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BAKER (MICHAEL) JR INC BEAVER PA
NATIONAL DAM SAFETY PROGRAM. RAGGED MOUNTAIN DAM NUMBER 1 (VA00--ETC(U)
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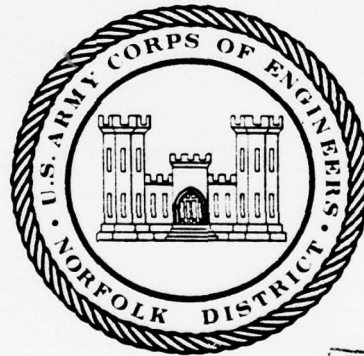
JAMES RIVER BASIN

Name of Dam: Ragged Mountain No. 1
Location: Albemarle County, State of Virginia
Inventory Number: VA 00304

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LEVEL II

PHASE I INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM



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SEPTEMBER 1978


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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.



PHASE I INSPECTION REPORT
 NATIONAL DAM SAFETY PROGRAM

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NAME OF DAM: RAGGED MOUNTAIN NO. 1

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam: Ragged Mountain No. 1
State: Virginia
County: Albemarle
Stream: Moores Creek
Date of Inspection: 26 July 1978

BRIEF ASSESSMENT OF DAM

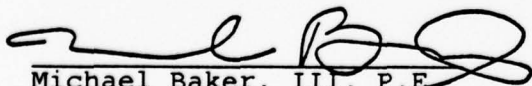
Ragged Mountain Dam No. 1 is an earthfill dam with an upstream concrete gravity wall. It is approximately 67 feet high and 400 feet long. Visual inspection and analyses indicate deficiencies requiring emergency attention.

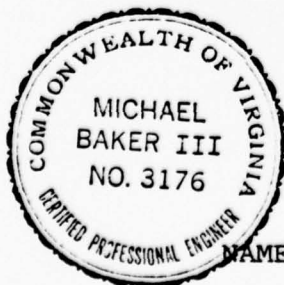
Using the Corps of Engineers screening criteria for initial review of spillway adequacy, it has been determined that the dam would be overtopped for all storms exceeding approximately 25 percent of the Probable Maximum Flood. The spillway is, therefore, judged as seriously inadequate, and the dam is assessed as unsafe, non-emergency. The stability of the dam should be investigated to assess the effect of seepage, steep (one and one-half vertical to one horizontal [1.5:1]) embankment slope, and lower reservoir levels on the upstream wall.

Items that require immediate attention are as follows:

- 1) Further investigation of spillway adequacy including the possibility of enlarging the spillway.
- 2) Installation of piezometers to assess the effect of seepage on dam stability.
- 3) Determination of concrete wall dimensions.
- 4) Stability analyses of the embankment and the wall.
- 5) A flood warning system for downstream residents.

MICHAEL BAKER, JR., INC.


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



SUBMITTED: Original signed by
JAMES A. WALSH

James A. Walsh
Chief, Design Branch

RECOMMENDED: Original signed by
ZANE M. GOODWIN

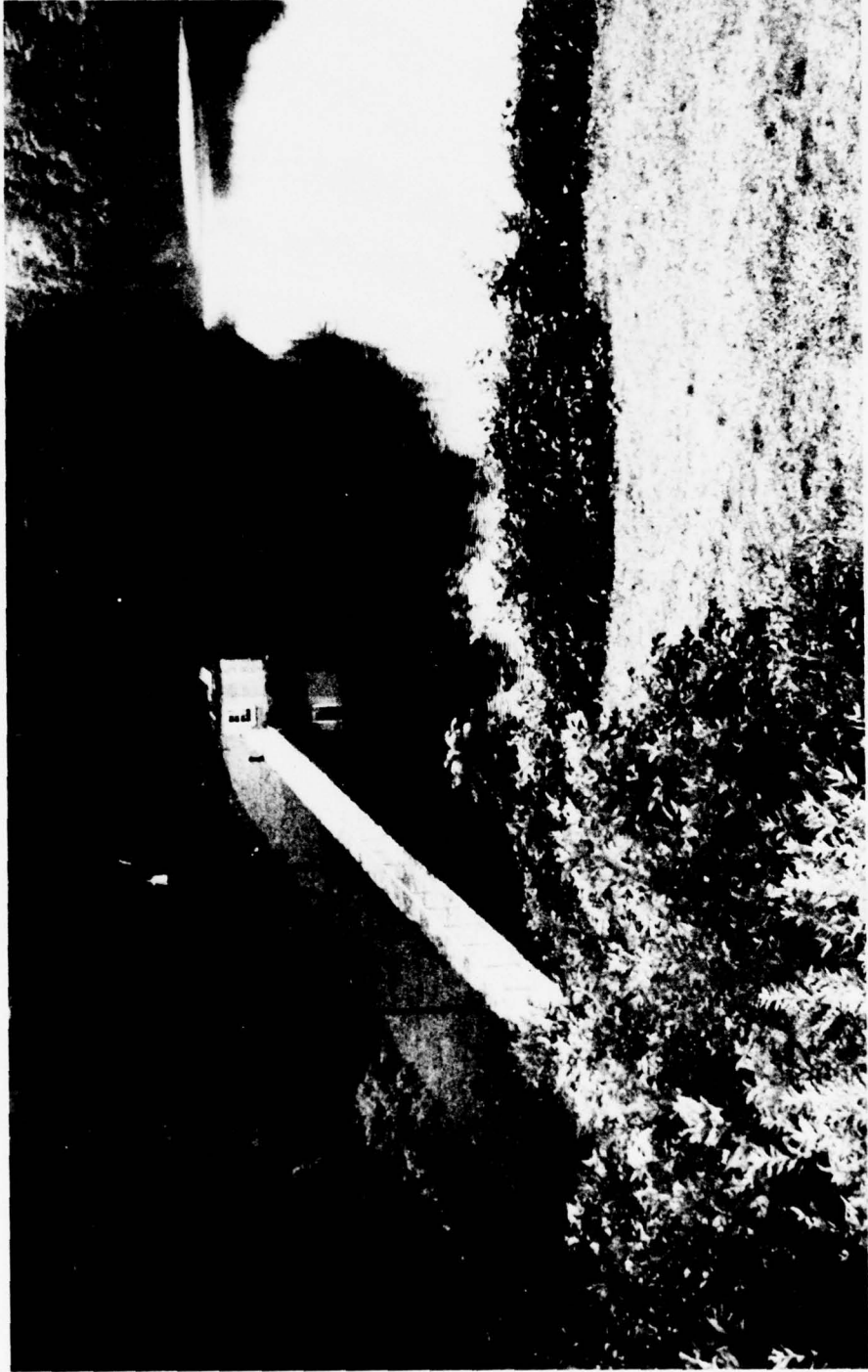
Zane M. Goodwin
Chief, Engineering

APPROVED: Original signed by:

Douglas L. DeHalse
Colonel, Corps of Engineers
District Engineer

Date: SEP 27 1978

NAME OF DAM: RAGGED MOUNTAIN NO. 1



OVERALL VIEW OF DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
NAME OF DAM: RAGGED MOUNTAIN NO. 1 ID# VA 00304

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: Ragged Mountain Dam No. 1 is an apparent combination concrete gravity and earthfill dam approximately 67 feet high and 400 feet long. The crest width is 24 feet with a 7.5 feet wide concrete walkway adjacent to the reservoir. The embankment has been constructed with two horizontal to one vertical (2:1) over 1.5:1 downstream slope ratios. A vertical concrete wall forms the upstream face of the dam which extends from crest level into the reservoir for an undetermined depth (see Photo 1).

The open channel spillway has a concrete invert with smooth mortared stone walls and is located on the left abutment area. The spillway alignment is curved with an approximate radius of 90 feet, and an upstream width of 13.2 feet and a downstream width of 8.2 feet. The spillway length is 112 feet long at its centerline. There is a seven percent slope from the upstream invert to the downstream invert.

NAME OF DAM: RAGGED MOUNTAIN NO. 1

A 30 inch diameter cast-iron pipe keep is located four feet to the right of the open channel spillway. The pipe has two flashboards placed in front of the intake and behind a trash rack (see Photo 5).

