

AD-A063 544

BAKER (MICHAEL) JR INC BEAVER PA  
NATIONAL DAM SAFETY PROGRAM. STONY CREEK NUMBER 9 (INVENTORY NU--ETC(U)  
AUG 78 M BAKER

F/G 13/2  
DACW65-78-D-0016  
NL

UNCLASSIFIED

1 OF  
AD  
A063 544



**Name Of Dam:** STONY CREEK NO. 9

**Location:** SHENANDOAH COUNTY, STATE OF VIRGINIA

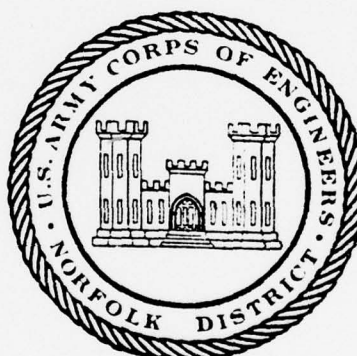
**Inventory Number:** VA 17101

AD A063544

1

# LEVEL PHASE I INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM

DDC FILE COPY



DDC  
RECEIVED  
JAN 22 1979  
D

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

**BY**

**DISTRIBUTION STATEMENT A**  
Approved for public release;  
Distribution Unlimited

**MICHAEL BAKER, JR., INC.**  
**BEAVER, PENNSYLVANIA 15009**

79 01 16 18

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM	
1. REPORT NUMBER VA 17101	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER	
4. TITLE (and Subtitle) Phase I Inspection Report National Dam Safety Program, Stony Creek No. 9 Number 9 Inventory Number VA 17101 Shenandoah County, State of Virginia, Phase I Inspection Report		5. TYPE OF REPORT & PERIOD COVERED Final	
7. AUTHOR(s) Michael/Baker, Jr., Inc.-Michael/Baker, III		6. PERFORMING ORG. REPORT NUMBER	
		8. CONTRACT OR GRANT NUMBER(s) DACW 65-78-D-0016	
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS	
11. CONTROLLING OFFICE NAME AND ADDRESS U. S. Army Engineering District, Norfolk 803 Front Street Norfolk, VA 23510		12. REPORT DATE	
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) (9) Final repty		13. NUMBER OF PAGES 65	
		15. SECURITY CLASS. (of this report) Unclassified	
16. DISTRIBUTION STATEMENT (of this Report) Approved for public release; distribution unlimited. (11) 23 Aug 78 (12) 68p.		15a. DECLASSIFICATION/DOWNGRADING SCHEDULE	
17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from 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)			

## 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.

# LEVEL II

ACCESSION for	
NTIS	White Section <input checked="" type="checkbox"/>
DDO	Out Section <input type="checkbox"/>
UNANNOUNCED	<input type="checkbox"/>
JUSTIFICATION	
BY	
DISTRIBUTION/AVAILABILITY CODES	
Dist.	AVAIL. and/or SPECIAL
A	

DDC  
RECEIVED  
JAN 22 1979  
D



PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM

CONTENTS

	<u>Page</u>
Brief Assessment of Dam. . . . .	1
Overall View of Dam. . . . .	3
Section 1: Project Information. . . . .	5
Section 2: Engineering Data . . . . .	9
Section 3: Visual Inspection. . . . .	11
Section 4: Operational Procedures . . . . .	13
Section 5: Hydraulic/Hydrologic Data. . . . .	15
Section 6: Dam Stability. . . . .	17
Section 7: Assessment/Remedial Measures . . . . .	21

Appendices

- I. Plates
- II. Photographs
- III. Check List - Visual Inspection
- IV. Check List - Engineering Data
- V. Annual Maintenance Inspection Reports
- VI. Geologic Report
- VII. Stability Analyses

NAME OF DAM: STONY CREEK NO. 9

PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM

Name of Dam: Stony Creek No. 9  
State: Virginia  
County: Shenandoah  
Stream: Stony Creek.  
Date of Inspection: 15 June 1978

BRIEF ASSESSMENT OF DAM

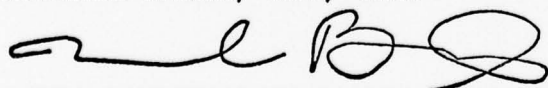
The Stony Creek Dam No. 9 is an earthfill dam approximately 73 feet high and 705 feet long, owned by Bryce Mountain Ski and Country Club and operated by the Lord Fairfax Soil and Water Conservation District. The visual inspections and review of engineering data, made in June 1978, indicate no deficiencies requiring emergency attention.

The spillway will pass the Probable Maximum Flood without overtopping the dam. Because of its clear seepage at the downstream toe, it is recommended that the owner conduct additional studies to assess piping potential and slope stability. The owner should also perform slope stability analyses using the as-built embankment section(s).

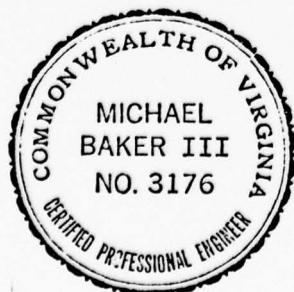
It is additionally recommended that the following items be included in the next maintenance period:

- 1) Repair erosion starting along the right abutment contact. Stone gutters will resist erosion at this location.
- 2) Reseed the major portions of the upstream and downstream faces of the dams where vegetation is very sparse.
- 3) Repair the lifting pedestal mount on the primary spillway.
- 4) Replace the trash racks damaged by ice, preferably by a type that is not as susceptible to ice damage.
- 5) Thin the heavy vegetation along the downstream channel.

MICHAEL BAKER, JR., INC.



Michael Baker, III, P.E.  
Chairman of the Board and  
Chief Executive Officer



APPROVED: Original signed by:

Douglas L. Haller

Douglas L. Haller  
Colonel, Corps of Engineers  
District Engineer

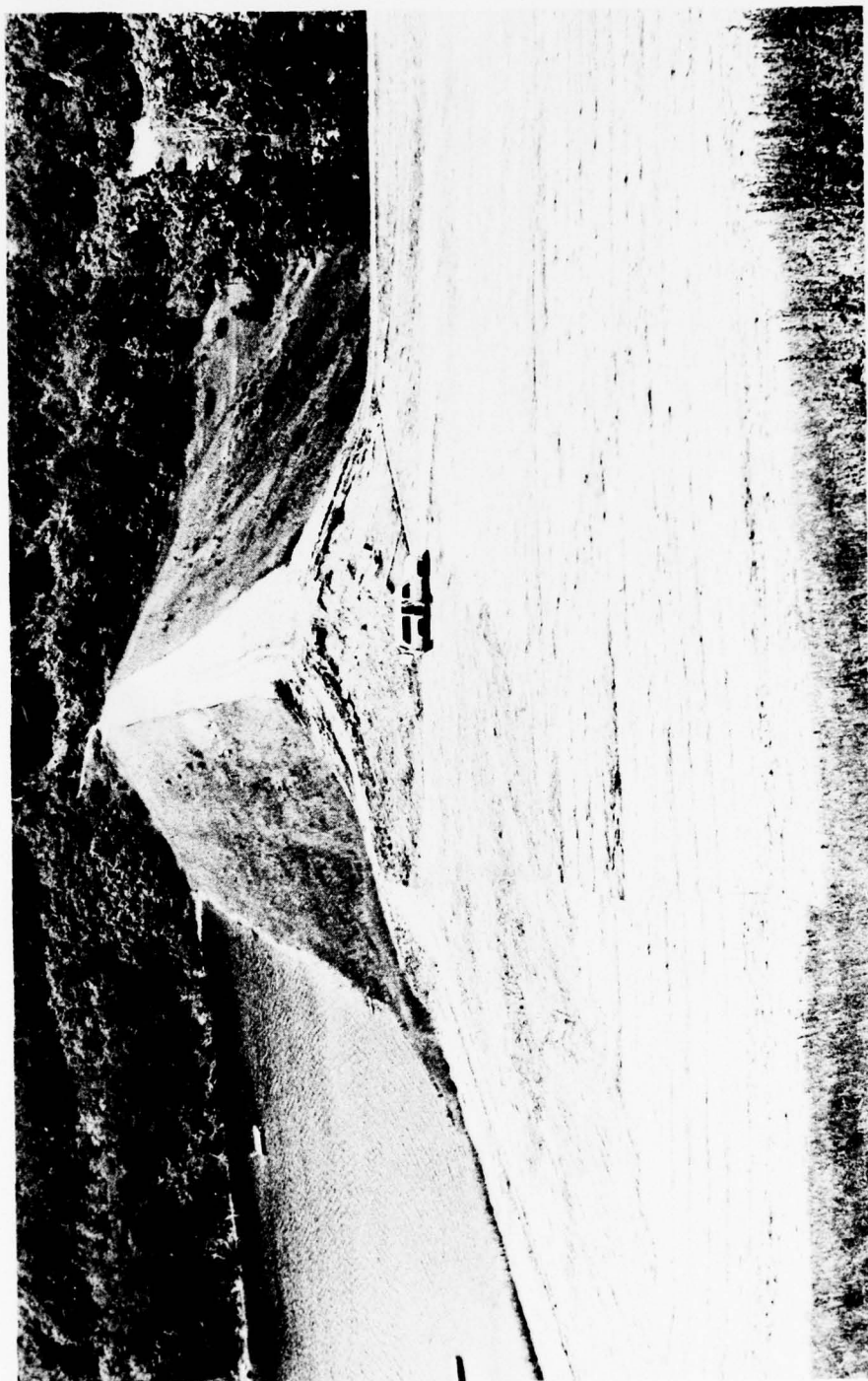
Date: AUG 23 1978

Original signed by:  
Submitted By: JAMES A. WALSH

Original signed by:  
Recommended By: ZANE M. GOODWIN

NAME OF DAM: STONY CREEK NO. 9

OVERALL VIEW OF DAM



OVERALL VIEW OF DAM

PHASE I INSPECTION REPORT  
NATIONAL DAM SAFETY PROGRAM  
NAME OF DAM: STONY CREEK NO. 9 ID# VA 17101

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. The main responsibility is to expeditiously identify those dams which may be a potential hazard to human life or property.

1.2 Description of Project

- 1.2.1 Description of Dam and Appurtenances: Stony Creek Dam No. 9 is an earthfill structure about 705 feet long and 73 feet high. The top of the dam is 20 feet wide and is at elevation 1376.5 feet M.S.L. Side slopes are two and one-half horizontal to one vertical (2.5:1).

The principal spillway consists of a 36 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 1342.7. A concrete outlet structure is provided at the downstream end of the principal spillway so discharges will not jeopardize the structural integrity of the dam.

