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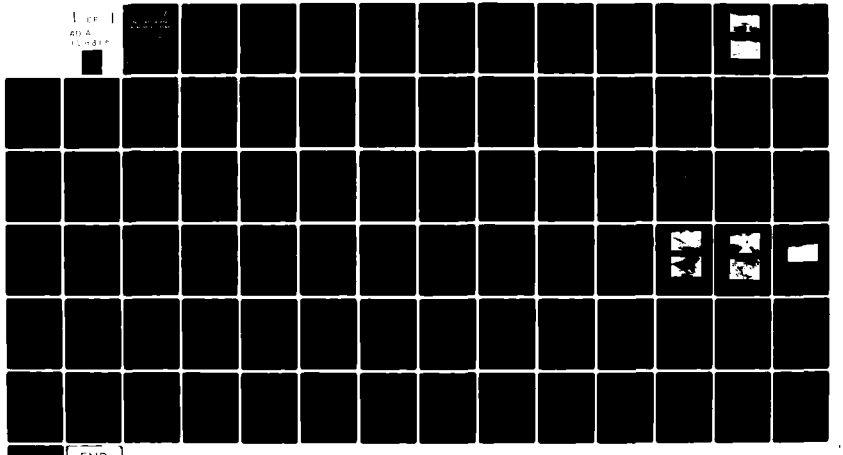

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Name Of Dam: LEATHERWOOD CREEK NO. 2A

Location: HENRY COUNTY, VIRGINIA

Inventory Number: VA. NO. 06905

PHASE I INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM

PREPARED FOR

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

BY

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

JULY 1981

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE

READ INSTRUCTIONS BEFORE COMPLETING FORM

1 REPORT NUMBER: VA 08905	2 GOVT ACCESSION NO: AD-A1[illegible]
3 RECIPIENT'S CATALOG NUMBER: [illegible]	
4 TITLE (and Subtitle): Phase I Inspection Report National Dam Safety Program Leatherwood Creek No. 2A Henry 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: July 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)

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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.

ROANOKE RIVER BASIN

NAME OF DAM: LEATHERWOOD CREEK NO. 2A
LOCATION: HENRY COUNTY, VIRGINIA
INVENTORY NUMBER: VA. NO. 08905

National Dam Safety Program. Leatherwood Creek Number 2A (Inventory Number VA 08905), Roanoke River Basin, Henry County, Virginia. Phase I Inspection Report.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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

BY

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

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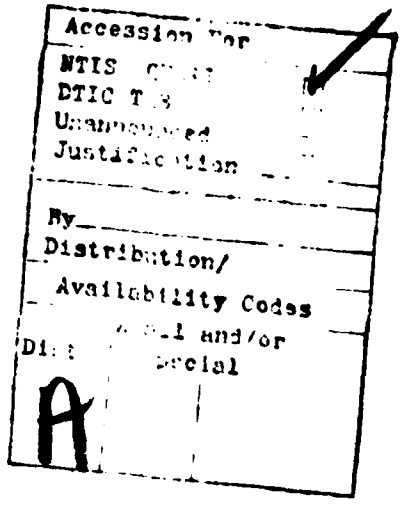


PREFACE

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:	Leatherwood Creek No. 2A Dam
State:	Virginia
Location:	Henry County
USGS Quad Sheet:	Martinsville East
Coordinates:	Lat 36°-44.3' Long 79°-48.6'
Stream:	West Fork, Leatherwood Creek
Date of Inspection:	July 1, 1981

Leatherwood Creek No. 2A dam is a zoned earthfill structure about 400 ft long and 51.9 ft high. The principal spillway consists of a reinforced concrete riser and a 36 inch diameter concrete outlet pipe which extends through the structure. An earth emergency spillway is located at the left abutment with a 30 ft wide bottom and 3H:1V side slopes. The structure is classified intermediate in size and is assigned a significant hazard classification. The dam is located on the West Fork of Leatherwood Creek approximately 3.5 miles west of Leatherwood, Virginia. The dam is used for irrigation, flood control and recreational purposes, and is owned and maintained by Mr. Thomas F. Walker.

Based on criteria established by the Department of the Army, Office of the Chief of Engineers(OCE), the appropriate Spillway Design Flood (SDF) is the ½ PMF. The spillways will pass 30 percent of the Probable Maximum Flood (PMF) or 60 percent of the SDF without overtopping the dam. During the SDF, the dam will be overtopped for four hours up to a maximum of 3 feet and reach a maximum velocity of 7.4 fps. A dam breach during the SDF would significantly increase the hazard to loss of life downstream of the dam over that which would exist just before overtopping failure. The spillway is judged seriously inadequate. Overtopping is considered detrimental to the embankment with respect to erosion.

Due to the inadequacy of the spillway and the resulting overtopping of the dam during the SDF, the potential for a breach of the dam exists. Based upon the possibility of a dam breach caused by overtopping during the SDF, the dam is assessed "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 could take place, significantly increasing the hazard to loss of life downstream from the dam.

It is, therefore, recommended that a qualified engineering firm be retained to perform a detailed hydrologic/hydraulic analysis of the downstream damage reach with a dam breach simulation. The owner is required to engage the services of a qualified engineering firm within two months of the issuance of the approved Phase I inspection report. The owner is required to have the consultant's report and to have reached an agreement with the Commonwealth of Virginia regarding required remedial measures within six months of the date of the issuance of the approved Phase I inspection report.

The visual inspection did not reveal any problems which would require immediate attention. Field measurements indicate the embankment crest is 5 ft narrower than shown on the "as built" drawings. The dam is considered stable for normal pool conditions and the review of design stability data indicates the structure is stable as designed.

It is recommended that the owner implement an emergency action plan measure immediately as of the date of this report in order to warn downstream dwellings of any dangers which may be imminent. In the interim the dam and reservoir should be monitored during periods of heavy precipitation and runoff.

The following routine maintenance and observation functions should be initiated as part of an annual maintenance program:

All brush growing on the embankment should be cut to the ground and removed from the embankment. The area of sloughing in the right abutment should be stabilized. The minor sloughing located above the outlet works should be monitored during maintenance. If increased erosion should occur, this area should be stabilized by backfilling and reseeding. Debris should be removed from the trash rack and the broken bar on the trash rack should be replaced. A staff gage should be installed to monitor water levels.

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

Ray E. Martin, Ph.D., P.E.
Commonwealth of Virginia

Submitted by:

Original signed by:
Carl S. Anderson, Jr.

Carl S. Anderson, Jr., P.E.
Acting Chief, Design Branch

Approved:

Original signed by:
Ronald E. Hudson

Ronald E. Hudson
Colonel, Corps of Engineers
Commander and District Engineer

Recommended by:

Original signed by
JACK G. STARR

Jack G. Starr, P.E.
Chief, Engineering Division

Date SEP 23 1981

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

1.2 Project Description:

1.2.1 Dam and Appurtenances: Leatherwood Creek No. 2A Dam is a zoned earthfill structure approximately 400 ft long and 51.9 ft high.* The crest of the dam is 12 ft wide, and side slopes are approximately 2.5 horizontal to 1 vertical (2.5H:1V) on the upstream and downstream slopes of the dam. A 10 ft wide berm occurs between elevation 782.7 and 783.7 msl on the upstream slope. The upstream slope is 3H:1V below the berm. The crest of the dam is at elevation 813.4 msl. "As built" drawings show the presence of a core trench which extends to "firm rock" and a seepage drain beneath the downstream slope. There is no slope protection on the upstream face of the dam.

---

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

The principal spillway consists of a reinforced concrete riser inlet. The riser has an internal opening of 9 ft by 3 ft, and is approximately 34 ft high. The riser has a low flow orifice (3 ft by .75 ft) at an invert elevation of 782.2 msl and two overflow weirs (9 ft by 1.5 ft) at elevation 794 msl. A 36 inch diameter slide gate in the riser at an invert elevation of 763 msl is used to drain the lake. The outlet pipe is a 36 inch diameter concrete pipe which outlets at an elevation of 761.5 msl into a Bradley Perterka impact basin. (See Plates 5 and 7, Appendix I).

The emergency spillway (EMS) consists of a vegetated earth and rock channel spillway located at the left abutment, having a crest elevation of 804 msl. The EMS has a bottom width of 30 ft at the control section and 3H:1V side slopes, and is entirely in a cut section. (See Plates 2 and 3, Appendix I).

1.2.2 Location: Leatherwood Creek No. 2A Dam is located on the West Fork of Leatherwood Creek, 3.5 miles west of Leatherwood, Virginia. (See Plate 1, Appendix I.)

1.2.3 Size Classification: The dam is classified as an intermediate size structure based on its height and maximum lake storage potential as defined in Reference 1, Appendix VI.

1.2.4 Hazard Classification: The dam is located in a rural area; however, based upon the proximity of an inhabited dwelling located 2 miles downstream, and several dwellings 5 miles downstream, the dam is assigned a "significant" hazard classification. The hazard

classification used to categorize a dam as a function of [illegible] and has nothing to do with its stability or probability of failure.

1.2.5 Ownership: The dam is owned and maintained by [illegible] Walker [illegible], Virginia.

1.2.6 [illegible]

1.2.7 Design and Construction History: [illegible] was constructed [illegible] 1964.

1.2.8 Normal Operational Procedure: [illegible] normal [illegible] for maintenance purposes.

1.3 Pertinent Data:

1.3.1 Drainage Area: The drainage area is [illegible] square miles.

1.3.2 Discharge at Dam Site: According to the owner, the maximum known flood at the dam site occurred in April 19[illegible] when an estimated pool elevation of 799 msl was observed. This corresponds to an approximate discharge of 182 CFS.

Plate [illegible] of Appendix I indicates that the dam is founded on overburden and includes a cutoff trench which extends through alluvial and residual soils to "firm rock." The cutoff also extends to the same materials in both abutments. The cutoff trench is 12 ft wide and has 1H:1V side slopes. No field permeability tests were taken during the subsurface investigation, however, permeability rates of [illegible] ft/day to [illegible] ft/day were assumed for the foundation soil materials as determined from tests conducted for the Leatherwood Creek No. 5 dam site. The underlying bedrock was described as less weathered than that encountered at the No. 5 site and was considered to be impermeable.

An internal drainage system was also constructed beneath the downstream slope to collect any seepage passing through the dam. The seepage drain was to consist of a [illegible] ft minimum width trench with 140 ft of [illegible] inch diameter bituminous coated perforated pipe encased in a granular envelope. Details of the seepage drain are provided on Plate 4 of Appendix I.

The principal spillway was designed as a drop inlet structure consisting of a reinforced concrete riser, a [illegible] inch conduit and a [illegible] impact basin at the outlet end of the conduit. Eight anti-seep collars on [illegible] ft centers were included in construction. Details are presented on Plate [illegible] of Appendix I. The principal spillway was designed to accommodate a [illegible] year flood without discharge occurring in the EMS.

The emergency spillway is located in a moderately sloping hillside in the left abutment. The spillway is a 30 ft wide trapezoidal rock and earthen channel bounded by 3H:1V cut slopes. The spillway is entirely

[illegible] and weathered [illegible]. Details of the typical section are shown on Plates [illegible] and [illegible] of Appendix [illegible].

The design report and supplementary data provided by the SCS include detailed laboratory test data describing the physical properties of the materials used to construct the embankment. A summary of this information is contained in Appendix [illegible]. There was no information on the consistency or in-place density of the foundation soils. In design, SCS assumed strong and slightly compressible soils similar to those encountered at the Leatherwood Creek No. [illegible] dam site. Shear strength parameters used in design of the embankment were determined by consolidated undrained triaxial compression tests as follows:

SECTION	SOIL	SHEAR STRENGTH PARAMETERS: Angle of Internal Friction	SHEAR STRENGTH PARAMETERS: Cohesion
Embankment	SM	[illegible]	[illegible] psf
	ML	[illegible]	[illegible] psf
	SM*	[illegible]	[illegible]

* From Leatherwood Creek No. [illegible]

Embankment stability was checked by the Swedish Circle Method Analysis and a factor of safety of 1.28 was calculated for full drawdown on the upstream slope ([illegible]H:1V with no berm). A minimum factor of safety of 1.43 was calculated for steady seepage on the downstream slope (2.5H:1V with no berm and no drain). The design report stated, "An analysis of a 50 foot embankment with the shear strength found in these embankment tests and one from Site 5 show acceptable safety factors for the proposed slopes."

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

2.3 Evaluation: "As built" drawings are generally representative of the structure. Field measurements indicate that the embankment crest is 5 ft narrower than shown on the "as built" drawings. Hydrologic and hydraulic calculations were available for evaluation. There is sufficient information to evaluate foundation conditions and embankment stability.

SECTION 3 - VISUAL INSPECTION

3.1 Findings: At the time of inspection, the dam appeared to be in excellent condition. Field observations are outlined in Appendix III.

3.1.1 General: An inspection was made on July 1, 1981 and the weather was cloudy with a temperature of 75°F. The pool and tailwater levels at the time of inspection were 782.5 and 761.5 msl, respectively, which corresponds to normal pool and tailwater elevations. Ground conditions were dry at the time of the inspection. Maintenance inspections are performed jointly by SCS and the Blue Ridge Soil and Water Conservation District on an annual basis. Inspection reports are available in the Soil and Water Conservation District office in Collinsville, Virginia.

3.1.2 Dam and Spillway: The embankment slopes and crest were grassed and well maintained. Cattle are allowed to graze on the embankment. Scattered patches of brush 1 to 2 inches in diameter were growing 5 to 10 ft$^{+}_{-}$ above pool level on the upstream slope to the right of the intake structure. A few small bushes and weeds were also present on the downstream slope.

Essentially no sloughing or erosion was noted on the embankment. Scattered shrinkage cracks were observed on the embankment, particularly near the right abutment. They were generally "pencil mark" in width and are probably the result of local drought conditions. A very small area of sloughing was noted on the downstream slope directly above the outlet works. The right abutment has an area of sloughing located 15 ft$^{+}_{-}$ below the crest of the dam. The area is 15 ft$^{+}_{-}$ long and 5 ft$^{+}_{-}$ high. This area is bare and has experienced some washing.

