

AD A108953

4 SUSQUEHANNA RIVER BASIN
5 PLUM RUN, FULTON COUNTY

6 PENNSYLVANIA

LEVEL

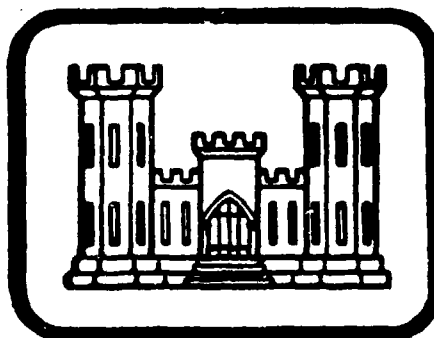
2 **CAMP SINOQUIPE LAKE DAM**

NDI ID NO. PA-1058

DER ID NO. 29-29

7 MASON-DIXON COUNCIL (BOY SCOUTS OF AMERICA)

8 PHASE I INSPECTION REPORT
1 NATIONAL DAM INSPECTION PROGRAM



12 63

DACW 31-81-C-0012

Prepared By

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
CBSBURG, PENNSYLVANIA
15931

DTIC
ELECTE
S DEC 29 1981 D

FOR

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT CORPS OF ENGINEERS
BALTIMORE, MARYLAND
21203

*Original contains color
plates: All DTIC reproductions
will be in black and
white*

AUGUST 1981

DISTRIBUTION STATEMENT A

Approved for public release;
Distribution Unlimited

411059

81 12 28 206

SUSQUEHANNA RIVER BASIN
PLUM RUN, FULTON COUNTY

PENNSYLVANIA

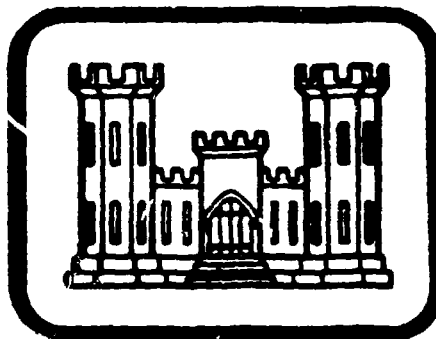
CAMP SINOQUIPE LAKE DAM

NDI ID NO. PA-1058

DER ID NO. 29-29

MASON-DIXON COUNCIL (BOY SCOUTS OF AMERICA)

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



Prepared By

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG, PENNSYLVANIA
15931

FOR

DEPARTMENT OF THE ARMY
BALTIMORE DISTRICT CORPS OF ENGINEERS
BALTIMORE, MARYLAND
21203

DTIC
ELECTE
S DEC 29 1981 D

"Original contains color
plates: All DTIC reproduct-
ions will be in black and
white"

AUGUST 1981

Accession For	
NTIS GRA&I	☒
DTIC TAB	☐
Unannounced	☐
Justification	
By <u>Rex DTIC Form 50</u>	
Distribution/ <u>on file</u>	
Availability Codes	
Dist	Avail and/or Special
A	

DISTRIBUTION STATEMENT A

Approved for public release;
Distribution Unlimited

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

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

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

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway 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.

PHASE I REPORT
NATIONAL DAM INSPECTION REPORT

NAME OF DAM	Camp Sinoquipe Lake Dam
STATE LOCATED	Pennsylvania
COUNTY LOCATED	Fulton
STREAM	Plum Run
DATES OF INSPECTION	April 23, 1981 and May 12, 1981
COORDINATES	Lat: 40° 5.7' Long: 77° 58'

ASSESSMENT

The assessment of the Camp Sinoquipe Lake Dam is based upon visual observations made at the time of inspection, review of available records and data, hydraulic and hydrologic computations and past operational performance.

In general, the dam appears to be in fair condition. No major erosion was observed on the embankment crest or slopes during the inspection. The retaining wall located at the junction of the embankment and the spillway should be repaired due to undercutting caused by flows in the discharge channel. The condition of the reservoir drainline is questionable, based on a 1966 memorandum in the DER files which indicates the construction of the drainline deviated from the original design.

Two seepage areas were observed during the inspection. One area was observed on the downstream slope in the area of the masonry retaining wall located at the junction of the embankment and spillway.

The Camp Sinoquipe Lake Dam is a low hazard-small size dam. The recommended spillway design flood (SDF) for a dam of this size and classification is in the range of the 50-year storm to the 100-year storm. No homes were observed to exist in the potential downstream flood plain associated with a dam failure and no significant structures were observed in the flood plain. A township road exists approximately 1200 feet downstream of the dam and agricultural areas exist approximately one mile downstream of the dam. The spillway design flood has been selected as the 100-year storm.

The visual observations, review of available data, hydrologic and hydraulic calculations and past operational performance indicate that the Camp Sinoquipe Lake Dam is capable of controlling the spillway design flood (100-year storm). The spillway is termed adequate.

1. The condition of the 24" reinforced concrete pipe drainline is questionable. Available information suggests that the drainline was not constructed as originally designed. The condition of the drainline should be investigated by a registered professional engineer

CAMP SINOQUIPE LAKE DAM
PA 1058

knowledgeable in dam design and analysis to include an assessment of the horizontal alignment of the pipe and condition of the pipe joints. Consideration should be given to excavating a major portion of the pipe and encasing it in concrete as originally designed.

2. It should be ascertained whether the upstream shutoff for the 24" drainline is operable. If it is found that the valve is not operable, it should be made operable or some means devised to drain the reservoir which does not include a pressurized pipe through the embankment. If the valve is operable, it should be operated and lubricated on a regular basis.

3. A detailed seepage analysis should be conducted by a registered professional engineer knowledgeable in dam design and analysis. The detailed seepage analysis should be conducted in conjunction with the investigation and assessment of the 24" reinforced concrete pipe drainline. Modifications to the structure should be completed if deemed necessary as a result of the seepage analysis. The analysis should indicate whether or not a stability analysis is warranted.

4. The masonry retaining wall located at the junction of the embankment and spillway should be repaired to insure the continued effectiveness of the wall to prevent erosion of the embankment.

5. Brush is beginning to collect on the embankment slopes. The brush should be cleared from the slopes and area immediately beyond the toe of the dam before the brush on the slopes becomes excessive.

6. A safety inspection program should be implemented with inspections at regular intervals by qualified personnel.

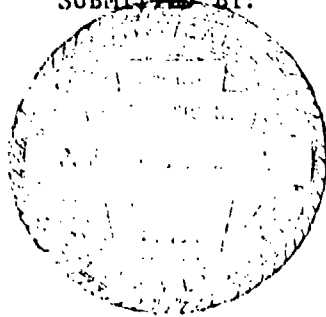
7. A regularly scheduled maintenance and operation plan should be prepared and implemented to insure the continued safe operation of the structure.

8. Positive drainage should be provided for the drainline discharge channel.

CAMP SINOQUIPE LAKE DAM
PA 1058

SUBMITTED BY:

L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS AND ARCHITECTS



8/6/81

Date

R. Jeffrey Kimball

R. Jeffrey Kimball, P.E.

APPROVED BY:

28 Aug 81

DATE

James W. Peck

JAMES W. PECK
Colonel, Corps of Engineers
District Engineer



Overview of Camp Sinoqui Lake Dam.

TABLE OF CONTENTS

	PAGE
SECTION 1 - PROJECT INFORMATION	1
1.1 General	1
1.2 Description of Project	1
1.3 Pertinent Data	2
SECTION 2 - ENGINEERING DATA	5
2.1 Design	5
2.2 Construction	5
2.3 Operation	5
2.4 Evaluation	5
SECTION 3 - VISUAL INSPECTION	6
3.1 Findings	6
3.2 Evaluation	7
SECTION 4 - OPERATIONAL PROCEDURES	8
4.1 Procedures	8
4.2 Maintenance of Dam	8
4.3 Maintenance of Operating Facilities	8
4.4 Warning System in Effect	8
4.5 Evaluation	8
SECTION 5 - HYDRAULICS AND HYDROLOGY	9
5.1 Evaluation of Features	9
5.2 Evaluation Assumptions	9
5.3 Summary of Overtopping analysis	10
SECTION 6 - STRUCTURAL STABILITY	11
6.1 Evaluation of Structural Stability	11
SECTION 7 - ASSESSMENT AND RECOMMENDATIONS/REMEDIAL MEASURES	13
7.1 Dam Assessment	14
7.2 Recommendations/Remedial Measures	14

APPENDICES

- APPENDIX A - CHECKLIST, VISUAL INSPECTION, PHASE I
- APPENDIX B - CHECKLIST. ENGINEERING DATA, DESIGN, CONSTRUCTION,
OPERATION, PHASE I
- APPENDIX C - PHOTOGRAPHS
- APPENDIX D - HYDROLOGY AND HYDRAULICS
- APPENDIX E - DRAWINGS
- APPENDIX F - GEOLOGY

PHASE I
NATIONAL DAM INSPECTION PROGRAM

CAMP SINOQUIPE LAKE DAM
NDI. I.D. NO. PA 1058
DER I.D. NO. 29-29

SECTION 1
PROJECT INFORMATION

1.1 General.

a. Authority. The National 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 the inspection is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project.

a. Dam and Appurtenances. Camp Sinoquipe Lake Dam is an earth-fill dam, 290 feet long (excluding spillway) and 19 feet high. The crest width of the dam is 10 feet. The upstream slope of the dam is 3H:1V and the downstream slope is 2H:1V. The upstream and downstream slopes of the dam are grass covered.

A concrete control structure exists on the upstream slope of the dam at mid-embankment. The structure houses a valve which controls flow through the drainline.

