DELAWARE RIVER BASIN
POISON BROOK, PIKE COUNTY

PENNSYLVANIA

SUNRISE LAKE DAM

NDI I.D. NO. PA-01091
PENNDER I.D. NO. 52-175

LEVEL II

SUNNYLANDS INCORPORATED

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

DACW31-81-C-0015

PREPARED FOR

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

PREPARED BY

GAI CONSULTANTS, INC.
570 BEATTY ROAD
MONROEVILLE, PENNSYLVANIA 15146

SEPTEMBER 1981

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 computatioal 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.

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 (greatest reasonably possible storm runoff) for the region, 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.

Breach analyses are performed, when necessary, to provide data to assess the potential for downstream damage and possible loss of life. The results are based on specific theoretical scenarios peculiar to the analysis of a particular dam and are not applicable to other related studies such as those conducted under the Federal Flood Insurance Program.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

ABSTRACT

Sunrise Lake Dam: NDI I.D. No. PA-01091

Owner:	Sunnylands Incorporated
State Located:	Pennsylvania (PennDER I.D. No. 52-175)
County Located:	Pike
Stream:	Poison Brook
Inspection Date:	19 May 1981
Inspection Team:	GAI Consultants, Inc. 570 Beatty Road Monroeville, Pennsylvania 15146

Based on a visual inspection, operational history, and hydrologic and hydraulic analysis, the dam is considered to be in good condition.

The size classification of the facility is small and its hazard classification is considered to be significant. In accordance with the recommended guidelines, the Spillway Design Flood (SDF) for the facility ranges between the 100-year frequency flood and the 1/2 PMF (Probable Maximum Flood). Since the facility is classified near the upper bounds of the small category, the SDF is considered to be the 1/2 PMF. Results of the hydrologic and hydraulic analysis indicate the facility is not capable of passing and/or storing the inflow resulting from a 1/2 PMF event without overtopping the emergency spillway dike. It must be noted, however, that the facility was found to be capable of accommodating the peak inflow from the 100-year frequency flood without overtopping. Nevertheless, the spillway system at Sunrise Lake Dam is considered to be inadequate.

It is recommended that the owner:

a. Immediately implement remedial measures necessary to restore the main embankment and emergency spillway dike to their design crest elevation at 1311.0 feet. In addition, the emergency spillway channel should be reconstructed to conform with its design configuration whereby it would be hydraulically adequate. In the meantime, additional erosion protection should be provided along the sidewalls of the present emergency spillway channel.

Sunrise Lake Dam: NDI I.D. No. PA-01091

b. Develop formal manuals of operation and maintenance to ensure future proper care and operation of the facility. Included in the manuals should be a formal warning system for the notification of potential downstream inhabitants should hazardous embankment conditions develop, with provisions for around-the-clock surveillance of the facility during periods of unusually heavy precipitation.

c. Drain the swampy areas situated along the downstream toe of the dike to central locations where they can be monitored during future inspections along with the seepage observed in the emergency spillway discharge channel. Turbidity and/or changes in flow rates should be noted.

d. Continue to observe, in all future inspections, the seepage and/or drainage condition encountered below the access road (Sunrise Drive) located along the downstream toe of the main embankment. Turbidity and/or changes in flow rate should be noted.

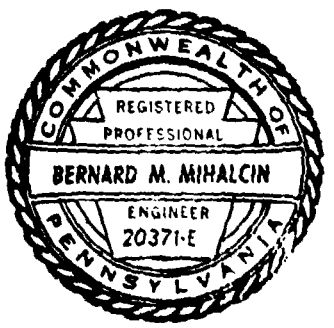
e. Clear the trash rack atop the service spillway drop inlet on a frequent, regular basis in order to assure unimpeded flow.

GAI Consultants, Inc.

Bernard M. Mihalcin, P.E.

Approved by:

James W. Peck
Colonel, Corps of Engineers
Commander and District Engineer



Date 10 Sept 1981

Date 18 Sep 1981

View of Main Embankment at Northwest
Corner of Sunrise Lake.

View of Dike at Southeast
Corner of Sunrise Lake.

OVERVIEW PHOTOGRAPHS

TABLE OF CONTENTS

TABLE OF CONTENTS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
SUNRISE LAKE DAM
NDI# PA-01091, PENNDER# 52-175

SECTION 1
GENERAL INFORMATION

1.0 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.

1.1 Purpose.

The purpose is to determine if the dam constitutes a hazard to human life or property.

1.2 Description of Project

a. Dam and Appurtenances. Sunrise Lake is impounded by a 14-foot high, 550-foot long earth embankment (Sunrise Lake Dam; also referred to as main embankment within this report) located at its northwest corner and by a 10-foot high, 470-foot long earth dike that also serves as an emergency spillway (emergency spillway dike) located at its southeast corner. The main embankment is equipped with a drop inlet type service spillway near its left abutment. The service spillway riser is provided with a gate device at its base to effect drawdown of the lake. The emergency spillway consists of a 55-foot wide, trapezoidal shaped channel (20-foot bottom width) constructed through the center of the appurtenant dike.

b. Location. Sunrise Lake Dam is located on Poison Brook in Dingman Township, Pike County, Pennsylvania. The facility is situated less than two miles south of Interstate Route 84, between interchanges nine and ten, and about two miles north of Pennsylvania Route 739. The dam, reservoir, and watershed are contained within the Edgemere, Pennsylvania, 7.5 minute U.S.G.S. topographic quadrangle (see Figure 1, Appendix E). The coordinates of the dam are N41°19.4' and W74°57.8'.

c. Size Classification. Small (14 feet high, 532 acre-feet storage capacity at top of dike).

d. Hazard Classification. Significant (see Section 3.1.e).

e. Ownership. Sunnylands Incorporated
R. D. #1, Box 3000
Milford, Pennsylvania 18337
Attn: Mr. Robert B. Ramagosa
Vice President

f. Purpose. Recreation.

g. Historical Data. Information contained in PennDER files indicates that Sunrise Lake Dam was constructed during the mid-1960's by Sunnylands Incorporated. Correspondence dated 1971 indicates that state officials did not become aware of the existence of the facility until several years after its completion, as no formal design documents had been submitted nor had a construction permit been issued. State officials subsequently requested a complete engineering investigation of the facility to determine its safety and adherence to modern design principles. The owner secured the services of L. Robert Kimball Consulting Engineers of Ebensburg, Pennsylvania, and a formal report was issued dated March 1974. The findings and conclusions of the study eventually resulted in extensive renovations which were completed in 1978. No significant modifications have reportedly been made to the facility since that date.

1.3 Pertinent Data.

a. Drainage Area (square miles). 1.2

b. Discharge at Dam Site.

Discharge Capacity of Outlet Conduit - Discharge curves are not available.

Discharge Capacity of Service Spillway at Maximum Pool (Top of Emergency Spillway Dike at elevation 1308.6) ≅ 80 cfs (see Appendix D, Sheet 9).

Discharge Capacity of Emergency Spillway at Maximum Pool ≅ 140 cfs (see Appendix D, Sheet 9).

c. Elevations (feet above mean sea level). The following elevations were obtained from design drawings and through field measurements based on the elevation of normal pool at 1305.5 feet (see Appendix D, Sheets 1 and 2).

Top of Main Embankment	1311.0 (design). 1309.8 (field).
Top of Emergency Spillway Dike	1311.0 (design). 1308.6 (field).
Downstream Toe of Main Embankment	1296.2 (field).
Maximum Design Pool	1310.8
Maximum Pool of Record	Not known.

Normal Pool	1305.5 (design; assumed datum).
Service Spillway Crest	1305.5
Emergency Spillway Crest	1309.0 (design).
	1307.2 (field).
Upstream Inlet Invert	1300.0 (design).
Downstream Outlet Invert	1294.0 (design).
	1295.5 (field).
Streambed at Dam Centerline	Not known.
Maximum Tailwater	Not known.

d. Reservoir Length (feet).

Top of Main Embankment	3200
Normal Pool	3200

e. Storage (acre-feet).

Top of Main Embankment	626
Top of Dike	532
Normal Pool	308

f. Reservoir Surface (acres).

Top of Main Embankment	81
Top of Dike	77
Normal Pool	68

g. Main Embankment.

Type	Earth.
Length	560 feet.
Height	14 feet (field measured; embankment crest to downstream embankment toe).
Top Width	Varies; 15 feet (minimum) at left abutment to 115 feet (maximum) near right abutment.
Upstream Slope	2H:1V
Downstream Slope	Varies; 5H:1V (minimum) at left abutment to 3.5H:1V (maximum) near embankment center.

	Zoning	Heterogeneous earth embankment comprised primarily of medium dense silty sands with some clay gravel and boulders. No definitive zones.
	Impervious Core	None indicated.
	Cutoff	None indicated.
	Grout Curtain	None indicated.
h.	Emergency Spillway Dike.	
	Type	Earth.
	Length	470 feet (including spillway).
	Height	10 feet (field measured; dike crest to downstream dike toe).
	Top Width	24 feet.
	Upstream Slope	Varies; 3.5H:1V (minimum) right of spillway to 3H:1V (maximum) left of spillway.
	Downstream Slope	2H:1V
	Zoning	Heterogeneous earth embankment reportedly comprised of materials ranging from "silty sand to sandy gravel with some clay matrix in places".
	Impervious Core	None indicated.
	Cutoff	None indicated.
	Grout Curtain	None indicated.
i.	Diversion Canal and Regulating Tunnels.	None.
j.	Service Spillway.	

Type	Uncontrolled, five foot diameter, drop inlet type, corrugated metal riser connected to a three foot diameter, corrugated metal, horizontal discharge conduit.
Crest Elevation	1305.5 feet.

k. Emergency Spillway.

Type	Uncontrolled, trapezoidal shaped, earth channel cut through the crest of the emergency spillway dike near its centerline.
Crest Elevation	1307.2 feet.
Crest Length	20 feet (bottom). 55 feet (top).

l. Outlet Conduit.

Type	Three foot diameter, corrugated metal pipe welded to the upstream base of the service spillway riser.
Closure and Regulating Facilities	Control device referred to as a "flap gate" is located at the inlet.
Access	The control device is submerged at the base of the riser and is reportedly accessible by diver only.

SECTION 2

ENGINEERING DATA

2.1 Design.

a. Design Data Availability and Sources. The facility was originally constructed around 1964 without a formal design having been submitted to the state for approval. Thus, no original design reports and/or calculations are available. State officials subsequently requested an engineering evaluation be performed on the as-built structure. The results are contained in a report available in PennDER files entitled, "Engineering Report for Sunrise Lake on Poison Brook, Pike County, Pennsylvania," prepared for Sunnylands Incorporated by L. Robert Kimball Consulting Engineers of Ebensburg, Pennsylvania, dated March 1974. The design of the present facility was performed primarily by the owner who apparently relied almost exclusively on the findings and recommendations of the above referenced Kimball report. Plans and specifications for the reconstruction, as prepared by Sunnylands Incorporated, are also contained in PennDER files along with various correspondence, memoranda and several dated photographs.

b. Design Features.

1. Main Embankment. Design features of the main embankment are presented in Figures 2, 4 and 5. As indicated, the structure is an unconventionally shaped, 14-foot high, 560-foot long, heterogeneous earth embankment. The crest of the structure is narrowest (15 feet) at the left abutment and gradually widens to a maximum (115 feet) near the right abutment. The upstream embankment face is sloped at 2H:1V and covered with large sandstone boulders to protect against erosion (see Photograph 3). The downstream embankment face is grass covered with its steepest slope set at 3.5H:1V near the center of the embankment. Test boring data shown in Figures 4 and 5 indicate the main embankment is comprised primarily of medium dense silty sands with some clay, gravel, and boulders. The 1974 engineering report states that the materials "were compacted to approximately 85 to 90 percent of the maximum dry density". The embankment materials were apparently placed atop medium dense to very dense glacial tills. There is no indication that any portion of the structure is founded on rock or that any type of cutoff trench was excavated. A small drainage system is provided along the downstream embankment toe for seepage control.

2. Appurtenant Structures.

a) Emergency Spillway Dike. As an impounding structure, the emergency spillway dike is similar to the main embankment. It is a 10-foot high, 470-foot long, heterogeneous

earth structure. The 1974 engineering report describes its composition as ranging from "silty sand to sandy gravel with some clay matrix in places....compacted to approximately 85 to 90 percent of the maximum dry density". The structure is 24 feet wide across its crest. The downstream dike face is sloped at 2H:1V while the upstream face varies from 3H:1V to 3.5H:1V. Large sandstone boulders provide riprap protection along the upstream face. The as-built spillway section is trapezoidal shaped, 20 feet long across its base and 55 feet long across the top of the channel. This differs substantially from the design structure depicted in Figures 3 and 4 whose base width measures 150 feet and top width 190 feet. Field measurements indicate the top of the dike (elevation 1308.6) to be about 1.2 feet below the field measured top of main embankment (elevation 1309.8), and about 2.4 feet below the design top of dam and design top of dike, both at elevation 1311.0.

b) Service Spillway. The service spillway is shown in plan in Figure 2. It consists of an uncontrolled, five foot diameter, drop inlet type, corrugated metal riser connected to a three foot diameter, corrugated metal, horizontal discharge conduit. The riser is set on a seven foot square by three foot thick reinforced concrete pad constructed along the upstream face of the left end of the main embankment. The three foot diameter discharge conduit is welded to the base of the riser where it meets the concrete pad. The discharge conduit runs through the dam and beneath the road (Sunrise Drive) that runs along the downstream embankment toe, eventually emptying into Rattlesnake Creek, a distance of approximately 230 feet from the riser.

c) Outlet Conduit. The outlet conduit consists of a three foot diameter, corrugated metal pipe welded to the upstream base of the service spillway riser. The conduit is reportedly equipped with a control device referred to in available construction specifications as a "flap gate". The gate is located at the inlet to the conduit and reportedly would require a diver and perhaps excavation equipment to open.

c. Specific Design Data and Criteria. The available data indicate the facility was originally constructed without a prior formal design. Nevertheless, the results contained in the 1974 engineering report indicate that the facility was considered to be structurally stable at that time. It was noted that "the measured phreatic line was similar to that typical of a homogeneous dam". Stability analysis that reportedly utilized conservative composite shear strength parameters revealed that the lowest factor of safety against failure for existing conditions was 3.2. Utilizing full effective stress under steady seepage conditions yielded safety factors no lower than 3.6. Furthermore, the report also indicated the dam and dike to be stable under earthquake analysis.

It is noted that the 1974 engineering report cited the facility for many deficiencies related to its original hydraulic

design and presented remedial recommendations in regards to these items. Specifics of the current hydrologic and hydraulic design are presented in Section 5.1, herein.

2.2 Construction Records.

No specific construction records, such as daily, weekly or monthly reports are available. The facility was reportedly renovated in the mid-1970's by Pike County Asphalt Products, Inc., a wholly owned and operated subsidiary of Sunnylands Incorporated.

2.3 Operational Records.

No records of the day-to-day operation of the facility are maintained. The owner reported that, to his knowledge, the emergency spillway has never discharged.

2.4 Other Investigations.

Aside from the previously mentioned engineering evaluation completed by the L. Robert Kimball Consulting Engineers of Ebensburg, Pennsylvania, in 1974, no other formal investigations have been performed at this facility.

2.5 Evaluation.

The available data are considered sufficient to make a reasonable Phase I evaluation of the facility.

SECTION 3

VISUAL INSPECTION

3.1 Observations.

a. General. The general appearance of the facility suggests the main embankment and its appurtenances are in good condition.

b. Main Embankment. Observations made during the visual inspection indicate the main embankment is in good condition. No evidence of sloughing, erosion, seepage through the downstream embankment face, or signs of maintenance neglect were observed (see Photographs 1 and 2). Field measurements indicate the embankment crest is low, in excess of one foot below the design top of dam elevation 1311.0, at an area located about 150 feet from the left abutment. Minor erosion was observed along the upstream embankment face behind the large boulder size riprap. The inspection team observed the ditch along the downstream embankment toe to be saturated. Minor seepage (≅ 1 to 2 gpm) was observed immediately downstream of Sunrise Drive near the embankment centerline (see Photograph 8). This flow could very well be toe drain discharge; however, no drain pipes were observed.

c. Appurtenant Structures.

1. Emergency Spillway Dike. The visual inspection revealed the emergency spillway dike is in fair condition. Field measurements indicate the dike crest is low, in excess of one foot below the field measured low top of main embankment elevation 1309.8, and more than two feet below the design top of dam elevation 1311.0. The crest and slopes are primarily unvegetated; however, no evidence of significant erosion was observed (see Photographs 9, 10, 11 and 12). No seepage was encountered through the downstream dike face. The areas immediately beyond the downstream dike toe on both sides of the spillway are swampy and some minor seepage (≅ 1 gpm) was observed in the spillway discharge channel about 25 feet downstream of the dike. The spillway channel itself is rock lined across its base with hand placed rock; however, its sidewalls are virtually unprotected (see Photograph 9).

2. Service Spillway. The visual inspection revealed the service spillway to be in good condition. During the inspection, the drop inlet was discharging under approximately 0.2 foot of head. The trash rack atop the inlet was observed to have collected some debris which should be removed (see Photographs 5 and 6).

3. Outlet Conduit. The outlet conduit was submerged and not observed by the inspection team. The owner related that the control device would require a considerable effort to operate, and thus, it was not operated in the presence of the inspection team. The owner does appear to have a proper understanding of what

would have to be done should the need develop to draw down the reservoir.

d. Reservoir Area. The drainage area contributing to Sunrise Lake is relatively flat with many swampy areas. The area immediately surrounding the lake is comprised of moderate to steep and heavily forested slopes that are partially developed, with future plans calling for increased development.

e. Downstream Channel. Two distinct downstream reaches are associated with Sunrise Lake; one being the reach below the main embankment along Rattlesnake Creek and the other being the reach below the emergency spillway dike along Dwarfs Kill Creek. Since a breach of either the main embankment or dike, separately or in tandem, is considered to be a possible occurrence, the physical characters of both downstream reaches were considered in the determination of the hazard classification.

