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NATIONAL DAM SAFETY PROGRAM. HAMILTON CITY WATER PLANT DAM (MO --ETC(U)  
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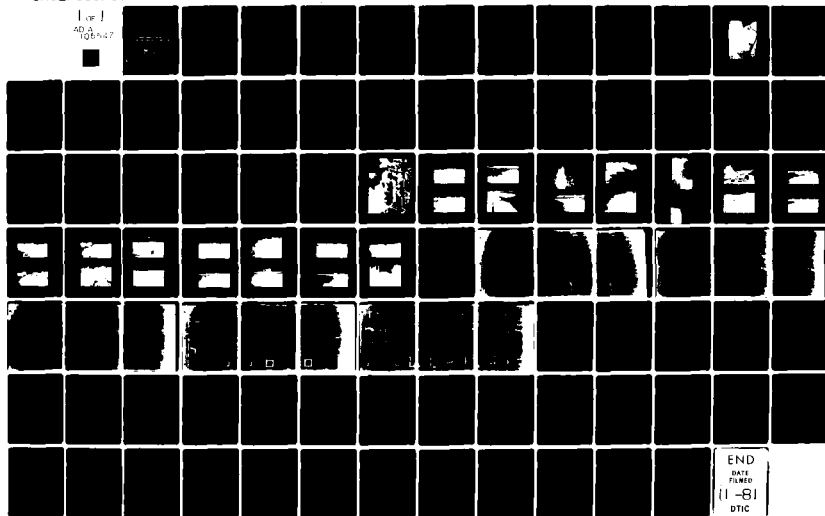
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HAMILTON CITY WATER PLANT DAM

CALDWELL COUNTY, MISSOURI

MO. 10261

# PHASE 1 INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM



United States Army  
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FOR: STATE OF MISSOURI

JULY, 1980

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| REPORT DOCUMENTATION PAGE                                                                                                                                                                                                                                                                                                                                                             |                                            | READ INSTRUCTIONS<br>BEFORE COMPLETING FORM                                       |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------|-----------------------------------------------------------------------------------|
| 1. REPORT NUMBER                                                                                                                                                                                                                                                                                                                                                                      | 2. GOVT ACCESSION NO.<br><i>AD-A105547</i> | 3. RECIPIENT'S CATALOG NUMBER                                                     |
| 4. TITLE (and Subtitle)<br>Phase I Dam Inspection Report<br>National Dam Safety Program<br>Hamilton City Water Plant Dam (MO 10261)<br>Caldwell County, Missouri                                                                                                                                                                                                                      |                                            | 5. TYPE OF REPORT & PERIOD COVERED<br>Final Report                                |
| 7. AUTHOR(s)<br>Hoskins-Western-Sonderegger, Inc.<br><i>Rey S. /Decker Gordon /Jamison<br/>Garold /Ulmer Harold P./Hoskins</i>                                                                                                                                                                                                                                                        |                                            | 6. PERFORMING ORG. REPORT NUMBER                                                  |
| 9. PERFO<br>U.S. Army Engineer District, St. Louis<br>Dam Inventory and Inspection Section, LMSED-PD<br>210 Tucker Blvd., North, St. Louis, Mo. 63101                                                                                                                                                                                                                                 |                                            | 8. CONTRACT OR GRANT NUMBER(s)<br><i>DACW43-80-C-0071</i>                         |
| 11. CONTROLLING OFFICE NAME AND ADDRESS<br>U.S. Army Engineer District, St. Louis<br>Dam Inventory and Inspection Section, LMSED-PD<br>210 Tucker Blvd., North, St. Louis, Mo. 63101                                                                                                                                                                                                  |                                            | 10. PROGRAM ELEMENT, PROJECT, TASK<br>AREA & WORK UNIT NUMBERS<br><i>11 12 13</i> |
| 14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)<br>National Dam Safety Program. Hamilton<br>City Water Plant Dam (MO 10261), Grand<br>- Chariton Basin, Caldwell County,<br>Missouri. Phase I Inspection Report.                                                                                                                                          |                                            | 12. REPORT DATE<br>July 1980                                                      |
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| 19. KEY WORDS (Continue on reverse side if necessary and identify by block number)<br><br>Dam Safety, Lake, Dam Inspection, Private Dams                                                                                                                                                                                                                                              |                                            |                                                                                   |
| 20. ABSTRACT (Continue on reverse side if necessary and identify by block number)<br>This report was prepared under the National Program of Inspection of<br>Non-Federal Dams. This report assesses the general condition of the dam with<br>respect to safety, based on available data and on visual inspection, to<br>determine if the dam poses hazards to human life or property. |                                            |                                                                                   |

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

HAMILTON CITY WATER PLANT DAM  
CALDWELL COUNTY, MISSOURI  
MISSOURI INVENTORY NO. MO 10261

PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM

PREPARED BY  
HOSKINS-WESTERN-SONDEREGGER, INC.  
CONSULTING ENGINEERS  
LINCOLN, NEBRASKA

UNDER DIRECTION OF  
ST. LOUIS DISTRICT, CORPS OF ENGINEERS

FOR  
GOVERNOR OF MISSOURI

JULY, 1980

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ATTENTION OF

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

SUBJECT: Hamilton City Water Plant Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Hamilton City Water Plant Dam (MO 10261).

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

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

- a. Spillway(s) will not pass 50 percent of the Probable Maximum Flood without overtopping the dam.
- b. Overtopping of the dam could result in failure of the dam.
- c. Dam failure significantly increases the hazard to loss of life downstream.

SUBMITTED BY:

**SIGNED**

Chief, Engineering Division

**5 JAN 1981**

Date

APPROVED BY:

Colonel, CE, District Engineer

**SIGNED**

**5 JAN 1981**

Date

PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM

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PHASE I REPORT  
NATIONAL DAM SAFETY PROGRAM  
ASSESSMENT SUMMARY

|                    |                               |
|--------------------|-------------------------------|
| Name of Dam        | Hamilton City Water Plant Dam |
| State Located      | Missouri                      |
| County Located     | Caldwell County               |
| Stream             | Tom Creek                     |
| Date of Inspection | July 1, 1980                  |

Hamilton City Water Plant Dam was inspected by an interdisciplinary team of engineers from Hoskins-Western-Sonderegger, Inc. The purpose of the inspection was to make an assessment of the general conditions of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.

The guidelines used in the assessment were furnished by the Department of the Army, Office of the Chief of Engineers and developed with the help of several Federal and State agencies, professional engineering organizations, and private engineers.

Hamilton City Water Plant Dam has a height of thirty-six (36) feet and a storage capacity at the minimum top elevation of the dam of twelve hundred (1200) acre-feet. In accordance with the guidelines, an intermediate size dam has a height greater than or equal to forty (40) feet but less than one hundred (100) feet and a storage capacity greater than or equal to one thousand (1,000) acre-feet but less than fifty thousand (50,000) acre-feet. The size classification is determined by either the storage capacity or height, whichever gives the larger size category. Hamilton City Water Plant Dam is classified as an intermediate size dam.

In accordance with the guidelines and based on visual observation, the dam is classified as having a high potential for damage and loss of life. Failure would threaten life and property. The estimated damage zone extends approximately seven (7) miles downstream of the dam. Within the damage zone are the City of Hamilton water treatment plant and Highway 36 Business Route (immediately downstream), Highway 36 (0.3 miles downstream), two dwellings and two barns (2.3 miles downstream), one dwelling and two barns (2.8 miles downstream) and Highway 13 (3.3 miles downstream).

Our inspection and evaluation indicate that the spillways do not meet the minimum criteria set forth in the recommended guidelines for an intermediate dam having a high hazard potential. The Probable Maximum Flood is the appropriate spillway flood. The spillways will pass the 100-year flood (a flood having a 1 percent probability of being exceeded in any year) without overtopping the dam. The spillways will pass 30 percent of the Probable Maximum Flood without overtopping the dam. The Probable Maximum Flood (PMF) is defined as the flood that may be expected

from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

Construction plans were available for this dam. Based on the information available from the plans and the observations made during the field inspection, the following deficiencies were found: inadequate spillway capacity, lack of seepage and stability analyses, tree growth on embankment and in outlet channel of the concrete spillway, erosion of areas of the upstream slope, displacement of the downstream sections of the concrete stilling basin, and open joints and scaling concrete in the concrete spillway. Remedial measures and maintenance procedures are recommended as listed below. All remedial measures should be performed under the guidance of a professional engineer experienced in the design and construction of dams.

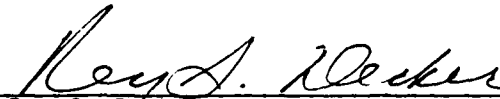
a. Alternatives

- (1) The spillway size and/or the height of dam should be increased to pass the Probable Maximum Flood without overtopping the dam.

b. Operation and Maintenance Procedures

- (1) Seepage and stability analyses comparable to the requirements of the recommended guidelines should be performed by a professional engineer experienced in the design and construction of dams.
- (2) Trees should be removed from the embankment slopes and the outlet channel of the concrete spillway. This should be done under the guidance of a professional engineer experienced in the design and construction of dams.
- (3) The eroded areas of the upstream slope should be repaired and additional riprap provided in order to prevent further erosion and deterioration of the slope. This should be done under the guidance of a professional engineer experienced in the design and construction of dams.
- (4) The last downstream sections of the concrete stilling basin should be monitored periodically to determine whether the inward displacement at the top of the walls is increasing. Remedial measures may be required.
- (5) The joints on the concrete spillway structure should be checked for missing joint filler. Open joints should be resealed.
- (6) The areas of the floor section and the walls of the concrete spillway structure where scaling has occurred should be repaired.

- (7) The present practice of mowing the embankment is excellent and should be continued.
- (8) A program of periodic inspection and maintenance should be initiated. Records of inspections should be made a part of the project file.



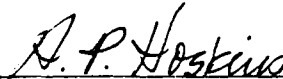
Rey S. Decker  
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Harold P. Hoskins, Chairman of the Board  
Hoskins-Western-Sonderegger, Inc.  
E-8696



PHOTO NO. 1 - OVERVIEW

PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM  
HAMILTON CITY WATER PLANT DAM - MO 10261  
CALDWELL COUNTY, MISSOURI

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 Hamilton City Water Plant Dam be made.
- b. Purpose of Inspection. The purpose of the inspection was to make an assessment of the general condition of the dam with respect to safety, based upon available data and visual inspection, in order to determine if the dam poses hazards to human life or property.
- c. Evaluation Criteria. Criteria used to evaluate the dam were furnished by the Department of the Army, Office of the Chief of Engineers, in "Recommended Guidelines for Safety Inspection of Dams", Appendix D to "Report of the Chief of Engineers on the National Program of Inspection of Dams," dated May, 1975, and published by the Department of the Army, Office of the Chief of Engineers.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances.

- (1) The dam is an earth fill of intermediate size located in the dissected till plains area within the Central Lowlands Physiographic Region about a mile west of Hamilton, Missouri. The dam is approximately 1300 feet in length with a maximum height of about 36 feet. The maximum water storage at the minimum top elevation of the dam is 1200 acre-feet.

The dam consists of two legs with the principal embankment oriented almost east-west and the secondary wing dike oriented northeast-southwest. The principal or primary spillway is located at the left end of the secondary wing dike. There is an emergency or secondary spillway cut through the right abutment of the principal (east-west) embankment.

- (2) The principal spillway is uncontrolled and consists of a vegetated earth approach channel excavated in the left abutment leading to a St. Anthony Falls type reinforced concrete chute.
  - (3) An uncontrolled, vegetated earth emergency spillway is cut through the right abutment. A 4-foot high dike used for a road crossing is constructed normal to the spillway along the centerline of the dam.
  - (4) Pertinent physical data are given in paragraph 1.3 below.
- b. Location. The dam is located in the north central portion of Caldwell County, Missouri, about 1 mile west of the City of Hamilton as shown on Plate A-2. The dam is shown on Plate A-1 in the SW1/4 of Section 15, T57N, R28W.
  - c. Size Classification. Criteria for determining the size classification of dams and impoundments are presented in the guidelines referenced in paragraph 1.1c above. Hamilton City Water Plant Dam has a height of 36 feet and a storage capacity of 1,200 acre-feet. This dam is classified as an intermediate size dam. An intermediate size dam has a height greater than or equal to 40 feet but less than 100 feet and a storage capacity greater than or equal to 1,000 acre-feet but less than 50,000 acre-feet. The size classification is determined by either the storage or height, whichever gives the larger size capacity.
  - d. Hazard Classification. Guidelines for determining hazard classification are presented in the same guidelines as referenced in paragraph 1.1c above. Based on referenced guidelines this dam is in the High Hazard Potential Classification. The estimated damage zone extends approximately seven miles downstream of the dam. It was determined by visual observation that within the damage zone are the City of Hamilton water treatment plant and Highway 36 Business Route (immediately downstream), Highway 36 (0.3 miles downstream), two dwellings and two barns (2.3 miles downstream), one dwelling and two barns (2.8 miles downstream), and Highway 13 (3.3 miles downstream).
  - e. Ownership. The dam is owned by the City of Hamilton, City Hall, Hamilton, Missouri 64644.
  - f. Purpose of Dam. The dam was constructed primarily as a source of water supply for the City of Hamilton, Missouri. It also provides recreation for the residents of the surrounding area.
  - g. Design and Construction History. Mr. Kuhnert, Water Superintendent for the City of Hamilton, stated that the initial dam construction at this site was done in 1920. The original dam was constructed with a 6-inch concrete core wall. In 1954 the dam as it presently exists was constructed from plans prepared by Kenneth H. Larkin

and Associates, Consulting Engineers, Kansas City, Missouri. The concrete core wall was left in place; the height of the dam was raised 12 feet +; the left wing of the dam was constructed; the dam was extended approximately 365 feet on the right and the two spillways were constructed.

- h. Normal Operating Procedure. The intake tower for the city water supply is equipped with two 8-inch cast iron intake pipes which are controlled by hand-operated rising stem gate valves. Water is drawn from the intake tower into the filtration plant through one 8-inch cast iron pipe as required to meet the City's demand for water. The pool level behind the dam is controlled by rainfall, infiltration, evaporation, the capacity of the uncontrolled spillways and the demand for potable water by the City of Hamilton.

### 1.3 PERTINENT DATA

- a. Drainage Area. 1,141 acres (1.783 square miles).
- b. Discharge at Damsite.

(1) Discharges at the damsite are through the following:

- (a) An uncontrolled principal spillway consisting of a vegetated earth approach channel excavated in the left abutment leading to a St. Anthony Falls type reinforced concrete chute having a crest width of 110 feet.
- (b) An uncontrolled vegetated earth emergency spillway, 85 feet in width, excavated in the right abutment. A 4-foot high dike crosses the spillway normal to the centerline of the spillway.
- (c) An intake tower equipped with two 8-inch cast iron intake pipes which are manually controlled by rising stem gate valves. Water is drawn from the intake tower through an 8-inch cast iron pipe into the Hamilton water treatment plant located at the downstream toe of the dam.

- (2) Estimated Maximum Flood at Damsite. The City Water Superintendent, Mr. Kuhnert, stated that 18 to 24 inches of water flowed through the control section of the principal spillway in 1964 or 1965.
- (3) The principal spillway capacity varies from 0 c.f.s. at elevation 110.0 feet to 2050 c.f.s. at the crest of the emergency spillway (elevation 113.5 feet) to 2250 c.f.s. at the minimum top of dam (elevation 113.7 feet).
- (4) The emergency spillway capacity varies from 0 c.f.s. at its crest elevation 113.5 feet to 7 c.f.s. at elevation 113.7 feet (minimum top of dam).

- (5) Total spillway capacity at the minimum top of dam is  
2257 c.f.s.  $\pm$

c. Elevations. (Local datum to conform with construction plans)

- (1) Observed pool - 108.7
- (2) Normal pool - 110.0
- (3) Spillway crest(s)
  - Principal - 110.0
  - Emergency - 113.5
- (4) Maximum experienced pool - 112  $\pm$
- (5) Top of dam (minimum) - 113.7
- (6) Streambed at centerline - 78  $\pm$
- (7) Maximum tailwater - unknown

d. Reservoir - Length (feet) of Pool.

- (1) At principal spillway crest - 4,000  $\pm$
- (2) At emergency spillway crest - 4,300  $\pm$
- (3) At top of dam (minimum) - 4,300  $\pm$

e. Storage (Acre-feet).

- (1) Observed pool - 800  $\pm$
- (2) Normal pool - 900  $\pm$
- (3) Spillway crest(s)
  - Principal - 900  $\pm$
  - Emergency - 1200  $\pm$
- (4) Maximum experienced pool - 1050  $\pm$
- (5) Top of dam (minimum) - 1200  $\pm$

f. Reservoir Surface (Acres).

- (1) Observed pool - 67  $\pm$
- (2) Normal pool - 73  $\pm$
- (3) Spillway crest(s)
  - Principal - 73  $\pm$
  - Emergency - 90  $\pm$
- (4) Maximum experienced pool - 82  $\pm$
- (5) Top of dam (minimum) - 91  $\pm$

g. Dam.

- (1) Type - Homogeneous rolled earth fill
- (2) Length - 1300 feet  $\pm$
- (3) Height - 36 feet  $\pm$  (maximum)
- (4) Top width - 10 feet  $\pm$  (plans); 13 feet (measured)
- (5) Side slopes -
  - (a) Downstream - 1V on 3H (Plans and measured). 1V on 2.25H (Plans and measured above filter building)
  - (b) Upstream - 1V on 2H (Plans) 1V on 2.75H (measured on exposed face)

- (6) Zoning - none
- (7) Impervious core - 6" concrete core wall - Sta. 6 + 65 to Sta. 12 + 50.4 in old dam which forms an upstream berm for the existing dam.
- (8) Cutoff - unknown
- (9) Grout curtain - none
- (10) Wave protection - Riprap (8-10 inch maximum size)
- (11) Drains - Pervious blanket (Sta. 8 + 50 to Sta. 11 + 50) with 6-inch perforated corrugated metal pipe connecting to manhole at water treatment plant. The location of the pervious blanket is shown on Plate C-2.
- h. Diversion Channel and Regulating Tunnel - none
- i. Spillway.
  - (1) Principal
    - (a) Type - An uncontrolled vegetated earth approach channel excavated in the left abutment leading to a St. Anthony Falls type reinforced concrete chute having a crest width of 110 feet and a total length from crest to end sill of 180 feet.
    - (b) Crest Elevation - 110.0  
End Sill Elevation - 79.0
    - (c) Upstream Channel - Free of obstructions and well vegetated.
    - (d) Downstream Channel - Well vegetated, few trees, highway bridge about 450 feet downstream from spillway chute.
  - (2) Emergency
    - (a) Type - Uncontrolled vegetated earth spillway having a width of 85 feet and side slopes of 1V on 4H.
    - (b) Control Section - A 4-foot high dike crossing the spillway normal to the spillway centerline.
    - (c) Crest Elevation - 113.5
    - (d) Upstream Channel - Well vegetated, open
    - (e) Downstream Channel - Well vegetated, open

- j. Regulating Outlets - Water is supplied to the city water intake tower by either of two 8-inch cast iron pipe intake lines that extend from the intake tower into the reservoir. These lines are manually controlled by operation of rising stem gate valves mounted within the intake tower on the ends of the intake pipes. Water is drawn from the intake tower into the filtration plant through an 8-inch cast iron pipe which is gate valve controlled within the filtration plant. The lower intake line from the reservoir has one cut-off collar. The 8-inch outlet pipe from the intake tower to the filtration plant is equipped with two cut-off collars. Details are shown on Plate C-4.

## SECTION 2 - ENGINEERING DATA

### 2.1 DESIGN

No design data were available for the original dam which was constructed in the 1920's. The plans prepared in 1953 by Kenneth H. Larkin and Associates, Consulting Engineers, Kansas City, Missouri for the enlargement of the dam show the original dam and its spillway as they were prior to the construction in 1954. The plans for the 1954 construction are included in Appendix C.

### 2.2 CONSTRUCTION

The surveys and measurements made during the inspection indicate that the dam and its spillways were constructed in 1954 in accordance with the plans included in Appendix C. The 6-inch concrete core wall, which was a feature of the original dam, was left in place and the new embankment was constructed on the downstream side of the core wall. The spillway of the original dam was removed, and the dam was extended by construction of the left wing. The dam was also extended approximately 365 feet on the right side. An earth spillway was constructed through the right abutment, and an earth channel leading to a St. Anthony Falls type reinforced concrete spillway chute was constructed through the left abutment.

### 2.3 OPERATION

No data were available on spillway operation. It was reported by Mr. Kuhnert that the maximum flow through the spillway was about 18 to 24 inches deep which occurred sometime in 1964 or 1965. There has been no significant flow through the spillway since 1974. There was no evidence that would indicate that the dam has been overtopped.

### 2.4 EVALUATION

- a. Availability. The data included in Appendix C were readily available from the City of Hamilton.
- b. Adequacy. The available data, field surveys and visual observation presented 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, which is considered a deficiency. These seepage and stability analyses should be performed for appropriate loading conditions (including earthquake loads) and made a matter of record.
- c. Validity. The available data and information supplied by Mr. Kuhnert are considered valid and acceptable.

