

O'BRIEN AND GERE ENGINEERS INC PHILADELPHIA PA F/G 13/13
NATIONAL DAM INSPECTION PROGRAM. SILVER LAKE DAM (NDI ID PA 007--ETC(U)
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DELAWARE RIVER BASIN
VAN HORN CREEK
PENNSYLVANIA

NDI ID PA 00791

PA DER 9-78

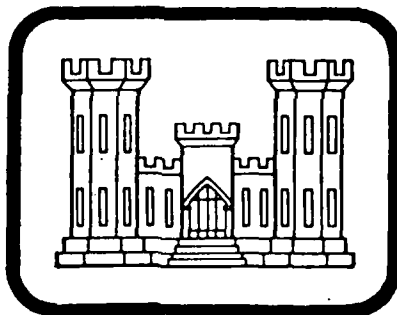
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SILVER LAKE DAM

OWNED BY

MAKEFIELD LAKE RECREATION ASSOCIATION

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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

BY



O'BRIEN & GERE

PHILADELPHIA, PENNSYLVANIA
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National Dam Inspection Program. Silver Lake Dam (NDI ID PA 00791, PA DER 9-78), Delaware River Basin, Van Horn Creek, Pennsylvania. Phase I Inspection Report,

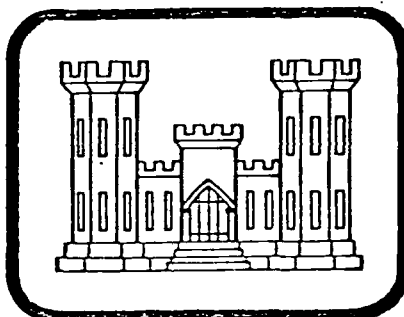
DELAWARE RIVER BASIN

SILVER LAKE DAM (YARDLEY)
PENNSYLVANIA

NDI ID PA 00791

OWNED BY
MAKEFIELD LAKE RECREATION ASSOCIATION, INC.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



Prepared for:

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

Prepared by:

O'BRIEN & GERE ENGINEERS, INC.
1617 JF Kennedy Boulevard - Suite 1760
Philadelphia, Pennsylvania 19103

Contract *12* **DACW31-81-C-0016** ✓

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PREFACE

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

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

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

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the spillway design flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The spillway design flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

Name of Dam:	Silver Lake Dam
State Located:	Pennsylvania
County Located:	Bucks
Stream:	Van Horn Creek
Coordinates:	Latitude 40°13.9', Longitude 74°50'
Date of Inspection:	December 17, 1980

ASSESSMENT

Silver Lake Dam is an earth embankment about 350 feet long and 15 feet high at its maximum section. An ungated overflow masonry spillway is located at the approximate midpoint of the embankment. The dam and impoundment are currently owned by the Makefield Lake Recreation Association. The impoundment is used solely for recreational purposes.

Silver Lake Dam has a maximum storage capacity of 51 acre feet and a maximum height of 15 feet. The dam is therefore classified as "Small" size structure. Because of the potential for the possible loss of a few lives and appreciable property losses in the damage area, located about 0.6 miles downstream, the dam is considered to be a "Significant" hazard structure.

The selected Spillway Design Flood (SDF) for Silver Lake Dam ("Small size, "Significant" hazard) is the one hundred year storm. An examination of the hydrologic and hydraulic analyses indicates that the spillway is not capable of passing the SDF without the dam being overtopped. The spillway is classified as "Inadequate."

Based on visual observations and a review of the information obtained from the Pennsylvania Department of Environmental Resources, Silver Lake Dam appears to be in fair condition.

Recommendations and Remedial Measures

The Owner should retain the services of a licensed engineer experienced in the design and construction of dams to assist in complying with the recommendations and remedial measures.

a. Facilities

1. The spillway capacity should be increased.
2. The embankment should be cleared of all trees and brush and any resulting voids should be backfilled with suitable compacted material. Any damage to the retaining wall during the removal of the trees should be repaired immediately. A grass cover should be established and maintained on the slopes and crest of the dam.

SILVER LAKE DAM
NDI ID NO PA 00791

3. The eroded areas on the upstream face of the dam should be filled with suitable material, regraded and compacted. Riprap should be placed on the upstream face to protect the embankment from wave action.

4. The reservoir drain system should be inspected and made operational. Provisions should be made for emergency closure of the drain at the intake.

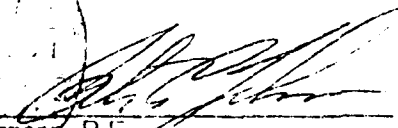
5. An investigation should be made to assess the sources and extent of the seepage observed near the right spillway sidewall. Seepage should be monitored if judged necessary.

b. Operation and Maintenance

1. A formal maintenance and inspection program should be developed and implemented to insure that the dam and appurtenances are maintained on a regularly scheduled basis. Maintenance performed should be recorded to provide a history of corrected deficiencies.

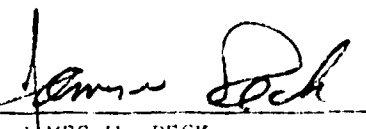
2. A downstream warning system should be developed. During periods of heavy rainfall, the dam should be monitored and appropriate agencies should be alerted in the event of an impending failure.

O'BRIEN & GERE ENGINEERS, INC.


Peter C. Johnson, P.E.
Senior Vice President
Pennsylvania Registration No. PE-02246-E

Date: 29 Apr 81

Approved by:


JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

Date: 22 MAY 81



UPSTREAM OVERVIEW OF SILVER LAKE DAM FROM THE LEFT
ABUTMENT. (12/17/80)



DOWNSTREAM OVERVIEW OF SILVER LAKE DAM FROM THE LEFT
ABUTMENT (12/17/80)

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PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM
SILVER LAKE DAM
NATIONAL ID NO PA00791
DER # 9-78

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 this inspection is to determine if Silver Lake Dam constitutes a hazard to human life or property.

1.2 Description of Project (Based on information obtained from the Pennsylvania Department of Environmental Resources (DER), Division of Dam Safety, Harrisburg, Pennsylvania, and from the field inspection).

a. Dam and Appurtenances. Silver Lake Dam is an earth embankment approximately 350 feet long with a maximum height of about 15 feet. An ungated overflow spillway approximately 45 feet long is located near the midpoint of the embankment. The dam, which is located at the northern end of the impoundment, has a crest width of approximately 15 feet. The upstream face of the dam is constructed on a slope of about 1H:1V. The downstream face of the dam, between the left abutment and the spillway, is relatively flat with the average slope being about 8H:1V. The downstream embankment face, from the spillway to within about 50 feet of the right abutment, is retained by a stone masonry wall about 100 feet long. The remainder of the downstream embankment face to the right abutment is on a gradual slope averaging about 8H:1V.

The spillway is a stone masonry structure; however, the upstream face, overflow weir and discharge channel are capped with concrete. A steel grating walkway is constructed over the spillway. A concrete gate chamber structure is located immediately to the left of the spillway. The concrete gate chamber has a metal grating positioned over an opening in its top. The interior of the gate chamber structure is divided into two sections by a wall. A gate operating stem extends above the grating at the location of the wall. A 24-inch diameter concrete discharge pipe outlets from the downstream face of the gate chamber structure.

A shallow 10-foot wide concrete lined overflow waterway about 0.5 feet deep is located immediately to the left of the concrete gate chamber structure. The waterway extends from the impoundment, across the crest, along the downstream face and terminates at the toe of the dam. The length of the waterway extending along the downstream face of the embankment is lined with grouted riprap, while the portion of the waterway across the crest of the dam is lined with concrete.

b. Location. Silver Lake Dam is located on Van Horn Creek in Makefield Township, Bucks County, Pennsylvania. The dam and impoundment are shown on the USGS Quadrangle sheet entitled "Trenton West PA-NJ" at coordinates N 40°13.9', W 74°50' approximately one mile south of Yardley, Pennsylvania. A regional location map for Silver Lake Dam is included as Figure 1, Appendix E of this report.

c. Size Classification. Silver Lake Dam is about 15 feet high and has a maximum storage capacity of 51 acre-feet. The dam is therefore classified as "Small". (height less than 40 feet, storage less than 1000 acre feet)

d. Hazard Classification

Three inhabited houses are located in close proximity to Van Horn Creek about 3,500 feet downstream of Silver Lake Dam. The floor elevation of the lowest house is approximately five feet above the streambed. Because of the potential for the possible loss of a few lives and appreciable property damage in the hazard area, Silver Lake Dam is classified as "Significant" hazard structure.

e. Ownership. The dam is owned by the Makefield Lake Recreation Association, Inc. All correspondence should be directed to: Dr. Dennis Tarr, President, Makefield Lake Recreation Association Inc., 14 Harvey Avenue, Yardley, Pennsylvania (Business Phone Number: 215-787-1501).

f. Purpose of Dam. The dam was originally constructed for ice harvesting and to supply water to the nearby Reading Railroad. The dam is currently used for recreational purposes only.

g. Design and Construction History. No documented information relative to the design or construction history of Silver Lake Dam is available. Based on a review of available correspondence, the dam was constructed prior to 1919. An inspection of the structure was made by the Commonwealth of Pennsylvania, Department of Forest and Waters, at that time. The structure was reported to be in poor condition.

