AD-A075 312 ARMY ENGINEERING DISTRICT NORFOLK VA F/G 13/2
NATIONAL DAM SAFETY PROGRAM. UPPER BLACKWATER RIVER DAM NUMBER --ETC(U)
AUG 79

UNCLASSIFIED NL

1 OF 1
AD
A075312



END
DATE
FILMED
11-79
DDC

B.S.

Name Of Dam: UPPER BLACKWATER NO. 6
Location: FRANKLIN COUNTY, VIRGINIA
Inventory Number: 06701

LEVEL II

AD A075312

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM



DDC
RECEIVED
OCT 23 1979
A

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

PREPARED BY
NORFOLK DISTRICT CORPS OF ENGINEERS
803 FRONT STREET
NORFOLK, VIRGINIA 23510

DDC FILE COPY

AUGUST 1979

79 10 22 149

DISCLAIMER NOTICE

THIS DOCUMENT IS BEST QUALITY PRACTICABLE. THE COPY FURNISHED TO DDC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

REPORT DOCUMENTATION PAGE	READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER: VA 06701	2. GOVT ACCESSION NO. / 3. RECIPIENT'S CATALOG NUMBER
4. TITLE *(and Subtitle)*: Phase I Inspection Report National Dam Safety Program UPPER BLACKWATER NO. 6 Franklin County, VA	5. TYPE OF REPORT & PERIOD COVERED: Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s): Norfolk District Corps of Engineers 803 Front Street Norfolk, VA	8. CONTRACT OR GRANT NUMBER(s): None (12) 73
9. PERFORMING ORGANIZATION NAME AND ADDRESS: (9) Final rept.	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS: U. S. Army Engineering District, Norfolk (11) 803 Front Street Norfolk, VA 23510	12. REPORT DATE: Aug [redacted] 79 13. NUMBER OF PAGES: 27
14. MONITORING AGENCY NAME & ADDRESS *(if different from Controlling Office)*	15. SECURITY CLASS. *(of this report)*: Unclassified 15a. DECLASSIFICATION/ DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT *(of this Report)*

Approved for public release; distribution unlimited.

17. DISTRIBUTION STATEMENT *(of the abstract entered in Block 20, if different from Report)*

(6) Dam

National Dam Safety Program. Upper Blackwater River Number 6 (Inventory Number Ø67Ø1), Tributary of the North Fork of the Blackwater River, Franklin County, Virginia. Phase I Inspection Report.

18. SUPPLEMENTARY NOTES

Copies are obtainable from National Technical Information Service, Springfield, Virginia 22151

19. KEY WORDS *(Continue on reverse side if necessary and identify by block number)*

Dams - VA
National Dam Safety Program Phase I
Dam Safety
Dam Inspection

20. ABSTRACT *(Continue on reverse side if necessary and identify by block number)*

(See reverse side)

471 030

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE *(When Data Entered)*

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.

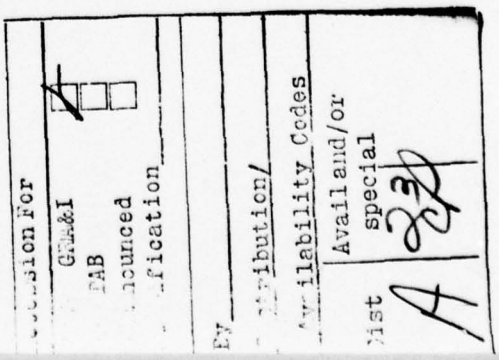


TABLE OF CONTENTS

Title	Page No.
PREFACE	i
BRIEF ASSESSMENT OF DAM	ii
OVERVIEW PHOTO:	
SECTION 1: PROJECT INFORMATION	1-1
SECTION 2: ENGINEERING INFORMATION	2-1
SECTION 3: VISUAL INSPECTION	3-1
SECTION 4: OPERATIONAL PROCEDURES	4-1
SECTION 5: HYDRAULIC/HYDROLOGIC DESIGN DATA	5-1
SECTION 6: DAM STABILITY	6-1
SECTION 7: ASSESSMENT/REMEDIAL MEASURES	7-1
APPENDIX I: MAPS AND DRAWINGS	
APPENDIX II: PHOTOGRAPHS	
APPENDIX III: FIELD OBSERVATIONS	
APPENDIX IV: GEOLOGIC REPORT	
APPENDIX V: DESIGN REPORT	
APPENDIX VI: REFERENCES	

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

BRIEF ASSESSMENT

Name of Dam	:	Upper Blackwater River No. 6
State	:	Virginia
County	:	Franklin
USGS Quad Sheet	:	Callaway
Stream	:	Tributary of the North Fork of the Blackwater River
Date of Inspection:		16 May 1979

Upper Blackwater River Dam No. 6 is a homogeneous earthfill structure about 550 feet long and 50 feet high. The dam is owned by Mr. Fred Barnhart and Mr. Hollace Bowman and maintained by the Blue Ridge Soil and Water Conservation District. The dam serves as a flood control structure and is classified as an intermediate size and significant hazard classification. The principal spillway consists of a 24-inch concrete pipe served by a drop inlet. The emergency spillway is an open channel earthen spillway. The dam is located 1 mile upstream of the Blackwater River.

The emergency spillway will pass 23 percent of the Probable Maximum Flood (PMF) without overtopping the dam. Based on criteria established by the Department of the Army, Office of the Chief of Engineers (OCE), the Spillway Design Flood (SDF) is the ½PMF. Since the spillway cannot pass the SDF, it is rated as inadequate. The visual inspection and review of existing records revealed no apparent problems and there are no immediate needs for remedial measures. Stability conditions are satisfactory and convention safety margins exist if the dam was constructed as specified in the design report. It is recommended within 12 months that the following measures be taken:

a. All bare spots should be seeded and fertilized to form a good grass cover.

b. All gullies caused by runoff should be filled with compacted soils of the same type forming the faces of dam. The restored areas should be seeded to form a good grass cover.

c. Remove all the debris accumulated at the intake structure. The debris, if any, should be removed after every storm or heavy rainfall.

d. Remove all trees and shrubs from the riprap at the stilling basin.

e. Clear the upstream slope of all logs and debris.

SUBMITTED BY: ORIGINAL SIGNED BY:
JOHN E. KENNEDY
for JAMES A. WALSH, P. E.
Chief, Design Branch

RECOMMENDED BY: ORIGINAL SIGNED BY:
CARL S. ANDERSON, JR.
CARL S. ANDERSON, JR., P. E.
Acting Chief, Engineering Division

APPROVED BY: Original signed by:
Douglas L. Haller
DOUGLAS L. HALLER
Colonel, Corps of Engineers
District Engineers

DATE: AUG 14 1979



CREST



UPSTREAM SLOPE

OVERALL VIEWS OF DAM

16 MAY 1979

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 throughout 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 VI, Reference 1). 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: Upper Blackwater Dam No. 6 is an earthfill structure about 550 feet long and 50 feet high. The top of the dam is 16 feet wide and is at elevation 1204.0 feet mean sea level (m.s.l.). The upstream slope has a 3.5 horizontal to 1 vertical (3.5:1) slope and the downstream slope is (2.5:1).

The principal spillway consists of a 24-inch diameter reinforced concrete pipe, running through the dam at a low level. This pipe is served by a drop-inlet structure (riser) located in a low elevation of the reservoir just upstream from the toe of the embankment. The crest of the riser is at elevation 1177.5.

The emergency spillway is a vegetated earth side-channel spillway located off the right end of the dam. It has a bottom width of about 150 feet with a crest at elevation 1200.4 and side slopes of 3 horizontal to 1 vertical.

A 24-inch sluice gate with invert at a low level (elevation 1160.0) permits withdrawal of water from the bottom of the reservoir.

1.2.2 Location: Upper Blackwater Dam No. 6 is located on Bush Run about 1 mile upstream from the Blackwater River.

1.2.3 Size Classification: The dam is classified as an "intermediate" size structure because of height (50 feet).

1.2.4 Hazard Classification: The dam is located in an rural area with 2 to 3 farms in the downstream area. The dam is therefore given a significant hazard classification in accordance with guidelines contained in Section 2.1.2 of Reference 1, Appendix VI.. The hazard classification used to categorize dams is a function of location only and has nothing to do with its stability or probability of failure.

1.2.5 Ownership: Mr. Fred Barnhart and Mr. Hollace Bowman.

1.2.6 Purpose: Flood Control.

1.2.7 Design and Construction History: The dam was designed and contructed under the supervision of the U.S. Soil Conservation Service. Construction was completed in 1972 by Cardinal Construction Company.

1.2.8 Normal Operational Procedures: Operation of the project is automatic. The principal spillway is ungated, therefore, water rising above the crest of the drop inlet is automatically passed downstream. Similarly, water is automatically passed through the emergency spillway in the event of an extreme flood which fills the flood storage space.

1.3 Pertinent Data

1.3.1 Drainage Areas: The dam controls a drainage area of 2.56 square miles.

1.3.2 Discharge at Damsite

Maximum flood at damsite not known.

Principal Spillway:

Pool level at top of dam . . . . . 76.5 c.f.s.

Emergency Spillway:

Pool level at top of dam . . . . . 2550 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.	Reservoir Capacity			Length miles
		Area, acres	Acre, feet	Watershed, inches	
Top of dam	1204.0	39	672	4.9	.75
Emergency spillway crest	1200.4	34	530	3.9	.65
Principal spillway crest	1177.5	9	77	.6	.25
Streambed at downstream toe of dam	1154±	-	-	-	-

SECTION 2
ENGINEERING DATA

2.1 Design: The dam was designed and constructed under the direction of the U.S. Soil Conservation Service (SCS). The design data and as-built drawings are available in the Office of the State Conservationist, U.S. Soil Conservation Service, P.O. Box 10026, Richmond, VA 23240.

The geologic investigation was conducted at the dam site by the SCS during the initial design stages. The investigation consisted of excavating and examining 16 test pits along the proposed centerline of dam, principal spillway, and emergency spillway. The test pits were excavated with backhoe to bedrock which was found from 3 to 9 feet below ground surface. Disturbed soil samples of all significantly different materials were collected for soil classification. The test pit locations and logs are shown in Plates I and II, Appendix I; the geologic report is inclosed as Appendix IV; and the embankment design data is inclosed as Appendix V.

Referring to Plate IV and V, Appendix I, the embankment is a homogeneous earth dam built on bedrock. The material for the dam is classified as alluvial ML material. A cutoff trench backfilled with more impervious material (classification not given) was constructed along the centerline of the dam with depths extending a minimum of 2 feet into weathered rock and with a bottom width of 20 feet. To lower the phreatic surface at the downstream slope and to collect seepages, an internal drainage system is located under the downstream portion of the dam as shown in Plate VI. The drainage system consists of a 6-inch diameter perforated pipe embedded in a trench 4 feet wide with variable depth and filled with graded filter materials. Two interceptive drains of similar construction connect the seepage drain and run parallel to the principal spillway discharging into

the stilling basin. Ten anti-seep collars were built around the principal spillway under the upstream and center portion of the dam to control the problem of piping.

Referring to Appendix V, soil samples were tested for classification and compaction properties, one consolidation test was made on the residual MH material, and one consolidated undrained shear test with pore pressure measurement on each of the residual MH and alluvial ML material. Four falling head permeability tests were made on consolidated samples of the MH material. Test specimens for the consolidated undrained strength test were compacted to 95 percent of the standard Proctor density and they were back-pressured to saturate them before the test was made. The test results and interpretations are summarized as follows:

1. Soil Classification and Compaction Test:

	Type of Material	
	ML	MH
Liquid limit, percent	35- 40	56
Plastic Index, percent	8- 10	16
Maximum dry density, pcf	98.5-103.5	91
Optimum water content, percent	20- 23.5	28.5

2. Consolidation Test:

Soil Classification MH material

Initial dry density	=	87 pcf
Initial void ratio	=	0.97
Compression index (C_c)	=	0.21

3. Consolidated Undrained Test:

	Type of Material	
	ML	MH
Dry density, pcf	96.9 - 97.4	87.5 - 88.4
Percentage std. Proctor, percent	95.0 - 95.5	96.0 - 97.0
Pure pressure parameter B (dimensionless)	0.98 - 1.0	0.95 - 0.98
Total strength parameter, ϕ degree	13.0	21.5
c, psf	400	325
Effective strength parameter, $\bar{\phi}$, degree	30.5	38.0
$\bar{c}$, psf	0	0

4. Falling Head Permeability Test:

Dry density, pcf	88.4	90.2	92.9	96.3
Permeability coeff., ft/day	.037	.0034	.00018	.00006

The slope stability analysis was made with a computer using the SCS program. The failure surfaces used in the analysis is circular, the analysis method used was the swedish circle. The dimensions of the dam used in the analysis are given in Appendix V. The conditions assumed for the analysis are summarized as follows:

Height of dam: 49.5 feet
Crest width: 16 feet
Upstream slope: 3:1 with two 10-foot berm
Downstream slope: 2½:1 with two 10-foot berm
Internal drain at downstream slope: c/b = 0.6

Two zone embankment material properties:

	Type of Materials	
	Zone I (inner core)	Zone II (outer shell)
Soil classification	MH	ML
Dry density, pcf	88.1	97.1
Saturated unit weight pcf	118.5	124.0
$\emptyset_{cu}$, degree	21.5	13
c_{cu}, psf	325	400
$\emptyset$, degree	38.0	30.5
c, psf	0	0

The analysis indicated that the minimum factor of safety for the upstream slope under full drawdown condition (pool level at emergency spillway crest, elevation 1200.4) is 1.36 and the downstream slope under steady seepage with pool level at the emergency spillway crest is 1.53. Computations for the stability analysis were not available. The upstream slope was also checked with an infinite slope analysis. Using an effective strength parameter of $\bar{\emptyset} = 35^{\circ}$, the factor of safety for 3:1 and 3½:1 slope are 1.04 and 1.2, respectively when the flow lines are assumed to be parallel to the slope.

No information on settlement and seepage analysis was available. An overfill allowance of 1.50 feet was recommended to compensate for consolidation of the compacted fill. The design specified a minimum placement density of 95 percent of standard Proctor density and placement moisture content slightly wet of optimum.

The emergency spillway located at the right abutment is formed by a cut into the abutment. The design specified a 150-foot bottom width with 3:1 side slopes. The approach channel slope is 2 percent, the control section is 30 feet long and the discharge channel slope is 4 percent. The bottom of the spillway was undercut by 1 foot and refilled with compacted fill.

2.2 Construction: The construction records were not furnished by the SCS office in Richmond, but they are available from the SCS office in Washington, D.C.

2.3 Evaluation: The Design Report and the as-built drawings provided by the SCS were adequate for review. Although no construction records were available to evaluate the construction methods, the general shape of the embankment appeared to be in accordance with the as-built drawings which were available during the inspection.

SECTION 3
VISUAL INSPECTION

3.1 Findings:

3.1.1 General: The inspection was made on 16 May 1979 during a normal period which was not preceded by a long period of rainfall nor a drought. The weather was clear and dry. The ground conditions at the embankment were firm and moist. Information observed in the field is given in Appendix III.

The dam is in good condition. There was no apparent evidence of leakage, seepage, undue settlement, slope instability, nor improper functioning of water passages and seepage drain. The eroded areas described below were not serious, but they would require backfilling with compacted soils and redressing with good vegetative cover.

3.1.2 Embankment: All faces of the embankment were firm, dry, and generally well covered with grasses over 2 feet tall. Although the tall grasses would hinder detection of cracks or depressions, the crest and upstream faces were smooth which indicated that there were no apparent settlement or instability problems. At normal pool, the lower berm of the upstream slope forms the lake shoreline. The whole face of the berm was lightly vegetated so that there was a large bare area not protected from wave action. Some huge logs were noted close to the upper berm of the upstream slope. About 4 feet above the upper berm on the downstream slope, bare spots with minor sloughing were noted along the face. About 40 feet to the left of the outlet pipe, a narrow strip of the downstream face was eroded, from the upper berm to the toe, with gullies formed up to 2½ feet deep. It appeared that the internal drainage system for the embankment is working properly as the water discharging from the two 6-inch drains (less than 1 gpm) was clear, indicating no sign of internal erosion.

