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NATIONAL DAM SAFETY PROGRAM, OLD WOLF DAM (MO 31118), MISSISSIP--ETC(U)
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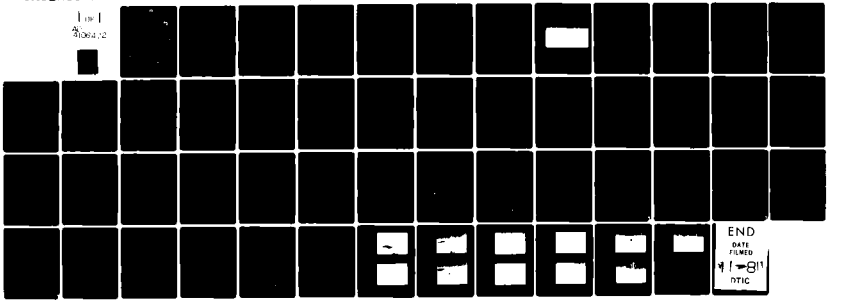

LEVEL II

MISSISSIPPI-KASKASKIA-ST. LOUIS BASIN

OLD WOLF DAM
WASHINGTON COUNTY, MISSOURI
MO 31118

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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

FOR: STATE OF MISSOURI

AUGUST 1979

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

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

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

REPLY TO ATTENTION OF

5 March 1980

SUBJECT: Old Wolf Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Old Wolf Dam (MO 31118). It was prepared under the National Program of Inspection of Non-Federal Dams.

SUBMITTED BY: SIGNED — 26 MAR 1980
Chief, Engineering Division — Date

APPROVED BY: SIGNED — 26 MAR 1980
Colonel CE District Engineer — Date

OLD WOLF DAM
WASHINGTON COUNTY, MISSOURI

MISSOURI INVENTORY NO. 31118

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY
INTERNATIONAL ENGINEERING COMPANY, INC.
CONSULTING ENGINEERS
SAN FRANCISCO, CALIFORNIA

UNDER DIRECTION OF
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
FOR
GOVERNOR OF MISSOURI

AUGUST 1979

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam	Old Wolf Dam
State	Missouri
County	Washington
Stream	Offstream from Tributary of Cadet Creek
Date of Inspection	9-10 April 1979

Old Wolf Dam, I.D. No. 31118, owned by Baroid Division of N. L. Industries, Potosi, Mo., was inspected by a civil engineer and an engineering geologist from International Engineering Company, Inc. of San Francisco, California. The purpose of the inspection was to assess the general condition of the dam with respect to safety. The assessment was based upon an evaluation of the available data, a visual inspection, and an evaluation of the hydrology and hydraulics of the site in order to determine if the dam poses hazards to human life or property. The dam provides impoundment for barite ore tailings.

Old Wolf Dam was inspected using the "Recommended Guidelines for Safety Inspection of Dams" furnished by the Department of the Army, Office of the Chief of Engineers. Based on these guidelines, this dam is classified as being of intermediate size. The St. Louis District Corps of Engineers has classified this dam to have a high downstream hazard potential. Failure of this dam could threaten life and property. The estimated damage zone provided by the St. Louis District Corps of Engineers extends approximately 2-1/2 miles downstream of the dam. There are 7 dwellings, a railroad bridge and part of the town of Cadet within this damage zone.

The results of the inspection and evaluation indicate that the dam meets the criteria given in the guidelines for a dam with the size and hazard potential of Old Wolf Dam. As an intermediate size dam with a high hazard potential, the Guidelines specify that the discharge capacity and/or storage capacity should be capable of safely handling the Probable Maximum Flood (PMF) without overtopping the crest. The PMF is the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

It has been calculated that the impoundment can retain a 100-year flood (a flood having a 1 percent chance of being equalled or exceeded in any 1 year) without overtopping the dam. It was also estimated that the dam could retain the PMF without overtopping the dam.

Dense vegetation covered the south portion of the dam making adequate inspection impossible. Animal burrows and narrow crest width were evident in this area. This portion of the dam should be cleared, any burrows filled, further inspection performed, and the crest widened. Small ponds from drainage observed at the dam toe should be permanently drained to reduce the possibility of weakening foundation materials by saturation.

Seepage and stability analyses of this dam are not available. These studies should be performed by a professional engineer experienced in the design and construction of tailings dams and should be made a matter of record. Based on the results of these analyses, remedial measures may become necessary. Remedial work should be performed under the direction of an engineer experienced in the design and construction of tailings dams.

An inspection and maintenance program should be initiated. Periodic inspections should be made and documented by qualified personnel to observe the performance of the dam and spillway.

It is recommended that the owner take action to correct the deficiencies described.

Kenneth B. King, P.E.

James H. Gray, P.E.

Donald E. Westcott

Overview of Old Wolf Dam ID No. 31118

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
OLD WOLF DAM
ID NO. MO 31118

TABLE OF CONTENTS

APPENDIX A

HYDROLOGIC AND HYDRAULIC ANALYSES

LIST OF PLATES

PHOTOGRAPHS

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
OLD WOLF DAM - ID NO. 31118

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 Old Wolf Dam be made.

b. Purpose of Inspection. The purpose of the inspection was to assess 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) Type of dam - Old Wolf Dam is an earthfill dam that impounds barite tailings. The impoundment is formed by an incomplete ring dam.

(2) Spillway - An uncontrolled open channel spillway is located at the left abutment at Station 46+70. The spillway crest elevation is higher than the low point on the dam crest, and it is ineffective as an overflow structure.

b. Location. The dam is located in Washington County, Missouri, as shown in Plate 1. The dam is shown in Plate 2 and is located in Section 27, Township 38 North, Range 3 East.

c. Size Classification. Old Wolf Dam is classified as an intermediate size dam in accordance with "Recommended Guidelines for the Safety Inspection of Dams".

d. Hazard Classification. This dam is classified as having a high hazard potential by the St. Louis District Corps of Engineers. The estimated damage zone, as provided by the St. Louis District Corps of Engineers, extends approximately 2-1/2 miles downstream. There are 7 dwellings, a railroad bridge and part of the town of Cadet within this damage zone.

e. Ownership. This dam is owned by:

Baroid Division
N. L. Industries
P. O. Box 8
Potosi, Missouri 63664

f. Purpose of Dam. The dam impounds tailings resulting from a barite separation and benefication process. Tailings are no longer conveyed to the impoundment.

g. Design and Construction History. There is no written design or construction data available for this dam. Information obtained from Mr. Clarence Houk, General Superintendent for Baroid indicates that the starter dam was built during the 1930's by a local contractor named Wolf. The impoundment operations ceased sometime during the 1940's. Baroid constructed the spillway at some unknown date after acquiring the property.

h. Normal Operating Procedures. No operating records are known to exist. Runoff into the pond is removed by seepage into the tailings and evaporation. The facility is inactive in that tailings are no longer conveyed to the impoundment.

1.3 PERTINENT DATA

a. General. Field surveys were made by Booker Associates, Inc. of St. Louis, Missouri on 25 April 1979. Measurements are valid as of the dates of inspection and survey.

b. Drainage Area. 46 acres (from ASCS air photograph #BMH-3MM-233)

c. Discharge at Damsite.

(1) Outlet Pipe - Not applicable.

(2) Total spillway discharge at maximum pool elevation - 0 cfs

d. Elevation (Feet Above M.S.L.)[1/]

(1) Top of dam (Maximum Pool) - 888.3 to 895.7 feet.

(2) Toe of dam - 841.1 feet.

(3) Pool elevation on 25 April 1979 - 882.1 feet.

(4) Spillway crest - 888.4 feet.

(5) Overflow pipe - Not applicable.

(6) Intake structure (flashboards) - Not applicable.

d. Reservoir.

(1) Length of maximum pool - 2100 feet ±. (ASCS airphoto - 233)

(2) Length of operating pool - 1000 feet ±.

e. Storage above Tailings Surface. 182 acre feet at El. 888.3 feet.

f. Reservoir Surface Area.

(1) Top of dam (Maximum Pool) - 40.5 acres at El. 888.3 feet.

(2) Operating pool - 7.5 acres at El. 882.1 feet.

(3) Spillway crest - 41 acres at El. 888.4 feet.

g. Dam.

(1) Type - Earthfill

(2) Length (crest) - 4500 feet.

(3) Height - 50 feet at Station 33+12.

(4) Crest width - Varies from approximately 5 to 25 feet.

[1/] Elevations are based on a reference elevation of 912.50 feet M.S.L. at the temporary bench mark shown on Plate 3. This datum was estimated from topographic data presented on the Mineral Pt. 7.5 minute Quadrangle Map.

(5) Side Slopes -

(a) D/S - Approximately 1.5(H):1(V)

(b) U/S - Unknown

(6) Zoning - The dam appears to be constructed consistent with the prevailing barite dam construction practice. This consists of a clay starter enlarged using -7/8-inch barite gravels.

(7) Cutoff - There is no written information available to indicate that a cutoff was designed or constructed.

h. Spillway.

(1) Type - open channel, uncontrolled, located at Sta. 46+70.

(2) Type of Weir - broad-crested. The weir is formed by road fill material placed in the outlet channel.

(3) Length of Weir - approximately 15 feet.

(4) Weir Discharge Coefficient - 3.0

(5) Crest Elevation - El. 888.4 feet.

(6) Upstream Channel - not applicable.

(7) Downstream Channel - approximately 12 feet wide.

i. Regulating Outlets. Not applicable.

j. Diversion Ditches. Not applicable.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No design drawings or data are known to exist.

2.2 CONSTRUCTION

a. Information. The dam was built during the 1930's by a local contractor name Wolfe. There are no records concerning construction methods, materials, or procedures.

b. Assessment of Construction Method and Materials. Procedures used to build this dam were developed by miners using trial and error techniques over the last 60 years. After construction of the starter dam, sand and angular gravels (finer than 7/8-inch) were hauled to the crest of the dam, end-dumped and spread; and excess material was pushed over the upstream and downstream faces of the dam. The sands and gravels placed in this manner are in a loose state and are at their natural angle of repose on the downsteam face. The material pushed over the upstream side rests on the tailings. The centerline of the dam remains approximately at the same position as the embankment is raised. Compaction of the material on the crest was by construction equipment.

The barite gravels (-7/8-inch) were used to enlarge this tailings dam. They are free draining, angular, and relatively well-graded through the gravel and coarse sand range. The gravel appears to function well as a drain material, and it also functions fairly well as erosion protection from rainfall; however, it is inadequate to prevent erosion from channeled surface flow with a velocity greater than 4 to 6 feet per second.

Foundation preparation for the downstream foundation zone appears to be nonexistent, as buried trees in the downstream face tend to indicate.

2.3 OPERATION

The impoundment was operated until the 1940's by an unknown owner. No records of operation are known to exist.

2.4 EVALUATION

a. Availability. No design or construction records were available. The only information made available to the inspection team was provided during conversations with Mr. Clarence Houk, General Superintendent of Baroid Division of N. L. Industries, present owner of the facility.

b. Adequacy. The field surveys and visual inspections documented herein are considered adequate to support the conclusions of this report. Seepage and stability analyses comparable to the requirements of "Recommended Guidelines for the Safety Inspection of Dams" are not available; the lack of these analyses is considered to be a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions, including earthquake loads, and should be made a matter of record.

c. Validity. Not applicable.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. The inspection team consisted of a civil engineer and an engineering geologist from International Engineering Company, Inc. Clarence Houk, General Superintendent for Baroid Division of N. L. Industries, met with the inspection team on 10 April 1979. An employee escorted the team to the damsite. The facility is an abandoned barite tailings impoundment. Photographs taken during the inspection are included in this report; locations are shown on Plate 7.

b. Project Geology. Bedrock at the site is gray dolomite of the Cambrian age Potosi Formation. Isolated outcrops of bedrock were found in the downstream channel. A considerable amount of water was issuing from the bedrock exposures along the channel. Residual soil overlies bedrock to an unknown depth. The residual overburden soil consists of dark red and brown barite rich clays derived from weathering of the dolomite. Intermixed with the clays are rock fragments consisting of barite, quartz, chert and dolomite which grade from fine gravel to boulders.

c. Dam. The plan of the dam is shown on Plate 3. The profile and cross-sections are shown on Plates 4, 5, and 6.

The slopes and edge of the crest of the dam were covered with trees and brush. The dam from Stations 1+80 to 12+00 was completely overgrown.

No detrimental settlement, depressions, sinkholes, erosion, or evidence of past embankment overtopping was observed at the embankment. Several animal burrows were seen on the crest of the dam between Stations 1+80 and 7+50.

The embankment gravels appear to be standing near or at their angle of repose. No springs or identifiable seepage from the dam were found. Ponded water was noted at the dam toe near Stations 8+00, Station 27+00, Station 25+00, and below Station 33+00. A ditch, probably constructed by a bulldozer some time ago along the dam toe from approximately Station 21+00 to Station 27+00, contains the last two accumulations of water mentioned. It is not evident whether the water resulted from seepage.