Inspections were also made in 1965 and 1967. The spillway section was judged to be in poor condition at the time of the 1965 inspection. Masonry stones were reported to be dislodged in both the abutments and the downstream face of the spillway. These deficiencies were apparently repaired by the Owner. A review of the findings of the 1967 inspection indicated that the spillway crest had been resurfaced, new wingwalls had been placed along the spillway and a new reservoir drain outlet had been placed next to the left abutment of the spillway.

According to a local resident, the spillway section failed approximately five years ago. No documented information to confirm this report is available; however, based on a review of photographs, it appears that the overflow waterway located immediately to the left of the gate chamber structure was constructed after 1967. The inspection team was also informed that the dam was built in 1901 to provide water for the Reading Railroad.

h. Normal Operating Procedures. No restraint to flow over the spillway exists. No information relative to operation of the reservoir drain is available.

1.3 Pertinent Data

a.	<u>Drainage Area</u> (Square Miles).	1.30
b.	<u>Discharge at Dam Site</u> (cfs).	
	Maximum Spillway Capacity at Low Point Top of Dam	200
c.	<u>Elevations</u> (Feet above MSL, estimated from USGS quad).	
	Top of Dam (Low Point of Top of Dam)	79.3
	Spillway Crest	78.0
	Normal Pool	78.0
	Invert of Overflow Waterway	78.8
	Streambed at Downstream Toe	+64.0
d.	<u>Reservoir Length</u> (Feet).	
	Normal Pool	1,300
	Top of Dam	1,700
e.	<u>Reservoir Storage</u> (Acre-Feet).	
	Normal Pool	38
	Top of Dam	51
f.	<u>Reservoir Surface Area</u> (Acres)	
	Normal Pool	8.8
	Top of Dam	11.4
g.	<u>Dam Data.</u>	
	Type	Earth
	Length	350 Feet
	Height (above streambed)	15.3 Feet
	Crest Width	15 Feet
	Freeboard at Normal Pool (To Low Point Top of Dam)	1.3 Feet
	Volume of Fill	7,800 Cubic Yards
	Side Slopes Upstream	1H:1V
	Downstream	8H:1V & Vertical Stone Masonry Wall
	Cut-off	No Information Available
	Foundation Treatment	No Information Available

h. Spillway.

Type	Ungated rockfill with concrete cap
Length	45 Feet
Height (from Crest to Apron)	10 Feet
Discharge Channel	Discharge over the Spillway enters a small pond (less than 2 acres) located immediately downstream.

i. Outlet.

Type	24-inch diameter concrete pipe
Control	24-inch diameter gate
Location	Immediately left of the spillway

SECTION 2
ENGINEERING DATA

2.1 Design

a. Data Available. No information relative to the design of Silver lake Dam is available. Information provided by Pennsylvania DER is limited to a correspondence file which contains no design data.

b. Design Features. A description of the design features is included in Section 1.2a, and a summary of the pertinent features is included in Section 1.3. Sketches of the structure developed from observations and measurements made during the field inspection are included in Appendix E.

2.2 Construction

No information relative to the construction of Silver Lake Dam is available. No records of completed repairs or modifications are available.

2.3 Operational Data

No information relative to operational data for Silver Lake Dam is available. No known reservoir stage or rainfall records are maintained.

2.4 Evaluation

a. Availability. Information was obtained from the files of the Department of Environmental Resources (DER), Harrisburg, Pennsylvania. The Owner's representative was unavailable for discussions.

b. Adequacy. The information made available by the Pennsylvania DER and observations made during the field inspection provided adequate data for a Phase I evaluation.

c. Validity. The available information from the above sources appears to be valid.

SECTION 3

VISUAL INSPECTION

3.1 Findings

a. General. The observations and comments of the field inspection team are presented in Appendix A of this report. At the time of the inspection, the water surface was approximately 0.1 feet above the spillway crest. No underwater portions of the structure were inspected. The overall appearance of the structure is fair.

b. Dam. The alignment of the upstream face of the dam is poor. Portions of the upstream face have been eroded and are nearly vertical. No protection, riprap or vegetative, is evident along the length of the upstream face of the embankment.

The crest of the embankment is approximately 15 feet wide. Trees with trunks up to 2 feet in diameter and 40 feet high are located along the entire length of the embankment.

A survey of the embankment crest was made by the inspection team. The maximum differential in elevation along the crest length is approximately 1.3 feet. The spillway sidewalls are the low points along the dam crest.

The slope of the downstream face of the dam is variable. On the left side of the spillway, the embankment slope is about 8H:1V. To the right of the spillway, a stone masonry wall about 100 feet long retains the embankment. The embankment slope to the right of the stone masonry wall to the right abutment is about 8H:1V. The alignment of the downstream face of the dam appears to be uniform. No evidence of slope instability was noted.

The downstream masonry retaining wall to the right of the spillway appears to be in fair condition. However, a number of large trees are located in the embankment immediately upstream of the wall.

Seepage estimated at less than 1 gpm was noted downstream of the wall about 10 feet from the right spillway sidewall. The flow appeared to be clear and no deposits of fines were noted in this area. Large trees are also located on the downstream face of the embankment.

c. Appurtenant Structures. The spillway structure appears to be in good condition. No misalignment was evident in the structure. The exposed concrete surfaces are in good condition. The masonry sidewalls are constructed with relatively large stones. No evidence of joint material deterioration was noted. No seepage through the structure was noted.

The gate chamber structure located immediately to the left of the spillway appears to be in good condition. No spalling or scaling of the concrete was noted. No seepage around the base of the structure was detected.

The overflow waterway is located immediately to the left of the gate chamber structure. The portion of this waterway constructed on the embankment crest is lined with concrete, while the portion constructed on the downstream face of the embankment is lined with grouted riprap. The structure appears to be in good condition. No cracking, settlement or displacement was noted in the concrete or grouted riprap linings.

d. Reservoir. The slopes adjacent to the reservoir are gentle, averaging about 5 percent, and appear to be stable. The perimeter of the reservoir is grass covered. Sedimentation of the impoundment has become a problem in recent years as a result of extensive residential construction activities in the watershed.

e. Downstream Channel.

Discharge from Silver Lake Dam enters a 2 acre impoundment immediately downstream. This impoundment is formed by a small dam located about 550 feet downstream of Silver Lake Dam. A number of homes are located around the lower impoundment. The homes appear to be constructed above the crest elevation of Silver Lake Dam.

Downstream of the lower impoundment Van Horn Creek flows about 3,500 feet to its confluence with the Delaware Canal. The creek varies in width from about 10 to 20 feet, side slopes average about 2H:1V and the invert gradient is about 0.7 percent.

3.2 Evaluation

Based on visual observations, the dam and appurtenances appear to be in fair condition; however, continued erosion of the embankment and the lack of a maintenance program to control vegetative growth, especially the large trees on the embankment, could lead to serious consequences. The trees immediately adjacent to the stone masonry wall could affect the integrity of the wall.

SECTION 4
OPERATIONAL PROCEDURES

4.1 Procedures

Under normal operating procedures, water is discharged over the spillway. It is not known if the reservoir drain system is operational.

4.2 Maintenance of the Dam

No evidence exists of a maintenance program for operating facilities.

4.4 Description of any Warning Systems in Effect

It is not known if a formal warning system or procedures are established for monitoring the structure during periods of heavy rainfall or in the event of impending dam failure.

4.5 Evaluation

A formal maintenance program for the dam and appurtenances should be developed and implemented. Records of all maintenance performed should be maintained by the Owner.

Periodic inspection of the dam and appurtenances should be made by a qualified engineer. The control valve for the reservoir drain should be operated for this inspection. Maintenance records should also be reviewed by the engineer.

The dam should be monitored during periods of heavy rainfall and a system for warning downstream residents should be developed. If the integrity of the structure is threatened, local authorities should be notified.

SECTION 5

HYDROLOGY AND HYDRAULICS

5.1 Evaluation of Features

- a. Design Data. No data relative to the design of the dam are available.

The watershed has a maximum width of about 1.3 miles and a maximum length of about 1.3 miles. Elevations range from a maximum of about 185 to normal pool Elevation 78. The drainage basin of approximately 1.3 square miles in area is heavily developed with residential and commercial properties.

- b. Experience Data. It is not known if rainfall or reservoir stage records are maintained. During the course of the inspection, no evidence that the embankment had ever been overtopped was apparent.

- c. Visual Observations. At the time of the inspection, the spillway entrance channel was free of debris. Because of the limited freeboard between the spillway crest and the foot bridge over the spillway, debris could collect on the spillway and reduce its capacity.

- d. Overtopping Potential. Silver Lake Dam is classified as a "Small" size, "Significant" hazard dam. Accordingly, the Spillway Design Flood (SDF) ranges from the one hundred year flood to fifty percent of the PMF. Because of the size of the dam ("Small"), the one hundred year flood was selected as the appropriate SDF. Hydrologic analysis shows that the spillway is incapable of passing the 100 year flood.

- e. Spillway Adequacy. The spillway is classified as "Inadequate" since it is not capable of passing SDF.