The emergency spillway is a vegetated earth side-channel spillway. It has a bottom width of about 400 feet, with a 175 feet wide trapezoidal channel, a crest at elevation



1362.4, and side slopes of 3:1. Selected topsoil is placed in four inch thicknesses on the side slopes and on the bottom of the spillway. The topsoil is well compacted on the bottom of the spillway.

A 36 inch slide gate lake drain with invert at a low level enters the upstream side of the riser from the reservoir.

- 1.2.2 Location: Stony Creek Dam No. 9 is located on Stony Creek about 2.2 miles northeast of Orkney Springs, Virginia.
- 1.2.3 Size Classification: The dam is classified as an "intermediate" size structure because of its maximum storage potential of 3260 acre-feet.
- 1.2.4 Hazard Classification: The dam is located one mile from the Town of Bayse and less than one mile from the Bryce Mountain Resort. Therefore, this dam is given a "high" hazard classification in accordance with guidelines contained in Section 2.1.2 of the Recommended Guidelines for the Safety Inspection of Dams. 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: The dam is owned by the Bryce Mountain Ski and Country Club.
- 1.2.6 Purpose of Dam: The dam is used for flood control and recreation purposes.
- 1.2.7 Design and Construction History: The dam was designed and constructed under the supervision of the U.S. Soil Conservation Service (S.C.S.). Construction was completed in 1971.
- 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. Water is withdrawn from the conservation storage space as needed for water supply.

NAME OF DAM: STONY CREEK NO. 9

No formal operational procedures are used since this is a recreational flood control structure.

### 1.3 Pertinent Data

1.3.1 Drainage Area: The dam controls a drainage area of 7.29 square miles.

1.3.2 Discharge at Dam Site: Maximum flood at dam site is not known.

#### Principal Spillway:

Pool level at emergency  
spillway crest . . . . . 195 c.f.s.  
Pool level at top of dam . . . . . 219 c.f.s.

#### Emergency Spillway:

Pool level at top of dam . . . . . 27,042 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		
			Capacity		Length feet
			Acre- feet(a)	Watershed inches(b)	
Top of dam	1376.5	116	3260	8.4	-
Maximum pool, design surcharge	1367.5	94	2410	6.2	6864
Emergency spillway crest	1362.4	83.5	1960	5.0	-
Principal spillway crest (c)	1342.7	44	660	1.7	4752
Streambed at center- line of dam	1304	0	0	0	0

(a) Total accumulated storage.

(b) Based on 7.29 square miles of watershed.

(c) Top of conservation pool and bottom of flood control pool.

NAME OF DAM: STONY CREEK NO. 9

## SECTION 2 - ENGINEERING DATA

2.1 Design: The design data reviewed included the following:

- 1) As-built drawings indicating plans, elevations and sections of the dam and appurtenant structures. Logs of the test borings and test pits were also included in the as-built drawings.
- 2) Hydrologic and hydraulic data.
- 3) Soils and Geologic Report (Appendix VI).
- 4) Slope Stability Analyses (Appendix VII).
- 5) Soil test results.
- 6) Work Plan.

All existing data has been filed with the Norfolk District for future reference.

2.2 Construction: The dam was constructed by Moore, Kelly and Reddish in 1971. Construction records were not available for this inspection report; however, they are on file in Washington, District of Columbia.

2.3 Operation: There are no formal operating procedures for this day. The slide gate used to drain the reservoir is not operated periodically. The Lord Fairfax Soil and Water Conservation District has a yearly maintenance program in conjunction with an annual inspection by the District Conservationist (see Appendix V for Annual Inspection Reports).

2.4 Evaluation

2.4.1 Design: The stability analyses performed for the design of the dam do not represent as-built conditions. The embankment zoning assumed for the analyses does not agree with the zoning shown on the as-built drawings. The owner should perform stability analyses using the as-built embankment zoning. Foundation conditions were determined using the Geologic Report. The hydrologic and hydraulic data provided was adequate for design review.

NAME OF DAM: STONY CREEK NO. 9

- 2.4.2      Construction: No construction records were available; however, the as-built drawings indicate modifications and changes made during construction.
- 2.4.3      Operation: Operation of the slide gate should be included in the annual maintenance and inspection program.

NAME OF DAM: STONY CREEK NO. 9

## SECTION 3 - VISUAL INSPECTION

### 3.1 Findings

3.1.1 General: The field inspection was made on 15 June 1978. No unusual weather conditions were experienced, and the lake was at normal pool. The embankment and appurtenant structure were found to be in good condition except for some clear seepage at the downstream toe and some minor maintenance which does not require immediate remedial treatment.

3.1.2 Dam: Erosion problems are present at three places on the downstream face of the embankment. One is a pedestrian path straight up the face of the embankment (see Photo 6). The other two places are the abutment contact areas. The pedestrian path should be filled and reseeded. Rubble gutters should be installed on the contact areas to prevent further erosion. Also, the upstream shore of the embankment is being wave eroded and should be riprapped if the condition worsens and creates a slope stability problem.

Non-measurable clear seepage was present at elevation 1317 for 50 feet to the right and 80 feet to the left (Photo 5) of the outlet pipe (see Photo 3). The grounds to the left of the pipe were wet for 15 to 20 feet out from the toe of the abutment. There was also another clear, non-measurable seep about 10 feet in diameter at the left end of the bench on the downstream face which may be spring seepage from the hillside.

3.1.3 Appurtenant Structures: At the time of the inspection, the trash racks were being held in place by cables since the bolts were sheared off by ice loads. In addition, the lift pedestal which controls the emergency gate is cracked at its mounting and is not operational (see Photos 1 and 2). It is recommended that the trash racks be refastened to the concrete structure, and that the lift pedestal mounting be repaired and reattached to the concrete. For safety reasons, a locking device should be put on the manhole cover on the intake structure.

NAME OF DAM: STONY CREEK NO. 9



- 3.1.4     Reservoir Area: The reservoir area is a recreation area which is used for boating and swimming. In addition, housing lots on the waterfront are planned.
- 3.1.5     Downstream Channels: The outlet channels for the outlet pipe and the emergency spillway are in good condition with minimal erosion and good ground cover (see Photo 4).
- 3.2     Evaluation: On the whole, the above items are not serious enough to warrant immediate repair since they do not threaten the integrity of the dam. However, the repair of the lift pedestal which operates the emergency gate and the repair of the trash racks should be accomplished in the annual maintenance program. Seepage should be observed when reservoir levels are higher to determine any increase in flow. Piezometer installation may be necessary to determine the phreatic line within the embankment.

#### SECTION 4 - OPERATIONAL PROCEDURES

- 4.1 Procedures: No formal operational procedures are used since this is a recreational and flood control structure.
- 4.2 Maintenance of Dam: The Lord Fairfax Soil and Water Conservation District has a yearly maintenance program in conjunction with an annual inspection by the District Conservationist (see Inspection Reports in Appendix V).
- 4.3 Maintenance of Operating Facilities: The Lord Fairfax Soil and Water Conservation District is responsible for the maintenance of the trash racks and the lift pedestal which operates the emergency gate.
- 4.4 Warning System: At the present time, there is no warning system or evacuation plan in operation. It is recommended the owner prepare and prominently display a formal emergency procedure to operating personnel. This procedure should include:
- 1) How to operate the dam in an emergency.
  - 2) Who to notify, including public officials in case evacuation of the downstream area is necessary.
  - 3) Procedures for evaluating inflow during periods of emergency operation.
- 4.5 Evaluation: Maintenance of the operating facilities is inadequate because of the unrepaired damage that has occurred to the lift gate pedestal and trash racks. Formal records of the lift gate checks should be made a part of the annual inspection.

NAME OF DAM: STONY CREEK NO. 9

## SECTION 5 - HYDRAULIC/HYDROLOGIC DATA

5.1 Design: The elevation of the crest (elevation 1342.7) of the drop inlet to the principal spillway was established at an elevation which would provide the conservation storage needed for sediment deposit and recreation. The capacity (195 c.f.s. with reservoir level at crest of emergency spillway) of the principal spillway was established by consideration of a number of factors including:

- 1) The capability of evacuating the flood storage space within a reasonable time ( $\pm$  10 days).
- 2) Not passing damaging flows downstream.
- 3) The capability of the reservoir to store the flood waters.

The crest (elevation 1362.4) of the emergency spillway was established at the maximum elevation reached in routing the principal spillway hydrograph which resulted from the 100 year, 10 day rainstorm. The elevation of the top of the dam (elevation 1376.5) was established by the maximum elevation reached in passing the freeboard hydrograph. The freeboard hydrograph is that computed from rainfall comparable to the Probable Maximum Precipitation (P.M.P.) as used by the Corps of Engineers and is therefore comparable to the Probable Maximum Flood (P.M.F.).

5.2 Hydrologic Records: None

5.3 Flood Experience: There is no evidence of damage due to past flooding, but there has been ice damage to the principal spillway riser.

5.4 Flood Potential: Design features of the dam were established by routing various hydrographs as noted in paragraph 5.1.

5.5 Reservoir Regulation: Pertinent dam and reservoir data are shown in Table 1.1, paragraph 1.3.3.

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 36 inch concrete conduit. Water also flows past the dam over the ungated emergency spillway in the event water in the reservoir rises over the crest of the spillway.

NAME OF DAM: STONY CREEK NO. 9

Outlet discharge capacity, reservoir area and storage capacity, and hydrograph and routing determinations were obtained from reports and computations furnished by the S.C.S. The routing of the emergency spillway and freeboard hydrographs began with the reservoir level at the crest of the principal spillway.

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

TABLE 5.1 RESERVOIR PERFORMANCE

Item	Normal	Hydrograph		
		Principal Spillway (a)	Emergency Spillway	Free-Board (b)
Peak flow, c.f.s.				
Inflow	-	2633	9845	31,551
Outflow	-	195	5338	27,261
Peak elev., ft. M.S.L.	-	1362.4	1367.5	1376.5
Emergency spillway				
Depth of flow, ft.	-	0	5.1	14.1
Avg. velocity, f.p.s.	-	0	10.5	-
Non-overflow section				
Depth of flow, ft.	-	-	-	-
Avg. velocity, f.p.s.	-	-	-	-
Tailwater elev., ft. M.S.L.	-	-	-	-

(a) 100 year, 10 day volume produces the most conservatively large indication of flood control storage required. Detailed discharge hydrograph was not determined.

(b) P.M.F. by C.O.E. standards.

- 5.7 Reservoir Emptying Potential: The 36 inch corrugated metal pipe entering upstream side of the riser at a low level will permit withdrawal of about 156 c.f.s. with the reservoir level at the spillway crest and essentially dewater the reservoir in about three days.