The difference in height between the crest elevation and the adjacent tailings surface varies between 3 feet and 7 feet. The crest elevation was measured on the crest roadway and the starter dam crest in places where it was exposed.

The low spot on the crest is located by Station 7+00 at elevation 888.3. This area on the crest appears to be part of the starter dam which was never enlarged. The crest width from Stations 1+50 to 7+17 is less than 10 feet wide, and vehicle access to this area is not possible.

No obvious abutments exist; however, the dam begins from original ground at Station 1+50 to original ground at the corner of the dam at Stations 12+00 to 13+00, and ties into original ground at the cut spillway at Station 46+70. The abutments consist of unmined residual soil.

Spillway sections and profile are shown on Plates 4 and 6.

d. Appurtenant Structures. The uncontrolled open channel spillway is located at Station 46+70 as shown on Plate 3. It is approximately 12 feet wide with a relatively flat slope and appears to have been cut with a single pass of a bulldozer. The bottom of the channel is composed of soil and tailings, covered by vegetation and debris. The floor of the channel is relatively smooth. There is no approach channel, stilling basin, or system for dissipating energy.

The low spot on the dam crest (El. 888.3 feet) is lower than the elevation at the spillway crest (El. 888.4 feet).

No outlet pipes or diversion ditches were found at the site.

e. Reservoir Area. No landslide activity or excessive erosion was observed in the reservoir area. Little sedimentation occurs at this site because the drainage basin is enclosed by the dam. There are no upstream hazards that might be subject to backwater flooding.

The impoundment consists of red silty clays deposited by hydraulic methods during active mine operations. No deposition has occurred for approximately 35 years. Some consolidation of the tailings has probably occurred, primarily in the immediate area adjacent to the dam where drainage can occur. Also, the surface zones have dessicated and small trees and grasses transpire some water from near the surface of the tailings.

Approximately 90 percent of the watershed area consists of tailings covered by small trees and grass, and 10 percent is undisturbed forest land.

f. Downstream Channels. Overflow from the spillway would flow overland approximately 500 feet to a tributary of Cadet Creek. The tributary channel is V-shaped, heavily overgrown and does not appear to be prone to flooding.

Overflow from the low area on the dam crest near Station 7+00 would accumulate at the dam toe, then overflow Route 47 into a ditch flowing south into a mined out area.

3.2 EVALUATION

The spillway appears to be incapable of functioning due to lack of freeboard available over the spillway crest elevation.

Interrupted drainage was observed at the dam toe near the maximum section at Station 33+12 and various locations along the dam. No adequate means of draining this water was evident. This could result in weakening of the clay foundation soil by saturation and adversely affect the stability of the dam.

The dam from Stations 1+50 to 12+00 was heavily overgrown with trees and brush, and contained several animal burrows. Adequate inspection was not possible due to the dense vegetation. The crest width was less than 10 feet between Stations 1+50 and 7+17.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

No regulating procedures exist for the structure.

4.2 MAINTENANCE

Information available to the inspection team indicates that the dam is not maintained.

4.3 MAINTENANCE OF OPERATING FACILITIES

Not applicable.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no warning system in effect at this dam.

4.5 EVALUATION

A periodic inspection program should be established so that indications of instability, such as cracks in the dam, sloughing, sudden settlement, erosion of the dam, or an increase in the volume or turbidity of water from seepage can be monitored. Maintenance of the dam is inadequate.

SECTION 5 - HYDRAULIC AND HYDROLOGIC ANALYSES

5.1 EVALUATION OF FEATURES

a. Design Data. The significant dimensions of the dam are presented in Section 1 - Project Information and are also presented in the accompanying field survey drawings, Plates 3 through 6. Hydrologic or hydraulic design information are not available.

For this evaluation, the watershed drainage area and reservoir area-elevation data were measured using 1971 U.S. Agricultural Stabilization and Conservation Service airphoto enlargements and survey data.

The total drainage area including the reservoir at Old Wolf Dam, I.D. No. 31118, is completely enclosed by the embankment and a 15-foot high dike. The total area is approximately 46 acres (0.072 square mile). The watershed location and drainage boundary are shown on Plate 2. About 90% of the drainage area was occupied by disposed tailings from barite mining, and the remaining 10% of the enclosed area was existing ground, partially covered with trees. Field surveys of the tailings behind the embankment (see Plate 3) showed the tailings profile was irregular and at different elevations. To obtain the active storage capacity, the spot surveys of the tailings elevations were transferred to the aerial photograph and used as a guide to develop contours of the tailings.

For computations of "basin" characteristics, a lag time of 0.1 hour, and a runoff curve number (CN) of 100 were assumed for the computations of flood runoff for the tailings within the reservoir.

The input data and computed parameters, such as basin lag time, unit hydrograph, probable maximum precipitation, and the reservoir elevation-area-capacity data are in Appendix A. As shown in the computer printouts, the reservoir surface areas are actual surface areas corresponding to the elevations shown. The capacities shown, as computed in the computer program by the Conic Method, are the active capacities at the given elevation adjusted for the tailings.

A small spillway is located at Sta. 46+70. The spillway crest elevation is at about El. 888.4. The lowest point along the dam crest is at about Sta. 7+00, with the minimum dam crest at El. 888.3, slightly lower than the spillway crest. Computations of the discharge rating curve for flows over the dam crest and through the spillway were made by using the weir flow formula with a weir coefficient of C=3.0. The combined discharge rating curve data are shown in Appendix A, under the input data listing on the Y4 and Y5 cards. The overtopping analysis was based on the effective crest elevations as surveyed on the dam crest. The effective crest elevation for overtopping was assumed to be at El. 888.3, the lowest point along the dam crest at about Sta. 7+00.

b. Experience Data. Rainfall, streamflow, and flood data for the entire watershed are not available.

c. Visual Observations. Visual observations are discussed in Section 3 - Visual Observations.

During the field inspection, it was observed that the low points of the tailings were submerged in water. The pond water surface elevation was at about El. 882.1 (see Plate 3).

d. Overtopping Potential. The probable maximum flood (PMF), and floods expressed as a percentage of PMF were computed and routed through the reservoir. The probable maximum flood is defined as the hypothetical flood event that would result from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible at a particular location or region.

The computed floods were routed through the project reservoir using the Modified Puls Method of flood routing. For all cases of the reservoir flood routing, the starting water surface elevation was set at El. 882.1, the observed water surface elevation behind the embankment.

Results of the overtopping analyses indicate that the dam is able to retain the probable maximum flood, with the highest reservoir water surface at about El. 887.6.

Results of the overtopping analyses are reported in Appendix A and summarized below.

Flood	Peak Inflow (cfs)	Peak Outflow (cfs)	Max WS Elev (ft)	Max Depth Over Min. Dam Crest (ft)	Freeboard (ft)
25% PMF	262	0	884.4	-	3.9
50% PMF	525	0	885.7	-	2.6
75% PMF	787	0	886.7	-	1.6
PMF	1049	0	887.6	-	0.7

Note: The amount of freeboard available was computed as the distance from the minimum dam crest (El. 888.3) to the water surface elevations obtained for the different ratios of the PMF.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Visual observations of conditions that adversely affect the structural stability of the dam are discussed in Section 3.

b. Design and Construction Data. No design or construction data pertaining to the structural 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, and lack of this information 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. Operating Records. No appurtenant structures are operable at this dam; no records of operations were located.

d. Post-Construction Changes. The dam has been enlarged during active mine operations, but no records are available concerning dates of enlargements, design, or materials used. Baroid personnel constructed the spillway at Station 46+70 at some unknown date. No information pertaining to the bulldozed ditch between Station 21+00 and Station 27+00 was available. No other post-construction changes were evident.

e. Seismic Stability. The dam is located in Seismic Zone 2, to which the 1976 Uniform Building Code assigns a "moderate" damage potential. There appears to be a potential for instability caused by ground shaking during earthquakes where the dam overlies soft saturated clay foundation soil. Some crest settlement and ravelling of the embankment gravels could also occur during seismic shaking because the the gravels are in a loose state and downstream slope is at or near the gravel's natural angle of repose.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. Several deficient conditions at the dam should be corrected to improve the margin of safety. Deficiencies noted are: soft foundation materials resulting from ponded water at the dam toe, excessive vegetation on the dam, animal burrows and insufficient crest width. The soft foundation conditions could adversely affect the stability of the dam. Seepage and stability analyses meeting the requirements of "Recommended Guidelines for the Safety Inspection of Dams" were not available; the lack of this information is considered a deficiency. Suggested remedial measures are discussed in Section 7.2 REMEDIAL MEASURES.

b. Adequacy of Information. No design or construction data were available. Seepage and stability analyses meeting the requirements of "Recommended Guidelines for Safety Inspection of Dams" were not available; the lack of this information is considered a deficiency.

Topographic data for this dam is inadequate. This is due primarily to the fact that no topographic relief of the dam and reservoir is shown on the USGS 7.5' quadrangle map. The drainage area measurement, reservoir area-capacity data and slopes were estimated using survey measurements and constructing topographic contours on a 1" = 660' air photo enlargement showing the reservoir and watershed areas. This data is considered adequate for a Phase I analysis; however, the evaluation of overtopping potential is approximate due to the available data.

Additional investigations should be completed as necessary so that seepage and stability analyses can be performed. The investigations should be undertaken by an engineer experienced in the design and construction of tailings dams. Also, further inspection of the dam as described below in Section 7.2.a is recommended.

c. Urgency. Priority should be given to clearing the dam crest from Stations 0+00 to 12+00 and performing further inspection.

d. Necessity for Phase II. No Phase II inspection is recommended.

7.2 REMEDIAL MEASURES

a. Clearing of Vegetation. Vegetation growing on the dam from Stations 0+00 to 12+00 should be removed under the supervision of an engineer experienced in the design and construction of tailings dams. Following clearing, further inspection of the dam in this area should be made.

b. Animal Burrows. Fill animal burrows near Station 6+00 and any others found during clearing.

c. Drainage of Water. Water which presently ponds at the dam toe at Stations 33+00 to 34+00 should be drained to remove water which could saturate and weaken foundation soil.

d. Inspection Program. The dam should be inspected periodically by an engineer who will observe and record the performance of the dam. The springs and seeps should be monitored as part of the inspection program. Records of these inspections should be maintained, and all maintenance or remedial measures performed at the site should be documented.

d. Increase in Crest Width. The crest of the dam from Stations 1+50 to 12+00 should be widened as required to provide vehicle access for inspection and maintenance.

e. Stability and Seepage Analyses should be performed by an engineer experienced in the design and construction of tailings dams. Included in these analyses should be seepage and stability computations performed with the reservoir water surface set at the top of the dam. The results of these studies may indicate that other remedial measures are required. All such remedial measures should be accomplished under the direction of an engineer experienced in the design and construction of tailings dams.

APPENDIX A

HYDROLOGIC AND HYDRAULIC ANALYSES

The hydrologic and hydraulic analyses were accomplished by using the computer program "Flood Hydrograph Package, HEC-1, Dam Safety Investigations Version, July 1978". This program was developed by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. The criteria and methodology used are briefly discussed below:

- Probable Maximum Precipitation (PMP) - The 24-hour PMP was obtained from Hydrometeorological Report No. 33. The 6-hour and the 1-hour depth-duration distributions followed Corps of Engineers EM 1110-2-1411 criteria.

- 100-year and/or 10-year storms - The 24-hour storm amounts and distributions were supplied by Corps of Engineers, St. Louis District, Missouri.

- Reservoir Area-Capacity - Areas were measured from U.S.G.S. topographic maps and/or from aerial photographs. Reservoir elevations and corresponding surface areas were input into the computer program, which determined the reservoir capacities by the Conic Method.

- *Flood Routing - The Modified Puls Method* was used for all flood routing and dam overtopping analyses.

The following pages present the input data listing, the computer program version and its last modification date, together with pertinent computer printouts of results. Definitions of all input and output variable names are presented in the September 1978 computer program "Users Manual", and are not explained herein.

```
A1          OLD WOLF DAM ID NO 31118
A2          HEC-1 PHASE 1 DAM SAFETY INVESTIGATION
A3          PMF ROUTING THROUGH CLOSED EMBANKMENT
B     288                   5
B1      5
J       1         4         1
J1    .25        .5       .75         1
K       0    IFLOW                                    1         1
K1    PMF INFLOW TO CLOSED EMBANKMENT ID NO 31118                                                    1
M       1         2     0.072                        1
P       0      26.0       102       120       130
T                                                                -1      -100
W2                0.1
X    -.01      -.01         1
K       1    CLSYS                                    1         1
K1    ROUTING THROUGH CLOSED EMBANKMENT
Y                                         1         1
Y1      1                                                  -882.1        -1
Y4    880   888.301    888.53    888.87     889.1    889.65       890
Y5      0     0.001      3.08      29.0     61.24       600      1400
$A      0       7.3        33      40.5        44
$E    880       882       886     888.3       890
$$  888.3
$D  888.3
K      99
A
A
A
A
A
```

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**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  26 FEB 79
**********************************

RUN  DATE= 79/07/25.
     TIME= 15.25.32.

