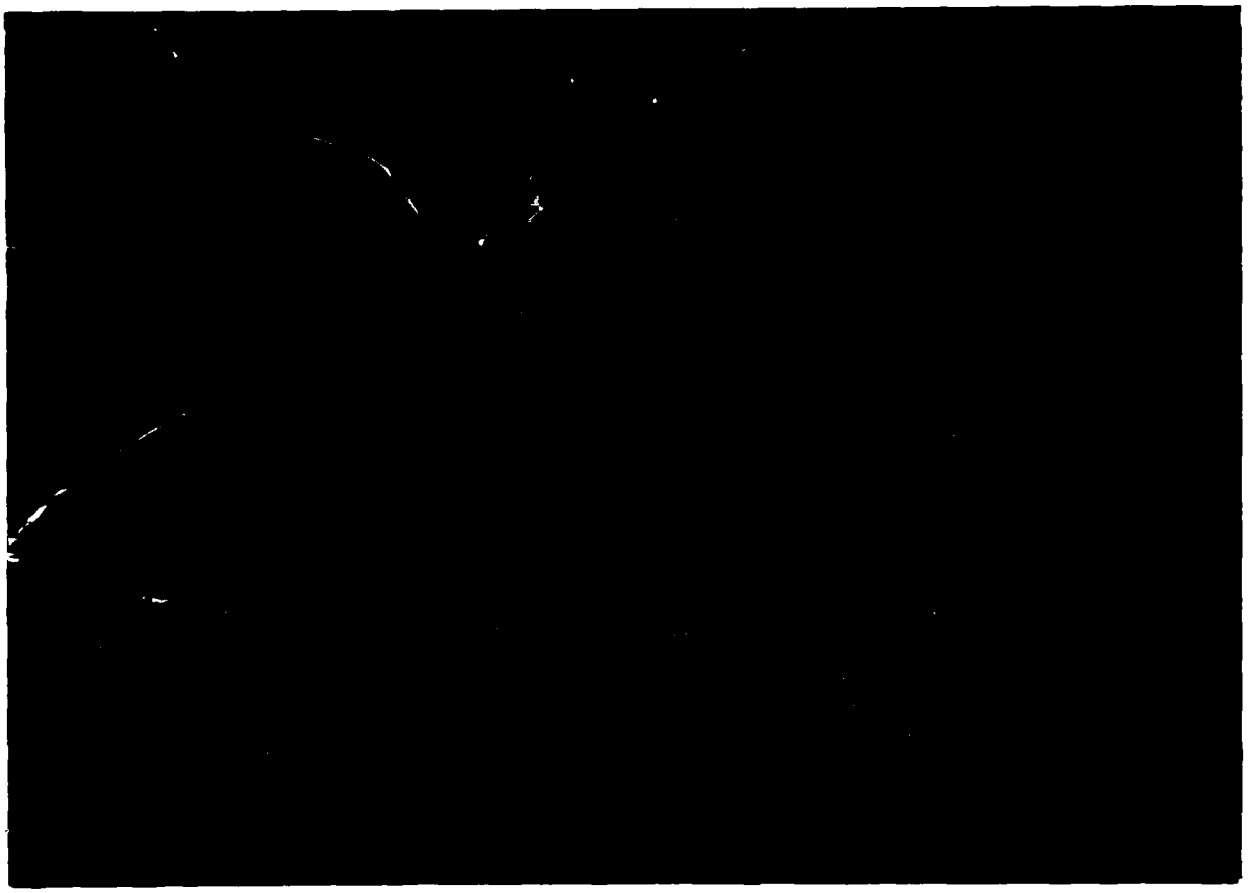

OVERVIEW

MOECKEL DAM

MISSOURI INVENTORY NUMBER 30476

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
MOECKEL DAM, MISSOURI INVENTORY NO. 30476
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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
MOECKEL DAM, MISSOURI INVENTORY NO. 30476

SECTION 1
PROJECT INFORMATION

1.1 General

a. **Authority.** The National Dam Inspection Act, Public Law 92-367, provides for a national inventory and inspection of dams throughout the United States. Pursuant to the above, an inspection was conducted of the Moeckel Dam (Mononame 266), Missouri Inventory Number 30476.

b. **Purpose of Inspection.** "The primary purpose of the Phase I investigation program is to identify expeditiously those dams which may pose hazards to human life or property... The Phase I investigation will develop an assessment of the general condition with respect to safety of the project based upon available data and a visual inspection, determine any need for emergency measures and conclude if additional studies, investigations and analyses are necessary and warranted" (Chapter 3, "Recommended Guidelines for Safety Inspection of Dams").

c. **Evaluation criteria.** The criteria used to evaluate the dam were established in the "Recommended Guidelines for Safety Inspection of Dams", Engineering Regulation No. 1110-2-106 and Engineering Circular No. 1110-2-188, "National Program for Inspection of Non-Federal Dams," developed by the Office of Chief of Engineers, Department of the Army, and "Hydrologic/Hydraulic Standards, Phase I Safety Inspection of Non-Federal Dams", prepared by the St Louis District, Corps of Engineers (SLD). These guidelines were developed with the help of several federal agencies and many state agencies, professional engineering organizations, and private engineers.

1.2 Description of Project

a. **Description of dam and appurtenances.** The Moeckel Dam is an abandoned barite tailings dam. Although its construction appears typical of other barite tailings dam in the area, it is not typical of dams constructed for the impoundment of water. The unique nature of these tailings dams has a significant impact on their evaluation. A brief description of their construction and usage is necessary to highlight the differences between a tailings dam and conventional water-retaining dams.

At the start of a barite mining operation a 10 to 20-ft high starter dam is usually first constructed across a natural stream channel. Generally the streams are intermittent so that construction is carried out in the dry. Trees and other vegetation are removed from the dam site and a cutoff is often made to shallow bedrock. Locally obtained earth, usually a gravelly clay, is then typically placed to form the embankment. Compaction is generally limited to that provided by the equipment.

The barite ore is contained within the residual gravelly clay which is mined with earth-moving equipment. At the processing plant, the ore is washed to loosen and remove the soil. This water is obtained from the reservoir area behind the dam. The soil-laden wash water and water from other steps in the process is then discharged into the reservoir. There the soil is deposited by sedimentation and the water is recycled. Another step in the process removes the broken gravel-sized waste which is called "chat".

As the level of the fine tailings increases, the dam is raised. The usual method is to place chat, by dumping, on the dam crest. Then the chat is spread over the crest so that a relatively constant crest width is maintained as the dam is raised. Generally the crest centerline location is also maintained. However, the crest centerline location may migrate upstream if there is insufficient chat available and downstream if an excessive quantity of chat is available. The latter is uncommon, because it is indicative of a poor ore deposit.

This method of construction results in slopes which are close to the natural angle of repose for the chat. They can be considered to be near a state of incipient failure.

A large quantity of water is required for a processing operation, on the order of 2000 to 5000 gal/min. Thus it has been the operators' practice to construct the dam so that all inflow to the reservoir is recycled in order to have sufficient water for the operation. The result is that formal spillways or regulating outlets are generally not constructed. In most cases a low point on or near the dam is provided, should the storage capacity be exceeded.

The fine tailings typically fill more than 80 percent of the total storage volume. This results from the operator's practice of maintaining only a 2 to 5 ft elevation differential between the level of the tailings and the dam crest. The differential is usually greater further away from the discharge point and also typically further away from the dam.

The geotechnical characteristics of the fine tailings are somewhat similar to recent lacustrine clay deposits. Where the tailings have been continuously submerged, they have a very soft consistency and high water content. When evaporation causes the water level to recede and the tailings are exposed, a stiff crust forms as the tailings dry out. Below the crust, the tailings retain their soft consistency for long periods of time. The consistency is very gradually modified by a slow process of consolidation.

The configuration of the Moeckel Dam is generally typical of other barite tailings dams in the area. One exception to its typical configuration, however, is the very steep downstream slope, on the order of 1.3(H) to 1(V). Other tailings dams have slopes of approximately 1.5(H) to 1(V). Also the downstream face of the dam is very densely vegetated, more so than is usual for barite tailings embankments in this area.

There are no regulating outlets other than the ungated, unlined informal spillway at the left abutment (as the observer faces downstream).

b. **Location.** The dam is located on an unnamed tributary of Mine à Breton Creek, approximately 3 miles northwest of Potosi, in Washington County, Missouri (Fig 1). The dam is located in mineral surveys 1873 and 430, T38N, R2E, on the USGS Potosi 7.5-minute quadrangle map.

c. **Size classification.** The dam is classified as intermediate due to its approximately 85 ft height and storage volume of about 1340 ac-ft. The intermediate size classification includes dams between 40 and 100 ft in height, or having a storage capacity between 1000 and 50,000 ac-ft.

d. **Hazard classification.** The St Louis District, Corps of Engineers (SLD), has classified this dam as having a high hazard potential; we concur with this classification. The damage zone length estimated by the St Louis District extends approximately 16 miles downstream of the dam. Although this zone is rural and sparsely populated, several occupied dwellings, the Missouri-Pacific Railroad, and several Missouri State Highways are located in this downstream hazard zone (Photos 9 and 10).

e. **Ownership.** It is our understanding that the dam is owned by Mr and Mrs Emil Moeckel, 11636 Spry Street, Norwalk, California, 90650. Correspondence should be sent to that address.

f. **Purpose of dam.** The dam was constructed to impound fine barite tailings and the process water. It is currently abandoned.

g. **Design and construction history.** Neither the present owner nor previous owners have records concerning the design and construction of this dam. It was reported by Mr Walter Hornsey, a previous owner, to have been constructed beginning in 1953 and finished in 1962. Its construction was reported as typical of tailings dams in the area, as described in Section 1.2a.

h. **Normal operating procedures.** The dam is currently abandoned and has been abandoned for approximately 18 years. There are no operating procedures in effect at this facility.

1.3 Pertinent Data

a. **Drainage area.** Approximately 1.26 mi^2

b. **Discharge at damsite.**

Maximum known flood at damsite	Unknown
Warm water outlet at pool elevation	N/A
Diversion tunnel low pool outlet at pool elevation	N/A
Diversion tunnel outlet at pool elevation	N/A
Gated spillway capacity at pool elevation	N/A
Gated spillway capacity at maximum spillway capacity	N/A
Ungated spillway capacity at maximum pool elevation	No formal spillway
Total spillway capacity of maximum pool elevation	No formal spillway

c. **Elevations (ft above MSL).**

Top of dam	858 to 867, averages 864
Maximum pool - design surcharge	N/A
Full flood control pool	N/A
Recreation pool	N/A
Spillway crest (gated)	N/A
Upstream portal invert diversion tunnel	N/A
Downstream portal invert diversion tunnel	N/A
Streambed at centerline of dam	Unknown
Toe of dam at maximum section	779
Maximum tailwater	N/A

d. **Reservoir.**

Length of maximum pool	Approximately 3320 ft
Length of recreation pool	N/A
Length of flood control pool	N/A

e. **Storage (acre-feet).**

Recreation pool	N/A
Flood control pool	N/A
Design surcharge	N/A
Top of dam	1340

f. **Reservoir surface (acres).**

Top of dam	94
Maximum pool	94
Flood control pool	N/A
Recreation pool	N/A
Spillway crest	94

g. **Dam.**

Type	Barite tailings
Length	Approximately 1585 ft
Height	85 ft
Top width	25 to 30 ft
Side slopes	D/S 1.3(H) to 1(V); U/S unknown
Zoning	Unknown (probably none)
Impervious core	Unknown (probably none)
Cutoff	Unknown (probably trench to shallow bedrock)
Grout curtain	Unknown (probably none)

h. **Diversion and regulating tunnel.**

Type	None
Length	N/A
Closure	N/A
Access	N/A
Regulating facilities	N/A

i. **Spillway.**

Type	Low area on crest of dam at left abutment (no formal spillway)
Length	Approximately 152 ft

Crest elevation	857.8 ft
Gates	None
Upstream channel	None
Downstream channel	Unlined earth, densely vegetated

j. **Regulating outlets.** None

SECTION 2
ENGINEERING DATA

2.1 Design

No design drawings or data were found for this dam.

2.2 Construction

No construction records or data were found for this dam. Construction was likely as described for typical barite tailings dams, Section 1.2a.

2.3 Operation

No records were found for reservoir water elevation or spillway discharge history. The dam is currently abandoned.

2.4 Evaluation

a. **Availability.** No data were available for review.

b. **Adequacy.** Insufficient data were available to determine the adequacy of the design.

Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" are not on record. These analyses should be performed by an engineer experienced in the design and construction of dams. Further, these seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

c. **Validity.** Not applicable.

2.5 Project Geology

The dam is located on the northern flank of the Ozark structural dome. The bedrock in the area is mapped on the Geologic Map of Missouri (1979) as Potosi and Eminence dolomite formations (Fig 4). The Potosi Formation consists of light gray, medium- to fine-grained siliceous dolomite and typically contains an abundance of quartz druse characteristic of chert bearing formations. The Eminence Formation conformably overlies the Potosi Formation, is similar in appearance but contains less chert and quartz. Some large springs and caves have been noted in the Eminence Formation in other parts of Missouri; however, no evidence of springs or solution activity was noted during the visual inspection of the dam site.

