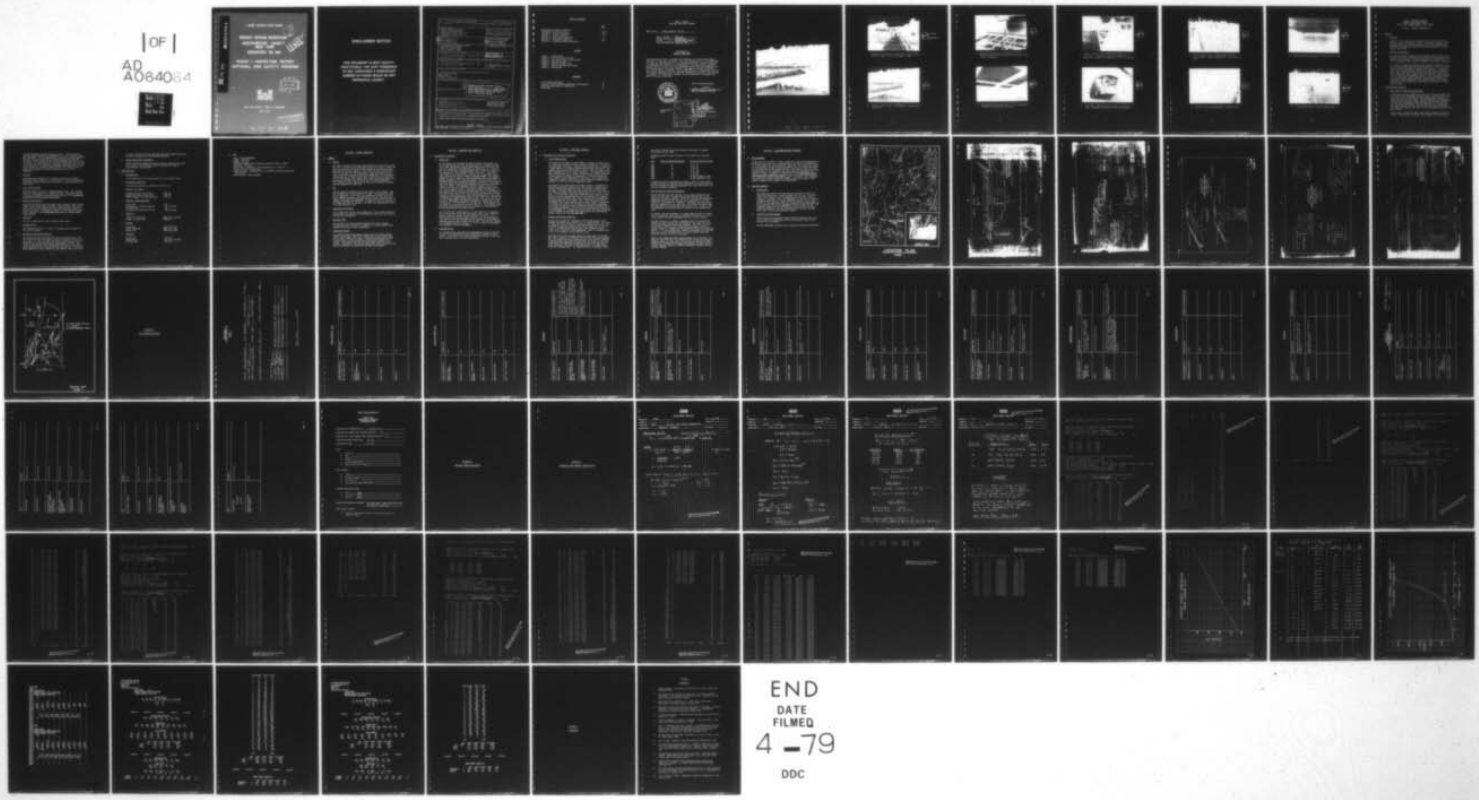
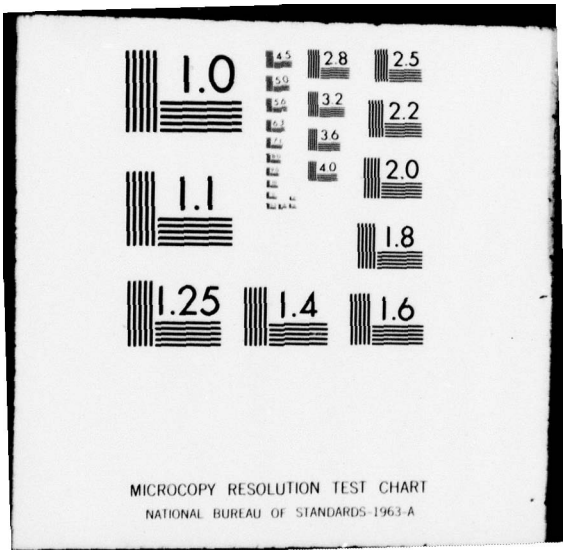
AD-A064 084 NEW YORK STATE DEPT OF ENVIRONMENTAL CONSERVATION ALBANY F/G 13/2
NATIONAL DAM SAFETY PROGRAM. GRASSY SPRAIN RESERVOIR (NY 188), --ETC(U)
JUL 78 J B STETSON DACW51-78-C-0035
UNCLASSIFIED NL



END
DATE FILMED
4 -79
DDC


1.0
1.1
1.25
1.4
1.6
1.8
2.0
2.2
2.5
2.8
3.2
3.6
4.0
4.5
5.0
5.6
6.3
7.1
8.0
9.0
10.0
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

AD A064084

DDC FILE COPY

LOWER HUDSON RIVER BASIN

GRASSY SPRAIN RESERVOIR

WESTCHESTER COUNTY
NEW YORK

INVENTORY Nº 188

LEVEL

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

DDC
RECEIVED
FEB 2 1979
A

NEW YORK DISTRICT CORPS OF ENGINEERS

JULY 1978

DISTRIBUTION STATEMENT A
Approved for public release;
Distribution Unlimited

79 01 31 017

DISCLAIMER NOTICE

THIS DOCUMENT IS BEST QUALITY PRACTICABLE. THE COPY FURNISHED TO DDC CONTAINED A SIGNIFICANT NUMBER OF PAGES WHICH DO NOT REPRODUCE LEGIBLY.

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Phase I Inspection Report Grassy Sprain Reservoir Westchester County, New York Inventory No. N.Y. 188		5. TYPE OF REPORT & PERIOD COVERED Phase I Inspection Report National Dam Safety Program 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) (10) John B. Stetson		8. CONTRACT OR GRANT NUMBER(s) (15) DACW51-78-C-0035
9. PERFORMING ORGANIZATION NAME AND ADDRESS Dale Engineering Company Bankers Trust Building Utica, New York 13501		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS New York State Department of Environmental Conservation / 50 Wolf Road Albany, New York 12233 393 970		(11) 12. REPORT DATE 28 July 1978 13. NUMBER OF PAGES
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) Department of the Army 26 Federal Plaza / New York District, CofE New York, New York 10007		15. SECURITY CLASS. (of this report) UNCLASSIFIED 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; Distribution unlimited.

(12) 74 p.

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

(6) National Dam Safety Program. Grassy Sprain Reservoir (NY 188), Lower Hudson River Basin, Grassy Sprain Brook, Westchester County, New York. Phase I Inspection Report.

18. SUPPLEMENTARY NOTES

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

Dam Safety
National Dam Safety Program
Visual Inspection
Hydrology, Structural Stability

Grassy Sprain Reservoir
Westchester County
Grassy Sprain Brook

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

This report provides information and analysis on the physical condition of the dam as of the report date. Information and analysis are based on visual inspection of the dam by the performing organization.

Grassy Sprain Reservoir Dam was judged to be safe.

393 970

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE

UNCLASSIFIED

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

TABLE OF CONTENTS

	Page
Assessment of General Conditions	i
Photographic Overview of Dam	ii-vii
Section 1 - Project Information	1-4
Section 2 - Visual Inspection	5
Section 3 - Hydrology & Hydraulics	6
Section 4 - Structural Stability	7-8
Section 5 - Assessment/Remedial Measures	9

FIGURES

Figure 1 - Location Map
Figure 2 - Plan and Profile of Dam
Figure 3 - Plan and Section of Dam Outlets
Figure 4 - Sections of Dam
Figure 5 - Details and Core Wall
Figure 6 - Plan of Spillway and Bridge
Figure 7 - Geology Map

APPENDIX

Field Inspection Report	A
Previous Inspection Reports/Relevent Correspondence	B
Hydrologic and Hydraulic Computation	C
References	D

PHASE I REPORT
NATIONAL DAM SAFETY PROGRAM

Name of Dam Grassy Sprain - NY 133

State Located New York
County Located Westchester
Stream Grassy Sprain Brook
Date of Inspection June 23, 1978

ASSESSMENT OF GENERAL CONDITIONS

The Grassy Sprain dam, an earthen dam structure, is a backup water supply reservoir for the City of Yonkers. The earth embankment is so overgrown that it cannot be concluded that it is not unsafe for normal reservoir operation. The embankment was difficult to evaluate due to the heavy brush and undergrowth. The city should clear the embankment area so that the embankment can be inspected again in the near future. Subsequent to another inspection, this report should be amended. The existing spillway is adequate to pass the 1/2 Probable Maximum Flood, provided the flashboard structure on the spillway is removed. The flashboard structure is also vulnerable to clogging from debris during a flood event.

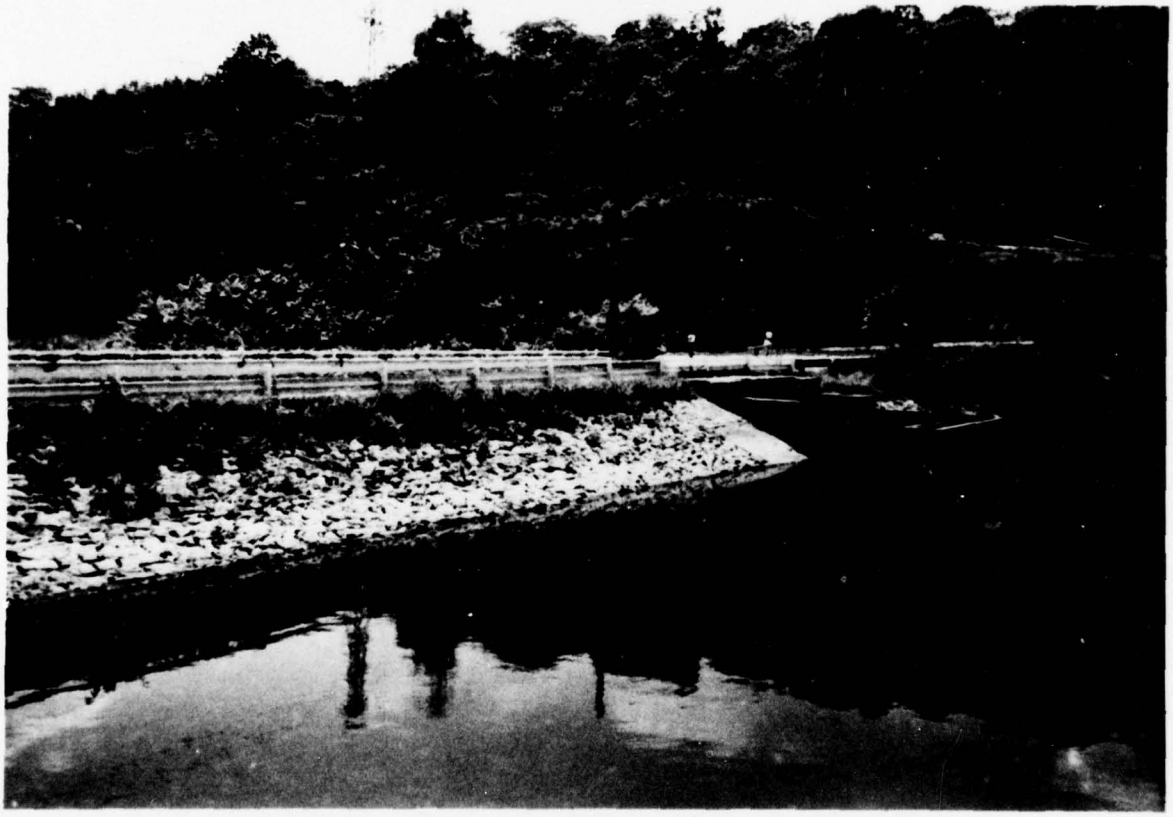
Dale Engineering Company

John B. Stetson, President

STATE OF NEW YORK
DALE ENGINEERING COMPANY, INCORPORATED
NO. 076
LICENSED PROFESSIONAL ENGINEER

ACCESSION for
NTIS White Section
DDC Buff Section
UNANNOUNCED
JUSTIFICATION
BY
DISTRIBUTION/AVAILABILITY CODES
Dist. AVAIL. and/or SPECIAL
A 23

Approved By: Col. Clark H. Benn
Date: New York District Engineer
28 July 78

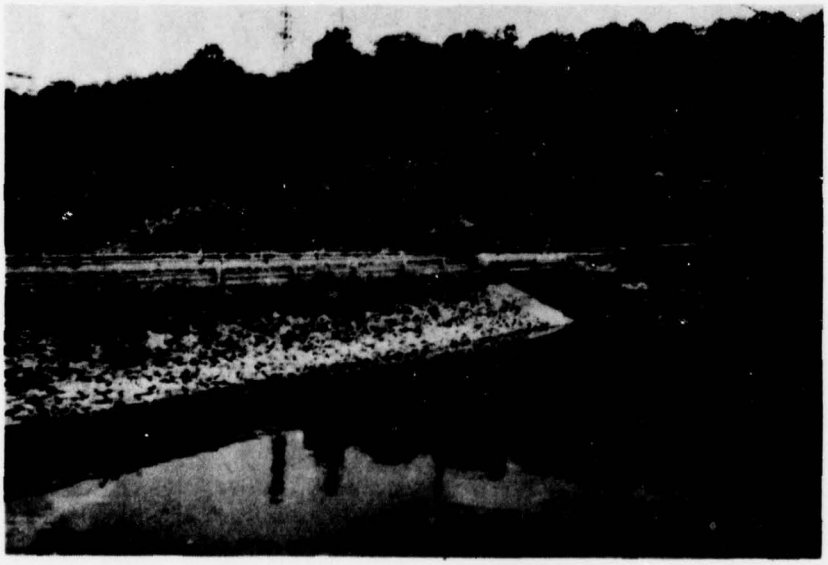


79 01 31 017



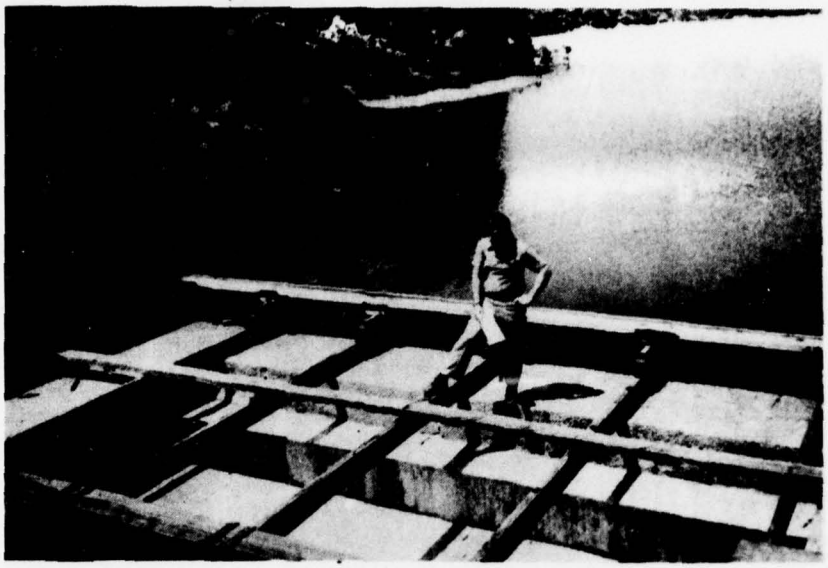


1. View of east side of embankment and riprap. Picture taken from gate house bridge.



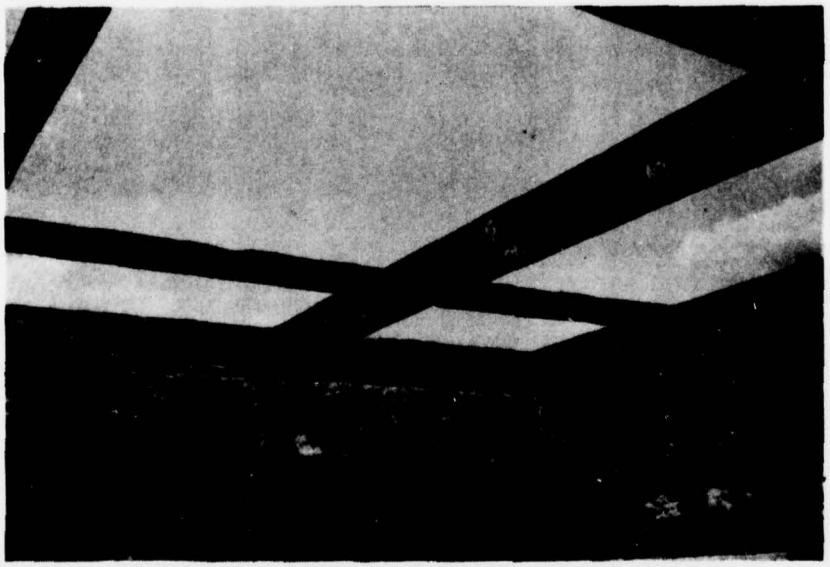


2. View of west side of embankment, riprap and spillway.



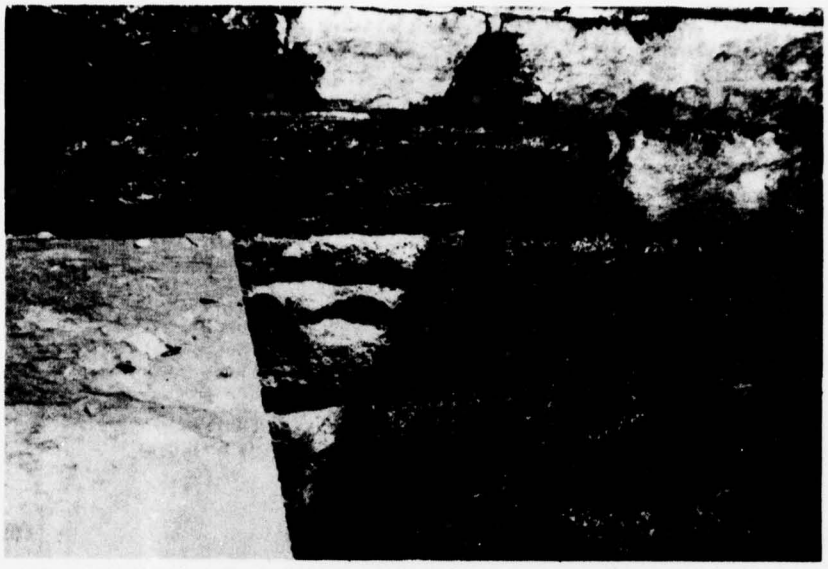


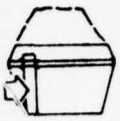
3. Spillway constructed of masonry with a wooden-framed cap structure to provide additional storage.