3.1.3 Junction of Embankment and Abutment: Minor erosion caused by runoff was observed at the lower section of the right junction of both the upstream and downstream slopes. Some bare spots were observed at the middle section of the right junction of the downstream slope.

3.1.4 Appurtenant Structures: The intake structure was not inspected because the structure is only accessible by boat. Observing from a distance, a substantial amount of debris had accumulated at the trash rack. However, water was flowing into the intake structure since the 24-inch-diameter outlet pipe was discharging about 1/6 full. The outlet pipe and its concrete saddle were in excellent condition. The handle for the emergency gate located at the intake structure was not in place; it is stored at the landowners' premises.

3.1.5. Emergency Spillway: All the spillway faces were covered with short grasses. The landowner used the entire area as cow pastures. The side slopes of the approach channel were steep and some minor sloughing was noted at the bare areas. Beyond the discharge channel (4 percent slope) the ground dipped into a steep slope which might present an erosion problem for the discharge channel should the emergency spillway operate.

3.1.6 Stilling Basin and Downstream Channel: The stilling basin extends approximately 30 feet from the toe of the dam at the outlet pipe. The banks were protected with ripraps of maximum size of 2 feet. The riprap surface appeared to be relatively even indicating that the rocks had been placed properly. Some small trees and shrubs are growing in the riprap. Water flowed freely from the basin into the downstream channel which is about 15 feet wide by 4 feet deep. Both the stilling basin and the downstream channel are in good condition.

3.1.7 Reservoir Area: The right bank of the reservoir is steep and high. The bank was formed from a cut resulting from the dam construction. The bank was covered with short grasses, and some minor sloughing was noted at the bare spots. Mild to steep wooded slopes form the rest of the reservoir bank. The shoreline around the entire reservoir was covered with shrubs (alders) which provided a good protection against wave action.

3.1.8 Downstream Area: The immediate downstream area is a flat flood plain about 500 to 800 yards wide. No spring activity was observed in any area immediately below the dam. There are 2 to 3 farms within 1 mile from the dam in the downstream area.

3.2 Evaluation: The embankment, appurtenant structures, emergency spillway, and stilling basin are in good condition. The visual inspection did not reveal any serious deficiencies, except for some eroded areas which can be corrected as part of the preventive maintenance program. The recommended measures for correcting the unfavorable conditions described in Section 3.1 are summarized as follows:

1. All bare spots should be seeded and fertilized to form a good grass cover.

2. All gullies caused by runoff should be filled with compacted soils of the same type forming the faces of dam. The restored areas should be seeded to form a good grass cover.

3. Remove all the debris accumulated at the intake structure. The debris, if any, should be removed after every storm or heavy rainfall.

4. Remove all trees and shrubs from the riprap at the stilling basin.

5. Clear the upstream slope of all logs and debris.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedures: Operation of the project is automatic. The 24-inch diameter principal spillway is ungated, therefore, water rising above the crest of the drop-inlet is automatically passed downstream. This in turn automatically maintains the pool level at or near elevation 1177.5 most of the time. Water is automatically passed through the emergency spillway in the event of an extreme flood which fills the flood storage space. A 24-inch sluice gate located at low level at the intake structure can be operated to dewater the reservoir.

4.2 Maintenance: Maintenance of the project consists mainly of fertilizing, liming, and mowing the embankment and emergency spillway, which is performed by the Blue Ridge Soil and Water Conservation District and dam owners. The owners clean debris from trash rack and the reservoir area 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, the annual maintenance and inspection program should be expanded from its present form to help detect and control problems that may occur.

SECTION 5

HYDRAULIC/HYDROLOGIC DATA

5.1 Design: The dam was designed and constructed as a class b dam under the U.S. Soil Conservation Service. The design data was obtained and evaluated according to the guidelines in Reference 1, Appendix VI.

5.2 Hydrologic Records: None were available.

5.3 Flood Experience: The maximum observed flood reached was approximately elevation 1184 or about 1 foot below the upper berm of the upstream slope.

5.4 Flood Potential: The ½ PMF and PMF were developed and routed through the reservoir by use of the HEC-1DB computer program (Reference 2, Appendix VI) 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 the U.S. Weather Bureau Publication (Reference 3, Appendix VI). 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.

Regulation of flow from the reservoir is automatic. Water rising above the crest of the drop-inlet flows into this inlet and through the dam in the 24-inch concrete conduit. Water also flows past the dam through the emergency spillway in the event water in the reservoir rises over the crest of the spillway.

The storage curve and the emergency spillway rating curve developed by the Soil Conservation Service was used in the development of this report. Rating curves were developed for the non-overflow section and the drawdown outlet. In routing hydrographs through the reservoir, it was assumed that the initial pool level was at the principal spillway crest. Flow through the principal spillway 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 ½ PMF	Hydrograph PMF 1/
Peak flow c.f.s.			
Inflow	3	7096	14191
Outlow	3	7058	14067
Maximum elevation ft., m.s.l.		1206.0	1207.4
Emergency spillway (el. 1200.4)			
Depth of flow, ft.		5.6	7.0
Duration, hrs.		9.3	9.5
Velocity, f.p.s. 2/		9.3	10.6
Non-overflow section (el. 1204.4)			
Depth of flow, ft.		1.6	3.0
Duration, hrs.		3.7	5.7
Velocity, f.p.s. 2/		5.8	7.9
Tailwater elevation ft., m.s.l.	1155±	-	-

1/ 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.

2/ Critical velocity.

5.7 Reservoir Emptying Potential: The 24-inch pipe entering the upstream side of the riser at a low level will permit withdrawal of about 66 c.f.s. with the reservoir level at the principal spillway crest and essentially dewater the reservoir in about 1 day.

5.8 Evaluation: Based on the size (intermediate) and hazard classification (significant), the recommended Spillway Design Flood is ½ PMF. Based on the risk involved in this project, it is considered that ½ PMF is appropriate as a Spillway Design Flood. The emergency spillway will pass 23 percent of the PMF without overtopping the dam. The ½ PMF will overtop the dam for a duration of 3.7 hours and reach a depth of 1.6 feet over the top of the dam.

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

SECTION 6

STRUCTURAL STABILITY

6.1 Foundation and Abutments: The dam is located in the Ridge and Valley Province of Virginia. Miscovite schist of the Lynchburg formation in Precambrian time underlies the damsite. The schist was exposed in the stream bottom in the foundation and in a small outcrop on the right abutment. On the left abutment, the weathered schist was overlain by 2 to 3 feet thick of residual soils consisting of micaceous silty sand and clayey silt. On the right abutment, the weathered schist was found 6 to 8 feet below ground. In the flood plain, the depth to weathered schist varied from 3 to 6 feet.

The dam is founded on weathered schist. A cutoff trench was constructed along the dam centerline and along both abutments to the crest of dam. The base width of the trench is 20 feet and the base is placed at approximately 2 feet into the weathered schist. The geologic report of the damsite is inclosed in Appendix IV. The logs of test holes and the profile along the center of the dam and cutoff trench are shown respectively on Plate II and III, Appendix I.

6.2 Embankment: Plate V, Appendix I indicates that the crest of dam is 18 feet wide and constructed to Elevation 1205.5. The estimated settlement of the fill was 1.5 feet so that the final elevation of the crest would be 1204.0 feet. The upstream slope is 3½:1 with a 10-foot-wide berm located at Elevation 1186.0 and at Elevation 1179.0. The berms slope downward at 10:1 slope. The downstream slope is 2½:1 with a 10-foot-wide berm located at Elevation 1180 and at Elevation 1172.0. The upper berm slopes upward at 10:1 slope and the lower berm is flat. The embankment is a homogeneous earthfill structure constructed with ML material. Contrary to the design

recommendations (see Section 2) there is no indication of the use of MH material for the core. All materials were to be placed at a minimum of 95 percent of standard Proctor density and with moisture content slightly wet of optimum.

6.3 Evaluation: The following evaluations are made based on visual inspection and review of existing records. The construction records and stability analysis calculations were not available. The visual inspection revealed no evidence of leakage, seepage, undue settlement, cracks, slope instability nor improper functioning of internal drains. The cutoff trench, the anti-seep collars around the principal spillway and the internal drains appeared to be effectively controlling the seepage during normal pool conditions. With proper maintenance, the grass vegetative cover appeared to be adequately protecting the faces of the embankment. The lower berm of the upstream slope is located at the normal pool elevation and the flat slope (10:1) provides good resistance to erosion of the shoreline due to wave action.

One departure was noted between the design and the as-built conditions. Referring to Appendix V, the design plan indicates that the embankment is a zoned earthfill structure with the inner core made of MH material and the outer shells made of ML material. The as-built drawing (plate V, Appendix I) indicates that the embankment is a homogeneous earthfill structure made of ML material. The effective strength of the ML material is lower than that of the MH material. The safety factor computed for the steady seepage case at the downstream slope is 1.53 based on designed conditions, whereas the safety factor would be lower for the as-built conditions. Since the safety factor recommended by the Corps of Engineers, reference 1, Appendix VI, for the steady seepage case is 1.50, the safety margin for the downstream slope may not meet the Corps' guideline. Safety factor computed for the full

drawdown case at the upstream slope is 1.36 for the designed conditions in which the upstream slope is 3:1. The embankment was constructed with a slope of 3½:1.

The flatter slope would result in a higher safety factor whereas the replacement of stronger MH soils by the weaker ML soils would result in a lower safety factor. The safety factor for the as-built conditions is not known. The safety factor recommended by the Corps of Engineers for the full drawdown case is 1.2. Since the as-built conditions do not differ substantially from the design assumptions, it is not necessary to perform stability analysis for the sudden drawdown and the steady seepage cases for the as-built conditions. The stability conditions are considered to be satisfactory and conventional safety margins exist.

As the dam is located in Seismic Zone 2, the dam may be assumed to present no hazard from earthquake provided static stability conditions are satisfactory and conventional safety margins exist.

SECTION 7

ASSESSMENT, RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Assessment. The Upper Blackwater River Dam No. 6, as observed 16 May 1979, appears sound without indication of instability or unsafe operation. Available engineering data was adequate for review. The SDF(½PMF) will overtop the dam for a duration of 4 hours and reach a depth of 1.6 feet over the top of the dam. The emergency spillway will pass 23 percent of the PMF before overtopping the dam. The emergency spillway is therefore, the spillway is adjudged as inadequate.

Based on the visual inspection and review of existing records, there are no apparent problems that require immediate action. The actual structure is similar to the as-built drawings given in Appendix 1. The stability conditions are considered to be satisfactory and conventional safety margins exist if the dam was constructed as specified in the design report.

7.2 Recommendations/Remedial Measures: There is no immediate need for remedial measures. However, the following actions are suggested and should be initiated within 12 months. These measures are suggested for monitoring and maintenance purposes only.

a. All bare spots should be seeded and fertilized to form a good grass cover.

b. All gullies caused by runoff should be filled with compacted soils of the same type forming the faces of dam. The restored areas should be seeded to form a good grass cover.

c. Remove all the debris accumulated at the intake structure and along the upstream slope.

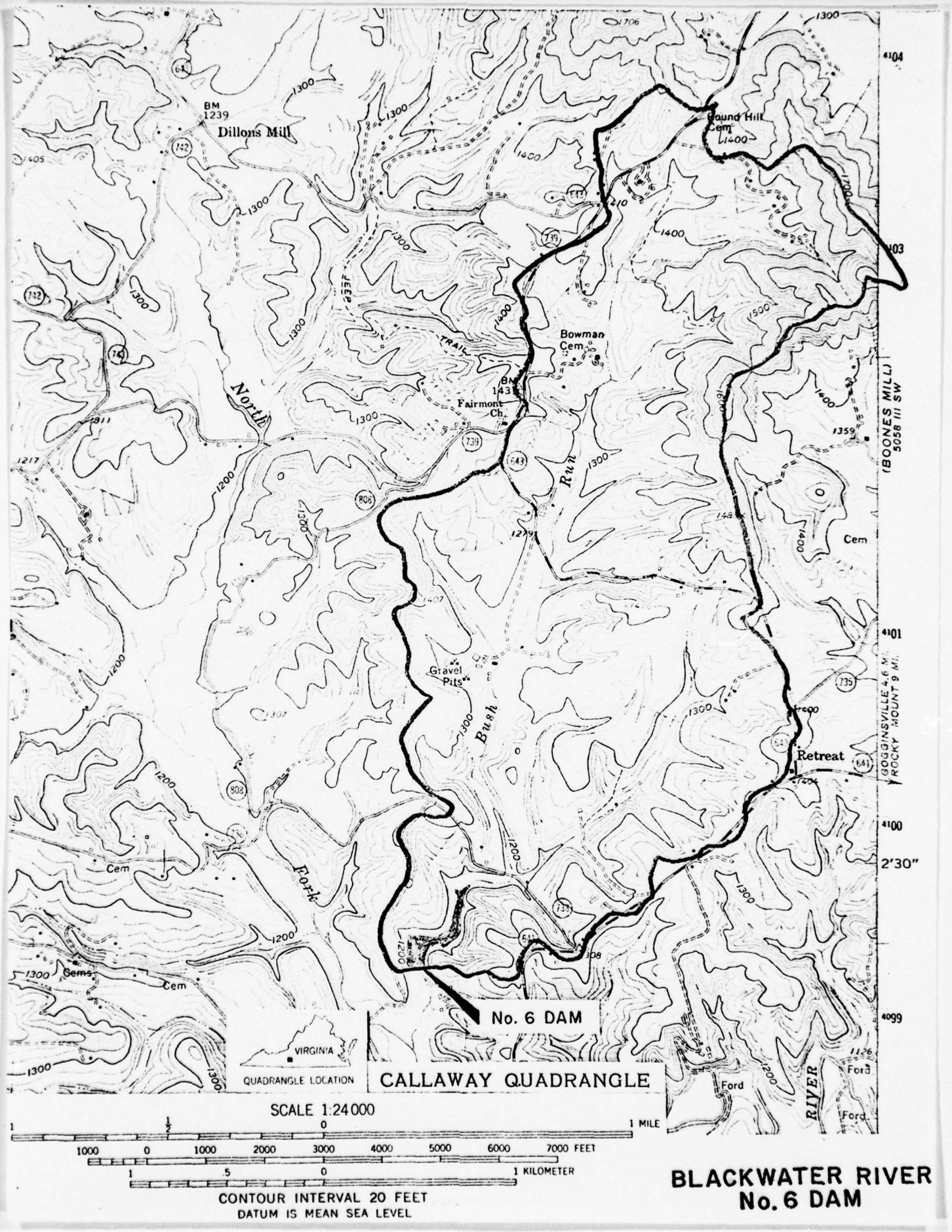
d. Remove all trees and shrubs from the riprap at the stilling basin.

e. Clear the upstream slope of all logs and debris.