The spillway for the dam is located at the right abutment. The spillway is rectangular, with a masonry retaining wall at the junction of the embankment and the left edge of the spillway. The right abutment of the spillway consists of natural ground. The control section for the spillway consists of a concrete lined masonry, semi-ogee section. The discharge channel for the spillway was excavated into bedrock and discharges flows beyond the toe of the dam. The spillway length is 60 feet.

b. Location. The dam is located on Plum Run, a tributary to the Little Aughwick Creek, approximately 2.5 miles north of the Fort Littleton interchange of the Pennsylvania Turnpike, Dublin Township, Fulton County, Pennsylvania. The Camp Sinoquipe Lake Dam can be located on the Burnt Cabins, PA U.S.G.S. 7.5 minute quadrangle.

c. Size Classification. The Camp Sinoquipe Lake Dam is a small size dam (19 feet high, 124 acre-feet).

d. Hazard Classification. The Baltimore District Corps of Engineers has directed that the Camp Sinoquipe Lake Dam be classified as a low hazard dam. No homes were observed during the inspection which were considered as being within the flood plain of the dam. No significant structures were observed, and no major economic losses are anticipated with the potential failure of the structure. Appreciable economic loss to downstream agricultural areas is probable, and a township roadway would be significantly damaged should failure of the dam occur.

e. Ownership. The Camp Sinoquipe Lake Dam is owned by the Mason-Dixon Council of the Boy Scouts of America. Correspondence should be addressed to:

Mason-Dixon Council
Boy Scouts of America
Hagerstown, Maryland 21740
301/739-1211

f. Purpose of Dam. The Camp Sinoquipe Lake Dam is used for the purposes of recreation.

g. Design and Construction History. Based on information contained in the PennDER files, it appears as though the construction of the dam began in late 1947, with construction of the dam completed during mid-1948. Information in the DER files suggest that an arch dam was originally planned but never constructed due to the depth of bedrock in the area. An earthfill dam was then subsequently designed and constructed. The design of the dam was completed by J.B. Ferguson and Company Engineers, Hagerstown, Maryland. No information was available relative to the actual construction of the dam.

h. Normal Operating Procedures. The reservoir is currently maintained at the spillway crest elevation. No other operations are conducted at the dam.

1.3 Pertinent Data.

a. Drainage Area. 5.7 square miles

b. Discharge at Dam Site (cfs).

Maximum flood at dam site	Unknown
Drainline capacity at normal pool	Unknown
Spillway capacity at top of dam (low spot)	3,450

c. Elevation (MSL) (feet). - Field survey based on an assumed spillway crest elevation of 757.0, which is the water surface shown on the U.S.G.S. 7.5 minute quadrangle. Design drawings included in Appendix E are based on some other datum and indicate difference in elevations relative to U.S.G.S. datum and field measurements taken during the inspection.

Top of dam - low point	765.3
Top of dam - design height	Unknown
Pool at time of inspection	757.0
Spillway crest	757.0
Maximum pool - design surcharge	Unknown
Full flood control pool	763.3
Upstream portal - 24" RCP	Unknown
Downstream portal - 24" RCP	744.1
Streambed at centerline of dam	Unknown
Maximum tailwater	Unknown
Toe of dam	744.1

d. Reservoir (feet).

Length of maximum pool	3000
Length of normal pool	1500

e. Storage (acre-feet).

Normal pool (spillway crest)	39.9
Top of dam	124.0

f. Reservoir Surface (acres).

Top of dam (low spot)	18.0
Normal pool	9.2
Spillway crest	9.2

g. Dam.

Type	Earthfill
Length (excluding spillway)	290 feet
Height	19 feet
Top width	10 feet
Side slopes - upstream	3H:1V
- downstream	2H:1V
Zoning	Yes
Impervious core	Yes
Cutoff	Partial
Grout curtain	None

h. Reservoir Drain.

Type	24" diameter reinforced concrete pipe
Length	120 feet
Closure	Gate valve on upstream end of pipe
Access	Control facility on upstream slope of dam

Regulating facilities

Unobserved during
inspection

1. Spillway.

Type

Rectangular with
semi-ogee shape

Length (crest length)

60 feet

Crest elevation

757.0

Upstream channel

Lake

(unrestricted)

Downstream channel

Plum Run

(tributary to the
Little Aughwick Creek)

SECTION 2 ENGINEERING DATA

2.1 Design. Review of available information in the files of the Commonwealth of Pennsylvania, Department of Environmental Resources, revealed that some correspondence, permit information and design drawings were available for review. Pertinent design drawings relative to the design of the Camp Sinoquipe Lake Dam are located in Appendix E of this report. Reference datum of these drawings is unknown.

2.2 Construction. No information was available regarding the construction of the dam.

2.3 Operation. No operations are conducted at the dam.

2.4 Evaluation.

a. Availability. Engineering data were provided by the PennDER, Bureau of Dams and Waterway Management. The Mason-Dixon Council Scout Executive, Mr. Allan Schaffer, was interviewed to obtain data relative to the dam. Mr. Schaffer did not supply any additional information.

b. Adequacy. This Phase I Report is based on the visual inspection and hydrologic and hydraulic analysis. Sufficient information exists to complete a Phase I Report.

SECTION 3
VISUAL INSPECTION

3.1 Findings.

a. General. The onsite inspection of Camp Sinoquipe Lake Dam was conducted by personnel of L. Robert Kimball and Associates on April 23, 1981 and May 12, 1981. The inspection consisted of:

1. Visual inspection of the retaining structure, abutments and toe.
2. Examination of the spillway facilities, exposed portion of any outlet works and other appurtenant works.
3. Observations affecting the runoff potential of the drainage basin.
4. Evaluation of the downstream area hazard potential.

b. Dam. The dam appears to be in fair condition. From a survey conducted during the inspection, it was noted that the low spot on the crest of the dam was located adjacent to the left spillway wingwall. The upstream slope of the dam was measured to be 3H:1V and the downstream slope of the dam was measured to be 2H:1V. It was noted during the inspection that the crest of the dam and the slopes are grass covered. A small amount of brush was observed as beginning to collect on the downstream slope of the dam.

Two concentrated seepage points were observed during the inspection. One seepage point was located on the downstream slope of the dam adjacent to the left spillway wingwall. Seepage from this area flows along the downstream toe of the dam toward the outlet for the drainline. The seepage was measured to be 3.5 gallons per minute. The second seepage point was located at the toe of the dam adjacent to the left abutment contact. Seepage in this area was measured to be 2.5 gallons per minute. The seepage located adjacent to the spillway was noted as being clear. Seepage observed near the left abutment contact displayed a yellow-red coloring. No major erosion areas were observed during the inspection. No obvious signs of settlement of the embankment or sloughing of the embankment slopes were noted during the inspection. The observed seepage and saturated condition at and beyond the downstream toe are indicators of questionable long term stability.

c. Appurtenant Structures. The spillway for the dam is located at the right abutment of the structure. The spillway control section was observed to be of masonry construction with a concrete cap. No major deficiencies were observed relative to the control section. A masonry wall was observed at the junction of the embankment and spillway. The wall extends along the entire width of the dam.

A concrete drainline intake structure exists along the upstream slope of the dam. A close inspection of the structure could not be made due to its location in the reservoir area. The drainline for the dam consists of a 24" reinforced concrete pipe. It was observed

during the inspection that the last section of pipe for the drainline had separated and the joint of the pipe was exposed. The potential for erosion of the downstream toe exists due to this condition.

d. Reservoir Area. The watershed was observed as being covered almost entirely with forested lands. Reservoir slopes are moderate to steep, but do not appear to be susceptible to landslides which would affect the storage volume of the reservoir or overtopping of the dam by displacing water.

e. Downstream Channel. The downstream channel for the Camp Sinoquie Lake Dam consists of Plum Run (a tributary to the Little Aughwick Creek). No homes or major structures were observed within the potential downstream floodplain for the dam during the inspection. Appreciable economic loss to downstream agricultural areas is probable, and a township roadway would be significantly damaged should failure of the dam occur.

3.2 Evaluation. The dam appears to be in fair condition. No major erosion problems were observed during the inspection. A small amount of brush is beginning to collect on the embankment slopes, and the brush should be removed from the embankment slopes and beyond the toe area.

The spillway appeared to be in fair condition. The masonry wall which exists at the junction of the embankment and spillway is beginning to be undercut near the downstream toe of the dam due to flow in the discharge channel. The undercutting of the retaining wall should be repaired.

The joint between the last section of pipe and the drainline should be closed. Protection should be provided at the outlet to insure that the drainline remains continuous through its entire length.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures. The reservoir is maintained at the spillway crest elevation. No other procedures are conducted at the dam.

4.2 Maintenance of the Dam. No planned maintenance schedule exists for the dam. Maintenance of the dam is considered fair.

4.3 Maintenance of Operating Facilities. There is no maintenance of the operating facilities. The close inspection of the intake structure on the upstream slope of the dam could not be made during the inspection. The valve for the drainline exists at the upstream end of the pipe, but the valve was not observed during the inspection.

4.4 Warning System in Effect. There is no warning system in effect to warn downstream residents of large spillway discharges or imminent failure of the dam.

4.5 Evaluation. No planned maintenance of the dam or operating facilities is conducted. Small amounts of brush are beginning to collect on the embankment slopes. The brush should be removed. Some undercutting of the spillway discharge channel wall is occurring. The undercutting of the wall should be repaired. The last section of the pipe for the 24" drainline has separated from the rest of the pipe. The end section of pipe should be reset and the joint properly sealed and protected. A close inspection of the valve on the upstream end of the drainline could not be made during the inspection. The valve was not operated during the inspection.

An emergency action plan should be available for every dam in the high and significant hazard categories. Such plans should outline actions to be taken by the operator to minimize downstream affects of an emergency, and should include an effective warning system. No emergency action plan is required, but the owner should be aware that development downstream of the dam could increase the hazard classification of the dam and an emergency action plan is required at that time.

SECTION 5
HYDRAULICS AND HYDROLOGY

5.1 Evaluation of Features.

a. Design Data. No detailed design data were available for review.

b. Experience Data. No rainfall, runoff or reservoir level data were available. The spillway reportedly has functioned adequately in the past.

c. Visual Observations. The spillway appeared to be in fair condition. The control section for the spillway consists of a semi-ogee, masonry section with a concrete cap. The spillway discharge channel was cut into natural bedrock. The crest length of the control section was measured to be 60 feet.

A roadway exists along the right abutment of the dam. It was noted that during the inspection that flow would occur along the roadway prior to overtopping of the dam. The additional capacity provided by the roadway area was evaluated as part of the hydraulic analysis.

The low spot on the embankment crest was observed to be near the masonry wall located at the junction of the embankment and the spillway.

d. Overtopping Potential. Overtopping potential was investigated through the development of the 100 year flood (peak inflow) for the region.

The Corps of Engineers, Baltimore District, has directed that the 100 year flood be computed by two methods and the average value used to analyze the spillway adequacy. The two sources of data used to determine the 100 year peak inflow are; (1) Resource Bulletin No. 13 and (2) Hydrologic Study (Typical Storm Agnes) prepared by the N.A.D., Corps of Engineers, 1975.

5.2 Evaluation Assumptions. To enable completion of the hydraulic and hydrologic analysis for this structure, it was necessary to make the following assumptions.

