



US Army Corps
of Engineers
New England Division

Drought Contingency Storage Plan

NOVEMBER 1984

Barre Falls Dam, Barre, Massachusetts

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US Army Corps of Engineers,
New England District



CONNECTICUT RIVER BASIN
WARE RIVER WATERSHED

DROUGHT CONTINGENCY STORAGE PLAN
BARRE FALLS DAM
BARRE, MASSACHUSETTS

NOVEMBER 1984

NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254-9149

SYLLABUS

A drought contingency plan was studied for Barre Falls Dam in an effort to be responsive to public needs during drought situations. Due to the existing MDC water supply operations in the Ware River watershed, drought contingency storage plans would be precluded at Barre Falls Dam. Releases of excess floodwaters from Barre Falls Dam are currently coordinated with the water supply operations of the Metropolitan District Commission of the Commonwealth of Massachusetts, with released water diverted to the Quabbin and Wachusett Reservoirs by means of an aqueduct system from the Coldbrook intake.

DROUGHT CONTINGENCY PLAN
BARRE FALLS DAM

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DROUGHT CONTINGENCY STORAGE PLAN
BARRE FALLS DAM

1. PURPOSE AND SCOPE

The purpose of this study and report was to develop and set forth a drought contingency storage plan of operation for Barre Falls Dam that would be responsible to public needs during drought periods and to identify possible constraints. This evaluation was based on preliminary studies using readily available information. This drought contingency plan includes a description of existing water supply systems, potential for water supply reallocation, and summary and conclusions.

2. AUTHORIZATION

The authority for the preparation of drought contingency plans is contained in ER 1110-2-1941 which provides that water control managers will continually review and, when appropriate, adjust water control plans in response to changing public needs. Drought contingency plans will be developed on a regional, basin-wide and project basis as an integral part of water control management activities.

3. PROJECT AUTHORIZATION CONDITIONS

Barre Falls Dam was authorized as a flood control project for the Chicopee River watershed in the Flood Control Act of 18 August 1941 (Public Law No. 228, 78th Congress) and 22 December 1944 (Public Law No. 534, 78th Congress).

4. PROJECT DESCRIPTION

Barre Falls Dam is a single purpose flood control project, located in Barre, Massachusetts on the Ware River, built and operated by the Corps of Engineers. The dam is about 32 miles upstream of the confluence of the Ware and Swift Rivers and about 52 miles upstream of the mouth of the Chicopee River. A map of the Connecticut River basin is shown on plate 1. The reservoir has a total storage capacity of 24,000 acre-feet (7.8 billion gallons), equivalent to 8.2 inches of runoff from a drainage area of 55 square miles. A capacity table is

shown on plate 2 and a summary of pertinent data at Barre Falls Dam is contained on plate 3.

Components of the project consist of a rolled earth-filled dam with rock slope protection, concrete spillway, three dikes and the outlet works. The outlet works consist of an intake structure, a gate tower and a 9'8" diameter horseshoe conduit. The discharge through the conduit is controlled by two 4.5 foot wide by 9.0 foot high sluice gates.

The three dikes, with a maximum height of 48 feet, have a total length of 3,215 feet. The dikes are located in three saddles along the southern rim of the reservoir.

5. PRESENT OPERATING REGULATIONS

a. Normal Periods. The normal gate openings are 2'-2". This gate setting automatically restricts discharges so that significant reservoir releases do not occur in the event of sudden increases in inflow. A winter pool is maintained at Barre Falls Dam at an elevation between 776 and 778 feet NGVD to prevent freezing of the flood control gates.

b. Flood Periods. The Barre Falls project is operated in concert with other flood control projects in the Connecticut River basin to reduce downstream flooding along the Ware, Chicopee and Connecticut Rivers. Operations for floods may be considered in three phases: phase I - appraisal of storm and river conditions during development of a flood; phase II - flow regulation and storage of flood runoff at the reservoir, and phase III - emptying the reservoir during recession of the flood. The regulation procedures are detailed in the Master Water Control Manual for the Connecticut River Basin.

c. Regulating Constraints

(1) Minimum Releases. A minimum release of about 10 cfs (6.5 mgd) is maintained during periods of flood regulation in order to sustain downstream fish life.

(2) Maximum Releases. The maximum nondamaging discharge capacity of the channel immediately downstream of Barre Falls Dam is about 1,000 cfs. Releases at or near this rate can be expected whenever reservoir inflows

exceed this value, and meteorologic and hydrologic conditions permit.