## SECTION 3 - VISUAL INSPECTION

### 3.1 FINDINGS

- a. General. A visual inspection of the Hamilton City Water Plant Dam was made on July 1, 1980. Engineers from Hoskins-Western-Sonderegger, Inc., Lincoln, Nebraska, making the inspection were: Rey S. Decker, Geotechnical; Gordon Jamison and Garold Ulmer, Hydrology and Hydraulics. Mr. B. Kuhnert, Water Superintendent, accompanied the inspection team for part of the time.

b. Dam.

- (1) Geology and Soils (abutment and embankment). The Hamilton City Water Plant Dam is located in the dissected till plains area within the Central Lowlands Physiographic Region. The dam is in a region where the stratigraphic sequence consists of 8 to 16 feet of loess overlying Kansan-age glacial till, of undeterminable thickness and character, which in turn overlies bedrock of the Kansas City Group, Missourian Series, Pennsylvanian System. Strata of this group consists of interlayered shales, limestones, sandstones, and thin beds of coal.

The upland soil deposits in the dam area consist of the Adair-Lagonda-Shelby soil association. These soils are formed from loess which overlies glacial till and formed on a rolling to gently rolling topography. The Adair soil has formed in the uppermost and weathered portion of the glacial till. The Lagonda soil has formed from loess occupying positions on gently rolling uplands and interstream divides. The Shelby soil occupies the steeper slopes and has developed from relatively unweathered glacial till.

Materials observed in the abutments consist of CL loess-till colluvium. No till nor bedrock was observed at the site. Materials in the embankment consist of silty clay (CL) soils apparently taken from the spillway excavations and from the upstream abutment areas.

- (2) Upstream Slope. The upstream slope is fairly well plated with limestone riprap. The riprap is quite small with nominal size of 1 to 1.5 inches and maximum size of 8 to 10 inches. Some deterioration of the riprap was noted. Some erosion of the slope, 2 to 3 feet above the lake level, was noted along most of the main (E-W) dam. In some areas a near

vertical scarp has developed. In the area between about station 9+00 to 11+00 (stationing according to plans), concrete rubble has been added to the original riprap. A few small trees are growing on the upstream slope. No slumps, slides or abnormal deformations were noted on the slope. Photos No. 14, 16, 19, 24 and 27 show the upstream slope.

- (3) Crest. The crest is well vegetated with adapted grasses and legumes. No cracks were observed on the crest. The survey of the crest of the dam indicates that the embankment has settled more than anticipated through the area of the old channel. A note on Plate C-3 of the construction plans specifies overfill between stations 3+00 and 16+00 to allow for settlement. The sag in the crest begins at station 7+00 and ends at station 13+00. The lowest point in the crest occurs at station 9+40+ opposite the intake tower where the crest elevation is 113.7. This elevation is 1.3 feet below the anticipated settled top elevation of the crest and is only two-tenths (0.2') of a foot higher than the crest of the control section of the emergency spillway. Plate C-6 shows the profile of the dam as determined during the inspection. Photos 15, 17 and 23 show the crest of the dam.
- (4) Downstream Slope. The downstream slope is well vegetated with adapted grasses. No slumps, slides, cracks or abnormal deformations were observed on the slope. A few small trees are growing on the slope. No evidence of seepage was observed on the slope or along the toe of the slope. Measurements indicate that the slope was constructed according to the plans. Photos No. 15, 18, and 22 show the downstream slope.

c. Appurtenant Structures.

- (1) The principal spillway is uncontrolled and consists of a reinforced concrete box, chute and St. Anthony Falls type stilling basin located in the left abutment. Measurements indicate that it was constructed according to the plans shown in Appendix C. The forebay or inlet is well vegetated and open. Photos 3, 4, 5 and 7 show the forebay and overall spillway. The joint between the first and second sections (upstream) of the left sidewall is open about 0.75 inches from the top down about 3 feet as shown in Photo No. 6. The floor of the next to the last (downstream) section of the chute (Sec. D-6 on plans) is badly scaled across most of the bottom, as shown in Photos 9, 12 and 13. All of the lower set of weep holes in the floor section were discharging clear water. The last downstream sections of the side walls of the stilling basin (Sec. H-6 on plans)

are both out of vertical alignment. The top of the left wall is displaced inward about 3 inches. The top of the right wall is displaced inward about 1.5 inches. The misalignments of the sidewalls are shown in Photos 10 and 11.

- (2) The emergency spillway is uncontrolled and consists of a vegetated earth channel cut through the right abutment with a roadway crossing that serves as a control weir. The spillway is well vegetated with adapted grasses. Measurements indicate that the spillway was constructed essentially as planned. No slides or slumps were observed, and there was no evidence of significant erosion in the spillway. There was no evidence that this spillway has operated. As noted previously, if this emergency spillway operates, there will probably be flow over the low swag in the crest of the dam. Photos 25 and 26 show the emergency spillway.
  - (3) The drawdown facility for this dam is related entirely to providing water for the city water treatment plant through the intake tower. Two 8-inch cast iron pipe intake lines extend from the intake tower into the reservoir. These lines are shown on the plans at elevations of 105 and 95 and are manually controlled by operation of rising stem gate valves. The elevation of the lower line is estimated to be 15 feet  $\pm$  above the low point in the reservoir. Water is drawn from the intake tower into the filtration plant through an 8-inch cast iron pipe which is gate valve controlled within the plant. The volume of flow through this line is dependent upon the demand for potable water by the city.
- d. Reservoir Area. The area around the reservoir is well vegetated with grass. No slides were observed and there was no evidence of significant erosion around the water line of the reservoir. There was no evidence of heavy siltation. Photo No. 20 shows a portion of the reservoir.
  - e. Downstream Channel. The channel downstream from the principal spillway appears to be stable. Mr. Kuhnert reported that bed-rock is close to the surface in the outlet channel. A number of trees are growing in the channel between the highway bridge and the structure. Photos No. 5 and 28 show the principal spillway channel.

The channel for the emergency spillway is open and vegetated with grass. Discharge from the emergency spillway would probably encroach upon the toe of the dam and the filtration plant.

### 3.2 EVALUATION

The dam appears to be in reasonably good structural condition with no serious potential of failure. There were no indications of

seepage on the downstream slope or along the toe of the dam. The crest of the embankment is very irregular with one area about the same elevation as the emergency spillway. The crest elevation should be brought up to planned elevation. Deterioration of the riprap and erosion on the upstream slope could ultimately impair the integrity of the dam. Trees on the embankment should be removed under the guidance of a professional engineer experienced in the design and construction of dams. The open joints in the walls and the scaling in the floor of the principal spillway should be repaired to prevent further deterioration. Removal of trees in the principal spillway channel would improve the discharge characteristics of the structure. The dike that crosses the emergency spillway reduces the capacity of the spillway and consideration should be given to its removal.

## SECTION 4 - OPERATIONAL PROCEDURES

### 4.1 PROCEDURES

The pool level is controlled by rainfall, infiltration, evaporation, the capacity of the uncontrolled spillways, and the demand for city water.

### 4.2 MAINTENANCE OF DAM

Maintenance of the vegetated sections of the dam appears to be good. One of Mr. Kuhnert's men reported that the crest and slopes of the dam are mowed several times each year. Some effort has been made to supplement the riprap on the upstream slope, but additional repair and maintenance is needed. No apparent maintenance work has been done on the concrete spillway.

### 4.3 MAINTENANCE OF OPERATING FACILITIES

The operating facilities connected with the withdrawal of water from the reservoir and treating it for use by the city appeared to be well maintained.

### 4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no warning system in effect for this dam.

### 4.5 EVALUATION

Maintenance and repair should be done on the concrete spillway in order to prevent further deterioration. The same applies to the upstream slope of the dam.

## SECTION 5 - HYDRAULIC/HYDROLOGIC

### 5.1 EVALUATION OF FEATURES

- a. Design Data. Plans for the 1954 reconstruction of the dam were furnished by the Hamilton City Water Department.
- b. Experience Data. The drainage area, reservoir surface area, and elevation-storage data were developed from the USGS Polo and Winston, Missouri, 15 minute topographic quadrangle maps. The hydraulic computations for the spillway and dam over-topping discharge ratings were based on data collected in the field at the time of the field inspection. Hydraulic/Hydro-logic computations are attached as Appendix D of this report.
- c. Visual Observations.
  - (1) The concrete principal spillway is only in fair condition. As the photographs indicate, much of the joint filler in the side walls has slipped or fallen out entirely, some of the side wall sections are considerably out of line, and there are several areas on the floor that show spalling and scaling.
  - (2) The earthen spillway channel through the right abutment is open and well vegetated on both upstream and downstream sides of the roadway dike that now serves as the control section of the spillway. The construction plans (Plate C-2) show that the spillway channel was to be excavated to an elevation of 110.2. The dike was then to be constructed across the excavated channel with a finished top elevation of 113.5 (confirmed during inspection). The dike was evidently constructed in order to provide a vehicular crossing of the spillway and with the knowledge that if over-topped the dike would erode down to the channel elevation of 110.2 which would then be the control elevation of the spillway. The control elevation of this spillway was intended to be two-tenths of a foot higher than the control section of the concrete spillway constructed through the right abutment (110.2 as compared to 110.0). The elevation difference between the crest of the emergency spillway and the low point in the crest of the dam is only two-tenths of a foot as described in paragraph 3.1b.(3) of this report. Overtopping of the dam immediately above the filter house would occur very shortly after flow commenced through the emergency spillway.
  - (3) More riprap should be added to several areas on the upstream face of the dam.

- d. Overtopping Potential. The spillways are too small to pass the probable maximum flood without overtopping the dam. The spillways will pass 30 percent of the probable maximum flood as well as the 1 percent probability flood without overtopping. Overtopping is dangerous because the flow of water over the crest will erode the face of the dam and, if continued long enough, will breach the dam with sudden release of all of the impounded water into the downstream floodplain. The hydrologic capability of this dam would be greatly enhanced by removal of the dike crossing the emergency spillway and by increasing the height of the low areas of the dam to the planned elevation of 115.0.

The results of the routing through the dam are tabulated in regards to the following conditions:

| <u>Frequency</u> | <u>Inflow<br/>Discharge<br/>c.f.s.</u> | <u>Outflow<br/>Discharge<br/>c.f.s.</u> | <u>Maximum<br/>Pool<br/>Elevation</u> | <u>Maximum<br/>Depth<br/>Over Dam<br/>Feet*</u> | <u>Duration<br/>Over<br/>Top Hours</u> |
|------------------|----------------------------------------|-----------------------------------------|---------------------------------------|-------------------------------------------------|----------------------------------------|
| 1/2 PMF          | 5,660                                  | 4,080                                   | 114.7                                 | 1.0                                             | 2                                      |
| PMF              | 11,300                                 | 10,500                                  | 115.9                                 | 2.2                                             | 5                                      |
| 0.3 PMF          | 3,750                                  | 2,260                                   | 113.7                                 | 0.0                                             | -                                      |

\*Minimum Top of Dam Elevation - 113.7

According to the recommended guidelines from the Department of the Army, Office of the Chief of Engineers, this dam is classified as having a high hazard potential rating and an intermediate size. Therefore, the PMF is the test for the adequacy of the dam and its spillways.

The estimated damage zone is described in Paragraph 1.2d in this report.

## SECTION 6 - STRUCTURAL STABILITY

### 6.1 EVALUATION OF STRUCTURAL STABILITY

- a. Visual Observation. There was no visual evidence such as slumps, slides, cracks or abnormal deformations to indicate structural instability of this dam. No evidence of seepage was observed either on the downstream slope or along the toe of the dam. Based on visual inspection and measurements the dam is considered to be structurally stable against shear and seepage failures. The area of the dam in which the sag in the crest exists (station 7+00 to 13+00) shows no evidence of abnormal deformation in the downstream slope. A cross section survey made during the inspection shows a slope of 1V on 2.3+H as compared to 1V on 2.25H as shown on the construction plans for the area upstream from the filter house (Plates C-7 and C-2). The embankment through the sag area has evidently settled more than originally anticipated. Reconstruction of the crest of the dam through the sag area to a uniform elevation of 115.0 (as planned) would minimize the danger of overtopping. The erosion of the upstream slope and tree growth on the embankment, if allowed to progress, could ultimately impair the integrity of the dam. The effects of overtopping on the erosional stability of the dam are not known. Continued deterioration of the concrete floor and the wall joints of the principal spillway should be halted.
- b. Design and Construction Data. Design data were available from the City of Hamilton. Measurements indicate that the structure was constructed according to the Kenneth H. Larkin and Associates plans, which are included in Appendix C. Seepage and slope stability analyses comparable to the "Recommended Guidelines for Safety Inspection of Dams" were not available. This is considered a deficiency.
- c. Operating Records. The operating facilities of this dam are used as needed to fulfill the demand for city water.
- d. Post Construction Changes. The inspection team is not aware of any post construction changes for this dam since the 1954 construction.
3. Seismic Stability. This dam is located in Seismic Zone 1. An earthquake of the magnitude predicted in this area is not expected to cause structural failure of this dam or the concrete spillway.

## SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

### 7.1 DAM ASSESSMENT

- a. Safety. This dam is in reasonably good structural condition. Analyses presented in Section 5 indicate that the spillways are not adequate to pass the Probable Maximum Flood without overtopping the dam. Overtopping is dangerous because the flow of water over the crest will erode the face of the dam and, if continued long enough, will breach the dam with sudden release of all of the impounded water into the downstream floodplain. Overtopping of this dam will occur almost directly above the city water treatment plant.

Based on visual inspection and measurements this dam is considered to be structurally stable against shear and seepage failures. Erosion on the upstream slope and tree growth on the embankment could impair the integrity of the structure if left uncontrolled. Deterioration of portions of the concrete spillway could ultimately require major repairs of the structure if remedial measures are not performed. Removal of trees in the principal spillway channel would improve the hydraulic efficiency of the structure. The hydrologic capabilities of the dam would be greatly enhanced by removal of the dike in the emergency spillway and by increasing the height of the low sections of the dam to be planned elevation of 115.0

- b. Adequacy of Information. The conclusions in this report are based upon performance history, visual observations, and data made available by the city. Seepage and stability analyses comparable to the "Recommended Guidelines for Safety Inspection of Dams" were not available, which is considered a deficiency.
- c. Urgency. The measures recommended in paragraph 7.2b should be accomplished in the near future. The item recommended in paragraph 7.2a should be pursued on a high priority basis.
- d. Necessity for Further Investigations. The additional studies and analyses recommended in paragraph 7.2b should be accomplished by the owner in the near future.
- e. Seismic Stability. This dam is located in Seismic Zone I. An earthquake of this magnitude is not expected to be hazardous to this dam. It is recommended, however, that the prescribed seismic loading for Seismic Zone I be applied in any stability analyses performed for this dam.

### 7.2 REMEDIAL MEASURES

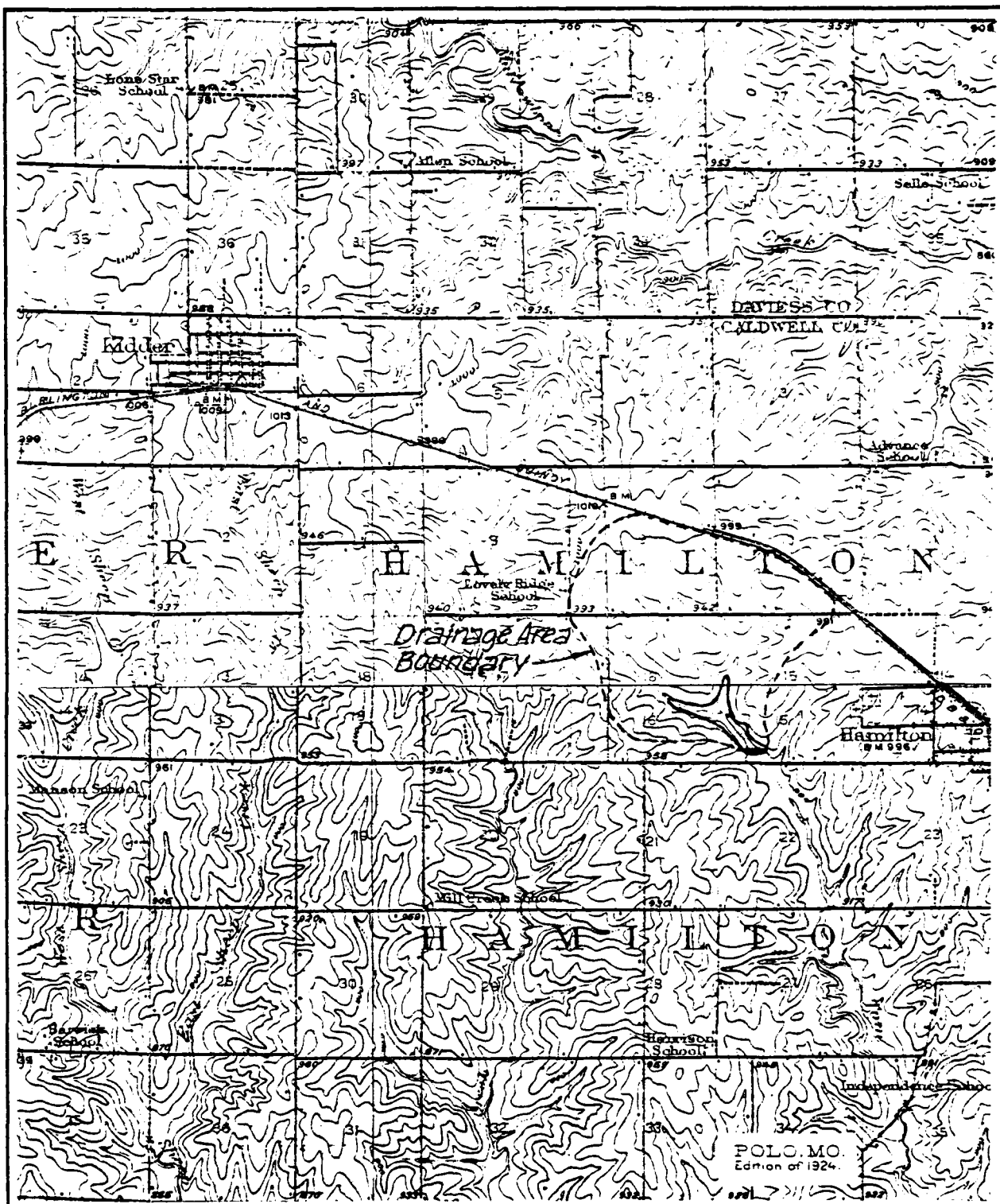
The following remedial measures and maintenance procedures are recommended. All remedial measures should be performed under the guidance of a registered professional engineer experienced in the design and construction of earth dams.

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

b. Operation and Maintenance Procedures.

- (1) Seepage and stability analyses comparable to the requirements of the recommended guidelines should be performed by a professional engineer experienced in the design and construction of dams.
- (2) Trees should be removed from the embankment slopes and the outlet channel of the concrete spillway. This should be done under the guidance of a professional engineer experienced in the design and construction of dams.
- (3) The eroded areas of the upstream slope should be repaired and additional riprap provided in order to prevent further erosion and deterioration of the slope. This should be done under the guidance of a professional engineer experienced in the design and construction of dams.
- (4) The last downstream sections of the concrete stilling basin should be monitored periodically to determine whether the inward displacement at the top of the walls is increasing. Remedial measures may be required.
- (5) The joints in the concrete spillway structure should be checked for missing joint filler. Open joints should be resealed.
- (6) The areas of the floor section and the walls of the concrete spillway structure where scaling has occurred should be repaired.
- (7) The present practice of mowing the embankment is excellent and should be continued.
- (8) A program of periodic inspection and maintenance should be initiated. Records of inspection should be made a part of the project file.