The downstream toe of the embankment was dry and no seepage was encountered. Two 6 inch CMP toe drains were encountered, one on the left side and one on the right side of the energy dissipater. Iron staining was noted at the end of the pipes, however, flow from the outlets could not be observed since the inverts were below the stilling basin pool level.

Except for a broken steel bar on the trash rack, the riser structure and outlet pipe showed no signs of deterioration and were functioning properly at the time of inspection. Debris was present in the low flow intake trash rack. According to the owner, the slide gate has not been operated since it was installed. The impact basin and outlet channel indicated no signs of deterioration. The emergency spillway was well vegetated except for where weathered bedrock was exposed in the approach channel.

3.1.3 Reservoir Area: The reservoir area was free of debris and the perimeter was wooded except on the right side where pasture exists. The reservoir is located in a valley with side slopes at approximately 4H:1V. Water was murky and a sedimentation buildup was reported by the owner.

3.1.4 Downstream Area: The downstream channel consists of a 15 ft wide channel located in a valley with side slopes of 3H:1V. This valley is heavily wooded except for an area 100 ft right of the channel which is a pasture. Approximately 2 miles downstream there is a dwelling about 15 ft above the stream channel, and 5 miles downstream there are several dwellings about 10 ft above the stream channel and several commercial facilities 15 ft above the channel.

3.1.5 Instrumentation: No instrumentation (monuments, observation wells, piezometers, etc.) was encountered for the structure. There is no staff gage.

3.2 Evaluation:

3.2.1 Dam and Spillway: Overall, the dam was in excellent condition at the time of the inspection. The presence of brush on the embankment, particularly those at pool level on the upstream slope, may promote the development of deep rooted vegetation and this type growth can encourage piping within an embankment. All brush growing on the embankment should be cut to the ground and removed from the embankment.

The scattered shrinkage cracks on the embankment are apparently the result of local drought conditions and require no special attention. The small area of sloughing located above the outlet does not require any attention at this time; however, if increased erosion should occur, this area should be stabilized by backfilling and reseeding. The area of sloughing in the right abutment does not inhibit the proper performance of the dam. It is recommended that attempts be made to stabilize the area in order to prevent its migration toward the embankment.

The outlet pipe and intake structures are in good structural condition. Debris should be removed from the trash rack and the broken bar repaired. A staff gage should be installed to monitor water levels.

3.2.2 Downstream Area: A breach in Leatherwood Creek No. 2A Dam during extreme flooding would possibly create a hazard to the downstream dwellings.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 Procedures: The normal storage pool is elevation 782.5 msl or 0.3 ft above the crest of the principal spillway low flow inlet. The lake provides an irrigation supply, flood control and recreation. Water automatically passes through the principal spillway as the water level in the reservoir rises above the low level orifice. Water will also pass automatically through the overflow crest when the water level in the reservoir exceeds elevation 794 msl and automatically through the emergency spillway when the pool level exceeds elevation 804 msl. A 36 inch slide gate at the low point in the riser structure is provided to drawdown the reservoir below normal pool.

4.2 Maintenance of Dam and Appurtenances: Maintenance is the responsibility of the owner and the Blue Ridge Soil and Water Conservation District. Maintenance is accomplished by a joint annual inspection by SCS and Soil and Water Conservation District personnel. Maintenance deficiences are noted and recommended remedial measures are made to the owner. If the owner fails to comply with these recommendations, maintenance is then performed by the Blue Ridge Soil and Water Conservation District.

4.3 Warning System: At the present time, there is no warning system or evacuation plan for the dam. The dam is monitored by SCS personnel during periods of heavy precipitation and runoff.

4.4 Evaluation: The dam and appurtenances are in good operating condition, and maintenance of the dam appeared to be excellent. 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 evaluation from the downstream area is necessary.

SECTION 5 - HYDRAULIC DESIGN

5.1 Design: [illegible] Creek [illegible] was developed by the Soil Conservation Service (SCS) as a multi-purpose dam, and hydrologic and hydraulic data is available. Standard SCS criteria and procedures were used in the evaluation. This structure is a Class "A" dam according to the SCS classification method.

5.2 Hydrological Records: There are [illegible] records available.

5.3 Flood Experience: According to Mr. Thomas E. Wagner, an estimated maximum pool elevation of [illegible] was attained on April 19[illegible]. This corresponds to a peak flow of [illegible] cfs.

5.4 Flood Potentials: In accordance with the established guidelines, the Spillway Design Flood (SDF) is based on the estimated "Probable Maximum Flood" for the region. This is the discharge that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region, or fractions thereof. The Probable Maximum Flood (PMF) and 1/2 PMF hydrographs were developed by the HEC-1 DB Computer Program (Reference 4, Appendix VI). Precipitation amounts for the flood hydrograph of the PMF were taken from the U. S. Weather Bureau Information (Reference 5, Appendix VI). Appropriate adjustments for basin size and shape were accounted for. These hydrographs were routed through the reservoir to determine maximum pool elevations.

5.5 Reservoir Regulations: For routing purposes, the pool at the beginning of flood was assumed to be at elevation 782.2 msl. Reservoir stage-storage data and stage-discharge data were utilized from the existing design report. Floods were routed through the reservoir using the principal spillway discharge up to a pool storage elevation of 804 msl and a combined principal and emergency discharges for pool elevations above 813.4 msl. Pool elevations above 813.4 msl were routed over the non-overflow section of the dam.

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 (½ PMF and PMF) are shown in the following Table 5.1:

TABLE 5.1 - RESERVOIR PERFORMANCE

	Normal Flow	Hydrograph ½ PMF	PMF
Peak Flow, CFS			
Inflow	6	11,578	23,156
Outflow	6	10,193	22,736
Maximum Pool Elevation			
Ft, msl	782.5	810.43	834.55
Non-Overflow Section (Elev 813.4 msl)			
Depth of Flow, Ft	-	3.0	20.2
Duration, Hours	-	4	6
Velocity, fps *	-	7.4	12.7
Tailwater Elevation			
Ft, msl	761.5	771.4	784.2

*Critical velocity

5.7 Reservoir Emptying Potential: A [illegible] elevation 763 msl is capable of [illegible] outlet pipe. Assuming that the [illegible] (782.5 msl) there is 6 cfs [illegible], it would take approximately [illegible] day to lower the reservoir to elevation 763 msl. This is equivalent to an approximate drawdown rate of [illegible] hydraulic height measured from normal pool to the invert of the drawdown pipe divided by the time to drawdown the reservoir.

5.6 Evaluation: The U. S. Army, Corps of Engineers' guidelines indicate the appropriate Spillway Design Flood (SDF) for an intermediate size, significant hazard dam is the ½ PMF to PMF. Because of the risk involved, the ½ PMF has been selected as the SDF. The spillway will pass 30 percent of the PMF without overtopping the crest of the dam (60 percent of the SDF). During the SDF, the dam will be overtopped for four hours up to a maximum of 3 feet and reach a maximum velocity of 7.4 fps.

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

[illegible]

[illegible] while the right half is underlain by the Rich Acres Formation. These igneous rock units are approximately [illegible] million years old. The Rich Acres Formation consists of coarse grained norites, metamorphosed gabbros and diorites. These rocks are similar in appearance to granites, but are comprised of more basic or darker colored minerals. The Leatherwood Granite, typically a coarse-grained to porphyritic granite, usually occurs as dikes or thin sheets on top of the Rich Acres Formation. Both rock units are believed to be from the same magma. Detailed geologic maps of the area do not indicate the presence of any faults in the site vicinity. Site geology is presented in more detail in the Design Geologic Report, which is included as Appendix IV.

The subsurface investigation indicated that along centerline of the dam the site was underlain by shallow alluvial and residual soils over weathered bedrock. The "firm bedrock" surface ranges in depth from 5 to 14 ft below the ground surface along the principal spillway. Bedrock was encountered at ground surface near the center of the section, at depths of 2 to 6 at the abutments, and below 10 ft at the principal spillway outlet. Hard unfractured rock underlies the toe drain at generally 2 to 7 ft below

[illegible]

The [illegible] that in the [illegible] area, "the materials [illegible]" [illegible] embankment. The [illegible] soil mechanics laboratory assessed the foundation soils to be "as strong and as slightly compressible as [illegible] from Site [illegible]."

The potential for seepage through the foundation was recognized and a cutoff extending into firm bedrock was specified. Moderate permeabilities ranging from [illegible] to [illegible] ft/day were anticipated for the foundation soils and the designer expected some seepage through all weathered bedrock.

[illegible] Embankment:

[illegible] Materials: "As built" drawings describe the dam as a zoned structure. Section No. 1 of the dam, consisting of the cutoff and interior core, was constructed with soils classifying as SM and MH. Section No. 2 (the upstream slope and crest) was constructed with SM and ML materials, while Section No. 3 (the downstream slope) was constructed with SM materials. All fill materials were excavated from select borrow areas. Materials in all three sections were to be compacted to 95% of maximum dry density in accordance with ASTM Standard D-698 (Standard Proctor). Compacted densities and shear strength values for the embankment

materials are summarized on page 2 of Appendix V. Specifications for maximum lift thickness and maximum rock sizes were not observed in the design data provided.

No one-dimensional consolidation test was performed, however, the SCS soils mechanics laboratory estimated from the consolidation phase of the shear tests that at least 6% settlement would be expected or an average of 3% based on fill height.

6.2.2 Subdrains and Seepage: In attempt to control seepage, a cutoff was constructed to "firm bedrock" below the more permeable alluvial soils in the floodplain and extending into the abutments. The bottom of the cutoff trench is 12 ft wide and side slopes are 1H:1V. An internal drainage system was also constructed, consisting of approximately 140 ft of 6 inch perforated bituminous coated corrugated metal pipe enclosed in an envelope of graded drain fill of variable depth. Drainage pipes were provided for transmitting the collected water to the plunge pool. Details are presented on Plate 4 of Appendix I. During the field inspection, it could not be determined if the drains were functioning properly because the drain inverts were slightly below the discharge pool level. In attempt to prevent piping around the principal spillway pipe, 8 anti-seep collars were included as shown on Plate 5 of Appendix I.

6.2.3 Stability: A stability analysis was performed for this structure and the report describing the engineering design data used is included as Appendix V. These data were reviewed along with the stability analysis and were found to be acceptable. The factor of safety of the upstream slope for the full drawdown condition is 1.28 as given in Appendix V. Reference 1, Appendix VI recommends a factor of safety of 1.2.

The factor of safety for the downstream slope is indicated to be 1.43. The required factor of safety is 1.5 according to Reference 1. The design report stated, "An analysis of a 50 ft embankment, with the shear strength found in these embankment tests and one from Site 5 show acceptable safety factors for the proposed slopes."

The dam is 52 ft high and has a crest width of 12 ft. "As built" drawings show a crest width of 17 ft. The upstream slope is 2.5H:1V with a 10 ft wide berm at pool level between elevations 782.7 and 783.7 msl. The upstream slope then continues at a 3H:1V slope below normal pool. The downstream slope is 2.5H:1V. The dam is subjected to a sudden draw - down since the lake level can be drawn down at a rate of 18 ft/day. This exceeds the critical rate of 0.5 ft per day for earth dams.

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

6.3 Evaluation: Based upon the visual inspection and the design report, the foundation is considered sound. The factor of safety for the upstream slope during the drawdown condition meets the U. S. Army, Corps of Engineers guidelines. Although the factor of safety of 1.43 calculated for the downstream slope under steady seepage condition is slightly less than the 1.5 factor of safety recommended in Reference 1, Appendix VI, this difference is considered minor, particularly in lieu of the performance history of this structure.

Overtopping is considered detrimental to the dam with respect to erosion because of the depth and duration of flood and also the velocity is greater than 6 fps, the effective eroding velocity for a vegetated earth embankment. Furthermore, the embankment crest appears to be 5 ft narrower than shown on the "as built" drawings.

Since no undue settlement, cracking or sloughing was noted at the time of inspection, it appears that the embankment is adequate for maximum control storage with water at elevation 782.5 msl.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment: Sufficient engineering data is available for assessing the dam. The visual inspection revealed no findings that proved the dam to be unsound. There is an annual inspection and maintenance program for this structure, but there is no emergency operation and warning plan. Overall, the dam was in excellent condition at the time of inspection. U. S. Army, Corps of Engineers guidelines indicate the appropriate Spillway Design Flood (SDF) for this dam is the ½ PMF. The spillway will pass 30 percent of the PMF (60 percent of the SDF) without overtopping the crest of the dam. Flows overtopping the dam at a maximum velocity of 7.4 fps during the SDF are considered detrimental to the embankment with respect to erosion. A dam breach during the SDF would significantly increase the hazard to loss of life downstream of the dam over that which would exist just before overtopping failure. The spillway is judged seriously inadequate. Review of available stability data indicates the structure is stable as designed. Field measurements indicate the embankment crest is 5 ft narrower than shown on "as built" drawings.

Due to the inadequacy of the spillway and the resulting overtopping of the dam during the SDF, and also the narrow crest width, the potential for a breach of the dam exists. Based upon the possibility of a dam breach caused by overtopping during the SDF, the dam is assessed "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.

7.2 Recommended Remedial Measures: A qualified engineering firm should be retained to perform a detailed hydrologic/hydraulic analysis of the downstream damage reach with a dam breach simulation. The owner is required to engage the services of a qualified engineering firm within two months of the issuance of the approved Phase I inspection report. The owner is required to have the consultant's report and to have reached an agreement with the Commonwealth of Virginia regarding required remedial measures within six months of the date of the issuance of the approved Phase I inspection report.

7.3 Required Maintenance: A formal emergency procedure should be prepared and furnished to all operating personnel. This should include how to operate the dam during an emergency, and who to notify including public officials, in case evacuation from the downstream area is necessary. In the interim the dam and reservoir should still be monitored during periods of heavy precipitation and runoff. Also, the inspection revealed the following maintenance items that should be scheduled by the owner during a regular maintenace period within the next 12 months:

a) All brush growing on the embankment should be cut to the ground and removed from the embankment.

b) The area of sloughing in the right abutment should be stabilized.

c) The minor sloughing located above the outlet works should be monitored during maintenance. If increased erosion should occur, this area should be stabilized by backfilling and reseeding.

