AD-A070 609 KIMBALL (L ROBERT) AND ASSOCIATES EBENSBURG PA F/G 13/2
NATIONAL DAM INSPECTION REPORT. LAUREL DAM (NDS I.D.-PA-00586, --ETC(U)
MAR 79 R J KIMBALL, K CHUANG DACW31-79-C-0009
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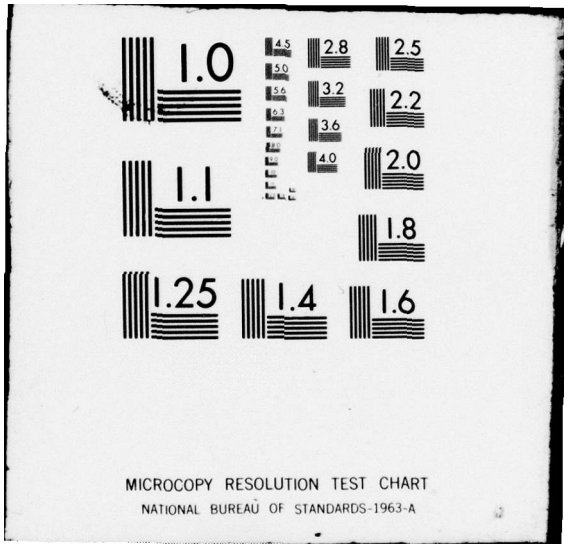
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NATIONAL BUREAU OF STANDARDS-1963-A

LEVEL

SUSQUEHANNA RIVER BASIN

MOUNTAIN CREEK, CUMBERLAND COUNTY

PENNSYLVANIA

LAUREL DAM

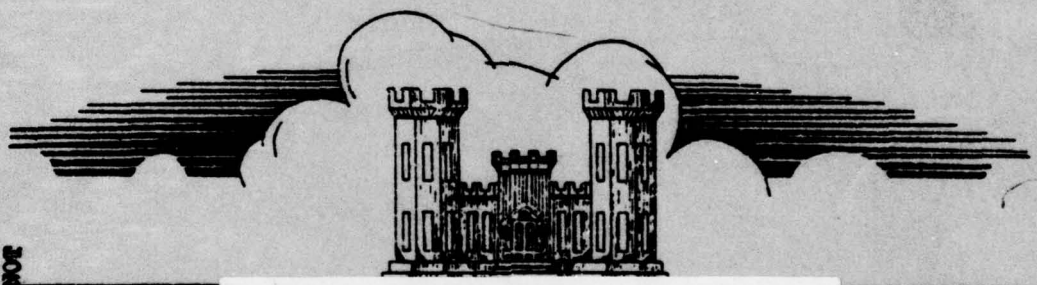
NDS ID NO. PA-00586

DER ID NO. 21-25

PENNSYLVANIA DEPT. OF ENVIRONMENTAL RESOURCES

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM



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Prepared by

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

For

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

MARCH 1979

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SUSQUEHANNA RIVER BASIN

MOUNTAIN CREEK, CUMBERLAND COUNTY

PENNSYLVANIA

LAUREL DAM

NDS ID NO. PA-00586

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PHASE I INSPECTION REPORT

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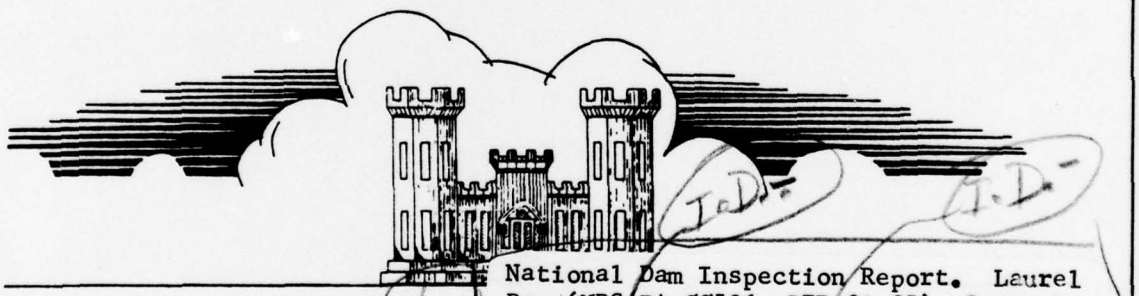

National Dam Inspection Report. Laurel Dam (NDS-PA-00586, DER-21-25), Susquehanna River Basin, Mountain Creek, Cumberland County, Pennsylvania. Phase I Inspection Report.

Prepared by

L. ROBERT KIMBALL and ASSOCIATES

CONSULTING ENGINEERS and ARCHITECTS

EBENSBURG, PENNSYLVANIA

15931

(10) R. Jessney /Kimball, Kuang-hwei /Chuang

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(15) DACW31-79-C-0009

(11) MARCH 1979

(12) 103 p.

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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: Laurel Dam
STATE LOCATED: Pennsylvania
COUNTY LOCATED: Cumberland
STREAM: Mountain Creek
DATE OF INSPECTION: October 31 and November 1, 1978

ASSESSMENT

The assessment of Laurel Dam is based upon visual observations made at the time of inspection, review of available records and data, hydrologic and hydraulic computations, and past operational performance.

The inspection and review of data of Laurel Dam did not reveal any problems which require immediate emergency action. The dam appears to be stable, well maintained, and safely operated.

The existing spillway and reservoir are capable of controlling approximately 84% of the PMF. Based upon criteria established by the Corps of Engineers, the spillway is termed adequate.

A review of the design stability analysis and an analysis performed for this study indicates that the dam is stable under PMF conditions.

A geologic study should be conducted to determine the potential for movement of faults in the area.

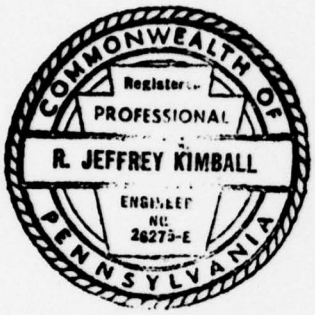
The following recommendations should be implemented as part of the regular operating and maintenance routine:

1. Continue with a routine inspection and surveillence program.

2. Continue with maintenance as needed and routine operation of the sluice gate control valve.

3. Develop an emergency warning and evacuation plan for this dam.

SUBMITTED BY: L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS AND ARCHITECTS



R. Jeffrey Kimball

R. Jeffrey Kimball, P.E.

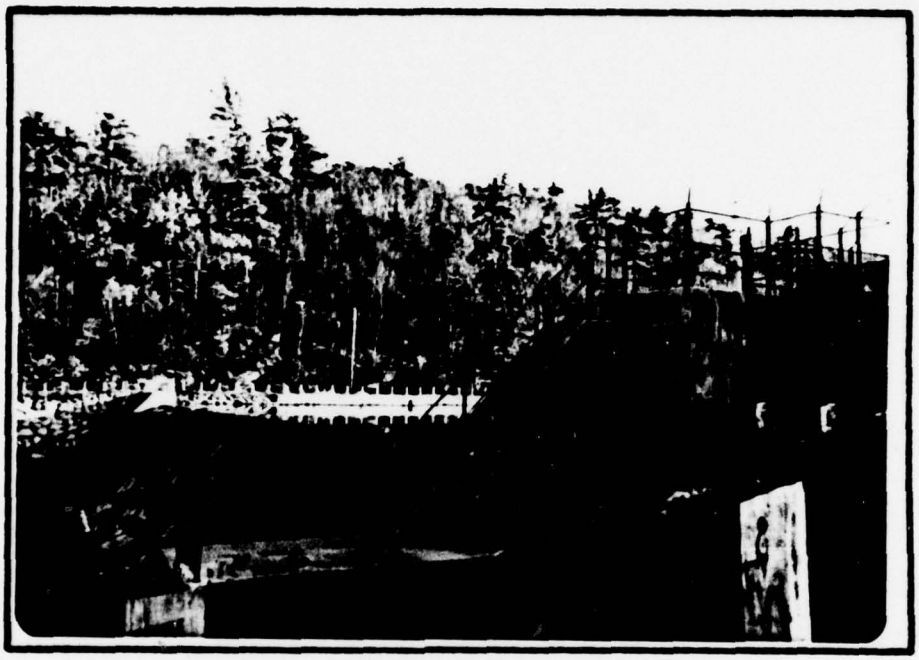
3-20-79
Date

K. Chuang

Kuang-hwei Chuang, P.E.

7 Apr 79
Date

G. K. WITHERS
Colonel, Corps of Engineers
District Engineer



Overview of dam from left abutment.

Overview of dam from right abutment.

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APPENDICES

PHASE I
NATIONAL DAM INSPECTION PROGRAM
LAUREL DAM
NDI I.D. NO. PA 586
DER I.D. NO. 20-25

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. Laurel Dam is a concrete gravity dam constructed in 1967. The dam is 25 feet high (32 feet above bedrock). The center overflow section consists of an ogee weir and is 200 feet long. The right abutment is a gravity non-overflow section. The left abutment consists of a 151 foot long non overflow concrete wingwall. This wingwall is 12.5 feet higher than the ogee crest. The drawdown conduit is a 3 feet by 5 feet concrete tunnel through the left abutment wingwall. The conduit is 29.5 feet long and is controlled by a sluice gate operated from the top of the wingwall.

b. Location. The dam is located on Mountain Creek, approximately 6.5 miles southwest of Mount Holly Springs, Pennsylvania. Laurel Dam can be located on the Dickinson, U.S.G.S. 7.5 minute quadrangle in Cooke Township, Cumberland County, Pennsylvania.

c. Size Classification. Laurel Dam is a small size structure (25 feet high, 160 acre-feet).

d. Hazard Classification. Laurel Dam is a high hazard dam. Downstream conditions indicate that loss of life is probable should the structure fail. Details on downstream exposure are included in Section 3.1e.

e. Ownership. Laurel Dam is owned by the Commonwealth of Pennsylvania, Department of Environmental Resources. Correspondence should be addressed to:

Bureau of Operation Resources Management
Department of Environmental Resources
P.O.Box 1467
Harrisburg, Pennsylvania 17120

f. Purpose of Dam. Recreation

g. Design and Construction History. Laurel Dam was designed by the Department of Forests and Waters, now incorporated into the Department of Environmental Resources, Commonwealth of Pennsylvania. The dam was constructed in 1967-68 by the H.J. Williams Co. Laurel Dam replaces an old (prior to 1915) rockfilled timber crib dam which had failed several times and which was constantly in need of repair. The old dam is partially inplace immediately upstream of the concrete dam.

h. Normal Operating Procedures. The reservoir is maintained at the spillway crest with the excess inflow discharging over the spillway. The reservoir is kept at this elevation to maintain a constant level for recreational use. The drawdown conduit is only operated periodically during inspections or when a drawdown of the reservoir is necessary for work on the dam or in the reservoir area.

1.3 Pertinent Data.

a. Drainage Area. 23.8 square miles

b. Discharge at Dam Site (cfs).

Maximum known flood at dam site	Estimated 6,080 elevation 778.5 (June, 1972)
Warm water outlet at pool elevation	N/A
Diversion tunnel low pool outlet at pool elevation	N/A
Gated spillway capacity at pool elevation	280
Gated spillway capacity at maximum pool elevation	Unknown
Ungated spillway capacity at maximum pool elevation, elevation 786.0	32,720
Total spillway capacity at maximum pool elevation	33,000

c. Elevation (U.S.G.S. Datum) (Feet).

Top of dam	786.0 left wingwall
Maximum pool - Design surcharge	785.0
Full flood control pool	N/A
Recreational pool	774.5
Spillway crest	774.5
Upstream portal invert drawdown conduit	761.0
Downstream portal invert drawdown conduit	760.5
Streambed at centerline of dam	754.0
Maximum tailwater	None

d. Reservoir (feet).

Length of maximum pool	5300
Length of normal (recreational) pool	2000
Length of flood control pool	N/A

e. Storage (acre-feet).

Normal (recreational pool)	160
Flood control pool	N/A
Design surcharge	820
Top of dam	896

f. Reservoir Surface (acres).

Top of dam	59
Maximum pool	24
Flood control pool	N/A
Normal pool (recreational)	24
Spillway crest	24

g. Dam.

Type	Concrete gravity
Length	250 feet (not including wingwall)
Height	25 feet
Top width	Overflow - N/A Right abutment - 6 feet Left abutment wingwall - 4 feet
Side slopes	Variable

	Downstream	Upstream
Overflow	Variable	1H:3V
Right abutment	1H:1V	Vertical
Wingwall	1H:2V	Vertical

Zoning	None
Impervious core	N/A
Cutoff	None
Grout curtain	None

h. Drawdown Conduit.

Type	3' x 5' concrete tunnel
Length	29.5 feet
Closure	Sluice gate
Access	Downstream invert
Regulating facilities	Sluice gate, operated on top of wingwall

i. Spillway.

Type	Ogee weir - overflow dam section
Length	200 feet
Crest elevation	774.5
Gates	None
Upstream channel	Lake
Downstream channel	Natural streambed

SECTION 2
ENGINEERING DATA

2.1 Design. Review of information on the files of the Commonwealth of Pennsylvania, Department of Environmental Resources showed that a considerable amount of engineering data is available for review of this structure. The information available includes the following:

1. 7 construction drawings.
2. Report on Laurel Lake Dam - Repairs and Subsurface Investigation.
3. Report of Subsurface Exploration by Borings, Soils and Testing Co.
4. Laurel Lake Dam Preliminary Design Report.
5. Laurel Lake Dam Preliminary Design Computations.
6. Laurel Lake Dam Final Design Report.
7. Correspondence and Annual Inspection Reports.

2.2 Construction. Information on construction of the dam is contained in the files of the General State Authority, who was in charge of construction of the dam. The files contain inspection reports and photographs.

2.3 Operation. No formal operating records are kept since no operations are normally performed on the dam. A permit is required for major drawdowns. Records of these drawdowns are in Penn DER files.

2.4 Evaluation.

a. Availability. Engineering data was provided by the Division of Dams and Encroachments and Division of Completed Projects, Department of Environmental Resources, Commonwealth of Pennsylvania. The owner made available an engineer and the operator of the dam to accompany the inspection team.

b. Adequacy. The amount of design and construction data available is considerable. The assessment of the structure must be based upon a review of this data, visual inspection, past performances, and hydrologic analysis.

SECTION 3
VISUAL INSPECTION

3.1 Findings.

a. General. The onsite inspection of Laurel Dam was conducted by personnel of L. Robert Kimball and Associates accompanied by the operating staff and an engineer on October 31, 1978 and November 1, 1978. The inspection consisted of:

1. Visual inspection of the retaining structure, abutments and toe.
2. Examination of the spillway facilities, exposed portions 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. Water was flowing evenly over the entire overflow section. No settlement of any of the monoliths was noted. The water flowing over the spillway did not permit close examination of the ogee weir and did not allow a detailed survey to be conducted. Several key features were measured at accessible locations. These features conformed closely to the construction drawings. (See Appendix E).