Beyond the main embankment, the downstream reach consists of a narrow, uninhabited, heavily forested valley with steep confining slopes. About 2.3 miles downstream of the dam, Interstate 84 crosses the valley and could be adversely affected by a sudden embankment failure. Rattlesnake Creek eventually flows into Shohola Reservoir about 4.5 miles below the dam, whereby any breach flows from the main embankment could be expected to be safely stored.

Downstream of the emergency spillway dike, the reach consists of a broad, flat, and swamp-like valley with heavily forested confining slopes. About four miles below the dike, the stream flows into a recreational reservoir known as Crescent Lake (Crescent Lake Dam, NDI No. PA-00413; Phase I Inspection Report available as prepared by Berger Associates, Inc. of Harrisburg, Pennsylvania, dated June 1980). Crescent Lake Dam is a 45-foot high, intermediate size and high hazard classification facility according to its available Phase I Inspection Report.

Due to the presence downstream of a major highway (Interstate 84) and a sizeable water retention facility (Crescent Lake Dam), a sudden failure of Sunrise Lake Dam and/or its emergency spillway dike could result in appreciable economic loss and public inconvenience. Loss of life in downstream structures is considered possible, however, not anticipated. As a result the hazard classification at Sunrise Lake Dam is considered to be significant.

3.2 Evaluation

The overall condition of the facility, based on visual observations, is considered to be good. Remedial measures should be implemented with regards to the following: 1) regrade the crests of both the main embankment and emergency spillway dike to the

design top of dam elevation 1311.0; 2) provide additional erosion protection along the sidewalls of the emergency spillway channel; 3) drain the swampy areas along the downstream toe of the emergency spillway dike; and 4) clear the debris from the trash rack atop the service spillway drop inlet.

SECTION 4

OPERATIONAL PROCEDURES

4.1 Normal Operating Procedure.

Sunrise Lake Dam is essentially a self-regulating facility. Excess inflow passes through the service spillway and into the discharge channel. Inflows in excess of the capacity of the service spillway are stored and/or discharged through the emergency spillway. Under normal operating conditions, the outlet conduit is closed. No formal operations manual is available.

4.2 Maintenance of Dam.

The facility is reportedly maintained on an unscheduled basis by the owner's maintenance staff. No formal maintenance program has been established at this facility and no formal manuals are available.

4.3 Maintenance of Operating Facilities.

See Section 4.2 above.

4.4 Warning System.

No formal warning system is presently in effect.

4.5 Evaluation.

The general appearance of the facility suggests that it has been adequately maintained to date. No formal maintenance or operations manuals are available, but, are recommended to ensure the continued proper care of the facility. In addition, formal warning system procedures should be incorporated into these manuals to provide for the protection of downstream residents and property should hazardous conditions develop.

SECTION 5

HYDROLOGIC/HYDRAULIC EVALUATION

5.1 Design Data.

The 1974 engineering report included a hydrologic analysis which yielded the parameters required for a complete spillway system design. The system was designed in accordance with the methods and procedures outlined in National Engineering Handbook of the U. S. Department of Agriculture, Soil Conservation Service (SCS).

The elevation of the emergency spillway crest was set at 1309.0 feet. This established that the facility, whose service spillway crest elevation was set at 1305.5, would be able to pass and/or store a 50-year flood frequency event (6.2 inches of rainfall in 24 hours) without discharging through the emergency spillway. (Note: the service spillway was deemed a necessary addition to the original structure in order to re-establish a base flow into Rattlesnake Creek immediately below the main embankment). The design top of dam elevation 1311.0 was established such that the facility would be able to pass and/or store the SCS Freeboard Hydrograph (13.0 inches of rainfall in 6 hours) when equipped with a service-emergency spillway system capable of discharging peak outflows of up to 1518 cfs.

5.2 Experience Data.

Renovations to the original facility were completed in 1978. The owner reported that, to his knowledge, the emergency spillway has never discharged.

5.3 Visual Observations.

Visual observations relative to the hydraulic aspects of the facility indicate that as-built conditions vary significantly from both the recommendations of the 1974 engineering report and the design drawings prepared by the owner, dated 1975. First and foremost, the emergency spillway channel is significantly undersized relative to its design. The design spillway was to be 150 feet long across its base and 190 feet long across the top of the channel. The available design freeboard was to be two feet. In contrast, the as-built emergency spillway channel is only 20 feet long across its base, 55 feet long across the top of the channel, and has only 1.4 feet of available freeboard. Field measurements also indicate the emergency spillway crest to be set at elevation 1307.2 rather than at elevation 1309.0 as required by the design. In addition, the crest of the emergency spillway dike was found to be in excess of two feet below the design top of dam elevation at 1311.0.

5.4 Method of Analysis.

The facility has been analyzed in accordance with the procedures and guidelines established by the U. S. Army, Corps of Engineers, Baltimore District, for Phase I hydrologic and hydraulic evaluations. The analysis has been performed utilizing a modified version of the HEC-1 program developed by the U. S. Army, Corps of Engineers, Hydrologic Engineering Center, Davis, California. Analytical capabilities of the program are briefly outlined in the preface contained in Appendix D.

5.5 Summary of Analysis.

a. Spillway Design Flood (SDF). In accordance with procedures and guidelines contained in the National Guidelines for Safety Inspection of Dams for Phase I Investigations, the Spillway Design Flood (SDF) for Sunrise Lake Dam ranges between the 100-year frequency flood and the 1/2 PMF (Probable Maximum Flood). This classification is based on the relative size of the dam (small), and the potential hazard of dam failure to downstream developments (significant). Since the facility is classified near the upper bounds of the small category (626 acre-feet storage at top of dam), the SDF is considered to be the 1/2 PMF.

b. Results of Analysis. Sunrise Lake Dam was evaluated under normal operating conditions. That is, the reservoir was initially at its normal pool or service spillway crest elevation of approximately 1305.5 feet, with both the service and emergency spillways capable of discharging freely. The service spillway consists of an uncontrolled, five foot diameter, corrugated metal riser pipe connected to a three foot diameter, corrugated metal outlet pipe, located within the main embankment. This outlet pipe also serves as the low level pond drain, with the inlet mechanism consisting of a flap gate at the upstream end of the pipe (assumed to be closed in this analysis). The emergency spillway, whose crest elevation is set at approximately 1307.2 feet, consists of an uncontrolled, trapzoidal shaped section cut through the appurtenant dike, which discharges into a watershed separate from that into which the service spillway discharges. Although the sidewalls of the emergency spillway were unprotected at the time of this inspection, and thus, subject to erosion under discharge conditions, they were assumed to be stable in this analysis. All pertinent engineering calculations relative to the evaluation of Sunrise Lake Dam are provided in Appendix D.

Overtopping analysis (using the modified HEC-1 computer program) indicated that the discharge/storage capacity of Sunrise Lake Dam can accommodate only about 23 percent of the PMF prior to overtopping at the emergency spillway dike. The 1/2 PMF (SDF) peak inflow of approximately 1530 cfs was attenunated by the discharge/storage capabilities of the dam and reservoir such that the resulting peak outflow was about 1160 cfs. Under 1/2 PMF conditions, the dike was overtopped for more than 7.5 hours, by depths of up to 1.2

_eet. The main embankment was overtopped by about 0.05 feet for less than one hour under the 1/2 PMF event (Appendix D, Summary Input/Output Sheets, Sheet D).

It is noted that a facility constructed in accordance with available design drawings would have a total discharge capacity of about 1518 cfs. The design facility would have been capable of passing and/or storing the 1/2 PMF (SDF) peak inflow of approximately 1530 cfs, considering the attenuating effects of reservoir storage which result in peak outflow of about 1160 cfs. Thus, the facility as depicted on available design drawings would have been hydraulically adequate.

The magnitude of the 100-year frequency flood peak was also determined in this analysis and was found to be approximately 470 cfs, as compared to the maximum total spillway capacity of approximately 220 cfs (Appendix D, Sheets 9, 12). However, from the various inflow and outflow hydrographs (Summary Input/Output Sheets, Sheets B and C), it can reasonably be assumed that the peak inflow under the 100-year event would be attenuated by the discharge/storage capabilities of the dam, such that overtopping would not occur under this event.

5.6 Spillway Adequacy.

As presented above, although Sunrise Lake Dam can accommodate the peak inflow resulting from the 100-year event without overtopping, it was found that the emergency spillway dike was subject to overtopping under 1/2 PMF (SDF) conditions. Therefore, the spillway system is considered to be inadequate.

SECTION 6

EVALUATION OF STRUCTURAL INTEGRITY

6.1 Visual Observations.

a. Main Embankment. Based on visual observations, the main embankment is considered to be in good structural condition. The seepage condition encountered downstream of the embankment is not considered to be significant at this time and may be normal flow emanating from the toe drain system. Efforts should be made to identify the origin of the flow and expose any existing drainage conduits. In either case, however, the condition should continue to be observed in all future inspections specifically noting any turbidity and/or changes in rate of flow.

Low areas in excess of one foot along the embankment crest are a considered deficiency as they serve to reduce the overall capacity of the spillway system by reducing the available freeboard. Moreover, low areas serve to concentrate overtopping flows which increases erosion potential and, thus, the potential for embankment failure. Consequently, the main embankment crest should be uniformly regraded and restored to the design top of dam elevation 1311.0 feet.

b. Appurtenant Structures.

1. Emergency Spillway Dike. The emergency spillway dike is considered to be in fair structural condition. Swampy conditions were observed along the downstream dike toe on both sides of the spillway channel. Efforts should be made to drain these areas and collect the flows at central locations where they can continue to be monitored in all future inspections along with the minor seepage observed in the spillway discharge channel. As with the main embankment crest, the crest of the dike should be uniformly regraded and brought up to the design top of dam elevation 1311.0 feet.

Field measurements indicate that the spillway dike was not constructed as designed and the spillway channel is undersized. Moreover, the existing channel is in need of additional erosion protection along its sidewalls. In this way, it will be capable of discharging at its maximum as-built capacity without detrimentally affecting the stablity of the dike due to channel sidewall erosion.

2. Service Spillway. The service spillway is considered to be in good structural condition. No significant structural deficiencies were observed.

3. Outlet Conduit. The outlet conduit was not observed by or operated in the presence of the inspection team. Its ability to operate when needed is a matter for conjecture; however, the

owner does appear to have a proper understanding of what would have to be done should the need develop to draw down the reservoir.

6.2 Design and Construction Techngiues.

Information contained in PennDER files indicates the facility was originally constructed without a prior formal design. The structure was later evaluated by the L. Robert Kimball Consulting Engineers of Ebensburg, Pennsylvania, utilizing modern engineering procedures and techniques. The results are available in a report, dated 1974, entitled, "Engineering Report for Sunrise Lake on Poison Brook, Pike County, Pennsylvania". No specific information pertaining to the subsequent construction phases of this facility is available.

6.3 Past Performance.

There are no records documenting any events during which the facility has not adequately functioned.

6.4 Seismic Stability.

The dam is located in Seismic Zone No. 1 and may be subject to minor earthquake induced dynamic forces. As the facility appears adequately constructed and statically stable, it is believed that it can withstand the expected dynamic forces; however, no calculations and/or investigations were performed to confirm this belief. It is noted that the 1974 engineering report indicated the dam and dike to be stable under earthquake analysis.

SECTION 7

ASSESSMENT AND RECOMMENDATIONS FOR REMEDIAL MEASURES

7.1 Dam Asssessment.

a. Safety. The results of this investigation indicate the facility is in good condition.

The size classification of the facility is small and its hazard classification is considered to be significant. In accordance with the recommended guidelines, the Spillway Design Flood (SDF) for the facility ranges between the 100-year frequency flood and the 1/2 PMF (Probable Maximum Flood). Since the facility is classified near the upper bounds of the small category, the SDF is considered to be the 1/2 PMF. Results of the hydrologic and hydraulic analysis indicate the facility is not capable of passing and/or storing the inflow resulting from a 1/2 PMF event without overtopping the emergency spillway dike. It must be noted, however, that the facility was found to be capable of accommodating the peak inflow from the 100-year frequency flood without overtopping. Nevertheless, the spillway system at Sunrise Lake Dam is considered to be inadequate.

b. Adequacy of Information. The available data are considered sufficient to make a reasonable Phase I assessment of the facility.

c. Urgency. The recommendations listed below should be implemented immediately.

d. Necessity for Additional Investigations. No additional investigations are deemed necessary at this time.

7.2 Recommendations/Remedial Measures.

It is recommended that the owner:

a. Immediately implement remedial measures necessary to restore the main embankment and emergency spillway dike to their design crest elevation at 1311.0 feet. In addition, the emergency spillway channel should be reconstructed to conform with its design configuration whereby it would be hydraulically adequate. In the meantime, additional erosion protection should be provided along the sidewalls of the present emergency spillway channel.

b. Develop formal manuals of operation and maintenance to ensure future proper care and operation of the facility. Included in the manuals should be a formal warning system for the notification of potential downstream inhabitants should hazardous embankment conditions develop, with provisions for around-the-clock surveillance of the facility during periods of unusually heavy precipitation.

c. Drain the swampy areas situated along the downstream toe of the dike to central locations where they can be monitored during future inspections along with the seepage observed in the emergency spillway discharge channel. Turbidity and/or changes in flow rates should be noted.

d. Continue to observe, in all future inspections, the seepage and/or drainage condition encountered below the access road (Sunrise Drive) located along the downstream toe of the main embankment. Turbidity and/or changes in flow rates should be noted.

e. Clear the trash rack atop the service spillway drop inlet on a frequent, regular basis in order to assure unimpeded flow.

APPENDIX A

VISUAL INSPECTION CHECKLIST AND FIELD SKETCHES

CHECK LIST
VISUAL INSPECTION
PHASE 1

NAME OF DAM Sunrise Lake Dam STATE Pennsylvania COUNTY Pike

NDI # PA — 01091 PENNDER # 52-175

TYPE OF DAM Earth SIZE Small HAZARD CATEGORY Significant

DATE(S) INSPECTION 19 May 1981 WEATHER Clear/overcast TEMPERATURE 50° @ 9:00 AM

POOL ELEVATION AT TIME OF INSPECTION 1305.7 feet M.S.L.

TAILWATER AT TIME OF INSPECTION N/A M.S.L.

INSPECTION PERSONNEL	OWNER REPRESENTATIVES	*OTHERS*
B. M. Mihalcin		
D. J. Spaeder		
D. L. Bonk		

RECORDED BY D. L. Bonk

EMBANKMENT

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA - 01091
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 observed between the boulder-size riprap and embankment. Riprap does not appear to be properly bedded; however, erosion not significant.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Horizontal - good. Vertical - see "Profile of Dam Crest from Field Survey," Appendix A. see "Profile of Dike Crest from Field Survey," Appendix A.
RIPRAP FAILURES	Large sandstone boulders are provided along the upstream embankment face at normal pool level. Apparent inadequate bedding has resulted in minor erosion behind the boulders.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Good condition.

EMBANKMENT

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA- 01091
DAMP AREAS IRREGULAR VEGETATION (LUSH OR DEAD PLANTS)	No damp areas observed along the downstream embankment face. Embankment crest and slopes are maintained in a lawn-like condition.
ANY NOTICEABLE SEEPAGE	None through downstream embankment face. Ditch between the downstream embankment toe and paved access road (Sunrise Drive) is saturated. Minor seepage (≈ 1 to 2 gpm) observed downstream of the road. May be toe drain discharge.
STAFF GAGE AND RECORDER	None.
DRAINS	Toe drains reportedly installed during reconstruction. Drains exit into manhole located along the downstream toe near the centerline of the dam (see "Any Noticeable Seepage" above). Manhole is flooded, drain is probably plugged.
MISCELLANEOUS	Swimming pool and bathhouse situated along the embankment crest near the right abutment.

OUTLET WORKS

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA - 01091
INTAKE STRUCTURE	Submerged, not observed.
OUTLET CONDUIT (CRACKING AND SPALLING OF CONCRETE SURFACES)	Located at the upstream base of service spillway riser. Submerged, not observed.
OUTLET STRUCTURE	Discharges at the base of the service spillway riser. Submerged, not observed.
OUTLET CHANNEL	Ultimately, flows from the outlet conduit are discharged through the 3-foot diameter, corrugated metal, service spillway conduit.
GATE(S) AND OPERATIONAL EQUIPMENT	A so called "flap gate" is reportedly situated at the outlet conduit inlet. Operation of the outlet conduit would require the removal of the flap gate which would likely necessitate the assistance of a diver and excavation equipment.

EMERGENCY SPILLWAY

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA- 01091
TYPE AND CONDITION	Uncontrolled, trapezoidal shaped, earth channel cut through the center of a small, earth dike (10 feet high) constructed at the southeast corner of Sunrise Lake about 4,000 feet from the main embankment. Spillway overflow section in good condition. No evidence of erosion noted.
APPROACH CHANNEL	None.
SPILLWAY CHANNEL AND SIDEWALLS	Channel floor is lined with flat, hand placed rock of various sizes. Some of the rock has been displaced. The channel sidewalls are unprotected.
STILLING BASIN PLUNGE POOL	None.
DISCHARGE CHANNEL	Spillway discharges into a relatively flat, broad valley. A small trapezoidal shaped (≈ 10 to 20 feet wide) channel extends downstream of the dam a distance of about 1,000 feet.
EMERGENCY SPILLWAY DIKE	Sparsely vegetated earthfill structure. Soil is very rocky-probably till (clayey silt and rock fragments). No erosion evident. No seepage through downstream dike face was observed. Area beyond downstream toe is swampy on both sides of the spillway.

