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NATIONAL DAM SAFETY PROGRAM. STEERS MILL DAM (INVENTORY NUMBER --ETC(U)
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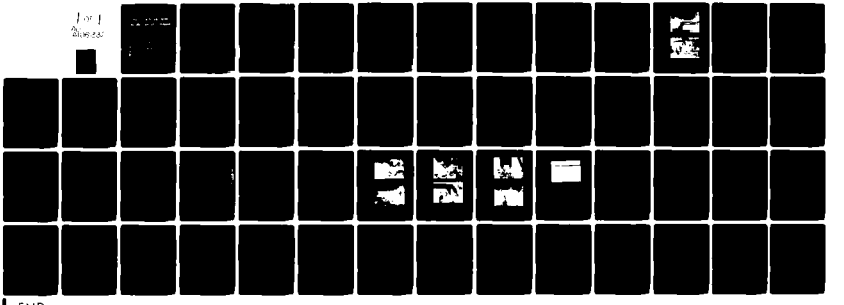

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Name Of Dam: NOTTOWAY RIVER BASIN

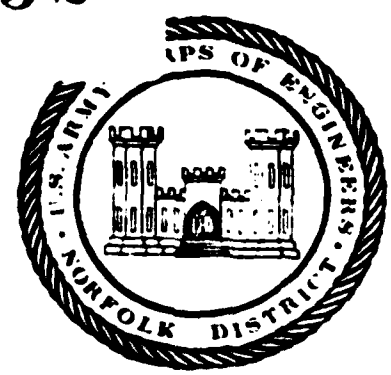
Location: STEERS MILL DAM

Inventory Number: DINWIDDIE COUNTY, VIRGINIA

VA. NO. 05302

LEVEL II

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM



PREPARED FOR

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803 FRONT STREET
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BY

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APRIL 1981

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER VA 05302	2. GOVT ACCESSION NO. AD-A106332	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Inspection Report National Dam Safety Program Steers Mill Dam Dinwiddie County, VA		5. TYPE OF REPORT & PERIOD COVERED Final 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) Schnabel Engineering Associates, P.C. J. K. Timmons and Associates, Inc.		8. CONTRACT OR GRANT NUMBER(s) DACW-65-81-D-0020 ✓
9. PERFORMING ORGANIZATION NAME AND ADDRESS Schnabel Engineering Associates, P. C. J. K. Timmons and Associates, Inc.		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS U. S. Army Engineer District, Norfolk 803 Front St., Norfolk, VA 23510		12. REPORT DATE April 1981 13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; distribution unlimited

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

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)

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SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

20. Abstract

Pursuant to Public Law 92-367, Phase I Inspection Reports are prepared under guidance contained in the recommended guidelines for safety inspection of dams, published by the Office of Chief of Engineers, Washington, D. C. 20314. The purpose of a Phase I Inspection 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 inspection. 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 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.

NOTTOWAY RIVER BASIN

NAME OF DAM: STEERS MILL DAM
LOCATION: DINWIDDIE COUNTY
INVENTORY NUMBER: VA. NO. 05302

National Dam Safety Program. Steers Mill Dam (Inventory Number VA Ø53Ø2), Nottoway River Basin, Dinwiddie County, Virginia. Phase I Inspection Report.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Ray E. Martin Carl S. Anderson, Jr.
Jack G. Starr

PREPARED FOR
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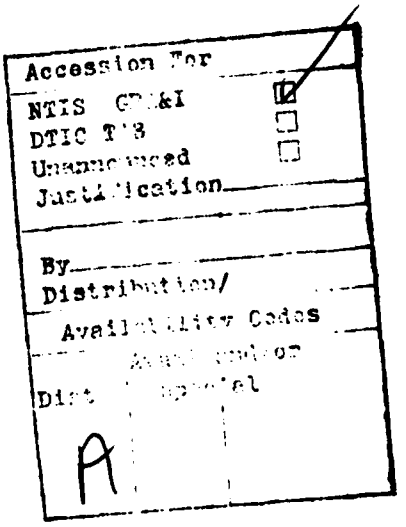

PREFACE

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 aid 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.

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

BRIEF ASSESSMENT OF DAM

Name of Dam:	Steers Mill Dam
State:	Virginia
Location:	Dinwiddie County
USGS QUAD sheet:	Petersburg, Virginia
Coordinates:	Lat 37° 7.8' Long 77° 29.3'
Date of Inspection:	April 21, 1981

Steers Mill Dam is a buttressed concrete structure approximately 220 ft long and 18 ft high. The dam is an overflow structure with the entire length of dam serving as a spillway. A 38 ft wide emergency spillway is located at the right abutment, 0.5 ft above the crest of the spillway. The dam is a small size structure and is assigned a significant hazard classification. The dam is located on Hatcher Run, in Dinwiddie County, Virginia. The lake is used for a grist mill operation and recreation and is owned and maintained by Mr. H. Lander-Allen.

Based on the criteria established by the Department of the Army, Office of the Chief of Engineers (OCE), the appropriate Spillway Design Flood (SDF) for the dam is the 100 Year Flood. The spillway will pass 10 percent of the Probable Maximum Flood (PMF) or 44 percent of the SDF without overtopping the non-overflow section. The 100 Year Flood will overtop the non-overflow section to a depth of 2.1 ft maximum, with a maximum velocity of 6.1 fps, and water will flow over the dam for 12 hours. Flows are not considered detrimental to the dam and abutments. The spillway is rated inadequate, but not seriously inadequate.

The visual inspection did not reveal any problems which would require immediate attention. An accurate check on the stability of the dam could not be made since there were no design data nor construction records available. It is recommended that the owner engage the services of a Professional Engineering firm to perform a stability analysis in order to evaluate the stability of the dam and modify as necessary. The structural cracks observed in the counterforts (particularly No. 3) should be examined during this study and repairs made as determined necessary. Based upon the type materials present in the abutments and past performance during flooding, overtopping of the dam during the SDF is not considered detrimental to the dam and abutments. An emergency operation and warning plan should be developed. Furthermore, a staff gage should be installed to monitor water levels. Spalling concrete and scattered cracking on the dam should be repaired including the damaged overflow section beside counterfort No. 11. Trees and other vegetation in the emergency spillway should be removed. Scouring observed at counterforts No. 8 and 9 should be examined annually to verify that the footings are not being undermined.

SCHNABEL ENGINEERING ASSOCIATES, P.C./
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Colonel, Corps of Engineers
Commander and District Engineer

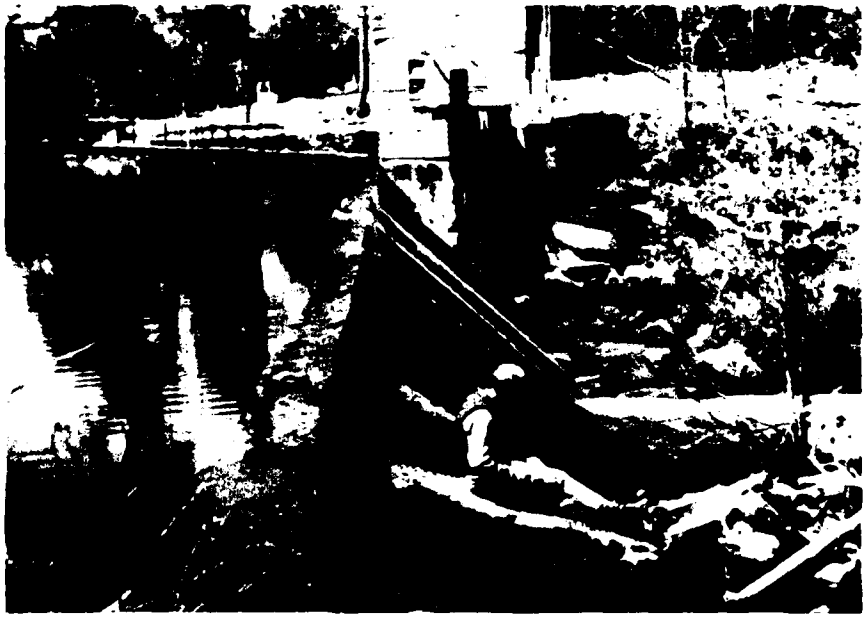
Recommended by:

Original signed by
JACK G. STARR

Jack G. Starr
Chief, Engineering Division

Date: SEP 2 1981

Steersmill Pond



Dam and Mill

Overview Photographs

SECTION I - 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 inspection 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 V). 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: Steers Mill Dam is a buttressed concrete overflow structure approximately 220 ft long and 18 ft high.* An additional 25 ft$^{+}_{-}$ of cutoff wall extends beneath the millhouse. The dam is 1.5 ft wide at the crest and is buttressed with 2 ft thick buttresses inclined at 45 to 60° on the downstream face of the dam. The entire dam is an overflow section except at the abutment walls. (See Plate 2, Appendix I) The crest of the dam is at elevation 129 msl and the abutment walls have a top elevation of 132 msl.

