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NATIONAL DAM SAFETY PROGRAM. MIDDLETON DAM (INVENTORY NUMBER VA--ETC(U)
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Name Of Dam: MIDDLETON DAM
Location: LEE COUNTY, VIRGINIA
Inventory Number: VA. NO. 10501

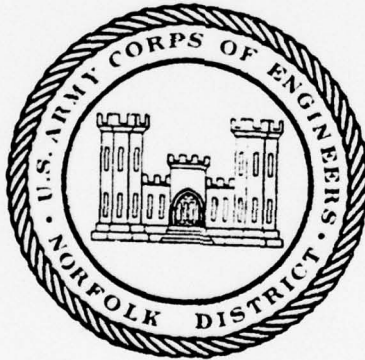
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LEVEL II

PHASE I INSPECTION REPORT

NATIONAL DAM SAFETY PROGRAM

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

BY
SCHNABEL ENGINEERING ASSOCIATES, P.C./
J. K. TIMMONS AND ASSOCIATES, INC.

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20. Abstract

Pursuant to Public Law 92-367, Phase I Inspection Reports are prepared under guidance contained in the recommended guidelines for safety inspection of dams, published by the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general conditions of the dam is based upon available data and visual inspections. Detailed investigation and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

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

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

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NAME OF DAM: MIDDLETON DAM
LOCATION: LEE COUNTY, VIRGINIA
INVENTORY NUMBER: VA. NO. 10501

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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Name of Dam: Middleton Dam Va. No. 10501
State: Virginia
County: Lee
USGS Quad Sheet: Pennington Gap
Coordinates: Lat 36° 45.5' Long 83° 06.9'
Stream: Bowman Hollow
Date of Inspection: May 23, 1979

BRIEF ASSESSMENT OF DAM

Middleton Dam is a homogeneous earthfill structure about 200 ft long and 28.5 ft high. The principal spillway consists of an 18 inch steel pipe riser with an 18 inch steel pipe extending through the structure. Water is discharged into the principal spillway through the riser and is expelled through the dam into a rock-filled embankment. There is an emergency spillway which is a 14 ft wide rock channel located at the right abutment. The dam is located in Bowman Hollow about 3.8 miles west of Stone Creek, Virginia. The dam was constructed for recreational purposes in 1965 and is owned and maintained by Mr. Steve Middleton.

The dam is rated as a "significant" hazard structure. The emergency spillway will pass 28% of the Probable Maximum Flood (PMF) prior to overtopping. Based on criteria established by the Department of the Army, Office of the Chief of Engineers (OCE), the Spillway Design Flood (SDF) is the $\frac{1}{2}$ PMF. The $\frac{1}{2}$ PMF will overtop the dam to a maximum depth of 2.4 ft, and water flow over the dam for a period of 10 hours at a critical velocity of 10 fps. The spillway is inadequate.

It is recommended that the owner provide for the design work required and the construction of the remedial work

outlined below within one year of the date of this report.

(1) There is no design or construction data available for this dam. It is recommended that the Owner have a professional geotechnical engineer perform a study in order to evaluate the safety of the dam. The study should include a detailed determination of the dam's stability, the Spillway Design Flood (SDF) appropriate to the dam and necessary modifications to the dam, spillway, floodplain, and/or any other methods of eliminating danger imposed by the project..

(2) The strip mine waste debris covering the outlet pipe should be removed in order to allow free flow through the conduit.

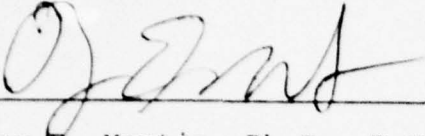
(3) A staff gage should be installed to monitor water levels.

The following routine maintenance and observation functions should be initiated:

Seepage observed along the downstream toe of the dam may actually be a spring; however, this could not be confirmed. Therefore, it is recommended that this area be monitored quarterly to detect any increase in flow rates which may cause piping within the embankment. The embankment should be reseeded in order to minimize surface erosion by runoff.

Prepared By:

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Recommended by:

Date: _____

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OVERVIEW PHOTOGRAPH

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
MIDDLETON DAM NO. 10501

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 (See Reference 1, Appendix VI). 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: Middleton Dam is a homogeneous earthfill structure approximately 200 ft long and 22 ft high.* The top of the dam varies in width and elevation. Where the width is 32 ft the elevation is 1747 M.S.L., and where the width is 40 ft the elevation is 1759 M.S.L. Side slopes are 1.8 horizontal to 1 vertical (1.8:1) on the downstream side and 1:1 on the upstream side (See Plates 2-4, Appendix I).

*Dam height is measured from the low point on the crest to the downstream toe.

The principal spillway consists of an 18-inch diameter steel riser pipe and an 18-inch steel outlet pipe running through the dam. The riser crest is at elevation 1740 M.S.L. and the 18-inch outlet pipe is approximately at elevation 1725+ M.S.L. The outlet pipe discharge end is covered over with a rock-fill embankment and stripmine debris, and water passage is limited to normal flows. There is an 18-inch valved inlet at elevation 1725 M.S.L. for purposes of draining the lake.

The emergency spillway is a rock channel with a bottom width of 14 ft and a crest elevation of 1740.3 M.S.L. The emergency spillway is located on the right end of the dam with side slopes of about 1:1 and 2:1 (See Plate 3, Appendix I). The left side of the emergency spillway is on a 2:1 slope and is in a fill section. The right side of the emergency spillway is in a cut section of a 1:1 slope.

1.2.2 Location: Middleton Dam is located in Bowman Hollow, 3.8 miles west of Stone Creek, Virginia, (See Plate 1, Appendix 1).

1.2.3 Size Classification: The dam is classified as a "small" size structure because of maximum storage capacity.

1.2.4 Hazard Classification: The dam is located in a rural forested area; however, based upon the downstream proximity of one home (2000 ft downstream) and Va. Route 421, the dam is assigned a "significant" hazard classification.

