Appendix D – NRHP Nomination Forms and ASME Designation Report

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

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES INVENTORY -- NOMINATION FORM

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

1 NAME

HISTORIC
Lowell Locks and Canals Historic District

AND/OR COMMON
Lowell Locks and Canals Historic District

2 LOCATION

STREET & NUMBER Between the Pawtucket and Hamilton Canals, the Concord River, and the Merrimack River — NOT FOR PUBLICATION

CITY, TOWN Lowell — VICINITY OF

CONGRESSIONAL DISTRICT 5

STATE	CODE	COUNTY	CODE
Massachusetts	25	Middlesex	017

3 CLASSIFICATION

CATEGORY	OWNERSHIP	STATUS	PRESENT USE	
XX DISTRICT	— PUBLIC	X OCCUPIED	— AGRICULTURE	X MUSEUM
— BUILDING(S)	— PRIVATE	X UNOCCUPIED	X COMMERCIAL	— PARK
— STRUCTURE	X BOTH	— WORK IN PROGRESS	X EDUCATIONAL	X PRIVATE RESIDENCE
— SITE	PUBLIC ACQUISITION	ACCESSIBLE	— ENTERTAINMENT	— RELIGIOUS
— OBJECT	— IN PROCESS	X YES: RESTRICTED	— GOVERNMENT	— SCIENTIFIC
	X BEING CONSIDERED	— YES: UNRESTRICTED	X INDUSTRIAL	— TRANSPORTATION
		— NO	— MILITARY	— OTHER:

4 OWNER OF PROPERTY

NAME
Multiple (See continuation sheet.)

STREET & NUMBER

CITY, TOWN — STATE

— VICINITY OF

5 LOCATION OF LEGAL DESCRIPTION

COURTHOUSE, REGISTRY OF DEEDS, ETC. Northern Middlesex District Registry of Deeds

STREET & NUMBER Goreham Street

CITY, TOWN Lowell — STATE Mass.

6 REPRESENTATION IN EXISTING SURVEYS

TITLE Historic American Engineering Record
National Register of Historic Places

DATE 1974; 1976 — X FEDERAL X STATE — COUNTY — LOCAL

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DEPOSITORY FOR SURVEY RECORDS Library of Congress; National Register

CITY, TOWN Washington — STATE D.C.

7 DESCRIPTION

CONDITION		CHECK ONE	CHECK ONE
__EXCELLENT	__DETERIORATED	__UNALTERED	X__ORIGINAL SITE
X__GOOD	__RUINS	X__ALTERED	__MOVED DATE_____
__FAIR	__UNEXPOSED		

DESCRIBE THE PRESENT AND ORIGINAL (IF KNOWN) PHYSICAL APPEARANCE

The Lowell Locks and Canals Historic District encompasses approximately 125 acres; ten principal canals or feeders and their accompanying gates, locks, dams, and other associated structures; seven extant mill yards and the ruins of another, with almost all buildings of red brick construction; the Locks and Canals yard and the Lowell Machine Shop; and several company boarding houses plus a company agent's residence. Included are the first canal built in Lowell (the Pawtucket, 1796), the last (the Northern, 1848), and all those constructed in the interim. These virtually unaltered waterways, together with the surprisingly large number of relatively little-altered mills and their machinery, form what is probably the most historically significant extant aggragation of early 19th-century industrial structures and artifacts in the United States. Several of the mills still rely on the canal system for power to turn electric generators, and some are still used for the manufacture of textiles. Most, however, house a variety of service and storage firms and small industries. Principal structures not extant include Merrimack Manufacturing Company and Middlesex Woolen Mills.

For the purpose of this nomination some descriptive material has been incorporated in the accompanying historical significance section. Also, because the Historic American Engineering Record has surveyed most of the Lowell Locks and Canals Historic District and described its edifices, waterways, and machinery in detail, most of the following descriptions of principal extant structures are taken virtually verbatim either from HAER inventory cards or from The Lower Merrimack River Valley: An Inventory of Historic Engineering and Industrial Sites, a joint HAER-Merrimack Valley Textile Museum project. Other descriptive passages are based, as usual, on the research and on-site inspections of the AASLH representative.

An asterisk (*) indicates HAER or HAER-Textile Museum descriptions.

(continued)

8 SIGNIFICANCE

ENGINEERING
INDUSTRY

PERIOD	AREAS OF SIGNIFICANCE -- CHECK AND JUSTIFY BELOW				
_PREHISTORIC	_ARCHEOLOGY-PREHISTORIC	_COMMUNITY PLANNING	_LANDSCAPE ARCHITECTURE	_RELIGION	
_1400-1499	_ARCHEOLOGY-HISTORIC	_CONSERVATION	_LAW	_SCIENCE	
_1500-1599	_AGRICULTURE	_ECONOMICS	_LITERATURE	_SCULPTURE	
_1600-1699	_ARCHITECTURE	_EDUCATION	_MILITARY	_SOCIAL/HUMANITARIAN	
_1700-1799	_ART	X ENGINEERING	_MUSIC	_THEATER	
X 1800-1899	_COMMERCE	_EXPLORATION/SETTLEMENT	_PHILOSOPHY	_TRANSPORTATION	
X 1900-	_COMMUNICATIONS	X INDUSTRY	_POLITICS/GOVERNMENT	_OTHER (SPECIFY)	
		_INVENTION			

SPECIFIC DATES 1821-1930's

BUILDER/ARCHITECT Nathan Appleton, Kirk Boott, James B. Francis

STATEMENT OF SIGNIFICANCE

Lowell, Mass., occupies an especially significant place in the Nation's history. Its "origin and growth," says geographer-historian Margaret Terrell Parker, "constitute the first instance in America of the development of a city of the primarily industrial type."[1] Futhermore, asserts historian Harry C. Dinmore "the energy supplied by its carefully controlled water-power gave birth and enduring life to the Industrial Revolution" in this country.[2]

Lowell owes its historic importance in part to the Pawtucket Falls of the Merrimack River and in part to the foresight and ingenuity of its founding fathers, chief of whom were Nathan Appleton and Patrick T. Jackson. These two industrialists and their associates began developing the falls' power in 1822. By 1826 they had completed the first portions of a complex canal system and established the city of Lowell, which they named in honor of pioneer textile manufacturer Francis Cabot Lowell. Over the next two decades they added several more canals to the system, and Lowell became the cotton textile manufacturing center of the United States. It "evolved," says American Heritage writer Alex Groner, "into the Manchester of America."[3]

The Lowell Locks and Canals Historic District encompasses approximately 125 acres; ten principal canals or feeders and their associated dams, locks, gates, and wasteways; seven extant mill yards, the ruins of another, and several ancillary structures; and four company boarding houses. The virtually

(continued)

[1]Margaret Terrell Parker, Lowell: A Study of Industrial Development (New York, 1940), 1.

[2]Harry C. Dinmore, "Proprietors of Locks and Canals: The Founding of Lowell," in Arthur L. Eno, Jr., Cotton Was King: A History of Lowell, Massachusetts (Lowell, 1976), 79.

[3]Alex Groner, The American Heritage History of American Business and Industry (New York, 1972), 101.

9 MAJOR BIBLIOGRAPHICAL REFERENCES

(See continuation sheet.)

10 GEOGRAPHICAL DATA

ACREAGE OF NOMINATED PROPERTY circa 125 acres

UTM REFERENCES

(See continuation sheet.)

	ZONE	EASTING	NORTHING		ZONE	EASTING	NORTHING
A				B			
C				D			

VERBAL BOUNDARY DESCRIPTION

(See last pages of description.)

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

STATE	CODE	COUNTY	CODE
STATE	CODE	COUNTY	CODE

11 FORM PREPARED BY

NAME / TITLE

George R. Adams, Director, Historic Landmarks Project

ORGANIZATION — DATE

American Association for State and Local History — June 1977

STREET & NUMBER — TELEPHONE

1400 Eighth Avenue South — 615/242-5583

CITY OR TOWN — STATE

Nashville, — Tennessee 37203

12 STATE HISTORIC PRESERVATION OFFICER CERTIFICATION

THE EVALUATED SIGNIFICANCE OF THIS PROPERTY WITHIN THE STATE IS:

NATIONAL ___ STATE ___ 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.

FEDERAL REPRESENTATIVE SIGNATURE

TITLE — DATE

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

DATE

DIRECTOR, OFFICE OF ARCHEOLOGY AND HISTORIC PRESERVATION

ATTEST: DATE

KEEPER OF THE NATIONAL REGISTER

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

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Owners of Property

Melvin Lezburg President Proprietors of Locks and Canals on Merrimack River Boott Mills Foot of John Street Lowell, Mass. 01852	All canals, locks, dams, gatehouses, and associated structures and machinery.
Melvin Lezburg President Boott Mills Foot of John Street Lowell, Mass. 01852	Boott and Massachusetts Mills structures and one Bigelow Yard structure.
Sullivan Trust 95 Bridge Street Lowell, Mass. 01852	Massachusetts Mills structure.
Vincent P. Morton, Inc. 93 Bridge Street Lowell, Mass. 01852	Massachusetts Mills structure. Appleton Mills structure at Jackson and Revere St.
William P. & Mary K. Spanos 260 Middlesex Street Lowell, Mass. 01852 (cc to same at 133 Havilah St.)	Boott Mills Boarding House NW corner Bridge & French St.
Fitzgerald-Keefe Corporation c/o John E. Keefe 66 Ravenswood Avenue Providence, R.I. 02908	Boott Mills Boarding House SW corner Bridge & French St.
Business Manager Massachusetts Electric Corp. Lowell, Mass 01852	Massachusetts Mills structure.
Capehart Corporation Foot of John Street Lowell, Mass. 01852	Boott Mills structure.

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Morris Sibulkin, Louis Shaftmaster, William F. Herlihy, Ed. I. McGarry Valley Associates 231 Mill Street Haverhill, Mass (Also contact: Bob Malavich Planning Director City of Lowell Lowell, Mass. 01852)	Bigelow Yard structures.
Merrimack Trading & Spinning Co. 256 Market Street Lowell, Mass. 01852	Bigelow Yard structure.
Barnet B. Stein & Martin C. Stein, Trustees c/o Grace Shoe Corporation Lowell, Mass. 01852	Bigelow Yard structure on Lower Pawtucket Canal.
Stanley Charren, Ruben Wisotzky, and James Stevens CWS Associates 200 Market Street Lowell, Mass. 01852 (cc to Pandel-Bradford, Inc. Lowell, Mass. 01852	Bigelow Yard structures on Lower Pawtucket Canal.
Lesson Corporation 2 Ashland Street Nashua, N.H.	Hamilton Yard structure.
Joan Fabrics Corporation 122 Western Avenue Lowell, Mass. 01851	Hamilton Yard structure Dutton Street Lowell Machine Shop structure.
Courier Citizen Company 165 Jackson Street Lowell, Mass. 01852	Hamilton Yard structure Tremont Yard structures.
James T. Lichoulas Appleton Trust 217 Jackson Street Lowell, Mass. 01852	Appleton Mills structures.

