FORGE POND DAM

MA 00806

MASSACHUSETTS COASTAL BASIN

CANTON, MASSACHUSETTS

NATIONAL DAM INSPECTION PROGRAM

TABLE OF CONTENTS

DESCRIPTION		1
EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES		2
OVERVIEW PHOTO		3
LOCATION PLAN		4
APPENDIX A	ENGINEERING DATA	
APPENDIX B	PHOTOGRAPHS	
APPENDIX C	HYDRAULIC/HYDROLOGIC CALCULATIONS	

DESCRIPTION

IDENTIFICATION NO.	:	MA 00806
NAME OF DAM	:	FORGE POND DAM
TOWN	:	CANTON
COUNTY AND STATE	:	NORFOLK COUNTY, MASSACHUSETTS
STREAM	:	MASSAPOAG BROOK

OWNER - Plymouth Rubber Co.
104 Revere Street
Canton, MA

The Forge Pond Dam consists of a concrete ogee shaped spillway 40 ft. long. The flow over the weir is controlled by one hand operated sluice gate about 6 ft. wide located in the center of the spillway and 6 bays of stop planks approximately 4'- 6" wide. The height of the dam is about 13 ft. The stop planks and sluice gate are operated from a concrete service bridge over the dam. Discharge from the spillway flows down a concrete discharge channel that varies in width from 40 ft. to 26 ft. under a reinforced concrete bridge located about 25 ft. downstream. This bridge spans the Massapoag Brook at Washington Street. Photo #1 is a view of the downstream face of the dam.

The dam was built in conjunction with this bridge in approximately 1949. The structure was designed by the Massachusetts Dept. of Public Works in 1949. Design drawings are included in Appendix A.

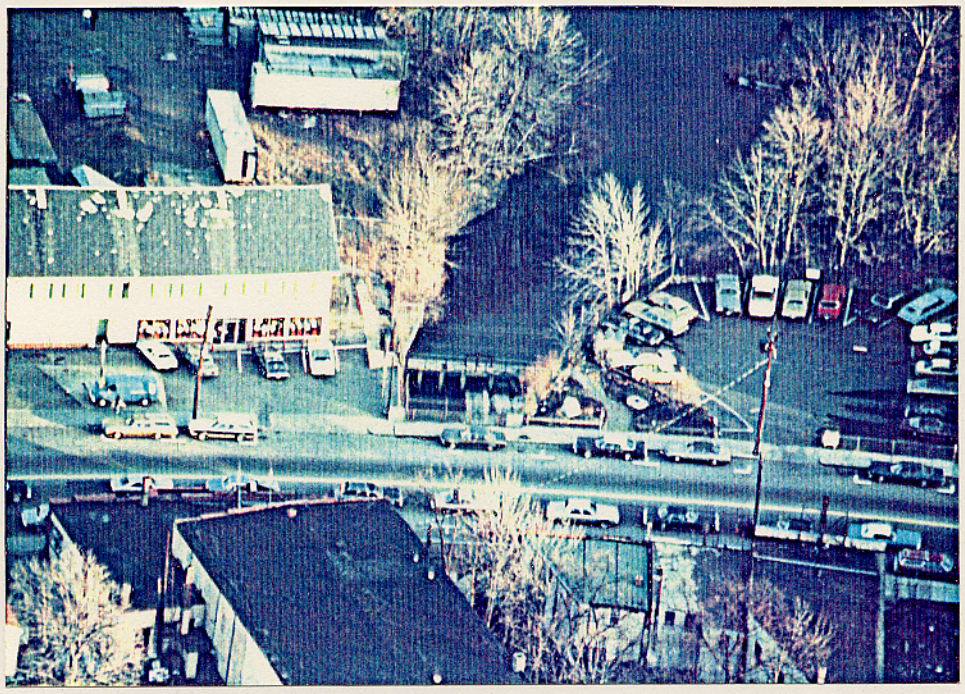
EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

The Forge Pond Dam has a tributary watershed of approximately 27 square miles. The watershed consists of suburban and lightly developed areas with many swamps. It ranges in elevation from about El. 90 to El. 350 ft. NGVD.

Storage capacity of the dam is estimated to be 60 acre-ft (from COE record data), total spillway capacity at the top of dam (El. 96.0 ± NGVD) was estimated to be about 2,500 cfs. The dam is considered "Small" in size based on storage capacity. Flood routing for failure at normal pool indicates the dam to be "Low Hazard".

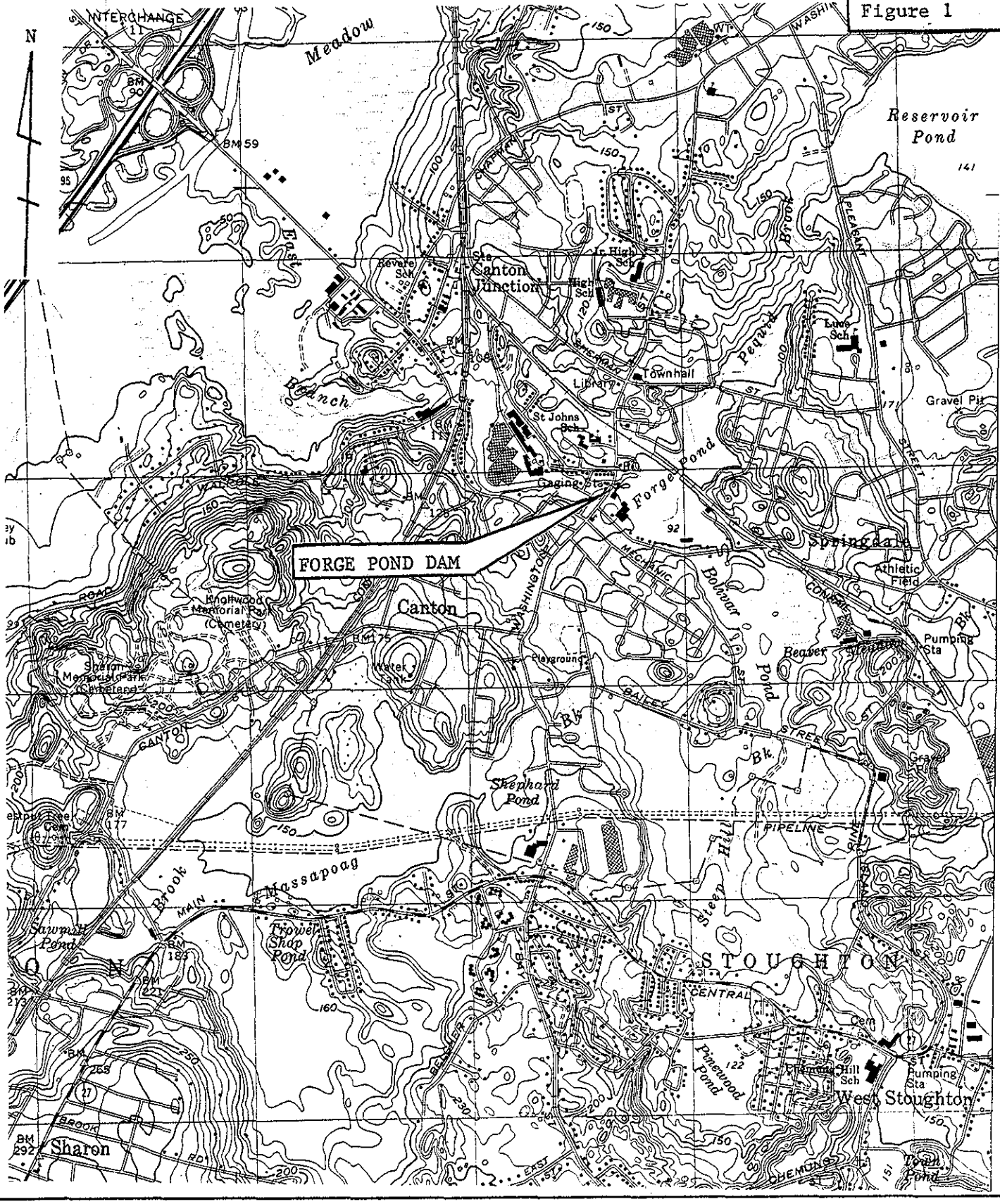
A dam breach analysis was made in accordance with Corps of Engineers' guidelines with the dam at normal pool. Normal pool elevation was based upon flow data obtained from USGS gaging station #0110550 located near the toe of the dam and determined to be El. 92.8 ft. NGVD. Width of breach was assumed to be 16 ft. yielding a breach outflow of 875 cfs. Spillway flow was included in the breach outflow.

The peak dam failure flow at normal pool is less than the 10 yr. storm flow as determined in the Flood Insurance Study for the Town of Canton. Analysis indicates the flooding due to the dam failure would be confined within the stream channel with depths ranging from about 1 to 5 ft. above normal stage. For hydraulic/ hydrologic computations please see Appendix C.



