

OHIO RIVER BASIN
BIGBY CREEK, SOMERSET COUNTY

PENNSYLVANIA

BIGBY RUN DAM

NDI ID NO. PA-226

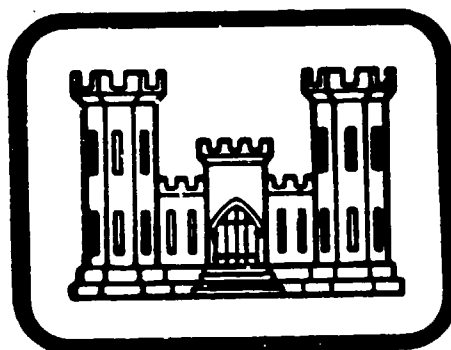
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~~GARRETT MUNICIPAL WATER AUTHORITY~~

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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Prepared By

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

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FOR

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

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OHIO RIVER BASIN
BIGBY CREEK, SOMERSET COUNTY

PENNSYLVANIA

BIGBY RUN DAM

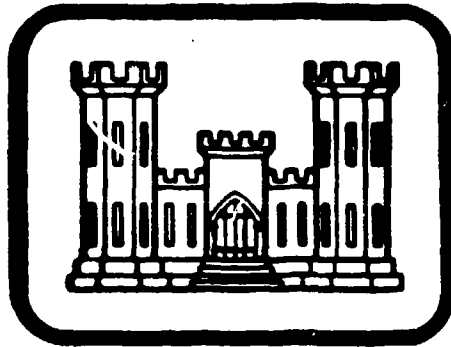
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PHASE I INSPECTION REPORT

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Contract DACW31-81-C-0012

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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	Bigby Run Dam
STATE LOCATED	Pennsylvania
COUNTY LOCATED	Somerset
STREAM	Bigby Run
DATES OF INSPECTION	November 6, 1980 and May 12, 1981
COORDINATES	Lat: 39° 51.6' Long: 79° 4.5'

ASSESSMENT

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

The Bigby Run Dam appears to be in fair condition. Maintenance is considered fair. The concrete spillway is deteriorating with marked deterioration on the right spillway wall. Minor seepage was observed at the toe of the dam, adjacent to the left abutment contact. Seepage was estimated at 2 to 5 gallons per minute. The seepage should be monitored.

The Bigby Run Dam is a high hazard-small size dam. The recommended Spillway Design Flood (SDF), for a dam of this size and classification, is in the range of 1/2 PMF to PMF. Since the Bigby Run Dam just meets the minimum criteria; and since the dam is located in a rural area suggesting only appreciable economic loss; compliance with the current practice of the Baltimore District Corps of Engineers leads to the selection of the 1/2 PMF as the Spillway Design Flood (SDF). The spillway and reservoir are capable of controlling approximately 25% of the PMF, without overtopping the embankment. Based on criteria established by the Corps of Engineers, the spillway is termed inadequate, but not seriously inadequate.

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 design modifications to increase the spillway capacity.
2. The observed seepage at the downstream toe of the dam, adjacent to the left abutment contact, should be monitored. Seepage moni-

BIGBY RUN DAM
PA 226

toring data should be evaluated by a registered professional engineer knowledgeable in dam design and analysis and control measures implemented as recommended.

3. The concrete in the spillway should be repaired.
4. An operation and maintenance schedule should be prepared and implemented to insure the continued safe operation of the structure.
5. The remaining trees on the upstream slope of the dam should be removed under the direction of a registered professional engineer knowledgeable in dam design and analysis.
6. A warning system should be developed to warn downstream residents of large spillway discharges or imminent failure of the dam.
7. Positive drainage should be provided at the outlet for the 18" cast iron pipe drainline.
8. 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

JUNE 15, 1981
Date

R Jeffrey Kimball
R. Jeffrey Kimball, P.E.

APPROVED BY:

7 July 81
Date

James W. Peck
JAMES W. PECK
Colonel, Corps of Engineers
Commander and District Engineer



Overview of Bigby Run Dam

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PHASE I
NATIONAL DAM INSPECTION PROGRAM

BIGBY RUN DAM
NDI. I.D. NO. PA 226
DER I.D. NO. 56-21

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. The Bigby Run Dam is an earthfill dam, 280 feet long and 25 feet high. The crest width of the dam is 14 feet. The upstream slope is paved with riprap, but the majority of the riprap and crest of the dam is covered over with grass. A valve house is located on the upstream slope of the dam. Controls for the 18" drainline and 10" supply line are housed in the structure. The valve house is located approximately mid-way across the embankment.

The spillway for the dam consists of a concrete ogee section, 76 feet long. Concrete retaining walls are located at either end of the ogee section. The spillway discharge channel is cut into natural rock, and discharges beyond the toe of the embankment section.

b. Location. The dam is located on Bigby Run, approximately 1 mile southwest of the Borough of Garrett in Somerset County, Pennsylvania. The Bigby Run Dam can be located on the Meyersdale, U.S.G.S. 7.5 minute quadrangle.

c. Size Classification. The Bigby Run Dam is a small size dam (25 feet high, 43 acre-feet).

d. Hazard Classification. The Bigby Run Dam is a high hazard dam. Downstream conditions indicate that loss of more than a few lives is probable should the structure fail. Several homes are located approximately 2,000 feet downstream of the dam, with one home being approximately 1,500 feet downstream of the dam and located approximately on the 2010 contour. The Borough of Garrett is located 1 mile downstream of the dam and several homes are located along the stream which were considered as being damaged and possible loss of life exists if a dam failure were to occur.

e. Ownership. The Bigby Run Dam is owned by Garrett Municipal Water Authority. Correspondence should be addressed to:

Garrett Municipal Water Authority
Box 141
Garrett, Pennsylvania 15542
Attention: Mr. Derbin Lohr
814/634-8749

f. Purpose of Dam. The dam is utilized by the Borough of Garrett as an alternate water supply.

g. Design and Construction History. An application for a permit to construct a dam across Bigby Run was made in July, 1930. The proposed purpose of the dam was to create a water storage reservoir for the use of the town of Garrett and as a water supply for locomotives of the B & O Railroad. The proposed structure was to replace a previous structure at the same location. The initial structure was ordered to be breached in June 1917. No information was available relative to the date the original structure was abandoned. A July 7, 1928 memorandum in the DER file contains information relative to an inspection at the structure. The memorandum states that a 12 foot breach existed in the structure at that time. The memorandum further stated that no further examination of the dam was necessary.

The dam was designed by Gray and Claflin, Consulting Civil Engineers, of Johnstown, Pennsylvania. The construction of the dam began in mid-1930, and approval was given to begin impounding water in early 1931. Only minor work was required to complete the dam at the time permission was given to impound water. No information was available as to who constructed the dam. No information is available as to the reference datum used in the design drawings included in the Appendix of this report.

h. Normal Operating Procedures. The reservoir is not currently used for water supply. Based on an interview with Mr. Derbin Lohr, representing the Garrett Municipal Authority, the quality of water is below standards, and water is presently supplied to the borough from an alternate source. No operations are presently conducted at the dam. During periods of previous operation, water was drawn from the reservoir through a 10" supply line, which feeds the Borough of Garrett.

1.3 Pertinent Data.

a. Drainage Area. 3.6 square miles

b. Discharge at Dam Site (cfs).

Maximum flood at dam site (Hurricane Hazel)	Discharge unknown
Drainline capacity at normal pool	Unknown
Spillway capacity at top of dam	2610

c. Elevation (M.S.L.) (feet). - Field survey based on an assumed spillway crest elevation, 2130.0 feet, U.S.G.S. 7.5 minute quadrangle.

Top of dam - low point	2134.5
Top of dam - design height	2134.0
Pool at time of inspection - November 6, 1980	2130.0
- May 12, 1981	2120.0
Spillway crest	2130.0
Maximum pool - design surcharge	2134.0
Upstream portal - 18" cast iron pipe	Unknown
Downstream portal - 18" cast iron pipe	2109.2
Streambed at centerline of dam	Unknown
Maximum tailwater	Unknown
Toe of dam	2109.2

d. Reservoir (feet).

Length of maximum pool	1000
Length of normal pool	800

e. Storage (acre-feet).

Spillway crest	25
Top of dam	43

f. Reservoir Surface (acres).

Top of dam	4.6
Normal pool	3.7
Spillway crest	3.7

g. Dam.

Type	Earthfill
Length (including spillway)	280 feet
Height	25 feet
Top width	14 feet
Side slopes - upstream	2.5H:1V
- downstream	2H:1V
Zoning	Yes
Impervious core	Concrete corewall
Cutoff	Yes
Grout curtain	Unknown

h. Reservoir Drain.

Type
Length
Closure

18" cast iron pipe
Approximately 142'
Gate valve upstream
of concrete corewall

Access

Valve stem
at gate house
on upstream slope
Gate valve

Regulating facilities

i. Spillway.

Type

Concrete ogee
section

Length

76 feet

Crest elevation

2130.0

Upstream channel

Lake

(unrestricted)

Downstream channel

Bigby Run

SECTION 2 ENGINEERING DATA

2.1 Design. Review of available information in the files of the Commonwealth of Pennsylvania, Department of Environmental Resources, revealed that some correspondence, permit information, pictures, and design drawings were available for review. Available design drawings are located in Appendix E of this report. Mr. Derbin Lohr, representing the Garrett Municipal Water Authority, accompanied the inspection team during the inspection, but was unable to supply any additional data.

2.2 Construction. No information exists regarding the construction of the dam.

2.3 Operation. No operating records are known to exist.

2.4 Evaluation.

a. Availability. Engineering data were provided by PennDER, Bureau of Dams and Waterway Management.

b. Adequacy. This Phase I Report is based on the visual inspection and hydrologic and hydraulic analysis. Sufficient information exists to complete a Phase I Report.

SECTION 3
VISUAL INSPECTION

3.1 Findings.

a. General. The onsite inspection of Bigby Run Dam was conducted by personnel of L. Robert Kimball and Associates on November 6, 1980 and May 12, 1981. During the November 6, 1980 inspection, the inspection team was accompanied by Mr. Chuck Woodward, representing the Department of Environmental Resources, Carnegie Regional Office, and Mr. Derbin Lohr, representing the Garrett Municipal Authority. 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 appeared to be in fair condition and adequately maintained. Based on a brief survey the crest of the dam is relatively consistent across the entire length of the earthen embankment section. No significant low spots were noted on the crest of the dam.

The upstream slope and crest of the dam were grass covered. A rock fill existed on the entire downstream slope of the dam. It was observed that design drawings did not indicate the existence of rock on the entire slope. Seepage was observed at the toe of the dam near the left abutment contact. Seepage was estimated at 2 to 5 gallons per minute. No other seepage was noted during the inspection.

A second inspection of the dam and appurtenant structures was completed on May 12, 1981. The reservoir pool at the time of the May 12, 1981 inspection was estimated at 2120.0, ten feet below the previous inspection. The drainline was open and attempts were underway to drain the reservoir. It was reported by Mr. Derbin Lohr that the drawdown was required to improve water quality in the reservoir. The brush on the downstream slope was cut since the November 6, 1981 inspection. Two trees still exist on the upstream slope of the dam.

c. Appurtenant Structures. The spillway was observed to be a concrete ogee section. Field measurements taken during the inspection indicated that the length of the crest was approximately 76 feet. In general, the concrete in the spillway was in a deteriorating condition. Deterioration of the concrete was observed on the right spillway retaining wall. The discharge channel for the spillway consisted of an open cut channel in bedrock. No major deficiencies were observed in the area of the spillway which were considered capable of significantly affecting the discharge potential of the structure. A valve house was observed on the upstream slope of the dam.

d. Reservoir Area. The watershed is covered almost equally with forested lands and open fields. Some strip mining is occurring within the watershed, south of the reservoir. The reservoir slopes are moderate to steep, but 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 for the Bigby Run Dam consists of Bigby Run. The channel is relatively narrow until it reaches the Borough of Garrett, at which point Bigby Run drains into the Casselman River. Several homes are located approximately 2,000 feet downstream of the dam, with one home being approximately 1,500 feet downstream of the dam and located approximately on the 2010 contour. The Borough of Garrett is located 1 mile downstream of the dam and several homes are located along the stream which were considered as being damaged and possible loss of life exists if a dam failure were to occur.

