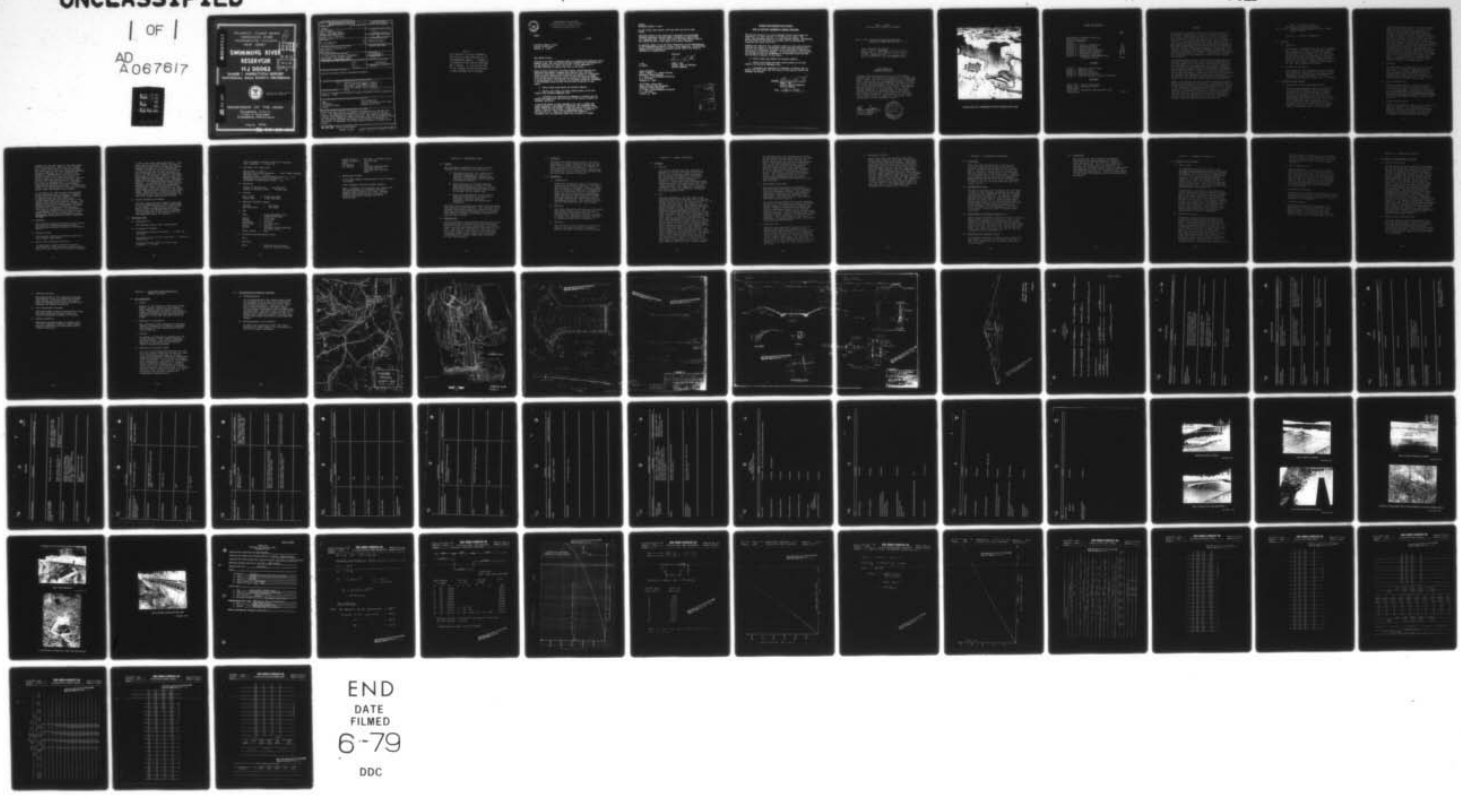
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ATLANTIC COAST BASIN
SWIMMING RIVER
MONMOUTH COUNTY
NEW JERSEY

LEVEL II

SWIMMING RIVER RESERVOIR
NJ 00082

PHASE 1 INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

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APR 20 1979
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DEPARTMENT OF THE ARMY
Philadelphia District
Corps of Engineers
Philadelphia, Pennsylvania

March, 1979

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REPORT DOCUMENTATION PAGE

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(6) National Dam Safety Program. Swimming River Reservoir (NJ 00082), Atlantic Coast Basin, Swimming River, Monmouth County, New Jersey. Phase I Inspection Report.

18. SUPPLEMENTARY NOTES

Copies are obtainable from National Technical Information Service, Springfield, Virginia, 22151.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Dams
Embankments
Structural Analysis
Safety
Visual Inspection
National Dam Inspection Act report
Monmouth County, N.J.

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

This report cites results of a technical investigation as to the dam's adequacy. The inspection and evaluation of the dam is as prescribed by the National Dam Inspection Act, Public Law 92-367. The technical investigation includes visual inspection, review of available design and construction records, and preliminary structural and hydraulic and hydrologic calculations, as applicable. An assessment of the dam's general condition is included in the report.

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PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO

NAPEN-D

3 APR 1979

Honorable Brendan T. Byrne
Governor of New Jersey
Trenton, NJ 08621

Dear Governor Byrne:

Inclosed is the Phase I Inspection Report for Swimming River Reservoir Dam in Monmouth County, New Jersey which has been prepared under authorization of the Dam Inspection Act, Public Law 92-367. A brief assessment of the dam's condition is given in the front of the report.

Based on visual inspection, available records, calculations and past operational performance, Swimming River Reservoir Dam, initially listed as a high hazard potential structure but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in good overall condition and the spillway is considered adequate. To insure adequacy of the structure, the following actions are recommended to be undertaken within one year from the date of approval of this report.

a. Refill eroded areas behind the waterway wingwalls.

b. Backfill and replant the minor erosion pockets at the back slopes on the northerly embankment dike.

c. Investigate the feasibility of supplying a different type of ground cover which would take hold better on the steep dry slopes, and implement accordingly.

A copy of the report is being furnished to Mr. Dirk C. Hofman, New Jersey Department of Environmental Protection, the designated State Office contact for this program. Within five days of the date of this letter, a copy will also be sent to Congressman James J. Howard of the Third District. Under the provision of the Freedom of Information Act, the inspection report will be subject to release

NAPEN-D
Honorable Brendan T. Byrne

by this office, upon request, five days after the date of this letter.

Additional copies of this report may be obtained from the National Technical Information Services (NTIS), Springfield, Virginia 22161 at a reasonable cost. Please allow four to six weeks from the date of this letter for NTIS to have copies of the report available.

An important aspect of the Dam Safety Program will be the implementation of the recommendations made as a result of the inspection. We accordingly request that we be advised of proposed actions taken by the State to implement our recommendations.

Sincerely,

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

1 Incl
As stated

Copies furnished:
Dirk C. Hofman, P.E., Deputy Director
Division of Water Resources
N. J. Dept. of Environmental Protection
P. O. Box CN029
Trenton, NJ 08625

John O'Dowd, Acting Chief
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SWIMMING RIVER RESERVOIR DAM (NJ00082)

CORPS OF ENGINEERS ASSESSMENT OF GENERAL CONDITIONS

This dam was inspected on 14 and 29 December 1978 by Louis Berger and Associates, Inc. under contract to the State of New Jersey. The state, under agreement with the U. S. Army Engineer District, Philadelphia, had this inspection performed in accordance with the National Dam Inspection Act, Public Law 92-367.

Swimming River Reservoir Dam, initially listed as a high hazard potential structure but reduced to a significant hazard potential structure as a result of this inspection, is judged to be in good overall condition and the spillway is considered adequate. To insure adequacy of the structure, the following actions are recommended to be undertaken within one year from the date of approval of this report.

a. Refill eroded areas behind the waterway wingwalls.

b. Backfill and replant the minor erosion pockets at the back slopes on the northerly embankment dike.

c. Investigate the feasibility of supplying a different type of ground cover which would take hold better on the steep dry slopes, and implement accordingly.

APPROVED: James G. Ton

JAMES G. TON
Colonel, Corps of Engineers
District Engineer

DATE: 13 April 1979

PHASE I REPORT
NATIONAL DAM INSPECTION PROGRAM

Name of Dam Swimming River Reservoir Dam
Fed ID# NJ 00082 NJ ID# 493

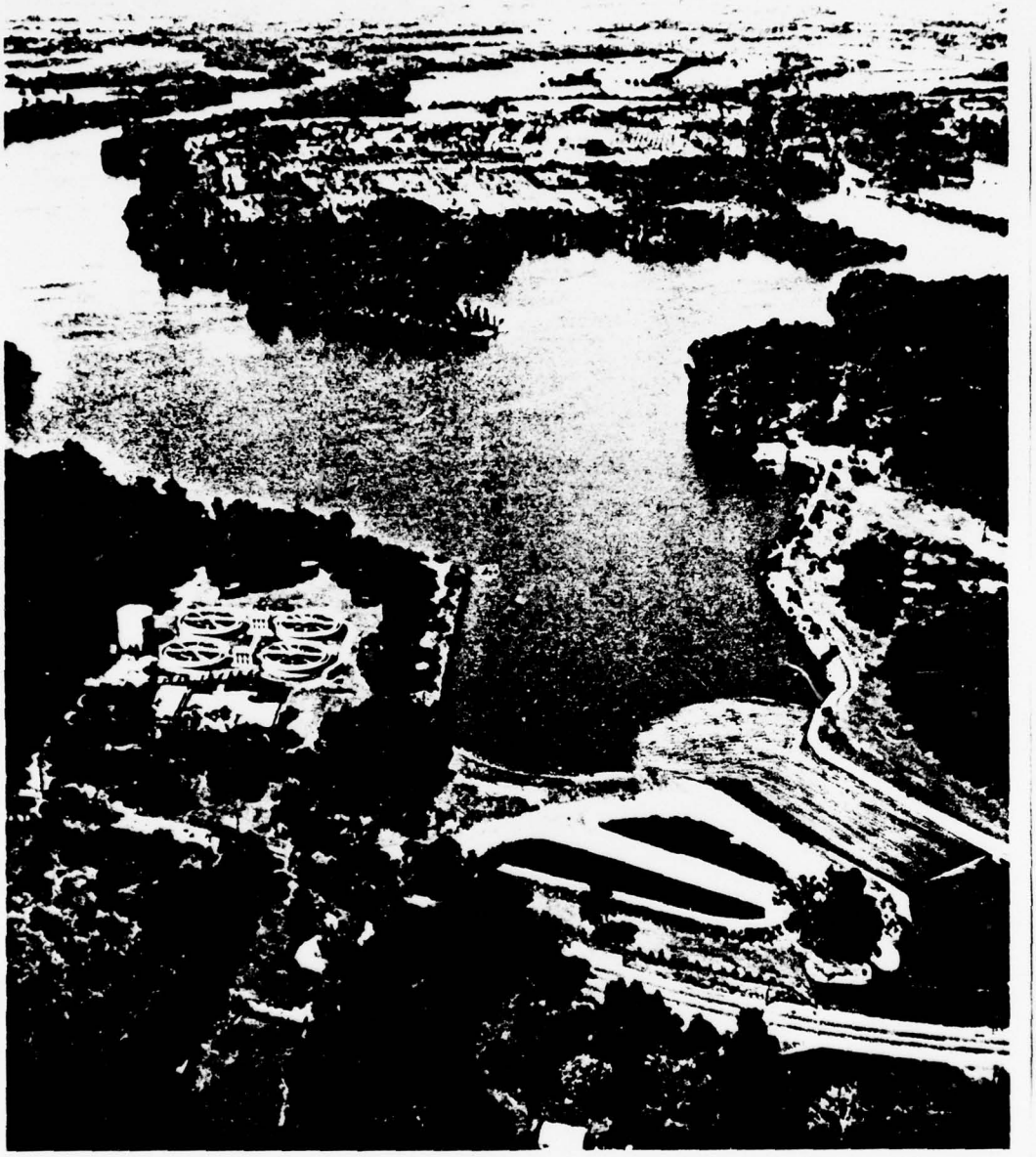
State Located New Jersey
County Located Monmouth
Coordinates Lat. 4019.1 - Long. 7407.1
Stream Swimming River
Date of Inspection 14, 29 December 1978

ASSESSMENT OF GENERAL CONDITIONS

Swimming River Reservoir Dam is in a good overall condition and the spillway is adequate to transmit the design flood. The dam is recommended to be downgraded from a high hazard to a significant hazard as overtopping would not appreciably increase the danger of loss of life or property damage. No detrimental findings were uncovered to warrant further study. Recommended remedial measures to be undertaken in the future include repairing of sloughed areas on embankment back slopes and refilling the eroded areas behind the wasteway wingwalls. Consideration by the owner could also be given to supplying a different type of ground cover to the embankment slopes.