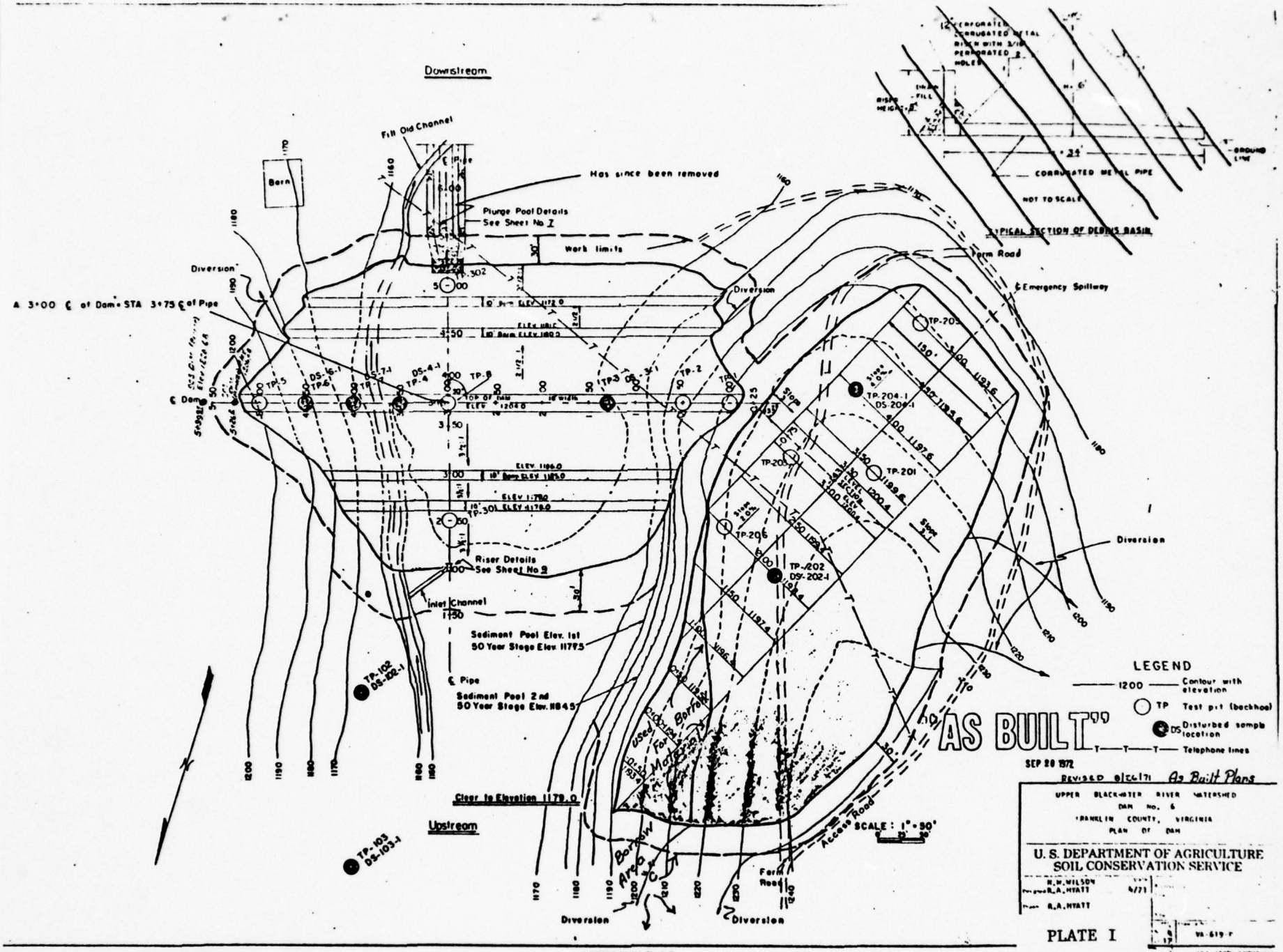
f. Install a staff gage in the reservoir to measure high pool elevations.

APPENDIX I

MAPS AND DRAWINGS



BLACKWATER RIVER
No. 6 DAM


Downstream
Fill Old Channel
Has since been removed
Barn
Plunge Pool Details
See Sheet No. 2
Work limits
Diversion
A 3+00 ℄ of Dam • STA 3+75 ℄ of Pipe
℄ Dam
Riser Details
See Sheet No. 2
Inlet Channel
Sediment Pool Elev. 1st
50 Year Stage Elev 1179.5
℄ Pipe
Sediment Pool 2nd
50 Year Stage Elev. 1184.5
Clear to Elevation 1179.0
Upstream
Borrow Area C
Used For Core Material
Farm Road
Access Road
Emergency Spillway
TYPICAL SECTION OF DEBRIS BASIN
CORRUGATED METAL PIPE
NOT TO SCALE
SCALE : 1" = 50'
LEGEND
1200 Contour with elevation
TP Test pit (backhoe)
DS Disturbed sample location
T—T—T— Telephone lines
"AS BUILT"
SEP 28 1972
REVISED 8/16/71 As Built Plans
UPPER BLACKWATER RIVER WATERSHED
DAM No. 6
FRANKLIN COUNTY, VIRGINIA
PLAN OF DAM
U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
R.W. WILSON
R.A. HYATT
4/71
R.A. HYATT
PLATE I
VA-619-P

TEST PITS

TP, 0+00 ℄ DAM, ELEV. 1199.6
JC 7/9/70

0.0	0.5	Clay, silty, red, w/grass roots - topsoil	(CL)
0.5	1.75	Clay, silty, red, hard, dry to damp	(CL)
1.75	8.2	Sand, silty, gray, hard, moist, w/mica - weathered schist - refusal - dry hole	(SM)

TP4, 0+50 ℄ DAM, ELEV. 1196.6
JC 7/9/70

0.0	0.5	Clay, silty, red, w/grass roots - topsoil	(CL)
0.5	2.0	Clay, silty, red, hard, moist	(CL)
2.0	6.5	Sand, silty, brown, hard, moist - weathered schist	(SM)

Refusal - dry hole

TP4, 1+30 ℄ DAM, ELEV. 1158.7
JC 7/9/70

0.0	0.5	Clay, silty, red, w/grass roots - topsoil	(CL)
0.5	3.5	Silt, clayey, w/sand, red, hard, moist	(ML)

DS 3-1 1.0-3.5

3.5	4.8	Silt, sandy, to sand, silty, gray, soft, moist to wet water table 4.8	(ML-SM)
4.8	6.0	Weathered mica schist - refusal	

TP5, 1+50 ℄ DAM, ELEV. 1159.4
JC 7/9/70

0.0	0.5	Sand, silty, red brown, w/grass roots - topsoil	(SM)
0.5	1.5	Sand, silty, red brown to lt gray, hard, damp to moist	(SM)

DS 4-1 1.0-3.5

1.5	5.6	Sand, silty, gray, hard, moist - micaceous	(SM)

Refusal - dry hole

TP6, 5+00 ℄ DAM, ELEV. 1158.1
JC 7/10/70

0.0	0.5	Clay, silty, red, w/leaves and roots - topsoil	(CL)
0.5	2.5	Sand, silty, gray-brown, hard, moist, micaceous, foliated - weathered schist - refusal - dry hole	(SM)

TP8, 4+50 ℄ DAM, ELEV. 1182.5
JC 7/10/70

0.0	0.5	Clay, silty, red, w/grass roots - topsoil	(CL)
0.5	3.5	Weathered muscovite schist - dips as 3-6" flags - breaks down into sand refusal - dry hole	(SM-SM)

DS 6-1 1.0-3.5

TP9, 4+00 ℄ DAM, ELEV. 1162.7
JC 7/10/70

0.0	0.5	Silt, sandy, red-brown, micaceous, w/grass roots - topsoil	(ML)
0.5	2.5	Silt, clayey, red-brown, hard, moist	(ML)

DS 7-1 1.0-2.5

2.5	5.0	Sand, silty, gray, hard, moist - micaceous - weathered mica schist	(SM)

Refusal - dry hole

TP, 3+00 ℄ DAM, ELEV. 1158.9
TP, 3+75 ℄ PIPE
JC 7/10/70

0.0	0.5	Sand, silty, red-brown, w/corn stalks - topsoil	(SM)
0.5	2.6	Sand, silty, red-brown, fine, moist - gray at bottom	(SM)

TP 8 Cont'd

2.6	3.6	1.0 weathered schist - 3-6" flags - refusal - dry hole	

TP 101 600' ℄ STA. 7+30 ℄ DAM, ELE., 1171.2
JC 7/9/70

0.0	0.5	Sand, silty, red, w/grass roots - topsoil	(SM)
0.5	4.4	Sand, silty, fine-medium, red, hard, dry to damp	(SM)
4.4	6.25	Silt, sandy, to sand, silty, dk gray, stiff, moist	(ML-SM)

DS 101-1 4.4-6.25

6.25	7.25	Weathered schist, blue-gray - refusal - dry hole	(SM)

TP 102 310' ℄ STA. 3+95 ℄ DAM, ELE., 1167.6
JC 7/10/70

0.0	0.5	Silt, sandy, red, w/grass roots - topsoil	(ML)
0.5	3.0	Silt, sandy, red, hard, moist	(ML)

DS 102-1 1.0-3.0

3.0	6.0	Silt, sandy, w/clay, lt brown, hard, moist, w/fine mica	
6.0	8.75	Silt, sandy lt gray, stiff, moist, micaceous	(ML)
8.75		Refusal on weathered schist - dry hole	

TP 103 480' ℄ STA. 4+05 ℄ DAM, ELE., 1166.4
JC 7/10/70

0.0	0.5	Silt, sandy, red, w/grass roots - topsoil	(ML)
0.5	1.7	Silt, sandy, red, hard, dry to damp	(ML)
1.7	4.5	Silt, sandy, w/fine mica, lt brown, hard, moist	(ML)

DS 103-1 1.7-4.5

4.5	5.9	Silt, sandy, lt gray-blue w/ brown mottles, hard, moist, micaceous - refusal - dry hole	(ML)

TP 104 795' ℄ STA. 5+50 ℄ DAM, ELEV. 1162.9
JC 7/10/70

0.0	0.5	Sand, silty, red-brown, w/grass roots - topsoil	(SM)
0.5	4.0	Sand, medium brown to lt gray, hard to stiff, moist	(SM)
4.0	4.9	Gravel, sandy, w/silt, brown, hard, moist, ±4 est. 80% as subangular to subrounded quartz pebbles and cobbles - max. size 8" - refusal on weathered schist - dry hole	(GM)

TP 105 (not surveyed)
JC 7/10/70

0.0	0.5	Clay, silty, red, w/grass roots - topsoil	(CL)
0.5	2.0	Boulder gravel, clayey, red, hard, moist, of hornblende gneiss, ±4 est. 80% - subrounded -colluvial	(GC)
2.0	4.0	Clay, silty, yellow-red, hard, moist, w/occasional boulders and cobbles of hornblende gneiss	(CL)
4.0	6.0	Weathered hornblende gneiss, as clayey boulder gravel -residual	(GC)

TP 106 735' ℄ STA. 7+05 ℄ DAM, ELEV. 1122.5
JC 7/10/70

0.0	0.5	Silt, sandy, red, w/grass roots - topsoil	(SM)
0.5	4.0	Silt, sandy, red, hard, dry to damp	(ML)
4.0	6.9	Weathered schist - refusal - dry hole	(SM)

TP 107 1110' ℄ STA. 4+70 ℄ DAM, ELEV. 1196.4
JC 7/10/70

0.0	0.5	Clay, silty, red, w/grass roots - topsoil	(CL)
0.5	5.0	Clay, silty, red, hard, moist	(CL)

TP 107 Cont'd

5.0	7.0	Silt, sandy, w/clay, red, hard moist	(ML)
7.0	10.0+	Sand, silty, brown, hard, moist, micaceous - dry hole	( )

TP 108 1100' ℄ STA. 3+70 ℄ DAM, ELEV. 1188.5
JC 7/10/70

0.0	0.5	Clay, silty, red, w/grass roots - topsoil	(CL)
0.5	3.5	Clay, silty, red, hard, moist	(CL)
3.5	8.9	Silt, clayey, to silt, sandy, brown, hard, moist - water table 7.0	(ML)
8.9	12.5+	Sand, silty, brown, micaceous, hard, moist	(SM)

TP 109 780' ℄ STA. 4+30 ℄ DAM, ELEV. 1166.2
JC 7/10/70

0.0	0.5	Silt, sandy, red w/grass roots - topsoil	(ML)
0.5	1.75	Sand, fine, silty, red, firm, moist to wet	(SM)
1.75	4.0	Sand, silty, gray, soft, wet water table 4.0	(SM)
4.0	5.0+	Gravel, sandy, w/silt, gray, hard, wet, ±4 80% as subrounded quartz cobbles and boulders	(GM)

TP 201 STA. 3+50 OUTSIDE EDGE EMS, ELEV. 1224.0
JC 7/9/70

0.0	0.5	Clay, silty, red, w/grass roots - topsoil	(CL)
0.5	4.0	Clay, silty, red, hard, moist	(CL)
4.0	8.0	Sand, silty, brown, hard, moist, micaceous - weathered schist	(SM)
8.0		Refusal - weathered schist - dry hole	

TP 202 STA. 2+00 OUTSIDE EDGE EMS, ELEV. 1225.6
JC 7/9/70

0.0	0.5	Clay, silty, red, w/grass roots - topsoil	(CL)
0.5	4.0	Clay, silty, red, hard, moist	(CL)

DS 202-1 1.0-4.0

4.0	9.0	Sand, silty, brown, hard, moist, micaceous, w/chlorite - weathered schist	(SM)
9.0		Refusal - dry hole	

TP 203 STA. 3+00 ℄ EMS, ELEV. 1219.0
JC 7/9/70

0.0	0.5	Clay, silty, red, w/grass roots - topsoil	(CL)
0.5	6.8	Clay, silty, red, hard, moist	(CL)
6.8	7.7	Gravel, silty, w/sand, red, hard, moist, ±4 80% subrounded quartz pebbles and cobbles - 4"	(GM)
7.7	9.2	Sand, silty, brown, hard, moist, micaceous - weathered schist	(SM)
9.2		Refusal --dry hole	

TP 204 STA. 4+00 ℄ EMS, ELEV. 1217.9
JG 7/9/70

0.0	0.5	Clay, silty, red, w/grass roots - topsoil	(CL)
0.5	2.5	Clay, silty, red, hard, moist	(CL)
2.5	2.75	Gravel, clayey, w/silt, red, hard, moist, ±4 80% quartz cobbles	
2.75	9.0	Sand, silty, brown, hard, moist, micaceous, weathered schist	(SM)

DS 204-1 2.75-9.0

TP 205 STA. 5+00 ℄ EMS, ELEV. 1201.5
JC 7/9/70

0.0	0.5	Clay, silty, red, w/grass roots - topsoil	(CL)
0.5	2.75	Clay, silty, red, hard, moist	(CL)
2.75	5.5	Sand, silty, gray, hard, moist, micaceous - weathered schist - refusal - dry hole	(SM)

TP 206 STA. 3+00 ℄ EMS, ELEV. 1209.6
JC 7/9/70

0.0	0.5	Clay, silty, red, w/grass roots - topsoil	(CL)
0.5	2.75	Clay, silty, red, hard, moist	(CL)
2.75	5.5	Sand, silty, gray, hard, moist, micaceous - weathered schist - refusal - dry hole	(SM)

TP 301 STA. 2+50 ℄ PIPE, ELEV. 1159.8
JC 7/10/70

0.0	0.5	Sand, silty, red-brown, w/corn stalks - topsoil	(SM)
0.5	1.5	Sand, fine, silty, red-brown, hard, moist	(SM)
1.5	2.6	Sand, silty, yellow-brown, hard, moist	(SM)
2.6	3.75	Gravel, sandy, w/silt, brown and gray, hard, moist, ±4 est. 80% pebbles and cobbles of quartz - subrounded - refusal on weathered schist - dry hole	(GM)

TP 302 STA. 5+00 ℄ PIPE, ELEV. 1156.9
JC 7/10/70

0.0	0.5	Sand, silty, red-brown, w/corn stalks - topsoil	(SM)
0.5	3.0	Sand, silty, red-brown, stiff, moist	(SM)
3.0	4.8	Boulder gravel, sandy, w/silt, red brown, loose, moist to wet ±4 est. 80% subrounded quartz boulders and cobbles - max 18" water table 3.5	(GM)
4.8	4.9	Refusal on weathered schist	

LEGEND

TEST HOLE NUMBERING SYSTEM

1 - 99	Centerline of Dam
101 - 199	Borrow Area
201 - 299	Emergency Spillway
301 - 399	Principal Spillway
401 - 499	Foundation
501 - 599	Foundation Drain - Relief Well
601 - 699	Other (Locate)

Hole numbers are not repeated

TEST HOLE NUMBER PREFIX

HA - Hand Auger
DH - Drill Hole - Rotary
TP - Test Pit - Backhoe or Dozer

SAMPLE TYPES

DS - Disturbed Sample (Loose, Mixed, Bagged)
US - Undisturbed (Sealed Block or Tube Type)
RC - Rock Core (Diameter)
SpT - Drive Sample - Standard Penetration Tube (Disturbed in Jar)