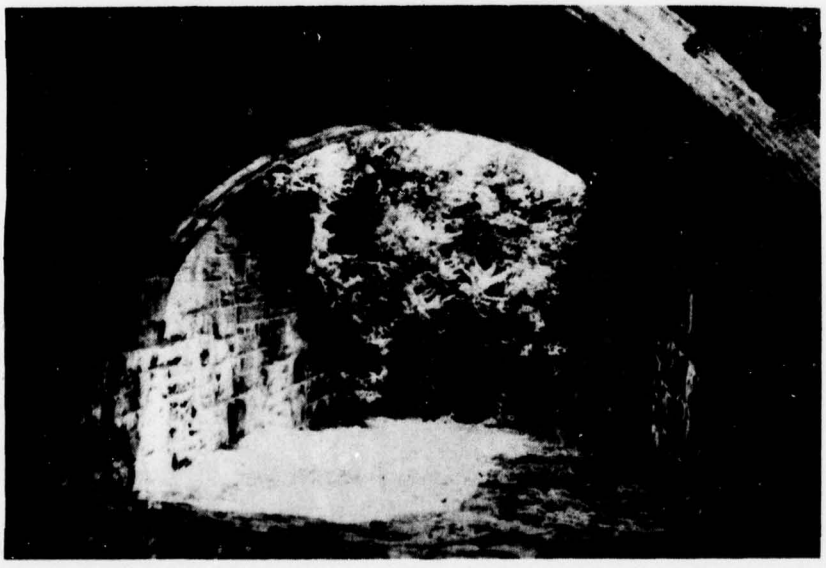


4. Looking north up spillway. Notice general condition of masonry is good.



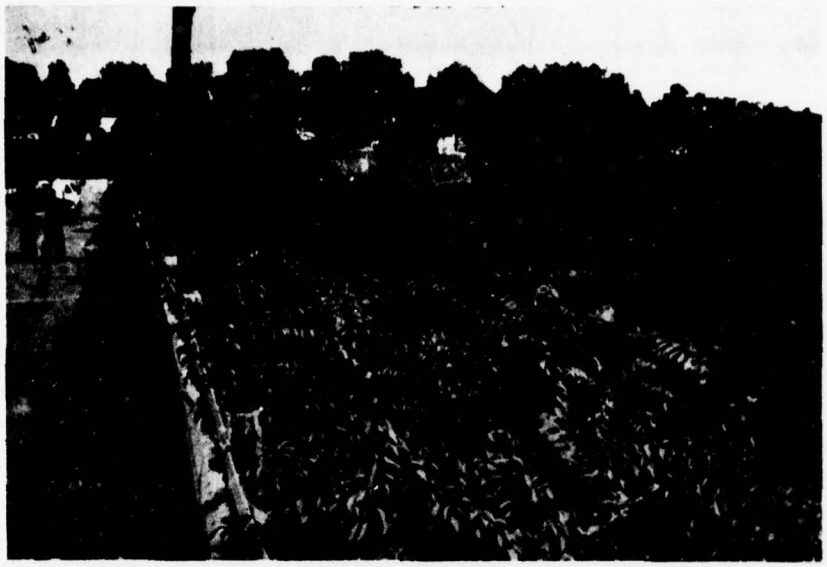


5. Detail of wall area along east face of spillway. Wetness is noted along wall, but there is no sign of movement or deterioration.





6. Spillway channel section under road atop of dam. General condition of arch is good.



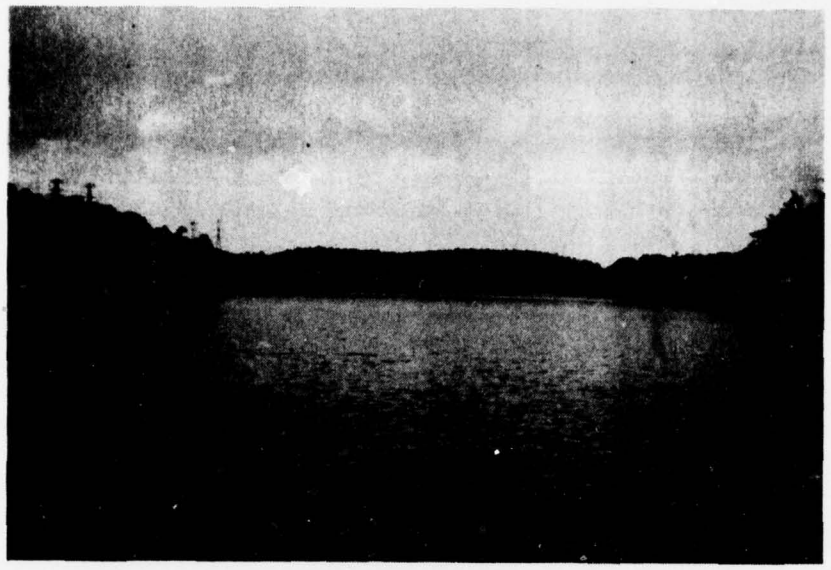


7. View looking east of embankment on downstream face. Heavy vegetation covers entire area.



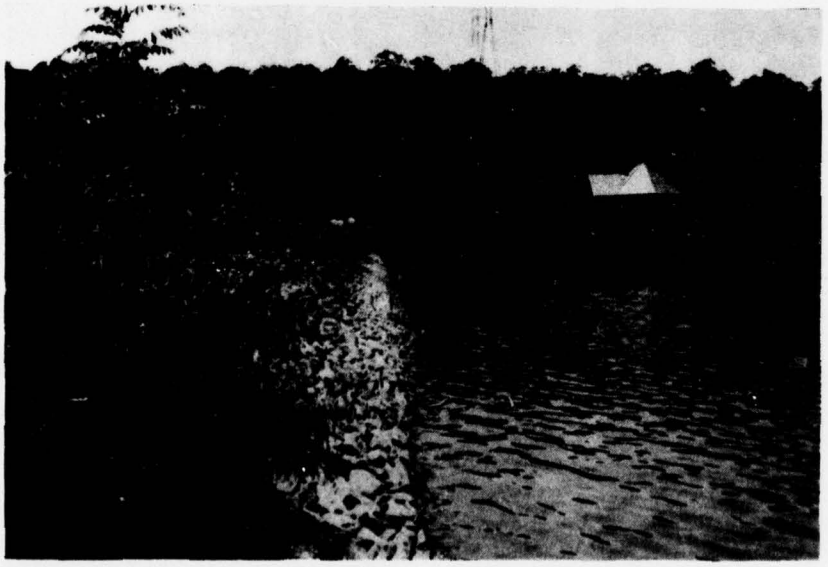


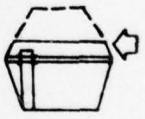
8. Another view of embankment looking west.





9. Upstream view of reservoir from top of dam.





10. View across face of dam looking west.

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
NAME OF DAM - GRASSY SPRAIN ID# - NY195

SECTION 1 - PROJECT INFORMATION

1.1 General

a. Authority

Authority for this report is provided by the National Dam Inspection Act, Public Law 92-367 of 1972. It has been prepared in accordance with a contract for professional services between Dale Engineering Company and The New York State Department of Environmental Conservation.

b. Purpose of Inspection

The purpose of this inspection is to evaluate the structural and hydraulic condition of the Grassy Sprain Dam and appurtenant structures, and to determine if the dam constitutes a hazard to human life or property and to transmit findings to the State of New York.

This Phase I inspection report does not relieve an Owner or Operator of a dam of the legal duties, obligations or liabilities associated with the ownership or operation of the dam. In addition, due to the limited scope of services for these Phase I investigations, the investigators had to rely upon the data furnished to them. Therefore, this investigation is limited to visual inspection and evaluations therefrom, review of data prepared by others, and simplified hydrologic, hydraulic and structural stability evaluations where appropriate. The investigators do not assume responsibility for defects or deficiencies in the dam or in the data provided.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances

A bituminous surface roadway along the top of the dam connects the east and the west abutments and also connects the north bound and south bound lanes of the Sprain Brook Parkway which bonders the reservoirs east and west sides. The west abutment of the dam has a masonry core wall which extends 180 feet from the west abutment into the earth embankment. The east abutment has a masonry core wall which extends 150 feet into the dam from the east abutment. The downstream slope of the dam is heavily overgrown with brush and small trees.

The spillway, located 125 feet from the west abutment and 20 feet wide, is constructed of masonry. The spillway arch and masonry

channel penetrates through the dam structure. The masonry and spillway channel through the embankment is 12 feet below the normal pool elevation. The spillway channel discharges to approximately a two foot high masonry walled flow channel downstream from the structure. The spillway structure and downstream receiving channel is generally in good condition. The dam is equipped with a 48 inch drain pipe which is controlled through the gate house that is used as the intake for the water supply system. The overflow pipe is supported on wooden piles near the downstream toe of the embankment.

b. Location

The Grassy Sprain Reservoir is located in the City of Yonkers, Weschester County, New York. The structure is built across Grassy Sprain Brook approximately two miles from its confluence with the Bronx River.

c. Size Classification

Maximum height of the dam is approximately 25 feet. The storage capacity in the reservoir is 2,956 acre feet. Therefore, the dam is in the intermediate size category as defined by the Recommended Guidelines for Saftey Inspection of Dams.

d. Hazard Classification

Grassy Sprain Brook below the Grassy Sprain Reservoir Dam flows adjacent to the Grassy Sprain Parkway, a major highway route in the area. The receiving stream also runs through heavily developed residential areas. Therefore, the dam is in the high hazard category as defined by the Recommended Guidelines for Safety Inspections of Dams.

e. Ownership

The dam is owned by the City of Yonkers water supply.

f. Purpose of Dam

The impounded reservoir is used as a standby source of water for the City of Yonkers.

g. Design and Construction History

The original Grassy Sprain Reservoir Dam was constructed in 1875 and 1876 by the City of Yonkers as with its principal use as a water supply. In 1915 and 1916, the dam was reconstructed and the height of the dam was increased by approximately 12 feet. The plans for the reconstruction of the dam indicate that the dam is a earth embankment with a clay puddle core (see Ref. No. 1 for background discussion) that connects to the puddled core of the origi-

nal dam. No other data has been made available regarding the construction procedures for the reconstructed dam.

h. Normal Operational Procedures

Normal operation procedures include routinely checking drain control valves in the gate house and to allow excess flows to discharge over the spillway.

1.3 PERTINENT DATA

a. Drainage Area

The drainage area of the Grassy Sprain is 1.91 square miles.

b. Discharge at Dam Site

No discharge records are available for this site.

Computed discharges:

Ungated spillway, top of dam	1430 cfs
Ungated spillway, design flood	1025 cfs
Gated drawdown, 48 inch pipe (max.)	440 cfs

c. Elevation (feet above MSL)

Top of dam	130
Maximum pool - design discharge	129 (1/2 PMF)
Spillway Crest	125
Stream bed at centerline of dam	105 estimated

d. Reservoir

Length of maximum pool	9800 feet (1/2 PMF)
Length of normal pool	9800 feet

e. Storage

Top of dam	3550 acres feet
Design surcharge	3500 acres feet
Normal pool	2960 acres feet

f. Reservoir

Top of dam	150 acre
Maximum pool	150 acre (1/2 PMF)
Spillway pool	148 acre

g. Dam

Type - Earth embankment.
Length - 600 feet.
Height - 25 feet.
Freeboard between normal reservoir and top of dam - 4 feet.
Top width - 30 feet.
Side Slopes - Estimate at 2-1/2 horizontal to 1 vertical.
Zoning - Earth fill with core.
Impervious core - Combination of clay puddles concrete and masonry (see plans).
Grout Curtain - None recorded.

SECTION 2 - VISUAL INSPECTION

2.1 SUMMARY

a. General

The visual inspection of Grassy Sprain Reservoir took place on June 23, 1978. The dam has not been modified over the years. Since the dams construction, the Sprain Brook Parkway has been constructed atop the side of the reservoir. The reservoir pool and dam are located in the median of the expressway. Some modification to the east side of the reservoir bank was performed with the placement of riprap material to stabilize the bank. Below the dam on the east side of the highway, the Parkway storm sewer system discharges into the natural overbank area below the toe of the dam embankment. This highway drainage appears to be the cause of wetness and heavy wetland vegetation in that area.

b. Dam

The dam visually conforms to the plans shown in this report. The dam alignment and riprap condition is good. The downstream slope of the embankment is difficult to traverse and inspect due to the heavy vegetative growth. The downstream face was traversed once across midway down the embankment and once across below the toe. No seepage or movement was observed. A number of trees are growing in the downstream face of the dam. The top of the dam contains a service road and guard rail.

c. Appurtenant Structures

The spillway and service road bridge were in fairly good condition. Some wetness was observed in the masonry spillway wall and step but no flow was discernible.

d. Reservoir Area

The reservoir area was traversed along Sprain Brook Parkway. Though some minor siltation is suspected, no accumulations were observed during the visual inspections.

e. Downstream Channel

The immediate downstream channel flows along the parkway median. Further downstream, additional tributaries join the stream along with a major highway storm sewer. Below the confluence of these drainage areas, a large residential neighborhood adjoins the stream. Open channel concrete structures were observed in the section. Reportedly, the area has been under study recently by the Corps of Engineers for additional drainage improvements.

SECTION 3 - HYDROLOGY AND HYDRAULICS

3.1 EVALUATION OF FEATURES

a. Design Data

No information was obtained relevant to design of the dam. For this investigation, the dam was evaluated for a Probable Maximum Flood (PMF) hydrograph using Probable Maximum Precipitation rainfall data obtained in Hydrometerlogical Report No. 51. Both the PMF and 1/2 PMF were evaluated whereas the 1/2 PMF was assumed to be approximately the Standard Project Flood (SPF). This was a requirement in utilizing the U.S. Army Corps of Engineers Hydrologic Engineering Center's Computer Program UHCOMP. The program UHCOMP was used to develop a unit hydrograph computed by Snyder's Method parameters and a flood hydrograph. The U.S. Army Corps of Engineers Hydrologic Engineering Center's Program HEC-1 was used to route the flood through the dam emergency spillway using the Modified Puls Method. The drawdown pipe was assumed not to be in operation during the flood crest since it requires manual operation and is capable of only a negligible amount of discharge. It was assumed that the masonry spillway crest was on the threshold of spilling at the start of the flood routing and there was no flood storage available below the top of spillway elevation. Peak flow discharges were approximately 2500 cfs and 1000 cfs for the PMF and 1/2 PMF events routed through the spillway. The relatively large reservoir impoundment area above the dam face reduced the 1/2 PMF discharge by a 1/3 from 1500 cfs to 1000 cfs. The estimated spillway capacity is estimated to be only 1400 cfs. The computed stage-discharge relationship on page C-21 indicates the dam threatens being overtopped by less than one foot.