1. The top of dam was considered to be the low spot elevation, 763.3.

2. The spillway control section was considered as exhibiting the properties of a semi-ogee crest.

5.3 Summary of Overtopping Analysis.

Peak inflow (100-year storm)	2150 cfs
Spillway capacity	3450 cfs

a. Spillway Adequacy Rating. The Spillway Design Flood (SDF) is based on the hazard and size classification of the dam. The recommended spillway design flood for a dam of this size and classification is in the range of the 50-year storm to the 100-year storm. No homes were observed during the inspection which existed within the potential floodplain associated with a dam failure. No major structures were observed downstream of the dam that were considered as being significantly affected by dam failure. Appreciable economic loss to downstream agricultural areas is probable, and a township roadway would be significantly damaged should failure of the dam occur. Therefore, the spillway design flood has been selected as the 100-year storm. The spillway is capable of safely passing the SDF (100-year storm). Approximately 1.6 feet of freeboard is available during the storm. Based on the following definition provided by the Corps of Engineers, the spillway is rated as adequate as a result of our hydrologic analysis.

Adequate - All low hazard dams which pass the spillway design flood (100-year storm).

SECTION 6 STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations. No major erosion areas were observed on the embankment crest or slopes. No sloughing or slumping of the embankment crest or slopes were observed during the inspection. Two seepage areas were observed during the inspection. One seepage area was observed on the downstream slope adjacent to the junction of the embankment and spillway. Seepage from this area was measured to be 3.5 gallons per minute. Discharges from the seepage area flow along the downstream toe of the dam and outlet at the discharge channel for the drainline. A second seepage point was observed near the downstream toe at the junction of the embankment and the left abutment. Discharges from the area flow along the downstream toe and outlet at the discharge channel for the drainline. Seepage from this area was measured to be 2.5 gallons per minute. The entire area along the downstream toe of the dam is saturated and a swampy condition exists.

Four requests were made by the owner to draw down the reservoir during the period between 1959 and 1966. Each request to draw down the reservoir included a statement noting that repairs were to be made to the drainline valve to stop leakage from the reservoir. A 1966 memorandum located in the DER files indicates that the dam was inspected by a representative of the Division of Dams and Encroachments to determine the cause of the leak which had stopped flow over the spillway. The memorandum also indicates that the pipe was excavated around the outlet. It was noted that the 24" concrete pipe was to be encased in concrete. The excavation disclosed that the pipe was not encased in concrete. The inspecting engineer concluded that there had been settlement along the pipe and a separation had taken place at a joint. It was noted that the pipe was to be excavated through the dam to about the middle third of the dam. The pipe was then to be completely encircled with concrete. The state was to be advised as to the start of work to repair the pipe. No information exists in the DER files which suggests that the work was ever completed.

It was noted during the inspection that no concrete existed around the exposed portion of the outlet. A separation in the pipe was observed between the last section of pipe and the rest of the drainline. It was noted that the potential for erosion existed due to this condition. During previous conversations with Mr. Allan Schaffer, the Mason-Dixon Scout Council Executive, it was reported that repairs had been made to the pipe some years ago. No date was associated with the repairs. Mr. Schaffer noted that during the repairs to the pipe it was noted that inadequate seals (tin foil) had been provided for the pipe joints. The subsequent repairs to the pipe did not include encasing the pipe in concrete.

b. Design and Construction Data. Only limited information was available in the DER files relative to the design and construction of the dam. The dam was designed by the J.B. Ferguson and Company, Engineers, Hagerstown, Maryland.

c. Operating Records. No operating records exist for the dam.

d. Post Construction Changes. It appears as though the drainline for the reservoir was repaired some time after 1966. Mr. Allan Schaffer, Scout Executive, was unable to report any details associated with the modifications to the drainline.

e. Evaluation. Due to information which is contained in the DER files relative to the reservoir drainline not being encased in concrete, and the observed seepage near the left and right abutments of the dam, no assessment of the static stability of the structure could be made. Seepage on an embankment slope is normally considered a deficiency relative to the static stability. The observed seepage on the downstream slope and the reported condition of the drainline are considered as conditions which with time may develop into safety hazards. A 1966 memorandum contained in the DER files indicates that an inspection was made by an engineer representing the Division of Dams and Encroachments. A portion of the memo indicates that a separation in the pipe may have occurred due to settlement. The observed seepage noted during the inspection is potentially related to this condition, since no information exists relative to adequate repairs to the pipe. Besides the two observed seepage areas at the abutments of the dam, the area along the entire downstream toe of the dam is saturated, and swampy conditions exist which could indicate a problem still exists with the drainline structure.

The condition of the drainline should be evaluated and the cause of the seepage should be investigated. Positive drainage should be provided in the area of the drainline outlet.

f. Seismic Stability. The dam is located in seismic zone I. No seismic stability analyses have been performed. Normally, it can be considered that if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected earthquake loading. Since the static stability of the dam is as yet undetermined, no assessment of the seismic stability of the structure can be made at this time.

SECTION 7
ASSESSMENT AND RECOMMENDATIONS/REMEDIAL MEASURES

7.1 Dam Assessment.

a. Safety. In general, the dam appears to be in fair condition. No major erosion was observed on the embankment crest or slopes during the inspection. The retaining wall located at the junction of the embankment and the spillway should be repaired due to undercutting caused by flows in the discharge channel. The condition of the reservoir drainline is questionable based on a 1966 memorandum in the DER files which indicates the construction of the drainline deviated from the original design. The drainline control structure was inaccessible during the inspection, and the condition of the valve and regulating facilities could not be determined.

Two seepage areas were observed during the inspection. One area was observed on the downstream slope in the area of the masonry retaining wall located at the junction of the embankment and spillway. Seepage from this area was measured to be 3.5 gallons per minute. A second seepage point was located near the toe of the dam in the area of the left abutment contact. Seepage from this point was measured to be 2.5 gallons per minute. Discharges from both seepage areas flow along the downstream toe of the dam and drain into the discharge channel for the reservoir drainline. The observed seepage and questionable condition of the discharge drainline indicate that the drainline may have separated at a joint and the potential for seepage along the drainline is possible. No assessment of the static stability can be made at this time.

The Camp Sinoquipe Lake Dam is a low hazard-small size dam. The recommended spillway design flood (SDF) for a dam of this size and classification is in the range of the 50-year storm to the 100-year storm. Due to the potential appreciable loss to downstream agricultural areas and a township roadway the Spillway Design Flood has been selected to be the 100-year storm.

The visual observations, review of available data, hydrologic and hydraulic calculations and past operational performance indicate that the Camp Sinoquipe Lake Dam is capable of controlling the spillway design flood (100-year storm). The spillway is termed adequate.

b. Adequacy of Information. Sufficient information is available to complete a Phase I report.

c. Urgency. The recommendations suggested below should be implemented as soon as possible.

d. Necessity for Further Investigation. In order to accomplish some of the recommendations/remedial measures outlined below, further investigations will be required by a professional engineer knowledgeable in dam design and construction.

7.2 Recommendations/Remedial Measures.

1. The condition of the 24" reinforced concrete pipe drainline is questionable. Available information suggests that the drainline was not constructed as originally designed. The condition of the drainline should be investigated by a registered professional engineer knowledgeable in dam design and analysis to include an assessment of the horizontal alignment of the pipe and condition of the pipe joints. Consideration should be given to excavating a major portion of the pipe and encasing it in concrete as originally designed. Pipe repairs and backfilling should be under the direction of a qualified professional engineer.

2. It should be ascertained whether the upstream shutoff for the 24" drainline is operable. If it is found that the valve is not operable, it should be made operable or some means devised to drain the reservoir which does not include a pressurized pipe through the embankment. If the valve is operable, it should be operated and lubricated on a regular basis.

3. A detailed seepage analysis should be conducted by a registered professional engineer knowledgeable in dam design and analysis. The detailed seepage analysis should be conducted in conjunction with the investigation and assessment of the 24" reinforced concrete pipe drainline. Modifications to the structure should be completed if deemed necessary as a result of the seepage analysis. The analysis should indicate whether or not a stability analysis is warranted.

4. The masonry retaining wall located at the junction of the embankment and spillway should be repaired to insure the continued effectiveness of the wall to prevent erosion of the embankment.

5. Brush is beginning to collect on the embankment slopes. The brush should be cleared from the slopes and area immediately beyond the toe of the dam before the brush on the slopes becomes excessive.

6. A safety inspection program should be implemented with inspections at regular intervals by qualified personnel.

7. A regularly scheduled maintenance and operation plan should be prepared and implemented to insure the continued safe operation of the structure.

8. Positive drainage should be provided for the drainline discharge channel.

APPENDIX A
CHECKLIST, VISUAL INSPECTION, PHASE I

CHECK LIST
VISUAL INSPECTION
PHASE I

NAME OF DAM Camp Sinoqui COUNTY Fullon STATE Pennsylvania ID# PA 1058
 TYPE OF DAM Earthfill HAZARD CATEGORY Low
 DATE(s) INSPECTION April 23, 1981 Overcast and cool
May 12, 1981 Clear and warm TEMPERATURE 55°
60°

POOL ELEVATION AT TIME OF INSPECTION 757.0 M.S.L. TAILWATER AT TIME OF INSPECTION 745.0 M.S.L.

INSPECTION PERSONNEL:

R. Jeffrey Kimball, P.E. - L. Robert Kimball and Associates

James T. Hockensmith - L. Robert Kimball and Associates

O.T. McConnell - L. Robert Kimball and Associates

O.T. McConnell

RECORDER

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None noted.	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	Minor sloughing in the area of the drainline outlet.	Drainline pipe should be repaired.
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None noted.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Appears to be all right.	
RIPRAP FAILURES	Design drawings indicate riprap was to be placed on the upstream slope of the dam along the normal flow line of the reservoir.	No riprap was observed on the upstream slope during the inspection. Riprap may have been covered with grass.

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	Crest and slopes are grass covered. Minor amounts of brush on the slope.	Brush should be removed from the slope before the condition become excessive.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM		
ANY NOTICEABLE SEEPAGE	Two seepage areas were observed during the inspection. See page A-12.	Seepage should be investigated.
STAFF GAUGE AND RECORDER	None.	
DRAINS	None.	

CONCRETE/MASONRY DAMS - NOT APPLICABLE

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	Not applicable.	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Not applicable.	
DRAINS	Not applicable.	
WATER PASSAGES	Not applicable.	
FOUNDATION	Not applicable.	