The hazard classification used to categorize a dam is a function of location only and has nothing to do with its stability or probability of failure.

1.2.5 Ownership: Mr. Steve Middleton owns the dam.

1.2.6 Purpose: Recreation

1.2.7 Design and Construction History:

The dam was constructed in 1965 by Mr. Steve Middleton and there was no formal design for this dam.

1.2.8 Normal Operational Procedures: The principal spillway is ungated; therefore, water rising above the crest of the riser inlet automatically is discharged downstream. Similarly, water is automatically passed through the emergency spillway in the event of above normal flows which create a pool elevation above that of the emergency spillway crest.

1.3 Pertinent Data:

1.3.1 Drainage Areas: The drainage area is 0.75 square miles, which was determined from the 1:24,000 USGS quadrangle of the area.

1.3.2 Discharge at Dam Site: Maximum known flood at the dam site occurred in April 1977, however, the pool elevation was not observed. During this maximum discharge the emergency spillway experienced some erosion which has been repaired.

Principal spillway outlet is blocked, but if functional with pool:

Pool at dam crest (El 1747)

Emergency Spillway Discharge:

Pool at Low Point of Dam (El 1747) 1058 CFS

1.3.3 Dam and Reservoir Data: See Table 1.1, below.

Table 1.1 DAM AND RESERVOIR DATA

| Item | Reservoir | | | | |
|------------------------------------------|--------------------------|---------------|--------------|-------------------------|-----------------|
| | Elevation Feet MSL | Storage | | | |
| | | Area Acres | Acre Feet | Watershed Inches (a) | Length Miles |
| Crest of Dam | 1746 (Avg) | 7 | 72 | .60 | .25 |
| Emergency Spill- way Crest | 1740.2 | 6 | 65 | .40 | .2 |
| Principal Spill- way Crest | 1740 | 6 | 64 | .30 | .2 |
| Streambed at Downstream Toe of Dam | 1725± | - | - | - | - |

SECTION 2 - ENGINEERING DATA

2.1 Design: There is no design data available.

2.2 Construction: No construction records are available.

2.3 Operation: There is no known operation and instrumentation procedure. Erosion reportedly occurred in the emergency spillway in 1977 due to extreme flooding, but has since been repaired.

2.4 Evaluation: Engineering calculations are not available for evaluation. Operational data should be recorded.

SECTION 3 - VISUAL INSPECTION

3.1 Findings: Field observations are outlined in Appendix III. Ground conditions were damp but firm from previous rains.

3.1.1 General: An inspection was made 23 May 1979 and the weather was cloudy with a temperature of 65°F. The pool elevation at the time of inspection was 3" over crest of riser and the tailwater was not found. Lake elevation was assumed to be 1740 M.S.L. for this report.

3.1.2 Dam and Spillway: The slopes of the dam had sparse vegetation, and a few trees were observed. Shallow eroded areas exist across much of the embankment as shown on photograph on Page II-4 of Appendix II. Field measurements indicate slopes are 1:1 on the upstream face and 1.8:1 on the downstream face. The dam appeared to be constructed from shale material. The surficial rock fill has a matrix which was visually classified sandy silt or clayey silt (ML) to silty sand (SM), according to Unified Soil Classification System. This material includes occasional blocks of shale up to 3 ft[±] in length. A sample of clay similar to that used during construction was examined and it was visually classified as a silty clay (CL). Seepage was noted along the downstream toe of the dam approximately 55 ft left of the emergency spillway. The dam was constructed by excavating the side slopes and pushing the cut material into a ravine, as reported by the owner/contractor, Mr. Steve Middleton.

The emergency spillway is located at the right abutment. The left side of the emergency spillway is at a slope of 1.5:1 and in fill. The right side of the spillway is at a 1:1 slope and is in cut. Previous erosion reported by the owner had been repaired.

The principal spillway intake was clogged with leaves and small tree branches at the time of inspection. This was removed by the owner and the intake seemed to function at a small flow rate. The outlet of the principal spillway could not be seen; and according to the owner, the outlet was covered with large rocks and strip mine over burden. The drain gate valve was not inspected.

Numerous outcrops exist at the site. Gray to brown iron-stained shale with thin sandstone interbeds were examined along the right upstream slope. The bedrock dips gently to the north. The coal strip bench area adjacent to the left abutment was also examined and consisted of the same rocks with several thin coal seams also exposed.

3.1.3 Reservoir Area: The reservoir area was wooded, showed no debris and had side slopes ranging from 2:1 to vertical. No sediment was observed.

3.1.4 Downstream Area: The downstream channel showed no erosion. There was minor debris collection from strip mining operations. The channel is 10 ft wide and .5 ft deep. Side slopes are 2:1. The flood plain is about 75 ft[±] wide and side slopes are 2:1. One home was observed 2000

ft below the impoundment approximately 4 ft above stream level.

3.2 Evaluation: Overall, the dam was in fair condition at the time of inspection. However, some remedial measures are required. The embankment is sparsely vegetated and is subject to erosion during heavy runoff. Erosion should be controlled by reseeding with a vegetative material which can grow on the shale slopes. The outlet pipe should be uncovered to allow a free flowing condition. The iron-staining associated with the seepage observed along the downstream toe could be derived from the iron-bearing shaly residual soils. It is not known whether this seepage represents a spring or is related to seepage through the dam. It should be monitored at least quarterly to detect any increase in flow rate which may cause piping within the embankment. The presence of several large boulders on the embankment slopes indicates that oversize material was included in the embankment fill.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures: The Middleton Dam is used for recreational purposes. The normal pool elevation is maintained by a riser-type inlet acting as the principal spillway. During periods of below normal flows, water flow is not maintained through the dam. Operation of the valved pipe is for lowering or cleaning of the reservoir. During periods of above normal flows, the pool elevation rises above the riser inlet and flow occurs through the principal spillway. Large increases in inflows which cannot be absorbed by storage are passed through the emergency spillway when the pool rises.