OVERVIEW PHOTO

U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM , MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	FORGE POND DAM TR. TO MASSAPOAG BROOK CANTON, MASS. MA 00806 AUGUST 7, 1981
ASEC CORP. CONSULTING ENGINEERS BOSTON , MASSACHUSETTS		



LOCATION PLAN

FORGE POND DAM
CANTON, MASSACHUSETTS

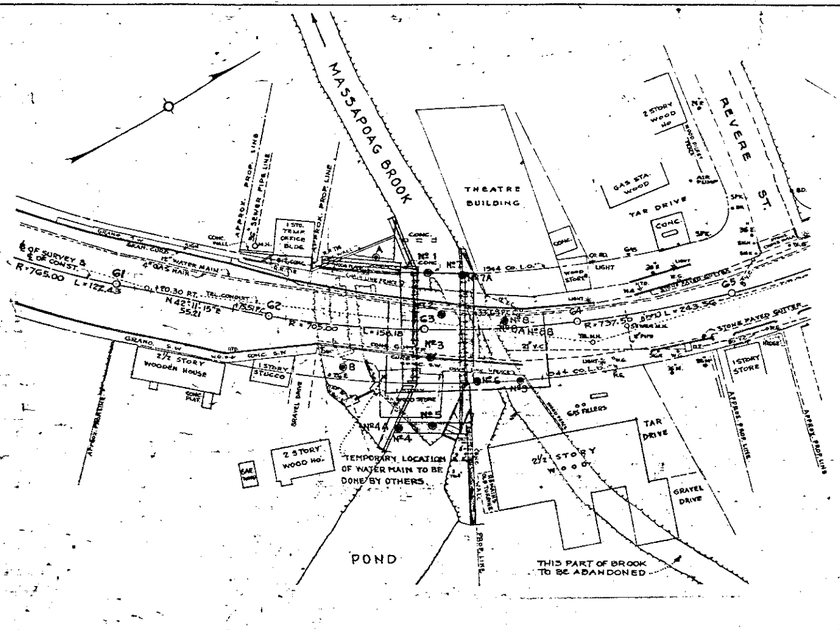
SCALE: 1 : 25 000

ASEC CORPORATION

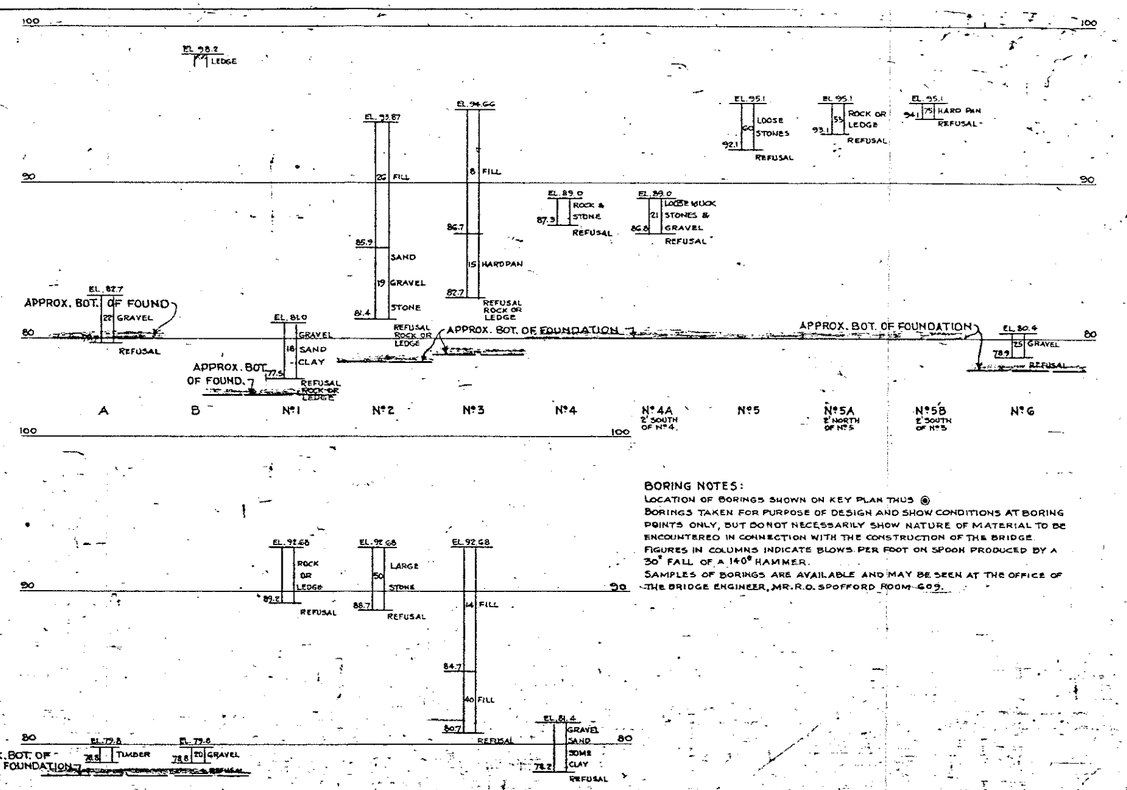
NORWOOD QUADRANGLE 1979

APPENDIX A

ENGINEERING DATA



KEY PLAN
SCALE 1" = 40'-0"



BORING NOTES:
LOCATION OF BORINGS SHOWN ON KEY PLAN THUS ⊗
BORINGS TAKEN FOR PURPOSE OF DESIGN AND SHOW CONDITIONS AT BORING POINTS ONLY, BUT DO NOT NECESSARILY SHOW NATURE OF MATERIAL TO BE ENCOUNTERED IN CONNECTION WITH THE CONSTRUCTION OF THE BRIDGE.
FIGURES IN COLUMNS INDICATE BLOWS PER FOOT ON SPOON PRODUCED BY A 30" FALL OF A 140# HAMMER.
SAMPLES OF BORINGS ARE AVAILABLE AND MAY BE SEEN AT THE OFFICE OF THE BRIDGE ENGINEER, MR. R.O. SPOFFORD ROOM 609.

BORING DATA
SCALE: 1" = 4'-0"
BORINGS TAKEN JULY 1946

GENERAL NOTES

FOUNDATIONS:
MAY BE ALTERED IF NECESSARY TO SUIT CONDITIONS OF CONSTRUCTION.

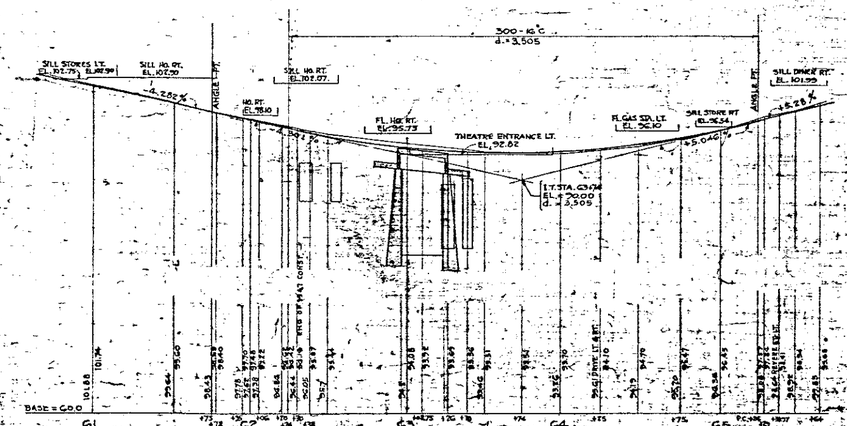
DATE:
TO BE PLACED IN CENTER OF INSIDE FACE OF NORTHWESTERLY AND SOUTHEASTERLY END POSTS. A SHEET SHOWING SIZE AND CHARACTER OF NUMERALS WILL BE FURNISHED.

DESIGN:
ACCORDING TO SPECIFICATIONS OF AMERICAN ASSOCIATION OF STATE HIGHWAY OFFICIALS (1944 ED.) FOR H-20 LOADING.

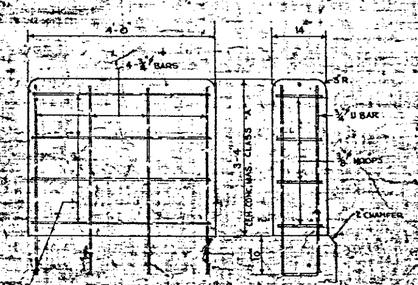
BENCH MARK:
VERT. SPIKE IN ROOT 14" MAPLE IN SCHOOL YARD STA. 60+27 RT. 50 EL. 110.15 SEA LEVEL DATUM OF 1929.

ESTIMATED QUANTITIES
(NOT GUARANTEED)

UNCLASSIFIED EXCAVATION	1600	CU. YDS.
CLASS B ROCK EXCAVATION	800	CU. YDS.
GRAVEL BORROW	800	CU. YDS.
STRIPPING GRAVEL PITS	80	CU. YDS.
CLASS I BIT. CONC. PAVE. TYPE I-1	25	TONS
CLASS A CEMENT CONCRETE MASONRY	1215	CU. YDS.
CLASS B CEMENT CONCRETE MASONRY	690	CU. YDS.
STEEL REINF. FOR STRUCTURES	41000	POUNDS
MEMBRANE WATERPROOFING	180	SQ. YDS.
METAL BRIDGE RAILINGS	51	LIN. FT.
STONE WALLS R. & R. IN CEMENT MORTAR	20	CU. YDS.
IRON PIPE FENCE	37	LIN. FT.
GRAINTE CURB TYPE VA STR. (6"×10")	62	LIN. FT.
GATE AND GATE HOIST		LUMP SUM
STOP PLANKS AND SLOTS		LUMP SUM



PROFILE
HOR. SCALE 1" = 40'-0" VERT. SCALE 1" = 8'-0"



DETAILS OF END POST
SCALE ¼" = 1'-0"