CONCRETE/MASONRY DAMS - NOT APPLICABLE

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Not applicable.	
STRUCTURAL CRACKING	Not applicable.	
VERTICAL AND HORIZONTAL ALIGNMENT	Not applicable.	
MONOLITH JOINTS	Not applicable.	
CONSTRUCTION JOINTS	Not applicable.	
STAFF GAUGE OR RECORDER	Not applicable.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	End-section of 24" reinforced concrete pipe drainline shows visible cracking at the joint.	The drainline should be repaired.
INTAKE STRUCTURE	Concrete structure on slope of dam. Structure inaccessible during the inspection.	No evaluation of the facility could be made.
OUTLET STRUCTURE	Exposed portion of 24" reinforced concrete pipe drainline shows visible cracking at the joint.	The drainline should be repaired.
OUTLET CHANNEL	Drainline outlets into a swampy area which exists immediately adjacent to and beyond the toe of the dam.	Positive drainage should be provided for the area.
EMERGENCY GATE	Unobserved during the inspection.	The condition of the valve should be investigated.

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	The spillway control section consists of a semi-shaped, masonry, concrete capped section. Spillway and crest appear to be in fair condition.	
APPROACH CHANNEL	Lake [Unrestricted]	
DISCHARGE CHANNEL	Spillway discharge channel cut into natural bedrock along right abutment. Downstream end of masonry retaining wall is undercut and in need of repair.	Retaining wall located at the junction of the embankment and spillway should be repaired.
BRIDGE AND PIERS	Not applicable.	

GATED SPILLWAY - NOT APPLICABLE

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	Not applicable.	
APPROACH CHANNEL	Not applicable.	
DISCHARGE CHANNEL	Not applicable.	
BRIDGE AND PIERS	Not applicable.	
GATES AND OPERATION EQUIPMENT	Not applicable.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	The discharge channel for the Camp Sinoqui Lake Dam consists of Plum Run [a tributary of the Little Aughwick Creek]. No major obstructions or debris were observed in the channel.	
SLOPES	Appear to be stable.	
APPROXIMATE NO. OF HOMES AND POPULATION	No homes or major significant structures were observed to be located within the potential flood plain associated with dam failure.	

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Moderate to steep, appear to be stable.	
SEDIMENTATION	Unknown.	

INSTRUMENTATION

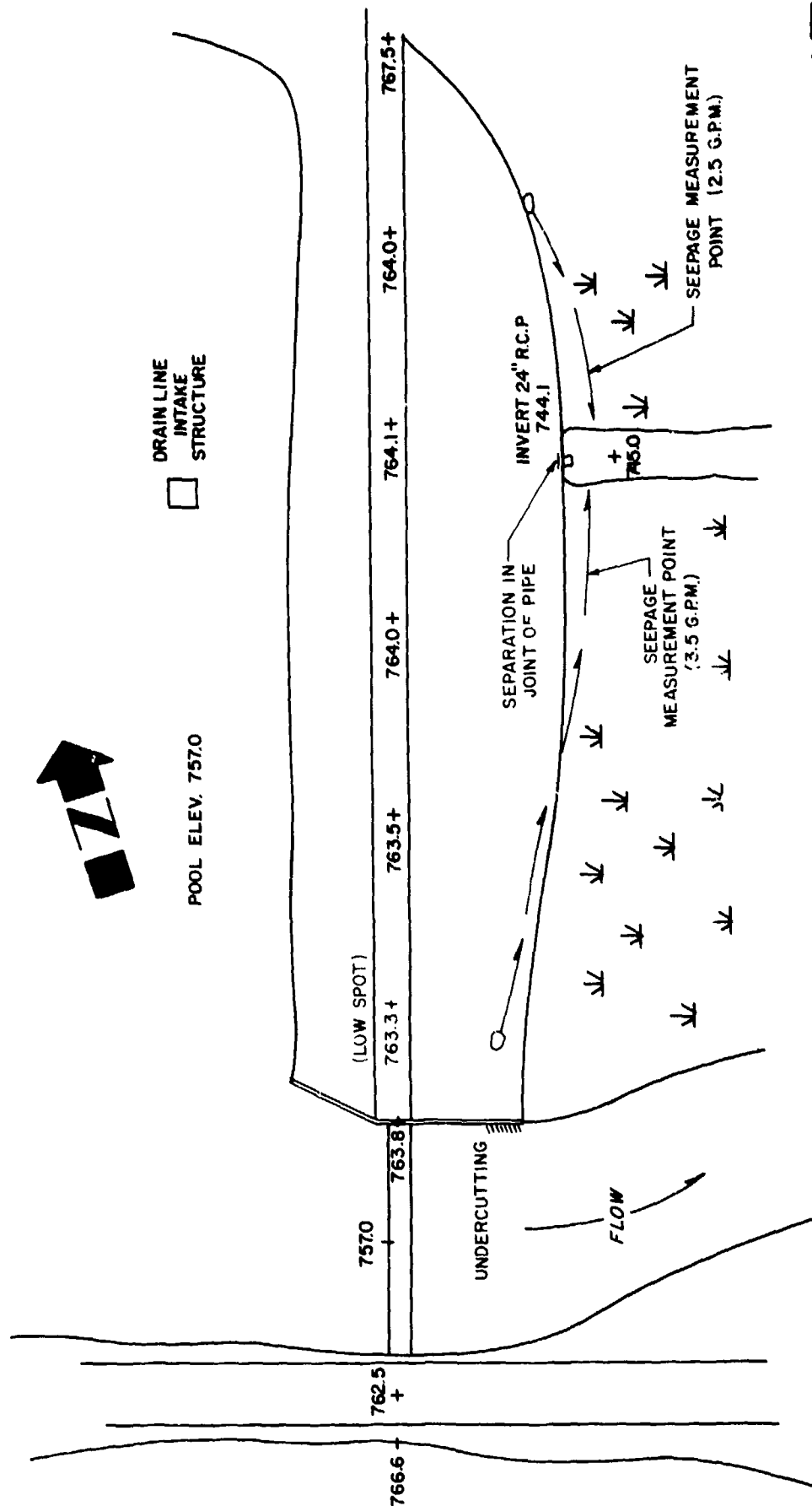
VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHER	None.	



DRAIN LINE
INTAKE
STRUCTURE



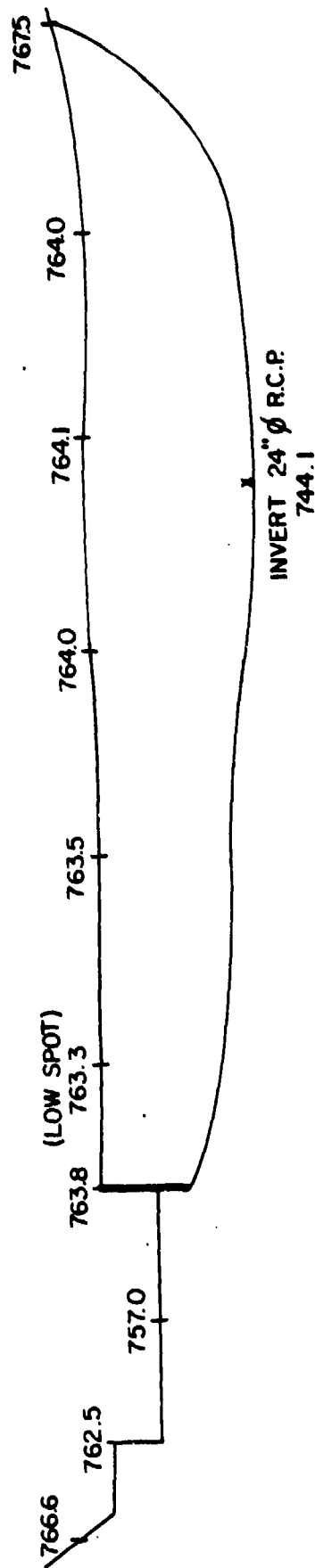
POOL ELEV. 7570



A-12

CAMP SINOQUIPE LAKE DAM

SCALE: 1"=40'



PROFILE
LOOKING UPSTREAM
SCALE: HORIZ. 1"=40'
VERT. 1"=20'

CAMP SINOQUIPE LAKE DAM



APPENDIX B
CHECKLIST, ENGINEERING DATA, DESIGN, CONSTRUCTION, OPERATION, PHASE I

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

Camp Sinoquipe
Lake Dam

NAME OF DAM _____
ID# PA 1058

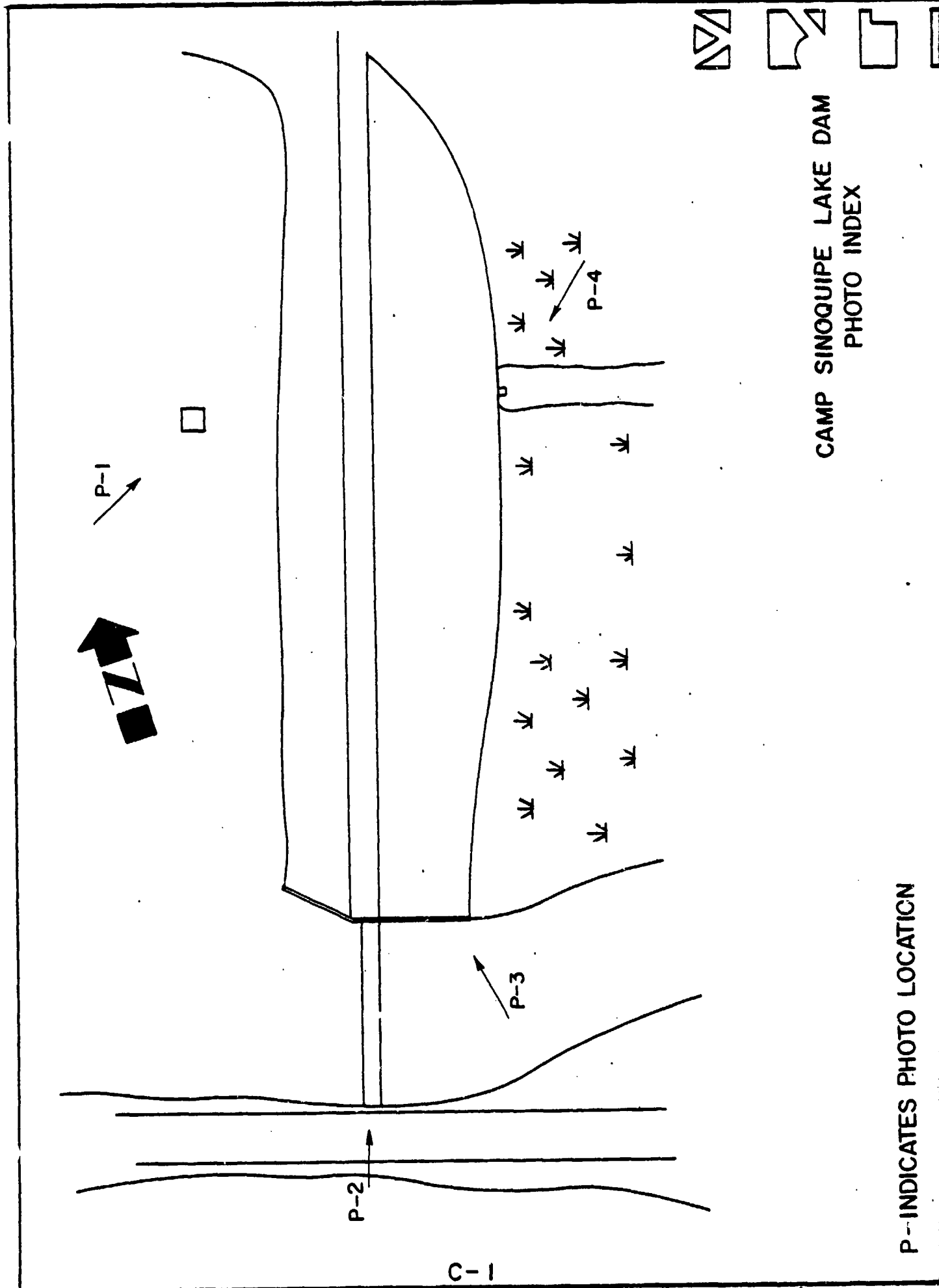
ITEM	REMARKS
AS-BUILT DRAWINGS	None.
REGIONAL VICINITY MAP	U.S.G.S. 7.5 minute quadrangle.
CONSTRUCTION HISTORY	Limited information available in DER files.
TYPICAL SECTIONS OF DAM	See Appendix E.
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS RAINFALL/RESERVOIR RECORDS	See Appendix E. See Appendix E. See Appendix E. None. None.