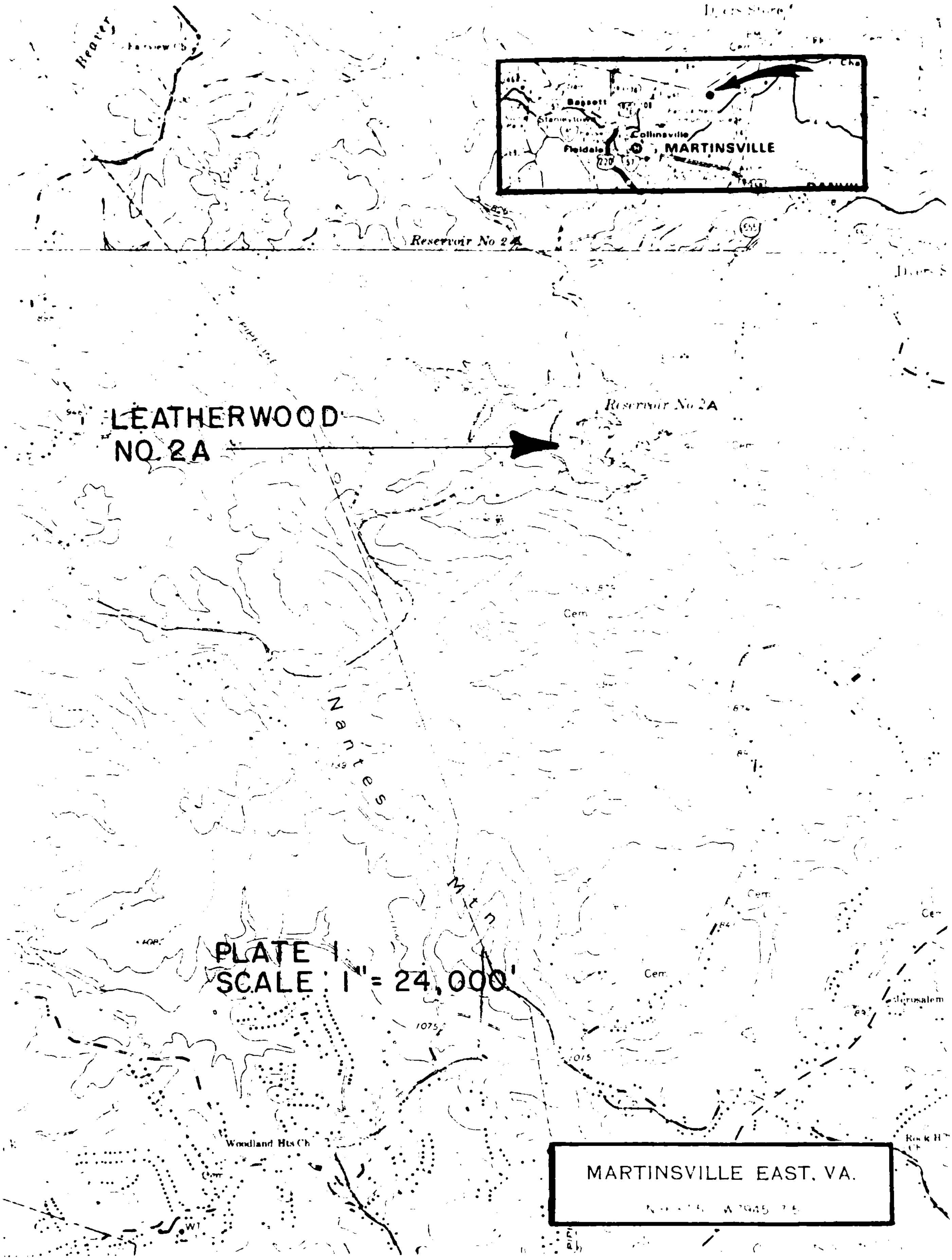
d) Debris should be removed from the trash rack.

e) The broken bar on the trash rack should be repaired.

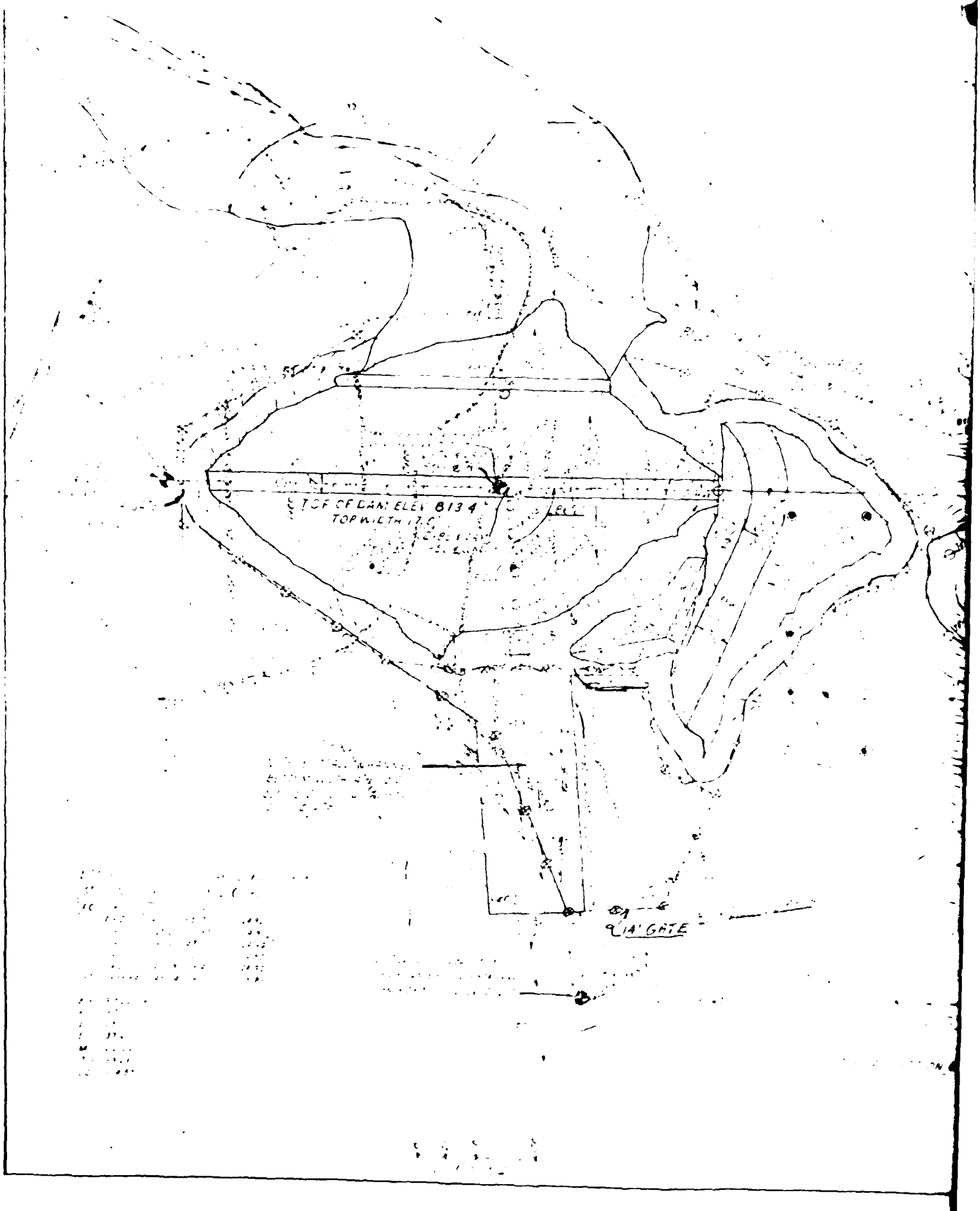
f) A staff gage should be installed to monitor water levels.

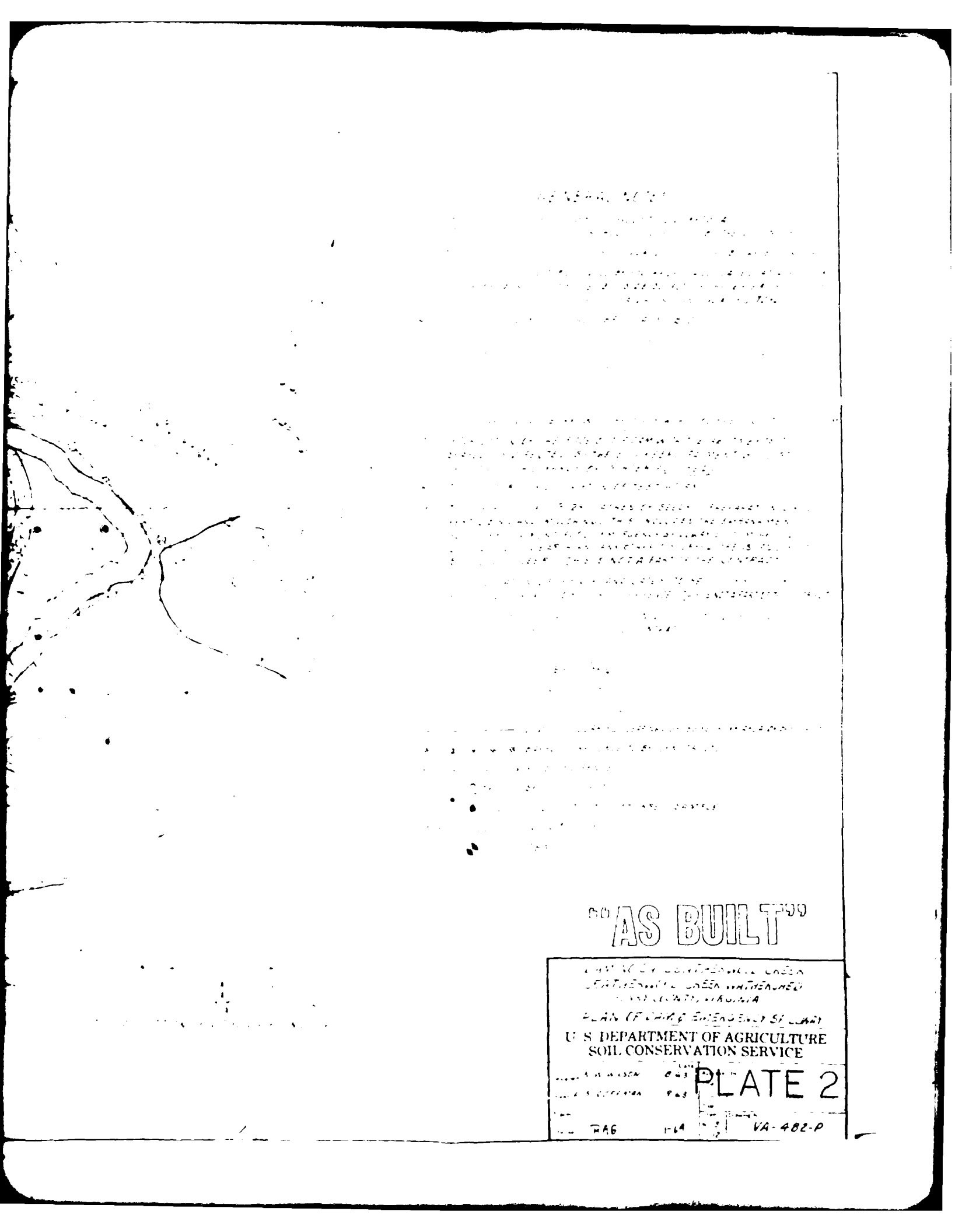
APPENDIX I

MAPS AND DRAWINGS



Beaver
Bassett
Collinsville
Fieldale
MARTINSVILLE
Reservoir No 2A
LEATHERWOOD
NO. 2A
Reservoir No 2A
Cem
Nantes Mtn
Cem
Cem
Cem
Jerusalem
PLATE 1
SCALE 1" = 24,000'
1075
1075
Woodland Hts Ch
MARTINSVILLE EAST, VA.


