CONNECTICUT RIVER

NEW HAMPSHIRE, VERMONT,
CONNECTICUT AND MASSACHUSETTS

REVIEW OF REPORTS ON FLOOD CONTROL

APPENDIX - VOLUME 3

SECTION 6 - LEVEES DETAILS & ESTIMATES
SECTION 7 - CHANNEL IMPROVEMENTS
SECTION 8 - PROFILES

UNITED STATES ENGINEER OFFICE
PROVIDENCE, RHODE ISLAND
28 FEBRUARY 1940
REVISED 18 DECEMBER 1944

REVIEW OF REPORTS ON SURVEYS OF THE CONNECTICUT RIVER AND TRIBUTARIES FOR FLOOD CONTROL

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SECTION 6

LEVEES - DETAILS AND ESTIMATES

SECTION 6

LEVEES - DETAILS AND ESTIMATES

1. EXISTING LEVEES. - Levees for protection from floods have been constructed by various interests in the lower Connecticut River since the middle of the nineteenth century. There are no protective levees in the upper valley, in the States of New Hampshire and Vermont. The levees constructed to protect rural areas are principally to prevent erosion. Levees constructed to protect real estate and industrial developments were constructed, in general, to give protection against a flood of the magnitude of 1854, which, in the lower valley, was approximately the same height as the more recent flood of 1927. After the all-time record flood of 1936, which topped all existing levees and caused great losses, a number of existing levees were raised and enlarged by the Engineer Department, with local cooperation, as work relief projects in accordance with the Flood Control Act of 1936. Construction of levees at seven localities, as outlined in the comprehensive plan, was approved by the Flood Control Act of 1938. Portions of these levees have been completed. Detailed information pertaining to existing levee protection is given in the following table.

(Table on following page)

TABLE XXXVII

EXISTING AND AUTHORIZED LEVEES, FLOOD WALLS, AND APPURTENANT WORKS

ALONG THE CONNECTICUT RIVER

LOCATION	CHARACTER OF WORK	ELEVATION OF TOP OF LEVEE (Ft. Above M.S.L.)	APPROXIMATE ELEVATION OF 1936 FLOOD (Ft. Above M.S.L.)	LENGTH OF LEVEE (FEET)	CONSTRUCTING AGENCY	DATE OF PROJECT	PROTECTED AREA ACRES	PROTECTED AREA CHARACTER (1)	CONSTRUCTION COSTS U.S.E.D.	CONSTRUCTION COSTS OTHERS	CONSTRUCTION COSTS TOTAL
Hatfield	Earth Levee	129.0	131.0	1,800	State	1903-05		R,A	-	$ 6,700	$ 6,700
	Earth Levee	129.0	131.0	2,100	State	1913-14		R,A	-	6,500	6,500
	Earth Levee	129.0	131.2	2,300	State	1926-29		R,A	-	36,300	36,300
	Earth Levee	129.0	130.8	3,000	Town	1933-34		R,A	-	13,830	13,830
	Earth Levee	129.0	131.0	2,800	State	1936		R,A	-	11,000*	11,000
	Earth Levee	134.0	134.5	1,240	U.S.E.D.	1936		R,A	$ 41,800	-	41,800
Hadley	Earth Levee	125.0*	129.6	1,093	State	1902		C,R,A,	-	4,800	4,800
	Earth Levee	130.0	130.7	1,545	State	1928-29		C,R,A	-	6,200	6,200
	Earth Levee	130.0	130.8	350	State	1933-34		C,R,A	-	3,200*	3,200
	Earth Levee	130.0	130.8	3,700	State	1936		C,R,A	-	12,000*	12,000
	Earth Levee	130.0	130.7	2,900	U.S.E.D.	1936		C,R,A	42,100	-	42,100
Northampton	Earth Levee	123.0	129.0	2,000	Private	1856-69	100	I,C,R,M	-	7,500*	7,500
N. 1	Foundation Treatment	-	-	-	U.S.E.D.	1938-39		I,C,R,M,A		-	
N. 2	Earth Levee	132.0 - 132.5		4,560	U.S.E.D.	1939		I,C,R,M,A		-	
N. 3A	Diversion Canal	-	-	-	U.S.E.D.	1939		I,C,R,M,A		-	
N. 3B	Bridge and Drop										
	Structure	-	-	-	U.S.E.D.	1939-	295	-		-	1,214,000
N. 3C	Riprap	-	-	-	U.S.E.D.	1939-40		-		-	
N. 3D	Levee and Wall	139.3 - 146.2		2,400	U.S.E.D.	1939		I,C,R,M,A		-	
N. 4	Pumping Station and										
	Levee Closure	130.0		350	U.S.E.D.	1940-		I,C,R,M,A		-	
South Hadley Falls	Concrete Wall	78.5	75.0	1,700	State	1936	30	C,M	-	28,000*	28,000
Holyoke	Earth Levee	58.0	70.7	148	State	1915-16	75	A	-	1,200*	1,200
HL. 1	Concrete Wall	80.0	78.3	630	U.S.E.D.	1938-39		I,C	82,000	-	82,000
HL. 2	Pumping Stations and										
	Concrete Wall	78.6 - 80.8	75.0 - 78.3	5,500	U.S.E.D.	1939-40	105	I,C,M	1,186,000	-	1,186,000
HL. 2A	Pumping Equipment	-	-	-	U.S.E.D.	1939-40	-	-	82,000*	-	82,000
HL. 3	Pumping Stations and										
	Concrete Wall	73.2 - 75.2	72.4 - 74.2	11,100	U.S.E.D.			I,C	1,363,000*	-	1,363,000
Springdale (Holyoke) (2)	Earth Levee	66.0	72.4	4,285	City	1928-31	100	I,R,U	-	109,300	109,300
	Pumping Plant	-	-	-	City	1929-31	-	-	-	13,200	13,200
	Raising Levee	73.0	72.4	5,890	City	1936-37	125	I,R,U	-	101,900*	101,900
Chicopee	Earth Levee	64.5	70.3	8,000	City	1936	250	I,R,M,A	-	30,000*	30,000
C. 1	Earth Levee	72.4 - 73.1	70.0 - 70.7	4,488	U.S.E.D.	1938-39		I,R,A,		-	
C. 2	Earth Levee	72.4 - 75.2	70.2 - 72.4	15,752	U.S.E.D.	1939	1,020	I,R,A		-	
C. 3A	Levee and Wall	70.6 - 72.6	69.8	1,825	U.S.E.D.	1939		I		-	
C. 3B	Levee and Wall	72.6 - 74.0	70.0 - 70.5	2,850	U.S.E.D.			I		-	1,591,000
C. 4	Levee and Wall	75.6 - 78.3	74.0	1,030	U.S.E.D.	1940-...		I,C,R	42,000*	-	
C. 5	Pumping Stations	-	-	-	U.S.E.D.			-		-	
Springfield	Earth Levee	63.0 - 64.0	66.0 - 67.0	6,200	City	1926	150	I,C,R,M	-	35,000	35,000
	Pumping Stations	-	-	-	City	1927-28	-	-	-	300,000	300,000
	Raising Levee	67.4 - 69.3	66.0 - 67.9	9,000	U.S.E.D.	1936-37	-	I,C,R,M	60,700	-	60,700
	Levee and Wall	66.9 - 69.6	66.9 - 67.6	4,290	U.S.E.D.	1937-38		I,C,U	68,500	-	68,500
S. 1	Earth Levee	69.7	67.3	380	U.S.E.D.	1938-39		M	6,000	-	6,000
S. 2	Levee and Wall	65.6 - 66.4	64.8 - 65.7	4,978	U.S.E.D.	1939-40	819	I,C,R,M	228,000	-	228,000
S. 3	Conduit	-	-	1,865	U.S.E.D.	1940-41		I,C,R,M	300,000	-	300,000
S. 4	Concrete Wall	67.6 - 68.7	67.4 - 66.4	5,700	U.S.E.D.	1939		I,C,R	325,000	-	325,000
S. 5	Concrete Wall	68.7 - 69.3	68.4 - 68.9	2,530	U.S.E.D.	1939		I,C,R	154,000	-	154,000
S. 5A	Pumping Stations	-	-	-	U.S.E.D.	1940		I,C,R	54,000		54,000
West Springfield	Earth Levee	62.0	65.5	11,500	Private	1917-18	1,600	I,C,R,M,U	-	45,000	45,000
	Earth Levee	66.4 - 67.3	66.1 - 67.0	6,070	U.S.E.D.	1936-37		I,C,R,M,U	182,800	-	182,800
	Raising Levee	68.3 - 69.0	66.3 - 67.0	6,108	U.S.E.D.	1938		I,C,R,U	153,500	-	153,500
WS. 1	Concrete Wall										
	and Raising Levee	70.1 - 76.3	65.6 - 66.6	3,900	U.S.E.D.	1938-39		R	177,000	-	177,000
WS. 2	Raising Levee	68.4 - 68.5	65.7	3,030	U.S.E.D.	1939		I,C,U	126,000	-	126,000
WS. 3	Raising Levee	68.4	65.6 - 65.7	2,487	U.S.E.D.	1940	1,044	I,C,U	132,000	-	132,000
WS. 4	Foundation Treatment	-	-	-	U.S.E.D.			I,C,U	306,000*		306,000
WS. 5	Concrete Wall and										
	Raising Levee	68.6 - 69.6	65.9 - 67.2	6,320	U.S.E.D.	1939-40		C,R,M	271,000		271,000
WS. 6	Concrete Wall and										
	Bank Improvement	67.4 - 69.8	67.2 - 67.7	410	U.S.E.D.	1939		R	97,000		97,000
WS. 7	Pumping Stations	-	-	-	U.S.E.D.	1941-43		I,C,R,U	378,000		378,000
Agawam	Earth Levee	50.0*	62.3	450	State	1913	50	A	-	1,000*	1,000
Hartford	Earth Levee	32.0	37.0	9,500	Private	1862-57	250	U	-	125,000*	125,000
	Earth Levee	33.5	36.1 - 36.7	15,500	City	1928-30	1,200	I,C,R,M,A,U	-	1,151,000	1,151,000
	Pumping Station	-	-	-	City	1929-30	-	-	-	150,000	150,000
	Raising Levee	36.2 - 36.9	36.1 - 36.9	17,400	U.S.E.D.	1936-37		I,C,R,M,A,U	133,000	-	133,000
	Raising Levee	42.5 - 43.0	36.8	11,700	U.S.E.D.	1937-38		M,U	433,500	-	433,500
Ht. 1	Earth Levee	47.5	37.6 - 37.7	6,600	U.S.E.D.	1938-39		A,U			
Ht. 2	Sheet Piling	-	-	-	U.S.E.D.	1938-39		A,U	2,558,000	594,000	3,152,000
Ht. 3	Pumping Station	-	-	-	U.S.E.D.	1939		A,U			
Ht. 4	Earth Levee	46.0 - 47.5	37.6	10,200	U.S.E.D.	1939	2,755	I,M,A,U			
Ht. 5	Levee and Wall	44.4 - 46.4	36.4 - 37.0	4,300	U.S.E.D.		(4)	I,C,R,M		(5)	(5)
Ht. 6, 6A, 6B	Wall, Conduit and		(3)								
	Pumping Stations	-	-	7,300	U.S.E.D.			I,C,R,M			
Ht. 7A	Raising Levee	43.0 - 43.6	36.9	900	U.S.E.D.	1939		M,U			6,169,000
Ht. 7B	Levee, Wall, and										
	Pumping Station	43.6 - 44.4	36.9	4,900	U.S.E.D.			M,U			
Ht. 8	Raising Levee	42.5 - 43.0	36.8	11,400	U.S.E.D.	1938-39		M,U	485,900		485,000
Ht. 9, 10	Temporary Pumping										
	Stations								175,000		175,000
East Hartford En. 1	Earth Levee	40.5	37.5	400	U.S.E.D.	1938-39		M	24,000		24,000
En. 2	Levee and Wall	39.1 - 40.7	36.9 - 37.5	7,150	U.S.E.D.	1939-41	582	C,R,A,U	710,000		710,000
En. 3	Earth Levee	39.1	36.9	1,600	U.S.E.D.	1941-43		C,R,A,U			
En. 4	Levee and Wall	39.1	36.9	5,300	U.S.E.D.	1941-43		C,R,A,U	1,242,000		1,242,000
En. 5A	Earth Levee	42.5 - 43.0	37.5 - 37.9	6,900	U.S.E.D.	1941-43	180	R,A,U			
En. 6	Pumping Stations	-	-	-	U.S.E.D.	1941-43	-	C,R,M,A,U	310,000		310,000

* Estimates

** Under Construction

(1) Key to Character of Protected Areas
- I - Industrial and Manufacturing
- C - Commercial
- R - Residential
- M - Municipal and Civic
- A - Agricultural
- U - Undeveloped

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(2) The Springdale Levee failed during the flood of ~~September 1938~~, and is inadequate except for minor floods.

(3) Top elevations as shown are approximately 6.0 feet higher than U.S.E.D. design grades. Local interests have requested this extra height and will bear the additional costs.

(4) Area protected by levees if built to U.S.E.D. design grades.

(5) Cost to local interests not available.

2. STATUS OF PROJECT. - The seven levee projects authorized by the Flood Control Act approved June 28, 1938 have been completed, or are at this time nearing completion by contract operations. Since the plans and specifications for these were approved in detail by reviewing authorities, the detailed estimates and costs are not given here. For future work, estimates are presented in as much detail as the design information now available permits (see Paragraphs 10 to 16, inclusive). These estimates are based upon the unit prices experienced under present contracts and hired labor construction.

3. SCOPE. - This section consists of a description of the work involved in the local protection work at each of the seven localities of the approved plan, and at two additional localities, including a detailed estimate of the costs. The purpose is to present the breakdown of the revised estimates and total cost figures of the approved plan, in order that the increases outlined in the body of the report may be analyzed; and to present the breakdown of the cost estimates for the levees recommended for Springdale and Riverdale, Massachusetts.

4. DATA AVAILABLE FOR DESIGN. - Plane-table surveys on a scale of 1:1200 with a vertical interval at 5 feet have been made of all the areas where levee improvements are proposed. These are supplemented by maps of the protected areas, obtained from local sources, and have been used as a basis for design. Foundation test pits, and auger and core borings were driven for investigation of foundation conditions. Soil samples have been examined in the Soils Laboratory to determine suitability of the materials for embankment construction and to determine the permeability of soil and expected seepage through and under the levees. The foundation explorations and investigations of the materials have been sufficient to permit determination of a safe and economical levee design.

5. BASIS OF ESTIMATES. - Earth levees with a 10-foot crown width and side slopes of 1 vertical on 2-1/2 horizontal are provided, except where lack of space precludes their use, in which case reinforced flood walls of the cantilever type are used. River banks and earth fills, which are subject to scour by ice action or high velocities, are protected by riprap. Steel sheet-piling cut-offs are provided under concrete walls and earth fills that may be subject to high heads and which are constructed on permeable foundations that will permit a relatively high amount of seepage. Subsurface filter drains are proposed at the landside of high earth sections to insure adequate stability of the wall structure by maintaining a low saturation line, and at the landside toe of all concrete walls to prevent piping. In the design of provisions for adequate drainage of the protected areas during flood stages of the Connecticut River, the capacities of the pumping plants and drainage systems have been based on the following factors: amount of rainfall, intensity, and duration of storms; sanitary sewage based upon population intensities; seepage through and under levees; leakage of gates; and size of storage basins, if any. The costs of the levees were estimated upon designs which will provide the most economical and safe construction for a particular site.

6. COOPERATION WITH OTHER LOCAL PROJECTS. - In all cases effort has been made to determine plans for future construction under consideration by local interests, in order that any proposed levee construction can be adapted to a local improvement program, as long as the Federal expenditure for flood control is not increased and the integrity of the levee construction is protected.

7. UNIT PRICES. - Unit prices are based upon construction costs for similar types of work in New England and elsewhere and recent contract work in the District, particular use being made of data on various existing

levees, and drainage and pumping systems in the Connecticut Valley. Unit prices vary with the conditions, method of construction, and the availability and location of materials at each site.

8. CONTINGENCIES, ENGINEERING, AND OVERHEAD. - Contingencies are estimated at 20 percent to take account of possible variations in the subsurface conditions, flexibility in the design of the levees, and construction difficulties anticipated. Engineering and overhead are estimated at 15 percent of the construction costs.

9. RIGHTS-OF-WAY AND DAMAGES. - The estimates of costs of rights-of-way and the estimated damages which will accrue because of the acquisition of lands for the construction of levees are based upon information from local officials, upon assessed valuations, and upon field reconnaissance in accordance with generally accepted appraisal methods. Under the state laws properties are assessed at their fair market values, based on appraisals made every ten years. Damages to riparian rights have been classed as damages since the disposition of the rights by the individual owners can not be foretold prior to acquisition of rights-of-way. Legal, overhead, and general expenses have been estimated at 20 percent.

10. HARTFORD, CONNECTICUT.

a. General description. - A general description of the project is given in the body of the report. The items of work and their approximate component costs are listed below. Their geographic limits are shown on Plate No. 95; typical sections are shown on Plate No. 96.

ITEM	STATUS	COST TO U. S. GOVT.	COST TO CITY OF HARTFORD	AMOUNT TO COMPLETE CONTRACT	TOTAL COST	REMARKS
Ht. 1 to Ht. 4, and 7a	Completed	$1,381,000	594,000	0	$1,975,000	
Ht. 5 - 7b	Completed	920,000	958,000	0	1,878,000	Construction
Ht. 5 - 7b	Completed		459,000		459,000	Reconstruction of Slide
Ht. 6	Completed	2,817,000	531,000	0	3,348,000	
Ht. 8	Nearly Completed	435,000	0	3,000	438,000	
Ht. 9	Completed	99,000	0	0	99,000	Temporary
Ht. 10	Completed	50,000	0	0	50,000	Temporary
KEENEY LANE PUMPING STATION	Under Design	24,000	*	(a) $140,000	164,000	Permanent Station
BUSHNELL PARK PUMPING STATION	Under Design	30,000	*	(a) 160,000	190,000	Permanent Station
	TOTALS	$5,756,000	$2,542,000	$303,000	$8,601,000	

* City of Hartford will bear portion of total cost after construction is complete.

(a) To be constructed after the present war emergency.

b. Local option. - The total cost to the United States of construction at Hartford is $5,756,000. This is based upon protection to the authorized grade, the earth levees having a 10-foot top width, and flood walls providing the protection along the Park River. The City of Hartford desires a grade for the general protection from 5 to 6 feet higher than that authorized, a 15-foot top width for earth levees, and a conduit instead of flood walls for the Park River. The city has borne the additional expense of such work.

c. Detailed description. - Items Ht. 1, 2, 3, and 4 provide pro-

tection for the zone north of Memorial Bridge. Items Ht. 1 and 2 have been completed by hired labor operations, and Items Ht. 3 and 4 were completed under contract.

(1) Item Ht. 1 involved the excavation and completion of the Meadow Brook diversion channel, and the placing of about 300,000 cubic yards of earth embankment and 145,000 square feet of steel sheet piling.

(2) Item Ht. 2 included the excavation of a cut-off trench and the placing of 136,000 square feet of steel sheet piling.

(3) Item Ht. 3 is a pumping plant serving a drainage area of 1,340 acres. Construction involved 13,000 cubic yards of common excavation, placement of 3,000 square feet of steel sheet piling and 3,325 cubic yards of reinforced concrete, construction of a superstructure, and installation of pumping equipment (furnished under separate contract).

(4) Item Ht. 4 consisted of the construction of an earth levee, complete with riprap protection, from Memorial Bridge north to Station 98, and from Station 158 to Station 162, the provision of steel sheet piling from Memorial Bridge to Station 58 and from Station 158+63 to Station 161+30, the construction of two stop-log structures and the excavation of the Pumping Station storage pond. The principal quantities were 927,000 cubic yards of earth embankment, 197,000 square feet of steel sheet piling, 2,400 cubic yards of reinforced concrete, and 41,000 cubic yards of riprap protection.

(5) Item Ht. 5, Memorial Bridge to 700 feet south of Park River, consisted of construction of approximately 4,800 linear feet of concrete wall with steel sheet piling, a small levee, and necessary bank treatment.

(6) Item Ht. 6, Park River protection and Pumping Stations, consisted of 5,600 feet of closed pressure concrete conduit along the Park River, and the construction of two pumping stations (temporary construction, see Item Ht. 9 and Item Ht. 10). The Park River conduit is a double-barreled structure, each compartment having a clear width of 30 feet and a maximum

clear height of 19.5 feet, with flatly curved roof and invert. The cost of rebuilding and repairing the bridges crossing the Park River has not been included in the estimate, since this is an obligation of the locality.

(7) Item Ht. 7a. Aviation Road north 900 feet, consisted of the enlargement and repair of 900 feet of the existing Clark Dike. It involved placing approximately 32,000 cubic yards of embankment and 1,000 cubic yards of riprap, and a number of incidental drainage items.

(8) Item Ht. 7b, 700 feet south of Park River to 900 feet north of Aviation Road, consisted of approximately 4,000 feet of earth levee and 900 feet of concrete wall, including steel sheet piling cut-off, and a pumping station of 25 c.f.s. capacity. This alinement includes protection for the South Meadows steam-electric station of the Hartford Electric Light Company, which originally was not included in the protection. The additional cost resulting from the change in alinement is estimated to be $252,000 over that of the original alinement. The South Meadows levee was enlarged and raised 2 feet between the railroad stop-log structure and high ground near Wethersfield Avenue.

(9) Item Ht. 8 - Gully Brook Conduit consisted of 2433 ft. of concrete conduit along Gully Brook.

(10) Item Ht. 9, Keeney Lane Pumping Station is a temporary station to provide protection until after the present war emergency. The temporary station consists of a concrete substructure and wooden building housing one 36" volute pump.

(11) Item Ht. 10, Bushnell Park Pumping Station is a temporary station to provide protection until after the present war emergency, when the permanent station will be constructed. The temporary station consists of a concrete substructure and wooden building housing one 36" volute pump.

11. EAST HARTFORD, CONNECTICUT.

a. Description. - A general description of the project is given in the body of the report. The items of work are listed below. Their geographic limits are shown on Plate No. 97; typical sections are shown on Plate No. 98.

Item of work and location	Present status	Estimated construction cost
East Hartford, Connecticut	Total	$2,286,000
EH.1 - Levee, initial hired labor unit	Completed	
EH.2 - Levee and wall, railroad south along Connecticut River	Completed	
EH.3 - Levee, Connecticut River to Swale	"	
EH.4 - Levee, Swale up Hockanum River	"	
EH.5a- Levee, north of New Haven Railroad	"	
EH.6 - Pumping stations	"	

(1) Item EH.1, a section of earth levee extending 400 feet north of Connecticut Boulevard, was completed by hired labor operations. The principal quantities were 9,000 cubic yards of excavation, 2,800 cubic yards of earth embankment, and 13 acres of clearing and grubbing.

(2) Item EH.2, consisting of an earth levee and a concrete flood wall from the railroad south along the Connecticut River, was completed by contract. The work consisted of 6,600 feet of earth levee and 550 feet of concrete flood wall, involving 430,000 cubic yards of earth embankment, 39,000 cubic yards of excavation, 4,800 cubic yards of reinforced concrete, 125,000 square feet of steel sheet-piling, and the construction of the outlet works for the Cherry Street and Pitkin Street Pumping Stations and related drainage facilities.

(3) Item EH.3, is an earth levee extending 1,600 feet from the Connecticut River to the Swale.

(4) Item EH.4 is a length of levee and wall extending from the Swale up the Hockanum River. It includes 5,100 feet of earth levee, 200 feet of concrete flood wall, one stop-log structure, and related drainage facilities.

(5) Item EH.5a consists of a levee north of the New York, New Haven and Hartford Railroad. The principal items of work were 6,900 feet of earth levee, one stop-log structure, drainage facilities, and river bank treatment.

(6) Item EH.6 consists of the construction of three pumping stations: Cherry Street (excluding outlet), 30 c.f.s.; Pitkin Street (excluding outlet), 45 c.f.s.; and at the south end of the Swale (including outlet and storage pond), 300 c.f.s.

12. SPRINGFIELD, MASSACHUSETTS.

a. Description. - A general description of the project is given in the body of the report. The items of work are listed below. Their geographic limits are shown on Plate No. 99; typical sections are shown on Plate No. 100.

Item of work and location	Present status	Estimated construction cost
Springfield, Massachusetts		Total $1,067,000
S.1 - Levee, hired labor unit above North End Bridge	Completed	
S.2 - South End levee section	Completed	
S.3 - Mill River Conduit	Completed	
S.4 - Wall, North End Bridge to Chicopee line	Completed	
S.5 - Wall, Chicopee line to high ground	Completed	
S.5a- Plainfield pumping station	Completed	

(1) Item S.1, consisting of earth levee construction from North End Bridge to Station 4+70, a total length of 380 feet, of which the principal quantity is 1,000 cubic yards of earth fill, was completed as a work relief project.

(2) Item S.2, South End levee section, consists of three sections of concrete wall and a length of earth levee. The wall units are: (1) from Elm Street and Columbus Avenue to high ground at Union Street, a total length of 1,790 feet, including reinforcement of the riverside wall of the United Electric Light Company plant; (2) from high ground at Gardner Street to Mill River, a total length of 1,220 feet; and (3) from Mill River to a point 300 feet north of South End Bridge, a total length of 1,660 feet. Earth levee extends from this point to South End Bridge, a length of 330 feet. Five stop-log structures were constructed. The principal quantities involved were 5,350 cubic yards of reinforced concrete and 67,000 square feet of steel sheet-piling. The project was constructed under contract.

(3) Item S.3, Mill River Conduit, consists of a reinforced concrete conduit and walls extending approximately 1,665 feet

upstream from the Connecticut River to an existing dam.

(4) Item S.4, 5,700 linear feet of concrete flood wall and river bank improvement, extends from about 500 feet north of the North End Bridge to the Chicopee city line. The principal quantities involved were 8,260 cubic yards of reinforced concrete, about 20,000 cubic yards of excavation and backfill, 1,000 cubic yards of riprap, and 104,500 square feet of steel sheet-piling. The project was constructed under contract.

(5) Item S.5, extending north from the Chicopee city line to high ground, consists of two sections of concrete flood wall and river bank protection: (1) from Chicopee city line to the south end of the existing flood wall at the Springfield Rendering Plant, a total length of 2,200 feet, and (2) from the north end of the existing flood wall at the Springfield Rendering Plant to high ground at the Boston and Maine Railroad, a total length of 330 feet. The principal quantities involved were 2,770 cubic yards of reinforced concrete, about 16,000 cubic yards of excavation, 3,800 cubic yards of hand-placed riprap, and 37,000 square feet of steel sheet-piling. The project was constructed under contract.

(6) Item S.5a, is a pumping plant located near Plainfield Street, Chicopee, serving a drainage area of 30 acres. The project was constructed under contract.

13. WEST SPRINGFIELD, MASSACHUSETTS

a. Description. - A general description of the project is given in the body of the report. The items of work are listed below. Their geographic limits are shown on Plate 101; typical sections are shown on Plate No. 102.

Item of work and location	Present status	Estimated Construction cost
West Springfield, Massachusetts	Total for all items	$1,486,000
WS.1 - Levee and wall above Agawam Bridge	Completed	
WS.2 - Levee, Memorial Bridge to Sta. 32	Completed	
WS.3 - Levee, Sta. 32 to Sta. 56+87	Completed	
WS.4 - Levee, Sta. 56+87 to Agawam Bridge	Under design	
WS.5 - Levee and wall, North End Bridge to Memorial Bridge	Completed	
WS.6 - Levee and wall, north of North End Bridge	Completed	
WS.7 - Pumping stations	Completed	

(1) Item WS.1 is a levee and wall extending from the Agawam Bridge upstream along the Westfield River to high ground, and consists of approximately 3,200 feet of earth levee enlargement and 600 feet of new concrete flood wall. The principal quantities involved are 82,000 cubic yards of embankment, 755 cubic yards of reinforced concrete, 9,400 square feet of steel sheet-piling, and 8,000 cubic yards of hand-placed riprap. The project was constructed as a hired labor job.

(2) Item WS.2 consists of 3,030 feet of earth levee enlargement extending from the Memorial Bridge to Station 32. The principal quantities are 32,000 cubic yards of earth fill, 29,100 square feet of steel sheet-piling, 1,700 cubic yards of rock fill, and 1,300 cubic yards of hand-placed riprap. The project was constructed under contract.

(3) Item WS.3 consists of 2,487 linear feet of earth levee enlargement along the Westfield River, between Stations 32 and 56+87.

(4) Item WS.4 consists of foundation treatment for approximately 6,100 linear feet of existing levee along the Westfield River, from Station 56+87 to the Agawam Bridge.

(5) Item WS.5 consisted of earth levee enlargement, construction of reinforced concrete flood walls, repairs of stop-log structures and concrete walls, and river bank improvement between the North End Bridge and the Memorial Bridge. The total length of earth levee is approximately 5,000 feet, and of concrete walls 1,320 linear feet. The project was constructed as a hired labor job.

(6) Item WS.6 includes 410 linear feet of reinforced concrete flood wall and 2,400 linear feet of river bank improvement, north of North End Bridge. The principal quantities are 235 cubic yards of reinforced concrete, 6,000 cubic yards of excavation, 8,000 cubic yards of rock fill, and 3,500 cubic yards of hand-placed riprap. The item was constructed as a work relief project.

(7) Item WS.7 includes three pumping stations. Each involved a substructure, superstructure, equipment and installation, and an outlet conduit. The stations are located (1) at Warren Street, north of North End Bridge, serving a drainage area of 500 acres; (2) at Bridge Street, between North End Bridge and Memorial Bridge, serving a drainage area of 380 acres; and (3) at Circuit Avenue on the Westfield River, serving a drainage area of 585 acres. The latter station is located at the Oxbow pond, which is used as a storage pond.

b. Cost estimates. - The detailed cost estimates for the item under design follows:

WEST SPRINGFIELD, MASSACHUSETTS

COST ESTIMATE - ITEMS.4

Sta. 56+87 to Agawam Bridge

Item No.	Designation	Quantity	Unit cost	Amount	Total
1	Preparation of site	10.78 acres	150.00	1,617	
2	Common excavation	29,600 cu.yd.	.25	7,400	
3	Steel sheet piling	200,600 sq.ft.	1.00	200,600	
4	Pervious fill	1,920 cu.yd.	.20	384	
5	Screened gravel	2,500 " "	2.00	5,000	
6	Semi-compacted backfill	750 " "	.25	184	
7	Tile drains				
	a. 8-inch V.C. pipe	3,500 lin.ft.	.40	1,400	
	b. 12-inch V.C. pipe	200 " "	.65	130	
8	Cement	115 bbl.	2.50	288	
9	Concrete	85 cu.yd.	12.00	1,020	
10	Steel reinforcement	2,660 lb.	.05	133	
11	Miscellaneous iron and steel	2,850 "	.15	428	
12	Topsoil	1,500 cu.yd.	1.00	1,500	
13	Sodding and seeding	1.0 acre	350.00	350	
14	Cleaning up		Lump sum	1,000	
					$221,434
	Contingencies 20%				44,287
					265,721
	Engineering and overhead 15%				39,279
	TOTAL				305,000

14. CHICOPEE, MASSACHUSETTS

a. Description. - A general description of the project is given in the body of the report. The geographic limits of the projects are shown on Plate No. 103; typical sections are shown on Plate No. 104.

(1) Item C.1 consists of an earth levee from Station 107+43 to Station 152+31, and was completed by hired labor. The principal items of work consisted of the removal of Ames Sword Company Dam on the Chicopee River, damaged by the flood of 1938, and the placing of approximately 66,000 cubic yards of earth embankment and 4,500 linear feet of rock toe drains.

(2) Item C.2 is an earth levee north of the Chicopee River, and was completed under contract. It extends from Station 0 to Station 202+40, except the section between Stations 107+43 and 152+31, which is included in Item C.1. The principal items are approximately 285,000 cubic yards of earth embankment, approximately 10,800 linear feet of rock toe drain, approximately 7,800 cubic yards of hand-placed riprap for bank protection, one stop-log structure, and the conduit for a proposed pumping plant.

(3) Item C.3a is an earth levee and concrete wall on the south bank of the Chicopee River, west of the railroad. It was constructed by hired labor operations and consists of approximately 575 feet of concrete wall, 1,050 feet of earth levee, and one stop-log structure, and one pumping station with a pumping capacity of 10 c.f.s.

(4) Item C.3b is a levee and wall on the south bank of the Chicopee River, east of the railroad, consisting of approximately 250 feet of earth levee, 2,600 feet of concrete wall, six tailrace gates and gate structures, and one stop-log structure.

(5) Item C.4, the Willimansett section, consists of approximately 600 feet of earth levee, relocation of Willimansett Brook Channel, and one stop-log structure. The construction of this project has been deferred until after the present war emergency.

(6) Item C.5 includes seven pumping stations having locations and approximate pumping capacities as follows:

Pumping Station	Approx. Capacity
Charbonneau Terrace	115 c.f.s.
Call Street	150 "
Jones Ferry	300 "
Paderewski	130 "
Bertha Avenue	100 "
Station No. 6 (South Bank)	10 "
" " 7 " "	63 "
" " 8 " "	31 "

The construction of each pumping station includes the substructure and superstructure, the mechanical equipment and installation, and the outlet conduit. The Bertha Avenue pumping station was provided with a small storage reservoir. All stations have been constructed except the Charbonneau Terrace pumping station. The total cost of Items C.1 to C.5 inclusive, not including Item C.4 (the Willimansett Section) and Item C.5e (Charbonneau Terrace Pumping Station), was about $1,549,000.

15. HOLYOKE, MASSACHUSETTS.

a. Description. - A general description of the project is given in the body of the report. The items of work are listed below. Their geographic limits are shown on Plate No. 105; typical sections are shown on Plate No. 106.

Item of work and location	Present status	Estimated construction cost
Holyoke, Massachusetts	Total for all items	$2,713,000
H1.1 - Wall, initial hired labor unit	Completed	
H1.2 - Wall and pumping stations, north section	Completed	
H1.2a- Pumping equipment	Completed	
H1.3 - Wall and pumping stations, south section	Under design	1,363,000

(1) Item H1.1 consists of a concrete flood wall extending from the Holyoke Water Power Company spillway 630 feet downstream. The principal quantities were 1,600 cubic yards of excavation, 1,740 cubic yards of reinforced concrete, and related drainage facilities. It was completed as a work relief project.

(2) Item H1.2 consists of three sections of concrete flood wall and earth levee, having a total length of 5,500 feet, and four pumping stations. The first section, 1,400 feet of concrete flood wall, extends from the initial unit, H1.1, along the north bank of the Holyoke No. 2 Wasteway to high ground on the west side of the Holyoke No. 2 Overflow. It has one pumping station of 62 c.f.s. capacity, serving a drainage area of 8 acres. The second section, 1,300 feet of concrete flood wall, extends from high ground on the east side of the No. 2 Overflow along the south bank of the No. 2 Wasteway to high ground at the County Bridge. It has one pumping station of 62 c.f.s. capacity, serving a drainage area of 7 acres. The third section, 2,400 feet of concrete flood wall and 400 feet of earth levee, extends from high ground at the County Bridge downstream to high

ground near Mosher Street. It has two pumping stations of 78 c.f.s. total capacity, serving a drainage area of 25 acres. The principal quantities involved were 62,000 cubic yards of earth and rock excavation, 21,900 cubic yards of reinforced concrete, 136,000 square feet of steel sheet-piling, 5,200 cubic yards of earth embankment, five stop-log structures, nine tailrace structures, related drainage facilities, four pumping stations, and installation of equipment. The project was constructed under contract.

(3) Item H1.2a, pumping equipment, includes the supplying of the necessary pumping units to the general contractor for Item H1.2.

(4) Item H1.3 consists of three sections of concrete flood wall having a total length of 11,100 feet. The first section is 3,100 feet long and extends from high ground near Appleton Street downstream to the No. 4 Wasteway, and along the bank of the No. 4 Wasteway and the Third Level Canal to high ground at Cabot Street. It has one pumping station of 67 c.f.s. capacity, serving a drainage area of 18 acres. The second section is 3,200 feet long and extends along the landside bank of the Third Level Canal from high ground at Cabot Street to high ground at Main Street. It has one pumping station of 111 c.f.s. capacity, serving a drainage area of 72 acres. The third section is 4,800 feet long and extends from the existing concrete flood wall near Main Street along the bank of the Third Level Canal to the No. 4 Wasteway and downstream to the existing Springdale levee. It has one pumping station of 89 c.f.s. capacity, serving a drainage area of 19 acres. The principal quantities involved are 50,000 cubic yards of earth and rock excavation, 17,800 cubic yards of reinforced concrete, 255,000 square feet of steel sheet-piling,

eight stop-log structures, eight tailrace structures, related drainage facilities, and three pumping stations, including equipment. The total estimated cost of this project is $1,363,000.

b. Cost estimate. - The detailed cost estimate for the item now under design follows:

HOLYOKE, MASSACHUSETTS

COST ESTIMATE - ITEM H1.3

Wall and pumping stations, south section

Item No.	Designation	Quantity	Unit cost	Amount	Total
1	Preparation of site	7 acres	300.00	$ 2,100	
2	Care of water		Lump sum	25,000	
3	Support of railroad		" "	25,000	
4	Excavation, common	50,000 cu.yd.	.40	20,000	
5	Steel sheet-piling	255,000 sq.ft.	1.00	255,000	
6	Backfill	35,000 cu.yd.	.25	8,750	
7	Riprap, hand-placed	500 " "	5.00	2,500	
8	Concrete, reinforced	17,800 " "	16.00	284,800	
9	Steel reinforcement	1,700,000 lb.	.05	85,000	
10	Gates and machinery		Lump sum	65,000	
11	Miscellaneous		" "	40,000	
12	Drainage and pumping		" "	175,000	
					$ 988,150
	Contingencies 20%				197,630
					1,185,780
	Engineering and overhead 15%				177,220
	TOTAL				$1,363,000

16. NORTHAMPTON, MASSACHUSETTS.

a. Description. - A general description of the project is given in the body of the report. The items of work are listed below. Their geographic limits are shown on Plate No. 107; typical sections shown on Plate No. 108.

Item of work and location	Present status	Estimated construction cost
Northampton, Massachusetts		Total $1,214,000
N.1 - Levee, initial hired labor unit	Completed	
N.2 - Connecticut River levee	Completed	
N.3a- Diversion Canal, hired labor	Completed	
N.3b- Diversion Canal, bridge and drop structure	Completed	
N.3c- Diversion Canal riprap	Completed	
N.3d- Levee along Mill River, hired labor	Completed	
N.4 - Pumping station plus closure section of levee along Connecticut River	Completed	

(1) Item N.1, initial unit, consisting of the foundation preparation of an earth levee between Stations 6+50 and 14, was completed by hired labor operation. The principal items of work consisted of 3,500 cubic yards of stripping, 1,750 cubic yards of cut-off excavation, and the placing of 2,600 cubic yards of earth embankment.

(2) Item N.2, Connecticut River levee, consisting of an earth levee between Stations 0 and 49+30, was constructed by contract. The principal items included placing 254,000 cubic yards of earth embankment, 2,600 cubic yards of hand-placed riprap, 7,300 square feet of steel sheet-piling, a nd two reinforced concrete stop-log structures.

(3) Item N.3a, the Diversion Canal between Stations C 1+50 and C 28+07, and between Stations C 35 and C 106, was completed by hired labor operations. The principal item of work was the excavation of 230,000 cubic yards of material.

(4) Item N.3b, the Diversion Canal bridge and drop structure, was constructed by contract. The item consisted of excavation of the diversion canal between Stations C 28+07 and C 35, the construction of a bridge and drop structure, and 2,250 feet of highway relocation. The prin-

cipal items of work included 75,600 cubic yards of excavation, 14,000 square feet of steel sheet-piling, 28,000 linear feet of timber piles, 5,600 cubic yards of reinforced concrete, and the relocation of roads.

(5) Item N.3c, Diversion Canal riprapping between Stations C 1+50 and C 28+07, was constructed under contract. The principal item was 14,300 cubic yards of hand-placed riprap along the upper portion of the canal.

(6) Item N. 3d, the levee along the Mill River, was constructed by hired labor operations. It involved 1,900 feet of earth levee, 500 feet of concrete wall, one small concrete bridge, and one stop-log structure. The principal items were 361,000 cubic yards of earth embankment, 33,000 square feet of steel sheet-piling, 4,400 cubic yards of hand-placed riprap, and 1,400 cubic yards of reinforced concrete for the walls, bridge, and stop-log structure.

(7) Item N.4 is a pumping station plus the closure section of earth levee approximately 350 feet long along the Connecticut River. The drainage area served by the pumping station is 770 acres, and the ultimate pumping capacity is 300 c.f.s. The principal construction items for the pumping station were the substructure, superstructure, pumping equipment, and outlet conduit.