                    OLD WOLF DAM ID NO 31118
                    HEC-1 PHASE 1 DAM SAFETY INVESTIGATION
                    PMF ROUTING THROUGH CLOSED EMBANKMENT

                                 JOB SPECIFICATION
      NO       NHR      NMIN     IDAY      IHR      IMIN     METRC     IPLT     IPRT    NSTAN
     288         0         5        0        0         0         0        0        0        0
                                  JOPER      NRT    LROPT    IRACE
                                      5        0        0        0

                              MULTI-PLAN ANALYSES TO BE PERFORMED
                                  NPLAN= 1 NRTIO= 4 LRTIO= 1
                RTIOS=     .25     .50     .75    1.00

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

                                SUB-AREA RUNOFF COMPUTATION

                PMF INFLOW TO CLOSED EMBANKMENT ID NO 31118

                             ISTAQ   ICOMP    IECON    ITAPE     JPLT     JPRT    INAME   ISTAGE    IAUTO
                             IFLOW       0        0        0        0        1        1        0        0

                                          HYDROGRAPH DATA
            IHYDG     IUHG    TAREA     SNAP    TRSDA    TRSPC    RATIO    ISNOW    ISAME    LOCAL
                1        2      .07     0.00      .07     1.00    0.000        0        1        0

                                          PRECIP DATA
                      SPFE      PMS       R6      R12      R24      R48      R72      R96
                      0.00    26.00   102.00   120.00   130.00     0.00     0.00     0.00

                                          LOSS DATA
          LROPT    STRKR    DLTKR    RTIOL    ERAIN    STRKS    RTIOK    STRTL    CNSTL    ALSMX    RTIMP
              0     0.00     0.00     1.00     0.00     0.00     1.00    -1.00  -100.00     0.00     0.00

            CURVE NO = -100.00  WETNESS =   -1.00  EFFECT CN =  100.00

                                      UNIT HYDROGRAPH DATA
                                TC=  0.00    LAG=   .10

                                      RECESSION DATA
                           STRTQ=    -.01    QRCSN=    -.01    RTIOR= 1.00

            TIME INCREMENT TOO LARGE--(NHQ IS GT LAG/2)