SAMPLE NUMBER

DS 101 1 - Disturbed from Hole No. 101 Sample No. 1
US 3 5 - Undisturbed from Hole No. 3, Sample No. 5
SpT 10.16 -Drive Sample from Hole No. 10, Sample No. 16

UNIFIED SOIL CLASSIFICATION SYMBOLS

GW - Well-graded gravels and gravel-sand mixtures, little or no fines.
GP - Poorly graded gravels and gravel-sand mixtures, little or no fines.
GM - Silty gravels, gravel-sand-silt mixtures.
GC - Clayey gravels, gravel-sand-clay mixtures
SW - Well-graded sands and gravelly sands, little or no fines
SP - Poorly grades sands and gravelly sands, little or no fines
SM - Silty sands, sand-silt mixtures
SC - Clayey sands, sand-clay mixtures
ML - Inorganic silts, very fine sands, rock flour, silty or clayey fine sands
CL - Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays
MH - Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts
CH Inorganic clays of high plasticity, fat clays

Based on Visual-Manual Procedure, ASTM D 2488

No Precipitation

"AS BUILT"
SEP 28 1972
As Built Plans

UPPER BLACKWATER RIVER WATERSHED
DAM SITE No. 6
FRANKLIN COUNTY, VA.
LOGS OF TEST HOLES

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

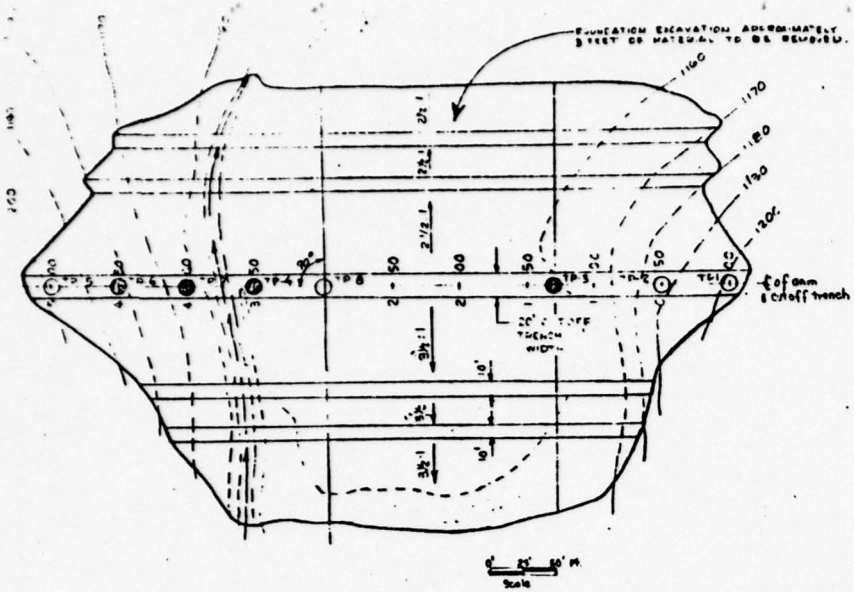
Investigated by: Date
Drawn J.W.GAFFNEY 7/20
C.W.TONEY

... State Conservation ... Engineer

PLATE II

16
17

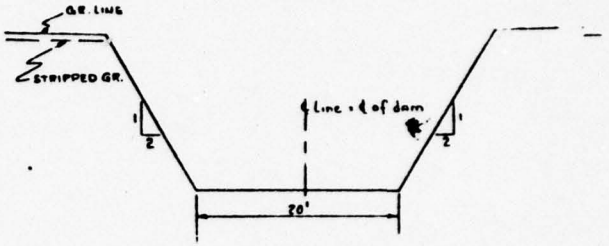
ML-619-P



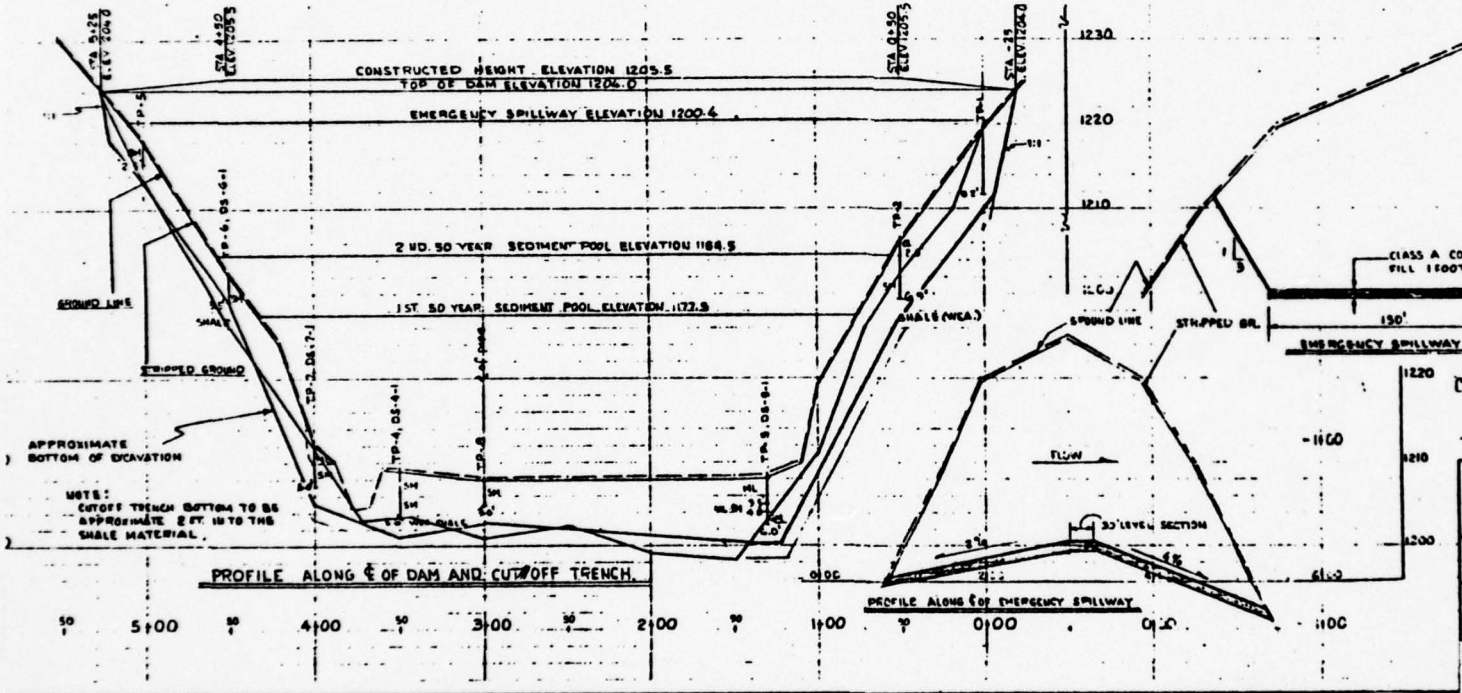
CONSTRUCTION DETAILS

THE EXCAVATION LIMITS ARE APPROXIMATE AND WILL BE ADJUSTED IN ACCORDANCE WITH CONDITIONS ENCOUNTERED.

2 INCH EXPOSED IN THE BOTTOM OF THE CUTOFF TRENCH SHALL BE THOROUGHLY CLEANED AND SHALL BE INSPECTED BY THE ENGINEER PRIOR TO THE PLACEMENT OF COMPACTED FILL MATERIAL.

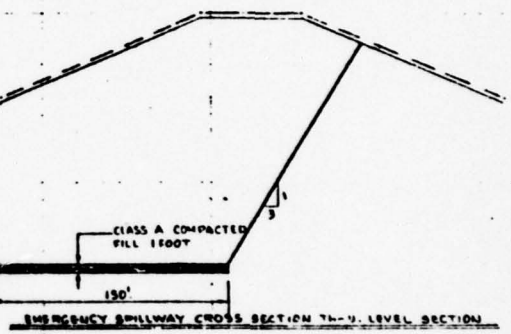


TYPICAL SECTION OF CUTOFF TRENCH



PROFILE ALONG ℄ OF DAM AND CUTOFF TRENCH.

PROFILE ALONG ℄ OF EMERGENCY SPILLWAY



EMERGENCY SPILLWAY CROSS SECTION TH-U, LEVEL SECTION

"AS BUILT" SEP 20 1972

As Built Plans

REVISED 6/2/71

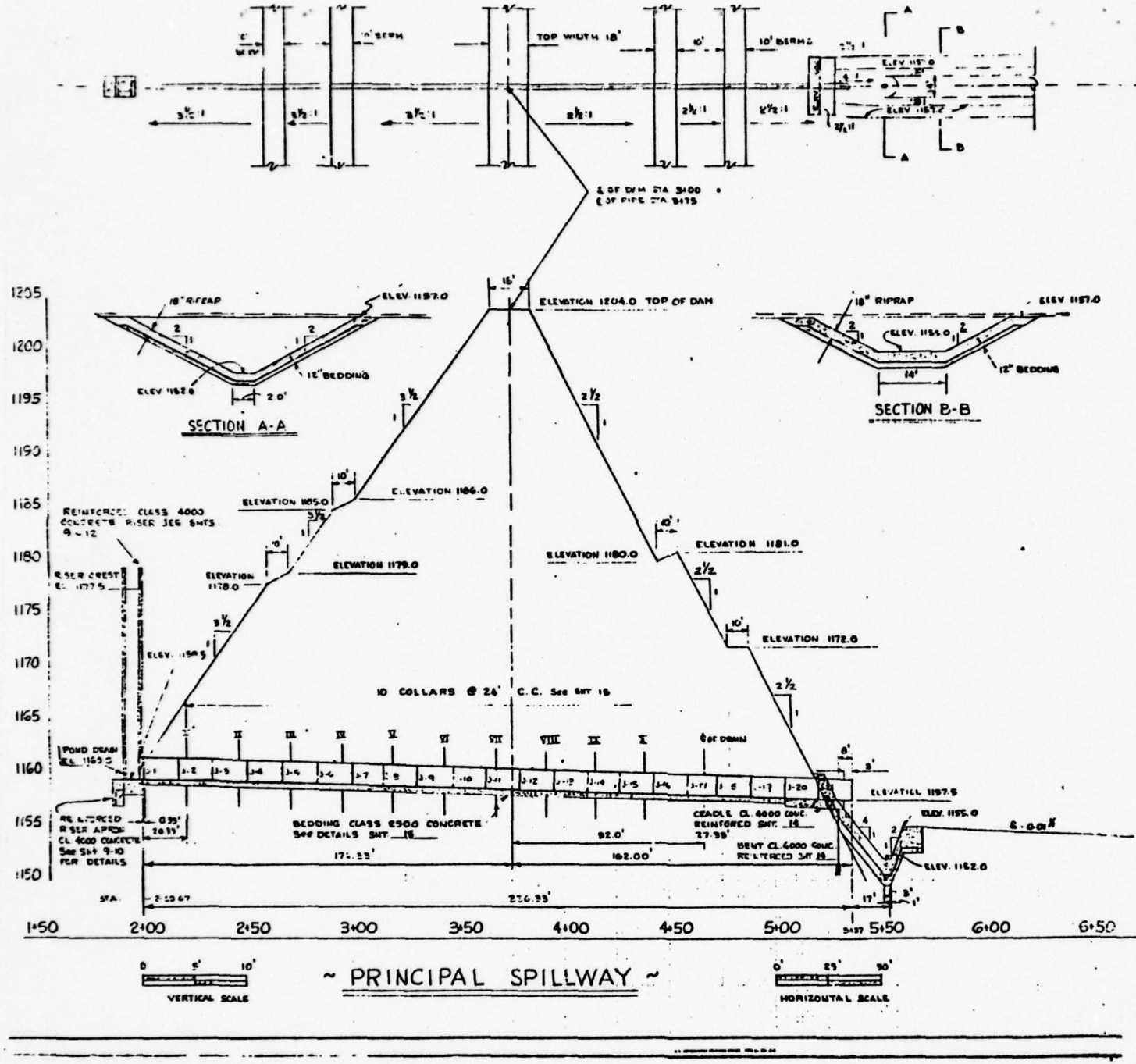
UPPER BLACKWATER RIVER WATERSHED
DAM NO. 6
FRANKLIN COUNTY, VIRGINIA
DETAILS OF CUTOFF TRENCH

U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

W.R. WARREN 4-71
P.E. NO. 4-71
R.A. NO. 4-71

PLATE III

VA-619-P



Joint	Dist. from Riser Toe	Invert Elev.	Slope
J-1	0.33	1159.50	
J-2	16.33	1159.40	
J-3	32.33	1159.31	
J-4	48.33	1159.24	
J-5	64.33	1159.12	
J-6	80.33	1159.02	
J-7	96.33	1158.93	
J-8	112.33	1158.83	
J-9	128.33	1158.74	
J-10	144.33	1158.64	
J-11	160.33	1158.55	
J-12	176.33	1158.49	
J-13	192.33	1158.36	
J-14	208.33	1158.24	
J-15	224.33	1158.17	
J-16	240.33	1158.07	
J-17	256.33	1157.98	
J-18	272.33	1157.88	
J-19	288.33	1157.78	
J-20	304.33	1157.69	
J-21	320.33	1157.59	
OUTLET	336.33	1157.50	

COLLARS	Dist. from Riser Toe	Invert Elev.	Slope
1	20.33	1159.38	
2	44.33	1159.24	
3	68.33	1159.09	
4	92.33	1158.95	
5	116.33	1158.81	
6	140.33	1158.67	
7	164.33	1158.52	
8	188.33	1158.38	
9	212.33	1158.24	
10	236.33	1158.09	

RIPRAP NOTE

a. Equipment placed riprap shall be well grade from 12" to 18" and shall be laid on 12" of bedding on the slope of the basin.

b. The bedding shall meet the gradation requirements of the coarse concrete aggregate.