6. MONITORING OF HYDROLOGIC CONDITIONS

The Reservoir Control Center directs the reservoir regulation activities at 28 New England Division flood control dams, and continually monitors rainfall, snow cover and runoff conditions throughout the region. When any of these hydrologic parameters have been well below normal for several months and it appears that possible drought conditions might develop, the Corps Emergency Operations Center (EOC) will be so informed. The EOC will then initiate discussions with the respective Federal and State agencies and other in-house Corps elements to review possible drought concerns and future Corps actions.

7. DESCRIPTION OF EXISTING WATER SUPPLY CONDITIONS

a. General. The area of concern is a portion of the central region of Massachusetts in the vicinity of Barre Falls Dam. Table 1 contains information about public water suppliers in this mostly rural area based on information provided by the Massachusetts Department of Environmental Management Division of Water Resources. Of the eight communities viewed as potential users of water from Barre Falls Dam during drought conditions, only three of the communities are served by a public water supply system. No data is available for those areas dependent on private individual water supplies.

b. Water Supply Systems. The primary objective of this analysis was to accumulate available data regarding water supply systems in the vicinity of Barre Falls Dam which could benefit from storage at the project and present the data in a manner accurately portraying existing water supply conditions. Projections of future demands were not developed because this study only addresses modifications in the operational procedure at Barre Falls Dam in order to provide storage for water supply purposes when drought conditions exist, and not to meet normal water supply demands at some future date.

c. Public Water Suppliers. As noted in table 1, the data given for each water supplier in the vicinity of Barre Falls Dam includes: community served, estimated population served by the system, source of supply (ground or surface water), average day and maximum day demands for 1980, estimated safe yield of supply sources, and any further information available on the source of supply.

Table 1
Major Water Suppliers - Vicinity of Barre Falls Dam

<u>Company or Agency</u>	<u>Town Served</u>	<u>Est. Population Served - 1980</u>	<u>Source of Supply SW/GW</u>	<u>1980 Demand</u>		<u>Safe Yield (MGD)</u>	<u>Comments</u>
				<u>Avg. Day (MGD)</u>	<u>Max. Day (MGD)</u>		
Barre Water Dept.	Barre	2,766	SW/GW	0.250	0.370	0.675	2 Wells Barre Reservoir
Barre Wool Combing Co.	Barre	270	GW	0.020	0.030	0.950	1 Well
Hardwick Ct. Water Dept.	Hardwick	63	GW	0.009	0.014	0.019	1 Well
Gilbertsville Water District	Hardwick	1,215	GW	0.074	0.112	0.150	1 Well
Wheelwright Water District	Hardwick	286	GW	0.039	0.039	0.418	2 Wells
	Hubbardston		No Public Water Supply				
	New Braintree		No Public Water Supply				
	Oakham		No Public Water Supply				
	Petersham		No Public Water Supply				
	Phillipston		No Public Water Supply				
Rutland Water Dept.	Rutland	2,770	SW	0.240	0.500	0.225	Maschopauge Pond
Cool Sandy Beach Co.	Rutland	95	GW	-	-	-	Seasonally Used

An analysis of adequacy of existing sources during drought conditions was not performed. The information has been accumulated to present a summary of the existing water supply conditions for area communities in the vicinity of Barre Falls Dam.

d. Population Projections. Population projections for communities in the immediate vicinity of Barre Falls Dam are given in table 2 to show population trends for each community potentially affected by a prolonged dry period. The projections for these communities were provided by the Massachusetts Department of Environmental Management Division of Water Resources. As can be seen from the table, an increase in population for the area as a whole is projected for the time period 1980-2000, although this increase, as a result of the rural nature of the area, amounts to only about 3,000 new residents in the area.

8. POTENTIAL FOR WATER SUPPLY REALLOCATION

a. General. There are several authorities that provide for the use of reservoir storage for water supply at Corps of Engineers projects. They vary from the provision of water supply storage as a major purpose in new projects to the discretionary authority to provide emergency supplies to local communities in need. In addition, guidance contained in ER 1110-2-1941 directs field offices to determine the short-term water supply capability of existing Corps reservoirs. Congressional authorization is not required to add municipal and industrial water supply if the related revisions in regulation would not significantly affect operation of the project for the originally authorized purposes.

