

DELAWARE RIVER BASIN
UNNAMED TRIBUTARY OF BRODHEAD CREEK
PENNSYLVANIA

NDI ID PA 00638

PA DER 45-32

LEVEL III

ANALOMINK LAKE DAM

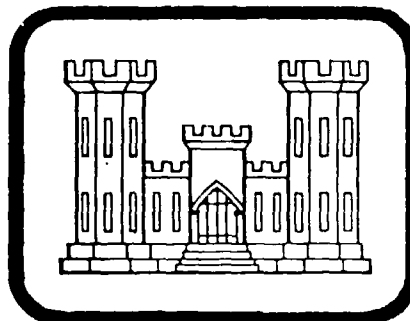
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ANALOMINK ROD AND GUN CLUB

PHASE I INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

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PREPARED FOR

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT CORPS OF ENGINEERS

BALTIMORE, MARYLAND
21203

BY

O'BRIEN & GERE

PHILADELPHIA, PENNSYLVANIA

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AUGUST 1981

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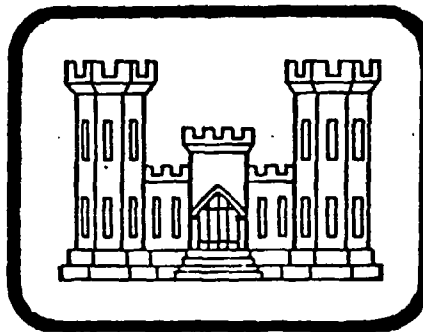
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PENNSYLVANIA

NDI ID PA 00638

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ANALOMINK ROD AND GUN CLUB, INC.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



Prepared for:

DEPARTMENT OF THE ARMY
Baltimore District, Corps of Engineers
Baltimore, Maryland 21203

Prepared by:

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AUGUST 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 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 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.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through frequent inspections can unsafe conditions be detected, and only through continued care and maintenance can these conditions be prevented or corrected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway 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.

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PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

Name of Dam:	Analomink Lake Dam
State:	Pennsylvania
County:	Monroe
Stream:	Unnamed Tributary of Brodhead Creek
Coordinates:	N41°03.6', W75°13.7'
Date of Inspection:	May 20 and June 1, 1981

ASSESSMENT

Analomink Lake Dam is an 11-foot high, 280-foot long rock fill and earth embankment, built approximately 70 years ago to provide an impoundment for recreational purposes. The dam has an average crest width of eight feet and a downstream slope which varies from 1H:1V to nearly vertical. The upstream face of the dam is almost completely submerged, but it is believed to have a much flatter slope than the downstream face. With the water surface at the crest of the spillway, Elevation 651, Analomink Lake has a surface area of approximately 22 acres. The maximum storage capacity of the impoundment at the low point of the top of the dam is 105 acre-feet. An 11.5-foot long concrete and stone masonry overflow spillway is located about 100 feet east of the southwest dam abutment. A gated 18-inch diameter low level outlet, which is used to drain the lake, is located near the base of the dam under the spillway.

Analomink Lake Dam is classified as a "Small" size, "Significant" hazard dam. The recommended Spillway Design Flood (SDF) for a dam in this classification ranges from the 100-year flood to one-half of the Probable Maximum Flood (PMF). Because of the limited hazard potential, the selected SDF is the 100-year flood. The SDF peak inflow is 943 cfs, while the existing spillway capacity is 38 cfs. The spillway is classified as "Inadequate".

Based upon the inspection of the dam and review of the information provided by the Pennsylvania Department of Environmental Resources (DER), Analomink Lake Dam is considered to be in poor condition. The observed deficiencies are reflected in the following recommendations and remedial measures and discussed in detail in the appropriate sections of this report.

Recommendations and Remedial Measures

The following recommendations and remedial measure should be initiated immediately.

ANALOMINK LAKE DAM NDI ID PA 00638

a. Facilities

The Owner should retain the services of a licensed professional engineer, experienced in the design and construction of dams, to assist in the implementation of the following recommendations:

1. The capacity of the spillway should be increased to provide for safe passage of the SDF.
2. Stability of the dam should be investigated and improved, if necessary.
3. An investigation should be made of the source and extent of the seepage observed from the downstream toe of the dam to about 150 feet downstream of the dam.

The Owner should initiate the following remedial measures:

1. Erosion protection should be provided on the upstream face of the dam.
2. Missing rock in the downstream face of the dam and spillway sidewalls should be replaced.
3. Trees present at the eastern abutment and at the toe of the dam, just to the east of the spillway, should be removed. Any resulting voids should be backfilled with suitable material and thoroughly compacted to ensure proper density.

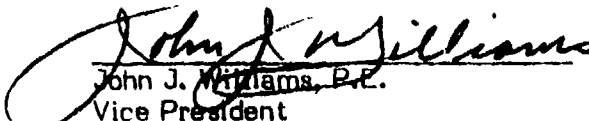
4. Spalled concrete in the spillway should be repaired.

b. Operation and Maintenance Procedures

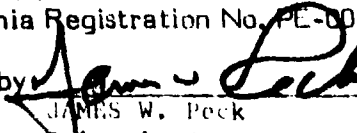
1. The existing operation and maintenance program should be expanded to include an annual technical inspection by a licensed professional engineer, experienced in the design and construction of dams.

2. A formal surveillance and downstream warning plan should be developed and implemented during periods of extreme rainfall so that downstream residents and the appropriate agencies are notified in case of impending dam failure or potential flooding.

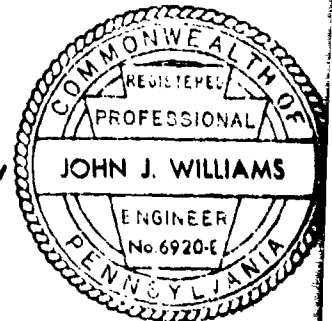
O'BRIEN & GERE ENGINEERS, INC.


John J. Williams, P.E.
Vice President
Pennsylvania Registration No. PE-006920-E

Date: 21 Aug. 1981

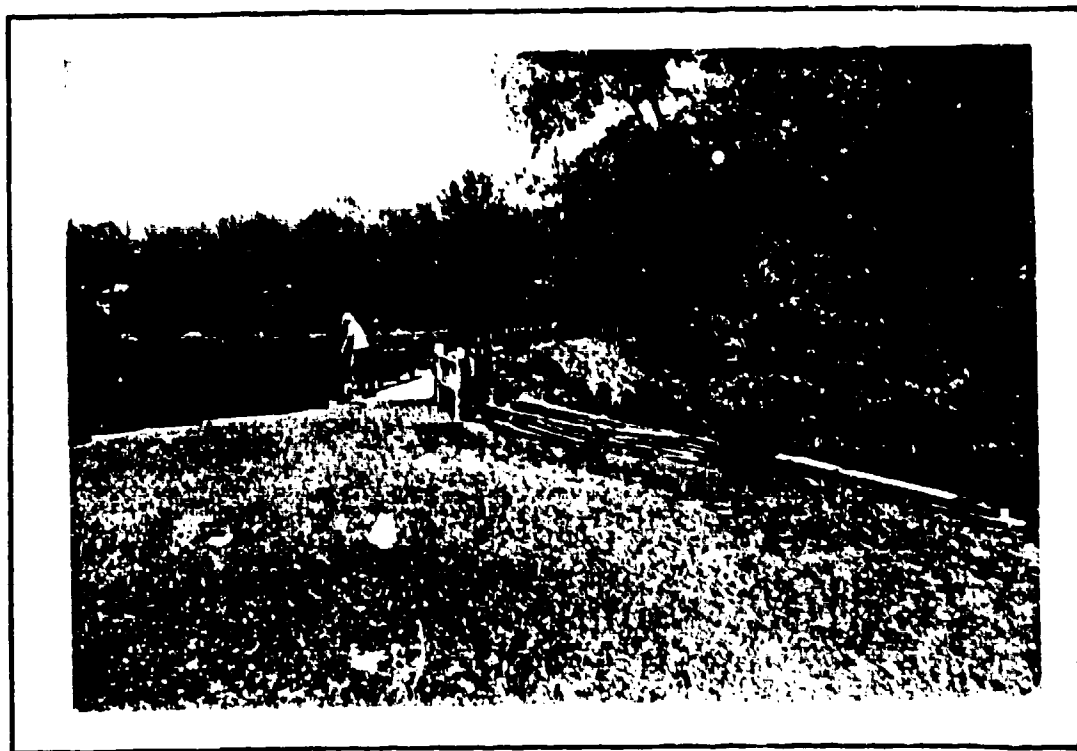
Approved by: 
JAMES W. Peck
Colonel, Corps of Engineers
District Engineer

Date: 31 Aug 81





OVERVIEW OF ANALOMINK LAKE DAM FROM THE LEFT ABUTMENT. (5/20/81)



OVERVIEW OF ANALOMINK LAKE DAM FROM THE RIGHT ABUTMENT.
(5/20/81)

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PHASE I REPORT

NATIONAL DAM INSPECTION PROGRAM ANALOMINK LAKE DAM NDI ID PA-00638 PA DER 45-32

SECTION 1

PROJECT INFORMATION

1.1 General

a. Authority. The Dam Inspection Act, Public Law 92-367, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a program of inspection of dams throughout the United States.

b. Purpose. The purpose of this inspection is to determine if Analomink Lake Dam constitutes hazard to human life and property.