3.2 Evaluation. In general, the dam and appurtenant structures appear to be in fair condition. No major erosion areas were observed during the inspection. One seepage area was observed at the downstream toe of the dam, and seepage was estimated at 2 to 5 gallons per minute. The concrete in the spillway is in a deteriorating condition. Marked deterioration of the right spillway wingwall was observed.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures. The reservoir is presently in the process of being drained in order to improve the water quality in the reservoir.

4.2 Maintenance of the Dam. No planned maintenance schedule exists for the dam. Maintenance of the dam is performed on an unscheduled, as-needed basis.

4.3 Maintenance of Operating Facilities. No planned maintenance exists. Maintenance of the facilities consists of unscheduled, as-needed maintenance of present facilities.

4.4 Warning System in Effect. There is no warning system in effect to warn downstream residents of large spillway discharges or imminent failure of the dam.

4.5 Evaluation. Maintenance of the dam and operating facilities is considered fair. The concrete in the spillway is in a deteriorating condition. Marked deterioration was observed at the right spillway wingwall. The concrete should be repaired. Minor seepage was observed at the toe of the dam adjacent to the left abutment contact.

An emergency action plan should be available for every dam in the high and significant category. Such plans should outline actions to be taken by the operator to minimize downstream effects of an emergency, and should include an effective warning system. No emergency action plan has been developed.

SECTION 5
HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features.

a. Design Data. No information was available relative to the hydrologic and hydraulic design of the dam.

b. Experience Data. No rainfall, runoff or reservoir level data were available. The spillway reportedly has functioned adequately in the past.

c. Visual Observations. The spillway appeared to be in fair condition. No obstructions were observed in the spillway approach or in the spillway discharge channel that would affect the discharge potential of the spillway. It was noted that during the inspection that the embankment crest was fairly consistent across the entire length.

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 completion of the hydraulic and hydrologic analysis for this structure, it was necessary to make the following assumptions.

1. The pool elevation in the reservoir prior to the storm was assumed to be at the spillway crest elevation, 2130.0.

2. The top of dam was considered to be at elevation, 2134.5.

3. No discharge was considered through the 18" cast iron pipe or the 10" service line.

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

Peak inflow (PMF)	10380 cfs
Peak inflow (1/2 PMF)	5190 cfs
Spillway capacity	2610 cfs

a. Spillway Adequacy Rating. The Spillway Design Flood (SDF) is based on the hazard and size classification of the dam. The recommended spillway design flood for a dam of this size and hazard classification is in the range of 1/2 PMF to PMF.

No definitive criteria exists to assist the evaluating engineer in selecting a SDF within the given range. The current practice adopted by the Baltimore District Corp of Engineers relates the selection of a Spillway Design Flood to the size and storage potential of the dam.

The Baltimore District Corps of Engineers has determined that the SDF be selected as the lesser value (1/2 PMF) of the 1/2 PMF range for high hazard dams which barely meet the minimum storage or height criteria (size classification), and which are located in rural areas.

Since Bigby Run Dam just meets the minimum size criteria; and since the dam is located in a rural area suggesting only appreciable economic loss; compliance with current practice of the Baltimore District Corps of Engineers leads to the selection of the 1/2 PMF as the Spillway Design Flood (SDF).

Based on the following definition provided by the Corps of Engineers, the spillway is rated as inadequate as a result of our hydrologic analysis.

Inadequate - All high hazard dams which do not pass the spillway design flood (1/2 PMF).

The spillway and reservoir are capable of controlling approximately 25% of the PMF without overtopping the embankment.

5.4 Summary of Dam Breach Analysis. As the subject dam cannot satisfactorily pass 50% of the PMF (based on our analysis), it was necessary to perform a dam breach analysis and downstream routing of the flood wave. This analysis determined the degree of increased flooding due to dam failure. A pool elevation of 2135.5, representing 1 foot of overtopping, was considered sufficient to cause failure of the dam due to overtopping.

The results of the dam breach analysis indicate that the downstream potential for loss of life and property damage is not significantly increased by dam failure from that which would exist just prior to failure. Therefore, the spillway is rated as inadequate, but not seriously inadequate. Details of the downstream routing of the flood wave are included in Appendix D.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations. No erosion was observed during the inspection. A seepage area was observed at the left abutment contact, at the toe of the dam. Seepage in this area was estimated at 2 to 5 gallons per minute. No other seepage was observed during the inspection. No movement or misalignment of the dam was observed during the inspection.

It was noted during the second inspection, May 12, 1981, that the seepage was not significantly reduced due to the reduced level of the reservoir. The seepage appeared to be equal to that observed during the November 6, 1980 inspection.

The spillway was in a visibly deteriorating condition. Deterioration was observed in the right spillway wingwall. During the May 12, 1981 inspection, the reduced level of the reservoir allowed a closer inspection of the ogee section. Soil was observed along the upstream face of the ogee section. This condition was not observed during the November 6, 1980 inspection due to discharges over the spillway at the time. It is possible that some of the material represents fill placed against the upstream face of the dam during construction of the dam. The fill material and silt slopes gently from the spillway crest to the reservoir at a slope of approximately 4H:1V.

b. Design and Construction Data. Construction of the dam began sometime around 1930. The design of the dam was completed by the Gray and Clafin, Consulting Engineers, Johnstown, Pennsylvania. A diagram of spillway thrusts exists in Appendix E, on page E-3. Apparently, a stability analysis of the spillway was completed, but no information was available in the DER files for review. The dam was constructed with a concrete core wall and cutoff, 18" thick at the base and 9" thick at the top. Pipe collars were to be encased in concrete at the joints and portions along the upstream end of the pipe were supported by concrete piers. No information was available relative to construction of the dam.

c. Operating Records. No operating records are known to exist for this dam.

d. Post Construction Changes. No post construction changes are known to have been completed.

e. Evaluation. No major deficiencies were observed during the inspection which were considered as having an immediate effect upon the static stability of the structure. Therefore, the Bigby Run Dam is considered to be statically stable at the present time.

f. Seismic Stability. The dam is located in seismic zone 1. No seismic stability analyses have been performed. Normally, if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected earthquake loading.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. The dam and appurtenant structures appear to be in fair condition and maintenance is considered fair. No major erosion areas were observed during the inspection. A minor seepage area was observed at the toe of the downstream slope, adjacent to the left abutment contact. Seepage was estimated at approximately 2 to 5 gallons per minute. It was observed during the inspection that the top of dam was relatively consistent across the entire length of the crest. The concrete in the spillway was observed to be in a deteriorating condition, with marked deterioration of the right spillway wall. The majority of the deterioration was observed at the bottom of the retaining wall.

The Bigby Run Dam is a high hazard-small size dam. The recommended Spillway Design Flood (SDF), for a dam of this size and classification, is in the range of 1/2 PMF to PMF. Since the Bigby Run Dam just meets the minimum size criteria; and since the dam is located in a rural area suggesting only appreciable economic loss; compliance with current practice of the Baltimore District Corps of Engineers leads to the selection of the 1/2 PMF as the Spillway Design Flood (SDF).

The visual observations, review of available data, hydrologic and hydraulic calculations, and past operational performance, indicate that the Bigby Run Dam is capable of controlling approximately 25% of the PMF. The spillway is termed inadequate, but not seriously inadequate.

b. Adequacy of Information. Sufficient information is available to complete a Phase I report.

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.

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 design modifications to increase the spillway capacity.

2. The observed seepage at the downstream toe of the dam, adjacent to the left abutment contact, should be monitored. Seepage moni-

toring data should be evaluated by a registered professional engineer knowledgeable in dam design and analysis and control measures implemented as recommended.

3. The concrete in the spillway should be repaired.

4. An operation and maintenance schedule should be prepared and implemented to insure the continued safe operation of the structure.

5. The remaining trees on the upstream slope of the dam should be removed under the direction of a registered professional engineer knowledgeable in dam design and analysis.

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

7. Positive drainage should be provided at the outlet for the 18" cast iron pipe drainline.

8. 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 Bigby Run Dam COUNTY Somerset STATE Pennsylvania ID# PA 226
TYPE OF DAM Earthfill HAZARD CATEGORY High
DATE(S) INSPECTION November 6, 1980 WEATHER Overcast and cold TEMPERATURE 35°
May 12, 1981 WEATHER Clear and cool TEMPERATURE 50-55°
POOL ELEVATION AT TIME OF INSPECTION 2130 TAILWATER AT TIME OF INSPECTION 2121.9 M.S.L. M.S.L. 2121.9 M.S.L.

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
Mr. Chuck Woodward - Department of Environmental Resources, Carnegie-Regional Office
Bureau of Dams and Waterway Management
Mr. Derbin Lohr - Representing the Garrett Water Authority

O.T. McConnell RECORDER

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None noted.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None noted.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None noted.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	appeared to be all right.	
RIPRAP FAILURES	None noted.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	Brush and trees existed on the downstream slope of the dam during the November 6, 1980 inspection.	The brush and trees had been cut as observed during the May 12, 1981 inspection. Remaining trees on upstream should be removed.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Appear to be all right.	
ANY NOTICEABLE SEEPAGE	Minor seepage observed at the downstream toe of the dam.	Seepage estimated to be 2 to 5 gallons per minute. Recommend monitoring seepage.
STAFF GAUGE AND RECORDER	None.	
DRAINS	None.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	Brush and trees existed on the downstream slope of the dam during the November 6, 1980 inspection.	The brush and trees had been cut as observed during the May 12, 1981 inspection.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Appear to be all right.	
ANY NOTICEABLE SEEPAGE	Minor seepage observed at the downstream toe of the dam.	Seepage estimated to be 2 to 5 gallons per minute. Recommend monitoring seepage.
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	Not applicable.	
INTAKE STRUCTURE	Not observed.	
OUTLET STRUCTURE	Not observed.	
OUTLET CHANNEL	Not applicable.	
EMERGENCY GATE	Valves on upstream slope in gate house. Controls in gate house for 10" service line and 18" cast iron pipe.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Concrete ogee section appears to be in fair condition. Deterioration of the concrete in the spillway is occurring. Marked deterioration of the right spillway wall was observed.	The concrete should be repaired.
APPROACH CHANNEL	Lake [unrestricted].	
DISCHARGE CHANNEL	Open cut channel on bedrock.	
BRIDGE AND PIERS	None.	

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	Not applicable.	
APPROACH CHANNEL	Not applicable.	
DISCHARGE CHANNEL	Not applicable.	
BRIDGE AND PIERS	Not applicable.	
GATES AND OPERATION EQUIPMENT	Not applicable.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	The downstream channel for the Bigby Run Dam consists of the Bigby Run.	
SLOPES	Appear to be stable.	
APPROXIMATE NO. OF HOMES AND POPULATION	One home is located approximately 1500 feet downstream of the dam, and the Borough of Garrett is located approximately 1 mile downstream of the dam. The population of the Borough of Garrett is estimated at 500 people.	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Moderate to steep, but appear to be stable.	
SEDIMENTATION	Sedimentation is unknown even though the water level was reduced during the May 12, 1981 inspection.	

INSTRUMENTATION

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



POOL
+ 2130

TREES

VALVE
HOUSE

2130.0
+

21370 +

CONCRETE
DETERIORATING

+ 2121.9

+ 2134.5

+ 2134.5

21345+

21348

21386

ROADWAY

FLOW

21032 +
INVERT
18" C.I.P.

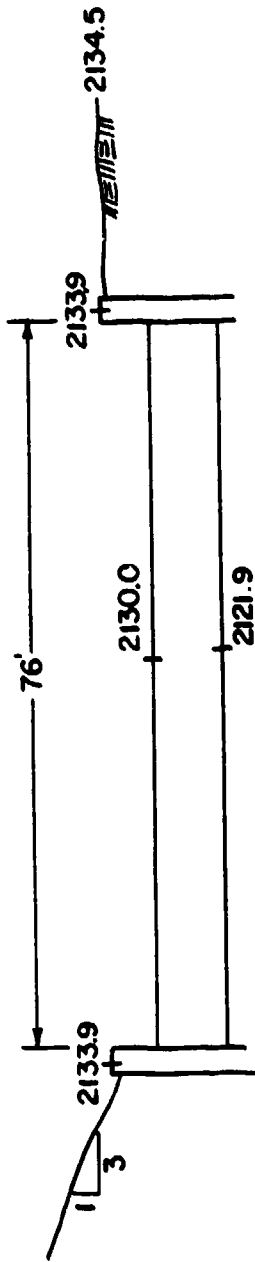
2109.2 +

SEEPAGE
2 - 5 G.P.M.