17. SPRINGDALE, MASSACHUSETTS.

a. Description. - Springdale is the southern section of the City of Holyoke, located on the right or west bank of the Connecticut River. It is largely a residential and mercantile section of a suburban nature. The entire Springdale area, with the exception of high ground at the extreme southern end, has been seriously affected by past floods. This area comprises Main Street and its mercantile outlets, three important industrial plants, and several residential streets.

b. The existing levee. - Following the flood of November 1927 a levee was built by the City of Holyoke extending from high ground near Day Street northward for 4,600 feet along the river bank and protecting an area of 122 acres, including three large factories, apartment buildings, stores, several homes, and a playground. This levee was overtopped in 1936 and a section of it was destroyed. It was repaired as a work relief project by local interests. This levee was seriously threatened during the flood of September 1938 when the water came within only one foot of its top. The levee as now built consists of an impervious homogeneous section of class 9 and 11 material with no toe drain. It is very poorly compacted and subject to cracking and sloughing at the inside toe during floods. The foundation consists of fine saturated sand in a loose state of compaction. These conditions render the levee unstable during floods and unreliable as protection for the area. This levee would join and form a continuous part of the protection authorized from Appleton Street south, for the southern area of Holyoke subject to flooding.

c. Flood losses. - The Springdale area of Holyoke was severely inundated by the flood of November 1927 and damaged to the extent of approximately $70,000 direct losses. The floods of March 1936 topped the levee which had been erected after the flood of November 1927 and resulted in direct losses of $312,800 and indirect losses of approximately the same

amount. After the flood of March 1936 the levee was again raised and, although the area was not flooded in September 1938, over 300 families evacuated their homes because of the hazardous and weakened condition of the levee, as well as flooding of cellars caused by failure of the pumping plant. In spite of the fact that the present levee afforded protection during the flood of September 1938, many lower floors and basements remain unoccupied and the value of industrial and residential property remains depressed as a result of general lack of confidence and fear of future flooding. The average annual benefits are estimated as $40,400.

d. Plan of improvement. - It is proposed to rebuild the Springdale Levee, following the existing alinement and raising the grade to that of the existing levee at Holyoke to which the Springdale Levee ties into at its northern end. The continuity of the improved earth levee will be broken only by a concrete gate structure, a pumping station, and concrete wing walls at the Berkshire Street sewer. The alinement of the levee is shown on Plate No. 109; typical sections are shown on Plate No. 110.

(1) Subsurface investigations. - Numerous test holes were driven along the existing levee to determine the condition of the underlying soil. The results of these investigations are shown on Plate No. 110, and indicate the need of a continuous steel sheet-piling cut-off to prevent the serious piping and seepage that the levee has been subjected to during past floods.

(2) Embankment. - The existing embankment will be improved with additional fill on the landside slope, and an impervious blanket on the riverside slope. There will be a crown 10 feet wide and the landside slope will be 1 vertical on 2-1/2 horizontal. The fill will be obtained locally and will consist of a well-compacted sandy clay well

suited for this type of structure. The final grade will be about 2 feet higher than that of the existing levee.

(3) Concrete walls and structures. - The concrete walls, which constitute protection between the gate and pumping station structure and the earth embankment, will vary from 12 feet to 32 feet in height and will be of cantilever design with landside counterforts where necessary. The gate structure and pumping station will be of reinforced concrete designed to match the similar structures now being built for the Holyoke Levee.

(4) Riprap. - Existing river currents and the small amount of foreshore indicate the need of riprap along the entire levee and it has been included in the design.

(5) Drainage and pumping. - The existing Berkshire Street sewer is a concrete pipe 10 feet in diameter and approximately 1,200 feet long, laid normal to the Connecticut River. It is impracticable to attempt its use as a pressure conduit and consequently it will be provided with a discharge gate and pumping station. A concrete pipe 4 feet in diameter will be laid along the landside of the levee from the existing Springdale pumping station to the Berkshire Street sewer at the gate structure. The Springdale pumping station will continue its operation, with any flow in excess of its capacity being taken care of by the proposed pumping station at the Berkshire Street sewer outlet.

(6) Basis of annual cost. - The Federal interest rate is 3-1/2 percent and amortization is 3-1/2 percent compounded annually. Non-Federal rates are 4-1/2 percent for each of the above items. Federal annual costs include interest and amortization of the total Federal investment. The total Federal investment includes the construction costs of the levee and pumping station. The non-Federal annual costs include, in addition to interest and amortization of the non-Federal investment,

tax loss computed at 4 percent per annum. The annual expenditure for operation and maintenance of the levee projects also will be borne by non-Federal interests. The total non-Federal investment would include the cost of lands, damages, and rights-of-way, the cost of relocation of a railroad siding, and the construction of drainage facilities. All costs would be amortized over a period of 50 years, except the pumping plant and equipment which would be amortized in 20 years. Maintenance and operation costs have been computed at 1 percent of the cost of the concrete and 3 percent of the cost of the pumping station. A lump sum has been added for maintenance of the embankment and other general expenses.

e. Cost estimate. - The estimated total and annual costs of the proposed plan follows.

SPRINGDALE (HOLYOKE), MASSACHUSETTS

COST ESTIMATE

Item No.	Item	Quantity	Unit	Unit cost	Cost	Total cost
1.	Levee construction					
	Clearing			Lump sum	$ 500	
	Stream control			Lump sum	5,000	
	Earth excavation, common	40,000	cu.yd.	0.40	16,000	
	Earth excavation, borrow	30,000	" "	0.35	10,500	
	Embankment, rolled	60,000	" "	0.35	21,000	
	Riprap, hand-placed	6,000	" "	5.00	30,000	
	Concrete, reinforced	1,100	" "	18.00	19,800	
	Reinforcement steel	80,000	lb.	0.05	4,400	
	Steel sheet piling	80,000	s.f.	1.25	100,000	
					207,200	
	Contingencies 20%				41,500	
					248,700	
	Engineering and overhead 15%				37,300	
	Total					$286,000
2.	Drainage and pumping facilities					
	Gates and machinery			Lump sum	8,000	
	Pumping plant 1- 80 c.f.s.			" "	63,000	
	Toe drainage			" "	5,000	
	Sewer connection (48")			" "	24,000	
					100,000	
	Contingencies 20%				20,000	
					120,000	
	Engineering and overhead 15%				18,000	
	Total					138,000
3.	Relocation of railroads and utilities					
	Railroad siding	0.2	mi.	Lump sum	5,000	
					5,000	
	Contingencies 10%				500	
					5,500	
	Engineering and overhead 10%				500	
	Total					6,000
4.	Rights-of-way and land					
	Land	8	acres	Lump sum	15,000	
					15,000	
	Legal, overhead, and general expense 20%				3,000	
	Total					18,000
5.	Grand total capital cost					448,000

SPRINGDALE (HOLYOKE), MASSACHUSETTS

ANNUAL COST ESTIMATE

Item No.	Item	Quantity Unit	Unit cost	Cost	Total cost
6.	Total annual cost				
	(a) Federal investment:				
	Levee construction	$207,200 by 1.38		$286,000	
	Pumping plant	63,000 by 1.38		87,000	
	Drainage and gates	13,000 by 1.38		18,000	
	Total Federal investment			391,000	
	(b) Federal annual charges				
	Interest $391,000 by 0.035			13,700	
	Amortization of obsolescence and depreciation:				
	Fixed parts $207,200 by 1.38 by .0076			2,180	
	Movable parts 76,000 by 1.38 by .0354			3,710	
	Total Federal annual charges				$19,590
	(c) Non-Federal investment				
	Land and damage	15,000 by 1.20		18,000	
	Drainage	24,000 by 1.38		33,000	
	Railroad relocation	5,000 by 1.21		6,000	
	Total non-Federal investment			57,000	
	(d) Non-Federal annual charges				
	Interest $57,000 by 0.045			2,560	
	Amortization of obsolescence and depreciation:				
	Land and damage	$15,000 by 1.20 by .0056		100	
	Drainage	24,000 by 1.38 by .0056		190	
	Railroad	5,000 by 1.21 by .0056		30	
	Tax loss on land $5,000* by 0.04			200	
	Maintenance and operation:				
	Embankment and general overhead			500	
	Operation and expendable supplies			500	
	Concrete $24,200 by 1.38 by .01			330	
	Pumping plant, gates, and machinery $71,000 by 1.38 by .03			2,940	
	Total non-Federal annual charges				7,350
	Total annual cost				$26,940

*City of Holyoke is owner of land valued at $10,000

17-A. RIVERDALE (W ST SPRINGFIELD), MASSACHUSETTS.

a. Description. - Riverdale is the northern section of the town of West Springfield, located on the right or west bank of the Connecticut River, and opposite the city of Chicopee. The area is an alluvial plain, subject to frequent floods. On it are located 60 sets of buildings, several commercial establishments, and many large market gardens.

b. Flood losses. - Freshets cause frequent damage by erosion and silting, and occasional loss of market garden crops. Recent extraordinary floods have caused severe losses, and have affected the desirability and growth of the area. The flood of March 1936 caused a direct loss of $136,700 and indirect losses of approximately $55,000 in the area between Goldine and Bagg Brooks. The flood of September 1938 caused a direct loss of approximately $64,100. In addition, real estate valued at approximately $980,000 prior to 1936 has sustained depreciation losses of $170,000. Floods have prevented the natural growth of the area and the increase in value which should result from its desirable location, on a main highway and within two miles of the industrial centers of Chicopee, Holyoke, Springfield, and West Springfield.

c. Plan of improvement. - It is proposed to build an earth levee commencing at high ground on the south side of Goldine Brook. The alinement of the levee follows Goldine Brook for about 1000 feet to the bank of the Connecticut River, thence along the river about 9000 feet to Bagg Brook. The levee then follows Bagg Brook about 3000 feet to high ground. This plan is shown on Plate No. 110-A. Stop-log structures are provided at three points where highways cross the levee alinement. Two pumping stations are provided for the disposal of interior drainage.

(1) Subsurface investigations. - Numerous test holes have been driven along the proposed alinement to determine the characteristics

of the underlying soil. The results of these investigations are shown on Plate No. 110-A, and were considered in the design of the levee and its drainage.

(2) Embankment. - Typical sections of the proposed levee are shown on Plate No. 110-A. Side slopes of 1 vertical to 2-1/2 horizontal will be used. The crown will be 10 feet wide. There will be an impervious blanket on the riverside slope, faced with one foot of hand-placed riprap along the entire levee excepting the section along the bank of Bagg Brook. The embankment fill will be obtained locally and will consist of well-compacted sandy clay, well suited for this type of structure. Five feet of freeboard is incorporated in the design grades.

(3) Concrete structures. - Three reinforced concrete stop-log structures, varying from 6 to 12 feet high, will permit highways to pass through the levee. Wooden stop-logs and adequate removable braces will be supplied. Two concrete pumping stations will be built at the locations shown on Plate No. 110-A.

(4) Drainage and pumping. - The capacity of the pumping stations considers seepage, sewage, and storm run-off. The greatest single factor is storm run-off from the drainage area behind the levee, 640 acres for the large and 70 acres for the small pumping station.

(5) Basis of annual cost. - The Federal interest rate is 3-1/2 percent, and amortization is 3-1/2 percent compounded annually. Non-Federal rates are 4-1/2 percent for each of the above items. Federal annual costs include interest and amortization of the total Federal investment. The total Federal investment includes the construction costs of the levee, the stop-log structures, and the pumping stations. In addition to interest and amortization of the non-Federal investment, the non-Federal annual costs include the tax loss computed at 3 percent per annum on the assessed valuations, the maintenance and operation of the entire

protective works, and the cost of land, damage, and rights-of-way. All costs are amortized over a 50-year period, excepting the pumping stations and equipment, which are amortized over a 20-year period. Maintenance and operation costs have been entered as a reasonable lump sum.

d. Cost estimate. - The cost estimate and the annual costs of the proposed protective works are as follows:

RIVERDALE (WEST SPRINGFIELD), MASSACHUSETTS

COST ESTIMATE

Item No.	Item	Quantity	Unit	Unit cost	Cost	Total cost
1	Levee construction					
	Preparation of site			Lump sum	$ 4,000	
	Earth excavation, common	67,500	cu.yd.	0.40	27,000	
	Earth excavation, borrow	270,000	" "	0.35	94,400	
	Embankment, rolled	262,000	" "	0.30	78,600	
	Riprap, hand-placed	13,000	" "	5.00	65,000	
	Concrete, reinforced	1,300	" "	18.00	23,500	
	Reinforcement steel	130,000	lb.	0.05	6,500	
	Steel sheet piling	16,000	sq.ft.	1.25	20,000	
					319,000	
	Contingencies 20%				63,700	
					382,700	
	Engineering and overhead 15%				57,300	
	TOTAL					$440,000
2	Drainage and pumping facilities					
	Pumping plants 1 - 20 c.f.s.	Concrete		Lump sum	16,000	
		Machinery		" "	12,000	
	1 - 130 c.f.s.	Concrete		" "	56,000	
		Machinery		" "	24,000	
					108,000	
	Contingencies 20%				21,600	
					129,600	
	Engineering and overhead 15%				19,400	
	TOTAL					149,000
3	Relocation of railroads and utilities				none	
4	Rights-of-way and land					
	Land			Lump sum	42,000	
					42,000	
	Legal, overhead, and general expense 20%				8,000	
	TOTAL					50,000
5	Grand total capital cost					639,000

RIVERDALE (WEST SPRINGFIELD), MASSACHUSETTS

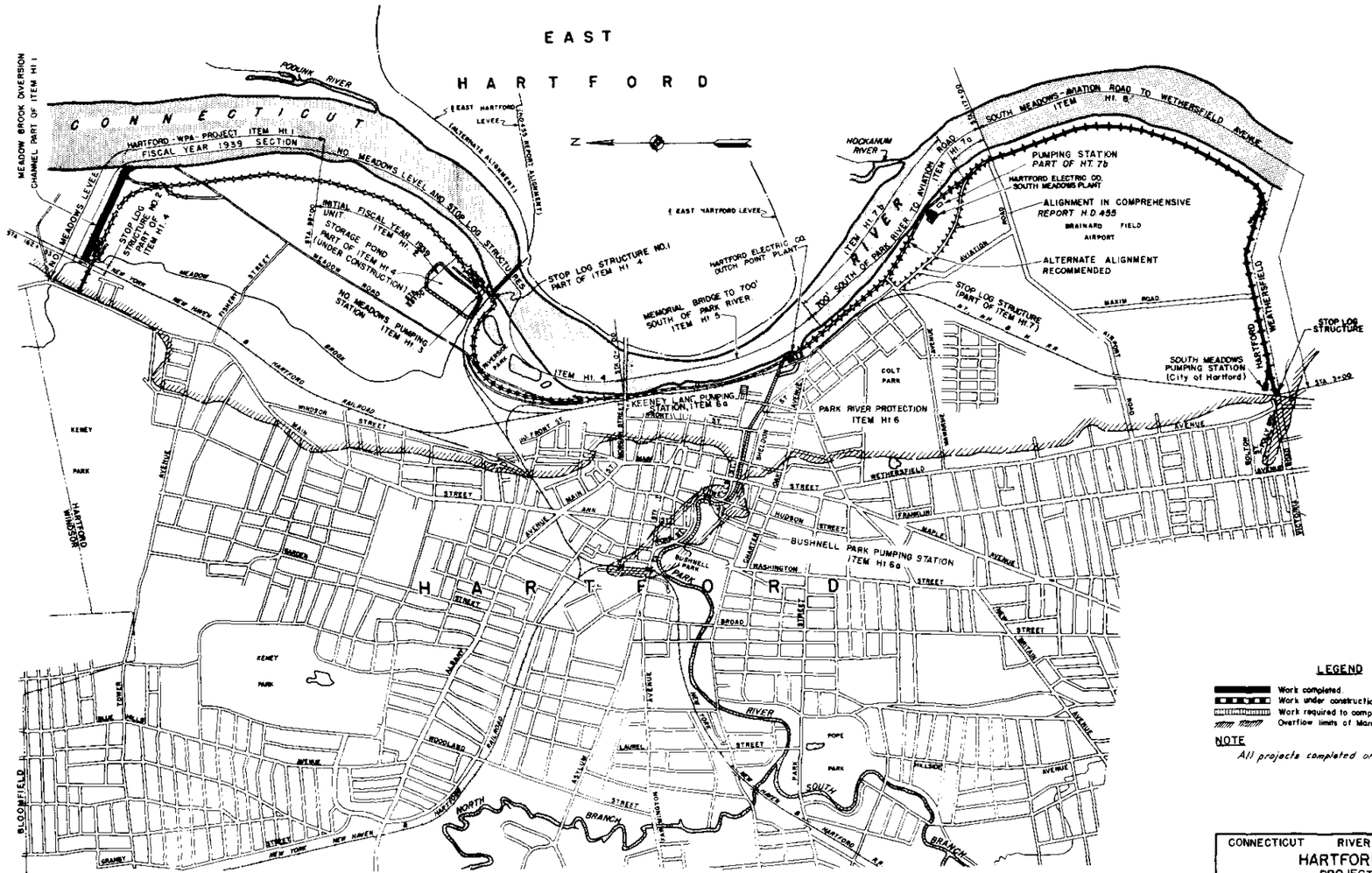
ANNUAL COST ESTIMATE

Item No.	Item	Quantity	Unit	Unit cost	Cost	Total cost
6	Total annual cost					
(a)	Federal investment					
	Levee construction	$289,000 x 1.38			$399,000	
	Concrete	102,000 x 1.38			140,500	
	Machinery	36,000 x 1.38			49,500	
	Total Federal investment				589,000	
(b)	Federal annual charges					
	Interest	589,000 x 0.035			20,600	
	Amortization of obsolescence and depreciation:					
	Earthwork and general	289,000 x 1.38 x .0076			3,030	
	Concrete	102,000 x 1.38 x .0076			1,070	
	Machinery	36,000 x 1.38 x .0354			1,760	
	Total Federal annual charges					$ 26,460
(c)	Non-Federal investment					
	Land and damage				50,000	
	Total non-Federal investment				50,000	
(d)	Non-Federal annual charges					
	Interest	50,000 x 0.045			2,250	
	Amortization of obsolescence and depreciation:					
	Land and damage	50,000 x .0056			280	
	Tax loss on land	42,000 x .015			630	
	Maintenance and operation:					
	Embankment and general overhead				500	
	Operation and expendable supplies				500	
	Concrete	102,000 x 1.38 x 0.01			1,400	
	Pumping plants	36,000 x 1.38 x 0.03			1,480	
	Total non-Federal annual charges					7,040
	Total annual cost					33,500

18. SUMMARY OF COSTS. - The summary of estimated costs to the United States of the local protection works, including work completed and under design, is given below:

Hartford, Connecticut	$ 5,900,000
East Hartford, Connecticut	2,286,000
Springfield, Massachusetts	1,067,000
West Springfield, Massachusetts	1,486,000
Chicopee, Massachusetts	1,549,000
Holyoke, Massachusetts	2,713,000
Northampton, Massachusetts	1,214,000
Total estimated cost to the United States	$16,215,000
Additional levees recommended herein*:	
Springdale (Holyoke), Massachusetts	391,000
Riverdale (West Springfield), Massachusetts	589,000
Total additional estimated cost to the United States	$ 980,000

*Channel improvements are discussed in Section 7 of the Appendix.



KEY	DATE	REVISION (Indicated by △)	REV BY	CK BY	AP BY

CONNECTICUT RIVER FLOOD CONTROL

HARTFORD CONN.

PROJECT MAP OF LOCAL PROTECTION WORKS

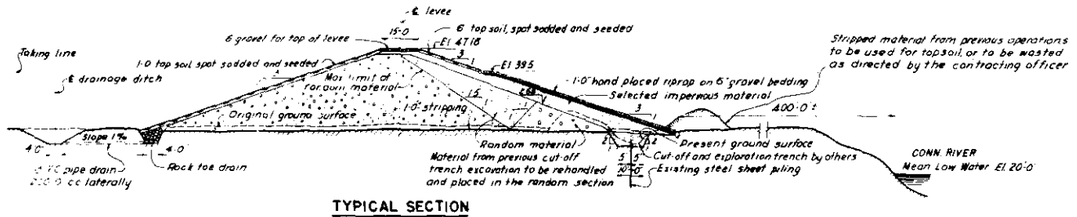
CONNECTICUT RIVER — CONNECTICUT

IN 2 SHEETS — SCALE 1 IN. = 1000 FT. (1000' 0 1000' 2000') — SHEET NO. 1

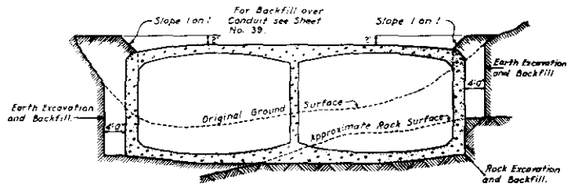
U. S. ENGINEER OFFICE, PROVIDENCE, R. I. — FEB. 1940

SUBMITTED: Senior Engineer, Head Design Section — APPROVAL RECOMMENDED: Principal Engineer, Chief, F. C. Engineering Div. — APPROVED: Col. Corps of Engineers, District Engineer

DESIGNED: Assoc. Engineer — DRAWN: E.J.H. — TRACED: A.L.K. — CHECKED: — TO ACCOMPANY REPORT DATED: FEB 29, 1940 — FILE NO. CT-4-2158

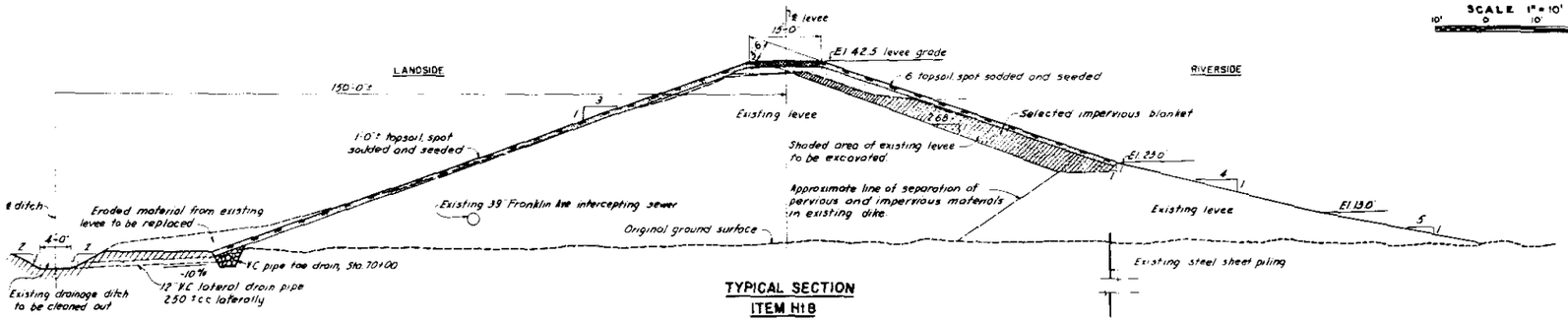


TYPICAL SECTION
ITEMS H11, H12 & H14

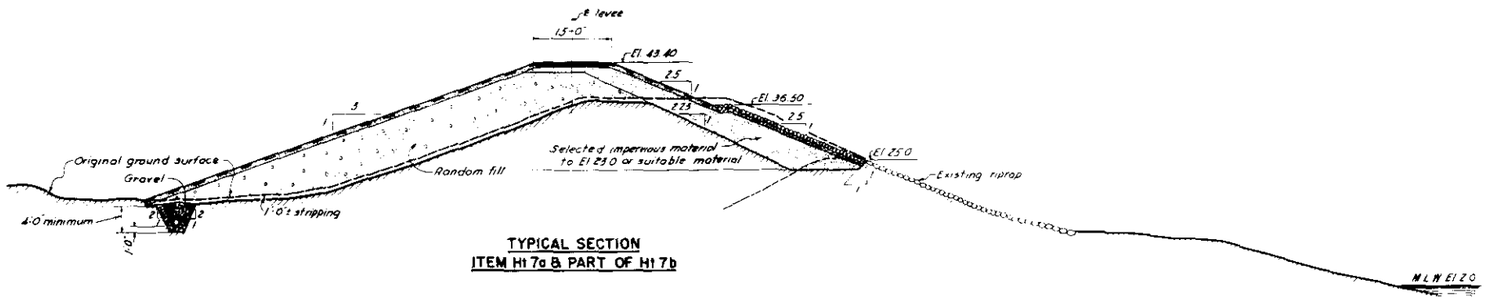


TYPICAL SECTION PARK RIVER

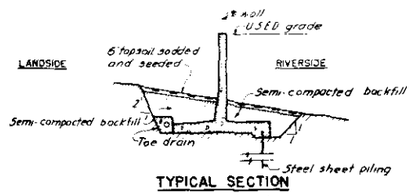
SCALE 1" = 10'
10' 0 10' 20'



TYPICAL SECTION
ITEM H18



TYPICAL SECTION
ITEM H17a & PART OF H17b



TYPICAL SECTION
ITEM H15 & PART OF H17b

NOTES

The levees for local protection at Hartford are being built to the grade desired by the City of Hartford, approximately 5 feet higher than the U.S.E.D. grade and with a crown width of 15 feet instead of the U.S.E.D. standard of 10 feet. The additional cost of the work is being contributed by the City of Hartford.

KEY	DATE	REVISION (Indicated by Δ)	REV'BY	CK'BY	APB'Y

CONNECTICUT RIVER FLOOD CONTROL

HARTFORD LEVEE

TYPICAL SECTIONS

HARTFORD, CONN.

CONNECTICUT RIVER — CONNECTICUT

IN 2 SHEETS — NOT TO SCALE — SHEET NO. 2

U. S. ENGINEER OFFICE, PROVIDENCE, R. I. — FEB 1940

SUBMITTED: Robert B. Nichols, Senior Engineer, Head Design Section

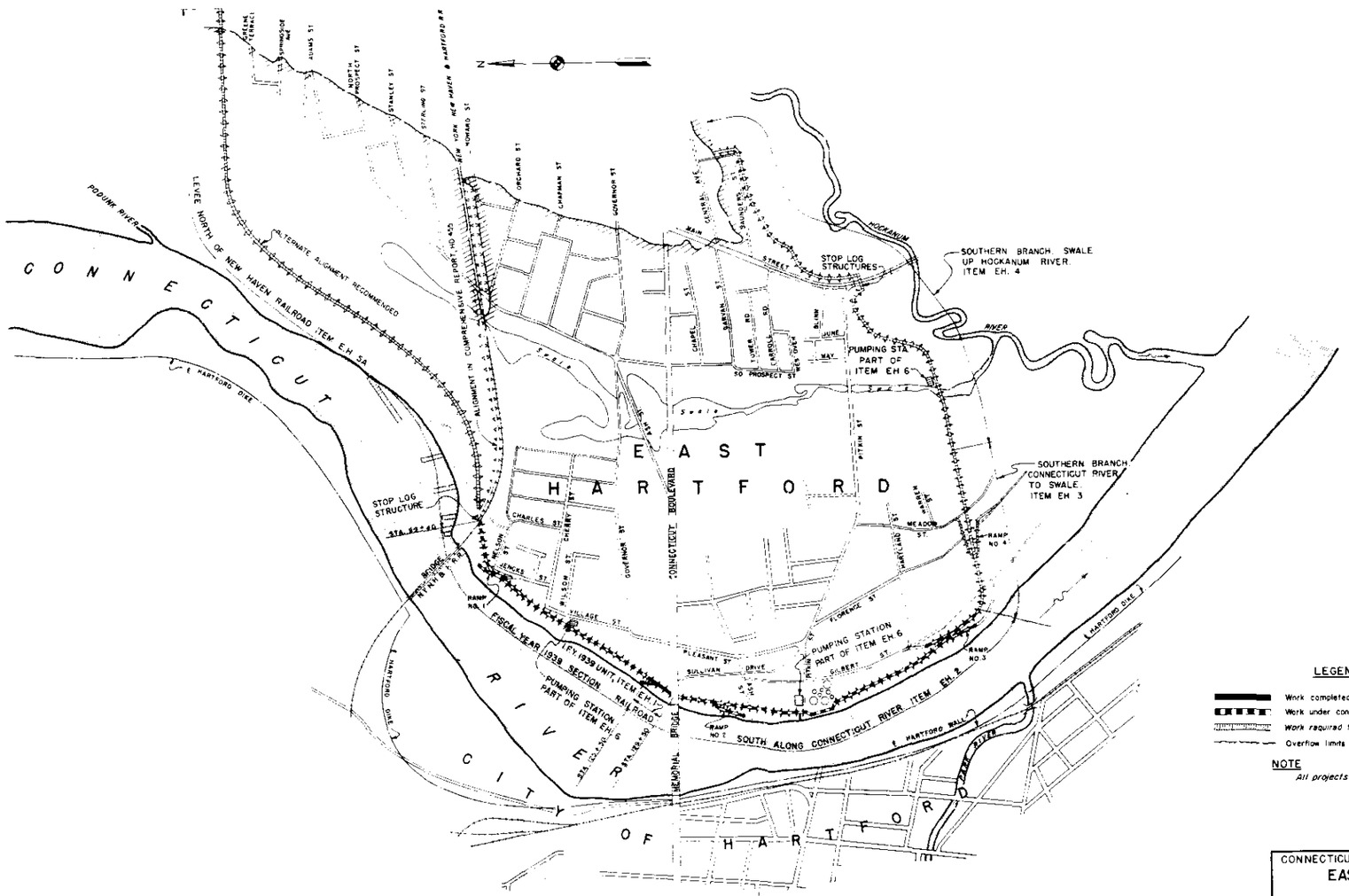
APPROVAL RECOMMENDED: J. S. Burns, Principal Engineer, Chief F.C. Engineering Div.

APPROVED: Colonel, Corps of Engineers, District Engineer

DESIGNED: J. Martin, Assoc. Engineer

DRAWN: F.D.R.
TRACED: R.L.W.
CHECKED: S.T.W.

TO ACCOMPANY REPORT DATED: FEB. 28, 1940
FILE NO. CT-4-2159



CONNECTICUT RIVER FLOOD CONTROL

EAST HARTFORD, CONN.

PROJECT MAP OF LOCAL PROTECTION WORKS

CONNECTICUT RIVER CONNECTICUT

IN 2 SHEETS SCALE 1 IN = 100 FT 000 0 100 200 SHEET NO 1

U. S. ENGINEER OFFICE, PROVIDENCE, R. I. FEB. 1940

SUBMITTED: SEN. OF ENGINEER, HEAD, DESIGN SECTION

APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF F. C. ENGINEERING DIV.

APPROVED: LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

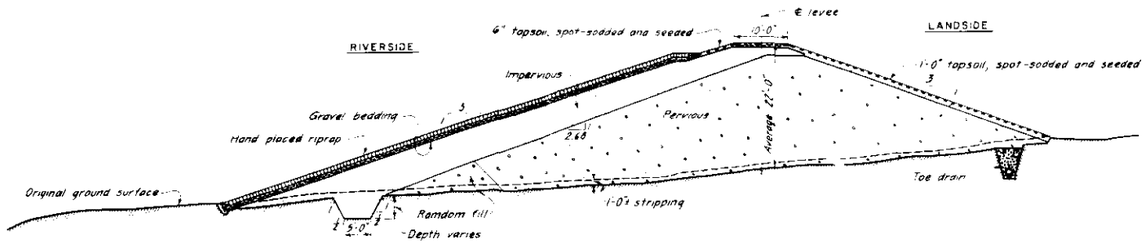
DESIGNED: ASSOC. ENGINEER

DRAWN C. I. M. TRACED F. H. H. CHECKED A. F. B.

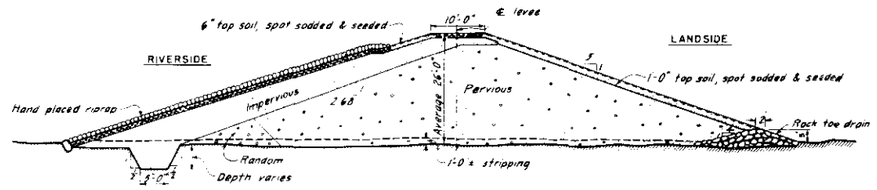
TO ACCOMPANY REPORT DATED FEB. 28, 1940

FILE NO. CT-4-2160

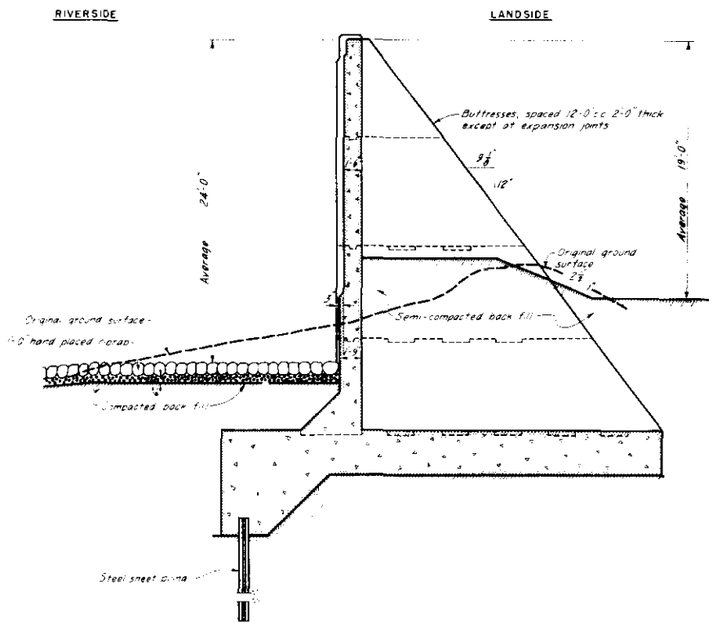
KEY	DATE	REVISION (Indicated by △)	REV BY	CK BY	AP BY



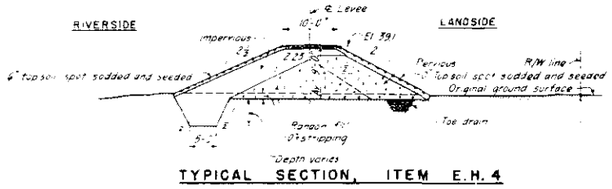
TYPICAL SECTION, ITEMS 1, 2, 3



TYPICAL SECTION, ITEM E. H. 5A



TYPICAL WALL SECTION, ITEM E. H. 2



TYPICAL SECTION, ITEM E.H. 4

NOTE
Elevations refer to Mean Sea Level Datum

KEY	DATE	REVISION (indicated by —)	REV BY	CK BY	AP BY

CONNECTICUT RIVER FLOOD CONTROL

EAST HARTFORD LEVEE

TYPICAL SECTIONS

EAST HARTFORD, CONN.

CONNECTICUT RIVER — MASSACHUSETTS

IN 2 SHEETS — NOT TO SCALE — SHEET NO. 2

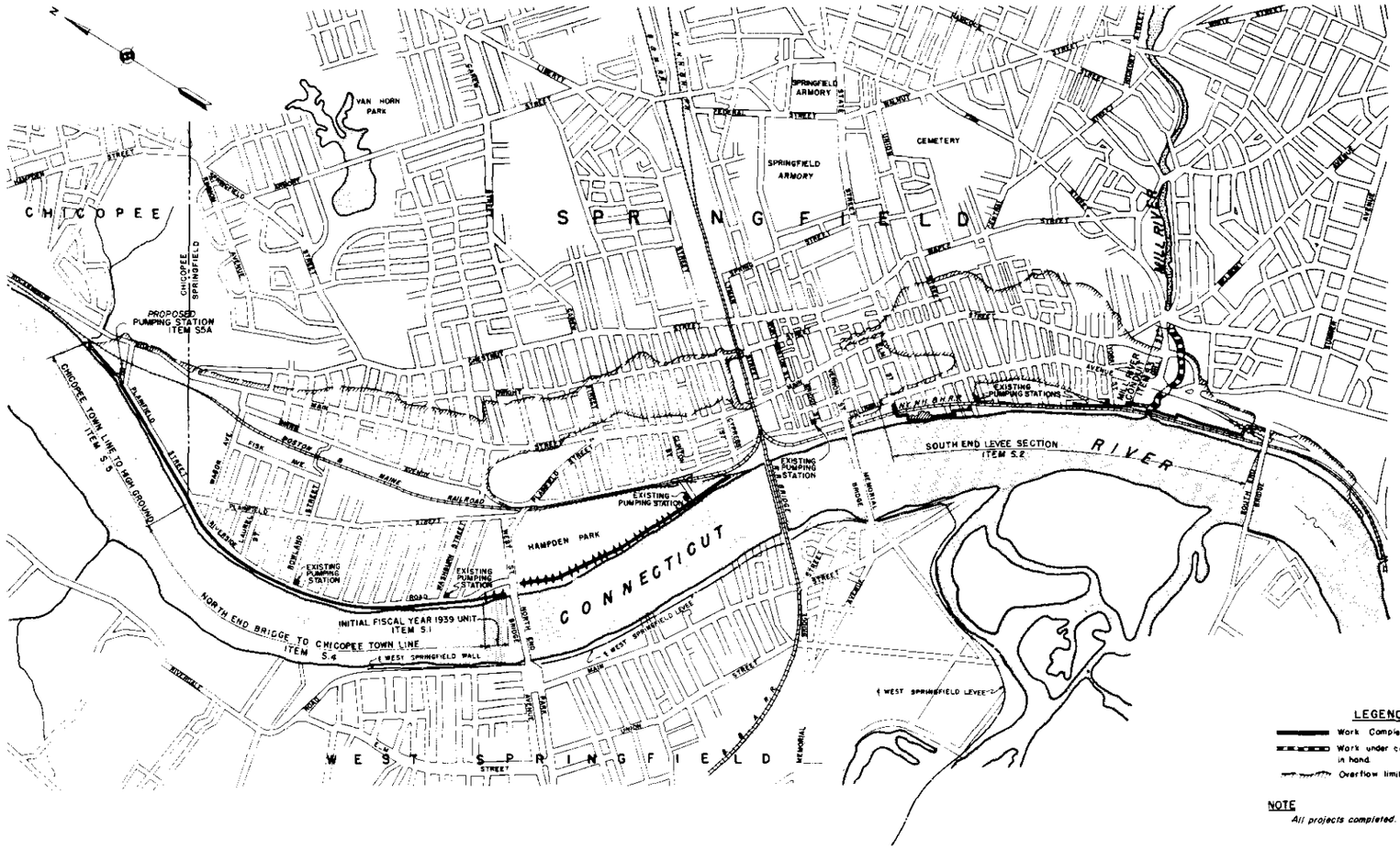
U. S. ENGINEER OFFICE, PROVIDENCE, R. I. — FEB 1940

SUBMITTED: Senior Engineer, Heat. Design Section — APPROVAL RECOMMENDED: Principal Engineer, Chief F.C. Engineering Div. — APPROVED: Colonel, Corps of Engineers, District Engineer

DESIGNED: Assoc. Engineer — DRAWN — TRACED — CHECKED

TO ACCOMPANY REPORT DATED FEB 28, 1940

FILE NO. CT-4-2161



LEGEND

Work Completed.

Work under construction or proposed with funds in hand.

Overflow limits of 1936 flood.

NOTE

All projects completed.

KEY	DATE	REVISION (indicated by △)	REV.BY	CK.BY	APBY

CONNECTICUT RIVER FLOOD CONTROL

SPRINGFIELD, MASS.

PROJECT MAP OF LOCAL PROTECTION WORKS

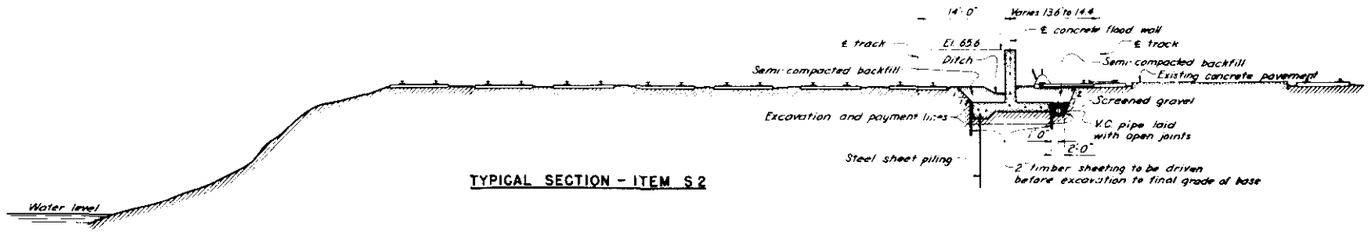
CONNECTICUT RIVER MASSACHUSETTS

IN 2 SHEETS — SCALE 1 IN = 800 FT (400' 0 800' 1600') — SHEET NO. 1

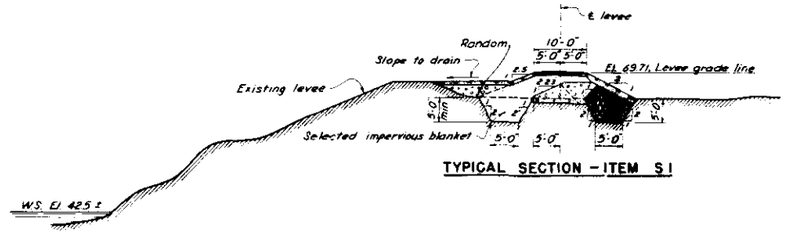
U. S. ENGINEER OFFICE, PROVIDENCE, R. I., FEB 1940

SUBMITTED: SENIOR ENGINEER, HEAD, DESIGN SECTION — APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, F. C. ENGINEERING DIV. — APPROVED: LIEUT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

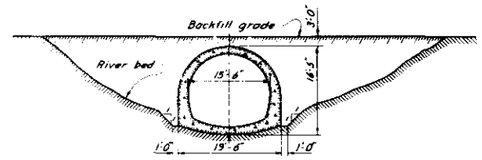
DESIGNED: ASSOC. ENGINEER — DRAWN: L.H. TRACED: E.H. CHECKED: — TO ACCOMPANY REPORT DATED: FEB 28, 1940 — FILE NO. CT-4-2162



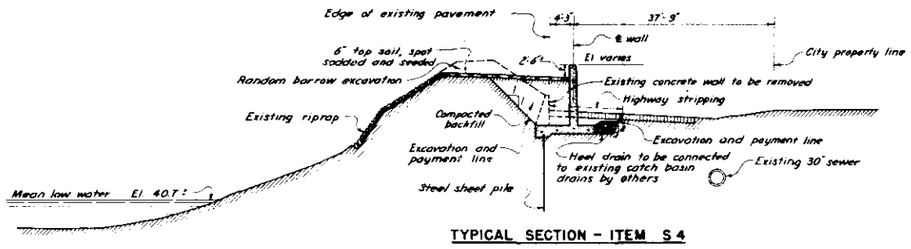
TYPICAL SECTION - ITEM S 2



TYPICAL SECTION - ITEM S 1



TYPICAL SECTION - ITEM S 3
MILL RIVER CONDUIT



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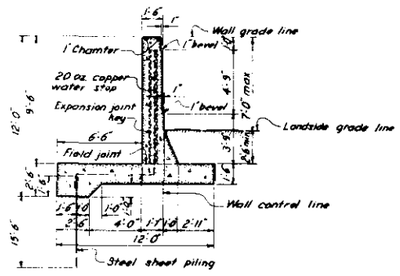
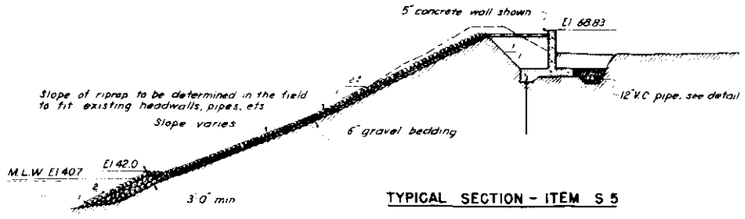


TYPICAL CONCRETE WALL SECTION
ITEMS S2, S4 & S5



TYPICAL SECTION - ITEM S 5

NOTE
Elevation refer to Mean Sea Level Datum.

