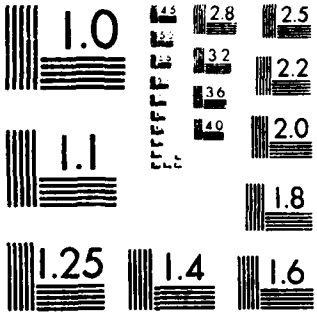
AD-A143 717 DROUGHT CONTINGENCY PLAN MILLERS RIVER WATERSHED 1/1
CONNECTICUT RIVER BASIN TULLY LAKE ROYALSTON
MASSACHUSETTS(U) CORPS OF ENGINEERS WALTHAM MA NEW
UNCLASSIFIED ENGLAND DIV APR 84 F/G 13/2 NL



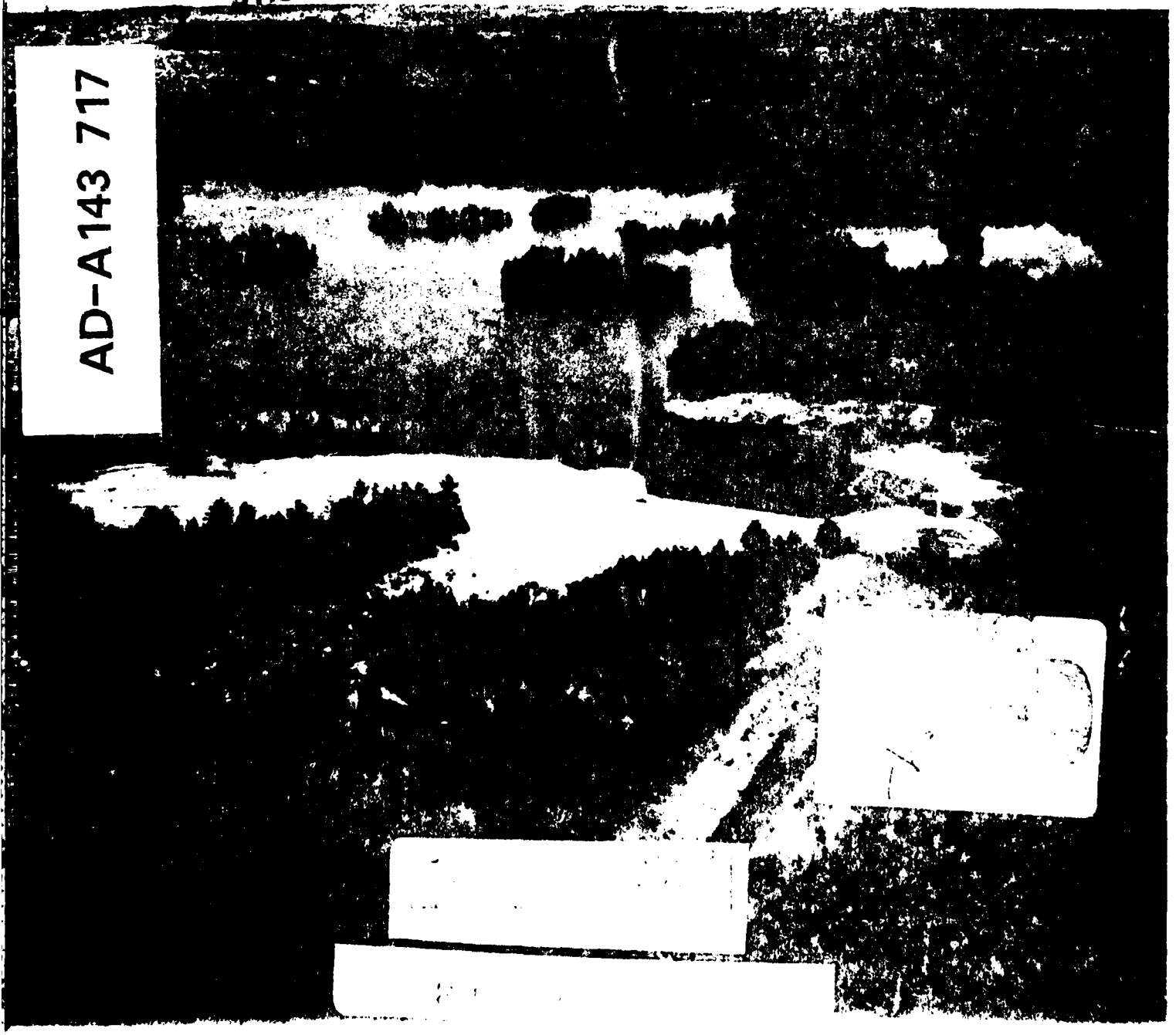
MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963-A

Drought Contingency Plan

US Army Corps of Engineers
New England Division

APRIL 1984

Tully Lake, Royalston, Massachusetts



SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER	2. GOVT ACCESSION NO. A143 717	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) Drought Contingency Plan, Tully Lake, Royalston, Mass; Connecticut River Basin, Millers River Watershed.		5. TYPE OF REPORT & PERIOD COVERED Contingency Report 6. PERFORMING ORG. REPORT NUMBER
7. AUTHOR(s) U.S. Army Corps of Engineers New England Division		8. CONTRACT OR GRANT NUMBER(s)
9. PERFORMING ORGANIZATION NAME AND ADDRESS		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS
11. CONTROLLING OFFICE NAME AND ADDRESS Dept. of the Army, Corps of Engineers New England Division NEDED 424 Trapelo Rd., Waltham, Mass. 02254		12. REPORT DATE April 1984 13. NUMBER OF PAGES 18
14. MONITORING AGENCY NAME & ADDRESS(if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

Approved for public release; Distribution Unlimited

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

18. SUPPLEMENTARY NOTES

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

Flood control
Droughts
Water supply
Water resources

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

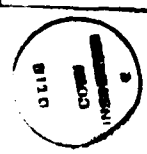
Tully Lake can store water to an elevation of 642 feet. The project can provide up to 1,825 acre-feet (595 million gallons) of water reservoir storage. The water at Tully Lake is of basically good quality but has high levels of color, iron and manganese which would have to be removed by standard treatment methods before it would be suitable for public water supply. Without treatment the water would still be suitable for agricultural uses, fire fighting, and some industrial uses.

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

CONNECTICUT RIVER BASIN
MILLERS RIVER WATERSHED

DROUGHT CONTINGENCY PLAN.
TULLY LAKE
ROYALSTON, MASSACHUSETTS

APRIL 1984



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

DROUGHT CONTINGENCY PLAN
TULLY LAKE

TABLE OF CONTENTS

Paragraph	Subject	Page
1	PURPOSE AND SCOPE	1
2	AUTHORIZATION	1
3	PROJECT AUTHORIZATION CONDITIONS	1
4	PROJECT DESCRIPTION	1
5	PRESENT OPERATING REGULATIONS	2
a	Normal Periods	2
b	Flood Periods	2
c	Regulating Constraints	2
	(1) Minimum Releases	2
	(2) Maximum Releases	2
6	MONITORING OF HYDROLOGIC CONDITIONS	3
7	DESCRIPTION OF EXISTING WATER SUPPLY CONDITIONS	3
a	General	3
b	Water Supply Systems	3
c	North-Central Massachusetts Water Suppliers	3
d	Population Projections	5
8	POTENTIAL FOR WATER SUPPLY REALLOCATION	5
a	General	5
b	Drought Contingency Storage	5
c	Effects of Regulated Flows	7
9	WATER QUALITY EVALUATION	7
a	Water Quality Classification	7
b	Existing Water Quality	7
c	Water Quality Requirements for Drought Storage	8
d	Effects of Drought Storage	8
e	Water Quality Conclusions	8

TABLE OF CONTENTS (Cont.)