F. Keith Jolls P.E.
Project Manager

STATE OF KENTUCKY
F. KEITH
JOLLS
5432
REGISTERED
PROFESSIONAL ENGINEER



OVERVIEW OF SWIMMING RIVER RESERVOIR DAM

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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 Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. 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 continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. The test flood provides a measure of relative spillway capacity and serves as an aide 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: SWIMMING RIVER RESERVOIR FED #NJ 00082
AND NJ ID #493

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority

This report is authorized by the Dam Inspection Act, Public Law 92-367, and has been prepared in accordance with Contract FPM-36 between Louis Berger & Associates, Inc. and the State of New Jersey and its Department of Environmental Protection, Divison of Water Resources. The State, in turn, is under agreement with the U.S. Army Corps of Engineers, Philadelphia to have this inspection performed.

b. Purpose of Inspection

The purpose of this inspection is to evaluate the structural and hydraulic condition of the Swimming River Reservoir Dam and appurtenant structures, and to determine if the dam constitutes a hazard to human life or property.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

Swimming River Reservoir Dam is a 2,400 foot long, horseshoe-shaped earth and concrete structure with a maximum height of almost 45 feet and contains a concrete overflow spillway and 450-foot long wasteway. The water-supply gatehouse, which is located at the northwesterly end of the dam, is a multi-level concrete intake structure which delivers water to the Swimming River Water Treatment Facility via 36" diameter supply mains. Immediately east of the gatehouse,

the embankment dams off the natural riverbed channel of Swimming River. This 600 foot dike contains a timber pile-supported, concrete core which extends from elevation 41 down to mean sea level. The remainder of the dam perimeter, with the exception of the spillway, consists of a relatively low earth dike overlying the natural higher terrain. The entire upstream face of the dam is overlain with 12" riprap. The concrete spillway consists of a 400-foot long, ogee type overflow and is comprised of five 80-foot long chords of a 165-foot radius and has a 40-foot wide shallow vee-notched weir at the north end. The concrete wasteway below the crest is a 150' wide, 450' long slab on grade constructed on an 8% slope. It discharges into a riprap paved stilling basin (at mean sea level) in the natural riverbed of Swimming River.

b. Location

The Swimming River Reservoir dam is located in Colts Neck Township, Monmouth County, New Jersey. The dam is approximately 1.5 miles southwest of Interchange 109 of the Garden State Parkway with the spillway situated about 300 feet west of the Swimming River bridge on Swimming River Road.

c. Size Classification

Swimming River Dam has a maximum height of 44.5 feet and a maximum storage capacity of 14,300 acre-feet. Accordingly, the dam is in the intermediate size category as defined by the criteria in the Recommended Guidelines for Safety Inspection of Dams (storage greater than 1,000 acre-feet and height greater than 40 feet).

d. Hazard Classification

Swimming River dam is about 3.5 miles upstream from the confluence of the Swimming and Navesink Rivers. The meandering downstream channel is generally bounded on both sides by marshland, although there are about 25 residences and the Monmouth Water Works

adjacent to the left bank of the river about 2 miles downstream. These are all located down within the reaches of the flood plain. The right bank of the river above the Hubbards Bridge in Red Bank is also bordered with residential developments, as well as older built-up areas at an elevation generally ranging from 20 to 30 feet above MSL. Approximately 2000 feet downstream from the dam, the river is traversed by a U.S. Government Railroad and Normandy Road (a restricted right-of-way munitions haulroad). Additionally, twenty five hundred feet to the east, the river passes under the Garden State Parkway.

In the event of a dam failure, the Swimming River Road bridge and Government transport artery could be severely damaged. However, it appears that the wide flood plain further downstream would absorb most of the release with only minor property damage. The Garden State Parkway bridges have sufficient hydraulic capacity to accommodate a failure related flood. Therefore, the Swimming River dam is recommended to be downgraded to a significant hazard classification in accordance with the criteria promulgated in the Recommended Guidelines for Safety Inspection of Dams.

e. Ownership

This dam and attendant facilities are owned by the Monmouth Consolidated Water Company, 661 Shrewsbury Avenue, Shrewsbury, New Jersey 07701.

f. Purpose of Dam

The Swimming River Dam functions solely as a water supply impoundment.

g. Design and Construction History

An earth and concrete dam was originally constructed in 1901 across the natural riverbed just to the right of the present gatehouse.

In 1956, the owners made application to the State Division of Water Policy and Supply requesting a permit to increase the storage capacity through the use of flashboards. In 1962 the overall dam system was rebuilt and raised from the original elevation of +24 to +43 MSL and a new spillway and gatehouse were constructed. Design of the 1962 modifications was provided by the American Water Works Service Company Inc., the parent company of the Monmouth Consolidated Water Company. It incorporated the older dam as a concrete corewall in the new construction. Concurrently, major reconstruction of the water supply mains and removal of the older intake and valve house structures were undertaken. Additionally, a gaging station was installed on the north low dike between the old river channel and the new spillway.

h. Normal Operating Procedures

The dam, along with the intake at the gatehouse and sedimentation lagoons immediately to the south, is operated as a part of the Water Company's supply system and feeds directly into the Swimming River treatment plant immediately to the south of the dam. For additional data, see Section 4.

1.3 PERTINENT DATA

a. Drainage Area

The drainage area is 48.5 square miles.

b. Discharge at Damsite

Maximum known flood at damsite - 11,800 cfs (in 1919)

Warm water outlet at pool elevation - 18 cfs at V-notch weir

Diversion piping outlet at normal pool elevation - 93 cfs

Total (ungated) spillway capacity at maximum pool elevation - 27,530 cfs

c. Elevation (ft. above MSL)

Top of Dam - +44.5
Maximum pool-design surcharge - +39.5 (MCWC records)
Spillway crest - +35.0
Upstream portal invert diversion piping - +4.0
Downstream portal invert diversion - +3.4
Streambed at centerline of dam - 0±

d. Reservoir

Length of maximum pool - 22,400± feet
Length at spillway crest - 16,200± feet

e. Storage

Top of Dam	-	14,300 acre-feet
Normal pool	-	8,000 acre-feet

f. Reservoir Surface (acres)

Top dam	-	738 acres
Spillway crest	-	557 acres

g. Dam

Type	-	Earth embankment with concrete spillway
Length	-	2,400 feet
Height	-	44.5 feet
Top Width	-	12 feet
Side Slopes	-	2.5H and 4H:1V
Zoning	-	Variable
Cutoff	-	Concrete cutoff supported on timber piling
Grout curtain	-	None

h. Diversion and Regulating Tunnel

None

i. Spillway

Type	-	Modified ogee concrete arch (on straight chords)

Length of weir	-	400 feet (5 chords at 80')
Crest elevation	-	+35 feet MSL
Gates	-	None
U/S Channel	-	None
D/S Channel	-	150-wide concrete apron with dentated sill emptying into stilling basin

j. Regulating Outlets

2-36" water supply concrete mains (one of which is sealed)

1-20" diameter concrete blowoff conduit.

Note: Discharge is limited by the capacity of the pumps and/or the treatment facility. Present plant capacity is 24 MGD. Maximum pumping capacity is 60 MGD, a portion of which can be routed through the 20" Ø blowoff pipe.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

The information available for review for the Swimming River Reservoir dam consisted of:

1) Dam Application No. 493, State Policy Commission September 9, 1956 (for temporary flashboards) together with various correspondence, specifications and approval thereof.

2) Eight drawings of the 1961 redesign; American Waterworks Service Co. Inc. Engineering Department Drawings 73-723, which depicted the overall construction of the dam in its present form.

3) Notes and computations by the owner's engineering personnel on subjects of hydrology, spillway capacity, inspection criteria and operational procedures.

The soils in the vicinity are recent alluvium mixed with overlying swamp deposits. The alluvium can be variable and consists mainly of sand and silt with some clay. The stratified material has a generally good internal drainage. The depth to bedrock is greater than 100 feet.

2.2 CONSTRUCTION

Little information was obtained regarding the actual construction as no as-built plans were available. From the various revisions indicated on the design plans, the work was substantially completed in late 1962. The revisions indicated at that time were of a minor nature. There are no apparent major structural modifications except the installation of sedimentation lagoons immediately southeast of the right abutment.

2.3 OPERATION

Excluding the water supply intake, the dam is operated as a simple overflow facility by the Water Company which maintains its offices and plant just south of the reservoir. The 6" vee-notch weir at the north end of the spillway (at Elevation +34.5) controls the overflow and maintains the reservoir elevation.

2.4 EVALUATION

a. Availability

Sufficient engineering data is available to assess the structural stability. No data was available or reviewed to base an assessment of safety in regard to the embankment zones or foundation stability, although at least two soils reports were prepared by Greer Engineering Associates and Woodward, Clyde and Sherard and Associates in 1958 and 1960 respectively, which analyzed the geotechnical aspects. The reports were not readily available and were not reviewed.

b. Adequacy

The field inspection and review of the available design plans reveal that the dam is structurally sound and well-built. It is believed that sufficient data was available to render this assessment without recourse to gathering additional information.

c. Validity

The validity of the engineering data available is not challenged and is accepted without recourse to further investigations.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General

The on-site inspections were conducted on December 12 and 29, 1978 and revealed the dam to be in excellent condition except for the minor considerations noted below. All of the major elements were in true alignment and in a well-maintained condition. Conferences were held with Water Company personnel who delineated their operational programs and joined in the initial inspection tour. The subsequent inspection was held in freezing weather to re-examine the major seepage zones.

b. Dam

The main embankment lies just east of the gatehouse on the left abutment and is approximately 45 feet tall to the piling cut-off (El. 0) of the older dam which now supports the concrete cut-off wall. This section extends almost 600 feet to the east before meeting the natural higher original ground levels. The remainder of the embankment further to the east is considerably shallower and has a lower crest elevation (+43.0) than the 600-foot section (+44.5). In effect, the remainder of the crest acts as an emergency overflow spillway. The embankment is faced with 12" riprap on the entire upstream slope and has a 20-foot level berm at El. 24, which is approximately the top crest elevation of the earlier embankment. The back slopes are well grassed and exhibit only minor sloughed swales. The crest roadway is in excellent shape with only minor vehicular track depressions. The embankment in the original dam outlet area north of the major dike exhibits some seepage in the lower zones. There is a pond in this area which is apparently being fed by a small pipe entering from the east. Upward seepage

was observed here and extended about 5 feet up the slopes, and the area south of the pond beyond the toe of fill were soft and wet. Water flowing down the natural ground slopes east of the high embankment were traced to the outlet pipe from the gaging station. However, about 20 feet east, additional wet areas were observed which do not appear to be attributable to the gaging station outlet. All drains appeared to be running clear. The remainder of the dam is in a satisfactory condition except for some erosion observed behind the wingwalls of the main spillway.

c. Appurtenant Structures

The gatehouse structure is in excellent condition with only minor surficial temperature and shrinkage cracking. The operating mechanical equipment is well maintained as evidenced by the constant inspection and adjustment. The gate controls and railings have been recently painted.

The main spillway crest and concrete wasteway apron are in a satisfactory condition with all of the expansion joints tightly caulked and sealed. There is some minor cavitation and plastic shrinkage cracking in the exposed faces but all major cracks appear to have been recently patched. There is considerable erosion behind the lower wingwalls at each side of the wasteway. Due to the depth of flow in the downstream riprapped stilling basin, its condition could not be observed.

d. Reservoir Area

Swimming River Reservoir extends almost 2.5 miles up two major stream reaches - the Yellow Brook and Willow Brook. The shorelines are well-defined and fairly clear of debris. There is some evidence of siltation along the gently sloping shorelines. The reservoir bed in the forebay area immediately above the spillway is at plan elevation +30.0, while the deeper zone in front at the gatehouse is at El. +2.0.

e. Downstream Channel

Immediately below the spillway, the river passes under Swimming River Road bridge and a timber-clad water pipe bridge. Interlocked steel sheeting has been installed along the northwest corner of the bridge which deflects flow southward from the stilling basin and original river channel into the under-bridge channel. Further downstream, all dwellings are well above potential highwater (see Section 1.2.d). After passing under the U.S. Government munition haulroad, the river spreads out into a wide (1000') tidal marshland. The downstream channel is tidal with the high tide roughly 4.5 feet above the spillway apron invert (at mean sea level). All downstream bridges are believed to be hydraulically adequate.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

Since this dam and reservoir is part of an extensive water supply system, personnel of the Water Company are at the site on a 24-hour basis. Operations which directly concern the dam are limited to regulation of the discharge from the reservoir to the water plant. Changes in the pumping rates are in direct response to water demands and are adjusted as necessary. Personnel from the U.S.G.S. visit the site once a month to collect the discharge data from the gaging station.