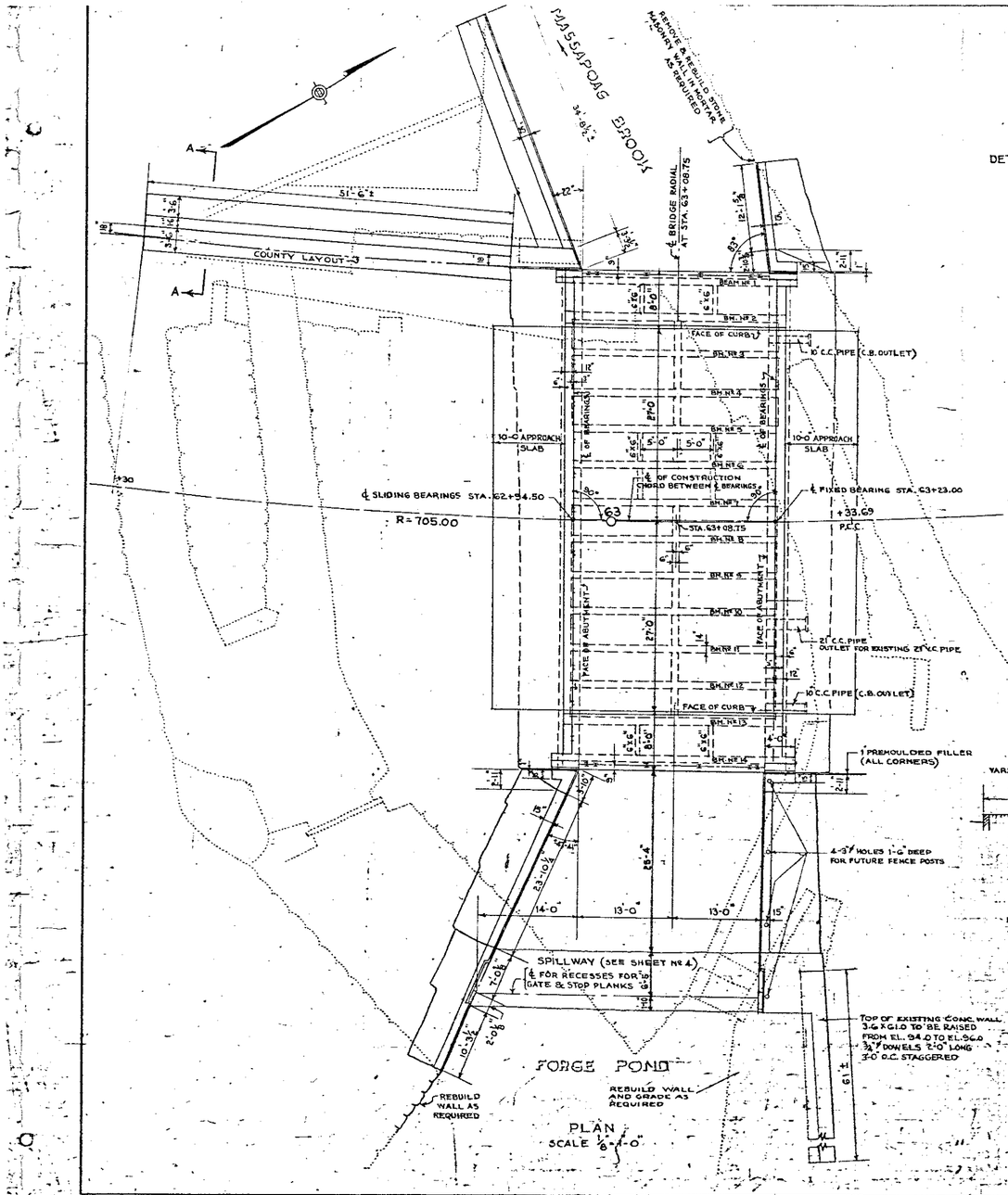
ADVERTISING, 4-23-49 | CONSTRUCTION 4-23-49

THE COMMONWEALTH OF MASSACHUSETTS
PROPOSED BRIDGE
CANTON
WASHINGTON ST. - STA. 63+08.75
OVER MASSAPOAG BROOK
SCALES AS NOTED
OFFICE OF
DEPARTMENT OF PUBLIC WORKS
100 NASHUA ST. - BOSTON, MASS.
APRIL 1949

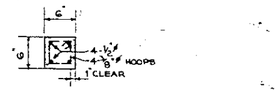
R. O. Spofford — BRIDGE ENGINEER
C. H. Cook — CHIEF ENGINEER

DESIGNED BY H.J.H. — TRACED BY H.J.H. & G. — CHECKED BY G.D.V.

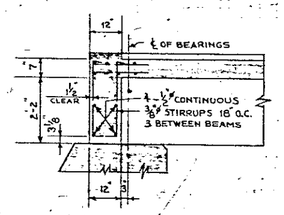
SHEET 1 OF 4 SHEETS BRIDGE N.C. 2-15



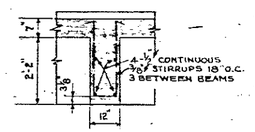
PLAN
SCALE 1/8" = 1'-0"



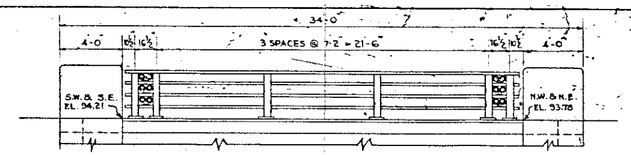
DETAIL OF 6" x 6" BEAM
SCALE 1" = 1'-0"



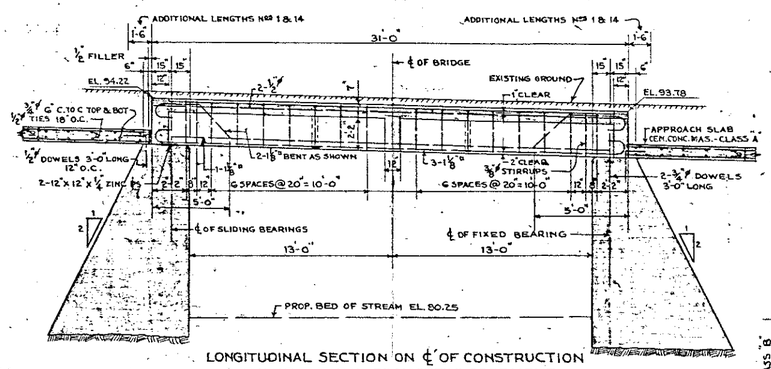
ABUTMENT DIAPHRAGMS
SCALE 1/2" = 1'-0"



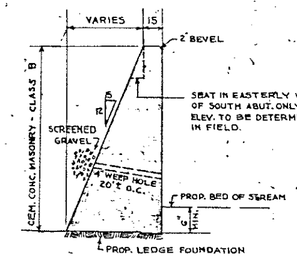
CENTER LINE DIAPHRAGMS
SCALE 1/2" = 1'-0"



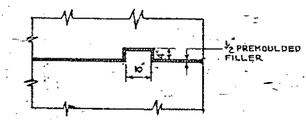
EASTERLY ELEVATION METAL BRIDGE RAILING
SCALE 1/4" = 1'-0"



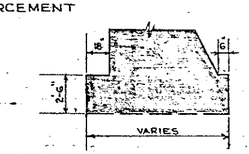
LONGITUDINAL SECTION ON ℄ OF CONSTRUCTION
SHOWING TYPICAL BEAM REINFORCEMENT
SCALE 1/4" = 1'-0"



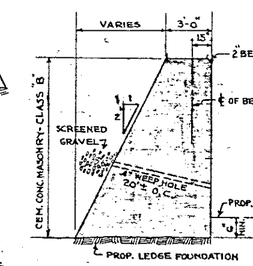
TYPICAL WING WALL SECTION
SCALE 1/4" = 1'-0"



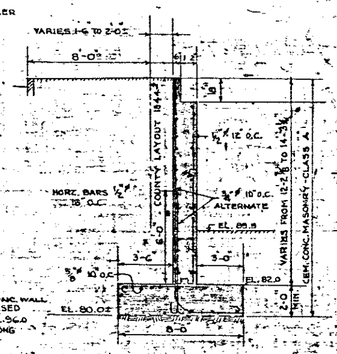
EXPANSION JOINT DETAIL
SCALE 1/2" = 1'-0"



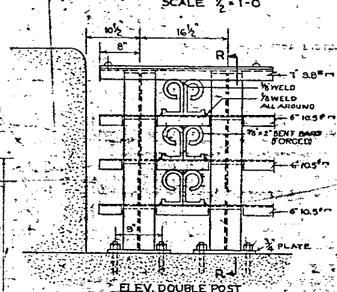
ABUTMENT OR WALL FOOTING
IF LEDGE IS NOT ENCOUNTERED
SCALE 1/4" = 1'-0"



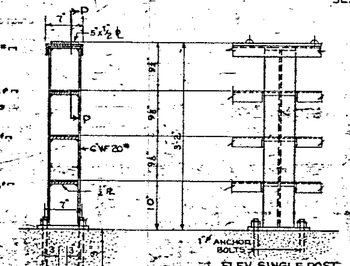
TYPICAL ABUTMENT SECTION
SCALE 1/4" = 1'-0"



SECTION A-A
REINF. CONC. RETAINING WALL
SCALE 1/4" = 1'-0"

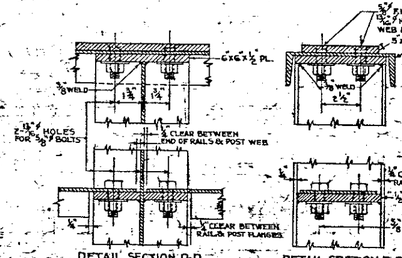


ELEV. DOUBLE POST



SECTION R-R
SCALE 1" = 1'-0"

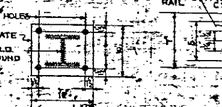
ELEV. SINGLE POST



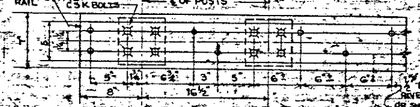
DETAIL SECTION P-P
SCALE 3" = 1'-0"

DETAIL SECTION R-R

NOTE: ALL MATERIAL FOR RAILING TO BE STRUCTURAL GRADE STEEL; ALL POSTS TO BE PLUMB; BASE OF POSTS CUT TO FOLLOW GRADE.