TOP OF DAM ELEV 813.4'
TOP WIDTH 17.0'
14' GATE

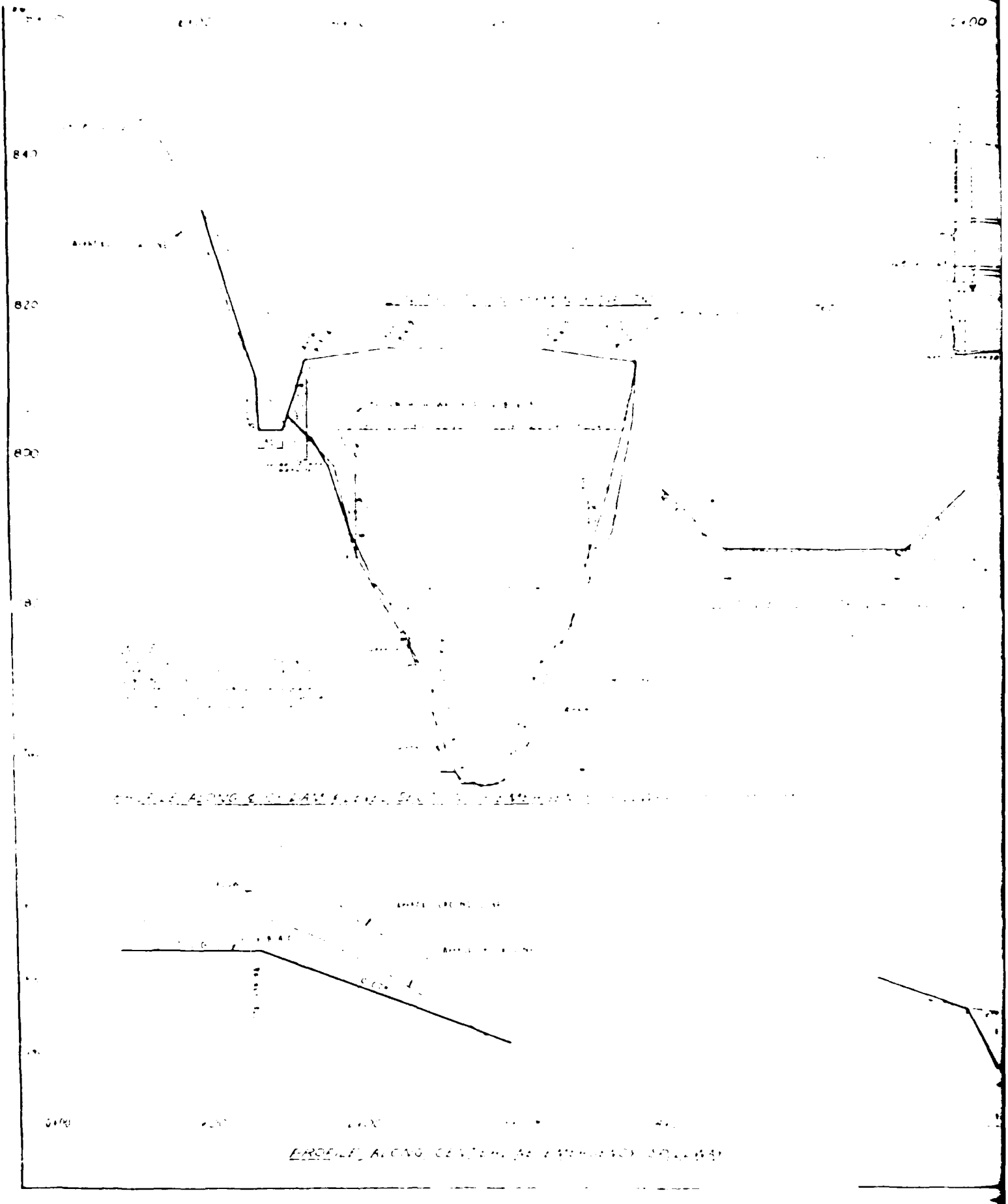


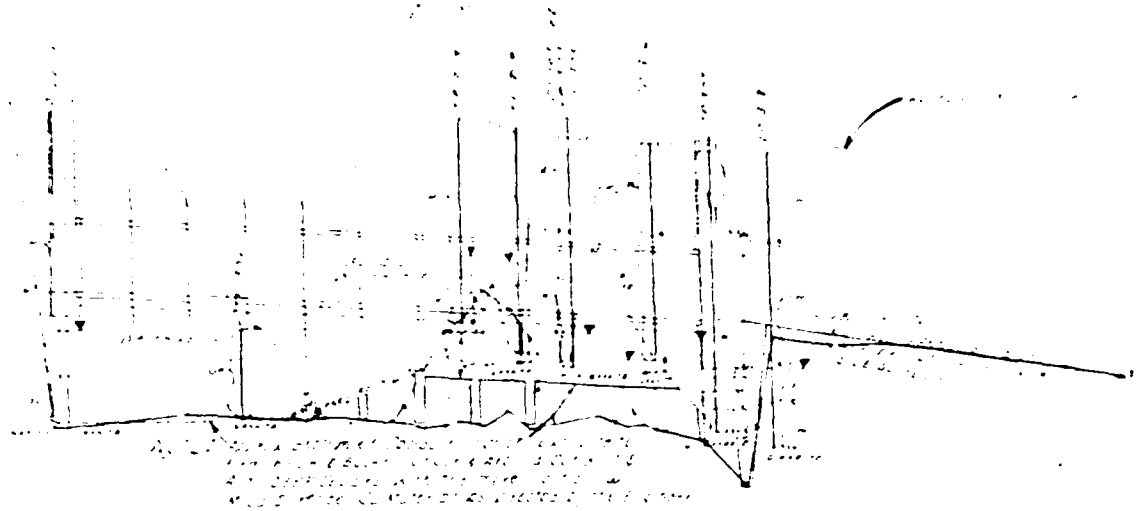
"AS BUILT"

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

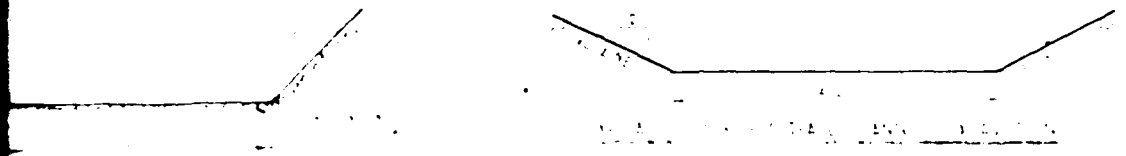
PLATE 2

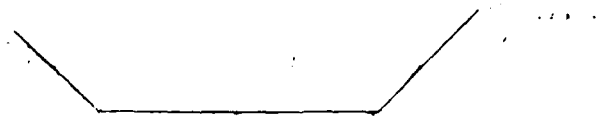
VA-482-P

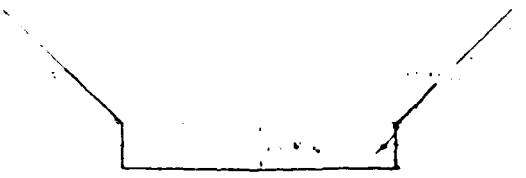




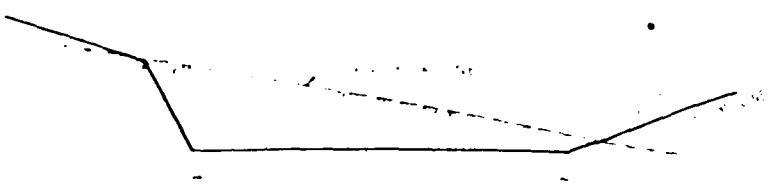
PROFILE ALONG CENTERLINE OF PRINCIPAL SPILLWAY







"AS BUILT"

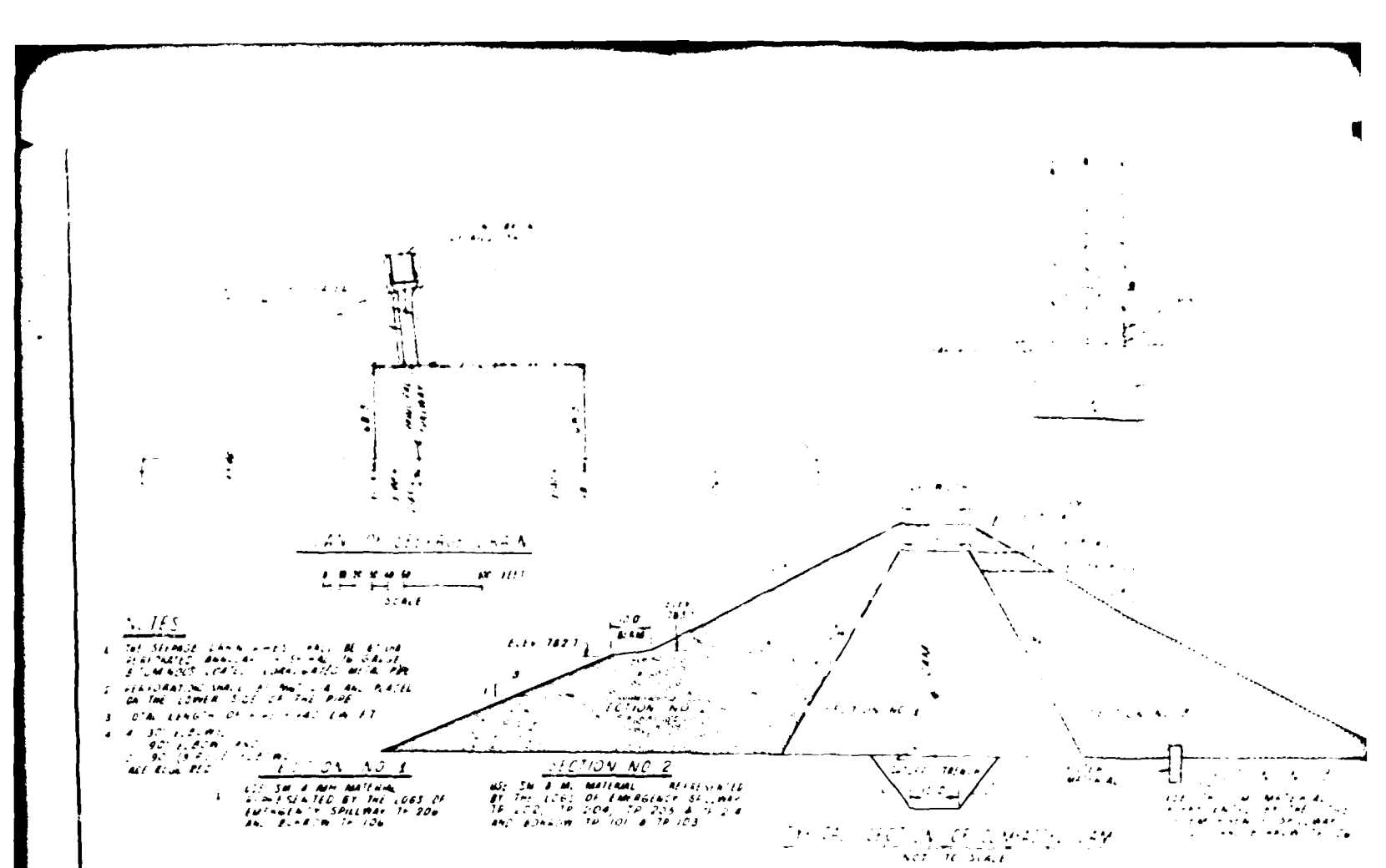


DAM NO 2A LEATHERWOOD CREEK
LEATHERWOOD CREEK WATERSHED

PROFILES

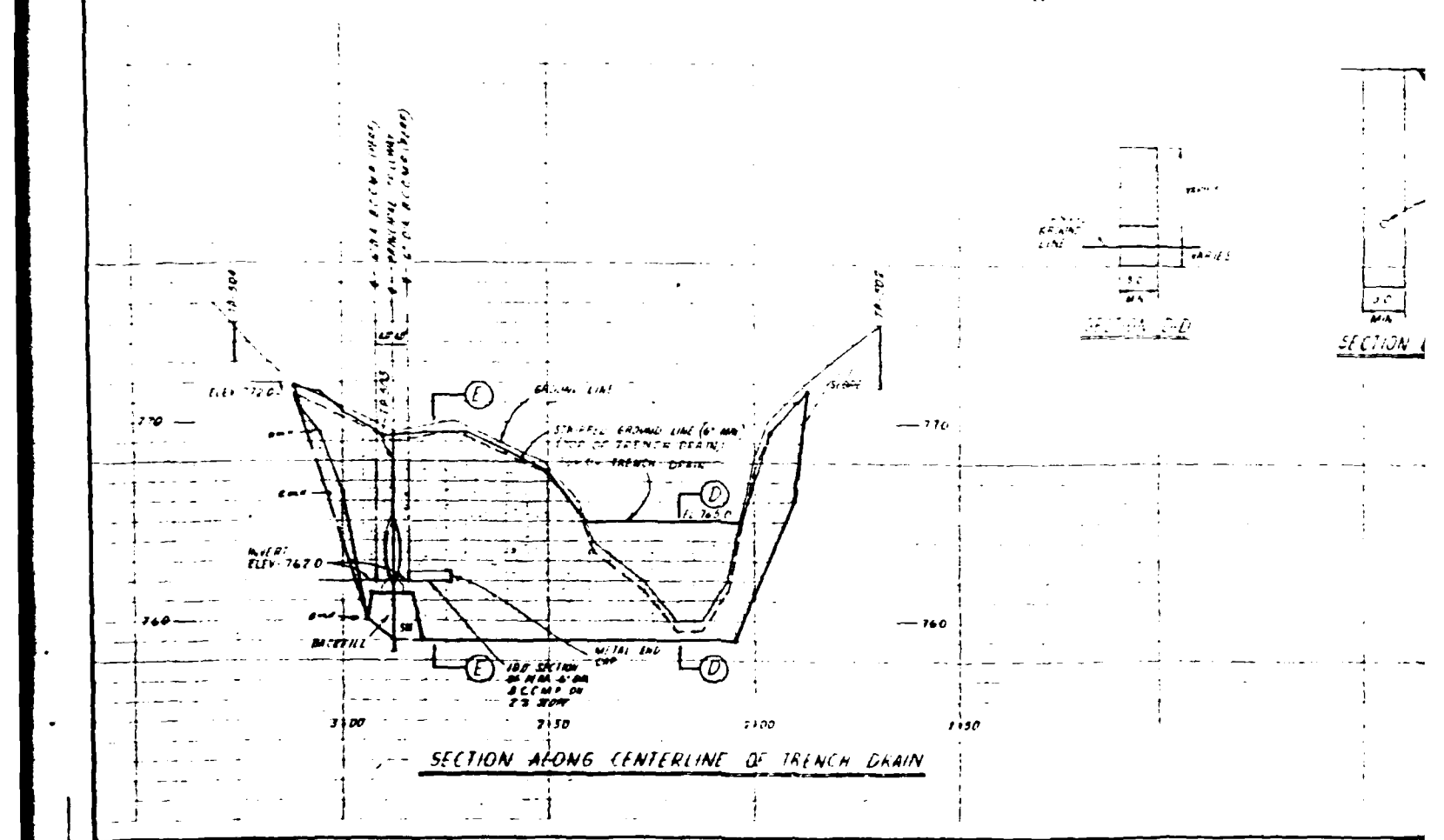
U S DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

