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NATIONAL DAM INSPECTION PROGRAM. LAKE LOUISE DAM (NDS ID NUMBER--ETC(U)
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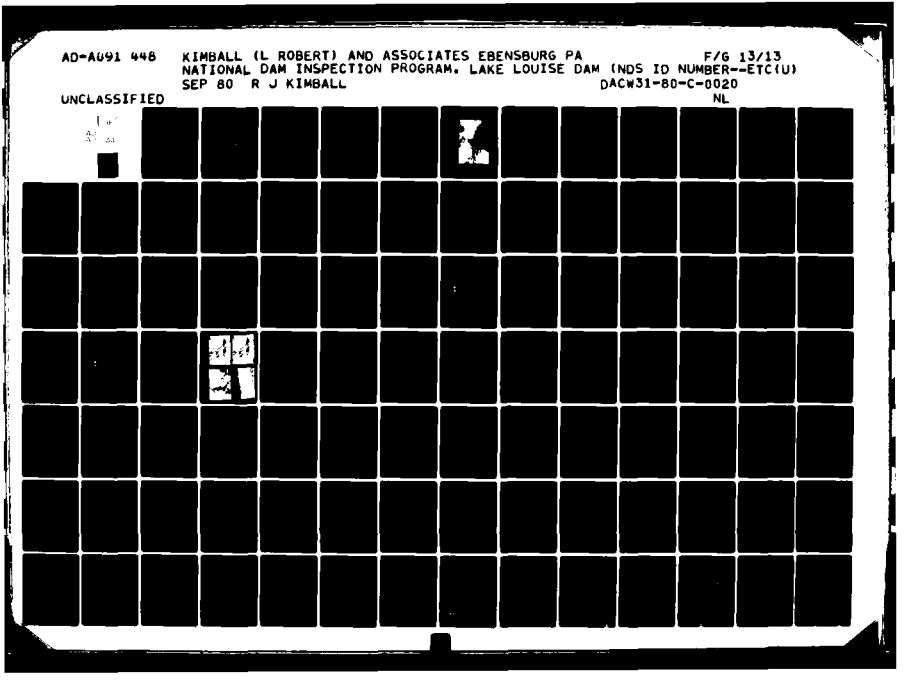

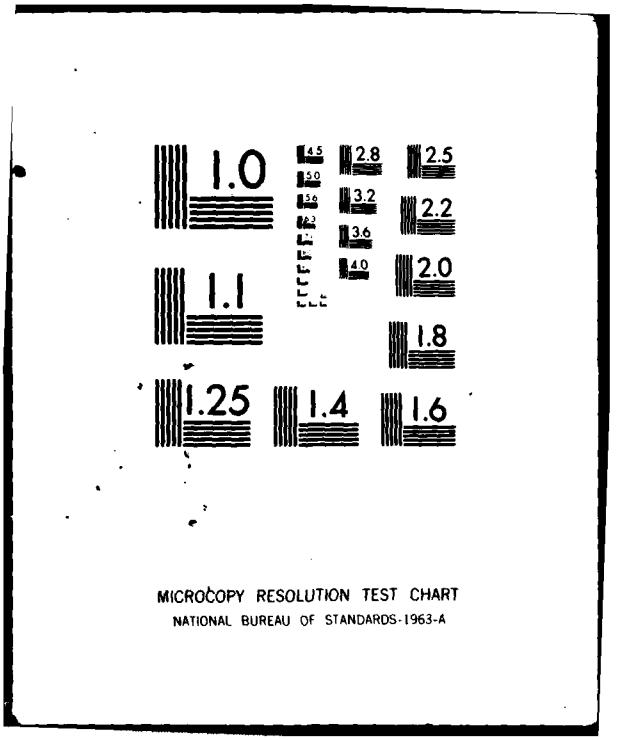
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NATIONAL BUREAU OF STANDARDS-1963-A

SUSQUEHANNA RIVER BASIN

SUTTONS CREEK, LUZERNE COUNTY

PENNSYLVANIA

LAKE LOUISE DAM

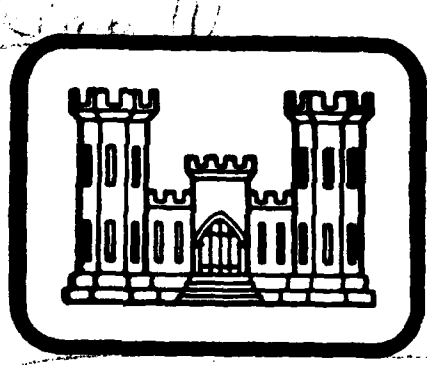
NDS ID PA-558,

DER ID 40-134

~~LAKE LOUISE ESTATES~~

PHASE I INSPECTION REPORT,

NATIONAL DAM INSPECTION PROGRAM



DACW31-80-C-0020

Prepared By

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG, PENNSYLVANIA
15931

"Original contains color plates: All DTIC reproductions will be in black and white"

FOR

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT CORPS OF ENGINEERS
BALTIMORE, MARYLAND
21203

SEPTEMBER 1980

SUSQUEHANNA RIVER BASIN

SUTTONS CREEK, LUZERNE COUNTY

PENNSYLVANIA

LAKE LOUISE DAM

NDS ID NO. PA-558

DER ID NO. 40-134

LAKE LOUISE ESTATES

PHASE I INSPECTION REPORT

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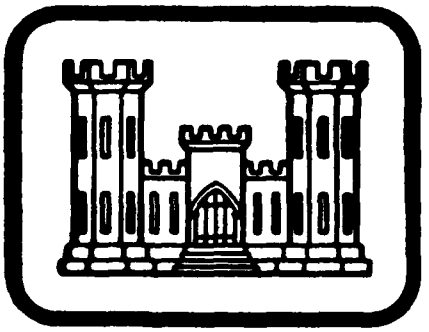

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BALTIMORE, MARYLAND

21203

SEPTEMBER, 1980

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

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

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I REPORT
NATIONAL DAM INSPECTION REPORT

NAME OF DAM	Lake Louise Dam
STATE LOCATED	Pennsylvania
COUNTY LOCATED	Luzerne
STREAM	Sutton Creek
COORDINATES	Lat: 41° 22.9' Long: 75° 54.6'
DATES OF INSPECTION	May 21, 1980 and July 30, 1980

ASSESSMENT

The assessment of Lake Louise Dam is based upon visual observations made at the time of inspection, review of available data, and hydraulic and hydrologic analysis.

Lake Louise Dam appears to be in poor condition. Lake Louise Dam is a high hazard small size dam. The spillway design flood is in the range of 1/2 PMF to PMF. The spillway design flood was selected to be the PMF (probable maximum flood) based on downstream potential for loss of life and property damage. The spillway is capable of controlling approximately 45% of the PMF. The dam breach analysis indicated that a significant increase in the downstream potential for loss of life and property damage exists should the dam fail. Based on criteria established by the Corps of Engineers, the spillway is termed seriously inadequate. The spillway exit and entrance channels are in poor condition. The heavy vegetation creates the potential for water infiltration and made visual inspection of the embankment difficult. Lake Louise Dam is classified as an unsafe non-emergency dam.

The following recommendations and remedial measures should be instituted immediately.

1. A detailed hydrologic and hydraulic analysis should be conducted by a registered professional engineer knowledgeable in dam design and construction to increase the spillway capacity of the dam. Recommendations resulting from this study should be implemented immediately.

The spillway discharge channel and outlet is in a deteriorating condition. The outlet is being undercut by spillway discharges and subsequent cracking of the concrete channel is occurring. The spillway should be evaluated during the hydrologic and hydraulic analysis and repairs made as required. The spillway entrance is obstructed by a wire fence and trapped debris and vegetation. These obstructions should be removed immediately.

2. The trees and heavy vegetation on the slopes should be removed at the direction of a registered professional engineer knowledgeable in dam design and construction. After the vegetation is removed a detailed visual inspection should be made to determine whether a stability analysis is warranted.

3. Erosion along the toe near the right abutment should be repaired and measures should be taken to prevent future erosion.

4. Some means of positive upstream closure of the drainline should be developed.

5. A warning system should be developed to warn any downstream residents of large spillway discharges or imminent failure of the dam.

6. A safety inspection program should be implemented with inspections at regular intervals by qualified personnel.

SUBMITTED BY:

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS AND ARCHITECTS

Date

R. Jeffrey Kimball, P.E.

APPROVED BY:

24 Sep 1980

Date

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

Overview of Lake Louise

TABLE OF CONTENTS

APPENDICES

PHASE I
NATIONAL DAM INSPECTION PROGRAM
LAKE LOUISE DAM
NDI. I.D. NO. PA 558
DER I.D. NO. 40-134

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 inspection of dams throughout the United States.

b. Purpose. The purpose of the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Lake Louise Dam is an earthfill dam with a bituminous paved road and guard rails for the entire length. The dam is 16 feet high and 210 feet long. The crest width is 26 feet. The upstream slope was measured to be 1.5H:1V with heavy brush and trees. The downstream slope was measured to be 1.5H:1V with heavy brush and trees. The reservoir drain consists of a 16" cast iron pipe encased in concrete. The reservoir drain is controlled by a cast iron gate valve located at the downstream outlet of the structure. The spillway is a weir type spillway consisting of two 14 foot sections passing under a highway bridge. The exit channel is protected with dry rubble wingwalls and a concrete slab. The dam has a concrete corewall which extends from elevation 1078 to approximately 1102.

b. Location. The dam is located on Sutton Creek, Luzerne County, Pennsylvania. Lake Louise Dam can be located on the Center Moreland, U.S.G.S. 7.5 minute quadrangle.

c. Size Classification. Lake Louise Dam is a small size structure (16 feet high, 705 acre-feet).

d. Hazard Classification. The hazard classification for Lake Louise Dam has been determined to be high. Downstream conditions at the time of inspection indicated that the loss of more than a few lives is probable should the structure fail. One home is located approximately 1/2 mile downstream of the dam and several homes exist within 1.5 miles downstream of the dam.

e. Ownership. Lake Louise Dam is owned by Lake Louise Estates. Correspondence should be addressed to:

Lake Louise Estates
% Climate Equipment Company
Woodward Hill Road
Dallastown, Pennsylvania
717-757-2129

f. Purpose of Dam. Lake Louise Dam was originally established for recreation but more recently it is used for real estate development.

g. Design and Construction History. Construction of Lake Louise Dam was completed in 1927. According to information located in PennDER files, the dam was constructed by the Luzerne County Construction Company, under the supervision of Fred C. Wintermute, a professional engineer from Wilkes-Barre, Pennsylvania. No construction testing was available for our review, however construction inspection reports indicated that construction proceeded satisfactorily. There was some information in the PennDER files which suggests that construction did not conform entirely to the original construction plans. However, this matter was resolved based on correspondence located in the PennDER files.

h. Normal Operating Procedures. A representative of the owner was available for interview at the time of inspection. It was determined that Lake Louise Estates, the present owner, obtained control of the dam in 1974. It was also determined that there are no scheduled operating procedures or maintenance schedule for the dam. The gate valve controlling the reservoir drain has not been opened in at least 5 years. The only maintenance that is done at the dam is provided by the state, in their efforts to maintain the roadway and the bridge.

1.3 Pertinent Data.

a. Drainage Area.

2.69 square miles

b. Discharge at Dam Site (cfs).

Maximum known flood at dam site	6" above present waterlevel (approximately 50)
Drainline capacity at normal pool	Unknown
Spillway capacity at top of dam	2039

c. Elevation (U.S.G.S. Datum) (feet). - Based on assumed pool elevation of 1093. Estimated from U.S.G.S. 7.5 minute quadrangle.

Top of dam - low point	1101.0
Top of dam - design height	Unknown
Maximum pool - design surcharge	Unknown
Normal pool	1093.0
Spillway crest	1093.0
Upstream invert - 16" drainline	Unknown
Downstream invert - 16" drainline	Unknown
Maximum tailwater	1085.1
Toe of dam	1085.1

d. Reservoir (feet).

Length of maximum pool	5300 feet
Length of normal pool	4000 feet

e. Storage (acre-feet).

Normal pool	193
Top of dam	705

f. Reservoir Surface (acres).

Top of dam	83
Normal pool	56
Spillway crest	56

g. Dam.

Type	Earthfill
Length	210
Height	16 feet
Top width	26 feet
Side slopes - upstream	1.5H:1V
- downstream	1.5H:1V
Zoning	No
Impervious core	Concrete corewall
Cutoff	Concrete cutoff
Grout curtain	No

h. Reservoir Drain.

Type	16" cast iron pipe
Length	100 feet

Closure	16" gate valve
Access	Valve box downstream toe
Regulating facilities	16" gate valve

i. Spillway.

Type	Concrete weir in channel under bridge
Length	Two 14 foot sections
Crest elevation	1093.0
Upstream channel	Lake
Downstream channel	Concrete channel

SECTION 2
ENGINEERING DATA

2.1 Design. Correspondence and permit information was available for review in the PennDER files. Some construction drawings were also available but these drawings did appear to indicate as-built conditions. No additional information was provided by the owner.

2.2 Construction. Some information was available in the PennDER files on the construction of the dam. One inspection report prepared by Fred C. Wintermute stated that construction was progressing satisfactorily. One correspondence report between Mr. Wintermute and the Department of Forest and Waters, explains that as-built conditions do not represent the design. The as-built conditions were presented to the Department of Forest and Waters and approved by them. These drawings do not exist in the current DER file.

2.3 Operation. No operating records are known to exist. The state maintains the bridge and roadway over the dam.

2.4 Evaluation.

a. Availability. Engineering data were provided by PennDER, Bureau of Dams and Waterways Management. A representative of the owner provided information on recent history and maintenance of the structure during the inspection.

b. Adequacy. Minimal design data was available for review for the purpose of this report. Limited information was available for review concerning the construction of the dam. No as-built drawings exist in the DER files. This Phase I Report is based on available data, visual inspection, hydrologic and hydraulic analysis. Sufficient information exists to complete a Phase I Report.

SECTION 3
VISUAL INSPECTION

3.1 Findings.

a. General. The on site inspection of Lake Louise Dam was conducted by personnel of L. Robert Kimball and Associates on May 21, 1980 and July 30, 1980. The inspection consisted of:

1. Visual inspection of the retaining structure, abutments and toe.
2. Examination of the spillway facilities, exposed portion of any outlet works and other appurtenant works.
3. Observations affecting the runoff potential of the drainage basin.
4. Evaluation of the downstream area hazard potential.

b. Dam. The dam appears to be in poor condition. From a brief survey conducted during the inspection, it was noted that the main embankment crest has a low spot midway across the embankment. The crest of the embankment is a paved state maintained roadway. The upstream and downstream slopes are covered with heavy brush and trees. At least one large tree had fallen creating a depression, slope over steepening and a location for infiltration and potential stability problems. No seepage was noted on the embankment or at the toe, however several wet spots exist beyond the toe. Erosion was noted along the right abutment contact resulting from roadway drainage.

An active slide, in natural ground, is present on the left abutment near the spillway exit channel. This slide has moved soil material into the exit channel and several large trees have fallen into the exit channel.

c. Appurtenant Structures. The waterlevel at the time of the inspections was estimated to be at elevation 1093.0. The spillway approach and exit channels are in poor condition. The spillway entrance channel is blocked by vegetation debris and a deteriorating fence (fish screen) across the spillway catches debris and increases blockage. The concrete exit channel is extensively cracked due to undercutting at the toe of the concrete. If this condition is allowed to continue it could lead to possible deterioration in the entire exit channel and could cause stability problems of the wingwalls and ultimate spillway failure. The wingwalls consist of masonry rubble and currently show movement and separation. The drainline for the reservoir consists of a 16" cast iron pipe encased in concrete. The drain is controlled by a 16" gate valve which has not been operated in at least 5 years. The overall condition of the

drainline is unknown. The intake and discharge structures were unobserved during the inspection. The valve chamber at the toe of the dam was observed during the inspection. No upstream shut-off is provided in the drainline.

d. Reservoir Area. The watershed is covered mostly with timber. The reservoir slopes are gentle to moderate and do not appear to be susceptible to massive landslides which would affect the storage volume of the reservoir or cause overtopping of the dam by displacing water.

e. Downstream Channel. The downstream channel of Lake Louise Dam is Sutton Creek a relatively narrow creek. The dam is about four miles from the North Branch of the Susquehanna River.

