AD-A106 048 ARMY ENGINEER DISTRICT MEMPHIS TN F/G 13/13
NATIONAL DAM SAFETY PROGRAM, TYWAPPITY COMMUNITY DAM (MO 40006)--ETC(U)
AUG 78 J L ANDERSON, R M DAVIS, J E MONROE

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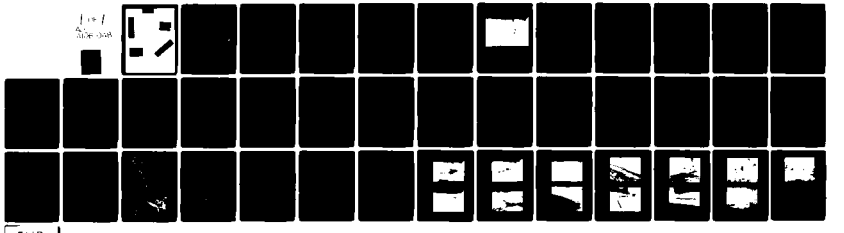

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

TYWAPPITY COMMUNITY DAM
SCOTT COUNTY, MISSOURI

MISSOURI INVENTORY NO. 40006

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY: ST. LOUIS DISTRICT CORPS OF ENGINEERS
FOR: GOVERNOR OF MISSOURI

AUGUST 1978

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam	Tywappity Community Dam
State Located	Missouri
County Located	Scott County
Stream	Hindman Cree
Date of Inspection	6 July 1978

Tywappity Community Dam was inspected by an interdisciplinary team of engineers from the Memphis District, U.S. Army Corps of Engineers. The purpose of the 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 poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers and developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers. Based on these guidelines, this dam is classified as a small size dam with a high downstream hazard potential. Failure would threaten the life and property of approximately 12 families downstream of the dam and cause appreciable damage to highways RA and A, within one mile downstream of the dam.

The inspection and evaluation indicate that the spillway does not meet the criteria set forth in the guidelines for a dam having the above mentioned size classification and hazard potential. According to the guidelines, the spillway is required to pass the Probable Maximum Flood (PMF) without the dam embankment being overtopped. The spillway will only pass 35 percent of the PMF before the dam embankment is overtopped. Because the spillway will not pass 1/2 of the PMF without overtopping, the dam is classified as "unsafe non-emergency." The spillway will pass the 100-year flood without overtopping, which is a flood that has a 1 percent chance of being exceeded in any given year.

Other deficiencies visually observed by the inspection team were brush on the upstream embankment slope and erosion gullies near the downstream toe. Another deficiency found was the lack of seepage and stability analysis records.

It is recommended that the owner take action to correct or control the deficiencies described. Corrective works should be in accordance with analyses and design performed by an engineer experienced in the design and construction of dams.

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SUBMITTED BY: SIGNED — Chief, Engineering Division — 21 SEP 19[illegible] — Date

APPROVED BY: SIGNED — Colonel, CE, District Engineer — 22 SEP 1978 — Date

Overview of Lake, Spillway, and Dam

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
TYWAPPITY COMMUNITY DAM - ID NO. 40006

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SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. The National Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of safety inspection of dams throughout the United States. Pursuant to the above, the St. Louis District, Corps of Engineers, District Engineer directed that a safety inspection of the Tywappity Community Dam be made.

b. Purpose of Inspection. The purpose of the 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 poses hazards to human life or property.

c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams." 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.

(1) The dam is an earth structure built in a narrow valley in the northern extension of Crowleys Ridge. Topography adjacent to the valley is rolling to steep. Soils on the ridge are formed of loess deposits over sand and gravel deposits. Topography in the vicinity of the dam is shown on Plate 2.

(2) A vertical inlet constructed of 48-inch diameter, bituminous coated, corrugated metal pipe junctioned with a 36-inch diameter, bituminous coated, corrugated metal pipe is the primary means of discharge. According to 1956 contract drawings provided by the Missouri Department of Conservation, a 12-inch steel drain pipe is also connected to the 36-inch discharge pipe. A grass covered, earth, emergency spillway is cut in the right abutment. The spillway is a trapezoidal section with a 50-foot bottom width and side slopes of approximately 1V on 3H. The spillway is 125 feet long and is intersected at right angles by a 20 foot wide asphalt road.

(3) Pertinent physical data are given in paragraph 1.3 below.

b. Location. The dam is located in the North portion of Scott County, Missouri, as shown on Plate 1. The lake formed by the dam is shown on the Chaffee, Missouri quadrangle sheet in Section 8, Township 29 North, Range 13 East.

c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1 c above. Based on these criteria, this dam and impoundment is in the small size category.

d. Hazard Classification. Guidelines for determining hazard classification are presented in the same guidelines as referenced in paragraph c above. Based on referenced guidelines, this dam is in the High Hazard Classification.

e. Ownership. This dam is owned by the Missouri Department of Conservation.

f. Purpose of Dam. The dam forms a 37-acre recreational lake.

g. Design and Construction History. The dam was designed by the Missouri Department of Conservation. Readily available design data were limited to a set of contract drawings dated 2 May 1956. However, it is known that hydraulic and hydrologic designs were performed based on similar criteria used by the Soil Conservation Service. Also prior to construction, borings were taken and the soil samples tested by the Soil Conservation Service. Whether or not slope stability analyses were performed using suitable loading conditions including earthquake forces is unknown. The boring logs were not presented on the contract drawings. Construction of the dam by the Harris Construction Company of Portageville, Missouri began in 1956 and the dam was completed in 1957. The earth embankment was constructed of silty soils excavated from borrow areas located on ridges in the vicinity of the right abutment. The soil was transported and then compacted in lifts by tractor pulled scrapers. The contract drawings specified a "core trench" with a 20-foot bottom width to be excavated to a depth as shown on Plate 3 and then backfilled with suitable material. A typical embankment cross-section from the contract drawings showing the primary features of the vertical inlet, discharge, and lake drain systems is presented on Plate 4. Based on the inspection survey a 48-inch diameter, vertical inlet pipe was used in place of the 42-inch diameter pipe specified in the 1956 contract drawings and a 36-inch diameter pipe was used in place of the specified 30-inch diameter pipe for the

discharge. Also an average 1V on 3.25H downstream slope was used instead of the 1V on 3H slope specified in the contract drawings.

h. Normal Operating Procedure. Normal rainfall, runoff, transpiration, and evaporation all combine to maintain a relatively stable water surface elevation. The emergency spillway was reportedly used only twice with the maximum experienced depth of one half of a foot occuring in the spring of 1973 for a duration of less than 12 hours. A lake drain is provided to draw down the lake for maintenance of the dam, appurtenances, and the lake. The lake reportedly has been drawn down by the lake drain only once.