PLATE 3

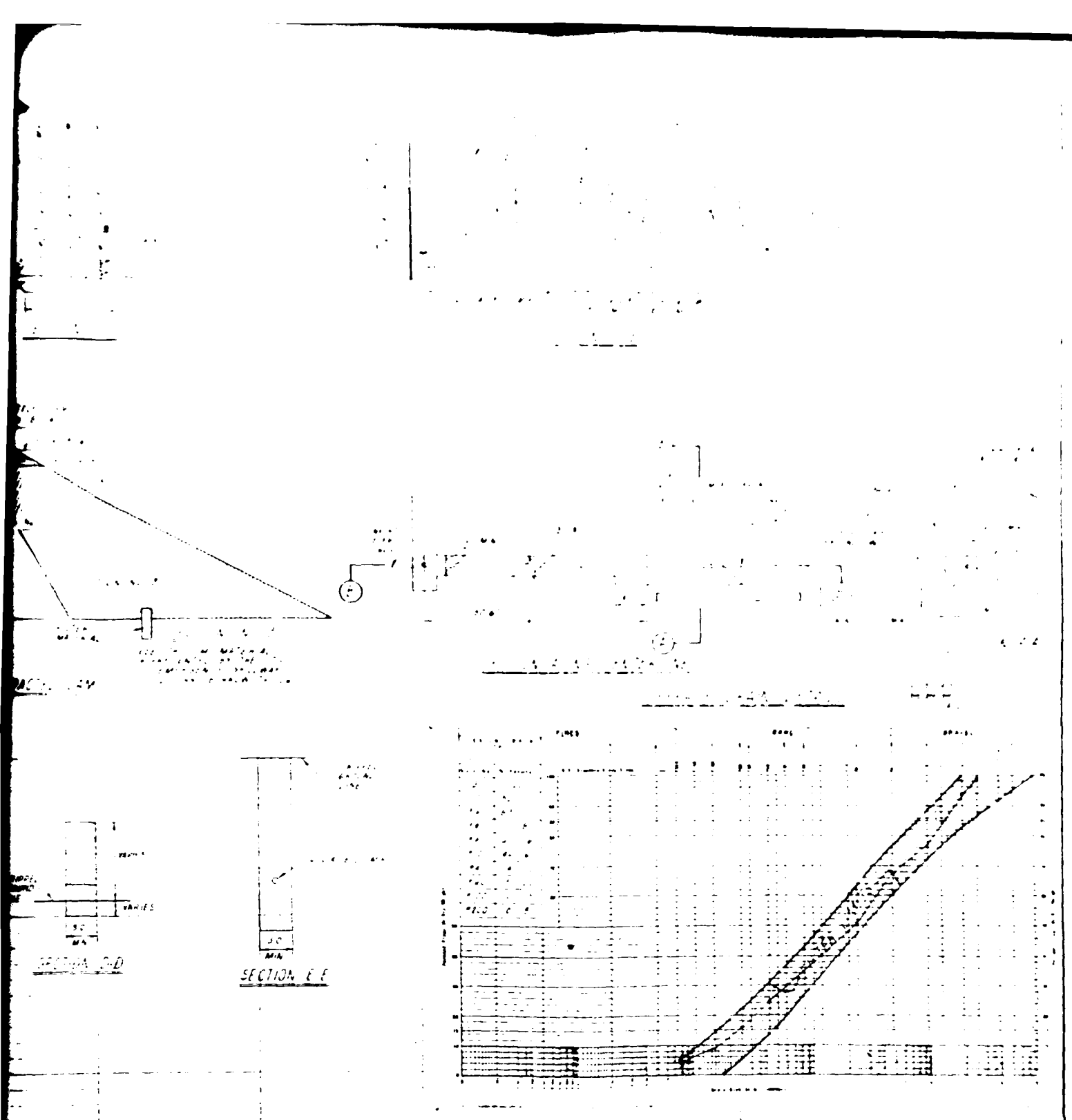


SECTION NO 1

SECTION NO 2



SECTION ALONG CENTERLINE OF TRENCH DRAIN



"As Built"

DAM NO 2A LEATHERWOOD CREEK
LEATHERWOOD CREEK WATERSHED
HENRY COUNTY, VIRGINIA

SEEPAGE DRAIN DETAILS

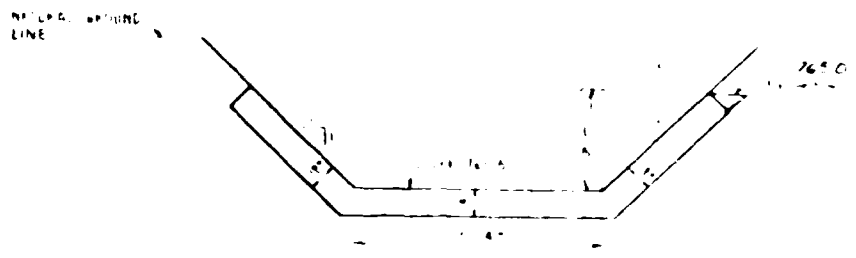
U.S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

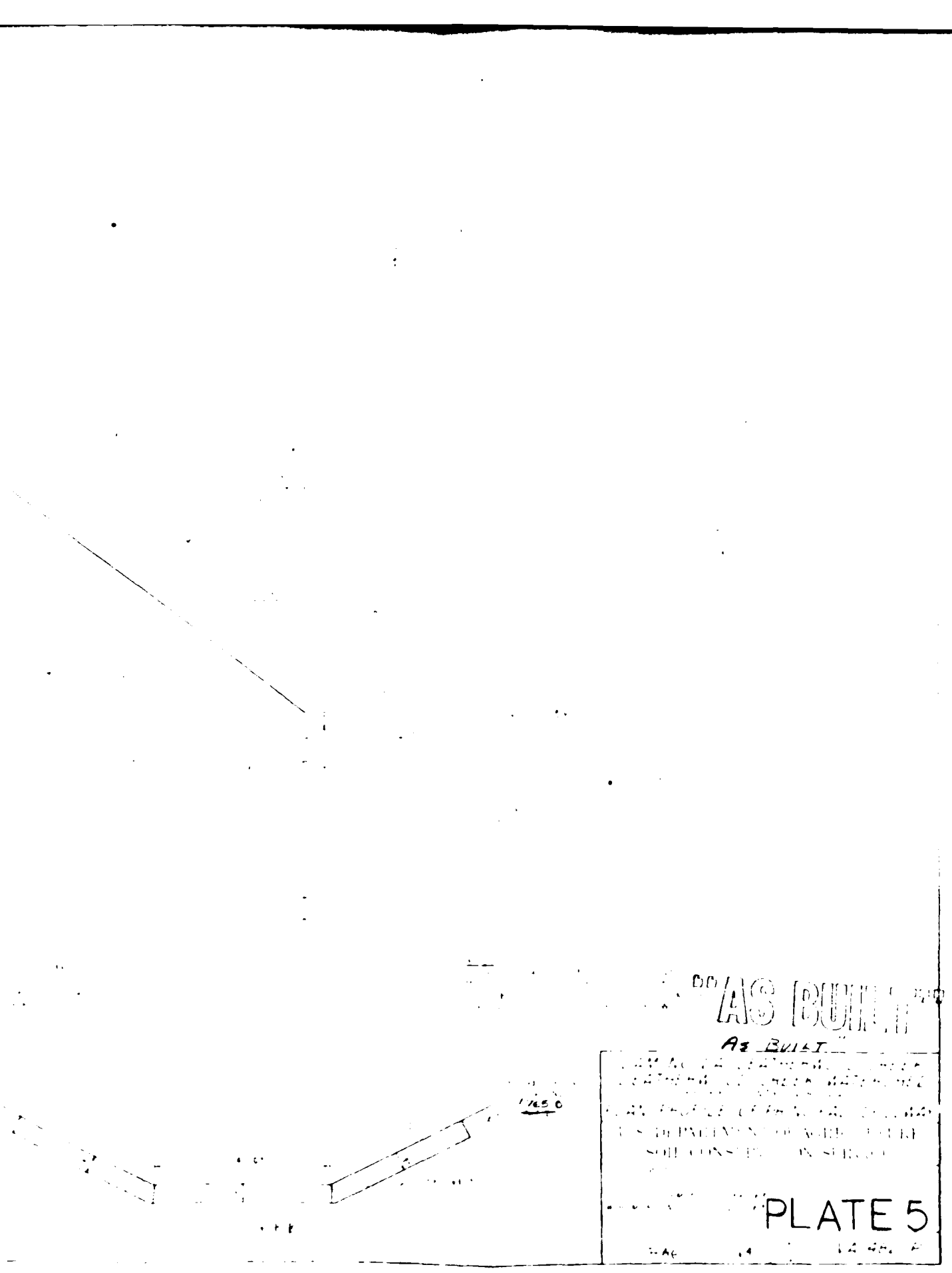
J.M. Zuelke 12/63
C.B. Ford 12-63

PLATE 4

VA-482-P

"AS BUILT"




AS BUILT
AS BUILT
PLATE 5

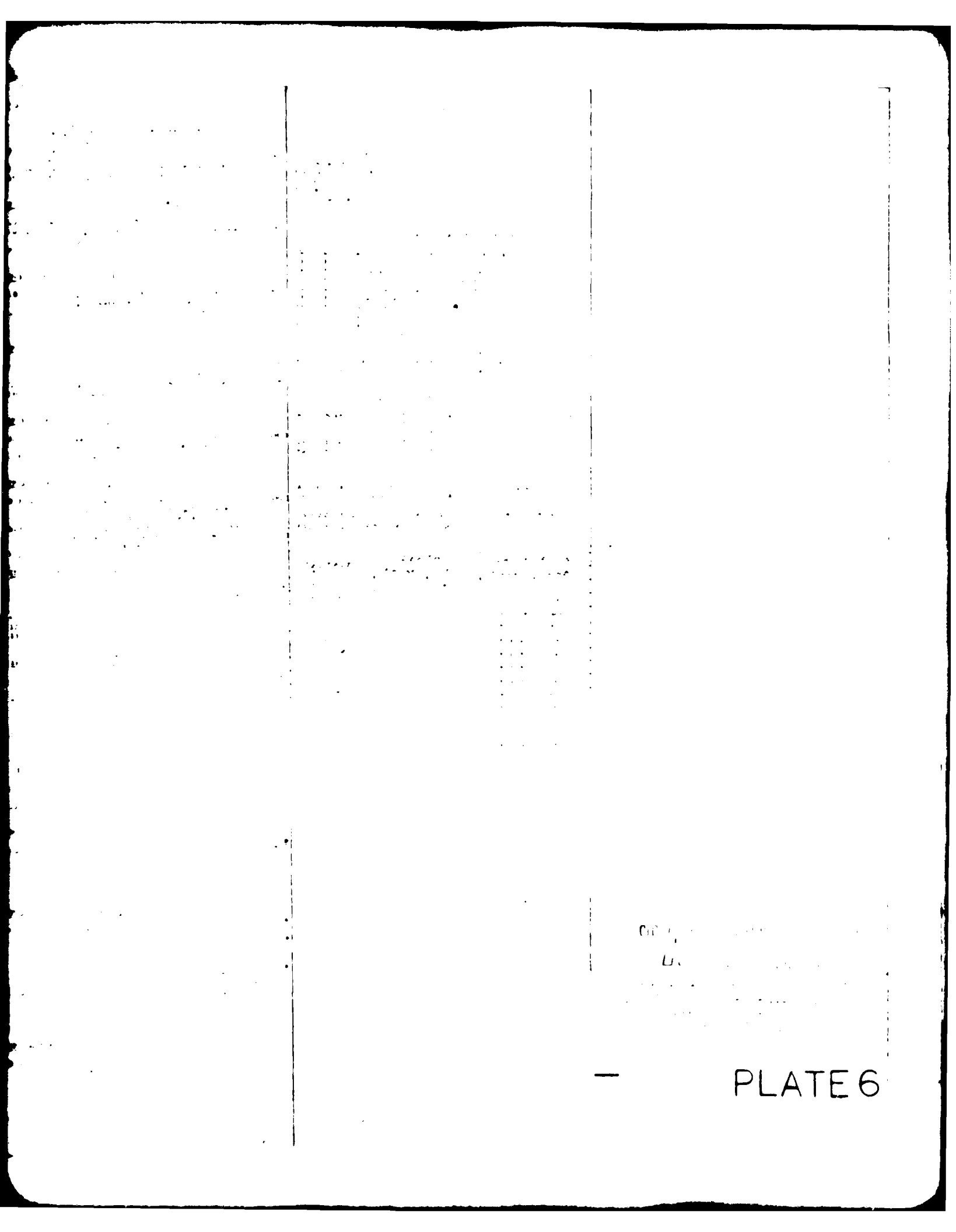
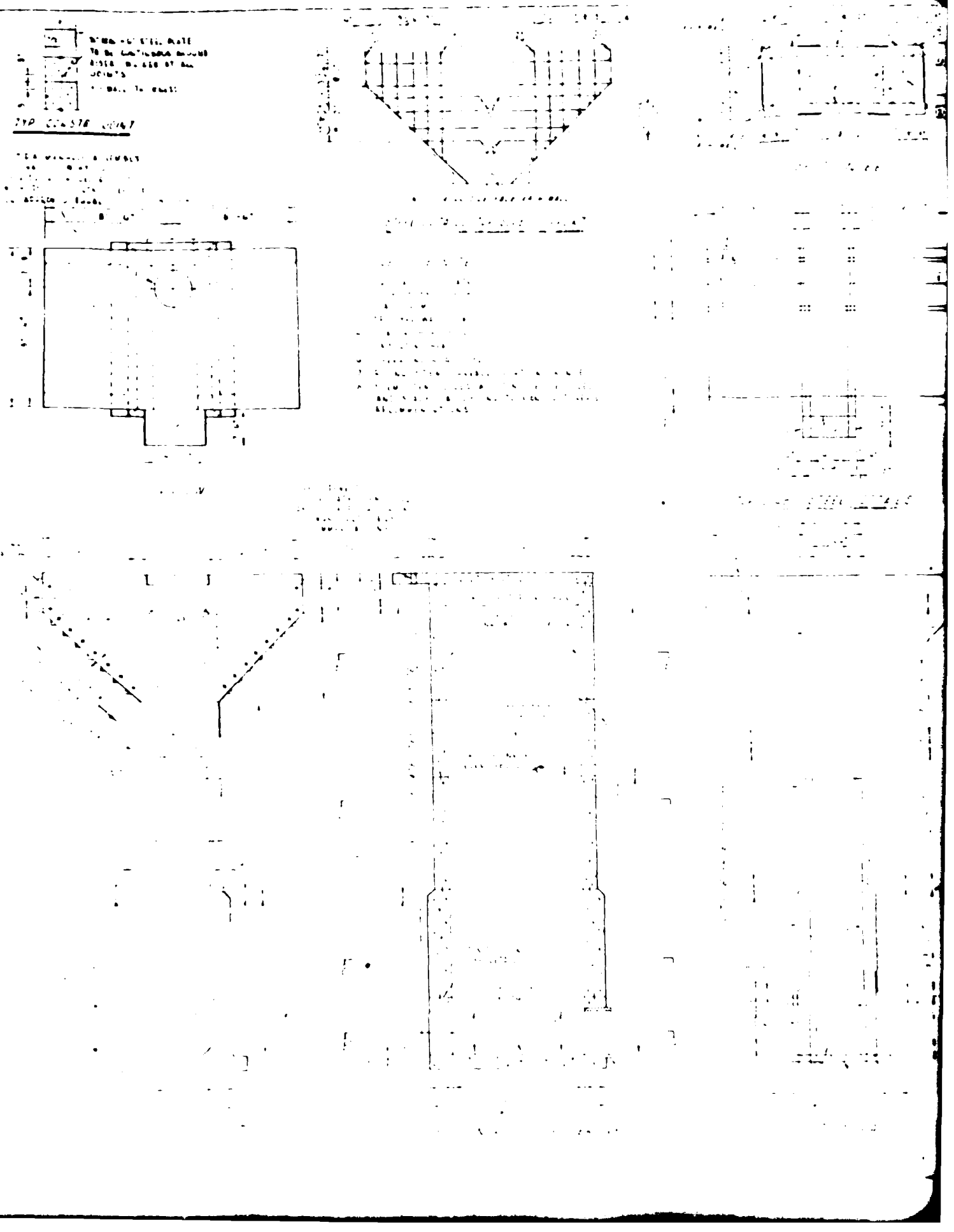
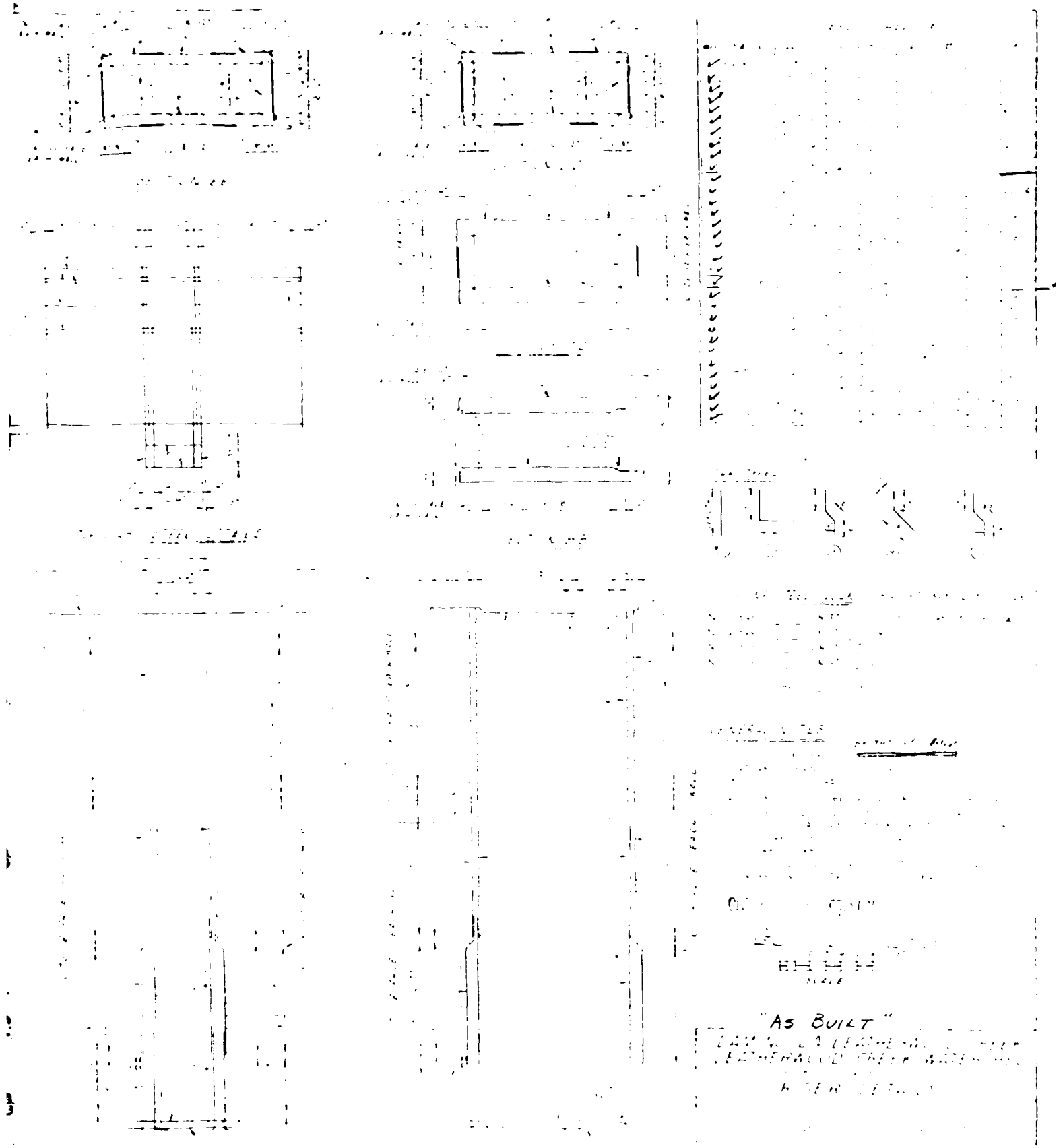


