Form No. 10-300 (Rev. 10-74)

PH0685003

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES INVENTORY -- NOMINATION FORM

FOR NPS USE ONLY
RECEIVED SEP 25 1978
DATE ENTERED APR 9 1980
ref no 80000638

SEE INSTRUCTIONS IN *HOW TO COMPLETE NATIONAL REGISTER FORMS*
TYPE ALL ENTRIES -- COMPLETE APPLICABLE SECTIONS

1 NAME

HISTORIC: Echo Bridge

AND/OR COMMON: same

2 LOCATION

STREET & NUMBER: ~~Crossing~~ Charles River and Ellis Street (Newton) ~~from Needham to Newton Upper Falls~~ at (also in Norfolk County)
__NOT FOR PUBLICATION

CITY, TOWN: Town of Needham ~~City of Newton~~ __VICINITY OF
CONGRESSIONAL DISTRICT: 9th (Needham) 4th (Newton)

STATE: Massachusetts
CODE: 02192 (Needham) 02164 (Newton)
COUNTY: Norfolk Middlesex
CODE: 021 017

3 CLASSIFICATION

CATEGORY	OWNERSHIP	STATUS	PRESENT USE	
__DISTRICT	X PUBLIC	__OCCUPIED	__AGRICULTURE	__MUSEUM
__BUILDING(S)	__PRIVATE	X UNOCCUPIED	__COMMERCIAL	X PARK
X STRUCTURE	__BOTH	X WORK IN PROGRESS	__EDUCATIONAL	__PRIVATE RESIDENCE
__SITE	**PUBLIC ACQUISITION**	**ACCESSIBLE**	__ENTERTAINMENT	__RELIGIOUS
__OBJECT	__IN PROCESS	X YES: RESTRICTED	__GOVERNMENT	__SCIENTIFIC
	__BEING CONSIDERED	__YES: UNRESTRICTED	__INDUSTRIAL	__TRANSPORTATION
		__NO	__MILITARY	X OTHER: Scenic Access

4 OWNER OF PROPERTY

NAME: Commonwealth of Massachusetts Metropolitan District Commission

STREET & NUMBER: 20 Somerset Street

CITY, TOWN: Boston __VICINITY OF
STATE: Massachusetts, 02108

5 LOCATION OF LEGAL DESCRIPTION

COURTHOUSE, REGISTRY OF DEEDS, ETC.: Norfolk County Registry of Deeds
Middlesex County Registry of Deeds

STREET & NUMBER: 858 Washington Street
40 Thorndike Street

CITY, TOWN: Dedham
Cambridge
STATE: Massachusetts, 02026
02120

6 REPRESENTATION IN EXISTING SURVEYS

TITLE: Inventory of the Historic Assets of the Commonwealth

DATE:

__FEDERAL X STATE __COUNTY __LOCAL

DEPOSITORY FOR SURVEY RECORDS: Massachusetts Historical Commission

CITY, TOWN: Boston
STATE: Massachusetts, 02108

7 DESCRIPTION

CONDITION		CHECK ONE	CHECK ONE
__EXCELLENT	__DETERIORATED	X UNALTERED	X ORIGINAL SITE
X GOOD	__RUINS	__ALTERED	__MOVED DATE_____
__FAIR	__UNEXPOSED		

DESCRIBE THE PRESENT AND ORIGINAL (IF KNOWN) PHYSICAL APPEARANCE

Echo Bridge crosses the Charles River and Ellis Street (in Newton) from the town of Needham to the Upper Falls section of the city of Newton. It was constructed in 1876-1877 to carry a section of conduit of the Sudbury Aqueduct across the Charles River en route to the Chestnut Hill Pumping Station (potential National Register), Boston. Set in picturesque Hemlock Gorge, it now serves as a pedestrian walkway connecting two Metropolitan District Commission park areas on either side of the Charles River. This use is in addition to its original function as a conduit carrier. Still used as such?

The west side of the river rises to a steep hillside, heavily wooded with hemlocks while the east side is primarily open land. There are water falls both above and below the bridge. Old silk mills with an associated village stand on the Newton side of the river above the bridge. These have been proposed as a potential historic district by the city of Newton. Below the bridge, on the west side of the river, there is an old stone mill now vacant and boarded up.

There is at least one known prehistoric site in Hemlock Gorge -- a rock-shelter, first excavated in 1914, and later tested by Dena Dincauze in 1968 -- she has seen Archaic, woodland and early historic materials from the shelter. This site is just over into the Wellesley line, about 500' from the bridge. Other sites are probably in the area.

The bridge is 500 feet in length and is supported by a series of seven granite arches. Five of these have a span of thirty-seven feet, the one over Ellis Street has a span of twenty-eight feet and the largest arch which stretches over the river itself has a span of one hundred and thirty feet. This large arch which is segmental in form (the others are semi-circular) has a radius of sixty-nine feet and a crown fifty-one feet above normal water level. The top of the bridge itself is seventy feet above water level. The keystone of this arch is five feet in depth, while the voussoirs increase to a depth of six feet at the base. This heavy arch exerts a pressure of about 2,000 tons or 16½ tons per square foot on the foundation. The entire bridge is constructed mainly of solid granite mansonry with the exception of the interior of the upper portion under the conduit which is brick and concrete with facilities for draining away any leakage from the conduit. The foundations of the bridge are ~~in~~ solid rock.

The bridge which is eighteen feet wide at its crown now supports a foot-bridge which is guarded on each side by a low iron railing. There is a path and stairway which lead down to a porch beneath the large arch which spans the river. While structurally sound, the bridge is currently disfigured by graffiti.