The concrete appeared to be in very good condition. The right abutment gravity section is four feet above the ogee weir. Adjacent to the concrete abutment is a roadway cut in rock at the same elevation as the abutment. Some water can flow over this roadway during flooding without serious erosion. The right abutment and the left abutment wingwall both have fencing for protection.

The side channel banks downstream of the dam have grouted riprap for erosion protection. This riprap is in excellent condition.

Immediately upstream of the dam is the old dam still intact except for a portion removed to create a channel to allow water to flow to the inlet of the drawdown conduit.

c. Appurtenant Structures. The sluice gate on the drawdown conduit was operated by the operating personnel during the inspection. The sluice gate appears to be in good condition. The gate has to be operated manually. The controls are kept chained and locked.

d. Reservoir Area. The watershed is almost totally covered with woodland. The reservoir slopes are not considered to be susceptible to massive landslides which would affect storage volume of the reservoir or overtopping of the dam by displacing water.

e. Downstream Channel. Mountain Creek downstream of the dam has a moderately wide channel for the first 6.5 miles. Downstream of the dam are numerous (estimated 50) cottages in the flood plain. These cottages are mostly occupied only several weeks of the year. Approximately 2.5 miles downstream is a newly developed camper park. This park is immediately adjacent to the stream.

About 6.4 miles downstream is the Upper Mount Holly Dam. This dam is an earth embankment with a concrete gravity overflow section. Gates are present to feed a mill. The dam is approximately five feet high and the reservoir is nearly silted up. Just below the dam the valley becomes very narrow and confined for a distance of .75 miles before widening at the town of Mount Holly Springs.

3.2 Evaluation. Visual inspection did not reveal any signs of instability. The dam and appurtenant works appear in very good condition and well maintained.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures. The reservoir is maintained at the spillway crest (elevation 774.5). The drawdown conduit is only operated during inspections or to draw the lake level down to perform maintenance of the dam or facilities in the reservoir. All operations are performed by the park staff.

4.2 Maintenance of the Dam. A maintenance inspection is conducted once a year. All maintenance is performed on an as-needed basis. Minor repair work is performed by the park staff. Major work is contracted. Maintenance of the dam is considered good.

4.3 Maintenance of Operating Facilities. The drawdown conduit sluice gate is operated at least twice a year by the park staff.

4.4 Warning System in Effect. There is no formal warning system in effect. The dam is maintained by park staff stationed at the park (several minutes from the dam).

4.5 Evaluation. The operational procedures of the dam and appurtenant structures are considered to be good. The dam is accessible to the park staff under all weather conditions from their residences. No warning system is in effect to warn downstream residents of failure of the dam.

SECTION 5
HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features.

a. Design Data. Considerable information on the design of the spillway was available from PennDER. The calculations are contained in the design reports.

b. Experience Data. No records were available of discharges over the spillway or through the drawdown conduit. The depth of water over the spillway during June, 1972 was estimated by the park superintendent to be four feet.

c. Visual Observations. Both the spillway and drawdown conduit appeared to be in good condition and functional.

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 PMF is that hypothetical flow induced by the most critical combination of precipitation, infiltration losses, and concentration of runoff at a specific location that is considered reasonably possible for a particular drainage area.

To assist the engineer, and provide a standard for hydrologic analyses, 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. A copy of the Users Manual should be obtained by engineers who need more precise definitions of the computer program requirements and methodology.

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. Water level in the reservoir prior to the flood was the spillway crest (Elevation 774.5).

2. Top of dam assumed to be top of left abutment wingwall (Elevation 786.0).

5.3 Summary of Overtopping Analysis. Complete summary sheets from the computer output are presented in the hydrologic appendix. To facilitate review the major results of the overtopping analysis are presented below.

a. Spillway Adequacy Rating. The spillway design flood (SDF) for Laurel Dam is 80% PMF. The SDF is based on the size and hazard classification of the dam. Based on the following definition provided by the Corps of Engineers the spillway for this dam is rated as adequate as a result of our hydrologic analysis. The spillway and reservoir are capable of controlling approximately 84% of the PMF.

> Adequate - For large and intermediate size dams the spillway and reservoir can safely pass the PMF. For small dams the spillway can pass 50% of the PMF.

5.4 Dam Breach Analysis. Since Laurel Dam is a small size structure and can satisfactorily pass 50% of the PMF (based on our analysis) is was not necessary to perform a breach analysis and downstream routing of the flood wave.

Note: Future development within the watershed, at the dam, or downstream may change the characteristics and assumptions made for this study and different results are likely. Future development downstream may also greatly increase the potential for loss of life due to failure of the structure.

5.5 Summary. Laurel Dam can satisfactorily pass greater than 50% of the PMF and therefore the spillway is termed adequate based on the Corps of Engineers criteria.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations. Visual inspection did not reveal any signs of immediate instability. The dam appears to be well constructed and conform to the construction drawings.

b. Design and Construction Data. Penn DER design calculations indicate that both the overflow and non-overflow sections are stable with a water surface of 785.0 and 786.0, respectively. The resultants fall in the middle third. In addition, the overflow section was checked for sliding and found to be stable. The as-built foundation configuration is not known. No as-built stability analysis has been performed.

c. Operating Records. There are no operating records. Laurel Dam controlled the June, 1972 flood with no serious affects.

d. Post-Construction Changes. There have been no post-construction changes.

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. However, Laurel Dam is reportedly situated over a fault and little is known of its extent or movement. A more detailed geologic reconnaissance study should be conducted to determine location, extent and past movement with recommendations for future potential movement.

f. Check of Stability Analysis. An approximate check of the stability of the overflow gravity section was performed for this study. The assumptions for this study were as follows:

1. PMF (elevation 787.0) water surface used.

2. Shape of typical section and depth of foundation assumed to be that which is shown on the construction drawings.

3. Uplift pressure equal to two-thirds the area applied to the base.

4. The conventional analysis for a vertical section having a width of 1 foot is considered. The arch action is neglected.

The analysis indicates that the overflow section of the dam is stable during the PMF.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. The visual observations, review of available information, hydrologic calculations, and past operational performance indicates that Laurel Dam does not appear to present an immediate danger to life or property. Laurel Dam is capable of controlling approximately 84% of the PMF without overtopping. The spillway is termed adequate.

b. Adequacy of Information. The information available appears to be adequate to complete a Phase I Report.

c. Urgency. The recommendations suggested below should be implemented on a continuing basis as part of the regular operating and maintenance routine for this dam.

d. Necessity for Further Investigations. A field reconnaissance study should be conducted to investigate the potential for movement of faults in the area of the dam.

7.2 Recommendations.

1. Continue with a routine inspection and surveillence program.

2. Continue with maintenance as needed and routine operation of the sluice gate control valve.

3. Develop an emergency warning and evacuation plan for this dam.

4. Conduct a geologic study to investigate the potential for movement of the faults in the area.

APPENDIX A

CHECKLIST, VISUAL INSPECTION, PHASE I

CHECK LIST
VISUAL INSPECTION
PHASE I

NAME OF DAM Laurel Dam COUNTY Cumberland STATE Pennsylvania ID# PA 586

TYPE OF DAM Concrete gravity HAZARD CATEGORY High

DATE(s) INSPECTION October 31, 1978 November 1, 1978 WEATHER Sunny, cool TEMPERATURE 50's

POOL ELEVATION AT TIME OF INSPECTION 774.6 M.S.L. TAILWATER AT TIME OF INSPECTION None M.S.L.

INSPECTION PERSONNEL:

R. Jeffrey Kimball - L. Robert Kimball and Associates

James T. Hockensmith - L. Robert Kimball and Associates

Kuang Hwei Chuang - L. Robert Kimball and Associates

Jack Hugendubler - Engineer, PennDER

Bob Lloyd - Park Superintendent

James T. Hockensmith RECORDER

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	N/A	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	N/A	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	N/A	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	N/A	
RIPRAP FAILURES	N/A	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	N/A	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	N/A	
ANY NOTICEABLE SEEPAGE	N/A	
STAFF GAUGE AND RECORDER	N/A	
DRAINS	N/A	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	None noted, flow over spillway did not permit examination.	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Both abutments appeared good.	
DRAINS	None.	
WATER PASSAGES	None.	
FOUNDATION	Unobserved - metarhyolite.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	None noted, surface of concrete appeared good.	
STRUCTURAL CRACKING	None noted.	
VERTICAL AND HORIZONTAL ALIGNMENT	Both appeared good.	
MONOLITH JOINTS	Good.	
CONSTRUCTION JOINTS	Good.	
STAFF GAUGE OR RECORDER	None.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Interior unobserved. 3' x 5' tunnel.	
INTAKE STRUCTURE	Sluice gate - unobserved.	
OUTLET STRUCTURE	Tunnel outlet in wingwall good.	
OUTLET CHANNEL	Natural stream.	
EMERGENCY GATE	None other than outlet works.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	200' long ogee - good condition.	
APPROACH CHANNEL	None.	
DISCHARGE CHANNEL	Natural stream.	
BRIDGE AND PIERS	None.	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	N/A	
APPROACH CHANNEL	N/A	
DISCHARGE CHANNEL	N/A	
BRIDGE AND PIERS	N/A	
GATES AND OPERATION EQUIPMENT	N/A	

DOWNSTREAM CHANNEL

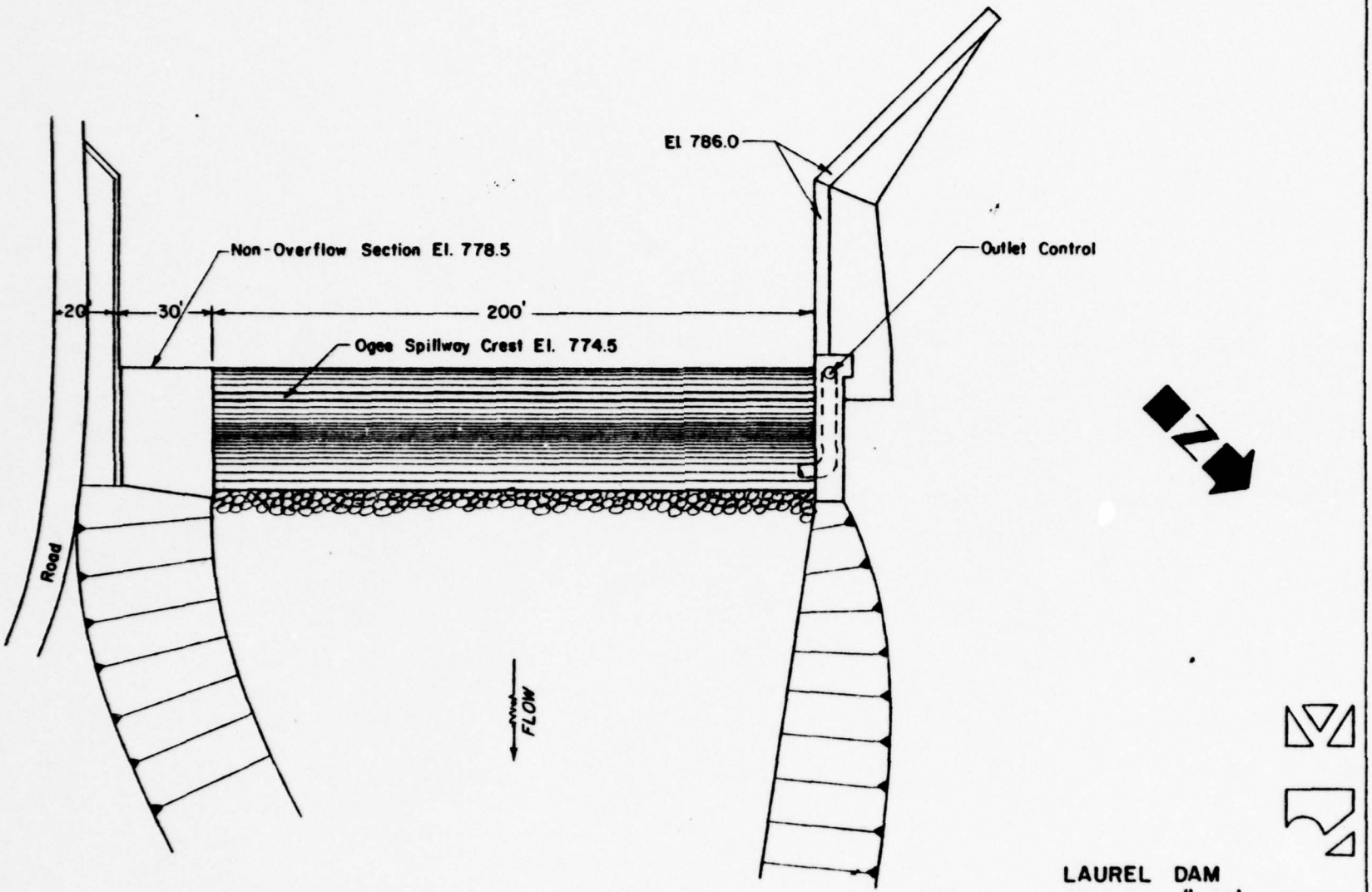
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Generally wide and flat beyond bridge located 500' downstream.	
SLOPES	Gentle.	
APPROXIMATE NO. OF HOMES AND POPULATION	50 cottages, trailor/camper park (capacity for about 100 trailors). Population variable with season. Several of the cottages are permanent residences.	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Moderately steep.	
SEDIMENTATION	Unknown.	

INSTRUMENTATION

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


El 786.0
Non-Overflow Section El. 778.5
Outlet Control
20'
30'
200'
Ogee Spillway Crest El. 774.5
Road
FLOW
N
LAUREL DAM
SCALE: 1"=50'

APPENDIX B

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

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Laurel Dam
ID# PA 586

ITEM	REMARKS
AS-BUILT DRAWINGS	None available.
REGIONAL VICINITY MAP	U.S.G.S. quadrangle.
CONSTRUCTION HISTORY	G.S.A. files.
TYPICAL SECTIONS OF DAM	Construction drawings.
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS	Construction drawings.
RAINFALL/RESERVOIR RECORDS	Unknown. None.

ITEM	REMARKS
DESIGN REPORTS	PennDER files.
GEOLOGY REPORTS	Unknown.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	PennDER files.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	PennDER files.
POST-CONSTRUCTION SURVEYS OF DAM	Unknown.
BORROW SOURCES	N/A

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	None.
HIGH POOL RECORDS	None.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None.
MAINTENANCE OPERATION RECORDS	Unknown.