SERVICE SPILLWAY

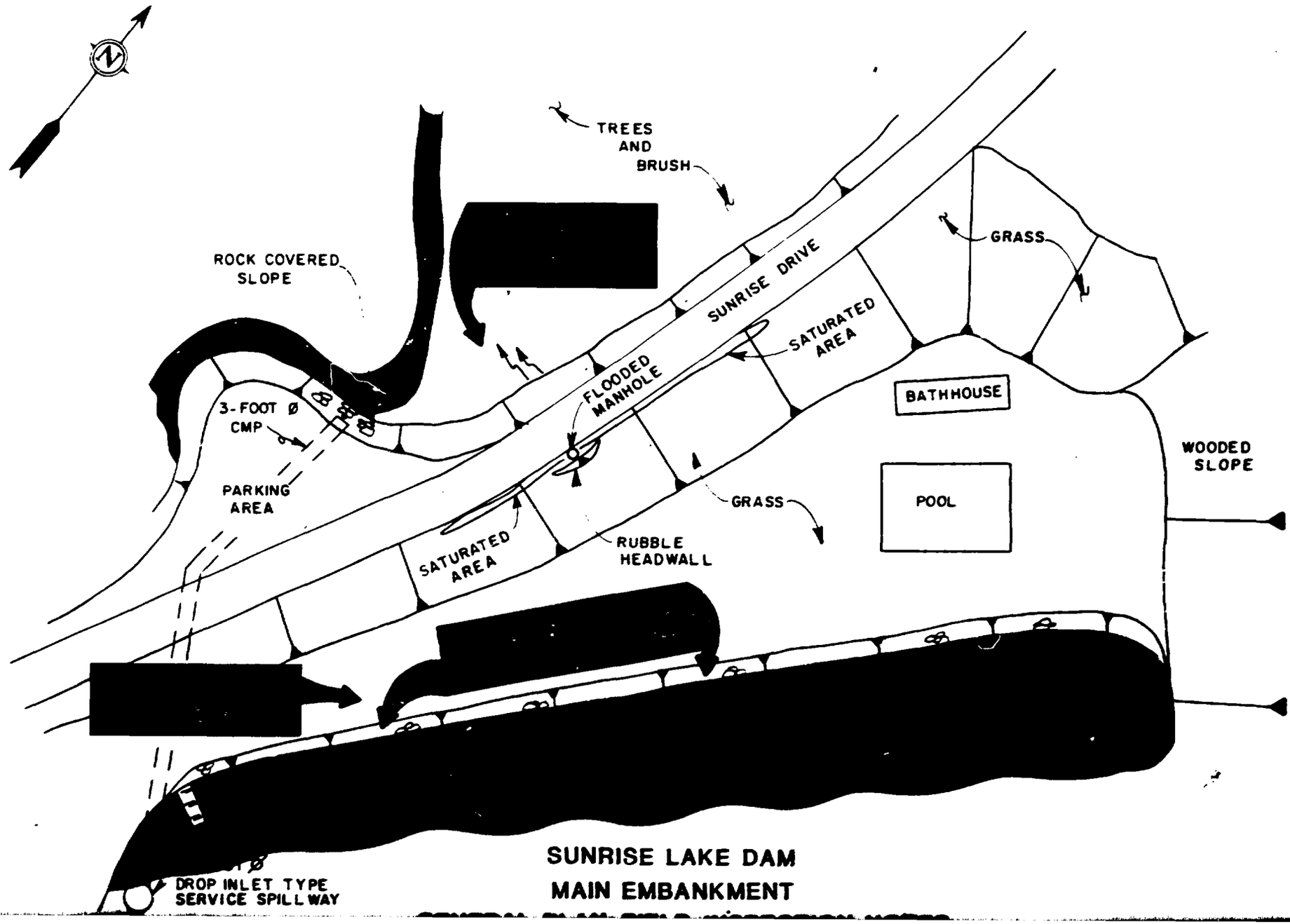
ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA - 01091
TYPE AND CONDITION	Five foot diameter, drop inlet type, corrugated metal riser connected to a three foot diameter, corrugated metal discharge conduit. Trash rack atop inlet is cluttered with debris and should be cleared.
APPROACH CHANNEL	N/A.
OUTLET STRUCTURE	36-inch diameter, corrugated metal pipe. Good condition.
DISCHARGE CHANNEL	Natural channel.

INSTRUMENTATION

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA - 01091
MONUMENTATION SURVEYS	None.
OBSERVATION WELLS	None.
WEIRS	None.
PIEZOMETERS	None.
OTHERS	None.

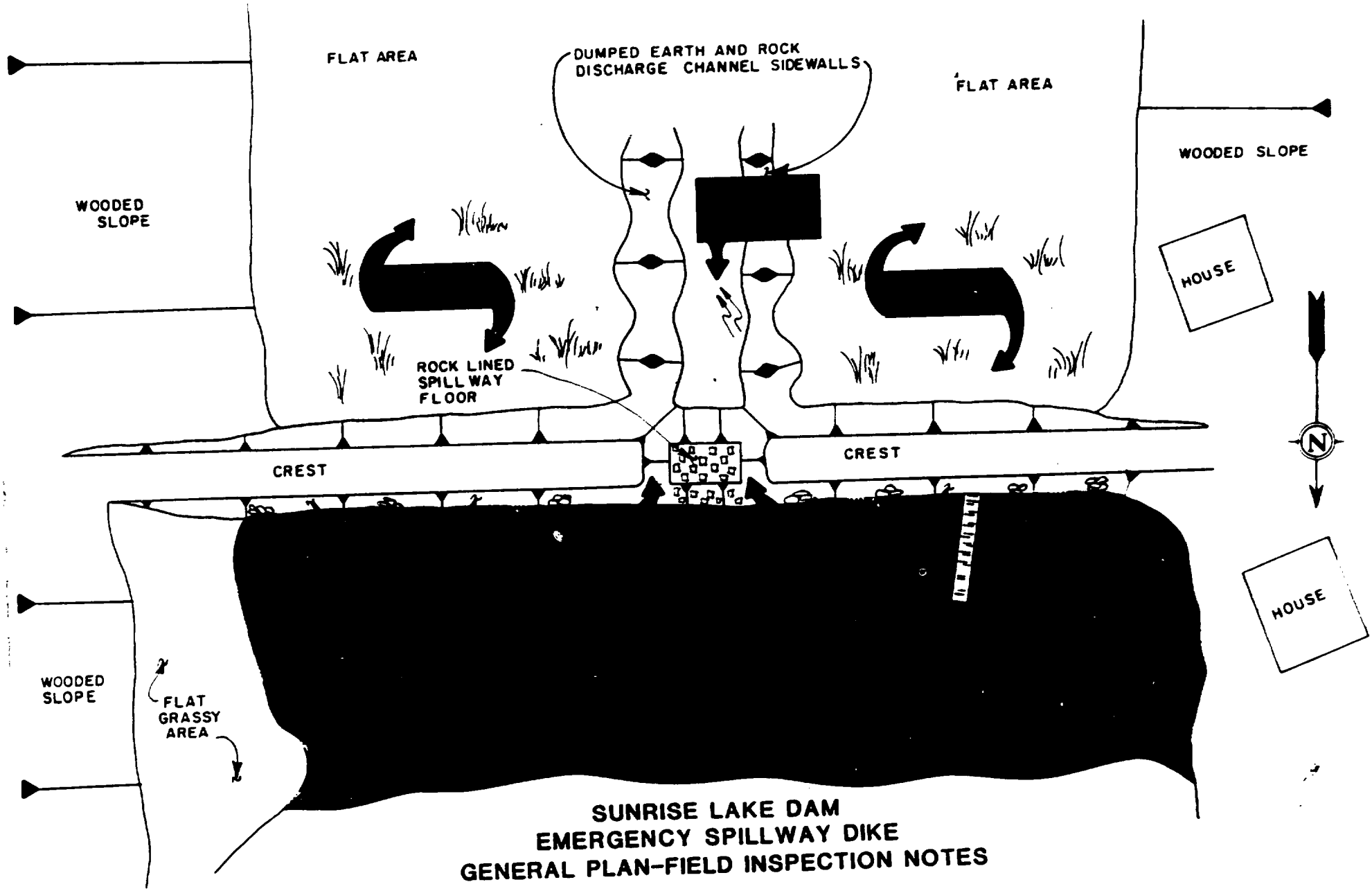
RESERVOIR AREA AND DOWNSTREAM CHANNEL

ITEM	OBSERVATIONS/REMARKS/RECOMMENDATIONS NDI# PA - 01091
SLOPES: RESERVOIR	Moderate to steep and heavily forested.
SEDIMENTATION	None observed.
DOWNSTREAM CHANNEL (OBSTRUCTIONS, DEBRIS, ETC.)	Interstate 84 crosses Rattlesnake Creek about 2.3 miles below the main embankment. Downstream of the emergency spillway dike, Dwarfs Kill Creek passes beneath a township road about 1.1 miles downstream. About four miles below the dike the stream flows into Crescent Lake.
SLOPES: CHANNEL VALLEY	Steep, narrow and heavily forested valley below the main embankment and a somewhat broader, swampy valley below the emergency spillway dike.
APPROXIMATE NUMBER OF HOMES AND POPULATION	Interstate 84 crosses Rattlesnake Creek about 2.3 miles below the main embankment. Crescent Lake Dam, an intermediate size, high hazard facility is located about four miles below the emergency spillway dike. Loss of life not anticipated between main embankment and highway or dike and Crescent Lake.



SUNRISE LAKE DAM

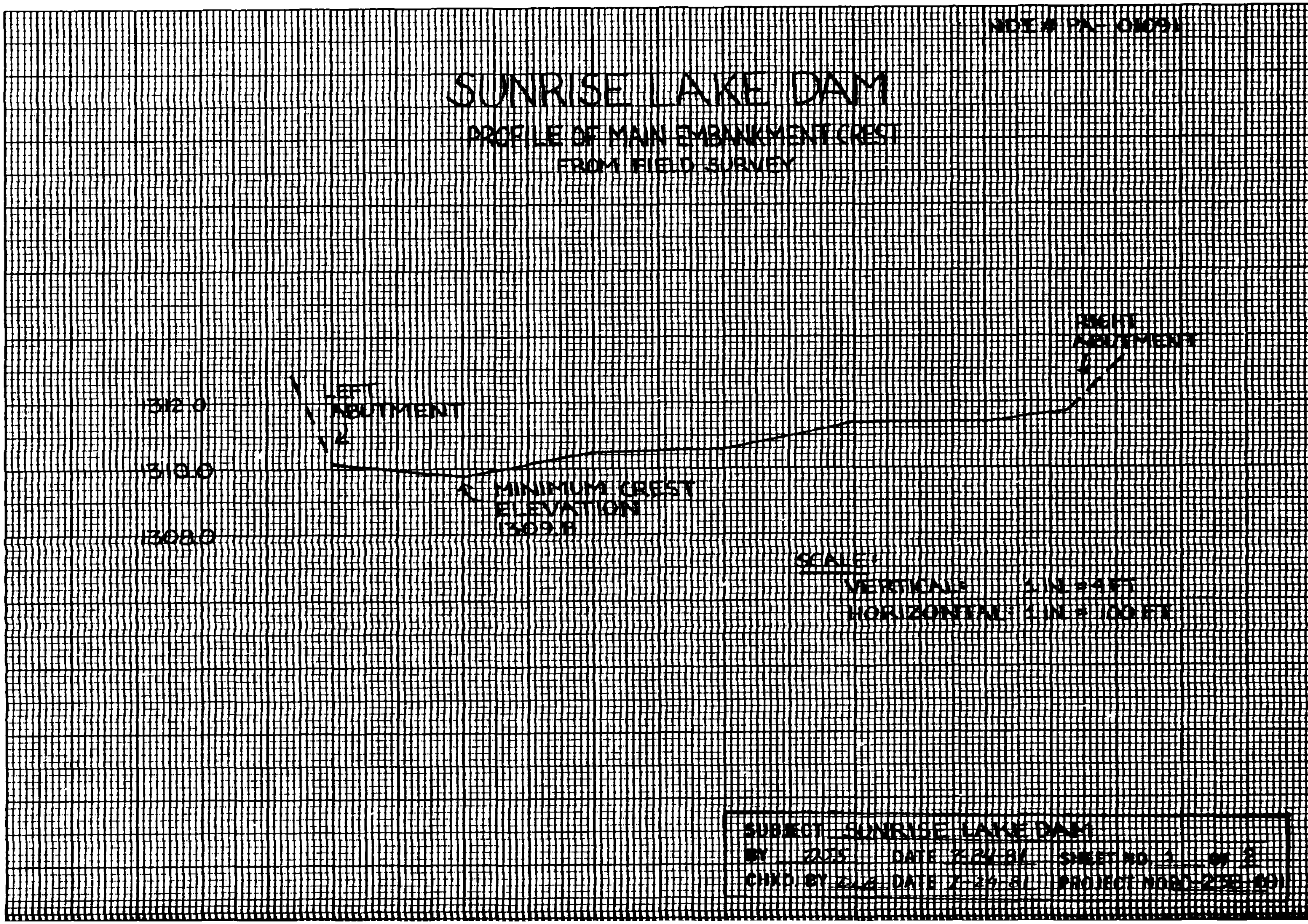
MAIN EMBANKMENT



SUNRISE LAKE DAM
EMERGENCY SPILLWAY DIKE
GENERAL PLAN-FIELD INSPECTION NOTES

K•E 10 X 10 TO ½ INCH 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.

46 1323

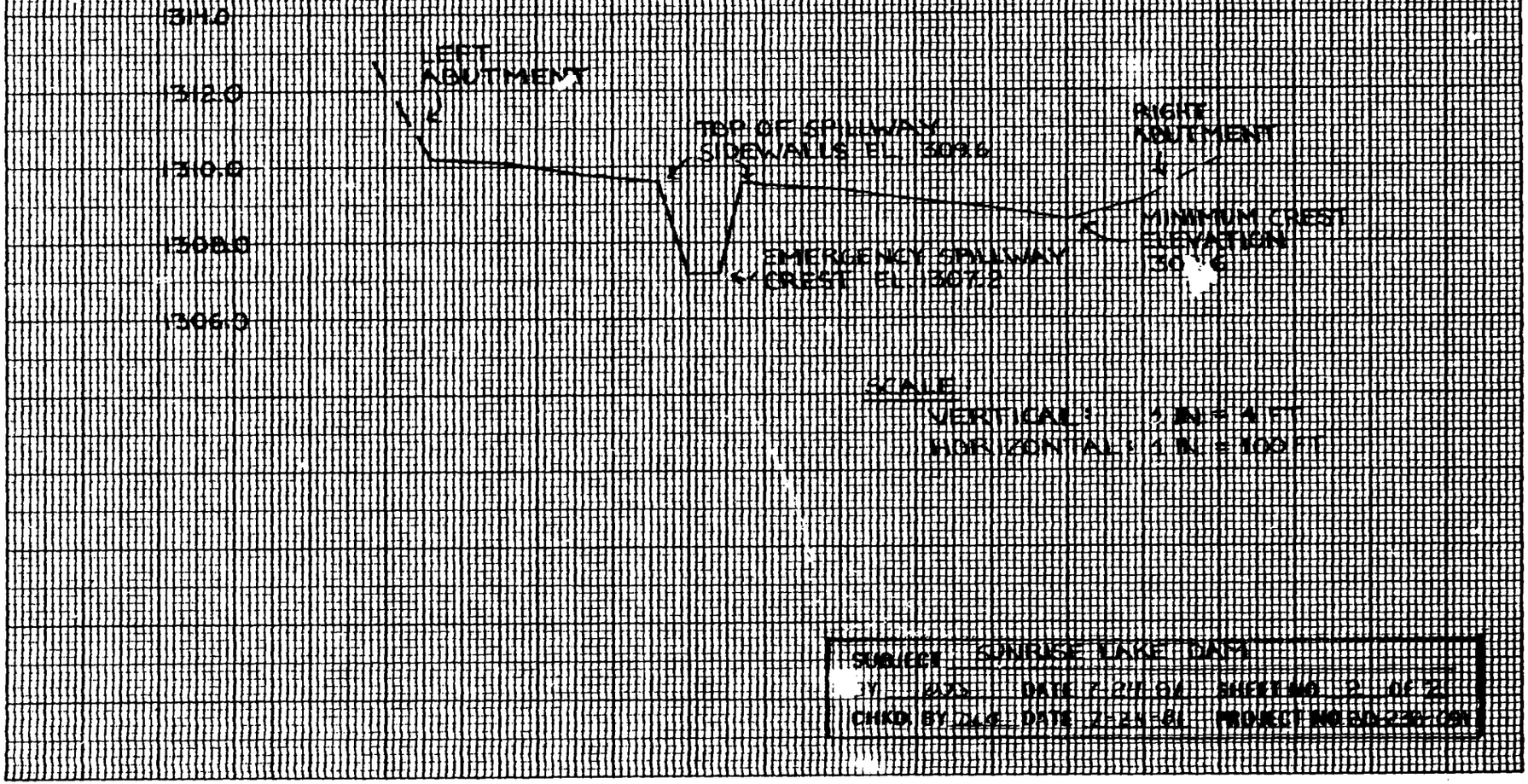


NDI # PA-01091

SUNRISE LAKE DAM

PROFILE OF DIKE CREST

FROM FIELD SURVEY



SCALE

VERTICAL: 1 IN = 4 FT

HORIZONTAL: 1 IN = 100 FT

SUBJECT SUNRISE LAKE DAM

BY JDS DATE 7-24-81 SHEET NO. 2 OF 2

CHKD BY DAG DATE 7-24-81 PROJECT NO. DA-2-36-081

APPENDIX B

ENGINEERING DATA CHECKLIST

CHECK LIST
ENGINEERING DATA
PHASE I

NAME OF DAM _____

ITEM	REMARKS	REFERENCE
OUTLETS PLAN DETAILS CONSTRUCTION EQUIPMENT		

PAGE ___ OF ___

CHECK LIST
ENGINEERING DATA
PHASE I
(CONTINUED)

ITEM	REMARKS NDI# PA- 01091
SPILLWAY: PLAN SECTION DETAILS	See Figures 2 and 3, Appendix E.
OPERATING EQUIP- MENT PLANS AND DETAILS	None available.
DESIGN REPORTS	None available. Original facility was never formally designed.
GEOLOGY REPORTS	Brief geology discussion contained in a report by L. Robert Kimball Consulting Engineers of Ebensburg, Pennsylvania entitled, "Engineering Report for Sunrise Lake on Poison Brook, Pike County, Pennsylvania," prepared for Sunnylands Incorporated, dated March 1974. Available from PennDER files.
DESIGN COMPUTATIONS: HYDROLOGY AND HYDRAULICS STABILITY ANALYSES SEEPAGE ANALYSES	See 1974 engineering report.
MATERIAL INVESTIGATIONS: BORING RECORDS LABORATORY TESTING FIELD TESTING	See 1974 engineering report.