Outlet channel bottom width 14' S.S. 2:1 S=0.01 1/1

PIPE SUPPLIERS NOTES

1. Cast outside of spigot joint ring with conc on one 16' - 0" section.
2. See pipe joint details sheet plans.

"AS BUILT"
SEP 28 1972

REVISED 8/24/71 As Built Plan

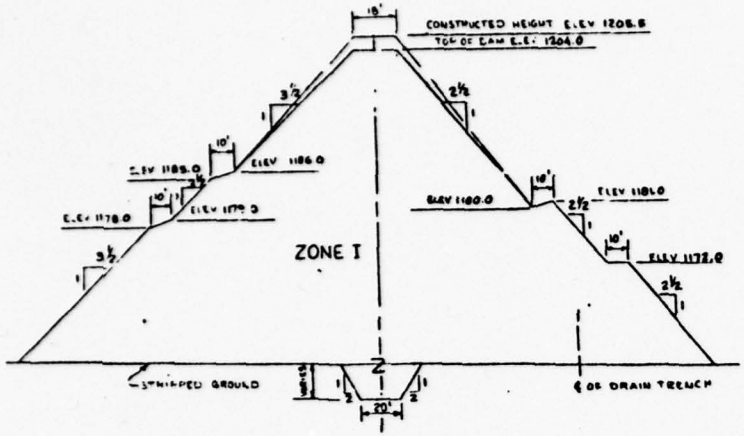
UPPER BLACKWATER RIVER WATERSHED
DAM No. 6
FRANKLIN COUNTY, VIRGINIA
PRINCIPAL SPILLWAY LAYOUT

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

Designed R.A. HYATT 4/71
Drawn R.A. HYATT 4-71
Traced
Checked
Approved

PLATE IV

Sheet No. 7 of 17 Sheets
Drawing No. VA-619-P



TYPICAL SECTION OF COMPACTED FILL

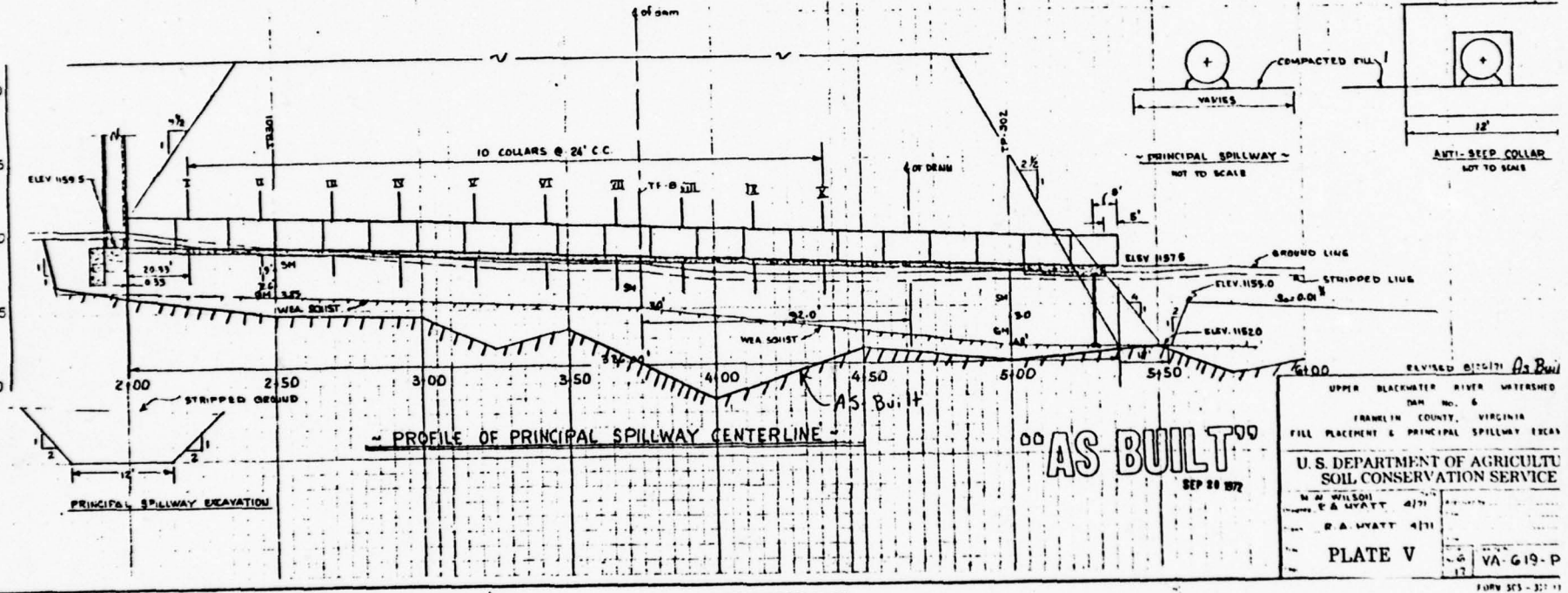
PLACEMENT OF EARTH FILL MATERIALS

FILL AREA	TYPE	LOCATION	AVERAGE DEPTH (FT.) FROM	TO	DESCRIPTION	CLASS	DEGREE OF COMPACTION (%)	MOISTURE LIMITS (%) + OPTIMUM FROM	TO	CONTROL TEST ASTM	DESIG-NATION	METHOD	REPORTED COMPACTION TEST SAMPLE NO. FIELD	LAB.	MAXIMUM DENSITY (PCF)	OPTIMUM MOISTURE (%)	% MAX. DENSITY ROCK	% MAX. DENSITY TOPSOIL
1																		
2																		
3																		
4																		
5																		

FILL AREA KEY TO STRUCTURES MIN. ROCK AREA 1.2"

SEE AASHO COMPACTION CURVES AND SHEET 12

PROFILE OF PRINCIPAL SPILLWAY CENTERLINE



REVISED 8/26/71 As Built

UPPER BLACKWATER RIVER WATERSHED
DAM NO. 6
FRANKLIN COUNTY, VIRGINIA
FILL PLACEMENT & PRINCIPAL SPILLWAY EXCAV.

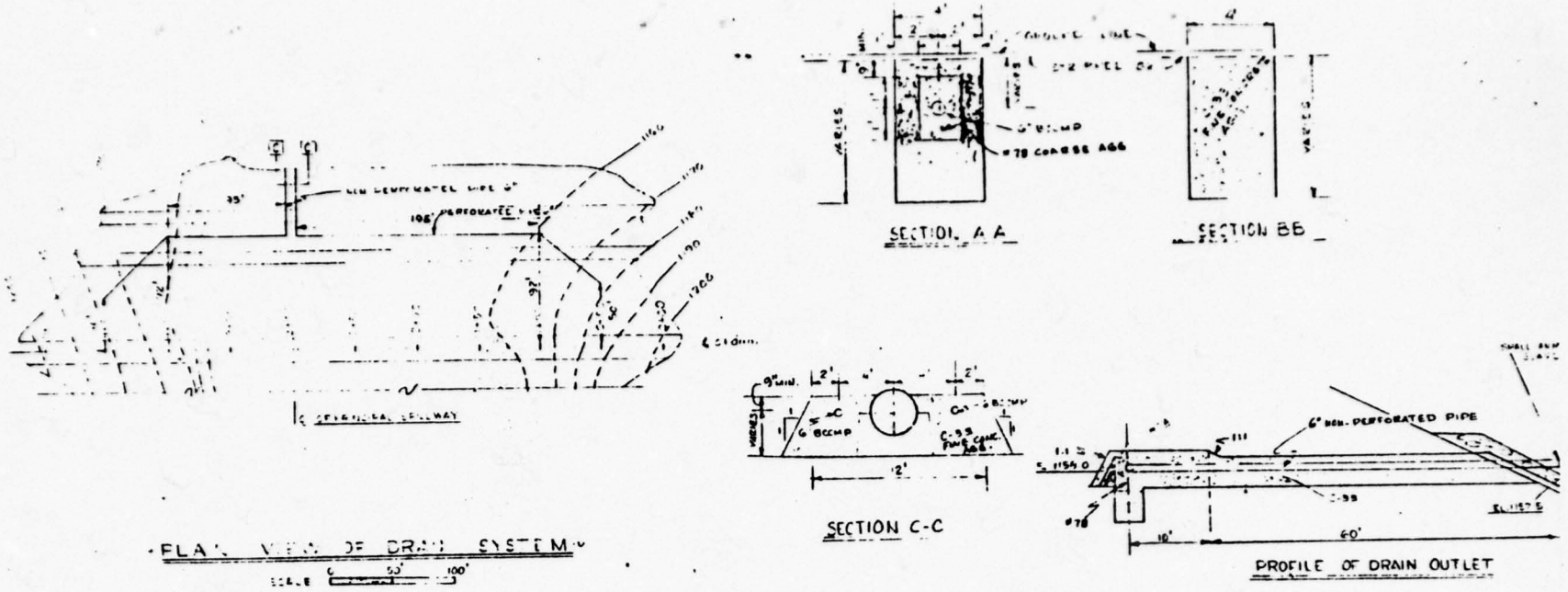
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

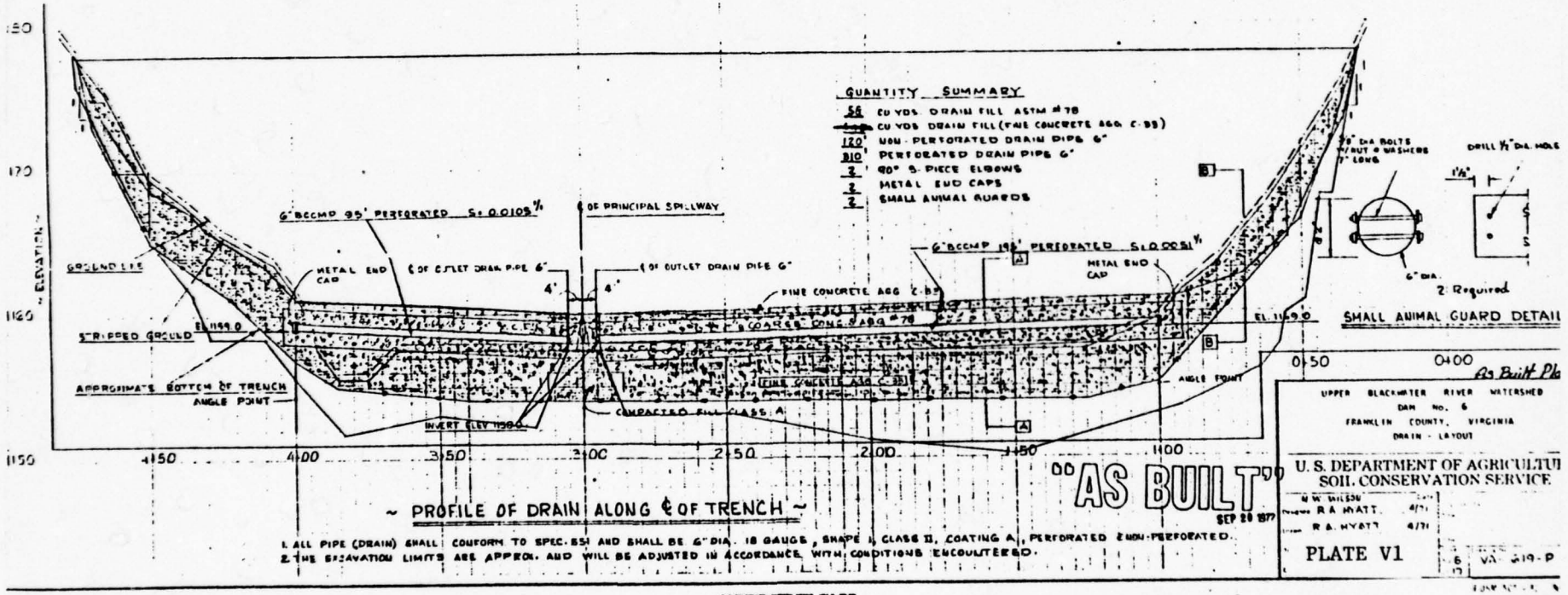
M.W. WILSON 4/71
P.A. HYATT 4/71
P.A. HYATT 4/71

PLATE V

VA-619-P

FORM SCS - 327-11





~ PROFILE OF DRAIN ALONG ℄ OF TRENCH ~

1. ALL PIPE (DRAIN) SHALL CONFORM TO SPEC. 551 AND SHALL BE 6" DIA. 18 GAUGE, SHAPE I, CLASS II, COATING A, PERFORATED & NON-PERFORATED.
2. THE EXCAVATION LIMITS ARE APPROX. AND WILL BE ADJUSTED IN ACCORDANCE WITH CONDITIONS ENCOUNTERED.

"AS BUILT"
SEP 20 1977

As Built Pla

UPPER BLACKWATER RIVER WATERSHED
DAM No. 6
FRANKLIN COUNTY, VIRGINIA
DRAIN - LAYOUT

U. S. DEPARTMENT OF AGRICULTUI
SOIL CONSERVATION SERVICE

DESIGNED	R A HYATT	4/71
DRAWN	R A HYATT	4/71
TRACED		
CHECKED		

PLATE V1

VA-319-P

APPENDIX II

PHOTOGRAPHS

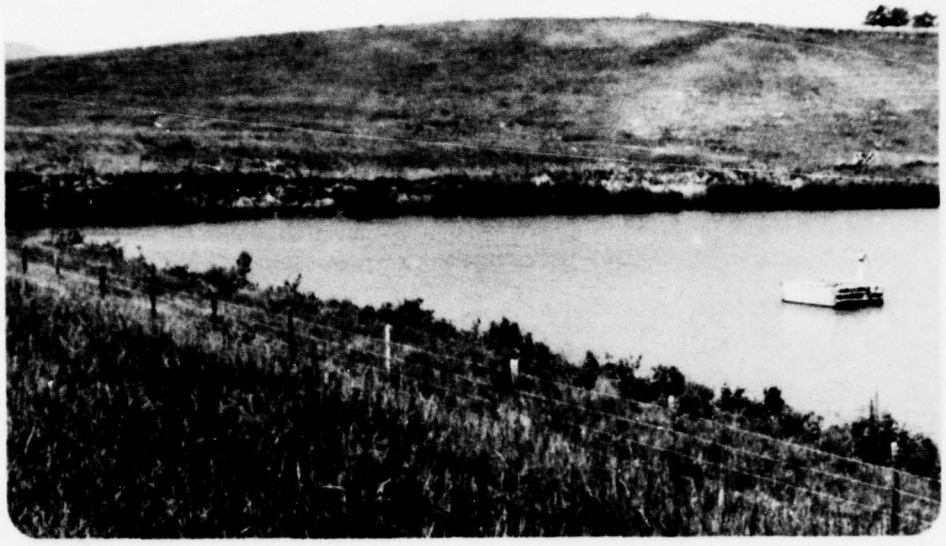


PHOTO # 1 INTAKE STRUCTURE

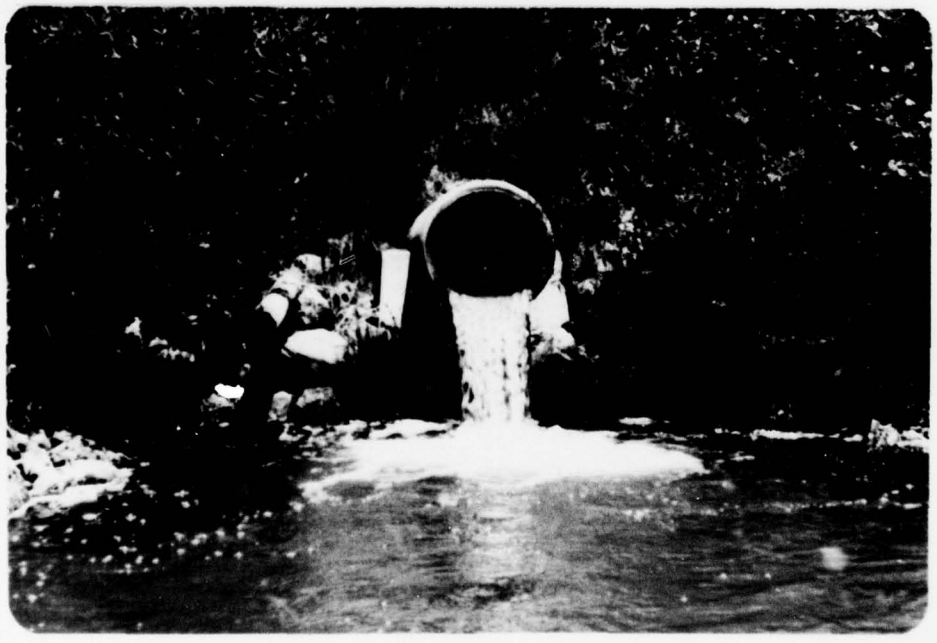


PHOTO # 2 OUTLET STRUCTURE

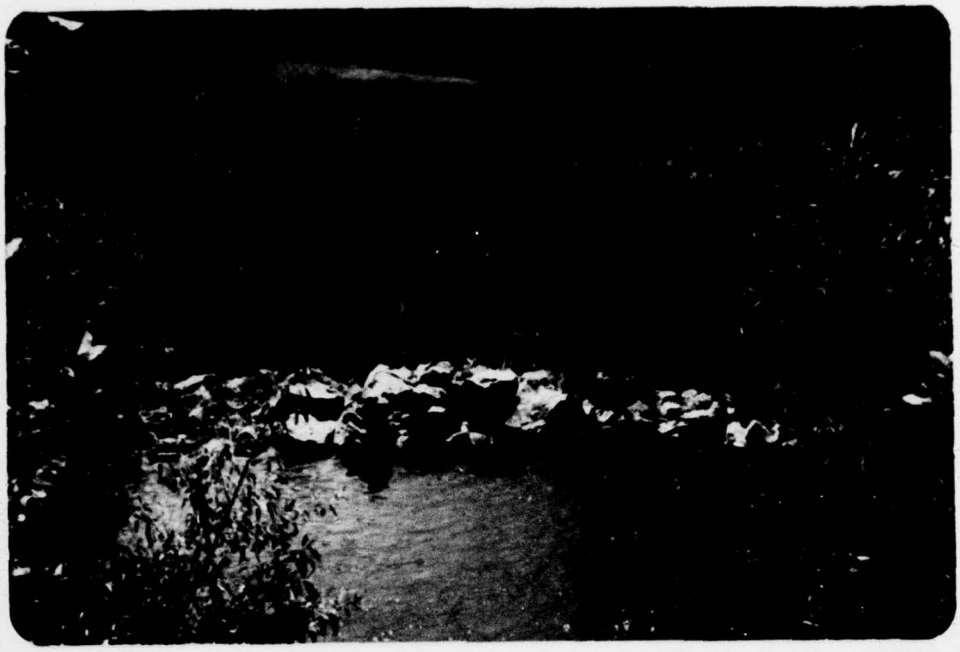


PHOTO #3 DOWNSTREAM CHANNEL



PHOTO #4 EROSION DOWNSTREAM SLOPE



PHOTO #5 EROSION DOWSTREAM SLOPE



PHOTO #6 CONTACT RT. ABUTMENT / EMBANKMENT
AND
EMERGENCY SPILLWAY

APPENDIX III

FIELD OBSERVATIONS

Check List
Visual Inspection
Phase 1
(VA I.D. NO. 06701)

Name Dam Upper Blackwater River #6 County Franklin State VA Coordinates Lat. 3702.2 Long. 8001.6

Date(s) 16 May 1979 Weather Clear Temperature 75°F

Pool Elevation at Time of Inspection 1177.5 M.S.L. Tailwater at Time of Inspection 1155± M.S.L.