A water turbine and intake are located in the dam in a turbine house approximately 75 ft form the left abutment. The turbine operates a grist mill located at the left abutment. The turbine intake is located approxi-

---

* Height is measured from the top of the dam to the downstream toe at the centerline of the stream.

mately 30 ft upstream of the dam face and was reported to be a 24 inch pipe with a slide gate. The turbine discharge opening is a 4 ft x 4 ft opening on the downstream face of the dam (see Photograph 5, Appendix II).

The emergency spillway (EMS) is a rock channel located at the right abutment, with a crest elevation of 129.5 msl. The emergency spillway is 38 ft wide, has 2H:1V side slopes on the right side and a vertical wall on the left side (see Plate 2, Appendix I). The EMS is in a cut section. The approach channel to the EMS is approximately 30 ft long at a gentle slope rising up to the control section. The discharge channel falls away from the control section at a mild slope and intersects the stream approximately 100 ft downstream of the dam.

1.2.2 Location: Steers Mills Dam is located on Hatcher Run approximately 7 miles southwest of Petersburg, Virginia. (See Plate 1, Appendix I)

1.2.3 Size Classification: The dam is classified as a "small" size structure based on its height and maximum lake storage potential.

1.2.4 Hazard Classification: The dam is located in a rural area, however, based upon the proximity of one inhabited structure located one mile downstream, 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: The dam is owned and maintained by Mr. H. Lander-Allen, Jr. of Petersburg, Virginia.

1.2.6 Purpose: Grist mill operation and recreation.

1.2.7 Design and Construction History: There was no information available concerning the design and construction of this structure. According to the owner the dam was constructed in 1923 by Mr. Albert Steer.

1.2.8 Normal Operational Procedures: The dam is an overflow type structure, therefore, water rising above the crest of the overflow section is automatically discharged downstream. Normal pool is maintained at elevation 129.1 msl at the crest of the dam. Flood discharges which cannot be absorbed by storage and the dam, flow through the emergency spillway at pool elevations above 129.5 msl. The 24 inch diameter turbine inlet gate is manually operated, and is used to operate the turbine or to lower the lake below normal pool.

1.3 Pertinent Data:

1.3.1 Drainage Area: The drainage area is 32.6 square miles.

1.3.1 Discharge at Dam Site: According to Mr. Lander-Allen the maximum known flood at the dam site occurred in October, 1979 with a maximum pool level of 4.5 ft above the dam. This corresponds to an approximate discharge of 8800 CFS.

Overflow Section Discharge:

Pool Elevation at non-overflow section (elev. 132)	4200 CFS

Emergency Spillway Discharge:

Pool Elevation at non-overflow section (elev. 132)	220 CFS

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

Table 1.1 - DAM AND RESERVOIR DATA

	Reservoir				
		Storage			
Item	Elevation feet msl	Area Acres	Volume Acre Feet	Watershed Inches	Length Miles
Crest of Non-Overflow Section	132	57	253	.15	1.2
Emergency Spillway Crest	129.5	33	137	.08	1.06
Crest of Overflow Section	129	24	120	.07	1.0
Streambed at Downstream Toe of Dam	114	-	-	-	-

SECTION 2 - ENGINEERING DATA

2.1 Design: There is no design data available.

2.2 Construction: No construction records are available. The dam was constructed as an overflow structure with the entire width of the dam acting as a spillway. The emergency spillway was constructed around the bedrock outcrops existing at the right abutment.

According to the owner the dam originally consisted of an earth embankment with mill structure in pre-Civil War days. The mill was burned during the Civil War. The concrete gravity dam and millhouse were constructed in 1923 by Mr. Albert Steer.

2.3 Evaluation: There is insufficient information to accurately evaluate foundation conditions and dam stability.

SECTION 3 - VISUAL INSPECTION

3.1 Findings: At the time of inspection the dam was in fair condition. Field observations are outlined in Appendix III.

3.1.1 General: An inspection was made on April 21, 1981 and the weather was sunny and clear with a temperature of 60° F. The pool and tailwater levels at the time of inspection were 129 msl and 114 msl respectively, which corresponds to normal pool and tailwater elevations. Ground conditions were dry at the time of inspection. No previous inspection reports were available.

3.2 Dam and Appurtenances: No seepage or leakage was observed through the foundation or the structure. However, flow was observed through bedrock joints below the dam, therefore it would be possible for seepage to occur through the underlying bedrock. Water was flowing over the crest of the spillway at most locations, consequently any existing seepage or leakage would be difficult to detect.

The base of the dam appears to rest primarily on slightly weathered granite bedrock, but at several locations may rest on very large boulders. The buttresses or counterforts rest on bedrock and very large boulders. It could not be determined if the dam is keyed into bedrock. The owner stated that he was told it did and some blasting was required during excavation. Threaded dowells were located in several boulders adjacent to the turbine structure and two 8 inch deep 2½ inch diameter drill holes were located in the bedrock at the end of Counterforts No. 6 and 7, (see Sheet 1, Appendix III). Some scouring of the concrete-rock contact was observed on both sides of Counterforts Nos. 8 and 9, however, the scour did not extend beneath the footings.

The right abutment includes large outcrops of slightly to moderately weathered granite, granular residual soils consisting of silty sand (SM) materials, and boulders. Residual soils were exposed in the left abutment and outcrops occur in the lower portion. The only erosion noted was under the millhouse at the left abutment as a result of past high water. This erosion did not appear to hinder the stability or satisfactory performance of the dam.

The dam crest indicated signs of spalling concrete in several areas. Damage was also noted in the overflow section of Counterfort No. 11, (see Photograph No. 4, Appendix II). Some weathering and spalling was also observed on the counterforts and face of the dam. Severe cracking was observed on Counterfort No. 3, while less obvious cracking was noted at several other locations.

The emergency spillway had small tree growth and scattered vegetation throughout the length of the approach and discharge channels. The turbine intake valve on the intake pipe was in good operating condition according to Mr. Lander-Allen, since it has been in use to operate the turbine and grist mill the past several years.

3.1.3 Reservoir Area: The reservoir area was free of debris and the perimeter was wooded on all sides (Overview Photograph, Page 4). The reservoir is located in a natural valley with side slopes at approximately 4H:1V. Sediment build-up in the upper reaches, was reported by the owner.

3.1.4 Downstream Area: The downstream channel is located in a narrow flood plain with 5H:1V side slopes above the channel banks (Photograph No. 7, Appendix II). The channel is approximately 2 ft deep with 1H:1V side slopes. A bridge crosses the stream approximately 100 ft downstream. One existing dwelling and one dwelling under construction approximately one mile below the dam are situated within the flood plain.

3.1.5 Instrumentation: No instrumentation (monuments, observation wells, piezometers, etc.) was encountered for the structure. A staff gage was not observed.

3.2 Evaluation: Overall, the dam was in fair condition at the time of the inspection.

3.2.1 Dam and Spillway: Spalling concrete and scattered cracking on the dam should be repaired. Structural cracks in the counterforts should be examined by a Professional Engineer and repairs made as determined necessary. The trees and other vegetation in the emergency spillway should be removed in order to maintain maximum efficiency and maintained in the future. The overflow section is functioning well. A staff gage should be installed to monitor water levels. Scouring observed at counterforts No. 8 and 9 should be examined annually to verify that the footings are not being undermined. The erosion beneath the millhouse does not require any special attention.

3.2.2 Downstream Area: A breach in the Steers Mill Dam during extreme flooding could create a hazard to the downstream dwelling.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures: The normal storage pool is elevation 129.1 msl or 0.1 ft above the crest of the overflow section. The lake provides recreation as its principal use and operates a water turbine. Water passes automatically over the overflow section as the water level in the reservoir rises above the dam crest. Water will also pass automatically through the emergency spillway when the water level in the reservoir reaches elevation 129.5 msl. A 24 inch slide gate valve on the turbine intake structure is provided to draw down the reservoir from normal pool and operates the turbine.

