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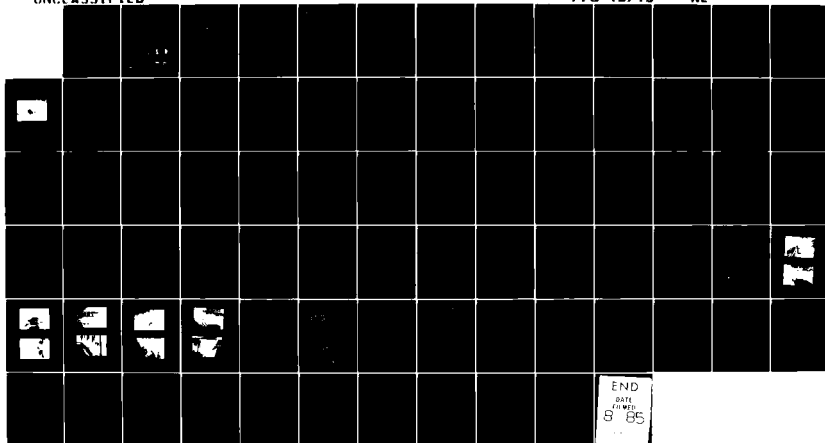
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TEXTILE PRINTING CO (...U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV MAR 79

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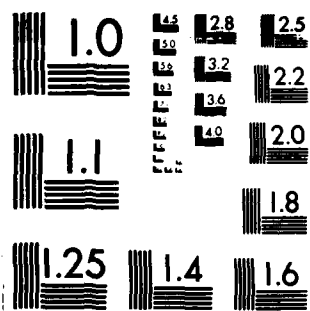
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AD-A156 142

CONNECTICUT RIVER BASIN
PALMER, MASSACHUSETTS

TEXTILE PRINTING CO. (UPPER) DAM
MA 00560

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM



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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER MA 00560	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Textile Printing Co. (Upper) Dam NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS		5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT
7. AUTHOR(s) U.S. ARMY CORPS OF ENGINEERS NEW ENGLAND DIVISION		6. PERFORMING ORG. REPORT NUMBER
9. PERFORMING ORGANIZATION NAME AND ADDRESS		8. CONTRACT OR GRANT NUMBER(s)
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19. KEY WORDS (Continue on reverse side if necessary and identify by block number) DAMS, INSPECTION, DAM SAFETY, Connecticut River Basin Palmer, Massachusetts Swift River		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) The dam has a length of about 230 ft. including the earth embankment on the right side and the canal on the left side structure. The gate house at the upstream end of the canal is considered to be in poor condition while the remaining portions of this facility are in general, fair condition. The dam is intermediate in size having a significant hazard potential. There are deficiencies which must be corrected to assure the continual performance of this dam ,		



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF:
NEDED-E

Honorable Edward J. King
Governor of the Commonwealth of
Massachusetts
State House
Boston, Massachusetts 02133

Dear Governor King:

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Inclosed is a copy of the Textile Printing Company Upper Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. The report is based upon a visual inspection, a review of past performance, and a preliminary hydrological analysis. A brief assessment is included at the beginning of the report.

Included in the Brief Assessment and Section 1.2.e of the report is a discussion concerning the ownership of the dam. Efforts to date to locate or definitely establish the owner of the dam have resulted in limited success. Therefore, it is recommended that the Department of Environmental Quality Engineering, the cooperating agency for the Commonwealth of Massachusetts, immediately initiate a title search to establish and locate the owner of the dam.

I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them and the results of your efforts to find the owner. This follow-up action is a vitally important part of the program.

A copy of this report has been forwarded to the Department of Environmental Quality Engineering, and they have been notified of the recommendation concerning the owner.

Copies of this report will be made available to the public, upon request to this office, under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

NEDED-E

Honorable Edward J. King

I wish to take this opportunity to thank you and the Department of Environmental Quality Engineering for the cooperation extended in carrying out this program.

Sincerely,



MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

Incl
As stated

TEXTILE PRINTING CO. (UPPER) DAM
MA 00560

CONNECTICUT RIVER BASIN
PALMER, MASSACHUSETTS

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

Identification No.: MA 00560
Name of Dam: TEXTILE PRINTING CO. (UPPER) DAM
Town: PALMER AND BELCHERTOWN
County and State: HAMPDEN COUNTY AND HAMPSHIRE COUNTY, MA.
Stream: SWIFT RIVER
Date of Inspection: 7 September and 14 September 1978

BRIEF ASSESSMENT

Textile Printing Co. (Upper) Dam has a length of approximately 230 feet including the earth embankment on the right side and the canal on the left side of structure. The center portion of the dam is a stone masonry weir approximately 133 feet in length including the slightly raised operating platform for the river drain. Flow into the canal is controlled by the timber gates within the gate house at the head end of the canal. The canal is separated from the river, by a stone masonry wall which contains an overflow weir and canal drain gate. Downstream of the dividing wall, the separation is accomplished by an earthen dike. A stone bulkhead and flume are present at the downstream end of the canal.

The Owner of the dam could not be located or definitely established. The contacting of the Owner should be made a priority item by the State.

Based on the results of a Dam Failure Analysis, Textile Printing Co. (Upper) Dam is classified as having a significant hazard potential.

The gate house at the upstream end of the canal is considered in poor condition while the remaining portions of this facility are, in general, considered to be in fair condition. This is based on the disrepair of the gate house and the observed leakage through the underlying timber bulkhead. The basis of rating the remainder of the facility is the lack of maintenance at the dam resulting in the growth of trees on the embankment and vegetation in masonry joints, and observed possible seepage through the canal dike.

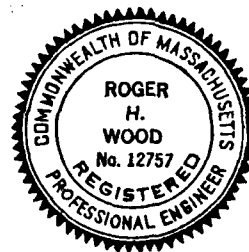
The one half Probable Maximum Flood (PMF) was selected as the spillway test flood in accordance with Corps of Engineers Guidelines for intermediate size dams of significant hazard potential. Hydraulic analysis indicates the test flood outflow at the dam would be 6,050 cfs. The spillway is considered to be sufficiently adequate to pass the test flood as the spillway capacity at the top of dam is 6,000 cfs.

Recommendations included in the report are an investigation of apparent seepage on the river side of the canal dike, and an investigation of the underwater condition of and necessary corrective action to the canal control structure. Remedial actions recommended in the report include the clearing of trees from the dam and dike embankments including the removal of stumps and backfilling, the repair of eroded portions of the dam embankment, the replacement of fallen stones from various masonry walls, the removal of vegetation from masonry wall joints, the river and canal drain gates and the repair of the crack in the canal overflow downstream abutment. It is recommended that the investigations and remedial measures be accomplished within one year of receipt of the report by the Owner. In addition, it is recommended that the Owner establish formal operational procedures, maintenance program, emergency procedures plan and warning system, and program of annual technical inspections. Alternatives to the recommendations are stated in Section 7.

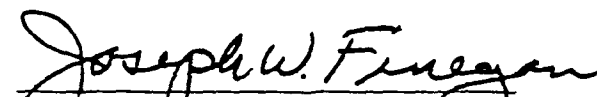
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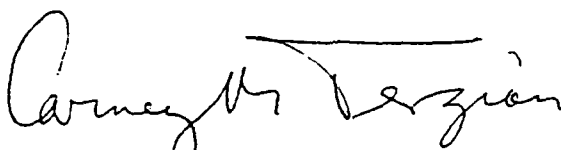
Roger H. Wood

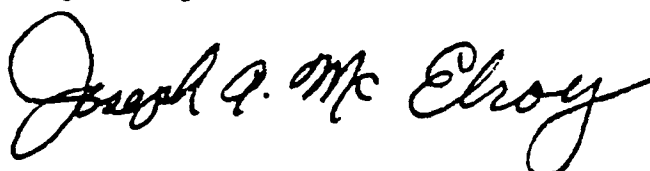
Roger H. Wood
Vice President




This Phase I Inspection Report on Textile Printing Company-Upper Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.


JOSEPH W. FINEGAN, JR., MEMBER
Water Control Branch
Engineering Division


CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division


JOSEPH A. MCELROY, CHAIRMAN
Chief, NED Materials Testing Lab.
Foundations & Materials Branch
Engineering Division

APPROVAL RECOMMENDED:


JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

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

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I Investigations are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the test flood is based on the estimated "probable maximum flood" for the region (greatest reasonably possible storm runoff), or a fraction thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aide in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

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SECTION 5: HYDRAULIC/HYDROLOGIC

5.1 Evaluation of Features

- a. General - Textile Printing Co. (Upper) Dam is located on the Swift River approximately 5 1/2 miles downstream of Quabbin Reservoir in the Bondsville section of Town of Palmer, MA. The dam is a stone masonry structure having a maximum total height of 28 ft. and a length of approximately 180 ft.; the main overflow spillway comprises two-thirds of this, having a length of 121.5 ft. and rising 15 ft. above the footing or base of the stone structure. The dam creates an impoundment of 60 acres and an estimated total storage capacity of 460 acre-feet, at its spillway crest elevation of 363.7. The pool at top of dam (Elev. 369.2) comprises 202 acres and has a total storage capacity of 1,160 acre-feet. Beginning just upstream of the dam and extending along the left bank in a downstream direction is an abandoned canal formed by a stone masonry wall on the left bank and a stone masonry divider wall between the canal and main overflow spillway. The canal begins at a structure housing ten timber gates, now considered inoperable in the closed position. The dividing stone masonry wall lengthens in a downstream direction to form an auxiliary spillway and contains a gated box outlet for draining the canal. The canal once delivered water to the Textile Printing Co. complex about 1,500 ft. downstream but these works were destroyed by fire in the mid-1960's, so the canal is no longer used.

After passing the former Textile Printing Co. complex, water then enters the pool of Textile Printing Co.'s Lower Dam about 3,800 ft. downstream of the upper dam.

- b. Design Data - There were no plans or records located concerning the design details or manner of construction of this dam. All hydraulic/hydrologic criteria used in this report were developed utilizing the U.S.G.S. quadrangle maps, flood records, and information gathered during the inspection.
- c. Experience Data - It is not known when the dam was constructed, but the two significant floods of record occurred in March, 1936 and September, 1938. The March 1936 flood occurred before the construction of Quabbin Reservoir and the 191 square mile drainage area then tributary produced a peak flow of 7,590 cfs on the Swift River at West Ware gaging station (D.A. 186 sq. mi.). The water level at Textile Printing Co. (Upper) Dam rose to elevation 369.8 and the estimated peak discharge at the dam for this flood was 7,880 cfs.

The September 1938 flood occurred during the construction of Quabbin Reservoir and it is presumed that the Swift River flows

SECTION 4: OPERATIONAL PROCEDURES

- 4.1 Evaluation - Due to the inability to locate the owner of the dam and based on observed conditions of the dam, it must be assumed that no operational procedures, including emergency preparedness plans and warning systems, are in effect for this dam.

percent). Approximately 250 ft. downstream of the Lower Dam the channel narrows to accommodate the State Street Bridge after a 15 to 20 ft. fall over the Lower Dam. Throughout this entire reach no development or dwellings presently exist along either river bank within the expected height of water for either the test flood or the heights experienced during either the March, 1936 or September, 1938 floods. Downstream of the State Street Bridge, the channel width varies between 100 and 200 ft. as it meanders along the Vermont Central Railroad right-of-way to its confluence with the Ware River, dropping approximately 25 ft. in the 2.7 mile distance for an average slope of 0.2 percent.

- 3.2 Evaluation - The Textile Printing Co. (Upper) Dam embankments and masonry structure are performing satisfactorily at this time. The local erosion and rock wall damage, and the possible slight seepage at the canal dike, do not appear to provide significant potential for failure of the embankments under present conditions. The pressure leakage through masonry joints does not appear to have caused noticeable displacement of individual stones nor were there any observed conditions which would indicate a significant potential for failure of the masonry portions of the dam or dividing wall between river and canal. The condition of the Canal Control House superstructure and the observed leakage through the timber bulkhead beneath the Canal Control House indicates that this structure is in poor condition and does have a potential for failure. A sudden release of additional water into the canal would not have a material effect at the downstream end of the canal. The on rushing water would probably overtop the downstream stone bulkhead, climb the embankment behind the bulkhead and return to the canal. The surge of water would leave the canal by the canal overflow weir at the head end and the flume at the downstream end. Undoubtedly, the flume would be overtopped and erosion of the unprotected soil behind flume walls would occur as the water returned to the river.

- (7) Some open joints, vegetation in joints and pressure leakage at joints at left downstream end of masonry portion of dam.
 - (8) One capstone at the extreme left downstream end of the dam over the river drain has shifted downward.
- c. Appurtenant Structures - The Canal Control House is in disrepair. A portion of the roof is missing and some of the siding. Several of the supporting timbers are damaged, with two broken off. Leakage through the bulkhead from the river to the canal was observed in seven places.

The masonry dividing wall between the river and canal has a number of open joints and joints with vegetation present. The portion beneath the canal overflow weir exhibits a number of pressure leaks. The downstream abutment of the canal overflow weir has a vertical crack in the riverside stone masonry wall. The fieldstone wall at the river face of the dike connecting to this abutment has crumbled.

Both canal and river drain outlets indicate that both timber gates are leaking.

The site was visited in March of 1979 just prior to the final submission of the report. It was noticed that leakage through the canal drain gate had considerably increased since the September inspection.

- d. Reservoir Area - There is no specific enlargement of the river channel to delineate the reservoir area of Textile Printing Co. (Upper) Dam. The river is bordered by forested moderate to steep banks that are essentially undeveloped. No development in the immediate upstream area was noted that would be affected by a river level at test flood elevation.

No significant potential was observed for landslides into the general pool area of the dam which could create waves that might overtop the abutments of the dam. No conditions were noted that would result in a sudden increase in sediment load into the upstream pool.

- e. Downstream Channel - Immediately downstream of the dam the left bank portion of the river contains the canal which formerly delivered water to the Textile Printing Co. complex about 1,500 ft. downstream. This canal now contains slow moving water caused by the downstream control. The river conveys the present day flows in a channel which is about 100 ft. wide just downstream of the dam. The remains of the Textile Printing Co. complex (destroyed by fire in the mid 1960's) have been largely removed to provide the necessary channel conveyance. Just downstream of the remains of the mill complex, the Depot Street Bridge

SECTION 4 VISUAL INSPECTION

3.1 Findings

- a. General - The visual examination of Textile Printing Co. (Upper) Dam was conducted on 7 September 1978 with a subsequent soils inspection on 14 September 1978. In general, the structures were observed to be in fair condition. However, the downstream abutment of the canal overflow weir and the Canal Control House were observed to be in poor condition. Flow over the main spillway precluded observation of the main portion of the masonry dam.

Visual inspection checklists for the dam are included in Appendix A and selected photographs are given in Appendix C.

- b. Dam - The earth embankments of the dam and the canal dike are generally in fair condition. There is no visual evidence of major lateral movement or settlement, but there is local erosion and a considerable growth of brush and trees. The masonry portion of the main dam, the spillway, to the extent observable was also found to be in fair condition. No evidence of major lateral movement or settlement was observed. The following specific items were noted:

- (1) The dam and dike crests and the slopes have a cover of brush and trees, and some stumps.
- (2) The dam embankment has eroded paths on the upstream and downstream slopes, and a steep eroded slope behind the downstream end of the spillway wall.
- (3) Considerable trash has been left scattered on the crest of the dam embankment.
- (4) A 10-foot length of the upper stones of the upstream rock wall at the dam right embankment has been dislodged into the water.
- (5) A number of individual rocks on the riverside canal dike wall have been dislodged and fallen into the adjacent river channel.
- (6) Slight seepage is evident at the base of the trees at the downstream end of the river-side canal dike wall. A small amount of sand has been deposited on leaves at the seepage location. It is not certain whether this seepage flow through the dike is from the canal, or is river channel flow that has entered the joints of the canal dike rock wall a short distance upstream.