The soil in the vicinity of the dam site is a dark red-brown to tan, plastic residual clay (CL-CH) characteristically developed on the Potosi Formation. The soil contains quartz druse gravel typical of soils on the Potosi Formation. This residual soil is locally overlain by a thin (2 to 5 ft) loess profile of clay and silt (ML). The soils in this area are mapped on the Missouri General Soils Map as Union-Goss-Gasconade-Peridge Association.

The Aptus Fault is mapped on the Geologic Map of Missouri (1979) approximately 3/4 mi southwest of the dam (Fig 4). However, the scale of the map (1 in. equals 8 mi) does not allow for precise location of the fault trace. No evidence of the fault was noted during the field inspection. The fault is approximately 15 miles long, trending northwest-southeast, and is mapped as northeast side up.

This fault, like others in the Ozark region, appears confined to the Paleozoic bedrock and is likely Paleozoic in age. The area is not considered seismically active, and the fault is not considered to pose a significant hazard to the dam.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. General. The Moeckel Dam was inspected on 16 August, 1980, without the owner's representative present. The results of this visual inspection indicate the dam is in generally poor condition.

b. Dam. The Moeckel Dam is an abandoned barite tailings dam that borders the impoundment area on the north. A well-maintained gravel road runs along the dam crest (Photo 1) and continues around the impoundment area.

The embankment is composed of gravel-sized tailings, or chat, consisting of coarse sand and fine gravel (GW-SW). Bullrock, the coarsest tailings fraction, from 6 in. to 2 ft in diameter, has been dumped on the downstream face of the embankment (Photos 2 and 3). The downstream and upstream slope of the dam are very heavily vegetated, to the point that most of the embankment is obscured from view (see Overview photograph). The dense vegetation on the upstream face appears to preclude the need for any other erosion protection, since the water surface appears to reach the upstream face only on infrequent occasions.

The configuration of the downstream face is noteworthy as it is extremely steep, on the order of 1.3(H) to 1(V). Other tailings dams in the area have slopes in the range of 1.4 to 1.7(H) to 1(V), which appears to be the angle of repose for the chat at the various mines. It appears that the bullrock, which forms the upper portions of the slope, has resulted in construction of an oversteepened slope which is likely only marginally stable. Several areas were noted where portions of the bullrock had slumped to the toe of the dam, apparently as a result of this oversteepened configuration. It appears that overtopping and erosion on the downstream face would likely result in additional slope failures due to the extreme steepness. The material comprising the slope is judged to be moderately to highly erodible, depending on particle size and steepness in specific locations.

In areas where the dam could be observed through the dense vegetation, the embankment appeared to be in reasonably satisfactory condition. There was no evidence found of displacement of the vertical or horizontal alignment of the crest, cracking, settlement, animal burrows, or sinkhole development. The only evidence of erosion noted was the small, localized slumping of the bullrock slope noted earlier; however, examination of much of the face of the dam was hindered from satisfactory observation by the very dense vegetation.

No significant seepage was noted along the toe of the dam. However, very dense vegetation at and beyond the toe of the dam prevented a detailed visual inspection of much of the area at the toe. The water impounded in the reservoir at the time of our inspection was located a substantial distance upstream of the dam (see Overview Photo).

c. **Appurtenant structures.** The informal spillway at the left abutment is the only appurtenant structure identified at this facility. This informal spillway consists of a low area, crossed by the gravel road, at the junction of the dam and left abutment (Photo 4). It is a wide trapezoid in shape, roughly 150 ft wide at the elevation of the crest of the dam (see Fig. 3). There are no low level outlets nor any control structures in this spillway. No evidence of any recent overflow through the spillway was noted during the field inspection, but grading and traffic on the road, and dense vegetation upstream and downstream of the road may have obscured this evidence. Erosion in the downstream discharge channel indicates evidence of some spillway flows in the past, but growth of vegetation indicates that such events were not recent. The roadway embankment and in situ soil in the spillway appear to be moderately to highly erodible in the event of flood flows through this spillway area.

d. **Reservoir area.** The reservoir area is nearly filled with fine tailings produced from the processing of the barite ore (Overview Photo). The tailings consist of fine sand, silt, and clay. The present elevation difference between the fine tailings and the top of the main dam embankment is of the order of 8 ft.

Only a relatively small portion of the impoundment area held water at the time of the visual inspection. The central part of the impoundment held a shallow pond, containing dead tree trunks and surrounded by grassy to bushy vegetation. The area adjacent to the dam was densely vegetated with mature trees to 24 in. diameter and heavy brush (Photo 5). The limit of the area of live large trees appeared to be the historical high water line for the reservoir, but was indistinct.

The slopes surrounding the reservoir are quite flat, 5(H) to 1(V) or flatter. No evidence of unstable slopes was noted during the inspection. Several new homes have been built in the area upstream of the reservoir, but sedimentation from grading in this area is insignificant relative to the volume of tailings deposited in the impoundment.

e. **Downstream channel.** The downstream channel below the informal spillway is a broad earth-lined swale running down the hillside to a narrow (6 to 8 ft wide) channel. This narrow channel is bordered by the natural hillside and a low earth dike (3 to 5 ft high) apparently pushed up to contain the discharge. If the dike is overtopped or eroded, discharge would apparently run along the toe of the dam, possibly causing erosion at the toe of the very steep slope.

The soils comprising the channel are the in situ residual clay and gravel soils and appear to be moderately to highly erodible. Substantial flows would likely result in erosion of both the bottom and the walls of the existing channel and could result in channel migration toward the toe of the dam.

The downstream channel is congested and obstructed for most of its length. The upper end, near the spillway, supports a dense growth of weeds and brush (Photo 6). The middle and lower reaches contain brush and small to large trees (Photos 7 and 8). There is a significant potential for obstruction and diversion of the discharge during flood events.

3.2 Evaluation

The visual inspection indicates the dam is in generally poor condition. The reservoir, embankment, and downstream areas are densely vegetated and inspection of much of the face and toe of the dam was hindered.

The downstream face of the embankment appears excessively steep, on the order of 1.3(H) to (1(V). Some erosion has already occurred and additional minor sloughing and erosion of the bullrock slope are anticipated. The embankment materials appear moderately erodible. Overtopping by flood waters or erosion at the toe would likely cause significant erosion and could result in failure of the dam.

The informal spillway consists of moderately to highly erodible materials and could be subject to significant erosion in the event of flood flows through the spillway.

The downstream channel appears to be obstructed by brush and trees. Flood flows could be diverted out of the existing channel and cause erosion at the toe of the dam.

No evidence of cracking, settlement, sinkhole development or animal burrows was noted during the visual inspection. No significant seepage was noted at the toe of the dam during the inspection.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures

The Moeckel Dam is currently abandoned. There are no operational procedures in effect for this dam. The water level is controlled by the crest of the informal spillway.

4.2 Maintenance of Dam

No records of maintenance on this facility were available. The gravel roadway along the crest of the dam appears to be frequently traveled and maintained.

4.3 Maintenance of Operating Facilities

There are no operating facilities at this dam.

4.4 Descriptions of Any Warning System in Effect

The inspection did not disclose any warning system in effect at this facility.

4.5 Evaluation

There are apparently no maintenance or operational procedures in effect. The lack of regular maintenance and periodic inspection is considered a deficiency.

The feasibility of a practical warning system should be evaluated to alert downstream residents should potentially hazardous conditions develop during periods of heavy precipitation.

SECTION 5
HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

a. **Design data.** No hydrologic or hydraulic design data were available for evaluation of this dam or impoundment. A field survey was conducted 13 August 1980,to obtain the dimensions of the dam. Other relevent data were measured during the visual inspection or estimated from topographic mapping. The map used in the analysis was the USGS Potosi, Missouri 7.5-minute quadrangle map (1958).

b. **Experience data.** No recorded history of rainfall, runoff, discharge or pool stage data were found for this reservoir or drainage area.

c. **Visual inspection.**

1. Watershed. Mature forest, second growth brush and woods, and previously mined-out areas comprise the majority of the drainage area. The area of the reservoir is approximately 9 percent of the total drainage area of 1.26 mi^2.

2. Reservoir. The reservoir and dam are best illustrated by maps and photographs enclosed herewith. This impoundment was constructed for the storage of mine tailings.

3. Spillway. No formal spillway exists for this dam. The lowest portion of the embankment is at the left abutment. This low area is expected to serve as the informal spillway in the event of high water within the reservoir. No evidence of recent outflow at this low area was found during the field inspection, but some flows have taken place in the past.

4. Seepage. The magnitude of seepage through this dam is not hydrologically significant to the overtopping potential.

d. **Overtopping potential.** A primary consideration in the evaluation of Moeckel Dam is the assessment of the potential for overtopping and consequent failure by erosion of the embankment. Since there is no formal spillway, substantial discharge is considered to produce the effects of overtopping. Discharge such as has apparently occurred in the past has caused some erosion in the downstream discharge channel, but posed no substantial safety threat to the dam. However, significant outflow for a long period of time, such as would occur for a large fraction of the Probable Maximum Flood (PMF), would likely erode or overtop the downstream channel and could cause erosion of the main part of the embankment and could lead to failure of the embankment. The PMF is defined as the flood event that may be expected to occur from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

For the 50 and 100 percent of the PMF, the starting water surface elevation was set equal to the lowest top-of-dam elevation of 857.8 ft since it is assumed that the antecedent storms would have resulted in a full reservoir. For the 1 and 10 percent probability-of-occurrence events, the starting water elevation was the high water mark in the reservoir, i.e. elevation 854.0. The results of the analysis indicate that a flood of greater than 13 percent of the PMF will overtop the dam at the informal spillway.

A flood with 10 percent probability-of-occurrence should not cause the dam to be overtopped. A flood with 1 percent probability-of-occurrence may overtop the informal spillway by approximately 0.8 ft.

The following table summarizes the hydrologic analysis for this dam:

Precipitation Event	Maximum W.S. Elevation, ft	Maximum Depth of Overtopping, ft	Maximum Outflow ft^3/sec	Duration of Overtopping, hr
1% Prob	858.6	0.8	50	7.5
13% PMF	857.8	0	0	0
14% PMF	858.0	0.2	1	5.2
50% PMF	861.7	3.9	2700	48.0
100% PMF	863.0	5.2	6150	48.0

Input data and output summaries for the hydrologic and hydraulic analyses summarized in this table are presented in Appendix B.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. **Visual observations.** The visual inspection of the Moeckel Dam revealed no evidence of horizontal or vertical displacement of the dam crest alignment. No signs of cracking, or detrimental settlement, animal burrows or sinkhole development were observed. Small localized slumps of the bullrock slope were noted at several locations on the downstream face of the dam. The downstream face of the dam was very steep, on the order of 1.3(H) to 1(V). This appears steeper than the angle of natural repose for "chat" tailings in this area, and suggests the slope is only marginally stable. The steep configuration is assumed to be due to the localized accumulations of bullrock.

b. **Design and construction data.** No design or construction data relating to the stability of the dam were available. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.

c. **Operating records.** The dam is currently abandoned and no operating records are available.

d. **Post construction changes.** The lack of design drawings or construction reports precludes identification of post construction changes. The only obvious change is the growth of the dense vegetation on the downstream face and in the impoundment area. No other changes were identified at this facility, except for the maintenance of roadways.

e. **Seismic stability.** The dam is in Seismic Zone 2, to which the guidelines assign a moderate seismic damage potential. Since no static stability analysis is available for review, the seismic stability cannot be evaluated. However, as the tailings are fine-grained, saturated material and the embankment consists of loose, granular material, it is expected that substantial deformation or failure of the embankment could occur in the event of a severe seismic event.

SECTION 7
ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment

a. **Safety.** Based on the visual inspection and analysis of the available data, the Moeckel Dam is judged to be in poor condition. The inadequate and informal spillway, very steep downstream slope, potential obstructions in the downstream channel, high erodibility of the embankment and downstream channel materials, and lack of periodic inspections are the primary reasons for this judgment.

Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" are not on record, which is considered a deficiency.

As a consequence of the widely-used construction procedure, the downstream slopes of the tailings dams are placed at the angle of natural repose for the "chat" material at any given operation. This results in slopes that are very steep and exist in a state close to incipient failure with safety factors close to one. This situation is subject to some gradual improvement with time as consolidation and/or desiccation of upstream fine-grained tailings results in an increase in strength thus reducing the lateral pressures on the embankment.

The slopes placed at the angle of natural repose will only remain stable, if they are protected against potential harmful changes, among which are:

1. Overtopping by water,
2. Higher pore pressures (or seepage forces),
3. Undercutting of the toe of the slope by erosion or mining activity,
4. Increase in the height of the slope,
5. Harmful effects of vegetation (particularly tree roots),
6. Liquefaction (such as may result from a seismic event).

The first five changes are subject to some control by owners and operators and must receive careful attention under the guidance of a professional engineer experienced in the design and construction of rockfill dams, in order to maintain stable and safe dam embankment. The sixth influence represents a risk the magnitude of which is not well understood without further study.

b. **Adequacy of information.** The lack of stability and seepage analyses for the dam as recommended in the guidelines precludes an evaluation of the structural and seismic stability of the dam. This is considered a deficiency.

c. **Urgency.** The deficiencies described in this report could affect the safety of the dam. Corrective actions should be initiated without undue delay.

d. **Necessity for Phase II.** In accordance with the "Recommended Guidelines for Safety Inspections of Dams", the subject investigation was a minimum study. This study revealed that additional, in-depth investigations are needed to complete the assessment of the safety of the dam. Those investigations which should be performed without undue delay are described in Section 7.2b. It is our understanding from discussions with the St Louis District that any additional investigations are the responsibility of the owner.

