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NATIONAL DAM SAFETY PROGRAM. KOOGLERS DAM (INVENTORY NUMBER VA --ETC(U)
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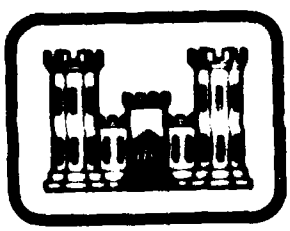
JAMES RIVER BASIN

LEVEL II

Name Of Dam: KOOGLER DAM
Location: ROCKBRIDGE COUNTY
Inventory Number: VA 16308

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM



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

IN CONJUNCTION WITH

COMMONWEALTH OF VIRGINIA
STATE WATER CONTROL BOARD

MAY 1981

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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 the 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.

JAMES RIVER BASIN

NAME OF DAM: Kooglers Dam
LOCATION: Rockbridge County
INVENTORY NUMBER: VA 16305

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

National Dam Safety Program. Kooglers Dam (Inventory Number VA 16305), James River Basin, Rockbridge County, Virginia Phase I Inspection Report.

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MAY 1981

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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 the 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 continued care and inspection can there be any chance that unsafe conditions be detected.

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

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

BRIEF ASSESSMENT OF DAM

Name of Dam:	Kooglers Dam
State:	Virginia
Location:	Rockbridge County
USGS Quad Sheet:	Vesuvius
Stream:	Moores Creek
Date of Inspection:	May 28, 1981

The Koogler Dam is an earthfill structure about 1000 feet long and 23.3 feet high with a gravel roadway traversing the entire dam. The dam is owned and maintained by Mr. Glenn Koogler as part of the Willow Lake Campground facility. The dam is classified as "small" on the basis of size, and given a hazard classification of "significant" on the basis of downstream area development. The principal spillway consists of a 42-inch diameter corrugated metal pipe (CMP) vertical riser connected to a 36-inch diameter CMP which passes through the dam at a low level. The emergency spillway is an open earth channel cut in the left abutment. The reservoir is used for recreation.

Based on criteria established by the Department of the Army, Office of the Chief of Engineers (OCE), the Spillway Design Flood (SDF) is the 1/2 PMF. The spillways will pass 10 percent of the PMF or 20 percent of the SDF without overtopping the crest of the dam. The SDF will overtop the dam by a maximum of 1.3 feet, reach an average critical velocity of 5.3 feet per second and flow over the dam for 9.7 hours. Flows overtopping the dam during the SDF are not considered detrimental to the embankment. The spillway is adjudged inadequate but not seriously inadequate.

The visual inspection revealed that there are no immediate needs for remedial measures, except for the monitoring of the spring beneath the primary spillway outlet. Maintenance is performed by the owner. However, there is no formal documented maintenance operations program or warning system. It is recommended that a regular maintenance and

operations program be instituted with provisions for accurate records of all maintenance performed. It is also recommended that a warning system be established and that the maintenance items listed in Section 7.2 be accomplished as part of the regular maintenance program within the next 12 months.

Submitted By:

Original signed by:
Carl S. Anderson, Jr.

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Acting Chief, Design Branch

Approved:

Original signed by:
Ronald E. Hudson

RONALD E. HUDSON
Colonel, Corps of Engineers
Commander and District Engineer

Date: SEP 15 1981

Recommended By

Original signed by
JAMES A. WALSH

JACK G. STARR, P.E.
Chief, Engineering Division

DAM

RESERVOIR

OVERALL VIEWS
KOOGLER DAM

28 MAY 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 Inspections of Dams throughout the United States. The Norfolk District has been assigned the responsibility of supervising the inspection of dams in the Commonwealth of Virginia.

1.1.2 Purpose of Inspection: The purpose is to conduct a Phase I Inspection according to the Recommended Guidelines for Safety Inspection of Dams (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: Kooglers Dam is an earthfill embankment about 1000* feet long and 23.3** feet high. The crest of the dam is 21 feet wide at elevation 107.1 TBM *** (1743.1 MSL). A gravel road traverses the crest along its entire length. The low point, in the center of the emergency spillway, is at elevation 103.4 TBM*** (1739.4 MSL). The upstream slope is 2 horizontal to 1 vertical (2H:1V) and the downstream slope is 2.5H:1V.

According to the owner the dam was constructed with a cutoff trench.

There are no known foundation drains.

The principal spillway consists of a 42-inch diameter corrugated metal pipe (CMP) vertical riser connected to a 36-inch diameter CMP which passes through the dam at a low level. The riser is located 37 feet from the shoreline at the present level.

The emergency spillway is an open earth channel cut into the left abutment. The width of the control section of the emergency spillway is 40 feet, with a minimum crest elevation of 103.4 TBM *** (1739.4 MSL).

* Dam length is measured from natural ground at the left abutment to natural ground at the right abutment. The width of the emergency spillway is not considered part of the dam length.

** Dam height based on the difference is elevation between the streambed at the toe of the dam and the maximum height of the crest.

*** TBM (Temporary Bench Mark) - taken as 100 feet elevation for the reservoir water surface during the inspection. Later the TBM was correlated with the U. S. Geological Survey Map, Vesuvius Va., to be 1736.0 feet elevation mean sea level (MSL) for the reservoir water surface.

There is a drawdown valve set in concrete which is connected at a low level to the principal spillway 42-inch CMP riser with a 24-inch CMP. The control stem to this valve is about 40 feet beyond the principal spillway riser. It has been bent by ice and at present is not operational.

1.2.2 Location: Kooglers Dam is located in Rockbridge County approximately one mile south of Raphine, between Interstate 81 and U. S. Route 11.

