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ARMY ENGINEERING DISTRICT NORFOLK VA
NATIONAL DAM SAFETY PROGRAM, BEAVERDAM CREEK DAM (VA-01903), BE--ETC(U)
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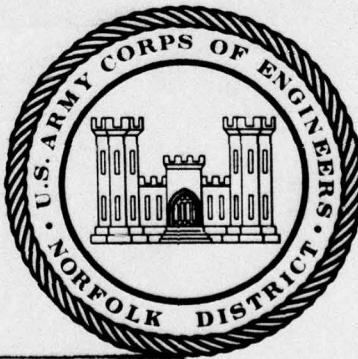
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Name Of Dam: BEAVERDAM CREEK
Location: BEDFORD COUNTY, VIRGINIA
Inventory Number: 01903

PHASE I INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM

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20. Abstract

Pursuant to Public Law 92-367, Phase I Inspection Reports are prepared under guidance contained in the recommended guidelines for safety inspection of dams, published by 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 conditions 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.

Based upon the field conditions at the time of the field inspection and all available engineering data, the Phase I report addresses the hydraulic, hydrologic, geologic, geotechnic, and structural aspects of the dam. The engineering techniques employed give a reasonably accurate assessment of the conditions of the dam. It should be realized that certain engineering aspects cannot be fully analyzed during a Phase I inspection. Assessment and remedial measures in the report include the requirements of additional indepth study when necessary.

Phase I reports include project information of the dam and appurtenances, all existing engineering data, operational procedures, hydraulic/hydrologic data of the watershed, dam stability, visual inspection report and an assessment including required remedial measures.

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 the 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 continued care and inspection can there be any chance that unsafe conditions be detected.

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 (flood discharges that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the design flood should not be interpreted as necessarily posing a highly inadequate condition. The design flood provides a measure of relative spillway capacity and serves as an aide 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.

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PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

BRIEF ASSESSMENT OF DAM

Name of Dam: Beaverdam Creek Dam
State: Virginia
County: Bedford
USGS Quad Sheet: Stewartsville
Stream: Beaverdam Creek
Date of Inspection: May 3, 1979

Beaverdam Creek Reservoir Dam is an earthfill structure about 450 feet long and 65 feet high. The dam is owned and operated by the city of Roanoke, Virginia. The dam is classified as an intermediate size with a significant hazard classification. The spillway consists of a concrete approach and discharge channel 18 feet wide and a crest elevation of 1929.0. Two water intake stacks are located in the reservoir. One stack can be used to empty the reservoir and the other is used to supply Falling Creek Reservoir with water for the Falling Creek Filtration Plant during dry weather and high water demand periods.

Based on criteria established by the Department of the Army, Office of the Chief of Engineers (OCE), the spillway is rated as inadequate. The spillway will pass only 46 percent of PMF, while the Spillway Design Flood (1/2 PMF) will overtop the dam by .5 feet.

The visual inspection revealed no apparent problems and there are no immediate needs for remedial measures. It is recommended within 12 months that the following work be accomplished:

a. All heavy vegetation and its root system should be removed from the dam embankment. All subsequent holes should be dressed with compacted fill and seeded.

b. The seep located in the downstream right abutment should be monitored for erosion. If erosion should develop, then the services of a qualified geotechnical engineering firm should be retained to recommend immediate remedial measures.

c. An annual maintenance and inspection program should be initiated to help detect and control problems that may occur.

Submitted By:

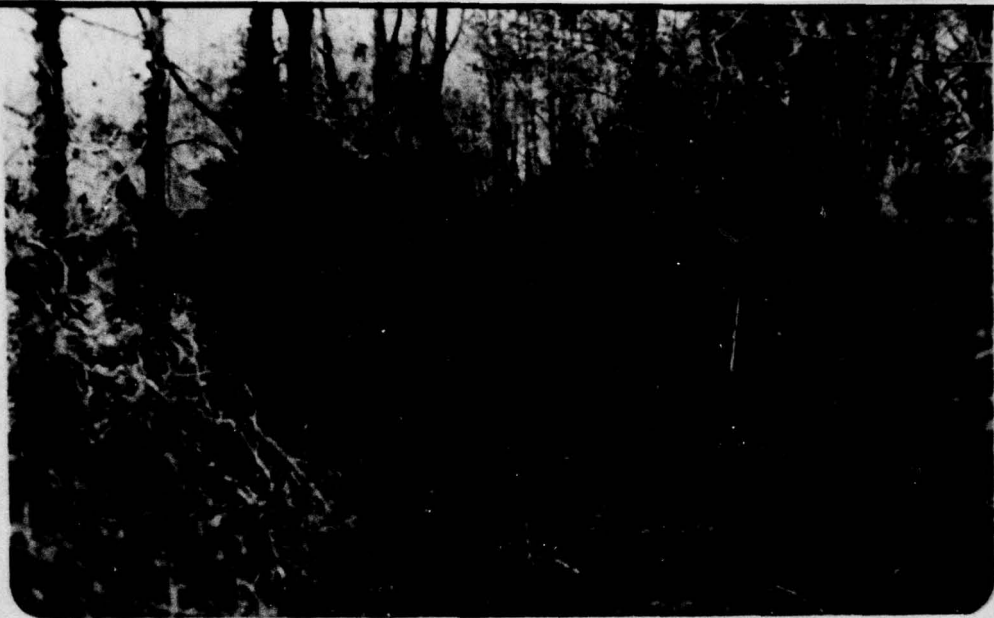
JAMES A. WALSH, P. E.
Chief, Design Branch

Recommended By:

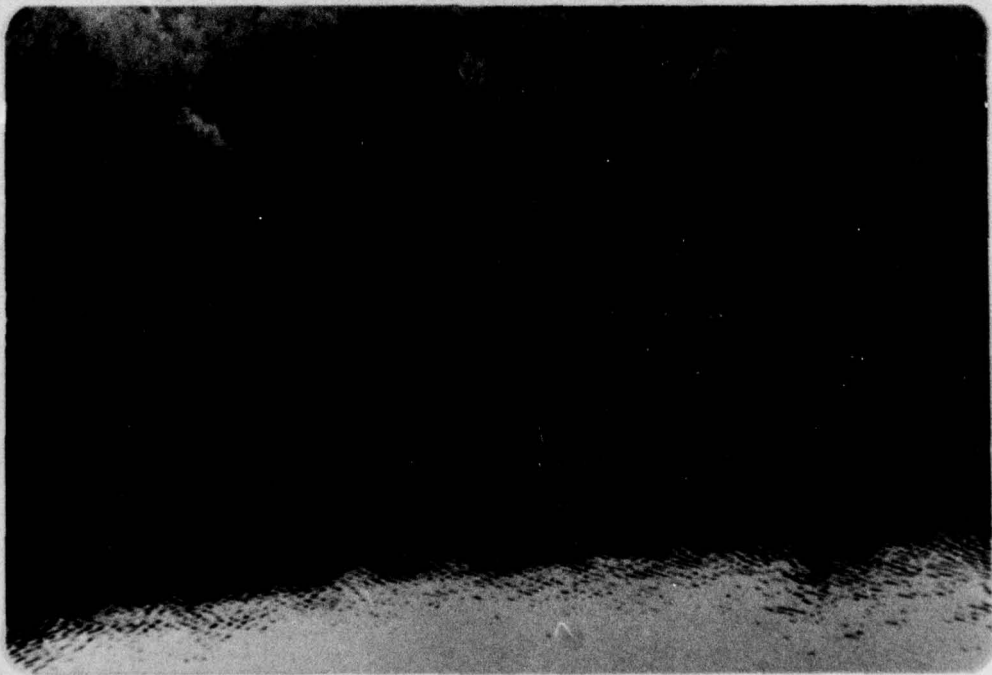
CARL S. ANDERSON, JR., P. E.
Acting Chief, Engineering Division

Approved:

DOUGLAS L. HALLER
Colonel, Corps of Engineers
District Engineer



CREST



UPSTREAM FACE

OVERALL VIEWS OF DAM

MAY 1970

SECTION 1
PROJECT INFORMATION

1.1 General:

1.1.1 Authority: Public Law 92-367, 8 August 1972 authorized the Secretary of the Army, through the Corps of Engineers to initiate a national program of safety inspections of dams through the United States. The Norfolk District has been assigned the responsibility of supervising the inspection of dams in the Commonwealth of Virginia.