7.2 Remedial Measures

a. **Alternatives.** There are several general options which may be considered to reduce the possibility of dam failure or to diminish the harmful consequences of such a failure. Some of these options are:

1. Remove the dam, or breach it to prevent storage of water.

2. Increase the height of dam and/or construct a formal spillway of sufficient size to pass the Probable Maximum Flood without overtopping the dam. In either case the spillway should be protected to prevent erosion.

3. Purchase downstream land that would be adversely impacted by dam failure and restrict human occupancy.

4. Provide a highly reliable flood warning system (generally does not prevent damage but diminishes chances for loss of life).

b. **Recommendations.** Based on our inspection of Moeckel Dam, it is recommended that a further study be conducted without undue delay to evaluate, as a minimum:

1. What spillway capacity should be provided and in what manner, taking into consideration the high potential erodibility of the embankment materials.

2. Realignment and clearing of the downstream discharge channel and erosion control to mitigate potential for erosion at the toe of the dam.

3. Necessity and feasibility of removing large trees from the face of the embankment. Removal of large trees should be done under the guidance of an engineer experienced in the design and maintenance of earth dams. Indiscriminate clearing could jeopardize the safety of the embankment.

4. Seepage and stability analyses should be performed by a professional engineer experienced in the design and construction of rockfill dams.

c. **O & M procedures.** A periodic inspection program should be implemented for the dam, spillway, and discharge channel. The inspections should include, but not be limited to:

1. Identifying evidence of unstable slopes such as cracking or slumping of the embankment;

2. Identifying erosion at the toe and on the surface of the dam, and;

3. Monitoring changes in seepage volume and turbidity in the seepage water.

The inspection report should include maintenance recommendations. Records of the inspections and necessary maintenance should be kept.

All remedial measures should be performed under the guidance of an engineer experienced in the design and construction of dams.

REFERENCES

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McCracken, Mary H., 1971, Structural Features Map of Missouri: Missouri Geological Survey, Scale 1:500,000.

Missouri Geological Survey, 1979, Geologic Map of Missouri: Missouri Geological Survey, Scale 1:500,000.

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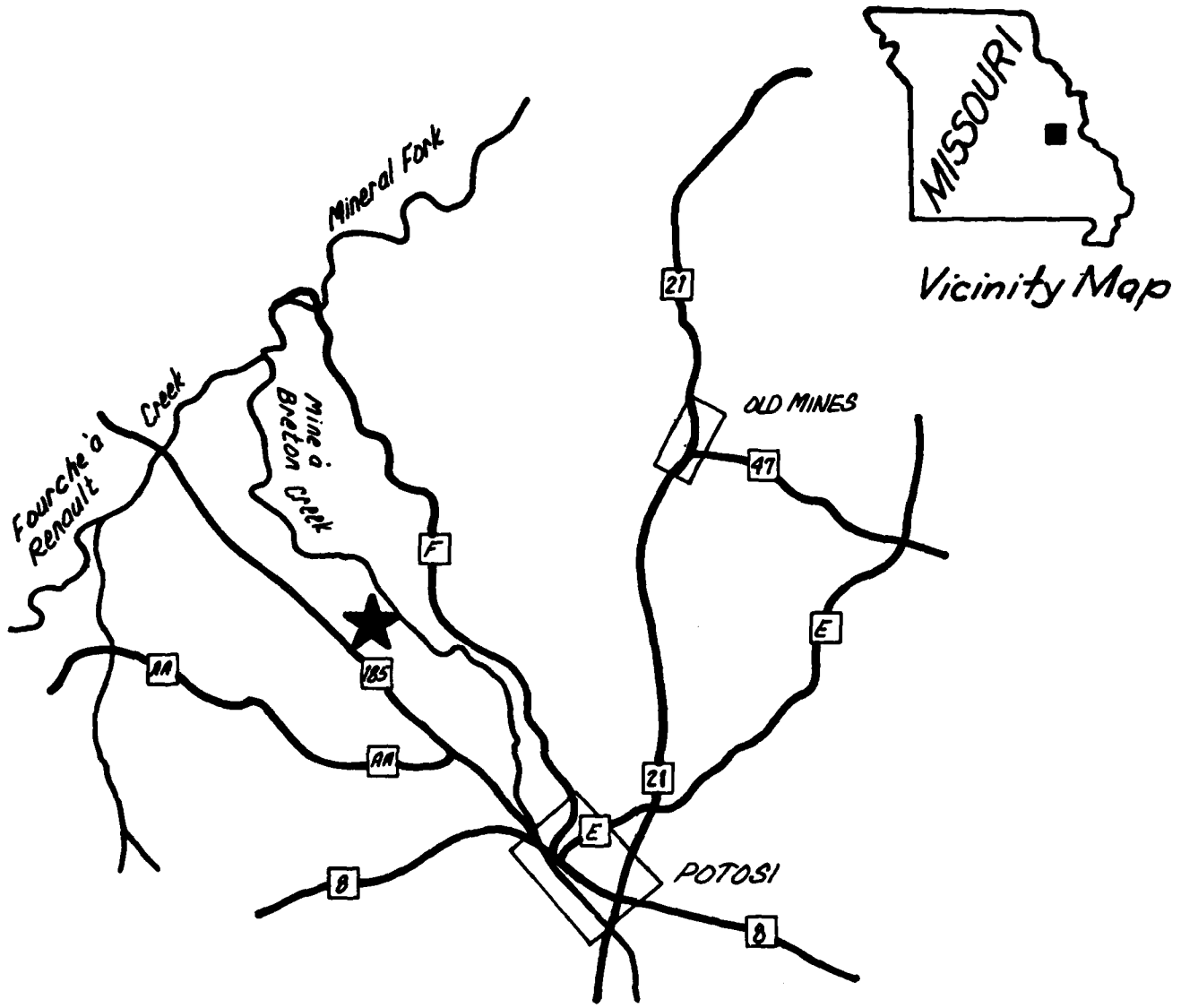
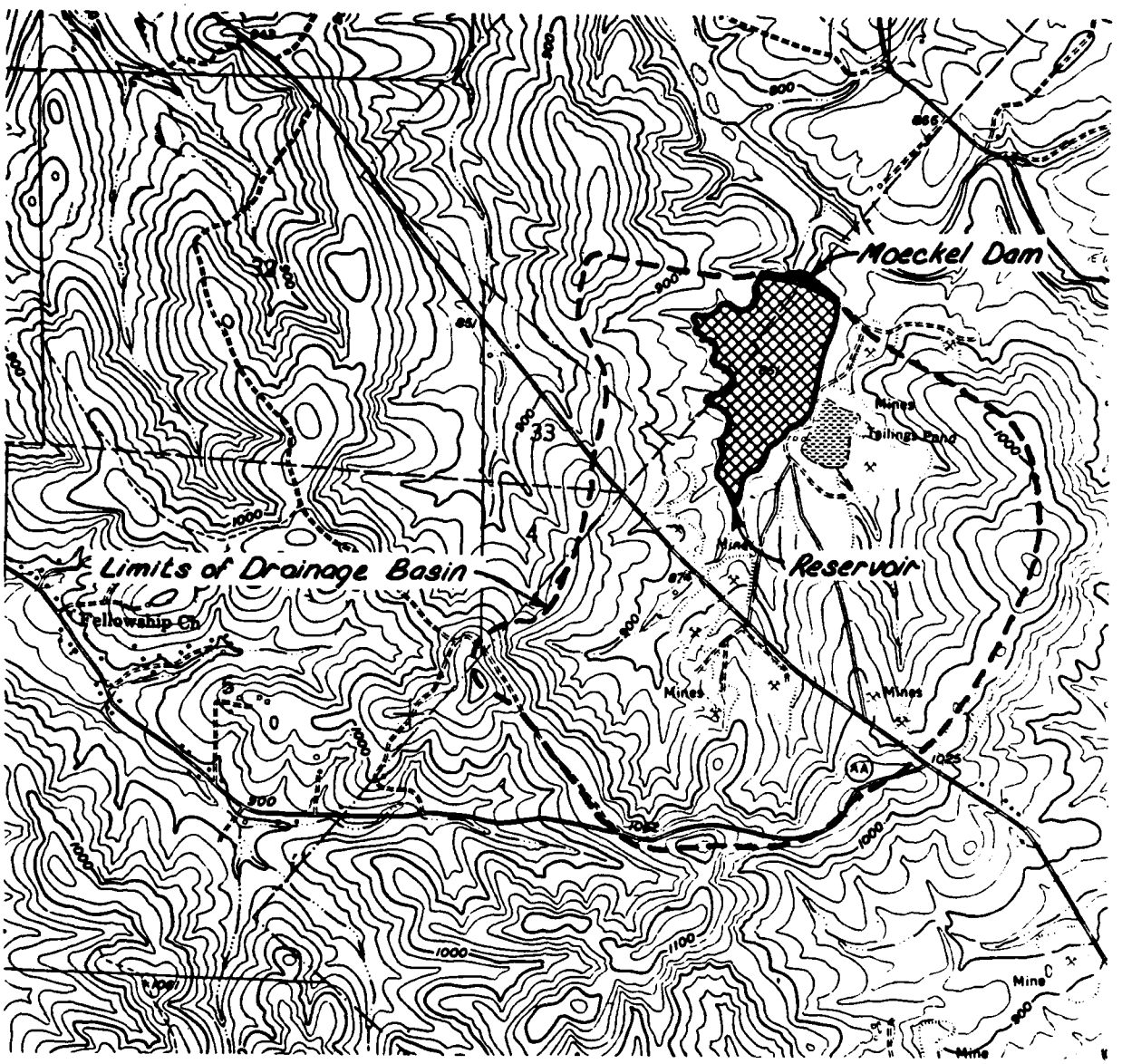
US Soil Conservation Service, 1971, "National Engineering Handbook," Section 4, Hydrology, 1971.