4.2 Maintenance of Dam and Appurtenances: Maintenance is the responsibility of Mr. Middleton. Dam maintenance consists of inspection of the structure, debris removal, mowing of the vegetative cover, and repair of the embankment and spillways. The operating appurtenances are reportedly in working order. The sparse vegetative growth on the embankment has not been maintained.

4.3 Warning System: No warning system exists.

4.4 Evaluation: The procedures for dam operation are adequate and maintenance has been performed as necessary except for the mowing of the vegetative cover.

SECTION 5 - HYDRAULICS/HYDROLOGIC DATA

5.1 Design: No hydraulic-hydrologic data is available.

5.2 Hydrologic Records: There are no hydrologic records available.

5.3 Flood Experience: The maximum pool elevation observed was in April of 1977, however, the pool elevation is unknown. Minor erosion damage occurred in the emergency spillway during this flood.

5.4 Flood Potential: 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. The Probable Maximum Flood (PMF), $\frac{1}{2}$ PMF, and 100-year Flood hydrographs were developed by the SCS method (Reference 4, Appendix VI). Precipitation amounts for the flood hydrographs of the PMF, $\frac{1}{2}$ PMF, and 100-year Flood are taken from the U. S. Weather Bureau Information (References 5 and 6, Appendix VI). Appropriate adjustments for basin size and shape were accounted for. These hydrographs were routed through the reservoir to determine maximum pool elevations.

5.5 Reservoir Regulation: For routing purposes,

the pool at the beginning of the flood was assumed to be at elevation 1740 M.S.L. Reservoir stage-storage data and stage-discharging data were determined from the field measurement and USGS quadrangle sheets. Floods were routed through the reservoir ignoring any discharge from the principal spillway and allowing all flow to pass through the emergency spillway.

5.6 Overtopping Potential: The predicted rise of the reservoir pool and other pertinent data were determined by routing the flood hydrographs through the reservoir as previously described. The results for the flood conditions (PMF, $\frac{1}{2}$ PMF, and 100 year Flood) are shown in the following Table 5.1.

TABLE 5.1 RESERVOIR PERFORMANCE

| | Normal Flow | Hydrograph | | |
|-------------------------------------------------|----------------|------------|---------|---------|
| | | 100-Year | ½ PMF | PMF |
| Peak Flow, CFS | | | | |
| Inflow | 1 | 914 | 2971 | 5942 |
| Outflow | 1 | 706 | 2657 | 5399 |
| Maximum Pool Elevation Ft., MSL | | | | |
| | | 1744.5 | 1749.4 | 1751 |
| Non-Overflow Section (El 1747 MSL, Low Pool) | | | | |
| Depth of Flow, Ft | - | - | 2.44 | 4.03 |
| Duration, Hours | - | - | 1.5 | 3.5 |
| Velocity, fps* | - | - | 10 | 13 |
| Emergency Spillway (El 1740.3 MSL) | | | | |
| Depth of Flow, Ft | - | 4.3 | 9.3 | 10.7 |
| Duration, hrs | - | 10 | 10 | 12 |
| Velocity, fps* | - | 11 | 14 | 11 |
| Tailwater Elevation Ft. MSL | | | | |
| | 1715± | 1716 | 1717.5+ | 1718.7+ |

* Critical Velocity at Control Section

5.7 Reservoir Emptying Potential: An 18-inch circular gate at elevation 1725+M.S.L. could drain the reservoir through the 18-inch pipe. Due to the blockage at the outlet of the 18-inch pipe, there is no way to determine the time required to empty the lake, but there is enough flow through the blockage to allow the lake to drain to elevation 1725+M.S.L. There are no methods for lowering the reservoir below this elevation.

If the blockage did not exist, the 18 inch pipe is capable of draining the lake in 2 days.

5.8 Evaluation: Department of the Army, COE, guidelines indicate the appropriate Spillway Design Flood (SDF) for a small size and significant hazard dam is the 100 year to $\frac{1}{2}$ PMF. Because of the risk involved, the $\frac{1}{2}$ PMF has been selected as the SDF. The spillway will pass 28 percent of the PMF. The SDF will overtop the dam a maximum of 2.4 ft, and remain above the dam crest for 1.5 hours with a critical velocity of 10 fps.

Hydrologic data used in the evaluation pertains to present day conditions with no consideration given to future development.

SECTION 6 - DAM STABILITY

6.1 Foundation and Abutments: The dam site is located within the southeast edge of the Appalachian Plateau (locally Cumberland Plateau) Physiographic Province of Virginia. In the Pennington Gap area, the ground surface is extremely rugged. Flat lands, even a few acres in extent, are rare and valley slopes, though not precipitous, are very steep.

Middleton Dam appears to be founded on alluvial, colluvial and/or residual soils, all of which are underlain by the Norton Formation. The Formation is approximately 1150 ft thick and consists of repetitious sequences of gray to brown sandstone, siltstone and shale with thin interbeds of coal. Interbeds of sandstone and shale are exposed in both abutments and coal has been strip mined from a bench cut into the downstream portion of the left abutment. The bedrock is slightly to moderately weathered and fractured. Bedrock exposed in the abutments probably underlies the embankment. The potential for seepage exists within the foundation since the dam is believed to be founded on soils possessing various rates of permeability. Furthermore, the weathered and fractured condition of the bedrock also increases the potential for seepage. Geologic maps of the area do not show the presence of faults in the immediate vicinity.

6.2 Embankment: The upstream slope is 1 horizontal to 1 vertical with crest ranging from elevation 1759 M.S.L. on the left side to elevation 1747 M.S.L. on the right side.