            UNIT HYDROGRAPH  8 END OF PERIOD ORDINATES, TC=    0.00 HOURS, LAG=    .10  VOL= 1.00
```

	158.	233.	102.	40.	15.	6.	2.	1.				
					END-OF-PERIOD FLOW							
MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.05	1	.01	.01	.00	2.	1.01	12.05	145	.22	.22	-.00	61.
1.01	.10	2	.01	.01	.00	6.	1.01	12.10	146	.22	.22	.00	97.
1.01	.15	3	.01	.01	.00	7.	1.01	12.15	147	.22	.22	-.00	113.
1.01	.20	4	.01	.01	.00	8.	1.01	12.20	148	.22	.22	-.00	119.
1.01	.25	5	.01	.01	-.00	8.	1.01	12.25	149	.22	.22	-.00	122.
1.01	.30	6	.01	.01	-.00	8.	1.01	12.30	150	.22	.22	.00	123.
1.01	.35	7	.01	.01	-.00	8.	1.01	12.35	151	.22	.22	-.00	123.
1.01	.40	8	.01	.01	.00	8.	1.01	12.40	152	.22	.22	.00	123.
1.01	.45	9	.01	.01	-.00	8.	1.01	12.45	153	.22	.22	-.00	123.
1.01	.50	10	.01	.01	.00	8.	1.01	12.50	154	.22	.22	.00	123.
1.01	.55	11	.01	.01	.00	8.	1.01	12.55	155	.22	.22	-.00	123.
1.01	1.00	12	.01	.01	.00	8.	1.01	13.00	156	.22	.22	-.00	123.
1.01	1.05	13	.01	.01	.00	8.	1.01	13.05	157	.27	.27	.00	130.
1.01	1.10	14	.01	.01	.00	8.	1.01	13.10	158	.27	.27	.00	140.
1.01	1.15	15	.01	.01	-.00	8.	1.01	13.15	159	.27	.27	.00	145.
1.01	1.20	16	.01	.01	.00	8.	1.01	13.20	160	.27	.27	.00	147.
1.01	1.25	17	.01	.01	.00	8.	1.01	13.25	161	.27	.27	.00	147.
1.01	1.30	18	.01	.01	.00	8.	1.01	13.30	162	.27	.27	.00	148.
1.01	1.35	19	.01	.01	-.00	8.	1.01	13.35	163	.27	.27	.00	148.
1.01	1.40	20	.01	.01	-.00	8.	1.01	13.40	164	.27	.27	.00	148.
1.01	1.45	21	.01	.01	.00	8.	1.01	13.45	165	.27	.27	.00	148.
1.01	1.50	22	.01	.01	-.00	8.	1.01	13.50	166	.27	.27	.00	148.
1.01	1.55	23	.01	.01	-.00	8.	1.01	13.55	167	.27	.27	.00	148.
1.01	2.00	24	.01	.01	-.00	8.	1.01	14.00	168	.27	.27	.00	148.
1.01	2.05	25	.01	.01	-.00	8.	1.01	14.05	169	.33	.33	-.00	158.
1.01	2.10	26	.01	.01	.00	8.	1.01	14.10	170	.33	.33	-.00	174.
1.01	2.15	27	.01	.01	-.00	8.	1.01	14.15	171	.33	.33	-.00	180.
1.01	2.20	28	.01	.01	-.00	8.	1.01	14.20	172	.33	.33	.00	183.
1.01	2.25	29	.01	.01	-.00	8.	1.01	14.25	173	.33	.33	-.00	184.
1.01	2.30	30	.01	.01	-.00	8.	1.01	14.30	174	.33	.33	.00	185.
1.01	2.35	31	.01	.01	.00	8.	1.01	14.35	175	.33	.33	-.00	185.
1.01	2.40	32	.01	.01	-.00	8.	1.01	14.40	176	.33	.33	.00	185.
1.01	2.45	33	.01	.01	-.00	8.	1.01	14.45	177	.33	.33	-.00	185.
1.01	2.50	34	.01	.01	.00	8.	1.01	14.50	178	.33	.33	-.00	185.
1.01	2.55	35	.01	.01	.00	8.	1.01	14.55	179	.33	.33	.00	185.
1.01	3.00	36	.01	.01	-.00	8.	1.01	15.00	180	.33	.33	-.00	185.
1.01	3.05	37	.01	.01	.00	8.	1.01	15.05	181	.20	.20	-.00	164.
1.01	3.10	38	.01	.01	.00	8.	1.01	15.10	182	.40	.40	.00	166.
1.01	3.15	39	.01	.01	.00	8.	1.01	15.15	183	.40	.40	.00	199.
1.01	3.20	40	.01	.01	.00	8.	1.01	15.20	184	.60	.60	.00	247.
1.01	3.25	41	.01	.01	.00	8.	1.01	15.25	185	.71	.71	.00	316.
1.01	3.30	42	.01	.01	.00	8.	1.01	15.30	186	1.71	1.71	.00	521.
1.01	3.35	43	.01	.01	-.00	8.	1.01	15.35	187	2.82	2.82	-.00	950.
1.01	3.40	44	.01	.01	.00	8.	1.01	15.40	188	1.11	1.11	.00	1049.
1.01	3.45	45	.01	.01	.00	8.	1.01	15.45	189	.71	.71	-.00	743.
1.01	3.50	46	.01	.01	.00	8.	1.01	15.50	190	.60	.60	.00	518.