b. Drought Contingency Storage

(1) General. Large portions of the Swift and Ware River watersheds are owned by, and controlled through, facilities of the Metropolitan District Commission (MDC) of the Commonwealth of Massachusetts for use as a source of water supply for Metropolitan Boston. The facilities consist of the Coldbrook Intake and Quabbin Reservoir, in the Ware River and Swift River watersheds, respectively. The Coldbrook intake, located downstream of Barre Falls, diverts water from the Ware River into the MDC system (i.e., Quabbin Reservoir and occasionally Wachusett Reservoir). The reservoir lands associated with Barre Falls, except for a small operating area, are owned by the MDC. Flow easements have been acquired by the Corps at Barre Falls, allowing for flood

Table 2
Population Projections - Communities Near Barre Falls Dam

<u>Town</u>	<u>Actual 1980</u>	<u>1985</u>	<u>1990</u>	<u>1995</u>	<u>2000</u>	<u>Percent Change</u>
Barre	4,102	4,175	4,200	4,225	4,250	3.5
Hardwick	2,272	2,325	2,375	2,400	2,425	6.7
Hubbardston	1,797	2,013	2,229	2,444	2,660	48.0
New Braintree	671	750	775	825	850	26.7
Oakham	994	1,050	1,100	1,125	1,175	18.2
Pertersham	1,024	1,029	1,034	1,039	1,044	2.0
Phillipston	953	993	1,034	1,075	1,115	17.0
Rutland	<u>4,334</u>	<u>4,650</u>	<u>4,975</u>	<u>5,275</u>	<u>5,600</u>	<u>29.2</u>
	16,147	16,985	17,722	18,408	19,119	18.4

control storage. Releases of excess floodwaters from Barre Falls Dam are coordinated with the MDC water supply operations.

(2) Coldbrook Intake. The Coldbrook intake is located approximately 4 miles downstream of Barre Falls Dam, and controls about 45 percent of the 216 square mile drainage area of the Ware River. The function of the intake structure is to divert water from the Ware River to the MDC system via a series of aqueducts.

The normal diversion period is 6 months (1 December to 31 May) but may be extended to 8 months (15 October to 15 June) if approved by the Massachusetts Board of Health. The maximum diversion capacity of the intake to Quabbin Reservoir is 890 cfs and the combined capacity to both Wachusett and Quabbin Reservoirs is 2,960 cfs. The MDC is required by law to allow 132 cfs to pass the Coldbrook Intake for use by downstream interests. Efforts are made to coordinate floodwater releases from Barre Falls with the MDC so as not to exceed their diversion capacity if water is needed within their system.

(3) Effects of MDC Water Supply Operations. Because of the existing MDC water supply operations within the Ware River watershed, drought contingency storage plans are precluded at Barre Falls. The MDC system, however, does not directly benefit the Swift and Ware River watersheds as the system's service area is Metropolitan Boston. In an emergency, state legislation could be enacted to allow communities in the Swift and Ware watersheds to obtain water from the MDC system. As most of the communities do not have the distribution facilities to enable them to tap directly into the MDC system, they would have to rely on pumping from the Quabbin Reservoir into containment vessels for transport back to the communities.

As the MDC does not divert flows during the summer months, it is possible that if a severe drought emergency were to occur during that time period, water could be stored at Barre Falls, or added diversion of the Ware River flows could be permitted at the Coldbrook intake. The curtailment of flows from Barre Falls during a drought emergency could adversely impact on the flowage rights of downstream riparian users, including the MDC. At this time it is not possible to review all of the various drought emergency situations that could occur, nor is it within the scope of this report to identify all those with water rights. It is important to note that