The gate house is located approximately at the midpoint of the dam (see Photos 3 and 4). An 18 inch pipe carries water from the gate house to a small treatment building located at the toe of the dam. There chemicals (presently chlorine for algae control) are added to the water supply main used to supply the City of Charlottesville, Virginia (see Photo 6).

Upstream approximately 2500 feet from Ragged Mountain Dam No. 1 is another earthfill dam constructed at some unknown date prior to the construction of Ragged Mountain Dam No. 1.

Based on U.S.G.S. maps, it is estimated that the upstream dam is 50 to 60 feet high with an estimated top elevation of 659.5 and a crest or normal pool impoundment elevation of 653. The crest or normal pool impoundment of the Ragged Mountain Dam No. 1 is at elevation 641. Therefore, the majority of this upstream dam is submerged with a difference in elevation of 12 feet between the normal pools.

Based on information obtained from the owner, this upstream dam is 472 feet long and has a riprap spillway in the right abutment 9.75 feet wide with a spillway crest 6.5 feet below the top of dam. An existing valve house accessible by catwalk contains valving arrangements which are not operated due to unknown results. The owner knows of no method for draining this reservoir. A ten inch diameter waterline (broken and no longer in service) from the valve house passes through this upstream dam and is routed in the vicinity of the original streambed (submerged by the Ragged Mountain Dam No. 1 impoundment) to Ragged Mountain Dam No. 1. This ten inch diameter pipe passes through Ragged Mountain Dam No. 1 and joins existing piping from the Ragged Mountain Dam No. 1 in the vicinity of the chemical feedhouse near the toe of Ragged Mountain Dam No. 1.

NAME OF DAM: RAGGED MOUNTAIN NO. 1

The owner further advised that:

- 1) The ten inch diameter waterline from the upper reservoir has broken within the Ragged Mountain No. 1 reservoir and is no longer in service.
- 2) The water impounded by the upstream dam does not flow over the spillway during normal runoff periods.

The owner has indicated that he believes the water from the upper reservoir primarily outlets from flow through the broken ten inch diameter pipe. Secondly, water outlets by seepage through the dam. The upper dam was not inspected by Michael Baker, Jr., Inc.

- 1.2.2 Location: Ragged Mountain Dam No. 1 is located approximately two miles west of the Charlottesville. Water supply to the reservoir is by natural drainage.
- 1.2.3 Size Classification: The maximum height of the dam is 67 feet. The reservoir volume to the top of dam is 1479 acre-feet. Therefore, the dam is in the "intermediate" size category as defined by the Recommended Guidelines for Safety Inspection of Dams.
- 1.2.4 Hazard Classification: Due to the proximity of the City of Charlottesville, Virginia, with a population of approximately 32,000, many lives could be lost in the event of failure of the dam. In addition, the small summer camp located approximately one mile downstream of the dam could be affected, and additional lives could be lost if failure were to occur at a time when this camp was inhabited. It is for these reasons that the Ragged Mountain Dam No. 1 is classified in the "high" hazard category as defined by Section 2.1.2 of the Recommended Guidelines for 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 Rivanna Water and Sewer Authority, Charlottesville, Virginia.

NAME OF DAM: RAGGED MOUNTAIN NO. 1

- 1.2.6 Purpose of Dam: The dam is used for water supply for the City of Charlottesville, Virginia.
- 1.2.7 Design and Construction History: The existing dam was designed by Mr. N. Wilson Davis, Engineer, in the early 1900's. The dam was built by Boggs and Halstead Contractors with work being completed on 31 August 1908.
- 1.2.8 Normal Operational Procedures: Normal pool elevation is maintained at 640.5 feet M.S.L. by the open channel spillway. Flood flows are passed through this spillway as well as through the 30 inch cast-iron pipe adjacent to it. The invert elevation of this pipe is 639.8. However, flashboards placed across the face of the pipe have increased the effective crest elevation to about 640.8, approximately 0.3 foot above the open channel spillway crest. Operation and general maintenance is by a resident operator whose domestic residence is immediately uphill from the left abutment of the dam.

1.3 Pertinent Data

- 1.3.1 Drainage Area: The drainage area of Ragged Mountain Dam No. 1 is approximately 1.83 square miles including the upstream dam drainage area.
- 1.3.2 Discharge at Dam Site: The maximum flood through the emergency spillway at the dam site is not known.

Pipe Spillway:
Pool level at top of dam. . . . 21 c.f.s.

Open Channel Spillway
Pool level at top of dam. . . . 174 c.f.s.
- 1.3.3 Dam and Reservoir Data: Pertinent data on the dam and reservoir are shown on the following table:

NAME OF DAM: RAGGED MOUNTAIN NO. 1

TABLE 1.1 DAM AND RESERVOIR DATA

| Item | Reservoir | | | | |
|-------------------------------------|--------------------------|---------------|---------------|---------------------|----------------|
| | Elevation feet M.S.L. | Area acres | Capacity | | |
| | | | Acre- feet | Watershed inches | Length feet |
| Top of dam | 643.3 | 57 | 1479 | 15.2 | - |
| Maximum pool, design surcharge | - | - | - | - | - |
| Pipe spillway crest | 640.8(a) | 54 | 1332 | 13.6 | - |
| Open channel spillway crest(b) | 640.5 | 54 | 1311 | 13.4 | 2400(c) |
| Streambed at center- line of dam | 582.5 | - | - | - | - |

(a) Elevation with 1 foot flashboard

(b) Controlled normal pool elevation at time of inspection

(c) Reservoir length measured from lower dam to upper dam

NAME OF DAM: RAGGED MOUNTAIN NO. 1

SECTION 2 - ENGINEERING DATA

- 2.1 Design: There were no design drawings or calculations available for review. All data contained in this report was obtained during the visual inspection of 16 July 1978.
- 2.2 Construction: Ragged Mountain Dam No. 1 was constructed in 1908 by Boggs and Halstead Contractors. Originally, this dam was concrete. However, an earth embankment was added in the 1930's when the original concrete dam was repaired and grouted. No construction reports or photos are available.
- 2.3 Operation: Ragged Mountain Dam No. 1 is operated and maintained by the Rivanna Water and Sewer Authority, Charlottesville, Virginia for water supply to the City of Charlottesville. An 18 inch diameter line located near the reservoir bottom at the gate house is the main intake for water supply from this reservoir. The water line goes through the dam and a concrete arch culvert which exits the chlorinating house. The treated water is then piped to the City of Charlottesville. No records of operation are available.

A series of valves is located near the chlorinating house which permits diverting the flow from the 18 inch line to the existing channel providing a means of draining the reservoir.

2.4 Evaluation

- 2.4.1 Design: There were no design or as-built drawings available to adequately assess the structural stability of the dam.
- 2.4.2 Construction: No as-built construction plans, material tests or boring logs were available to adequately assess the condition of the dam. The assessment made in this report was based solely on the visual inspection of 26 July 1978.
- 2.4.3 Operation: The information available regarding the operation of the water supply system was provided by Mr. E. K. Potter of the Rivanna Water and Sewer Authority. The operational procedures are adequate for this water supply facility.

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NAME OF DAM: RAGGED MOUNTAIN NO. 1

SECTION 3 - VISUAL INSPECTION

3.1 Findings

- 3.1.1 General: Some problems noted during the inspection of the dam should be corrected as part of a regular maintenance schedule. The complete visual inspection check list is given in Appendix III.
- 3.1.2 Dams: Generally, all the concrete structures, which include the sidewalk, the gate house, the spillway paving, and the concrete wall on the upstream face of the dam are in fair condition. Minor spalling and surface cracks are present in the sidewalk and gate house.