The crest of the dam varies in width from 32 to 40 ft. Normal pool level is elevation 1740 M.S.L. or 7 ft below the top of the lowest portion of the dam. Drawings of the structure were made from field measurements and are included as Plates 2, 3 and 4 of Appendix I. The downstream slope is 1.8 horizontal to 1 vertical. According to the owner, a 12 to 14 ft \pm wide core trench, excavated to hard clay, extends along the axis of the dam. Site grading prior to filling included a 115 ft \pm cut into the right abutment slope and a 30 ft \pm cut into the left abutment slope. Approximately 90% of the embankment was said to have been constructed with clay, which is covered with a thin shell or shale debris of unknown thickness. Field density tests were not made on the fill, which was "compacted" with the excavating equipment.

The right side of the emergency spillway is in cut material which includes weathered sandstone and shale.

6.3 Evaluation:

6.3.1 Foundation and Abutments: Dam foundations must be evaluated on the basis of potential settlement, sliding and seepage. Excessive settlement of the dam is not believed to be a problem assuming the structure rests upon fairly competent bedrock and firm to compact alluvial, colluvial, and/or residual soils. Without any subsurface data, the actual strength of the overburden soils cannot be assessed. Gradual consolidation of underlying soils would be expected during application of fill materials. The underlying soils probably had essentially fully consolidated under the applied load at the end of the construction period.

Sliding within the foundation bedrock would not normally appear to be a problem based upon the nature of the Norton formation. A review of the geologic data indicates that there are probably no adversely oriented weak planes within the foundation rock that would act as a potential sliding plane. However, previous experience with this formation makes it necessary to consider the presence of clay shales beneath the dam. A clay shale is a soft shale which becomes very clayey and slick once in contact with water. Clay shales encountered during core drilling will expand once they are wet, and consequently, are very difficult to extract from the core barrel. If clay shales exist at shallow depth beneath the dam, it is possible for seepage to come into contact, thus creating a slick and expensive zone which could then become a plane of weakness. The presence or absence of such a near surface zone should be considered in a stability analysis.

The potential for seepage exists within the foundation since the dam is believed to be founded, at least, in part, on alluvial, colluvial and residual soils possessing various rates of permeability. The thickness of overburden soils is not known; however, based upon past experience in the plateau area, overburden thicknesses of more than 10 ft do not often occur along the upper reaches of stream channels. The permeability of underlying bedrock may also vary considerably, based upon composition, degree of fracturing and weathering. Although the condition of the underlying bedrock is not known, some seepage should be expected in the upper

portion of the bedrock. In attempt to control seepage the owner excavated a core trench into clay. No other seepage control measures were reported. Since there are no construction reports, an accurate determination of the foundation conditions under the cutoff trench is not possible. Furthermore, it could not be determined whether the seepage observed along the downstream toe is related to spring activity or seepage through or beneath the dam.

The embankment has been constructed in part with shale debris, which often decomposes when in contact with water. If seepage is passing through the embankment, piping could develop as a result of the decomposition of the shale fill materials. Although the observed seepage is not believed to be serious at the present time, it should be monitored to detect any increase in flow rates which might cause piping through the embankment.

The steep slopes which form the right side of the emergency spillway are cut into partially weathered sandstone and shale. They were considered safe and essentially stable at the time of investigation. Minor sloughing often occurs in shale cuts, therefore the accumulation of shale debris may occur in the channel, but would not be a hindrance to proper functioning of the spillway unless large quantities of rock accumulate.

6.3.2 Embankment: The embankment slopes do not meet the requirement recommended by the U. S. Bureau of Reclamation for small homogeneous earthfill dams on stable foundation. Since no undue settlement, cracking or seepage was noted at the time of inspection, it appears that the embankment is adequate for normal pool level with water elevation at 1740 M.S.L.

An accurate check on the stability of this structure cannot be made since there is no design and construction data. The slopes are very steep and the foundation condition is not known. It is recommended that a stability analysis be made by a professional geotechnical engineer.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment: The Middleton Dam at the time of inspection appeared sound and in a safe operating condition. The spillway will pass 28% of the PMF without overtopping. The SDF is the $\frac{1}{2}$ PMF, and the dam will be overtopped by 2.4 ft during the $\frac{1}{2}$ PMF. The spillway is considered inadequate.

The embankment was constructed without the benefit of a design and no construction records were kept. Without design data and construction records, the stability of the structure cannot be assessed. Furthermore, the embankment slopes do not meet the requirements recommended by the U. S. Bureau of Reclamation, Reference 2, Appendix VI, for small homogeneous earthfill dams on stable foundations.

7.2 Remedial Measures:

7.2.1 Investigation by Owner: It is recommended that the Owner have a professional geotechnical engineer perform **a study** in order to evaluate the stability condition of the dam and to make specific recommendations for the required remedial measures.

7.2.2 The emergency spillway should be modified to accommodate the $\frac{1}{2}$ PMF without overtopping the dam.

7.2.3 Strip mine waste debris should be removed from over the outlet pipe to allow a free flowing condition during increased lake levels.