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Pellon Corporation 491 Dutton Street Lowell, Mass. 01852	Lowell Machine Shop Bldg.
Macheras Oil Company 66 Broadway Street Lowell, Mass. 01852	Locks & Canals Yard.
Frank E. Barrett Real Estate 170 Merrimack Street Lowell, Mass. 01852	Tremont Yard structure.
William J. Graham Co., Inc. 572 Suffolk Street Lowell, Mass. 01854	Suffolk Yard bldg., corner of Hall and Suffolk.
Margaret O. & Edward A. Larter Wannalancit Textile Company 562 Suffolk Street Lowell, Mass. 01854	Wannalancit Textile Co. bldgs., Suffolk Yard.
Wanskuck Company 562 Suffolk Street Lowell, Mass. 01854	Suffolk Yard structure.
Stony Brook Properties 40 Main Street Westford, Mass. 01986	Suffolk Yard structure.
Leo R. LaFortune, Inc. 6 Chandler Rd. Tewksburg, Mass. 01876	Suffolk Yard structure.
Richards Auto Supply Corner Cabot & Halls Streets Lowell, Mass. 01854 (Also contact for forwarding: Bob Malavich Planning Director City of Lowell Lowell, Mass. 01852)	Lot at NW corner of Suffolk Yard.
Steam Associates, Inc. 750 Suffolk Street Lowell, Mass. 01854	Lawrence Yard structures.

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George W. McQuade 5 Butt Hinge Road Chelmsford, Mass. 01824	Lawrence Yard structure on Perkins Street.
Interin Corporation, Inc. 750 Suffolk Street Lowell, Mass. 01854	Lawrence Yard structure.
Kenneth M. Scagel and Kenneth M. Scagel, Jr. Atlantic Associates 576 Lawrence Street Lowell, Mass. (Send also to: Scagel & Scagel Atlantic Associates c/o Donald Sisson 234 Nesmith Street Lowell, Mass.)	Lawrence Yard structure.
Ames Textile Corp. 720 Suffolk Street Lowell, Mass. 01854	Lawrence Yard structure.
Aiken Realty Corporation 361 Aiken Street Lowell, Mass. 01854	Lawrence Yard structures.
Woodle Realty Company 361 Aiken Street Lowell, Mass. 01854	Lawrence Yard structures.
Ms. Ruthanne Jaffe Executive Director Lowell Day Nursery 119 Hall Street Lowell, Mass. 01854	Lowell Day Nursery.
Ms. Eva Soucy 197 White Street Lowell, Mass. 01854	Suffolk Boarding House Apt.

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Normand J. and Florence Langlois 129 Cabot Street Lowell, Mass. 01854	Suffolk Boarding House Apt.
Ernest and Alda Beland 121 Cabot Street Lowell, Mass. 01854	"
Ms. Isabelle Watson 119 Cabot Street Lowell, Mass. 01854	"
Ms. Rose A. Sarrasin 113 Cabot Street Lowell, Mass. 01854	"
Ms. Lorraine I. Veator 111 Cabot Street Lowell, Mass. 01854	"
Paul J. and Lorraine L. Desmarais Maplewood Ave. Tyngsborough, Mass. 01879	"

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I. The Canals.

*Pawtucket Canal. This canal was built in 1796 as a transportation canal to avoid the Pawtucket Falls of the Merrimack River. In 1822 the builders of Lowell transformed the Pawtucket into a feeder for the Merrimack Canal, which powered the first of Lowell's large mills, the Merrimack Manufacturing Co. The Pawtucket became a two-level canal. The first level, about 30 feet above the lower Merrimack and Concord, flowed from a few hundred feet upstream of the dam to the Swamp Locks, a distance of about 5,700 feet. Locks for barges and a gatehouse were located near the intersection of the canal with Broadway, about 1,700 feet from the upper Merrimack. At the Swamp Locks were a set of locks and a wasteway. The Merrimack Canal joined the Pawtucket at this place. At the Swamp Locks the Pawtucket Canal dropped 13 feet and continued at the lower level, 17 feet above the river, for another 2,150 feet. Here, at the Lower Locks, was another set of locks and a wasteway, at which point the canal dropped into the Concord River. The width of the Pawtucket varies from 80 to 100 feet and the average depth is about 8 feet. The Pawtucket Canal today is essentially the same as that of 1825, with the exception of modification in such control areas as the locks and wasteways. It flows through Lowell from Pawtucket Dam to the Concord River.

*Merrimack Canal. This was the first power canal built by the Proprietors of Locks and Canals. It was intended to power the Merrimack Manufacturing Company with a 30-foot fall of water. Its design was crude; little attention was expended upon creating a uniform section. In some areas the section is rectangular, but in most of the Merrimack the canal has simply been gouged out of the native rock. The canal is 10 feet deep, 2,580 feet in length, and 40 to 50 feet wide. In addition to the Merrimack Manufacturing Co., the canal supplied water to the Lowell Manufacturing Co., and it provided the Eastern Canal with water, after the construction of a wasteway, rolling dam and penstock in the 1840's. Only the Merrimack Canal provides a full 30-foot fall; the other canals provide either a 13- or 17-foot fall. In order to increase the amount of water flowing in the Merrimack Canal, the Moody Street feeder, connecting the

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Western Canal with the Merrimack Canal, was built in 1848. The extra water was available in 1848 because of the construction of the Northern Canal in 1847.

*Hamilton Canal. This was completed in 1826 in order to provide a 13-foot fall of water to the Hamilton and Appleton Mills. The Canal begins at the Swamp Locks and draws its water from the upper Pawtucket Canal. The water flows through the penstocks of the Hamilton and Appleton Mills and is discharged into the lower Pawtucket Canal. Excess water flows from a wasteway at the end of the Hamilton Canal to the lower Pawtucket. The Hamilton Canal is 1,936 feet in length, 10 feet deep, 35 to 100 feet wide, and is rectangular in section.

*Lowell Canal. The Lowell Canal was constructed in 1828 to provide power for the Lowell Manufacturing Co. It draws its water from the Merrimack Canal. Water from the Lowell Canal dropped 13 feet through the wheels of the Lowell Mfg. Co. and exited into the Lower Pawtucket Canal. The Lowell is 500 feet in length, 30 feet wide, and averages 10 feet in depth. It is rectangular in section. The canal was covered in 1880 by the Brussels Carpet Weaving Mill of Lowell Manufacturing Company.

*Western Canal. The Western Canal was built in 1831-32 as a two-level water power system for the Tremont and Suffolk Mills on the upper level and the Lawrence Mills on the lower level. Locks were initially constructed in the Western to enable barges to reach the textile mills but locks were filled in during the 1840's; the remnants of the locks at the Hickey Hall Dam are still visible. The Western initially drew its water from the upper Pawtucket Canal, above the Swamp Locks, and flowed in a northerly direction to the Tremont-Suffolk Mill complex. These mills, on opposite sides of the Western's upper level, drew practically all of the water through their wheelpits, a fall of 13 feet, and discharged the water into the Lawrence Canal, a spur of the lower level of the Western. Any water which did not flow through the penstock of the Tremont and Suffolk Mills flowed through the wasteway of the Western Canal and fell into the Western's lower level, where it joined the Lawrence Canal. Water from the lower level of the Western as well as

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the Lawrence Canal dropped 17 feet into the wheelpits of the Lawrence Mills, and discharged into the Merrimack River. A wasteway constructed just below the intersection of the Lawrence and lower level Western, carried excess water into the Merrimack River. The construction of the Northern Canal in 1847 radically altered the role of the Western Canal. The Northern delivered all of its water into the Western at the headgates of the Tremont and Suffolk Mills, and the mills now drew their water directly from the Northern. The lower level of the Western-Lawrence Canals remained unchanged. The upper level of the Western, however, was greatly altered. The flow of the Northern reversed the direction of the upper Western's current, and the upper Western became a feeder for the upper Pawtucket, thus providing extra water for the Merrimack, Hamilton and lower Pawtucket. The Moody Street Feeder, finished in 1848, also drew its water from the upper Western and delivered it to the Merrimack Canal. This arrangement is followed by the present operators of the Lowell Canal system. The total length of the Western Canal is 4,964 feet. Its width varies from 35 to 55 feet, and its average depth is 9 feet.

*Eastern Canal. This canal was constructed in 1835 as a single level canal to power the Prescott, Massachusetts, and Boott Mills. The Eastern began just above the wasteway and locks of the lower Pawtucket Canal, and ran for 2,037 feet, providing water with a 17-foot drop to the Massachusetts, Prescott, and Boott Mills, which discharged the water into the Concord and Merrimack Rivers. The Eastern averaged 8 feet in depth, 40 to 65 feet in width, and was rectangular in section. Additional water for the Eastern was supplied from the Merrimack Canal, which was connected by a penstock to the Eastern at the wasteway of the Eastern. Excess water from the Eastern flowed through this wasteway and into the Merrimack River.

*Northern Canal. The Northern Canal was designed by James B. Francis, Chief Engineer of the Proprietors of Locks and Canals, as a feeder to supplement the Pawtucket Canal. Built simultaneously with the dam across the Merrimack, the Northern was also intended to raise the total head available at Lowell by 3 feet, since it reduced velocity and friction losses throughout the canal system. The canal is rectangular

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in section and has only one major curve, thus allowing the water to flow in as smooth a manner as possible. It is 4,373 feet in length, averages 100 feet in width and is 15 to 21 feet in depth, depending upon the width of the canal at a given point.

*Moody Street Feeder. The Moody Street Feeder was built as part of the Northern Canal project and, like the Northern, was designed by James B. Francis. The feeder drew water from the upper Western Canal and delivered it to the Merrimack Canal, where it could be used to meet the needs of the Merrimack Manufacturing Co. The Merrimack Canal, so provided with water by the feeder, was also used to supply the Eastern Canal with water, by means of a penstock constructed in the years 1846-48. The feeder is 1,418 feet long, 30 feet in width, and 10 feet in height. It is divided into three parts by two longitudinal walls, forming the piers for three arches, which close the conduit on top. The segmented arches are made of brick. The piers and sidewalls are granite.

*Boott Penstock (near Kirk and French Streets). The Boott Penstock was built in 1846 to supply water to the Eastern Canal from the Merrimack Canal. It was enlarged in 1848 and again in 1873. In 1889 an extension to the penstock was built, designed to reduce problems of turbulence and icing in the Eastern Canal. The modification was a channel run parallel to the Eastern Canal and connected to it by 15 underwater openings through a masonry wall. An iron penstock gatehouse was added in 1906.