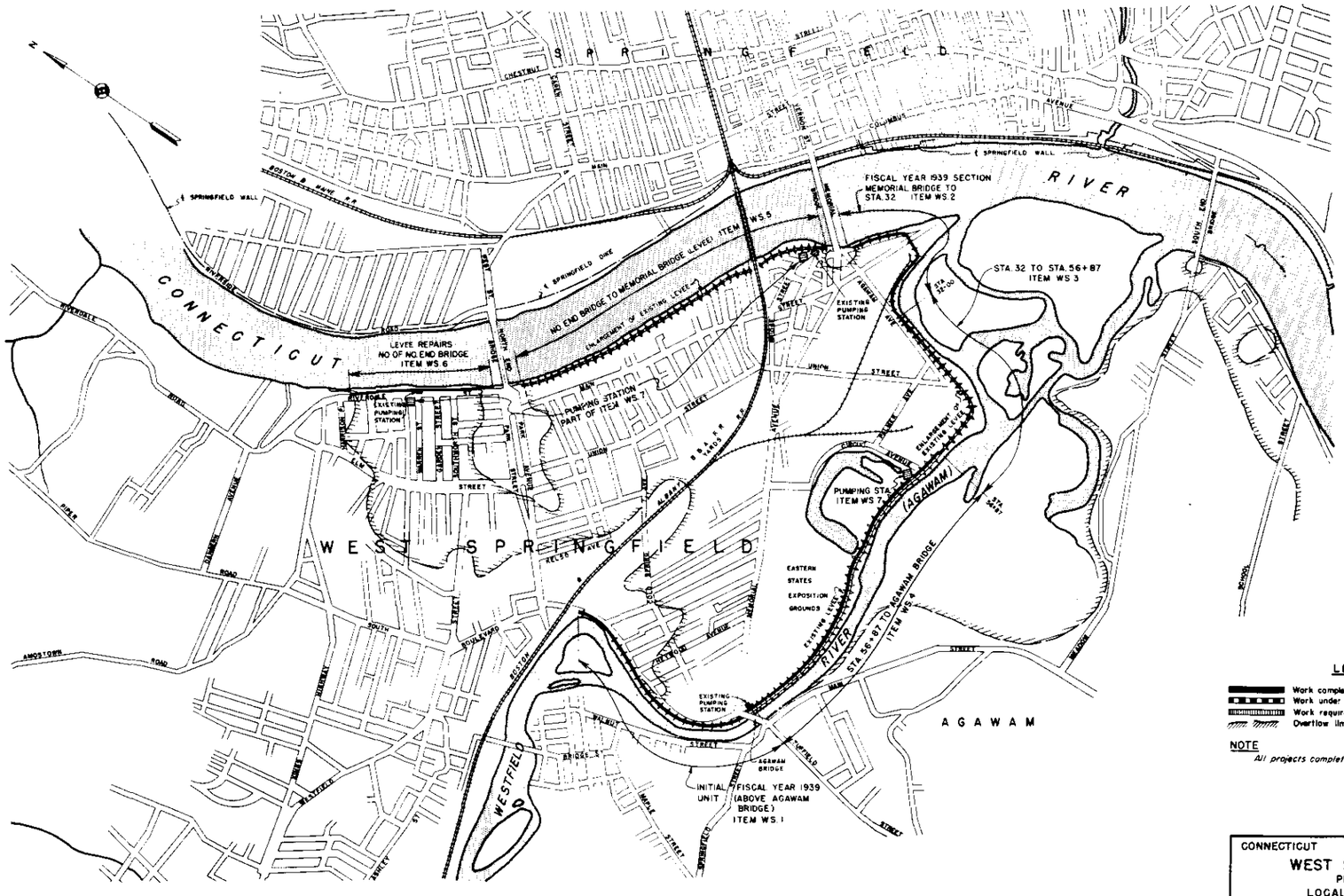
KEY	DATE	REVISION (indicated by △)	REV BY	CK BY	AP BY

CONNECTICUT RIVER FLOOD CONTROL
SPRINGFIELD LEVEE
TYPICAL SECTIONS
SPRINGFIELD, MASS.

CONNECTICUT RIVER — MASSACHUSETTS
IN 2 SHEETS — NOT TO SCALE — SHEET NO. 2

U. S. ENGINEER OFFICE, PROVIDENCE, R. I. — FEB 194

SUBMITTED: SENIOR ENGINEER, HEAD, DESIGN SECTION
APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF F.C. ENGINEERING DIV.
APPROVED: COL., CORPS OF ENGINEERS
DESIGNED: ASSOC. ENGINEER
DRAWN
TRACED
CHECKED
TO ACCOMPANY REPORT DATED FEB. 28, 1940
FILE NO. CT-4-2163



LEGEND

- Work completed
- Work under construction or proposed with funds in hand
- Work required to complete plan
- Overflow limits of March 1936 Flood

NOTE

All projects completed except Item WS 4.

KEY	DATE	REVISION (indicated by △)	REV BY	CKD BY	APP BY

CONNECTICUT RIVER FLOOD CONTROL

WEST SPRINGFIELD, MASS.

PROJECT MAP OF

LOCAL PROTECTION WORKS

CONNECTICUT RIVER MASSACHUSETTS

IN 2 SHEETS SCALE: 1 IN. = 800 FT. SHEET NO. 1

U. S. ENGINEER OFFICE, PROVIDENCE, R. I. FEB. 1940

SUBMITTED: Senior Engineer, Head, Design Section

APPROVAL RECOMMENDED: Principal Engineer, Chief, F. C. Engineering Div.

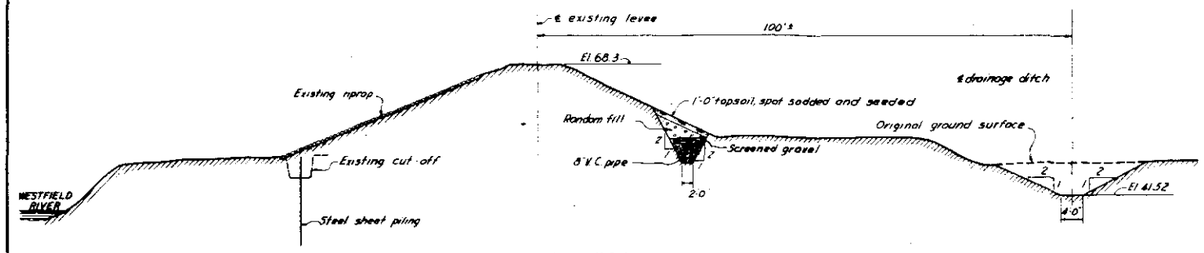
APPROVED: Colonel, Corps of Engineers, District Engineer

DESIGNED: Asst. Engineer

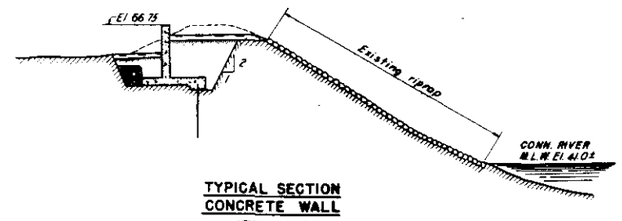
DRAWN: L.H. TRACED: L.H. CHECKED: J.T.M.

TO ACCOMPANY REPORT DATED: FEB. 28, 1940

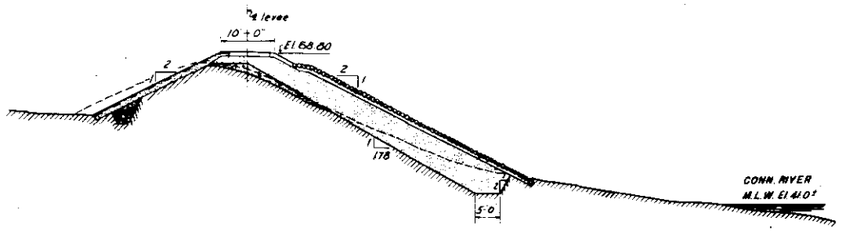
FILE NO. CT-4-2164



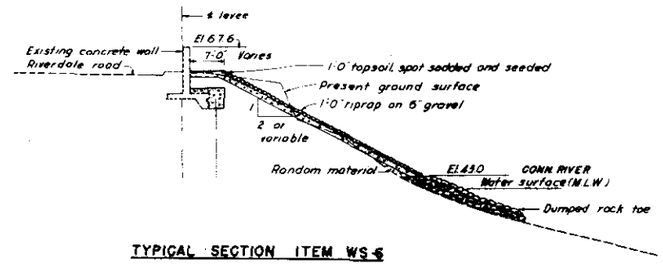
TYPICAL SECTION-ITEM WS 4



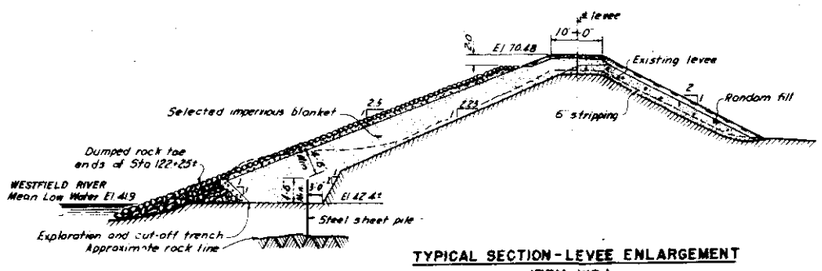
TYPICAL SECTION
CONCRETE WALL
ITEM WS 5



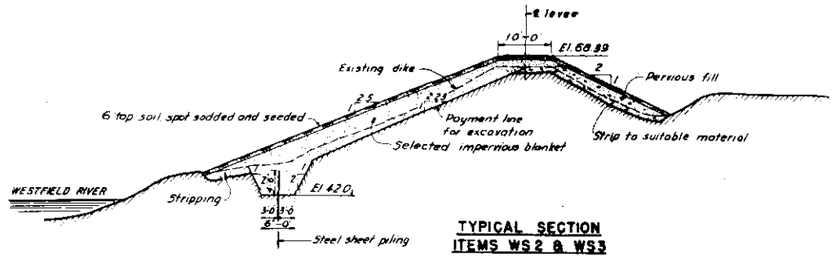
TYPICAL SECTION-LEVEE ENLARGEMENT
ITEM WS 5



TYPICAL SECTION ITEM WS 6

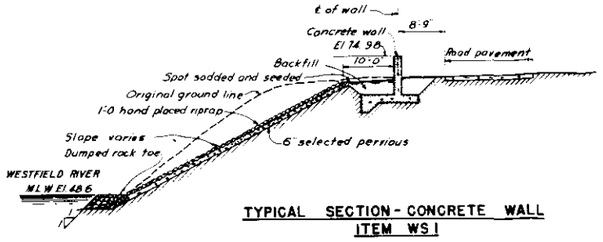


TYPICAL SECTION-LEVEE ENLARGEMENT
ITEM WS 1



TYPICAL SECTION
ITEMS WS 2 & WS 3

NOTE
Elevations refer to Mean Sea Level Datum.



TYPICAL SECTION-CONCRETE WALL
ITEM WS 1

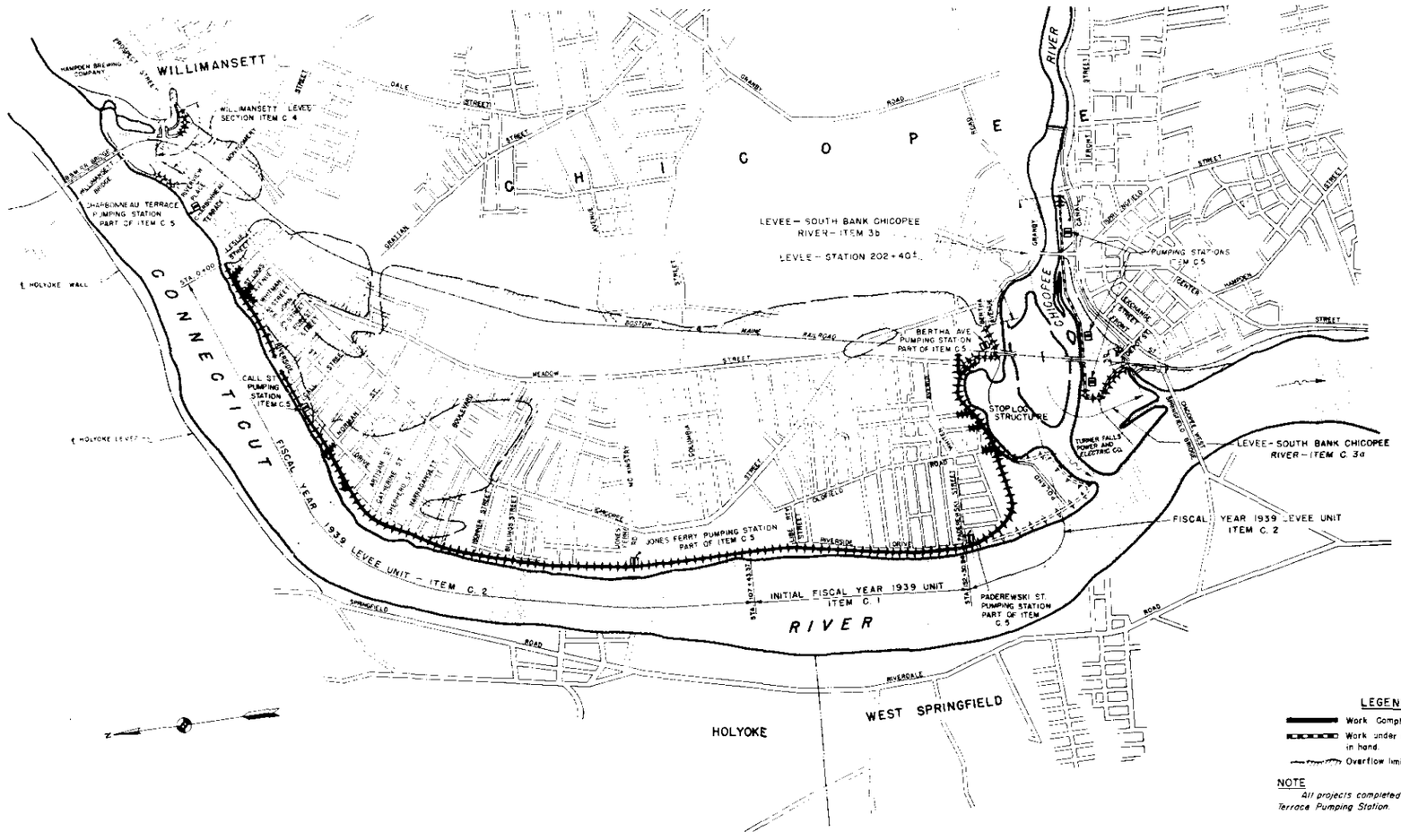
KEY	DATE	REVISION (Indicated by Δ)	REV BY	CK BY	AP BY

CONNECTICUT RIVER FLOOD CONTROL
WEST SPRINGFIELD LEVEE
TYPICAL SECTIONS
WEST SPRINGFIELD, MASS.
CONNECTICUT RIVER MASSACHUSETTS
IN 2 SHEETS NOT TO SCALE SHEET NO. 2

U. S. ENGINEER OFFICE, PROVIDENCE, R. I. FEB. 1940

SUBMITTED: SENIOR ENGINEER, HEAD, DESIGN SECTION
APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, F. C. ENGINEERING DIV.
APPROVED: LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

DESIGNED: ASSOC. ENGINEER
DRAWN: F.F.C.
TRACED: A.J.V.
CHECKED: J.J.M.
TO ACCOMPANY REPORT DATED FEB 28, 1940
FILE NO CT-4-216.5



CONNECTICUT RIVER FLOOD CONTROL

CHICOPEE, MASS.

PROJECT MAP OF LOCAL PROTECTION WORKS

CONNECTICUT RIVER MASSACHUSETTS

IN 2 SHEETS SCALE 1 IN = 800 FT SHEET NO 1

U. S. ENGINEER OFFICE, PROVIDENCE, R. I. FEB. 1940

SUBMITTED: SENIOR ENGINEER, HEAD, DESIGN SECTION

APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, F. C. ENGINEERING DIV.

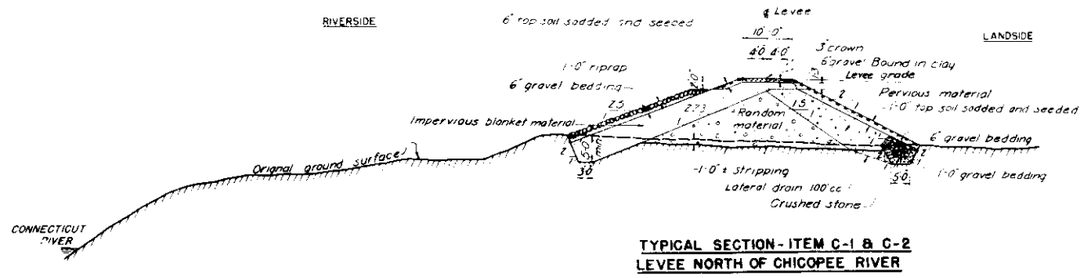
APPROVED: LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

DESIGNED: ASST. ENGINEER

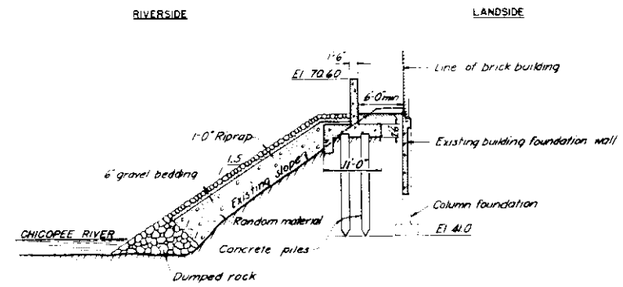
DRAWN: W.S.B.
TRACED: H.M.E.
CHECKED: [illegible]

TO ACCOMPANY REPORT DATED FEB. 28, 1940
FILE NO CT-4 2166

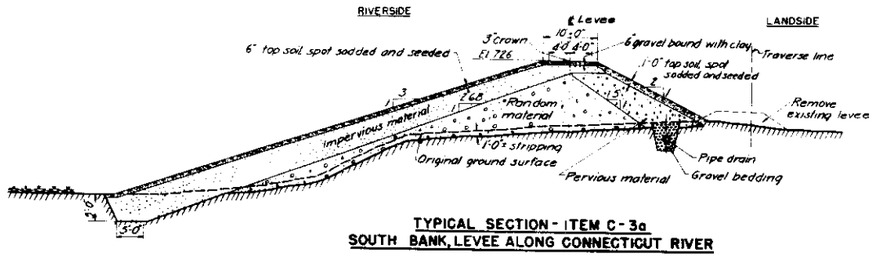
KEY	DATE	REVISION (Indicated by △)	REV BY	CK BY	AP BY



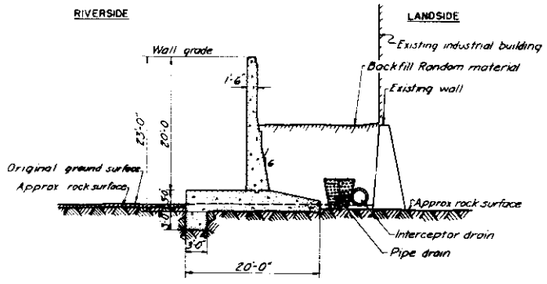
TYPICAL SECTION - ITEM C-1 & C-2
LEVEE NORTH OF CHICOPEE RIVER



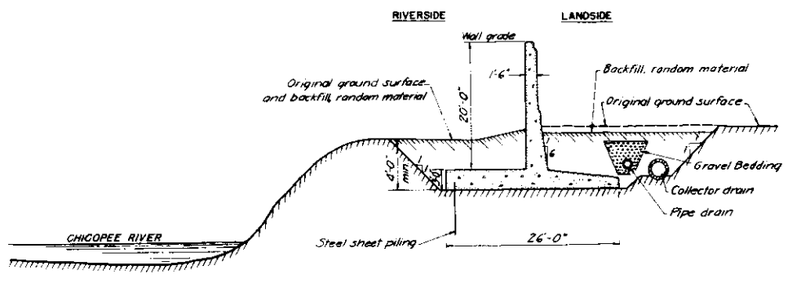
TYPICAL SECTION - ITEM C-3a
SOUTH BANK, LEVEE WEST OF RAILROAD BRIDGE



TYPICAL SECTION - ITEM C-3a
SOUTH BANK, LEVEE ALONG CONNECTICUT RIVER



TYPICAL SECTION - ITEM C-3b
SOUTH BANK, LEVEE EAST OF HIGHWAY BRIDGE



TYPICAL SECTION - ITEM C-3b
SOUTH BANK, LEVEE FROM RAILROAD BRIDGE TO HIGHWAY BRIDGE

NOTE:
Elevations refer to mean sea level datum

KEY	DATE	REVISION (Indicated by △)	REV BY	CK BY	AP BY

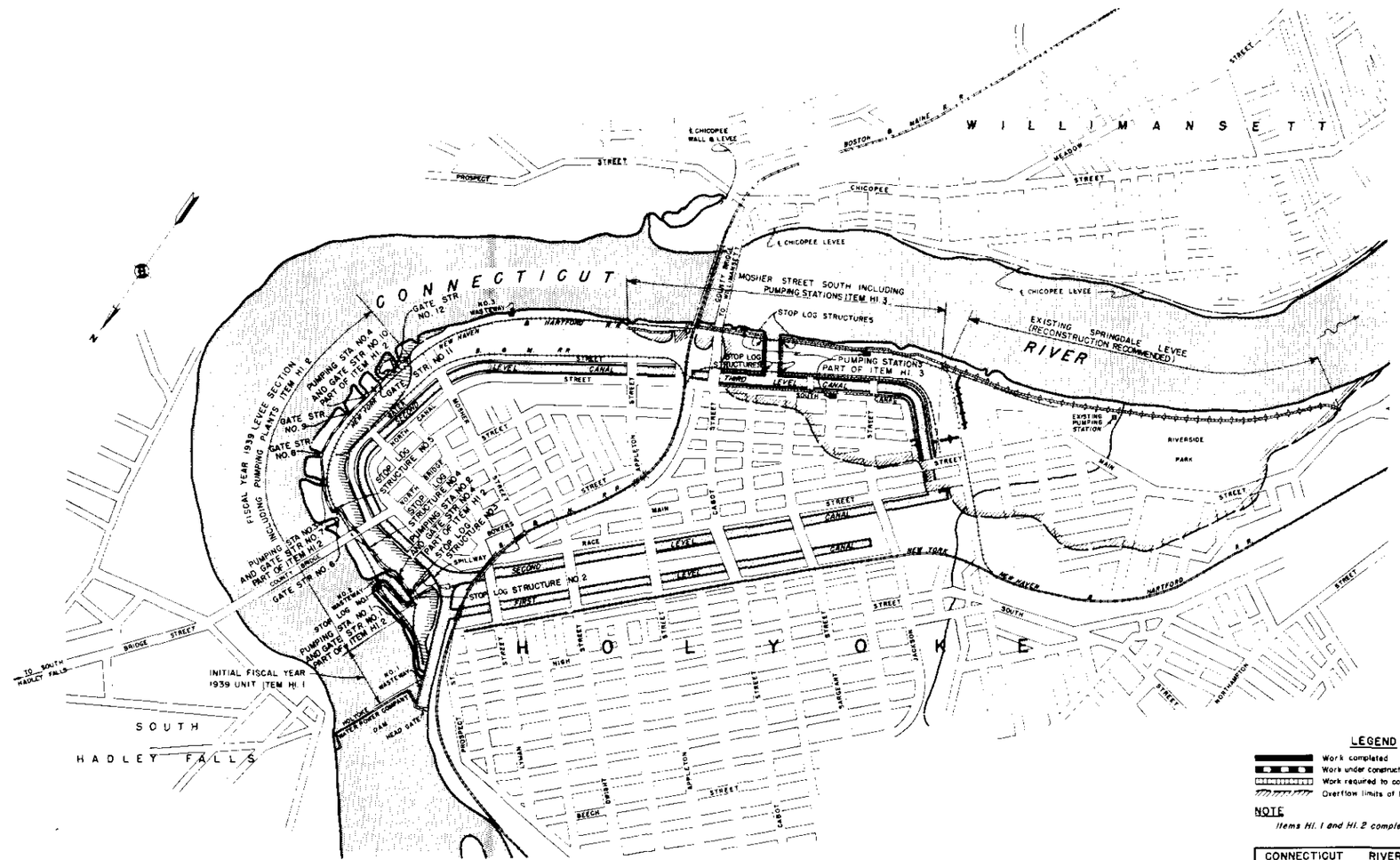
CONNECTICUT RIVER FLOOD CONTROL
CHICOPEE LEVEE
TYPICAL SECTIONS
CHICOPEE, MASS.
CONNECTICUT AND CHICOPEE RIVERS MASSACHUSETTS

IN 2 SHEETS — NOT TO SCALE — SHEET NO. 2

U. S. ENGINEER OFFICE, PROVIDENCE, R. I., FEB. 1940

SUBMITTED: SENIOR ENGINEER, MEAS., DESIGN SECTION
APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, F. C. ENGINEERING DIV.
APPROVED: LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

DESIGNED: ASST. ENGINEER
DRAWN: R.A.T.
TRACED: A.J.T.
CHECKED: A.J.R.
TO ACCOMPANY REPORT DATED: FEB. 28, 1940
FILE NO. CT-4-2167



KEY	DATE	REVISION (indicated by Δ)	REV. BY	CK. BY	AP. BY

CONNECTICUT RIVER FLOOD CONTROL

HOLYOKE, MASS.

PROJECT MAP OF LOCAL PROTECTION WORKS

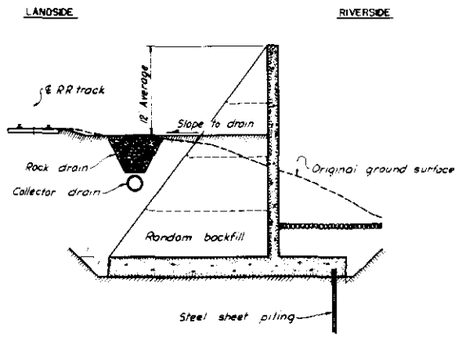
CONNECTICUT RIVER — MASSACHUSETTS

IN 2 SHEETS — SCALE: 1 IN. = 600 FT. (600' 0 600' 1200') — SHEET NO. 1

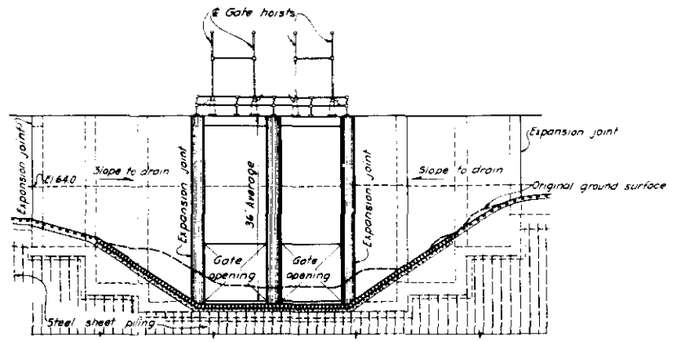
U. S. ENGINEER OFFICE, PROVIDENCE, R. I., FEB. 1940

SUBMITTED: SENIOR ENGINEER, HEAD, DESIGN SECTION — APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF F. C. ENGINEERING DIV. — APPROVED: COLONEL, CORPS OF ENGINEERS, DISTRICT ENGINEER

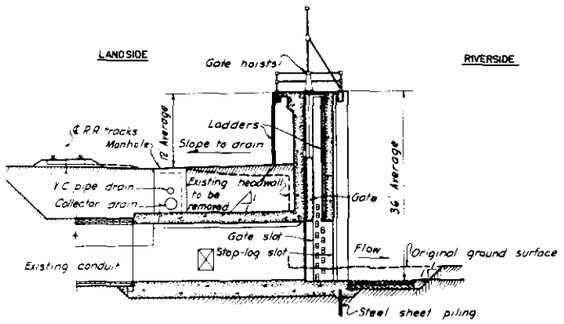
DESIGNED: ASSOC. ENGINEER — DRAWN: R.S.S. TRACED: P.V.S. CHECKED: — TO ACCOMPANY REPORT DATE FEB. 28, 1940 FILE NO. CT-4-2168



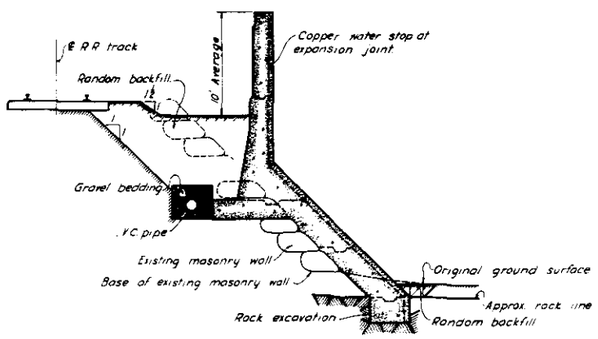
TYPICAL WALL AT TAILRACES, PART OF ITEMS H1. 2 & 3



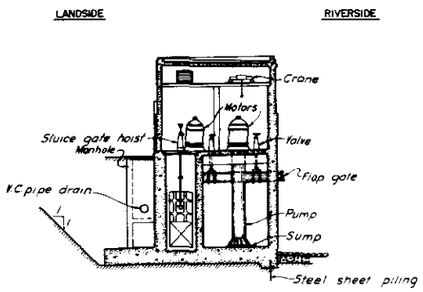
TYPICAL ELEVATION OF GATE STRUCTURE
PART OF ITEMS H1. 2 & 3



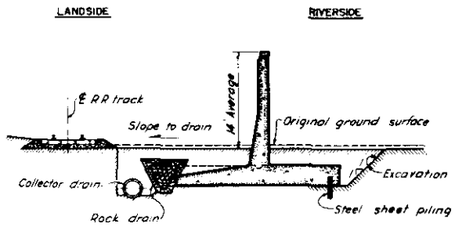
TYPICAL SECTION THRU GATE STRUCTURE
PART OF ITEMS H1. 2 & 3



TYPICAL WALL SECTION, PART OF ITEMS H1. 1 & 2



TYPICAL PUMPING STATION
PART OF ITEMS H1. 2 & 3.



TYPICAL WALL SECTION
PART OF ITEMS H1. 2 & 3.

KEY	DATE	REVISION (Indicated by △)	REV BY	CK BY	AP BY

CONNECTICUT RIVER FLOOD CONTROL
HOLYOKE LEVEE
TYPICAL SECTIONS
HOLYOKE, MASS.

CONNECTICUT RIVER — MASSACHUSETT

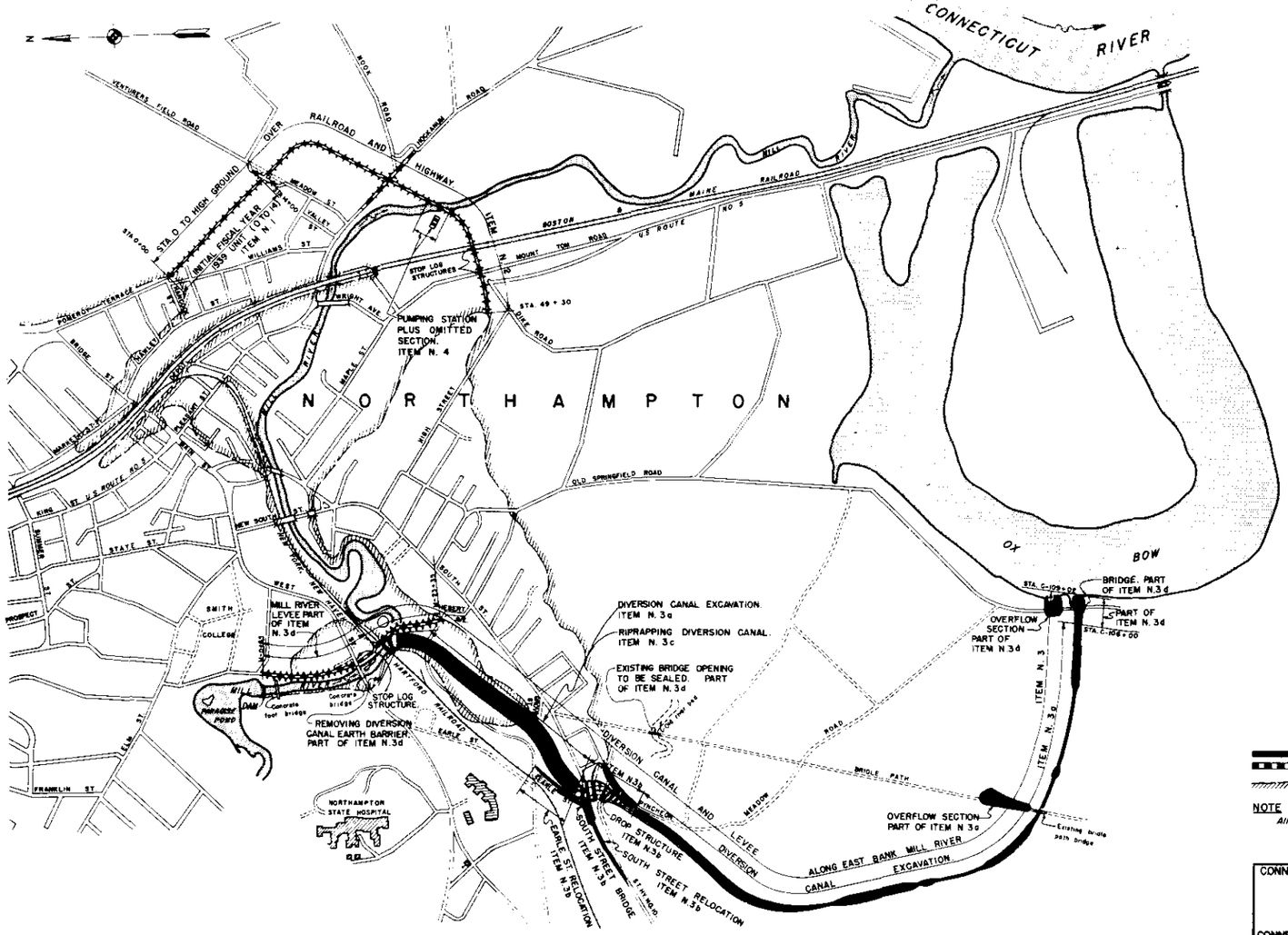
IN 2 SHEETS — NOT TO SCALE — SHEET NO. 2

U. S. ENGINEER OFFICE, PROVIDENCE, R. I. — FEB. 194

SUBMITTED: SENIOR ENGINEER, HEAD, DESIGN SECTION
APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, F. C. ENGINEERING DIV.
APPROVED: LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER

DESIGNED: ASSOC. ENGINEER
DRAWN: H.S.P.
TRACED: J.B.
CHECKED: W.C.K.

TO ACCOMPANY REPORT DATED: FEB. 28, 1940.
FILE NO. CT-4-2169



LEGEND

Work Completed

Work under construction or proposed with funds in hand.

Overflow limits of March 1936 Flood.

NOTE

All projects completed.

CONNECTICUT RIVER FLOOD CONTROL

NORTHAMPTON, MASS.

PROJECT MAP OF LOCAL PROTECTIVE WORKS

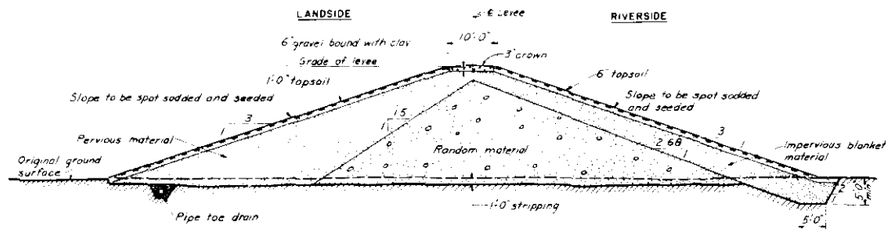
CONNECTICUT RIVER MASSACHUSETTS

IN 2 SHEETS — SCALE 1 IN = 600 FT. (600 0 600 1200) — SHEET NO. 1.