- 5.8 Evaluation: Hydrologic and hydraulic determinations of the project as prepared by the S.C.S. appear reasonable. The dam and spillway are designed to pass a flood essentially equal to the P.M.F., which would be developed under standards used by the Corps of Engineers.

It should be indicated that conclusions pertain to present day conditions, and that the effect of future development on the hydrology has not been considered.



## SECTION 6 - DAM STABILITY

- 6.1 Foundation and Abutments: The foundation of the dam consists of two to four feet of silty clay overlying a two and one-half to six feet thick gravelly layer. Weathered shale with interbedded sandstone underlies the gravel. The cut-off trench provided for seepage control extends to unweathered bedrock.

High in the left abutment, shallow colluvial soils overlie the shale bedrock. Moderately deep colluvium is present on the lower valley slopes. On the right abutment, the shale has weathered to a silty gravel to a depth of one to eleven feet. The medium-hard shale exposed in the emergency spillway strikes N.30°E. and dips 30° SE.

### 6.2 Stability Analysis

- 6.2.1 Visual Observations: No evidence of instability in the embankment or cut slopes was observed. There are some structural cracks in the riser (see Photos 1 and 2). Clear seepage was noticed in the vicinity of the outlet of the principal spillway on both sides (see Photos 3 and 5). Minor, clear seepage occurs in the bench on the downstream slope at the left abutment.

The clear seepage, located near the toe of the dam approximately below elevation 1317 and between Stations 19+75 and 21+05<sup>1</sup>, represents an undesirable condition that needs further investigation. In addition, the clear seepage is concentrated around the outlet pipe indicating a possibility that the pipe leaks when it flows full.

- 6.2.2 Design Data: Slope stability was checked using a modification of the Swedish Circle Method on a zoned embankment section. These analyses indicate that the section chosen consisted of three soil zones:

- 1) An impervious core with slope ratios of 1.5:1.

---

<sup>1</sup>Stations are indicated on Plate 1.



- 2) A zone as the shell of the dam adjacent to the upstream face of the core (upstream shell).
- 3) A zone comprising the downstream shell.

The following shear strength parameters were assumed for these soil types and the foundation:

core . . . . .	$\phi = 24.5^\circ$	$c = 725$ p.s.f.
upstream shell . . .	$\phi = 29^\circ$	$c = 450$ p.s.f.
downstream shell . .	$\phi = 35^\circ$	$c = 0$
foundation . . . . .	$\phi = 28.5^\circ$	$c = 0$

The shear strengths of the core, upstream shell and foundation soils were determined from consolidated undrained triaxial shear tests. Minimum safety factors computed were 1.33 for the 2.5:1 over 3:1 upstream slope under full drawdown and 1.63 for the 2.5:1 downstream slope. Berms were required both upstream and downstream in order to obtain satisfactory factors of safety.

- 6.2.3 Operating Records: The yearly inspections indicate no deteriorating conditions beyond minor surface erosion (see Photo 6) which has been controlled by seeding. High water marks on the upstream slope above the normal pool indicate that the water elevation has risen without any significant damage to the dam.

The inspection reports do not mention the clear seepage at and beyond the toe of the embankment and at the left abutment.

- 6.2.4 Post-Construction Changes: There were no alterations made to the dam since it was constructed.

- 6.2.5 Seismic Stability: Stony Creek Dam No. 9 is situated in Seismic Zone 2, and presents no hazard from earthquakes according to the Recommended Guidelines for Safety Inspection of Dams.

- 6.3 Evaluation: The embankment section chosen for these stability analyses is not compatible with the as-built drawings. An additional soil zone consisting of shale comprises the shell of the dam above the berms as shown on the as-built drawings. Although shear strength

NAME OF DAM: STONY CREEK NO. 9

parameters for compacted shale were determined as  $\phi = 25^\circ$  and  $c = 675$  p.s.f. (consolidated undrained triaxial shear test results), these parameters are not indicated as having been used for the analyses. Since the failure surface may pass through this zone of shale, additional stability analyses are recommended using as-built conditions. Also, the clear seepage on the downstream slope may indicate a phreatic line that exists on the downstream slope rather than terminating at the drain near the toe of the center core. If further observation indicates that the clear seepage is originating from the reservoir, additional stability analyses should also be made using the existing phreatic surface.

## SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

- 7.1 Dam Assessment: No detrimental findings were discovered as a result of this inspection. The spillway is considered adequate to pass the P.M.F. without overtopping the embankment.

The data available were sufficient to evaluate the adequacy of design. However, the stability analyses performed for design do not represent as-built conditions.

The dam will not require urgent remedial treatment although a more detailed investigation is warranted because of clear seepage at the downstream toe.

Further investigation is considered necessary to evaluate the effect of the clear seepage on slope stability and piping potential, and to check the changes from design conditions. Future observations of seepage should be correlated with higher reservoir levels.

- 7.2 Recommended Remedial Measures: The inspection revealed certain items of rehabilitation or other work which should be done by the owner as part of the annual maintenance and inspection program:

- 1) The repair of erosion development, possibly by stone gutters, on the right downstream abutment.
- 2) Reseeding a major portion of the downstream and upstream face where indicated.
- 3) Repair of the lift pedestal and trash racks on the principal spillway.
- 4) Installation of a locking manhole cover as specified on the plans.
- 5) Stability analyses using as-built conditions.
- 6) Further investigation of the clear seepage at the downstream toe.
- 7) Development of a warning system that will alert downstream residents when the reservoir level approaches the emergency spillway.

NAME OF DAM: STONY CREEK NO. 9

APPENDIX I

PLATES

## CONTENTS

Location Plan

Plate 1: Plan of Dam

Plate 2: Details of Cut-Off Trench

Plate 3: Profiles and Typical Sections

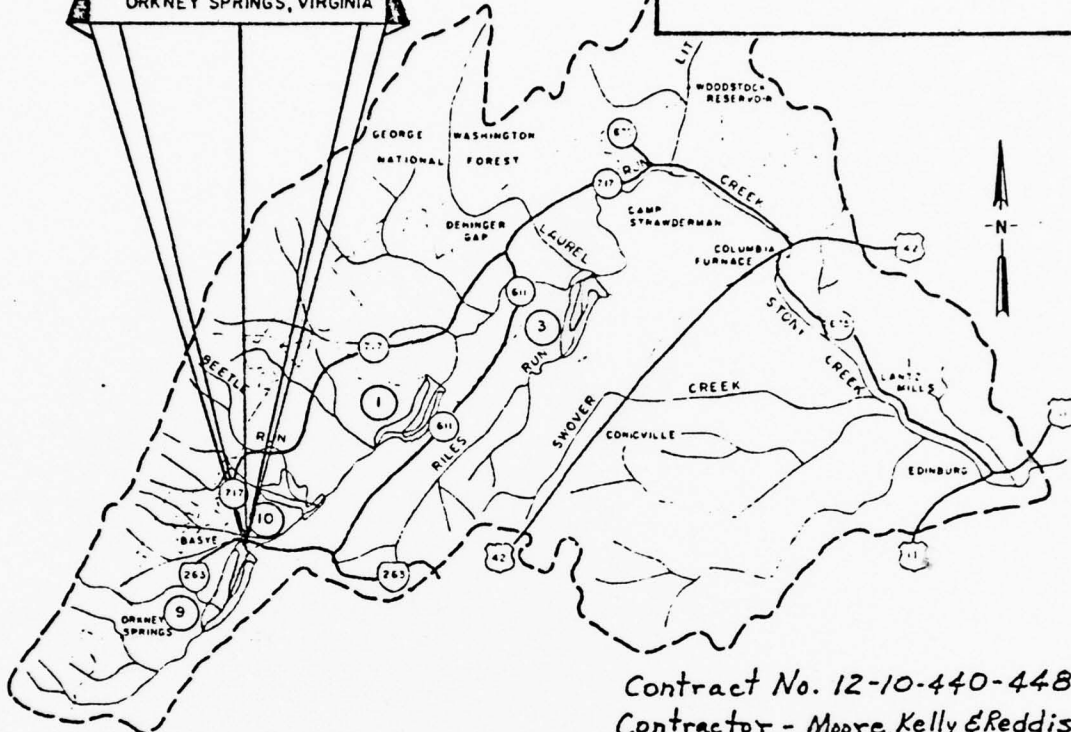
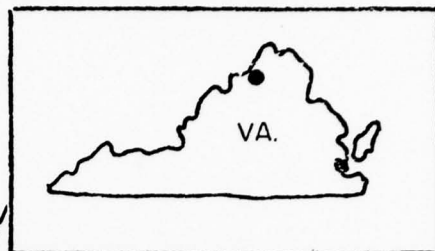
Plate 4: Principal Spillway

NAME OF DAM: STONY CREEK NO. 9



THIS PAGE IS BEST QUALITY PRACTICABLE  
FROM COPY FURNISHED TO DDC

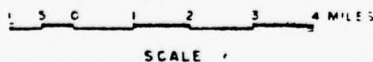
SITE NO. 9  
APPROXIMATELY 2.2 MILES  
NORTH EAST OF  
ORKNEY SPRINGS, VIRGINIA



Contract No. 12-10-440-448  
Contractor - Moore, Kelly & Reddish  
Date of Completion, Dec. 21, 1971

"AS BUILT"

LOCATION MAP



AS BUILT

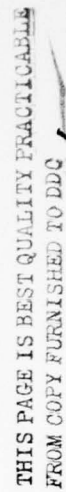
STONY CREEK SITE NO. 9  
STONY CREEK WATERSHED DEC 21 1971  
SHENANDOAH COUNTY, VA.  
COVER SHEET

U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE

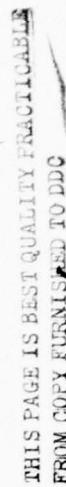
Designed N. W. WILSON R. E. CURTIS R. A. HYATT	Date 2/71	Approved by <i>L. A. Burton, Jr.</i> Title STATE CONSERVATION ENG.
Drawn G. N. HOBBS	Date 2/71	Title HEAD, E. D. AD. UNIT
Traced <i>[Signature]</i>	Sheet No. 1 of 22	Drawing No. VA-588-P

LOCATION PLAN  
STONY CREEK NO. 9

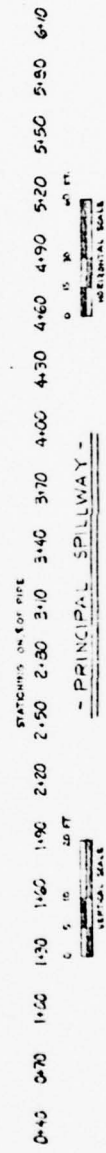
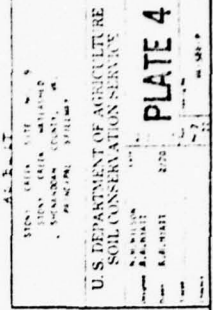