II. The Mill Yards and Shops.

*Hamilton Yard (Jackson Street between Hamilton and Gorham Sts). The Hamilton Manufacturing Company was the second of the large cotton corporations to begin operations in Lowell, its first mill going into production in 1826. The company was sited on the Hamilton Canal, and the water from this canal passed through its wheelpits, dropping 13 feet into the Lower Pawtucket Canal. The Hamilton manufactured shirtings, sheetings, drills, and print cloth. Like those of the Merrimack Manufacturing Company, the Hamilton's owners constructed a print works in 1828. The company, in 1839,

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produced 5 million yards of cloth annually. By 1890 the figure had risen to almost 40 million yards. The Hamilton continued operations until after World War II, when it ceased operations. The mill has been tenanted ever since. The print works have been totally removed, and only one of the original mills remains. This structure is Mill No. 4, built in 1847. The mill was originally 4 stories high, 50 feet wide, and 400 feet in length, twice the size of the original "Waltham style" mills. It had a pitch roof with dormers at 10 foot intervals, one stair tower and a water closet tower. An unusual feature in the building's construction is the use of only a single row of wooden columns, allowing a bay 25 feet deep and 10 feet wide. Most mills employed a double row of columns. In 1882 a six-story mill was completed that was adjacent to Mill No. 4 and about 90 feet of the old mill was demolished to accommodate the new structure. Sometime during the 1880's the pitch roof was removed from Mill No. 4 and two additional stories were added, with a flat roof. All of the remaining buildings in the Hamilton yard date from the very late 19th and early 20th centuries.

*Appleton Yard (Jackson Street between Revere and Hamilton Sts). The Appleton Company was established in 1828 as a manufactory of sheetings, shirtings, and drills. It drew the water for its water wheels and later its turbines from the Hamilton Canal, and its tailraces faced on the Lower Pawtucket Canal. In 1839 the company's annual production was 5,000,000 yards of cloth. In 1890 it was close to 20,000,000 yards. The company suspended operations in the 1920's, and has been tenanted ever since. Ten turbines are still in place. The two oldest are McCormack horizontal turbines (1901). The two latest turbines are horizontally mounted Hunt wheels. None of the original buildings remain. The two oldest surviving structures are a cotton storehouse dating from about 1890 and a spinning and weaving mill, entirely steam powered, which was built in 1873.

*Bigelow Yard (Market, Gorham, and Dutton Streets). The Lowell Manufacturing Company began operations in 1828 as a maker of Osnaburgs or Negro Cloth. Hand woven carpets were also made. In 1842 the Bieglow power carpet loom was introduced, and in 1848 the company switched its entire operation to carpet making. In 1914 the Company moved its

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operations to Thompsonville, Conn., as part of a conglomerate of carpet manufacturers which had been organized in 1901. The buildings were leased to the U. S. Cartridge Co. until 1920 when they were distributed among a number of small manufacturers. None of the original buildings survive and the Lowell Canal, which supplied power for the Company, has been covered over. The oldest remaining building is an 1880 weaving mill for Brussels Carpets, three stories high, 400 feet by 75 feet. The mill ran by steam power, and the boiler house built to house the boiler for the 500 HP steam engine is still standing, but is now derelict.

*Suffolk and Tremont Yards (Suffolk Street and Northern Canal). The Suffolk Manufacturing Company was organized in 1831 for the manufacture of cotton sheetings, shirtings and drills. It drew water from the Western Canal and discharged it into the Lower Western or Lawrence Canal, after a drop of 13 feet. The Suffolk was poorly managed during the Civil War years and the mill passed into the control of the Ayer brothers in 1871, together with the Tremont Mills, which faced the Suffolk Mills across the Western Canal. From this point onward the Company was known as the Suffolk and Tremont Mills. During the 1930's the mills were closed and became tenanted properties. The Suffolk remains so today, but the Tremont has been completely destroyed as part of urban renewal. Of the 1831 buildings, only the counting house remains. The remaining original buildings were replaced with larger structures during the 1860's.

*Lawrence Yard (Perkins Street). The Lawrence Manufacturing Company, named after the Boston family of financiers who invested so heavily in the industries of Lowell, was incorporated in 1831 by William Appleton and Benjamin R. Nichols, and by 1848 included 45,000 spindles, manufacturing 13.5 million yards of print cloths, shirtings and sheetings per year. In 1864 the Company added knitting frames and began to produce hosiery and knit underwear. By 1885 the mills included 105,000 spindles and 2,360 looms and knitting frames. In one week the company manufactured 425,000 yards of cloth and about 300,000 items of knitwear. Power was supplied by means of water from the Lawrence Canal and steam engines which were installed in the 1870's and '80's. Water turbines produced about 3500 HP and steam engines produced an additional 2700 HP. Six turbines remain in use, all of which are Hercules turbines dating from 1909-16. Two of the original 1832

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mills remain, although altered by the addition of a fifth story. The mill which connects these two buildings was constructed in 1855. Two other mill buildings facing upon the river were built in 1861 and 1870, but were constructed in an almost identical fashion to the 1832 mills. A bleaching house, built in 1876, remains unaltered, as does an 1876 boiler house, engine house and octagonal chimney. An 1835 cotton storehouse remains largely unaltered. The remaining buildings were erected in the years 1890-1910.

*Boott Mills (Amory Street). The Boott Mills were established in 1835 by Abbott and Nathan Lawrence and John A. Lowell and named after Kirk Boott. By 1848 the Boott produced 10.5 million yards of heavy drills, fine shirtings and print cloth per year. The mills contained 35,000 spindles. In 1884 the Boott contained 140,000 spindles and 3,875 looms. All of the six original mills, built between 1835 and 1843, are standing, although the original pitch and clerestory monitor roofs have been replaced by an additional story and flat roofs. In the 1860's several large additional buildings were added. These buildings are also still in place. The engine and boiler house were built in 1885. The steam engines produced 2400 HP. The main sorce of power was that of breast wheels, then water turbines, which were supplied with water from the Eastern Canal. Seven turbines remain in the wheel pits of the Boott, including two Swain turbines dating from 1874 and 1875, two Allis-Chalmers (1940's) and three Leffels (1920's).

*Massachusetts Mills (Bridge Street and Central Bridge). The Massachusetts Mills were the last of the large textile mills to be incorporated in Lowell. They were established in 1839 by John A. Lowell and Abbott Lawrence. In 1848 the company operated 46,000 spindles and manufactured 25 million yards of sheetings, shirtings, and drillings per year. This continued to be the company's product until the 1940's, when all operations were transferred to the company's mills in the South. The buildings today are occupied by a considerable number of tenant industries. The Massachusetts, sited at a point of land between the Concord and Merrimack Rivers, drew its water power from the Eastern Canal, and employed steam engines as well. The wheelhouse, rebuilt in 1872-88, contains six Hercules turbines dating from 1920-21, still in operation. The boiler and power houses, built in 1910, are used for other purposes. The four original mill buildings, constructed in

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1839, are in place, although altered by the addition of a fifth story and a shallow pitch roof. They are standard-sized first generation Lowell mills, 200 feet by 50 feet, with four stories and a basement. The four original buildings have been connected by additional structures erected in the 1860's and 1870's. Most interesting of the modern buildings is an 11-story, reinforced concrete storehouse dating from 1910. It was designed by Lockwood Greene Engineers. It is constructed of reinforced concrete and brick and has load bearing walls at 64-foot intervals in its 256-foot length. The basement, third, sixth, and ninth floors are concrete; the rest are of wood. The pillars are cast iron. This is a good example of a textile building constructed during the transition from brick to concrete.

*Proprietors of Locks and Canals Workshops (Western Canal near Broadway). The offices and workshops of the Proprietors of Locks and Canals were built along the Western Canal, Broadway, and Worthen Street during the 1820's and 30's. Three adjoining shops remained in 1974. Two were of wood and one was constructed of brick. All were pitch roofed. Their total length was 100 feet, and their width was 25 feet. The buildings were said to contain a large number of patterns as well as a number of tools and machines, most notably a rotary planer. The owner would not allow anyone to enter the buildings. The Proprietors of Locks and Canals moved their offices to the Boott Mills during the 1950's, and the office buildings and shops were used for storage afterward. Fire destroyed some of the buildings in 1976, but two principal ones have been stabilized.

Lowell Machine Shop (Dutton Street at Western Canal). Most of what once constituted the Lowell Machine Shop was razed in the 1930's. Those demolished structures stood, according to the Massachusetts Historical Commission, on the island created by the Pawtucket, Lowell, and Merrimack Canals. Extant, however, are a five-story red brick building (circa 1900) and a reinforced concrete plant (circa 1910 on Dutton Street at the Western Canal.

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III. Locks, Dams, Gates, and Other Canal-Related Structures.

*Great (Francis) Gate (Pawtucket Canal north of Broadway). The Great Gate was designed in 1848 by James B. Francis, Chief Engineer of the Proprietors of Locks and Canals, and completed in 1850. The portcullis gate, of southern pine, is made up of 26 timbers, each 27 feet long and 17 inches wide. The gate has been dropped twice, in 1876 protective sheathing was attached to part of the upstream portion of the gate to protect it from floating debris. No other modifications have been made.

*Guard Locks Gatehouse (Pawtucket Canal north of Broadway). This brick gatehouse, built in 1870, replaced an 1848 wooden structure. The 1848 guard dam replaced an 1832 dam, which in its turn replaced an 1822 dam. The gatehouse encloses five sluice gates, operated by hydraulic lifting machinery. The water pressure was supplied by a 6-inch main from the Locks and Canals reservoir in Belvidere. The gatehouse and lifting machinery are essentially intact, with the exception of the three middle cylinders, which were replaced with oil hydraulic cylinders and pistons in 1965.

*Guard Locks Lockhouse (Pawtucket Canal north of Broadway). This building was erected over the upstream pair of gates in 1881, replacing the first building on this site, a functionally similar structure built in 1857. The structure shelters chain and windlass equipment which mechanically assists in opening each of the navigation guard gates. This winding equipment, also built in 1881, replaced similar machinery built prior to 1846. The light wooden frame building has a slate shingled hipped roof. The south corners of the building contain horizontal slots which permit the rotation of the gate lever beams which extend outside the structure.

*Swamp Locks and Dam (Pawtucket Canal at confluence with Merrimack Canal). The basic configuration of this complex (two navigation locks and dam at the west end of the upper lock) was achieved in 1822-23 when the Pawtucket Canal was reconstructed. However, the extant physical works are based on the rebuilding of 1839-41,

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when the dam was rebuilt in its stepped configuration and the locks narrowed from 25 feet to 12 feet. The lock walls around the three gate pockets were done in ashlar, and the remaining chamber walls were constructed of wood, all within the existing 25-foot rubble locks. The wooden sides no longer remain although they were periodically renewed. The walls of the upper chamber only were rebuilt in stone masonry to the 12-foot width in 1892. The sluice way on the south part of the dam was probably built in 1841 and the sluice way around the south end of the dam was completed in 1928. A protective light frame house over the length of the crest of the dam and the sluice gate in the dam was constructed first in 1859. Concrete was used to rebuild the north wall of the wasteway in 1942 and the apron on the face of the dam north of the 1841 sluice way in 1946.