APPENDIX A  
MAPS



Scale in feet  
3000 0 3000 6000 9000 12000

Contour Interval - 20'



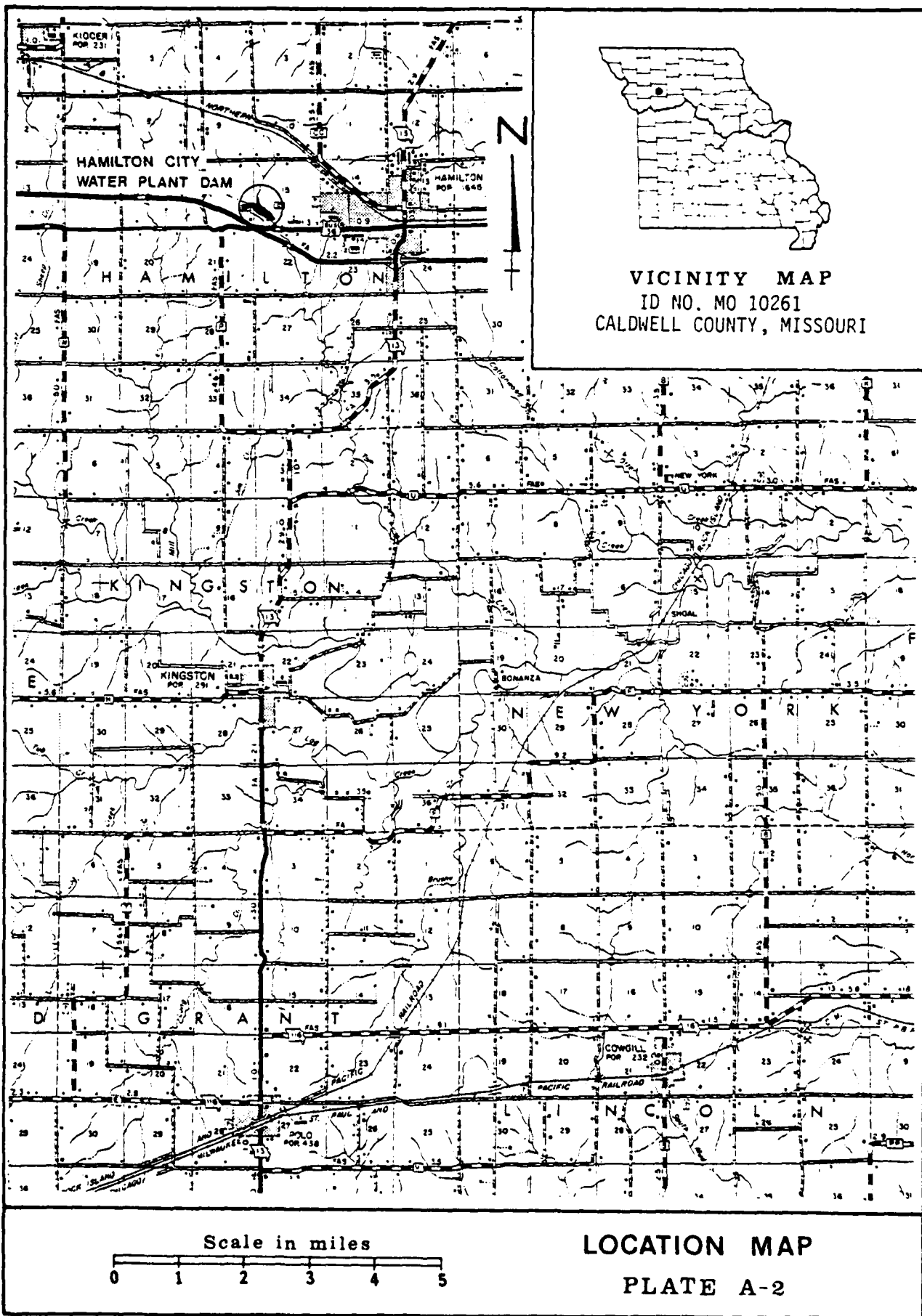
## VICINITY TOPOGRAPHY

HAMILTON CITY WATER PLANT DAM

CALDWELL COUNTY, MISSOURI

MO. 10261

PLATE A-1



APPENDIX B  
PHOTOGRAPHS



HAMILTON CITY WATER PLANT DAM  
CALDWELL COUNTY, MISSOURI  
MO 10261

PHOTO INDEX

PLATE B-1



PHOTO NO. 2 - OVERVIEW TAKEN FROM UPPER LEFT SIDE.



PHOTO NO. 3 - ENTRANCE CHANNEL TO PRINCIPAL SPILLWAY. LOOKING  
DOWNSTREAM TO CONCRETE CHUTE.

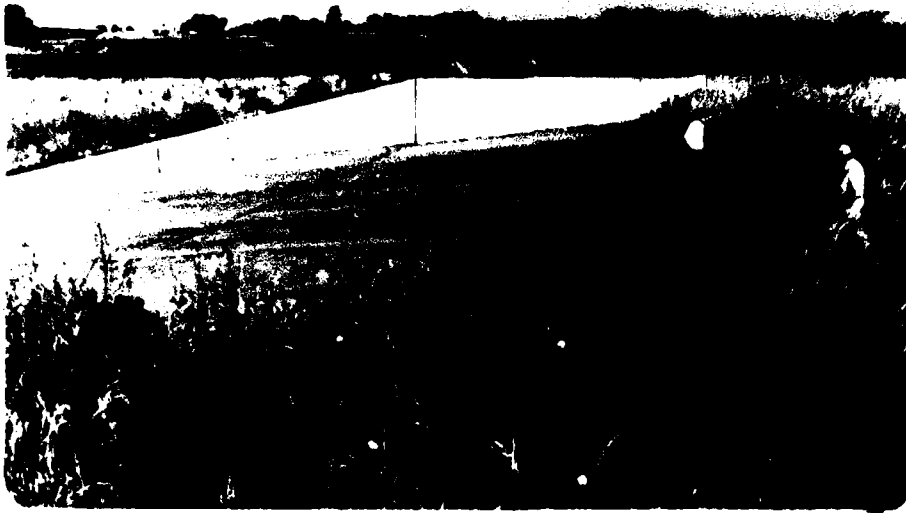


PHOTO NO. 4 - VIEW OF PRINCIPAL SPILLWAY CHUTE TAKEN FROM LEFT SIDE.



PHOTO NO. 5 - LOOKING DOWN PRINCIPAL SPILLWAY CHUTE FROM LEFT SIDE.



PHOTO NO. 6 - VIEW OF  
OPENING OF FIRST JOINT  
ON LEFT SIDE OF PRINCIPAL  
SPILLWAY CHUTE.



PHOTO NO. 7 - VIEW OF FOREBAY OF PRINCIPAL SPILLWAY CHUTE  
TAKEN FROM LEFT SIDE.

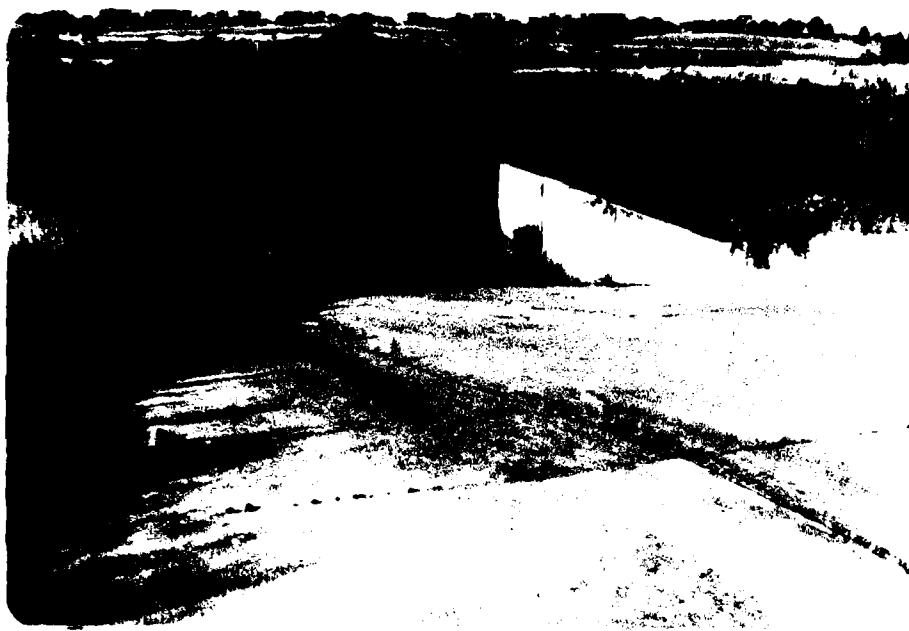


PHOTO NO. 8 - DOWNSTREAM VIEW OF PRINCIPAL SPILLWAY CHUTE.

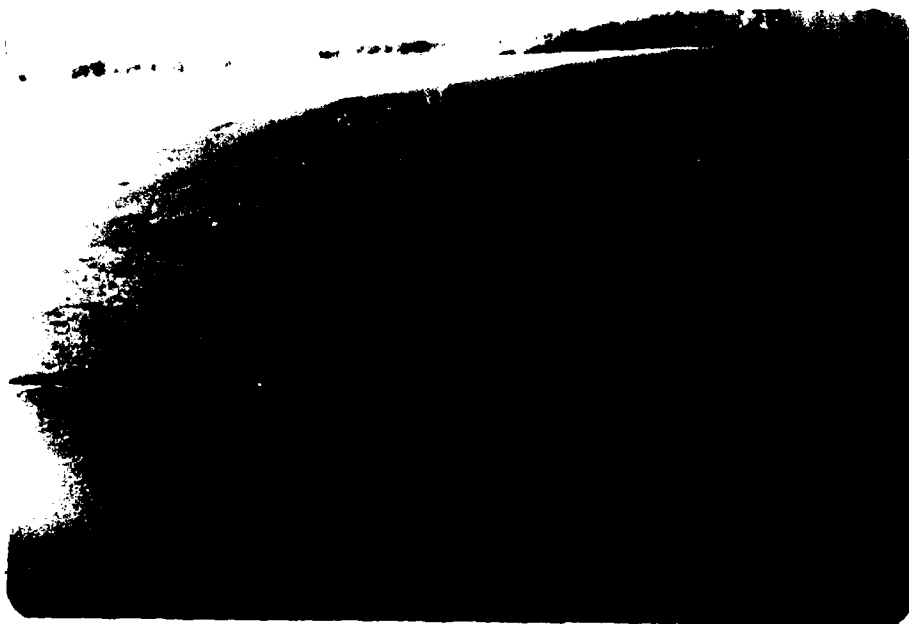


PHOTO NO. 9 - CONCRETE SCALING AT SECOND JOINT ON LEFT SIDE OF PRINCIPAL SPILLWAY CHUTE.



PHOTO NO. 10 - MISALIGN-  
MENT OF DOWNSTREAM SECTION  
OF SPILLWAY ON LEFT SIDE.

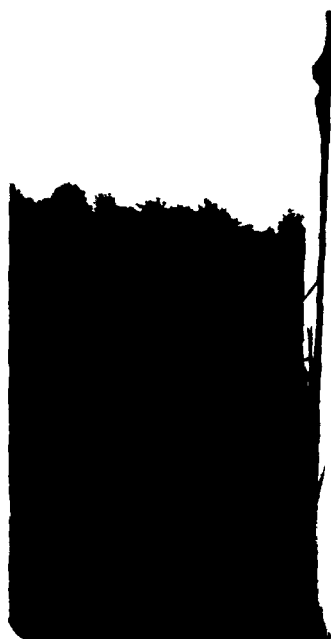


PHOTO NO. 11 - MISALIGN-  
MENT OF DOWNSTREAM SECTION  
OF SPILLWAY ON RIGHT SIDE.



PHOTO NO. 12 - CONCRETE SCALING UPSTREAM OF CHUTE BLOCKS ON LEFT SIDE OF CENTERLINE.



PHOTO NO. 13 - CONCRETE SCALING UPSTREAM OF CHUTE BLOCKS ON RIGHT SIDE OF CENTERLINE.



PHOTO NO. 14 - UPSTREAM FACE TAKEN FROM END OF LEFT LEG OF DAM.



PHOTO NO. 15 - CREST AND DOWNSTREAM SLOPE OF LEFT LEG OF DAM.



PHOTO NO. 16 - UPSTREAM SLOPE OF MAIN DAM TAKEN FROM LEFT LEG OF DAM.



PHOTO NO. 17 - CREST OF MAIN DAM TAKEN FROM LEFT AT POINT OF CURVATURE WITH LEFT LEG.



PHOTO NO. 18 - DOWNSTREAM SLOPE OF MAIN DAM TAKEN FROM LEFT.



PHOTO NO. 19 - UPSTREAM SLOPE OF LEFT END OF MAIN DAM SHOWING  
EROSION AND DETERIORATION OF RIPRAP.



PHOTO NO. 20 - VIEW UPSTREAM WITH INTAKE TOWER TO WATER TREATMENT PLANT  
IN FOREGROUND.



PHOTO NO. 21 - VIEW DOWNSTREAM TAKEN FROM INTAKE TOWER LOCATION. BRIDGE  
AT EXTREME LEFT SPANS OUTLET CHANNEL.



PHOTO NO. 22 - DOWNSTREAM SLOPE TAKEN FROM RIGHT.



PHOTO NO. 23 - CREST OF MAIN DAM TAKEN FROM RIGHT. MAN IN BACKGROUND STANDING IN SAG OVER OR NEAR PIPE FROM INTAKE TOWER TO WATER TREATMENT PLANT.



PHOTO NO. 24 - VERTICAL DROP AND EROSION OF UPSTREAM FACE NEAR RIGHT END.



PHOTO NO. 25 - VIEW UPSTREAM IN EMERGENCY SPILLWAY. DIKE AND ROAD CROSSING SPILLWAY SHOWS IN CENTER OF PICTURE.



PHOTO NO. 26 - VIEW DOWNSTREAM IN EMERGENCY SPILLWAY.



PHOTO NO. 27 - VIEW OF UPSTREAM FACE TAKEN FROM RIGHT END.

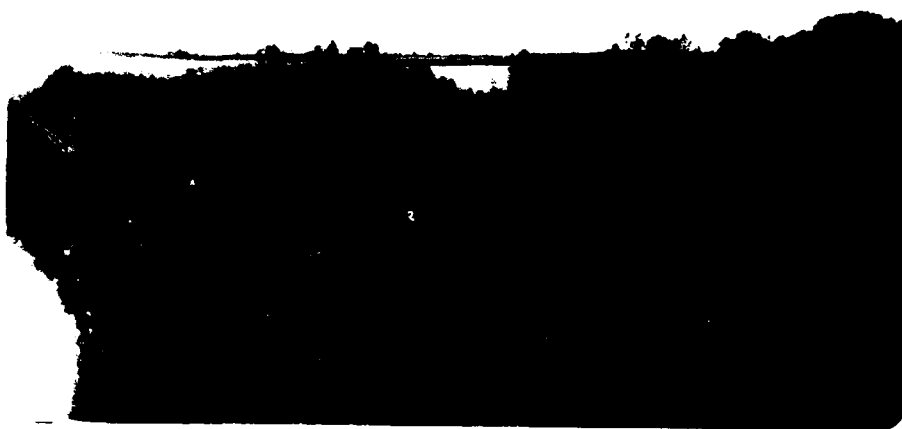
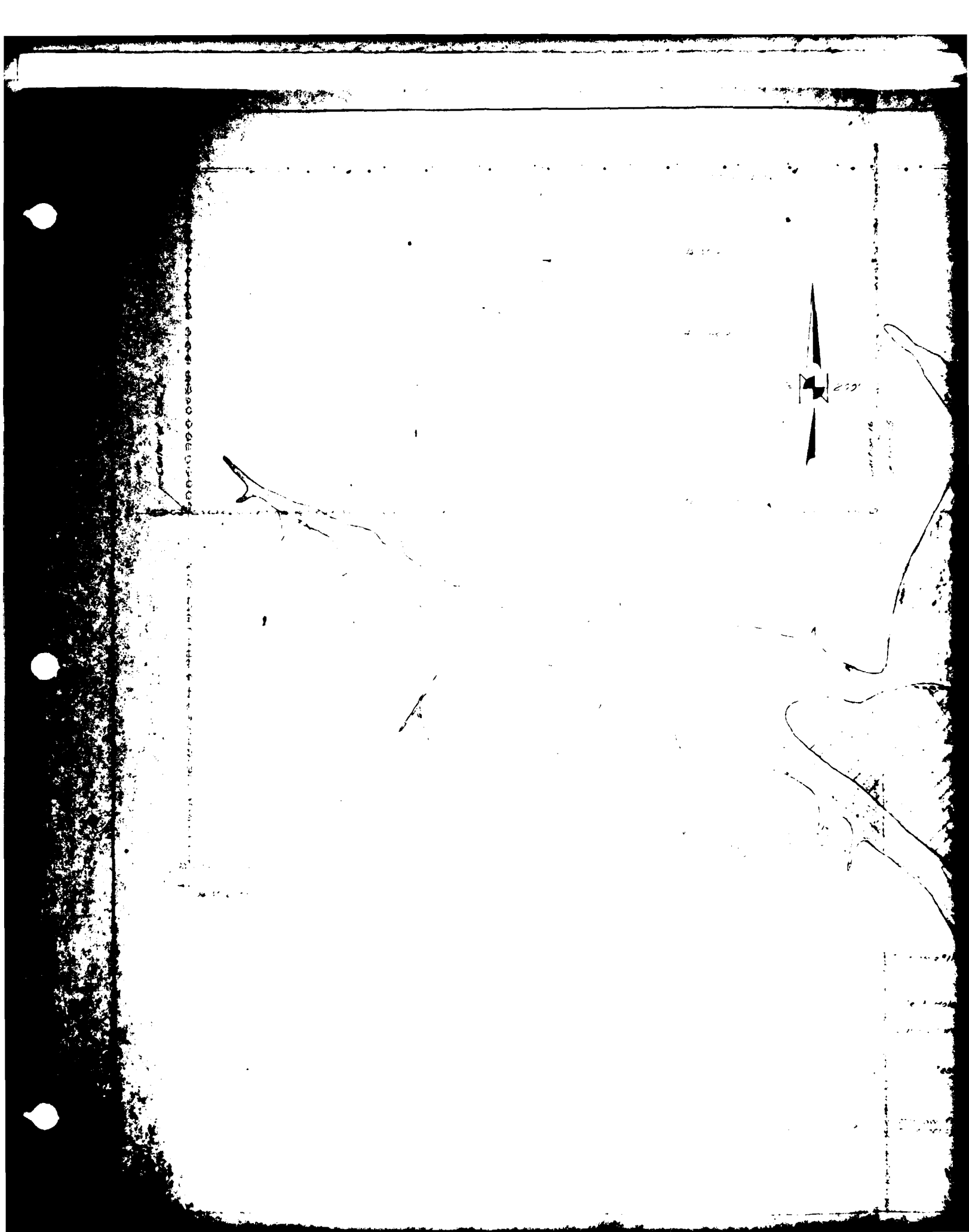


PHOTO NO. 28 - VIEW OF PRINCIPAL SPILLWAY CHUTE AND DOWNSTREAM CHANNEL  
TAKEN FROM HIGHWAY BRIDGE.



PHOTO NO. 29 - HOUSE IN FLOODPLAIN, 2 MILES DOWNSTREAM OF DAM.

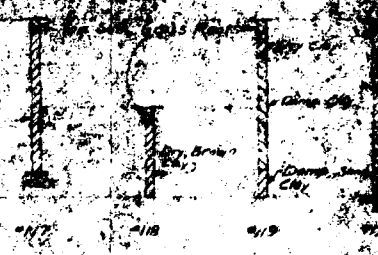
APPENDIX C  
PROJECT PLATES





Present Lake Level  
Elev. 1000

Sandy Brown  
Clay



**AUGER TEST HOLES ALONG**

Note: See sheet 2 and 3 for details

NOTE:  
Design for Reservoir Site is to be  
in accordance with the Specifications

New Lake - Elev. 10 - Area Approx 73 Acres

Old Lake - Elev. 90 - Area Approx 27 Acres

East Lake - Elev. 100 - Area Approx 10 Acres

Test Hole #122

Test Hole #121

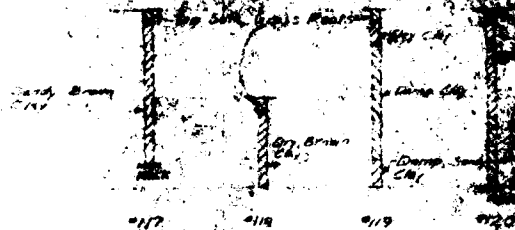
Lake Shore Borrow

Test Hole #120

Borrow Pit  
Spillway Excavation

- 1. 1/4"
- 2. 1/2"
- 3. 1"
- 4. 2"
- 5. 4"
- 6. 8"
- 7-10

Project Lake Erie  
Elev. 1000



# AUGER TEST HOLES ALONG L.I.E.

Scale 1" = 1'

Note: See sheet 8 for plan view and details.

NOTE:  
Crossing for the right side of the  
road is shown in the plan view.