1.1.2 Purpose of Inspection: The purpose is to conduct a Phase I inspection according to the Recommended Guidelines for Safety Inspection of Dams (Appendix V, Reference 3). The main responsibility is to expeditiously identify those dams which may be a potential hazard to human life or property.

1.2 Project Description:

1.2.1 Dam and Appurtenances: Beaverdam Creek Dam is an earthen embankment dam about 450 feet long and 65 feet high. The top of the dam is 15 feet wide at an elevation of 1937.0 feet m.s.l. The upstream side has 1 vertical to 2 horizontal (1:2) slope with riprap protection. The downstream slope is (1:2) and benched at elevation 1907.

The embankment has an impervious core keyed into foundation bedrock with a foundation drainage system. A cross section of the dam and a hand sketch of the plan view are shown on Plates II and III Appendix I, respectively.

The spillway consists of a concrete approach and discharge channel 18 feet wide with the crest elevation at 1929.0. Two water intake stacks are located in the reservoir. One stack can be used to empty the reservoir and the other stack is used to supply Falling Creek Reservoir with water for the Falling Creek Filtration Plant during dry weather and high water demand periods.

1.2.2 Location: Beaverdam Creek Dam is located on Beaverdam Creek about 4 miles upstream of Stewartsville, Virginia.

1.2.3 Size Classification: The dam is classified as an "intermediate" size structure because of height (65 feet) and maximum storage (2010 acre feet).

1.2.4 Hazard Classification: The dam is located in a rural area and is therefore, given a significant hazard classification in accordance with guidelines contained in Section 2.1.2 of Reference 3, Appendix IV. The hazard classification used to categorize dams is a function of location only and has nothing to do with their stability or probability of failure.

1.2.5 Ownership: City of Roanoke, Virginia.

1.2.6 Purpose: Water supply for the city of Roanoke, Virginia.

1.2.7 Design and Construction History: The dam was completed in 1925. The contractor is unknown. The ungated spillway was lined with concrete in 1973.

1.2.8 Normal Operational Procedures: Water is released to Falling Creek Reservoir in the dry months and high demand periods to supplement the needs of the Falling Creek Filtration Plant. Otherwise, regulation of flows is largely automatic with water rising above the crest of the spillway passing freely downstream.

1.3 Pertinent Data:

1.3.1 Drainage Area: The dam controls a drainage area of 1.43 square miles.

1.3.2 Discharge at Dam Site:

Maximum flood - unknown

Spillway

pool level at top of dam 1220 c.f.s.

1.3.3 Dam and Reservoir Data: Pertinent data on the dam and reservoir are shown in the following table:

Table 1.1 DAM AND RESERVOIR DATA

Item	Elevation feet m.s.l.	Area, acres	Reservoir		Length miles
			Acre, feet	Watershed, inches	
Top of dam	1937	123	2010	26.4	1.03
Spillway crest	1929	71	1363	17.9	.88
Streambed at the toe of the dam	1872+	-	-	-	-

SECTION 2

ENGINEERING DATA

2.1 Design: Design data was provided by the owners. The data reviewed included the following:

a. Limited 1924 design drawings showing the site plan of the dam, the cross section of the dam along the principle spillway, and a plan and profile of the original spillway since modified, Appendix I, Plates I, II, and III respectively.

b. "Memorandum on the New Geological Conditions at Roanoke" by Charles P. Berkey, New York City, September 1924, Appendix IV.

c. Reservoir Storage Elevation Curve.

This data is very limited. There were no other drawings pertinent to the dam. There is absolutely no information pertaining to laboratory design data, and calculations. The above mentioned geology report is the only reference to observed field investigations. The report outlines foundation conditions encountered during excavation and recommends a realignment of the dam upstream. The storage elevation curve shows gallons of storage versus pool elevation.

2.2 Construction: The only available information was construction photographs which presented a detailed account of the dam construction sequence. Based on these photographs the following conclusions were drawn.

Foundation excavations indicated a blocky rock formation with near vertical dips. Site investigations consisted of several inspection trenches and pits. The geology report has a site plan outlining spring trench, and pit locations. The spring and test pits are also shown on the design site plan.

Foundation treatments consisted of placing parallel concrete core walls through the center of the dam. Also, French drains were constructed to function as some form of foundation drainage system.

The embankment was constructed in lifts and compacted with mechanical equipment. The material appeared well compacted with a Galion Steel wheel roller. Lifts were placed with a steel blade dozer, were level, and showed no signs of erosion, settlement, or sloughing. The upstream slope was protected with placed rock and the downstream with a mixture of soil and rock. The drawings show an impervious core, but this is not discernible in the photographs. The borrow pits were located in the immediate upstream area. The spillway consisted of cyclopean type masonry.

2.3 Evaluations: The design data is inadequate. However, the construction photographs indicated that the dam was well constructed under the direction of professional attention.

SECTION 3

VISUAL INSPECTION

3.1 Findings:

3.1.1 General: The results of the 3 May 1979 inspection are recorded in Appendix III. At the time of the inspection the pool elevation was at 1929.2 feet m.s.l., or about normal pool elevation. The outlet works were closed and, therefore, not passing any flow through the dam. However, flow was passing through the spillway. There are no known past inspection reports available.

3.1.2 Dam: The embankment is in good condition, but is thickly vegetated with brush and heavy trees. See the overall photographs in the front of the report. No sloughing, erosion, settlement, or misalignment were noted. One seep was found on the right abutment and is shown on Plate IV, Appendix I. Two more distinct seeps were found in the toe area, Appendix II, Photos 5 and 6.

3.1.3 Appurtenant Structures: Observations of the intake structure were made from the embankment and no deterioration was noted. However, most of the structure was submerged at the time of the inspection, Appendix II, Photo 1. The blowoff valves on the 12-inch line (outlet works) passing through the dam were closed.

3.1.4 Spillway: The channel is concrete lined, shallow, free from debris, and in good condition, Appendix II, Photos 2, 3, and 4.

3.1.5 Instrumentation: The only instrumentation is a staff gage located on the intake structure.

3.1.6 Reservoir Area: The surrounding area is wooded, mountainous terrain with no shoreline erosion or apparent slope failures. There is no available information pertaining to sedimentation.

3.1.7 Downstream Channel: The channel is shallow and narrow, but sufficient for most flows. Overbanks contain heavy brush and trees. The flood plain is about 300 feet wide. There are 3 to 4 homes located 1 to 3 miles downstream in the flood plain.

3.2 Evaluation: Overall the dam appears to be in good condition. However, all the heavy vegetation, brush, and root systems should be removed. All subsequent holes should be dressed with compacted fill and seeded.

It is suspected that the two seeps in the toe area are discharge from toe drains and not a concern. The abutment seep is probably attributed to the spring noted on the site drawings and in the geology report. However, it should be monitored for erosion during periodic inspections. If erosion should develop, then the services of a qualified geotechnical engineering firm should be retained to recommend immediate remedial measures.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedure: The normal storage pool is elevation 1929.0, which is the crest of the spillway. The reservoir provides water storage for the City of Roanoke Water Department. The water can be discharged into Falling Creek Reservoir through a 12-inch pipe in a mountain tunnel by opening valves in an intake stack located in the Beaverdam Creek Reservoir. The valves are opened during high water demand periods to help supply the water needs of the Roanoke Water Department. A 12-inch blowoff valve is located below the downstream toe of the dam, which can dewater the reservoir if necessary. Flows will pass automatically through the spillway when the reservoir rises above the spillway crest.