8 SIGNIFICANCE

PERIOD	AREAS OF SIGNIFICANCE -- CHECK AND JUSTIFY BELOW				
__PREHISTORIC	__ARCHEOLOGY-PREHISTORIC	__COMMUNITY PLANNING	__LANDSCAPE ARCHITECTURE	__RELIGION
__1400-1499	__ARCHEOLOGY-HISTORIC	X CONSERVATION	__LAW	__SCIENCE
__1500-1599	__AGRICULTURE	__ECONOMICS	__LITERATURE	__SCULPTURE
__1600-1699	X ARCHITECTURE	__EDUCATION	__MILITARY	__SOCIAL/HUMANITARIAN
__1700-1799	__ART	X ENGINEERING	__MUSIC	__THEATER
X 1800-1899	__COMMERCE	__EXPLORATION/SETTLEMENT	__PHILOSOPHY	__TRANSPORTATION
__1900-	__COMMUNICATIONS	__INDUSTRY	__POLITICS/GOVERNMENT	X OTHER (SPECIFY) Urban planning
		__INVENTION		

SPECIFIC DATES 1876-1877 **BUILDER/ARCHITECT**

STATEMENT OF SIGNIFICANCE

Echo Bridge was constructed in 1876-77 as a portion of the Sudbury River Conduit to carry water from the Sudbury River to the growing City of Boston. The system was 18.8 miles long, running from Farm Pond in Farmington to the Chestnut Hill Reservoir in Boston. It entered Newton at the Upper Falls, then passed through that village to the north of Newton Highlands, then through Newton Center to the Resevoir.

During construction the arches rested on timber falsework. Approximately 110,000 feet of spruce, oak and hard pine were used in the construction of the major arch spanning the river alone. When the bridge was completed and the falsework removed the bridge settled only two inches.

Shortly after completion the main arch of the bridge was described by F.H. Barrett, a Boston Water Works engineer, asthe second largest on this continent and one of the largest stone arches in the world.

The bridge receives its name from the echo which can be heard when standing beneath it by the rivers edge.

FHR-8-300A
(11/78)
UNITED STATES DEPARTMENT OF THE INTERIOR
HERITAGE CONSERVATION AND RECREATION SERVICE

NATIONAL REGISTER OF HISTORIC PLACES INVENTORY -- NOMINATION FORM

Echo Bridge possesses integrity of location, design, setting, materials and workmanship and important associations with the development of a major water system to serve Boston's growing population in the late nineteenth century. Its total length of 475' is composed of seven arches of varying spans; the longest of these is almost 130' in length, making it for many years the second longest masonry arch in the United States. Located in Hemlock Gorge, one of the first areas acquired by the Metropolitan District Commission for recreation purposes, it was also a part of the conservation movement which helped to shape metropolitan Boston.

Echo Bridge was among the earliest of long masonry bridges built in the United States in 1880. Long stone or brick bridges were, in fact, uncommon anywhere in the world. H.G. Tyrell claimed that, at that time, there were fewer than 60 such bridges with single spans of more than 120' in the world. Echo Bridge's largest arch, which spans the Charles River, is nearly 130' in length, and at the time of construction and for many years following was the second longest masonry arch in this country (the longest was Gabin John Bridge in Washington D.C. with a single span of 220'). The total length of Echo Bridge with its 7 arches of varying spans is 475'. Because the place selected for the abutment for the largest arch on the river's eastern bank appeared to have a disintegrating rock formation, the base of the bridge was widened. Consequently, the arch, only 18' wide at the top under the conduit, was gradually widened by a curved line to 22' as it reached the ground. In addition to solving an engineering problem, this adds to the graceful appearance of the bridge. The design of the arch is acoustically such that fine echoes can be made under it, and it is from this that the bridge took its name. Because of the flaring form of the principle arch and the varying depths of the voissoirs, the ring stones were difficult to cut as no two were alike. So carefully constructed, Echo Bridge settled only 2" upon the removal of the supporting framework.

Echo Bridge is a graceful and handsomely constructed bridge of granite and brick which adds to the rugged beauty of Hemlock Gorge. Its purpose was only to carry an aqueduct across the river, but its design was carefully conceived to contribute to its magnificent site rather than to detract from it. Echo Bridge is unusual for its time for its assymmetry in arch arrangement, necessitated by the lay of the land.

The City of Boston had grown so tremendously by the close of the Civil War that its needs for water had outgrown its supply greatly augmented only 20 years before. Engineer Joseph P. Davis was retained by the Cochituate Water Board on November 22, 1871, to examine the possible sources of water for Boston within a 50 mile radius. In February of 1872, Davis made his first report recommending the Charles and the Sudbury Rivers

NATIONAL REGISTER OF HISTORIC PLACES INVENTORY -- NOMINATION FORM

as the best sources of supply. In the beginning of April of that year, the Sudbury River Act was signed by the Governor of the Commonwealth and J.P. Davis was elected as Boston City Engineer the following December. Soon after election, Davis presented a long and detailed report proposing a new system for the storage and conveyance of water from the Sudbury River to Boston. Its construction began on April 12, 1873, with A. Fteley(sic.) appointed as Resident Engineer in charge of the works.

One of the many problems to be solved in the construction of the aqueduct was finding the best means of carrying the conduit over the Charles River. Davis recommended that this be done at Hemlock Gorge, Newton Upper Falls, by a high level bridge, so that neither a change of grade nor long siphon lines would be necessary. This plan was adopted by the Water Board on July 3, 1873. Quoting from the project completion report from 1882: "The location of the bridge required some care. The line had to be established so as to interfere as little as possible with the homes at Newton Upper Falls. It was also desirable to avoid a curve, and to select the narrowest point of the Charles River where a good foundation could be found. The present location of the bridge unites these advantages. Two houses only had to be removed a short distance..." 2 Newton Upper Falls was a busy and crowded industrial village and concern was clearly taken to disturb the village minimally.

Plans stated that "The bridge is to be built in a most substantial manner of granite and brick work. The piers, arches and abutments up to the level of the conduit will be of granite, and above this there will be a handsome face-brick parapet, formed by pilasters into panels, and capped with a heavy granite coping, the whole surmounted by an ornamental railing."3 The plans were well carried out.

George W. Phelps of Springfield, Mass., was selected as the contractor, coming forth with the winning bid of $198,722.50. Ground was broken on December 7, 1875.