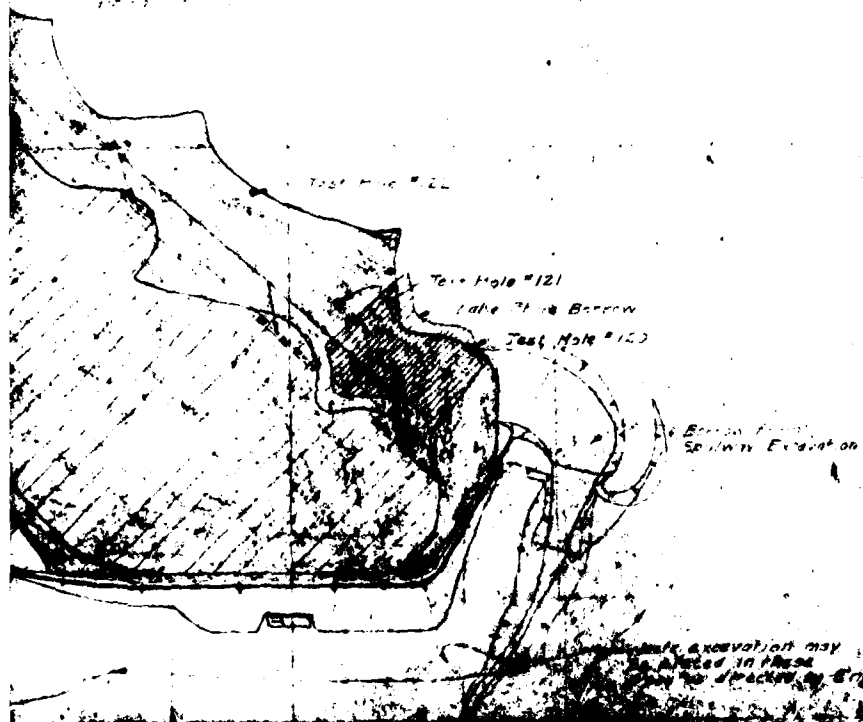
New Lake Erie - Elev. 1000 - Approx. 73 Acres

Project Lake Erie - Elev. 1000 - Approx. 27 Acres

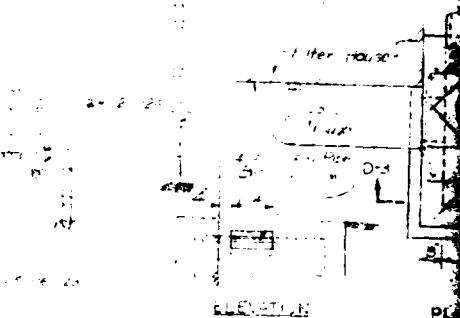
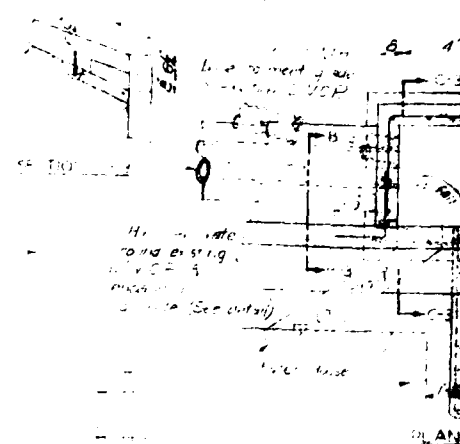
Project Lake Erie - Elev. 1000 - Approx. 27 Acres

## LIST OF

1. TITLE SHEET
2. MAP SHEET
3. LAYOUT SHEET
4. DAM SECTION
5. DETAILS AND
6. SPILLWAY
- 7-10. CROSS SECTION



Drainage Capacity



### LOC OF AUGER HOLES

See DEP sheet 10 for auger holes & bottom logs

ELEVATION

PLAN

Existing 6 Core Core Log  
Sta 6465 to Sta 12104

BASE LINE

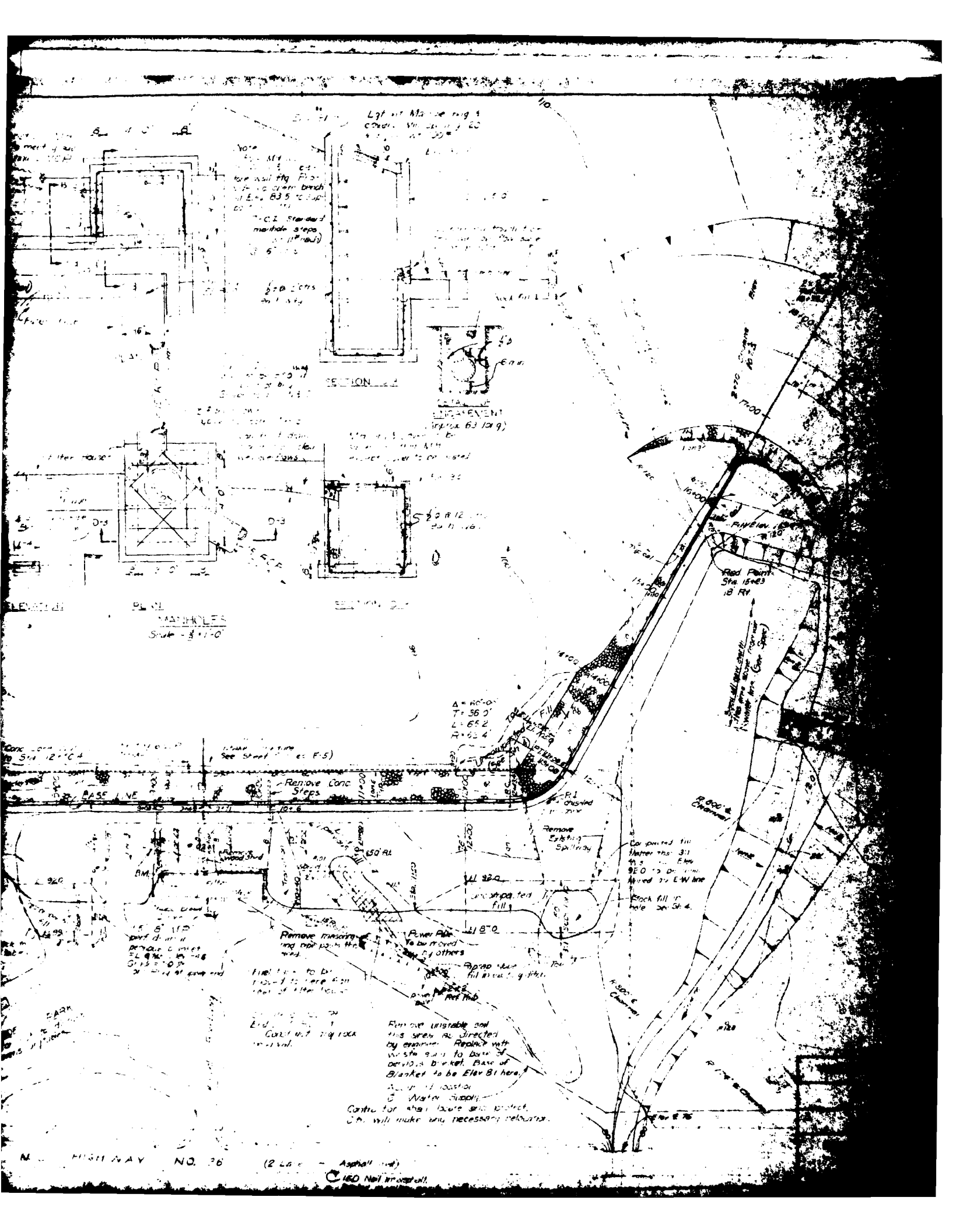
### GENERAL NOTES

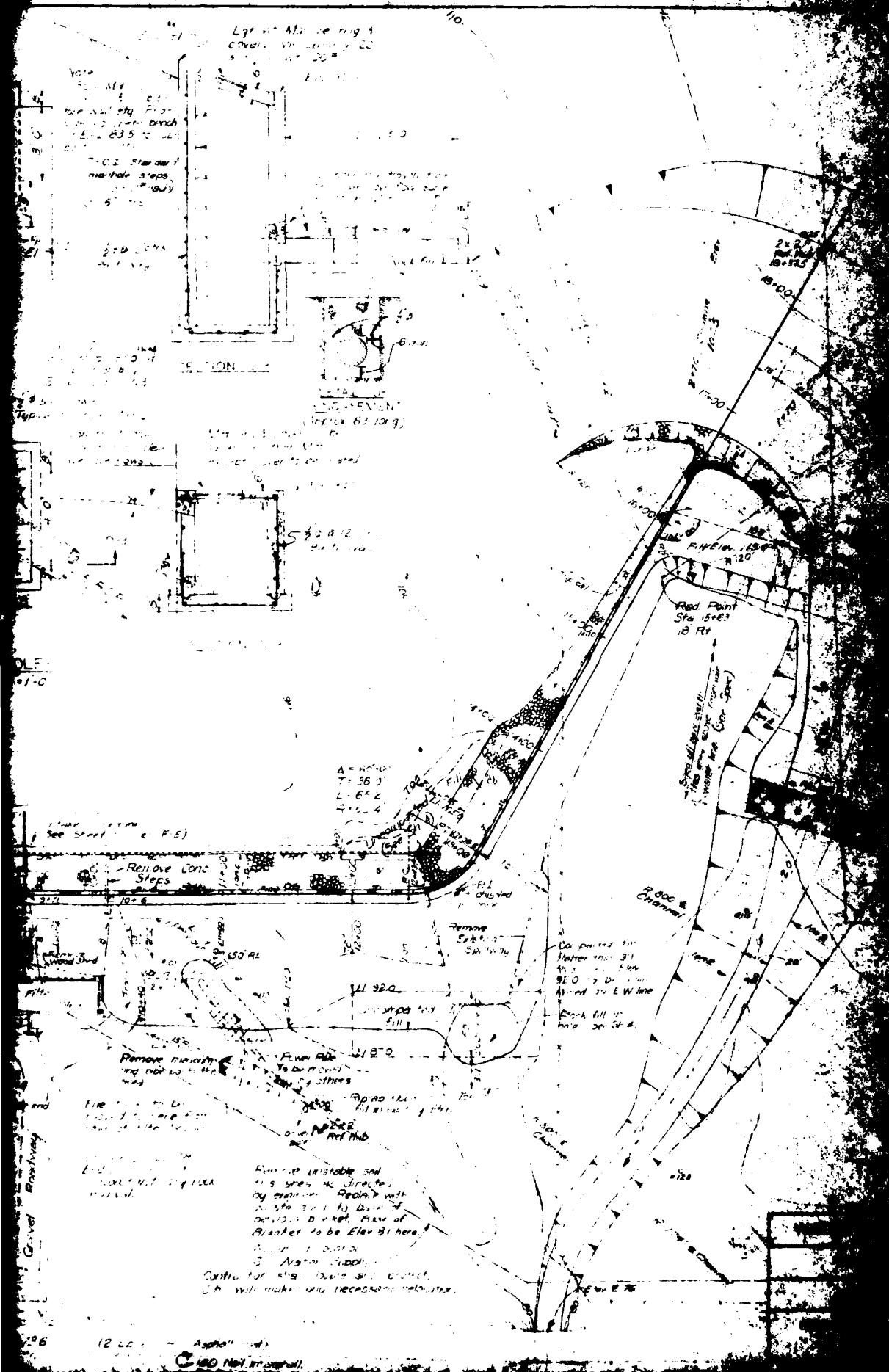
See DEP sheet 10 for auger holes & bottom logs  
This is a preliminary sketch of the proposed  
location of the auger holes. The actual  
location of the auger holes will be determined  
by the DEP sheet 10.

See DEP sheet 10 for  
auger holes & bottom logs

PARK

N.S. HIGHWAY





[illegible]

2 D.P. - 50' JUNE 6'  
10' 4" 3' 0" USED ROCK  
600' 11' 3" WEST END  
FROM 11' 3" AT NE CORNER  
POINT.

CONTRACTED FILL

# CUS PLANKED SETTLING BASING

Scale 1" = 25'

CONTRACTED FILL

CONTRACTED FILL

CONTRACTED FILL

Slope Varies See Plan, SH. E

76'-0"

50'-0"

(Mass. North - 1900)

Line 92

CONTRACTED FILL

Remove old spillway  
and use for Rock Fill  
on riprap.

## TYPICAL SECTION AT EXISTING SPILLWAY

Line 92 - 100' 0" - 100' 0"

LINE 92 - 100' 0" - 100' 0"

Quarry - 100' 0" - 100' 0"

CONTRACTED FILL

50'-0"

Line 92

COMPACTED FILL

Slope Values See Plan, Sht. 2

76.0

50'-0"

(N. 105° North - 50°)

1.00 96

Remove old spillway  
and use for Rock Fill  
or riprap.

WATERWAY

Proposed

DETAIL SECTION AT EXISTING RAILWAY

See Specifications for  
Slope, Sht. 2

Note in location of  
Existing Spillway

Quarry Run  
100 to 150 ft.  
with gravel



SECTION D-5  
Scale 1/4" = 1'-0"

SECTION C-5  
Scale 1/4" = 1'-0"



SECTION E-5  
Scale 1/4" = 1'-0"

SECTION I-5  
Scale 1/4" = 1'-0"

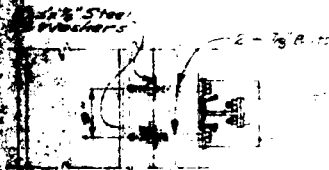
Notes:  
1. Exposed end of  
all steel members to  
be painted with  
防锈漆 (Anti-rust paint)



SECTION J-5  
Scale 1/4" = 1'-0"



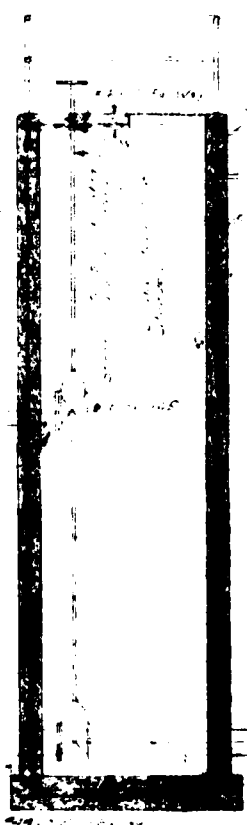
TYPICAL  
DETAIL FOR



SECTION K-5  
Scale 1/4" = 1'-0"

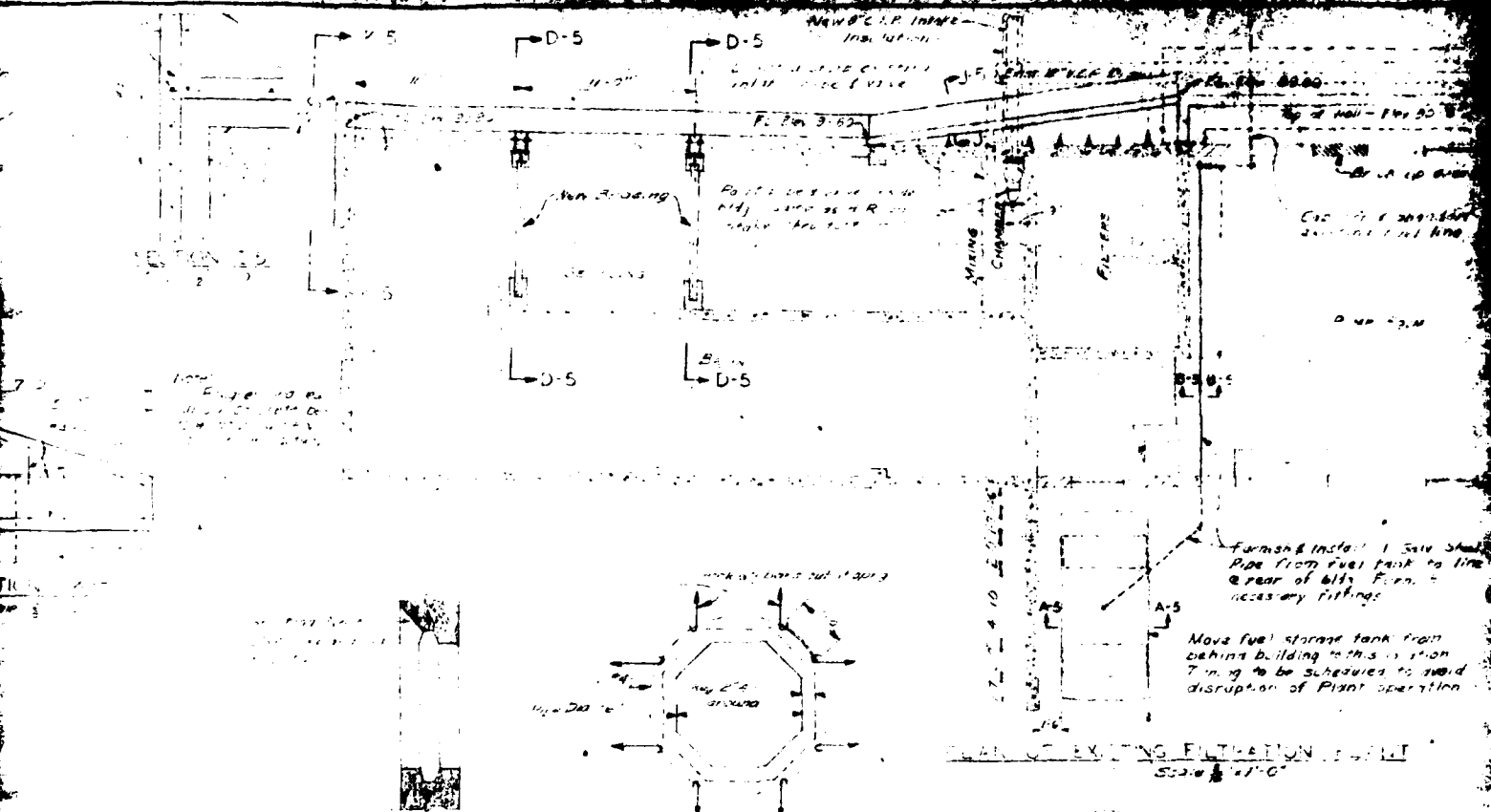


SECTION L-5  
Scale 1/4" = 1'-0"

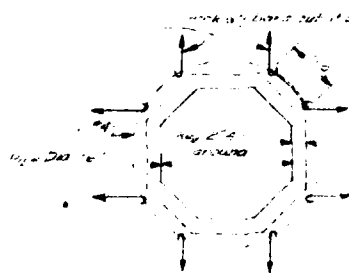


SECTION F-5  
Scale 1/4" = 1'-0"

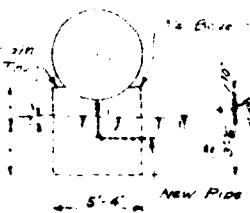
DETAIL



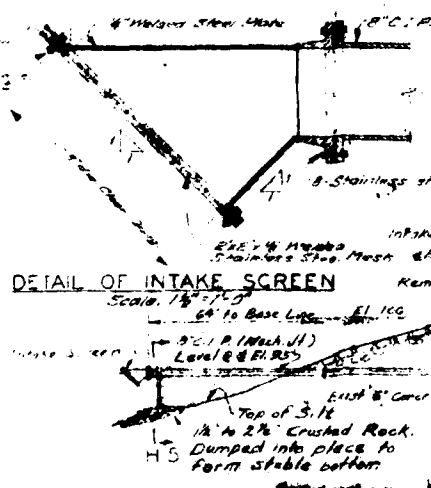
TYPICAL PIPE OPENING  
DETAIL FOR INTAKE STRUCTURE



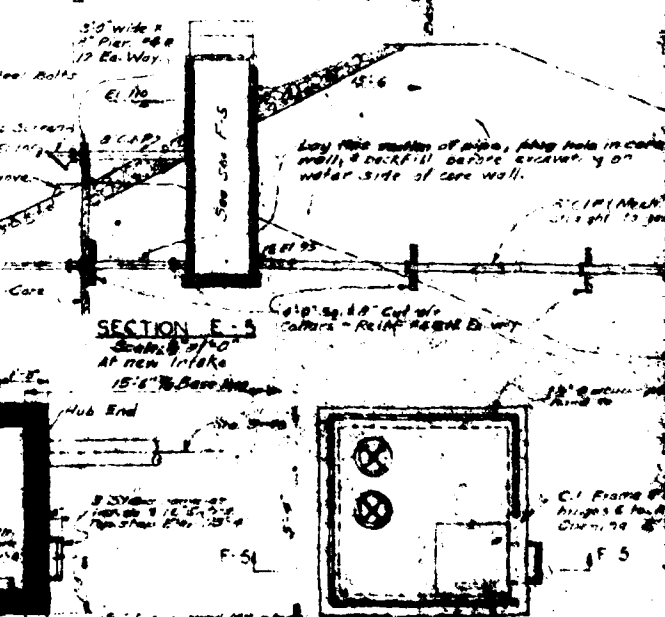
Construct 2' x 4' x 12' concrete Pier in Tank  
Form in 1:5  
Pour against trench walls



DETAIL OF INTAKE SCREEN  
Scale 1/4" = 1'-0"

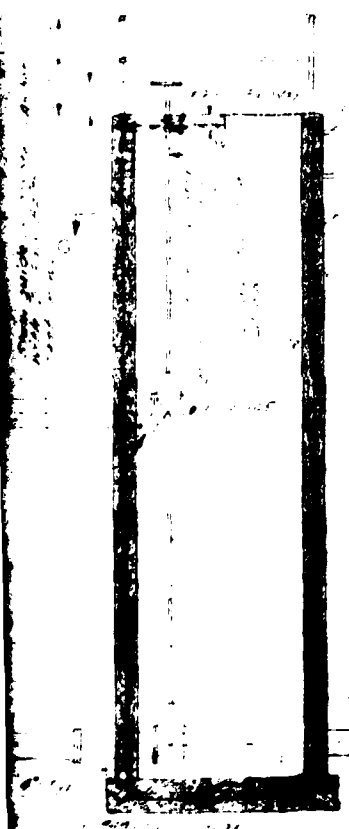


SECTION E-5  
Scale 1/4" = 1'-0"