4.2 Maintenance of Dam and Appurtenances: Maintenance is the responsibility of the owner. Maintenance consists of inspection, debris removal and repair. Maintenance is not routinely performed.

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

4.4 Evaluation: The dam and appurtenances are in fair operating condition, however, maintenance of the dam was not adequate.

An emergency operation and warning plan should be developed. It is recommended that a formal emergency procedure be prepared and furnished to all operating personnel. This should include:

a. How to operate the dam during an emergency.

b. Who to notify, including public officials, in case evacuation from the downstream area is necessary.

SECTION 5 - HYDRAULICS/HYDROLOGIC DATA

5.1 Design: Steers Mill Dam was designed as a single purpose dam. Hydrologic and hydraulic data are not available.

5.2 Hydrologic Records: There are no records available.

5.3 Flood Experience: According to Mr. Lander-Allen, the maximum pool elevation was 133.5 msl in October, 1979.

5.4 Flood Potentials: 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 meterologic and hydrologic conditions that are reasonably possible in the region), or fractions thereof. The Probable Maximum Flood (PMF) and ½ PMF and 100 year flood hydrographs were developed by the HEC-1 method (*Reference 4, Appendix V*). Precipitation amounts for the flood hydrograph of the PMF and 100 year flood were taken from U. S. Weather Bureau Information (Reference 5 and 6, Appendix V). Appropriate adjustments for basin size and shape were accounted for. These inflow hydrographs were routed through the reservoir to determine maximum pool elevations.

5.5 Reservoir Regulations: For routing purposes, the pool at the beginning of flood was assumed to be at elevation 129 msl. Reservoir stage-storage data and stage-discharge data were computed from field measurements and existing U.S.G.S. topographic maps. Floods were routed through the reservoir using the overflow section discharge up to a pool storage elevation of 129.5 msl and a combined overflow section and emergency spillway discharges for pool elevations

above 129.5 msl. Discharges above pool elevations 132 msl were routed over the non-overflow section of the dam in addition to the overflow section and 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, ½ PMF and 100 year flood are shown in the following Table 5.1:

TABLE 5.1 - RESERVOIR PERFORMANCE

		Hydrograph		
	Normal Flow	100 Yr. Flood	½ PMF	PMF
Peak Flow, CFS				
Inflow	32	10,600	23,241	46,481
Outflow	32	10,582	23,196	46,394
Maximum Pool Elevation Ft, msl	129.1	134.1	137.4	142.8
Non-Overflow Section (Elev 132 msl)				
Depth of Flow, Ft	-	2.1	5.4	10.8
Duration, Hours	-	12	9	12
Velocity, fps *	-	6.1	9.8	13.8
Tailwater Elevation Ft, msl	114	121.6	130.1	137.5

* Critical velocity

5.7 Reservoir Emptying Potential: A 24 inch diameter gate at elevation 119 msl is capable of lowering the reservoir through the turbine outlet. Assuming that the lake is at normal pool elevation (129.1 msl) and there is 32 cfs inflow, it would take approximately 7 days to lower the reservoir to elevation 123.5. Below elevation 123.5 inflow is greater than outflow. This is equivalent to an approximate drawdown rate of 0.8 ft/day based on the hydraulic height measured from normal pool to the invert of the drawdown pipe divided by the time to dewater the reservoir.

5.8 Evaluation: The U. S. Army, Corps of Engineers' guidelines indicate the appropriate Spillway Design Flood (SDF) for a small size, significant hazard dam is the 100 year to ½ PMF. Because of the risk involved, the 100 Year Flood has been selected as the SDF. The non-overflow section will pass 10 percent of the PMF without overtopping the non-overflow section of the dam (44 percent of the SDF). During the SDF, the dam will be overtopped by a maximum of 2.1 ft for a period of 12 hours at a maximum velocity of 6.1 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 is located along the eastern edge of the Piedmont physiographic province of Virginia. The site is underlain by the Petersburg Granite of Paleozoic geologic age. The Petersburg Granite consists of fine to coarse grained, foliated to nonfoliated granite, but also includes granodiorite and minor amounts of quartz monzonite. Numerous outcrops of fresh to slightly weathered bedrock are exposed in the stream channel and in both abutments. Granular residual soils and boulders also occur in the abutments. Scattered joint sets were observed in the rock, striking 10 to 40 degrees to the northwest and 75 degrees to the northeast. Dips were essentially vertical. The state geologic map does not indicate the presence of any faults in the site vicinity.

There is no subsurface data for this structure. The base of the dam appears to rest on slightly weathered Petersburg Granite, but at several locations could possibly rest on very large boulders. The counterforts rest within bedrock and in several locations on boulders. It could not be determined if the entire structure is keyed into bedrock; however, the owner said he was told that the dam was excavated into rock and some blasting was required.

Gradual consolidation of underlying materials would not be expected during construction of the dam because the structure is founded on rock. Based upon the performance history of this dam and the bedrock exposures, a stable foundation is assumed.

No seepage was observed along the base of the dam; however, the toe was slightly submerged as a result of water flowing over the crest of the dam. Flow was observed through bedrock joints below the dam, therefore it would be possible for seepage to occur through the underlying bedrock in those joints oriented perpendicular (75° NE) and oblique (40 - 48° NW) to the axis of the dam.

6.2 Evaluation:

6.2.1 Foundation and Abutments: There was no design or construction data available for this structure therefore the foundation and abutments can only be evaluated from visual observations. Based upon the outcrops exposed in the streambed at the base of the structure and immediately downstream, excessive settlement of the dam does not appear to be a problem. Outcrops in the immediate area consist of fairly competent fresh to slightly weathered granite bedrock. Measured attitudes indicate there are probably no adversely oriented weak joint surfaces within the foundation rock that would act as a potential sliding plane. If the joints observed are continuous beneath the structure only minor seepage would be expected through them as a result of their thickness, abundance and the small hydraulic head.

Considerable bedrock, boulders and granular residual soils are exposed in the right abutment. Only residual soils were observed in the left abutment, while slightly weathered bedrock is exposed just above stream level at the base of the left abutment. The left abutment experienced minor erosion as a result of overtopping in 1979, however, no detrimental effects were noted. Apparently the residual soils are dense and compact enough to prevent serious erosion. The slopes in both abutments were considered safe and stable at the time of inspection.

6.2.2 Stability Analysis: An accurate stability analysis could not be made since neither contract drawings nor construction records are available to indicate the foundation embedment. However, an evaluation was made in accordance with Section 4.4 of Reference 1, Appendix V. Assuming the structure resting upon a horizontal bedrock surface with the wall of the dam and counterforts keyed into rock, the stability was evaluated at sections through a full 45 degree counterfort and a full 60 degree counterfort, with respect to sliding resistance and overturning.

Water was assumed at the dam crest, and 5.5 ft over the crest which corresponds to a 100 year flood. The analysis did not consider end restraint. Calculations are included in Appendix IV. A factor of safety of about 1.8 was obtained for the sliding condition for the 45° and 60° counterforts at normal pool level conditions. A factor of safety of about 2.0 was obtained for the sliding condition for both counterfort sections for 100 year flood pool level conditions. These factors of safety are lower than the factor of safety of 3 required by Reference 1, Appendix V. The stability of the structure with respect to overturning for the two reservoir conditions was also determined. At normal pool, the resultant of all forces does not pass through the base for either of the counterfort sections.

A stability check of the dam is required. The owner should engage the services of a qualified professional engineer with expertise in Geotechnical and Structural Engineering to perform necessary studies and design work.

During the SDF the non-overflow section will be overtopped by 2.1 ft for a 12 hr period. The velocity across the non-overflow section is 6.1 fps and minor erosion is expected, particularly in the left abutment. The non-overflow section was overtopped in 1979 and only minor erosion occurred in the residual soils of the left abutment. Based upon the type materials present in the abutments and past performance during flooding, overtopping is not considered detrimental to the dam and abutments.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURE

7.1 Dam Assessment: Sufficient engineering data is not available to accurately assess the dam for stability. U. S. Army, Corps of Engineers guidelines indicate the appropriate Spillway Design Flood (SDF) for this dam is the 100 Year Flood. The spillway will pass 10 percent of the PMF (44 percent of the SDF) without overtopping the non-overflow section of the dam. The velocity across the non-overflow section during the 100 Year Flood is 6.1 fps and only minor erosion is expected particularly in the left abutment. However, because the non-overflow section has been overtopped in the past and only minor erosion occurred in the residual soils of the left abutment, overtopping is not considered detrimental to the dam and abutments. The overflow section is judged inadequate, but not seriously inadequate.