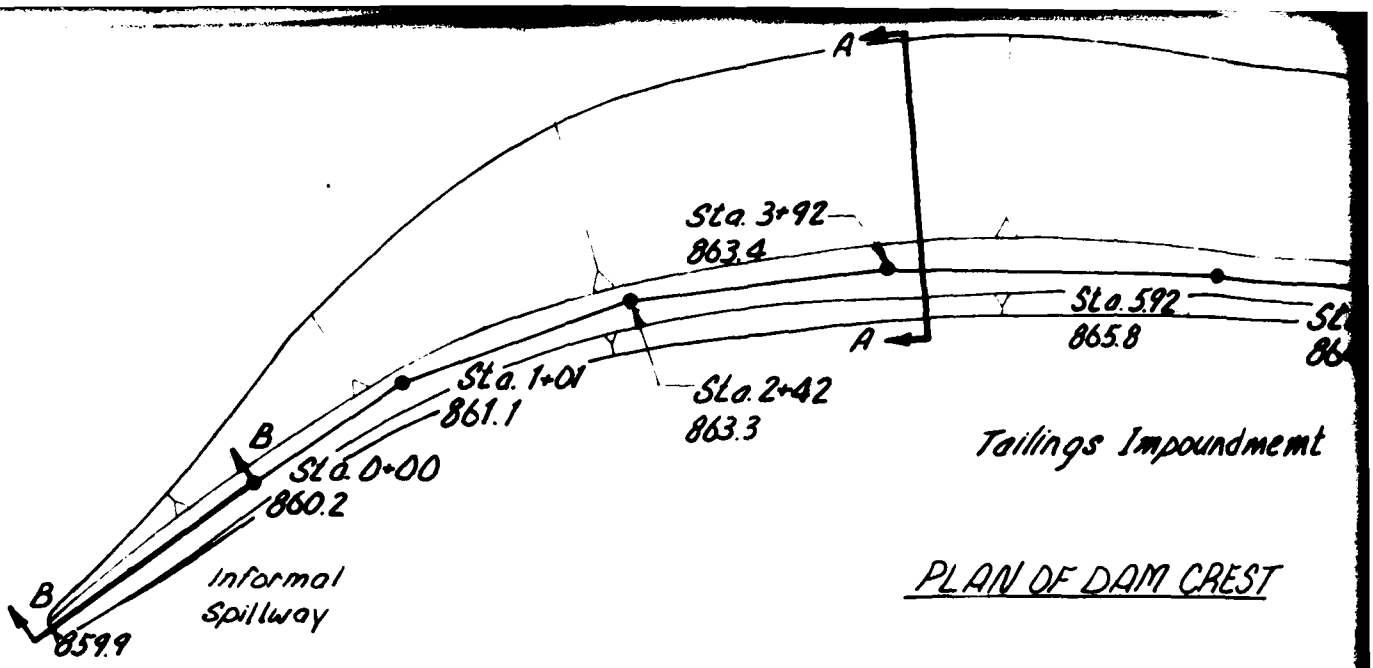


SITE LOCATION MAP	
MOECKEL DAM	
MO 30476	Fig. 1

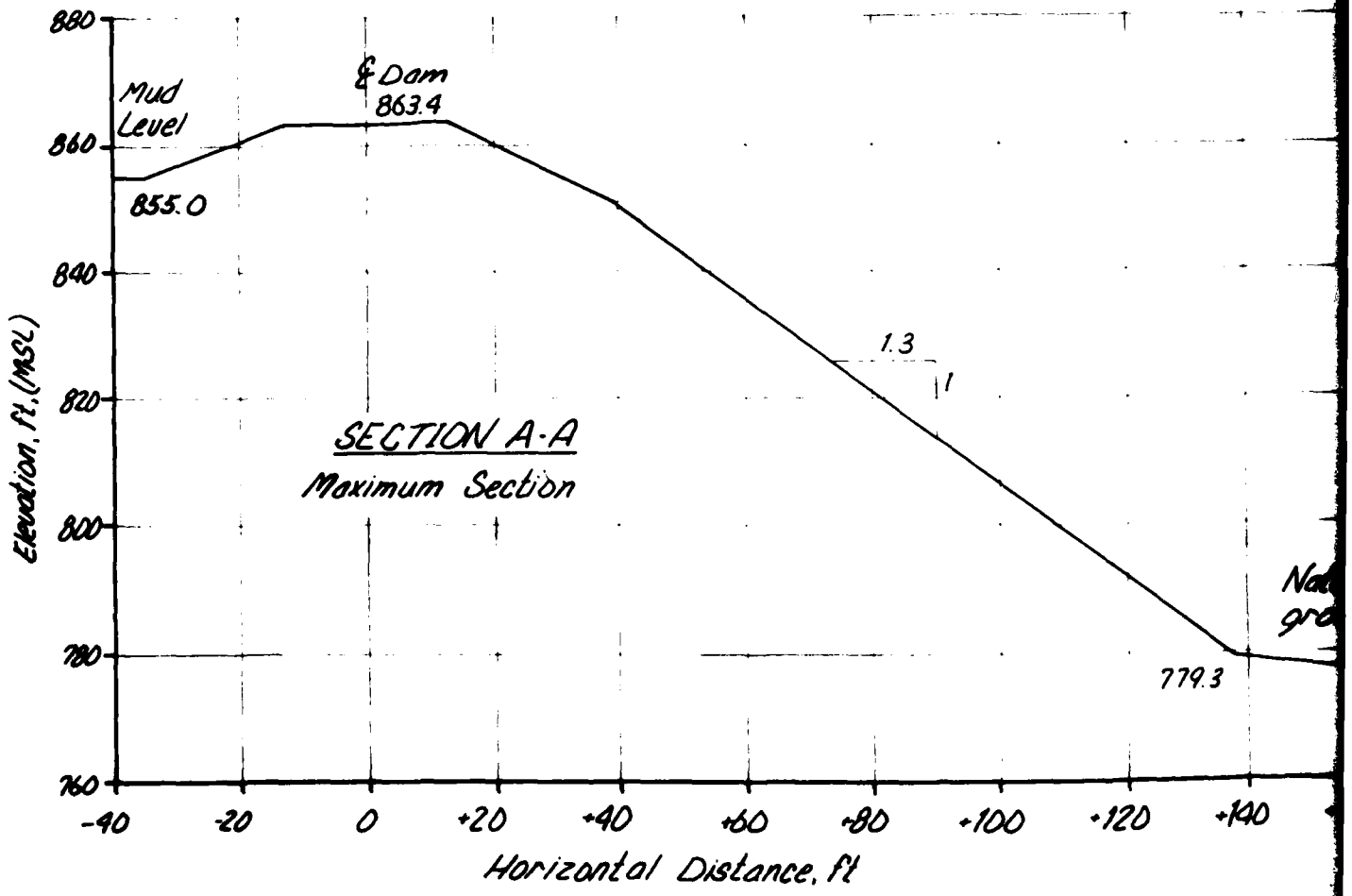


1. Topography from USGS Potosi 7½ minute quadrangle map.

DRAINAGE BASIN AND SITE TOPOGRAPHY	
MOECKEL DAM	
MO 30476	Fig. 2

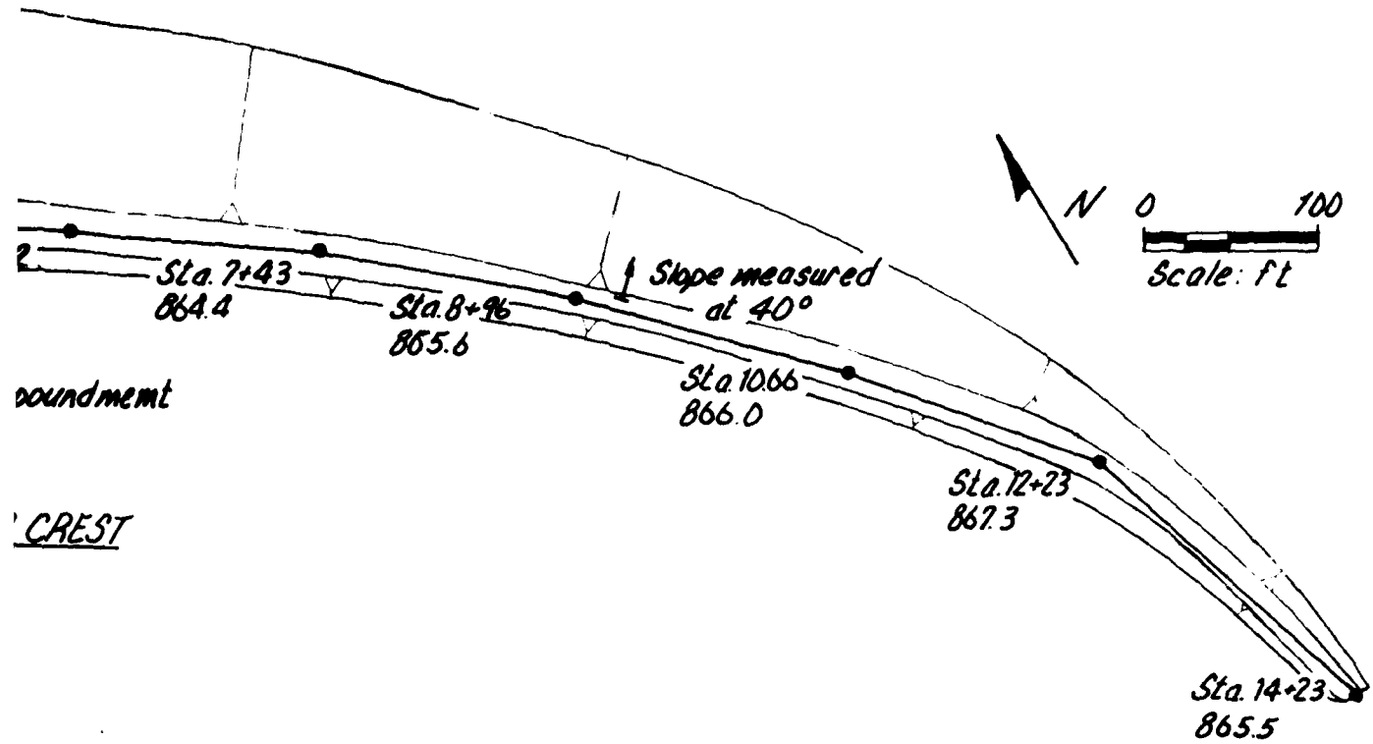


PLAN OF DAM CREST



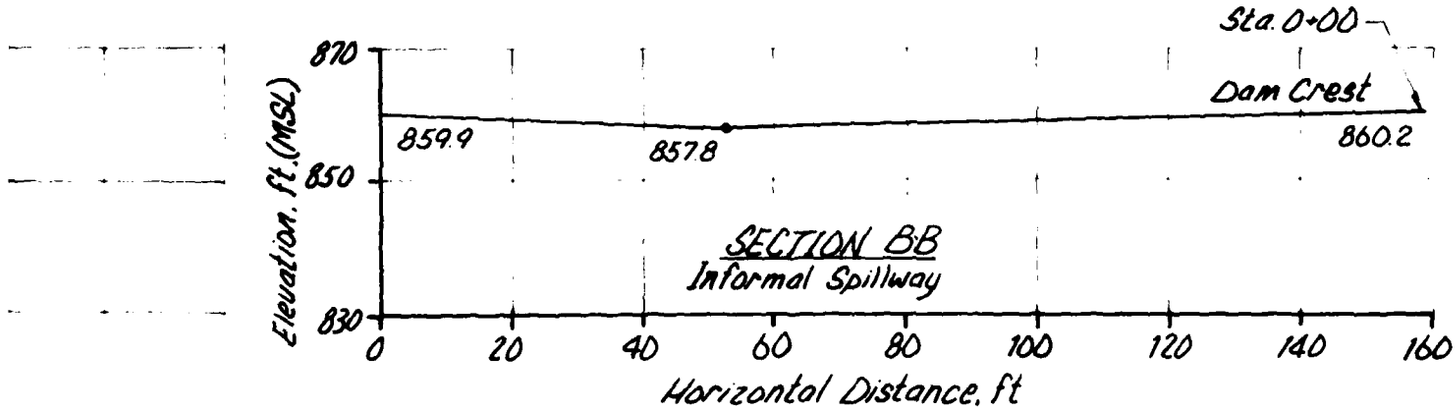
SECTION A-A

Maximum Section

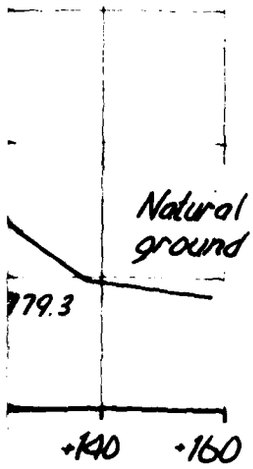


oundment

CREST

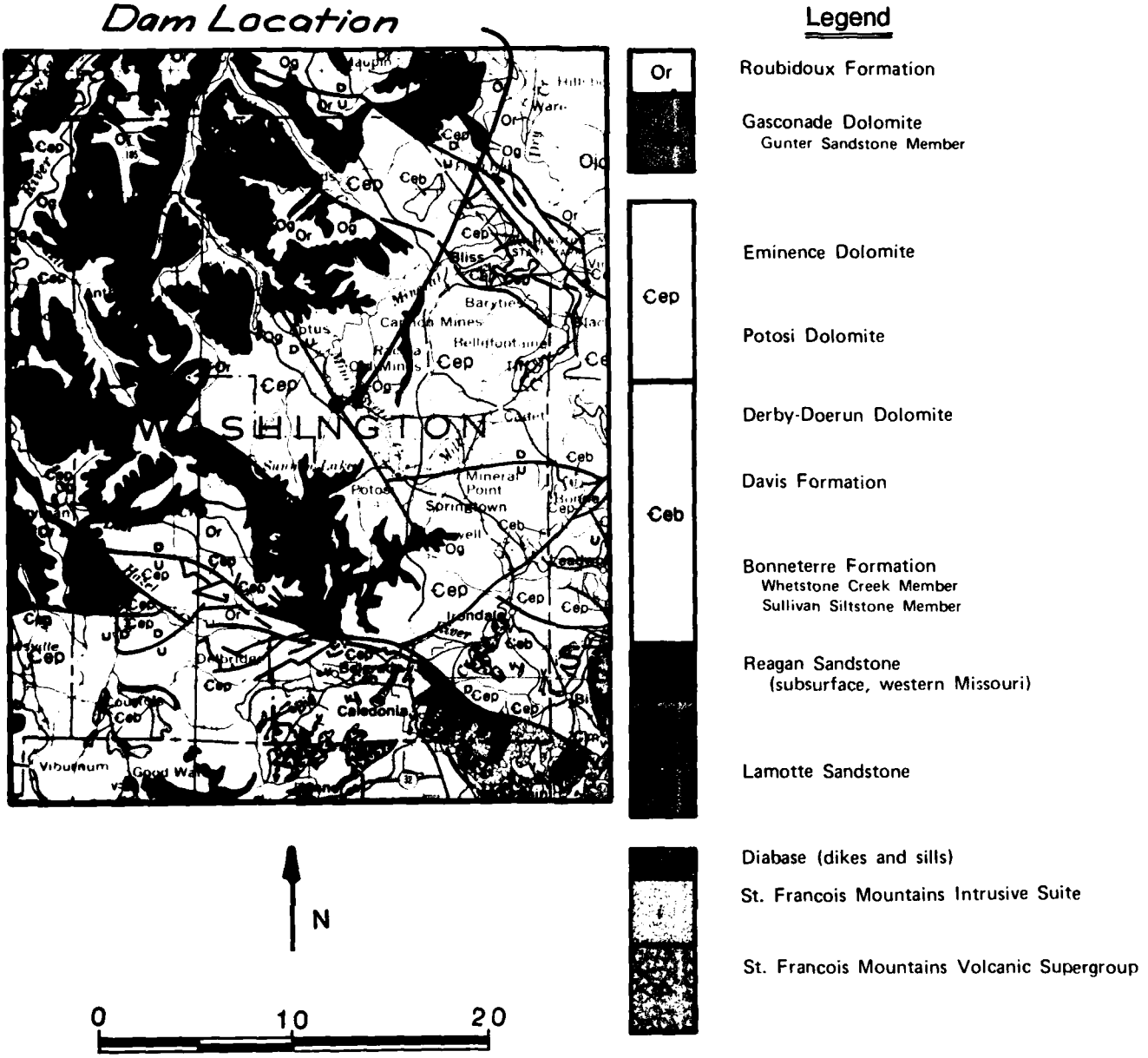


SECTION BB
Informal Spillway



PLAN OF DAM CREST AND SECTIONS	
MOECKEL DAM	
MO 30478	FIG. 3

2



REGIONAL GEOLOGIC MAP

MOECKEL DAM

MO 30476 | **Fig. 4**

APPENDIX A

Photographs

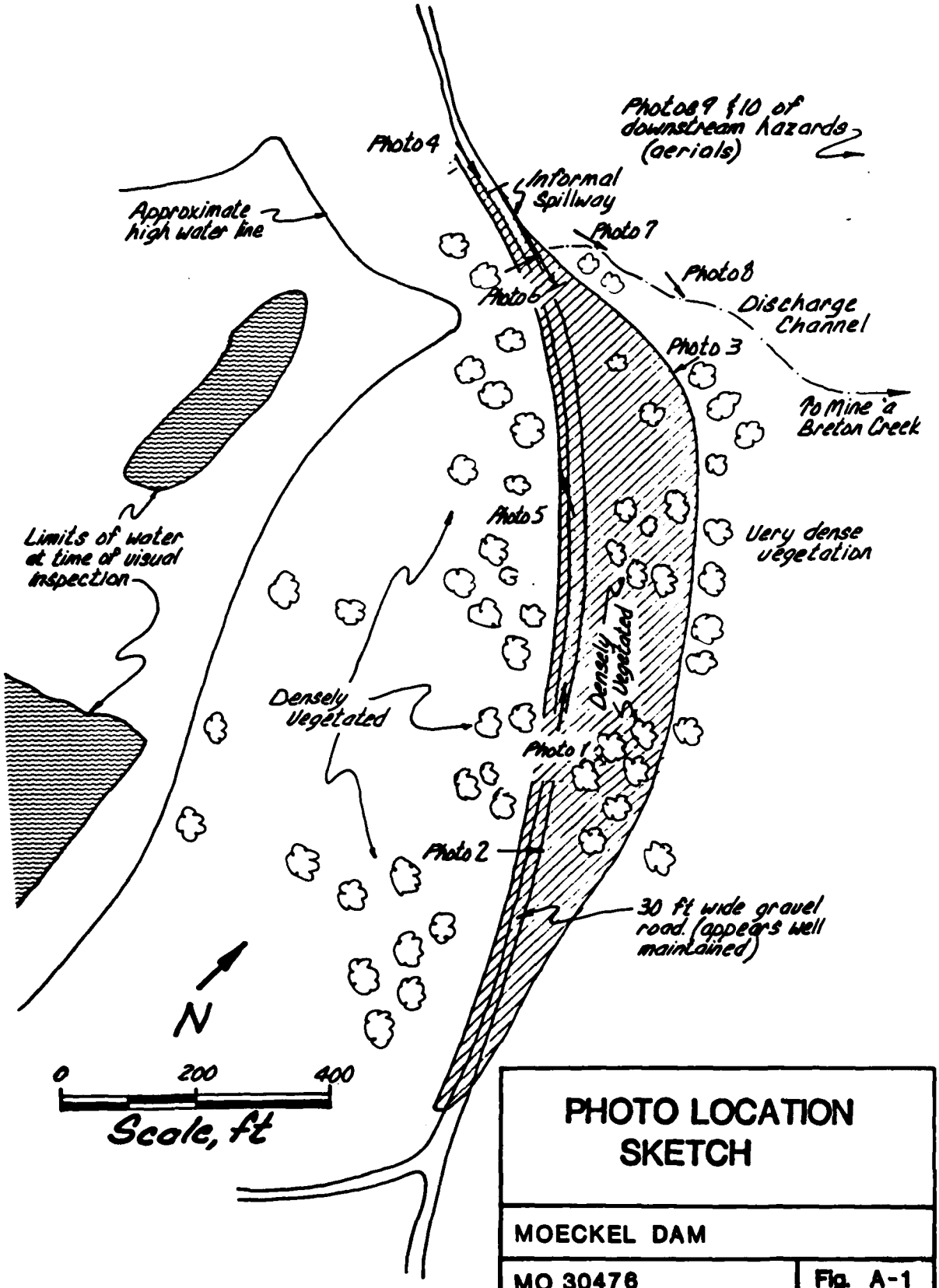


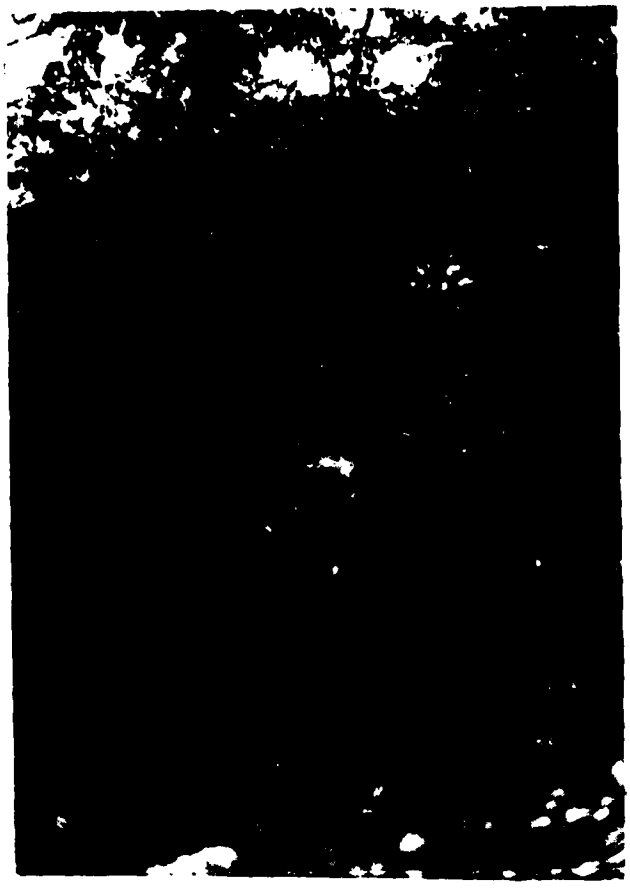
PHOTO LOCATION SKETCH

MOECKEL DAM

MO 30476 | Fig. A-1

1. Gravel road on crest of dam. Looking northwest. Impoundment to the left.

2. Bullrock and dense vegetation on the downstream face of the dam. Looking north from the crest of the dam.



3. Bullrock slope from toe of dam. Note dense vegetation obscures overall view of dam. Looking south (upstream).

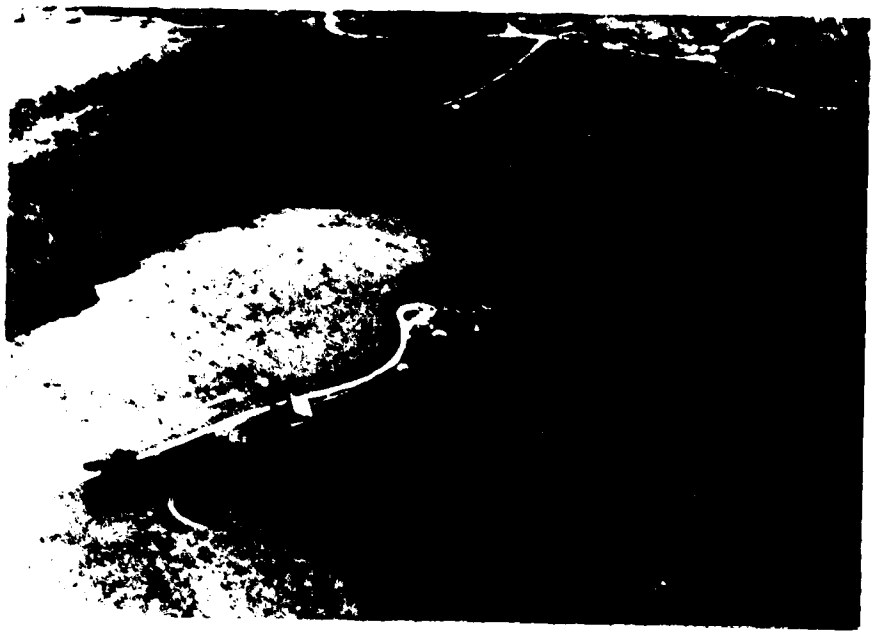
4. Informal spillway at left abutment. Car is parked in low area at center of overflow area. Looking east. Impoundment is to the right.

5. Vegetation in impoundment area adjacent to the crest of dam. Looking west-southwest from dam crest.

6. Brushy vegetation in downstream channel immediately downstream of informal spillway (foreground). Looking north, (downstream).

7. Dense brush and tree vegetation in middle reaches of downstream channel. Looking north (downstream).

8. Dense vegetation in lower reaches of downstream channel. Channel lies between observer standing on left bank and soil dike pushed up on right, visible through vegetation along right of photo. Looking northeast, (downstream).



9. Downstream hazards below Moeckel Dam. Looking southeast. Dam in upper right corner of photo.

10. Typical structures in downstream hazard zone below dam.

APPENDIX B

Hydraulic/Hydrologic Data and Analyses

APPENDIX B
Hydraulic/Hydrologic Data and Analyses

B.1 Procedures

a. General. The hydraulic/hydrologic analyses were performed using the "HEC-1, Dam Safety Version (1 Apr 80)" computer program. The inflow hydrographs were developed for various precipitation events by applying them to a synthetic unit hydrograph. The inflow hydrographs were subsequently routed through the reservoir and appurtenant structures by the modified Puls reservoir routing option.

b. Precipitation events. The Probable Maximum Precipitation (PMP) and the 1 and 10 percent probability-of-occurrence events were used in the analyses. The total rainfall and corresponding distributions for the 1 and 10 percent probability events were provided by the St. Louis District, Corps of Engineers. The Probable Maximum Precipitation was determined from regional curves prepared by the US Weather Bureau (Hydrometeorological Report Number 33, 1956).