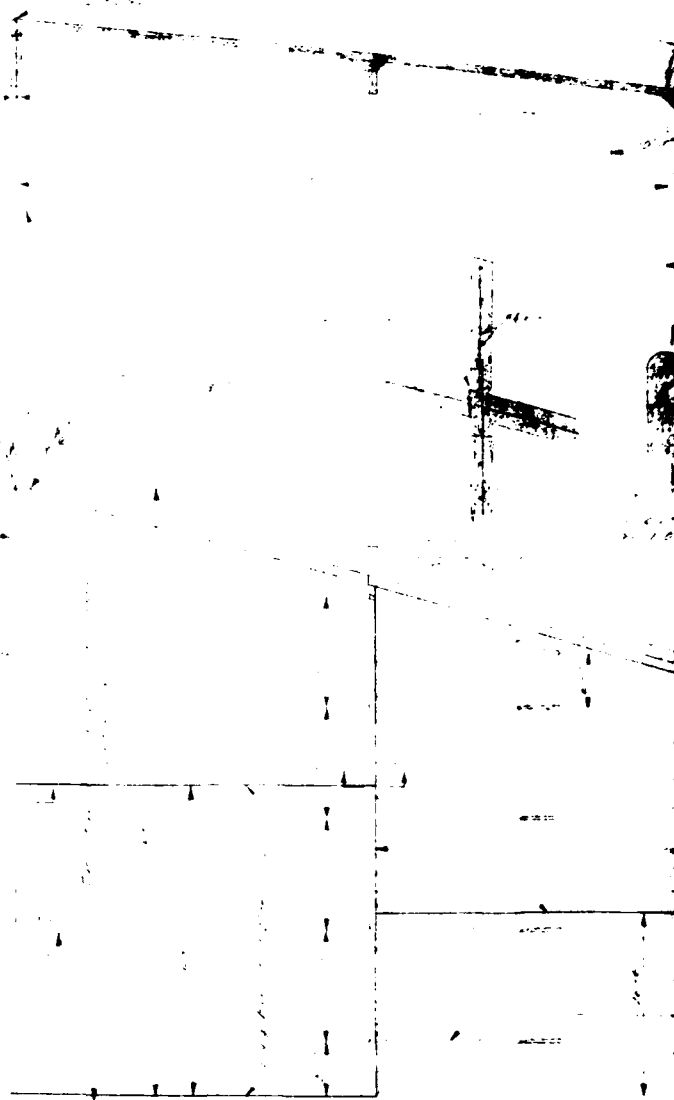
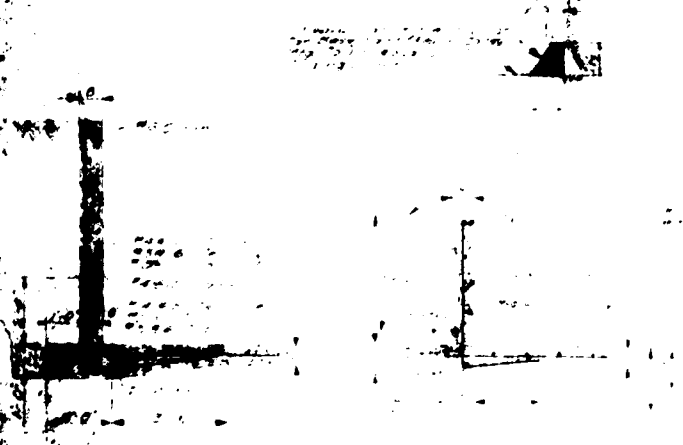
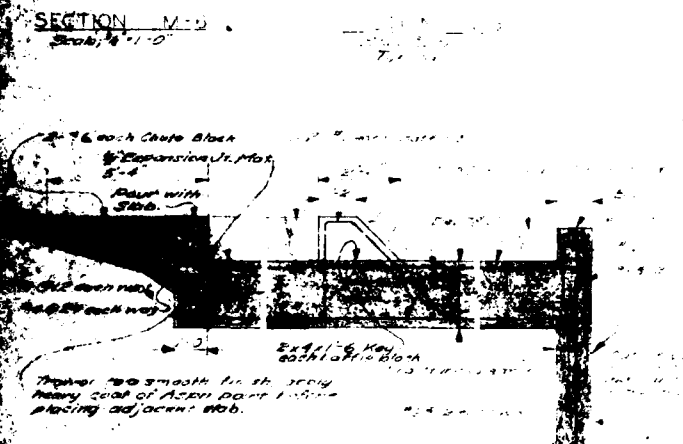
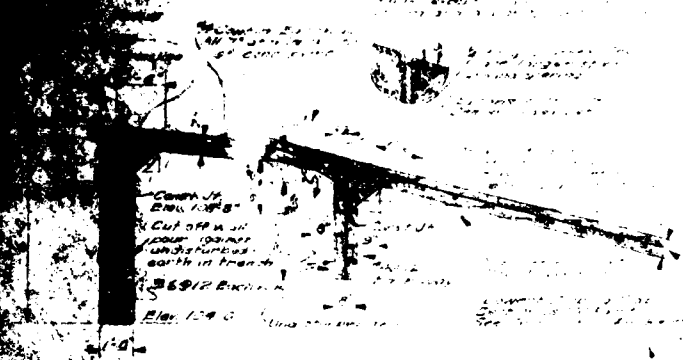
SECTION B-5

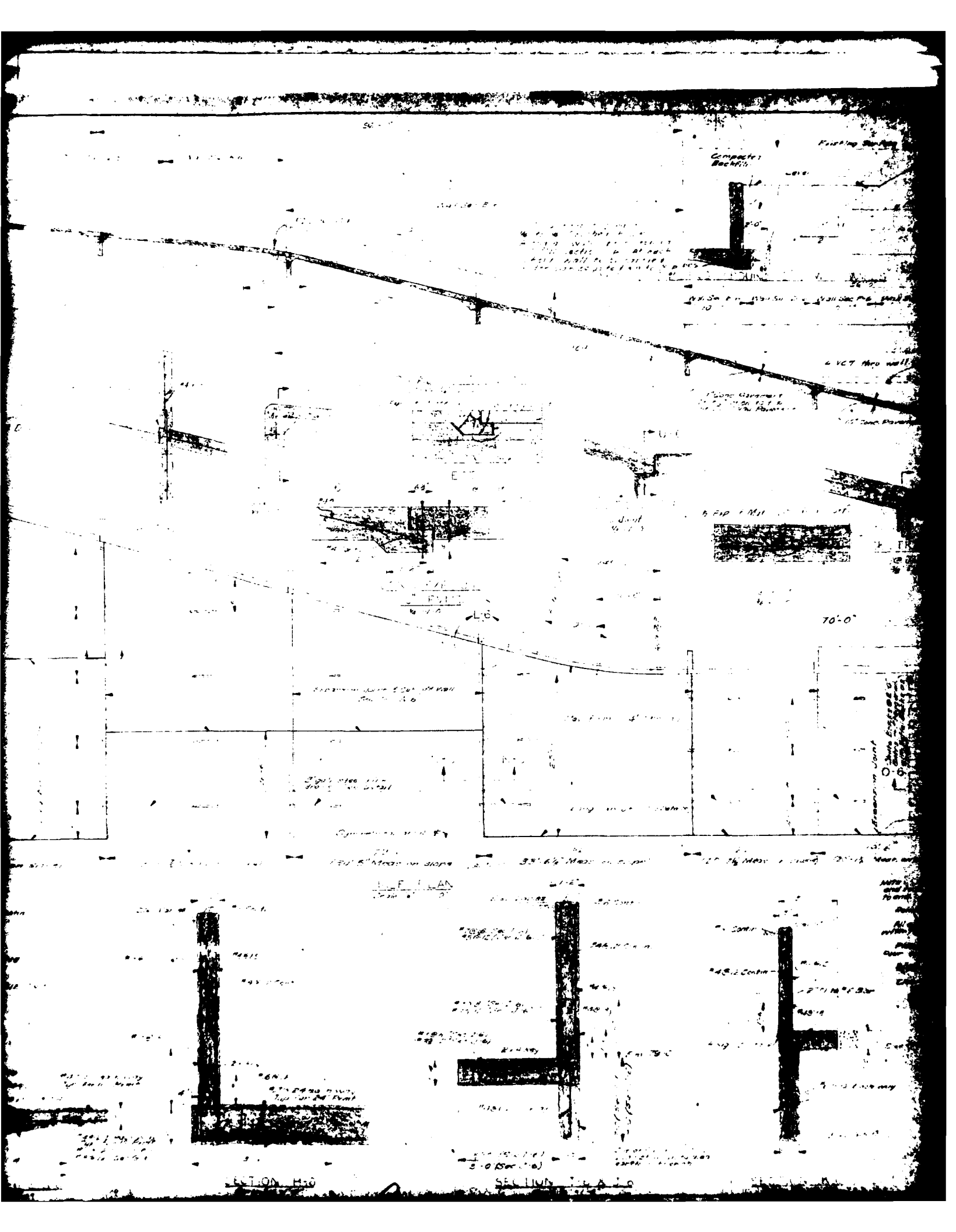
TOP INTAKE

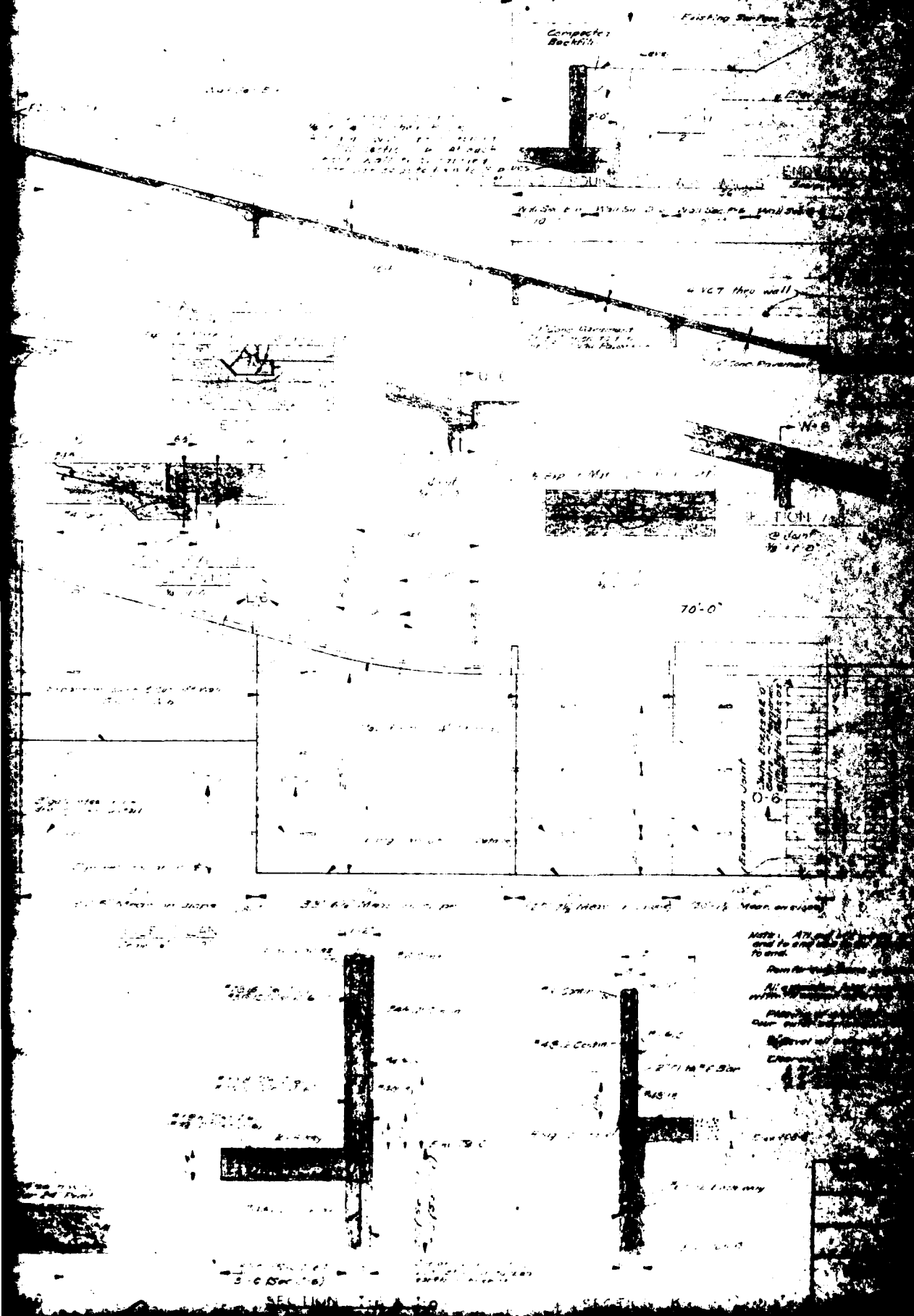


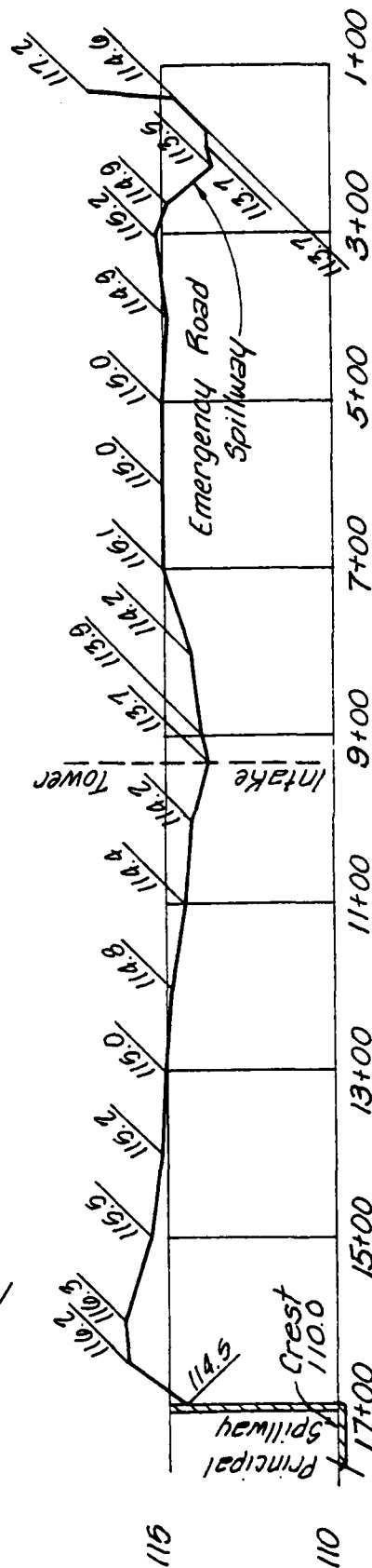
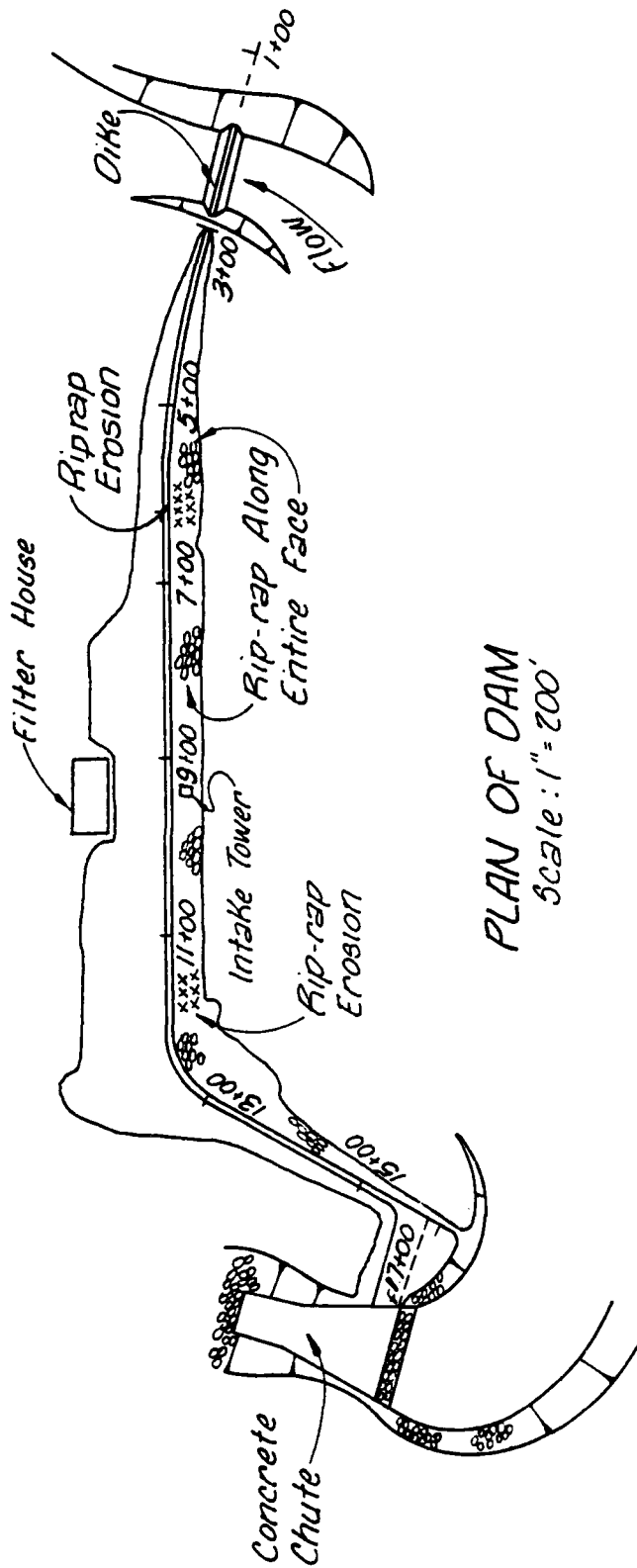


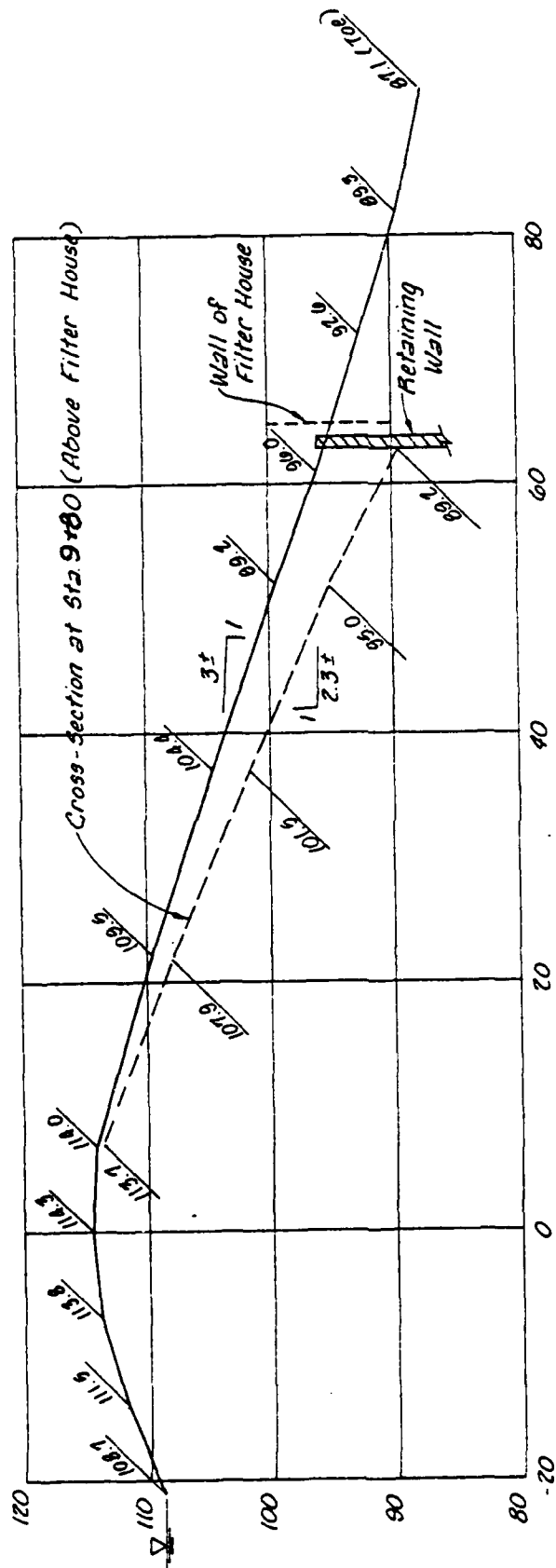
Area Elev 189.7











CROSS-SECTION OF DAM AT STA. 10+30

Scale: 1"=10'

