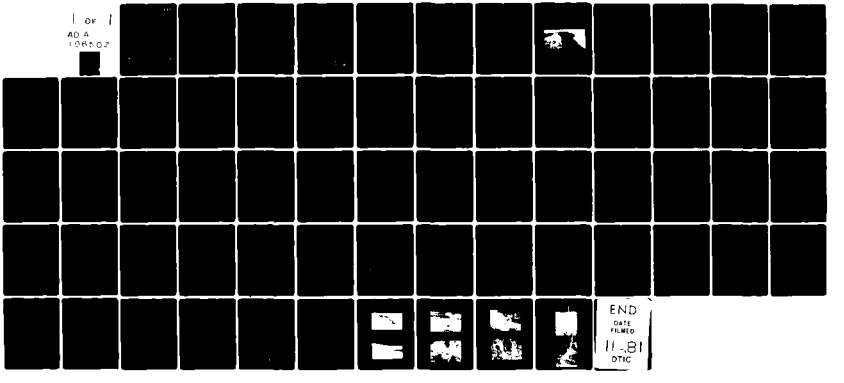
AD-A106 502 INTERNATIONAL ENGINEERING CO INC SAN FRANCISCO CA F/G 13/13
NATIONAL DAM SAFETY PROGRAM, DRESSER NUMBER 1 DAM (MO 31117), M--ETC(U)
JUN 79 K B KING, M P FORREST, D R SANDERS DACW43-79-C-0037
UNCLASSIFIED NL

1 OF 1
AD A
106502



END
DATE FILMED
11-81
DTIC

LEVEL II

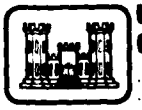
1

MISSISSIPPI-KASKASKIA-ST. LOUIS BASIN

AD A103502

DRESSER NO. 1 DAM
WASHINGTON COUNTY, MISSOURI
MO 31117

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM



United States Army
Corps of Engineers
...Serving the Army
...Serving the Nation

St. Louis District

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

FOR: STATE OF MISSOURI

JUNE 1979

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. AD-A106 502	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Dam Inspection Report National Dam Safety Program Dresser #1 Dam (MO 31117) Washington County, Missouri		5. TYPE OF REPORT & PERIOD COVERED Final Report
		6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) International Engineering Company, Inc.		8. CONTRACT OR GRANT NUMBER(s) DACW43-79-C-0037
9. PERFORMING ORGANIZATION NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS U.S. Army Engineer District, St. Louis Dam Inventory and Inspection Section, LMSED-PD 210 Tucker Blvd., North, St. Louis, Mo. 63101		12. REPORT DATE June 1979
		13. NUMBER OF PAGES Approximately 70
14. MONITOR National Dam Safety Program. Dresser Number 1 Dam (MO 31117), Mississippi-Kaskaskia-St. Louis Basin, Washington County, Missouri. Phase I Inspection Report.		15. SECURITY CLASS. (of this report) UNCLASSIFIED
		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE
16. DISTRIBUTION STATEMENT (of this Report) Approved for release; distribution unlimited.		
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)		
18. SUPPLEMENTARY NOTES		
19. KEY WORDS (Continue on reverse side if necessary and identify by block number) Dam Safety, Lake, Dam Inspection, Private Dams		
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.		

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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

IN REPLY REFER TO

December 21, 1979

SUBJECT: Dresser No. 1 Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Dresser No. 1 Dam.

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

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

1) Spillway will not pass a 10-year frequency flood without overtopping of the dam. The spillway is, therefore, considered to be unusually small and seriously inadequate.

2) Overtopping could result in dam failure.

3) Dam failure significantly increases the hazard to life and property downstream.

Submitted By: SIGNED
Chief, Engineering Division — Date: 3 MAR 1980

Approved By: SIGNED
Colonel, CE, District Engineer — Date: 3 MAR 1980

Accession For	
NTIS GRA&I	X
DTIC TAB	☐
Unannounced	☐
Justification	
By	
Distribution/	
Availability Codes	
Dist	Avail and/or Special
A	

DRESSER NO. 1 DAM
WASHINGTON COUNTY, MISSOURI

MISSOURI INVENTORY NO. 31117

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

JUNE 1979

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam	Dresser No. 1 Dam
State	Missouri
County	Washington
Stream	Tributary of Rubeneau Branch of Mill Creek
Date of Inspection	22 March 1979

Dresser No. 1 Dam was inspected by a civil engineer and an engineering geologist from International Engineering Company, Inc. of San Francisco, California. This dam is owned by Dresser Minerals Division of Potosi, Missouri. The purpose of the inspection was to assess the general condition of the dam with respect to safety. The assessment was based on an evaluation of the available data, a visual inspection, and an evaluation of the hydrology and hydraulics of the site to determine if the dam poses hazards to human life or property.

The purpose of the dam is to impound tailings from a barite separation and beneficiation operation. The dam completely encircles the impoundment. Runoff from the watershed is diverted around the north side of the impoundment via a diversion ditch.

Dresser No. 1 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 intermediate size. The U.S. Corps of Engineers has classified this dam as having a high downstream hazard potential to indicate that failure of this dam could threaten life and property. The damage zone estimated by the U.S. Corps of Engineers extends approximately eight miles downstream of the dam. Information provided by the Corps of Engineers and the inspection indicates that about five dwellings, two railroad bridges, a highway bridge, the town of Mineral Point with about eighty dwellings and Tailings Dam MO 30753, are within this damage zone.

The results of the inspection indicate an absence of adequate facilities for discharging flood water, inadequate freeboard, and failure of the dam to meet the hydraulic criteria given in the Guidelines for a structure with the size and hazard potential of Dresser No. 1 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 is reasonably possible in the region. The results of the hydraulic and hydrologic analyses indicate that the dam cannot handle 50 percent of the PMF without overtopping the embankment. It was calculated that the impoundment cannot retain the 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 calculated that the impoundment

cannot retain the 10 year flood (a flood having a 10 percent chance of being equalled or exceeded in any 1 year) without overtopping the dam.

Adequate overflow facilities and/or freeboard should be provided so that the impoundment can handle the PMF without overtopping the crest and without significant erosion of the embankment.

Adequate erosion protection should be provided on the embankment slopes adjacent to the ponds located upstream and downstream of the impoundment. Also adequate erosion protection should be provided in the diversion ditch to prevent flows from eroding the embankment. Excavation of gravels from the embankment has locally decreased the stability of the embankment. This activity should cease, until an engineer qualified to design and construct tailings dams has recommended safe methods to proceed. The areas previously excavated should be repaired to provide adequate embankment stability.

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 done under the direction of a professional engineer experienced in tailings dam design and construction.

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 diversion ditch.

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

Kenneth B. King, P.E.

Michael P. Forrest, P.E.

Donald R. Sanders, R.G.

OVERVIEW OF THE LAST END OF THE TAILINGS
IMPOUNDMENT OF DRESSER NO. 1 DAM AND DOWNSTREAM POND

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
DRESSER NO. 1 DAM
ID NO. 31117

TABLE OF CONTENTS

APPENDIX A

HYDROLOGIC AND HYDRAULIC ANALYSES

LIST OF PLATES

PHOTOGRAPHS

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
DRESSER NO. 1 DAM - ID NO. 31117

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 inspections 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 Dresser No. 1 Dam be made and authorized International Engineering Company, Inc. to make the inspection.

b. Purpose of the Inspection. The purpose of the inspection was to assess the general condition of the dam with respect to safety, based on available data and visual inspection, 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) This dam is an earthfill embankment that completely encircles the impoundment. The dam retains tailings from a barite separation and beneficiation operation, and the tailings consist of reddish-brown soft, silty clay. They were deposited as a slurry in a water environment. Tailings are no longer conveyed to the impoundment, which is overgrown with brush and small trees.

(2) No open channel spillways exist at this dam. Two 12-inch diameter steel pipes are present, and they are located at the southeast corner and on the west side of the impoundment; however, these pipes are considered inactive as discussed in paragraph 1.3b. These pipes were apparently used for decanting water from the pond when active tailings deposition was taking place. Ponds are adjacent to the impoundment on the east (downstream) and west (upstream) sides. A diversion

ditch is located along the north side of the impoundment, and it connects the two ponds and leads eventually to the Rubeneau Branch of Mill Creek.

b. Location. The dam is located in the eastern portion of Washington County, Missouri, as shown in Plate 1. The dam (shown in Figure 1) is located in Section 8, Township 37 North, Range 3 East.

c. Size Classification. This dam is greater than 40 feet high and less than 100 feet high and is therefore in the intermediate size classification, according to the "Recommended Guidelines for Safety Inspection of Dams".

d. Hazard Classification. The U.S. Corps of Engineers has classified this dam in the high hazard potential category. The damage zone, estimated by the Corps of Engineers, extends approximately eight miles downstream of the dam. Information provided by the Corps of Engineers and the inspection indicates that about five dwellings, two railroad bridges, a highway bridge, the town of Mineral Point with about eighty dwellings and Tailings Dam MO 30753 are within this damage zone.

e. Ownership. This dam is owned by:

Dresser Minerals Division
Dresser Industries, Inc.
P.O. Box 8
Potosi, Missouri 63664

f. Purpose. The purpose of the dam is to impound tailings from a barite separation and beneficiation operation.

g. Design and Construction History. Mr. A. E. Williams of Dresser Minerals Division indicated that construction of the dam began about 1954. No design information or construction data are available.

h. Normal Operating Procedures. No operating records are known to exist. Dresser personnel consider the tailings impoundment inactive because tailings are no longer conveyed to the impoundment. Available information indicates that the impoundment became inactive in the mid-1960's.

1.3 PERTINENT DATA

Field surveys were made by Booker Associates, Inc. of St. Louis, Missouri on 2 April 1979. The survey information is shown in Plates 3, 4, and 5.

a. Drainage Area. Since the impoundment is completely enclosed by an embankment and because runoff is diverted around the north end of the impoundment, the only drainage area is the impoundment itself, which has an area of 44 acres. (Aerial photograph, scale: 1 inch = 660 feet, 1971.)

b. Discharge at Dam Site.

(1) Overflow pipes (inactive) -

(a) 12-inch diameter steel pipe at southeast corner of impoundment (Station 13+06) - This pipe would not discharge flood water because it is located at the highest point within the impoundment. This pipe is therefore inactive.

(b) 12-inch diameter steel pipe at west end of impoundment (Station 42+85) - For the purpose of hydraulic and hydrologic analyses (see Section 5), this pipe is considered to be plugged with debris and would therefore be inactive.

(2) Spillway. There is no spillway at this dam. Not applicable.

(3) Maximum experienced outflow at damsite. No available information.

c. Elevation (Feet above M.S.L.)[1/]

(1) Top of dam - Varies from El. 930.3 to El. 944.3 along the crest roadway. Upstream berms in sections of the east, south and west embankments are about 2 to 3 feet higher than the crest roadway.

(2) Tailings surface - Varies from El. 928 ± at the west end to El. 940 ± at the southeast corner of the impoundment.

(3) Downstream (east) pond water surface - El. 905.3 (on date of survey).

(4) Upstream (west) pond water surface - El. 926.6 (on date of survey).

(5) Streambed at east end of impoundment (below east pond water surface) - El. 880 ± (from topographic quadrangle, 7.5-minute series, Mineral Point, Missouri, 1958).

(6) 12-inch diameter steel overflow pipe inlets (inactive) -

(a) 92-foot pipe at Station 13+06 - Invert El. 939.63.

(b) 60-foot pipe at Station 42+85 - Invert El. 929.79.

[1/] Elevations are based on a reference datum of El. 932.00 feet M.S.L. at the temporary bench mark (see Plate 3). This elevation was estimated from the topographic quadrangle.

d. Reservoir - Approximate maximum dimensions of tailings impoundment: 1600 feet (north-south) by 1600 feet (east-west). The approximate plan shape of the impoundment is shown in Plate 2. (Aerial photograph, 1971, scale: 1 inch = 660 feet.)

e. Storage.

(1) Approximate active storage for pool at top of dam (El. 930.3) - 10 acre-feet.

(2) Estimated approximate quantity of tailings in impoundment - 1400 acre-feet.

f. Reservoir Surface area.

(1) Water surface area for pool at top of dam (El. 930.3) - 8 acres ±.

(2) Area of impoundment - 44 acres.

g. Dam.

(1) Type - Earthfill.

(2) Length - 5231 feet.

(3) Height (maximum above streambed) - 55 feet ±.

(4) Top Width - Varies from 15 to 40 feet.

(5) Side Slopes -

(a) Downstream - 1.5(H) to 1.0(V).

(b) Upstream - Unknown.

(6) Zoning - The embankment probably consists of a clay starter dam with overlying sands and gravels that are finer than 7/8-inch. A clay section of the embankment begins at Station 26+70 and ends at Station 35+71.

(7) Cutoff - There is no information available that pertains to the design or construction of a cutoff.

h. Spillway. None.

i. Regulating Outlets. None.

j. Diversion Ditches. A diversion ditch is located along the north side of the impoundment adjacent to the downstream toe of the dam. The ditch conducts runoff impounded in the upstream pond located at the west end of the impoundment to the downstream pond located at the east end of the impoundment. The diversion ditch is V-shaped to U-shaped, about 6 to 8 feet deep and about 1800 feet long. A cross-section of this ditch at Station 23+20 is shown in Plate 5A.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

No design drawings or data were available.

2.2 CONSTRUCTION

No detailed construction information was available. Mr. A. E. Williams, the owner's representative, indicated that construction began about 1954. This dam was probably constructed by the method generally used to construct barite tailings dams in southeast Missouri. An earthfill starter dam was probably constructed across the drainage. Sands and gravels were then hauled in trucks from the mill and dumped on the crest to raise the dam. The sands and gravels were spread and were pushed over the upstream and downstream faces of the dam. The material pushed over the upstream side rests on the tailings. The sands and gravels placed in this manner are in a loose state and are at their natural angle of repose on the downstream face. The centerline of the dam remained approximately at the same position as the embankment was raised above the starter dam. Material on the crest was compacted by construction equipment.

2.3 OPERATION

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 the owner's representative.

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 the "Recommended Guidelines for Safety Inspection of Dams" were not available; the lack of this information is considered a deficiency. These seepage and stability analyses should be performed for the appropriate loading conditions, including earthquake loads, and should be made a matter of record.

c. Validity. Not applicable because no design data were available.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. The dam was inspected by a civil engineer and an engineering geologist from International Engineering Company, Inc. on 22 March 1979. Mr. A. E. Williams from Dresser Minerals met with the inspection team on 21 March 1979. The impoundment contains barite tailings; however, tailings are no longer conveyed to the impoundment.

Photographs taken during the inspection are included in this report. The field locations of the photographs are shown in Plate 6

b. Project Geology. The area geology has been mapped as cherty dolomite of Cambrian Age (Geologic Map of Missouri, Missouri Geological Survey, scale 1:500,000, 1979). In the reservoir area, dolomite outcrops were observed to be horizontally bedded and closely jointed. The surface soils consist of reddish brown silty clay containing resistant nodules of chert. The surface soils generally appear to be less than 10 feet thick.

c. Dam. The plan of the dam is shown in Plate 3. The profile and cross-sections of the dam are presented in Plates 4A, 4B, 4C, 5A and 5B.

The gravel sections of the dam are almost free of vegetative cover. Some small trees, which appeared to be rooted in the foundation, were observed growing through the embankment. The section of the dam at the north end of the impoundment is constructed of clayey soil and is overgrown with small trees and brush. The tailings pond is heavily vegetated with small trees and brush.

No sliding, detrimental settlement, depressions, cracking, sinkholes, or animal burrows were observed in the embankment. Flow in the diversion ditch is undercutting the foundation soils at the toe of the dam along the north section of the impoundment. The resulting scarp was observed to be about 2 to 3 feet high (see Photo No. 4). Gravels have been excavated from the dam at the southeast corner of the impoundment at the overflow pipe location and at the west side of the impoundment adjacent to the other overflow pipe. Vertical scarps 10 to 20 feet high have resulted from the excavation activities (see Photo No. 2).