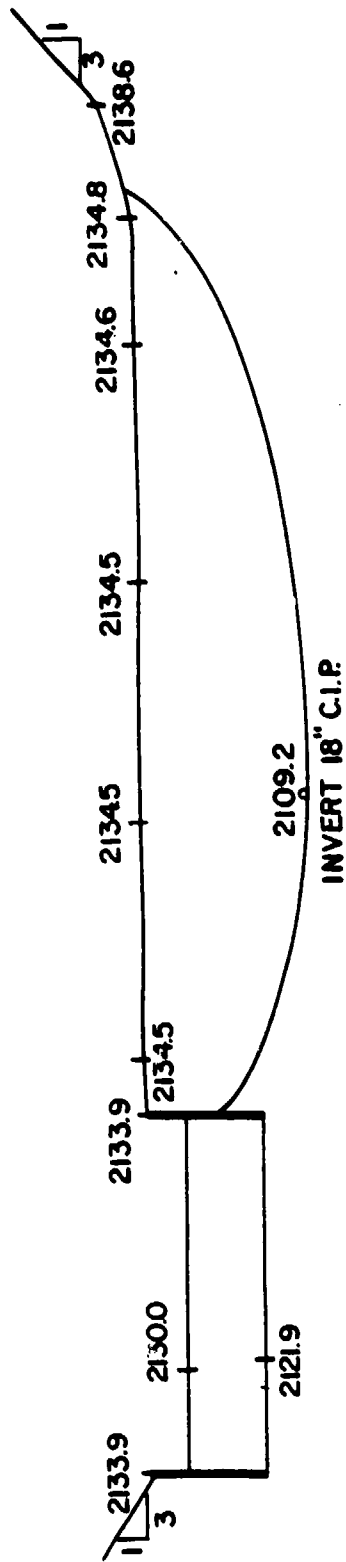
BIGBY RUN DAM
SCALE: 1" = 50'

A-12



**SPILLWAY PROFILE
LOOKING UPSTREAM
SCALE: 1"=20'**

A-13



**PROFILE
LOOKING UPSTREAM
HORIZ. 1"=40'
SCALE: VERT. 1"=20'**



BIGBY RUN DAM

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

**CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I**

NAME OF DAM Highby Run Dam

ID# PA 226

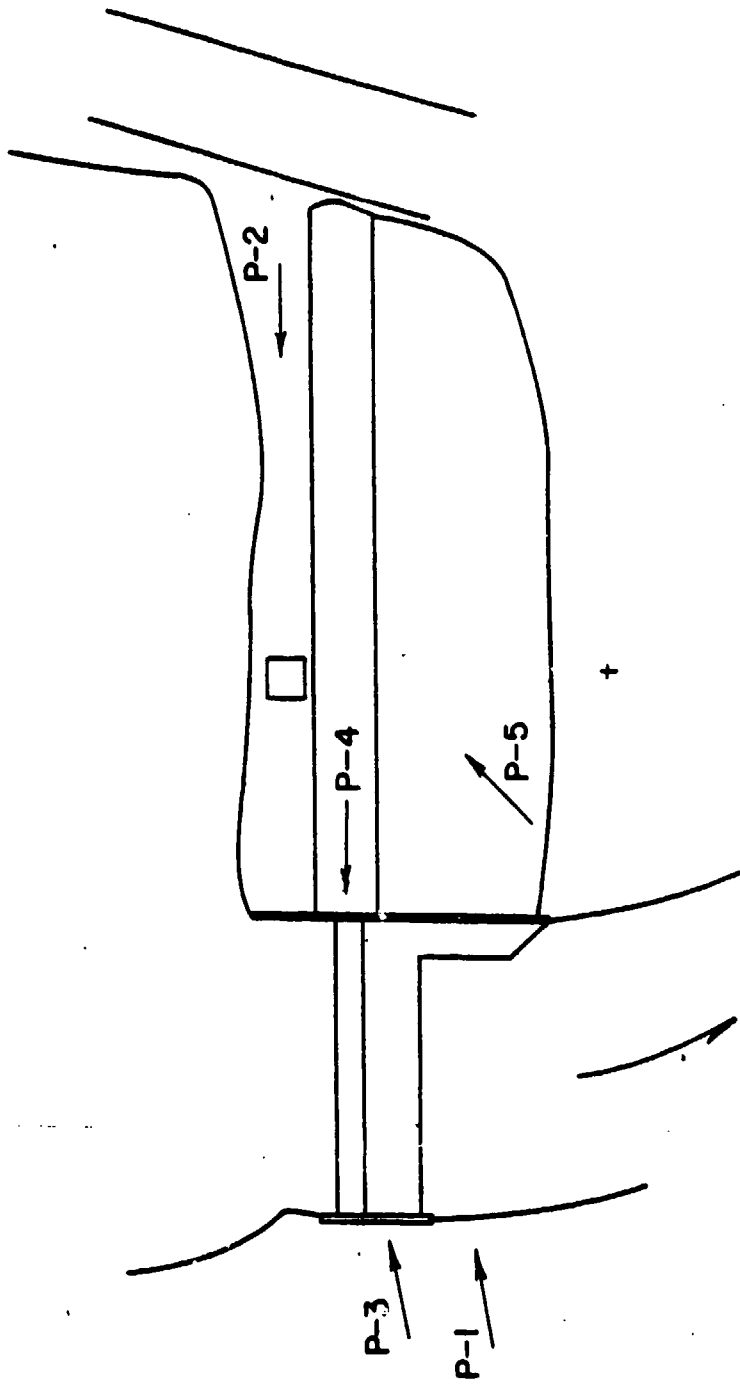
ITEM	REMARKS
AS-BUILT DRAWINGS	None.
REGIONAL VICINITY MAP	U.S.G.S. quadrangle.
CONSTRUCTION HISTORY	Limited information available in DER files.
TYPICAL SECTIONS OF DAM	See Appendix E.
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS RAINFALL/RESERVOIR RECORDS	See Appendix E. See Appendix E. See Appendix E. None. None.

ITEM	REMARKS
DESIGN REPORTS	Unknown.
GEOLOGY REPORTS	Unknown.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Unknown.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	Unknown. Some data available in Appendix E on page E-2.
POST-CONSTRUCTION SURVEYS OF DAM	None known to have occurred.
BORROW SOURCES	Unknown.

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

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	See Appendix E.
OPERATING EQUIPMENT PLANS & DETAILS	See Appendix E.

**APPENDIX C
PHOTOGRAPHS**



C-1



BIGBY RUN DAM PHOTO INDEX

P-INDICATES PHOTO LOCATION

BIGBY RUN DAM
PA 226

Sheet 1

Front

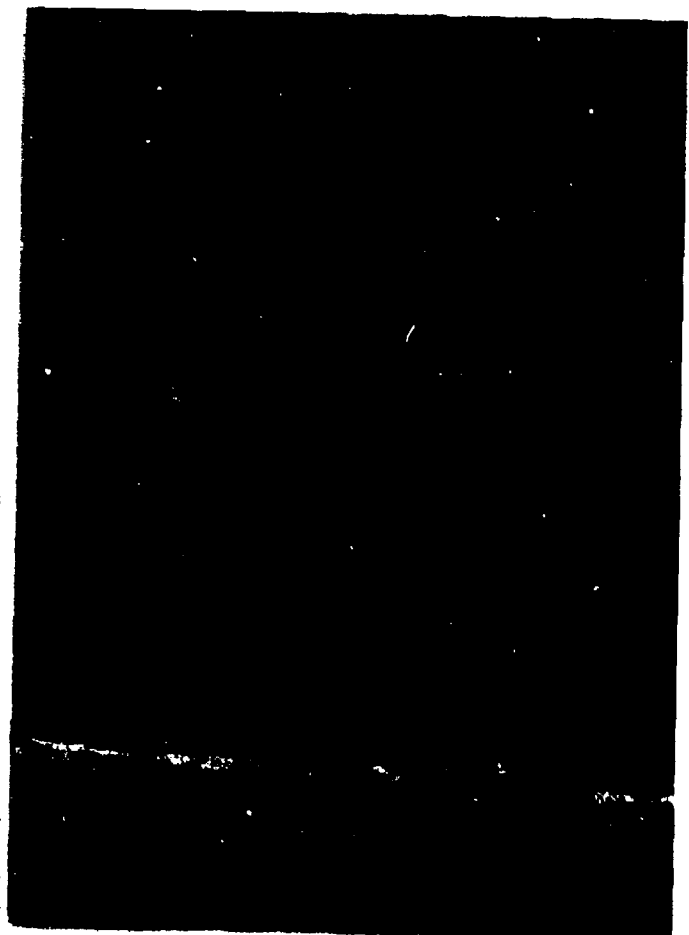
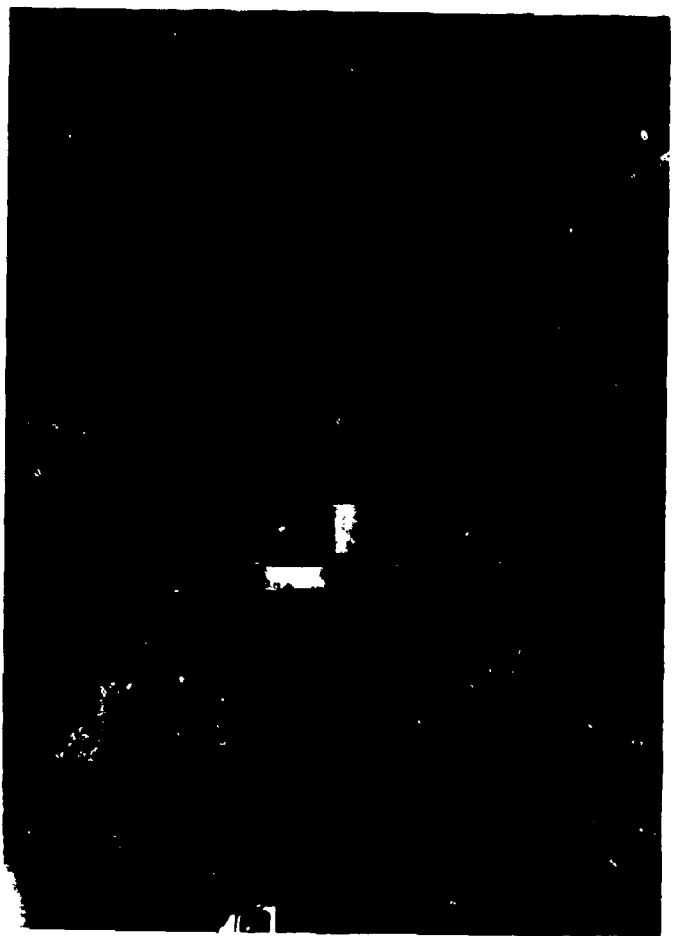
1. Upper left - View of crest and downstream slope of dam. View towards the left abutment.
2. Upper right - View of upstream slope of dam. Note gate house on upstream slope.
3. Lower left - View of spillway.
4. Lower right - View of spillway crest. View towards the right abutment. Note deterioration of concrete on right spillway wall.

