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NATIONAL DAM INSPECTION PROGRAM. HOPEWELL DAM (NDS I.D. NUMBER --ETC(U)

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DELAWARE RIVER BASIN
SCOTTS RUN, BERKS COUNTY
PENNSYLVANIA
NDS ID PA. 00724
DER ID 6-401

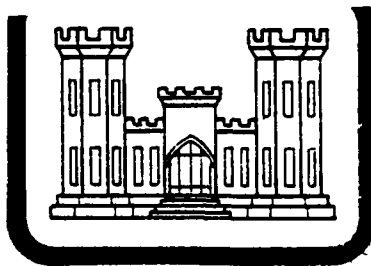
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HOPEWELL DAM

PHASE I INSPECTION REPORT NATIONAL DAM INSPECTION PROGRAM

WOODWARD-CLYDE CONSULTANTS

DACW31-80-C-0018



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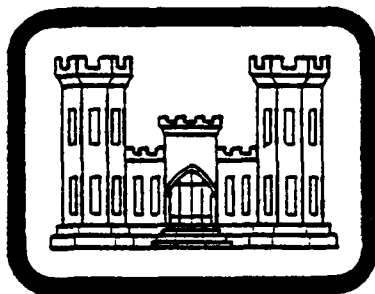
DELAWARE RIVER BASIN

SCOTTS RUN

HOPEWELL DAM, BERKS COUNTY, PENNSYLVANIA

National Dam Inspection Program
NDS I.D. NO. PA 00724
DER I.D. NO. 6-401)

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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JUN 9 1980
[Handwritten initials]

Prepared by:

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5120 Butler Pike
Plymouth Meeting, Pennsylvania 19462

Submitted to:

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

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JOB

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams for Phase I Investigations. Copies of these guidelines may be obtained from the Office of the Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I investigation is to expeditiously identify 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, testing and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify the need for more detailed studies.

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

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

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

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

Name of Dam:	Hopewell Dam
County Located:	Berks County
State Located:	Pennsylvania
Stream:	French Creek
Coordinates:	Latitude 40° 12.3' Longitude 75° 46.7'
Date of Inspection:	March 20, 1980

Hopewell Dam is a recreational structure located in French Creek State Park and owned by the Commonwealth of Pennsylvania. Visual inspection and review of the design and construction documentation indicate that the dam and appurtenant structures of Hopewell Dam are in good condition, although the condition of the dormant vegetation appeared to be fair at the time of the inspection.

In accordance with criteria established by Federal (OCE) Guidelines, the spillway design flood for this "Small" size dam and "High" hazard classification is one-half to the full Probable Maximum Flood (PMF). As the dam's total capacity is near the upper limit of the size classification and Hopewell Village is located at a narrow section of the floodplain, the selected spillway design flood is the full PMF. Hydrologic and hydraulic computations presented in Appendix D indicate the spillway is capable of passing approximately 33 percent of the PMF without overtopping the embankment. As the one-half PMF is estimated to cause failure of the structure and to significantly increase the potential for downstream damage, the spillway system of this structure is considered to be "Seriously Inadequate" and the dam is in an "unsafe, nonemergency" condition.

It is recommended that the following measures be undertaken as soon as practical. Items (1) through (3) should be under the direction of a registered professional engineer experienced in the design and construction of dams.

- (1) A study should be made to determine the best method of increasing the spillway capacity to meet current hydrologic/hydraulic criteria.
- (2) The large trees on the embankment to the left of the spillway should be removed, and the long-term stability of the slope should be evaluated in the light of the decaying root systems.

HOPEWELL DAM, NDS I.D. No. PA 00724

- (3) The embankment should be raised to the design elevation on the left side of the spillway, and the entire embankment crest should be leveled.
- (4) As planned during the routine spring maintenance of the embankment, the woody vegetation should be removed. It is recommended that the written operation and maintenance manual be expanded to include procedures for maintenance of embankment vegetation.
- (5) The mortar joints in the spillway should be repaired.

Because of the location of the dam upstream of the Hopewell Village National Historic Site and the potential to cause extreme property damage and possible loss of life in the event of failure, a formal procedure of observation and warning during periods of high precipitation should be developed and implemented. This procedure should include a method of warning downstream personnel if high flows are expected and provisions for evacuating these people in the event of an emergency. It is recommended that the operation and maintenance manual be expanded to include procedures for the maintenance of the embankment vegetation. It is also recommended that errors in the manual with respect to the physical features of the dam be corrected.

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Date

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Date

APPROVED BY:

James W. Peck
JAMES W. PECK
Colonel, Corps of Engineers
District Engineer

21 MAY 80
Date



OVERVIEW
HOPEWELL DAM, UNION TOWNSHIP, BERKS COUNTY, PENNSYLVANIA

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PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
HOPEWELL DAM
NATIONAL ID NO. PA 00724
DER NO. 6-401

SECTION 1
PROJECT INFORMATION

1.1 General.

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

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

1.2 Description of Project.

a. Dam and Appurtenances. Hopewell Dam is a zoned earth fill dam about 29 feet high and 1,000 feet long. The upstream section, reportedly constructed of relatively impervious materials, has a design slope of not less than 3H:1V. At the waterline, the embankment is protected with hand placed riprap, as shown in Photograph 5. The central portion of the dam and underlying cutoff trench were constructed of select core materials reported to be clay. The top of the dam and central core section are 12 feet wide. The cutoff trench is 10 feet wide at the bottom, with 1H:2V side slopes, and was designed to be carried to an impervious rock base. The downstream zone is reportedly constructed of pervious materials, and the design slope was not less than 2H:1V. Stone steps approximately 80 feet right of the spillway protect the embankment from foot traffic. The design elevation at the top of the dam is 510.67 feet.

The spillway is located near the left abutment of the dam. The ogee weir and spillway retaining walls are concrete faced with stone. The weir is 42 feet long with a crest elevation of 505 and has an eight foot long notch in the center, which measures six inches deep instead of three inches, as shown on Plate 3, Appendix E. The upper portion (about four feet) of the weir is faced with small stones, permitting a relatively smooth ogee shape. The facing stones for the rest of the weir and the retaining walls are up to two

feet thick, making a series of steps, as shown in Photograph 3. A 30 inch drain pipe, gated at its upstream end immediately upstream of the weir, discharges through the spillway and has intake and discharge elevations of about 483. The control tower is provided with channels for the use of stop-logs. Not shown on any plans is a rectangular concrete intake tunnel from the spillway backfill upstream toe to the control tower. The spillway discharges into a large rock stilling basin; see Photograph 4. A single line grout curtain was installed in the rock under the spillway, as described in paragraph g below, and concrete cutoff walls extend ten feet into the embankment on both sides of the spillway.

b. Location. Hopewell Dam is located across French Creek in Union Township, Berks County, Pennsylvania. The dam site is located approximately three miles north of the intersection of Pennsylvania Routes 23 and 345. The dam site and reservoir are located on the USGS Quadrangle map entitled, "Elverson, Pennsylvania", at coordinates N 40° 12.3' W 75° 46.7'. A regional location plan of Hopewell Dam and reservoir is enclosed as Plate 1, Appendix E.

c. Size Classification. The dam is classified as a "Small" size structure by virtue of its 29 foot height and estimated total capacity of 943 acre-feet.

d. Hazard Classification. Hopewell Dam is located immediately upstream of the boundary of the Hopewell Village National Historic Site. There are several buildings of historic value within the park, about 1,200 feet downstream of the dam, and the park superintendent's house is only two feet above the stream bank channel. Therefore, Hopewell Dam is considered to have a "High" hazard classification.

e. Ownership. Hopewell Dam, located within French Creek State Park, is owned by the Commonwealth of Pennsylvania. All correspondence should be addressed to Resources Management, Bureau of Operations, Department of Environmental Resources, Post Office Box 1467, Harrisburg, Pennsylvania 17120.

f. Purpose of Dam. The dam was originally built for recreational purposes and also serves as a water supply for the waterwheel at the reconstructed iron mill at the downstream Hopewell Village.

g. Design and Construction History. Hopewell Dam was designed by the Department of the Interior National Park Service as a Civilian Conservation Corps (CCC) project. The dam was built to replace a smaller stone dam that had created a lake at elevation 488.8. By September 1935, a dam with a

broad crested spillway 50 feet wide at elevation 498 had been designed for the site. By December 1935, the spillway was redesigned to be an ogee section 42 feet wide at elevation 505.

Construction of Hopewell Dam began early in 1936. In March 1936, excavation in the spillway area was carried to elevation 483.5, at which depth the rock was considered unsatisfactory for the spillway foundation and was not sufficiently impervious to be used as the bottom of the cutoff trench under the earth embankment. A test pit was then excavated in the left hillside at a point where the original ground surface was about 503. The top of rock at the test pit was 495, the bottom of the test pit was 483, and a hole was drilled to elevation 478. From the top of the rock to nearly the bottom of the pit, the rock was described as sandstone blocks separated by wide seams in all directions. The bottom of the pit consisted of badly broken shale. The drill hole in the bottom of the pit indicated a harder and more compact rock beneath the bottom of the pit. It was decided to shift the spillway structure 20 feet to the south in an effort to reduce rock excavation and to obtain a better foundation.

A state engineer recommended that the cutoff wall on the left of the spillway be continued into the left abutment hillside in the form of a low wall, with the top at least two feet above the rock surface. He also noted the desirability of constructing a low cutoff wall to the right end of the dam, embedded two feet into the foundation, if warranted by the condition of the foundation after excavation. The concrete wall was to act as an added seal between the bottom of the dam and the clay core. (There is no evidence that the cutoff wall on the right side was constructed.) The state engineer also noted that grouting might be necessary to prevent leakage under the dam. In May 1936, after inspecting the revised spillway foundation excavation, the state engineer formally recommended that a single line grout curtain be installed under the spillway, with holes on three feet centers and to a depth of about 15 feet. In July, grouting pipes were installed at three foot intervals. Every third or fourth hole was to be grouted initially, and then the intermediate holes would be grouted if necessary. It was also noted that the cutoff wall on the left side of the spillway would extend about 25 feet into the hillside. In October 1936, a state progress report noted that the job as a whole was 50 percent complete and the work quality satisfactory.

In January 1937, work on the dam was halted until warmer weather in March. A June 1937 inspection of the dam site indicated that fill was being placed containing too much moisture, and that compaction was not quite sufficient. Fill

was being placed faster than it could be properly compacted. The Department of the Interior replied that more care would be taken in placing the material and reported that recent compaction tests indicated good results. They also reported that it was decided not to install the cutoff wall to the left of the spillway, but that weep holes would be installed through the downstream spillway wing walls. "Graded gravel wells", designed to permit the passage of water and at the same time retain the embankment material, would be installed to control any seepage between the spillway and the left abutment. A state progress report later in the same month indicated that embankment fill was being placed satisfactorily.

On August 3, 1937, the Department of the Interior National Park Service notified the state that on Friday, August 6, the gates of the dam at Hopewell, Pennsylvania, would be closed. On October 18, 1937, a state inspection report noted that work was in progress for the stilling pool. Leakage amounting to about 300 gallons per day was coming through the left wing wall downstream. According to reports, this leakage was from springs. On June 5, 1938, water flowed over the crest of the spillway for the first time.

Hopewell Dam was deeded to the Commonwealth of Pennsylvania on November 25, 1946. The terms of the deed allowed the Department of the Interior, through the National Park Service, to take water from Hopewell Lake to operate the water wheel at the Hopewell Furnace, downstream of the dam. In 1951, a water supply line was laid through the dam. An eight inch pipe with an intake about 100 feet out in the reservoir was installed. Flow through the pipe is controlled by a gate valve located in a locked valve box to the left of the spillway.

On March 19, 1962, the lake was lowered to work on the swimming beaches and boat docks. In April, and again in May, unsuccessful attempts were made to close the gate. An August 1962 state inspection noted that the gate was still not closed. The lake was subsequently drawn down again to repair the sluice gate. A December 1962 State Parks Department inspection report noted that the lake had been drawn completely, the valve cleaned, the bottom of the inlet tunnel and tower were cleaned of debris, iron parts were scaled and painted with rustoleum, and the valve closed on October 25.

In 1966, it was thought that the valve was in danger of failing, and a contract was awarded to repair or replace the valve. The contractor found that the valve, which was constructed of brass, was in good working order, but that the openings in the trash rack were too large, allowing stones and

other debris to lodge in the gate. Extra bars were added to the trash rack to prevent this occurrence.

About 1975, fill was placed at the downstream toe to the right of the spillway, filling in a marshy area and creating an access road to the stilling basin.

h. Normal Operating Procedures. Excess water is normally discharged over the spillway, and water is drawn off for use at the furnace at Hopewell Village.

1.3 Pertinent Data.

The summary of pertinent data for Hopewell Dam is presented as follows.

a.	Drainage Area (square miles)	2.56
b.	Discharge at Dam Site (cfs)	
	Maximum Known Flood at Dam Site	Unknown
	At Top of Dam	1,747
c.	Elevation (feet above MSL)	
	Top of Dam	
	Existing	509.9
	Design	510.67
	Spillway Weir Crest	505.0
	Water Supply Intake	502±
	Pond Drain Inlet	483.0
	Stream Bed at Downstream Toe	
	(est)	481.0
d.	Reservoir Length (feet)	
	Length at Normal Pool	3,500
	Length at Maximum Pool (est)	4,000
e.	Storage (acre-feet)	
	To Spillway Crest (normal pool)	569
	To Top of Dam (existing)	943
f.	Reservoir Surface Area (acres)	
	Normal Pool	66
g.	Embankment Data	
	Type	Zoned earth w/ clay core & cutoff trench
	Length	1,000 feet
	Maximum Height (above stream bed at downstream toe)	29 feet

Top Width	12 feet
Volume	24,000 cubic yards
Side Slopes	
Upstream	3H:1V
Downstream	2H:1V
Cutoff	Clay filled cutoff trench to rock, 10 ft wide at base, w/ 1H:2V side slopes
Grout Curtain	Single line grout curtain under spillway
h. Spillway	
Type	Ogee weir, concrete with stone facing
Length	42 feet
Weir Crest Elevation	505.0, with 8 foot long notch
Notch Elevation	
Design	504.75
Existing	504.5
i. Pond Drain	
Type	30 inch pipe through spillway, 22 feet long, w/ sluice gate at upstream end
Inlet Elevation	483.0

SECTION 2 ENGINEERING DATA

2.1 Design.

a. Data Available. The data available for review are contained in the Pennsylvania Department of Environmental Resources (DER) files and consist of plans, photographs, correspondence, inspection reports and memoranda. Engineering analyses located in DER files are limited to a stability analysis of the spillway section and evaluations of the spillway capacity.

b. Design Features. The principal design features of Hopewell Dam are illustrated on the plans and cross-sections enclosed in Appendix E. Data for these sections were obtained from plans located in DER files. The design features are also described in Section 1.2, paragraph a, and pertinent data relative to the structure are presented in Section 1.3.

2.2 Construction.

The known construction information is detailed in Section 1.2, paragraph g.

2.3 Operational Data.

There are no operational records maintained.

2.4 Evaluation.

a. Availability. Information presented herein was obtained from the records located in DER files in Harrisburg, Pennsylvania, and from conversations with the Owner's representative.

b. Adequacy. The available data included in the state files are not considered adequate to evaluate the engineering aspects of the dam and appurtenant structures.

c. Validity. There is no reason to question the validity of the available data. It is noted that plans for two dams with different elevations and spillways are included in DER files. Appendix E contains only those plans pertaining to the existing dam.