1.3 PERTINENT DATA

a. Drainage Area - 379 acres (1973 inventory).
376 acres (Topographic Quadrangle).
399 acres (1956 Contract Drawings).

b. Discharge at Damsite.

(1) Discharge can take place both through a vertical pipe inlet and an emergency spillway.

(2) Estimated experienced maximum flood at the damsite - 214 cfs.

(3) Estimated ungated spillway capacity at maximum pool elevation - 646 cfs.

c. Elevation (Feet above M. S. L.)

(1) Top of dam - 405.6 ± (See Plate 3).

(2) Top of vertical inlet - 400.6.

(3) Invert of discharge pipe at the stilling basin - 369.0.

(4) Spillway crest - 403.6 ± .

(5) Streambed at centerline of dam - 369.6 (1956 contract drawings).

(6) Maximum tailwater - unknown.

d. Reservoir. Length of maximum pool - 2900 feet (1956 contract drawings

e. Storage (Acre-feet).

(1) Maximum - 792 (1973 inventory).
952 (1956 contract drawings and 748 acre-feet as normal storage).

(2) Normal - 748 (1973 inventory).

f. Reservoir Surface (Acres).

(1) Top of dam - 44.9.

(2) Spillway crest - 41.4.

g. Dam.

(1) Type - earth embankment.

(2) Length - 500 ± feet.

(3) Height - 36 feet maximum (1973 inventory)

(4) Top width - 14 ± feet.

(5) Side slopes -

(a) Downstream - 1V on 3.25H (Average).

(b) Upstream - 1V on 3.0H (Above berm from 1956 contract drawings).

- 1V on 3.5H (Below berm from 1956 contract drawings).

(6) Upstream berm - el. 394.6 feet m.s.l. and 10 feet wide (1956 contract drawings).

(7) Zoning - unknown.

(8) Impervious core - unknown.

(9) Cutoff - 20 foot wide trench with depths as shown on Plate 3 .

(10) Grout curtain - unknown.

h. Diversion and Regulating Tunnel. None

i. Primary Discharge System.

(1) Type - An uncontrolled 48-inch diameter inlet pipe with a 36-inch diameter discharge pipe (see paragraph 1.2 a).

(2) Length of 48-inch diameter pipe - 20 feet (1956 contract drawings).

(3) Length of 36-inch diameter pipe - 160 feet (1956 contract drawings).

(4) Top elevation of vertical inlet - 400.6 feet m.s.l.

(5) Invert of discharge pipe at stilling basin - 369.0 feet m.s.l.

j. Emergency Spillway.

(1) Type - Uncontrolled grass covered earth with 20 foot wide asphalt road (see paragraph 1.2 a).

(2) Width of weir - 50 feet.

(3) Length of weir - 125 $\pm$ feet.

(4) Crest elevation - 403.6 $\pm$ feet m.s.l.

k. Regulating Outlet. (Based on the 1956 contract drawings.)

(1) Type - valve controlled 12-inch diameter pipe.

(2) Length of pipe - 85 feet.

(3) Invert of pipe in lake - 376.8 feet m.s.l.

(4) Discharge Invert - 369.0 feet m.s.l. (36-inch diameter discharge pipe).

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

The dam was designed by the Missouri Department of Conservation. Readily available design data were limited to a set of contract drawings dated 2 May 1956. However, it is known that a hydraulic and hydrologic design was performed based on similar criteria used by the Soil Conservation Service. Also borings were taken and the soil samples tested prior to construction by the Soil Conservation Service. Whether or not slope stability analyses were performed using suitable loading conditions including earthquake forces is unknown. The boring logs were not presented on the contract drawings.

2.2 CONSTRUCTION

The dam was constructed in 1956 and 1957 by the Harris Construction Company of Portageville, Missouri. The earth embankment was constructed of silty soils excavated from borrow areas located on ridges in the vicinity of the right abutment. The soil was transported and then compacted in lifts by tractor pulled scrapers. The contract drawings specified a "core trench" with a 20-foot bottom width to be excavated at a depth as shown on Plate 3 and then backfilled with suitable material. A typical embankment cross-section from the contract drawings showing the primary features of the vertical inlet, discharge, and lake drain systems is presented on Plate 4. Based on the inspection survey a 48-inch diameter, vertical inlet pipe was used in place of the 42-inch diameter pipe specified in the 1956 contract drawings and a 36-inch diameter pipe was used in place of the specified 30-inch diameter pipe for the discharge. Also an average 1V on 3.25H downstream embankment slope was used instead of the 1V on 3H slope specified in the contract drawings.

2.3 OPERATION

The emergency spillway was reportedly used only twice with the maximum experienced depth of one half of a foot occurring in the spring of 1973 for a duration of less than 12 hours. Also the lake level has been lowered at least once by using the 12-inch pipe drain.

2.4 EVALUATION

a. Availability. The only engineering data available were a set of contract drawings.

b. Adequacy. The drawings are inadequate to make a detail assessment of the design. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

c. Validity. The contract drawings appear to be valid except for the differences mentioned in paragraph 2.2 above.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS.

a. General. A visual inspection of Tywappity Community Dam was performed on 6 July 1978. Personnel making the inspection were employees of the Memphis District, Corps of Engineers, and included a hydraulic engineer, geologist, and soils engineer. Specific observations are discussed below.

b. Project Geology. The dam is located on a Monadnockic Ridge which is a remnant of the Pleistocene. Tertiary and Cretaceous Formations which covered the Mississippi Embayment prior to its dissection by the Ohio - Mississippi River complex. The ridge is a northern extension of Crowleys Ridge which is the predominant topographical feature of the embayment area.