THIS PAGE IS BEST QUALITY PRACTICABLE  
FROM COPY FURNISHED TO DDQ







THIS PAGE IS BEST QUALITY PRACTICABLE  
FROM COPY FURNISHED TO DDC



APPENDIX II

PHOTOGRAPHS

## CONTENTS

- Photo 1: Structural Cracks in Riser With Cable Across the Top Holding the Trash Racks
- Photo 2: Cracks in Riser and Cable Across the Top Holding the Trash Racks
- Photo 3: Outlet of Principal Spillway Into Stilling Basin With Two Small Drain Pipes and a Long Diversion Pipe
- Photo 4: Downstream Channel With Heavy Growth
- Photo 5: Clear Seepage at Toe of Embankment on Right Side of Outlet for the Principal Spillway
- Photo 6: Erosion Path Near Right Abutment on Downstream Slope
- Note: Protographs were taken 15 June 1978

NAME OF DAM: STONY CREEK NO. 9



PHOTO 1

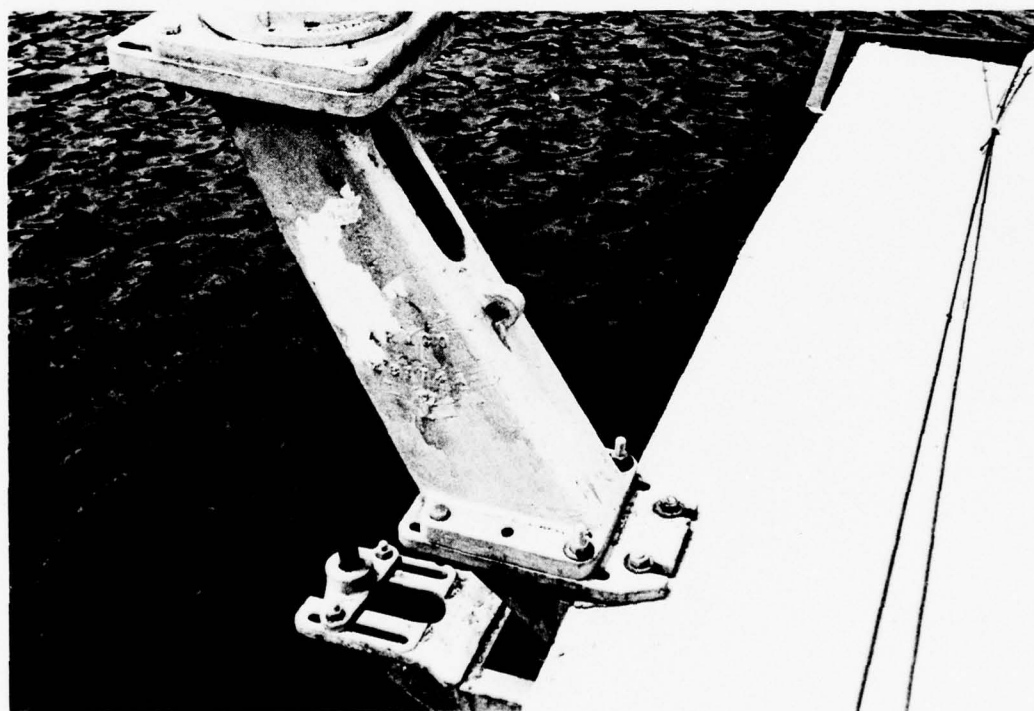


PHOTO 2

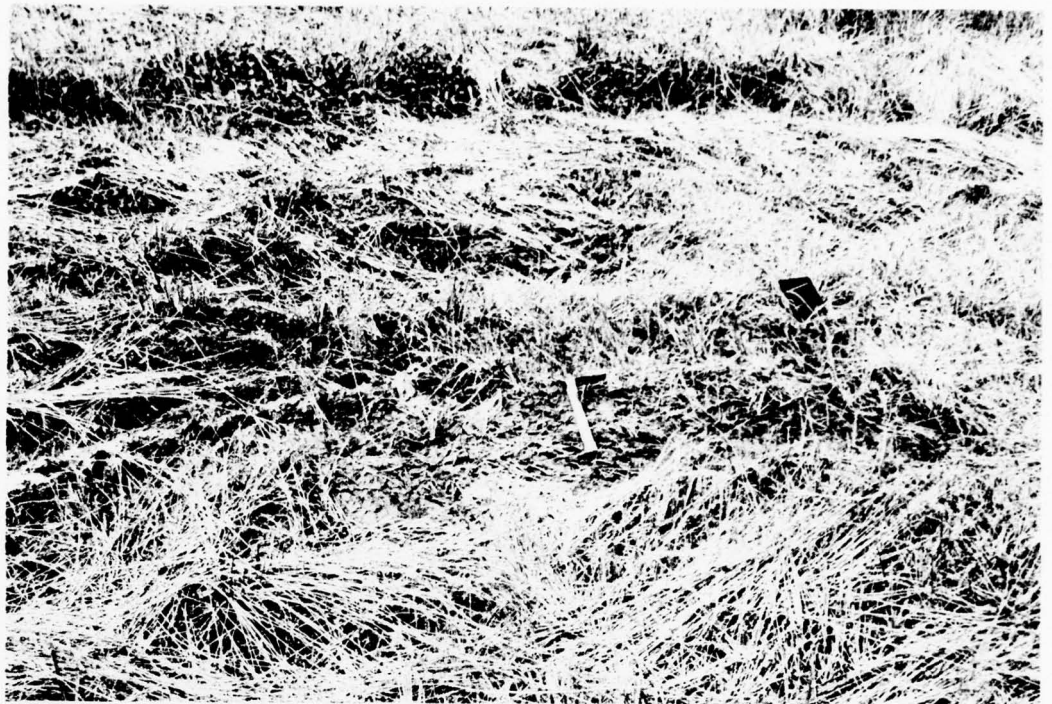


PHOTO 3



PHOTO 4





**PHOTO 5**



**PHOTO 6**



APPENDIX III

CHECK LIST - VISUAL INSPECTION

Check List  
Visual Inspection  
Phase 1

Name Dam Stony Creek No. 9 County Shenandoah State Virginia Coordinates Lat. 3848.2  
Long. 7847.5

Date Inspection 15 June 1978 Weather Partly cloudy Temperature 72° F.

Pool Elevation at Time of Inspection 1342.8 M.S.L. Tailwater at Time of Inspection 1303.0 M.S.L.

III-1

Inspection Personnel:

MICHAEL BAKER, JR., INC.:

D. J. Greenwood  
J. M. Thompson  
W. L. Sheaffer

VA WATER CONTROL BOARD:

Ken Hinkle

D. J. Greenwood Recorder

## EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	There were no significant surface cracks visible during the field inspection.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	No unusual movement or cracking beyond the toe was visible.	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	There is no visible sloughing of the embankment or abutment slopes. The embankment slopes are very sparsely seeded due primarily to a lack of topsoil over the shale. Erosion problems are starting in two areas on the downstream rt. face. One is at the abutment contact and the other on a pathway up the face (Photo 6). The upstream face shows signs of wave erosion.	The dam face upstream and downstream should be reseeded. The areas of present erosion should also be filled and reseeded. A rubble gutter should be installed on the Rt. downstream abutment contact to prevent further erosion in the area. The upstream shore should be rippedraped.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	The vertical and horizontal crest alignment is good.	
RIPRAP FAILURES	There are none.	

THIS PAGE IS BEST QUALITY PRACTICAL COPY  
FROM COPY FURNISHED TO DDG

Stony Creek No. 9

EMBANKMENT

THIS PAGE IS BEST QUALITY PRACTICAL COPY  
FROM COPY FURNISHED TO DDQ

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONSTRUCTION MATERIAL	Dry to damp, brown, dense silt, sand and rock fragments in variable percentages were observed at different locations on the surface of the dam. The dam was designed to be constructed with four zones of material including impervious earth fill.	The installation of rubble gutters on the contacts will be necessary to prevent further erosion.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	The junctions of the embankment and the abutments show signs of erosion particularly on the Rt. junction. The spillway junction with the dam is in good condition. The dam abutments are founded on gray and brown, medium-hard, jointed shale with a dip of 28° to 35° SE. and a strike of 30° E.	The seepage is not muddy and the flow is not concentrated enough to cause erosion or affect the stability of the outlet pipe. Periodic inspection and further investigation is recommended.
ANY NOTICEABLE SEEPAGE	There is seepage from the downstream toe of the dam extending approximately 80 feet to the Lt. and 50 feet Rt. of the pipe outlet (Photos 3 and 5). The flow was not measurable. The flat area adjacent to the toe is soft and wet. A minor unmeasurable seepage occurs in a small area (10 feet diameter) at the end of the bench on the downstream dam slope in the slope drain at the Lt. abutment.	
III-3		
STAFF GAGE AND RECORDER	None	
DRAINS	There are two 6 inch BCCMP drains exiting at the stilling basin. These drains were flowing partially full at the time of our inspection (Photo 3). The drains, according to the plans, receive flow from the drainage trench under the dam toe.	These drains should be inspected regularly to insure they are flowing and are not plugged.
FOUNDATION	The foundation is on gray, soft-jointed shale with sandstone interbedded (Chemung formation) according to the borings and test pits on the as-built drawings. The dip varies from 20° to 27° SE. The attitude of the bedding as measured in the emergency spillway and rock exposures in the vicinity strikes N. 30° E.	

# OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	The concrete surfaces of the outlet conduit are in good condition.	
INTAKE STRUCTURE	The intake structure is a S.C.S. standard fixed concrete riser pipe with an outlet drain controlled by a lift pedestal. Upon examination, the pedestal is cracked at its mounting and is inoperative. The trash screens are also broken from their mountings and are temporarily held in place by cables. The tower also has no hand railing (Photos 1 and 2) for safety and it also does not have a locking manhole cover.	The pedestal mounting must be repaired and made operative. The trash racks must also be reinstalled. A locking manhole inspection cover should be installed along with hand railing. It may also be beneficial to lower the lake level in the winter to prevent further ice damage to the riser.
OUTLET STRUCTURE	The outlet structure is a 36 inch diameter concrete pipe with a limestone riprap stilling basin and trapazoidal channel. There is a six inch water line in the outlet for unknown reasons as it protrudes in only one foot (Photo 3).	
OUTLET CHANNEL	The outlet channel is a uniform trapazoidal shape with rocky bottom and well-vegetated banks. The channel has little debris. There is a noticeable amount of brush on the banks which can catch debris (Photo 4).	The brush along the channel should be cut regularly to prevent debris buildup and the riprap should be inspected regularly.
EMERGENCY GATE	The emergency gate is a 36 inch diameter slide gate with a hand-operated pedestal. The gate is inoperative due to pedestal condition.	The pedestal must be remounted and the gate checked for proper functioning.