1.01	3.55	47	.01	.01	-.00	8.	1.01	15.55	191	.40	.40	-.00	376.
1.01	4.00	48	.01	.01	.00	8.	1.01	16.00	192	.40	.40	.00	286.
1.01	4.05	49	.01	.01	-.00	8.	1.01	16.05	193	.31	.31	-.00	233.
1.01	4.10	50	.01	.01	.00	8.	1.01	16.10	194	.31	.31	.00	196.
1.01	4.15	51	.01	.01	.00	8.	1.01	16.15	195	.31	.31	.00	181.
1.01	4.20	52	.01	.01	.00	8.	1.01	16.20	196	.31	.31	-.00	175.
1.01	4.25	53	.01	.01	.00	8.	1.01	16.25	197	.31	.31	.00	173.
1.01	4.30	54	.01	.01	-.00	8.	1.01	16.30	198	.31	.31	-.00	173.
1.01	4.35	55	.01	.01	.00	8.	1.01	16.35	199	.31	.31	.00	172.

1.01	4.40	56	.01	.01	.00	8.	1.01	16.40	200	.31	.31	-.00	172.
1.01	4.45	57	.01	.01	.00	8.	1.01	16.45	201	.31	.31	.00	172.
1.01	4.50	58	.01	.01	.00	8.	1.01	16.50	202	.31	.31	.00	172.
1.01	4.55	59	.01	.01	.00	8.	1.01	16.55	203	.31	.31	.00	172.
1.01	5.00	60	.01	.01	.00	8.	1.01	17.00	204	.31	.31	-.00	172.
1.01	5.05	61	.01	.01	.00	8.	1.01	17.05	205	.24	.24	-.00	162.
1.01	5.10	62	.01	.01	.00	8.	1.01	17.10	206	.24	.24	-.00	147.
1.01	5.15	63	.01	.01	-.00	8.	1.01	17.15	207	.24	.24	-.00	140.
1.01	5.20	64	.01	.01	.00	8.	1.01	17.20	208	.24	.24	-.00	137.
1.01	5.25	65	.01	.01	.00	8.	1.01	17.25	209	.24	.24	.00	136.
1.01	5.30	66	.01	.01	-.00	8.	1.01	17.30	210	.24	.24	-.00	136.
1.01	5.35	67	.01	.01	.00	8.	1.01	17.35	211	.24	.24	-.00	136.
1.01	5.40	68	.01	.01	.00	8.	1.01	17.40	212	.24	.24	-.00	135.
1.01	5.45	69	.01	.01	.00	8.	1.01	17.45	213	.24	.24	.00	135.
1.01	5.50	70	.01	.01	.00	8.	1.01	17.50	214	.24	.24	-.00	135.
1.01	5.55	71	.01	.01	.00	8.	1.01	17.55	215	.24	.24	.00	135.
1.01	6.00	72	.01	.01	.00	8.	1.01	18.00	216	.24	.24	.00	135.
1.01	6.05	73	.07	.06	.00	16.	1.01	18.05	217	.02	.02	-.00	101.
1.01	6.10	74	.07	.06	.00	28.	1.01	18.10	218	.02	.02	-.00	49.
1.01	6.15	75	.07	.06	.00	33.	1.01	18.15	219	.02	.02	-.00	26.
1.01	6.20	76	.07	.06	.00	35.	1.01	18.20	220	.02	.02	-.00	17.
1.01	6.25	77	.07	.06	.00	36.	1.01	18.25	221	.02	.02	.00	14.
1.01	6.30	78	.07	.06	.00	36.	1.01	18.30	222	.02	.02	-.00	13.
1.01	6.35	79	.07	.07	-.00	36.	1.01	18.35	223	.02	.02	.00	12.
1.01	6.40	80	.07	.06	.00	36.	1.01	18.40	224	.02	.02	-.00	12.
1.01	6.45	81	.07	.06	.00	36.	1.01	18.45	225	.02	.02	-.00	12.
1.01	6.50	82	.07	.06	.00	36.	1.01	18.50	226	.02	.02	-.00	12.
1.01	6.55	83	.07	.06	.00	36.	1.01	18.55	227	.02	.02	.00	12.
1.01	7.00	84	.07	.07	-.00	36.	1.01	19.00	228	.02	.02	-.00	12.
1.01	7.05	85	.07	.06	.00	36.	1.01	19.05	229	.02	.02	-.00	12.
1.01	7.10	86	.07	.06	.00	36.	1.01	19.10	230	.02	.02	-.00	12.
1.01	7.15	87	.07	.06	.00	36.	1.01	19.15	231	.02	.02	-.00	12.
1.01	7.20	88	.07	.06	.00	36.	1.01	19.20	232	.02	.02	-.00	12.
1.01	7.25	89	.07	.06	.00	36.	1.01	19.25	233	.02	.02	-.00	12.
1.01	7.30	90	.07	.06	.00	36.	1.01	19.30	234	.02	.02	-.00	12.
1.01	7.35	91	.07	.06	.00	36.	1.01	19.35	235	.02	.02	-.00	12.
1.01	7.40	92	.07	.06	.00	36.	1.01	19.40	236	.02	.02	-.00	12.
1.01	7.45	93	.07	.06	.00	36.	1.01	19.45	237	.02	.02	-.00	12.
1.01	7.50	94	.07	.06	.00	36.	1.01	19.50	238	.02	.02	-.00	12.
1.01	7.55	95	.07	.06	.00	36.	1.01	19.55	239	.02	.02	-.00	12.