3.2 Evaluation. In general, the embankment, spillway structure and outlet works appear in poor condition.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures. The water level is maintained at the spillway crest elevation of 1093.0. A representative of the owner indicated that there is no maintenance schedule or operational procedures.

4.2 Maintenance of the Dam. No planned maintenance schedule for the dam exists other than the maintenance of the roadway by state maintenance crews.

4.3 Maintenance of Operating Facilities. Operating facilities for the dam have not been maintained or operated in at least 5 years. The condition of these facilities are unknown.

4.4 Warning System in Effect. There is no known warning system in effect to warn downstream residents or property owners of large spillway discharges or imminent failure of the dam. At the time of inspection there were several downstream residences.

4.5 Evaluation. The condition of the operating facilities is unknown and no maintenance procedures exists. There is no warning system to warn downstream residents.

SECTION 5
HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features.

a. Design Data. The PennDER files contained only minimal hydrologic and hydraulic design information. There are some hand written calculations in the files, however these do not seem to be part of the design criteria. Information in the files suggested that the spillway design dealt with bridge stability rather than hydrologic or hydraulic considerations.

b. Experience Data. No rainfall or runoff data were available. It was indicated that the maximum known reservoir level obtained was 6" above the normal pool level. The spillway reportedly has functioned adequately in the past.

c. Visual Observations. The spillway approach and discharge channels are in poor condition. The upstream channel is blocked by vegetation and debris while the downstream channel has extensive deterioration due to undercutting of concrete at the toe. A fence (fish screen) across the spillway crest traps debris and will cause further blockage.

d. Overtopping Potential. Overtopping potential was investigated through the development of the probable maximum flood (PMF) for the watershed and the subsequent routing of the PMF and fractions of the PMF through the reservoir and spillway.

The Corps of Engineers, Baltimore District, has directed that the HEC-1 Dam Safety Version systemized computer program be utilized. The program was prepared by the Hydrologic Engineering Center (HEC), U.S. Army Corps of Engineers, Davis, California, July, 1978. The major methodologies or key input data for this program are discussed briefly in Appendix D.

5.2 Evaluation Assumptions. To enable us to complete the hydraulic and hydrologic analysis for this structure, it was necessary to make the following assumptions.

1. Pool elevation prior to the storm was at the spillway crest elevation of 1093.0.

2. Cummings Pond a natural upstream pond exists and was considered capable of storing some of the inflow. Lake Manjo a small man made upstream pond was ignored in this analysis.

3. Top of the dam was considered to be at the low spot elevation of 1101.0 feet.

4. Blockage of the spillway was not taken into account.

5.3 Summary of Overtopping Analysis. Complete summary sheets for the computer output are presented in Appendix D.

Peak inflow (PMF)	7340 cfs
Spillway capacity	2039 cfs

a. Spillway Adequacy Rating. The Spillway Design Flood (SDF) for a dam of this size and classification is in the range of 1/2 PMF to PMF. The SDF is based on the hazard and size classification of the dam. Based on the hazard potential for this dam the spillway design flood (SDF) was selected to be the PMF. Based on the following definition provided by the Corps of Engineers, the spillway is rated as seriously inadequate as a result of our hydrologic analysis.

> Seriously inadequate - High hazard classification dams not capable of passing 50% of the spillway design flood and where there is a significant increase in the downstream hazard potential for loss of life due to overtopping failure.

The spillway and reservoir are capable of controlling approximately 45% of the PMF without overtopping the embankment at the low spot. Because of the blockage of the spillway entrance the spillway capacity could be further reduced.

5.4 Summary of Dam Breach Analysis. The subject dam cannot satisfactorily pass 50% of the PMF based on our analysis therefore it was necessary to perform the dam breach analysis and downstream routing of the flood wave. This analysis determined the degree of increased flooding due to dam failure.

The 1/2 PMF storm overtops the low spot on the dam crest by 1.10 feet for a duration of 2.25 hours. A reservoir pool elevation of 1102 was considered sufficient to cause failure of the Lake Louise Dam. This elevation represents a depth of overtopping of approximately 1 foot over the low spot of the dam and approximately 1.3 inches over the critical left abutment area.

The resulting flood wave was routed downstream with and without failure considerations. Downstream potential for loss of life and property damage is significantly increased by dam failure. Therefore the spillway is rated as seriously inadequate. A detailed printout of the breach analysis is included in Appendix D.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations. Visual observations indicated a slide in natural ground near the left abutment and erosion along the downstream toe near the right abutment. The spillway wingwalls which consist on masonry rubble slow signs of deterioration.

The stability of the dam is of concern because of the fairly steep slopes and the dense vegetation. At least one large tree has fallen creating the potential for water infiltration and potential stability problems. There is no indication that a stability analysis had been performed in the past. The vegetation on the slope should be removed in a controlled manner. After removal, a detailed visual inspection should be conducted by a registered professional engineer knowledgeable in dam design and construction to determine whether a stability analysis of the structure should be conducted.

b. Design and Construction Data. No stability analysis was conducted for this dam. No as-built drawings were available for review by the inspection team and limited construction data is available.

c. Operating Records. No operating records are maintained.

d. Post Construction Changes. There were no indications of any post construction changes in the DER files. There were no as-built drawings available for review.

e. Seismic Stability. The dam is located in seismic zone 1. No seismic stability analysis has been performed. Normally, it can be considered that if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected earthquake loading. No visual deficiences were observed during the inspection. There exist no known stability analysis to document the stability of the dam.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. Lake Louise Dam was heavily vegetated making the inspection difficult. The dam appeared to be in poor condition. A small slide was observed near the left abutment in natural ground adjacent to the spillway wingwall. Erosion was observed along the downstream toe of the embankment. Both slopes are covered with heavy brush and trees and at least one large tree had fallen. Falling trees could lead to infiltration and could cause potential instability.

Visual observations, and hydrologic and hydraulic calculations indicated that Lake Louise Dam's spillway is seriously inadequate. The spillway is capable of controlling approximately 45% of the PMF without overtopping the embankment at the low spot. The dam breach analysis indicated that a significant increase in the downstream potential for loss of life and property damage exists should the dam fail. Lake Louise Dam is classified as an unsafe non-emergency dam.

b. Adequacy of Information. This Phase I Report is based on visual observations, hydrologic and hydraulic calculations and interviews with the owners. Inspection and evaluation of the embankment was difficult due to trees and brush located on the slopes and toe.

c. Urgency. The recommendations suggested below should be implemented immediately.

d. Necessity for Further Investigation. In order to accomplish some of the recommendations/remedial measures outlined below, further investigations will be required. Inspection of the dam was difficult due to the heavy vegetation. A more in-depth evaluation should be made once the vegetation is removed.

7.2 Recommendations/Remedial Measures.

1. A detailed hydrologic and hydraulic analysis should be conducted by a registered professional engineer knowledgeable in dam design and construction to increase the spillway capacity of the dam. Recommendations resulting from this study should be implemented immediately.

The spillway discharge channel and outlet is in a deteriorating condition. The outlet is being undercut by spillway discharges and subsequent cracking of the concrete channel is occurring. The spillway should be evaluated during the hydrolo-

gic and hydraulic analysis and repairs made as required. The spillway entrance is obstructed by a wire fence and trapped debris and vegetation. These obstructions should be removed immediately.

2. The trees and heavy vegetation on the slopes should be removed at the direction of a registered professional engineer knowledgeable in dam design and construction. After the vegetation is removed a detailed visual inspection should be made to determine whether a stability analysis is warranted.

3. Erosion along the toe near the right abutment should be repaired and measures should be taken to prevent future erosion.

4. Some means of positive upstream closure of the drainline should be developed.

5. A warning system should be developed to warn any downstream residents of large spillway discharges or imminent failure of the dam.

6. A safety inspection program should be implemented with inspections at regular intervals by qualified personnel.

APPENDIX A
CHECKLIST, VISUAL INSPECTION, PHASE I

CHECK LIST
VISUAL INSPECTION
PHASE I

NAME OF DAM Lake Louise Dam COUNTY Luzerne STATE Pennsylvania ID# PA 558

TYPE OF DAM Earthfill HAZARD CATEGORY High

DATE(s) INSPECTION May 21, 1980
July 30, 1980 WEATHER Seasonal TEMPERATURE Seasonal

POOL ELEVATION AT TIME OF INSPECTION 1093.0 M.S.L. TAILWATER AT TIME OF INSPECTION _____ M.S.L.

A-1

INSPECTION PERSONNEL:

R. Jeffrey Kimball, P.E. - L. Robert Kimball and Associates

James T. Hockensmith - L. Robert Kimball and Associates

O.T. McConnell - L. Robert Kimball and Associates

Cameron R. Mock - L. Robert Kimball and Associates

James T. Hockensmith
RECORDER

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	Small slide near the left abutment.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Erosion along the downstream toe. Minor erosion near bridge - see A-12.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Horizontal alignment appears to be good. Low spot on the embankment crest approximately 200 feet from the left abutment.	
RIPRAP FAILURES	None.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	Heavy brush and trees on both slopes.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Spillway in a deteriorating condition - See A-12.	
ANY NOTICEABLE SEEPAGE	None.	
STAFF GAUGE AND RECORDER	None.	
DRAINS	None.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	Not applicable.	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Not applicable.	
DRAINS	Not applicable.	
WATER PASSAGES	Not applicable.	
FOUNDATION	Not applicable.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Not applicable.	
STRUCTURAL CRACKING	Not applicable.	
VERTICAL AND HORIZONTAL ALIGNMENT	Not applicable.	
MONOLITH JOINTS	Not applicable.	
CONSTRUCTION JOINTS	Not applicable.	
STAFF GAUGE OR RECORDER	Not applicable.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Exit channel concrete is cracking due to undercutting erosion.	
INTAKE STRUCTURE	Blocked by debris.	
OUTLET STRUCTURE	Cracking due to erosion and undercutting.	
OUTLET CHANNEL	Natural streambed.	
EMERGENCY GATE	None.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Appears to be good condition. Although exit channels and entrance channels need some work.	
APPROACH CHANNEL	Blocked by debris.	
DISCHARGE CHANNEL	Creek. Exit channel has some erosion and undercutting.	
BRIDGE AND PIERS	Appear to be in good condition. Although minor erosion exists near the abutments.	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	None.	
APPROACH CHANNEL	None.	
DISCHARGE CHANNEL	None.	
BRIDGE AND PIERS	None.	
GATES AND OPERATION EQUIPMENT	None.	

DOWNSTREAM CHANNEL

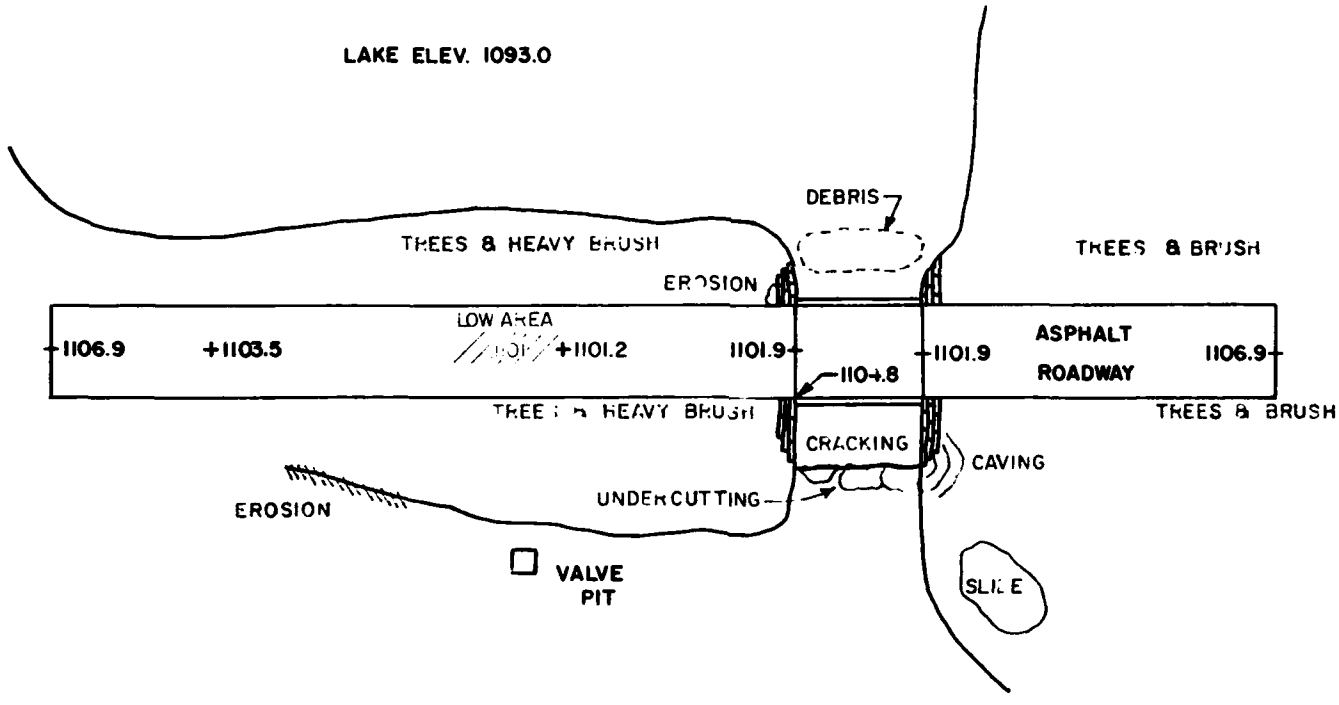
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Erosion near the toe of slopes. Slide exists on the left abutment in natural ground adjacent to spillway.	
SLOPES	Appear to be stable.	
APPROXIMATE NO. OF HOMES AND POPULATION	One home - 4 people - approximately 1/2 mile downstream. Several homes - 10 people - exist within 1 1/2 mile downstream of the dam.	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Moderate. Appear to be stable.	
SEDIMENTATION	Unknown.	

INSTRUMENTATION

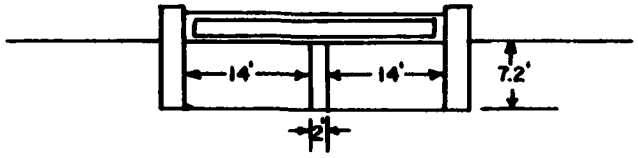
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHER	None.	



