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O'BRIEN AND GERE ENGINEERS INC PHILADELPHIA PA JUSTIN--ETC F/G 13/2
NATIONAL DAM SAFETY PROGRAM. RECORDS POND DAM (DE00057); NANTIC--ETC(U)
JUN 78 J J WILLIAMS DACW61-78-C-0052

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LEVEL II

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NANTICOKE RIVER BASIN

BROAD CREEK, SUSSEX COUNTY

DELAWARE

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RECORDS POND DAM

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PHASE I INSPECTION REPORT

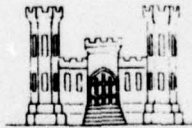
NATIONAL DAM SAFETY PROGRAM

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DE 00057

DDC

SEP 7 1978



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DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE - 2D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

JUNE 78 00 25 052

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER DE00057	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Inspection Report National Dam Safety Program Records Pond Dam (NJ00057) Sussex County Delaware	5. TYPE OF REPORT & PERIOD COVERED 9 FINAL rept.	6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) 10 John J. Williams	8. CONTRACT OR GRANT NUMBER(s) 15 DACW61-78-C-0052	
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17. DISTRIBUTION STATEMENT (of the 6 National Dam Safety Program. Records Pond Dam (DE00057), Nanticoke River Basin, Broad Creek, Sussex County, Delaware, 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- Del. National Dam Safety Program Phase I Records Pond Dam, Del.		
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 ade- quacy. 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.		



DEPARTMENT OF THE ARMY
PHILADELPHIA DISTRICT, CORPS OF ENGINEERS
CUSTOM HOUSE-2 D & CHESTNUT STREETS
PHILADELPHIA, PENNSYLVANIA 19106

IN REPLY REFER TO

NAPEN-D

28 JUL 1978

Honorable Pierre S. DuPont
Governor of Delaware
Dover, Delaware 19901

Dear Governor DuPont:

Inclosed is the Phase I Inspection Report for Records Pond Dam in Sussex County, Delaware 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 on the first two pages of the report.

Based on visual inspection, available records, calculations and past operational performance, Records Pond Dam is judged to be in fair condition. However, the spillway is considered to be seriously inadequate. To insure adequacy of the structure, the following actions, as a minimum, are recommended:

a. Hydrologic and hydraulic investigations and engineering studies should be initiated within three months of the date of approval of this report to determine corrective action required to increase the capacity of the spillway to pass at least $\frac{1}{2}$ PMF. Construction of an improved spillway should commence in calendar year 1979. Due to the potential for overtopping of the dam, a detailed emergency operation, drawdown and warning system should be developed by the owner within the next two months.

b. Within one year from the date of approval of this report trees and brush should be removed from the embankments, slope erosion corrected and a suitable controlled vegetation established.

A copy of the report is being furnished to Mr. Austin P. Olney, Delaware Department of Natural Resources and Environmental Control, 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 Thomas B. Evans. Under the provisions of the Freedom of Information

NAPEN-D

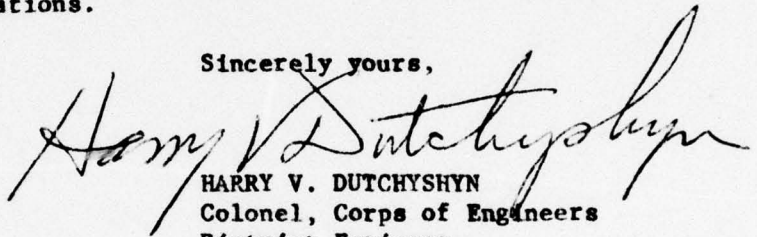
Honorable Pierre S. DuPont

Act, the inspection report will be subject to release by this office, upon request, thirty 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 yours,



HARRY V. DUTCHYSHYN
Colonel, Corps of Engineers
District Engineer

1 Incl
As stated

Cy Furn:
Mr. Austin P. Olney, Secretary
Department of Natural Resources and
Environmental Control

LEVEL II

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM



Name of Dam: Records Pond Dam

State Located Delaware
County Located Sussex County
Stream Broad Creek
Date of Inspection May 24, 1978

ASSESSMENT OF GENERAL CONDITIONS

The Records Pond Dam consists of four sluiceways or culverts controlled by movable, hand operated timber gates flanked by an earth causeway or dam. This causeway is Willow Street and the sluiceway or culverts are referred to as the Willow Street Bridge. A complete inspection of the gates was not possible since approximately eight (8) inches of water was flowing over them at the time of the inspection.

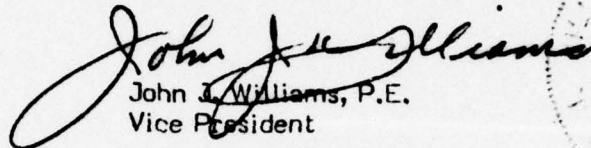
Although the structure was completed in 1900, it appears to be in fairly good condition. Aggregate is exposed in the concrete along both wing walls but no serious cracking is apparent.

Hydraulics/Hydrologic analyses reveal that the embankments would be overtopped for all storms exceeding approximately six (6) per cent of Probable Maximum Flood (PMF) ; therefore, the sluiceways can be

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DDI	Buff Section <input type="checkbox"/>
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REMARKS/NOTES/SPECIAL	
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considered "seriously inadequate" as cited in Engineering Technical Letter No. 1110-2, January 25, 1978. In order to satisfy criteria established by the Department of the Army, Office of the Chief of Engineer, remedial measures that should be considered include providing an additional waterway to pass at least $\frac{1}{2}$ PMF without overtopping the embankments.

O'BRIEN & GERE ENGINEERS, INC.
JUSTIN & COURTNEY


John J. Williams, P.E.
Vice President

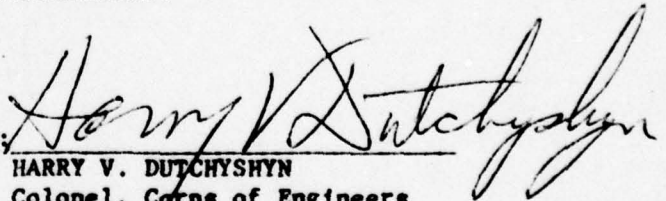


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a. Hydrologic and hydraulic investigations and engineering studies should be initiated within three months of the date of approval of this report to determine corrective action required to increase the capacity of the spillway to pass at least $\frac{1}{2}$ PMF. Construction of an improved spillway should commence in calendar year 1979. Due to the potential for overtopping of the dam, a detailed emergency operation, drawdown and warning system should be developed by the owner within the next two months.

b. Within one year from the date of approval of this report trees and brush should be removed from the embankments, slope erosion corrected and a suitable controlled vegetation established.

APPROVED:



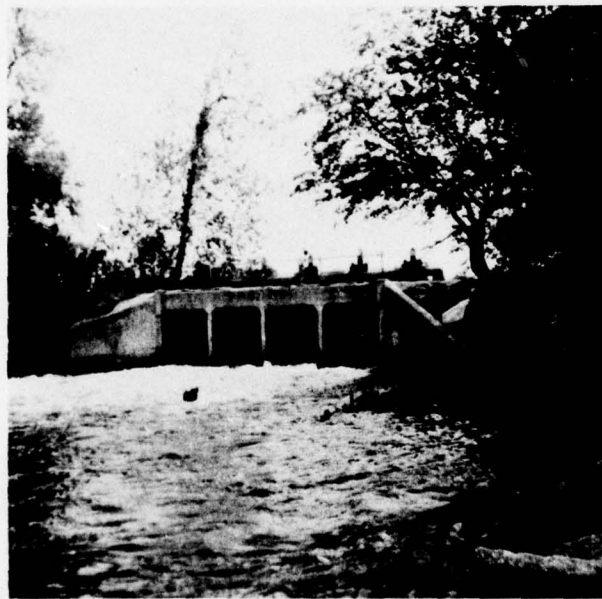
HARRY V. DUTCHYSHYN
Colonel, Corps of Engineers
District Engineer

DATE:

28 July 1978



UPSTREAM FACE WITH GATES



FOUR CELL BOX CULVERT DOWNSTREAM VIEW

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
NAME OF DAM RECORDS POND DAM ID# 00057

SECTION I - 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 #DACW 61-78-C-0057 between O'Brien and Gere Engineers, Justin and Courtney Division and the United States Army Engineer, Philadelphia District.

b. Purpose of Inspection - The purpose of this inspection is to evaluate the structural and hydraulic conditions of the Records Pond Dam and to determine if the dam constitutes a hazard to human life or property.

1.2 PROJECT DESCRIPTION - (According to information provided by the State of Delaware, Division of Soil and Water Conservation as itemized in Section 2.1 below.)

a. Description of Dam and Appurtenances - The dam at Records Pond is principally a water level control structure consisting of a four (4) cell box culvert with movable, hand operated timber gates flanked by an earth causeway or dam. The causeway is actually Willow Street and the box culvert structure is locally referred to as the Willow Street Bridge. Each of the four cells provides a flow opening approximately 7.1 feet wide and 7.7 feet high. The timber gates move vertically by hand operated cranks to control the water elevation in Records Pond. Flow passes through the structure and into a downstream pool which serves as the confluence of Broad Creek and Rossakatum Branch. Residential properties line the left bank of this pool and industrial property lines the right bank. Just downstream of this pool, Broad Creek passes under another road bridge which allows for a very short rise in pool elevation.

A depression exists in the Willow Street causeway near its intersection with Cooper Street. This depression appears lower than the top of the dam and apparently acts as an additional spillway allowing high flood water to flow onto Fourth Street, then into Rossakatum Branch and back into Broad Creek.

b. Location - Records Pond is located on Broad Creek just east of Laurel, Delaware, a community with a 1970 population of 2,408. The drainage area is 73.1 square miles as obtained from State of Delaware, Division of Highways computations entitled "Hydrology Investigation and Hydraulic Computation for Records Pond - Sussex County", dated October 9, 1970. The drainage area is approximately 8 miles long and 9.5 miles wide and is situated in both Sussex County, Delaware and Wicomico County, Maryland.

c. Size Classification - The maximum height of the dam is approximately 11 feet and the reservoir volume to normal pool elevation is 270 acre feet. Therefore, the dam is in the small size category as defined by the Recommended Guidelines for Safety Inspection of Dams.

d. Hazard Classification - Significant development is present immediately downstream of this structure and serious flooding would result in damage to personal property and, possibly, loss of human life. Therefore, Records Pond Dam should be classified in the high hazard category as defined by the Recommended Guidelines for Safety Inspection of Dams.

e. Ownership - The dam is owned by the State of Delaware Department of Natural Resources and Environmental Control.

f. Purpose of Dam - Information provided by the State of Delaware lists the purpose of Records Pond and Dam as recreation.

g. Design and Construction History - According to information provided by the U.S. Army Engineer District, Philadelphia the present structure was completed in 1900. It was originally a privately owned water level control structure and presently is owned by the State of Delaware. From the visual inspection, it appears that the original design provided for a spillway at the southwest corner of the reservoir near the intersection of Willow Street and Cooper Street. Although the gated structure at that location is inoperable, the elevation of Willow Street near that intersection appears low enough to allow for flow to pass over the roadway before overtopping the main 4 cell box culvert.

Improvements/Plans were recommended by Edward H. Richardson Associates, Inc. dated 1/9/74. These included construction of a semi-circular weir just upstream of the present structure as shown in the enclosed Figure #3. The recommended spillway would be constructed of PMA-22 steel sheet piles with a downstream face and energy dissipation basin constructed of 150 pound stone riprap. Implementation of these improvements also calls for the construction of a 150 feet long earth dike located in the southwest corner of the reservoir to allow for increased storage. This dike would be lined on its upstream face with grouted riprap. These improvements/plans have not been implemented.

h. Normal Operational Procedure - Records Pond and Records Pond Dam are operated by the Division of Fish and Wildlife, Delaware Department of Natural Resources and Environmental Control. Under normal conditions, the water surface elevation in the pool is approximately 8.9.

According to officials from the Division of Fish and Wildlife, Department of Natural Resources and Environmental Control, the gates are opened each time rainfall occurs. Even light rainfall requires opening of the gates since Records Pond rises rapidly. Employees of the Division of Fish and Wildlife are responsible for operating the gates and for maintaining them in an operable condition. There is no flood warning system in effect.

1.3 PERTINENT DATA (Provided by The State of Delaware, Division of Soil and Water Conservation.)

a. Drainage Area - The drainage area for the Records Pond Reservoir is 73.1 square miles as taken from the State of Delaware Report of October 1970.

b. Discharge At Damsite - The maximum discharge at the damsite is unknown since no records were made available. However, from computations referred to in 1.2.b above, the 50 year discharge is 2,840 cfs or 1,835 MGD. Normal pool discharge is 10.3 MGD.

c. Elevation (Feet above MSL)

Top of Gates - 8.6
Normal Pool - 8.9
Willow Street Birdge Underclearance - 9.16

d. Reservoir (Miles)

Length of Normal Pool 1.27

e. Storage (Acre Feet)

Normal Pool - 270

f. Reservoir Surface (Acres)

Normal Pool - 90

g. Dam

Type - Earthfill Causeway
Length - Approximately 500 feet
Height - Approximately 10.5 feet
Top Width - Approximately 18 feet (Roadway width)

h. Diversion and Regulating Tunnel

None

i. Spillway

Type - Four cell, gated box culvert
Combined Width of Culverts - 28.5 feet
Crest Elevation - 8.6 (variable)
Gates - 4 concrete cells (7.12 ft. x 7.67 ft.) with
separate, hand operated timber gates.
- Flow area with gates full open = 221.2 sq. ft.

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

The available data relative to this structure consists of the following:

- a. Preliminary Survey, Willow Street Bridge, October 1970 (includes sketches of existing structure)
- b. Hydrology Investigation and Hydraulic Computations for Records Pond - Sussex County; October 1970
- c. Investigation Report for Records Pond; November 1970
- d. Sheet 1 through 4 describing proposed improvements to Records Pond Dam; January 1974
- e. Water-Table, Surface-Drainage, and Engineering Soils Map of the Laurel Area, Delaware.

2.2 CONSTRUCTION

No information was made available.

2.3 OPERATION

In the event of any rainfall or potential flooding, the hand operated gates are opened in an attempt to prevent flow over the roadway. The operation is the responsibility of the Division of Fish and Wildlife, Department of Natural Resources and Environmental Control.

2.4 EVALUATION

Data regarding design and construction of the dam was not made available.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General - The visual inspection of Records Pond Dam was conducted on May 24, 1978. At the time of the inspection, approximately 8 inches of water was flowing over the tops of the timber gates.

b. Dam - Minor concrete cracking is apparent and the aggregate is exposed in both wingwalls and in the culvert structure itself. However, the structure appears stable. Trees and brush growth are apparent directly adjacent to the concrete structure along the downstream slopes. Some erosion was noted along the downstream slope of the causeway. This could be the result of surface runoff along Willow Street or previous overtopping.

c. Appurtenant Structures - There are no appurtenant structures.

d. Reservoir Area - The tree and brush lined reservoir banks are stable, gently rising and well defined.

e. Downstream Channel - A downstream pool exists which serves as the confluence between Broad Creek and Rossakatum Branch. This pool is lined with residences on its left bank and industrial property on its right bank.

Just downstream of this pool is a roadway bridge. (See Photograph A-4) The bottom of the bridge girders were only a few feet above water surface elevation during inspection. This structure may act as a control in the event of flooding.

3.2 EVALUATION

The dam and 4 cell box culvert appear to be structurally sound. However, downstream flooding is probable since even light rainfall causes a considerable rise in Records Pond as reported by officials from the Department of Natural Resources and Environmental Control.

SECTION 4 - OPERATIONAL PROCEDURES

Operational procedures are discussed in Section 1.2h.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data - The Probable Maximum Flood (PMF) was determined from Probable Maximum Precipitation and Standard Reduction Factors for this geographic location and basin size. The peak discharge of the PMF is approximately 84,000 cfs. The peak discharge of $\frac{1}{2}$ PMF is approximately 42,500 cfs. The U.S. Army Corps of Engineers computer program HEC-1 was used to determine the PMF and $\frac{1}{2}$ PMF and other percentages of the PMF. Those percentages were 10%, 20%, 30%, 40%, 60%, 70% and 80%. From flood routing analyses, it appears that the dam will be overtopped when the flood exceeds 6% of the PMF.

The present sluiceways are adequate to provide for effective drawdown of the reservoir. With the gates in the full open position, and no inflow considered, drawdown to the invert of the culvert may be accomplished in 3 hours (See computations sheet #4).

The 50 year storm was determined in the study entitled "Hydrology Investigation and Hydraulic Computations For Records Pond - Sussex County", dated October 1970. According to this report, the existing structure is not capable of passing the 50 year flood even with all four gates completely opened.

b. Experience Data- No gage recording information was made available.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observation

1. Causeway - Erosion of the downstream slope was apparent. A considerable number of pot holes were observed on the roadway surface. Large trees, brush and dumped waste concrete line both downstream slopes.

2. Bridge/Box Culverts - Aggregate is exposed in the concrete but no serious cracking was observed. A full inspection of the timber gates was not possible since overflow was occurring but the hand operated controls and the timber gate stems were in satisfactory condition. Large trees are directly adjacent to the structure.