As a part of the widespread conservation movement which took place in the United States during the 1880's and '90's, serious efforts were made to upgrade the Charles River and its banks in recognition of its value as open space for the burgeoning metropolitan Boston area. The Metropolitan Park Commission was established in 1893, and this commission quickly selected the reknowned architectural landscaping firm of Olmstead, Olmstead and Eliot to make a thorough study of the potentials of the Charles River. In the firm's report to the commission submitted in 1895, it was proposed that the Charles River be made a water parkway, governed by a park commission, and on the basis that "the life of a river, like that of a human being, consists in the union of soul and body - the water and the banks", that land all along the banks of the river be acquired

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by the commission from private owners through gift, purchase of condemnation.

Among the first areas acquired by the MDC was the land bordering Hemlock Gorge, "containing the beautiful bridge of the Boston Water Works, widely known as Echo Bridge". Walking trails, canoe carries, little rustic bridges and picnic areas were developed. Currently under the management of the Metropolitan District Commission, the area on the eastern bank lies within the Newton Upper Falls H.D.

#9. BIBLIOGRAPHY

1. Tyrell, H.G., The History of Bridge Engineering, 1891.

2. Additional Supply from Sudbury River: Description of the Work with Plates, Boston Water Works, Boston, 1882.

3. Report of the Joint Board upon the Improvement of Charles River, 1896, Metropolitan Park Commission & State Board of Health, Boston, 1896.

4. History of the Boston Water Works from 1868 to 1876, under direction of Desmond FitzGerald, Supt., Western Division, Boston, 1876.

5. Report of the Metropolitan Park Commission, 1893 and 1897.

9 MAJOR BIBLIOGRAPHICAL REFERENCES

History of Newton, Samuel F. Smith, 1880
King's Handbook of Newton, M.F. Sweetser, 1889

10 GEOGRAPHICAL DATA

ACREAGE NOT VERIFIED
UTM NOT VERIFIED

ACREAGE OF NOMINATED PROPERTY less than one acre

UTM REFERENCES

	ZONE	EASTING	NORTHING
A	19	316 420	4686 900
B			
C			
D			

VERBAL BOUNDARY DESCRIPTION

Please refer to the attached plat map which is plan #145 filed with the Assessors' Department, Town of Needham, and section 51, block 1-2 filed with the Assessors' Department, Town of Newton

LIST ALL STATES AND COUNTIES FOR PROPERTIES OVERLAPPING STATE OR COUNTY BOUNDARIES

STATE	CODE	COUNTY	CODE
		Norfolk	21
STATE	CODE	COUNTY	CODE
		Middlesex	17

11 FORM PREPARED BY

NAME / TITLE : Candace Jenkins , National Register Editor

ORGANIZATION	DATE
Massachusetts Historical Commission	September 11, 1978
STREET & NUMBER	TELEPHONE
294 Washington Street	617-727-8470
CITY OR TOWN	STATE
Boston	Massachusetts, 02108

12 STATE HISTORIC PRESERVATION OFFICER CERTIFICATION

THE EVALUATED SIGNIFICANCE OF THIS PROPERTY WITHIN THE STATE IS:

NATIONAL ___ STATE X LOCAL ___

As the designated State Historic Preservation Officer for the National Historic Preservation Act of 1966 (Public Law 89-665), I hereby nominate this property for inclusion in the National Register and certify that it has been evaluated according to the criteria and procedures set forth by the National Park Service.