SECTION 2: ENGINEERING DATA

The owner(s), after much effort, could not be located. The mill, which the dam serviced, burned down in the 1960s and the mill property sold. The dam was not included in the transaction. Due to the inability to contact the owner of the dam and in the absence of records or plans at State or County agencies, no engineering data on the dam was located. The evaluation of the dam for the purpose of this investigation must be based on the visual inspection.

(7) Impervious Core	Unknown	Unknown
(8) Cutoff	Unknown	Unknown
(9) Grout Curtain	Probably none	Probably none

h. Diversion and Regulating Tunnel-----None

i. Spillway

(1) Type-----	Broad crested stone masonry
(2) Length of weir-----	121.5 feet
(3) Crest elevation-----	363.7
(4) Gates-----	None
(5) U/S Channel-----	Swift River
(6) D/S Channel-----	8-ft. deep pool

j. Regulating Outlets - Flow at the dam was regulated in the past by a canal control structure which is now abandoned and in disrepair. The cross section and invert of the 38 ft. wide canal are unknown. Flow was regulated at the structure by a series of 10 manually operated timber gates. The gates are presently in the closed position and are not completely visible.

A manually operated timber gate canal drain is located immediately downstream of the dam. The gate is in the closed position and is located on the canal side of a 3.5 ft. wide by 4.5 ft. high box outlet through the masonry well.

The river drain is controlled by a manually operated timber gate on the upstream side of the spillway's left abutment. The gate is in the closed position.

All gates appear not to have been used for sometime and it is doubtful that they are operable. Leakage was observed from both drain gates and in the upper regions of the gate control structure at the canal control facility.

d. Reservoir

- (1) Length of test flood pool-----N/A
- (2) Length of recreation pool-----N/A
- (3) Length of flood control pool-----N/A

e. Storage (acre-feet)

- (1) Recreation pool-----460 (Est.)
- (2) Flood control pool-----N/A
- (3) Spillway crest pool-----460 (Est.)
- (4) Top of dam -----1,160 (Est.)
- (5) Test flood pool-----1,200 (Est.)

f. Reservoir Surface (acres)

- (1) Recreation pool-----60 (Est.)
- (2) Flood control pool-----N/A
- (3) Spillway crest-----60 (Est.)
- (4) Test flood pool-----205 (Est.)
- (5) Top of dam-----202 (Est.)

g. Earth Embankments

Right Embankment

Canal Dike

- | | | |
|-----------------|---|--|
| (1) Type | Earth embankment with partial stone wall along U/S face | Earth embankment with partial stone wall along river-side face |
| (2) Length | Approx. 40 ft | 50 ft, transitions to natural ground |
| (3) Height | Approx. 20 ft maximum | Approx. 15 ft maximum |
| (4) Top width | 40 to 50 ft | Varies, not well defined |
| (5) Side slopes | Irregular, 1.2 to 3:1 D/S | Irregular, generally 2:1 or flatter D/S |
| (6) Zoning | Unknown | Unknown |

dam during the March 1936 flood is 7,880 cfs. This flood occurred prior to the construction of Quabbin Reservoir. The September 1938 flood occurred during the construction of Quabbin Reservoir, but it is presumed the flow was diverted beneath the dam with only slight reduction of peak rate. The estimated peak discharge at Textile Printing Co. (Upper) Dam is 5,690 cfs for this flood. There is an indication that the canal gates were open and the canal operating during both of these floods.

- (1) Outlet works size: 40 ft wide canal emptying into 4-ft wide by 3-ft high RC Flume.
- (2) Maximum known flood at damsite occurred on 19 March 1936 and is estimated to have been 7,880 cfs.
- (3) Ungated spillway capacity at top of dam 5,530 cfs at elevation 369.2
- (4) Ungated spillway capacity at test flood elevation 6,000 cfs at elevation 369.5
- (5) Gated spillway capacity at normal pool elevation-----N/A
- (6) Gated spillway capacity at test flood elevation-----N/A
- (7) Total spillway capacity at test flood elevation 6,000 cfs at elevation 369.5
- (8) Total project discharge at test flood elevation 6,050 cfs at elevation 369.5

c. Elevation (ft. above MSL)

- (1) Streambed at centerline of dam-----341.0
- (2) Test flood tailwater-----356.0
- (3) Upstream portal invert diversion tunnel-----None
- (4) Recreational pool-----363.7
- (5) Full flood control pool-----N/A
- (6) Spillway crest-----363.7
- (7) Design surcharge (Original Design)-----Unknown
- (8) Top of dam-----369.2
- (9) Test flood design surcharge-----369.5

- c. Size Classification - The height of the dam is approximately 28 feet and the estimated total storage capacity at the top of dam is 1,160 acre feet. According to guidelines established by the Corps of Engineers, the dam is classified in the intermediate category based on the storage capacity.
- d. Hazard Classification - Development in the downstream area between the dam and the Ware River is sparse. The dam failure analysis indicates that there is no significant potential for loss of life, but as the Central Vermont Railroad track parallels the river and probably would be affected, the dam is classified in the significant category.
- e. Ownership - The last known Owner of the dam was Mr. Jack Endelson (now deceased), Bondsville Realty, Inc., Bondsville, MA. Although the adjacent mill property has since been sold, the dam was not part of the transaction. It is assumed that the dam is now owned by Mr. Jack Endelson's heir, his son Mr. Barry Endelson. Efforts to locate Mr. Barry Endelson were fruitless.
- f. Operator - There is no known operator of the dam.
- g. Purpose of the Dam - Textile Printing Co. (Upper) Dam originally diverted water to the Textile Printing Co. Mills. Since the mills were destroyed by fire in the 1960's, the only purpose of the dam is recreational (primarily fishing from the banks).
- h. Design and Construction History - No records of the design or the construction were located. The type of construction utilized indicates that the dam was constructed around 1900.
- i. Normal Operational Procedures - There are no operational procedures currently in effect for this structure.

1.3 Pertinent Data

Elevations given in this report are on National Geodetic Vertical Datum (NGVD) formerly referred to as Mean Sea Level (MSL).

- a. Drainage Area - The dam impounds waters of the Swift River at the boundary between Belchertown and Palmer, Massachusetts. The watershed above the dam is 193 square miles, of which 186 square miles is within the watershed of the upstream Quabbin Reservoir. The watershed is heavily forested rolling terrain. Quabbin Reservoir has a surface area of 21 percent of the area of its watershed while the pool at spillway crest for Textile Printing Co. (Upper) Dam has a surface area of 1 percent of the area of the remaining watershed or a negligible percent of the total watershed.
- b. Discharge at Dam Site - There are records on two significant floods on the Swift River. The estimated peak discharge at the

- b. Description of Dam and Appurtenances - The Textile Printing Co. (Upper) Dam consists primarily of a stone masonry structure with a nearly full-width spillway that is 121.5 feet wide and 15 feet high, with provisions for flashboards. Beyond the right spillway wall there is approximately a 40 feet length of earth embankment that extends to a road along the valley side slope.

To the left of the main spillway there is a stone masonry gate structure which contains the reservoir drain and a wall which separates the headworks of an abandoned canal from the dam and river. The canal originates at a timber gate structure, which spans between the left stone masonry spillway wall and the bottom of the river valley side slope, and extends down the left side of the valley. The dividing stone masonry wall is lengthened downstream to provide an overflow spillway between the canal and the Swift River, and then terminates at a stone masonry abutment. The upstream end of the overflow spillway contains the canal drain in a stone masonry gate structure. Beyond the abutment an earth embankment functions as a dike to continue the separation between the canal and river. A sketch plan prepared from the Phase I inspection reports is shown in Appendix C.

The canal is terminated at a stone wall backed up by an earthen embankment near the site of the former mill, a concrete and granite flume, approximately five feet wide, allows the water in the canal to return to the river at the downstream end.

The right dam embankment has a minimum crest width of 40 feet and a maximum height of 20 feet at the spillway wall. The embankment slopes and crest are generally irregular. Behind the downstream end of the spillway wall the slope is particularly steep, at approximately 1.2 horizontal to 1 vertical, but the remainder of the dam embankment slopes appear to be 2 to 1 or flatter. The upstream slope is interrupted by a random rock wall at about water level. The slopes have a cover of trees and brush, and there are a few trees on the crest.

The separating embankment or dike between the canal and the river widens and appears to gradually merge with natural ground as the nearly level canal moves up the left valley slope downstream of the dam. The upstream portion of the canal dike, to about 50 feet downstream from the stone masonry dividing wall, has a 6 to 8 feet high sloping face rock wall on the river side. Within the length of the river-side wall, the dike has a maximum width of 50 feet to the edge of the canal and a height of about 15 feet. The remainder of the canal dike has irregular earth slopes, generally flatter than 2 to 1, with scattered stones on the edge of the river. This section has a poorly defined crest of varying width. The dike has a relatively open cover of trees and brush.

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM
TEXTILE PRINTING CO. (UPPER) DAM
MA 00560

SECTION 1: PROJECT INFORMATION

1.1 General

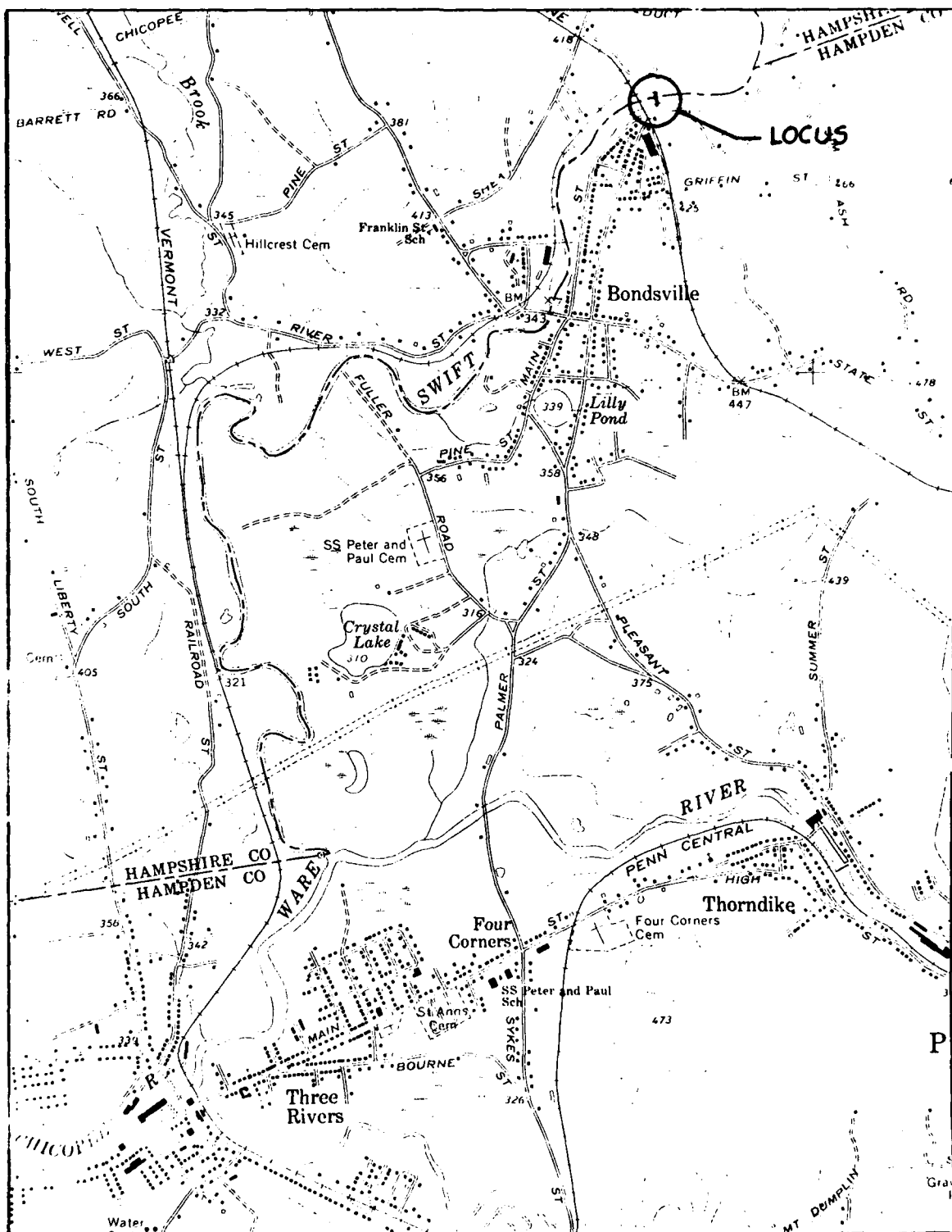
- a. Authority - Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a national program of dam inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region.

Camp Dresser & McKee Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Massachusetts. Authorization and notice to proceed was issued to Camp Dresser & McKee Inc. under letters of 12 July 1978 and 23 October 1978 from Colonel John P. Chandler, Corps of Engineers. Contract No. DACW 33-78-C-0354 has been assigned by the Corps of Engineers for this work. Haley and Aldrich, Inc. has been retained by Camp Dresser & McKee Inc. for soils and geological portions of the work.

- b. Purpose - The primary purpose of the investigation is to:
- (1) Perform technical inspection and evaluation of non-Federal dams to identify conditions which threaten the public safety and thus permit correction in a timely manner by non-Federal interests.
 - (2) Encourage and assist the States to initiate quickly effective dam safety programs for non-Federal dams.
 - (3) Update, verify and complete the National Inventory of Dams.

1.2 Description of Project

- a. Location - Textile Printing Co. (Upper) Dam is located on the Swift River in the Bondsville section of the Town of Palmer, Massachusetts. The dam is approximately 5-1/2 miles downstream of Quabbin Reservoir and 3-3/4 miles upstream from the confluence of the Swift River with the Ware River. Access to the north end of the dam is via a dirt road along a Central Vermont Railroad spur track while the south end of the dam is adjacent to Main Street.



DAM TEXTILE PRINGINT CO. - UPPER

IDENTIFICATION NO. MA 00560



LOCATION MAP
USGS QUADRANGLE

PALMER, MA

APPROX. SCALE: 1" = 2000'



1. OVERVIEW OF DAM FROM LEFT EMBANKMENT.

tributary to the reservoir site were diverted beneath the dam with only slight reduction in peak rate due to reservoir and channel storage. A peak flow of 5,540 cfs was recorded on the Swift River at West Ware gaging station. The water level at Textile Printing Co. (Upper) Dam rose to Elev. 368.4 and the estimated peak discharge at the dam for this flood was 5,690 cfs. Preparation of the spillway rating curve for this dam indicated that in all probability the ten wooden gates which admit water to the canal were operable and in the open position during both of these floods.

- d. Visual Observation - At the time of the inspection of the dam on 7 September 1978, the water level was 7 inches over the spillway crest, an estimated discharge of 180 cfs. The stone masonry full-width overflow spillway appeared to be in good hydraulic condition. While provision is made to add flashboards to the dam, less than half of the spillway length had flashboards installed. The channel immediately downstream of the dam consists of boulders and pieces of cut stone in random fashion. The channel narrows to a width just under 100-ft. as the bottom slope approaches 1.0 percent just downstream of the dam.
- e. Test Flood Analysis - Based upon Corps of Engineers Guidelines, the recommended test flood for the size (intermediate) and hazard potential (significant) is within the range of 1/2 PMF to a full PMF (Probable Maximum Flood). Because the size classification of the dam barely exceeded the "small" category, the 1/2 PMF was adopted as the test flood. The PMF was determined using the guideline curves as presented by the New England Division of the Corps in "Estimating Maximum Probable Discharges" for the Phase I, Dam Safety Investigations. The watershed terrain was determined to be rolling to mountainous, providing a peak inflow rate of 1925 cfs per square mile for the intervening drainage area of only seven square miles, thereby resulting in a test flood inflow of approximately 6,750 cfs.

Storage routing of the 1/2 PMF inflow rate of 6,750 cfs indicated that this peak rate would be reduced to approximately 5,330 cfs by the storage and spillway characteristics of the dam. The flow characteristics of the dam and spillway are such as to cause the level of the impounded water to rise to Elev. 369.1 during the 5,330 cfs discharge condition.