1.2 Description of Project. (Based upon information obtained from the Pennsylvania Department of Environmental Resources (DER), Division of Dam Safety, Harrisburg, PA, from Mr. Joseph Zacharias of the Analomink Rod and Gun Club, Inc., and from the field inspection.)

a. Dam and Appurtenances. Analomink Lake Dam is an estimated 280-foot long rock fill and earth embankment, which was built approximately 70 years ago for recreational purposes. The dam is about 11 feet high and impounds Analomink Lake with a normal pool surface area of approximately 22 acres. The maximum storage capacity of the impoundment at the low point of the top of the dam is about 105 acre-feet. The dam has an average crest width of approximately 8 feet and a downstream slope which varies from 1H:1V to nearly vertical. The dam appears to be essentially a stone structure, as evidenced by the stone spillway and downstream face of the dam. The upstream face of the dam is almost entirely submerged. No drawings for the original construction of the dam are available.

A stone and concrete over flow spillway is located about 100 feet left of the southwest dam abutment. The original spillway was entirely stone. An intermediate concrete pier separates the spillway into two sections: one is 6 feet long, and the other 5.5 feet long. A concrete cap on the spillway is approximately one-foot thick and extends for the entire length of the spillway. The abutment walls and wingwalls of the spillway are also concrete.

The low level outlet for the dam is located near the base of the dam under the west side of the spillway. The outlet consists of a gated 18-inch diameter cast iron pipe which extends from the lake to the outlet channel just downstream of the spillway. The gate valve on this pipe is accessible from the walkway bridge over the spillway, where a capped service box is located.

b. Location. Analomink Lake Dam is located on an unnamed tributary of Brodhead Creek in Stroud Township, Monroe County, Pennsylvania. To illustrate the location, a portion of the USGS quadrangle entitled "East Stroudsburg, PA" has been included as Figure 1 of Appendix E. USGS reference coordinates for this dam are N41°03.6' and W75°13.7'.

c. Size Classification. Analomink Lake Dam has a maximum storage capacity of 105 acre feet and a maximum height of 11 feet. The dam is, therefore, classified as a "Small" size dam (height less than 40 feet and storage less than 1,000 acre feet).

d. Hazard Classification. Four homes are located near the western abutment of the dam. Appreciable damage and the loss of a few lives could occur in these homes with a failure of the dam. Therefore, Analomink Lake Dam is classified as a "Significant" hazard dam.

e. Ownership. The dam is owned by the Analomink Rod and Gun Club, Inc. The current secretary is R. K. Allen, RD #7, Box 554, East Stroudsburg, PA 18301 (Telephone: 717-421-3498).

f. Purpose of Dam. The dam was built approximately 70 years ago to provide an impoundment for recreational purposes. The impoundment continues to be used for recreational purposes by the members of the Analomink Rod and Gun Club.

g. Design and Construction History. Analomink Lake Dam was constructed about 1910. Many years ago, a concrete cap was placed over the stone of the overflow portion of the spillway. Concrete side abutments and an intermediate pier replaced the original stone abutments and pier in 1967. Concrete wingwalls were installed at the inlet of the spillway in 1978.

According to correspondence in the Pennsylvania DER files, the downstream wall of the dam was repaired in 1934 following an overtopping of the dam which occurred in 1933.

No drawings or construction information could be located.

h. Normal Operating Procedures. The reservoir surface area is normally maintained at the spillway crest, Elevation 651. Drawdown of the lake may be accomplished by opening the 18-inch diameter gate valve on the low level outlet.

1.3 Pertinent Data

a. Drainage Area.

Square Miles

1.3

b. Discharge at Dam Site (cfs).

Spillway (water surface at the low point of the top of the dam, El. 652.0) 38

Outlet Works (Water surface at normal pool, El. 651) 32

c. Elevation (MSL).

Top of Dam (Low Point)	652.0
Spillway Crest (Normal Pool)	651.0
Outlet Works (Inlet Invert)	+643.0
Outlet Works (Outlet Invert)	+642.5
Streambed at Toe of Dam	+641.0

d. Reservoir Length (Feet).

Normal Pool	1,600
Maximum Non-overtopping Pool	1,650

e. Storage (Acre-Feet).

Normal Pool, Elevation 651	73
Top of Dam (Low Point), Elevation 652	98

f. Reservoir Surface Area (Acres)

Normal Pool, Elevation 651	22
Top of Dam (Low Point), Elevation 652	27

g. Dam Data

Type	Rock and Earthfill Embankment
Length	280 Feet
Height to Low Point of Dam	11 Feet
Crest Width	Average of 8 feet
Side Slopes (Upstream)	2H:1V where visible
(Downstream)	1H:1V to near vertical
Zoning	Unknown
Impervious Core	Unknown
Cutoff	Unknown
Grout Curtain	Unknown

h. Spillway.

Type	Broad-crested, overflow
Length of Weir	11.5 feet
Crest Elevation	651.0
Gates	None
Upstream Channel	Impoundment
Downstream Channel	The channel is boulder strewn and ill defined with flat, well vegetated side slopes.

SECTION 2

ENGINEERING DATA

2.1 Design

a. Data Available. The following information is available at the main office of the Pennsylvania DER in Harrisburg, Pennsylvania: (1) Miscellaneous correspondence, memoranda, etc. and (2) Several photos taken just after construction and during routine inspections.

b. Design Features. The design features are described in Sections 1.2a and 1.3 of this report. No drawings of the dam are available.

2.2 Construction. Analomink Lake Dam appears to have been constructed of stone and earth. Since no drawings of the dam are available, it is not possible to verify its construction without further investigation.

2.3 Operation. According to the Owner's representative, the outlet works are operated periodically. The procedure involves removing a short section of the walkway over the spillway, opening the capped service box and inserting an extended stem operator to open an 18-inch diameter gate valve on the low level outlet. The valve was operated during the field inspection.

2.4 Evaluation

a. Availability. Little information relative to the Analomink Lake Dam is available from either the Pennsylvania DER or the Owner. The information presented in this report was obtained from correspondence in the Pennsylvania DER files, from conversations with the Owner's representative and from the field inspection.

b. Adequacy. The information provided by the Pennsylvania DER and the Owner, along with information obtained during the visual inspection, has been adequate for a Phase 1 Evaluation of Analomink Lake Dam.

c. Validity. None of the available information conflicted with the information obtained during the field investigation.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. Analomink Lake Dam was inspected on May 20 and June 1, 1981. At the time of the inspections, the level of the lake was estimated to be 0.1 feet above the spillway crest, Elevation 651. Underwater areas were not inspected.

The observations and comments of the field inspection team are noted on a checklist included as Appendix A of this report.

b. Dam. The dam appears to be in poor overall condition. The dam appears to have been constructed with a downstream zone of stone while, possibly, the rest of the structure is an earth embankment. Most of the crest is covered with crushed stone and, as illustrated on Sheet 11B of Appendix A, is not at a consistent elevation. The slope of the downstream face of the dam varies from approximately 1H:1V to nearly vertical. Rock slides on the downstream face were observed. Most of the upstream face of the dam was submerged at the time of the inspection; however, the portion visible appeared to be on about a 2H:1V slope. Small crushed stone has been placed on the upstream face, which does not appear to be adequate to protect the embankment from erosion.

The abutment areas of the dam appear to be sound. No areas of settlement, cracking or unusual movement were noted. The primary problem with the dam is the seepage noted from the downstream toe to about 150 feet downstream of the toe. At least 50 gallons per minute of seepage was noted over the downstream area. A pool of seepage is located approximately 150 feet downstream of the dam. (See Photo 9, Appendix C).

Trees present problems at two locations. One is at the eastern dam abutment where four trees with trunks ranging in size from 12 to 24 inches in diameter are located. The other location is at the downstream toe of the dam just to the east of the spillway, where several trees, with trunks averaging about 12 inches in diameter, are growing very close to the dam.

c. Appurtenant Structures. The spillway, which is located about 100 feet east of the southwest dam abutment, is a stone and concrete overflow structure. The original spillway was constructed of stone, but has since been provided with a concrete cap along its crest, concrete wingwalls at its entrance, concrete abutments walls and an intermediate concrete pier six feet from the western abutment wall. The total length of the overflow weir is approximately 11.5 feet. Concrete has been placed at the downstream base of the spillway, presumably to prevent erosion due to the force of the water flowing over the spillway.