3. Wingwalls - Aggregate is also exposed along both upstream wingwalls, but the visible portions showed no cracking or structural deficiencies.

b. Design and Construction Data - A "Preliminary Survey of the Willow Street Bridge" was provided by the State of Delaware, Division of Soil and Water Conservation. (See appendix). The information contained provided "as built" dimensions but does not give complete foundation data.

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

d. Post Construction Changes - The "Preliminary Survey of Willow Street Bridge" indicates that winches were initially used to raise and lower the timber gates. As stated on sheet #2 of this report:

"Gate winches shown above are no longer used. Gates are raised and lowered by a wooden frame attached to the gate."

A spillway gate at the southwest corner of Records Pond has been abandoned and is inoperable. However, low banks still categorize this corner of the reservoir and it is expected that these banks act as an additional spillway during severe flood.

e. Seismic Stability - The structure is located in relatively featureless topography within the Atlantic Coastal Plain physiographic province of southern Delaware. Relief in the general area ranges from elevation 5 to 40 MSL datum. The dam is founded in Recent alluvium and abuts on silty to clayey sandy unconsolidated sediments of the Pleistocene Columbia formation. Bedrock is of no consideration in the foundation of this dam.

An assessment of the dam's vulnerability to seismic events indicates that the structure is located in Seismic Zone 1. This zone presents no hazard from earthquake activity when static stability conditions are satisfactory. Accordingly, Records Pond Dam is considered seismically stable.

f. Evaluation - Based upon the visual inspection, the dam appears stable. However, when subjected to a period of prolonged overtopping, it is probable that the embankments would fail. A previous visual inspection conducted in 1970 by the Delaware Division of Highways stated:

"Visual inspection reveals that the facility is structurally sound. There are no signs of distress and it appears to have been adequately maintained."

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety - Although the culvert/causeway may be structurally sound, it is adequate to pass only six (6) per cent of the PMF without overtopping the roadway embankment. During the period of overtopping, failure of the embankment is probable.

Residential and industrial properties are immediately downstream as is the confluence with Rossakatum Branch. A bridge is situated just downstream of this confluence and could act as a control structure in the event of flooding, (See Photograph #A-4).

b. Adequacy of Information - Adequate information is not available for a complete stability analysis of the structure.

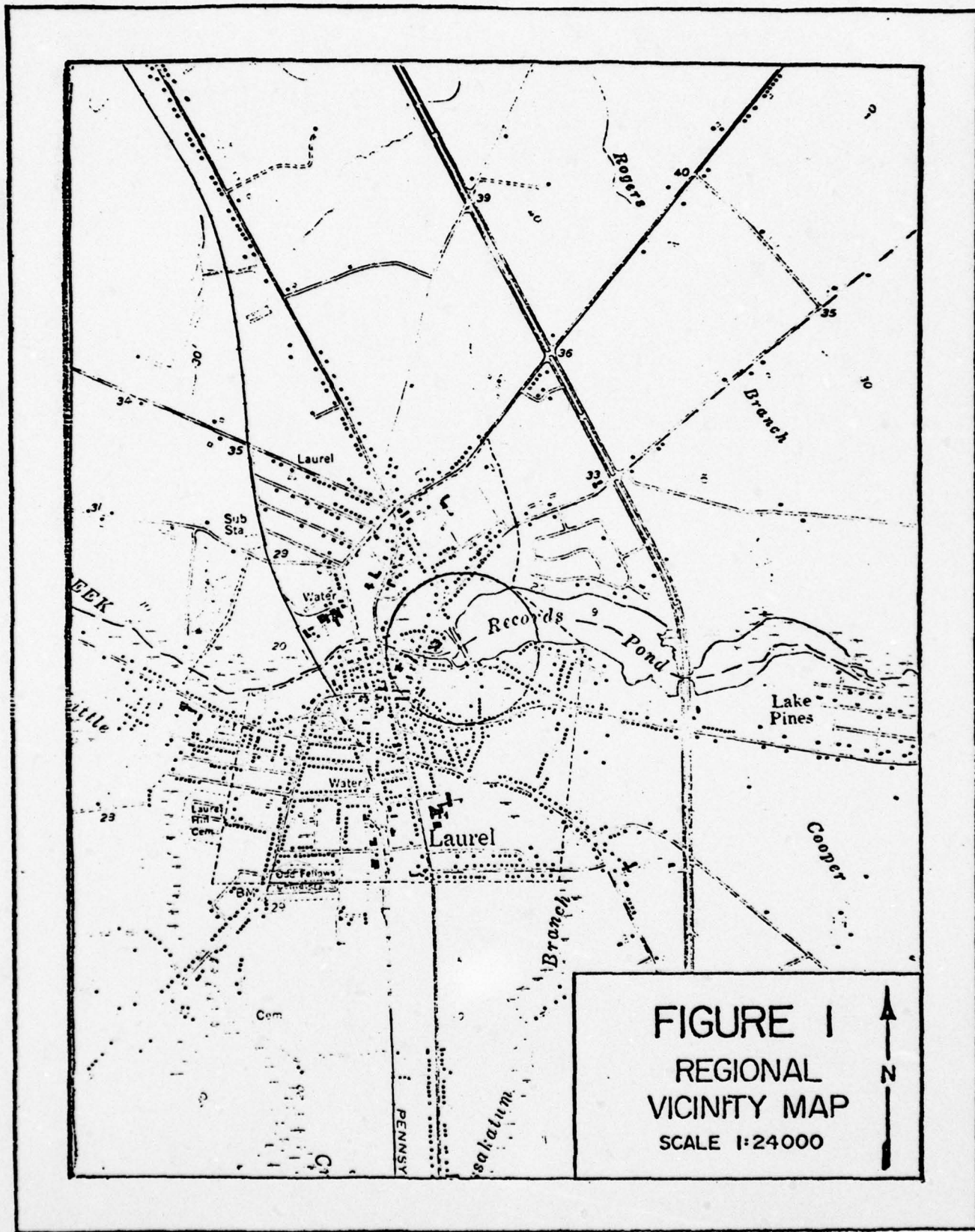
7.2 REMEDIAL MEASURES

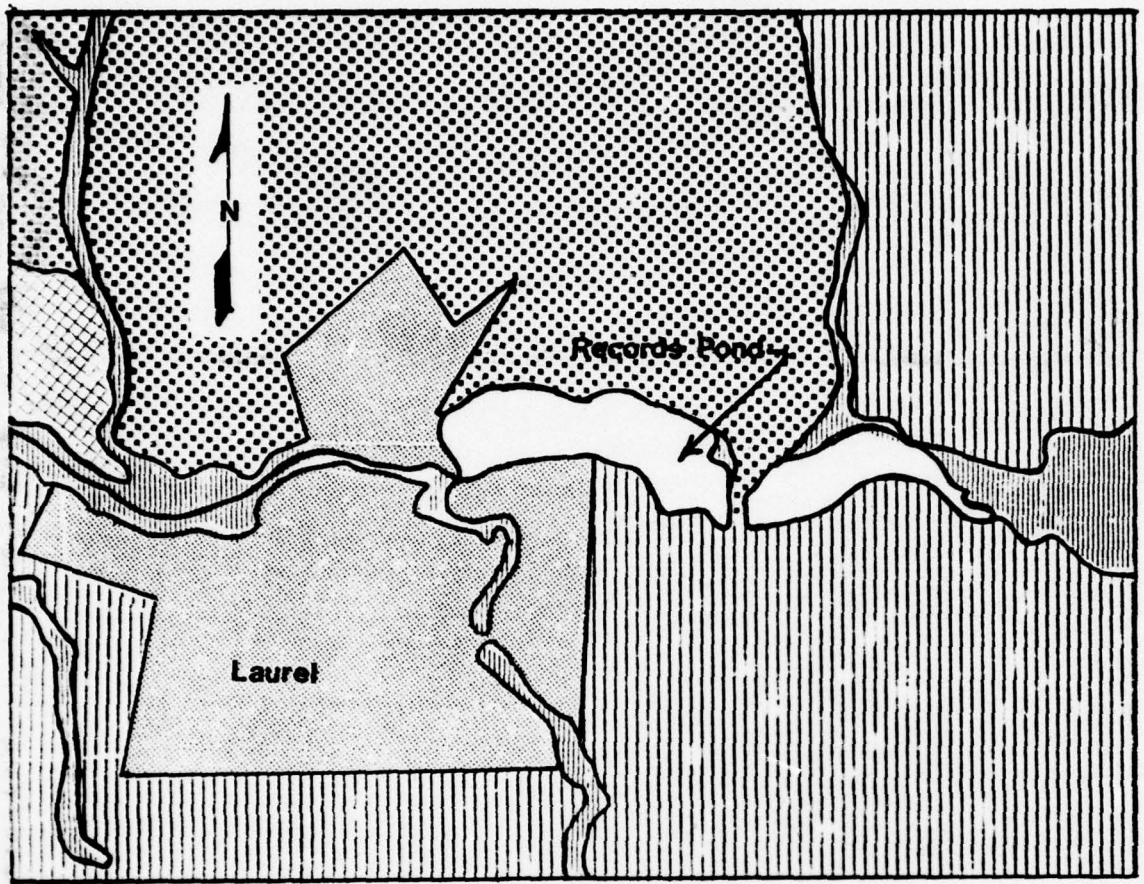
a. In order to satisfy criteria established by the Department of the Army, Office of the Chief Engineer, remedial measures that should be considered include; providing an additional waterway to pass at least $\frac{1}{2}$ of the PMF without overtopping the embankments.

Bank stabilization measures should be taken or drainage facilities provided to eliminate erosion along the downstream slope of the Willow Street causeway.

Large trees adjacent to the present abutments and wingwalls should be removed.

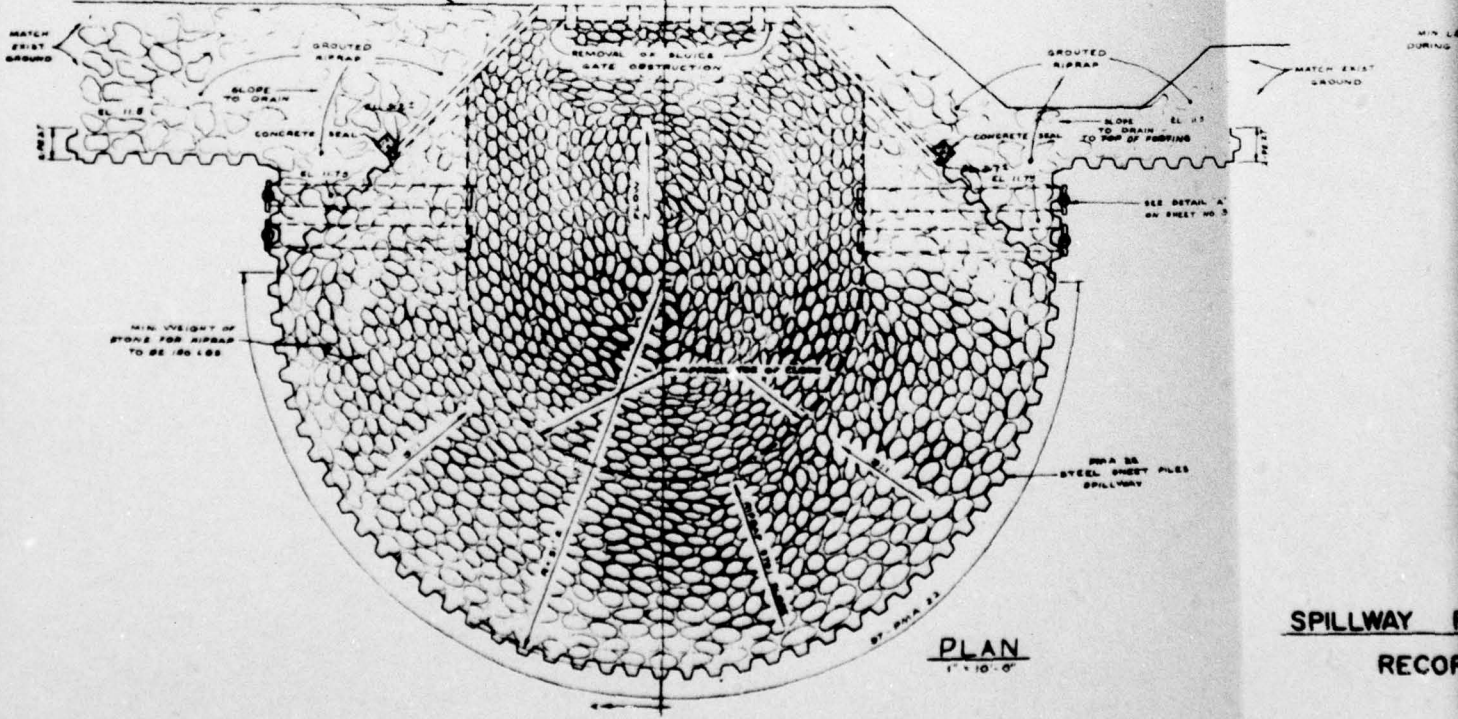
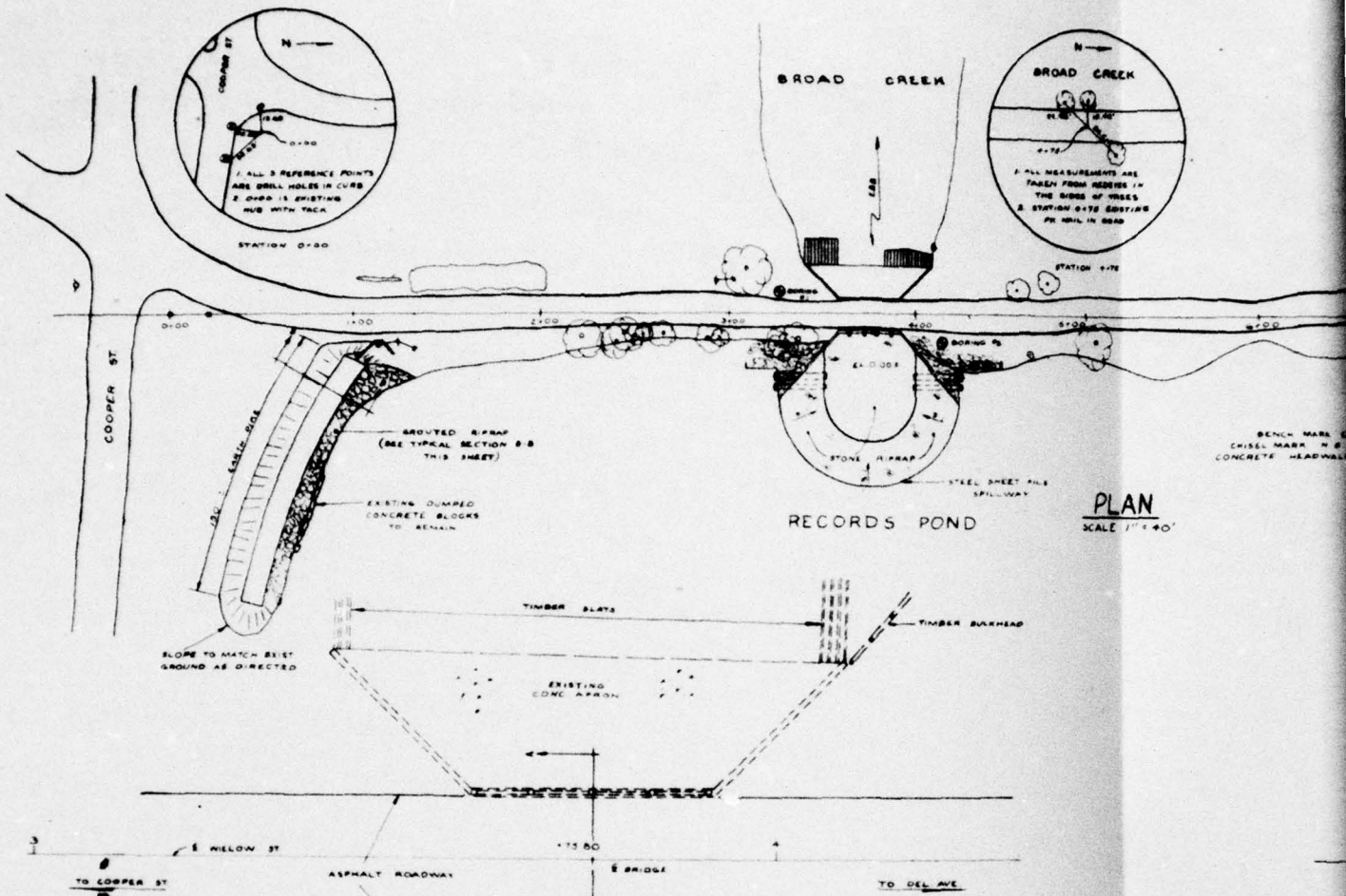
b. O&M Maintenance & Procedures - A flood warning system and evacuation plan is recommended.