A-12

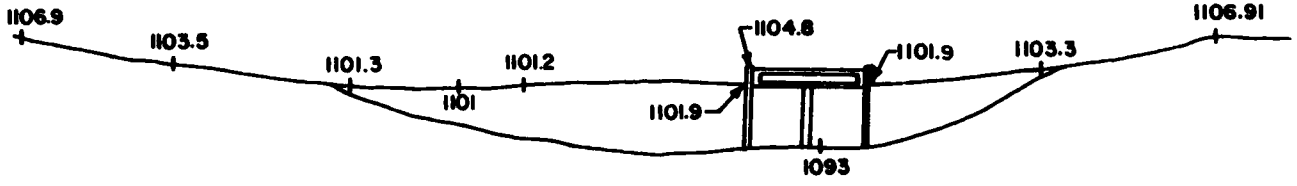
LAKE LOUISE DAM

Scale: 1" = 50'



SPILLWAY SECTION

(Not To Scale)



PROFILE

LOOKING UPSTREAM

Scale: Horiz. 1"=50'
Vert. 1"= 20'

LAKE LOUISE DAM

A-13

APPENDIX B
CHECKLIST, ENGINEERING DATA, DESIGN, CONSTRUCTION, OPERATION, PHASE I

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Lake Louise Dam

ID# 558

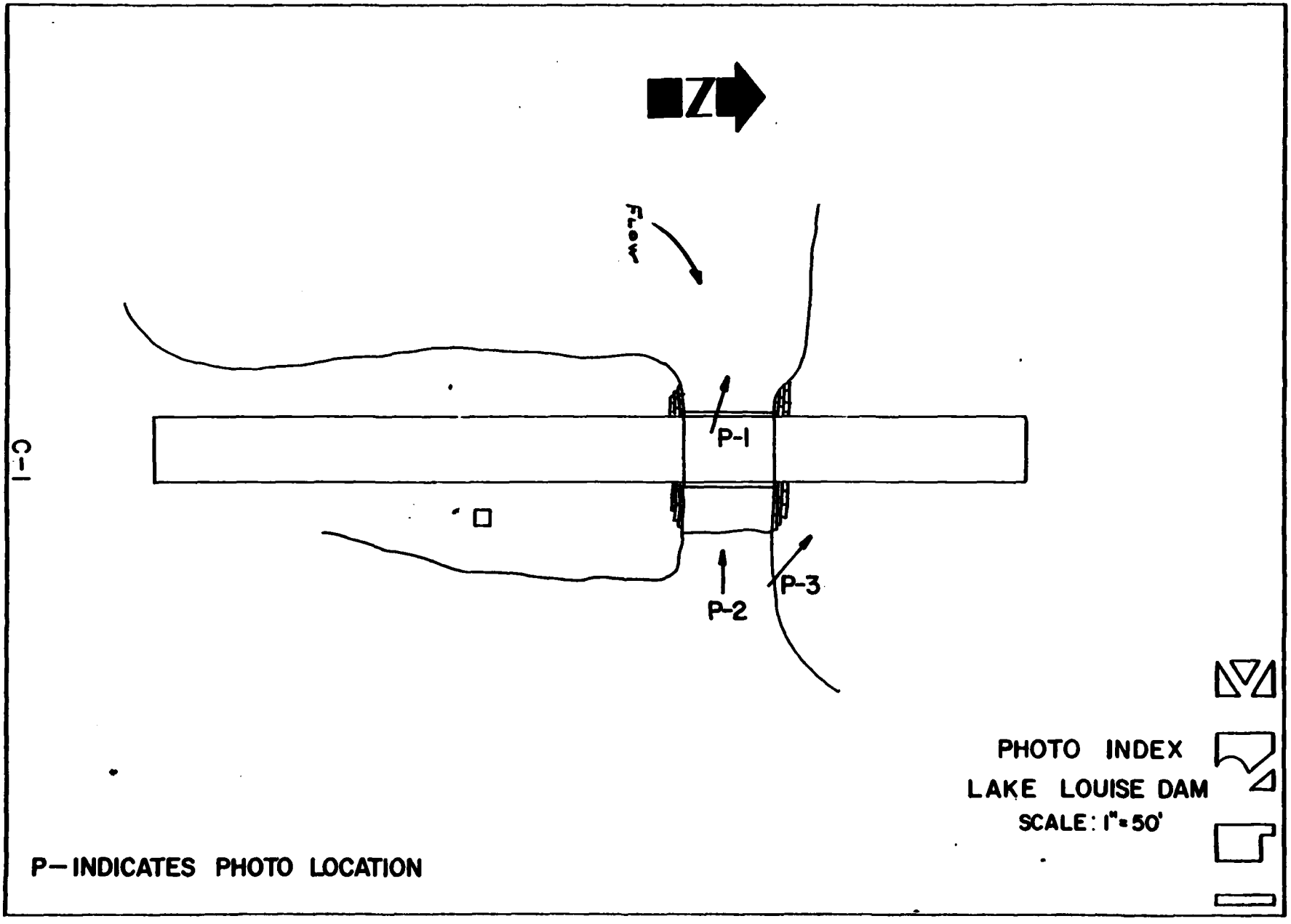
ITEM	REMARKS
AS-BUILT DRAWINGS	None. Although some original construction plans do exist.
REGIONAL VICINITY MAP	U.S.G.S. 7.5 minute quadrangle.
CONSTRUCTION HISTORY	DER files.
TYPICAL SECTIONS OF DAM	None.
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS RAINFALL/RESERVOIR RECORDS	None. None. None. None. None.

ITEM	REMARKS
DESIGN REPORTS	Construction inspection report explains as-built conditions and reasons for them.
GEOLOGY REPORTS	None.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Some limited calculations which do not appear to be significant as far as design.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None.
POST-CONSTRUCTION SURVEYS OF DAM	None.
BORROW SOURCES	Unknown.

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	Unknown.
HIGH POOL RECORDS	6" over normal pool level.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Unknown.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None.
MAINTENANCE OPERATION RECORDS	None, although state maintains a road over the dam.

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	None.
OPERATING EQUIPMENT PLANS & DETAILS	None.

APPENDIX C
PHOTOGRAPHS


N
Flow
P-1
P-2
P-3
C-1
PHOTO INDEX
LAKE LOUISE DAM
SCALE: 1"=50'
P— INDICATES PHOTO LOCATION

LAKE LOUISE DAM
PA 558

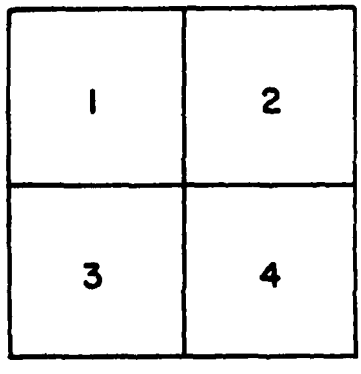
Photograph Descriptions

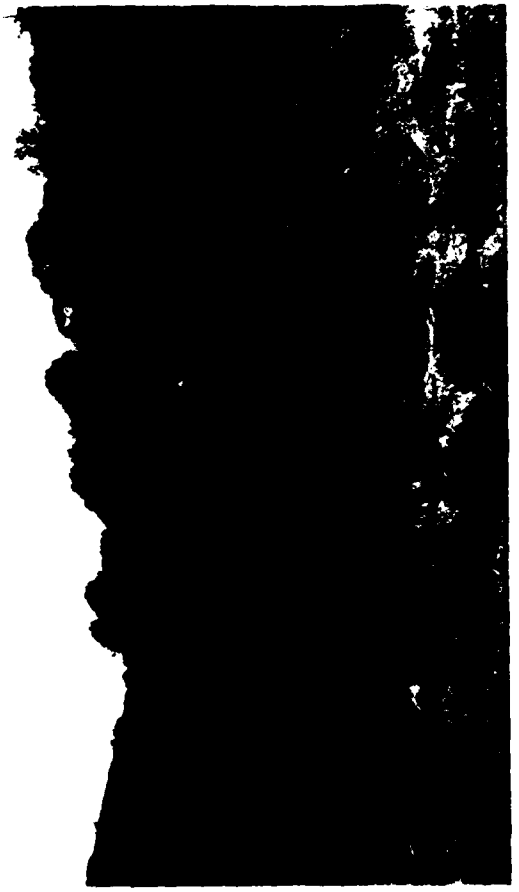
Sheet 1

Front

(1) Upper left - Spillway approach and debris in entrance channel.
(2) Upper right - Culvert spillway and downstream culvert channel. Note cracking of concrete and undercutting.
(3) Lower left - Slide on downstream slope on left abutment.
(4) Lower right - Downstream exposure

TOP OF PAGE





APPENDIX D
HYDROLOGY AND HYDRAULICS

APPENDIX D
HYDROLOGY AND HYDRAULICS

Methodology. The dam overtopping and breach analyses were accomplished using the systemized computer program HEC-1 (Dam Safety Investigation), September, 1978, prepared by the Hydrologic Engineering Center, U.S. Army Corps of Engineers, Davis, California. A brief description of the methodology used in the analysis is presented below.

1. Precipitation. The Probable Maximum Precipitation (PMP) is derived and determined from regional charts prepared from past rainfall records including "Hydrometeorological Report No. 40" prepared by the U.S. Weather Bureau.

The index rainfall is reduced from 10% to 20% depending on watershed size by utilization of what is termed the HOP Brook adjustment factor. Distribution of the total rainfall is made by the computer program using distribution methods developed by the Corps.

2. Inflow Hydrograph. The hydrologic analysis used in development of the overtopping potential is based on applying a hypothetical storm to a unit hydrograph to obtain the inflow hydrograph for reservoir routing.

The unit hydrograph is developed using the Snyder method. This method requires calculation of several key parameters. The following list gives these parameters their definition and how they were obtained for these analysis.

Parameter	Definition	Where Obtained
Ct	Coefficient representing variations of watershed	From Corps of Engineers*
L	Length of main stream channel miles	From U.S.G.S. 7.5 minute topgraphic
Lca	Length on main stream to centroid of watershed	From U.S.G.S. 7.5 minute topographic
Cp	Peaking coefficient	From Corps of Engineers*
A	Watershed size	From U.S.G.S. 7.5 minute topographic

*Developed by the Corps of Engineers on a regional basis for Pennsylvania.

3. Routing. Reservoir routing is accomplished by using Modified Plus routing techniques where the flood hydrograph is routed through reservoir storage. Hydraulic capacities of the outlet works, spillways and the crest of the dam are used as outlet controls in the routing.

The hydraulic capacity of the outlet works can either be calculated and input or sufficient dimensions input and the program will calculate an elevation discharge relationship.

Storage in the pool area is defined by an area - elevation relationship from which the computer calculates storage. Surface areas are either planimetered from available mapping or U.S.G.S. 7.5 minute series topographic maps or taken from reasonably accurate design data.

4. Dam Overtopping. Using given percentages of the PMF the computer program will calculate the percentage of the PMF which can be controlled by the reservoir and spillway without the dam overtopping.

5. Dam Breach and Downstream Routing. The computer program is equipped to determine the increase in downstream flooding due to failure of the dam caused by overtopping. This is accomplished by routing both the pre-failure peak flow and the peak flow through the breach (calculated by the computer with given input assumptions) at a given point in time and determining the water depth in the downstream channel. Channel cross-sections taken from U.S.G.S. 7.5 minute topographic maps were used in the downstream flood wave routing. Pre and post failure water depths are calculated at locations where cross-sections are input.

HYDROLOGY AND HYDRAULICS ANALYSIS
DATA BASE

NAME OF DAM: Lake Louise Dam

PROBABLE MAXIMUM PRECIPITATION (PMP) = 22.2 (.97) - 21.53 inches

STATION	1	2	3	4
Station Description	Cummings Pond	Subarea 2	Subarea 3	Subarea 4
Drainage Area (square miles)	.44	.57	.40	1.28
Cumulative Drainage Area (square miles)	.44	1.01	1.41	2.69
Adjustment of PMF for Drainage Area (%)(1)				
6 hours	117	117	117	117
12 hours	127	127	127	127
24 hours	136	136	136	136
48 hours	142	142	142	142
72 hours	145	145	145	145
Snyder Hydrograph Parameters				
Zone (2)	11	11	11	11
Cp (3)	.62	.62	.62	.62
Ct (3)	1.50	1.50	1.50	1.50
L (miles) (4)	.76	1.17	1.37	1.94
Lca (miles) (4)	.15	.62	.80	1.09
tp = Ct(LxLca) 0.3 hrs.	.78	1.36	1.54	1.88
Spillway Data				
Crest Length (ft)				
Freeboard (ft)				
Discharge Coefficient				
Exponent				

(1) Hydrometeorological Report 40 (Figure 1), U.S. Army Corps of Engineers, 1965.

(2) Hydrological zone defined by Corps of Engineers, Baltimore District, for determining Snyder's coefficients (C_p and C_t).

(3) Snyder's Coefficients.

(4) L=Length of longest water course from outlet to basin divide. L_{ca}=Length of water course from outlet to point opposite the centroid of drainage area.

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: D.A. 2.69 mi^2 wooded, gentle slopes

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 193 ac-ft

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 705 ac-ft

ELEVATION MAXIMUM DESIGN POOL: Unknown

ELEVATION TOP DAM: 1101

SPILLWAY CREST:

a. Elevation 1093
b. Type Concrete weir in channel
c. Width 28
d. Length N/A
e. Location Spillover 60' from left abutment
f. Number and Type of Gates

OUTLET WORKS:

a. Type 16" cast iron pipe encased in concrete
b. Location 160' from left abutment
c. Entrance inverts Unknown
d. Exit inverts Unknown
e. Emergency draindown facilities 16" gate valve

HYDROMETEOROLOGICAL GAUGES:

a. Type Unknown
b. Location Unknown
c. Records Unknown

MAXIMUM NON-DAMAGING DISCHARGE: Unknown

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CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

DAM NAME LAKE LOUISE
I.D. NUMBER 558
SHEET NO. 1 OF 8
BY CAB DATE 7-9-80

Loss Rate and Base Flow Parameters

As recommended by Corps of Engineers Baltimore District.

STRTL = 1 inch

CNSTL = .05 in/hr

STRTQ = 1.5 cfs/mi²

RTIOR = 2.0

QRCSN = .05 (5% of peak flow)

Elevation - Area - Capacity Relationships

From U.S.G.S. 7.5 min. Quad., DER files, and field inspection data.

Cummings Pond

Crest Elev = 1191
Pond Surface Area = 39 ac
Zero Storage Elev = 1185
Area at Elev. 1185 = 4.5 ac
Area at Elev. 1200 = 82 ac

From the conic method of reservoir volume

$$\Delta V = \frac{h}{3}\left(A_1 + A_2 + \sqrt{A_1 A_2}\right)$$

Storage at Elev 1191 = 113 ac ft
Storage at Elev 1200 = 916 ac ft

$S	0	113	310	913
$E	1185	1191	1195	1200

LAKE LOUISE

CREST ELEV. = 1093
POND SURFACE AREA = 56 AC.
ZERO STORAGE ELEV. = 1085
AREA AT ELEV 1100 = 80 AC
AREA AT ELEV 1120 = 159 AC
AREA AT ELEV 1090 = 35 AC

FROM U.S.G.S. 7.5-MIN QUAD AND INSPECTION DATA

FROM THE CONIC METHOD OF RESERVOIR STORAGE

$$\Delta V = \frac{h}{3}\left(A_1 + A_2 + \sqrt{A_1 A_2}\right)$$

STORAGE TO ELEV. 1090 = 58 AC-FT
STORAGE TO ELEV. 1093 = 193 AC-FT
STORAGE TO ELEV 1100 = 666 AC-FT
STORAGE TO ELEV. 1120 = 3011 AC-FT