Several deficiencies were noted relative to the spillway. The primary problems are associated with the stability of the stone portion. It appears that settlement has occurred in each abutment wall and, as a result, openings have developed between

some of the stones. In addition, 1.5 to 2-inch openings have developed at the east side junction between the concrete cap and the stone abutment wall and under the concrete cap at its junction with the spillway. The crest of the concrete cap is spalled.

The outlet works for the dam consist of a gated 18-inch diameter cast iron pipe located under the west side of the spillway. Access to the gate valve on the outlet is available from a walkway, which has been constructed over the spillway (Photo 2, Appendix C). The valve was operated during the inspection.

d. Reservoir Area. The reservoir area consists of approximately 1.3 square miles of moderately sloped and forested land. The only developed area is along the shores of Analomink Lake. No evidence of excessive siltation or unstable slopes along the perimeter of the reservoir were observed.

e. Downstream Channel. The low level outlet discharges to an open channel, which conveys flow for a distance of approximately 2,500 feet, prior to discharging into Brodhead Creek. The channel is boulder strewn and ill defined with flat, well vegetated side slopes. About 1,000 feet downstream of the dam, the stream enters an impoundment of about 12 acres prior to continuing to Brodhead Creek.

3.2 Evaluation. The dam is in poor overall condition. The deficiencies described above should be corrected to prevent further deterioration and to help ensure the safety of the dam.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Procedures. Two features of the dam require operation: the 18-inch diameter low level outlet under the west side of the spillway and the two fish screens located at the crest of the spillway. In order to drain the lake, the operator must remove a small section of the walkway over the spillway, open a capped service box and insert an extended stem operator to open the gate valve on the 18-inch diameter outlet. Debris accumulating at the outlet of the fish screens must be removed frequently. The screens may be removed by lifting them out of the slots provided at the pier and abutment walls of the spillway.

4.2 Maintenance of the Dam. According to the Owner's representative, no established maintenance program exists for the dam. Maintenance is performed on an "as-needed" basis.

4.3 Maintenance of Operating Facilities

According to the Owner's representative, the valve on the low level outlet is operated several times a year in order to keep it functional. The fish screens are cleaned almost daily.

4.4 Description of Any Warning System in Effect. According to the Owner's representative, no formal surveillance and downstream warning system is in effect at the Analomink Lake Dam.

4.5 Evaluation. It appears that the routine maintenance operations are adequate, but seepage and potential structural problems have been left unattended. Once the recommendations discussed in Section 7 of this report are implemented, a comprehensive maintenance program should be developed and instituted to ensure that potential problems are investigated.

A formal surveillance and downstream warning plan should be developed and implemented during periods of extreme rainfall to ensure that downstream residents and the appropriate agencies are notified in the case of an impending dam failure.

SECTION 5

HYDROLOGY AND HYDRAULICS

5.1 Evaluation of Features

a. Design Data. Analomink Lake Dam has a drainage area of approximately 1.3 square miles and a maximum storage capacity of 105 acre feet at the low point of the top of the dam. The drainage area lies northwest and southwest of the dam and consists of moderately sloped and forested terrain ranging from about Elevation 1,000 at the western most boundary of the drainage area to Elevation 651 at normal pool elevation. The drainage area is sparsely populated, except along the shores of Analomink Lake, and no other significant impoundments presently exist upstream of the dam. From the upper reaches of the drainage area, runoff flows overland to an unnamed tributary of Brodhead Creek and then easterly on an average slope of approximately 3.5 percent to Analomink Lake. The easterly portion of the drainage area, comprising approximately 15 percent of the total area, is very swampy. No original hydrologic or hydraulic calculations are available.

b. Experience Data. No operation and maintenance records for the dam have been kept. According to the Owner's representative, the maximum water surface elevation occurred in 1955, during Hurricane Diane, when the dam was overtopped by a few inches. No rainfall data or upstream gaging station information is available.

c. Visual Observation. The spillway is in poor overall condition. It was originally constructed of stone and has since been provided with a one-foot thick concrete cap. According to correspondence in the Pennsylvania DER files, this was added to raise the level of Analomink Lake. During the inspection, 1.5 to 2-inch openings were noted just under the concrete cap and at the east side spillway abutment. In addition, the crest of the concrete cap was observed to be spalling.

The stone spillway abutment walls located just downstream of the overflow portion appeared to have settled. As a result, some of the stone on the abutment walls have started to slide downstream (See Photo 4, Appendix C). It was also observed that concrete has been placed at the downstream base of the spillway, presumably to prevent erosion due to the force of water flowing over the spillway.

The outlet works consist of an 18-inch diameter lake drain located under the west side of the spillway. Flow through the 18-inch diameter outlet is controlled from the walkway over the spillway by operating a gate valve on the outlet pipe. As illustrated on Photo 5 of Appendix C, a capped service box has been provided under the walkway on the west side of the spillway. The valve was operated during the inspection.

d. Overtopping Potential. The recommended Spillway Design Flood (SDF) for a "Small" size, "Significant" hazard dam ranges from the 100-year flood to one-half of the Probable Maximum Flood (PMF). Four homes near the western abutment of the dam could be damaged with a failure of the dam. Little chance for loss of life

SECTION 6

STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observations. The dam does not appear to be stable. Several deficiencies were observed which reflect potential stability problems. As illustrated on Photo 3 of Appendix C, the downstream slope of the dam is very steep (1H:1V to nearly vertical) and, as a result, numerous rock slides have occurred. The upstream face of the dam is almost entirely submerged, but it is evident that there is insufficient protection against erosion near the crest of the dam. Trees are present at the eastern dam abutment and also at the top of the dam just to the east of the spillway. These trees range from 12 to 24 inches in diameter and should be removed. Also, it is estimated that more than 50 gpm of water is seeping through and under the dam.

Other evidence of potential structural problems were observed at the spillway. The spillway appears to have settled and several openings have formed. The most noticeable opening has formed just under and at the east side of the concrete cap at the crest of the spillway. Several concrete patches were observed in the stone spillway wall and at the base of the spillway.

b. Design and Construction Data. Drawings of the dam are not available from either the Pennsylvania DER or the Owner. The only available information with regard to the site is in the form of correspondence, miscellaneous memoranda, and inspection photos in the Pennsylvania DER files.

c. Operating Records. According to the Owner's representative, no operating records have been kept.

d. Post Construction Changes. The most significant post construction change was the raising the spillway crest elevation by approximately one foot with the placement of a concrete cap on the spillway crest. No record of this construction is available, but it appears to have been made several years ago. Concrete abutments and a concrete intermediate pier were built in 1967, replacing the spillway's original stone abutments and pier. Concrete wingwalls were installed at the inlet to the spillway in 1978. No records or drawings of any of the post construction changes are available.

e. Seismic Stability. Analomink Lake Dam is located in Seismic Zone 1, according to the Seismic Zone Map of Contiguous States. A dam located in Seismic Zone 1 will generally be stable under expected Zone 1 earthquake conditions, if it is stable under static loading conditions. Since the dam does not appear to be stable for potential static loadings, it is questionable if the dam would be stable for seismic loadings.

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SECTION 7

ASSESSMENT, RECOMMENDATIONS AND PROPOSED REMEDIAL MEASURES

7.1 Dam Assessment

a. Evaluation. Visual inspection of Analomink Lake Dam indicates that the dam is in poor overall condition. The following observations were made during the inspection: 1) seepage (50+ gpm) was observed over a large area just downstream of the dam; 2) inadequate spillway capacity; 3) rock slides on the downstream face of the dam; 4) settlement at the spillway abutment walls and openings which have formed as a result of the settlement; 5) trees on the eastern abutment and at the toe of the dam just to the east of the spillway; and 6) inadequate riprap protection is provided on the upstream face of the dam.

It is important that these conditions be corrected in a timely manner to ensure the future safety of the dam.

The selected Spillway Design Flood (SDF) for Analomink Lake Dam is the 100-year flood. The SDF peak inflow was computed to be 943 cfs. Since the existing spillway capacity is only 38 cfs, the spillway is classified as "Inadequate".

b. Adequacy of Information. The information provided by the Pennsylvania DER, along with the information obtained from the inspection and conversations with the Owner's representative, is considered adequate for a Phase I Evaluation.

c. Urgency. The recommendations and remedial measures discussed in Section 7.2 should be implemented immediately.

d. Necessity for Further Investigation. Further investigations should be implemented as discussed in Section 7.2.

7.2 Recommendations and Remedial Measures

The following recommendations and remedial measure should be initiated immediately.

a. Facilities

The Owner should retain the services of a licensed professional engineer, experienced in the design and construction of dams, to assist in the implementation of the following recommendations:

1. The capacity of the spillway should be increased to provide for safe passage of the SDF.

2. Stability of the dam should be investigated and improved, if necessary.

3. An investigation should be made of the source and extent of the seepage observed from the downstream toe of the dam to about 150 feet downstream of the dam.