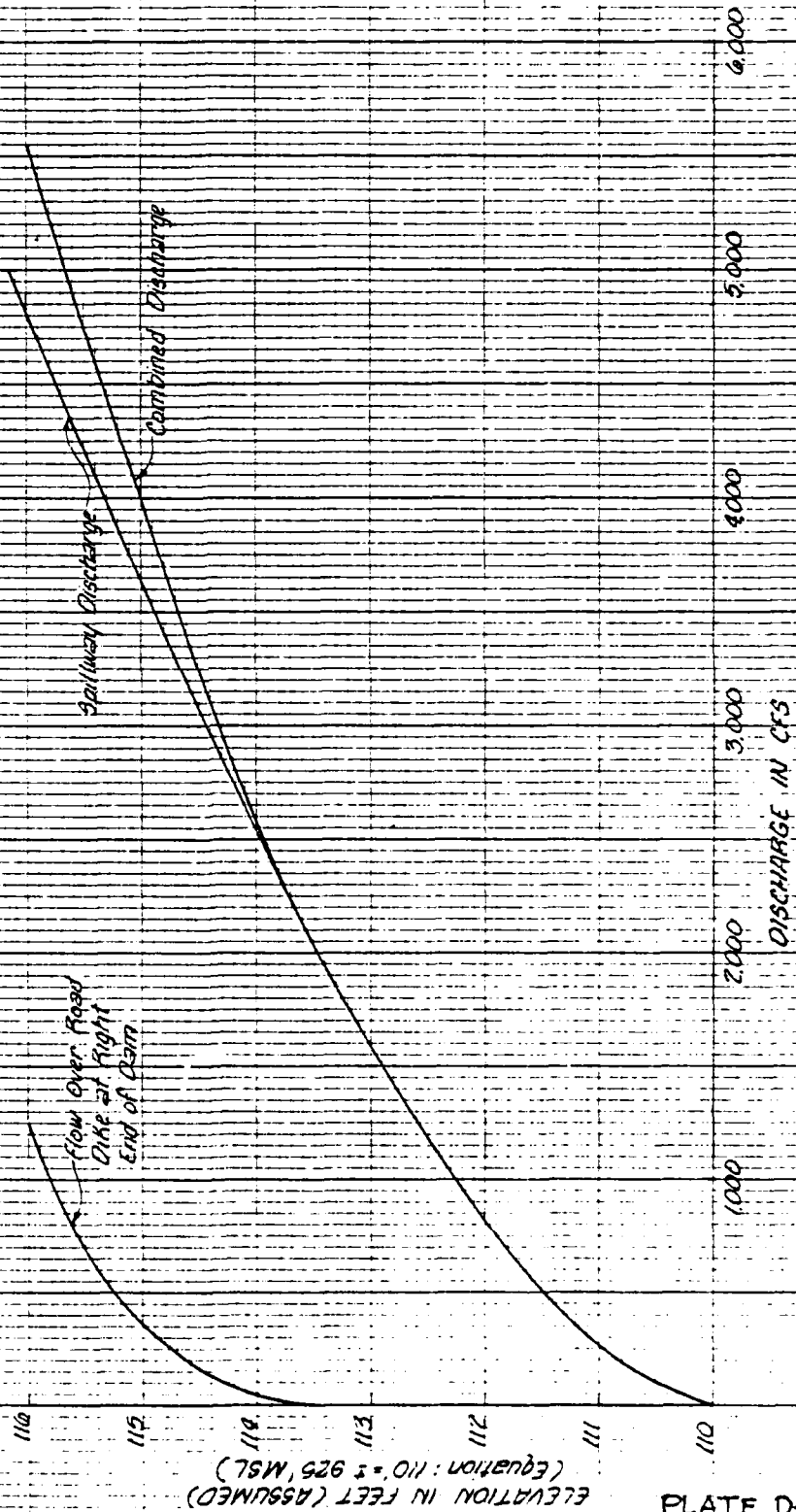
APPENDIX D  
HYDRAULIC AND HYDROLOGIC DATA

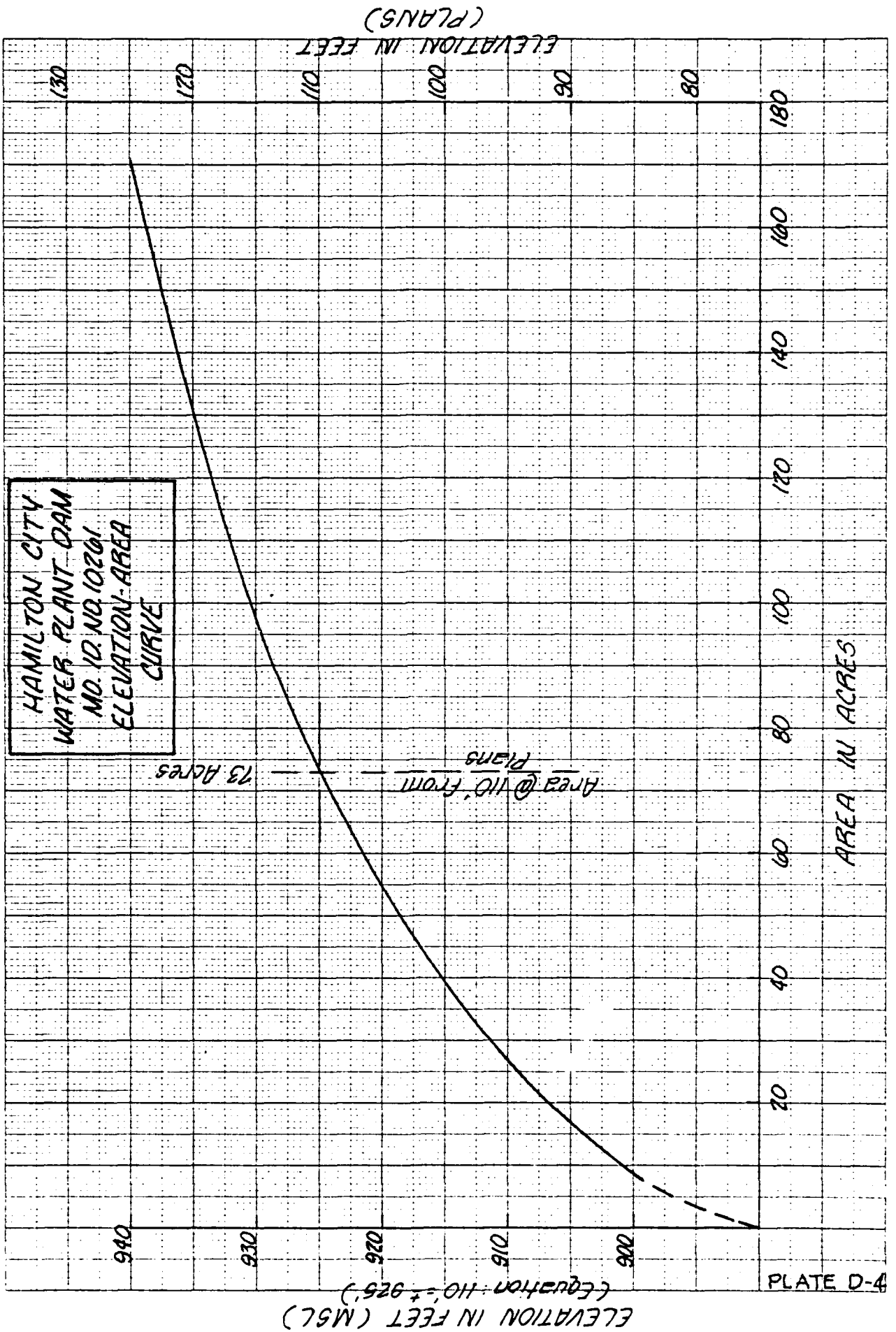
## HYDROLOGIC COMPUTATIONS

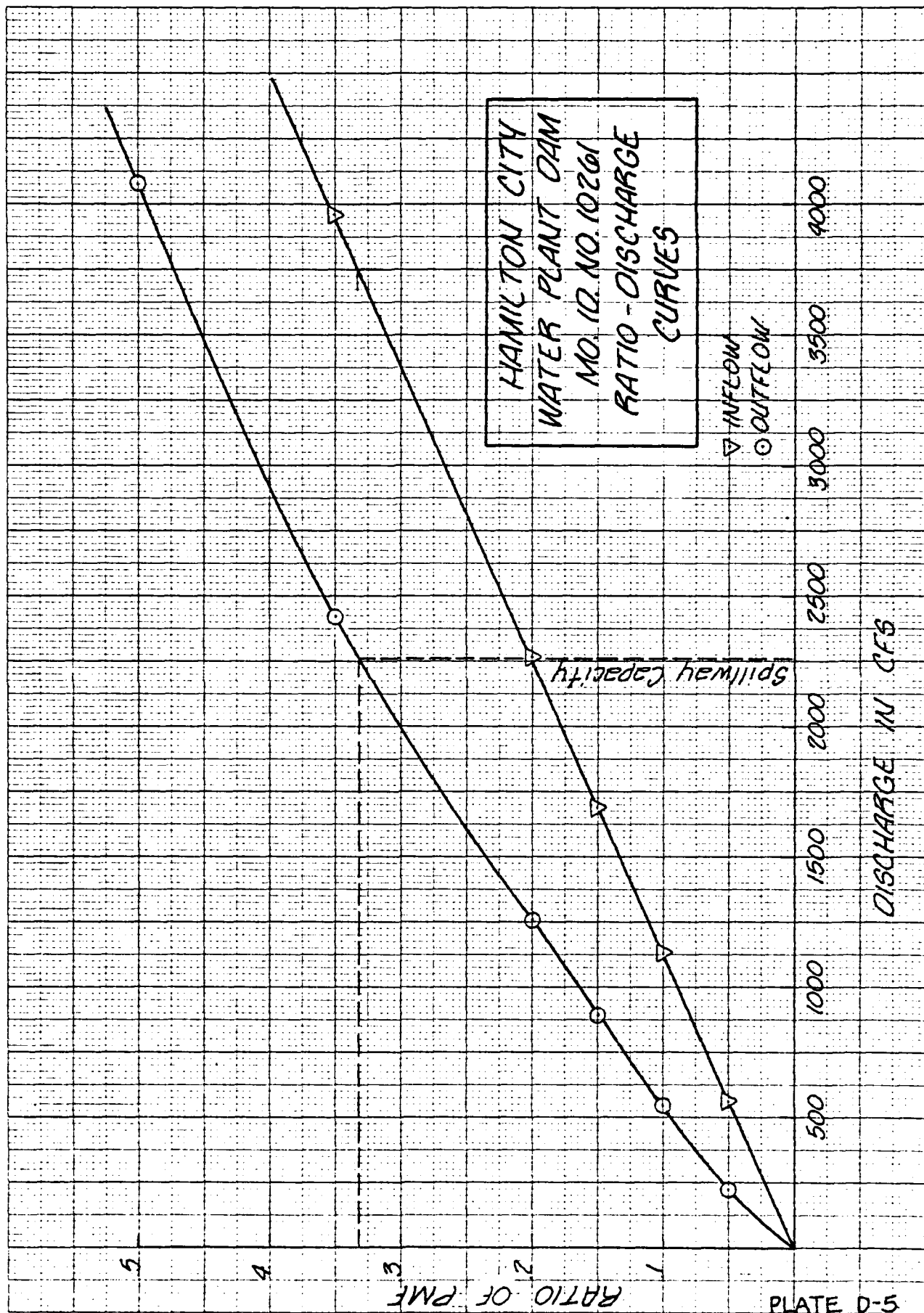
1. The SCS dimensionless unit hydrograph and the systemized computer program HEC-1 (Dam Safety Version), July 1978, prepared by the Hydrologic Engineering Center, U.S. Corps of Engineers, Davis, California, were used to develop the inflow hydrographs (See this Section).
  - a. Forty-eight hour, one percent probabilistic rainfall for the dam location was taken from the data for the rainfall station at Chillicothe, MO. as supplied by the St. Louis District, Corps of Engineers per their letter dated 4 March 1980. The forty-eight hour probable maximum precipitation was taken from the curves of Hydrometeorological Report No. 33 and current Corps of Engineers and St. Louis policy and guidance for hydraulics and hydrology.
  - b. Drainage area = 1.78 square miles (1,141 acres).
  - c. Time of concentration of runoff = 56 minutes (computed from the "Kirpich" formula). This compares to 58 minutes as computed from California Culverts Practice, California Highways and Public Works.
  - d. The antecedent storm conditions for the probable maximum precipitation were heavy rainfall and low temperatures which occurred on the previous 5 days (SCS AMC III). The antecedent storm conditions for the one percent probabilistic precipitation were an average of the conditions which have preceded the occurrence of the maximum annual flood on numerous watersheds (SCS AMC II). The initial pool elevation was assumed at the invert of the principal spillway.
  - e. The total forty-eight hour storm duration losses for the one percent probabilistic storm were 2.28 inches. The total losses for the PMF storm were 1.02 inches. These data are based on SCS runoff curve No. 81 and No. 92 for antecedent moisture conditions SCS AMC II and AMC III respectively. The watershed is composed of primarily SCS soil groups C and D (Lagonda-Lamoni-Adair Soil Association). The watershed is approximately 60% under cultivation in row crops, small grain, and legumes on partially contoured or terraced land. The remainder is pasture and woodland.
  - f. Average soil loss rates = 0.02 inch per hour approximately (For PMF storm, AMC III).
2. The combined discharge rating consisted of three components: the flow through the principal spillway, the flow through the emergency spillway and the flow going over the top of the dam.
  - a. The principal spillway (concrete chute) rating was developed using the Corps of Engineers Water Surface Profile HEC-2 computer program assuming critical depth at the chute weir-crest.
  - b. The emergency spillway (earthen channel with dike) rating was developed using road-overflow methods and coefficients found in USGS TWRI, Bk 3, Ch. A5 "Measurement of Peak Discharge at Dams by Indirect Methods".

- c. The flows over the dam were determined by using the dam overtopping analyses (irregular top of dam) within the HEC-1 (Dam Safety Version) program.
- 3. Floods were routed through the reservoir using the HEC-1 (Dam Safety Version) program to determine the capabilities of the spillway and dam embankment crest. The input, output and plotted hydrographs are attached in this Section.

HAMILTON CITY  
WATER PLANT DAM  
NO. 12, NO. 10261  
OUTFLOW-RATING  
CURVES







A1 HAMILTON CITY WATER PLANT DAM/MD ID NO 10261  
A2 SAFETY ANALYSIS OF DAM OVERTOPPING USING ASSIGNED FLOOD FREQUENCIES  
A3 H & H ANALYSIS BY RCUTING PMF RATIOS THRU THE RESERVOIR  
2880000000000000010 000000000000000000003

[illegible]

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

RUN DATE= 80/07/25.  
 TIME= 13.29.56.

HAMILTON CITY WATER PLANT DAM/NO ID NO 10261  
 SAFETY ANALYSIS OF DAM OVERTOPPING USING ASSIGNED FLOOD FREQUENCIES  
 H & H ANALYSIS BY ROUTING PMF RATIOS THRU THE RESERVOIR

| JOB SPECIFICATION |     |      |       |     |       |       |      |      |       |
|-------------------|-----|------|-------|-----|-------|-------|------|------|-------|
| NQ                | NHR | NMIN | IDAY  | IHR | IMIN  | METRC | IPLT | IPRT | NSTAN |
| 288               | 0   | 10   | 0     | 0   | 0     | 0     | 0    | 3    | 0     |
|                   |     |      | JOPER | NMT | LROPT | TRACE |      |      |       |
|                   |     |      | 5     | 0   | 0     | 0     |      |      |       |

MULTI-PLAN ANALYSES TO BE PERFORMED

NPLAN= 1 NRTIO= 8 LRTIO= 1  
 RTIOS= .05 .10 .15 .20 .25 .50 .75 1.00

\*\*\*\*\*

SUB-AREA RUNOFF COMPUTATION

CALCULATION OF INFLOW HYDRO TO RESERVOIR 10261

| ISTAQ  | ICOMP | IECON | ITAPE | JPLT | JPRT | INAME | ISTAGE | TAUTO |
|--------|-------|-------|-------|------|------|-------|--------|-------|
| 000001 | 0     | 0     | 0     | 0    | 0    | 1     | 0      | 0     |

HYDROGRAPH DATA

| IHYDG | IUNG | TAREA | SNAP | TRSDA | TRSPC | RATIO | ISNOM | ISAME | LOCAL |
|-------|------|-------|------|-------|-------|-------|-------|-------|-------|
| 1     | 2    | 1.78  | 0.00 | 1.78  | 1.00  | 0.000 | 0     | 1     | 0     |

PRECIP DATA

| SPFE | PM5   | R6     | R12    | R24    | R48    | R72  | R96  |
|------|-------|--------|--------|--------|--------|------|------|
| 0.00 | 24.20 | 102.00 | 121.00 | 130.00 | 140.00 | 0.00 | 0.00 |

LOSS DATA

| LROPT | STKR | DLTKR | RTIOL | ERATN | STRS | RTIOK | STRTL | CNSTL  | ALSMX | RTIMP |
|-------|------|-------|-------|-------|------|-------|-------|--------|-------|-------|
| 0     | 0.00 | 0.00  | 1.00  | 0.00  | 0.00 | 1.00  | -1.00 | -92.00 | 0.00  | 0.00  |

CURVE NO = -92.00 WEINSS = -1.00 EFFECT CN = 92.00

UNIT HYDROGRAPH DATA  
 TC= 0.00 LAG= .56

RECESSION DATA

STRTQ= 0.00 QRCSN= -.01 RTIOR= 1.00

UNIT HYDROGRAPH 19 END OF PERIOD ORDINATES, IC= 0.00 HOURS, LAG= .56 VOL= 1.00  
 204. 670. 1205. 1331. 1157. 829. 515. 342. 227. 148.  
 97. 64. 42. 27. 18. 13. 8. 5. 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  | 1.10  | 1      | .00  | 0.00 | .00  | 0.     | 1.02  | 1.10  | 145    | .02  | .02  | .00  | 22.    |
| 1.01  | 1.20  | 2      | .00  | 0.00 | .00  | 0.     | 1.02  | 1.20  | 146    | .02  | .02  | .00  | 35.    |
| 1.01  | 1.30  | 3      | .00  | 0.00 | .00  | 0.     | 1.02  | 1.30  | 147    | .02  | .02  | .00  | 59.    |
| 1.01  | 1.40  | 4      | .00  | 0.00 | .00  | 0.     | 1.02  | 1.40  | 148    | .02  | .02  | .00  | 85.    |
| 1.01  | 1.50  | 5      | .00  | 0.00 | .00  | 0.     | 1.02  | 1.50  | 149    | .02  | .02  | .00  | 108.   |
| 1.01  | 1.00  | 6      | .00  | 0.00 | .00  | 0.     | 1.02  | 1.00  | 150    | .02  | .02  | .00  | 125.   |
| 1.01  | 1.10  | 7      | .00  | 0.00 | .00  | 0.     | 1.02  | 1.10  | 151    | .02  | .02  | .00  | 135.   |
| 1.01  | 1.20  | 8      | .00  | 0.00 | .00  | 0.     | 1.02  | 1.20  | 152    | .02  | .02  | .00  | 142.   |
| 1.01  | 1.30  | 9      | .00  | 0.00 | .00  | 0.     | 1.02  | 1.30  | 153    | .02  | .02  | .00  | 147.   |
| 1.01  | 1.40  | 10     | .00  | 0.00 | .00  | 0.     | 1.02  | 1.40  | 154    | .02  | .02  | .00  | 150.   |
| 1.01  | 1.50  | 11     | .00  | 0.00 | .00  | 0.     | 1.02  | 1.50  | 155    | .02  | .02  | .00  | 152.   |
| 1.01  | 2.00  | 12     | .00  | 0.00 | .00  | 0.     | 1.02  | 2.00  | 156    | .02  | .02  | .00  | 153.   |
| 1.01  | 2.10  | 13     | .00  | 0.00 | .00  | 0.     | 1.02  | 2.10  | 157    | .02  | .02  | .00  | 154.   |
| 1.01  | 2.20  | 14     | .00  | 0.00 | .00  | 0.     | 1.02  | 2.20  | 158    | .02  | .02  | .00  | 155.   |
| 1.01  | 2.30  | 15     | .00  | 0.00 | .00  | 0.     | 1.02  | 2.30  | 159    | .02  | .02  | .00  | 155.   |
| 1.01  | 2.40  | 16     | .00  | 0.00 | .00  | 0.     | 1.02  | 2.40  | 160    | .02  | .02  | .00  | 156.   |
| 1.01  | 2.50  | 17     | .00  | 0.00 | .00  | 0.     | 1.02  | 2.50  | 161    | .02  | .02  | .00  | 156.   |
| 1.01  | 3.00  | 18     | .00  | 0.00 | .00  | 0.     | 1.02  | 3.00  | 162    | .02  | .02  | .00  | 156.   |
| 1.01  | 3.10  | 19     | .00  | 0.00 | .00  | 0.     | 1.02  | 3.10  | 163    | .02  | .02  | .00  | 156.   |
| 1.01  | 3.20  | 20     | .00  | 0.00 | .00  | 0.     | 1.02  | 3.20  | 164    | .02  | .02  | .00  | 157.   |
| 1.01  | 3.30  | 21     | .00  | 0.00 | .00  | 0.     | 1.02  | 3.30  | 165    | .02  | .02  | .00  | 157.   |
| 1.01  | 3.40  | 22     | .00  | 0.00 | .00  | 0.     | 1.02  | 3.40  | 166    | .02  | .02  | .00  | 157.   |
| 1.01  | 3.50  | 23     | .00  | 0.00 | .00  | 0.     | 1.02  | 3.50  | 167    | .02  | .02  | .00  | 157.   |
| 1.01  | 4.00  | 24     | .00  | 0.00 | .00  | 0.     | 1.02  | 4.00  | 168    | .02  | .02  | .00  | 157.   |
| 1.01  | 4.10  | 25     | .00  | 0.00 | .00  | 0.     | 1.02  | 4.10  | 169    | .02  | .02  | .00  | 157.   |
| 1.01  | 4.20  | 26     | .00  | 0.00 | .00  | 0.     | 1.02  | 4.20  | 170    | .02  | .02  | .00  | 157.   |
| 1.01  | 4.30  | 27     | .00  | 0.00 | .00  | 0.     | 1.02  | 4.30  | 171    | .02  | .02  | .00  | 158.   |
| 1.01  | 4.40  | 28     | .00  | 0.00 | .00  | 0.     | 1.02  | 4.40  | 172    | .02  | .02  | .00  | 158.   |
| 1.01  | 4.50  | 29     | .00  | 0.00 | .00  | 0.     | 1.02  | 4.50  | 173    | .02  | .02  | .00  | 158.   |
| 1.01  | 5.00  | 30     | .00  | 0.00 | .00  | 0.     | 1.02  | 5.00  | 174    | .02  | .02  | .00  | 158.   |
| 1.01  | 5.10  | 31     | .00  | 0.00 | .00  | 0.     | 1.02  | 5.10  | 175    | .02  | .02  | .00  | 158.   |
| 1.01  | 5.20  | 32     | .00  | 0.00 | .00  | 0.     | 1.02  | 5.20  | 176    | .02  | .02  | .00  | 158.   |
| 1.01  | 5.30  | 33     | .00  | 0.00 | .00  | 0.     | 1.02  | 5.30  | 177    | .02  | .02  | .00  | 158.   |
| 1.01  | 5.40  | 34     | .00  | 0.00 | .00  | 0.     | 1.02  | 5.40  | 178    | .02  | .02  | .00  | 158.   |
| 1.01  | 5.50  | 35     | .00  | 0.00 | .00  | 0.     | 1.02  | 5.50  | 179    | .02  | .02  | .00  | 158.   |
| 1.01  | 6.00  | 36     | .00  | 0.00 | .00  | 0.     | 1.02  | 6.00  | 180    | .02  | .02  | .00  | 159.   |
| 1.01  | 6.10  | 37     | .01  | 0.00 | .01  | 0.     | 1.02  | 6.10  | 181    | .13  | .12  | .01  | 179.   |
| 1.01  | 6.20  | 38     | .01  | 0.00 | .01  | 0.     | 1.02  | 6.20  | 182    | .13  | .12  | .01  | 252.   |
| 1.01  | 6.30  | 39     | .01  | 0.00 | .01  | 0.     | 1.02  | 6.30  | 183    | .13  | .12  | .01  | 365.   |
| 1.01  | 6.40  | 40     | .01  | 0.00 | .01  | 0.     | 1.02  | 6.40  | 184    | .13  | .12  | .00  | 497.   |
| 1.01  | 6.50  | 41     | .01  | 0.00 | .01  | 0.     | 1.02  | 6.50  | 185    | .13  | .12  | .00  | 612.   |
| 1.01  | 7.00  | 42     | .01  | 0.00 | .01  | 0.     | 1.02  | 7.00  | 186    | .13  | .12  | .00  | 646.   |
| 1.01  | 7.10  | 43     | .01  | 0.00 | .01  | 0.     | 1.02  | 7.10  | 187    | .13  | .12  | .00  | 748.   |
| 1.01  | 7.20  | 44     | .01  | 0.00 | .01  | 0.     | 1.02  | 7.20  | 188    | .13  | .12  | .00  | 783.   |
| 1.01  | 7.30  | 45     | .01  | 0.00 | .01  | 0.     | 1.02  | 7.30  | 189    | .13  | .12  | .00  | 807.   |
| 1.01  | 7.40  | 46     | .01  | 0.00 | .01  | 0.     | 1.02  | 7.40  | 190    | .13  | .12  | .00  | 824.   |
| 1.01  | 7.50  | 47     | .01  | 0.00 | .01  | 0.     | 1.02  | 7.50  | 191    | .13  | .12  | .00  | 835.   |
| 1.01  | 8.00  | 48     | .01  | 0.00 | .01  | 0.     | 1.02  | 8.00  | 192    | .13  | .12  | .00  | 842.   |
| 1.01  | 8.10  | 49     | .01  | 0.00 | .01  | 0.     | 1.02  | 8.10  | 193    | .13  | .12  | .00  | 848.   |
| 1.01  | 8.20  | 50     | .01  | 0.00 | .01  | 1.     | 1.02  | 8.20  | 194    | .13  | .12  | .00  | 852.   |
| 1.01  | 8.30  | 51     | .01  | 0.00 | .01  | 1.     | 1.02  | 8.30  | 195    | .13  | .12  | .00  | 855.   |
| 1.01  | 8.40  | 52     | .01  | 0.00 | .01  | 2.     | 1.02  | 8.40  | 196    | .13  | .13  | .00  | 857.   |
| 1.01  | 8.50  | 53     | .01  | 0.00 | .01  | 3.     | 1.02  | 8.50  | 197    | .13  | .13  | .00  | 859.   |
| 1.01  | 9.00  | 54     | .01  | 0.00 | .01  | 4.     | 1.02  | 9.00  | 198    | .13  | .13  | .00  | 861.   |
| 1.01  | 9.10  | 55     | .01  | 0.00 | .01  | 5.     | 1.02  | 9.10  | 199    | .13  | .13  | .00  | 862.   |
| 1.01  | 9.20  | 56     | .01  | 0.00 | .01  | 7.     | 1.02  | 9.20  | 200    | .13  | .13  | .00  | 862.   |
| 1.01  | 9.30  | 57     | .01  | 0.00 | .01  | 8.     | 1.02  | 9.30  | 201    | .13  | .13  | .00  | 863.   |
| 1.01  | 9.40  | 58     | .01  | 0.00 | .01  | 8.     | 1.02  | 9.40  | 202    | .13  | .13  | .00  | 864.   |
| 1.01  | 9.50  | 59     | .01  | 0.00 | .01  | 10.    | 1.02  | 9.50  | 203    | .13  | .13  | .00  | 865.   |
| 1.01  | 10.00 | 60     | .01  | 0.00 | .01  | 11.    | 1.02  | 10.00 | 204    | .13  | .13  | .00  | 865.   |