SECTION 6
STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

a. Visual Observation. The overall structural appearance of the dam at the time of inspection was fair. The eroded upstream slopes and the presence of large trees on the embankment could develop into serious conditions relative to the embankment. The seepage (1 gpm) noted at the toe of the embankment near the right side of the spillway should be monitored. Based on observations made during visual inspection, the dam appears to be structurally stable.

b. Design and Construction Data. No design or construction data are available.

c. Operating Records. No operating records were made available.

d. Post-Construction Changes. No records of post-construction changes were made available. However, it is evident that recent repairs have been made to the spillway structure. Also, based on a review of available photographs, it appears that the gate chamber and overflow waterway were constructed since 1966.

e. Seismic Stability. Silver Lake Dam is located in Seismic Zone 1 as shown on the Seismic Zone Map of Contiguous States. A dam located in Seismic Zone 1 is considered to be structurally adequate for Zone 1 earthquake loading if it is structurally adequate for static loading.

SECTION 7

ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

a. Evaluation. Based on visual observations, the dam and appurtenances appear to be in fair condition. However, the large trees which are growing on the embankment and the eroded portions of the upstream face could develop into serious conditions relative to the embankment.

The seepage observed near the right spillway sidewall appeared to be clear at the time of the inspection. The quantity of seepage was estimated to be less than 1 gpm.

The reservoir drain valve was not exercised during the inspection. It is not known if the drain system is operational.

The SDF for Silver Lake Dam is the one hundred year flood. The spillway is classified as "Inadequate", since it is not capable of passing the one hundred year flood.

b. Adequacy. The information made available by the Pennsylvania DER and observations made during the field investigation provided adequate data for a Phase I evaluation.

c. Urgency. The recommendations and remedial measures outlined in Section 7.2 should be effected immediately.

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

7.2 Recommendations and Remedial Measures

The Owner should retain the services of a licensed engineer experienced in the design and construction of dams to assist in complying with the recommendations and remedial measures.

a. Facilities

1. The spillway capacity should be increased.

2. The embankment should be cleared of all trees and brush and any resulting voids should be backfilled with suitable compacted material. Any damage to the retaining wall during the removal of the trees should be repaired immediately. A grass cover should be established and maintained on the slopes and crest of the dam.

3. The eroded areas on the upstream face of the dam should be filled with suitable material, regraded and compacted. Riprap should be placed on the upstream face to protect the embankment from wave action.

4. The reservoir drain system should be inspected and made operational. Provisions should be made for emergency closure of the drain at the intake.

5. An investigation should be made to assess the sources and extent of the seepage observed near the right spillway sidewall. Seepage should be monitored if judged necessary.

b. Operation and Maintenance

1. A formal maintenance and inspection program should be developed and implemented to insure that the dam and appurtenances are maintained on a regularly scheduled basis. Maintenance performed should be recorded to provide a history of corrected deficiencies.

2. A downstream warning system should be developed. During periods of heavy rainfall, the dam should be monitored and appropriate agencies should be alerted in the event of an impending failure.

APPENDIX A
CHECKLIST
VISUAL INSPECTION

CHECK LIST
VISUAL INSPECTION
PHASE I

Sheet 1 of 11

Name Dam Silver Lake Dam (Yardley) County Bucks State Pennsylvania National
Type of Dam Earth and Masonry Hazard Category Significant NDI PA 00791
Date(s) Inspection 12/17/80 Weather Cloudy/Cold Temperature 30°F

Pool Elevation at Time of Inspection ±78 M.S.L. Tailwater at Time of Inspection ±65 M.S.L.

Inspection Personnel:

<u>Lee DeHeer</u>	<u>Leonard Beck</u>	<u>Steven Snider</u>
<u>Jon Rauschkolb</u>	<u>Richard Beck</u>	
	<u>Lee DeHeer</u>	<u>Recorder</u>

Remarks:

Dr. Dennis Tarr, President, Makefield Lake Recreation Association, was not able
to accompany us during the inspection.

CONCRETE/MASONRY DAMS

Sheet 2 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE		
	Less than 1 gpm observed next to right sidewall of spillway.	Sources of the seepage should be investigated and monitored if judged necessary.
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Appears satisfactory	
DRAINS	None observed.	
WATER PASSAGES	18-inch diameter reservoir drain pipe and gate valve built into a concrete structure left of the left spillway sidewall in 1967.	
FOUNDATION		Foundation material not known.

CONCRETE/MASONRY DAMS

Sheet 3 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	No significant cracks were observed in the stone masonry walls or the concrete portion of the dam.	
STRUCTURAL CRACKING	None observed	
VERTICAL AND HORIZONTAL ALIGNMENT	Appears satisfactory	
MONOLITH JOINTS	N/A	
CONSTRUCTION JOINTS	Appear satisfactory	

EMBANKMENT

Sheet 4 of 11

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
SURFACE CRACKS	None observed	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Upstream embankment slope shows evidence of erosion for nearly the entire length of the dam. Many large trees with up to 2-foot diam. trunks and 40 feet high growing on both upstream and downstream faces and crest of dam.	Remove all trees, backfill all voids left by root systems, regrade and riprap upstream embankment face and establish grass cover over entire dam except where ripped.
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Vertical alignment varies by about 1.3 feet with the sidewalls of the spillway being the low point. Horizontal alignment appears to be satisfactory except for the erosion along the upstream face from wave action.	Riprap the upstream face to protect against wave action.
RIPRAP FAILURES		

EMBANKMENT

Sheet 5 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
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JUNCTION OF EMBANKMENT
AND ABUTMENT, SPILLWAY
AND DAM

No problems observed

ANY NOTICEABLE SEEPAGE

No seepage observed in
embankment portion of dam.

STAFF GAGE AND RECORDER

None

DRAINS

None observed

OUTLET WORKS

Sheet 6 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	None observed	
INTAKE STRUCTURE	Intake and outlet a self contained concrete box structure built imme- diately left of the left spillway sidewall.	
OUTLET STRUCTURE		
OUTLET CHANNEL	Pond immediately downstream of outlet pipe.	
EMERGENCY GATES	Gates observed through the grating on top of the intake/outlet concrete box structure.	Gates should be inspected and operated at least on an annual basis.

UNIGATED SPILLWAY

Sheet 7 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	No problem apparent	
APPROACH CHANNEL	Silver Lake, no actual channel	
DISCHARGE CHANNEL	Pond immediately downstream, no actual channel.	
BRIDGE AND PIERS	Metal walkway over spillway with bottom of stringer about 18 inches above crest of spillway appears to be in good condition.	Walkway would be raised if sidewalls of spillway are raised.

GATED SPILLWAY

Sheet 8 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	N/A	
APPROACH CHANNEL	N/A	
DISCHARGE CHANNEL	N/A	
BRIDGE AND PIERS	N/A	
GATES AND OPERATION EQUIPMENT	N/A	

INSTRUMENTATION

Sheet 9 of 11

REMARKS OR RECOMMENDATIONS

OBSERVATIONS

VISUAL EXAMINATION

MONUMENTATION/SURVEYS

None

OBSERVATION WELLS

None

WEIRS

None

PIEZOMETERS

None

OTHER

None

RESERVOIR

Sheet 10 of 11

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

SLOPES

Slopes around the perimeter of the lake average about 5 percent and are grass covered and appear stable.

SEDIMENTATION

The lake has been dredged several times since the 1960's to remove sediment resulting from construction in the watershed

Better controls are needed to control sediment accumulation during construction.

DOWNSTREAM CHANNEL

Sheet 11 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Immediately downstream is a pond about 550 feet long. For the next approximately 600 feet Van Horn Creek flows through a brushy, wooded relatively flat terrain before flowing through the Yardley Golf Club grounds for about 0.25 miles. The final 0.25 miles of Van Horn Creek before it outlets into the Delaware Canal flows through a wooded residential area.	
SLOPES	The average channel slope is about one percent.	
APPROXIMATE NO. OF HOMES AND POPULATION	A failure of Silver Lake Dam would possibly affect 4 homes in Yardley. The floor elevation of the lowest house is about 5 feet above the streambed.	A downstream warning system should be developed by the Owner. During periods of heavy rainfall, the dam should be monitored and appropriate agencies should be alerted in the event of an impending failure.