An investigation was also made of the impact on flows at the Textile Printing Co. (Upper) Dam due to spillway discharge from Quabbin Reservoir, 5.4 miles upstream, during a test flood having a peak inflow rate equivalent to 1/2 PMF. It was determined that the test flood inflow of 6,750 cfs at Textile would be increased to 7,400 cfs by early discharges from Quabbin (6 weeks after start of storm) and further, that the later maximum discharge from Quabbin (41 hours after start of storm) would exceed this value,

reaching a peak rate of 7,970 cfs. Storage routing of this peak rate of 7,970 cfs indicated a reduction to approximately 6,050 cfs could be expected due to the storage and spillway characteristics of the dam. The flow characteristics of the dam and spillway cause the level of the impounded water to rise to Ele. 369.5 during 6,050 cfs discharge condition. Since this level is only slightly above the top of dam (0.3 ft.), the spillway is still considered adequate to pass this combined test flood from both Quabbin and Textile. For comparison purposes, a PMF outflow of 16,370 cfs from Quabbin would be reduced to 12,700 cfs by surcharge-storage routing and would result in an approximate water level of 372.3 at Textile Mill Dam.

- f. Dam Failure Analysis - Based on Corps of Engineers Guidelines for Estimating Dam Failure hydrographs and assuming that a failure would occur along a section 49 ft. in length, with the water level at the top of dam (Elev. 369.2), the failure would result in a peak outflow rate of 12,500 cfs. Because of the available storage between the "Upper" and "Lower" Textile Printing Co. dams, this rate of flow would reduce to 11,900 cfs, causing a water surface at Elev. 348.3, or 8.2 ft. above the crest of the "Lower" dam. With the exception of the remaining ruins of the Textile Printing Co. complex, there are no dwellings or developments within the expected river level within this reach. About 800 ft. downstream of the "Lower" dam the State Street bridge causes a minor constriction and downstream of the bridge the channel width varies between 100 and 200-ft. as it meanders along the Vermont Central Railroad right-of-way to its confluence with the Ware River 2.7 miles downstream. Although there exists approximately 8-10 cottages at or below Elev. 320 at Crystal Lake about 3,000-ft. upstream of the confluence with Ware River, there is sufficient channel and flood plain storage along the 2 mile stretch of the Swift River upstream to absorb effects of the peak flow rate caused by the dam failure.

SECTION 6: STRUCTURAL STABILITY

6.1 Evaluation of Structural Stability

- a. Visual Observations - There was no visible evidence of dam or dike instability during the site examinations on 7 and 14 September 1978. The slight seepage at the canal dike was not confirmed to result from flow through the dike, and it is not considered to pose an immediate hazard to the stability of the downstream slope. The pressure leakage through masonry joints was not observed to have caused displacement of the masonry.
- b. Design and Construction Data - There is apparently no design or construction information available on the dam and dike. Local surface exposure indicates gravelly sand with a little silt embankment material, but the extent of such material is not certain. The type and appearance of the masonry portions indicate they are gravity sections but the geometry of the sections is unknown. Thus, theoretical analysis of the structural stability of the embankments and masonry portions of the structure is not possible.

The above water embankment and spillway geometry, as determined by limited measurements at the site, and the long period of service of the dam, indicate that the embankments and masonry portions of the structure would be expected to be adequately stable under static loading conditions.

- c. Operating Records - No operating records for the dam were located.
- d. Post-Construction Changes - Without design or "as built" drawings, it is not known if there have been any post-construction changes. None were noted in the available inspection reports. The types of structural elements observed appeared to be consistent, indicating construction of the same vintage.
- e. Seismic Stability - Textile Printing Co. (Upper) Dam is located in Seismic Zone No. 2 and in accordance with recommended Phase I guidelines does not warrant seismic analysis.

SECTION 7: ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

7.1 Dam Assessment

- a. Condition - The visual examination of the Textile Printing Co. (Upper) Dam, including the canal dike, did not reveal any evidence of failure or conditions which would warrant urgent remedial treatment. However, because of the need of maintenance and additional investigations that are outlined hereinafter, the embankment portions of the project are considered to be in only fair condition. The Canal Control Structure is in disrepair and is considered in poor condition. Failure of this structure during a flood could cause a surge in the canal and river.
- b. Adequacy of Information - All of the information for the Phase I investigation had to be obtained from visual examination and limited measurements at the site. This information has been sufficient for the purpose of this investigation.
- c. Urgency - The recommended additional investigations and remedial measures outlined in Section 7.2 and 7.3, respectively, should be undertaken within 1 year of receipt of this report by the owner.
- d. Need for Additional Investigation - Additional investigations should be performed by the owner as outlined in the following section.

7.2 Recommendations

It is recommended that the following additional investigations be performed by the owner:

- (1) An investigation to determine whether or not slight seepage that is appearing at the downstream rock wall of the canal dike on the river side originates from the canal. If such is the case the seepage should be monitored at regular intervals to determine whether or not corrective measures are warranted.
- (2) An investigation to determine the underwater condition of the Canal Control House substructure, including the condition of the gates and bulkhead, to determine the necessary corrective action for the entire structure or alternatives for the canal facility.

7.3 Remedial Measures

a. Operation and Maintenance Procedures - It is recommended that the following remedial work be undertaken by the Owner, in addition to the investigations outlined in Section 7.2, to correct deficiencies noted during the visual examination:

- (1) Clear brush, trees and trash from the dam embankment, and from the up-river end of the canal dike, including stump removal and backfilling. Establish vegetative cover and cut grass and weeds and clear the embankment at least once a year.
- (2) Repair eroded portions of the dam embankment and stabilize the steep slope behind the spillway wall.
- (3) Replace fallen stones in the various rock walls.
- (4) Remove vegetation from all masonry joints and fill open masonry joints with mortar.
- (5) Repair cracked section of masonry at the downstream abutment for the canal overflow weir.
- (6) Clear logs, stumps and other debris from discharge channel.
- (7) Repair and/or reseal river and canal drain gates to reduce leakage.

It is recommended that during periods of unusually high river levels and heavy precipitation the Owner provide surveillance of the Canal Control Structure and embankments. A formal emergency procedures plan and warning systems should be developed in cooperation with local officials in downstream communities. It is also recommended that the Owner establish a formal program of annual technical inspections.

7.4 Alternatives - There are two alternatives to the recommendations and remedial measures enumerated above. The alternatives are: (1) to breach the dam, including the submerged timber crib dam if necessary or, (2) to open all gates at the dam, including the canal gates. While the only known material use of the upstream pool is for fishing, the environmental impact should be assessed before either action is taken.

APPENDIX A
INSPECTION TEAM ORGANIZATION AND CHECK LIST

Page No.

VISUAL INSPECTION PARTY ORGANIZATION

A-1

VISUAL INSPECTION CHECK LIST

Dam Embankment - Right	A-2
Spillway - Main Dam	A-3
Outlet Works - River Drain	A-4
Outlet Works - Canal Control Structure	A-5
Spillway - Canal Overflow Structure	A-6
Outlet Works - Canal Drain	A-7
Hydrologic-Hydraulic Considerations	A-8&9

VISUAL INSPECTION PARTY ORGANIZATION
NATIONAL DAM INSPECTION PROGRAM

DAM: Textile Printing Co. (Upper)

DATE: 7 September 1978 (soils - geology on 14 September 1978)

TIME: 1800

WEATHER: Mostly cloudy, 60°F, Light variable wind

WATER SURFACE ELEVATION UPSTREAM: 7" above D/S edge of spillway
crest

STREAM FLOW: _____

INSPECTION PARTY:

1. Roger H. Wood, CDM, Structural-Operations
2. Charles E. Fuller, CDM, Hydrology-Hydraulics
3. Joseph E. Downing, CDM, Ass't Hydrology-Hydraulics
4. Peter LeCount, H & A, Soils-Geology
5. _____
6. _____

PRESENT DURING INSPECTION:

1. _____
2. _____
3. _____
4. _____

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Textile Printing Co. (Upper)

DATE: 9/14/78

EMBANKMENT: Right

CHECK LIST	CONDITION
1. Upstream Slope a. Vegetation b. Sloughing or Erosion c. Rock Slope Protection - Riprap Failures d. Animal Burrows 2. Crest a. Vegetation b. Sloughing or Erosion c. Surface cracks d. Movement or Settlement 3. Downstream Slope a. Vegetation b. Sloughing or Erosion c. Surface cracks d. Animal Burrows e. Movement or Cracking near toe f. Unusual Embankment or Downstream Seepage g. Piping or Boils h. Foundation Drainage Features i. Toe Drains 4. General a. Lateral Movement b. Vertical Alignment c. Horizontal Alignment d. Condition at Abutments and at Structures e. Indications of Movement of Structural Items f. Trespassing g. Instrumentation Systems	1. a. Scattered trees, brush & weeds. b. Eroded paths down through rocks (2). c. Rock wall, upper stones fallen down over 10' of length. d. None observed 2. a. Partial grass & weeds, few trees. b. Irregular surface w/paths c. None d. Not apparent 3. a. Trees, brush, weeds & stumps. b. Erosion behind corner of spillway wall w/resulting earth slope approaching 1:1. c. None evident d. None observed on slope. e. Erosion scarp approx. 6' above river level below toe may have been caused by high water downstream in recent past. f. None evident g. None evident h. None evident i. None evident. 4. a., b., c. Irregular surface, but no indication of movement. d. Soil loss behind downstream end of spillway wall. e. None evident f. Extensive g. None

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Textile Printing Co. (Upper)

DATE: 7 September 1978

SPILLWAY: (Main Dam)

CHECK LIST	CONDITION
<p>1. Approach Channel</p> <p>a. General Condition</p> <p>b. Obstructions</p> <p>c. Log Boom etc.</p> <p>2. Weir</p> <p>a. Flashboards</p> <p>b. Weir Elev. Control (Gate)</p> <p>c. Vegetation</p> <p>d. Seepage or Efflorescence</p> <p>e. Rust or Stains</p> <p>f. Cracks</p> <p>g. Condition of Joints</p> <p>h. Spalls, Voids or Erosion</p> <p>i. Visible Reinforcement</p> <p>j. General Struct. Condition</p> <p>3. Discharge Channel</p> <p>a. Apron</p> <p>b. Stilling Basin</p> <p>c. Channel Floor</p> <p>d. Vegetation</p> <p>e. Seepage</p> <p>f. Obstructions</p> <p>g. General Struct. Condition</p> <p>4. Walls</p> <p>a. Wall Location <u>Right</u></p> <p>(1) Vegetation</p> <p>(2) Seepage or Efflorescence</p> <p>(3) Rust or Stains</p> <p>(4) Cracks</p> <p>(5) Condition of Joints</p> <p>(6) Spalls, Voids or Erosion</p> <p>(7) Visible Reinforcement</p> <p>(8) General Struct. Condition</p>	<p>1.</p> <p>a. Good condition</p> <p>b. No obstruction at or near water surface. Pipe upstream beneath surface. Probable old dam upstream beneath water surface.</p> <p>c. None present. Anchorage on channel banks from possible former boom.</p> <p>2.</p> <p>a. Flashboards 3 to 4 inch height during inspection.</p> <p>b. None</p> <p>c. thru i. Structure could not be viewed due to flowing water.</p> <p>j. Areas which can be observed appear good.</p> <p>3.</p> <p>a. Not visible</p> <p>b. None</p> <p>c. Areas which can be observed appear rocky.</p> <p>d. Tree growth in channel D/S of dam</p> <p>e. View obscured</p> <p>f. Few logs and stumps in channel</p> <p>g. Good to fair</p> <p>4.a.</p> <p>(1) Grass-weeds in upstream joints</p> <p>(2) None observed</p> <p>(3) None observed</p> <p>(4) Vertical crack D/S of weir</p> <p>(5) Joints open at waterline. U/S end in poorer condition.</p> <p>(6) Few small stones missing</p> <p>(7) None observed</p> <p>(8) Good to fair</p>

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Textile Printing Co. (Upper)

DATE: 7 September 1978

OUTLET WORKS: River Drain

CHECK LIST	CONDITION
1. Inlet a. Obstructions b. Channel c. Structure d. Screens e. Stop Logs f. Gates 2. Control Facility a. Structure b. Screens c. Stop Logs d. Gates e. Conduit f. Seepage or Leaks 3. Outlet a. Structure b. Erosion or Cavitation c. Obstructions d. Seepage or Leaks 4. Mechanical and Electrical a. Crane Hoist b. Hydraulic System c. Service Power d. Emergency Power e. Lighting f. Lightning Protection 5. Other	1. a. None observed b. No formal channel-part of river c., d., e., & f. - see 2 2. a. Stone masonry at lt. edge of spillway. Minor vegetation upper courses. Wall joints have lost mortar. b. None observed c. None observed d. Single sluice gate-size unknown e. Stone conduit-size unknown-approx. 3 feet wide f. 5 leaks in wall D/S face-Gate leaks 3. See 2. Drain outlets into main river channel. No immediate obstruction. 4. Manually operated gate only 5. The river side of the U/S left training wall has grass and weed growth in joints. Upper jts have mortar. Joints at water line are missing mortar. Wall in good to fair condition.

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Textile Printing Co. (Upper)

DATE: 7 September 1978

OUTLET WORKS: Canal Control Structure

CHECK LIST	CONDITION
<ol style="list-style-type: none"> 1. Inlet <ol style="list-style-type: none"> a. Obstructions b. Channel c. Structure d. Screens e. Stop Logs f. Gates 2. Control Facility <ol style="list-style-type: none"> a. Structure b. Screens c. Stop Logs d. Gates e. Conduit f. Seepage or Leaks 3. Outlet <ol style="list-style-type: none"> a. Structure b. Erosion or Cavitation c. Obstructions d. Seepage or Leaks 4. Mechanical and Electrical <ol style="list-style-type: none"> a. Crane Hoist b. Hydraulic System c. Service Power d. Emergency Power e. Lighting f. Lightning Protection 	<ol style="list-style-type: none"> 1. <ol style="list-style-type: none"> a. None observed. Anchorage on shore for possible former log boom. b. No formal channel-side of river c., d., e. & f. See 2 2. <ol style="list-style-type: none"> a. Timber building on timber posts and stone channel walls. Most of roof is missing. D/S siding either missing or never in place. Support posts for bldg. are damaged-2 are broken off. Flooring is fair. b. None observed c. No formal stop logs observed. Boards or curtain wall of boards present on upstream face. At least 7 leaks present. d. 10 gate stems come up to service floor. e. Gates essentially full width of canal (approx. 38 ft.) f. See a. 3. <ol style="list-style-type: none"> a. Outlet in canal. Lt. wall is an open joint stone wall, fair condition. Rt. wall is mortared cut stone masonry wall. Vegetation in joints, good to fair condition. b. N/A c. None observed d. Leakage into river channel 4. Manually operated gates-not hydraulic or electric power.

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Textile Printing Co. (Upper) DATE: 7 September 1978

SPILLWAY: Canal Overflow Weir

CHECK LIST	CONDITION
1. Approach Channel a. General Condition b. Obstructions c. Log Boom etc.	1. a. Good condition b. None observed-just canal control structure upstream c. None
2. Weir a. Flashboards b. Weir Elev. Control (Gate) c. Vegetation d. Seepage or Efflorescence e. Rust or Stains f. Cracks g. Condition of Joints h. Spalls, Voids or Erosion i. Visible Reinforcement j. General Struct. Condition	2. a. None b. None c. Grass and brush in D/S face masonry joints. Minor grass in top masonry joints. d. Multi-leakage points D/S face e. None observed f. N/A-Stone masonry structure g. Number of open joints h. Some stones missing i. None observed j. Fair due to leakage and vegetation
3. Discharge Channel a. Apron b. Stilling Basin c. Channel Floor d. Vegetation e. Seepage f. Obstructions g. General Struct. Condition	3. a. None observed b.-g. See spillway (main dam)
4. Walls a. Wall Location <u>Left</u> (1) Vegetation (2) Seepage or Efflorescence (3) Rust or Stains (4) Cracks (5) Condition of Joints (6) Spalls, Voids or Erosion (7) Visible Reinforcement (8) General Struct. Condition	4.a. (1) Some weed growth in joints D/S of weir (2) None observed (3) None observed (4) Vertical crack D/S of weir (5) Some open joints present (6) See (8) (7) None observed (8) Wall in good condition adjacent to weir (mortared joint cut stone masonry). Wall in poor condition D/S of weir (open joint fieldstone-cut stone masonry, partially collapsed).