|      |       |     |     |     |     |      |      |       |     |      |      |     |        |
|------|-------|-----|-----|-----|-----|------|------|-------|-----|------|------|-----|--------|
| 1.01 | 10.10 | 61  | .01 | .00 | .01 | 13.  | 1.02 | 10.10 | 205 | .13  | .13  | .00 | 866.   |
| 1.01 | 10.20 | 62  | .01 | .00 | .01 | 14.  | 1.02 | 10.20 | 206 | .13  | .13  | .00 | 866.   |
| 1.01 | 10.30 | 63  | .01 | .00 | .01 | 15.  | 1.02 | 10.30 | 207 | .13  | .13  | .00 | 867.   |
| 1.01 | 10.40 | 64  | .01 | .00 | .01 | 16.  | 1.02 | 10.40 | 208 | .13  | .13  | .00 | 868.   |
| 1.01 | 10.50 | 65  | .01 | .00 | .01 | 17.  | 1.02 | 10.50 | 209 | .13  | .13  | .00 | 868.   |
| 1.01 | 11.00 | 66  | .01 | .00 | .01 | 18.  | 1.02 | 11.00 | 210 | .13  | .13  | .00 | 869.   |
| 1.01 | 11.10 | 67  | .01 | .00 | .01 | 19.  | 1.02 | 11.10 | 211 | .13  | .13  | .00 | 869.   |
| 1.01 | 11.20 | 68  | .01 | .00 | .01 | 20.  | 1.02 | 11.20 | 212 | .13  | .13  | .00 | 869.   |
| 1.01 | 11.30 | 69  | .01 | .00 | .01 | 21.  | 1.02 | 11.30 | 213 | .13  | .13  | .00 | 870.   |
| 1.01 | 11.40 | 70  | .01 | .00 | .01 | 21.  | 1.02 | 11.40 | 214 | .13  | .13  | .00 | 870.   |
| 1.01 | 11.50 | 71  | .01 | .00 | .01 | 22.  | 1.02 | 11.50 | 215 | .13  | .13  | .00 | 871.   |
| 1.01 | 12.00 | 72  | .01 | .00 | .01 | 23.  | 1.02 | 12.00 | 216 | .13  | .13  | .00 | 871.   |
| 1.01 | 12.10 | 73  | .03 | .01 | .02 | 26.  | 1.02 | 12.10 | 217 | .41  | .41  | .00 | 928.   |
| 1.01 | 12.20 | 74  | .03 | .01 | .02 | 33.  | 1.02 | 12.20 | 218 | .41  | .41  | .00 | 1117.  |
| 1.01 | 12.30 | 75  | .03 | .01 | .02 | 45.  | 1.02 | 12.30 | 219 | .41  | .41  | .00 | 1456.  |
| 1.01 | 12.40 | 76  | .03 | .02 | .02 | 60.  | 1.02 | 12.40 | 220 | .41  | .41  | .00 | 1831.  |
| 1.01 | 12.50 | 77  | .03 | .02 | .02 | 74.  | 1.02 | 12.50 | 221 | .41  | .41  | .00 | 2157.  |
| 1.01 | 13.00 | 78  | .03 | .02 | .01 | 86.  | 1.02 | 13.00 | 222 | .41  | .41  | .00 | 2391.  |
| 1.01 | 13.10 | 79  | .04 | .02 | .02 | 96.  | 1.02 | 13.10 | 223 | .49  | .49  | .00 | 2554.  |
| 1.01 | 13.20 | 80  | .04 | .02 | .02 | 106. | 1.02 | 13.20 | 224 | .49  | .49  | .00 | 2706.  |
| 1.01 | 13.30 | 81  | .04 | .02 | .01 | 118. | 1.02 | 13.30 | 225 | .49  | .49  | .00 | 2870.  |
| 1.01 | 13.40 | 82  | .04 | .02 | .01 | 129. | 1.02 | 13.40 | 226 | .49  | .49  | .00 | 3022.  |
| 1.01 | 13.50 | 83  | .04 | .02 | .01 | 140. | 1.02 | 13.50 | 227 | .49  | .49  | .00 | 3145.  |
| 1.01 | 14.00 | 84  | .04 | .03 | .01 | 149. | 1.02 | 14.00 | 228 | .49  | .49  | .00 | 3233.  |
| 1.01 | 14.10 | 85  | .05 | .03 | .01 | 158. | 1.02 | 14.10 | 229 | .62  | .61  | .00 | 3313.  |
| 1.01 | 14.20 | 86  | .05 | .03 | .01 | 169. | 1.02 | 14.20 | 230 | .62  | .62  | .00 | 3432.  |
| 1.01 | 14.30 | 87  | .05 | .03 | .01 | 183. | 1.02 | 14.30 | 231 | .62  | .62  | .00 | 3605.  |
| 1.01 | 14.40 | 88  | .05 | .04 | .01 | 197. | 1.02 | 14.40 | 232 | .62  | .62  | .00 | 3786.  |
| 1.01 | 14.50 | 89  | .05 | .04 | .01 | 210. | 1.02 | 14.50 | 233 | .62  | .62  | .00 | 3939.  |
| 1.01 | 15.00 | 90  | .05 | .04 | .01 | 221. | 1.02 | 15.00 | 234 | .62  | .62  | .00 | 4049.  |
| 1.01 | 15.10 | 91  | .04 | .03 | .01 | 229. | 1.02 | 15.10 | 235 | .56  | .56  | .00 | 4106.  |
| 1.01 | 15.20 | 92  | .07 | .06 | .02 | 238. | 1.02 | 15.20 | 236 | .94  | .94  | .00 | 4191.  |
| 1.01 | 15.30 | 93  | .13 | .11 | .02 | 266. | 1.02 | 15.30 | 237 | 1.69 | 1.69 | .00 | 4559.  |
| 1.01 | 15.40 | 94  | .32 | .27 | .05 | 360. | 1.02 | 15.40 | 238 | 4.22 | 4.21 | .01 | 5975.  |
| 1.01 | 15.50 | 95  | .09 | .08 | .01 | 523. | 1.02 | 15.50 | 239 | 1.22 | 1.22 | .00 | 8411.  |
| 1.01 | 16.00 | 96  | .06 | .05 | .01 | 682. | 1.02 | 16.00 | 240 | .75  | .75  | .00 | 10751. |
| 1.01 | 16.10 | 97  | .04 | .04 | .01 | 727. | 1.02 | 16.10 | 241 | .58  | .58  | .00 | 11312. |
| 1.01 | 16.20 | 98  | .04 | .04 | .00 | 673. | 1.02 | 16.20 | 242 | .58  | .58  | .00 | 10367. |
| 1.01 | 16.30 | 99  | .04 | .04 | .00 | 568. | 1.02 | 16.30 | 243 | .58  | .58  | .00 | 8666.  |
| 1.01 | 16.40 | 100 | .04 | .04 | .00 | 466. | 1.02 | 16.40 | 244 | .58  | .58  | .00 | 7045.  |
| 1.01 | 16.50 | 101 | .04 | .04 | .00 | 400. | 1.02 | 16.50 | 245 | .58  | .58  | .00 | 5999.  |
| 1.01 | 17.00 | 102 | .04 | .04 | .00 | 357. | 1.02 | 17.00 | 246 | .58  | .58  | .00 | 5307.  |
| 1.01 | 17.10 | 103 | .03 | .03 | .00 | 327. | 1.02 | 17.10 | 247 | .45  | .45  | .00 | 4820.  |
| 1.01 | 17.20 | 104 | .03 | .03 | .00 | 303. | 1.02 | 17.20 | 248 | .45  | .45  | .00 | 4437.  |
| 1.01 | 17.30 | 105 | .03 | .03 | .00 | 281. | 1.02 | 17.30 | 249 | .45  | .45  | .00 | 4091.  |
| 1.01 | 17.40 | 106 | .03 | .03 | .00 | 262. | 1.02 | 17.40 | 250 | .45  | .45  | .00 | 3798.  |
| 1.01 | 17.50 | 107 | .03 | .03 | .00 | 247. | 1.02 | 17.50 | 251 | .45  | .45  | .00 | 3570.  |
| 1.01 | 18.00 | 108 | .03 | .03 | .00 | 238. | 1.02 | 18.00 | 252 | .45  | .45  | .00 | 3413.  |
| 1.01 | 18.10 | 109 | .00 | .00 | .00 | 226. | 1.02 | 18.10 | 253 | .04  | .04  | .00 | 3231.  |
| 1.01 | 18.20 | 110 | .00 | .00 | .00 | 202. | 1.02 | 18.20 | 254 | .04  | .04  | .00 | 2885.  |
| 1.01 | 18.30 | 111 | .00 | .00 | .00 | 164. | 1.02 | 18.30 | 255 | .04  | .04  | .00 | 2334.  |
| 1.01 | 18.40 | 112 | .00 | .00 | .00 | 122. | 1.02 | 18.40 | 256 | .04  | .04  | .00 | 1745.  |
| 1.01 | 18.50 | 113 | .00 | .00 | .00 | 87.  | 1.02 | 18.50 | 257 | .04  | .04  | .00 | 1245.  |
| 1.01 | 19.00 | 114 | .00 | .00 | .00 | 63.  | 1.02 | 19.00 | 258 | .04  | .04  | .00 | 891.   |
| 1.01 | 19.10 | 115 | .00 | .00 | .00 | 47.  | 1.02 | 19.10 | 259 | .04  | .04  | .00 | 671.   |
| 1.01 | 19.20 | 116 | .00 | .00 | .00 | 37.  | 1.02 | 19.20 | 260 | .04  | .04  | .00 | 526.   |
| 1.01 | 19.30 | 117 | .00 | .00 | .00 | 30.  | 1.02 | 19.30 | 261 | .04  | .04  | .00 | 429.   |
| 1.01 | 19.40 | 118 | .00 | .00 | .00 | 26.  | 1.02 | 19.40 | 262 | .04  | .04  | .00 | 366.   |
| 1.01 | 19.50 | 119 | .00 | .00 | .00 | 23.  | 1.02 | 19.50 | 263 | .04  | .04  | .00 | 325.   |
| 1.01 | 20.00 | 120 | .00 | .00 | .00 | 21.  | 1.02 | 20.00 | 264 | .04  | .04  | .00 | 298.   |
| 1.01 | 20.10 | 121 | .00 | .00 | .00 | 20.  | 1.02 | 20.10 | 265 | .04  | .04  | .00 | 280.   |
| 1.01 | 20.20 | 122 | .00 | .00 | .00 | 19.  | 1.02 | 20.20 | 266 | .04  | .04  | .00 | 269.   |

|                              |       |     |     |     |     |     |      |       |     |                                |     |     |      |
|------------------------------|-------|-----|-----|-----|-----|-----|------|-------|-----|--------------------------------|-----|-----|------|
| 1.01                         | 20.30 | 123 | .00 | .00 | .00 | 18. | 1.02 | 20.30 | 267 | .04                            | .04 | .00 | 262. |
| 1.01                         | 20.40 | 124 | .00 | .00 | .00 | 18. | 1.02 | 20.40 | 268 | .04                            | .04 | .00 | 256. |
| 1.01                         | 20.50 | 125 | .00 | .00 | .00 | 18. | 1.02 | 20.50 | 269 | .04                            | .04 | .00 | 253. |
| 1.01                         | 21.00 | 126 | .00 | .00 | .00 | 18. | 1.02 | 21.00 | 270 | .04                            | .04 | .00 | 251. |
| 1.01                         | 21.10 | 127 | .00 | .00 | .00 | 18. | 1.02 | 21.10 | 271 | .04                            | .04 | .00 | 250. |
| 1.01                         | 21.20 | 128 | .00 | .00 | .00 | 18. | 1.02 | 21.20 | 272 | .04                            | .04 | .00 | 250. |
| 1.01                         | 21.30 | 129 | .00 | .00 | .00 | 18. | 1.02 | 21.30 | 273 | .04                            | .04 | .00 | 250. |
| 1.01                         | 21.40 | 130 | .00 | .00 | .00 | 18. | 1.02 | 21.40 | 274 | .04                            | .04 | .00 | 250. |
| 1.01                         | 21.50 | 131 | .00 | .00 | .00 | 18. | 1.02 | 21.50 | 275 | .04                            | .04 | .00 | 250. |
| 1.01                         | 22.00 | 132 | .00 | .00 | .00 | 18. | 1.02 | 22.00 | 276 | .04                            | .04 | .00 | 250. |
| 1.01                         | 22.10 | 133 | .00 | .00 | .00 | 18. | 1.02 | 22.10 | 277 | .04                            | .04 | .00 | 250. |
| 1.01                         | 22.20 | 134 | .00 | .00 | .00 | 18. | 1.02 | 22.20 | 278 | .04                            | .04 | .00 | 250. |
| 1.01                         | 22.30 | 135 | .00 | .00 | .00 | 18. | 1.02 | 22.30 | 279 | .04                            | .04 | .00 | 250. |
| 1.01                         | 22.40 | 136 | .00 | .00 | .00 | 18. | 1.02 | 22.40 | 280 | .04                            | .04 | .00 | 250. |
| 1.01                         | 22.50 | 137 | .00 | .00 | .00 | 18. | 1.02 | 22.50 | 281 | .04                            | .04 | .00 | 250. |
| 1.01                         | 23.00 | 138 | .00 | .00 | .00 | 18. | 1.02 | 23.00 | 282 | .04                            | .04 | .00 | 250. |
| 1.01                         | 23.10 | 139 | .00 | .00 | .00 | 18. | 1.02 | 23.10 | 283 | .04                            | .04 | .00 | 250. |
| 1.01                         | 23.20 | 140 | .00 | .00 | .00 | 18. | 1.02 | 23.20 | 284 | .04                            | .04 | .00 | 250. |
| 1.01                         | 23.30 | 141 | .00 | .00 | .00 | 18. | 1.02 | 23.30 | 285 | .04                            | .04 | .00 | 250. |
| 1.01                         | 23.40 | 142 | .00 | .00 | .00 | 18. | 1.02 | 23.40 | 286 | .04                            | .04 | .00 | 250. |
| 1.01                         | 23.50 | 143 | .00 | .00 | .00 | 18. | 1.02 | 23.50 | 287 | .04                            | .04 | .00 | 250. |
| 1.02                         | 0.00  | 144 | .00 | .00 | .00 | 18. | 1.03 | 0.00  | 288 | .04                            | .04 | .00 | 250. |
| SUM 33.88 32.86 1.02 225730. |       |     |     |     |     |     |      |       |     | 1.861.11.835.11 26.11 6391.961 |     |     |      |

|            |        |      |        |         |        |         |        |              |         |
|------------|--------|------|--------|---------|--------|---------|--------|--------------|---------|
| CES        | 11312. | PEAK | 4591.  | 24-HOUR | 1490.  | 72-HOUR | 783.   | TOTAL VOLUME | 225601. |
| CMS        | 320.   |      | 130.   |         | 42.    |         | 22.    |              | 6380.   |
| INCHES     |        |      | 23.95  |         | 31.09  |         | 32.69  |              | 32.69   |
| MM         |        |      | 608.33 |         | 789.61 |         | 830.45 |              | 830.45  |
| AC-FT      |        |      | 2276.  |         | 2955.  |         | 3107.  |              | 3107.   |
| THOUS CU M |        |      | 2808.  |         | 3645.  |         | 3833.  |              | 3833.   |

# HYDROGRAPH AT STA000001 FOR PLAN 1. RTIO 1

|            |      |      |       |         |       |         |       |              |        |
|------------|------|------|-------|---------|-------|---------|-------|--------------|--------|
| CES        | 566. | PEAK | 230.  | 24-HOUR | 74.   | 72-HOUR | 39.   | TOTAL VOLUME | 11280. |
| CMS        | 16.  |      | 6.    |         | 2.    |         | 1.    |              | 319.   |
| INCHES     |      |      | 1.20  |         | 1.55  |         | 1.63  |              | 1.63   |
| MM         |      |      | 30.42 |         | 39.48 |         | 41.52 |              | 41.52  |
| AC-FT      |      |      | 114.  |         | 148.  |         | 155.  |              | 155.   |
| THOUS CU M |      |      | 140.  |         | 182.  |         | 192.  |              | 192.   |