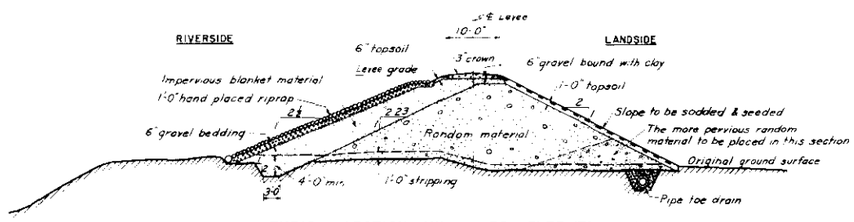
U. S. ENGINEER OFFICE, PROVIDENCE, R. I. — FEB. 1940

SUBMITTED	APPROVAL RECOMMENDED	APPROVED
SENIOR ENGINEER — HEAD, DESIGN SECTION	MEMBER, ENGINEER — CHIEF, F. C. ENGINEERING DIV.	COLONEL, CORPS OF ENGINEERS — DISTRICT ENGINEER

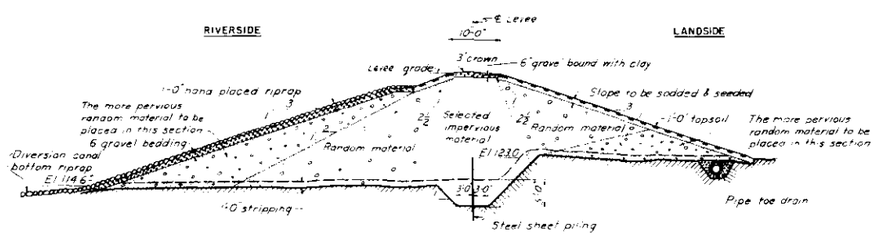
DESIGNED — ASSOC. ENGINEER	DRAWN I. P. K. TRACED H. E. CHECKED	TO ACCOMPANY REPORT DATED FEB 28, 1940 FILE NO. CT-4-2170



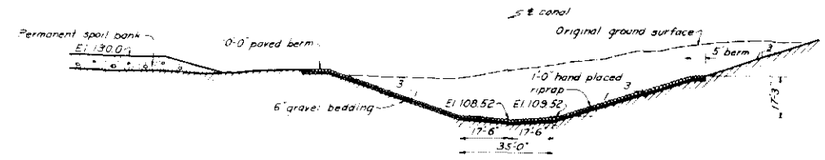
TYPICAL SECTION- CONNECTICUT RIVER LEVEE-ITEM N1 & 2



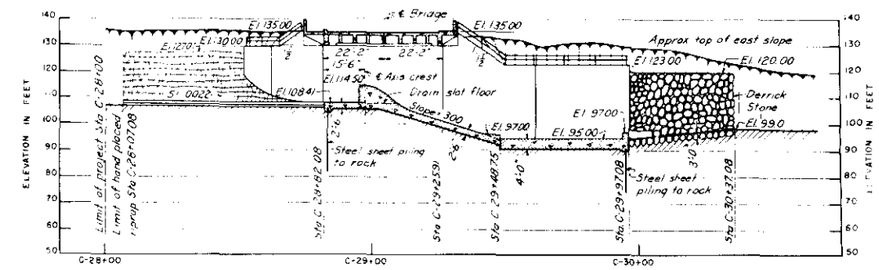
TYPICAL SECTION- MILL RIVER LEVEE-ITEM N3d



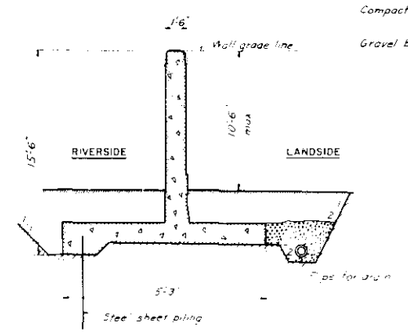
TYPICAL SECTION- MILL RIVER CLOSURE LEVEE-ITEM N3d



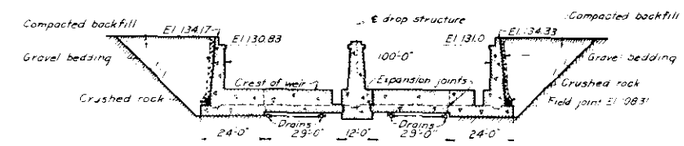
TYPICAL SECTION- DIVERSION CANAL- ITEM N3a & c



PROFILE DROP STRUCTURE - DIVERSION CANAL - ITEM N3b



TYPICAL WALL SECTION- MILL RIVER LEVEE- ITEM N3d



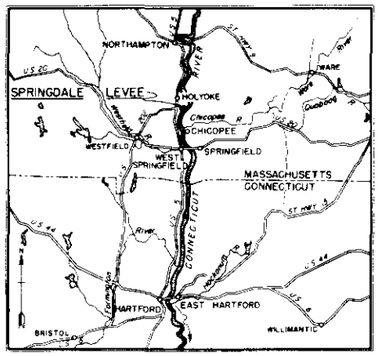
CROSS SECTION DROP STRUCTURE
DIVERSION CANAL - ITEM N3b

NOTE

Elevations refer to Mean Sea Level Datum

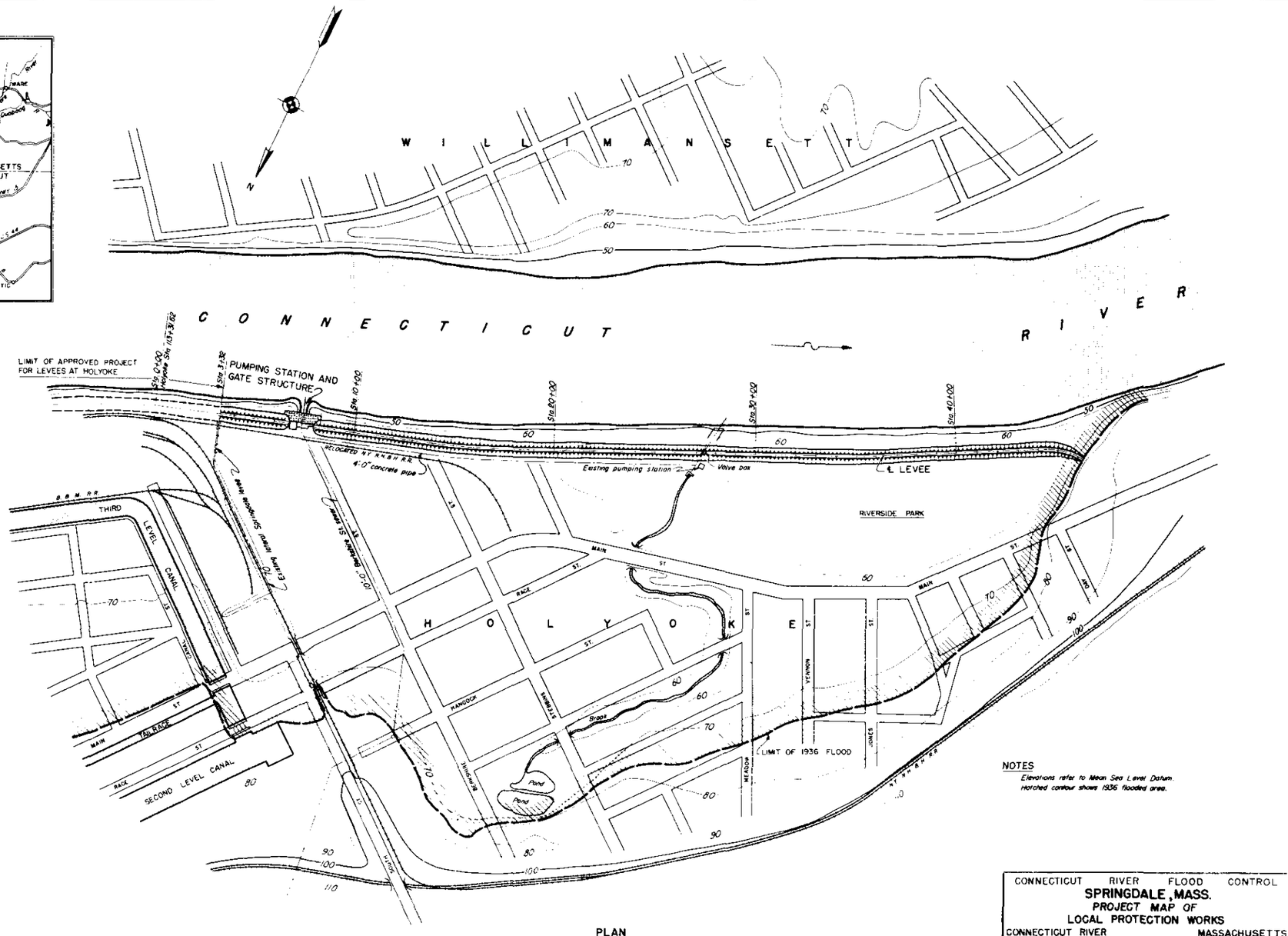
REV.	DATE	REVISION	Indicated by	REVISION BY	APBY

CONNECTICUT RIVER FLOOD CONTROL
NORTHAMPTON LEVEE
TYPICAL SECTIONS
NORTHAMPTON, MASS.
CONNECTICUT & MILL RIVERS MASSACHUSETTS
IN 2 SHEETS NOT TO SCALE SHEET NO 2
U. S. ENGINEER OFFICE, PROVIDENCE, R. I. FEB. 1940
SUBMITTED: SENIOR ENGINEER, HEAD, DESIGN SECTION
APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, F. C. ENGINEERING DIV.
APPROVED: LT. COL., CORPS OF ENGINEERS, DISTRICT ENGINEER
DESIGNED: ASST. ENGINEER
DRAWN J.G.D. TRACED G.J.P. CHECKED
TO ACCOMPANY REPORT DATED FEB 28, 1940
FILE NO. CT-4-2171



VICINITY MAP

SCALE 1" = 8 MI.



PLAN

REV.	DATE	REVISION	REV. BY	CK. BY	AP. BY

CONNECTICUT RIVER FLOOD CONTROL

SPRINGDALE, MASS.

PROJECT MAP OF

LOCAL PROTECTION WORKS

CONNECTICUT RIVER — MASSACHUSETTS

IN 2 SHEETS — SCALE 1 IN. = 200 FT. — SHEET NO. 1

U.S. ENGINEER OFFICE, PROVIDENCE, R.I. — FEB. 1940

SUBMITTED: Lewis B. Stokes, CAPT. C.E., ASST. ENGINEER, HEAD DESIGN SECTION

APPROVAL RECOMMENDED: J. B. Burns, PRINCIPAL ENGINEER, CHIEF F.C. ENGINEERING DIV.

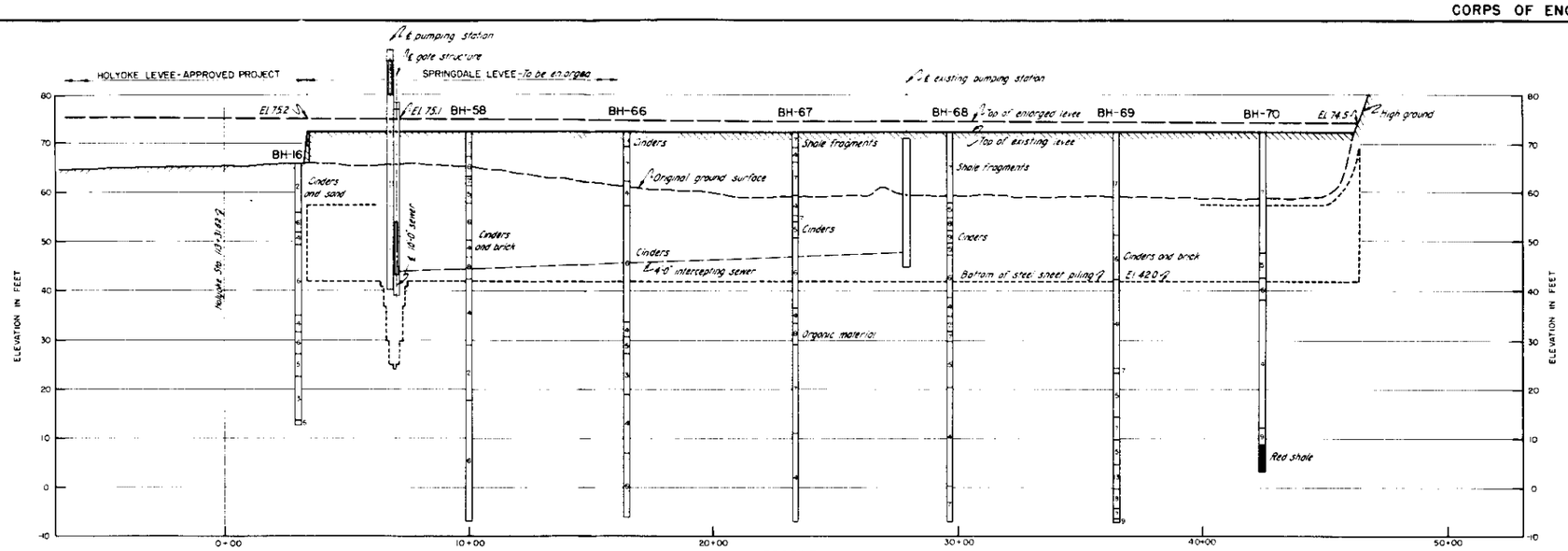
APPROVED: W. M. Wood, COL. CORPS OF ENGINEERS, DISTRICT ENGINEER

DESIGNED: B. P. Wagner, ASSOC. ENGINEER

DRAWN: L.I.W.; TRACED: J.E.D.; CHECKED: [illegible]

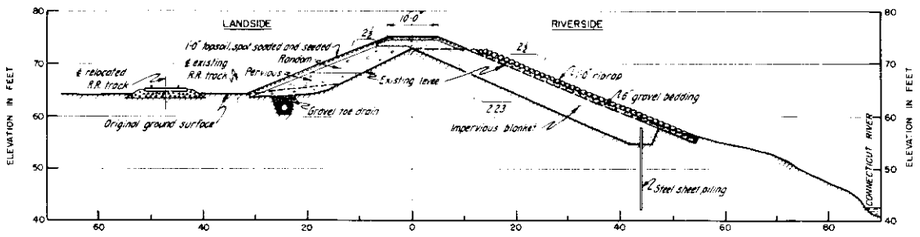
TO ACCOMPANY REPORT DATED FEB. 28, 1940

FILE NO. CT-4-2156



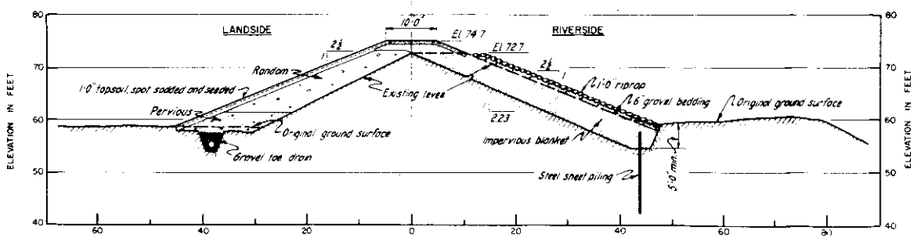
PROFILE

SCALES: HOR. 1" = 200' VERT. 1" = 10'



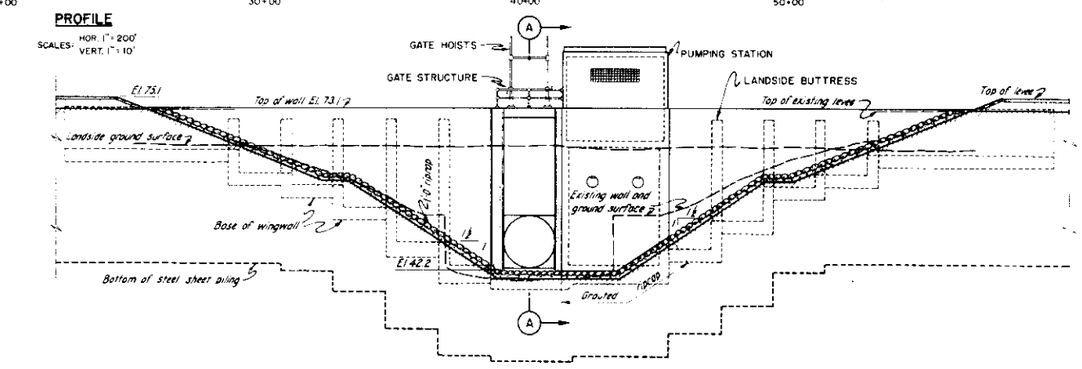
ENLARGED SECTION AT STA. 5+00

SCALE 1" = 10'



ENLARGED SECTION AT STA. 34+10

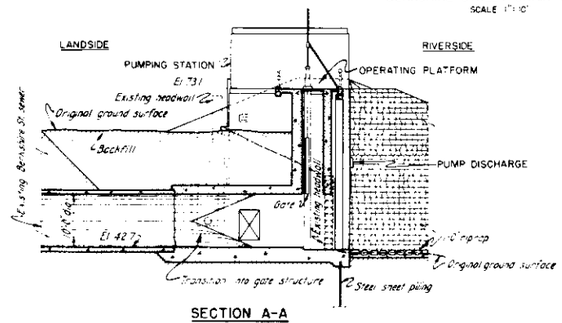
SCALE 1" = 10'



PUMPING STATION AND GATE STRUCTURE

BERKSHIRE STREET DRAIN OUTLET

SCALE 1" = 10'



SECTION A-A

SCALE 1" = 10'

NOTES

Elevations refer to Mean Sea Level Datum

DESCRIPTION OF NUMERICAL CLASSES

- Coarse to medium sand
- Medium to fine sand
- Fine sand to coarse silt
- Coarse to medium silt
- Gravel or coarse sand to fine silt
- Gravel to medium sand
- Gravel to fine sand
- Gravel to coarse silt
- Gravel to medium silt
- Coarse sand to clay

KEY	DATE	REVISION (Indicated by Δ)	REV BY	CK BY	AP BY

CONNECTICUT RIVER FLOOD CONTROL

SPRINGDALE LEVEE

PROFILE AND TYPICAL SECTIONS

SPRINGDALE, MASS.

CONNECTICUT RIVER — MASSACHUSETTS

IN 2 SHEETS — SCALE 1" = 10 FT — SHEET NO 2

U. S. ENGINEER OFFICE, PROVIDENCE, R.I., FEB., 1940

APPROVAL RECOMMENDED: J. B. Burns, PRINCIPAL ENGINEER, CHIEF, ENGINEERING DIV.

APPROVED: J. B. Burns, COLONEL, CORPS OF ENGINEERS, DISTRICT ENGINEER

DESIGNED: C. D. Wagner, ASST. ENGINEER

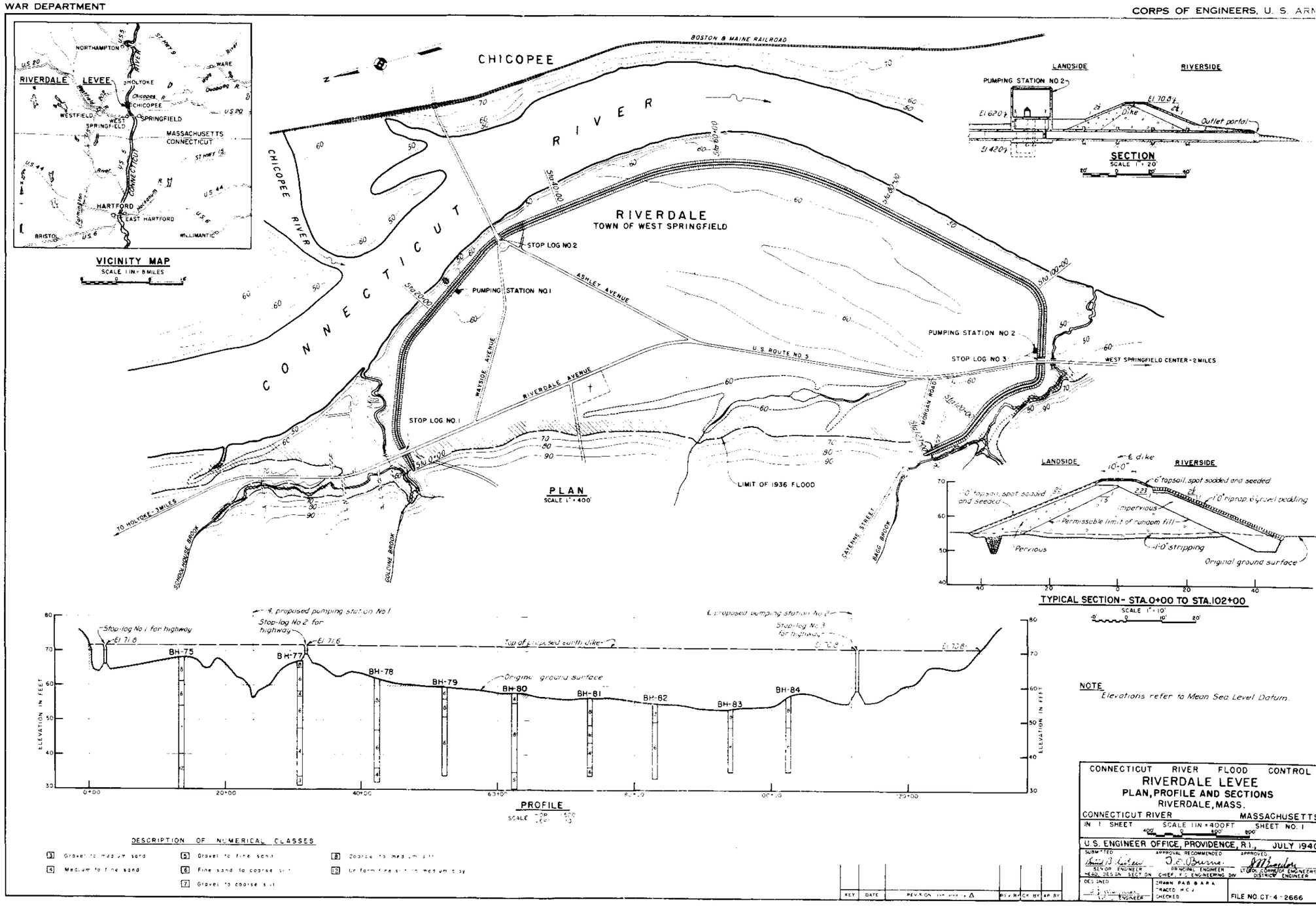
DRAWN: J.L.M. TRACED: M.H.H. CHECKED: M.P.D.A.

TO ACCOMPANY REPORT DATED FEB. 28, 1940

FILE NO. CT-4-2157

WAR DEPARTMENT

CORPS OF ENGINEERS, U. S. ARM



NOTE
Elevations refer to Mean Sea Level Datum.

DESCRIPTION OF NUMERICAL CLASSES

3 Gravel to medium sand	5 Gravel to fine sand	8 Coarse to medium silt
4 Medium to fine sand	6 Fine sand to coarse silt	12 Uniform fine silt to medium clay
	7 Gravel to coarse silt	

CONNECTICUT RIVER FLOOD CONTROL
RIVERDALE LEVEE
PLAN, PROFILE AND SECTIONS
RIVERDALE, MASS.
CONNECTICUT RIVER MASSACHUSETTS
IN 1 SHEET SCALE 1 IN = 400 FT SHEET NO. 1
U. S. ENGINEER OFFICE, PROVIDENCE, R.I., JULY 1940
SUBMITTED: SENIOR ENGINEER, HEAD, DESIGN SECTION
APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, F.C. ENGINEERING DIV.
APPROVED: LT. COL. CORPS OF ENGINEERS, DISTRICT ENGINEER
DESIGNED: ENGINEER
DRAWN: P.A.B. & A.R.A.
TRACED: H.C.J.
CHECKED:
FILE NO. CT-4-2666

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488.1 APPENDIX PLATE NO. 110

SECTION 7

CHANNEL IMPROVEMENTS

SECTION 7

CHANNEL IMPROVEMENTS

1. SCOPE. - This section of the Appendix presents detailed studies of channel improvements at the following locations:

River	Reach
Connecticut	Mount Tom Narrows below Northampton, Massachusetts
Connecticut	Pecowsic Narrows below Springfield, Massachusetts
Connecticut	Gildersleeve Cut-off below Hartford, Connecticut
Ashuelot	From Winchester, New Hampshire to Ashuelot, New Hampshire
Mill	At Springfield, Massachusetts
Mad	At Winsted, Connecticut

It contains estimates of the cost of these improvements, their effect on flood levels in their vicinity and upstream, and the probable benefits resulting from such improvements. Sources of engineering data are shown for each study.

2. COMPUTATIONS OF STAGE REDUCTIONS. - In determining the effect of channel improvements on flood heights, backwater computations were made and adjusted to reproduce the profile of a flood of record under existing channel conditions. Similar computations were then made with a flood of the same magnitude but with the enlarged channel considered. Computations were also made, in some cases, of a design flood under both natural and improved conditions. Manning's formula was used to determine the friction losses. Reasonable values were allowed for transition losses and bridge pier losses.

3. BENEFITS. - The direct benefits in any damage zone affected by a channel improvement are the difference between the recurring losses under natural and under modified conditions. The procedure used in determining these benefits is described in Section 2 of the Appendix.

4. MOUNT TOM NARROWS BELOW NORTHAMPTON.

a. Description. - The reach of river studied extends from

Calvin Coolidge Bridge at Northampton to Holyoke Dam, a distance of about 11 miles. In the upper 5 miles of this reach the flood channel is over 1-1/2 miles wide and flows with a slope of about 0.4 foot per mile. Below the mouth of the Oxbow the river flows through a gap in the Holyoke Range, the flood width is reduced abruptly to about 1/2 mile, and for a distance of 2-1/2 miles the flood slope is about 1 foot per mile. Below this the river enters the constricted section known as Mount Tom Narrows, occupying the entire valley width of about 700 feet, and for a distance of 1-1/2 miles the flood slope is about 6 feet per mile. The constricted section ends in the pool of the Holyoke Dam. A map of this reach is shown on Plate No. 111.

b. Problem. - The channel constriction at the Narrows appears to be the major factor in backing up flood waters to Northampton and above, since more than two-thirds of the total fall in the eleven-mile reach occurs in this section. The backing-up amounts to about 4 feet in a major flood. The high-water profile for the March 1936 flood shows the great increase in the flood slope through the Narrows; reduction of this flood slope would lower flood levels at points upstream, including Northampton. Such slope reduction can be accomplished by enlarging the flood channel through the most constricted section of the Narrows, thereby increasing the carrying capacity and reducing friction and transition losses.

c. Scope of plan studied. - In the Report on Survey and Comprehensive Plan for Flood Control printed in House Document No. 455, Seventy-fifth Congress, second session, a plan for enlargement of the Narrows was studied. It has been reexamined in view of new hydraulic data obtained since then. The plan studied provides channel enlargement by widening the banks and excavating down to low-water elevation. Most of the material excavated would come from the east bank of the river,

thereby straightening the channel and effecting a more uniform cross section. For a distance of about 3500 feet the cross-sectional area of the channel below the level of the crest of the flood of March 1936 is less than 22,000 square feet, with a minimum area of 13,400 square feet at the most constricted section. Because of the quantity of rock involved in excavating a channel of uniform carrying capacity through this reach, it does not appear economical to eliminate entirely the head losses from contraction and expansion. The line of cut is so placed, however, that the peak flow of the flood of March 1936 would have passed through this reach with a head loss of only 1.3 feet from contraction and expantion, about half of the loss computed under existing conditions. It is estimated that this cut would require approximately 50,000 cubic yards of earth excavation and 450,000 cubic yards of rock excavation at a total cost of $1,295,000. The minimum cross-sectional area thus obtained is 17,200 square feet. No relocation of highway or railroad is necessary. No borings have been made but the numerous outcroppings of ledge along this reach indicate that bedrock is covered by a relatively thin covering of earth.

d. Benefits. - The proposed channel improvement would have lowered the crest of the flood of March 1936 about 2.8 feet immediately above the channel enlargement and 1.2 feet at Calvin Coolidge Bridge, Northampton. The total average annual benefits, before the reservoirs of the Revised Comprehensive Plan, would be $63,200. After the reservoirs of the Revised Comprehensive Plan, the total average annual benefits would be $8600. The ratio of benefits to costs, after the reservoirs, is 0.12. This channel improvement is not economically justified.

5. PECOWSIC HARROWS BELOW SPRINGFIELD, MASSACHUSETTS.

a. Description. - The reach of river studied extends from the foot of Holyoke Dam to the lower end of Pecowsic Harrows below Springfield,

a total length of about 13 miles. The river flows in a generally southerly direction in a series of wide bends. The flood plain is about a mile wide throughout most of this reach but the construction of dikes on both sides of the river has limited the flood width to about 1300 feet. The average flood slope in the lower portion is about 1.0 foot per mile. Two tributaries enter this reach, the Chicopee River from the east, about 6 miles below Holyoke Dam, and the Westfield River from the west about 4-1/2 miles below the mouth of the Chicopee. A map of this reach is shown on Plate No. 112.

b. Problem. - Profiles of the March 1936 and September 1938 floods indicate a slight increase in slope through the constricted section termed Pocowsic Narrows. The backing-up amounts to one-half foot, or less, for a major flood. Reduction of this slope through this section would lower flood stages at Springfield, Chicopee, and parts of Holyoke. This slope can be reduced by removal of the constriction at Pocowsic Point. At the crest of the March 1936 flood the cross-sectional area of the channel was less than 42,000 square feet for a distance of about 1000 feet above Pocowsic Point and 3000 feet below, with a minimum area of 29,000 square feet at the most constricted section. Three plans were studied.

c. Original plan -- east bank.

(1) Scope. - In the report printed in House Document No. 455, Seventy-fifth Congress, second session, two plans for removal of Pocowsic Point were studied. The larger of these has been reexamined for this report using new hydraulic data obtained since then. Topographic data used are from soundings made in 1937 and from U. S. Geological Survey maps, scale 1:31680, surveyed in 1933-34. The general plan of the line of cut is shown on Plate No. 112. This would provide a minimum cross-sectional area of 46,000 square feet below the 1936 flood level by

excavating about 2,000,000 cubic yards of earth and 500,000 cubic yards of rock at a total estimated cost of $2,170,000. The average annual cost would be approximately $93,000.

(2) Benefits. - As a result of this plan the crest of the flood of March 1936 would have been lowered approximately 0.3 foot at Memorial Bridge, Springfield, and approximately 0.15 foot at Chicopee Bridge. The total average annual benefits, before the reservoirs of the Revised Comprehensive Plan, would be $700 and the total average annual benefits, after the reservoirs of the Revised Comprehensive Plan, would be $200. The ratio of benefits to costs, after the reservoirs, is 0.01. Channel improvement by excavation of the east bank is not economically justified.

d. Alternate plan -- west bank.

(1) Scope. - Another plan, not previously studied, has been prepared for this report. In this plan the proposed line of cut would begin about 1600 feet below South End Bridge and extend for 2300 feet in almost a straight line. The west bank would be excavated down to elevation 40 with a maximum width of excavation of 200 feet, tapering to a point on each end. This plan would provide a minimum cross section of 33,500 square feet below the crest of the flood of March 1936, an increase of 15 percent. About 200,000 cubic yards of earth and 44,000 cubic yards of rock would be excavated at a total estimated cost of $193,000. The average annual cost is approximately $9700.

(2) Benefits. - As a result of this plan the crest of the flood of March 1936 would have been lowered about 0.15 foot at Memorial Bridge, Springfield, and about 0.07 foot at Chicopee Bridge. The total average annual benefits, before the reservoirs of the Revised Comprehensive Plan, would be $300. There would be no benefit after the reservoirs of the Revised Comprehensive Plan. Channel improvement by

excavation of the west bank is not economically justified.

e. Extension to Enfield Dam. - The increase in slope through Pocasic Narrows is so slight that no reasonable improvement plan at this locality can reduce flood levels more than about half a foot. To provide greater reductions, the channel enlargement must be extended downstream to the next steep slope, which occurs below Enfield Dam, 6 miles downstream. Because a canal runs part of the way along the west side and a railroad along the east side, most of the excavation must be confined to the channel itself. In addition to improving 4.5 miles of channel, Enfield Dam would require removal or alteration to lower flood elevations at the dam. It is estimated that 2,200,000 cubic yards of earth and rock would be excavated under this plan at a total cost of about $3,790,000. The average annual cost would be $200,000. As a result of this plan the crest of the flood of March 1936 would have been lowered 1.1 feet at Memorial Bridge, Springfield, and about 0.6 foot at Chicopee Bridge. Since this plan would cost more per foot of reduction than the excavation of the west bank at Pocasic Point, no further consideration was given to it.

6. GILDERSLEEVE CUT-OFF BELOW HARTFORD, CONNECTICUT.

a. Description. - The reach of river studied extends from Windsor Locks at the foot of Enfield Rapids to Haddams at the downstream end of the narrows below Middletown, a total distance of 37 miles. In the reach from Windsor Locks to Hartford, the valley is more than a mile wide and most of it is flooded during great floods. At Hartford the dikes now built or authorized restrict the flood to the channel width of the river. From Hartford to Gildersleeve Island the river winds through a wide, flat valley that is flooded to a width of over two miles during great floods. Below Gildersleeve Island the valley gradually narrows, turns from its southerly direction to southwest, and then bends to the

east at Middletown. Below Middletown the valley narrows to a quarter mile, most of it occupied by the river. A map of this reach on Plate No. 113 shows the area flooded in March 1936.

b. Problem. - Profiles of the March 1936 and September 1938 floods on the same plate indicate that the slope increases noticeably in the 8 miles below Gildersleeve Island. Any appreciable reduction of the flood slope in this reach would lower flood stages at Middletown, Hartford, and other damage centers throughout the reach. The topography east of Middletown is adapted to the construction of a cut-off channel to carry part of the flood flow from Gildersleeve Island to Paper Rock just below the Narrows. The economic justification of such a channel depends upon the relation of the cost of the work to the benefits to be derived.

c. Scope of plan studied. - In the report printed in House Document No. 455, Seventy-fifth Congress, second session, such a cut-off channel was studied. It has been reexamined for this report using new hydraulic data. Topographic data used are from current sounding charts and from cross sections taken by the United States Engineer Department in 1936. No new estimate of cost has been prepared. Geological reconnaissance of the region made in 1938 indicated that most of the excavation could be made in earth; this confirmed previous estimates of the rock and earth quantities. The general plan of the proposed channel is shown on Plate No. 113. The total length of the channel would be about 4 miles; the corresponding river distance is 7-1/2 miles. The channel would have a uniform bottom width at mean sea level of 600 feet and side slopes of 1 on 2 in earth. The total estimated cost of this plan is about $20,350,000. The channel would carry 32 percent of the peak flow of a flood such as that of March 1936 and would reduce the flood stage 2.7 feet at Gildersleeve Island. Investigation

has been made of the effect of other widths. A channel 250 feet wide would carry 20 percent of the peak flow and reduce the flood stage 2.2 feet. A channel 1000 feet wide would carry 45 percent of the peak flow and reduce the flood stage 4.3 feet. Comparison of approximate excavation quantities for these widths indicates that the excavation per foot of reduction would be a minimum for diversion of 10 percent of the peak flow, and becomes excessive for diversions greater than 40 percent. Ten percent diversion would reduce flood elevations only 1.4 feet. The 600-foot width was selected for study.

d. Flood reducing effect. - The proposed channel, had it been constructed, would have diverted 32 percent of the peak discharge of the flood of March 1936, causing a reduction in flood elevation at Gildersleeve Island of 2.7 feet. The reduction would have been 1.5 feet at Hartford and 1.1 feet at Windsor Locks. Similarly the canal would have diverted 31 percent of the peak discharge of the flood of September 1938, causing a reduction in flood elevation of 2.2 feet at Gildersleeve Island, 1.0 foot at Hartford, and 0.9 foot at Windsor Locks.

e. Benefits. - The benefits from this plan are small since levees at Hartford and East Hartford will effectively protect those areas. The total average annual benefits from the Gildersleeve Cut-off would be $52,700 before the reservoirs and levees of the Revised Comprehensive Plan, and $7400 after the reservoirs and levees of the Revised Comprehensive Plan. The total estimated cost of this cut-off is estimated at $20,350,000 with annual charges of $954,000. The ratio of benefits to costs, after the reservoirs, is 0.01. This cut-off is not economically justified.

f. Alternate plan of improvement. - No serious consideration can be given to the possibility of excavating only a pilot channel and thereafter depending on future floods to scour out an adequate channel,

although such a plan has been proposed. It would probably take several great floods to scour out such a pilot channel before it became effective, and since the navigable channel from Middletown to the mouth, now maintained by dredging, would be injured as a result of each flood, no value is attached to this pilot channel alternative.

7. ASHUELOT RIVER BELOW WINCHESTER, NEW HAMPSHIRE.

a. Description. - The reach of river studied extends from the Lawrence Leather Company Bridge above Winchester to the broken dam of the New Hampshire Public Service Company below Ashuelot, a total distance of 3.5 miles. Through the upper 2-1/2 miles of the reach studied, the river flows through several bends, in a flood plain about half a mile wide, with a flood slope of two feet per mile. In the last mile the river is relatively straight, from the Boston and Maine Railroad bridge to the village of Ashuelot, and flows with a flood slope of 12 feet per mile. In the floods of March 1936 and September 1938 the greatest flood losses occurred in Winchester at the head of this reach. Any reduction in the flood slope between the railroad bridge and the broken dam of the New Hampshire Public Service Company would lower flood stages at Winchester. Removal of the broken dam, and excavation of the channel through Ashuelot and near the railroad bridge, would effect such reduction.

b. Plan of improvement. - The improvement plan studied provides for enlargement of the flood channel at the railroad bridge and through the village of Ashuelot. After enlargement the channel would be trapezoidal in cross section, with a bottom width of 125 feet and 1 on 2 side slopes. Such a channel would require excavation of 42,000 cubic yards of earth and boulders at the railroad bridge, and 68,000 cubic yards of earth and boulders at Ashuelot. The broken dam of the New Hampshire Public Service Company, located 500 feet below the highway bridge, would be completely removed. The abutments of the railroad bridge

would require alterations. The central pier of the covered highway bridge at Ashuelot would be protected by riprap. Details are shown on Plate No. 114.

c. Benefits. - This improvement would provide a reduction in stage of a flood similar to that of September 1938 of 1.6 feet at Winchester. The total cost of the plan is estimated at $163,000 with annual charges of $8300. The total average annual benefits, before the reservoirs of the Revised Comprehensive Plan, would be $2800. The ratio of benefits to costs, after the reservoirs, is 0.34. This plan of channel improvement is not economically justified.

8. MILL RIVER, SPRINGFIELD, MASSACHUSETTS.

a. Description. - The reach of the Mill River considered extends from the upstream end of the existing Mill River Conduit project at the Bay State Thread Company Dam, located approximately 1700 feet above the confluence of the Connecticut and Mill Rivers, to the United States Arsenal Dam above, a total distance of 1.2 miles. There are 5 dams, including the Bay State Thread Company Dam and the United States Arsenal Dam, and 3 bridges located in this reach. The total difference between the crest elevations of the first and the last dam is approximately 80 feet. The river channel is generally narrow with high banks and, except directly above the Springfield Waste Company Dam, the normal storage is confined within the natural river banks. A general map with profile of the river is shown on Plate No. 115.

b. Problem. - A design flood of 4300 cubic feet per second was selected for the Mill River Conduit, to be constructed from the Bay State Thread Company Dam to the Connecticut River as part of the general flood protection of the City of Springfield. This flood was selected after a study of flood run-off from the Mill River drainage area and its synchronism with Connecticut River floods of various magnitude. Under

existing conditions the river channel cannot carry the design flood within banks; there are 6 locations at which this design flood would overflow the banks of the river. These are:

U. S. Arsenal Dam
Hill Street Bridge
Hancock Avenue Bridge
Springfield Waste Company Dam
Belmont Avenue Bridge
Bay State Thread Company Dam

At the first three of these such flooding would cause local inconvenience but the water would rejoin the main channel a short distance below. At the last 3 locations topography prevents any overflow from rejoining the channel. The diverted water would inundate the southern part of Springfield. To complete the protection of Springfield, conditions at these 3 locations must be improved.

c. Proposed improvements. - The proposed work, which will eliminate the hazard to Springfield, is shown on Plate No. 115. Details for each location are as follows:

(1) Springfield Waste Company Dam. - The right bank above this dam is low, about two feet above the crest of the dam for a distance of several hundred feet upstream; however, high ground parallels the river about 60 feet from the edge of the pool and prevents flood waters from reaching the city, except through a "bottleneck" extending from the upstream end of the building to a point where the hillside slopes to street level at the property entrance gate. Sandbags were used at this point during the 1938 flood. The proposed protective works consist of a 7.5-foot high reinforced-concrete wall with a stop-log structure and reinforced-concrete facing of the upstream brick wall of the factory building. The length of the improvement will be 95 feet and the total cost $4000. A detailed estimate follows:

COST ESTIMATE FOR WALL AT SPRINGFIELD WASTE COMPANY DAM

TOTAL COST

Item No.	Item	Quantity	Unit cost	Amount	Total
1.	Construction				
	Stream control.		Lump sum	$300	
	Earth excavation, common . . .	170 cu. yd.	0.40	70	
	Backfill, semi-compacted. . . .	170 " "	0.25	40	
	Concrete, walls and footings. .	90 " "	16.00	1,440	
	Reinforcement steel	8,000 lb.	0.05	400	
	Timber stop-logs.	1,000 ft.b.m.	0.10	100	
	Cleaning up		Lump sum	200	
				2,540	
	Contingencies.			530	
				3,170	
	Engineering and overhead			480	
	TOTAL.				$3,650
2.	Rights-of-way and land				
	Land.		Lump sum	290	
	Legal, overhead, and general expense . . .		20%	60	
	TOTAL				350
3.	Grand total capital cost				4,000

ANNUAL COST

Item No.	Item	Amount	Total
1.	Federal investment		
	Construction $2645 x 1.38	$3,650	
	TOTAL (Federal investment)	3,650	
2.	Federal annual charges		
	Interest $3650 x 0.035	128	
	Amortization of obsolescence and depreciation		
	Fixed parts $2645 x 1.38 x .0076	26	
	Movable parts 100 x 1.38 x .0354	5	
	TOTAL (Federal annual charges).	159	$160
3.	Non-Federal investment		
	Land and damage $290 x 1.20	350	
	TOTAL (non-Federal investment)	350	
4.	Non-Federal annual charges		
	Interest $350 x 0.045	16	
	Amortization of obsolescence and depreciation		
	Land and damage $290 x 1.20 x .0056	2	
	Tax loss on land 290 x .03.	9	
	Maintenance and operation		
	Concrete $1935 x 1.38 x .01	27	
	Gates and machinery $100 x 1.38 x .03	4	
	TOTAL (non-Federal annual charges) . . .	58	60
5.	Total annual cost		220

(2) Belmont Avenue Bridge. - Three streets intersect and cross the river on this bridge, which thereby becomes a conduit about 190 feet long. It consists of two intersecting arches. The upstream portion, about 60 feet long, is a concrete arch of about 7.5 feet radius: it is in good condition except that the bottom of the conduit has silted up to about the springing line. The area of opening is about 130 square feet. The downstream portion, about 130 feet long, consists of three brick-lined arches, but only the center arch is open for flow. The area of opening is about 235 square feet. Under present conditions this conduit cannot carry the design flood of 4300 cubic feet per second; a portion of the discharge would overflow the right abutment at the entrance to the conduit and would not rejoin the river. Additional carrying capacity under the bridge is necessary. This could be obtained by enlarging the opening or by providing another opening in the upstream portion to connect with one of the unused arches in the lower portion. Either would require reconstruction of practically the whole bridge and the cost would be excessive. A better method of increasing the carrying capacity would be to increase the head on the conduit and to eliminate the head losses within the conduit itself. The improvement recommended proposes concrete walls 6 feet high; these would provide about 12 feet of head on the conduit entrance. Head losses within the conduit could be greatly reduced by cleaning out the silted portion and lining the entire length with 8 inches of concrete. Proper forming of concrete at entrance and exit to reduce losses at those points and reduced friction loss in the conduit would reduce the head loss to about four-tenths of its present value. With the proposed improvement the design flood of 4300 cubic feet per second could pass through the conduit and a freeboard of 1 foot would be maintained on the entrance wall. A detailed estimate of the cost of this improvement follows:

COST ESTIMATE FOR IMPROVEMENTS TO FELMONT AVENUE BRIDGE

TOTAL COST

Item No.	Item	Quantity	Unit cost	Amount	Total
1.	Construction				
	Stream control		Lump sum	$ 1,820	
	Earth excavation, common .	400 cu.yd.	0.50	200	
	Backfill, semi-compacted .	260 cu.yd.	0.75	200	
	Concrete, walls and footings	500 cu.yd.	25.00	12,500	
	Steel sheet-piling	1,800 lin.ft.	1.00	1,800	
	Miscellaneous drains . . .	150 lin.ft.	5.00	750	
				17,270	
	Contingencies		20%	3,460	
				20,730	
	Engineering and overhead		15%	3,120	
	TOTAL				$23,850
2.	Rights-of-way and land				
	Land		Lump sum	960	
	Legal, overhead, and general expense		20%	190	
	TOTAL				1,150
3.	Grand total capital cost				25,000

ANNUAL COST

Item No.	Item	Amount	Total
1.	Federal investment		
	Construction $17,270 x 1.38	$23,850	
	TOTAL (Federal investment).	23,850	
2.	Federal annual charges		
	Interest $23,850 x 0.035	830	
	Amortization of obsolescence and depreciation		
	Fixed parts $17,270 x 1.38 x .0076	180	
	TOTAL (Federal annual charges).		$1,010
3.	Non-Federal investment		
	Land and damage $960 x 1.20	1,150	
	TOTAL (non-Federal investment).	1,150	
4.	Non-Federal annual charges		
	Interest $1150 x 0.045	51	
	Amortization of obsolescence and depreciation		
	Land and damage $960 x 1.20 x .0056.	6	
	Tax loss on land 960 x .03.	29	
	Maintenance and operation		
	Concrete $12,500 x 1.38 x .01.	152	
	TOTAL (non-Federal annual charges)	238	240
5.	Total annual cost		1,250

(3) Bay State Thread Company Dam. - The right bank immediately upstream from this dam is approximately at Elevation 78. The water surface for the design flood of 4300 cubic feet per second would rise to Elevation 80.5 above the dam. Any flood water escaping at this point would flow down Mill Street and would not rejoin the river. A concrete wall at this point would eliminate this hazard. The problem at this dam is complicated by the necessity of installing a new headgate in addition to reinforced concrete facing of existing walls. Plan and details of the proposed improvements are shown on Plate No. 115. A detailed estimate follows:

COST ESTIMATE FOR IMPROVEMENTS NEAR THE BAY STATE THREAD COMPANY DAM

TOTAL COST

Item No.	Item	Quantity	Unit cost	Amount	Total
1.	Construction				
	Stream control		Lump sum	700	
	Earth excavation, common	140cu.yd.	0.40	60	
	Earth excavation, rock borrow .	70cu.yd.	3.50	240	
	Backfill, semi-compacted	140cu.yd.	0.25	40	
	Removal of existing concrete structures	20cu.yd.	4.00	80	
	Concrete, walls and footings . .	125cu.yd.	16.00	2,000	
	Concrete, gate structure	90cu.yd.	20.00	1,800	
	Reinforcement steel.	27,200 lb.	0.05	1,360	
	Gate and operating machinery		Lump sum	8,000	
	Miscellaneous metal work		Lump sum	1,000	
	Cleaning up		Lump sum	300	
				15,580	
	Contingencies		20%	3,120	
				18,700	
	Engineering and overhead		15%	2,800	
	TOTAL				21,500
2.	Rights-of-way and land				
	Land		Lump sum	420	
	Legal, overhead, and general expense . . .		20%	80	
	Total				500
3.	Grand total capital cost				22,000

ANNUAL COST

Item No.	Item	Amount	Total
1.	Federal investment		
	Construction $15,579 x 1.38	$21,500	
	TOTAL (Federal investment).	$21,500	
2.	Federal annual charges		
	Interest $21,500 x 0.035	752	
	Amortization of obsolescence and depreciation .		
	Fixed parts $6579 x 1.38 x .0076	69	
	Movable parts 9000 x 1.38 x .0354	440	
	TOTAL (Federal annual charges).	1,261	1,260
3.	Non-Federal investment		
	Land and damage $420 x 1.20	500	
	TOTAL (non-Federal investment).	500	
4.	Non-Federal annual charges		
	Interest $500 x 0.045	22	
	Amortization of obsolescence and depreciation .		
	Land and damage $420 x 1.20 x .0056	2	
	Tax loss on land 420 x .03	12	
	Maintenance and operation		
	Concrete $5,162 x 1.38 x .01	71	
	Gates and machinery $9000 x 1.38 x .03	373	
	TOTAL (non-Federal annual charges)		480
5.	Total annual cost		1,740

d. Conclusions. - Improvements at these three locations are considered necessary since the levee system at Springfield cannot provide complete protection to Springfield unless the hazard of flooding from Mill River is eliminated.