The embankment section has more notable deficiencies which are briefly explained below:

- 1) Seepage was noted at the midpoint of the dam at the downstream toe. Flow was estimated as three g.p.m. and develops into a small stream. The flow is clear. This may, at one time, have been the original stream channel.
 - 2) There are trees growing in the gutters provided at both abutments on the downstream face of the embankment. Debris is also present in the area of the gutters.
 - 3) A one to two feet wide footpath on the downstream face of the dam becomes a watercourse during wet weather and may erode. Scattered eroded areas were also noted where little or no vegetation was present.
- 3.1.3 Appurtenant Structures: The overflow spillway is in good condition. There is no evidence of deterioration in the concrete paving. A small amount of mortar deterioration is present between the stone masonry in the training walls on either side of the spillway. The spillway is free from debris.

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NAME OF DAM: RAGGED MOUNTAIN NO. 1

3.1.4 Reservoir Area: The reservoir slopes are moderate to steep and are comprised of silt, sand and rock fragments with weathered quartz monzonite outcrops in some areas. Most of the shoreline is wooded with the exception of the left abutment area near the caretaker's home. Soundings were made every 25 feet along the crest of the dam and no indication of significant sedimentation was present.

3.1.5 Downstream Channel: The downstream channel below the end of the emergency spillway consists of hard coarse quartz monzonite with steep to vertical joints. The banks of the channel have been undercut by high flows (Photo 7). Boulders, cobbles and weathered bedrock are present throughout the channel. Wooden debris and a tree which has been undercut constrict flow approximately 150 feet downstream from the paved spillway.

Approximately 300 feet downstream of the paved spillway, the channel slope decreases and the stream channel banks are not very well defined. There is heavy tree and vegetative growth in this lowland area.

3.2 Evaluation

3.2.1 Dam: All concrete is in fair surface condition, and no remedial work is necessary at this time. The footpath on the downstream face of the dam should be reseeded to prevent further erosion in this area. The seepage does not appear to have caused erosion at the toe. Observation of this condition should be maintained to assure it does not increase.

The large trees and debris should be removed from the downstream face of the dam especially in the area of the gutters.

3.2.2 Appurtenant Structures: The 30 inch diameter high water pipe adjacent to the spillway needs no repair at this time.

3.2.3 Reservoir Area: The earth dam located 2500 feet upstream of Ragged Mountain Dam No. 1 should be investigated.

3.2.4 Downstream Channel: Placement of heavy riprap in the highly scoured area downstream from the paved spillway should be done immediately to insure against further serious scour

NAME OF DAM: RAGGED MOUNTAIN NO. 1

of the stream channel and undermining of the overbanks.

The fallen trees and debris which has accumulated in the lowland area of the downstream channel should be removed to insure unobstructed flow through this area.

NAME OF DAM: RAGGED MOUNTAIN NO. 1

SECTION 4 - OPERATIONAL PROCEDURES

- 4.1 Procedures: Operational procedures are generally discussed in paragraphs 1.2.8 and 2.3. The normal reservoir elevation of 640.5 is controlled by the open channel spillway at the left of the dam.

There is no formal written procedure for emergency downstream evacuation in the event of an overtopping. In addition to the resident caretaker, the dam is visited by maintenance personnel from the Rivanna Water and Sewer Authority. These personnel should be instructed to watch for distressed conditions. Emergency drawdown can be performed through valves in the 18 inch waterline.

- 4.2 Maintenance of Dam: The overall maintenance condition of the dam appears to be good with some deficiencies which include surface cracks and minor spalling on the concrete structures, seepage at the toe, and tree growth at the gutters of the embankment. Maintenance should be devoted to these items.
- 4.3 Maintenance of Operating Facilities: Maintenance personnel of the Rivanna Water and Sewer Authority can operate the valves for the waterlines from the Ragged Mountain Reservoir and the upstream reservoir where the lines connect to regulate the water supply system as required. Both lines are served by the chlorinator house near the downstream toe of the dam.
- 4.4 Warning System: There is no warning system or evacuation plan in operation. It is recommended that a formal emergency procedure be prepared, and prominently displayed and furnished to all operating personnel. This should include:
- 1) How to operate the dam during an emergency.
 - 2) Who to notify, including public officials, in case evacuation from the downstream area is necessary.
 - 3) Procedures for evaluating inflow during periods of emergency operations.
- 4.5 Evaluation: Maintenance of the dam by personnel of the Rivanna Water and Sewer Authority is considered to be acceptable except for tree growth and minor erosion.

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NAME OF DAM: RAGGED MOUNTAIN NO. 1

SECTION 5 - HYDRAULIC/HYDROLOGIC DATA

- 5.1 Design: No design data other than a storage capacity curve provided by the Rivanna Water and Sewer Authority was available for use in producing this report.
- 5.2 Hydrologic Records: No records of lake levels were available.
- 5.3 Flood Experience: No flood experience records are available.
- 5.4 Flood Potential: Performance of the reservoir by routing various hydrographs is shown in Table 5.1.
- 5.5 Reservoir Regulation: Pertinent dam and reservoir data are shown in Table 1.1, paragraph 1.3.3.

Except for withdrawal for water supply, flow from the reservoir is automatic. Normal flows are controlled by an open channel spillway with a crest elevation of 640.5. A 30 inch cast-iron pipe has an invert of 639.8; however, flashboards across the face of the pipe inlet control inflows at an elevation of 640.8.

A reservoir immediately upstream of the Ragged Mountain Dam No. 1 controls 1.28 square miles or 70 percent of the total watershed. Its effects were included in the hydrologic evaluations for Ragged Mountain Dam No. 1 by routing the hydrographs listed in Table 5.1 through the reservoir and combining the resultant outflows with the inflow from the remaining 30 percent of the watershed of Ragged Mountain Dam No. 1. This combined inflow hydrograph, also consisting of direct runoff attributed to the Ragged Mountain Lake area, was routed through the dam beginning with the reservoir level at the open channel spillway crest.

Approximate field measurements of the upper dam's spillway were obtained from personnel of the Rivanna Water and Sewer Authority for the dam immediately upstream of Ragged Mountain Dam No. 1.

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

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NAME OF DAM: RAGGED MOUNTAIN NO. 1

TABLE 5.1 RESERVOIR PERFORMANCE

| Item | Normal | Hydrographs | | |
|-----------------------------|--------|-------------|---------|--------|
| | | 100 Year | ½P.M.F. | P.M.F. |
| Peak flow, c.f.s. | | | | |
| Inflow | - | 1602 | 2300 | 7433 |
| Outflow | - | 96 | 1911 | 6485 |
| Peak elev., ft. M.S.L. | 640.5 | 642.3 | 644.5 | 646.1 |
| Open channel spillway | | | | |
| Depth of flow, ft. | - | 1.1 | 2.6 | 3.6 |
| Avg. velocity, f.p.s. | - | 6.1 | 9.1 | 10.8 |
| Non-overflow section | | | | |
| Depth of flow, ft. | - | - | 0.8(a) | 1.9(b) |
| Average velocity, f.p.s. | - | - | 5.1 | 7.7 |

- (a) Duration of overtopping nine hours.
 (b) Duration of overtopping ten hours.

- 5.7 Reservoir Emptying Potential: The time to draw the reservoir down from normal pool to the pond drain invert is approximately 48 days. This was determined using approximate field information for the drawdown facilities. The discharge through the 18 inch outlet pipe with the reservoir level at normal pool is about 54 c.f.s.
- 5.8 Evaluation: Ragged Mountain Dam, classified as an "intermediate" size-"high" hazard dam, must pass a spillway design flood essentially equal to the Probable Maximum Flood (P.M.F.). The P.M.F. was routed through the dam and reservoir and determined to overtop the dam by 1.9 feet. The one-half P.M.F. was then routed and also determined to overtop the dam by 0.8 foot. Since the discharge capacity is sufficient to pass approximately 25 percent of the P.M.F., the spillway for Ragged Mountain Dam No. 1 must be assessed as seriously inadequate.

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: No information was available regarding the foundation material. However, from visual observations of outcrops observed at the time of inspection, the dam is probably founded on quartz monzonite. There have been no foundation problems reported throughout the dam's 70 year existence.

6.2 Stability Analysis

6.2.1 Visual Observations: During the inspection no unusual movement or cracking beyond the toe was noticed. No evidence of sloughage or major erosion was noticed. There were scattered areas of erosion on the downstream face where a minimum amount of cover vegetation was present.