*Lower Locks and Dam (Lower Pawtucket Canal east of Central Street). The basic configuration of this complex (two navigation locks and dam at the west end of the upper lock) was achieved in 1822-23 when the Pawtucket Canal was reconstructed. However, the extant physical works are based on the rebuilding of 1841-43, when the dam was rebuilt in its stepped configuration and the locks narrowed from 25 feet to 12 feet. The lock walls around the three gate pockets and the lower portion of the lower chamber were done in ashlar, and the remaining chamber walls were constructed of wood, all within the existing 25-foot rubble locks. The wood sides no longer remain although they were previously renewed. Due to frequent low water conditions in the Concord River at the low end of the locks, in 1905 the easterly half of the lower lock was deepened about 2.5 feet. In 1910, a 24-inch pipe was laid from a valve in the canal above the dam, beneath the upper lock, emptying into the lower lock, to drain the lower Pawtucket Canal. The sluice way on the north side of the dam, which was probably built in 1841, was reconstructed in 1887. A protective light frame house has been atop the crest of the dam and over the sluiceway since the late 19th century. Three concrete siphon spillways were built over the dam between 1946 and 1958.

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*Hickey Hall (Tremont) Locks and Dam (Western Canal at intersection of Suffolk and Hall Streets). As first constructed in 1831, this site included a dam which maintained the upper level of the Western Canal, and a flight of two navigation locks which provided access to the Lawrence Manufacturing Company's mills. In 1845, the dam was rebuilt into its present stepped configuration. As a result of changes in the system caused by the Northern Canal project, the locks were removed in 1848 and the upper chamber opening sealed to the height of the dam. This action was taken since the dam was not rebuilt to accommodate the new upper level. Instead, in order to maintain the new level, the Western Canal below its confluence with the Northern Canal was blocked by some form of dam or gates at the site of the Tremont Gate House, making navigation to the Lawrence Mills no longer possible. In 1868, the dam was cut down 2 feet in order to increase the supply of water directly into the Lawrence Canal when the Tremont and Suffolk Mills were not in full operation. A sluice way was then built in the dam next to the former lock chamber wall about 1870.

*Lawrence Dam (Lawrence Wasteway at intersection of Suffolk and Perkins Streets). This waste dam was initially constructed in 1831 when the Lawrence and Western Canals were built. It maintained the level of the Lawrence Canal. It was probably rebuilt in its present stepped configuration in the 1840's, the period when most of the other dams on the system were similarly reconstructed. The sluice way probably dates from the same period. The framehouse that was located over the sluice way was built in the latter part of the 19th century. In 1913, the cast iron flash board standards were replaced and raised one foot, as was the sluice gatehouse. The house was not extended the full length of the dam until the three siphon spillways, which required insulation, were built in 1948-49. The entire building along the crest of the dam burned in 1965.

*Tremont Gatehouse (Western Canal at Suffolk Street and French Street Extension). This gatehouse along with its gate operating equipment was built in 1855, replacing the temporary installation of 1847 that was built as part of the Northern Canal project. Its purpose was to permit the supply of water directly into the Lawrence Canal from the Northern Canal, if

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necessary. Normally, the Lawrence Canal was supplied with water through the tailraces of the Tremont and Suffolk Mills. The gatehouse contains two offset sluice gates which are each manually operated with counterweighted rack and pinion equipment. Manual operation was replaced with electric motor drive that was added to the original equipment early in the 20th century.

*Merrimack Canal Guard Gates (Canal at Swamp Locks Basin). These gates were constructed in 1847 to allow the separate draining of the Merrimack and Lowell Canals. The extant gates are a single set of swing gates of massive timber construction that are much heavier than standard navigation gates since they are required to withstand the force of the impounded water the full depth of the gate for extended periods. The operation of these gates was mechanically assisted by chain and windlass equipment, now no longer extant.

*Rolling Dam (Merrimack Canal near intersection of Kirk and French Streets). The initial construction of this dam took place in 1835 when the Merrimack Wasteway was reconstructed to facilitate wasting from the then new Eastern (Boott) Canal. It provided the intermediate level necessary to vertically align the Merrimack Canal (on the upper level of the system) and the Eastern Canal (on the lower level) so they both could discharge water through the Merrimack Wasteway. This intermediate level was later used to supply water to the Eastern Canal from the Merrimack Canal through the Boott penstock. A house sheltering either a weir or a gate was erected over the dam sometime during the latter half of the 19th century to maintain a water level of sufficient height to adequately feed the Boott penstock. A house remains over the dam, but the device used to control the water level has been removed. There is no evidence that a roller gate of the type generally associated with a "rolling dam" was ever used at this site. It is possible that this name was given to this dam because it was the only one to survive with a curved configuration to its face, although there were, at one time, several of this type in the system. The profile of the dam was slightly altered in 1934 when a concrete facing with iron strap overlay was added which slightly increased its height.

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*Boott Dam (Eastern Canal near intersection of Kirk and French Streets). This dam was originally built in 1835 to control the level of the Eastern Canal, completed at the same time. Its face was in a curved configuration and its crest was topped with flashboards. In 1878, a sluice way with portcullis gate was built into the dam to facilitate the removal of ice from the Eastern Canal. The face of the dam was probably rebuilt into its present stepped configuration and the first enclosing structure built over it at that time. In 1892, the house was rebuilt to accommodate a hydraulic lift on the sluice gate. This house and its gate machinery are extant. Subsequently, three concrete siphon spillways were added. The pair on the south side of the dam was constructed in 1948, and the one on the north side at about the same time.

*Hamilton Wasteway Gatehouse (Near intersection of Jackson and Central Streets). The Hamilton Wasteway was first built in 1850 to waste ice from the Hamilton Canal into the Lower Pawtucket Canal. The original gates and gatehouse were replaced when the wasteway was rebuilt in 1872. The gate operating equipment and the gatehouse of 1872 are extant. The two gates were originally manually controlled by counter-weighted rack and pinion machinery. The gatehouse is located at the head of the brick vaulted wasteway. Manual operation was replaced with electric motor drive that was added to the original equipment early in the 20th century.

*Hamilton Canal Guard Gates (Hamilton Canal adjacent to Jackson Street between King and Revere Streets). These gates were originally constructed in 1847 near the head of the Hamilton Canal to allow it to be drained separately. The original gates were replaced in 1853. The extant gates are a single set of swing gates of massive timber construction that are much heavier than standard navigation gates since they are required to withstand the force of the impounded water the full depth of the gate for extended periods. The operation of these gates was mechanically assisted by chain and windlass equipment which was in place at each gate by 1855, when a wooden framed house enclosed the winding equipment on the south bank. Subsequently, a house was built over the equipment on the north bank, but neither are extant, although the winding equipment is.

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*Moody Street Feeder Gatehouse (Merrimack and Dutton Streets). The Moody Street Feeder Gatehouse was completed in 1848 as part of the feeder itself. The house contains three manually operated sluice gates equipped with counterweighted rack and pinion equipment. This equipment is original except for the counterweights, which were added in 1853.

*Western Canal Guard Gates (Western Canal at intersection of Moody and Suffolk Streets). These gates were constructed in 1848 to allow the draining of selective parts of the canal system in conjunction with gate closings on other parts of the system as required. This was done by a double set of swing gates in the Western Canal between the Swamp Locks Basin and the entrance to the Moody Street Feeder. The gates, located back-to-back, open in opposite directions. Only one pair of gates was closed at a given time, depending on the portion of the system to be drained. These massive timber gates are much heavier than standard navigation gates since they were required to withstand the force of impounded water the full depth of the gate for extended periods. The gates were manually operated with chains from their ends rather than with lever beams. One of the four gates was broken off in 1960 and rests in the bottom of the canal at the entrance to the Moody Street Feeder.

*Pawtucket Dam (Merrimack River above School Street). This masonry dam was built in 1847 and 1875, replacing earlier masonry and wood dams of 1826 and 1833. The dam follows the outline of the natural ledge of the Falls. The foundation of the dam consists of granite blocks laid in a trench. The face of the dam is constructed of quarry faced granite blocks, and the interior is granite rubble set in hydraulic cement. The dam has no spillway. Its crest averages 15 feet in height above the ledge of the falls, depending on the contour of the river bottom. With its flashboards in place, the dam is capable of ponding the river for a distance of about 18 miles. The dam is 1,093.5 feet in length. The fishway was built in 1921.

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*Great River Wall (Northern Canal along Merrimack River). The Great River Wall was built as a retaining wall for the upper Northern Canal in 1846-47. The wall is about 2,300 feet long, and is largely built of random coursed granite

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rubble laid in cement. About 700 feet of the wall was erected on an island formed by the excavation of the canal. As a result of the 1936 flood, about 100 feet of the lower river wall was replaced with a concrete plug.

*Northern Canal Guard Gates and Pawtucket Gatehouse (Merrimack River at School Street). This site contains the guard sluice gates, their brick gatehouse, and a navigation lock, all part of the northern canal construction project of 1846-47. The 10 sluice gates were operated by a mechanical system that consisted of a turbine located in a chamber beneath the deck of the School Street Bridge which transmitted power to the two hoisting screws on each gate. Most of the original equipment, including the Francis turbine, is intact. Alterations include a water tight enclosing wooden cover in the turbine pit in 1872 to prevent flooding of the turbine chamber in high water. Also, the line shaft was replaced in 1881, and the smaller belt pulleys replaced in 1883 by friction pulleys and clutch mechanisms which allowed independent operation of each gate. Early in the 20th century, electric motors replaced the turbine as the line shaft's prime mover. These motors were subsequently replaced by individual motors at each gate. The navigation lock has not been used since 1871 when a wooden bulkhead was built to close the lock. This bulkhead was replaced by a concrete wall in 1939.

*Northern Canal Waste Gates (Northern Canal below Moody Street Bridge). This site, which comprises the downstream end of the Great River Wall, originally included four waste gates and their manually powered operating machinery, along with a waste weir divided into multiple bays by cast iron standards. These works were completed in 1847 as part of the Great River Wall project. Major modification took place in 1872 when one of the scouring holes was converted into a wheel pit where a turbine was installed to power mechanical gate operating equipment which was added atop the original manually operated mechanisms. At the same time, a flat roofed heavy timber framed building was erected over the waste gates, and a hip-roofed, light-timber-framed building was built over the waste weir.

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*Massachusetts Wasteway Gatehouse (Eastern Canal at east side of Bridge Street). This wasteway and its gatehouse were built in 1862 to facilitate the removal of ice from the Eastern Canal. The original small wooden framed gatehouse at the entrance, which contains four bays of flashboards, is extant. In 1883, the wasteway was lengthened when the Massachusetts Yard was extended about 26 feet to the newly established river line.

