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NATIONAL DAM SAFETY PROGRAM. LAKE MONOCAN DAM (ID VA-12502), JA--ETC(U)
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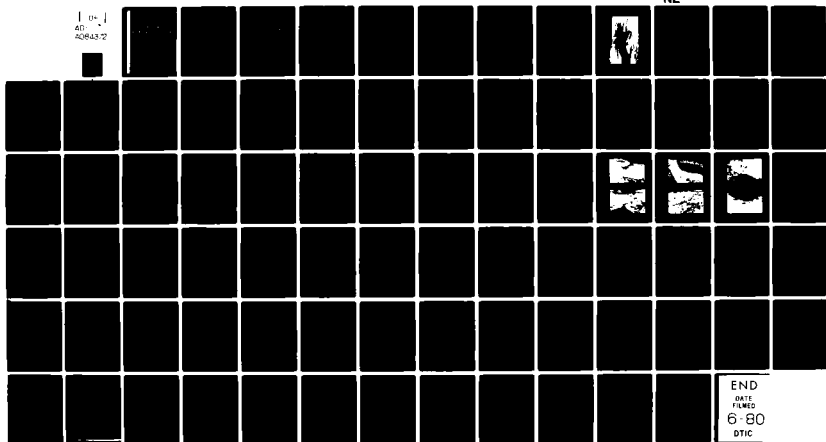
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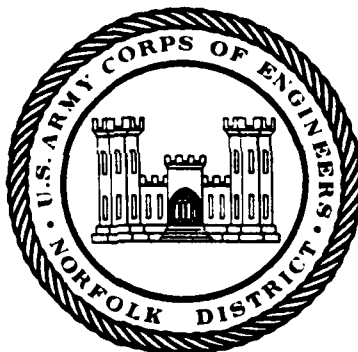
Name of Dam: Lake Monocan Dam

Location: Nelson County, State of Virginia

Inventory Number: VA 12502

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PHASE I INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM



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PREPARED FOR
NORFOLK DISTRICT CORPS OF ENGINEERS
803 FRONT STREET
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20. Abstract

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

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

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

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 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 INSPECTION REPORT NATIONAL DAM SAFETY PROGRAM

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NAME OF DAM: LAKE MONOCAN DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam: Lake Monocan Dam
State: Virginia
County: Nelson
USGS 7.5 Minute Quadrangle: Greenfield, VA
Stream: Allen Creek
Date of Inspection: 29 November 1979

BRIEF ASSESSMENT OF DAM

Lake Monocan Dam is a zoned earthfill embankment approximately 410 feet long and 32.5 feet high, with a 49 foot wide vegetated earth emergency spillway. The dam, located approximately 1.0 mile north of Nellysford, Virginia, is used for irrigation, snowmaking, and recreation by the owner, the Wintergreen Development Corporation. Lake Monocan Dam is a "small" size - "significant" hazard structure as defined by the Recommended Guidelines for Safety Inspection of Dams.

Using the Corps of Engineers' screening criteria for initial review of spillway adequacy, the 100-year flood was selected as the spillway design flood (SDF). The SDF was routed through the reservoir and found to reach a maximum water surface elevation 2.5 feet below the top of the dam. The spillway is capable of passing up to 35 percent of the Probable Maximum Flood (PMF). It is adjudged as adequate.

Visual inspection and office analyses indicate no deficiencies requiring emergency attention.

A warning system and emergency action plan should be developed and put into operation. A qualified geotechnical engineering firm should be engaged to inspect the flow from the toe drain outlet and determine whether the particulate matter in the flow is embankment material or material that accidentally entered the drain during installation.

The following remedial measures should be undertaken as part of a regularly scheduled inspection and maintenance program:

- 1) All areas of sparse vegetation should be reseeded and fertilized as necessary.
- 2) All areas of erosion should be regraded and reseeded.
- 3) A staff gage should be installed to monitor lake levels above normal pool.

NAME OF DAM: LAKE MONOCAN DAM

MICHAEL BAKER, JR., INC.

SUBMITTED:

Original signed by:

JAMES A. WALSH

James A. Walsh, P.E.
Chief, Design Branch


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

RECOMMENDED:

Original signed by:

JACK G. STARR

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

APPROVED:

Original signed by:

Douglas L. Haller

Douglas L. Haller
Colonel, Corps of Engineers
District Engineer



Date: _____

MAY 5 1980

NAME OF DAM: LAKE MONOCAN DAM



OVERALL VIEW OF DAM

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
NAME OF DAM: LAKE MONOCAN DAM ID# VA 12502

SECTION 1 - PROJECT INFORMATION

1.1 General

- 1.1.1 Authority: Public Law 92-367, 8 August 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of safety inspections of dams throughout the United States. The Norfolk District has been assigned the responsibility of supervising the inspection of dams in the Commonwealth of Virginia.
- 1.1.2 Purpose of Inspection: The purpose is to conduct a Phase I inspection according to the Recommended Guidelines for Safety Inspection of Dams. The main responsibility is to expeditiously identify those dams which may be a potential hazard to human life and property.

1.2 Description of Project

- 1.2.1 Description of Dam and Appurtenances: Lake Monocan Dam is a zoned earthfill embankment approximately 32.5 feet high¹ and 410 feet long with a crest width of 10 feet. The upstream and downstream embankment slopes are approximately 2H:1V (Horizontal to Vertical) and 2.5H:1V, respectively. The crest of the dam has a minimum elevation of 686.6 feet Mean Sea Level (M.S.L.)² at a point adjacent to the emergency spillway.

The principal spillway is a side channel spillway located at the junction of the upstream embankment and the right³ abutment. The broad-crested weir crest, at elevation

¹Measured from the streambed at the downstream toe to the embankment crest.

²All elevations are referenced to Mean Sea Level (M.S.L.) based upon the elevation shown for the existing spillway crest in the proposed plans.

³Facing downstream.

NAME OF DAM: LAKE MONOCAN DAM

677.0 feet M.S.L., is 38.4 feet long. Vertical steel reinforcing bars embedded in the crest of the weir act as a trash rack. The principal spillway conduit is a 4 foot by 7 foot reinforced concrete conduit. Discharge from the principal spillway emerges from the conduit and passes over a concrete fan with wing walls before flowing into a riprapped plunge pool. The downstream invert elevation of the concrete fan is 658.2 feet M.S.L.

The vegetated earth emergency spillway, located in the right abutment, has a trapezoidal cross-section. It has a bottom width of 49 feet; the left and right side slopes are 6H:1V and 4H:1V, respectively. The invert elevation of the emergency spillway's control section is 681.7 feet M.S.L.

A 16 inch cast-iron pipe serves as the emergency drawdown conduit. It discharges at elevation 658 feet M.S.L. into a riprapped stilling basin. The emergency drawdown conduit is controlled by a 16 inch gate valve located in a manhole approximately halfway up the downstream embankment.

- 1.2.2 Location: Lake Monocan Dam is located on Allen Creek, a tributary of the South Fork Rockfish River, approximately 1 mile north of Nellysford, Nelson County, Virginia. A Location Plan is included with this report.
- 1.2.3 Size Classification: The maximum height of the dam is 32.5 feet and the reservoir storage capacity at the crest of the dam (elevation 687.5 feet M.S.L.) is 240 acre-feet. Therefore, the dam is in the "small" size category as defined by the Recommended Guidelines for Safety Inspection of Dams.
- 1.2.4 Hazard Classification: State Route 151 crosses Allen Creek approximately 0.6 mile below the dam. Although loss of human life is not highly probable, severe economic loss due to blockage of State Route 151 and destruction of farmland are likely in the event of a dam failure. Lake Monocan Dam is therefore considered in the "significant" hazard category as defined by the Recommended Guidelines for Safety Inspection of Dams. The hazard classification used to categorize dams is a

NAME OF DAM: LAKE MONOCAN DAM

function of location only and has nothing to do with its stability or probability of failure.

- 1.2.5 Ownership: The dam is owned by the Wintergreen Development Corporation, Wintergreen, Virginia 22938.
- 1.2.6 Purpose of Dam: The dam is used for recreation and to supply water for irrigation and snowmaking.
- 1.2.7 Design and Construction History: Both the original facility and the modifications currently underway were designed by Wiley and Wilson, Inc. of Lynchburg, Virginia. The original facility was completed in 1954.

Modifications to Lake Monocan Dam are currently underway. The modifications consist of the following:

- 1) Raise the embankment 6 feet and install an additional toe drain.
- 2) Raise the crest of the side channel principal spillway 5.0 feet.
- 3) Modify and repair the fan-shaped transition at the downstream end of the principal spillway conduit.
- 4) Provide an emergency spillway with a concrete control section.
- 5) Extend the emergency drawdown conduit downstream and replace the existing gate valve on the drawdown conduit with a sluice gate at the upstream end of the conduit.
- 6) Construct a concrete head wall at the outlets of the drawdown conduit and toe drain.

During the summer of 1979, the embankment was raised, the additional toe drain was installed, the emergency drawdown conduit was extended downstream, and a rough excavation was made for the emergency spillway. The remaining work, including final grading of the emergency spillway, is scheduled to be completed during the summer of 1980.

NAME OF DAM: LAKE MONOCAN DAM

- 1.2.8 Normal Operational Procedures: The reservoir is normally operated at the level of the principal spillway crest, elevation 677.0 feet M.S.L. No formal operating procedures are followed for this structure. See paragraph 4.1 for detailed operating procedures.

1.3 Pertinent Data

- 1.3.1 Drainage Area: The drainage area above Lake Monocan Dam is 1.41 square miles.

- 1.3.2 Discharge at Dam Site: Maximum discharge at the dam site is unknown.

Principal Spillway:

Pool level at top of dam . . . 1000 c.f.s.

Emergency Spillway:

Pool level at top of dam . . . 2540 c.f.s.

- 1.3.3 Dam and Reservoir Data: Pertinent data on the dam and reservoir are shown in the following table:

TABLE 1.1 DAM AND RESERVOIR DATA

Item	Elevation feet M.S.L.	Area acres	Reservoir Capacity		Length feet
			Acre- feet	Watershed inches	
Top of dam (average)	687.5	22.0	240	3.2	1500
Emergency spillway crest	681.7	14.5	135	1.8	1300
Principal spillway crest (normal pool)	677.0	10.3	77	1.0	975
Steambed at downstream toe of dam	655±	-	-	-	-

NAME OF DAM: LAKE MONOCAN DAM

SECTION 2 - ENGINEERING DATA

- 2.1 Design: The site was investigated and the embankment designed by Wiley and Wilson, Inc. of Lynchburg, Virginia. There were no as-built plans or complete geologic report available for preparation of this section; however, the proposed plans for both the modifications currently underway and the original dam and a geotechnical study prepared for the current addition of an emergency spillway to the dam were available for review.

The dam lies within the Blue Ridge Mountain Complex, specifically the Marshall Formation, which is characterized by silty soils, boulders, rock of biotite, quartz, feldspathic granite, gneiss, and quartz monzonite. The available geotechnical study was prepared in April of 1979 by Sayre and Associates, Inc., of Richmond, Virginia, and included the logs of four test borings. The geotechnical study is included in this report as Appendix IV. The borings were localized in the area of the proposed emergency spillway slightly west of the embankment; however, they most likely represent the soils underlying the embankment, abutments, and appurtenant structures because of their close proximity to the emergency spillway. The soils of the borings were covered by a thin layer of topsoil, below which existed approximately 5 feet of brown, clayey sands. Underlying these sands are combinations of gray silty sands with boulders and gray clayey sands. The deepest bore hole was 25 feet deep.

In their study, Sayre and Associates, Inc. concluded that the material to be excavated from the area of the emergency spillway would be suitable for use in raising the embankment with two provisions: that no boulders larger than 6 inches be used in the fill and that large rocks and small boulders must be scattered through the fill and not allowed to "nest". No clay material satisfactory for use in the core of the dam was present in the spillway cut.

As mentioned above, there were no as-built plans available for review. According to the owner's representatives and the proposed plans, the dam has a concrete cut-off wall surrounded by an impervious core. The borrow sources for the impervious core and the original embankment are unknown. The borrow source for the raising of the embankment was the emergency spillway cut. There were no stability analyses or compaction tests available for preparation of this section. The

NAME OF DAM: LAKE MONOCAN DAM

proposed drawings of the dam modifications currently underway are included in Appendix I.

- 2.2 Construction: The original dam was completed in 1954. Modifications to the dam are currently underway. See Section 1.2.7 for a list of these modifications. Construction records were not available for this inspection.
- 2.3 Evaluation: No stability analyses or hydrologic and hydraulic data were available for review. No construction records or as-built plans were available to adequately assess the condition of the dam. All evaluations and assessments in this report were based upon field observations and office analyses.

NAME OF DAM: LAKE MONOCAN DAM

SECTION 3 - VISUAL INSPECTION

3.1 Findings

3.1.1 General: The field inspection was conducted on 29 November 1979. At the time of the inspection, the pool elevation was 677.1 feet M.S.L.; the tailwater elevation was 655.0 feet M.S.L.; the weather was partly cloudy, windy, and cold with temperatures in the low 40's°F. The ground surface at the embankment and appurtenant structures during the inspection were found to be in good overall condition. Deficiencies found at the time of the inspection are not believed to indicate any major stability problems although they will require remedial treatment. The following are brief summaries of deficiencies found during the inspection. A Field Sketch of conditions is shown on Plate 1. The complete visual inspection check list is given in Appendix III.