c. Unit hydrograph. The Soil Conservation Services (SCS) Dimensionless Unit Hydrograph method (National Engineering Handbook, Section 4, Hydrology, 1971) was used in the analysis. This method was selected because of its simplicity, applicability to drainage areas less than 10 mi^2, and its easy availability within the HEC-1 computer program.

The watershed lag time was computed using the SCS "curve number method" by an empirical relationship as follows:

$$L = \frac{\ell^{0.8}\,(s+1)^{0.7}}{1900\,Y^{0.5}} \qquad \text{(Equation 15-4)}$$

where: L = lag in hours
ℓ = hydraulic length of the watershed in feet
$s = \frac{1000}{CN} - 10$ where CN = hydrologic soil curve number
Y = average watershed land slope in percent.

This empirical relationship accounts for the soil cover, average watershed slope and hydraulic length.

With the lag time thus computed, another empirical relationship is used to compute the time of concentration as follows:

$$T_c = \frac{L}{0.6} \qquad \text{(Equation 15-3)}$$

where: T_c = time of concentration in hours

L = lag in hours.

Subsequent to the computation of the time of concentration, the unit hydrograph duration was estimated utilizing the following relationship:

$$\Delta D = 0.133 T_c \qquad \text{(Equation 16-12)}$$

where: ΔD = duration of unit excess rainfall
T_c = time of concentration in hours.

The final interval was selected to provide at least three discharge ordinates prior to the peak discharge ordinate of the unit hydrograph. For this dam, a time interval of 10 minutes was used.

d. Infiltration losses. The infiltration losses were computed by the HEC-1 computer program internally using the SCS curve number method. The curve numbers were established taking into consideration the variables of: (a) antecedent moisture condition, (b) hydrologic soil group classification, (c) degree of development, (d) vegetative cover and (e) present land usage in the watershed.

Antecedent moisture condition III (AMC III) was used for the PMF events and AMC II was used for the 1 and 10 percent probability events, in accordance with the guidelines. The remaining variables are defined in the SCS procedure and judgements in their selection were made on the basis of visual field inspection.

e. Starting elevations. Reservoir starting water surface elevations for this dam were set as follows:

(1) 1 and 10 percent probability events - high water mark (el 854.0)

(2) Probable Maximum Storm - informal spillway crest elevation (el 857.8)

f. Spillway Rating Curve. The basic weir equation was utilized to compute the spillway rating curve. The weir equation is as follows:

$$Q = CLH^{3/2}$$

where Q = discharge in cubic feet per second
L = effective length of spillway in feet
C = coefficient of discharge (2.2)
H = total head over spillway in feet

B.2 Pertinent Data

a. Drainage area. 1.26 mi^2

b. Storm duration. A unit hydrograph was developed by the SCS method option of HEC-1 program. The design storm of 48 hours duration was divided into 10 minute intervals in order to develop the inflow hydrograph.

c. Lag time. 0.77 hr

d. Hydrologic soil group. C

e. SCS curve numbers.