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Textile Printing Co. (Upper)

DATE: 7 September 1978

OUTLET WORKS: Canal Drain

CHECK LIST	CONDITION
1. Inlet a. Obstructions b. Channel c. Structure d. Screens e. Stop Logs f. Gates 2. Control Facility a. Structure b. Screens c. Stop Logs d. Gates e. Conduit f. Seepage or Leaks 3. Outlet a. Structure b. Erosion or Cavitation c. Obstructions d. Seepage or Leaks 4. Mechanical and Electrical a. Crane Hoist b. Hydraulic System c. Service Power d. Emergency Power e. Lighting f. Lightning Protection	1. a. None, except canal control structure upstream b. Approx. 40 ft. wide canal, good condition. c., d., e., & f. See 2 and canal control structure 2. a. Stone masonry at rt. edge of canal overflow weir. Vegetation heavy in D/S joints. b. None observed c. None observed d. Single sluice gate-Est. 3-1/2' X 4' e. Stone conduit 3-1/2' X 4' high f. Seepage in wall D/S face. Gate leaks 3. See 2. Drain outlets into main river channel. No immediate obstruction. 4. Manually operated gate only.

VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Textile Printing Co. (Upper) DATE: 7 September 1978

HYDROLOGIC-HYDRAULIC CONSIDERATIONS: _____

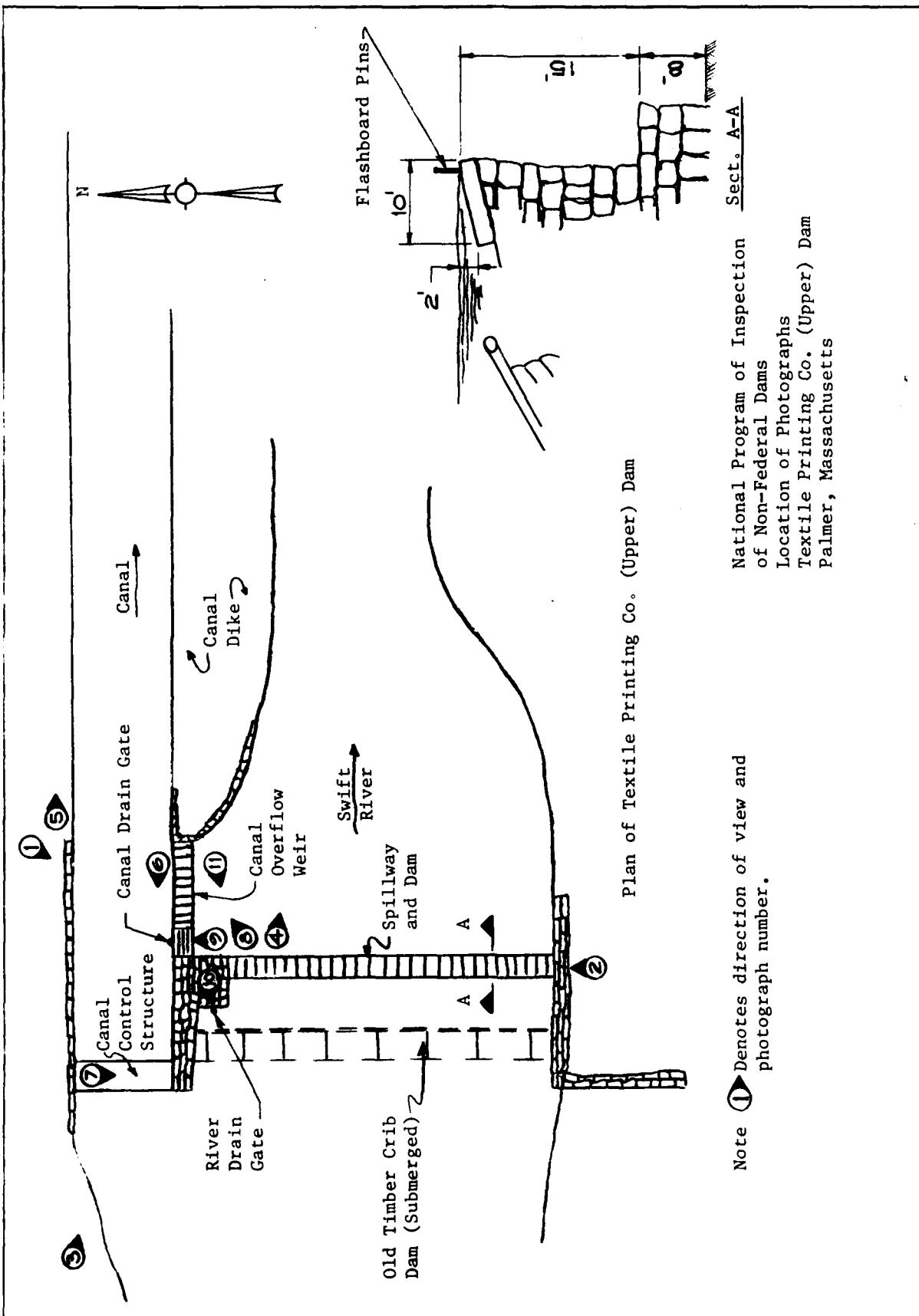
CHECK LIST	CONDITION
<p>1. Upstream Watershed</p> <p>a. Type of Terrain</p> <p>b. Hydrologic Controls</p> <p>2. Reservoir</p> <p>a. Type of Terrain</p> <p>b. Development</p> <p>3. Spillway</p> <p>a. Adjacent Low Points</p> <p>b. Spillway Approach (Slope)</p> <p>c. Spillway Discharge (Slope)</p> <p>d. Spillway Type</p> <p>4. Downstream Watershed</p> <p>a. Reach No. 1</p> <p>(1) Control (Bridge, dam, culvert, etc.)</p> <p>(2) Channel Characteristics</p> <p>(3) Development</p> <p>(4) Visible Utilities</p> <p>(5) Special Problems (Hospital, etc.)</p> <p>4. Downstream Watershed</p> <p>b. Reach No. 2</p>	<p>1.</p> <p>a. Moderately hilly with some steep hills (10-20% average slope).</p> <p>b. Swift River flows are completely controlled by operation of Quabbin Reservoir 4.5 miles upstream.</p> <p>2.</p> <p>a. The terrain immediately adjacent to the upstream pool is steep-banked to a plateau (El. 380 to 400) after which rises are again steep to form moderate to steep hills in adjacent area.</p> <p>b. There is no development within the range of expected water levels caused by the dam. Houses on North Main Street are 30-40 ft. above the normal pool level created by the dam.</p> <p>3.</p> <p>a. The lowest point adjacent to the main dam (spillway) is the 50-ft. section on the right bank which is 5.5 ft. above the main spillway crest.</p> <p>b. The spillway approach is sections of cut granite placed so as to provide a mildly rising bottom (S=3'in 10')</p> <p>c. The spillway discharges over the edge of the cut-stone crest and the water drops 15-ft. to a stone base, then another 8-ft. to the beginning of the downstream channel.</p> <p>d. The spillway is composed of sections of cut granite, approximately 10-ft. long sloping up 2.8' from the back (U/S) end to the spillway crest. The spillway stone are placed atop the main dam which is also composed of cut stone placed to form the 15 ft. high wall.</p> <p>4.</p> <p>a. 3500-ft. from Textile Printing Co. (Upper) Dam to Lower Dam Control is</p>



2. OVERVIEW OF DAM AND CANAL OVERFLOW FROM RIGHT ABUTMENT.



3. VIEW TOWARDS CREST OF DAM AND CANAL CONTROL HOUSE
FROM UPSTREAM LEFT EMBANKMENT.



Note ① Denotes direction of view and photograph number.

National Program of Inspection
of Non-Federal Dams
Location of Photographs
Textile Printing Co. (Upper) Dam
Palmer, Massachusetts

APPENDIX C
SELECTED PHOTOGRAPHS OF PROJECT

LOCATION PLAN

Page No.

Location of Photographs

C-1

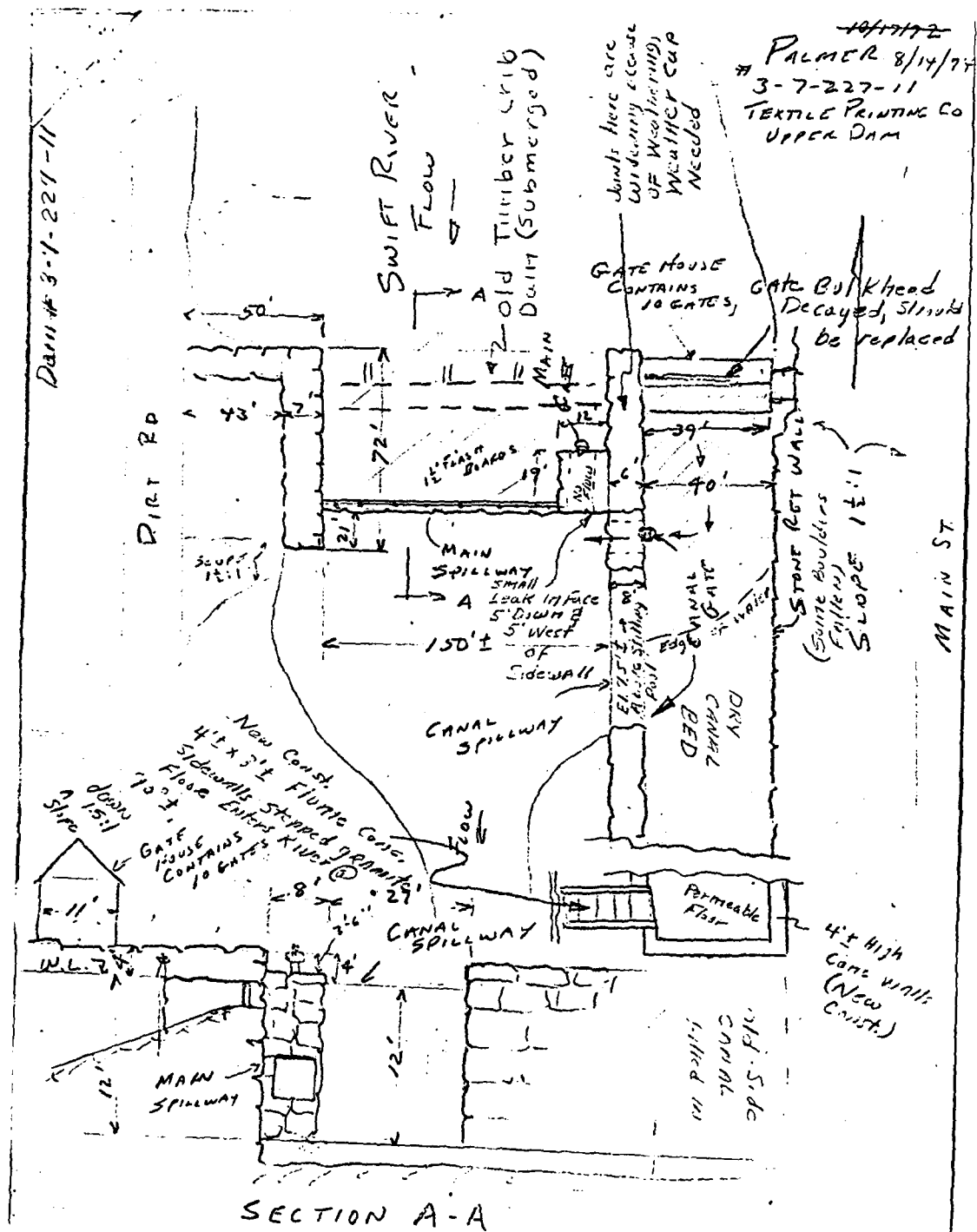
PHOTOGRAPHS

No. Title

Page No.

- | | | |
|-----|--|-----|
| 1. | Overview of Dam from Left Embankment | |
| 2. | Overview of Dam and Canal Overflow from Right Abutment | C-2 |
| 3. | View Towards Crest of Dam and Canal Control House from
Upstream Left Embankment | C-2 |
| 4. | View of Downstream Channel from Dam | C-3 |
| 5. | View Downstream along Canal from Left Bank | C-3 |
| 6. | Downstream Face of Canal Control Structure | C-4 |
| 7. | Canal Control Gate Operators | C-4 |
| 8. | Vegetation and Leakage Beneath Canal Overflow Weir | C-5 |
| 9. | Leakage of Canal Drain Outlet Beneath Canal Overflow Weir | C-5 |
| 10. | River Drain Gate Operator Adjacent to Canal Wall | C-6 |
| 11. | River Drain Outlet at Left Abutment of Dam | C-6 |





12. Remarks & Recommendations: (Fully Explain)

"This inspection was initiated at the request of Arthur Davenport, Director of the New England Outdoor Writers Association, who contacted the Dist. II Office. Russ Salls contacted us because the dam is within Dist. III jurisdiction. Russ Salls & Harold Shumway accompanied us and participated in the investigation."

"Mr. Davenport's principal concern was that the upstream water level was lowered slightly resulting in mud flats occurring in wildlife habitats immediately adjacent to the river. Our investigation revealed that there were originally 2 9" flashboards at the top of the principal spillway but the top board is missing. This condition should be corrected. The gate bulkhead under the gate house consists of rotted wood planks which should be replaced because a bulkhead failure, while not a sever threat to life and property, would result in a further lowering of the upstream water level. Another complication could arise in the event that the bulkhead failed while the side canal gate was closed. This is so because the side canal on the East side originally flowed Parallel to the River, under a factory (now demolished), and thence back into the River at a slight skew angle. Since the last inspection the Palmer Redevelopment Authority has taken Title to the land several hundred feet down the side canal (see sketch) and has done the following:

1. Demolished the old factory
2. Dammed the canal with a 4'+ high ret. wall.
3. Constructed a 4'V x 3'H R.C. flume (with stepped gran-floor) to divert side canal flow 90° downslope into the River."

"If the side canal gate were closed it is probable that the capacity of this flume would be exceeded and some flooding of the Palmer Redevelopment Project would occur; if the bulkhead should fail this situation would certainly be exaggerated."

"Because of the above; the Owner should be requested to keep the side canal gate open at all times and to repair the gate bulkhead."

"The main masonry body of the dam is in generally sound condition, with the downstream toe reposing on solid ledge. Other minor repairs that should be made include weather capping the gate block and removing brush behind the west wingwall."