POST BASE
SCALE 1" = 1'-0"



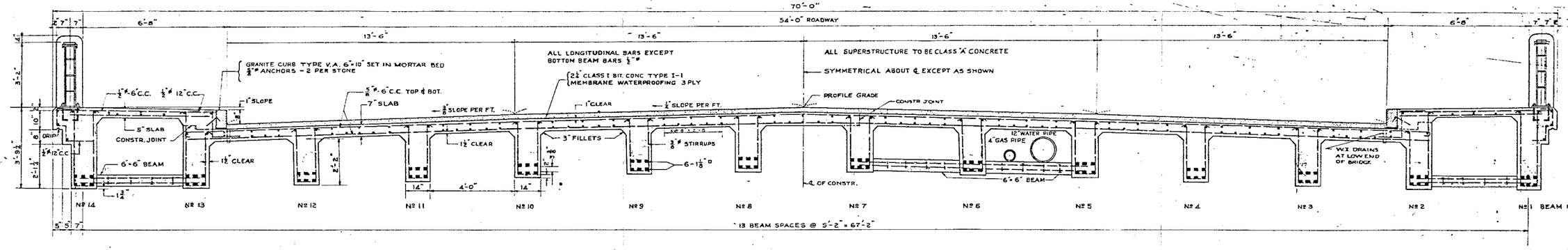
PLAN OF TOP RAILING
SCALE 1" = 1'-0"

METAL BRIDGE RAILING
SCALES AS NOTED

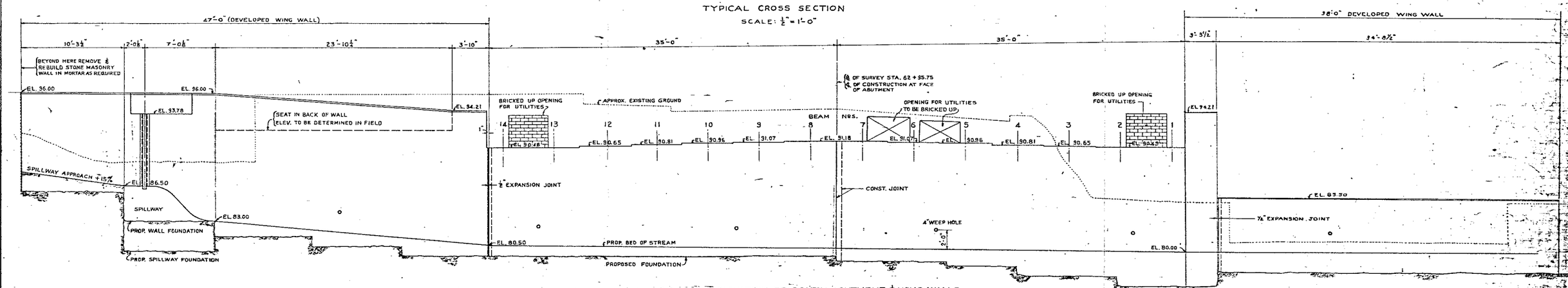
DATE	DESCRIPTION
4-23-49	CONSTRUCTION
4-23-49	ADVERTISING

USE ONLY PRINTS OF LATEST DATE

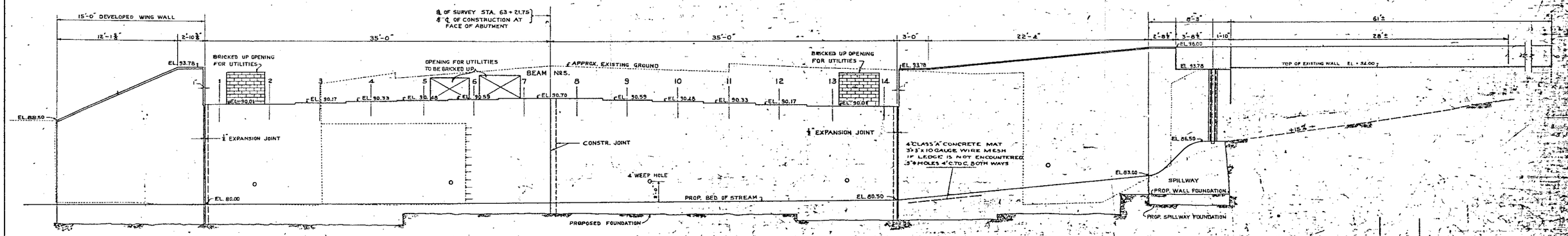
SHEET 2 OF 4 SHEETS BRIDGE No C.2-15



TYPICAL CROSS SECTION
SCALE: 1/2" = 1'-0"



ELEVATION OF SOUTH ABUTMENT & WING WALLS
SCALE: 1/4" = 1'-0"

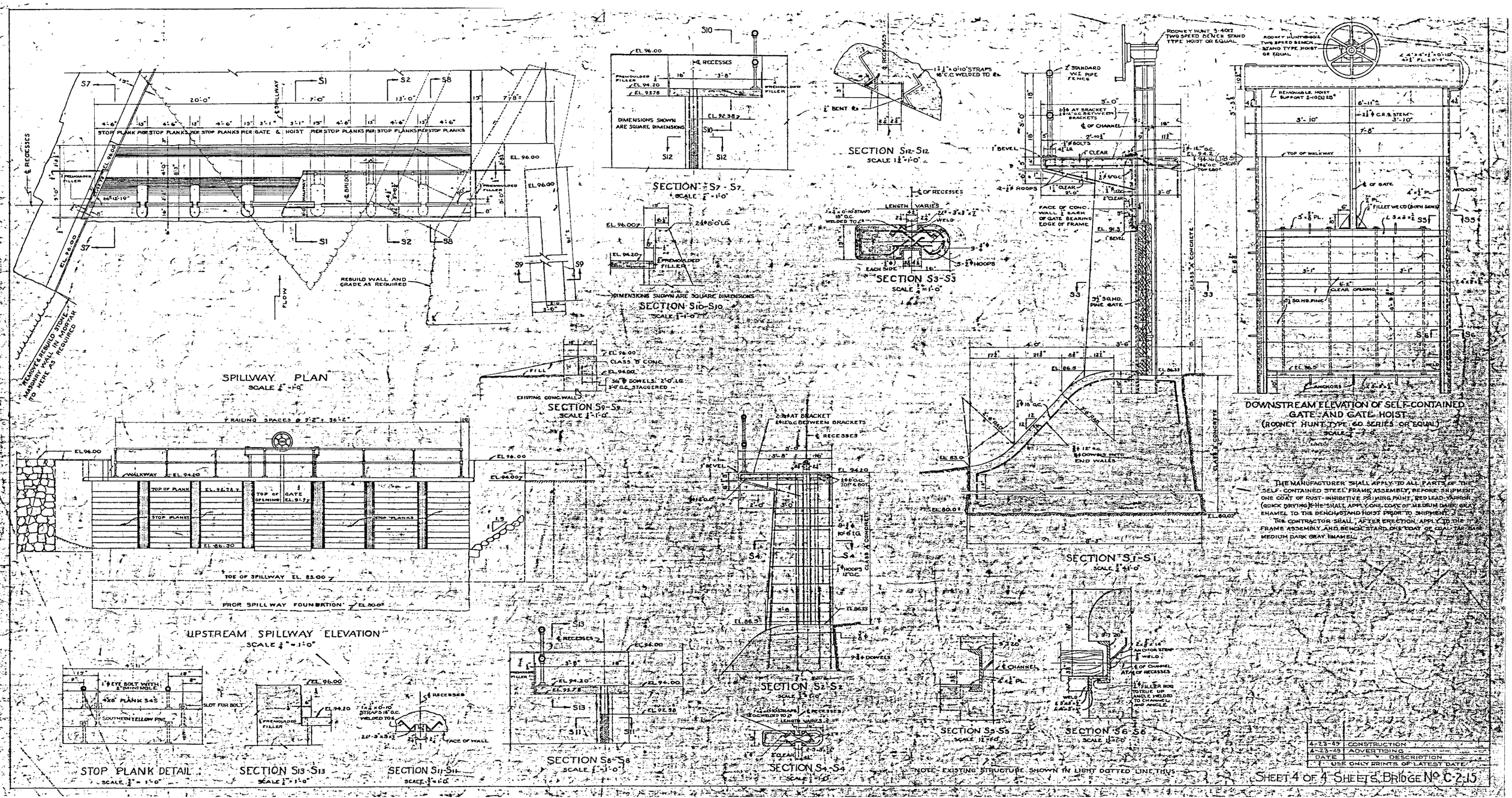


ELEVATION OF NORTH ABUTMENT & WING WALLS
SCALE: 1/4" = 1'-0"