4.2 MAINTENANCE OF DAM

The dam is systematically inspected at least once a month by Water Company engineers who have been trained for dam inspections and who are equipped with extensive checklists. In addition, company employees may generally be found working around the dam on a daily basis. Deficiencies noted during inspections are corrected expeditiously as evidenced by numerous surface repairs to the concrete wasteway noted during the inspections. Light vegetation on the embankment is cut back as required. Heavier growth is removed every other year.

4.3 MAINTENANCE OF OPERATING FACILITIES

Water Company personnel likewise perform all maintenance on the operating facilities as part of the procedures attendant with day-to-day monitoring. Those facilities requiring such routine maintenance include, but are not limited to, the concrete gatehouse, the gates and stems, the screens and trash racks, the pumps and motors, and the 36" and 20" transmission lines and blowoff.

4.4 DESCRIPTION OF WARNING SYSTEM

No mechanical/electrical system exists except for the routine monitoring of the dam by personnel of the water company who are in contact with their office nearby.

4.5 EVALUATION

The operational and maintenance procedures practiced by the Water Company at Swimming River Reservoir Dam are extensive, detailed and well conceived. They are considered to be adequate for responsible dam management and satisfactory in every respect since an experienced, well-managed staff has as its primary duty the operation and maintenance. Nothing is envisioned in the nature of improving their well-established procedures.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data

In accordance with the criteria in the Recommended Guidelines for Safety Inspection of Dams, it has been determined that the dam at Swimming River Reservoir is intermediate in size and in the significant hazard category. As explained below, the spillway design flood (SDF) was selected by the inspection team to be one-half the probable maximum flood (PMF). The inflow hydrograph was calculated using precipitation data from Hydrometeorological Report #33.

As directed by the Corps of Engineers, the inflow hydrograph and flood routing were performed utilizing the HEC-1 computer program. This gave a peak inflow into the reservoir for the ½ PMF of 22,895 cfs and when routed through the reservoir, this reduced insignificantly to 21,250 cfs. The spillway capacity before overtopping occurs is approximately 27,530 cfs. Therefore, the spillway will easily accommodate the design flood. Under design storm conditions, there would be approximately 1.2 feet of freeboard.

b. Experience Record

According to Water Company engineers, the largest estimated flow to have occured at this site was approximately 11,800 cfs (in 1919). The gaging station records indicate a maximum discharge of 8910 cfs occured on 27 October 1943 and the dam Application #493 (April 1956) stated that a design flood of 9800 cfs was deigned to be applicable. Additional Water Company hydrology on subsequent applications indicated volumes of 7,800 and 17,600 cfs for 100 and 1,000 year frequency floods (based on their statistical extrapolations). Consequently, it was adjudged that the one-half PMF value represents

the most valid representation of a probable maximum discharge value, especially in light of the 55 years of records and the detailed analyses undertaken by the Water Company engineers.

c. Visual Observations

During inspection, the spillway was awash with several inches of flow. Some debris had also collected below the vee-notch weir. The tailwater was at El. +2 which covered the ripraped stilling basin. As previously stated, the major concern of the inspection team was the wet areas at the lower slopes of the north embankment and any possible interrelationship with the old channel or the supply mains.

d. Overtopping Potential

As there are no records of the dam being overtopped and the fact that the spillway can easily accommodate the design flood there is little potential for overtopping.

e. Drawdown Potential

The drawdown time for the Swimming River Reservoir is completely controlled by the pumping capacity of 60 mgd at the water supply intake. It would therefore take approximately 43 days to draw the reservoir down to a low pool at approximately El. +10.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations

Reflecting the relative newness of structure, the well-designed and supervised construction and the continual maintenance, the visible aspects of Swimming River Reservoir dam are in good to excellent condition. The upper zones of riprap show little evidence of subgrade subsidence and the embankment crests and intermediate benches are at design line and grade. The apparent seepage and wet zones at the toe of the main northerly dike have no discernible influence on the structural stability and can be easily repaired as can the eroded areas behind the wasteway wingwalls. The concrete spillway and wasteway are in excellent shape with little noticeable differential settlement. There has been some movement of the sloped side sections but this is relatively unimportant as long as the overall structure maintains its integrity. In summary, nothing was visually noted to create or worsen a hazardous condition that cannot be readily maintained. The only major element not visible for inspection was the existence and condition of the riprap stilling basin below the wasteway (especially regarding its interrelationship to the Swimming River Road bridge.

b. Design and Construction Data

From the review of the contract plans for the 1962 reconstruction, the design appears to be well-engineered, reflects a conservative approach and employed conventional analytical techniques. Based upon the condition of the dam and the hazard classification, it is assessed that additional design studies are unnecessary.

c. Operating Records

The performance of this structure has been satisfactory since its completion although some concern is expressed for the future when the subgrade drain systems beneath the wasteway may become clogged up.

d. Post Construction Changes

There have been no major modifications since the 1962 construction which affect the overall structural integrity of the dam.

e. Seismic Stability

Experience indicates dams in Seismic Zone 1 will have adequate stability under dynamic loading conditions if stable under static loading conditions.

SECTION 7 - ASSESSMENTS/RECOMMENDATIONS/ REMEDIAL ACTIONS

7.1 DAM ASSESSMENT

a. Safety

Subject to the inherent limitations of the Phase I visual inspection, the Swimming River Reservoir dam is judged to be in a sound, satisfactory structural and hydraulic condition and the spillway has sufficient capacity to discharge the design flood of ½ PMF.

b. Adequacy of Information

The information made available by the Water Company is deemed to be adequate regarding the analyses of safe operation and structural stability.

c. Urgency

No urgency is attached to implementing any further studies or the remedial measures set forth below. They can be undertaken sometime in the future as part of the regular maintenance program.

d. Necessity for Further Study

In view of the hazard classification of this dam, its overall condition and the fact that it is continually monitored by trained engineering personnel, additional inspections under the purview of P.L. 92-367 are deemed to be unnecessary. The Monmouth Consolidated Water Company has embarked on an internal system of periodic inspections, emergency action plans etc. which basically reflects the requirements legislated under P.L. 92-367. Further, their continuity of action is not contingent upon external funding and bureaucratic considerations.