Paragraph	Subject	Page
10	DISCUSSION OF IMPACTS	9
a	General	9
b	Flood Control	9
c	Recreation	9
d	Project Operations	10
e	Effect on the Aquatic Ecosystem	10
f	Effects on the Terrestrial Environment	11
g	Effects on Wildlife	12
h	Historic and Archaeological Resources	12
11	SUMMARY AND CONCLUSIONS	13

LIST OF TABLES

Table	Title	Page
1	Major Water Suppliers - Athol-Orange Area	4
2	Population Projections - Athol-Orange Area	6

LIST OF PLATES

Plate	Title
1	Connecticut River Basin Map
2	Tully Reservoir - Area and Capacity
3	Pertinent Data - Tully Lake
4	Drought Contingency Storage Versus Flow Duration
5	Tully Lake - Reservoir Map

DROUGHT CONTINGENCY PLAN
TULLY LAKE

1. PURPOSE AND SCOPE

The purpose of this study and report was to develop and set forth a drought contingency plan of operation for Tully Lake that would be responsive to public needs during drought periods and identify possible modifications to project regulation within current administrative and legislative constraints. This evaluation was based on preliminary studies utilizing readily available information. The scope of this drought contingency plan includes a description of existing water supply conditions, the possibility of reallocation of reservoir storage within specified limits, evaluation of water quality, discussion of impacts on other project purposes, effects on the environment, 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 basinwide and project basis as an integral part of water control management activities.

3. PROJECT AUTHORIZATION CONDITIONS

Tully Lake was authorized by the Flood Control Act approved 22 June 1936 (Public Law 738, 74th Congress), as amended by Public Law 111, 75th Congress, approved 28 June 1938.

In May 1964, a request for approval of inclusion of a conservation pool for recreational purposes in the flood control reservoir was made to the Chief of Engineers. This request was the result of a combined planning effort of the New England Division and the Massachusetts Department of Natural Resources. Authorization was granted by a letter from the Chief of Engineers, dated 15 July 1964, with the first pool maintained during the summer of 1966.

4. PROJECT DESCRIPTION

Tully Lake, completed in 1949, is located on the East Branch of the Tully River in Royalston, Massachusetts. A map of the Connecticut River basin is shown on plate 1.

The project contains storage for flood control and recreation. The recreation pool at elevation 641 feet NGVD contains 1,500 acre-feet equal to 0.60 inch of runoff. This pool is maintained at a depth of approximately 16 feet creating a 300 acre pool. It is established each spring after

snowmelt occurs and held until about mid-September when it is drawn down to about an 11-foot stage. The flood control storage contains an additional 20,525 acre-feet for a total of 22,025 acre-feet equivalent to 8.3 inches of runoff from the 50 square mile drainage area. A capacity table is shown on plate 2 and a summary of pertinent data at Tully Lake is contained on plate 3.

Components of the project consist of a rolled earth dam with a dumped rock shell, a concrete spillway and outlet works. The outlet works at the east abutment of the dam consist of a 6-foot diameter concrete tunnel with an invert at elevation 625 feet NGVD. Flow through the outlet is controlled by two 3'-6" by 5'-0" electrically operated slide gates.

5. PRESENT OPERATING REGULATIONS

a. Normal Periods. A seasonal recreation pool will be maintained at about 16 feet following the snowmelt in the spring until about mid-September. Both gates will be completely closed or throttled, depending on the inflow into the reservoir. Following the recreation season, the pool will be lowered to a stage of 11 feet and maintained throughout the winter months. One gate will be closed and the other opened to maintain a constant winter pool.

b. Flood Periods. The Tully project is operated in concert with other projects in the basin to reduce downstream flooding in the Tully and Millers Rivers and further downstream in the Connecticut River. 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 Tully Lake is about 650 cfs. Releases up to 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 north-central region of Massachusetts in the vicinity of Athol and Orange. Parts of this area are located in Franklin and Worcester counties. Table 1 contains information about public water suppliers in the 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 Tully Lake during drought conditions, all or portions of seven 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 Tully Lake which could benefit from storage at the project, and to present the data in a manner portraying existing water supply conditions. Projections of future demands were not developed because this study only addresses modifications in the operational procedure at Tully Lake in order to provide storage for water supply purposes when emergency drought conditions exist, and not to meet normal water supply demands at some future date.

c. North-central Massachusetts Water Suppliers. As noted in table 1, the data given for each water supplier 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 the source, and any further information available on the source of supply. An analysis of the 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 Tully Lake.

TABLE 1
MAJOR WATER SUPPLIERS - ATHOL-ORANGE AREA

COMPANY OR AGENCY	TOWN SERVED	EST. POPULATION SERVED - 1980	SOURCE OF SUPPLY SW/GW	1980 DEMAND AVG.DAY (MGD)	1980 DEMAND MAX DAY (MGD)	SAFE YIELD (MGD)	COMMENTS
Athol Dept. of Public Works	Athol	10,102	SW/GW	1.16	2.00	1.74	.74 SW - Newton Reservoir, Phillipston Res. 1.00 GW - 1 Well
Millers Falls Fire & Water District	Erving	550			0.04		From Turner's Falls Fire & Water District New well with safe yield of 0.43 MGD expected on line Fall 1983
Gardner Water Dept.	Gardner	17,184	SW	1.92	3.00	1.78	Crystal Lake, Perley Brook, Cowee Pond
Orange Water Dept.	Orange	5,187	GW	0.58	0.93	0.80	Wells New well with safe yield of 0.32 MGD expected on line in 1983
	Phillipston		No Public Water Supply				
South Royalston Improvement Corp.	Royalston	300	GW	0.02	0.06	0.07	1 Well
Templeton Water Dept.	Templeton	5,220	GW	0.49	0.75	1.25	4 Wells
Winchendon Water Dept.	Winchendon	5,855	SW	0.63	0.80	0.70	Upper Naukey Lake

d. Population Projections. Population projections for communities in the immediate vicinity of Tully Lake 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, a decrease in population for the area as a whole is projected for the time period 1980-2000, a general rule being the larger towns will have decreases in population with any growth in population occurring in the smaller communities.

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 that would be functional under existing authorities. 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. It has been determined that a portion of the existing storage at Tully Lake could be utilized for emergency drought storage without having an adverse impact on the project's flood control function. Maximum storage could be made available to a pool elevation of about 644 feet NGVD (19-foot stage). This represents a volume of about 2,600 acre-feet, equivalent to 847 million gallons or about 10 percent of the total reservoir storage. This volume is comprised of 525 acre-feet of permanent storage (elevation 636), and 975 acre-feet of conservation storage (elevation 641) and 1,100 acre-feet of flood control storage (elevation 644). The 1,100 acre-feet represents an infringement of about 0.4 inch of runoff on the flood control storage. However, an evaluation of the impacts of this proposed level has revealed some significant adverse impacts on the terrestrial environment and project operations. Therefore, consideration is given to limiting drought storage to a pool elevation of 642 feet (17-foot stage). This level represents a total volume of 1,825 acre-feet, equivalent to 595 million gallons.