The overflow weir configuration is in the shape of an inverted U. The 20 foot width of the weir was added to the 10 foot effective depth to yield an overall effective width of 40 feet. It is believed that the effective weir width will not be significantly less than 40 feet and subsequently the spillway (with flashboard removed) would be able to carry the 1/2 PMF. The analysis assumed the flashboard would be removed. If left in place, the dam would be endangered of being overtopped.

b. Experience Data

No information was obtained from knowledgeable people at the site relevent to performance of the spillway during extreme rainfall events - only that in the spring of each year the dam is spilling but, routinely, that it is not significant.

SECTION 4 - STRUCTURAL STABILITY

4.1 Evaluation of Structural Stability

a. Visual Observations

The reservoir dam shows no misalignment, sloughing surface cracks or erosion which would indicate structural movement or distress of the embankment structure. Riprap on the upstream face is generally in good condition, although some pieces have been displaced. Riprapped slopes forming the reservoir sides in the area close to the dam's embankments are in similar condition. The downstream slope and area below the toe of slope is covered with a dense growth of various types and heights of vegetation, a condition which seriously hampers close examination of the slope. The accomplished inspection, however, indicates no sign of seepage through the embankment or below the toe of downstream slope.

The masonry (cut stone block) spillway structure is generally in good and serviceable condition but some reservoir seepage occurs through deteriorated masonry joints in the weir section of the spillway. Spillway water also seeps below the cut stone floor of the spillway channel, entering through open joints in this stone work. No significant stone work deterioration or erosion of supporting soil was observed because of this seepage flow, however. Dense foliage interfered with close inspection of the downstream discharge opening of the outlet pipe. Storm drainage from the northbound lane of the adjacent Sprain Brook Parkway is delivered via underground conduit for discharge on the parkway embankment slope close to where the dam's downstream easterly abutment meets the parkway embankment. Pooling of this discharge has resulted in the development of a swampy area some distance below the downstream toe of the dam but the condition apparently is not creating any harmful effects for the dam embankment.

b. Geology and Seismic Stability

Grassy Sprain Reservoir inundated a valley whose bedrock floor beneath the glacial and alluvial fill is Inwood Marble. The valley is along the eastern limb of a northward plunging anticline. As indicated on the cross section (Fig. 2) the west wall of the reservoir is Fordham Gneiss and the east wall, Manhattan Schist. Trend of the foliation of the metamorphic rocks is northeast with dips to the southeast in the reservoir area.

Bryn Mawr fault may be present about 0.7 miles south of the dam. This fault, which is not shown on the 1971 New York State Geologic Map, was encountered during construction of the Catskill aqueduct. A decaying shear zone about 50 feet thick was found at that time. Based upon the topography and geology the fault has been tentatively located in the area of the intersection of Grassy Sprain Road with Tuckahoe Road. Its probable trend is northwest, along

the valley from New York State Thruway Interchange 6 southeast along Grassy Sprain Brook.

Earthquakes known to have occurred in this region are tabulated below.

Date	Intensity-Modified Mercalli	Location Relative to Dam
1872	IV	4 mi. SE
1874	V	4 mi. SE
1916	IV	4 mi. NE
1926	V	5 mi. SW
1933	III	4 mi. NE
1938	III	9 mi. NE
1947	V	15 ENE Greenwich, Conn.
1950	IV	15 ENE Greenwich, Conn.

Although the area is designated as being in Zone 1 of the Seismic Probability Map, the New York State Geological Survey believes this area of Westchester should be upgraded to at least Zone 2 with possibility of Zone 3 potential.

c. Data Review and Stability Evaluation

Design drawings show that the dam at its present dimensions consists of a core wall of masonry at the end sections and a clay puddle for the center section. Earth fill upstream and downstream embankments adjoining the core wall are constructed to provide slopes of 2 horizontal on 1 vertical. Procedures for soil placement and compaction are not detailed. The design information does indicate the dam structure bears directly on rock. Visually, the dam embankment and related structure conform to the design drawings.

At present, the dam structure is in good condition with no indication of structural instability, significant deterioration, or ongoing seepage from past earthquake activity or other factors.

The dam's design is in general accordance with the construction professions past practice for structures of this type, and satisfactory performance typically has resulted. This site is in an area having a seismic Zone 1 designation (although a change in rating to Zone 2 is suggested) and convention assumes no earthquake hazard. It is anticipated that, properly maintained, this dam will continue to serve satisfactorily for future loading conditions which are similar to those of the past.

However, the downstream slope urgently needs to be cleared of the heavy foliage which could be responsible for permitting seepage to commence (roots of large trees), for hiding the presence of deep animal holes through which seepage could begin, and which tends to provide a general masking of possible embankment movement and developing seepage.

SECTION 5 - ASSESSMENT/REMEDIAL MEASURES

5.1 DAM ASSESSMENT

On the basis of the Phase I visual examination, the earth embankmment of the Grassy Sprain Dam is so overgrown that it cannot be concluded that it is not unsafe for normal reservoir operation. The heavy brush growth on the downstream slope of the dam obstructs and has limited the extent of the inspection of the downstream face. The reservoir has only been traversed once on the embankment and once below the embankment toe. The ungated spillway is adequate, as determined by the Recommended Guidelines for Safety Inspection of Dams, to pass the design storm provided the flashboard structure has been removed. In addition, the flashboard structure could become clogged with debris which could lodge in the wooden framework which supports the flashboards.

5.2 REMEDIAL MEASURES

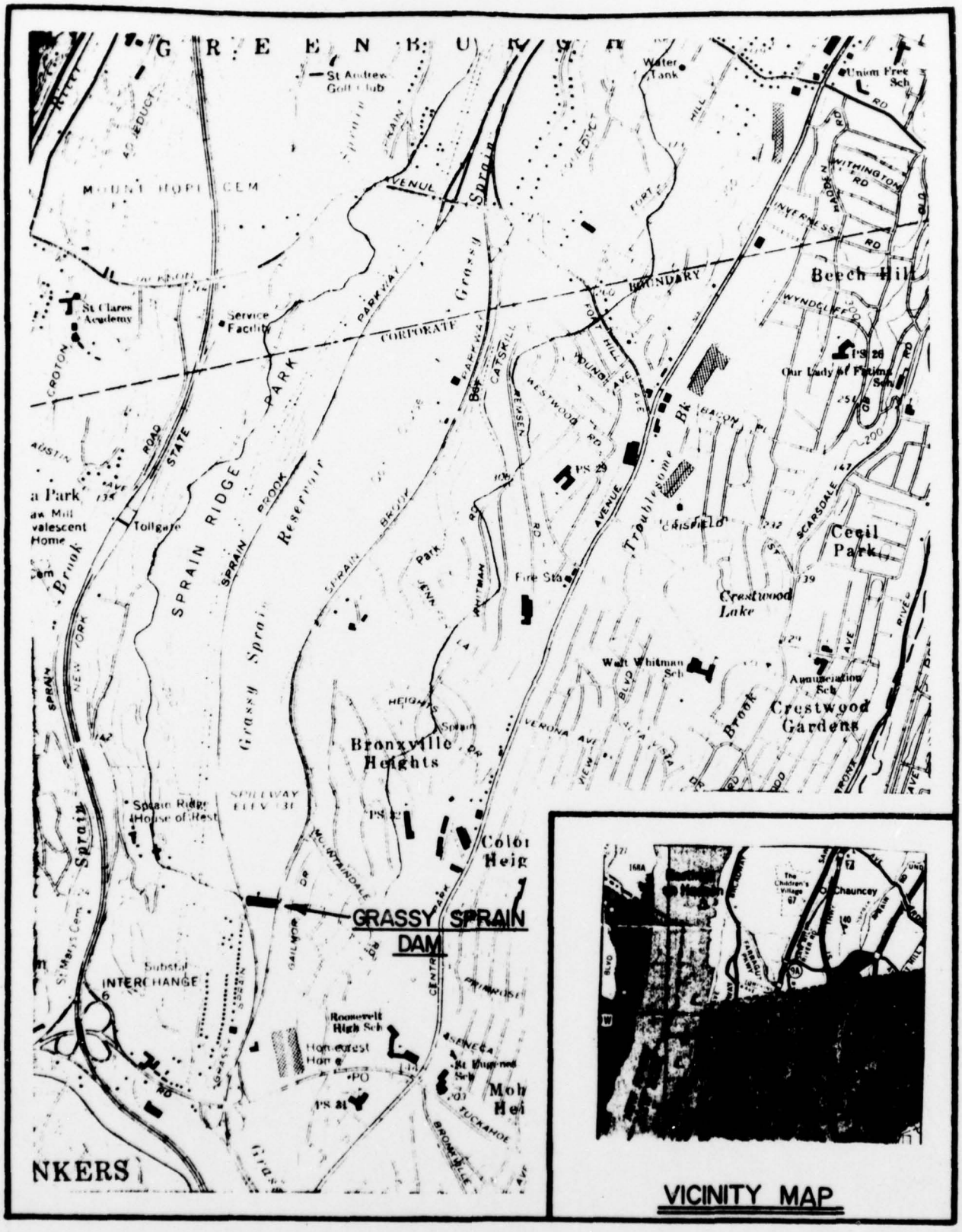
a. Alternatives

The downstream slope of the dam should be cleared of brush and trees and planted with a cover suitable for this use. This will allow close inspection of the downstream face for any signs of seepage or slouging. After the embankment is cleared, it should be inspected again and this report should be amended. Only a small portion of the downstream could be inspected and the embankment was only traversed once on the embankment and once below the toe. The framework supporting the flashboards on the principal spillway should be removed to preclude blockage of the spillway by waterborne debris during high periods of runoff.

b. Operation and Maintenance

Normal operation procedures include routinely checking drain control valves in the gate house and to allow excess flows to discharge over the spillway.

The dam embankment should be cut, cleared and routinely maintained.



LOCATION PLAN

FIGURE 1

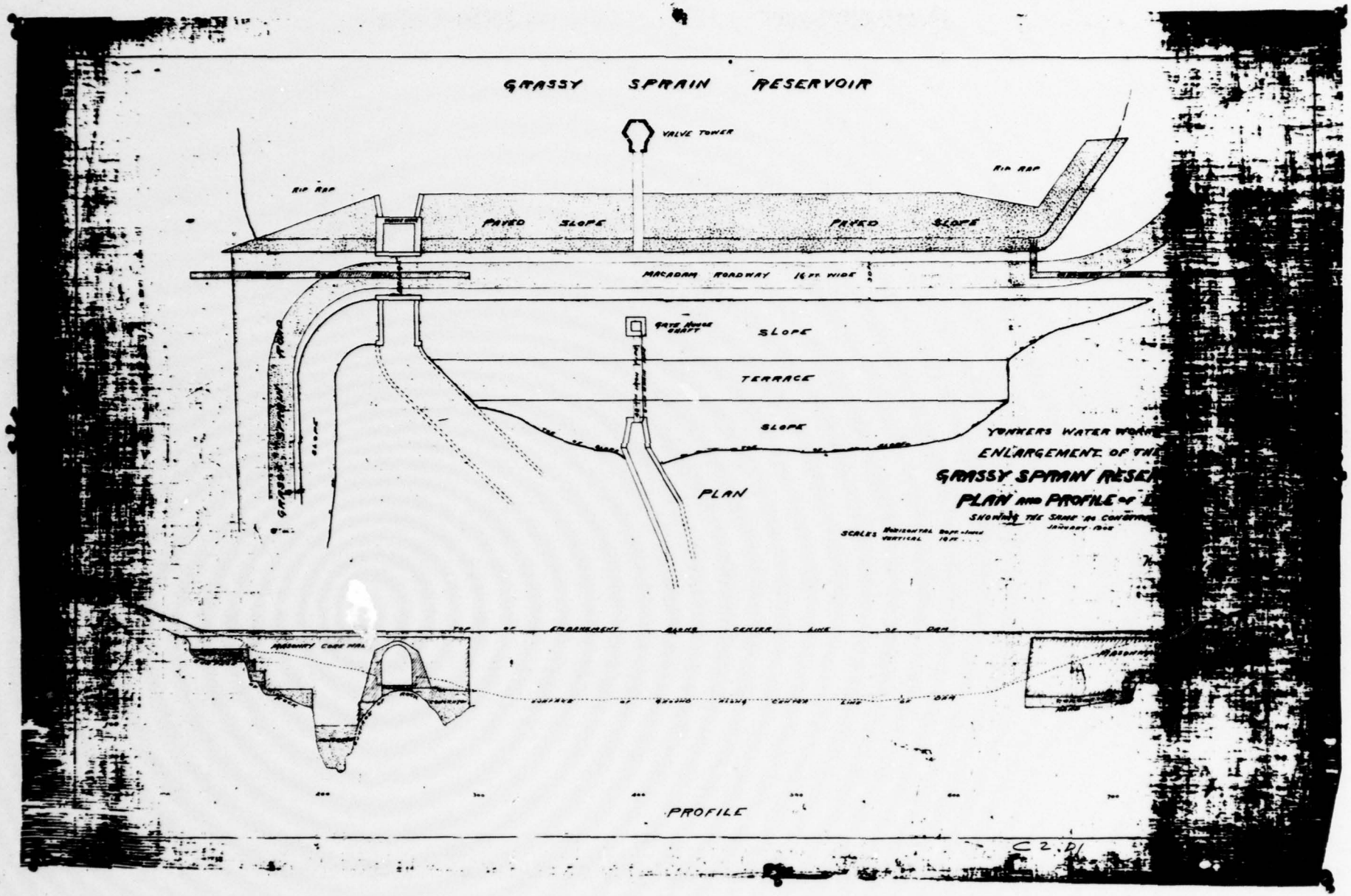

GRASSY SPRAIN RESERVOIR
VALVE TOWER
RIP RAP
RIP RAP
PAVED SLOPE
PAVED SLOPE
MACADAM ROADWAY 16 FT. WIDE
GATE HOUSE
SHAFT
SLOPE
TERRACE
SLOPE
PLAN
YONKERS WATER WORK
ENLARGEMENT OF TH
GRASSY SPRAIN RESE
PLAN AND PROFILE OF
SHOWING THE SAME AS CONSTR
JANUARY 1908
SCALES HORIZONTAL
VERTICAL
TOP OF EMBANKMENT ALONG CENTER LINE OF DAM
PROFILE
C 2.01

FIGURE 2

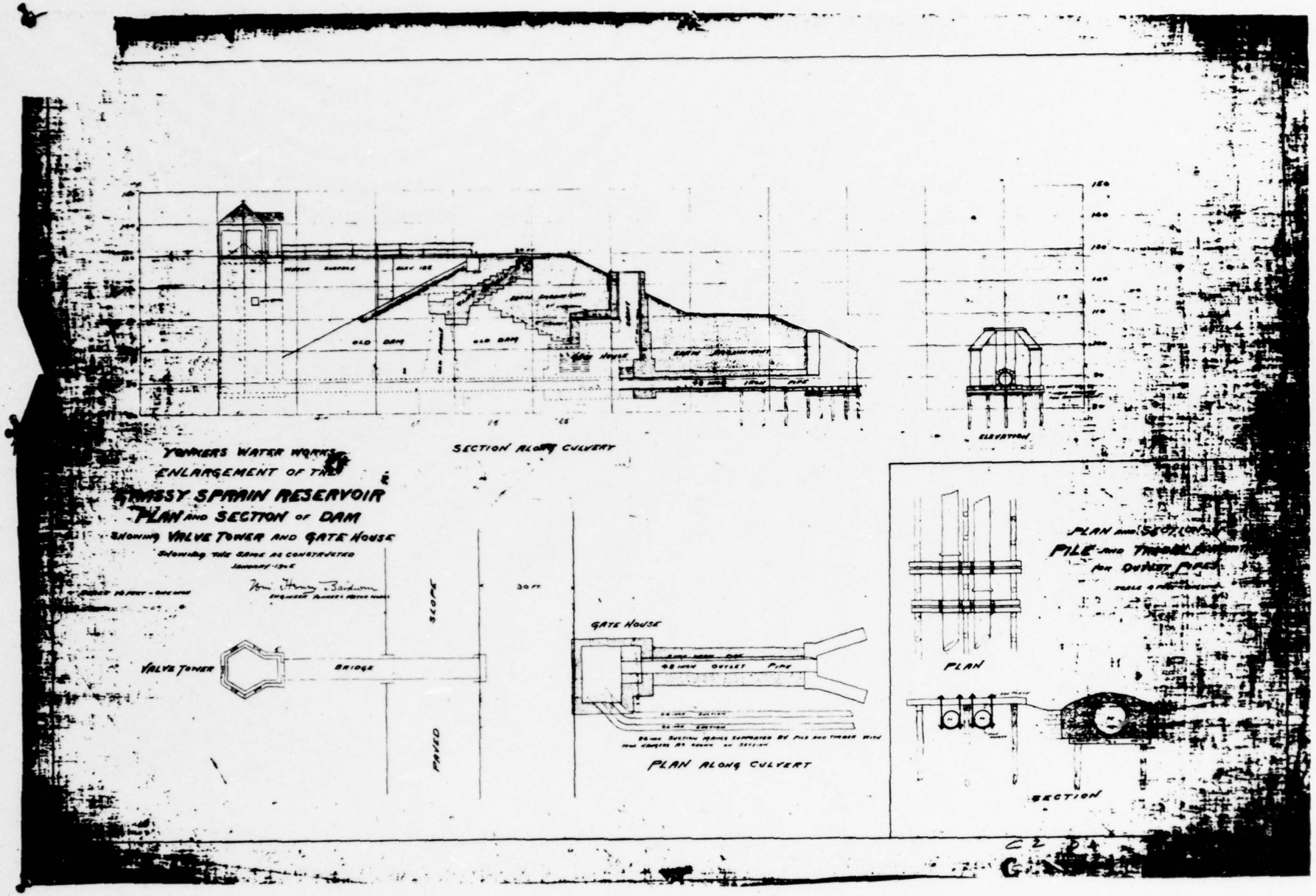

YONKERS WATER WORKS
ENLARGEMENT OF THE
CROTON SPRAIN RESERVOIR
PLAN AND SECTION OF DAM
SHOWING VALVE TOWER AND GATE HOUSE
SECTION ALONG CULVERT
ELEVATION
SLOPE
PAVED
VALVE TOWER
BRIDGE
GATE HOUSE
PLAN ALONG CULVERT
PLAN
SECTION