No confirmed seepage or springs were observed; however, several small ponded areas along the east and south sides of the impoundment adjacent to the downstream toe of the dam were observed. Most of these ponded areas appear to be excavated pits that were filled with runoff. A possible seepage area was observed at the northeast corner of the impoundment (see Photo No. 6). Wet ground was observed, but it could not be determined if this condition was caused by seepage or rainfall.

The difference in elevation between the dam crest and the tailings surface varies from 0.5-foot to about 8 feet. Sections of the east, west and south embankments have irregular berms at the upstream edges of the crest. These berms at a few locations of the east and south sections are about 6 inches above the tailings level.

No erosion protection exists on the downstream faces of the dam adjacent to the ponds. The vegetation on the clayey embankment sections of the dam at the north end of the impoundment would provide some erosion protection.

d. Appurtenant Structures.

(1) Overflow pipe at southeast corner of impoundment, Station 13+06 (Photo No. 2). The 12-inch diameter steel overflow pipe appears to be in good condition. Some cobbles and soil are inside the pipe. The inlet end of the pipe is at the level of the tailings (Photo No. 3). The outlet end of the pipe protrudes 6 feet beyond the face of the dam, just above a scarp formed by excavation activities. No erosion protection exists at the outlet end of the pipe. This pipe is located at the highest point in the impoundment and therefore cannot decant flood water. A second 12-inch diameter steel pipe lies below the overflow pipe and it emerges from the scarp. The inlet end of this second pipe could not be found and it could be buried under the tailings.

(2) Overflow pipe on west side of impoundment, Station 42+85 (Photo No. 8). This 12-inch diameter steel pipe has a 45-degree elbow at the inlet end which is about 2 to 3 feet above the tailings surface. The pipe outlet is at the pond on the west side of the impoundment. It could not be determined if debris is inside the pipe.

(3) Diversion ditch (Photo No. 4 and No. 5). A diversion ditch is located along the north side of the impoundment adjacent to the downstream toe of the embankment. This ditch conducts water from the west pond to the pond at the east side of the impoundment. The ditch is in clayey soil.

e. Reservoir Area. The impoundment consists of silty clay tailings which were deposited as a slurry in a water environment. Tailings are no longer conveyed to the impoundment. Some consolidation of the tailings has probably taken place. The tailings slope downward to the west and are overgrown with brush and trees.

The watershed area is characterized by downward sloping ground to the south and east. Most of the watershed consists of mined areas. These areas have irregular topography, which consist of numerous pits and stripped land. This area is partially vegetated with small trees and brush. The mined areas are subject to erosion and sedimentation. Backwater flooding would not at present be a potential problem because no structures are located immediately upstream of the impoundment.

f. Downstream Channels. The impoundment was constructed across a tributary to Rubeneau Branch of Mill Creek. Runoff is diverted around the north side of the impoundment, which eventually flows into Rubeneau Branch. Rubeneau Branch intersects Mill Creek immediately to the north (downstream) of Mineral Point, approximately 1 mile northeast of the impoundment. No Name 587 Tailings Dam (MO 30753) is located about 800 feet east (downstream) of Dresser No. 1 Dam (see Plate 2).

3.2 EVALUATION

Water flowing in the diversion ditch along the north side of the impoundment is undercutting the foundation soils at the downstream toe of the dam. This erosion process could adversely affect embankment stability during times of high flow in the diversion ditch. The downstream slope of the embankment is steep (at the angle of repose of the gravel), and its long-term stability cannot be determined until seepage and stability analyses are performed. The scarps caused by excavating activities at the west end and southeast corner of the embankment are potentially unstable. No erosion protection of the embankment slopes is provided adjacent to the ponds located upstream and downstream of the impoundment. The wet ground condition at the northeast corner of the impoundment could adversely affect embankment stability.

The embankment is a relatively porous granular structure above the tailings surface. If the water level were to rise above the tailings surface due to flood runoff, there could be significant seepage through the embankment which could adversely affect the stability of the dam.

The southeast overflow pipe is located at the highest elevation of the tailings impoundment. Because of its location, this pipe cannot decant water from the impoundment. During flood runoff within the impoundment, debris could plug the pipe at the west end of the impoundment.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

No regulating procedures are known to exist.

4.2 MAINTENANCE OF DAM

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

4.3 MAINTENANCE OF OPERATING FACILITIES

There are no operating facilities at this dam. Not applicable.

4.4 DESCRIPTION OF WARNING SYSTEM IN EFFECT

Information available to the inspection team indicates that there is no warning system for this dam.

4.5 EVALUATION

The behavior of the dam should be monitored periodically to observe any indications of instability, such as cracks in the dam, sloughing, sudden settlement, erosion of the dam, emerging seepage or piping in or near the dam. A maintenance program should be initiated for this embankment and the diversion ditch.

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 in the field survey drawings, Plates 3 through 5. Hydrologic and hydraulic design information is not available.

The tailings impoundment is completely enclosed by the embankment (see Section 1.3.a). The total enclosed area inside the embankment is approximately 44 acres (0.07 square mile). The impoundment is shown in Plate 2.

No topographical information of the tailings impoundment surface is given on the U.S.G.S. Mineral Point Quadrangle (1958). Field surveys indicate that the tailings surface elevation is variable (see Plate 3). To obtain an approximate reservoir area-elevation relationship, the spot elevations on the tailings were transferred to the 1971 U.S. Agricultural Stabilization and Conservation Service aerial photograph (scale: 1 inch = 660 ft.) which were used as a guide to develop approximate contours of the tailings surface.

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 impoundment.

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. The capacities were calculated by the conic method in the computer program and are the active capacities at a given elevation. No spillway is present at the damsite. The drain pipes in the embankment were assumed to be non-functional (see Sections 1 and 3). Computations of the discharge rating curve for flows over the dam crest were made by using the weir flow formula with a weir coefficient of 3.0 for the dam crest. The discharge rating curve for flows over the dam crest is in Appendix A, under the input data listing on the Y4 and Y5 cards. The overtopping analysis was based on the elevations as surveyed on the dam crest. The crest elevation for overtopping was assumed to be at El. 930.3, the lowest point along the dam crest, at about Sta. 1+00 to Sta. 2+00. Overtopping could also occur at higher water surface elevations at about Sta. 44+00.

b. Experience Data. Rainfall, streamflow, and flood data for the watershed are not available. There is no evidence of overtopping of Dresser No. 1 Dam.

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

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

The computed floods were routed through the impoundment using the Modified Puls Method of flood routing. For all cases of flood routing, the starting water surface was set at El. 929.0. This corresponds to approximately 1 to 2 feet of active water storage above the bottom of the reservoir, which was assumed to be the antecedent condition prior to the occurence of the floods. For the purpose of the overtopping computations, it was assumed that erosion of the embankment would not occur as flood water is discharged over the crest. Therefore, the discharge rating curve was computed for the specific profiles shown in Plates 4A, 4B and 4C.

Results of the overtopping analyses indicate that the dam cannot retain the 50 percent PMF without overtopping the minimum dam crest. The 100-year flood and 10-year flood were computed and routed through the impoundment in the same manner as discussed above. Results of the overtopping analyses also indicate that the dam cannot store the 100-year flood or the 10-year flood without overtopping the dam crest. There are two locations where overtopping would occur. The primary overtopping location is at about Sta. 1+00 to Sta. 2+00, the lowest point of the embankment (El. 930.3). The second overtopping location is at about Sta. 43+80 to Sta. 44+00 (El. 930.6).

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

Flood	Peak Inflow (cfs)	Peak Outflow (cfs)	Max WS Elev (ft)	Max Depth Over Min. Dam Crest (ft)	Duration Overtopped (hrs)
10-year	192	78	930.8*	0.5	12.5
100-year	277	115	931.0*	0.7	13.2
10% PMF	102	38	930.6*	0.3	8.7
15% PMF	154	64	930.7*	0.4	10.3
20% PMF	205	84	930.8*	0.5	11.1
25% PMF	256	102	931.0*	0.7	11.7
30% PMF	307	120	931.1*	0.8	12.4
40% PMF	410	219	931.2*	0.9	14.2
PMF	1025	651	931.8*	1.5	17.3

* Dam overtopped (Minimum Dam Crest El. 930.3).

Note: Water surface elevations include the velocity heads corresponding to the velocities computed for the various flow depths for the overtopping section.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. Conditions that may adversely affect the structural stability of this 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 this lack of information is considered 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. Operating Records. No appurtenant structures requiring operation exist at this dam, and no records of operation are known to exist.

d. Post-Construction Changes. The only apparent post-construction change is the excavation of embankment gravels from the southeast corner and from the west side of the impoundment. Scarps 10 to 20 feet high have resulted from the excavation activities.

e. Seismic Stability. The dam is located in Seismic Zone 2, as defined in the Uniform Building Code. Some settlement and ravelling of the gravels could occur during seismic shaking because the gravels are loose and the downstream slope is at or near the natural angle of repose.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. There are several deficiencies that should be corrected. (1) There is no erosion protection for slopes of the dam adjacent to the upstream and downstream ponds. (2) Excavation of gravels from the dam is causing vertical scarps to develop and to reduce the stability of the dam. (3) The toe of the dam along the north side of the impoundment is being undercut by flow through the diversion ditch. (4) The wet ground condition at the northeast corner of the impoundment could adversely affect the stability of the embankment. (5) It was estimated that the impoundment cannot safely handle 50 percent of the Probable Maximum Flood (PMF) without overtopping the dam. The PMF is the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that is reasonably possible in the region. As an intermediate size dam with a high hazard potential, the "Recommended Guidelines for Safety Inspection of Dams" specify that the discharge capacity and/or storage capacity should be capable of safely handling the PMF without overtopping. (6) Seepage and stability analyses were not available, and they should be performed for appropriate loading conditions, including earthquake loads, and made a matter of record.

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

Results of the hydrologic studies could be changed if topographic maps of the tailing surface become available. The only available topographic maps are the 7.5-minute, 1:24,000 scale USGS quadrangles with 20-foot contour intervals. No topographical information of the tailings impoundment surface is given on these quadrangles. Contours of the tailings surface were approximated using the survey data (Plate 3) and an aerial photograph (scale: 1 inch = 660 feet). The use of the survey data and aerial photograph for the hydrologic studies results in an approximate evaluation of the flood storage capacity.

c. Urgency. The Phase I inspection indicated apparent deficiencies in the condition of the dam. Priority should be given to initiating remedial work to provide adequate discharge capacity and/or storage capacity of the impoundment.

d. Necessity for Phase II. No Phase II investigation is recommended, however, additional investigative work should be done as required so that seepage and stability analyses can be performed. The investigations should be undertaken by a professional engineer experienced in the design and construction of tailings dams.

7.2 REMEDIAL MEASURES

The following remedial measures are recommended:

a. Adequate erosion protection should be provided for the embankment slopes adjacent to the upstream and downstream ponds to prevent wave erosion.

b. Adequate erosion protection should be provided in the diversion ditch along the north side of the impoundment to protect the dam and its foundation from erosion.

c. The excavation of gravels from the dam has locally decreased embankment stability. This activity should cease until an engineer qualified to design and construct tailings dams has recommended safe methods to proceed. The areas previously excavated should be repaired to provide adequate embankment stability.

d. Seepage and stability analyses should be performed by a professional engineer experienced in the design and construction of tailings dams. The embankment is a relatively porous granular structure above the tailings surface. If the impoundment water level were to rise above the tailings surface, there could be significant seepage through the embankment which could adversely affect the stability of the dam. Included in these analyses, therefore, seepage and stability computations should also be performed with the reservoir water surface set at the top of the dam. Based on the results of the stability studies, remedial measures may become necessary. Remedial work should be done under the direction of a professional engineer experienced in design and construction of tailings dams.

e. Adequate drainage should be provided at the northeast corner of the embankment, where a wet ground condition was observed.

f. To comply with the Guidelines for a dam of this size and hazard potential, adequate discharge facilities and/or freeboard should be provided so that the impoundment can handle the PMF without overtopping the crest and without significant erosion of the embankment. Also, the crest width should be sufficient so that when flood water rises within the impoundment, adequate stability can be maintained.

g. Further studies may indicate the feasibility of other alternatives to providing adequate overflow facilities and freeboard to handle the PMF. For example, consideration could be given to grading the embankment crest gravels level with the tailings surface so that no active storage can exist. In this case, the gravel embankment around the tailings impoundment should be resistant to erosion from sheet flow over the impoundment. These studies should be performed under the direction of an engineer experienced in the design and construction of tailings dams.

h. An inspection and maintenance program should be initiated. Periodic inspections should be made by qualified personnel to observe the performance of the dam and diversion ditch. Observations should include indications of instability, such as cracks in the embankment, piping, sloughing, erosion, sudden settlement, or emerging seepage. Records should be kept of the inspections and of any corrective maintenance made to the dam and diversion ditch.

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 in 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   DRESSER NO 1  ID NO 31117
A2   HEC-1  PHASE 1  DAM SAFETY INVESTIGATION
A3   PMF ROUTING THROUGH CLOSED SYSTEM
B    288                  5                                          0
B1     5
J      1        7        1
J1   .10      .15      .20      .25      .30      .40     1.00
K      0 RUNOFF                                          1        1
K1   PMF RUNOFF FROM ENCLOSED AREA - DRESSER NO1  ID NO 31117
M      1        2     .069                               1.
P      0     26.5      102      120      130
T                                                                -1     -100
W2           0.10
X    -.01     -.01       1.
K      1 ROUTING                                              1        1
K1   ROUTING THROUGH CLOSED SYSTEM
Y                                      1        1
Y1     1                                                       -929       -1
Y4 930.3    931.1    932.2    933.4    934.5    935.7    936.8
Y5     0      124      963     2760     6400    12990    21900
$A    .0      5.5     19.8     30.8     38.5     42.5
$E   928      930      932      934      936      938
$$ 930.3
$D 930.3
K     99
A
```

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

RUN  DATE= 79/ 7/23.
     TIME= 15.36.31.
```

DRESSER NO 1 ID NO 31117
HEC-1 PHASE 1 DAM SAFETY INVESTIGATION
PMF ROUTING THROUGH CLOSED SYSTEM

JOB SPECIFICATION

NO	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	5	0	0	0	0	0	0	0

JOPER	NRT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 7 LRTIO= 1

RTIOS= .10 .15 .20 .25 .30 .40 1.00

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

SUB-AREA RUNOFF COMPUTATION

PMF RUNOFF FROM ENCLOSED AREA = DRESSER NO1 ID NO 31117

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

HYDROGRAPH DATA

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

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	26.50	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 METNESS = -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--(DTHR IS GT LAG/2)

UNIT HYDROGRAPH 0 END-OF-PERIOD ORDINATES, TC= 0.00 HOURS, LAG= .10 VOL= 1.00

	151.	22m.	98.	30.	15.	6.	2.	1.