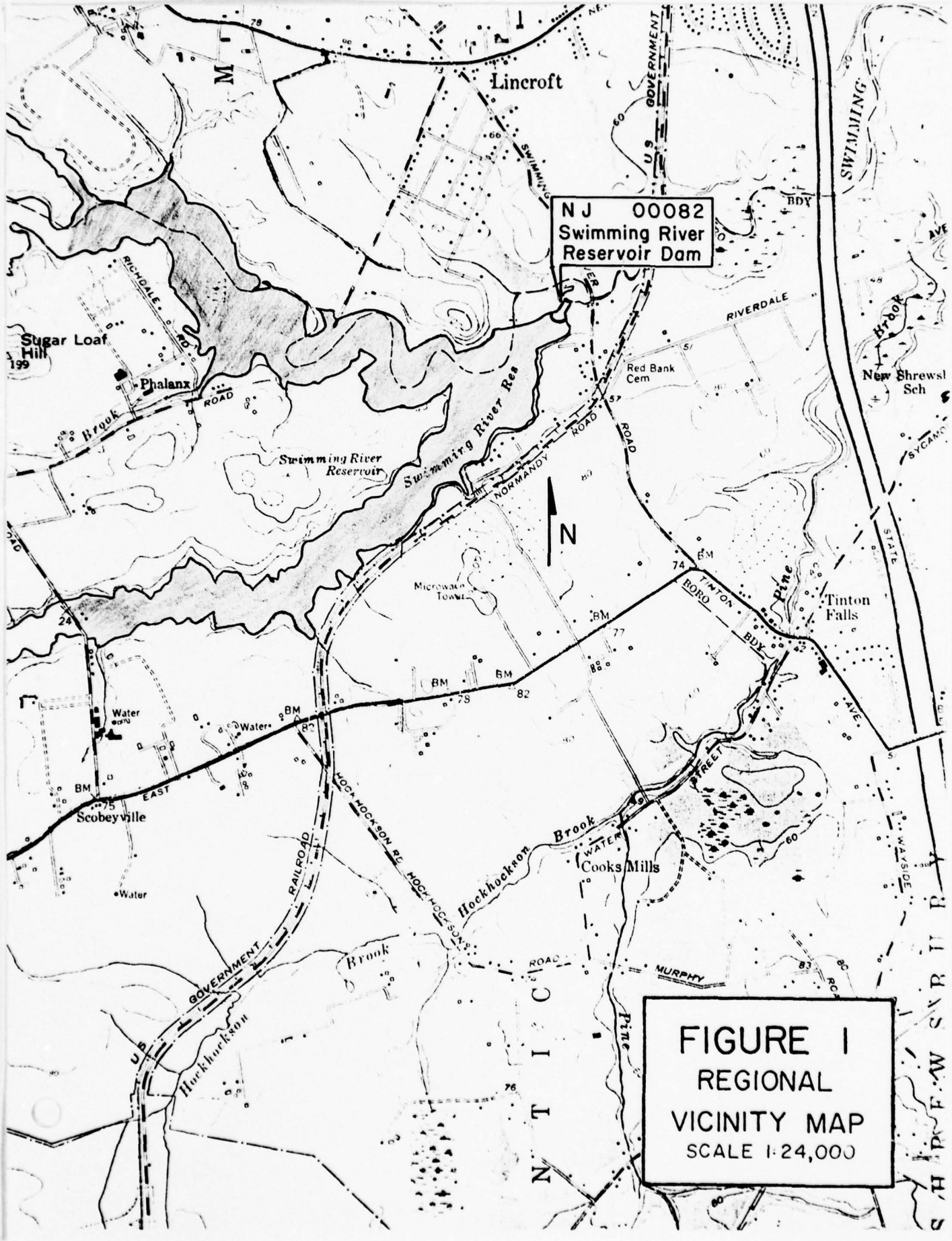
7.2 RECOMMENDATIONS/REMEDIAL MEASURES

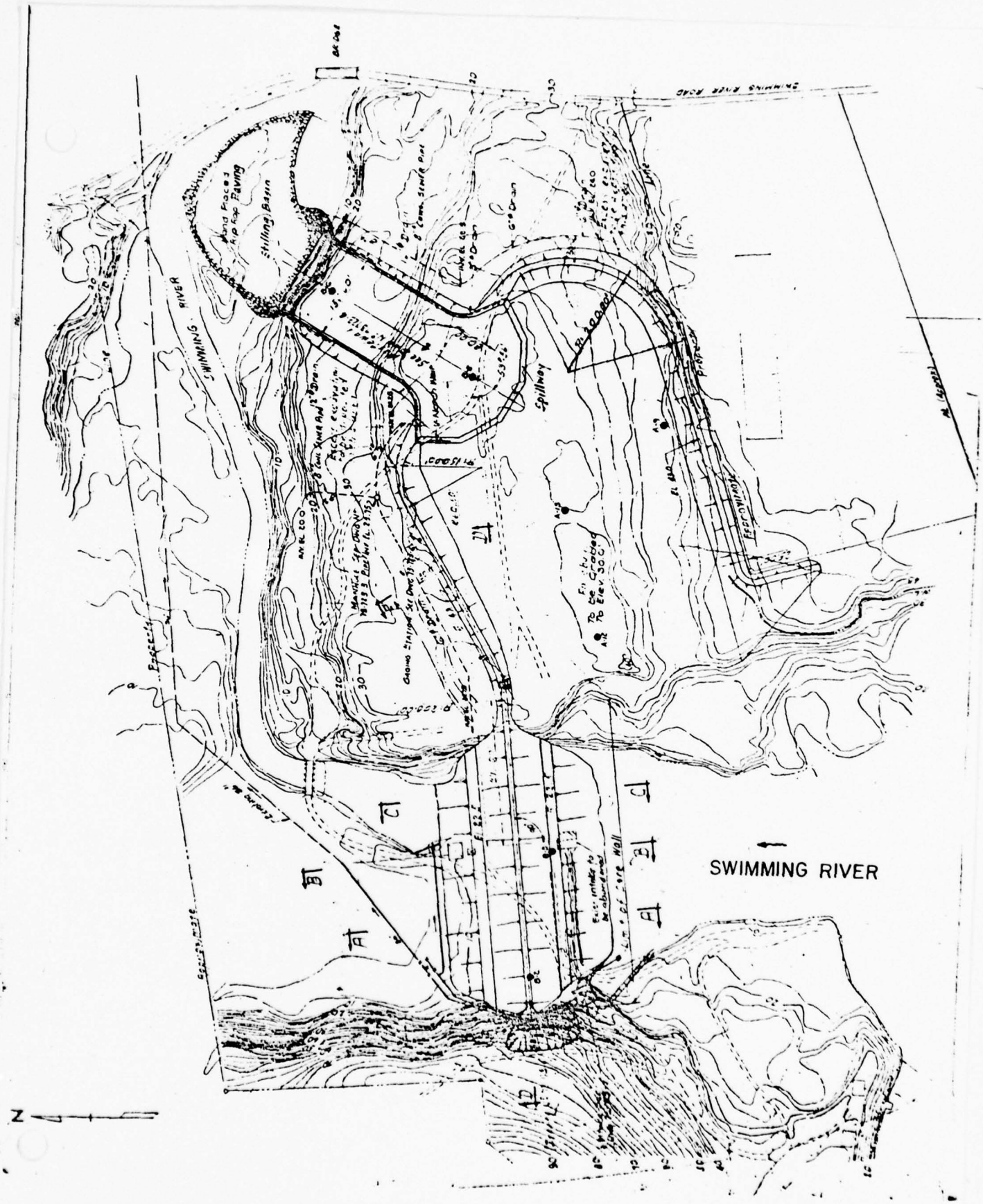
a. Recommendations

It is suggested that the eroded areas behind the spillway wings at the top and bottom of the wasteway be backfilled with stone and/or ditch slope protection. Additionally, the minor erosion pockets at the back slopes on the northerly embankment dike be backfilled and replanted. The owner might consider investigation into supplying a different type of ground cover (similar possibly to crown vetch) which would better take hold on the steep dry slopes.

b. O&M Maintenance and Procedures

No additional procedures other than those currently in effect appear to be warranted in view of the above assessment.

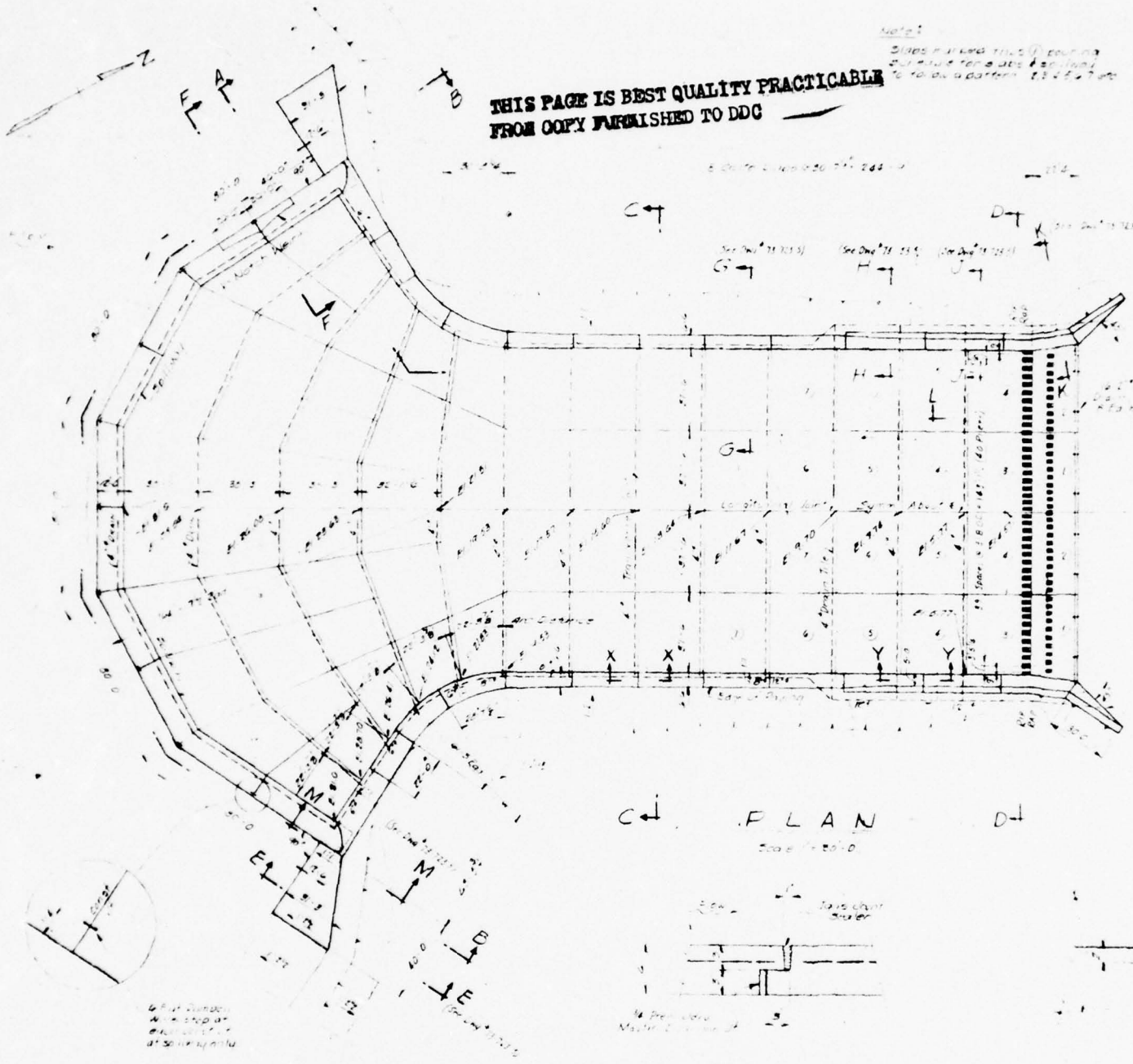

NJ 00082
Swimming River
Reservoir Dam
Lincroft
Sugar Loaf
Hill
Phalanx
Swimming River
Reservoir
Swimming River Res
Red Bank
Cem
New Shrewsl
Sch
Microwave
Tower
Tinton
Falls
Scobeyville
Cooks Mills
Hockhockson Brook
Brook
Pine
Water
BM
N
FIGURE 1
REGIONAL
VICINITY MAP
SCALE 1:24,000



GENERAL PLAN

FIGURE 2

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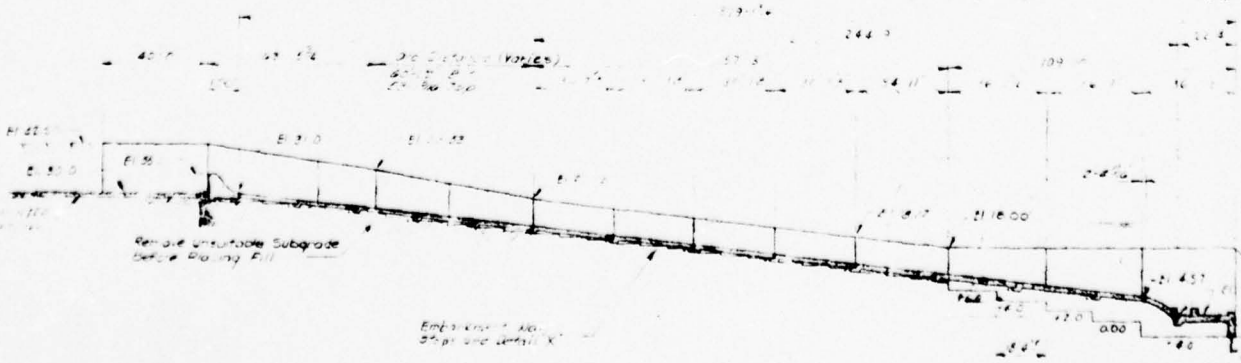


PLAN

SECTION X-X



SECTION Y-Y



PROFILE A-A

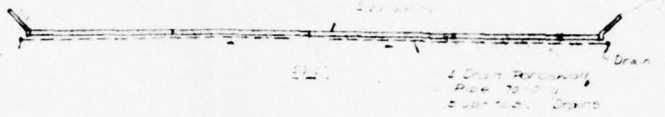
MAKE THIS LINE

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SECTION B-B



SECTION C-C



SECTION D-D



DETAIL X

Notes:

1. For concrete not shown see Dwg 73-723-6
2. For location of Rip Rap see Dwg 73-723-1
3. Provide drain dug as 39" bars spaced (3'-0" O.C.) across bottoms of 3 drain pipe outlets

Remove Unsuitable Subgrade Before Placing Fill

PLANS PREPARED BY
HOWARD J. CARLOCK P.E.
NEW JERSEY REG. NO. 6208

REVISIONS

SWIMMING RIVER DAM
1961 ADDITIONS
WASTEWAY - PLAN & SECTIONS

MONMOUTH CONSOLIDATED WATER COMPANY
LONG BRANCH, N.J.

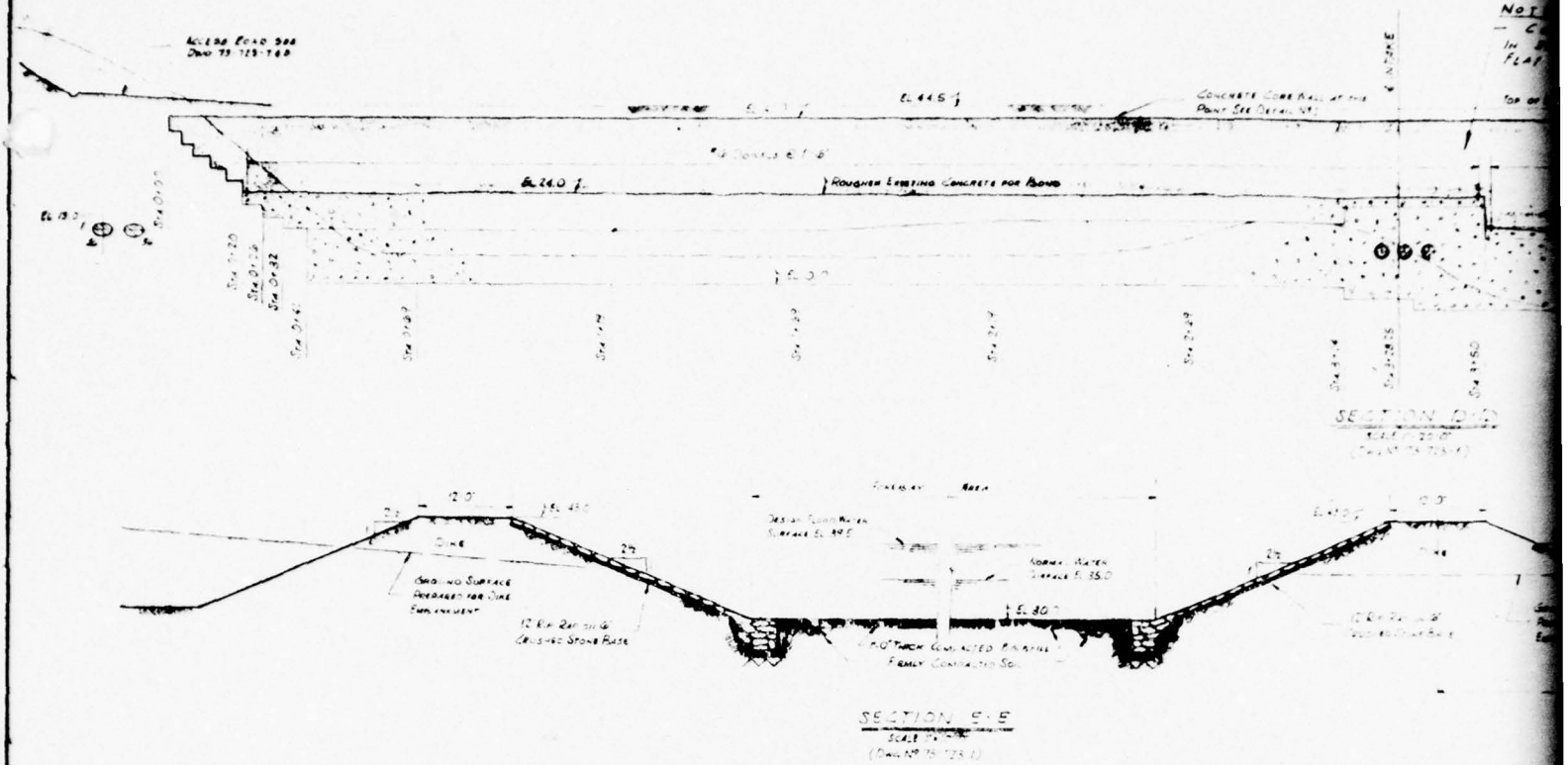
AMERICAN WATER WORKS SERVICE COMPANY, INC.
THREE PENN CENTER PLAZA PHILADELPHIA, PA.