4.2 Maintenance: A routine maintenance program has not been established for the Beaverdam Creek Dam, although periodic maintenance has occurred. Copper sulfate is added to the reservoir when necessary.

4.3 Warning System: At the present time, there is no warning system or evacuation plan in operation.

4.4 Evaluation: The dam does not require an elaborate operational and maintenance procedure. However, an annual maintenance and inspection program should be initiated to help detect and control problems that may occur.

SECTION 5

HYDRAULIC/HYDROLOGIC DATA

- 5.1 Design: None were available.
- 5.2 Hydrologic Records: None were available.
- 5.3 Flood Experience: No records available.

5.4 Flood Potential: The PMF and 1/2 PMF were developed and routed through the reservoir by use of the HEC-1DB computer program (Reference 1, Appendix V) and appropriate unit hydrograph, precipitation, and storage-outflow data. Clark's Tc and R coefficients for the local drainage area were estimated from basin characteristics. The rainfall applied to the developed unit hydrograph was obtained from a U.S. Weather Bureau Publication (Reference 2, Appendix V). Losses were estimated at an initial loss of 1.0 inch and a constant loss thereafter of 0.05 inch/hour.

5.5 Reservoir Regulation: Pertinent dam and reservoir data are shown in Table 1.1.

Water is passed from Beaverdam Reservoir to Falling Creek Reservoir during high water demand periods. A 12-inch pipeline from a stack in the Beaverdam Reservoir runs through a tunnel to the Falling Creek Reservoir. Water also flows past the dam over the spillway in the event water in the reservoir rises above elevation 1929.0.

The storage curve supplied by the owner was extended above the top of the spillway crest by use of U.S. Geological Survey Quadrangle Maps. Rating curves were developed for the spillway, non-over-flow section of the dam, and the drawdown outlet. In routing hydrographs through the reservoir, it was assumed that the initial pool level was at the spillway crest. Flow to Falling Creek Reservoir was neglected during routing.

5.6 Overtopping Potential: The probable rise of the reservoir and other pertinent information on reservoir performance is shown in the following table:

Table 5.1 RESERVOIR PERFORMANCE

Item	Normal flow	Hydrograph	
		1/2 PMF	PMF (a)
Peak flow c.f.s			
Inflow	2	7180	14360
Outflow	-	2000	10950
Maximum elevation feet, m.s.l.		1937.5	1940.4
Spillway (elevation 1929.0)			
Depth of flow, feet		8.5	11.4
Duration, hours		19	19
Velocity, fps (b)		13.4	15.5
Non-overflow Section (elevation 1937.0)			
Depth of flow, foot		.5	3.4
Duration, hours		1.7	3.7
Velocity, fps (b)		3.2	8.5
Tailwater elevation, feet m.s.l. 1872+		-	-

a. The PMF is an estimate of flood discharges that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.

b. Critical velocity.

5.7 Reservoir Emptying Potential: A 12-inch blowoff valve below the toe of the dam at elevation 1874.0 is available for dewatering the reservoir. The valve will permit withdrawal of about 27 c.f.s. with the reservoir level at the crest of the spillway and essentially dewater the reservoir in about 36 days.

5.8 Evaluation: Based on the size (intermediate) and hazard classification (significant) the recommended Spillway Design Flood is 1/2 PMF. Based on the risk involved in this project, it is considered that 1/2 PMF is appropriate as a Spillway Design Flood. The spillway will pass 46% of the PMF without overtopping the dam. The 1/2 PMF will overtop the dam for 2 hours and reach a maximum of 0.5 feet over the top of the dam, with an average critical velocity of 3.2 feet per second.

Conclusions pertain to present day conditions. The effect of future development on the hydrology has not been considered.

SECTION 6

DAM STABILITY

6.1 Foundation and Abutments: The geology report by Charles P. Berkey, provided in Appendix IV is the only record of the foundation condition. Generally, the area geology consists of residual soils overlying intermittently weathered bedrock. The bedrock is composed primarily of granite with zones of weathered rock consisting of granitic gneiss. It was further noted that there were no underground channels of circulation or caverns, and leakage except along ordinary joints of the rock. The report includes recommendations for moving the structure upstream to less weathered conditions. Also it concludes that adequate care in cutoff construction will catch everything that is practicable to stop.

It is suspected the structure has abutment junction drains and a toe drain even though no drains are indicated on the drawings. This conclusion is based on the construction photographs and the visual inspection. As outlined in Section 2, and shown on Plate II, Appendix I, the dam has two parallel concrete core walls passing through the impervious core. There is no indication of how the dam was keyed into the foundation other than the core wall. Based on the visual inspection and the above information, the dam appears to be on a stable foundation.

6.2 Embankment:

6.2.1 Materials: There are no records indicating the nature of the embankment materials. Plate II, Appendix I, shows that the dam has an impervious core. Also, it is known that the borrow area was located in the immediate upstream reservoir area which probably consists of residual silts and clays. However, the construction photographs show the material to be rather uniform and free from large stones. As noted in Section 2 the impervious core is not discernible in the photographs. Also the visual inspection revealed no cracking in the embankment due to core walls in the material. However, the heavy vegetation and age of the dam may have obscured any cracks.

6.2.2 Stability: There are no stability calculations for any loading conditions on the dam. The structure was designed in 1924 and it is seriously doubted any analyses were performed. Based on the drawings, the embankment is 15 feet wide with a 1V:2H upstream slope. The downstream slope is also 1V:2H, but is benched at elevation 1907 or about midway down the slope. According to the guideline outlined in Design of Small Dams, U.S. Department of Interior, Bureau of

Reclamation, homogeneous earthfilled dams on stable foundations, the recommended minimum width for this type dam is 23 feet with side slopes of 1V:3H upstream, and 1V:2.5H downstream for clay/silt soils. Based on these guidelines, the width and slopes are inadequate.

6.2.3 Seismic Stability: The dam is located in Seismic Zone 2. Therefore, according to Reference 1, Appendix V, the dam is considered to have no hazard from earthquakes provided static stability conditions are satisfactory and conventional safety margins exist.

6.3 Evaluation: Despite the lack of data and apparent inadequate geometrics, the dam is considered to have a stable embankment and a sound foundation. This conclusion is based on the visual inspection, the geology report, and the construction photographs.

Also, despite the inability of the spillway to pass the design flood, the depth, duration, and rate of overtopping flows are not considered detrimental to the embankment. Overtopping flows are shallow, only last 2 hours, and the velocity is less than 6 fps, the effective eroding velocity for a vegetated earth embankment.

Stability calculations are not required because of past performance, apparent by the visual inspection, and sound structure determined from the available information.