FIGURE 3

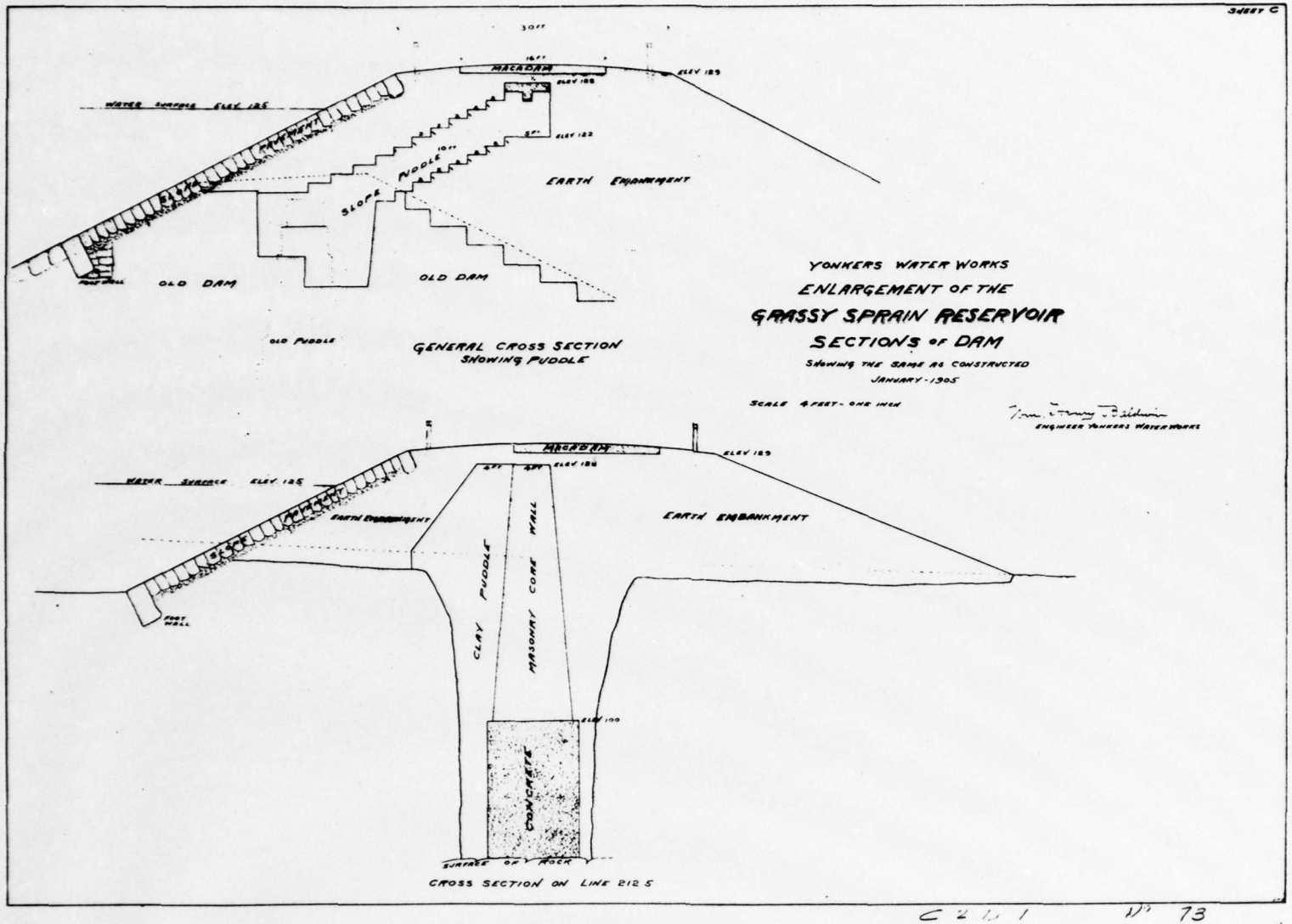

SHEET C
MACADAM
ELEV 129
WATER SURFACE ELEV 125
EARTH EMBANKMENT
SLOPE
PUDDLE
ELEV 122
OLD DAM
OLD DAM
OLD PUDDLE
GENERAL CROSS SECTION
SHOWING PUDDLE
YONKERS WATER WORKS
ENLARGEMENT OF THE
GRASSY SPRAIN RESERVOIR
SECTIONS OF DAM
SHOWING THE SAME AS CONSTRUCTED
JANUARY - 1905
SCALE 4 FEET - ONE INCH
ENGINEER YONKERS WATER WORKS
MACADAM
ELEV 129
ELEV 126
WATER SURFACE ELEV 125
EARTH EMBANKMENT
CLAY PUDDLE
MASONRY CORE WALL
ELEV 100
CONCRETE
SURFACE OF ROCK
CROSS SECTION ON LINE 212.5

FIGURE 4

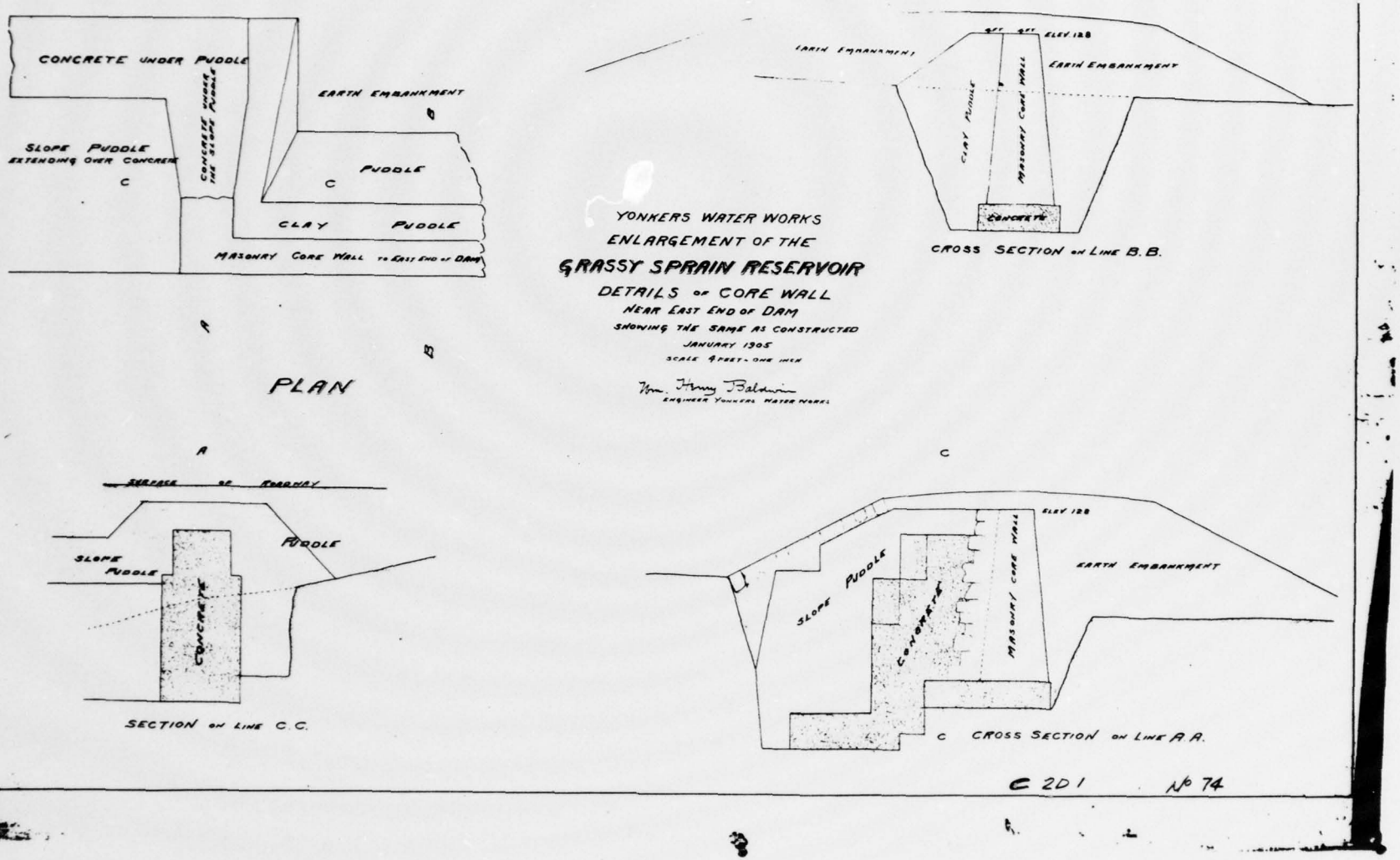

SHEET D
CONCRETE UNDER PUDDLE
EARTH EMBANKMENT
SLOPE PUDDLE EXTENDING OVER CONCRETE
CONCRETE UNDER PUDDLE
PUDDLE
CLAY
PUDDLE
MASONRY CORE WALL to EAST END of DAM
PLAN
YONKERS WATER WORKS
ENLARGEMENT OF THE
GRASSY SPRAIN RESERVOIR
DETAILS of CORE WALL
NEAR EAST END of DAM
SHOWING THE SAME AS CONSTRUCTED
JANUARY 1905
SCALE 4 FEET - ONE INCH
Wm. Henry Baldwin
ENGINEER YONKERS WATER WORKS
EARTH EMBANKMENT
ELEV 128
EARTH EMBANKMENT
CLAY PUDDLE
MASONRY CORE WALL
CONCRETE
CROSS SECTION on LINE B.B.
SURFACE of ROADWAY
SLOPE PUDDLE
PUDDLE
CONCRETE
SECTION on LINE C.C.
ELEV 128
EARTH EMBANKMENT
SLOPE PUDDLE
CONCRETE
MASONRY CORE WALL
CROSS SECTION on LINE A.A.
C 201
No 74

FIGURE 5

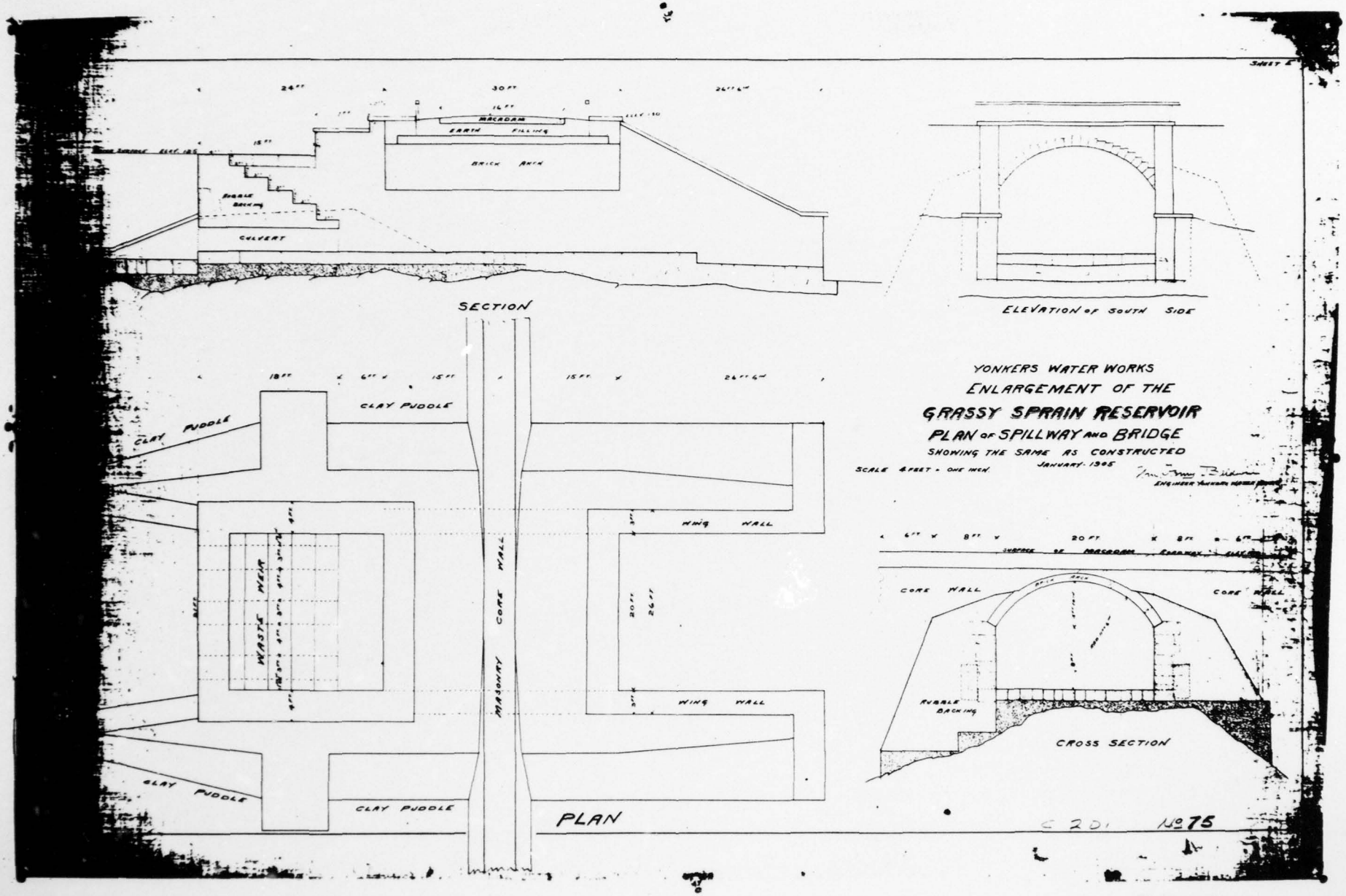
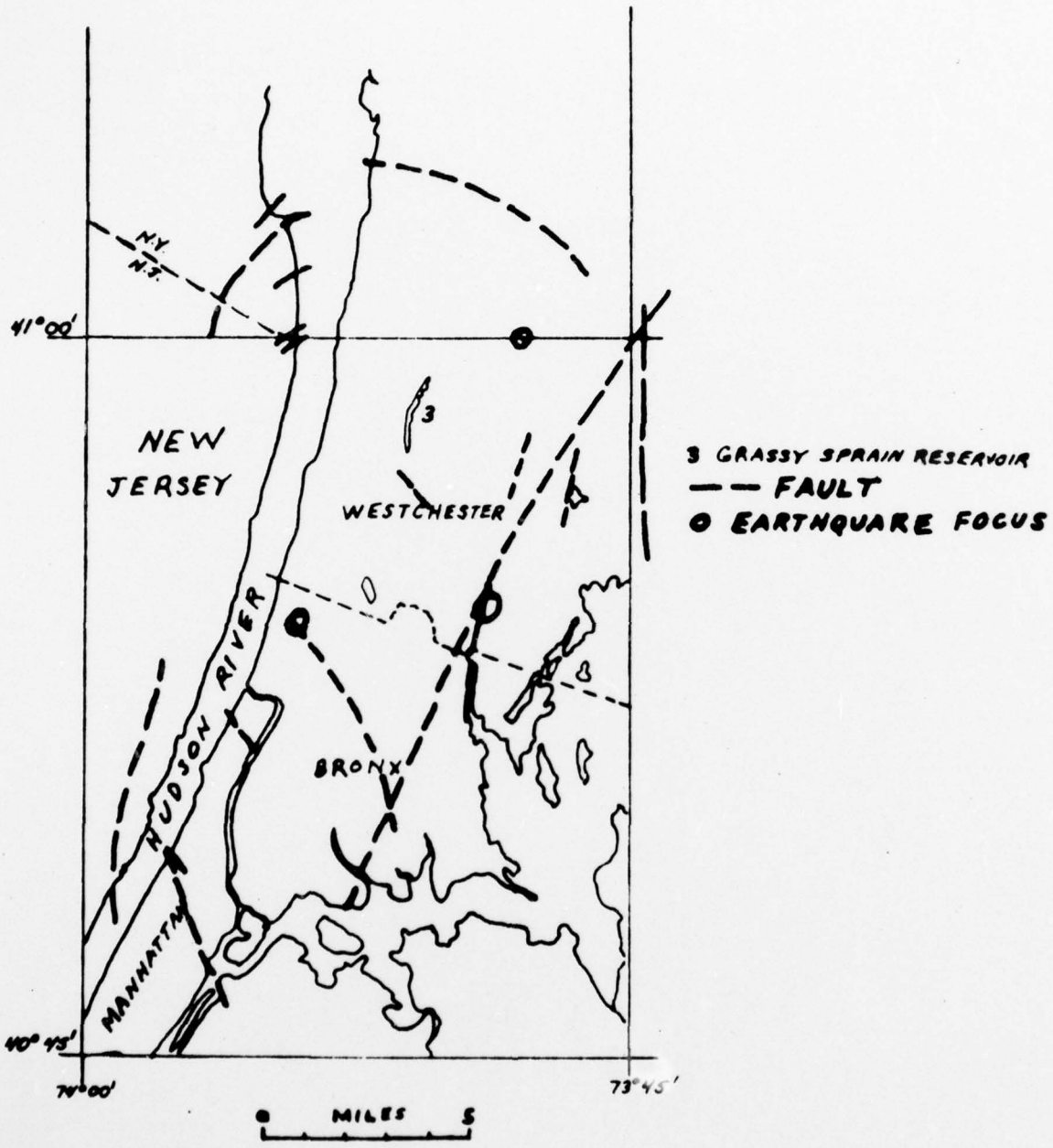