Visual examination of the dam in late March 1978 disclosed a wet area along the downstream toe of the embankment, with small areas of seepage scattered throughout the wet area. A significant amount of seepage was flowing around the base of the valve box on the drawdown conduit. A blocked underdrain pipe, suspected to be the cause of the seepage, was exposed and allowed to drain for several weeks. On 24 April 1978, Mr. Robert A. Sayre, P.E., of Sayre and Sutherland, Inc., who had been present during the original examination in March, revisited the dam; he found that the entire toe of the dam was dry and that there was a relatively small amount of clean water flowing from the underdrain pipe. Mr. Sayre concluded that the seepage observed in March was the result of the blocked underdrain pipe. He found no evidence of unsafe conditions in the embankment and recommended that the raising of the embankment be allowed to proceed. Relevant correspondence is included in Appendix V of this report.

3.1.2 Dam: The embankment was found to be in generally good condition with no surface cracks, slumps, or other indications of instability either on the embankment or at the toe. There were scattered areas of

NAME OF DAM: LAKE MONOCAN DAM

sparse vegetation which were showing signs of minor erosion, particularly the junction between the downstream embankment and the right abutment. The embankment area directly above the spillway outlet was severely eroded due to the lack of vegetation. The owner's representatives stated that plans to remedy the situation are presently underway. Erosion was also noted on the left upstream abutment.

There was a flow estimated at 5 gallons per minute draining from the riprapped wall of the plunge pool for the reservoir drawdown outlet works. The flow was colorless but contained some particulate matter. Discussion with Wiley and Wilson, the designers of the dam, disclosed that this flow comes from the toe drain, which is currently covered with riprap. A head wall is to be constructed at the outlets during the summer of 1980.

- 3.1.3 Appurtenant Structures: The principal spillway is a side channel spillway. The overflow weir is 38.4 feet long and drops 2.5 feet at the upstream wall. The conduit is a 4.0 foot by 7.0 foot reinforced concrete box opening to a concrete fan with wing walls. There is a crack extending the length of the joint between the outlet channel wall and the left wing wall.

The emergency spillway was in good condition; however, minor erosion gullies were beginning to form in the discharge channel. This area was seeded for the first time last summer and erosion probably began before the vegetation became established. The owner's representatives stated that proposed additions to the dam will include a concrete weir for this spillway.

- 3.1.4 Reservoir Area: The reservoir slopes are gentle and covered with trees and brush. There were no instabilities noted in this area. The reservoir level is to rise 5 feet after the current dam modifications are completed and the areas of the reservoir slope to be affected by the raised water level have already been cleared. No sedimentation which would affect the operation of the reservoir was observed during the inspection.

NAME OF DAM: LAKE MONOCAN DAM

3.1.5 Downstream Channel: The stilling basin and downstream channel are clearly defined and well lined with riprap. The overbanks are vegetated with small trees and brush. There is only one residence in the downstream damage area, approximately 1.3 miles below the dam. This residence is on a rock outcropping which rises well above the surrounding floodplain.

3.1.6 Instrumentation: There is no instrumentation at the dam.

3.2 Evaluation: The dam is generally in good condition. The major deficiency to be corrected is the erosion occurring at various places, most noticeably on the downstream face above the principal spillway outlet. A qualified geotechnical engineering firm should be engaged to inspect the flow from the toe drain and determine whether the particulate matter is embankment material or material that accidentally entered the drain during installation.

NAME OF DAM: LAKE MONOCAN DAM

SECTION 4 - OPERATIONAL PROCEDURES

- 4.1 Procedures: The reservoir is maintained at the normal pool elevation of 677.0 feet M.S.L. by means of the weir crest of the side channel principal spillway.

During periods of heavy inflow, the excess water is diverted around the dam by means of the emergency spillway. To protect the downstream toe from erosion caused by flow through the emergency channel, a berm was left between the embankment and spillway when the spillway was cut into the right abutment.

- 4.2 Maintenance of Dam: Maintenance of the dam is the responsibility of the owner. There is no formal inspection or maintenance schedule but inspections are made periodically and maintenance performed as needed.
- 4.3 Maintenance of Operating Facilities: The only control equipment at the dam is the gate valve on the drawdown conduit. According to the owner's representatives, this valve is operable.
- 4.4 Warning System: At the present time, there is no warning system or emergency action plan in operation.
- 4.5 Evaluation: Maintenance of the dam is considered adequate. A warning system and emergency action plan should be developed and put into operation.

NAME OF DAM: LAKE MONOCAN DAM

SECTION 5 - HYDRAULIC/HYDROLOGIC DATA

- 5.1 Design: Portions of the hydrologic design calculations for the ongoing modifications to the dam were available for review. Relevant correspondence is contained in Appendix V. The 100-year flood was used to design the emergency spillway. The maximum design discharge of the proposed emergency spillway is 484 c.f.s. at a reservoir level of 685.0 feet M.S.L.
- 5.2 Hydrologic Records: No rainfall or stream flow records were available at the dam site.
- 5.3 Flood Experience: There were no high water marks available at the dam site. According to the owner's representatives, the dam was overtopped during Hurricane Camille in 1969, but suffered no damage.
- 5.4 Flood Potential: The Probable Maximum Flood (PMF), 1/2 Probable Maximum Flood (1/2 PMF), and the 100-year flood were developed and routed through the reservoir, for both existing and proposed conditions, by use of the HEC-1 DB computer program (Reference 9, Appendix VI) and appropriate unit hydrograph, precipitation, and storage-outflow data. Clark's T_c and R coefficients for the local drainage areas were estimated from basin characteristics. The rainfall applied to the unit hydrograph was taken from publications by the U.S. Weather Bureau and the National Oceanic and Atmospheric Administration (References 16 and 17, Appendix VI). Rainfall losses for the 100-year flood were estimated at an initial loss of 1.5 inches and a constant loss of 0.15 inch per hour thereafter. An initial loss of 1.0 inch and a constant loss rate of 0.05 inch per hour were used for the PMF and 1/2 PMF.
- 5.5 Reservoir Regulation: Pertinent dam and reservoir data are shown in Table 1.1, Paragraph 1.3.3.

Regulation of flow from the reservoir is automatic. Normal flows are maintained by the weir crest of the side channel principal spillway at elevation 677.0 feet M.S.L. Water also flows past the dam through the ungated, vegetated emergency spillway in the event water in the reservoir rises above an elevation of 681.7 feet M.S.L.

Outlet discharge capacity was computed by hand; reservoir area was planimetered from the Greenfield, Virginia, 7.5 minute USGS quadrangle; and storage capacity was computed by the HEC-1 DB program. All flood routings

NAME OF DAM: LAKE MONOCAN DAM

were begun with the reservoir at normal pool. Flows through the principal spillway were included in the routings.

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

TABLE 5.1 RESERVOIR PERFORMANCE

Item	Hydrographs				
	Normal(a)	100-year flood(b)	100-Year flood	1/2 PMF	PMF(c)
Peak flow, c.f.s.					
Inflow	3	2052	2052	5154	10,309
Outflow	3	1835	1522	5007	10,048
Peak elev., ft. M.S.L.	677.0	685.9	685.0	688.4	690.0
Emergency spillway (d) (elev. 681.7 feet M.S.L.)					
Depth of flow, ft.	-	3.2	3.3	6.7	8.3
Average velocity, f.p.s.	-	8.3	8.4	12.0	13.4
Duration of flow, hrs.	-	6.3	2.8	5.3	7.8
Non-overflow section (d) (elev. 687.5 ft. M.S.L.)					
Depth of flow, ft.	-	-	-	0.9	2.5
Average velocity, f.p.s.	-	-	-	3.9	7.3
Total duration of over- topping, hrs.	-	-	-	1.3	2.8
Tailwater elev., ft. M.S.L.	655.0	-	-	-	-

- (a) Conditions at time of inspection.
(b) After current modifications are completed; emergency spillway elev. = 682.7 ft. M.S.L.
(c) 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.
(d) Velocity estimates were based on critical depth at the control section.

- 5.7 Reservoir Emptying Potential: The reservoir can be drawn down by means of the gated 16 inch cast-iron emergency drawdown conduit. Neglecting inflow, the reservoir can be drawn down from normal pool in approximately 9 days. This is equivalent to an approximate drawdown rate of 1.7 feet per day, based on the hydraulic height measured from normal pool divided by the time to dewater the reservoir.

- 5.8 Evaluation: Lake Monocan Dam is a "small" size - "significant" hazard dam requiring evaluation for a

NAME OF DAM: LAKE MONOCAN DAM

spillway design flood (SDF) in the range between the 100-year flood and the 1/2 PMF. Because of the risk involved, the 100-year flood has been selected as the SDF. The 100-year flood was routed through the reservoir and found to reach a maximum water surface elevation 2.5 feet below the top of the dam. The spillways as existing at the time of inspection are capable of passing up to 35 percent of the PMF.

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

NAME OF DAM: LAKE MONOCAN DAM

SECTION 6 - DAM STABILITY

6.1 Foundation and Abutments: There is no information available on the foundation conditions. The dam is located in the Blue Ridge geologic region of Virginia. The predominate deposit in the area is the Precambrian Age Marshall Formation. According to the proposed plans, the dam has a drainage system consisting of a 6 inch diameter perforated pipe wrapped with poly filter x material and surrounded by a filter blanket. The proposed plans show a concrete core wall a maximum of 5 feet high extending at least 1 foot into hard rock free of fissures; the core wall is shown surrounded by an impervious core. The predominate foundation materials are biotite, quartz, feldspathic granite, gneiss, and quartz monzonite.

6.2 Embankment

6.2.1 Material: There is no information available on the specific nature of the materials used in the original embankment. The embankment was raised 6 feet in the summer of 1979. A geotechnical study made for the emergency spillway was available for review; this study included the logs of four test borings made slightly to the west of the embankment. The boring logs show that the soils found were clayey and silty sands. Material from the area where the borings were located was used to raise the embankment in the summer of 1979.

6.2.2 Stability: There are no available stability calculations. The dam is 32.5 feet high and 10 feet wide. It has an upstream slope of 2H:1V and a downstream slope of 2.5H:1V.

The elevation of the normal pool will be raised by 5 feet when the current modifications to the dam are completed. In 1969, the then-existing embankment was overtopped, but it did not fail. Duration and depth of the overtopping flows are not known. At the time of the inspection, the dam had a freeboard of 4.7 feet between the principal spillway crest and the emergency spillway invert. When the ongoing modifications are completed, the freeboard will be reduced to 0.7 foot. The dam is subject to a sudden drawdown because

NAME OF DAM: LAKE MONOCAN DAM

the approximate reservoir drawdown rate of 1.7 feet per day exceeds the critical rate of 0.5 foot per day for earth dams.

According to the guidelines presented in Design of Small Dams by the U.S. Department of the Interior, Bureau of Reclamation, for small zoned earthfill dams, with a minimum core and stable foundation, subjected to a drawdown, and composed of clayey and silty sands (SC, SM); the recommended slopes are 2H:1V both upstream and downstream. The recommended width is 16 feet. Based on these guidelines, the upstream slope is adequate and the downstream slope is more than adequate; however, the width is inadequate.

6.2.3 Seismic Stability: Lake Monocan 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 adequately evaluate the stability of the dam. The visual inspection revealed a flow draining from the riprap surrounding the emergency drawdown outlet; the flow was colorless but contained some particulate matter. Conversations with the designer of the dam disclosed that this flow issued from the outlet of the toe drain, which was temporarily covered with riprap; a concrete head wall is scheduled to be constructed during the summer of 1980. Other than this, the visual inspection revealed no indications of instability. Based on the Bureau of Reclamation guidelines, the upstream slope is adequate and the downstream slope is more than adequate, but the crest width is inadequate. The spillway passes the design flood with the maximum water surface elevation 2.5 feet below the top of the dam.

Although the crest width is inadequate based on the Bureau of Reclamation guidelines, those guidelines state that "... the crest width is, as a rule, determined empirically and largely by precedent ...". Taking this and the fact that the downstream slope is more than adequate into consideration, the inadequacy of the crest width is not considered to indicate any potential for instability.

NAME OF DAM: LAKE MONOCAN DAM

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

- 7.1 Dam Assessment: The engineering data available was insufficient to adequately evaluate the condition of the dam. No deficiencies were discovered during the field inspection and office analyses which would require emergency attention; however, the presence of particulate matter in the flow from the toe drain will require further investigation. The dam and appurtenant structures are generally in good condition; maintenance of the dam is considered adequate.

Using the Corps of Engineer's screening criteria for initial review of spillway adequacy, the 100-year flood was selected as the SDF for the "small" size - "significant" hazard classification of Lake Monocan Dam. It has been determined that the spillway would pass the SDF with a maximum water surface 2.5 feet below the top of the dam. The spillway is capable of passing up to 35 percent of the PMF and is adjudged as adequate.

There is no warning system or emergency action plan currently in operation.

- 7.2 Recommended Remedial Measures: A warning system and emergency action plan should be developed and put into operation as soon as possible. A qualified geotechnical engineering firm should be engaged to inspect the flow from the toe drain outlet and determine whether the particulate matter in the flow is embankment material or material that accidentally entered during installation.

The following measures should be carried out as part of the general maintenance of the dam.

- 1) All areas of sparse vegetation should be reseeded and fertilized as necessary.
- 2) All areas of erosion should be graded and reseeded.
- 3) A staff gage should be installed to monitor reservoir levels above normal pool.

NAME OF DAM: LAKE MONOCAN DAM

Based on the visual inspection, comparison with the Bureau of Reclamation guidelines, and the ability of the spillway to pass the design flood, there is no reason to doubt the stability of the dam and a stability check is not required. However, a qualified geotechnical engineering firm should be engaged to inspect the flow from the toe drain and determine whether the particulate matter is embankment material or material that accidentally entered the drain during installation.