1.01	8.00	96	.07	.06	.00	36.	1.01	20.00	240	.02	.02	-.00	12.
1.01	8.05	97	.07	.06	.00	36.	1.01	20.05	241	.02	.02	-.00	12.
1.01	8.10	98	.07	.06	.00	36.	1.01	20.10	242	.02	.02	-.00	12.
1.01	8.15	99	.07	.06	.00	36.	1.01	20.15	243	.02	.02	.00	12.
1.01	8.20	100	.07	.06	.00	36.	1.01	20.20	244	.02	.02	-.00	12.
1.01	8.25	101	.07	.06	.00	36.	1.01	20.25	245	.02	.02	-.00	12.
1.01	8.30	102	.07	.07	-.00	36.	1.01	20.30	246	.02	.02	-.00	12.
1.01	8.35	103	.07	.06	.00	36.	1.01	20.35	247	.02	.02	-.00	12.
1.01	8.40	104	.07	.06	.00	36.	1.01	20.40	248	.02	.02	-.00	12.
1.01	8.45	105	.07	.07	-.00	36.	1.01	20.45	249	.02	.02	-.00	12.
1.01	8.50	106	.07	.06	.00	36.	1.01	20.50	250	.02	.02	-.00	12.
1.01	8.55	107	.07	.07	-.00	36.	1.01	20.55	251	.02	.02	-.00	12.
1.01	9.00	108	.07	.06	.00	36.	1.01	21.00	252	.02	.02	-.00	12.
1.01	9.05	109	.07	.07	-.00	36.	1.01	21.05	253	.02	.02	-.00	12.
1.01	9.10	110	.07	.06	.00	36.	1.01	21.10	254	.02	.02	-.00	12.
1.01	9.15	111	.07	.06	.00	36.	1.01	21.15	255	.02	.02	-.00	12.
1.01	9.20	112	.07	.07	-.00	36.	1.01	21.20	256	.02	.02	-.00	12.
1.01	9.25	113	.07	.06	.00	36.	1.01	21.25	257	.02	.02	-.00	12.
1.01	9.30	114	.07	.06	.00	36.	1.01	21.30	258	.02	.02	-.00	12.
1.01	9.35	115	.07	.06	.00	36.	1.01	21.35	259	.02	.02	.00	12.

1.01	9.40	116	.07	.06	.00	36.	1.01	21.40	260	.02	.02	-.00	12.
1.01	9.45	117	.07	.06	.00	36.	1.01	21.45	261	.02	.02	.00	12.
1.01	9.50	118	.07	.06	.00	36.	1.01	21.50	262	.02	.02	-.00	12.
1.01	9.55	119	.07	.06	.00	36.	1.01	21.55	263	.02	.02	-.00	12.
1.01	10.00	120	.07	.06	.00	36.	1.01	22.00	264	.02	.02	-.00	12.
1.01	10.05	121	.07	.06	.00	36.	1.01	22.05	265	.02	.02	.00	12.
1.01	10.10	122	.07	.06	.00	36.	1.01	22.10	266	.02	.02	-.00	12.
1.01	10.15	123	.07	.06	.00	36.	1.01	22.15	267	.02	.02	-.00	12.
1.01	10.20	124	.07	.06	.00	36.	1.01	22.20	268	.02	.02	-.00	12.
1.01	10.25	125	.07	.06	.00	36.	1.01	22.25	269	.02	.02	.00	12.
1.01	10.30	126	.07	.06	.00	36.	1.01	22.30	270	.02	.02	-.00	12.
1.01	10.35	127	.07	.06	.00	36.	1.01	22.35	271	.02	.02	-.00	12.
1.01	10.40	128	.07	.06	.00	36.	1.01	22.40	272	.02	.02	-.00	12.
1.01	10.45	129	.07	.06	.00	36.	1.01	22.45	273	.02	.02	-.00	12.
1.01	10.50	130	.07	.07	-.00	36.	1.01	22.50	274	.02	.02	-.00	12.
1.01	10.55	131	.07	.06	.00	36.	1.01	22.55	275	.02	.02	.00	12.
1.01	11.00	132	.07	.06	.00	36.	1.01	23.00	276	.02	.02	-.00	12.
1.01	11.05	133	.07	.06	.00	36.	1.01	23.05	277	.02	.02	-.00	12.
1.01	11.10	134	.07	.06	.00	36.	1.01	23.10	278	.02	.02	-.00	12.
1.01	11.15	135	.07	.06	.00	36.	1.01	23.15	279	.02	.02	-.00	12.
1.01	11.20	136	.07	.06	.00	36.	1.01	23.20	280	.02	.02	.00	12.
1.01	11.25	137	.07	.06	.00	36.	1.01	23.25	281	.02	.02	-.00	12.
1.01	11.30	138	.07	.06	.00	36.	1.01	23.30	282	.02	.02	-.00	12.
1.01	11.35	139	.07	.06	.00	36.	1.01	23.35	283	.02	.02	-.00	12.
1.01	11.40	140	.07	.06	.00	36.	1.01	23.40	284	.02	.02	.00	12.
1.01	11.45	141	.07	.06	.00	36.	1.01	23.45	285	.02	.02	-.00	12.
1.01	11.50	142	.07	.06	.00	36.	1.01	23.50	286	.02	.02	-.00	12.
1.01	11.55	143	.07	.06	.00	36.	1.01	23.55	287	.02	.02	-.00	12.
1.01	12.00	144	.07	.06	.00	36.	1.02	0.00	288	.02	.02	.00	12.