STATE HISTORIC PRESERVATION OFFICER SIGNATURE Patricia L Weslowski

TITLE Executive Director, Mass. Historical Commission DATE 9/19/78

FOR NPS USE ONLY

I HEREBY CERTIFY THAT THIS PROPERTY IS INCLUDED IN THE NATIONAL REGISTER

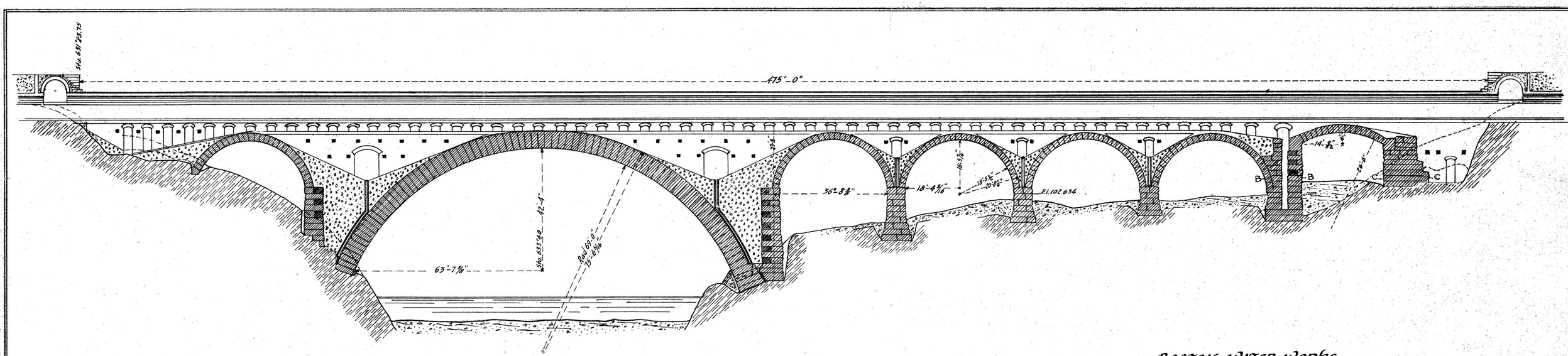
Bruce Mac Dougall DATE 4/9/80

DIRECTOR, OFFICE OF ARCHEOLOGY AND HISTORIC PRESERVATION

ATTEST: Patrick Andrus DATE 4/8/80

KEEPER OF THE NATIONAL REGISTER

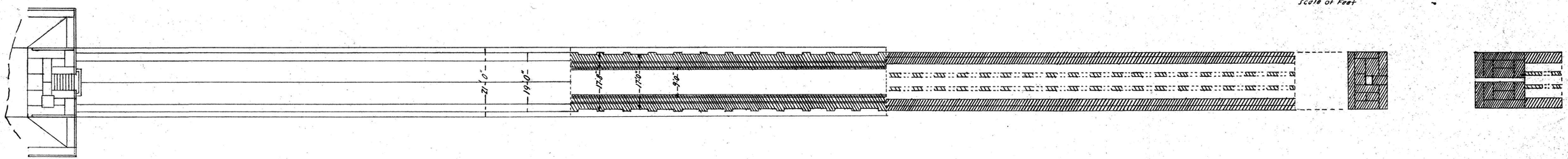
GPO 892-453



Section on Centre Line

BOSTON WATER WORKS
Sudbury River Conduit
Charles River Bridge
Dec. 1875

0 5 10 15 20 25 30
Scale of Feet



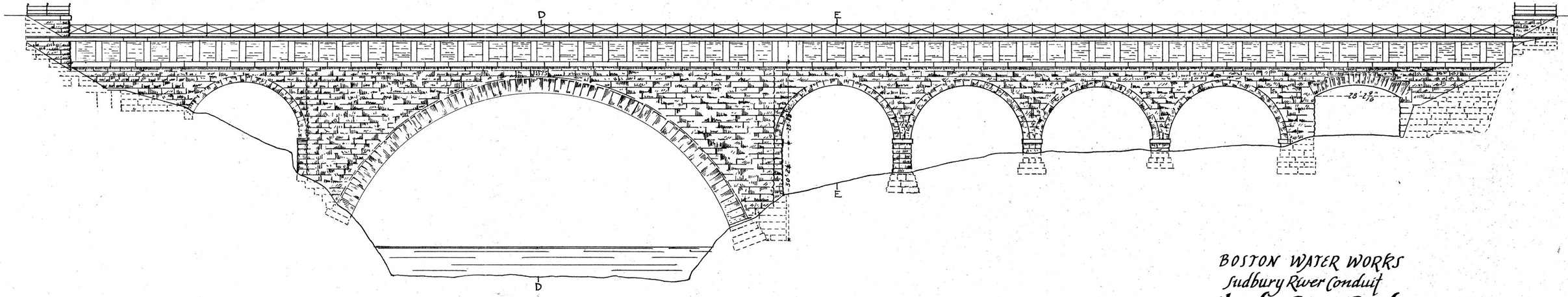
Plan on Top

Section on Springing Line of Conduit

Section on AA

Section on BB

Section on CC

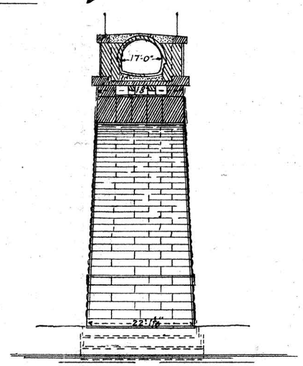


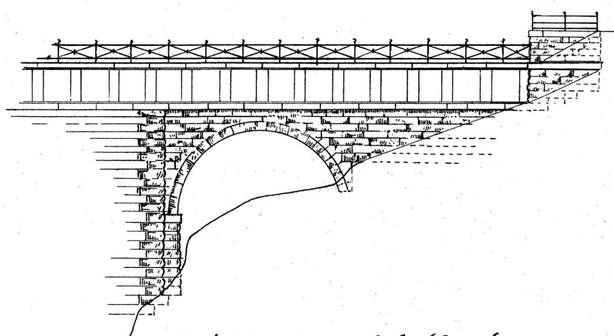
Elevation of South Side

BOSTON WATER WORKS
Sudbury River Conduit
Charles River Bridge
Dec. 1875

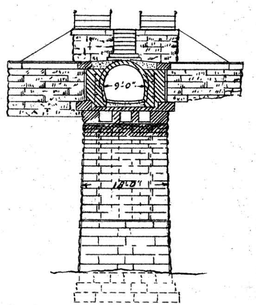
0 5 10 15 20 25 30
Scale of Feet

Section on DD

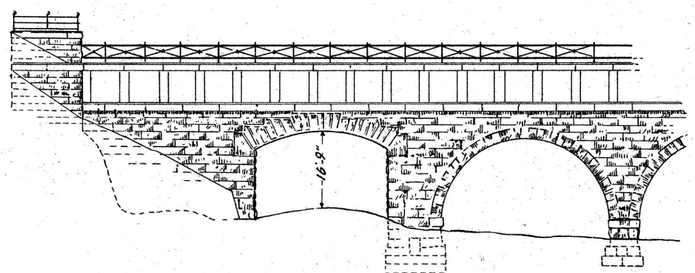




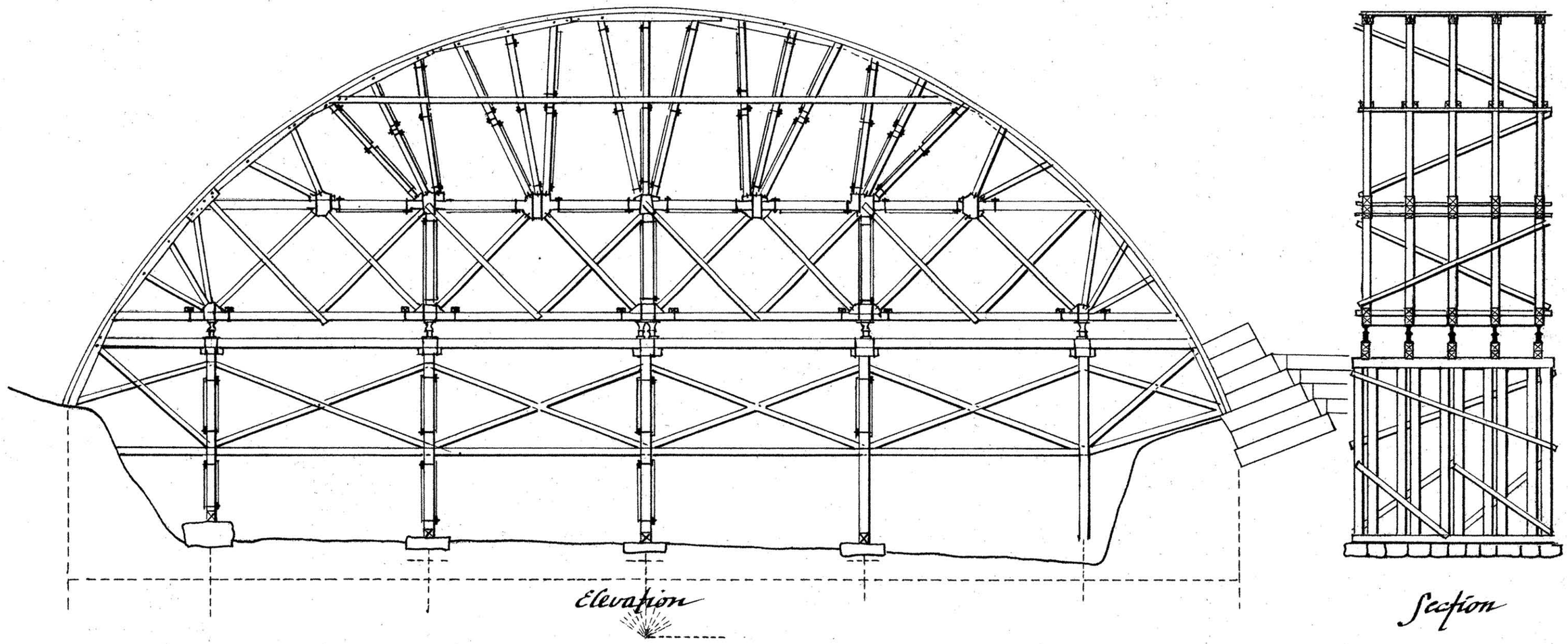
Part Elevation of North Side



Section on EE



Part Elevation of North Side



Centering for Large Arch, Charles River Bridge

Scale of Feet

from 8 to 12 feet.

SECTION 15.

Section 15 extends from Station 623 to Station 639. The west part of it is built in a moderately deep trench, half sand and half rock. The balance of the section includes Charles-River bridge, with its approaches. The location of the bridge required some care. The line had to be established so as to interfere as little as possible with the houses at Newton Upper Falls. It was also desirable to avoid a curve, and to select the narrowest point of Charles River where a good foundation could be found. The present location of the bridge unites these advantages. Two houses only had to be removed a short distance, and the out-buildings of two others were slightly interfered with.

The bridge is formed of 7 arches. The first, on the western bank, is a segmental arch, of 18 feet radius; the second arch, a segmental one, with a radius of 69 feet, spans the river with an opening of nearly 130 feet. The next 4 arches, 36 ft. 8 in. in span, on the eastern shore, are semi-circular. The seventh, a flat segmental arch of 26 ft. 6 in. radius, 28 ft. in span, is built over Ellis street. The bridge between its terminal-chambers is 475 ft. long. (Plates 59 and 60.) The whole structure is built on conglomerate rock. On the east bank, at the place intended for the abutment of the largest arch, the rock appeared seamy and disintegrated, and it was thought prudent to widen the