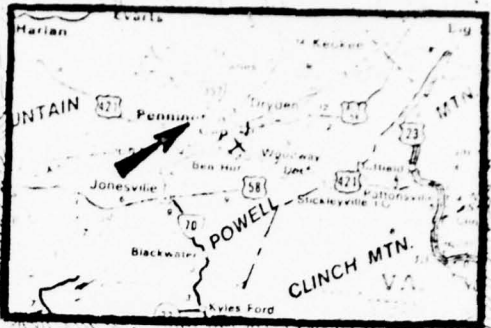
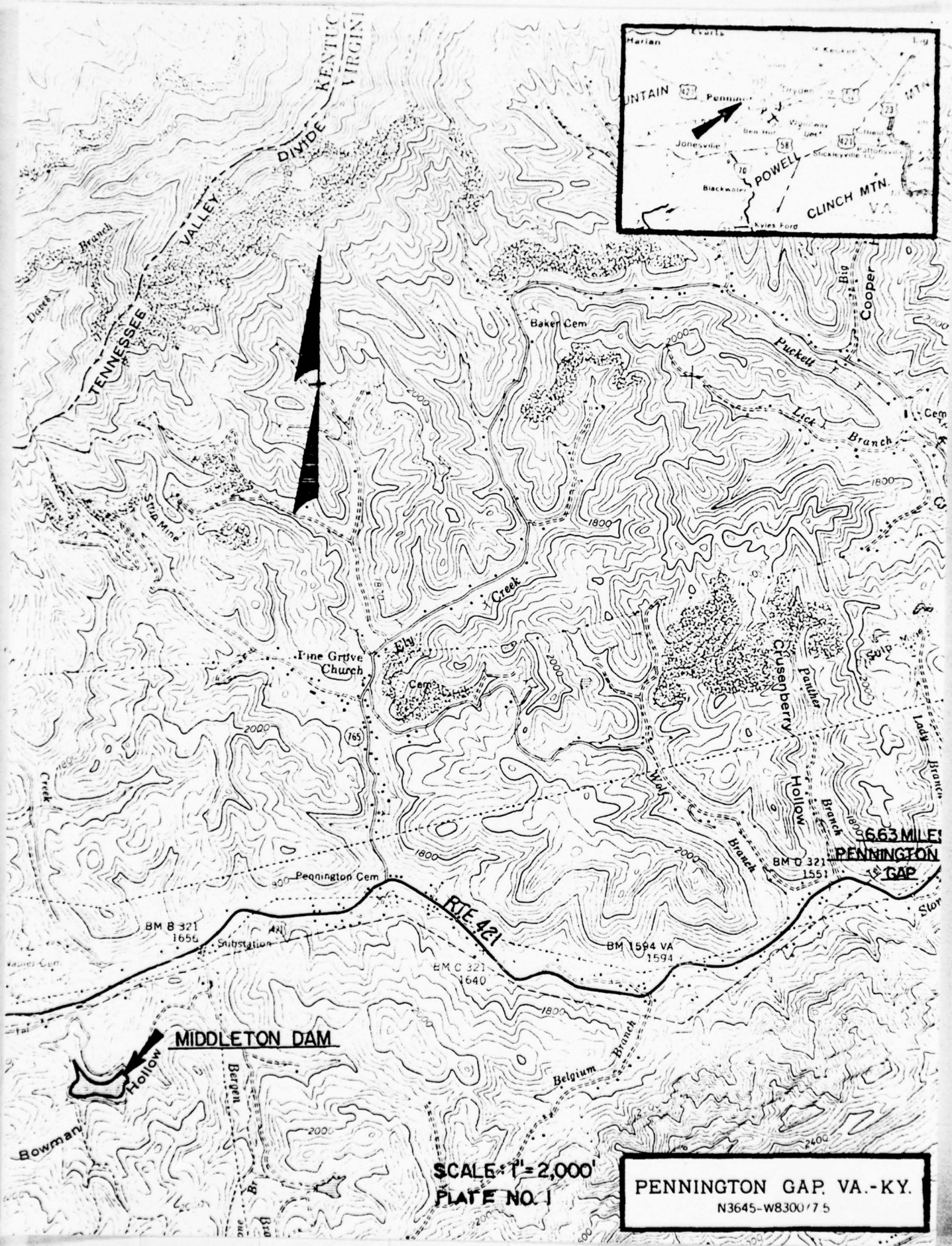
7.2.4 A staff gage should be installed to monitor water levels.

7.3 Required Maintenance:

7.3.1 Seepage observed along the downstream toe of the embankment should be monitored quarterly to detect any increase in flow which may cause piping within the embankment.

7.3.2 The embankment should be reseeded in order to minimize surface erosion by runoff and should be mowed at least twice per year.