Based on an all-season low flow duration analysis using 65 years of flow records for the gaging station on the East Branch Tully River near Athol, Massachusetts, it was determined that during a 10-year frequency drought period, the volume of runoff could: (a) fill the reservoir from elevation 641 to 642 feet NGVD in a 50-day summer period provided no

TABLE 2
POPULATION PROJECTIONS - ATHOL-ORANGE AREA

TOWN	Actual 1980	1985	1990	1995	2000	PERCENT CHANGE
Athol	10,634	10,359	20,083	9,808	9,532	-10.4
Erving	1,236	1,359	1,392	1,425	1,458	18.0
Gardner	17,900	17,151	16,331	15,511	14,691	-17.9
Hubbardston	1,797	2,013	2,229	2,445	2,661	48.1
Orange	6,844	7,214	7,584	7,954	8,324	21.6
Royalston	955	1,028	1,101	1,174	1,247	30.6
Templeton	6,070	6,147	6,241	6,336	6,430	5.9
Winchendon	7,019	7,124	7,229	7,334	7,439	6.0
	52,455	52,395	52,190	51,987	51,782	-1.3

releases were made from the dam, or (b) fill the reservoir to elevatio 642 in a 140-day period if a continuous release of about 5 cfs or 3.2 mgd (0.10 cfs/sq. mi.) were maintained. However, the reservoir could filled to elevation 642 in about a one week period in May while contin releasing about 10 cfs or 6.5 mgd. The water stored could be drawn directly from the reservoir or released downstream during or prior to the completion of the filling period for municipal supply with proper treatment. Drought contingency storage versus flow duration at Tully is shown graphically on plate 4.

c. Effects of Regulated Flows. The curtailment of flows from Tul Lake during the drought emergency could adversely impact on the flowage rights of downstream riparian users. At this time, however, it is not possible to review all of the various drought emergency situations tha 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

a. Water Quality Classification. The entire length of the Tully River and its tributaries in Massachusetts are rated class B by the Massachusetts Division of Water Pollution Control (MDWPC). Class B wa are designated for the protection and propagation of fish, other aquat life and wildlife; and for primary and secondary contact recreation. Public water supply after treatment is not one of the uses given in Massachusetts Water Quality Standards for class B waters. However, a water which meets class B standards could be made potable with standar treatment processes.

Technical requirements for class B waters included a minimum disso oxygen concentration (DO) of 5 mg/l, pH in the range of 6.5-8.0 standa units, and fecal coliform bacteria not to exceed a log mean of 200 per ml for a set of samples nor shall more than 10 percent of the total samples exceed 400 per 100 ml during any monthly sampling period; and waters shall be free from pollutants in concentrations that exceed the sensitive receiving water use.

b. Existing Water Quality. Tully Lake has good water quality whi usually meets or exceeds the requirements of its Massachusetts class B designation. DO levels are high except in the depths of the lake duri summer stratification, and coliform bacteria levels are low. Low pH i the only parameter which regularly violates state standards, and it is caused by natural watershed conditions and acid precipitation. Low pH levels are not a health problem in public water supply. Water quality

conditions at Tully Lake for which there are no state standards but are of concern in a public water supply include high color levels and frequent high iron and manganese levels. These would not present public health hazards, but highly colored water is unappealing, and high iron and manganese levels can cause laundry-staining problems. The elevated levels of these parameters are caused by natural conditions in the watershed. Color, iron, and manganese levels can be reduced by standard treatment processes. Other water quality measurements show good conditions; turbidity and dissolved solids are low, and the water is soft with low alkalinity.

Tully Lake is a borderline mesotrophic-oligotrophic impoundment which exhibits moderate thermal density induced stratification during the summer. Despite its shallow depth, temperature differences of 16°F can occur between the surface and the bottom of the lake. DO measurements show low to anaeorbic levels in the depths of the lake indicative of a lack of mixing even when only a small temperature difference is observed in the lake.

c. Water Quality Requirements for Drought Storage. There are two requirements to be met. The waters must meet state standards for surface waters and must be of a quality suitable for the water supply user. A water which meets class B standards could be made usable for public water supply with standard treatment processes. The water quality required for industrial water supply depends on the industrial process involved.

d. Effects of Drought Storage. Increasing the size of the pool at Tully Lake for drought storage will have little effect on the existing water quality in the lake or the discharge from the lake. The proposed plan would increase the depth of the lake one foot above the recreation pool and flood an additional 60 acres of land. The decay of organic material on the land may increase the extent and duration of anaerobic conditions in the lake. This could lead to increases in levels of color, iron and manganese in the lake; however, these substances are already in such high concentrations as to require removal prior to the water's use for public water supply. The trophic status of the lake is not likely to change if the pool is increased, and the recreational water quality will not be affected. Because the pool is already controlled by a low level gate, the proposed plan for drought storage will have little effect on the thermal regime of the lake or the temperature of the discharges from the lake.

e. Water Quality Conclusions. The water at Tully Lake has high levels of color, iron, and manganese which would have to be removed before it would be suitable for public water supply. Color, iron and manganese

can be removed by standard treatment processes. No treatment would be required for the water to be suitable for agricultural uses, fire-fighting or some industrial processes. Increasing the pool one foot to provide extra storage would have no significant effects on the water quality.

10. DISCUSSION OF IMPACTS

a. General. Any action resulting in a temporary change of a reservoir's storage volume will have impacts on other project purposes which must be evaluated before a storage reallocation plan can be implemented. An evaluation has been made of the impacts resulting from drought contingency storage on the flood control purpose of this project. Effects on recreation, sedimentation and the aquatic and terrestrial environments as well as the historic and archaeological resources are discussed in the following paragraphs. Because of the minimal level of effort afforded this study, certain environmental concerns may require further consideration prior to project implementation. These are identified in the appropriate environmental sections, with estimates of the amount of time needed for such assessments.

b. Flood Control. A review of the regulation procedures at Tully Lake was undertaken to determine the volume of water that could be made available for drought contingency purposes. The water would be stored by temporarily utilizing existing flood control storage. It is recognized that major floods occur in every season of the year, thus any use of flood control storage would be continually monitored to insure there would be no adverse impacts on downstream flood protection.

At Tully Lake the proposed pool elevation for drought contingency storage has been estimated to be elevation 642 feet, representing an infringement on the flood control storage of about 0.10 inch of runoff from the upstream 50-square mile drainage area.

Based on a 10-year event, the anticipated rate of pool level rise would exceed 0.01 foot per day over a 140-day period beginning in June. This condition assumes a flow of about 5 cfs (3.2 mgd) would be released downstream for the duration of the drought. Storage would probably take place during the months of May, June, July and August and would be drawn as needed in the following months. The storage may be held for a period of one month or longer at the 642-foot elevation.

c. Recreation. The recreational features at Tully Lake will be unaffected by the proposed 1-foot increase in pool level for drought contingency purposes.

d. Project Operations. Tully Lake is cleared to a stage of 16 feet and any storage above 17 feet will inundate a considerable number of shoreline trees. Water was stored at Tully Lake to a stage of 19 feet from the end of July to the first part of October of 1981 for drought emergency purposes. As a result, a significant number of conifer trees were killed even though a major part of the growing season had passed. With a projection of 140 days or an early May storage date required to reach 17 feet, this prolonged period may kill most of the vegetation between 16 and 17 feet.