SECTION 3 VISUAL INSPECTION

3.1 Findings.

a. General. Observations and comments of the field inspection team are contained in the checklist enclosed herein as Appendix A, and are summarized and evaluated in the following subsections. In general, the appearance of the facility indicates that the dam is in good condition. Plan and cross-sections of the dam are presented in Appendix E.

b. Dam. During the visual inspection, there were no indications of distortions in alignment or grade that would be indicative of movement of the dam or the foundation. The vertical alignment of the dam was checked, and a profile is included in Appendix A as sheet 5B. Hand-placed riprap protects the upstream face of the embankment along the waterline. One or two stones are out of position near the spillway. Above the riprap, the embankment is protected with grass. There is a small amount of erosion on the upstream embankment near the right end of the dam. The crest is uneven, both longitudinally, as shown in the profile on sheet 5B, and perpendicular to the profile. Near the left end of the embankment on the upstream side is a swale that appears to have been made by foot traffic and which has been reseeded.

The crest of the dam is protected with mine screenings, consisting of coarse sand and fine gravel size rock fragments. Both the upstream and downstream embankments are steepest near the top. This possibly results from additional topsoil being placed on the dam during previous repairs. The lower portion of the downstream embankment is hummocky, or uneven. A set of stone steps, as shown on Photograph 8, and which are not shown on the plans, were installed on the downstream face of the dam when it was constructed. There are two small cedar trees growing near the steps, as shown in Photographs 7 and 8. About five years ago, an access road was made to the spillway stilling basin along the downstream toe of the bank, filling in a marshy area. At one point, about midway between the right abutment and the spillway, this road does not appear to drain well, and there is a soft spongy area extending up onto the embankment a short distance. At the junction of the downstream embankment and right abutment, a stone paved gutter carries surface runoff. About 60 feet downstream of the dam, as shown on sheet 5A, is a marshy area with standing water. Three springs were noted downstream of the dam to the left of the discharge channel. While seepage under the dam cannot be completely ruled out,

this water is assessed to be principally the result of hillside seepage.

The vegetation on the downstream slope consists of grass, particularly near the right abutment, and near the maximum section consists of Crownvetch, grass and briars, with woody vegetation gaining foothold. The grass was in a dormant state at the time of the inspection, but appeared to be in fair condition. The Owner's representative indicated that soil tests and fertilization were not done. Large trees and brush are on the downstream embankment to the left of the spillway. While the area to the left of the spillway resembles natural ground, construction photographs indicate that this is fill material. On both sides of the stilling basin, foot traffic has worn paths through the vegetation.

The original design called for six "seepage detector pipes" to be installed through the embankment, as shown on Plate 2. Park employees knew of only one pipe, shown on Photograph 9. The cap was removed and the water depth was measured to be 20 feet below the top of the dam crest, and the total length of the pipe to be about 30 feet.

c. Appurtenant Structures.

1. Spillway. The concrete ogee weir, faced with stone, appears to be in good condition, with some leakage through it. DER files and visual inspection indicate that the mortar joints of the weir and spillway walls are repaired periodically. Visual inspection indicated two small holes in the mortar of the small stones of the ogee section between the notch and the left spillway wall. Between the spillway notch and the right spillway wall, water was leaking through the weir at the junction of the small facing stones with the large facing stones; see Photograph 11. Between the notch and the left spillway wall, water was seeping through the mortar joints. Water was also leaking through both the left and right spillway walls. The surface of the rock was stained almost from the top of the wall, indicating leakage. Leakage through both spillway walls has been of a long-term occurrence, as leakage has been noted in the state files since the reservoir was filled, and as evidenced by a stalagmite of about an inch in height which has developed on the left spillway wall. No movement of the spillway walls was noted. No erosion of the downstream channel below the stilling basin was noted. Relief drains through the left stilling basin walls referred to in DER files were not located.

2. Outlet Works. The intake conduit and sluice gate are completely underwater. Water is discharged through a 22 foot long, 30 inch conduit through the spillway, and

outlets as shown in Photograph 3. In order to operate the pond drain gate, a platform of concrete blocks and planks is constructed on top of the stop-log structure, as shown in Photograph 2. The gate was seated completely before operation, operated easily and seated completely again afterwards.

d. Reservoir. The reservoir side slopes are moderate and well vegetated to the water's edge with grass and trees. Little debris was noted. There is little sediment at the upper end of Hopewell Lake, which would have little or no effect on flood water storage. About 5/8 mile upstream of Hopewell Dam is Scott's Run Dam, also within French Creek State Park. This dam is about 34 feet high and has a maximum pool storage capacity of 425 acre-feet.

e. Downstream Channel. Immediately below the dam, the 20 foot wide, two foot deep, channel flows through a wooded area to the Hopewell Village National Historic Site. The village itself is located adjacent to the channel about 1,200 feet below the dam. The park superintendent's house is a few feet above the channel bank, and there are several other historical buildings and a house that are two feet above the channel bank and would be damaged in the event of failure. There are no other significant damage centers for over a mile downstream of Hopewell Village. Thus, in the event of failure, excessive property damage is likely and possible loss of life, justifying a "High" hazard potential classification.

3.2 Evaluation.

In summary, the visual survey of the dam and appurtenant facilities disclosed no evidence of incipient failure of the dam. Items noted of a routine maintenance nature include cutting brush and woody vegetation on the downstream slope and repairing two small holes in the mortar of the spillway. More extensive rehabilitation would consist of removal of large trees to the left of the spillway and restoring the embankment to its original condition.

Seepage through the spillway and stilling basin walls is assessed to represent a stable condition and to require only visual monitoring.

SECTION 4 OPERATIONAL PROCEDURES

4.1 Procedures.

Operation of the dam does not require a dam tender. Water normally discharges over the spillway at elevation 505. Operating procedures include maintaining a sufficient downstream flow to maintain fish life if the reservoir level is below the spillway crest. Hopewell Village also draws off water for operation of the water wheel at the downstream furnace.

4.2 Maintenance of the Dam.

The Bureau of State Parks has developed an operation and maintenance manual for Hopewell Dam. Park employees provide maintenance for the dam. It is noted that although procedures are suggested for seeding areas, no procedures were suggested for maintaining a good vegetative cover on the embankment.

4.3 Maintenance of Operating Facilities.

The pond drain gate is operated at least twice a year. Procedures for inspection and maintenance of operating facilities are included in the operation and maintenance manual.

4.4 Warning Systems In Effect.

There are no written warning procedures in effect for this dam. The park has a general warning procedure in which a siren is sounded indicating an emergency. Park employees would then report to headquarters for details and instructions.

4.5 Evaluation.

It is judged that the current operating procedure, which does not require a dam tender, is a realistic means of operating the relatively simple control facilities of Hopewell Dam. The written operation and maintenance manual was reviewed, and the recommendation is made that provisions be made for adequate maintenance of embankment vegetation. A

warning procedure should be developed and implemented that would include surveillance of the dam during periods of high rainfall runoff.

It is also noted that the manual contains factual errors relative to the physical features of the dam. These errors (elevations, dimensions, etc.) are based on an early design of the dam, which was subsequently revised prior to construction.

SECTION 5 HYDROLOGY/HYDRAULICS

5.1 Evaluation of Features.

a. Design Data. The original design data for this dam were located in the Department of Environmental Resources files and were available for review. The original data are dated 1935. Hydrologic and hydraulic calculations made as a part of this investigation are contained in Appendix D.

The watershed is small and undeveloped, located almost entirely within French Creek State Park boundaries. The oval shaped watershed is about 2.2 miles long and 1.4 miles wide, having a total area of 2.56 square miles. Elevations range from about 1,000 feet in the upper reaches to 505, normal pool elevation. The upper 1.0 square mile of the watershed is controlled by Scott's Run Lake Dam, located about 3,300 feet above Hopewell Lake. The Scott's Run Watershed is over half wooded, with the rest open/farmland. There is almost no residential development within the watershed. The Hopewell Lake Watershed is almost completely wooded. Development within the watershed is limited to development of recreational facilities within the park. The runoff characteristics of either watershed are not expected to change significantly with time.

The original design information on Hopewell Dam indicates a spillway capacity of 1,674 cfs, based on a 42 foot long ogee weir, a coefficient of discharge equal to 3.95 and a design head of 4.67 feet. Original calculations indicated that the spillway is capable of safely passing the runoff of 0.96 inches per hour for ten hours, or 8.3 inches of runoff.

In accordance with criteria established by Federal (OCE) Guidelines, the recommended spillway design flood for this "Small" size dam and "High" hazard classification is one-half to the full Probable Maximum Flood (PMF). As the total storage capacity of this dam is close to the upper limit for a "Small" size classification and Hopewell Village is located at a narrow section of the floodplain, the full PMF has been selected as the spillway design storm.

b. Experience Data. No reservoir level records are maintained. The only estimate available of previous high reservoir levels is a maximum depth of 18 inches over the weir during Hurricane Agnes, June 1972. It is noted that Hopewell Lake does not lie in the path of maximum rainfall for that event.

c. Visual Observations. On the date of the inspection, there were no conditions observed that would indicate a reduction in spillway capacity in the event of a large storm. Other observations regarding the condition of the downstream channel, spillway and reservoir are presented in Appendix A and are discussed in greater detail in Section 3.

d. Overtopping Potential. The overtopping potential of this dam was estimated using the HEC-1, Dam Safety Version, computer program. A brief description of this program is included in Appendix D. Calculations for this investigation estimate the maximum spillway capacity to be about 1,750 cfs when the reservoir level is at the minimum crest elevation. The HEC-1 computed PMF peak inflow is 7,885 cfs for the existing watershed, considering the effect of upstream Scott's Run Dam. The spillway passes about 33 percent of the PMF without overtopping the dam.

e. Spillway Adequacy. The spillway is considered "Seriously Inadequate" as all of the following criteria are met.

- (1) The spillway will not pass 50 percent of the PMF without overtopping the dam.
- (2) It is assessed that overtopping by the 0.5 PMF will cause failure.
- (3) There would be a significant increase in property damage and the potential for loss of life as a result of failure by overtopping.

The overtopping potential is discussed in the above paragraph. Based on visual observations, the embankment is assessed to fail if overtopped by about nine inches of water for an hour or more. The increase in hazard due to failure is discussed in the following paragraph.

f. Downstream Conditions. About 1,200 feet below the dam within the Hopewell Village National Historic Site is a road with several buildings along it, as shown on Plate 1. Photograph 14, taken from the north side of the stream, shows the buildings indicated on Plate 1. Photograph 13, taken from the south side of the stream looking north, shows a building not shown on Plate 1. Four sheds and buildings are within three feet above the stream bank along the road, including two houses. Upon failure during one-half the PMF, some but not all of these buildings will be flooded. Computed maximum water levels of the downstream section within Hopewell Village

indicate a 2.4 foot increase in water elevation resulting from failure during one-half the PMF over nonfailure during one-half the PMF. The flood wave resulting from failure is judged to significantly increase property damage and the potential for loss of life.

SECTION 6 STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability.

a. Visual Observations. Visual observations detected no evidence of potential instability of the dam or its components. The downstream slopes are reasonably uniform, with no signs of significant erosion or sloughing. Foot traffic paths were noted on both sides of the spillway. Woody vegetation is beginning to develop on the slopes, but reportedly is scheduled to be removed this spring. The vegetation is in a dormant condition and is assessed to be in fair condition. The crest, although uneven, is protected by mine screenings, and is not damaged by foot traffic. The upstream slope and riprap are in good condition.

The spillway is judged to be in good condition. Seepage through the ogee weir and stilling basin walls is judged to represent a stable condition.

b. Design and Construction Data. All available documentation, drawings and data received from the Department of Environmental Resources, and supplemented by conversations with the French Creek State Park superintendent, were assessed and reviewed. A stability analysis of the spillway was included in the design drawings, but not of the embankment. Based on the lack of visual signs of significant deterioration, it is qualitatively assessed that the stability of the embankment is adequate if not overtopped.

c. Operating Records. An operation and maintenance manual for Hopewell Dam, French Creek State Park, dated February 1979, has been developed for this dam.

d. Post-Construction Changes. There is no record nor is there any evidence that any major modifications were made to this dam.

e. Seismic Stability. The dam is located in Seismic Zone 1. Normally it is considered that if a dam in this zone is stable under static loading conditions, it can be assumed safe for any expected earthquake conditions. As the dam is qualitatively assessed to be stable under static loading conditions, it can reasonably be assumed to be stable under seismic loading conditions.

SECTION 7
ASSESSMENT/REMEDIAL MEASURES

7.1 Dam Assessment.

a. Evaluation. Visual inspection and review of the design and construction documentation indicate that the dam and appurtenant structures of Hopewell Dam are in good condition, although the condition of the dormant vegetation appeared to be only fair at the time of the inspection.

In accordance with criteria established by Federal (OCE) Guidelines, the spillway design flood for this "Small" size dam and "High" hazard classification is one-half to the full Probable Maximum Flood (PMF). As the dam's total capacity is near the upper limit of the size classification and Hopewell Village is located at a narrow section of the floodplain, the selected spillway design flood is the full PMF. Hydrologic and hydraulic computations presented in Appendix D indicate the spillway is capable of passing approximately 33 percent of the PMF without overtopping the embankment. As the one-half PMF is estimated to cause failure of the structure and to significantly increase the potential for downstream damage, the spillway system of this structure is considered to be "Seriously Inadequate" and the dam is in an "unsafe, nonemergency" condition.

b. Adequacy of Information. The combined visual inspection, review of available data and simplified calculations presented in Appendix D were sufficiently adequate to determine that further investigations are required for this structure.

c. Urgency. It is recommended that the measures presented in Section 7.2 be implemented as specified.

7.2 Remedial Measures.

a. Facilities. It is recommended that the following measures be undertaken as soon as practical. Items (1) through (3) should be under the direction of a registered professional engineer experienced in the design and construction of dams.

- (1) A study should be made to determine the best method of increasing the spillway capacity to meet current hydrologic/hydraulic criteria.

- (2) The large trees on the embankment to the left of the spillway should be removed, and the long-term stability of the slope should be evaluated in the light of the decaying root systems.
- (3) The embankment should be raised to the design elevation on the left side of the spillway, and the entire embankment crest should be leveled.
- (4) As planned during the routine spring maintenance of the embankment, the woody vegetation should be removed. It is recommended that the written operation and maintenance manual be expanded to include procedures for maintenance of embankment vegetation.
- (5) The mortar joints in the spillway should be repaired.

b. Operation and Maintenance Procedures. Because of the location of the dam upstream of the Hopewell Village National Historic Site and the potential to cause extreme property damage and possible loss of life in the event of failure, a formal procedure of observation and warning during periods of high precipitation should be developed and implemented. This procedure should include a method of warning downstream personnel if high flows are expected and provisions for evacuating these people in the event of an emergency. It is recommended that the operation and maintenance manual be expanded to include procedures for the maintenance of the embankment vegetation. It is also recommended that errors in the manual with respect to the physical features of the dam be corrected.

APPENDIX

A

CHECK LIST
VISUAL INSPECTION
PHASE I

Sheet 1 of 11

Name Dam Hopewell Dam County Berks State Pennsylvania National ID # PA 00724
 Type of Dam Earth Hazard Category High
 Date(s) Inspection 3/20/80 Weather Partly sunny Temperature 40°s

Pool Elevation at Time of Inspection 505.0 M.S.L. Tailwater at Time of Inspection 482.0 M.S.L.

Inspection Personnel:

Mary F. Beck (Hydrologist) Vincent McKeever (Hydrologist)
Arthur H. Dvinoff (Geotechnical) (Geotechnical)
Raymond S. Lombert (Geologist) John H. Frederick (Civil)
(4/9/80)

Mary F. Beck Recorder

Remarks:

Mr. Donald Clewell, Park Superintendent, was on site and provided assistance to the inspection team. Four park employees were also on site to operate the pond drain gate.