13. Overall Condition:

1. Safe _____
 2. Minor repairs needed _____ ✓
 3. Conditionally safe - major repairs needed _____ (C)
 4. Unsafe _____
 5. Reservoir impoundment no longer exists (explain) _____
- Recommend removal from inspection list _____

APPENDIX B-7

Item 12 copied by COM in 1979 for clarity for Phase 1 Report

8. Downstream Face of Dam:

Condition: 1. Good _____ 2. Minor Repairs ✓
 3. Major Repairs _____ 4. Urgent Repairs _____

Comments: Small Leak in Gate Block (see sketch)

9. Emergency Spillway: see (12)

Condition: 1. Good _____ 2. Minor Repairs _____
 3. Major Repairs _____ 4. Urgent Repairs _____

Comments: _____

10. Water Level at time of inspection: 3/4 ft. above V below _____
 top of dam _____ principal spillway ✓
 other _____ (AT TOP OF 9" Flash boards)

11. Summary of Deficiencies Noted:

Growth (Trees and Brush) on Embankment Small Amount At West Abutment
 Animal Burrows and Washouts None Noted
 Damage to slopes or top of dam _____
 Cracked or Damaged Masonry Joints in top of Gate Block Weathered
 Evidence of Seepage _____
 Evidence of Piping _____
 Erosion _____
 Leaks Leak in Gate Block
 Trash and/or debris impeding flow Light debris behind Flash board
 Clogged or blocked spillway No
 Other _____

INSPECTION REPORT - DAMS AND RESERVOIRS

1. Location: City/Town PALMER (Bondsville Sect) Dam No. 3-7-227-N
 Name of Dam Textile Printing Upper Dam Inspected by Regan #Dist
 Date of Inspection 8/19/74

2. Owner/s: per: Assessors ✓ Prev. Inspection _____
 Reg. of Deeds _____ Pers. Contact _____

1. ENDOLSON Bondsville Realty Inc Bondsville MA 01821
 Name _____ St. & No. _____ City/Town State Tel. No. _____

2. _____
 Name _____ St. & No. _____ City/Town State Tel. No. _____

3. _____
 Name _____ St. & No. _____ City/Town State Tel. No. _____

3. Caretaker (if any) e.g. superintendent, plant manager, appointed by absentee owner, appointed by multi owners.

Name: _____ St. & No.: _____
 City/Town: _____ State: _____ Tel.No.: _____

4. No. of Pictures taken 0

5. Degree of Hazard: (if dam should fail completely)*

1. Minor _____ 2. Moderate _____
 3. Severe ✓ 4. Disastrous _____

* This rating may change as land use changes (future development)

6. Outlet Control: Automatic _____ Manual ✓
 Operative ✓ yes; _____ No.

Comments: Gates operative but Gate Bulkhead is decayed and Needs Replacement

7. Upstream Face of Dam: Condition:

1. Good _____ 2. Minor Repairs _____
 * 3. Major Repairs ✓ 4. Urgent Repairs _____
 * Not critical to overall dam safety

Comments:

Weather Cap Needed on Top of Sidewall,
 Bulkhead decayed [See (6) and informational Sketch]
 Main Spillway originally capped with 2 9" Flashboards,
 Top Board is now missing.

PORTION OF INSPECTION BELIEVED TO BE
DATED 27 OCTOBER 1969

**TIGHE
& BOND** CONSULTING ENGINEERS

-7-

K. Textile Printing Company Upper Dam //

The stone masonry forming this dam is in fairly good condition. On the day of inspection normal flashboards were on the crest and water level in storage was just above elevation of the upper flashboard.

The stone masonry and the earth fill at the right abutment were noted to be o. k.

In general, the left abutment was o. k. However, at the downstream end of the stone abutment wall which separates the canal headworks from the dam and river, masonry is in need of jointing repairs and the corner of the dam crest, left end of the dam, directly abutting the left abutment wall, has settled and shifted a bit. Motion has been minor. The condition will be observed during the inspection next year, and if there is further movement a recommendation will be made regarding needed repairs.

The canal spillway wall was o. k. Some of the joints in the canal wall at the spillway leak and water squirts from the joints into the river below the dam. This condition is not dangerous. The gatehouse at the canal headworks is about 50% torn down. All gates are closed or are very nearly closed.

Water and water power available at this dam apparently are not used now since the mills in Bondsville, downstream of this dam, were burned in the great Bondsville fire.

(TIGHE & BOND'S COMMENTS ON OTHER DAMS IN THE AREA INCLUDED IN THIS .
PAGE IS OMITTED FROM THIS REPRODUCTION.)

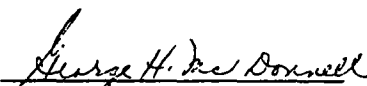
**TIGHE
& BOND CONSULTING ENGINEERS**

Page 3 of 3

In the report you will note the dams referred to as Self-Locking Carton Co. Dams are now owned by Diamond National Corp. Also, the Upper and Lower Dam of Textile Printing Co. are now owned by Bondsville Realty, Inc. For the purpose of record continuity, we have generally maintained files based on the original name or one of the more common names applied to a dam.

In the report you will note reference to a Lions Club Dam under Section G and a Duda Dam under Section J. These are small dams and normally would not be inspected.

The Lizak Dam under Section P on Page 10 of the report is the dam referred to in the list as Campers Country Club Dam.


George H. McDonnell
County Hydraulic Engineer
Hampden County

APPENDIX B-3

**TIGHE
& BOND CONSULTING ENGINEERS**

Page 2 of 3

10. Forest Lake Dam 2-7-227-10
Mr. Dwight Holbrook, 424 Main Street, Palmer, Mass.
11. Textile Printing Company - Upper Dam 2-7-227-11
Mr. Jack Endelson, Bondsville Realty, Inc., Bondsville, Mass.
12. Textile Printing Company - Lower Dam 2-7-227-12
Mr. Jack Endelson, Bondsville Realty, Inc., Bondsville, Mass.
13. Diamond National Corp. - Upper Dam 2-7-227-13
Diamond National Corp., Thorndike, Mass.
14. Diamond National Corp. - Lower Dam 2-7-227-14
Diamond National Corp., Thorndike, Mass.
15. Sasur Dam 2-7-227-15
Palmer Highway Department, Palmer, Mass.
16. Lizak Dam (Campers Country Club) 2-7-227-16
Campers Country Club, Division of Heritage Hills Farm, 190B
Thorndike St., Palmer, Mass.

The last routine inspections of all dams located within the Town of Palmer were conducted in the fall of 1969. The letter-report on the conditions noted at each of the many dams was submitted to the Commissioners of Hampden County on October 27, 1969.

Of the dams inspected, the Lower Dam at the State Fish Hatchery and the dam forming Sasur Pond, were the only dams in need of attention and maintenance work.

A copy of my report addressed to the Commissioners of Hampden County and dated October 27, 1969 is attached hereto for your information. Letters outlining recommended maintenance and repair work at the two mentioned dams were sent to the owners involved.

APPENDIX B-2

**TIGHE
& BOND CONSULTING ENGINEERS**

Page 1 of 3

DAMS IN HAMPDEN COUNTY, MASSACHUSETTS

PALMER

1. V. V. McNitt Dam 2-7-227-1
Breton Estates, Blanchardville Road, Palmer, Mass.
2. Palmer Fire District No. 1 - Upper Dam 2-7-227-2
Board of Water Commissioners, Palmer Fire District No. 1,
Palmer, Mass.
3. Palmer Fire District No. 1 - Lower Dam 3-7-227-3
Board of Water Commissioners, Palmer Fire District No. 1,
Palmer, Mass.
4. Mongo Dam 3-7-227-4
Mass. Turnpike.
5. Thorndike Fire and Water District Dam - Upper Dam 3-7-227-5
Board of Water Commissioners, Thorndike Fire and Water District,
Thorndike, Mass.
6. Thorndike Fire and Water District Dam - Lower Dam 3-7-227-6
Board of Water Commissioners, Thorndike Fire and Water District,
Thorndike, Mass.
7. Lake Thompson Dam 2-7-227-7
Lake Thompson Civic Association, Palmer, Mass.
8. State Fish Hatchery Dams - Upper Dam 2-7-227-8
Mass. Fish Hatchery, Ware Road, Palmer, Mass.
9. State Fish Hatchery Dams - Lower Dam 2-7-227-9
Mass. Fish Hatchery, Ware Road, Palmer, Mass.

APPENDIX B

LIST OF AVAILABLE DOCUMENTS AND
PRIOR INSPECTION REPORTS

Page No.

PRIOR INSPECTION REPORTS

<u>DATE</u>	<u>BY</u>	
1. October 27, 1969	Tighe & Bond	B-1, 2, 3, 4
2. August 13, 1974	Palmer Redevelopment Authority	B-5, 6, 7, 8, 9

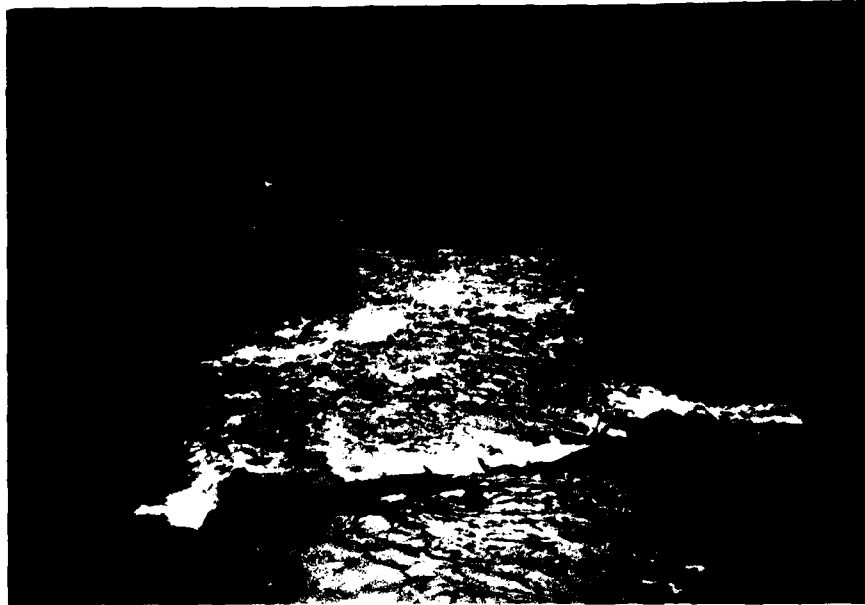
VISUAL INSPECTION CHECK LIST
NATIONAL DAM INSPECTION PROGRAM

DAM: Textile Printing Co. (Upper)

DATE: 7 September 1978

HYDROLOGIC-HYDRAULIC CONSIDERATIONS: (Continued)

CHECK LIST	CONDITION
<ol style="list-style-type: none"> 1. Upstream Watershed <ol style="list-style-type: none"> a. Type of Terrain b. Hydrologic Controls 2. Reservoir <ol style="list-style-type: none"> a. Type of Terrain b. Development 3. Spillway <ol style="list-style-type: none"> a. Adjacent Low Points b. Spillway Approach (Slope) c. Spillway Discharge (Slope) d. Spillway Type 4. Downstream Watershed <ol style="list-style-type: none"> a. Reach No. 1 <ol style="list-style-type: none"> (1) Control (Bridge, dam, culvert, etc.) (2) Channel Characteristics (3) Development (4) Visible Utilities (5) Special Problems (Hospital, etc.) 4. Downstream Watershed <ol style="list-style-type: none"> b. Reach No. 2 	<p>spillway of Lower Dam with a fall of 6-ft in 3500-ft. approach. Channel is 50-75 ft. in width with mildly sloping banks covered with brush and some trees in some areas, but open in other areas. The only development is the remains of the Textile Printing Co. buildings, destroyed in the great Bondsville fire; most of these remains have been removed. About 300-ft. d.s. of the dam a single track line of the Boston & Maine R.R. crosses the river on a high (50') steel trestle.</p> <p>4. b. 16,500-ft. from Lower Dam to confluence with Ware River. Main channel is 100-200 ft. wide with broad flood plain and flat main channel slope ($S=0.002$). Development non-existent to very sparse in this reach.</p>



4. VIEW OF DOWNSTREAM CHANNEL FROM DAM.



5. VIEW DOWNSTREAM ALONG CANAL FROM LEFT BANK.



6. DOWNSTREAM FACE OF CANAL CONTROL STRUCTURE.
OVERFLOW WEIR AND CANAL DRAIN OPERATOR IN
LEFT FOREGROUND.



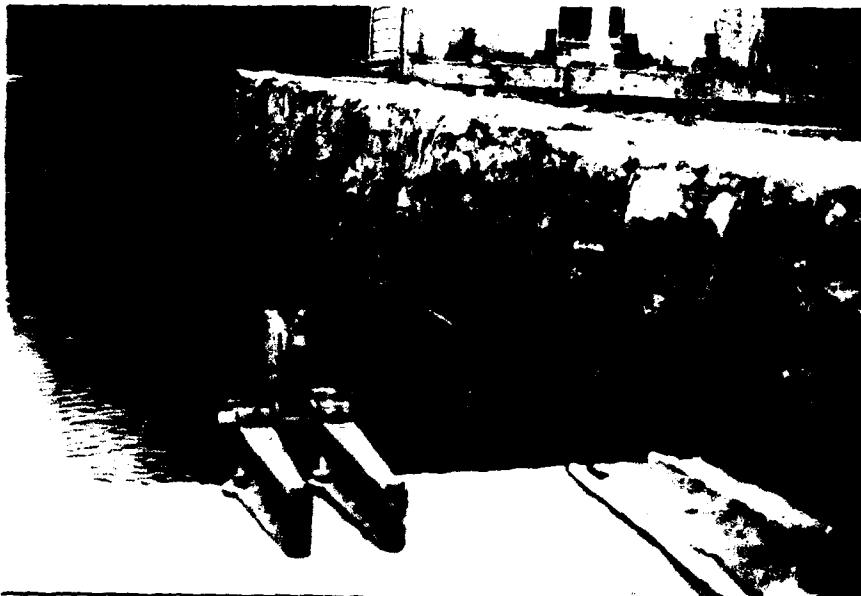
7. CANAL CONTROL GATE OPERATORS.



8. VEGETATION AND LEAKAGE BENEATH CANAL OVERFLOW WEIR
(SWIFT RIVER SIDE).



9. LEAKAGE AT CANAL DRAIN OUTLET BENEATH CANAL OVERFLOW
WEIR.



10. RIVER DRAIN GATE OPERATOR ADJACENT TO CANAL WALL.




11. RIVER DRAIN OUTLET AT LEFT ABUTMENT OF DAM.

APPENDIX D
OUTLINE OF DRAINAGE AREA AND
HYDRAULIC COMPUTATIONS

	<u>Page No.</u>
 <u>OUTLINE OF DRAINAGE AREA</u>	
Drainage Area Map	D-1
Drainage Area	D-2
 <u>COMPUTATIONS</u>	
Dam Failure Analysis, Storage Curve	D-3
Spillway Rating Curve, Lower	D-4
Dam Failure Analysis (continued)	D-5
Storage Curve; Size Classification	D-6
Test Flood	D-7
Upper Bondsville Dam Rating Curve	D-8
Spillway Rating Curve	D-9
Historic Flood Profile	D-10
Tailwater Analysis	D-11
Test Flood Outflow From Quabbin Reservoir	D-12 to D-16
Dam Failure Impact Area Map	D-17



<p>CAMP DRESSER & MCKEE Inc. Consulting Engineers Boston, Mass.</p>	<p>N </p>	<p>TEXTILE PRINTING CO. DAM DRAINAGE AREA MAP SCALE: 1" = 250,000</p>
--	--	--

CAMP DRESSER & MCKEE
Environmental Engineers
Boston, Mass.

CLIENT CORP OF ENGINEERS
PROJECT INSPECT. OF HIGH-FEED DAMS
DETAIL SWIFT RIVER (7)
PALMER & WINSOR DAMS, IIIA. QUADS

JOB NO. 80-5-RT
DATE CHECKED 1/25/78
CHECKED BY PAE

PAGE 5/15/78
DATE PAE
COMPUTED BY

FROM WATER RESOURCES DATA, DRAINAGE AREA TO
GAGE #C1175500 (SWIFT RIVER @ WEST WARE)
IS 186 mi². MEASURE DRAINAGE AREA FROM DAM
UP TO GAGE AND ADD IN.