ITEM	REMARKS
DESIGN REPORTS	None.
GEOLOGY REPORTS	None.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	None available.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	None.
POST-CONSTRUCTION SURVEYS OF DAM	No formal survey is known to have occurred.
BORROW SOURCES	Unknown.

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	Modifications to the 24" reinforced concrete drainline appear to have been completed sometime after 1966. No details available.
HIGH POOL RECORDS	None.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	No formal studies or report known to exist.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None known to have occurred.
MAINTENANCE OPERATION RECORDS	None.

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	See appendix E.
OPERATING EQUIPMENT PLANS & DETAILS	None.

APPENDIX C
PHOTOGRAPHS



CAMP SINOQUIPE LAKE DAM
PA 1058

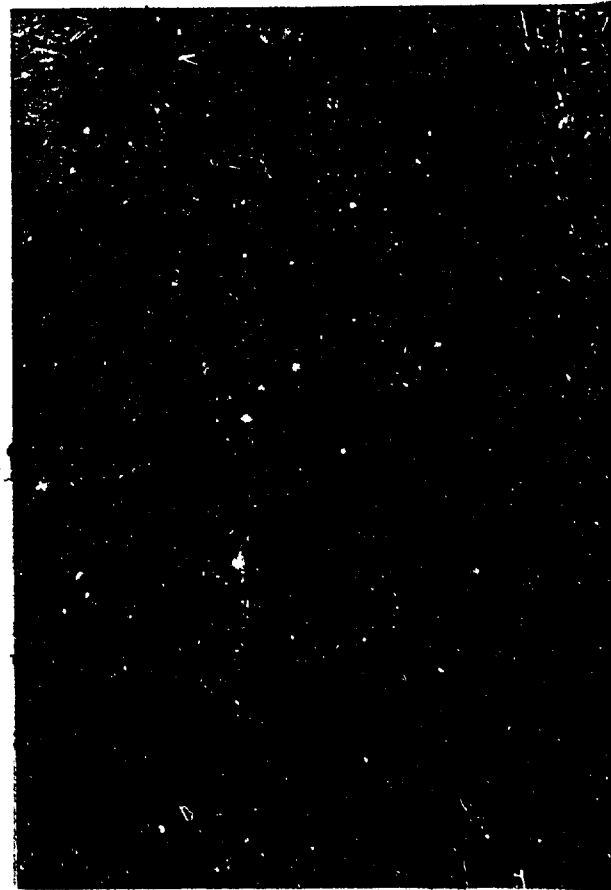
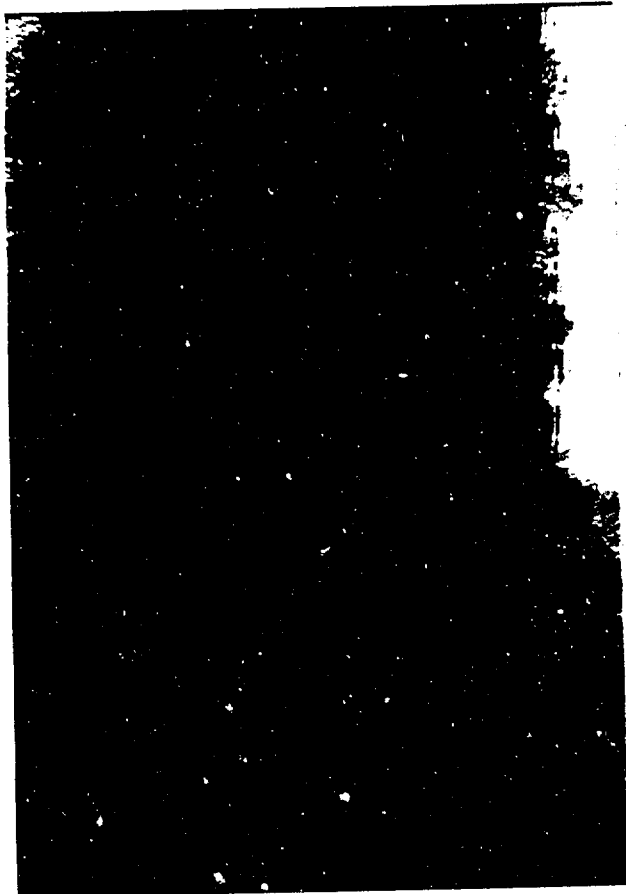
Sheet 1

Front

- (1) Upper left - View of upstream slope of dam and drainline control structure. View towards the left abutment.
- (2) Upper right - View of spillway crest, retaining wall, and crest of dam. View towards the left abutment.
- (3) Lower left - View of undercutting at the downstream end of the spillway discharge channel retaining wall.
- (4) Lower right - View of drainline outlet, downstream slope and toe of dam. View towards the right abutment.

TOP OF PAGE

1	2
3	4



APPENDIX D
HYDROLOGY AND HYDRAULICS

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 5.7 sq.mi.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 757.0 [39.9 ac-ft]

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 763.3 [124 ac-ft]

ELEVATION MAXIMUM DESIGN POOL: Unknown

ELEVATION TOP DAM: 763.3 [low spot]

SPILLWAY CREST:

757.0

a. Elevation Semi-ogee shaped

b. Type Length of crest = 60 feet

c. Width Not applicable

d. Length Right abutment

e. Location Spillover None

f. Number and Type of Gates

OUTLET WORKS:

a. Type 24" diameter reinforced concrete pipe

b. Location Maximum section

c. Entrance inverts Unknown

d. Exit inverts 744.1

e. Emergency drawdown facilities 24" diameter reinforced concrete pipe

HYDROMETEOROLOGICAL GAUGES:

a. Type None

b. Location None

c. Records None

MAXIMUM NON-DAMAGING DISCHARGE: Unknown

NOTE: Elevations refer to MSL.



L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBensburg PENNSYLVANIA

NAME CAMP SQUOIRE LAKE DAM
NUMBER PA-1058

SHEET NO. 1 OF 4
BY OTM DATE 7/31

HYDROLOGIC-HYDRAULIC ANALYSIS

DETERMINATION OF 100-YR FLOOD INFLOW

SUSQUEHANNA RIVER BASIN, LOWER JUNIATA
SUB-BASIN.

METHOD No. 1:

FROM HYDROLOGIC STUDY (TROPICAL STORM AGNES)
N.A.D., CORPS OF ENGINEERS, 1975.

$$\log Q(P) = \log(Q_m) + K(P_g) S$$

1) DRAINAGE AREA = 5.7

$$\begin{aligned} 2) \log(Q_m) &= 1.9 + [0.75 \log(5.7)] \\ &= 1.9 + 0.75(0.75) \\ &= 2.467 \end{aligned}$$

$$\begin{aligned} 3) S &= 0.4 - 0.05 \log(5.7) \\ &= 0.4 - 0.038 \\ &= 0.362 \end{aligned}$$

4) SKEW COEFFICIENT = +0.45

5) $K(P_g) = 2.658$

$$\begin{aligned} 6) \log(Q_1) &= 2.467 + 2.658(0.362) \\ &= 3.430 \\ Q_1 &= \underline{2,690 \text{ cfs}} \end{aligned}$$

METHOD No. 2:

FROM RESOURCES BULLETIN No. 13, Oct. 1977.

CONSIDER MODEL No. 6-B:



L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBensburg PENNSYLVANIA

NAME _____
NUMBER PA-1053

SHEET NO. 2 OF 4
BY OTM DATE 7/9/

$$Q_T = C A^x$$

WHERE, $C = 2.59$, $A = 5.7$, $x = 1.050$

$$\therefore Q_{100} = 2.59 (5.7)^{1.050}$$

$$= \underline{1610 \text{ cfs}}$$

$$Q_{100\text{-yr AVERAGE}} = \frac{Q_{\text{METHOD 1}} + Q_{\text{METHOD 2}}}{2}$$

$$= \frac{2,690 + 1,610}{2}$$

$$= \underline{2,150 \text{ cfs}}$$

DISCHARGE RATING

CONSIDER A SEMI-Ogee SPILLWAY.

$$\text{FROM, } Q = C L h^{3/2}$$

WHERE $C = 3.6$, $L = 60'$, $h_{\text{MAX}} = (763.3 - 757.0) = 6.3'$

$$\therefore Q_{\text{MAX}} = (3.6)(60)(6.3)^{1.5}$$

$$= \underline{3,415 \text{ cfs.}}$$

NOTE: ADDITIONAL DISCHARGE CAPACITY EXISTS AT THE RIGHT ABUTMENT. FLOW WILL OCCUR ALONG THE ROADWAY, ADJACENT TO THE SPILLWAY.

$$\text{FROM, } Q = C L h^{3/2}$$

WHERE $C = 2.9$, $L_{\text{AVG}} = 18'$, $h_{\text{MAX}} = (763.3 - 762.5) = 0.8'$

$$\therefore Q_{\text{ADD.}} = (2.9)(18)(0.8)^{1.5}$$

$$= \underline{37 \text{ cfs}}$$

COMBINED CAPACITY - USE 3,450 cfs



L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBENSBURG PENNSYLVANIA

NAME _____

NUMBER PA-1559

SHEET NO. 3 OF 4

BY OTW DATE 7/81

SPILLWAY ADEQUACY RATING

ASSUME OUTFLOW = INFLOW

DISCHARGE CAPACITY > 100-YR FLOOD INFLOW

3,450 cfs > 2,150 cfs.