CONCRETE/MASONRY DAMS

Sheet 2 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
ANY NOTICEABLE SEEPAGE	N/A	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	N/A	
DRAINS	N/A	
WATER PASSAGES	N/A	
FOUNDATION	N/A	

CONCRETE/MASONRY DAMS

Sheet 3 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	N/A	
STRUCTURAL CRACKING	N/A	
VERTICAL AND HORIZONTAL ALIGNMENT	N/A	
MONOLITH JOINTS	N/A	
CONSTRUCTION JOINTS	N/A	

EMBANKMENT

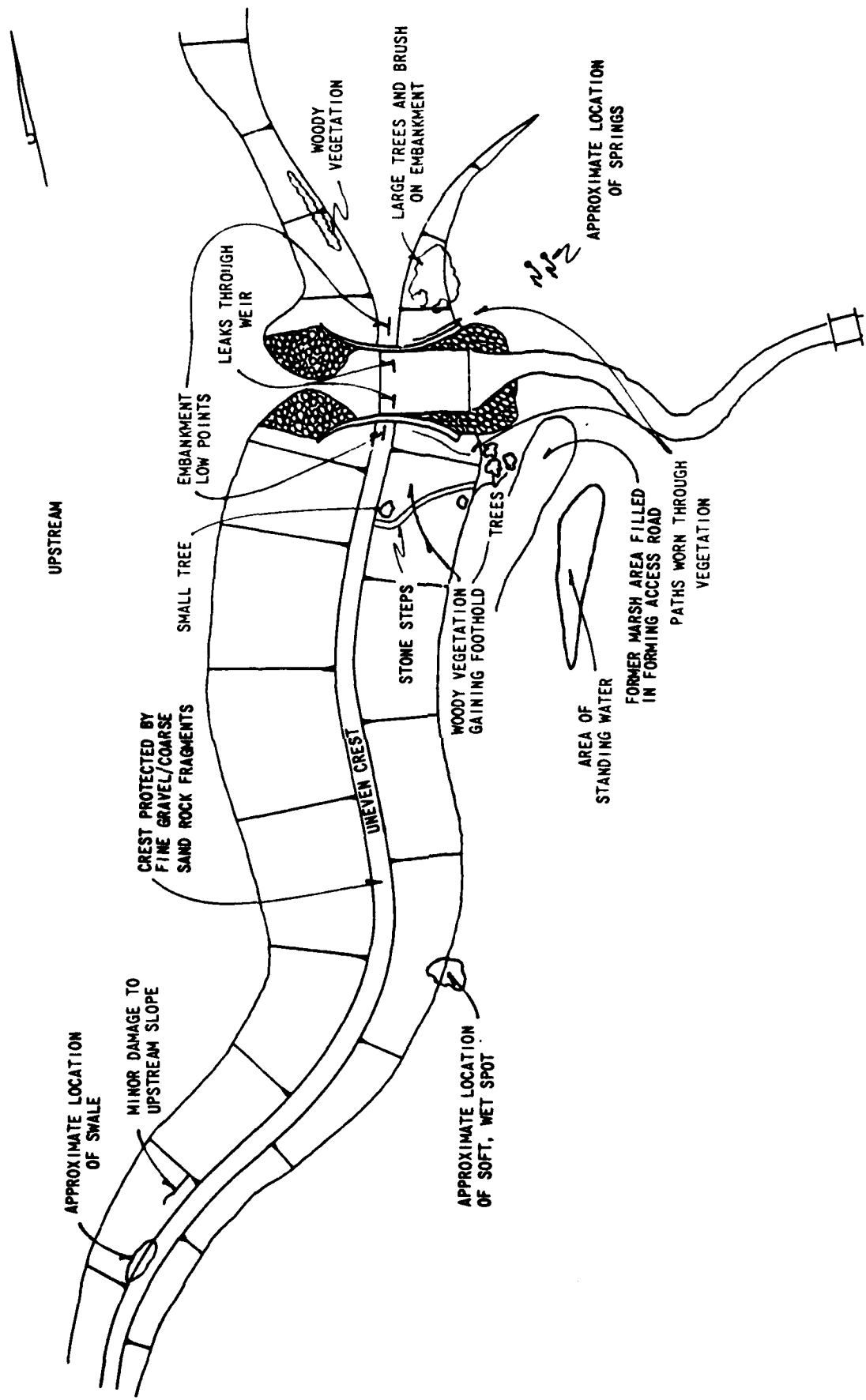
Sheet 4 of 11

<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. Both upstream and downstream sides of the embankment have a variable slope, steeper near the crest (about 3H:1V). The lower portion of the downstream slope is "hummocky"	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Very minor sloughing/erosion/damage is on both upstream and downstream slopes near the right end. Downstream damage has either been repaired or was of a limited depth. The upstream crest edge near the right abutment has an old (well vegetated) swale, a type caused by foot traffic.	
VERTICAL AND HORIZONTAL ALIGNMENT OF THE CREST	Horizontal alignment is satisfactory. The crest is not level, either parallel to dam centerline or perpendicular to the centerline. See Sheet 5B. A portion of the crest is below the design elevation.	
RIPRAP FAILURES	None, the hand-placed riprap is generally good condition. Some riprap was displaced near the right spillway wall.	

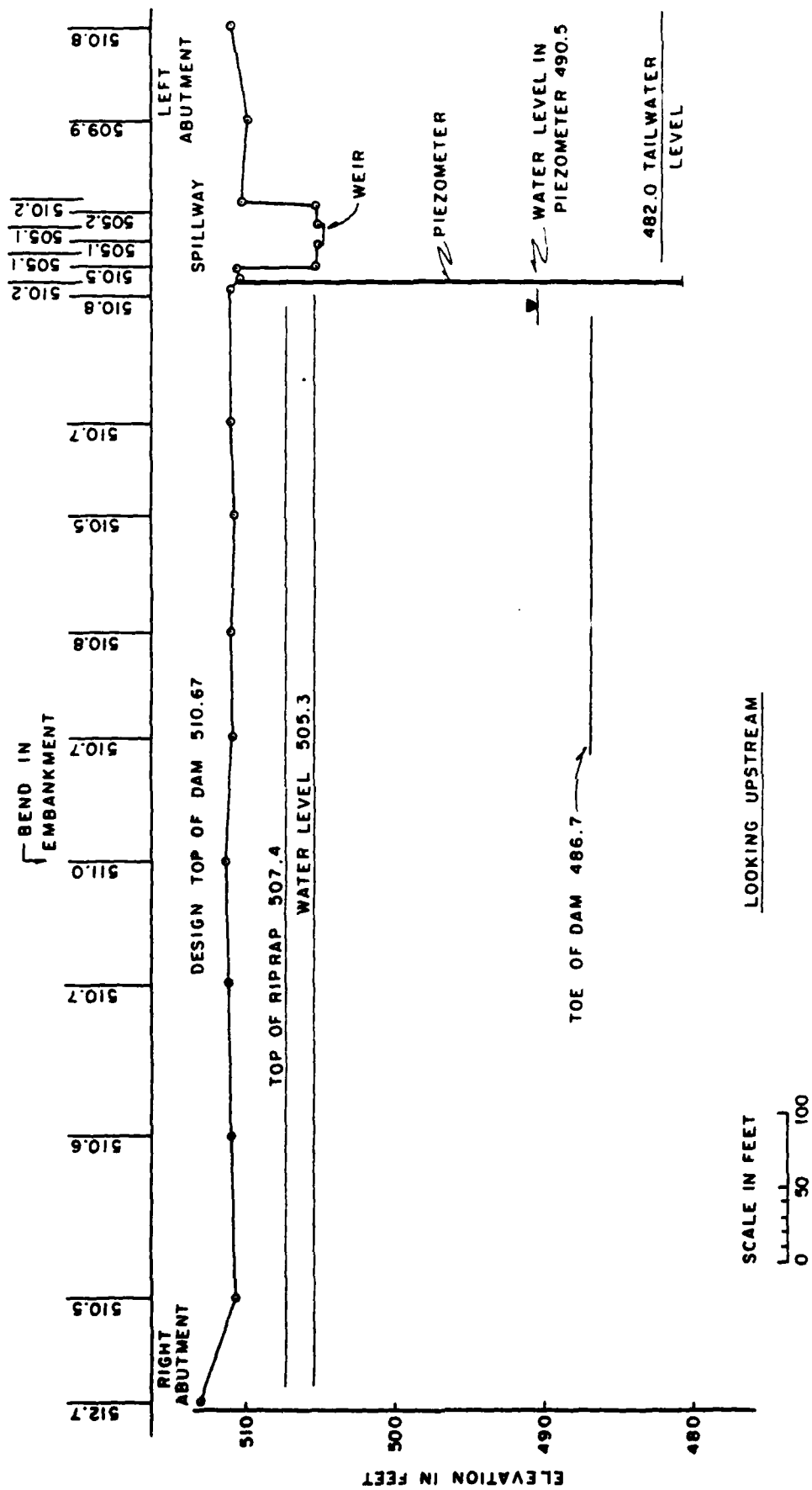
EMBANKMENT

Sheet 5 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATION	Vegetation was in a dormant state at the time of inspection. Vegetation on the upstream slope is grass. The crest is protected with mine screenings, coarse sand/fine gravel size rock fragments. There are two cedar trees on the downstream slope. Vegetation near the maximum section includes grass, woody vegetation (sumac), Crownvetch and briars.	
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	All junctions are in good condition. The downstream junction between the embankment and right abutment is a paved stone gutter. Junctions between the spillway and abutment and spillway and embankment are in good condition except foot traffic has worn paths through the vegetation.	
ANY NOTICEABLE SEEPAGE	Yes, see Sheet 5A.	
STAFF GAGE AND RECORDER	None. Staff gages to be installed.	
DRAINS	None observed.	



FIELD OBSERVATION PLAN
HOPEWELL DAM



FIELD OBSERVATION PROFILE
 HOPEWELL DAM
 SHEET 5B OF 11

OUTLET WORKS

Sheet 6 of 11

<u>VISUAL EXAMINATION OF</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	30 inch conduit not inspected.	
INTAKE STRUCTURE	Completely underwater.	
OUTLET STRUCTURE	None, conduit discharges into spillway stilling basin.	
OUTLET CHANNEL	None.	
EMERGENCY GATE	Seats completely. A platform of concrete blocks and planks is constructed to operate gate.	

UNGATED SPILLWAY

Sheet 7 of 11

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

CONCRETE WEIR

The concrete weir is faced with stone. The upper 4 feet is faced with small stones and is fairly smooth. Below that are large stones forming steps up to 2 feet high. Water is exiting the stone face. Mortared joints have been repaired. Only two small holes were located in mortared joints.

APPROACH CHANNEL

None.

DISCHARGE CHANNEL

Spillway discharges into a large stilling basin. Spillway retaining walls are stone faced concrete. Water was exiting the stone face of both retaining walls. Water staining was evident to nearly the top of the walls.

BRIDGE AND PIERS

None

GATED SPILLWAY

Sheet 8 of 11

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

INSTRUMENTATION

<u>VISUAL EXAMINATION</u>	<u>OBSERVATIONS</u>	<u>REMARKS OR RECOMMENDATIONS</u>
<u>MONUMENTATION/SURVEYS</u>	<i>None</i>	

Sheet 9 of 11

OBSERVATION WELLS

Six observation wells shown on design drawings; only one, on the crest near the spillway, was located. The water level at the time of inspection was 20 feet below the crest. The total depth of the well is 30 feet.

WEIRS

None

PIEZOMETERS

None

OTHER

None

INSTRUMENTATION

VISUAL EXAMINATION	OBSERVATIONS	Sheet 9 of 11
MONUMENTATION/SURVEYS	None	REMARKS OR RECOMMENDATIONS

OBSERVATION WELLS

Six observation wells shown on design drawings; only one, on the crest near the spillway, was located. The water level at the time of inspection was 20 feet below the crest. The total depth of the well is 30 feet.

WEIRS

None

PIEZOMETERS

None

OTHER

None

RESERVOIR

Sheet 10 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	<i>Reservoir side slopes are flat to moderate and well vegetated to waters edge with trees. Little debris was noted.</i>	
SEDIMENTATION	<i>Very little sediment was noted at the upper end. Sediment accumulation has little or no effect on flood water storage.</i>	

DOWNSTREAM CHANNEL

Sheet 11 of 11

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	<i>Immediately below the dam, the 20 foot wide channel flows through a wooded flood plain to Hopewell Village.</i>	
SLOPES	<i>The valley gradient is about 0.01 below the dam.</i>	
APPROXIMATE NO. OF HOMES AND POPULATION	<i>The main damage center is about 1200 feet downstream of the dam in Hopewell Village, a National Historic Site. In addition to the appreciable economic damage to historic buildings in the event of failure, the Park Superintendent lives in a house which is a few feet above the stream bank.</i>	

APPENDIX

B

NAME OF DAM Hopewell Dam
ID # PA 00724

Sheet 1 of 4

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE I

REMARKS
None available.

ITEM
AS-BUILT DRAWINGS

REGIONAL VICINITY MAP

See Plate 1, Appendix E.

CONSTRUCTION HISTORY

See text, Section 1.2

TYPICAL SECTIONS OF DAM

See Appendix E.

OUTLETS - PLAN

DETAILS

CONSTRAINTS

DISCHARGE RATINGS

RAINFALL/RESERVOIR RECORDS

See Appendix E.

See Appendix D.

None

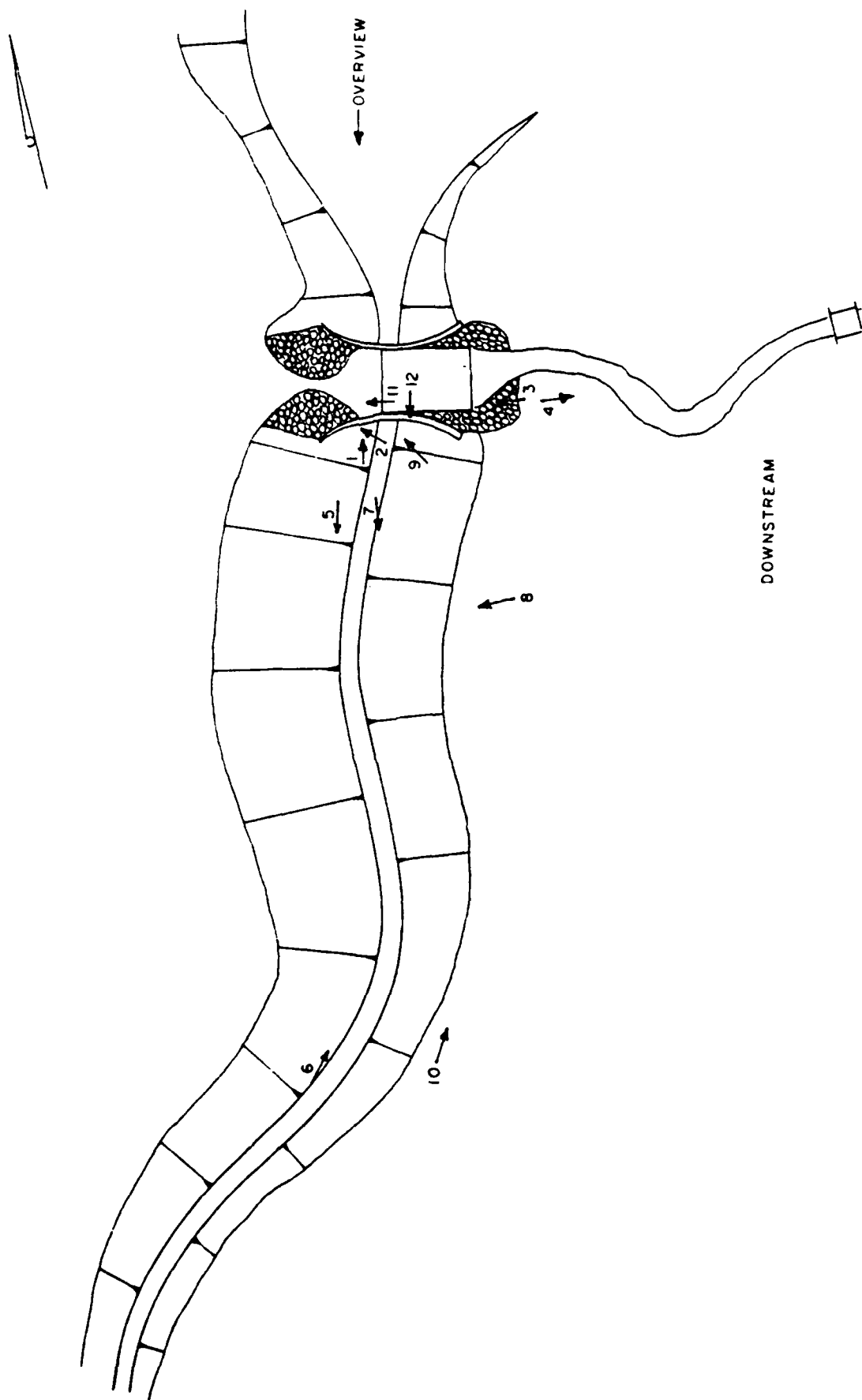
ITEM	REMARKS
DESIGN REPORTS	None available.
GEOLOGY REPORTS	See Appendix F.
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Spillway stability, see Appendix E. Hydrology and hydraulics, see Appendix D for discussion.
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	See text, Section 1.2
POST-CONSTRUCTION SURVEYS OF DAM	None
BORROW SOURCES	Two borrow pits were reportedly used. One borrow pit was 300 feet upstream of the dam on the left slope of the reservoir basin and the other was located about two miles from the dam.