The ridge is composed of loess overlying a sand layer which grades into a gravel directly above the Creataceous Formation. The loess represents the Recent while the sand and the gravel are Tertiary deposits. In this area the Cretaceous is the Ripley Formation of the Upper Cretaceous. The Ripley Formation consists of sand, sandy clay and clay.

As the dam was constructed of local borrow material it is probable that the dam is composed of predominantly silt and sand sized material. The dam is located in a Seismic Zone 3.

c. Dam. No detrimental settlement, cracking, slides or animal burrows were observed in or near the earth embankment. Typical existing cross-sections of the embankment are shown on Plate 5. These sections are consistent with the cross-sections presented in the Missouri Department of Conservation 1956 contract drawings except the existing downstream slope is a 1V on 3.25H instead of the specified 1V on 3H (see Plate 4 for a typical dam section from the 1956 contract drawings). The dam embankment appears to be well maintained and is clear of bushes and trees except for a few small bushes growing on the upstream slope along the lake edge (see Photo 5). The slopes had recently been mowed and cleared of small brush growth (see Photo 6). The lower portion of the downstream slope had been dressed with a dozer blade (see Photo 7). The upstream slope of the dam is faced with a riprap blanket from the crown to below the lake level (see Photo 4). On the 1956 contract drawings the riprap blanket is specified to be 8 inches thick and to extend from 2 feet below

the **upstream slope berm to the crown of the dam (see Plate 4).** In a few areas the riprap blanket has thinned exposing the underlying soil but no eroding of the soil has occurred.

No seepage was observed below the dam. A low area (approximately 20 feet wide and 40 feet long) having a growth of willows and cattails was observed approximately a 100 feet from the left abutment near the downstream toe (see Photos 12 and 13). No water was ponded in the area and the ground was not spongy. The plants are probably being supplied with water from near surface seepage.

Two erosion gullies, approximately 1.5 feet deep, 2 feet wide and 5 feet long, were located approximately 25 feet from the downstream toe just to the left and right of the dam center line (see Photo 11). The gullies were caused by runoff water flowing from the left and right abutment areas.

d. Appurtenant Structures. A vertical inlet constructed of 48-inch diameter, bituminous coated, corrugated metal pipe junctioned with a 36-inch diameter, bituminous coated, corrugated metal pipe is the primary means of discharge. A 2.1-foot by 7.5-foot corrugated metal baffle is mounted on the vertical inlet. A trash rack composed of timber posts and strands of barbed wire surrounds the inlet (see Photo 8). The outlet pipe discharges into an earth stilling basin located approximately 134 feet downstream of the dam center line (see Plate 5 and Photo 9).

The stilling basin has scoured to elevation 366.2 m.s.l. approximately 2 feet below the stilling basin elevation specified in the 1956 contract drawings (see Plates 4 and 5). The stilling basin erosion has apparently stabilized.

A grass covered, earth, emergency spillway is cut in the right abutment. The spillway is a trapezoidal section with a 50-foot bottom width and side slopes of 1V on 3H. The spillway is 125 feet long and is intersected at right angles by a 20-foot wide asphalt road. No erosion was observed in the emergency spillway area (see Photo 10).

A lake drain consisting of a 12-inch diameter steel pipe is specified in the contract drawings (see Plate 4). This structure is junctioned by a valve to the 36-inch diameter discharge pipe mentioned above. Because of the unaccessible location of the drain, it could not be inspected. Reportedly the lake was drained by the lake drain several years ago.

e. Reservoir Area. No wave wash, excessive erosion or slides were observed along the shore of the reservoir.

f. Downstream Channel. The downstream channel has some tree and brush growth in the channel.

3.2 EVALUATION

None of the conditions observed are significant enough to indicate a need for immediate remedial action or a serious potential of failure.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

The primary discharge system and the emergency spillway are uncontrolled; therefore, no regulating procedures exist for these structures. The valve controlled lake drain described in paragraph 3.1 d is used for lake and dam maintenance. No known operating procedures are available for this structure.

4.2 MAINTENANCE OF DAM

The dam embankment and appurtenant structures appear well maintained.

4.3 MAINTENANCE OF OPERATING FACILITIES

No information is available concerning maintenance of the lake drain.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

The inspection team is not aware of any existing warning system for this dam.

4.5 EVALUATION

The maintenance of **the dam appears adequate.**

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. No hydraulic nor hydrologic design data is readily available.

b. Experience Data. The drainage area was developed using USGS Chaffee, Mo. Quadrangel. The lake surface area and storage values were determined using the 1956 contract drawings furnished by the Missouri Department of Conservation. The spillway and dam layout are made from surveys conducted by the inspection team. Comparisons were made with the 1956 contract drawings and the inspection surveys. All relative elevations checked except the crest elevation of the emergency spillway which was .5' higher than the elevation on the contract drawings.

c. Visual Observations.

(1) The vertical shaft and earthen spillway are in excellent condition.

(2) The vertical shaft is located approximately in the center of the dam, while the spillway is located in the right abutment. Releases from either structure will not endanger the integrity of the dam.

(3) A 12-inch diameter steel pipe shown on the contract drawings is for draw down purposes. However, its existence or operational capabilities could not be verified by the inspection team.

d. Overtopping Potential. The spillway will pass 35 percent of the Probable Maximum Flood (PMF), without overtopping the dam. The Probable Maximum Flood (PMF) is defined as the flood discharge that may be expected from the most severe combination of critical meterologic and hydrologic conditions that are reasonably possible in the region. For its size and hazard category, this dam is required by the guidelines to pass from one-half PMF to PMF. However, considering the high hazard potential to life and property of approximately 12 families downstream fo the dam, the spillway size and/or height of dam should be increased to pass the PMF, without overtopping the dam. Because the spillway will not pass one-half of the PMF without overtopping, the dam is classified as "unsafe non-emergency." The spillway will pass the 100-year flood without overtopping, which is a flood that has a one percent chance of being exceeded in any given year.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. There were no visual observations which adversely affect the structural stability of this dam.

b. Design and Construction Data. The design and construction data were limited to that information discussed in paragraphs 2.1 and 2.2.

c. Operating Records. There have been no known operations which have affected the structural stability of the dam.

d. Post Construction Changes. No post construction changes exist which will affect the structural stability of the dam.