THEREFORE, THE SPILLWAY IS RATED AS
ADEQUATE FOR THE SPILLWAY DESIGN
FLOOD, 100-YR FLOOD.

ELEVATION-AREA-CAPACITY RELATIONSHIPS

FROM U.S.G.S. 7.5-MIN. QUAD., DEC. FILES
AND FIELD INSPECTION DATA.

TOP OF DAM (LOW SPOT) = 763.3

SPILLWAY CREST ELEVATION = 757.0

ASSUME ZERO STORAGE AT ELEVATION = 744.0

ELEVATION (FT.)	AREA (AC.)
744.0	0 (EST.)
757.0	9.2
760.0	13.8
780.0	73.5
800.0	137.7



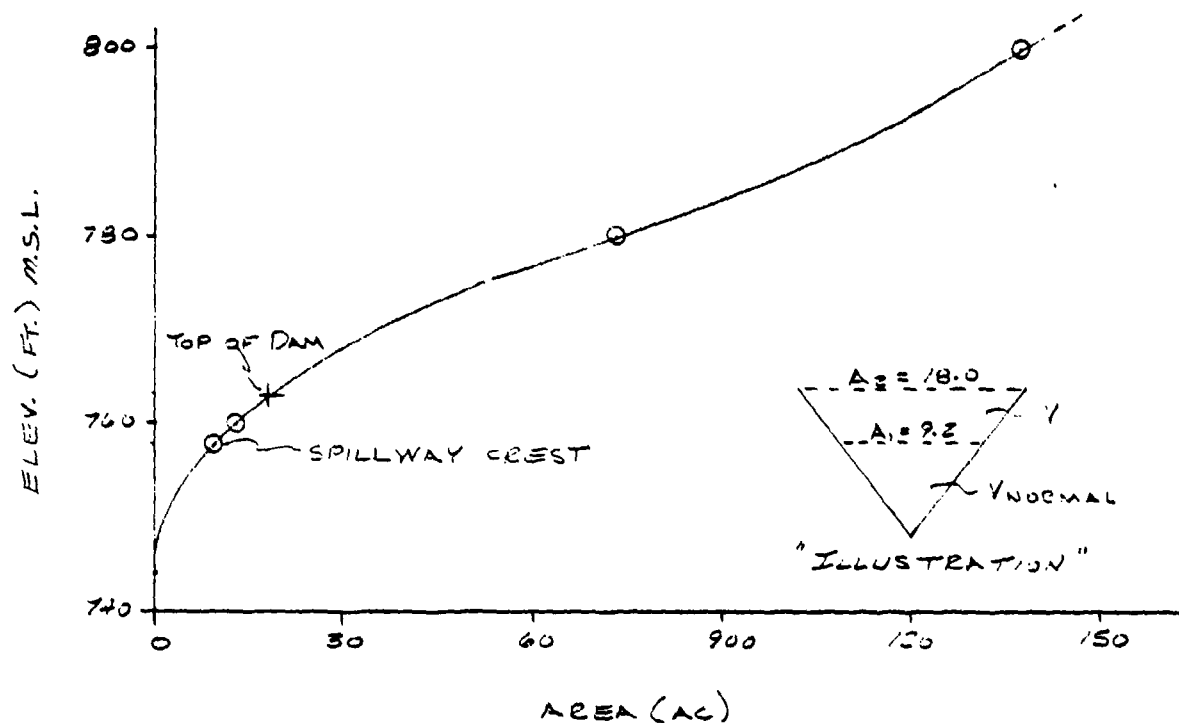
L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS
EBensburg PENNSYLVANIA

NAME _____

NUMBER PA-1053

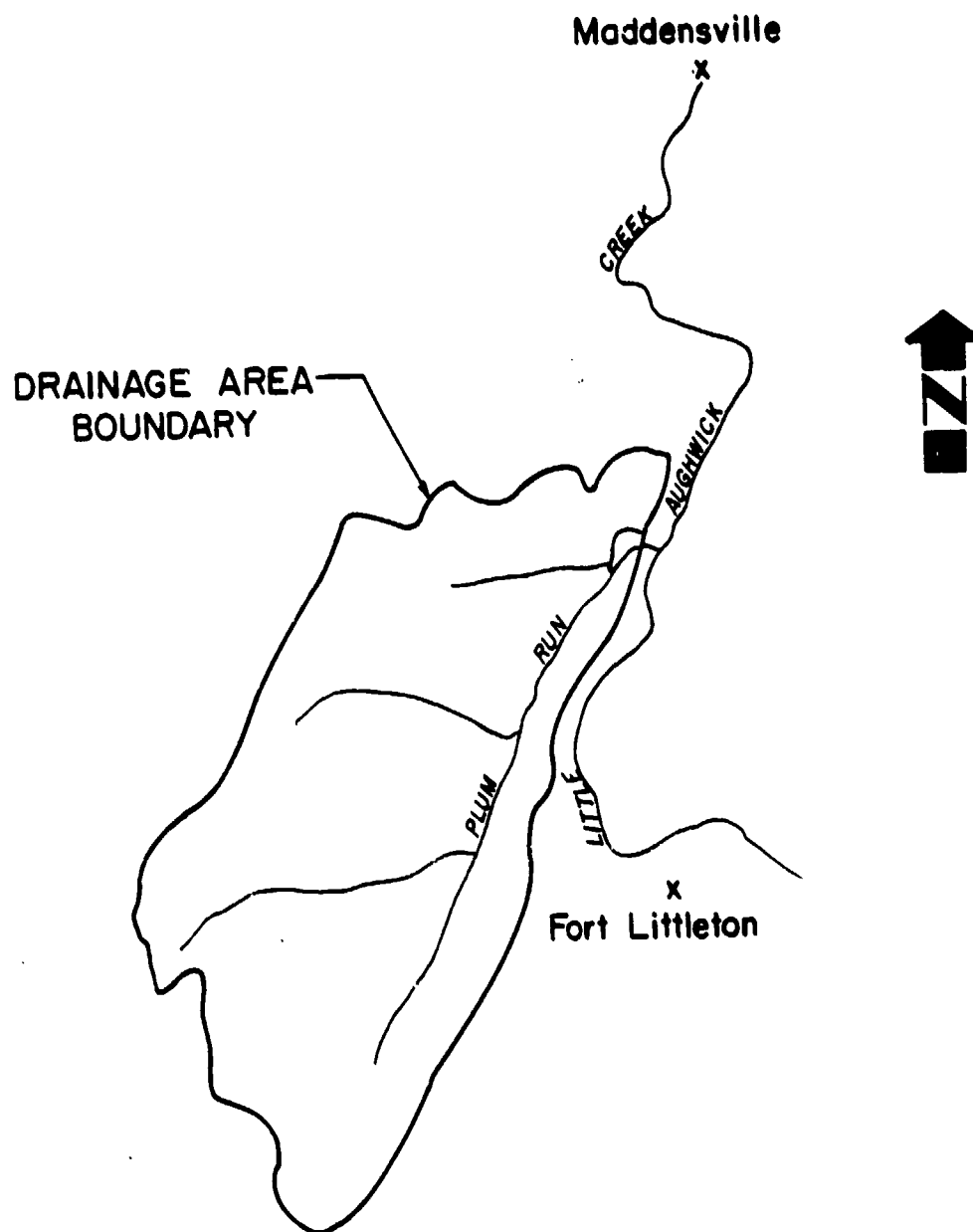
SHEET NO. 1 OF 1

BY OTM DATE 7/91



$$\begin{aligned}
 Y_{NORMAL} &= h A / 3 \\
 &= (757.0 - 744)(9.2) / 3 \\
 &= (13)(9.2) / 3 \\
 &= \underline{39.9 \text{ AC. FT.}}
 \end{aligned}$$