1.2.3 Size Classification: The dam is classified as "small" in size based on the criteria in Reference 1 of Appendix V.

1.2.4 Hazard Classification: Kooglers Dam is located in a rural area. There are several residences and mobile homes, with associated outbuildings, in the downstream area. Therefore, a "significant" hazard classification is given to this structure according to guidelines contained in Section 2.1.2 of Reference 1 of Appendix V. The hazard classification used to categorize dams is a function of location only and has nothing to do with their stability or failure.

1.2.5 Ownership: The dam is owned by Mr. Glenn Koogler.

1.2.6 Purpose: Recreation.

1.2.7 Design and Construction History: The dam was designed in 1970 by Dave Bowling of Piney River, Virginia in accordance with guidelines of the Soil Conservation Service.

1.2.8 Normal Operational Procedures: Water passes automatically through the spillways when the reservoir reaches the respective crest elevation of the principal and emergency spillways.

1.3 Pertinent Data:

1.3.1 Drainage Area: The dam controls a drainage area of 2.0 square miles.

1.3.2 Discharge at Dam Site: Maximum flood - not known.

Pool level at crest of dam

Emergency Spillway . . . . . 1068.0 cfs
Principal Spillway . . . . . 106.0 cfs

1.3.1 Dam and Reservoir Data Pertinent data shown in the table below.

TABLE 1.1 DAM AND RESERVOIR DATA

Item	Elevation feet msl	Reservoir Capacity: Area, acres	Reservoir Capacity: Acre-feet	Watershed, inches	Length feet
Crest of Dam	1345.0	6	160.0	1.5	3600
Emergency Spillway Crest	1340.0	13	125.0	1.2	2900
Permanent Spillway Crest	1332.5	11.5	112.5	1.1	2400
Stream bed at Dam, Upstream Toe of Dam	1319.8	---	----	---	-----

SECTION 2

ENGINEERING DATA

2.1 Design: There is no known formal design information, i.e., plans, specifications, etc.

2.2 Construction: There are no known formal construction records, but the owner was present when the dam was built, and closely observed the process. A neighbor who was associated with the Soil Conservation Service, Mr. Burt Hawkins, also followed the construction of the dam closely.

According to the owner, the dam does have a core trench and the material placed in the embankment was well compacted in accordance with accepted practices for such projects.

After the dam was completed, the principal spillway riser was shortened by 18 inches to lower the pool level and provide for more freeboard on the embankment.

The owner also indicated that this particular vicinity of his property had exhibited natural spring activity prior to the construction of the embankment and filling of the reservoir.

2.3 Evaluation: There is insufficient information to evaluate foundation and embankment stability.

SECTION 3

VISUAL INSPECTION

3.1 Findings

3.1.1 General. The results of the inspection on May 28, 1981 are recorded in Appendix III. At the time of the inspection, the weather was overcast with a temperature of [illegible]°F. The reservoir elevation was at [illegible] MSL. [illegible] below the principal spillway crest [illegible] spillways at the time of the inspection. The tailwater elevation was at [illegible] MSL. [illegible] inspection reports.

3.1.2 Embankment. A sketch of the embankment, showing a cross section and crest profile, is presented in Appendix I. A plan view is also given in Appendix I. Overall views of the dam are presented at the beginning of the report.

The crest was uniform in elevation and width with no misalignment and is traversed by a gravel roadway. The crest is well vegetated with grass for approximately four feet on either side of the roadway.

The upstream face is well vegetated with tall grass, scattered shrubs, and a few small trees. The upstream face has a continuous growth of cattails across the entire length of the dam at pool level. Also some wave erosion is apparent at pool level. There is one broad erosion gully. Additionally, one animal burrow was detected on the upstream face. Minor sloughs were evident all along the entire upstream face. There was no uniformly placed riprap on the upstream face, but large boulders are randomly grouped along the water's edge.

The downstream face appeared to have no slope irregularities, however, dense vegetation prevented detailed observation and assessment of surface conditions. There is a dense growth of small pines and hardwood trees overall with trunk diameters up to 6 inches. There is dense underbrush mixed with the trees and several open areas of tall grass. A marsh area begins a few feet beyond the toe near the left abutment contact. The marsh area seemed to be predominantly from springs and possibly some seepage from the dam. The area was approximately 150 feet by 75 feet with extensive growth of cattails.

A spring of clear water was detected immediately below the outlet pipe with a flow of 30 to 50 gallons per minute. The temperature of the spring water below the pipe was 60°F. The reservoir water temperature was 65°F. The spring beneath the principal spillway was detected early in the life of the dam according to owner.

A spring exists approximately 25 feet left of the principal spillway outlet. The flow from the spring joins the earth wall discharge channel. The springs was in existence before the dam was constructed according to owner. The vicinity was characterized by natural spring

activity prior to the construction of the embankment, according to the owner. Flow from beneath the outlet was noted early in the life of the dam. This flow may be affected by changes in the water table and other factors related to the existence of the dam, and seepage through or beneath the dam may be contributing to the discharge. At the time of the inspection there was no evidence of turbid, or muddy, flow which would signify internal erosion or the removal of soil from within the embankment, but any flow in the vicinity of a dam should be closely monitored for evidence of this condition, known as piping.