e. Seismic Stability. Considering the **Seismic Zone 3 in** which this dam is located, **it is likely that an earthquake could occur of sufficient intensity to cause severe damage or failure of the dam.**

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. A few items were noted during the visual inspection by the inspection team which should be corrected or monitored. These items are detailed in paragraph 7.2 c. The Probable Maximum Flood (the design flood) and one-half of the Probable Maximum Flood will both overtop the dam. Because the spillway will not pass one-half of the PMF without overtopping the dam, the dam is classified as "unsafe non-emergency."

b. Adequacy of Information. Due to the lack of engineering design and construction data, the conclusions in this report were based on performance history and external visual conditions. The inspection team considers that these data are sufficient to support the conclusions herein.

c. Urgency. The remedial measures recommended in paragraph 7.2 should be accomplished in the near future.

d. Necessity for Phase II. Based on the results of the Phase I inspection, no Phase II inspection is recommended.

e. Seismic Stability. This dam is located in Seismic Zone 3. Since this dam is located in Seismic Zone 3, it is likely that an earthquake could occur of sufficient intensity to cause severe damage of failure of the dam.

7.2 REMEDIAL MEASURES

a. Alternatives. Spillway size and/or height of dam should be increased to pass the probable maximum flood without overtopping the dam.

b. Seepage and stability analyses comparable to the requirements of the "Recommended Guidelines for Safety Inspection of Dams" were not available which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.

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

(1) Cut the brush growing on the upstream slope.

(2) Fill the 2 erosion gullies near the dam centerline just downstream of the downstream toe.

(3) The low area near the downstream toe should be monitored for seepage and/or for ponding of water. If seepage or ponding developes then this condition should be rectified.

(4) The upstream slope should be monitored for erosion in areas where the riprap blanket has thinned exposing the underlying soil.

(5) The stilling basin should be monitored for active erosion.

(6) If conditions warrant in (4) and (5) above, riprap protection should be provided.

(7) A detailed inspection of the dam should be made at least every 5 years by an engineer experienced in design and construction of dams.

APPENDIX A

HYDROLOGIC COMPUTATIONS

HYDROLOGIC COMPUTATIONS

1. HEC-1 was used to develop the inflow hydrograph for PMF and hydrologic characteristic of drainage basin.

2. HEC-1 uses **Snyder** Method for developing synthetic unit hydrographs with Clarks Modification.

Final Variables

Drainage Area	0.59 sq. mi.
Travel Time of Runoff	30 min.
Initial Loss of Rainfall	0.5 in.
Average Loss Rate	0.05 in/hr.
C_t	0.75
C_p	0.698
PMF Rainfall	**27.0 in.**
PMF Percentages	**6 hr. 102**
	12 hr. 120
	24 hr. 130

3. The inflow hydrograph was routed through the reservoir using HEC-1's modified Puls option. Releases were calculated for both the pipe and spillway. The pipe was assumed flowing full and the broadcrested weir equation was used to calculate spillway discharges. Variables for the pipe and spillway discharges are listed below.

Pipe

n	.025
L	190 ft.
D	3 ft.

Spillway

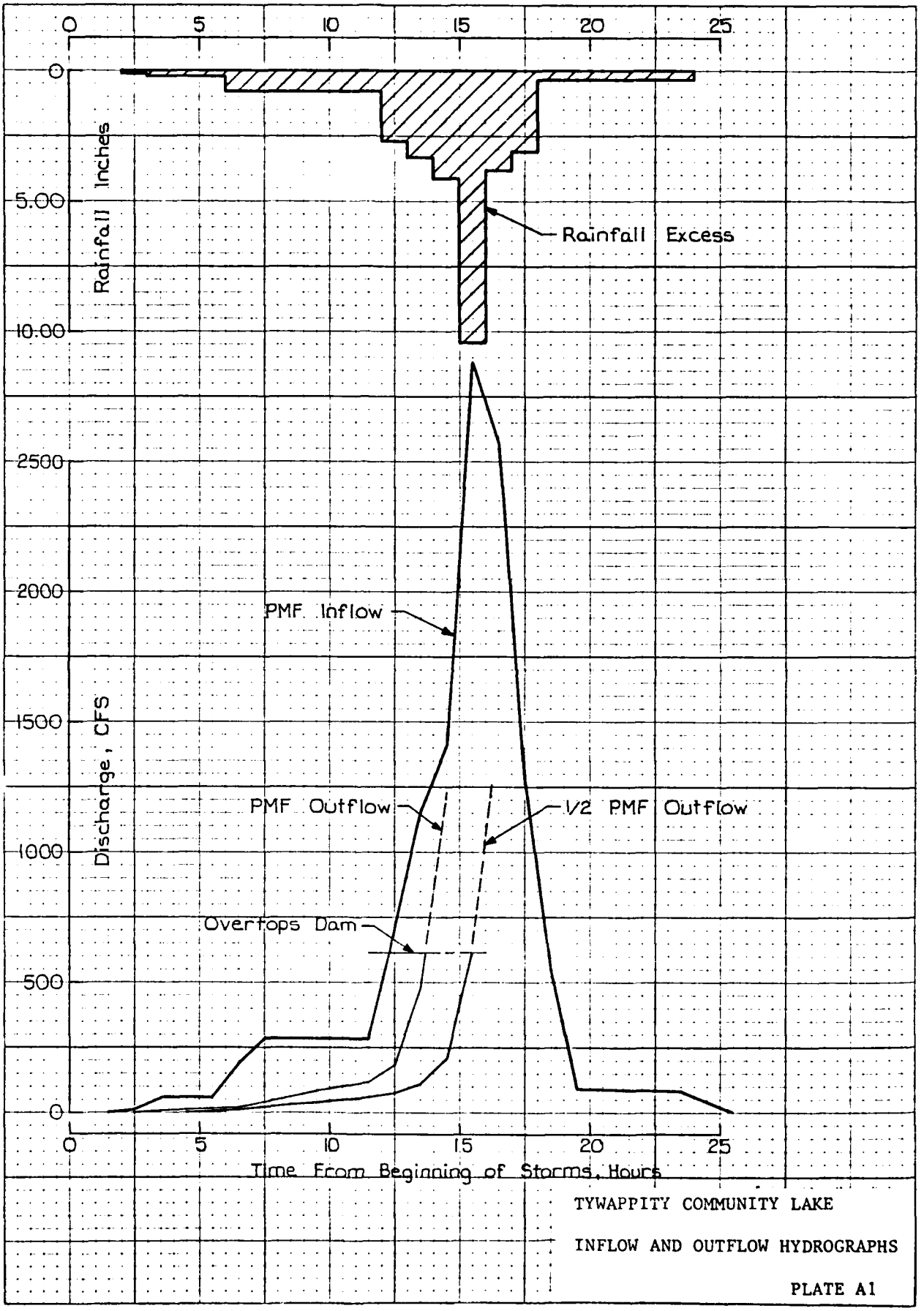
C	2.8
L	60 ft.*

* The spillway discharge was approximated using a rectangular weir width of 60 ft.