PLATE 6





"AS BUILT"

PLATE 7

APPENDIX II

PHOTOGRAPHS

Photograph No. 2 - Downstream Slope

[illegible] Spillway

APPENDIX III

FIELD OBSERVATIONS

Check List
Visual Inspection
Phase I

Name Dam Leatherwood No. 2A County Henry State Virginia Coordinates Lat 36°-44.3' Long 79°-48.6'

Date(s) Inspection July 1, 1981 Weather Partly Cloudy Temperature 72°F

Pool Elevation at Time of Inspection 782.5 msl Tailwater at Time of Inspection 761.5 msl

Inspection Personnel:

Schnabel Engineering Associates, P.C.
James J. Seli
Stephen G. Werner
Raymond A. DeStephen, P.E.*

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

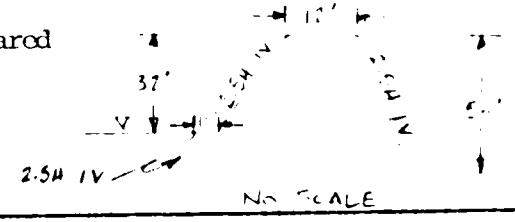
Recorders
Stephen G. Werner
Steve Oddi

State Water Control Board
Leon Musselwhite

Owner
Thomas F. Walker

* Not present during this inspection, but visited site on August 17, 1981.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	Scattered shrinkage cracks were observed on the embankment; particularly near the right abutment. They were generally "pencil mark" in width and are the result of drought conditions. Ground conditions were dry at the time of the inspection.	No problem.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	No unusual movements were noted on the dam or beyond the downstream toe.	-
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	A very small area of sloughing was noted on the downstream slope directly above the outlet works. The right abutment has an area of sloughing located 15 ft± below the crest of the dam. The area is 15 ft± long and 5 ft± high. This area is bare and has experienced some washing. It is in the abutment and does not create any problem.	-
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	The vertical and horizontal alignment of the dam appeared to be good. Note adjacent field measurements.	
RIPRAP FAILURES	There was no riprap on the upstream slope. Riprap consisting of 1 to 2 ft± granite blocks was located below the discharge section at the end of the energy dissipator. The riprap was functioning properly and appeared to be in good condition.	-

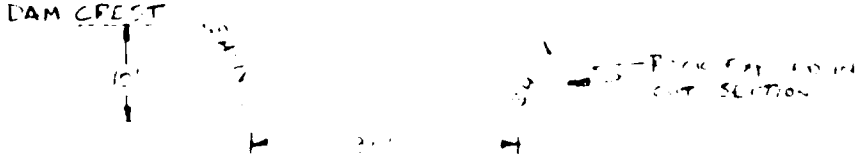
EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Both ends of the embankment tie in properly with the abutments. The right abutment is vegetated and includes numerous outcrops downstream. The emergency spillway occupies the left abutment.	-
ANY NOTICEABLE SEEPAGE	No seepage was encountered. The downstream toe is dry.	-
DRAINS	Two 6 inch cope drains with 5 reinforcing bars over each end exist on the left and right sides of the energy dissipater. Iron staining was noted at the end of the pipes, but couldn't tell if there was flow since the pipe invert was below the stilling basin pool level.	-
MATERIALS	The embankment surface consists of light brown to red fine to medium sandy silt with mica (ML). Includes scattered gravel and small boulders less than 1 ft long.	-
VEGETATION	The embankment is grassed and is well maintained. Cattle are allowed to graze on the embankment. Scattered patches of brush (1" - 2" diameter) are growing 5 to 10 ft^{+} above pool level on the upstream slope to the right of the intake structure. A few small bushes and weeds also occur on the downstream slope.	The brush should be removed.

PRINCIPAL SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
CONTROL SECTIONS	Concrete riser type structure with low level orifice and high level weir. In good condition but 1 bar is broken on the trash rack. There was some debris present in the low flow intake trash rack.	The debris should be removed from the trash rack and the broken bar on the rack should be repaired.
APPROACH CHANNEL	-	-
DISCHARGE CHANNEL	13 ft wide energy dissipater. The plunge pool is lined with riprap. The outlet is a 36 inch concrete pipe.	-
BRIDGE AND PIERS	-	-
EMERGENCY GATE	-	-
GATES AND OPERATION	Has a crank drain valve, which according to the owner, has never been used.	-

EMERGENCY SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONTROL SECTIONS	The left side of the control section contains slightly to highly weathered Leatherwood Granite, same as described below. Gneissic portion has foliation strike of N85E and vertical dip.	-
APPROACH CHANNEL	The basal 15 ft± of the approach channel includes large flat outcrops of Leatherwood Granite. It includes slightly weathered, gray coarse - grained granite with xenoliths and flow banding.	-
DISCHARGE CHANNEL		-
BRIDGE AND PIERS		
MISCELLANEOUS	DAM CREST 	Good vegetation. No erosion.

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATION
MONUMENTATION/SURVEYS	Good	-
OBSERVATION WELLS	Good	-
WELLS	Good	-
PIEZOMETERS	Good	-
STAFF GAUGES	Good	Should be installed.
OTHER		-

RESERVOIR

VISUAL EXAMINATION	OBSERVATIONS	REMARKS AND RECOMMENDATIONS
SLOPES	Shoreline appears stable - no erosion observed. 4H:1V± side slopes around the reservoir. Left side - moderate, densely wooded slopes Right side - grassed 100 - 200 ft± above the lake then wooded, moderate slopes. Scattered granite outcrops occur at pool level along the left side. The reservoir area was free of debris.	-
SEDIMENTATION	According to Mr. Walker several fishermen have commented that the lake appears to be silting up in the upper reaches. The water is very murky.	-

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	15 ft wide and 5 ft high, tree-lined. 100 ft wide flood-plain. Road crossing 500 ft downstream, 14 ft above stream bed.	n = 0.06 n = 0.05 - 0.1
SLOPES	3H:1V± side slopes. Pasture on left, n = 0.05 Woods on right, n = 0.06	-
APPROXIMATE NO. OF HOMES AND POPULATION	Approximately 2 miles downstream there is a dwelling 15 ft± above the stream channel. Approximately 5 miles downstream there are several dwellings 10 ft± above the channel and several commercial facilities 15 ft± above the channel.	-

CHECK LIST

ENGINEERING DATA

DESIGN, CONSTRUCTION, OPERATION

ITEM		REMARKS
REGIONAL VICINITY MAP	Martinsville East 7½ minute topographic map (U.S.G.S.)	-
DESIGN/CONSTRUCTION HISTORY	Designed by USDA SCS. Constructed by Curtis S. Horton and completed in 1964.	-
PLAN OF DAM	See Appendix I	-
TYPICAL SECTIONS OF DAM	See Appendix I	-
OUTLETS - PLAN DETAILS CONSTRAINTS DISCHARGE RATINGS	See Appendix I	-
SPILLWAY- PLAN SECTION DETAILS	See Appendix I	-
OPERATING EQUIPMENT - PLAN DETAILS	See Appendix I	-

ITEM		REMARKS
MONITORING SYSTEMS	None	-
RAINFALL/RESERVOIR HIGHPOOL RECORDS	None	-
GEOLOGY REPORTS	See Appendix IV and Reference 3, Appendix VI	-
BORROW SOURCES	See Appendix I	-
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY-FIELD TEST DATA	See Appendix I	-
HYDROLOGIC/HYDRAULIC DATA	Design data available at USDA, SCS offices in Richmond, Virginia	-

ITEM		REMARKS
DESIGN REPORTS	Summary included as Appendix IV. Complete Design Report available at USDA, SCS office in Richmond, Virginia	-
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Available at USDA, SCS office in Richmond, Virginia	-
POST CONSTRUCTION ENGINEERING STUDIES RECORDS, SURVEYS	As built drawings included in Appendix I	-
MODIFICATIONS	None	-
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None	-
MAINTENANCE OPERATION RECORDS	None	-

APPENDIX IV

DESIGN REPORT

[illegible]
[illegible]
[illegible] PROTECTION PROJECT
[illegible]
[illegible], VIRGINIA

This floodwater retarding [illegible] is located on the West Fork of Leatherwood Creek approximately 3-1/2 miles west of Leatherwood, Virginia. Sheet 4 of this report, together with the Martinsville, Virginia-North Carolina 15-minute quadrangle published by the U.S. Geological Survey, may be used to locate the structure.

A summary of pertinent design information is given on sheet 2 of this report.

Criteria and procedures used in this design are given in the following Soil Conservation Service publications:

National Engineering Memorandum No. 27, Limiting Criteria for the Design of Earth Dams
National Engineering Memorandum No. 42, Reinforced Concrete Pipe Drop Inlet Barrels
National Engineering Handbook No. 4, Hydrology
National Engineering Handbook No. 5, Hydraulics
National Engineering Handbook No. 6, Structural Design
Engineering Division Technical Release No. 2, Earth Spillways
Engineering Division Technical Release No. 5, Structural Design of Underground Conduits
Engineering Division Technical Release No. 10, Storage--Floodwater Retarding Structures
Engineering Division Technical Release No. 12, Procedure for Computing Sediment Requirements for Retarding Reservoirs
Engineering Division Technical Release No. 16, Joint Gap Computation for Reinforced Concrete Pipe Drop Inlet Barrels

This is one of five flood retention structures designed to reduce flooding in the Leatherwood valley. It will retard a 50-year frequency storm without discharge occurring in the emergency spillway.