3.1.3 Principal Spillway. The principal spillway consists of a 42-inch diameter CMP vertical riser connecting to a 36-inch diameter CMP which passes through the dam at a low level. The 36-inch CMP of the principal spillway discharges into a heavily overgrown, steep, earth wall channel without riprap. The discharge is about 30 feet beyond the toe of the dam. The discharge channel runs to an open marsh area shortly downstream of the dam. The 42-inch diameter CMP riser is also connected at a low level to a corrugated metal pipe with a valve for drawdown. The drawdown pipe was observed and the size estimated to be 24 inches in diameter. The valve size is also estimated to be 24 inches. The drawdown valve is set in concrete upstream of the principal spillway. The control stem has been bent to an angle by ice and is not functional. The control wheel for the stem is not in place. The principal spillway riser was lowered 18 inches to its present level shortly after the reservoir was first filled. The riser does not have a trash guard. The principal spillway outlet pipe is located approximately 30 feet beyond the toe of the dam and the flow from beneath it appears to be a natural spring.

3.1.4 Emergency Spillway. The emergency spillway is an earthen channel in the left abutment with a control section 40 feet wide. The channel is well vegetated with only a few very bare spots visible. A pile of debris is near the left spillway wall in the control section, i.e. a heavy tractor tire, broken block, and rock pieces. There are several small hardwood trees growing in the debris. The emergency spillway approach channel is unobstructed and is well vegetated with only a few very bare spots visible. The discharge channel is traversed by a gravel roadway. Otherwise it is well vegetated. A line of pines are planted near the right spillway discharge channel wall. The gravel road forks in the spillway with one fork running longitudinally along the length of the discharge channel. A shallow erosion gully has begun in the pines near the right discharge channel wall due to runoff from the gravel road.

3.1.5 Instrumentation. There is no instrumentation of the dam.

3.1.6 Reservoir. The slopes of the watershed are mild and are predominantly covered with gently rolling pasture or clear fields. The immediate reservoir perimeter is an open grassy area used as a campground. There is no significant slope failure or erosion apparent.

3.1.7 Downstream Channel The downstream channel is overgrown at the dam. Two-hundred feet downstream the channel broadens into a large open marsh area. A half mile downstream the discharge follows a natural streambed through clear and grassy, gently rolling hills. There are approximately eight homes or mobile homes with five outbuildings below the dam.

3.1.8 Stilling Basin There is no well-formed stilling basin. The area of the stilling basin is a heavily overgrown, steep, earth wall channel that runs into an open marsh.

3.2 Evaluation Overall, the dam appears to be in good condition. The inspection revealed certain preventative maintenance items which should be scheduled as part of an annual maintenance program. These are:

a. Monitor the springs and marsh area for changes in flow or turbidity, giving particular attention to the flow from beneath the primary spillway outlet. Should an increase in flow and or turbidity occur, a qualified geotechnical consultant should be retained immediately to further evaluate these conditions.

b. Remove trees and underbrush from dam, emergency spillway, and stilling basin. Cut all trees at the ground. All trees growing on the dam greater than 3 inches in diameter should have their root ball removed and have compacted fill placed in the holes and the fill seeded. Seed bare areas exposed by the clearing operations. Mow the entire embankment and emergency spillway rountinely.

c. Install staff gage, which is a staff, rod, or post with elevations indicated on it permanently mounted to show the depth of water. It should be of sufficient height to indicate depth of flow through the emergency spillway and over the dam.

d. Install a trash guard on the principal spillway intake.

e. Remove underbrush from around the principal spillway outlet. Place riprap at outlet in channel to prevent erosion.

f. Sloughs, burrow, and erosion gullies on the upstream face should be filled, compacted, and seeded.

g. Straighten control stem of the drawdown valve to a functional position. Obtain an operating wheel for emergency gate. Store it in a secure location with easy access in the event it becomes necessary to dewater the reservoir.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedures: The normal storage pool is at elevation 1737.5 MSL, which is the crest of the principal spillway riser. Water passes automatically through the principal spillway when the reservoir rises above the spillway riser crest. Water will pass through the emergency spillway when the reservoir rises above its crest, at elevation 1739.4 MSL. A low level drain is presently not operational.

4.2 Maintenance: Maintenance is performed as needed by the owner, which includes maintaining the grass cover on the embankment and the gravel road across the crest.

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

4.4 Evaluation: The dam does not require an elaborate operational and maintenance procedure. However, the present program of periodic observation and maintenance should be documented to help detect and correct any problems that may arise. An emergency operation and warning plan should be developed. It is recommended that a formal emergency procedure be prepared to be readily available to anyone managing the facility. 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.

The local Emergency Services Coordinator of the State Office of Energy and Emergency Services can assist in the preparation of an Emergency Warning Plan.

SECTION 5

HYDRAULIC/HYDROLOGIC DATA

5.1 Design: None were available.

5.2 Hydrologic Records: None were available.

5.3 Flood Experience: No records were available.

5.4 Flood Potential: The 100-Year Flood, 1/2 PMF, and PMF were developed using the HEC-1 computer program (Reference 2, Appendix IV) and routed through the reservoir using the NWS-Dambreak computer program (Reference 3, Appendix IV) and appropriate precipitation and storage outflow data. Clark's Tc and R coefficients for the local drainage area were estimated from basin characteristics. The rainfall applied to the developed unit hydrograph was obtained from National Weather Service Publications (Reference 4 and 5, Appendix IV).

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

Water passes automatically through the principal and emergency spillways as the reservoir rises above the spillway crests.

The storage curve was developed based on areas obtained from a U. S. Geological Survey Quadrangle Map. Survey data taken during the inspection was correlated to the Vesuvius, Virginia Quadrangle Map to help develop the area-storage data. Rating curves for the emergency spillway and non-overflow section were developed internally by the Dambreak computer model. A rating curve for the principal spillway was developed externally and input to the Dambreak computer model. In routing hydrographs through the reservoir it was assumed that the initial pool level was at the principal spillway crest (elevation 1737.5 MSL).