DRAINAGE AREA TO BE ADDED:

Scale: 1" = 2000' ∴ #in² × 91.53 = # Acres (A)

#A ÷ 640 = mi²

PALMER, MA. QUAD

1. 21.72
2. 43.37 } 21.65 Ave = 21.685 in²

WINSOR, MA. QUAD

1. 16.14
2. 32.38 } 16.24 Ave = 16.19 in²

Total = 37.875 in² = 3478.0 A = 5.434 mi²

TOTAL DRAINAGE AREA =

193 mi²

DAM FAILURE ANALYSIS

$$Q_p = \frac{8}{27} W_b \sqrt{g} Y_o^{3/2}$$

S @ el 369.5 = 1500 ac-ft
dam to fail @ U.S. el 369.5
Toe of dam @ elevation 341.0
 $Y_o = 28.5$

Main Spillway = 121.5'

$$W_b = (.4)(121.5) = 48.6 \text{ SAY } 49'$$

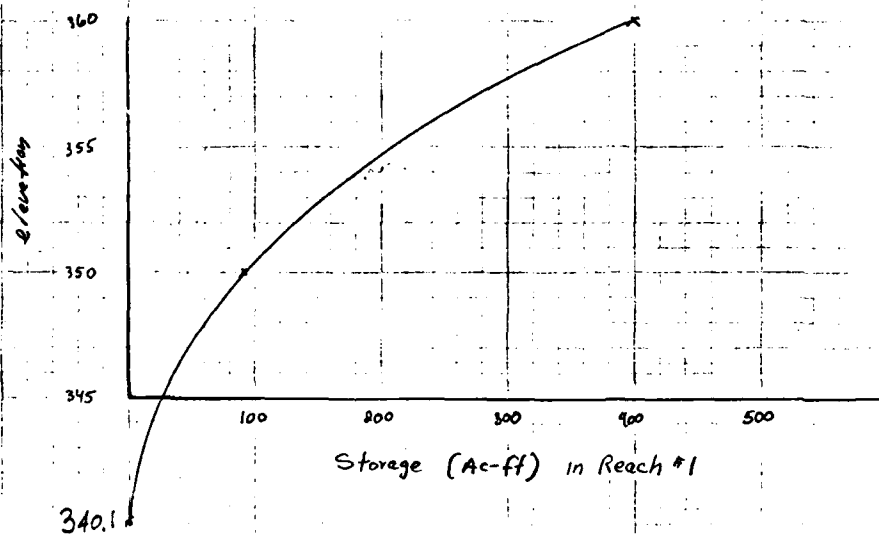
$$Q_p = \frac{8}{27} (49)(\sqrt{32.2})(28.5)^{3/2} = 12,500 \text{ cfs}$$

Reach 1 Upper Bondsville dam to Lower Bondsville dam

area @ el 340.1 (crest of lower dam) = 4.6 acres
area @ el 350 = 13.8 acres
area @ el 360 = 41.5 acres

surcharge stor.
0
911 ac-ft
402.6 ac-ft

compute surcharge storage above crest of lower dam



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Environmental Engineers
Boston, Mass.

CLIENT COE
PROJECT TEXTILE PRINTING (CPR)
DETAIL _____

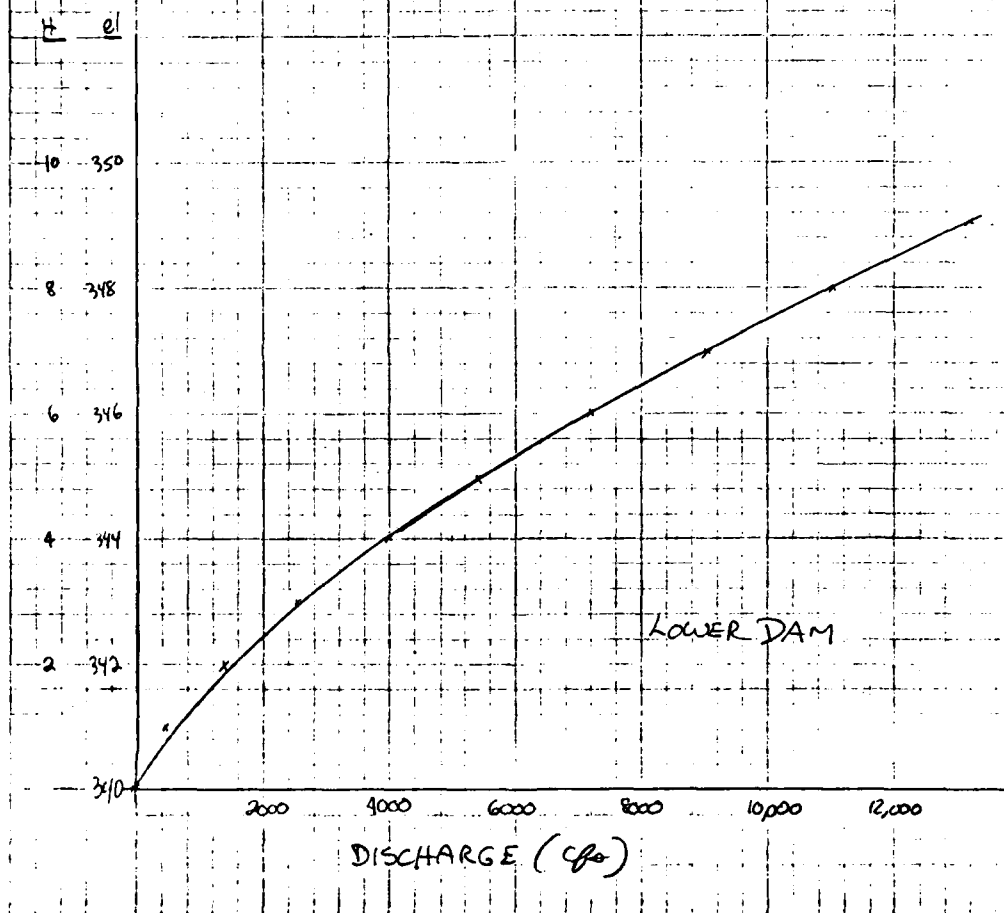
JOB NO. 380-5-7
DATE CHECKED 1-25-79
CHECKED BY ASR

PAGE 2
DATE 15 Feb 79
COMPUTED BY JA

Assume lower dam crest length = 150 ft $C=2.3$

$$Q = CLH^{3/2} = 420H^{3/2}$$

H	Q	H	Q	H	Q
1	495	5	5534	9	13365
2	1400	6	7275	10	15653
3	2572	7	9168		
4	3960	8	11200		



APPENDIX D-4

From "Rule of Thumb" Dam Failure Method

$$Q_p = 12,500 \text{ cfs at lower dam el} = 348.6$$

$$\therefore V_1 = 60 \text{ AC FT}$$

$$Q_{p2} \text{ Trial} = Q_p \left(1 - \frac{V_1}{S}\right) = 12,500 \left(1 - \frac{60}{1160}\right)$$

$$= 11853 \text{ cfs} = \text{el. } 348.3 \quad V_2 = 540$$

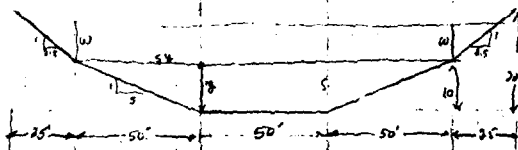
$$\frac{V_1 + V_2}{2} = \frac{60 + 540}{2} = 300 \text{ AC FT}$$

$$Q_{p2} = 12,500 \left(1 - \frac{300}{1160}\right) = 11,886 \text{ cfs} = \text{el. } 348.3$$

Reach 2 from lower dam to State St Bridge

Check D.S. channel capacity @ $Q = 11,886 \text{ cfs}$

assume $s = \frac{10}{1300} = .0077$; assume $Q = 11,886 \text{ cfs}$ is a surcharge flow above normal flow.



$$Q = 1.49 AR^{2/3} S^{1/2} \quad n = 0.025 \quad S = .0077$$

$$AR^{2/3} = \frac{(11,886)(.025)}{1.49(.0077)} = 228$$

$$\text{Let } y = 5 \quad AR^{2/3} = 54(10+y) \left[\frac{54(10+y)}{50+102y} \right]^{2/3}$$

$$= 5 \quad = 903$$

$$AR^{2/3} = 375 + 150y + 2.5y^2 \left[\frac{375 + 150y + 2.5y^2}{101 + 5.38y} \right]^{2/3}$$

$$\text{Let } y = 7 \quad AR^{2/3} = 2047 \quad \text{OK}$$

$$\text{Let } y = 8 \quad Q = \left(\frac{1.49}{.025} \right) (720) (5.478)^{2/3} (.0077)^{1/2} = 11,661 \text{ cfs} \approx 11,890 \text{ cfs}$$

$$A = 504 + 54^2 = 54(10+y)$$

$$wp = 50 + 2\sqrt{y^2 + 25y} = 50 + 102y$$

$$R = \frac{54(10+y)}{50 + 102y}$$

$$A = 375 + 150y + 2.5y^2$$

$$wp = 101 + 2\sqrt{y^2 + 25y}$$

$$= 101 + 5.38y$$

From contour map downstream of lower dam el ≈ 330 dist to bridge $\approx 200 \text{ ft}$
at a slope of .0077 w.s. el in vicinity of bridge $\approx 330 - 200(.0077) = 328$
at $328 + 7$ rise to accommodate additional 11,000 cfs. $\approx \text{el } 335$.

Downstream of bridge development is sparse and is generally above el 340
Development @ Crystal Lake @ el 320-325, however river drops additional 15' also. \therefore No danger

CAMP DRESSER & MCKEE
Environmental Engineers
Boston, Mass.

CLIENT Corps of Engineers
PROJECT Textile Printing Co (Upper)
DETAIL _____

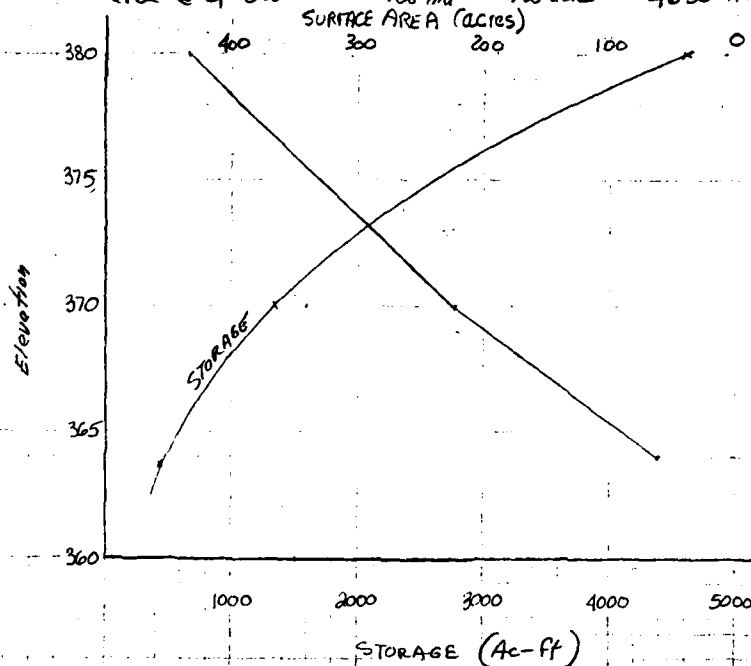
JOB NO. 380-5-7
DATE CHECKED 1-25-78
CHECKED BY Miller

PAGE 4
DATE 1 NOV 1978
COMPUTED BY JUL

UPPER BONDVILLE DAM

area @ el 363.7 (crest) = .09 mi² = 60 acres
area @ el 370 = .34 mi² = 221 acres
area @ el 380 = .68 mi² = 436 acres

Total Storage
460 Ac-ft
1345 Ac-ft
4630 Ac-ft



Determine Size Classification of Textile Mill dam

Top of dam at el 381.2
Toe of dam at el 342.7
height = 28.5 ∴ small

Storage at top of dam 1160 ac-ft ∴ intermediate

Dam has size classification of intermediate

CAMP DRESSER & MCKEE
Environmental Engineers
Boston, Mass

CLIENT Corps of Engineers
PROJECT Textile Printing Co (upper)
DETAIL _____

JOB NO. 380-5-7
DATE CHECKED 1-25-78
CHECKED BY Becker

PAGE 5
DATE 1 Nov 78
COMPUTED BY JW

From Dam Failure analysis, downstream hazard potential is Significant

Test Flood

for: Significant hazard $> 1/2$ PMF to PMF
intermediate size

USE $1/2$ PMF as size classification of dam just edges
Textile Dam into the intermediate category

D.A. to dam = 193 mi^2
less D.A. to Quabbin 186
Trib. D.A. = 7 mi^2

From PMF CURVE midway between rolling + mountainous

$7 \text{ mi}^2 @ 1975 \text{ cfs/ac} = 13,475 \text{ cfs}$

$1/2 \text{ PMF} = 6737 \text{ say } 6750 \text{ cfs}$

@ el 359.8

Check effect of routing flow

$Q_p = 6750 \text{ cfs} @ \text{el } 359.8$ Storage = 1200

less storage to crest = 460

840 = surcharge storage

D.A. = $7 \text{ mi}^2 = 4480 \text{ acres}$

$\frac{840 \text{ ac-ft}}{4480 \text{ Ac}} = .1875 \text{ ft} = 2.25 \text{ in R.O. = SUR}$

$Q_{p2} = Q_{p1} \left(1 - \frac{\text{STOR}_1}{9.5}\right) = 6750 \left(1 - \frac{1200}{9.5}\right) = 5150 \text{ cfs} @ \text{el } 358.7 \text{ SUR} = 1110 - 460 = 650$

$\text{STOR}_2 = \frac{650}{1.460} = 1.74 \text{ inches}$

$Q_{p1} = 6750 \left(1 - \frac{2.25 + 1.74}{9.5}\right) = 5332 \text{ cfs}$

USE 5330 cfs @ el 369

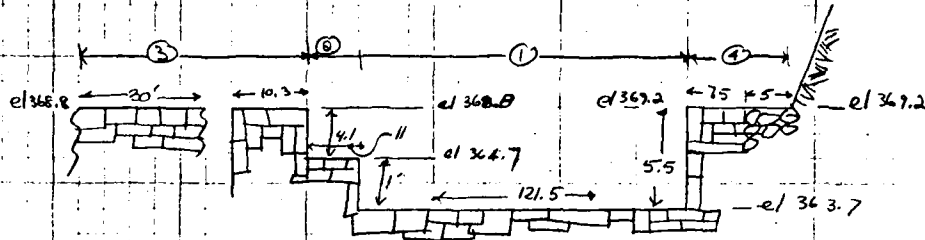
CAMP DRESSER & McKEE
Environmental Engineers
Boston, Mass.