CHECK LIST
ENGINEERING DATA
PHASE I
(CONTINUED)

ITEM	REMARKS NDI# PA- 01091
BORROW SOURCES	Some material came from the area immediately downstream of the emergency spillway dike. The remainder came from other areas outside of the reservoir.
POST CONSTRUCTION DAM SURVEYS	None since reconstruction.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	1974 engineering report by Kimball contained in PennDER files. Owner also has a copy.
HIGH POOL RECORDS	Emergency spillway reportedly has not discharged since reconstruction was completed in 1978.
MONITORING SYSTEMS	None.
MODIFICATIONS	None since reconstruction.

CHECK LIST
ENGINEERING DATA
PHASE I
(CONTINUED)

ITEM	REMARKS NDI# PA- 01091
PRIOR ACCIDENTS OR FAILURES	None.
MAINTENANCE: RECORDS MANUAL	No maintenance records or formal manual are available. Owner has a full-time, year-round maintenance staff.
OPERATION: RECORDS MANUAL	No operating records or formal manual are available.
OPERATIONAL PROCEDURES	Self regulating. Outlet conduit would be difficult to operate if necessary. Would probably require the use of divers and excavation equipment.
WARNING SYSTEM AND/OR COMMUNICATION FACILITIES	No warning system is presently in effect.
MISCELLANEOUS	

CHECK LIST
HYDROLOGIC AND HYDRAULIC ENGINEERING DATA

NDI ID # PA-01091
PENNDER ID # 52-175

SIZE OF DRAINAGE AREA: 1.2 square miles.

ELEVATION TOP NORMAL POOL: 1305.5 STORAGE CAPACITY: 308 acre-feet.

ELEVATION TOP FLOOD CONTROL POOL: - STORAGE CAPACITY: -

ELEVATION MAXIMUM DESIGN POOL: - STORAGE CAPACITY: -

ELEVATION TOP DAM: 1309.8 STORAGE CAPACITY: 626 acre-feet.

SPILLWAY DATA

CREST ELEVATION: 1305.5 (service); 1307.2 (emergency).

TYPE: 5-foot diameter drop inlet (service); trapezoidal channel (emergency).

CREST LENGTH: Emergency; 20 feet (base), 55 feet (top).

CHANNEL LENGTH: N/A (service); 24 feet (emergency).

SPILLOVER LOCATION: Near left abut (service); at dike center (emergency).

NUMBER AND TYPE OF GATES: None.

OUTLET WORKS

TYPE: 3-foot diameter corrugated metal pipe.

LOCATION: Upstream base of service spillway riser.

ENTRANCE INVERTS: 1300.0 (design).

EXIT INVERTS: 1294.0 (design); 1295.5 (field).

EMERGENCY DRAWDOWN FACILITIES: "Flap Gate" at inlet.

HYDROMETEOROLOGICAL GAGES

TYPE: None.

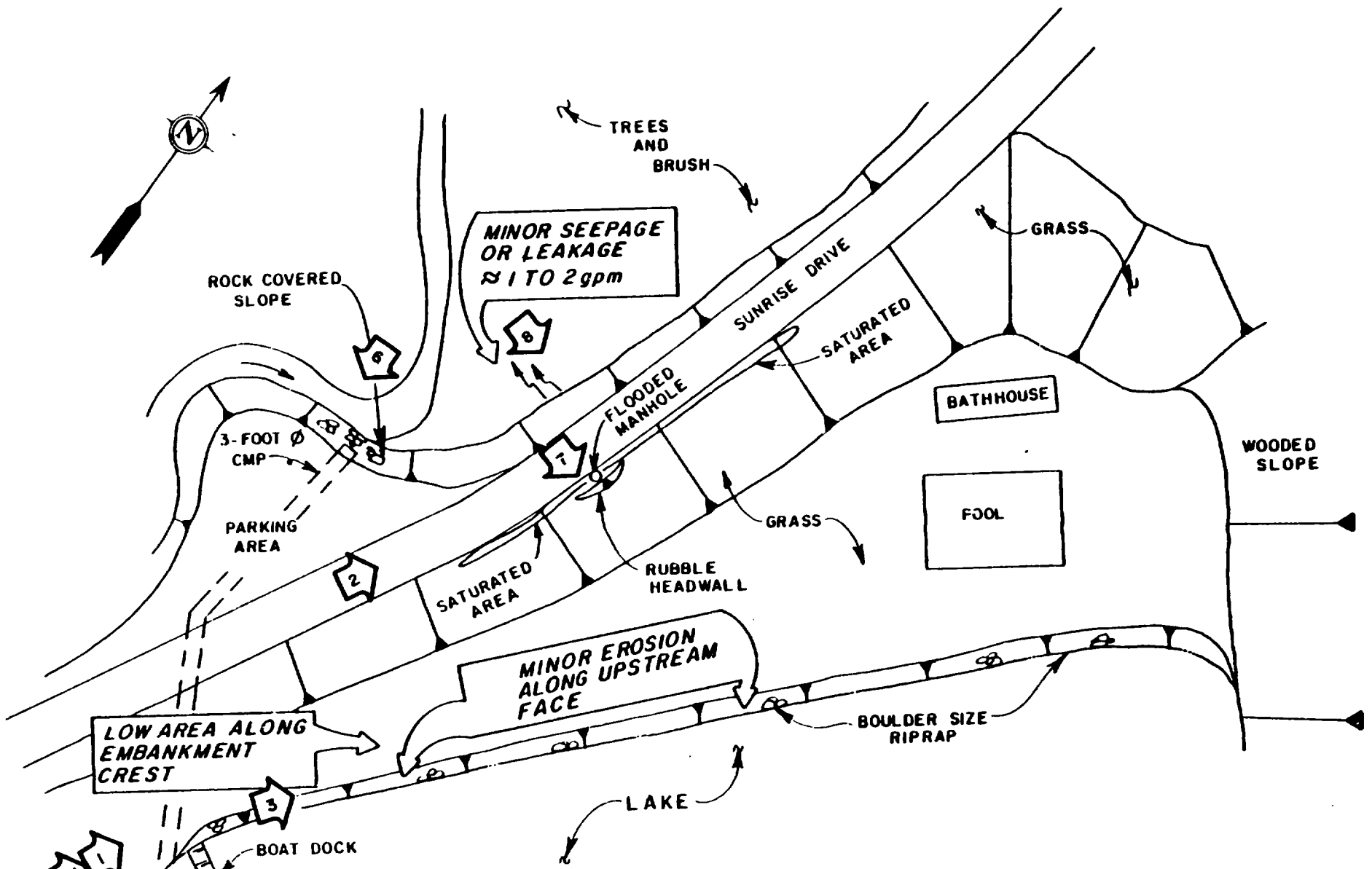
LOCATION: -

RECORDS: -

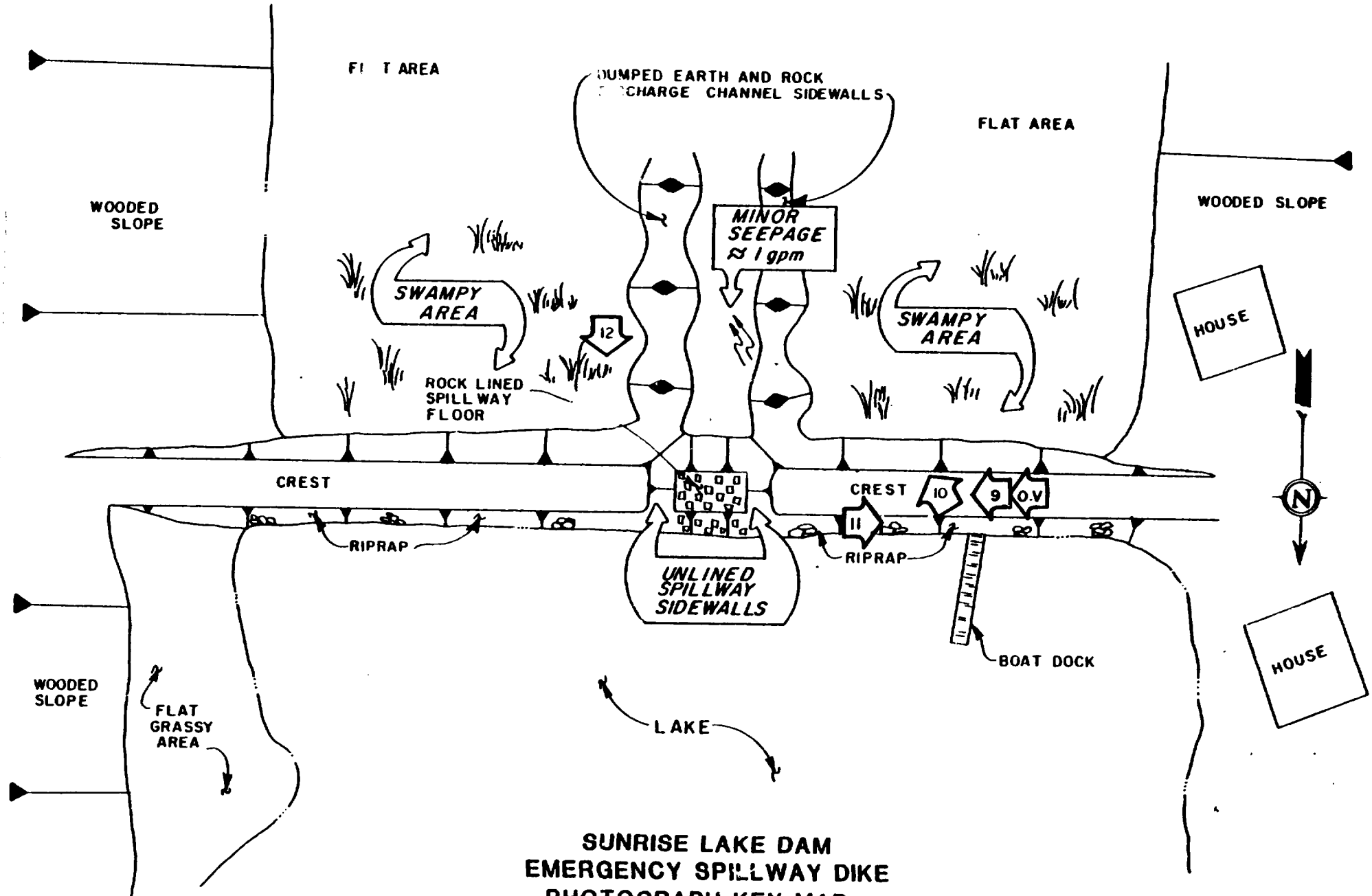
MAXIMUM NON-DAMAGING DISCHARGE: Not known.

APPENDIX C

PHOTOGRAPHS



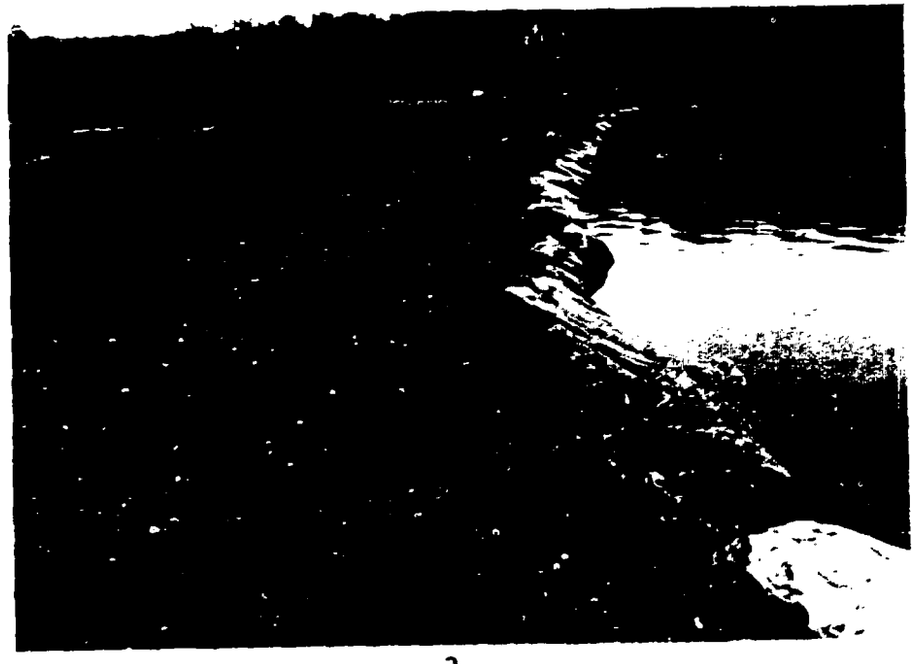
SUNRISE LAKE DAM
MAIN EMBANKMENT
PHOTOGRAPH KEY MAP



SUNRISE LAKE DAM
EMERGENCY SPILLWAY DIKE
PHOTOGRAPH KEY MAP

1

2



3

4

PHOTOGRAPH 1 View of the main embankment as seen from the left abutment.

PHOTOGRAPH 2 View of the downstream main embankment face as seen from the roadway at the left abutment.

PHOTOGRAPH 3 View of the upstream main embankment face looking toward the right abutment.

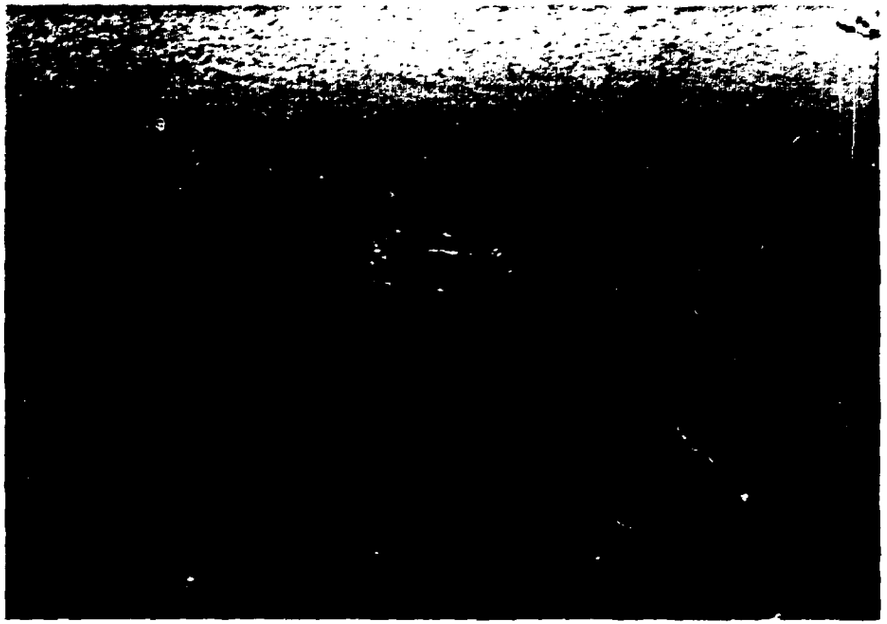
PHOTOGRAPH 4 View of the reservoir area, adjacent the left abutment and upstream of the main embankment, where the service spillway drop inlet is located.

PHOTOGRAPH 5 Close-up view of the service spillway drop inlet.

PHOTOGRAPH 6 View of the discharge end of the service spillway.

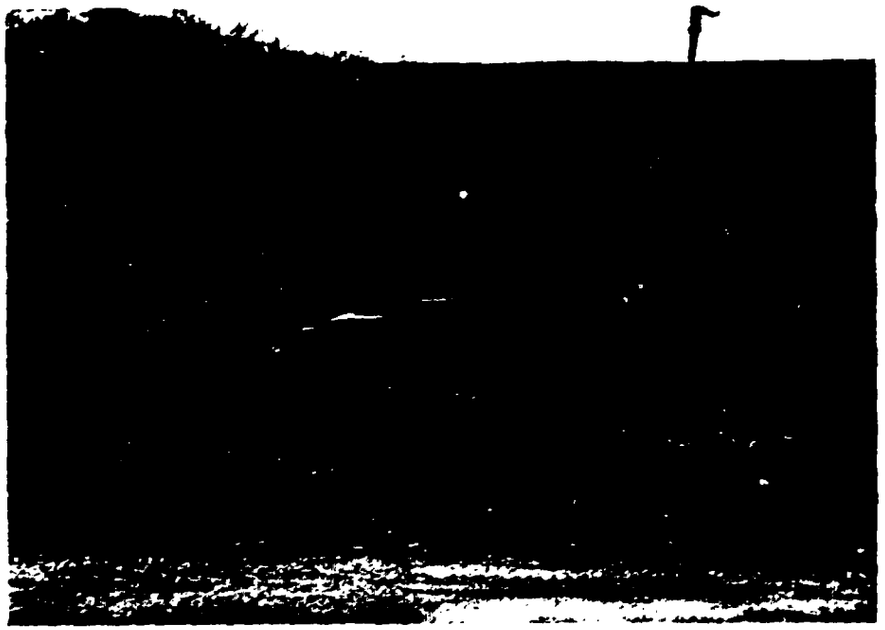
PHOTOGRAPH 7 View of the toe drain access manhole situated along the downstream main embankment toe.

PHOTOGRAPH 8 View of seepage and/or toe drain discharge downstream of the road (Sunrise Drive) which runs along the downstream main embankment toe.