1. For PMF- AMC III - Curve Number 90
2. For 1 and 10 percent probability-of-occurrence events AMC II - Curve Number 78

f. Storage. Elevation-area data were developed by planimetering areas at various elevation contours on the USGS Potosi, Missouri 7.5 minute quadrangle map. The data were entered on the $A and $E cards so that the HEC-1 program could compute storage volumes.

g. Outflow over dam crest. As the profile of the dam crest is irregular, flow over the crest was computed according to the "Flow Over Non-Level Dam Crest" supplement to the HEC-1 User's Manual. The crest length-elevation data and hydraulic constants were entered on the $D, $L, and $V cards.

h. Outflow capacity. Flow over the informal spillway at this dam in its present condition was considered to produce the effects of overtopping. The informal spillway rating curve was computed by the intrinsic formula within the HEC-1 program, with pertinent informal spillway data entered on the $$ cards.

i. Reservoir elevations. For the 50 and 100 percent of the PMF events, the starting reservoir elevation was 857.8 ft, the informal spillway crest elevation. For the 1 and 10 percent probability-of-occurrence events, the starting reservoir elevation was 854.0 ft, the elevation of the high water line in the reservoir area.

B.3 Results

The results of the analyses as well as the input values to the HEC-1 program follow in this Appendix. Only the results summaries are included, not the intermediate output. Complete copies of the HEC-1 output are available in the project files.

Input Data
1% Probability Event
Moeckel Dam
MO 30476

B4

(Note:Moeckel Dam entered to HEC-1 as Manatee.)

```
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION        JULY 1978
 LAST MODIFICATION  01 APR 80

A1      DAM NO. 30476 - LAKE MANATEE(NONONAME 266), WASHINGTON COUNTY, MISSOURI.
A2      WOODWARD-CLYDE CONSULTANTS, HOUSTON JOB 79CH009.
A3      PROBABILISTIC FLOOD 100-YEAR
B    288      0     10     -0     -0     -0     -0     -0     -0     -0
B1     3
K      0   Q-IN                                 1
K1  RAIN STA--4-SULLIVAN -- FREQ= 1.0% -- INTERVAL= 10 MIN -- DURATION=  48HR
M      0      2   1.26                   1.0
O    288  8.622              DA =  1.50
O1  .010   .010   .010   .010   .010   .010   .010   .010   .010   .010
O1  .010   .010   .010   .010   .010   .010   .010   .010   .010   .010
O1  .010   .010   .010   .010   .010   .010   .010   .010   .010   .010
O1  .010   .010   .010   .010   .010   .010   .010   .010   .010   .010
O1  .010   .010   .010   .010   .010   .010   .010   .010   .010   .010
O1  .010   .010   .010   .010   .010   .010   .010   .010   .010   .010
O1  .010   .010   .010   .010   .010   .010   .010   .010   .010   .010
O1  .010   .010   .010   .010   .010   .010   .010   .010   .010   .010
O1  .010   .010   .010   .010   .010   .010   .010   .010   .010   .010
O1  .010   .010   .010   .010   .010   .010   .010   .010   .010   .010
O1  .010   .010   .010   .010   .010   .010   .010   .010   .010   .010
O1  .010   .010   .010   .010   .010   .010   .010   .010   .010   .010
O1  .010   .010   .010   .010   .010   .010   .010   .010   .010   .010
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O1  .014   .014   .014   .014   .014   .014   .014   .014   .014   .014
O1  .014   .014   .014   .014   .014   .014   .014   .014   .014   .014
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O1  .028   .028   .028   .028   .028   .028   .028   .028   .028   .028
O1  .028   .028   .028   .028   .028   .028   .028   .028   .028   .028
O1  .028   .028   .028   .028   .028   .028   .028   .028   .028   .028
O1  .028   .028   .028   .028   .028   .028   .044   .044   .044   .044
O1  .044   .044   .044   .044   .044   .062   .062   .062   .122   .122
O1  .123   .265   .266   .630  1.367   .500   .265   .123   .123   .122
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O1  .044   .044   .014   .014   .014   .014   .014   .014   .014   .014
O1  .014   .014   .014   .014   .014   .014   .014   .014   .014   .014
O1  .014   .014   .014   .014   .014   .014   .014   .014   .014   .014
O1  .014   .014   .014   .014   .014   .014   .014   .014
T                                              -1    -78           0.09
W2          0.77
X     -1   -.05      5
K      1    DAM                                 1
K1  LAKE MANATEE(NO. 30476-NONONAME 266) FLOOD ROUTING, 100-YR.
V                           1
Y1     1                                     -854.
SA    0.   42.6    76.    94.  107.4  141.8
SE  790.   851.   855.  857.8   860.   870.
SS 857.8          2.2    1.5
SD 857.8    2.3    1.5
SL    0.    45.    80.   150.   280.   385.   480.   750.
SV 857.8  858.5   859.   860.   861.   862.   863.   864.
K     99
```