All costs associated with drought contingency storage and cleanup following storage will be the responsibility of the requestor. A weir at the intake structure is scheduled for construction in FY 85, however, the top of the weir will be about a stage of 16 feet. Therefore, it will be necessary to regulate the gates in order to maintain the pool at a stage of 17 feet.

e. Effect on the Aquatic Ecosystem. The aquatic environment of the project area is located along the East Branch of the Tully River in the Connecticut River basin. The entire length of the Tully River and its tributaries in Massachusetts are rated class B by the Massachusetts Division of Water Pollution Control (MDWPC). Tully Lake is a borderline mesotrophic-oligotrophic impoundment.

The existing fisheries management in the Tully Lake area is directed at both a cold water fishery in major streams during the spring and to the warmwater fishery in the conservation pool. The Massachusetts Division of Fisheries and Wildlife stocks brook trout and rainbow trout at selected locations in the East Branch of the Tully River and Lawrence Brook upstream of the project area. Generally, the numbers stocked vary according to their availability from state hatcheries. The East Branch is usually stocked with approximately 150 brook trout, 1,000 browns and 1,500 rainbows. Lawrence Brook is stocked with about 3,000 brook trout a year.

Both streams are popular and are fished heavily after stocking. Those fish not caught usually make their way downstream and into the conservation pool where they are available to boat fishermen.

Trout fishing usually slackens off in late June as high water temperatures make trout stocking impractical, and action shifts to the warm water species. Minimum length and bag limits on the more popular warm water fish and the enforcement of Massachusetts Fish and Game laws generally results in an adequate self-sustaining, warm water fishery.

The warm water fish present in the lake (chain pickerel, bullheads, white and yellow birch, large-mouth bass and sunfish) generally spawn close to the shoreline where the water is relatively shallow from late April through June.

The most common and widely distributed submerged aquatic plant found at Tully Lake is coontail Certophyllum demersum . There are large concentrations of this aquatic weed in the shallow areas of the lake.

Numerous sections of wetland are located throughout the area of Tully Lake, with the majority of the wetlands situated in the vicinity and north of the Long Pond.

An increase in the impoundment for the proposed drought contingency storage would temporarily raise the water level by one foot above the summer conservation pool elevation 642 feet NGVD, through the storage period. Generally, a temporary pooling of this extra storage for a season would not have any substantial effects on the cold and warm water fisheries. There could be a slight short-term impact on the fish, but they would be able to adjust to new conditions. The increased storage should not impact the reproduction of most warm water species (generally occurring during spring and early summer) in the conservation pool. Some new shallow areas in which warm water species spawn may be created.

Wetlands within the Tully Lake project area particularly those in the vicinity of Long Pond, are classified by the U.S. Fish and Wildlife Service as the Palustrine type and provide important habitat in the project area. With the drought contingency pool operating at 642 feet NGVD, there would be no significant inundation of these wetlands. The effective rooting depth of the wetland vegetation would not be affected. The wetlands should not be affected by any prolonged storage.

f. Effects on the Terrestrial Environment. Eight major forest cover types exist at Tully Lake. The most extensive is the white pine-northern red oak-white ash type which covers 325 acres. The second largest group is the eastern white pine type, which is pure and predominate in mixture on approximately 211 acres. Associates are red maple, yellow birch, white oak, northern red oak and red spruce. Other types and acreages include: gray birch-red maple (118 acres), hemlock (27 acres), northern hardwoods (11 acres), pioneer aspen (7 acres) and paper birch (3 acres).

The Massachusetts Department of Environmental Management (DEM) has a 50-year lease through the year 2005 for management of the recreation fish and wildlife and forestry resources covering 1,150 acres of land and water upstream of the dam.

Tully Lake, because of the gently rolling topography of its immediate area, has a complex shoreline with many embayments, projecting points and islands when the water level is maintained at the summer pool elevation. The surrounding forest cover abruptly borders most of the lake edge.

Increasing the summer conservation pool up to 642 feet NGVD would not result in inundation of the forest cover. Any vegetation below the 17-foot stage would not be inundated. There would be no problems associated with debris falling into the lake that could pose a danger to boaters.

g. Effects on Wildlife. Some animals present at Tully Lake are cottontail rabbit, varying hare, grey squirrel, raccoon and white-tailed deer. Game birds and waterfowl include woodcock, ruffed grouse, black duck, mallard duck, and less frequently, Canada geese.

Beaver, otter, muskrat and red and grey fox inhabit the project area. A few bobcat have been observed and, infrequently, black bear are spotted in or around the project. Several species of smaller animals, such as red squirrels, chipmunks, woodchucks, skunks and oppossum can also be found.

There have been no rare or endangered species reported in the project area.

The most significant wildlife observation area is the wetlands and riverbanks of the East Branch of the Tully River from the Doane Hill Road boat ramp north to Route 68. The parking area on top of the dam on State Route 32 is also a popular wildlife observation area in the spring and fall when migrating ducks and geese stop to rest and feed in the conservation pool.

Effects on upland and fur bearing wildlife that utilize habitat between 641 and 642 feet NGVD would be minimal. There would be no significant loss of habitat with the one foot increase of the conservation pool. The wetland habitat in the Long Pond area would not change with the increased elevation, so there would be no adverse effects on the wildlife that are dependent on that habitat.

h. Historic and Archaeological Resources. While there are no recorded prehistoric archaeological sites within the Tully Lake project area, a high probability exists for presence of unrecorded sites within the project lands. Examination of project construction plans reveals no historic period structures standing below 642 NGVD, but remains of early historic sites may be present.

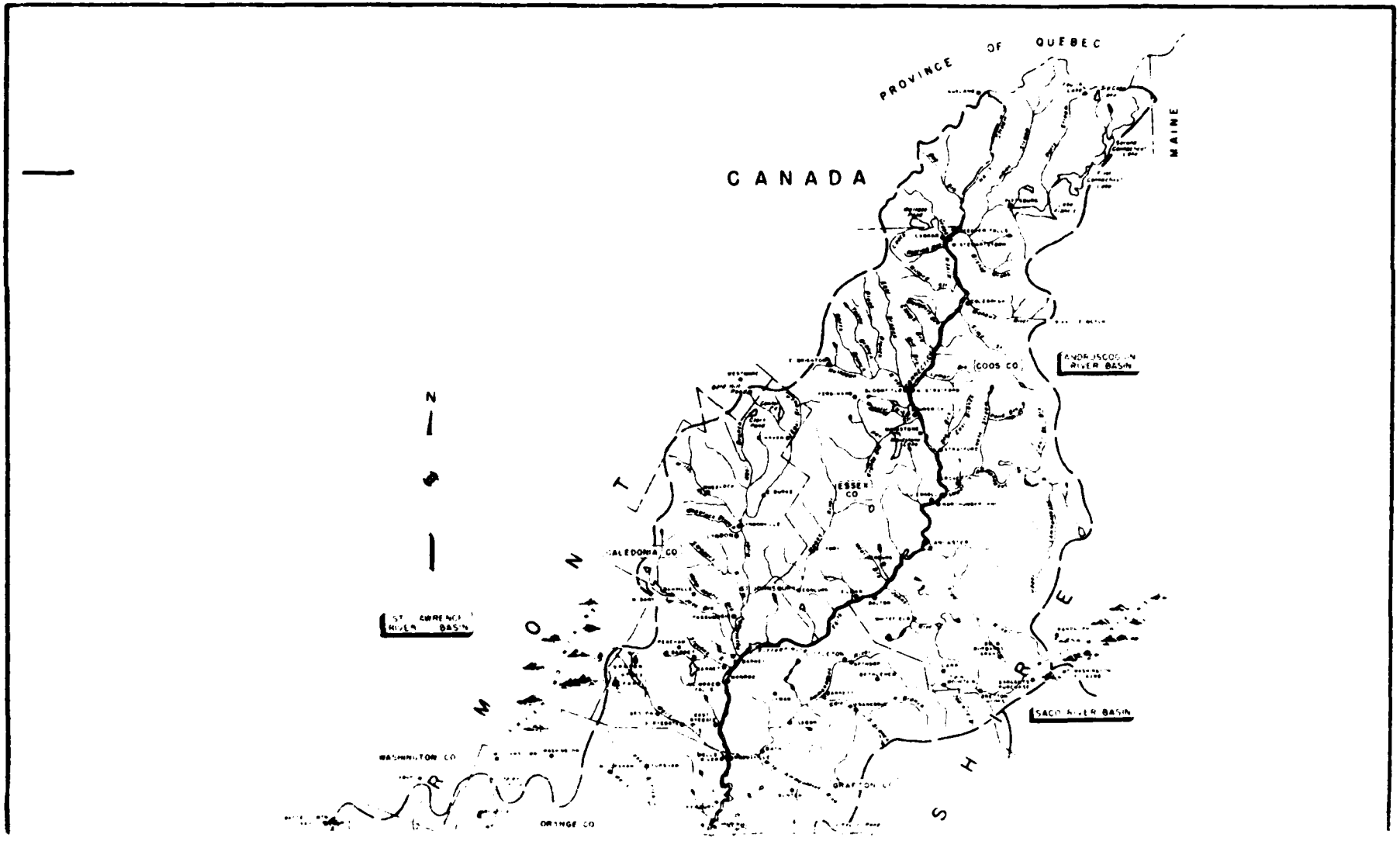
Prior to drought contingency plan implementation, an archaeological survey would be required involving several weeks duration.