EXCESS-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP 2	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP 2
1.01	.05	1	.01	.01	0.00	2.	1.01	12.05	145	.23	.23	.00	59.
1.01	.10	2	.01	.01	0.00	6.	1.01	12.10	146	.23	.23	.00	95.
1.01	.15	3	.01	.01	.00	7.	1.01	12.15	147	.23	.23	.00	111.
1.01	.20	4	.01	.01	-.00	8.	1.01	12.20	148	.23	.23	.00	117.
1.01	.25	5	.01	.01	-.00	8.	1.01	12.25	149	.23	.23	-.00	119.
1.01	.30	6	.01	.01	-.00	8.	1.01	12.30	150	.23	.23	.00	120.
1.01	.35	7	.01	.01	-.00	8.	1.01	12.35	151	.23	.23	.00	120.
1.01	.40	8	.01	.01	-.00	8.	1.01	12.40	152	.23	.23	-.00	120.
1.01	.45	9	.01	.01	.00	8.	1.01	12.45	153	.23	.23	.00	120.
1.01	.50	10	.01	.01	.00	8.	1.01	12.50	154	.23	.23	.00	120.
1.01	.55	11	.01	.01	.00	8.	1.01	12.55	155	.23	.23	-.00	120.
1.01	1.00	12	.01	.01	.00	8.	1.01	13.00	156	.23	.23	-.00	120.
1.01	1.05	13	.01	.01	.00	8.	1.01	13.05	157	.27	.27	-.00	127.
1.01	1.10	14	.01	.01	-.00	8.	1.01	13.10	158	.27	.27	-.00	137.
1.01	1.15	15	.01	.01	.00	8.	1.01	13.15	159	.27	.27	-.00	142.
1.01	1.20	16	.01	.01	-.00	8.	1.01	13.20	160	.27	.27	-.00	143.
1.01	1.25	17	.01	.01	.00	8.	1.01	13.25	161	.27	.27	-.00	144.
1.01	1.30	18	.01	.01	.00	8.	1.01	13.30	162	.27	.27	-.00	144.
1.01	1.35	19	.01	.01	.00	8.	1.01	13.35	163	.27	.27	-.00	144.
1.01	1.40	20	.01	.01	.00	8.	1.01	13.40	164	.27	.27	-.00	144.
1.01	1.45	21	.01	.01	.00	8.	1.01	13.45	165	.27	.27	-.00	144.
1.01	1.50	22	.01	.01	.00	8.	1.01	13.50	166	.27	.27	-.00	144.
1.01	1.55	23	.01	.01	-.00	8.	1.01	13.55	167	.27	.27	-.00	144.
1.01	2.00	24	.01	.01	.00	8.	1.01	14.00	168	.27	.27	.00	144.
1.01	2.05	25	.01	.01	.00	8.	1.01	14.05	169	.34	.34	-.00	155.
1.01	2.10	26	.01	.01	.00	8.	1.01	14.10	170	.34	.34	.00	170.
1.01	2.15	27	.01	.01	-.00	8.	1.01	14.15	171	.34	.34	-.00	176.
1.01	2.20	28	.01	.01	.00	8.	1.01	14.20	172	.34	.34	.00	179.
1.01	2.25	29	.01	.01	.00	8.	1.01	14.25	173	.34	.34	-.00	180.
1.01	2.30	30	.01	.01	-.00	8.	1.01	14.30	174	.34	.34	.00	180.
1.01	2.35	31	.01	.01	.00	8.	1.01	14.35	175	.34	.34	.00	180.
1.01	2.40	32	.01	.01	.00	8.	1.01	14.40	176	.34	.34	.00	180.
1.01	2.45	33	.01	.01	-.00	8.	1.01	14.45	177	.34	.34	.00	180.
1.01	2.50	34	.01	.01	.00	8.	1.01	14.50	178	.34	.34	.00	180.
1.01	2.55	35	.01	.01	.00	8.	1.01	14.55	179	.34	.34	-.00	180.
1.01	3.00	36	.01	.01	.00	8.	1.01	15.00	180	.34	.34	.00	180.
1.01	3.05	37	.01	.01	.00	8.	1.01	15.05	181	.21	.21	.00	180.
1.01	3.10	38	.01	.01	.00	8.	1.01	15.10	182	.41	.41	.00	182.
1.01	3.15	39	.01	.01	.00	8.	1.01	15.15	183	.41	.41	.00	195.
1.01	3.20	40	.01	.01	.00	8.	1.01	15.20	184	.62	.62	.00	241.
1.01	3.25	41	.01	.01	.00	8.	1.01	15.25	185	.72	.72	-.00	348.
1.01	3.30	42	.01	.01	.00	8.	1.01	15.30	186	1.75	1.75	.00	568.
1.01	3.35	43	.01	.01	-.00	8.	1.01	15.35	187	2.88	2.88	-.00	964.
1.01	3.40	44	.01	.01	.00	8.	1.01	15.40	188	1.13	1.13	.00	1025.
1.01	3.45	45	.01	.01	.00	8.	1.01	15.45	189	.72	.72	-.00	765.
1.01	3.50	46	.01	.01	.00	8.	1.01	15.50	190	.62	.62	-.00	546.
1.01	3.55	47	.01	.01	.00	8.	1.01	15.55	191	.41	.41	.00	367.
1.01	4.00	48	.01	.01	.00	8.	1.01	16.00	192	.41	.41	-.00	279.
1.01	4.05	49	.01	.01	.00	8.	1.01	16.05	193	.31	.32	-.00	228.
1.01	4.10	50	.01	.01	-.00	8.	1.01	16.10	194	.32	.32	.00	198.
1.01	4.15	51	.01	.01	.00	8.	1.01	16.15	195	.32	.32	.00	177.
1.01	4.20	52	.01	.01	.00	8.	1.01	16.20	196	.32	.32	.00	171.
1.01	4.25	53	.01	.01	.00	8.	1.01	16.25	197	.32	.32	-.00	169.
1.01	4.30	54	.01	.01	-.00	8.	1.01	16.30	198	.32	.32	.00	169.
1.01	4.35	55	.01	.01	.00	8.	1.01	16.35	199	.32	.32	.00	168.

1.01	4.40	56	.01	.01	.00	8.	1.01	16.40	240	.32	.32	.00	168.
1.01	4.45	57	.01	.01	.00	8.	1.01	16.45	241	.32	.32	-.00	168.
1.01	4.50	58	.01	.01	-.00	8.	1.01	16.50	242	.32	.32	.00	168.
1.01	4.55	59	.01	.01	.00	8.	1.01	16.55	243	.32	.32	-.00	168.
1.01	5.00	60	.01	.01	.00	8.	1.01	17.00	244	.32	.32	.00	168.
1.01	5.05	61	.01	.01	.00	8.	1.01	17.05	245	.25	.25	.00	150.
1.01	5.10	62	.01	.01	-.00	8.	1.01	17.10	246	.25	.25	-.00	143.
1.01	5.15	63	.01	.01	.00	8.	1.01	17.15	247	.25	.25	-.00	136.
1.01	5.20	64	.01	.01	.00	8.	1.01	17.20	248	.25	.25	.00	134.
1.01	5.25	65	.01	.01	-.00	8.	1.01	17.25	249	.25	.25	-.00	133.
1.01	5.30	66	.01	.01	.00	8.	1.01	17.30	250	.25	.25	.00	133.
1.01	5.35	67	.01	.01	.00	8.	1.01	17.35	251	.25	.25	-.00	132.
1.01	5.40	68	.01	.01	.00	8.	1.01	17.40	252	.25	.25	-.00	132.
1.01	5.45	69	.01	.01	-.00	8.	1.01	17.45	253	.25	.25	.00	132.
1.01	5.50	70	.01	.01	-.00	8.	1.01	17.50	254	.25	.25	-.00	132.
1.01	5.55	71	.01	.01	-.00	8.	1.01	17.55	255	.25	.25	-.00	132.
1.01	6.00	72	.01	.01	-.00	8.	1.01	18.00	256	.25	.25	-.00	132.
1.01	6.05	73	.07	.07	.00	16.	1.01	18.05	217	.02	.02	.00	98.
1.01	6.10	74	.07	.07	.00	27.	1.01	18.10	218	.02	.02	.00	48.
1.01	6.15	75	.07	.07	.00	32.	1.01	18.15	219	.02	.02	.00	26.
1.01	6.20	76	.07	.07	.00	34.	1.01	18.20	220	.02	.02	.00	17.
1.01	6.25	77	.07	.07	.00	35.	1.01	18.25	221	.02	.02	.00	14.
1.01	6.30	78	.07	.07	.00	35.	1.01	18.30	222	.02	.02	.00	12.
1.01	6.35	79	.07	.07	.00	35.	1.01	18.35	223	.02	.02	.00	12.
1.01	6.40	80	.07	.07	.00	35.	1.01	18.40	224	.02	.02	.00	12.
1.01	6.45	81	.07	.07	-.00	35.	1.01	18.45	225	.02	.02	.00	12.
1.01	6.50	82	.07	.07	.00	35.	1.01	18.50	226	.02	.02	.00	12.
1.01	6.55	83	.07	.07	.00	35.	1.01	18.55	227	.02	.02	-.00	12.
1.01	7.00	84	.07	.07	.00	35.	1.01	19.00	228	.02	.02	.00	12.
1.01	7.05	85	.07	.07	-.00	35.	1.01	19.05	229	.02	.02	.00	12.
1.01	7.10	86	.07	.07	.00	35.	1.01	19.10	230	.02	.02	.00	12.
1.01	7.15	87	.07	.07	.00	35.	1.01	19.15	231	.02	.02	.00	12.
1.01	7.20	88	.07	.07	.00	35.	1.01	19.20	232	.02	.02	.00	12.
1.01	7.25	89	.07	.07	.00	35.	1.01	19.25	233	.02	.02	.00	12.
1.01	7.30	90	.07	.07	.00	35.	1.01	19.30	234	.02	.02	-.00	12.
1.01	7.35	91	.07	.07	.00	35.	1.01	19.35	235	.02	.02	.00	12.
1.01	7.40	92	.07	.07	.00	35.	1.01	19.40	236	.02	.02	.00	12.
1.01	7.45	93	.07	.07	.00	35.	1.01	19.45	237	.02	.02	-.00	12.
1.01	7.50	94	.07	.07	.00	35.	1.01	19.50	238	.02	.02	.00	12.
1.01	7.55	95	.07	.07	.00	35.	1.01	19.55	239	.02	.02	.00	12.
1.01	8.00	96	.07	.07	.00	35.	1.01	20.00	240	.02	.02	.00	12.
1.01	8.05	97	.07	.07	.00	35.	1.01	20.05	241	.02	.02	.00	12.
1.01	8.10	98	.07	.07	-.00	35.	1.01	20.10	242	.02	.02	.00	12.
1.01	8.15	99	.07	.07	.00	35.	1.01	20.15	243	.02	.02	.00	12.
1.01	8.20	100	.07	.07	.00	35.	1.01	20.20	244	.02	.02	.00	12.
1.01	8.25	101	.07	.07	-.00	35.	1.01	20.25	245	.02	.02	.00	12.
1.01	8.30	102	.07	.07	.00	35.	1.01	20.30	246	.02	.02	.00	12.
1.01	8.35	103	.07	.07	.00	35.	1.01	20.35	247	.02	.02	.00	12.
1.01	8.40	104	.07	.07	-.00	35.	1.01	20.40	248	.02	.02	.00	12.
1.01	8.45	105	.07	.07	.00	35.	1.01	20.45	249	.02	.02	.00	12.
1.01	8.50	106	.07	.07	-.00	35.	1.01	20.50	250	.02	.02	.00	12.
1.01	8.55	107	.07	.07	.00	35.	1.01	20.55	251	.02	.02	.00	12.
1.01	9.00	108	.07	.07	.00	35.	1.01	21.00	252	.02	.02	.00	12.
1.01	9.05	109	.07	.07	.00	35.	1.01	21.05	253	.02	.02	.00	12.
1.01	9.10	110	.07	.07	.00	35.	1.01	21.10	254	.02	.02	.00	12.
1.01	9.15	111	.07	.07	.00	35.	1.01	21.15	255	.02	.02	.00	12.
1.01	9.20	112	.07	.07	-.00	35.	1.01	21.20	256	.02	.02	.00	12.
1.01	9.25	113	.07	.07	.00	35.	1.01	21.25	257	.02	.02	-.00	12.
1.01	9.30	114	.07	.07	-.00	35.	1.01	21.30	258	.02	.02	.00	12.
1.01	9.35	115	.07	.07	.00	35.	1.01	21.35	259	.02	.02	-.00	12.

1.01	9.40	116	.07	.07	.00	35.	1.01	21.40	260	.02	.02	.00	12.
1.01	9.45	117	.07	.07	.00	35.	1.01	21.45	261	.02	.02	.00	12.
1.01	9.50	118	.07	.07	.00	35.	1.01	21.50	262	.02	.02	-.00	12.
1.01	9.55	119	.07	.07	.00	35.	1.01	21.55	263	.02	.02	.00	12.
1.01	10.00	120	.07	.07	.00	35.	1.01	22.00	264	.02	.02	.00	12.
1.01	10.05	121	.07	.07	-.00	35.	1.01	22.05	265	.02	.02	.00	12.
1.01	10.10	122	.07	.07	.00	35.	1.01	22.10	266	.02	.02	.00	12.
1.01	10.15	123	.07	.07	-.00	35.	1.01	22.15	267	.02	.02	.00	12.
1.01	10.20	124	.07	.07	.00	35.	1.01	22.20	268	.02	.02	.00	12.
1.01	10.25	125	.07	.07	.00	35.	1.01	22.25	269	.02	.02	.00	12.
1.01	10.30	126	.07	.07	.00	35.	1.01	22.30	270	.02	.02	-.00	12.
1.01	10.35	127	.07	.07	-.00	35.	1.01	22.35	271	.02	.02	.00	12.
1.01	10.40	128	.07	.07	.00	35.	1.01	22.40	272	.02	.02	.00	12.
1.01	10.45	129	.07	.07	.00	35.	1.01	22.45	273	.02	.02	.00	12.
1.01	10.50	130	.07	.07	.00	35.	1.01	22.50	274	.02	.02	.00	12.
1.01	10.55	131	.07	.07	.00	35.	1.01	22.55	275	.02	.02	.00	12.
1.01	11.00	132	.07	.07	.00	35.	1.01	23.00	276	.02	.02	-.00	12.
1.01	11.05	133	.07	.07	.00	35.	1.01	23.05	277	.02	.02	.00	12.
1.01	11.10	134	.07	.07	.00	35.	1.01	23.10	278	.02	.02	.00	12.
1.01	11.15	135	.07	.07	.00	35.	1.01	23.15	279	.02	.02	.00	12.
1.01	11.20	136	.07	.07	.00	35.	1.01	23.20	280	.02	.02	.00	12.
1.01	11.25	137	.07	.07	.00	35.	1.01	23.25	281	.02	.02	.00	12.
1.01	11.30	138	.07	.07	.00	35.	1.01	23.30	282	.02	.02	.00	12.
1.01	11.35	139	.07	.07	.00	35.	1.01	23.35	283	.02	.02	.00	12.
1.01	11.40	140	.07	.07	-.00	35.	1.01	23.40	284	.02	.02	.00	12.
1.01	11.45	141	.07	.07	.00	35.	1.01	23.45	285	.02	.02	.00	12.
1.01	11.50	142	.07	.07	.00	35.	1.01	23.50	286	.02	.02	.00	12.
1.01	11.55	143	.07	.07	.00	35.	1.01	23.55	287	.02	.02	.00	12.
1.01	12.00	144	.07	.07	.00	35.	1.02	0.00	288	.02	.02	.00	12.
									SUM	34.45	34.45	.00	18373.
										(875.)(	875.)(	0.)(	520.27)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1025.	199.	64.	64.	18377.
CMS	29.	6.	2.	2.	520.
INCHES		20.65	34.41	34.41	34.41
MM		881.97	874.03	874.03	874.03
AC-FT		99.	127.	127.	127.
THOUS CU M		122.	156.	156.	156.

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

HYDROGRAPH ROUTING

ROUTING THROUGH CLOSED SYSTEM

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
ROUTING	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	NSTOL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-929.	-1

STAGE	930.30	931.10	932.20	933.40	934.50	935.70	936.80
FLOW	0.00	124.00	963.00	2760.00	6400.00	12990.00	21900.00
SURFACE AREA=	0.	6.	20.	31.	39.	45.	
CAPACITY=	0.	4.	27.	78.	147.	228.	
ELEVATION=	928.	930.	932.	934.	936.	938.	