IV. Mill Housing and Other Structures.

Suffolk Mills Boarding House (Cabot between Moody Street and French Street Extension). A fine example of workers' row housing, this 2 1/2-story, 18-bay-long, red brick, gable-roofed structure was erected about 1845. It contains five apartment units and has been partially restored. According to the Massachusetts Historical Commission, in the 1960's five other apartment units were removed from the north end of the building to make way for the extension of French Street. Each remaining apartment is individually owned.

Boott and Massachusetts Mills Boarding Houses (Corner of French and Bridge Streets). These red brick structures probably represent the largest remaining concentration of company housing in Lowell. Both were erected in the 1840's. The Massachusetts Mills boarding house rises three and one-half stories and is rendered in the Greek Revival style. The L-shaped, four-story Boott Mills boarding house displays an 1890's Queen Anne facade. Both buildings appear to be in sound condition.

Boott Mills Boarding House Block (Between French and Amory Streets at Kirk Street). Now the Cotton House of Boott Mills, this multistory red brick structure served formerly as a boarding house for Boott employees.

Lowell Day Nursery (119 Hall Street). This 3 1/2-story, parapet-gable-roofed structure was constructed of gray stone, laid in random ashlar, sometime prior to 1885. According to the Massachusetts Historical Commission, it served originally as the residence of the agent of the Lawrence Manufacturing Company and became the home of the mill-sponsored Lowell Day Nursery sometime after 1885, probably about 1889 when the nursery received its charter. The building displays little

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exterior alteration and still serves as a nursery facility. In the rear it is attached by an enclosed walkway to a new red brick addition.

Locks and Canals Blacksmith Shop (South bank of Merrimack River adjacent to Northern Canal Gatehouse). A small one-story frame structure, the blacksmith shop was used, according to the Massachusetts Historical Commission, in the repair of lock machinery after spring flooding. It appears to be in fair condition.

Northern Canal Gatekeeper's Cottage (On School Street adjacent to Northern Canal Gatehouse). This 1 1/2-story, Victorian style, wood frame cottage was constructed about 1850 to serve as living quarters for the gatekeeper for the Northern Canal.

Boundary Justification. The boundary of the historic district encompasses (1) the entire Lowell canal system including the several waterways and their support structures, (2) the extant structures of each principal 19th-century mill yard that used the system, and (3) several company boarding houses. Not included within the boundary are numerous attendant commercial, municipal, religious, and residential structures that appear also to merit the recognition and protection that they might receive from inclusion in a NHL district. They are excluded largely because they could not be studied adequately within the time and budgetary limits of this survey as a result of (1) new NPS inventory-preparation guidelines resulting from the Tax Reform Act of 1976 (which was passed after the survey was budgeted) and (2) the unavailability of necessary preliminary primary-source data from state and local agencies during the planning stages of this study. Some of these structures already form the Lowell City Hall National Register district, however. Furthermore, because they reflect the social and cultural aspects of Lowell as a planned industrial community, it is likely that they will be the subject of a separate NHL inventory-nomination in the next phase of the survey of commercial and industrial properties. Meanwhile, their ommission from the Locks and Canals district does not detract from its national significance.

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Boundary Description. As indicated in red on the accompanying maps [(1) U.S.G.S. 7.5' Series, Mass., Lowell Quad., 1966; (2) Locks and Canals Historic District Map, 1 inch=250 feet, Lowell Planning Department, circa 1976; and (3) Proprietors of the Locks and Canals on Merrimack River Canal System, reduced from 1 inch=300 feet, Historic American Engineering Record, 1975], a line beginning at a point on the west bank of the Pawtucket Canal at its junction with the Merrimack River and extending in a southeasterly direction approximately 6,000 feet along the right bank of said canal (and encompassing its associated structures at the upper locks) to its junction with the Hamilton Canal; thence, eastward along the south bank of the Hamilton Canal about 275 feet to a point opposite the northwest corner of the Appleton Yard structure owned by Vincent P. Morton at the northeast corner of Revere and Jackson Streets; thence, southeastward approximately 225 feet along the plane of the west side of said building to a point immediately opposite its southwest corner; thence, eastward approximately 750 feet along the plane of the south walls of said building and its associated buildings between Revere and Hamilton Streets to west curb of Hamilton Street; thence, northward about 145 feet along the west curb of Hamilton to the south curb of Jackson; thence, eastward approximately 750 along the south curb of Jackson Street to a point opposite the east side of the Hamilton wasteway near the intersection of Jackson and Central Streets; thence, northward approximately 350 feet along the east side of the Hamilton wasteway to the south bank of the Lower Pawtucket Canal; thence, eastward approximately 1,200 feet to the west bank of the Concord River; thence, northward about 140 feet along the west bank of the Concord at its junction with the Lower Pawtucket to the north bank of the Lower Pawtucket; thence, westward about 375 feet along the north bank of the Lower Pawtucket to its junction with the Eastern Canal; thence, eastward approximately 550 feet along the south bank of the Eastern Canal to a point opposite the northeast corner of the Federal Building on East Merrimack Street; thence, southward approximately 250 feet along the plane of the east side of the Federal Building to the west bank of the Concord River; thence, northeastward approximately 850 feet along the west bank of the Concord to its junction with the Merrimack River; thence, northwestward approximately 1,800 feet along the right bank of the Merrimack to the north bank of the Merrimack Canal wasteway; thence,

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southwest and then northwest approximately 700 feet along the north bank of the curving Merrimack wasteway to the south bank of the Merrimack Canal; thence, northeast about 150 feet, then northwest about 450 feet, then southwest about 300 feet along the riverside bank of the curving Merrimack Canal to its point of termination; thence, northeastward about 300 feet, then southeastward about 450 feet, then southwestward about 1,000 feet along the opposite bank of the curving Merrimack Canal to its junction with the Moody Street Feeder (and including the gatehouse at that junction); thence, northwestward approximately 1,350 feet along the northeast right-of-way of the Moody Street Feeder to the south bank of the Western Canal; thence, northeastward approximately 280 feet along the south bank of the Western Canal to the northeast curb of the French Street Extension; thence, southeastward approximately 380 feet along the northeast curb of said extension to the north curb of Tremont Street; thence, northeastward approximately 1,250 feet along the north curb of Tremont to the right bank of the Merrimack River; thence, northwestward approximately 1,600 feet along the right bank of the Merrimack to the south curb of Aiken Street; thence, southwestward approximately 600 feet along the south curb of Aiken to the northeast curb of Perkins Street; thence southeastward approximately 190 feet along the south curb of Perkins to a point on a plane parallel to and about 20 feet northwest of the northwest exterior wall of the Lowell Day Nursery at 119 Hall Street; thence, southwestward approximately 200 feet along said plane to the northeast curb of Hall Street; thence, south about 140 feet along the east curb of Hall to the northwest curb of Cabot Street; thence, eastward approximately 200 feet along the northwest curb of Cabot to the northeast curb of Perkins; thence, southeastward approximately 575 feet along the northeast curb of Perkins to the north bank of the Western Canal; thence, westward about 235 feet along the north bank of the Western Canal to the southwest curb of Hall Street; thence, northwestward approximately 525 feet along the southwest curb of Hall to the south curb of Cabot; thence, westward approximately 500 feet along the south curb of Cabot to the east bank of the Northern Canal; thence, north then west approximately 1,750 feet along the east bank of the Northern Canal to the right bank of the Merrimack River; thence, westward approximately 2,000 feet along the right bank of the river to a point opposite the west side of the

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School Street-Mammoth Road bridge; thence, due northwest approximately 350 feet to the left bank of the river; thence, southwestward approximately 500 feet along the left bank of the river to a point opposite the northernmost tip of the Pawtucket Dam; thence, due east-southeast approximately 1,000 feet to the right bank of the river (and encompassing the entire dam) at a point opposite the southern corner of the Locks and Canals Blacksmith Shop and corresponding to the Proprietors of Locks and Canals property line at that point; thence, northeastward approximately 315 feet along said property line to the west curb of School Street; thence, northward about 75 feet to the south bank of the Northern Canal; thence, eastward and southeastward approximately 3,600 feet along the curving south bank of the Northern Canal to the south curb of Cabot Street; thence, southwestward approximately 375 feet along the south curb of Cabot to the north curb of Moody Street; thence, south along the south curb of Moody about 55 feet to a point opposite the southeast corner of the Suffolk Mills Boarding House; thence, northeast approximately 375 feet along the plane of the southeast side of the boarding house to the north curb of the French Street Extension; thence, southeastward approximately 425 feet along the north curb of said extension to the north bank of the Western Canal; thence, southwestward approximately 2,600 feet and southeastward approximately 425 feet along the north bank of the Western Canal to its junction with the Pawtucket Canal; thence, westward and then northward along the east bank of the Pawtucket approximately 5,900 feet (and including its associated structures at the upper locks) to the right bank of the Merrimack River; thence, westward about 175 feet across the mouth of the canal to the point of beginning.

Excluded from the area described above are four sections defined as follows:

(1) A line beginning at the junction of the south curb of Market Street and the east bank of the Merrimack Canal and extending eastward approximately 475 feet along the eastern boundary of the Bigelow Yard complex to the north bank of the Lower Pawtucket Canal; thence, northeastward approximately 1,500 feet along the north bank of said canal to a point opposite the southeast corner of the Vincent P. Morton building in the Massachusetts Mills complex; thence, north- (611)

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westward about 200 feet along the exterior plane of the southwest end wall of said building to the northwest curb of Bridge Street; thence, southwest approximately 125 feet along the northwest curb of Bridge Street to the north curb of Paige Street; thence, northwest approximately 50 feet along the north curb of Paige to a point opposite the northwest corner of the Massachusetts Mills boarding house; thence, northeast approximately 200 feet along the exterior plane of the northwest wall of said building to the north curb of French Street; thence northwest about 125 feet along said curb of French to a point opposite the southwest corner of the Boott Mills boarding house; thence, north approximately 50 feet and then southeast about 125 feet and then northeast about 200 feet along the exterior planes of the northwest end and north sides of the L-shaped boarding house to north curb of Amory Street; thence northwestward along the north curb of Amory to a point opposite the northeast corner of the old Boott Mills Boarding House Block; thence, southwest approximately 210 feet along the exterior plane of the southeast wall of said block to the northeast curb of French Street; thence, northward approximately 500 feet along the northeast curb of French to the south bank of the Merrimack Canal; thence, southwestward approximately 1,250 feet along the south bank of the Merrimack Canal to the point of beginning.

(2) A line beginning at the intersection of the south bank of the Western Canal and the south curb of Broadway and extending approximately 700 feet southward along the south curb of Broadway to the north bank of the Merrimack Canal; thence, northeastward approximately 1,175 feet along the north bank of the Merrimack Canal to its junction with the south right-of-way of the Moody Street Feeder; thence, northwestward approximately 1,250 feet along the south right-of-way of the Moody Street Feeder to the south bank of the Western Canal; thence, southwestward approximately 1,500 feet along the south bank of the Western Canal to the point of beginning.