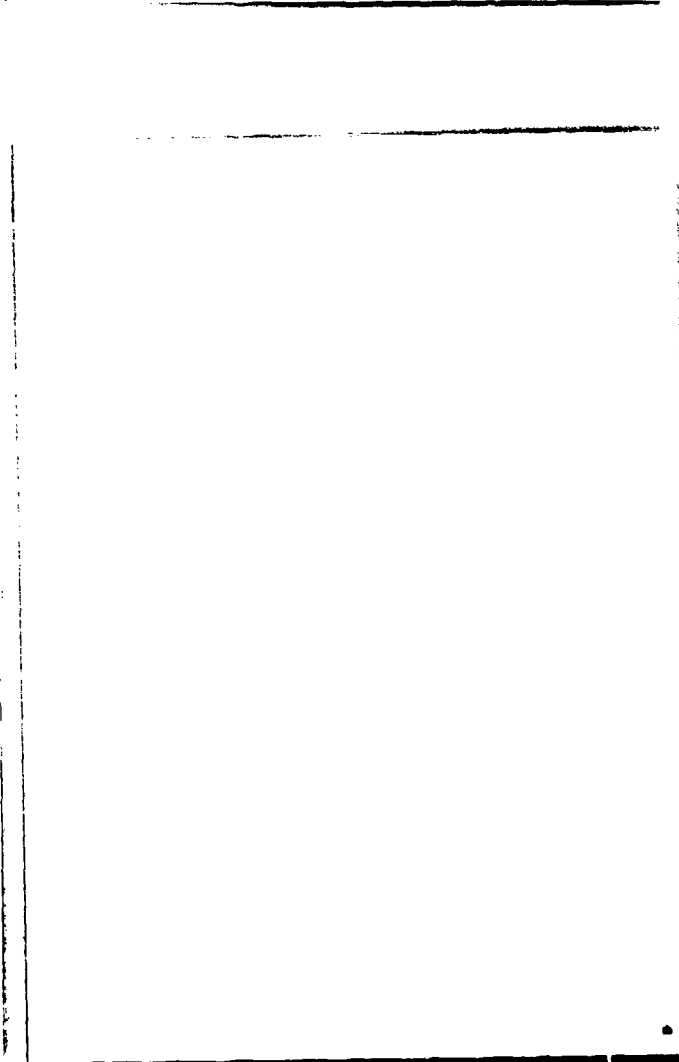
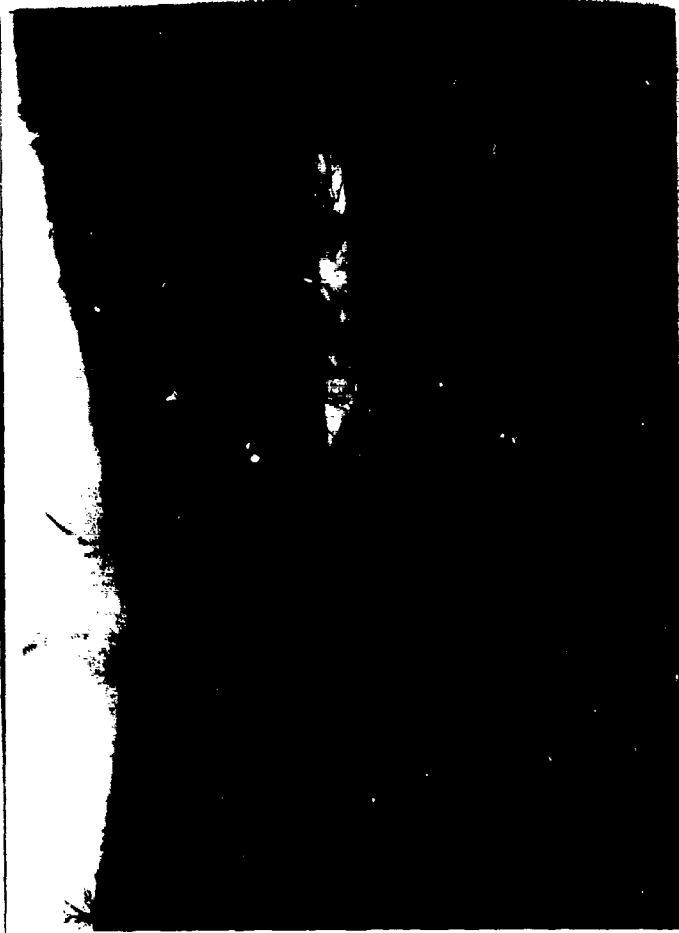
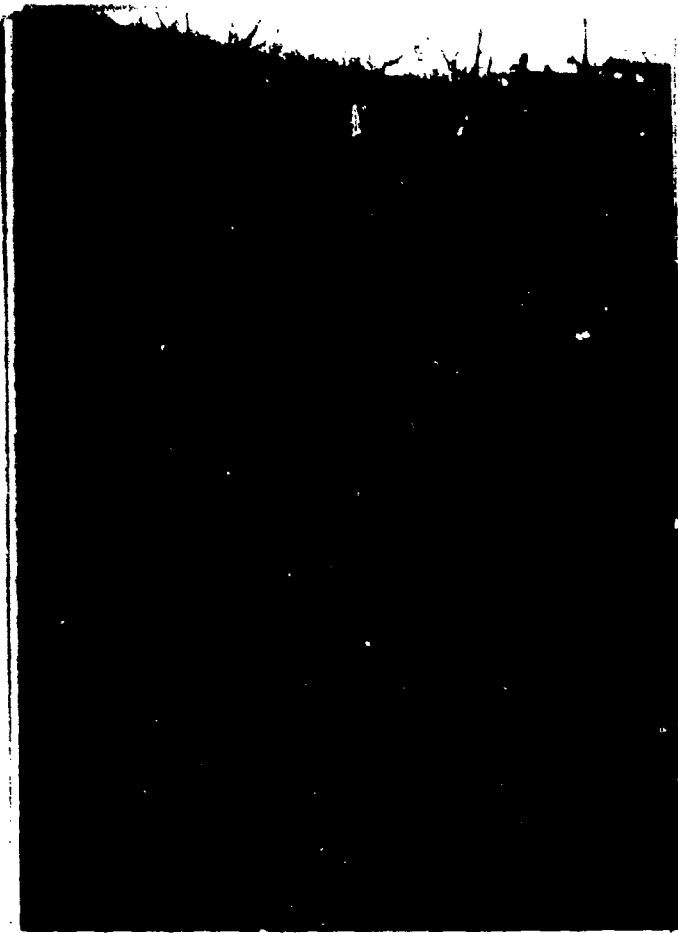
Sheet 1

Back

5. Upper left - View of downstream slope of dam. Note rock on slope.
6. Upper right - Downstream exposure.

1,5	2,6
3	4





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. 33" prepared by the U.S. Weather Bureau.

The index rainfall may be 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 topographic
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: Bigby Run Dam

PROBABLE MAXIMUM PRECIPITATION (PMP) = 24.0 inches

STATION	1	2	3
Station Description	Bigby Run		
Drainage Area (square miles)	3.6		
Cumulative Drainage Area (square miles)	3.6		
Adjustment of PMF for Drainage Area (%) ⁽¹⁾	(Zone 7)		
6 hours	102		
12 hours	120		
24 hours	130		
48 hours	140		
72 hours	N/A		
Snyder Hydrograph Parameters			
Zone ⁽²⁾	25		
C _p ⁽³⁾	0.40		
C _t ⁽³⁾	1.0		
L (miles) ⁽⁴⁾	2.46		
L _{ca} (miles) ⁽⁴⁾	1.14		
t _p = C _t (L/L _{ca}) 0.3 hrs.	1.36		
Spillway Data			
Crest Length (ft)	76		
Freeboard (ft)	4.5		
Discharge Coefficient	3.6		
Exponent	1.5		

(1) Hydrometeorological Report 33 (Figure 1), U.S. Weather Bureau and U.S. Army Corps of Engineers, 1956.

(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: 3.6 sq.mi.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 2130.0 [25 ac-ft]

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 2134.5 [43 ac-ft]

ELEVATION MAXIMUM DESIGN POOL: 2134.5

ELEVATION TOP DAM: 2134.5

SPILLWAY CREST:

- a. Elevation 2130.0
- b. Type Concrete ogee
- c. Width Crest length = 76 feet
- d. Length Not applicable
- e. Location Spillover Right abutment
- f. Number and Type of Gates None

OUTLET WORKS:

- a. Type One 10" service and one 18" cast iron pipe drainline
- b. Location Mid embankment
- c. Entrance inverts Unknown
- d. Exit inverts 2109.2 [18" CIP]
- e. Emergency drawdown facilities 18" cast iron pipe

HYDROMETEOROLOGICAL GAUGES:

- a. Type None
- b. Location None
- c. Records None

MAXIMUM NON-DAMAGING DISCHARGE: Unknown

NOTE: Elevations referred to M.S.L.



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

NAME BIGBY RUN DAM
NUMBER PA-226

SHEET NO. 1 OF 3
BY OTM DATE MAY, 1981

LOSS RATE AND BASE FLOW PARAMETERS

STR TL = 1 INCH
CNSTL = 0.05 IN/HR
STR TQ = 1.5 CFS/MI²
QRCSN = 0.05 (5% OF PEAK FLOW)
RTIOR = 2.0

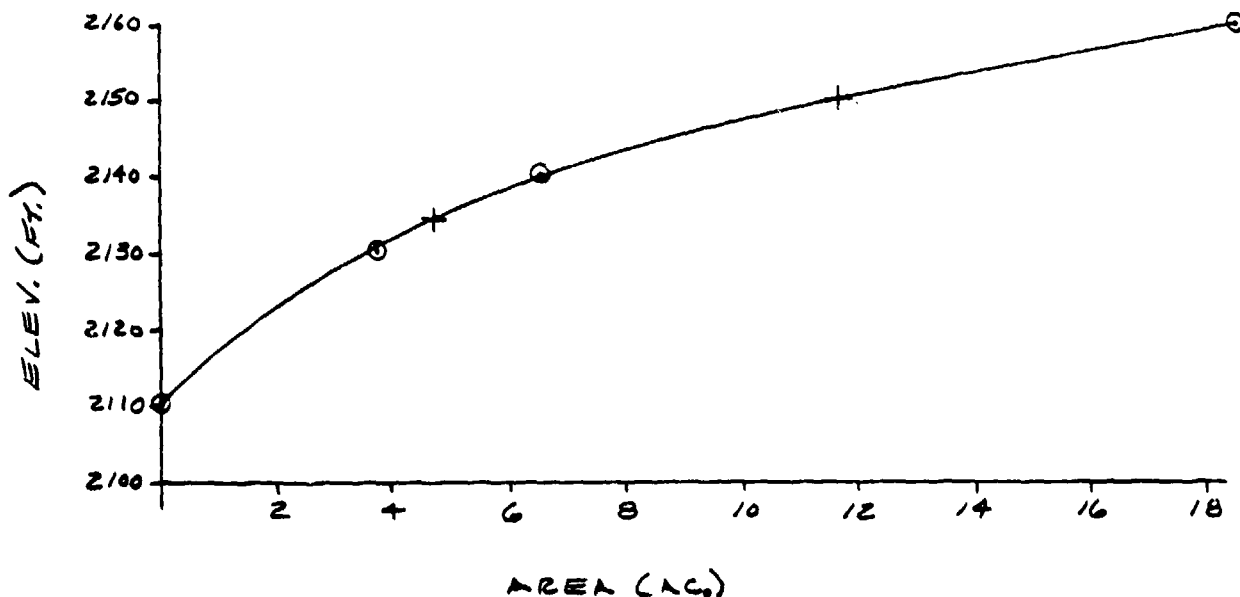
AS RECOMMENDED BY THE BALTIMORE DISTRICT
CORPS OF ENGINEERS.

ELEVATION-AREA-CAPACITY RELATIONSHIPS

FROM U.S.G.S. 7.5-MIN. QUAD., D.E.R. FILES,
AND FIELD INSPECTION DATA.

SPILLWAY CREST ELEVATION = 2130.0
SURFACE AREA AT SPILLWAY CREST = 3.7 ACRES
ASSUME ZERO STORAGE AT ELEV. = 2110.0

AT ELEV. 2140, AREA = 6.4 ACRES
AT ELEV. 2160, AREA = 18.4 ACRES





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

NAME _____
NUMBER PA-226

SHEET NO. 2 OF 3
BY OTM DATE MAY, 1981

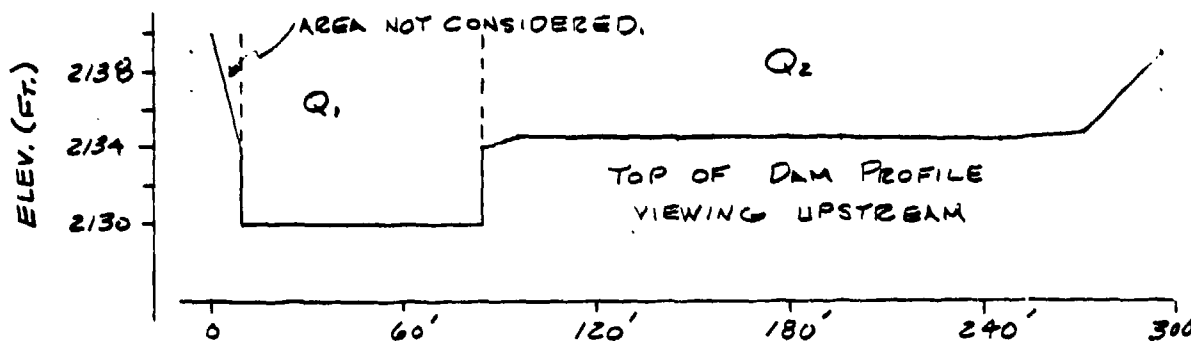
AREA (AC)	0	3.7	4.6	6.4	11.7	18.4
ELEV. (FT.)	2110	2130	2134.5	2140	2150	2160