9. WINSTED, CONNECTICUT.

a. Description. - The reach studied extends from Clock Shop Dam on the Still River (drainage area 42 square miles) to Lake Street Bridge on the Mad River, a total distance of about two miles. Clock Shop Dam, crest elevation 687.5, controls flood elevations as far as the confluence of the Mad and Still Rivers. In this 4000-foot reach the river is fairly straight and flat with a nearly uniform width of about 75 feet between the walls, which line 30 percent of the total bank length. The left bank, adjoining North Main Street, is steep with practically no overbank channel during floods. The right bank is flatter and has an overbank channel less than 200 feet wide even in extreme floods. None of the three bridges that cross the Still River in this reach augments floods. From the confluence of the rivers to Lake Street Bridge, Mad River rises 46 feet in a distance of 6200 feet. In much of this reach the river is confined between walls only 40 to 50 feet apart. Overhanging houses and garages encroach on even this narrow space, and in five cases buildings completely bridge the stream. Two unused dams, five low bridges, and a debris-filled channel augment the flood hazard in this reach. Plan and profile of this reach are shown on Plate No. 116. Above Winsted, water from Mad River is diverted into Bugg Brook Reservoir (water area 45 acres) and Crystal Lake (150 acres) for water supply. Overflow from the latter flows into Highland Lake (water area 490 acres) which is controlled for power. The outlet from Highland Lake enters Mad River just above Lake Street Bridge. Storage in these three lakes slightly reduces flood flows through Winsted.

b. Problem. - In past floods of record, notably those of 1927, 1936, and 1938, the constriction at Clock Shop Dam has backed water up to the confluence of Mad and Still Rivers. The dam is of gravity section, built on projecting ledge. There are no flashboards, flood gates, or other devices for lowering flood elevations upstream. A building four stories high, connecting Gilbert Clock Company buildings on both sides of the river, bridges the river a short distance downstream from the dam. The flood of September 1938 nearly reached the bottom chord of this bridge; for higher discharges the limited area between the bottom chord and dam crest would appreciably increase flood heights upstream. With still higher discharges the control would shift to the Willins Street Bridge 100 feet downstream, a stone arch with an area of 535 square feet. The flood problem is not serious on the Still River; the Gilbert Clock Company appears to be the item most likely to suffer flood damage and it has suffered so little in past floods that no steps have been taken to install flashboards or flood gates on the dam. From the confluence of Mad and Still Rivers to Lake Street, flood damages have been more serious because of the previously mentioned encroachments on the stream bed. At least twice during recent years, in 1927 and 1938, flood waters escaped into Main Street at a point just above the constriction caused by Winsted Motor Sales Garage, causing considerable damage. Three of the five dams which were located on this reach of river in 1938 have since been removed, thereby lessening the flood hazard in their vicinity, but the channel is so choked that each bridge and building across the stream remains a potential damage point.

c. Flood control plans investigated. - (1) Storage. - The presence of Highland and Crystal Lakes on a tributary entering the Mad River just above Winsted suggests the possibility of storing enough flood flow in them to reduce effectively the flood peak discharge. However,

the drainage area of these two lakes is only about 7 of the 32 square miles of drainage area above Winsted, and complete control of these lakes would have lowered the September 1938 crest discharge only 22 percent in Winsted. Since the water area of the lakes exceeds one square mile, there is at present sufficient natural storage in the lakes for their own drainage area. The possibility of diverting flood flow from the upper Mad River into these lakes has been considered. The existing tunnels, originally built to divert water for municipal use from the Mad River into these lakes, are insufficient to divert any appreciable flood flow. The other alternative would be an expensive side-hill canal about a mile long. The cost of such a canal would be prohibitive. Apparently flood flow from Mad River cannot be diverted into Highland Lake except at a cost out of proportion to the benefit secured. Examination of topography elsewhere above Winsted reveals no site on the Mad River suitable for a flood control reservoir. The valley is so steep that adequate storage could be obtained only with a high dam at excessive cost.

(2) Diversion. - It is possible to divert flood flows from Mad River to Still River by a tunnel that entirely avoids the present natural channel through the center of Winsted. The proposed diversion line runs directly east from the confluence of Mad River and Indian Meadow Brook. The line of diversion would be about 6000 feet long, approximately 40 percent of the existing channel length. The topography and the available drop of over 100 feet in water surface favor a pressure conduit. A preliminary study indicates that of the total 6000-foot length of diversion only 4400 feet would need to be dug as a tunnel, the remaining 1600 feet being an open cut. With a 20-foot diameter horseshoe tunnel and a diversion dam to raise the water surface to elevation 815.0 at the point of diversion at Mad River and Indian Meadow Brook, the conduit could

carry slightly over 16,000 cubic feet per second, thus affording complete protection to Winsted against the maximum predicted flood of the Mad River. Preliminary estimates indicate that the cost of such a diversion channel would far exceed the benefits.

(3) Channel improvement. - A brief examination of the Mad and Still Rivers indicates that by clearing out the river channel, the flood hazard would be greatly reduced. This was recognized in Winsted and a flood control committee, formed after the 1936 flood, recommended that the unused dams on the river be removed and the channel cleared. Since then two dams have been removed. To be effective, the improvement plan must include removal of the remaining dams and the deepening and straightening of the channel. The river is considered in two reaches.

(a) Improvement in Zone A. - Flood stages in the entire downstream reach, Zone A, are at present controlled by the spillway of Gilbert Dam. The reach extends up to the Case Avenue Bridge. The improvement studied included:

1. Lowering the permanent crest of Gilbert Dam 4 feet, present pool height being maintained by flashboards.

2. Excavation of a trapezoidal channel in Still River, with a 50-foot bottom width and 1 on 2 side slopes. This channel would be so placed that no underpinning of existing walls would be required.

3. Excavation of a trapezoidal channel in Mad River with average bottom width of 25 feet and 1 on 2 side slopes. The bottom width varies from 20 to 30 feet to avoid underpinning of existing walls.

4. Removal of one 2-1/2 story frame building above Rowley Street Bridge to widen the channel at this point from 33 feet to 50 feet. Elimination of bend in river near foot of Walnut Street.

This improvement would lower the stage of a flood equal in magnitude to that of September 1938 about six feet in the vicinity of Rowley Street. The resulting average annual benefits would be $1900. The total esti-

mated cost of the improvement would be $169,000 with annual charges of $11,600. Since the ratio of benefits to costs is 0.16, channel improvement in Zone A is not economically justified.

(b) Improvement in Zone B. - In the upstream reach, Zone B, the slope is so steep that flood stages at any point depend on the next obstruction downstream. The improvement plan studied included:

1. Removal of Maden & Kelley Dam and New England Knitting Company Dam.

2. Excavation of a trapezoidal channel with average bottom width of 25 feet and 1 on 2 side slopes. The bottom width varies from 22 feet to 42 feet to avoid underpinning of existing walls.

3. Underpinning piers on which warehouse at Station 88+00 is built.

4. Riprapping trapezoidal channel except where channel is in rock.

This improvement would lower the stage of a flood equal in magnitude to that of September 1938 about 11-1/2 feet on the upstream side of Winsted Motor Sales Building. The resulting average annual benefits would be $12,000. The total estimated cost of the improvement is $137,000, with annual charges of $8600. Since the ratio of benefits to costs is 1.40, channel improvement in Zone B is economically justified. Detailed cost estimate follows:

COST ESTIMATE OF WINSTED CHANNEL IMPROVEMENT - ZONE B

TOTAL COST

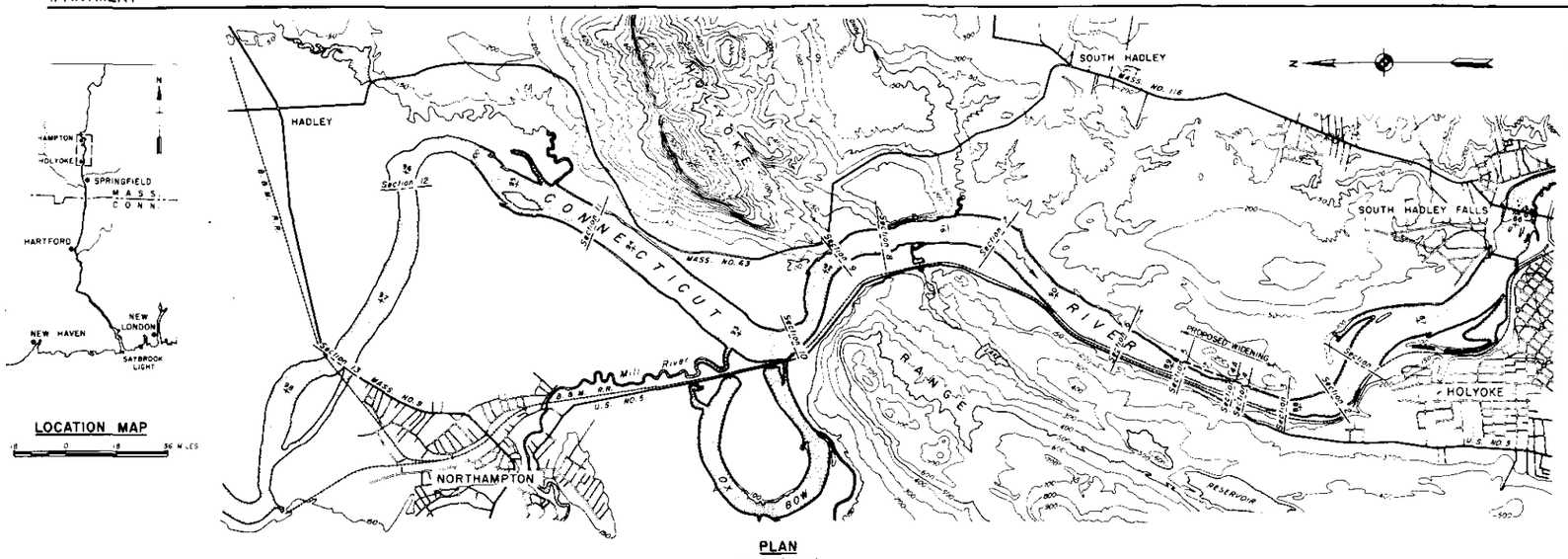
Item No.	Item	Quantity	Unit	Unit cost	Amount	Total
1.	Construction cost					
	Common excavation	16,000	cu.yd.	$ 2.50	$40,000	
	Rock excavation	6,000	cu.yd.	5.00	30,000	
	Riprap, hand-placed . . .	4,000	cu.yd.	5.00	20,000	
	Rubble masonry walls . .	700	cu.yd.	10.00	7,000	
					97,000	
	Contingencies	20%			19,400	
					116,400	
	Engineering and overhead	15%			17,600	
	TOTAL					$134,000
2.	Relocation of railroads and utilities				None	
3.	Rights-of-way and damages					
	Land	5	acres	Lump sum	500	
	Water rights, developed			Lump sum	2,000	
					2,500	
	Legal, overhead, and general expense . . .			20%	500	
	TOTAL					3,000
4.	Highway relocation				None	
5.	Grand total capital cost					137,000

ANNUAL COST

Item No.	Item	Unit cost	Amount	Total cost
1.	Federal investment			
	Construction cost		$134,000	
	Interest during construction		0	
	TOTAL (Federal investment)		134,000	
2.	Federal annual charges			
	Interest	134,000 x 0.035	4,700	
	Amortization of obsolescence and depreciation	134,000 x 0.0076	1,000	
	Maintenance and operation		0	
	TOTAL (Federal annual charges)			5,700
3.	Non-Federal investment			
	Construction cost		0	
	Rights-of-way and damages		3,000	
	TOTAL (non-Federal investment)		3,000	
4.	Non-Federal annual charges			
	Interest	3,000 x 0.045	100	
	Amortization of obsolescence and depreciation	3,000 x 0.0056	0	
	Maintenance and operation	134,000 x 0.02	2,700	
	Tax loss on land	2,500 x 0.025	100	
	TOTAL (non-Federal annual charges)			2,900
5.	Total annual cost			8,600

d. Local participation. - Local interests should bear the cost of lands, damages, and rights-of-way. Local interests have indicated informally that a portion of the cost might be provided by them although funds are not immediately available from the town.

e. Conclusion. - Flood control protection for Winsted by means of a diversion channel or by storage above the city can be obtained only at excessive cost. Protection channel improvement on the Mad River is economically justified in Zone B. A contribution by local interests of 20 percent of the construction cost, and all lands, damages, and rights-of-way is warranted.



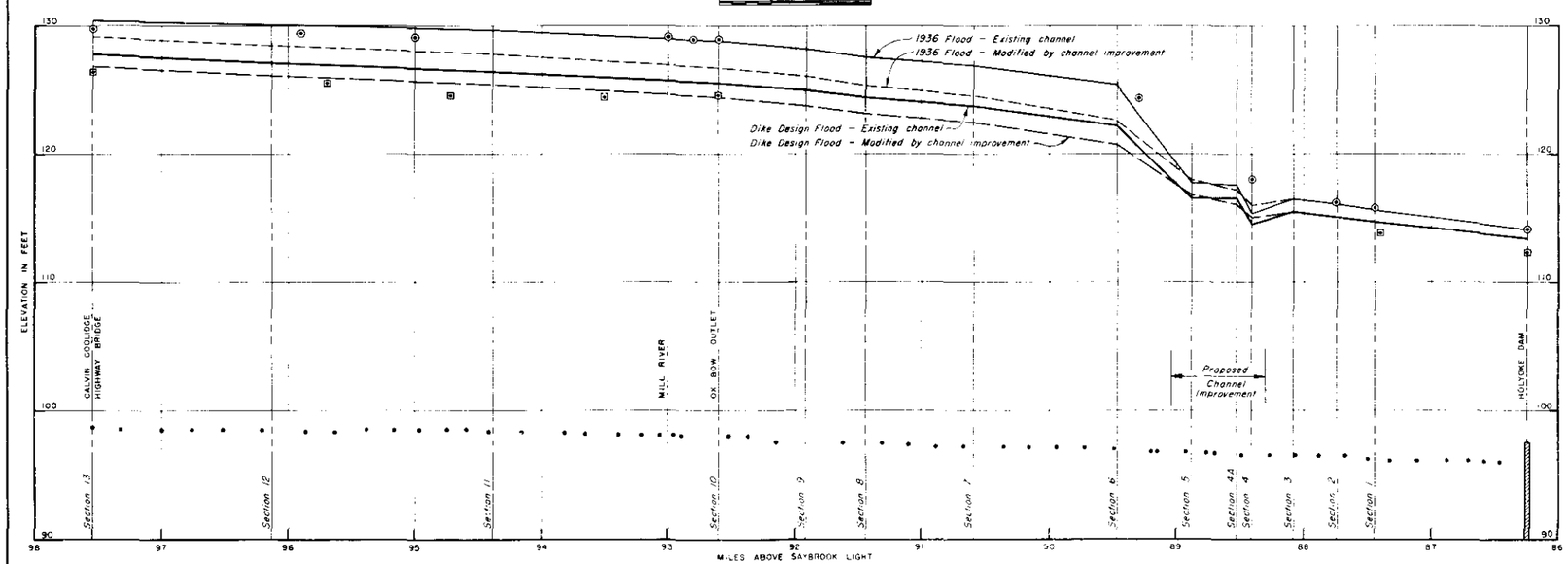
LOCATION MAP

18 0 18 36 MILES

PLAN

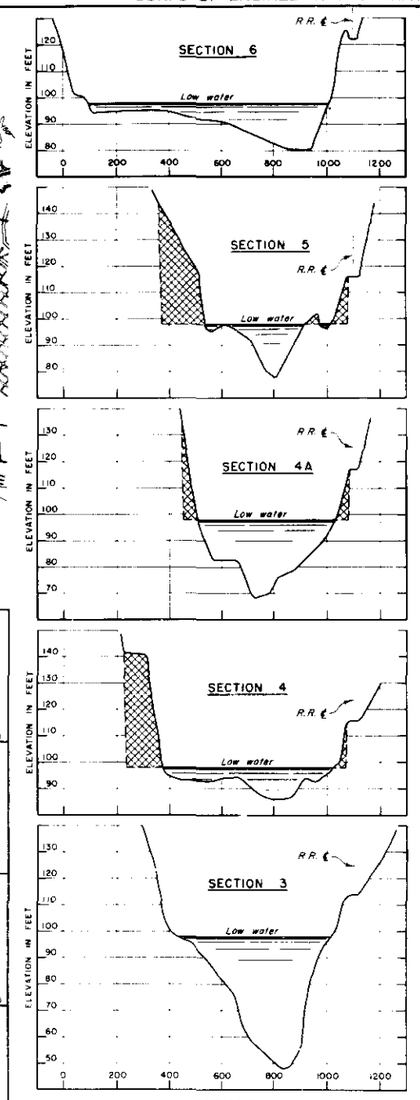
SCALE 1" = 2000'

2000 0 2000 4000'



PROFILE

SCALE: HOR. 1" = 0.4 MILE
VERT. 1" = 40'



SECTIONS

SCALES. HOR. 1" = 200'
VERT. 1" = 20'

TABLE OF FLOOD DISCHARGES	
FLOOD	DISCHARGE
MARCH 1936	249,000 c.f.s.
SEPTEMBER 1938	199,000 c.f.s.
DIKE DESIGN	218,000 c.f.s.

LEGEND

- Indicates high water marks of March 1936
- Indicates high water marks of September 1938
- Indicates low water profile of September 1939
- Profile with existing channel.
- Profile modified by channel improvement
- 95 Miles above Saybrook Light
- Indicates proposed cut.

NOTES

Topography taken from U.S.G.S. maps surveyed in 1933 - 1935.

Cross sections taken by U.S.E.D. in 1936 and 1939

Elevations refer to Mean Sea Level Datum

Sections face downstream.

KEY	DATE	REVISION (indicated by Δ)	REVD BY	CK BY	AP BY

CONNECTICUT RIVER FLOOD CONTROL

CHANNEL IMPROVEMENT

PLAN, PROFILES AND SECTIONS

MT. TOM NARROWS BELOW NORTHAMPTON

CONNECTICUT RIVER MASSACHUSETTS

IN 1 SHEET SCALES AS SHOWN SHEET NO. 1

U. S. ENGINEER OFFICE, PROVIDENCE, R. I., FEB. 1940

SUBMITTED: Walter B. Crowston, ASST. ENGINEER, HEAD HYDRAULICS SECTION

APPROVAL RECOMMENDED: J. J. Burns, PRINCIPAL ENGINEER, CHIEF, R.I. ENGINEERING DIV.

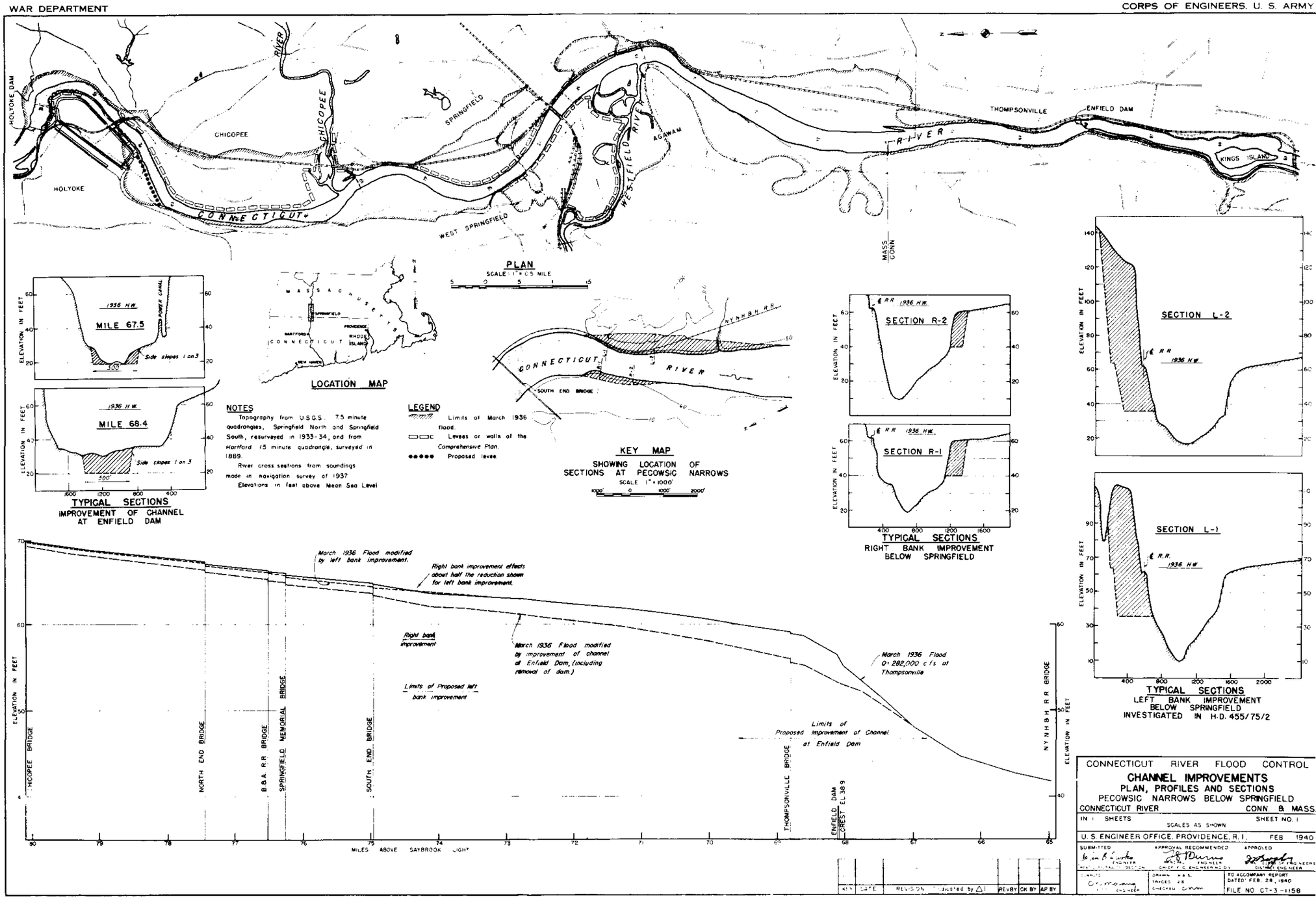
APPROVED: J. J. Bagden, COL. CORPS OF ENGINEERS, DISTRICT ENGINEER

COMPILED: Arthur Ring, ASST. ENGINEER

DRAWN: H.A.K. TRACED: J.F.C. CHECKED: G.H.M.

TO ACCOMPANY REPORT DATED FEB 28 1940

FILE NO. CT-3-1149



CONNECTICUT RIVER FLOOD CONTROL

CHANNEL IMPROVEMENTS

PLAN, PROFILES AND SECTIONS

PECOWSIC NARROWS BELOW SPRINGFIELD

CONNECTICUT RIVER — CONN. & MASS.

IN 1 SHEETS — SCALES AS SHOWN — SHEET NO. 1

U. S. ENGINEER OFFICE, PROVIDENCE, R. I. — FEB 1940

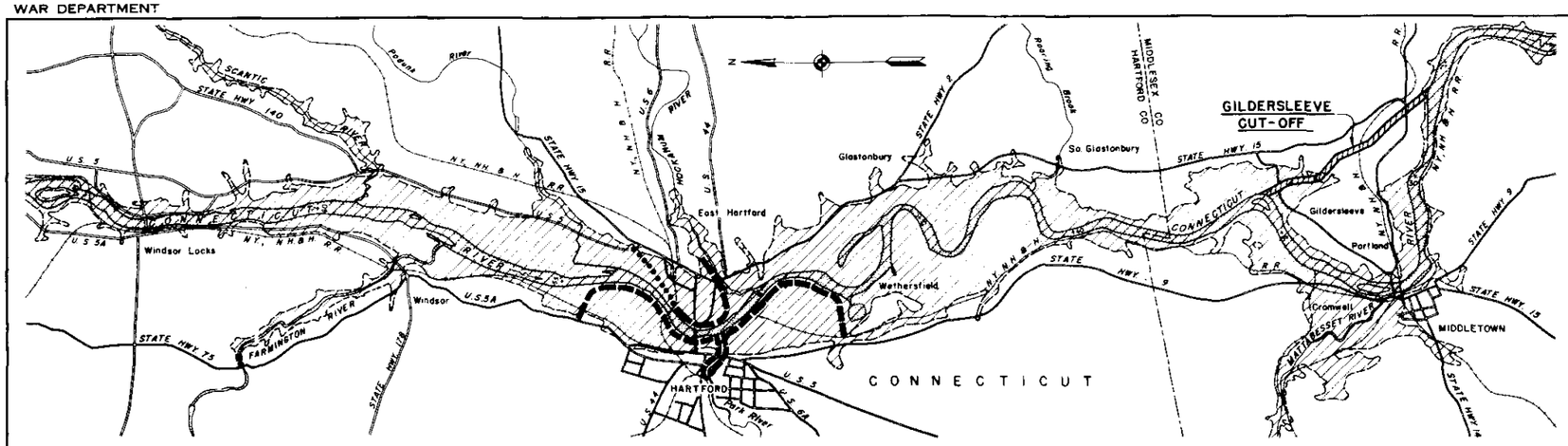
SUBMITTED — APPROVAL RECOMMENDED — APPROVED

DRAWN H.A.L. — TRACED J.S. — CHECKED C.H.M.

TO ACCOMPANY REPORT DATED FEB. 28, 1940

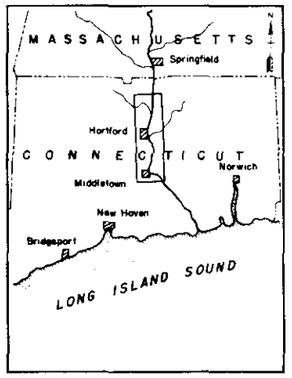
FILE NO. CT-3-1158

KEY	DATE	REVISION (indicated by △)	REV BY	CK BY	AP BY



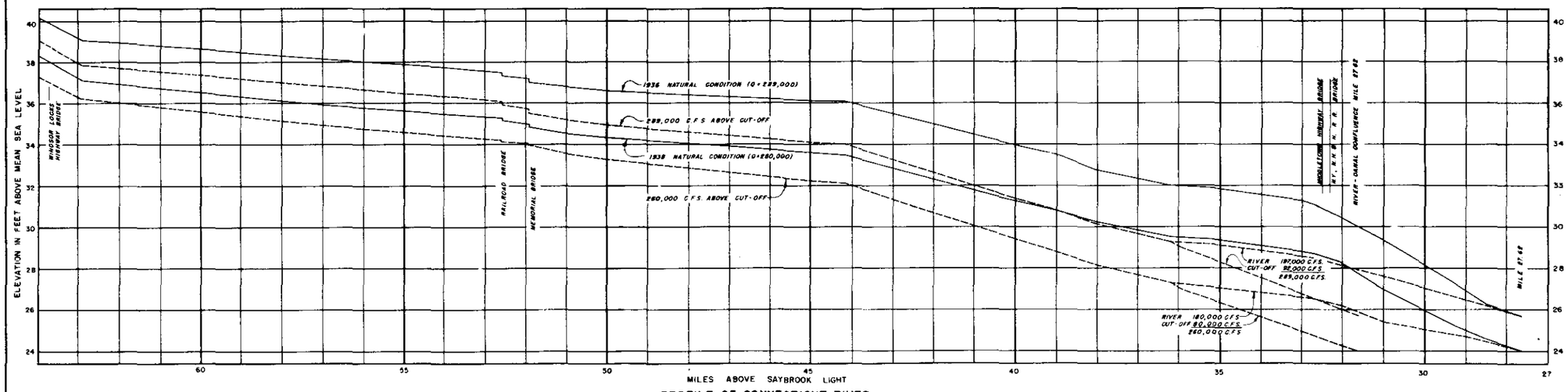
GENERAL PLAN

SCALE 1/62,500

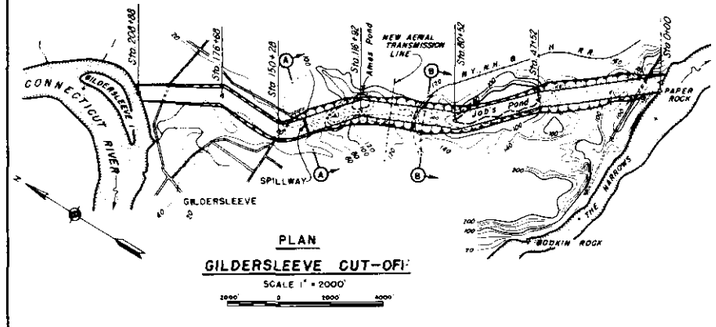


LOCATION MAP

SCALE IN MILES



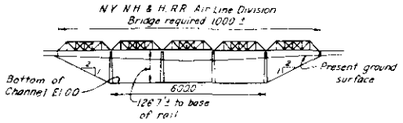
PROFILE OF CONNECTICUT RIVER



PLAN

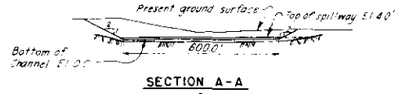
GILDERSLEEVE CUT-OFF

SCALE 1" = 2000'



SECTION B-B

SCALE 1" = 200'



SECTION A-A

SCALE 1" = 200'

NOTES

Topographic information taken from U.S.G.S. sheets surveyed in 1889. (Hartford and Middletown Quads)

Cross sections 1-15, surveyed in 1936 by U.S.E.D., were used in hydraulic computations

LEGEND

- Limits of March 1936 flood.
- Levees or walls of the Comprehensive Plan.
- Proposed levees.

KEY	DATE	REVISION (indicated by △)	REV BY	CK. BY	APB Y

CONNECTICUT RIVER FLOOD CONTROL

GILDERSLEEVE CUT-OFF

PLAN AND PROFILE

BELOW HARTFORD

CONNECTICUT RIVER — CONNECTICUT

IN 1 SHEETS — SCALE: 1/62,500 — SHEET NO. 1

U. S. ENGINEER OFFICE, PROVIDENCE, R. I. — FEB. 1940

SUBMITTED: John L. Bridge, ENGINEER, HEAD, HYDRAULIC DESIGN SECTION

APPROVAL RECOMMENDED: L. L. Durrua, PRINCIPAL ENGINEER, CHIEF, F. C. ENGINEERING DIV.

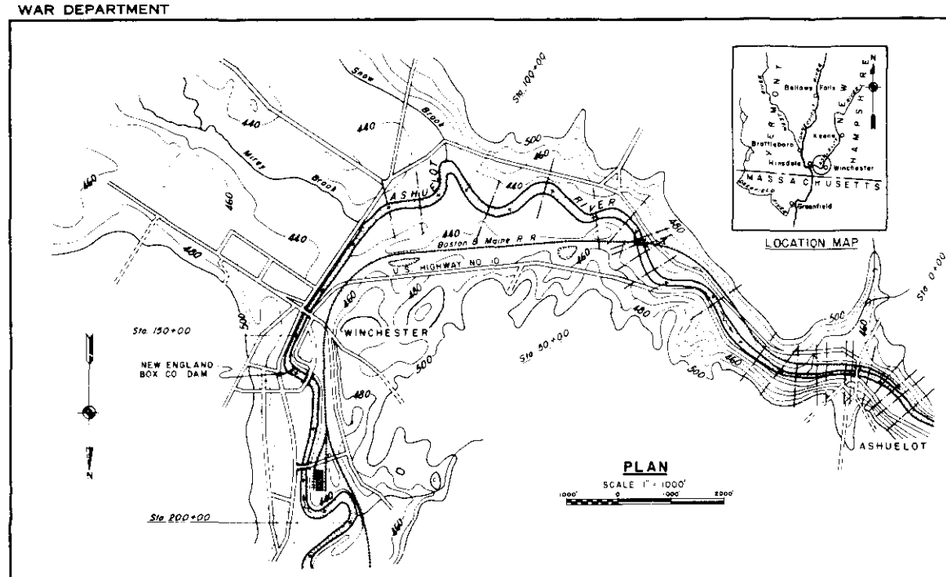
APPROVED: Thos. Carroll, COLONEL, CORPS OF ENGINEERS, DISTRICT ENGINEER

COMPILED BY: C. M. Cooney, ASST. ENGINEER

DRAWN: H. W. TRACED: W.B.R. CHECKED: C.M.M.

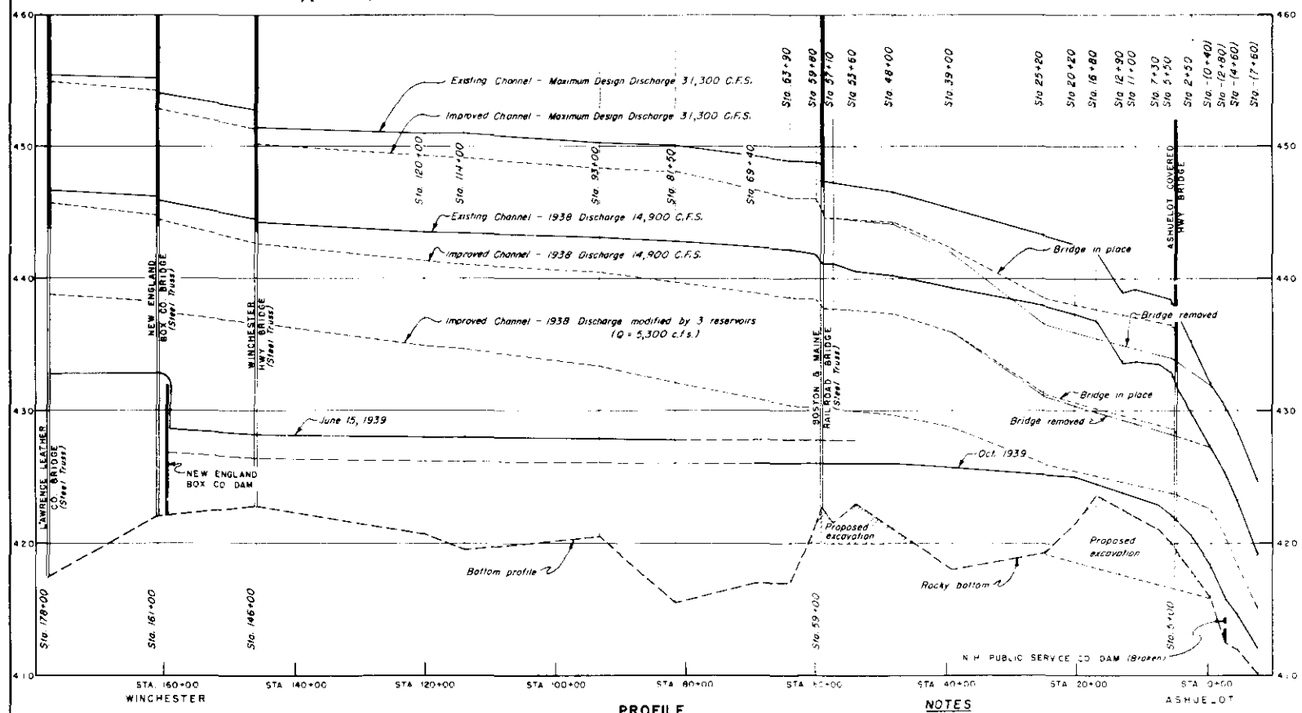
TO ACCOMPANY REPORT DATED: FEB. 28, 1940

FILE NO. CT-1-1439



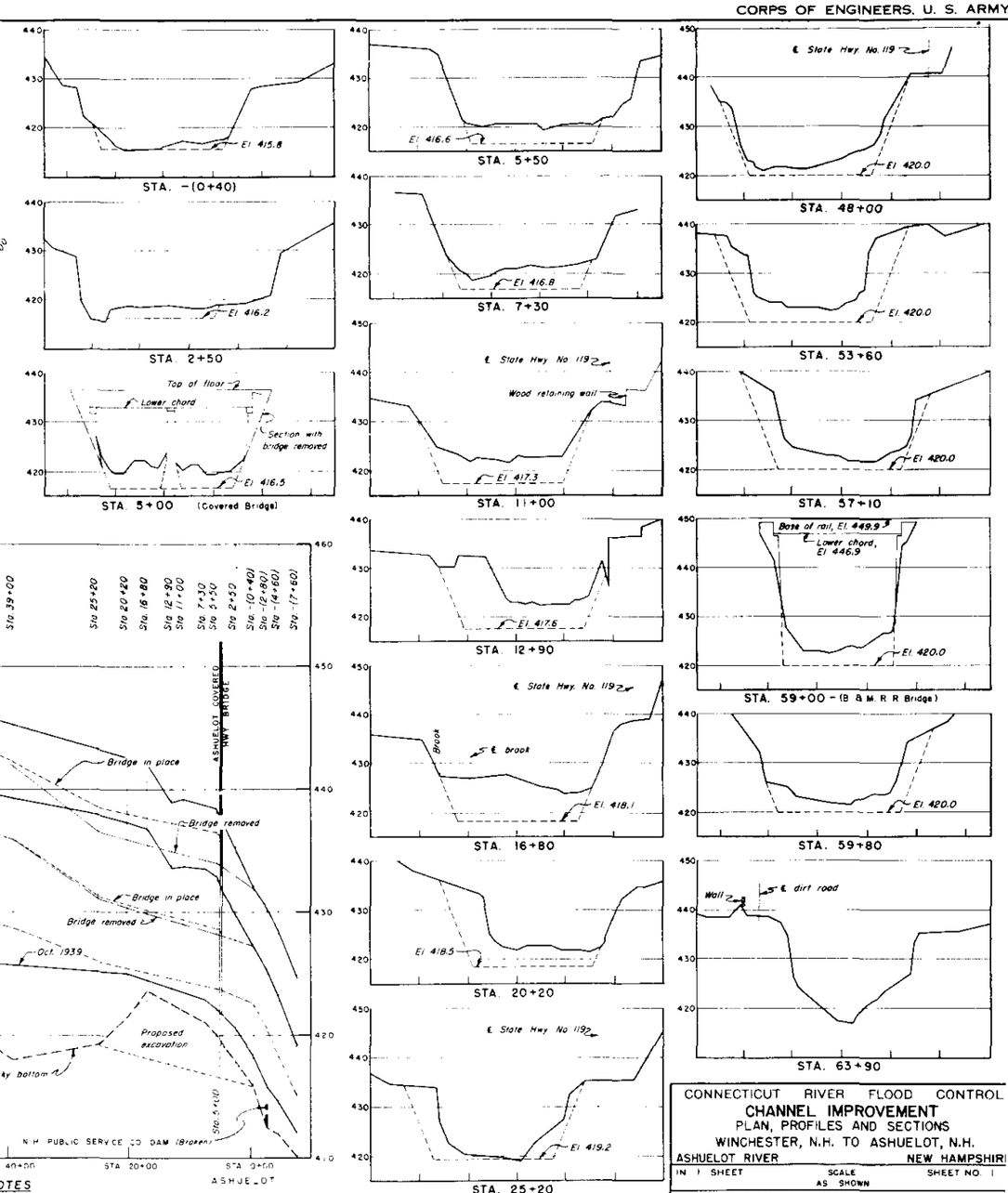
PLAN

SCALE 1" = 1000'



PROFILE

SCALE HOR. 1" = 800' VERT. 1" = 4'



SCALES FOR CROSS SECTIONS. HOR. 1" = 50' VERT. 1" = 10'

NOTES

Survey information taken from U. S. G. S. Topographic Sheet surveyed in 1932. (Keene Quadrangle)
Cross sections surveyed in 1939 by U. S. E. D.
Slope of cut 1 on 2 in cross sections.
Elevations on profile and cross sections in feet above mean sea level datum

KEY	DATE	REVISION (indicated by △)	REV BY	CK BY	APB Y

CONNECTICUT RIVER FLOOD CONTROL

CHANNEL IMPROVEMENT

PLAN, PROFILES AND SECTIONS

WINCHESTER, N.H. TO ASHUELOT, N.H.