In addition, clear seepage was present from the toe of the dam at its approximate mid-point. It was estimated to be three g.p.m.

The slopes of the downstream face were 2:1 from the crest for approximately two-thirds of the way down where the slope increased to 1.5:1 (see Plate 1). The slopes are well vegetated with some large trees present on the downstream face in the area of the left abutment.

6.2.2 Design Data: No stability calculations were available.

6.2.3 Operating Records: The structure has no instrumentation for indicating movements, deflections or other pertinent information on stability.

6.2.4 Post-Construction Changes: No unusual post-construction changes have been made in the dam or in the watershed area which would substantially affect the water level.

6.2.5 Seismic Stability: The dam is located in Seismic Zone 2; therefore, the dam is considered to have no hazard from earthquake according to the Recommended Guidelines for Safety Inspection of Dams provided static stability conditions are satisfactory and conventional safety margins exist.

NAME OF DAM: RAGGED MOUNTAIN NO. 1

6.3 Evaluation: A slope stability analysis could not be performed due to the inadequacy of the information available. However, the following field conditions indicate potential instability: 1) seepage at the downstream toe of the dam, 2) steep (1.5:1) slopes on the downstream face of the dam, and 3) unknown dimensions of the concrete wall on the upstream face of the dam. It is recommended that a further investigation into: 1) the water level within the earthen embankment be determined by installation of observation wells and 2) the thickness and depth of the concrete wall be determined along with the compressive strength of the concrete. After this information has been determined, an accurate stability analysis should be performed. It is also important to check the stability of the concrete wall against overturning upstream when the reservoir level is lowered.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

- 7.1 Dam Assessment: There are findings, as a result of this inspection, that indicate deficiencies requiring immediate attention. The most urgent of these items is the inability of the open channel spillway to pass the one-half P.M.F. Using the Corps of Engineers screening criteria for initial review of spillway adequacy, it has been determined that the dam would be overtopped for all storms exceeding approximately 25 percent of the P.M.F. The spillway is, therefore, adjudged as seriously inadequate and the dam is assessed as unsafe, non-emergency.

The classification of "unsafe" applied to a dam because of a seriously inadequate spillway is not meant to connote the same degree of emergency as would be associated with an "unsafe" classification applied for a structural deficiency. It does mean, however, that based on an initial screening, and preliminary computations, there appears to be a serious deficiency in spillway capacity so that if a severe storm were to occur, overtopping and failure of the dam would take place, significantly increasing the hazard to loss of life downstream from the dam.

Although no visible evidence of embankment and concrete wall instability was observed; seepage, the steepness of the embankment toe, and the unknown dimensions of the wall indicate the need for immediate investigation of the stability of the dam.

- 7.2 Recommended Remedial Measures: It is recommended that within two months from the date of notification to the Governor of the Commonwealth of Virginia, the owners should engage the services of a professional consultant to determine by more sophisticated methods and procedures the adequacy of the spillway. Within six months of the date of notification to the governor, appropriate recommendations by the professional consultant for remedial mitigating measures should have been completed, and the owner should have an agreement with the Commonwealth of Virginia for a reasonable time frame in which all remedial measures will be completed. In the interim, a detailed emergency operation plan and warning system should be promptly developed. Also, during periods of unusually heavy precipitation, around-the-clock surveillance should be provided.

The inspection revealed certain items of rehabilitation or other work which should be implemented immediately by the owner. These are:

- 1) Install piezometers or observation wells to determine the elevation of the seepage line through the embankment.
- 2) Determine the concrete wall dimensions.
- 3) Perform stability analyses for the embankment and the wall. The wall should additionally be checked for overturning in the upstream direction when the reservoir is at lower levels.

The following items can be done as part of the Rivanna Sewer and Water Authority's maintenance program:

- 1) Grade and seed the footpath area and other bare spots.
- 2) Remove the trees from the embankment.
- 3) Clean debris from the downstream channel and place riprap in the highly scoured areas.
- 4) Monitor the seep at the toe of the dam.

APPENDIX I

PLATES

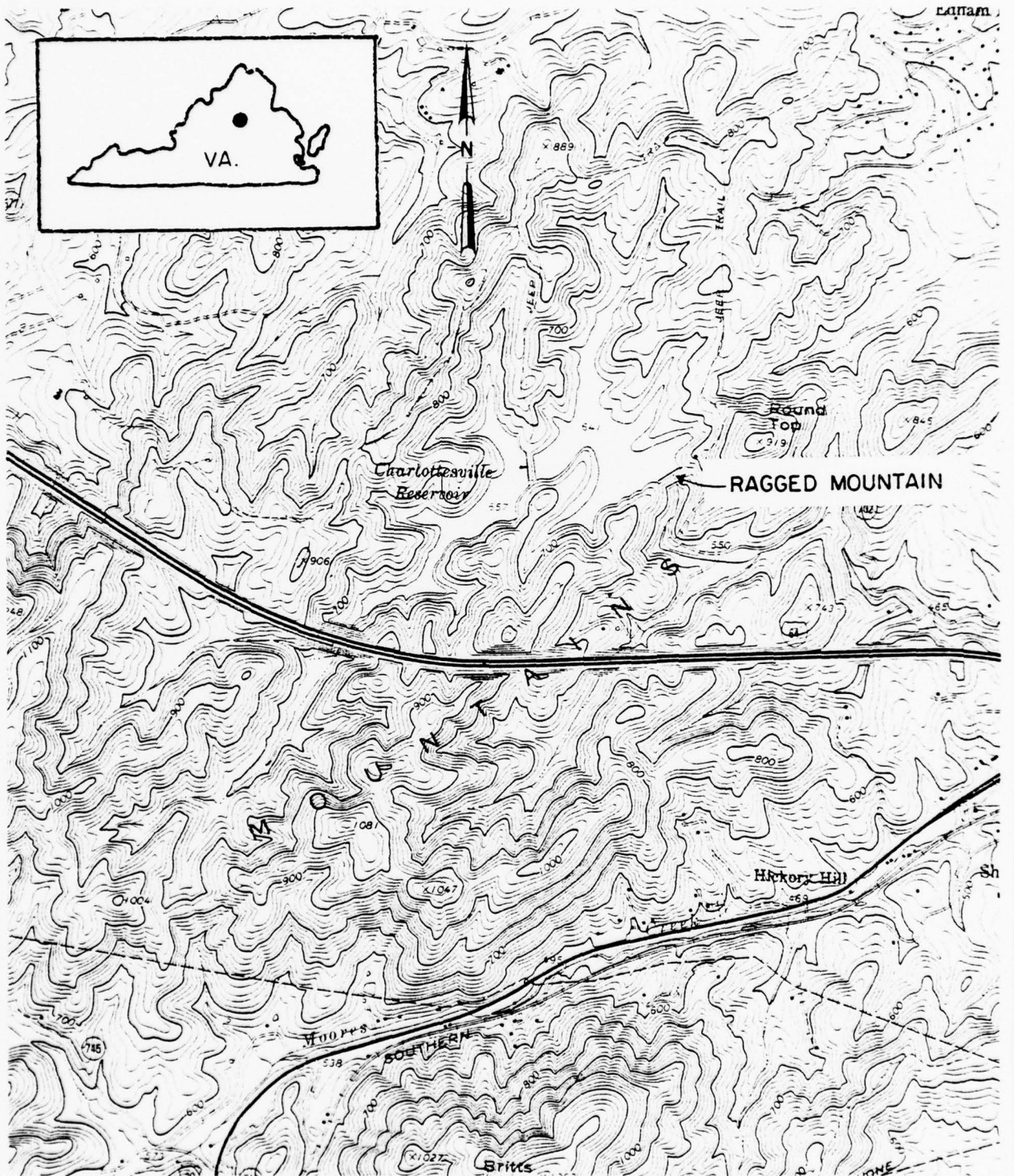
CONTENTS

Location Plan

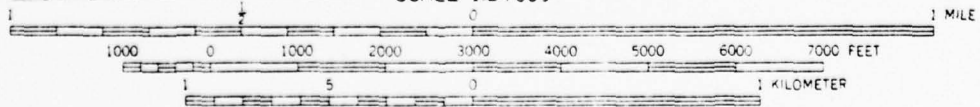
Plate 1: Section Through Center of Dam (Michael Baker, Jr.,
Inc. Sketch)