The Owner should initiate the following remedial measures:

1. Erosion protection should be provided on the upstream face of the dam.
2. Missing rock in the downstream face of the dam and spillway sidewalls should be replaced.
3. Trees present at the eastern abutment and at the toe of the dam, just to the east of the spillway, should be removed. Any resulting voids should be backfilled with suitable material and thoroughly compacted to ensure proper density.
4. Spalled concrete in the spillway should be repaired.

b. Operation and Maintenance Procedures

1. The existing operation and maintenance program should be expanded to include an annual technical inspection by a licensed professional engineer, experienced in the design and construction of dams.

2. A formal surveillance and downstream warning plan should be developed and implemented during periods of extreme rainfall so that downstream residents and the appropriate agencies are notified in case of impending dam failure or potential flooding.

APPENDIX A
INSPECTION CHECKLIST

CHECK LIST
VISUAL INSPECTION
PHASE I

Sheet 1 of 11

Name Dam Analomink Lake Dam County Monroe State Pennsylvania National ID # PA-00638
Type of Dam Rock Fill Embankment Hazard Category Significant
Date(s) Inspection 5-20-81 Weather Clear (5/20/81) Temperature 65° (5/20/81)
& 6/3/81

Pool Elevation at Time of Inspection 651.0 M.S.L. Tailwater at Time of Inspection +642 M.S.L.

Inspection Personnel:

Leonard Beck Alan Hanscom Jon Raushkoib

Lee DeHeer (6/3/81) _____

Alan Hanscom Recorder

Sheet 1 of 11

Remarks:

Mr. Joseph Zacharias of the Analomink Rod and Gun Club, Inc. accompanied the inspection team

during the site investigation on 5/20/81.

MASONRY DAM

Sheet 2 of 11

REMARKS OR RECOMMENDATIONS

OBSERVATIONS

VISUAL EXAMINATION OF

ANY NOTICEABLE SEEPAGE

Much seepage (in excess of 50 gpm) was observed over a large area just d/s of the dam. (Photos 7, 8 and 9, Appendix C)

Recommend detailed seepage and stability analyses.

STRUCTURE TO
ABUTMENT/EMBANKMENT
JUNCTIONS

The junctions at each side abutment appear to be sound. No signs of settlement or misalignment were observed.

DRAINS

Not applicable.

WATER PASSAGES

Not applicable.

FOUNDATION

It appears that the dam was constructed on bedrock, since outcroppings of fissured stone were observed just d/s of the dam.

MASONRY DAM

Sheet 3 of 11

REMARKS OR RECOMMENDATIONS

VISUAL EXAMINATION OF

OBSERVATIONS

SURFACE CRACKS CONCRETE SURFACES

Concrete cap over spillway crest is spalled.

3 year old concrete wingwalls at spillway are in excellent condition.

Repair the cracked concrete.

STRUCTURAL CRACKING

Cracks have formed just under and at the east side of the concrete cap of stone masonry spillway.

Repair spillway abutment wall.

VERTICAL AND HORIZONTAL ALIGNMENT

No misalignment observed, except at the east side spillway abutment wall which was shifted slightly. (Photo 4, Appendix C)

MOROLITH JOINTS

Dry stone masonry construction,

Many stones displaced.

CONSTRUCTION JOINTS

Not applicable

EMBANKMENT
(Abutment Areas)

Sheet 4 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REPAIRS 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**

Minor erosion on u/s face of dam.

Provide riprap on u/s dam face.

Replace displaced riprap on
d/s face of the dam.

Displaced stones on d/s face.

**VERTICAL AND HORIZONTAL
ALIGNMENT OF THE CREST**

Appears to be good over most of dam.

RIPRAP FAILURES

Several slides on both the u/s and d/s dam
faces. (Photo 3, Appendix C)

Displaced riprap should be
replaced. Small stones on
u/s face should be supplemented
with larger angular riprap.

EMBANKMENT

Sheet 5 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
-----------------------	--------------	----------------------------

MISCELLANEOUS

Several trees were noted at the east side dam abutment, some up to 24" in diameter.
Minor brush at u/s dam face.

All brush and trees should be removed from the dam and abutment areas.

JUNCTION OF EMBANKMENT
AND ABUTMENT, SPILLWAY
AND DAM

Abutment and spillway junction areas appear to be sound.

ANY NOTICEABLE SEEPAGE

See sheet 2 of this Appendix.

STAFF GAGE AND RECORDER

None available.

DRAINS

None

OUTLET WORKS

Sheet 6 of 11

REMARKS OR RECOMMENDATIONS

OBSERVATIONS

VISUAL EXAMINATION OF

CRACKING AND SPALLING OF
CONCRETE SURFACES IN
OUTLET CONDUIT

Not applicable

INTAKE STRUCTURE

None

OUTLET STRUCTURE

None

OUTLET CHANNEL

Ill-defined channel, weathered stone base,
with slight to moderate vegetation.

EMERGENCY GATE

18-inch diameter gate valve is operable.
Access is available through a capped service
box located under the bridge over the
spillway. (Photo 5, Appendix C)

UNGATED SPILLWAY

Sheet 7 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
-----------------------	--------------	----------------------------

CONCRETE WEIR

Concrete cap on stone masonry spillway is spalled.

A crack has developed just under the cap.

Repair the crack.

APPROACH CHANNEL

None

DISCHARGE CHANNEL

Spillway has free fall to outlet channel.
(Photo 4, Appendix C)

BRIDGE AND PIERS

Side and center abutments at spillway are in good condition.

3 year old concrete wingwalls are in excellent condition.
(See Photos 2 and 4)

GATED SPILLWAY

Sheet 8 of 11

REMARKS OR RECOMMENDATIONS

OBSERVATIONS

VISUAL EXAMINATION OF

CONCRETE SILL

Not applicable.

APPROACH CHANNEL

Not applicable.

DISCHARGE CHANNEL

Not applicable.

BRIDGE AND PIERS

Not applicable.

GATES AND OPERATION
EQUIPMENT

Not applicable.

INSTRUMENTATION

Sheet 9 of 11

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
--------------------	--------------	----------------------------

MONUMENTATION/SURVEYS

Not applicable.

OBSERVATION WELLS

Not applicable.

WEIRS

Not applicable.

PIEZOMETERS

Not applicable.

OTHER

Not applicable.

RESERVOIR

Sheet 10 of 11

REMARKS OR RECOMMENDATIONS

OBSERVATIONS

VISUAL EXAMINATION OF

SLOPES

The slopes around the lake appear to be moderate and are covered with primarily deciduous trees.

SEDIMENTATION

No evidence of excessive erosion or sedimentation was observed or mentioned by the Owner's Representative.

DOWNSTREAM CHANNEL

Sheet 11 of 11

REMARKS OR RECOMMENDATIONSOBSERVATIONSVISUAL EXAMINATION OF

CONDITION
(OBSTRUCTIONS,
DEBRIS, ETC.)

Minor to moderate growth was observed
along the downstream channel.

SLOPES

The channel is ill defined,
with flat, well vegetated
slopes.