5

6



7

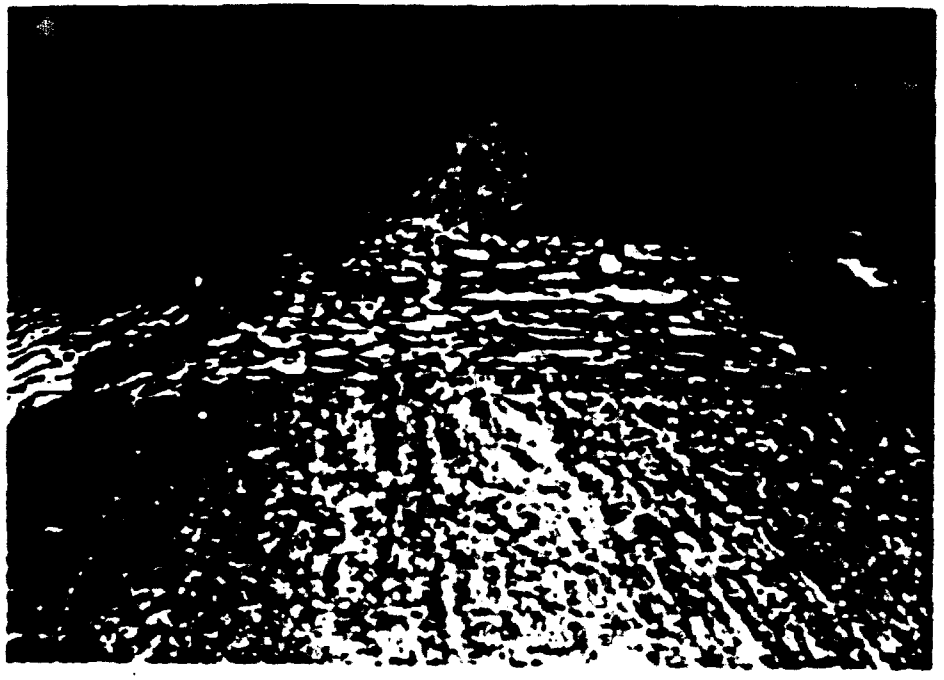
8

PHOTOGRAPH 9 View of the emergency spillway dike looking toward the left abutment.

PHOTOGRAPH 10 View of the general area downstream of the emergency spillway dike as seen from the dike crest.

PHOTOGRAPH 11 View of the upstream face of the emergency spillway dike looking toward the right abutment.

PHOTOGRAPH 12 View of the downstream face of the emergency spillway dike to the left of the overflow.



9

10

APPENDIX D

HYDROLOGIC AND HYDRAULIC ANALYSES

PREFACE

The modified HEC-1 program is capable of performing two basic types of hydrologic analyses: 1) the evaluation of the overtopping potential of the dam; and 2) the estimation of the downstream hydrologic-hydraulic consequences resulting from assumed structural failures of the dam. Briefly, the computational procedures typically used in the dam overtopping analysis are as follows:

a. Development of an inflow hydrograph(s) to the reservoir.

b. Routing of the inflow hydrograph(s) through the reservoir to determine if the event(s) analyzed would overtop the dam.

c. Routing of the outflow hydrograph(s) from the reservoir to desired downstream locations. The results provide the peak discharge(s), time(s) of occurrence the peak discharge(s), and the maximum stage(s) of each routed hydrograph at the downstream end of each reach.

The evaluation of the hydrologic-hydraulic consequences resulting from an assumed structural failure (breach) of the dam is typically performed as shown below.

a. Development of an inflow hydrograph(s) to the reservoir.

b. Routing of the inflow hydrograph(s) through the reservoir.

c. Development of a failure hydrograph(s) based on specified breach criteria and normal reservoir outflow.

d. Routing of the failure hydrograph(s) to desired downstream locations. The results provide estimates of the peak discharge(s), time(s) to peak and maximum water surface elevation(s) of failure hydrograph(s) for each location.

HYDROLOGY AND HYDRAULIC ANALYSIS
DATA BASE

NAME OF DAM: SUNRISE LAKE DAM

PROBABLE MAXIMUM PRECIPITATION (PMP) = 22.0 INCHES/24 HOURS (1)

STATION	1	2	3
STATION DESCRIPTION	SUNRISE LAKE DAM		
DRAINAGE AREA (SQUARE MILES)	1.2		
CUMULATIVE DRAINAGE AREA (SQUARE MILES)	-		
ADJUSTMENT OF PMF FOR DRAINAGE AREA LOCATION (%) (1)	Zone 1		
6 HOURS	111		
12 HOURS	123		
24 HOURS	133		
48 HOURS	142		
72 HOURS	-		
SNYDER HYDROGRAPH PARAMETERS			
ZONE (2)	1		
C_p (3)	0.45		
C_t (3)	1.23		
L (MILES) (4)	1.8		
L_{ca} (MILES) (4)	0.6		
$t_p = C_t (L \cdot L_{ca})^{0.3}$ (HOURS)	1.26		
SPILLWAY DATA			
CREST LENGTH (FEET)	See Calculation Sheets 6,7.		
FREEBOARD (FEET)			

(1) HYDROMETEOROLOGICAL REPORT 33, U.S. ARMY CORPS OF ENGINEERS 1956.
(2) HYDROLOGIC ZONE DEFINED BY CORPS OF ENGINEERS, BALTIMORE DISTRICT, FOR DETERMINATION OF SNYDER COEFFICIENTS (C_p AND C_t).
(3) SNYDER COEFFICIENTS
(4) L = LENGTH OF LONGEST WATERCOURSE FROM DAM TO BASIN DIVIDE
L_{ca} = LENGTH OF LONGEST WATERCOURSE FROM DAM TO POINT OPPOSITE BASIN CENTROID.

SUBJECT DAM SAFETY INSPECTION
SUNRISE LAKE DAM

BY DJS DATE 6-23-81 PROJ. NO. 80-238-091

CHKD. BY DLB DATE 7-30-81 SHEET NO. 1 OF 13

gai CONSULTANTS, INC.
Engineers • Geologists • Planners
Environmental Specialists

DAM STATISTICS

HEIGHT OF DAM = 14 FT (FIELD MEASURED — TOP OF DAM TO DOWNSTREAM EMBANKMENT TOE; "TOP OF DAM" HERE AND ON ALL SUBSEQUENT CALCULATION SHEETS REFERS TO THE LOW AREA IN THE EMBANKMENT CREST.)

HEIGHT OF EMERGENCY SPILLWAY DIKE = 10 FT (FIELD MEASURED - TOP OF DIKE (AT LOW AREA) TO DOWNSTREAM TOE.)

NORMAL POOL STORAGE CAPACITY = 308 AC-FT
STORAGE CAPACITY AT TOP OF DIKE = 532 AC-FT
STORAGE CAPACITY AT TOP OF MAIN DAM = 626 AC-FT (SHEET 3)

DRAINAGE AREA = 1.2 SQ. MI. (PLANIMETERED ON USGS TOPO QUAD - EDGEMERE, PA)

ELEVATIONS:

TOP OF DAM (DESIGN)	= 1311.0	(FIG. 4)
TOP OF DAM (FIELD)	= 1309.8	
TOP OF DIKE (DESIGN)	= 1311.0	(FIG. 4)
TOP OF DIKE (FIELD)	= 1308.6	
NORMAL POOL	= 1305.5	(FIG. 2)
CREST OF SERVICE SPILLWAY	= 1305.5	(FIG. 2)
CREST OF EMERGENCY SPILLWAY (DESIGN)	= 1309.0	(FIG. 3)
CREST OF EMERGENCY SPILLWAY (FIELD)	= 1307.2	
UPSTREAM INLET INVERT (DESIGN)	= 1300.0	(SEE NOTE 1, SHEET 2)
DOWNSTREAM OUTLET INVERT (DESIGN)	= 1294.0	(SEE NOTE 1, SHEET 2)
DOWNSTREAM OUTLET INVERT (FIELD)	= 1295.5	

SUBJECT DAM SAFETY INSPECTION
SUNRISE LAKE DAM

BY DJS DATE 6-23-81 PROJ. NO. 80-238-091

CHKD. BY DLG DATE 7-30-81 SHEET NO. 2 OF 13

gai CONSULTANTS
Engineers • Geologists • Planners
Environmental Specialists

ELEVATIONS :

DOWNSTREAM EMBANKMENT TOE = 1296.2 (FIELD MEASURED)
STREAMBED @ DAM CENTERLINE = NOT KNOWN

DAM CLASSIFICATION

DAM SIZE: SMALL (REF 1, TABLE 1)

HAZARD CLASSIFICATION: SIGNIFICANT (FIELD OBSERVATION)

REQUIRED SDF: 100-YEAR FLOOD TO ½ PMF (REF 1, TABLE 3)

SELECTED SDF = ½ PMF

RESERVOIR CAPACITY

THE RESERVOIR STORAGE TABLE PROVIDED ON SHEET 3 IS TAKEN FROM THE ENGINEERING REPORT FOR SUNRISE LAKE (SEE NOTE 1).

NOTE 1: FROM "PLANS AND SPECIFICATIONS FOR SUNRISE LAKE", SUNNYLANDS, INC., MILFORD, PA; FOUND IN PENNDER FILES.

NOTE 2: FROM "ENGINEERING REPORT FOR SUNRISE LAKE ON POISON BROOK PIKE COUNTY, PENNSYLVANIA," PREPARED FOR SUNNYLANDS INCORPORATED, PREPARED BY L. ROBERT KIMBALL CONSULTING ENGINEERS, EDGEMONT, PA, MARCH 1974; FOUND IN PENNDER FILES.

SUBJECT DAM SAFETY INSPECTION
SUNRISE LAKE DAM

BY DJS DATE 6-23-81 PROJ. NO. 80-238-091

CHKD. BY DLB DATE 7-30-81 SHEET NO. 3 OF 13

gai CONSULTANTS, INC.
Engineers • Geologists • Planners
Environmental Specialists

STORAGE CALCULATIONS*

ELEV.	SURF. AREA (AC)	SURF AREA (S.F.)	AVG. AREA (S.F.)	VOLUME (C.F.)	VOLUME (AC. FT.)	Σ VOLUME (AC. FT.)
1300	0	1,731,509				
			1,997,008	3,994,016	91.69	
1302	51.94	2,262,506				91.69
			2,528,004	5,056,010	116.07	
1304	64.13	2,793,503				207.76
			2,909,155	5,818,310	133.57	
1306	69.44	3,024,806				341.33
			3,137,191	6,274,382	144.04	
1308	74.60	3,249,576				485.37
			3,407,046	6,815,092	156.43	
1310	81.83	3,564,515				641.80
			3,633,884	3,633,884	83.42	
1311		3,703,254				725.22
			3,772,623	3,772,623	86.61	
1312	88.20	3,841,992				811.83

TOTAL VOLUME 35,363,317 C.F.

* — SEE NOTE 2, SHEET 2.

NORMAL POOL STORAGE CAPACITY = 308 AC-FT
STORAGE CAPACITY @ TOP OF DIKE (EL. 1308.6) = 532 AC-FT
STORAGE CAPACITY @ TOP OF MAIN DAM (EL. 1309.8) = 626 AC-FT

(BY LINEAR INTERPOLATION)

SUBJECT DAM SAFETY INSPECTION
SUNRISE LAKE DAM

BY DJS DATE 6-24-81 PROJ. NO. 80-238-091

CHKD. BY DLB DATE 7-30-81 SHEET NO. 4 OF 13

gai CONSULTANTS, INC.
Engineers • Geologists • Planners
Environmental Specialists

HYDROGRAPH PARAMETERS

$C_p = 0.45$
$C_t = 1.23$

(SUPPLIED BY C.O.E., ZONE 1, DELAWARE RIVER BASIN)

LENGTH OF LONGEST WATERCOURSE: $L = 1.8$ MILES

LENGTH OF LONGEST WATERCOURSE FROM DAM TO A POINT OPPOSITE BASIN CENTROID: $L_{ca} = 0.6$ MILES

(MEASURED ON USGS TOPO QUAD – EDGEMERE, PA; THE STREAM LENGTHS WERE MEASURED FROM THE EMERGENCY SPILLWAY DIKE, RATHER THAN FROM THE MAIN DAM, SINCE THE EMERGENCY SPILLWAY WOULD BE THE PRIMARY SOURCE OF DISCHARGE UNDER ½ PMF (SDF) CONDITIONS.)

SNYDER'S STANDARD LAG:

$$t_p = C_t (L \cdot L_{ca})^{0.3}$$
$$= 1.23 (1.8 \times 0.6)^{0.3}$$
$$= 1.26 \text{ HRS}$$

(NOTE: HYDROGRAPH VARIABLES USED HERE ARE DEFINED IN REF. 2, IN SECTION ENTITLED "SNYDER SYNTHETIC UNIT HYDROGRAPH.")

SUBJECT DAM SAFETY INSPECTION
SUNRISE LAKE DAM

BY RJT DATE 6-24-81 PROJ. NO. 80-238-091

CHKD. BY DLB DATE 7-30-81 SHEET NO. 5 OF 13

gai CONSULTANTS, INC.
Engineers • Geologists • Planners
Environmental Specialists

PMP CALCULATIONS

APPROXIMATE RAINFALL INDEX = 22 INCHES
(CORRESPONDING TO A DURATION OF 24 HOURS AND
A DRAINAGE AREA OF 200 SQUARE MILES)

(REF 3, FIG. 1)

DEPTH - AREA - DURATION ZONE 1 (REF 3, FIG. 1)

ASSUME DATA CORRESPONDING TO A 10-SQUARE MILE AREA
MAY BE APPLIED TO THIS 1.2 SQUARE MILE BASIN:

DURATION (HRS)	PERCENT OF INDEX RAINFALL
6	111
12	123
24	133
48	142

(REF 3, FIG. 2)

HOP BROOK FACTOR (ADJUSTMENT FOR BASIN SHAPE AND FOR THE LESSER LIKELIHOOD OF A SEVERE STORM CENTERING OVER A SMALL BASIN) FOR A DRAINAGE AREA OF 1.2 SQUARE MILES 0.80

(REF 4, p. 48)

SUBJECT DAM SAFETY INSPECTION
SUNRISE LAKE DAM

BY DJS DATE 6-24-81 PROJ. NO. 80-238-091

CHKD. BY DLB DATE 7-30-81 SHEET NO. 6 OF 13

CONSULTANTS, INC.
Engineers • Geologists • Planners
Environmental Specialists

SERVICE SPILLWAY CAPACITY

THE SERVICE SPILLWAY CONSISTS OF AN UNCONTROLLED 5-FOOT DIAMETER CORRUGATED METAL RISER PIPE CONNECTED TO A 3-FOOT DIAMETER CORRUGATED METAL OUTLET PIPE. THE CREST OF THE RISER PIPE IS SET AT EL. 1305.5. THE SPILLWAY RATING TABLE, OBTAINED FROM THE ENGINEERING REPORT FOR SUNRISE LAKE (SEE NOTE 2), IS PROVIDED BELOW.

SERVICE SPILLWAY RATING TABLE:

RESERVOIR ELEVATION (FT)	Q (CFS)
1305.5	0
1305.7	7
1306.0	22
1306.5	56
1307.0	77
1307.5	79
1308.0	80
1308.5	82
1309.0	84
1309.5	85
1310.0	87
1310.5	88
1311.0	89

SUBJECT DAM SAFETY INSPECTION
SUNRISE LAKE DAM

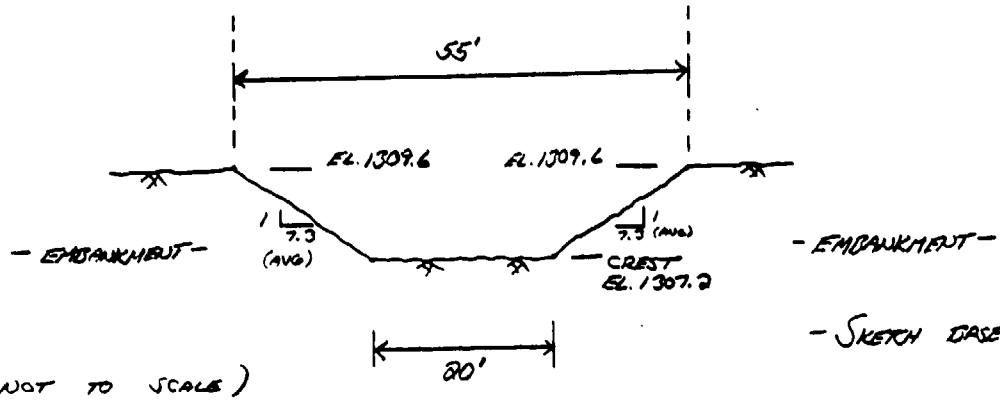
BY JJS DATE 6-25-81 PROJ. NO. 80-238-091

CHKD. BY DLB DATE 7-30-81 SHEET NO. 7 OF 13

gai CONSULTANTS, INC.
Engineers • Geologists • Planners
Environmental Specialists

EMERGENCY SPILLWAY CAPACITY

CROSS-SECTION:



(NOT TO SCALE)

- SKETCH BASED ON FIELD SURVEY.

THE EMERGENCY SPILLWAY CONSISTS OF AN UNCONTROLLED TRAPEZOIDAL SHAPED SECTION CUT THROUGH THE APPURTENANT DIKE. (IT IS NOTED HERE THAT WHILE THE EMERGENCY SPILLWAY IS LOCATED AT THE DIKE, THE SERVICE SPILLWAY IS LOCATED WITHIN THE MAIN EMBANKMENT; SEE FIG. 1).

BASED ON THE ASSUMPTION THAT CRITICAL FLOW OCCURS WITHIN THE SECTION,

$$\frac{Q^2 T}{g A^3} = 1.0 \qquad \text{(REF 5, p. 8-7)}$$

WHERE Q = DISCHARGE, IN CFS;
T = TOP WIDTH OF FLOW AREA, IN FT;
g = GRAVITATIONAL ACCELERATION CONSTANT = 32.2 FT/SEC^2;
A = FLOW AREA, IN FT^2.