CLIENT COE
PROJECT TEXTILE PRINTING CO (UPPER)
DETAIL _____

JOB NO 360-5-7
DATE CHECKED 1-25-79
CHECKED BY DEK

PAGE _____
DATE 16 FEB 79
COMPUTED BY gju

UPPER BONDSDVILLE DAM RATING CURVE



$C_1 = 3.33$ $C_2 = 3.0$ $C_3 = 3.0$ $C_4 = 2.9$ 10 gates @ 3.5' x 4.0'

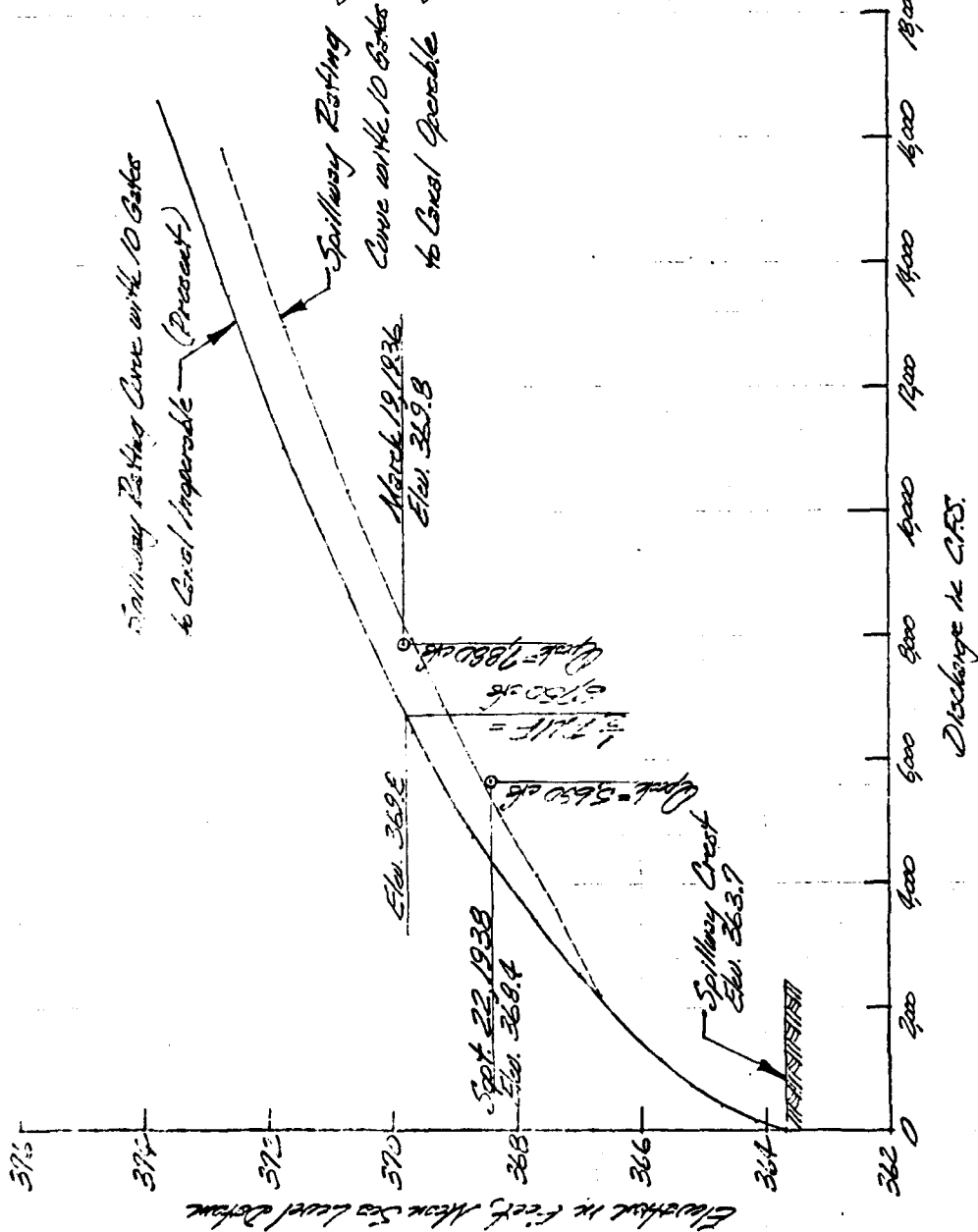
H	FL	Q_1	Q_2	Q_3	Q_4	GATES	Q TOTAL 4% GATES	Q TOTAL w/ GATES
0	363.7	0	0				0	
.5	364.2	143	0				143	
1.0	364.7	405	0				405	
1.5	365.2	713	12				755	
2	365.7	1144	33				1177	
3	366.7	2122	93			0	2195	
4	367.7	3237	171			752	3408	4160
5	368.7	4524	264			1172	4788	5760
5.1	368.8	4660	274			1206	4934	6140
5.3	369.0	4937	294	11		1271	5242	6513
5.5	369.2	5219	315	30		1333	5565	6813
6	369.7	5946	369	121	59	1477	6495	772
7	370.7	7493	485	342	306	1729	8626	10355
8	371.7	9155	611	628	659	1949	11083	13012
9	372.7	10924	747	967	1092	2146	13730	15876
10	373.7	12794	891	1353	1592	2326	16629	18955

$$Q = (0.8)(3.5)(4)(10) \sqrt{2gH}$$

CAMP DRESSER & MCKEE
Environmental Engineers
Boston, Mass

CLIENT General Engineering & Surveying, Inc. JOB NO. 380-5-07
PROJECT Little Hunting Co. Spillway CHECKED BY 15 Feb 77
DETAIL Spillway Rating Curve CHECKED BY 961

PAGE 7 of 8
DATE Dec. 24, 1976
COMPUTED BY W. J. Miller

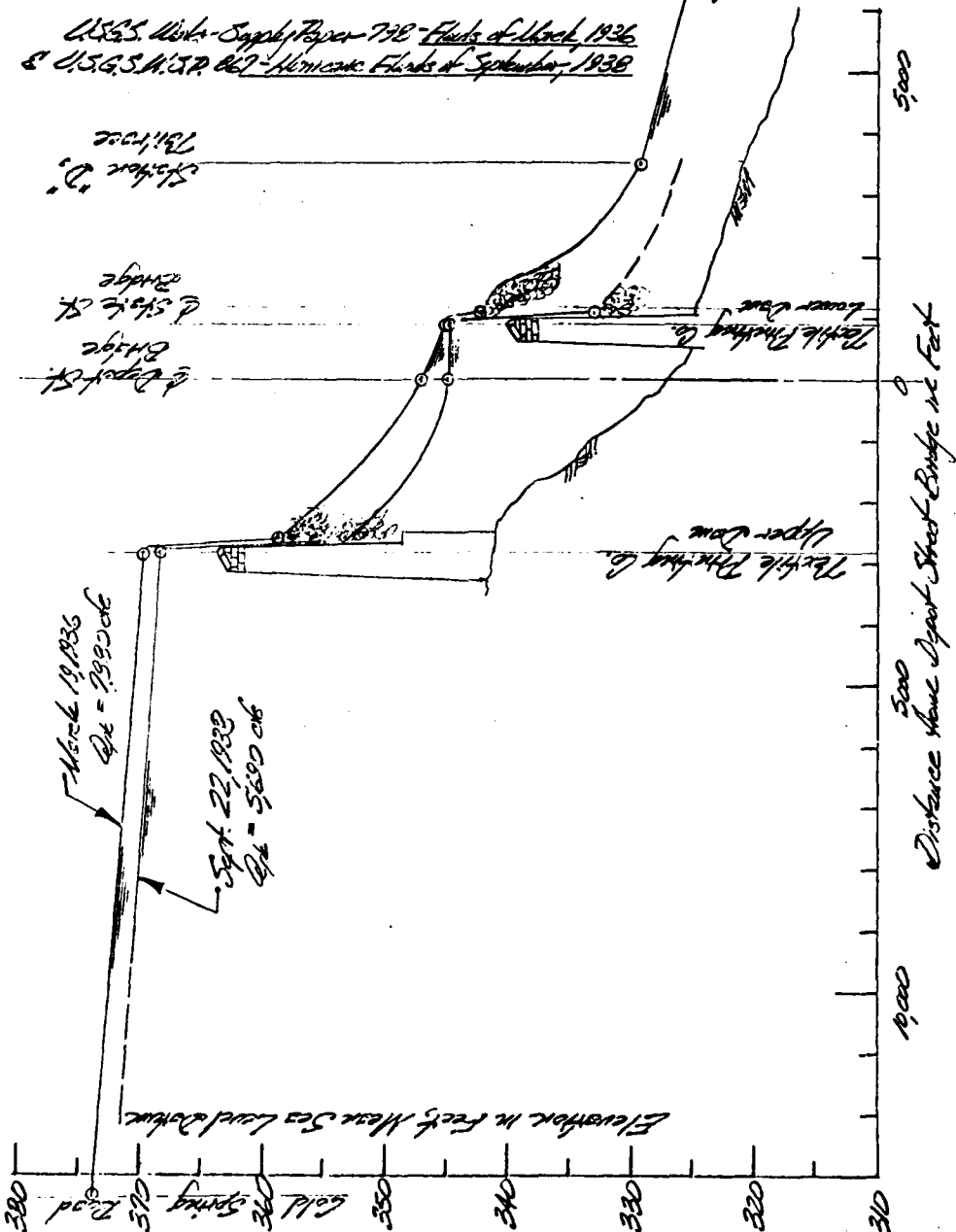


APPENDIX D-9

CAMP DRESSER & MCKEE
 ENVIRONMENTAL ENGINEERS
 BOSTON, MASS.

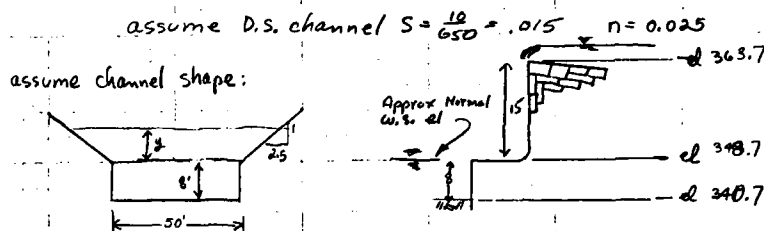
CLIENT City of Everett, Wash. JOB NO. 380-5-07 PAGE 72 of 8
 PROJECT Teahale Flushing Co. Upper Dam DATE CHECKED 1/26/79 DATE Jan. 24, 1979
 DETAIL Historic Flood Profiles CHECKED BY RM COMPUTED BY Stetler

U.S.S. Works Supply River 79E Flood of March, 1936
& U.S.G.S. N.S.P. 667 - Historic Flood of September, 1938



Peak Routed outflow from Quabbin will occur about 40 hrs after storm event and will have no effect on the 1/2 PMF discharge computed for Tektile Dam

TAILWATER ANALYSIS



check the effect of storage on 1/2 PMF discharge

$$Q_p = 6750 \text{ cfs @ el } 349.8 \quad \text{STORAGE} = 1300 \text{ Ac-ft}$$

less storage to crest -460
840 Ac-ft surcharge storage

$$D.A. = 7 \text{ mi}^2 = 4480 \text{ Acres}$$

$$\frac{840 \text{ Ac-ft}}{4480 \text{ Ac}} = .1875 \text{ ft} = 2.25 \text{ inches R.O.} = \text{STOR}_1$$

$$Q_{p_2} = Q_p \left(1 - \frac{\text{STOR}_1}{9.5}\right) = 6750 \left(1 - \frac{2.25}{9.5}\right) = 5250 \text{ cfs @ el } 348.9$$

$$\text{STOR}_2 = \frac{650}{4480} = 1.74 \text{ inches}$$

$$\text{STOR} = 1110 - 460 = 650 \text{ Ac-ft}$$

$$Q_{p_3} = (6750) \left(1 - \frac{2.25 + 1.74}{9.5}\right) = 5330 \text{ cfs}$$

USE 5330 cfs for tailwater analysis

look at surcharge flow

$$Q = 1.49 A R^{4/3} S^{1/2}$$

$$A = 50y + 2.5y^2 = 2.5y(20+y)$$

$$WP = 50 + 2\sqrt{y \cdot 6.25y^2} = 50 + 5.385y$$

$$A R^{4/3} = \frac{(5330)(.015)^{1/2}}{(1.49)(.0006)^{2/3}} = 1155 = 2.5y(20+y) \left[\frac{2.5y(20+y)}{50 + 5.385y} \right]^{4/3}$$

$$\text{let depth} = 7.3' \quad A = 265 \quad WP = 41.6 \quad R = 5.650$$

$$A R^{4/3} = 1158 \approx 1155$$

$$WS \approx 348.7 + 7.3 = 356'$$

D.S. W.S. is below crest
OK

Hydrology - Storm Water
Cambridge, Mass.

1.0 in/hr. 15 min. depth to 6.0 in/hr. 15 min. depth to 1.0 in/hr. 15 min. depth

Time in hrs.	Land Surface Inflow	Time in hrs.	Land Surface Inflow	Water Surface Inflow	Total Hydrograph
0	0	0	0	0	0
1	225	1	225	33,800	34,025
2	475	2	475	35,750	36,225
3	750	3	750	107,500	108,250
4	1050	4	1050	57,900	60,950
5	1450	5	1450	36,900	39,750
6	2100	6	2100	12,000	14,100
7	2800	7	2800	0	2,800
8	3400	8	3400	0	3,600
9	5,000	9	5,000	0	5,000
10	6,400	10	6,400	0	6,400
etc.	etc.	etc.	etc.	etc.	etc.
11	63,000				
12	66,500				
13	67,000				
14	63,000				
15	51,000				
16	47,000				
17	41,000				
18	37,500				
19	34,000				
20	30,800				
21	27,500				
22	24,900				
23	22,000				
24	20,000				
25	19,800				
26	15,000				
27	14,000				
28	13,500				
29	11,500				
30	10,000				
31	9,500				
32	5,500				
33	5,800				

Previous flood routing indicates that
effect of 35" rainfall (0.917') in 6 hrs.
was to raise water level in Cambridge L.S.
by 1.18' at end of 13 hours, thereby affecting
stream the watershed. It will assume that the
lesser rainfall of 9.5" in 6 hrs. (0.27') will
also be effectively stored so as to produce an
increase in W.S. to 0.90' at end of 6 hrs.
 $Q = 10,000 \text{ cfs}$

CAMP DRESSER & MCKEE
ENVIRONMENTAL ENGINEERS
BOSTON, MASS.

CLIENT City of Cambridge, Mass. JOB NO. 300-57 PAGE 2 of 5
PROJECT Public Works Dept. Flood Control DATE CHECKED 4/13/72 DATE April 5, 1972
DETAIL Highway - Flood Routing CHECKED BY JED COMPUTED BY Dr. J. E. D.