SHEET 2
24 FT
30 FT
26 FT 6 IN
16 FT
MACADAM
EARTH FILLING
BRICK ARCH
RUBBLE BACKING
CULVERT
SECTION
ELEVATION of SOUTH SIDE
YONKERS WATER WORKS
ENLARGEMENT OF THE
GRASSY SPRAIN RESERVOIR
PLAN of SPILLWAY and BRIDGE
SHOWING THE SAME AS CONSTRUCTED
SCALE 4 FEET = ONE INCH
JANUARY 1905
ENGINEER YONKERS WATER WORKS
18 FT
6 FT
15 FT
CLAY PUDDLE
WASTE WEIR
MASONRY CORE WALL
WING WALL
20 FT
24 FT
PLAN
8 FT
6 IN
CORE WALL
RUBBLE BACKING
CROSS SECTION
C 201
No 75

FIGURE 6



GEOLOGIC MAP
FIGURE 7

APPENDIX A

FIELD INSPECTION REPORT

CHECK LIST
VISUAL INSPECTION

PHASE 1

Name Dam Grassy Sprain Reservoir County Westchester State New York ID # 195

Type of Dam Earthen Hazard Category 1

Date(s) Inspection June 23, 1978 Weather Clear Temperature 75-80°

Pool Elevation at Time of Inspection 125 ± M.S.L. Tailwater at Time of Inspection None

Inspection Personnel:

N. F. Dunlevy - Dale Engineering Company	James Neery, City of Yonkers, Water Works Supt.	
F. W. Byszewski - Dale Engineering Company	John Hanrahan, City of Yonkers, Senior Engineer	
Dave McCarthy - Dale Engineering Company	Richard Aglietti, City of Yonkers, Deputy City Engineer	

Neal F. Dunlevy Recorder

CONCRETE/MASONRY DAMS

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

CONCRETE/MASONRY DAMS

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

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SURFACE CRACKS	None observed.	Old highway over top of dam. Road now serves only as service road. Upstream face riprap. Downstream face with heavy vegative growth. Extremely difficult to inspect.
UNUSUAL MOVEMENT OR CRACKING AT OR BEYOND THE TOE	None observed.	Below toe overbank areas swampy due to drainage from cxpressway which traverse longitudely Grassy Sprain of both sides. Toe area difficult to inspect due to vegatation.
SLOUGHING OR EROSION OF EMBANKMENT AND ABUTMENT SLOPES	None observed.	Embankment was traversed through heavy vegatation. Only a portion of the entire face was inspected.
VERTICAL AND HORIZONTAL ALINEMENT OF THE CREST	Good condition.	
RIPRAP FAILURES	Minor disarrangement. Generally in good condition.	

EMBANKMENT

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
VEGETATIVE GROWTH ON EMBANKMENT	Heavily overgrown including some trees.	Trees should be removed and embankment cut for inspection observations.
JUNCTION OF EMBANKMENT AND ABUTMENT, SPILLWAY AND DAM	Abutments interfere with limited access, high grade slopes. No appearance of any problems.	
ANY NOTICEABLE SEEPAGE	None observed.	
STAFF GAGE AND RECORDER	None.	
DRAINS	None observed.	

UNGATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE WEIR WOOD FRAME WEIR SET ON MASONRY SPILLWAY	Good condition. No debris.	Needs to be inspected periodically for accumulation of debris. Specifically after storms.
APPROACH CHANNEL	Reservoir face.	
DISCHARGE CHANNEL	Lined with large masonry elements. Good condition.	
BRIDGE AND PIERS	Brick faced. Arch bridge in good condition.	Should be inspected periodically.

GATED SPILLWAY

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONCRETE SILL	None.	
APPROACH CHANNEL	None.	
DISCHARGE CHANNEL	None.	
BRIDGE AND PIERS	None.	
GATES AND OPERATION EQUIPMENT	None.	

OUTLET WORKS

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CRACKING AND SPALLING OF CONCRETE SURFACES IN OUTLET CONDUIT	None observed.	
INTAKE STRUCTURE	Intake House. Intake pipe submerged.	
OUTLET STRUCTURE	No visible defects.	
OUTLET CHANNEL	Masonry U-shaped. Channel heavily overgrown.	Should be cleared so that channel can be periodically inspected.
EMERGENCY GATE	Blow-off or draw-down gate was indicated as operable.	

DOWNSTREAM CHANNEL

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
CONDITION (OBSTRUCTIONS, DEBRIS, ETC.)	At the time of inspection, channel not obstructed. Heavy overgrowth should be removed.	
SLOPES	No noticable problem areas.	
APPROXIMATE NO. OF HOMES AND POPULATION	A couple of miles below dam Grassy Sprain. Traverses through substantial residential areas. Frequent flooding problems from major storm drainage culverts and downstream tributaries has been studied by the Corps of Engineers.	Failure of dam a definite threat of damage and loss of life.

INSTRUMENTATION

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
MONUMENTATION/SURVEYS	None.	
OBSERVATION WELLS	None.	
WEIRS	None.	
PIEZOMETERS	None.	
OTHER		

RESERVOIR

VISUAL EXAMINATION OF	OBSERVATIONS	REMARKS OR RECOMMENDATIONS
SLOPES	Significant slopes cut from rock. Highway divides rock slopes with reservoir.	
SEDIMENTATION	None observed. Reservoir banks and head waters observed.	

CHECK LIST
ENGINEERING DATA
DESIGN, CONSTRUCTION, OPERATION
PHASE 1

NAME OF DAM Grassy Sprain

ID # 195

ITEM	REMARKS
AS-BUILT DRAWINGS	None available.
REGIONAL VICINITY MAP	See this report.
CONSTRUCTION HISTORY	See this report. Also City of Yonkers may have additional dates.
TYPICAL SECTIONS OF DAM	See this report.
OUTLETS - PLAN - DETAILS - CONSTRAINTS - DISCHARGE RATINGS	See this report.
RAINFALL/RESERVOIR RECORDS	Not kept at reservoir. Records available for area.

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

ITEM	REMARKS
MONITORING SYSTEMS	None.
MODIFICATIONS	None disclosed.
HIGH POOL RECORDS	Not disclosed.
POST CONSTRUCTION ENGINEERING STUDIES AND REPORTS	None.
PRIOR ACCIDENTS OR FAILURE OF DAM DESCRIPTION REPORTS	None disclosed.
MAINTENANCE OPERATION RECORDS	See City of Yonkers.

ITEM	REMARKS
SPILLWAY PLAN SECTIONS DETAILS	See this report.
OPERATING EQUIPMENT PLANS & DETAILS	None.

GRASSY SPRAIN RESERVOIR

CHECK LIST
HYDROLOGIC & HYDRAULIC
ENGINEERING DATA

DRAINAGE AREA CHARACTERISTICS: 1.9 square miles

ELEVATION TOP NORMAL POOL (STORAGE CAPACITY): 127

ELEVATION TOP FLOOD CONTROL POOL (STORAGE CAPACITY): 127

ELEVATION MAXIMUM DESIGN POOL: 131 feet

ELEVATION TOP DAM: 131 feet

CREST:

a. Elevation
b. Type
c. Width
d. Length
e. Location Spillover
f. Number and Type of Gates

OUTLET WORKS:

a. Type
b. Location
c. Entrance Inverts
d. Exit Inverts
e. Emergency Draindown Facilities

HYDROMETEOROLOGICAL GATES:

a. Type None
b. Location None
c. Records None

MAXIMUM NON-DAMAGING DISCHARGE: Not determined. Downstream flood areas affected by tributaries.

WATER SUPPLY INTAKE:

a. Intake in gate house consists of two 24-inch mains to pumping station.

APPENDIX B

PREVIOUS INSPECTION REPORTS

APPENDIX C

HYDROLOGIC AND HYDRAULIC COMPUTATIONS

DALE

DESIGN BRIEF

DESIGNED BY JPG DATE 7.6.78

CHECKED BY PAGE C-1 OF

PROJECT NO. 2210 SHORT TITLE NY DAM INSPECTION

DESIGN SUBJECT GRASSY SPRAIN REF. DWGS.

ESTIMATE OF Tc

Estimate of Clarke's Parameters

$$T_c = 11.9\,(L^3)^{.385}/H = (11.9\,(3.409)^3/74)^{.385} = 2.040 \text{ HR}$$

SCS

$$L = \frac{P^{.8}\,(S+1)^{.7}}{1900\,Y^{.5}} = \frac{(2536.4)^{.8}\,(2.79)^{.7}}{1900\,(12.0)^{.5}}$$

$$S = \frac{1000}{CN} - 10 = 3.33$$

$$= \frac{7075.53}{6581.79} = 1.075$$

$$T_c = L/.6 = 1.075/.6 = 1.792 \text{ HR}$$

North Atlantic Division Water Resources Study, February 1972

$$(T_c + R) = 10\,(a)\,(DA/S)^{0.25}$$

$$= 9.925$$

$$(R/(TC+R)) = 0.4$$

$$R = 3.97$$

$$TC = 5.95$$

$a = 1.82$

$DA = 1.92$

$S = 21.71$

THIS PAGE IS BEST QUALITY PRACTICABLE
FROM COPY FURNISHED TO DDC

DALE

DESIGN BRIEF

DESIGNED BY ND DATE 7-7-78

CHECKED BY PAGE C-2 OF

PROJECT NO. 2210 SHORT TITLE N.Y. Dam Surveys

DESIGN SUBJECT Grassy Spring REF. DWGS.

Estimate of Snyder's Parameters

640CP From Lock Hunter Report N-Y Dist '77

$640\,C_p = 422$

$C_p = 0.66$

$C_t = 3.33$

$t_p = C_t (L L_{ca})^{0.3}$

$t_p = 3.33 (3.41 \times 1.66)^{0.3}$

$t_p = 5.60$

$t_r = t_r / 5.5 = 1.02$

$t_{pr} = 5.60 + 0.25 (1.0 - 1.02)$

$t_{pr} = 5.60$

Summary of Parameters

Clark's

BPR $T_c = 2.04$ hour

CCS (CN Method) $T_c = 1.79$ hour

North Atlantic Div. $T_c = 5.95$

Use 1.80 hours

$R = R/(1.80+R) = 0.4$

$R = 1.20$ hours

Snyder's

$T_{pr} = 5.60$

$C_p = 0.66$

THIS PAGE IS BEST QUALITY PRACTICABLE
FROM COPY FURNISHED TO DDC

DALE

THIS PAGE IS BEST QUALITY PRACTICABLE
FROM COPY FURNISHED TO DDC

DESIGN BRIEF

DESIGNED BY ND DATE 7-7-78

CHECKED BY PAGE C-3 OF

PROJECT NO. 2210 SHORT TITLE NY DAM INSPECTIONS

DESIGN SUBJECT Grassy Sprain REF. DWGS.

D-A-D Relationship *

Drainage Area less than 10 sq. mi.
Use values for 10 sq. mi.

Duration	Depth	% of Index
6 HR	26.0	106
12 HR	30.0	122
24 HR	33.5	137
48 HR	37.0	151
72 HR	38.0	155

AMA Index Rainfall **

24.5 in.

Base Flow

Estimate 2 cubic feet per second per square mile

Base Flow = 2 x 2.0 = 4.0

Loss Rates

Initial Loss	1.0 in
Constant Loss	0.1 in/hour

* From Hydrometeorological Report No. 51
** Index rainfall - estimate for 24 hour duration for area < 200 sq. mi.

DALE

THIS PAGE IS BEST QUALITY PRACTICABLE
FROM COPY FURNISHED TO DDC

DESIGN BRIEF

DESIGNED BY N.D DATE July 12, 1978

CHECKED BY PAGE E-4 OF

PROJECT NO. 2210 SHORT TITLE N.Y. Dam Inspections

DESIGN SUBJECT Grassy Sprain REF. DWGS.

UHCOMP Computer Runs Results
(Prior To Routing Thru Spillway)

RUN NO	Description	Peaks	Pages
1	PMF Snyder CP=0.66 TP=5.60	2800	5-7
2	PMF Clark Tc=1.80 R=1.2	5600	8-9
3	SPF (½PMF) Clark	3000	10-12
4	SPF (½PMF) Snyder	1500	13-15

SYNOPSIS

Computations based on Snyder parameters are based on Lower Hudson Basin Report data for Grassy Sprain. Clark coefficients computed by UHCOMP concur with values predicted by The Division study of 1972.

Clark coefficients used in Runs 2 & 3 were based on SCS formula rational method which for this basin its resulting Tc value cannot be verified

Use results from Runs 1 & 4

```
SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      1
ENTER TIME INTERVAL(MIN)=    6C.


SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      2
ENTER DRAINAGE AREA (SQMI) =      2.10
SELECT 1-3 (1=INPUT UH, 2=CLARK, 3=SNYDER )       3
ENTER SNYDERS CP AND TP (HRS) =          0.66       5.00
ENTER INITIAL EST. CLARKS TC & (HRS) (0=DEFAULT)=  0.00       0.00

       TP        CP        TC        R

     4.87     0.620      6.44      4.21
     5.33     0.671      6.77      4.28
     5.72     0.696      6.62      4.51
     5.64     0.675      6.62      4.62
     5.67     0.676      6.54      4.69
     5.60     0.661      6.54      4.69


SELECT 1-4 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      3
ENTER RATIO  IMPERVIOUS =        0.00
SELECT 1-3 ( 1=RAIN, 2=SPS, 3=PMS )       3
ENTER PMS INDEX RAINFALL (IN) = 24.50
ENTER R6,R12,R24,R48,R72,R96 =     106.00   122.00   137.00   151.00   155.00     0.00
ENTER TRSPC AND TRSDA (SQMI) =          0.00       2.10
SELECT 1-3 (1=INIT+CONST, 2=ACUM LOSS, 3=SCS)      1
ENTER INITIAL LOSS(IN), CONSTANT LOSS(IN/HR) =      1.00       0.10


SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      4
ENTER A TITLE PLEASE -   GRASSY SERAIN PMF
ENTER STRTQ,RECSN,AND RTIOR =        4.00     4.00     1.00

HR MIN   RAIN  LOSS EXCESS  UNIT HG    RECSN     FLOW
 1   6   0.02  0.02   0.00      11.       4.        4.
 2   6   0.02  0.02   0.00      41.       4.        4.
 3   6   0.02  0.02   0.00      79.       4.        4.
 4   6   0.02  0.02   0.00     119.       4.        4.
 5   6   0.02  0.02   0.00     148.       4.        4.
 6   6   0.02  0.02   0.00     160.       4.        4.
 7   6   0.03  0.03   0.00     150.       4.        4.
 8   6   0.03  0.03   0.00     120.       4.        4.
 9   6   0.03  0.03   0.00     102.       4.        4.
10   6   0.03  0.03   0.00      82.       4.        4.
11   6   0.03  0.03   0.00      68.       4.        4.
12   6   0.03  0.03   0.00      54.       4.        4.
13   6   0.03  0.03   0.00      43.       4.        4.
14   6   0.03  0.03   0.00      35.       4.        4.
15   6   0.27  0.20   0.07      29.       4.        5.
16   6   0.74  0.10   0.64      23.       4.       15.
17   6   1.41  0.17   1.24      15.       4.       39.
18   6   1.21  0.10   1.11      15.       4.       73.
19   6   0.03  0.03   0.00      12.       4.      111.
20   6   0.03  0.03   0.00      10.       4.      142.
```