ALSO,

$$H_m = D_c + \frac{D_m}{2}$$

AND

$$D_m = A/T \qquad \text{(REF 5, p. 8-8)}$$

SUBJECT DAM SAFETY INSPECTION
SUNRISE LAKE DAM

BY DJS DATE 6-25-81 PROJ. NO. 80-238-091

CHKD. BY DLB DATE 7-30-81 SHEET NO. 8 OF 13

gai CONSULTANTS, INC.
Engineers • Geologists • Planners
Environmental Specialists

WHERE H_m = TOTAL HEAD AT CRITICAL DEPTH, OR MINIMUM SPECIFIC ENERGY, IN FT;
D_c = CRITICAL DEPTH, IN FT;
D_m = MEAN DEPTH OF FLOW AREA, IN FT.

THE RESERVOIR ELEVATION CORRESPONDING TO ANY PARTICULAR DISCHARGE IS THEN $H_m + 1307.2$ (WHERE INVERT OF CONTROL SECTION = 1307.2). THIS IS BASED ON THE ASSUMPTION OF ZERO-VELOCITY HEAD AT THE RESERVOIR JUST UPSTREAM OF THE CONTROL SECTION, AND NEGLIGIBLE HEAD LOSS TO THE CONTROL SECTION → NO APPROACH LOSSES.

EMERGENCY SPILLWAY RATING TABLE: *

D_c (FT)	A ① (FT^2)	T ② (FT)	D_m ③ (FT)	H_m ④ (FT)	Q ⑤ (CFS)	RESERVOIR ELEVATION ⑥ (FT)
0.5	11.8	27.3	0.43	0.7	44	1307.9
1.0	27.3	34.6	0.79	1.4	138	(TOP OF DIKE) 1308.6
1.4	42.3	40.4	1.05	1.9	246	1309.1
1.8	59.7	46.3	1.29	2.4	385	(TOP OF SPILLWAY SIDEWALLS) 1309.6
2.1	74.2	50.7	1.46	2.8	509	1310.0
2.4	90.0	55.0	1.64	3.2	653	1310.4
2.7	106.5	55.0	1.94	3.7	841	1310.9
3.0	123.0	55.0	2.24	4.1	1044	1311.3
3.3	139.5	55.0	2.54	4.6	1261	1311.8
3.6	156.0	55.0	2.84	5.0	1491	1312.2

① FOR $D_c < 2.4$, $A = 20D_c + 7.3D_c^2$
FOR $D_c \geq 2.4$, $A = 90 + 55(D_c - 2.4)$
② FOR $D_c < 2.4$, $T = 20 + 17.6D_c$
FOR $D_c \geq 2.4$, $T = 55$
③ $D_m = A/T$
④ $H_m = D_c + D_m/2$
⑤ $Q = \sqrt{g \cdot A^3/T}$
⑥ RESERVOIR ELEVATION = $H_m + 1307.2$

* NOTE: ALTHOUGH THE SIDEWALLS OF THE EMERGENCY SPILLWAY WERE UNPROTECTED AT THE TIME OF INSPECTION AND THUS SUBJECT TO EROSION UNDER DISCHARGE, THEY WERE ASSUMED TO BE STABLE FOR THIS ANALYSIS.

SUBJECT DAM SAFETY INSPECTION
SUNRISE LAKE DAM

BY DJS DATE 6-25-81 PROJ. NO. 80-238-091

CHKD. BY DGB DATE 7-30-81 SHEET NO. 9 OF 13

gai CONSULTANTS, INC.
Engineers • Geologists • Planners
Environmental Specialists

TOTAL SPILLWAY CAPACITY

$Q_{TOTAL\ SPILLWAY} = Q_{SERVICE\ SPILLWAY} + Q_{EMERGENCY\ SPILLWAY}$

RESERVOIR ELEVATION (FT)	① $Q_{SERVICE\ SPILLWAY}$ (CFS)	② $Q_{EMERGENCY\ SPILLWAY}$ (CFS)	Q_{TOTAL} (CFS)
1305.5	0	—	0
1305.7	10	—	10
1306.0	20	—	20
1306.5	60	—	60
1307.0	80	—	80
1307.2	80	0	80
1307.5	80	20 *	100
1307.9	80	40	120
1308.6 (TOP OF DIKE)	80	140	220
1309.1	80	250	330
1309.6 (TOP OF SPILLWAY EMBANKMENT)	90	390	480
1309.8 (TOP OF DAM)	90	450 *	540
1310.0	90	510	600
1310.4	90	650	740
1311.0	90	890 *	980

* - BY LINEAR INTERPOLATION FROM RATING TABLE, SHEET 8.

① FROM RATING TABLE, SHEET 6 (ROUNDED TO NEAREST 10 CFS).
② FROM RATING TABLE, SHEET 8 (ROUNDED TO NEAREST 10 CFS).

SUBJECT DAM SAFETY INSPECTION
SUNRISE LAKE DAM

BY DJS DATE 6-25-81 PROJ. NO. 80-238-091

CHKD. BY DLB DATE 7-30-81 SHEET NO. 10 OF 13

gai CONSULTANTS, INC.
Engineers • Geologists • Planners
Environmental Specialists

EMBANKMENT DISCHARGE

DISCHARGE OVER THE EMBANKMENTS WILL BE COMPUTED INTERVALLY IN THE HEC-1 PROGRAM, WITH THE ASSUMPTION THAT CRITICAL DEPTH OCCURS ON THE CREST, AND WITH THE CREST PROFILE REPRESENTED BY A SERIES OF TRAPEZOIDS. THE INPUT DATA IS PROVIDED BELOW:

RESERVOIR ELEVATION	LENGTH OF EMBANKMENT INUNDATED
(FT)	(FT)
1308.6	0
1308.9	80
1309.1	150
1309.4	210
1309.6	290
1309.8	350
1310.2	620
1310.5	680
1311.0	850

(BASED ON FIELD SURVEY)

SUBJECT DAM SAFETY INSPECTION
SUNRISE LAKE DAM

BY DJS DATE 7-2-81 PROJ. NO. 80-238-091

CHKD. BY DLB DATE 7-30-81 SHEET NO. 11 OF 13

GAI CONSULTANTS, INC
Engineers • Geologists • Planners
Environmental Specialists

100-YEAR FLOOD COMPUTATION

THE FOLLOWING DATA AND METHODOLOGY WERE TAKEN FROM THE "REGIONAL FREQUENCY STUDY, UPPER DELAWARE AND HUDSON RIVER BASINS, NEW YORK DISTRICT;" PREPARED FOR THE NEW YORK DISTRICT, CORPS OF ENGINEERS BY THE HYDROLOGIC ENGINEERING CENTER, DAVIS, CALIFORNIA, NOVEMBER 1974.

COMPUTE THE 100-YEAR FREQUENCY FLOOD PEAK FOR SUNRISE LAKE DAM:

1) COMPUTE THE MEAN LOG OF THE ANNUAL PEAK DISCHARGE:

$$\text{LOG}(Q_m) = C_m + 0.87 \text{ LOG}(A)$$

WHERE Q_m = GEOMETRIC MEAN OF ANNUAL FLOOD PEAKS, IN CFS,
C_m = MAP COEFFICIENT,
A = DRAINAGE AREA = 1.2 SQ. MI. *

FROM FIG. 2, "REGIONAL FREQUENCY STUDY,"

$$C_m = 1.6$$

$$\therefore \text{LOG}(Q_m) = 1.6 + 0.87 \text{ LOG}(1.2)$$
$$= 1.669$$

2) COMPUTE STANDARD DEVIATION:

$$S = C_s - 0.05 \text{ LOG}(A)$$

---

* NOTE: ALTHOUGH THE RESULTS OF THE "REGIONAL FREQUENCY STUDY" ARE FOR BASINS OF DRAINAGE AREA GREATER THAN 13 SQUARE MILES, IT IS ASSUMED THAT THEY CAN BE APPLIED TO THIS 1.2 SQUARE MILE BASIN.

SUBJECT DAM SAFETY INSPECTION
SUNRISE LAKE DAM

BY DJS DATE 7-2-81 PROJ. NO. 80-238-091

CHKD. BY DLB DATE 7-30-81 SHEET NO. 12 OF 13

GAI CONSULTANTS, INC.
Engineers • Geologists • Planners
Environmental Specialists

WHERE S = STANDARD DEVIATION OF LOGARITHMS OF ANNUAL PEAKS,
C_S = MAP COEFFICIENT FOR STANDARD DEVIATION.

FROM FIG. 3, "REGIONAL FREQUENCY STUDY,"

$$C_S = 0.35$$

$$\therefore S = 0.35 - 0.05 \log (1.2) = \underline{0.346}$$

3) COMPUTE 100-YEAR FLOOD PEAK:

$$\log (Q(P)) = \log(Q_m) + K(P, g) \cdot S$$

WHERE $\log (Q(P))$ = LOG OF ANNUAL FLOOD PEAKS FOR A GIVEN EXCEEDANCE FREQUENCY (P),
$\log (Q_m)$ = MEAN LOG OF ANNUAL FLOOD PEAKS,
$K(P, g)$ = MAGNITUDE IN STANDARD DEVIATIONS FROM MEAN FOR A GIVEN EXCEEDANCE FREQUENCY PERCENTAGE (P) AND SKEW COEFFICIENT (g),
S = STANDARD DEVIATION OF LOGS OF ANNUAL FLOOD PEAKS.

FROM FIG. 5, "REGIONAL FREQUENCY STUDY,"

$$g = \underline{+0.8}.$$

FOR 100-YEAR EVENT, $P = 1.0$ PERCENT.

FROM TABLE 10, "REGIONAL FREQUENCY STUDY,"

$$K(1.0, 0.8) = \underline{2.90}$$

$$\therefore \log (Q_1) = 1.669 + (2.90)(0.346) = 2.672$$

$$Q_1 = \underline{470} \text{ CFS} = \underline{\underline{100\text{-YEAR FLOOD PEAK.}}}$$

SUBJECT DAM SAFETY INSPECTION
SUNRISE LAKE DAM

BY DJS DATE 7-2-81 PROJ. NO. 80-238-091

CHKD. BY DLB DATE 7-30-81 SHEET NO. 13 OF 13

GAI CONSULTANTS, INC.
Engineers • Geologists • Planners
Environmental Specialists

FROM THE OVERTOPPING ANALYSIS (SEE SUMMARY INPUT/OUTPUT SHEETS), IT CAN BE SEEN THAT SUNRISE LAKE DAM CAN ACCOMMODATE ONLY ABOUT 23 PERCENT OF THE PMF PRIOR TO OVERTOPPING AT THE EMERGENCY SPILLWAY DIKE. HOWEVER, FROM THE GIVEN INFLOW AND OUTFLOW HYDROGRAPHS, IT CAN REASONABLY BE ASSUMED THAT THE PEAK INFLOW UNDER THE 100-YEAR EVENT (470 CFS) WOULD BE ATTENUATED BY THE DISCHARGE/STORAGE CAPABILITIES OF THE DAM, SUCH THAT NO OVERTOPPING WOULD OCCUR.

SUBJECT: DAM SAFETY INSPECTION
SUNRISE LAKE DAM

BY: DJS DATE: 7-6-81 PROJ. NO.: 80-238-091
CHKD. BY: DLB DATE: 7-30-81 SHEET NO.: A OF D

GAI CONSULTANTS, INC.
Engineers • Geologists • Planners
Environmental Specialists

SUMMARY INPUT/OUTPUT SHEETS

OVERTOPPING ANALYSIS

DAM SAFETY INSPECTION
SUNRISE LAKE DAM *** OVERTOPPING ANALYSIS ***
10-MINUTE TIME STEP AND 48-HOUR STORM DURATION

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
288	0	10	0	0	0	0	0	0	0

JOPER	NWT	LROPT	TRACE
5	0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRTIO= 5 LRTIO= 1

RTIOS= .20 .23 .26 .30 .50

********** ********** ********** ********** **********

SUB-AREA RUNOFF COMPUTATION

RESERVOIR INFLOW

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
1	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	1.20	0.00	1.20	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.00	22.00	111.00	123.00	133.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

INITIAL & CONSTANT RAINFALL LOSSES AS PER C.O.E.

LOSS DATA

LROPT	STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.05	0.00	0.00

UNIT HYDROGRAPH DATA
TP= 1.26 CP= .45 NTA= 0

BASE FLOW PARAMETERS AS PER C.O.E.

RECESSION DATA
STRTQ= -1.50 QRCSN= -.05 RTIOR= 2.00

APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 7.97 AND R=12.05 INTERVALS

UNIT HYDROGRAPH 60 END-OF-PERIOD ORDINATES, LAG= 1.26 HOURS, CP= .45 VOL= 1.00

12.	44.	89.	147.	196.	240.	269.	280.	269.	247.
228.	203.	191.	177.	163.	150.	138.	127.	117.	108.
99.	91.	84.	77.	71.	66.	60.	55.	51.	47.
43.	40.	37.	34.	31.	29.	26.	24.	22.	20.
19.	17.	16.	15.	14.	12.	11.	11.	10.	9.
8.	8.	7.	6.	6.	5.	5.	5.	4.	4.
4.	3.	3.	3.	3.	2.	2.	2.		

	RAIN	EXCS	LOSS	COMP Q
SUM	24.99	22.60	2.39	101560.
	(635.)(	574.)(	61.)(	2876.43)

SUBJECT DAM SAFETY INSPECTION
SUNRISE LAKE DAM
BY DJS DATE 7/6/81 PROJ. NO. 80-238-091
CHKD. BY DLB DATE 7-30-81 SHEET NO. 13 OF 22

Engineers • Geologists • Planners
Environmental Specialists
CONSULTANTS, INC

RESERVOIR INFLOW HYDROGRAPHS

0.20PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	614.	408.	138.	70.	20292.
CMS	17.	12.	4.	2.	575.
INCHES		3.16	4.29	4.37	4.37
MM		80.32	109.03	110.99	110.99
AC-FT		202.	275.	280.	280.
THOUS CU M		249.	339.	345.	345.

0.23PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	706.	469.	159.	81.	23336.
CMS	20.	13.	5.	2.	661.
INCHES		3.64	4.94	5.02	5.02
MM		92.36	125.39	127.63	127.63
AC-FT		233.	316.	321.	321.
THOUS CU M		287.	390.	396.	396.

0.26PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	796.	530.	180.	92.	26360.
CMS	23.	15.	5.	3.	747.
INCHES		4.11	5.58	5.68	5.68
MM		104.41	141.74	144.28	144.28
AC-FT		263.	357.	363.	363.
THOUS CU M		324.	440.	448.	448.

0.30PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	921.	612.	208.	106.	30438.
CMS	26.	17.	6.	3.	862.
INCHES		4.74	6.44	6.55	6.55
MM		120.47	163.55	166.48	166.48
AC-FT		303.	412.	419.	419.
THOUS CU M		374.	508.	517.	517.

0.50PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1534.	1020.	346.	176.	50730.
CMS	43.	29.	10.	5.	1437.
INCHES		7.91	10.73	10.92	10.92
MM		200.79	272.58	277.47	277.47
AC-FT		506.	686.	699.	699.
THOUS CU M		624.	847.	862.	862.

********** ********** ********** ********** **********

HYDROGRAPH ROUTING

ROUTE THROUGH RESERVOIR

ISTAO	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISTAGE	IAUTO
101	1	0	0	0	0	1	0	0

ROUTING DATA

GLOSS	CLOSS	AVG	IRES	ISAME	IOPT	IPMP	LSTR
0.0	0.000	0.00	1	1	0	0	0

NSTPS	NSTOL	LAG	AMSKK	X	ISK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1300.	-1

SUBJECT DAM SAFETY INSPECTION
SUNRISE LAKE DAM
BY JJS DATE 7-6-81 PROJ. NO. 80-228-091
CHKD. BY DLG DATE 7-30-81 SHEET NO. C OF D

CONSULTANTS, INC.
Engineers • Geologists • Planners
Environmental Specialists

STAGE	1305.50	1305.70	1306.00	1306.50	1307.00	1307.20	1307.50	1307.90	1308.60
	1309.00	1309.60	1310.00	1310.40	1311.00				
FLOW	0.00	10.00	20.00	60.00	80.00	80.00	100.00	120.00	220.00
	480.00	530.00	600.00	740.00	980.00				
CAPACITY	0.	92.	208.	108.	341.	485.	532.	626.	642.	723.
ELEVATION=	1300.	1302.	1304.	1306.	1306.	1308.	1309.	1310.	1310.	1311.

CREL	SPWID	COQW	EXPW	ELEVL	COQL	CAREA	EXPL
1305.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COQD	EXPD	DAMWID
1308.6	0.0	0.0	0.

CREST LENGTH	0.	80.	150.	210.	290.	350.	620.	680.	850.
AT OR BELOW ELEVATION	1308.6	1308.9	1309.1	1309.4	1309.6	1309.8	1310.2	1310.5	1311.0

RESERVOIR OUTFLOW HYDROGRAPHS

0.20 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	109.	108.	50.	25.	7360.
CMS	3.	3.	1.	1.	208.
INCHES		1.11	1.58	1.58	1.58
MM		29.08	39.68	40.15	40.15
AC-FT		73.	100.	101.	101.
THOUS CU M		90.	123.	125.	125.

0.23 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	208.	188.	82.	32.	9083.
CMS	6.	5.	2.	1.	257.
INCHES		1.40	1.93	1.96	1.96
MM		37.00	49.05	49.68	49.68
AC-FT		93.	124.	125.	125.
THOUS CU M		115.	152.	154.	154.

0.26 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	270.	233.	78.	36.	11034.
CMS	8.	7.	2.	1.	313.
INCHES		1.81	2.35	2.38	2.38
MM		45.90	59.67	60.37	60.37
AC-FT		116.	150.	152.	152.
THOUS CU M		143.	185.	188.	188.