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
930.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
930.3	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 .10	RATIO 2 .15	RATIO 3 .20	RATIO 4 .25	RATIO 5 .30	RATIO 6 .40	RATIO 7 1.00
HYDROGRAPH AT	UNOFF	.07	1	102.	154.	205.	256.	307.	410.	1025.
	(	.18)	(	2.90)(	4.35)(	5.80)(	7.25)(	8.71)(	11.61)(	29.02)(
ROUTED TO	OUTING	.07	1	35.	64.	84.	102.	120.	219.	651.
	(	.18)	(	1.08)(	1.80)(	2.37)(	2.90)(	3.40)(	6.21)(	18.44)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN PMF

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	929.00	930.30	930.30
STORAGE	0.	0.	0.
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
.10	930.55	.25	7.	38.	8.67	15.92	0.00
.15	930.71	.41	9.	64.	10.25	15.92	0.00
.20	930.84	.54	10.	84.	11.08	15.92	0.00
.25	930.96	.66	12.	102.	11.67	15.92	0.00
.30	931.07	.77	13.	120.	12.42	15.92	0.00
.40	931.23	.93	15.	219.	14.17	15.83	0.00
1.00	931.79	1.49	24.	651.	17.33	15.75	0.00

```
A1   DRESSER NO 1  ID NO 31117
A2   HEC-1  PHASE 1  DAM SAFETY INVESTIGATION
A3   100-YR ROUTING THROUGH CLOSED SYSTEM
B    144              10                                  0
B1     3
K      0 RUNOFF                                      1     1
K1   100-YR RUNOFF FROM ENCLOSED AREA - DRESSER NO 1  ID NO 31117
M      0        2    .069
O    144
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     .014     .014
O1  .014     .014     .014     .014     .014     .014     .028     .028     .028     .028
O1  .028     .028     .028     .028     .028     .028     .028     .028     .028     .028
O1  .028     .028     .028     .028     .044     .044     .044     .044     .044     .044
O1  .044     .044     .044     .062     .062     .062     .122     .122     .122     .264
O1  .384     .601    1.205     .384     .264     .122     .122     .122     .062     .062
O1  .062     .044     .044     .044     .044     .044     .044     .044     .044     .044
O1  .028     .028     .028     .028     .028     .028     .028     .028     .028     .028
O1  .028     .028     .028     .028     .028     .028     .028     .028     .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     .014     .014
O1  .014     .014     .014     .014
T                                                        -1    -100
W2           0.10
X   -.01     -.01      1.
K      1 ROUTING                                     1     1
K1    ROUTING THROUGH CLOSED SYSTEM
Y                                  1
Y1     1                                            -929      -1
Y4 930.3    931.1    932.2    933.4    934.5    935.7    936.8
Y5     0      124      963     2760     6400    12990    21900
SA    .0      5.5     19.8     30.8     38.5     42.5
SE   928      930      932      934      936      938
SS 930.3
SD 930.3
K     99
A
```

****
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 28 FEB 79
****

RUN DATE= 04/07/23.
TIME= 15.33.38.

DRESSER NO 1 ID NO 31117
HEC-1 PHASE 1 DAM SAFETY INVESTIGATION
100-YR ROUTING THROUGH CLOSED SYSTEM

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
144	0	10	0	0	0	0	0	0	0
			JOPER	NRT	LROPT	TRACE			
			3	0	0	0			

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

SUB-AREA RUNOFF COMPUTATION

100-YR RUNOFF FROM ENCLOSED AREA - DRESSER NO 1 ID NO 31117

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

HYDROGRAPH DATA

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

PRECIP DATA

	NP	STORM	DAJ	DAK
	144	0.00	0.00	0.00

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	.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	.26
.58	.58	1.21	.58	.26	.12	.12	.12	.06	.06
.06	.04	.04	.04	.04	.04	.04	.04	.04	.04
.03	.03	.03	.03	.03	.03	.03	.03	.03	.03
.03	.03	.03	.03	.03	.03	.03	.03	.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	.1						

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIMK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	-1.00	-100.00	.00	0.00

CURVE NO = -100.00 RETNESS = -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 5 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= .10 VOL= 1.00
179. 68. 16. 4. 1.

0 MO,DA	HR,MN	PERIOD	RAIN	EXCS	LOSS	END-OF-PERIOD FLOW COMP Q	MO,DA	HR,MN	PERIOD	RAIN	EXLS	LOSS	COMP Q
1.01	.10	1	.01	.01	.00	2.	1.01	12.10	73	1.21	1.21	.00	277.
1.01	.20	2	.01	.01	.00	3.	1.01	12.20	74	.38	.38	-.00	165.
1.01	.30	3	.01	.01	0.00	4.	1.01	12.30	75	.26	.26	-.00	96.
1.01	.40	4	.01	.01	.00	4.	1.01	12.40	76	.12	.12	-.00	51.
1.01	.50	5	.01	.01	.00	4.	1.01	12.50	77	.12	.12	-.00	37.
1.01	1.00	6	.01	.01	-.00	4.	1.01	13.00	78	.12	.12	-.00	33.
1.01	1.10	7	.01	.01	-.00	4.	1.01	13.10	79	.06	.06	-.00	22.
1.01	1.20	8	.01	.01	-.00	4.	1.01	13.20	80	.06	.06	.00	18.
1.01	1.30	9	.01	.01	.00	4.	1.01	13.30	81	.06	.06	-.00	17.
1.01	1.40	10	.01	.01	-.00	4.	1.01	13.40	82	.04	.04	.00	13.
1.01	1.50	11	.01	.01	-.00	4.	1.01	13.50	83	.04	.04	-.00	12.
1.01	2.00	12	.01	.01	-.00	4.	1.01	14.00	84	.04	.04	-.00	12.
1.01	2.10	13	.01	.01	.00	4.	1.01	14.10	85	.04	.04	.00	12.
1.01	2.20	14	.01	.01	-.00	4.	1.01	14.20	86	.04	.04	-.00	12.
1.01	2.30	15	.01	.01	-.00	4.	1.01	14.30	87	.04	.04	.00	12.
1.01	2.40	16	.01	.01	-.00	4.	1.01	14.40	88	.04	.04	-.00	12.
1.01	2.50	17	.01	.01	-.00	4.	1.01	14.50	89	.04	.04	-.00	12.
1.01	3.00	18	.01	.01	.00	4.	1.01	15.00	90	.04	.04	.00	12.
1.01	3.10	19	.01	.01	.00	4.	1.01	15.10	91	.03	.03	-.00	9.
1.01	3.20	20	.01	.01	.00	4.	1.01	15.20	92	.03	.03	.00	8.
1.01	3.30	21	.01	.01	.00	4.	1.01	15.30	93	.03	.03	.00	8.
1.01	3.40	22	.01	.01	.00	4.	1.01	15.40	94	.03	.03	-.00	7.
1.01	3.50	23	.01	.01	.00	4.	1.01	15.50	95	.03	.03	.00	7.
1.01	4.00	24	.01	.01	.00	4.	1.01	16.00	96	.03	.03	.00	7.
1.01	4.10	25	.01	.01	.00	4.	1.01	16.10	97	.03	.03	-.00	7.
1.01	4.20	26	.01	.01	.00	4.	1.01	16.20	98	.03	.03	.00	7.
1.01	4.30	27	.01	.01	.00	4.	1.01	16.30	99	.03	.03	-.00	7.
1.01	4.40	28	.01	.01	.00	4.	1.01	16.40	100	.03	.03	.00	7.
1.01	4.50	29	.01	.01	.00	4.	1.01	16.50	101	.03	.03	.00	7.
1.01	5.00	30	.01	.01	-.00	4.	1.01	17.00	102	.03	.03	.00	7.
1.01	5.10	31	.01	.01	.00	4.	1.01	17.10	103	.03	.03	.00	7.
1.01	5.20	32	.01	.01	-.00	4.	1.01	17.20	104	.03	.03	.00	7.
1.01	5.30	33	.01	.01	.00	4.	1.01	17.30	105	.03	.03	.00	7.
1.01	5.40	34	.01	.01	-.00	4.	1.01	17.40	106	.03	.03	.00	7.
1.01	5.50	35	.01	.01	.00	4.	1.01	17.50	107	.03	.03	-.00	7.
1.01	6.00	36	.01	.01	.00	4.	1.01	18.00	108	.03	.03	.00	7.
1.01	6.10	37	.03	.03	.00	6.	1.01	18.10	109	.01	.01	-.00	5.
1.01	6.20	38	.03	.03	.00	7.	1.01	18.20	110	.01	.01	-.00	4.
1.01	6.30	39	.03	.03	.00	7.	1.01	18.30	111	.01	.01	-.00	4.
1.01	6.40	40	.03	.03	.00	7.	1.01	18.40	112	.01	.01	-.00	4.
1.01	6.50	41	.03	.03	.00	7.	1.01	18.50	113	.01	.01	-.00	4.
1.01	7.00	42	.03	.03	.00	7.	1.01	19.00	114	.01	.01	.00	4.
1.01	7.10	43	.03	.03	.00	7.	1.01	19.10	115	.01	.01	-.00	4.
1.01	7.20	44	.03	.03	.00	7.	1.01	19.20	116	.01	.01	-.00	4.

1.01	7.30	45	.03	.03	.00	7.	1.01	19.30	117	.01	.01	-.00	0.
1.01	7.40	46	.03	.03	-.00	7.	1.01	19.40	118	.01	.01	-.00	0.
1.01	7.50	47	.03	.03	.00	7.	1.01	19.50	119	.01	.01	-.00	0.
1.01	8.00	48	.03	.03	.00	7.	1.01	20.00	120	.01	.01	.00	0.
1.01	8.10	49	.03	.03	.00	7.	1.01	20.10	121	.01	.01	-.00	0.
1.01	8.20	50	.03	.03	-.00	7.	1.01	20.20	122	.01	.01	.00	0.
1.01	8.30	51	.03	.03	.00	7.	1.01	20.30	123	.01	.01	-.00	0.
1.01	8.40	52	.03	.03	.00	7.	1.01	20.40	124	.01	.01	-.00	0.
1.01	8.50	53	.03	.03	.00	7.	1.01	20.50	125	.01	.01	.00	0.
1.01	9.00	54	.03	.03	.00	7.	1.01	21.00	126	.01	.01	-.00	0.
1.01	9.10	55	.04	.04	.00	10.	1.01	21.10	127	.01	.01	-.00	0.
1.01	9.20	56	.04	.04	.00	11.	1.01	21.20	128	.01	.01	.00	0.
1.01	9.30	57	.04	.04	.00	12.	1.01	21.30	129	.01	.01	-.00	0.
1.01	9.40	58	.04	.04	.00	12.	1.01	21.40	130	.01	.01	-.00	0.
1.01	9.50	59	.04	.04	.00	12.	1.01	21.50	131	.01	.01	-.00	0.
1.01	10.00	60	.04	.04	.00	12.	1.01	22.00	132	.01	.01	-.00	0.
1.01	10.10	61	.04	.04	.00	12.	1.01	22.10	133	.01	.01	.00	0.
1.01	10.20	62	.04	.04	.00	12.	1.01	22.20	134	.01	.01	-.00	0.
1.01	10.30	63	.04	.04	.00	12.	1.01	22.30	135	.01	.01	-.00	0.
1.01	10.40	64	.06	.06	.00	15.	1.01	22.40	136	.01	.01	-.00	0.
1.01	10.50	65	.06	.06	-.00	16.	1.01	22.50	137	.01	.01	-.00	0.
1.01	11.00	66	.06	.06	.00	16.	1.01	23.00	138	.01	.01	.00	0.
1.01	11.10	67	.12	.12	0.00	27.	1.01	23.10	139	.01	.01	-.00	0.
1.01	11.20	68	.12	.12	0.00	31.	1.01	23.20	140	.01	.01	-.00	0.
1.01	11.30	69	.12	.12	.00	32.	1.01	23.30	141	.01	.01	.00	0.
1.01	11.40	70	.26	.26	.00	58.	1.01	23.40	142	.01	.01	-.00	0.
1.01	11.50	71	.38	.38	-.00	89.	1.01	23.50	143	.01	.01	-.00	0.
1.01	12.00	72	.80	.80	-.00	174.	1.02	0.00	144	.01	.01	.00	0.
									SUM	7.21	7.21	.00	1929.
										(183.)(	183.)(	0.)(	54.62)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	277.	38.	13.	13.	1922.
CMS	8.	1.	0.	0.	54.
INCHES		5.19	7.20	7.21	7.20
CM		131.79	182.81	182.99	182.88
AC-FT		19.	26.	26.	26.
THOUS CU M		24.	33.	33.	33.

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

HYDROGRAPH ROUTING

ROUTING THROUGH CLOSED SYSTEM

ISTAG	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
ROUTING	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	0	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-999.	-1

STAGE	930.30	931.10	932.20	933.40	934.50	935.70	936.60
FLOW	0.00	124.00	963.00	2760.00	6400.00	12990.00	21900.00
SURFACE AREA=	0.	6.	20.	31.	39.	43.	
CAPACITY=	0.	4.	27.	78.	147.	228.	
ELEVATION=	928.	930.	932.	934.	936.	938.	

CREL	SPWID	COOW	EXPW	ELEVL	COGL	CAREA	EXPL
930.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
930.3	0.0	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	UNOFF	277.	38.	13.	13.	.07
		(7.84)(	1.09)(	.38)(	.38)(	.18)
ROUTED TO	OUTING	115.	37.	11.	11.	.07
		(3.25)(	1.04)(	.30)(	.30)(	.18)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 100-year

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	929.00	930.30	930.30
STORAGE	0.	6.	6.
OUTFLOW	0.	0.	0.

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
931.04	.74	12.	115.	13.17	12.50	0.00

```
A1   DRESSER NO 1  ID NO 31117
A2   HEC-1  PHASE 1  DAM SAFETY INVESTIGATION
A3   TEN-YR ROUTING THROUGH CLOSED SYSTEM
B    144                10                                    0
B1     3
K      0 RUNOFF                                          1        1
K1   TEN-YR RUNOFF FROM ENCLOSED AREA - DRESSER NO 1 ID NO 31117
M      0        2    .069
O    144
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     .020     .020     .020     .020
O1  .020     .020     .020     .020     .020     .020     .020     .020     .020     .020
O1  .020     .020     .020     .020     .030     .030     .030     .030     .030     .030
O1  .030     .030     .030     .062     .062     .062     .098     .098     .098     .172
O1  .249     .538     .846     .249     .172     .098     .098     .098     .062     .062
O1  .062     .030     .030     .030     .030     .030     .030     .030     .030     .030
O1  .020     .020     .020     .020     .020     .020     .020     .020     .020     .020
O1  .020     .020     .020     .020     .020     .020     .020     .020     .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
T                                                          -1     -100
W2           0.10
X   -.01    -.01      1.
K      1 ROUTING                                         1        1
K1   ROUTING THROUGH CLOSED SYSTEM
Y                                 1
Y1     1                                                  -929       -1
Y4 930.3   931.1    932.2    933.4    934.5    935.7    936.8
Y5     0     124      963     2760     6400    12490    21900
$A    .0     5.5     19.8     30.8     38.5     42.5
$E   928     930      932      934      936      938
$$ 930.3
$D 930.3
K     99
A
```

****
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 28 FEB 79
****

RUN DATE= 79/11/24.
TIME= 16.35.11.

DRESSER NO 1 ID NO 31117
HEC-1 PHASE 1 DAM SAFETY INVESTIGATION
TEN-YR ROUTING THROUGH CLOSED SYSTEM

JOB SPECIFICATION

NQ	NRR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
144	0	10	0	0	0	0	0	0	0
			JOPER	NWT	LROPT	IPACE			
			3	0	0	0			

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

SUB-AREA RUNOFF COMPUTATION

TEN-YR RUNOFF FROM ENCLOSED AREA - DRESSER NO 1 ID NO 31117

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

HYDROGRAPH DATA

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

PRECIP DATA

NP	STORM	DAJ	DAK
144	0.00	0.00	0.00

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	.02	.02	.02	.02
.02	.02	.02	.02	.02	.02	.02	.02	.02	.02
.02	.02	.02	.02	.03	.03	.03	.03	.03	.03
.03	.03	.03	.06	.06	.06	.10	.10	.10	.17
.25	.54	.55	.25	.17	.10	.10	.10	.06	.06
.06	.03	.03	.03	.03	.03	.03	.03	.03	.03
.02	.02	.02	.02	.02	.02	.02	.02	.02	.02
.02	.02	.02	.02	.02	.02	.02	.02	.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						

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOR	STRTL	CNSTL	ALSMS	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	-1.	-1000.0	0.0	0.0

CURVE NO = =100.00 RETNESS = =1. ; 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--(DTHR IS GT LAG/2)

UNIT HYDROGRAPH 5 END OF PERIOD ORDINATES, TC= 0.00 HOURS, LAG= .10 VOL= 1.00
179. 68. 16. 4. 1.