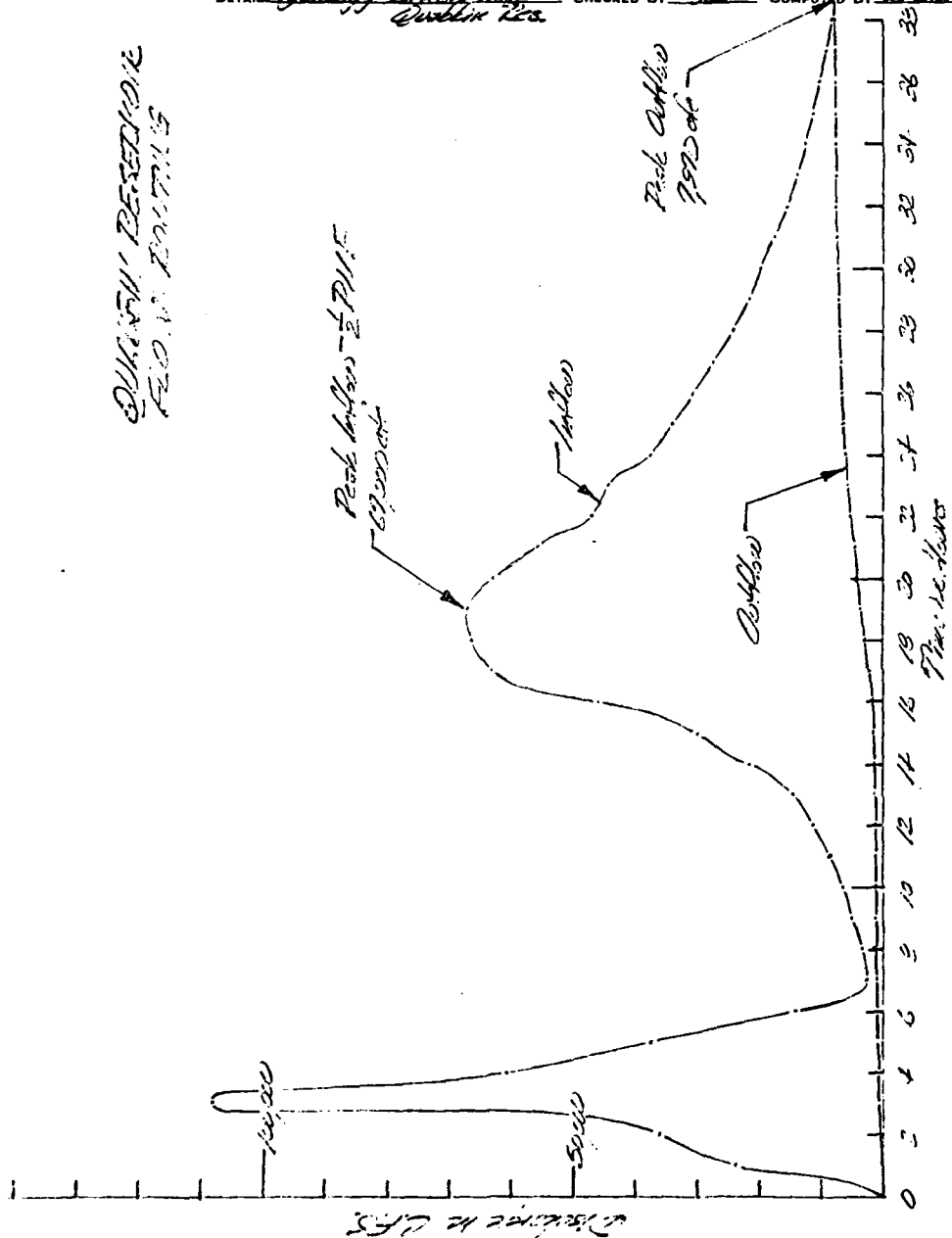
GLACIER IN RESERVOIR - FLOOD ROUTING

Time	Observed Inflow (cfs)	Assumed Inflow (cfs)	$\Sigma - \frac{Q}{2}$ AT	$\Sigma + \frac{Q}{2}$ AT	Head at Spillway (ft.)	Outflow (cfs)
8 hrs	3,600	3,200	229,706	212,906	0.80	1,060
9	5,000	4,300	241,626	245,926	0.82	1,090
10	6,400	5,700	244,771	250,471	0.83	1,110
11	8,800	7,600	247,223	256,823	0.85	1,160
12	11,500	11,200	253,544	265,744	0.86	1,230
13	14,800	13,300	264,420	277,620	0.92	1,320
14	21,800	18,300	276,237	294,537	0.98	1,465
15	30,000	25,900	283,070	318,970	1.06	1,665
16	46,000	38,000	317,300	355,300	1.18	1,965
17	63,000	54,500	353,265	417,765	1.35	2,360
18	66,500	64,800	415,270	470,070	1.55	2,960
19	67,000	66,800	446,963	533,763	1.76	3,640
20	62,000	65,000	530,049	595,049	1.96	4,290
21	56,000	59,500	590,753	650,353	2.14	4,940
22	47,000	51,500	645,631	697,134	2.30	5,320
23	44,400	45,700	692,282	739,982	2.43	5,720
24	39,500	41,000	732,928	773,928	2.55	6,120
25	34,900	35,800	768,697	804,497	2.65	6,440
26	30,800	32,400	799,114	831,514	2.73	6,660
27	27,500	29,200	825,997	855,197	2.81	6,920
28	24,400	26,000	847,563	875,563	2.88	7,120
29	22,000	23,200	869,829	893,029	2.93	7,300
30	20,000	21,000	889,208	908,208	2.98	7,440
31	19,800	19,900	902,311	921,211	3.02	7,560
32	18,800	18,800	915,242	932,042	3.06	7,640
33	18,000	18,900	926,009	940,909	3.08	7,680
34	13,800	13,400	934,822	948,222	3.11	7,820
35	11,500	12,200	942,092	954,292	3.12	7,840
36	10,300	10,900	943,126	959,026	3.14	7,890
37	9,300	9,800	952,831	962,631	3.148	7,920
38	8,400	8,800	956,415	965,215	3.156	7,950
39	7,500	8,000	959,984	966,984	3.161	7,960
40	6,900	7,200	962,711	967,711	3.164	7,970
41	6,300	6,600	964,694	968,294	3.165	7,970
42	5,800	6,000	966,044	968,044	3.164	7,970
43	5,400	5,600	967,775	967,575	3.162	7,960

CAMP DRESSER & MCKEE
ENVIRONMENTAL ENGINEERS
BOSTON, MASS.

CLIENT Cox & Sumner, Inc. Job No. 340-5-7 PAGE 3 of 5
PROJECT Particle Tracking Analysis DATE CHECKED 4/13/77 DATE April 8, 1977
DETAIL Hydrology - Effluent Study CHECKED BY VED COMPUTED BY STP/WR
Quabbin Res.

QUABBIN RESERVOIR
FED. RES. 7/1/75



APPENDIX D-14

Hydrology - Upper Tectile Parking Co. (Upper) Dam

Drainage Area = $1.6 + 5.4 = 7.0$ sq. mi. (not including Quabbin Res. watershed)

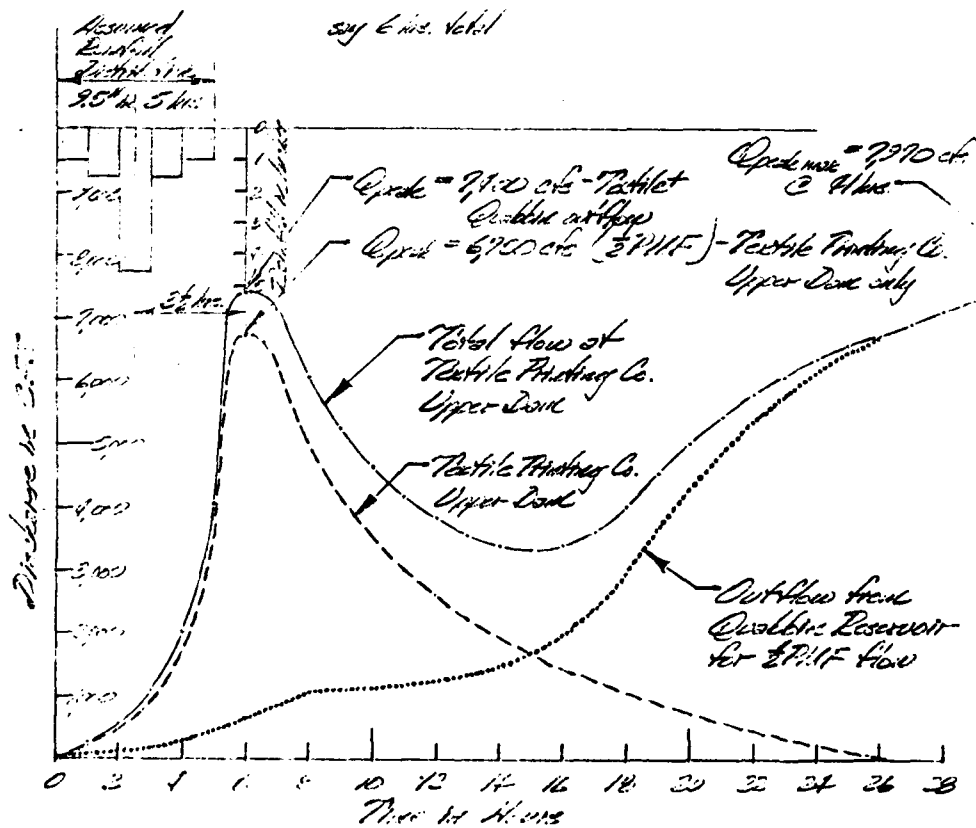
Re $\frac{1}{2}$ P.H.F. use 3.5" pipe, 100' at 6-hrs

Consider flow of concentration for 7.0 sq. mi. watershed

overland $\frac{7.0 - 5.4}{3600} = \frac{1.6}{3600}$ say 40 min.

in pipe $\frac{5.4 - 3.9}{3600} = \frac{1.5}{3600}$ 0.37 hrs. = 22 min.

Sanitary $\frac{3.9 - 3.4}{3600} = \frac{0.5}{3600}$ 5 hrs.



CAMP DRESSER & MCKEE
Environmental Engineers
Boston, Mass

CLIENT Capt. J. G. Gannon, U.S. Army JOB NO. 380-5-7
PROJECT Quabbin Reservoir (S. 100 ft) DATE CHECKED 4/13/79
DETAIL Quabbin Reservoir CHECKED BY JED

PAGE 5 of 5
DATE April 4, 1979
COMPUTED BY JED

Consider effect of surcharge storage on Quabbin Reservoir
as a result of test flood = $\frac{1}{2}$ T.M.F.

$$Q_{peak\ initial} = 7970 \text{ cfs @ 41 hrs.} \quad \text{Stage} = \text{Elev. 570.4}$$

$$\begin{aligned} \text{Storage} &= 1450 \\ \text{loss storage to bed} &= -460 \\ \hline 990 &= \text{surcharge storage} \end{aligned}$$

$$\text{Loss storage} = 7.0 \text{ sq. mi.} = 4480 \text{ acres} \quad \frac{990}{4480} = 0.221 \text{ ft.} = 2.65 \text{ in. R.O. = 572.1}$$

$$Q_{p2} = Q_{p1} \left(1 - \frac{572.1}{570.4}\right) = 7970 \left(1 - \frac{2.65}{95}\right) = 5717 \text{ cfs} \quad \text{Stage} = \text{Elev. 569.3}$$

$$\text{surcharge storage} = 1185 - 460 = 725 \quad \frac{725}{4480} = 0.162 \text{ ft.} = 1.94 \text{ in. R.O. = 570.2}$$

$$Q_{p3} = 7970 \left[1 - \frac{2.65 + 1.94}{95}\right] = 6095 \text{ cfs} \quad \text{Stage} = \text{Elev. 569.15}$$

Consider effect of surcharge storage as noted for T.M.F. test flood with flow
at 16,370 cfs for Quabbin Reservoir.

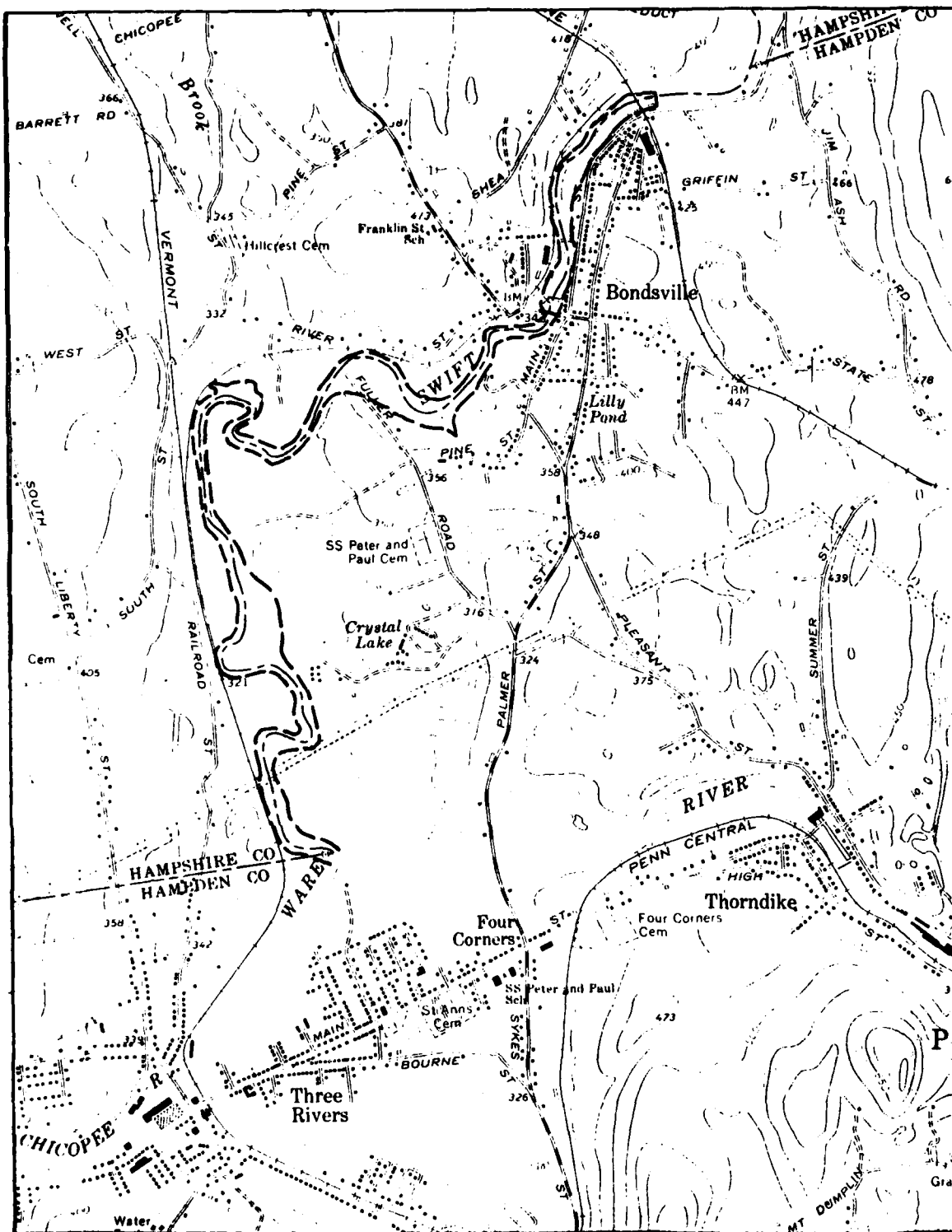
$$Q_{peak\ initial} = 16,370 \text{ cfs @ 41 hrs.} \quad \text{Stage} = \text{Elev. 573.6}$$

$$\begin{aligned} \text{Storage} &= 2250 \\ \text{loss storage to bed} &= -460 \\ \hline 1790 &= \text{surcharge storage} \quad \frac{1790}{4480} = 0.399 \text{ ft.} = 4.79 \text{ in. R.O. = 572.1} \\ &= 572.1 \end{aligned}$$

$$Q_{p2} = Q_{p1} \left(1 - \frac{572.1}{573.6}\right) = 16,370 \left(1 - \frac{4.79}{90}\right) = 12,243 \text{ cfs} \quad \text{Stage} = \text{Elev. 572.15}$$

$$\text{surcharge storage} = 1650 - 460 = 1190 \quad \frac{1190}{4480} = 0.265 \text{ ft.} = 3.18 \text{ in. R.O. = 572.2}$$

$$Q_{p3} = 16,370 \left[1 - \frac{4.79 + 3.18}{90}\right] = 12,704 \text{ cfs} \quad \text{Stage} = \text{Elev. 572.21}$$



DAM TEXTILE PRINTING CO. - UPPER
 IDENTIFICATION NO. MA 00560



DAM FAILURE IMPACT AREA MAP
 USGS QUADRANGLE

PALMER, MA.

APPROX. SCALE: 1" = 2000'

APPENDIX D-17

APPENDIX E
INFORMATION AS CONTAINED IN
THE NATIONAL INVENTORY OF DAMS

DAM

INVENTORY OF DAMS IN THE UNITED STATES

STATE	DIVISION	IDENTITY NUMBER	STATE	COUNTY	CORNER	NAME	LATITUDE (NORTH)	LONGITUDE (WEST)	REPORT DATE
MA	540	160	MA	013	02	TEXTILE PRINTING COMPANY-UPPER DAM	4213.3	7220.3	00FEB79

POPULAR NAME	NAME OF IMPOUNDMENT
	SWIFT RIVER

REGION BASIN	RIVER OR STREAM	NEAREST DOWNSTREAM CITY-TOWN-VILLAGE	DIST FROM DAM (MI.)	POPULATION
01	SWIFT RIVER	PALMER	0	11700

TYPE OF DAM	YEAR COMPLETED	PURPOSES	STRUCTURAL HEIGHT (FT.)	IMPOUNDING CAPACITIES (ACRES-FT.)	DIST OWN	FED R	PRV/FED	SCS A	VER/DATE
REGULAT	1900		20	1160	460	N	N	N	N

REMARKS

D/S HAS	SPILLWAY	MAXIMUM DISCHARGE (CFS)	VOLUME OF DAM (CU)	POWER CAPACITY (MW)	INSTALLED	PROPOSED	NO.	LENGTH (FT.)	WIDTH (FT.)	HEIGHT (FT.)	LENGTH (FT.)	WIDTH (FT.)	HEIGHT (FT.)
2	230	5330											

OWNER	ENGINEERING BY	CONSTRUCTION BY
GOPODSVILLE REALTY INC.		

DESIGN	CONSTRUCTION	OPERATION	MAINTENANCE
NONE	NONE	NONE	NONE

INSPECTION BY	INSPECTION DATE	AUTHORITY FOR INSPECTION
CAMP DRESSER + MCKEE INC	07SEP78	PL 92-367

REMARKS

DATE
FILMED
-8