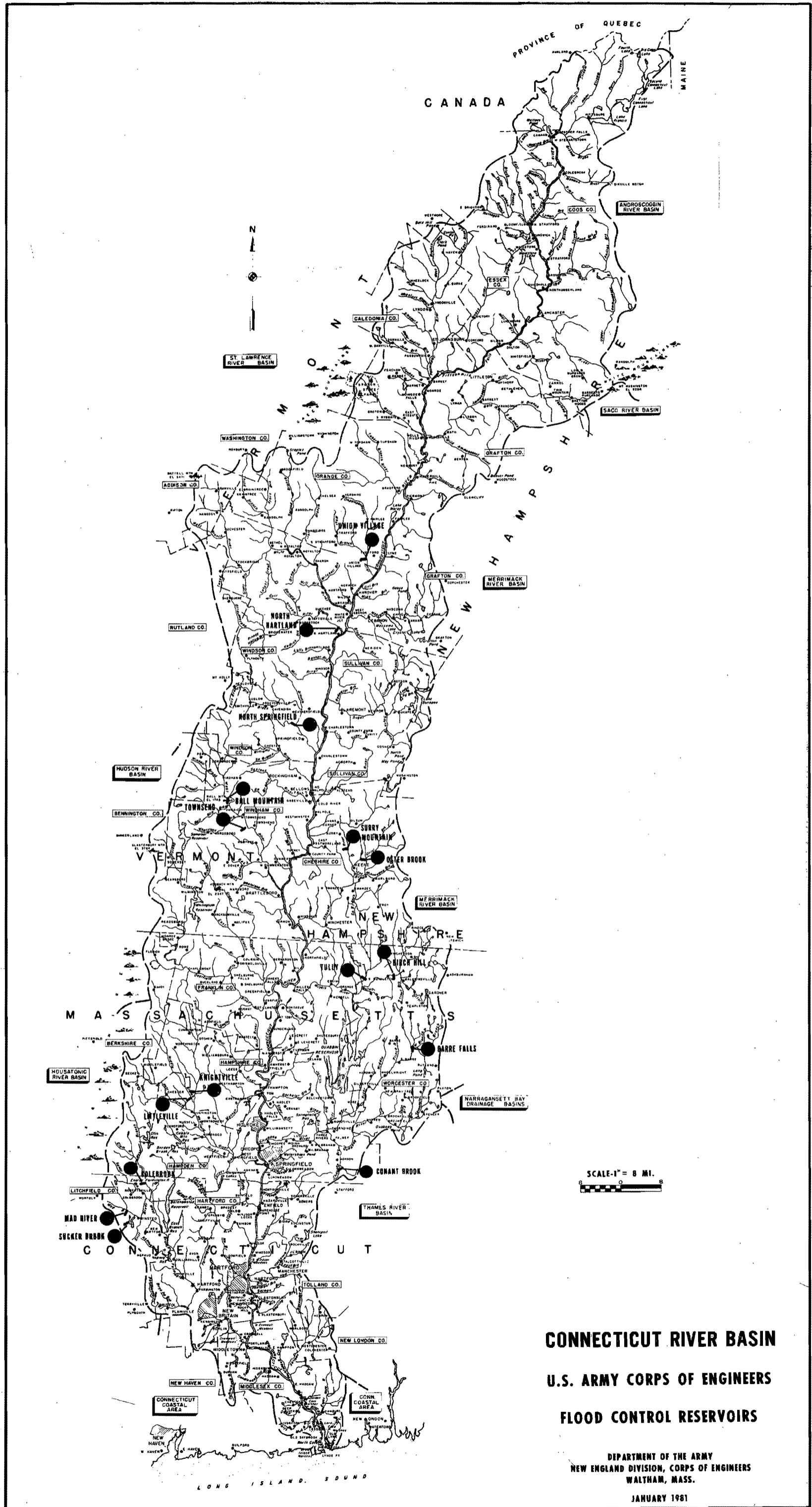
when a specific drought emergency does occur, the legal implications would have to be weighed.

9. WATER QUALITY EVALUATION

The water quality of the Ware River at Barre Falls Dam meets Massachusetts class A water quality standards but is not suitable for public water supply without treatment. The water is highly colored, low in pH, and has high levels of iron and manganese. All of these conditions are due to the natural effects of swamps and marshes in the watershed. After the water is diverted to Quabbin Reservoir, natural processes in the reservoir eliminate these undesirable characteristics and make the water ultimately acceptable for public water supply. For these reasons, the present mode of operation at Barre Falls Dam for water supply is the best from a water quality perspective.

10. SUMMARY AND CONCLUSIONS

Under current provisions, releases of excess floodwaters from Barre Falls Dam are coordinated with the water supply operation of the Metropolitan District Commission of the Commonwealth of Massachusetts. The released water from Barre Falls is diverted into the MDC system via the Coldbrook intake. This existing operational procedure would preclude the development of a drought contingency storage plan at Barre Falls Dam. In an emergency, State legislation might be enacted permitting added diversion of Ware River flows at the Coldbrook intake thereby maximizing water supply potential of the river, without need for drought contingency storage at Barre Falls.



CONNECTICUT RIVER BASIN
U.S. ARMY CORPS OF ENGINEERS
FLOOD CONTROL RESERVOIRS

DEPARTMENT OF THE ARMY
 NEW ENGLAND DIVISION, CORPS OF ENGINEERS
 WALTHAM, MASS.
 JANUARY 1981

PLATE I

BARRE FALLS DAM
AREA AND CAPACITY

DRAINAGE AREA = 55 SQ.MI.