$S	0	58	193	666	705	850
$E	1085	1090	1093	1100	1101	1105

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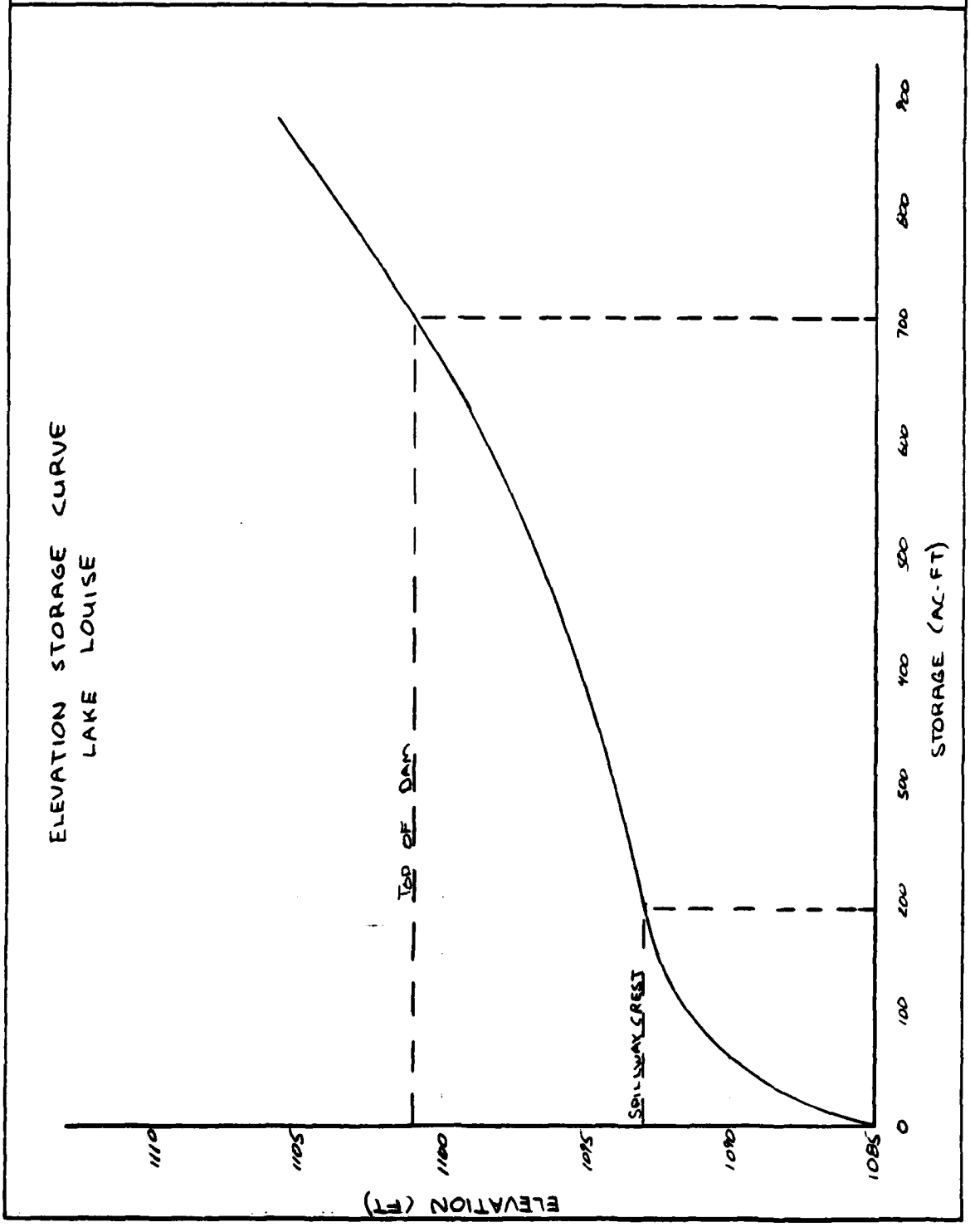
DAM NAME LAKE LOUISE
I.D. NUMBER 558
SHEET NO. 5 OF 8
BY CAB DATE 7-9-90



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DAM NAME LAKE LOUISE
I.D. NUMBER 558
SHEET NO. 4 OF 6
BY CAB DATE 7-9-80

OVERTOP PARAMETERS

CUMMINGS POND

THE NATURAL POND WILL BE CONSIDERED A DAM FOR THIS ANALYSIS

CREST ELEV = 1191
LENGTH OF DAM (EXCLUDING SPILLWAY) = 10'
TOP OF DAM ELEV. = 1193
COEFFICIENT OF DISCHARGE = 3.0

SL	10	587	1350	1190
SV	1193	1200	1210	1220

LAKE LOUISE

CREST ELEV = 1093
LENGTH OF DAM (EXCLUDING SPILLWAY) = 95'
TOP OF DAM ELEV. = 1101
COEFFICIENT OF DISCHARGE = 3.0

SL	5	35	75	105	135	190
SV	1101	1101.2	1101.5	1101.8	1102	1103

233	260	285
1104	1105	1106

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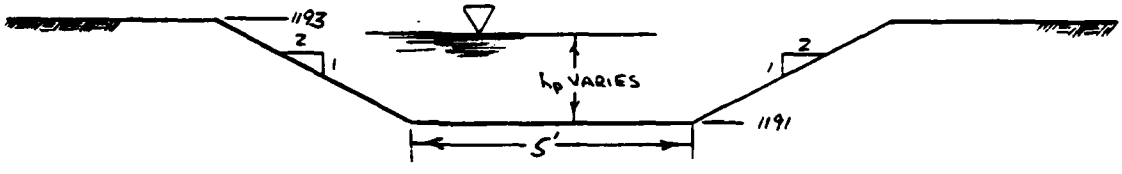
EBENSBURG PENNSYLVANIA

NAME Lake Louise
NUMBER 558
SHEET NO. 5 OF 8
BY CAB DATE 7-9-80

SPILLWAY RATING CURVE

CUMMINGS POND

TRAPEZOIDAL SPILLWAY
(NOT TO SCALE)



	TRAPEZOIDAL		WEIR		
ELEV (FT)	h_p (FT)	Q* (CFS)	h_p (FT)	Q* (CFS)	Q^*_{TOTAL} (CFS)
1191	0	0			0
1192	1	20			20
1193	2	65			65
1194			1	40	105
1195			2	115	180
1197			4	320	385
1200			7	745	810

* VALUES ROUNDED TO NEAREST 5CFS

TRAPEZOIDAL FLOW FROM:

$$Q = 8.03\, C' h_v^{1/2} (h_p - h_v)\left[B + Z(h_p - h_v)\right]$$

$$h_v = \frac{3(2Zh_p + B) - \left(16Z^2 h_p^2 + 16ZBh_p + 9B^2\right)^{1/2}}{10Z}$$

$B = 5'$ $Z = 2'$ $C' = .95$

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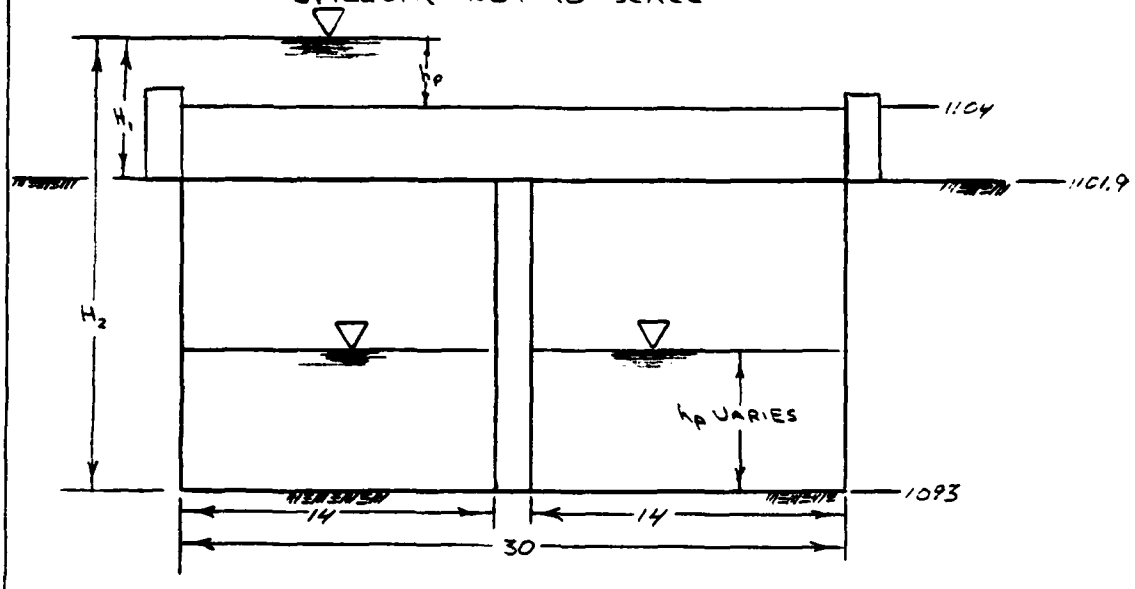
NAME LAKE LOUISE
NUMBER 556
SHEET NO. 6 OF 8
BY CAR DATE 7-5-90

LAKE LOUISE

SPILLWAY NOT TO SCALE



	WEIR		ORIFICE		
ELEV (FT)	h_p (FT)	Q* (CFS)	H_1 (FT)	Q* (CFS)	Q* TOTAL (CFS)
1093	0	0			0
1095	2	250			250
1098	5	1000			1000
1100	7	1660			1660
1101.9	8.9	2380			2380
1103			1.1	2740	2740
1104			2.1	3010	3010
1105	1.0	90	3.1	3250	3340
1107	3.0	500	5.1	3680	4180
1110	6.0	1410	8.1	4235	5645

*VALUES ROUNDED TO NEAREST 5 CFS

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NAME LAKE LOUISE
NUMBER 55B
SHEET NO. 7 OF 8
BY CAB DATE 7-5-80

WEIR FLOW FROM:

$$Q = C L h_p^{1.5}$$

FOR CUMMINGS POND

$C = 5.1 \quad L = 13$

NOTE:
30' TOTAL LENGTH.
28' EFFECTIVE LENGTH.

FOR LAKE LOUISE

$C = 3.2 \quad L = 28, 30$

ORIFICE FLOW FROM:

$$Q = \tfrac{2}{3} C \sqrt{2g}\, L \left(H_2^{3/2} - H_1^{3/2}\right)$$

$C = .6 \quad g = 32.2 \quad L = 28$

SOURCE: WATER AND WASTEWATER ENGINEERING
by; FAIR GEYER, OKUM 1966

LOW DAMS by; NATIONAL RESOURCES COMMITTEE, WASHINGTON DC.

HANDBOOK OF APPLIED HYDRAULICS
by; DAVIS, SORENSEN

CHANNEL ROUTING

CROSS SECTIONS OBTAINED FROM U.S.G.S 7.5 MIN. QUAD.

CHANNEL MANNINGS' $n = .05$
OVERBANK MANNINGS' $n = .06$

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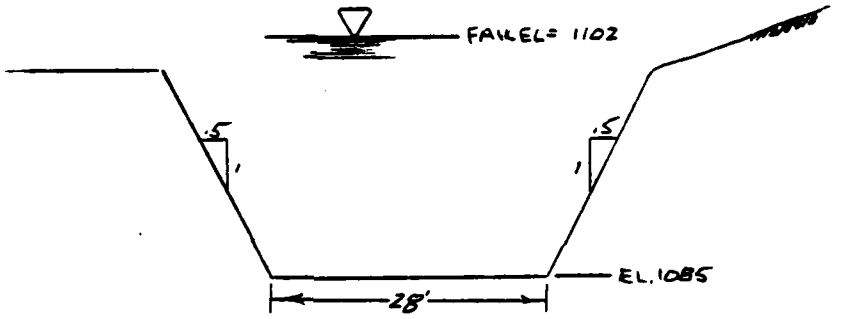
EBENSBURG PENNSYLVANIA

DAM NAME LAKE LOUISE
I.D. NUMBER 558
SHEET NO. 8 OF 8
BY CAB DATE 7-9-80

DAM BREACH PARAMETERS

ASSUME THE DAM FAILS NEAR THE LEFT ABUTMENT DUE TO OVERTOPPING AND EROSION OF THE DAMAGED AREA. IT IS BELIEVED THAT THE ASPHALT ROAD SURFACE WILL NOT SUPPLY SUFFICIENT PROTECTION AGAINST UNDER-CUTTING AND EVENTUAL FAILURE.



PMF RATIO = .5
TIME OF FAILURE (TFAIL) = 2.0 HR.
FAILURE ELEV. (FAILEL) = 1102
SIDE SLOPES (Z) = .5
BREACH BOTTOM WIDTH (ELBM) = 28'

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

```
    1          A1    ANALYSIS OF DAM OVERTOPPING USING RATIOS OF THE PMF
    2          A2    HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF LAKE LOUISE DAM
    3          A3    RATIOS OF THE PMF ROUTED THROUGH THE RESERVOIR (558)
    4          B   288       0      15       0       0       0       0       0       0       0
    5          B1  5
    6          J     1       5       1
    7          J1  .3      .4      .5      .6       1                               1
    8          K     0       1                                               1
    9          K1    INFLOW TO CUMMINGS POND
   10          M     1       1     .44                                                       1
   11          P           21.53     117     127     136     142     145
   12          T                                                   1.0     .05
   13          W   .78     .62
   14          X  -1.5    -.05     2.0
   15          K     1       2                                               1
   16          K1    ROUTE THROUGH CUMMINGS POND
   17          Y                                       1       1
   18          Y1    1                                                 -1191     -1
   19          Y4  1191    1192    1193    1196    1195    1197    1200
   20          YB    0      20      65     105     180     385     810
   21          S8    0     113     310     913
   22          SE  1185    1191    1195    1200
   23          S8  1191
   24          SD  1193     2.0     1.5      10
   25          SL    10     887    1350    1190
   26          SV  1193    1200    1210    1220
   27          K     1       3                                               1
   28          K1    ROUTE THROUGH CHANNEL REACH NO. 1
   29          Y                                       1       1
   30          Y1    1
   31          Y6  .06      .05     .06    1098    1140    4250    .022
   32          Y7    0     1140     110    1120     250    1100     254    1098     259    1098
   33          Y7  263     1100     400    1120     700    1140
   34          K     0       4                                               1
   35          K1    INFLOW FROM SUBAREA NO. 2
   36          M     1       1     .57                                                       1
   37          P           21.53     117     127     136     142     145
   38          T                                                   1.0     .05
   39          W  1.36     .62
   40          X  -1.5    -.05     2.0
   41          K     2       5                                               1
   42          K1    COMBINING TWO HYDROGRAPHS
   43          K     0       6                                               1
   44          K1    INFLOW FROM SUBAREA NO. 3
   45          M     1       1     .40                                                       1
```

```
46          P          21.53     117     127     136     142     145
                                                                1.0     .05
47          I
48          W   1.54     .62
49          X  -1.5     -.05     2.0                                  1
50          K     0        7
51          K1      INFLOW FROM SUBAREA NO. 4                                    1
52          M     1        1     1.28
53          P          21.53     117     127     136     142     145
                                                                1.0     .05
54          B
55          W   1.88     .62
56          X  -1.5     -.05     2.0                                  1
57          K     3        8
58          K1      COMBINING THREE HYDROGRAPHS                          1
59          K     1        9
60          K1      ROUTE THROUGH LAKE LOUISE
61          Y                                    1       1                   -1093     -1
62          Y1    1
63          Y4  1093     1095    1098    1100    1101.9    1103    1104    1105    1107    1110
64          Y5     0      250    1000    1660    2380      2740    3010    3340    4180    5645
65          SS     0       58     193     665     705       850
66          SE  1085     1090    1093    1100    1101      1105
67          SS  1093
68          SD  1101      3.0     1.5      95
69          SL     5       55      75     105     139       190     233     260     285
70          SV  1101   1101.2  1101.5  1101.8    1102      1103    1104    1105    1106
71          K     99
```