ITEM	REMARKS
MONITORING SYSTEMS	Original design specified observation wells in the embankment. Only one located.
MODIFICATIONS	None known.
HIGH POOL RECORDS	None
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None known.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None known.
MAINTENANCE OPERATION RECORDS	None

ITEM	REMARKS
SPILLWAY PLAN	
SECTIONS DETAILS	See Appendix E.
OPERATING EQUIPMENT PLANS & DETAILS	Shown on plans.
MISCELLANEOUS	DER files containing: 1. Design drawings. 2. Correspondence, memoranda, progress reports. 3. Inspection reports. 4. 117 black and white photographs taken between 1936 and 1973. 5. Operation and Maintenance Manual (Bureau of State Parks).

APPENDIX

C



PHOTOGRAPH LOCATION PLAN
HOPEWELL DAM

PLATE C-1



UPPER PORTION OF WEIR, SMALL
STONES USED FOR FACING TO
PROVIDE UNIFORM SHAPE.

PHOTOGRAPH NO. 1



PLATFORM CONSTRUCTED ON OUTLET
STRUCTURE UPSTREAM OF WEIR TO
STAND ON WHILE OPERATING POND
DRAIN GATE.

PHOTOGRAPH NO. 2



WEIR AND STILLING BASIN. NOTE
LARGE FACING STONES CREATING STEPS
ON FACE OF WEIR. ALSO NOTE DISCHARGE
FROM POND DRAIN AT BOTTOM LEFT OF
SPILLWAY DISCHARGE.

PHOTOGRAPH NO. 3



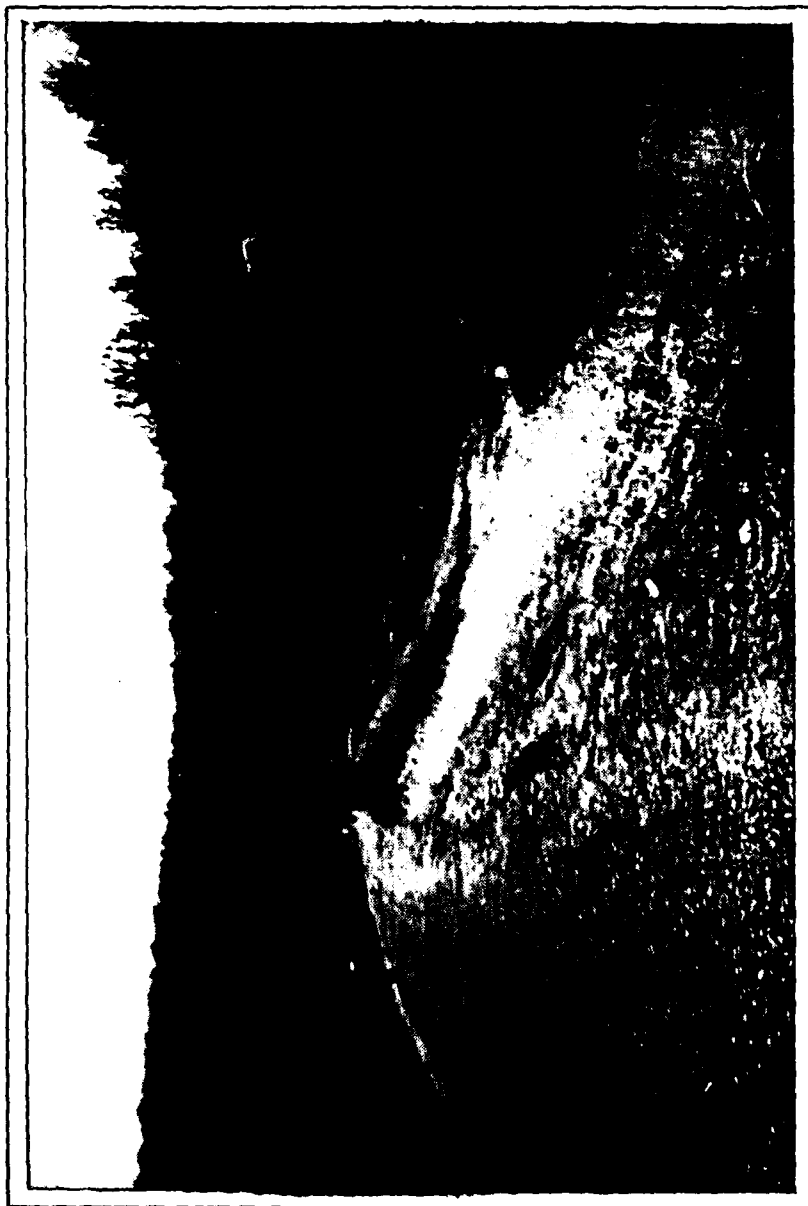
STILLING BASIN.

PHOTOGRAPH NO. 4



UPSTREAM SLOPE.

PHOTOGRAPH NO. 5



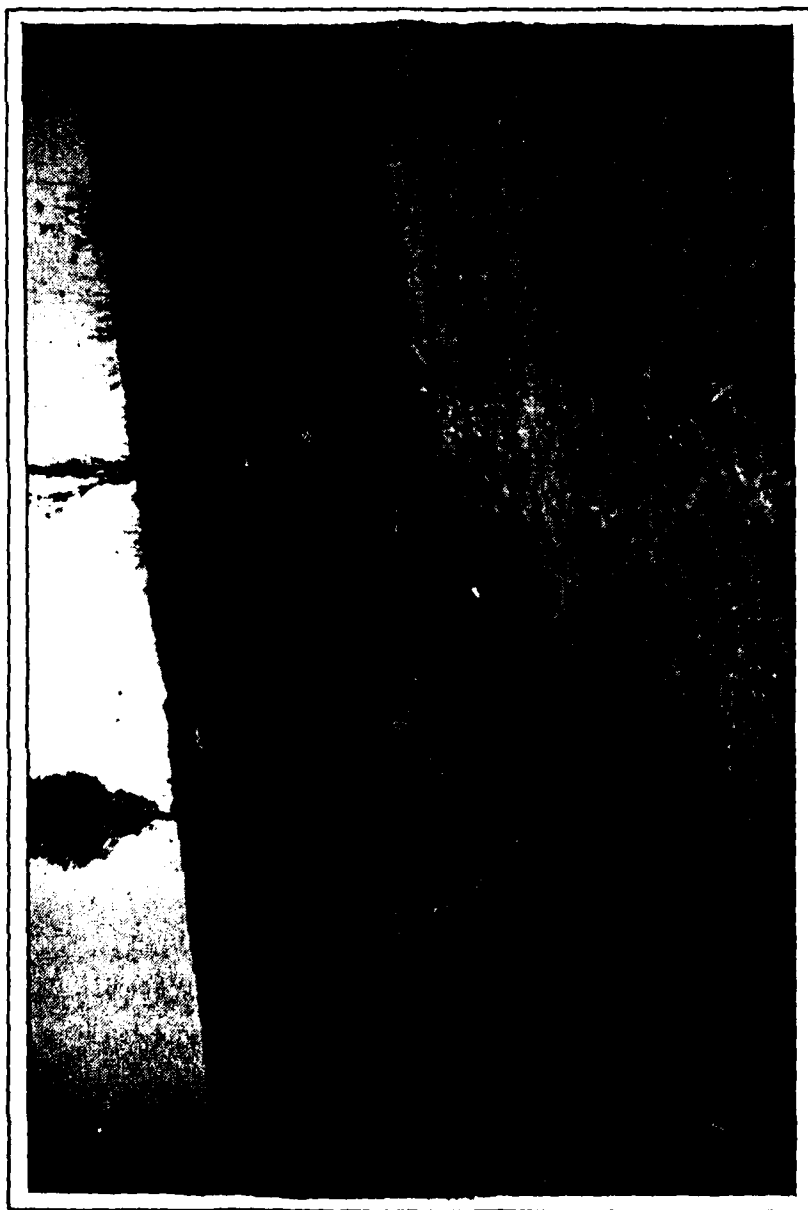
CREST AND OVERALL VIEW OF DOWNSTREAM
SLOPE.

PHOTOGRAPH NO. 6



TREES, BRIARS AND WOODY VEGETATION
ON DOWNSTREAM SLOPE.

PHOTOGRAPH NO. 7



STONE STEPS ON DOWNSTREAM SLOPE.

PHOTOGRAPH NO. 8



WATER OBSERVATION PIPE WITH
CAP OFF.

PHOTOGRAPH NO. 9



LOCATION OF STANDING WATER AND
SOFTER EMBANKMENT ON DOWNSTREAM
SLOPE.

PHOTOGRAPH NO. 10



LEAKAGE THROUGH WEIR BETWEEN NOTCH
AND RIGHT RETAINING WALL.

PHOTOGRAPH NO. 11



LEACHATE AS A RESULT OF
SEEPAGE THROUGH RIGHT
STILLING BASIN WALL.

PHOTOGRAPH NO. 12



DOWNSTREAM DAMAGE CENTER AT HOPEWELL
VILLAGE.

PHOTOGRAPH NO. 13



ANOTHER VIEW OF THE BUILDING SHOWN
IN PHOTOGRAPH NO. 13.

PHOTOGRAPH NO. 14



ONE OF THE BUILDINGS IN THE BACKGROUND
IS AN OCCUPIED RESIDENCE.

PHOTOGRAPH NO. 15

C

APPENDIX

D

O

HOPEWELL DAM
CHECK LIST
HYDROLOGIC AND HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 80% wooded, 1% residential development
upstream of dam.

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 505.0 feet (569 Acre-Feet).

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 509.9 feet (943 Acre-Feet).

ELEVATION MAXIMUM DESIGN POOL: ---

ELEVATION TOP DAM: 509.9 feet.

SPILLWAY

- a. Elevation 505.0 feet.
- b. Type Stone faced concrete ogee weir
- c. Width 42 feet.
- d. Length --
- e. Location Spillover Near left abutment.
- f. Number and Type of Gates None

OUTLET WORKS:

- a. Type 30 inch conduit gated upstream of weir.
- b. Location Through spillway adjacent to right retaining wall.
- c. Entrance inverts 483 feet.
- d. Exit inverts 483- feet.
- e. Emergency draindown facilities through outlet works.

HYDROMETEOROLOGICAL GAGES:

- a. Type None within watershed, rainfall measured at Hopewell Village.
- b. Location ----
- c. Records ----

MAXIMUM NON-DAMAGING DISCHARGE: Not determined.

HYDROLOGIC AND HYDRAULIC
BASE DATA

Sheet 2 of 15

DRAINAGE AREA: ⁽¹⁾ Scott's Run, 1.0 square mile; Hopewell, 1.56 square miles;
2.56 square miles total.
PROBABLE MAXIMUM PRECIPITATION (PMP)
FOR 10 SQ. MILES IN 24 HOURS: ⁽²⁾ 23.5 inches.

ADJUSTMENT FACTORS FOR DRAINAGE AREA (%): ⁽³⁾

Zone	<u>6</u>
6 Hours	<u>113</u>
12 Hours	<u>123</u>
24 Hours	<u>132</u>
48 Hours	<u>142</u>

SNYDER HYDROGRAPH PARAMETERS: ⁽⁴⁾

	<u>Scott's Run Dam</u>	<u>Hopewell Dam</u>
Zone	<u>7*</u>	<u>7</u>
C _p , C _t	<u>0.65*, 1.35*</u>	<u>0.65, 1.35</u>
L (5)	<u>1.2 miles*</u>	<u>L¹ = 1.52 miles**</u>
L _{ca} (6)	<u>0.4 mile*</u>	
tp = C _t (L · L _{ca}) ^{0.3}	<u>1.1 hr. *</u>	<u>tp = C_t (L¹)^{0.6} = 1.73</u>

SPILLWAY CAPACITY AT MAXIMUM
WATER LEVEL ⁽⁷⁾

Hopewell Dam - 1747 cfs

- (1) Measured from USGS maps.
- (2) Hydrometeorological Report No. 33, Figure 1.
- (3) Hydrometeorological Report No. 33, Figure 2.
- (4) Information received from Corps of Engineers, Baltimore District.
- (5) Length of longest water course from outlet to basin divide, measured from USGS maps.
- (6) Length of water course from outlet to point opposite the centroid of drainage area, (see Plate 1, Appendix E) measured from USGS maps.
- (7) See Sheets 5, 14 of this Appendix.

* Values obtained from Phase I Inspection Report, Scott's Run Lake Dam, July, 1979

** L¹ = length from upper end of reservoir to watershed divide, used when watershed centroid within or very near reservoir.

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.

Included in this Appendix are the HEC-1, Rev. pertinent input values and a summary print-out tables.

BY MFB DATE 4/2/80

SUBJECT

SHEET 4 OF 15

CHKD. BY _____ DATE _____

Hopewell Dam

JOB No. _____

Hydrology / Hydraulics

Classification (Ref: Recommended Guidelines for Safety Inspection of Dams)

1. The hazard potential is rated as "High" as there would be loss of life if the dam failed
2. The size classification is "Small" based on its 26 ft. height and 94.9 Ac.-Ft. total storage capacity.
3. The selected spillway design flood, based on size and hazard classification is the Probable Maximum Flood (PMF).

Hydrology and Hydraulic Analysis

1. Original/Evaluation Data.

Spillway - designed as ogee weir.

$$Q = C_d L H_o^{3/2}$$

$$L = 42 \text{ ft.}$$

$$H_o = 4.67 \text{ ft. design head}$$

$$C_d = 3.95$$

- calculations indicate spillway can discharge a 10 hr event of 0.96 in./hr or 8.3 inches of runoff.