ASHUELOT RIVER — NEW HAMPSHIRE

IN 1 SHEET — SCALE AS SHOWN — SHEET NO. 1

U. S. ENGINEER OFFICE, PROVIDENCE, R. I., FEB. 1940

SUBMITTED: John P. Dirato, ENGINEER, HEAD, HYDRAULICS SECTION

APPROVAL RECOMMENDED: D. S. Burns, PRINCIPAL ENGINEER, CHIEF F. C. ENGINEERING DIV.

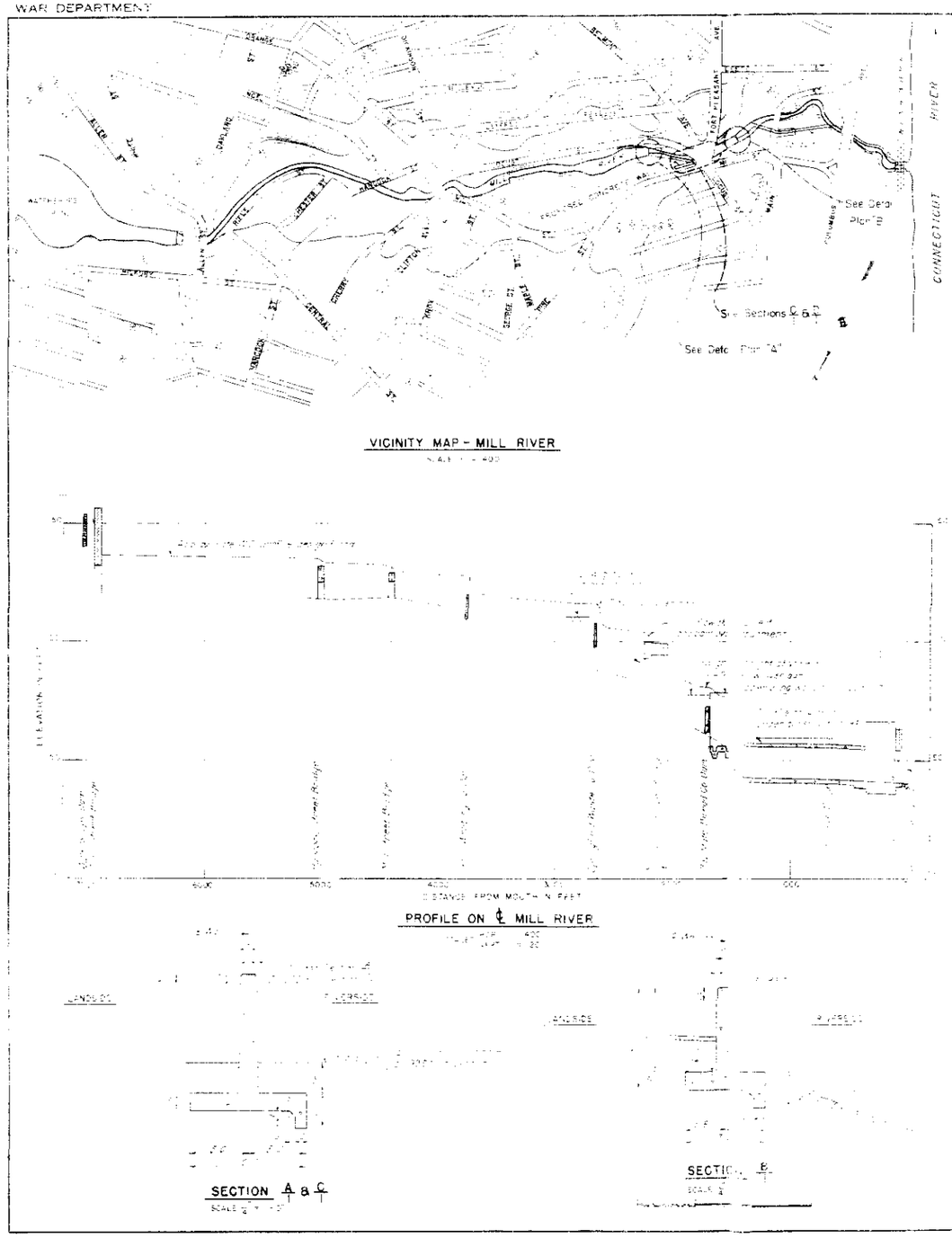
APPROVED: J. W. Langley, Col. CORPS OF ENGINEERS, DISTRICT ENGINEER

COMPILED: J. R. Murray, ASST. ENGINEER

DRAWN: A. K. S. TRACED: K. H. W. CHECKED: C. H. M.

TO ACCOMPANY REPORT DATED FEB. 28, 1940

FILE NO. CT-3-1129



CONNECTICUT RIVER FLOOD CONTROL

PROPOSED MILL RIVER WALLS

PLAN, PROFILE AND DETAILS

SPRINGFIELD, MASS

CONNECTICUT RIVER MASSACHUSETTS

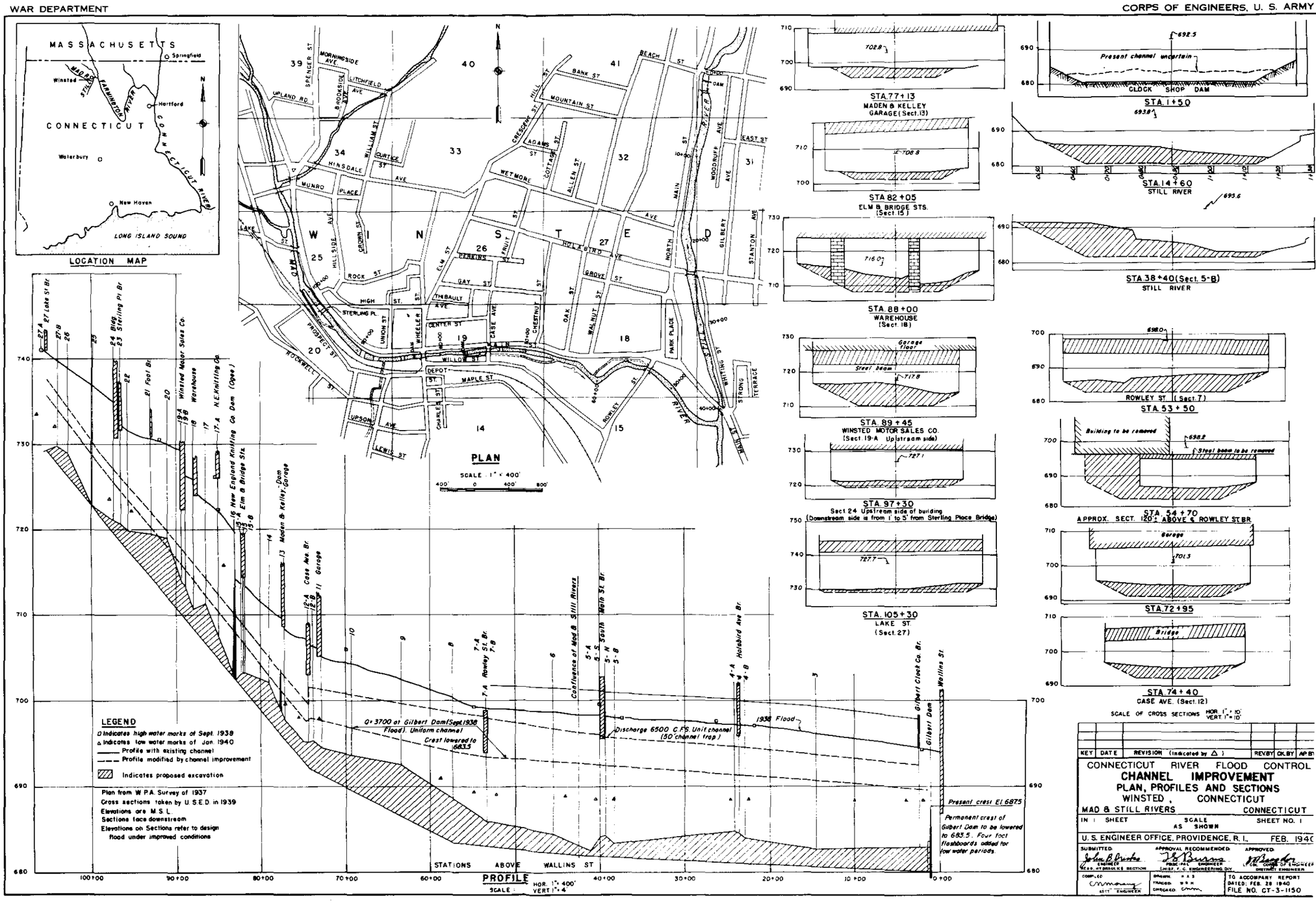
U. S. ENGINEER OFFICE, PROVIDENCE R. I. FEB. 1940

SUBMITTED APPROVAL RECOMMENDED APPROVED

TO ACCOMPANY REPORT DATED FEB. 26 1940

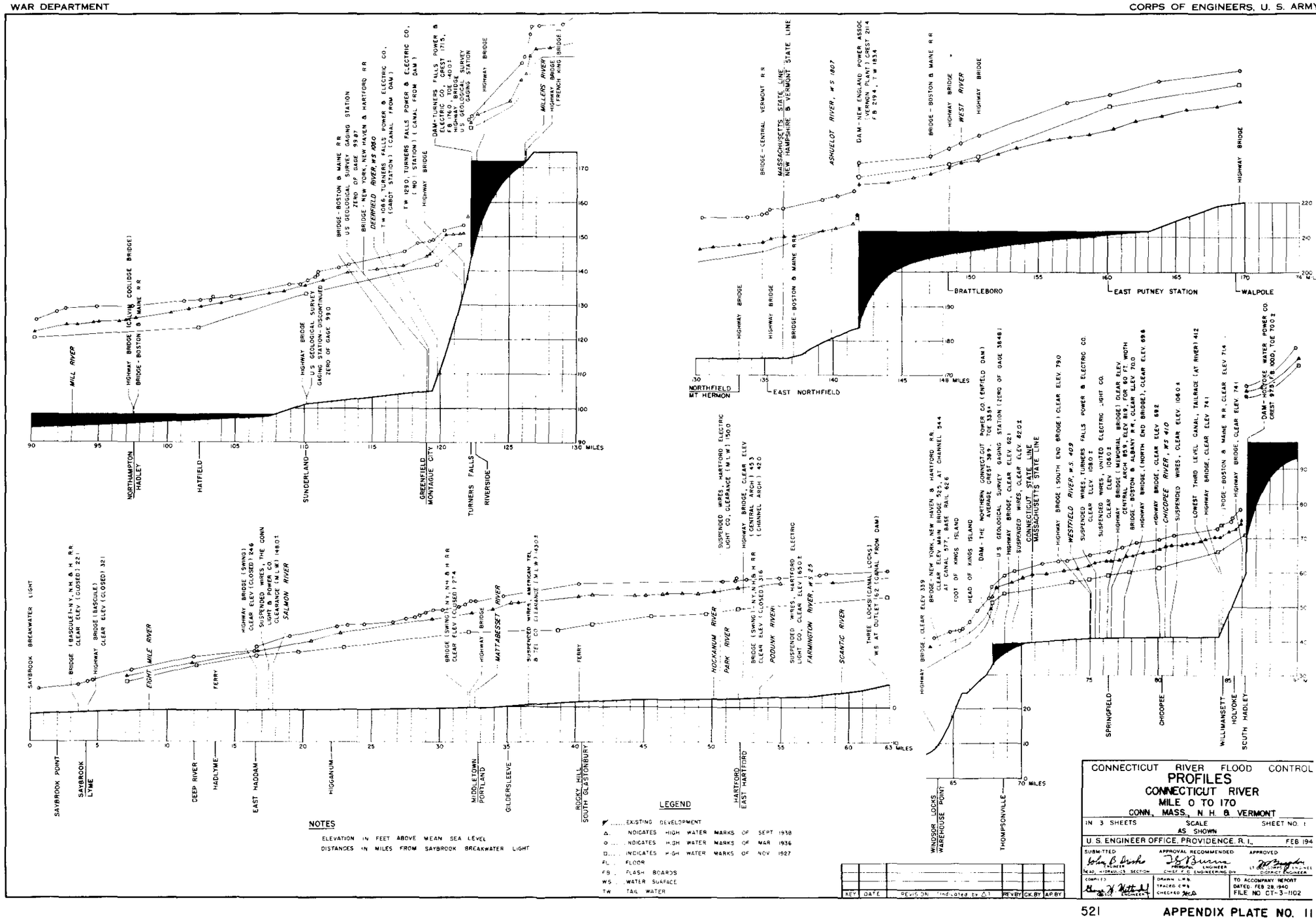
FILE NO. 4-2-54

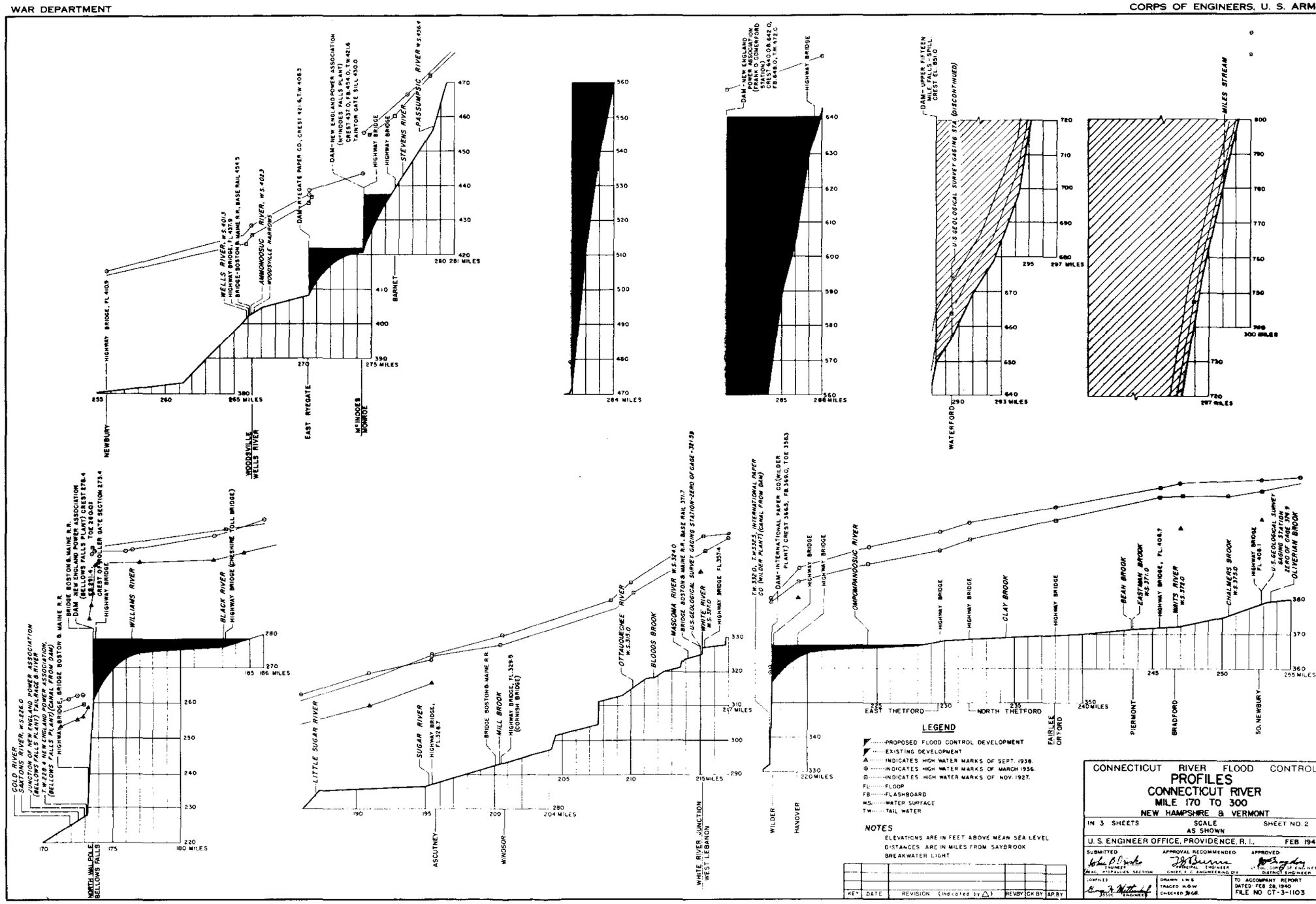
KEY	DATE	REVISION	REV. BY	CK. BY	AP. BY

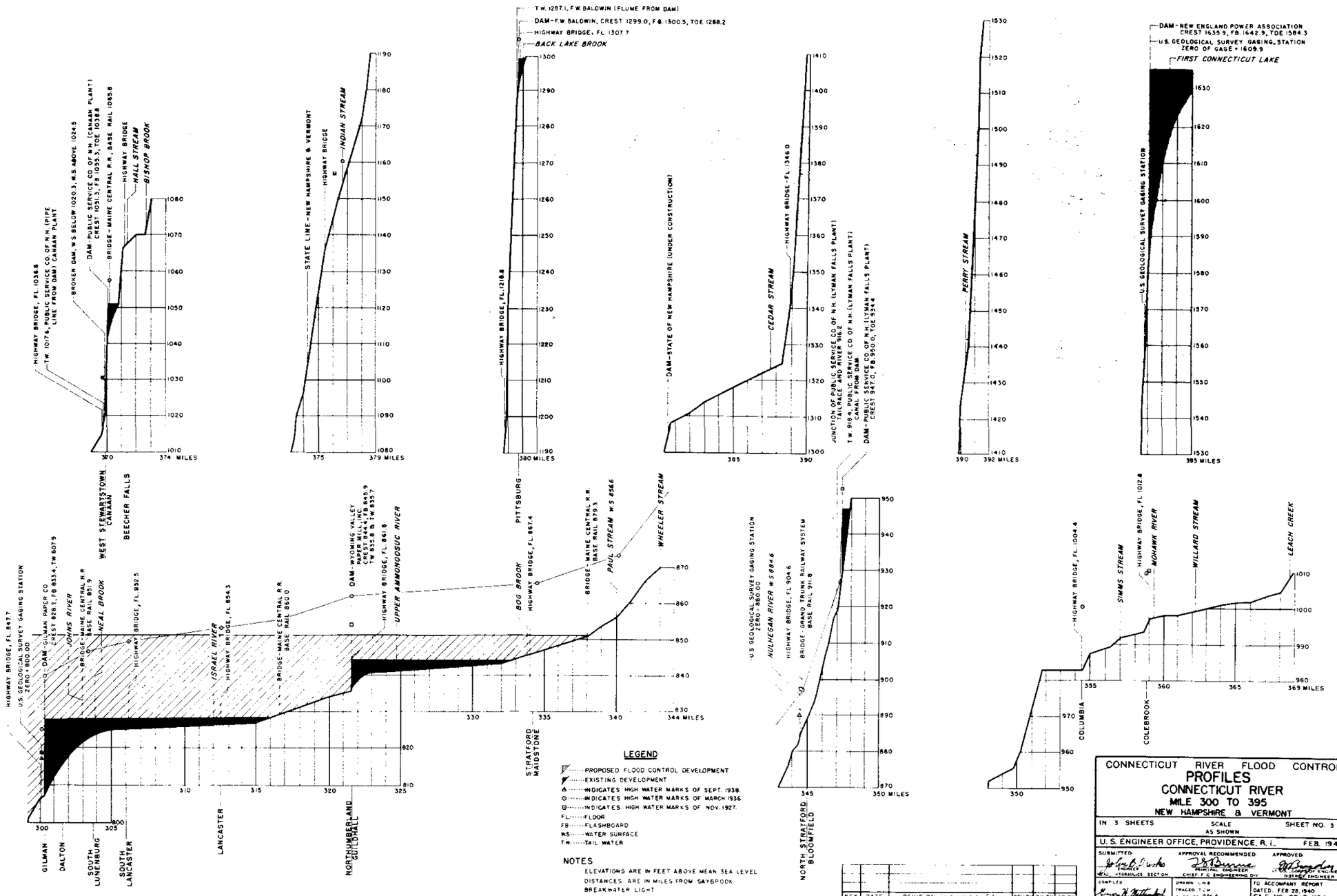

MASSACHUSETTS
Springfield
Winsted
MAD RIVER
STILL RIVER
FARMINGTON RIVER
Hartford
CONNECTICUT
CONNECTICUT RIVER
Waterbury
New Haven
LONG ISLAND SOUND
LOCATION MAP
PLAN
SCALE 1" = 400'
WINSTED
LEGEND
Indicates high water marks of Sept. 1938
Indicates low water marks of Jan. 1940
Profile with existing channel
Profile modified by channel improvement
Indicates proposed excavation
Plan from W.P.A. Survey of 1937
Cross sections taken by U.S.E.D. in 1939
Elevations are M.S.L.
Sections face downstream
Elevations on Sections refer to design flood under improved conditions
Q=3700 at Gilbert Dam (Sept. 1938 Flood). Uniform channel
Crest lowered to 683.5
Discharge 6500 C.F.S. Unit channel (50' channel trap)
1938 Flood
Present crest El. 687.5
Permanent crest of Gilbert Dam to be lowered to 683.5. Four foot flashboards added for low water periods.
STATIONS ABOVE WALLINS ST
PROFILE
SCALE: HOR. 1" = 400' VERT. 1" = 4'
STA. 77+13 MADEN & KELLEY GARAGE (Sect. 13)
STA. 82+05 ELM & BRIDGE STS. (Sect. 15)
STA. 88+00 WAREHOUSE (Sect. 18)
STA. 89+45 WINSTED MOTOR SALES CO. (Sect. 19-A Upstream side)
STA. 97+30 Sect. 24 Upstream side of building (Downstream side is from 1 to 5' from Sterling Place Bridge)
STA. 105+30 LAKE ST. (Sect. 27)
STA. 1+50 CLOCK SHOP DAM
STA. 14+60 STILL RIVER
STA. 38+40 (Sect. 5-B) STILL RIVER
STA. 53+50 ROWLEY ST. (Sect. 7)
STA. 54+70 APPROX. SECT. 120' ± ABOVE ℄ ROWLEY ST. BR.
STA. 72+95
STA. 74+40 CASE AVE. (Sect. 12)
SCALE OF CROSS SECTIONS HOR. 1" = 10' VERT. 1" = 10'
KEY DATE REVISION (indicated by △) REV. BY CK. BY APP. BY
CONNECTICUT RIVER FLOOD CONTROL
CHANNEL IMPROVEMENT
PLAN, PROFILES AND SECTIONS
WINSTED, CONNECTICUT
MAD & STILL RIVERS CONNECTICUT
IN 1 SHEET SCALE AS SHOWN SHEET NO. 1
U. S. ENGINEER OFFICE, PROVIDENCE, R. I., FEB. 1940
SUBMITTED: ENGINEER, HEAD, HYDRAULIC SECTION
APPROVAL RECOMMENDED: PRINC. ASST. ENGINEER, CHIEF, F.C. ENGINEERING DIV.
APPROVED: COL. CORPS OF ENGINEERS, DISTRICT ENGINEER
COMPUTED: ASST. ENGINEER
DRAWN: R.A.S.
TRACED: W.R.H.
CHECKED:
TO ACCOMPANY REPORT DATED: FEB. 28 1940
FILE NO. CT-3-1150

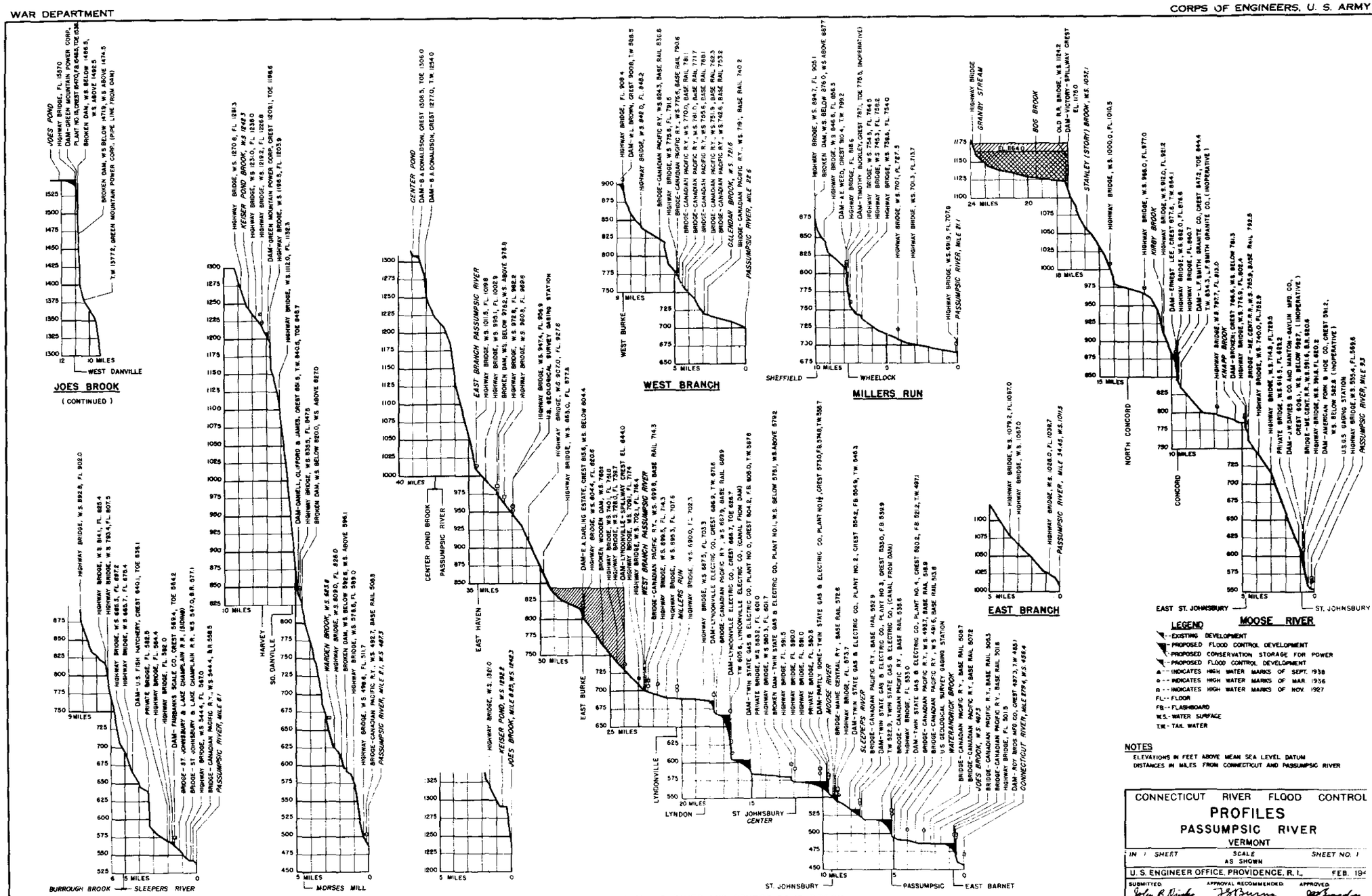
SECTION 8

PROFILES


MILL RIVER
HIGHWAY BRIDGE (CALVIN COOLIDGE BRIDGE)
BRIDGE - BOSTON & MAINE R R
HIGHWAY BRIDGE
U S GEOLOGICAL SURVEY GAGING STATION ZERO OF GAGE 591.0
BRIDGE - BOSTON & MAINE R R
U S GEOLOGICAL SURVEY GAGING STATION ZERO OF GAGE 591.7
BRIDGE - NEW YORK, NEW HAVEN & HARTFORD R R
DEERFIELD RIVER, WS 1050
TW 1056, TURNERS FALLS POWER & ELECTRIC CO. (CABOT STATION) (CANAL FROM DAM)
TW 1290, TURNERS FALLS POWER & ELECTRIC CO. (NO 1 STATION) (CANAL FROM DAM)
HIGHWAY BRIDGE
DAM - TURNERS FALLS POWER & ELECTRIC CO., CREST 1715, F B 1760, TOE 1400 ±
HIGHWAY BRIDGE
U S GEOLOGICAL SURVEY GAGING STATION
HIGHWAY BRIDGE
MILLERS RIVER
HIGHWAY BRIDGE (FRENCH KING BRIDGE)
NORTHAMPTON
HADLEY
HATFIELD
SUNDERLAND
GREENFIELD
MONTAGUE CITY
TURNERS FALLS
RIVERSIDE
130 MILES
BRIDGE - CENTRAL VERMONT R R
MASSACHUSETTS STATE LINE
NEW HAMPSHIRE & VERMONT STATE LINE
ASHUELOT RIVER, WS 1007
DAM - NEW ENGLAND POWER ASSOC VERNON PLANT, CREST 214 F B 2194, T W 1834
BRIDGE - BOSTON & MAINE R R
HIGHWAY BRIDGE
WEST RIVER
HIGHWAY BRIDGE
HIGHWAY BRIDGE
HIGHWAY BRIDGE
BRIDGE - BOSTON & MAINE R R
NORTHFIELD
MT HERMON
EAST NORTHFIELD
BRATTLEBORO
EAST PUTNEY STATION
WALPOLE
149 MILES
SAYBROOK BREAKWATER LIGHT
BRIDGE (BASCULE) - N Y, N H & H R R CLEAR ELEV (CLOSED) 22.1
HIGHWAY BRIDGE (BASCULE) CLEAR ELEV (CLOSED) 32.1
EIGHT MILE RIVER
FERRY
HIGHWAY BRIDGE (SWING) CLEAR ELEV (CLOSED) 24.6
SUSPENDED WIRES, THE CONN LIGHT & POWER CO CLEARANCE (M L W) 148.0 ±
SALMON RIVER
BRIDGE (SWING) - N Y, N H & H R R CLEAR ELEV (CLOSED) 27.4
HIGHWAY BRIDGE
MATTABESSET RIVER
SUSPENDED WIRES, AMERICAN TEL & TEL CO CLEARANCE (M L W) 143.0 ±
FERRY
HOCKANUM RIVER
PARK RIVER
SUSPENDED WIRES, HARTFORD ELECTRIC LIGHT CO, CLEARANCE (M L W) 150.0
HIGHWAY BRIDGE, CLEAR ELEV (CENTRAL ARCH) 43.5 (CHANNEL ARCH) 42.0
BRIDGE (SWING) - N Y, N H & H R R CLEAR ELEV (CLOSED) 31.6
PODUNK RIVER
SUSPENDED WIRES, HARTFORD ELECTRIC LIGHT CO, CLEAR ELEV (65.0 ±
FARMINGTON RIVER, WS 25
SCANTIC RIVER
THREE LOCKS (CANAL LOCKS) WS AT OUTLET (92 (CANAL FROM DAM)
63 MILES
SAYBROOK POINT
SAYBROOK
LYME
DEEP RIVER
HADLYME
EAST HADDAM
HIGGANUM
MIDDLETOWN
PORTLAND
GILDERSLEEVE
ROCKY HILL
SOUTH GLASTONBURY
HARTFORD
EAST HARTFORD
HIGHWAY BRIDGE, CLEAR ELEV 33.9
BRIDGE - NEW YORK, NEW HAVEN & HARTFORD R R CLEAR ELEV MAIN BRIDGE 52.2, AT CHANNEL 54.4 AT CANAL 57.7, BASE RAIL 62.6
FOOT OF KINGS ISLAND
HEAD OF KINGS ISLAND
DAM - THE NORTHERN CONNECTICUT POWER CO (ENFIELD DAM) AVERAGE CREST 38.9, TOE 33.9 ±
U S GEOLOGICAL SURVEY GAGING STATION (ZERO OF GAGE 38.48)
HIGHWAY BRIDGE, CLEAR ELEV 62.1
SUSPENDED WIRES, CLEAR ELEV 82.0 ±
CONNECTICUT STATE LINE
MASSACHUSETTS STATE LINE
HIGHWAY BRIDGE (SOUTH END BRIDGE) CLEAR ELEV 79.0
WESTFIELD RIVER, WS 40.9
SUSPENDED WIRES, TURNERS FALLS POWER & ELECTRIC CO. CLEAR ELEV 108.0 ±
SUSPENDED WIRES, UNITED ELECTRIC LIGHT CO. CLEAR ELEV 106.0 ±
HIGHWAY BRIDGE (MEMORIAL BRIDGE) CLEAR ELEV CENTRAL ARCH 85.9, ELEV 81.9, FOR 80 FT WIDTH
BRIDGE - BOSTON & ALBANY R R, CLEAR ELEV 70.0
HIGHWAY BRIDGE, (NORTH END BRIDGE), CLEAR ELEV 69.8
HIGHWAY BRIDGE, CLEAR ELEV 69.2
CHICOPEE RIVER, WS 41.0
SUSPENDED WIRES, CLEAR ELEV 106.0 ±
LOWEST THIRD LEVEL CANAL, TAILRACE (AT RIVER) 41.2
HIGHWAY BRIDGE, CLEAR ELEV 74.1
BRIDGE - BOSTON & MAINE R R, CLEAR ELEV 71.4
HIGHWAY BRIDGE, CLEAR ELEV 74.1
DAM - HOLYOKE WATER POWER CO. CREST 97.5, F B 100.0, TOE 70.0 ±
SPRINGFIELD
CHICOPEE
WILLIMANSETT
HOLYOKE
SOUTH HADLEY
WINDSOR LOCKS
WAREHOUSE POINT
THOMPSONVILLE
70 MILES
LEGEND
EXISTING DEVELOPMENT
△ INDICATES HIGH WATER MARKS OF SEPT 1938
○ INDICATES HIGH WATER MARKS OF MAR 1936
□ INDICATES HIGH WATER MARKS OF NOV 1927
FL FLOOR
FB FLASH BOARDS
WS WATER SURFACE
TW TAIL WATER
NOTES
ELEVATION IN FEET ABOVE MEAN SEA LEVEL
DISTANCES IN MILES FROM SAYBROOK BREAKWATER LIGHT
KEY DATE REVISION indicated by △1 REV BY CK BY APD BY
CONNECTICUT RIVER FLOOD CONTROL
PROFILES
CONNECTICUT RIVER
MILE 0 TO 170
CONN., MASS., N. H. & VERMONT
IN 3 SHEETS
SCALE AS SHOWN
SHEET NO. 1
U. S. ENGINEER OFFICE, PROVIDENCE, R. I., FEB 194
SUBMITTED
HEAD, HYDRAULICS SECTION
APPROVAL RECOMMENDED
CHIEF, F. C. ENGINEERING DIV
APPROVED
LT COL CORPS OF ENGINEERS DISTRICT ENGINEER
COMPILED
DRAWN
TRACED
CHECKED
TO ACCOMPANY REPORT DATED FEB 28, 1940
FILE NO CT-3-1102


HIGHWAY BRIDGE, FL 410.9
NEWBURY
WELLS RIVER, W.S. 401.5
HIGHWAY BRIDGE, FL 437.9
BRIDGE-BOSTON & MAINE R.R., BASE RAIL 454.5
AMMONOOSUC RIVER, W.S. 402.3
WOODSVILLE HARBORS
WOODSVILLE WELLS RIVER
DAM-RIVERGATE PAPER CO., CREST 421.6, T.W. 408.3
EAST RIVERGATE
DAM-NEW ENGLAND POWER ASSOCIATION (McINDOES FALLS PLANT) CREST 437.0, FB. 454.0, T.W. 421.6 TAINTOR GATE SILL 450.0
HIGHWAY BRIDGE
McINDOES MONROE
HIGHWAY BRIDGE
STEVENS RIVER
PASSUMPSIC RIVER W.S. 456.4
BARNET
280 281 MILES
COLD RIVER
SALTONS RIVER, W.S. 226.0
JUNCTION OF NEW ENGLAND POWER ASSOCIATION (BELLOWS FALLS PLANT) TAILRACE & RIVER T.W. 228.4 NEW ENGLAND POWER ASSOCIATION, (BELLOWS FALLS PLANT) (CANAL FROM DAM)
HIGHWAY BRIDGE, BRIDGE BOSTON & MAINE R.R.
BRIDGE BOSTON & MAINE R.R.
DAM NEW ENGLAND POWER ASSOCIATION (BELLOWS FALLS PLANT) CREST 276.4 GATE 281.4, TOE 280.0 CREST OF ROLLER GATE SECTION 273.4
HIGHWAY BRIDGE
WILLIAMS RIVER
BLACK RIVER
HIGHWAY BRIDGE (CHESHIRE TOLL BRIDGE)
NORTH WALPOLE
BELLOWS FALLS
185 186 MILES
LITTLE SUGAR RIVER
SUGAR RIVER
HIGHWAY BRIDGE, FL 328.7
ASCUTNEY
BRIDGE BOSTON & MAINE R.R.
MILL BROOK
HIGHWAY BRIDGE, FL 329.9 (CORNISH BRIDGE)
WINDSOR
OTTAUQUECHEE RIVER W.S. 335.0
BLOODS BROOK
MASCOMA RIVER W.S. 324.0
BRIDGE BOSTON & MAINE R.R., BASE RAIL 371.7
U.S. GEOLOGICAL SURVEY GAGING STATION-ZERO OF GAGE-391.59
WHITE RIVER W.S. 321.0
HIGHWAY BRIDGE FL 357.4
WHITE RIVER JUNCTION
WEST LEBANON
215 MILES
204 MILES
TW 332.0, T.W. 325, INTERNATIONAL PAPER CO. (WILDER PLANT) (CANAL FROM DAM)
DAM-INTERNATIONAL PAPER CO. (WILDER PLANT) CREST 366.5, FB. 369.0, TOE 358.3
HIGHWAY BRIDGE
HIGHWAY BRIDGE
OMPOMPANOOSUC RIVER
WILDER
HANOVER
220 MILES
EAST THETFORD
NORTH THETFORD
FAIRLEE
ORFORD
240 MILES
HIGHWAY BRIDGE
HIGHWAY BRIDGE
CLAY BROOK
HIGHWAY BRIDGE
BEAN BROOK
EASTMAN BROOK W.S. 371.0
HIGHWAY BRIDGE, FL 406.7
WAITS RIVER W.S. 371.0
CHALMERS BROOK W.S. 372.0
HIGHWAY BRIDGE FL 456.1
U.S. GEOLOGICAL SURVEY GAGING STATION ZERO OF GAGE 394.9 OLIVERIAN BROOK
PIERMONT
BRADFORD
SO. NEWBURY
255 MILES
DAM-NEW ENGLAND POWER ASSOCIATION (FRANK D. COMERFORD PLANT) CREST 640.0, FB. 642.0, TW. 472.0
HIGHWAY BRIDGE
DAM-UPPER FIFTEEN MILE FALLS SKILL. CREST EL. 851.0
U.S. GEOLOGICAL SURVEY GAGING STA. (DISCONTINUED)
WATERFORD
WILES STREAM
LEGEND
PROPOSED FLOOD CONTROL DEVELOPMENT
EXISTING DEVELOPMENT
INDICATES HIGH WATER MARKS OF SEPT. 1938.
INDICATES HIGH WATER MARKS OF MARCH 1936.
INDICATES HIGH WATER MARKS OF NOV. 1927.
FL FLOOR
FB FLASHBOARD
W.S. WATER SURFACE
T.W. TAIL WATER
NOTES
ELEVATIONS ARE IN FEET ABOVE MEAN SEA LEVEL
DISTANCES ARE IN MILES FROM SAYBROOK BREAKWATER LIGHT
KEY DATE REVISION (indicated by △) REV BY CK BY AP BY
CONNECTICUT RIVER FLOOD CONTROL
PROFILES
CONNECTICUT RIVER
MILE 170 TO 300
NEW HAMPSHIRE & VERMONT
IN 3 SHEETS
SCALE AS SHOWN
SHEET NO. 2
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.,
FEB 1940
SUBMITTED
APPROVAL RECOMMENDED
APPROVED
ENGINEER
ASS'T. ENGINEER
CHIEF, PHYSICAL ENGINEERING DIV.
LT. COL. CORPS OF ENG'RS
DISTRICT ENGINEER
COMPILED
DRAWN L.W.B.
TRACED H.G.W.
CHECKED
TO ACCOMPANY REPORT DATED FEB 28, 1940
FILE NO. CT-3-1103