DATE	DESCRIPTION
4-23-49	CONSTRUCTION
4-23-49	ADVERTISING

USE ONLY PRINTS OF LATEST DATE

SHEET 3 OF 4 SHEETS. BRIDGE Nº C-215


SPILLWAY PLAN
SCALE 1/8" = 1'-0"
UPSTREAM SPILLWAY ELEVATION
SCALE 1/8" = 1'-0"
STOP PLANK DETAIL
SCALE 1/2" = 1'-0"
SECTION S13-S13
SECTION S11-S11
SECTION S8-S8
SECTION S9-S9
SECTION S10-S10
SECTION S7-S7
SECTION S12-S12
SECTION S3-S3
SECTION S1-S1
SECTION S2-S2
SECTION S5-S5
SECTION S6-S6
SECTION S4-S4
DOWNSTREAM ELEVATION OF SELF-CONTAINED GATE AND GATE HOIST
(ROONEY HUNT TYPE 60 SERIES OR EQUAL)
SCALE 1/4" = 1'-0"
THE MANUFACTURER SHALL APPLY TO ALL PARTS OF THE SELF-CONTAINED STEEL FRAME ASSEMBLY, BEFORE SHIPMENT, ONE COAT OF RUST-INHIBITIVE PRIMING PAINT, RED LEAD VARNISH (QUICK DRYING). HE SHALL APPLY ONE COAT OF MEDIUM DARK GRAY ENAMEL TO THE BENCH STAND HOIST PRIOR TO SHIPMENT.
THE CONTRACTOR SHALL, AFTER ERECTION, APPLY TO THE FRAME ASSEMBLY AND BENCH STAND ONE COAT OF COAL TAR BASE MEDIUM DARK GRAY ENAMEL.
NOTE: EXISTING STRUCTURE SHOWN IN LIGHT DOTTED LINE THUS
4-23-49 CONSTRUCTION
4-23-49 ADVERTISING
DATE DESCRIPTION
USE ONLY PRINTS OF LATEST DATE
SHEET 4 OF 4 SHEETS, BRIDGE No. C-215

APPENDIX B

PHOTOGRAPHS

SPILLWAY LOOKING UPSTREAM

U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM , MASSACHUSETTS ASEC CORP. CONSULTING ENGINEERS BOSTON , MASSACHUSETTS	NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS	FORGE POND DAM TR. TO MASSAPOAG BROOK CANTON, MASS. MA 00806 AUGUST 7, 1981

APPENDIX C

HYDRAULIC/HYDROLOGIC CALCULATIONS

FORGE POND DAM

CANTON, MA

FAILURE ANALYSIS

AT NORMAL POOL

FORGE POND DAM

Case of dam failure with "normal pool".

NORMAL POOL

Average discharge at USGS gage #01105500 located at the the toe of the dam is approximately 50 CFS for 24 years of record. From a dam rating curve (Graph #1), the approximate "normal" water surface is 92.8'.

Gate Opening Discharge

$Q_1 = CLH^{1.5}$

C = 3.2 (sharp-crested weir)

L = 6.1'

H = head on gate crest (elevation 91.3' NGVD)

$Q_1 = 3.2 \times 6.1 \times H^{1.5}$

Stop Planks Spillway Discharge

$Q_2 = CLH^{1.5}$

C = 3.2 (sharp-crested weir)

L = 4.5' (x 6 openings)

H = head on stop planks (elevation 92.6' NGVD)

Total Discharge

$Q_{Total} = Q_1 + Q_2$

Assume that the dam fails at "normal" pool level, which corresponds to elevation 92.8' just 0.2' above the elevation of the stop planks. The elevation of the gate opening is 91.3' NGVD and the stop planks 92.6' NGVD. The toe of the spillway is at elevation 83.0' NGVD. A plan of the spillway is shown in Figure 1.

Cross-sections located throughout the downstream impact area along the East Branch Neponset River were obtained from the Federal Emergency Management Agency, Flood Insurance Study for the Town of Canton. Results of the HEC-2 multiple profile run were used to construct stage-discharge curves and stage cross-section area curves for each section downstream of the dam (Graphs #2-7).

The following are locations of cross-sections used in the dam failure analysis:

Distance D/S of dam (ft)	Normal Water Level (ft-NVGD)*
284	80.5
499	80.3
729	80.3
1029	73.1
2279	61.3
3779	58.4

* Approximate elevations of normal flow in stream channel.

Breach Outflow

$$Q_{pl} = 8/27 \times Wb \times \sqrt{g} \times Y_o^{1.5}$$

where: Wb = width of breach

$\leq$ 0.4 x (width of dam at ½ height)

$\leq$ 0.4 x 40'

use: Wb = 16'

Y_o = pool elevation - downstream invert

= 92.8 - 83 + 9.8'

$$Q_{pl} = 8/27 \times 16 \times \sqrt{32.2} \times 9.8^{1.5} = 825 \text{ CFS}$$

Total Outflow

$$Q_{total} = 50 + 825 = 875 \text{ CFS}$$

Volume Impounded by the Dam (COE inventory)

At "normal" pool = 60 acre-feet

Downstream Flooding

Immediately downstream of the dam Washington Street crosses the East Branch Neponset River. The waterway opening under this bridge is approximately 26' wide by 11' in height or 286 square feet. This bridge will handle the failure flow of 875 CFS without overtopping the roadway.

At 284' d/s of the dam assume no attenuation of the failure flow.

depth = 84.6' - 80.5' = 4.1' (Graph #2, with Q = 875 CFS)

To estimate the peak dam break flow in the reaches downstream of the dam, we use the stage-discharge and stage-cross-section area curves (graphs #2-7) and follow the COE "Rule of Thumb Guidance for Estimating Downstream Dam Failure Hydrographs". Assume channel and overbank storage of the flood wave is equal to the reach length times the average of the upstream post-failure flow area minus the upstream pre-failure flow area and the downstream post-failure flow area minus the downstream pre-failure flow area. The attenuation of the dam failure flow due to storage in any reach is:

$$Q_{p2} = \text{"normal flow"} + Q_{p1}\left(1 - \frac{V_1}{S}\right)$$

where: V_1 = volume of storage in reach above pre-failure stage (acre-feet)

S = storage in pond at "normal" water surface (acre-feet)

Q_{p1} = breach outflow at upstream end of reach

Q_{p2} = total outflow at downstream end of reach

The peak dam failure flow at "normal" pool of 875 CFS is less than the 10-year storm of 930 CFS as determined in the Flood Insurance Study for the Town of Canton. The stage-discharge curves developed from the HEC-2 analysis of the East Branch Neponset River indicate the flooding due to the dam failure would be conveyed within the stream channel with depths ranging from approximately 1 to 5 feet. All downstream bridge waterway areas and dam spillways are sufficient to handle the peak dam failure flow. There would be no significant damage to downstream areas. The peak dam failure flow would be attenuated to 649 CFS 3779' downstream of the dam near the

intersection of Walpole Street and the Conrail railroad bridge.

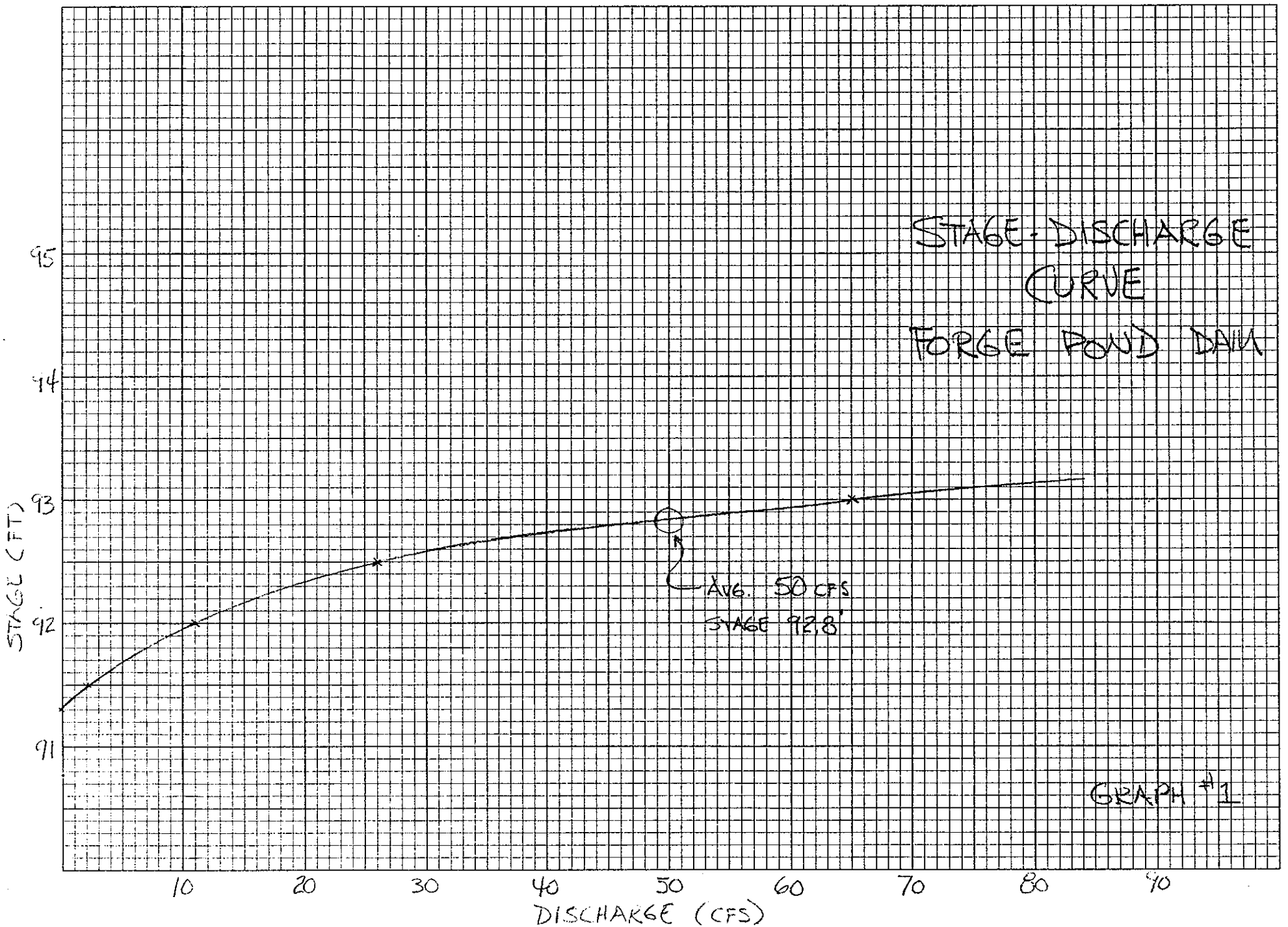
Classification:

SIZE: SMALL (storage between 50 and 1000 acre-feet; height $\angle$ 40')

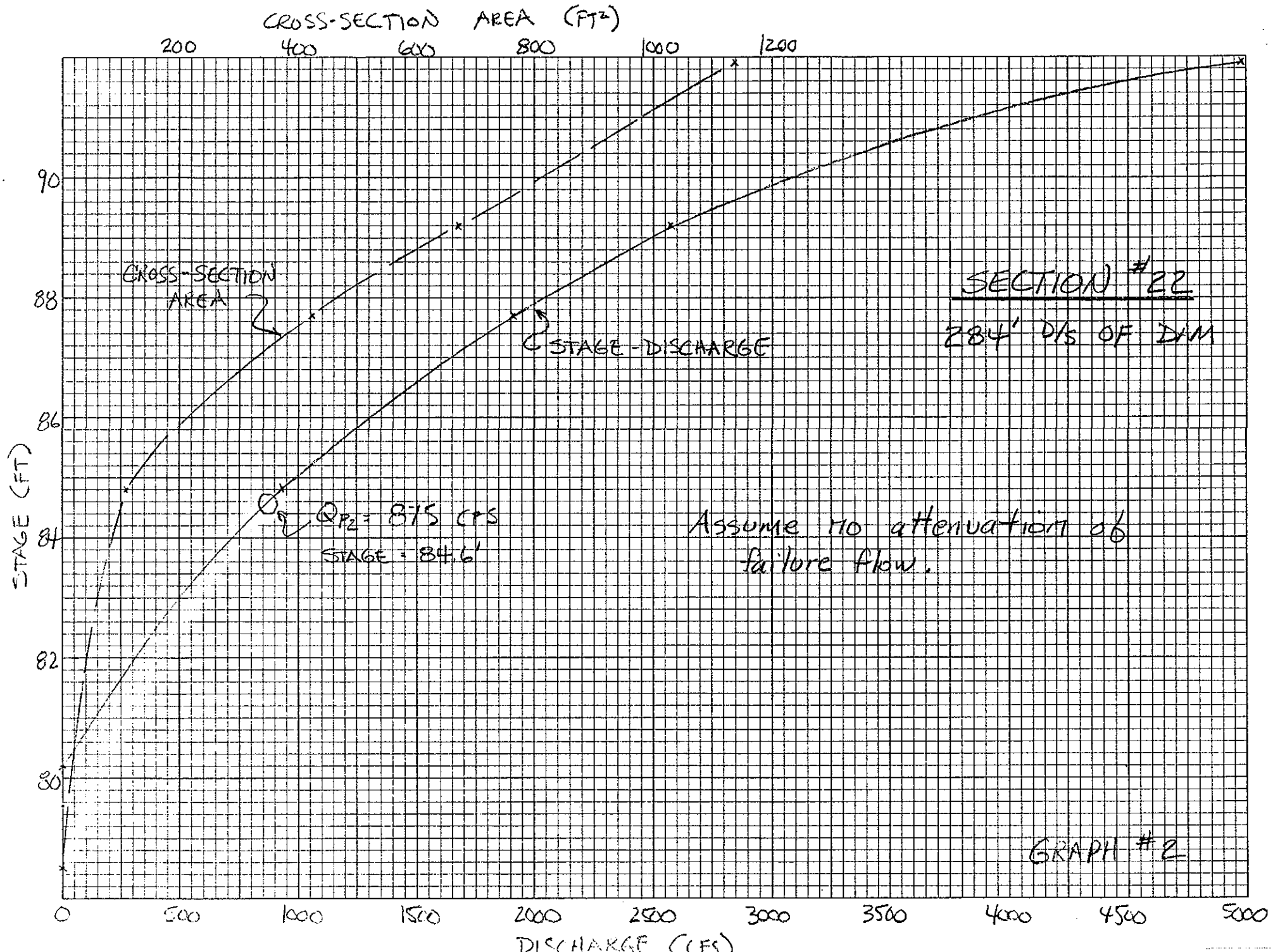
HAZARD: LOW (based on failure analysis at "normal" pool, insignificant flooding less than 10-year storm).

NO. 341-10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH

DIETZGEN CORPORATION
MADE IN U.S.A.



NO. 341-10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH
DIETZGEN CORPORATION
MADE IN U.S.A.



NO. 341-10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH

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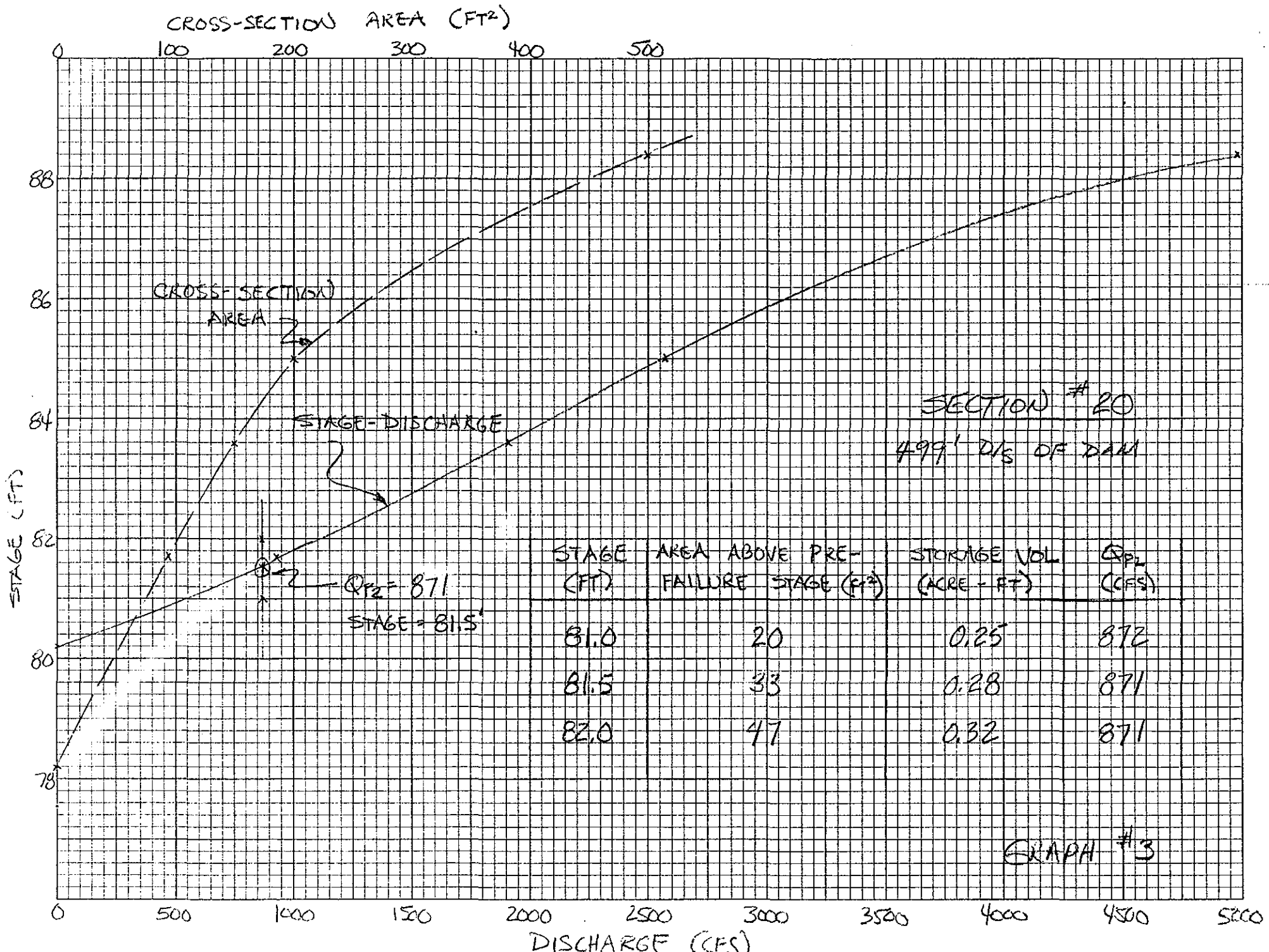

STAGE (FT)	AREA ABOVE PRE-FAILURE STAGE (ft²)	STORAGE VOL (ACRE - FT)	Q_{P2} (CFS)
81.0	20	0.25	872
81.5	33	0.28	871
82.0	47	0.32	871