5.6 Overtopping Potential: The probable rise in the reservoir and other pertinent information on reservoir performance are shown in the following table:

Table 5.1 RESERVOIR PERFORMANCE

	Normal Flow	100-Year Flood 1*	1/2 PMF	PMF 2*
Peak flow cfs				
Inflow	2	2202	5679	11319
Outflow	2	2184	5639	11279
Maximum elevation feet msl	1737.5	1743.6	1744.4	1745.4
Non-over flow section (elevation 2235.8)				
Depth of flow, feet.	---	.5	1.3	2.2
Duration, hrs.	---	2.4	9.7	9.8
Velocity, fps 3*	---	3.4	5.3	6.9
Tailwater elevation feet msl	1720	---	---	----

1* The 100-Year Flood has one chance in 100 of occurring in any given year.
2* The PMF is an estimate of flood discharges that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region.
3* Critical Velocity.

5.7 Reservoir Emptying Potential: The size of the drawdown outlet is assumed to be 24 inches in diameter. The drawdown valve intake and outlet elevation is assumed to be 1722.3 MSL. The drawdown valve will pass 56.8 c.f.s. with the reservoir level at the crest of the principal spillway and essentially dewater the reservoir in 2.25 days. This is equivalent to an approximate drawdown rate of 6.8 feet per day. This is based on the hydraulic height (15.2 ft.) measured from the normal storage pool at elevation 1737.5 (principal spillway crest) to the outlet pipe elevation divided by the time (53.7 hrs.) to dewater the reservoir.

5.8 Evaluation: Based on the size (small) and the hazard classification (significant), the recommended spillway design flood is the 100-Year Flood to the 1/2 PMF. Because of the risk involved, the 1/2 PMF has been selected as the SDF. The spillway will pass 10 percent of the PMF or 20 percent of the SDF without overtopping the dam. The SDF will overtop the dam by a maximum of 1.3 feet, reach an average critical velocity of 5.3 feet per second, and flow over the dam for 9.7 hours.

Conclusions pertain to present day conditions. The effect of future development of the hydrology has not been considered.

SECTION 6

DAM STABILITY

6.1 Foundation and Abutments: Although there are no formal records of a subsurface investigation for the project, considerable information can be inferred from geologic and soils studies of the area, which lies within the Ridge and Valley physiographic province. Briefly, the area is underlain by massive beds of dolomite of the Beekmantown formation, outcrops of which were visible in the vicinity of the dam along with fragments of the chert contained in the dolomite bedrock. Residual soils derived from the underlying rock are brown, brownish-red, or dark red friable clays. Soils samples examined during the inspection were identified, on the basis of the dry strength and other field identification test, as highly compressible red clays. This agrees with the description of the vicinity found in Soil Survey of Rockbridge County, Virginia, which classifies the area soil as Hagerstown stony silt loam.

The site should affort a good foundation for the dam, assuming that proper care was taken during construction to guard against the potential problems that clay soils can pose to earthwork projects. These soils are relatively impermeable, which is favorable from the standpoint of seepage under the dam. Also, the dam was constructed with a core trench. In view of the relatively shallow depth to bedrock at the site (2 to more than 4 feet, according to Soil Survey of Rockbridge County, Virginia,) it is likely that at least portions, and perhaps most or all, of the central core of the dam extends to bedrock. The dam does not have a foundation drainage system. Springs were evident on the site prior to the construction of the dam, and it is difficult to say how much of the moisture apparent beyond the toe of the dam is seepage and how much is due to these natural springs. At present, excessive seepage does not appear to be a problem. The outlet pipe is located approximately 30 feet beyond the toe of the embankment, and the flow from beneath it appears to be a natural spring.

6.2 Embankment:

6.2.1 Materials: The source of borrow for the dam was located in the vicinity of the dam site and reservoir area. As noted, the area soils were identified, on the basis of field test, to be clays of high plasticity. For the purpose of a stability assessment, the dam is considered to be homogeneous.

6.2.3 Stability: There are no available stability calculations. The dam is 23.3 feet high and 21 feet wide at the crest. The upstream slope is 2H:1V and the downstream slope is 2.5H.1V. If the low level outlet drain were restored to an operable condition, the dam would be subject to a rapid drawdown if the valve were to be completely opened. The dam has existed at maximum control storage pool (water at the level of the emergency spillway) in the past with no ill effects.

According to the guidelines presented in Design of Small Dams, U. S. Department of the Interior, bureau of Reclamation, the slopes recommended for a homogeneous small dam of similar highly plastic clay material subjected to a rapid drawdown are 4H:1V upstream and 2.5H:1V downstream. The recommended crest width is 14.5 feet. Based on these guidelines, Kooglers Dam has an inadequate upstream slope, and adequate downstream slope, and a crest width considerably wider than the minimum 14.5 feet.

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: There is insufficient information to completely evaluate the stability of the dam. However, the visual inspection revealed no apparent instability. Based on the visual inspection, the foundation is considered sound. Based on the Bureau of Reclamation guidelines, the crest width is more than adequate, the downsteam slope is adequate and the upstream slope is inadequate. The crest is considerably wider than the minimum width, which enhances the overall adequacy of the structure from the standpoint of stability. The embankment is considered stable during both normal pool and maximum storage pool operations. In addition, overtopping is not a problem because flows are relatively shallow (1.3 feet) and the velocity is less than 5 fps, which is the effective eroding velocity for a vegetated earth embankment. A stability check is not required.