base of the structure. For this purpose the largest arch, which at the top under the conduit is only 18 feet wide, was gradually widened by a curved line to 22 ft. at the level of the ground. (Section on DD, Plate 59.) That disposition has also the advantage of giving to the arch a more graceful appearance. The voussoirs of the smaller arches are uniformly 2 ft. 3 in. in depth, with the exception of the ring-stones of the street arch, which are considerably deeper. The voussoirs of the largest arch are 5 ft. deep at the top and 6 ft. at the level of the ground.

Owing to the flaring form of the arch, and to the variable depths of the voussoirs, the ring-stones were difficult to cut; they were all different for one side of the bridge, and none presented two arrises of the same length. The contractor executed the work with such precision that, although the stones were entirely finished at the quarry, none were found defective.

The size of the voussoirs of the largest arch is so proportioned that in no case, whether the conduit is supposed built on the arch or not, the curve of pressure leaves the middle third of the space between the intrados and extrados. With the conduit full of water the horizontal thrust at the crown is 15.7 tons per square foot, equivalent to 1,413 tons for the whole section of the crown. At the lowest voussoir, at the level of the ground, the load is 25 tons per square foot, equivalent to 3,360 tons for the whole section of the arch at that point. On the rock of the east bank, which was not so sound, the load was reduced by the means of 4 heavy stepping-courses of foundation-stones to 11½ tons per square foot of surface.

The frame necessary to support the large arch during its construction was of some magnitude. It was supported by 5 rows of posts on the coarse gravel forming the bottom of the stream in the following manner: The water in the river having been lowered to within a foot or more from the bottom, large stones, of a roughly rectangular shape, 5

feet long and 2 feet thick, were laid side by side on the bottom transversely to the conduit and well bedded in the gravel for a length of 24 feet. Three of these lines of stones were laid corresponding to 3 of the rows of posts which were to support the frame. On each of these lines of stones a continuous shallow groove was cut wide enough to receive a sill of hard-pine timber 14 inches by 14 inches, and sufficiently smooth to form a joint with the timber. On this sill were erected 5 pairs of hard-pine posts, 12 inches by 14 inches. The other two rows of posts, near the shores, rested on a sill reposing on a base of concrete. (See Plate 61.)