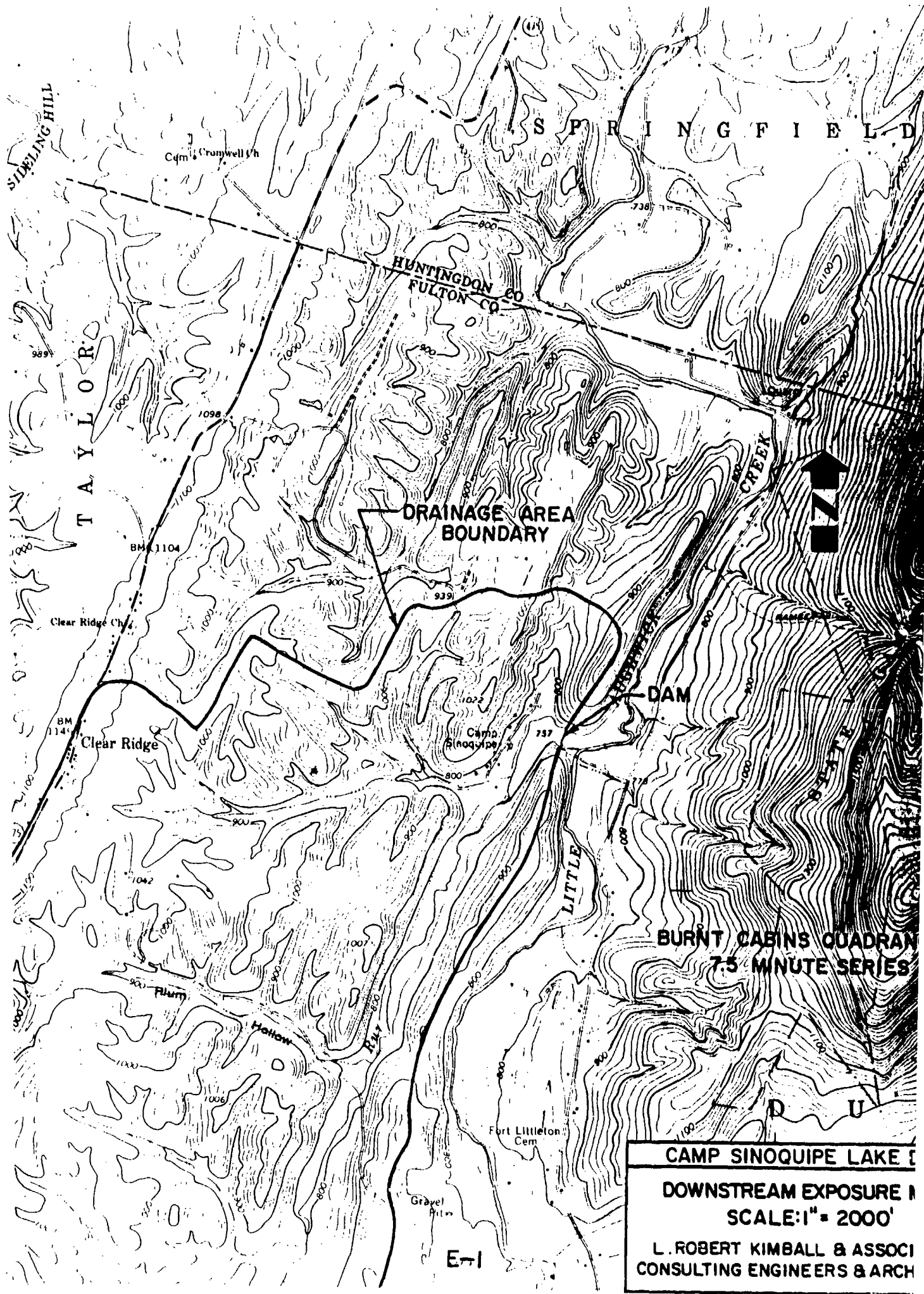
$$\begin{aligned}
 Y_{MAX} &= h (A) / 3 + Y_{NORMAL} \\
 &= (763.3 - 757.0)(9.2 + 18.0 + \sqrt{(9.2)(18.0)}) / 3 + Y_{NORMAL} \\
 &= (6.3)(13.4) + Y_{NORMAL} \\
 &= 84.4 + 39.9 \\
 &= \underline{124 \text{ AC. FT.}}
 \end{aligned}$$



CAMP SINOQUIPE LAKE DAM

DRAINAGE AREA MAP
APPROX. SCALE: 1" = 5000'

APPENDIX E
DRAWINGS

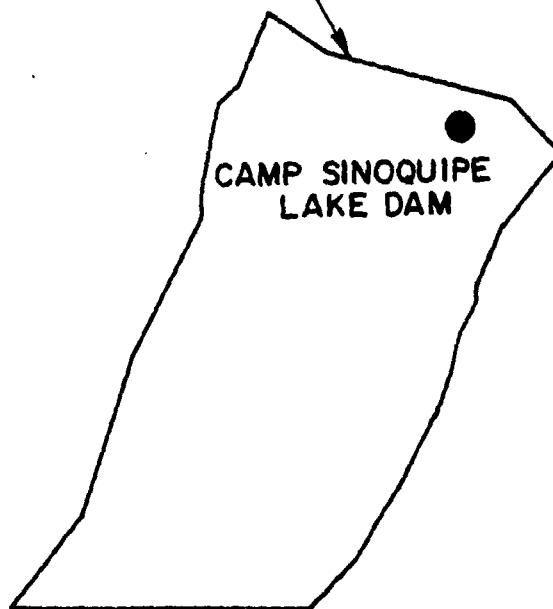
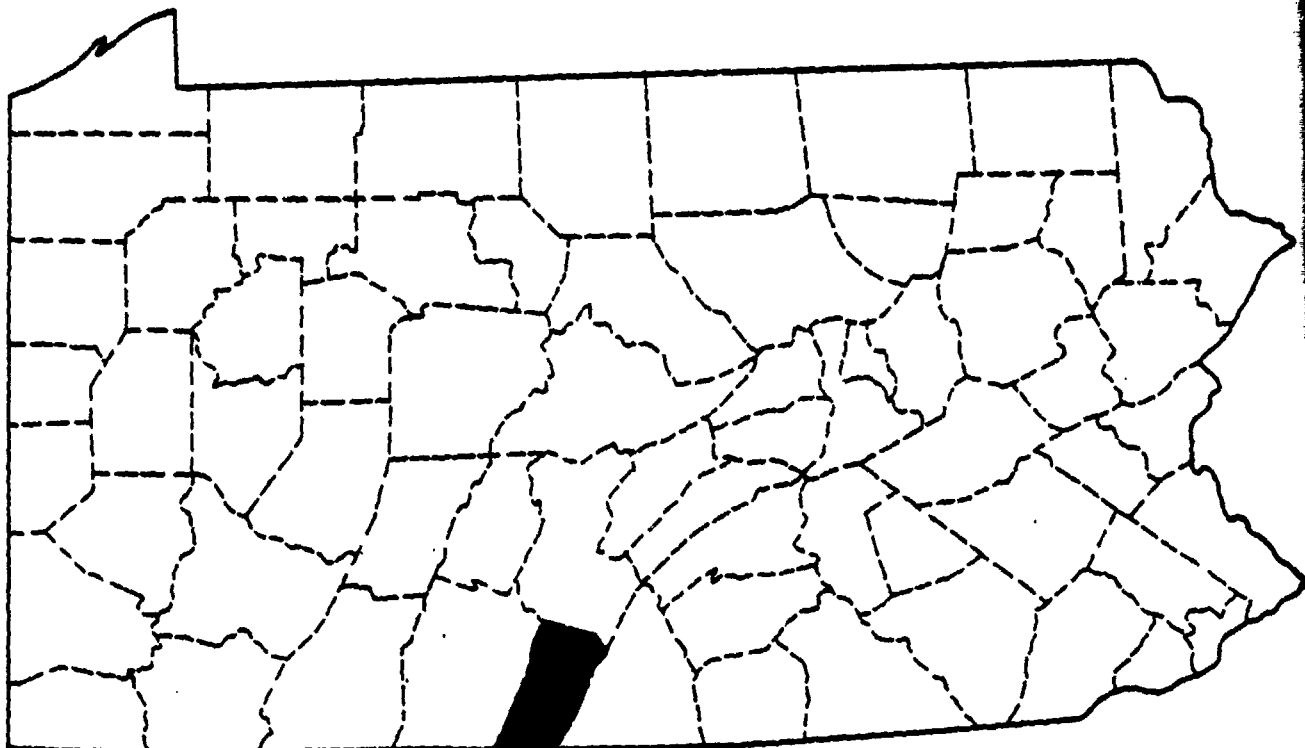


CAMP SINOQUIPE LAKE

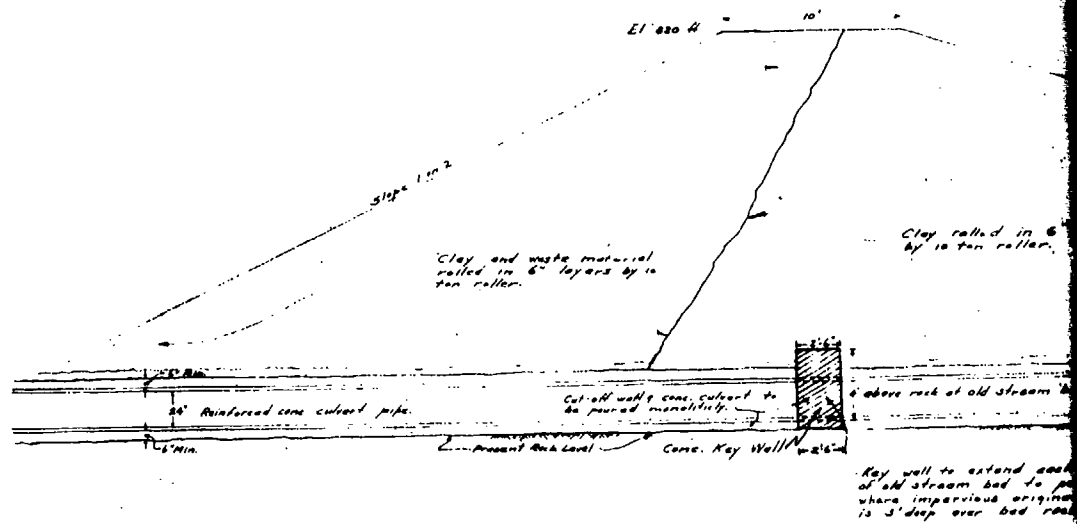
DOWNSTREAM EXPOSURE

SCALE: 1" = 2000'

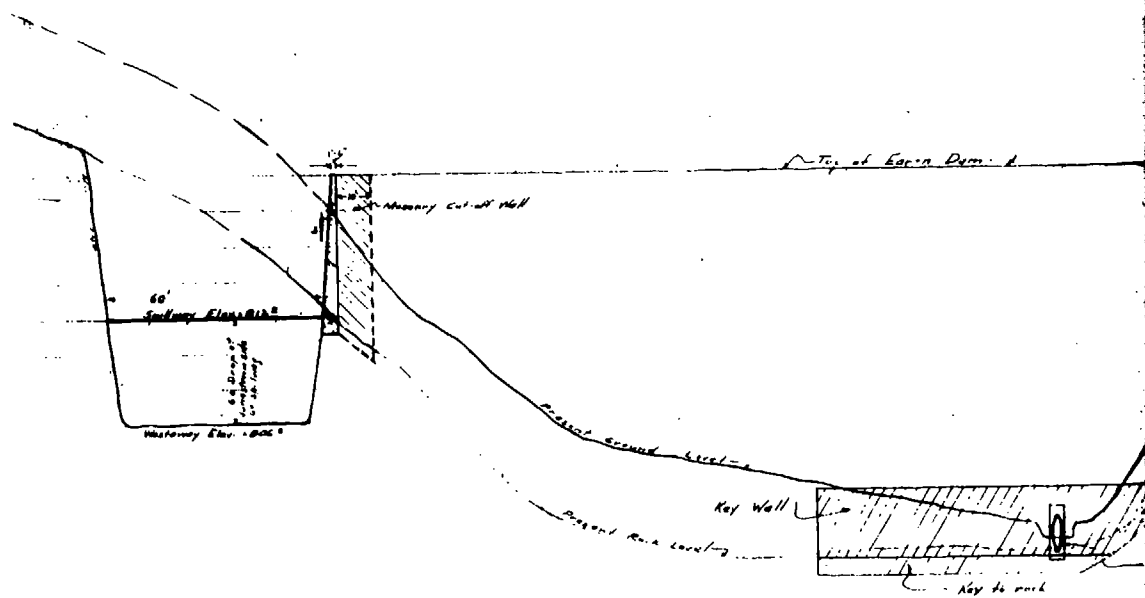
L. ROBERT KIMBALL & ASSOCI
CONSULTING ENGINEERS & ARCH