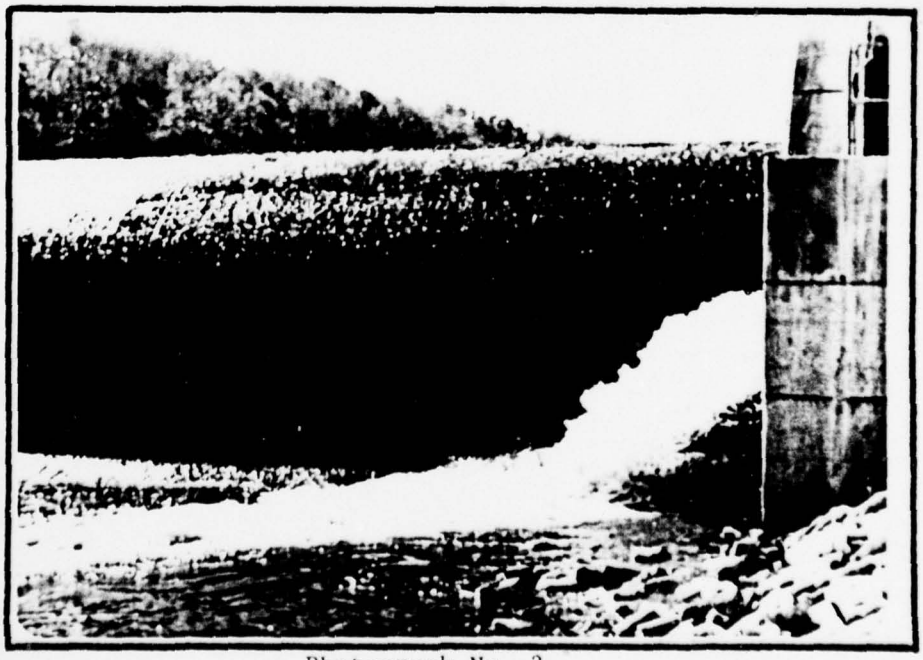
ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	Construction drawings.
OPERATING EQUIPMENT PLANS & DETAILS	Construction drawings.

APPENDIX C

PHOTOGRAPHS

Photograph No. 1

Looking at left abutment, downstream riprap and reservoir drawdown outlet.

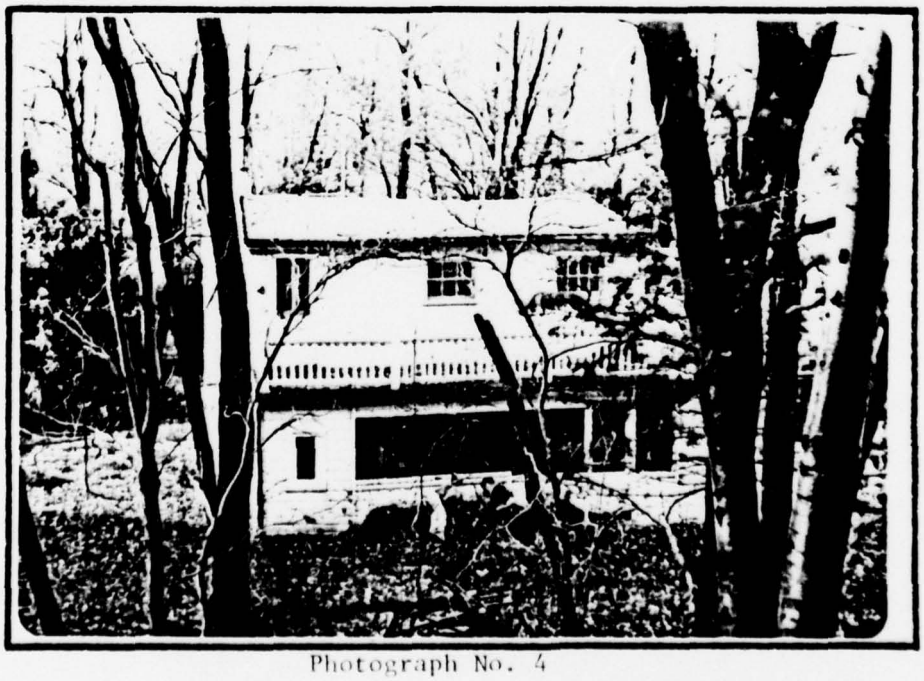


Photograph No. 2

Reservoir drawdown outlet discharging.

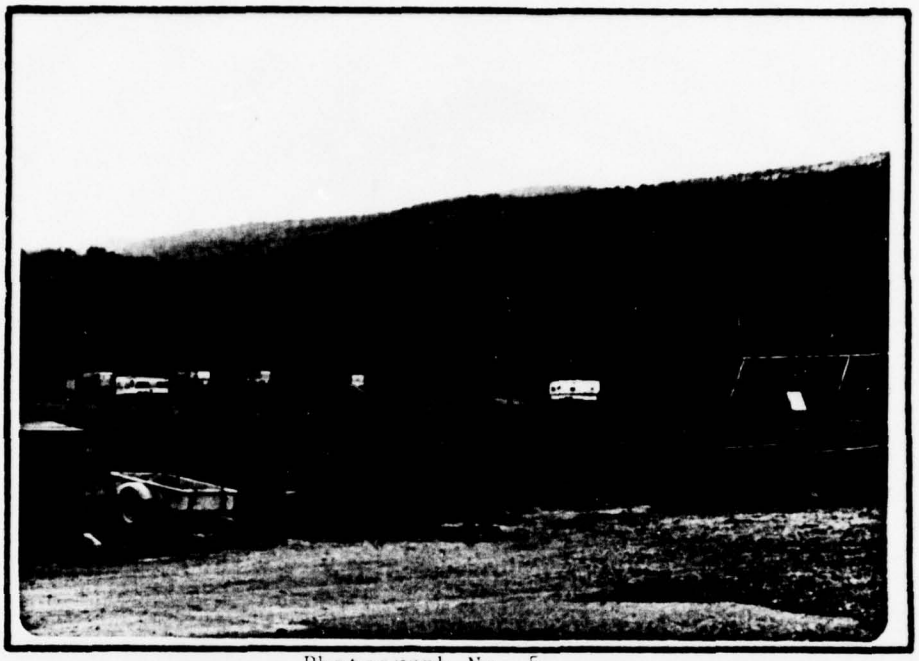
Photograph No. 3

Immediate downstream channel.



Photograph No. 4

First dwelling (Cottage) downstream.



Photograph No. 5

Camper/trailer park downstream.

Photograph No. 6

Upper Mount Holly reservoir.

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 analyses is presented below.

1. Precipitation. The Probable Maximum Precipitation (PMP) is derived and determined from regional charts prepared from past rainfall records including "Hydrometeorological Reports No. 33 prepared by the National Weather Service.

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
C_t	Coefficient representing variations of watershed slope and storage	From Corps of Engineers*
L	Length of main stream channel miles	From U.S.G.S. 7.5 minute topographic
L_{ca}	Length on main stream to centroid of watershed	From U.S.G.S. 7.5 minute topographic
C_p	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.

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

DAM NAME LAUREL LAKE DAM
I.D. NUMBER PA. 21-25
SHEET NO. 1 OF 3
BY OTM DATE 2-1-79

LAUREL LAKE DAM

DRAINAGE AREA

AREA = 23.8 Sq. Mi. (FROM U.S.G.S. QUAD.)

UNIT HYDROGRAPH PARAMETERS

DAMSITE LOCATED IN ZONE 15-A, SUSQUEHANNA RIVER BASIN. FROM CORPS. OF ENGINEERS, BALTIMORE DISTRICT REGIONAL STUDY.

$C_p = 0.54$, $C_t = 1.15$ { FROM C.O.E. BALTIMORE DIST. }

$L = 9.0$ MILES, $L_{ca} = 5.0$ MILES { FROM U.S.G.S. QUAD. }

$t_p = C_t (L \times L_{ca})^{0.3} = 1.15 (9.0 \times 5.0)^{0.3}$

$t_p = 1.15 (3.13) = 3.60$ HRS. (SNYDERS LAG (t_p) IN HRS.)

LOSS RATE AND BASE FLOW PARAMETERS:

AS RECOMMENDED BY CORPS. OF ENGINEERS, BALTIMORE DISTRICT.

STRTL = 1 INCH
CNSTL = 0.05 IN./HR.
STRTQ = 1.50 CFS/SQ. MI.
QRCSN = 0.05 (5% OF PEAK FLOW)
RTIOR = 2.00

PROBABLE MAXIMUM STORM:

FROM H.R. NO. 40

P.M.P. INDEX RAINFALL - 22.2 INCHES

$R_6 = 108\%$, $R_{12} = 118\%$, $R_{24} = 127\%$, $R_{48} = 134\%$, $R_{72} = 137\%$

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

DAM NAME LAUREL LAKE DAM
I.D. NUMBER PA. 21-25
SHEET NO. 2 OF 3
BY OTM DATE 2-1-79

ELEVATION - AREA - CAPACITY RELATIONSHIPS:

AT SPILLWAY CREST ELEV. 774.5' AREA = 25 ACRES
A) INITIAL STORAGE = 160 ACRE · FT

FROM U.S.G.S. QUAD.
A) ELEV. 780.0' SURFACE AREA = 40 ACRES
B) ELEV. 790.0' SURFACE AREA = 73 ACRES

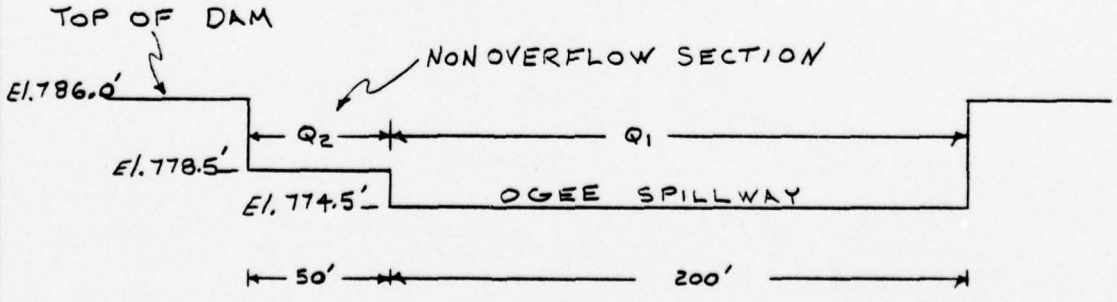
FROM CONIC METHOD FOR RESERVOIR VOLUME. FLOOD HYDROGRAPH PACKAGE (HEC-1). DAM SAFETY VERSION (USERS MANUAL).

$H = 3V/A = 3(160)/25 = 19.2 (FT.)$

ELEV. AT CAPACITY EQUALS ZERO;
774.5 - 19.2 = 755.3 (FT.)

ELEV. (FT)	755.3	774.5	776.5	778.5	780.0	782.0	786.0	790
AREA (Ac)	0	25	30	35.5	40	45.5	59	73

SPILLWAY DISCHARGE



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

DAM NAME LAUREL LAKE DAM
I.D. NUMBER PA. 21-25
SHEET NO. 3 OF 3
BY OTM DATE 2-1-79

ELEVATION	H_1 (FT)	Q_1 (CFS)	H_2 (FT.)	Q_2 (CFS)	Q TOTAL (CFS)
774.5	0	0	0	0	0
775.5	1	760	0	0	760
776.5	2	2,150	0	0	2,150
777.5	3	3,950	0	0	3,950
778.5	4	6,080	0	0	6,080
780.0	5.5	9,803	1.5	275	10,078
782.0	7.5	15,610	3.5	980	16,590
784.0	9.5	22,254	5.5	1935	24,189
786.0	11.5	29,640	7.5	3080	32,720
788.0	13.5	37,700	9.5	4390	42,090

TABULATED FROM $Q = C_1 L H^{3/2}$ WHERE $C_1 = 3.8$ (OGEE) $C_2 = 3.0$ (BROAD CRESTED WEIR).

DAM BREACH

NOT REQUIRED SINCE SPILLWAY PASSED 0.50 P.M.F.

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 23.8 sq. miles-Moderately steep to steep woodland.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 774.5 (160 Ac-ft)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): N/A

ELEVATION MAXIMUM DESIGN POOL: 785.0

ELEVATION TOP DAM: 786.0

SPILLWAY CREST:

a. Elevation 774.5
b. Type Ogee
c. Width
d. Length 200 ft.
e. Location Spillover Center of dam.
f. Number and Type of Gates None

OUTLET WORKS:

a. Type 3 ' x 5' concrete tunnel
b. Location Left abutment wingwall
c. Entrance inverts 761.0
d. Exit inverts 760.5
e. Emergency draindown facilities Outlets work to elevation 761.0

HYDROMETEOROLOGICAL GAUGES:

a. Type None
b. Location
c. Records

MAXIMUM NON-DAMAGING DISCHARGE: June, 1972 - est. 6,080 cfs

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  25 SEP 78
**********
     1              A1       ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
     2              A2       HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF LAUREL LAKE DAM
     3              A3       RATIOS OF PMF ROUTED THROUGH THE RESERVOIR  PA. ID. 21-25
     4              B    300        0       15        0        0        0        0        0       -4        0
     5              B1     5
     6              J      1        4        1
     7              J1   .5     .8       .9       1.
     8              K      0        1                                    1
     9              K1       INFLOW TO RESERVOIR
    10              M      1        1    23.8                23.8                                 1
    11              P               22.2      108      118      127      134      137
    12              T                                                    1.0     0.05
    13              W    3.6     0.54
    14              X   -1.5     -.05      2.0
    15              K      1        2                                    1
    16              K1       ROUTE THRU RESERVOIR
    17              Y                                          1        1
    18              Y1     1                                                    160.       -1
    19              Y4 774.5    775.5    776.5    777.5    778.5     780.     782.     784.     786.     788.
    20              Y5   0.      760.    2150.    3950.    6080.   10078.   16590.   24189.   32720.   42090.
    21              $A     0       25       30     35.5       40     45.5       52       59     66.5     73.4
    22              $E 755.3    774.9    776.5    778.5      780      782      784      786      788      790
    23              $$774.5
    24              $D 786.    3.05      1.5      150.
    25              K     99
```

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

```
RUNOFF HYDROGRAPH AT          1
ROUTE HYDROGRAPH TO           2
END OF NETWORK
```

```
**********
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  25 SEP 78
**********