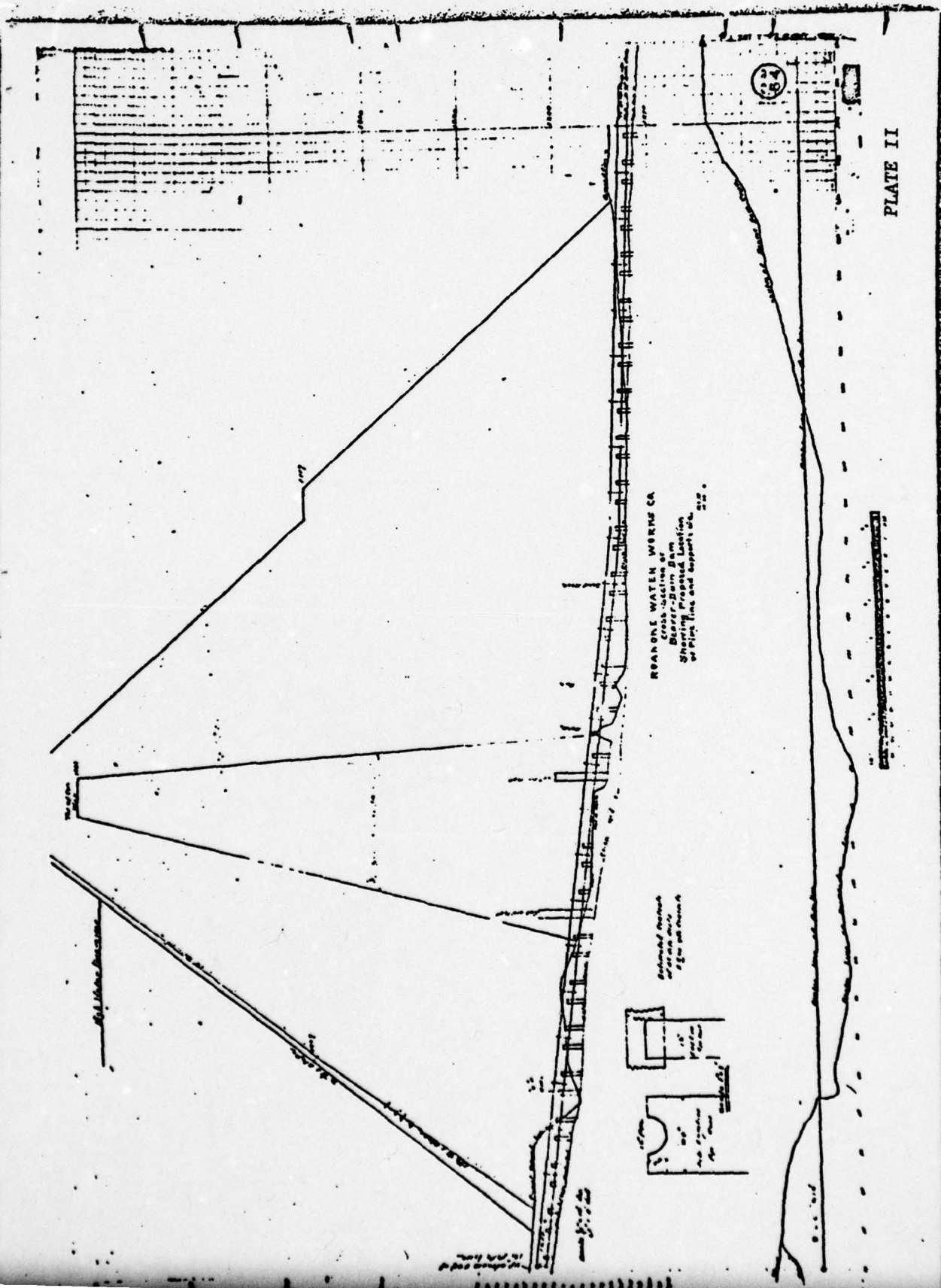
SECTION 7

7.1 Dam Assessment: The available design data is inadequate, but available construction photographs indicate that the dam was well constructed under professional supervision. The visual inspection revealed no findings that proved the dam to be unsound during normal pool operations. However, there is no regular maintenance program which has allowed the dam to be overgrown with heavy vegetation. The spillway will not pass the Spillway Design Flood (SDF) and therefore is adjudged as inadequate. Flows overtopping the dam during the SDF would not be detrimental to the embankment. The dam is considered stable and stability calculations will not be required. Overall, the dam is in good condition and there is no immediate need for remedial measures.

7.2 Recommended Remedial Measures: The inspection revealed certain items of rehabilitation or other work which should be implemented within 12 months by the owner. These are:

- a. All the heavy vegetation, brush, and root systems should be removed from the dam embankment. All subsequent holes should be dressed with compacted fill and seeded.
- b. The seep located in the downstream right abutment should be monitored for erosion during periodic inspections. If erosion should develop, then the services of a qualified geotechnical engineering firm should be retained to recommend immediate remedial measures.
- c. An annual maintenance and inspection program should be initiated to help detect and control problems that may occur.

APPENDIX I
MAPS AND PLATES



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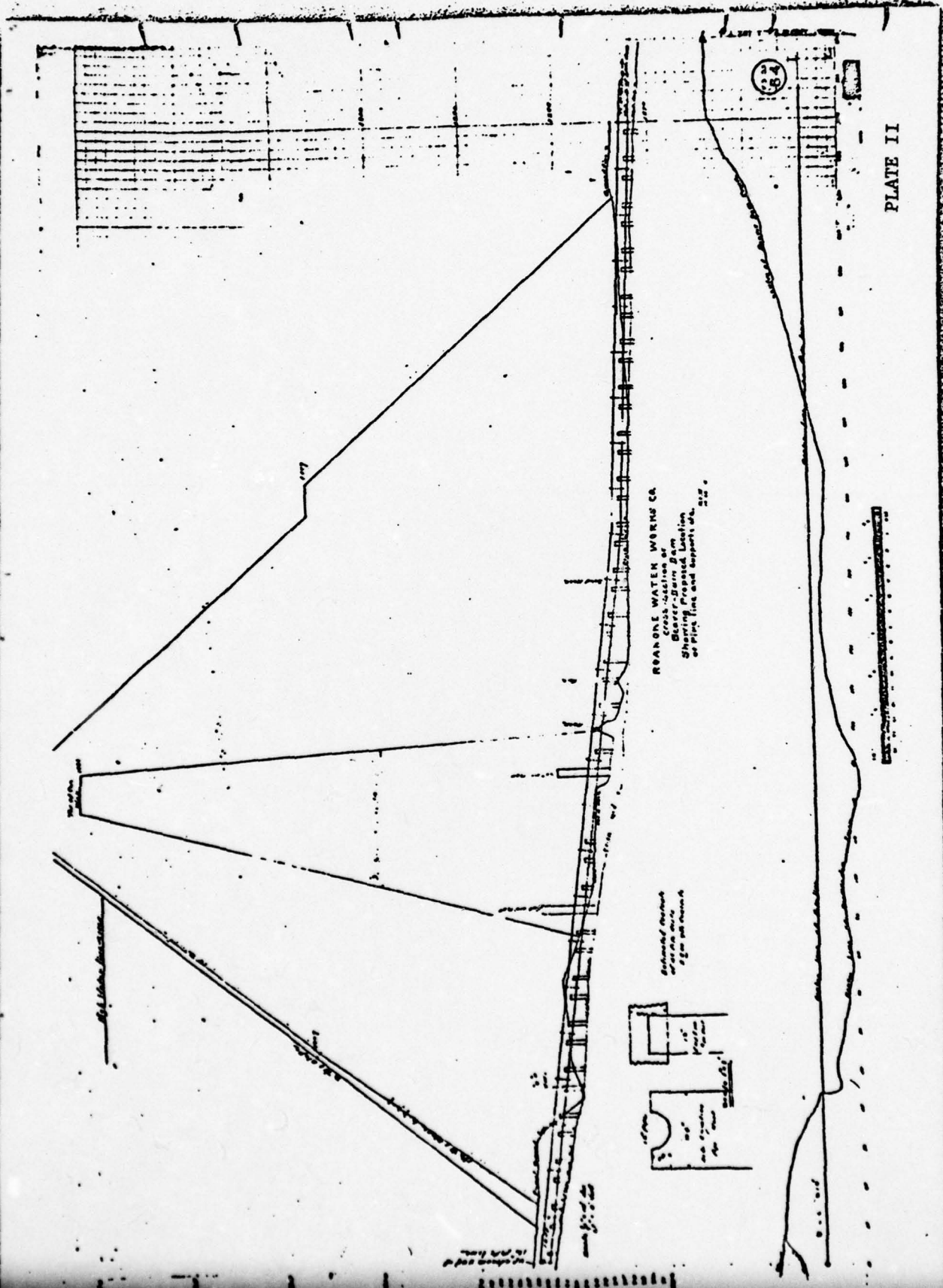