SECTION 7

ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment: The available engineering data is insufficient to completely evaluate the stability of the embankment. The visual inspection revealed no findings that proved the dam to be unsound. The dam is maintained by the owner, but there is no formal documented maintenance operations program or emergency operations and warning plan. Based on criteria established by the Department of the Army, Office of the Chief of Engineers (OCE), the Spillway Design Flood (SDF) is the 1/2 PMF. The spillways will pass 10 percent of the PMF or 20 percent of the SDF without overtopping the dam. Flows overtopping the dam during the SDF are not considered detrimental to the embankment. The combined capacity of the spillways is adjudged inadequate but not seriously inadequate. Overall the dam is in good condition and there is no immediate need for remedial measures, except for the continued monitoring of the spring beneath the principal spillway. A stability check of the dam is required.

7.2 Recommended Remedial Measures: It is recommended that the regular maintenance operations program be documented for future reference. 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. The local emergency services coordinator of the State Office of Energy and Emergency Services can assist in the preparation of an Emergency Warning Plan. Also, the inspection revealed the following maintenance items that should be scheduled by the owner during a regular maintenance period within the next 12 months:

a. Monitor the spring beneath the principal spillway outlets for changes in flow or clarity. At the time of the inspection there was no evidence of turbid, or muddy, flow which would signify internal erosion or the removal of soil from within the embankment, but any flow in the vicinity of a dam should be closely monitored for evidence of this condition, known as piping. Should this flow become turbid or show a marked increase, a qualified geotechnical engineering firm should be retained to evaluate this condition further.

b. Remove trees and underbrush from dam, emergency spillway, and stilling basin. Cut all trees growing in the dam less than 3 inches in diameter at the ground. All trees growing in the dam greater than 3 inches in diameter should have their root ball removed and have compacted fill placed in the holes and the fill seeded. Seed bare areas exposed by the clearing operations. Mow the entire embankment and emergency spillway routinely.

c. Install staff gage, which is a staff, rod, or post with elevations indicated on it permanently mounted to show the depth of water. It should be of sufficient height to indicate depth of flow through the emergency spillway and over the dam.

d. Install a trash guard on the principal spillway intake.

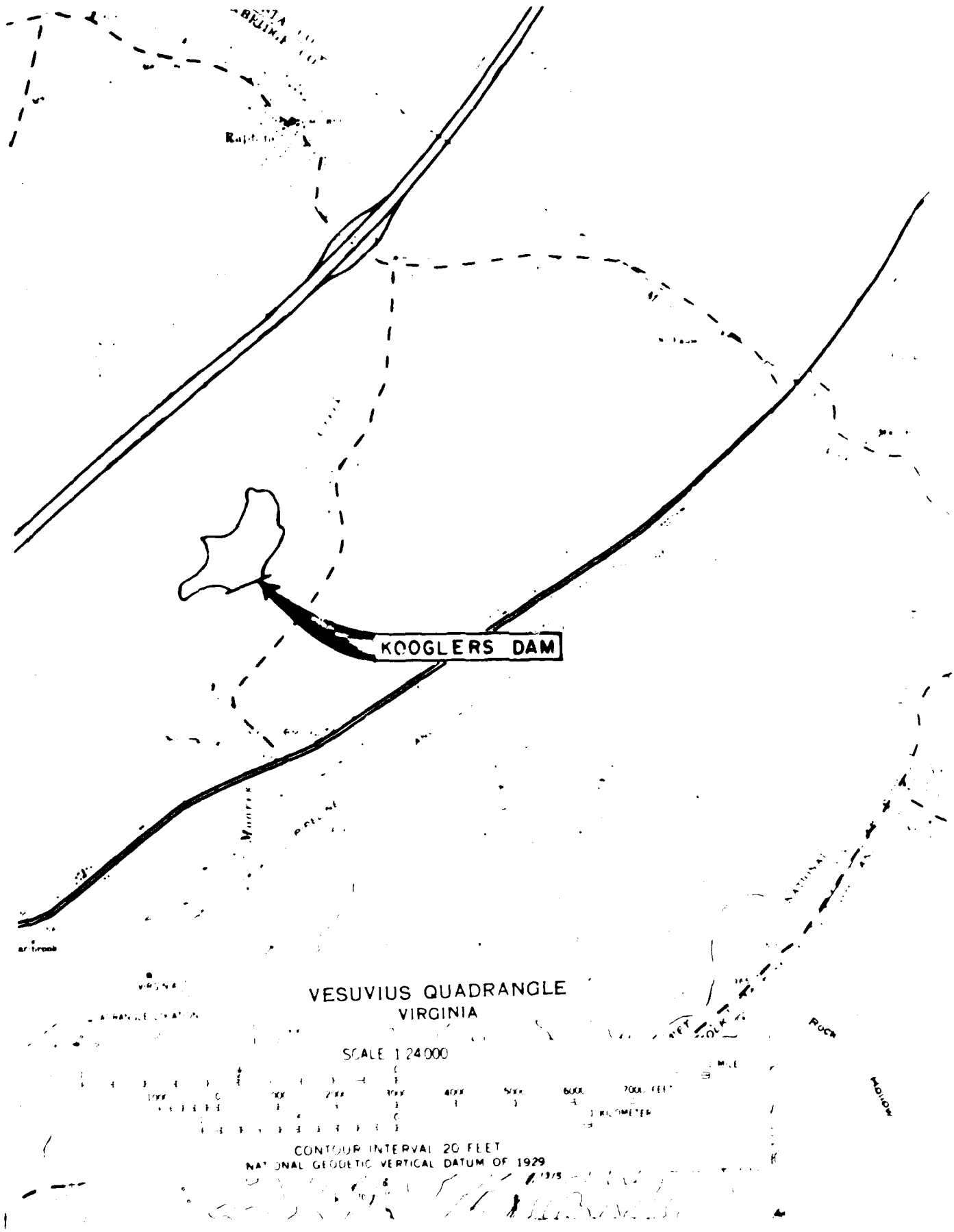
e. Remove underbrush from around the principal spillway outlet. Place riprap at outlet in channel to prevent erosion.