HIGHWAY BRIDGE, FL. 1038.8
T.W. 1017.6, PUBLIC SERVICE CO. OF N.H. (PIPE LINE FROM DAM) CANAAN PLANT
BROKEN DAM, W.S. BELOW 1020.3, W.S. ABOVE 1024.5
DAM-PUBLIC SERVICE CO. OF N.H. (CANAAN PLANT) CREST 1051.3, F.B. 1055.3, TOE 1038.8
BRIDGE-MAINE CENTRAL R.R., BASE RAIL 1065.8
HIGHWAY BRIDGE
HALL STREAM
BISHOP BROOK
STATE LINE-NEW HAMPSHIRE & VERMONT
HIGHWAY BRIDGE
INDIAN STREAM
T.W. 1287.1, F.W. BALDWIN (FLUME FROM DAM)
DAM-F.W. BALDWIN, CREST 1299.0, F.B. 1300.5, TOE 1288.2
HIGHWAY BRIDGE, FL. 1307.7
BACK LAKE BROOK
HIGHWAY BRIDGE, FL. 1218.8
DAM-STATE OF NEW HAMPSHIRE (UNDER CONSTRUCTION)
CEDAR STREAM
HIGHWAY BRIDGE-FL. 1346.0
JUNCTION OF PUBLIC SERVICE CO. OF N.H. (LYMAN FALLS PLANT) TAILRACE AND RIVER 916.2
T.W. 916.4, PUBLIC SERVICE CO. OF N.H. (LYMAN FALLS PLANT) CANAL FROM DAM
DAM-PUBLIC SERVICE CO. OF N.H. (LYMAN FALLS PLANT) CREST 947.0, F.B. 950.0, TOE 934.4
PERRY STREAM
DAM-NEW ENGLAND POWER ASSOCIATION CREST 1635.9, F.B. 1642.9, TOE 1584.3
U.S. GEOLOGICAL SURVEY GAGING STATION ZERO OF GAGE = 1609.9
FIRST CONNECTICUT LAKE
U.S. GEOLOGICAL SURVEY GAGING STATION
HIGHWAY BRIDGE, FL. 847.7
U.S. GEOLOGICAL SURVEY GAGING STATION ZERO = 800.00
DAM-GILMAN PAPER CO. CREST 828.2, F.B. 833.4, T.W. 807.9
JOHNS RIVER
BRIDGE-MAINE CENTRAL R.R. BASE RAIL 851.9
NEAL BROOK
HIGHWAY BRIDGE, FL. 852.5
WEST STEWARTSTOWN
CANAAN
BEECHER FALLS
ISRAEL RIVER
HIGHWAY BRIDGE, FL. 854.3
BRIDGE-MAINE CENTRAL R.R. BASE RAIL 860.0
DAM-WYOMING VALLEY PAPER MILL, INC. CREST 844.4, F.B. 845.9 T.W. 832.8, T.W. 835.7
HIGHWAY BRIDGE, FL. 861.8
UPPER AMMONOOSUC RIVER
BOG BROOK
HIGHWAY BRIDGE, FL. 867.4
PITTSBURG
BRIDGE-MAINE CENTRAL R.R. BASE RAIL 879.3
PAUL STREAM W.S. 856.6
WHEELER STREAM
U.S. GEOLOGICAL SURVEY GAGING STATION ZERO = 800.00
NULHEGAN RIVER W.S. 884.6
HIGHWAY BRIDGE, FL. 904.6
BRIDGE-GRAND TRUNK RAILWAY SYSTEM BASE RAIL 911.8
HIGHWAY BRIDGE, FL. 1004.4
SIMMS STREAM
HIGHWAY BRIDGE, FL. 1012.8
MOHAWK RIVER
WILLARD STREAM
LEACH CREEK
GILMAN
DALTON
SOUTH LUNENBURG
SOUTH LANCASTER
LANCASTER
NORTHUMBERLAND
GUILDHALL
STRATFORD
MAIDSTONE
NORTH STRATFORD
BLOOMFIELD
COLUMBIA
COLEBROOK
LEGEND
PROPOSED FLOOD CONTROL DEVELOPMENT
EXISTING DEVELOPMENT
INDICATES HIGH WATER MARKS OF SEPT. 1938.
INDICATES HIGH WATER MARKS OF MARCH 1936.
INDICATES HIGH WATER MARKS OF NOV. 1927.
FL. FLOOR
FB. FLASHBOARD
WS. WATER SURFACE
T.W. TAIL WATER
NOTES
ELEVATIONS ARE IN FEET ABOVE MEAN SEA LEVEL
DISTANCES ARE IN MILES FROM SAYBROOK BREAKWATER LIGHT
CONNECTICUT RIVER FLOOD CONTROL
PROFILES
CONNECTICUT RIVER
MILE 300 TO 395
NEW HAMPSHIRE & VERMONT
IN 3 SHEETS
SCALE AS SHOWN
SHEET NO. 3
U.S. ENGINEER OFFICE, PROVIDENCE, R.I., FEB. 1940
SUBMITTED
APPROVAL RECOMMENDED
APPROVED
CHIEF, HYDRAULICS SECTION
PRINCIPAL ENGINEER
CHIEF, F.C. ENGINEERING DIV.
DISTRICT ENGINEER
COMPILED
ENGINEER
DRAWN
TRACED
CHECKED
TO ACCOMPANY REPORT
DATED FEB. 28, 1940
FILE NO. CT-3-1104
KEY
DATE
REVISION
REVBY
CK BY
AP BY



CONNECTICUT RIVER FLOOD CONTROL

PROFILES

PASSUMPSIC RIVER

VERMONT

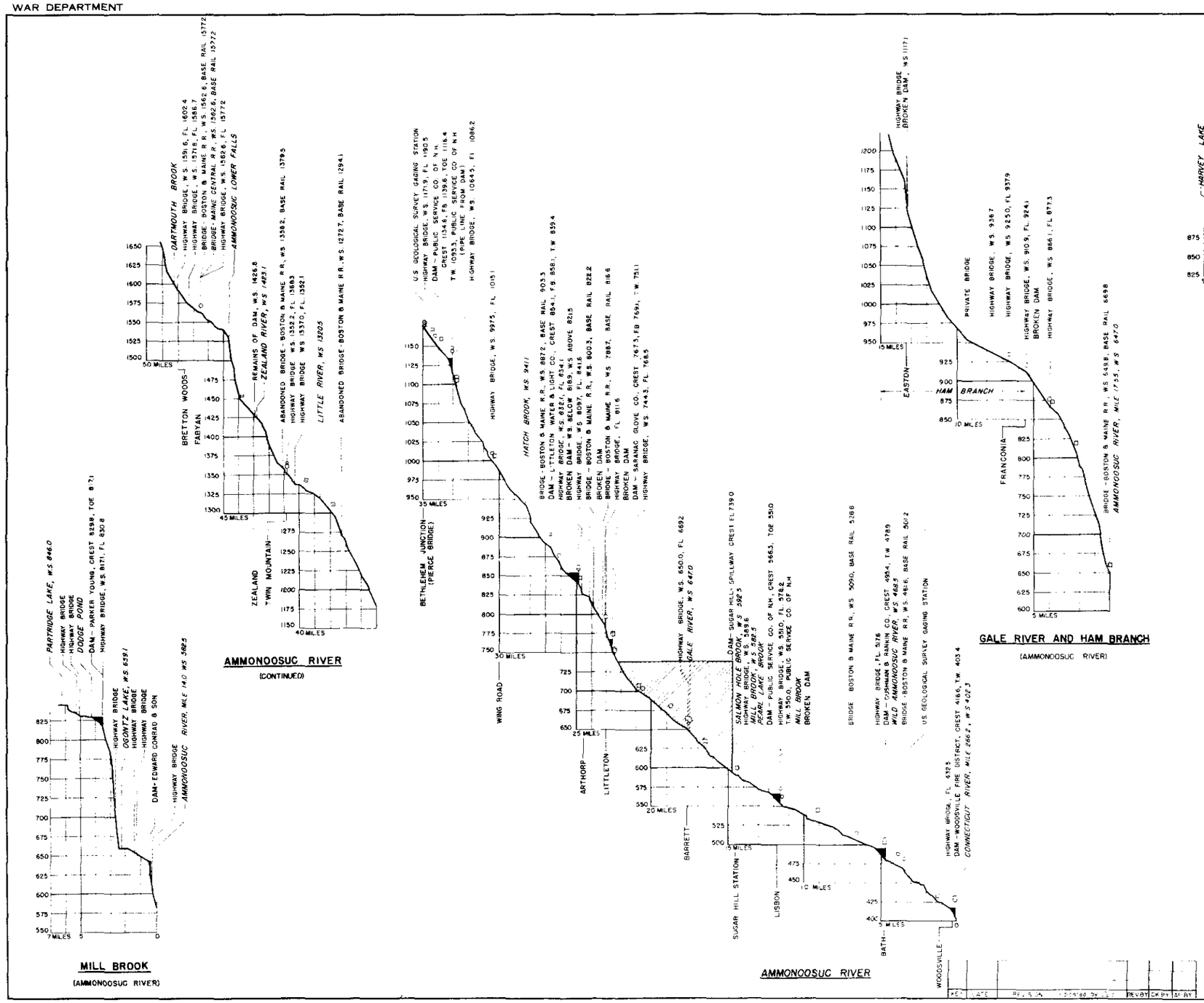
IN 1 SHEET	SCALE AS SHOWN	SHEET NO. 1

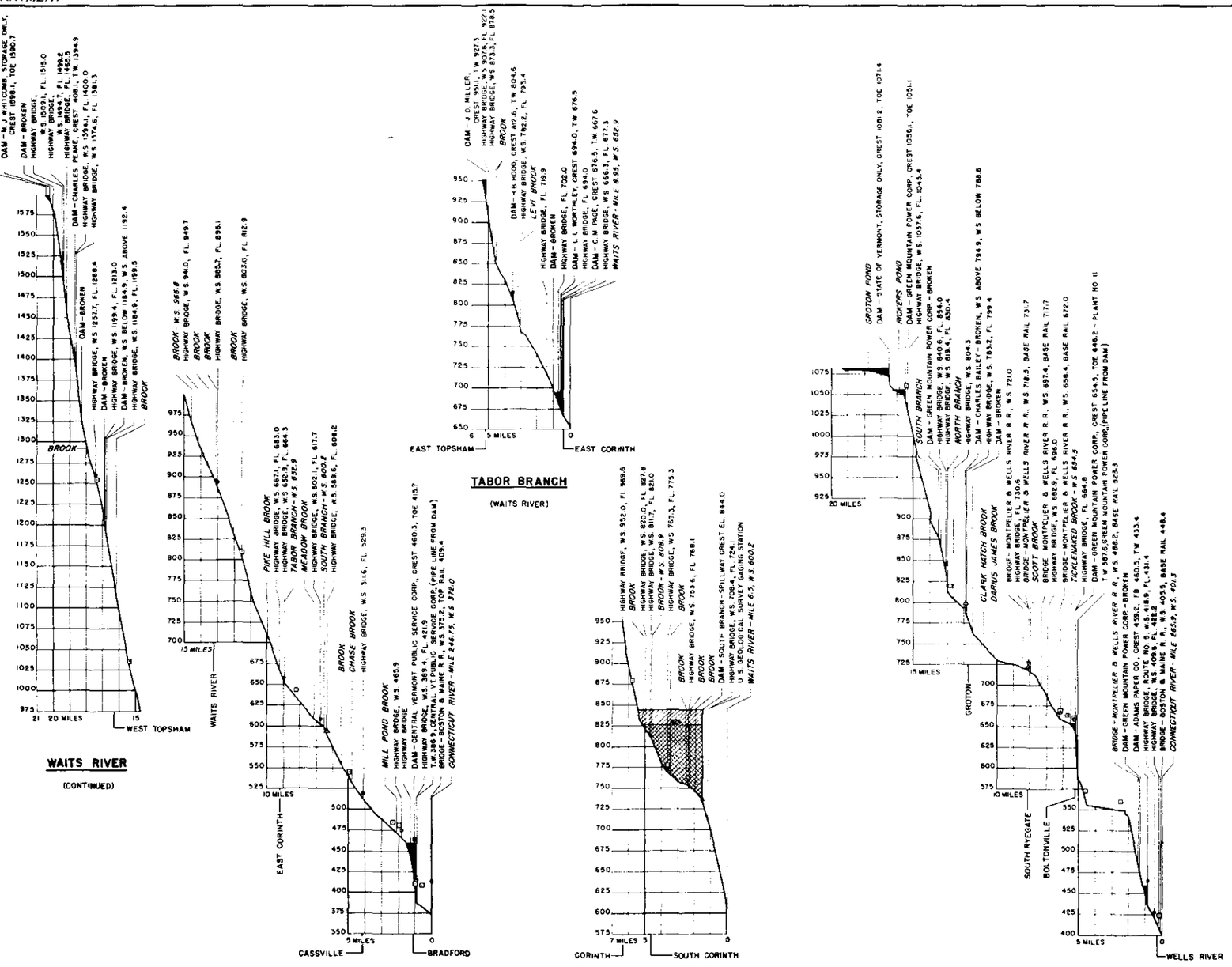
U. S. ENGINEER OFFICE, PROVIDENCE, R. I., FEB. 194

SUBMITTED:	APPROVAL RECOMMENDED:	APPROVED:
John B. Drinker, ENGINEER, HEAD, HYDRAULICS SECTION	F. A. Burns, PRINCIPAL ENGINEER, CHIEF, F. C. ENGINEERING DIV.	[signature], DISTRICT ENGINEER

COMPILED:	DRAWN: J.J.J.	TO ACCOMPANY REPORT DATED: FEB. 28, 1940
[signature], ASSOC. ENGINEER	TRACED: KEL. & C.W.B. CHECKED: H.C.B.	FILE NO. CT-3-1117

KEY	DATE	REVISION (Indicated by △)	REV. BY	CK. BY	APBY


MILL BROOK
(AMMONOOSUC RIVER)
AMMONOOSUC RIVER
(CONTINUED)
AMMONOOSUC RIVER
GALE RIVER AND HAM BRANCH
(AMMONOOSUC RIVER)
STEVENS RIVER
LEGEND
EXISTING DEVELOPMENT
PROPOSED FLOOD CONTROL DEVELOPMENT
INDICATES HIGH WATER MARKS OF SEPT 1938
INDICATES HIGH WATER MARKS OF MARCH 1936
INDICATES HIGH WATER MARKS OF NOV. 1927
FL - FLOOR
FB - FLASHBOARD
WS - WATER SURFACE
TW - TAIL WATER
NOTES
ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL
DISTANCES IN MILES FROM CONNECTICUT & AMMONOOSUC RIVERS
CONNECTICUT RIVER FLOOD CONTROL
PROFILES
AMMONOOSUC RIVER AND STEVENS RIVER
NEW HAMPSHIRE
VERMONT
IN 1 SHEET
SCALE AS SHOWN
SHEET NO
U.S. ENGINEER OFFICE, PROVIDENCE, R.I.
SUBMITTED
APPROVAL RECOMMENDED
APPROVED
TO ACCOMPANY REPORT DATED FEB 28, 1946
FILE NO CT-3



LEGEND

- PROPOSED FLOOD CONTROL DEVELOPMENT
- PROPOSED FLOOD CONTROL DEVELOPMENT
- PROPOSED CONSERVATION STORAGE FOR POWER
- EXISTING DEVELOPMENT

△ INDICATES HIGH WATER MARKS OF SEPT. 1938.
◆ INDICATES HIGH WATER MARKS OF MAR. 1936.
□ INDICATES HIGH WATER MARKS OF NOV. 1927.
FL = FLOOR.
W.S. = WATER SURFACE.
T.W. = TAIL WATER
FB. = FLASHBOARD

NOTES

ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL DATUM.
DISTANCES IN MILES FROM CONNECTICUT, WAITS AND WELLS RIVER

KEY	DATE	REVISION (Indicated by △)	REV. BY	CK. BY	APP'D

CONNECTICUT RIVER FLOOD CONTROL

PROFILES

WAITS RIVER AND WELLS RIVER

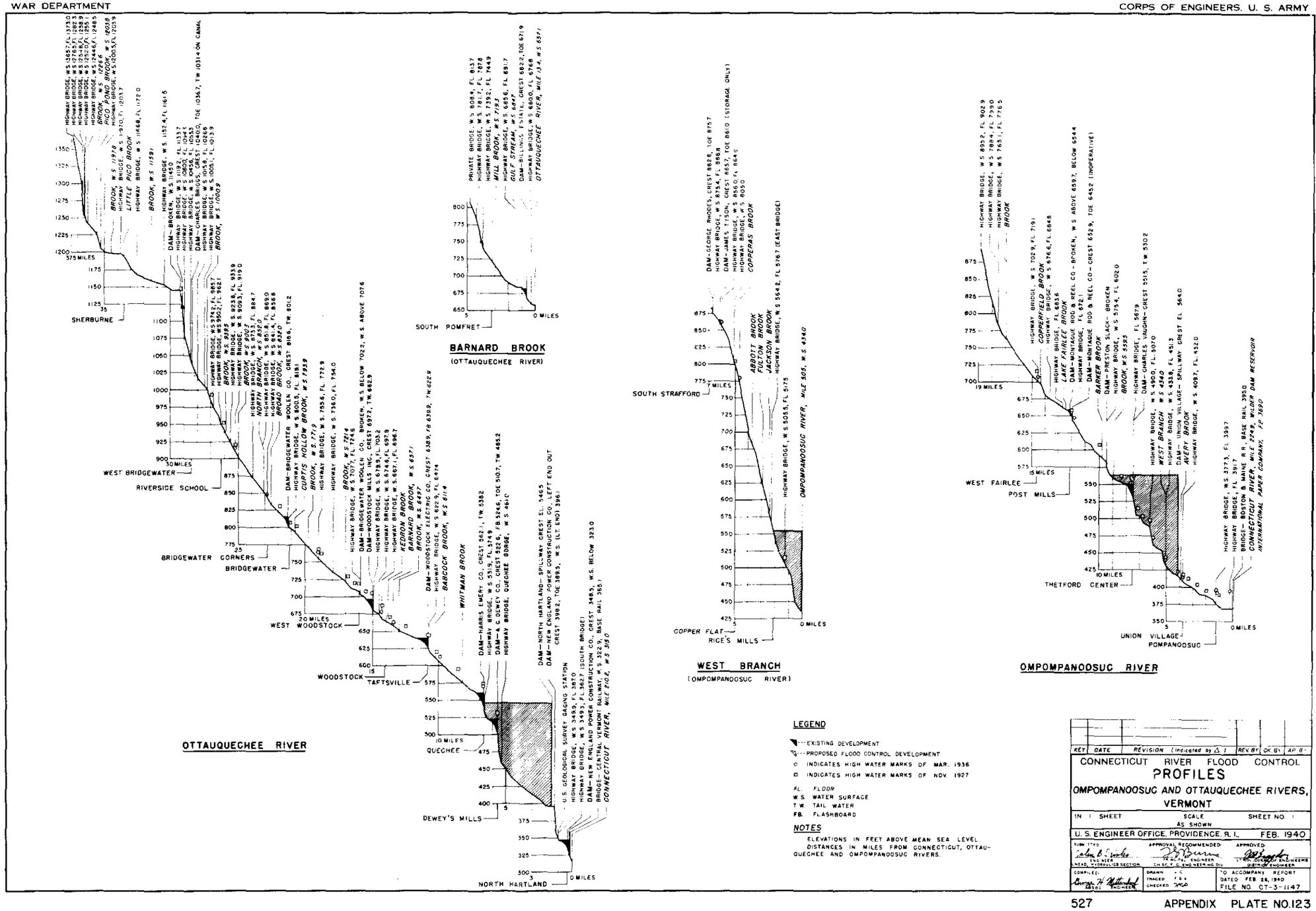
VERMONT

IN 1 SHEET — SCALE AS SHOWN — SHEET NO. 1

U. S. ENGINEER OFFICE, PROVIDENCE, R. I. — FEB. 1940

SUBMITTED: Walter B. Drisko, ENGINEER, WAR DEPARTMENT, WATERWAYS SECTION
APPROVAL RECOMMENDED: J. N. Durrwachter, MUNICIPAL ENGINEER, CHIEF, F. C. ENGINEERING DIV.
APPROVED: Lt. Col. Corps of Engineers, DISTRICT ENGINEER

COMPILED: George H. Matthews, ASSOC. ENGINEER
DRAWN: J.C. TRACED: E.R.M. CHECKED: J.N.D.
TO ACCOMPANY REPORT DATED: FEB. 28, 1940
FILE NO. CT-3-1152



LEGEND

- EXISTING DEVELOPMENT
- PROPOSED FLOOD CONTROL DEVELOPMENT
- ○ INDICATES HIGH WATER MARKS OF MAR. 1936
- □ INDICATES HIGH WATER MARKS OF NOV. 1927

FL. FLOOR
W.S. WATER SURFACE
T.W. TAIL WATER
FB. FLASHBOARD

NOTES

ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL.
DISTANCES IN MILES FROM CONNECTICUT, OTTAUQUECHEE AND OMPOMPANOOSUC RIVERS.

KEY	DATE	REVISION (indicated by △)	REV. BY	CK. BY	AP. BY

CONNECTICUT RIVER FLOOD CONTROL

PROFILES

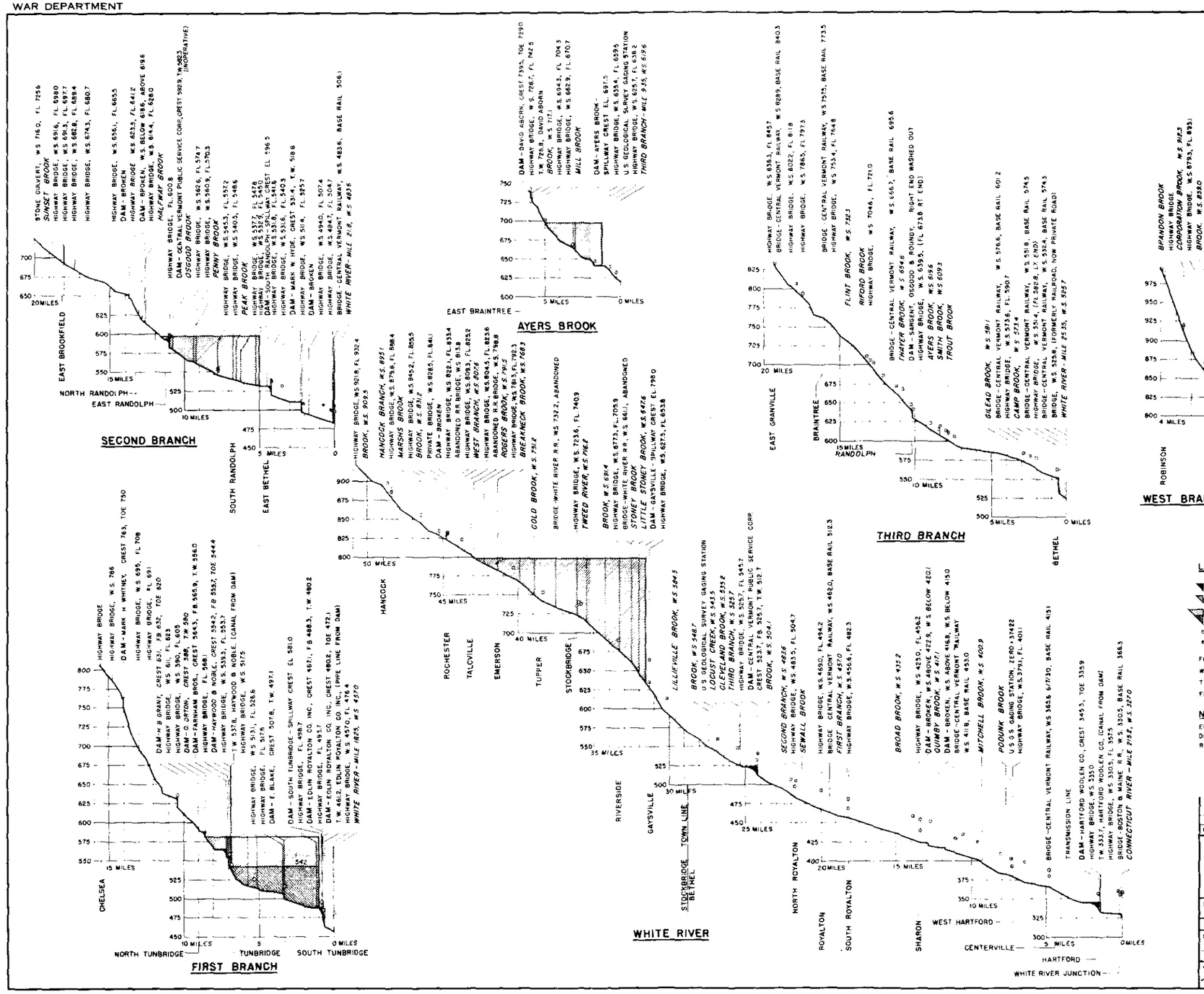
OMPOMPANOOSUC AND OTTAUQUECHEE RIVERS, VERMONT

IN 1 SHEET — SCALE AS SHOWN — SHEET NO. 1

U. S. ENGINEER OFFICE, PROVIDENCE, R. I., FEB. 1940

SUBMITTED: ENGINEER, HEAD, HYDRAULICS SECTION — APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, F. C. ENGINEERING DIV. — APPROVED: LT. COL. CORPS OF ENGINEERS, DISTRICT ENGINEER

COMPILED: ASSOC. ENGINEER — DRAWN: TRACED: CHECKED: — TO ACCOMPANY REPORT DATED FEB. 26, 1940 FILE NO. CT-3-1147



LEGEND

- EXISTING DEVELOPMENT
- PROPOSED FLOOD CONTROL DEVELOPMENT
- PROPOSED FLOOD CONTROL DEVELOPMENT
- PROPOSED CONSERVATION STORAGE FOR POWER
- INDICATES HIGH WATER MARKS OF MARCH 1936
- INDICATES HIGH WATER MARKS OF NOVEMBER 1927

FL = FLOOR
W.S. = WATER SURFACE
T.W. = TAIL WATER
FB. = FLASHBOARD

NOTES

ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL.
DISTANCES IN MILES FROM CONNECTICUT AND WHITE RIVERS.

KEY	DATE	REVISION (Indicated by △)	PLATE	CHART

CONNECTICUT RIVER FLOOD CONTRO

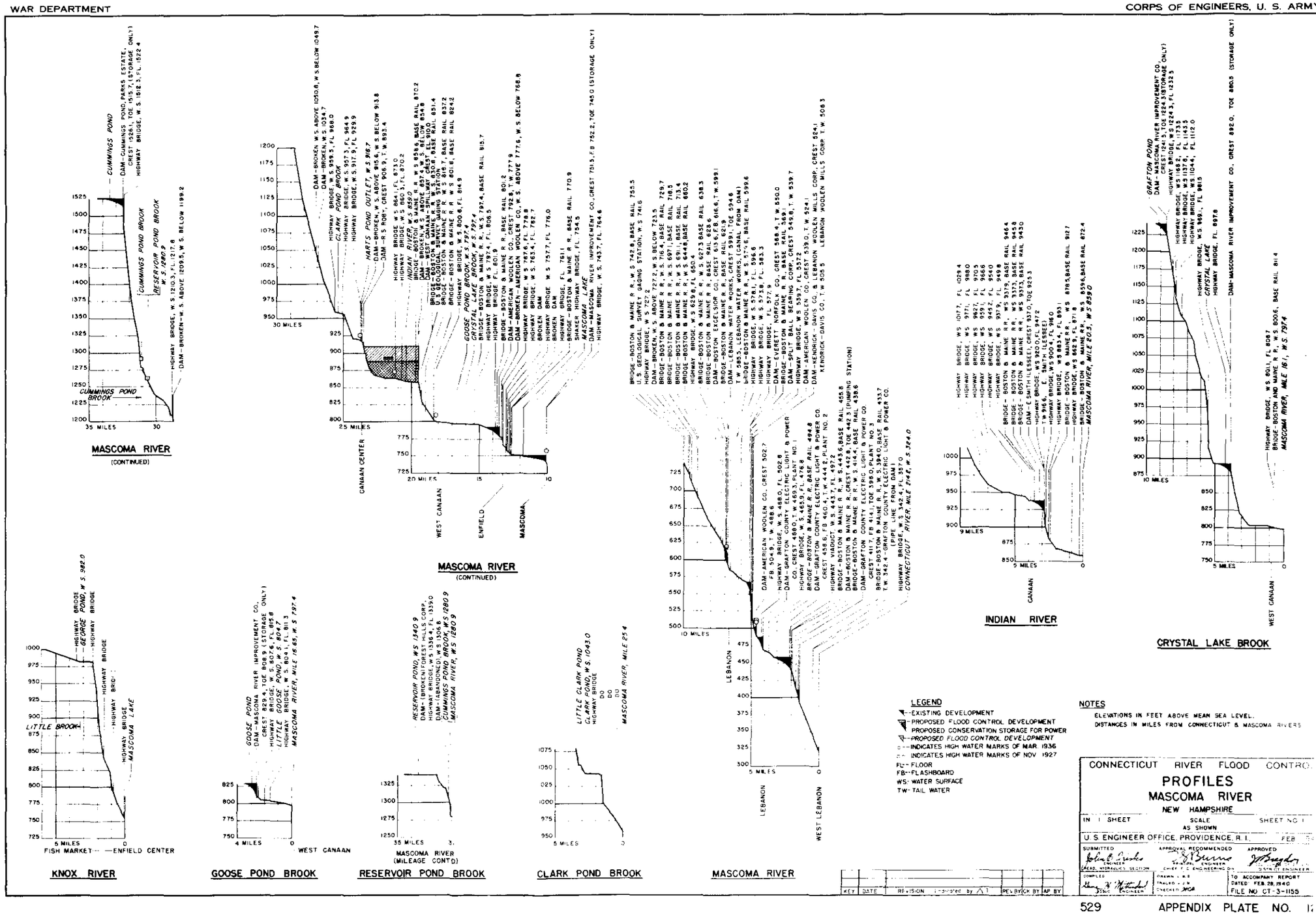
PROFILES
WHITE RIVER
VERMONT

IN 1 SHEET — SCALES AS SHOWN — SHEET NO

U. S. ENGINEER OFFICE, PROVIDENCE, R. I., FEB. 194

SUBMITTED: ENGINEER, HEAD, HYDRAULICS SECTION — APPROVAL RECOMMENDED: PRINCIPAL ENGINEER, CHIEF, F. C. ENGINEERING DIV. — APPROVED: CORPS OF ENGINEERS, DISTRICT ENGINEER

COMPILED: ASSOC. ENGINEER — DRAWN: HCD — TRACED: D.L.B. — CHECKED: D.C.D. — TO ACCOMPANY REPORT DATED FEB. 28, 1940 FILE NO. CT-3-1148



LEGEND

- EXISTING DEVELOPMENT
- PROPOSED FLOOD CONTROL DEVELOPMENT
- PROPOSED CONSERVATION STORAGE FOR POWER
- PROPOSED FLOOD CONTROL DEVELOPMENT
- INDICATES HIGH WATER MARKS OF MAR. 1936
- INDICATES HIGH WATER MARKS OF NOV. 1927

FL - FLOOR
FB - FLASHBOARD
WS - WATER SURFACE
TW - TAIL WATER

NOTES

ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL.
DISTANCES IN MILES FROM CONNECTICUT & MASCOMA RIVERS

KEY	DATE	REVISION	REVISED BY	REV BY	CK BY	AP BY

CONNECTICUT RIVER FLOOD CONTROL

PROFILES

MASCOMA RIVER

NEW HAMPSHIRE

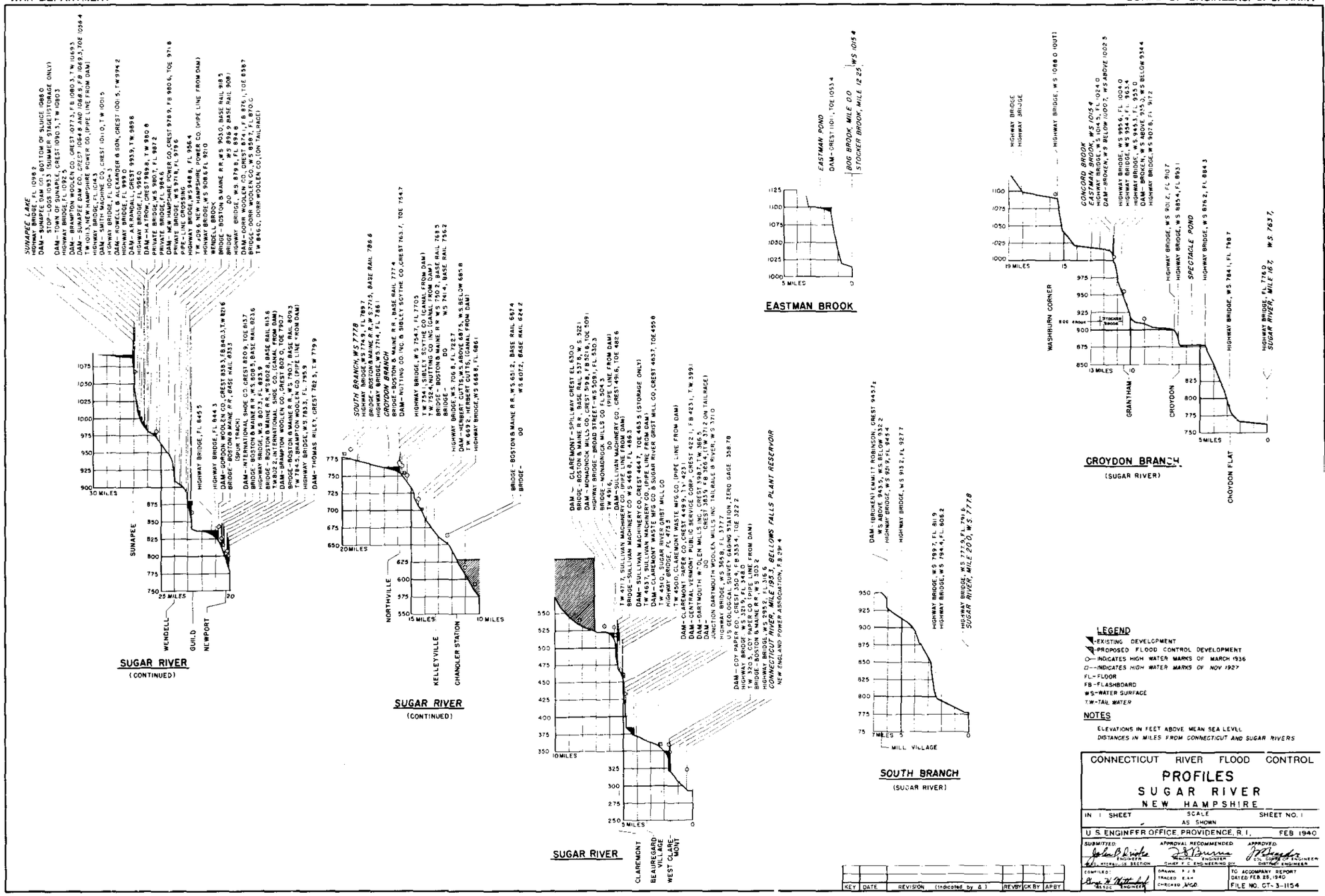
IN 1 SHEET — SCALE AS SHOWN — SHEET NO 1

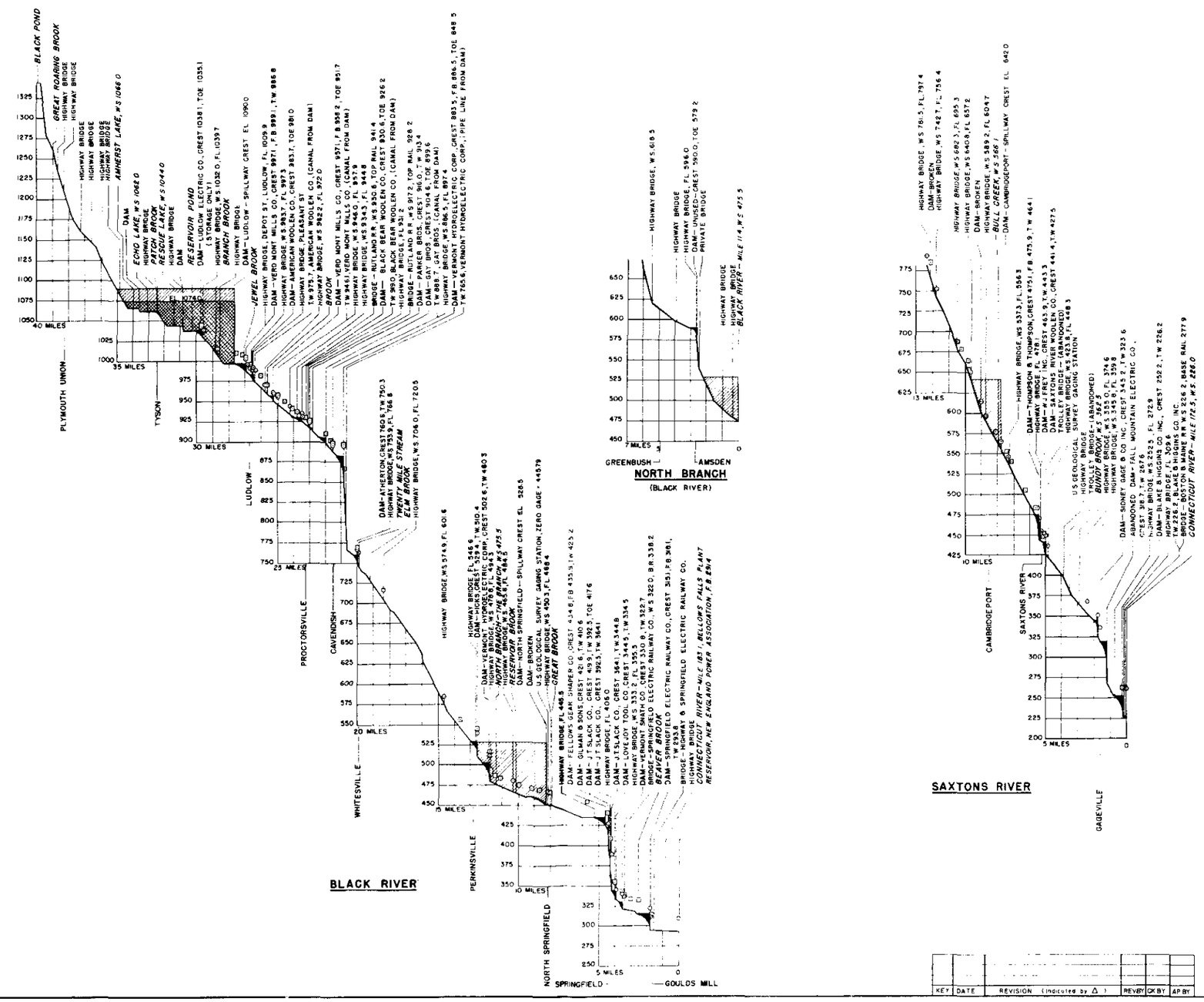
U.S. ENGINEER OFFICE, PROVIDENCE, R.I. — FEB

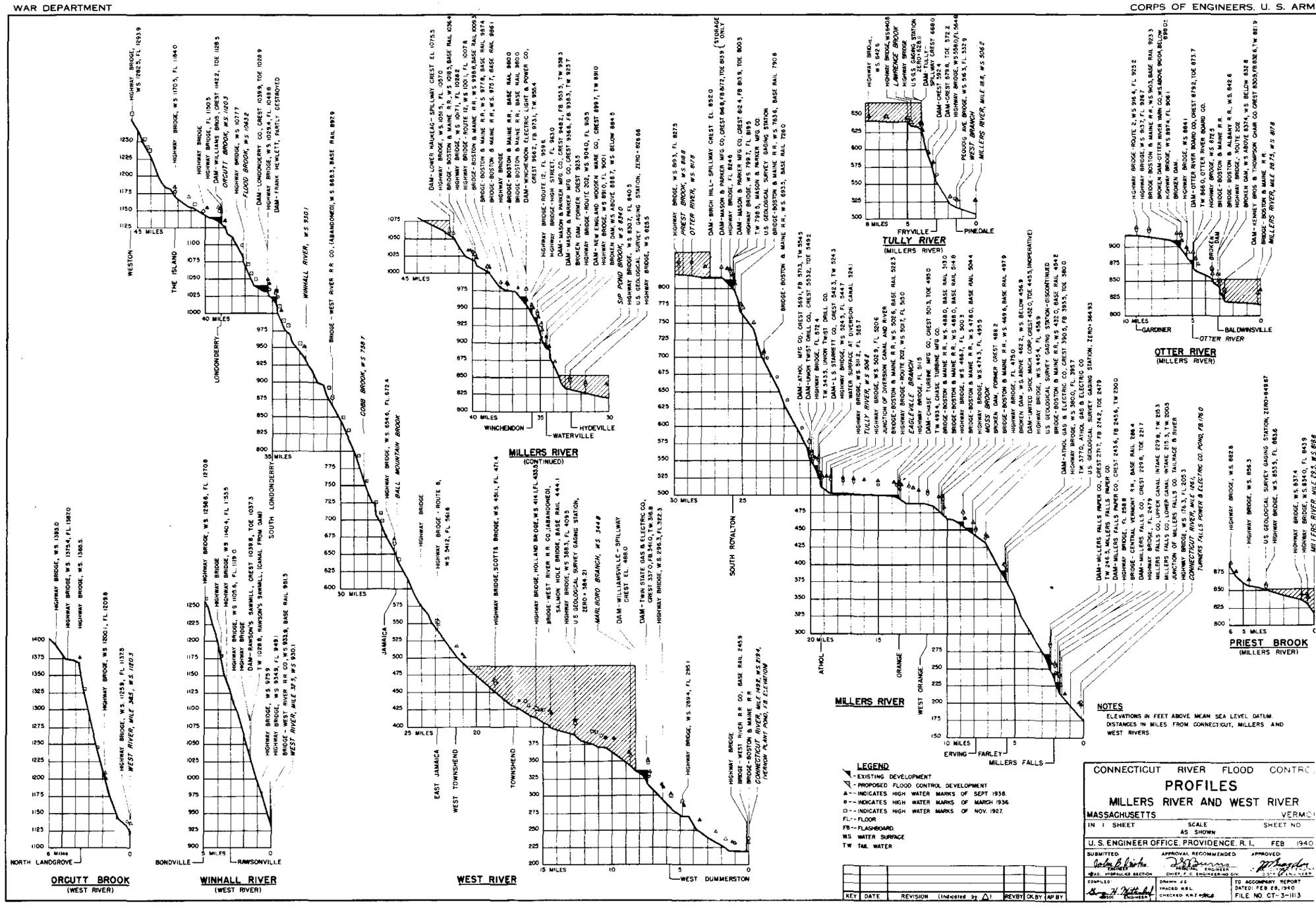
SUBMITTED: John E. Cooke, ENGINEER, HEAD, HYDRAULICS SECTION
APPROVAL RECOMMENDED: Sa. Burns, SR. CIVIL ENGINEER, CHIEF, F.C. ENGINEERING DIV.
APPROVED: W. Brugler, COLONEL, CORPS OF ENGINEERS, DISTRICT ENGINEER