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

 RUN  DATE= 80/07/16.
      TIME= 14.22.45.
```

ANALYSIS OF DAM OVERTOPPING USING RATIOS OF THE PMF
HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF LAKE LOUISE DAM
RATIOS OF THE PMF ROUTED THROUGH THE RESERVOIR (55@)

JOB SPECIFICATION

NQ	NMR	NMIN	IDAY	IHR	IMIN	METHC	IPLT	IPRT	NSTAN
288	0	15	0	0	0	0	0	0	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 5 LRTIO= 1

RTIOS= .30 .40 .50 .60 1.00

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

1 SUB-AREA RUNOFF COMPUTATION

INFLOW TO CUMMINGS POND

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

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.44	0.00	.44	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	21.93	117.00	127.00	136.00	142.00	145.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA
TP= .78 CP= .62 NTA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 3.80 AND R= 2.75 INTERVALS

UNIT HYDROGRAPH 17 END-OF-PERIOD ORDINATES, LAG= .78 HOURS, CP= .62 VOL= 1.00

33.	117.	199.	218.	175.	121.	84.	58.	40.	28.
19.	13.	9.	6.	4.	3.	2.			

HYDROGRAPH ROUTING

ROUTE THROUGH CUMMINGS POND

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

ROUTING DATA

CLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.60	0.000	0.00	1	1	0	0	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1191.	-1

STAGE	1191.00	1192.00	1193.00	1194.00	1195.00	1197.00	1200.00
FLOW	0.00	20.00	65.00	105.00	180.00	385.00	810.00

CAPACITY=	0.	113.	310.	913.
ELEVATION=	1188.	1191.	1195.	1200.

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
1191.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
1193.0	3.0	1.5	10.

CREST LENGTH	10.	587.	1350.	1190.
AT OR BELOW ELEVATION	1193.0	1200.0	1210.0	1220.0

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HYDROGRAPH ROUTING

ROUTE THROUGH CHANNEL REACH NO. 1

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3	1	0	0	0	0	1	0	0

ROUTING DATA

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

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

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.04600	.04500	.04600	1098.0	1140.0	4250.	.02200

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 1140.00 110.00 1120.00 250.00 1100.00 254.00 1098.00 259.00 1098.00
263.00 1100.00 400.00 1120.00 700.00 1140.00

STORAGE	0.00	2.09	8.79	22.12	42.06	68.61	101.75	141.50	187.86
240.81	300.37	368.27	445.94	533.38	630.60	737.59	854.36	980.90	1117.21
1263.29									
OUTFLOW	0.00	119.67	677.35	2042.48	4530.98	8414.02	13937.24	21328.58	30802.56
42563.02	56727.72	72386.65	91562.45	114443.67	141261.15	172260.44	207690.66	247799.75	292832.35
343028.99									
STAGE	1098.00	1100.21	1102.42	1104.63	1106.84	1109.05	1111.26	1113.47	1115.68
1117.89	1120.11	1122.32	1124.53	1126.74	1128.95	1131.16	1133.37	1135.58	1137.79
1140.00									
FLOW	0.00	119.67	677.35	2042.48	4530.98	8414.02	13937.24	21328.58	30802.56
342563.02	56727.72	72386.65	91562.45	114443.67	141261.15	172260.44	207690.66	247799.75	292832.35
343028.99									

SUB-AREA RUNOFF COMPUTATION

INFLOW FROM SUBAREA NO. 2

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	THSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.97	0.00	.57	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	21.93	117.00	127.00	136.00	142.00	145.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 1.26 CP= .62 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 6.27 AND R= 5.12 INTERVALS

UNIT HYDROGRAPH 31 END-OF-PERIOD ORDINATES, LAG= 1.39 HOURS, CP= .62 VOL= 1.00

12.	43.	85.	127.	157.	168.	159.	129.	106.	87.
72.	59.	48.	40.	33.	27.	22.	18.	15.	12.
10.	8.	7.	6.	5.	4.	3.	3.	2.	2.
1.									

COMBINE HYDROGRAPHS

COMBINING TWO HYDROGRAPHS

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
5	2	0	0	0	0	1	0	0

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SUB-AREA RUNOFF COMPUTATION

INFLOW FROM SUBAREA NO. 3

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
6	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUNG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.40	0.00	.40	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	21.53	117.00	127.00	136.00	142.00	145.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRTL	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 1.54 CP= .62 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 7.11 AND R= 5.64 INTERVALS

UNIT HYDROGRAPH 34 END-OF-PERIOD ORDINATES. LAG= 1.54 HOURS. CP= .62 VOL= 1.00

6.	23.	46.	70.	91.	103.	105.	95.	80.	67.
56.	47.	39.	33.	28.	23.	19.	16.	14.	11.
9.	8.	7.	6.	5.	4.	3.	3.	2.	2.
2.	1.	1.	1.						

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SUB-AREA RUNOFF COMPUTATION

INFLOW FROM SUBAREA NO. 4

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
7	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	1.28	0.00	1.28	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	21.53	117.00	127.00	136.00	142.00	145.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 1.88 CP= .62 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC=3.58 AND R= 5.94 INTERVALS

UNIT HYDROGRAPH 42 END-OF-PERIOD ORDINATES, LAG= 1.87 HOURS, CP= .63 VOL= 1.00

12.	46.	92.	144.	197.	241.	269.	279.	266.	236.
204.	177.	153.	132.	115.	99.	86.	74.	64.	56.
48.	42.	36.	31.	27.	23.	20.	18.	15.	13.
11.	10.	9.	7.	6.	6.	5.	4.	4.	3.
3.	2.								

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

COMBINE HYDROGRAPHS

COMBINING THREE HYDROGRAPHS

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

HYDROGRAPH ROUTING

ROUTE THROUGH LAKE LOUISE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
9	1	0	0	0	0	1	0	0

ROUTING DATA

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

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1093.	-1

STAGE	1093.00	1095.00	1098.00	1100.00	1101.90	1103.00	1104.00	1105.00	1107.00
341110.00									
FLOW	0.00	250.00	1000.00	1660.00	2380.00	2740.00	3010.00	3340.00	4180.00
5645.00									
CAPACITY=	0.	58.	193.	666.	709.	850.			
ELEVATION=	1085.	1090.	1093.	1100.	1101.	1105.			

CREL	SPWID	COOW	EXPW	ELEVL	COOL	CAREA	EXPL
1093.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
1101.0	3.0	1.5	95.

CREST LENGTH	5.	35.	75.	105.	135.	190.	233.	260.	285.
AT OR BELOW ELEVATION	1101.0	1101.2	1101.5	1101.8	1102.0	1103.0	1104.0	1105.0	1106.0

STATION 9. PLAN 1. RATIO 1

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

OPERATION	STATION	AREA	PLAN	RATIOS APPLIED TO FLOWS RATIO 1 .30	RATIO 2 .40	RATIO 3 .50	RATIO 4 .60	RATIO 5 1.00
HYDROGRAPH AT	1	.44	1	538.	717.	897.	1076.	1793.
		(1.14)		(15.23)	(20.31)	(25.39)	(30.47)	(50.78)
ROUTED TO	2	.44	1	110.	238.	399.	577.	1140.
		(1.14)		(3.12)	(6.75)	(11.29)	(16.33)	(32.28)
ROUTED TO	3	.44	1	109.	237.	398.	574.	1137.
		(1.14)		(3.10)	(6.72)	(11.27)	(16.26)	(32.21)
HYDROGRAPH AT	4	.57	1	529.	706.	882.	1059.	1765.
		(1.48)		(14.99)	(19.99)	(24.99)	(29.98)	(49.97)
2 COMBINED	5	1.01	1	585.	812.	1149.	1532.	2849.
		(2.62)		(16.58)	(22.99)	(32.43)	(43.39)	(80.68)
HYDROGRAPH AT	6	.40	1	352.	469.	586.	703.	1172.
		(1.04)		(9.95)	(13.27)	(16.59)	(19.91)	(33.18)
HYDROGRAPH AT	7	1.28	1	1018.	1357.	1697.	2036.	33934
		(3.32)		(28.83)	(38.44)	(48.05)	(57.66)	(96.09)
3 COMBINED	8	2.69	1	1926.	2614.	3398.	4235.	7340.
		(6.97)		(54.55)	(74.01)	(96.23)	(119.92)	(207.84)
ROUTED TO	9	2.69	1	1170.	1725.	2670.	3740.	7251.
		(6.97)		(33.12)	(48.86)	(75.60)	(105.92)	(205.33)

SUMMARY OF DAM SAFETY ANALYSIS
(CUMMINGS POND)

PLAN 1 ••••••••••••••••

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1191.00	1191.00	1193.00
STORAGE	113.	113.	212.
OUTFLOW	0.	0.	65.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	1193.48	.48	235.	110.	6.75	43.00	0.00