Inspection Personnel:

Hollace Bowman (Owner) James Robinson (COE) Stephen Hedrick (SCS) (BRS & WCD)

Fred Barnhardt (Owner) Hugh Gildea (SWCB)

Robert Cheng (COE)

Boris O. Taran (COE) Recorder

(SCS) Soil Conservation Service
(BRS & WCD) Blue Ridge Soil & Water Conservation District
(COE) Corps of Engineers
(SWCB) State Water Control Board

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	No visible cracks were noted on any face of the dam.	The surface of the dam was well covered with grass and it prohibited the detection of any cracks if there were any.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	No unusual movement or cracking was observed.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Mild sloughing exists about 4 feet above upper berm on downstream side of dam. About 40± to lt. of principal spillway a gully exists from the top berm to toe of dam on the downstream (D.S.) side. The gully depth varies from 6 inches to 2 feet 6 inches depth. On the U.S. side of embankment the lower berm is lightly vegetated.	Mild sloughing due to bare spots. The gully should be filled in to prevent further erosion. This area is very sensitive and will be subjected to wave action. This area should be protected by a good vegetative cover.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	No visible movement was noted.	
RIPRAP FAILURES	Riprap not used for embankment protection.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
DEBRIS ON EMBANKMENT	Tree limbs and branches from high watermark rest 2-3 feet below upper berm on upstream face.	Remove debris.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Downstream Bare spots noted on right abutment junction about at the mid point. Minor erosion caused by surface runoff at junction on right. Upstream Minor erosion caused by surface runoff at contact of abutment and embankment on right side.	All bare spots and erosion should be filled and reseeded.
ANY NOTICEABLE SEEPAGE	No noticeable wet areas were observed.	
DRAINS	Water flowing from both the drains was clear and was observed to be less than one gallon per minute.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	None noted. Concrete saddle supporting outlet pipe appeared to be in excellent condition.	
INTAKE STRUCTURE	Substantial debris accumulated in trash rack. Concrete portion of the riser could not be inspected due to inaccessability.	Intake structure should be kept free of debris at all times.
OUTLET STRUCTURE	24-inch diameter concrete pipe flowing 1/6 full discharges freely into a riprapped stilling basin.	
OUTLFT CHANNEL	Stilling basin extends approximately 30 feet with riprap lining. Some small trees and shrubs are growing in the riprap. A narrow channel 5 feet wide lies below the basin with a wide flat overbank.	Trees and shrubs should be removed in riprap area.
EMERGENCY GATE	Emergency gate wheel was not in place.	Emergency gate wheel is stored at landowner's premises.

EMERGENCY SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
APPROACH CHANNEL	Vegetated 2% slope. Steep slope encountered from water surface to approach channel.	
DISCHARGE CHANNEL	Vegetated 4% slope. Beyond channel a severe slope occurs so that any excess flow may cause immediate erosion of the discharge channel.	

INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
STAFF GAGES	No staff gage or recorder were noted.	Staff gage should be installed.

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Right bank of reservoir is very steep. The bank is grass covered with minor sloughing. Balance of a reservoir is wooded with mild to steep slopes. Shoreline around entire reservoir is covered with shrubs (alders) which will protect shoreline from wave action.	
SEDIMENTATION	Not investigated.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Small trees and shrubs growing in riprap. Some logs and branches were noted at the upper level of riprap. Stilling basin and channel appear in good condition. Channel 5 feet wide and 4 feet deep below stilling basin.	Remove trees and shrubs, and debris from riprap.
SLOPES	Flat flood plain 500 - 800 yards wide.	
APPROXIMATE NO. OF HOMES AND POPULATION	2 - 3 farms within 1 mile of dam. 6 - 10 people possible.	

APPENDIX IV

GEOLOGIC REPORT

Form SCS VA-67
Sheet 1 of 4

12-65

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

GENERAL

State Virginia County Franklin ; ___ ¼, ___ ¼, Sec. ___, T ___ R ___ ; Watershed Upper Blackwater River

Subwatershed ___ Fund class WP-2-2 (FP-2, WP-1, etc.) Site number 6 Site group 1 Structure class b

Investigated by Geologist (signature and title), Equipment used Backhoe; Dozer (Type, size, make, model, etc.) Date 7/70

SITE DATA

Drainage area size 2.56 sq. mi., ___ acres. Type of structure Earth Fill Purpose Flood Prevention

Direction of valley trend (downstream) South, Maximum height of fill 49.0 feet. Length of fill 525 feet.

Estimated volume of compacted fill required 93,000 yards

STORAGE ALLOCATION

	Volume (ac. ft.)	Surface Area (acres)	Depth at Dam (feet)
Sediment	149	10	24.5
Floodwater	362	33	40

SURFACE GEOLOGY AND PHYSIOGRAPHY

Physiographic description Piedmont, Topography Moderate to steep, Attitude of beds: Dip -- Strike --

Steepness of abutments: Left 33 percent; Right 33 percent. Width of floodplain at centerline of dam 275 feet

General geology of site: Upper Blackwater Site #6 is located in northwestern Franklin County, 10 miles west of Rocky Mount, Virginia. The site lies on a northern tributary of the Upper Blackwater River. Muscovite schist of the Lynchburg formation (Precambrian) underlies this site. The schist is exposed in the stream bottom in the foundation and in a small outcrop on the right abutment.

Thin residual soil lies on the left abutment, and residual soil is thicker on the right. Micaceous silty sand constitutes a C-horizon over the schist and is overlain by a red clay B-horizon (absent on the left abutment). Shallow alluvium underlies the floodplain. It consists of quartz gravel, silty sand, and sandy silt layers. Some colluvial silt is at the toe of each abutment.

HERMAN/WATTSVILLE, MD. 1966

On the right side, this colluvium partly extends over alluvial SM. Weathered schist, as sandy gravel with silt, lies beneath the floodplain alluvium.

The Virginia Blue Ridge complex of gneisses lies just northwest of this site. The gneisses were intruded into the rocks of the Lynchburg formation in Precambrian time. The stream pattern is dendritic.

Methods and Procedures

1. The Unified Soil Classification System was used in describing soils encountered on the test pits.

2. All test pits were dug by backhoe. Twenty-five pound samples were taken of all significantly different materials.

Centerline of the Dam

The centerline of the dam crosses a moderately wide valley bottom between steep abutments. On the left abutment, residual soil extends from Sta. 4+00 to the top of the dam. Gray to brown micaceous silty sand, 2 - 3 feet thick, overlies hard schist. This SM is the C-horizon. The B-horizon is absent here. At the toe of the abutment, the micaceous sand is overlain by 2 feet of colluvial red-brown clayey silt. On the right abutment, residual soil extends from Sta. 1+25 to the top of the dam. Brown to gray micaceous silty sand, 2 - 6.5 feet thick, overlies schist. Downslope from 0+50 there is no B-horizon, but upslope from this point 1.5 - 1.25 feet of red silty clay (B-horizon) overlies the SM. Depth to rock on the left abutment varied from 2.5 to 5 feet. On the right abutment, rock was from 6 to 8.2 feet below ground.

In the floodplain, 1.3 to 2.0 feet of gray sandy silt to silty sand overlies hard schist on the left side and weathered schist (GM) 1.2 feet thick on the right. Red-brown silty sand, 3 feet thick, overlies the gray ML-SM, except at the centerline of the pipe where it lies directly on weathered schist. At the toe of the right abutment, 3 feet of red clayey silt with sand overlies the gray ML-SM. This red ML is thought to be colluvial.

Depth to bedrock in the floodplain varies from 3 feet at the ℄ pipe to 6 feet at the right edge. The water table at the time of investigation lay about 4.8 feet below the surface. Eight holes were dug along the ℄ dam. They are numbered TP-1 to TP-8.

Centerline of the Pipe

The centerline of the pipe crosses the centerline of the dam at 3+00 ℄ dam and 3+75 ℄ pipe. The two centerlines cross at right angles. The pipe parallels the creek, about 50 feet to the right of it.

Red-brown silty sand is the top alluvial layer, as along the ℄ dam. At the upstream end of the pipe, this layer is 1 foot thick (below topsoil) and overlies 1.1 feet of yellow-brown SM, which in turn overlies 0.6 feet of hard, quartz pebble and cobble gravel. At bottom is hard schist. At the ℄ dam the other alluvial layers wedge out and the red-brown SM lies on weathered schist. At the downstream end, red-brown SM, 2.5 feet thick, overlies quartz gravel, 1.8 feet thick.

The rock line declines from 1156.5 feet (Sta. 2+50) to 1152.0 feet (5+00) in elevation. The water table lay 3.5 feet below the surface at the time of investigation. Two test pits were dug along the ℄ pipe. They are numbered TP-301 and TP-302.

Emergency Spillway

The revised centerline of the emergency spillway crosses the ℄ of the dam at -1+55 ℄ dam and 4+07 ℄ EMS. The two centerlines form an angle of 45°. The original ℄ of the spillway lay 30 feet to the left of and parallel to the new centerline. Red silty clay, 2.5 to 4.0 feet thick, overlies 2.75 to 6.25 feet of brown to gray micaceous silty sand. The micaceous sand, sometimes gravel, is residual on schist, as on the ℄ dam. Along the old centerline of the emergency spillway, a thin layer of quartz pebble and cobble gravel, 0.25 to 0.9 feet thick, lies between the micaceous sand and the clay above. This gravel layer, and the red CL above it are apparently an old stream terrace soil.

Backhoe refusal on schist occurred from 2 to 9.2 feet below the surface. Six test pits were dug in the spillway. They are numbered TP-201 and TP-206. The pits were dug along the ℄ and outside edge of the spillway before revision.

Borrow Area

The borrow area consists of alluvium and colluvium extending 1000 feet or more upstream from the centerline of the dam. Alluvium, in the upstream portion, consists of red-brown sandy silt to fine silty sand, 1.25 to 4.0 feet thick, underlain by gray silty sand, 1.85 - 2.25 feet thick. A foot or more of quartz pebble and cobble gravel underlies the sand layers. Downstream, the red-brown sandy silt overlies brown sandy silt with clay.

Colluvium, in the lower right slope, consists of red silty clay, 3 - 4.5 feet thick, over 2 - 5.4 feet of red to brown sandy silt with clay. Weathered schist lies from 4 to 9 feet below the surface. The water table lay from 4 to 10 feet or more below the surface at the time of investigation.

Form SCS-534
MAY 55

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL SAMPLE LIST
SOIL AND FOUNDATION INVESTIGATIONS

Location Franklin County, Va. Owner _____

Watershed Upper Blackwater R. Sub-watershed -- Site No. 6

Submitted by J. W. Gaffney Date Nov. 1970

Sent by Trans. Co. (carrier) Government B/L No. _____

Lab. No.	Field Sample No.	Sample Description		Depth		Type of Sample	
		Location	Grid or Station	From	To	Undist.	Dist.
	3-1	℄ Dam	1+30	1.0	3.5		x
	4-1	"	3+50	1.0	3.5		x
	6-1	"	4+50	1.0	3.5		x
	7-1	"	4+00	1.0	2.5		x
	101-1	Borrow Area		4.4	6.25		x
	102-1	"		1.0	3.0		x
	103-1	"		1.7	4.5		x
	202-1	Outside Edge EMS	2+00	1.0	4.0		x
	204-1	℄ EMS	4+00	2.75	9.0		x

Original to Soils Laboratory
Copy to E and WP Unit
Distribute other copies as directed by State Conservationist

VA 619
Sheet 4 of 4 Sheets

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SCS-376C
REV. 2-64
SHEET 1 OF 3

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

WATERSHED	SUBWATERSHED	COUNTY	STATE
Upper Blackwater River		Franklin	Virginia

SITE NO.	SITE GROUP	STRUCTURE CLASS	INVESTIGATED BY: (SIGNATURE OF GEOLOGIST)	DATE
6	1	b		7/70

FOR IN-SERVICE USE ONLY
INTERPRETATIONS AND CONCLUSIONS

1. Cutoff should be made into hard schist to at least a level above the sediment pool (2nd 50-year stage). This will involve a cutoff trench from 3 - 10 feet deep. Although much of the floodplain could not be investigated due to cultivation, test pits indicate a shallow depth to cutoff here.

2. The pipe location appears satisfactory. A clay cushion should be emplaced under the pipe.

3. The schist in the emergency spillway is expected to be rippable.

4. There should be sufficient borrow to construct the embankment. Good core material is present in the colluvium on the lower right slopes. See the soils correlation chart for placement of borrow materials.

5. All topsoil should be stockpiled for use as top dressing.

Upper Blackwater River			6		Va.			J.W.Gaffney		11/70
DS-102-1	1.0-3.0	ML	101	0.5-4.4	SM	Flood-plain	Transition		30,000	Alluvi
			102	0.5-3.0	ML	"	"			"
			103	0.5-1.7	ML	"	"			"
			106	0.5-4.0	ML	"	"			"
			109	0.5-1.75	SM	"	"			"
DS-103-1	1.7-4.5	ML	102	3.0-6.0	ML	Flood-plain	Transition		25,000	Alluviu
			103	1.7-4.5	ML	"	"			"
			104	0.5-4.0	SM	"	"			"
DS-101-1	4.4-6.5	ML-SM	101	4.4-6.5	ML-SM	Flood-plain	Transition		25,000	Alluviu
			102	6.0-8.75	ML	"	"			"
			103	4.5-5.9	ML	"	"			"
			109	1.75-4.0	SM	"	"			"
DS-202-1	1.0-4.0	CL	107	0.5-5.0	CL	Lower Rt.Slopes	Core		20,000	Colluvi residua
			108	0.5-3.5	CL	"	"			"
			201	0.5-4.0	CL	EMS	"		10,000	"
			202	0.5-4.0	CL	"	"			"
			203	0.5-6.8	CL	"	"			"
			204	0.5-2.5	CL	"	"			"

Upper Blackwater River			6		Va.		J.W.Gaffney		11/70
DS-202-1	1.0-4.0	CL	206	0.5-2.75	CL	EMS	Core	10,000	Colluvi Residua
DS-3-1	1.0-3.5	ML	107	5.0-7.0	ML	Lower Rt. Slopes	Core	25,000	Colluvi
			108	3.5-8.9	ML	"	"		"
DS-204-1	2.75-9.0	SM	201	4.0-8.8	SM	EMS	Shell	10,000	Schist Residua
			202	4.0-9.0	SM	"	"		"
			203	7.7-9.2	SM	"	"		"
			204	2.75-9.0	SM	"	"		"
			206	2.75-5.5	SM	"	"		"
								145,000	TOTAL

APPENDIX V

DESIGN REPORT

UNITED STATES DEPARTMENT OF AGRICULTURE

SOIL CONSERVATION SERVICE - Soil Mechanics Laboratory

800 "J" Street, Lincoln, Nebraska 68508

SUBJECT: ENG 22-5, Virginia WP-08, Upper Blackwater Site No. 6 (Franklin County)

DATE: February 25, 1971

TO: Louis S. Button, Jr., State Conservation Engineer
SCS, Richmond, Virginia

ATTACHMENTS

1. Form SCS-354, Soil Mechanics Laboratory Data, 2 sheets.
2. Form SCS-128, Consolidation Test Data, 1 sheet.
3. Form SCS-127, Soil Permeability, 1 sheet.
4. Form SCS-355A & B, Triaxial Shear Test Data, 2 tests, 4 sheets.
5. Form SCS-352, Compaction and Penetration Resistance, 6 sheets.
6. Form SCS-357, Summary - Slope Stability Analysis, 2 sheets.
7. Investigational Plans and Profiles.