Overall the dam was in fair condition at the time of inspection. A routine maintenace program does not exist for this structure and there is no emergency operation and warning plan. The visual inspection revealed no apparent problems except structural cracking in one counterfort and there are no immediate needs for remedial measures. A stability check of the dam is required because the structure will be subject to overturning failure under the normal pool with ice thrust and 100 year flood loading conditions.

7.2 Recommended Remedial Measures: The following remedial measures should be implemented within one year of the date of this report:

7.2.1 Perform a stability analysis in order to evaluate the stability of the dam and modify as necessary. The owner should engage the services of a qualified Professional Engineering firm with expertise in Geotechnical and Structural Engineering to perform necessary

studies and design work. The structural cracks observed in the counterforts (particularly No. 3) should be examined during this study and repairs made as determined necessary.

7.2.2 Emergency Operation and Warning Plan: It is recommended that a formal emergency procedure be prepared, 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 is necessary.

7.3 Required Maintenance: The following maintenace items should be scheduled by the owner within the next twelve months:

7.3.1 Spalling concrete and scattered cracking on the dam should be repaired including the damaged overflow section at Counterfort No. 11.

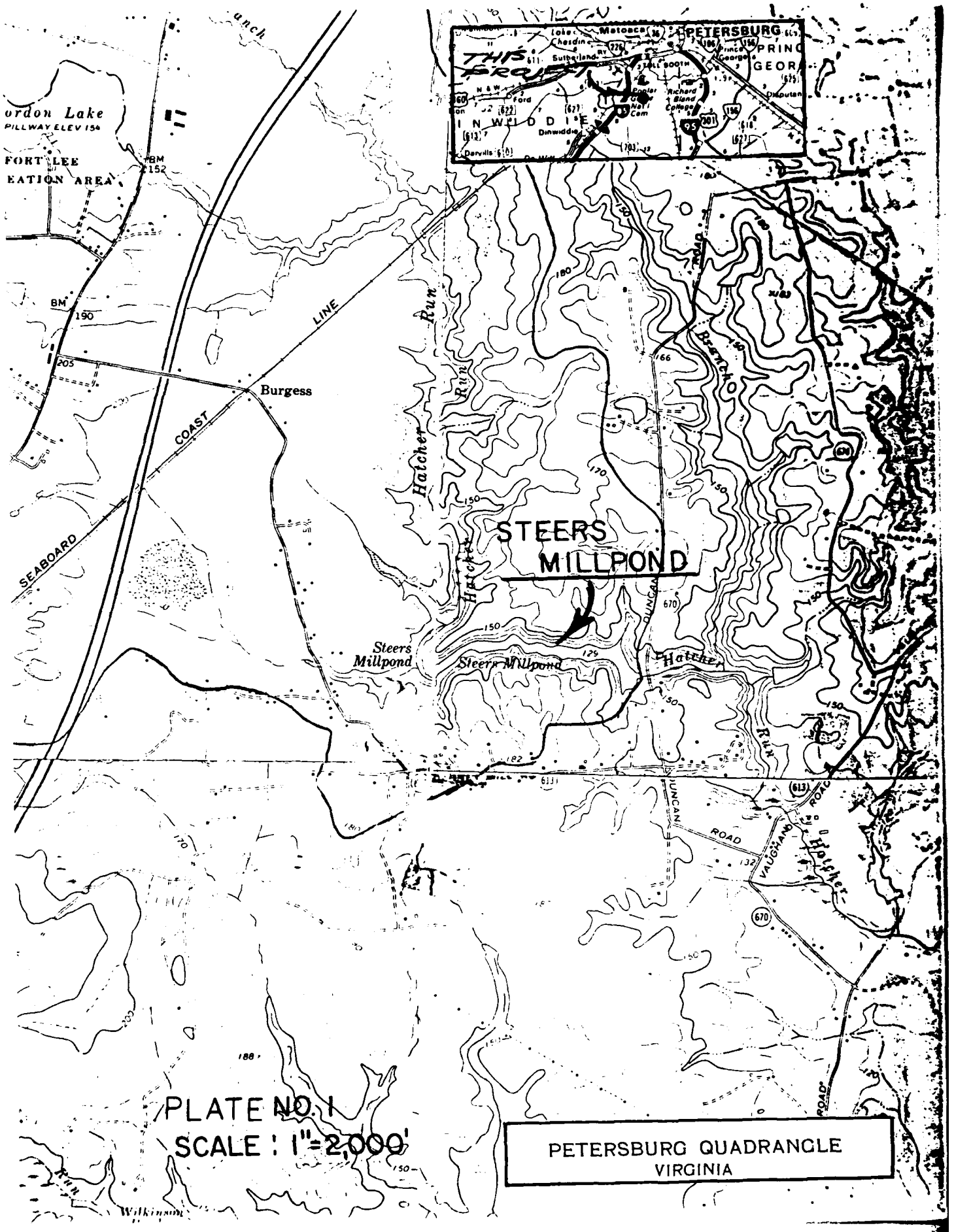
7.3.2 Trees and other vegetation in the emergency spillway should be removed and maintained on a scheduled basis in the future.

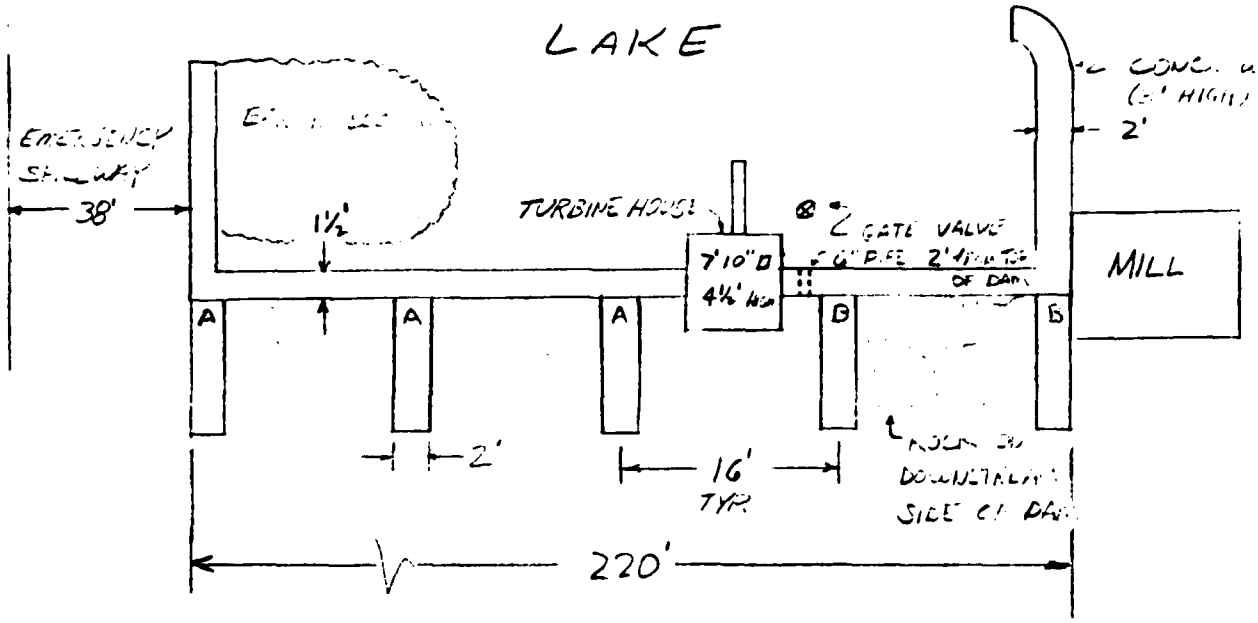
7.3.3 Scouring observed at Counterforts No. 8 and 9 should be examined annually to verify that the footings are not being undermined.