Output Summary
1% Probability Event
Moeckel Dam
MO 30476

B5

```
**************************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
LAST MODIFICATION  01 APR 80
**************************************

RUN  DATE: 22 AUG 80
     TIME: 12.09.33
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DAM NO. 30476 - LAKE MANATEE(NONONAME 266), WASHINGTON COUNTY, MISSOURI.
WOODWARD-CLYDE CONSULTANTS, HOUSTON JOB 79CH009.
PROBABILISTIC FLOOD 100-YEAR

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	10	-0	-0	-0	-0	-0	-0	-0

JOPER	NWT	LROPT	TRACE
3	-0	-0	-0

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

SUB-AREA RUNOFF COMPUTATION

RAIN STA--4=SULLIVAN -- FREQ= 1.0: -- INTERVAL= 10 MIN -- DURATION= 48HR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
Q-IN	0	-0	-0	-0	-0	1	-0	-0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
0	2	1.26	-0.	1.26	1.00	-0.	-0	-0	-0

PRECIP DATA

NP	STORM	DAJ	DAK
288	8.62	-0.	-0.

PRECIP PATTERN

.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.03	.03	.03	.03	.03	.03	.03	.03	.03	.03
.03	.03	.03	.03	.03	.03	.03	.03	.03	.03
.03	.03	.03	.03	.03	.03	.03	.03	.03	.03
.03	.03	.03	.03	.03	.03	.04	.04	.04	.04
.04	.04	.04	.04	.04	.06	.06	.06	.12	.12
.12	.27	.27	.63	1.37	.50	.27	.12	.12	.12

.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01	.01	.01
.01	.01	.01	.01	.01	.01	.01	.01		

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
-0	-0.	-0.	1.00	-0.	-0.	1.00	-1.00	-78.00	-0.	.09

CURVE NO = -78.00 WETNESS = -1.00 EFFECT CN = 78.00

UNIT HYDROGRAPH DATA

TC= -0. LAG= .77

RECESSION DATA

STRTQ= -1.00 QRCSN= -.05 RTIOR= 5.00

UNIT HYDROGRAPH 25 END OF PERIOD ORDINATES. TC= -0. HOURS. LAG= .77 VOL= 1.00

69.	213.	452.	649.	712.	675.	575.	432.	299.	216.
161.	117.	85.	62.	45.	33.	24.	17.	13.	9.
7.	5.	4.	2.	1.					

0 END-OF-PERIOD FLOW

NO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	NO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.10	1	.01	.00	.01	1.	1.02	.10	145	.01	.01	.01	22.
1.01	.20	2	.01	.00	.01	1.	1.02	.20	146	.01	.01	.01	23.
1.01	.30	3	.01	.00	.01	1.	1.02	.30	147	.01	.01	.01	24.
1.01	.40	4	.01	.00	.01	2.	1.02	.40	148	.01	.01	.01	25.
1.01	.50	5	.01	.00	.01	2.	1.02	.50	149	.01	.01	.01	27.
1.01	1.00	6	.01	.00	.01	3.	1.02	1.00	150	.01	.01	.01	28.
1.01	1.10	7	.01	.00	.01	3.	1.02	1.10	151	.01	.01	.01	29.
1.01	1.20	8	.01	.00	.01	4.	1.02	1.20	152	.01	.01	.01	30.
1.01	1.30	9	.01	.00	.01	4.	1.02	1.30	153	.01	.01	.01	31.
1.01	1.40	10	.01	.00	.01	4.	1.02	1.40	154	.01	.01	.01	32.
1.01	1.50	11	.01	.00	.01	4.	1.02	1.50	155	.01	.01	.01	32.
1.01	2.00	12	.01	.00	.01	4.	1.02	2.00	156	.01	.01	.01	33.
1.01	2.10	13	.01	.00	.01	4.	1.02	2.10	157	.01	.01	.01	33.
1.01	2.20	14	.01	.00	.01	4.	1.02	2.20	158	.01	.01	.01	34.
1.01	2.30	15	.01	.00	.01	4.	1.02	2.30	159	.01	.01	.01	34.
1.01	2.40	16	.01	.00	.01	4.	1.02	2.40	160	.01	.01	.01	34.
1.01	2.50	17	.01	.00	.01	4.	1.02	2.50	161	.01	.01	.01	35.
1.01	3.00	18	.01	.00	.01	4.	1.02	3.00	162	.01	.01	.01	35.
1.01	3.10	19	.01	.00	.01	4.	1.02	3.10	163	.01	.01	.01	35.
1.01	3.20	20	.01	.00	.01	4.	1.02	3.20	164	.01	.01	.01	35.
1.01	3.30	21	.01	.00	.01	4.	1.02	3.30	165	.01	.01	.01	36.
1.01	3.40	22	.01	.00	.01	4.	1.02	3.40	166	.01	.01	.01	36.
1.01	3.50	23	.01	.00	.01	4.	1.02	3.50	167	.01	.01	.01	36.
1.01	4.00	24	.01	.00	.01	4.	1.02	4.00	168	.01	.01	.01	36.
1.01	4.10	25	.01	.00	.01	4.	1.02	4.10	169	.01	.01	.01	37.
1.01	4.20	26	.01	.00	.01	4.	1.02	4.20	170	.01	.01	.01	37.
1.01	4.30	27	.01	.00	.01	4.	1.02	4.30	171	.01	.01	.01	37.
1.01	4.40	28	.01	.00	.01	4.	1.02	4.40	172	.01	.01	.01	37.
1.01	4.50	29	.01	.00	.01	4.	1.02	4.50	173	.01	.01	.01	38.
1.01	5.00	30	.01	.00	.01	4.	1.02	5.00	174	.01	.01	.01	38.
1.01	5.10	31	.01	.00	.01	4.	1.02	5.10	175	.01	.01	.01	38.
1.01	5.20	32	.01	.00	.01	4.	1.02	5.20	176	.01	.01	.01	39.
1.01	5.30	33	.01	.00	.01	4.	1.02	5.30	177	.01	.01	.01	39.
1.01	5.40	34	.01	.00	.01	4.	1.02	5.40	178	.01	.01	.01	39.
1.01	5.50	35	.01	.00	.01	4.	1.02	5.50	179	.01	.01	.01	39.
1.01	6.00	36	.01	.00	.01	4.	1.02	6.00	180	.01	.01	.01	39.
1.01	6.10	37	.01	.00	.01	4.	1.02	6.10	181	.03	.02	.01	40.
1.01	6.20	38	.01	.00	.01	4.	1.02	6.20	182	.03	.02	.01	42.
1.01	6.30	39	.01	.00	.01	4.	1.02	6.30	183	.03	.02	.01	46.
1.01	6.40	40	.01	.00	.01	4.	1.02						

Output Summary
1% Probability Event
Moeckel Dam
MO 30476

B6

Output Summary
1% Probability Event
Moeckel Dam
MO 30476

B7

1.	7.10	43	.01	.00	.01	4.	1.02	7.10	187	.03	.02	.01	69.
1.0.	7.20	44	.01	.00	.01	4.	1.02	7.20	188	.03	.02	.01	72.
1.01	7.30	45	.01	.00	.01	4.	1.02	7.30	189	.03	.02	.01	76.
1.01	7.40	46	.01	.00	.01	4.	1.02	7.40	190	.03	.02	.01	78.
1.01	7.50	47	.01	.00	.01	4.	1.02	7.50	191	.03	.02	.01	80.
1.01	8.00	48	.01	.00	.01	4.	1.02	8.00	192	.03	.02	.01	82.
1.01	8.10	49	.01	.00	.01	4.	1.02	8.10	193	.03	.02	.01	83.
1.01	8.20	50	.01	.00	.01	4.	1.02	8.20	194	.03	.02	.01	84.
1.01	8.30	51	.01	.00	.01	4.	1.02	8.30	195	.03	.02	.01	85.
1.01	8.40	52	.01	.00	.01	4.	1.02	8.40	196	.03	.02	.01	86.
1.01	8.50	53	.01	.00	.01	4.	1.02	8.50	197	.03	.02	.01	87.
1.01	9.00	54	.01	.00	.01	4.	1.02	9.00	198	.03	.02	.01	88.
1.01	9.10	55	.01	.00	.01	4.	1.02	9.10	199	.03	.02	.01	88.
1.01	9.20	56	.01	.00	.01	4.	1.02	9.20	200	.03	.02	.01	89.
1.01	9.30	57	.01	.00	.01	4.	1.02	9.30	201	.03	.02	.01	90.
1.01	9.40	58	.01	.00	.01	4.	1.02	9.40	202	.03	.02	.01	90.
1.01	9.50	59	.01	.00	.01	4.	1.02	9.50	203	.03	.02	.01	91.
1.01	10.00	60	.01	.00	.01	4.	1.02	10.00	204	.03	.02	.01	91.
1.01	10.10	61	.01	.00	.01	5.	1.02	10.10	205	.03	.02	.01	92.
1.01	10.20	62	.01	.00	.01	5.	1.02	10.20	206	.03	.02	.01	92.
1.01	10.30	63	.01	.00	.01	5.	1.02	10.30	207	.03	.02	.01	93.
1.01	10.40	64	.01	.00	.01	5.	1.02	10.40	208	.03	.02	.01	93.
1.01	10.50	65	.01	.00	.01	5.	1.02	10.50	209	.03	.02	.01	94.
1.01	11.00	66	.01	.00	.01	6.	1.02	11.00	210	.03	.02	.01	94.
1.01	11.10	67	.01	.00	.01	6.	1.02	11.10	211	.03	.02	.01	95.
1.01	11.20	68	.01	.00	.01	6.	1.02	11.20	212	.03	.02	.01	95.
1.01	11.30	69	.01	.00	.01	6.	1.02	11.30	213	.03	.02	.01	96.
1.01	11.40	70	.01	.00	.01	7.	1.02	11.40	214	.03	.02	.01	96.
1.01	11.50	71	.01	.00	.01	7.	1.02	11.50	215	.03	.02	.01	97.
1.01	12.00	72	.01	.00	.01	7.	1.02	12.00	216	.03	.02	.01	97.
1.01	12.10	73	.01	.00	.01	7.	1.02	12.10	217	.04	.03	.01	98.
1.01	12.20	74	.01	.00	.01	8.	1.02	12.20	218	.04	.03	.01	101.
1.01	12.30	75	.01	.00	.01	8.	1.02	12.30	219	.04	.03	.01	107.
1.01	12.40	76	.01	.00	.01	8.	1.02	12.40	220	.04	.03	.01	113.
1.01	12.50	77	.01	.00	.01	9.	1.02	12.50	221	.04	.03	.01	124.
1.01	13.00	78	.01	.00	.01	9.	1.02	13.00	222	.04	.03	.01	135.
1.01	13.10	79	.01	.00	.01	9.	1.02	13.10	223	.04	.03	.01	140.
1.01	13.20	80	.01	.00	.01	9.	1.02	13.20	224	.04	.03	.01	146.
1.01	13.30	81	.01	.00	.01	10.	1.02	13.30	225	.04	.03	.01	150.
1.01	13.40	82	.01	.00	.01	10.	1.02	13.40	226	.06	.05	.01	154.
1.01	13.50	83	.01	.00	.01	10.	1.02	13.50	227	.06	.05	.01	160.
1.01	14.00	84	.01	.00	.01	10.	1.02	14.00	228	.06	.05	.01	169.
1.01	14.10	85	.01	.00	.01	11.	1.02	14.10	229	.12	.10	.03	189.
1.01	14.20	86	.01	.00	.01	11.	1.02	14.20	230	.12	.10	.02	209.
1.01	14.30	87	.01	.00	.01	11.	1.02	14.30	231	.12	.10	.02	237.
1.01	14.40	88	.01	.00	.01	11.	1.02	14.40	232	.26	.22	.05	288.
1.01	14.50	89	.01	.00	.01	12.	1.02	14.50	233	.27	.22	.04	359.
1.01	15.00	90	.01	.00	.01	12.	1.02	15.00	234	.63	.53	.09	488.
1.01	15.10	91	.01	.00	.01	12.	1.02	15.10	235	1.36	1.21	.16	692.
1.01	15.20	92	.01	.00	.01	12.	1.02	15.20	236	.50	.49	.03	1027.
1.01	15.30	93	.01	.00	.01	13.	1.02	15.30	237	.26	.24	.02	1469.
1.01	15.40	94	.01	.00	.01	13.	1.02	15.40	238	.12	.11	.01	1817.
1.01	15.50	95	.01	.00	.01	13.	1.02	15.50	239	.12	.11	.01	1959.
1.01	16.00	96	.01	.00	.01	13.	1.02	16.00	240	.12	.11	.01	1966.
1.01	16.10	97	.01	.00	.01	13.	1.02	16.10	241	.06	.06	.00	1713.
1.01	16.20	98	.01	.00	.01	14.	1.02	16.20	242	.06	.06	.00	1444.
1.01	16.30	99	.01	.00	.01	14.	1.02	16.30	243	.06	.06	.00	1167.
1.01	16.40	100	.01	.00	.01	14.	1.02	16.40	244	.04	.04	.00	948.
1.01	16.50	101	.01	.00	.01	14.	1.02	16.50	245	.04	.04	.00	777.
1.01	17.00	102	.01	.00	.01	14.	1.02	17.00	246	.04	.04	.00	638.
1.01	17.10	103	.01	.00	.01	15.	1.02	17.10	247	.04	.04	.00	526.
1.01	17.20	104	.01	.00	.01	15.	1.02	17.20	248	.04	.04	.00	440.
1.01	17.30	105	.01	.00	.01	15.	1.02	17.30	249	.04	.04	.00	376.
1.01	17.40	106	.01	.00	.01	15.	1.02	17.40	250	.04	.04	.00	328.

1	14.10	109	.01	.00	.01	16.	1.02	14.10	253	.01	.01	.00	247.
1.01	14.20	110	.01	.00	.01	16.	1.02	14.20	254	.01	.01	.00	227.
1.01	14.30	111	.01	.00	.01	16.	1.02	14.30	255	.01	.01	.00	208.
1.01	14.40	112	.01	.00	.01	17.	1.02	14.40	256	.01	.01	.00	190.
1.01	14.50	113	.01	.00	.01	17.	1.02	14.50	257	.01	.01	.00	174.
1.01	19.00	114	.01	.00	.01	17.	1.02	19.00	258	.01	.01	.00	131.
1.01	19.10	115	.01	.00	.01	17.	1.02	19.10	259	.01	.01	.00	111.
1.01	19.20	116	.01	.00	.01	17.	1.02	19.20	260	.01	.01	.00	97.
1.01	19.30	117	.01	.00	.01	17.	1.02	19.30	261	.01	.01	.00	87.
1.01	19.40	118	.01	.00	.01	18.	1.02	19.40	262	.01	.01	.00	81.
1.01	19.50	119	.01	.00	.01	18.	1.02	19.50	263	.01	.01	.00	78.
1.01	20.00	120	.01	.00	.01	18.	1.02	20.00	264	.01	.01	.00	72.
1.01	20.10	121	.01	.00	.01	18.	1.02	20.10	265	.01	.01	.00	70.
1.01	20.20	122	.01	.00	.01	18.	1.02	20.20	266	.01	.01	.00	68.
1.01	20.30	123	.01	.00	.01	19.	1.02	20.30	267	.01	.01	.00	67.
1.01	20.40	124	.01	.00	.01	19.	1.02	20.40	268	.01	.01	.00	66.
1.01	20.50	125	.01	.00	.01	19.	1.02	20.50	269	.01	.01	.00	65.
1.01	21.00	126	.01	.00	.01	19.	1.02	21.00	270	.01	.01	.00	64.
1.01	21.10	127	.01	.00	.01	19.	1.02	21.10	271	.01	.01	.00	64.
1.01	21.20	128	.01	.00	.01	19.	1.02	21.20	272	.01	.01	.00	64.
1.01	21.30	129	.01	.00	.01	20.	1.02	21.30	273	.01	.01	.00	64.
1.01	21.40	130	.01	.00	.01	20.	1.02	21.40	274	.01	.01	.00	64.
1.01	21.50	131	.01	.00	.01	20.	1.02	21.50	275	.01	.01	.00	64.
1.01	22.00	132	.01	.00	.01	20.	1.02	22.00	276	.01	.01	.00	64.
1.01	22.10	133	.01	.00	.01	20.	1.02	22.10	277	.01	.01	.00	64.
1.01	22.20	134	.01	.00	.01	20.	1.02	22.20	278	.01	.01	.00	64.
1.01	22.30	135	.01	.00	.01	21.	1.02	22.30	279	.01	.01	.00	64.
1.01	22.40	136	.01	.00	.01	21.	1.02	22.40	280	.01	.01	.00	64.
1.01	22.50	137	.01	.00	.01	21.	1.02	22.50	281	.01	.01	.00	64.
1.01	23.00	138	.01	.00	.01	21.	1.02	23.00	282	.01	.01	.00	64.
1.01	23.10	139	.01	.00	.01	21.	1.02	23.10	283	.01	.01	.00	64.
1.01	23.20	140	.01	.00	.01	21.	1.02	23.20	284	.01	.01	.00	64.
1.01	23.30	141	.01	.00	.01	21.	1.02	23.30	285	.01	.01	.00	64.
1.01	23.40	142	.01	.00	.01	22.	1.02	23.40	286	.01	.01	.00	64.
1.01	23.50	143	.01	.00	.01	22.	1.02	23.50	287	.01	.01	.00	64.
1.02	0.	144	.01	.00	.01	22.	1.03	0.	288	.01	.01	.00	64.
									SUM	8.62	6.71	2.41	29961.
										219.11	158.11	61.11	846.701

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1959.	600.	198.	104.	29885.
CMS	55.	17.	6.	3.	846.
INCHES		4.43	5.84	6.13	6.13
MM		112.45	148.30	155.67	155.67
AC-FT		297.	392.	412.	412.
THOUS CU M		367.	484.	508.	508.

Output Summary
1% Probability Event
Moeckel Dam
MO 30476

B8

HYDROGRAPH ROUTING

LAKE MANATEE(NO. 30476-MONONAME 2661 FLOOD ROUTING, 100-YR.

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
DAM	1	-0	-0	-0	-0	1	-0	-0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
-0.	-0.	-0.	1	-0	-0	-0	-0

RUNOFF SUMMARY. AVERAGE FLOW IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES(SQUARE KILOMETERS)

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	Q-IN	1959.	600.	198.	104.	1.26
		(55.47)(	16.98)(	5.60)(	2.94)(	3.26)
ROUTED TO	DAM	49.	40.	11.	9.	1.26
		(1.38)(	1.14)(	.30)(	.25)(	3.26)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	994.00	857.80	857.80
STORAGE	1029.	1338.	1338.