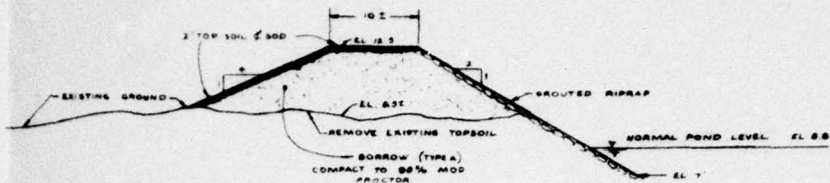
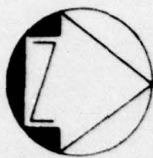
- 
AM2/24 - Sandy soil
- 
AM2/23 - Poorly graded sandy soil
- 
AR Z - Alluvial gravel, silt, sand and clay
- 
AM12/24 - Gravelly and sandy soil
- 
Laurel, DE

Figure 2
Geological Map

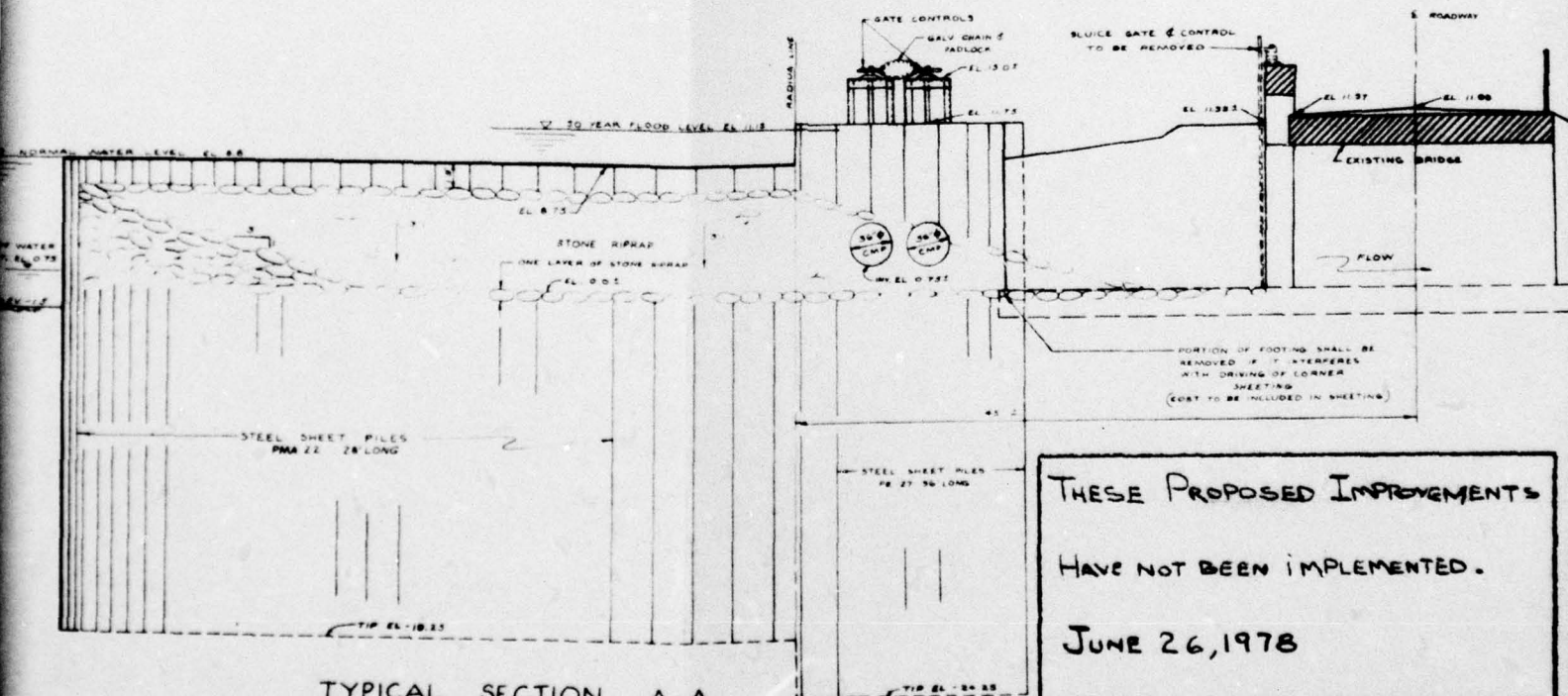


40 39 38 37 36 35 34 33 32 31 30 29 28 27 26 25 24 23 22

SPILLWAY F
RECOR



TYPICAL EMBANKMENT SECTION B-B
(ADJACENT TO COOPER STREET)
NOT TO SCALE



THESE PROPOSED IMPROVEMENTS
HAVE NOT BEEN IMPLEMENTED.
JUNE 26, 1978

TYPICAL SECTION A-A
SCALE 1/4" = 1'-0"

SECTION
POND

THIS DRAWING DOES NOT INCLUDE NECESSARY COMPONENTS FOR CONSTRUCTION SAFETY
ALL CONSTRUCTION MUST BE DONE IN COMPLIANCE WITH THE OCCUPATIONAL SAFETY AND HEALTH ACT OF 1970 AND ALL RULES AND REGULATIONS THEREBY APPROPRIATE

REVISIONS	CHECKED BY DATE

EDWARD H. RICHARDSON ASSOCIATES, INC.
CONSULTING ENGINEERS NEWARK, DELAWARE

APPROVED BY: *Carl Cook*

THIS DRAWING AND THE DESIGN FEATURES OR CONSTRUCTION ENCLOSED ARE PROPRIETARY TO EDWARD H. RICHARDSON ASSOCIATES AND SHALL NOT BE REPRODUCED, ALTERED OR COPIED WITHOUT WRITTEN PERMISSION. SHALL NOT BE USED IN ANY MANNER DISSEMINATING TO ITS INTEREST AND SHALL BE RETURNED UPON REQUEST.

SCALE: AS NOTED
DRAWN BY: D.H.

DESIGNED BY: C.H.
CHECKED BY: A.J.F.

DATE: 11-9-74
FILE NO. E-003
SHEET NO. 3 OF 4

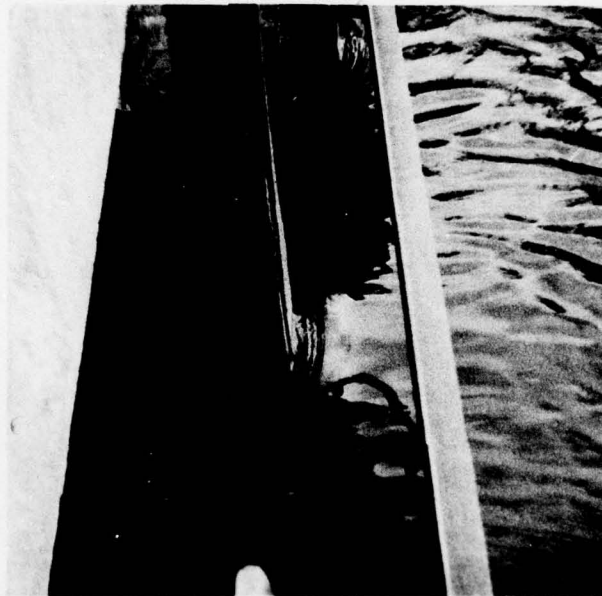
APPENDIX

PHOTOGRAPHS

A-1



TYPICAL GATE CONTROL

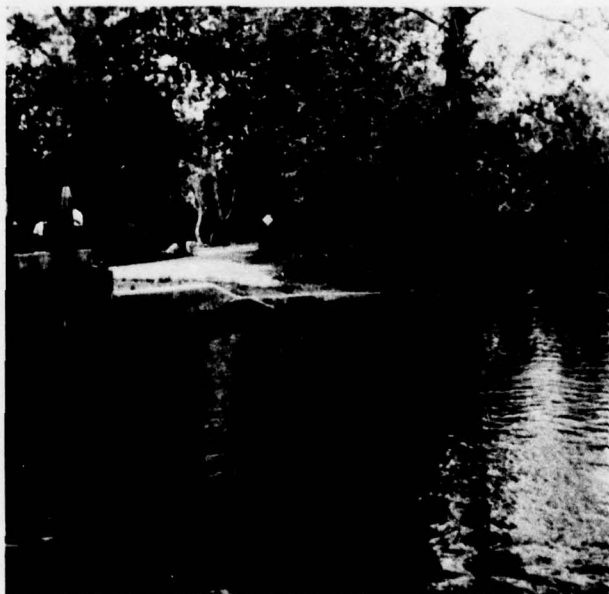


OVERFLOW AT TIME OF INSPECTION

78 08 03 45



UPSTREAM LEFT BANK



UPSTREAM RIGHT BANK



DOWNSTREAM RESIDENCES, LEFT BANK



DOWNSTREAM BRIDGE AND INDUSTRIAL PROPERTY,
RIGHT BANK

FIELD INSPECTION REPORT

Check List
Visual Inspection
Phase 1

Name Dam Records Pond Dam County Sussex State Delaware Coordinators Mr. Krishna Patel

Date(s) Inspection May 24, 1978 Weather Overcast Temperature 65°

Pool Elevation at Time of Inspection 8.8 M.S.L. Tailwater at Time of Inspection 1.0 M.S.L.
(approx.)

Inspection Personnel:

Mr. George C. Elias

Mr. Frank E. Falcone

Mr. Richard E. Horvath

Mr. Frank E. Falcone Recorder

Mr. Krishna Patel
Division Engineer
State of Delaware
Division of Soil and Water Conservation

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF OBSERVATIONS REMARKS OR RECOMMENDATIONS

SURFACE CRACKS
CONCRETE SURFACES

Aggregate is exposed approximately 8 feet below the roadway on the downstream face of the culvert and along both wing walls, no severe cracking.

None.

STRUCTURAL CRACKING

No severe cracking observed.

None.

VERTICAL AND HORIZONTAL
ALIGNMENT

Good condition.

None.

A-7

MONOLITH JOINTS

No appreciable cracking or separation.

None.

CONSTRUCTION JOINTS

No appreciable cracking or separation.

None.

CONCRETE/MASONRY DAMS

VISUAL EXAMINATION OF

OBSERVATIONS

REMARKS OR RECOMMENDATIONS

SEEPAGE OR LEAKAGE

None observed.

The entire structure could not be inspected since overflow was occupying.

STRUCTURE TO
ABUTMENT/EMBANKMENT
JUNCTIONS

Aggregate is exposed approximately 8 feet below the roadway surface but no severe cracking was visible.

The invert of the four cell box culvert should be inspected under minimum flow conditions.

DRAINS

A-8

None observed.

None.

WATER PASSAGES

None.

None.

FOUNDATION

Unobserved, no plans available.

None.

EMBANKMENT

REMARKS OR RECOMMENDATIONS

OBSERVATIONS

VISUAL EXAMINATION OF

EMBANKMENT EROSION

Some erosion of downstream face due to surface runoff.

Downstream bank should be stabilized.

JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAN

Large trees are growing immediately adjacent to the wing walls.

These trees should be removed to prevent undermining.

A-9

ANY NOTICEABLE SEEPAGE

None observed.

None.

STAFF GAGE AND RECORDER

None present.

None.

DRAINS

None provided.

None.

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF

CONDITION
(OBSTRUCTIONS,
DEBRIS, ETC.)

The downstream channel forms a pool and is the confluence between Broad Creek and Rossakatum Branch. Just downstream of the confluence, an existing low bridge may cause a constriction.

OBSERVATIONS

Both residential and industrial properties are present along the banks of this downstream pool. Due to lack of storage in Record's Pond, the area is traditionally prone to flooding.

REMARKS OR RECOMMENDATIONS

SLOPES

Well defined and stable.

None.

APPROXIMATE NO.
OF HOMES AND
POPULATION

Approximately 8 homes with a population of 35 on the left bank and one industrial site on the right bank. More severe flooding could affect 1,000 people.

Traditionally prone to flooding.

ITEM

REMARKS

DESIGN REPORTS

No design reports available.

GEOLOGY REPORTS

No geology reports available except "Water-Table, Surface-Drainage, and Engineering Soils Map of the Laurel Area, Delaware" published by the U.S. Geological Survey.

**DESIGN COMPUTATIONS
HYDROLOGY & HYDRAULICS
DAM STABILITY
SEEPAGE STUDIES**

"Preliminary Survey of Willow Street Bridge" dated October 1970.
"Additional Survey of Bridges over Broad Creek" dated October 1970.
"Hydrology Investigation and Hydraulic Computation for Records Pond.
"Sussex County" dated October, 1970.

A-11

**MATERIALS INVESTIGATIONS
BORING RECORDS
LABORATORY
FIELD**

None provided.

POST-CONSTRUCTION SURVEYS OF DAM

Investigation of Records Pond Water Control Structure by the Delaware Department of Highways dated November 11, 1970.

BORROW SOURCES.

Unknown.

ITEM

REMARKS

MONITORING SYSTEMS

Water level in Records Pond monitored by employees of the Division of Fish and Wildlife, Delaware Department and Natural Resources and Environmental Control.

MODIFICATIONS

Winches originally installed to operate the timber gates have been removed. Gates are now manually operated.

HIGH POOL RECORDS

None available.

A-12

POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS

Investigation of the Records Pond Water Control Structure by the Delaware Department of Highways dated November 1970 recommended the addition of a semi-circular weir to effectively pass the 50-year flood. This plan was expanded and is shown in Figure #3.

PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS

No reports available but downstream pool/confluence with Rossakatum Branch is traditionally a flood prone area.

MAINTENANCE OPERATION RECORDS

None available. The structure is operated and maintained by the Division of Fish and Wildlife, Department of Natural Resources and Environmental Control.

ITEM **REMARKS**

SPILLWAY PLAN

SECTIONS
See Appendix.

DETAILS

**OPERATING EQUIPMENT
PLANS & DETAILS**

See Appendix.

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	No concrete sill spillway, water flows over four timber gates.	These gates were not observed, since six to ten inches of flow was occurring over them at the time of inspection.
APPROACH CHANNEL	No approach channel.	None.
DISCHARGE CHANNEL	Well defined four cell box culvert in good condition, hydraulic jump occurs downstream.	None.
BRIDGE AND PIERS	Good condition.	None.
GATES AND OPERATION EQUIPMENT	Four hand operated timber gates mounted on timber stems operated in the event of rainfall, even minor rainfall.	Gates should be inspected in the raised position during low flow conditions.

RESERVOIR

VISUAL EXAMINATION OF

OBSERVATIONS

REMARKS OR RECOMMENDATIONS

SLOPES

Gently rising, grass, brush and tree-lined; well defined and stable.

Southwest corner should be built up to allow for greater storage. Proposed plan is shown in Figure #3.

SEDIMENTATION

Not observed.

Should be inspected during low flow or drawdown conditions.

PROJECT: Access to Park
DATE: 1/25/54
DRAWN BY: JAC

HYDROLOGIC & HYDRAULIC

Station	Flow (cfs)	Velocity (ft/sec)	Depth (ft)
1	100	1.5	1.0
2	200	2.0	1.5
3	300	2.5	2.0
4	400	3.0	2.5
5	500	3.5	3.0
6	600	4.0	3.5
7	700	4.5	4.0
8	800	5.0	4.5
9	900	5.5	5.0
10	1000	6.0	5.5
11	1100	6.5	6.0
12	1200	7.0	6.5
13	1300	7.5	7.0
14	1400	8.0	7.5
15	1500	8.5	8.0
16	1600	9.0	8.5
17	1700	9.5	9.0
18	1800	10.0	9.5
19	1900	10.5	10.0
20	2000	11.0	10.5

NAME OF CLIENT _____

PROJECT RECORDS POND DAM

STAGE DISCHARGE RELATIONSHIP

1. CRITICAL DEPTH @ CULVERT, USE $CLH^{3/2}$ Q FROM EL. 1.13 TO EL. 9.16
2. PRESSURE FLOW FROM EL. 9.16 TO 26.16
3. WEIR FLOW OVER ROADWAY FROM 10.66 TO 26.16

1. $Q = CLH^{3/2}$ $C = 3.2$
 $L = 4 \times 7.21 = 28.84, CL = 92.29$

ELEVATION	HEAD	$H^{3/2}$	DISCHARGE
1.13	0	0	0
2.13	1.0	1.0	92.3
4.13	3.0	5.2	479.9
6.13	5.0	11.2	1033.6
8.13	7.0	18.5	1707.4
8.80	7.67	21.2	1956.6

2. PRESSURE FLOW, USE $Q = CA\sqrt{2gH}$ $C = .6$ $A = 4 \times 7.21 \times 7.67 = 221.2$ SQ. FT.

ELEVATION	HEAD (FM. 6 OF CUR.)	$\sqrt{2gH}$	DISCHARGE	EL. = 4.97
8.8	3.83	15.7	2083.7	
9.66	4.69	17.4	2309.3	
10.16	5.19	18.3	2428.8	
10.66	5.69	19.1	2535.0	
11.16	6.19	20.0	2654.4	
12.16	7.19	21.5	2853.5	
13.16	8.19	23.0	3052.6	
14.16	9.19	24.3	3225.1	
20.16	15.19	31.3	4154.1	
26.16	21.19	36.9	4897.4	

NAME OF CLIENT _____

PROJECT _____

REGONOS POND DAM

3. WEIR FLOW OVER ROARWAY

$C = 3.0$

$L = 500'$; $CL = 1500$

ELEVATION	HEAD	$H^{3/2}$	DISCHARGE
10.66	0	0	0
11.16	0.5	0.35	525.0
12.16	1.5	1.84	2760.0
13.16	2.5	3.95	5925.0
14.16	3.5	6.55	9825.0
20.16	9.5	29.28	43920.0
26.16	15.5	61.02	91530.0