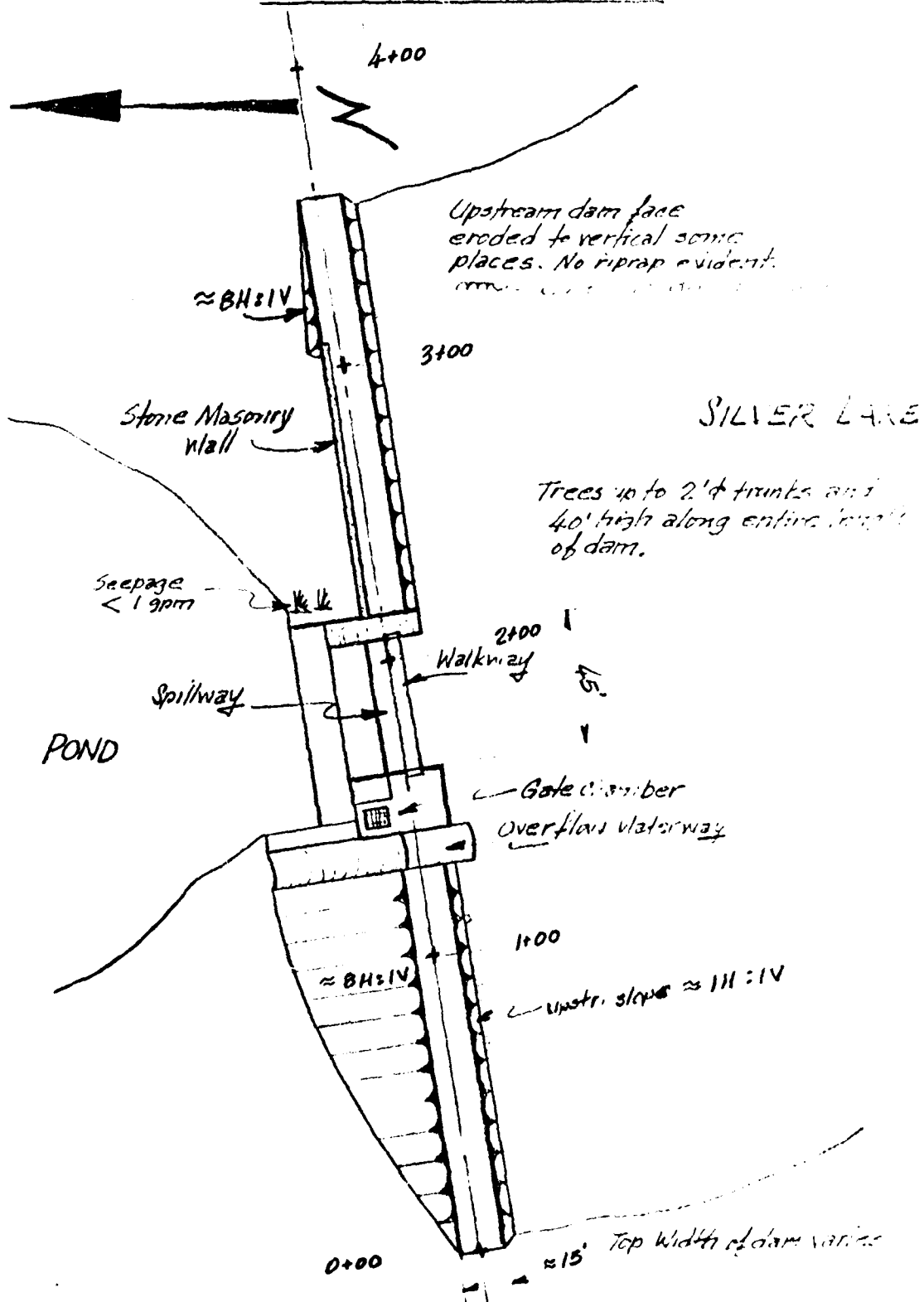
Silver Lake Dam, Yardley

SHEET
11A

1/2"

1/2, 1/4, 1/8"

1/2, 1/4, 1/8"

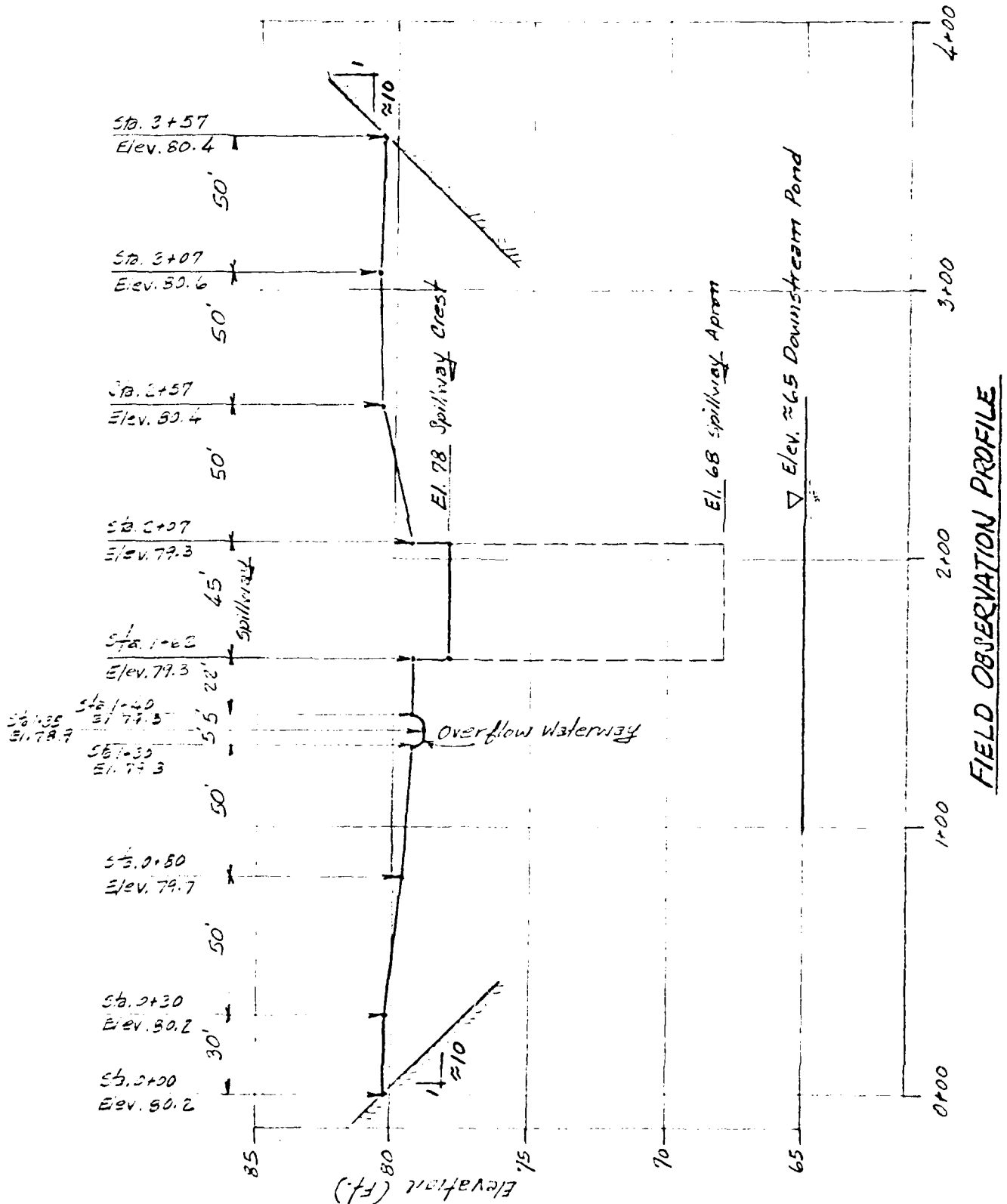
FIELD OBSERVATION PLAN

Silver Lake Dam, Yardley

SHEET 11B

DATE 1/29/81

JOB NO. 1841-014



APPENDIX B
CHECKLIST
ENGINEERING DATA

O'BRIEN & GERE

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

NAME OF DAM Silver Lake Dam (Yardley)
NDI PA 00791

Sheet 1 of 4

ITEM
AS-BUILT DRAWINGS

REMARKS
None Available

REGIONAL VICINITY MAP

Refer to Figure 1, Appendix E

CONSTRUCTION HISTORY

Originally built to store water for the Reading Railroad in 1901. The impoundment has been used solely for recreation for many years.

TYPICAL SECTIONS OF DAM

Refer to Sheet 3, Appendix E

OUTLETS - PLAN
DETAILS
CONSTRAINTS

Refer to Sheet 3, Appendix E

DISCHARGE RATINGS
RAINFALL/RESERVOIR RECORDS

None Available
None.

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

Sheet 3 of 4

ITEM	REMARKS
MONITORING SYSTEMS	None
MODIFICATIONS	In 1967 the spillway crest was resurfaced, wingwalls were placed along the spillway and a new outlet structure was placed beside the left abutment.
HIGH POOL RECORDS	None Available.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None Known to Exist.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	No documented information is available. According to a local resident, the spillway section failed about 5 years ago.
MAINTENANCE OPERATION RECORDS	None Available.

ITEM	REMARKS
SPILLWAY PLAN	Refer to Sheet 3, Appendix E
SECTIONS	
DETAILS	
OPERATING EQUIPMENT PLANS & DETAILS	None Available
MISCELLANEOUS	Extremely little information is available for this dam.