Top of Dam

C 2.8
L 500 ft.

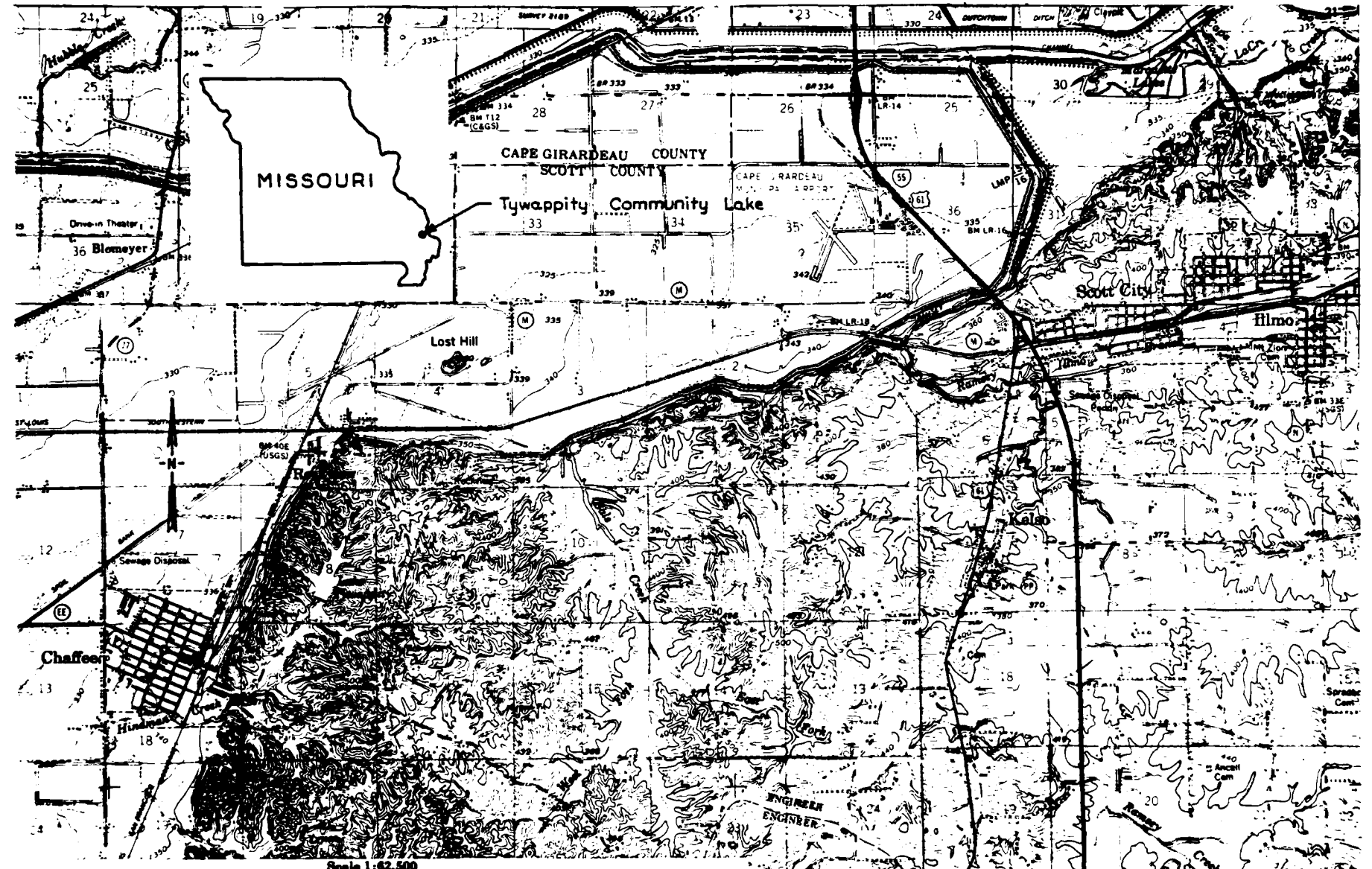
4. PMF rainfall distribution, inflow hydrograph, and outflow hydrograph are shown on Plate A1.