NAME OF DAM: LAKE MONOCAN DAM

APPENDIX I

PLATES

CONTENTS

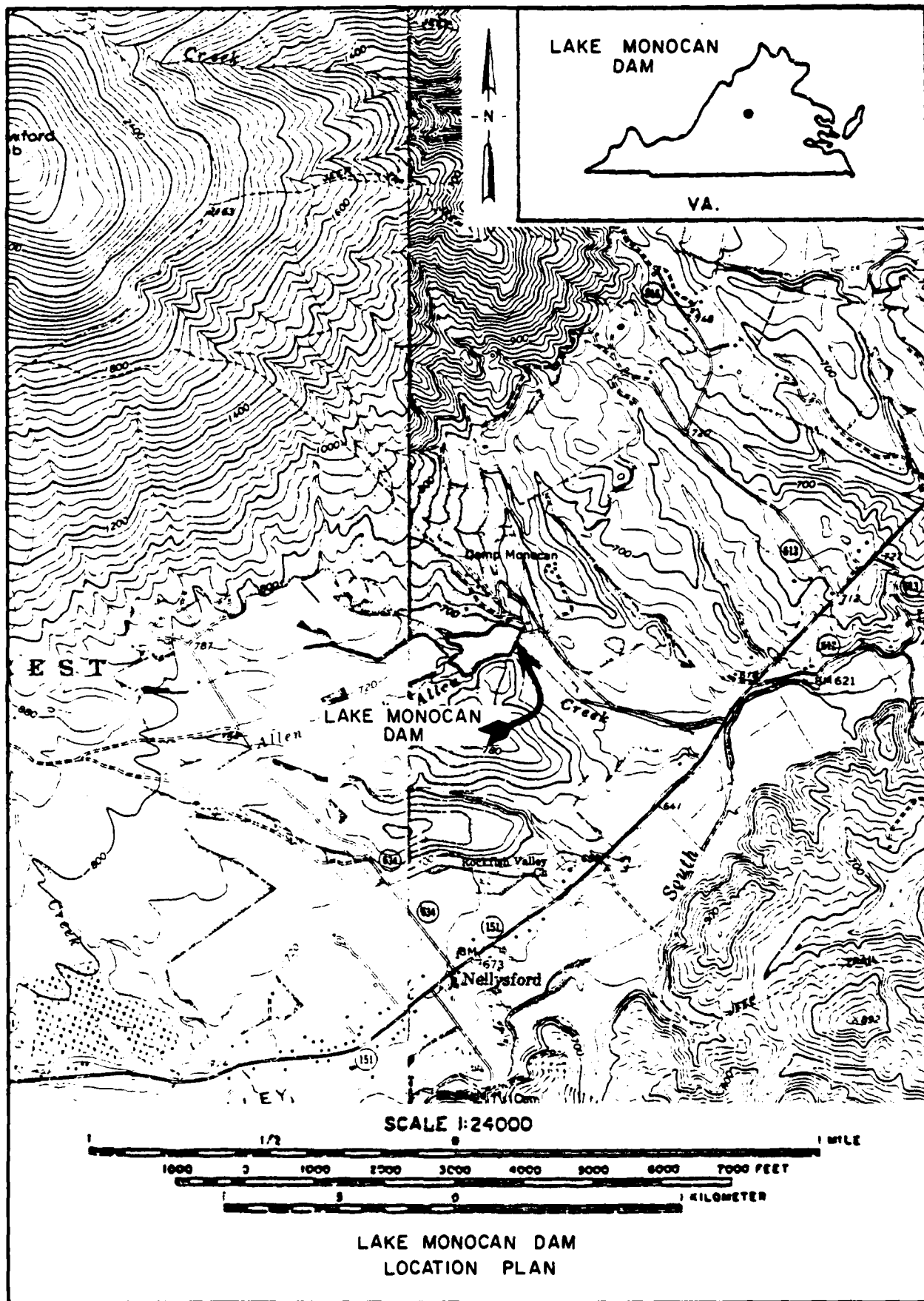
Location Plan

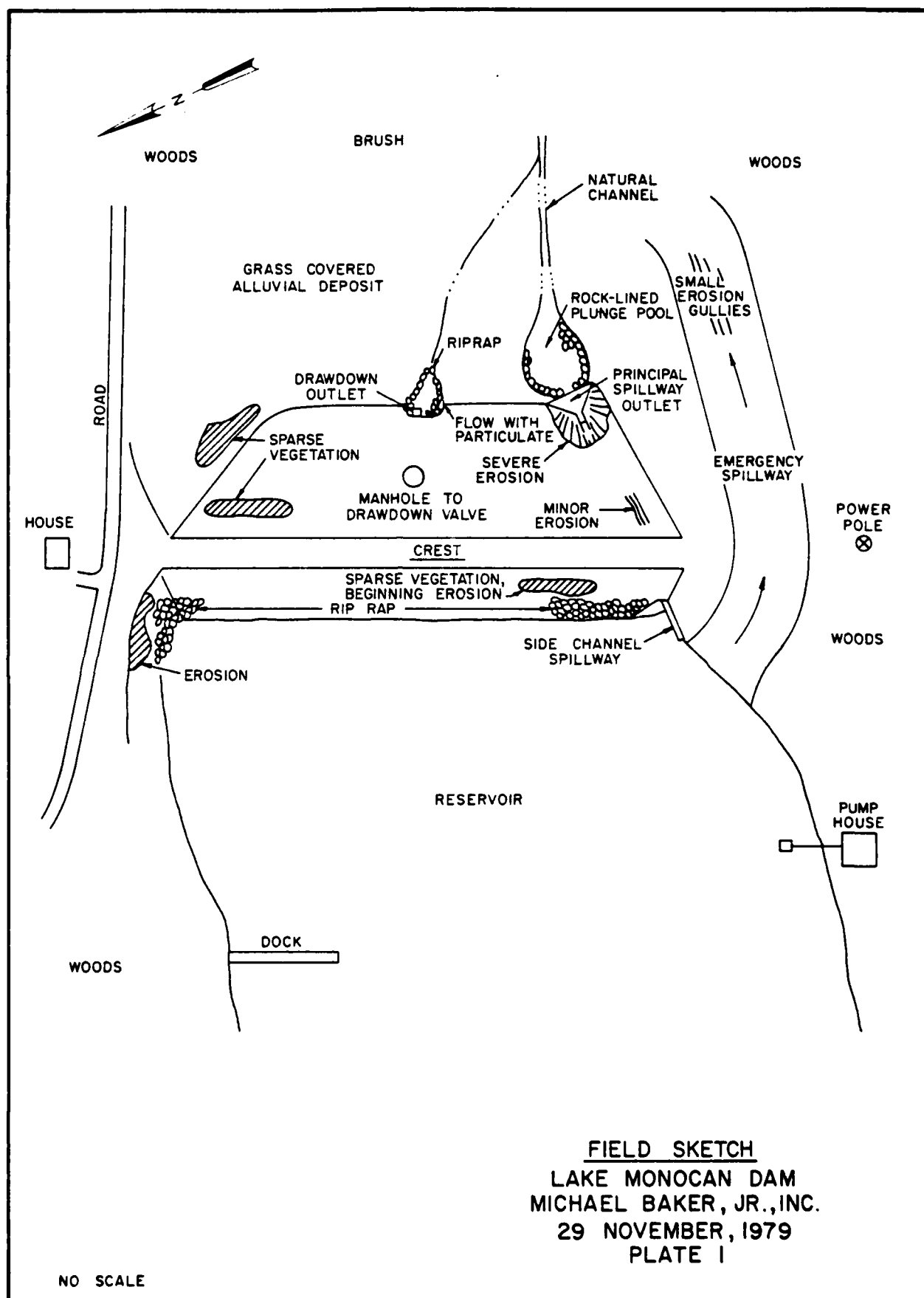
Plate 1: Field Sketch

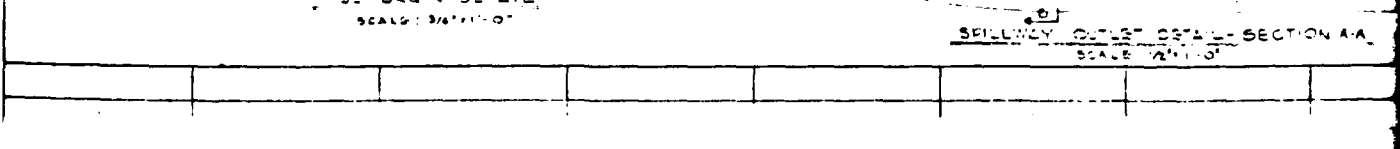
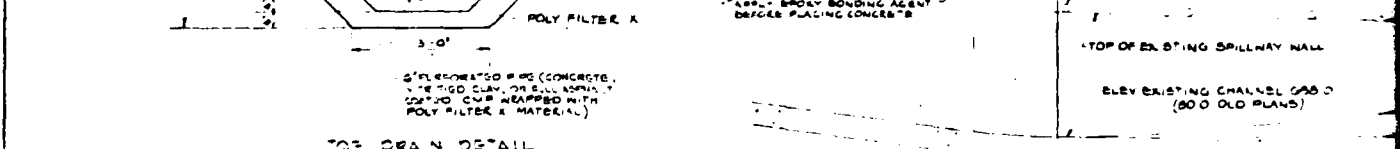
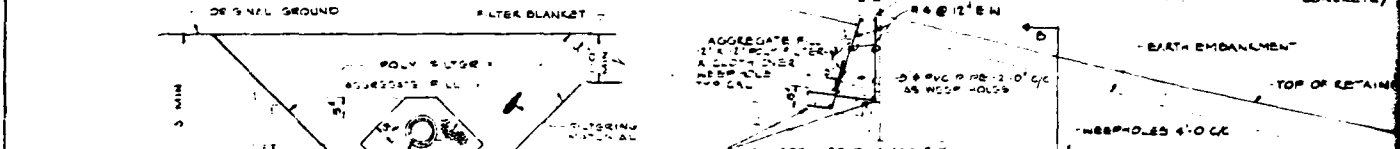
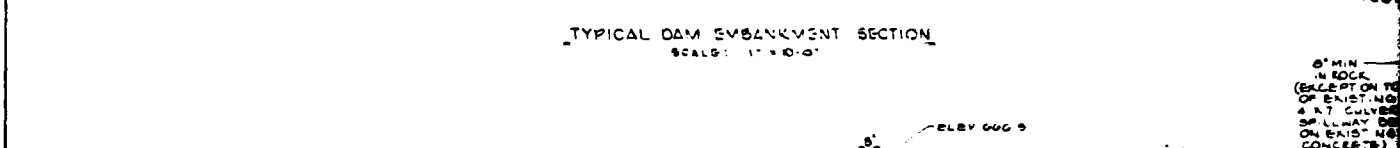
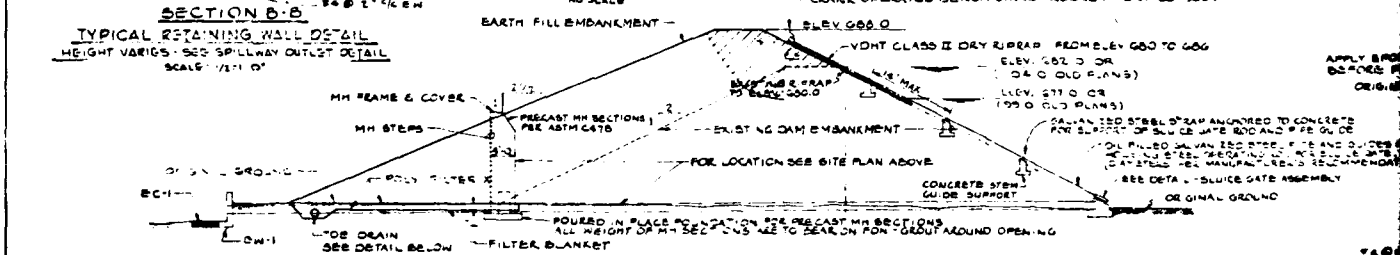
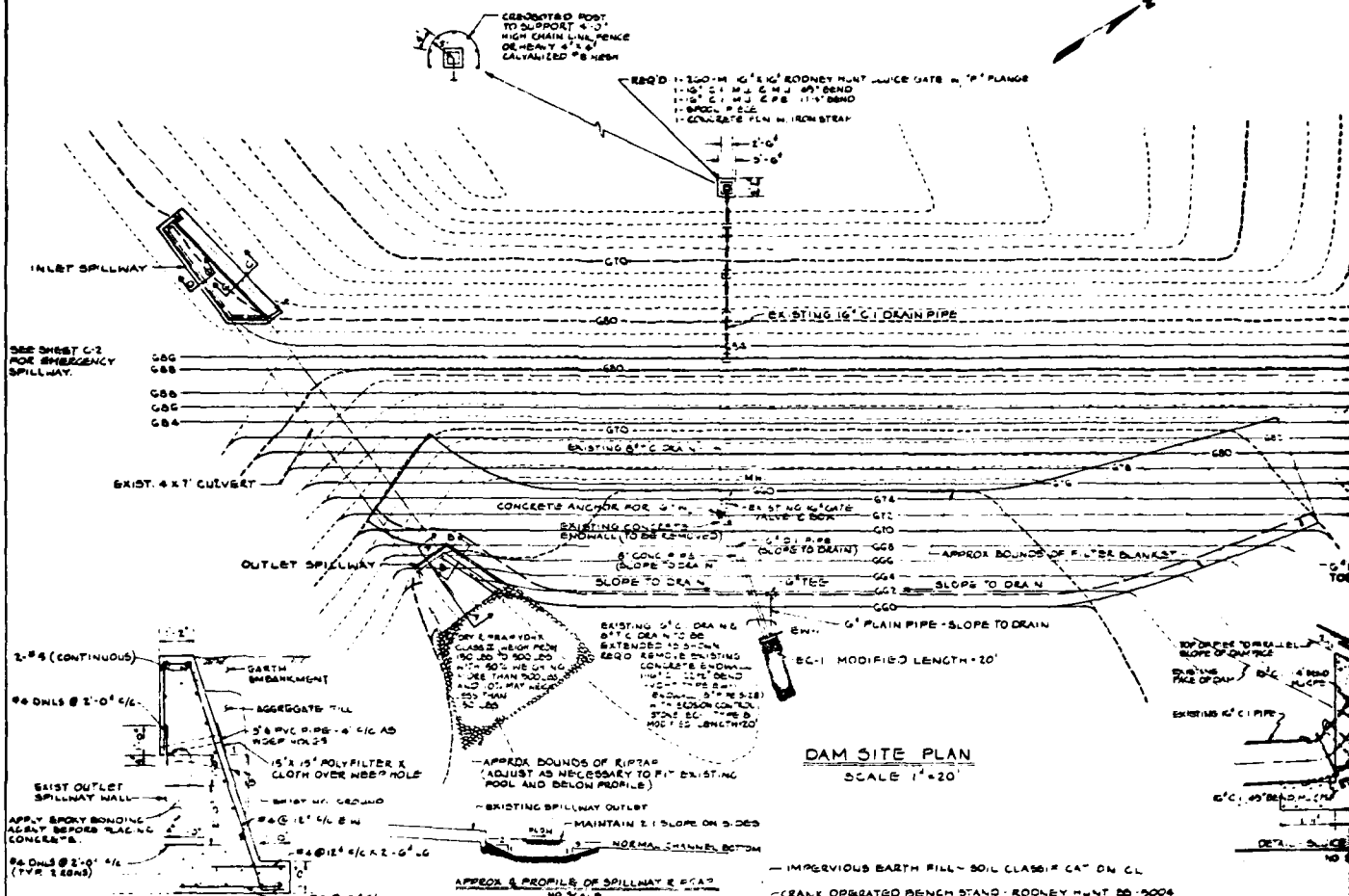
Plate 2: Dam Site, Sections, and Details