									SUM	33.80	33.80	.00	18798.
										(859.)(	859.)(	0.)(	532.30)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1049.	204.	65.	65.	18815.
CMS	30.	6.	2.	2.	533.
INCHES		26.34	33.76	33.76	33.76
MM		669.10	857.54	857.54	857.54
AC-FT		101.	130.	130.	130.
THOUS CU M		125.	160.	160.	160.

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HYDROGRAPH ROUTING

ROUTING THROUGH CLOSED EMBANKMENT

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
CLSYS	1	0	0	0	1	1	0	0

ROUTING DATA

QLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-882.	-1

STAGE	880.00	888.30	888.53	888.87	889.10	889.65	890.00
FLOW	0.00	.00	3.08	29.00	61.24	600.00	1400.00
SURFACE AREA=	0.	7.	33.	41.	44.		
CAPACITY=	0.	5.	79.	164.	235.		
ELEVATION=	880.	882.	886.	888.	890.		

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
888.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
888.3	0.0	0.0	0.

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)

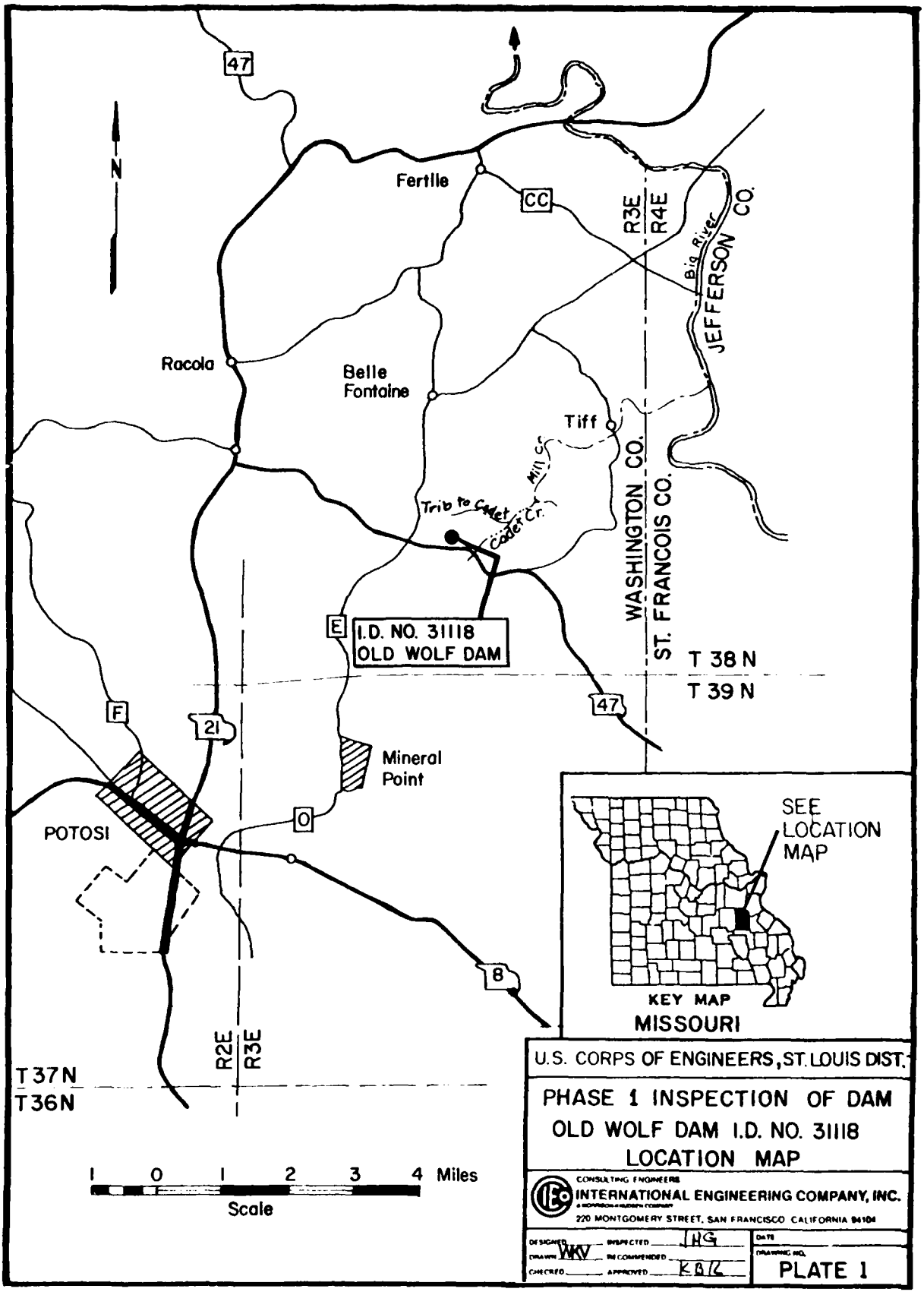
OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .25	RATIO 2 .50	RATIO 3 .75	RATIO 4 1.00
HYDROGRAPH AT	IFLOW	.07	1	262.	525.	787.	1049.
	(	.19)	(	7.43)(	14.85)(	22.28)(	29.71)(
ROUTED TO	CLSYS	.07	1	0.	0.	0.	0.
	(	.19)	(	.00)(	.00)(	.00)(	.00)(

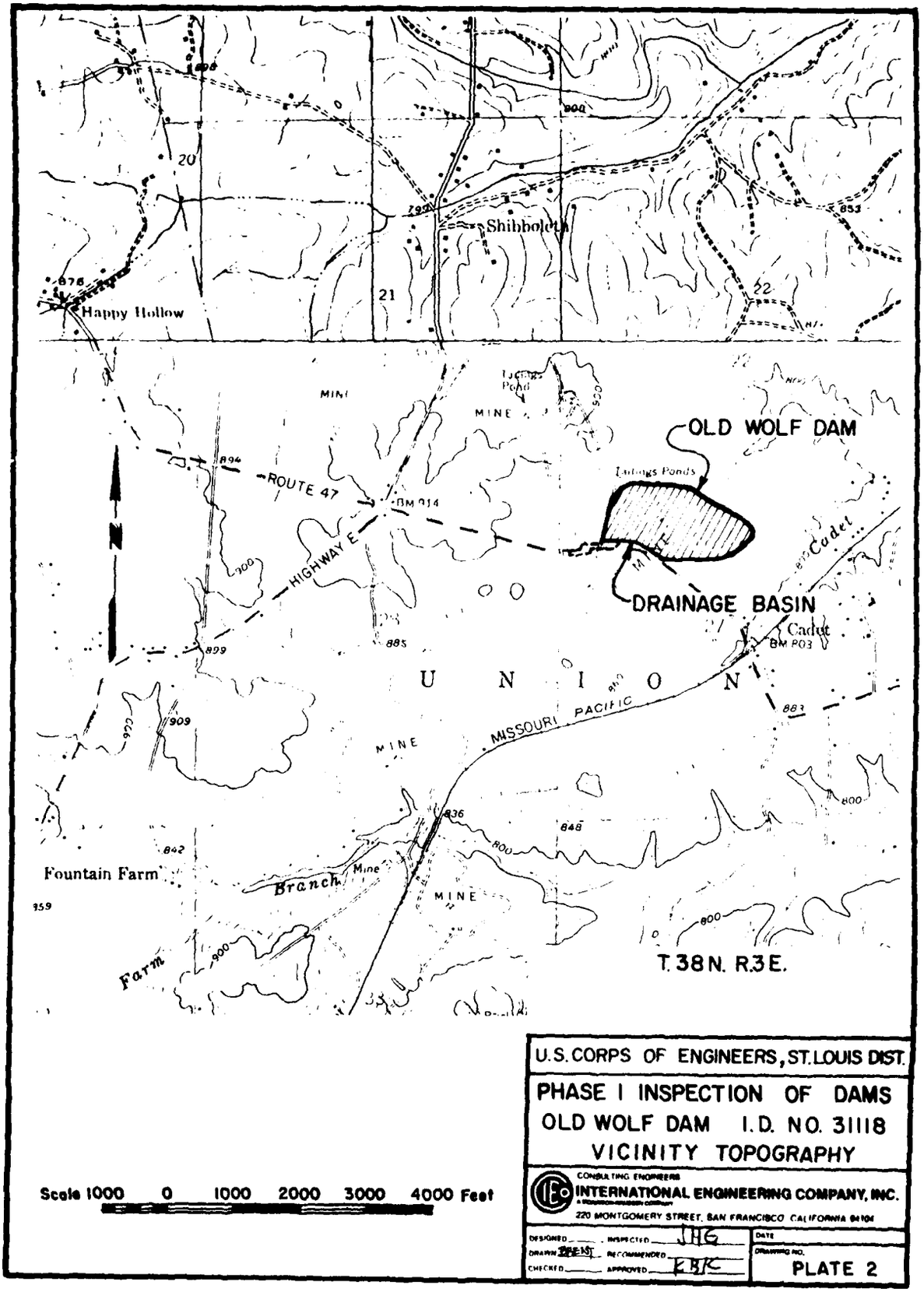
SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	882.10	888.30	888.30
STORAGE	6.	164.	164.
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
.25	884.41	0.00	37.	0.	0.00	24.00	0.00
.50	885.68	0.00	69.	0.	0.00	24.00	0.00
.75	886.66	0.00	102.	0.	0.00	24.00	0.00
1.00	887.55	0.00	134.	0.	0.00	24.00	0.00


47
N
Fertile
CC
R3E
R4E
Big River
JEFFERSON CO.
Racola
Belle
Fontaine
Tiff
Mill Cr.
Trib to Cadet Cr.
Cadet Cr.
WASHINGTON CO.
ST. FRANCOIS CO.
E
I.D. NO. 31118
OLD WOLF DAM
T 38 N
T 39 N
47
F
21
Mineral
Point
POTOSI
O
8
R2E
R3E
T37N
T36N
SEE
LOCATION
MAP
KEY MAP
MISSOURI
1 0 1 2 3 4 Miles
Scale
U.S. CORPS OF ENGINEERS, ST. LOUIS DIST.
PHASE 1 INSPECTION OF DAM
OLD WOLF DAM I.D. NO. 31118
LOCATION MAP
CONSULTING ENGINEERS
INTERNATIONAL ENGINEERING COMPANY, INC.
220 MONTGOMERY STREET, SAN FRANCISCO CALIFORNIA 94104
DESIGNED
DRAWN WKV
CHECKED
INSPECTED HG
RECOMMENDED
APPROVED KAK
DATE
DRAWING NO.
PLATE 1

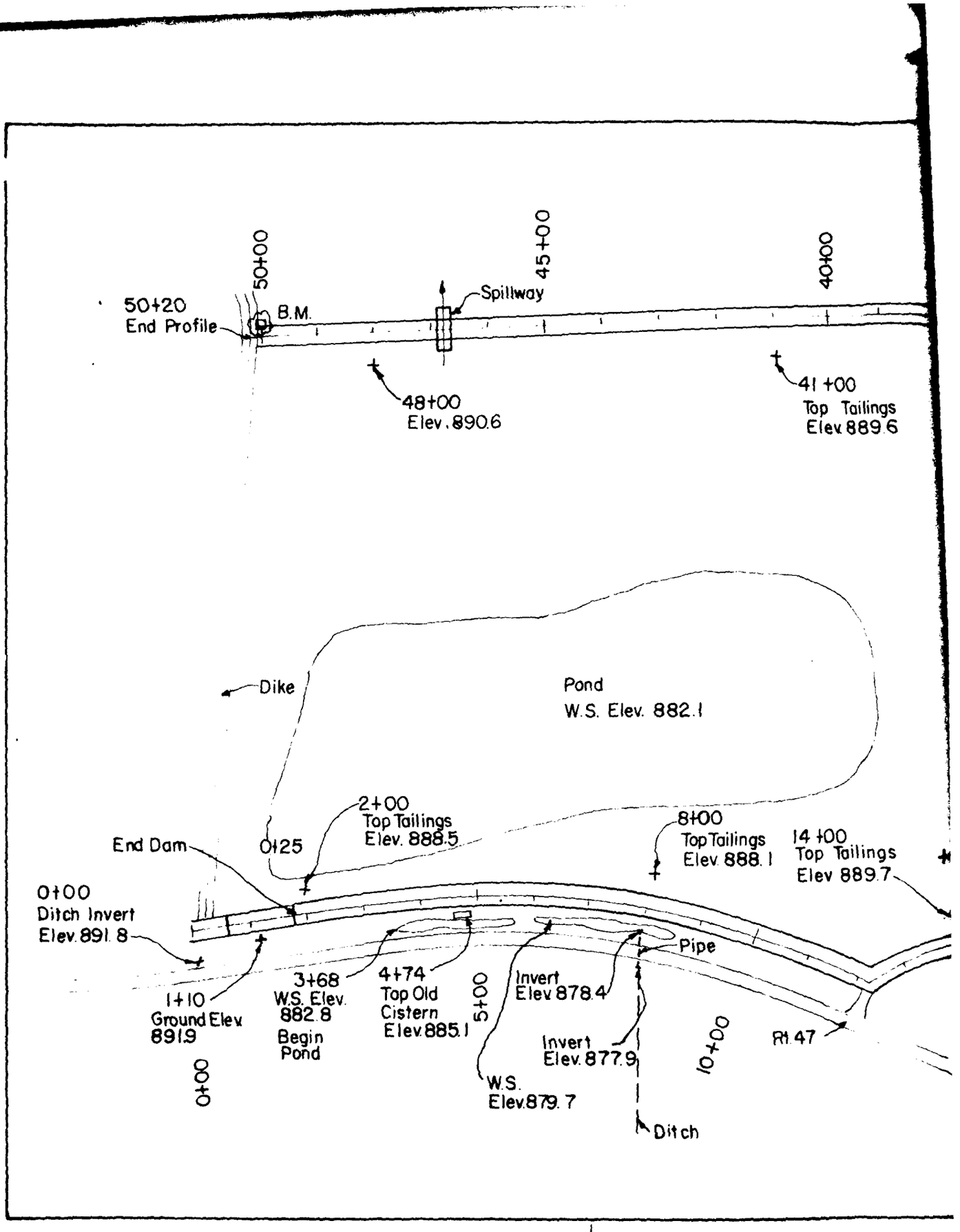


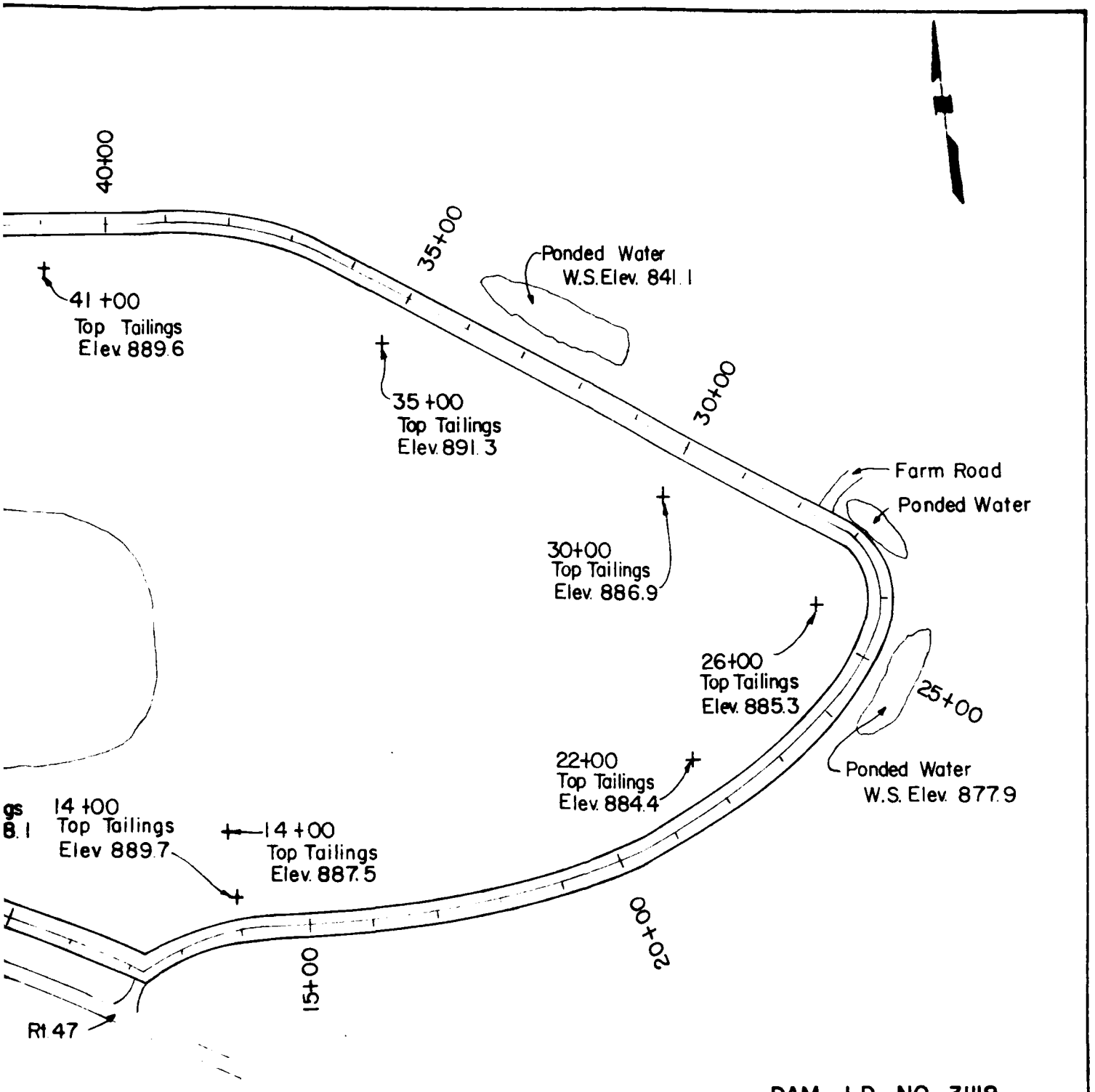
U.S. CORPS OF ENGINEERS, ST. LOUIS DIST.

PHASE I INSPECTION OF DAMS
OLD WOLF DAM I.D. NO. 31118
VICINITY TOPOGRAPHY

CONSULTING ENGINEERS
INTERNATIONAL ENGINEERING COMPANY, INC.
220 MONTGOMERY STREET, SAN FRANCISCO CALIFORNIA 94104

DESIGNED	INSPECTED JHG	DATE	
DRAWN BRENT	RECOMMENDED	DRAWING NO.	PLATE 2
CHECKED	APPROVED EBK		


50+00
45+00
40+00
50+20
End Profile
B.M.
Spillway
48+00
Elev. 890.6
41+00
Top Tailings
Elev. 889.6
Dike
Pond
W.S. Elev. 882.1
2+00
Top Tailings
Elev. 888.5
End Dam
0+25
8+00
Top Tailings
Elev. 888.1
14+00
Top Tailings
Elev 889.7
0+00
Ditch Invert
Elev. 891.8
Pipe
1+10
Ground Elev.
891.9
3+68
W.S. Elev.
882.8
Begin
Pond
4+74
Top Old
Cistern
Elev. 885.1
5+00