RUN  DATE  79/01/16.
     TIME  17.10.15.
```

ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF LAUREL LAKE DAM
RATIOS OF PMF ROUTED THROUGH THE RESERVOIR PA. ID. 21-25

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
300	0	15	0	0	0	0	0	-4	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 4 LRTIO= 1

RTIOS= .50 .80 .90 1.00

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

SUB-AREA RUNOFF COMPUTATION

INFLOW TO RESERVOIR

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	23.80	0.00	23.80	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.20	108.00	118.00	127.00	134.00	137.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .828

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= 3.60 CP= .54 NTA= 0

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

UNIT HYDROGRAPH100 END-OF-PERIOD ORDINATES, LAG= 3.63 HOURS, CP= .54 VOL= 1.00

40.	151.	310.	499.	709.	937.	1177.	1427.	1668.	1880.
2055.	2193.	2293.	2353.	2365.	2306.	2191.	2068.	1952.	1842.
1739.	1641.	1549.	1462.	1380.	1303.	1230.	1161.	1096.	1034.
976.	921.	870.	821.	775.	731.	690.	651.	615.	580.
548.	517.	488.	461.	435.	410.	387.	366.	345.	326.
307.	290.	274.	259.	244.	230.	217.	205.	194.	183.
173.	163.	154.	145.	137.	129.	122.	115.	109.	103.
97.	91.	86.	81.	77.	73.	69.	65.	61.	58.
54.	51.	48.	46.	43.	41.	38.	36.	34.	32.
31.	29.	27.	26.	24.	23.	22.	20.	19.	18.

0 END-OF-PERIOD FLOW

MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q	MO.DA	HR.MN	PERIOD	RAIN	EXCS	LOSS	COMP Q
									SUM	25.20	22.48	2.72	1372671.
										(640.)(571.)(69.)(38869.71)			

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

HYDROGRAPH ROUTING

ROUTE THRU RESERVOIR

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
2	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	160.	-1

STAGE	774.50	775.50	776.50	777.50	778.50	780.00	782.00	784.00	786.00
788.00									
FLOW	0.00	760.00	2150.00	3950.00	6080.00	10078.00	16590.00	24189.00	32720.00
42090.00									
SURFACE AREA=	0.	25.	30.	36.	40.	46.	52.	59.	67.	73.
CAPACITY=	0.	160.	215.	280.	337.	422.	520.	631.	756.	896.
ELEVATION=	755.	775.	777.	779.	780.	782.	784.	786.	788.	790.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
774.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
786.0	3.1	1.5	150.

PEAK OUTFLOW IS 19149. AT TIME 43.25 HOURS

PEAK OUTFLOW IS 30623. AT TIME 43.25 HOURS

PEAK OUTFLOW IS 34470. AT TIME 43.25 HOURS

PEAK OUTFLOW IS 38306. AT TIME 43.25 HOURS

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

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 .50	RATIO 2 .80	RATIO 3 .90	RATIO 4 1.00
HYDROGRAPH AT	1	23.80	1	19212.	30740.	34582.	38424.
		(61.64)		(544.03)(	870.45)(	979.25)(	1088.06)(
ROUTED TO	2	23.80	1	19149.	30623.	34470.	38306.
		(61.64)		(542.24)(	867.14)(	976.09)(	1084.69)(

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ..... INITIAL VALUE SPILLWAY CREST TOP OF DAM

ELEVATION	774.50	774.50	786.00
STORAGE	160.	160.	631.
OUTFLOW	0.	0.	35854.

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	782.67	0.00	454.	19149.	0.00	43.25	0.00
.80	785.51	0.00	602.	30623.	0.00	43.25	0.00
.90	786.28	.28	648.	34470.	1.50	43.25	0.00
1.00	787.05	1.05	694.	38306.	2.75	43.25	0.00

APPENDIX E

DRAWINGS


O O K E
SOUTH
MOUNTAIN
Mountain
Pine Grove Furnace
Pine Grove Chapel
Fuller Lake
Swimming Pool
Saint Eleanor Regina
State Forest Monument
LAUREL DAM
Laurel Pond
Laurel Run
Sage Run
Creek
Pole Steeple
APPALACHIAN TRAIL
BM 1401
BM 1041
BM 877
BM 1330
BM 1038
CUMBERLAND CO
ADAMS CO

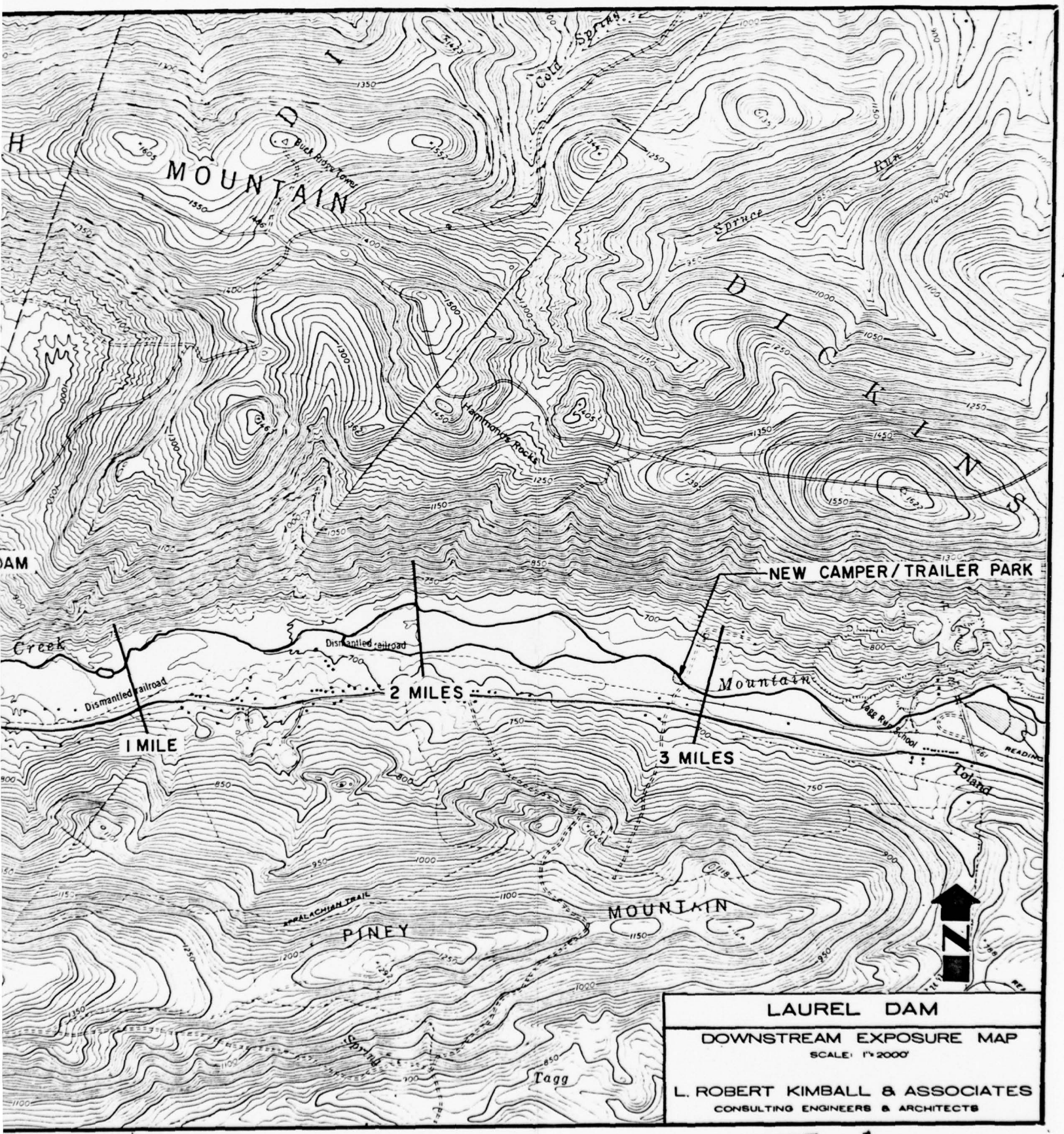
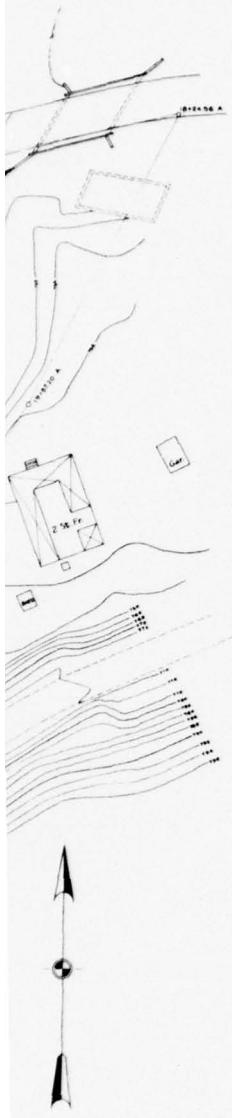

MOUNTAIN
Buck Ridge Tower
Cold Spring
Spruce
Pine
DICKINS
Hammonds Rocks
NEW CAMPER/TRAILER PARK
Dismantled railroad
Dismantled railroad
2 MILES
1 MILE
3 MILES
Mountain
Tagg Run School
READING
Toland
APPALACHIAN TRAIL
PINEY
MOUNTAIN
Spring
Tagg
N
LAUREL DAM
DOWNSTREAM EXPOSURE MAP
SCALE: 1"=2000'
L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS

FIGURE 1

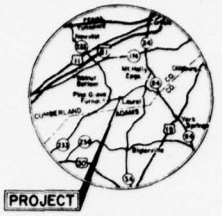
PLAN
Scale: 1 in = 30 ft.

1



TRAVERSE DATA

Traverse Station	Coordinates North	Coordinates East
12+03.20A	5135.70	4141.32
13+00A ⌀ 0+00C	5157.21	4235.74
18+24.56A	5273.73	4747.24
19+87.20A	5128.45	4674.36
23+06.75A	4854.74	4508.65
27+51.82A	4511.56	4226.40
0+00C ⌀ 13+00A	5157.21	4235.74
1+93.47C	4983.43	4321.15
4+85.86C	4823.22	4076.29



LOCATION MAP

Scale: 1 in. = 9 mi.

21-25-A-1
FILE NUMBER

RECEIVED IN THE OFFICE OF THE WATER & POWER RESOURCES BOARD - DEPARTMENT OF FORESTS & WATERS ON THE 1st DAY OF May A.D. 1967

Chief

RECD. _____ FOR _____

REE REPORT NO. _____

Div. Dams

GENERAL NOTES:

1. All elevations shown are based on U.S.G.S. datum.