OUTFLOW	0.	0.	0.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
1.00	858.64	.84	1419.	49.	7.50	48.00	0.

Output Summary
1% Probability Event
Moeckel Dam
MO 30476

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FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
 LAST MODIFICATION  01 APR 80
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     1          AL       DAM NO. 30476 - LAKE MANATEE(MONONAME 2661, WASHINGTON COUNTY, MISSOURI.
     2          A2       WOODWARD-CLYDE CONSULTANTS, HOUSTON JOB 79CH009.
     3          A3       PROBABLE MAXIMUM FLOODS (PMF) ANALYSIS.
     4          B    288        0        10       -0       -0       -0       -0       -0       -0       -0
     5          B1     5
     6          J      1        2         1
     7          J1   .50     1.00
     8          K      0     O-IN                                                    1
     9          K1   LAKE MANATEE(MONONAME 2661 INFLOW COMPUTATION, PMF RATIO FLOODS.
    10          M      1        2     1.26                          1.0
    11          P      0      26.      102      120      130      140
    12          T                                                          -1      -90              0.09
    13          W2            0.77
    14          X     -1     -.05        5
    15          X      1      DAM                                                    1
    16          K1   LAKE MANATEE(NO. 30476-MONONAME 2661 FLOOD ROUTING, PMF RATIO FLOODS.
    17          Y                                        1        1
    18          Y2     1                                                  -857.8
    19          $A     0.     42.6      76.      94.    107.4    141.8
    20          $E   790.     851.     855.    857.8     860.     870.
    21          $S 857.8                2.2      1.9
    22          $D 857.8      2.3      1.9
    23          $L     0.      45.      80.     150.     280.     385.     480.     750.
    24          $V 857.8     858.5     859.     860.     861.     862.     863.     864.
    25          K     99
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Input Data
Various PMF Events
Moeckel Dam
MO 30476

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DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 01 APR 80

RUN DATE: 22 AUG 80
TIME: 12.09.34

DAM NO. 30476 - LAKE MANATEE(NONONAME 2661, WASHINGTON COUNTY, MISSOURI.
WOODWARD-CLYDE CONSULTANTS, HOUSTON JOB 79CH009.
PROBABLE MAXIMUM FLOODS (PMF) ANALYSIS.

JOB SPECIFICATION

NO	NWR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	10	-0	-0	-0	-0	-0	-0	-0

JOPER	NWT	LROPT	TRACE
9	-0	-0	-0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 2 LRTIO= 1
RTIOS= .50 1.00

SUB-AREA RUNOFF COMPUTATION

LAKE MANATEE(NONONAME 2661 INFLOW COMPUTATION, PMF RATIO FLOODS.

ISTRG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
0-IN	0	-0	-0	-0	-0	1	-0	-0

HYDROGRAPH DATA

IHYDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	2	1.26	-0.	1.26	1.00	-0.	-0	-0	-0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.	26.00	102.00	120.00	130.00	140.00	-0.	-0.

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
-0	-0.	-0.	1.00	-0.	-0.	1.00	-1.00	-90.00	-0.	.09

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

UNIT HYDROGRAPH DATA
TC= -0. LAG= .77

RECESSION DATA
STRTQ= -1.00 QRCSN= -.05 RTIOR= 5.00

UNIT HYDROGRAPH 25 END OF PERIOD ORDINATES, TC= -0. HOURS, LAG= .77 VOL= 1.00

89.	213.	492.	649.	712.	675.	575.	432.	299.	216.
161.	117.	85.	62.	45.	33.	24.	17.	13.	9.
7.	5.	4.	2.	1.					

END-OF-PERIOD FLOW

NO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	NO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q

Output Summary
Various PMF Events
Moeckel Dam
MO 30476

Bll

1.01	.20	2	.00	.00	.00	1.	1.02	.20	146	.03	.03	.00	21.
1.	.30	3	.00	.00	.00	1.	1.02	.30	147	.03	.03	.00	32.
1.01	.40	4	.00	.00	.00	1.	1.02	.40	148	.03	.03	.00	47.
1.01	.50	5	.00	.00	.00	1.	1.02	.50	149	.03	.03	.00	62.
1.01	1.00	6	.00	.00	.00	1.	1.02	1.00	150	.03	.03	.00	79.
1.01	1.10	7	.00	.00	.00	1.	1.02	1.10	151	.03	.03	.00	93.
1.01	1.20	8	.00	.00	.00	1.	1.02	1.20	152	.03	.03	.00	103.
1.01	1.30	9	.00	.00	.00	1.	1.02	1.30	153	.03	.03	.00	110.
1.01	1.40	10	.00	.00	.00	1.	1.02	1.40	154	.03	.03	.00	115.
1.01	1.50	11	.00	.00	.00	1.	1.02	1.50	155	.03	.03	.00	119.
1.01	2.00	12	.00	.00	.00	1.	1.02	2.00	156	.03	.03	.00	122.
1.01	2.10	13	.00	.00	.00	1.	1.02	2.10	157	.03	.03	.00	124.
1.01	2.20	14	.00	.00	.00	1.	1.02	2.20	158	.03	.03	.00	126.
1.01	2.30	15	.00	.00	.00	1.	1.02	2.30	159	.03	.03	.00	127.
1.01	2.40	16	.00	.00	.00	1.	1.02	2.40	160	.03	.03	.00	128.
1.01	2.50	17	.00	.00	.00	1.	1.02	2.50	161	.03	.03	.00	129.
1.01	3.00	18	.00	.00	.00	1.	1.02	3.00	162	.03	.03	.00	129.
1.01	3.10	19	.00	.00	.00	1.	1.02	3.10	163	.03	.03	.00	130.
1.01	3.20	20	.00	.00	.00	1.	1.02	3.20	164	.03	.03	.00	130.
1.01	3.30	21	.00	.00	.00	1.	1.02	3.30	165	.03	.03	.00	130.
1.01	3.40	22	.00	.00	.00	1.	1.02	3.40	166	.03	.03	.00	131.
1.01	3.50	23	.00	.00	.00	1.	1.02	3.50	167	.03	.03	.00	131.
1.01	4.00	24	.00	.00	.00	1.	1.02	4.00	168	.03	.03	.00	131.
1.01	4.10	25	.00	.00	.00	1.	1.02	4.10	169	.03	.03	.00	131.
1.01	4.20	26	.00	.00	.00	1.	1.02	4.20	170	.03	.03	.00	131.
1.01	4.30	27	.00	.00	.00	1.	1.02	4.30	171	.03	.03	.00	131.
1.01	4.40	28	.00	.00	.00	1.	1.02	4.40	172	.03	.03	.00	132.
1.01	4.50	29	.00	.00	.00	1.	1.02	4.50	173	.03	.03	.00	132.
1.01	5.00	30	.00	.00	.00	1.	1.02	5.00	174	.03	.03	.00	132.
1.01	5.10	31	.00	.00	.00	1.	1.02	5.10	175	.03	.03	.00	132.
1.01	5.20	32	.00	.00	.00	1.	1.02	5.20	176	.03	.03	.00	132.
1.01	5.30	33	.00	.00	.00	1.	1.02	5.30	177	.03	.03	.00	132.
1.01	5.40	34	.00	.00	.00	1.	1.02	5.40	178	.03	.03	.00	132.
1.01	5.50	35	.00	.00	.00	1.	1.02	5.50	179	.03	.03	.00	132.
1.01	6.00	36	.00	.00	.00	1.	1.02	6.00	180	.03	.03	.00	132.
1.01	6.10	37	.01	.00	.01	1.	1.02	6.10	181	.13	.12	.01	139.
1.01	6.20	38	.01	.00	.01	1.	1.02	6.20	182	.13	.12	.01	160.
1.01	6.30	39	.01	.00	.01	1.	1.02	6.30	183	.13	.12	.01	203.
1.01	6.40	40	.01	.00	.01	2.	1.02	6.40	184	.13	.12	.01	266.
1.01	6.50	41	.01	.00	.01	2.	1.02	6.50	185	.13	.12	.01	334.
1.01	7.00	42	.01	.00	.01	3.	1.02	7.00	186	.13	.12	.01	400.
1.01	7.10	43	.01	.00	.01	3.	1.02	7.10	187	.13	.12	.01	454.
1.01	7.20	44	.01	.00	.01	4.	1.02	7.20	188	.13	.13	.00	498.
1.01	7.30	45	.01	.00	.01	4.	1.02	7.30	189	.13	.13	.00	528.
1.01	7.40	46	.01	.00	.01	4.	1.02	7.40	190	.13	.13	.00	550.
1.01	7.50	47	.01	.00	.01	4.	1.02	7.50	191	.13	.13	.00	567.
1.01	8.00	48	.01	.00	.01	4.	1.02	8.00	192	.13	.13	.00	579.
1.01	8.10	49	.01	.00	.01	4.	1.02	8.10	193	.13	.13	.00	588.
1.01	8.20	50	.01	.00	.01	4.	1.02	8.20	194	.13	.13	.00	595.
1.01	8.30	51	.01	.00	.01	4.	1.02	8.30	195	.13	.13	.00	601.
1.01	8.40	52	.01	.00	.01	4.	1.02	8.40	196	.13	.13	.00	605.
1.01	8.50	53	.01	.00	.01	4.	1.02	8.50	197	.13	.13	.00	608.
1.01	9.00	54	.01	.00	.01	5.	1.02	9.00	198	.13	.13	.00	610.
1.01	9.10	55	.01	.00	.01	5.	1.02	9.10	199	.13	.13	.00	612.
1.01	9.20	56	.01	.00	.01	5.	1.02	9.20	200	.13	.13	.00	614.
1.01	9.30	57	.01	.00	.01	6.	1.02	9.30	201	.13	.13	.00	615.
1.01	9.40	58	.01	.00	.01	6.	1.02	9.40	202	.13	.13	.00	617.
1.01	9.50	59	.01	.00	.01	7.	1.02	9.50	203	.13	.13	.00	618.
1.01	10.00	60	.01	.00	.01	7.	1.02	10.00	204	.13	.13	.00	619.
1.01	10.10	61	.01	.00	.01	8.	1.02	10.10	205	.13	.13	.00	619.
1.01	10.20	62	.01	.00	.01	9.	1.02	10.20	206	.13	.13	.00	620.
1.01	10.30	63	.01	.00	.01	9.	1.02	10.30	207	.13	.13	.00	620.
1.01	10.40	64	.01	.00	.01	10.	1.02	10.40	208	.13	.13	.00	621.
1.01	10.50	65	.01	.00	.01	11.	1.02	10.50	209	.13	.13	.00	621.

Output Summary
Various PMF Events
Moeckel Dam
MO 30476

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Output Summary
Various PMF Events
Moeckel Dam
MO 30476

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1.01	22.00	132	.00	.00	.00	15.	1.02	22.00	276	.04	.04	.00	211.
1.01	22.10	133	.00	.00	.00	15.	1.02	22.10	277	.04	.04	.00	211.
1.01	22.20	134	.00	.00	.00	15.	1.02	22.20	278	.04	.04	.00	211.
1.01	22.30	135	.00	.00	.00	15.	1.02	22.30	279	.04	.04	.00	211.
1.01	22.40	136	.00	.00	.00	15.	1.02	22.40	280	.04	.04	.00	211.
1.01	22.50	137	.00	.00	.00	15.	1.02	22.50	281	.04	.04	.00	211.
1.01	23.00	138	.00	.00	.00	15.	1.02	23.00	282	.04	.04	.00	211.
1.01	23.10	139	.00	.00	.00	15.	1.02	23.10	283	.04	.04	.00	211.
1.01	23.20	140	.00	.00	.00	15.	1.02	23.20	284	.04	.04	.00	211.
1.01	23.30	141	.00	.00	.00	15.	1.02	23.30	285	.04	.04	.00	211.
1.01	23.40	142	.00	.00	.00	15.	1.02	23.40	286	.04	.04	.00	211.
1.01	23.50	143	.00	.00	.00	15.	1.02	23.50	287	.04	.04	.00	211.
1.02	0.	144	.00	.00	.00	15.	1.03	0.	288	.04	.04	.00	211.
									SUM	36.40	35.22	1.18	170593.
										925.11	894.91	30.11	4828.961

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	7972.	3444.	1126.	592.	170438.
CMS	209.	98.	32.	17.	4826.
INCHES		25.43	33.26	34.95	34.95
MM		645.80	844.84	887.81	887.81
AC-FT		1708.	2234.	2348.	2348.
THOUS CU M		2106.	2756.	2896.	2896.

HYDROGRAPH AT STA Q-IN FOR PLAN 1, RTIO 1

1.	0.	0.	0.	0.	1.	1.	1.	1.	1.
1.	1.	1.	1.	1.	1.	1.	1.	1.	1.
1.	1.	1.	1.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.	0.	0.	1.	1.	1.	1.
1.	1.	2.	2.	2.	2.	2.	2.	2.	2.
2.	2.	2.	2.	2.	3.	3.	3.	3.	4.
4.	4.	5.	5.	5.	6.	6.	6.	6.	7.
7.	7.	8.	9.	12.	15.	19.	24.	28.	32.
36.	40.	43.	47.	51.	55.	59.	63.	68.	73.
77.	81.	87.	105.	137.	180.	215.	228.	223.	209.
181.	158.	142.	131.	121.	112.	105.	99.	93.	86.
77.	69.	53.	42.	33.	25.	20.	17.	14.	12.
11.	10.	9.	9.	8.	8.	8.	8.	8.	7.
7.	7.	7.	7.	7.	7.	7.	7.	7.	7.
7.	7.	7.	7.	8.	11.	16.	23.	32.	40.
46.	51.	55.	58.	60.	61.	62.	63.	63.	64.
64.	65.	65.	65.	65.	65.	65.	65.	66.	66.
66.	66.	66.	66.	66.	66.	66.	66.	66.	66.
70.	80.	102.	133.	167.	200.	228.	249.	264.	275.
283.	290.	294.	298.	300.	302.	304.	305.	306.	307.
308.	308.	309.	309.	310.	310.	310.	310.	311.	311.
311.	311.	311.	312.	312.	312.	323.	356.	425.	526.
636.	740.	833.	909.	976.	1038.	1095.	1143.	1187.	1230.
1281.	1339.	1397.	1459.	1492.	1533.	1613.	1882.	2364.	3011.
3517.	3686.	3566.	3250.	2836.	2457.	2190.	1993.	1827.	1684.
1563.	1465.	1373.	1270.	1130.	957.	778.	614.	475.	371.
297.	243.	204.	176.	156.	142.	132.	124.	119.	115.
112.	110.	108.	107.	106.	106.	106.	106.	106.	106.
106.	106.	106.	106.	106.	106.	106.	106.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	3686.	1722.	563.	296.	85219.
CMS	104.	49.	16.	8.	2413.
INCHES		12.71	16.63	17.48	17.48
MM		322.90	422.42	443.90	443.90
AC-FT		894.	1117.	1174.	1174.

Output Summary
Various PMF Events
Moeckel Dam
MO 30476

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO APPLIED TO FLOWS RATIO 1	RATIO 2
				.50	1.00
HYDROGRAPH AT	O-IN	1.26	1	3686.	7372.
		(3.26)		(104.38)(	208.75)(
ROUTED TO	DAM	1.26	1	2699.	6148.
		(3.26)		(76.43)(	174.10)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	857.80	857.80	857.80
STORAGE	1338.	1338.	1338.
OUTFLOW	0.	0.	0.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	861.67	3.87	1743.	2699.	48.00	40.83	0.
1.00	863.00	5.20	1896.	6148.	48.00	40.67	0.

Output Summary
Various PMF Events
Moeckel Dam
MO 30476

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1	RATIO 2	RATIO 3
				.12	.13	.14
HYDROGRAPH AT	O-IN	1.26	1	885.	959.	1032.
		(3.26)		(25.05)(	27.14)(	29.23)(
ROUTED TO	DAM	1.26	1	0.	0.	1.
		(3.26)		(0.)(	0.)(	.04)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	854.00	857.80	857.80
STORAGE	1029.	1338.	1338.
OUTFLOW	0.	0.	0.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.12	857.50	0.	1310.	0.	0.	0.	0.
.13	857.76	0.	1334.	0.	0.	0.	0.
.14	858.00	.20	1357.	1.	5.17	48.00	0.

Output Summary
Various PMF Events
Moeckel Dam
MO 30476