APPROXIMATE NO.
OF HOMES AND
POPULATION

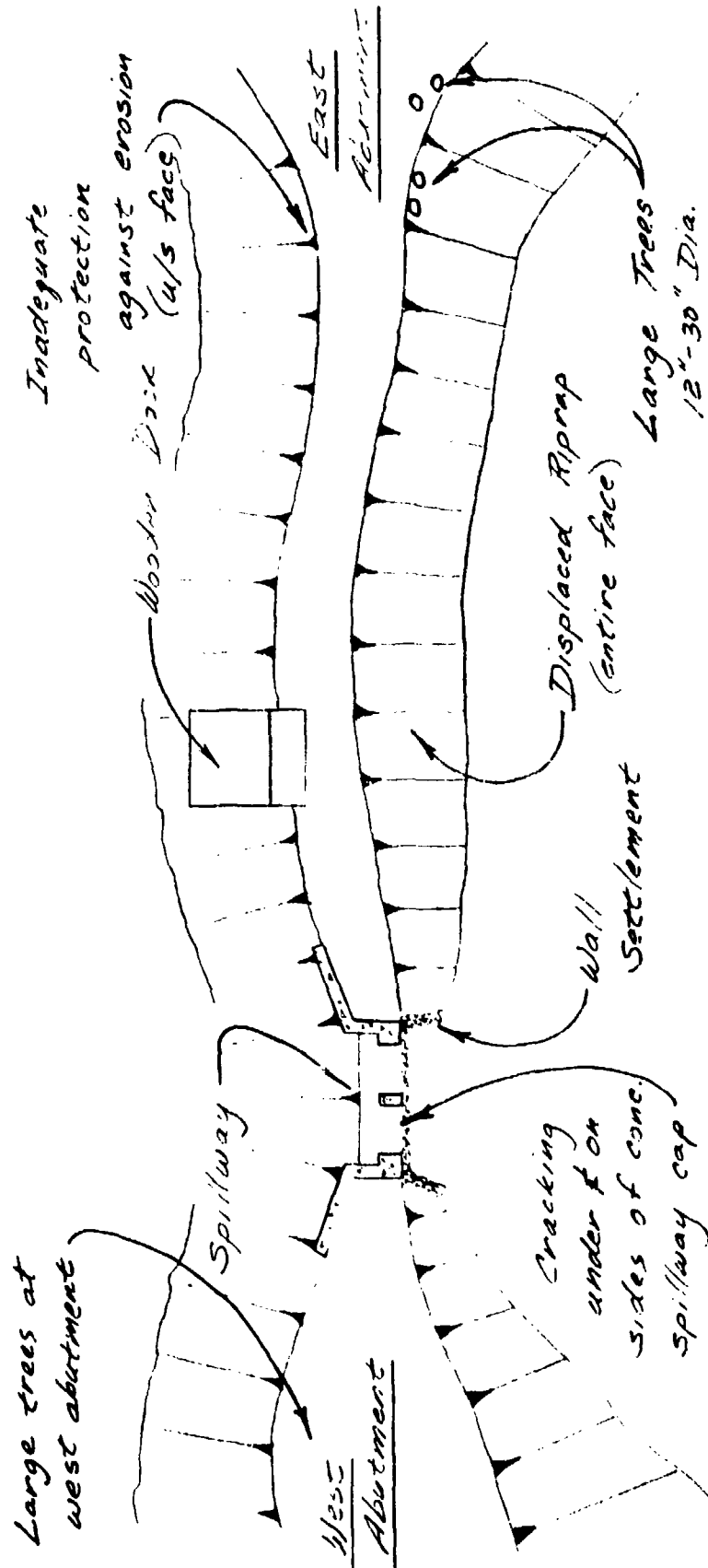
Two homes downstream of the dam
near the western abutment could
be damaged with an overtopping
or failure of the dam. Two other
homes in the area could also
be damaged during prolonged over-
topping of the dam. Little chance
for loss of life exists.

SUBJECT	SHEET	BY	DATE	JOB NO.
Analomink Lake Dam	11A	ADH	7/13/81	1841.01A

LOCATION PLAN OF DEFICIENCIES
OBSERVED DURING VISUAL INSPECTION
ON MAY 20, 1981

Analomink Lake

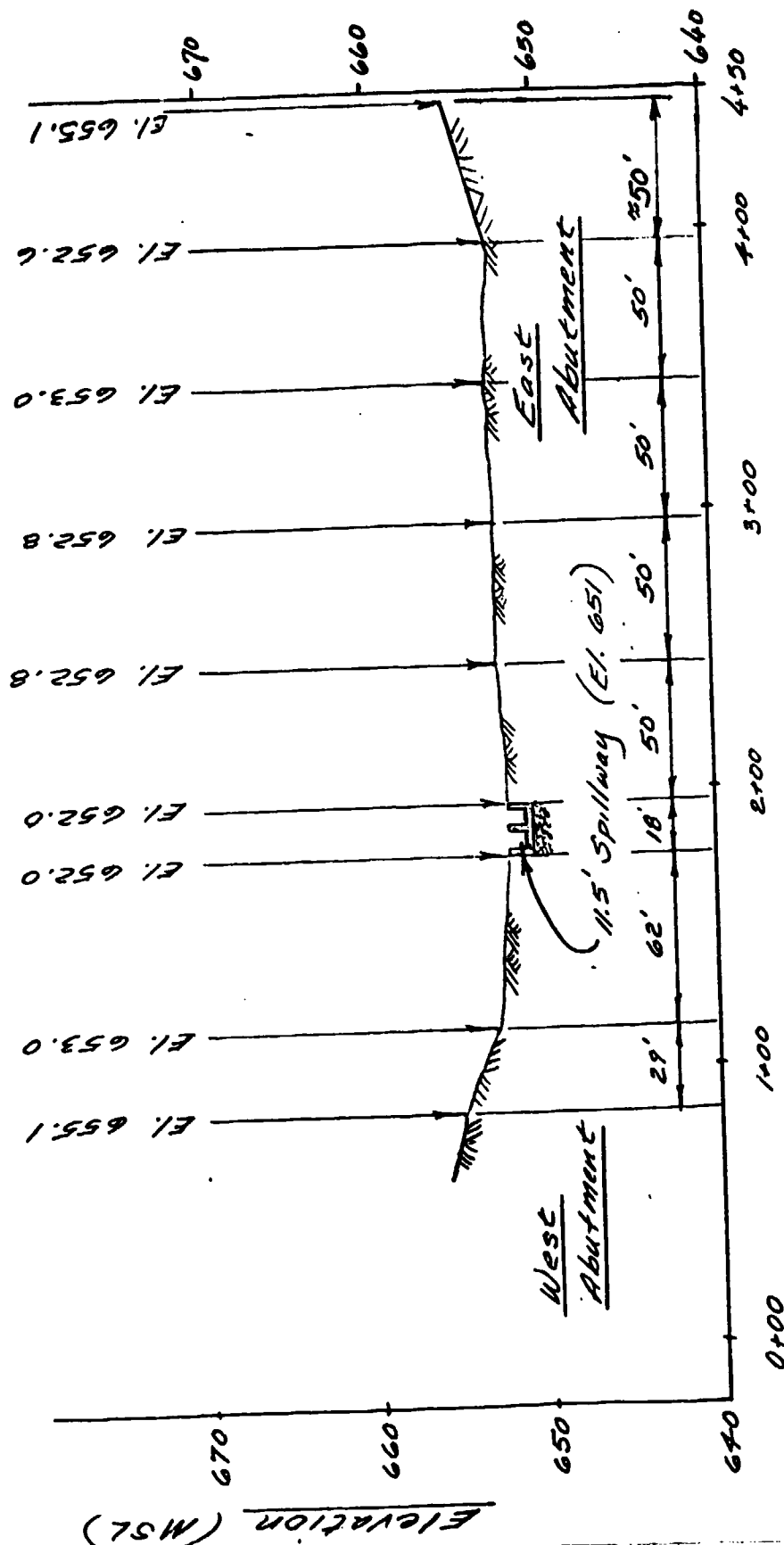
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* Much seepage over entire d/s area up to 50 gpm

Sketch: Air 35
Analomink Lake Dam

PROJECT	SHEET	BY	DATE	JOB NO.
Analomink Lake Dam	11B	ADH	7-01-81	1841.014



PROFILE: ANALOMINK LAKE DAM

Approx. Scales:
Hbr. 1" = 60'
Vert. 1" = 10'

Note:
An 18-inch diameter low level outlet
is located at the west side of the
dam.

APPENDIX B
CHECKLIST
ENGINEERING DATA

O'BRIEN & GERE

NAME OF DAM Analomink Lake Dam
 NDI ID # PA-00638

Sheet 1 of 4

CHECK LIST
 ENGINEERING DATA
 DESIGN, CONSTRUCTION, OPERATION
 PHASE I

REMARKS

ITEM

AS-BUILT DRAWINGS

None available.

REGIONAL VICINITY MAP

See Figure 1, Appendix E.

CONSTRUCTION HISTORY

The dam was constructed around 1910. According to correspondence in the DER files, new concrete piers were installed at the spillway around 1967 and new concrete wingwalls were installed at the spillway in 1978.

TYPICAL SECTIONS OF DAM

None available.

OUTLETS - PLAN

DETAILS

CONSTRAINTS

None available. Refer to Sheets 2 & 3 of Appendix C for a sketch of the dam and the location of the outlet.

DISCHARGE RATINGS None available.

RAINFALL/RESERVOIR RECORDS None available.

Sheet 2 of 4

ITEM	REMARKS
DESIGN REPORTS	None available.
GEOLOGY REPORTS	None available.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None available.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY } FIELD }	None available
POST-CONSTRUCTION SURVEYS OF DAM	None
BORROW SOURCES	Unknown

Sheet 3 of 4

REMARKS

ITEM

MONITORING SYSTEMS

None

MODIFICATIONS

New concrete wingwalls were installed at the spillway 3 years ago.

HIGH POOL RECORDS

No records have been kept; however, the dam was slightly overtopped during Hurricane Diane in 1955 and, according to correspondence in the DER files, was overtopped in 1933.

POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS

None

PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS

According to correspondence in the DER files, the downstream wall of the dam had to be repaired around 1934.

MAINTENANCE OPERATION RECORDS

No records are kept.