DISCHARGE RATING

RATING CURVE INCLUDES POTENTIAL OVERTOPPING.

$$Q_1 \text{ SPILLWAY} = C_1 l h_1^{3/2} \quad \text{USE } C_1 = 3.6, l = 76' \quad h_{\text{MAX}} = 4.5'$$

$$Q_2 \text{ OVERTOP} = C_2 l_2 h_2^{3/2} \quad \text{USE } C_2 = 2.9, l \text{ VARIES W/ } h$$



ELEV. (FT.)	SPILLWAY		OVERTOPPING			DISCHARGE Q (cfs)
	h ₁ (FT.)	Q ₁ (cfs)	h ₂ (FT.)	l (FT.)	Q ₂ (cfs)	
2130.0	0	0				0
2131.0	1	275				275
2132.0	2	775				775
2133.0	3	1420				1420
2134.0	4	2190				2190
2134.5	4.5	2610	—	—	0	2610
2135.0	5	3060	0.5	188	190	3250
2136.0	6	4021	1.5	194	1035	5060
2137.0	7	5070	2.5	200	2290	7360
2138.0	8	6190	3.5	206	3910	10100

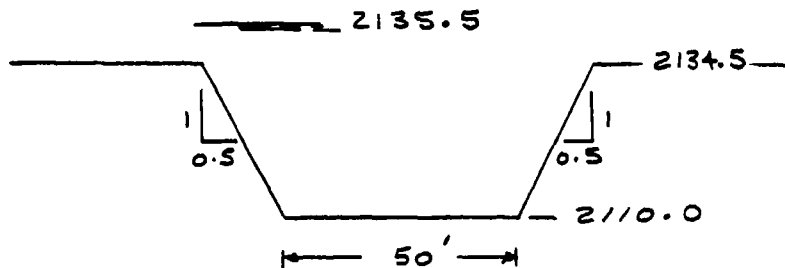


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CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

NAME _____
NUMBER PA-226

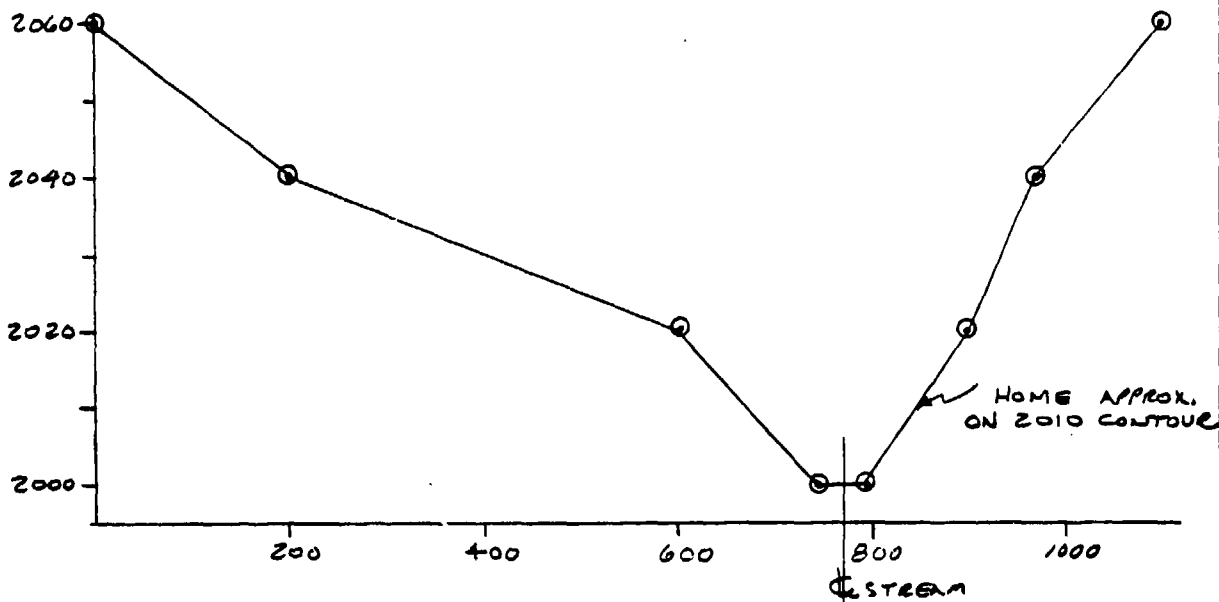
SHEET NO. 3 OF 3
BY OTA DATE MAY, 1981

DAM BREACH AND FLOOD ROUTING



BRWID = 50 FT.
Z = 0.5
ELBM = 2110.0
TFAIL = 3
WSEL = 2130.0
FAILEL = 2135.5

CONSIDER 1.0 FT. OF OVER-
TOPPING SUFFICIENT TO
CAUSE FAILURE OF THE
STRUCTURE.
DURATION OF OVERTOPPING
EQUALS 4.50 HRS.



REACH No. 1

REACH CROSS-SECTION LOCATED 1500 FT. DOWNSTREAM
OF DAM. SECTION FROM USGS, 7.5-MIN. QUAD.
MANNINGS CHANNEL (n) ASSUMED TO EQUAL 0.05
MANNINGS OVERBANK (n) ASSUMED TO EQUAL 0.06
AVERAGE SLOPE = 0.07

 FLOC HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 01 APR 80

A1 ANALYSIS OF DAM OVERTOPPING USING RATIOS OF THE PMF
 A2 HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF BIGBY RUN DAM
 A3 RATIOS OF THE PMF ROUTED THROUGH THE RESERVOIR (PA-226)

1	200	0	10	0	0	0	0	0	0
2	5	4	1						
3	2	3	.5	1					
4	0	1							
5	1	INFLOW							
6	1	24	3.6	102	130	140	1		
7								1.0	0.05
8	1.36	0.40							
9	-1.05	-0.05	2.0						
10	1	1	2						
11		ROUTE							
12									
13									
14									
15									
16									
17									
18	Y1	2130	2131	2132	2133	2134	2134.5	-2130	2130
19	Y4	2130	2131	2132	2133	2134	2134.5	2135	2136
20	Y5	0	275	775	1420	2190	2610	3250	5060
21	SA	0	3.7	6.6	6.4	11.7	18.4	7360	10100
22	SE	2110	2130	2134.5	2140	2150	2160		
23	SS	2130							
24	SD	2134.5							
25	K								

 FLOC HYDROGRAPH PACKAGE (HEC-1)
 DAM SAFETY VERSION JULY 1978
 LAST MODIFICATION 01 APR 80

RUN DATE: 01/05/19.
 TIME: 09.29.38.

ANALYSIS OF DAM OVERTOPPING USING RATIOS OF THE PMF
 HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF BIGBY RUN DAM
 RATIOS OF THE PMF ROUTED THROUGH THE RESERVOIR (PA-226)

NO	NHR	NMIN	IDAY	IMR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	10	0	0	0	0	0	-4	0
		JOPER	5	NHT	LROPT	TRACE			
				0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED

MPLAN= 1 MR10= 4 LR10= 1
 RT10= 920 930 950 1.00

SUB-AREA RUNOFF COMPUTATION

INFLOW

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

HYDROGRAPH DATA

IMYDG	IUMG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	3.60	0.00	3.60	1.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	24.00	102.00	120.00	130.00	140.00	0.00	0.00

MO,DA		HR,MM	PERIOD	RAIN	EXCS	LOSS	END-OF-PERIOD FLOW		NO,DA	HR,MM	PERIOD	RAIN	EXCS	LOSS	COMP 0
							COMP Q								
86.	80.	75.	70.	66.	62.	58.	54.	51.	47.						
44.	42.	39.	36.	34.	32.	30.	28.	26.	25.						
23.	22.	20.	19.	18.	17.	16.	15.	14.	13.						
12.	11.	10.	10.	9.	9.	8.	8.	7.	7.						
6.	6.	5.	5.	5.	4.										

SUM 33.60 31.12 2.48 409915.
 (853.11 790.11 63.111607.50)

HYDROGRAPH ROUTING

ROUTE	ISTAG	IComp	TECOM	IIAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
	2	1	0	0	0	0	1	0	0
ROUTING DATA									
LOSS	CLOSS	AVG	IRES	ISAME	IORT	IPMP	LSTR		
0.0	0.000	0.00	1	1	0	0	0		
MSTPS MSTDL LAG ANSKK X TSK STORA ISPRAT									
1	0	0	0.000	0.000	-2130.	-1			
STAGE	2110.00	2131.00	2133.00	2134.00	2134.50	2135.00	2136.00	2137.00	
FLOW	0.00	275.00	775.00	1420.00	2190.00	2610.00	3250.00	3060.00	7360.00
FLOW	10100.00								

SURFACE AREA=	CAPACITY=	ELEVATION=	CREL	SPMID	COOM	EXPW	ELEVEL	COOL	CAREA	EXPL
99	257	2110.	2130.	2135.	2140.	2150.	2160.	0.0	0.0	0.0

TOPEL	C	M DATA	EXPD	DAMWID
2134.5			0.0	0.

PEAK OUTFLOW IS 2068. AT TIME 41.17 HOURS

PEAK OUTFLOW IS 3108. AT TIME 41.00 HOURS

PEAK OUTFLOW IS 5168. AT TIME 41.00 HOURS

PEAK OUTFLOW IS 10372. AT TIME 41.00 HOURS

6/10

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)

RATIOS APPLIED TO FLOWS

OPERATION STATION AREA PLAN RATIO 1 RATIO 2 RATIO 3 RATIO 4

OPERATION	STATION	AREA	PLAN RATIO 1	RATIO 2	RATIO 3	RATIO 4
HYDROGRAPH AT	1	3.60	2075.	3113.	5188.	10376.
	(9.321	58,761	89,131	146,911	293,821
ROUTED TO	2	3.60	2068.	3108.	5188.	10372.
	(9.321	58,551	88,021	146,901	293,701

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1

ELEVATION STORAGE	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
OUTFLOW	2130.00	2130.00	2134.50
	25.00	25.00	43.00
	0.00	0.00	2610.00

RATIO OF PWF	MAXIMUM RESERVOIR M.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	2133.84	0.00	60.	2068.	0.00	41.17	0.00
.30	2134.89	.39	45.	3108.	2.17	41.00	0.00
.50	2136.06	1.56	51.	5188.	4.50	41.00	0.00
1.00	2138.19	3.60	62.	10372.	8.50	41.00	0.00

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)

RATIOS APPLIED TO FLOWS

OPERATION STATION / AREA PLAN RATIO 1
50

HYDROGRAPH AT 1 3.60 1 5188.
2 9.321 1 146.9111
3 5188.
4 146.9111

ROUTED TO 2 3.60 1 5246.
3 9.321 1 146.8616
4 5188.
5 146.9011

ROUTED TO 3 3.60 1 5247.
4 9.321 1 146.5911
5 5188.
6 146.8111

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 *****

INITIAL VALUE SPILLWAY CREST TOP OF DAM
2130.00 2130.00 2134.50
25. 25. 43.
0. 0. 2610.

ELEVATION
STORAGE
OUTFLOW

RATIO OF PMF 0.50
MAXIMUM RESERVOIR W.S.ELEV 2155.04
MAXIMUM DEPTH OVER DAM 1.34
MAXIMUM STORAGE AC-FT 50
MAXIMUM OUTFLOW CFS 5257
DURATION OVER TOP HOURS 2.06
TIME OF MAX OUTFLOW HOURS 41.04
TIME OF FAILURE HOURS 40.33

PLAN 2 *****

INITIAL VALUE SPILLWAY CREST TOP OF DAM
2130.00 2130.00 2134.50
25. 25. 43.
0. 0. 2610.