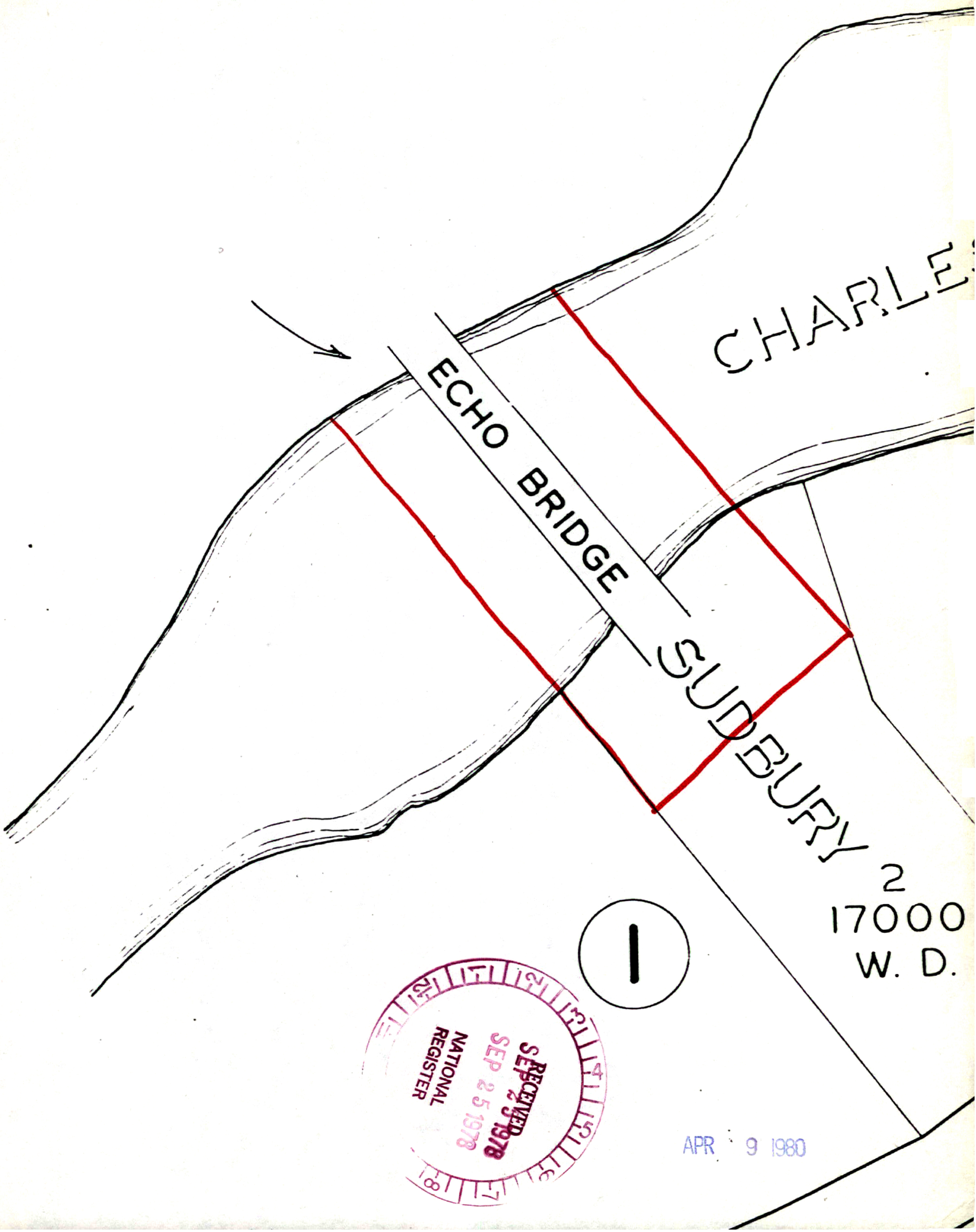
The frame was composed of 5 trusses, each of which was supported on 5 jack-screws, 4 inches in diameter, placed on the capping of the posts. There being 5 rows of posts and 5 trusses, the frame and its load were consequently supported by 25 screws which were found of great service for adjusting the structure, and afterwards for striking the centring. The struts, 8 inches by 10 inches, of spruce timber, 25 in number for each truss, and supporting the 4-inch lagging, were radial in direction. It being important to keep the settlement of the frame within narrow limits, all the joints of the timber were adjusted with care, and all the pieces were calculated to support a load of no more than 600 pounds per square inch.

During the construction of the arch a settlement was to be expected, due to the compression of the gravel in the bed of the river and of the several timber joints. To this was to be added the probable settlement of the arch after striking the centring. The frame was erected in the exact position that the intrados of the arch was intended to occupy, and, in order to compensate for the expected settlement, a furring of wood, 2 inches thick at the crown and gradually diminishing to nothing at the haunches, was spiked to the ribs, and on it the lagging was fastened.

By the time the arch was closed the frame had settled gradually down almost exactly to its theoretical position (see Diagram, fig. 1), and, after striking the centring, the arch settled down to a point a little lower than expected. After the whole structure had been completed, with the conduit built on the top, the arch stood at the crown $\frac{5}{8}$ inch lower than was contemplated. (See Diagram, fig. 2.) The arch was closed in November, 1876. The faces of the voussoirs were cut for $\frac{1}{4}$-inch joints; but many joints exceed that limit.

The interior construction of Charles-River bridge is identical with that of Waban bridge, and the conduit is built on it in the same manner. The interior drainage galleries and other empty spaces are accessible through a vertical door in the east abutment of the road-arch and through two man-holes, one on the north side of the west abutment of the street arch, the other on the south side of the bridge, about 25 feet westerly from the foot of the arch on the Needham shore. (See Plate 60.) The chambers under these two man-holes are drained by pipes laid under ground.

At each end of the bridge the conduit is enlarged into a chamber. (Plates 59 and 60.) These chambers, used for examination and repairs, will also be found useful for gauging the flow of water in the conduit. The top of the conduit is 75 feet above the water-level of Charles River.



NEWTON

"Hemlock Gorge"

"ECHO BRIDGE"

RESE

Carmelo and Bru

(Wooded)
"B"
3. Acres
7440. S.F. (incl. st.)