0.30 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	388.	308.	98.	49.	14247.
CMS	11.	9.	3.	1.	403.
INCHES		2.39	3.04	3.07	3.07
MM		60.68	77.11	77.92	77.92
AC-FT		153.	194.	196.	196.
THOUS CU M		188.	240.	242.	242.

0.50 PMF

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1102.	757.	228.	115.	33102.
CMS	31.	21.	6.	3.	937.
INCHES		5.87	7.07	7.13	7.13
MM		149.03	179.70	181.05	181.05
AC-FT		375.	453.	456.	456.
THOUS CU M		463.	558.	562.	562.

SUBJECT DAM SAFETY INSPECTION
SUNRISE LAKE DAM
BY BJS DATE 7-6-81 PROJ. NO. 80-238-091
CHKD. BY DAB DATE 7-30-81 SHEET NO. 2 OF 2

CONSULTANTS, INC.
Engineers • Geologists • Planners
Environmental Specialists

********** ********** ********** ********** **********

PEAK FLOW AND STORAGE (END OF PERIOD) SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS
FLOWS IN CUBIC FEET PER SECOND (CUBIC METERS PER SECOND)
AREA IN SQUARE MILES (SQUARE KILOMETERS)

OPERATION	STATION	AREA	PLAN	RATIO 1 .20	RATIO 2 .23	RATIO 3 .26	RATIO 4 .30	RATIO 5 .50	
HYDROGRAPH AT	1	1.20	1	614.	706.	798.	921.	1534.	(INFLOW)
	(	3.11)	(	17,38)(	19,99)(	22,59)(	26,07)(	43,45)(	
ROUTED TO	101	1.20	1	164.	208.	270.	388.	1162.	(OUTFLOW)
	(	3.11)	(	4.65)(	5,90)(	7.64)(	11,00)(	32.89)(	

SUMMARY OF DAM SAFETY ANALYSIS

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	1305.50	1305.50	1308.00
STORAGE	308.	308.	532.
OUTFLOW	0.	0.	220.

RATIO OF PMF	MAXIMUM RESERVOIR W.S.ELEV	MAXIMUM DEPTH OVER DAM	MAXIMUM STORAGE AC-FT	MAXIMUM OUTFLOW CFS	DURATION OVER TOP HOURS	TIME OF MAX OUTFLOW HOURS	TIME OF FAILURE HOURS
.20	1308.21	0.00	501.	164.	0.00	45.00	0.00
.23	1308.52	0.00	520.	208.	0.00	44.67	0.00
.26	1308.80	.20	540.	270.	3.83	44.50	0.00
.30	1309.10	.50	561.	388.	5.83	44.00	0.00
.50	1309.85	1.25	630.	1162.	7.50	42.50	0.00

OVERTOPPING OCCURS @ >0.23PMF

LIST OF REFERENCES

1. "Recommended Guidelines for Safety Inspection of Dams," prepared by Department of the Army, Office of the Chief of Engineers, Washington, D. C. (Appendix D).

2. "Unit Hydrograph Concepts and Calculations," by the U. S. Army, Corps of Engineers, Baltimore District (L-519).

3. "Seasonal Variation of Probable Maximum Precipitation East of the 105th Meridian for Areas from 10 to 1,000 Square Miles and Durations of 6, 12, 24, and 48 Hours," Hydrometeorological Report No. 33, prepared by J. T. Reidel, J. F. Appleby and R. W. Schloemer, Hydrologic Service Division, Hydrometeorological Section, U. S. Army, Corps of Engineers, Washington, D. C., April 1956.

4. Design of Small Dams, U. S. Department of the Interior, Bureau of Reclamation, Washington, D. C., 1973.

5. Handbook of Hydraulics, H. W. King, and E. F. Brater, McGraw-Hill, Inc., New York, 1963.

6. Standard Handbook for Civil Engineers, F. S. Merritt, McGraw-Hill, Inc., New York, 1963.

7. Open-Channel Hydraulics, V. T. Chow, McGraw-Hill, Inc., New York, 1959.

8. Weir Experiments, Coefficients, and Formulas, R. E. Horton, Water Supply and Irrigation Paper No. 200, Department of the Interior, United States Geological Survey, Washington, D. C., 1907.

9. "Probable Maximum Precipitation, Susquehanna River Drainage Above Harrisburg, Pennsylvania," Hydrometerological Report No. 40, prepared by H. V. Goodyear and J. T. Riedel, Hydrometeorological Branch Office of Hydrology, U. S. Weather Bureau, U. S. Department of Commerce, Washington, D. C., May, 1965.

10. Flood Hydrograph Package (HEC- 1) Dam Safety Version, Hydrologic Engineering Center, U. S. Army, Corps of Engineers, Davis, California, July 1978.

11. "Simulation of Flow Through Broad Crest Navigation Dams with Radial Gates," R. W. Schmitt, U. S. Army, Corps of Engineers, Pittsburgh District.

12. "Hydraulics of Bridge Waterways," BPR, 1970, Discharge Coefficient Based on Criteria for Embankment Shaped Weirs, Figure 24, page 46.

13. Applied Hydraulics in Engineering, H. M. Morris and J. N. Wiggert, Virginia Polytechnic Institute and State University, 2nd Edition, The Ronald Press Company, New York, 1972.

14. Standard Mathematical Tables, 21st Edition, The Chemical Rubber Company, 1973, page 15.

15. Engineering Field Manual, U. S. Department of Agriculture, Soil Conservation Service, 2nd Edition, Washington, D. C., 1969.

16. Water Resources Engineering, R. K. Linsley and J. B. Franzini, McGraw-Hill, Inc., New York, 1972.

17. Engineering for Dams, Volume 2, W. P. Creager, J. D. Justin, J. Hinds, John Wiley & Sons, Inc., New York, 1964.

18. Roughness Characteristics of Natural Channels, H. H. Barnes, Jr., Geological Survey Water-Supply Paper 1849, Department of the Interior, United States Geological Survey, Arlington, Virginia, 1967.

19. "Hydraulic Charts for the Selection of Highway Culverts," Hydraulic Engineering Circular No. 5, Bureau of Public Roads, Washington, D. C., 1965.

APPENDIX E

FIGURES

LIST OF FIGURES

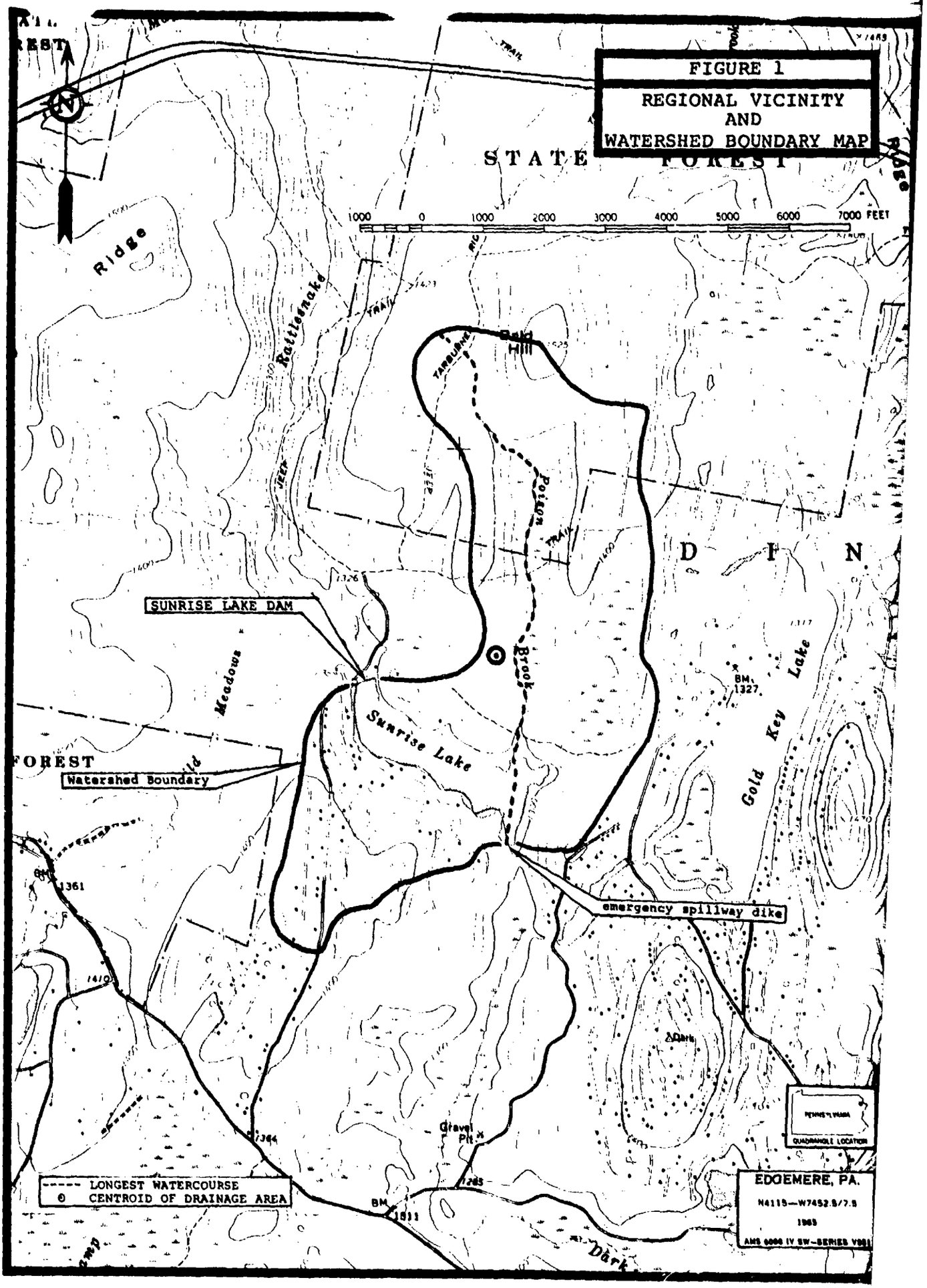
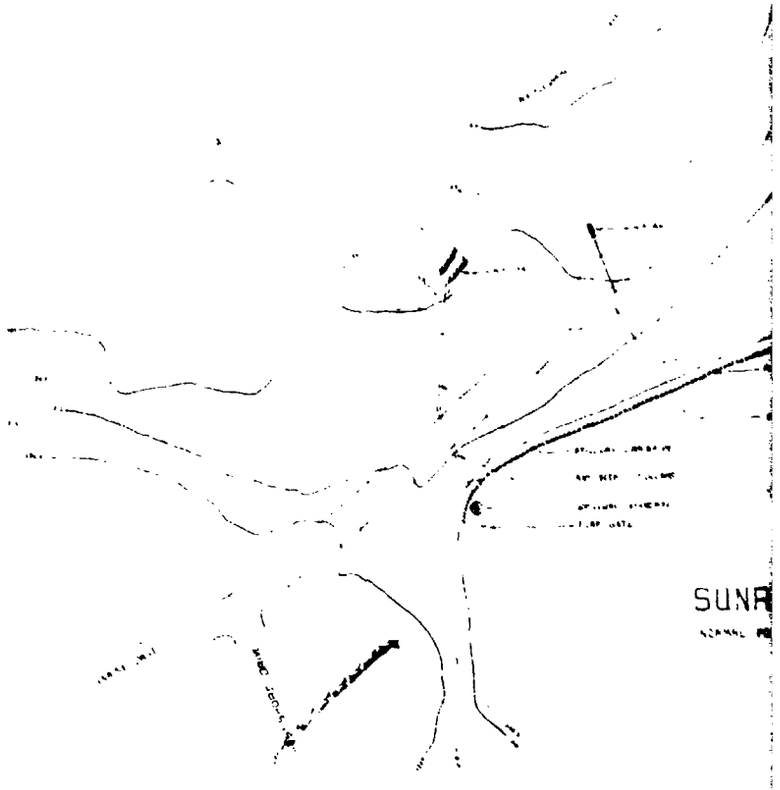


FIGURE 1
REGIONAL VICINITY
AND
WATERSHED BOUNDARY MAP
STATE FOREST
1000 0 1000 2000 3000 4000 5000 6000 7000 FEET
Ridge
Rattlesnake
TRAIL
JEEP
Bald Hill
TARBURNER
Poison
TRAIL
SUNRISE LAKE DAM
Meadows
Brook
Sunrise Lake
Gold Key Lake
BM 1327
FOREST
Watershed Boundary
BM 1361
emergency spillway dike
Gravel Pit
BM 1311
Dark
PENNSYLVANIA
QUADRANGLE LOCATION
EDGEMERE, PA.
N4115—W7452.5/7.5
1969
AMS 6066 IV SW—SERIES V881
----- LONGEST WATERCOURSE
⊙ CENTROID OF DRAINAGE AREA


SUNR

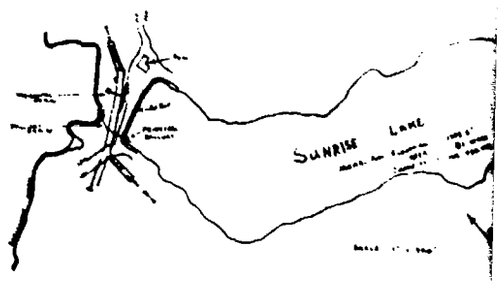
SUNRISE LAKE

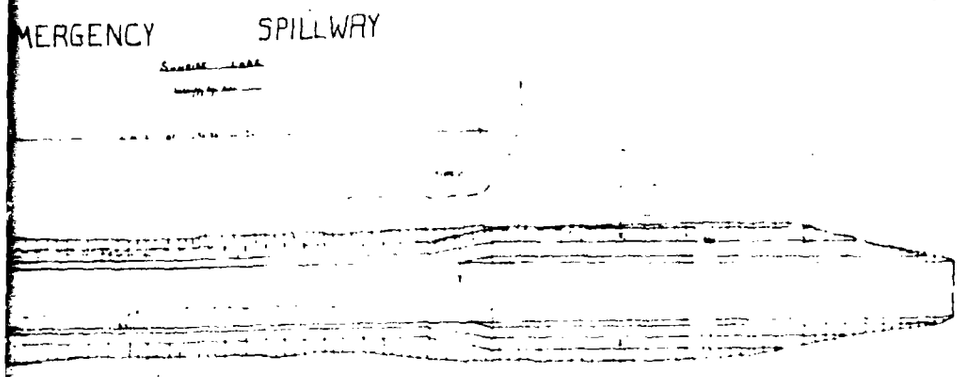
SUNRISE LAKE
PRINCIPAL SPILLWAY
GENERAL PLAN

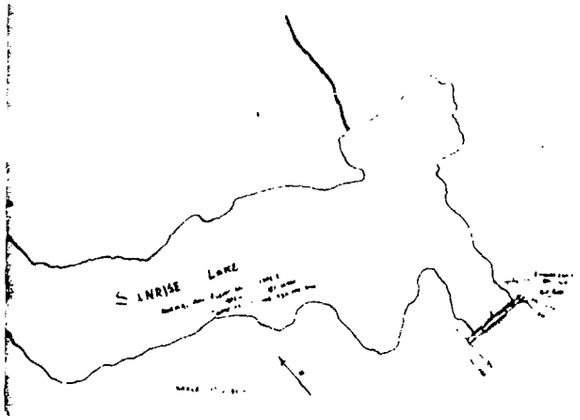
GAI CONSULTANTS, INC.

FIGURE 2

EMERGENCY SPIL



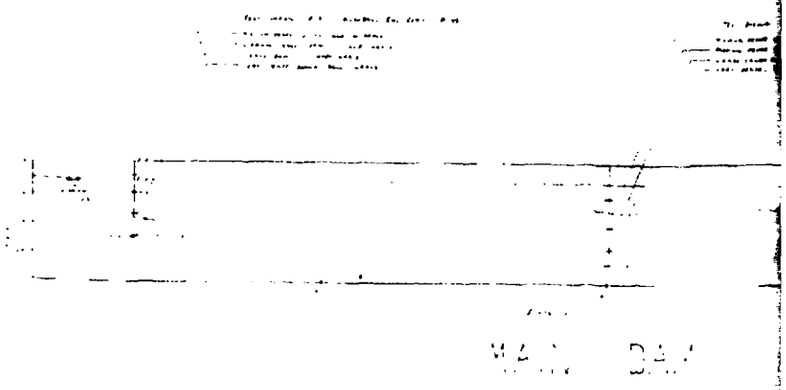




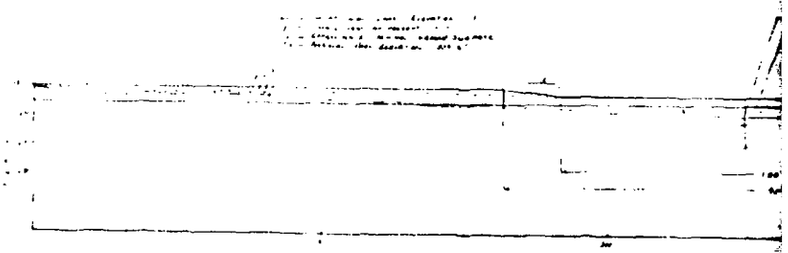
SUNRISE LAKE
GENERAL PLAN

GAI CONSULTANTS, INC.