PLATE II

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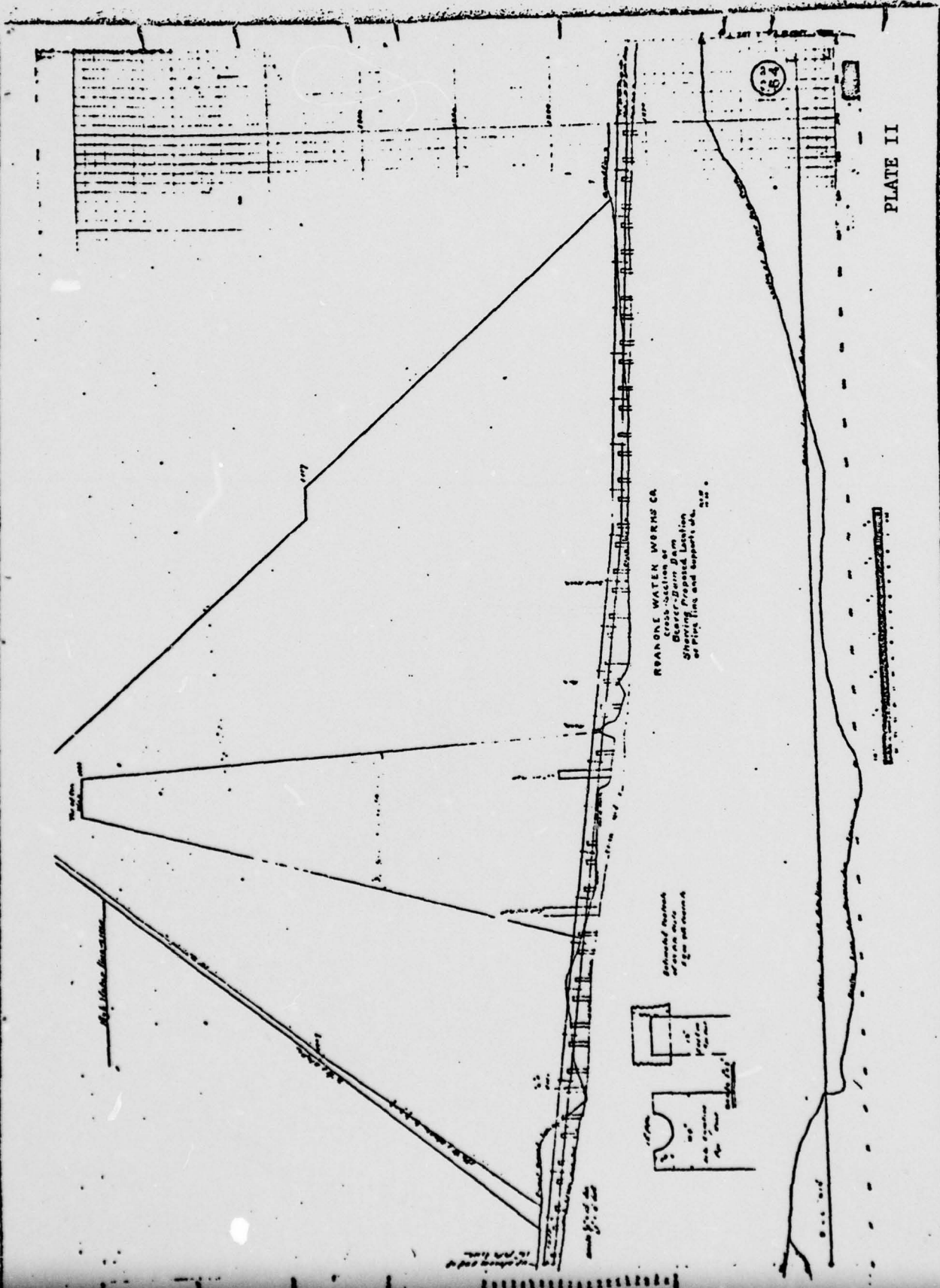
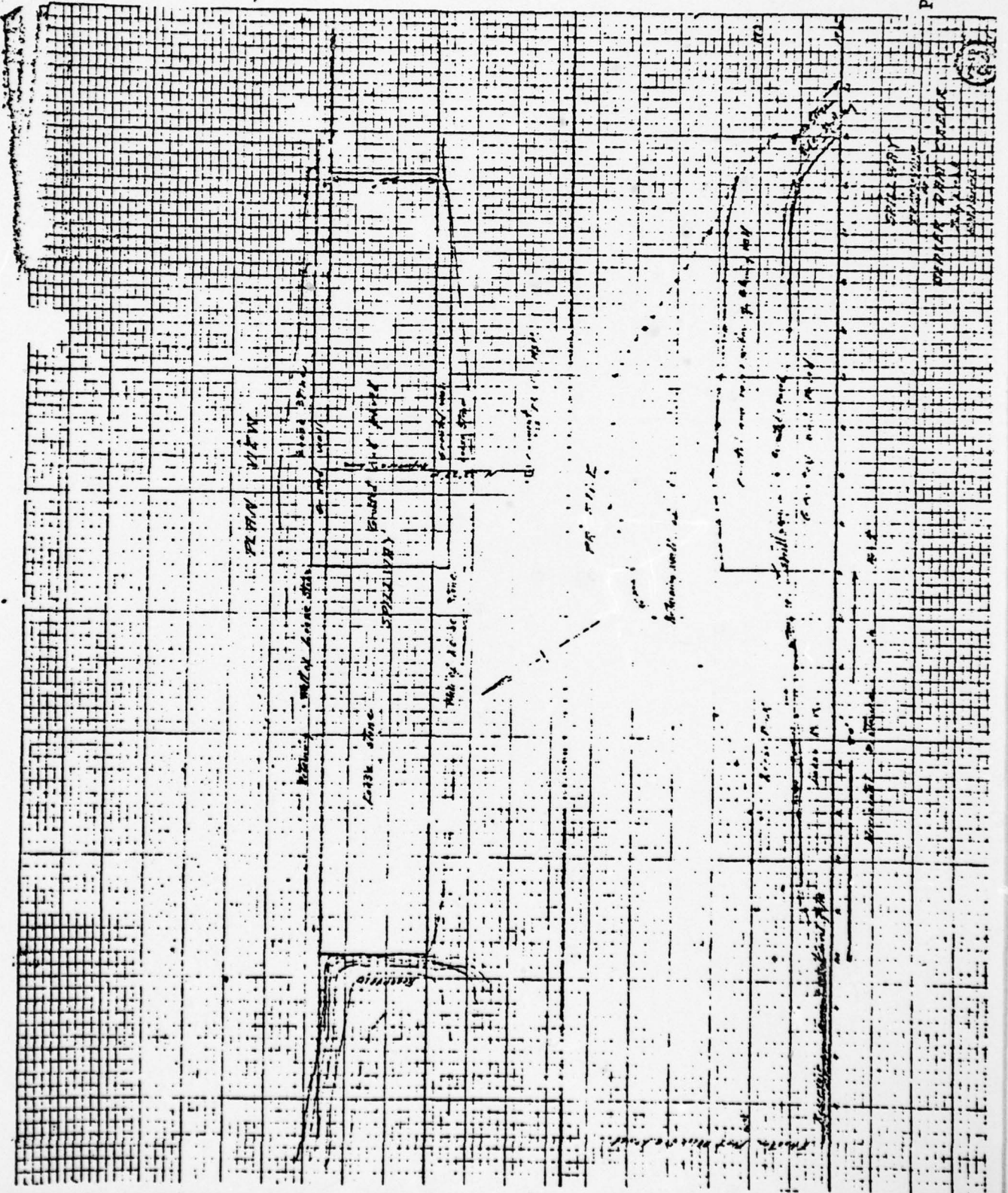