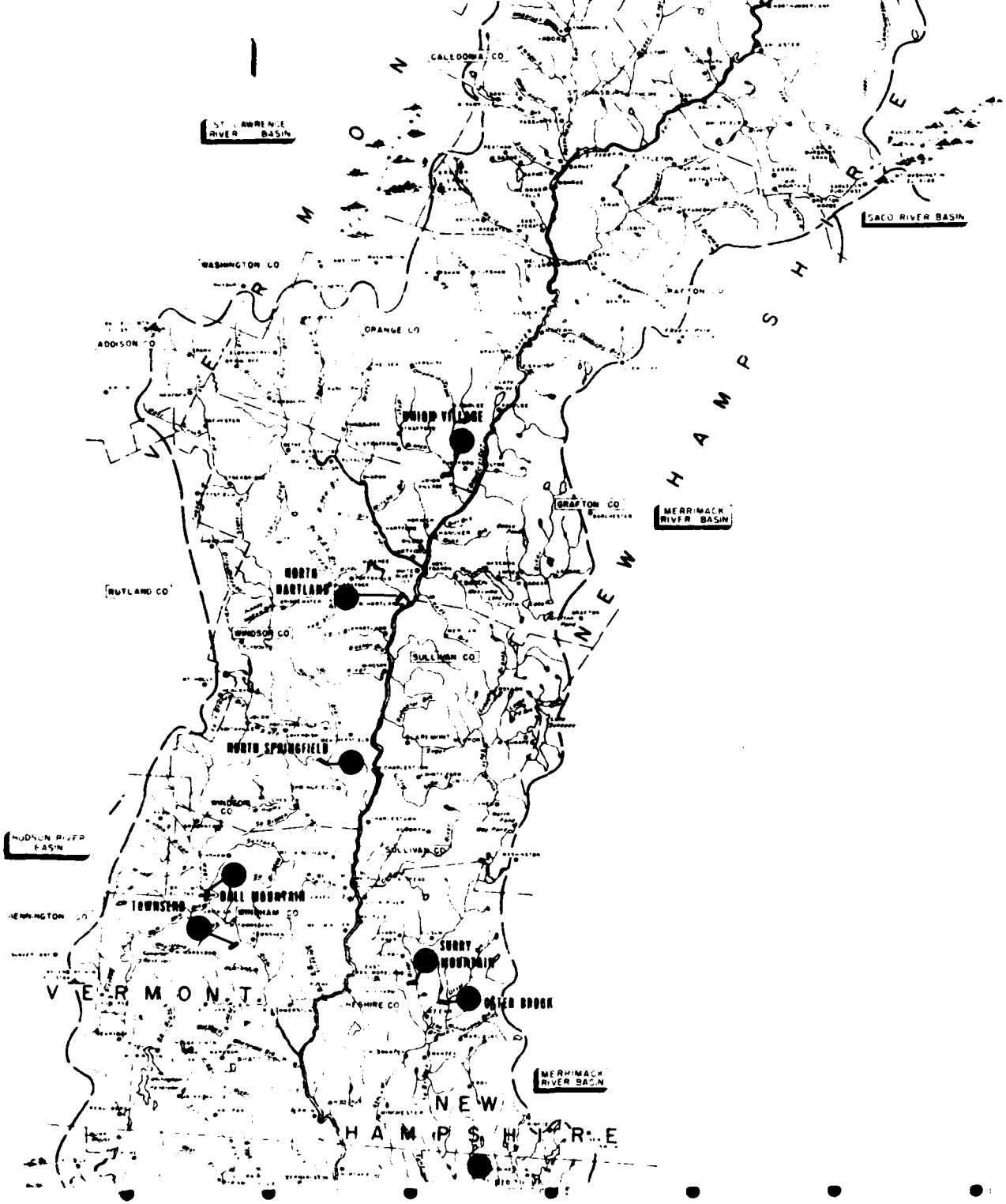
11. SUMMARY AND CONCLUSIONS

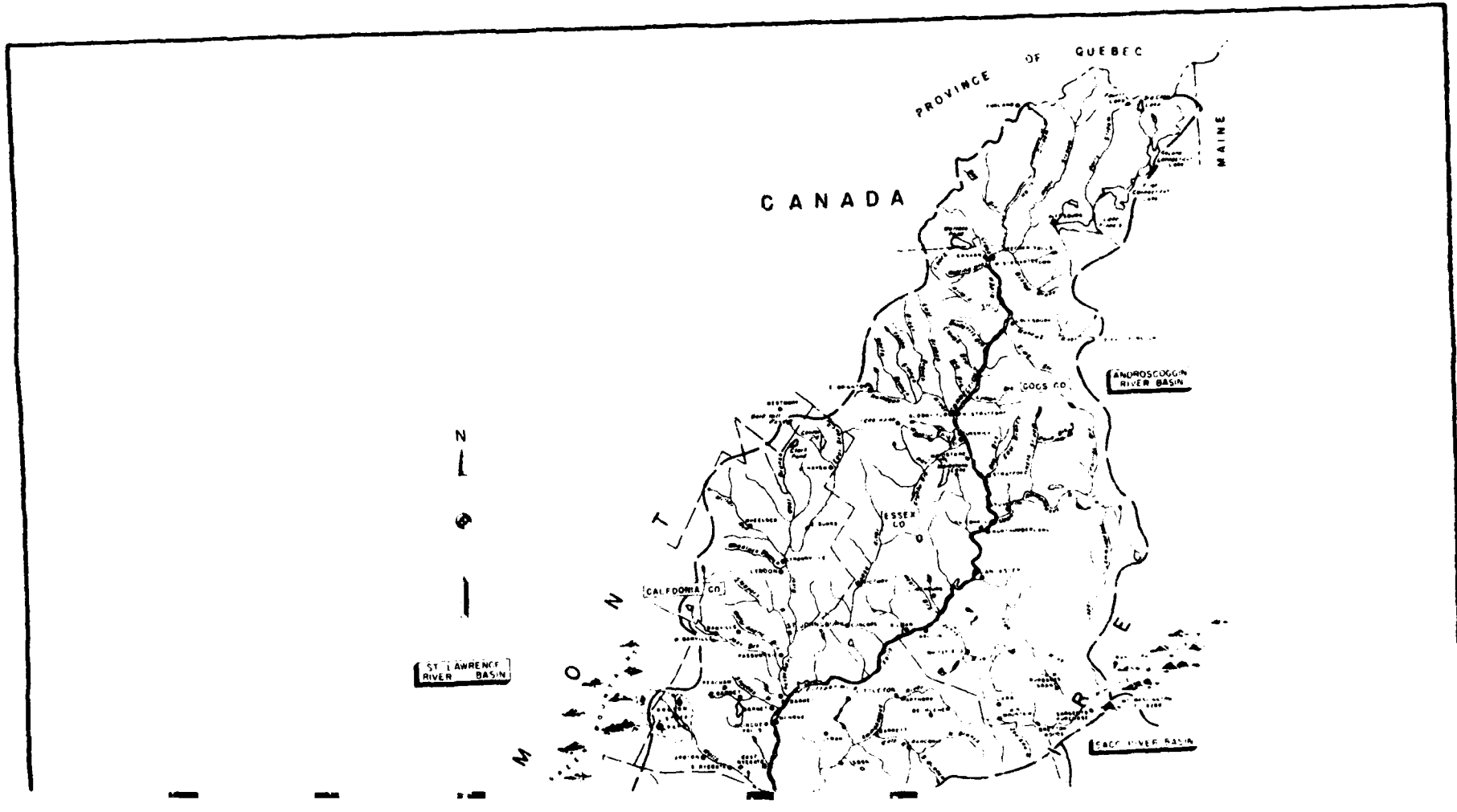
It has been determined that a portion of the existing storage at Tully Lake could be utilized for emergency drought purposes without having an adverse impact on the project's flood control effectiveness. The water could be temporarily stored to an elevation of 642 feet. At this level, one foot above the permanent pool, it would be possible for the project to provide up to approximately 1,825 acre-feet (595 million gallons) of reservoir storage for drought emergency purposes.

An evaluation of the effects of this plan on the environmental aspects of the project has revealed only limited impacts. At the 642 foot elevation there would be no inundation of the campground areas and no flooding of trees along the shoreline. The wildlife habitat would not be affected by the inundation of the wetlands in the Long Pond area.

The water at Tully Lake is of basically good quality but has high levels of color, iron and manganese which would have to be removed by standard treatment methods before it would be suitable for public water supply. Without treatment the water would still be suitable for agricultural uses, fire fighting, and some industrial processes.


PROVINCE OF QUEBEC
CANADA
MAINE
N
COOS CO
ESSEX CO
CALEDONIA CO
WASHINGTON CO
ORANGE CO
GRAFTON CO
ST. LAWRENCE RIVER BASIN
ANDROSCOGGIN RIVER BASIN
SACO RIVER BASIN
NORTHERN SHORE


CALEDONIA CO
ST. LAWRENCE RIVER BASIN
SACO RIVER BASIN
WASHINGTON CO
ORANGE CO
ADDISON CO
UNION VILLAGE
GRAFTON CO
MERRIMACK RIVER BASIN
RUTLAND CO
NORTH HARTLAND
WINDSOR CO
SULLIVAN CO
NORTH SPRINGFIELD
HUDSON RIVER BASIN
BALL MOUNTAIN
TOWNSEND
SUNAPEE MOUNTAIN
OTTER BROOK
MERRIMACK RIVER BASIN
VERMONT
NEW HAMPSHIRE
CONNECTICUT RIVER


PROVINCE OF QUEBEC
CANADA
MAINE
ANDROSCOGGIN RIVER BASIN
GOOS CO.
ESSEX CO.
CALEDONIA CO.
ST. LAWRENCE RIVER BASIN
CONNECTICUT RIVER BASIN
N
VERMONT

TULLY RESERVOIR