APPENDIX C
PHOTOGRAPHS

O'BRIEN & GERE

APPENDIX C
PHOTOGRAPH TABLE OF CONTENTS

	<u>Page No.</u>
Site Plan	A
<u>PHOTOGRAPH</u>	
<u>No.</u>	
1. View along centerline of dam from the right abutment. (12/17/80)	1
2. Spillway, concrete box of outlet works and overflow waterway in foreground. (12/17/80)	1
3. Downstream stone masonry and concrete wall to the right of the spillway. (12/17/80)	2
4. View along the top of dam from the right sidewall of the spillway. (12/17/80)	2
5. Typical large tree growing on the dam. (12/17/80)	3
6. Seepage in the vicinity of the downstream end of the right sidewall of the spillway. (12/17/80)	3
7. Silver Lake Dam viewed from the dam for the downstream pond. (12/17/80)	4
8. Spillway for the downstream pond. (12/17/80)	4
9. Typical channel conditions about 1,000 feet downstream of Silver Lake Dam. (12/17/80)	5
10. Initial potential hazard area about 3,300 feet downstream from the dam. (12/17/80)	5
11. Potential hazard area about 3,500 feet downstream from the dam. (12/17/80)	6
12. Delaware Canal where Van Horn Creek discharges into it 3,900 feet downstream from the dam. (12/17/80)	6

Silver Lake Dam, Yardley

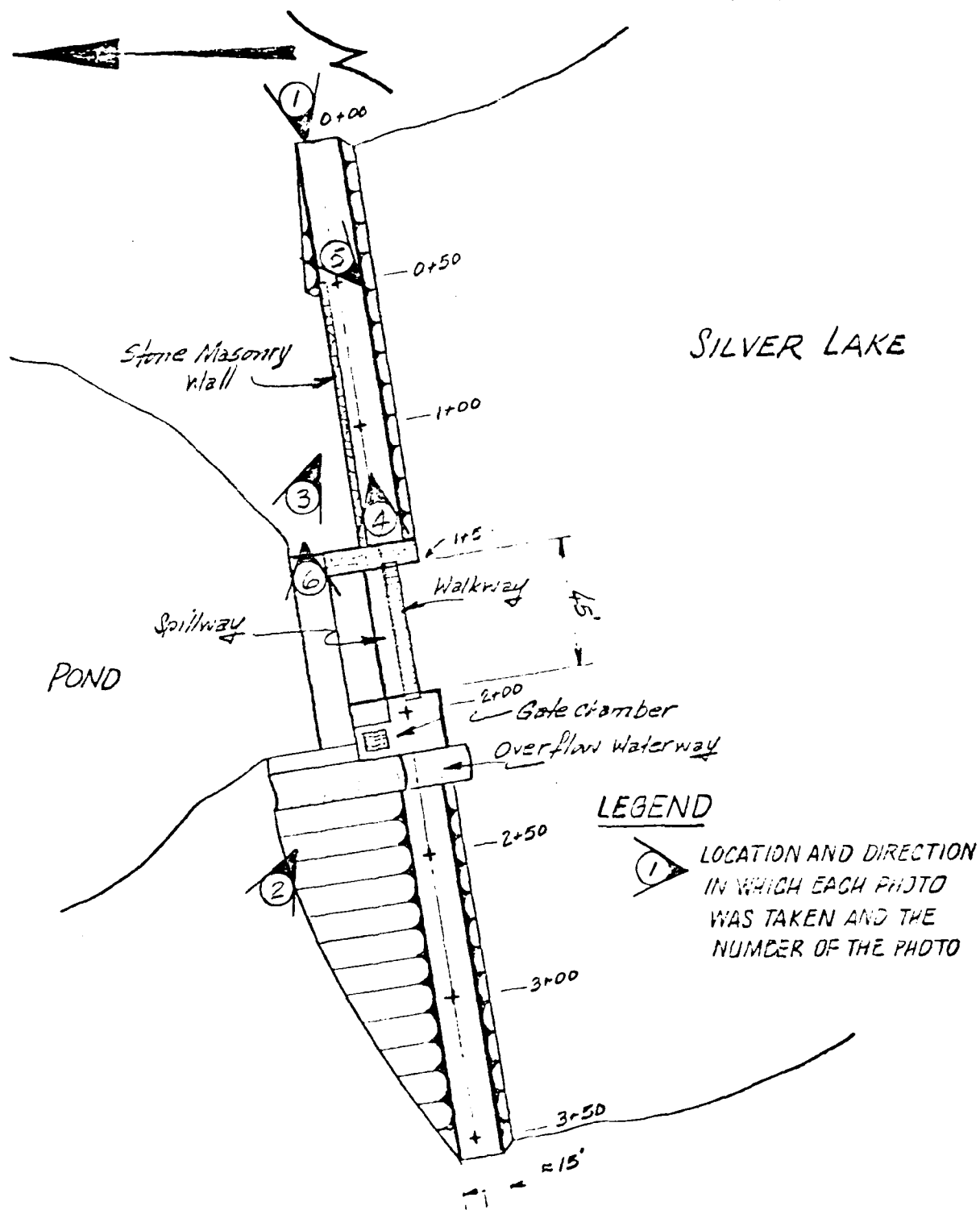
A

B

1/29/81

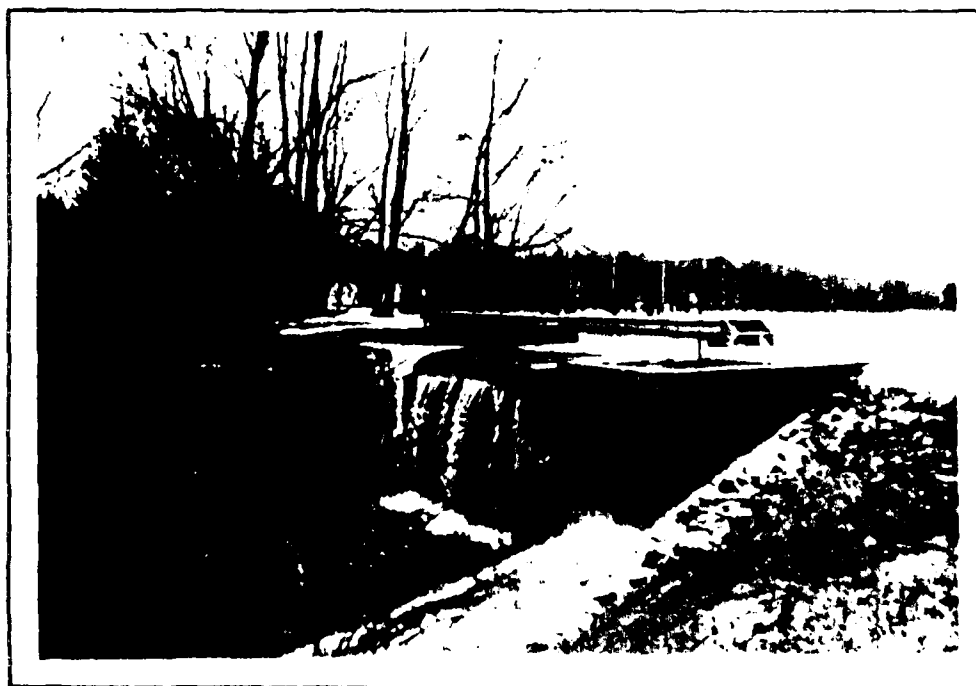
1841-014

SITE PLAN





1. VIEW ALONG CENTERLINE OF DAM FROM THE RIGHT ABUTMENT.
(12/17/80)



2. SPILLWAY, CONCRETE BOX OF OUTLET PIPES AND OVERFLOW
WATERWAY IN FOREGROUND. (12/17/80)



3 DOWNSTREAM STONE MASONRY AND CONCRETE WALL TO THE RIGHT OF THE SPILLWAY. (12/17/80)



4 VIEW ALONG THE TOP OF DAM FROM THE RIGHT SIDEWALK OF THE SPILLWAY. (12/17/80)



5. TYPICAL LARGE TREE GROWING
ON THE DAM. (12/17/80)



6. SEEPAGE IN THE VICINITY OF THE DOWNSTREAM END OF THE RIGHT
SIDEWALL OF THE SPILLWAY.



7. SILVER LAKE DAM VIEWED FROM THE DAM FOR THE DOWNSTREAM POND. (12/17/80)



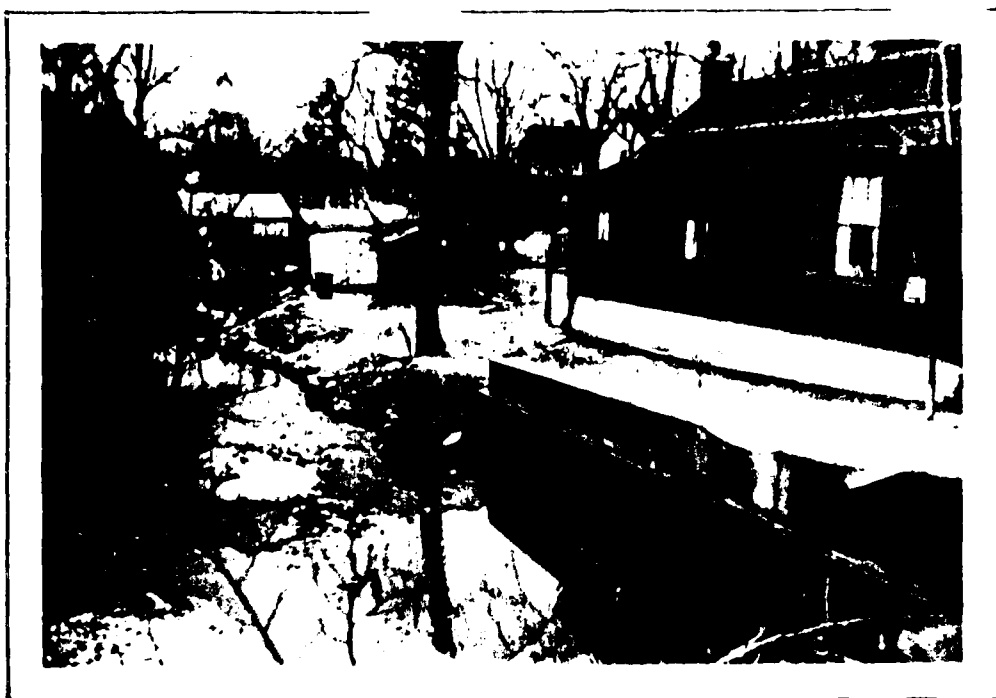
8. SPILLWAY FOR THE DOWNSTREAM POND. (12/17/80)