Sheet 4 of 4

ITEM	REMARKS
SPILLWAY PLAN { SECTIONS DETAILS	None available. See sketch on page 3 of Appendix C and photo 4 of Appendix C.
OPERATING EQUIPMENT PLANS & DETAILS	No plans are available which illustrate details of the low level outlet valve.
MISCELLANEOUS	

APPENDIX C
PHOTOGRAPHS

APPENDIX C
PHOTOGRAPH TABLE OF CONTENTS

	<u>Page No.</u>
Site Plan	A
<u>PHOTOGRAPH NO.</u>	
1. Overview of the impoundment from the right abutment. (5/20/81)	1
2. Inlet channel for the spillway and the upstream face of the dam. (5/20/81)	1
3. Downstream face of the dam. (5/20/81)	2
4. Spillway near the right abutment. Note the movable fish screens. (5/20/81)	2
5. Capped pipe for access to control of valve of reservoir drain. (5/20/81)	3
6. Downstream outlet of reservoir drain. (5/20/81)	3
7. Typical seepage conditions about 25 feet downstream of the dam. (5/20/81)	4
8. Concentration of seepage discharge about 50 feet downstream of the dam and about 20 feet left of the spillway discharge channel. (5/20/81)	4
9. Seepage concentrated in a pool about 150 feet downstream of the dam. (5/20/81)	5
10. Potential damage area on the downstream face of the dam. (5/20/81)	5

SUBJECT

Analomink Lake Dam

SHEET

A

BY

ADH

DATE

7/13/81

JOB NO

1841.014

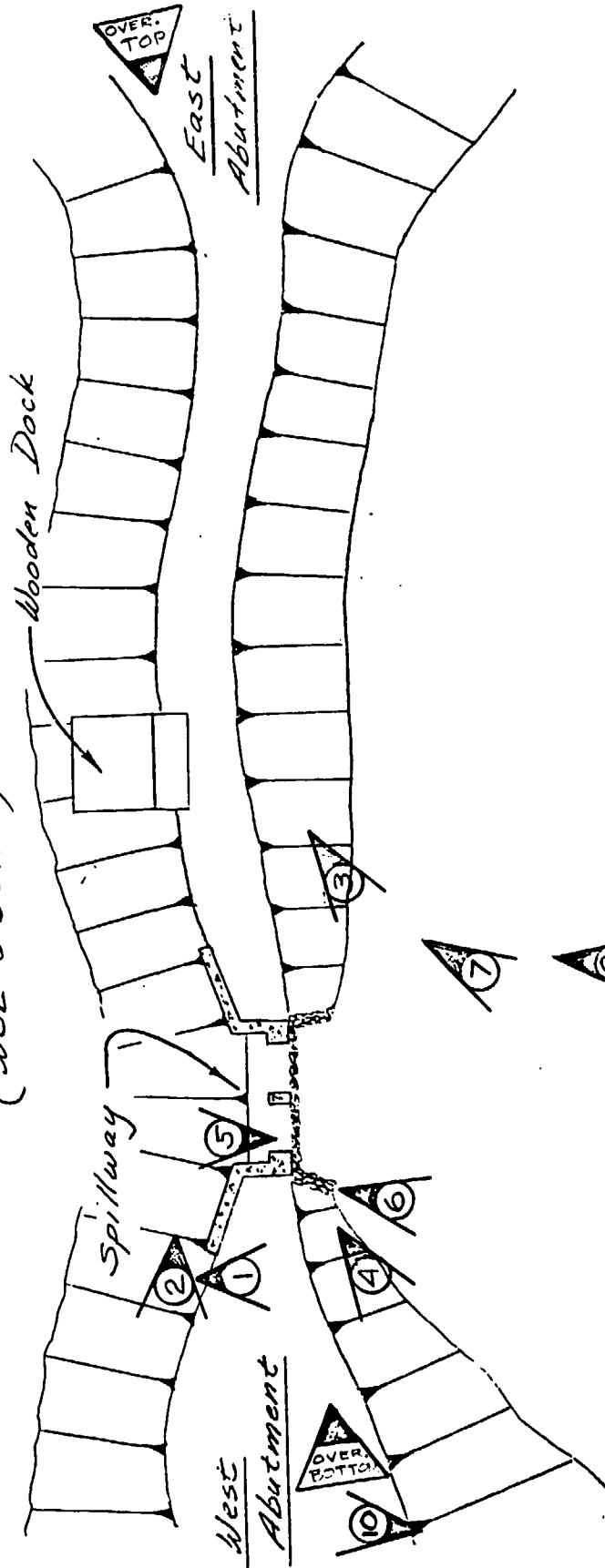
LEGEND:



THE LOCATION AND DIRECTION
IN WHICH EACH PHOTO WAS
TAKEN AND THE NUMBER OF
THE PHOTO

Analomink Lake

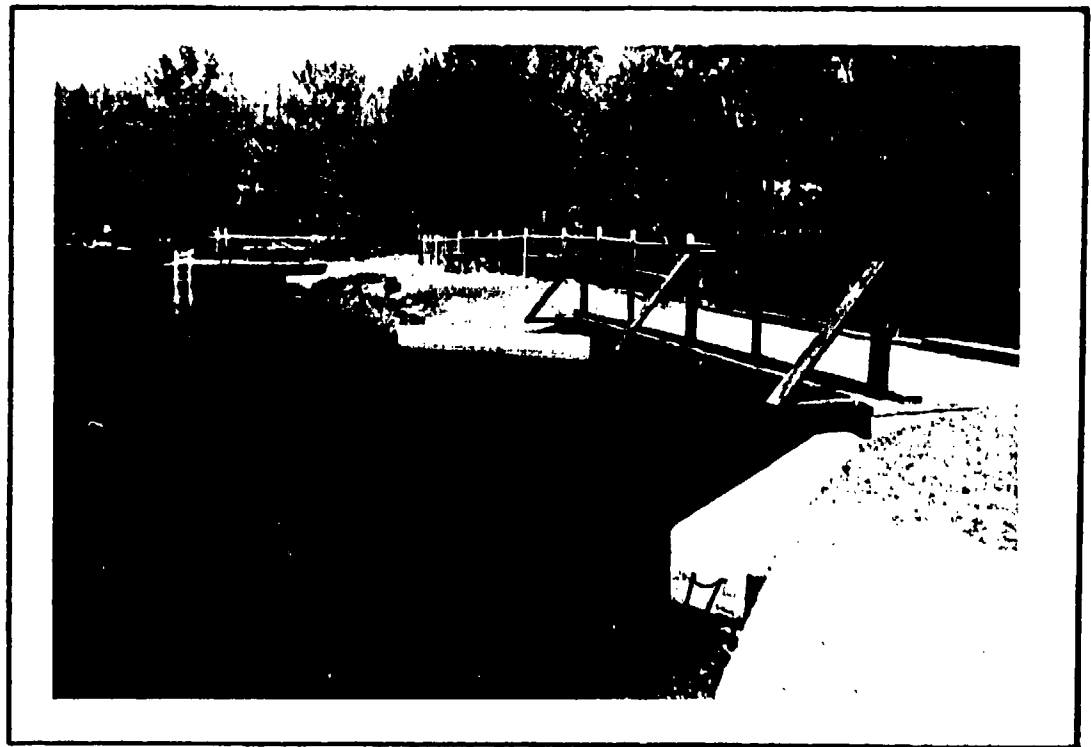
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*Sketch: Plan of
Analomink Lake Dam*



1. OVERVIEW OF THE IMPOUNDMENT FROM THE RIGHT ABUTMENT. (5/20/81)



2. INLET CHANNEL FOR THE SPILLWAY AND THE UPSTREAM FACE OF THE DAM. (5/20/81)



3. DOWNSTREAM FACE OF THE DAM. (5/20/81)



4. SPILLWAY NEAR THE RIGHT ABUTMENT.
NOTE THE MOVABLE FISH SCREENS. (5/20/81)



5. CAPPED PIPE FOR ACCESS TO CONTROL OF VALVE OF RESERVOIR DRAIN. (5/20/81)



6. DOWNSTREAM OUTLET OF RESERVOIR DRAIN. (5/20/81)



7. TYPICAL SEEPAGE CONDITIONS ABOUT 25 FEET DOWNSTREAM OF THE DAM. (5/20/81)



8. CONCENTRATION OF SEEPAGE DISCHARGE ABOUT 50 FEET DOWNSTREAM OF THE DAM AND ABOUT 20 FEET LEFT OF THE SPILLWAY DISCHARGE CHANNEL. (5/20/81)



9. SEEPAGE CONCENTRATED IN A POOL ABOUT 150 FEET DOWNSTREAM OF THE DAM. (5/20/81)



10. POTENTIAL DAMAGE AREA ON THE DOWNSTREAM FACE OF THE DAM. (5/20/81)

APPENDIX D
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

O'BRIEN & GERE

ANALOMIK LAKE DAM
APPENDIX D
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA
TABLE OF CONTENTS

	<u>Sheet</u>
Checklist, Hydrologic and Hydraulic Engineering Data	1
Hydrology Calculations	2
Peak Inflow Determination, 100 Year Flood	3
Stage - Discharge and Stage - Storage Calculations	4

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATADRAINAGE AREA CHARACTERISTICS: Moderately sloped, forestedELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 651.0 (73 acre-feet)ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): NA

ELEVATION MAXIMUM DESIGN POOL: _____

ELEVATION TOP DAM: (Low point of dam) 652.0

SPILLWAY

- a. Elevation 651.0
- b. Type Broad-crested overflow weir
- c. Width 4 feet ±
- d. Length 11.5 feet
- e. Location Spillover Near center of Dam
- f. Number and Type of Gates None, fish screens provided

OUTLET WORKS:

- a. Type 18-inch diameter cast iron pipe.
- b. Location Through west side of spillway wall
- c. Entrance inverts 643.0[±]
- d. Exit inverts 642.5[±]
- e. Emergency draindown facilities gate valve under spillway walk

HYDROMETEOROLOGICAL GAGES:

- a. Type None
- b. Location NA
- c. Records NA

MAXIMUM NON-DAMAGING DISCHARGE: Not determined

Hydrology Calcs.