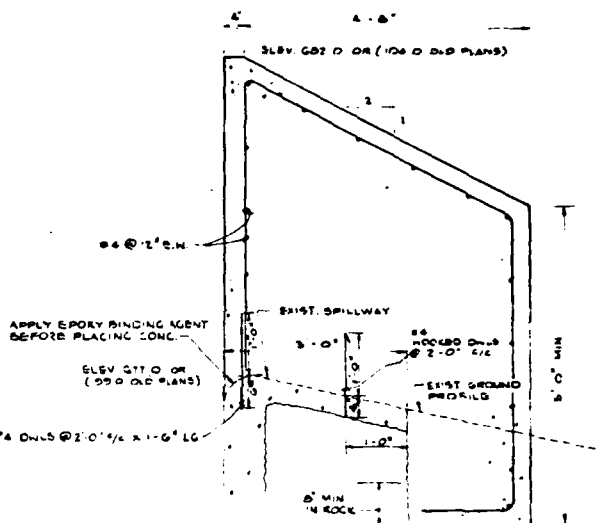
Plate 3: Emergency Spillway Profile and Sections

NAME OF DAM: LAKE MONOCAN DAM









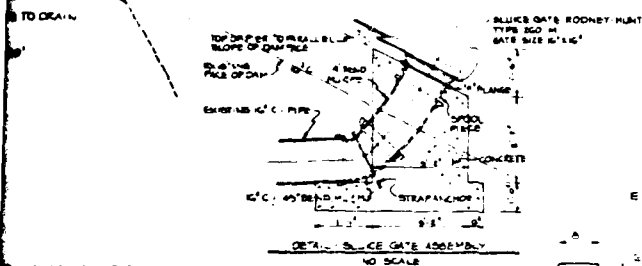
INLET SPILLWAY DETAIL-SECTION C-C
SCALE: 1" = 10'
(TYPICAL FOR NORMAL OVERFLOW SPILLWAY)

LEGEND

OWLS	DOMALS
LO	LONG
GOO	BAITING CONTINUES
TO	FINISHED CONTINUED
TH	MAINTENANCE
ELBY	ELBY ON
DIND	DIRECTOR OF MECHANICAL UNIT
EXOT	EXOTIC
YOUT	YOUTH DEPARTMENT OF HIGHWAYS & TRANSPORTATION
GC	GENERAL GOVERNMENT
MY	MYN
ALT	ALTERNATE
SM	SALARY
	TELEPHONE

GENERAL NOTES

1. POW AT CAMP 2, 1000 YARDS EAST OF THE MAIN CAMP, ALSO BY CAPTAIN H. L. B. CINCINNATI, OHIO. INITIAL FILED WITH THE MAIN CAMP, REFS 3000, 3000, 3000.
2. BATTLE THE CAMP 2, 1000 YARDS EAST OF THE MAIN CAMP, ALSO BY CAPTAIN H. L. B. CINCINNATI, OHIO. INITIAL FILED WITH THE MAIN CAMP, REFS 3000, 3000, 3000.
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6. BATTLE THE CAMP 2, 1000 YARDS EAST OF THE MAIN CAMP, ALSO BY CAPTAIN H. L. B. CINCINNATI, OHIO. INITIAL FILED WITH THE MAIN CAMP, REFS 3000, 3000, 3000.
7. BATTLE THE CAMP 2, 1000 YARDS EAST OF THE MAIN CAMP, ALSO BY CAPTAIN H. L. B. CINCINNATI, OHIO. INITIAL FILED WITH THE MAIN CAMP, REFS 3000, 3000, 3000.
8. BATTLE THE CAMP 2, 1000 YARDS EAST OF THE MAIN CAMP, ALSO BY CAPTAIN H. L. B. CINCINNATI, OHIO. INITIAL FILED WITH THE MAIN CAMP, REFS 3000, 3000, 3000.
9. BATTLE THE CAMP 2, 1000 YARDS EAST OF THE MAIN CAMP, ALSO BY CAPTAIN H. L. B. CINCINNATI, OHIO. INITIAL FILED WITH THE MAIN CAMP, REFS 3000, 3000, 3000.
10. BATTLE THE CAMP 2, 1000 YARDS EAST OF THE MAIN CAMP, ALSO BY CAPTAIN H. L. B. CINCINNATI, OHIO. INITIAL FILED WITH THE MAIN CAMP, REFS 3000, 3000, 3000.



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NO. ROONEY HUNT DO-9004

MAP FROM S.E. 60 TO 606
N. 602 D OR
S O 606 P.A.N.)
N. 612 D OR

FOR SUPPORT OF SUB CE 44

ALL INFORMATION CONTAINED
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OR GINA

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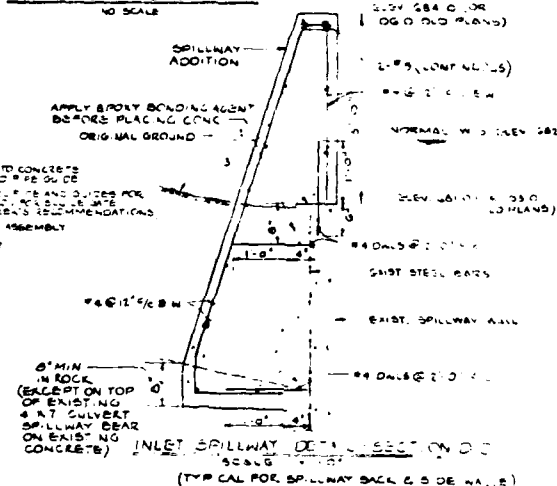
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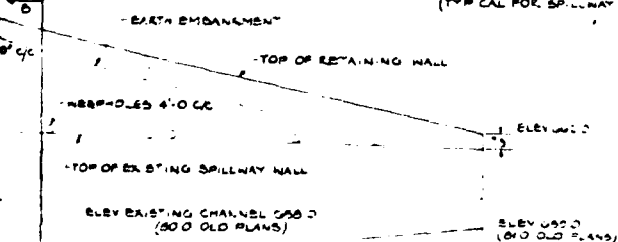
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SCALE 1:100

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(TYPICAL FOR SPILLWAY BACK & SIDE WALLS)



RAY - OUTLET DETAIL - SECTION A-A
SCALE 1/2" = 1'-0"

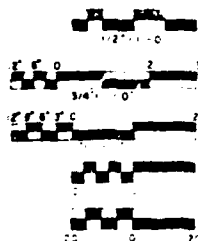


PLATE 2

ALLEN GREEN DAY MODIFICATION
FOR
WINNIE GREEN
NELSON CO VIRGINIA

NO. 08-101
A-5-5-A-101
FEDERAL BUREAU OF INVESTIGATION
FEDERAL TRIALS PLANNERS
WASHINGTON D.C.

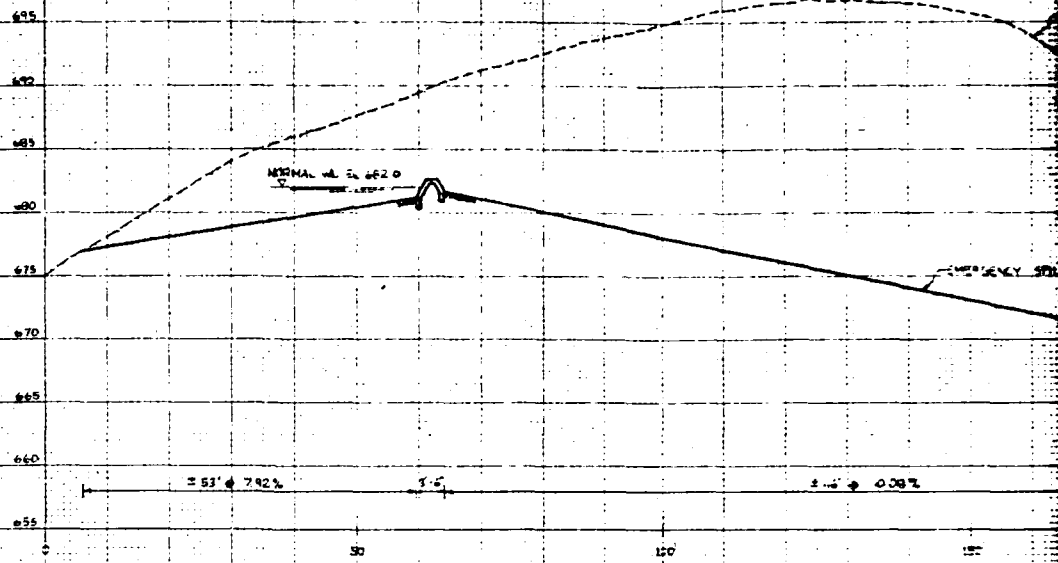
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DATE 07-10-20 BY 60322 UCBAW