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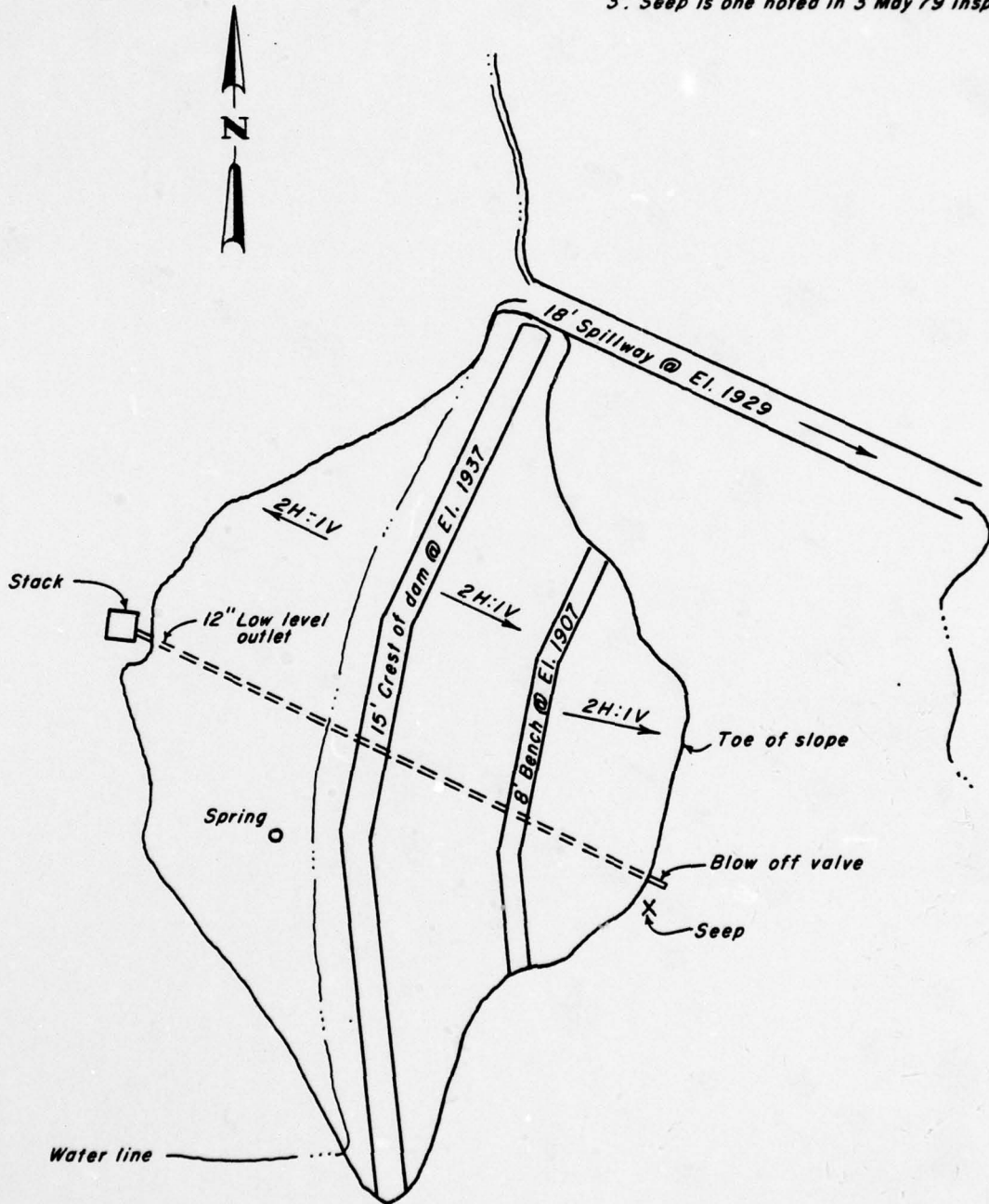
PLATE III



SPILLWAY
DESIGN DRAWING

NOTES:

1. Sketch made from field notes.
2. Spring is the one noted on PLATE I and noted in "Geology Report, Appendix IV."
3. Seep is one noted in 3 May 79 inspection.



NOT TO SCALE

PLAN VIEW
BEAVERDAM CREEK DAM
BEDFORD, VIRGINIA

PLATE IV
6-27-79

APPENDIX II

PHOTOGRAPHS



PHOTO #1 : INTAKE TOWER



PHOTO #2 : EMERGENCY SPILLWAY



PHOTO # 3 DISCHARGE CHANNEL



PHOTO # 4 DISCHARGE CHANNEL

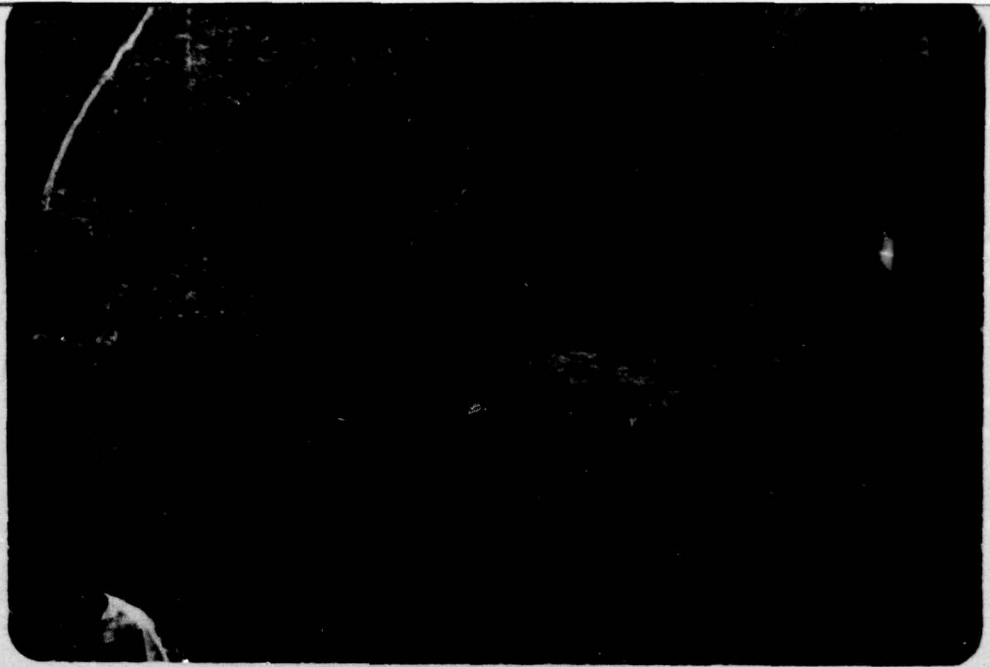


PHOTO # 5 SEEP AT DOWNSTREAM TOE OF DAM



PHOTO # 6 SEEP AT JUNCTION RT. ABUTMENT AND EMBANKMENT

APPENDIX III
FIELD OBSERVATIONS

Check List
Visual Inspection
Phase I

Name Dam BEAVERDAM CREEK County BEDFORD State VA Coordinates LONG 79° 48.9' LAT 37° 18.8'

Date(s) Inspection 3 May 79 Weather OVERCAST W/LIGHT RAIN Temperature 45°F

Pool Elevation at Time of Inspection 1929.2 M.S.L.* Tailwater at Time of Inspection 1874 † M.S.L.

* Spillway Crest

Inspection Personnel:

J. ROBINSON, COE

J. IRVING, COE

D. PEZZA, COE

B. TARAN, COE

D. HARVEY, SWCB

H. GILDEA, P.E. SWCB

C. SLUSS, CITY OF ROANOKE

PEZZA & ROBINSON Recorder

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	No surface cracks were observed. However, the entire embankment is covered with thick brush and heavy vegetation which inhibited the visual inspection.	The embankment should be completely stripped of vegetation. All root structures should be removed. All subsequent holes should be dressed with compacted fill.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	No movement or cracking was observed. However, the downstream area is wet with local ponding. The area supports swamp like vegetation and is full of iron bacteria.	None.
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	No sloughing or erosion was found. Two trees were found overturned just above a seep in the downstream right abutment. The trees are dead and must have fallen a long time ago. There are no other signs of possible slope problems.	None.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	The alignment do not deviate from the drawings.	None.
RIPRAP FAILURES	There were no observed failures.	None.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	The junctions appear sound. No erosion, sloughing or settlement were observed.	None.
ANY NOTICEABLE SEEPAGE	One seep was found on the right abutment with an estimated 1-2 GPM flow w/iron bacteria. Two more distinct seeps were found in the toe area. It is suspected the latter two seeps are drainage from toe drains.	The abutment seep should be periodically observed. If any indications of erosion or slope failure develop, immediate remedial measures should be taken.
STAFF GAGE AND RECORDER	There is no instrumentation on the embankment.	None.
DRAINS	Construction photos indicate French drains were installed. Based on field observation it is suspected that drains exist at abutment junctions and the toe of the dam.	None.