DISCUSSION

GENERAL

The proposed 49-foot high hazard class b dam is located in the Piedmont physiographic area in Franklin County.

FOUNDATION

A. Bedrock. The bedrock at this site is logged as Muscovite schist of the Lynchburg formation. The bedrock outcrops in the stream channel and on a small area on the right abutment. On the abutments the bedrock is mantled with about 2 to 8 feet of residual soil, and in the floodplain section the alluvium is generally less than 6 feet thick.

B. Soil Classification. The residual soil on the left abutment is logged as SM. A sample from test hole 6 on this abutment is a very micaceous sandy soil classed as SP. The residual soil on the right abutment is logged as SM overlying bedrock. In the upper portion where weathering has progressed to a greater depth, the residual surface zone is logged as CL. Samples of colluvium were submitted from test hole 7 and test hole 3 located near the base of each abutment. These samples contain about 70 percent fines and about 30 percent finer than 0.002 mm. Sample 3-1 has an LL of 36, a PI of 10, and Sample 7-1 is nonplastic. Both samples are classed as ML.

The alluvium is logged primarily as SM and GM. A sample from test hole 4-1 contains 20 percent fines. It is classed as a nonplastic SM.

C. Engineering Properties. Undisturbed samples were not submitted for engineering properties tests.

EMBANKMENT

A. Soil Classification. Borrow samples were submitted representing residual soil from the emergency spillway and alluvium from the borrow area. The samples from the emergency spillway represent a fine-grained soil classed as MH and a coarse-grained soil classed as SM.

The samples of alluvium are fine-grained materials that contain from 56 to 76 percent fines. The liquid limits range from 35 to 40 and the PI's range from 8 to 10. The samples are classed as ML.

B. Compacted Density. Standard Proctor compaction tests were made on one sample of colluvium, two samples of residual soil, and on three samples of alluvium. The maximum dry density obtained ranged from 91 pcf on a residual MH to 103.5 pcf on an alluvial ML.

C. Consolidation. A consolidation test was made on Sample 202-1. The test specimen was compacted to 95 percent of standard Proctor density, and it was flooded at the start of the test. The data indicate that at this density this material has a consolidation potential of about 0.05 ft/ft for a loading equivalent to that at the base of the proposed embankment.

D. Shear Strength. Consolidated undrained triaxial shear tests were made on Samples 202-1 and 102-1. The test specimens were compacted to 95 percent of Proctor density and they were backpressured to saturate them. The test data obtained are summarized as follows:

Sample No.		Test γ_d		B	Shear Strength Parameters			
					Total Stress		Effective Stress	
Field	Laboratory	pcf	% Proctor	Parameter	ϕ deg.	c psf	$\bar{\phi}$ deg.	$\bar{c}$ psf
202-1	71W1239	87.5-88.4	96.0-97.0	0.95-0.98	21.5	325	38.0	0
102-1	71W1242	96.9-97.4	95.0-95.5	0.98-1.0	13.0	400	30.5	0

SLOPE STABILITY

A slope stability analysis was made with a computer and the SCS program. The analysis considers the full drawdown condition on the upstream slope and the steady seepage condition on the downstream slope. The analysis was made for the maximum section where the foundation is bedrock.

The inventory of materials indicates that there is about 20,000 cubic yards of the fine-grained material like Sample 202-1 and about 10,000 cubic yards of the sandy material like 204-1 in the emergency spillway. The remainder of the embankment material will consist of alluvium from the floodplain or colluvial and residual material from the lower right slopes. A check was made with laboratory charts and it was determined that for the embankment planned the shear strength of the alluvial ML was slightly less than that of the residual MH. The MH test specimens were at a little higher percent of Proctor density, however. In order to consider both materials in the analysis, it was assumed that the MH would be utilized in the central section and that the remainder of the fill would be represented by the ML tested. A summary of the analysis is attached, and it shows that two 10-foot berms are required on the $2\frac{1}{2}$:1 downstream slope in order to get an acceptable factor of safety and that a 3:1 upstream slope with two 10-foot berms is required in order to get an acceptable factor of safety.

The 3:1 upstream slope was checked with an infinite slope analysis also assuming a $\bar{\phi}$ value of 35° and $\bar{c} = 0$. This is intended to represent the SM material like Sample 204-1. The $\bar{\phi} = 35°$ value was assumed based on effective stress parameters obtained on the ML and the MH. Assuming that the flow lines are parallel to the slope, the factor of safety is 1.04. For the assumption that the flow lines are horizontal the factor of safety computed is 0.92. This is based on a material with a saturated unit weight of 124 pcf. The factors of safety computed for a $3\frac{1}{2}$:1 slope are $F_s = 1.22$ for the assumption of parallel flow and $F_s = 1.11$ for the assumption of horizontal flow by the infinite slope method.

CONCLUSIONS AND RECOMMENDATIONS

A. Site Preparation. The alluvium has not been tested and it ranges in thickness from about 2 to 5 feet. Unless this material is known to be strong, we suggest that it be removed from the base area.

B. Cutoff. We concur with the suggestion to bottom the cutoff trench in hard schist below elevation of the second 50-year stage on the abutments. The cutoff for the floodplain section will be somewhat dependent upon whether or not the alluvium is removed. If the alluvium is removed, a normal width cutoff that bottoms in firm bedrock is suggested. If all of the alluvium is not removed, then a wider than normal cutoff trench that bottoms in firm bedrock is suggested.

We recommend that the trench backfill be compacted to a minimum of 95 percent of standard Proctor density.

C. Principal Spillway. The proposed alignment crosses the centerline of dam at Station 3+00. Upstream from centerline the alluvium is about 3 feet thick and at TP-302, which is located 125' downstream

from centerline, the alluvium is about 5 feet thick. The location appears to be satisfactory and it appears that the conduit can be bedded on or in close proximity of the bedrock. Some settlement might be expected in the weathered schist bedrock but we do not have enough information on it to make an estimate.

D. Drain. We recommend that a drain be installed to provide a controlled outlet for seepage that bypasses the cutoff trench. On the basis of the present data it appears that the weathered bedrock will be more permeable near the surface than it is at depth; and if so, then a trench drain that penetrates the bedrock several feet may be used.

The gradation of the alluvium and of the weathered bedrock appears to be variable, and for this reason it appears that it would be advisable to use a double-layer drain with a material like ASTM fine concrete aggregate as the fine element and a material like ASTM No. 78 coarse aggregate as the coarse element. The filter requirements should be evaluated on site, however, when the trench is opened.

E. Embankment Design.

1. Placement of Materials. We suggest selective placement of materials to utilize the MH in the interior portion of the dam and the sandy residual material in the upstream slope. The ML alluvium may be used for the rest of the embankment.

   We recommend that all materials be placed at a minimum of 95 percent of standard Proctor density with the control based on the minus No. 4 fraction. A placement moisture content slightly wet of optimum is suggested.

2. Slopes. For a placement density of 95 percent of Proctor density the following slopes are suggested:

   a. Upstream - 3½:1

   b. Downstream - 2½:1 with 10-foot berms at elevations 1180.4 and 1172.0

   As an alternative to flattening the upstream slope and adding berms to the downstream slope, a higher placement density might be used. It would be necessary to determine the shear strength at the increased density and make another stability analysis to determine how effective this would be, however.

3. Settlement. An overfill allowance of ~~1.25~~ 1.50 ft. feet is suggested to compensate for residual consolidation.

Lorn P. Dunnigan

Lorn P. Dunnigan
Head, Soil Mechanics Laboratory

Attachments

cc:
L. S. Button (4)
Neil F. Bogner, Upper Darby, Pa. (2)

Form SCS 357
Rev 6-65

MATERIALS TESTING REPORT	U. S. DEPARTMENT of AGRICULTURE SOIL CONSERVATION SERVICE	SUMMARY - SLOPE STABILITY ANALYSIS

PROJECT and STATE: UPPER BLACKWATER SITE #6 VIRGINIA

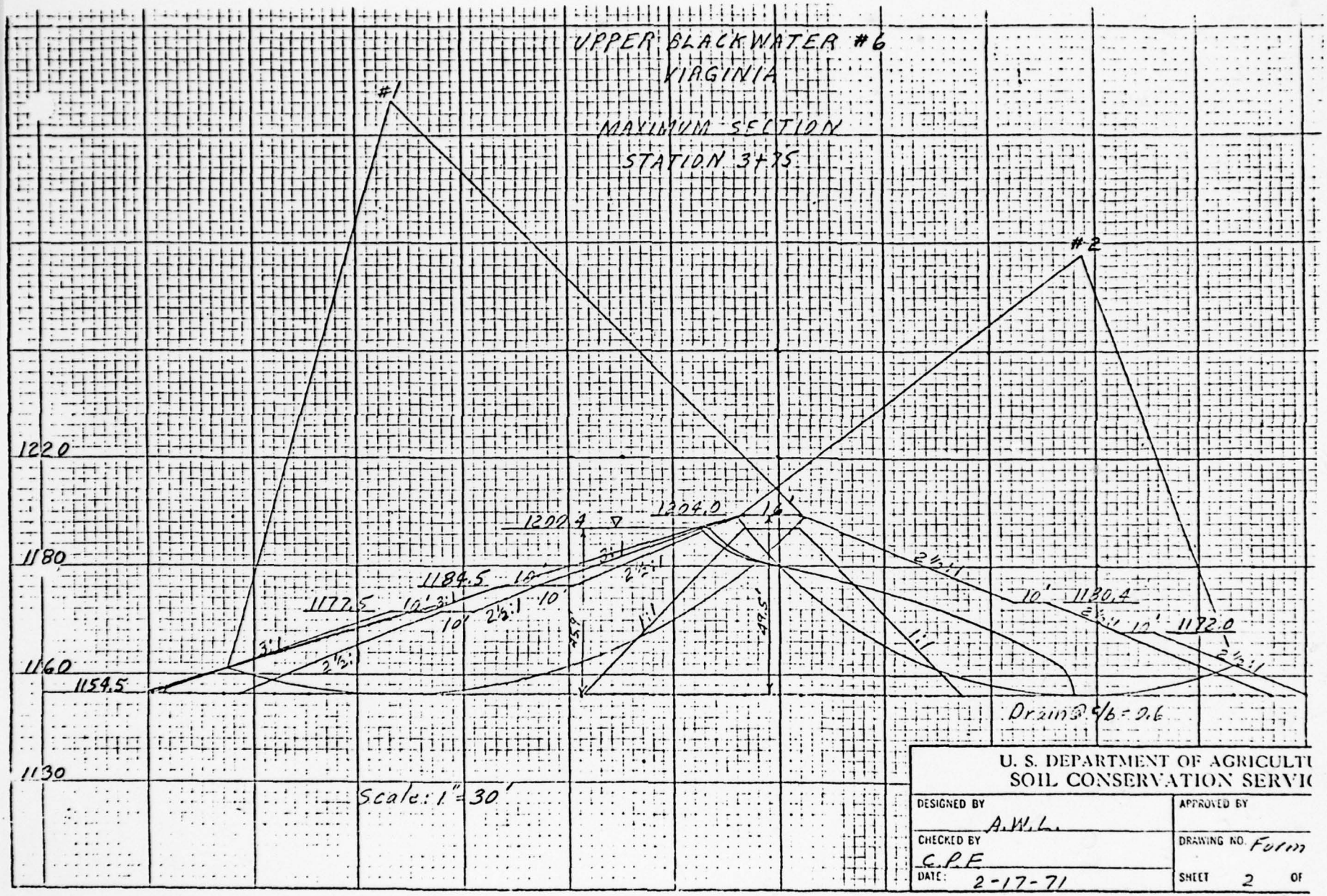
DATE: 2-17-71

METHOD OF ANALYSIS: SWEDISH CIRCLE

ANALYZED AT: S.M.L., LINCOLN, NE

APPROVED BY:

TRIAL NO.	SLOPE	SOURCE AND USE OF MATERIALS	CLASSIFICATION	ADOPTED DESIGN DATA: Yd (pcf)	Ym (pcf)	Ysat (pcf)	Ysub (pcf)	ϕ (deg.)	Ion ϕ	c (psf)	REMARKS	Fs
①		EMBANKMENT 1	ML	97.1	112.5	124.0	61.5	13.0	0.231	400	CU	
②								30.5	0.589	0		
③		EMBANKMENT	MH	88.1	113.0	118.5	56.0	21.5	0.394	325	CD	
④								38.5	0.795	0		
⑤												
⑥												
⑦												
⑧												
1 C/p	2½:1	MAXIMUM SECTION CONDITIONS AT STATION 3+75 Fulldrawdown-10'berms@elev's.1172.5&1182.5-Arc cut thru zoned embankment only. Shell (13°-400), Core (21.5-325).										1.24
1A C/p	3:1	Same conditions as trial #1 except 3:1 slope.										1.36
2 Dn	2½:1	Drain @ c/b = 0.6 - 10' berm @ elev. 1180.4 - Arc cut thru zoned emb only. Emb. zoning same as trial #1.										1.42
2A Dn	2½:1	Same conditions as trial #2 except 10' berm added @ elev. 1172.0										1.53
		Computer stability Analysis: Only minimum factors of safety are shown.										