THIS PAGE IS BEST QUALITY PRACTICABLE
FROM COPY FURNISHED TO DDC

41	5	.02	0.03	0.01	5.	4.	158.	
42	6	0.01	0.03	0.01	7.	4.	155.	
43	6	0.01	0.03	0.01	6.	4.	137.	
44	6	0.01	0.03	0.01	5.	4.	114.	
45	5	0.1	0.1	0.1	4.	4.	99.	
46	5	0.1	0.1	0.1	3.	4.	81.	
47	5	0.1	0.1	0.1	3.	4.	75.	
48	5	0.1	0.1	0.1	3.	4.	71.	
49	5	0.1	0.1	0.1	3.	4.	64.	
50	5	0.1	0.1	0.1	3.	4.	58.	
51	6	0.1	0.1	0.1	3.	4.	53.	
52	6	0.1	0.1	0.1		4.	167.	
53	6	0.1	0.1	0.1		4.	159.	
54	6	0.1	0.1	0.1		4.	174.	
55	6	0.1	0.1	0.1		4.	221.	
56	6	0.1	0.1	0.1		4.	271.	
57	6	0.1	0.1	0.1		4.	359.	
58	6	0.1	0.1	0.1		4.	455.	
59	6	0.1	0.1	0.1		4.	602.	
60	6	0.1	0.1	0.1		4.	799.	
61	6	0.1	0.1	0.1		4.	1051.	
62	6	0.1	0.1	0.1		4.	1.374.	
63	6	0.1	0.1	0.1		4.	1806.	
64	6	0.1	0.1	0.1		4.	2093.	
65	6	0.1	0.1	0.1		4.	2255.	
66	6	0.1	0.1	0.1		4.	2653.	
67	6	0.1	0.1	0.1		4.	2244.	
68	6	0.1	0.1	0.1		4.	1989.	
69	6	0.1	0.1	0.1		4.	1659.	
70	6	0.1	0.1	0.1		4.	1380.	
71	6	0.1	0.1	0.1		4.	1146.	
72	6	0.1	0.1	0.1		4.	948.	
73	6	0.1	0.1	0.1		4.	780.	
74	6	0.01	0.1	0.01		4.	637.	
75	6	0.01	0.01	0.01		4.	518.	
76	6	0.01	0.01	0.01		4.	421.	
77	6	0.01	0.1	0.01		4.	343.	
78	6	0.01	0.01	0.01		4.	279.	
79	6	0.01	0.01	0.01		4.	228.	
80	6	0.01	0.01	0.01		4.	187.	
81	6	0.01	0.01	0.01		4.	154.	
82	6	0.07	0.07	0.01		4.	127.	
83	6	0.0	0.06	0.01		4.	105.	
84	6	0.21	0.16	0.11		4.	88.	
85	6	0.0	0.0	0.01		4.	77.	
86	6	0.01	0.01	0.01		4.	69.	
87	6	0.01	0.01	0.01		4.	64.	
88	6	0.01	0.01	0.01		4.	58.	
89	6	0.01	0.01	0.01		4.	51.	
90	6	0.01	0.01	0.01		4.	42.	
91	6	0.01	0.01	0.01		4.	28.	
92	6	0.01	0.01	0.01		4.	21.	
93	6					4.	15.	
94	6					4.	13.	
95	6					4.	11.	
96	6					4.	10.	
97	6					4.	8.	
98	6					4.	7.	
99	6					4.	7.	
100	6					4.	6.	

THIS PAGE IS BEST QUALITY PRACTICABLE
FROM COPY FURNISHED TO DDC

81	1				4.	6.	
82	0				4.	5.	
83	0				4.	5.	
84	0				4.	5.	
85	1				4.	5.	
86	0				4.	5.	
87	0				4.	5.	
88	0				4.	4.	
89	1				4.	4.	
90	0				4.	4.	
91	0				4.	4.	
92	0				4.	4.	
93	0				4.	4.	
94	0				4.	4.	
95	0				4.	4.	
96	0				4.	4.	
97	0				4.	4.	
98	0				4.	4.	
99	0				4.	4.	
100	0				4.	4.	
101	0				4.	4.	
102	0				4.	4.	
TOTAL	27.9	4.56	23.42	1346.	408.	32392.	

THIS PAGE IS BEST QUALITY PRACTICABLE
FROM COPY FURNISHED TO DDC

```
SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      1
ENTER TIME INTERVAL(MIN)=    60.

SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      2
ENTER DRAINAGE AREA (SQMI) =      2.10
SELECT 1-3 (1=INPUT UH, 2=CLARK, 3=SNYDER )       2
ENTER NUMBER OF TIME-AREA ORDINATES (0=NONE)=     0
ENTER CLARKS TC AND R (HRS) =         1.80       1.20

      TP        CP       TC        R

    1.59    0.579     1.80     1.20


SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      3
ENTER RATIO  IMPERVIOUS =         0.00
SELECT 1-3 ( 1=RAIN, 2=SFS, 3=PMS )       3
ENTER PMS INDEX RAINFALL (IN) = 24.50
ENTER R6,R12,R24,R48,R72,R96 =     106.00  122.00  137.00  151.00  155.00
ENTER TRSTC AND TRSDA (SQMI) =            0.00       2.10
SELECT 1-3 (1=INIT+CONST, 2=ACUM LOSS, 3=SCS)       1
ENTER INITIAL LOSS(IN), CONSTANT LOSS(IN/HR) =      1.00       0.10

SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      4
ENTER A TITLE PLEASE -   GRASSY SPRAIN PMF
ENTER STRTQ,QRCSN,AND RTIOR =          4.00     4.00     1.00

 HR MIN   RAIN  LOSS  EXCESS  UNIT HG    RECSN     FLOW
  1   0   0.02  0.02   0.00      231.       4.        4.
  2   0   0.02  0.02   0.00      494.       4.        4.
  3   0   0.02  0.02   0.00      371.       4.        4.
  4   0   0.02  0.02   0.00      153.       4.        4.
  5   0   0.02  0.02   0.00       63.       4.        4.
  6   0   0.02  0.02   0.00       26.       4.        4.
  7   0   0.05  0.05   0.00       11.       4.        4.
  8   0   0.05  0.05   0.00        5.       4.        4.
  9   0   0.05  0.05   0.00                 4.        4.
 10   0   0.05  0.05   0.00                 4.        4.
 11   0   0.05  0.05   0.00                 4.        4.
 12   0   0.05  0.05   0.00                 4.        4.
 13   0   0.20  0.20   0.00                 4.        4.
 14   0   0.23  0.23   0.00                 4.        4.
 15   0   0.29  0.20   0.09                 4.       25.
 16   0   0.74  0.10   0.64                 4.      197.
 17   0   0.27  0.10   0.17                 4.      393.
 18   0   0.21  0.10   0.11                 4.      364.
 19   0   0.03  0.03   0.00                 4.      225.
 20   0   0.03  0.03   0.00                 4.      114.
 21   0   0.03  0.03   0.00                 4.       49.
 22   0   0.03  0.03   0.00                 4.       23.
 23   0   0.03  0.03   0.00                 4.       12.
 24   0   0.03  0.03   0.00                 4.        6.
 25   0   0.18  0.10   0.08                 4.       23.
 26   0   0.18  0.10   0.08                 4.       62.
 27   0   0.18  0.10   0.08                 4.       92.
 28   0   0.18  0.10   0.08                 4.      104.
```

THIS PAGE IS BEST QUALITY PRACTICABLE
FROM COPY FURNISHED TO DDC

29	0	0.18	0.10	0.08		4.	109.
30	0	0.18	0.10	0.08		4.	111.
31	0	0.48	0.10	0.38		4.	181.
32	0	0.48	0.10	0.38		4.	330.
33	0	0.48	0.10	0.38		4.	441.
34	0	0.48	0.10	0.38		4.	487.
35	0	0.48	0.10	0.38		4.	506.
36	0	0.48	0.10	0.38		4.	514.
37	0	1.91	0.10	1.81		4.	848.
38	0	2.29	0.10	2.19		4.	1644.
39	0	2.87	0.10	2.77		4.	2497.
40	0	7.27	0.10	7.17		4.	4161.
41	0	2.68	0.10	2.58		4.	5037.
42	0	2.10	0.10	2.00		4.	5016.
43	0	0.27	0.10	0.17		4.	3340.
44	0	0.27	0.10	0.17		4.	1823.
45	0	0.27	0.10	0.17		4.	890.
46	0	0.27	0.10	0.17		4.	504.
47	0	0.27	0.10	0.17		4.	344.
48	0	0.27	0.10	0.17		4.	266.
49	0	0.01	0.01	0.00		4.	204.
50	0	0.01	0.01	0.00		4.	111.
51	0	0.01	0.01	0.00		4.	48.
52	0	0.01	0.01	0.00		4.	22.
53	0	0.01	0.01	0.00		4.	11.
54	0	0.01	0.01	0.00		4.	7.
55	0	0.01	0.01	0.00		4.	5.
56	0	0.01	0.01	0.00		4.	4.
57	0	0.01	0.01	0.00		4.	4.
58	0	0.01	0.01	0.00		4.	4.
59	0	0.01	0.01	0.00		4.	4.
60	0	0.01	0.01	0.00		4.	4.
61	0	0.06	0.06	0.00		4.	4.
62	0	0.07	0.07	0.00		4.	4.
63	0	0.08	0.08	0.00		4.	4.
64	0	0.21	0.10	0.11		4.	29.
65	0	0.06	0.06	0.00		4.	58.
66	0	0.06	0.06	0.00		4.	45.
67	0	0.01	0.01	0.00		4.	21.
68	0	0.01	0.01	0.00		4.	11.
69	0	0.01	0.01	0.00		4.	7.
70	0	0.01	0.01	0.00		4.	5.
71	0	0.01	0.01	0.00		4.	5.
72	0	0.01	0.01	0.00		4.	4.
73	0					4.	4.
74	0					4.	4.
75	0					4.	4.
76	0					4.	4.
77	0					4.	4.
78	0					4.	4.
79	0					4.	4.
TOTAL		27.96	4.56	23.42	1355.	316.	32048.

THIS PAGE IS BEST QUALITY PRACTICABLE
FROM COPY FURNISHED TO DDC

```
SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      1
ENTER TIME INTERVAL(MIN)=    5.

SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      2
ENTER DRAINAGE AREA (SQMI) =       2.10
SELECT 1-3 (1=INPUT UH, 2=CLARK, 3=SNYDER )        2
ENTER NUMBER OF TIME-AREA ORDINATES (0=NONE)=      0
ENTER CLARKS TC AND R (HRS) =          1.80        1.20

      TP        CP        TC         R

    1.59     0.579      1.80      1.20

SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      3
ENTER RATIO  IMPERVIOUS =          0.00
SELECT 1-3 ( 1=RAIN, 2=SPS, 3=PMS )        2
ENTER SPS INDEX RAINFALL (IN) = 12.25
ENTER TRSPC AND TRSDA (SQMI) =              1.00        2.10
SELECT 1-3 (1=INIT+CONST, 2=ACUM LOSS, 3=SCS)        1
ENTER INITIAL LOSS(IN), CONSTANT LOSS(IN/HR) =       1.00        0.10

SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)      4
ENTER A TITLE PLEASE -   GRASSY SPRAIN SHE
ENTER STRTQ,QRCSN,AND RTIOR =          4.00      4.00      1.00

 HR MIN   RAIN   LOSS EXCESS  UNIT HG    RECSN     FLOW
  1   5   0.00   0.00   0.00     231.       4.        4.
  2   0   0.00   0.00   0.00     494.       4.        4.
  3   0   0.00   0.00   0.00     371.       4.        4.
  4   0   0.00   0.00   0.00     153.       4.        4.
  5   5   0.00   0.00   0.00      63.       4.        4.
  6   0   0.00   0.00   0.00      26.       4.        4.
  7   0   0.01   0.01   0.00      11.       4.        4.
  8   0   0.01   0.01   0.00       5.       4.        4.
  9   0   0.01   0.01   0.00                4.        4.
 10   0   0.01   0.01   0.00                4.        4.
 11   0   0.01   0.01   0.00                4.        4.
 12   0   0.01   0.01   0.00                4.        4.
 13   0   0.03   0.03   0.00                4.        4.
 14   0   0.04   0.04   0.00                4.        4.
 15   0   0.05   0.05   0.00                4.        4.
 16   0   0.12   0.12   0.00                4.        4.
 17   0   0.04   0.04   0.00                4.        4.
 18   0   0.03   0.03   0.00                4.        4.
 19   0   0.01   0.01   0.00                4.        4.
 20   0   0.01   0.01   0.00                4.        4.
 21   0   0.01   0.01   0.00                4.        4.
 22   0   0.01   0.01   0.00                4.        4.
 23   0   0.01   0.01   0.00                4.        4.
 24   0   0.01   0.01   0.00                4.        4.
 25   0   0.02   0.02   0.00                4.        4.
 26   0   0.02   0.02   0.00                4.        4.
 27   0   0.02   0.02   0.00                4.        4.
 28   0   0.02   0.02   0.00                4.        4.
```

THIS PAGE IS BEST QUALITY PRACTICABLE
FROM COPY FURNISHED TO DDC

29	0	0.02	0.02	0.00	4.	4.
30	0	0.02	0.02	0.00	4.	4.
31	0	0.04	0.04	0.00	4.	4.
32	0	0.04	0.04	0.00	4.	4.
33	0	0.04	0.04	0.00	4.	4.
34	0	0.04	0.04	0.00	4.	4.
35	0	0.04	0.04	0.00	4.	4.
36	0	0.04	0.04	0.00	4.	4.
37	0	0.14	0.14	0.00	4.	4.
38	0	0.16	0.13	0.03	4.	11.
39	0	0.20	0.10	0.10	4.	42.
40	0	0.52	0.10	0.42	4.	162.
41	0	0.19	0.10	0.09	4.	274.
42	0	0.15	0.10	0.05	4.	233.
43	0	0.03	0.03	0.00	4.	133.
44	0	0.03	0.03	0.00	4.	66.
45	0	0.03	0.03	0.00	4.	30.
46	0	0.03	0.03	0.00	4.	15.
47	0	0.03	0.03	0.00	4.	8.
48	0	0.03	0.03	0.00	4.	5.
49	0	0.13	0.10	0.03	4.	11.
50	0	0.13	0.10	0.03	4.	26.
51	0	0.13	0.10	0.03	4.	37.
52	0	0.13	0.10	0.03	4.	41.
53	0	0.13	0.10	0.03	4.	43.
54	0	0.13	0.10	0.03	4.	44.
55	0	0.34	0.10	0.24	4.	93.
56	0	0.34	0.10	0.24	4.	197.
57	0	0.34	0.10	0.24	4.	275.
58	0	0.34	0.10	0.24	4.	307.
59	0	0.34	0.10	0.24	4.	320.
60	0	0.34	0.10	0.24	4.	326.
61	0	1.05	0.10	0.95	4.	492.
62	0	1.26	0.10	1.16	4.	893.
63	0	1.57	0.10	1.47	4.	1332.
64	0	3.98	0.10	3.88	4.	2229.
65	0	1.47	0.10	1.37	4.	3031.
66	0	1.15	0.10	1.05	4.	2690.
67	0	0.21	0.10	0.11	4.	1785.
68	0	0.21	0.10	0.11	4.	984.
69	0	0.21	0.10	0.11	4.	496.
70	0	0.21	0.10	0.11	4.	294.
71	0	0.21	0.10	0.11	4.	210.
72	0	0.21	0.10	0.11	4.	170.
73	0	0.01	0.01	0.00	4.	132.
74	0	0.01	0.01	0.00	4.	73.
75	0	0.01	0.01	0.00	4.	32.
76	0	0.01	0.01	0.00	4.	16.
77	0	0.01	0.01	0.00	4.	9.
78	0	0.01	0.01	0.00	4.	6.
79	0	0.02	0.02	0.00	4.	5.
80	0	0.02	0.02	0.00	4.	4.