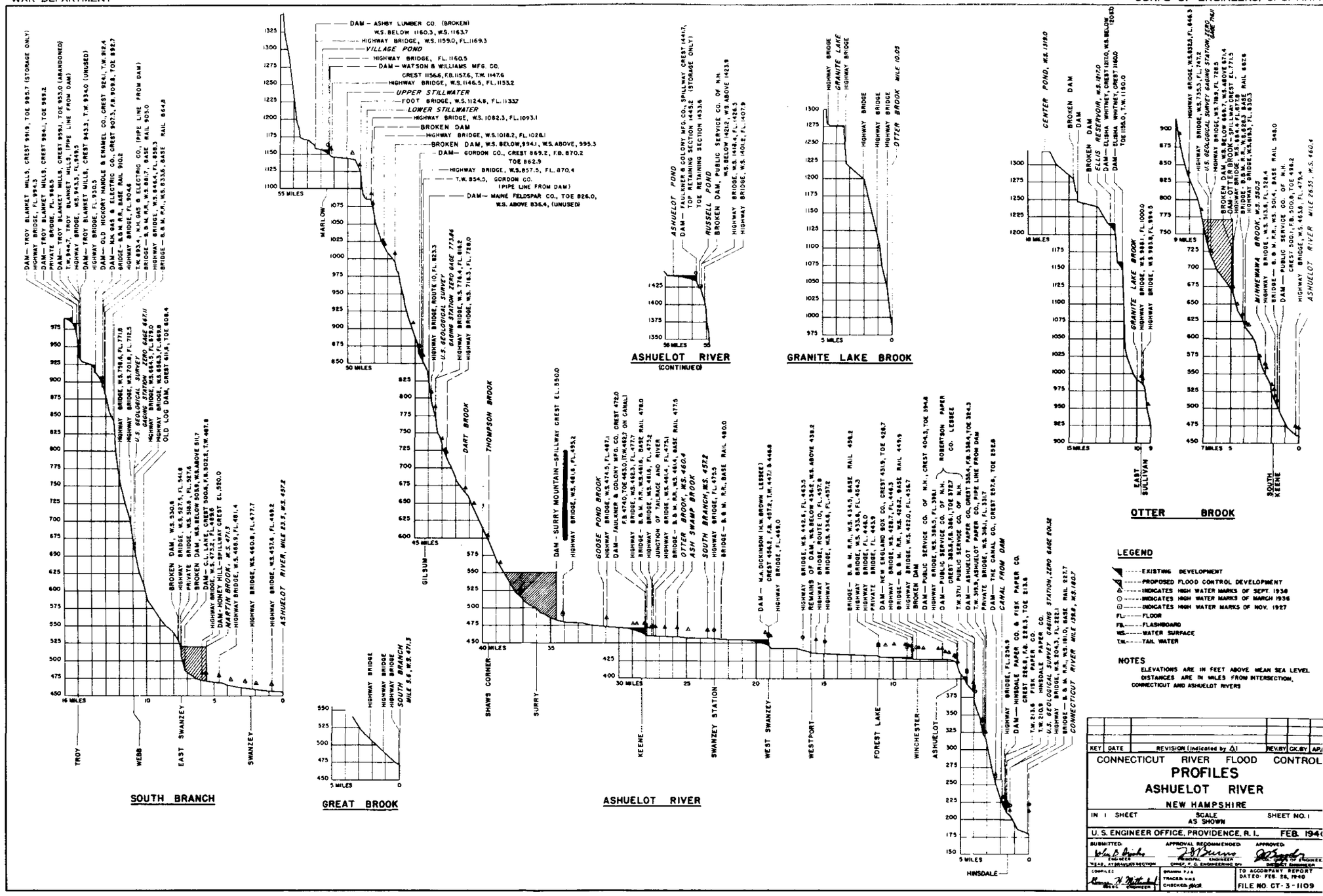
COMPILED: Henry F. Mitchell, ENGINEER
DRAWN: J.B.B.
TRACED: J.M.
CHECKED: MCG

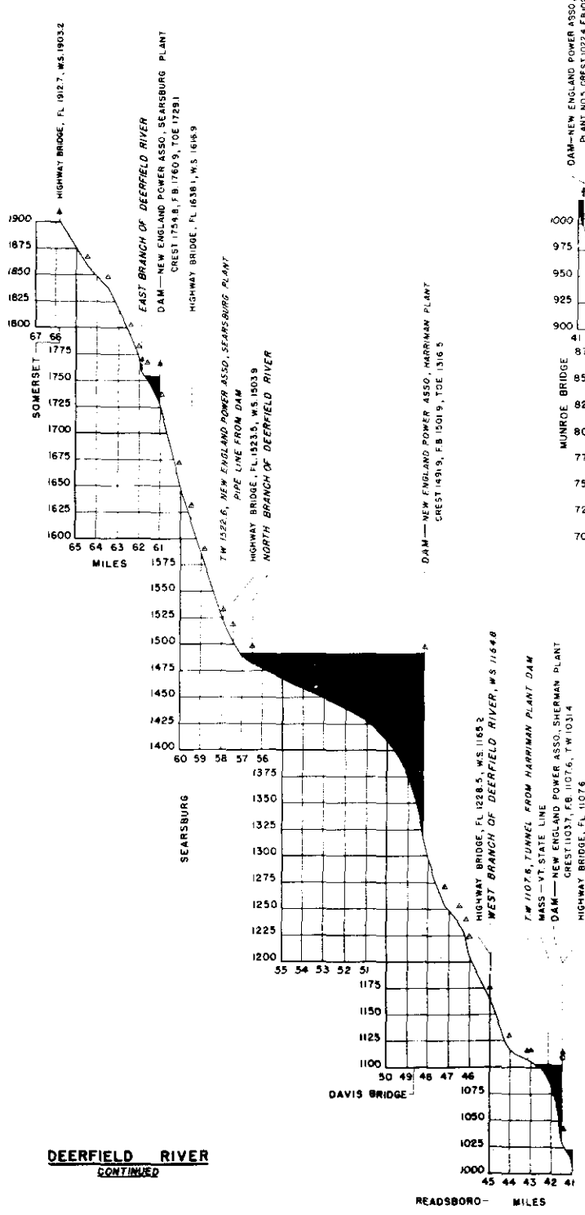
TO ACCOMPANY REPORT DATED FEB 28, 1940
FILE NO CT-3-1155


SUNAPEE
WENDELL
GUILD
NEWPORT
SUGAR RIVER
(CONTINUED)
NORTHVILLE
KELLEYVILLE
CHANDLER STATION
SUGAR RIVER
(CONTINUED)
CLAREMONT
BEAURIGARD VILLAGE
WEST CLAREMONT
SUGAR RIVER
EASTMAN BROOK
GRANTHAM
WASHURN CORNER
CROYDON
CROYDON FLAT
CROYDON BRANCH
(SUGAR RIVER)
MILL VILLAGE
SOUTH BRANCH
(SUGAR RIVER)
LEGEND
EXISTING DEVELOPMENT
PROPOSED FLOOD CONTROL DEVELOPMENT
INDICATES HIGH WATER MARKS OF MARCH 1936
INDICATES HIGH WATER MARKS OF NOV 1927
FL-FLOOR
FB-FLASHBOARD
WS-WATER SURFACE
T.W.-TAIL WATER
NOTES
ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL
DISTANCES IN MILES FROM CONNECTICUT AND SUGAR RIVERS
CONNECTICUT RIVER FLOOD CONTROL
PROFILES
SUGAR RIVER
NEW HAMPSHIRE
IN 1 SHEET
SCALE AS SHOWN
SHEET NO. 1
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.
FEB 1940
SUBMITTED:
APPROVAL RECOMMENDED:
APPROVED:
KEY
DATE
REVISION (indicated by δ)
REV BY
CK BY
APBY

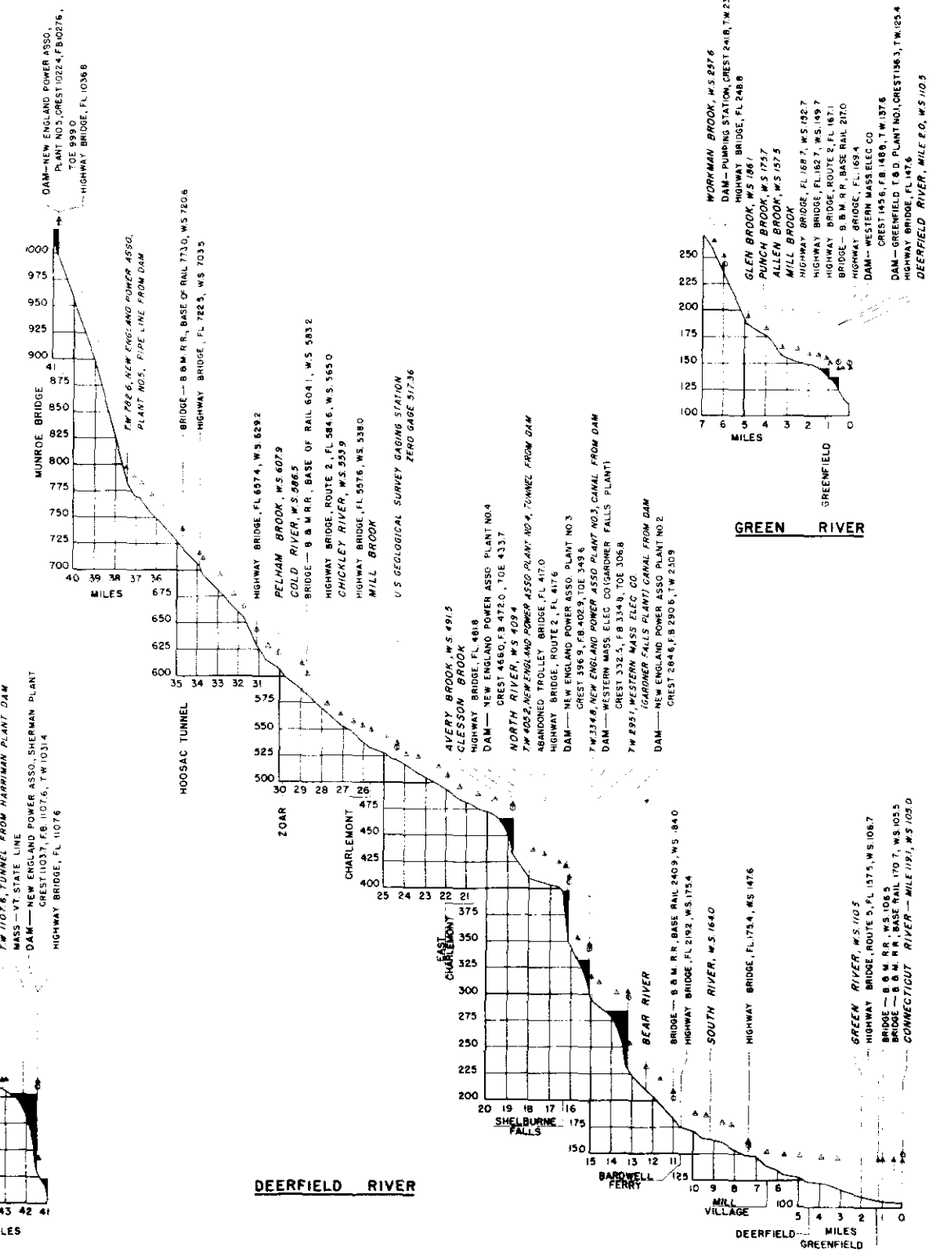

BLACK RIVER
SAXTONS RIVER
NORTH BRANCH
(BLACK RIVER)
PLYMOUTH UNION
TYSON
LUDLOW
PROCTORSVILLE
CAVENDISH
WHITESVILLE
PERKINSVILLE
NORTH SPRINGFIELD
SPRINGFIELD
GOULDS MILL
GREENBUSH
AMSDEN
CAMBRIDGEPORT
SAXTONS RIVER
GAGEVILLE
BLACK POND
GREAT ROARING BROOK
AMHERST LAKE, WS 1066.0
ECHO LAKE, WS 1062.0
RESERVOIR POND
JEWEL BROOK
BRANCH BROOK
BROOK
BEAVER BROOK
BULL CREEK, WS 566.1
BLACK RIVER—MILE 114, WS 473.5
CONNECTICUT RIVER—MILE 172.5, WS 226.0
LEGEND
EXISTING DEVELOPMENT
PROPOSED FLOOD CONTROL DEVELOPMENT
PROPOSED CONSERVATION STORAGE FOR POWER
PROPOSED FLOOD CONTROL DEVELOPMENT
INDICATES HIGH WATER MARKS OF MAR 1936
INDICATES HIGH WATER MARKS OF NOV. 1927
FL--FLOOR
WS--WATER SURFACE
TW--TAIL WATER
NOTES
ELEVATION IN FEET ABOVE MEAN SEA LEVEL
DISTANCES IN MILES FROM CONNECTICUT AND BLACK RIVERS
CONNECTICUT RIVER FLOOD CONTROL
PROFILES
BLACK RIVER AND SAXTONS RIVER
VERMONT
IN 1 SHEET
SCALE AS SHOWN
SHEET NO. 1
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.
FEB. 1940
SUBMITTED
APPROVAL RECOMMENDED:
APPROVED:
HEAD, HYDRAULICS SECTION
CHIEF, R. C. ENGINEERING DIV.
DISTRICT ENGINEER
COMPILED
DRAWN
TRACED
CHECKED
TO ACCOMPANY REPORT
DATED FEB. 28, 1940
FILE NO. CT-3-1140
KEY
DATE
REVISION (Indicated by Δ)
REV BY
CK BY
AP BY


ORCUTT BROOK
(WEST RIVER)
WINHALL RIVER
(WEST RIVER)
WEST RIVER
MILLERS RIVER
(CONTINUED)
MILLERS RIVER
TULLY RIVER
(MILLERS RIVER)
OTTER RIVER
(MILLERS RIVER)
PRIEST BROOK
(MILLERS RIVER)
NOTES
ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL DATUM.
DISTANCES IN MILES FROM CONNECTICUT, MILLERS AND WEST RIVERS.
LEGEND
EXISTING DEVELOPMENT
PROPOSED FLOOD CONTROL DEVELOPMENT
INDICATES HIGH WATER MARKS OF SEPT 1938.
INDICATES HIGH WATER MARKS OF MARCH 1936.
INDICATES HIGH WATER MARKS OF NOV. 1927.
FL - FLOOR
FB - FLASHBOARD
WS - WATER SURFACE
TW TAIL WATER
KEY DATE REVISION (Indicated by △) REV BY OK BY AP BY
CONNECTICUT RIVER FLOOD CONTRO
PROFILES
MILLERS RIVER AND WEST RIVER
MASSACHUSETTS VERMO
IN 1 SHEET
SCALE AS SHOWN
SHEET NO
U. S. ENGINEER OFFICE, PROVIDENCE, R. I., FEB 1940
SUBMITTED
APPROVAL RECOMMENDED
APPROVED
COMPILED
DRAWN J.S.
TRACED H.B.L.
CHECKED K.M.J.
TO ACCOMPANY REPORT DATED: FEB 28, 1940
FILE NO. CT-3-1113


SOUTH BRANCH
GREAT BROOK
ASHUELOT RIVER
(CONTINUED)
GRANITE LAKE BROOK
OTTER BROOK
LEGEND
EXISTING DEVELOPMENT
PROPOSED FLOOD CONTROL DEVELOPMENT
INDICATES HIGH WATER MARKS OF SEPT. 1938
INDICATES HIGH WATER MARKS OF MARCH 1936
INDICATES HIGH WATER MARKS OF NOV. 1927
FL.—FLOOR
FB.—FLASHBOARD
WS.—WATER SURFACE
T.W.—TAIL WATER
NOTES
ELEVATIONS ARE IN FEET ABOVE MEAN SEA LEVEL
DISTANCES ARE IN MILES FROM INTERSECTION, CONNECTICUT AND ASHUELOT RIVERS
KEY
DATE
REVISION (Indicated by Δ)
REV. BY
CK. BY
CONNECTICUT RIVER FLOOD CONTROL
PROFILES
ASHUELOT RIVER
NEW HAMPSHIRE
SCALE AS SHOWN
SHEET NO. 1
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.
FEB. 1940
SUBMITTED
APPROVAL RECOMMENDED
APPROVED
FILE NO. CT-3-1109



DEERFIELD RIVER
CONTINUED



LEGEND

- EXISTING DEVELOPMENT
- PROPOSED FLOOD CONTROL DEVELOPMENT
- △ INDICATES HIGH WATER MARKS OF SEPT 1938
- ○ INDICATES HIGH WATER MARKS OF MARCH 1936
- FL FLOOR
- FB FLASHBOARD
- W.S. WATER SURFACE
- T.W. TAIL WATER

NOTES

ELEVATIONS ARE IN FEET ABOVE MEAN SEA LEVEL
DISTANCES IN MILES FROM CONNECTICUT AND DEERFIELD RIVERS.

KEY	DATE	REVISION (Indicated by △)	REV BY	CK BY	AP BY

CONNECTICUT RIVER FLOOD CONTROL

PROFILES
DEERFIELD RIVER

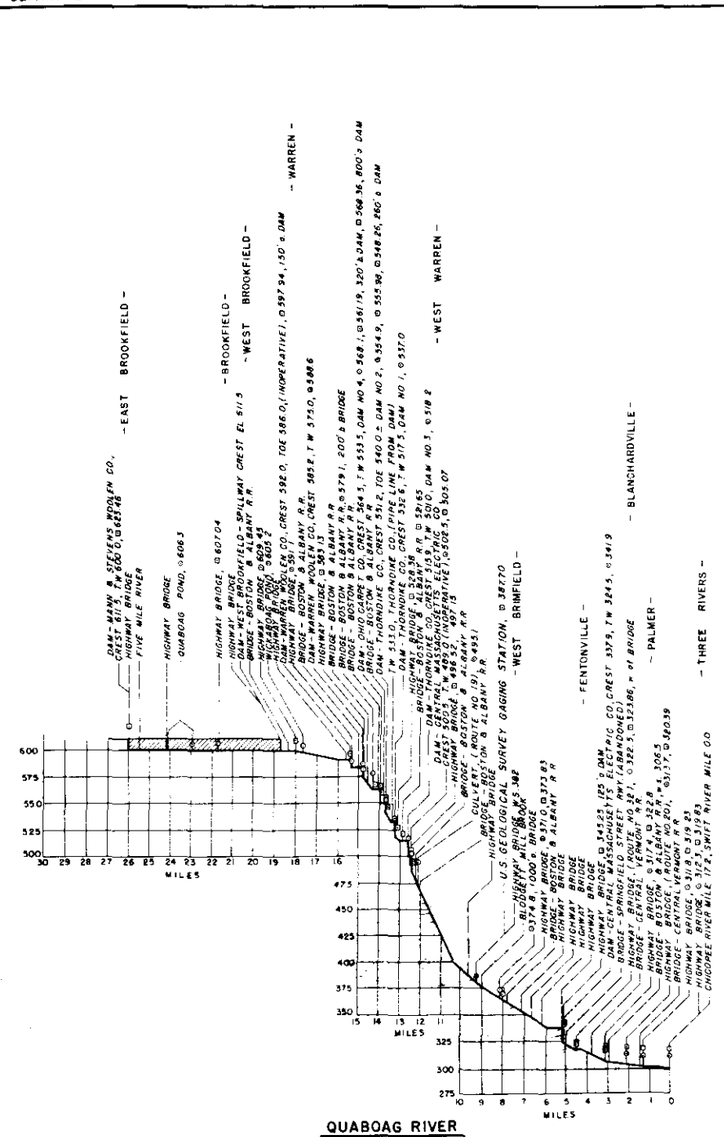
MASSACHUSETTS — VERMONT

IN 1 SHEET	SCALE AS SHOWN	SHEET NO. 1

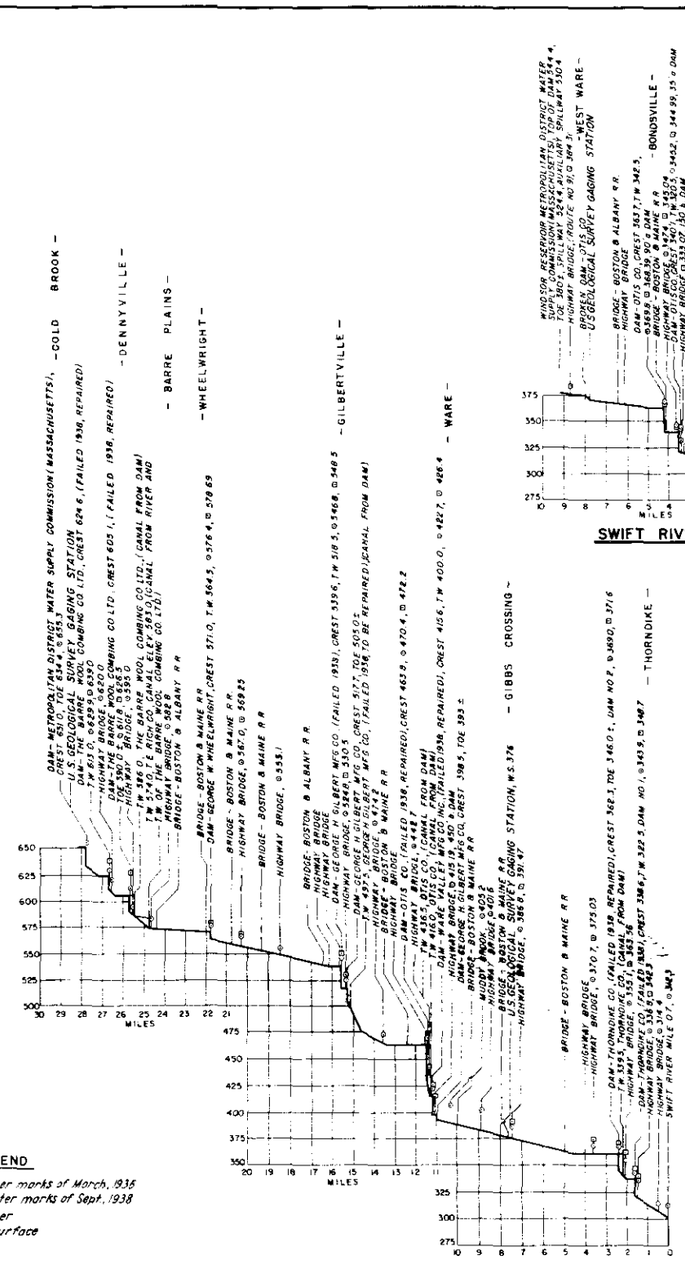
U. S. ENGINEER OFFICE, PROVIDENCE, R. I., FEB. 194

SUBMITTED	APPROVAL RECOMMENDED	APPROVED
ENGINEER, HEAD HYDRAULIC DESIGN SECTION	PRINCIPAL ENGINEER, CHIEF F.C. ENGINEERING DIV.	DISTRICT ENGINEER

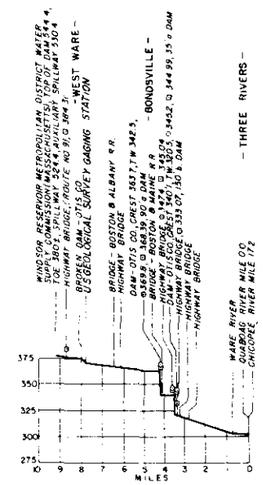
COMPILED	DRAWN	TO ACCOMPANY REPORT
STAFF ENGINEER	TRACED VMS	DATED FEB. 28, 1940
	CHECKED	FILE NO. CT-3-1114



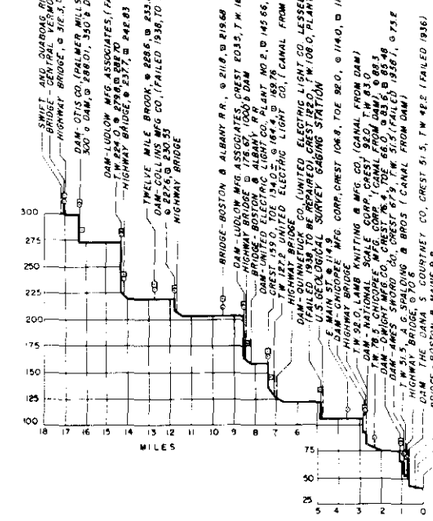
QUABOAG RIVER



WARE RIVER



SWIFT RIVER



CHICOPEE RIVER

LEGEND

- High water marks of March, 1936
- High water marks of Sept., 1938
- TW Tail water
- W.S. Water surface
- a above
- b. below
- Proposed flood control developement

NOTES

Elevations in feet above Mean Sea Level.

Data taken principally from report of the Commission on Waterways and Public Lands, 1918, Commonwealth of Massachusetts.

Distances in miles from mouth of river.

High water marks of March, 1936, taken from the report of the Massachusetts Geodetic Survey on High Water Data - Flood of March, 1936.

High Water Marks of Sept. 1938, taken from field by United States Engineer Survey.

KEY	DATE	REVISION (indicated by △)	REV BY	CK BY	APBY

CONNECTICUT RIVER FLOOD CONTROL

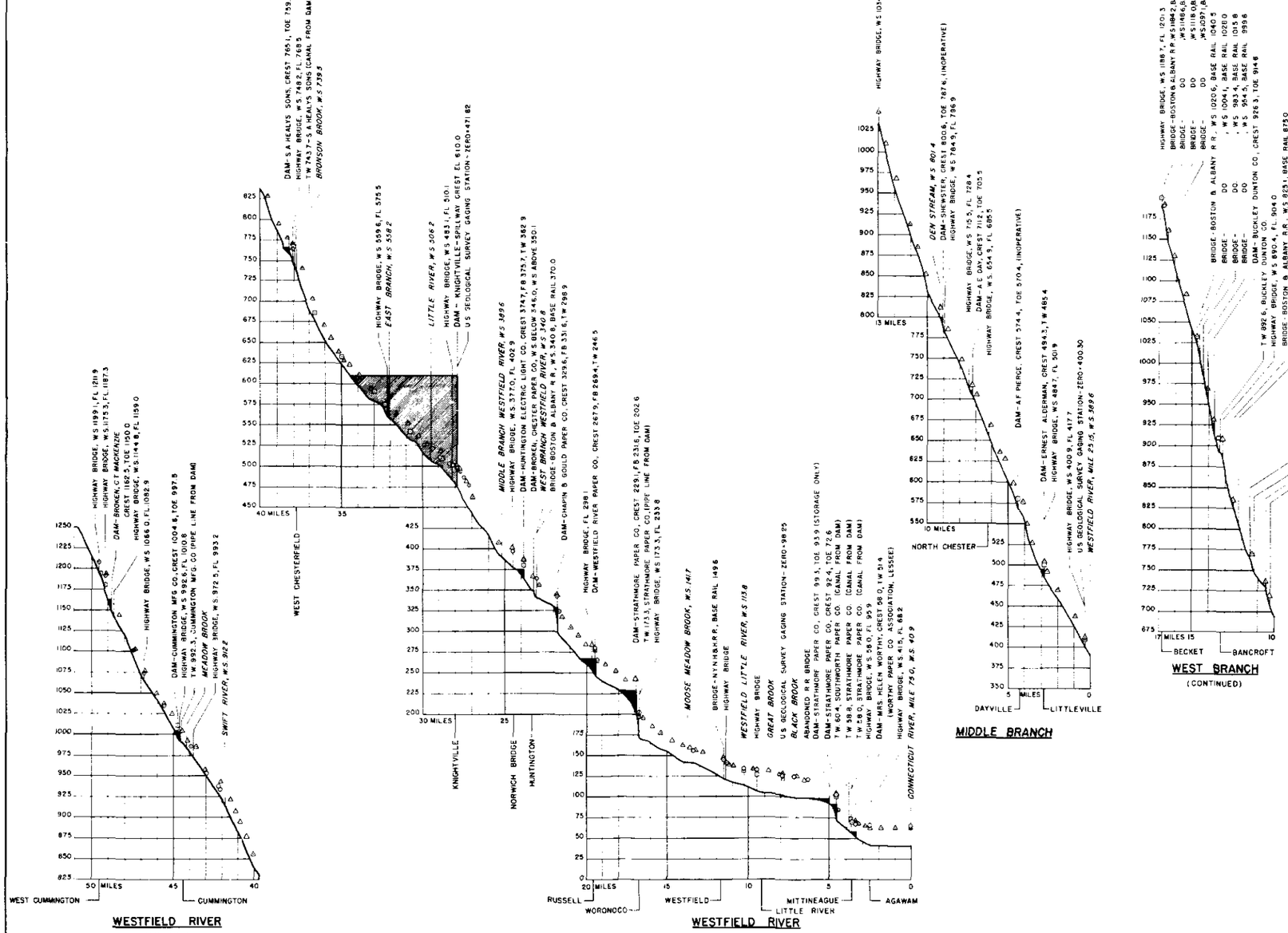
PROFILES
CHICOPEE RIVER
MASSACHUSETTS

IN 1 SHEET — SCALE AS SHOWN — SHEET NO 1

U.S. ENGINEER OFFICE, PROVIDENCE, R.I., FEB., 1940

SUBMITTED: John B. Drake, ENGINEER, HEAD HYDRAULICS SECTION — APPROVAL RECOMMENDED: [signature], PRINCIPAL ENGINEER, CHIEF F.C. ENGINEERING DIV. — APPROVED: [signature], LT. COL. CORPS OF ENGINEERS, DISTRICT ENGINEER

COMPILED: [signature], ASSOC. ENGINEER — DRAWN H.C.D. TRACED: R.F.B. CHECKED: [illegible] — TO ACCOMPANY REPORT DATED FEB. 28, 1940 — FILE NO. CT-3-1-60



LEGEND

- EXISTING DEVELOPMENT
- PROPOSED FLOOD CONTROL DEVELOPMENT
- △--INDICATES HIGH WATER MARKS OF SEPT 1938
- ⊖--INDICATES HIGH WATER MARKS OF MARCH 1936
- □--INDICATES HIGH WATER MARKS OF NOV 1927
- FL-FLOOR
- FB-FLASHBOARD
- W.S-WATER SURFACE
- T.W-TAIL WATER

NOTES

ELEVATIONS IN FEET ABOVE MEAN SEA LEVEL DATUM.
DISTANCES IN MILES FROM CONNECTICUT RIVER

KEY	DATE	REVISION (Indicated by △)	REV BY	CK BY	AP BY

CONNECTICUT RIVER FLOOD CONTROL

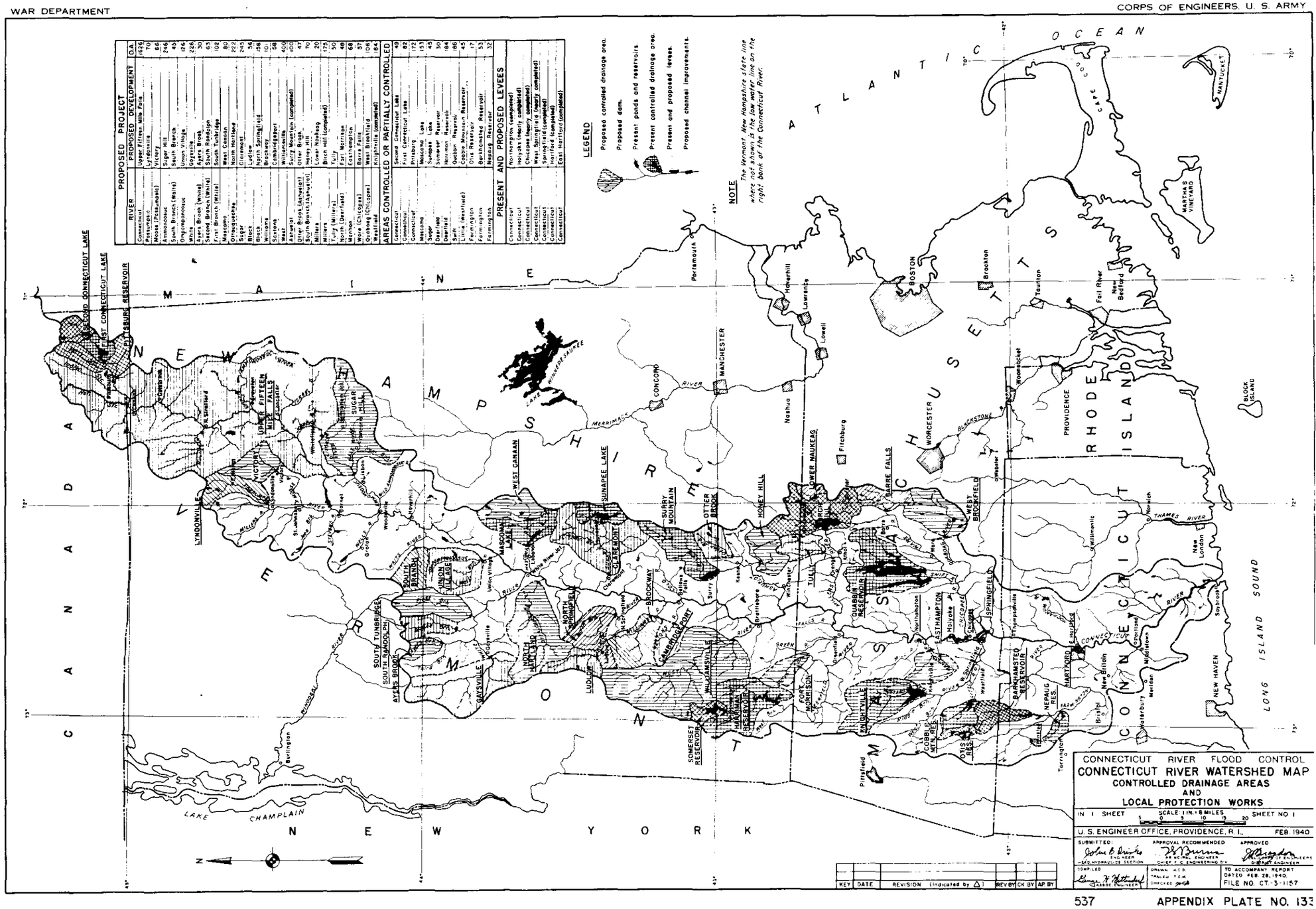
PROFILES
WESTFIELD RIVER
MASSACHUSETTS

IN 1 SHEET — SCALE AS SHOWN — SHEET NO. 1

U. S. ENGINEER OFFICE, PROVIDENCE, R. I. — FEB 1940

SUBMITTED: John B. Drisko, ENGINEER, HYDRAULICS SECTION — APPROVAL RECOMMENDED: F. M. Burns, PRINCIPAL ENGINEER, CHIEF F. C. ENGINEERING DIV. — APPROVED: [signature], COLONEL OF ENGINEERS, DISTRICT ENGINEER

COMPILED: [signature], ASSOC. ENGINEER — DRAWN JC, TRACED H.G.L., CHECKED HCB — TO ACCOMPANY REPORT DATED: FEB. 28, 1940 — FILE NO. CT-3-1107


CONNECTICUT RIVER FLOOD CONTROL
CONNECTICUT RIVER WATERSHED MAP
CONTROLLED DRAINAGE AREAS
AND
LOCAL PROTECTION WORKS
IN 1 SHEET
SCALE: 1 IN. = 8 MILES
SHEET NO 1
U. S. ENGINEER OFFICE, PROVIDENCE, R. I.
FEB. 1940
SUBMITTED:
APPROVAL RECOMMENDED
APPROVED
COMPILED
DRAWN
TRACED
CHECKED
TO ACCOMPANY REPORT
DATED FEB. 28, 1940.
FILE NO. CT-3-1157
KEY
DATE
REVISION (Indicated by △)
REV BY
CK BY
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LEGEND
Proposed controlled drainage area.
Proposed dam.
Present ponds and reservoirs.
Present controlled drainage area.
Present and proposed levees.
Proposed channel improvements.
NOTE
The Vermont, New Hampshire state line where not shown is the low water line on the right bank of the Connecticut River.
PROPOSED PROJECT
RIVER
PROPOSED DEVELOPMENT
D.A.
Connecticut — Upper Fifteen Mile Falls — 1626
Passumpsic — Lyndonville — 70
Moose (Passumpsic) — Victory — 86
Ammonoosuc — Sugar Hill — 246
Wells (Branch) (Wells) — South Ryegate — 46
Ompompanoosuc — Union Village — 226
White — Gaysville — 726
Ayers Brook (White) — Ayers Brook — 30
Second Branch (White) — South Randolph — 63
First Branch (White) — South Tunbridge — 102
Mascoma — West Canaan — 80
Ottauquechee — North Hartland — 222
Sugar — Claremont — 245
Black — Ludlow — 56
Black — North Springfield — 108
Williams — Brockway — 100
Saxtons — Cambridgeport — 56
West — Williamsville — 406
Ashuelot — Surry Mountain (completed) — 100
Otter Brook (Ashuelot) — Otter Brook — 47
South Branch (Ashuelot) — Honey Hill — 70
Millers — Lower Naukeag — 20
Millers — Birch Hill (completed) — 175
Tully (Millers) — Tully — 50
North (Deerfield) — Fort Morrison — 48
Deerfield — East Hawley — 66
West (Chicopee) — Barre Falls — 57
Quaboag (Chicopee) — West Brookfield — 106
Westfield — Knightville (completed) — 164
AREAS CONTROLLED OR PARTIALLY CONTROLLED
Connecticut — Second Connecticut Lake — 49
Connecticut — First Connecticut Lake — 82
Connecticut — Pittsburg — 172
Mascoma — Mascoma Lake — 153
Sugar — Sunapee Lake — 45
Deerfield — Somerset Reservoir — 30
Deerfield — Hermon Reservoir — 184
Swift — Quabbin Reservoir — 186
Little (Westfield) — Cobble Mountain Reservoir — 45
Farmington — Otis Reservoir — 17
Farmington — Barkhamsted Reservoir — 353
Farmington — Nepaug Reservoir — 132
PRESENT AND PROPOSED LEVEES
Connecticut — Northampton (completed)
Connecticut — Holyoke (nearly completed)
Connecticut — Chicopee (nearly completed)
Connecticut — West Springfield (nearly completed)
Connecticut — Springfield (completed)
Connecticut — Hartford (completed)
Connecticut — East Hartford (completed)
CANADA
NEW HAMPSHIRE
VERMONT
MASSACHUSETTS
CONNECTICUT
RHODE ISLAND
NEW YORK
ATLANTIC OCEAN
COD, CAPE
MARTHA'S VINEYARD
NANTUCKET
BLOCK ISLAND
LONG ISLAND SOUND
LAKE CHAMPLAIN
LAKE WINNIPESAUKEE
SECOND CONNECTICUT LAKE
FIRST CONNECTICUT LAKE
PITTSBURG RESERVOIR
UPPER FIFTEEN MILE FALLS
SUGAR HILL
LYNDONVILLE
VICTORY
WEST CANAAN
SUNAPEE LAKE
CLAREMONT
SURRY MOUNTAIN
OTTER BROOK
HONEY HILL
LOWER NAUKEAG
BARRE FALLS
WEST BROOKFIELD
SOUTH TUNBRIDGE
SOUTH RANDOLPH
AYERS BROOK
GAYSVILLE
MASCOMA LAKE
UNION VILLAGE
NORTH HARTLAND
NORTH SPRINGFIELD
BROOKWAY
CAMBRIDGEPORT
LUDLOW
WILLIAMSVILLE
HAWKMAN RESERVOIR
SOMERSET RESERVOIR
FORT MORRISON
TULLY
KNIGHTVILLE
QUABBIN RESERVOIR
EASTHAMPTON
SPRINGFIELD
BARKHAMSTED RESERVOIR
NEPAUG RES.
HARTFORD
COBBLE MTN. RES.
OTIS RES.
Burlington
Portsmouth
Hebronville
Lawrence
Lowell
Nashua
Fitchburg
MANCHESTER
CONCORD
BOSTON
Brockton
Taunton
Fall River
New Bedford
WORCESTER
Woonsocket
PROVIDENCE
Pittsfield
Torrington
Bristol
New Britain
Middletown
Meriden
Waterbury
Ansonia
Derby
Shelton
Stratford
Bridgeport
Stamford
Norwalk
New Haven
New London
Norwich
Stonington
Westerly
Saybrook
Hartford
Springfield
Holyoke
Chicopee
Northampton
Greenfield
Gardner
Leominster
Fitchburg
Nashua
Manchester
Concord
Portsmouth
Burlington
Rutland
Bellows Falls
Brattleboro
Keene
Claremont
Lebanon
Hanover
Littleton
Lancaster
Berlin
Gorham
Rochester
Dover
Exeter
Hampton
Newburyport
Salem
Lynn
Boston
Brockton
Taunton
Fall River
New Bedford
Worcester
Woonsocket
Providence
Pawtucket
Newport
Block Island
Martha's Vineyard
Nantucket
Cape Cod
Atlantic Ocean
Long Island Sound
Lake Champlain
Lake Winnipesaukee
Connecticut River
Merrimack River
Nashua River
Blackstone River
Thames River
Housatonic River
Hoosic River
Deerfield River
Millers River
Ashuelot River
Sugar River
Black River
Williams River
Saxtons River
Ompompanoosuc River
Ammonoosuc River
Passumpsic River
Moose River
Wells River
Mascoma River
Ottauquechee River
Quaboag River
Chicopee River
Westfield River
Farmington River
Housatonic River
Shetucket River
Quinebaug River
Pomperaug River
Naugatuck River
Mattabassett River
Salmon River
Hockanum River
Scantic River
Farmington River
Connecticut