SCALE: AS NOTED
DRAWN BY: P.J.V.
APPROVED: H.J.C.
DATE: 5-22-58
PROJECT: P-82
CHECKED BY:
INSP. BY:

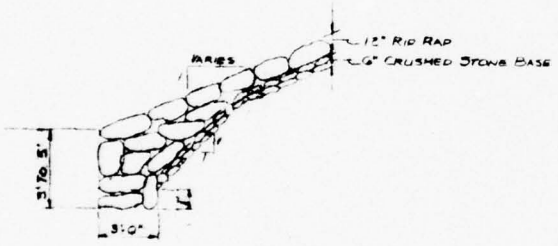
USE APPROVED DRAWINGS ONLY FOR CONSTRUCTION PURPOSES

73-723

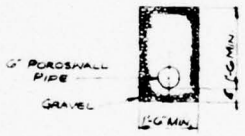
FIGURE 3



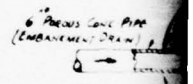
SECTION E-E
SCALE 1"=10'
(DWG NO 75-125-1)



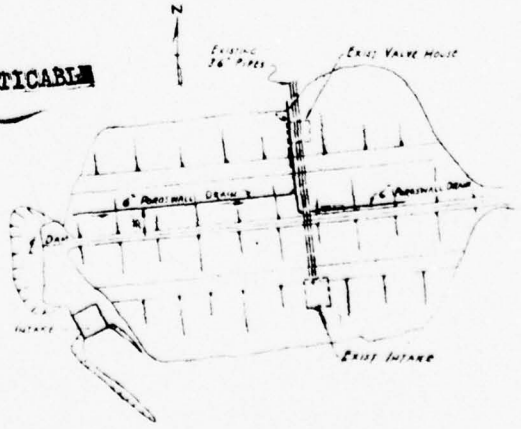
TOE IN DETAIL



DETAIL "X"

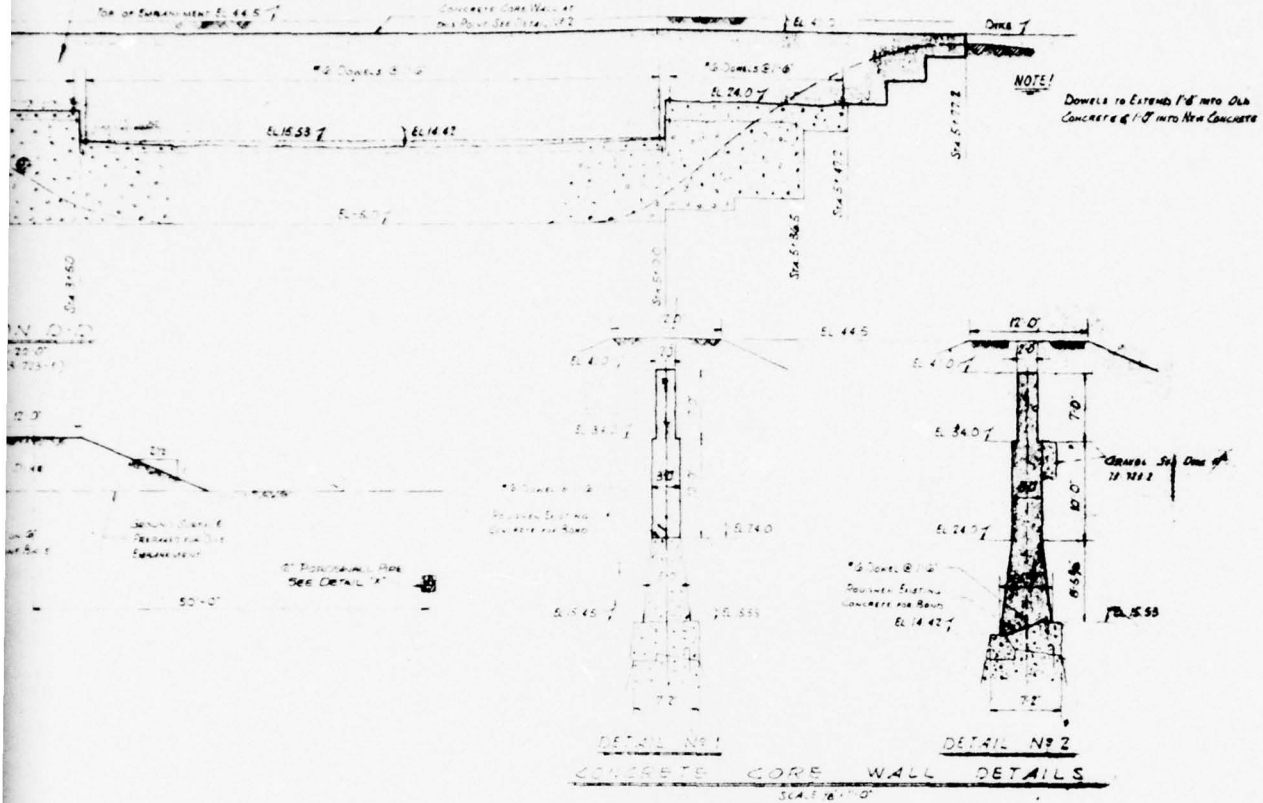


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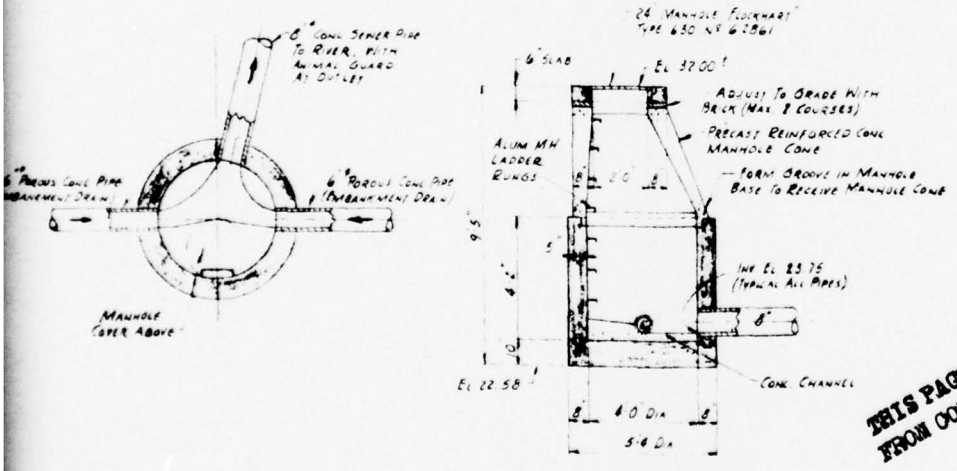


DRAINAGE PLAN
SCALE 1"=10'

NOTE:
CORE WALL TO BE POURED IN 30' MAX. LENGTHS WITH 6" FLAT DUMBELL TYPE WATERSTOP



CONCRETE CORE WALL DETAILS
SCALE 1/8" = 1'-0"



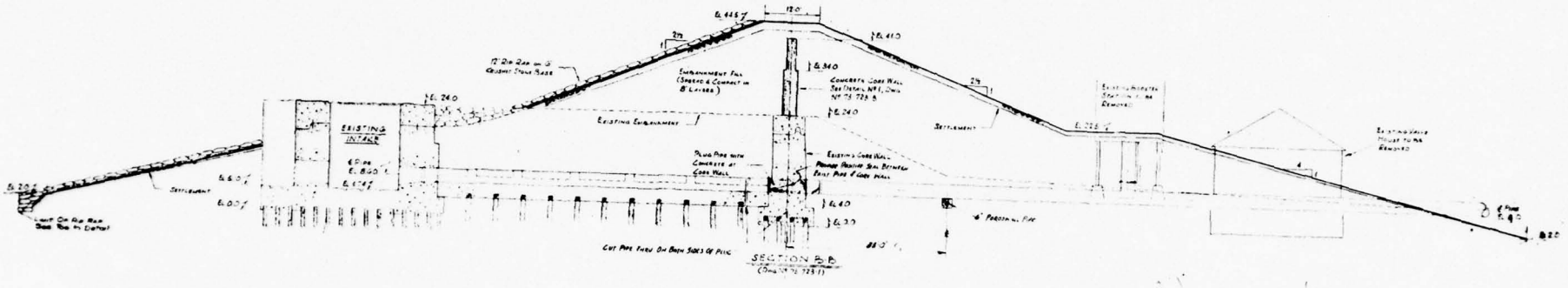
MANHOLE DETAILS
SCALE 1/8" = 1'-0"

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FIGURE 4

SWIMMING RIVER DAM
1961 ADDITIONS
EMBANKMENT - SECTIONS & DETAILS

AMERICAN WATER WORKS SERVICE



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SECTION THROUGH
ORIGINAL STRUCTURE

FIGURE 5

Check List
Visual Inspection
Phase 1

Name Dam Swimming River Reservoir County Monmouth State New Jersey Coordinators NJDEP

Date(s) Inspection 12/12,29/78 Weather Cloudy Temperature 35°F

Pool Elevation at Time of Inspection 35.3 M.S.L. Tailwater at Time of Inspection 3.5 M.S.L.

Inspection Personnel:

T. Chapter
W. Pearce (MCWC)
E. Simone
L. Baines
K. Jolls
A. E. Shearman (MCWC)

L. Baines Recorder

Dam No. 00082

EARTH EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SEE PAGE ON LEAKAGE	None observed	
STRUCTURE TO ABUTMENT/EMBANKMENT JUNCTIONS	Generally good (less than 6" along the juncture of the approach channels lab and the left upstream embankment) although there is major erosion behind lower portions of spillway wingwalls.	
DRAINS	Toe drains at both embankment downstream from discharge apron. Drains also located at the toe of left embankment and empties into former discharge channel.	All drains running clear
WATER PASSAGES	Good	
FOUNDATION	Not observed in field (see contract plans)	

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF	OBERSVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS CONCRETE SURFACES	Minor surface cracking. Surface cavitation and pitting in spillway - minor.	Most cracks have been patched.
STRUCTURAL CRACKING	Some structural cracking observed in wingwall joints and lower portions of sides of spillway walls.	Only minor shifting of side slabs. Top edges could be regraded in some areas to prevent future undercutting.
VERTICAL AND HORIZONTAL ALIGNMENT	Satisfactory	
MONOLITH JOINTS	Good	All sealed. Key joints sealed with jointing compound.
CONSTRUCTION JOINTS	Satisfactory (see contract plans)	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed	
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed	
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	Slight slope erosion localized at wall of old channel. It is an area of approximately 4' x 6' and is located near seepage area.	
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	Satisfactory	
RIPRAP FAILURES	None observed	No riprap on downstream slope of embankment except at stilling basin (under water).