Scott's Run Dam - Phase I Inspection, July 1975.

Inflow hydrograph parameters, elevation-storage data and spillway discharge characteristics obtained from report

2. Evaluation of Data.

Inflow hydrograph parameters shown on sheet 2.

Reservoir Routing

elevation-storage data, obtained from 12/11/35 drawing and shown on Plate I of Hopewell Dam O & M manual enclosed as sheet 6. Normal pool area verified by current USGS map. Flood storage estimated from USGS map.

elevation-discharge data. Ogee weir design head is 4.67 ft. The reported coefficient of discharge, C_d , of 3.95 corresponds to a height of weir above upstream #1, P, of 11.6 ft. (Ref - Design of Small Dams, 2ed., 1973, Bureau of Reclamation).

BY MEB DATE 4/3/80SUBJECT Hopewell DamSHEET 5 OF 15CHKD. BY AHD DATE 4/7/80Hydrology / HydraulicsJOB No.

As $P = 2.3'$ (reported during construction), C_o for weir is reduced; $C_o = 3.8$

W.S.	H_e	H_{e1}/H_e	C/C_o	C_o	L	Q	
505.0	0	0				0	
506.0	1	0.21	0.85	3.80	42'	135 cfs	✓
507.0	2	0.43	0.90			406	✓
508.0	3	0.64	0.94			780	✓
509.0	4	0.86	0.98			1251	✓
510.0	5	1.07	1.01			1802	✓
511.0	6	1.28	1.03			2416	✓
513.0	8	1.71	1.07			3864	✓

Overtopping - as shown on sheet 14, the embankment is overtopped by 1.2 ft during the 0.5 PMF event and by 2.6 ft during the PMF.

Overtopping is assessed to cause failure if the embankment is overtopped by about one foot for more than one hour, say 0.8 ft.

Increase in downstream damage, discharge from dam routed downstream to Hopewell Village Historic Site.

An estimated 2.4 ft increase in water level resulting from failure during 0.5 PMF over non-failure during the 0.5 PMF is assessed to significantly increase the potential for damage. Buildings shown in Photos 13, 14 are at about elevation 479.5.

Spillway Adequacy - the spillway is rated as "Seriously Inadequate".

SUBJECT

FILE NO.

HOPEWELL DAM

SECTION NO.

FRENCH CREEK STATE PARK

SHEET 6 OF 15
SHEET NO.

COMPUTED BY

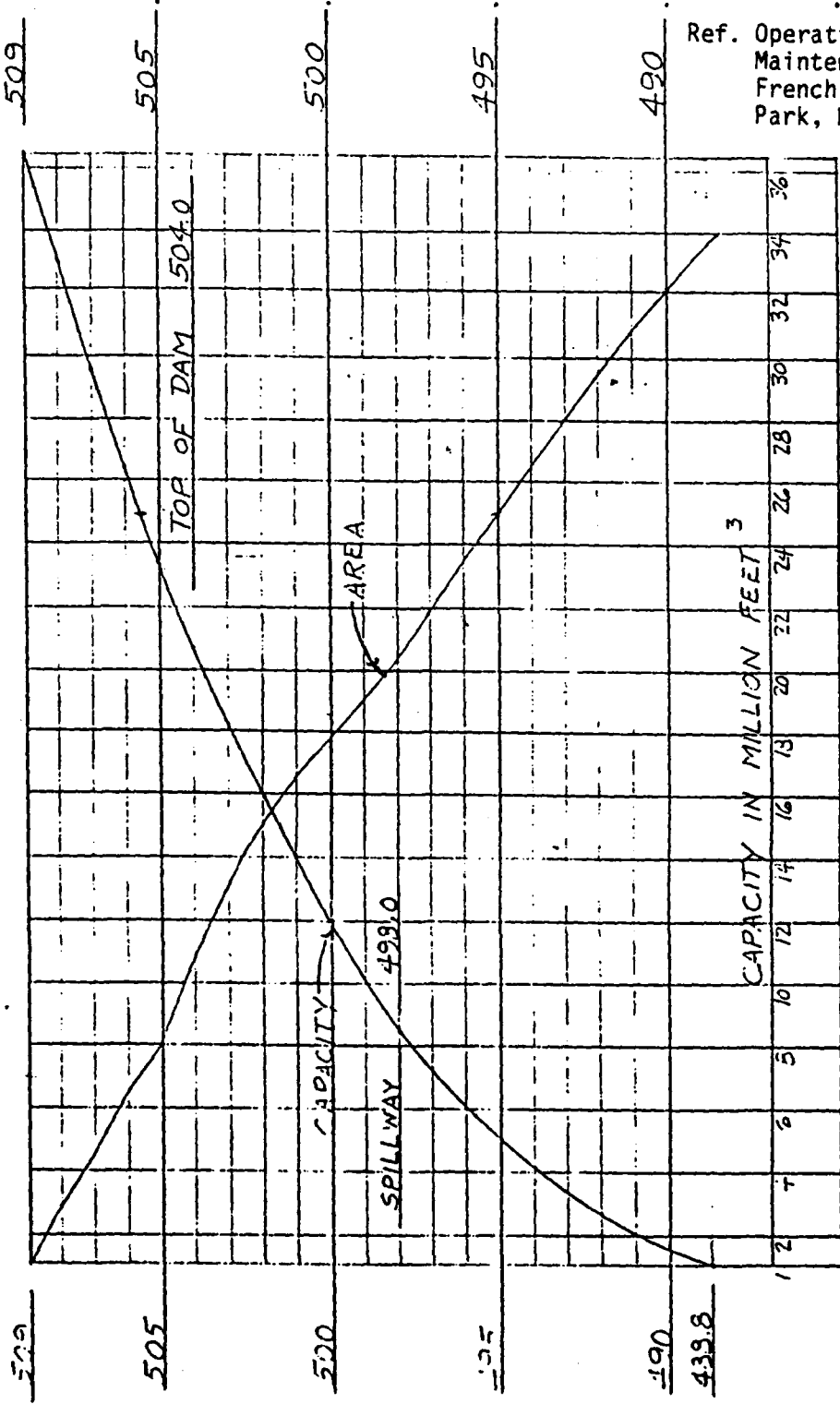
CHECKED BY

DATE

MADE IN CONNECTION WITH

AREA IN ACRES

83 80 76 71 67 62 57 53 48 44 39 34 29 25 20 15 10 6 0



Ref. Operation and Maintenance Manual
French Creek State Park, Hopewell Dam

23 46 32 138 184 230 275 321 367 413 459 505 551 597 639 735 781 826

PLATE NO. 1 AREA-CAPACITY RELATIONSHIP

PREVIEW OF SEQUENCE OF STREAM NETWORK CALCULATIONS

```

1*****
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION    JULY 1978
LAST MODIFICATION    26 FEB 79
*****
RUN  DATE* 80/04/02.
      TIME* 10.31.21.

      RUNOFF HYDROGRAPH AT      SRIN
      ROUTE HYDROGRAPH TO      SROU
      ROUTE HYDROGRAPH TO      CHA
      RUNOFF HYDROGRAPH AT      HWIN
      COMBINE 2 HYDROGRAPHS AT  COM
      ROUTE HYDROGRAPH TO      OUT
      ROUTE HYDROGRAPH TO      DS1
      ROUTE HYDROGRAPH TO      DS2
      END OF NETWORK
  
```

HOPEWELL DAM
 NAT ID NO. PA 00724 DER NO. 6-401
 OVERTOPPING ANALYSIS

JOB SPECIFICATION									
NO	NHR	NMIN	IDAY	IHR	IWIN	METRC	IPLT	IPRY	NSTAN
200	0	15	0	0	0	0	0	-4	0
	JOPER			NWT	LROPT	TRACE			
	5			0	0	0			

MULTI-PLAN ANALYSES TO BE PERFORMED
 NPLAN= 1 NRTIO= 5 LRTIO= 1
 RTIOS= .20 .30 .40 .50 1.00

SUB AREA NUMBER COMPUTATION

SCOTTS RUN INFLOW HYDROGRAPH

ISTAO ICUMP IECUP ITAPE JPLI JPMI INAME ISTAGE IAUO
SKIN 0 0 0 0 0 1 9 0

HYDROGRAPH DATA

INTBG IUNG TAREA SNAP TMSDA TRSPC RATID ISMBU ISARE LOCAL
1 1 1.00 0.00 2.36 0.00 0.000 0 1 0

PRECIP DATA

SPFE PMS R6 R12 R24 R48 R72 R96
0.00 23.50 113.00 123.00 132.00 142.00 0.00 0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT STRKR DLTNR RTIOL EXAIN STRKS RTIOK STRIL CNSTL ALSM1 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= 1.10 CP= .65 RTA= 0

RECESSION DATA

STRTO= -1.50 ORCSN= -.05 RTIOR= 2.00

UNIT HYDROGRAPH 23 END-OF-PERIOD ORBITATES, LAG= 1.11 HOURS, CP= .64 VOL= 1.00

36. 120. 245. 340. 377. 339. 264. 201. 154. 117.
90. 68. 52. 40. 30. 23. 18. 14. 10. 8.
6. 5. 3.

END-OF-PERIOD FLOW
MO.BA HR.MM PERIOD RAIN EXCS LOSS COMP 0 MO.BA HR.MM PERIOD RAIN EXCS LOSS COMP 0

SUM 26.70 24.30 2.40 62855.
(678.) (617.) (61.) (1779.86)

HYDROGRAPH ROUTING

SCOTTS RUN OUTFLOW HYDROGRAPH

ISTAO ICUMP IECUP ITAPE JPLI JPMI INAME ISTAGE IAUO
SROU 1 0 0 0 0 1 0 0

ROUTING DATA

OLOSS CLOSS AVG IRES ISAME IDPT IPMP LSTR
0.0 0.000 0.00 1 1 0 0 0

NSTPS NSTBL LAG AMSK X TSK STORA ISPRAT
1 0 0 0.000 0.000 0.000 -592. 0

SURFACE AREA= 0. 22. 46.
CAPACITY= 0. 198. 464.
ELEVATION= 565. 592. 600.

CREL SPWID COBW EXPW ELEV COUL CAREA EXPL
592.0 40.0 3.5 1.5 0.0 0.0 0.0 0.0

DAM DATA

TOPEL COBW EXPW DAMWID
599.0 3.1 1.5 500.

HYDROGRAPH ROUTING

CHANNEL ROUTING BETWEEN SCOTTS RUN AND HOPEWELL

ISTAD	ICUAP	IELDM	ITAME	JPLT	JPRT	INAME	ISAGE	IAUTO
CHA	1	0	0	0	0	1	0	0
ROUTING DATA								
GLOS	CLOS	AVG	IRIS	ISAME	IDPT	IPMP	LSIR	
0.0	0.000	0.00	1	010000000	0		0	
MSIPS	MSIDL	LAG	AMSKR	E	TSK	SIURA	ISPKAT	
1	0	0	0.000	0.000	0.000	0.	0	

NORMAL DEPTH CHANNEL ROUTING

QK(1)	QK(2)	QK(3)	ELNVT	ELMAX	HLNTH	SEL
.0550	.0500	.0550	530.0	545.0	4000.	.01300

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

0.00	545.00	332.00	535.79	422.00	535.70	422.00	530.00	434.00	530.00
434.00	535.70	500.00	536.00	595.00	545.00				

STORAGE	0.00	.07	1.74	2.61	3.48	4.35	5.22	6.09	15.54	30.88
	48.87	69.50	92.78	118.71	147.28	178.50	212.37	248.89	288.85	329.86
OUTFLOW	0.00	25.32	74.70	137.45	209.06	286.97	369.57	455.76	750.28	1538.01
	2757.24	4415.60	6535.33	9143.29	12267.99	15938.44	20183.64	25032.36	30513.00	36653.55
STAGE	530.00	530.79	531.58	532.37	533.16	533.95	534.74	535.53	536.32	537.11
	537.89	538.68	539.47	540.26	541.05	541.84	542.63	543.42	544.21	545.00
FLOW	0.00	25.32	74.70	137.45	209.06	286.97	369.57	455.76	750.28	1538.01
	2757.24	4415.60	6535.33	9143.29	12267.99	15938.44	20183.64	25032.36	30513.00	36653.55

SUB-AREA RUNOFF COMPUTATION

UNCONTROLLED AREA RUNOFF HYDROGRAPH INTO HOPEWELL LAKE

ISTAD	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME	ISAGE	IAUTO
NUIN	0	0	0	0	0	1	0	0

HYDROGRAPH DATA

INHYG	IUNG	TAREA	SNAP	TRSDA	TRSPC	KATIO	ISHOW	ISARE	LOCAL
1	1	1.56	0.00	2.56	0.00	0.000	0	1	0

PRECIP DATA

SPFE	PRS	R6	R12	R24	R48	R72	R96
0.00	23.50	113.00	123.00	132.00	142.00	0.00	0.00

TRSPC COMPUTED BY THE PROGRAM IS .800

LOSS DATA

LROPT	STKR	BLTKR	RTIOL	ERAIN	STKRS	RTIOK	STRTL	CNSTL	ALSMX	RTIMP
0	0.00	0.00	1.00	0.00	0.00	1.00	1.00	.85	0.00	0.00

UNIT HYDROGRAPH DATA

TP= 1.73 CP= .65 RTA= 0

RECESSION DATA

STR0= -1.50 GRCSM= -.05 RTIO= 2.00

UNIT HYDROGRAPH 36 END-OF-PERIOD ORDINATES, LAG= 1.73 HOURS, CP= .65 VOL= 1.00

20.	73.	146.	226.	302.	356.	382.	375.	333.	281.
230.	201.	170.	143.	121.	102.	86.	73.	62.	52.
44.	37.	31.	26.	22.	19.	16.	13.	11.	10.
0.	7.	6.	5.	4.	3.				

NO.DA	HR.AN	PERIOD	RAIN	EXCS	LOSS	CORP Q	NO.DA	HR.AN	PERIOD	RAIN	EXCS	LOSS	CORP Q
-------	-------	--------	------	------	------	--------	-------	-------	--------	------	------	------	--------

SUM 26.70 24.30 2.40 17286.
(478.) (617.) (61.) (2754.83)

 LUNARINE HYDROGRAPHS

HOPEWELL INFLOW HYDROGRAPH

ISTAD	ICOMP	IECON	ITAPE	JPL1	JPRT	INAME	ISTAGE	IAUTO
CON	2	0	0	0	0	1	0	0

 HYDROGRAPH ROUTING

HOPEWELL DAM OUTFLOW HYDROGRAPH

ISTAD	ICOMP	IECON	ITAPE	JPL1	JPRT	INAME	ISTAGE	IAUTO
OUT	1	0	0	0	0	1	0	0

ROUTING DATA

BLOSS	CLOSS	AVG	IES	ISARE	IOPT	IPNP	LSTR
0.0	0.000	0.00	1	1	0	0	0

INSTPS INSTDL LAG ANSK X TSK STORA ISPRAT

INSTPS	INSTDL	LAG	ANSK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-503.	-1

STAGE	505.00	506.00	507.00	508.00	509.00	510.00	511.00	513.00
FLOW	0.00	135.00	406.00	780.00	1251.00	1802.00	2416.00	3064.00

SURFACE AREA= 0. 4. 27. 45. 68. 83. 87. 154.

CAPACITY= 0. 12. 119. 296. 603. 867. 952. 2141.

ELEVATION= 482. 488. 495. 500. 506. 509. 510. 520.

CREL SPWID CORW EXPW ELEVL COQL CAREA EXPL

CREL	SPWID	CORW	EXPW	ELEVL	COQL	CAREA	EXPL
505.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

DAM DATA

TOPEL	COOD	EXPD	DAMWID
509.9	0.0	0.0	0.