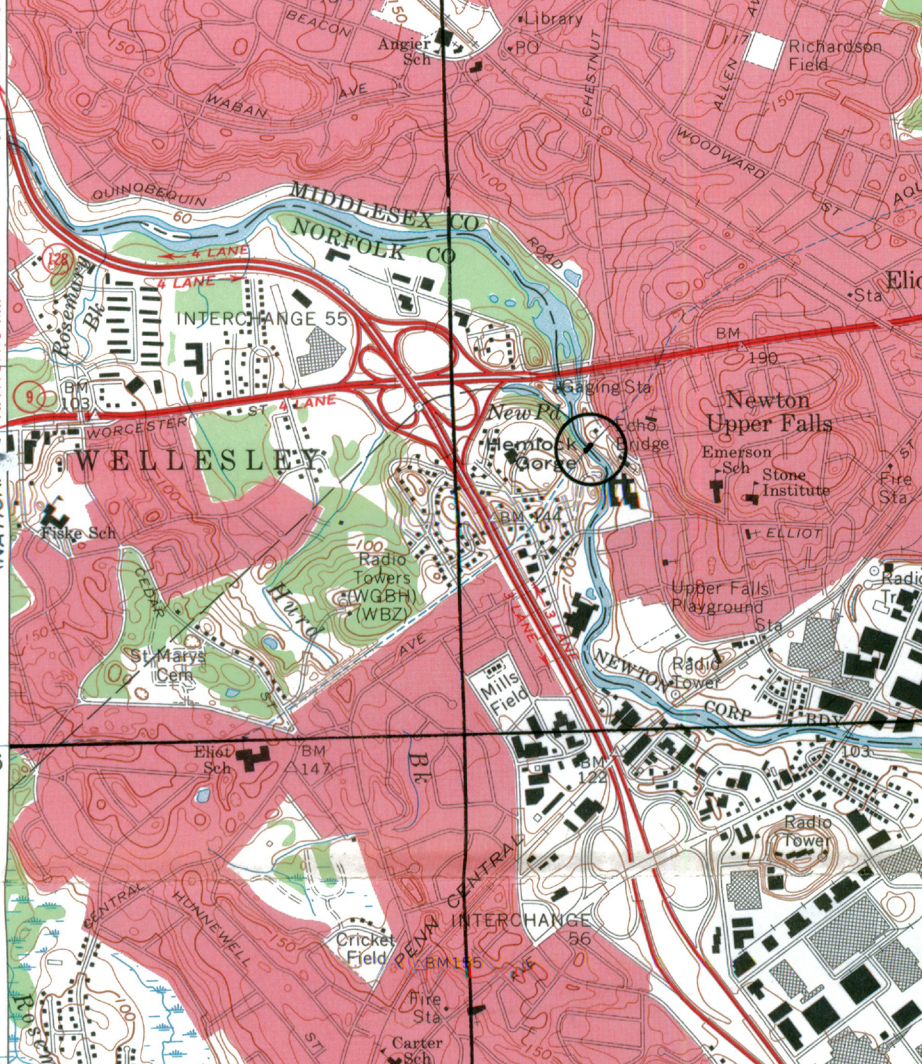
354.

210. ±

R=1910.08
252.89
83.00
R=1835.08
R=1985.08
189.82
R=777.20
257.60
90.91
106.53
60.0
417.43

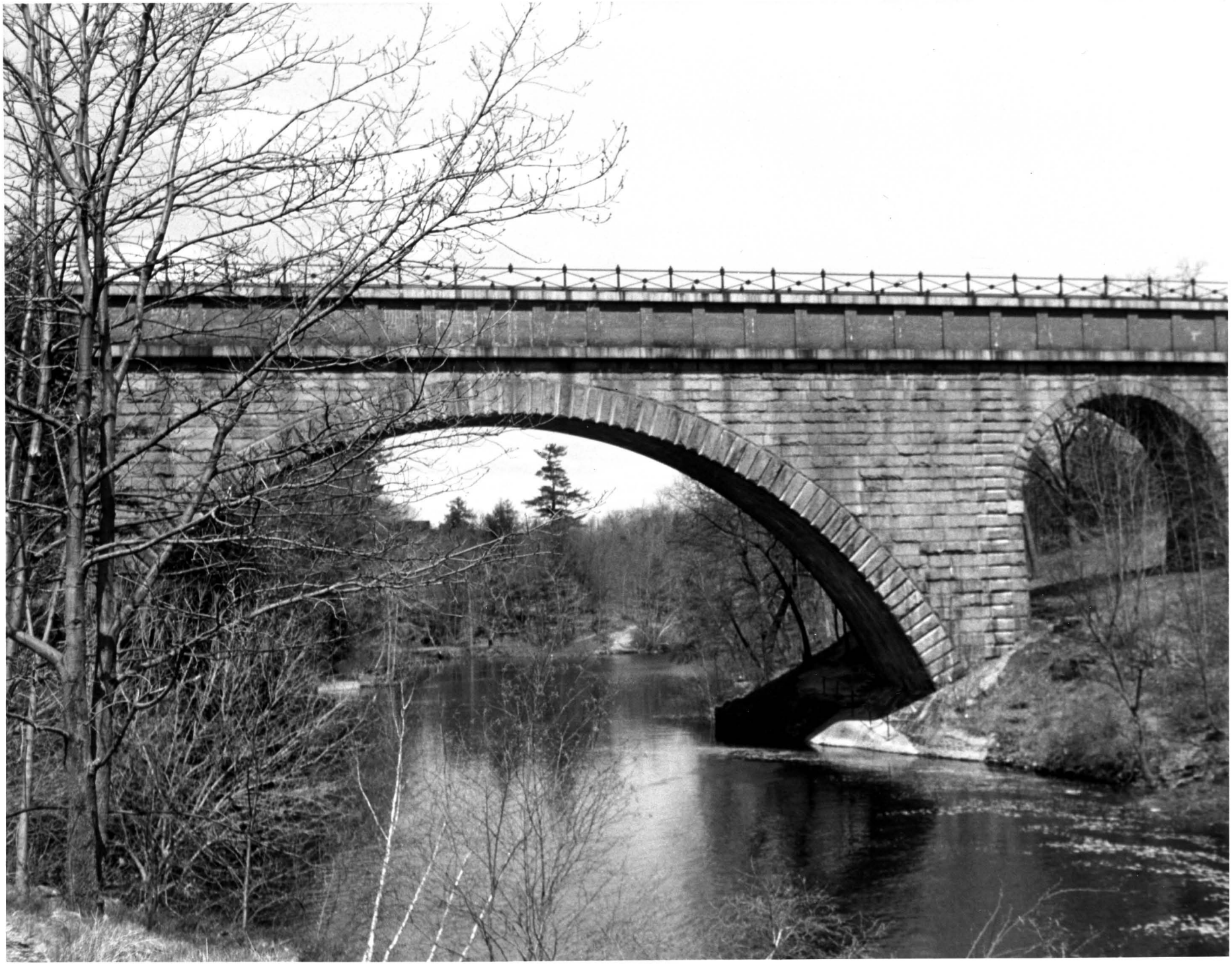
69 ±
29.8
124. ±
49. ±
0.50
0.54 Acre.
245.0
203.0
50.
50.
10.0
43.0