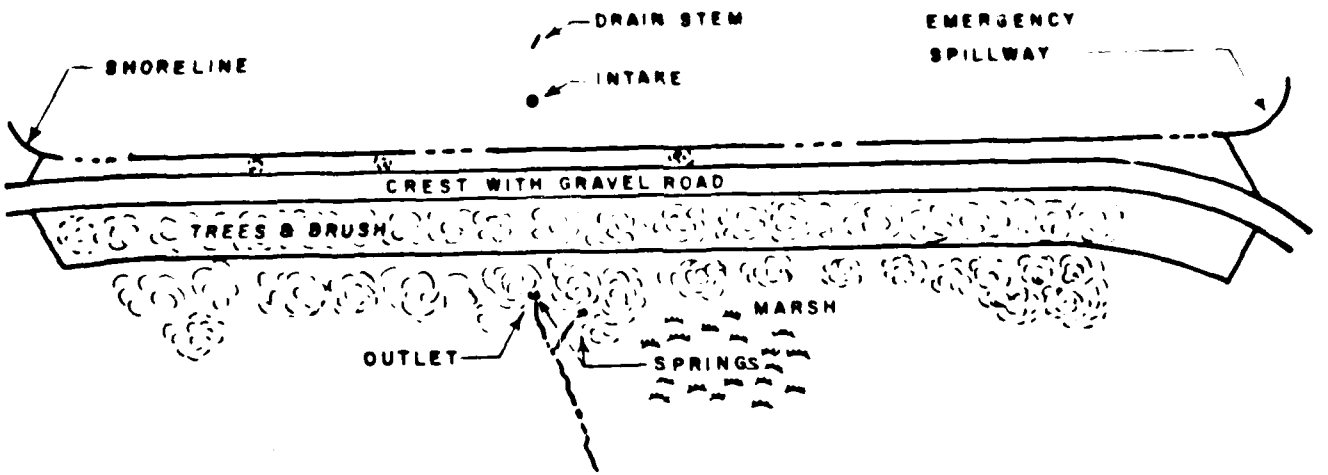
f. Sloughs, burrow, and erosion gullies on the upstream face should be filled, compacted, and seeded.

g. Straighten control stem of the drawdown valve to a functional position. Obtain an operating wheel for emergency gate. Store it in a secure location with easy access in the event it becomes necessary to dewater the reservoir.

APPENDIX I

MAPS AND DRAWINGS


KOOGLERS DAM
VESUVIUS QUADRANGLE
VIRGINIA
SCALE 1:24000
CONTOUR INTERVAL 20 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929



PLAN VIEW

KOOGLERS DAM

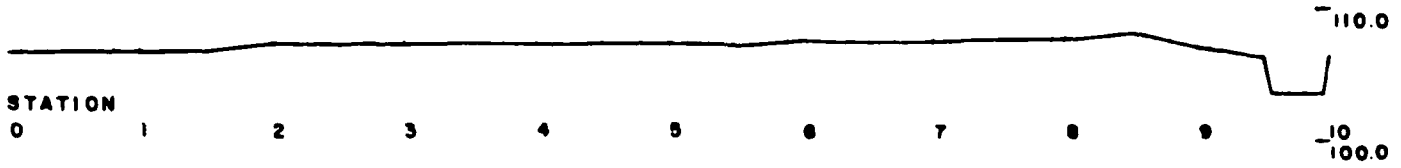
ROCKBRIDGE CO., VIRGINIA

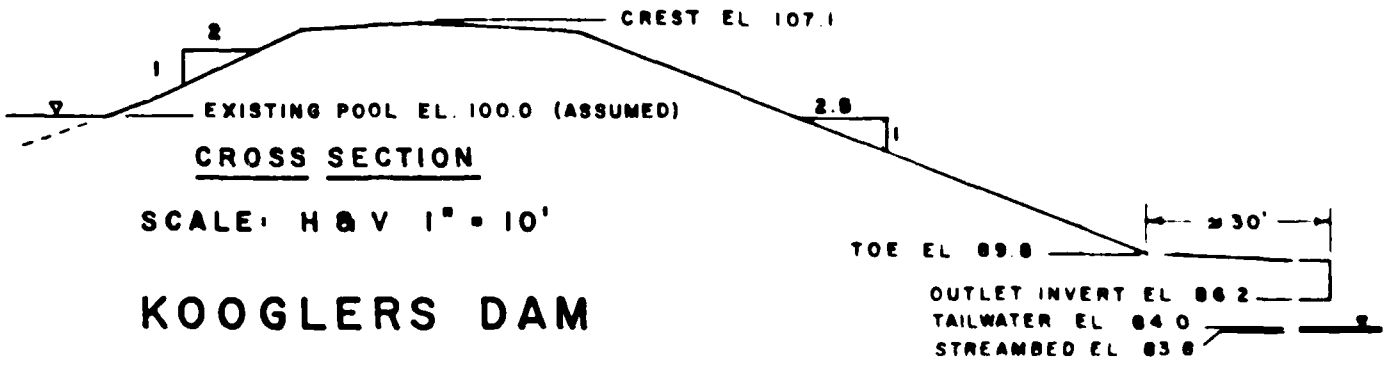
28 MAY 1981 SCALE: 1"≈100'