CREST LENGTH AT OR BELOW ELEVATION

CREST LENGTH	0.	75.	117.	460.	540.
AT OR BELOW ELEVATION	509.9	510.2	510.6	510.7	512.0

HYDROGRAPH ROUTING

DOWNSTREAM SECTION 400 FT BELOW DAM

ISTAB	ICORP	IELDN	ITAPE	JPLT	JPHI	INAME	ISTAGE	IAUTO
D51	1	0	0	0	0	1	0	0
ROUTING DATA								
LOSS	CLOSS	AVG	INES	ISAME	IPPT	IPMP	LSIR	
0.0	0.000	0.00	1	1	0	0	0	
NSIPS	NSIBL	LAG	AMSKE	X	TSK	STOKA	ISPRAT	
1	0	0	0.000	0.000	0.000	0.	0	

NORMAL DEPTH CHANNEL ROUTING

DN(1)	DN(2)	DN(3)	ELNVT	ELNAX	RLNTH	SEL
.0350	.0300	.0550	478.0	491.0	400.	.01000

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

STA	ELEV	STA	ELEV	ETC
0.00	491.00	15.00	486.00	31.50 489.50
61.50	480.50	269.00	486.10	389.00 491.00

	0.00	32.09	103.81	208.65	353.06	569.39	883.40	1323.51	1914.18	2677.62
STORAGE	0.00	.13	.29	.45	.65	.98	1.49	2.17	3.02	4.04
	5.24	6.40	8.14	9.82	11.61	13.53	15.56	17.70	19.97	22.36
OUTFLOW	0.00	32.09	103.81	208.65	353.06	569.39	883.40	1323.51	1914.18	2677.62
	3634.48	4804.25	6219.24	7945.54	9915.11	12135.85	14616.05	17364.14	20388.66	23698.19
STAGE	478.00	478.68	479.37	480.05	480.74	481.42	482.11	482.79	483.47	484.16
	484.84	485.53	486.21	486.89	487.58	488.26	488.95	489.63	490.32	491.00
FLOW	0.00	32.09	103.81	208.65	353.06	569.39	883.40	1323.51	1914.18	2677.62
	3634.48	4804.25	6219.24	7945.54	9915.11	12135.85	14616.05	17364.14	20388.66	23698.19

HYDROGRAPH ROUTING

DOWNSTREAM SECTION 1200 FT BELOW DAM

ISTAB	ICORP	IELDN	ITAPE	JPLT	JPHI	INAME	ISTAGE	IAUTO
D52	1	0	0	0	0	1	0	0
ROUTING DATA								
LOSS	CLOSS	AVG	INES	ISAME	IPPT	IPMP	LSIR	
0.0	0.000	0.00	1	1	0	0	0	
NSIPS	NSIBL	LAG	AMSKE	X	TSK	STOKA	ISPRAT	
1	0	0	0.000	0.000	0.000	0.	0	

NORMAL DEPTH CHANNEL ROUTING

DN(1)	DN(2)	DN(3)	ELNVT	ELNAX	RLNTH	SEL
.0400	.0400	.0400	475.0	495.0	800.	.00700

CROSS SECTION COORDINATES--STA,ELEV,STA,ELEV--ETC

STA	ELEV	STA	ELEV	ETC
0.00	495.00	25.00	479.50	145.00 475.00
158.00	479.50	375.00	481.50	660.00 495.00

	0.00	27.33	89.79	184.79	314.00	786.10	2238.29	4977.38	8813.95	13643.31
STORAGE	0.00	.18	.40	.67	.98	3.53	8.84	15.88	23.24	31.14
	39.51	48.33	57.63	67.38	77.60	88.27	99.41	111.02	123.08	135.61
OUTFLOW	0.00	27.33	89.79	184.79	314.00	786.10	2238.29	4977.38	8813.95	13643.31
	19427.04	26186.02	33891.62	42561.55	52207.59	62844.24	74487.89	87156.29	100868.12	115642.78
STAGE	475.00	476.05	477.11	478.16	479.21	480.26	481.32	482.37	483.42	484.47
	485.53	486.58	487.63	488.68	489.74	490.79	491.84	492.89	493.95	495.00
FLOW	0.00	27.33	89.79	184.79	314.00	786.10	2238.29	4977.38	8813.95	13643.31
	19427.04	26186.02	33891.62	42561.55	52207.59	62844.24	74487.89	87156.29	100868.12	115642.78

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	RATIOS APPLIED TO FLOWS				
				RATIO 1	RATIO 2	RATIO 3	RATIO 4	RATIO 5
				.20	.30	.40	.50	1.00
HYDROGRAPH AT	SRIN	1.00 (2.59)	1	745. (21.11)	1118. (31.66)	1491. (42.22)	1864. (52.77)	3727. (105.54)
ROUTED TO	SROU	1.00 (2.59)	1	572. (16.19)	875. (24.78)	1179. (33.38)	1482. (41.97)	3313. (93.81)
ROUTED TO	CHA	1.00 (2.59)	1	556. (15.74)	861. (24.37)	1163. (32.94)	1463. (41.42)	3226. (91.34)
HYDROGRAPH AT	HUIN	1.56 (4.04)	1	932. (26.39)	1398. (39.58)	1864. (52.77)	2330. (65.96)	4659. (131.93)
2 COMBINED	COM	2.56 (6.63)	1	1464. (41.47)	2229. (63.13)	3001. (84.97)	3763. (106.55)	7885. (223.27)
ROUTED TO	OUT	2.56 (6.63)	1	1001. (28.35)	1589. (45.00)	2261. (64.03)	3223. (91.26)	7569. (214.34)
ROUTED TO	DS1	2.56 (6.63)	1	1001. (28.35)	1588. (44.98)	2261. (64.01)	3228. (91.41)	7575. (214.49)
ROUTED TO	DS2	2.56 (6.63)	1	1001. (28.34)	1587. (44.94)	2261. (64.02)	3226. (91.36)	7578. (214.59)

SUMMARY OF DAM SAFETY ANALYSIS

SCOTT'S RUN DAM

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
	ELEVATION STORAGE OUTFLOW		INITIAL VALUE	SPILLWAY CREST		TOP OF DAM	
			592.00	592.00		599.00	
			198.	198.		420.	
			0.	0.		2593.	
.20	594.56	0.00	263.	572.	0.00	41.50	0.00
.30	595.39	0.00	288.	875.	0.00	41.50	0.00
.40	596.14	0.00	312.	1179.	0.00	41.50	0.00
.50	596.82	0.00	335.	1482.	0.00	41.50	0.00
1.00	599.42	.42	438.	3313.	1.50	41.25	0.00

PLAN 1 STATION CHA			
Channel routing between dams			
RATIO	MAXIMUM FLOW, CFS	MAXIMUM STAGE, FT	TIME HOURS
.20	556.	535.8	42.00
.30	861.	536.4	41.75
.40	1163.	536.7	41.75
.50	1463.	537.0	41.75
1.00	3226.	538.1	41.25

SUMMARY OF DAM SAFETY ANALYSIS

HOPEWELL DAM

ELEVATION	INITIAL VALUE	NO FAILURE SPILLWAY CREST	TOP OF DAM
STORAGE	505.00	505.00	509.90
OUTFLOW	569.	569.	943.
	0.	0.	1747.

RATIO OF PMF	MAXIMUM RESERVOIR U.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	508.47	0.00	823.	1001.	0.00	43.25	0.00
.30	509.61	0.00	918.	1589.	0.00	43.00	0.00
.40	510.58	.68	1003.	2261.	3.00	42.75	0.00
.50	511.13	1.23	1054.	3223.	4.00	42.50	0.00
1.00	512.45	2.55	1183.	7569.	6.50	41.75	0.00

PLAN 1 STATION DS1				PLAN 1 STATION DS2			
Section 400 ft. below Hopewell Dam				Section 1200 ft. below Hopewell Dam			
RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS	RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	1001.	482.3	43.25	.20	1001.	480.4	43.25
.30	1588.	483.1	43.00	.30	1587.	480.8	43.25
.40	2261.	483.8	42.75	.40	2261.	481.3	43.00
.50	3228.	484.6	42.50	.50	3226.	481.7	42.50
1.00	7575.	486.7	41.75	1.00	7578.	483.1	41.75

SUMMARY OF DAM SAFETY ANALYSIS

HOPEWELL DAM

Failure assumed. No upstream failures.

	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
ELEVATION	505.00	505.00	509.90
STORAGE	569.	569.	943.
OUTFLOW	0.	0.	1747.

RATIO OF PMF	MAXIMUM RESERVOIR U.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	508.47	0.00	823.	1001.	0.00	43.25	0.00
.30	509.61	0.00	918.	1589.	0.00	43.00	0.00
.40	510.58	.68	1003.	2261.	3.00	42.75	0.00
.50	510.95	1.05	1036.	12418.	1.16	42.25	41.75
1.00	511.22	1.32	1062.	13550.	1.28	40.75	40.25

PLAN 1 STATION DS1

Section 400 ft. below Hopewell Dam

RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	1001.	482.3	43.25
.30	1588.	483.1	43.00
.40	2260.	483.8	42.75
.50	12279.	488.3	42.25
1.00	13425.	488.6	40.75

PLAN 1 STATION DS2

Section 1200 ft. below Hopewell Dam

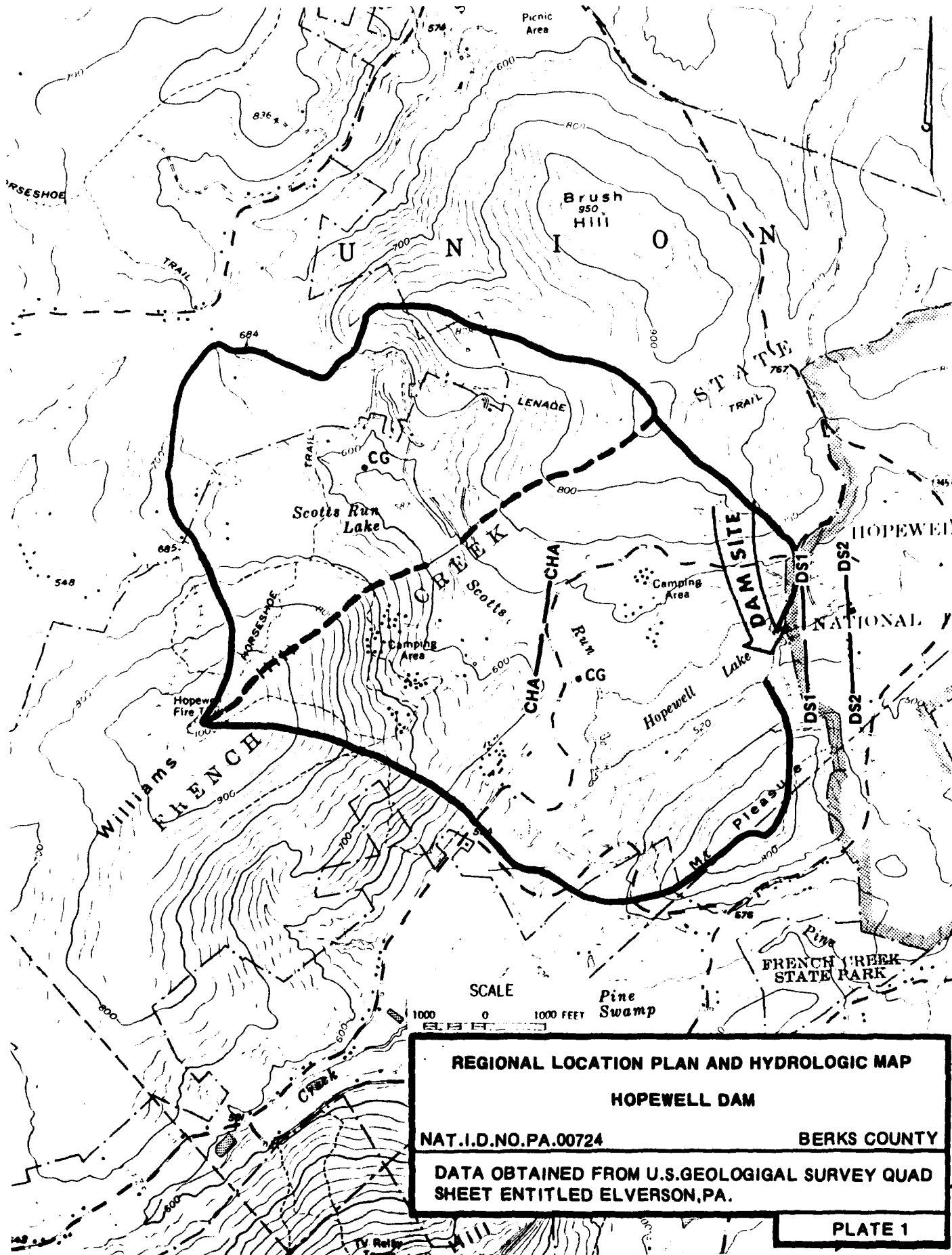
RATIO	MAXIMUM FLOW,CFS	MAXIMUM STAGE,FT	TIME HOURS
.20	1001.	480.4	43.25
.30	1587.	480.8	43.25
.40	2261.	481.3	43.00
.50	11879.	484.1	42.25
1.00	13055.	484.3	40.75

DAM BREACH DATA

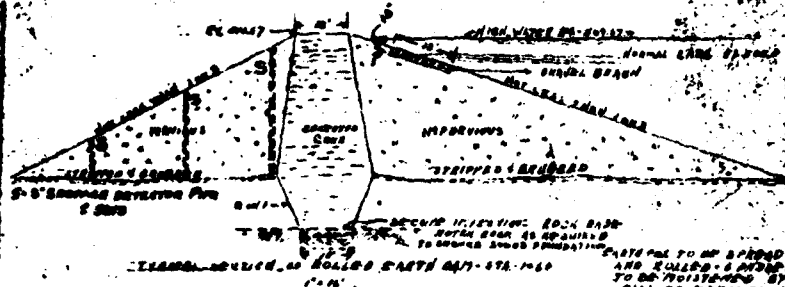
BRUID	Z	ELBM	TFAIL	USEL	FAILEL
30.	0.00	485.00	.50	505.00	510.70