THIS PAGE IS BEST QUALITY PRACTICABLE
FROM COPY FURNISHED TO DDC

81	0	0.02	0.02	0.00		4.	4.
82	0	0.02	0.02	0.00		4.	4.
83	0	0.02	0.02	0.00		4.	4.
84	0	0.02	0.02	0.00		4.	4.
85	0	0.05	0.05	0.00		4.	4.
86	0	0.06	0.06	0.00		4.	4.
87	0	0.08	0.08	0.00		4.	4.
88	0	0.20	0.10	0.10		4.	27.
89	0	0.07	0.07	0.00		4.	53.
90	0	0.06	0.06	0.00		4.	41.
91	0	0.01	0.01	0.00		4.	19.
92	0	0.01	0.01	0.00		4.	10.
93	0	0.01	0.01	0.00		4.	7.
94	0	0.01	0.01	0.00		4.	5.
95	0	0.01	0.01	0.00		4.	4.
96	0	0.01	0.01	0.00		4.	4.
97	0					4.	4.
98	0					4.	4.
99	0					4.	4.
100	0					4.	4.
101	0					4.	4.
102	0					4.	4.
103	0					4.	4.
TOTAL		17.65	4.70	12.95	1355.	412.	17958.

THIS PAGE IS BEST QUALITY PRACTICABLE
FROM COPY FURNISHED TO DDC

```
SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)        1
ENTER TIME INTERVAL(MIN)=    5.

SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)        2
ENTER DRAINAGE AREA (SQMI) =       2.10
SELECT 1-3 (1=INPUT UH, 2=CLARK, 3=SNYDER )        3
ENTER SNYDERS CP AND TP (HRS) =            0.60        5.60
ENTER INITIAL EST. CLARKS TC & R (HRS) (0=DEFALLT)=  0.00        0.00

      TP        CP        TC        R

    4.87     0.620     6.44     4.21
    5.55     0.671     6.77     4.28
    5.72     0.695     6.62     4.51
    5.64     0.675     6.62     4.62
    5.67     0.670     6.54     4.69
    5.66     0.681     6.54     4.69

SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)        3
ENTER RATIO  IMPERVIOUS =        0.00
SELECT 1-3 ( 1=RAIN, 2=SPS, 3=PMS )        2
ENTER SPS INDEX RAINFALL (IN) = 12.25
ENTER TRSPC AND TRSDA (SQMI) =             1.00        2.10
SELECT 1-3 (1=INIT+CONST, 2=ACUM LOSS, 3=SCS)        1
ENTER INITIAL LOSS(IN), CONSTANT LOSS(IN/HR) =       1.00        0.10

SELECT 1-6 (1=TIME INT,2=UNIT H,3=RAIN,4=RUNOFF,5=PNT,'6=STOP)        4
ENTER A TITLE PLEASE -  GRASSY SPRAIN SPF
ENTER STRTQ,QRCSN,AND RTIOR =          4.00      4.00      1.00

 HR MIN   RAIN   LOSS EXCESS  UNIT HG    RECSN     FLOW
  1   0   0.00   0.00   0.00      11.       4.        4.
  2   0   0.00   0.00   0.00      41.       4.        4.
  3   0   0.00   0.00   0.00      79.       4.        4.
  4   0   0.00   0.00   0.00     119.       4.        4.
  5   0   0.00   0.00   0.00     146.       4.        4.
  6   0   0.00   0.00   0.00     160.       4.        4.
  7   0   0.01   0.01   0.00     150.       4.        4.
  8   0   0.01   0.01   0.00     126.       4.        4.
  9   0   0.01   0.01   0.00     102.       4.        4.
 10   0   0.01   0.01   0.00      82.       4.        4.
 11   0   0.01   0.01   0.00      66.       4.        4.
 12   0   0.01   0.01   0.00      54.       4.        4.
 13   0   0.03   0.03   0.00      43.       4.        4.
 14   0   0.04   0.04   0.00      35.       4.        4.
 15   0   0.05   0.05   0.00      29.       4.        4.
 16   0   0.12   0.12   0.00      23.       4.        4.
 17   0   0.04   0.04   0.00      19.       4.        4.
 18   0   0.03   0.03   0.00      15.       4.        4.
 19   0   0.01   0.01   0.00      12.       4.        4.
 20   0   0.01   0.01   0.00      10.       4.        4.
 21   0   0.01   0.01   0.00       8.       4.        4.
 22   0   0.01   0.01   0.00       7.       4.        4.
 23   0   0.01   0.01   0.00       6.       4.        4.
 24   0   0.01   0.01   0.00       5.       4.        4.
 25   0   0.02   0.02   0.00       4.       4.        4.
 26   0   0.02   0.02   0.00       3.       4.        4.
 27   0   0.02   0.02   0.00       3.       4.        4.
 28   0   0.02   0.02   0.00       2.       4.        4.
```

THIS PAGE IS BEST QUALITY PRACTICABLE
FROM COPY FURNISHED TO DDC

29	0	0.02	0.02	0.00	2.	4.	4.
30	0	0.02	0.02	0.00	2.	4.	4.
31	0	0.04	0.04	0.00	1.	4.	4.
32	0	0.04	0.04	0.00		4.	4.
33	0	0.04	0.04	0.00		4.	4.
34	0	0.04	0.04	0.00		4.	4.
35	0	0.04	0.04	0.00		4.	4.
36	0	0.04	0.04	0.00		4.	4.
37	0	0.14	0.14	0.00		4.	4.
38	0	0.16	0.13	0.03		4.	4.
39	0	0.20	0.10	0.10		4.	6.
40	0	0.52	0.10	0.42		4.	15.
41	0	0.19	0.10	0.09		4.	34.
42	0	0.15	0.10	0.05		4.	58.
43	0	0.03	0.03	0.00		4.	85.
44	0	0.03	0.03	0.00		4.	101.
45	0	0.03	0.03	0.00		4.	109.
46	0	0.03	0.03	0.00		4.	104.
47	0	0.03	0.03	0.00		4.	91.
48	0	0.03	0.03	0.00		4.	76.
49	0	0.13	0.10	0.03		4.	63.
50	0	0.13	0.10	0.03		4.	53.
51	0	0.13	0.10	0.03		4.	46.
52	0	0.13	0.10	0.03		4.	42.
53	0	0.13	0.10	0.03		4.	41.
54	0	0.13	0.10	0.03		4.	41.
55	0	0.34	0.10	0.24		4.	44.
56	0	0.34	0.10	0.24		4.	55.
57	0	0.34	0.10	0.24		4.	70.
58	0	0.34	0.10	0.24		4.	96.
59	0	0.34	0.10	0.24		4.	127.
60	0	0.34	0.10	0.24		4.	161.
61	0	1.05	0.10	0.95		4.	201.
62	0	1.26	0.10	1.16		4.	258.
63	0	1.57	0.10	1.47		4.	348.
64	0	3.98	0.10	3.88		4.	505.
65	0	1.47	0.10	1.37		4.	744.
66	0	1.15	0.10	1.05		4.	1022.
67	0	0.21	0.10	0.11		4.	1281.
68	0	0.21	0.10	0.11		4.	1454.
69	0	0.21	0.10	0.11		4.	1507.
70	0	0.21	0.10	0.11		4.	1432.
71	0	0.21	0.10	0.11		4.	1268.
72	0	0.21	0.10	0.11		4.	1079.
73	0	0.01	0.01	0.00		4.	905.
74	0	0.01	0.01	0.00		4.	757.
75	0	0.01	0.01	0.00		4.	632.
76	0	0.01	0.01	0.00		4.	525.
77	0	0.01	0.01	0.00		4.	433.
78	0	0.01	0.01	0.00		4.	354.

THIS PAGE IS BEST QUALITY PRACTICABLE
FROM COPY FURNISHED TO DDC

79	0	0.02	0.02	0.00		4.	288.
80	0	0.02	0.02	0.00		4.	235.
81	0	0.02	0.02	0.00		4.	191.
82	0	0.02	0.02	0.00		4.	156.
83	0	0.02	0.02	0.00		4.	128.
84	0	0.02	0.02	0.00		4.	105.
85	0	0.05	0.05	0.00		4.	87.
86	0	0.06	0.06	0.00		4.	72.
87	0	0.08	0.08	0.00		4.	60.
88	0	0.20	0.10	0.10		4.	51.
89	0	0.07	0.07	0.00		4.	46.
90	0	0.06	0.06	0.00		4.	43.
91	0	0.01	0.01	0.00		4.	42.
92	0	0.01	0.01	0.00		4.	40.
93	0	0.01	0.01	0.00		4.	36.
94	0	0.01	0.01	0.00		4.	31.
95	0	0.01	0.01	0.00		4.	22.
96	0	0.01	0.01	0.00		4.	17.
97	0					4.	14.
98	0					4.	12.
99	0					4.	10.
100	0					4.	9.
101	0					4.	8.
102	0					4.	7.
103	0					4.	6.
104	0					4.	6.
105	0					4.	6.
106	0					4.	5.
107	0					4.	5.
108	0					4.	5.
109	0					4.	5.
110	0					4.	5.
111	0					4.	4.
112	0					4.	4.
113	0					4.	4.
114	0					4.	4.
115	0					4.	4.
116	0					4.	4.
117	0					4.	4.
118	0					4.	4.
119	0					4.	4.
120	0					4.	4.
121	0					4.	4.
122	0					4.	4.
123	0					4.	4.
124	0					4.	4.
125	0					4.	4.
126	0					4.	4.
TOTAL		17.65	4.70	12.95	1366.	504.	18189.

THIS PAGE IS BEST QUALITY PRACTICABLE
FROM COPY FURNISHED TO DDC

GRASSY SPRAIN (PRINC SPILLWAY)

THIS PAGE IS BEST QUALITY PRACTICABLE
FROM COPY FURNISHED TO DDC

DIAMETER OF PIPE (FT) 4.00
START ELEV OF PIPE (FT) 90.00
ROUGH COEFFICIENT 0.0140
HEIGHT-HEAD (FT) 50.00
PIPE LENGTH (FT) 175.00

KT,KO,KENT,KEXT 2.09 0.99 0.10 1.00

C 0.691

ELEV	HEIGHT	2gH	(2gH)**1/2	Q/C	Q
91	1.00	64.40	8.02	100.84	69.69
92	2.00	128.80	11.35	142.62	98.55
93	3.00	193.20	13.90	174.67	120.70
94	4.00	257.60	16.05	201.69	139.37
95	5.00	322.00	17.94	225.50	155.82
96	6.00	386.40	19.66	247.02	170.70
97	7.00	450.80	21.23	266.81	184.37
98	8.00	515.20	22.70	285.23	197.10
99	9.00	579.60	24.07	302.53	209.06
100	10.00	644.00	25.38	318.90	220.37
101	11.00	708.40	26.62	334.46	231.13
102	12.00	772.80	27.80	349.34	241.40
103	13.00	837.20	28.93	363.60	251.26
104	14.00	901.60	30.03	377.33	260.74
105	15.00	966.00	31.08	390.57	269.90
106	16.00	1030.40	32.10	403.38	278.75
107	17.00	1094.80	33.09	415.79	287.33
108	18.00	1159.20	34.05	427.85	295.66
109	19.00	1223.60	34.98	439.57	303.76
110	20.00	1288.00	35.89	450.99	311.65
111	21.00	1352.40	36.77	462.13	319.35
112	22.00	1416.80	37.64	473.00	326.86
113	23.00	1481.20	38.49	483.63	334.21
114	24.00	1545.60	39.31	494.04	341.40
115	25.00	1610.00	40.12	504.22	348.44
116	26.00	1674.40	40.92	514.21	355.34
117	27.00	1738.80	41.70	524.00	362.10
118	28.00	1803.20	42.46	533.62	368.75
119	29.00	1867.60	43.22	543.06	375.28
120	30.00	1932.00	43.95	552.35	381.69
121	31.00	1996.40	44.68	561.48	388.00
122	32.00	2060.80	45.40	570.46	394.21
123	33.00	2125.20	46.10	579.31	400.32
124	34.00	2189.60	46.79	588.02	406.34
125	35.00	2254.00	47.48	596.60	412.27
126	36.00	2318.40	48.15	605.07	418.12
127	37.00	2382.80	48.81	613.41	423.89
128	38.00	2447.20	49.47	621.65	429.58
129	39.00	2511.60	50.12	629.77	435.20
130	40.00	2576.00	50.75	637.80	440.74
131	41.00	2640.40	51.38	645.72	446.21
132	42.00	2704.80	52.01	653.55	451.62
133	43.00	2769.20	52.62	661.28	456.97
134	44.00	2833.60	53.23	668.93	462.25
135	45.00	2898.00	53.83	676.49	467.47

138	48.00	3091.20	55.60	698.67	482.81
139	49.00	3155.00	56.17	705.91	487.81
140	50.00	3220.00	56.75	713.08	492.76

THIS PAGE IS BEST QUALITY PRACTICABLE
FROM COPY FURNISHED TO DDC

CRASSY SPRAT..
«EIR FLO.. PROGRAM"

THIS PAGE IS BEST QUALITY PRACTICABLE
FROM COPY FURNISHED TO DDC

GIVE C,L 3.20 40.00
GIVE ELEVATION TO START FLOW AND HEIGHT 125 20

ELEV	126 FT	DISCHARGE	128. CFS
ELEV	127 FT	DISCHARGE	362. CFS
ELEV	128 FT	DISCHARGE	665. CFS
ELEV	129 FT	DISCHARGE	1024. CFS
ELEV	130 FT	DISCHARGE	1431. CFS
ELEV	131 FT	DISCHARGE	1881. CFS
ELEV	132 FT	DISCHARGE	2371. CFS
ELEV	133 FT	DISCHARGE	2896. CFS
ELEV	134 FT	DISCHARGE	3456. CFS
ELEV	135 FT	DISCHARGE	4048. CFS
ELEV	136 FT	DISCHARGE	4670. CFS
ELEV	137 FT	DISCHARGE	5321. CFS
ELEV	138 FT	DISCHARGE	6000. CFS
ELEV	139 FT	DISCHARGE	6705. CFS
ELEV	140 FT	DISCHARGE	7436. CFS
ELEV	141 FT	DISCHARGE	8192. CFS
ELEV	142 FT	DISCHARGE	8972. CFS
ELEV	143 FT	DISCHARGE	9775. CFS
ELEV	144 FT	DISCHARGE	10601. CFS
ELEV	145 FT	DISCHARGE	11449. CFS

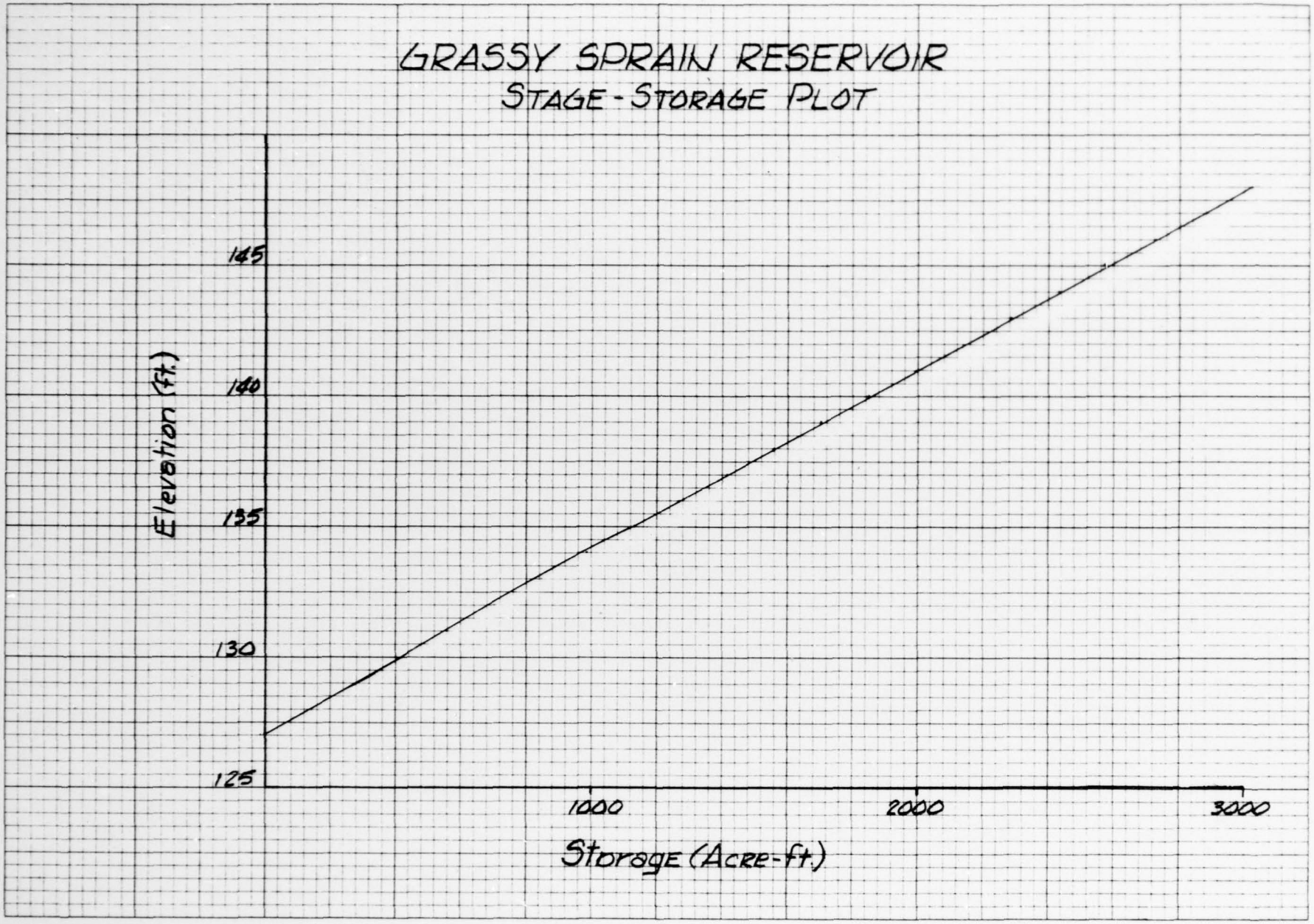
THIS PAGE IS BEST QUALITY PRACTICABLE
FROM COPY FURNISHED TO DDC

GRASSY STRAIN
WEIR FLOW PROGRAM

GIVE C,L 2.64 610.00
GIVE ELEVATION TO START FLOW AND HEIGHT 130 15

ELEV	131 FT	DISCHARGE	1610. CFS
ELEV	132 FT	DISCHARGE	4555. CFS
ELEV	133 FT	DISCHARGE	8368. CFS
ELEV	134 FT	DISCHARGE	12883. CFS
ELEV	135 FT	DISCHARGE	18005. CFS
ELEV	136 FT	DISCHARGE	23668. CFS
ELEV	137 FT	DISCHARGE	29825. CFS
ELEV	138 FT	DISCHARGE	36439. CFS
ELEV	139 FT	DISCHARGE	43481. CFS
ELEV	140 FT	DISCHARGE	50925. CFS
ELEV	141 FT	DISCHARGE	58752. CFS
ELEV	142 FT	DISCHARGE	66943. CFS
ELEV	143 FT	DISCHARGE	75483. CFS
ELEV	144 FT	DISCHARGE	84358. CFS
ELEV	145 FT	DISCHARGE	93556. CFS

NO. 340-10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH
DIETZGEN CORPORATION
MADE U.S.A.