Stony Creek No. 9

UNGATED SPILLWAY

VISUAL EXAMINATION OF		OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	None		
APPROACH CHANNEL		The approach channel to the emergency spillway is composed of thin, compacted fill which is well-seeded and cut overlying shale and siltstone. The channel is 175 feet wide at the base, of trapezoidal shape and on an adverse two percent slope.	The channel vegetation should be cut regularly and inspected for signs of erosion.
DISCHARGE CHANNEL		The discharge channel is composed of thin, compacted fill over shale and siltstone, at an approximate 2.2 percent slope and well-seeded. The channel ends abruptly and exits into a drainage swale to the right of the Rt. abutment. The channel is in good condition.	The channel vegetation should be cut regularly and inspected for signs of erosion.
BRIDGE AND PIERS	None		
CUT SLOPES		Gray and brown, medium-hard shale with some sandstone interbedded was observed in the cut slopes. The bedding dips 30° SE. and strikes N. 30° E. There are two sets of steep to vertical joint systems. The cut slopes on both sides were made at a 2:1 ratio and are covered with four inches of brown, sandy silt with rock fragments and topsoil fostering a grass cover. There is a 10 foot berm near the middle of the deep cut on the right side. The slopes appear to be stable.	

Stony Creek No. 9

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	There are none.	
OBSERVATION WELLS	There are none.	
WEIRS III-6	There are none.	
PIEZOMETERS	There are none.	
OTHER	There are none.	

Stony Creek No. 9

RESERVOIR

VISUAL EXAMINATION OF		OBSERVATIONS	REMARKS OR RECOMMENDATIONS
-----------------------	--	--------------	----------------------------

SLOPES

The reservoir slopes are well forested, steep and show little signs of erosion or sloughing. There is little development presently along the lake.

SEDIMENTATION

The level of sedimentation in the reservoir is minimal and at an elevation of approximately 1313 feet near the riser pipe, as observed by soundings taken from the riser.

Stony Creek No. 9

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF		REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	OBSERVATIONS	
	The majority of the channel is in good condition with cobbles and boulders on the bottom and grass sides. There is little debris along the channel except immediately below the dam which is wooded and overgrown. The channel varies in width from 10 to 20 feet (Photo 4).	
SLOPES	The stream flows along an approximately 500 foot wide flood plain then at the floodplain's edge, the slopes rise rapidly to the mountain tops and plateaus. The channel slope is about 0.5 percent.	
APPROXIMATE NO. OF HOMES AND POPULATION	There are approximately 20 structures within reasonable proximity downstream of the dam. The structures include homes, offices of Bryce Mountain Resort and condominiums. The population of Bayse is about 20 although, depending on the season, the Bryce Mountain Resort has many more.	

APPENDIX IV

CHECK LIST - ENGINEERING DATA



Stony Creek No. 9

CHECK LIST  
ENGINEERING DATA  
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS
PLAN OF DAM	A complete set of as-built plans are available at the Norfolk District of the Corps of Engineers. a plan view of the dam is included in this report as Plate 1.
REGIONAL VICINITY MAP	A location map shown on the as-built plans Title Sheet was used as a vicinity map and is attached as the Location Plan.
CONSTRUCTION HISTORY	The foundation investigation was done in 1970. The dam was designed by the S.C.S. in 1971 and constructed by Moore, Kelly & Reddish Company in the same year.
TYPICAL SECTIONS OF DAM	Typical sections of the dam are enclosed in the Phase I Construction Report as Plate 3.
HYDROLOGIC/HYDRAULIC DATA	A complete set of hydrologic and hydraulic data is on file at the Norfolk District of the Corps of Engineers.
OUTLETS - PLAN and DETAILS	are available at the Norfolk District of the Corps of Engineers
- CONSTRAINTS	
- DISCHARGE RATINGS	are included in the S.C.S. design calculations and are available at the Norfolk District of the Corps of Engineers.
RAINFALL/RESERVOIR RECORDS	No rainfall or reservoir level records are available at the dam. Rainfall data is available from Virginia Climatological Records.

Stony Creek No. 9

ITEM	REMARKS
DESIGN REPORTS	Design calculations by the S.C.S. are available at the Norfolk District of the Corps of Engineers. No contract specifications were available.
GEOLOGY REPORTS	A subsurface investigation consisting of test pits and test borings are part of the design documents. Geologic reports were available.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Design computations were done by the S.C.S. for hydrology and hydraulics. Stability and seepage quantity calculations were available.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	A foundation and borrow investigation was performed with test borings and test pits. Constant head borehole permeability tests and pressure testing was done in the borings.
POST-CONSTRUCTION SURVEYS OF DAM	The dam is inspected yearly by the S.C.S. District Conservationist. Copies of these inspection reports are attached to this report.
BORROW SOURCES	The as-built drawings show the borrow sources.

Stony Creek No. 9

ITEM	REMARKS
------	---------

MONITORING SYSTEMS	No monitoring systems other than the spillway riser were designed into the dam.
--------------------	---

MODIFICATIONS	No known modifications have been made other than repairing erosion and reseeding.
---------------	---

HIGH POOL RECORDS	No high water records are available.
-------------------	--------------------------------------

17-3

POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS
---

Yearly inspections are made by the District Conservationist of the S.C.S. No known major construction has been done since the dam was built.
---

PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS
---

There were none reported.
---------------------------

MAINTENANCE OPERATION RECORDS
-------------------------------

Yearly inspections are made by the S.C.S. Erosion repair and reseeding have been done.
--

Stony Creek No. 9

ITEM	REMARKS
SPILLWAY PLAN	Sections and details of the ungated overflow spillway are attached as Plate 4.
SECTIONS	The section measured in field closely matches that on plans, 175 feet wide and approximately the same slopes.
DETAILS	Earth with minimal growth. Slight erosion was noted from hillside drainage.
OPERATING EQUIPMENT PLANS & DETAILS	Crank-operated lift with pedestal base was used. Plans and details are available at the S.C.S. Richmond Office.

CHECK LIST  
HYDROLOGIC AND HYDRAULIC DATA  
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 7.29 square miles of heavily wooded and undeveloped land

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 1342.7 (660 acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 1362.4 (1300 acre-feet)

ELEVATION MAXIMUM DESIGN POOL: 1367.5 (1750 acre-feet)

ELEVATION TOP DAM: 1376.5 (2600 acre-feet)

CREST: Emergency Spillway

- a. Elevation 1362.4
- b. Type Uncontrolled trapazoidal discharge channel
- c. Width 175 feet
- d. Length 400 feet
- e. Location Spillover Adjacent to Rt. abutment
- f. Number and Type of Gates None

OUTLET WORKS: Principal Spillway

- a. Type Standard S.C.S. conc. fixed crest riser
- b. Location Left upstream (inlet) Left downstream base at dam (outlet)
- c. Entrance inverts 1307.7 (drain invert) 1342.7 (fixed crest)
- d. Exit inverts 1306.0 (outlet pipe invert)
- e. Emergency draindown facilities 36 inch slide gate

HYDROMETEOROLOGICAL GAGES: None at site.

- a. Type \_\_\_\_\_
- b. Location \_\_\_\_\_
- c. Records \_\_\_\_\_

MAXIMUM NON-DAMAGING DISCHARGE Unknown

Name of Dam: Stony Creek No. 9



APPENDIX V

ANNUAL MAINTENANCE INSPECTION REPORTS

February 1976

Structure No. 9 is now owned by Bryce Mt. Ski and Country Club. The maintenance, however, is the responsibility of the Lord Fairfax Soil and Water Conservation District.

The entire area surrounding the lake is being developed for cottages on small lots. I feel this development will increase the runoff of water draining into the lake and may result in increased erosion problems in the future. I have recommended that the drainways from this area not be disturbed and that reseeding of all disturbed road areas be done as soon as possible after the area is disturbed. I also recommended that culverts be installed at proper intervals on the roads to prevent concentrating water in any one drainway.

The dam and area below the dam is mowed regularly to make the area as asthetically pleasing as possible to the lot owners. I have recommended that the mowing be stopped during extremely dry weather and after August 15 to allow the grass to recover properly.

See attached Maintenance Inspection Report for recommendations.

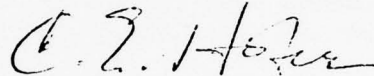
LORD FAIRFAX SOIL AND WATER CONSERVATION DISTRICT  
REPORT OF ANNUAL MAINTENANCE INSPECTION OF WATERSHED DAMS  
STONE CREEK WATERSHED PROGRAM

APRIL 8, 1977

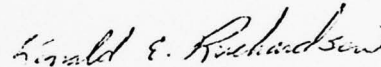
The inspection was made after the Lord Fairfax S&WCD monthly meeting. Most of the District Directors were on hand for the inspection.

Dam No. 9 There is an adequate vegetative cover on the dam and spillway. No erosion was noted. The grass cover was limed and fertilized in 1976. However, due to extremely dry weather, the grass has not had a chance to respond to this treatment.

Dam No. 10 The dam, spillway, etc., are in good condition with good vegetative cover.



C.E. Hofer, Chairman  
Lord Fairfax S&WCD



Donald E. Richardson, I.C.  
Soil Conservation Service

LIST: SCS Harrisonburg Area Office  
SCS Woodstock Field Office  
Lord Fairfax S&WCD

P. O. Box 390, Woodstock, Virginia 22664  
June 30, 1976

Report of Inspection at Dam No. 9

The stand of Ky 31 fescue is well established. However, the growth is not as dense as it should be due to acid soil. In addition, some potential erosion problems exist due to traffic on the face of the dam. The three eroded drainways on the east side of the lake have begun to heal over.

It is recommended that:

- 1) Mowing frequency be kept to a minimum;
- 2) 1 ton of agricultural ground limestone per acre be applied to the dam and spillway area;
- 3) A soil sample be taken every year, and that lime and fertilizer be applied according to the test results.

---

Edward M. Conklin, Director  
Lord Fairfax Soil & Water Conservation District

---

Ronald E. Richardson, District Conservationist  
Soil Conservation Service

---

Kenneth C. Brill, Technician  
Soil Conservation Service

# COMMONWEALTH OF VIRGINIA



## LORD FAIRFAX SOIL AND WATER CONSERVATION DISTRICT REPORT OF ANNUAL MAINTENANCE INSPECTION OF WATERSHED DAMS STONY CREEK WATERSHED PROGRAM

APRIL 29, 1975

Dam No. 9 - The stand of Ky. 31 Fescue is well established. However, the growth is not as dense as should be due to excessive mowing and lack of plant nutrients. In addition, some erosion problems exist due to traffic on the face of the dam. Three (3) drainways on the east side of the lake are showing signs of active erosion where they enter the lake.