Plate 2: Soundings at Upstream Face - Looking Upstream
(Michael Baker, Jr., Inc. Sketch)

Plate 3: Plan of Spillway (Michael Baker, Jr., Inc. Sketch)



SCALE 1:24 000



LOCATION PLAN
RAGGED MOUNTAIN

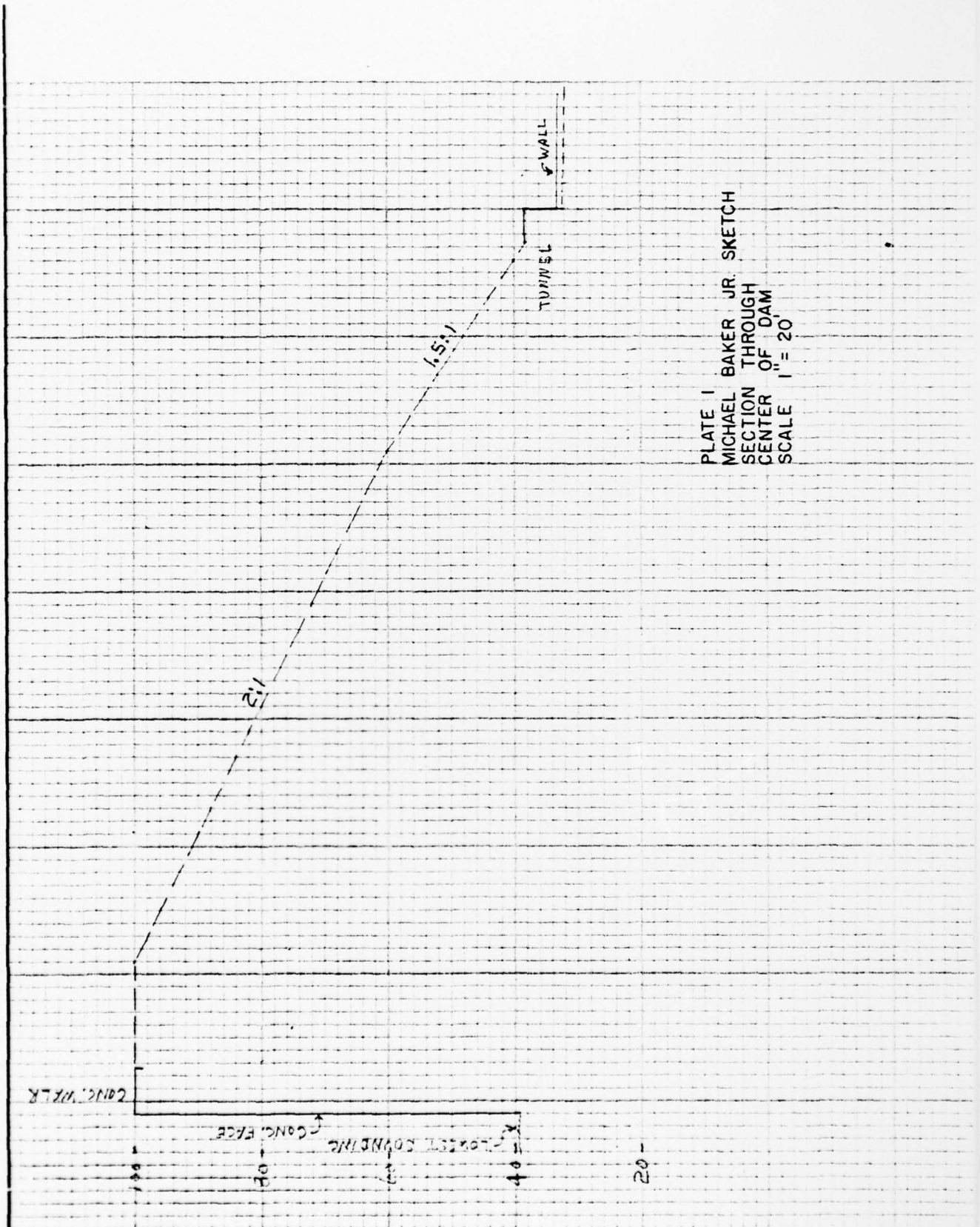


PLATE I
 MICHAEL BAKER JR. SKETCH
 SECTION THROUGH
 CENTER OF DAM
 SCALE 1" = 20'