TOTAL DISCHARGE

ELEVATION	CULVERT Q.	PRESSURE Q.	ROARWAY Q.	TOTAL Q.
1.13	0			0
2.13	92.3			92.3
4.13	479.9			479.9
6.13	1033.6			1033.6
8.13	1707.4			1707.4
8.80	1956.6			1956.6
9.66		2309.3		2309.3
10.16		2428.8		2428.8
10.66		2535.0		2535.0
11.16		2654.4	525.0	3179.4
12.16		2853.5	2760.0	5613.5
13.16		3052.6	5925.0	8977.6
14.16		3225.1	9825.0	13050.1
20.16		4154.1	43920.0	48074.1
26.16		4897.4	91530.0	96427.4

JUSTIN & COURTNEY, INC.
Division of O'Brien & Gere Engineers, Inc.
PHILADELPHIA, PA

SHEET NO. 2A OF _____

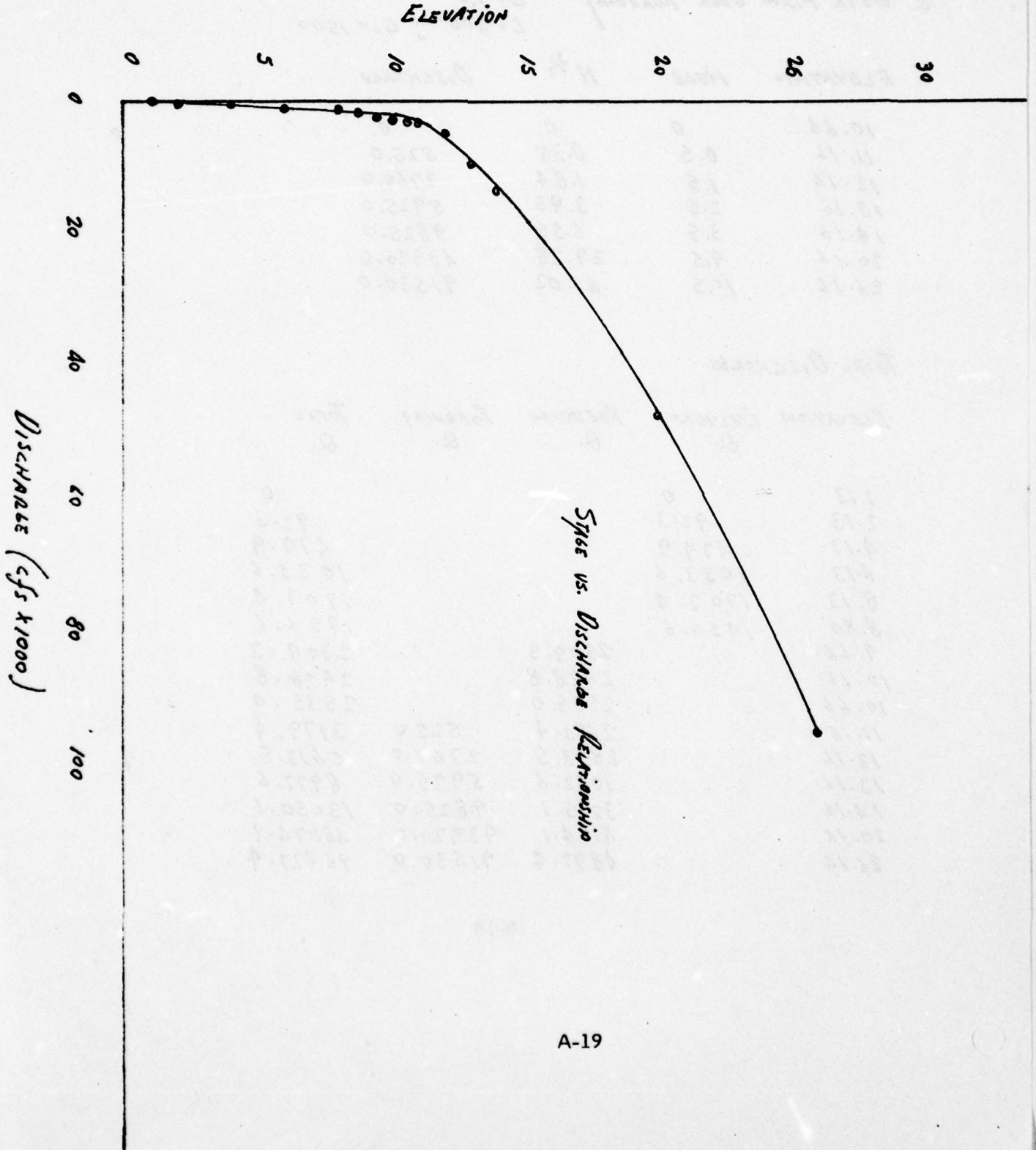
DATE 7/18/78

COMP. BY FBF

NAME OF CLIENT _____

PROJECT RECOMS POND DAM

CHECKED BY _____



NAME OF CLIENT _____

PROJECT RECORDS Pond Dam

CHECKED BY DSC

STAGE/STORAGE RELATIONSHIP

AREA @ EL 9.0 = 90 ACRES.
 AREA @ EL 10.0 = 120 ACRES. } FROM PLANIMETER

UNIFORM AREA/DEPTH RELATIONSHIP = 30 ACRES/FT.

AREA = 30 (DEPTH) + 90

STORAGE = $\int 30D + 90 = 15D^2 + 90D$ (NORMAL POOL EL. = 8.9)

ELEVATION	DEPTH	$15D^2$	$90D$	ABOVE CREST STORAGE	TOTAL STORAGE
9.16	0.26	1.01	23.40	24.4	294.4
9.66	0.76	8.66	68.40	77.1	3471
10.16	1.26	23.81	113.40	137.2	407.2
10.66	1.76	46.46	158.40	204.9	474.9
11.16	2.26	76.61	203.40	280.0	550.0
11.66	2.76	114.26	248.40	362.7	632.7
12.16	3.26	159.41	293.40	452.8	722.8
12.66x	3.76	212.06	338.40	550.5	820.5
13.16	4.26	272.21	383.40	655.6	925.6
13.66x	4.76	339.86	428.40	768.3	1038.3
14.16	5.26	415.01	473.40	888.4	1158.4
20.16	11.26	1901.81	1013.40	2915.2	3185.2
26.16	17.26	4468.61	1553.40	6022.0	6292.0

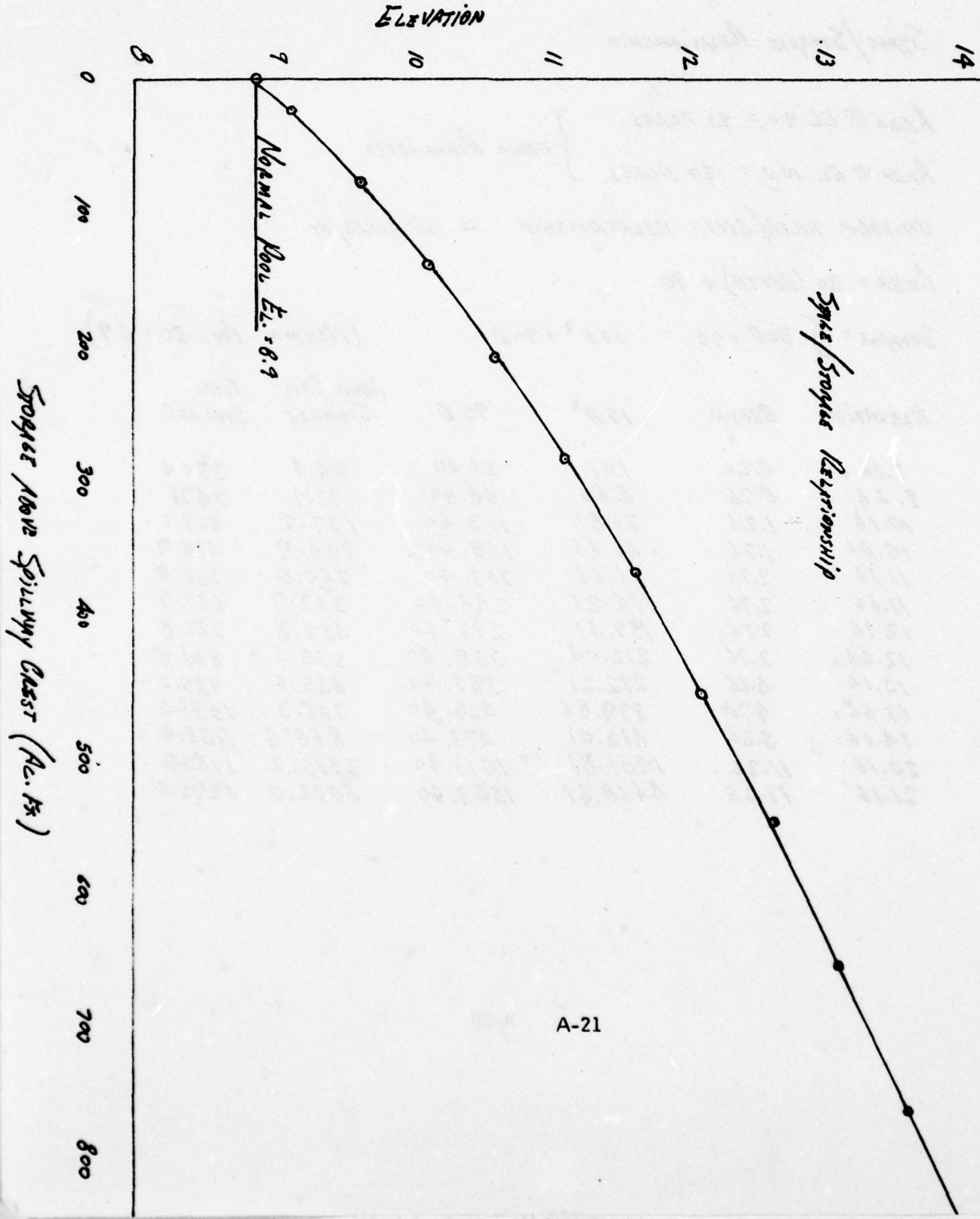
NAME OF CLIENT _____

DATE 7/18/78

PROJECT RECORDS POND DAM

COMP. BY F.R.

CHECKED BY DBC

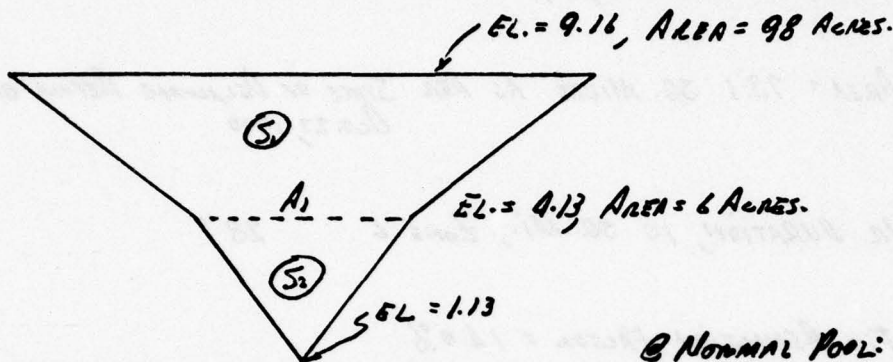


NAME OF CLIENT _____

PROJECT _____

REGONAS POND DAM

DRAWDOWN COMPUTATIONS



@ NORMAL POOL:
EL. = 8.9
STORAGE = 270 AC. FT.
AREA = 90 ACRES.

$$\begin{aligned} \text{EQ. 1)} & (98 + A_1) / 2 \times 5.03 = S_1 \\ \text{EQ. 2)} & (A_1 + 0) / 2 \times 3 = S_2 \\ \text{EQ. 3)} & S_1 + S_2 = 270 \text{ AC. FT.} \end{aligned}$$

→ $S_1 = 261 \text{ AC. FT.}; S_2 = 9 \text{ AC. FT.}$

FOR DISCHARGE DETERMINATION, USE $Q = CLH^{3/2}$ (NO TAILWATER ASSUMED).

$C = 3.1, L = 4 \times 7.21 = 28.84; CL = 89.40$

ELEV. (TOP)	ELEV. (LOW)	ELEV. (AVE)	HEAD	DISCHARGE	INCR. STORAGE	TIME (SEC/HR)
9.16	6.13	7.65	6.52	1488.4	212	6206/1.72
6.13	4.13	5.13	4.00	715.2	49	2984/0.83
4.13	1.13	2.63	1.50	164.2	9	2388/0.66

@ EL. 6.13:

TOTAL DRAWDOWN TIME = 3.21 HRS.

AREA = $18.29 D + 6 = 42.6 \text{ ACRES}$

SAF 3 HRS.

STORAGE = $(\frac{18.29}{2}) D^2 + 6D = 48.6 \text{ A.F.} \approx 49 \text{ A.F.}$

NAME OF CLIENT _____
PROJECT RECONSTRUCT POND DAM

PROBABLE MAXIMUM FLOOD COMPUTATIONS

DRAINAGE AREA = 73.1 SQ. MILES AS PER STATE OF DELAWARE REPORT DATED OCT. 27, 1970

PMP = 6 HR. DURATION, 10 SQ. MI., ZONE 6 28"

ISONYETAL FIT REDUCTION FACTOR = 14.0%

DEPTH, AREA DURATION ADJUSTMENT = 82.0%

ADJUSTED PMP = 28" x 82% x 86% = 19.75"

TIME (HRS.)	% 6 HR. PMP	6 HR. PMP	INCR. PMP	DESCENDING ORDER	DISTRIBUTION
0.5	30	5.93	5.93	5.93	0.59
1.0	49	9.68	3.75	3.75	0.59
1.5	58	11.46	1.78	1.78	0.99
2.0	65	12.84	1.38	1.38	0.99
2.5	70	13.83	0.99	0.99	0.99
3.0	75	14.81	0.98	0.99	0.99
3.5	80	15.80	0.99	0.99	3.75
4.0	85	16.79	0.99	0.99	5.93
4.5	88	17.38	0.59	0.98	1.78
5.0	93	18.37	0.99	0.79	1.38
5.5	96	18.96	0.59	0.59	0.98
6.0	100	19.75	0.79	0.59	0.79

NAME OF CLIENT _____
 PROJECT RECORDS POND DAM

RAINFALL/RUNOFF DISTRIBUTION

CN = 70
 * Minimum Loss Rate = 1"/5 HR.

TIME (HRS)	RAINFALL		RUNOFF		LOSSES	
	INCR.	SUMMATION	INCR.	SUMMATION	INCR.	SUMMATION
0.5	0.59	0.59	0	.018	0.59	0.59
1.0	0.59	1.18	.01	.023	0.58	1.17
1.5	0.99	2.17	.29	.308	0.70	1.87
2.0	0.99	3.16	.50	.805	0.49	2.36
2.5	0.99	4.15	.63	1.431	0.36	2.72
3.0	0.99	5.14	.71	2.141	0.28	3.00
3.5	3.75	8.89	3.10	5.238	0.65	3.65
4.0	5.93	14.82	5.45	10.684	0.48	4.13
4.5	1.78	16.60	1.68 *	12.374	0.10 *	4.23
5.0	1.38	17.98	1.28 *	13.695	0.10 *	4.33
5.5	0.98	18.96	.88 *	14.628	0.10 *	4.43
6.0	0.79	19.75	.69 *	15.400	0.10 *	4.53