HMG

CREST PROFILE

SCALE: H 1" = 100' / V 1" = 10"





CROSS SECTION

SCALE: H & V 1" = 10'

KOOGLERS DAM

HMG

APPENDIX II

PHOTOGRAPHS

PHOTO #1 CREST OF DAM

PHOTO #2 CREST OF DAM

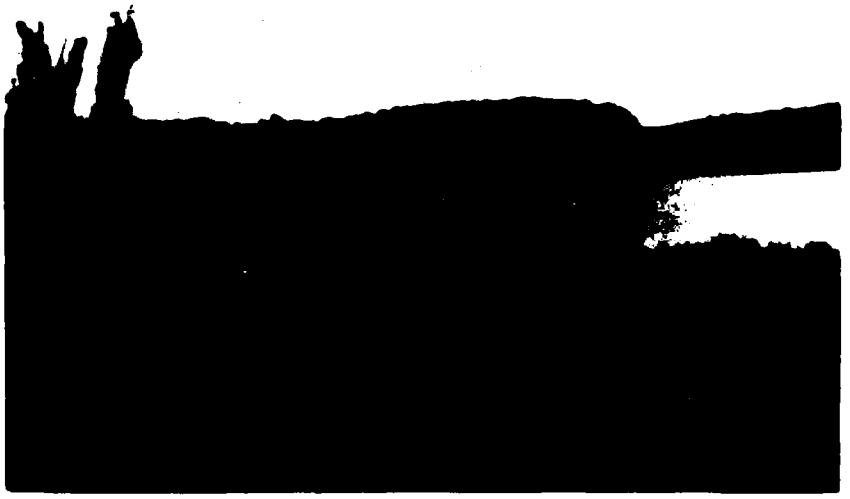


PHOTO #3 UPSTREAM FACE OF DAM

PHOTO #4 UPSTREAM FACE OF DAM

PHOTO #5 PRINCIPAL SPILLWAY INTAKE AND RESERVOIR DRAIN OPERATOR (LEANING)

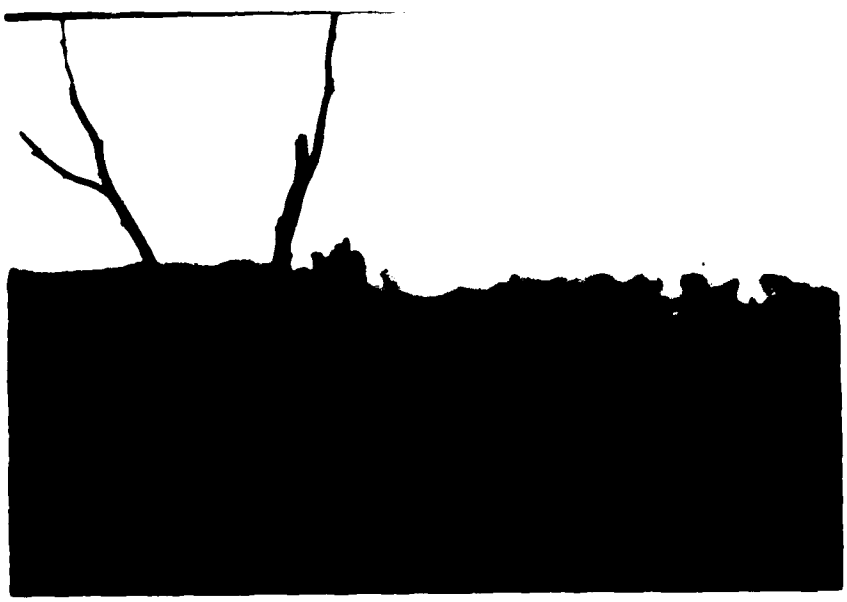


PHOTO #6 DOWNSTREAM AREA

APPENDIX III

FIELD OBSERVATIONS

Check List
Visual Inspection
Phase 1

Name Dam: Koogler's Dam (Willow Lake Campground) County: Rockbridge State: Virginia Coordinates: Lat. 38°- 55.2' N
Long. 79° 14.0' W

Date Inspection: 28 May 1981 Weather: 65° Temperature: 65°

Pool Elevation at Time of Inspection: 100.0 TBM Tailwater at Time of Inspection: 84.0 TBM

Inspection Personnel:

B. Taran, COE	Hugh Gildea, SWCB	Dave Koogler, owner's brother
Leonard Jones, COE	Leon Musselwhite, SWCB	Glenn Koogler, owner
Joe Miller, COE	Liz Goode, SWCB	