The results of hydrologic and hydraulic computations are given on sheet 3 of this report.

The structure consists of a compacted earth fill with a cutoff through alluvial sand in the foundation. A drainage system is located under the downstream portion of the earth fill to collect seepage.

The principal spillway is a drop inlet structure consisting of a reinforced concrete riser, 36-inch diameter concrete water pipe, and a Bradley Porterkin impact basin to dissipate energy at the outlet end of the conduit.

The emergency spillway is designed as an earth and rock cut in the left abutment with the control section on Leatherwood Granite.

I. Watershed data

A. Structure class. (Refer to Engineering [illegible]) (c)

B. Drainage area A.

C. Time of concentration - [illegible] hrs.

D. Hydrologic curve number - [illegible]

1. Moisture condition II 77

2. Moisture condition III 93.5

II. Principal spillway

A. Conduit

1. Size (dia.) 24" In.

2. Length [illegible] Ft.

B. Riser

1. Size 24" Ft.

2. Height 1.0 Ft.

C. Weir length 12.0 Ft.

D. Orifice size 2 1/2" In.

E. Pond drain size 2" In.

F. Type of energy dissipator - concrete impact basin

III. Emergency spillway

A. Width 60 Ft.

B. Side slopes-1/2:1 in rock, 3:1 in soil

C. Length of level section 25 Ft.

D. Exit slope [illegible] Ft./Ft.

E. Maximum velocity at control section (P.M.F.) [illegible] Ft./Sec.

F. Duration of flow (P.M.F.) through emergency spillway [illegible] hrs.

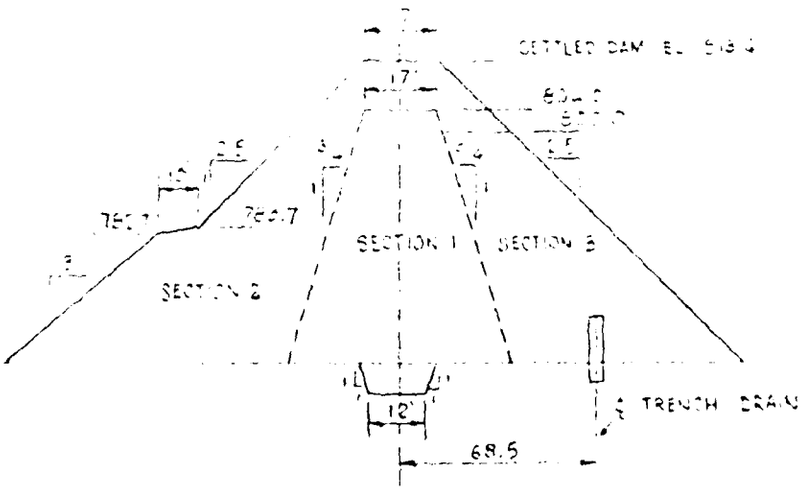
G. Frequency of use Once in [illegible] years

IV. Earth fill

A. Height [illegible] Ft.

B. Volume [illegible] Cu. Yds.

C. Compaction Specify [illegible]



Typical Cross Section

ENGINEERING & WATERSHED PLANNING UNIT, UPPER DARBY, PA

Sheet [illegible]

J. Thomas 24

U S DEPARTMENT OF AGRICULTURE – SOIL CONSERVATION SERVICE

Element of Structure	Determining Factor	Elevation	Surface Area Acres	Storage		Inflow		Peak Outflow c.f.s.
				Acre-Feet	Inches*	Volume Inches*	Rate c.f.s.	
Invert of orifice	50-year sediment accumulation	782.0	20.4	12[1]	-	-	-	-
Crest of riser	1 inch of runoff	794.0[3]	40.3	346[2]	1.06	-	-	[illegible]
Crest of emergency spillway	50-year frequency storm, moisture condition II	804.0[3]	67.2	882[2]	2.69	-	-	1[illegible]
Design high water	0.[illegible] X 6-hour point rainfall, moisture condition II	[illegible]6.5	74.5	9[illegible][2]	2.84	5.83	2,63[illegible]	45[illegible]
Top of dam	1.[illegible] X 6-hour point rainfall, moisture condition II	813.4	-	1,45[illegible][2]	4.44	8.02	5,455	[illegible],000

*Inches of runoff from controlled area of [illegible] acres.
Time required to empty flood storage is [illegible] days.

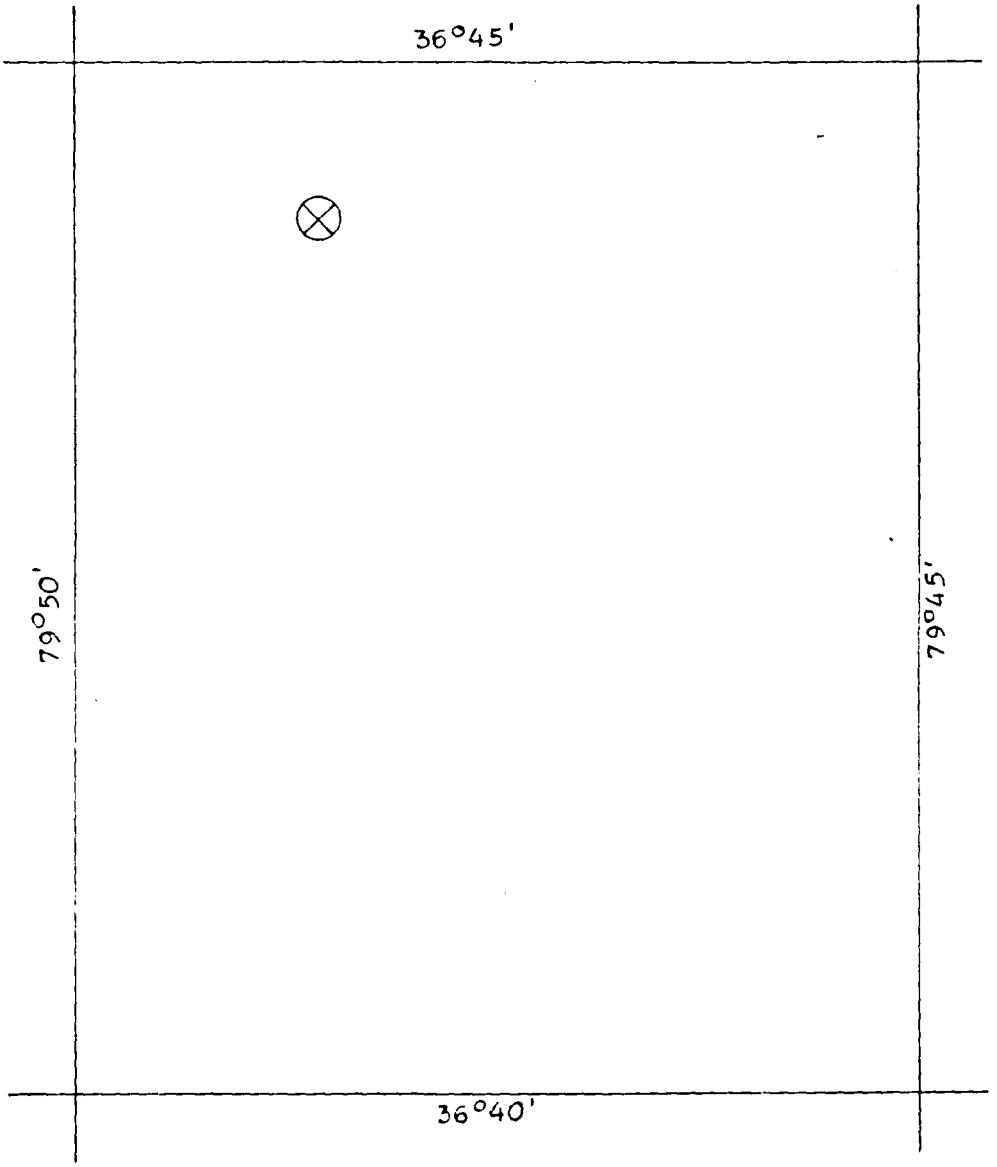
1/ Does not include 14 acre-feet of sediment allocated to flood pool.
2/ Does not include storage allocated to sediment.
3/ Established by procedure described in technical release No. 10.

ENGINEERING & WATERSHED PLANNING UNIT, UPPER DARBY, PA

Sheet 5

U S DEPARTMENT OF AGRICULTURE - SOIL CONSERVATION SERVICE

LEATHERWOOD CREEK WATERSHED PROTECTION PROJECT
SITE NO. 2A
VA-482
HENRY COUNTY, VIRGINIA



Reference

MARTINSVILLE, VA-NC
15' QUAD
1947

ENGINEERING & WATERSHED PLANNING UNIT, UPPER DARBY, PA

Sheet 4

Reports concerning soil engineering tests and the geologic conditions at this site are included in this design folder.

Copies of the publications referred to in this report may be obtained from Mr. Tom F. McGourin, State Conservationist, USDA, Soil Conservation Service, Richmond, Virginia.

Concurred:

Stanley C Rossiter for

Gerald E. Oman
Design Engineer

R. C. Barnes, Jr.
State Conservation Engineer

Joseph W. Kreber for

Vincent McKeever
Hydrologist

Robert F. Fonner

Robert F. Fonner
Geologist

Sheet 1 of 3

UNITED STATES DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

12-53

DETAILED GEOLOGIC INVESTIGATION OF DAM SITES

GENERAL

State Virginia County Henry - ¼ - ¼ Sec - T - R - Watershed Leatherwood Creek

Subwatershed - Fund class FP-68 (FP 2 WF 1, etc.) Site number 24 Site group I Structure class c

Investigated by L.A. Gorman, Geologist (signature and title) Equipment used Case backhoe (Type, size, make, model, etc.) Date 4/63

T. Mack, Soil Scientist

SITE DATA

Drainage area size 6.14 sq. mi. 3929 acres Type of structure Earth Fill Purpose Flood Prevention

Direction of valley trend (downstream) ESE Maximum height of fill 49.7 feet. Length of fill 355 fee

Estimated volume of compacted fill required 47,201 cubic yards

STORAGE ALLOCATION

	Volume (ac. ft.)	Surface Area (acres)	Depth at Dam (feet)
Sediment	124	20.4	14
Floodwater	850	66.0	33

SURFACE GEOLOGY AND PHYSIOGRAPHY

Physiographic description Piedmont Province Topography rolling Attitude of beds Dip none Strike none

Steepness of abutments Left 37 percent Right 35 percent Width of floodplain at centerline of dam 170 fe

General geology of site The site is underlain by Leatherwood granite which is of Paleozoic age. In this area this formation is a syenite. Minerals in this syenite are feldspar, biotite muscovite, and some quartz. As outcrops of a migmatite occur northeast of the dam site, there appears to have been lit-par-lit action present. These outcrops are scattered which shows that the interspersing of igneous and metamorphic rocks is fine. Minerals present in the injection gneiss are feldspar, hornblende and garnet. Deeply weathered areas that contain a high content of phlogopite, and sericite mica are present. In other areas the residual soil is extremely shallow.

The west fork of Leatherwood Creek flows through a comparatively narrow stream valley at the dam site. The floodplain here is filled with recent stream alluvium which is unconsolidated SM with some ML. The stream channel is slowly degrading. This process is retarded by colluvial material moving into the stream channel from the adjacent hillsides. This stream flows in a strongly entrenched dendritic pattern. The topography has reached early maturity.

Centerline -

The right and left abutments of the dam centerline are underlain by syenite. On both

abutments the lower elevations (770 to 790 feet) have shallow soils with the [illegible] ranging from 2 to 6 feet below the ground surface. The higher elevations on the center-line (790 feet and above) have deeply weathered soils. Recent stream alluvium to a depth of 10 feet fills the floodplain on the centerline.

No fractures were observed in the syenite outcrops in the area of the dam centerline. This unfractured condition is characteristic of the Leatherwood granite. This formation is used for large stone monuments.

Hard unfractured rock underlies the toe drain at generally 2 to 7 feet below the original ground surface. The lower parts of both abutments have shallow soils on the centerline of the toe drain. A granite spine underlies the toe drain in the flood plain. However, this spine drops off sharply within 5 feet upstream of the toe drain.

<u>Emergency Spillway</u> -
The emergency spillway is located in the left abutment. A rockline of massive igneous rock that ranges from 2 to 11 feet below the ground surface underlies the spillway from station 1 ≠ 50 ~~to station~~ to station 3 ≠ 30. Between these stations the left side of spillway will have a rock floor. From station 3 ≠ 30 to 1 ≠ 70 deeply weathered micaceous soil underlies the spillway. In this area no rockline was found although one test pit (TP 215) was dug to depth of 17 feet.

Shallow Louisburg soil occurs on the left slope from station 1 ≠ [illegible] to 3 ≠ 30. It is red and silty with a blocky structure of [illegible] films. [illegible] and low permeability properties for this soil appear to be better than for any other soil in the spillway cut. The area [illegible] the [illegible] spillway [illegible] left slope downstream from station 3 ≠ 30 has micaceous [illegible] highly micaceous [illegible]. These soils appear elastic and hard to compact. Soil of this [illegible] also occurs on the entire length of the right slope.

A few outcrops of [illegible] were observed in the emergency spillway area. No fracture [illegible] be [illegible] the syenite.