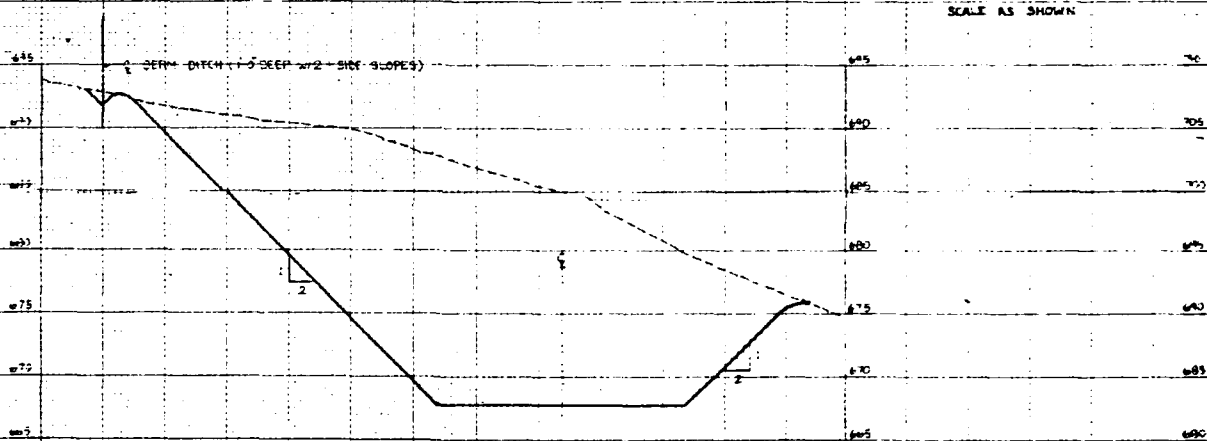
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U.S. DEPARTMENT OF JUSTICE
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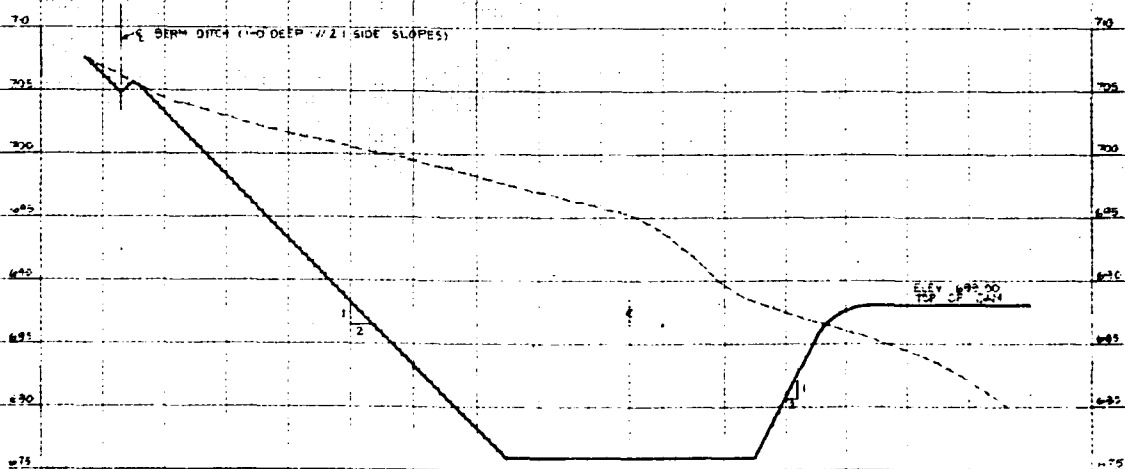
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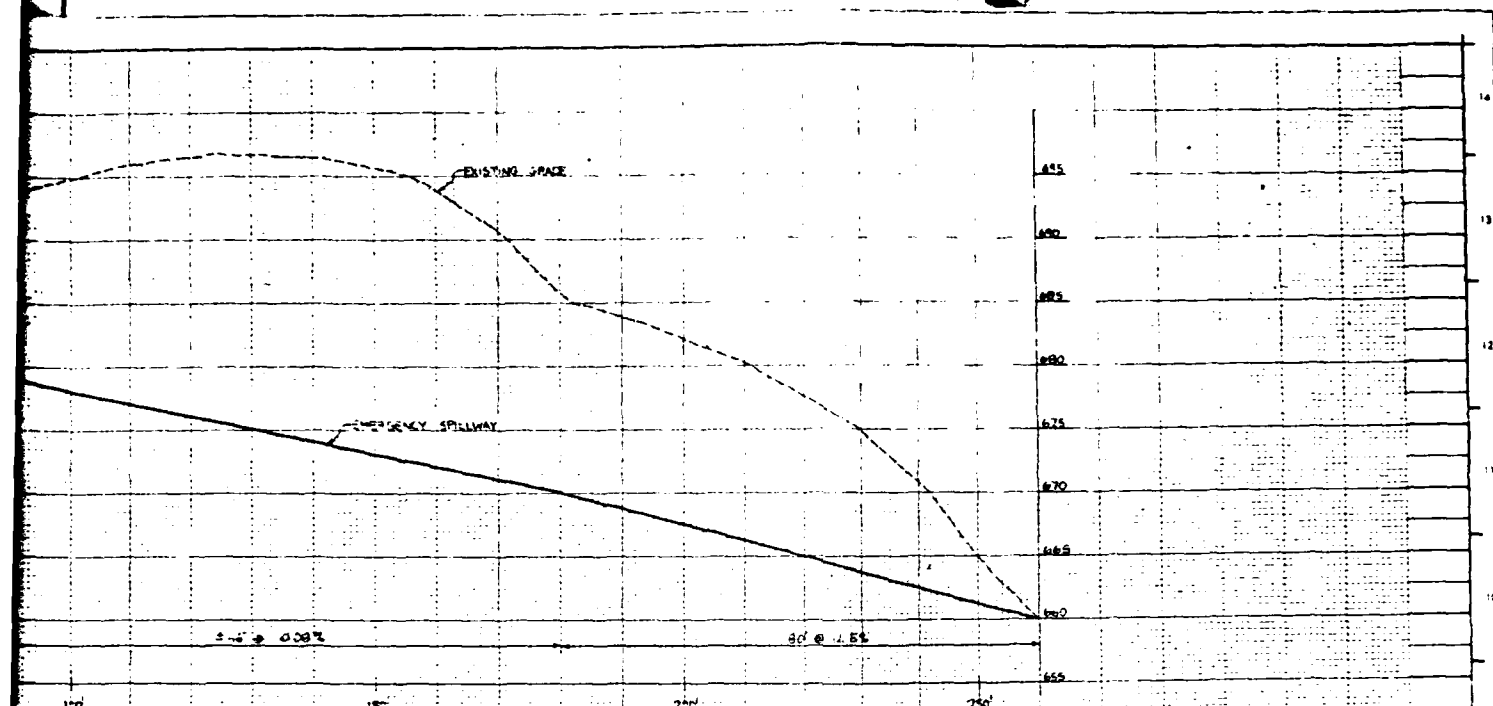
PROFILE EMERGENCY SPILLWAY
SCALE AS SHOWN



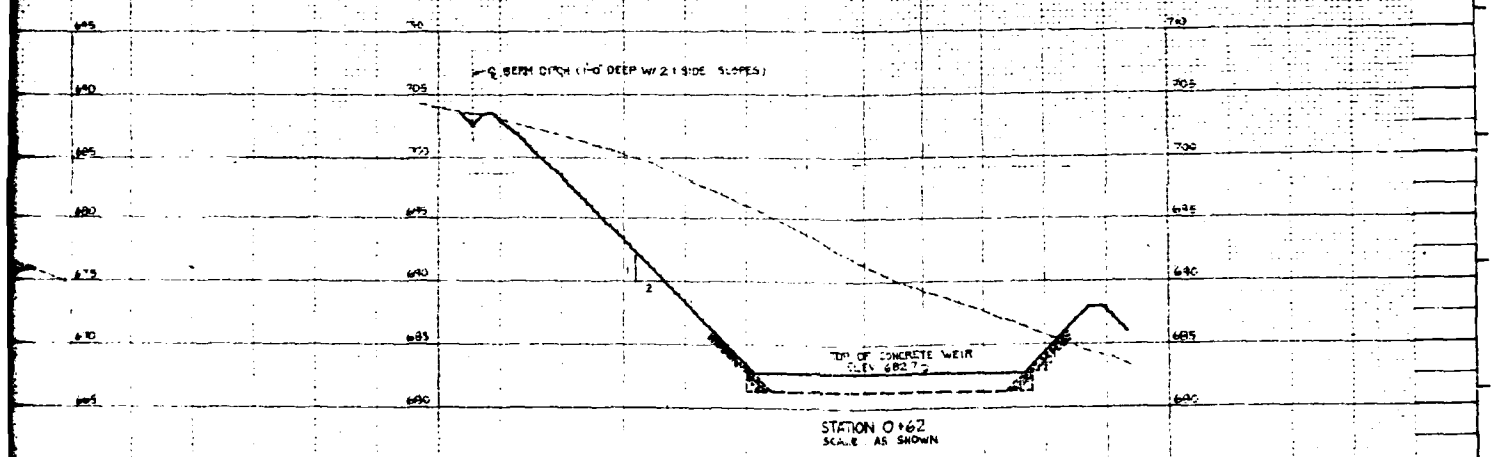
STATION 2+00
SCALE AS SHOWN



STATION 1+20
SCALE AS SHOWN



PROFILE EMERGENCY SPILLWAY
SCALE AS SHOWN



STATION 0+62
SCALE AS SHOWN

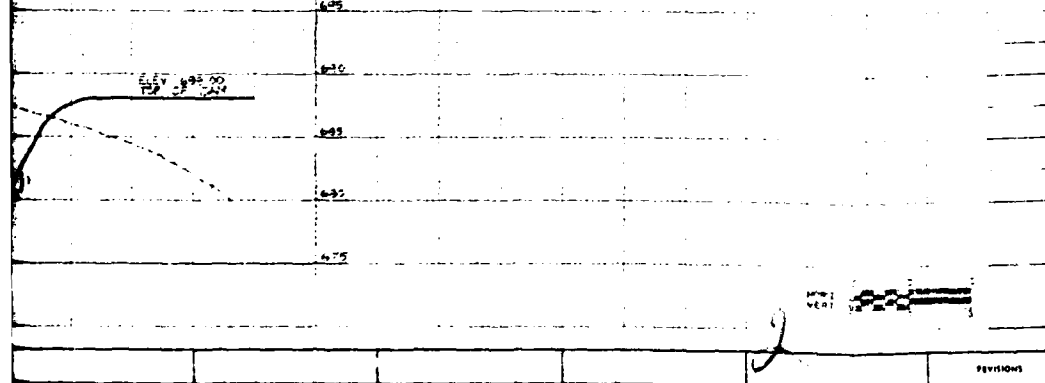


PLATE 3

WILEY & WILSON, INC. A PROFESSIONAL CORPORATION ENGINEERS - ARCHITECTS - PLANNERS			
PROJECT NO.	DATE	SCALE	BY
REVISION	DATE	SCALE	BY
REVISION			
DWG			

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PHOTOGRAPHS

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- Photo 1: Principal Spillway Intake Structure
- Photo 2: Principal Spillway Outlet Structure; Erosion
Around Outlet Structure
- Photo 3: View of Crack at Junction of Principal Spillway
Conduit and Outlet Structure
- Photo 4: Emergency Drawdown Outlet; Area of Seepage is
Below the Glove
- Photo 5: Plunge Pool and Downstream Channel
- Photo 6: Emergency Spillway Discharge Channel and Right
Abutment

Note: Photographs were taken on 29 November 1979.

NAME OF DAM: LAKE MONOCAN DAM

LAKE MONOCAN DAM

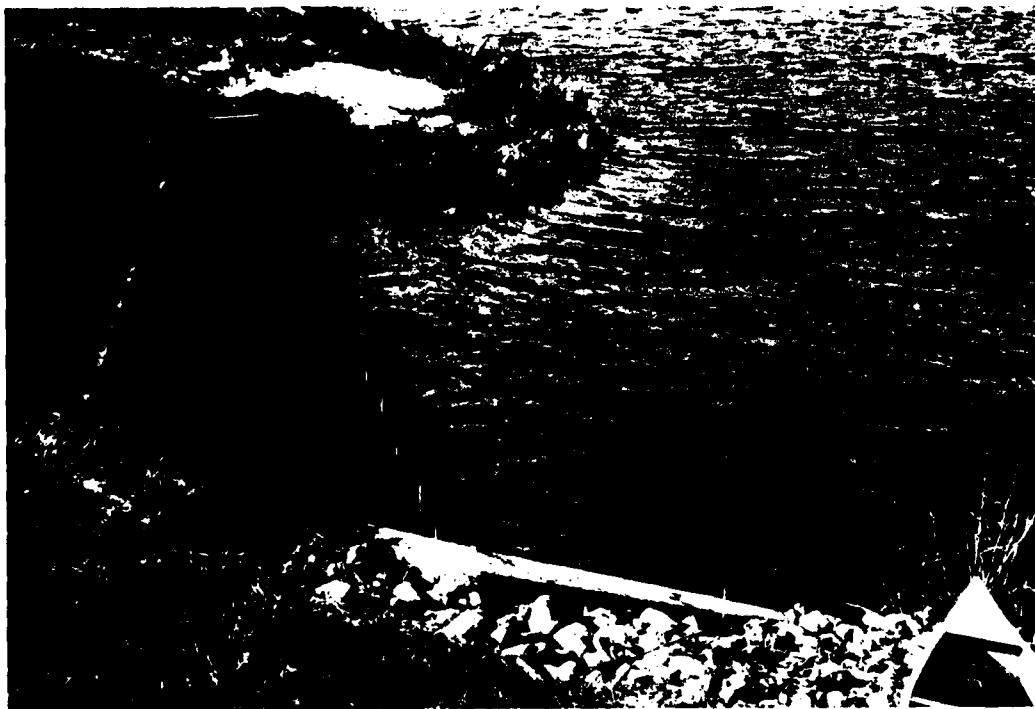


PHOTO 1. Principal Spillway Intake Structure



**PHOTO 2. Principal Spillway Outlet Structure;
Erosion Around Outlet Structure**

LAKE MONOCAN DAM



**PHOTO 3. View of Crack at Junction of Principal Spillway Conduit
and Outlet Structure**



PHOTO 4. Emergency Drawdown Outlet; Area of Seepage is Below the Glove

LAKE MONOCAN DAM



PHOTO 5. Plunge Pool and Downstream Channel

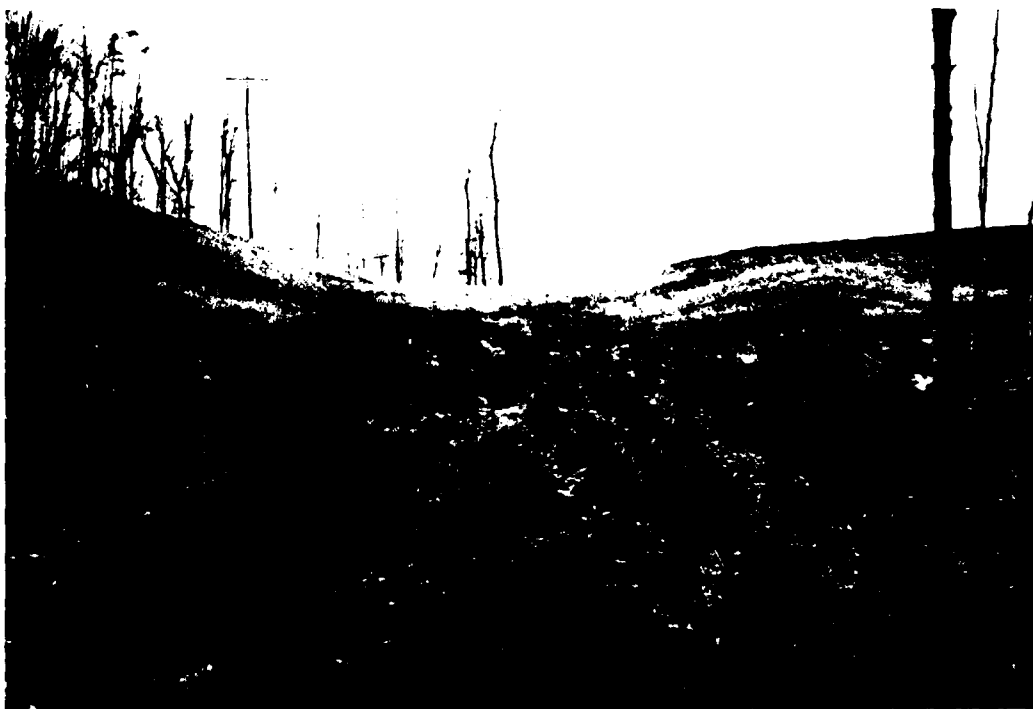


PHOTO 6. Emergency Spillway Discharge Channel and Right Abutment

APPENDIX III
VISUAL INSPECTION CHECK LIST

Check List
Visual Inspection
Phase 1

Name of Dam Lake Monocan Dam County Nelson State Virginia Coordinates Lat. 3754.2
Long. 7852.1

Date of Inspection 29 November 1979 Weather Windy, cool Temperature Low 40's° F.