2. Number shown in circle as (No) indicates number of pay item.
3. All concrete is Class B. (14)
4. All reinforcement 2" clear (edge of steel to surface of concrete) unless otherwise noted.
5. Steel reinforcement will be paid for under item (15)
6. ⌀ No. indicates concrete finish.
7. Chamfer 3/4" all exposed edges and all exposed joints in walls.
8. All excavation shall be used to augment the parking area on the left bank.

PRE FINAL

REVISED	DESIGNED	SUBMITTED
	JRC	Victor L. Butler, Chief, Design Branch
	RECOMMENDED	Chief, Division of Flood Control
	APPROVED	C. Shiras Campbell, Chief Engineer, Department of Forests & Waters
	APPROVED	ASSISTANT DIRECTOR OF ENGINEERING G.S.A.
	CHECKED BY THE GENERAL STATE AUTHORITY	
	ARCH.	STRUCT.

PROJECT No. — G. S. A. — 193-17

REPLACEMENT OF DAM
PINE GROVE FURNACE STATE PARK
CUMBERLAND COUNTY — PENNA.

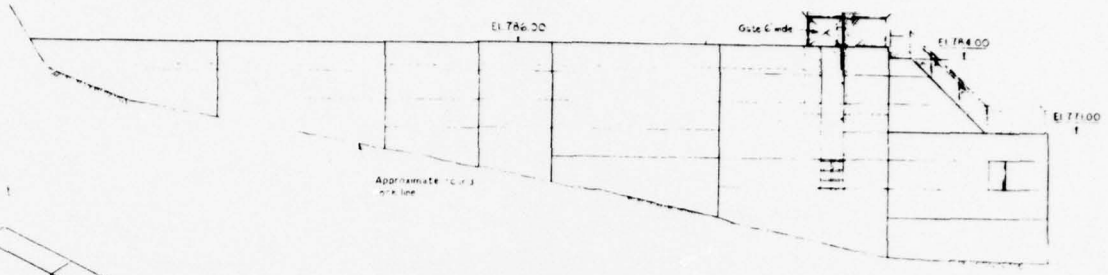
GENERAL PLAN

DEPARTMENT OF FORESTS & WATERS
DIVISION OF FLOOD CONTROL

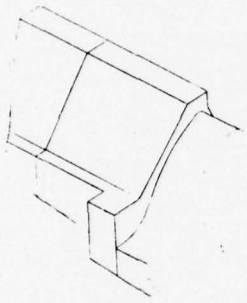
DATE	THE GENERAL STATE AUTHORITY	SHEET No.
7-21-66	RAYMOND P. SHAFER, PRESIDENT	
SCALE	ROBERT L. KUNZIG, EXECUTIVE DIRECTOR	
As shown	HARRISBURG, PENNSYLVANIA	1.1

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS

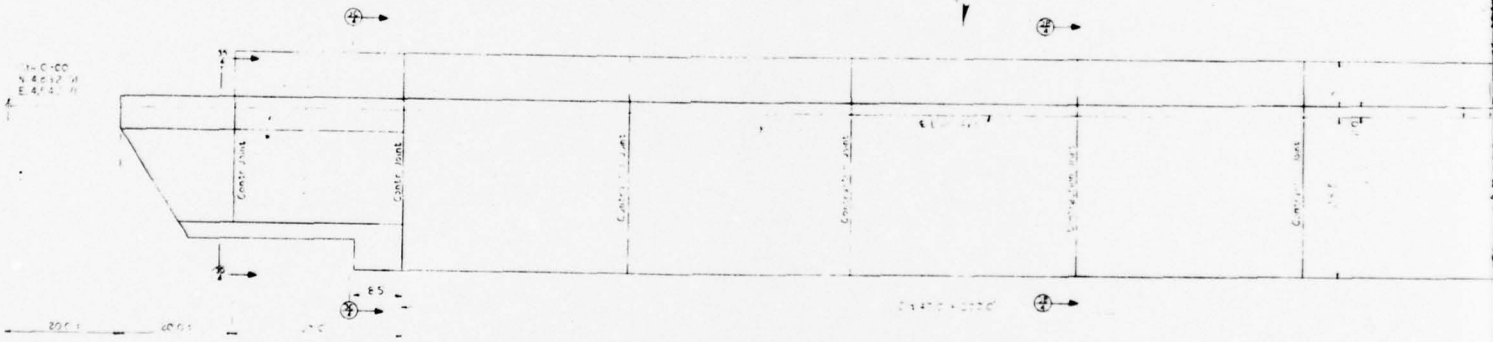
FIGURE 2



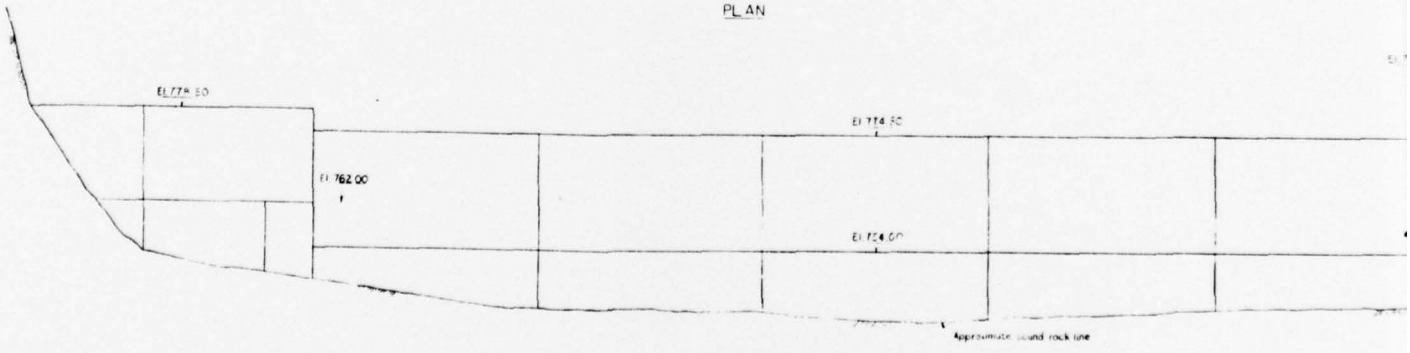
SECTION (24)



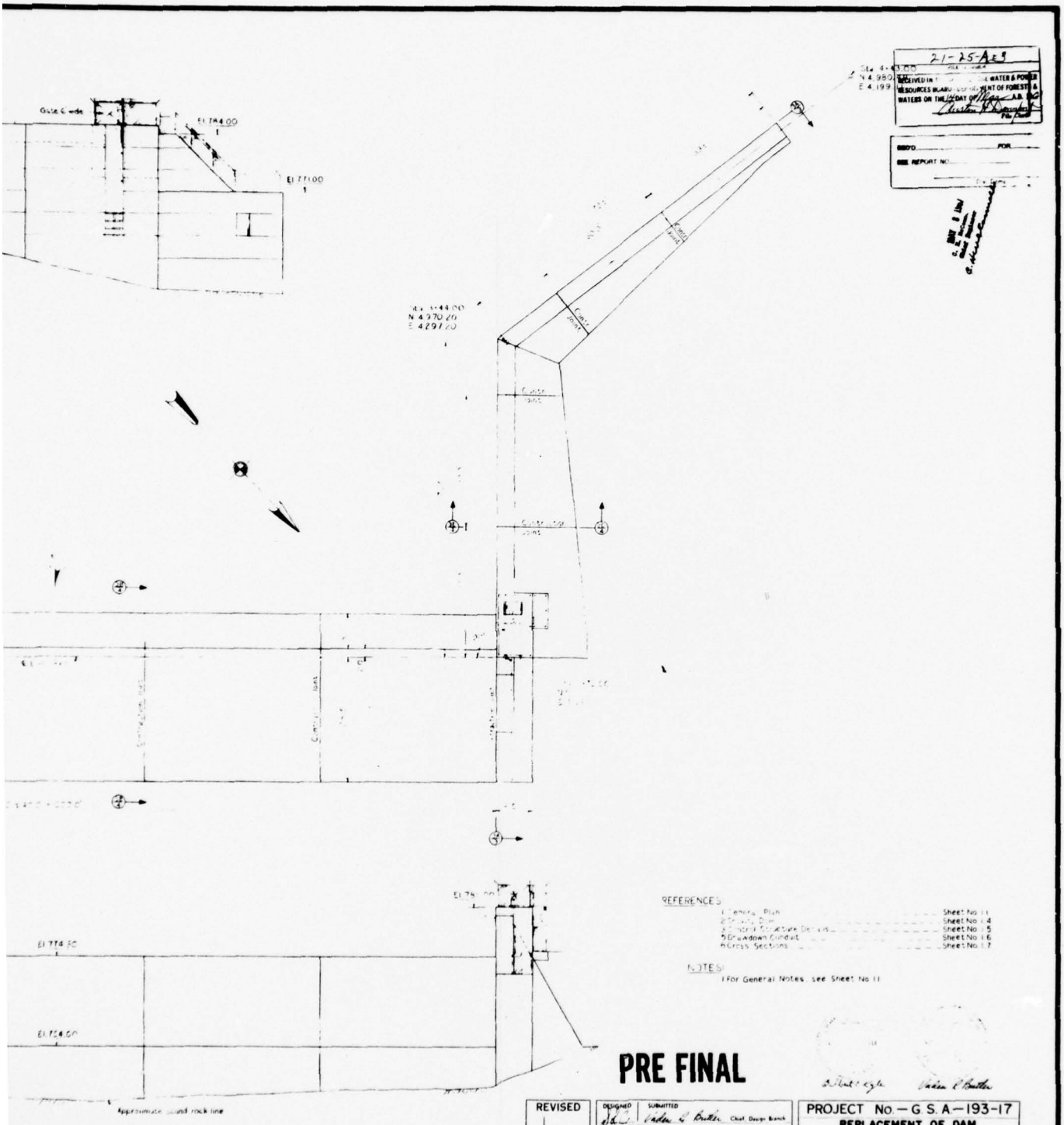
ISOMETRIC VIEW
GRAVITY OVERFLOW - RIGHT ABUTMENT



PLAN



PROFILE



REFERENCES

1 General Plan	Sheet No. 11
2 Profile Dam	Sheet No. 4
3 Typical Section Details	Sheet No. 5
5 Breakdown Conduit	Sheet No. 16
6 Cross Sections	Sheet No. 17

NOTES:
1 For General Notes, see Sheet No. 11

PRE FINAL

REVISED	DESIGNED	SUBMITTED
	J.R.J.	Carlos G. Butler Chief Design Branch
	RECOMMENDED	Chief Division of Flood Control
	APPROVED	C. Raymond Cornelius Chief Engineer, Department of Forests & Waters
	APPROVED	ASSISTANT DIRECTOR OF ENGINEERING G.S.A.
	CHECKED BY THE GENERAL STATE AUTHORITY	ARCH. STRUCT.

PROJECT No. — G.S.A. — 193-17
REPLACEMENT OF DAM
PINE GROVE FURNACE STATE PARK
CUMBERLAND COUNTY — PENNA.

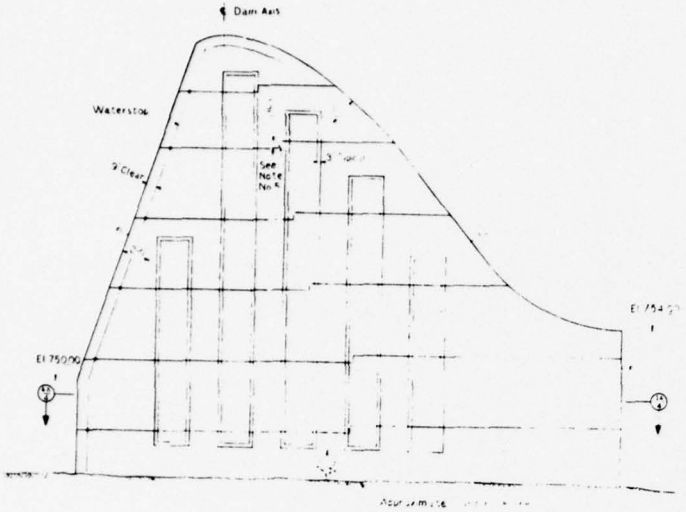
PLAN AND PROFILE

DEPARTMENT OF FORESTS & WATERS
DIVISION OF FLOOD CONTROL

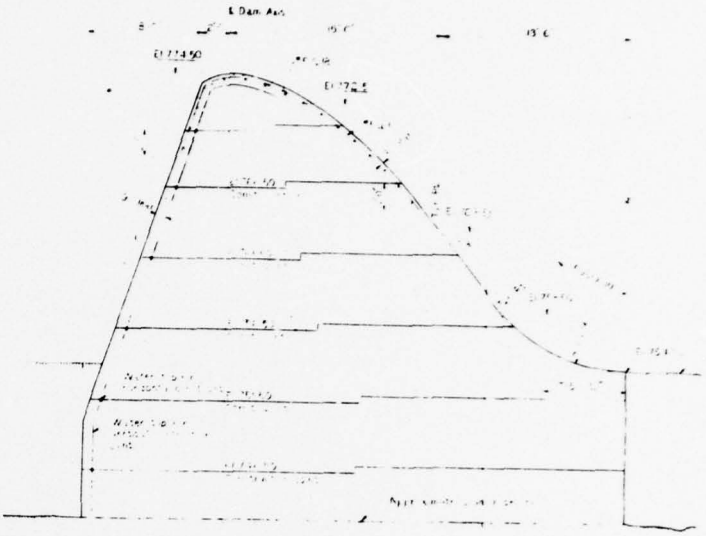
DATE	THE GENERAL STATE AUTHORITY	SHEET No.
7-21-66	RAYMOND P. SHAFER PRESIDENT	
SCALE	ROBERT L. KUNZIG EXECUTIVE DIRECTOR	
1in.=10ft.	HARRISBURG PENNSYLVANIA	13

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS

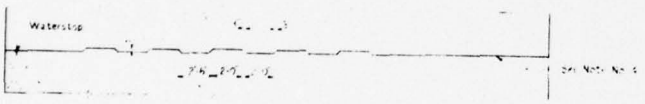
FIGURE 3



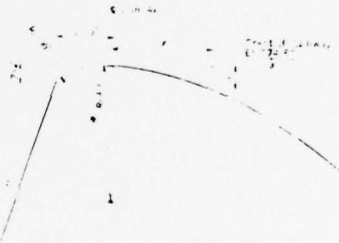
ELEVATION



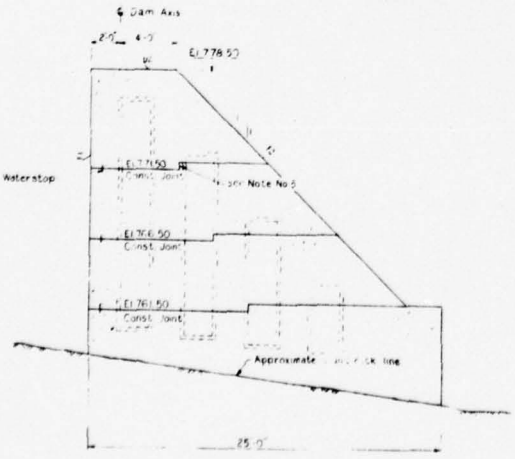
SECTION



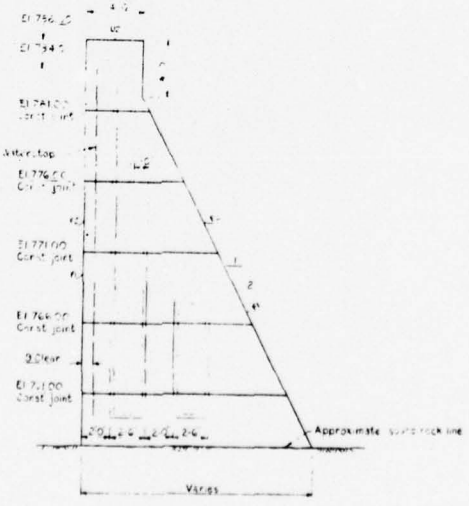
SECTION



SHEAR KEYS
OGEE WEIR



SECTION

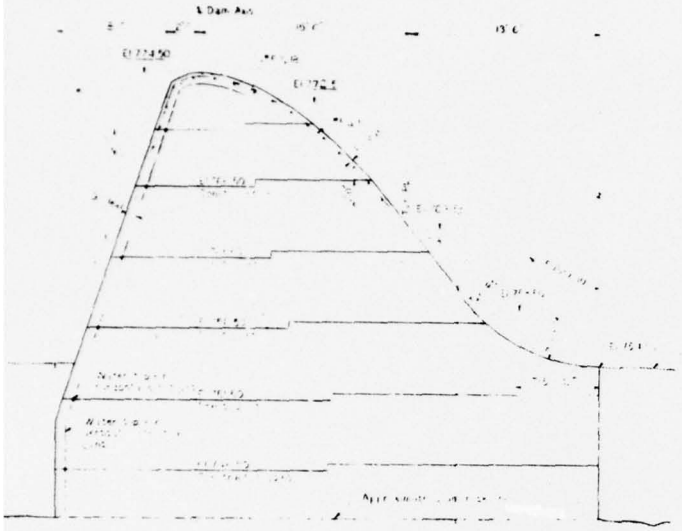


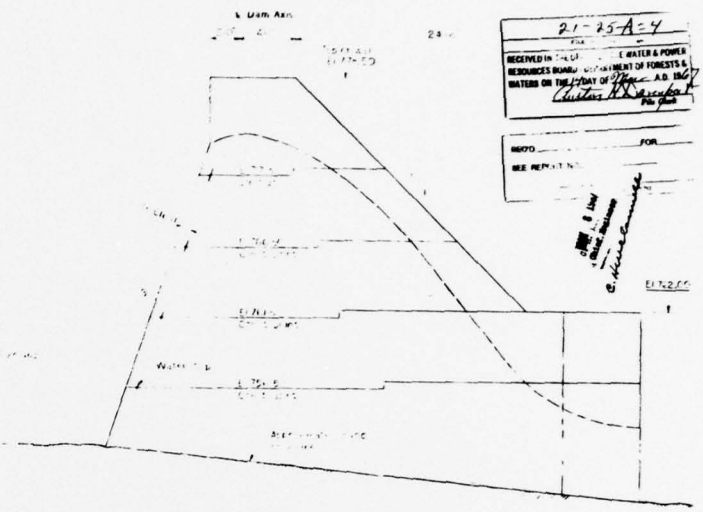
SECTION

13	8.53	765.5	
14	9.47	764.6	
15	10.97	763.1	

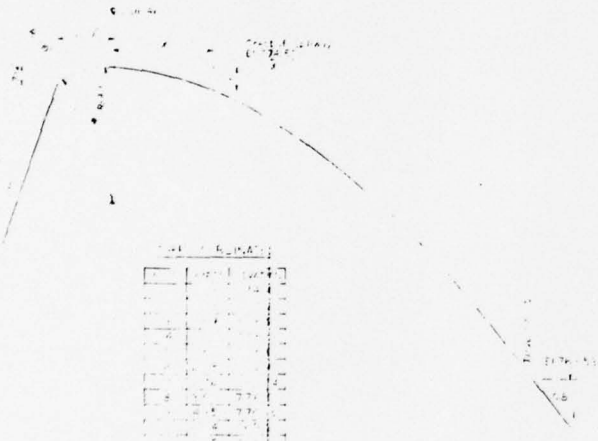
OGEE CREST DETAILS

Albert Eagle Helen Eagle



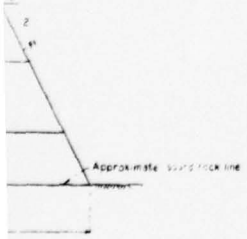


SECTION ⊕



SECTION ⊕

OGEE CREST DETAILS



Approximate bedrock line

REFERENCES

1 General Plan	Sheet No. 1.1
2 Plan and Profile	Sheet No. 1.3
3 Cross Sections	Sheet No. 1.7

NOTES

1. For General Notes, see Sheet No. 1.1
2. Do not use water stop in horizontal construction joint in the overflow gravity wall
3. For key lines, see Sheet No. 1.7
4. Cover [illegible] with bituminous coating.
5. Locate the key at the middle of the top of each lift

Gilbert C. Lyle Victor L. Butler

PRE FINAL

REVISED	DESIGNED	SUBMITTED
	VLB	Victor L. Butler, Chief, Design Branch
	RECOMMENDED	Chief, Division of Flood Control
	APPROVED	C. Lawrence Cornell, Chief Engineer, Department of Forests & Waters
	APPROVED	ASSISTANT DIRECTOR OF ENGINEERING G.S.A.
	CHECKED BY THE GENERAL STATE AUTHORITY	
	ARCH.	STRUCT.

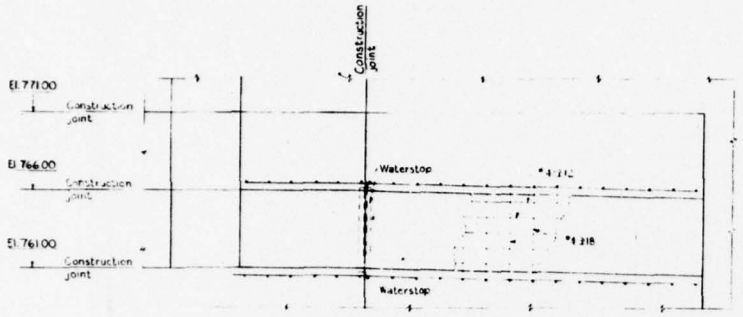
PROJECT No — G.S.A—193-17

REPLACEMENT OF DAM
PINE GROVE FURNACE STATE PARK
CUMBERLAND COUNTY — PENNA

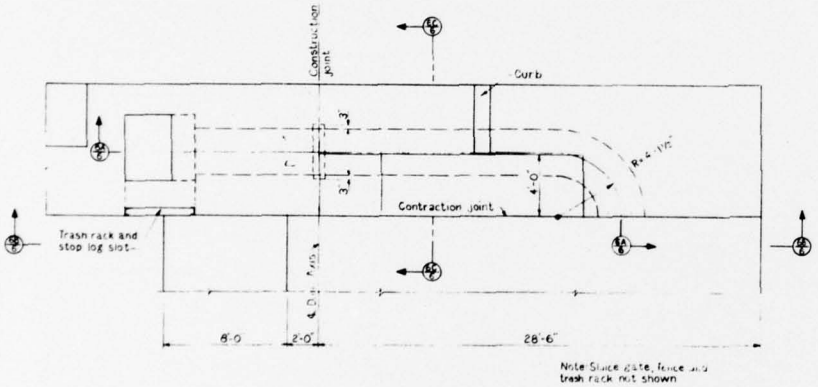
GRAVITY DAM

DEPARTMENT OF FORESTS & WATERS
DIVISION OF FLOOD CONTROL

DATE	THE GENERAL STATE AUTHORITY	SHEET No.
7-21-66	RAYMOND P. SHAFER, PRESIDENT	
SCALE	ROBERT L. KUNZIG, EXECUTIVE DIRECTOR	
As shown	HARRISBURG, PENNSYLVANIA	1.4

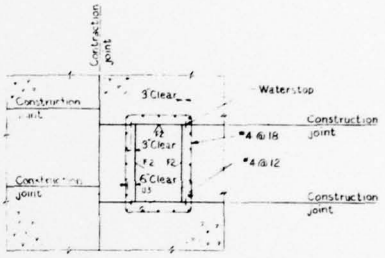


SECTION (5A/E)
Scale: ¼ in = 1 ft

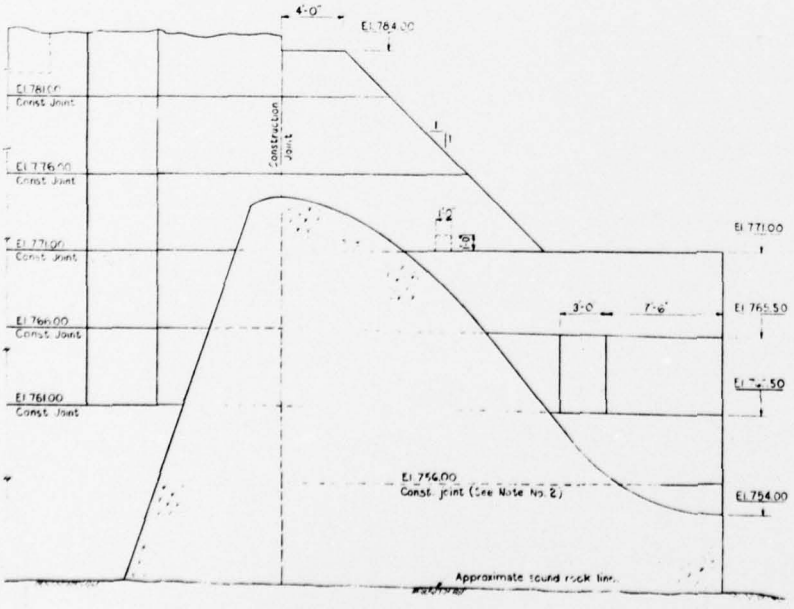


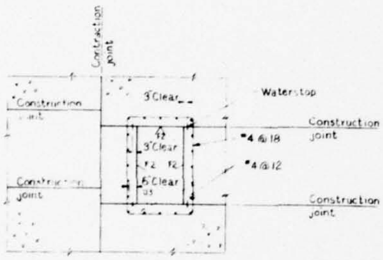
Note: Sluice gate, fence and trash rack not shown

PLAN
Scale: ¼ in = 1 ft

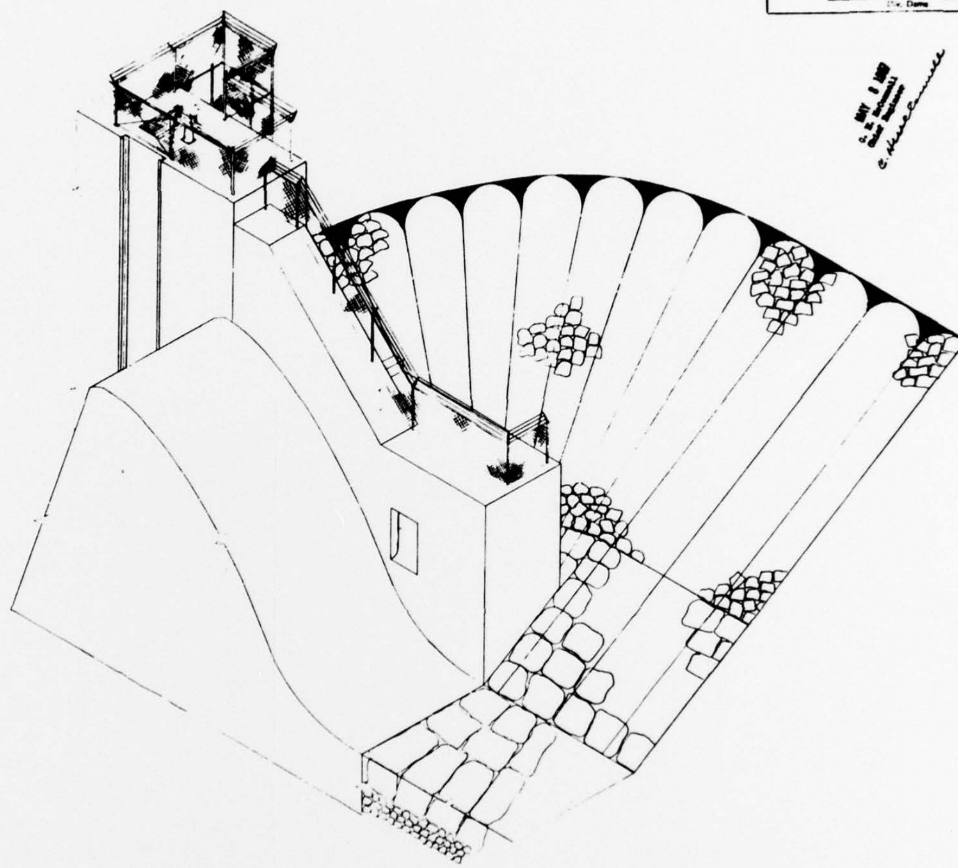


SECTION (5C/E)
Scale: ¼ in = 1 ft





SECTION
Scale: 1/4 in = 1 ft



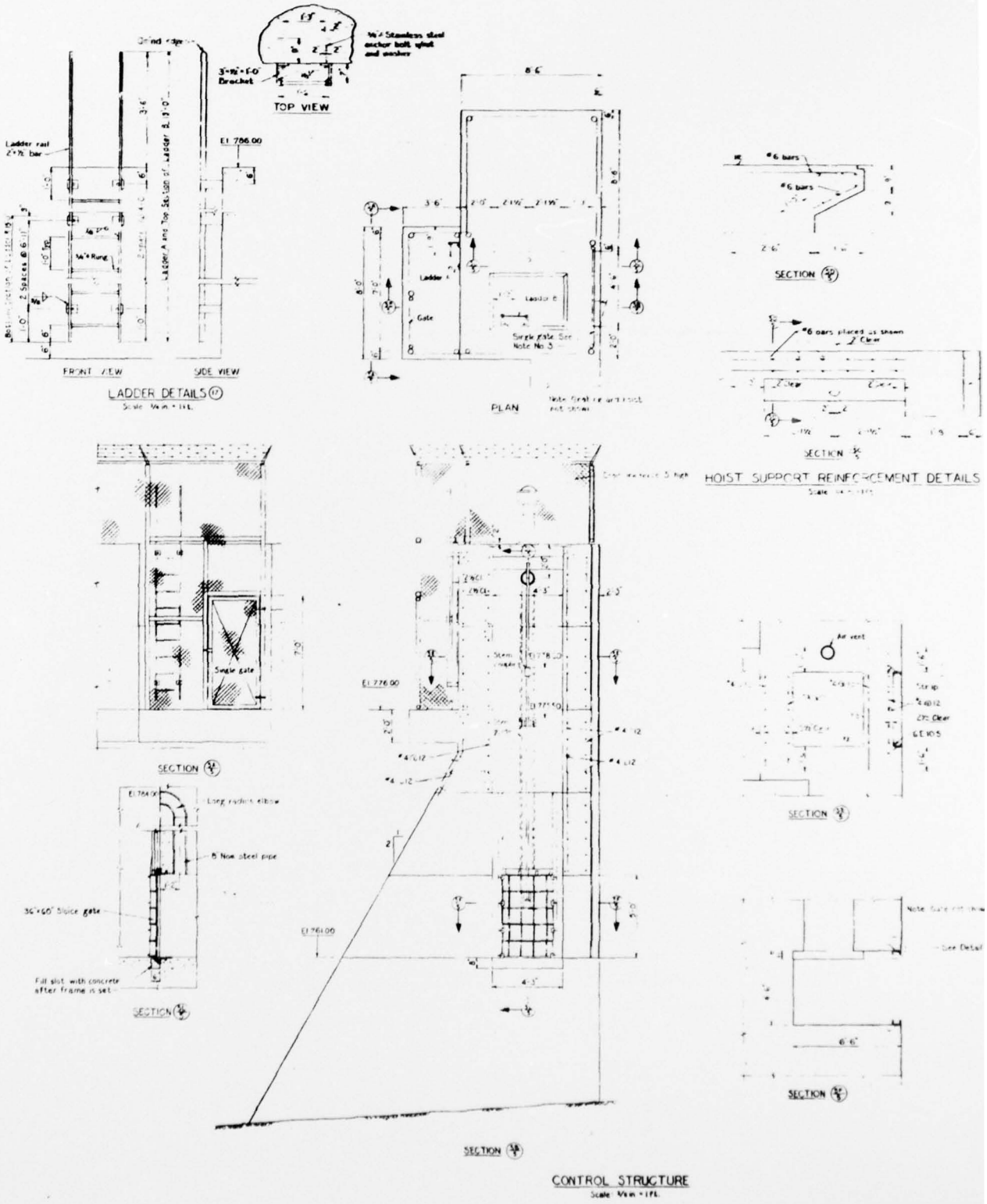
ISOMETRIC VIEW
LEFT ABUTMENT
Scale: 1 in = 6 Ft

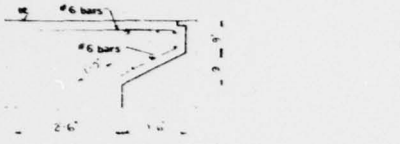