APPENDIX

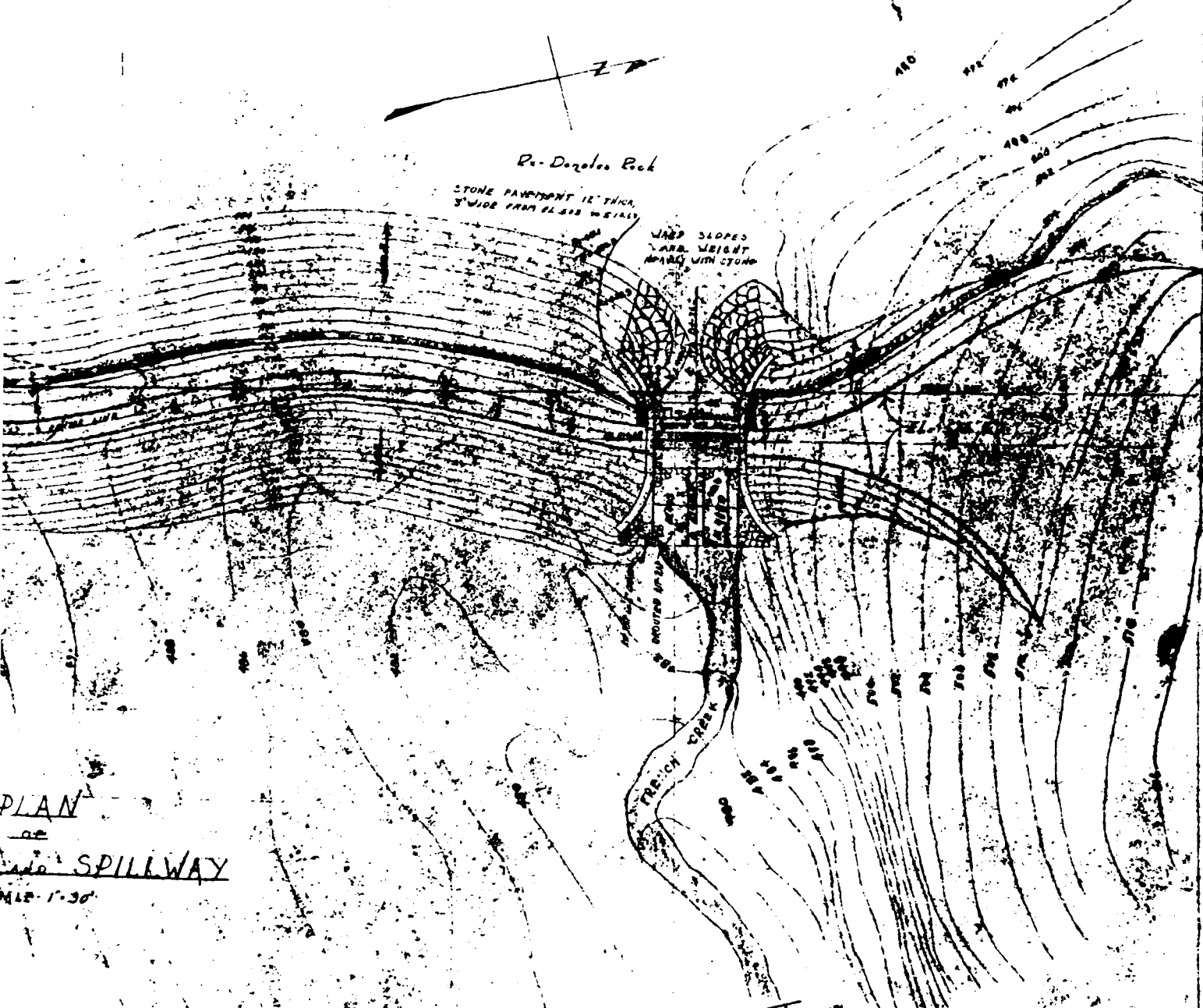
E



PLAN
OF
EARTH DAM AND SPILLWAY
SCALE 1"=30'



SPILLWAY TO BE SPREAD EWAY IN CHANNELS
AND ROLLED-LEVELLED BY HEAVY ROLLER -
TO BE MAINTAINED BY SPRINKLING TO SPREAD
FIL OF FINEST, WHITE OR LIGHT-
GRAY, SAND NOT OF PLASTIC.
AFTER DISCONTINUANCE OF ROLLING FOR A CARBIDE-
LINED THE SURFACE OF THE SPILLWAY SHALL BE
TIGHTENED AND COVERED BY HARDWOOD TO BE
REMOVED AFTER DRYING AND NEW FIL

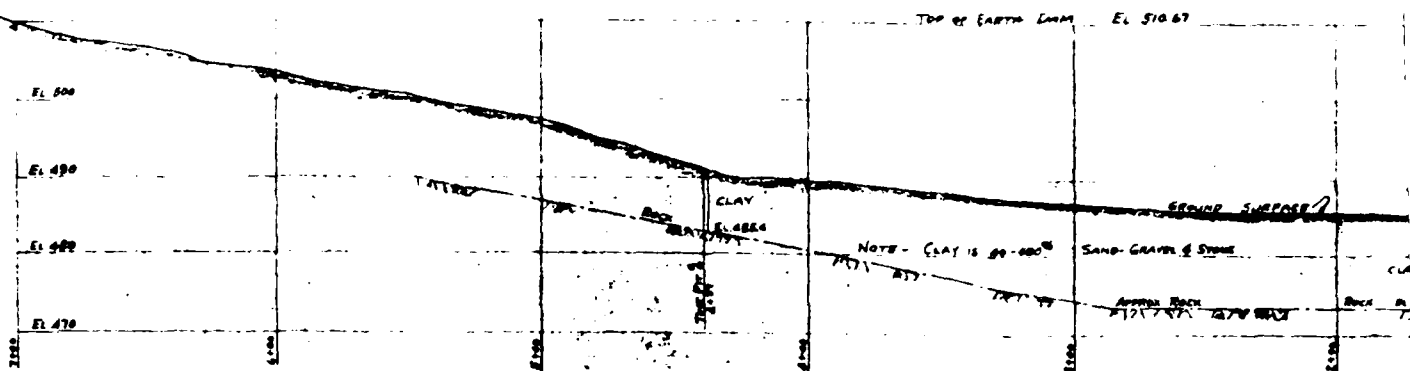


PLAN
 of
 SPILLWAY
 MAP 1-30

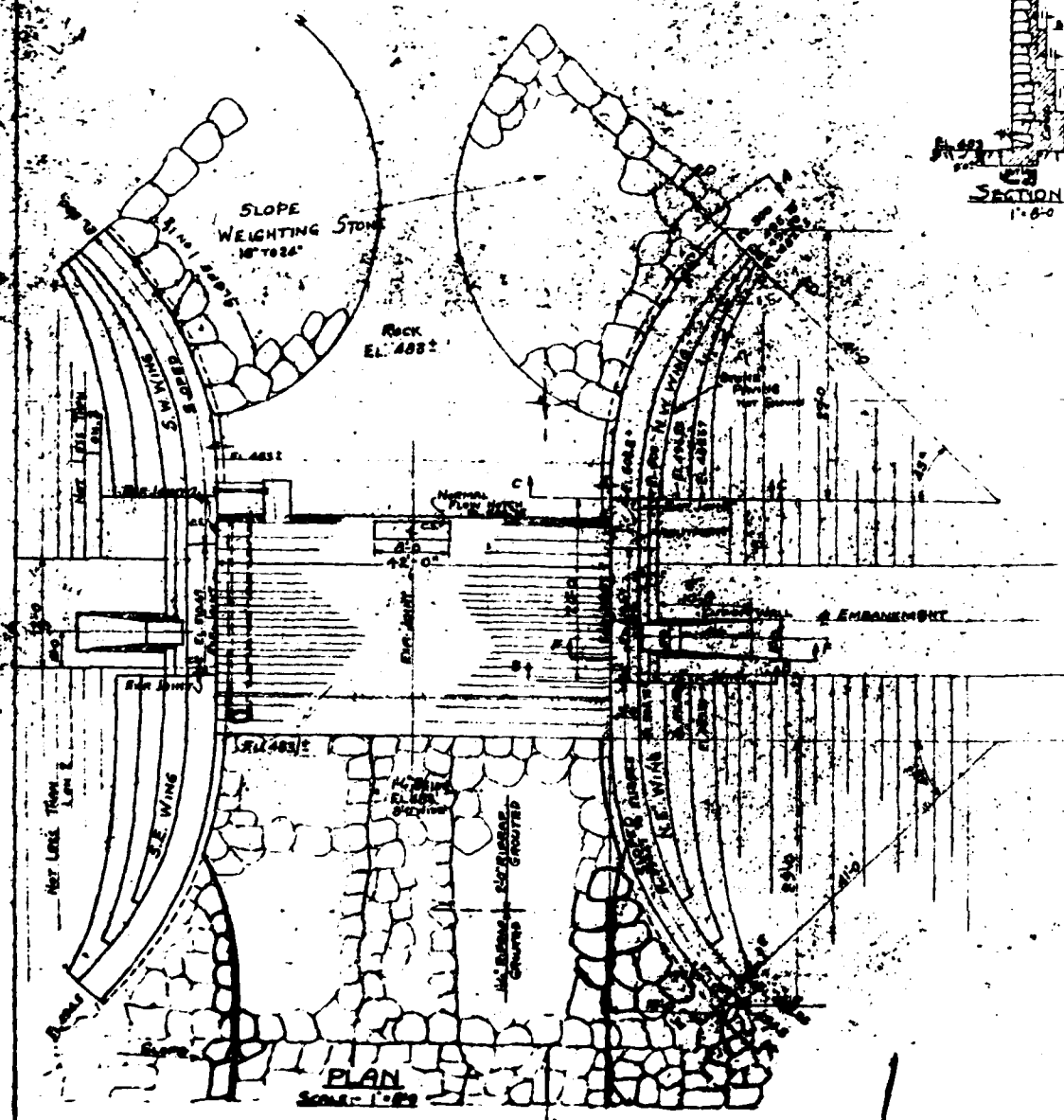
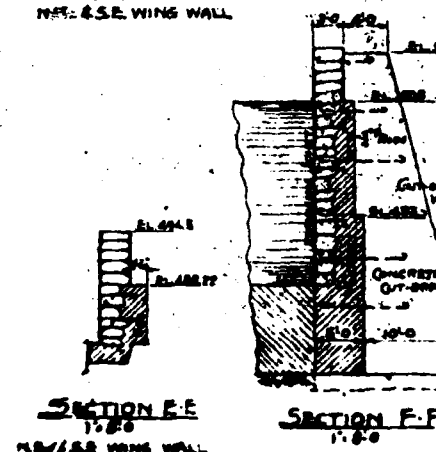
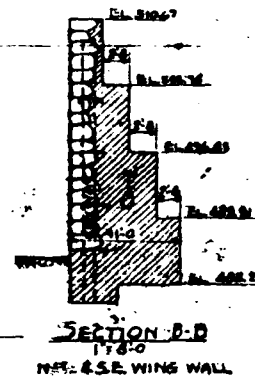
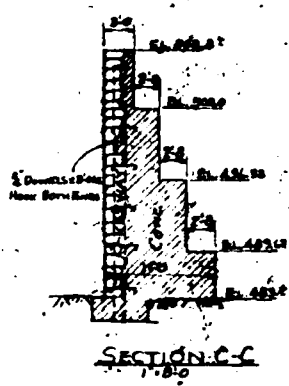
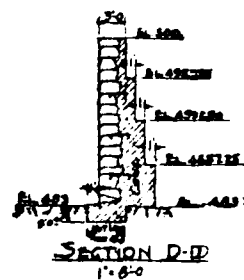
BRIDGE

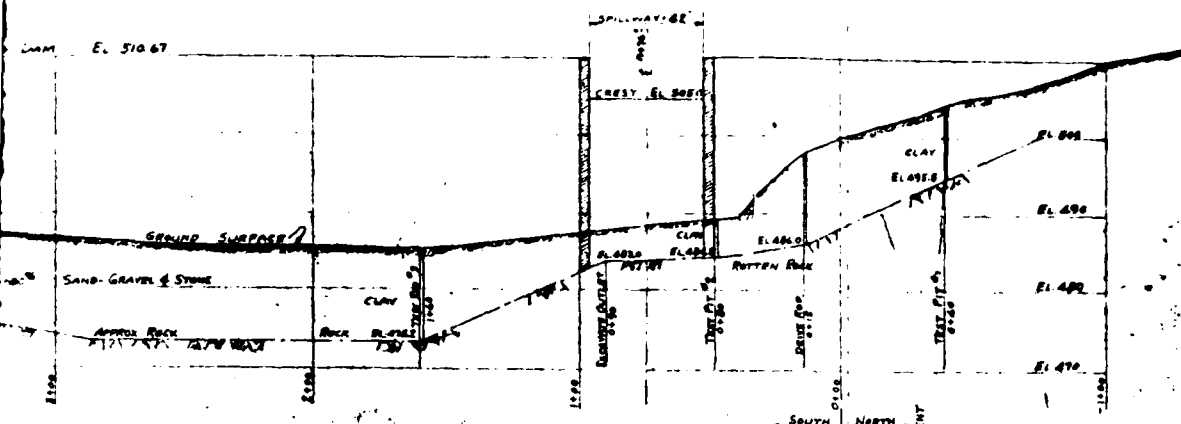
DEPARTMENT OF THE INTERIOR		
NATIONAL PARK SERVICE		
BRANCH OF PLANNING RECREATIONAL DEMONSTRATION PROJECTS		
FRENCH CREEK PROJECT NO. 2		
SEVEN, CHESTER CO.	PENNSYLVANIA	
PLAN EARTH DAM AND		
MASONRY OGEE TYPE SPILLWAY		
DRAWN BY C. G. B. L.	SCALE 1" = 40'	DATE 10-7-35
DESIGNED BY L. G. B. L.	AS INDICATED	NO. 22
APPROVED		
 PROJECT MANAGER		
STATE AGENCY	INCHARGE	
REGIONAL OFFICE	NATIONAL PARK SERVICE	

2
 PLATE 2

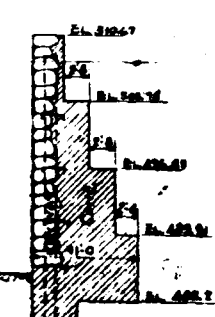
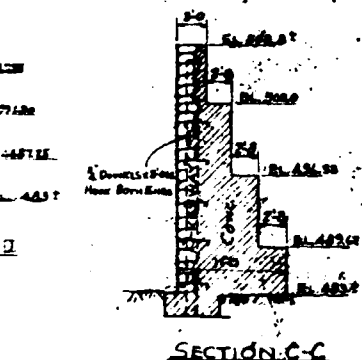


DOWNSTREAM PROFILE OF DAM
HOR. SCALE - 1" = 30'
VERT. SCALE - 1" = 10'

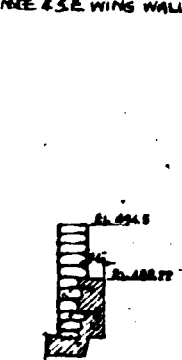




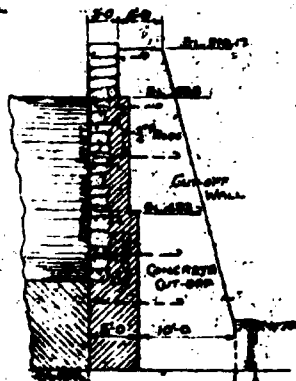
DOWNSTREAM PROFILE OF DAM
HOR. SCALE - 1" = 30'
VERT. SCALE - 1" = 10'



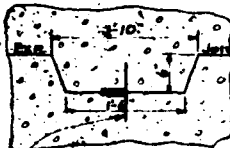
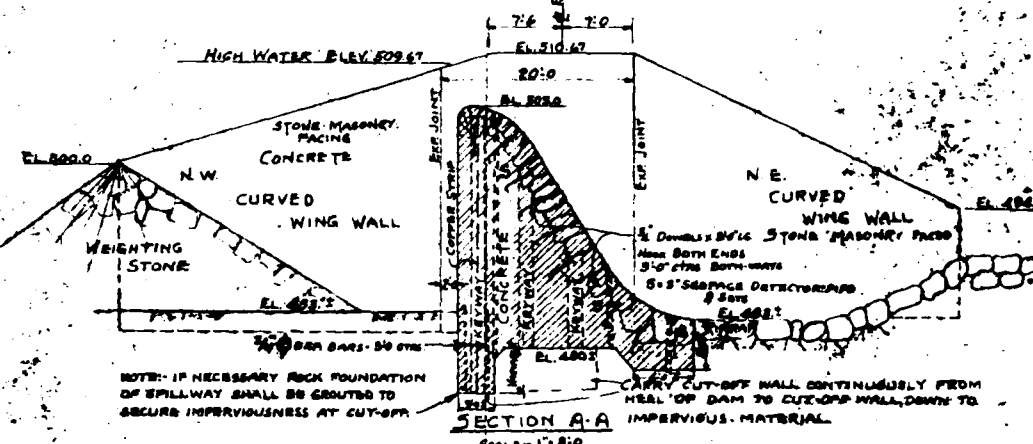
SECTION D-D
1" = 10'



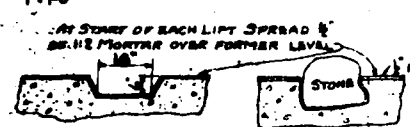
SECTION E-E
1" = 10'



SECTION F-F
1" = 10'



KEYWAY DETAIL
1" = 10'



HORIZONTAL JOINTS
1" = 2'-0"



NOTCH - 8'-0" LONG
1" = 2'-0"

NOTE: CONCRETE TO BE MIXED 1:2:4 WITH 3 LBS. CELITE PER SACK OF CEMENT - 6 GALS. OF WATER PER SACK. MORTAR FOR STONE MASONRY TO BE 1:2 MIX WITH 3 LBS. CELITE PER SACK OF CEMENT. PLUMS OF SOUND NATIVE STONE ARE TO BE DEPOSITED AS CONCRETING ADVANCES. SURFACES OF EXPANSION JOINTS TO BE SWABBED 3 COATS ASPHALTIC EMULSION. SLUSH GROUT FOR REPAIR TO BE 1:3 MIX-CONCRETE TO BE USED FOR LARGER WORKS. STONE MASONRY PILES ARE INDICATED FOR ALL EXPOSED WORK. FACE APPEARANCE OF THIS MASONRY WILL BE CONTROLLED IN FIELD. THE BASES OF STRUCTURES SHOWN IN THIS SHEET ARE APPROX. ONLY AND MAY BE CHANGED BY THE ENGINEER TO BE OF ANY DIMENSIONS OR AT ANY ELEVATIONS NECESSARY TO SECURE A PROPER FOUNDATION. STONE MASONRY PILING IN ALL WALLS AND DAM TO BE CARRIED IN ADVANCE OF CONCRETE WHICH IS DEPOSITED BETWEEN MASONRY AND A BACK FORM.