ELEVATION
STORAGE
OUTFLOW

RATIO OF PMF 0.50
MAXIMUM RESERVOIR W.S.ELEV 2126.06
MAXIMUM DEPTH OVER DAM 1.36
MAXIMUM STORAGE AC-FT 210
MAXIMUM OUTFLOW CFS 3189
DURATION OVER TOP HOURS 9.80
TIME OF MAX OUTFLOW HOURS 41.00
TIME OF FAILURE HOURS 0.00

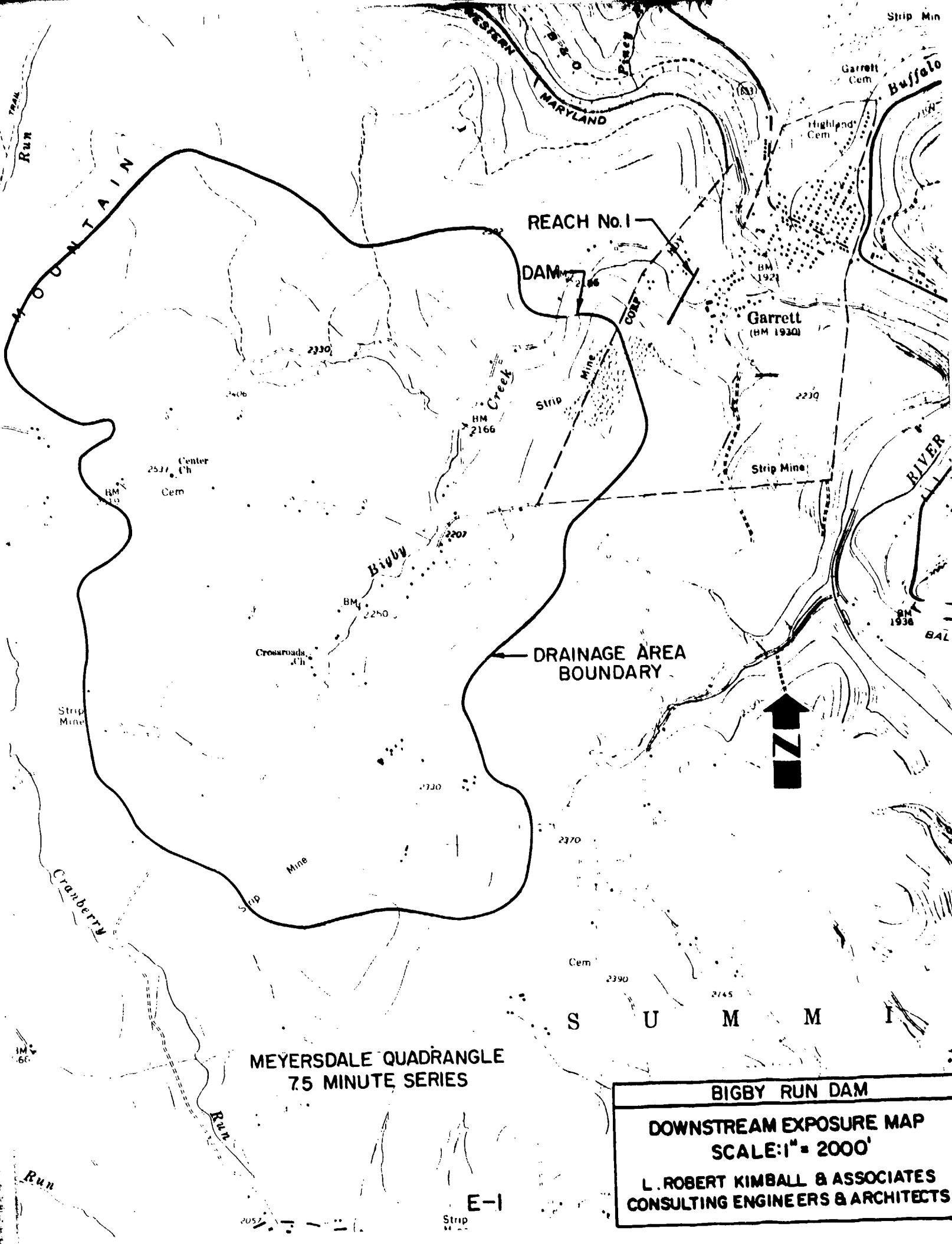
PLAN 1 STATION 3

RATIO 0.50
MAXIMUM FLOW CFS 5257
MAXIMUM STAGE FT 2003.9
TIME HOURS 41.17

PLAN 2 STATION 3

RATIO 0.50
MAXIMUM FLOW CFS 5185
MAXIMUM STAGE FT 2003.9
TIME HOURS 41.00

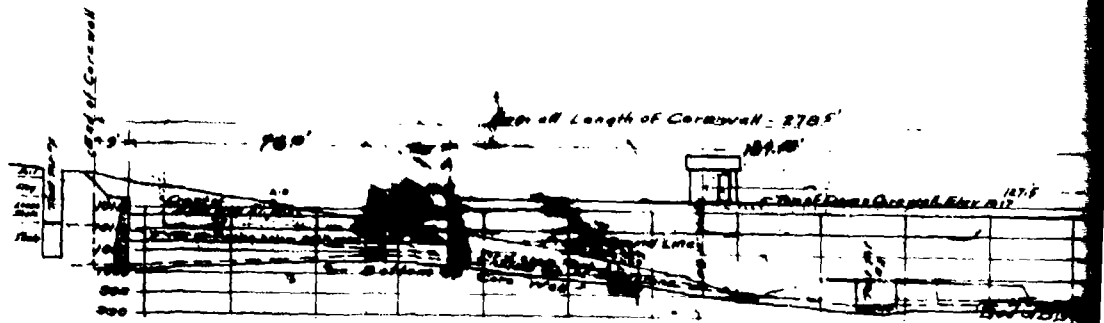
APPENDIX E
DRAWINGS



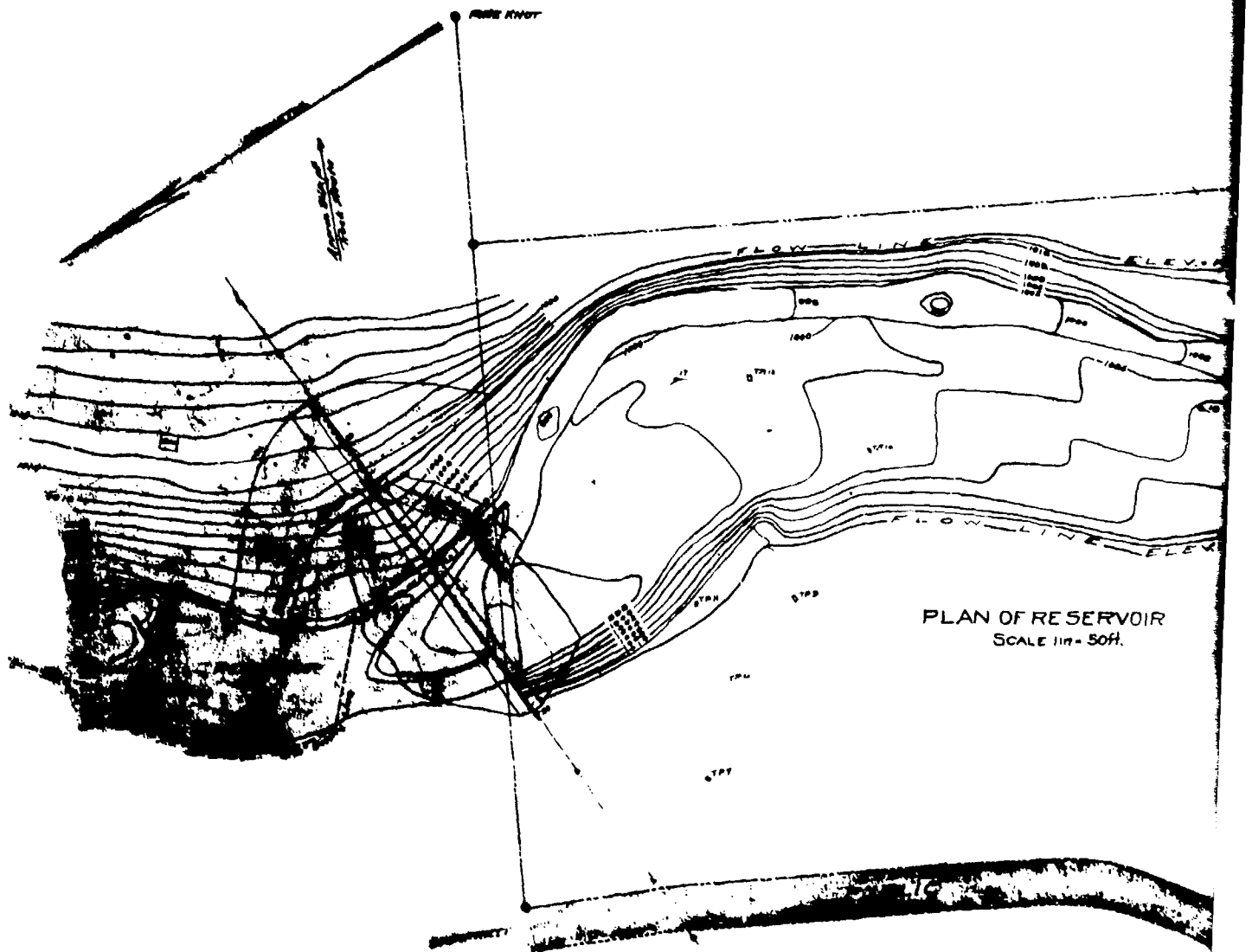
MEYERSDALE QUADRANGLE
75 MINUTE SERIES

BIGBY RUN DAM
DOWNSTREAM EXPOSURE MAP
SCALE: 1" = 2000'
L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS

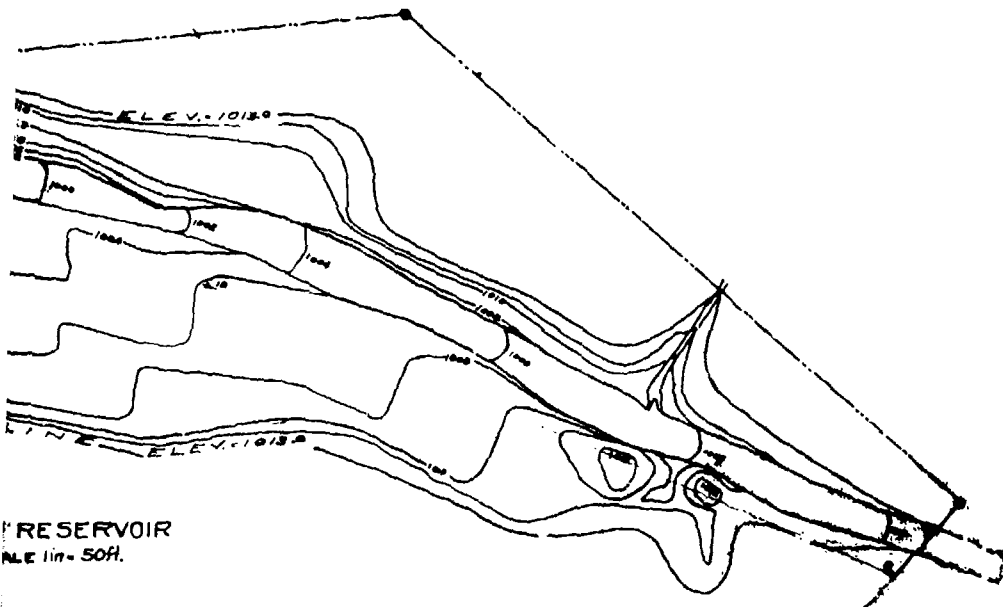
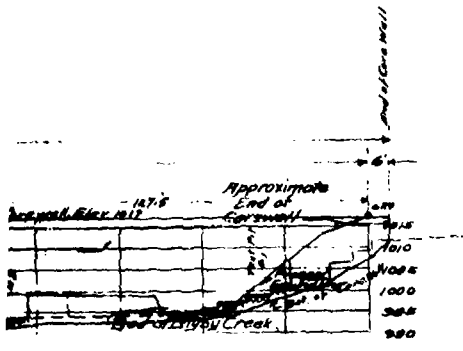
E-1