9. TYPICAL CHANNEL CONDITIONS ABOUT 1,000 FEET DOWNSTREAM
OF SILVER LAKE DAM. (12/17/80)



10 INITIAL POTENTIAL HAZARD AREA ABOUT 3,800 FEET DOWNSTREAM
FROM THE DAM. (12/17/80)



11. POTENTIAL HAZARD AREA ABOUT 3,500 FEET DOWNSTREAM FROM THE DAM. (12/17/80)



12. DELAWARE CANAL WHERE VAN HORN CREEK DISCHARGES INTO IT 3,900 FEET DOWNSTREAM FROM THE DAM. (12/17/80)

APPENDIX D
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

SILVER LAKE DAM, YARDLEY
APPENDIX D
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

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Checklist, Hydrologic and Hydraulic Engineering Data	1
HEC-1, Revised, Flood Hydrograph Package	2
Hydrology Data	3 through 7
Hydraulics	8 through 9
HEC-1 Dam Safety Version, 100 Year Flood Computer Output	10 through 13

CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: Gently rolling topography, extensive residential & commercial development
ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 78 (38 ac ft)
ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 79.3 (51 ac ft)
ELEVATION MAXIMUM DESIGN POOL: Unknown
ELEVATION TOP DAM: Elev. 79.3 (low point)

SPILLWAY

- a. Elevation 78
- b. Type Broad crested overflow
- c. Width 15 Feet
- d. Length 45 Feet
- e. Location Spillover Near mid-point of dam length
- f. Number and Type of Gates None

OUTLET WORKS:

- a. Type Gated pipe
- b. Location Immediately left of left sidewall of spillway
- c. Entrance inverts ± Elev. 68
- d. Exit inverts ± Elev. 68
- e. Emergency draindown facilities 2 Gates

HYDROMETEOROLOGICAL GAGES:

- a. Type None within watershed
- b. Location N/A
- c. Records N/A

MAXIMUM NON-DAMAGING DISCHARGE: Not determined

Note : Elevations estimated from Quad map (USGS).
Elevations are in feet, mean sea level.

HEC-1, REVISED
FLOOD HYDROGRAPH PACKAGE

The original "Flood Hydrograph Package" (HEC-1), developed by the Hydrologic Engineering Center, Corps of Engineers, has been modified for use under the National Dam Inspection Program. The "Flood Hydrograph Package (HEC-1), Dam Safety Version", hereinafter referred to as, HEC-1, Rev., has been modified to require less detailed input and to include a dam breach analysis. The required input is obtained from the field inspection of a dam, any available design/evaluation data, relatively simple hydraulic calculations, or information from the USGS Quadrangle maps. The input format is flexible in order to reflect any unique characteristics of an individual dam.

HEC-1, Rev. computes a reservoir inflow hydrograph based on individual watershed characteristics such as: area, percentage of impervious surface area, watershed shape, and hydrograph characteristics determined from regional correlation studies by the Corps of Engineers, Baltimore District. The inflow is routed through the reservoir using spillway discharge data obtained from the field inspection or design data. Flood storage capacity is determined from USGS maps or design information and verified by the field inspection. In the event a spillway cannot discharge 0.5 PMF without overtopping and failure of the dam, downstream channel characteristics obtained from the field inspection and USGS maps are input and flows are routed downstream to the damage center and a dam breach analysis is performed *✓*

✓ "High " hazard structures only



O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	PROJECT
SILVER LAKE DAM @ YARDLEY	3	JFK	4-16-81	1841-014

SCS LAG TIME

$$\begin{aligned} \text{AVG. BASIN SLOPE} &= \frac{\Delta \text{EL.}}{L} \\ &= \frac{120 - 78}{10,800} = 0.009 \frac{\text{FT}}{\text{FT}} \end{aligned}$$

$$V = 1.9 \text{ fps} \quad (\text{SCS HANDBOOK, SEC. 4, HYDROLOGY})$$

$$T_c = \frac{10,800}{1.9} = 5684 \text{ SEC.} = 1.58 \text{ hrs.}$$

$$L = 0.6 T_c = 0.45 \text{ hrs.}$$

$$\begin{aligned} T_p &= \frac{D}{2} + L - \frac{0.123 T_c}{2} + L \\ &= \frac{.123 (1.58)}{2} + 0.45 \\ &= 1.06 \text{ hrs.} \end{aligned}$$

WHERE T_c = TIME OF CONCENTRATION

L = LAG

T_p = TIME TO PEAK

D = DURATION OF RAINFALL

Drainage Area (Planimetered from USGS Quad 24)

≈ 1.31 sq. miles



O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO.
SILVER LAKE DAM (P. 40-41)	4	JFK	4-15-81	1841-014-111

ONE HUNDRED YEAR STORM DEVELOPMENT

RAINFALL FOR 100 YEAR RETURN *

DURATION	RAINFALL
30 MIN.	2.4"
1 HR.	3.2"
2 HR.	3.9"
3 HR.	4.3"
6 HR.	5.2"
12 HR.	6.2"
24 HR.	7.2"

* FROM TP-40, U.S. WEATHER BUREAU

THE FOLLOWING HYPOTHETICAL HYETOGRAPH WAS DEVELOPED USING THE SCS METHOD OF RAINFALL DISTRIBUTION. DATA FOR THE STORM WAS ACQUIRED FROM AN ACCUMULATED RAINFALL-DURATION CURVE. THE 24-HOUR MASS CURVE WAS DIVIDED INTO 15 MINUTE INTERVALS TO OBTAIN THE CORRESPONDING RAINFALL INCREMENTS.

**O'BRIEN & GERE**

PROJECT	DRAWN BY	DATE	JOB NO.
SILVER LAKE DAM - VALLEY	E	4-15-81	1841-014-111

100 YK. STORM DISTRIBUTION

TIME INTERVAL (HOURS)		RAINFALL INCREMENT (INCHES)	NUMBER OF INCREMENTS
FROM	TO		
0	4 3/4	.02	19
4 3/4	7 1/4	.03	10
7 1/4	8	.04	3
8	9	.05	4
9	9 1/2	.06	2
9 1/2	10	.07	2
10	10 1/2	.08	2
10 1/2	10 3/4	.10	1
10 3/4	11	.12	1
11	11 1/4	.14	1
11 1/4	11 1/2	.20	1
11 1/2	11 3/4	.34	1
11 3/4	12	.90	1
12	12 1/4	1.50	1
12 1/4	12 1/2	.41	1
12 1/2	12 3/4	.20	1
12 3/4	13	.16	1
13	13 1/4	.13	1
13 1/4	13 1/2	.10	1
13 1/2	13 3/4	.09	1
13 3/4	14 1/4	.08	2
14 1/4	14 3/4	.07	2
14 3/4	15 1/4	.06	2
15 1/4	16	.05	3
16	17	.04	4
17	19 1/2	.03	10
19 1/2	24	.02	18
		<u>7.20"</u>	<u>96</u>

**O'BRIEN & GERE**

SUBJECT

SILVER LAKE DAM & YARDLEY

SHEET

C

BY

JFK

DATE

4-22-81

JOB NO

1841-014

PEAK INFLOW FOR 100 YR. FLOOD

Reference: Regional Frequency Study, Upper Delaware
and Hudson River Basins, New York District,
C.O.E., November, 1974.

$$\log(Q_m) = C_m + 0.87 \log(A)$$

$$S = C_s - 0.05 \log(A)$$

$$\log(Q_{100}) = \log(Q_m) + K S$$

$$C_m = 1.7 \quad (\text{Figure 2})$$

$$C_s = 0.322 \quad (\text{Figure 3})$$

$$y = +0.4 \quad \therefore K = 2.615$$

$$S = 0.322 - 0.05 \log(1.3) = 0.317$$

$$\log(Q_m) = 1.7 + 0.87 \log(1.3) = 1.799$$

$$\log(Q_{100}) = 1.799 + 2.615(0.317) = 2.628$$

$$Q_{100} = 425 \text{ cfs}$$



Silver Lake Dam, Yandley	1	REH	4/27/81	
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HYDRAULICSStage - Storage

<u>El (Feet)</u>	<u>Area (Acres)</u>	<u>Storage (AF)</u>
78 (Normal Pool) *	8.3	38
80	12.9	60
100	90.9	980

* Normal Pool elev estimated from USGS Quad. sheet

Assume zero storage El 65.0

Stage - Discharge

Spillway: $Q_s = C L_s H_s^{3/2}$
 $C = 3.0$ (Broad-Crested Weir, ≈ 15 ft wide, conc.)
 $L_s = 45'$

Top of Dam: $Q_D = C L_D H_D^{3/2}$
 $C = 2.7$ (Broad-crested, tree covered top of dam)