Invert
Elev. 878.4
Invert
Elev. 877.9
10+00
Rt. 47
W.S.
Elev. 879.7
Ditch

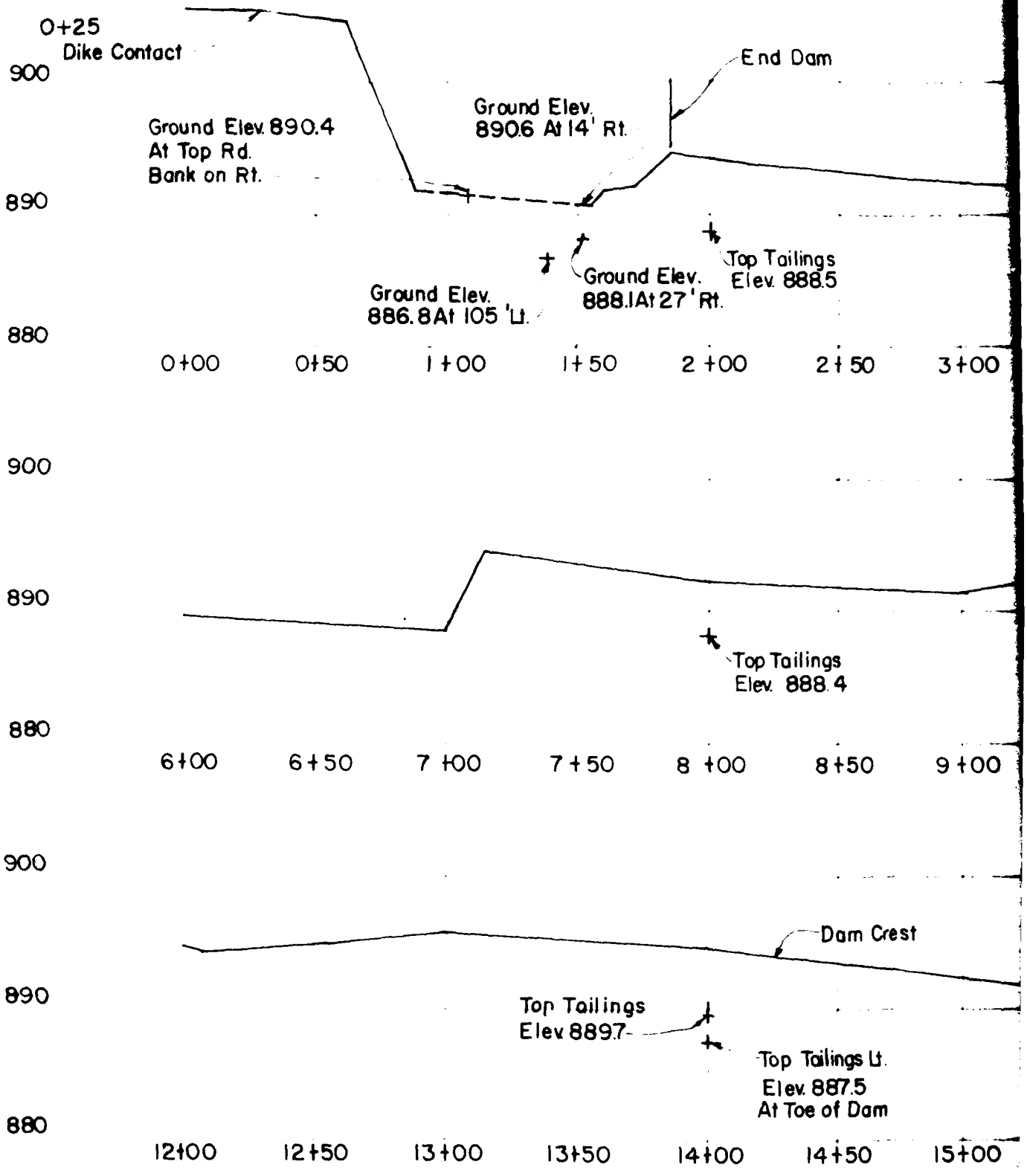


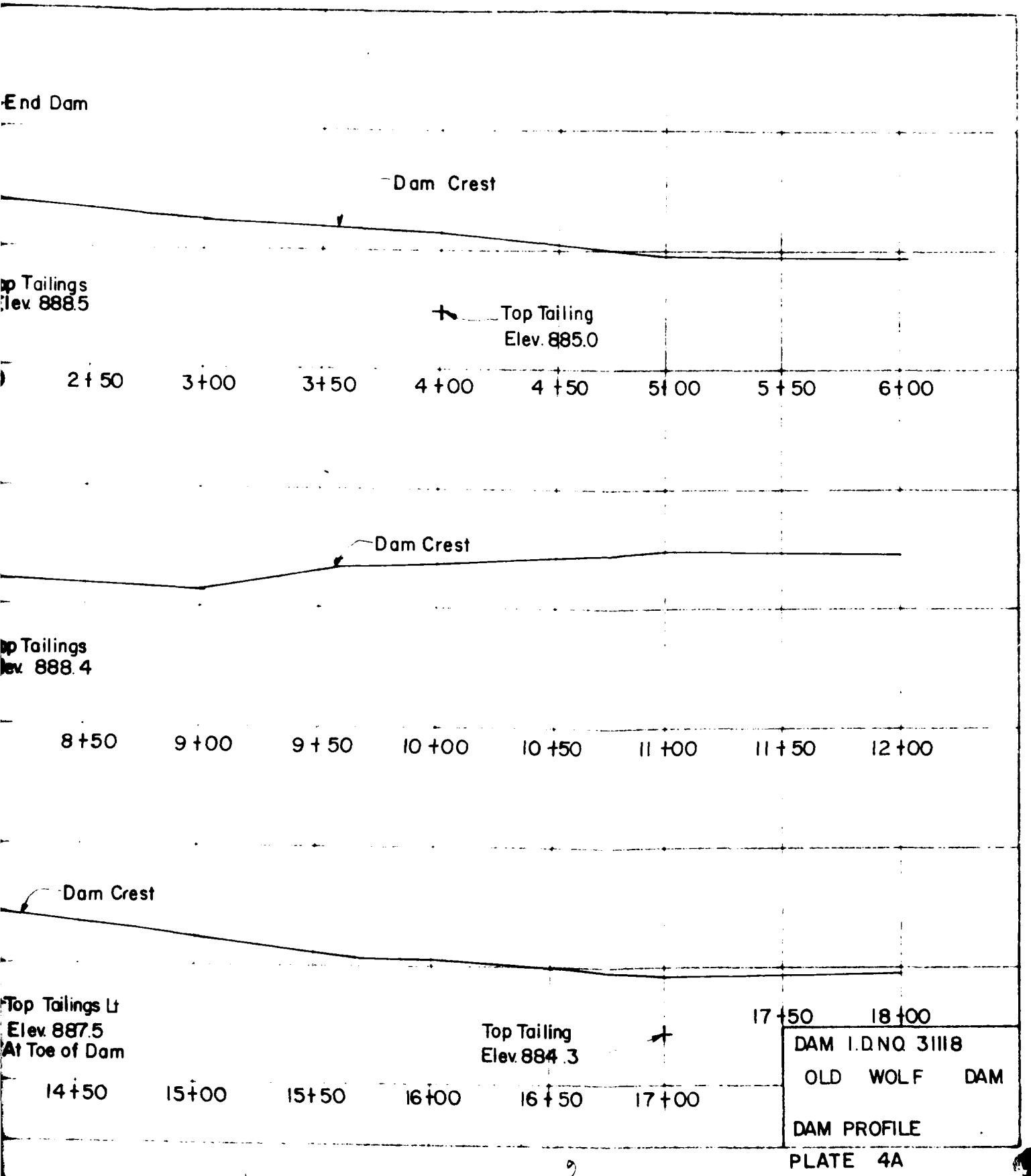
B.M. - 80d Spike in 8" Sycamore
at Sta. 49+96 Dam ℄
Elev. 898.71

Date of Survey: 4/25/79

DAM I.D. NO. 31118
OLD WOLF DAM
PLAN
SCALE IN FEET
200 100 0 200

PLATE 3


0+25
Dike Contact
900
890
880
Ground Elev. 890.4
At Top Rd.
Bank on Rt.
Ground Elev.
890.6 At 14' Rt.
End Dam
Ground Elev.
886.8 At 105 'Lt.
Ground Elev.
888.1 At 27 'Rt.
Top Tailings
Elev. 888.5
0+00
0+50
1+00
1+50
2+00
2+50
3+00
900
890
880
Top Tailings
Elev. 888.4
6+00
6+50
7+00
7+50
8+00
8+50
9+00
900
890
880
Dam Crest
Top Tailings
Elev 889.7
Top Tailings Lt.
Elev. 887.5
At Toe of Dam
12+00
12+50
13+00
13+50
14+00
14+50
15+00

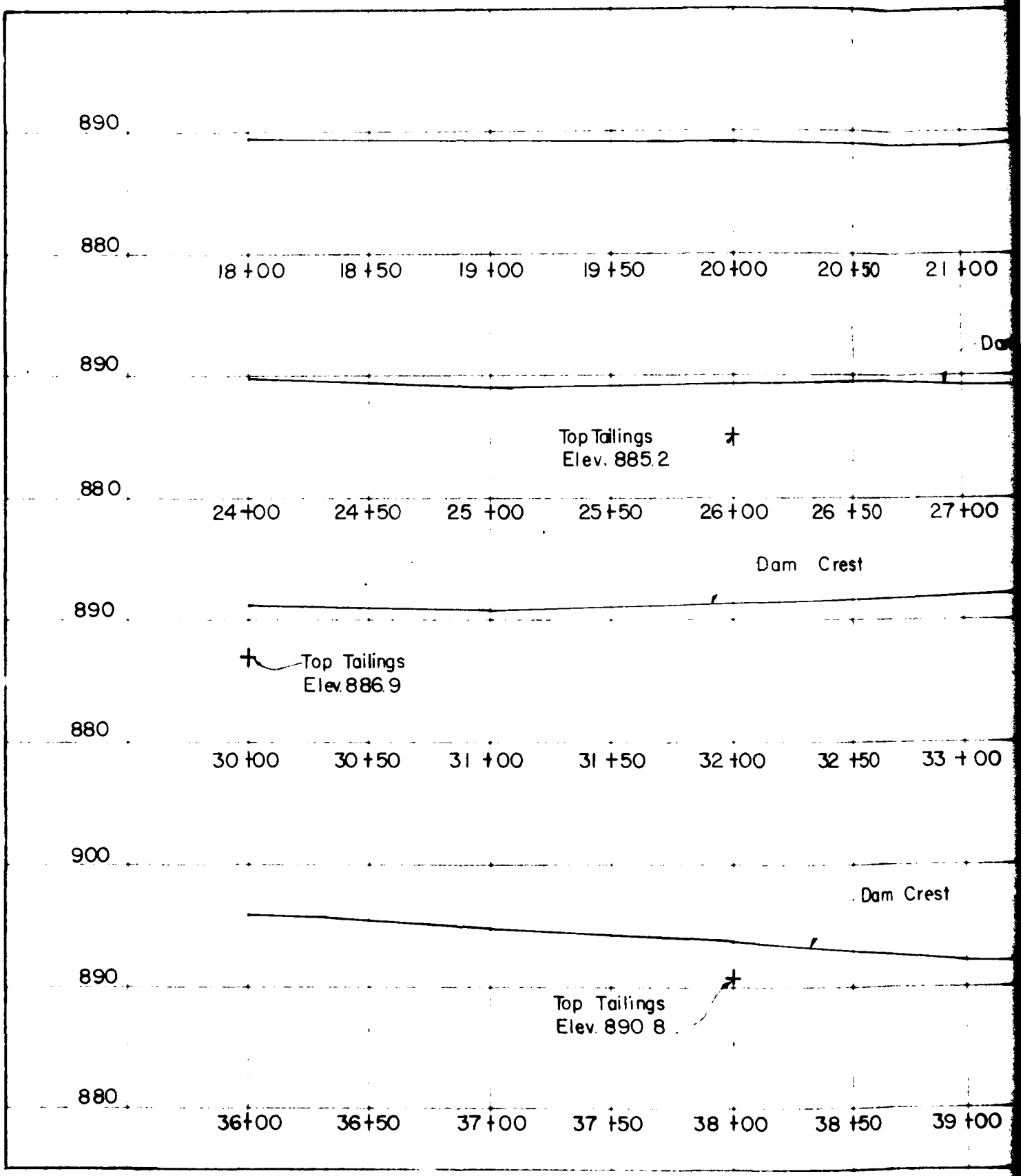


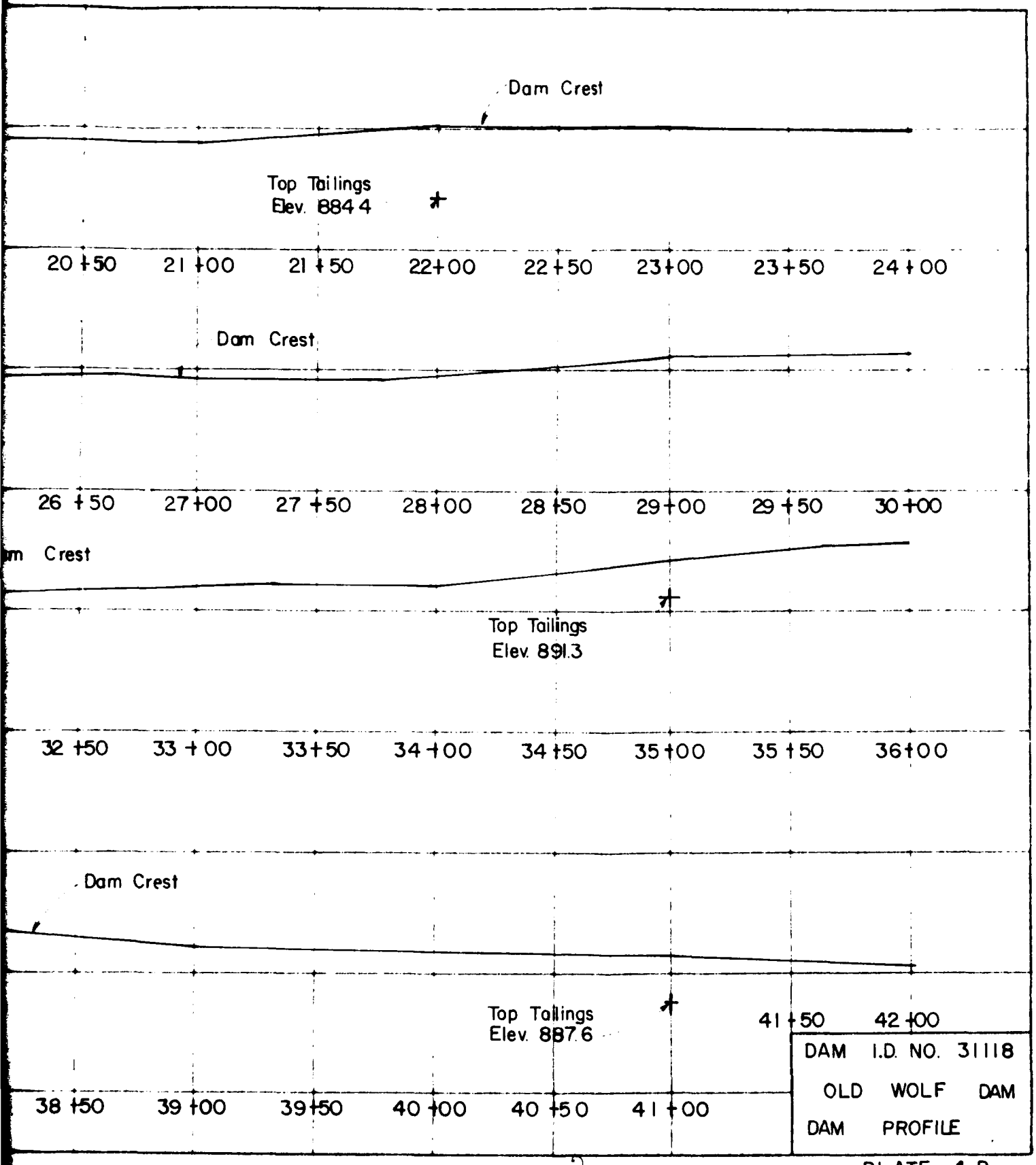
DAM I.D.NO. 31118

OLD WOLF DAM

DAM PROFILE

PLATE 4A


890
880
18+00
18+50
19+00
19+50
20+00
20+50
21+00
Da
890
Top Tailings
Elev. 885.2
880
24+00
24+50
25+00
25+50
26+00
26+50
27+00
Dam Crest
890
Top Tailings
Elev. 886.9
880
30+00
30+50
31+00
31+50
32+00
32+50
33+00
900
Dam Crest
890
Top Tailings
Elev. 890.8
880
36+00
36+50
37+00
37+50
38+00
38+50
39+00

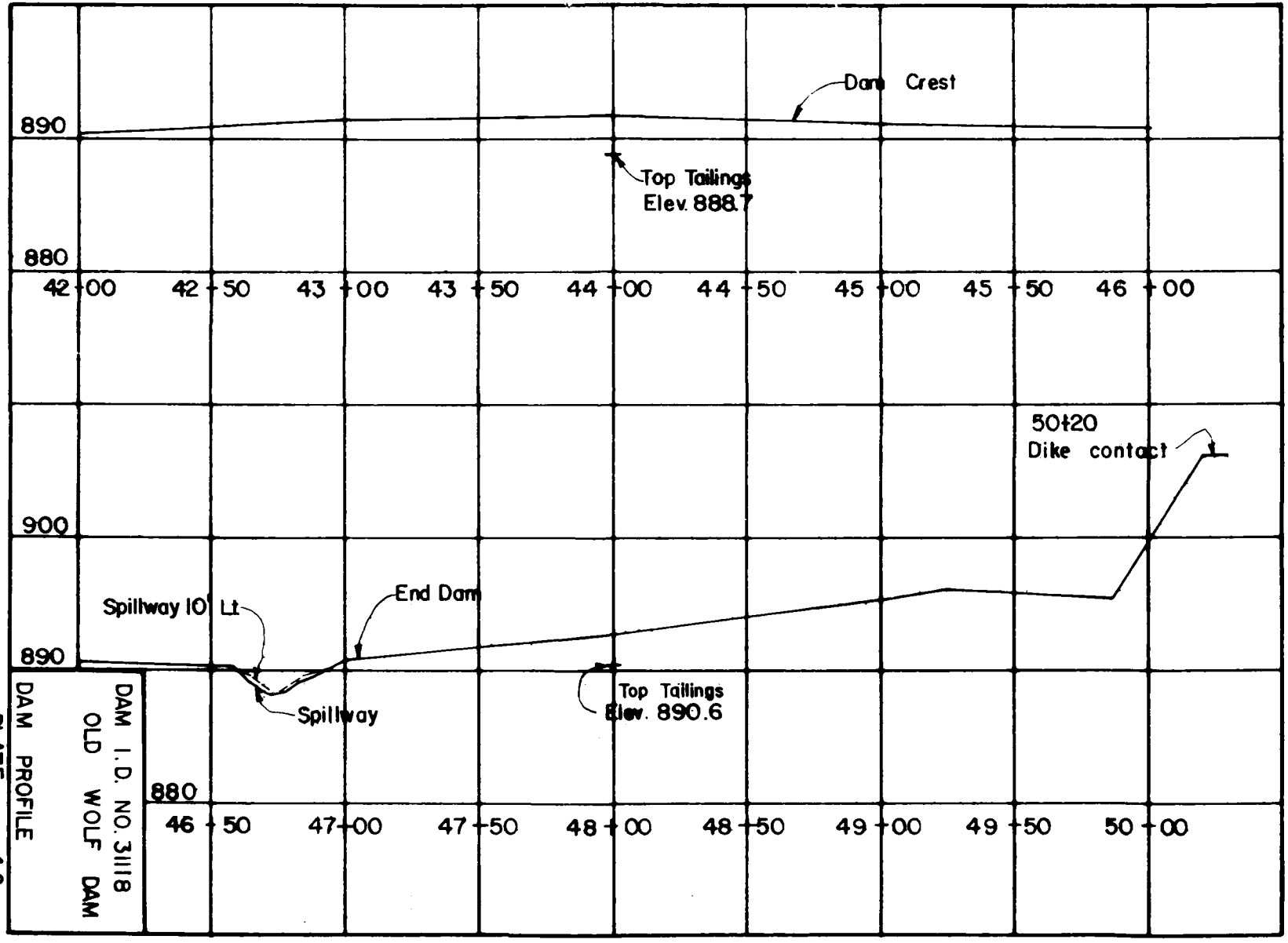


DAM I.D. NO. 31118

OLD WOLF DAM

DAM PROFILE

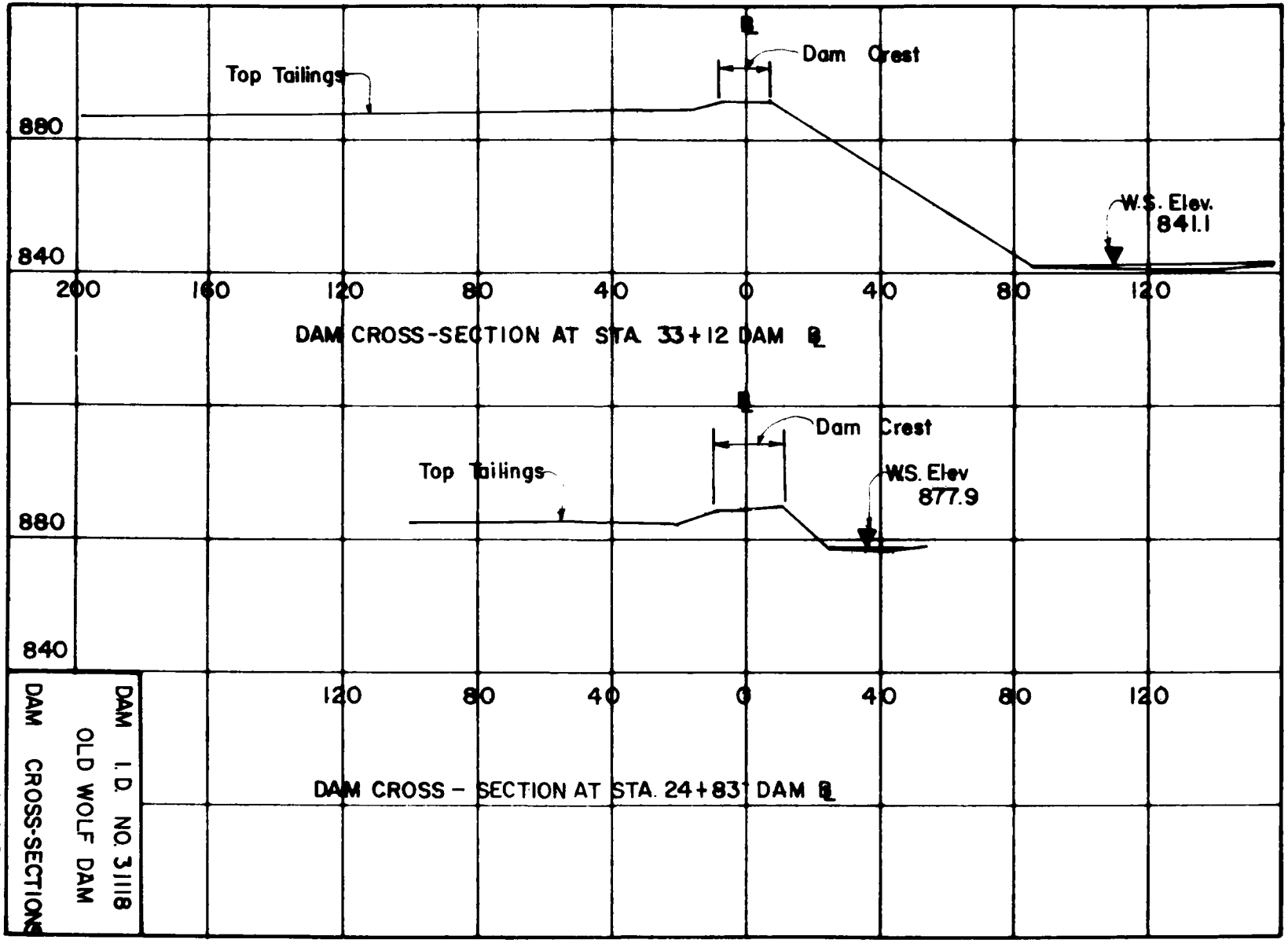
PLATE 4 B



DAM PROFILE

DAM I.D. NO. 31118
OLD WOLF DAM

PLATE 4C



DAM I.D. NO. 31118
OLD WOLF DAM
DAM CROSS-SECTIONS

PLATE 5

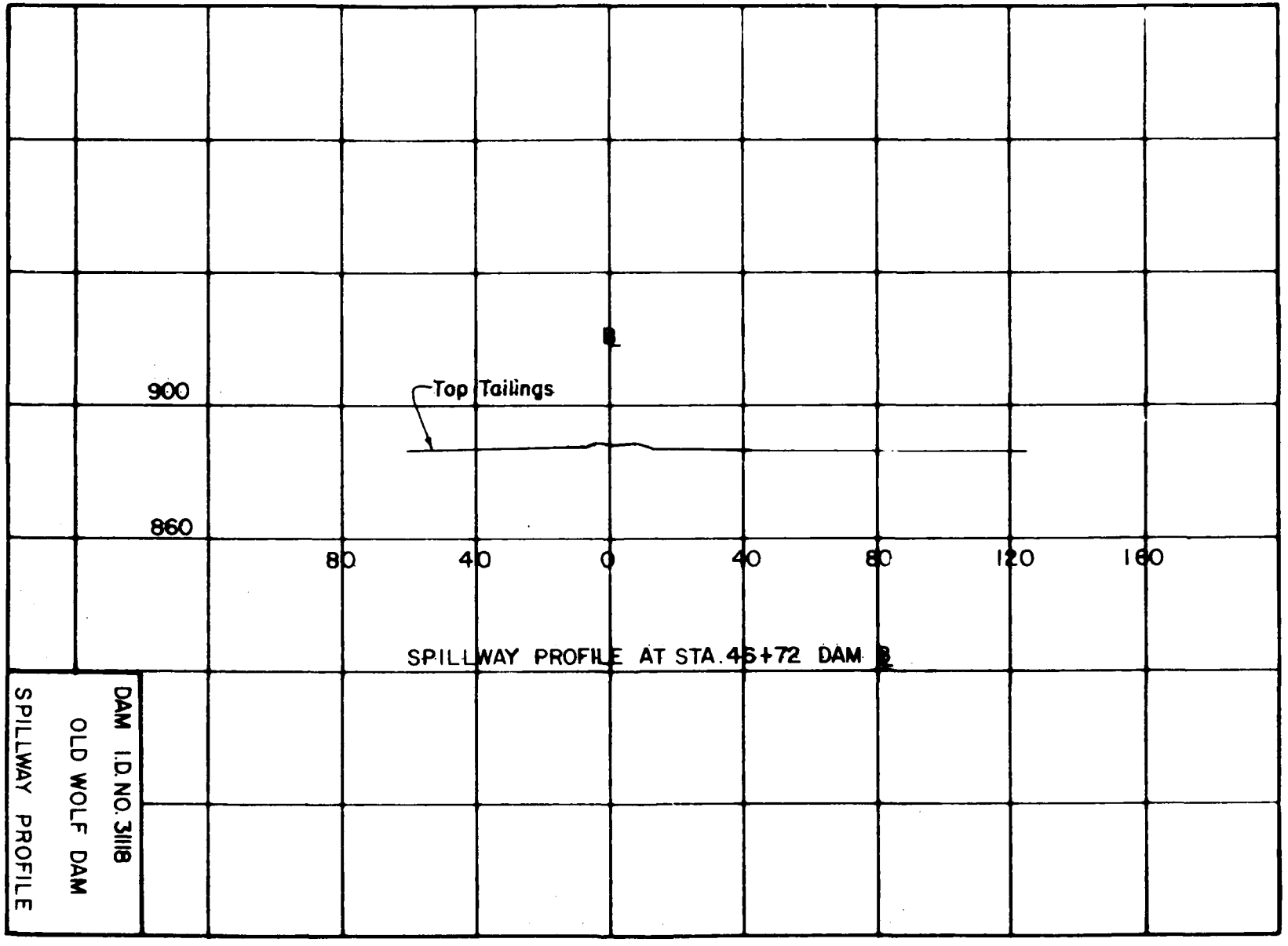
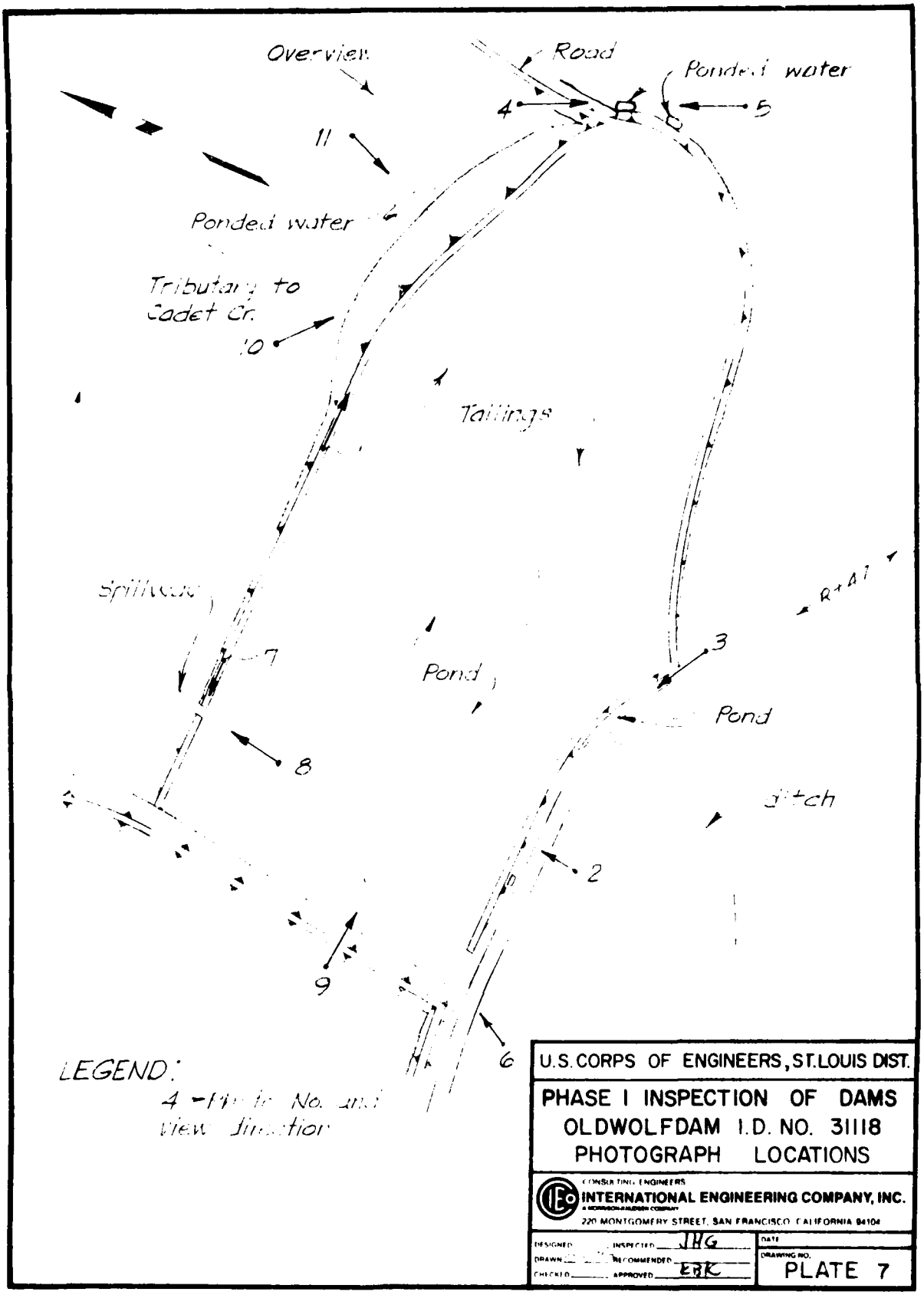


PLATE 6

SPILLWAY PROFILE

OLD WOLF DAM

DAM I.D. NO. 31118



U.S. CORPS OF ENGINEERS, ST. LOUIS DIST.

PHASE I INSPECTION OF DAMS
OLDWOLFDAM I.D. NO. 31118
PHOTOGRAPH LOCATIONS

CONSULTING ENGINEERS
INTERNATIONAL ENGINEERING COMPANY, INC.
A MORRISON-KNUDSEN COMPANY
220 MONTGOMERY STREET, SAN FRANCISCO, CALIFORNIA 94104

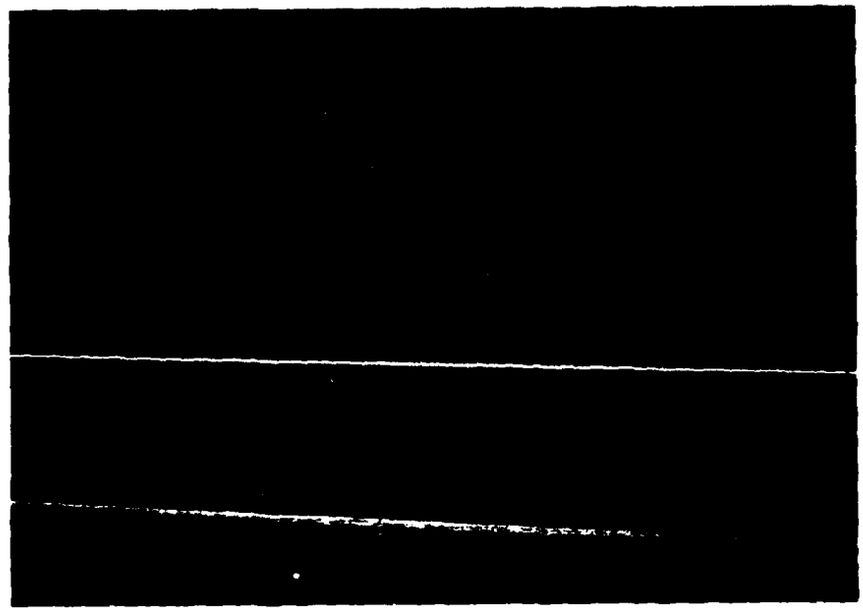
DESIGNED	INSPECTED JHG	DATE	
DRAWN	RECOMMENDED	DRAWING NO.	PLATE 7
CHECKED	APPROVED EBK		

PHOTOGRAPH RECORD

OLD WOLF DAM - I.D. NO. 31118

Photo No.	Description
1.	View west of dam crest from Station 40+00. Note vegetation on slopes and on crest.
2.	View north of dam at Station 7+10. Note vegetation, abrupt change in crest elevation, and water ponded at toe.
3.	View east of dam from Rt. 47 by dam Station 10+00. Note ponded water at dam toe.
4.	View south of ponded water in toe ditch at Station 27+00.
5.	View northwest of ponded water at Station 15+00.
6.	View north of low area near Stations 0+50 to 1+50. This is one of the dam's abutments.
7.	View west along dam crest past spillway at Station 46+70 towards dam abutment.
8.	Looking downstream through the spillway control section.
9.	View east of pond within the tailings impoundments.
10.	Downstream slope of embankment near Station 38+00.
11.	Looking south at the maximum dam section near Station 33+00.

1

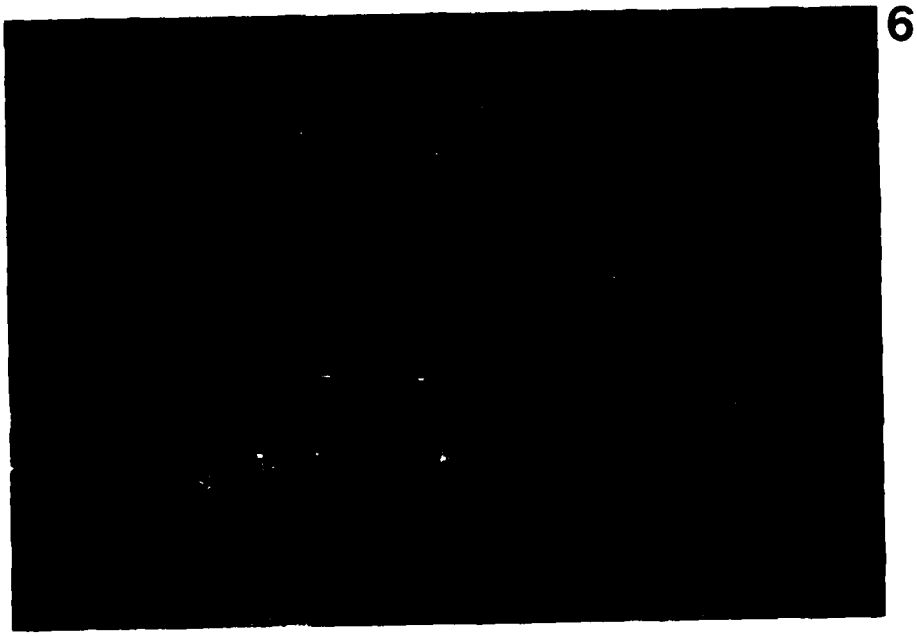


2

3

4

5



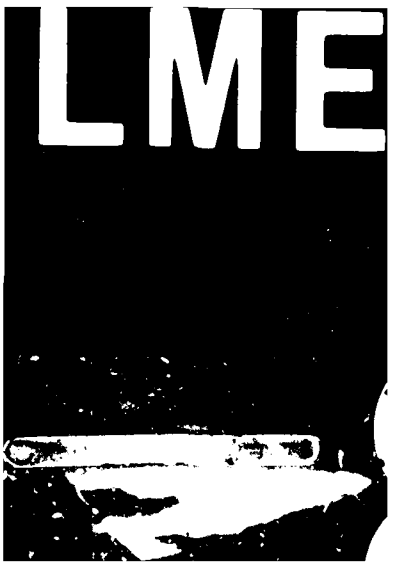
6

7

8

9

10


LME