$C_T = 0.90$

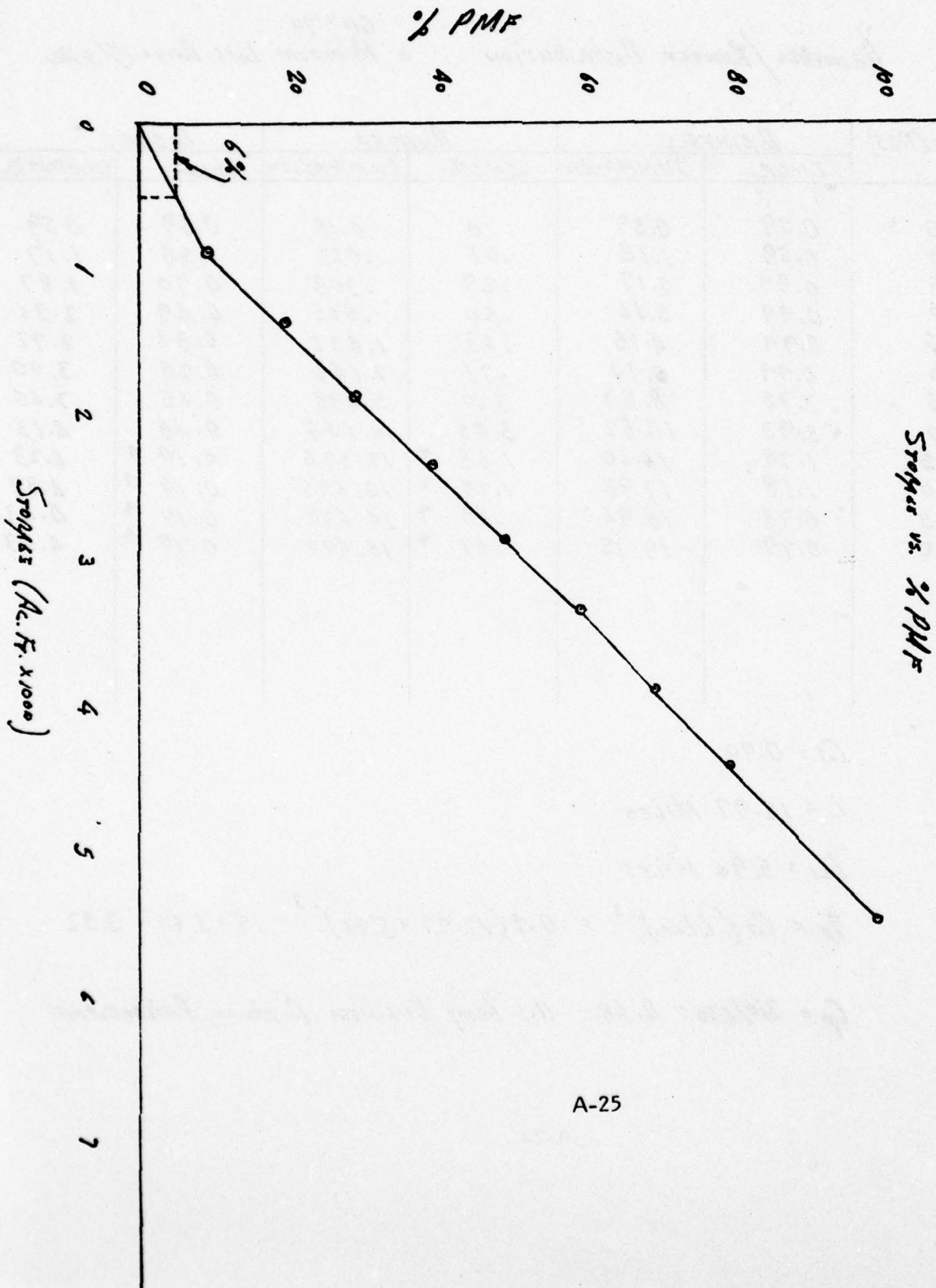
$L = 12.97$ MILES

$L_{CA} = 5.96$ MILES

$T_p = C_T (L L_{CA})^{.3} = 0.9 (12.97 \times 5.96)^{.3} = .9 \times 3.69 = 3.32$

$C_p = 310/640 = 0.48$ U.S. ARMY ENGINEER DISTRICT, PHILADELPHIA

NAME OF CLIENT _____
PROJECT RECORDS HONO DAM



DBC

MEC-1 VERSION DATED JAN 1973
UPDATED AUG 74
CHANGE NO. 01

PMF ROUTING
RECORDS POND DAM
O'BRIEN -> GERE JUSTIN + COURTNEY DIV.

JOB SPECIFICATION
NO NMR NMIN IDAY IHR IMIN METRC IPLT IPRT NSTAN
48 0 30 1 0 0 0 0 2 0
JOPER NMT
5 0

MULTI-PLAN ANALYSES TO BE PERFORMED
NPLAN= 1 NRATIO= 9 LRATIO= 1

RTIOS= .10 .20 .30 .40 .50 .60 .70 .80 1.00

A-26

SUB-AREA RUNOFF COMPUTATION
IS1AQ IGOMP IECON ITAPE JPLT JPRT INAME
1 0 0 0 1 0 0

HYDROGRAPH DATA

IHYDC IJMG IAREA SNAP TRSDA TRSPC RATIO ISNOW ISAME LOCAL
0 1 73.10 0.00 0.00 0.00 0.000 0 1 0

PRECIP DATA
NP STORM DAJ DAK
12 0.00 0.00 0.00
PRECIP PATTERN .71 3.10 5.45 1.68 1.28

LOSS DATA

STRKR OLTEP RTIOL ERAIN STRKS RTIOK STRTL CNSTL ALSHK RTIMP
0.00 0.00 1.00 0.00 0.00 1.00 0.00 0.00 0.00 0.00

UNIT HYDROGRAPH DATA
TP= 3.52 CP= .48 NTA= 0

REGRESSION DATA

STRTO= 0.00 OPCSN= 0.00 RTIOR= 1.00
APPROXIMATE CLARK COEFFICIENTS FROM GIVEN SNYDER CP AND TP ARE TC= 7.59 AND Q=10.05 INTERVALS

UNIT HYDROGRAPH SA END-OF-PERIOD ORIGINATES, LAF= 3.53 HOURS, CP= .48 VOL= 1.00
302. 1128. 2289. 1630. 4924. 5908. 6471. 6465. 5990. 5422.
4906. 4443. 4021. 1640. 3295. 2983. 2700. 2444. 2212. 2003.
1813. 1641. 1485. 1345. 1217. 1102. 977. 903. 817. 740.
670. 606. 549. 497. 450. 368. 311. 302. 273. 247.
224. 203. 183. 166. 150. 145. 123. 111. 101.
91. 83. 75. 68. 58. 51. 45. 50. 45.

U	BU	UL	UL	UL	UL	UL
1	1 30	.24	.24	.24	.24	.24
1	1 60	.50	.50	.50	.50	.50
1	2 30	.63	.63	.63	.63	.63
1	2 60	.71	.71	.71	.71	.71
1	3 30	3.10	3.10	3.10	3.10	3.10
1	3 60	5.45	5.45	5.45	5.45	5.45
1	4 30	1.68	1.68	1.68	1.68	1.68
1	4 60	1.28	1.28	1.28	1.28	1.28
1	5 30	.88	.88	.88	.88	.88
1	5 60	.69	.69	.69	.69	.69
1	6 30	0.00	0.00	0.00	0.00	0.00
1	6 60	0.00	0.00	0.00	0.00	0.00
1	7 30	0.00	0.00	0.00	0.00	0.00
1	7 60	0.00	0.00	0.00	0.00	0.00
1	8 30	0.00	0.00	0.00	0.00	0.00
1	8 60	0.00	0.00	0.00	0.00	0.00
1	9 30	0.00	0.00	0.00	0.00	0.00
1	9 60	0.00	0.00	0.00	0.00	0.00
1	10 30	0.00	0.00	0.00	0.00	0.00
1	10 60	0.00	0.00	0.00	0.00	0.00
1	11 30	0.00	0.00	0.00	0.00	0.00
1	11 60	0.00	0.00	0.00	0.00	0.00
1	12 30	0.00	0.00	0.00	0.00	0.00
1	12 60	0.00	0.00	0.00	0.00	0.00
1	13 30	0.00	0.00	0.00	0.00	0.00
1	13 60	0.00	0.00	0.00	0.00	0.00
1	14 30	0.00	0.00	0.00	0.00	0.00
1	14 60	0.00	0.00	0.00	0.00	0.00
1	15 30	0.00	0.00	0.00	0.00	0.00
1	15 60	0.00	0.00	0.00	0.00	0.00
1	16 30	0.00	0.00	0.00	0.00	0.00
1	16 60	0.00	0.00	0.00	0.00	0.00
1	17 30	0.00	0.00	0.00	0.00	0.00
1	17 60	0.00	0.00	0.00	0.00	0.00
1	18 30	0.00	0.00	0.00	0.00	0.00
1	18 60	0.00	0.00	0.00	0.00	0.00
1	19 30	0.00	0.00	0.00	0.00	0.00
1	19 60	0.00	0.00	0.00	0.00	0.00
1	20 30	0.00	0.00	0.00	0.00	0.00
1	20 60	0.00	0.00	0.00	0.00	0.00
1	21 30	0.00	0.00	0.00	0.00	0.00
1	21 60	0.00	0.00	0.00	0.00	0.00
1	22 30	0.00	0.00	0.00	0.00	0.00
1	22 60	0.00	0.00	0.00	0.00	0.00
1	23 30	0.00	0.00	0.00	0.00	0.00
1	23 60	0.00	0.00	0.00	0.00	0.00
SUM 15.22 15.22 1398739.						

3FS	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
09437.	71770.	29140.	29140.	29140.	1398736.
INCHES	9.13	14.83	14.83	14.83	14.83
AC-FT	35607.	57829.	57829.	57829.	57829.

0.	10.	50.	145.	317.	648.	1330.	2433.	3840.
5390.	6866.	8051.	8776.	8964.	8137.	7514.	6856.	6216.
5626.	5093.	4610.	3777.	3419.	3095.	2802.	2536.	2296.
2078.	1881.	1703.	1541.	1263.	1143.	1035.	937.	840.
788.	695.	629.	569.	466.	422.	382.		

3FS	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
0944.	7177.	2914.	2914.	2914.	139874.

HYDROGRAPH AT STA 1 FOR PLAN 1, R110 2										
	0.	1.	20.	100.	291.	63%.	1296.	2659.	4065.	7600.
10779.	13733.	16102.	17552.	17087.	17315.	16273.	15028.	15028.	13711.	12430.
11252.	10185.	9220.	8346.	7554.	6838.	6190.	5603.	5603.	5072.	4591.
4156.	3762.	3405.	3082.	2790.	2526.	2286.	2070.	2070.	1873.	1696.
1935.	1389.	1258.	1139.	1031.	933.	844.	764.	764.		
PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME										
		17987.	14354.	5828.	5828.	279747.				
		1.83	2.97	2.97	2.97					
		7121.	11566.	11566.	11566.					

HYDROGRAPH AT STA 1 FOR PLAN 1, R110 3										
	0.	1.	30.	150.	436.	951.	1945.	3989.	7298.	11519.
16169.	20599.	24453.	26320.	26031.	25972.	24410.	22541.	20566.	20566.	18645.
16878.	15278.	13829.	12518.	11332.	10257.	9285.	8405.	8405.	7608.	6887.
6234.	5643.	5108.	4624.	4185.	3789.	3429.	3104.	3104.	2810.	2544.
2303.	2084.	1887.	1708.	1546.	1399.	1267.	1147.	1147.		
PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME										
		26831.	21531.	8742.	8742.	419621.				
		2.74	4.45	4.45	4.45					
		10682.	17349.	17349.	17349.					

HYDROGRAPH AT STA 1 FOR PLAN 1, R110 4										
	0.	1.	40.	200.	582.	1269.	2593.	5318.	9730.	15359.
24559.	27465.	32284.	35108.	35775.	34630.	32546.	30055.	27422.	27422.	24860.
22504.	20370.	18439.	16691.	15109.	13677.	12380.	11206.	10144.	10144.	9182.
8312.	7524.	6811.	6165.	5581.	5051.	4573.	4139.	3747.	3747.	3392.
3070.	2779.	2516.	2277.	2061.	1866.	1689.	1529.			
PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME										
		35775.	28700.	11656.	11656.	559494.				
		3.65	5.93	5.93	5.93					
		14243.	23132.	23132.	23132.					

HYDROGRAPH AT STA 1 FOR PLAN 1, R110 5										
	0.	2.	49.	251.	727.	1586.	3241.	6648.	12163.	19199.
26449.	34331.	40255.	43880.	44719.	43287.	40683.	37569.	34277.	34277.	31076.
28130.	25463.	23049.	20864.	18886.	17096.	15475.	14008.	12680.	12680.	11478.
18390.	9405.	8513.	7706.	6976.	6314.	5716.	5174.	4683.	4683.	4239.
3838.	3474.	3144.	2846.	2576.	2332.	2111.	1911.			
PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME										
		44719.	35885.	14570.	14570.	699368.				
		4.57	7.42	7.42	7.42					
		17803.	28914.	28914.	28914.					

HYDROGRAPH AT STA 1 FOR PLAN 1, R110 6										
	0.	2.	59.	301.	873.	1903.	3689.	7978.	14596.	23039.
32339.	41190.	46306.	52656.	53662.	51945.	48819.	45083.	41133.	41133.	37291.
33755.	30555.	27659.	25037.	22663.	20515.	18570.	16810.	15216.	15216.	13773.
12468.	11286.	10216.	9247.	8371.	7577.	6859.	6209.	5620.	5620.	5087.
4005.	4168.	3773.	3416.	3032.	2799.	2533.	2293.			
PEAK 6-HOUR 24-HOUR 72-HOUR TOTAL VOLUME										
		53662.	43062.	17484.	17484.	83242.				
		5.48	8.90	8.90	8.90					
		21364.	34697.	34697.	34697.					

HYDROGRAPH AT STA 1 FOR PLAN 1, R110 7										
	0.	2.	69.	351.	1010. <th>2220. <th>4537. <th>9307. <th>17028. <th>26878. </th></th></th></th></th>	2220. <th>4537. <th>9307. <th>17028. <th>26878. </th></th></th></th>	4537. <th>9307. <th>17028. <th>26878. </th></th></th>	9307. <th>17028. <th>26878. </th></th>	17028. <th>26878. </th>	26878.
37728.	48064.	56357.	61432.	62600.	60602.	56956.	52546.	47988.	47988.	43506.

20000 10000 10000 20000 30000 40000 50000 60000 70000 80000 90000
 0. 2. 4. 6. 8. 10. 12. 14. 16. 18. 20. 22. 24. 26. 28. 30. 32. 34. 36. 38. 40. 42. 44. 46. 48. 50. 52. 54. 56. 58. 60. 62. 64. 66. 68. 70. 72. 74. 76. 78. 80. 82. 84. 86. 88. 90. 92. 94. 96. 98. 100.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 4
 PEAK 62686. 50239. 20394. 20394. 20394. 979115. TOTAL VOLUME
 SFS 6.39 10.38 10.38 10.38 10.38
 INCHES 24925. 40400. 40400. 40400. 40400.
 AC-FT 1164. 2537. 5185. 10637. 19461. 30714.
 43119. 54930. 64408. 70208. 71550. 69260. 65092. 60110. 54844. 49721.
 45007. 40741. 36878. 33382. 30218. 27353. 24760. 22413. 20288. 18365.
 16624. 15048. 13621. 12330. 11161. 10103. 9145. 8278. 7493. 6741.
 6140. 5558. 5031. 4554. 4122. 3732. 3378. 3059.

HYDROGRAPH AT STA 1 FOR PLAN 1, RTIO 9
 PEAK 71550. 57416. 23312. 23312. 1118983. TOTAL VOLUME
 SFS 7.31 11.87 11.87 11.87 11.87
 INCHES 28485. 46263. 46263. 46263. 46263.
 AC-FT 1455. 3172. 6482. 13296. 24326. 38398.
 53497. 68663. 80510. 87760. 89437. 86575. 81365. 75138. 68555. 62151.
 56257. 50926. 46098. 41728. 37772. 34191. 30950. 28016. 25360. 22956.
 20780. 18810. 17027. 15412. 13951. 12629. 11432. 10348. 9367. 8479.
 7675. 6947. 6289. 5693. 5153. 4664. 4222. 3822.

HYDROGRAPH ROUTING
 I-STAQ ICOMP IECON ITAPE JPLT JPRT I-NAME
 2 1 0 0 0 0 0
 QLOSS CLOSS AVG IRES ISAME
 0.0 0.000 0.00 0.00 1 1

STATION 2, PLAN 1, RTIO 1
 STORAGE= 0. 270. 347. 407. 550. 721. 926. 1158. 3185. 6292.
 OUTFLOW= 0. 1957. 2309. 2429. 3179. 5614. 8978. 13050. 48074. 96427.

STATION 1, RTIO 1
 STORAGE= 1447. 1070. 793. 594. 465. 404. 571. 913. 1492.
 2188. 2767. 4343. 6251. 7582. 8204. 8302. 8059. 7613. 7063.
 6480. 5908. 5198. 4964. 4508. 4094. 3372. 3125. 2985.
 2830. 2664. 2493. 2386. 2313. 2148. 1766. 1563. 1388.
 1237. 1105. 990. 888. 798. 718. 647. 583.

STATION 1, RTIO 9
 STORAGE= 200. 148. 109. 82. 64. 56. 59. 79. 206.
 320. 471. 633. 761. 842. 879. 885. 871. 844. 810.
 775. 741. 708. 675. 644. 615. 588. 564. 540. 513.
 483. 452. 419. 385. 357. 312. 276. 244. 216. 191.
 171. 152. 137. 122. 110. 93. 89. 80.

STATION		2. PLAN 1, RTIO 2				STOR	
1070.	794.	603.	497.	448.	612.	968.	2433.
4523.	11905.	14462.	16176.	16276.	16056.	16222.	14107.
12311.	10657.	9659.	8759.	7962.	7223.	6547.	5398.
4436.	4085.	3706.	3359.	3120.	2980.	2624.	2446.
2381.	2141.	1978.	1756.	1555.	1381.	1231.	
STOR							
200.	110.	83.	69.	67.	86.	134.	408.
645.	1087.	1240.	1339.	1382.	1378.	1342.	1219.
1150.	1022.	965.	913.	865.	820.	779.	708.
675.	614.	587.	563.	539.	512.	482.	418.
384.	310.	275.	242.	214.	191.	170.	
PEAK		6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME		
2FS	16926.	13897.	5863.	5863.	281426.		
INCHES	1.77	2.98	2.98	2.98	2.98		
AC-FT	6895.	11635.	11635.	11635.	11635.		