REFERENCES:
1. General Plan .... Sheet No. 1.1
2. Plan and Profile .... Sheet No. 1.3
3. Control Structure Details .... Sheet No. 1.5
4. Cross Sections .... Sheet No. 1.7

NOTES:
1. For General Notes, see Sheet No. 1.1
2. Joints in Ogee Section not shown.

PRE FINAL

REVISED		
	DESIGNED: S.C. — SUBMITTED: Chief, Design Branch RECOMMENDED: Chief, Division of Flood Control APPROVED: C. H. Connell, Chief Engineer, Department of Forests & Waters APPROVED:	PROJECT No. — G.S.A. — 193-17 REPLACEMENT OF DAM PINE GROVE FURNACE STATE PARK CUMBERLAND COUNTY —— PENNA. DRAWDOWN CONDUIT





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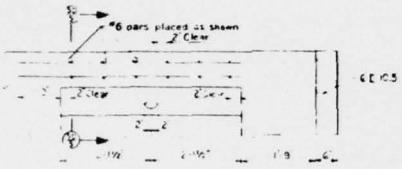
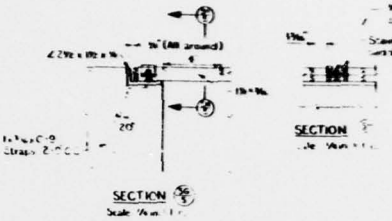


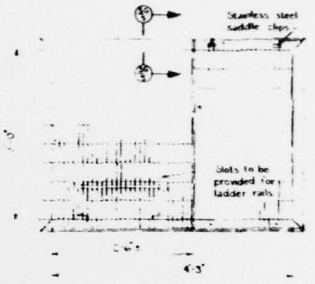
SECTION

HOIST SUPPORT REINFORCEMENT DETAILS



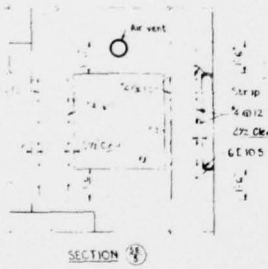
SECTION

SECTION

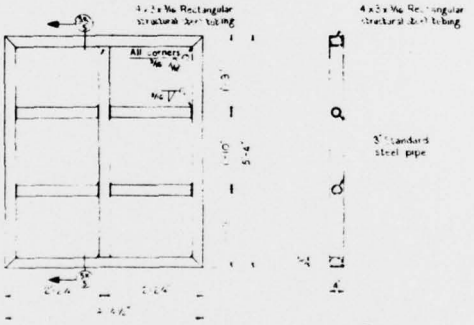


PLAN

HOIST FLOOR GRATING DETAILS



SECTION

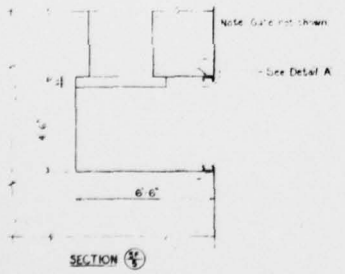


FRONT VIEW

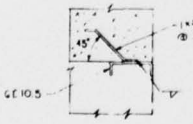
SECTION

TRASH RACK DETAILS

(See Table No. 2. Not to scale)



SECTION



DETAIL "A"

REFERENCES:

1. General Plan ..... Sheet No. 1.1
2. Plan and Profile ..... Sheet No. 1.3
3. Drawdown Conduit ..... Sheet No. 1.6

NOTES

1. For General Notes, see sheet No. 1.1
2. Galvanize after unit is fabricated.
3. A single gate with barbed brg. as shown on Sheet No. 1.3

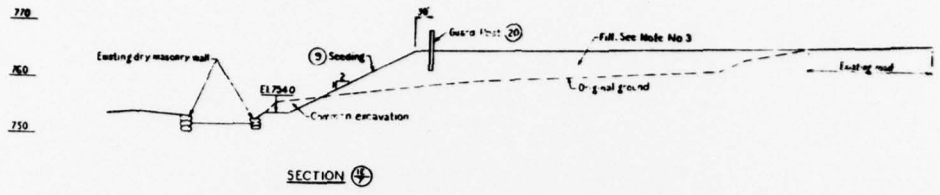
THIS PAGE IS BEST QUALITY PRACTICABLE FROM COPY FURNISHED TO DDC

PRE FINAL

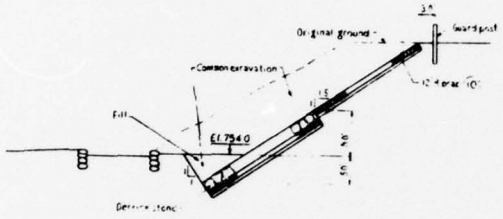
REVISED	DESIGNED / SUBMITTED	PROJECT No. — G. S. A — 193-17
	RECOMMENDED Chief, Design Branch	REPLACEMENT OF DAM PINE GROVE FURNACE STATE PARK
	Chief, Division of Flood Control	CUMBERLAND COUNTY — PENNA.
	APPROVED Chief Engineer, Department of Forests & Waters	CONTROL STRUCTURE DETAILS
	APPROVED ASSISTANT DIRECTOR OF ENGINEERING G.S.A.	DEPARTMENT OF FORESTS & WATERS DIVISION OF FLOOD CONTROL
	CHECKED BY THE GENERAL STATE AUTHORITY ARCH. STRUCT.	DATE 7-21-68 THE GENERAL STATE AUTHORITY RAYMOND P. SHAFER, President ROBERT L. KUNZIG, Executive Director HARRISBURG PENNSYLVANIA
		SCALE SHEET No. 1.5

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS

FIGURE 6



SECTION



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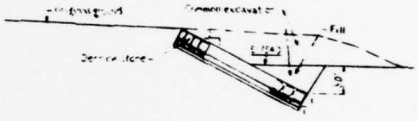

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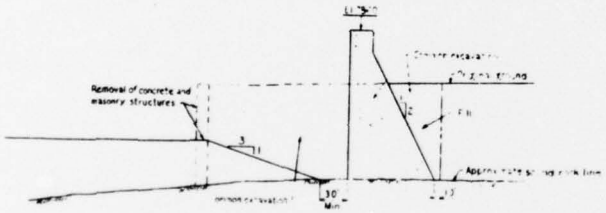

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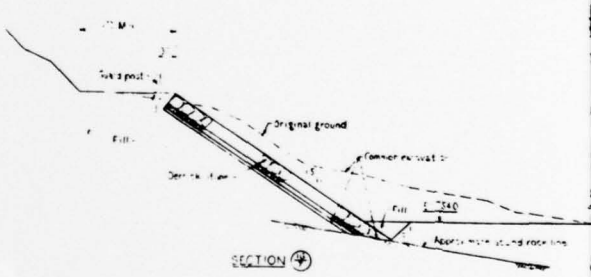

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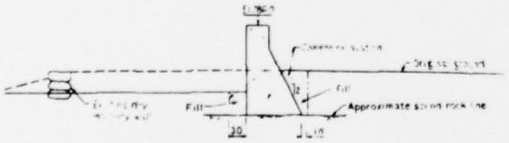
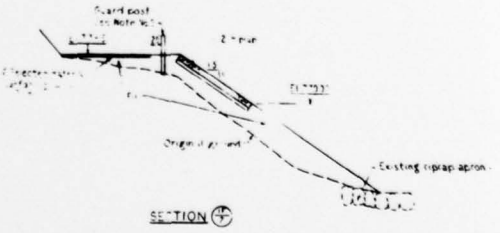


SECTION

LEFT BANK



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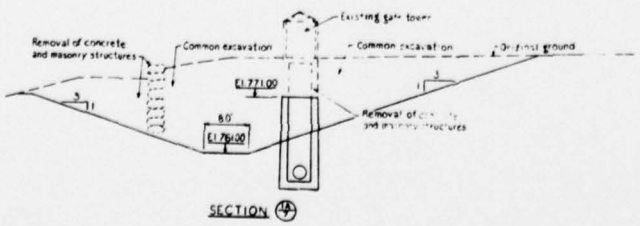

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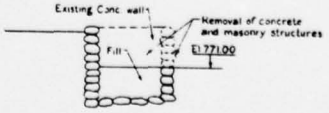
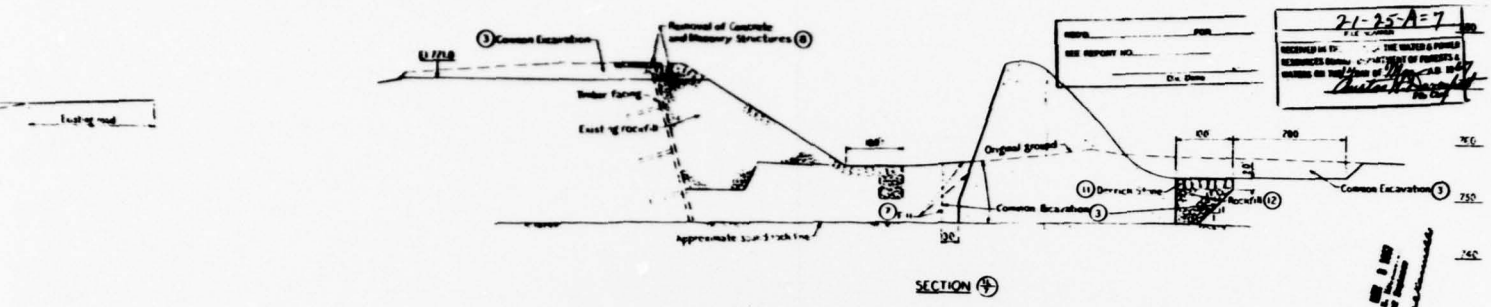
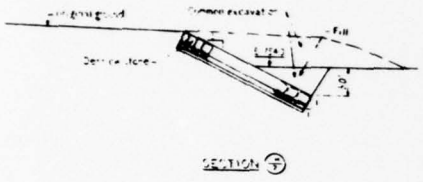
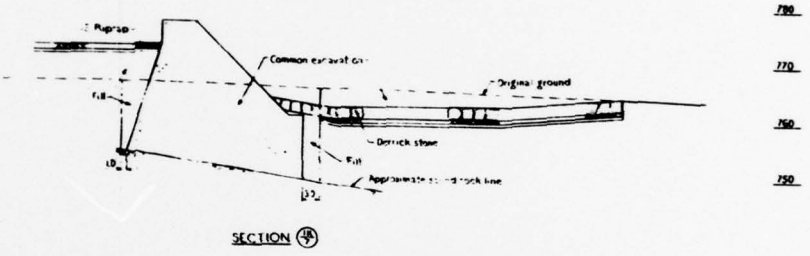


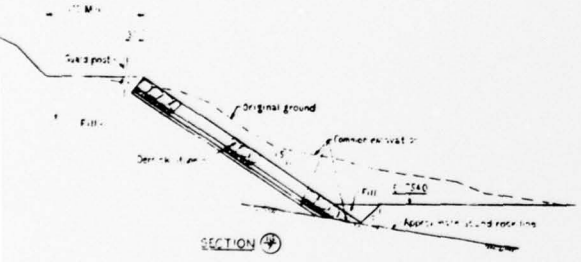
SECTION

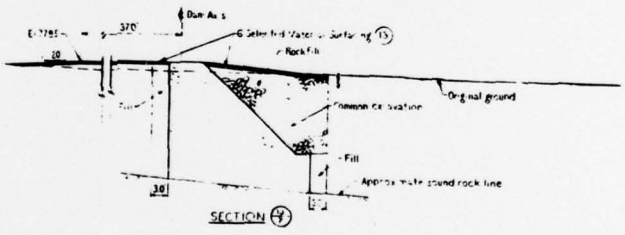
RIGHT BANK

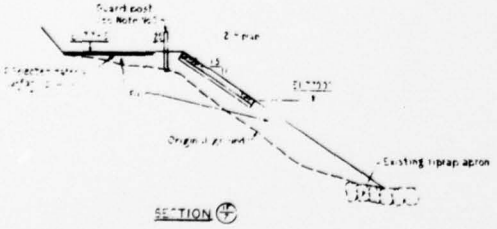


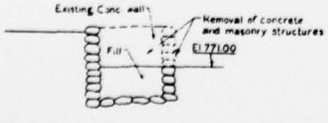












RIGHT BANK

REFERENCES

1 General Plan ..... Sheet No. 1.1
2 Subsurface Exploration ..... Sheet No. 1.2
3 Plan and Profile ..... Sheet No. 1.3
4 Gravity Curtain ..... Sheet No. 1.4
5 Control Structure Details ..... Sheet No. 1.5

NOTES

1 For General Notes, see Sheet No. 1.
2 Locate guard posts as directed by The Authority.
3 Slope as directed.
4 [illegible] shown from available information. Accuracy not guaranteed.

PRE FINAL

REVISED

DESIGNED DC — SUBMITTED Carlos R. Bertha, Chief, Design Branch
RECOMMENDED — Chief, Division of Flood Control
APPROVED C. Hunn Cannell, Chief Engineer, Department of Forests & Waters
APPROVED — ASSISTANT DIRECTOR OF ENGINEERING G.S.A.
CHECKED BY THE GENERAL STATE AUTHORITY
ARCH. STRUCT.

PROJECT No. — G. S. A. — 193-17
REPLACEMENT OF DAM
PINE GROVE FURNACE STATE PARK
CUMBERLAND COUNTY — PENNA.

CROSS SECTIONS

DEPARTMENT OF FORESTS & WATERS
DIVISION OF FLOOD CONTROL
THE GENERAL STATE AUTHORITY
RAYMOND P. SHAFER, GOVERNOR
ROBERT L. KUNZIG, EXECUTIVE DIRECTOR
HARRISBURG PENNSYLVANIA

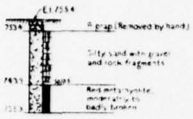
DATE 7-21-66
SCALE AS NOTED
SHEET No. 1.7

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS

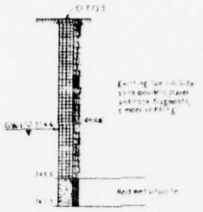
FIGURE 7

BORING NO. D-1

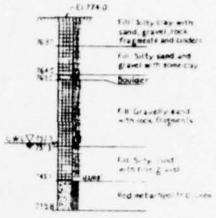
BORING NO. D-2



BORING NO. D-3



BORING NO. D-5



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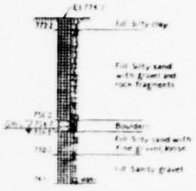