Drainage Area (planimetered from USGS Quad sh.) = 1.30 mi^2

Surface Area

<u>El.</u>	<u>Area (Acres)</u>
640 ±	0
651. (Normal Pool from Quad)	22
660	71

PMP Calcs. (HMR 33)

Area is in Zone 1

24 hr, 200 mi^2 rainfall = 22.0"

<u>Hr.</u>	<u>To</u>	<u>Rainfall (in.)</u>	<u>Δ Rainfall (in.)</u>
6	111	24.4	24.4
12	123	27.1	2.7
24	133	29.3	2.2
48	142	31.2	1.9

Snyder Coefficients (Information provided by Balt. COE)

Area is in Zone 1

$$C_p = 0.45, C_t = 1.23$$

$$T_p = 1.23 (L + L_{CA})^{0.3}$$

$$L \approx 1.73 \text{ mi}, L_{CA} \approx 1.23 \text{ mi}$$

$$T_p = 1.23 (1.73 + 1.23)^{0.3}$$

$$T_p = 1.54 \text{ hrs.}$$



O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO
Analomink Lake Dam	3	ADH	6/30/81	1841.014

1 \$ 7/22/81

Peak Inflow Determination: 100-year FloodMethod 1 - From "Water Resources Bulletin No. 13", Floods in Pennsylvania; October, 1977.

- From plate 1, site is located in Region 5.

- $Q_T = C(A^x)(P_L)^y$, where A = drainage area
 & P_L = 50 in (from PL)- For Q_{100} ; $x = .751$ & $y = .744$ - $(P_L) = 50$ inches from PL 2. & $C = 42.2$

$$\Rightarrow Q_{100} = (42.2)(1.3)^{.751}(50)^{.744} = \underline{943 \text{ cfs}} \text{ US}$$

Method 2 - From "Regional Frequency Study,

Upper Delaware & Hudson River Basins, New York District Corps of Engineers; Nov., 1974.

- Formulas:

$$\left. \begin{aligned} \log Q_m &= C_m + 0.87 \log A \\ \log Q_{100} &= \log Q_m + k s \\ s &= C_s - 0.05 \log A \end{aligned} \right\} \Rightarrow Q_{100} = \underline{667 \text{ cfs}}$$

where $C_m = 1.7$, from Fig. 2; $g = +0.8$, Fig. $C_s = 0.36$, from Fig. 3; $\Rightarrow k = 2.88$
Tb, C-2, App C Intp

PROJECT	SHEET	BY	DATE	JOB NO.
Anaconda Lake Dam	4	ADH	7/13/81	1841-014

Stage-Discharge Calculations for Spillway

Assume $C \approx 3.3$
 $L \text{ spillway} \approx 11.5'$

$$Q_s = CL_s H_s^{3/2}$$

Elev.	H_s	Q_s
651.0	0	0
652.0	1	38
652.6	1.6	77
653.0	2.0	107
654.0	3.0	197
655.0	4.0	304

For discharge over the top of the dam
 assume $C \approx 2.6$

Stage-Storage Calculations

Elev.	Area (Acres)	Storage (Acres-Feet)
641 (Assumed Bottom of Impoundment)	0	0
651 (Normal Pool)	22	73
660	71	472

1) Based on conical formula

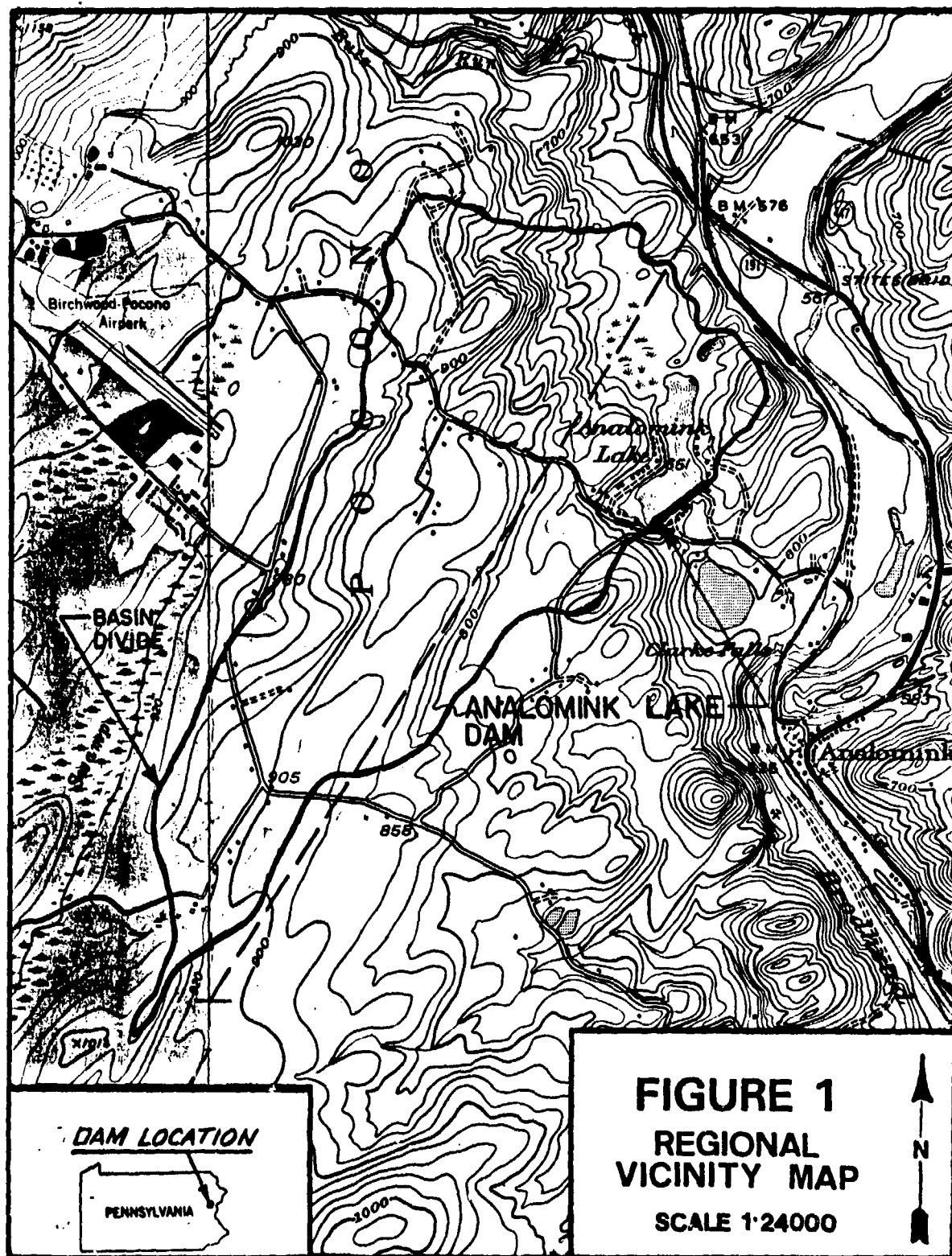
$$V = H/3 (A_1 + A_2 + \sqrt{A_1 A_2})$$