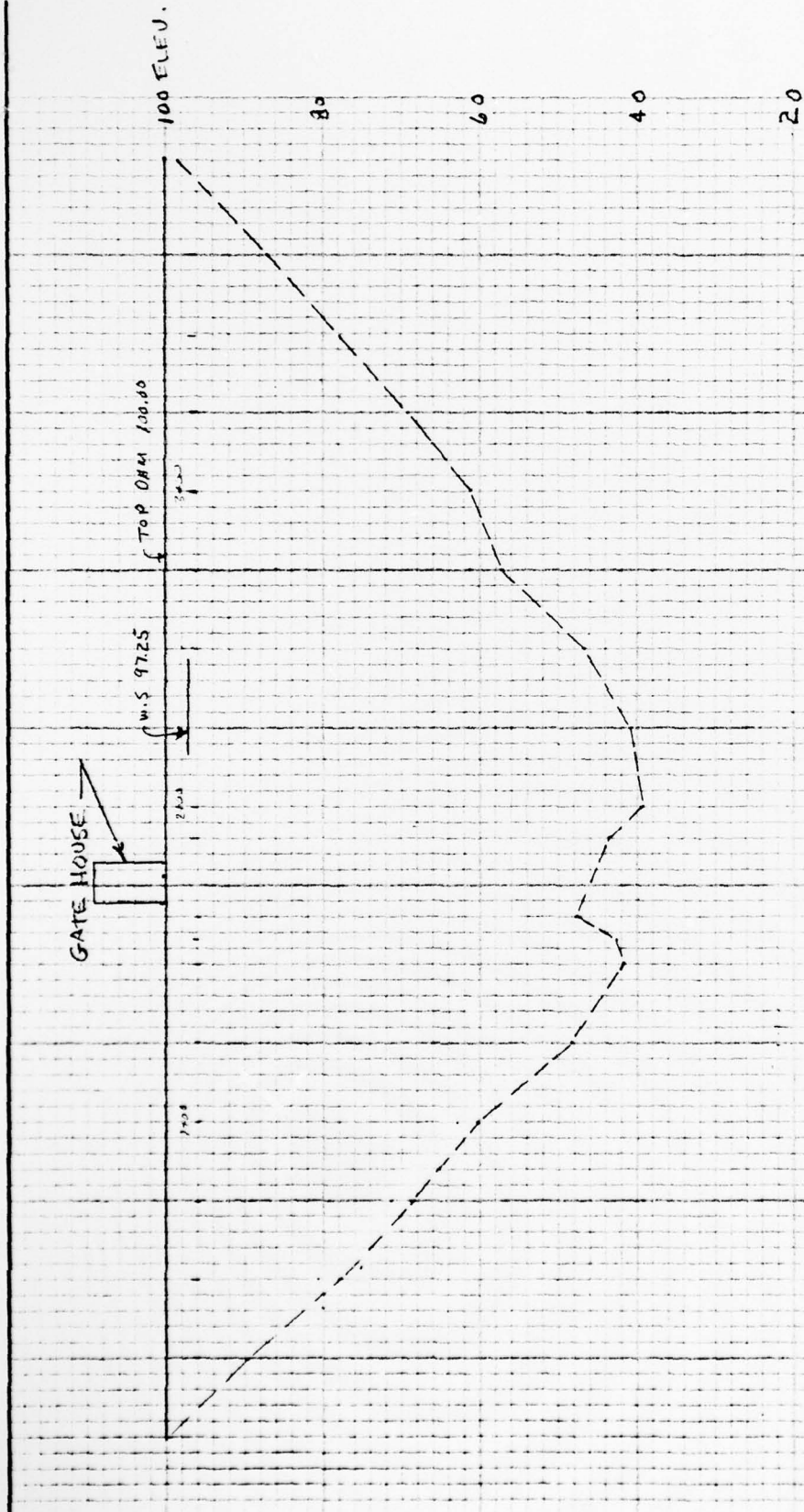
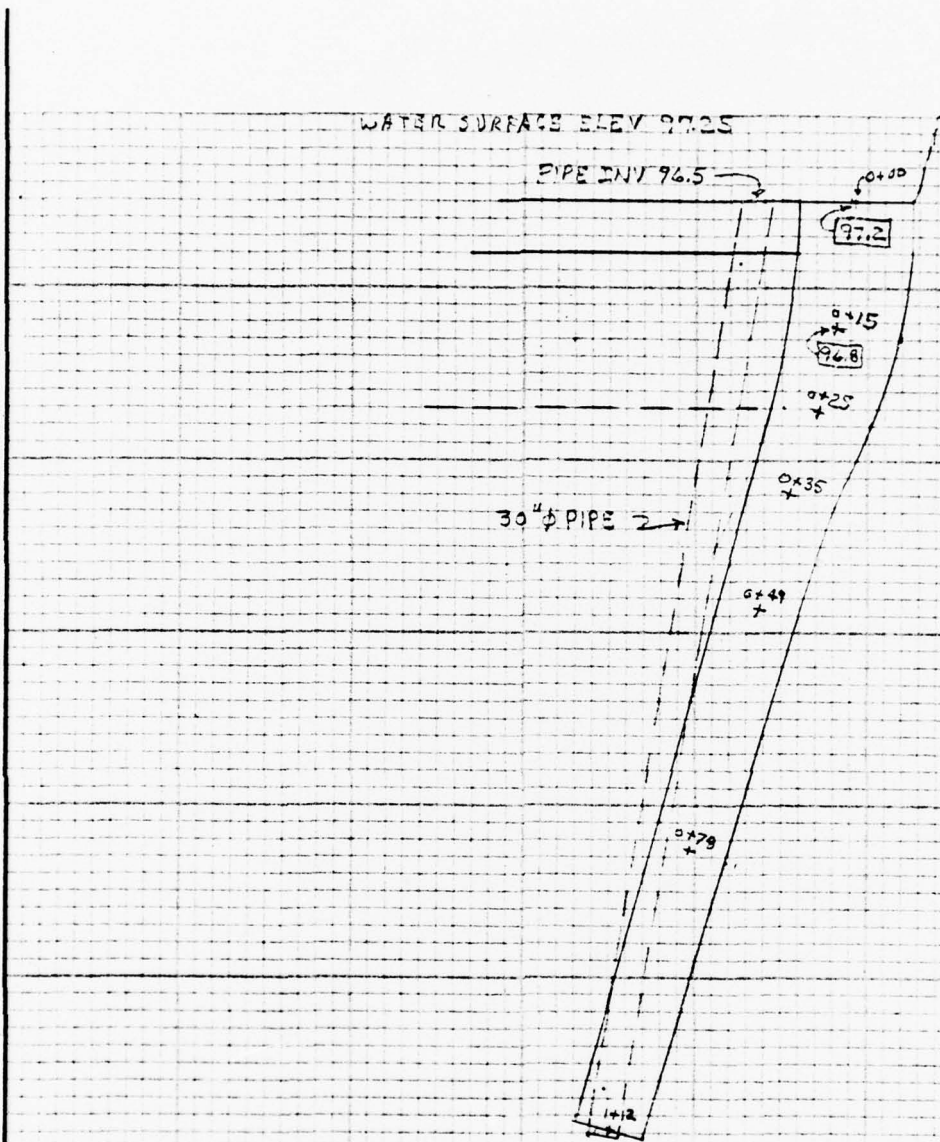


PLATE 2
 MICHAEL BAKER JR. SKETCH
 SOUNDINGS AT UPSTREAM
 FACE - LOOKING UPSTREAM
 VERTICAL SCALE 1" = 20'
 HORIZONTAL SCALE 1" = 50'



BOARD OVER END
 OF PIPE INCREASES
 WATER SURFACE
 ELEVATION.
 TOP OF BOARD 97.5'

PLATE 3
 MICHAEL BAKER JR. SKETCH
 PLAN OF SPILLWAY
 SCALE 1" = 20'

APPENDIX II

PHOTOGRAPHS

CONTENTS

- Photo 1: View of Dam Crest, Gate House and Reservoir From Left Abutment
- Photo 2: View of Downstream Face of Dam From Right Abutment Area
- Photo 3: View of Emergency Spillway Looking Upstream
- Photo 4: View of Emergency Spillway Looking Downstream
- Photo 5: View of 30 Inch Intake Pipe and Trash Rack Adjacent to Emergency Spillway
- Photo 6: View of Chlorinating House and Concrete Arch Culvert at Toe of Dam
- Photo 7: View of Scoured Downstream Channel

Note: Photographs were taken 26 July 1978.