Pool Elevation at Time of Inspection 677.1 ft. M.S.L. Tailwater at Time of Inspection 655.0 ft. M.S.L.

H
H
H
H

Inspection Personnel:

Michael Baker, Jr., Inc.:

Jeffrey A. Quay
James A. Kunceliman
Leslie K. Black

Virginia State Water Control Board:

Edwin B. Constantine, III

Owner's Representatives:

George Nicklas
Barlow Delk

Leslie K. Black Recorder

EMBANKMENT

Name of Dam: LAKE MONOCAN DAM

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	There are scattered areas of sparse vegetation which show signs of minor erosion, particularly the junction between the downstream embankment and the right abutment. The embankment area directly above the principal spillway outlet is severely eroded due to the lack of vegetation. Erosion is also taking place on the left upstream abutment.	The dam was raised approximately 6 ft. last year; the embankment was not seeded until mid-summer. The areas of erosion should be repaired and reseeded. According to the owner's representatives, the principal spillway outlet structure will be reconstructed next year; the erosion will be repaired at that time.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Vertical and horizontal alignment of the crest agrees closely with the proposed drawings.	
RIPRAP FAILURES	The upstream face of the dam is riprapped below elevation 681 ft. M.S.L. The riprap is in good condition.	

EMBANKMENT

Name of Dam: LAKE MONOCAN DAM

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	The embankment is covered with grass. The grass is thin in some areas.	The dam was raised approximately 6 ft. last year; the embankment was not seeded until mid-summer. The areas of sparse vegetation should be reseeded.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Minor erosion is occurring along the junction of the right abutment and downstream embankment.	
ANY NOTICEABLE SEEPAGE	During the inspection, there was some flow (approximately 5 g.p.m.) emanating from the wall of the plunge pool for the reservoir drawdown outlet works. The flow was colorless but contained some particulate matter.	Discussion with Wiley and Wilson disclosed that this flow comes from the toe drain, which is currently covered with riprap. A head wall is to be constructed at the outlets during the summer of 1980. A qualified geotechnical engineering firm should inspect the flow and determine whether the particulate matter is embankment material or material that entered the drain during installation.
STAFF GAGE AND RECORDER	None observed	A staff gage should be installed to monitor reservoir levels.
DRAINS	None observed	The proposed plans for the original dam and for the modifications presently underway show a 6 in. underdrain running the length of the embankment and discharging near the drawdown outlet. The inspection team could not locate the outlet of the underdrain

OUTLET WORKS

Name of Dam: LAKE MONOCAN DAM

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	The outlet conduit is a 4 ft. by 7 ft. reinforced concrete box conduit. The conduit appears to be in good condition with no cracking or spalling.	
INTAKE STRUCTURE	The intake structure is a concrete side-channel spillway with a weir length of 38.4 ft. The intake structure appears to be in good condition with no cracking or spalling.	The intake structure is scheduled to be reconstructed in 1980. During the reconstruction, the crest of the overflow weir will be raised 5.0 ft.
OUTLET STRUCTURE	The outlet structure is a reinforced concrete fan with vertical sides discharging into a rock-lined plunge pool. There is a vertical crack extending the length of the junction between the outlet conduit and outlet structure.	The outlet structure is scheduled to be reconstructed in 1980.
OUTLET CHANNEL	The outlet discharges into a rock-lined plunge pool. The discharge then flows into a natural channel which is free of obstructions.	
EMERGENCY GATE	The emergency gate is a 16 in. gate valve and box located in the downstream embankment (at the toe of the original embankment). Access to the emergency gate is through a manhole. The gate appears to be in good condition.	According to the owner's representatives, the emergency gate is operable.

EMERGENCY SPILLWAY

Name of Dam: LAKE MONOCAN DAM

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	None	A concrete weir is scheduled to be constructed in the emergency spillway in 1980.
APPROACH CHANNEL	The approach channel is well covered with short grass. There is no erosion in the approach channel.	
DISCHARGE CHANNEL	The discharge channel is covered with short grass. Small erosion gullies are beginning to form near the downstream end of the discharge channel.	This area was seeded for the first time last summer and the erosion probably began before the vegetation became established. The areas of erosion should be regraded and reseeded.
BRIDGE AND PIERS	Not Applicable	

INSTRUMENTATION

Name of Dam: LAKE MONOCAN DAM

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	According to the plans for the ongoing enlargement of the dam, the crest of the existing weir on the side channel spillway is at elevation 677.0 ft. M.S.L. The crest of the proposed (raised) weir will be at elevation 682.0 ft. M.S.L.	
OBSERVATION WELLS	None observed	
WEIRS	The overflow weir of the side channel spillway is not used to measure flows.	
PIEZOMETERS	None observed	
OTHER		

RESERVOIR

Name of Dam: LAKE MONOCAN DAM

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	The reservoir slopes are gentle and covered with trees and brush. There were no instabilities noted in this area.	The reservoir is scheduled to be raised 5 ft. The slopes have been cleared to this level.
SEDIMENTATION	No sedimentation which would affect the operation of the reservoir was observed during the inspection.	

DOWNSTREAM CHANNEL

Name of Dam: LAKE MONOCAN DAM

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	The downstream channel is a natural stream-bed with no obstructions.	
SLOPES	The overbank areas contain trees and brush. The downstream channel has a slope of approximately 1.3%.	
APPROXIMATE NO. OF HOMES AND POPULATION	At present, there is only one residence in the downstream damage reach, approximately 1.3 mi. below the dam. This residence is on a rock outcropping which rises well above the surrounding floodplain.	

APPENDIX IV
GEOTECHNICAL STUDY

GEOTECHNICAL STUDY
SPILLWAY, ALLEN CREEK DAM
WINTERGREEN
NELSON COUNTY, VIRGINIA

Prepared for
WINTERGREEN CORPORATION
Nellysford, Virginia

Prepared by
SAYRE & ASSOCIATES, p.c.
Richmond, Virginia

Project: 79027

April 1979

TABLE OF CONTENTS

GEOTECHNICAL STUDY

SPILLWAY, ALLEN CREEK DAM
WINTERGREEN
NELSON COUNTY, VIRGINIA

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Description of Soil	2	
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Sketch - Location of Borings		
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Notes to Boring Logs (Continued)		
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GEOTECHNICAL STUDY

SPILLWAY, ALLEN CREEK DAM WINTERGREEN NELSON COUNTY, VIRGINIA

INTRODUCTION

As a result of a meeting between Wintergreen Corporation personnel and Sayre & Associates held on March 22, 1979, at the project, authorization was given to make a geotechnical study for the Emergency Spillway proposed for Monacan Lake. The lake is fed by Allen Creek and is a part of the Wintergreen Corporation property located in Nelson County, Virginia. The purpose of our study was to determine if solid rock would be encountered in excavation for the spillway and if the excavated material could be used in the proposed enlargement of the existing embankment. Our study included an examination of the site by an engineer, drilling of test borings, and an analysis of the data.

SUMMARY OF FINDINGS

We are of the opinion that ~~Solid Rock~~ will be encountered in the ~~bottom one or two feet~~ of the excavation for the proposed emergency spillway, near ~~Station 1+50.~~

~~The excavated material can be used in building up the dam, except for boulders over 6-inches in any dimension, provided certain restrictions are recognized.~~

DESCRIPTION OF PROJECT AND SITE

The plans for the project are shown on Wiley & Wilson, Inc. drawings C-1, C-2 and C-3 of the Allen Creek Dam Modification for Wintergreen, Nelson County, Virginia, dated December 19, 1977

and March 30, 1978. The proposed spillway is planned to be 260 feet in length, 40 feet wide at the bottom with 2:1 side slopes. Depth at the spillway cut varies to a maximum of 45 feet. An existing inlet spillway is about 50 feet east of the proposed emergency spillway structure on the southwest dam abutment.

Monacan Lake is on the Allen Creek about one mile west of State Route 151. Allen Creek flows east from the dam and crosses Route 151 about one mile north of Nellysford in Nelson County, Virginia. The lake was formerly a part of a Boy Scout complex and is presently a part of the water storage facility for Wintergreen.

Vegetation over the site consists of a sparse cover of mixed hardwoods. Drainage is excellent due to the steep hillside.

The area lies within the Blue Ridge Mountain physiographic province which is characterized by silty soils, boulders, and rock.

SUBSURFACE INVESTIGATION

Four test borings were drilled 15 to 24 feet right of the proposed centerline of the spillway at the locations shown on the sketch in the Appendix. The borings were made to depths of 10 to 25 feet which corresponds to the bottom of the proposed cut. A truck-mounted, motor-driven, hollow-stem auger was used to drill the borings. Split-spoon samples and penetration resistance values (N) were obtained at depths of 2 feet, 4 feet, and then at 5-foot intervals to the extent of the borings in accordance with the procedures given in ASTM Method D-1586.

DESCRIPTION OF SOIL

A thin layer (less than one foot) of topsoil and forest litter covers the site. The soil below the topsoil is residual material derived from decomposition of the parent rock.

Decomposition of the rock to soil is incomplete so that specific soil strata are not identifiable. The original rock structure is still evident in the soil. The soil is composed primarily of sand with varying amounts of silt and clay. Boulders and rock fragments were found scattered throughout the full depth of each boring. A stratum of silty clay was found in the upper 7 feet at Station 2+00 and a layer of silt was found between 17 and 25 feet at Station 1+00.

Dense decomposed rock was found from 9 to 10.2 feet at Station 0+50. Refusal was encountered at 20.5 feet at Station 1+50. The other borings were terminated in soil.

No ground water was encountered in the borings.

DISCUSSION

~~The material excavated from the emergency spillway can be used as fill on the downstream side of the existing earth dam with two provisions. First, all boulders larger than 6 inches in any dimension must not be used in the fill. Second, large rocks and small boulders must be scattered through the fill and not allowed to "nest". No clay material satisfactory for use in the core of the dam is present in the spillway cut.~~

Dense decomposed rock was encountered at approximately the bottom of the cut at Station 1+50. A maximum of about one to two feet of this material is anticipated in the cut. It is our opinion that the dense decomposed rock can be removed with a large tractor, such as a Caterpillar D-8 or D-9, equipped with a single-tooth ripper.

LIMITATIONS

The analysis and recommendations submitted in this report are based upon the data obtained from soil borings performed at the locations shown on the sketch in the Appendix. This report

does not reflect any variations which may occur between these borings. The nature and extent of variations between the borings may not become evident until construction is underway. If variations become evident, this firm should be notified so that immediate observations can be made of the conditions and appropriate recommendations can be rendered.

This report has been prepared for the Wintergreen Corporation to be used in the design and construction of the proposed structure. Anyone using this report for any purpose other than design and construction of the structure described herein must draw his own conclusions regarding construction procedures and soil conditions.

We recommend that this report in its entirety, including the Appendix, be furnished as information to prospective bidders. We disclaim all responsibility and liability for any part which is removed, quoted, or reproduced separately from the entire report.

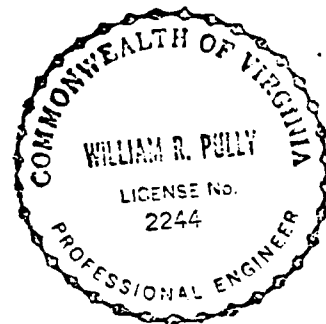
We request the opportunity to review those portions of the plans and specifications for this project which pertain to earthwork and foundations to determine if they are consistent with our recommendations.

April 9, 1979

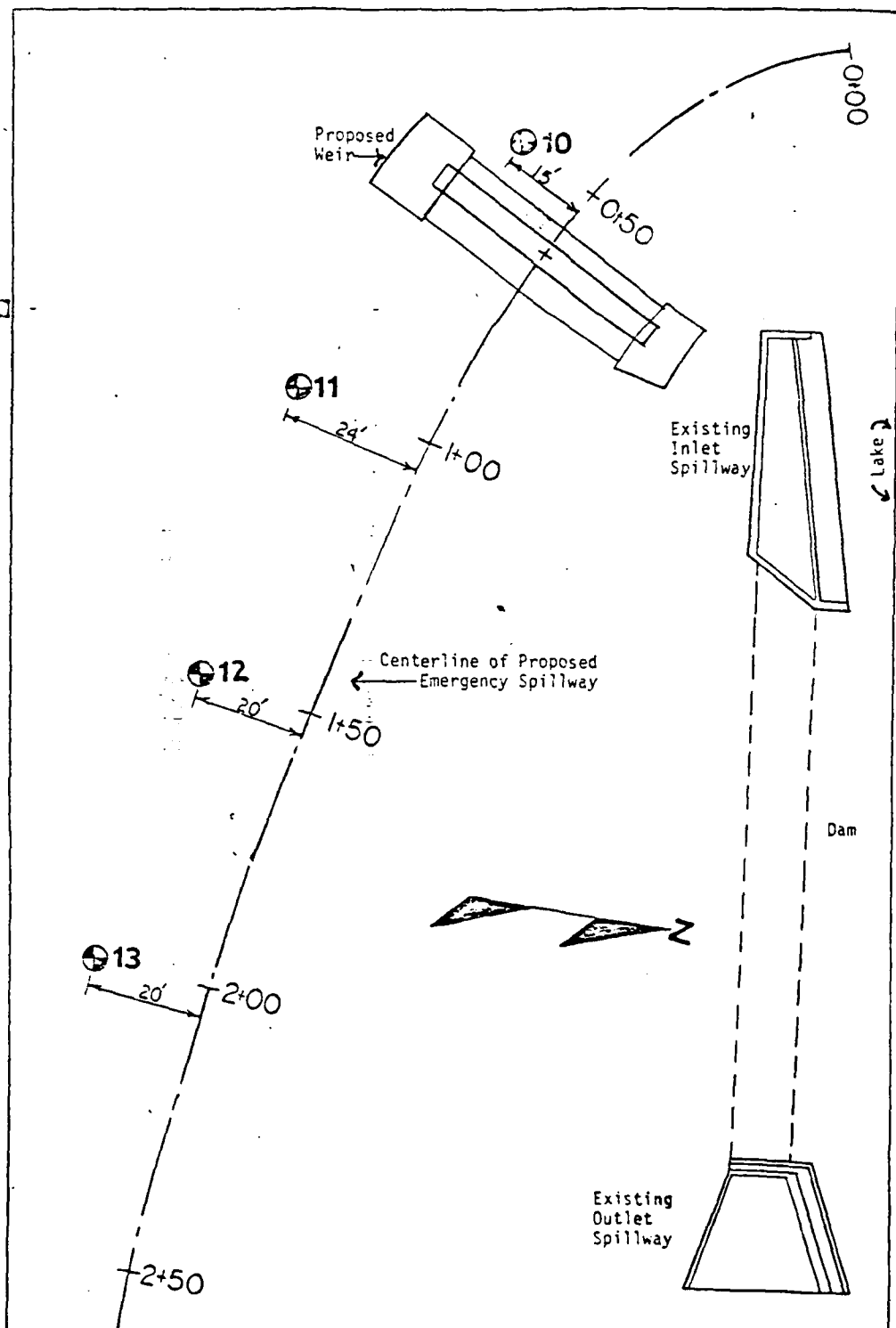
SAYRE & ASSOCIATES, p.c.