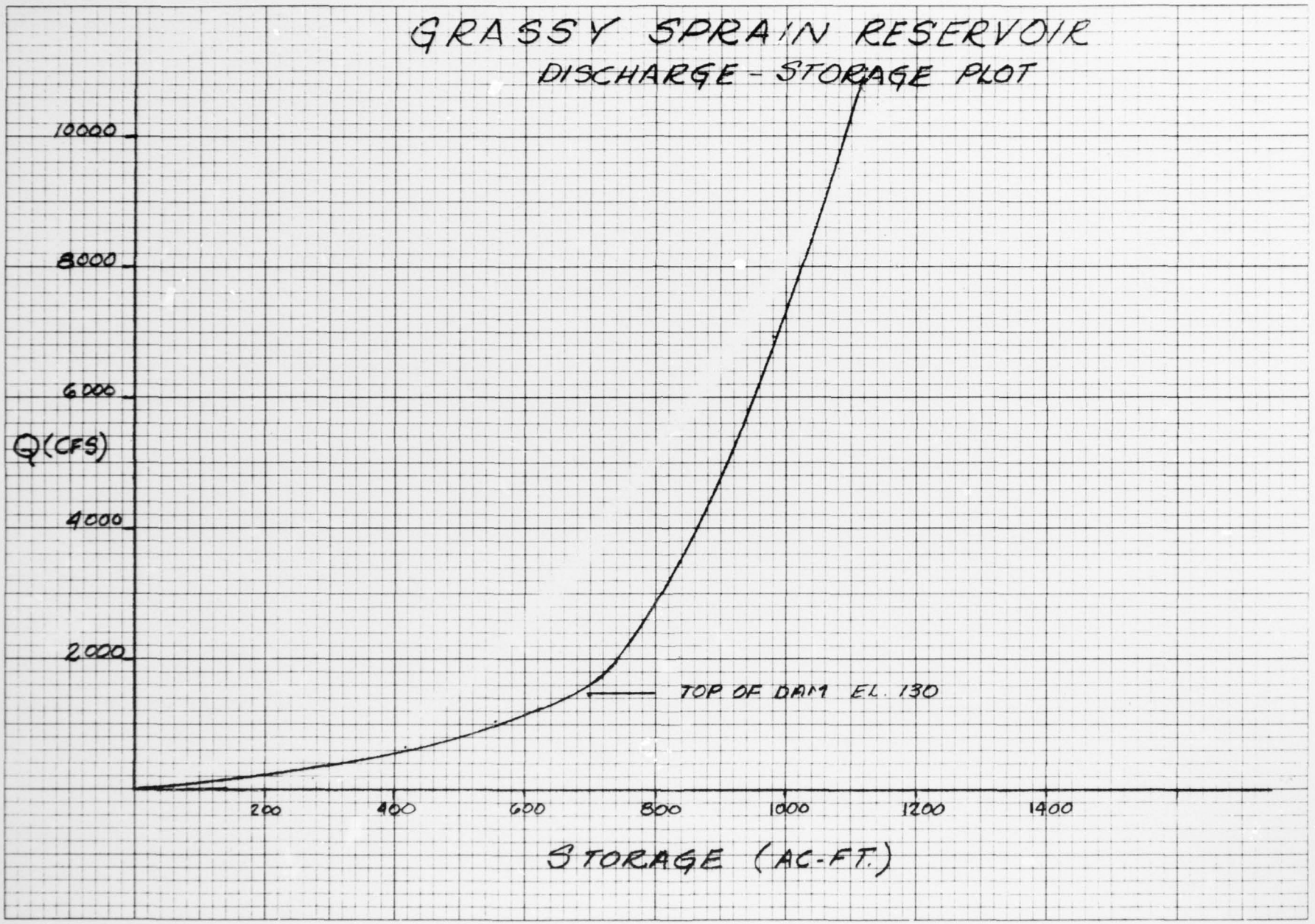


STAGE-DISCHARGE TABULATION
FROM CREST OF SPILLWAY

NAME	ELEV.	H	Q PRINC SPWY *	Q EMERG SPWY	Q DAM	Q TOT.
GRASSY-SPRAIN	125	—	412.27	—	—	—
	126	1	418.12	128	—	128
	127	2	423.89	362	—	362
	128	3	429.58	665	—	665
	129	4	435.20	1024	—	1,024
TOP DAM	130	5	440.74	1431	—	1,431
	131	6	446.21	1881	1610	3,491
	132	7	451.62	2371	4555	6,926
	133	8	456.97	2896	8368	11,264
	134	9	462.25	3456	12883	16,339
	135	10	467.47	4048	18005	22,053
	136	11	472.64	4670	23668	28,338
	137	12	477.75	5321	29825	35,146
	138	13	482.81	6000	36439	42,439
	139	14	487.81	6705	43481	50,186
	[illegible]	15	492.76	7436	50925	58,361
	141	16		8192	58752	66,944
	142	17		8972	66943	75,915
	143	18		9775	75483	85258
	144	19		10601	84358	94,959
	145	20		11449	93556	105,005

* PIPE SPILLWAY MANUALLY OPERATED AND ASSUMED NOT ACTING IN THIS TABULATION.

NO. 340-10 DIETZGEN GRAPH PAPER
10 X 10 PER INCH
DIETZGEN CORPORATION
MADE IN U.S.A.



```
 OLD NY195SS
#LNHFF
$0100 A GRASSY SPRAIN
$110 A RESERVOIR ROUTING OF SPF OVER STRUCTURE
$120 A INCLUDES EMERGENCY SPILLWAY ONLY
$130 B     27         1
$140 1      3
$150 K
$160 M     -1              1.92
$170 N    127       161       201       258       348       505       744      1022      1281      1454
$180 N   1507      1432      1268      1079       905       757       632       525       433       354
$190 N    288       235       191       156       128       105        87
$200 K                 (1)
$210 Y                                   1
$220 1      1                                                   -1
$230 2              138.9     278.3     418.0     558.2     698.8     839.7     981.1    1122.8
$240 3              128.0     362.0     665.0    1024.0    1431.0    3491.0    6926.0   11264.
$250 K     99
$260 A
$270 A
$280 A
#OLD NY195PM
#LNHFF
$0100 A GRASSY SPRAIN
$110 A RESERVOIR ROUTING OF SPF OVER STRUCTURE
$120 A INCLUDES EMERGENCY SPILLWAY ONLY
$130 B     40         1
$140 1      3
$150 K
$160 M     -1              1.92
$170 N     71        74        80        89       107       135       174       221       271       334
$180 N    435       392       899      1351      1876      2366      2693      2793      2653      2344
$190 N   1989      1659      1386      1146       948       788       637       518       421       343
$191 N    279       228       187       154       127       105        88        77        69        64
$200 K                 (1)
$210 Y                                   1
$220 1      1                                                   -1
$230 2              138.95    278.30    418.65    558.20    698.75    839.70    981.04   1122.8
$240 3              128.0     362.0     665.0    1024.0    1431.0    3491.0    6926.0   11264.0
$250 K     99
$260 A
$270 A
$280 A
$
```

****
EC-1 VERSION DATED JAN 1973
PDATED AUG 74
HANGE NO. 01
****

GRASSY SPRAIN
RESERVOIR ROUTING OF OPF OVER STRUCTURE
INCLUDES EMERGENCY SPILLWAY ONLY

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
40	1	0	0	0	0	0	0	0	0

JOPER	NWT
3	0

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

SUB-AREA RUNOFF COMPUTATION

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

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
-1	0	1.92	0.0	0.0	0.0	0.0	0	0	0

INPUT HYDROGRAPH

71.	74.	80.	89.	107.	135.	174.	221.	271.	334.
435.	302.	899.	1351.	1876.	2366.	2693.	2793.	2653.	2344.
1989.	1659.	1380.	1146.	948.	780.	637.	518.	421.	343.
279.	228.	187.	154.	127.	105.	88.	77.	69.	64.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2793.	2473.	1194.	762.	30467.
INCHES		11.98	23.13	24.60	24.60
AC-FT		1227.	2369.	2519.	2519.

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

HYDROGRAPH ROUTING

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

ROUTING DATA

QLOSS	CLOSS	AVC	IRES	ISAME
0.0	0.0	0.0	1	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
1	0	0	0.0	0.0	0.0	-1.

STORAGE#	0.	139.	278.	418.	558.	699.	840.	981.	1123.	0.
OUTFLOW#	0.	128.	362.	665.	1024.	1431.	3491.	6926.	11264.	0.

TIME	EOP STOR	AVG IN	EOP OUT
1	77.	71.	71.
2	77.	73.	71.
3	78.	77.	72.
4	79.	85.	72.
5	81.	98.	74.
6	84.	121.	78.
7	91.	155.	83.
8	100.	198.	92.
9	112.	246.	103.
10	128.	303.	118.
11	149.	385.	144.
12	166.	369.	173.
13	199.	601.	229.
14	268.	1125.	345.
15	365.	1614.	549.
16	483.	2121.	831.
17	609.	2530.	1172.
18	717.	2743.	1701.
19	770.	2723.	2471.
20	771.	2499.	2492.
21	755.	2167.	2247.
22	733.	1824.	1928.
23	712.	1520.	1620.
24	691.	1263.	1408.
25	664.	1047.	1331.
26	630.	864.	1231.
27	591.	709.	1120.
28	551.	578.	1006.
29	511.	470.	903.
30	472.	382.	803.
31	435.	311.	709.
32	401.	254.	628.
33	369.	208.	559.
34	340.	171.	495.
35	313.	141.	437.
36	288.	116.	384.
37	266.	97.	342.
38	246.	83.	308.
39	228.	73.	278.
40	212.	67.	250.
SUM			28930.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	2492.	2076.	1113.	723.	28930.
INCHES		10.06	21.57	23.36	23.36
AC-FT		1030.	2209.	2392.	2392.

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

RUNOFF SUMMARY, AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	6	2793.	2473.	1194.	762.	1.92
ROUTED TO	6	2492.	2076.	1113.	723.	1.92

****
EC-1 VERSION DATED JAN 1973
PDATED AUG 74
HANGE NO. 01
****

GRASSY SPRAIN
RESERVOIR ROUTING OF SPF OVER STRUCTURE
INCLUDES EMERGENCY SPILLWAY ONLY

JOB SPECIFICATION

NQ	NHR	NMIN	IDAY	IHR	IMIN	METRC	IPLT	IPRT	NSTAN
27	1	0	0	0	0	0	0	0	0

JOPER	NWT
3	0

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

SUB-AREA RUNOFF COMPUTATION

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

HYDROGRAPH DATA

IHYDG	IUHG	TAREA	SNAP	TRSDA	TRSPC	RATIO	ISNOW	ISAME	LOCAL
-1	0	1.92	0.0	0.0	0.0	0.0	0	0	0

INPUT HYDROGRAPH

127.	161.	201.	258.	348.	505.	744.	1022.	1281.	1454.
1507.	1432.	1268.	1079.	905.	757.	632.	525.	433.	354.
288.	235.	191.	156.	128.	105.	87.			

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1507.	1337.	661.	599.	16183.
INCHES		6.48	12.81	13.07	13.07
AC-FT		663.	1312.	1338.	1338.

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

HYDROGRAPH ROUTING

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

ROUTING DATA

QLOSS	CLOSS	AVC	IRES	ISAME
0.0	0.0	0.0	1	0

NSTPS	NSTDL	LAG	AMSKK	X	TSK	STORA
1	0	0	0.0	0.0	0.0	-1.

STORAGE#	0.	139.	278.	418.	558.	699.	840.	981.	1123.	0.
OUTFLOW#	0.	128.	362.	665.	1024.	1431.	3491.	6926.	11264.	0.

TIME	EOP STOR	AVG IN	EOP OUT
1	138.	127.	127.
2	139.	144.	128.
3	143.	181.	135.
4	151.	230.	147.
5	163.	303.	168.
6	183.	427.	201.
7	215.	625.	256.
8	264.	883.	337.
9	326.	1152.	465.
10	394.	1368.	613.
11	459.	1481.	771.
12	512.	1470.	905.
13	545.	1350.	990.
14	559.	1174.	1025.
15	556.	992.	1019.
16	542.	831.	983.
17	521.	695.	928.
18	494.	579.	861.
19	466.	479.	788.
20	436.	394.	712.
21	407.	321.	641.
22	378.	262.	579.
23	351.	213.	519.
24	324.	174.	462.
25	300.	142.	409.
26	278.	117.	361.
27	257.	96.	327.
SUM			14856.

	PEAK	6-HOUR	24-HOUR	72-HOUR	TOTAL VOLUME
CFS	1025.	975.	603.	550.	14856.
INCHES		4.72	11.68	12.00	12.00
AC-FT		484.	1196.	1228.	1228.

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

RUNOFF SUMMARY, AVERAGE FLOW

		PEAK	6-HOUR	24-HOUR	72-HOUR	AREA
HYDROGRAPH AT	0	1507.	1337.	661.	599.	1.92
ROUTED TO	0	1025.	975.	603.	550.	1.92

APPENDIX D

REFERENCES

APPENDIX

REFERENCES

1. Edward Wegmann: The Design and Construction of Dams, John Wiley and Sons (1918)

2. The University of the State of New York - The State Education Department - State Museum and Science Service - Geological Survey: Geological Map of New York (1961)

3. Water Resources Engineers, Inc., Lower Hudson River Basin, Hydrologic Flood Routing Model, January 1977

4. Department of the Army, Office of the Chief of Engineers. National Program of Investigation of Dams; Appendix D: Recommended Guidelines for Safety Inspection of Dams, 1976

5. Linsley and Franzini: Water Resources Engineering, Second Edition, McGraw-Hill (1972)

6. Sherard, Woodward, Gizienski, Clevenger: Earth and Earth - Rock Dams, John Wiley and Sons, Inc., 1963

7. Louis C. Schreiner and John T. Riedel: Hydrometeorological Report No. 51, U.S. Department of Commerce, National Oceanic and Atmospheric Administration National Weather Service, Office of Hydrology; Silver Springs, Maryland, September 1976

8. Delaware Water Supply News, 1942-1953, N.Y. State Library, Library No. S628-1097471 qD349

9. Ven Te Chow: Handbook of Applied Hydrology, McGraw-Hill, 1964

10. The Hydrologic Engineering Center: Computer Program 723-X6-L2010, HEC-1 Flood Hydrograph Package, User's Manual, Corps of Engineers, U.S. Army, 609 Second Street, Davis, California 95616, January 1973

11. The Hydrologic Engineering Center, Art Pabst: Computer Program UHCOMP, Unpublished, Corps of Engineers, U.S. Army, 609 Second Street, Davis, California 95616

12. North Atlantic Regional Water Resources Study Coordinating Committee: Appendix C, Climate, Meteorology and Hydrology, February 1972

13. Soil Conservation Service (Engineering Division): Urban Hydrology for Small Watersheds, Technical Release No. 55, U.S. Department of Agriculture, January 1975

14. H.W. King, E.F. Brater: Handbook of Hydraulics, McGraw-Hill, 5th Edition, 1963