STATION		2. PLAN 1, RTIO 3				STOR	
1070.	795.	612.	529.	572.	800.	1364.	3955.
8781.	18347.	21974.	24397.	25452.	25315.	24347.	22877.
19370.	16015.	14520.	13155.	11900.	10767.	9744.	9826.
2276.	5972.	5432.	4969.	4527.	4113.	3732.	3383.
2991.	2669.	2499.	2388.	2315.	2153.	1990.	
STOR							
200.	110.	86.	73.	79.	110.	188.	605.
914.	1465.	1674.	1815.	1876.	1868.	1812.	1827.
1524.	1338.	1243.	1164.	1092.	1028.	970.	868.
823.	745.	710.	677.	646.	616.	589.	541.
514.	453.	420.	387.	350.	313.	277.	
PEAK		6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME		
2FS	25452.	20951.	8727.	8727.	41889.		
INCHES	2.67	4.44	4.44	4.44	4.44		
AC-FT	10394.	17318.	17318.	17318.	17318.		

STATION		2. PLAN 1, RTIO 4				STOR	
1070.	797.	621.	561.	556.	988.	1761.	6560.
12839.	24693.	29408.	32581.	33960.	33764.	32468.	28209.
25827.	23517.	19360.	17540.	15884.	14381.	13019.	10549.
9637.	7934.	7196.	6521.	5906.	5373.	4918.	4069.
3691.	3115.	2974.	2817.	2650.	2479.	2380.	
STOR							
200.	110.	86.	77.	90.	116.	243.	786.
1146.	1832.	2105.	2288.	2368.	2357.	2282.	2035.
1897.	1639.	1523.	1418.	1322.	1235.	1156.	1021.
964.	863.	818.	776.	741.	706.	674.	613.
586.	538.	511.	481.	449.	417.	383.	
PEAK		6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME		
2FS	33960.	27971.	11588.	11588.	556215.		
INCHES	3.56	5.90	5.90	5.90	5.90		
AC-FT	13877.	22996.	22996.	22996.	22996.		

STATION		2. PLAN 1, RTIO 5				STOR	
1070.	798.	629.	593.	740.	1176.	2090.	9450.
16660.	31002.	36824.	40757.	42865.	42212.	40588.	35262.
32284.	29397.	24200.	21924.	19855.	17977.	16274.	13336.
STOR							
200.	110.	86.	740.	740.	1176.	2090.	9450.
16660.	31002.	36824.	40757.	42865.	42212.	40588.	35262.
32284.	29397.	24200.	21924.	19855.	17977.	16274.	13336.

1447.	148.	110.	80.	86.	114.	188.	357.	674.	1101.
1367.	2079.	2560.	2962.	3235.	3359.	3346.	3233.	3058.	2855.
2271.	2445.	2257.	2084.	1925.	1782.	1651.	1533.	1426.	1329.
1102.	1241.	1090.	1026.	967.	915.	866.	822.	781.	743.
650.	709.	644.	615.	588.	564.	540.	513.		

200.	148.	110.	80.	86.	114.	188.	357.	674.	1101.
1577.	2079.	2560.	2962.	3235.	3359.	3346.	3233.	3058.	2855.
2686.	2445.	2257.	2084.	1925.	1782.	1651.	1533.	1426.	1329.
1241.	1162.	1090.	1026.	967.	915.	866.	822.	781.	743.
709.	676.	644.	615.	588.	564.	540.	513.		

1447.	1070.	800.	638.	625.	624.	1363.	2329.	4919.	12044.
20207.	28959.	37268.	44220.	40060.	50779.	50586.	48817.	45873.	4236A.
38767.	35288.	32036.	29043.	26311.	23826.	21572.	19529.	17679.	16004.
14487.	13113.	11857.	10726.	9786.	8792.	7989.	7247.	6567.	5948.
5413.	4950.	4509.	4097.	3717.	3369.	3124.	2985.		

200.	148.	110.	80.	86.	114.	188.	357.	674.	1101.
1577.	2079.	2560.	2962.	3235.	3359.	3346.	3233.	3058.	2855.
2686.	2445.	2257.	2084.	1925.	1782.	1651.	1533.	1426.	1329.
1241.	1162.	1090.	1026.	967.	915.	866.	822.	781.	743.
709.	676.	644.	615.	588.	564.	540.	513.		

1447.	1070.	801.	647.	657.	907.	1551.	2400.	6486.	14593.
23911.	33900.	43534.	51350.	56542.	59005.	58895.	56891.	53680.	49820.
45554.	41324.	37449.	33918.	30712.	27805.	25171.	22786.	20626.	18871.
16901.	15299.	13849.	12530.	11331.	10252.	9277.	8421.	7645.	6931.
6280.	5687.	5203.	4748.	4319.	3921.	3556.	3222.		

200.	148.	110.	89.	91.	125.	214.	417.	776.	1247.
1787.	2365.	2922.	3396.	3729.	3887.	3980.	3752.	3545.	3297.
3039.	2794.	2570.	2366.	2180.	2012.	1860.	1721.	1596.	1483.
1381.	1280.	1204.	1128.	1060.	999.	943.	892.	846.	802.
763.	727.	694.	662.	631.	603.	577.	553.		

1447.	1071.	802.	656.	689.	991.	1739.	2778.	6070.	17043.
27501.	38825.	49663.	58249.	64395.	67319.	67250.	64988.	61333.	58929.
52274.	47670.	43008.	38863.	35147.	31800.	29774.	26046.	23575.	21340.
19316.	17485.	15827.	14327.	12968.	11725.	10607.	9598.	8699.	7903.
7166.	6495.	5883.	5360.	4900.	4461.	4053.	3677.		

200.	148.	111.	90.	95.	137.	240.	474.	871.	1389.
1996.	2650.	3287.	3839.	4234.	4422.	4417.	4272.	4037.	3754.
3455.	3162.	2892.	2652.	2437.	2283.	2068.	1910.	1767.	1638.
1201.	1119.	1019.	919.	819.	719.	619.	519.	419.	319.

1447.	1071.	802.	656.	689.	991.	1739.	2778.	6070.	17043.
27501.	38825.	49663.	58249.	64395.	67319.	67250.	64988.	61333.	58929.
52274.	47670.	43008.	38863.	35147.	31800.	29774.	26046.	23575.	21340.
19316.	17485.	15827.	14327.	12968.	11725.	10607.	9598.	8699.	7903.
7166.	6495.	5883.	5360.	4900.	4461.	4053.	3677.		

200.	148.	111.	90.	95.	137.	240.	474.	871.	1389.
1996.	2650.	3287.	3839.	4234.	4422.	4417.	4272.	4037.	3754.
3455.	3162.	2892.	2652.	2437.	2283.	2068.	1910.	1767.	1638.
1201.	1119.	1019.	919.	819.	719.	619.	519.	419.	319.

1986.	177.	111.	70.	95.	137.	240.	474.	871.	1389.
3455.	2650.	3287.	3839.	4234.	4422.	4417.	4272.	4037.	3756.
1521.	3162.	2992.	2652.	2437.	2243.	2060.	1910.	1767.	1638.
817.	1415.	1319.	1232.	1153.	1082.	1019.	961.	909.	861.
	776.	739.	705.	672.	641.	612.	585.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	67319.	55995.	23139.	23139.	1110688.
INCHES	7.13	11.78	11.78	11.78	
AC-FT	27780.	45920.	45920.	45920.	

1447.	1071.	405.	673.	753.	1159.	2061.	3650.	11219.	21839.
34629.	48608.	61250.	72386.	80275.	84037.	84004.	81205.	76651.	71153.
65339.	59623.	58216.	49202.	44321.	39933.	36059.	32599.	29489.	26684.
24150.	21050.	19705.	17909.	16211.	14674.	13203.	12012.	10865.	9831.
8981.	8090.	7339.	6651.	6025.	5474.	5010.	4565.		

STOR

200.	148.	111.	93.	104.	168.	293.	583.	1054.	1667.
2407.	3219.	4032.	4747.	5254.	5496.	5494.	5314.	5021.	4668.
4298.	3927.	3580.	3258.	2968.	2716.	2490.	2289.	2109.	1947.
1800.	1668.	1548.	1439.	1341.	1252.	1171.	1099.	1034.	975.
921.	872.	827.	786.	748.	713.	680.	648.		

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	84037.	69945.	28937.	28937.	1389371.
INCHES	6.90	14.73	14.73	14.73	
AC-FT	34701.	57425.	57425.	57425.	

PEAK FLOW SUMMARY FOR MULTIPLE PLAN-RATIO ECONOMIC COMPUTATIONS

OPERATION	STATION	PLAN	RATIOS APPLIED TO FLOWS								
			.10	.20	.30	.40	.50	.60	.70	.80	1.00
HYDROGRAPH AT	1	1	8944.	17887.	26831.	35775.	44719.	53662.	62606.	71550.	89437.
	2	2	0.	0.	0.	0.	0.	0.	0.	0.	0.
ROUTED TO	1	1	8302.	16926.	25452.	33960.	42465.	50779.	59005.	67319.	84037.
	2	2	0.	0.	0.	0.	0.	0.	0.	0.	0.

State Department	DEPARTMENT OF HIGHWAY DEPARTMENT	County No.
Date	Bill No.	Item
Project No.	Estimate No.	Description

PREVIOUS REPORTS

DELAWARE STATE HIGHWAY DEPARTMENT

Contract No.

Item:

Source
Document #

By:

Entered In:

Field Measurements And
Preliminary Calculation of Quantities

PRELIMINARY SURVEY
WILLOW ST BRIDGE

INDEX:

EAST VIEW WILLOW ST BRIDGE	pg. 1
TOP VIEW CONC. PAD & GATE WEIR	pg. 2
SOUTH VIEW CONC. WING WALL ST. 12	pg. 3
NORTH VIEW CONC. WING WALL ST. 12	pg. 4
TOP VIEW OF GATE WEIR	pg. 5

OCT 8, 1968

D. [unclear]
S. [unclear]
P. [unclear]
T. [unclear]

A-35

DELAWARE STATE HIGHWAY DEPARTMENT

Contract No. 11/12/55

Source Document #

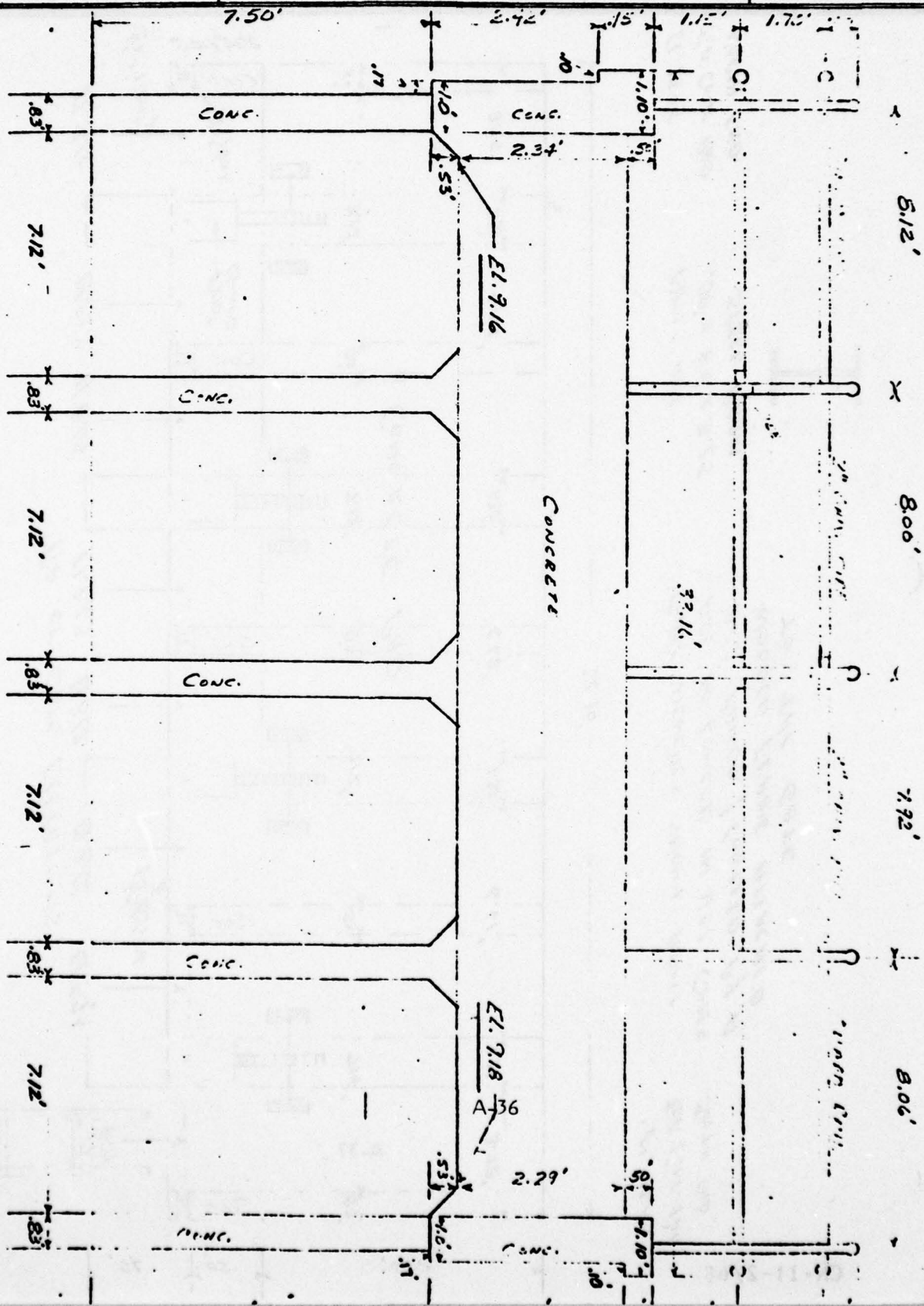
Item:

Field Measurements And Preliminary Calculation of Quantities

By:

Entered In:

HIGH WHITE ELEV. = 2.45
LOW WHITE ELEV. = 0.15



DELAWARE STATE HIGHWAY DEPARTMENT

Source Document #

By:

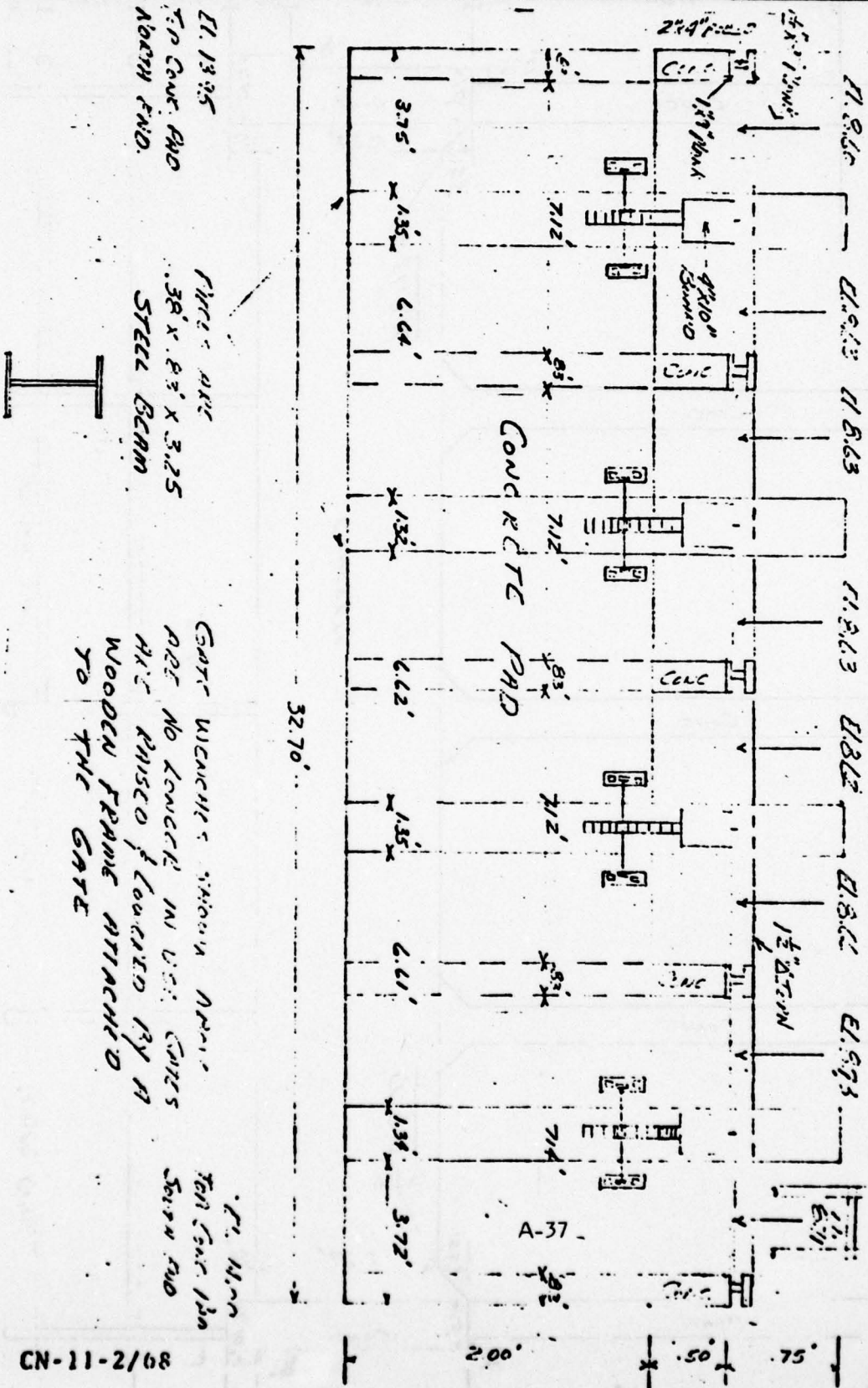
Entered In:

Contract No.