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

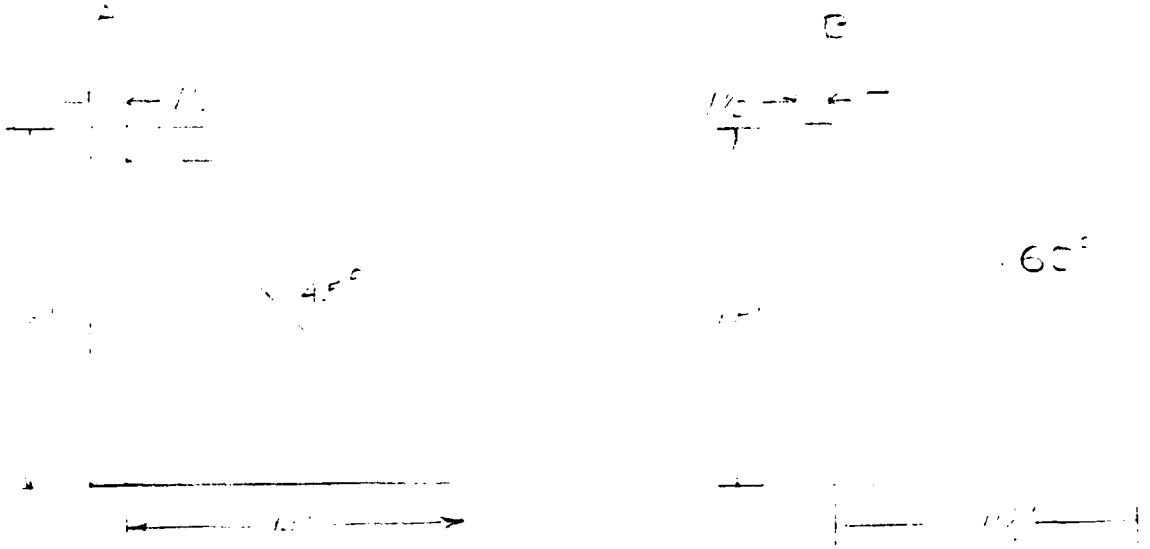
APPENDIX I

MAPS AND DRAWINGS


PETERSBURG
INWOODIE
Lake Chesdin
Matoaca
Sutherland
Ford
Dinwiddie
Darvills
Richard Bland College
Petersburg Nat'l Cem
Disputanta
Ordon Lake
SPILLWAY ELEV 154
FORT LEE
EATION AREA
BM 152
BM 190
205
COAST LINE
SEABOARD
Burgess
Hatcher Run
Steers Millpond
STEERS MILLPOND
DUNCAN ROAD
VAUGHAN ROAD
HOLLIER ROAD
Wilkinson Run
PLATE NO. 1
SCALE : 1"=2,000'
PETERSBURG QUADRANGLE
VIRGINIA



PLAN
NO SCALE



TYPICAL SECTION
NO SCALE

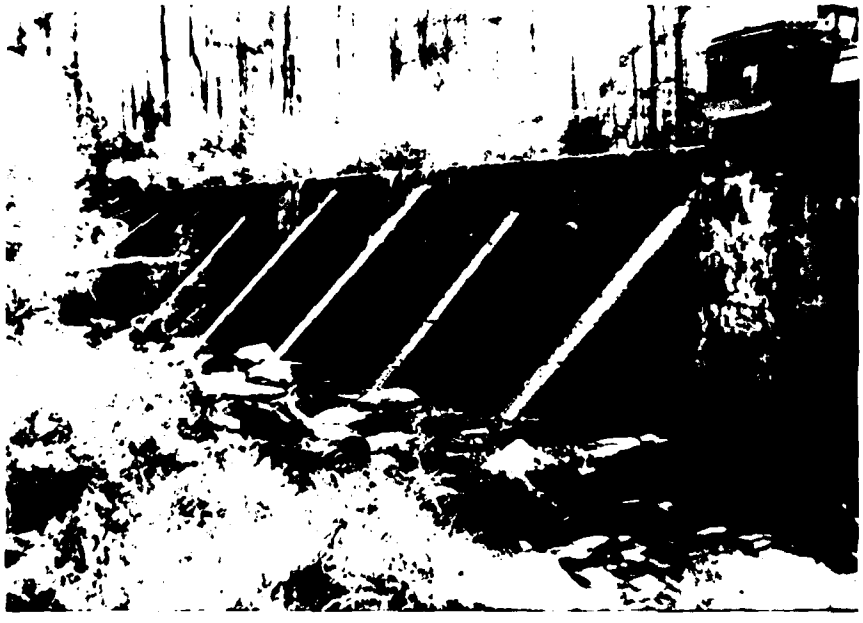
FIELD SKETCH
STEERS MILL POND

PLATE NO. 2
22 MAY 1981

APPENDIX II

PHOTOGRAPHS

Photograph No. 1 - Overflow Section at Left End of Dam, Catwalk, Turbine House and Mill (Arrow)



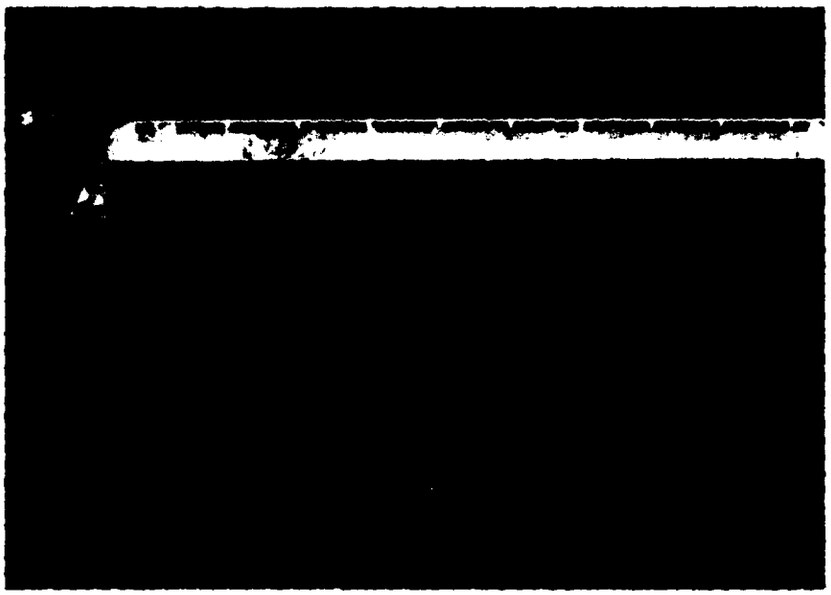
Photograph No. 2 - Overflow Section, Right End of Dam

Photograph No. 3 - Emergency Spillway

Photograph No. 4 - Damaged Area of Overflow Section (Arrow)

Photograph No. 5 - Turbine Discharge Gate (Arrow)

Photograph No. 6 - Turbine Intake Structure (Arrow)



Photograph No. 7 - Downstream Channel

APPENDIX III

FIELD OBSERVATIONS

Check List
Visual Inspection
Phase I

Name Dam Steers Mill County Dinwiddie State Virginia Coordinates Lat. 37° - 7.8' Long 77° -29.3'

Date(s) Inspection April 21, 1981 Weather Sunny & Clear Temperature 60° F

Pool Elevation at Time of Inspection 129 msl Tailwater at Time of Inspection 114 msl

Inspection Personnel:

Schnabel Engineering Associates, P.C.
Stephen G. Werner
Gilbert T. Seese
Raymond A. DeStephen, P.E.*

J. K. Timmons and Associates, Inc.
Robert G. Roop, P.E.
Steve Oddi

State Water Control Board
Leon Musselwhite

Owner
H. Lander-Allen, Jr.

Recorder
Gilbert T. Seese

* Not present during April 21, 1981 inspection, but visited the dam on June 3,1981