Needham
Newton
RIVER



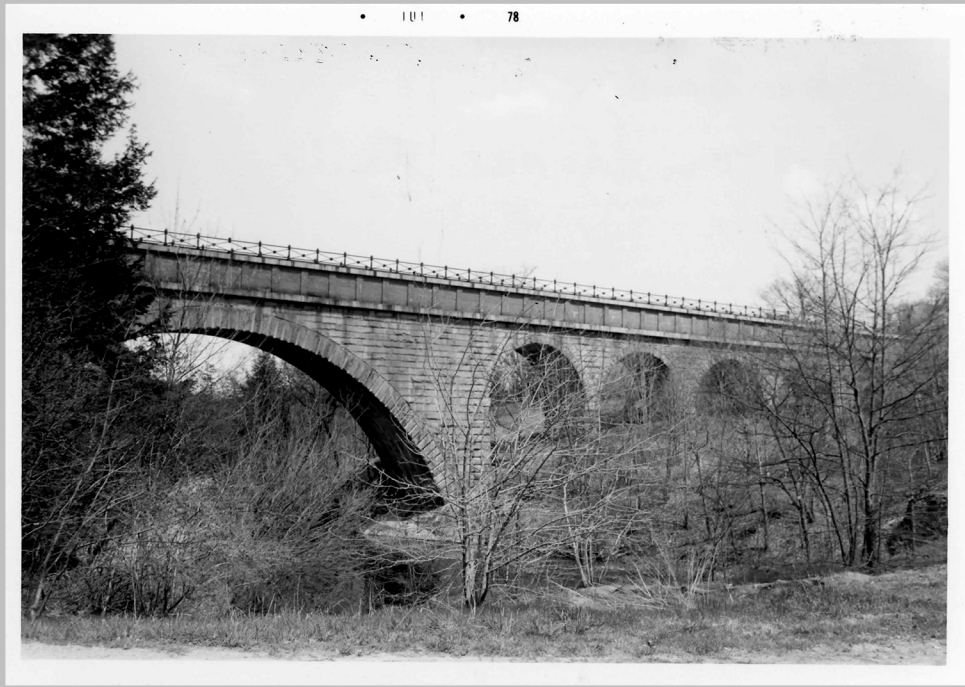
Echo Bridge
Needham and Newton Upper Falls, Massachusetts
UTM Coordinates:
19/316 420/4686 900

1. Looking south toward bridge. (Photograph: Kenneth Newcomb, 1976)

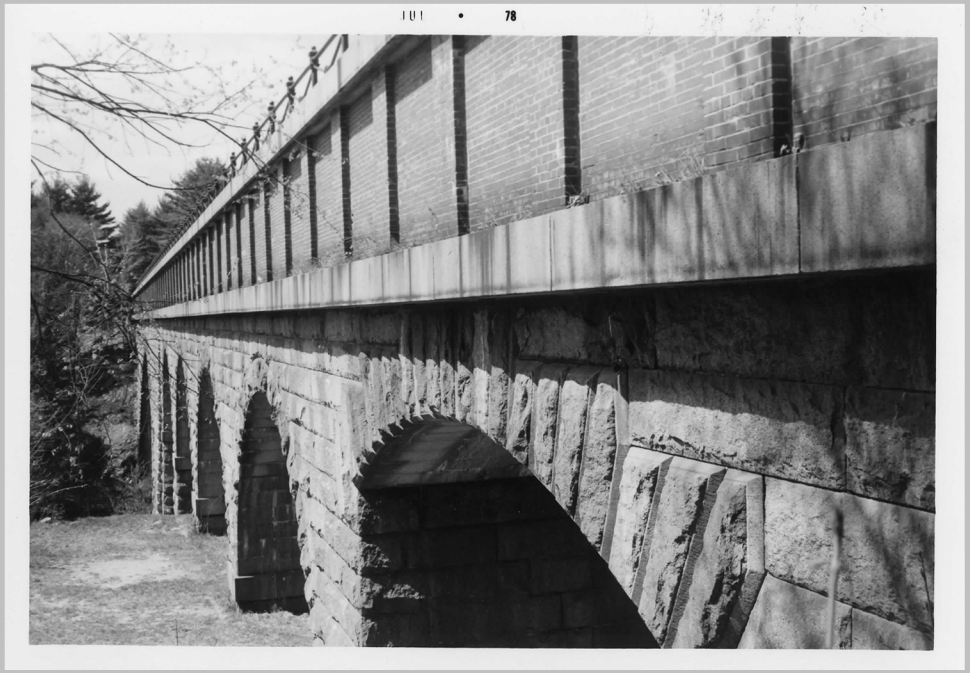


2. Looking north toward bridge (Photograph: Kathlyn Hatch, 1978)

Echo Bridge, Newton (Middlesex Co.) and Needham (Norfolk Co.), MA



3. South face of bridge



4. North face of bridge from beneath main arch

5. Footpath across bridge

All photos: Kathlyn Hatch, July 1978