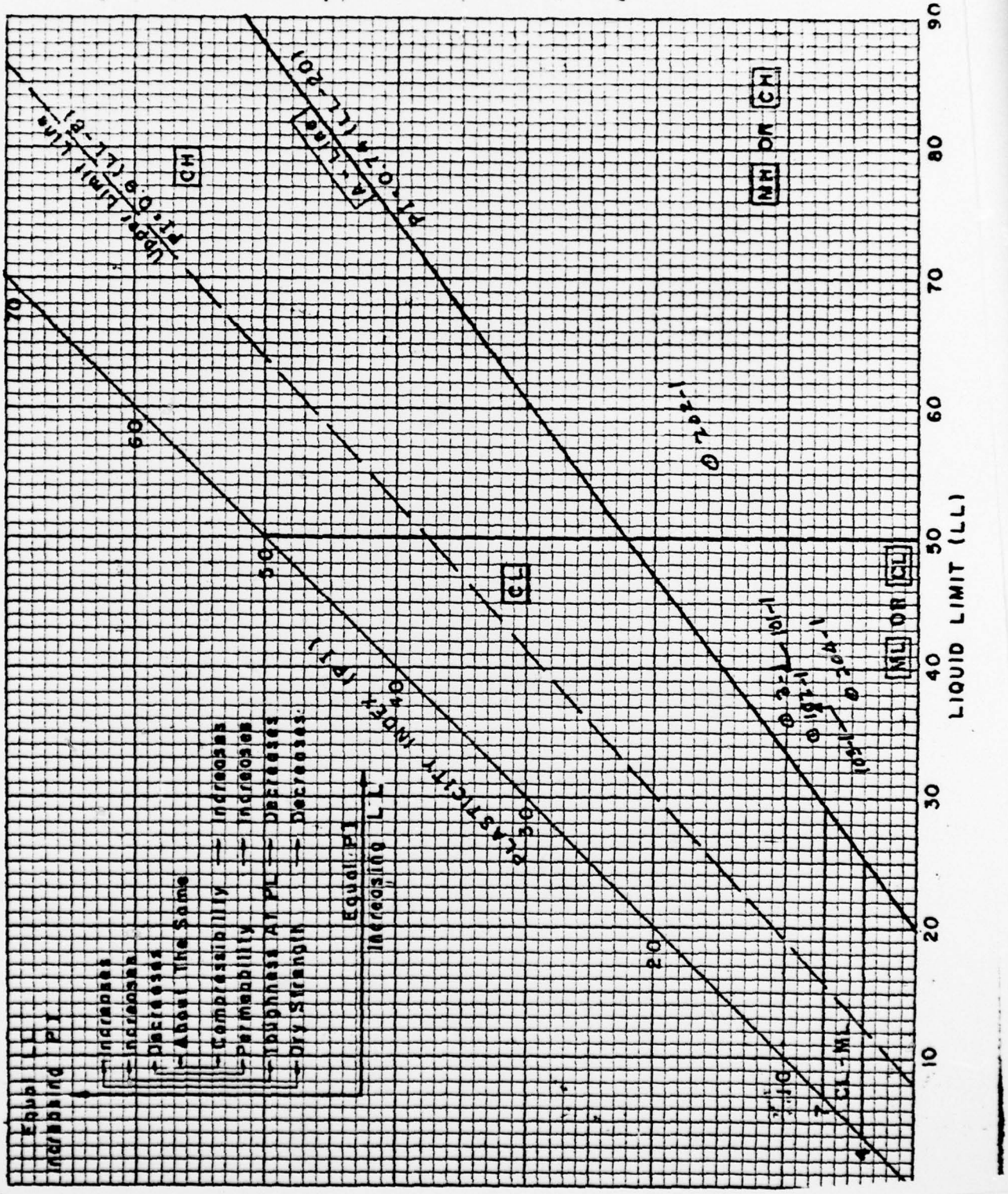
U. S. DEPARTMENT OF AGRICULTU
SOIL CONSERVATION SERVIC

DESIGNED BY A.W.L.	APPROVED BY
CHECKED BY C.P.E	DRAWING NO. Form
DATE: 2-17-71	SHEET 2 OF

Form

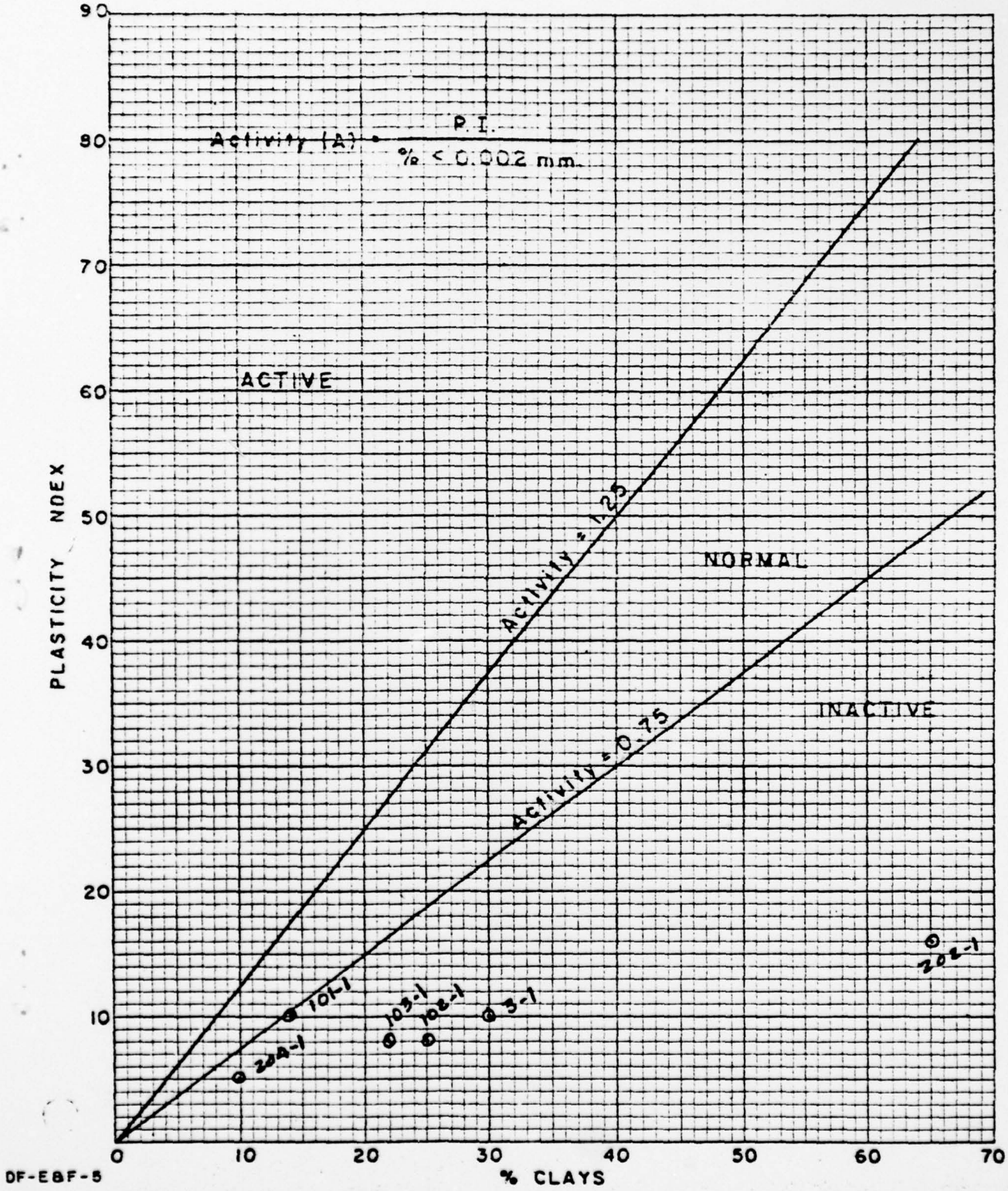
#6

State VIRGINIA		Project: UPPER BLACKWATER DAM NO. 6		
By RDH	Date 4/71	Checked by	Date	Job No VA-619-58F
Subject PLASTICITY PLOT				Sheet 4 of



58F-4

State VIRGINIA	Project UPPER BLACKWATER DAM NO. 6	
By RDH Date 4/71	Checked By	Date
Subject ACTIVITY PLOT		Sheet 5 of



DF-EBF-5

State VIRGINIA | Project UPPER BLACKWATER DAM NO. 6

By RDH | Date 4-71 | Checked By | Date | Job No. VA-619-EE

Subject CLASSIFICATION OF EMBANKMENT MATERIALS | Sheet 6 of

SAMPLE	DEPTH	U.S.C.S.	D_{50} m.m.	P.I.	L.L.	% 0.005 m.m.	PIPING *	CRACKING *	REMARKS
204-1	2.75-9.0	SM	2.6	5	38	12	5	3	
202-1	1-4'	MH	-	14	56	70	4	6	
102-1	1-3'	ML	0.015	8	35	37	5+	4+	
103-1	1.7'-4.5'	ML	0.035	8	37	37	5+	4+	
101-1	4.4-6.25'	ML	0.043	10	40	26	4	6	

* DEGREE OF RESISTANCE (1 GREATEST TO 6 LEAST)

DF-E&F-3

State VIRGINIA | Project UPPER BLACKWATER DAM NO. 6

By RDH | Date 4/71 | Checked By | Date | Job No. VA-619-E&F

Subject CLASSIFICATION OF FOUNDATION MATERIALS | Sheet 2 of

SAMPLE	DEPTH	U.S.C.S.	D_{50} m.m.	P.I.	L.L.	% 0.005 m.m.	PIPING *	CRACKING *	REMARKS
7-1	1-2.5'	ML	0.013	-	-	43	4	6	
3-1	1-3.5'	ML	0.015	10	36	42	5+	5	
4-1	1-3.5'	SM	0.17	-	-	8	5	3	
6-1	1-3.5'	SP	20.0	-	-	3	3	3	

* DEGREE OF RESISTANCE (1 GREATEST TO 6 LEAST)

COMPUTATION SHEET
SCS-ENG-523 Rev. 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

☆ GPO 1969—O-357-545

STATE		PROJECT		
VIRGINIA		UPPER BLACKWATER DAM NO. 6		
BY	DATE	CHECKED BY	DATE	JOB NO
RAH	4/71			VA-619-E&F
SUBJECT				SHEET 8 OF
MATERIAL INVENTORY				

Geology Report

ML from borrow

30,000
25,000
25,000
20,000
100,000 cu yds

EMS.

10,000
10,000
25,000
10,000
55,000 cu. yds.

Required

98,190 Total Emb.
2,614 cut off trench
542 Principal Spillway
2,477 Ems. under cut
103,823 cu. yds to build dam

∴ enough material is available
To Build DAM

STATE VIRGINIA | PROJECT UPPER BLACKWATER DAM #6

BY RDI | DATE 4/71 | CHECKED BY | DATE | JOB NO VA-619-EAF

SUBJECT EARTH FILL REQUIREMENTS | SHEET 9 OF

EARTH FILL REQUIREMENTS

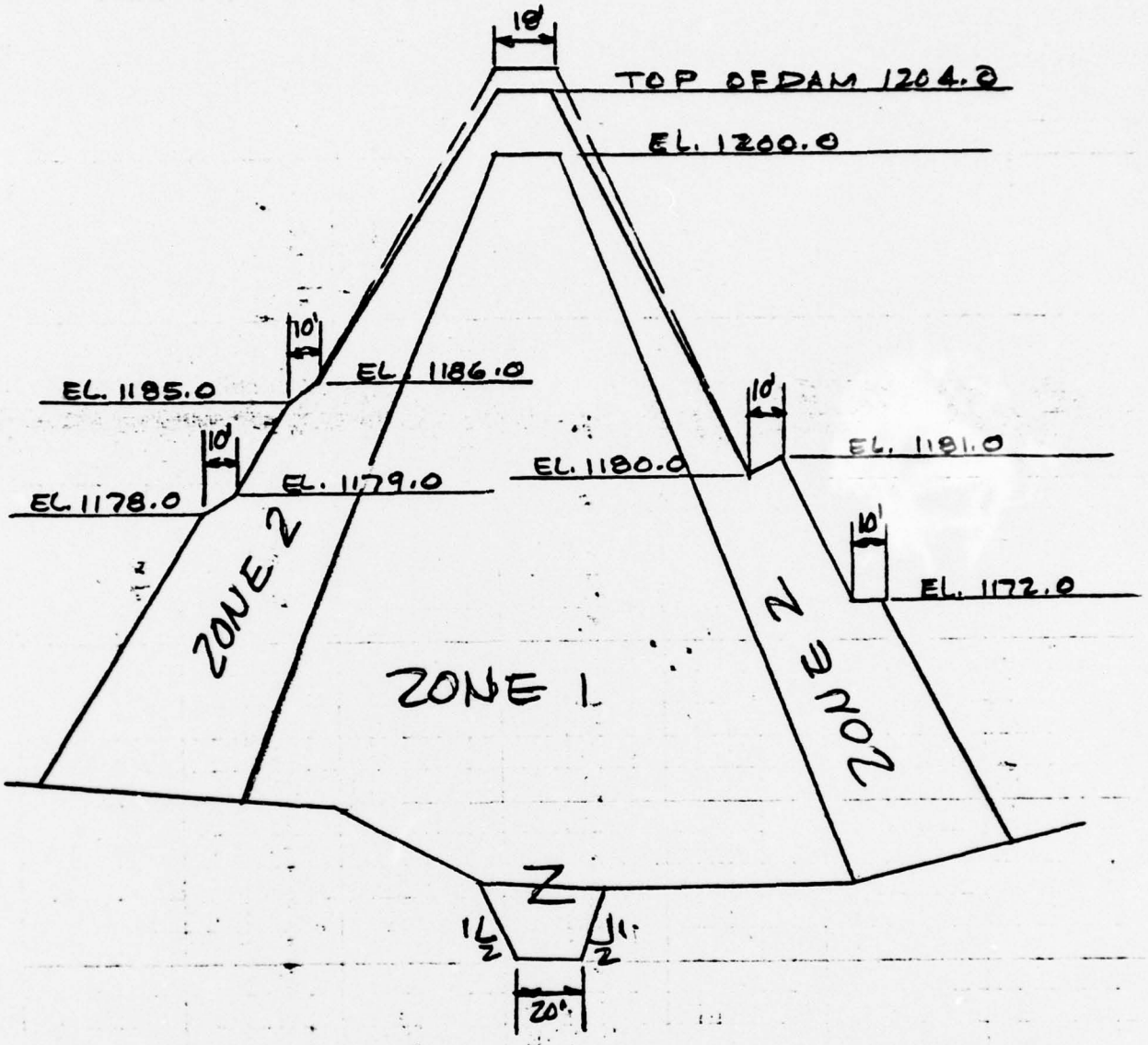
ZONE	MATERIAL	SOURCE	MAX. ROCK SIZE [1]	MAX. LIFT [2] THICKNESS	REQUIRED WATER CONTENT	COMPACTION [3] CLASS	COMPACTION [3] DEFINITION
I	Silty Sands & Gravelly Sands (SM & SW) 202-1 1-4' 204-1 2,7S 1-9.0'	Emb. Spwy	6"	9"	+ Optimum	A	98% MAX. Density by ASTM D698 METHOD A
II	Silts & very fine Sands (ML) Reposited by Hydraulic Fill 101-1 4,4 2,2S 1-3' 102-1 1-3' 103-1 1-7,4 1S'	Borrow A	6"	9"	+ optimum	A	95% MAX Density by ASTM D698 METHOD A

1. FOR FILL ADJACENT TO STRUCTURES, MAX. ROCK SIZE = 3"
2. AT TIME OF PLACEMENT
3. FOR TYPICAL COMPACTION CURVES SEE Plate 5ht.

COMPUTATION SHEET
SCS-ENG-523 Rev 8-69

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
☆GPO 1969—O-357-345

STATE VIRGINIA		PROJECT UPPER BLACKWATER DAM NO. 6		
BY RDH	DATE 4/71	CHECKED BY	DATE	JOB NO. VA-619-E&F
SUBJECT TYPICAL SECTION				SHEET 10 OF



#6

U.S. DEPARTMENT OF AGRICULTURE - SOIL CONSERVATION SERVICE

DESIGN REPORT SUMMARY

I. Watershed Data		
A. Structure Class	b	
B. Drainage Area	1638	Ac.
C. Time of Concentration - T_c	3.67	Hrs.
D. Hydrologic Curve Number - C_n		
1. Moisture Condition II	62.0	
II. Principal Spillway		
A. Conduit		
1. Inside Dia.	24.	In.
2. Length	312.	Ft
B. Riser		
1. Inside Dimensions	2'x6'	Ft.
2. Height (Floor to Crest)	18.0	Ft.
C. Weir Length	12	Ft.
D. Orifice Dimensions	-	In.
E. Reservoir Drain Size	24.	In.
F. Type of Energy Dissipater	Plunge Pool (unrapped)	
III. Emergency Spillway		
A. Width	150.	Ft.
B. Side Slopes	3:1	
C. Length of Level Section	30.	Ft.
D. Exit Slope	0.040	Ft/Ft.
E. Max. Velocity in Exit Section @ D.H.W.	4.5	Ft/Sec.
F. Duration of Flow thru Emer. Spillway @ D.H.W.	6.75	Hrs.
G. Frequency of Use	Once in 100yrs: 1%	
IV. Earth Fill		
A. Height	45.	Ft.
B. Volume	104,300.	C.Y.
C. Compaction	Class A Compaction	

FILL PLACEMENT

Sht. 4

APPENDIX VI

REFERENCES

1. Recommended Guidelines for Safety Inspection of Dams, Office of the Chief of Engineers, Department of the Army, Washington, D.C.

2. HEC-1DB Flood Hydrograph Package (Hydrologic Engineering Center, U.S. Army Corps of Engineers, September 1978).

3. "Seasonal Variation of the Probable Maximum Precipitation East of the 105th Meridian", Hydrometeorological Report No. 33, (U.S. Weather Bureau, April 1956).