OUTLET WORKS

VISUAL EXAMINATION OF CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
INTAKE STRUCTURE	N/A	None.
OUTLET STRUCTURE	The stack was submerged and non-observable.	None.
OUTLET CHANNEL	N/A	None.
EMERGENCY GATE	The blowoff valves on the 12-inch line passing through the dam are closed.	None.

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	There is no weir.	None.
APPROACH CHANNEL	The channel is concrete lined, shallow and free from debris.	None.
SPILLWAY CHANNEL	The channel is lined and free from debris. The lining was a post construction addition that raised the normal pool 0.5 feet to elevation 1929.5.	None.
DISCHARGE CHANNEL	The channel is concrete lined. Water flowed into an energy dissipater then into a small channel below the toe of the dam.	None.

INSTRUMENTATION

VISUAL OF EXAMINATION OF MONUMENTATION/SURVEYS	OBSERVATIONS	REMARKS OR RECOMMENDATION
OBSERVATION WELLS	There are no wells.	None.
WEIRS	There are no weirs.	None.
PIEZOMETERS	There are no piezometers.	None.
OTHER	A staff gage is located on the stack (intake structure).	None.

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OF RECOMMENDATIONS
SLOPES	The surrounding area is wooded mountainous terrain with no observed slope failures. Apparent slope failures on the right just upstream of the dam, are old borrow sources as noted by Sluss and shown in the construction photos.	None.
SEDIMENTATION	There is no information available on reservoir sedimentation.	None.

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OF RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	The channel is shallow and narrow but sufficient for most flows. Overbanks contain heavy brush and trees. The flood plain is about 300 feet wide.	None.
SLOPES	The slopes are mountainous and heavily vegetated. Debris from a winter ice storm still litters the area.	None.
APPROXIMATE NO. OF HOMES AND POPULATION	There are 3 to 4 homes in the downstream flood plain 1-3 miles below the dam.	None.

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	There is no plan view of the dam. There is a site plan showing the original terrain.
REGIONAL VICINITY MAP	There is no vicinity map other than a USGS Stewartville quadrangle map.
CONSTRUCTION HISTORY	The only construction data are some photographs taken during construction.
TYPICAL SECTIONS OF DAM	There is only one section showing a profile along the principal spillway.
HYDROLOGIC/HYDRAULIC DATA	The only available information is a reservoir storage elevation curve.
OUTLETS - PLANS - DETAILS - CONSTRAINTS - DISCHARGE RATINGS	There is no information pertaining to the outlet works.
RAINFALL/RESERVOIR RECORDS	There are no records.

ITEM	REMARKS
DESIGN REPORTS	There are no reports.
GEOLOGY REPORTS	There is a geology report available, titled "Memorandum on the New Geological Conditions at Roanoke" by Charles P. Berkey.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	There are no known computations, stability analyses, or seepage studies.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	There are no available records pertaining to investigations, drilling, and testing. Construction photos and drawings do indicate that test pits and inspection trenches were dug.
POST-CONSTRUCTION SURVEYS OF DAM	No post construction surveys have been made.
BORROW SOURCES	The only information available are construction photos showing borrow pit locations.

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	Drawings show the plan view and cross sections of the original spillway.
OPERATING EQUIPMENT PLANS & DETAILS	There are no documented data available on the equipment.
MONITORING SYSTEMS	There are none.
MODIFICATIONS	The ungated spillway was lined with concrete in 1973.
HIGH POOL RECORDS	There are no records.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	No studies or reports have been performed.

ITEM	REMARKS
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	There are no known accidents or failures.
MAINTENANCE OPERATION RECORDS	There are no periodic maintenance and operating records.

APPENDIX IV

"MEMORANDUM ON THE NEW GEOLOGICAL CONDITIONS
AT ROANOKE"

MEMORANDUM

ON

THE NEW GEOLOGICAL CONDITIONS AT ROANOKE

By

Charles P. Berkey

New York City

September 1924

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MEMORANDUM

. ON

THE NEW GEOLOGICAL CONDITIONS AT ROANOKE

A trip of inspection was made September 20 to 21, 1924, to the new work being done at Roanoke, Virginia. The chief purpose was to determine the meaning of the unexpectedly deep decay conditions found on the lower side of the site now being stripped preparatory to the building of a dam across Beaver Dam Creek.

The location for the dam had been selected before all of this exploratory evidence was available, and the conditions now shown differ so much on different parts of the ground that it was considered advisable, not only to review the facts and their significance but to raise also the question of a possible slight shift of location in the hope of avoiding the worst ground.

The site was examined in company with and under the guidance of Mr. Moore, the resident manager; Mr. Wysor, the engineer, and Mr. Bachmann, and the meaning of the facts disclosed by the excavation as well as the changes proposed, were fully discussed with them in the field.

Observations

Inspection of the pits and trenches shows that there is very general rock decay on this site and that this condition varies abruptly from place to place. The trenches in some places have already penetrated to a depth of five or six feet in this decayed material and rods can be driven down farther. In other places, very near by, solid rock comes near to the surface and even forms ledges at the surface. In the surface ledges, occasional narrow decay zones can be seen, following joints and crush zones through the rock.

In general the depth of decay is much less on the south side of the stream than on the north side, and more regular. The average depth of severe decay on the south side is probably less than two feet, and is more regular or uniform. The average depth on the north side is probably about eight to ten feet and is very irregular. In some cases on the present site, the rock is probably completely rotted to a depth of fifteen feet.

No ledges outcrop below the site on either side of the valley in the immediate vicinity, and no ledges outcrop on the lower half of the site as the dam is now laid out.

Ledges can be seen, however, at the surface, 50 feet above the present location on the north side, whereas the same rock is decayed to a depth of ten or fifteen feet at the site of the lower cut-off trench. This is a part of the irregularity of decay observed in the vicinity. It is due, doubtless, to slight differences in quality of rock and in the amount of jointing or other deformation weaknesses of it.

All of the decay effects shown on this ground have been produced by weathering and are of purely superficial origin. They are the result of the attack of the atmosphere and the rainwater that has soaked into the ground, following the crevices and joints of the rock. This is the normal method of producing rock decay. The chemical action of this attack, added to the mechanical disruptive action caused by repeated freezing, has given all of the decay effects that are seen. Wherever the rock was badly broken or closely fractured, it is badly decayed. And wherever also, it was originally made up of coarser grained rock or mineral content more readily attacked by the leaching action of the water, there the decay is deeper.

The soil that is left on the surface is simply that portion not yet removed by ordinary surface erosion, and has been formed from the rock in place on the same hillsides by these processes of decay, to which is added the action and accumulations of decaying vegetable matter.

Examination of the quality of rock on different parts of the ground showed plainly that there is some difference in that respect also in different parts of the location. The rock has the general composition of a granite, but there is considerable variety in it, both in composition and texture and structure. Some of it is much more streaked and banded than other portions, having the structure of a granite gneiss and some of it is a very great deal coarser than other portions.

Some of the rock, therefore, is clearly of simple igneous origin and is a simple granite, made up chiefly of quartz and feldspar. Other portions, on the other hand, are much more complex and

carry such minerals as garnet and biotite in abundance, and the rock is many times coarser and more streaked. No other varieties were noticed on the ground. These streaked and coarse varieties with mixed mineralogy are decayed the worst. They can be classified as Granite Gneiss

Some of the ground is completely covered, especially a narrow strip in the very bottom of the valley, so that one can not see the rock floor but there is no reason to believe the rock there is materially different.

or
The streakedness/^{or}so-called structure of the rock, runs through the site diagonally and seems to have little control in the matter of behavior of decay. The decay behavior is controlled chiefly by the jointing or fracturing and the distribution of coarse quality of rock, as already indicated.