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SEEPAGE/LEAKAGE	No seepage or leakage was observed, however water flowing over the crest of the dam at most locations would obstruct any visible seepage. Flow was observed through bedrock joints below the dam, therefore it would be possible for seepage to occur through the underlying rock.	Seepage/leakage can only be assessed when there is no flow over the crest. Attitudes of bedrock joints are shown on the Field Sketch, Sheet 1.
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Both abutments include large outcrops of slightly to moderately weathered Petersburg Granite, residual granular soils consisting basically of silty sand (SM) materials and boulders. The structure appears to join both abutments properly. The millhouse is located at the left abutment, while the right abutment is wooded.	-
DRAINS	None Observed	-
WATER PASSAGES	See Field Sketch, Sheet 1. 4x4 ft passage at base of turbine structure.	-
FOUNDATION	The base of the dam appears to rest primarily on slightly weathered Petersburg Granite. Locally it may rest on very large boulders. The counterforts definitely rest on both bedrock and very large boulders. Mr. Lander-Allen said he was told the dam was excavated (keyed) into rock and some blasting was required. The Owner also stated that when the water is extremely clear he can see counterforts sloping back off the upstream face of the plain. Probing with a bamboo pole failed to detect any such structures.	
	Some undermining of the concrete-rock contact was present on either side of counterforts #8 and 9, but did not extend beneath the footings. Dowells, consisting of 5/8" threaded bolts with 3/4" nuts, were located in several or the boulders adjacent to the turbine structure. A 2½" diameter 8 inch drill hole was located at the end of counterfort No. 6 and also at the end of counterfort No. 7.	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Some weathering and spalling of the concrete was observed on the counterforts and face of the dam. Aggregate was exposed in many of these areas. Damage was also noted in Counterfort No. 11 (Photograph No. 4, Appendix II)	Should be repaired to avoid future deterioration
STRUCTURAL CRACKING	Bad cracking was observed on Counterfort No. 3 as illustrated on Sheet 2. Some cracking was also observed at several locations. The majority of the cracking was occurring in those counterforts resting on boulders and not bedrock.	-
VERTICAL AND HORIZONTAL ALIGNMENT	The vertical and horizontal alignment of the dam appeared to be good.	-
MONOLITH JOINTS (VERTICAL)	None Observed.	-
CONSTRUCTION JOINTS	Horizontal joints occur every 8 inches ± and scattered reinforcing wires were often observed at the joints. Numerous cracks and pits due to spalling and weathering were observed along the construction joints.	-
Erosion of Abutment Slopes:	The only erosion noted was under the millhouse as a result of past high water. This erosion did not appear to hinder the stability or proper performance of the dam. Both abutments include considerable bedrock and boulders, particularly the right abutment.	-

PRINCIPAL SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CONTROL SECTIONS	220 Ft concrete overflow wier extends over the length of the dam from the millhouse to the right abutment. Some spalling of concrete observed at the left end. See Field Sketch, Sheet 3.	Spillway was free of debris.
APPROACH CHANNEL	None	-
DISCHARGE CHANNEL	None	-
BRIDGE AND PIERS	Timber bridge from millhouse to water turbine and control valves. (see field sketch)	The bridge was in fair condition.
EMERGENCY GATE	24" inlet for turbine. This is the only method of lowering the pool.	-
GATES AND OPERATION	Water turbine is located in the dam. It is used during normal flow to run the grist mill. The discharge from the turbine is through a 4' by 4' outlet gate. (see Sheet 1). The inlet is a 24 inch gate.	The mill is operational

EMERGENCY SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONTROL SECTIONS	Emergency spillway is cut in rock at right end of principal spillway or right abutment. (see Field Sketch, Sheet 3) There are numerous trees in the spillway channel.	The trees should be removed.
APPROACH CHANNEL	Control section of spillway is 6 inches above normal pool elevation. There are numerous trees in the approach channel.	The trees should be removed.
DISCHARGE CHANNEL	Rock channel with some vegetation.	Vegetation should be removed.
BRIDGE AND PIERS	None	-
MISCELLANEOUS	None	-

INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATION
MONUMENTATION/SURVEYS	None	-
OBSERVATION WELLS	None	-
WEIRS	None	-
PIEZOMETERS	None	-
STAFFGAGES	None	Should be installed
OTHER	None	-

VISUAL EXAMINATION	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
SLOPES	Gently sloping 3H:1V to 4H:1V wooded slopes extend to the reservoir surface around most of the reservoir. Several houses are located along the right side of the lake. The owner has a 50 ft easement around the lake. Shore line appears stable. No erosion was observed on the banks. The shoreline appears to be very stable. The reservoir area was free of debris.	-
SEDIMENTATION	No sedimentation observed. Water was very clear.	Owner indicated some sediment deposited during the construction of I-85.

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	The downstream channel is located in a narrow flood plain with 5H:1V side slopes above the channel banks. The channel is approximately 2.0 ft deep with 1H:1V side slopes. The State Route 670 bridge spans the channel approximately 100 ft downstream. The bridge opening is 76 ft wide by 18 ft high. The top of the bridge is 20 ft above the natural stream channel which is 30 ft wide.	-
SLOPES	Gentle to moderate wooded slopes, N = .07. The downstream channel is located in a narrow floodplain with 5H:1V side slopes above the channel banks. The channel is approximately 2 ft deep with 1H:1V side slopes.	-
APPROXIMATE NO. OF HOMES AND POPULATION	Two homes exist on the fringe of the natural flood plain, less than a mile downstream from the dam. One is occupied and the other is under construction.	-

CHECK LIST

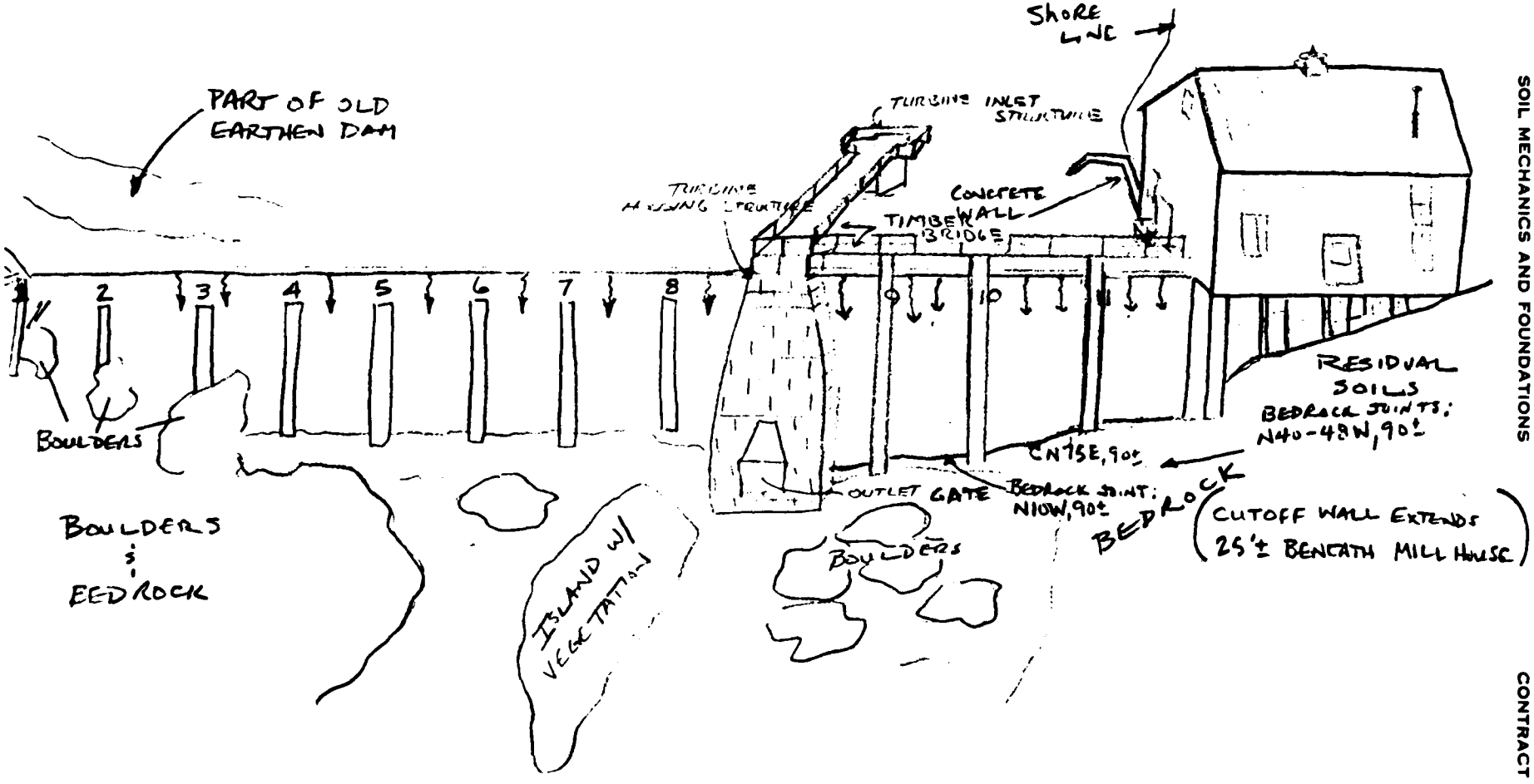
ENGINEERING DATA

DESIGN, CONSTRUCTION, OPERATION

ITEM		REMARKS
REGIONAL VICINITY MAP	Petersburg, Virginia 15 minute Quadrangle	-
DESIGN/CONSTRUCTION HISTORY	Originally consisted of earth embankment with mill structure in pre-Civil War days. Mill burned during Civil War. Concrete buttress dam constructed in 1923 as was millhouse by Mr. Albert Steer.	-
PLAN OF DAM	None available. See Sketch, Appendix I	-
TYPICAL SECTIONS OF DAM	None available. See Sketch, Appendix I	-
OUTLETS - PLAN DETAILS CONSTRAINTS DISCHARGE RATINGS	None available	-
SPILLWAY- PLAN SECTION DETAILS	None available	-
OPERATING EQUIPMENT - PLAN DETAILS	None available	-