Item:

Field Measurements And Preliminary Calculation of Quantities

GATE WENCHES -



EL. 13.95
TOP CONC. PND
NORTH END.

PIERS ARE
38" x 8" x 3.25
STEEL BEAM



GATE WENCHES SHOWN ABOVE
ARE NO LONGER IN USE. GATES
ARE RUSTED & LOCATED BY A
WOODEN FRAME ATTACHED
TO THE GATE

PI. MIN
TOP CONC. PND
SOUTH END

1" x 3" ONK TRAPS
AND FORMS OF CONCRETE

Item:

Field Measurements And
Preliminary Calculation of Quantities

By:

Entered In:

23.85'

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SOUTH VIEW OF CONC. VINYL WALL 1" @
WILLOW ST BRIDGE

0.60'

1.48'

CN-11-2/68

CN-11-5/68

Contract No.		Source Document #	
Item:	Field Measurements And Preliminary Calculation of Quantities	By:	
		Entered In:	



NORTH VIEW OF CUR. WHITE WAIL ST. BRIDGE

Contract No.

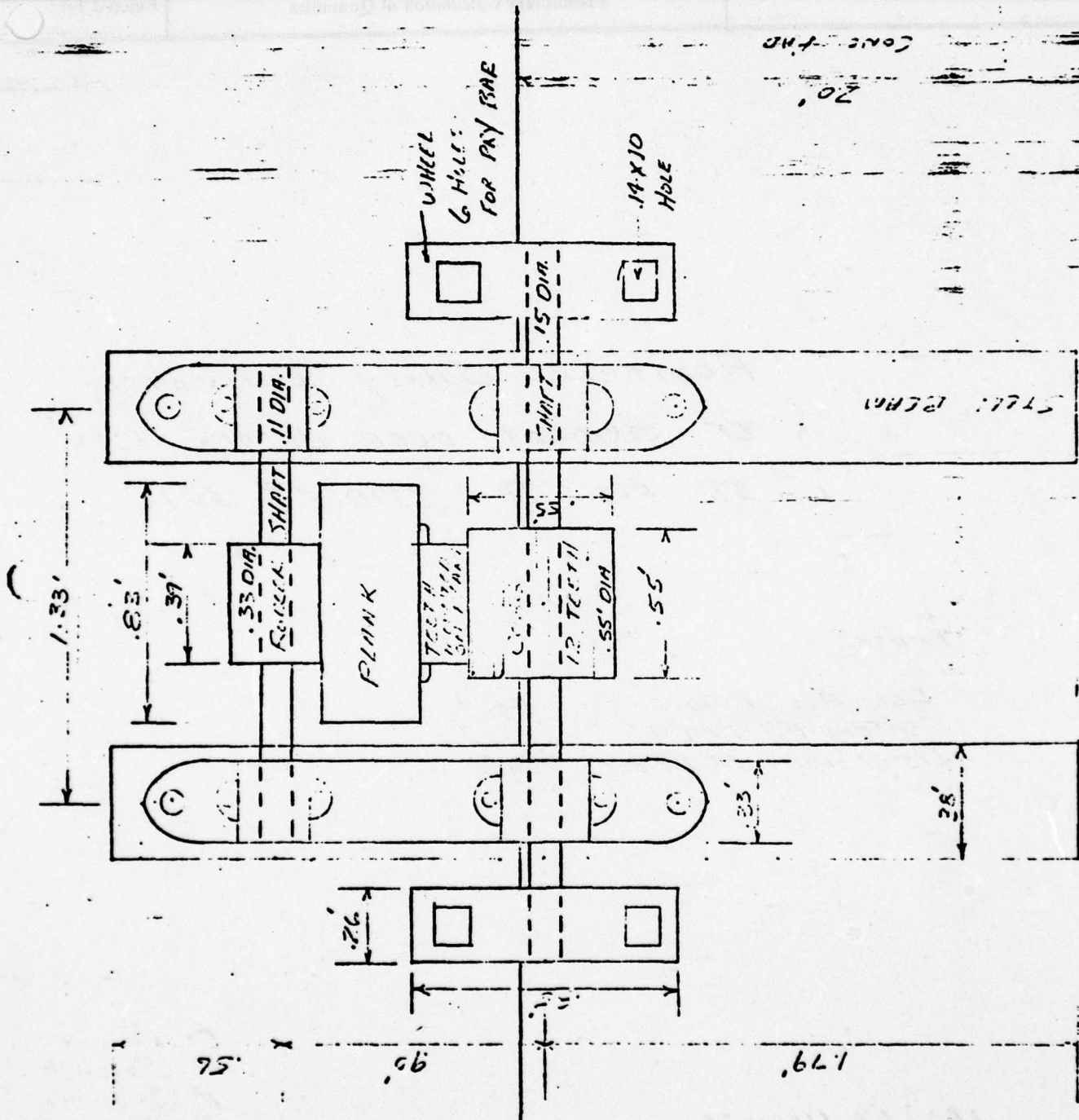
Item:

Field Measurements And Preliminary Calculation of Quantities

Document #

By:

Entered In:



A-40

CN-11-2/68

CN-11-2/68

Contract No.	DELAWARE STATE HIGHWAY DEPARTMENT	Source Document #
Item:	Field Measurements And Preliminary Calculation of Quantities	By: Entered In:

ADDITIONAL SURVEY INTERFERENCES
 OF BRIDGES OVER BROAD CREEK
 IN REF. TO BRIDGE # 329

INDEX:

EEL AVE BRIDGE	pg. 1
CENTRAL AVE BRIDGE	pg. 2
EAST PENNING ST BRIDGE	pg. 3

SEE: THE INTERFERENCES IN
 THESE ARE BEING DONE

D. J. [unclear]
 G. [unclear]
 P. [unclear]
 T. [unclear]

DELAWARE STATE HIGHWAY DEPARTMENT

Source _____
Document # _____

Field Measurements And
Preliminary Calculation of Quantities

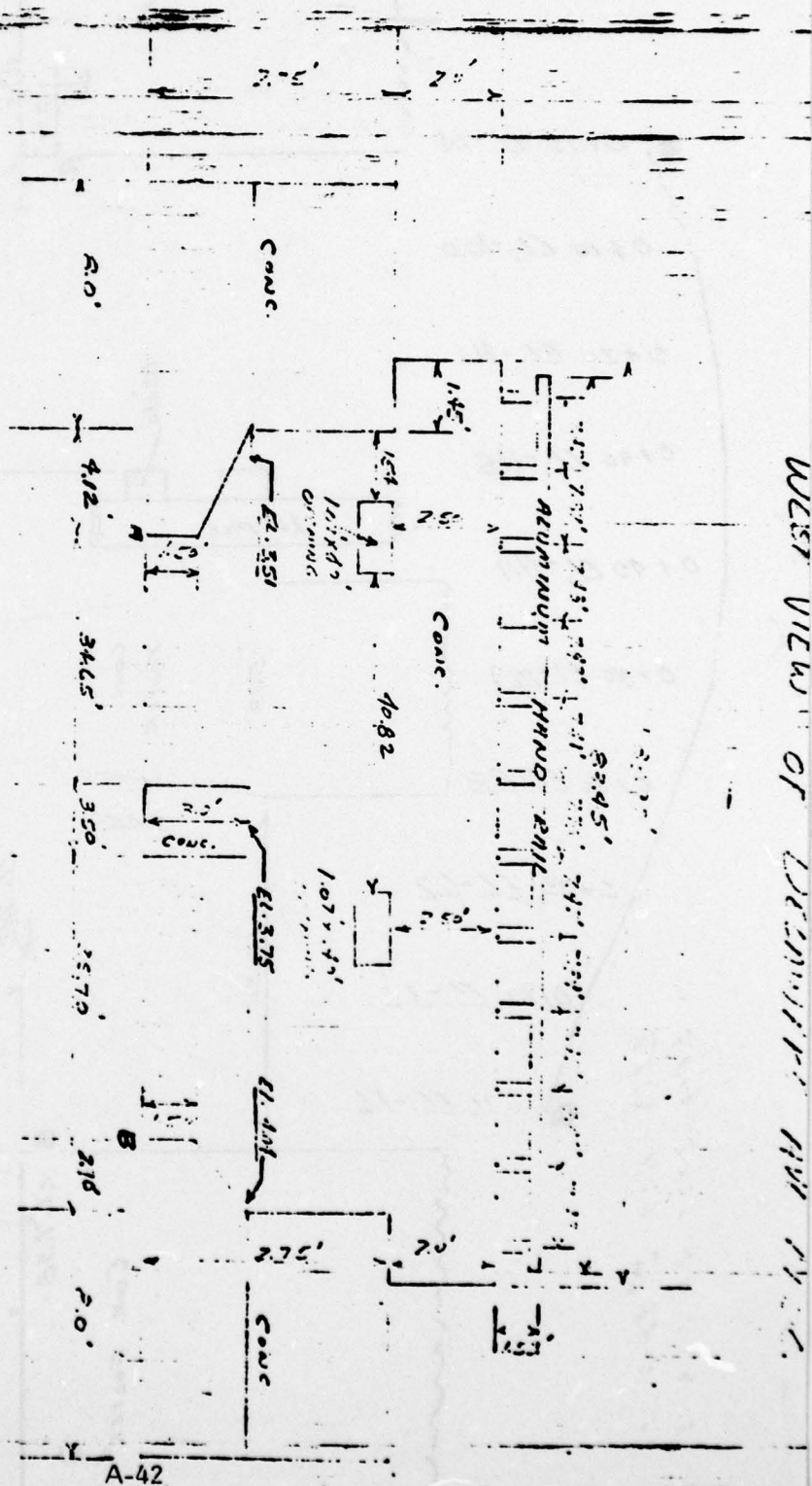
By: _____

Entered In: _____

HIGH WHITE EL. 7.45
LOW WHITE EL. 0.15

EL. TAKEN 1' EAST OF EAST EDGE OF CURB

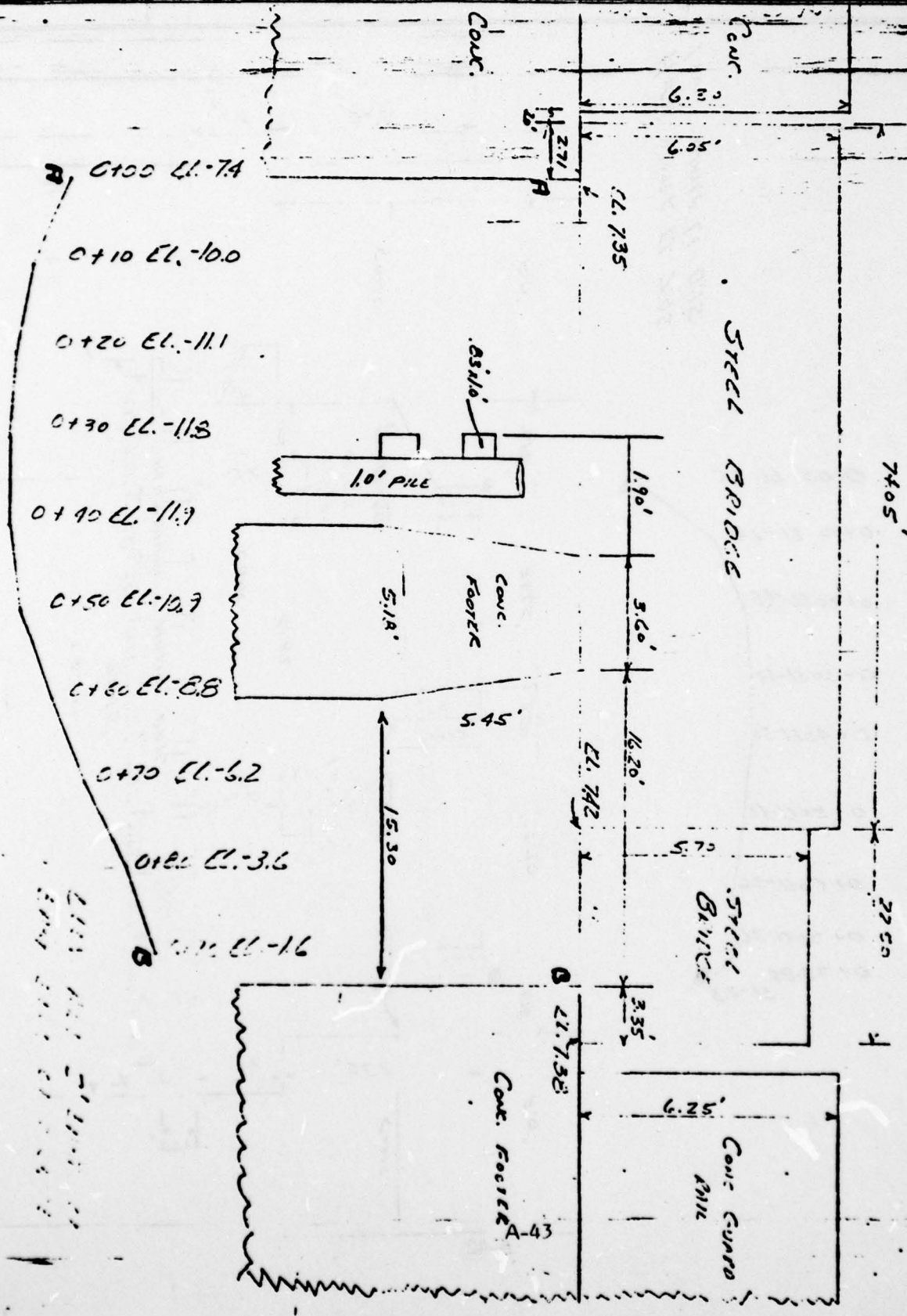
- 0+00 EL. 25
- 0+10 EL. 24
- 0+20 EL. 45
- 0+30 EL. 49
- 0+40 EL. 50
- 0+50 EL. 42
- 0+60 EL. 36
- 0+70 EL. 36
- 0+73.85 EL. 23



WEST VIEW OF CONCRETE CURB

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Contract No.	Field Measurements And Preliminary Calculation of Quantities	Document
Item:		By:
		Entered In:



Contract No.

Item:

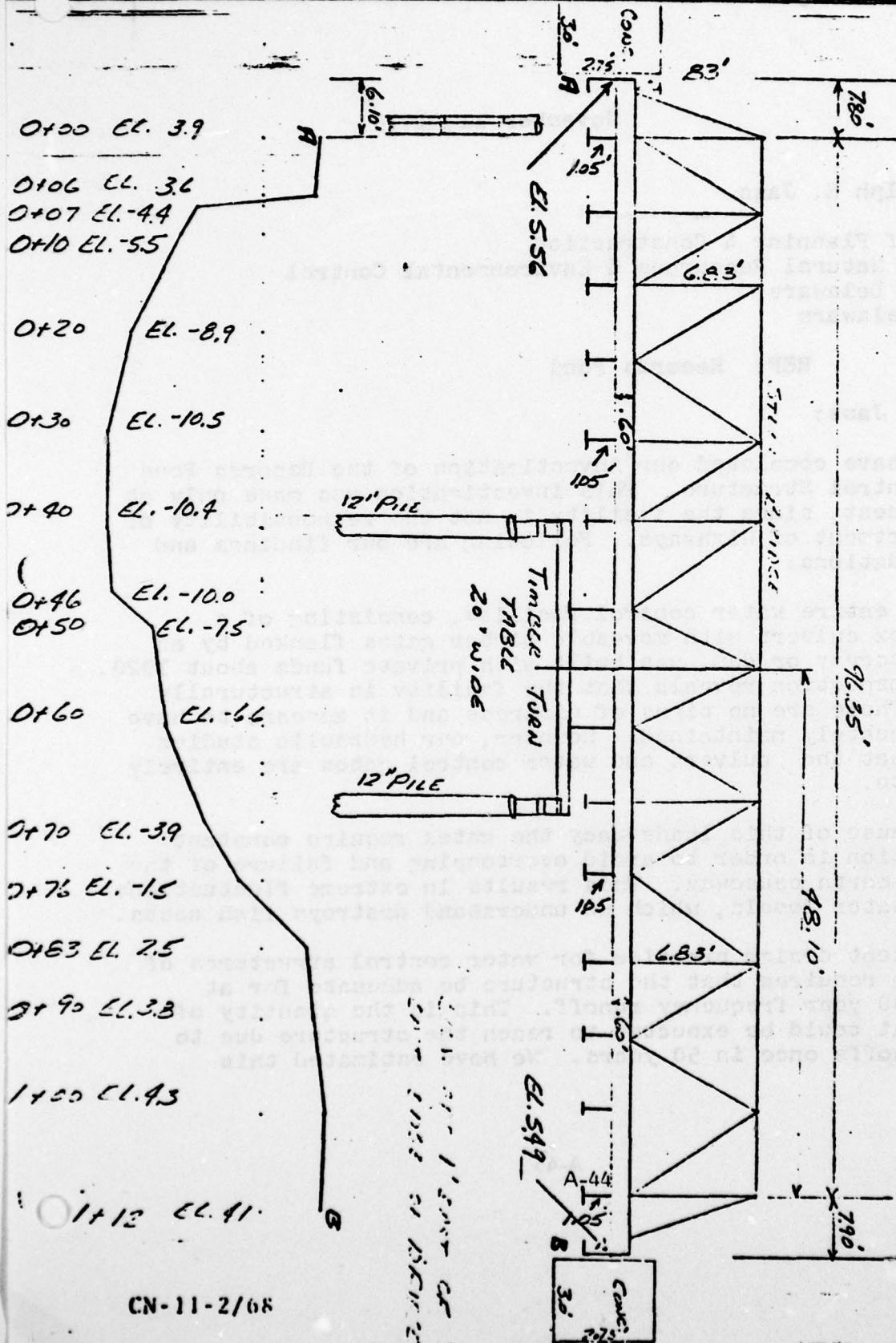
Source

Document #

By:

Entered In:

Field Measurements And
Preliminary Calculation of Quantities



CN-11-2/68

November 11, 1970

Mr. Rudolph E. Jass
Director
Office of Planning & Construction
Dept. of Natural Resources & Environmental Control
State of Delaware
Dover, Delaware

REF: Records Pond

Dear Mr. Jass:

We have completed our investigation of the Records Pond Water Control Structure. This investigation was made only at your request, since the facility is not the responsibility of the Department of Highways. Following are our findings and recommendations:

The entire water control facility, consisting of a 4 cell box culvert with moveable timber gates flanked by an earth causeway or dam, was built with private funds about 1920. Visual inspection reveals that the facility is structurally sound. There are no signs of distress and it appears to have been adequately maintained. However, our hydraulic studies reveal that the culvert and water control gates are entirely inadequate.