0 HO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	END-OF-PERIOD FLOW COMP Q	HO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
1.01	.10	1	.01	.01	0.00	2.	1.01	12.10	73	.05	.05	=.00	192.
1.01	.20	2	.01	.01	0.00	2.	1.01	12.20	74	.05	.05	=.00	112.
1.01	.30	3	.01	.01	0.00	3.	1.01	12.30	75	.17	.17	.00	63.
1.01	.40	4	.01	.01	0.00	3.	1.01	12.40	76	.10	.10	.00	37.
1.01	.50	5	.01	.01	0.00	3.	1.01	12.50	77	.10	.10	.00	23.
1.01	1.00	6	.01	.01	0.00	3.	1.01	13.00	78	.10	.10	.00	27.
1.01	1.10	7	.01	.01	.00	3.	1.01	13.10	79	.06	.06	.00	20.
1.01	1.20	8	.01	.01	=.00	3.	1.01	13.20	80	.06	.06	=.00	17.
1.01	1.30	9	.01	.01	=.00	3.	1.01	13.30	81	.06	.06	=.00	17.
1.01	1.40	10	.01	.01	=.00	3.	1.01	13.40	82	.03	.03	.00	11.
1.01	1.50	11	.01	.01	=.00	3.	1.01	13.50	83	.03	.03	=.00	4.
1.01	2.00	12	.01	.01	=.00	3.	1.01	14.00	84	.03	.03	=.00	8.
1.01	2.10	13	.01	.01	.00	3.	1.01	14.10	85	.03	.03	=.00	8.
1.01	2.20	14	.01	.01	.00	3.	1.01	14.20	86	.03	.03	=.00	8.
1.01	2.30	15	.01	.01	.00	3.	1.01	14.30	87	.03	.03	=.00	8.
1.01	2.40	16	.01	.01	.00	3.	1.01	14.40	88	.03	.03	=.00	8.
1.01	2.50	17	.01	.01	.00	3.	1.01	14.50	89	.03	.03	=.00	8.
1.01	3.00	18	.01	.01	.00	3.	1.01	15.00	90	.03	.03	=.00	8.
1.01	3.10	19	.01	.01	=.00	3.	1.01	15.10	91	.02	.02	=.00	6.
1.01	3.20	20	.01	.01	.00	3.	1.01	15.20	92	.02	.02	=.00	6.
1.01	3.30	21	.01	.01	=.00	3.	1.01	15.30	93	.02	.02	=.00	5.
1.01	3.40	22	.01	.01	.00	3.	1.01	15.40	94	.02	.02	=.00	5.
1.01	3.50	23	.01	.01	.00	3.	1.01	15.50	95	.02	.02	=.00	5.
1.01	4.00	24	.01	.01	=.00	3.	1.01	16.00	96	.02	.02	=.00	5.
1.01	4.10	25	.01	.01	.00	3.	1.01	16.10	97	.02	.02	=.00	5.
1.01	4.20	26	.01	.01	.00	3.	1.01	16.20	98	.02	.02	.00	5.
1.01	4.30	27	.01	.01	=.00	3.	1.01	16.30	99	.02	.02	=.00	5.
1.01	4.40	28	.01	.01	.00	3.	1.01	16.40	100	.02	.02	=.00	5.
1.01	4.50	29	.01	.01	=.00	3.	1.01	16.50	101	.02	.02	=.00	5.
1.01	5.00	30	.01	.01	.00	3.	1.01	17.00	102	.02	.02	.00	5.
1.01	5.10	31	.01	.01	=.00	3.	1.01	17.10	103	.02	.02	=.00	5.
1.01	5.20	32	.01	.01	.00	3.	1.01	17.20	104	.02	.02	=.00	5.
1.01	5.30	33	.01	.01	.00	3.	1.01	17.30	105	.02	.02	=.00	5.
1.01	5.40	34	.01	.01	.00	3.	1.01	17.40	106	.02	.02	=.00	5.
1.01	5.50	35	.01	.01	.00	3.	1.01	17.50	107	.02	.02	.00	5.
1.01	6.00	36	.01	.01	.00	3.	1.01	18.00	108	.02	.02	=.00	5.
1.01	6.10	37	.02	.02	=.00	4.	1.01	18.10	109	.01	.01	.00	4.
1.01	6.20	38	.02	.02	.00	5.	1.01	18.20	110	.01	.01	.00	3.
1.01	6.30	39	.02	.02	=.00	5.	1.01	18.30	111	.01	.01	.00	3.
1.01	6.40	40	.02	.02	.00	5.	1.01	18.40	112	.01	.01	=.00	3.
1.01	6.50	41	.02	.02	.00	5.	1.01	18.50	113	.01	.01	.00	3.
1.01	7.00	42	.02	.02	.00	5.	1.01	19.00	114	.01	.01	.00	3.
1.01	7.10	43	.02	.02	=.00	5.	1.01	19.10	115	.01	.01	.00	3.
1.01	7.20	44	.02	.02	.00	5.	1.01	19.20	116	.01	.01	.00	3.

1.01	7.30	45	.02	.02	-.00	5.	1.01	19.30	117	.01	.01	.00	3.
1.01	7.40	46	.02	.02	.00	5.	1.01	19.40	118	.01	.01	.00	3.
1.01	7.50	47	.02	.02	.00	5.	1.01	19.50	119	.01	.01	.00	3.
1.01	8.00	48	.02	.02	.00	5.	1.01	20.00	120	.01	.01	.00	3.
1.01	8.10	49	.02	.02	.00	5.	1.01	20.10	121	.01	.01	.00	3.
1.01	8.20	50	.02	.02	.00	5.	1.01	20.20	122	.01	.01	-.00	3.
1.01	8.30	51	.02	.02	.00	5.	1.01	20.30	123	.01	.01	.00	3.
1.01	8.40	52	.02	.02	.00	5.	1.01	20.40	124	.01	.01	-.00	3.
1.01	8.50	53	.02	.02	.00	5.	1.01	20.50	125	.01	.01	.00	3.
1.01	9.00	54	.02	.02	.00	5.	1.01	21.00	126	.01	.01	.00	3.
1.01	9.10	55	.03	.03	.00	7.	1.01	21.10	127	.01	.01	.00	3.
1.01	9.20	56	.03	.03	-.00	6.	1.01	21.20	128	.01	.01	.00	3.
1.01	9.30	57	.03	.03	.00	8.	1.01	21.30	129	.01	.01	.00	3.
1.01	9.40	58	.03	.03	-.00	8.	1.01	21.40	130	.01	.01	.00	3.
1.01	9.50	59	.03	.03	-.00	8.	1.01	21.50	131	.01	.01	.00	3.
1.01	10.00	60	.03	.03	-.00	8.	1.01	22.00	132	.01	.01	.00	3.
1.01	10.10	61	.03	.03	.00	8.	1.01	22.10	133	.01	.01	-.00	3.
1.01	10.20	62	.03	.03	-.00	8.	1.01	22.20	134	.01	.01	.00	3.
1.01	10.30	63	.03	.03	-.00	8.	1.01	22.30	135	.01	.01	.00	3.
1.01	10.40	64	.06	.06	.00	14.	1.01	22.40	136	.01	.01	.00	3.
1.01	10.50	65	.06	.06	.00	16.	1.01	22.50	137	.01	.01	.00	3.
1.01	11.00	66	.06	.06	.00	16.	1.01	23.00	138	.01	.01	.00	3.
1.01	11.10	67	.10	.10	-.00	23.	1.01	23.10	139	.01	.01	.00	3.
1.01	11.20	68	.10	.10	.00	25.	1.01	23.20	140	.01	.01	.00	3.
1.01	11.30	69	.10	.10	.00	26.	1.01	23.30	141	.01	.01	.00	3.
1.01	11.40	70	.17	.17	.00	39.	1.01	23.40	142	.01	.01	.00	3.
1.01	11.50	71	.25	.25	-.00	58.	1.01	23.50	143	.01	.01	.00	3.
1.01	12.00	72	.54	.54	.00	116.	1.02	0.00	144	.01	.01	.00	3.
									SUM	5.17	5.17	.00	1389.
										(131.)(	131.)(	0.)(	39.33)

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	192.	28.	10.	10.	1376.
CMS	5.	1.	0.	0.	39.
INCHES		3.72	5.15	5.15	5.15
MM		94.49	130.91	130.91	130.91
AC-FT		14.	19.	19.	19.
THOUS CU M		17.	23.	23.	23.

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

HYDROGRAPH ROUTING

ROUTING THROUGH CLOSED SYSTEM

ISTAJ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
OUTING	1	0	0	0	1	1	0	0

ROUTING DATA

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

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-929.	-1

STAGE	930.30	931.10	932.20	933.40	934.50	935.70	936.80
FLOW	0.00	124.00	963.00	2760.00	6400.00	12990.00	21900.00
SURFACE AREA=	0.	6.	20.	31.	39.	43.	
CAPACITY=	0.	4.	27.	78.	147.	228.	
ELEVATION=	928.	930.	932.	934.	936.	938.	

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
930.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
930.3	0.0	0.0	0.

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

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

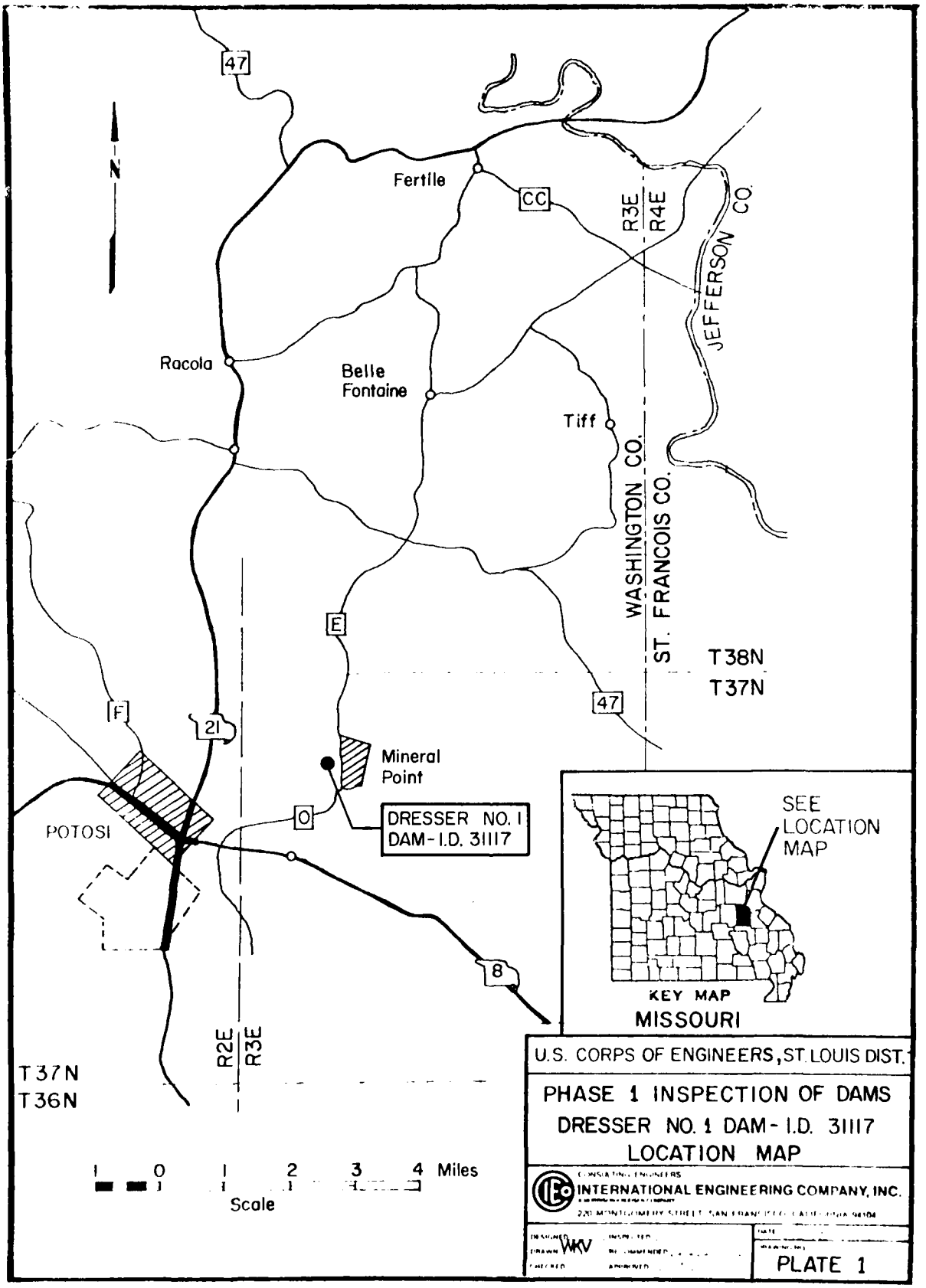
		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	RUNOFF	192.	28.	10.	10.	.07
		(5.45)(	.78)(	.27)(	.27)(	.18)
ROUTED TO	ROUTING	78.	24.	7.	7.	.07
		(2.21)(	.67)(	.19)(	.19)(	.18)

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 10-year

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	929.00	930.30	930.30
STORAGE	0.	6.	6.
OUTFLOW	0.	0.	0.

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
930.80	.50	10.	78.	12.50	12.50	0.00



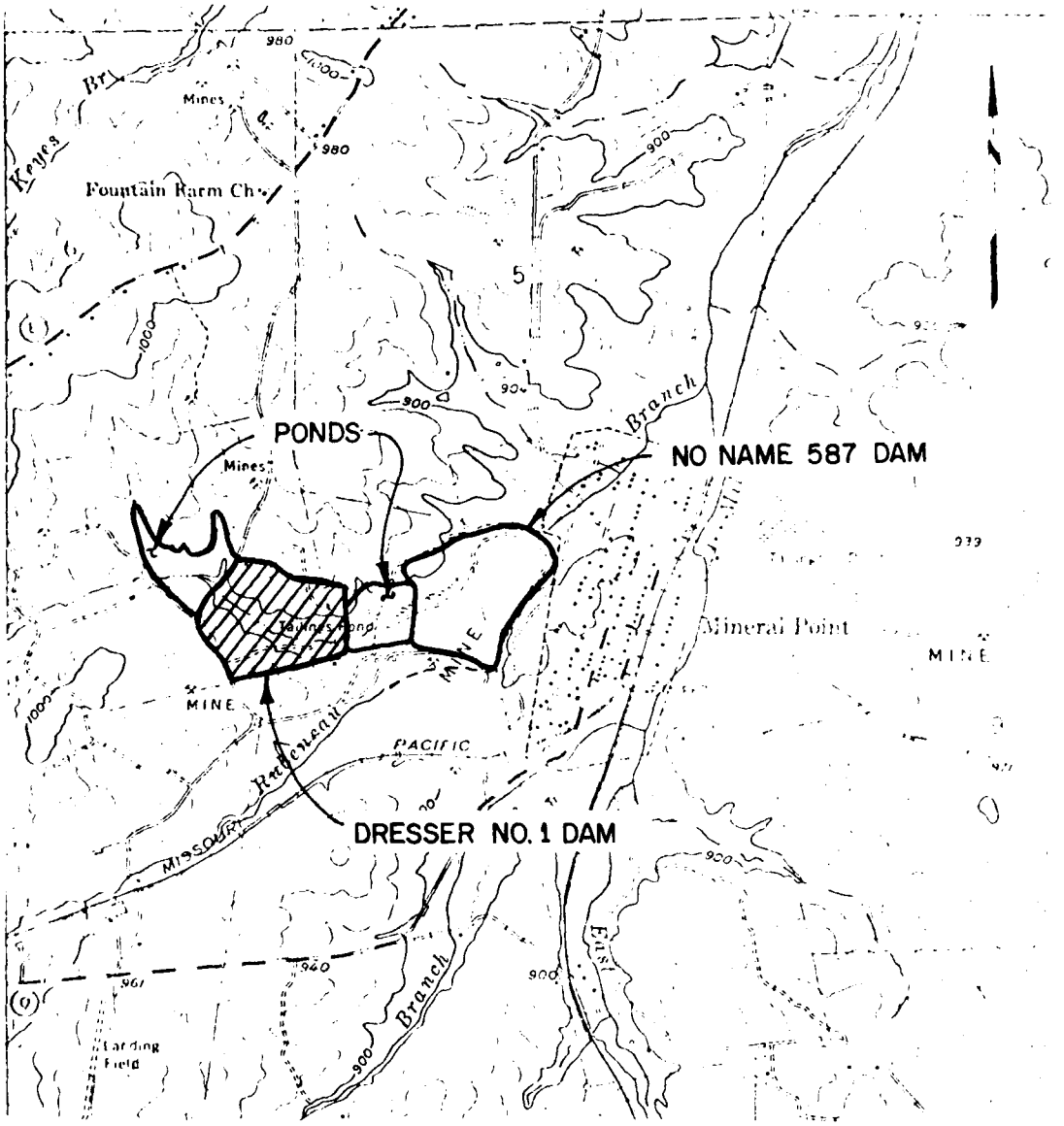
U.S. CORPS OF ENGINEERS, ST. LOUIS DIST.