It is recommended that:

- ✓(1) Mowing frequency should be kept to a minimum, in any event no shorter than 4" - 6".
- ✓(2) 600 lbs. per acre of 5-10-10 fertilizer (or equivalent) should be applied to the dam and spillway area. A soil sample should be taken every year and lime and fertilizer applied each fall in accordance with the test results;
- ✓(3) All traffic should be excluded from the dam face;
- (4) The gullies in the drainways should be smoothed and lined with concrete or other masonry material. This material should extend from the normal water level to the top of the embankment at the old road.

- ✓ Dam No. 10 - The stand of Ky. 31 Fescue was well established and healthy with one exception. There is some active erosion at the spillway entrance, i.e. the west side of the dam. The erosion is caused by an accumulation of water from a small watershed above the dam draining through a section of the spillway entrance which failed to establish a good stand of grass cover. A small gully approximately 200 feet in length has formed and is outletting into the lake.

It is recommended that this area be repaired and reestablished in grass.

*B. A. Hepner*

B. A. Hepner, Director, Lord Fairfax  
Soil and Water Conservation District

*Ronald E. Richardson*

Ronald E. Richardson, DC  
Soil Conservation Service

*E. M. Conklyn*

Edward M. Conklyn, Director, Lord Fairfax  
Soil and Water Conservation District

DIST: SCS State Office  
SCS Area Office  
SCS Woodstock Field Office  
Lord Fairfax S&WCD  
Bryce Mountain Resort



LORD FAIRFAX SOIL AND WATER CONSERVATION DISTRICT

REPORT OF ANNUAL MAINTENANCE INSPECTION OF WATERSHED DAMS  
STONY CREEK WATERSHED PROGRAM

DECEMBER 18, 1974

The inspection was made on December 4, 1974; conditions and recommendations are as follows:

Dam No. 9 The stand of Ky. 31 Fescue was well established. The current year's growth was stunted, however, due to the extremely dry weather during the fall growing season in conjunction with close mowing during this same time period.

It is recommended that mowing operations be terminated by about August 15 in order for the grass to establish a good winter mulch.

Dam No. 10 The stand of Ky. 31 Fescue was well established and healthy with one exception. There is some active erosion at the spillway entrance, i.e. the west side of the dam. The erosion is caused by an accumulation of water from a small watershed above the dam draining through a section of the spillway entrance which failed to establish a good stand of grass cover. A small gully approximately 200 feet in length has formed and is outletting into the lake.

It is recommended that this area be repaired and reestablished in grass.

*B.A. Hepner*  
B.A. Hepner, Director, Lord Fairfax  
Soil and Water Conservation District

*Ronald E. Richardson*  
Ronald E. Richardson, DC  
Soil Conservation Service

*Kenneth C. Brill*  
Kenneth C. Brill, Conservation Tech.  
Soil Conservation Service

DIST: SCS State Office  
SCS Area Office  
SCS Woodstock Field Office  
Lord Fairfax S&WCD

THIS PAGE IS BEST QUALITY PRACTICABLE  
FROM COPY FURNISHED TO DDC

APPENDIX VI

GEOLOGIC REPORT

THIS PAGE IS BEST QUALITY PRACTICABLE  
FROM COPY FURNISHED TO DDC

## DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

## GENERAL

State Virginia County Shenandoah : 1/4 Sec. 1 T 1 R 1 ; Watershed Stony Creek  
 Subwatershed Stony Creek Fund class FP-03 Site number 9 Site group I Structure class C  
 Investigated by Josh W. Bailey (signature and title) Geologist (FP-2, WP-1, etc.) Equipment used Sprague & Henwood 40-C Drill Date 8/69 & 1/  
Acker Truck Mounted Drill (Type, size, make, model, etc.) (2)  
Front-End Loader & Backhoe

## SITE DATA

Drainage area size 7.29 sq. mi., 4665.6 acres. Type of structure Earth Fill Purpose Flood Prevention  
Recreation  
 Direction of valley trend (downstream) NE Maximum height of fill 73.0 feet. Length of fill 725  
 Estimated volume of compacted fill required 276,800 yards

## STORAGE ALLOCATION

	Volume (ac. ft.)	Surface Area (acres)	Depth at Dam (feet)
Sediment	<u>464</u>	<u>25</u>	<u>32.7</u>
Floodwater	<u>1,256</u>	<u>85</u>	<u>52.4</u>
Recreation	<u>428</u>	<u>45</u>	

## SURFACE GEOLOGY AND PHYSIOGRAPHY

Physiographic description Valley & ridge Topography Mountainous Attitude of beds: Dip 24.4° Strike N 50° E  
 Steepness of abutments: Left 50 percent; Right 40 percent. Width of floodplain at centerline of dam 250 feet  
 General geology of site: Stony Creek site #9 is located in southwestern Shenandoah  
County at Basye, Virginia, about 17 miles southwest of Woodstock, Virginia

The rock underlying this site is of the Chemung Formation of Upper Devonian age. The rock consists of gray, soft shale with interbeds of fine, lighter gray arkosic sandstone which does not comprise more than 30% of the geologic section. No one sandstone bed is usually more than 6" thick and is generally much thinner (1/8 - 2"); no single sandstone interbed extends more than a few feet, at most, laterally. The rock is fractured with the joints generally following the bedding or dipping 45° - 60° NW and striking approximately N 65° E.

The damsite is situated on the western limb of an open syncline, in the core of which is exposed the Hampshire Formation. This formation lies

ove the Chemung and is east of this site. Below the Chemung, dipping under it ~~from~~ the west, is the Brallier shale.

A few minor faults occur in the Chemung Formation. They are all parallel with the bedding and may represent minor slippage concurrent with the folding of rocks in this region during the Pennsylvanian period. The stream pattern in this region is dendritic, a form typical of the Valley and Ridge province where dips are not too shallow.

Shallow alluvium consisting of cobbles and pebbles of sandstone and shale, with a silty sand matrix, occurs in the floodplain. Overlying this is silty clay or clayey silt with minor amounts of silty sand. Moderately deep colluvium is present on the lower valley slopes. This is GC or CL material. Shallow residual soil occurs elsewhere on valley slopes (CL-GM).

#### Methods & Procedures

1. Pressure tests were taken, increasing and then decreasing pressure. This was to show whether fractures opened or closed after pressure was increased. Closing of fractures was probably due to silting up of openings.

2. Permeability was measured generally after each drill run (usually 5 feet). The K factor is recorded in ft/day. It was calculated for NX core by the formula  $K = C_p Q/h$ .

$C_p$  is obtained for different lengths of test section of NX diameter from the table on page 545 in the Earth Manual. In permeability calculations in rock subtract the Q value from the Q value above, to obtain the g.p.m. value for depths below which the casing is advanced.

3. In addition to rock recovery, the rock quality designation of each core run was recorded. This value is the total length of all core pieces more than 4" in length (separated by weathered fractures) divided by the length of the run and expressed as a per cent.

#### Centerline of the dam

Shale and interbedded fine sandstone of the Chemung Formation underlie the centerline of the dam. The rock color varies from dark gray in the shale to light gray in the sandstone.

The rock is permeable to slightly permeable from 10 to 30 feet below the top of rock. Permeability is due to the fracture pattern with attendant weathering. The dip of the strata ranges from  $21^{\circ}$  -  $30^{\circ}$ , with an average dip of  $24.4^{\circ}$ , SE (toward the right abutment).

On the left abutment, shallow colluvium (Jefferson Series) occurs in the vicinity of Sta. 22+00. This is a silty clay with gravel, light gray with light yellow-brown mottles. The colluvium occupies a bench. Below and above this bench is shallow residual soil (Muskingum Series).

Sheet 2 of 6  
VA 588-G



valle bedrock is exposed at the toe of the left abutment along the edge of the stream. K factors from permeability tests range from 0 - 7.06 ft/day in this abutment, and K from pressure tests varies from .02 - 6.98 ft/day.

The floodplain extends from 21+25 to 18+50  $\nabla$  dam. GM material with a silty sand matrix overlies weathered shale. This gravel is from 2.6 - 3.2 feet thick and contains pebbles, cobbles, and boulders of sandstone and shale. Overlying the gravel is silty clay, lt gray with red-brown mottles, from 2 - 3 feet thick. This layer becomes red-brown clayey silt near the stream bank at the left-hand edge of the floodplain.

From 17+75 to 18+50, a colluvial bench overlies the CL alluvium. This colluvium (Jefferson Series) consists of 3.6 feet of gravelly clay to clayey gravel with the gravel as shale pebbles. Under this bench the shale has weathered deeply to produce a residual clayey to silty gravel, often with the bedding retained.

In the shale under the floodplain and right-hand colluvial bench, K factors from permeability tests range from 0 - 20.65 ft/day with the vast majority of values below 2.0. K factors from pressure tests range from 0 - 10.04 ft/day.

On the right abutment, the shale has weathered to a silty gravel to a depth of 1 - 11 feet. K factors range from 0 - 43.31 ft/day with most values under 2 ft/day. The 43.31 ft/day occurs above 10 feet. Pressure factors vary from 0 - .34 feet/day. No pressure test could be made above from 15 - 40 feet along the centerline of the dam due to water bypassing one or both packers by way of joints and fractures.

To investigate the centerline of the dam, 6 test pits and 7 drill holes were made. They are TP 1- TP 6 and DH 11 - DH 17.

#### Principal Spillway

The proposed principal spillway crosses the centerline of the dam at 20+28  $\nabla$  dam and 3+00 on the  $\nabla$  of the pipe. The two centerlines are at right angles. GM material similar to that under the centerline of the dam underlies the pipe. It varies from 1.8 - 5.2 feet thick. Gray silty clay with brown mottles on red brown clayey silt overlies the gravel and is from 1.5 - 3 feet thick. The rock line is generally even, decreasing gradually downstream from 1305 to 1299 feet. 11 test pits and 2 drill holes were made along the pipe centerline. They are TP 301 - TP 311 and DH 321 and 322.

#### Foundation

Foundation conditions, both upstream and downstream, are generally the same as in the centerline of the dam. The colluvial bench on the right side of the valley is thicker in the upstream half of the foundation

Sheet 3 of 6  
VA 588-G



than it is on the centerline of the dam, while it is nearly absent downstream. This colluvium is shaly GC material. Seven test pits were dug in the foundation in addition to the holes on the pipe and centerline of the dam. They are TP 401 - TP 404 upstream, and TP 501 - TP 503 downstream.