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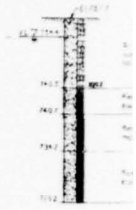

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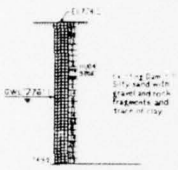

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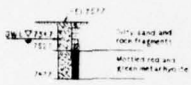

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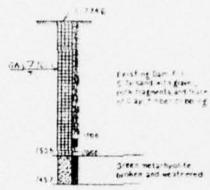

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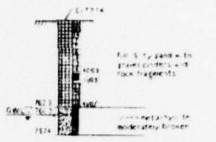

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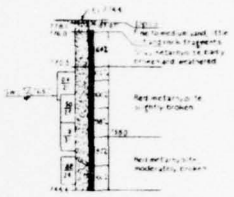

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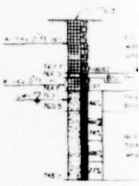

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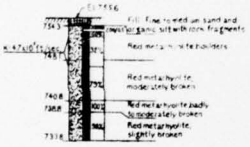

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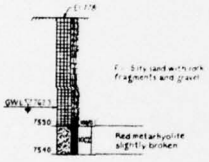

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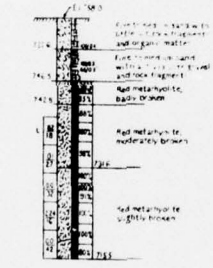

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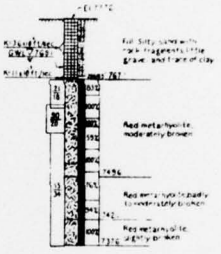

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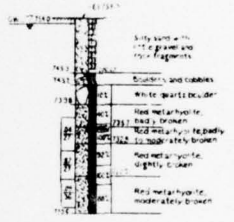

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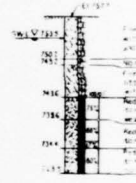

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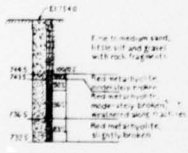

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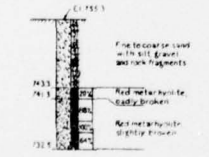

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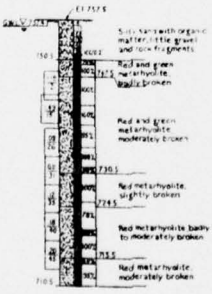

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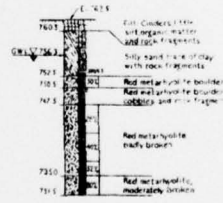

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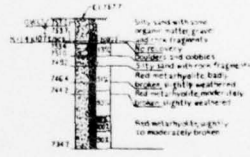

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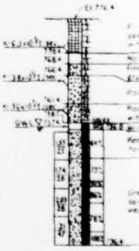

REFERENCES

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2. Soil classification has been made according to the United Soil Classification System as published by the Waterways Experiment Station, Vicksburg, Mississippi.

DRILLING LEGEND

Drive Sample Boring. Numbers represent blows per lineal foot by a 140 lb. hammer falling 30 inches on a standard 2 inch O.D. split spoon sampler unless otherwise noted.

Wash Boring

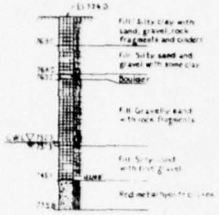
Core Boring, NX Number represents percentage of recovered core in the noted section

K represents the coefficient of permeability, ft/day as determined by tests performed in the noted section of the drill hole

Hydraulic Pressure Test. The number represents average water loss per foot, GPM/ft over the noted section. Bottom number represents average pressure psi, on the test section. Denotes locations where the packers could not be seated tight.

Scale: Vert. 1in = 10 ft.

BORING NO D-5



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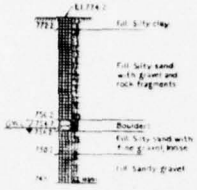

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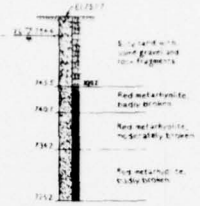

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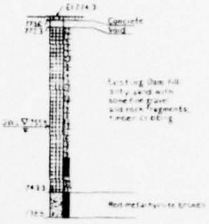

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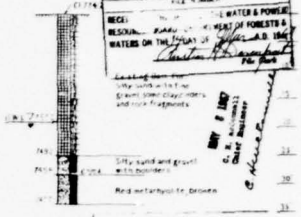

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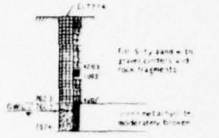

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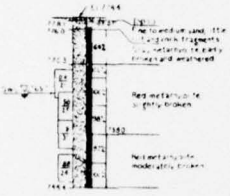

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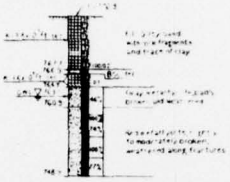

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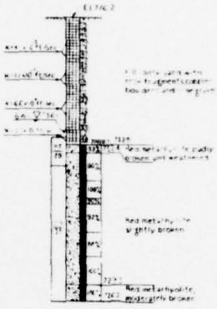

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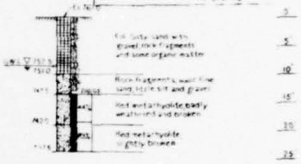

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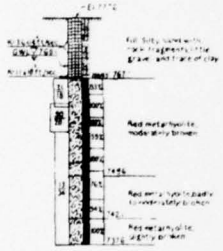

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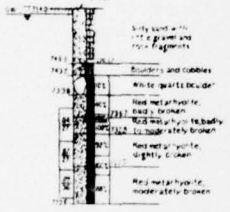

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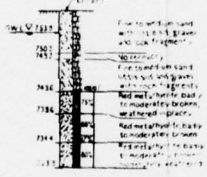

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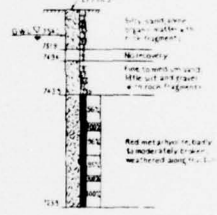

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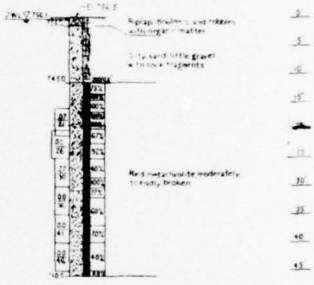

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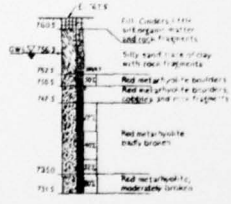

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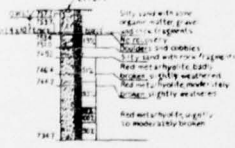

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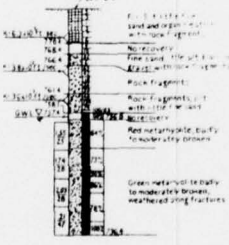

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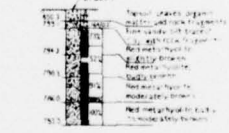

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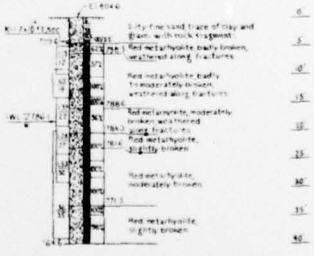

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Scale Vert 1in = 10ft

PRE FINAL

REVISED	DESIGNED	SUBMITTED