RAGGED MOUNTAIN DAM NO. 1



PHOTO 1. View of Dam Crest, Gate House and Reservoir From Left Abutment



PHOTO 2. View of Downstream Face of Dam From Right Abutment Area

RAGGED MOUNTAIN DAM NO. 1

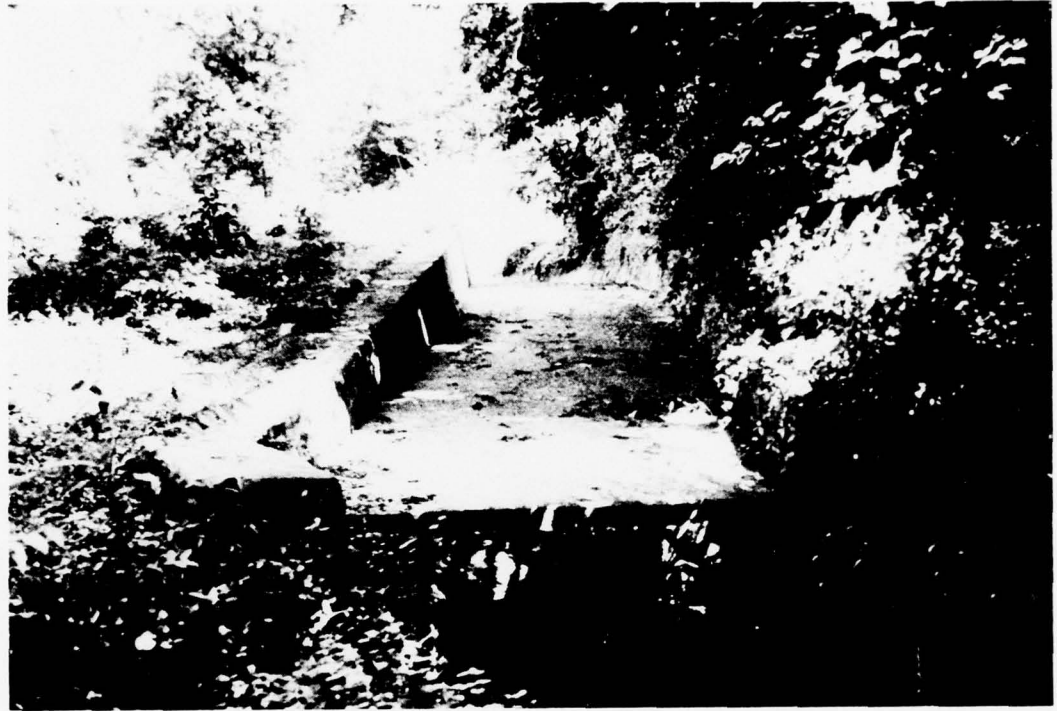


PHOTO 3. View of Emergency Spillway Looking Upstream

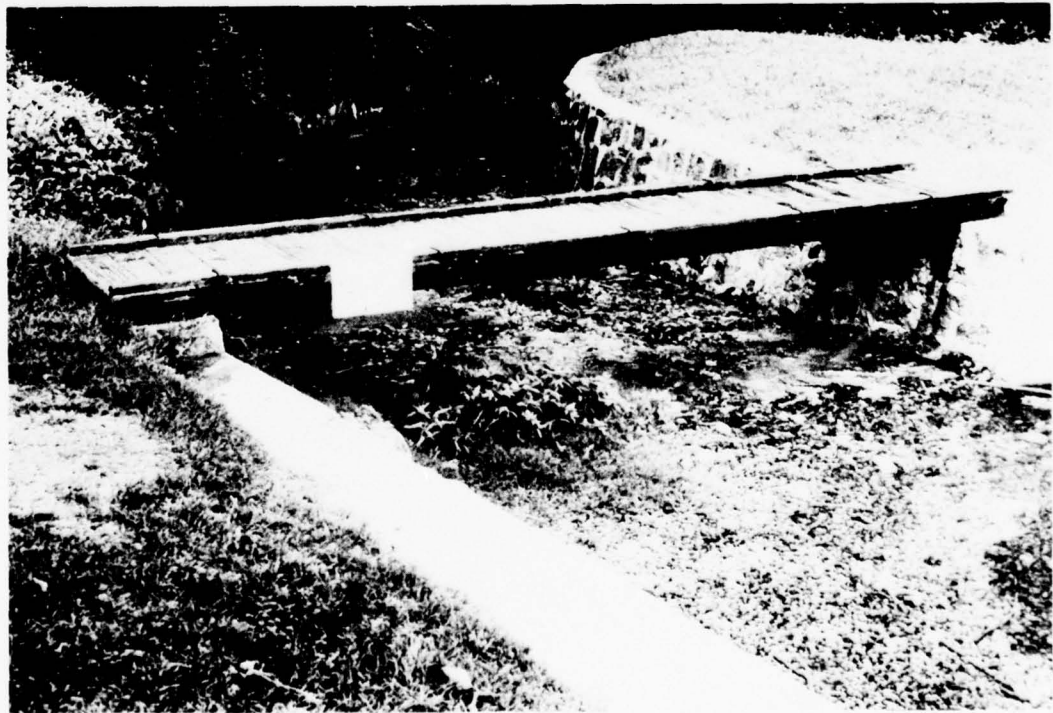


PHOTO 4. View of Emergency Spillway Looking Downstream

RAGGED MOUNTAIN DAM NO. 1



PHOTO 5. View of 30 Inch Intake Pipe and Trash Rack Adjacent to Emergency Spillway

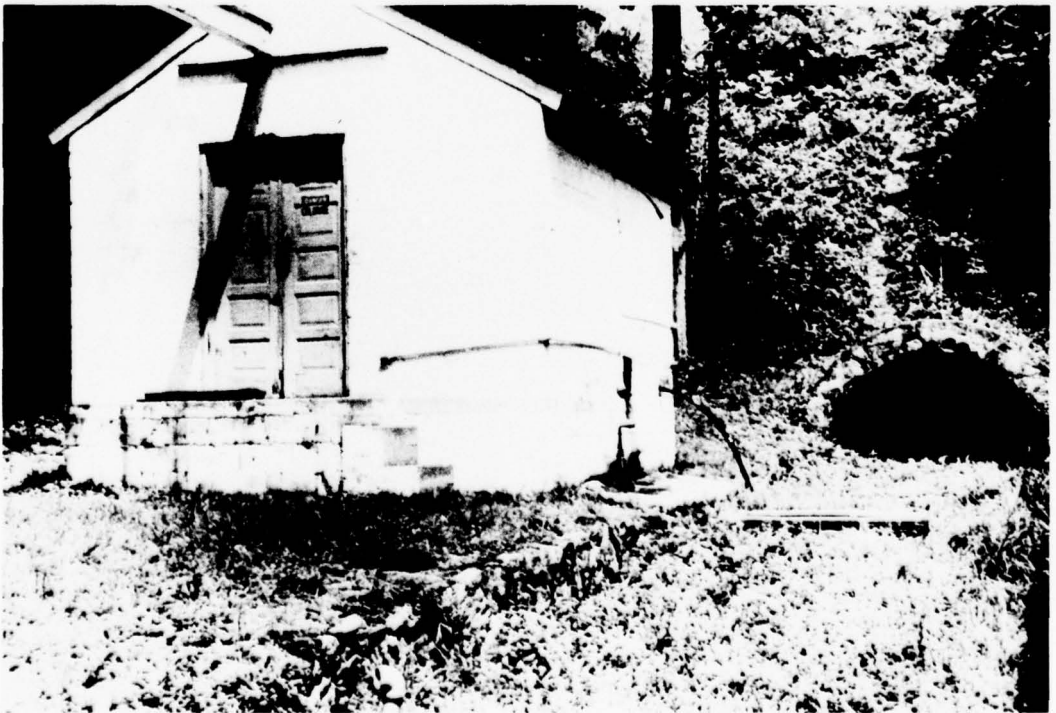


PHOTO 6. View of Chlorinating House and Concrete Arch Culvert at Toe of Dam

RAGGED MOUNTAIN DAM NO. 1



PHOTO 7. View of Scoured Downstream Channel

APPENDIX III

CHECK LIST - VISUAL INSPECTION

Check List
Visual Inspection
Phase 1

Name Dam Ragged Mountain No. 1 County Albemarle State Virginia Coordinates Lat. 3801.8
Long. 7833.8

Date Inspection 26 July 1978 Weather Cloudy. Rain Temperature 75°F.

Pool Elevation at Time of Inspection 640.8 M.S.L. Tailwater at Time of Inspection 583.0 M.S.L.

H
H
H
P.

Inspection Personnel:

VIRGINIA WATER CONTROL BOARD:

Bill Lorenz

MICHAEL BAKER, JR., INC.:

T. J. Dougan
M. H. Moore
W. L. Sheaffer

M. H. Moore Recorder

CONCRETE/MASONRY DAMS

RAGGED MOUNTAIN NO. 1

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|--|--------------------------|----------------------------|
| STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS | Not visible. | |
| DRAINS | None were observed. | |
| H H H L 2 | | |
| WATER PASSAGES | None were observed. | |
| FOUNDATION | There were no exposures. | |

CONCRETE/MASONRY DAMS

RAGGED MOUNTAIN NO. 1

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|--------------------------------------|---|----------------------------|
| SURFACE CRACKS CONCRETE SURFACES | Slight spalling and small hairline cracks are present on the paved walkway across the top of the dam and on the concrete face at the upstream part of the dam above water level. The concrete face was only visible above water level (two and one-half to three feet). | |
| STRUCTURAL CRACKING | There are none. | |
| VERTICAL AND HORIZONTAL ALIGNMENT | No bulging or depressions were observed. | |
| MONOLITH JOINTS | None were visible. | |
| CONSTRUCTION JOINTS | None were visible. | |

111-3

EMBANKMENT

RAGGED MOUNTAIN NO. 1

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|--|--|---|
| SURFACE CRACKS | None were observed. | |
| UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE | No movement or cracks were observed. | |
| H H -4 | | |
| SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES | There is a path (one to two feet) on the downstream slope which has become a watercourse in wet weather causing some erosion on the right downstream slope. There are indications of minor erosion in a few small areas where the vegetation is sparse. | Recommend seeding of the path and discouraging people from using the paths. |
| VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST | No bulging or depressions were observed. | |
| RIPRAP FAILURES | Riprap was not used. | |
| CONSTRUCTION MATERIALS | Based on surface observations the embankment was constructed of brown silty sand and rock fragments and partly of red sandy silt with little rock fragments and traces of mica flakes. The downstream slope is well covered with vegetation, most of which is low. Some trees have grown on the lower part of the dam near the toe on the left side. | It is suggested that the trees on the dam be removed. |