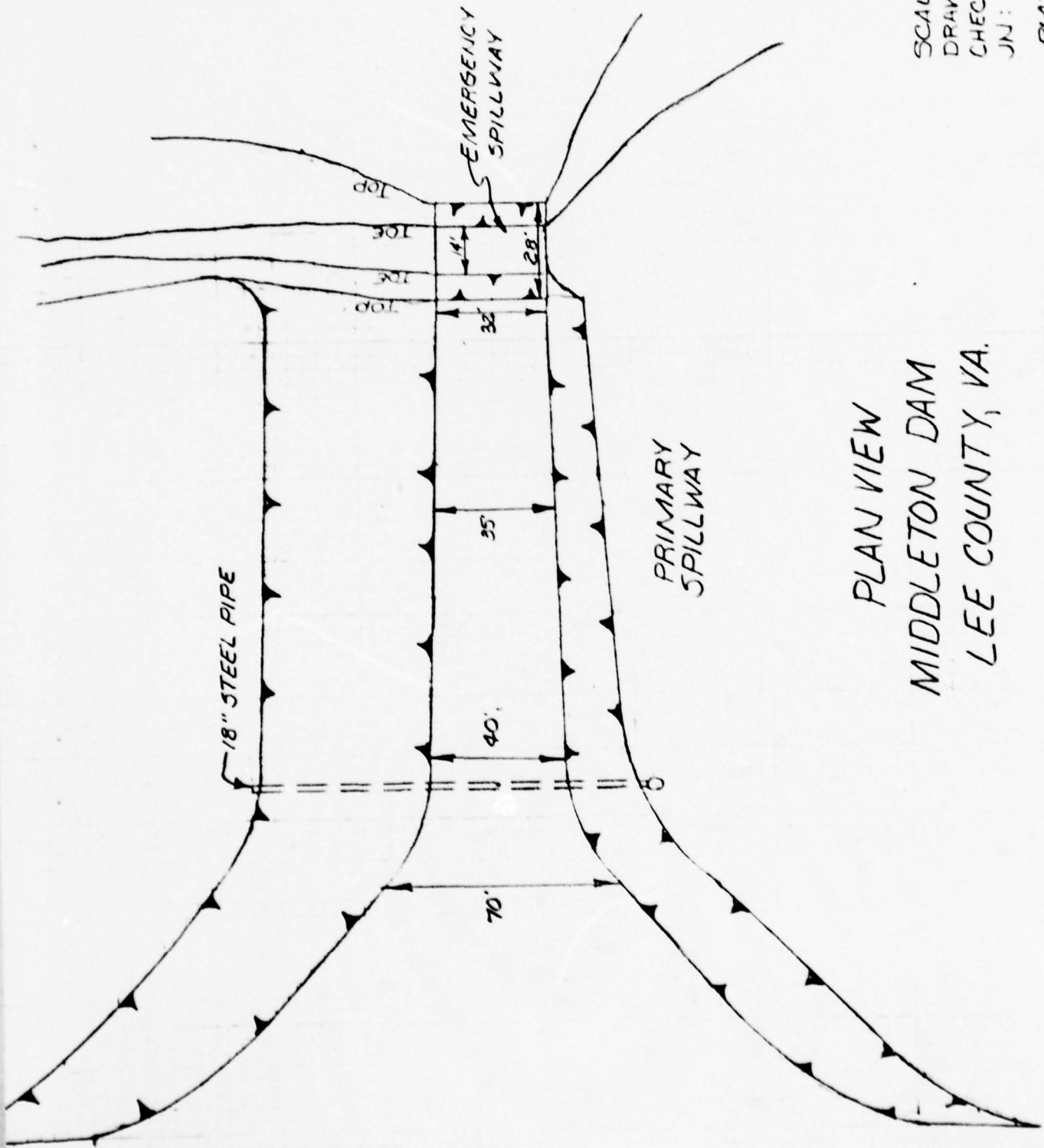
APPENDIX I
MAPS AND DRAWINGS



MIDDLETON DAM

SCALE: 1" = 2,000'
 PLATE NO. 1

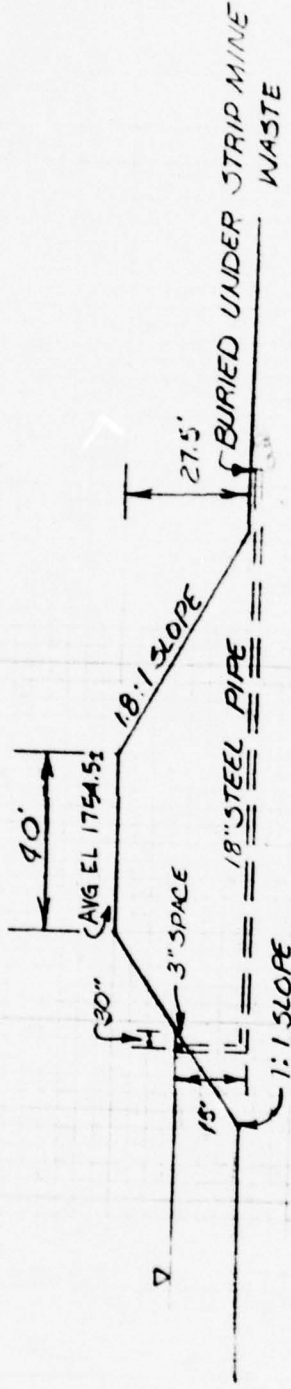
PENNINGTON GAP, VA.-KY.
 N3645-W8300/7 5



SCALE: 1"=40'
 DRAWN: FESSLER
 CHECKED: ROOP
 JN: 13015

PLATEZ

PLAN VIEW
 MIDDLETON DAM
 LEE COUNTY, VA.



TYPICAL SECTION
 MIDDLETON DAM
 LEE COUNTY, VA.

SCALE: 1" = 40'
 DRAWN: FESSLER
 CHECKED: ROOP
 JUN: 13015

PLATE 3



ELEVATION VIEW
 MIDDLETON DAM
 LEE COUNTY, VA.