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Slight erosion (see page 2).	Superficial erosion where sheet runoff from concrete slab meets left earth embankment.
	Severe erosion behind foot of right and left wingwalls.	Should be filled to existing slope of embankment.
ANY NOTICEABLE SEEPAGE	Seepage from left embankment originating at point 12' above and 50' east of old spillway channel. Seepage located in area above toe drain. Discharging at 2 gpm - clean.	
STAFF GAGE AND RECORDER	At intake structure for outlet works. USGS Recorder located on left embankment.	
DRAINS		

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	Only minor surface cracking.	Overall good condition.
INTAKE STRUCTURE	Stage gage broken at 37.2'. Intake structure contains aluminum trash racks.	
OUTLET STRUCTURE	Gravity blow off.	
OUTLET CHANNEL	Good	
EMERGENCY GATE	20" blow off.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR	Modified arch ogee weir. Good condition.	Minor debris on crest of weir and apron. Geometric slope does not get much arching action. Top sections on chords (straight).
APPROACH CHANNEL	Satisfactory	
DISCHARGE CHANNEL	Spillway apron empties into large stilling basin. The walls of the basin are interlocking steel and timber piling.	Appears in satisfactory condition.
BRIDGE AND PIERS	Downstream bridge carries outlet piping and road (stands on timber piles).	Appears in satisfactory condition.

GATED SPILLWAY

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

VISUAL EXAMINATION	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	Water Company has internal survey controls and bench marks.	
OBSERVATION WELLS	None	
WEIRS	V-notched weir near USGS gaging station.	
PIEZOMETERS	None	
OTHER		

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Gently sloping - forested.	
SEDIMENTATION	At this juncture - slight.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	Channel width 750'. Clear, free-flowing. North of the left embankment is an old stream channel. It is extended to the north and ties back into the main downstream channel just below the spillway.	Wooden bridge causes some restriction. Perched settlement basins southeast from dam.
SLOPES	Several areas quite steep below spillway - natural wooded slopes.	
APPROXIMATE NO. OF HOMES AND POPULATION	Most dwellings are well above potential highwater (15'-20').	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION

ITEM	REMARKS	
PLAN OF DAM	Available	(All data in Water Company records except as noted).
REGIONAL VICINITY MAP	Available	(Quad Sheet)
CONSTRUCTION HISTORY	Available	
TYPICAL SECTIONS OF DAM	Available	
HYDROLOGIC/HYDRAULIC DATA	Available	
OUTLETS - PLAN	Available	
- DETAILS		
-CONSTRAINTS -DISCHARGE RATINGS		
RAINFALL/RESERVOIR RECORDS	Available	

ITEM	REMARKS
DESIGN REPORTS	Available
GEOLOGY REPORTS	Available
DESIGN COMPUTATIONS HYDROLOGY & HYDRAULICS DAM STABILITY SEEPAGE STUDIES	Available
MATERIALS INVESTIGATIONS BORING RECORDS LABORATORY FIELD	Available
POST-CONSTRUCTION SURVEYS OF DAM	None
BORROW SOURCES	Not available

ITEM	REMARKS
MONITORING SYSTEMS	Available
MODIFICATIONS	Available
HIGH POOL RECORDS	Available - USGS Gage 4075
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	Available
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None reported
MAINTENANCE OPERATION RECORDS	Available

ITEM	REMARKS
SPILLWAY PLAN	
SECTIONS	Available
DETAILS	
OPERATING EQUIPMENT PLANS & DETAILS	Available



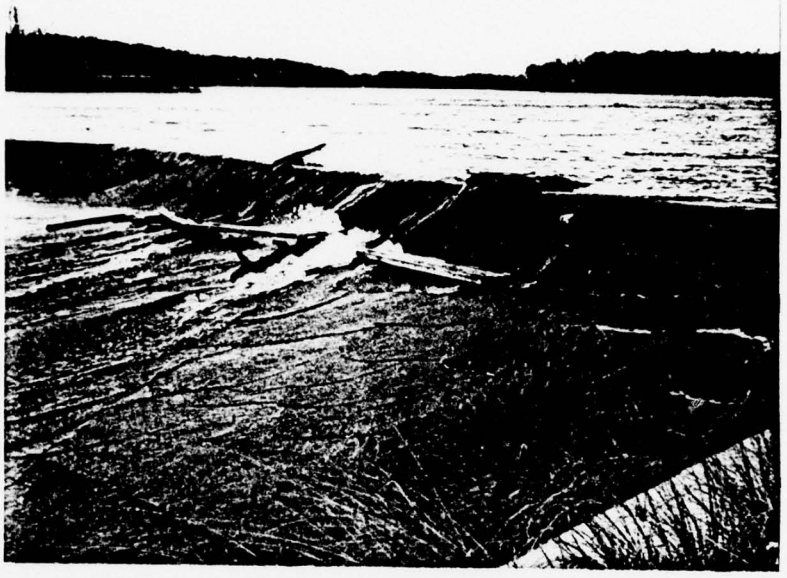
Downstream view of spillway

December 1978



View of spillway from right embankment

December 1978



View of debris on spillway

December 1978



View of erosion behind left wingwall

December 1978



View of original downstream channel

December 1978



Sloughing on downstream side of left embankment at original spillway channel

December 1978

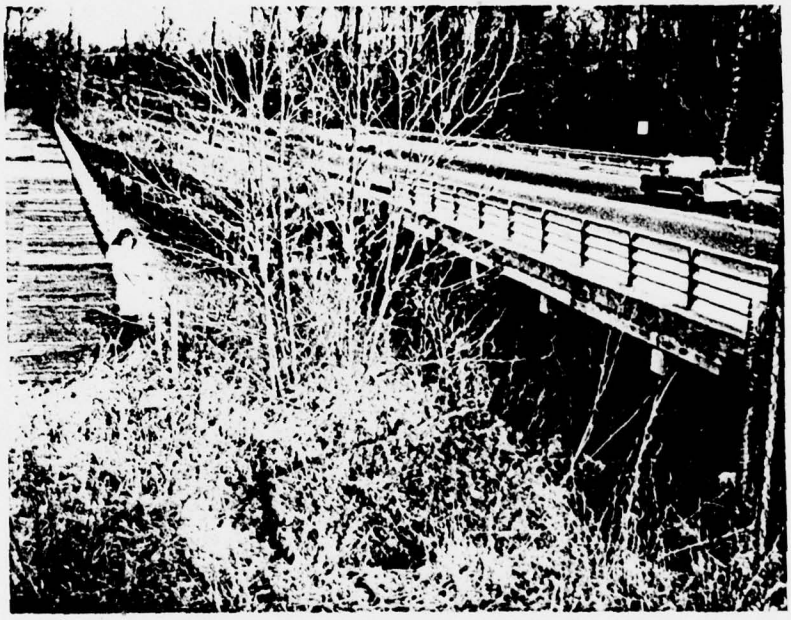


View of left embankment

December 1978



V- notched weir on downstream side of left embankment



View of bridge downstream from dam

December, 1978

Dam No. 00082

CHECK LIST
HYDROLOGIC AND HYDRAULIC DATA
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 48.5 sq.miles

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 35 M.S.L. (8000 acre-feet)

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 44.5 M.S.L. (14,300 acre-feet)

ELEVATION MAXIMUM DESIGN POOL: 39.5 M.S.L. (MCWC records)

ELEVATION TOP DAM: 44.5 M.S.L.

CREST:

a. Elevation 35 M.S.L.
b. Type Concrete arch ogee-type with V-notch weir
c. Width 12 feet
d. Length 400 feet
e. Location Spillover North chord
f. Number and Type of Gates None

OUTLET WORKS:

a. Type 2-36" diameter concrete piers
b. Location Gate-house on northwest end of dam
c. Entrance inverts 4.0 ø 10.75 M.S.L.
d. Exit inverts 3.43 ø
e. Emergency draindown facilities 20" diament blowoff pipe

HYDROMETEOROLOGICAL GAGES: USGS gage No. 4025 and v-notch weir
a. Type Water-stage recorder
b. Location Midway along north abutment
c. Records Continues from 1922 to present

MAXIMUM NON-DAMAGING DISCHARGE: 27,530 CFS

BY D.J.M. DATE 1-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A1 OF
CHKD. BY DATE SWIMMING RIVER DAM INSPECTION PROJECT C227
SUBJECT

Drainage Area = 48.5 sq miles

SNYDER COEFFICIENTS (FROM CORPS OF ENGINEERS)

$C_t = 4.0$

$C_p = 0.70$

$t_p = C_t (L L_c)^{0.3}$ $L = 6$ miles; $L_c = 2.27$ miles

$\therefore t_p = 4.0 (6 \times 2.27)^{0.3}$

$= 8.76$ hours

PRECIPITATION

PMF for 24 hours & 200 square miles = 23"

Maximum 6 hour percentage = 97%

" 12 " " = 106%

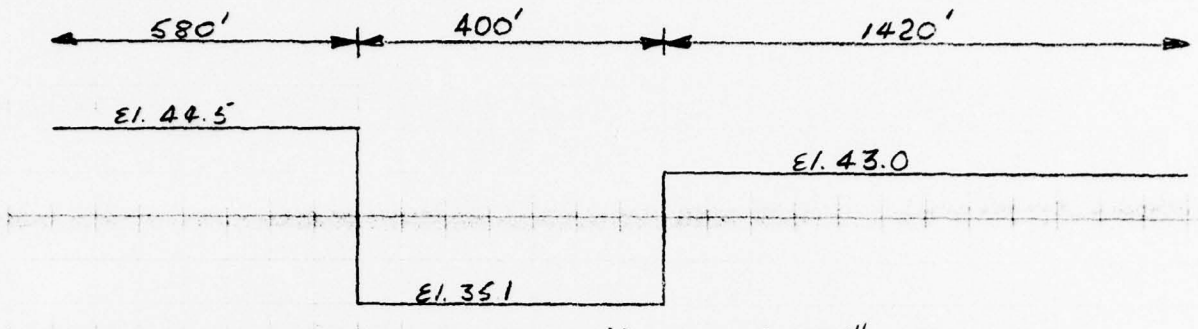
" 24 " " = 116%

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BY D.J.M. DATE 1-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A2 OF

CHKD. BY DATE SWIMMING RIVER DAM INSPECTION PROJECT C 226

SUBJECT Spillway discharge capacity



2 x 36" pipes
OO (max capacity 60 M.G.D)

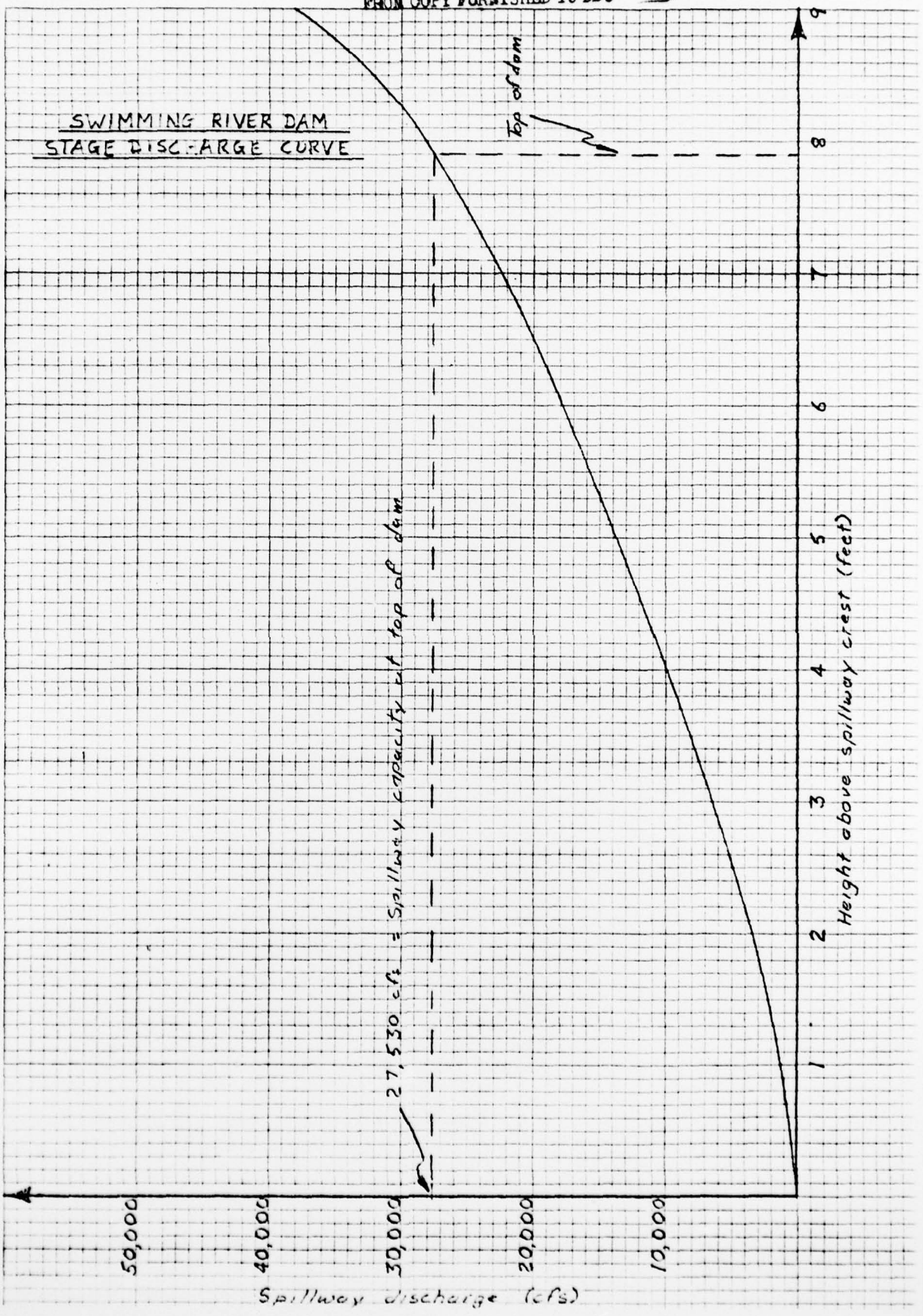
Over Spillway L = 400'			Over Dam L = 1420			Over Dam L = 580'			Σ Q
H	C	Q	H	C	Q	H	C	Q	Q
1	3.1	1,240							1,240
2	3.1	3,507							3,507
3	3.1	6,443							6,443
4	3.1	9,920							9,920
5	3.1	13,864							13,864
6	3.1	18,224							18,224
7	3.1	22,965							22,965
8	3.1	28,058	0.1	2.8	126				28,184
9	3.1	33,480	1.1	2.8	4587				38,067
10	3.1	39,212	2.1	2.8	12100	0.6	2.8	755	52,067