EMBANKMENT

RAGGED MOUNTAIN NO. 1

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|---|---|---|
| FOUNDATION | <p>Information concerning the foundation of the dam is not available. The dam is founded on quartz monzonite based on observations of rock exposures in the vicinity. No stability problems have been reported in the 70 years since it has been built.</p> | |
| JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM | <p>The bedrock in the region is a coarse-grained quartz monzonite of variable composition in the Precambrian Lovinston Formation as shown on the Geologic Map of Albemarle County. The right abutment appears to be in weathered quartz monzonite in a low ridge. The left abutment at the emergency spillway is apparently on the hard jointed quartz monzonite as observed at the end of the paved spillway. The massive exposure contains springs near the lower abutment.</p> | <p>There is no erosion at the toe of the dam.</p> |
| ANY NOTICEABLE SEEPAGE | <p>There is some seepage at the toe of the downstream slope near the midpoint where clayey silt is wet and develops into a stream flow approximately 30 feet away. Total seepage was measured at three p.m. This was probably the old stream channel. The water is clear.</p> | |
| STAFF GAGE AND RECORDER | <p>There are none.</p> | |
| DRAINS | <p>Trees are growing in the surface gutters at both abutments on the downstream face. There is some debris near the toe. The gutter is in soil on the right and rock on the left.</p> | <p>It is recommended that the debris and thick growth be removed.</p> |

OUTLET WORKS

RAGGED MOUNTAIN NO. 1

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|--|---|----------------------------|
| CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT | None of the 30 inch cast-iron pipe was exposed. | |
| INTAKE STRUCTURE | A 30 inch pipe with entrance on the upstream face of the concrete wall. An 18 inch waterline valved at the control tower. | |
| OUTLET STRUCTURE | The 30 inch pipe is routed under the emergency spillway slab and outlets at the end of the emergency spillway. The 18 inch waterline connects to the downstream distribution system. | |
| OUTLET CHANNEL | Same as stilling basin. | |
| EMERGENCY GATE | The 18 inch valve may possibly be used to drain the reservoir. | |

INSTRUMENTATION

RAGGED MOUNTAIN NO. 1

| VISUAL EXAMINATION | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|-----------------------|---------------------|----------------------------|
| MONUMENTATION/SURVEYS | None were observed. | |
| OBSERVATION WELLS | There are none. | |
| WEIRS | There are none. | |
| HHH - 8 | | |
| PIEZOMETERS | There are none. | |
| OTHER | | |

UNGATED SPILLWAY

RAGGED MOUNTAIN NO. 1

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|-----------------------|--|--|
| CONCRETE WEIR | There is none. | |
| APPROACH CHANNEL | There is none. | |
| DISCHARGE CHANNEL | The rectangular channel has a concrete slab and stone walls. The upstream width is 13.2 feet and downstream width is 8.2 feet. The slope is about seven percent. | |
| BRIDGE AND PIERS | There is a wooden plank pedestrian bridge across the spillway. | |
| DOWNSTREAM CHANNEL. | Hard coarse quartz monzonite with steep to vertical joints comprises the open channel below the end of the paved spillway and 30 inch pipe beneath. The flow from the 30 inch pipe was measured downstream at a 30 feet drop as two g.p.m. The channel downstream from the waterfall is cut deep (10-30 feet banks) into soil with boulders and cobbles and highly weathered bedrock. It joins the other stream further in the woods. There are occasional wooden debris and a tree which fell across the deep channel after being undercut by flow. | It is recommended that scattered debris and the fallen trees be removed. |

RESERVOIR

RAGGED MOUNTAIN NO. 1

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|-----------------------|--|--|
| SLOPES | The slopes are moderate to steep in silt, sand and rock fragments with weathered quartz monzonite exposed in some areas. Most of the shoreline is wooded except near the left abutment in the vicinity of the cartaker's home. | |
| SEDIMENTATION | No measureable sedimentation. | |
| | | NOTE: There is a second reservoir 2500 feet upstream. This dam was not inspected by Michael Baker, Jr., Inc. |

DOWNSTREAM CHANNEL

RAGGED MOUNTAIN NO. 1

| VISUAL EXAMINATION OF | OBSERVATIONS | REMARKS OR RECOMMENDATIONS |
|---|---|--|
| CONDITION (OBSTRUCTIONS, DEBRIS, ETC.) | The channel does not have well defined banks in the low land and is surrounded with heavy growth. There is scattered wooden debris in the channel. | It is recommended that the heavy growth be cut in the vicinity of the channel and the debris be removed. |
| SLOPES | The slopes are low in fine-grained soil in the vicinity of the dam toe. The banks in sand and silt with cobbles become more defined downstream and grade into coarse-material at the junction with the deeper channel from the ungated spillway where the streambed is covered with cobbles, gravel and boulders. | |
| APPROXIMATE NO. OF HOMES AND POPULATION | A few homes are located downstream of the dam and are at higher elevations. A summer camp is located approximately one mile downstream and is occupied on a seasonal basis. | |

APPENDIX IV

CHECK LIST - ENGINEERING DATA

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

RAGGED MOUNTAIN NO. 1

| ITEM | REMARKS |
|----------------------------|---|
| PLAN OF DAM | None were available. |
| REGIONAL VICINITY MAP | Enclosed as the Location Plan. |
| CONSTRUCTION HISTORY | Designed by N. Wilson Davis in early 1900's. Built by Boggs and Halstead in 1908. Information pertaining to the construction history was provided by Mr. E. K. Potter of the Rivanna Water and Sewer Authority. |
| TYPICAL SECTIONS OF DAM | None were available. |
| HYDROLOGIC/HYDRAULIC DATA | None were available. |
| OUTLETS - PLAN | |
| - DETAILS | |
| - CONSTRAINTS | None were available. |
| - DISCHARGE RATINGS | |
| RAINFALL/RESERVOIR RECORDS | None were available. |

RAGGED MOUNTAIN NO. 1

| ITEM | REMARKS |
|------|---------|
|------|---------|

| | |
|----------------|----------------------|
| DESIGN REPORTS | None were available. |
|----------------|----------------------|

| | |
|-----------------|----------------------|
| GEOLOGY REPORTS | None were available. |
|-----------------|----------------------|

| | |
|------------------------|----------------------|
| DESIGN COMPUTATIONS | None were available. |
| HYDROLOGY & HYDRAULICS | |
| DAM STABILITY | |
| SEEPAGE STUDIES | |

1-2
2

| | |
|--------------------------|----------------------|
| MATERIALS INVESTIGATIONS | None were available. |
| BORING RECORDS | |
| LABORATORY | |
| FIELD | |

| | |
|----------------------------------|----------------------|
| POST-CONSTRUCTION SURVEYS OF DAM | None were available. |
|----------------------------------|----------------------|

| | |
|----------------|--|
| BORROW SOURCES | Not indicated, except there appears to have been some excavation on the slopes of the ridges near both abutments which may have been minor sources of borrow of soil and rock. |
|----------------|--|

RAGGED MOUNTAIN NO. 1

| ITEM | REMARKS |
|------|---------|
|------|---------|

| | |
|---------------|----------------------|
| SPILLWAY PLAN | None were available. |
|---------------|----------------------|

SECTIONS

DETAILS

| | |
|--|----------------------|
| OPERATING EQUIPMENT PLANS & DETAILS | None were available. |
|--|----------------------|

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 1.83 square miles

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 640.5 (1311 acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 643.3 (1479 acre-feet)

ELEVATION MAXIMUM DESIGN POOL: Unknown

ELEVATION TOP DAM: 643.3

CREST: Open Channel Spillway

- a. Elevation 640.5
- b. Type Open channel with stone walls and concrete bottom
- c. Width 13.2 feet
- d. Length 112 feet
- e. Location Spillover Northeast end of dam
- f. Number and Type of Gates None

OUTLET WORKS: Pipe Outlet

- a. Type 30 inch cast-iron pipe, 112 feet long
- b. Location Northeast end of dam
- c. Entrance inverts 640.8 (top of flashboard)
- d. Exit inverts 628.9
- e. Emergency draindown facilities 18 inch pipe

HYDROMETEOROLOGICAL GAGES: None available

- a. Type _____
- b. Location _____
- c. Records _____

MAXIMUM NON-DAMAGING DISCHARGE Unknown

NAME OF DAM: RAGGED MOUNTAIN DAM NO. 1