# HYDROGRAPH AT STA000001 FOR PLAN 1. RTIO 2

|            |       |      |       |         |       |         |       |              |        |
|------------|-------|------|-------|---------|-------|---------|-------|--------------|--------|
| CES        | 1131. | PEAK | 459.  | 24-HOUR | 149.  | 72-HOUR | 78.   | TOTAL VOLUME | 22560. |
| CMS        | 32.   |      | 13.   |         | 4.    |         | 2.    |              | 639.   |
| INCHES     |       |      | 2.39  |         | 3.11  |         | 3.27  |              | 3.27   |
| MM         |       |      | 60.83 |         | 78.96 |         | 83.04 |              | 83.04  |
| AC-FT      |       |      | 228.  |         | 295.  |         | 311.  |              | 311.   |
| THOUS CU M |       |      | 281.  |         | 364.  |         | 383.  |              | 383.   |

# HYDROGRAPH AT STA000001 FOR PLAN 1. RTIO 3

|            | PEAK  | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|------------|-------|--------|---------|---------|--------------|
| CFS        | 1697. | 689.   | 723.    | 118.    | 33840.       |
| CMS        | 48.   | 19.    | 6.      | 3.      | 958.         |
| INCHES     |       | 3.59   | 4.66    | 4.90    | 4.90         |
| MM         |       | 91.25  | 118.44  | 124.57  | 124.57       |
| AC-FT      |       | 341.   | 443.    | 466.    | 466.         |
| THOUS CU M |       | 421.   | 547.    | 575.    | 575.         |

#### HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 4

|            | PEAK  | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|------------|-------|--------|---------|---------|--------------|
| CFS        | 2262. | 918.   | 298.    | 157.    | 45120.       |
| CMS        | 64.   | 26.    | 8.      | 4.      | 1278.        |
| INCHES     |       | 4.79   | 6.22    | 6.54    | 6.54         |
| MM         |       | 121.67 | 157.92  | 166.09  | 166.09       |
| AC-FT      |       | 455.   | 591.    | 621.    | 621.         |
| THOUS CU M |       | 562.   | 729.    | 767.    | 767.         |

#### HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 5

|            | PEAK  | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|------------|-------|--------|---------|---------|--------------|
| CFS        | 3959. | 1607.  | 521.    | 274.    | 78960.       |
| CMS        | 112.  | 45.    | 15.     | 8.      | 2236.        |
| INCHES     |       | 8.38   | 10.88   | 11.44   | 11.44        |
| MM         |       | 212.91 | 276.37  | 290.66  | 290.66       |
| AC-FT      |       | 797.   | 1034.   | 1088.   | 1088.        |
| THOUS CU M |       | 983.   | 1276.   | 1342.   | 1342.        |

#### HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 6 $\frac{1}{2}$ PM F

|            | PEAK  | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|------------|-------|--------|---------|---------|--------------|
| CFS        | 5656. | 2295.  | 745.    | 392.    | 112800.      |
| CMS        | 160.  | 65.    | 21.     | 11.     | 3194.        |
| INCHES     |       | 11.97  | 15.54   | 16.35   | 16.35        |
| MM         |       | 304.16 | 394.81  | 415.22  | 415.22       |
| AC-FT      |       | 1138.  | 1477.   | 1554.   | 1554.        |
| THOUS CU M |       | 1404.  | 1822.   | 1916.   | 1916.        |

#### HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 7

|            | PEAK  | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|------------|-------|--------|---------|---------|--------------|
| CFS        | 8484. | 3443.  | 1117.   | 588.    | 169201.      |
| CMS        | 240.  | 97.    | 32.     | 17.     | 4791.        |
| INCHES     |       | 17.96  | 23.32   | 24.52   | 24.52        |
| MM         |       | 456.24 | 592.21  | 622.84  | 622.84       |
| AC-FT      |       | 1707.  | 2216.   | 2331.   | 2331.        |
| THOUS CU M |       | 2106.  | 2733.   | 2875.   | 2875.        |

#### HYDROGRAPH AT STA000001 FOR PLAN 1, RTIO 8 PM F

|     | PEAK   | 6-HOUR | 24-HOUR | 72-HOUR | TOTAL VOLUME |
|-----|--------|--------|---------|---------|--------------|
| CFS | 11512. | 4591.  | 1490.   | 783.    | 225601.      |

CMS 320. 130. 42. 22. 6388.  
 INCHES 23.95 31.09 32.69 32.69  
 MM 608.33 789.61 830.45 830.45  
 AC-FI 2276. 2955. 3107. 3107.  
 THOUS CU M 2808. 3645. 3833. 3833.

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# HYDROGRAPH ROUTING

ROUTED FLOWS THRU RESERVOIR 10261

ISTAQ ICOMP IECON ITAPE JPLT JPRT INAME ISTAGE IAUTO  
 000002 1 0 0 2 0 0 0

## ROUTING DATA

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

NSTPS NSTOL LAG AMSKK X TSK STORA ISPRAT  
 1 0 0 0.000 0.000 0.000 -110. -1

STAGE 110.00 110.50 111.00 111.50 112.00 113.00 113.50 114.00 115.00 116.00

FLOW 0.00 100.00 250.00 500.00 800.00 1550.00 2050.00 2580.00 4010.00 5550.00

SURFACE AREA= 0. 3. 16. 39. 73. 98. 130. 171.

CAPACITY= 0. 5. 91. 358. 909. 1335. 1903. 2653.

ELEVATION= 75. 80. 90. 100. 110. 115. 120. 125.

CREL SPWID COQW EXPW ELEV COQL CAREA EXPL  
 110.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0 0.0

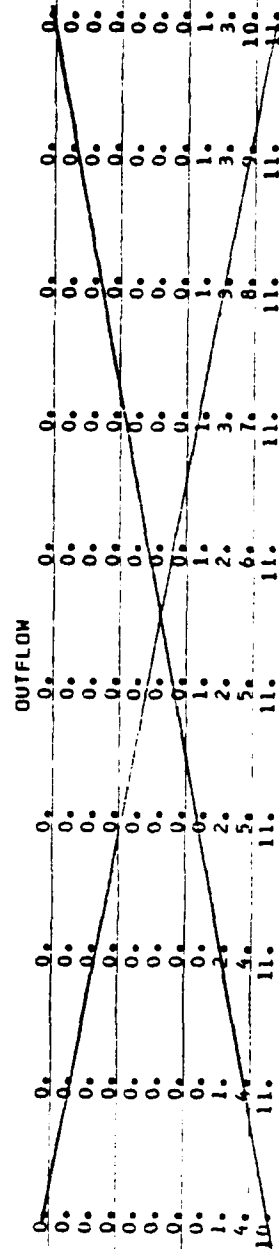
## DAM DATA

TOPEL COQD EXPD DAMHID  
 113.7 2.8 1.5 1200.

CREST LENGTH 0. 44. 200. 325. 675. 825. 1015. 1100. 1200. 1300.  
 AT OR BELOW  
 ELEVATION 113.7 113.9 114.2 114.4 115.0 115.0 115.1 115.2 115.5 116.3

STATION 000002 PLAN 1:1 RATIO 1

END OF PERIOD HYDROGRAPH ORIGINATES



$\frac{1}{2} \text{ pmf}$ 

STATION 000002, PLAN 1, RATIO 6

END-OF-PERIOD HYDROGRAPH ORDINATES

[illegible]

| STORAGE |       |       |       |       |       |       |       |       |       |       |       |
|---------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 909.    | 909.  | 909.  | 909.  | 909.  | 909.  | 909.  | 909.  | 909.  | 909.  | 909.  | 909.  |
| 909.    | 909.  | 909.  | 909.  | 909.  | 909.  | 909.  | 909.  | 909.  | 909.  | 909.  | 909.  |
| 909.    | 909.  | 909.  | 909.  | 909.  | 909.  | 909.  | 909.  | 909.  | 909.  | 909.  | 909.  |
| 909.    | 909.  | 909.  | 909.  | 909.  | 909.  | 909.  | 909.  | 909.  | 909.  | 909.  | 909.  |
| 909.    | 909.  | 909.  | 909.  | 909.  | 909.  | 909.  | 909.  | 909.  | 909.  | 909.  | 909.  |
| 909.    | 909.  | 909.  | 909.  | 909.  | 909.  | 909.  | 909.  | 909.  | 909.  | 909.  | 909.  |
| 910.    | 910.  | 910.  | 910.  | 910.  | 910.  | 910.  | 910.  | 910.  | 910.  | 910.  | 910.  |
| 911.    | 911.  | 911.  | 911.  | 911.  | 911.  | 911.  | 911.  | 911.  | 911.  | 911.  | 911.  |
| 914.    | 915.  | 916.  | 917.  | 918.  | 918.  | 918.  | 918.  | 918.  | 918.  | 918.  | 918.  |
| 924.    | 925.  | 926.  | 927.  | 928.  | 929.  | 930.  | 931.  | 932.  | 933.  | 934.  | 935.  |
| 947.    | 948.  | 949.  | 950.  | 951.  | 952.  | 953.  | 954.  | 955.  | 956.  | 957.  | 958.  |
| 950.    | 951.  | 952.  | 953.  | 954.  | 955.  | 956.  | 957.  | 958.  | 959.  | 960.  | 961.  |
| 940.    | 939.  | 938.  | 937.  | 936.  | 935.  | 934.  | 933.  | 932.  | 931.  | 930.  | 929.  |
| 922.    | 921.  | 920.  | 919.  | 918.  | 917.  | 916.  | 915.  | 914.  | 913.  | 912.  | 911.  |
| 926.    | 925.  | 924.  | 923.  | 922.  | 921.  | 920.  | 919.  | 918.  | 917.  | 916.  | 915.  |
| 924.    | 923.  | 922.  | 921.  | 920.  | 919.  | 918.  | 917.  | 916.  | 915.  | 914.  | 913.  |
| 928.    | 927.  | 926.  | 925.  | 924.  | 923.  | 922.  | 921.  | 920.  | 919.  | 918.  | 917.  |
| 931.    | 930.  | 929.  | 928.  | 927.  | 926.  | 925.  | 924.  | 923.  | 922.  | 921.  | 920.  |
| 934.    | 933.  | 932.  | 931.  | 930.  | 929.  | 928.  | 927.  | 926.  | 925.  | 924.  | 923.  |
| 962.    | 961.  | 960.  | 959.  | 958.  | 957.  | 956.  | 955.  | 954.  | 953.  | 952.  | 951.  |
| 990.    | 989.  | 988.  | 987.  | 986.  | 985.  | 984.  | 983.  | 982.  | 981.  | 980.  | 979.  |
| 1025.   | 1024. | 1023. | 1022. | 1021. | 1020. | 1019. | 1018. | 1017. | 1016. | 1015. | 1014. |
| 1111.   | 1110. | 1109. | 1108. | 1107. | 1106. | 1105. | 1104. | 1103. | 1102. | 1101. | 1100. |



◆OVF◆

STATION000002

|          | 0. | 1000. | 2000. | 3000. | 4000. | 5000. | 6000. | 0. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
|----------|----|-------|-------|-------|-------|-------|-------|----|----|----|----|----|----|----|----|
| 10 11    | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 20 21    | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 30 31    | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 40 41    | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 50 51    | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 1.00 61  | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 1.10 71  | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 1.20 81  | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 1.30 91  | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 1.40 101 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 1.50 111 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 2.00 121 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 2.10 131 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 2.20 141 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 2.30 151 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 2.40 161 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 2.50 171 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 3.00 181 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 3.10 191 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 3.20 201 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 3.30 211 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 3.40 221 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 3.50 231 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 4.00 241 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 4.10 251 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 4.20 261 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 4.30 271 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 4.40 281 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 4.50 291 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 5.00 301 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 5.10 311 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 5.20 321 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 5.30 331 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 5.40 341 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 5.50 351 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 6.00 361 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 6.10 371 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 6.20 381 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 6.30 391 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 6.40 401 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 6.50 411 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 7.00 421 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 7.10 431 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 7.20 441 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 7.30 451 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 7.40 461 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 7.50 471 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 8.00 481 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 8.10 491 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 8.20 501 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 8.30 511 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 8.40 521 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 8.50 531 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 9.00 541 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 9.10 551 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |
| 9.20 561 | .  | .     | .     | .     | .     | .     | .     | .  | .  | .  | .  | .  | .  | .  | .  |

9.30 571  
9.40 581  
9.50 591  
10.00 601  
10.10 611  
10.20 621  
10.30 631  
10.40 641  
10.50 651  
11.00 661  
11.10 671  
11.20 681  
11.30 691  
11.40 701  
11.50 711  
12.00 721  
12.10 731  
12.20 741  
12.30 751  
12.40 761  
12.50 771  
13.00 781  
13.10 791  
13.20 801  
13.30 811  
13.40 821  
13.50 831  
14.00 841  
14.10 851  
14.20 861  
14.30 871  
14.40 881  
14.50 891  
15.00 901  
15.10 911  
15.20 921  
15.30 931  
15.40 941  
15.50 951  
16.00 961  
16.10 971  
16.20 981  
16.30 991  
16.40 1001  
16.50 1011  
17.00 1021  
17.10 1031  
17.20 1041  
17.30 1051  
17.40 1061  
17.50 1071  
18.00 1081  
18.10 1091  
18.20 1101  
18.30 1111  
18.40 1121  
18.50 1131  
19.00 1141  
19.10 1151  
19.20 1161  
19.30 1171  
19.40 1181



6.10181.1  
6.20182.1  
6.30183.01  
6.40184.01  
6.50185.0  
7.00186.0  
7.10187.0  
7.20188.0  
7.30189.0  
7.40190.0  
7.50191.0  
8.00192.0  
8.10193.0  
8.20194.0  
8.30195.0  
8.40196.0  
8.50197.0  
9.00198.0  
9.10199.0  
9.20200.0  
9.30201.0  
9.40202.0  
9.50203.0  
10.00204.0  
10.10205.0  
10.20206.0  
10.30207.0  
10.40208.0  
10.50209.0  
11.00210.0  
11.10211.0  
11.20212.0  
11.30213.0  
11.40214.0  
11.50215.0  
12.00216.0  
12.10217.0  
12.20218.0  
12.30219.0  
12.40220.0  
12.50221.0  
13.00222.0  
13.10223.0  
13.20224.0  
13.30225.0  
13.40226.0  
13.50227.0  
14.00228.0  
14.10229.0  
14.20230.0  
14.30231.0  
14.40232.0  
14.50233.0  
15.00234.0  
15.10235.0  
15.20236.0  
15.30237.0  
15.40238.0  
15.50239.0  
16.00240.0  
16.10241.0  
16.20242.0

PLATE D-19

STATION 000002, PLAN 1, RATIO 8

END-OF-PERIOD HYDROGRAPH ORDINATES

[illegible][illegible]

## STAGE

PEAK OUTFLOW IS 10503. AT TIME 40.33 HOURS

PLATE D-21

\*0VF\*

STATION000002

|      | 0.  | 2000. | 4000. | 6000. | 8000. | 10000. | 12000. | 0. | 0. | 0. | 0. | 0. | 0. | 0. |
|------|-----|-------|-------|-------|-------|--------|--------|----|----|----|----|----|----|----|
| •10  | 11  |       |       |       |       |        |        |    |    |    |    |    |    |    |
| •20  | 21  |       |       |       |       |        |        |    |    |    |    |    |    |    |
| •30  | 31  |       |       |       |       |        |        |    |    |    |    |    |    |    |
| •40  | 41  |       |       |       |       |        |        |    |    |    |    |    |    |    |
| •50  | 51  |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 1.00 | 61  |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 1.10 | 71  |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 1.20 | 81  |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 1.30 | 91  |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 1.40 | 101 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 1.50 | 111 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 2.00 | 121 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 2.10 | 131 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 2.20 | 141 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 2.30 | 151 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 2.40 | 161 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 2.50 | 171 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 3.00 | 181 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 3.10 | 191 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 3.20 | 201 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 3.30 | 211 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 3.40 | 221 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 3.50 | 231 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 4.00 | 241 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 4.10 | 251 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 4.20 | 261 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 4.30 | 271 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 4.40 | 281 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 4.50 | 291 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 5.00 | 301 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 5.10 | 311 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 5.20 | 321 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 5.30 | 331 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 5.40 | 341 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 5.50 | 351 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 6.00 | 361 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 6.10 | 371 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 6.20 | 381 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 6.30 | 391 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 6.40 | 401 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 6.50 | 411 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 7.00 | 421 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 7.10 | 431 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 7.20 | 441 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 7.30 | 451 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 7.40 | 461 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 7.50 | 471 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 8.00 | 481 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 8.10 | 491 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 8.20 | 501 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 8.30 | 511 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 8.40 | 521 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 8.50 | 531 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 9.00 | 541 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 9.10 | 551 |       |       |       |       |        |        |    |    |    |    |    |    |    |
| 9.20 | 561 |       |       |       |       |        |        |    |    |    |    |    |    |    |

This image shows a full page of dot grid paper. The grid consists of small, evenly spaced black dots arranged in horizontal and vertical rows across the entire page. There are no margins, text, or other markings present.

19.5011910  
20.0012010  
20.1012110  
20.2012210  
20.3012310  
20.4012410  
20.5012510  
21.0012610  
21.1012710  
21.2012810  
21.3012910  
21.4013010  
21.5013110  
22.001321  
22.101331  
22.201341  
22.301351  
22.401361  
22.501371  
23.001381  
23.101391  
23.201401  
23.301411  
23.401421  
23.501431  
0.001441  
101451  
201461  
301471  
401481  
5014901  
1.0015001  
1.1015101  
1.2015201  
1.3015301  
1.4015401  
1.5015501  
2.0015601  
2.1015701  
2.2015801  
2.3015901  
2.4016001  
2.5016101  
3.0016201  
3.101631  
3.201641  
3.301651  
3.401661  
3.501671  
4.001681  
4.101691  
4.201701  
4.301711  
4.401721  
4.501731  
5.001741  
5.101751  
5.201761  
5.301771  
5.401781  
5.501791  
6.001801





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

| OPERATION     | STATION | AREA  | PLAN | RATIO  | RATIOS APPLIED TO FLOWS |          |          |           |           |           |           |      |
|---------------|---------|-------|------|--------|-------------------------|----------|----------|-----------|-----------|-----------|-----------|------|
|               |         |       |      |        | 1                       | 2        | 3        | 4         | 5         | 6         | 7         | 8    |
|               |         |       |      |        | .05                     | .10      | .15      | .20       | .35       | .50       | .75       | 1.00 |
| HYDROGRAPH AT | 000001  | 1.78  | 1    | 566.   | 1131.                   | 1697.    | 2262.    | 3959.     | 5656.     | 8484.     | 11312.    |      |
|               | (       | 4.62) | (    | 16.02) | ( 32.03)                | ( 48.05) | ( 64.07) | ( 112.12) | ( 160.17) | ( 240.25) | ( 320.33) |      |
| ROUTED TO     | 000002  | 1.78  | 1    | 219.   | 543.                    | 895.     | 1258.    | 2418.     | 4082.     | 7418.     | 10503.    |      |
|               | (       | 4.62) | (    | 6.20)  | ( 15.36)                | ( 25.36) | ( 35.61) | ( 68.46)  | ( 115.58) | ( 210.07) | ( 297.42) |      |

# SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 .....

|                                 |                                       |                                        |                                        |
|---------------------------------|---------------------------------------|----------------------------------------|----------------------------------------|
| ELEVATION<br>STORAGE<br>OUTFLOW | INITIAL VALUE<br>110.00<br>909.<br>0. | SPILLWAY CREST<br>110.00<br>909.<br>0. | TOP OF DAM<br>113.70<br>1212.<br>2262. |
|---------------------------------|---------------------------------------|----------------------------------------|----------------------------------------|

| RATIO<br>OF<br>PMF | MAXIMUM<br>RESERVOIR<br>W.S. ELEV | MAXIMUM<br>DEPTH<br>OVER DAM | MAXIMUM<br>STORAGE<br>AC-FT | MAXIMUM<br>OUTFLOW<br>CFS | DURATION<br>OVER TOP<br>HOURS | TIME OF<br>MAX OUTFLOW<br>HOURS | TIME OF<br>FAILURE<br>HOURS |
|--------------------|-----------------------------------|------------------------------|-----------------------------|---------------------------|-------------------------------|---------------------------------|-----------------------------|
| .05                | 110.90                            | 0.00                         | 977.                        | 219.                      | 0.00                          | 41.33                           | 0.00                        |
| .10                | 111.57                            | 0.00                         | 1030.                       | 543.                      | 0.00                          | 41.00                           | 0.00                        |
| .15                | 112.13                            | 0.00                         | 1075.                       | 895.                      | 0.00                          | 40.83                           | 0.00                        |
| .20                | 112.61                            | 0.00                         | 1116.                       | 1258.                     | 0.00                          | 40.83                           | 0.00                        |
| .35                | 113.84                            | .14                          | 1226.                       | 2418.                     | .67                           | 40.67                           | 0.00                        |
| .50                | 114.70                            | 1.00                         | 1306.                       | 4082.                     | 2.33                          | 40.50                           | 0.00                        |
| .75                | 115.47                            | 1.77                         | 1382.                       | 7418.                     | 3.83                          | 40.33                           | 0.00                        |
| 1.00               | 115.91                            | 2.21                         | 1427.                       | 10503.                    | 5.00                          | 40.33                           | 0.00                        |