PHASE 1 INSPECTION OF DAMS
DRESSER NO. 1 DAM - I.D. 31117
LOCATION MAP

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

DESIGNED WKV INSPECTED
DRAWN RECOMMENDED
CHECKED APPROVED
DATE

PLATE 1

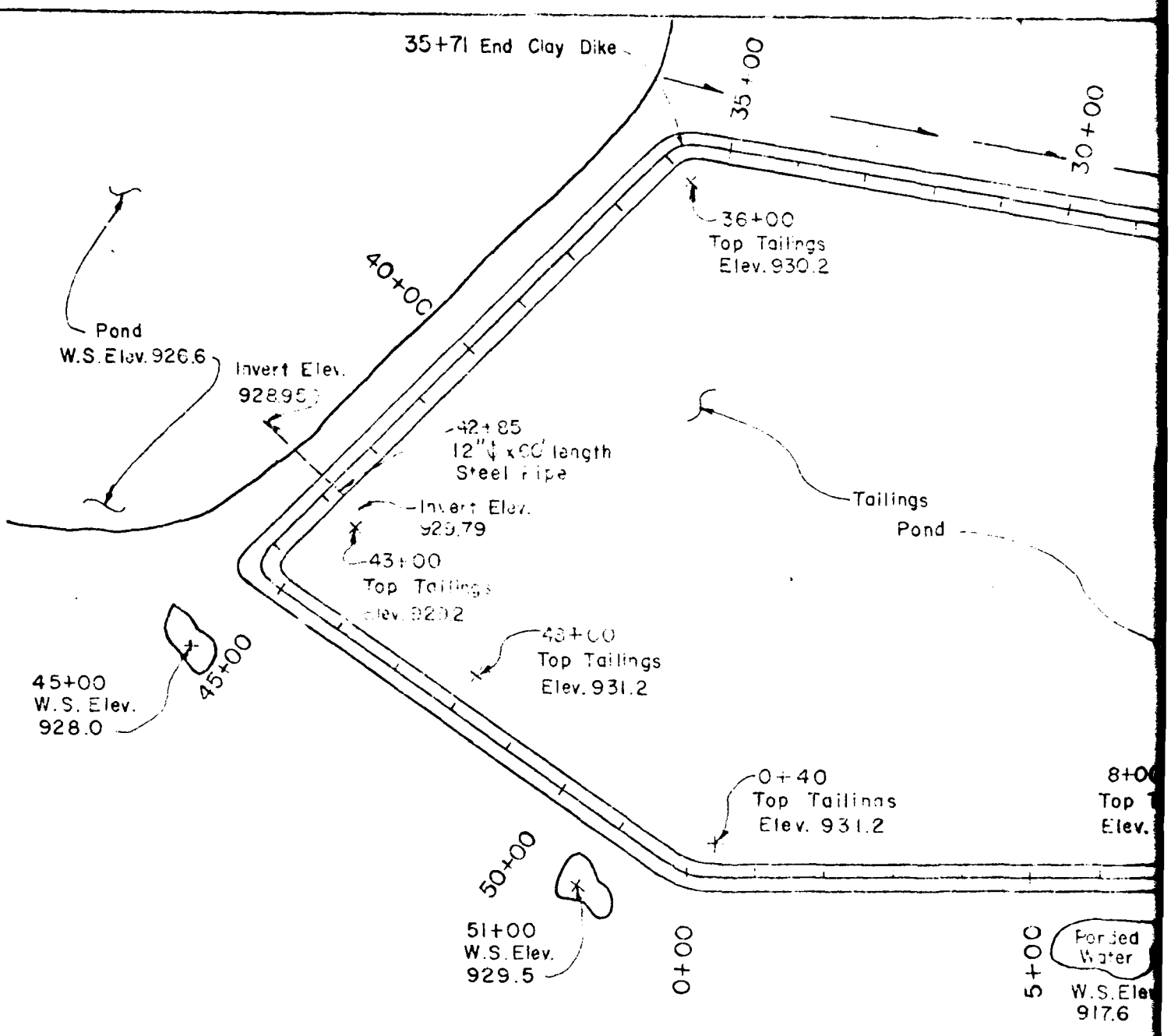


U.S. CORPS OF ENGINEERS, ST. LOUIS DIST.

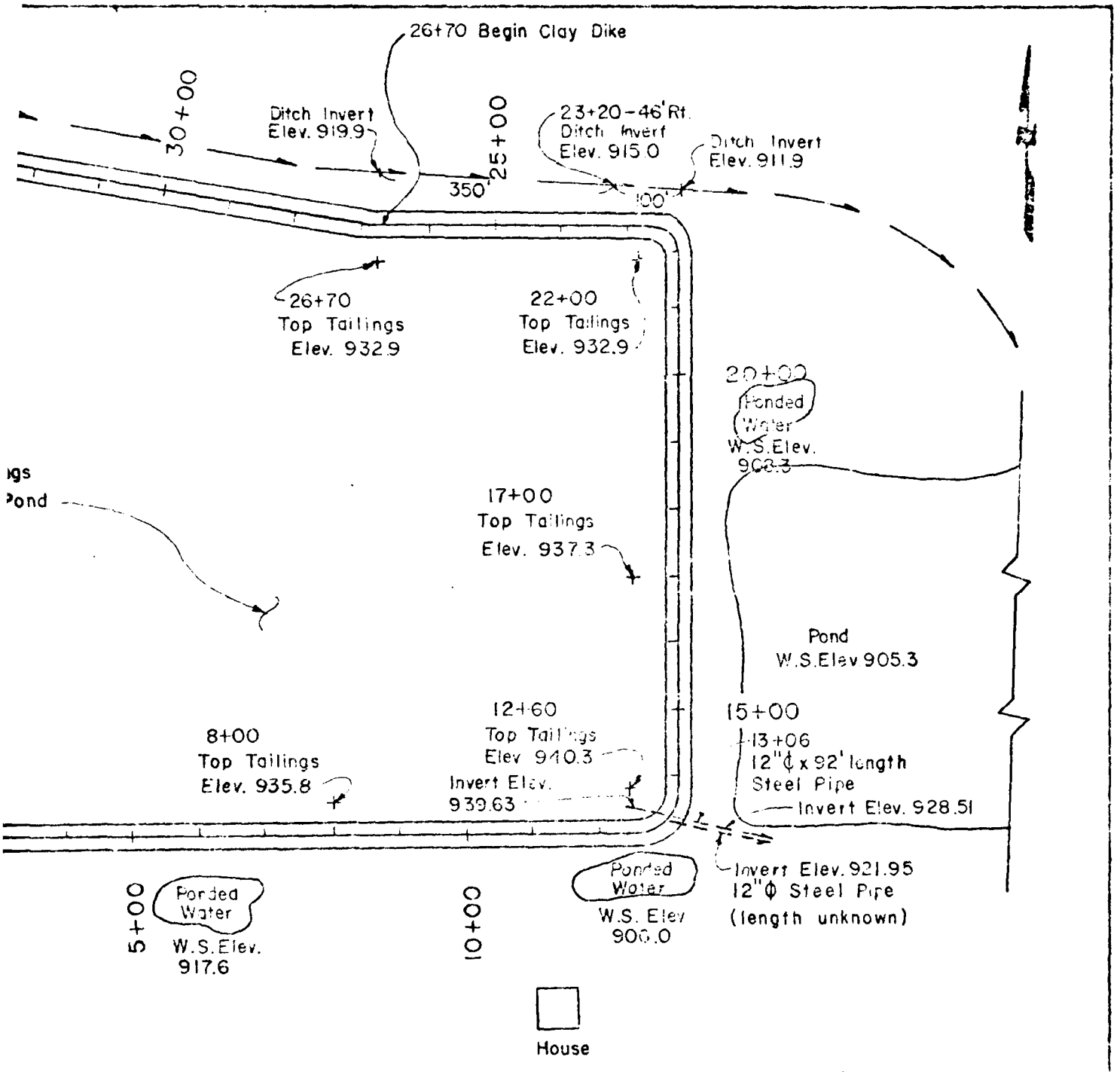
PHASE I INSPECTION OF DAMS
DRESSER NO. 1 DAM-I.D. 31117
VICINITY TOPOGRAPHY

INTERNATIONAL ENGINEERING COMPANY, INC.

PLATE 2



Bench Mark – R.R. Spike in 8" Tree,
S.W. Corner of Tailings Pond,
30' Left of Sta. 0+40 ℄
Elev. = 932.00
Date of Survey : 4-2-79