.40	1194.02	1.02	262.	238.	9.50	42.50	0.00
.50	1194.39	1.39	280.	399.	10.50	42.00	0.00
.60	1194.69	1.69	295.	577.	11.50	41.75	0.00
1.00	1195.36	2.36	354.	1140.	14.00	41.25	0.00

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.30	109.	1100.0	43.25
.40	237.	1100.7	42.75
.50	398.	1101.3	42.25
.60	574.	1102.0	41.75
1.00	1137.	1103.2	41.50

SUMMARY OF DAM SAFETY ANALYSIS
(LAKE LOUISE DAM)

PLAN 1 ••••••••••••••••

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1093.00	1093.00	1101.00
STORAGE	193.	193.	705.
OUTFLOW	0.	0.	2039.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	1098.91	0.00	566.	1170.	0.00	43.25	0.00
.40	1100.17	0.00	673.	1725.	0.00	43.25	0.00
.50	1102.10	1.10	745.	2670.	2.25	42.75	0.00
.60	1103.11	2.11	782.	3740.	3.25	42.25	0.00
1.00	1105.08	4.08	853.	7251.	5.25	41.50	0.00

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**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION     JULY 1978
 LAST MODIFICATION  26 FEB 79
**********
     1              A1      RATIOS OF PMF ROUTED THROUGH THE RESERVOIR AND DOWNSTREAM
     2              A2      DOWNSTREAM CONDITION DUE TO OVERTOPPING (LAKE LOUISE)
     3              A3      PLAN 1 ASSUMES BREACH, PLAN 2 ASSUMES NO BREACH
     4              B   288       0      15       0       0       0       0       0       0       0
     5              B1    5
     6              J     2       1       1
     7              J1  .5
     8              K     0       1                                       1
     9              K1      INFLOW TO CUMMINGS POND
    10              M     1       1     .44                                                       1
    11              P           21.53     117     127     136     142     145
    12              T                                                     1.0    .05
    13              W   .78     .62
    14              X  -1.5    -.05     2.0
    15              K     1       2                                       1
    16              K1      ROUTE THROUGH CUMMINGS POND
    17              Y                                       1       1
    18              Y1    1                                                -1191    -1
    19              Y4  1191    1192    1193    1194    1195    1197    1200
    20              Y5    0      20      65     105     180     385     810
    21              SS    0     113     310     913
    22              SE 1185    1191    1195    1200
    23              SS 1191
    24              SD 1193     3.0     1.5      10
    25              SL   10     587    1350    1190
    26              SV 1193    1200    1210    1220
    27              K     1       3                                       1
    28              K1      ROUTE THROUGH CHANNEL REACH NO. 1
    29              Y                                       1       1
    30              Y1    1
    31              Y6  .06     .05     .06    1098    1140    4250    .022
    32              Y7    0    1140     110    1120     250    1100     254    1098     259    1098
    33              Y7  263    1100     400    1120     700    1140
    34              K     0       4                                       1
    35              K1      INFLOW FROM SUBAREA NO. 2
    36              M     1       1     .57                                                       1
    37              P           21.53     117     127     136     142     145
    38              T                                                     1.0    .05
    39              W  1.38     .62
    40              X  -1.5    -.05     2.0
    41              K     2       5                                       1
    42              K1      COMBINING TWO HYDROGRAPHS
    43              K     0       6                                       1
    44              K1      INFLOW FROM SUBAREA NO. 3
    45              M     1       1     .40                                                       1
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46          P          21.53     117     127     136     142     145
47          T                                                    1.0      .05
48          W   1.54     .62
49          X  -1.5     -.05     2.0
50          K     0        7                                       1

51          K1      INFLOW FROM SUBAREA NO. 4                                                          1
52          M     1        1     1.28
53          P          21.53     117     127     136     142     145
54          T                                                    1.0      .05
55          W   1.88     .62
56          X  -1.5     -.05     2.0
57          K     1        8                                       1
58          K1      COMBINING THREE HYDROGRAPHS
59          K     1        9                                       1
60          K1      ROUTE THROUGH LAKE LOUISE
61          Y                                  1       1
62          Y1    1                                              -1093    -1
63          Y4  1093     1095    1098    1100   1101.9    1103    1104     1105     1107     1110
64          Y5     0      250    1000    1660    2380    2740    3010     3340     4180     5649
65          SS     0       58     193     666     705     850
66          SE  1085     1090    1093    1100    1101    1105
67          SS  1093
68          SD  1101      3.0     1.5      95
69          SL     5       35      75     105     135     190     233      260      285
70          SV  1101   1101.2  1101.5  1101.8    1102    1103    1104     1105     1106
71          SB    28       .5    1085     2.0    1093    1102
72          SB    28       .5    1085     2.0    1093    1105
73          K     1       10                                       1
74          K1      ROUTE DOWNSTREAM REACH 1
75          Y                                  1       1
76          Y1    1
77          Y6   .06      .05     .06    1018    1060    3750     .02
78          Y7    0     1060     290    1040     350    1020      354     1018      359     1018
79          Y7  .363     1020     400    1040     480    1060
80          K     1       11                                       1
81          K1      ROUTE DOWNSTREAM REACH 2
82          Y                                  1       1
83          Y1    1
84          Y6   .06      .05     .06     938     980    3500     .02
85          Y7    0      980     100     960     370     940      .374     938      379      938
86          Y7  383      940     710     960     890     980
87          K    99
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FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION JULY 1978
LAST MODIFICATION 26 FEB 79
****

RUN DATE= 80/07/18.
TIME= 13.50.10.

RATIOS OF PMF ROUTED THROUGH THE RESERVOIR AND DOWNSTREAM
DOWNSTREAM CONDITION DUE TO OVERTOPPING (LAKE LOUISE)
PLAN 1 ASSUMES BREACH, PLAN 2 ASSUMES NO BREACH

JOB SPECIFICATION

NO	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	15	0	0	0	0	0	0	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 2 NRTIO= 1 LRTIO= 1

RTIOS= .50

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SUB-AREA RUNOFF COMPUTATION

INFLOW TO CUMMINGS POND

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

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.44	0.00	.44	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	21.53	117.00	127.00	136.00	142.00	145.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

4/30

UNIT HYDROGRAPH DATA
TP= .78 CP= .62 NTA= 0

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 3.80 AND R= 2.75 INTERVALS

UNIT HYDROGRAPH 17 END-OF-PERIOD ORDINATES, LAG= .78 HOURS, CP= .62 VOL= 1.00