GRAPH #3

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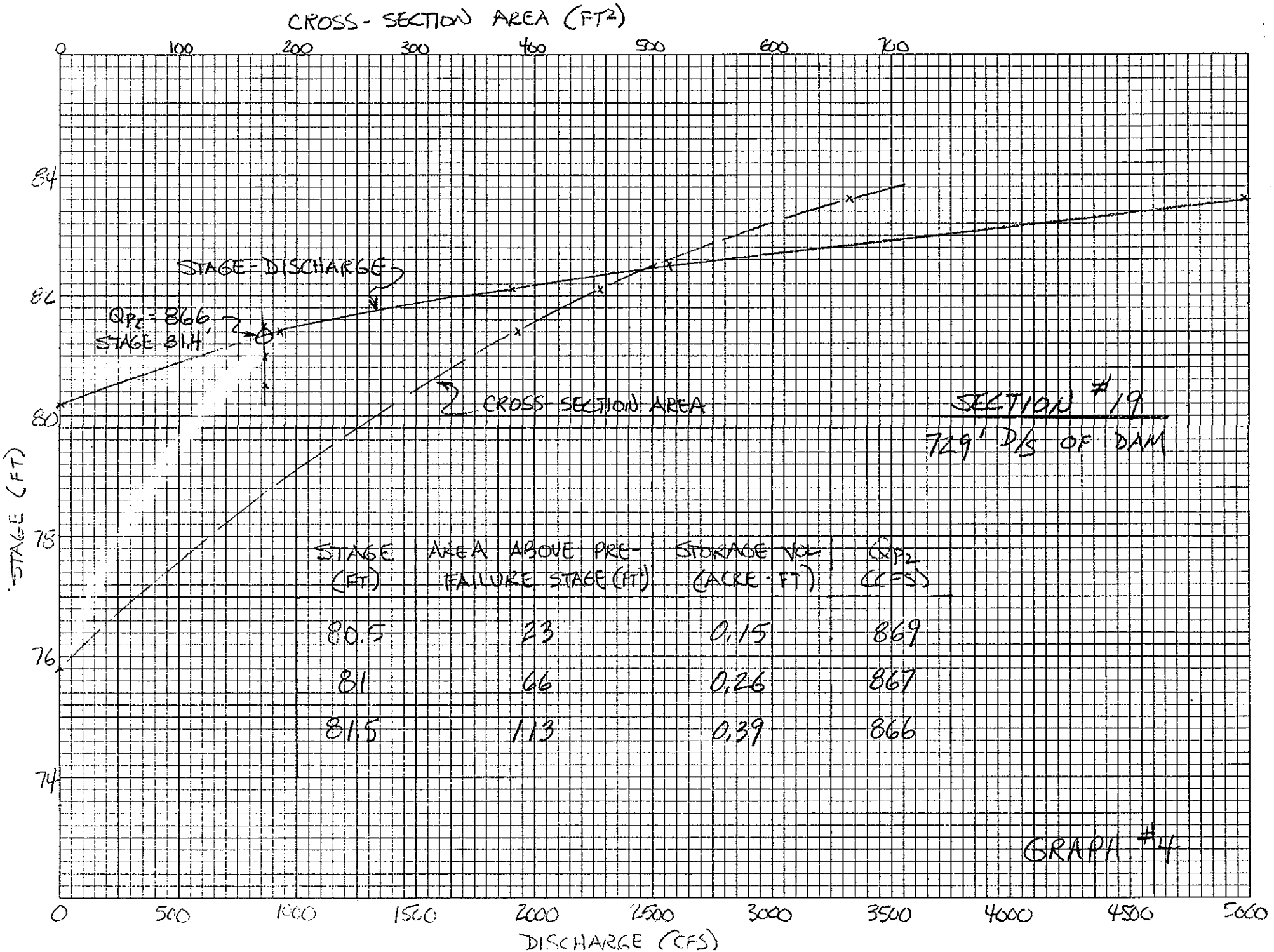

STAGE (FT)	AREA ABOVE PRE-FAILURE STAGE (FT)	STORAGE VOL (ACRE-FT)	Q_{P_2} (CFS)
80.5	23	0.15	869
81	66	0.26	867
81.5	113	0.39	866

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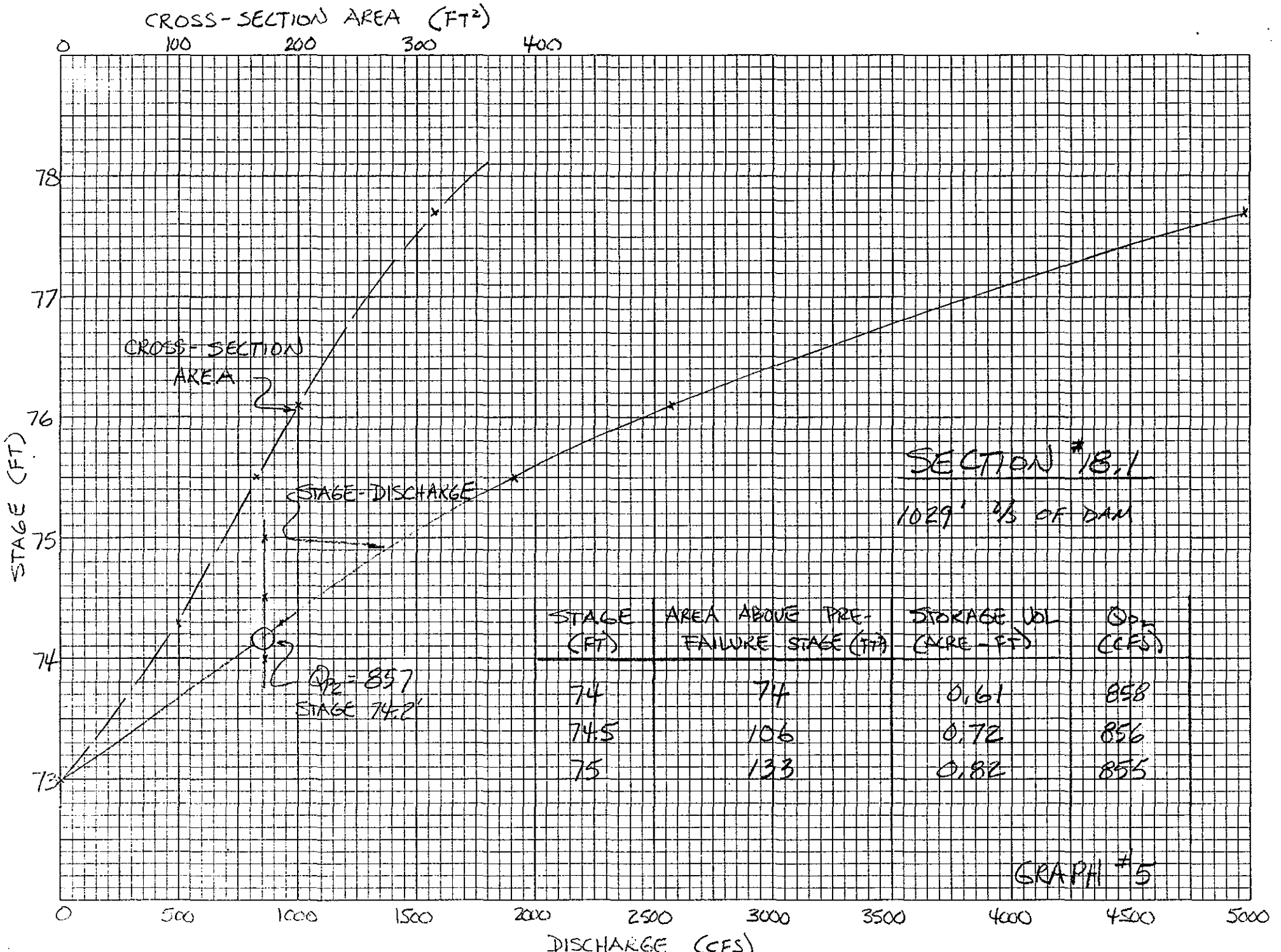

STAGE (FT)	AREA ABOVE PRE-FAILURE STAGE (FT²)	STORAGE VOL (ACRE-FT)	$Q_{D_{72}}$ (CFS)
74	74	0.61	858
74.5	106	0.72	856
75	133	0.82	855

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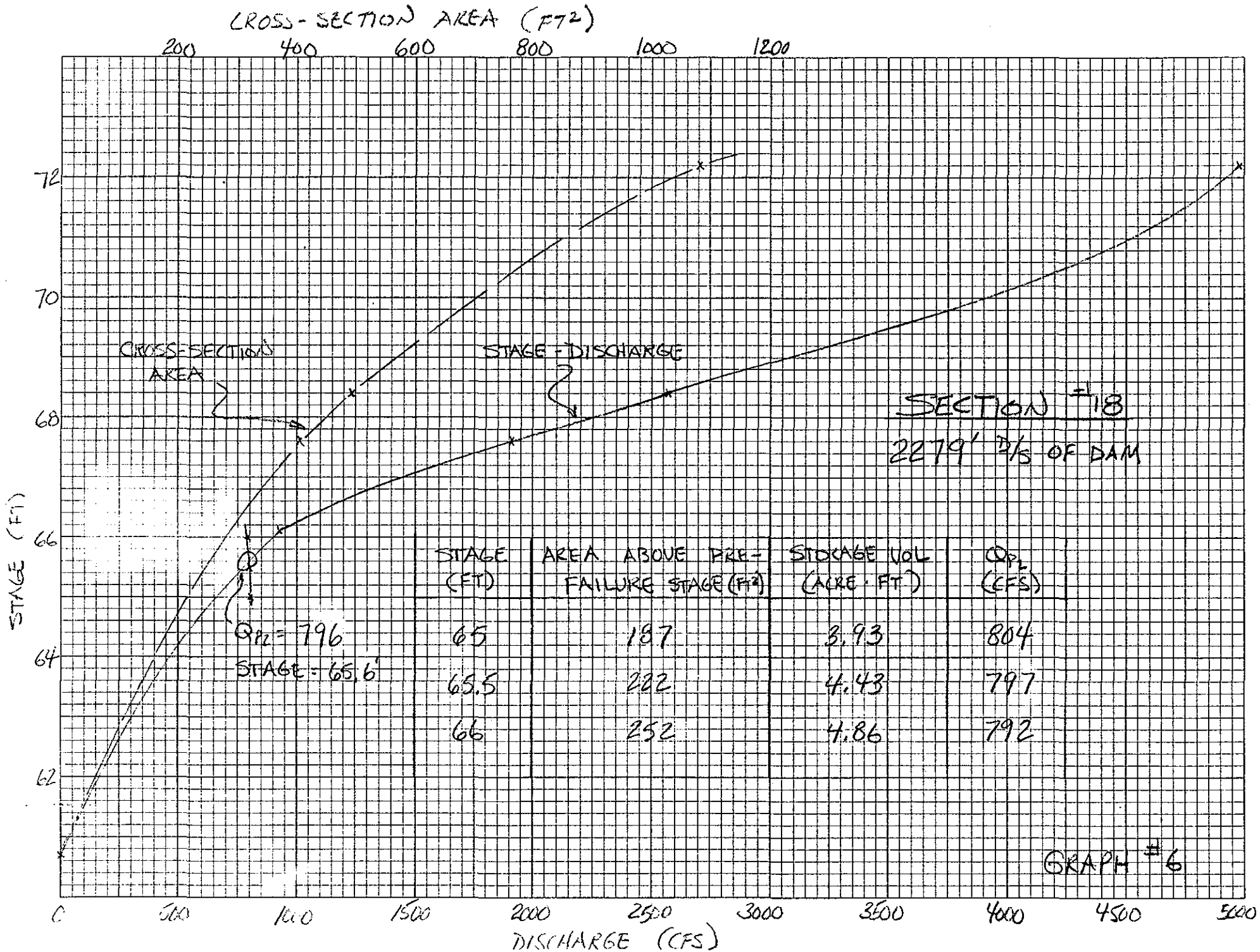