(SCS NEH-4 L_D is variable & measured @ $\frac{5}{6}$ the actual water surface elev above top of dam. Abutment slope $\approx 10 H : 1 V$)

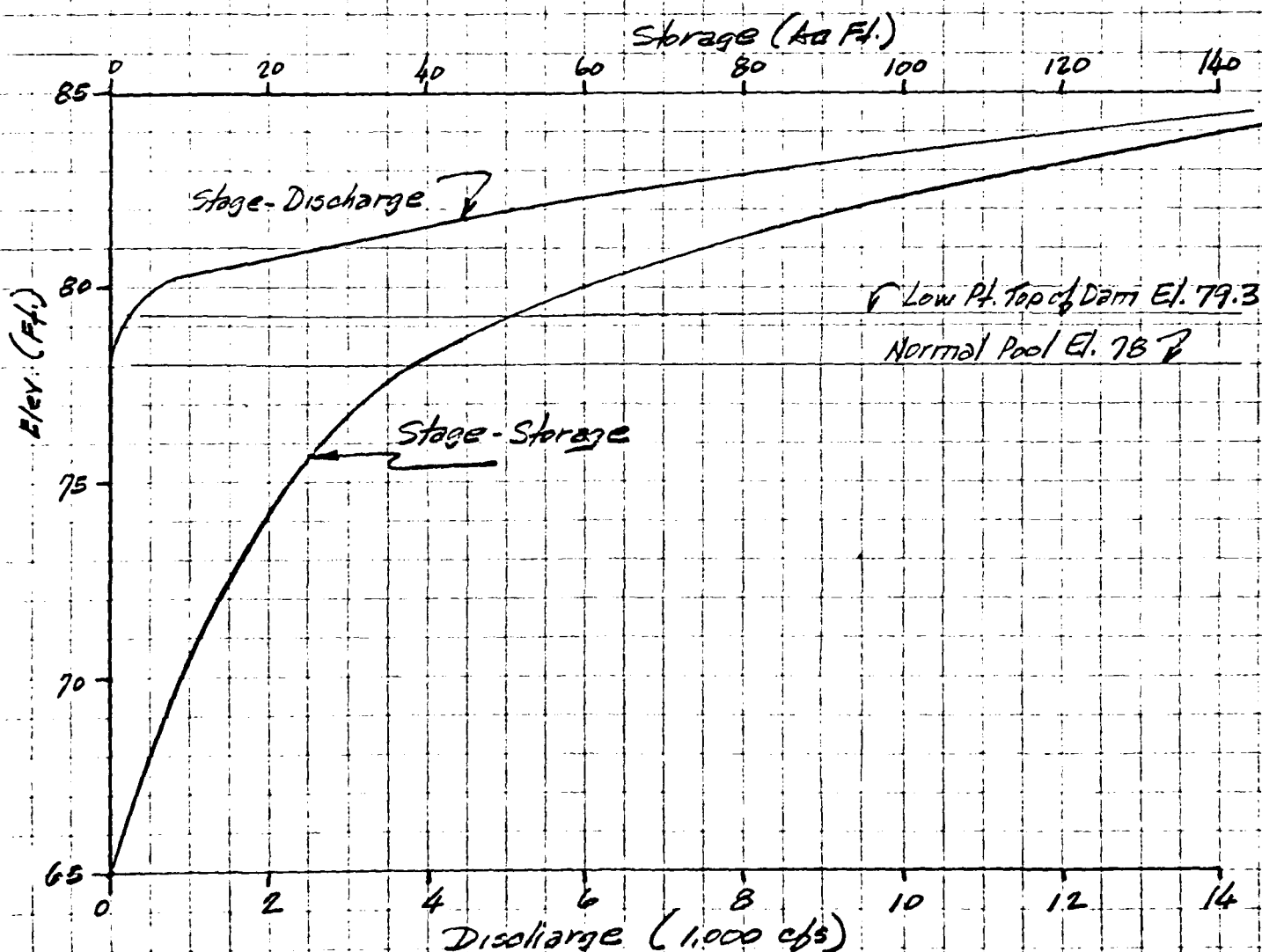


O'BRIEN & GERE

SUBJECT	SHEET	BY	DATE	JOB NO.
Silver Lake Dam, Yardley	8	B	1/30/61	1841-014

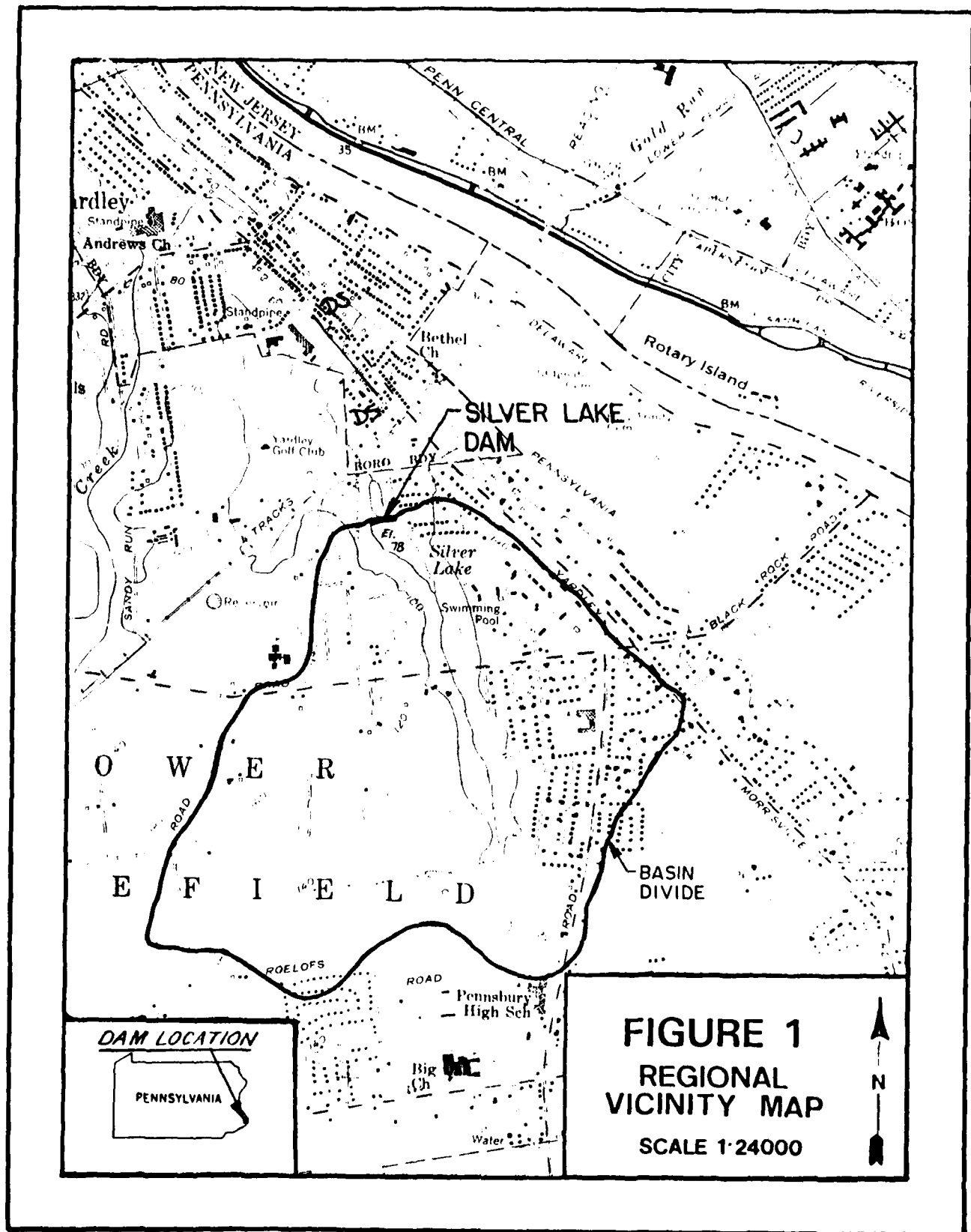
Discharge @ Silver Lake (Refer to Field Observation Profile, Sk 5B, App A)

Elev.	H_s (Ft.)	Q_s (cfs)	H_D (Ft.)	L_D (Ft.)	Q_D (cfs)	Q_{Tot} (cfs)
78	0	0				0
78.7	0.7	80				80
79.3	1.3	200	0	0	0	200
80.2	2.2	440	0.9	145	330	770
81.0	3.0	700	1.7	320	1920	2620
82.0	4.0	1080	2.7	335	4010	5090
85.0	7.0	2500	5.7	385	14150	16650