33.	117.	199.	218.	175.	121.	84.	58.	40.
28.	19.	13.	9.	6.	4.	3.	2.	

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HYDROGRAPH ROUTING

ROUTE THROUGH CUMMINGS POND

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

ALL PLANS HAVE SAME ROUTING DATA

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

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1191.	-1

STAGE	1191.00	1192.00	1193.00	1194.00	1195.00	1197.00	1200.00
FLOW	0.00	20.00	65.00	105.00	180.00	385.00	810.00

CAPACITY=	0.	113.	310.	913.
ELEVATION=	1185.	1191.	1195.	1200.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
1191.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
1193.0	3.0	1.5	10.

CREST LENGTH AT OR BELOW	10.	587.	1350.	1190.
ELEVATION	1193.0	1200.0	1210.0	1220.0

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HYDROGRAPH ROUTING

ROUTE THROUGH CHANNEL REACH NO. 1

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
3	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

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

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

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0600	.0600	.0600	1098.0	1140.0	4250.	.04200

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 1140.00 .110.00 1120.00 250.00 1100.00 254.00 1098.00 259.00 1098.00
263.00 1100.00 400.00 1120.00 700.00 1140.00

STORAGE	0.00	2.05	8.79	22.12	42.06	68.61	101.75	141.50	187.86
1240.81									
	300.37	368.27	445.94	533.38	630.60	737.59	854.36	980.90	1117.21
1263.29									
OUTFLOW	0.00	119.67	677.35	2042.48	4530.98	8414.02	13937.24	21328.58	30802.56
42563.02									
	56727.72	72386.65	91562.45	114443.67	141261.15	172260.44	207690.66	247799.75	292832.35
343028.99									
STAGE	1098.00	1100.21	1102.42	1104.63	1106.84	1109.05	1111.26	1113.47	1115.68
1117.89									
	1120.11	1122.32	1124.53	1126.74	1128.95	1131.16	1133.37	1135.58	1137.79
1140.00									
FLOW	0.00	119.67	677.35	2042.48	4530.98	8414.02	13937.24	21328.58	30802.56
342563.02									
	56727.72	72386.65	91562.45	114443.67	141261.15	172260.44	207690.66	247799.75	292832.35
343028.99									

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

SUB-AREA RUNOFF COMPUTATION

INFLOW FROM SUBAREA NO. 2

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
4	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.57	0.00	.57	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	21.53	117.00	127.00	136.00	142.00	145.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 1.56 CP= .62 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 6.27 AND R= 9.12 INTERVALS

UNIT HYDROGRAPH 31 END-OF-PERIOD ORDINATES, LAG= 1.35 HOURS, CP= .62 VOL= 1.00

12.	43.	85.	127.	157.	168.	155.	129.	106.	87.
72.	59.	48.	40.	33.	27.	22.	18.	15.	12.
10.	8.	7.	6.	5.	4.	3.	3.	2.	2.
1.									

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

COMBINE HYDROGRAPHS

COMBINING TWO HYDROGRAPHS

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
5	2	0	0	0	0	1	0	0

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

SUB-AREA RUNOFF COMPUTATION

INFLOW FROM SUBAREA NO. 3

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
6	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	.40	0.00	.40	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	21.53	117.00	127.00	136.00	142.00	145.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 1.54 CP= .62 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 7.11 AND R= 5.64 INTERVALS

UNIT HYDROGRAPH 34 END-OF-PERIOD ORDINATES, LAG= 1.54 HOURS, CP= .62 VOL= 1.00

6.	23.	46.	70.	91.	103.	105.	95.	80.	67.
56.	47.	39.	33.	28.	23.	19.	16.	14.	11.
9.	8.	7.	6.	5.	4.	3.	3.	2.	2.
2.	1.	1.	1.						

****

SUB-AREA RUNOFF COMPUTATION

INFLOW FROM SUBAREA NO. 4

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
7	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	1.28	0.00	1.28	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96

0.00	21.53	117.00	127.00	136.00	142.00	145.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 1.88 CP= .62 NTA= 0

RECESSION DATA

STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 8.58 AND R= 6.94 INTERVALS

UNIT HYDROGRAPH 42 END-OF-PERIOD ORDINATES, LAG= 1.87 HOURS, CP= .63 VOL= 1.00

12.	46.	92.	144.	197.	241.	269.	279.	266.	236.
204.	177.	153.	132.	115.	99.	86.	74.	64.	56.
48.	42.	36.	31.	27.	23.	20.	18.	15.	13.
11.	10.	9.	7.	6.	6.	5.	4.	4.	3.
3.	2.								

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

COMBINE HYDROGRAPHS

COMBINING THREE HYDROGRAPHS

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	JAUTO
8	3	0	0	0	0	1	0	0

HYDROGRAPH ROUTING

ROUTE THROUGH LAKE LOUISE

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
9	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

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

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1093.	-1

STAGE	1093.00	1095.00	1098.00	1100.00	1101.90	1103.00	1104.00	1105.00	1107.00
1110.00									
FLOW	0.00	250.00	1000.00	1660.00	2380.00	2740.00	3010.00	3340.00	4180.00
345645.00									
CAPACITY=	0.	88.	193.	666.	705.	850.			
ELEVATION=	1085.	1090.	1093.	1100.	1101.	1105.			

CREL	SPWID	COQW	EXPW	ELEVL	COOL	CAREA	EXPL
1093.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
1101.0	3.0	1.5	95.

CREST LENGTH AT OR BELOW ELEVATION	5.	35.	75.	105.	135.	190.	233.	260.	285.
	1101.0	1101.2	1101.5	1101.8	1102.0	1103.0	1104.0	1105.0	1106.0

DAM BREACH DATA

BRWID	Z	ELBM	TFAIL	WSEL	FAILEL
28.	.50	1085.00	2.00	1093.00	1102.00

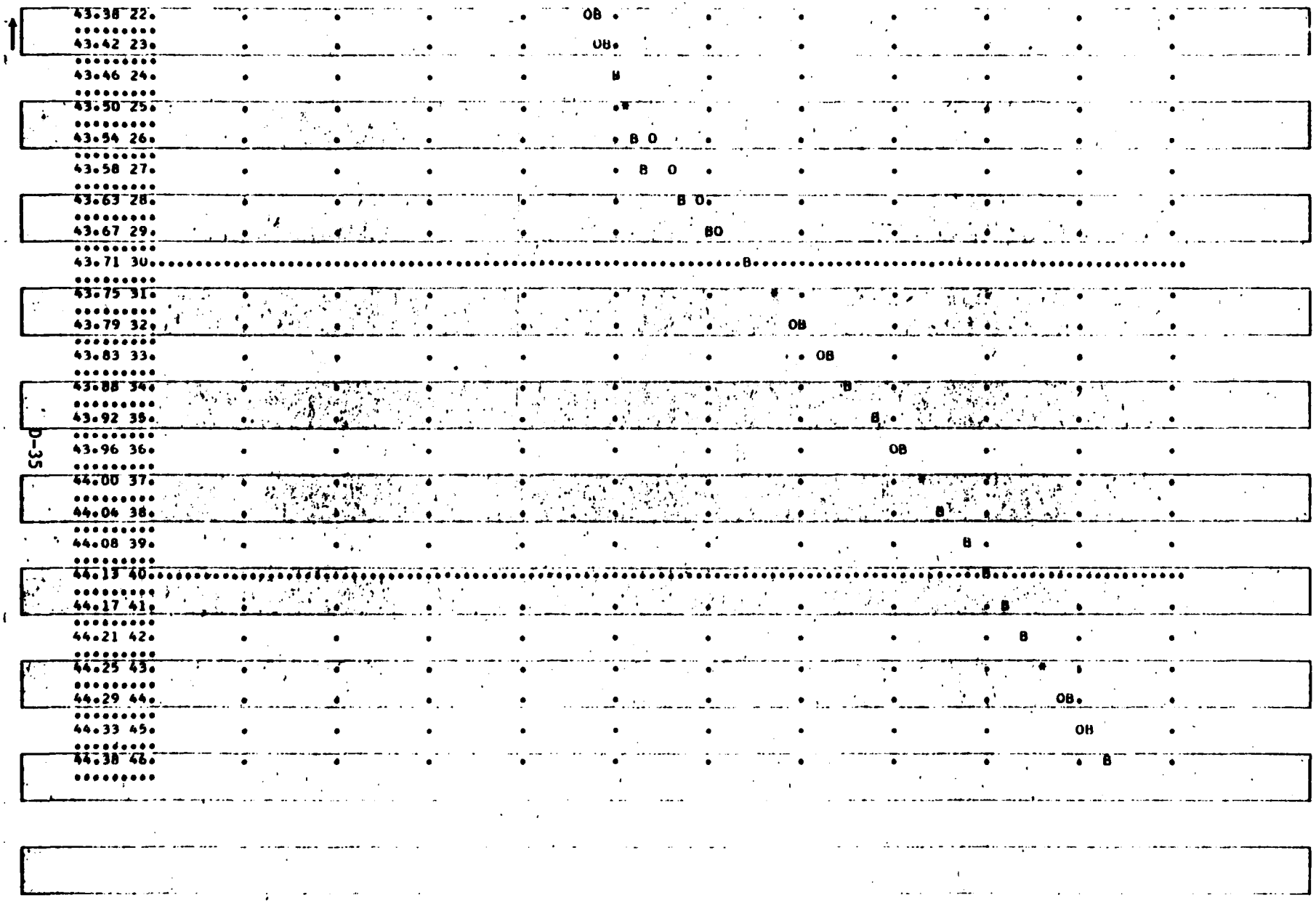
OVF

STATION 9

TIME (HRS) — (O) INTERPOLATED BREACH HYDROGRAPH; (B) COMPUTED BREACH HYDROGRAPH; (*) POINTS AT NORMAL TIME INTERVAL

2600. 2800. 3000. 3200. 3400. 3600. 3800. 4000. 4200. 4400. 4600. 4800.

345645.0.
42.50 1. *
345645.0.
42.54 2. OB
345645.0.
42.58 3. OB
345645.0.
42.63 4. OB
345645.0.
42.67 5. OB
345645.0.
42.71 6. B
345645.0.
42.75 7. B
345645.0.
42.79 8. OB
345645.0.
42.83 9. OB
345645.0.
42.88 10. ..... B .....
.....
42.92 11. B
.....
42.96 12. B
.....
43.00 13.
.....
43.04 14. B
.....
43.08 15. B
.....
43.13 16. B
.....
43.17 17. OB
.....
43.21 18. B
.....
43.25 19.
.....
43.29 20. ..... OB .....
.....
43.33 21. B
.....


43.38 22.
43.42 23.
43.46 24.
43.50 25.
43.54 26.
43.58 27.
43.63 28.
43.67 29.
43.71 30.
43.75 31.
43.79 32.
43.83 33.
43.88 34.
43.92 35.
43.96 36.
44.00 37.
44.04 38.
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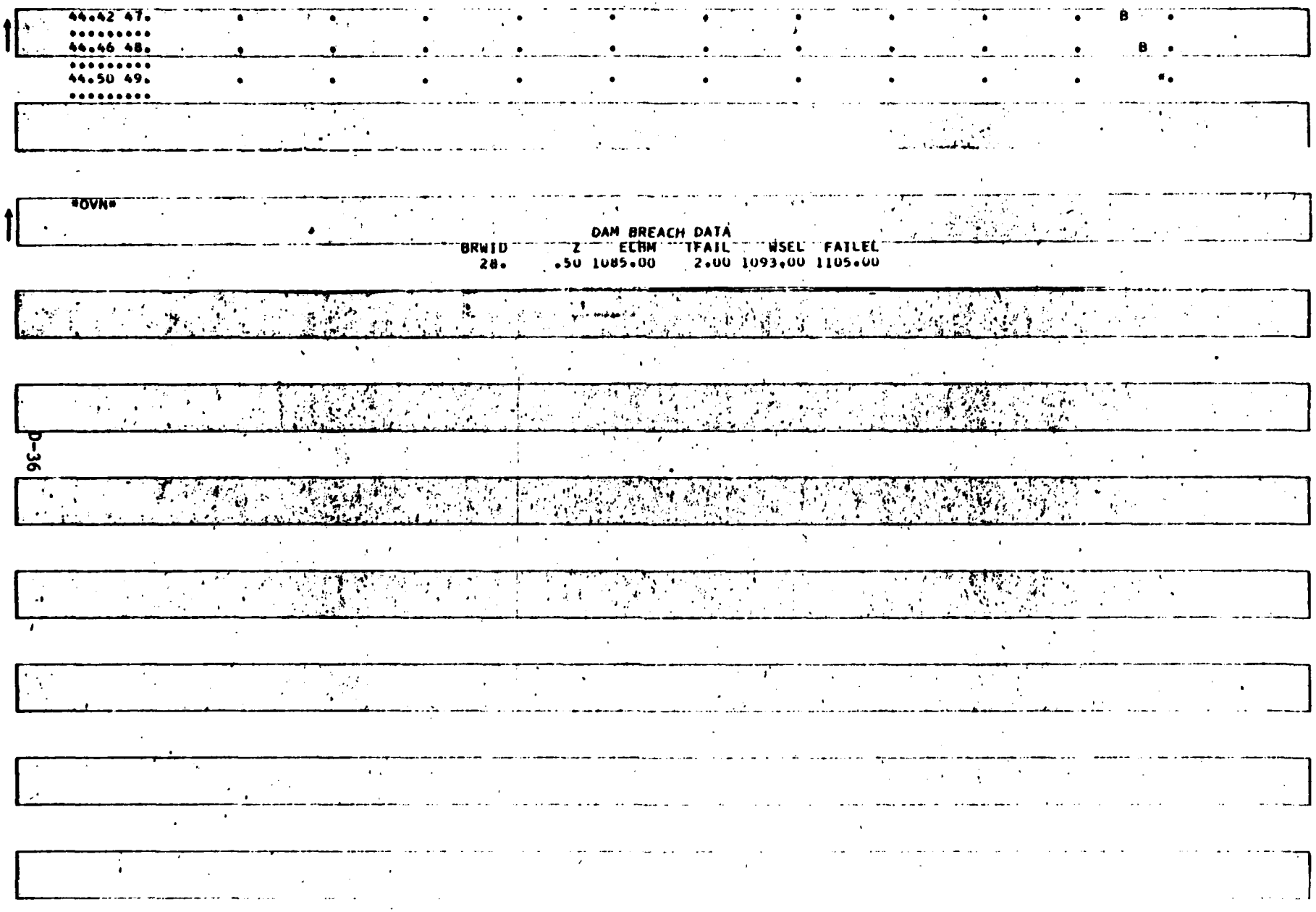

44.42 47.
44.46 48.
44.50 49.
B
B
OVN
DAM BREACH DATA
BRWID Z ECHM TFAIL WSEL FAILEL
28. .50 1085.00 2.00 1093.00 1105.00

HYDROGRAPH ROUTING

ROUTE DOWNSTREAM REACH 1

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
10	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

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

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

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0600	.0500	.0600	1018.0	1060.0	3750.	.02000

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC
0.00 1060.00 290.00 1040.00 350.00 1020.00 354.00 1018.00 359.00 1018.00
363.00 1020.00 400.00 1040.00 480.00 1060.00

STORAGE	0.00	1.79	5.48	11.21	18.98	28.79	40.64	54.53	70.46
1188.43	108.44	132.64	166.62	207.37	255.92	312.24	376.35	448.23	527.91
1615.36									
OUTFLOW	0.00	113.94	538.74	1343.47	2610.48	4415.57	6829.72	9920.12	13750.82
18383.25	23741.47	28282.46	35209.37	44452.35	56169.34	70579.37	87917.95	108422.46	132326.96
159860.42									
STAGE	1018.00	1020.21	1022.42	1024.63	1026.84	1029.05	1031.26	1033.47	1035.68
1037.89	1040.11	1042.32	1044.53	1046.74	1048.95	1051.16	1053.37	1055.58	1057.79
1060.00									