The pipes' capacities are dictated by the capacity of the pumps
The total capacity = 93 cfs

(Σ Q does not include capacity of pipes)

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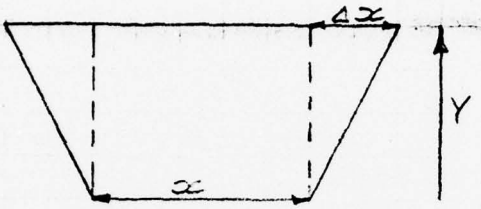
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46 0706
10 X 10 TO THE INCH • 7 X 10 INCHES
KEUFFEL & ESSER CO. MADE IN U.S.A.

BY D J M DATE 1-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A4 OF
CHKD. BY DATE SWIMMING RIVER DAM INSPECTION PROJECT C227
SUBJECT

AREA OF LAKE @ El. 35.1 ≈ 557 Acres
AREA OF CONTOUR @ El. 40.0 ≈ 670 Acres



Increment in volume $\Delta V = (x + \Delta x)y$

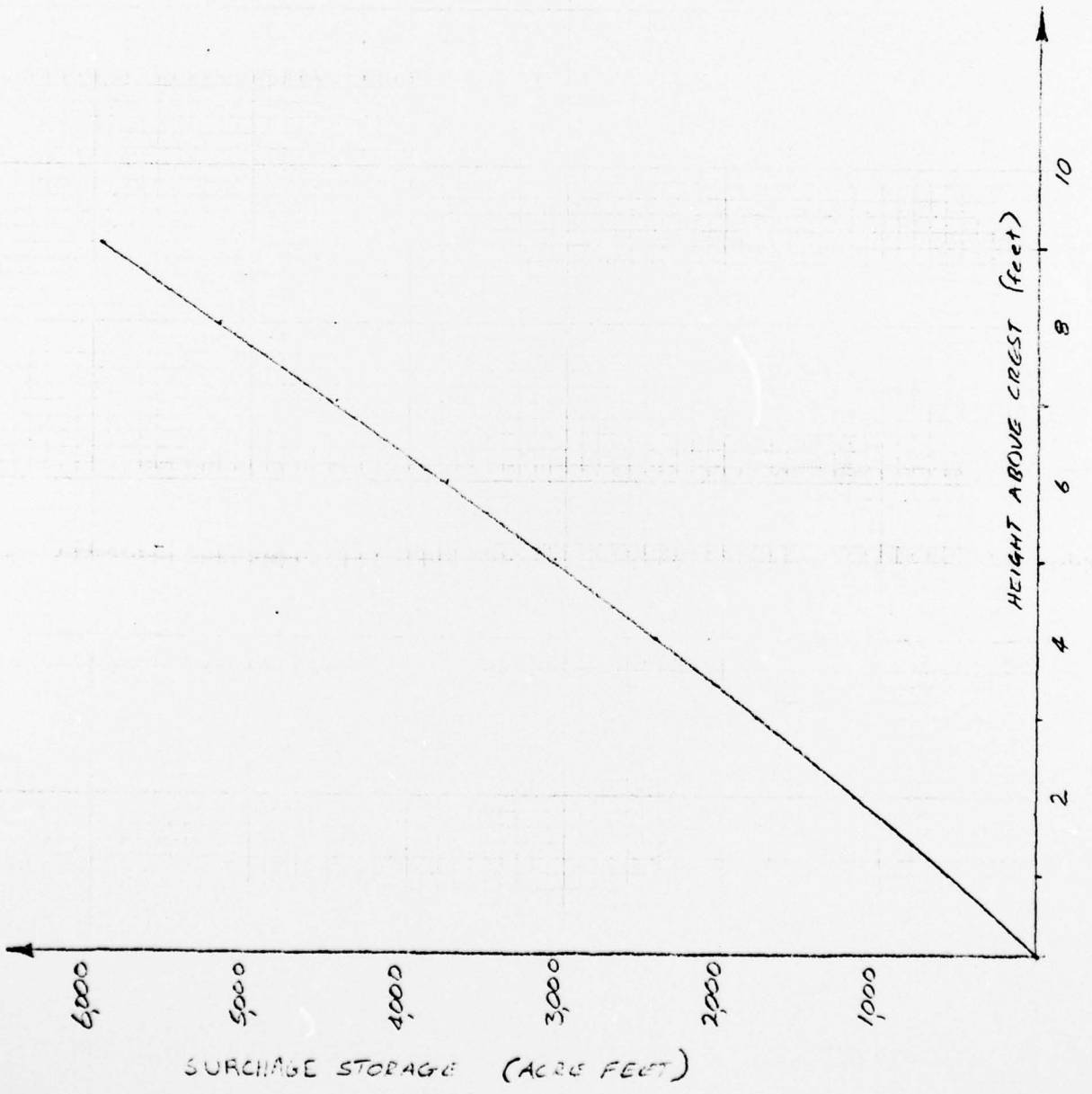
HEIGHT ABOVE CREST (FEET)	STORAGE (ACRE FEET)
1	569
2	1160
3	1775
4	2412
5	3073
6	3757
7	4464
8	5194
9	5947
10	6723

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AFTER El 400 Area assumed to increase at same rate as before

BY D.J.M DATE 1-79 SUBJECT STAGE STORAGE CURVE SHEET NO. OF A5
CHKD. BY DATE SWIMMING RIVER DAM INSPECTION JOB NO. C227

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BY D.J.M. DATE 1-79 **LOUIS BERGER & ASSOCIATES INC.** SHEET NO. A6 OF

CHKD. BY _____ DATE _____ SWIMMING RIVER DAM INSPECTION PROJECT C226

SUBJECT APPROXIMATE DRAWDOWN CALCULATIONS

Volume = 8000 x 43560 ft³

Discharge controlled by pumps

max = 93 cfs

$$\therefore \text{time} = \frac{8000 \times 43560}{93 \times 3600}$$

= 1040 hours

= 43 days

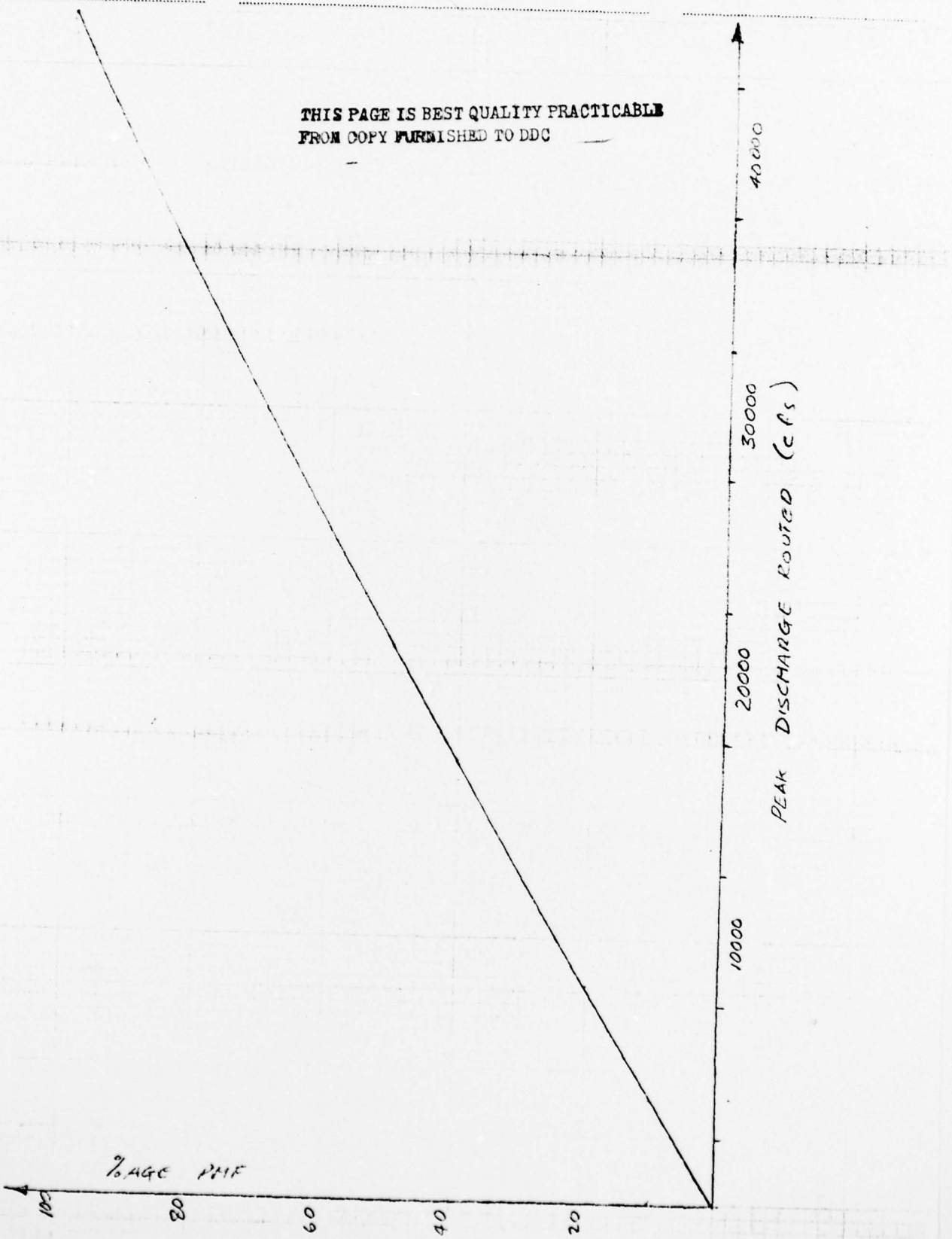
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BY D.J.M DATE 1-79
CHKD. BY DATE

SUBJECT % PMF V PEAK DISCHARGE
SWIMMING RIVER DAM INSPECTION

SHEET NO. 17 OF
JOB NO. C227

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SWIMMING RIVER DAM INSPECTION NORTH GROUP C227
BY D.J.MULLIGAN
JANUARY 1979

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
150	1	0	0	0	0	0	0	3	0

JOPER	NWT
3	0

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

SUB-AREA RUNOFF COMPUTATION

INFLOW HYDROGRAPH

ISTAQ	ICOMP	IECON	ITAPE	JPLT	JPRT	INAME
9	0	0	0	0	0	1

HYDROGRAPH DATA

IRYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
1	1	48.50	0.0	48.50	0.0	0.500	0	0	0

PRECIP DATA

SPFE	PMS	R6	R12	R24	R48	R72	R96
0.0	23.00	97.00	106.00	116.00	0.0	0.0	0.0

TRSPC COMPUTED BY THE PROGRAM IS 0.849

LOSS DATA

STRKR	DLTKR	RTIOL	ERAIN	STRKS	RTIOR	STRTL	CNSTL	ALSMX	RTIMP
0.0	0.0	1.00	0.0	0.0	1.00	0.50	0.10	0.0	0.0

UNIT HYDROGRAPH DATA
TP= 8.76 CP=0.70 NTA= 0

RECESSION DATA
STRTQ= 0.0 QRCSN= 0.0 RTIOR= 1.00
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC=10.12 AND R= 6.53 INTERVALS

UNIT HYDROGRAPH 41 END-OF-PERIOD ORDINATES, LAG= 8.71 HOURS, CP= 0.69 VOL= 1.00

98.	341.	720.	1123.	1545.	1954.	2270.	2463.	2535.	2472.
2236.	1922.	1648.	1414.	1212.	1040.	892.	765.	656.	563.
483.	414.	355.	304.	261.	224.	192.	165.	141.	121.
104.	89.	76.	66.	56.	48.	41.	35.	30.	26.
22.									