#### Emergency Spillway

The emergency spillway is located in the right abutment in an area of badly jointed, fractured, and weathered shale. The centerline of the spillway crosses the dam centerline at 15+40 centerline of the dam and 5+30 on the centerline of the spillway. The two centerlines make an angle of 80°. Jefferson Series colluvium underlies the outside half of the spillway. It consists of clayey gravel or gravelly clay 1.4 - 2.2 feet thick, containing shale and sandstone pebbles. Muskingum residual soil underlies the inside half of the spillway and includes silty to clayey gravel up to 4 feet thick with the bedding retained.

At DH 223, on the downstream end of the outside edge, the usual shale with sandstone interbeds becomes sandstone with shale interbeds below 17.2 feet. This was encountered nowhere else. Rock quality designation of the rock in all drill holes in the spillway was 0.

Four drill holes, DH 221 - DH 224, and 10 test pits, TP 201 - TP 210, were made to investigate the spillway.

#### Borrow Area

The borrow area extends 4800 feet upstream from the centerline of the dam. Borrow materials consist mainly of colluvial deposits on the lower valley sides and low alluvial terrace deposits in the valley bottom. There is some residual soil on shale and siltstone in the borrow area. The thickness of deposits ranges from less than two feet in the terrace alluvium to more than 12 feet in colluvium. (See isopach borrow map). The colluvium on the left side of the valley is thinner and less continuous than that on the right.

In the colluvial slopes on the right valley side, the most widespread unit is a light gray silty clay, mottled red brown to yellow red, 2.3 - 11.7 feet thick. This clay is cobbly in places. Often overlying this layer is brown, red brown, or yellow red clayey gravel, 1.4 - 4.6 feet thick, containing pebbles or cobbles of shale, siltstone, and sandstone. It covers about 50% of the colluvium. In other places, overlying the gray mottled clay, is 1.3 - 2.0 feet of silty clay, in color brown to red brown. This clay has partly washed down over the adjacent terrace alluvium, as has the light gray mottled clay. Silty clay, two feet thick, also overlies the clayey gravel in one area. In most places, weathered shale, siltstone, or sandstone of the Chemung Formation underlie directly the gray, mottled clay first mentioned. Occasionally, a dark gray, stiff

Sheet 4 of 6  
VA 588-G

Silty clay 1.9 - 3.5 feet thick underlies the gray mottled clay and in yet other places red brown clayey gravel or silty sand 2 feet thick or less underlies it. These materials underlying the light gray mottled clay are minor in extent. Borrow thickness in the right side colluvial area varies from 2.5 to 13.0 feet. Ground water is usually encountered just above the rock line.

The low terrace deposits include most commonly brown clayey or silty gravel, with sand, containing 80% by weight of pebbles, cobbles and boulders of sandstone, siltstone, and shale. The gravel is from 1 - 5 feet thick, and in most parts of the floodplain is the top and only alluvial layer over shale, siltstone and sandstone bedrock. However, much of the marginal area of the alluvium is covered with 1.4 to 5.0 feet of silty clay washed from adjacent colluvial slopes. In several places scattered about the floodplain, the alluvial gravel is overlain by red brown clayey to gravelly silt, 1.0 - 6.0 feet thick, and/or by silty clay, light gray with brown mottles, 1.9 - 2.7 feet thick, of alluvial origin.

In some upstream portions, the gravel is not underlain directly by bedrock, but by 2 feet of light gray silty clay with brown mottles. The clay in turn is underlain by 1 - 2.2 feet of gray clayey gravel in a few places. The thickness of alluvial borrow varies from 1.3 - 8.4 feet. The water table varies from 2.4 to 6.1 feet below the surface.

materials in the colluvium on the left valley slope are somewhat similar to those on the right, but in lesser quantity. Light gray silty clay or clayey silt, mottled brown, is found over most of this area. It is 1.5 - 4.0 feet thick and is overlain variously by red brown or yellow brown silty clay, silty gravel, clayey sand, or clayey gravel, 2.0 - 6.7 feet thick. In one area, 4.9 feet of the gray mottled CL-ML material overlies red brown clayey gravel 4.6 feet thick. Total colluvial thickness on the left valley side varies from 3.5 to 10 feet. Water was encountered at only one place on the left slope, just above shale bedrock.

Forty eight test pits were dug to investigate the borrow area. They are numbered TP 101 to TP 148.

Sheet 5 of 6  
VA 588-G

UNITED STATES DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE

Location Shenandoah County Owner Bryce Mt. Resort  
Watershed Stony Creek Sub-watershed Stony Creek Site No. 9  
Submitted by J. W. Gaffney Date Mar. 1977  
Sent by Truck Government B/L No. \_\_\_\_\_  
(carrier)

[illegible]

Sheet 6 of 6 Sh.  
VA-58A-G

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

WATERSHED Stony Creek		SUBWATERSHED Stony Creek		COUNTY Shenandoah	STATE Virginia
SITE NO. 9	SITE GROUP I	STRUCTURE CLASS C	INVESTIGATED BY: (SIGNATURE OF GEOLOGIST) <i>Joseph W. Galbraith</i>		DATE 8/6 6-1/7

INTERPRETATIONS AND CONCLUSIONS

1. Cutoff should be taken 10-15 feet into bedrock. This will involve a 15-30 foot cutoff trench. Sides of this cutoff should be sloped on at least 1:1.
2. Grout should not be necessary in this foundation.
3. The GM material in the foundation is considered to have adequate bearing strength to support the structure. The CL material should be removed, especially in the swampy area occurring roughly at right angles to 19+00 @ dam.
4. The pipe location should be adequate.
5. All or almost all (95% at least) of the rock in the emergency spillway is considered rippable. The slope may have to be made 1:1 or flatter instead of the originally proposed 1/2:1 slope.
6. Sufficient borrow is present to build the dam. Suggested placement of borrow is given in the soil correlation chart. Good core material is found in the Jefferson Series colluvium on the lower right-hand slopes.
7. The minor faults encountered are few, do not exhibit weathering and appear tight. They should not be a source of significant leakage.
- 8 All topsoil should be stockpiled for use as top dressing.



APPENDIX VII

STABILITY ANALYSES



**MATERIALS  
TESTING REPORT**

 U. S. DEPARTMENT of AGRICULTURE  
SOIL CONSERVATION SERVICE

**SUMMARY - SLOPE  
STABILITY ANALYSIS**

PROJECT and STATE		DATE						
STONY CREEK SITE #9 VIRGINIA		9-12-70						
METHOD OF ANALYSIS		ANALYZED AT		APPROVED BY				
SWEDISH CIRCLE		S.M.L. LINCOLN, N.C.						
SOURCE AND USE OF MATERIALS	CLASSIFICATION	ADOPTED DESIGN DATA					REMARKS	
		Yd (pcf)	Ym (pcf)	Ysub (pcf)	φ (deg)	Ion φ (psi)		
① Found	CLAY	93.6		122.0	59.5	23.5	543	CU
②						33.5	1662	CU
③ Assumed Emb. Shell	GC	115.0	125.0	135.0	72.5	35	1700	CU
④ Embank.	SHALE	106.5	125.0	130.5	68.0	25	466	CU
⑤						28.5	543	CU
⑥ Embank.	CL	100.1	120.0	126.0	63.5	24.5	456	CU
⑦						27.5	531	CU
⑧ Embank.	GC	119.0	133.0	137.5	75.0	29	554	CU
						33.5	1662	CU
TRIAL NO.	SLOPE	CONDITIONS					F	
1 Up	2 1/2:1	Maximum Section Station 1343.7 - Arc cut thru emb (29°-45°)					1.59	
2 Up	2 1/2:1	Full drawdown - 10' berm @ elev. 1343.7 - Arc cut thru emb shell (29°-45°) & Core (24.5°-72.5°)					1.67	
3 Up	2 1/2:1	Same conditions as trial #2.					1.65	
4 Up	2 1/2:1	Same conditions as trial #1.					1.61	
5 Up	2 1/2:1	Drawn @ elev. 1341.7 - Arc cut thru emb (35°-0°)					1.93	
6 Up	2 1/2:1	Drawn @ elev. 1341.7 - Arc cut thru emb shell (35°-0°) & Core (24.5°-72.5°)					1.96	
7 Up	2 1/2:1	Same conditions as trial #5.					1.93	
8 Up	2 1/2:1	Same conditions as trial #5.					1.95	
		Flood Plain Section @ Station 17+80						
9 Up	2 1/2:1	Full drawdown - 10' berm @ elev. 1343.7 - Arc cut thru emb shell (29°-45°) & Core (24.5°-72.5°) & 7' found (28.5°-0°)					1.40	
10 Up	2 1/2:1	Full drawdown - 10' berm @ elev. 1343.7 - Arc cut thru emb (29°-45°) & 7' found (28.5°-0°)					1.33	
11 Up	2 1/2:1	Same conditions as trial #10.					1.37	
12 Up	2 1/2:1	Same conditions as trial #10.					1.36	
Continued on sheet 2 of 4								