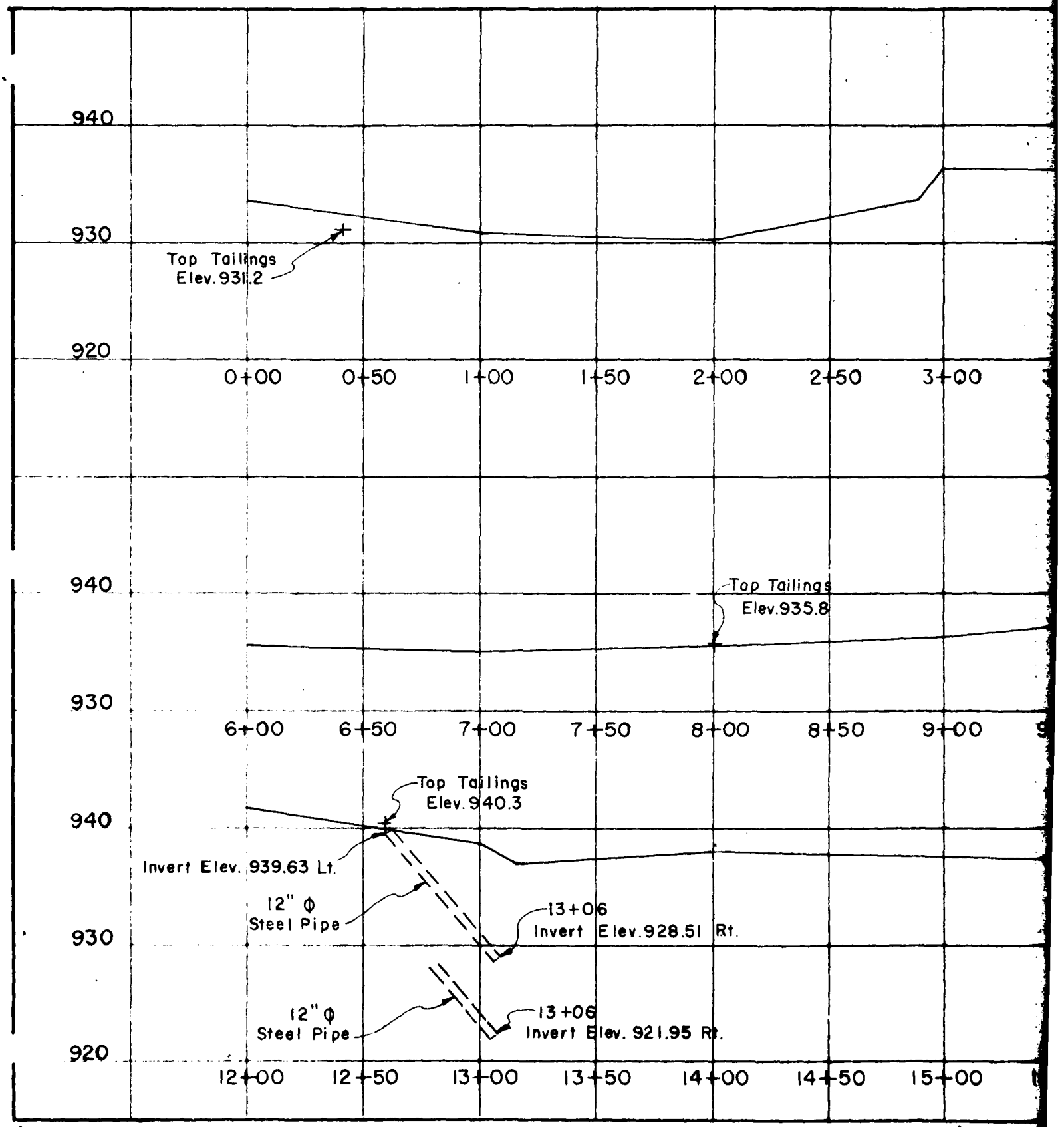
DAM I.D. NO. 31117
DRESSER NO. 1

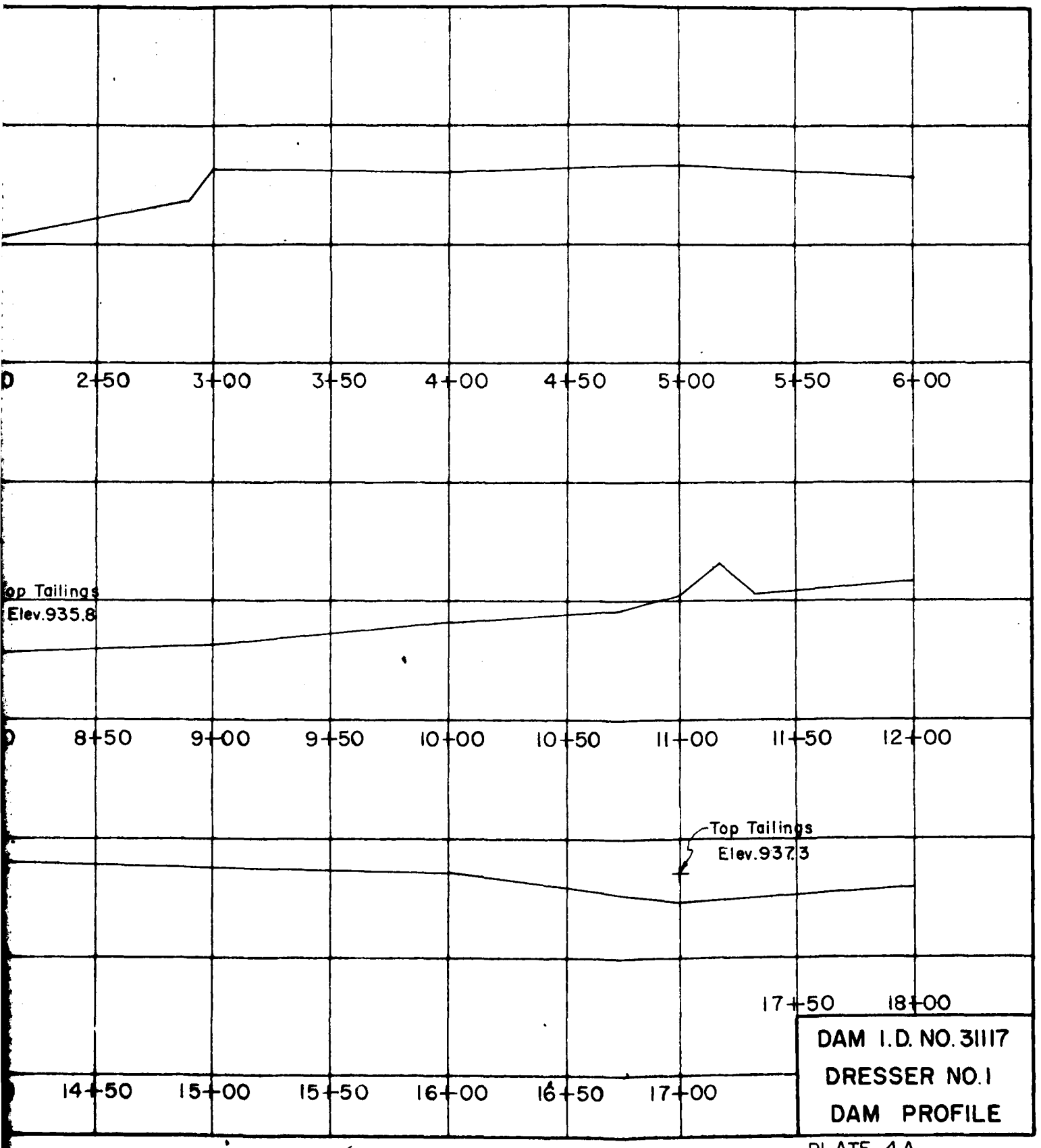
PLAN

SCALE IN FEET

200 100 0 200

PLATE 3

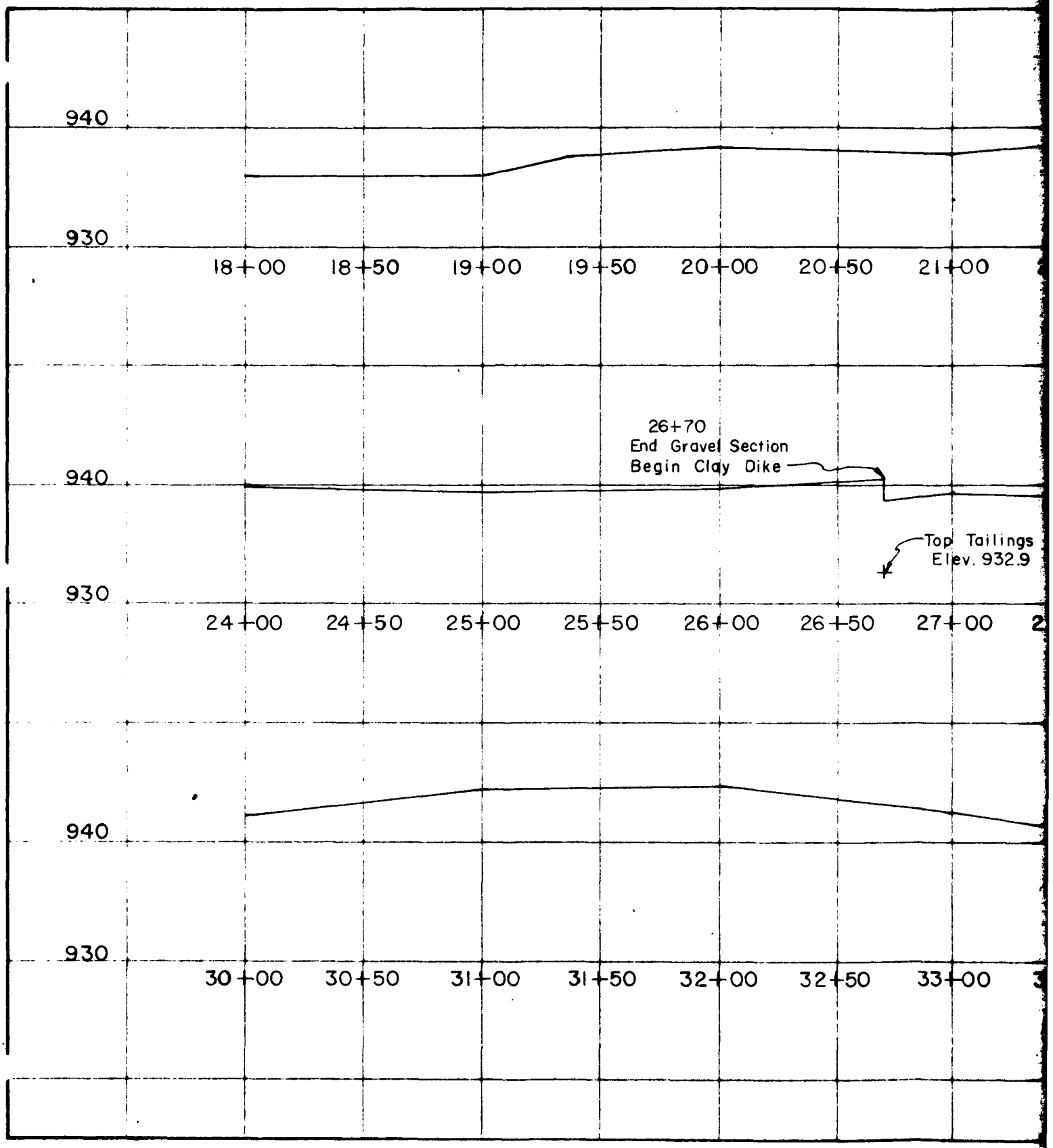

940
930
920
Top Tailings
Elev. 931.2
0+00
0+50
1+00
1+50
2+00
2+50
3+00
940
930
Top Tailings
Elev. 935.8
6+00
6+50
7+00
7+50
8+00
8+50
9+00
940
930
920
Top Tailings
Elev. 940.3
Invert Elev. 939.63 Lt.
12" ϕ
Steel Pipe
13+06
Invert Elev. 928.51 Rt.
12" ϕ
Steel Pipe
13+06
Invert Elev. 921.95 Rt.
12+00
12+50
13+00
13+50
14+00
14+50
15+00

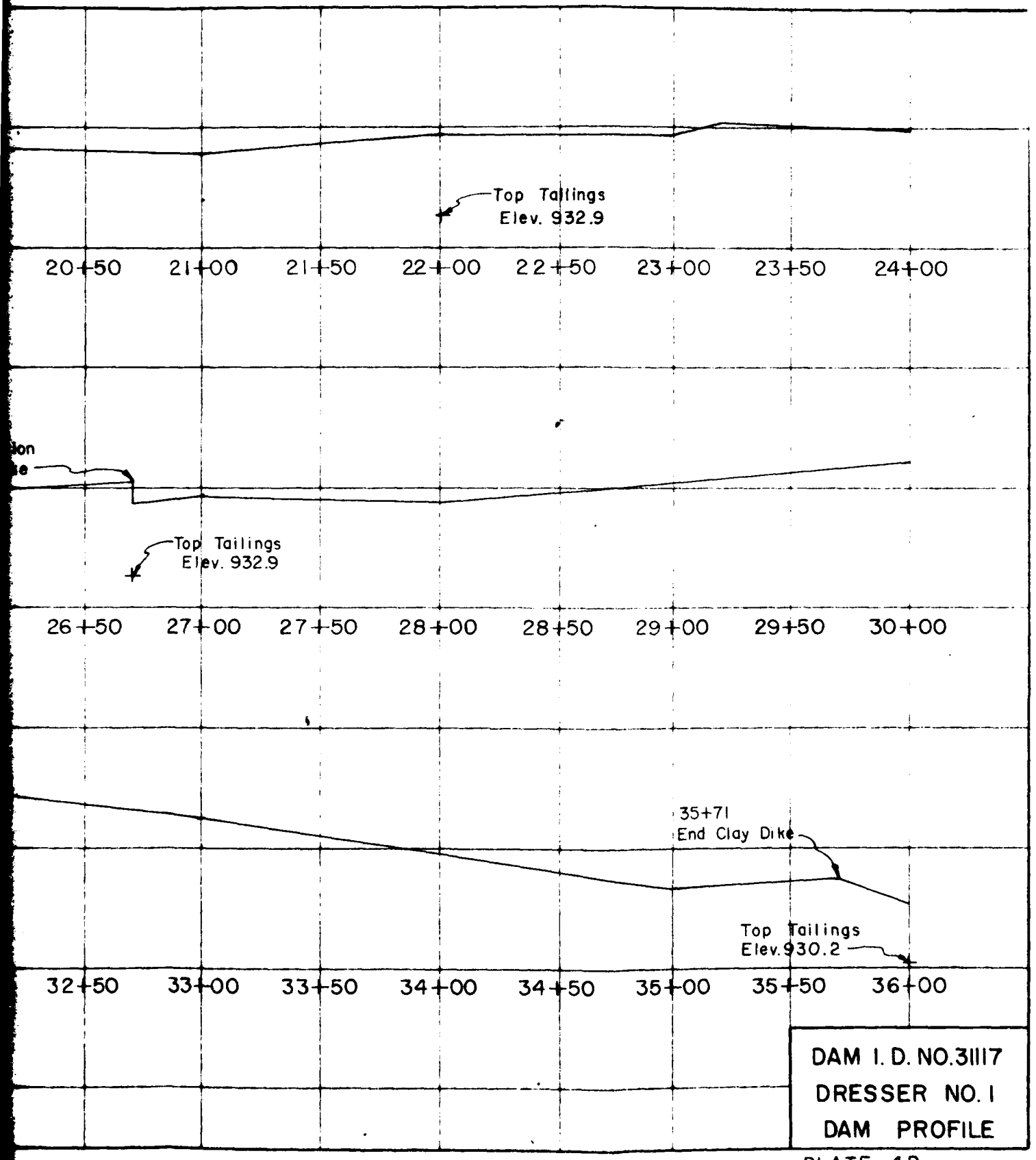


DAM I.D. NO. 31117
DRESSER NO. 1
DAM PROFILE

PLATE 4A

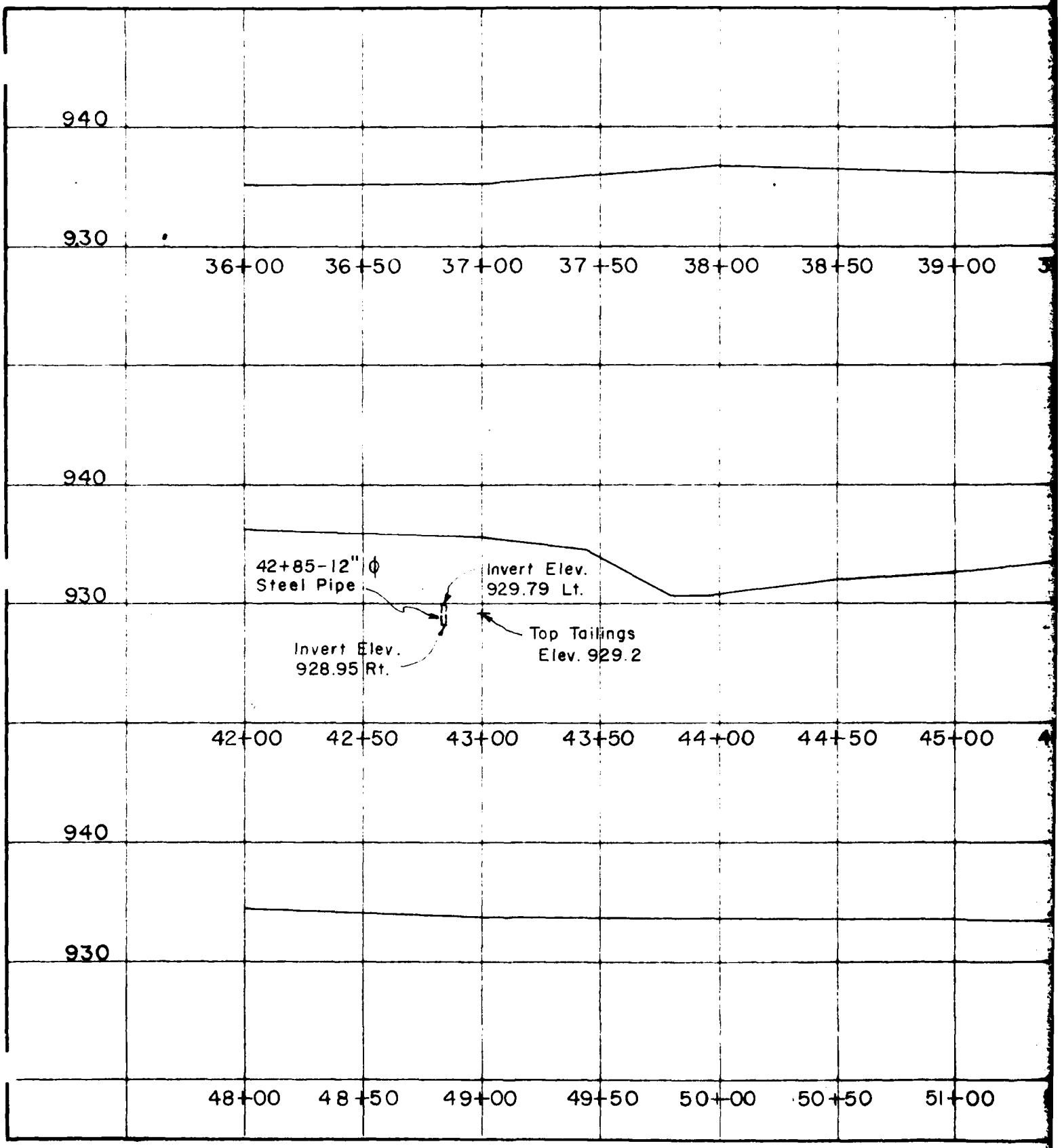
2

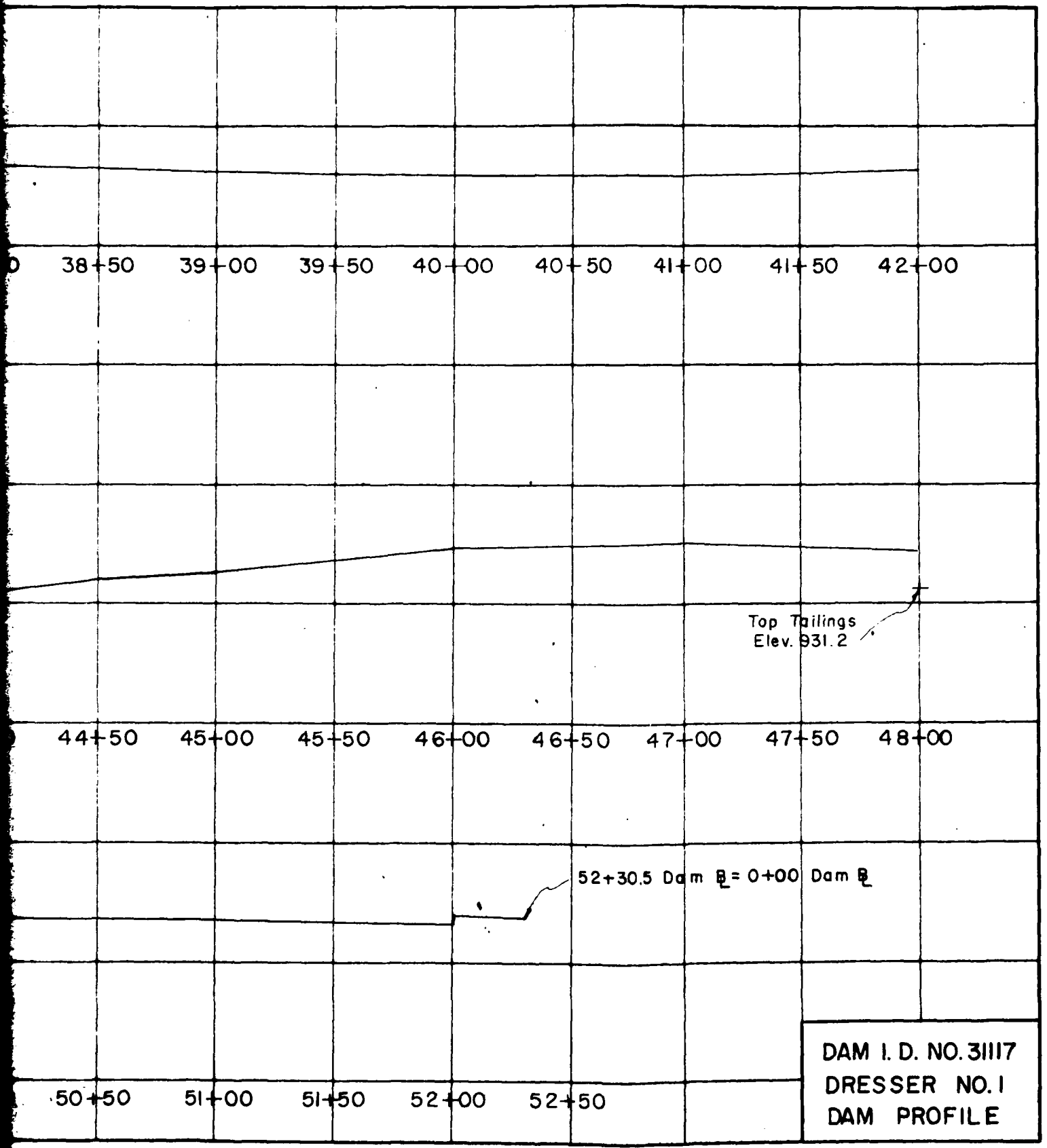

940
930
18+00
18+50
19+00
19+50
20+00
20+50
21+00
26+70
End Gravel Section
Begin Clay Dike
940
Top Tailings
Elev. 932.9
930
24+00
24+50
25+00
25+50
26+00
26+50
27+00
940
930
30+00
30+50
31+00
31+50
32+00
32+50
33+00