<u>Elev.</u> <u>(msl)</u>	<u>Stage</u> <u>(ft)</u>	<u>Area</u> <u>(acres)</u>	<u>Capacity</u>		<u>Elev.</u> <u>(msl)</u>	<u>Stage</u> <u>(ft)</u>	<u>Area</u> <u>(acres)</u>	<u>Capacity</u>	
			<u>Ac-Feet</u>	<u>Inches</u>				<u>Ac-Feet</u>	<u>Inches</u>
770	0	0	0	0.00	789	19	620	5510	1.88
					790	20	660	6170	2.10
771	1	20	15	.01	791	21	700	6870	2.34
772	2	50	60	.02	792	22	740	7610	2.59
773	3	80	120	.04	793	23	790	8410	2.86
774	4	100	220	.07	794	24	830	9250	3.15
775	5	125	340	.12	795	25	870	10100	3.44
776	6	160	490	.17					
777	7	180	670	.23	796	26	920	11000	3.75
778	8	215	880	.30	797	27	960	12000	4.09
779	9	245	1120	.38	798	28	1000	13000	4.46
780	10	280	1390	.47	799	29	1040	14100	4.80
					800	30	1090	15200	5.18
781	11	320	1700	.58					
782	12	360	2050	.70	801	31	1140	16300	5.55
783	13	390	2430	.83	802	32	1180	17500	5.96
784	14	430	2850	.97	803	33	1220	18700	6.37
785	15	460	3300	1.12	804	34	1260	20000	6.81
					805	35	1300	21300	7.26
786	16	500	3790	1.29					
787	17	540	4320	1.47	806	36	1350	22600	7.70
788	18	580	4900	1.67	807	37	1400	24000	8.20

Crest Elevation = 807

Invert Elevation = 761 due to
9 foot drop at inlet channel.

PERTINENT DATA
BARRE FALLS DAM

July 1978

LOCATION Ware River; Barre, Massachusetts

DRAINAGE AREA 55 Square Miles

STORAGE USES Flood Control

	<u>Elevation</u> (ft msl)	<u>Stage</u> (ft)	<u>Area</u> (acres)	<u>Capacity</u>	
				<u>Acre-Feet</u>	<u>Inches on Drainage Area</u>
Inlet Elevation	761	0	0	0	0
Spillway Crest	807	46	1,400	24,000	8.2
Maximum Surcharge	825	64	2,950	63,000	21.5
Top of Dam	830	69	-	-	-

EMBANKMENT FEATURES

		<u>Dikes</u>
Type	<u>Main Dam</u> - Rolled earth fill with rock protection	3
Length (feet)	885	3,215 (total)
Top Width (feet)	25	15
Top Elev. (ft msl)	830	830
Max. Height (ft)	69	48

SPILLWAY

Location	Right abutment of the dam
Type	Uncontrolled ogee weir, chute spillway in rock
Crest Length (feet)	60
Crest Elev. (ft msl)	807
Max. Surcharge (ft)	18.0
Maximum Discharge	
Capacity (cfs)	16,300

SPILLWAY DESIGN FLOOD

	<u>Original Design</u>	<u>1973 Studies</u>
Peak Inflow (cfs)	68,300	61,000
Peak Outflow (cfs)	16,300 (spillway only)	14,800
Volume Runoff (Ac. Ft.)	62,500	55,500

OUTLET WORKS

Type	Horseshoe conduit
Tunnel Inside	9'8" diameter
Tunnel Length (ft)	250
Service Gate Type	Electrically operated gear driven sluice
Size	Two 4.5' wide x 9.0' high
Emergency Gate Type	None
Downstream Channel	
Capacity (cfs)	1,000
Discharge Cap. at Spillway Crest (cfs)	3,000

LAND ACQUISITION

Guide Taking Line	815 ft msl (both fee and easement)
Fee (acres)	557
Easement (acres)	1,869

MAXIMUM POOL OF RECORD

Date	April 1960
Stage (feet)	36.5
Elevation (ft msl)	797.9
Percent Full	50

UNIT RUNOFF

One Inch Runoff (Ac. Ft.)	2,935
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OPERATING TIME

Open/close all gates	1 foot/min
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PROJECT COST (THROUGH FY 1977) \$1,968,000

DATE OF COMPLETION July 1958

MAINTAINED BY New England Division, Corps of Engineers