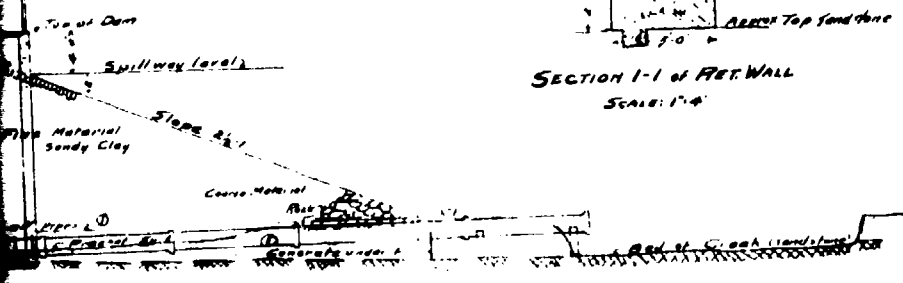
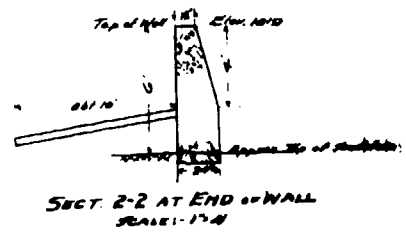
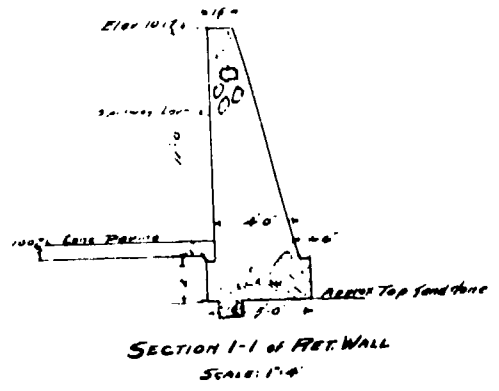
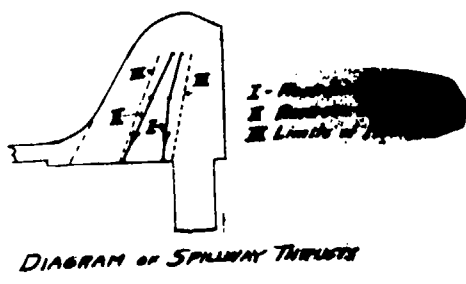
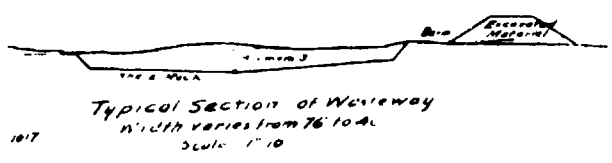
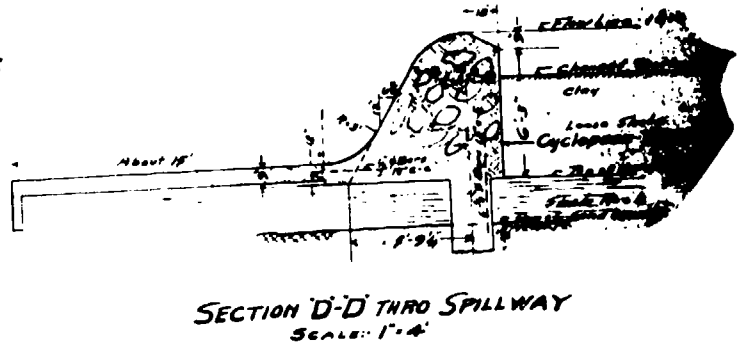
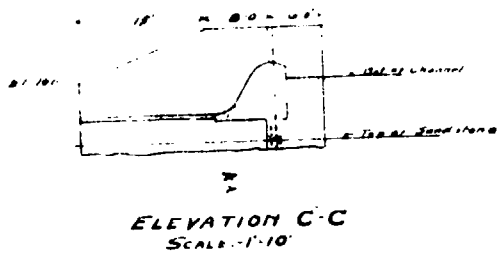
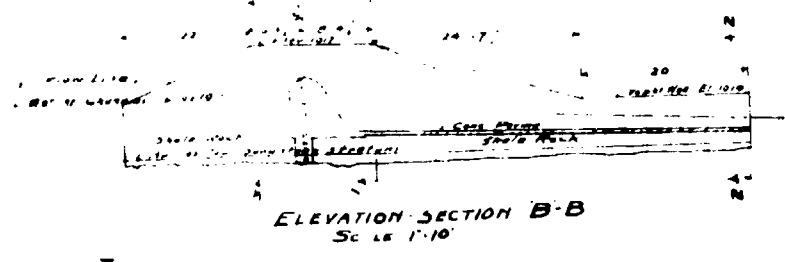
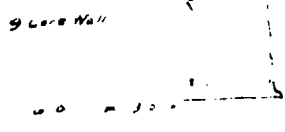
PROFILE OF DAM
SCALE 1/16" = 20'



PLAN OF RESERVOIR
SCALE 1/16" = 50'

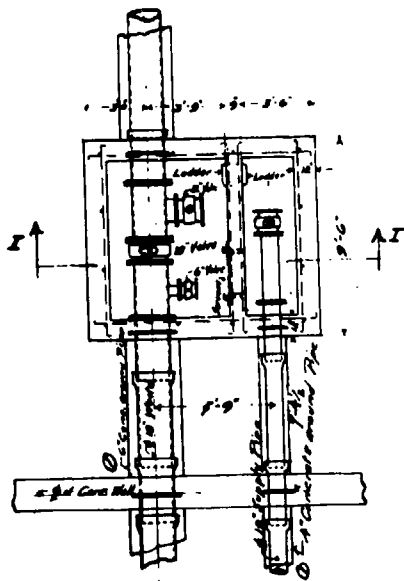


E 2

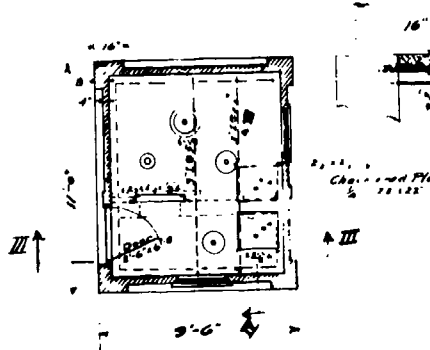


GARRETT WATER CO.
DAM ON BIGBY CREEK
SCALE - UNUSUAL

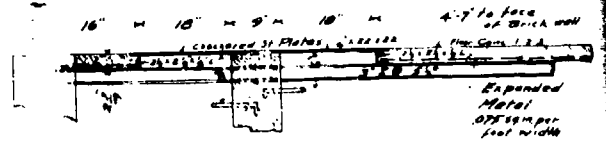
REVISION	DATE	GRAY & CLARK CONSULTING CIVIL ENGINEERS JANNEYTOWN, MD. Job No. 100
(1) Initial Design	1917	



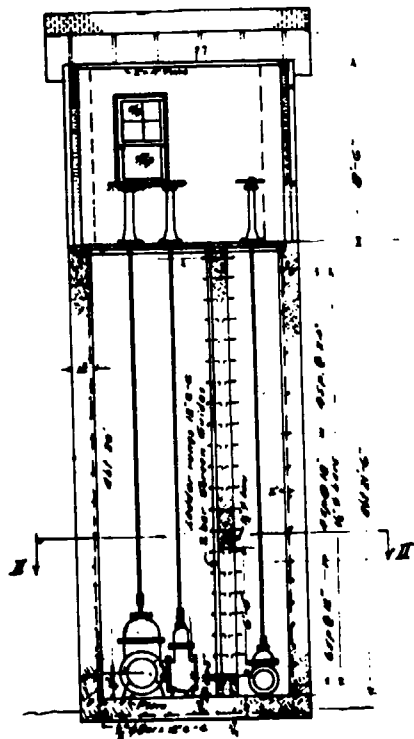
GATE HOUSE PIPING - SECT II-II



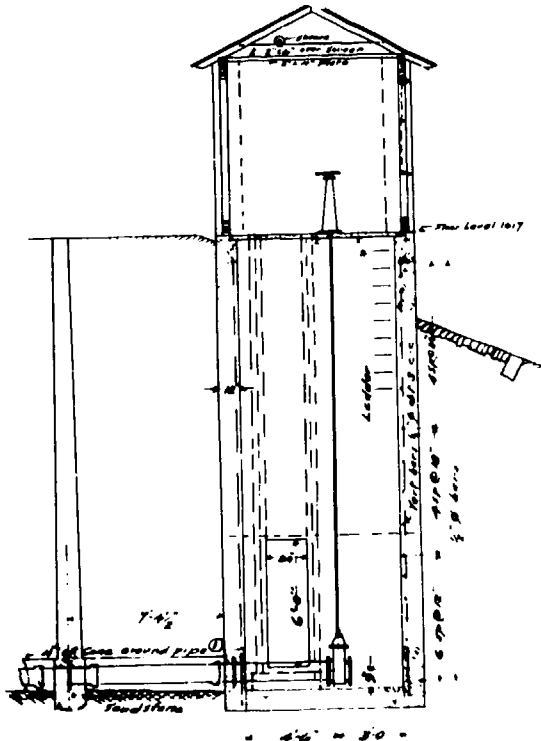
PLAN OF GATE HOUSE FLOOR



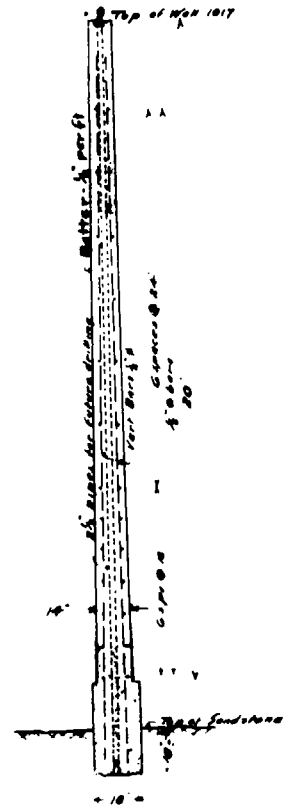
SECTION IV-IV
SCALE: 1/2" = 1'



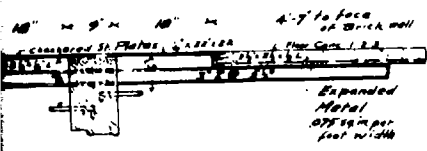
SECT I-I THRU GATE HOUSE
SCALE: 1/4"



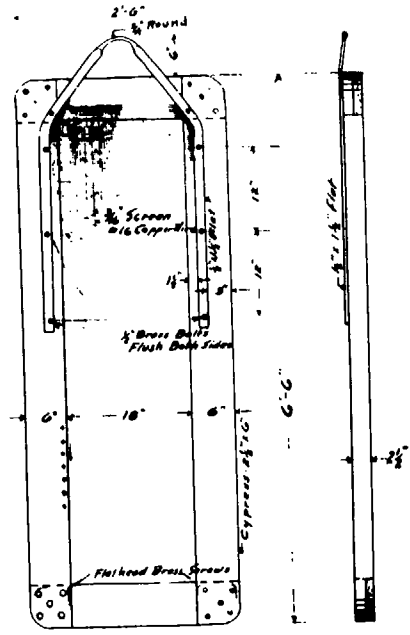
SECTION III-III
SCALE: 1/4"



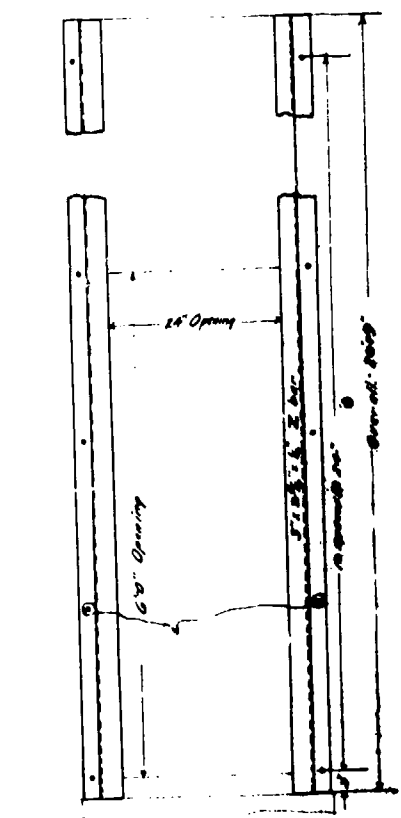
SECTION OF CORE WALL
SCALE: 1/4" = 1'



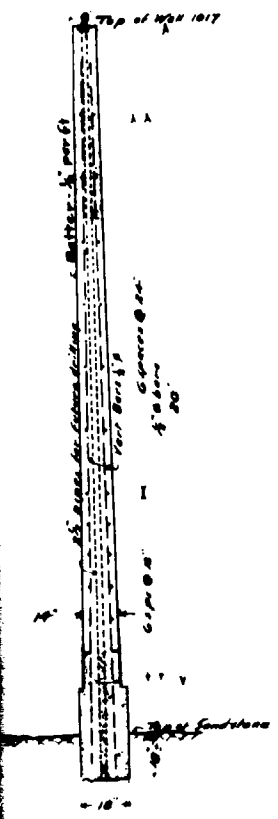
SECTION IV-IV
SCALE: 1/2" = 1'



DETAIL OF SCREEN
SCALE: 1" = 1'