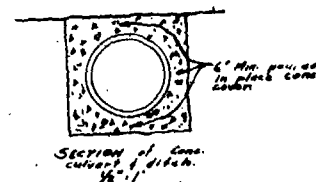
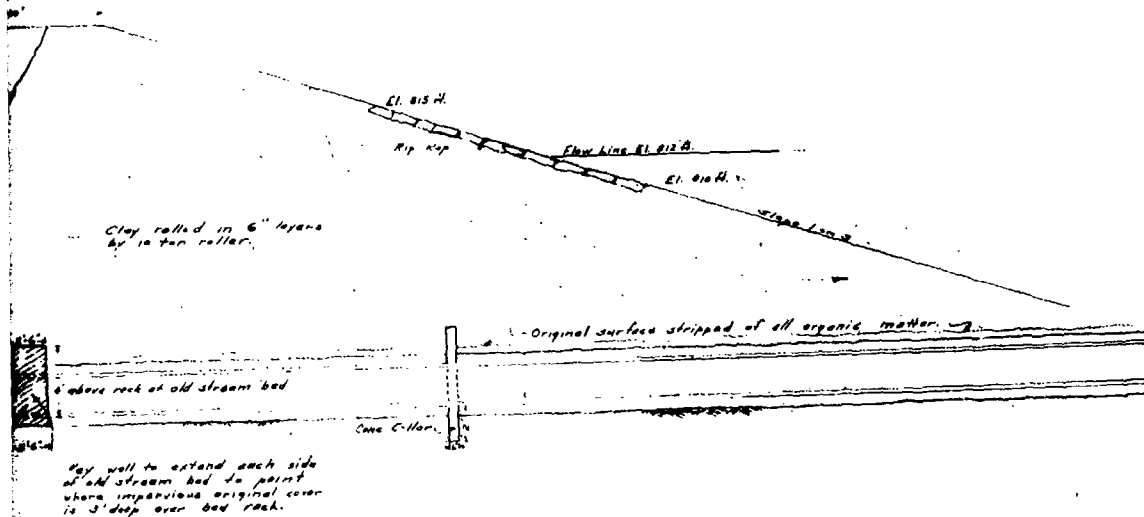
SITE LOCATION MAP
FULTON COUNTY, PENNSYLVANIA



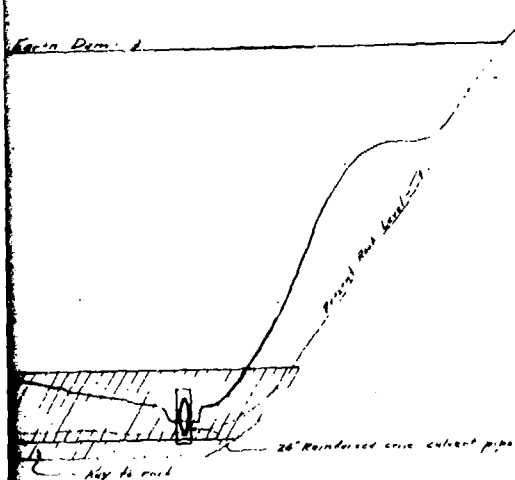
CROSS SECTION
1/4" = 1'



LONGITUDINAL SECTION
Hor. 1" = 20'
Vert. 1" = 4'

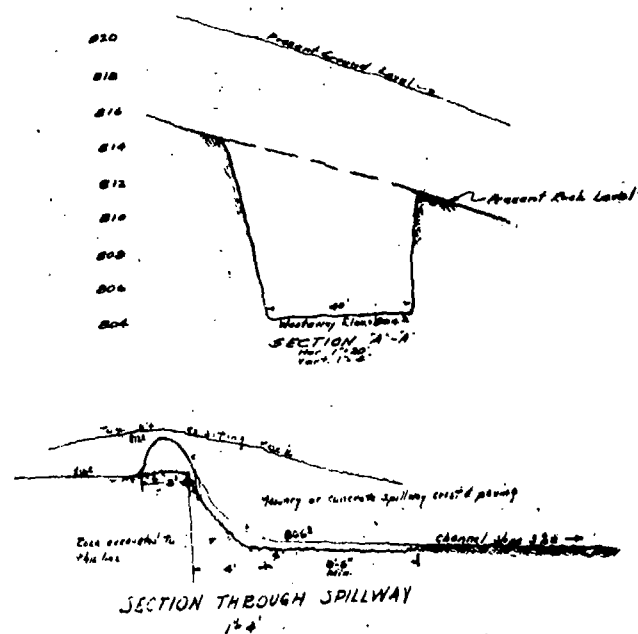


SECTION



ADJACENT SECTION

820
818
816
814
812
810
808
806
804
802
800
798



SECTIONS OF DAM
BOY SCOUTS OF AMERICA
Washington Area Council
1968
Port Littleton, Pa.
Butler County
Dublin Township

Scale As shown

J.B. Ferguson & Co.
Engineers
Hagerstown, Md.
Registered Engineer No. 2099, A
E.E.

10-18-67
Rev. 11-18-67

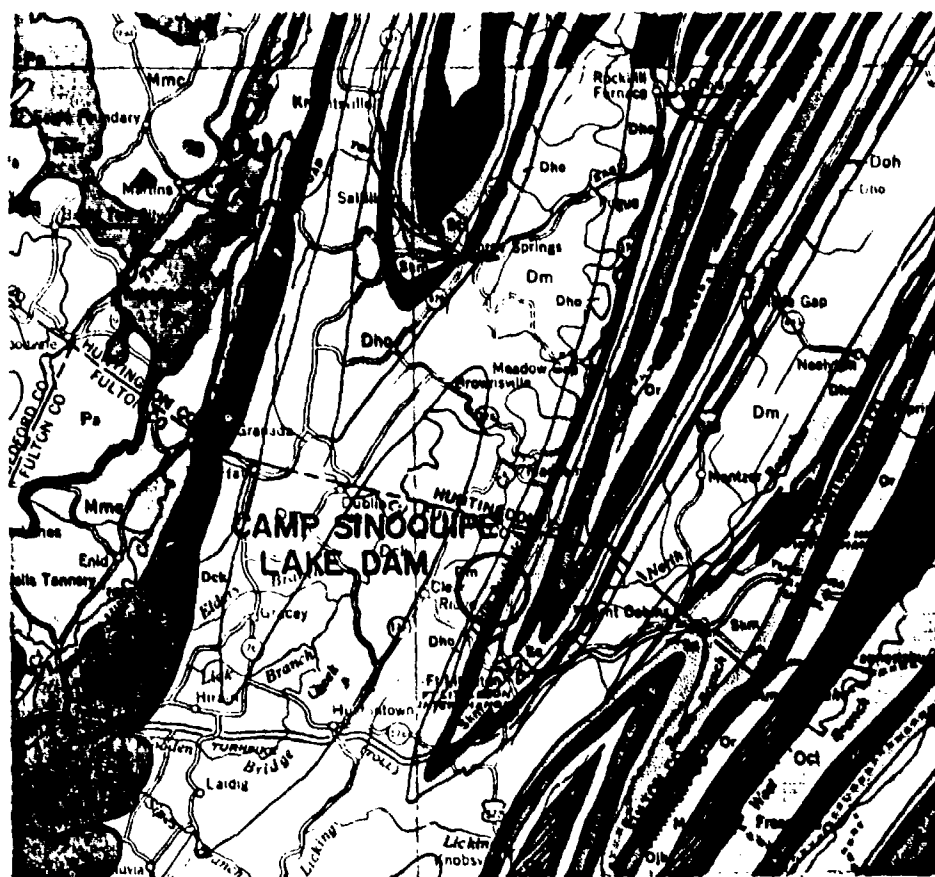
L. ROBERT KIMBALL & ASSOCIATES
CONSULTING ENGINEERS & ARCHITECTS

APPENDIX F
GEOLOGY

General Geology

The Camp Sinoquipe Lake Dam is located in the Appalachian Mountain Section of the Valley and Ridge Province. This section is separated from the Allegheny Mountain Section of the Appalachian Plateaus Province to the west by the Allegheny Front. In the Appalachian Mountain Sections Paleozoic rocks have been deformed into large amplitude folds and many faults, resulting in a succession of narrow ridges and broad or narrow valleys trending northeast. The major structural feature in the vicinity of the dam is the Blacklog Anticline which lies just to the east of the site. The dip direction of the strata is to the northwest. No known major faults exist near the dam.

The rock underlying the dam belong to the Hamilton Group of Devonian Age. It consists of three formations, the Mahantango, Marcellus, and Onondaga. These formations are composed of shale with interbedded sandstones, carbonaceous shale with thick sandstone, and medium bedded limestone with shale, respectively.



GEOLOGIC MAP OF THE AREA AROUND THE CAMP SINOQUIPE LAKE DAM
SCALE 1:250,000

DEVONIAN MIDDLE AND LOWER

	Mahantango Formation Brown to olive shale with interbedded sandstones which are dominant in places (Montebello); highly fossiliferous in upper part; contains "Centerfield coral bed" in eastern Pennsylvania.
	Marcellus Formation Black, fossiliferous, carbonaceous shale with thick brown sandstone (Turkey Ridge) in parts of central Pennsylvania.
	Onondaga Formation Greenish blue, thin bedded shale and dark blue to black, medium bedded limestone with shale predominant in most places; includes Selinagrova Limestone and Needmore Shale in central Pennsylvania and Buttermilk Falls Limestone and Escopus Shale in easternmost Pennsylvania; in Lehigh Gap area includes Palmerton Sandstone and Howmanstown Chert.
	Oriskany Formation White to brown, fine to coarse grained, partly calcareous, locally conglomeratic, fossiliferous sandstone (Hugobey) at the top; dark gray, cherty limestone with some interbedded shales and sandstones below (Shriver).
	Helderberg Formation Dark gray, calcareous, thin bedded shale (Mandata) at the top, equivalent to Port Ewen Shale and Hecraft Limestone in the east; dark gray, cherty, thin bedded, fossiliferous limestone (New Scotland) with some local sandstone in the middle, and, at the base dark gray, medium to thick bedded, crystalline limestone (Acquama), sandy and shaly in places with some chert nodules.