(3) A line beginning at the junction of the south bank of the Merrimack Canal and the north bank of the Lower Pawtucket Canal and extending approximately 800 feet along the north bank of the Lower Pawtucket to a chain link fence marking the western edge of the Bigelow Yard; thence, northward approximately 620 feet along said fence to the south bank

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of the Merrimack Canal; thence, southwestward approximately 800 feet along the south bank of said canal to the point of beginning.

(4) A line beginning at the junction of the south bank of the Lower Pawtucket Canal and the north bank of the Hamilton Canal and extending approximately 625 feet along the north bank of the Hamilton to the southwest corner of the western-most mill of that portion of the Appleton Yard on the north side of said canal; thence, northward approximately 500 feet along the exterior plane of the west side of said building to the south bank of the Lower Pawtucket Canal; thence, southwestward approximately 650 feet along the south bank of the Lower Pawtucket to the point of beginning.

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unaltered waterways, together with the surprisingly little altered mills and their machinery, form what is probably the most historically significant extant aggragation of early 19th-century industrial structures and artifacts in the United States.

History

Lowell, Mass., is situated on the right bank of the Merrimack River next to Pawtucket Falls. Here, before it joins the Concord River, the Merrimack bends sharply to the south and drops more than 30 feet. Because of its tremendous potential for waterpower development, this location proved one of the two chief ingredients in Lowell's becoming, according to Lowell Canal Survey historian Patrick M. Malone, "America's first great industrial city."[4] The other determinant was a group of ingenious industrialists led by Nathan Appleton and Patrick T. Jackson. Along with Francis Cabot Lowell and others, these energetic entrepreneurs built the country's first modern factory, a cotton textile operation, in Waltham in 1813. With the exception of Lowell who died in 1817, they were anxious by 1821 to establish a new factory to make finer grades of cloth, and they chose East Chelmsford, near Pawtucket Falls and the future site of Lowell, as the location for their venture. Besides Appleton and Jackson, other principals in this new enterprise, the Merrimack Manufacturing Company, included Paul Moody, Warren Dutton, and Kirk and John W. Boott.

Before these industrial developers could build in the area, they first had to secure the holdings and mill privileges of the Proprietors of the Locks and Canals on Merrimack River. Chartered in 1792, this company had constructed a 9,000-foot transportation canal around Pawtucket Falls and linked the upriver country with Newburyport on the coast. In 1803, however, the Middlesex Canal opened a direct route from the Merrimack to Boston and took most of the river traffic away from the Pawtucket, which soon lapsed into financial trouble. In the autumn of 1821 Kirk Boott, acting as chief agent and spokesman for the Appleton group, quietly bought up farm land on both sides of the river and purchased a majority of stock in the canal company. By December Boott's activities had sparked

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[4]Patrick M. Malone, Selections from the Lowell Canal Survey by the Historic American Engineering Record (Washington, 1976), 1.

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a rise in land prices from $20 to $4,300 per acre, but he and his colleagues had acquired some of the choicest property and gained control of the Proprietors of the Locks and Canals. Boott, Appleton, and Jackson all won seats on the company's board of directors.

Early the next year, 1822, Appleton and his fellow promoters pushed rapidly ahead with their plans for developing the area. First, they legally incorporated the Merrimack Manufacturing Company under a State charter and enlisted new investors. Some of those who bought shares had been partners in the old Locks and Canals company, while others were associates of Appleton's in the Boston Manufacturing Company of Waltham. Once their financial arrangements were completed, the promoters turned, says Appleton biographer Frances W. Gregory, "to the mechanics of establishing a mill town in the 'wilderness,' [and] their speed and zeal caught the community by surprise."[5] Kirk Boott, a partner and former British army officer with some engineering training, acted as resident supervisor of construction. Ezra Worthen served as superintendent of a crew of about 500 laborers, and Moody and Jackson provided technical guidance.

Fully utilizing the power potential of Pawtucket Falls presented special engineering problems. Malone explains in a Historic American Engineering report:

> The ideal way to supply a number of mills with water power is to use a single canal running parallel to a river with a falls. If the canal leaves the river above the falls and reenters at some distance downstream, then the land between the canal and the river becomes an extended island on which mills can be placed in a line. By keeping the level of water in the canal close to that of the river above the falls, there will be a major difference in water level between the canal and the river at every point below the falls. Water from the canal can enter the mills on the island to drop through power-producing machinery, such as water wheels,

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(continued)

[5]Frances W. Gregory, Nathan Appleton: Merchant and Entrepreneur, 1779-1861 (Charlottesville, 1975), 181.

and back into the lower river. In this way, the potential energy of the water due to its elevation, or "head", can power manufacturing processes in each mill.

Unfortunately for the planners of Lowell, the topography of their site and the route of the existing canal were not suitable for implementation of the ideal scheme. The land on the south side of Pawtucket Falls was rocky and rose steeply from the river's edge. The builders of the Pawtucket Canal had avoided high ground by running their channel in a wide arc around the bend in the Merrimack and ending it at the Concord River, close to the junction with the larger stream. Since Boott could not place mills on land higher than the level of the upper river, he had to plan mill sites away from the falls and new canals to reach them. The Pawtucket would have to be reconstructed to feed smaller power canals, but the resulting system would obviously be a complex one, creating far more engineering problems than a single canal. An additional difficulty was the necessity of retaining the original function of the old transportation waterway. Construction supplies, raw materials, and manufactured products would be carried in the Pawtucket Canal for years.[6]

By mid-1823 Boott had completed both the first of the Merrimack Manufacturing Company's mills and the first new canal, also named Merrimack. This waterway extended about 3,000 feet from the swamp locks basin on the lower arm of the Pawtucket Canal directly eastward to the mill site, which was on the bank of the Merrimack River but downstream of the bend. Along this course the new canal maintained the 30-foot, above-the-falls level of the river. Within another year Boott had the Pawtucket Canal operating again as a transportation artery with strengthened guard locks to hold back high water in floods, a set of sluice gates to control flow into the system, swamp locks to drop the water 13 feet into the lower section of the canal, and lower locks for a drop of 17 more feet into the

(585)

(continued)

[6]Malone, Selections from the Lowell Canal Survey, 3.

Concord River. From this rebuilding effort Boott turned again to expansion of the system, and by 1825 he and his follow planners had laid out routes for four more branch power canals, three to feed from the Pawtucket Canal and one from the Merrimack.

Before this work got underway, however, the Merrimack Manufacturing Company's directors, having encountered problems managing their myriad construction and manufacturing activities simultaneously, decided to form a separate company to control their surplus land (about 400 acres), the canal system, and the machine shop. In 1824 the entrepreneurs revived the old Proprietors of the Locks and Canals on the Merrimack River and transferred this property to it. The rejuvenated firm, which had the same principal owners as the Merrimack Manufacturing Company, would sell mill sites to new enterprises established in Lowell and would sell power and textile machinery to both the newcomers and the Merrimack Company. According to Gregory, this reorganization by the Lowell promoters "began the separation of business functions within the textile industry."[7]

The first new factory founded after the reorganization was the Hamilton Manufacturing Company, established by Appleton and associates in 1825. Like the Merrimack Company, which ranked among the first producers of calicoes, the Hamilton Company helped increase the diversity of textile products in the United States. "The development of calico printing," says Caroline F. Ware, historian of New England textile manufacturing, "radically altered the character and uses of plain goods, without changing the process of making the cloth."[8] Americans made no fancy goods, like checks and plaids, until after the Civil War, but the Hamilton Company did turn out bedticking, jeans, twilled goods, stripes, and Canton flannels. It was also the first company to lease water in units called "mill powers," a measure used ever since in Lowell. Led by Appleton, a committee of the Locks and Canals company formulated this means of allocating water privileges to newcomers subject

(continued) (596)

[7]Gregory, Nathan Appleton, 183.

[8]Caroline F. Ware, The Early New England Cotton Manufacture: A Study in Industrial Beginnings (Boston, 1931), 84.

to the prior rights of mills already situated in the community. One mill power represented the amount of power needed to drive the 3,584 spindles and other machinery in Appleton's second Waltham mill, about 60 net horsepower.

Between 1825 and 1836 the Locks and Canals company completed the remaining planned additions to the power system. For the Hamilton Company in 1826 Locks and Canals engineers and construction crews dug an upper level canal south of and parallel to the lower Pawtucket. In 1828 they completed the short Lowell Canal off the Merrimack to serve the Lowell Manufacturing Company; in 1831 they opened the Western Canal which extended from the Pawtucket near the swamp locks to the Merrimack River and served the Tremont, Suffolk, and Lawrence Mills; and in 1836 they finished the Eastern Canal which ran from the Pawtucket above the lower locks to the Merrimack just above its junction with the Concord. The latter canal served the Boott, and later the Massachusetts, mills.

By now, in addition to running the Locks and Canals' own machinery, the system powered 9 mill complexes, including 26 individual mills and 2 print shops. Almost 8,000 persons worked in the mills and turned out nearly 50 million yards of cloth annually. The population of Lowell, which was incorporated and named in 1826, approached 18,000, but houses. and business were situated only where they did not interfere with the routing of power canals and the production of textiles. Waterways and factories dominated the community's landscape. The scene "constitute[d]," says Parker, the first instance in America of the development of a city of the primarily industrial type."[9] And according to Ware, the corporations that ran the factories "called attention to the business advantages of the corporation accumulating a large capital, securing continuity, and making it possible to transfer shares and shift ownership." Furthermore the "enlargement of mills and increase in investment brought a geographical

(continued)

[9]Parker, Lowell, 1.

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shift, drawing the bigger mills away from the small and easily dammed streams of Rhode Island and southern Massachusetts" and moving "the principal seat of the industry to . . . northern New England towns."[10] Lowell, says Groner, became "the Manchester of America."[11]

In 1845 the directors of the Locks and Canals company sold its machine shop and most of its land and then called in all its stock and reissued it to corporations on the canal system. The Proprietors of the Locks and Canals on Merrimack River became a service company for the textile corporations. Immediately they approved plans by Locks and Canals chief engineer James B. Francis to build a second feeder canal to bring additional water into the system. The demand for power had been rising steadily in Lowell, and now in addition to the usual shortages of the summer months, the mills were experiencing difficulties throughout the year. Between 1846 and 1848 Francis supervised construction of the Northern Canal, which ran about 4,000 feet from the head of Pawtucket Falls to the Western Canal; the Great River Wall, which held the canal above the lower rapids of Pawtucket Falls where river and canal ran parallel; the Pawtucket gatehouse, which controlled flow into the canal and operated on a waterpowered Howd inward-flow turbine; and two underground waterways, including the Boott penstock which transferred some of the Northern's flow from the Merrimack to the Eastern Canal. Later, in 1850, Francis built a tremendous wooden portcullis gate over the single lock chamber at the Pawtucket Canal's guard locks. This structure, ridiculed at first, drew wide applause in 1852 and again in 1936 when it proved instrumental in saving the town from flood waters. These and other feats of design and construction, says Malone, earned Francis and his Lowell colleagues elite positions in engineering history:

> Francis' experimental work resulted in an improved inward-flow turbine and in effective methods for measuring the flow in open channels

(continued) (588)

[10]Ware, The Early New England Cotton Manufacture, 82, 145.