TYWAPPITY COMMUNITY LAKE

INFLOW AND OUTFLOW HYDROGRAPHS

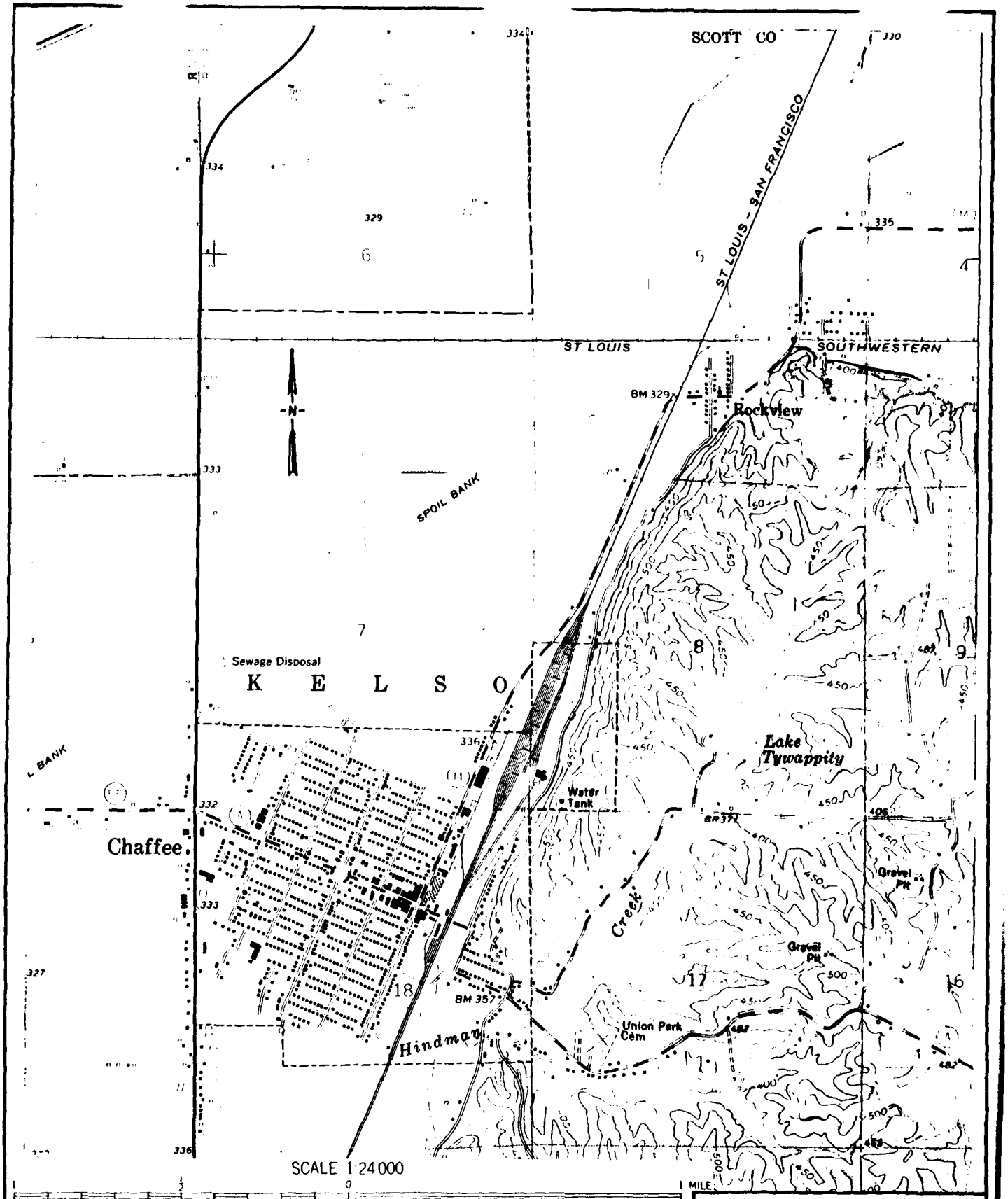
PLATE A1



TYWAPPITY COMMUNITY LAKE

LOCATION MAP

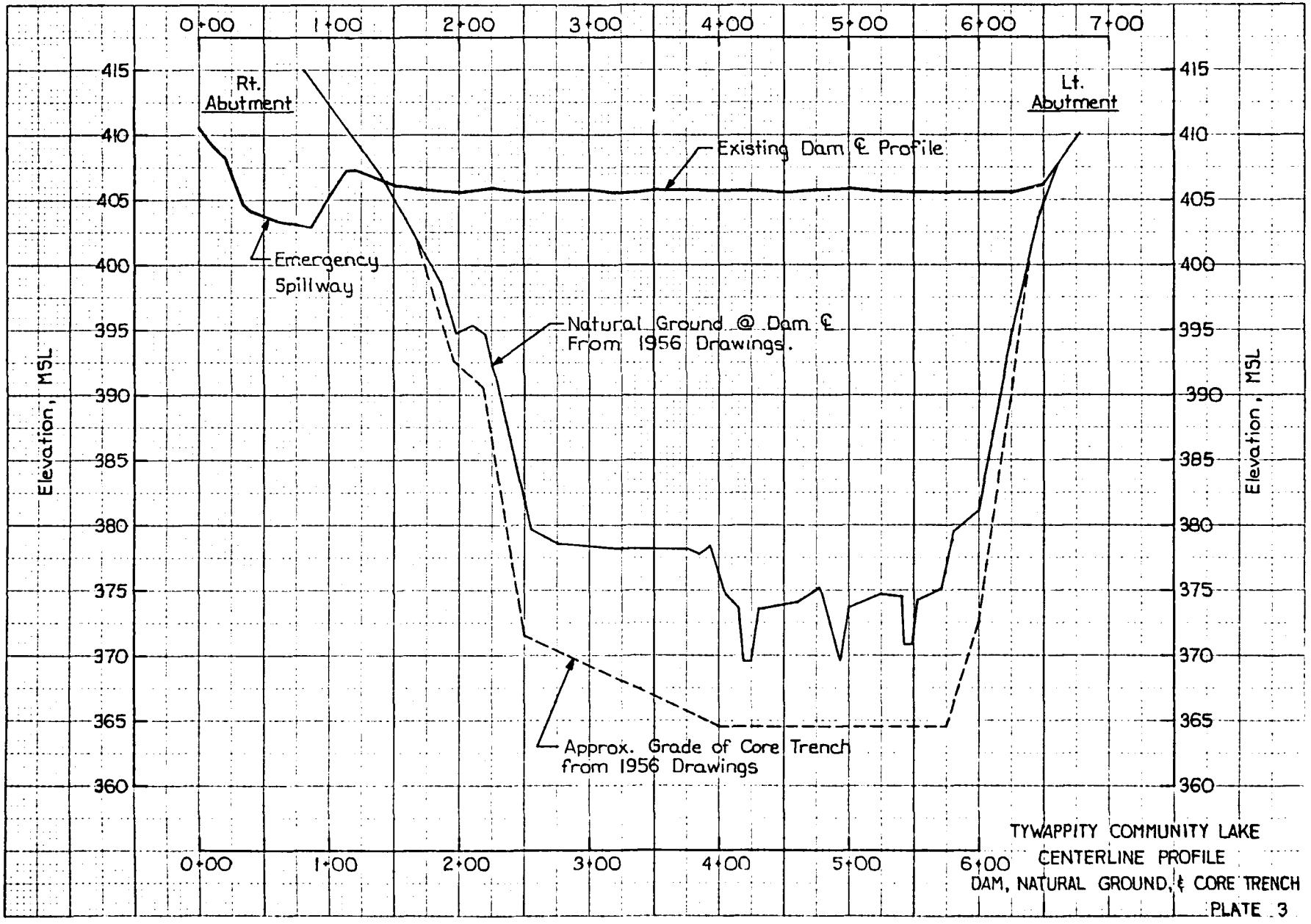
PLATE 1



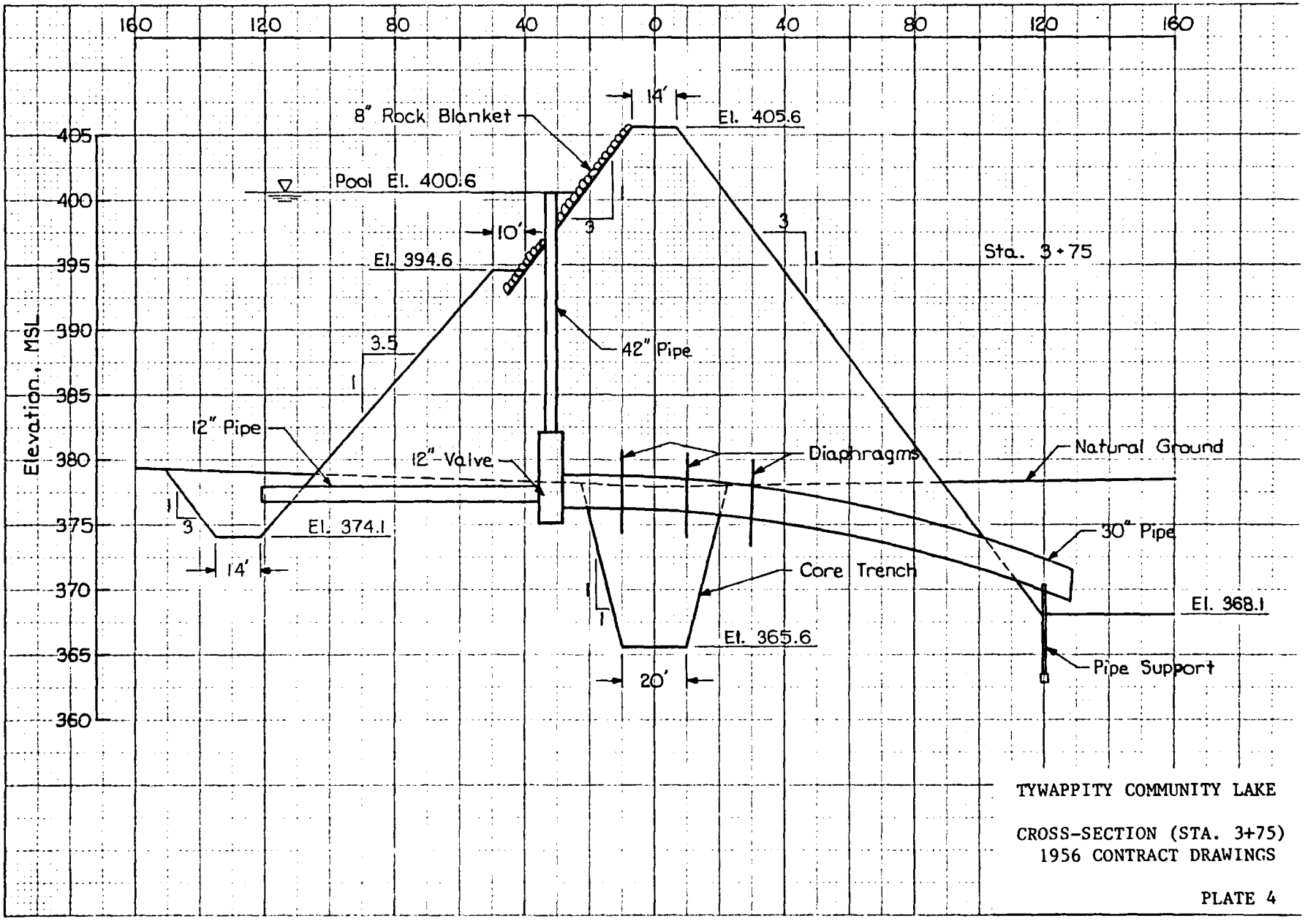
TYWAPPITY COMMUNITY LAKE

VICINITY TOPOGRAPHY

PLATE 2



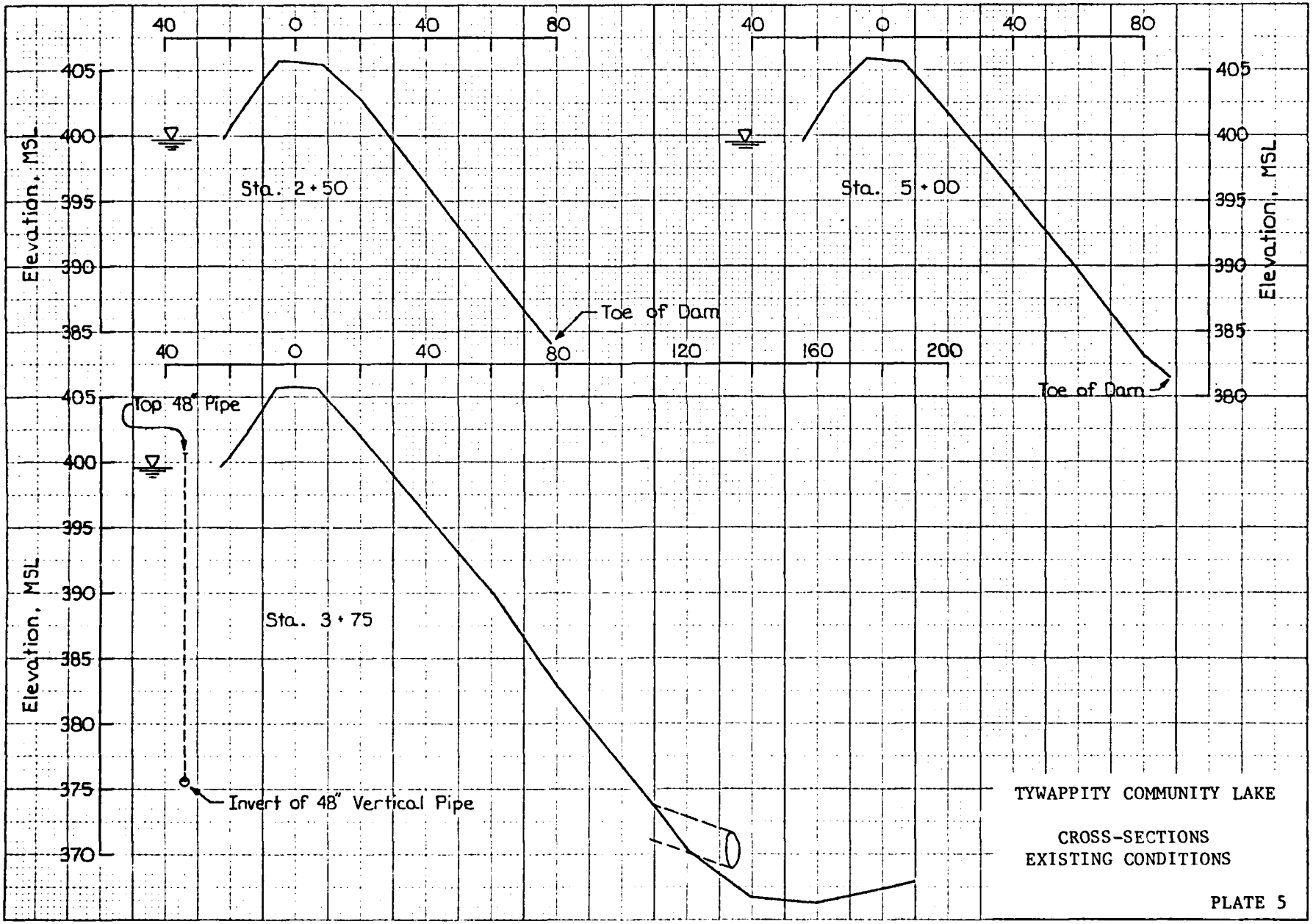
TYWAPPITY COMMUNITY LAKE
CENTERLINE PROFILE