ITEM		REMARKS
MONITORING SYSTEMS	None	-
RAINFALL/RESERVOIR HIGHPOOL RECORDS	None available	-
GEOLOGY REPORTS	None. Information available from state geologic map.	-
BORROW SOURCES	Unknown	-
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY-FIELD TEST DATA	None	-
HYDROLOGIC/HYDRAULIC DATA	None available	-

ITEM		REMARKS
DESIGN REPORTS	None	-
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None	-
POST CONSTRUCTION ENGINEERING STUDIES RECORDS, SURVEYS	None	-
MODIFICATIONS	None	-
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None	-
MAINTENANCE OPERATION RECORDS	None	-



FIELD SKETCH STEERS MILL POND DAM
NO SCALE DATE 6-16-81
SHEET 1

SOIL MECHANICS AND FOUNDATIONS

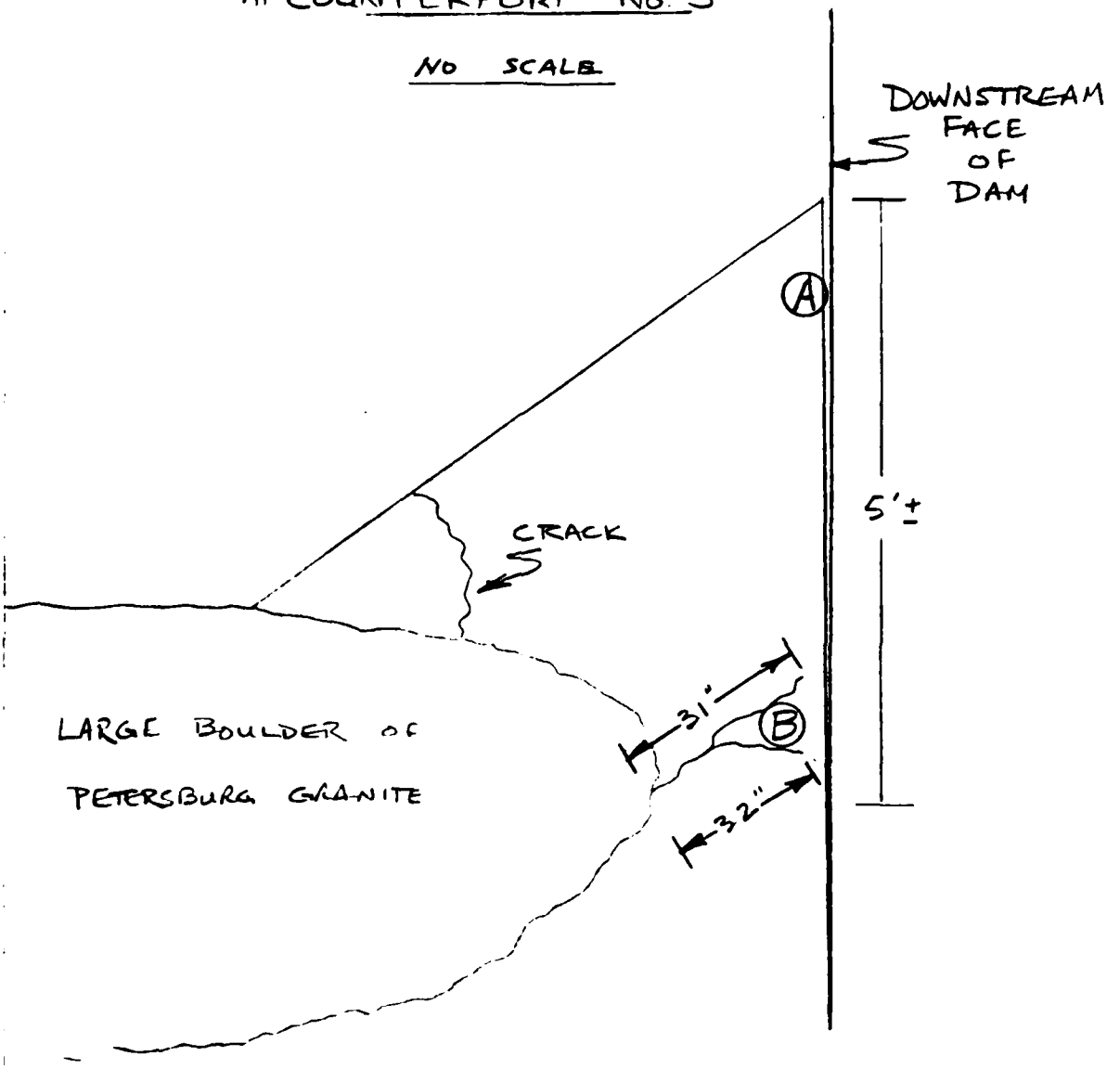
CONTRACT NO.

STEERS MILL POND
SHEET 2
4-21-81

STRUCTURAL CRACKING

AT COUNTERFORT NO. 3

NO SCALE



(A) UPPER 5FT OF COUNTERFORT SEPARATED FROM DAM 1 - 3 INCHES ±

(B) STUCK RULER INTO THE 31 INCH CRACK, TO DEPTH OF 8 INCHES

APPENDIX IV

STABILITY ANANLYSIS

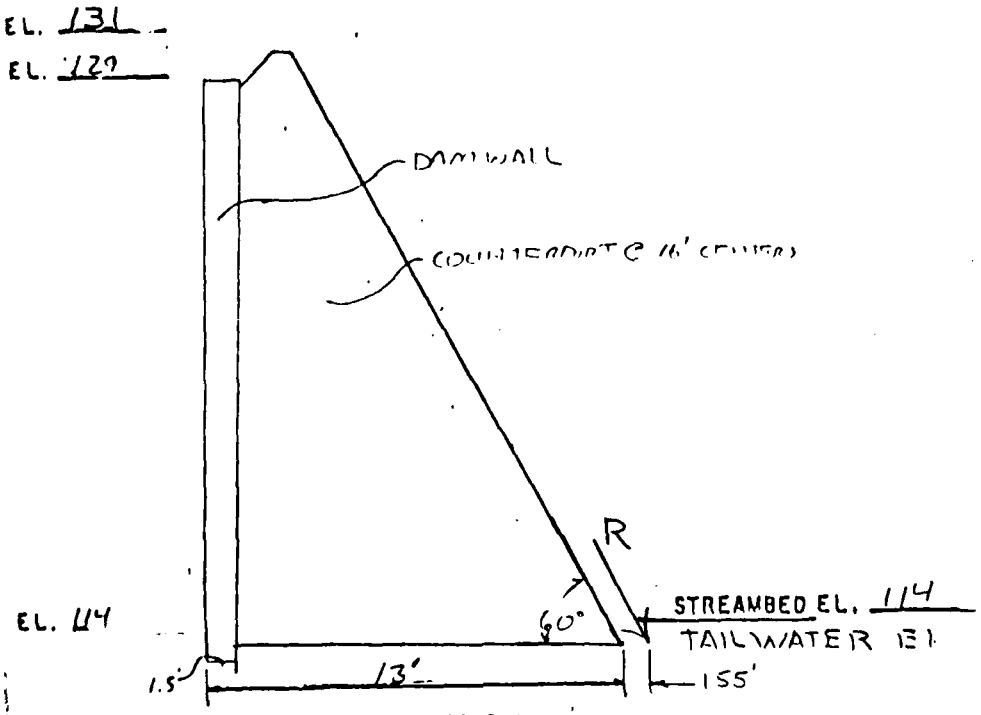
This analysis was performed in accordance with Section 4.4 of Reference 1, Appendix V.