END-OF-PERIOD FLOW

TIME	RAIN	EXCS	COMP Q
1	0.13	0.00	0.
2	0.13	0.00	0.
3	0.13	0.00	0.
4	0.13	0.00	0.
5	0.13	0.03	5.
6	0.13	0.03	17.

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LOUIS BERGER & ASSOCIATES INC.

SWIMMING RIVER DAM

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PROJECT C-227

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7	0.29	0.19	57.
8	0.29	0.19	151.
9	0.29	0.19	317.
10	0.29	0.19	560.
11	0.29	0.19	881.
12	0.29	0.19	1274.
13	1.89	1.79	1875.
14	2.27	2.17	2964.
15	2.84	2.74	4787.
16	7.20	7.10	7947.
17	2.65	2.55	12798.
18	2.08	1.98	18945.
19	0.20	0.10	25734.
20	0.20	0.10	32458.
21	0.20	0.10	38440.
22	0.20	0.10	42953.
23	0.20	0.10	45450.
24	0.20	0.10	45789.
25	0.0	0.0	44097.
26	0.0	0.0	40560.
27	0.0	0.0	36010.
28	0.0	0.0	31414.
29	0.0	0.0	27196.
30	0.0	0.0	23511.
31	0.0	0.0	20294.
32	0.0	0.0	17486.
33	0.0	0.0	15037.
34	0.0	0.0	12908.
35	0.0	0.0	11071.
36	0.0	0.0	9496.
37	0.0	0.0	8144.
38	0.0	0.0	6985.
39	0.0	0.0	5991.
40	0.0	0.0	5138.
41	0.0	0.0	4407.
42	0.0	0.0	3780.
43	0.0	0.0	3242.
44	0.0	0.0	2780.
45	0.0	0.0	2385.
46	0.0	0.0	2045.
47	0.0	0.0	1753.
48	0.0	0.0	1500.
49	0.0	0.0	1283.
50	0.0	0.0	1096.
51	0.0	0.0	937.
52	0.0	0.0	800.
53	0.0	0.0	682.
54	0.0	0.0	551.
55	0.0	0.0	431.
56	0.0	0.0	317.
57	0.0	0.0	135.
58	0.0	0.0	67.
59	0.0	0.0	19.
60	0.0	0.0	15.
61	0.0	0.0	11.
62	0.0	0.0	8.
63	0.0	0.0	5.
64	0.0	0.0	2.
65	0.0	0.0	0.
66	0.0	0.0	0.
67	0.0	0.0	0.

BY D.J.M DATE

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SWIMMING RIVER DAM

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PROJECT C-227

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68	0.0	0.0	0.
69	0.0	0.0	0.
70	0.0	0.0	0.
71	0.0	0.0	0.
72	0.0	0.0	0.
73	0.0	0.0	0.
74	0.0	0.0	0.
75	0.0	0.0	0.
76	0.0	0.0	0.
77	0.0	0.0	0.
78	0.0	0.0	0.
79	0.0	0.0	0.
80	0.0	0.0	0.
81	0.0	0.0	0.
82	0.0	0.0	0.
83	0.0	0.0	0.
84	0.0	0.0	0.
85	0.0	0.0	0.
86	0.0	0.0	0.
87	0.0	0.0	0.
88	0.0	0.0	0.
89	0.0	0.0	0.
90	0.0	0.0	0.
91	0.0	0.0	0.
92	0.0	0.0	0.
93	0.0	0.0	0.
94	0.0	0.0	0.
95	0.0	0.0	0.
96	0.0	0.0	0.
97	0.0	0.0	0.
98	0.0	0.0	0.
99	0.0	0.0	0.
100	0.0	0.0	0.
101	0.0	0.0	0.
102	0.0	0.0	0.
103	0.0	0.0	0.
104	0.0	0.0	0.
105	0.0	0.0	0.
106	0.0	0.0	0.
107	0.0	0.0	0.
108	0.0	0.0	0.
109	0.0	0.0	0.
110	0.0	0.0	0.
111	0.0	0.0	0.
112	0.0	0.0	0.
113	0.0	0.0	0.
114	0.0	0.0	0.
115	0.0	0.0	0.
116	0.0	0.0	0.
117	0.0	0.0	0.
118	0.0	0.0	0.
119	0.0	0.0	0.
120	0.0	0.0	0.
121	0.0	0.0	0.
122	0.0	0.0	0.
123	0.0	0.0	0.
124	0.0	0.0	0.
125	0.0	0.0	0.
126	0.0	0.0	0.
127	0.0	0.0	0.
128	0.0	0.0	0.

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129	0.0	0.0	0.
130	0.0	0.0	0.
131	0.0	0.0	0.
132	0.0	0.0	0.
133	0.0	0.0	0.
134	0.0	0.0	0.
135	0.0	0.0	0.
136	0.0	0.0	0.
137	0.0	0.0	0.
138	0.0	0.0	0.
139	0.0	0.0	0.
140	0.0	0.0	0.
141	0.0	0.0	0.
142	0.0	0.0	0.
143	0.0	0.0	0.
144	0.0	0.0	0.
145	0.0	0.0	0.
146	0.0	0.0	0.
147	0.0	0.0	0.
148	0.0	0.0	0.
149	0.0	0.0	0.
150	0.0	0.0	0.
SUM	22.65	20.13	626992.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	45789.	42881.	24196.	8708.	626988.
INCHES		8.22	18.56	20.04	20.04
AC-FT		21274.	48018.	51844.	51844.

RUNOFF MULTIPLIED BY 0.50

0.	0.	0.	0.	2.	9.	28.	76.	159.	280.
441.	637.	938.	1482.	2393.	3973.	6399.	9473.	12867.	16229.
19220.	21477.	22725.	22695.	22049.	20280.	18005.	15707.	13598.	11759.
10147.	8743.	7519.	6454.	5536.	4748.	4072.	3493.	2995.	2569.
2203.	1890.	1621.	1390.	1192.	1022.	877.	750.	641.	548.
468.	400.	341.	275.	215.	158.	68.	34.	10.	7.
5.	4.	2.	1.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0

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SWIMMING RIVER DAM

SHEET NO. A-12 OF

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ROUTING DATA

GLOSS	CLOSS	AVG	IRES	ISAME
0.0	0.0	0.0	1	0

	NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
	1	0	0	0.0	0.0	0.0	0.
STORAGE=	0.	1160.	1775.	2412.	3073.	3757.	4464.	5194.	5947.
OUTFLOW=	0.	3507.	6443.	9920.	13864.	18224.	22965.	28184.	33867.

TIME	EOP STOR	AVG IN	EOP OUT
1	0.	0.	0.
2	0.	0.	0.
3	0.	0.	0.
4	0.	0.	0.
5	0.	1.	0.
6	1.	5.	1.
7	2.	19.	4.
8	5.	52.	12.
9	13.	117.	29.
10	28.	219.	61.
11	51.	360.	110.
12	83.	539.	181.
13	129.	787.	281.
14	199.	1210.	435.
15	313.	1938.	683.
16	503.	3183.	1096.
17	799.	5186.	2121.
18	1212.	7936.	3754.
19	1724.	11170.	6198.
20	2288.	14540.	9243.
21	2852.	17724.	12547.
22	3366.	20349.	15729.
23	3782.	22101.	18392.
24	4068.	22810.	20309.
25	4208.	22472.	21248.
26	4202.	21164.	21211.
27	4069.	19142.	20314.
28	3845.	16856.	18813.
29	3574.	14653.	17055.
30	3287.	12677.	15230.
31	3006.	10951.	13467.
32	2740.	9445.	11876.
33	2492.	8131.	10394.
34	2263.	6986.	9107.
35	2053.	5995.	7961.
36	1863.	5142.	6924.
37	1692.	4410.	6045.
38	1535.	3782.	5299.
39	1394.	3244.	4622.
40	1267.	2782.	4016.
41	1154.	2386.	3484.
42	1051.	2047.	3090.
43	956.	1755.	2725.

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SWIMMING RIVER DAM

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44	869.	1506.	2391.
45	791.	1291.	2090.
46	721.	1107.	1821.
47	658.	949.	1583.
48	603.	815.	1372.
49	554.	696.	1208.
50	508.	595.	1107.
51	462.	508.	1008.
52	419.	434.	913.
53	378.	370.	823.
54	339.	308.	738.
55	301.	245.	657.
56	266.	187.	579.
57	230.	113.	502.
58	196.	51.	428.
59	165.	22.	360.
60	139.	9.	302.
61	116.	6.	253.
62	97.	5.	212.
63	82.	3.	178.
64	68.	2.	149.
65	57.	1.	124.
66	48.	0.	104.
67	40.	0.	87.
68	33.	0.	72.
69	28.	0.	60.
70	23.	0.	50.
71	19.	0.	42.
72	16.	0.	35.
73	13.	0.	29.
74	11.	0.	24.
75	9.	0.	20.
76	8.	0.	17.
77	7.	0.	14.
78	5.	0.	12.
79	5.	0.	10.
80	4.	0.	8.
81	3.	0.	7.
82	3.	0.	6.
83	2.	0.	5.
84	2.	0.	4.
85	2.	0.	3.
86	1.	0.	3.
87	1.	0.	2.
88	1.	0.	2.
89	1.	0.	2.
90	1.	0.	1.
91	1.	0.	1.
92	0.	0.	1.
93	0.	0.	1.
94	0.	0.	1.
95	0.	0.	1.
96	0.	0.	0.
97	0.	0.	0.
98	0.	0.	0.
99	0.	0.	0.
100	0.	0.	0.
101	0.	0.	0.
102	0.	0.	0.
103	0.	0.	0.
104	0.	0.	0.
105	0.	0.	0.
106	0.	0.	0.
107	0.	0.	0.
108	0.	0.	0.
109	0.	0.	0.
110	0.	0.	0.
111	0.	0.	0.

112	0.	0.	0.
113	0.	0.	0.
114	0.	0.	0.
115	0.	0.	0.
116	0.	0.	0.
117	0.	0.	0.
118	0.	0.	0.
119	0.	0.	0.
120	0.	0.	0.
121	0.	0.	0.
122	0.	0.	0.
123	0.	0.	0.
124	0.	0.	0.
125	0.	0.	0.
126	0.	0.	0.
127	0.	0.	0.
128	0.	0.	0.
129	0.	0.	0.
130	0.	0.	0.
131	0.	0.	0.
132	0.	0.	0.
133	0.	0.	0.
134	0.	0.	0.
135	0.	0.	0.
136	0.	0.	0.
137	0.	0.	0.
138	0.	0.	0.
139	0.	0.	0.
140	0.	0.	0.
141	0.	0.	0.
142	0.	0.	0.
143	0.	0.	0.
144	0.	0.	0.
145	0.	0.	0.
146	0.	0.	0.
147	0.	0.	0.
148	0.	0.	0.
149	0.	0.	0.
150	0.	0.	0.
SUM			313492.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	21248.	20048.	11802.	4353.	313492.
INCHES		3.85	9.05	10.02	10.02
AC-FT		9946.	23420.	25917.	25922.

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RUNOFF SUMMARY. AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	9	22895.	21441.	12098.	4354.	48.50
ROUTED TO	99	21248.	20048.	11802.	4353.	48.50