DAM I. D. NO. 31117
DRESSER NO. 1
DAM PROFILE

PLATE 4B

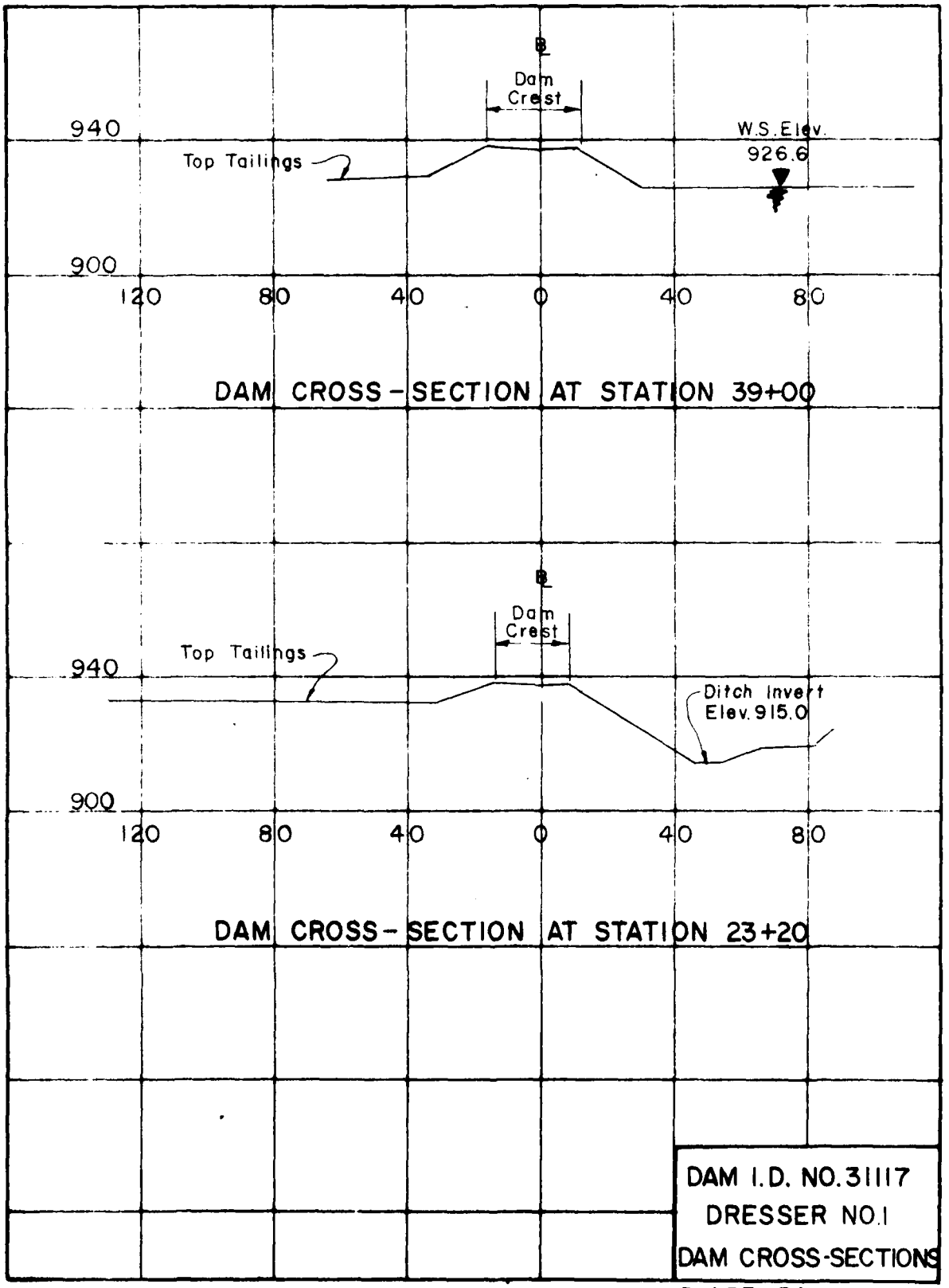

940
930
36+00
36+50
37+00
37+50
38+00
38+50
39+00
940
930
42+85-12" ϕ
Steel Pipe
Invert Elev.
929.79 Lt.
Invert Elev.
928.95 Rt.
Top Tailings
Elev. 929.2
42+00
42+50
43+00
43+50
44+00
44+50
45+00
940
930
48+00
48+50
49+00
49+50
50+00
50+50
51+00



DAM I. D. NO. 31117
DRESSER NO. 1
DAM PROFILE

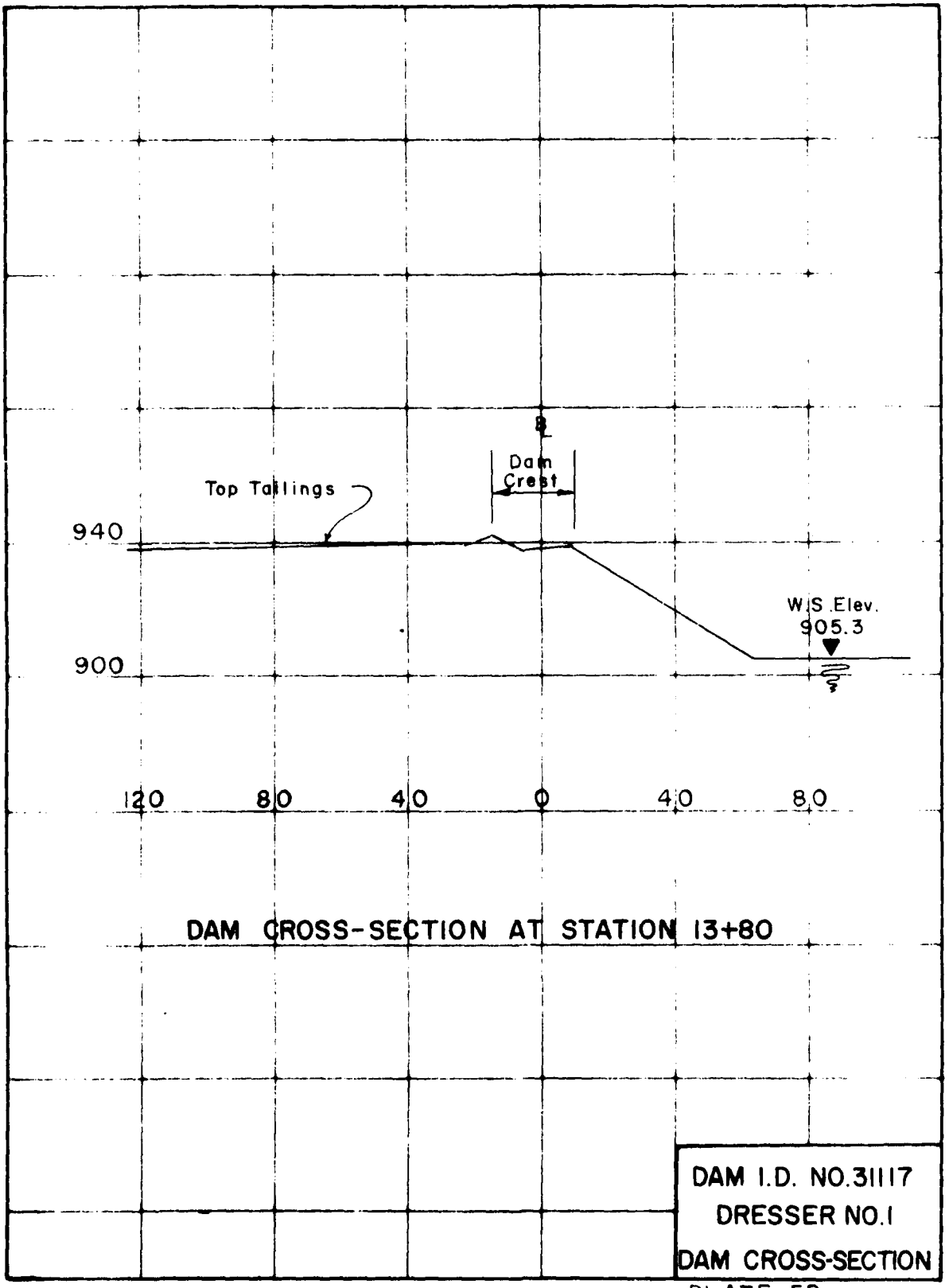
PLATE 4C

12



DAM I.D. NO. 31117
DRESSER NO. 1
DAM CROSS-SECTIONS

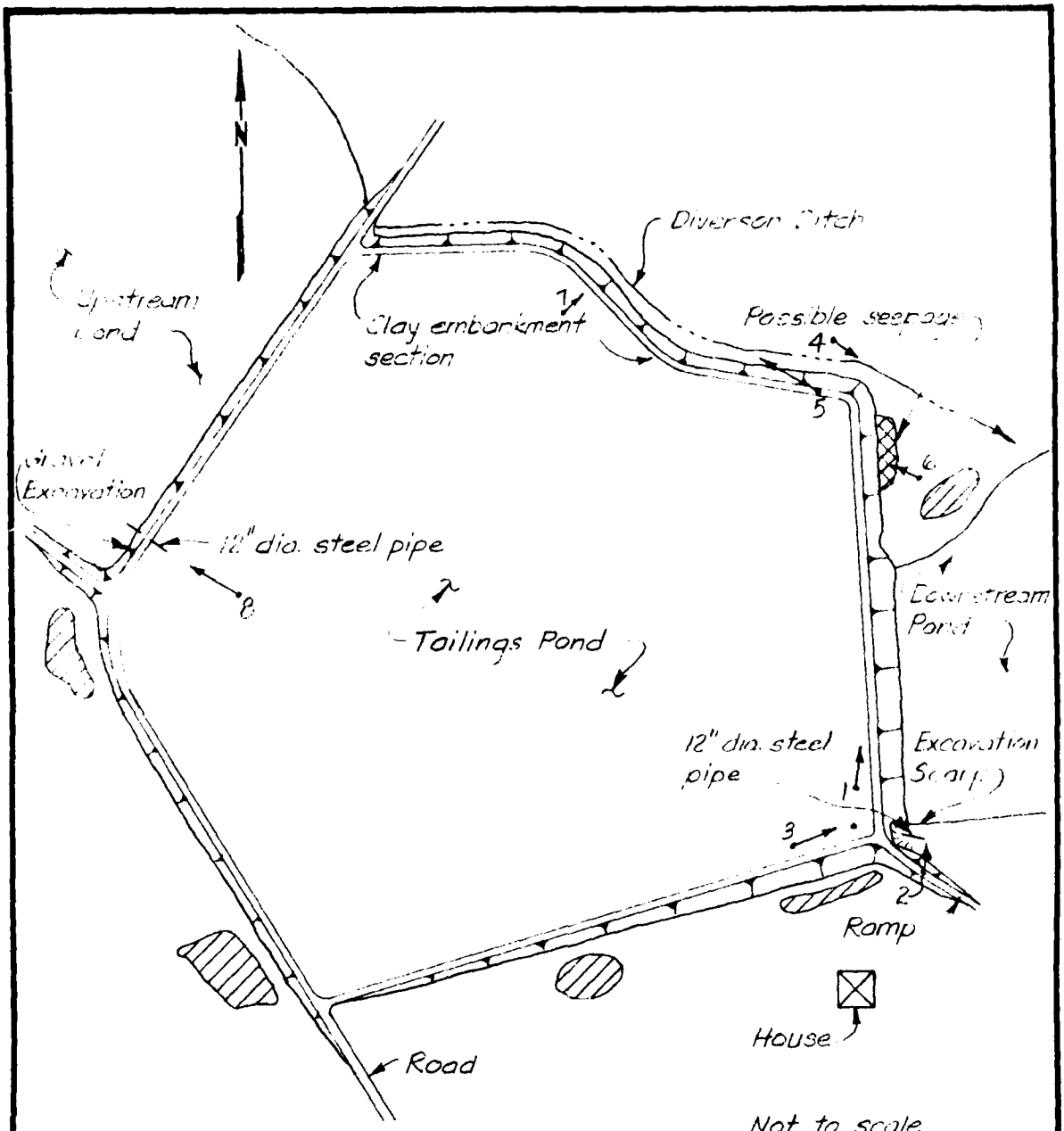
PLATE 5A



DAM CROSS-SECTION AT STATION 13+80

DAM I.D. NO.31117
DRESSER NO.1
DAM CROSS-SECTION

PLATE 5B



LEGEND:

- small area of ponded water
- 4 → Photo number and view direction

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

PHASE I INSPECTION OF DAMS
DRESSER NO. 1 DAM - I.D. 31117
PHOTOGRAPH LOCATION MAP

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

DESIGNED ____ INSPECTED AJPF	DATE JUNE 1979
DRAWN W.K.V. RECOMMENDED ____	DRAWING NO.
CHECKED ____ APPROVED EBK	PLATE 6

PHOTOGRAPH RECORD

DRESSER NO. 1 DAM - I.D. NO. 31117

Photo No.	Description
1.	Crest of dam and tailings surface at southeast corner of impoundment.
2.	12-inch diameter steel pipes at southeast corner of impoundment. Gravel excavation has caused the 20-foot ± high scarp below the pipes. Face of embankment and downstream pond are shown in the background.
3.	Inlet end of upper 12-inch diameter steel pipe.
4.	View downstream of diversion ditch at northeast corner of impoundment.
5.	Diversion ditch along north side of impoundment. Scarp was caused by erosion.
6.	Possible seepage at toe of embankment.
7.	Clay embankment section from inside the impoundment.
8.	Inlet end of 12-inch diameter steel pipe at west end of impoundment.

1

2

3

4

5

6

7

8