		Chief, Design Branch
	RECOMMENDED	Chief, Division of Flood Control
	APPROVED	Chief Engineer, Department of Forests & Waters
	APPROVED	ASSISTANT DIRECTOR OF ENGINEERING G.S.A.
	CHECKED BY THE GENERAL STATE AUTHORITY	
	ARCH.	STRUCT.

PROJECT No. — G. S. A — 193-17

REPLACEMENT OF DAM
PINE GROVE FURNACE STATE PARK

CUMBERLAND COUNTY — PENNA.

SUBSURFACE EXPLORATION

DEPARTMENT OF FORESTS & WATERS
DIVISION OF FLOOD CONTROL

DATE	THE GENERAL STATE AUTHORITY	SHEET No.
7-21-66	RAYMOND P. SHAFER PRESIDENT	
SCALE	ROBERT L. KUNZIG EXECUTIVE DIRECTOR	
As shown	HARRISBURG PENNSYLVANIA	12

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS

FIGURE 8

APPENDIX F

GEOLOGY

Laurel Lake Dam - Cumberland County

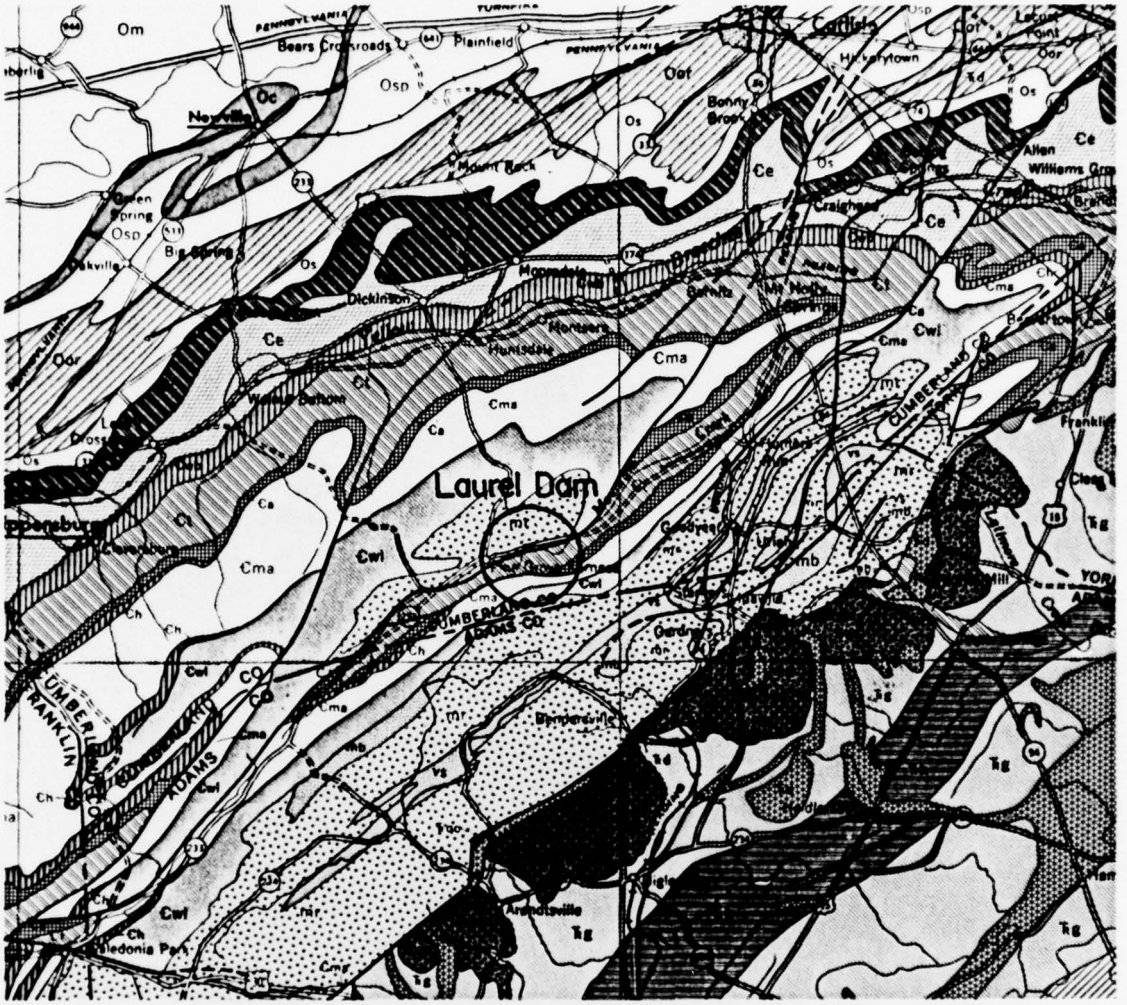
General Geology:

Laurel Lake (Laurel Forge Pond) lies within the South Mountain Section of the Blue Ridge Physiographic Province. This area is characterized by very complex structural features including major folds and low angle faults.

The lake and dam lie astride a fault separating a Pre Cambrian aged metarhyolite (mr) from the Cambrian aged Tomstown Formation (Ct). No specific information is available on the metarhyolite, but they are usually fine-grained, red, gray and blue, and have phenocrysts of both quartz and feldspar. There is no bedding, but there may be joints. These may be abundant and closely spaced, but are usually only moderately developed with an irregular pattern. It is highly resistant to weathering, but a thin weathered rind may sometimes have to be removed before it can be utilized as a foundation material for heavy structures. It has good surface drainage and a low magnitude secondary porosity.

The Tomstown Formation is a moderately well bedded and massive gray dolomite. It is finely crystalline and weathers to a buff and olive gray color. Any joints present have a blocky pattern and are moderately to well developed. They are usually widely spaced and have an irregular pattern. The dolomite is moderately resistant to weathering and may form a good foundation for heavy structures if excavated to sound material. Any sinkholes or bedrock pinnacles should be thoroughly investigated however. It has good surface drainage and the joints and solution channels provide only a low magnitude source of secondary porosity.

Little is known of the fault separating the dolomite from the metarhyolite. There is also a second fault parallelling the first at a distance of about one mile to the south.



Geologic Map of Laurel Dam Area

Ol — **Ledger Formation**
Light gray, locally mottled, massive, pure, coarse crystalline dolomite, siliceous in middle part.

Kinzers Formation
Dark brown shale at the base; above this is gray and white spotted limestone and marble with irregular partings grading to sandy limestone which weathers to fine porous sandstone.

Cv — **Vintage Formation**
Dark gray, knotty argillaceous dolomite with impure light gray marble at the base.

Ct Clv — **Tomstown Formation (Ct) or Leithsville Formation (Clv)**
Massive dolomite with thin shaly interbeds.

Tmr — **Metarhyolite**

Scale: 1:250,000

APPENDIX G

STABILITY CALCULATIONS

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

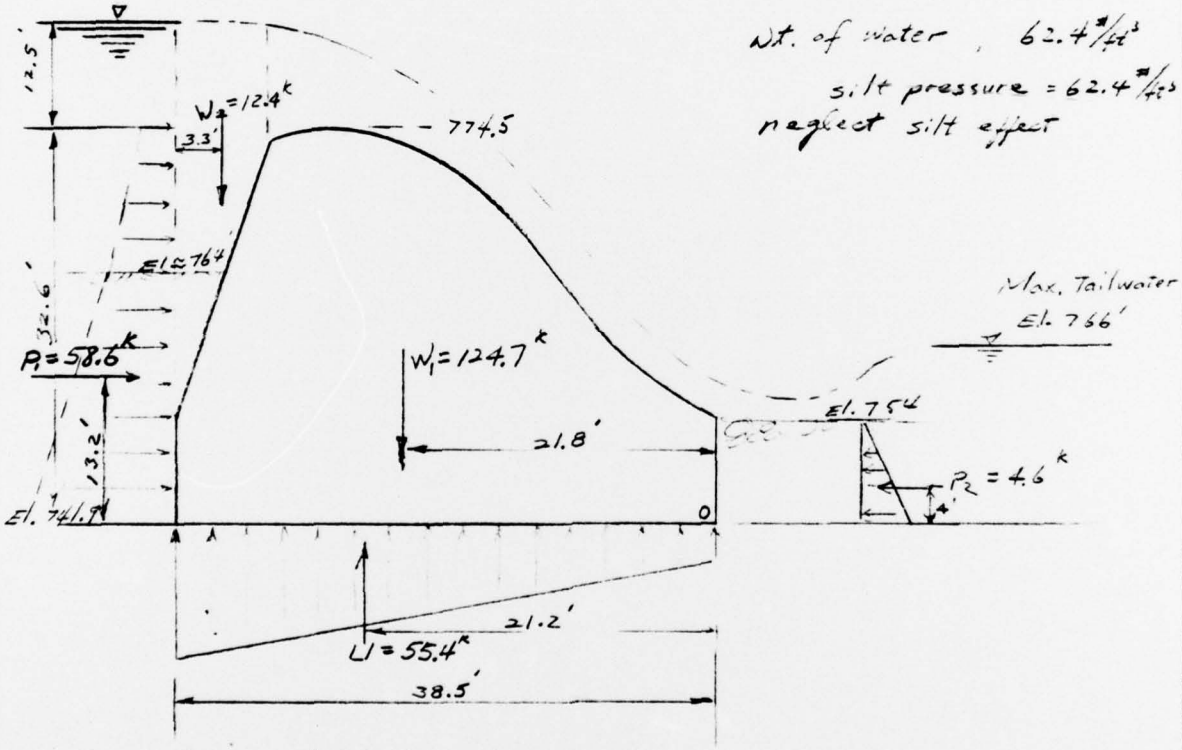
DAM NAME Lauel Lake Dam
I.D. NUMBER 21-25
SHEET NO. 1 OF 2
BY KHC DATE 2-1-79

Stability Analysis

Overflow section

Max. Pool El. 787.0'

Wt. of Concrete, 150 #/ft³
Wt. of water, 62.4 #/ft³
silt pressure = 62.4 #/ft³
neglect silt effect



from design data (DER)

$W_1 = 150(831.) = 124.7^k$

Moment arm $\ell = 21.8'$

$W_2 = 12.4^k$, Moment arm, $\ell = 38.5 - 3.3' = 35.2'$

$P_1 = 58.6^k$, Moment arm, $\ell = 13.2'$, $P_2 = 4.7^k$, $\ell = 4'$

Uplift force, use 66%

$U = \frac{2}{3}(.0624)(38.5)\left(\frac{45.1+24.1}{2}\right) = 55.4^k$

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

DAM NAME Lauel Lake Dam
I.D. NUMBER PA 21-25
SHEET NO. 2 OF 2
BY KHC DATE

$\Sigma V = W_1 + W_2 - U = 124.7 + 12.4 - 55.4 = 81.7^{K}$

$\Sigma H = P_1 - P_2 = 58.6 - 4.6 = 54.0^{K}$

Slide factor, $f = \frac{54.0}{81.7} = .66$

Point of application of resultant, distance from toe.

$$d = \frac{(124.7)(21.8) + 12.4(35.2) + 4.6(4) - 58.6(13.2) - 55.4(21.2)}{81.7}$$

$d = \frac{1225}{81.7} = 15.0' > \frac{38.5}{3} = 12.83'$ within middle third

ok

$e = \frac{38.5}{2} - 15.0 = 4.25'$

$\sigma_{max} = \frac{81.7 \times 10^3}{144(38.5)}\left(1 + \frac{6 \times 4.25}{38.5}\right) = 14.74(1.66) = \underline{24.5 (psi)}$

$\sigma_{min} = 14.74(.34) = \underline{5.0\ psi}$

use $\phi = .65$, $C = 50\ psi$

Shear friction factor of safety

$$Q = \frac{81.7(.65) + 38.5(144)(.05)}{54.0} = 6.1 > 3 \quad ok$$