It is very evident that for some reason the rock on the lower half of the site is decayed worse than that on the upper half, and worse, also, than that immediately above the location, especially on the north side of the valley. There is, however, no evidence of marked zones of weakness, although one can see that there has been some fracturing or close jointing on a part of this ground. It is possible that in the very bottom of the valley there is more of a zone of this kind. There is ledge rock in the stream, to be sure, at the north side of the flat-bottom, but the rocks that are seen across the rest of the bottom are all boulders, and the actual rock floor may be several feet deeper and is likely to show some decay.

The bowldery character of the ground where decay is seen is in every way a normal development. It marks the progress of decay where this attack follows joint planes and other weaknesses, because the decay proceeds along those joints themselves and spreads from them. The sound interior portions of the blocks set off between these joint planes, therefore, remain as chunks of hard rock for a long time and become essentially the same form as bowlders. As a matter of fact, if the material is excavated, either by nature or artificially, these portions do roll out as hard portions and form real bowlders. This is the origin of all of the bowlders of the region and is not in any way peculiar to this ground. The hard patches and irregularities seen in the excavations are all of this nature. There is nothing otherwise peculiar or disturbing about them.

Opinion

There is no doubt but that the decayed condition is somewhat worse on the lower half of the site than it is a little farther upstream. This is true particularly of the north valley side.

The ledges that are exposed at the surface fifty feet farther upstream would furnish a substantial foundation with less stripping than does the present site.

There is nothing about the present site, however, that is impracticable. Foundations can undoubtedly be secured on the present line, but, if it is desired to strip down ^{to} sound rock foundation, considerably greater amount of excavation will be required on the present line than would be necessary forty or fifty feet farther upstream.

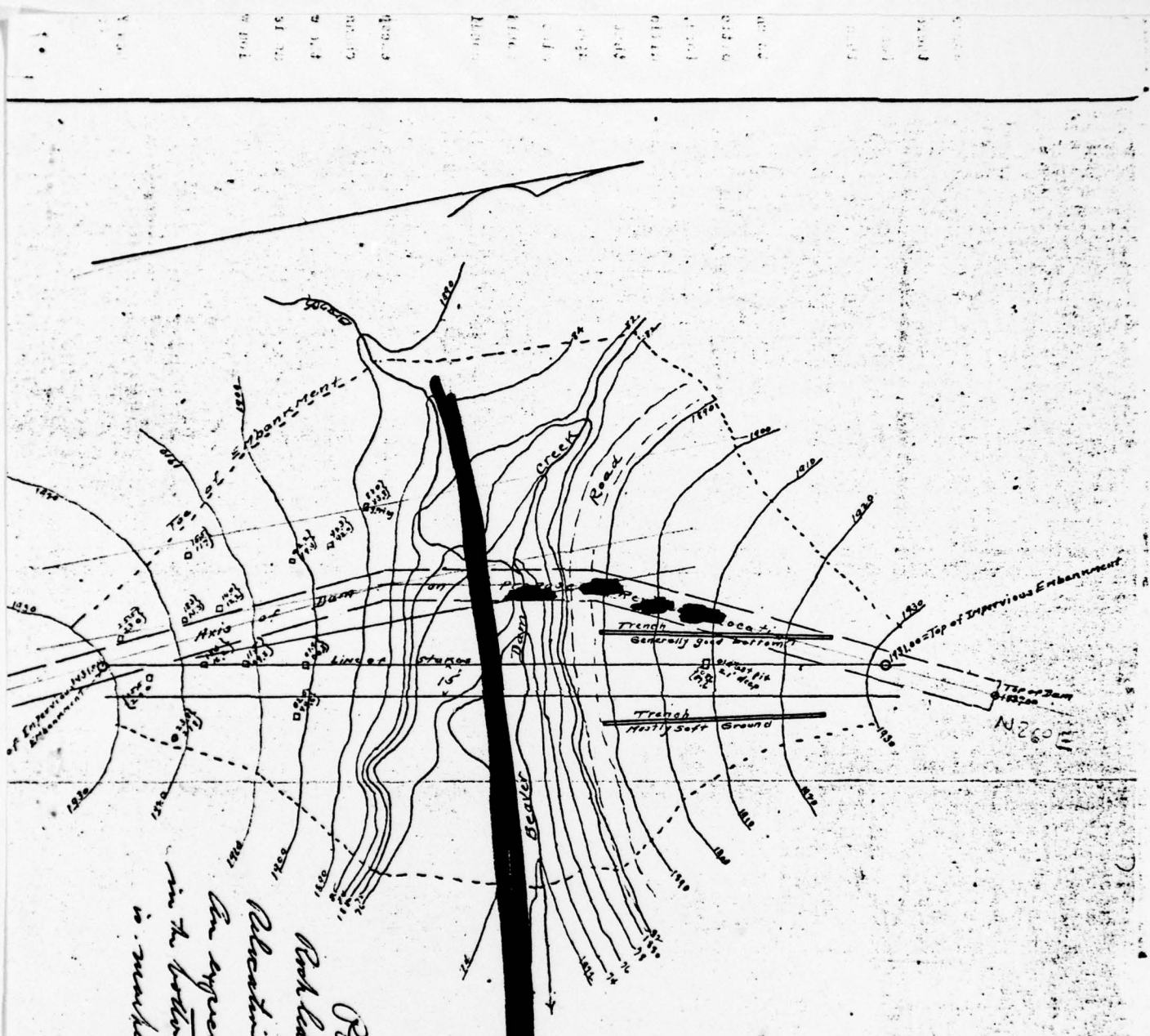
No conditions, that I can think of in other respects, are any worse upstream than on the present line. There is this much advantage, therefore, on the north side of the valley, in moving the dam fifty feet farther up. From field inspection only it does not look as though this change would increase the cross-section appreciably.

On the south side of the valley, however, it is not advisable to shift the location, simply because the topography and other conditions are favorable where it now stands. It is feasible, therefore, to shift the line so as to take advantage of the better conditions. I know of no engineering or other difficulties in making that much of a change, and there are appreciable geological advantages to be gained, not only on the north valley-side but probably also in the valley bottom. A shift of 40 or 50 feet is all that would be necessary in order to take advantage of all of the best conditions that are available on the ground.

There are no underground channels of circulation and leakage except the ordinary joints of the rock, and there are no distant channels or hidden courses or connected caverns. The foundations of the whole valley are of crystalline rock of about the same behavior as is exhibited on the dam site. Adequate care in cut-off construction will catch everything that it is practicable to stop.

New York City,
September 27th, 1924.

Charles P. Berkey
Charles P. Berkey,
GEOLOGIST.



Plan of the site
 Rock ledges marked in red.
 Elevation indicated.
 An suggested deep zone
 in the bottom of the Valley
 is marked in green

Roanoke Water Works Co.
 Plat showing
 Proposed Revised Location
 for Dam
 Beaver Dam Creek
 45 feet up-stream
 at Center
 as advised by
 Dr. Chas. P. Serkey
 Columbia University

Scale 1"=50'

Plat surveyed & drawn by
 R. E. Wyser, C.E.
 Sept 20, 1910. Roanoke, Va.

APPENDIX V

REFERENCES

1. HEC-1DB Flood Hydrograph Package, (Hydrologic Engineering Center, U. S. Army Corps of Engineers, July 1978).
2. "Seasonal Variation of the Probable Maximum Precipitation East of the 105th Meridian," Hydrometeorological Report No. 33, (U. S. Weather Bureau, April 1956).
3. Recommended Guidelines for Safety Inspection of Dams, Office of the Chief of Engineers, Department of the Army, Washington, D. C.