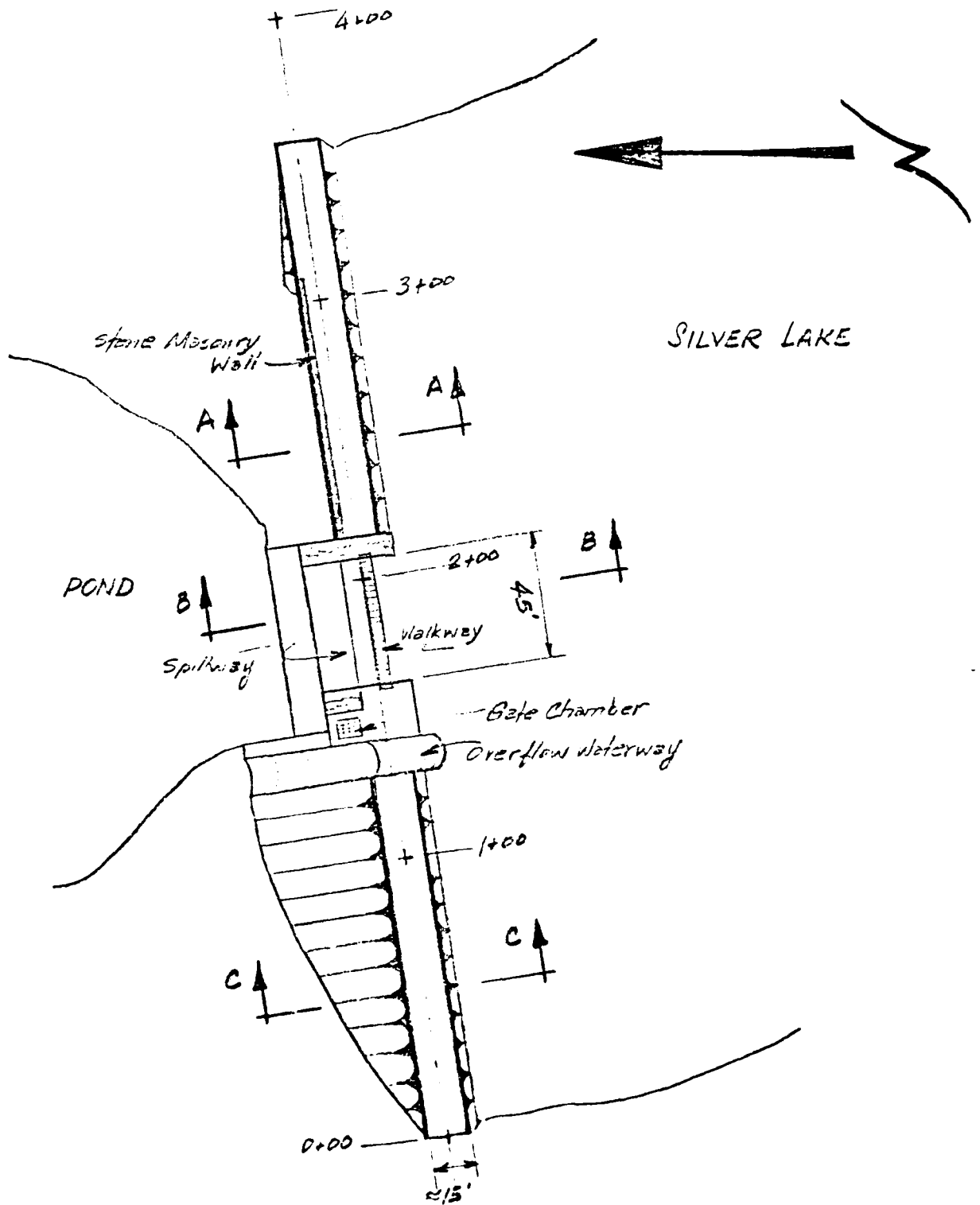


APPENDIX E
REGIONAL VICINITY MAP
&
DRAWINGS

O'BRIEN & GERE



PROJECT	DATE	BY	DATE	JOB NO.
Silver Lake Dam, Yardley	2	2	2/2/31	1841-014



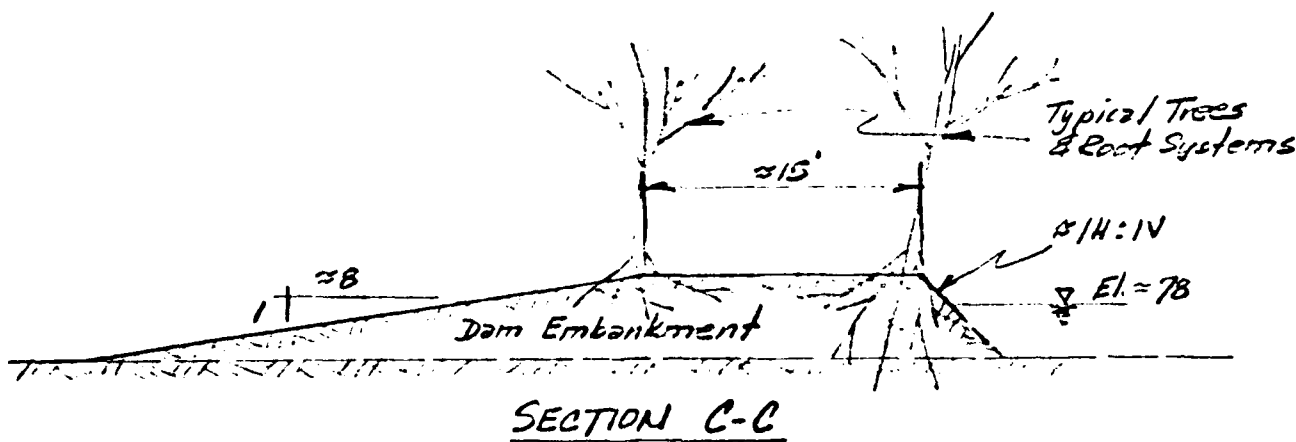
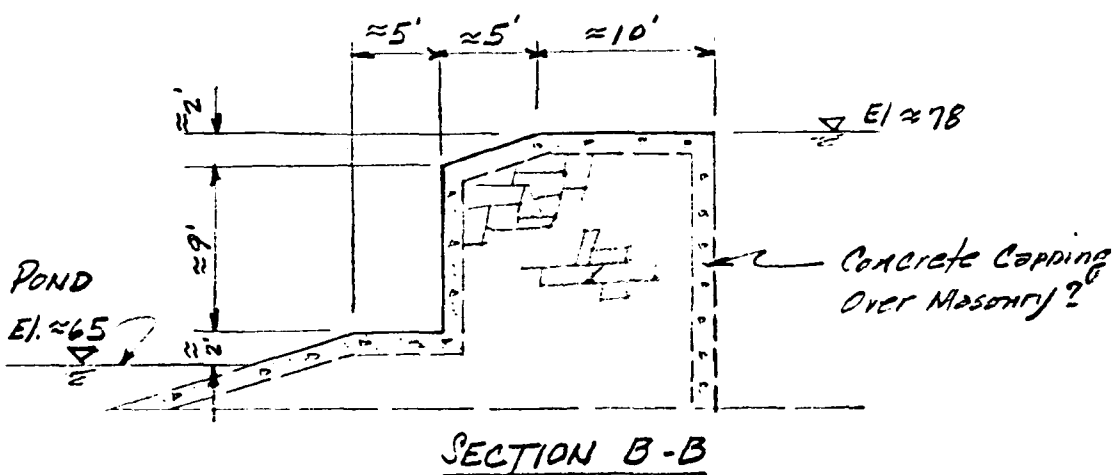
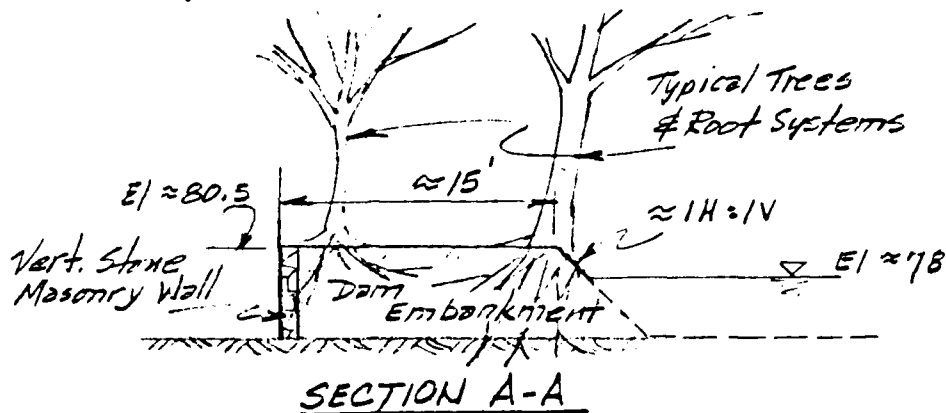
Silver Lake Dam, Yardley

3

2

2/2/81

1841-014



APPENDIX F
GEOLOGY

SITE GEOLOGY

SILVER LAKE DAM (YARDLEY)

Silver Lake Dam is located in the Lowland Section of the Piedmont, Physiographic Province. As shown in Figure 1, bedrock at the damsite is composed of brown and gray shales and arkoses known as the Stockton Lithofacies.

The Stockton Lithofacies differ widely in bedding, texture and color. They range from coarse conglomerate, through coarse-grained and fine-grained arkose, to fine-grained siliceous sandstone and shale. The several types are interbedded throughout most of the Stockton Lithofacies. The interbedding of the types varies. In a given exposure it is common to find similar beds for 20 to 50 feet of thickness; however, in limited zones rapid alternation of different types occurs.

Approximately 800 feet both east and west of the dam, as shown in Figure 1, bedrock changes to unconsolidated sands and gravels in river terraces of Pre-Wisconsin Pleistocene Deposits.