Leon Musselwhite Recorders
Liz Goode

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed	Dense vegetation on downstream face made this difficult to evaluate.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed	Underbrush and other vegetation made this difficult to evaluate.
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Upstream face has scarp at pool level. There was one broad erosion gulley on the upstream face. Minor sloughs were evident all along the entire upstream face. The downstream face appeared to be uniform; however, dense vegetation obstructed observation.	Sloughs, burrow, and erosion gullies and scarp should be filled, compacted, and seeded.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	The crest was uniform in elevation and width with no misalignment.	None.
RIPRAP FAILURES	There was no uniformly placed riprap on the upstream face, but large boulders are randomly grouped along the face. Crest has road with a gravel surface. A roadway with a gravel surface traverses emergency spillway also.	None.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
FOUNDATION	There is no evidence of foundation instability.	None.
ANY NOTICEABLE SEEPAGE	No seepage observed on downstream face; however, a marsh area begins a few feet beyond the toe near the left abutment contact. The area seemed to be predominately from springs and possibly seepage from the dam. The area was extensive, approximately 150 feet by 75 feet. The area was vegetated with cattails. A spring observed left of the P.S. outlet, approximately 30' feet beyond the toe. A spring of clear water was detected immediately below the principal spillway outlet pipe, with a flow estimated to be 30 to 50 gallons per minute. The temperature of the water below the pipe was 60°F. The reservoir water temperature was 65°F. The spring beneath the principal spillway was detected early in the life of the dam according to owner.	The springs in the marsh area should be observed routinely for change, increased flows, or turbidity. A qualified geotechnical engineering consultant should be retained for a further evaluation should marked increased flows or turbidity develop.
DRAINS	None observed.	None.
MATERIALS	Borrow from surrounding hills. Local clays were used for core.	None.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	The dam crest is well vegetated the gravel road for four feet either side. The upstream face has a tall grass cover with scattered shrubs and a few small trees. The upstream face has a continuous growth of cattails across the entire width of the dam at pool level. The downstream face has dense underbrush mixed with the trees. There are several open areas of tall grass on the downstream face.	All trees less than 3 in. in diameter should be cut off even with the ground. All trees greater than 3 in. should be cut down, their root ball removed, and compacted fill placed in the hole and seeded. The underbrush should be removed from the embankment.

PRINCIPAL SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONTROL SECTIONS	The principal spillway consists of a 42" diameter CMP vertical riser connecting to a 36" diameter CMP which passes through the dam at a low level. The 42" diameter CMP riser is also connected at a low level to a 24"* CMP with a valve for drawdown. There is not a trash guard on the spillway riser. *Estimated-Not Measured.	Install a trash guard onto the CMP vertical riser.
APPROACH CHANNEL	Clear	None.
DISCHARGE CHANNEL	The 36" CMP discharges into a heavily overgrown, steep, earth wall channel that runs to an open marsh area shortly. Riprap is partially buried in the channel bottom, none protecting sidewalls. There is no well defined stilling basin, but straight channel with earth sides.	Remove underbrush from around P. S. outlet. Place additional riprap at outlet in channel to prevent erosion.
BRIDGE AND PIERS	None.	None.
EMERGENCY GATE	There is a 24" (estimated) drawdown valve set in concrete upstream of the principal spillway. The control stem has been bent to an angle by ice and is not functional.	Straighten control stem to a functional position.
GATES AND OPERATION EQUIPMENT	The operating wheel for the stem of the emergency gate is not present. The principal spillway was lowered 18" shortly after the reservoir was first filled.	Obtain an operating wheel for emergency gate. Store it in a secure location.

EMERGENCY SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONTROL SECTIONS	Earth channel in the left abutment. It is well vegetated with grass with only a few very bare spots visible. A pile of debris is near the left spillway wall in the control section, i.e. a heavy tractor tire, broken block, and rock pieces. In the debris, there are several small hardwood trees growing. Control section is 40 ft. wide.	Seed bare areas to ensure continuity of grass cover. Remove debris. Cut trees to the ground.
APPROACH CHANNEL	Unobstructed and well vegetated with grass. Only a few bare spots visible.	Seed bare areas to ensure continuity of grass cover.
DISCHARGE CHANNEL	The discharge channel is traversed by a roadway. Otherwise the channel is well vegetated with grass. A line of pines are planted near the right spillway discharge channel wall. The gravel road forks in the spillway with one fork running longitudinally along the length of the discharge channel.	None.
BRIDGE AND PIERS	None.	None.
MISCELLANEOUS	A shallow erosion gully has begun in the pines near the right discharge channel wall due to runoff from the gravel road.	Fill gully, compact, and seed to prevent continued erosion.

INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATION
MONUMENTATION/SURVEYS	There are no monuments.	None.
OBSERVATION WELLS	There are no observation wells.	None.
WEIRS	None observed.	None.
PIEZOMETERS	None observed.	None.
STAFFGAGES	None observed	Place staffgage permanently in such a manner to determine the depth of water flowing through the principal spillway, emergency spillway, and depth overtop the dam should overtopping occur.

RESERVOIR

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Predominantly gently rolling pasture or clear fields. The immediate reservoir perimeter is an open grassy area used as a campground. There is no significant slope failure or erosion apparent.	None.
SEDIMENTATION	Not measured. The reservoir water temperature is 65°F.	None.

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	The downstream channel is overgrown at dam. 200 feet downstream the channel broadens into a lar e open marsh area. A half mile downstream, the discharge follows a natural streambed through clear and grassy, gently rolling hills.	None.
SLOPES	The downstream channel is bordered by low gentle hills and somewhat broad flood plain areas. a moderate slope.	None.
APPROXIMATE NO. OF HOMES AND POPULATION	Approximately 8 homes or mobile homes and four or five outbuildings.	None.

APPENDIX IV

REFERENCES

APPENDIX IV
REFERENCES

1. Recommended Guidelines for Safety Inspection of Dams, Office of the Chief of Engineers, Department of the Army, Washington, D. C.

2. HEC-1DB Flood Hydrograph Package, (Hydrologic Engineering Center, U. S. Army Corps of Engineers, September 1978).

3. "Probable Maximum Precipitation Estimates, United States East of the 105th Meridian", Hydrometeorological Report No. 51, (U. S. Weather Bureau, June 1978).

4. "Rainfall Frequency Atlas of the United States", Technical Paper No. 40, (U. S. Weather Bureau, Nay 1961).

5. Geology of the Vesuvius Quadrangle, Virginia, H. J. Werner, Virginia Division of Mineral Resources, 1966.

6. Soil Survey of Rockbridge County, Virginia, U. S. Department of Agriculture, 1931.

END

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