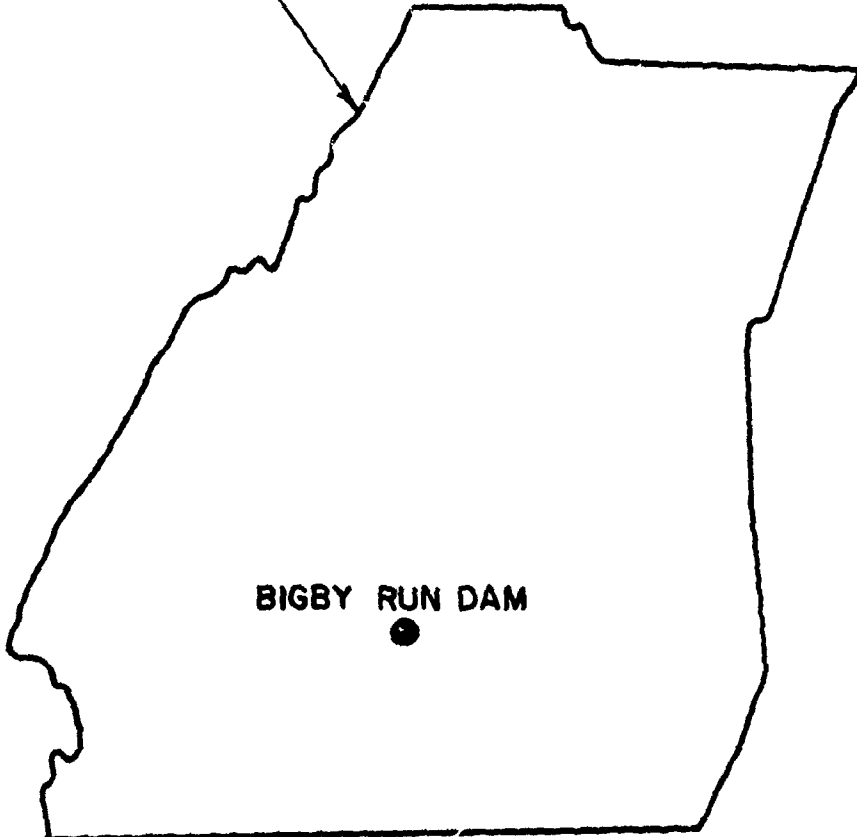
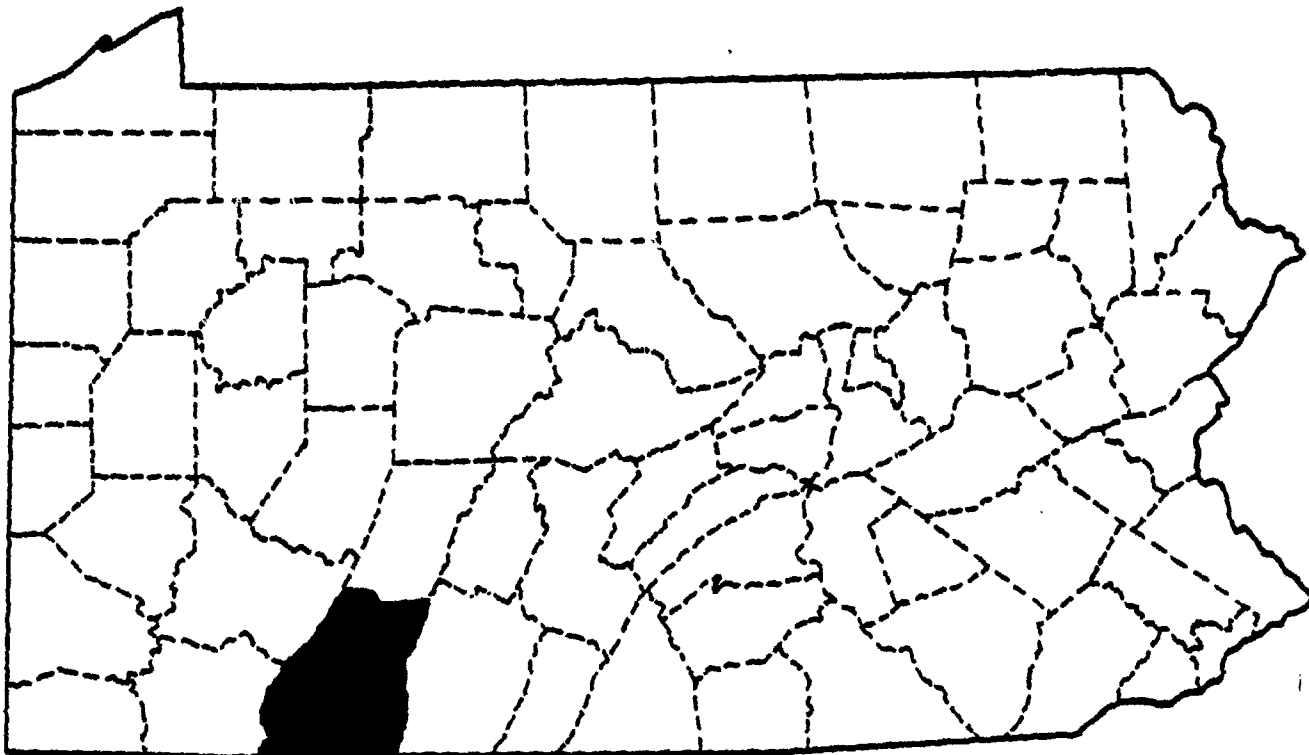
SCREEN GUIDES & BOLTS
SCALE: 1" = 1'



SECTION OF CORE WALL
SCALE: 1/2" = 1'

GARRETT WATER CO.		GRAY & CLARK
GATE HOUSE & DETAILS, BARRY GREEN		CONCRETE WORK
SCALE: INDICATED		JANUARY
REVISION	DATE	JOB No.
1	Added openings 7/20/10	

2



BIGBY RUN DAM

SITE LOCATION MAP
SOMERSET COUNTY, PENNSYLVANIA
E-5

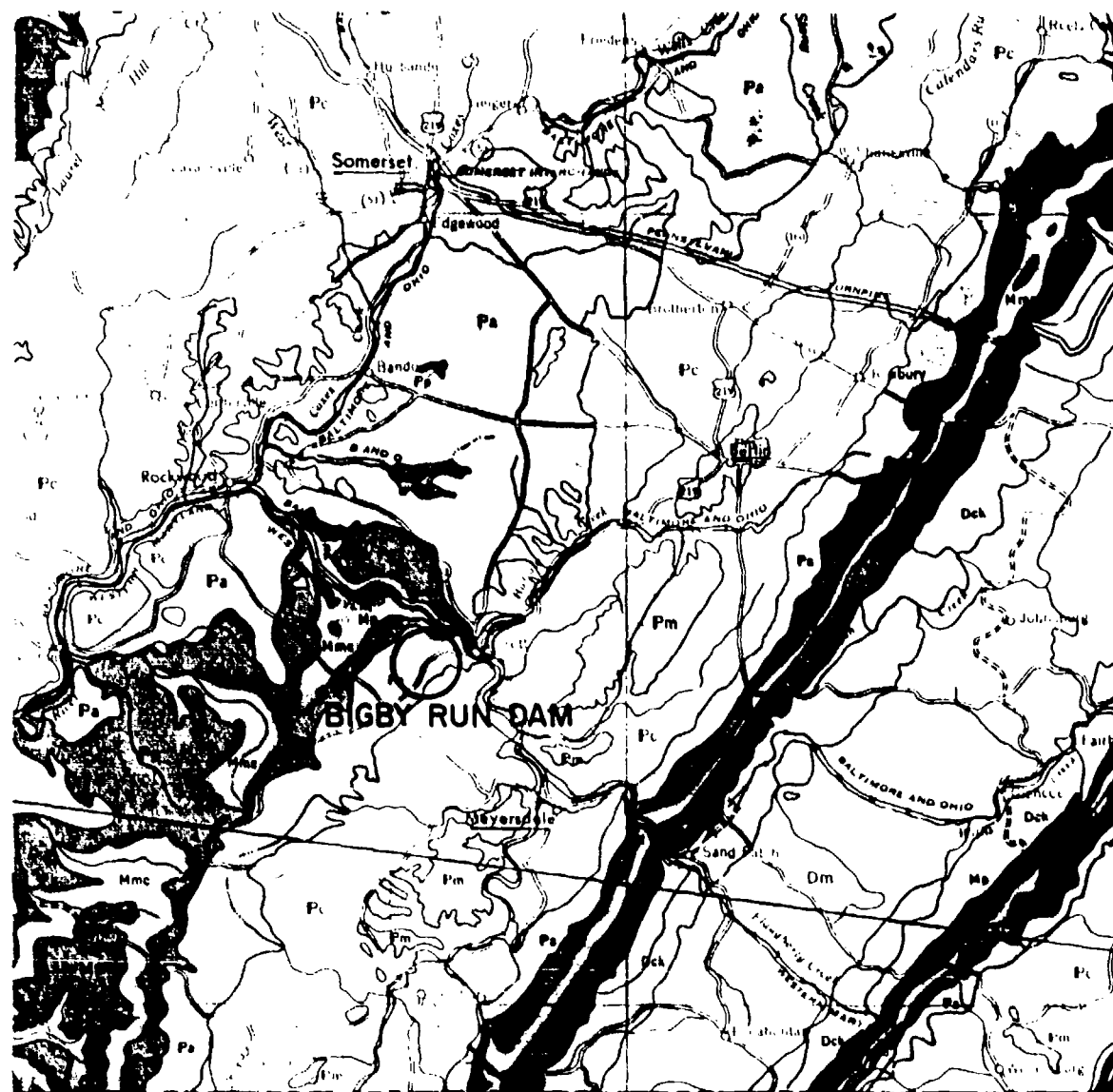
APPENDIX F
GEOLOGY

General Geology

The Bigby Run Dam is located in the Allegheny Mountain Section of the Appalachian Plateaus Province. This section lies between the Pittsburgh Plateaus Section to the west and Valley and Ridge Province to the east. It is typified by rather open folds with flank dips generally ranging between 5 and 20 degrees. The folding is more intense than the folding in the Pittsburgh Plateau Section, but is unlike the Valley and Ridge Province in that the valleys between the ridges stand relatively high and are underlain by rather gently inclined strata. Structurally, there is a parallelism of northeast-trending ridges. The Bigby Run Dam lies on the eastern limb of the Negro Mountain Anticline which is the common flank of the Berlin Syncline. The average strike of these folds and the subsequent strata is N32°E. The rock dips to the southeast about 5 degrees. No major faulting is noted in the vicinity of the dam.

The rock underlying the Bigby Run Dam and exposed in the nearby vicinity consists of shales, sandstones, and clays, with several workable coal beds. It belongs to the Kittanning Formation of the Allegheny Group of Pennsylvanian Age. This formation extends from the Upper Kittanning coal seam to the Lower Kittanning coal seam and has an average thickness of 100 feet. The bottom of the Allegheny Group is at the base of the Brookville-Clarion coal seam.

The dam is located in the Main Bituminous Coal Field, of which the Allegheny Group is characteristic due to the several workable coal seams it carries. In the area of the dam the Upper Kittanning coal seam has been eroded away. The dam rests on strata approximately 40 feet above the Lower Kittanning coal seam which is an economically important seam due to its consistent thickness and good quality. It's thickness ranges from 2.3' to 3.5'. Data obtained prior to 1974 indicates the Upper Kittanning seam has been mined to the southeast of the dam, and that no mining has occurred on the Lower Kittanning seam, beneath or near the Bigby Run Dam.



GEOLOGIC MAP OF THE AREA AROUND BIGBY RUN DAM
SCALE 1:250,000

PENNSYLVANIAN
APPALACHIAN PLATEAU

- | | |
|----|---|
| Pm | <p>Monongahela Formation
Cyclic sequences of sandstone, shale, limestone and coal, limestone prominent in northern outcrop areas, shale and sandstone increase southward, commercial coals present base at the bottom of the Potomac coal.</p> |
| C | <p>Conemaugh Formation
Cyclic sequences of red and gray shales and siltstones with thin limestones and coals, massive Mahoning Sandstone commonly present at base, Area Limestone present in middle of sections, Brush Creek Limestone in lower part of section.</p> |
| Pa | <p>Allegheny Group
Cyclic sequences of sandstone, shale, limestone and coal, numerous commercial coals, limestone thicken westward, Vanport Limestone in lower part of section includes Freeport, Kittanning, and Clarion Formations.</p> |
| | <p>Pottsville Group
Predominantly sandstones and conglomerates with thin shales and coals, some coals mineable locally.</p> |