AREA AND CAPACITY

DRAINAGE AREA = 50 SQ. MI.

ELEV. MSL	STAGE FEET	AREA ACRES	CAPACITY AC. FT.	CAPACITY INCHES
625	0	0	0	0
626	1	5	5	0
627	2	10	10	0
628	3	17	15	.01
629	4	20	20	.01
630	5	23	25	.01
631	6	32	125	.05
632	7	38	200	.08
633	8	45	225	.08
634	9	55	375	.14
635	10	65	425	.16
	Permanent Pool = 636			
636	11	78	525	.20
637	12	95	650	.24
638	13	112	825	.31
639	14	140	1,025	.39
640	15	210	1,225	.46
641	16	305	1,500	.60
	Recreation Pool = 641			
641	16	305	0	0
642	17	365	325	.12
643	18	420	700	.26
644	19	465	1,100	.41
645	20	505	1,525	.57
646	21	545	1,975	.74
647	22	580	2,525	.95
648	23	615	3,075	1.16
649	24	650	3,625	1.36
650	25	685	4,225	1.59
651	26	710	4,875	1.83
652	27	745	5,550	2.09
653	28	775	6,325	2.38
654	29	800	7,125	2.68
655	30	825	7,950	2.99
656	31	855	8,775	3.30
657	32	880	9,600	3.61
658	33	905	10,450	3.93
659	34	930	11,300	4.25
660	35	955	12,250	4.61
661	36	980	13,225	4.97
662	37	1,005	14,150	5.32
663	38	1,025	15,225	5.78
664	39	1,050	16,225	6.10
665	40	1,075	17,250	6.49
666	41	1,095	18,425	6.93
667	42	1,115	19,525	7.34
668	43	1,140	20,525	7.72
	Crest Elevation = 668			
669	44	1,160	21,525	8.09
670	45	1,185	22,525	8.47
671	46	1,205	23,525	8.85
672	47	1,225	24,525	9.22
673	48	1,245	25,525	9.60

PLATE 2

PERTINENT DATA
TULLY LAKE

LOCATION East Branch Tully River, Royalston, Massachusetts

DRAINAGE AREA 50 square miles

STORAGE USES Flood Control and Recreation

RESERVOIR STORAGE

	Elevation (ft msl)	Stage (ft)	Area (acres)	Capacity Acre-Feet	Capacity Inches on Drainage Area
Inlet Elevation	625.0	0	0	0	0
Winter Pool	636.0	11	78	525	.2
Recreation Pool	641.0	16	300	1,500	0.6
Spillway Crest	668.0	43	1,130	20,500 (net)	7.7 (net)
Maximum Surcharge	678.8	53.8	1,360	13,800 (net)	5.1 (net)
Top of Dam	684.0	59			

EMBANKMENT FEATURES

Type	Rolled earth fill, rock slope protection, impervious core
Length (feet)	1,570
Top Width (feet)	30
Top Elevation (ft msl)	684.0
Maximum Height (feet)	62
Volume (cubic yards)	185,000
Dike	None