SCALE: NO SCALE
 DRAWN: GORRELL
 CHECKED: ROOP
 J.N. 13015
 PLATE No 4

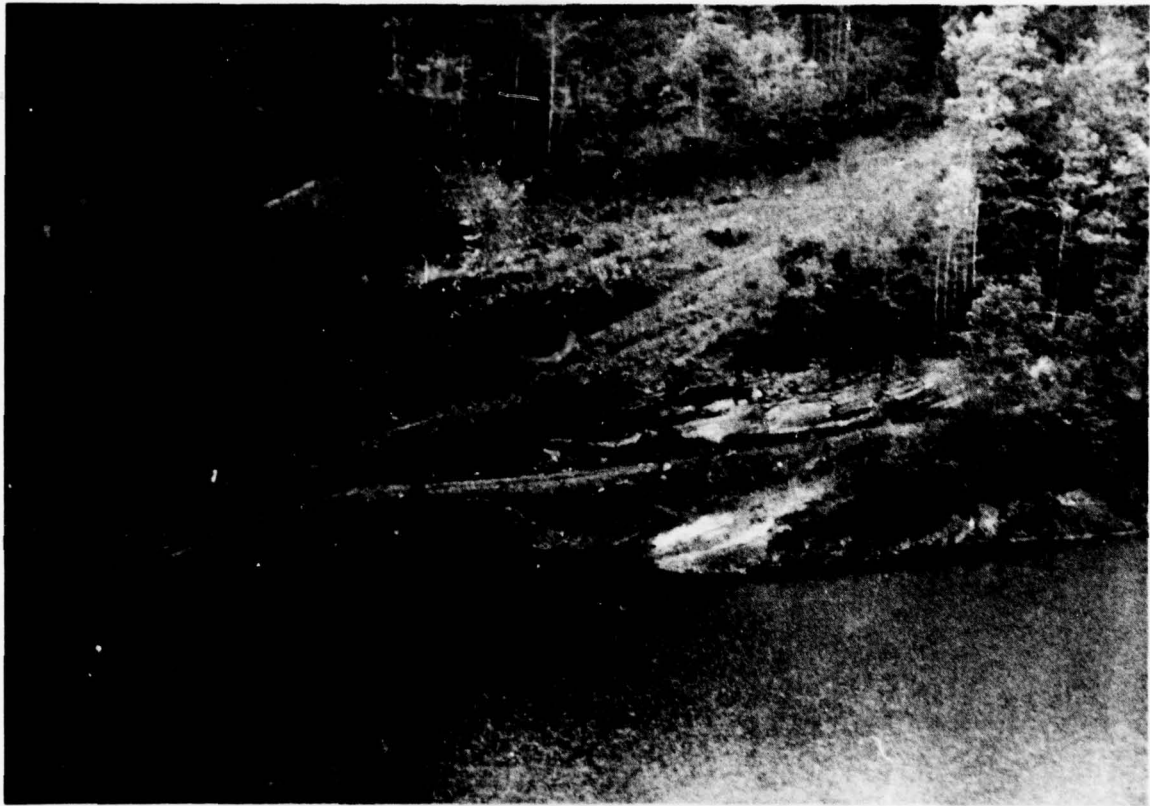
APPENDIX II
PHOTOGRAPHS



CLOSE-UP PRINCIPAL SPILLWAY

(NOTE: TRASH ON TOP)

II-1



VIEW OF CUT AT RIGHT ABUTMENT



PHOTOGRAPH EMERGENCY SPILLWAY



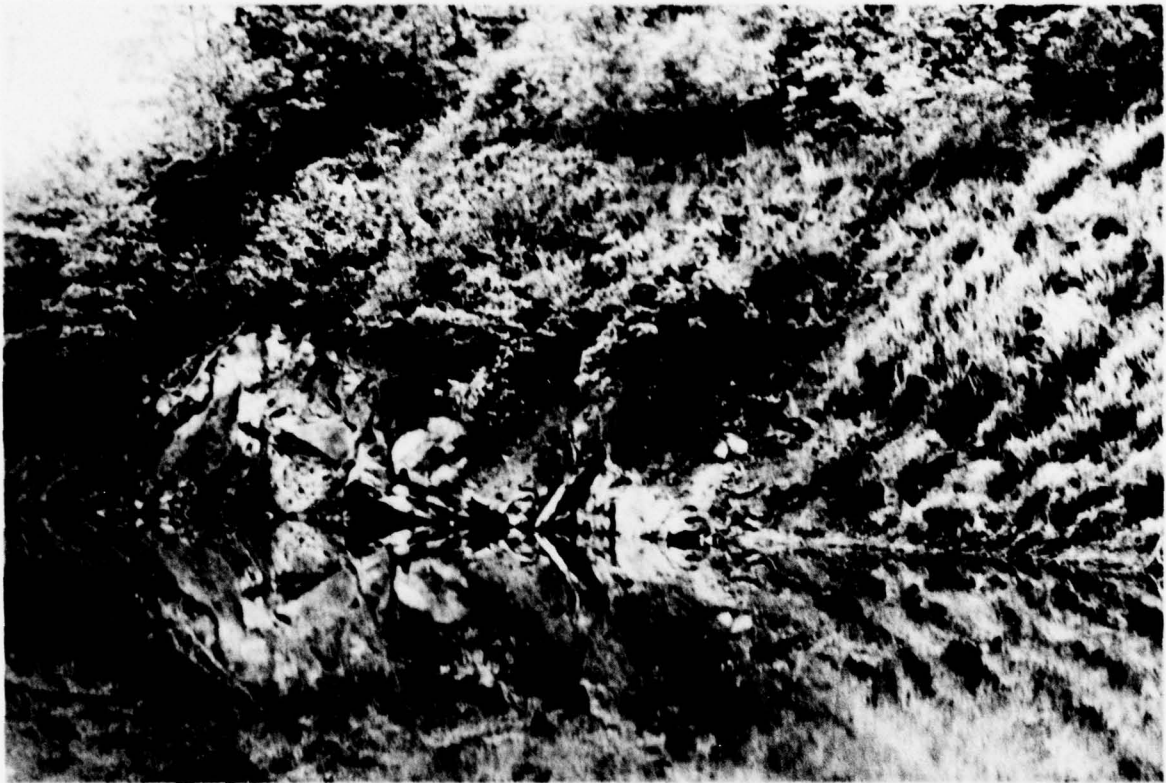
EROSION ON DOWNSTREAM FACE



VIEW LOOKING DOWNSTREAM FROM EARTHEN BERM



HOMES IN DOWNSTREAM FLOODPLAIN



VERTICAL SLOPE AT LEFT ABUTMENT

APPENDIX III
FIELD OBSERVATIONS

FIELD OBSERVATIONS

Name of Dam: Middleton Dam

County: Lee

State: Virginia

Coordinates: Lat 36° - 45.5' Long 83° - 06.9'

Date of Inspection: May 23, 1979

Weather: Cloudy, temperature 65°F

Pool Elevation at Time of Inspection: 1740 M.S.L.

Tailwater at Time of Inspection: 1715 M.S.L.