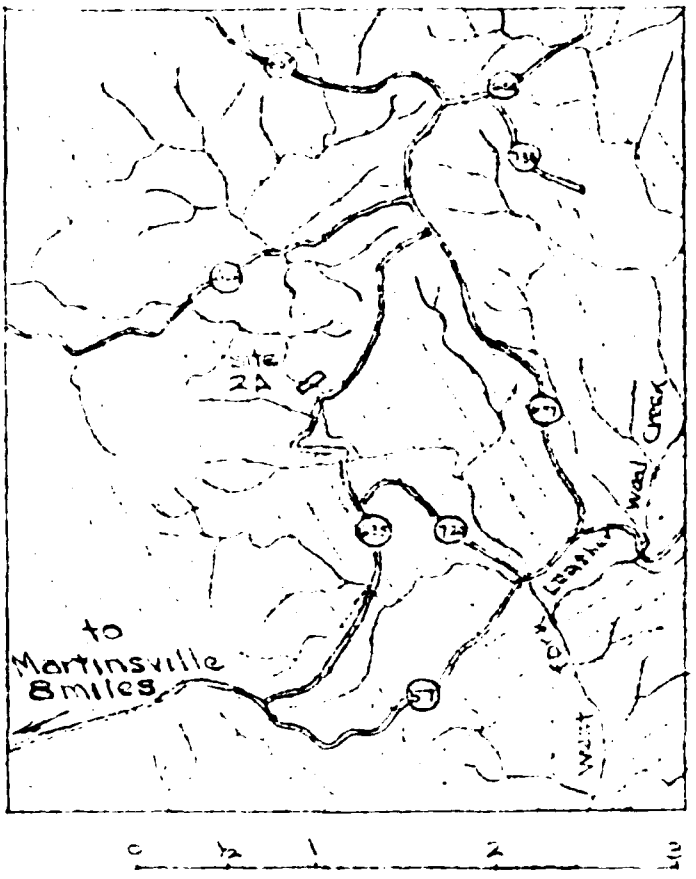
<u>Principal Spillway</u> -
Syenite underlies the centerline of the principal spillway. It is firm. [illegible] rock line ranges in depth from 5 to 14 feet below the ground surface. The deepest section is under the riser and the outlet. The closest [illegible] to the ground surface is under the toe drain. A rockline cross section is included in the plans.

The waterline ranges from 10 to 6 feet below the surface of the ground. A gray reduced zone of SC is present 7 to 12 feet below the ground surface. This zone ranges from 1 to 2 feet in thickness. It is slightly organic, wet, and unstable.

<u>Borrow Area</u> -
Two borrow areas were investigated. One is located 300 yards upstream from the dam centerline. This area is underlain by recent stream alluvium bordering both banks of the west fork of Leatherwood Creek. It is in the permanent pool area. Only the upper 5 feet of this alluvium are useable. This is the brownish oxidized zone of ML and SM that makes the Congaree soil. Below this is a dark gray reduced zone of SC that is unstable and unuseable. In wet weather this lower reduced gray zone will limit the amount of material that can be taken from the upper zone. This is due to the danger

of heavy equipment miring down in the [illegible] unstable [illegible].

The second borrow area is located [illegible] on the right [illegible]. The upper 5 to 6 feet of this soil is [illegible] construction material. [illegible] that can be used but is not [illegible] dam [illegible] material. [illegible] to the dam and has a downgrade haul.



0 ½ 1 2 3

Leatherwood granite and syenite with porphyritic microstructure

Leatherwood granite with cataclastic structure (boundary diffuse)

GEOLOGIC MAP OF THE AREA SURROUNDING SITE NO. 2A
LEATHERWOOD CREEK W/S, HENRY COUNTY, VIRGINIA

APPENDIX V

STABILITY DATA

UNITED STATES GOVERNMENT

Memorandum

TO : R. C. Barnes, State Conservation Engineer, SCS, Lincoln, Nebraska

DATE: August 27, 1963

FROM : Rey S. Decker, Head, Soil Mechanics Laboratory, SCS, Lincoln, Nebraska

SUBJECT: Virginia WP-08, Leatherwood Creek, Site No. 2-A

ATTACHMENTS

1. Form SCS-354, Soil Mechanics Laboratory Data, 2 sheets.
2. Form SCS-355, Triaxial Shear Test Data, 2 sheets.
3. Form SCS-352, Compaction and Penetration Resistance Report, 10 sheets.
4. Form SCS-353, Filter Material, 1 sheet.
5. Form SCS-357, Summary - Slope Stability Analysis, 1 sheet.
6. Form SCS-372, Recommended Use of Excavated Material, 1 sheet.
7. Geologic Plans and Profiles.

INTERPRETATION AND DISCUSSION OF DATA

FOUNDATION MATERIALS

A. Classification and Description: The site is on slightly weathered granite. The soil cover ranges up to 14 feet thick. Soils class as CL, SC, MH, ML and SM and are slightly to highly micaceous.

B. Consistency, Strength and Compressibility: No information on the consistency or in-place density of the foundation soils was submitted. We have assumed them to be as strong and as slightly compressible as cores submitted from Site 5. The stability is checked on this basis and should be reviewed if our assumption is considered to be wrong.

C. Permeability: Rates of 0.1 ft./day to 10 ft./day are assumed for the foundation soil materials as found from tests on Site 5.

This rock is described as less weathered and is considered impermeable.

EMBANKMENT MATERIALS

A. Classification: Borrow samples submitted were MH, ML and SM. Most of them are deep vertical composites and the surface 3 to 4 feet in places may class as CL or SC. Those areas described as red and non-micaceous or only slightly micaceous may be in this class.

2 -- R. C. Barnes -- 8/27/63
Roy S. Decker
Subj: Virginia WP-08, Leatherwood Creek, Site No. 2-A

B. Compacted Dry Densities: Standard Proctor compaction yielded maximum dry densities of 86.0 p.c.f. to 93.0 p.c.f. for MH, 86.0 p.c.f. to 108.0 p.c.f. for ML and 92.0 p.c.f. to 110.0 p.c.f. for SM.

C. Permeability: No tests were made. Rates will be low except in the low-density SM, Sample 63W3849, and in the low-density ML, Sample 63W3853. Rates would be expected in a range of .01 ft./day to 2.0 ft./day in the compacted material.

D. Shear Strength: Two samples from the emergency spillway were tested, an SM and an MH. Specimens were molded at 95% of Standard and soaked before testing in consolidated, undrained triaxial shear. Parameters from the tests are $\phi = 30°$, c = 425 p.s.f. for the SM and $\phi = 23°$, c = 550 p.s.f. for the MH. These values are recommended for design.

E. Consolidation: No one-dimensional test was made; however, from the consolidation phase of the shear tests it appears that at least 6% would be expected, or an average of 3% based on fill height.

STABILITY ANALYSIS

An analysis of a 50-foot embankment with the shear strength found in these embankment tests and one from Site 5 show acceptable safety factors for the proposed slopes.

FORM SCS-357
10-58

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

SOIL MECHANICS LABORATORY

SUMMARY - SLOPE STABILITY ANALYSIS

State _____ Project _____

Date 2-14-63 Analysis Made By _____ Checked By _____

Method of Analysis _____

Location of Material										
Sample No.										
γ_d										
γ_m										
γ_s										
γ_b										
Condition	Opt.	Sat.	Opt.	Sat.	Opt.	Sat.	Opt.	Sat.	Opt.	Sat.
ϕ										
Tan ϕ										
K										
C										

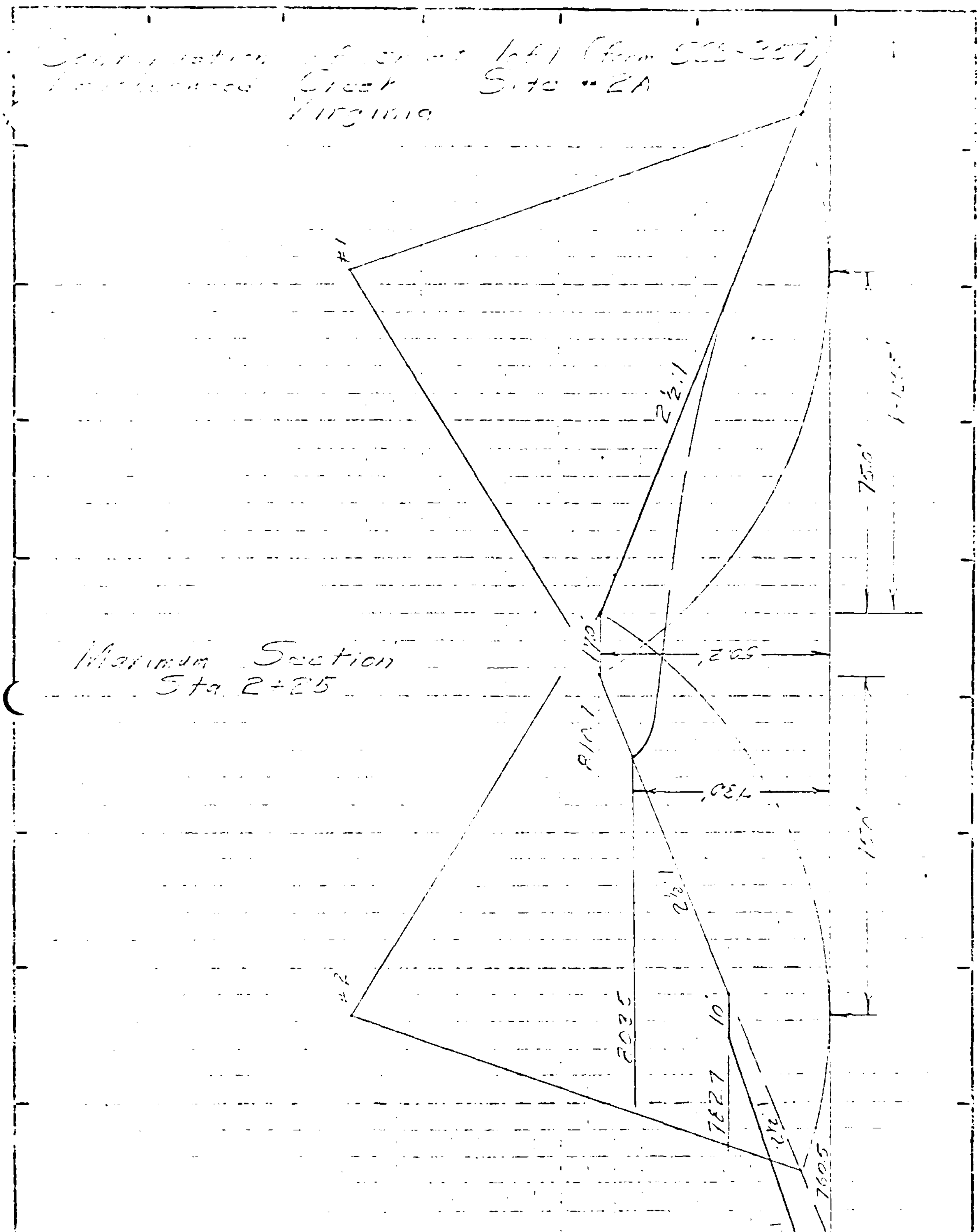
UPSTREAM SLOPE

Trial	Slope	Conditions	Fs
2	2:1		

DOWNSTREAM SLOPE

Trial	Slope	Conditions	Fs
1	2:1		
1A	2:1		
1B	2:1		

To be used to report to field offices data used for slope stability analyses and the results of the analyses. The right side of the form will be used for a sketch of the embankment on which the analyses have been made.



Scale 1 inch= Feet

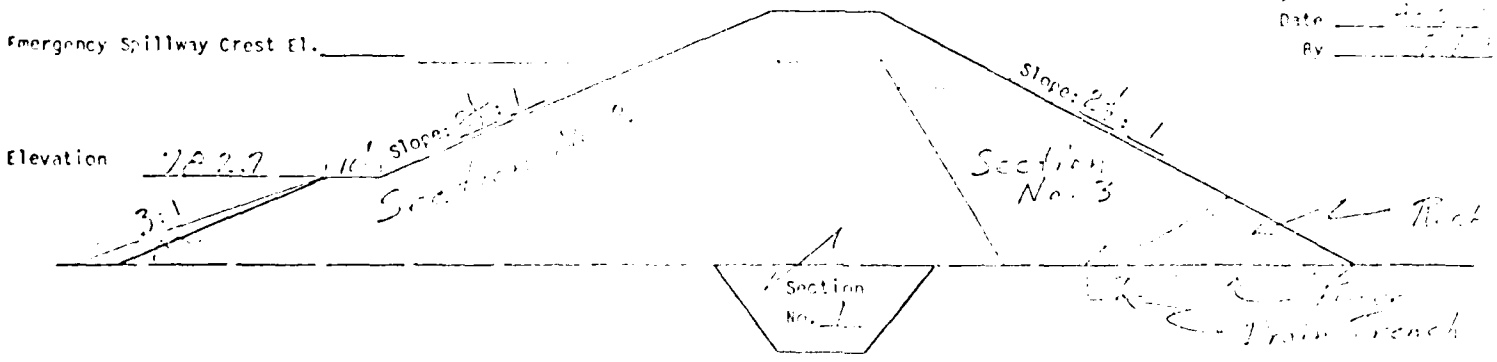
SCS-372
(3/59)

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE

State
Project
Date
By

RECOMMENDED USE OF EXCAVATED MATERIAL

☐ Formal Zoning Plan ☒ Selective Placement Plan



TYPICAL EMBANKMENT SECTION

Embankment Section		Source of Fill Material			Lab. Sample No.	Lab Test		Curve No.	Compaction Requirements Class of Fill	
			Ave. Depth						Minimum Density	Moisture Range
Sec. No.	Description	Location	From	To		Max. Den.	Optim. Moist.		Lbs. per Cu.Ft.	Percent

2. [illegible] for Safety Inspection of Dams, Department of Army, Office of the Chief of Engineers, 46 pp.

3. [illegible] Small Dams, U. S. Department of Interior, Bureau of [illegible], 1954, 816 pp.

4. [illegible] Snow Creek, Martinsville East, Price and Spray Quadrangles, Virginia by J. T. Worley and W. S. Henika, Virginia Division of Mineral Resources Reports of Investigations 33, 71 pp.

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. Hydrometeorological Report No. 33, U. S. Department of Commerce, Weather Bureau, U. S. Department of Army, Corps of Engineers, Washington, D. C., April, 1956.

6. Technical Paper No. 40, U. S. Department of Commerce, Weather Bureau, Washington, D. C., May, 1961.