GRAVITY DAM DESIGN
STABILITY ANALYSIS

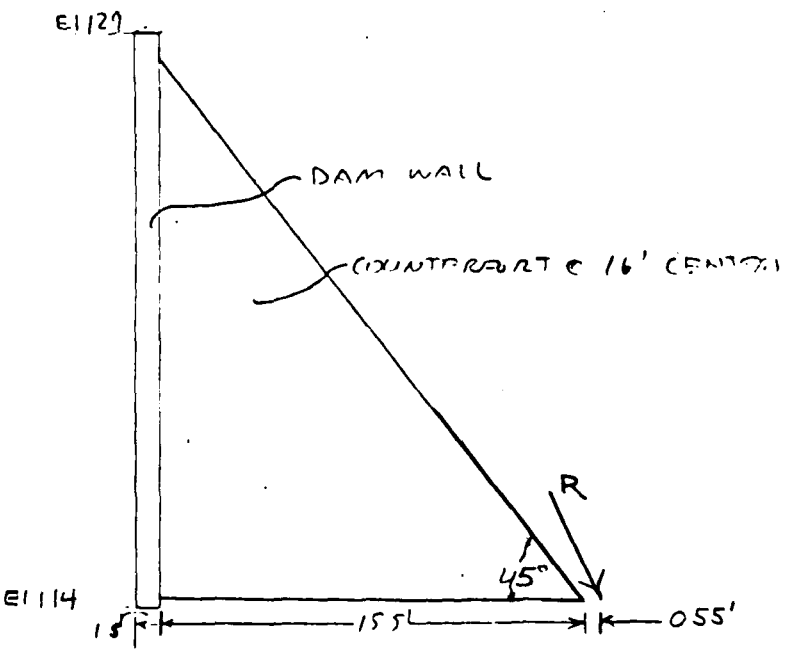
ANALYSIS DONE ON X FULL SECTIONS ___ PARTIAL SECTION
LOCATION OF SECTION At full 45° & 60° Counterforts
ANALYSIS PREPARED BY G. Seese

LOADING CASE	ELEV. HEAD WATER	ELEV. TAIL WATER	ΣV.	ΣH	ΣH/ΣV	LOCATION RESULTANT FROM TOE	% BASE IN COMPRESSION	FACTOR SAFETY SLIDING	FOUNDATION PRESSURE	
									TOE	HEEL
Normal Pool 45° Counterfort	129	114	75.4	136.32	1.8	0.55'*	0%	1.8	0	0
Normal Pool 60° Counterfort	129	114	68.5	136.32	1.9	1.25'*	0%	1.8	0	0

*Distances to right of toe. Resultants outside base of dam.



FULL SECTION

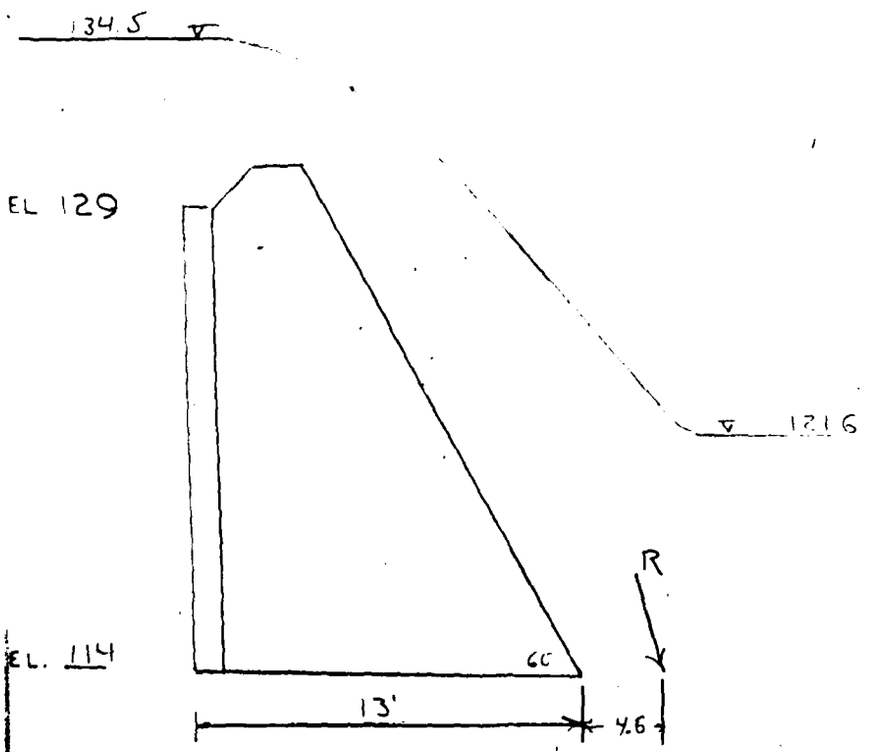


GRAVITY DAM DESIGN
STABILITY ANALYSIS

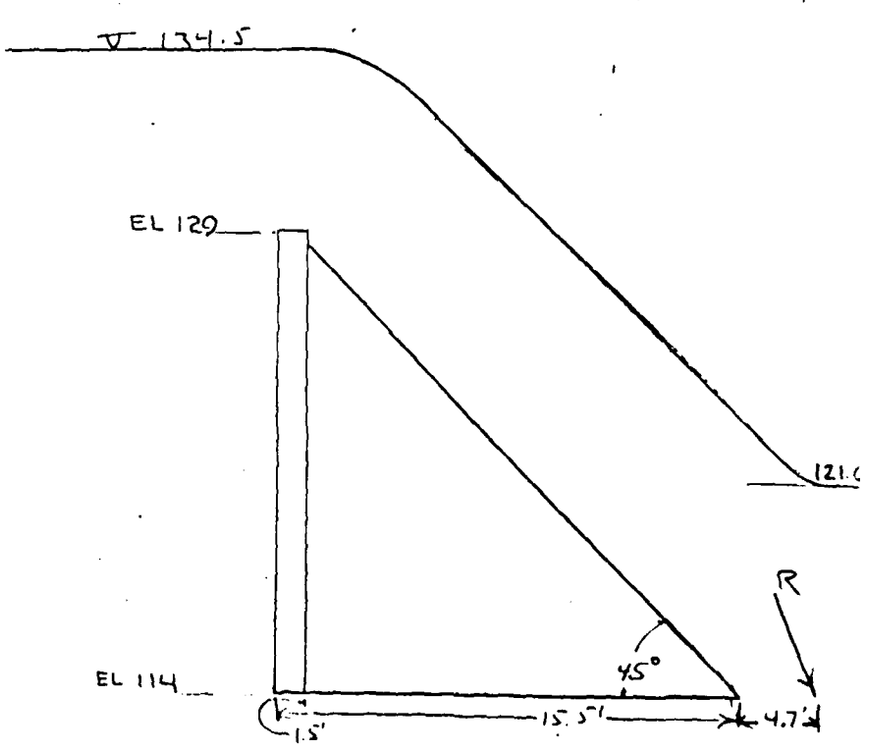
ANALYSIS DONE ON X. FULL SECTION ___ PARTIAL SECTION
LOCATION OF SECTION At full 45° & 60° counterforts
ANALYSIS PREPARED BY G. Seese

LOADING CASE	ELEV. HEAD WATER	ELEV. TAIL WATER	ΣV.	ΣH	ΣH/ΣV	LOCATION RESULTANT FROM TOE	% BASE IN COMPRESSION	FACTOR SAFETY SLIDING	FOUNDATION PRESSURE	
									TOE	HEEL
100 Year Flood 45° Counterfort	134.5	121.6	48.4	124.8	2.6	4.7'*	0%	2.2	0	0
100 Year Flood 60° Counterfort	134.5	121.6	55.3	124.8	2.3	4.5'*	0%	2.0	0	0

*Distances to right of toe. Resultants outside base ~~of dam.~~

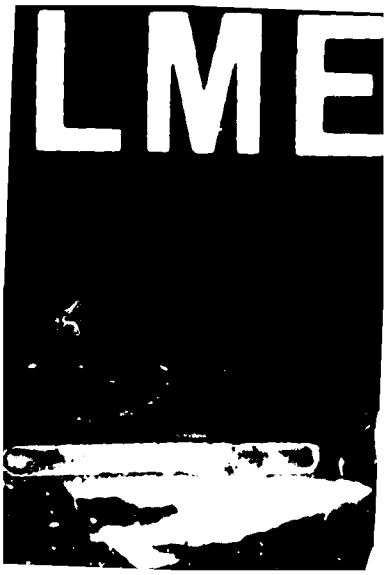


FULL SECTION



APPENDIX V - 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 Virginia, Virginia Division of Mineral Resources 1963.
4. HEC - 1 Dam Break Version, Flood Hydrograph Package, Users Manual for Dam Safety Investigations, the Hydrologic Engineering Center, U. S. Army Corps of Engineers, September, 1978.
5. Hydrometerologic 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.


LME