DAM, NATURAL GROUND, ℄ CORE TRENCH
PLATE 3



TYWAPPITY COMMUNITY LAKE

CROSS-SECTION (STA. 3+75)
1956 CONTRACT DRAWINGS

PLATE 4



TYWAPPITY COMMUNITY LAKE

CROSS-SECTIONS
EXISTING CONDITIONS

PLATE 5

PHOTO 1: Overview of Lake, Spillway, and Dam

PHOTO 2: Overview of Lake

PHOTO 3: Crest of Dam

PHOTO 4: Riprap Protection on Upstream Slope

PHOTO 5: Small Bushes on Upstream Slope

PHOTO 6: Mowed Grass on Downstream Slope

PHOTO 7: Dozer Dressed Area on Downstream Slope

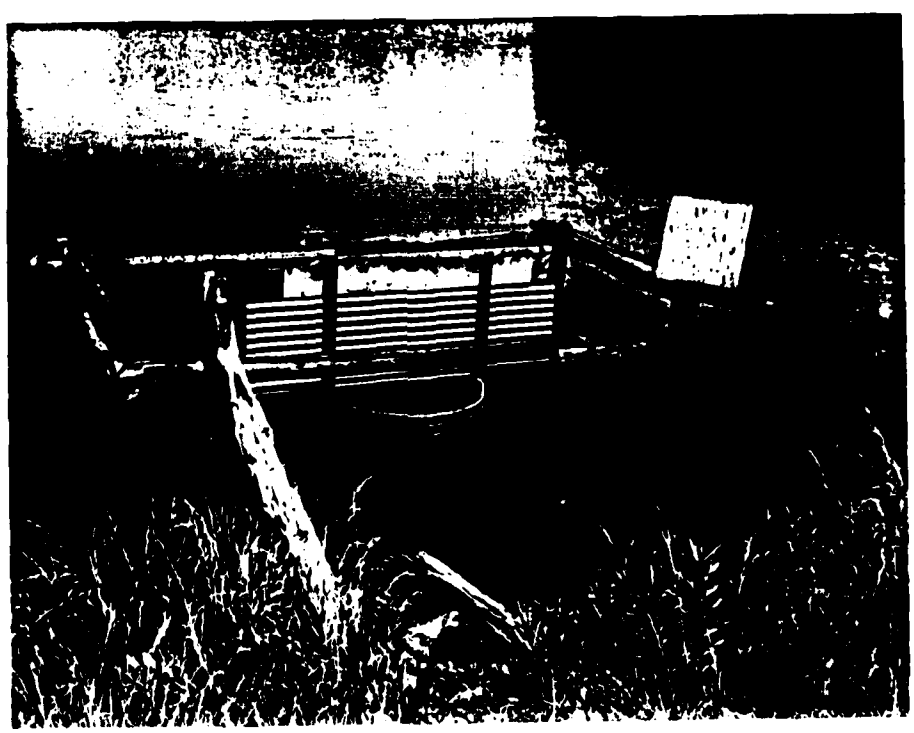


PHOTO 8: Inlet of Vertical Structure

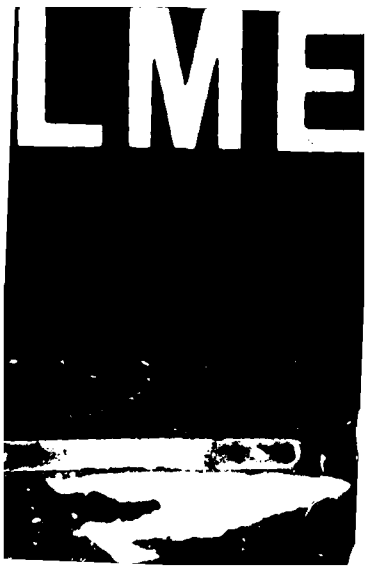
PHOTO 9: Discharge of Vertical Structure

PHOTO 10: Emergency Spillway

PHOTO 11: Erosion Gully

PHOTO 12: Low Area Near Downstream Toe

PHOTO 13: Willow Growth in Low Area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