FLOW	0.00	113.94	538.74	1343.47	2610.48	4415.57	6829.72	9920.12	13750.82
118383.25	23741.47	28282.46	35209.37	44452.35	56169.34	70579.37	87917.95	108422.46	132326.96
159860.42									

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

HYDROGRAPH ROUTING

ROUTE DOWNSTREAM REACH 2

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
11	1	0	0	0	0	1	0	0

ALL PLANS HAVE SAME ROUTING DATA

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

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

NORMAL DEPTH CHANNEL ROUTING

QN(1)	QN(2)	QN(3)	ELNVT	ELMAX	RLNTH	SEL
.0600	.0500	.0600	938.0	980.0	3500.	.02000

D-38

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00 980.00 100.00 960.00 370.00 940.00 374.00 938.00 379.00 938.00
383.00 940.00 710.00 960.00 890.00 980.00

STORAGE	0.00	1.72	11.00	32.01	64.73	109.18	165.34	233.22	312.83
1404.15	507.19	618.54	735.39	857.74	985.58	1118.92	1257.76	1402.10	1551.93
1707.25									
OUTFLOW	0.00	114.38	833.46	3005.68	7315.71	14342.33	24605.76	38586.41	56734.97
179478.69									
	107404.89	144058.75	185749.50	232502.60	284366.29	341404.53	403692.42	471313.07	544355.52
622913.13									
STAGE	938.00	940.21	942.42	944.63	946.84	949.05	951.26	953.47	955.68
1957.89	960.11	962.32	964.53	966.74	968.95	971.16	973.37	975.58	977.79
1980.00									
FLOW	0.00	114.38	833.46	3005.68	7315.71	14342.33	24605.76	38586.41	56734.97
679478.69	107404.89	144058.75	185749.50	232502.60	284366.29	341404.53	403692.42	471313.07	544355.52
622913.13									

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

OPERATION	STATION	AREA	PLAN	RATIO 1 .50
HYDROGRAPH AT	1	.44 (1.14)	1	897. (25.39)
			2	897. (25.39)
ROUTED TO	2	.44 (1.14)	1	399. (11.29)
			2	399. (11.29)
ROUTED TO	3	.44 (1.14)	1	398. (11.27)
			2	398. (11.27)
HYDROGRAPH AT	4	.57 (1.48)	1	882. (24.99)
			2	882. (24.99)
2 COMBINED	5	1.01 (2.62)	1	1145. (32.43)
			2	1145. (32.43)
HYDROGRAPH AT	6	.40 (1.04)	1	586. (16.59)
			2	586. (16.59)
HYDROGRAPH AT	7	1.28 (3.32)	1	1697. (48.05)
			2	1697. (48.05)
3 COMBINED	8	2.69 (6.97)	1	3398. (96.23)

			2	3398.
			(	96.23)(
ROUTED TO	9	2.69	1	4779.
	(	6.97)	(	135.32)(
			2	2670.
			(	75.60)(
ROUTED TO	10	2.69	1	4719.
	(	6.97)	(	133.63)(
			2	2667.
			(	75.53)(
ROUTED TO	11	2.69	1	4626.
	(	6.97)	(	130.98)(
			2	2652.
			(	75.11)(

SUMMARY OF DAM SAFETY ANALYSIS
(CUMMINGS POND)

PLAN 1 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1191.00	1191.00	1193.00
STORAGE	113.	113.	212.
OUTFLOW	0.	0.	65.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	1194.39	1.39	280.	399.	10.50	42.00	0.00

PLAN 2 .....

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1191.00	1191.00	1193.00
STORAGE	113.	113.	212.
OUTFLOW	0.	0.	65.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	1194.39	1.39	280.	399.	10.50	42.00	0.00

PLAN 1 STATION 3

RATIO	MAXIMUM FLOW.CFS	MAXIMUM STAGE.FT	TIME HOURS
.50	398.	1101.3	42.25

PLAN 2 STATION 3

RATIO	MAXIMUM FLOW.CFS	MAXIMUM STAGE.FT	TIME HOURS
.50	398.	1101.3	42.25

SUMMARY OF DAM SAFETY ANALYSIS
(LAKE LOUISE DAM)

PLAN 1		INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	ELEVATION	1093.00	1093.00	1101.00
	STORAGE	193.	193.	705.
	OUTFLOW	0.	0.	2039.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	1102.07	1.07	744.	4779.	1.50	44.50	42.50

PLAN 2		INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
	ELEVATION	1093.00	1093.00	1101.00
	STORAGE	193.	193.	705.
	OUTFLOW	0.	0.	2039.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.50	1102.10	1.10	745.	2670.	2.25	42.75	0.00

PLAN 1 STATION 10

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	4719.	1029.3	44.50

PLAN 2 STATION 10

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	2667.	1028.9	42.75

PLAN 1 STATION 11

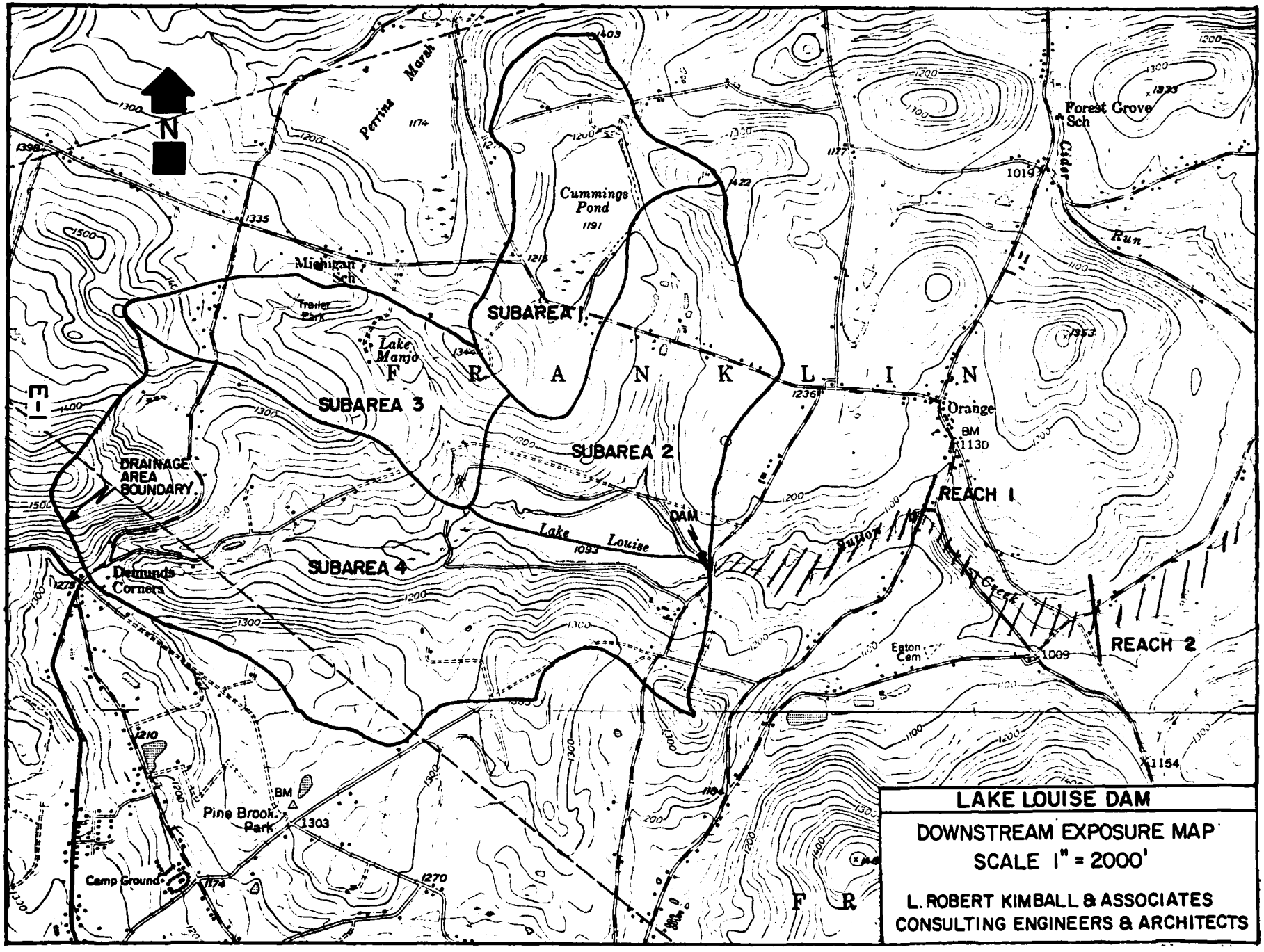
RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS

.50	4626.	945.5	44.50

PLAN 2 STATION 11

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.50	2652.	944.3	43.00

APPENDIX E
DRAWINGS

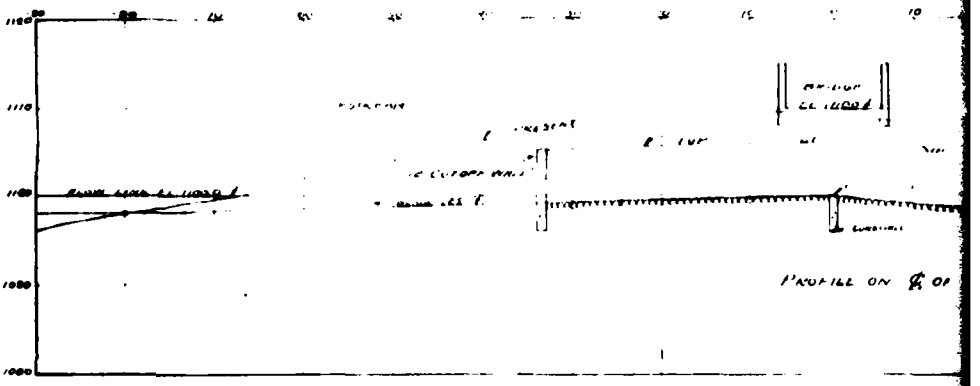


LAKE LOUISE DAM

DOWNSTREAM EXPOSURE MAP

SCALE 1" = 2000'

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS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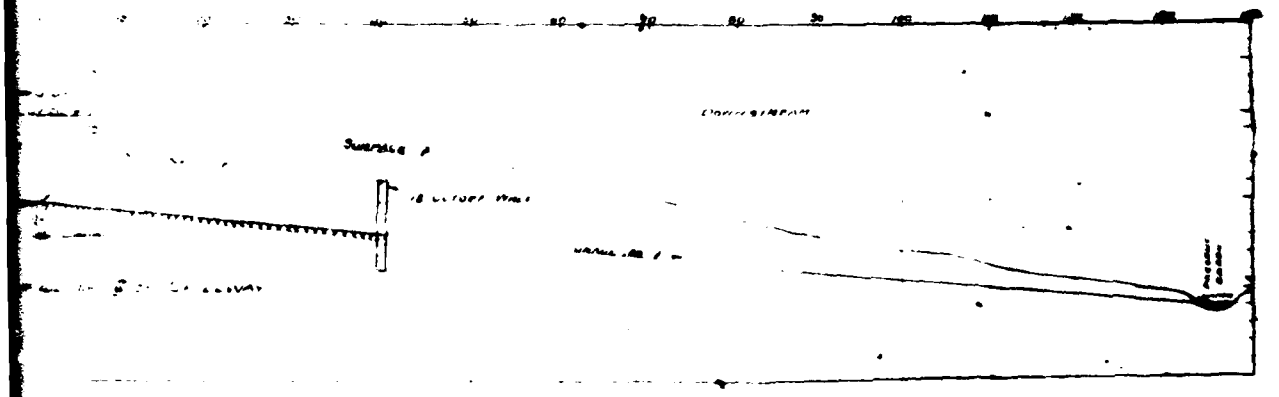
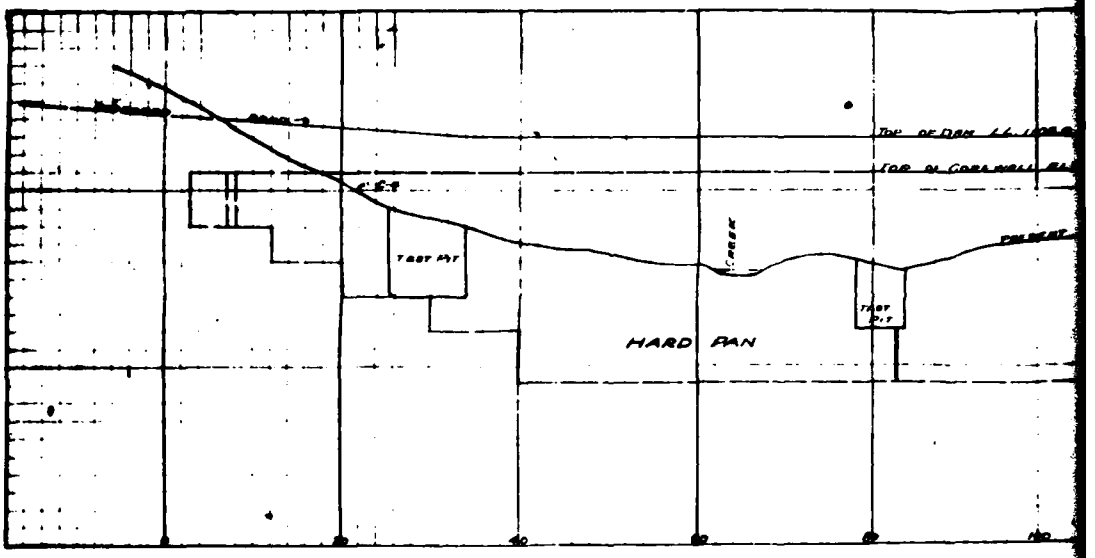
1110
1100
1090
1080

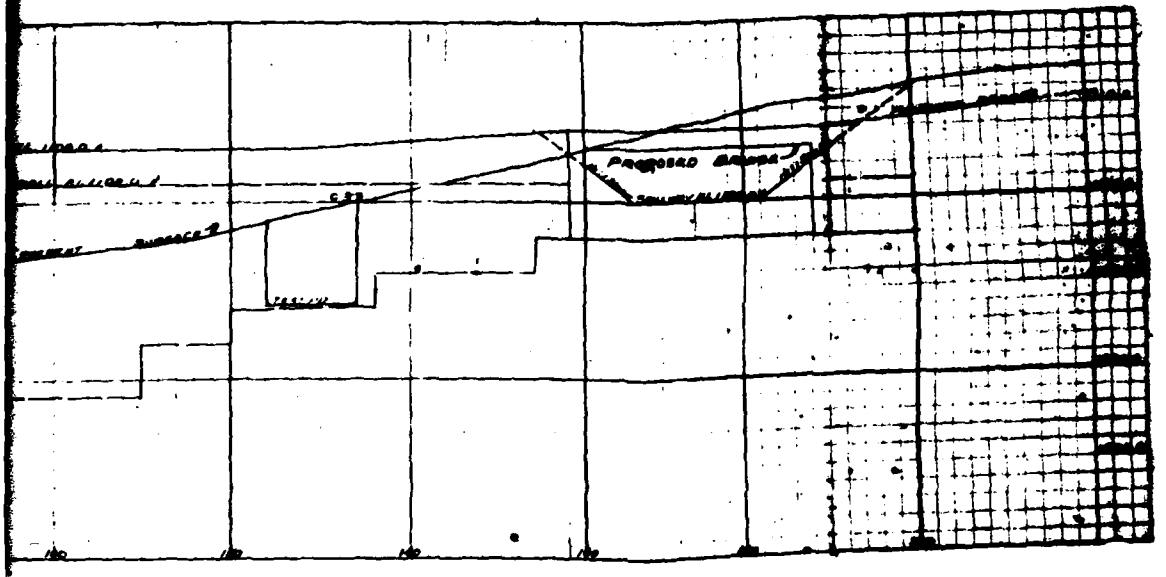


PROPOSED DAM

HOFFMAN FARM

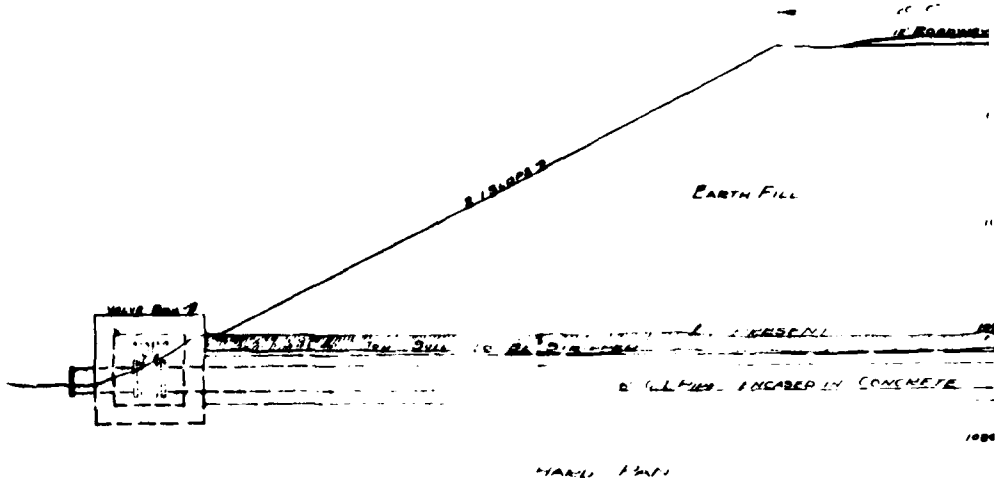


LONG
GOERING
FRANKLIN
SCALE



LONGITUDINAL SECTION
PROPOSED DAM
RINGER & HOFFMAN FARM
NKLIN TWP. LUZERNE CO., PA.
SCALE: AS NOTED OCTOBER 1965.

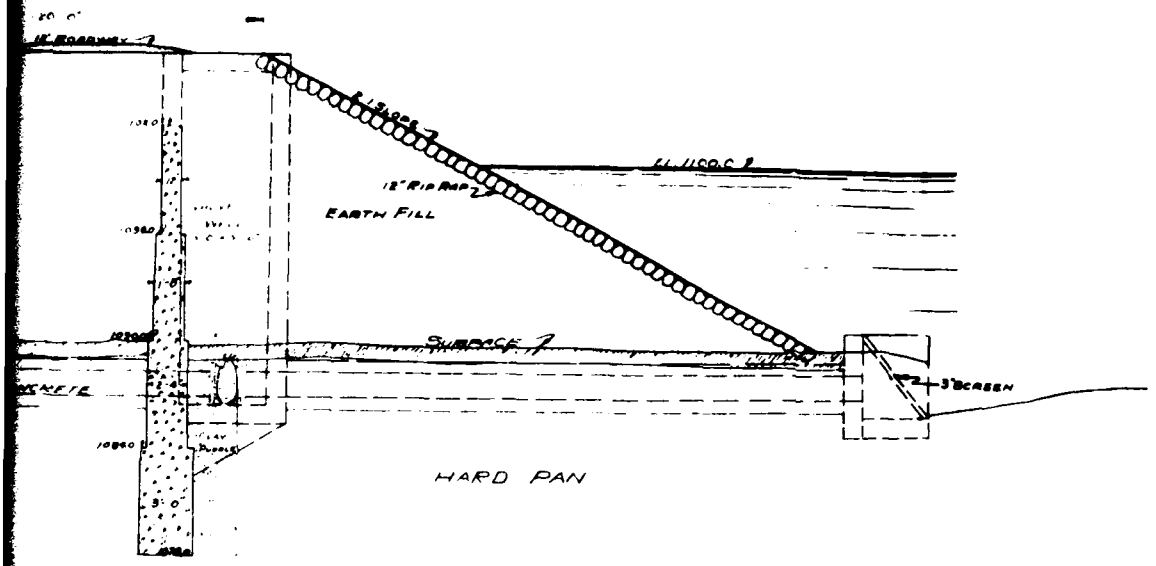
L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
WILKES-BARRE, PA.



Estimated Quantities

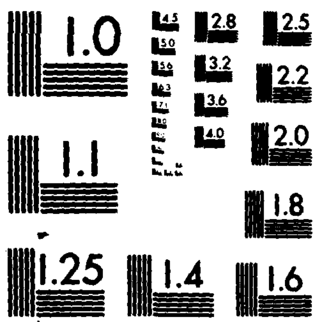
- [illegible] Cu.Yds. Trench Excavation
- [illegible] " " Roadway
- [illegible] " " Fill
- [illegible] " " Concrete 1:2:4
- [illegible] Sq " " Road Surface
- [illegible] " " Rip Rap
- [illegible] " " Sheeting
- 1200 Lin. Ft. 16" C.I. Pipe
- 3 — 16" P.&P. Gate Valves

CROS
PROP
GOERINGER
FRANKLIN TW
SCALE: 1"=4'

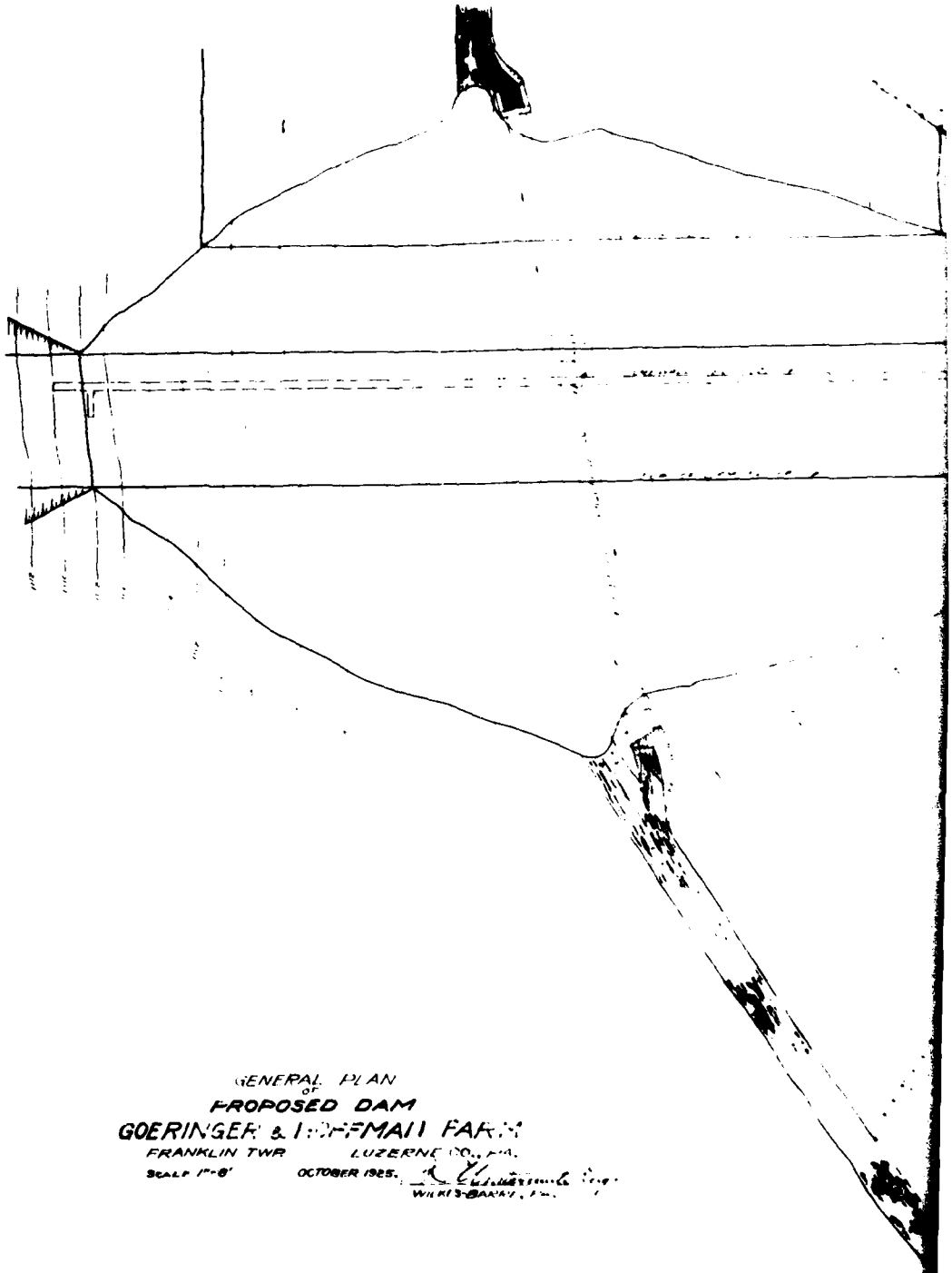


CROSS SECTION
OF
PROPOSED DAM
NGER & HOFFMAN FARM
KLIN TWP. LUZERNE CO., PA.
1"=4' OCTOBER 1925. H. C. Wintermute Engr
WILKES-BARRE, PA.

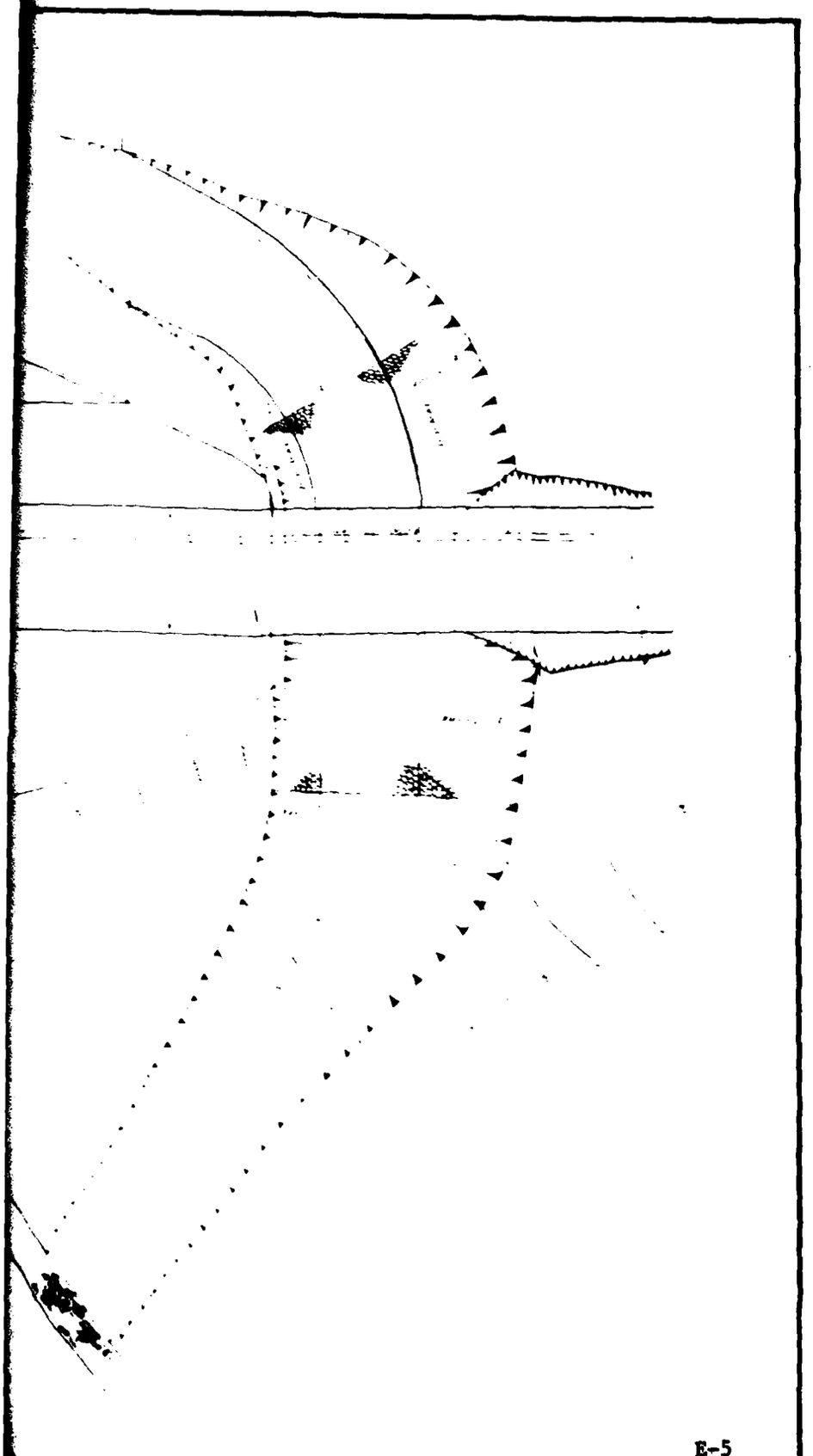
AD-A091 448 KIMBALL (L ROBERT) AND ASSOCIATES EBENSBURG PA F/G 13/13
NATIONAL DAM INSPECTION PROGRAM. LAKE LOUISE DAM (NDS ID NUMBER--ETC(U)
SEP 80 R J KIMBALL DACW31-80-C-0020
UNCLASSIFIED NL



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A



GENERAL PLAN
OF
PROPOSED DAM
GOERINGER & HOFFMAN FARM
FRANKLIN TWP LUZERNE CO., PA.
SCALE 1"=8' OCTOBER 1925.

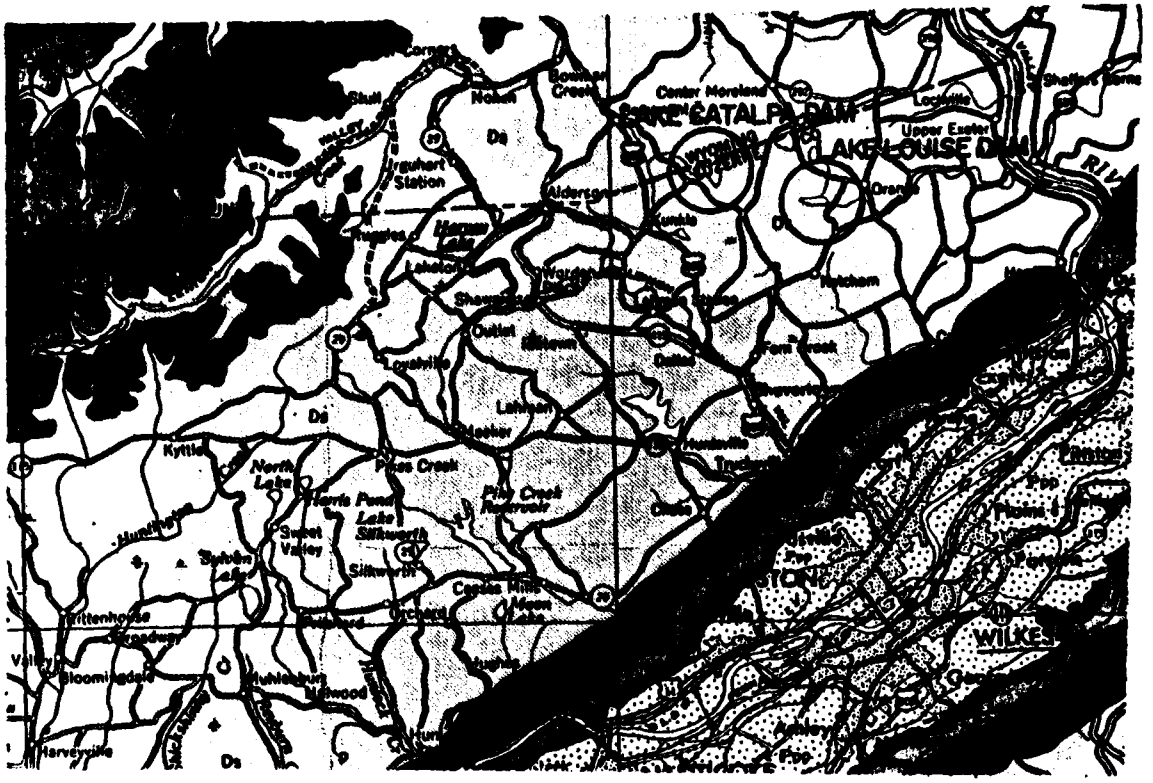


APPENDIX F
GEOLOGY

General geology

Lake Louise and its dam lie within the (Glaciated) Low Plateaus Section of the Appalachian Plateaus Physiographic Province. This area is characterized by broad anticlines and synclines and little, if any, faulting. There are no known faults in the vicinity of the dam.

The rocks underlying the lake and dam consist of the Devonian aged Susquehanna Group. This is a complex unit of conglomerate, sandstone, siltstone and shale. The usually well developed bedding ranges in thickness from less than one to over fifteen feet. The well developed joints are regular and closely spaced in the shales and siltstones. They are vertical or steeply dipping and usually form a blocky or platy pattern. The shales disintegrate rapidly, but the siltstone, sandstone and conglomerate are fairly resistant to weathering. The rocks of the Susquehanna Group form a good foundation for heavy structures if excavated to sound material and the shales and siltstones are kept water free. The interstitial porosity of the coarser rocks is low, but joint development has created a medium level effective porosity.



GEOLOGIC MAP OF THE AREA AROUND LAKE CATALPA DAM AND LAKE LOUISE DAM

Oswayo Formation
Brownish and greenish gray, fine and medium grained sandstones with some shales and scattered calcareous lenses; includes red shales which become more numerous eastward. Relation to type Oswayo not proved.

Dck — **Catskill Formation**
Chiefly red to brownish shales and sandstones; includes gray and greenish sandstone tongues named Elk Mountain, Honesdale, Shohola, and Delaware River in the east.

Dm — **Marine beds**
Gray to olive brown shales, graywackes, and sandstones; contains "Chemung" beds and "Portage" beds including Burket, Brallier, Harrell, and Trimmers Rock; Tully Limestone at base.

Ds — **Susquehanna Group**
Barbed line is "Chemung-Catskill" contact of Second Pennsylvania Survey County reports; barbs on "Chemung" side of line.

SCALE 1:250,000