William R. Pully

William R. Pully, P.E.



A P P E N D I X



LOCATION OF BORINGS

Proposed Emergency Spillway
 Allen Creek Dam Modifications
 Wintergreen
 Nelson County, Virginia

scale - 1" = 20'

date - March 1979

SAYKE & ASSOCIATES, p.c. geotechnical engineers

NOTES TO BORING LOGS

These notes refer to and are a part of the accompanying boring logs.

1. The borings were made by a boring contractor under the continuous observation of an engineer of Sayre & Associates. These boring logs were compiled from Sayre & Associates field logs and the results of visual examination of the soil samples in our laboratory.
2. The logs of the borings apply only at the specific boring locations and at the dates indicated. They are not warranted to be representative of subsurface conditions at other locations and times.
3. The depth of the indicated boundaries between soil or rock strata is approximate. The transition between the strata may be gradual.
4. The ground water levels shown on the boring logs represent average or typical values observed during the period of the boring operation or shortly after completion of a boring. These observations do not reflect seasonal changes in the water table or the effects of intense rainfall or runoff. In any excavation, trickling flow or seepage may be encountered from perched water which is at levels above the water table observed in the borings.
5. "Decomposed rock" is residual material having a standard penetration resistance of 100 blows or more per foot. Decomposed rock can be an extremely hard and compact mixture of soil and weathered fragments of rock which may require rock excavation methods for removal.
6. "Sound" and/or "relatively sound" rock are non-decomposed rock and rock in which weathering is largely confined to joints. Such rock may be fractured to varying degrees.
7. Soil samples and rock cores recovered from the borings and which remained after laboratory testing have been stored at Ayers & Ayers, Inc., Richmond, Virginia, and are available for inspection by appointment. The soil samples and rock cores will be discarded six months after completion of the borings unless a request is received to retain them for a longer period.
8. The locations of borings were determined by tape measurement from the centerline stakes set by others. Elevations of borings were determined by interpolation between plan contours. The location and elevation of the borings should be considered accurate only to the degree implied by the method used.

NOTES TO BORING LOGS (continued)

Definition of Terms and Abbreviations

All soil descriptions are based on visual examination and on the following definitions of terms and abbreviations:

Components

- GRAVEL - particles larger than 1/4" diameter
- SAND - particles smaller than 1/4" diameter and larger than No. 200 sieve (individual grains visible to naked eye)
- SILT - particles smaller than No. 200 sieve (individual grains not distinguishable): low plasticity to non-plastic
- CLAY - particles smaller than No. 200 sieve; medium to high plasticity
- TOPSOIL - surface soil containing a significant proportion of organic matter
- FILL - man-made deposit

Composition

- GRAVEL, SAND, SILT CLAY
 - major component (50% or more)
- gravelly, sandy, silty, clayey
 - secondary component (33% to 50%)
- some
 - minor component (10% to 33%)
- trace
 - minor component (1% to 10%)
- and
 - two major components (nearly equal proportions)

Moisture

- saturated - below water table
- wet - much above optimum
- moist - near optimum
- dry - much below optimum

Structure

- stratified - layers 1/2 to 12 inches thick
- laminated - layers less than 1/2 inch thick

Color

- dark, light - significant difference in shade
- mottled - irregularly colored, usually indicates lack of drainage

- WOH - weight of hammer
- RQD - rock quality designation (% of core which is 4" or longer)
- NSR - no sample recovered

BORING LOG

Boring No.: 10	Elevation - Top of Boring:	Date of Boring: March 26, 1979
Project: Spillway, Allen Creek Dam	Station 0+50, 15' R of C	
Location: Wintergreen, Nelson County, Virginia		
Type of Boring: Hollow-stem auger		
Drilling Contractor: Avers & Avers, Inc., Richmond, Virginia		

Depth	Stratum Description	Sample Depth	Sample Blows* Core Recovery**	Sample Description
0	Topsoil			
2.0	Brown clayey SAND		2-5	Brown clayey SAND
3.0				
4.0				
5.0			4-4	
9.0	Gray silty SAND, decomposed rock			
10.0	Boring terminated at 10.2 ft.	10.0	100/0.2	Gray silty SAND, decomposed rock
10.2		10.2	100/0.2	Gray silty SAND, decomposed rock
15				
20				
25				
30				
35				
40				
45				

Ground Water Data:

Water level is _____ ft. below ground surface _____ hrs. after completion.

No water encountered.

SAYRE & ASSOCIATES, p.c.

*Geotechnical Engineers
Richmond, Virginia*

* No. of Blows 140-lb. Hammer, 30-in. Fall, Required to Drive 2 in. O.D., 1.375 in I.D. Sampler 6 Inches
 ** Core Recovery as Percent of Length of Drill Run.
 See NOTES TO BORING LOG which are a part of this log.

BORING LOG

Boring No.:	11	Elevation - Top of Boring:		Date of Boring:	March 26, 1979
Project:	Spillway, Allen Creek Dam			Station 1+00, 24' R of C	
Location:	Wintergreen, Nelson County, Virginia				
Type of Boring:	Hollow-stem auger				
Drilling Contractor:	Ayers & Ayers, Inc., Richmond, Virginia				

Depth	Stratum Description	Sample Depth	Sample Blows* Core Recovery**	Sample Description
0	Topsoil			
2.0			32-34	Brown and gray silty SAND and rock fragments (boulders)
3.0				
4.0			14-14	Brown and gray silty SAND and rock fragments (boulders)
5.0				
9.0			45-48	Brown and gray silty SAND and rock fragments (boulders)
10.0	Brown and gray SAND and rock fragments (boulders)			
14.0			100/0.2	No sample recovered - boulder
15.0				
19.0			10-14	Dark brown SILT
20.0	Dark brown SILT			
24.0			19-19	Dark brown SILT
25.0	Boring terminated at 25.0 ft.			

Ground Water Data:

Water level is _____ ft. below ground surface _____ hrs. after completion.

No water encountered.

SAYRE & ASSOCIATES, p.c.

Geotechnical Engineers

Richmond, Virginia

* No. of Blows 140-lb. Hammer, 30-in. Fall, Required to Drive 2 in. O.D., 1.375 in I.D. Sampler 6 Inches.

** Core Recovery as Percent of Length of Drill Run.

See NOTES TO BORING LOG which are a part of this log.

BORING LOG

Boring No. 12	Elevation - Top of Boring:	Date of Boring: March 26, 1979
Project: Spillway, Allen Creek Dam	Station 1+50, 20' R of C.	
Location: Wintergreen, Nelson County, Virginia		
Type of Boring: Hollow-stem auger		
Drilling Contractor: Ayers & Ayers, Inc., Richmond, Virginia		

Depth	Stratum Description	Sample Depth	Sample Blows* Core Recovery**	Sample Description
0	Topsoil			
	Brown clayey SAND	2.0		
		3.0	6-8	Brown clayey SAND
		4.0		
		5.0	7-17	Brown clayey SAND
5	Gray silty SAND	9.0		
		10.0	10-14	Gray silty SAND
		14.0		
		15.0	7-12	Gray sandy SILT
		19.0		
		20.0	7-10	Gray silty SAND
		20.5	100/0.0	No sample recovered.
		Refusal at 20.5 ft.		
25				
30				
35				
40				
45				

Ground Water Data:

Water level is _____ ft. below ground surface _____ hrs. after completion.

No water encountered.

SAYRE & ASSOCIATES, p.c.

Geotechnical Engineers

Richmond, Virginia

* No. of Blows 140-lb. Hammer, 30-in. Fall, Required to Drive 2 in. O.D., 1.375 in I.D. Sampler 6 inches.

** Core Recovery as Percent of Length of Drill Run.

See NOTES TO BORING LOG which are a part of this log.

BORING LOG

Boring No.:	13	Elevation - Top of Boring:	Date of Boring: March 26, 1979
Project:	Spillway, Allen Creek Dam		Station 2+00, 20' R of C
Location:	Wintergreen, Nelson County, Virginia		
Type of Boring:	Hollow-stem auger		
Drilling Contractor:	Ayers & Ayers, Inc., Richmond, Virginia		

Depth	Stratum Description	Sample Depth	Sample Blows* Core Recovery**	Sample Description
0	Topsoil			
2.0	Brown silty CLAY, trace of sand		2-5	Brown silty CLAY, trace of sand
3.0				
4.0				
5.0			9-12	
9.0	Gray silty SAND, boulders			Gray silty SAND, boulders
10.0			100/0.3	
14.0	Gray clayey SAND		10-20	Gray clayey SAND
15.0				
19.0				
20.0			15-17	
20.0	Boring terminated at 20.0 ft.			
25				
30				
35				
40				
45				

Ground Water Data: Water level is _____ ft. below ground surface _____ hrs. after completion. No water encountered.	SAYRE & ASSOCIATES, p.c. <i>Geotechnical Engineers</i> <i>Richmond, Virginia</i>
--	--

* No. of Blows 140-lb. Hammer, 30-in. Fall, Required to Drive 2 in. O.D., 1.375 in I.D. Sampler 6 inches.
 ** Core Recovery as Percent of Length of Drill Run.
 See NOTES TO BORING LOG which are a part of this log.

APPENDIX V
CORRESPONDENCE

SAYR & SUTHERLAND INC.

Consulting Engineers

SOIL MECHANICS • FOUNDATION ENGINEERING • GEOLOGY

5407 LAKESIDE AVENUE • P. O. BOX 9532 • RICHMOND, VIRGINIA 23228 • Telephone 804/266-9646

March 27, 1978

Wintergreen
Wintergreen, Virginia 22938

Attn: Mr. George Nicklas, Construction Department

Dam
Wintergreen, Virginia
Project 73005A

Gentlemen:

At the request of Mr. W. D. Wright, P.E., of Wiley & Wilson, Inc. an examination was made of the existing Allen Creek dam at Wintergreen and of a proposed borrow area. The purpose of the examinations was to observe the conditions of the dam and to verify the suitability of the material in the borrow area for use in an earth dam.

Visual examination of the Allen Creek dam disclosed an area of wetness along the downstream toe of the embankment. A significant amount of seepage was flowing around the base of the valve box at the outlet pipe. Small areas of seepage were observed scattered throughout the wet area at the toe. Hand auger holes were attempted in two locations where seepage was occurring. Broken rock was encountered within 6 to 8 inches of the surface. Both holes began to fill with water as soon as they were drilled. Water was observed seeping into the holes for their full depth.

Discussions with Mr. Wright and Mr. Nicklas of Wintergreen disclosed that the original construction drawings showed an underdrain pipe discharging near the valve box of the outlet pipe. Investigation disclosed that the pipe did exist but was buried in roots and soil. When exposed, the pipe discharged a large quantity of water for 20 to 30 minutes. The flow then began to decrease and the water was less turbid.

It is possible that the cause of the seepage was the blocked drain pipe. We recommend that the pipe be allowed to drain for two to three weeks and that the area be re-examined. If opening the drain pipe stops the seepage, it is our opinion that the existing dam can be enlarged to provide an additional 5 feet of water in the reservoir. In the event that the seepage continues, further investigation of the cause will be required.

Wintergreen
March 27, 1978
Page 2

The soil in the proposed borrow area had been investigated in our study in 1974. ("Soil Study, Wintergreen Dam, Nellysford, Virginia", June 10, 1974). The boring logs indicate that there is 7 to 9 feet of clayey silt below the topsoil in this area. Hand auger holes confirmed this finding. The soil is acceptable for use in the embankment; however, there are problems in using this soil. The following comments are taken from our earlier report.

"As mentioned earlier in this report, the available borrow materials are not the most desirable materials from a construction standpoint. The predominant silt proportions influence the engineering characteristics of the soil. Strict control of the moisture content will be a key factor in successfully placing the material at a proper degree of compaction. We recommend that the embankment be compacted to 95% of the maximum dry density as determined by ASTM Method D-698 (Standard Proctor). Variation of more than 2% either side of optimum moisture content will probably result in compaction problems. The natural moisture content of the borrow material suggests a wide range of moisture conditions. Both wetting and drying of the various material will probably be necessary during construction."

If you have any questions or comments, please call me.

Sincerely,

SAYRE & SUTHERLAND, INC.


R. D. Sayre, P.E.

SAYR & SUTHERLAND INC.