SPILLWAY

Location	About 800 feet southeast of left abutment of dam
Type	Uncontrolled, ogee weir, chute, saddle spillway
Crest Length (feet)	255
Crest Elevation (ft msl)	668.0
Maximum Surcharge (ft above crest)	10.8 (Elevation 678.8 feet msl)
Maximum Discharge Capacity (cfs)	32,700

SPILLWAY DESIGN FLOOD

	Original Design 1944	1967 Analysis
Peak Inflow (cfs)	40,000	47,000
Peak Outflow (cfs)	32,700	39,000
Volume Runoff (acre-feet)	41,900	44,300

OUTLET WORKS

Type	One circular tunnel
Tunnel, Inside Diameter (ft)	6
Tunnel Length (feet)	274
Service Gate Type	Electrically operated gear-driven slide
Size	Two, 3'-6" wide x 6'0" high
Emergency Gate Type	Crane operated slide
Size	One, 4'-0" wide x 10'0" high
Downstream Channel Capacity (cfs)	825
Maximum Discharge Capacity Spillway Crest (cfs)	1,030

RECREATION POOL

Type of Structure	None (pool level controlled by service gates)
Recreation Pool Stage (feet)	16
Area (acres)	300
Shoreline Length (feet)	32,000

LAND ACQUISITION

Fee Elevation (ft msl)	668
Fee (acres)	1,300
Easement Elevation (ft msl)	668
Easement (acres)	4
Clearing Elevation (ft msl)	641

MAXIMUM POOL RECORD

Date	8 April 1960
Stage (feet)	32.3
Elevation (ft msl)	657.3
Percent Full	51

UNIT RUNOFF

One Inch Runoff (acre-feet)	2,665

OPERATING TIME

Open/Close All Gates	Each gate at speed of about 1 foot per minute

PROJECT COST (THROUGH FY 71) $1,551,600

DATE OF COMPLETION September 1949

MAINTAINED BY New England Division, Corps of Engineers
Recreation facilities operated and maintained by Massachusetts Department of Natural Resources

PLATE 3

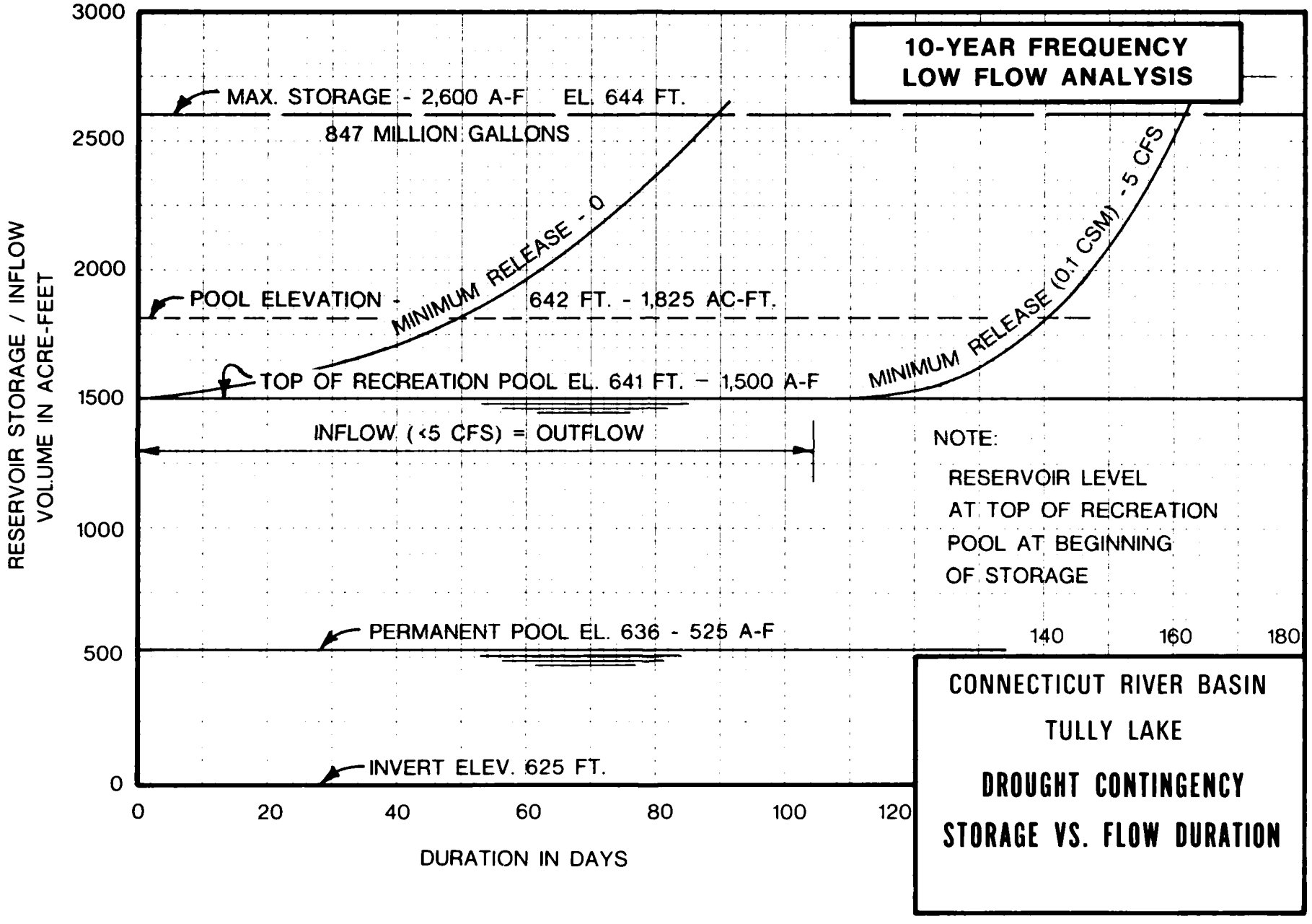
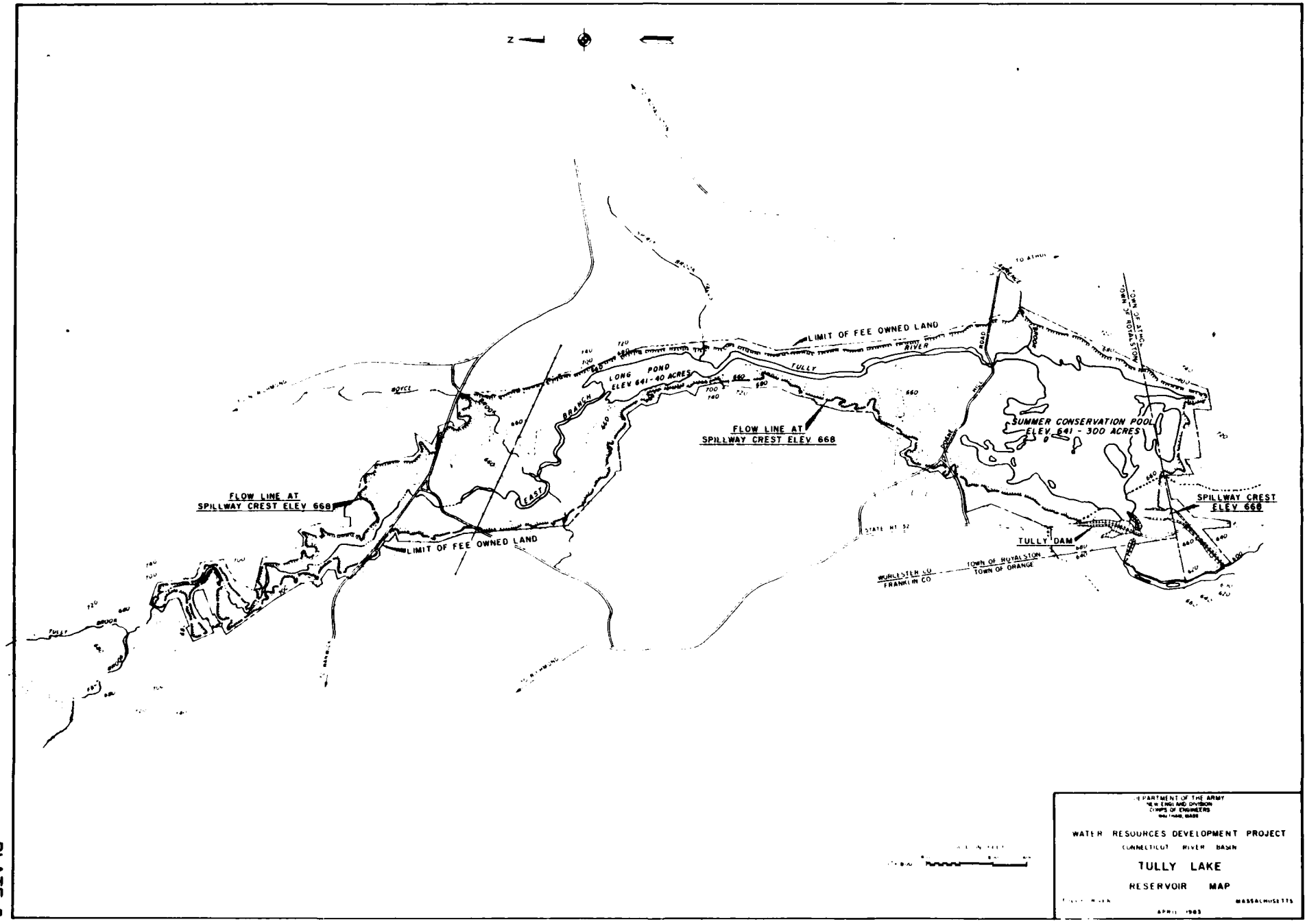