Inspection Personnel:

Schnabel Engineering Associates, P.C.
Ray E. Martin, P.E.*
Stephen G. Werner (recorder)

J. K. Timmons and Associates, Inc.
Robert G. Roop, P.E.
William A. Johns (recorder)

State Water Control Board
Hugh Gildea, P.E.
S. Middleton - Owner

1 Embankment;

1.1 Surface Cracks: The slopes, crest, emergency spillway, and abutment contacts were inspected and no cracks were noted. The downstream slope is sparsely covered with weeds, otherwise no vegetation.

1.2 Unusual Movement: No unusual movements were noted on the dam or downstream beyond the embankment toe.

* Not present during May 23, 1979 inspection, but visited the dam on June 12, 1979.

1.3 Sloughing or Erosion: Abutment slopes appear stable. The embankment ties into shale with sandstone interbeds. Upper left area is a coal strip bench. Some erosion due to runoff exists along the left end of the downstream slope and across the road extending across the crest. Occasional embankment sloughing is present on the downstream slope. These shallow narrow washes are generally less than 1 ft wide and 1 ft deep. The embankment surface consists of SM and ML material; a shale fill with blocks up to 3 ft in length.

1.4 Alignment: Satisfactory. Axis trends $35^{\circ\pm}$ to the northwest.

1.5 Riprap: None

1.6 Junctions: Conditions appear good at the junction of the embankment and the abutments. The bottom of the embankment is not keyed into bedrock but rests on "blue clay." The core trench is reportedly 12 - 14^{\pm} ft wide and filled with "clay" from surrounding slopes. The owner showed S. Werner a typical outcrop of the "blue clay" core material. Mr. Middleton stated that he excavated a core trench up into the right abutment about 115^{\pm} ft. Apparently the right abutment had a more gentle slope than the left abutment. Middleton described a cut of 25 - 35^{\pm} ft into the steeper left abutment. The upstream slope is $1:1^{\pm}$; downstream is 1.8^{\pm} .

It was visually described as silty clay, trace fine sand, moist - gray (CL). This would be good core material. It is a residual clay derived from a clay shale. Mr. Middleton described 90% of the dam as being constructed with this material before the rock shell was placed as an outer zone. This same clay was reportedly exposed in the core trench and was cut out in blocks.

Bedrock exposed along the right upstream slope strikes 50 to 80° NW and dips 16° SE. It consists of gray to brown iron-stained shale with thin sandstone interbeds. No observed joint patterns, however the rock is highly fractured. The same rock is exposed in the strip area along the left abutment, with coal also present. The rock strikes essentially East-West and dips 21° N. Rectangular joint patterns were measured: N35E, 74SE; N70W, 75NE.

1.7 Seepage: Seepage flowing at less than 1 gpm occurs near the base of a tree along the toe of the downstream slope, approximately 55 ft left of the emergency spillway. Mr. Middleton described this as a spring which existed prior to construction of the dam.

Water was flowing at 10 gpm[±] from beneath the waste pile bounding the left slope of the strip bench (downstream). This may be water from the outlet pipe, which was covered by waste debris from strip operations. Also observed water along the right downstream side slope, which could be runoff from the slope or spillway water.

1.9 Drains: None

2 Outlet Works:

2.1 Outlet Conduit: None found. Outlet was covered by strip mining operation (conduit is reportedly steel pipe).

2.2 Intake Structure: Intake clogged with leaves but cleaned during inspection. 18" steel with perforated screen on top.

2.3 Outlet Structure: None found. 18" steel pipe according to the owner.

3 Emergency Spillway:

3.1 Channel: Slope of spillway is 1%. Bottom width is 14 ft, top width is 28 ft. The channel narrows to 12 ft bottom downstream at control section.

The channel is cut into natural ground. The right side is in shale and sandstone, while the left side appears to be a combination of cut and fill. The left side does not appear to be as stable because of the loose debris present. Side slopes 5 - 15 ft[±] high on left side and up to 30 ft[±] on the right side. A considerable amount of loose debris in the upper 100 ft of the channel, then black shale bedrock is exposed further away from the impoundment.

3.2 Emergency Gate: 18" drain valve, which according to the owner is operational.

4 Ungated Spillway:

4.1 Approach Channel: Clear and unobstructed.

4.2 Discharge Channel: Minor debris from strip mining; 10 ft[±] wide and 0.5 ft ± deep.

5 Reservoir:

5.1 Slopes: Moderately steep slopes occur along the right side and steep to vertical slopes bound the left side. Most of the slopes are wooded.

5.2 Sedimentation: None observed.

6 Downstream Channel:

6.1 Condition: No debris.

6.2 Slopes: Slope from 2:1 to vertical. These slopes occur along both sides of the channel, are wooded and appeared stable at the time of the inspection.

6.3 Population and Facilities: One house exists along the creek about 700 ft downstream, but is 20 ft or greater above the stream; and one house exists on the creek about 2000 ft downstream and 4 ft above the stream.

7 Instrumentation:

7.1 Monumentation: None

7.2 Observation Wells and Piezometers: No observation wells or piezometers were noted in the field.

APPENDIX IV - REFERENCES

1. Recommended Guidelines for Safety Inspection of Dams, Department of Army, Office of the Chief of Engineers, 46 pp.
2. Design of Small Dams, U. S. Department of Interior, Bureau of Reclamation, 1974, 816 pp.
3. Geologic Map of the Pennington Gap Quadrangle, Lee County, Virginia, and Harlan County, Kentucky, Map GQ-1098; Miller, Ralph L. and Roen, John B.; U. S. Geological Survey, Washington, D.C. 1973.
4. Section 4, Hydrology, Part 1, Watershed Planning, SCS National Engineering Handbook, Soil Conservation Service, U. S. Department of Agriculture, 1964.
5. Hydrometeorological Report No. 33, U. S. Department of Commerce, Weather Bureau, U. S. Department of Army, Corps of Engineers, Washington, D.C. April 1956.
6. Technical Paper No. 40, U. S. Department of Commerce Weather Bureau, Washington, D. C., May 1961.