Consulting Engineers

SOIL MECHANICS • FOUNDATION ENGINEERING • GEOLOGY

5407 LAKESIDE AVENUE • P. O. BOX 9532 • RICHMOND, VIRGINIA 23228 • Telephone 804/266-9646

April 25, 1978

WINTERGREEN
Wintergreen, Virginia 22938

Attn: Mr. George Nicklas
Construction Department

Dam
Wintergreen, Virginia
Project 73005A

Gentlemen:

As suggested in our letter of March 27, 1978, we re-examined the existing Allen Creek dam at Wintergreen on April 24, 1978. The purpose of the re-examination was to determine if seepage along the toe had stopped.

At the time of the re-examination the entire toe of the dam was dry. The shallow hand auger holes dug during our previous visit were also dry. A relatively small amount of clean water was flowing from the underdrain pipe.

It is our opinion that the seepage along the toe of the dam, previously observed, was the result of the blocked underdrain pipe. There is no visual evidence of unsafe conditions in the embankment of the dam. We recommend that the proposed addition to the embankment proceed.

Sincerely,

SAYRE & SUTHERLAND, INC.


Robert D. Sayre, P.E.

cc: W. D. Wright

V-3

add to 9.9.9.9.9.9.9 4/28

May 24, 1978

District Engineer
U. S. Army Engineer District-Norfolk
603 Front Street
Norfolk, Virginia 23510

Attn: NAOOP-D

Re: Wintergreen - Allen Creek Reservoir
Comm. No. 7240

Dear Sir:

We are enclosing, herewith, two (2) sets of plans covering the raising of the existing dam on Allen Creek by 6 feet. We are requesting your review of this project. We have submitted to the State Water Control Board for their approval of this construction. Utilizing the criteria of 5 CFS, 5 square miles of drainage area and 10 acres of reservoir, we do not feel this construction is within your jurisdiction. However, we would like your concurrence in this matter.

The project involves raising of an existing structure by 6 feet to allow for additional water storage of 5 feet. The purpose of the raising of the structure is to provide additional water supply to the recreational development at Wintergreen. The existing structure has an existing side outlet channel spillway, which we anticipate raising. We also anticipate constructing an overflow spillway through the existing original ground to the south of the existing dam. All is shown on our detail plans accompanying this letter. The raising of the dam involves the flooding of approximately 13 acres. The average flow determined by the State Water Control Board, copy of their letter attached for the reservoir at Allen Creek is 2.86 cubic feet per second. In order to provide additional water for the reservoir a diversion structure has been installed along Stoney Creek, which will divert a portion of flow into the Reservoir. This is controlled by pipe which is to be installed as shown on the enclosed plans.

Based on the above and the criteria utilized by the Corps of Engineers for determination of jurisdiction, we do not feel that this project falls within your criteria. We would appreciate your advising us after you have had a chance to review the enclosed.

District Engineer

- 2 -

May 24, 1978

If you have any questions, please do not hesitate to give me a call at 804 847-9192 or George Nicklas at Wintergreen 804 361-2200.

I plan to be in the Norfolk area next week and can drop by to answer any questions, if you have any at that time.

Sincerely,

WILEY & WILSON, INC.

Wm. Douglas Wright, PE

WDW:jn

cc - George Nicklas



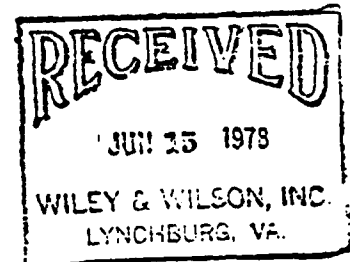
DEPARTMENT OF THE ARMY
NORFOLK DISTRICT, CORPS OF ENGINEERS
FORT NORFOLK, 803 FRONT STREET
NORFOLK, VIRGINIA 23510

IN REPLY REFER TO

NAOOP-P

14 June 1978

Mr. W. Douglas Wright
Wiley and Wilson, Inc.
2310 Langhorne Road
P.O. Box 877
Lynchburg, Virginia 24505



Dear Mr. Wright:

This is in reference to your letter of 24 May 1978 regarding the raising of an existing dam on Allen Creek near Wintergreen, Nelson County, Virginia. You are advised that the proposed work is covered by a nationwide permit since the Allen Creek Reservoir is located on a stream with an average flow of less than 5 cubic feet per second. The proposed pipe within the diversion channel from Stony Creek will not require a Department of the Army permit, provided there is no disposal of dredged or fill material within the waterway.

Should you have any questions regarding this matter, please contact Mr. Woodie Poore at (804) 446-3657.

Sincerely yours,

JACK G. STARR
Chief, Construction-Operations Division

EGGLESTON & THELEN

ATTORNEYS AT LAW
SOUTH FRONT STREET
POST OFFICE BOX 317
LOVINGSTON, VIRGINIA 22949

SAM D. EGGLESTON, JR.
T. DAVID THELEN

June 19, 1978

TELEPHONE 464-265 (467)

Mr. George Nicklas
Construction Superintendent
WINTERGREEN
Wintergreen, Virginia 22938

Re: Monocan Expansion

Dear George:

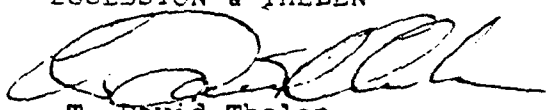
Pursuant to our recent conversation, I enclose herewith copies of documentation received not only from the State Water Control Board, but also, via Wiley & Wilson, Inc., from the Army Corps of Engineers, regarding the Lake expansion and elevation, for which the Nelson County Circuit Court has a hearing scheduled for Friday, June 23, 1978, at 9:30 a.m.

By carbon copy of this letter to William Douglas Wright, P.E., at Wiley & Wilson, Inc., I am forwarding a photocopy of the State Water Control Board materials for his file.

Trusting this meets with your approval, I remain

Very truly yours,

EGGLESTON & THELEN

By:  T. David Thelen

TDT/dsh

Enclosures as stated

cc: William Douglas Wright, P. E.
Wiley & Wilson, INC.
P. O. Box 877
Lynchburg, Virginia 24505

JUN 07 1978



COMMONWEALTH of VIRGINIA

STATE WATER CONTROL BOARD
2111 Hamilton Street

R. V. Davis
Executive Secretary
Post Office Box 11143
Richmond, Virginia 23230
(804) 257-0056

BOARD MEMBERS
Warren L. Braun
Chairman
Col. J. Leo Bourassa
Vice-Chairman
George M. Cornet
Roy B. Martin, Jr.
Millard B. Rice, Jr.
Kenneth S. Robbins
R. Allen Wright

JUN 07 1978

Honorable Robert C. Goad
Twenty-Ninth Judicial Circuit
Nelson County Court House
Lovingston, Virginia 22949

Dear Judge Goad:

This is with reference to the petition and exhibits filed in the Circuit Court of Nelson County on behalf of the limited partnership known as Wintergreen to obtain leave for the impoundment of additional floodwaters on Allen Creek by raising the height of the impoundment structure five (5) feet.

The following comments regarding this project are supplied in compliance with the provisions of Section 62.1-109 of the Code of Virginia, as amended:

1. The average flow of Allen Creek at the impoundment site is approximately 2.86 cubic feet per second. Actual flows are not available for this stream and the foregoing estimate is based on flow records of the Rockfish River near Greenfield, Virginia.
2. Records in this office indicate that the proposed elevation of the impoundment structure will not conflict with any other proposed or likely development within the watershed.
3. The proposed project should have no appreciable environmental effect as long as the provisions of Section 62.1-106-111 are adhered to.
4. Recommended procedures for the control of erosion and sedimentation should be used during the construction phase of this project.

The current annual roster of the Virginia State Board for the Examination and Certification of Architects, Professional Engineers, and Land Surveyors indicates, that Mr. W. E. Hancock, Jr. is a certified professional engineer.

Please accept the contents of comments number three and four as the certified statement relating to the effect of the proposed addition on pollution abatement. Such a statement is required under the provisions of Subparagraph (3) Section 62.1-109 of the 1950 Code of Virginia, as amended.

If further comments are necessary please contact us.

Sincerely,



R. V. Davis
Executive Secretary

/lrc

cc: Mr. T. Davis Thelen



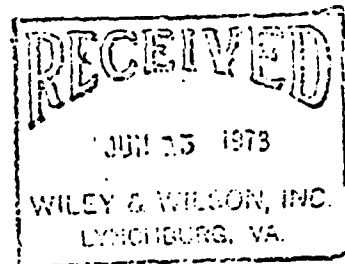
DEPARTMENT OF THE ARMY
NORFOLK DISTRICT, CORPS OF ENGINEERS
FORT NORFOLK, 803 FRONT STREET
NORFOLK, VIRGINIA 23510

IN REPLY REFER TO

NAOOP-P

14 June 1978

Mr. W. Douglas Wright
Wiley and Wilson, Inc.
2310 Langhorne Road
P.O. Box 877
Lynchburg, Virginia 24505



Dear Mr. Wright:

This is in reference to your letter of 24 May 1978 regarding the raising of an existing dam on Allen Creek near Wintergreen, Nelson County, Virginia. You are advised that the proposed work is covered by a nationwide permit since the Allen Creek Reservoir is located on a stream with an average flow of less than 5 cubic feet per second. The proposed pipe within the diversion channel from Stony Creek will not require a Department of the Army permit, provided there is no disposal of dredged or fill material within the waterway.

Should you have any questions regarding this matter, please contact Mr. Woodie Poore at (804) 446-3657.

Sincerely yours,

JACK G. STARR
Chief, Construction-Operations Division

WILEY & WILSON, INC.

A PROFESSIONAL CORPORATION

ENGINEERS • ARCHITECTS • PLANNERS

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J. L. THOMPSON, PE R. A. LEMON, PE

June 15, 1978

Mr. T. David Thelen
Eggleston & Thelen
South Front Street
P. O. Box 317
Lovingston, Virginia 22949

Re: Allen Creek Reservoir
Wintergreen
Comm. No. 7240

Dear Mr. Thelen:

I am enclosing a copy of the letter from the Norfolk District Corps of Engineers dated 14 June 1978 pertaining to the subject project. This letter gives us the authorization necessary to construct the Allen Creek Reservoir and the diversion structure at Stony Creek without obtaining construction permits from the Corps.

Please contact me if we need to discuss any of the items on this project prior to the court hearing set for Friday, June 23, 1978 at 9:30 A.M. at the Courthouse in Lovingston, Virginia.

Sincerely,

WILEY & WILSON, INC.

Wm. Douglas Wright, P.E.

WDW:vs
Enclosure
cc: George Nicklas
Walt Hancock

SITE VISIT REPORT

SAYRE & ASSOCIATES, P.C.

PROJECT Allen Creek Dam
Modifications DATE April 23, 1979

LOCATION Wintergreen, Nelson County, Virginia

TALKED TO Barr Delk COMPANY Wintergreen Corporation
Jim Elliott Wiley & Wilson, Inc.

OBSERVATIONS:

I visited the Allen Creek Dam project on April 23 at the request of Mr. Barr Delk. The purpose of the visit was to observe the soil conditions in the vicinity of the drain pipe. The area on which the downstream slope of the dam is to be expanded had been stripped at the time of the visit. This area slopes downward to the existing drain outlet. In the low part of the stripped area water is present and the soil is unstable. The contractor had placed "river jack" in the unstable areas in an effort to improve the condition. Where the "river jack" was above the water level it had strengthened the soil. Below the water table there was little improvement.

We concur with Mr. Delk's proposal to place an underdrain in the unstable area. The underdrain should include filter fabric on the bottom and be covered with porous stone. The use of perforated pipe in this instance is optional.

The construction drawings indicate that the entire area to receive new fill will be covered with filter fabric, a one foot porous stone filter, and be topped with another layer of filter fabric. It is our opinion that in addition to providing the desired drainage, this layer of stone will also significantly improve the stability of the soft area. It may be necessary to add another foot of crushed stone above the filter to obtain stability in the soft areas. We recommend that the initial layers of fill be placed by end-dumping and spreading in the soft areas.

We suggest that the specified materials for the filter may be modified to reduce the cost while still maintaining the desired characteristics. Our recommendations are:

1. That a single size of crushed stone be used throughout the filters and drainage ditch. This stone should be similar to VDH&T No. 3 or No. 5 crushed stone.
2. That the filter fabric specified to be wrapped around the drain pipe be eliminated. It is our opinion that since the entire drain is encased in filter fabric there is little need for fabric around the pipe.

..... If you have any questions or comments, please contact me.

V-12

cc: Delk, Hancock, Wright


Robert D. Sayre, P.E.

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February 11, 1980

Michael Baker Jr., Inc.
P. O. Box 280
Beaver, Pennsylvania 15009

Attn: Mr. Jeff Quay

Re: Wintergreen Dam Hydrology
W&W Comm. No. 7240

Dear Mr. Quay:

Enclosed are our calculations for the Probable Maximum Flood and Reductions "A" and "B" according to procedures outlined in the Design of Small Dams by the Bureau of Reclamation. Also attached is a copy of our letter (May 24, 1978) to the Corps of Engineers outlining the proposal for raising the dam and their response dated June 14, 1978.

Design for raising of this dam was in accordance with provisions outlined in Regulation No. 9 of the Virginia State Water Control Board. The reservoir and dam fell within the "small" category and "low" hazard potential classification. It was determined that there were no structures downstream for human habitation that would be affected by a dam failure. Therefore, a 100-year flood was selected for the spillway design.

If there are any further questions regarding the Wintergreen Dam, please do not hesitate to contact us.

Sincerely,

WILEY & WILSON, INC.

Walter E. Hancock

Walter E. Hancock, P.E.

WEH/bc

cc: George Nicklas, w/Encl.

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APPENDIX VI
GENERAL REFERENCES

GENERAL REFERENCES

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NAME OF DAM: LAKE MONOCAN DAM