[11]Groner, American Heritage History of American Business and Industry, 101.

and over weirs of various shapes. As the agent of Locks and Canals, he could use the canal system as a laboratory for hydraulic experiments. Here at Lowell, perhaps for the first time in America, science exerted a regular and profound influence on technology. Other talented men who worked for Locks and Canals or for the Lowell Machine Shop also made major contributions to our knowledge of hydraulic engineering. Uriah Boyden, Asa Swain, Joseph Frizell, Clemens Herschel, Hiram Mills, and Arthur Safford became major figures in the profession.[12]

Before he retired in 1885, Francis installed hydraulic rams to operate the sluice gates at the Pawtucket guard locks and a turbine to power waste gates in the Great River Wall. Over the years his successors made other improvements, such as adding electric gate controls and implementing dredging and widening programs. Despite these changes, however, the canal system still looks much as it did in Francis' time. Most of the mills that used it have survived too, and several still rely on it for power to turn electric generators.

According to Parker the peak year for Lowell's textile factories was 1918. In 1839, soon after completion of the Locks and Canals company's first major expansion program, the nine principal corporations had approximately 163,000 spindles and 5,000 looms in operation. By 1895 these same firms, along with Massachusetts Mills, were operating 900,000 spindles and 26,000 looms and producing $23 million worth of textiles annually. In 1918 yearly production soared above $73 million. The following year, however, the city's textile production began a marked decline when the Bigelow Carpet Company completed its move from Lowell to Thompsonville, Conn. Already, in 1890, the historic community had slipped to second place among New England textile centers, behind Fall River. Subsequently, during the 1920's and 1930's the Appleton Company moved to South Carolina, and some of the other Lowell mills closed their doors. These

(continued) (594)

[12]Malone, Selections from the Lowell Canal Survey, 13.

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developments corresponded, of course, to a rapid increase in textile manufacturing in the South, where electric power proved somewhat cheaper, transportation of raw cotton required less time and expense, and laborers worked for lower wages. Today textile production in Lowell is minimal compared to the late 19th century, but most of the extant mill complexes remain in use, serving a variety of service and storage firms and small industries.

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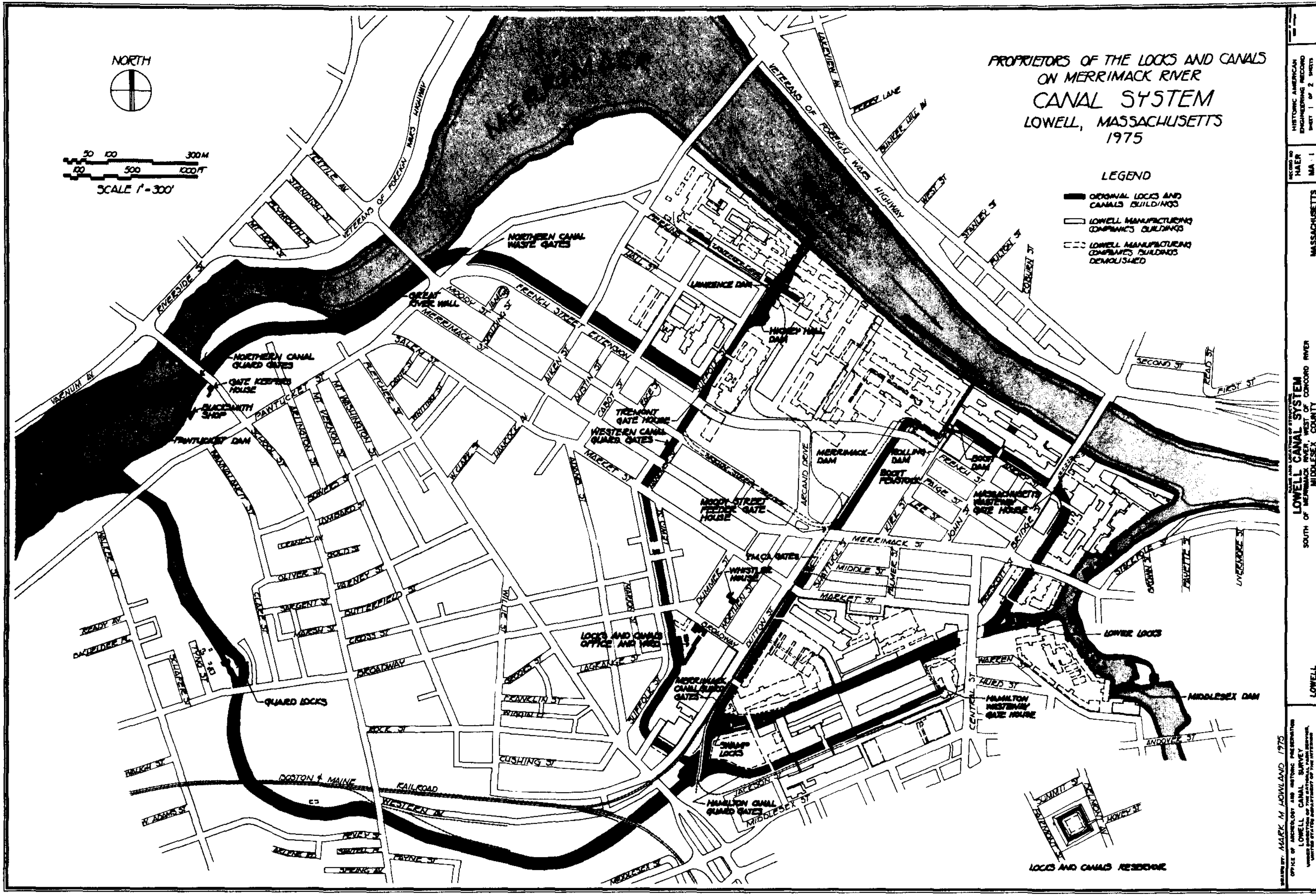
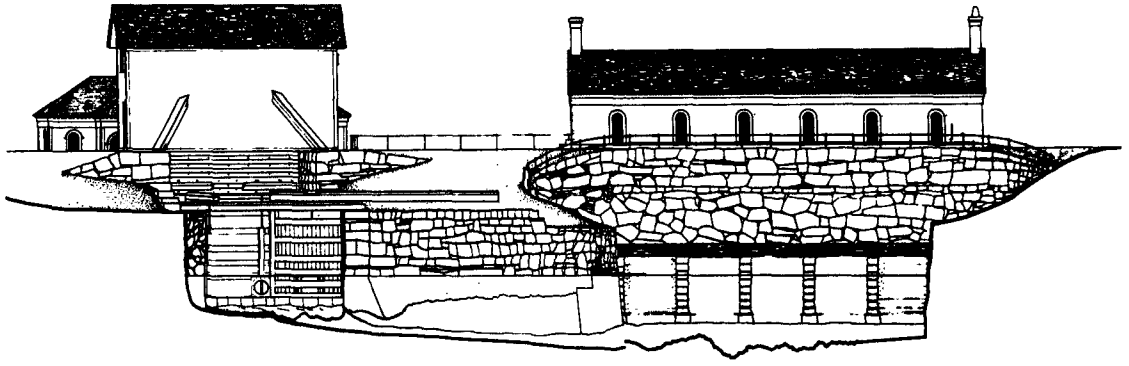

PROPRIETORS OF THE LOCKS AND CANALS ON MERRIMACK RIVER
CANAL SYSTEM
LOWELL, MASSACHUSETTS
1975
NORTH
SCALE 1" = 300'
LEGEND
ORIGINAL LOCKS AND CANALS BUILDINGS
LOWELL MANUFACTURING COMPANIES BUILDINGS
LOWELL MANUFACTURING COMPANIES BUILDINGS DEMOLISHED
NORTHERN CANAL WASTE GATES
GREAT RIVER WALL
NORTHERN CANAL GUARD GATES
GATE KEEPERS HOUSE
BLACKSMITH SHOP
PAWTUCKET DAM
LAWRENCE DAM
HICKEY HALL DAM
TREMONT GATE HOUSE
WESTERN CANAL GUARD GATES
MERRIMACK DAM
ROLLING DAM
BOOTT DAM
BOOTT PENSTOCK
MASSACHUSETTS WASTEWAY GATE HOUSE
MOODY STREET FEEDER GATE HOUSE
THOMAS GATES
WHISTLER HOUSE
LOCKS AND CANALS OFFICE AND YARD
MERRIMACK CANAL GUARD GATES
SWAMP LOCKS
HAMILTON CANAL GUARD GATES
HAMILTON WASTEWAY GATE HOUSE
LOWER LOCKS
MIDDLESEX DAM
GUARD LOCKS
LOCKS AND CANALS RESERVOIR
BOSTON & MAINE RAILROAD
VETERANS OF FOREIGN WARS HIGHWAY
FRENCH STREET EXTENSION
MERRIMACK ST
PAWTUCKET ST
MARKET ST
MIDDLE ST
BROADWAY
WESTERN AV
VARNUM AV
RIVERSIDE ST
CENTRAL ST
WARREN ST
HURD ST
ANDOVER ST
MIDDLESEX ST
JACKSON ST
CUSHING ST
FRANKLIN ST
SECOND ST
FIRST ST
DRAWN BY: MARK M. HOWLAND 1975
OFFICE OF ARCHEOLOGY AND HISTORIC PRESERVATION
LOWELL CANAL SURVEY
UNDER DIRECTION OF THE NATIONAL PARK SERVICE, UNITED STATES DEPARTMENT OF THE INTERIOR
NAME AND LOCATION OF STRUCTURE
LOWELL CANAL SYSTEM
SOUTH OF MERRIMACK RIVER, WEST OF CONCORD RIVER
LOWELL
MIDDLESEX COUNTY
MASSACHUSETTS
RECORD NO
HAER
MA - 1
HISTORIC AMERICAN ENGINEERING RECORD
SHEET 1 OF 2 SHEETS
IF REPRODUCED, PLEASE CREDIT HISTORIC AMERICAN ENGINEERING RECORD, NATIONAL PARK SERVICE, NAME OF DELINEATOR, DATE OF THE DRAWING