STAGE (FT)	AREA ABOVE PRE-FAILURE STAGE (FT²)	STORAGE VOL (ACRE · FT)	Q_{P2} (CFS)
65	187	3.93	804
65.5	222	4.43	797
66	252	4.86	792

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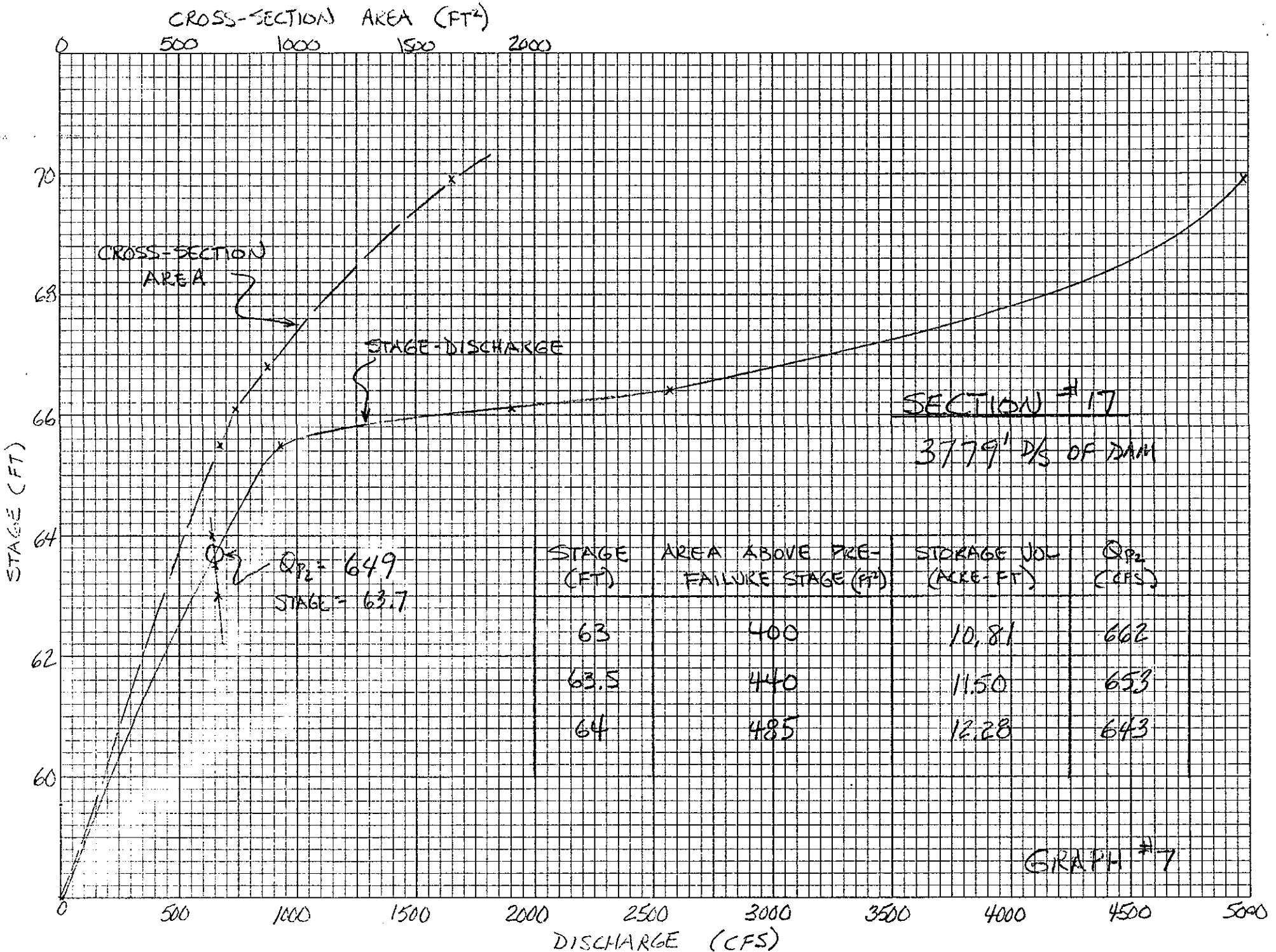

STAGE (FT)	AREA ABOVE PRE-FAILURE STAGE (FT²)	STORAGE VOL (ACRE-FT)	Q_{P_2} (CFS)
63	400	10.81	662
63.5	440	11.50	653
64	485	12.28	643

ASEC CORP.
496A Commercial Street
BOSTON, MA 02109
(617) 227-0766

JOB CORPS OF ENGINEERS
SHEET NO. 1 OF 1
CALCULATED BY JFM DATE 8/14/81
CHECKED BY JFM DATE 8/14/81
SCALE

COMPUTATION OF SPILLWAY CAPACITY - TOP OF DAM

TOP OF DAM = EL. 96.0 NGVD

$Q = CLH^{3/2}$

$C = 3.1$ (BROAD CRESTED WEIR)

$L = 6.1$ FT. & $(4.5' \times 6) = 27$ FT

$H = 8.5$ FT

$Q = (3.1)(6.1\ FT)(8.5\ FT)^{3/2} + 6[(3.1)(4.5\ FT)(8.5\ FT)^{3/2}$

$= 469$ cfs $+ 2074$ cfs

$= 2543 \approx 2{,}500$ cfs

TOTAL SPILLWAY CAPACITY (TOP OF DAM) = 2,500 cfs

ASEC CORPORATION
CONSULTING ENGINEERS DIV.

496A COMMERCIAL ST., BOSTON, MA 02109
(617) 227-0766

August 14, 1981

Department of the Army
New England Division, Corps of Engineers
424 Trapelo Road
Waltham, MA 02154

ATTN: Mr. E.P. Gould

RE: Inspection of Non-Federal Dams FY '81
Southeastern MA
Contract No.
DACW-33-81-C-0023

Gentlemen:

On December 10, 1980 and subsequent dates, the Forge Pond Dam was visited by ASEC Corporation and its consultants. From information gathered from this visit and subsequent hydraulic-hydrologic investigations we concluded that the dam is a low hazard dam as per your Recommended Guidelines for Safety Inspection of Dams.

We are enclosing a brief report substantiating our findings.

Very truly yours,

John F. Modzelewski P.E.
ASEC Corporation

cc: Vollmer Associates
encl.

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

REPLY TO
ATTENTION OF:

NEDED-E

25 August 1981

Mr. Anthony D. Cortese, Commissioner
Department of Environmental Quality
Engineering
Commonwealth of Massachusetts
100 Cambridge Street
Boston, Massachusetts 02202

Dear Commissioner Cortese:

Inclosed for your use is a copy of the Report on Forge Pond Dam (MA-00806). During the field inspection and the early stages of the preparation of this report, our contractor found that this dam had a "low potential hazard" for downstream damage in the event of a failure. Based on this finding, we directed our contractor to terminate his work and summarize the work accomplished to date. The report inclosed is a copy of this summary.

Sincerely,

JOE B. FRYAR
Chief, Engineering Division

Incl
as stated

CF: Mr. Gould
Eng Div Files 112S

DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

REPLY TO
ATTENTION OF:

NEDED-E

25 August 1981

Plymouth Rubber Co.
104 Revere Street
Canton, MA

Gentlemen:

Inclosed for your use is a copy of the Report on Forge Pond Dam (MA-00806). During the field inspection and the early stages of the preparation of this report, our contractor found that this dam had a "low potential hazard" for downstream damage in the event of a failure. Based on this finding, we directed our contractor to terminate his work and summarize the work accomplished to date. The report inclosed is a copy of this summary.

If you have any questions concerning this report, we suggest you contact the Commonwealth of Massachusetts, Department of Environmental Quality Engineering first; then if there are further questions contact Mr. Gould, Project Management Branch, Engineering Division of this office at (617) 894-2400, extension 313.

Sincerely,

Incl
as stated

JOE B. FRYAR
Chief, Engineering Division

CF: Mr.Gould
Eng Div Files 112S