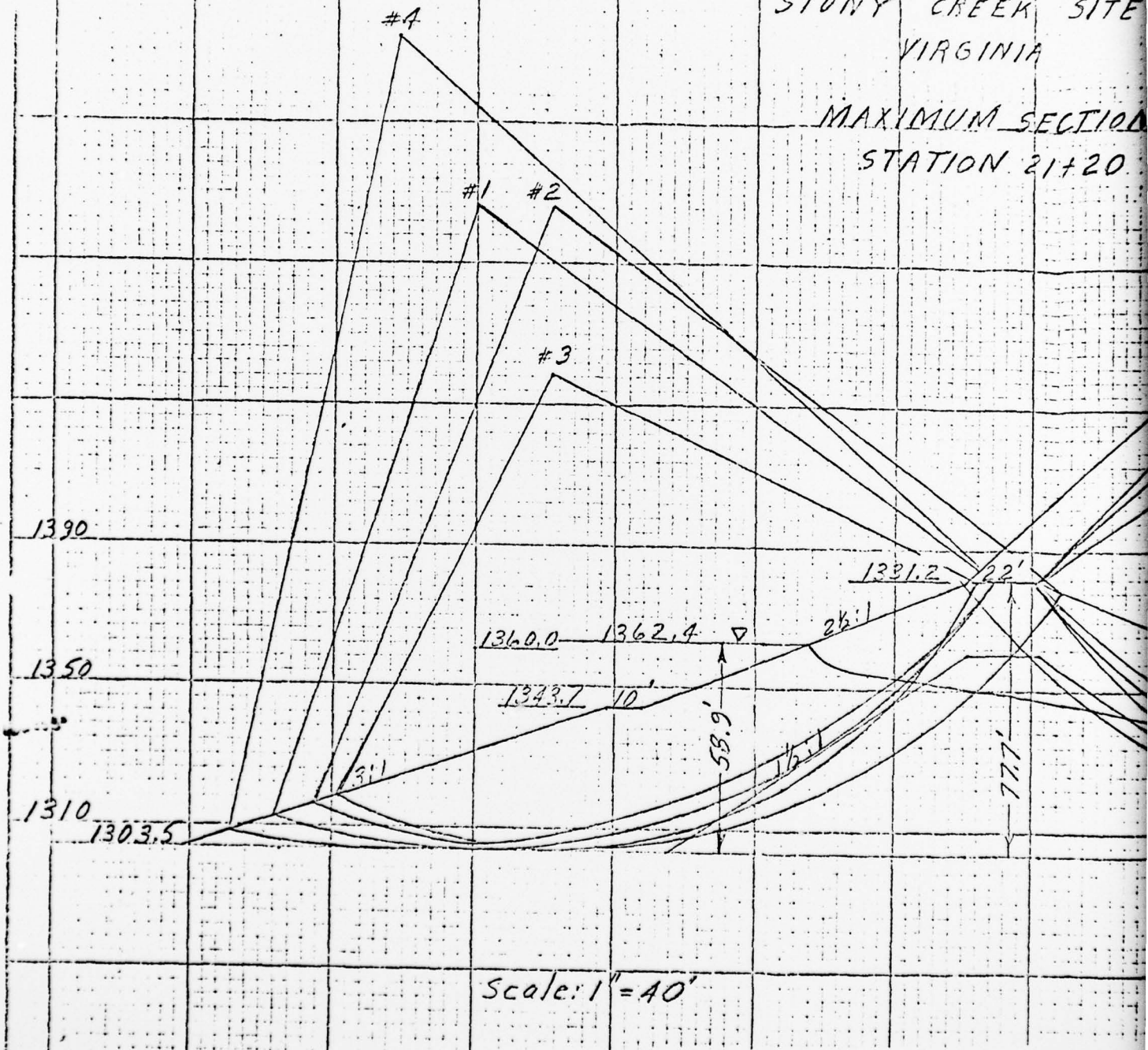


CHECKED BY R D L

DATE: 9-12-70

STONY CREEK SITE  
VIRGINIA

MAXIMUM SECTION  
STATION 21+20





DRAWING NO. Form SCS-357

SHEET 3 OF 4

9

#6  
#5  
#7

THIS PAGE IS BEST QUALITY PRACTICABLE  
FROM COPY FURNISHED TO DDC

10' 1341.7

Drain  $\frac{1}{2}$  = 0.6

U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE

DESIGNED BY

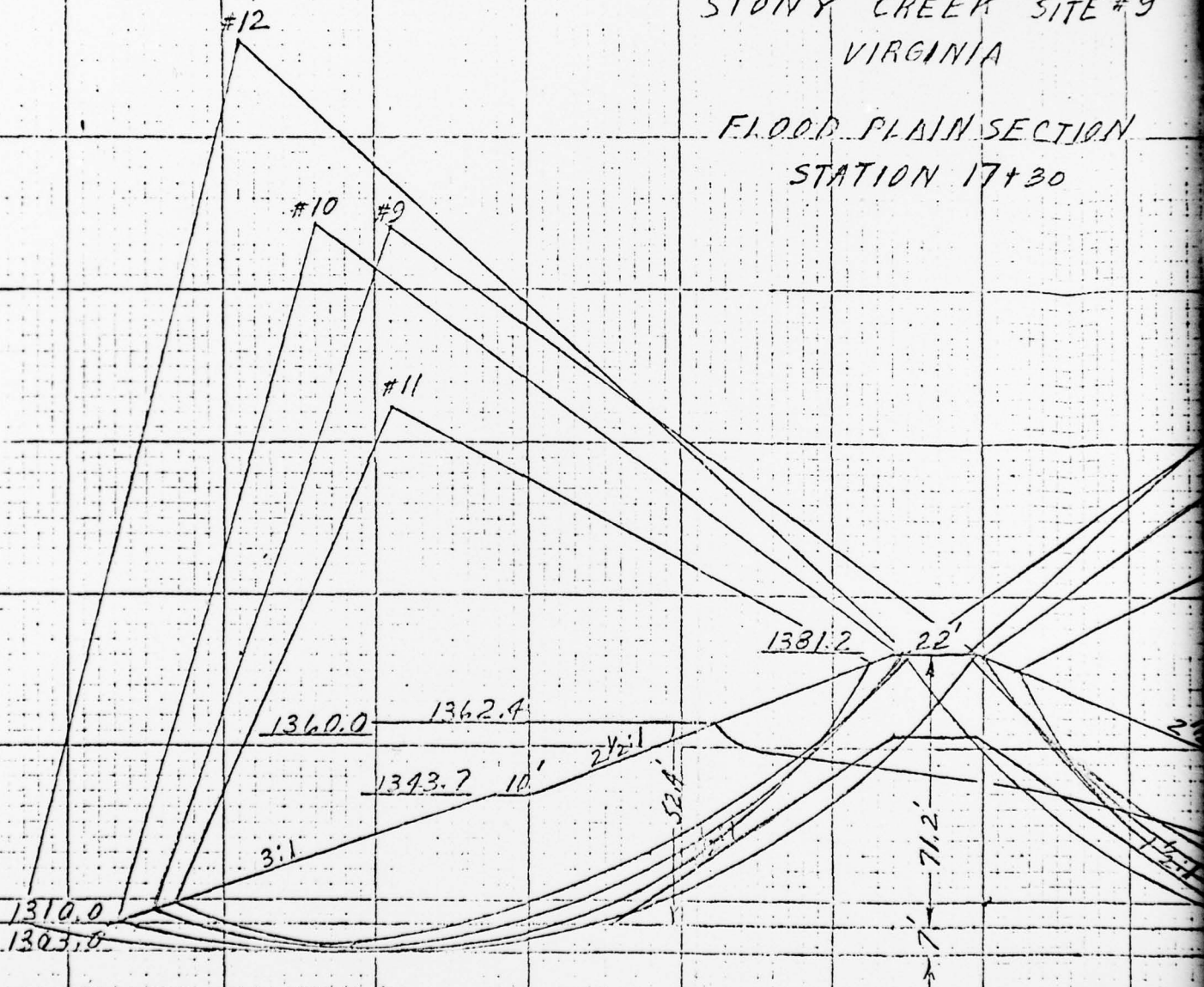
A.M.L.

APPROVED BY

2

STONY CREEK SITE #9  
VIRGINIA

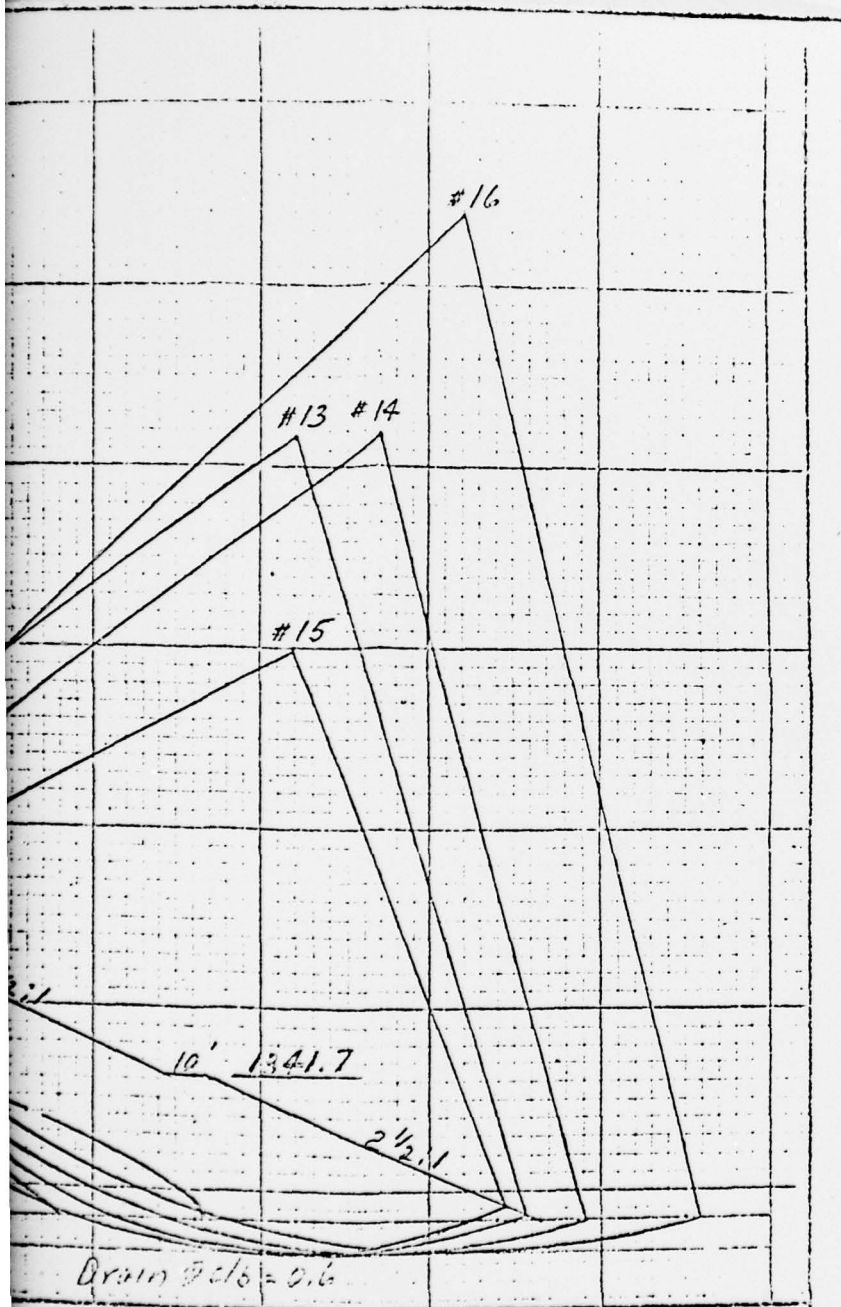
FLOOD PLAIN SECTION  
STATION 17+30



Scale: 1"=40'

DES  
CH





U. S. DEPARTMENT OF AGRICULTURE  
SOIL CONSERVATION SERVICE

DESIGNED BY A. W. L.	APPROVED BY
DRAWN BY R. D. L.	DRAWING NO. Form SCS-557