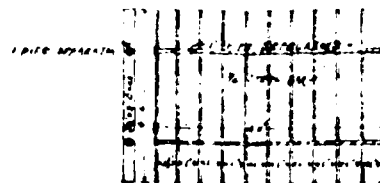
DEPARTMENT OF THE INTERIOR			
NATIONAL PARK SERVICE			
BRANCH OF PLANNING-RECONSTRUCTION-DEVELOPMENT-PROJECTS			
FRENCH CREEK PROJECT, P.L.R.-2			
SERIES & CHESTER CO.		PENNSYLVANIA	
PROFILE OF EARTH DAM			
SPILLWAY DETAILS			
Drawn by: C. J. [illegible]	Scale: 1" = 10'	Sheet: 17	Page: 128
Checked by: [illegible]	As: [illegible]	1940-93	NO. 88
Project Manager: [illegible]		Inspector: [illegible]	
State Authority: [illegible]		Regional Office: [illegible]	
National Park Service		National Park Service	

PLATE 3

BLG-F	WT-TONS	DISTANCE IN MILES	WIDE OF SECTION	WIDE OF SECTION
BLG-505	2.5	1.75	5.00	0.17
BLG-506	1.03	2.36	6.75	0.28
BLG-507	5.77	4.39	11.70	0.76
BLG-508	13.68	5.77	16.75	0.97
BLG-509	2.63	7.50	28.70	0.17

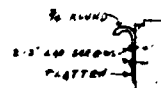
NEGATIVE 'WEIGHT' OF TAIL WATER

WATER ON CRIST AND UC IN STRIAL FACE



SCREEN DETAIL

1-RFQ'D. WT 220 LBS



LIFTING H.

[illegible]

WATER UPLIFT

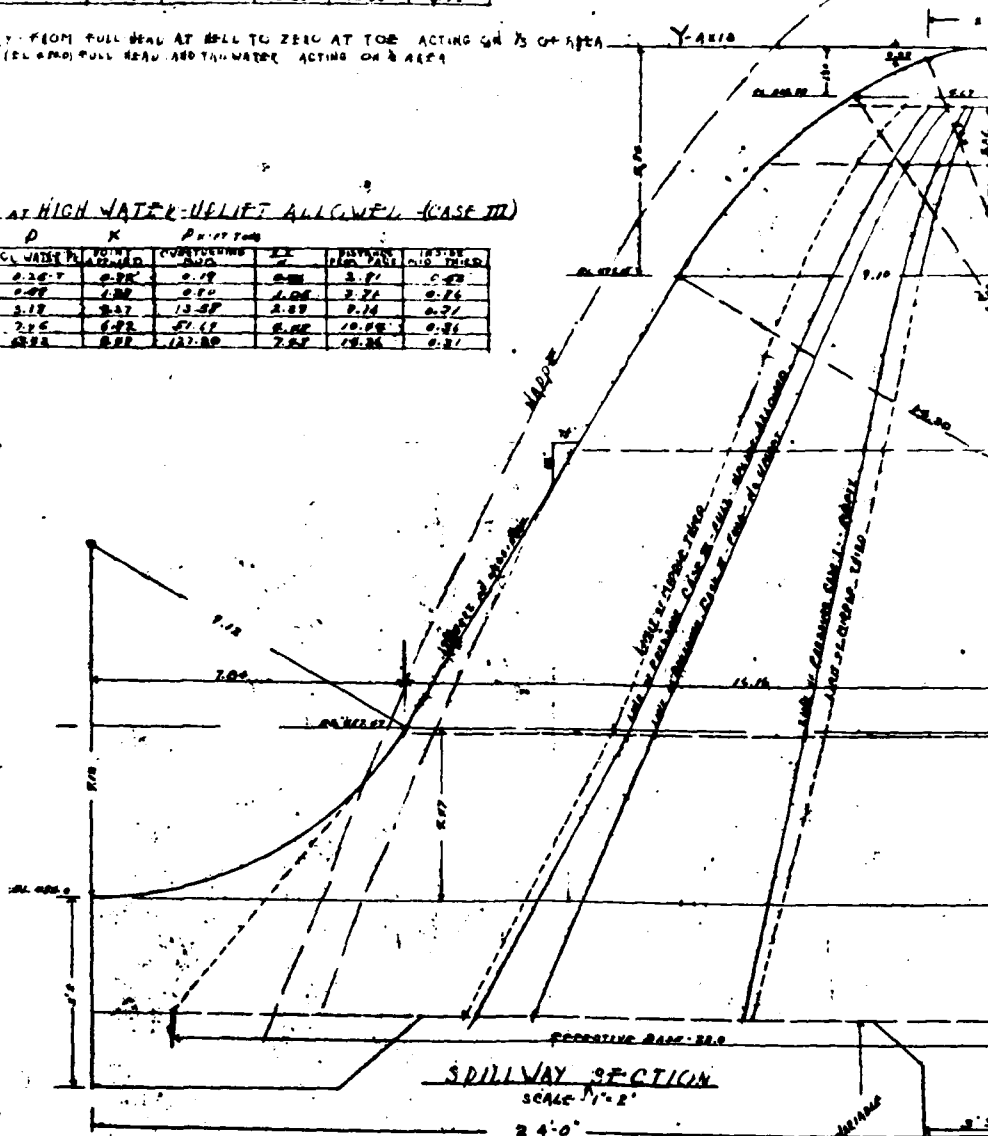
WITHIN MASONRY - FROM FULL HEAD AT BELL TO ZERO AT TOP ACTING ON 1/3 OF AREA
AT FOUNDATION (EL 200) FULL HEAD AND TAILWATER ACTING ON 2/3 AREA

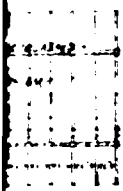
BLOCK	WT. TONS	DIST. FROM N
HAIR END - HAIR END	0.16 F	1.87
" " 203 0	0.27	2.20
" " 205 67	0.98	2.93
" " 207 23	1.90	3.81
" " 210 0	6.62	5.90

[illegible]

	VALUES	g = 30	16.00 MONTHS
Y	RELATIVE HEIGHT	UNCORRECTED HEIGHT	RELATIVE HEIGHT
0.00	0.57	- 3.16	0.57
0.57	0.17	- 3.70	0.17
1.00	0.03	- 3.60	0.03
1.57	0.00	- 3.93	0.00
2.00	0.00	- 3.88	0.00
2.57	0.37	- 2.90	0.37
3.00	0.66	- 2.33	0.66
3.57	1.00	- 1.78	1.00
4.00	1.00	- 1.02	1.00
4.57	0.70	- 0.18	0.70
5.00	0.15	0.10	0.15
5.57	0.00	0.00	0.00
6.00	0.00	0.00	0.00
6.57	0.00	0.00	0.00
7.00	0.00	0.00	0.00
7.57	0.00	0.00	0.00
8.00	0.00	0.00	0.00
8.57	0.00	0.00	0.00
9.00	0.00	0.00	0.00
9.57	0.00	0.00	0.00
10.00	0.00	0.00	0.00
10.57	0.00	0.00	0.00
11.00	0.00	0.00	0.00
11.57	0.00	0.00	0.00
12.00	0.00	0.00	0.00
12.57	0.00	0.00	0.00
13.00	0.00	0.00	0.00
13.57	0.00	0.00	0.00
14.00	0.00	0.00	0.00
14.57	0.00	0.00	0.00
15.00	0.00	0.00	0.00
15.57	0.00	0.00	0.00
16.00	0.00	0.00	0.00

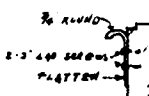
NOTE: AS PER CREAGER AND JUSTIN'S
HYDROELECTRIC HANDBOOK-PAGE 209
UNITY CREST PROFILE.
MODIFIED SLIGHTLY TO SECURE
REGULAR CURVE AND SLOPES





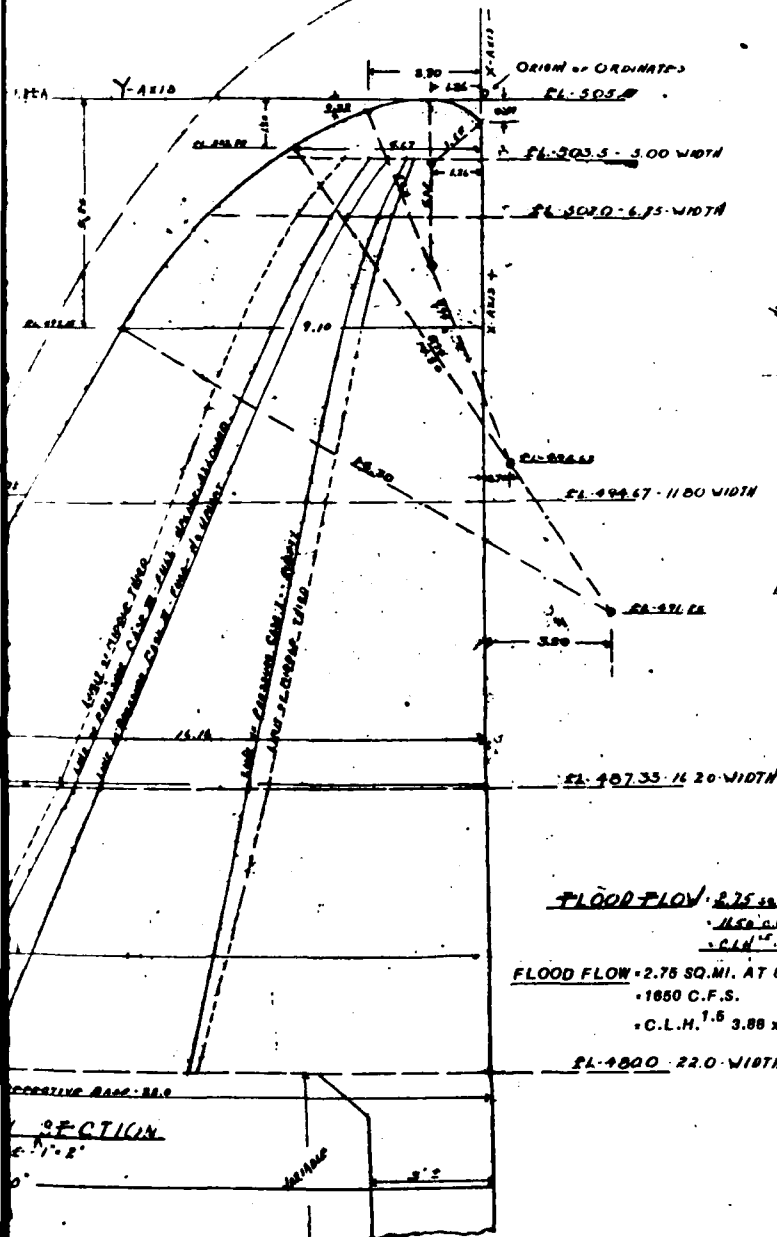
0.5\"/>

SECTION A-A



LIFTING HOOK

HIGH WATER: 509.67



FLOOD FLOW 2.75 SQ. MI. AT 100 SEC. FT. / SQ. MI.

1850 C.F.S.

FLOOD FLOW = 2.75 SQ. MI. AT 800 SEC. FT. / SQ. MI.

1850 C.F.S.

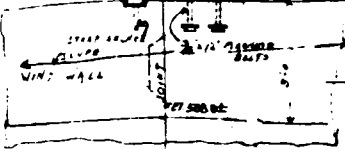
C.L.H. 1.5 3.88 x 42' x 4.07' 1.5, 1850 C.F.S.

EL 480.0 22.0 WIDTH

2.10' 2.10' 2.10'

30 DISCHARGE PIPE

30\"/>



PLAN SLUICE GATE ELEV. 503.5

SCALE 1\"/>

FOR DETAILS SEE SHEET 402

HIGH WATER EL 509.67

FORCE SYSTEM FOR SLUICE GATE
FOR WATER PRESSURE - P. 2.00' 10\"/>

SECTION C-C THRU SLUICE GATE

DEPARTMENT OF THE INTERIOR		
NATIONAL PARK SERVICE		
BRANCH OF PLANNING	RECREATIONAL DEVELOPMENT PROJECTS	
FRENCH CREEK PROJECT M-2-2		
BEERS & CROSBY COS.	PITTSBURGH, PA.	
STABILITY COMPUTATION		
FOR DAM AND SLUICE DETAIL		
DRAWN BY C. H. HILL	SCALE AS INDICATED	DATE 10-1-55
CHECKED BY J. C. HILL		
APPROVED		
[Signature]		
PROJECT M-2-2		
STATE AUTHORITY		
DESIGNED BY J. C. HILL		

2

PLATE 4

APPENDIX

F

SITE GEOLOGY
HOPEWELL DAM

Hopewell Dam is located in the Triassic Lowland Section of the Piedmont Physiographic Province. As shown on Plate F-1, the bedrock at the site is the Vintage Dolomite of lower Cambrian age. No bedrock exposures were observed during the field inspection and, therefore, the bedrock type and its extent are drawn from the geologic mapping published by the U.S. Geological Survey in 1938. As shown on Plate F-1, the left abutment and spillway areas are in the vicinity of the contact between the Vintage Dolomite and the Triassic age shale and sandstone beds of the Stockton Formation. Contained in the Department of Environmental Resources files in Harrisburg is limited information describing the bedrock. Progress reports describe bedrock in the left abutment and spillway areas as badly broken shale and sandstone dipping to the left (northerly). Therefore, it may be correct to assume that the left portion of the dam is underlain by the Stockton Formation and the right portion of the dam is underlain by the solution prone Vintage Dolomite. A regional thrust fault, referred to as the Elverson Overthrust, and related faults strike northeasterly through the hillsides within 1,000 feet south of the dam.

TE
MED
80