Because of this inadequacy the gates require constant manipulation in order to avoid overtopping and failure of the adjacent earth causeway. This results in extreme fluctuations in pond water levels, which we understand destroys fish nests.

Present design practice for water control structures of this type requires that the structure be adequate for at least a 50 year frequency runoff. This is the quantity of water that could be expected to reach the structure due to storm runoffs once in 50 years. We have estimated this

Mr. R. E. Jass

November 11, 1970

quantity at 2,840 cubic feet per second.

Even with the gates completely open the existing structure is not capable of carrying this quantity of water. Thus the present practice of lowering the pond level in anticipation of heavy runoffs is necessary.

In order to correct this situation we would recommend construction of a new bridge and water control structure. In order to eliminate water control gate manipulation and maintenance, we recommend the use of a fixed weir type structure large enough to accommodate the design runoff of 2,840 c.f.s. The existing structure would remain in place with the gates maintained for draining the pond or other purposes as may be required. They would also be available for emergency use should runoffs greater than the design occur.

The attached sketch indicates this solution, utilizing a semi-circular weir similar to several constructed elsewhere in the State. We estimate the cost of this improvement would be \$200,000.

Until such improvements are made it is imperative that constant maintenance of the present gates be continued. Without gate manipulation, causeway overtopping, and failure would be a certainty.

Should you require additional information or clarification please advise.

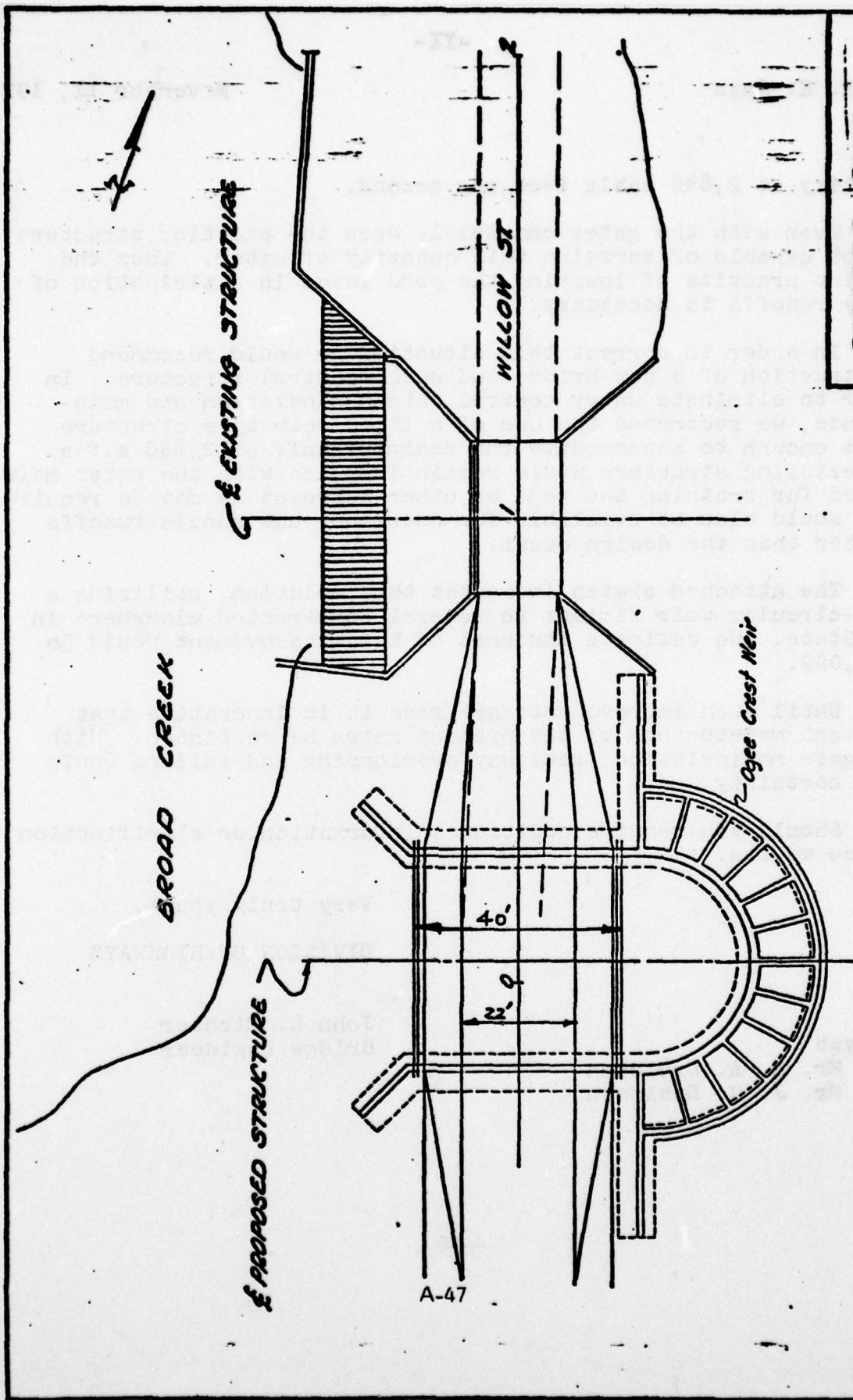
Very truly yours,

DIVISION OF HIGHWAYS

John E. Richter
Bridge Engineer

JER:ysb

cc: Mr. E. A. Davidson
Mr. J. S. Robinson



RECORDS POND
INVESTIGATION

STATE OF DELAWARE
DEPT. OF HIGHWAYS AND
TRANSPORTATION
DIVISION OF HIGHWAYS

RECORDS POND

A-47

Records Pond Water Control structure

Drainage Area = 46737 Acres = 73.1 sq. miles (approx.)

Design frequency = 50 years

46737 Acres

- 95 muskegonis Pond area

46642 Acres

Using Burkli-Ziegler Formula

$$Q = ACi \sqrt[4]{S/A}$$

$$\therefore Q = 46642 \times 0.20 \times 3.25 \sqrt[4]{\frac{2}{46642}}$$

$$= 2453 \text{ c.f.s.} \quad \begin{matrix} \text{(considering no loss)} & \text{(considering partial loss)} \\ \text{in Records Pond area} & \text{in Chipman Pond} \end{matrix}$$

$$\therefore \text{Total } Q = 2453 + 95 \times 3.25 + 40 \times 2.00 = 2841 \text{ c.f.s. say } 2840 \text{ c.f.s.}$$

using computer data of the Trap Pond outlet

$$\frac{46642}{640} \times \frac{182}{16.7} = 2540 \text{ c.f.s.}$$

$$\therefore \text{total } Q = 2540 + 95 \times 3.25 + 40 \times 2.00 = 2928 \text{ c.f.s.}$$

use 2840 c.f.s.

$$\begin{aligned} \text{Existing Waterway area} &= 4 \times 7.12 \times 8.03 \text{ sq. ft.} \\ &= 228.7 \text{ sq. ft.} \end{aligned}$$

Existing top of opening EL. 9.16

A-48

We can have a max. upstream EL. 10.00, because beyond this EL. going to endanger the property and houses along the pond.

\therefore We have a max. allowable head water

From Computer Program Hydraulic Design of Culverts
for 2840 c.f.s. with A.H.W. 9.5' & D.T.W.
we need minimum waterway area = $4 \times 11 \times 8'$
= 352 sq. ft.

With AHW = 9.8' & D.T.W. 3.0'
for 2840 c.f.s.
we need minimum waterway area = $4 \times 9 \times 8'$ sq.
= 288 sq. ft.

The opening we needed without considering the
tide which going to effect hydraulic and all
head water also.

Having a limit on allowable head at
9 feet for 8.9 A.H.W., 2840 c.f.s. need a
at least 410 sq. ft. minimum waterway area
opening at Records Pond.

I also feel that it is better to low
the existing water level of the Records
on the upstream side of the Cr. # 329. And
keep between El. 7.5 and El. 8.00. So we have
immediate extra capacity for the flood
discharge. And so we would not have to at
the peak discharge from the structure and
to endanger the down stream of the Recor
Pond and Laurel town.

102

66-09-702

Oct. 26, 1966

Records Pond Water control structures

Drainage area = 46737 Acres
= 73.1 sq. miles

Design frequency = 50 Years

Estimated runoff = 2840 cusecs

Hydraulics Capacity of the existing structure as opening the gate as a weir is 485 cusecs if allowable headwater is 2.9 feet above the top of existing gate elevation that means $8.60 + 2 = 11.50$ H.W.L., which is the Road elevation

If raise the H.W.L. to 12.6 the hydraulics cap of the existing structure as a weir is 787 cusecs and if raise the H.W.L. to 13.6 the hydraulics cap of the existing structure as a weir is 1100 cusecs. From the above one can conclude that existing structure as a weir is inadequate for the estimated runoff.

The existing structure with opening of all gates is barely adequate to carry estimated runoff with very high pond on the upstream side and without high tide on downstream side and also with the loss of fish, water fowl nests, and all forms of ecology which live in the upper part of the pond water.

owl.

66-09-702

Oct 20

In accordance with the telephone conversation ^{with us} with the dept. of natural resources environmental control would like to have water control structure with some fixed and without the operations of gates.

If we choose fixed elevation spillway need to have another spillway to carry 2355 acres.

For this runoff we need 125' spill.

Because of the obviously long length spillway that would be required if upstre conditions were to be unchanged, it was decided to consider only the ogee shape since the most efficient of all types.

As previously discussed, using the criteria of not raising the water level on upstre side, it was necessary to provide for a 125' long spillway. This could not be done with a straight spillway since it was not possible to reduce the width.

In addition, any shape other than the ogee increased the length of spillway required. For this reason, a curved ogee spillway was selected.

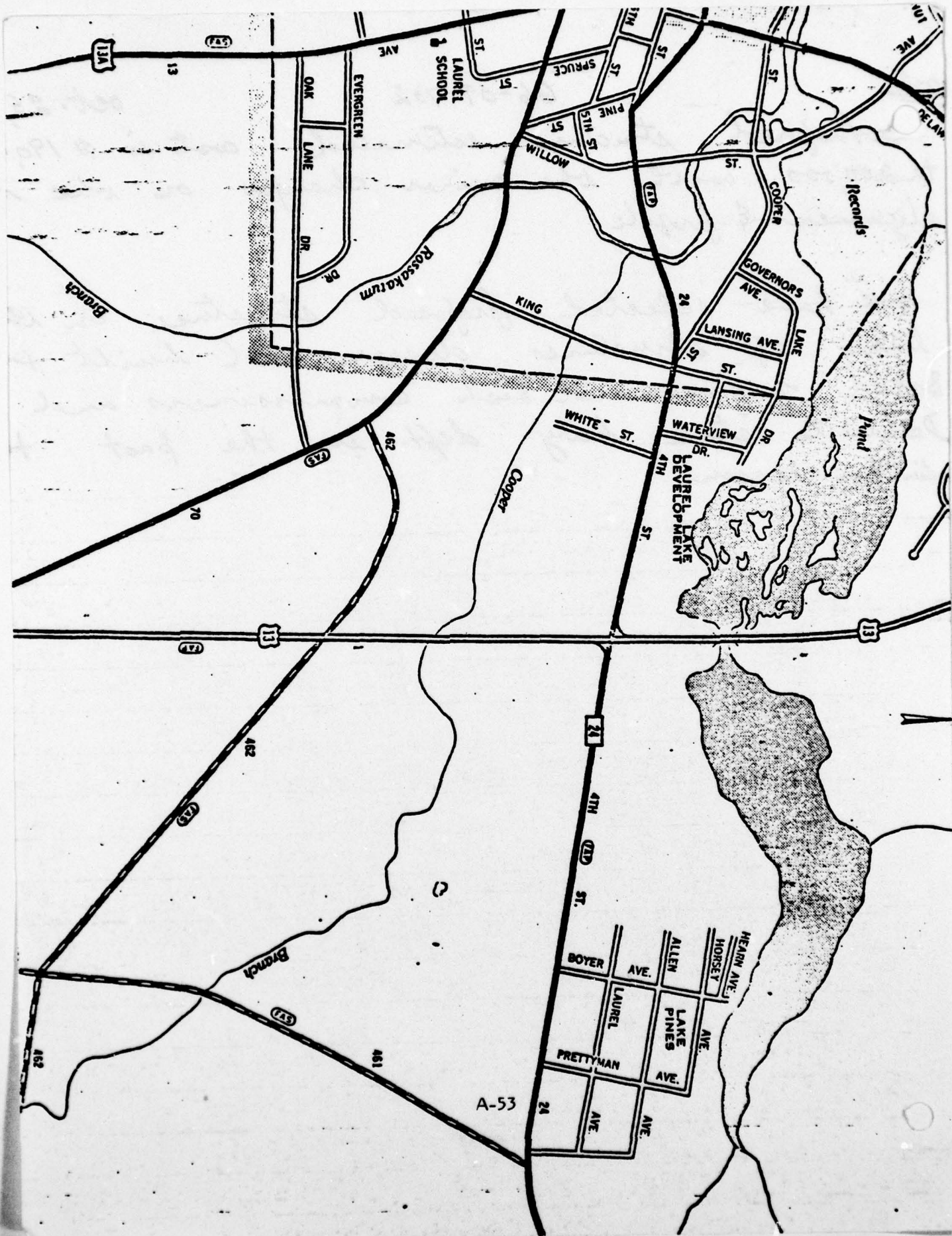
71P

66-09-702

Oct. 26,

Proposed structure estimated cost is \$190,000 to 200,000 with the minor changes on the alignment & profile.

We have selected proposed structure on the basis of structures design and built to Board of game and fish commissioners and Delaware state hwy. dept. in the past for similar reason.



LAUREL SCHOOL

LAUREL LAKE DEVELOPMENT

Records Pond

A-53



2nd

66-09-702

Oct. 27, 1966

Records Pond water control structures

Drainage area = 46737 Acres
= 73.1 sq. miles

Design frequency = 50 years
Estimated runoff = 2841 cuses

formula used to calculate estimated runoff
as under

$$Q = Aci \sqrt[4]{S/A}$$

where Q = Estimated runoff

A = Drainage area in A

C = Coefficient depending
the character of the S

i = ^{drained} Average rate of rainfall
inches per hour

S = Average of slope of g
in ft. per 100 ft.

In our case

$$A = 46737$$

$$- \quad 95 \text{ (Records pond)}$$

$$\hline 46642$$

$$C = 0.20$$

$$i = 3.25$$

$$S = 2$$

$$Q = 46642 \times 0.20 \times 3.25 \sqrt[4]{2/46642}$$

$$= 2453$$

(considering full concentration
in Records Pond)

$$Q_{Total} = 2453 + 3.25 \times 95 + 20 \times 40$$

$$= 2453 + 308 + 80$$

$$= 2841 \text{ cuses}$$

Oct. 27,

Hydraulics capacity of the existing structure without opening the gate as a spillway is cusecs, if allowable headwater is 2.9 feet above the top of existing gate elevation that mean $8.60 + 2.90 = 11.50$ H.W.L., which is the Road profile elevation between structure.

If we allow to raise the H.W.L. to 12. the hydraulics capacity of the existing structure as a spillway is 787 cusecs. And if we allow to raise the H.W.L. to 13.6 the hydraulics capacity of the existing structure as a spillway is 1100 cusecs.

The formula used to calculate above discharge is as follows

$$Q = CLH^{3/2}$$

where

C = discharge coef

In our case 3.4

L = spillway length

H = hydraulics head

above top of the

spillway

Q = Calculated runoff

From the above one can conclude that existing structure as a spillway is inadequate for the estimated runoff.