10-YEAR FREQUENCY
LOW FLOW ANALYSIS
MAX. STORAGE - 2,600 A-F EL. 644 FT.
847 MILLION GALLONS
POOL ELEVATION - 642 FT. - 1,825 AC-FT.
MINIMUM RELEASE - 0
MINIMUM RELEASE (0.1 CSM) - 5 CFS
TOP OF RECREATION POOL EL. 641 FT. - 1,500 A-F
INFLOW (<5 CFS) = OUTFLOW
PERMANENT POOL EL. 636 - 525 A-F
INVERT ELEV. 625 FT.
NOTE:
RESERVOIR LEVEL
AT TOP OF RECREATION
POOL AT BEGINNING
OF STORAGE
CONNECTICUT RIVER BASIN
TULLY LAKE
DROUGHT CONTINGENCY
STORAGE VS. FLOW DURATION
RESERVOIR STORAGE / INFLOW
VOLUME IN ACRE-FEET
3000
2500
2000
1500
1000
500
0
0
20
40
60
80
100
120
140
160
180
DURATION IN DAYS

PLATE 4



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

WATER RESOURCES DEVELOPMENT PROJECT

CONNECTICUT RIVER BASIN

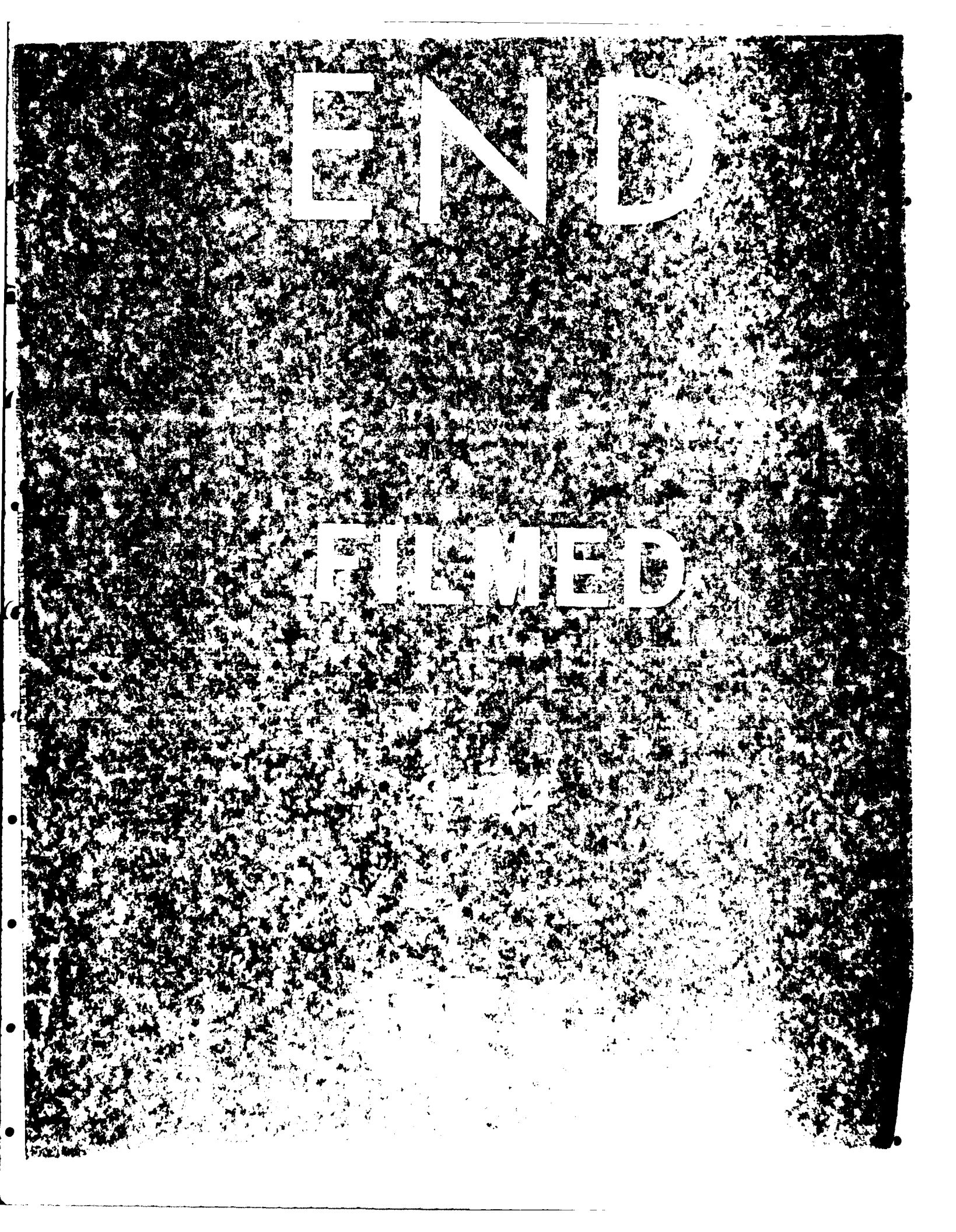
TULLY LAKE

RESERVOIR MAP

MASSACHUSETTS

APRIL 1963

PLATE 5


END
FILMED