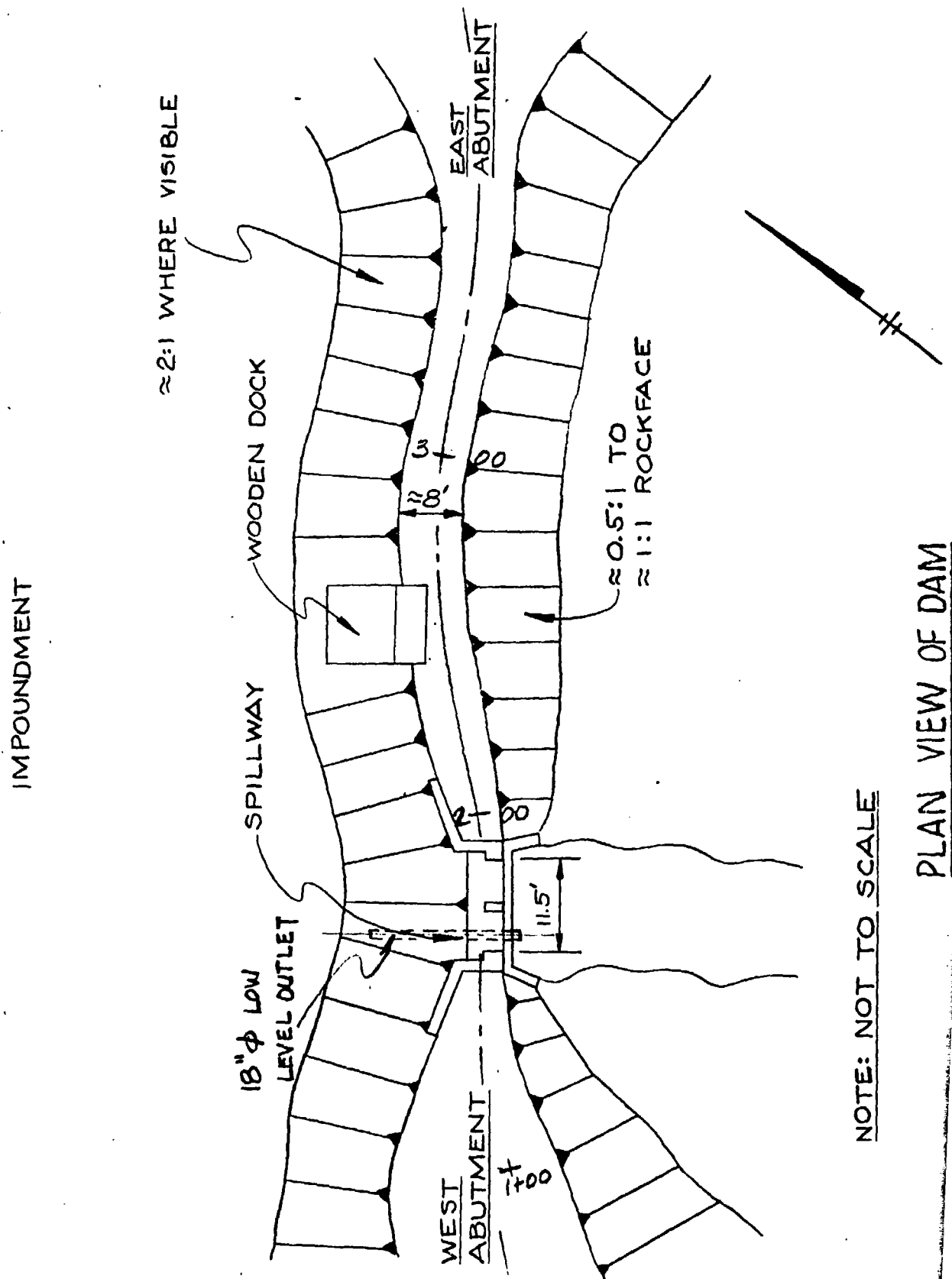
APPENDIX E
REGIONAL VICINITY MAP
&
DRAWINGS

APPENDIX E
REGIONAL VICINITY MAP AND DRAWINGS

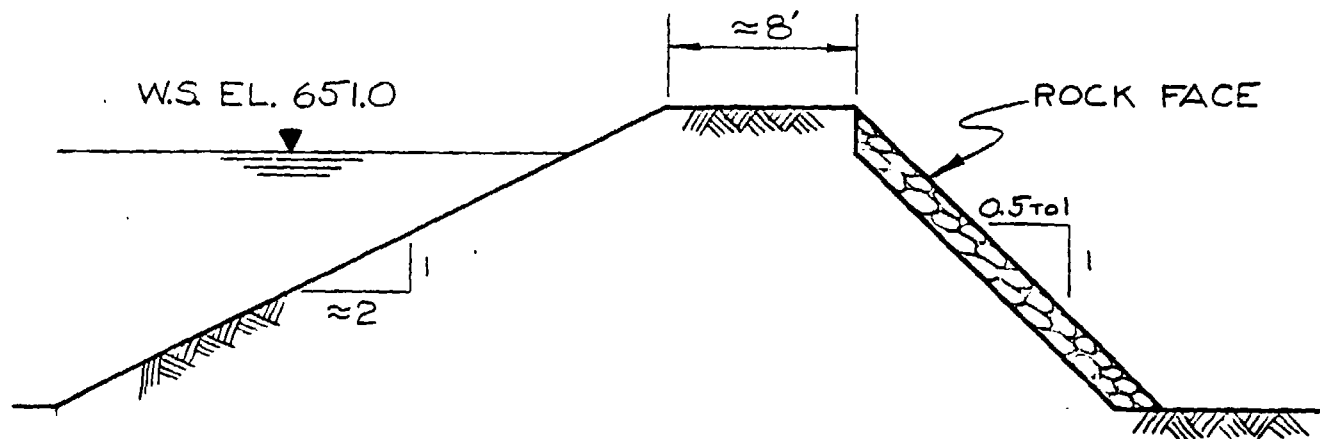
TABLE OF CONTENTS

	<u>Sheet</u>
Regional Vicinity Map, Figure 1	1
Plan View of Dam	2
Typical Embankment Section	3
Spillway Section	3

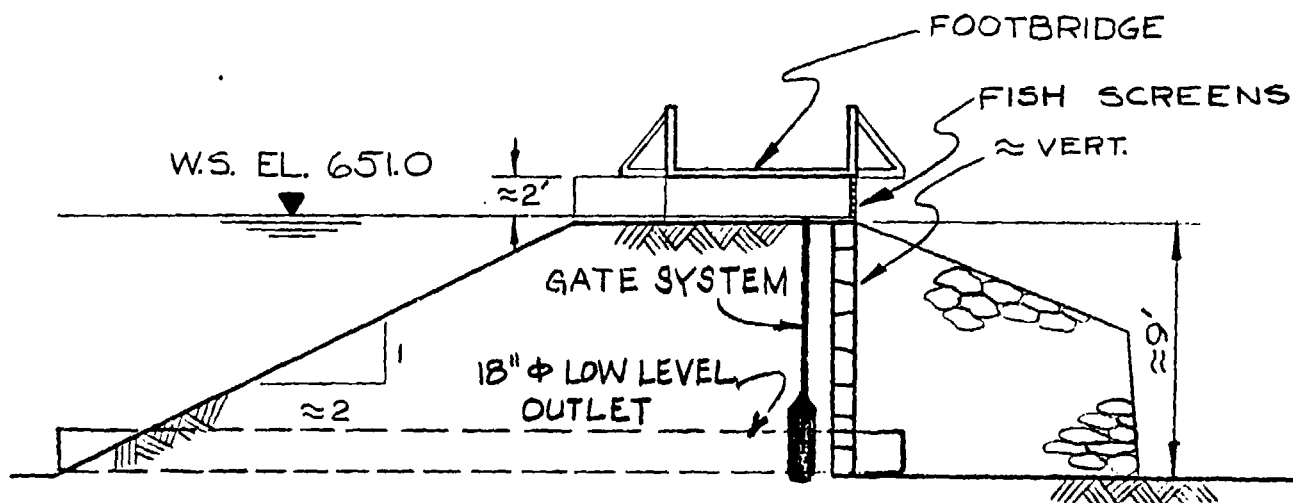




SUBJECT	ANALOMINK LAKE DAM	SHEET	3	BY	RAB	DATE	7/23/81	JOB NO	1841.014
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TYPICAL EMBANKMENT SECTION



SPILLWAY SECTION

NOTE: NOT TO SCALE

APPENDIX F

GEOLOGY

O'BRIEN & GERE

SITE GEOLOGY

ANALOMINK LAKE DAM

Analomink Lake Dam is located in Monroe County within the Pocono Plateau section of the Appalachian Plateau physiographic province. The site is underlain by Devonian age Catskill group continental bedrock units (Analomink and Delaware flag members), consisting of red to brown and gray shale siltstone, sandstone and conglomerate. To the southeast of the site, older Devonian marine beds outcrop normal to Brodhead Creek and dip beneath the Catskill units. Both the Catskill and marine beds strike about N.65°E. and dip about 15°NW.

Bedrock in the area is mantled by Wisconsin epoch glacial drift deposits varying in thickness and ranging from very fine sand to boulder sizes.

No major structural deficiencies are noted in the dam area; jointing and fracturing are well defined in the Catskill units giving them an effective porosity. These units are considered to constitute a fair to good ground water aquifer.