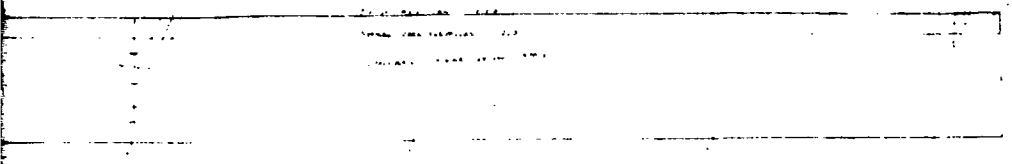
FIGURE 3



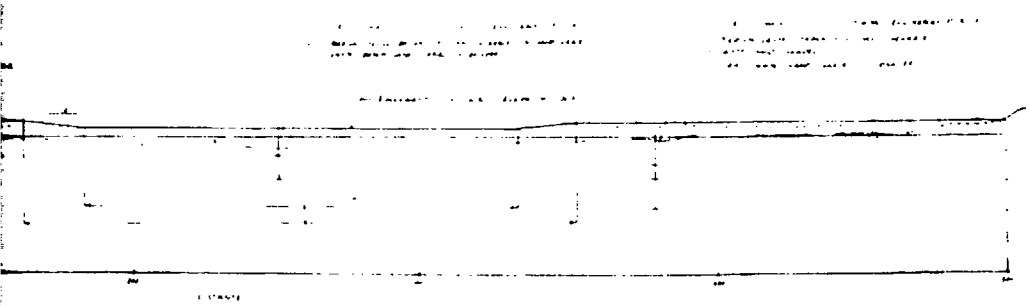
MAIN DAM



SMALL DAM



MAIN DAM

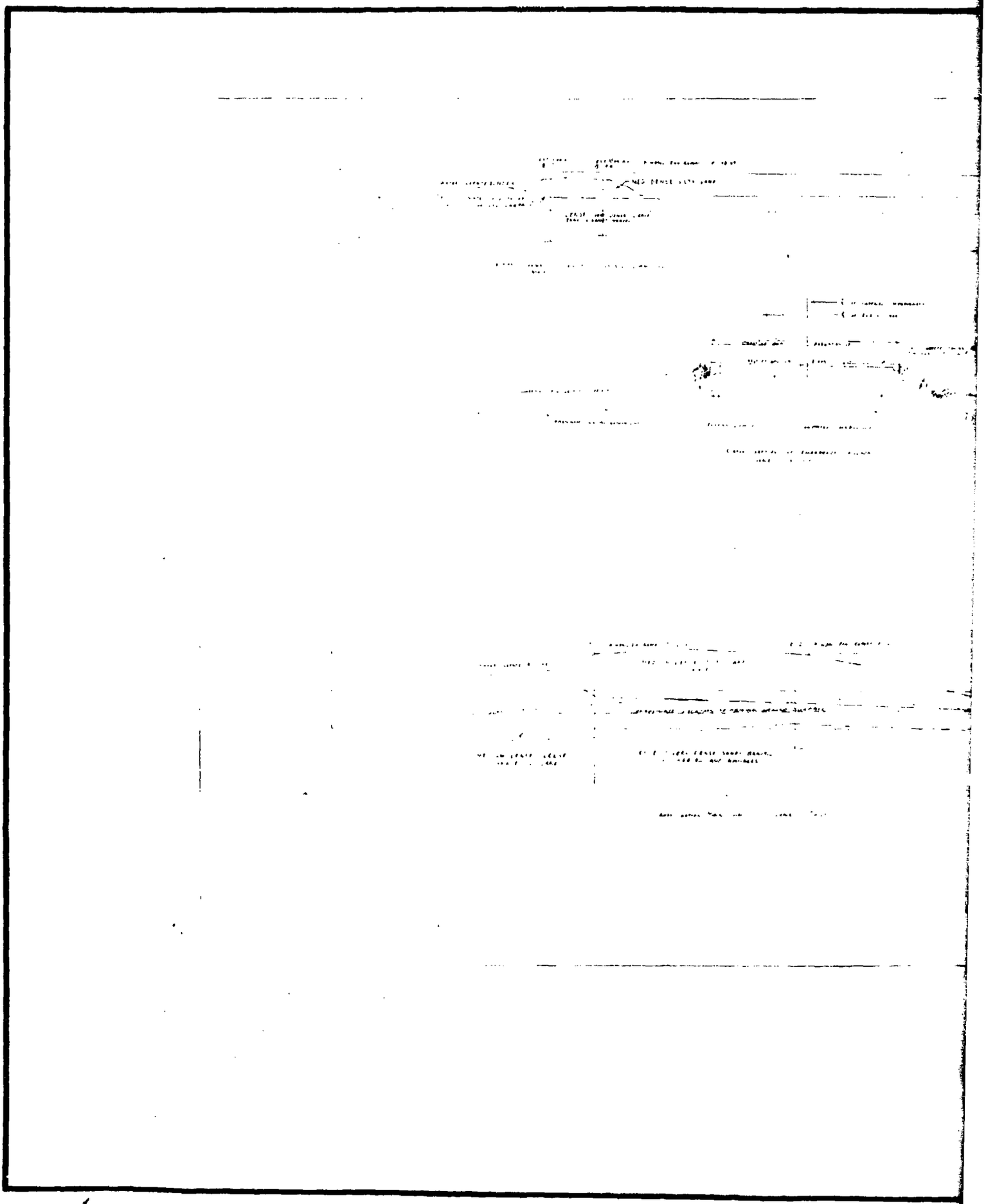


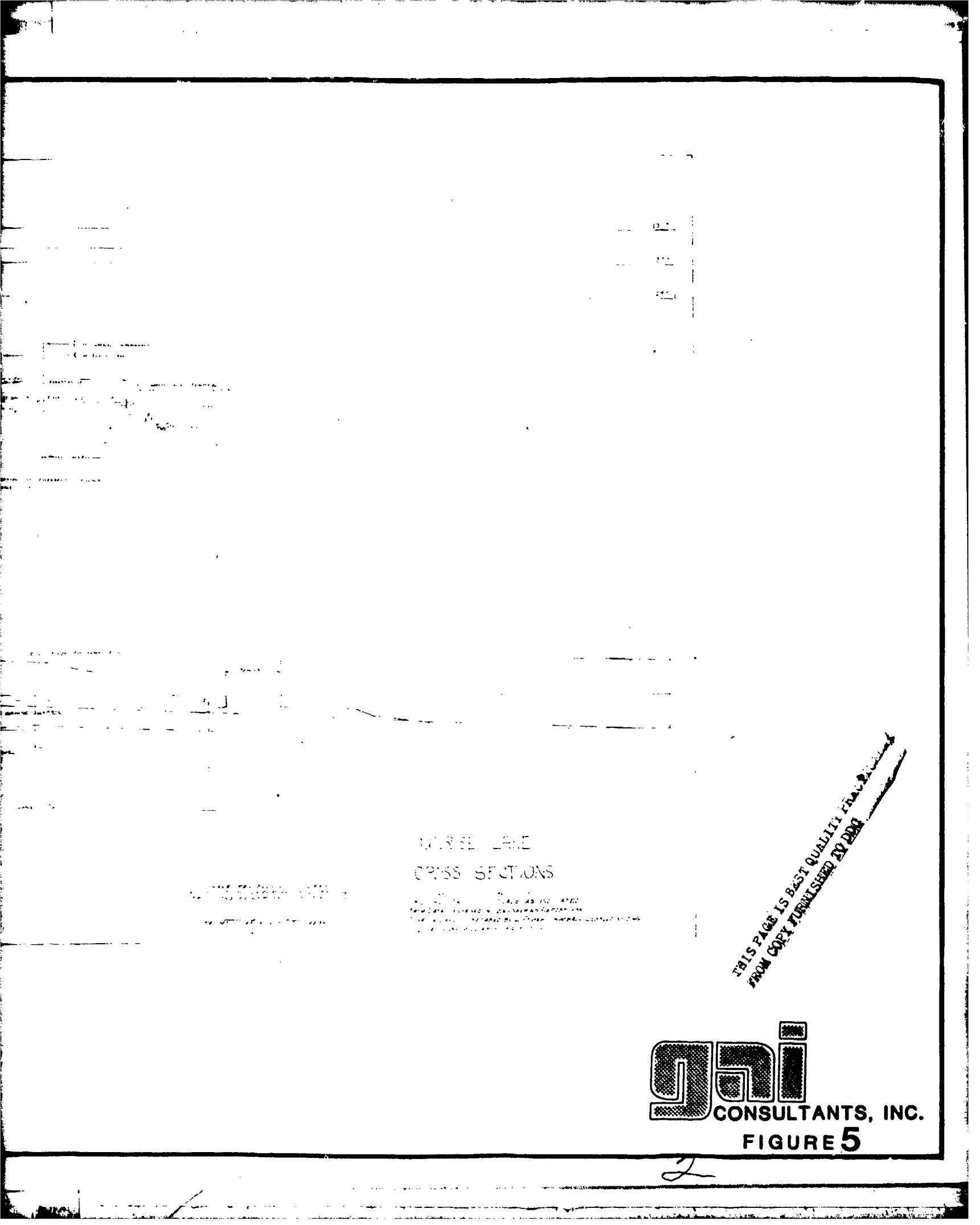
SMALL DAM

SUNRISE LAKE
LONGITUDINAL SECTIONS

GAI CONSULTANTS, INC.

FIGURE 4





CROSS SECTIONS

GAI CONSULTANTS, INC.

FIGURE 5

APPENDIX F

GEOLOGY

Geology

Sunrise Lake Dam is located in the glaciated Low Plateaus section of the Appalachian Plateaus physiographic province of eastern Pennsylvania. In this area, the Appalachian Plateaus province is characterized topographically by flat-topped, hummocky hills formed as a result of glaciation and subsequent stream dissection of nearly flat-lying strata. The Devonian age sedimentary rock strata in Pike County regionally strike N35°E and dip gently to the northwest. The Delaware River is the major drainage basin in the area. Major tributary streams intersect the Delaware River at right angles; whereas, smaller streams display a slightly more random tributary pattern. Both major and minor tributary stream systems are joint controlled and exhibit modified rectangular and trellis-type drainage patterns.

Structurally, the area containing Pike County lies on the south flank of a broad, asymmetrical synclinorium that plunges to the southwest. Superimposed on this broad structural basin are numerous anticlinal and synclinal folds characterized by planar limbs and narrow hinges. Due to prior glaciation, low relief and surficial soil cover, fold axes are difficult to trace.

The sedimentary rock sequences in the vicinity of the dam and reservoir are probably [illegible] of the Susquehanna Group of Upper Devonian age (see Geology [illegible]). The sedimentological changes observed in the Catskill Formation indicate that the rate of sedimentation exceeded the rate of basin subsidence resulting in a facies change from marine to non-marine strata. On the accompanying geology map the delineation between the Middle and Upper Devonian age sedimentary rock sequences represents the Allegheny Front which separates the Valley and Ridge physiographic province from the Appalachian Plateaus physiographic province.

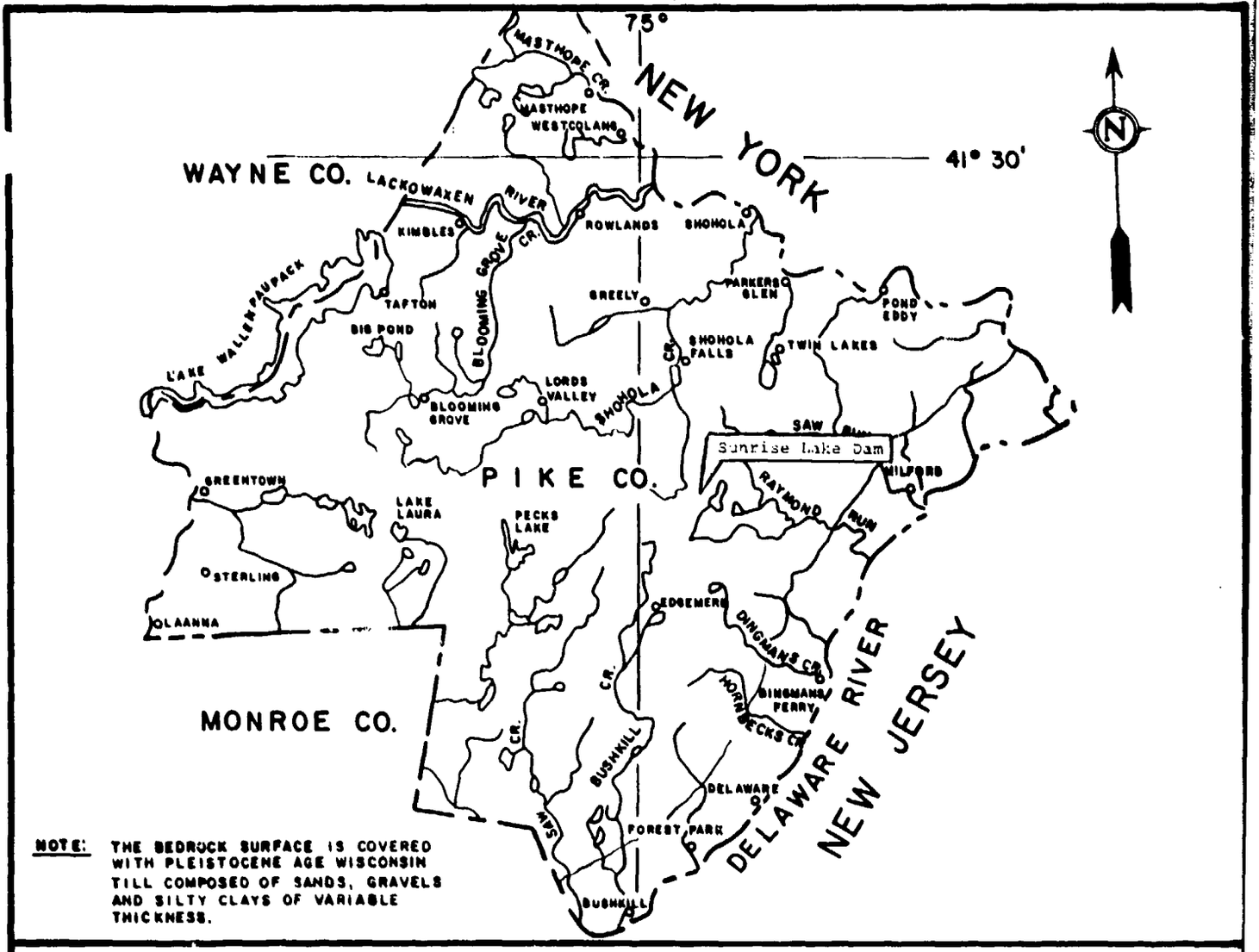
Approximately half of Pike County, including the dam site, is covered by a blanket of Wisconsin age (most recent) glacial drift which, based on the degree of weathering, was probably deposited during the Woodfordian stage. Valley bottoms are typically covered by recent alluvium and Woodfordian outwash of variable thickness, but typically less than 10 feet. These deposits are characteristically unconsolidated stratified sand and gravel, usually with more gravel than sand and some small boulders. The direction of the Wisconsin ice advance was from the northeast over the Catskill Mountains and from the north over the Appalachian Plateau. The terminal moraine resulting from the southern most advance of the Wisconsin ice sheet in this area is located in the southern portion of Monroe County which borders Pike County to the South.

References:

1. Fletcher, F. W., Woodrow, D. L., "Geology and Economic Resources of the Pennsylvania Portion of the Milford and Port Jervis 15 minute U.S.G.S. Topographic Quadrangles," Pennsylvania Geological Survey, Fourth Series, Harrisburg, Atlas 223, 1970.

2. Sevon, W. D., Berg, T. M., "Geology and Mineral Resources of the Skytop Quadrangle, Monroe and Pike Counties, Pennsylvania", Pennsylvania Geological Survey, Fourth Series, Harrisburg, Atlas 214A., 1978.

3. Sevon, W., Personal Communication, Commonwealth of Pennsylvania Department of Environmental Resources, Harrisburg, December 3, 1980.



NOTE: THE BEDROCK SURFACE IS COVERED WITH PLEISTOCENE AGE WISCONSIN TILL COMPOSED OF SANDS, GRAVELS AND SILTY CLAYS OF VARIABLE THICKNESS.

LEGEND

UPPER DEVONIAN

SUSQUEHANNA GROUP

Catskill Formation - *Shohola Member interbedded 5- to 25-foot thick units of greenish-gray and grayish-red very fine to medium-grained sandstone and sandy shale and lesser medium-gray to medium-dark-gray sandstone and shale. Sandstones are predominantly low-rank graywackes. Beds are thin to very thick and most have simple or planar sets of small- to medium-scale, generally low-angle cross stratification. Contacts with shale units are abruptly disconformable to gradational. Sandstones are poorly cleaved. Shale is thinly laminated and well cleaved. Mud cracks, c. asblute bedding, and sole marks are present near contacts with sandstone units. Member is more than 2,000 feet thick. Lower contact is gradational and is placed at top of highest red bed of the underlying Analomink. Analomink Red Shale Member, medium-grayish red silty, micaceous, finely laminated well-cleaved shale containing thin beds of brownish-gray sandy siltstone and silty very fine grained sandstone. Unit is the "first red" going up section in Upper Devonian sequence. member is about 100 feet thick. Lower contact is gradational and is placed at the base of lowest red bed. Lauare River Flags Member, grayish-green, micaceous, laminated sandstone and lesser interbedded sandy shale. Beds range from a few inches to as much as 4 feet thick. Sandstones are low-rank graywackes and contain no marine fossils. Member is about 300 feet thick. Lower contact is gradational.*

MIDDLE DEVONIAN

HAMILTON GROUP

Mahantango Formation - *Upper member medium-dark-gray, fairly coarse grained, thin-bedded siltstone and silty shale; member is about 700 feet thick and is separated from lower member by the "Centerfield Reef," a calcareous siltstone limestone containing abundant horn corals. The Centerfield is about 35 feet thick, lower member, virtually same lithology as upper member. Unit is about 1,100 feet thick. Lower contact is gradational.*

Marcellus Shale - *Dark-gray, evenly laminated, silty clay shale and clayey silt shale. Unit commonly contains very hard limy concretions and is well cleaved; bedding is generally obscured. Member is about 75-feet thick. Lower contact is gradational.*

SCALE

0 6 12 18 MILES

REFERENCE:

GEOLOGIC MAP OF NORTHEASTERN PENNSYLVANIA COMPILED BY GEO. W. STOSE AND O.A. LJUNGSTEDT COMMONWEALTH OF PENNSYLVANIA DEPT. OF INTERNAL AFFAIRS DATED 1932, SCALE 1" = [illegible]

GEOLOGY MAP

gai CONSULTANTS, INC.