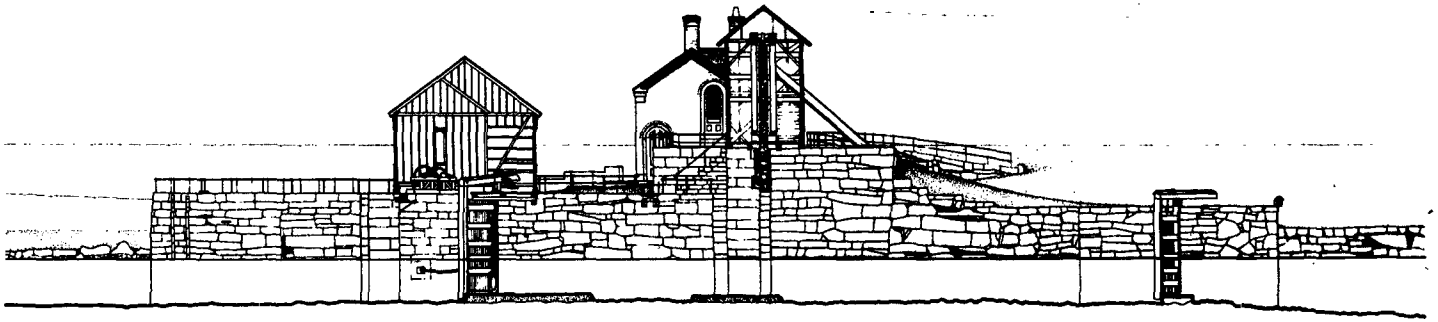
SOUTH

WEST

LOWELL CANAL SYSTEM GUARD LOCKS: FRANCIS GATE (1848-50), GATEHOUSE (1870), LOCK HOUSE (1869)



NORTH



EAST

LOWELL CANAL SYSTEM GUARD LOCKS: PRATTS GATE (1848-50), MERRIMACK (1870), LOCK HOUSE (1880)

Lowell

Locks and Canals Historic District, Lowell, MA

Joe Orfant, 1975

CDA, 50 Arcand Drive, Lowell

looking south at the sluiceways gatehouse at the Francis Gate site

photo #5 of 6

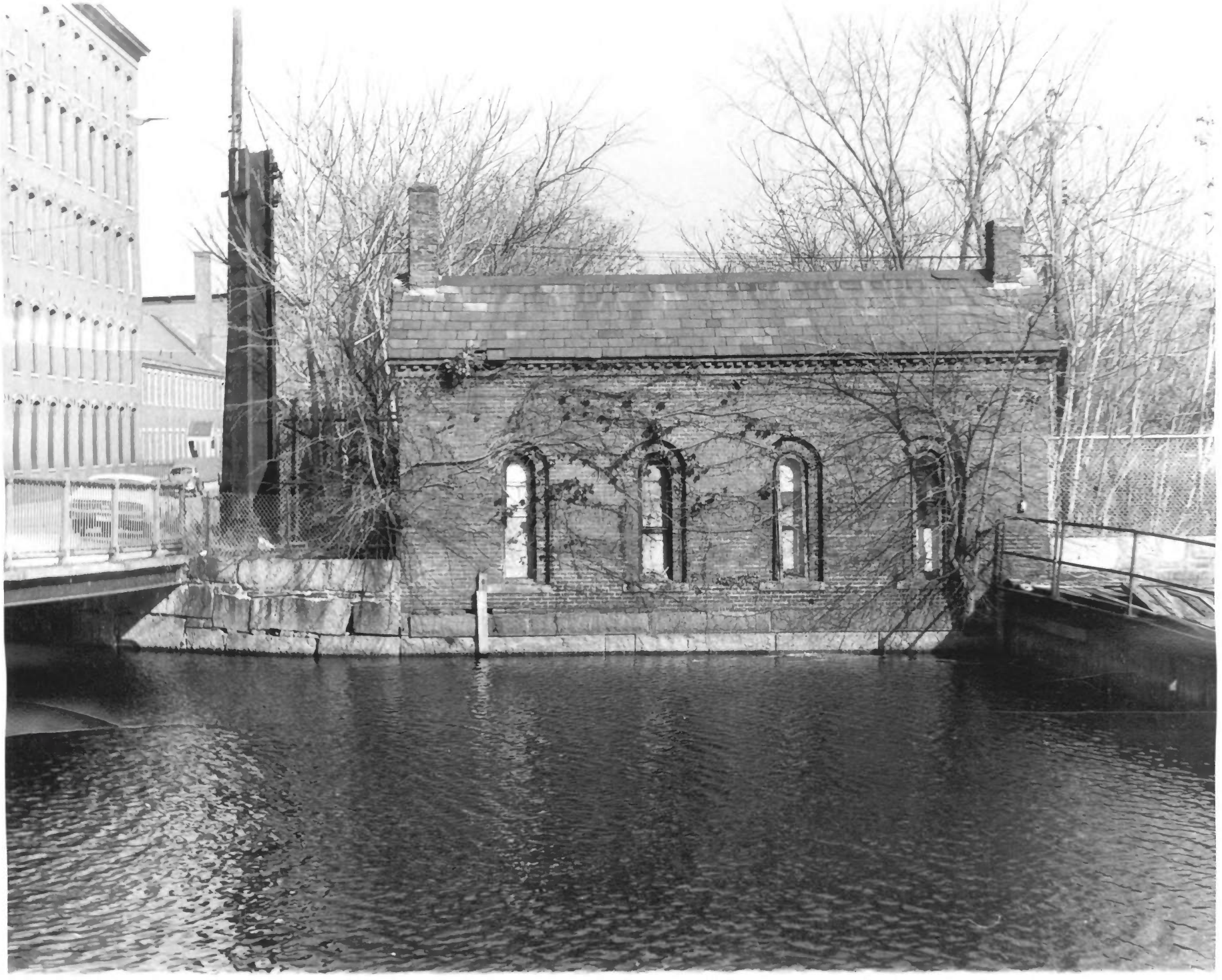
Middlesex Co. Mass.

Middlesex Co. Mass.

Lowell
Locks and Canals Historic District, Lowell, MA
Joe Orfant, 1975
CDA, 50 Arcand Drive, Lowell
looking north on Suffolk Street to the Suffolk Yard on the left, the Lawren ce County House in the background, and the Tremont Yard on the right

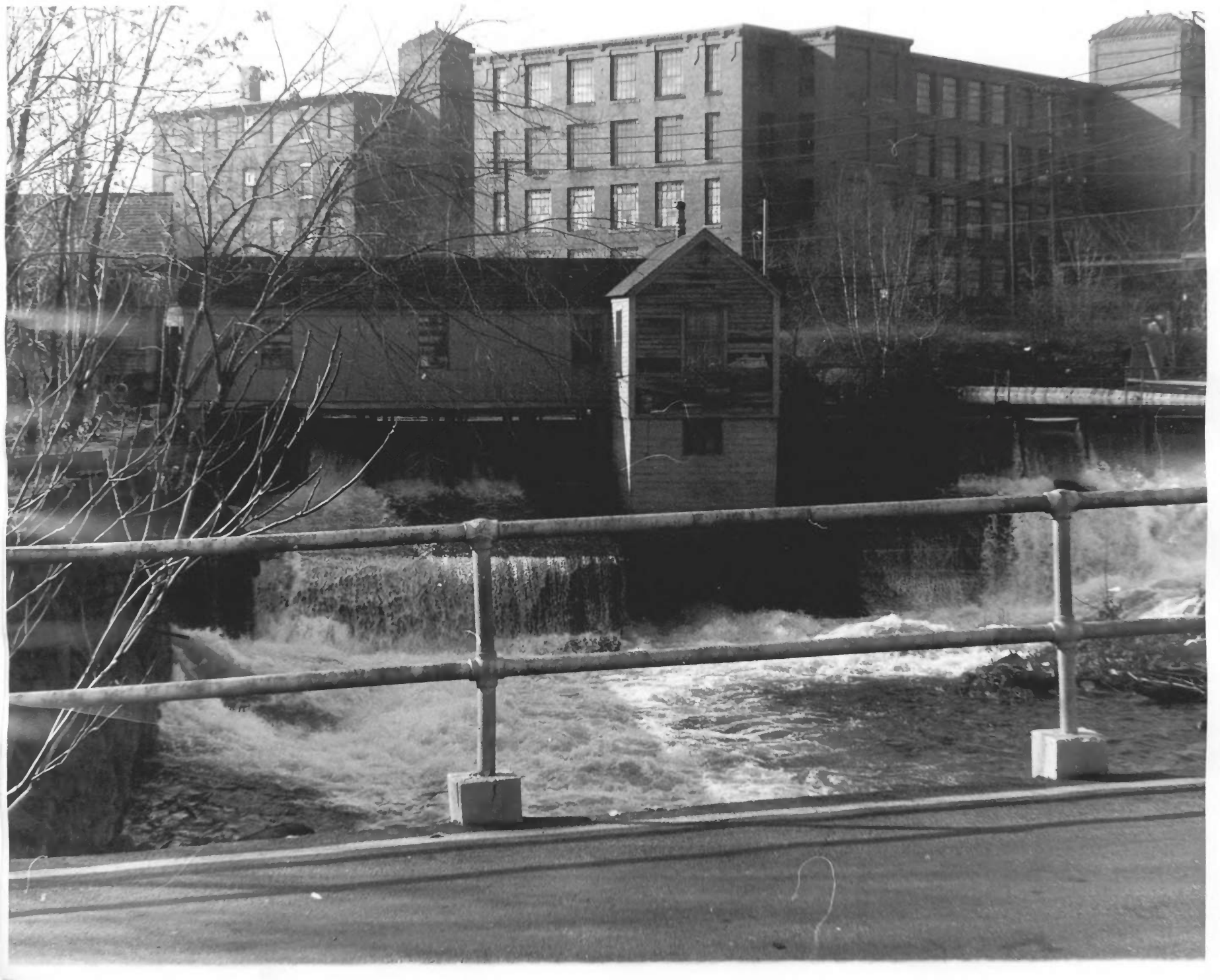
photo #4 of 6

Middlesex Co. Mass.



Lowell
Locks and Canals Historic District, Lowell, MA
Joe Orfant, 1975
CDA, 50 Arcand Drive, Lowell
looking north from French Street Extension to the Tremont Gatehouse and the Suffolk Yard on the left
photo # 3 of 6

Middlesex Co. Mass



Lowell
Locks and Canals Historic District, Lowell, MA
Joe Orfant, 1975
CDA, 50 Arcand Drive, Lowell
looking southwest at the Swamp Locks Dam and Sluicway, in the Background is the 1890 plant of the Lowell Machine Shop
photo #2 of 6
Merrimack Co, Mass.

Lowell

Locks and Canals Historic District, Lowell, MA
Joe Orfant, 1975
City Development Authority, Lowell, MA
looking northeasterly from the O'Donnell Bridge
at the Northern Canal and the Canal Walk
photo #1 of 6

Middlesex Co., Mass.

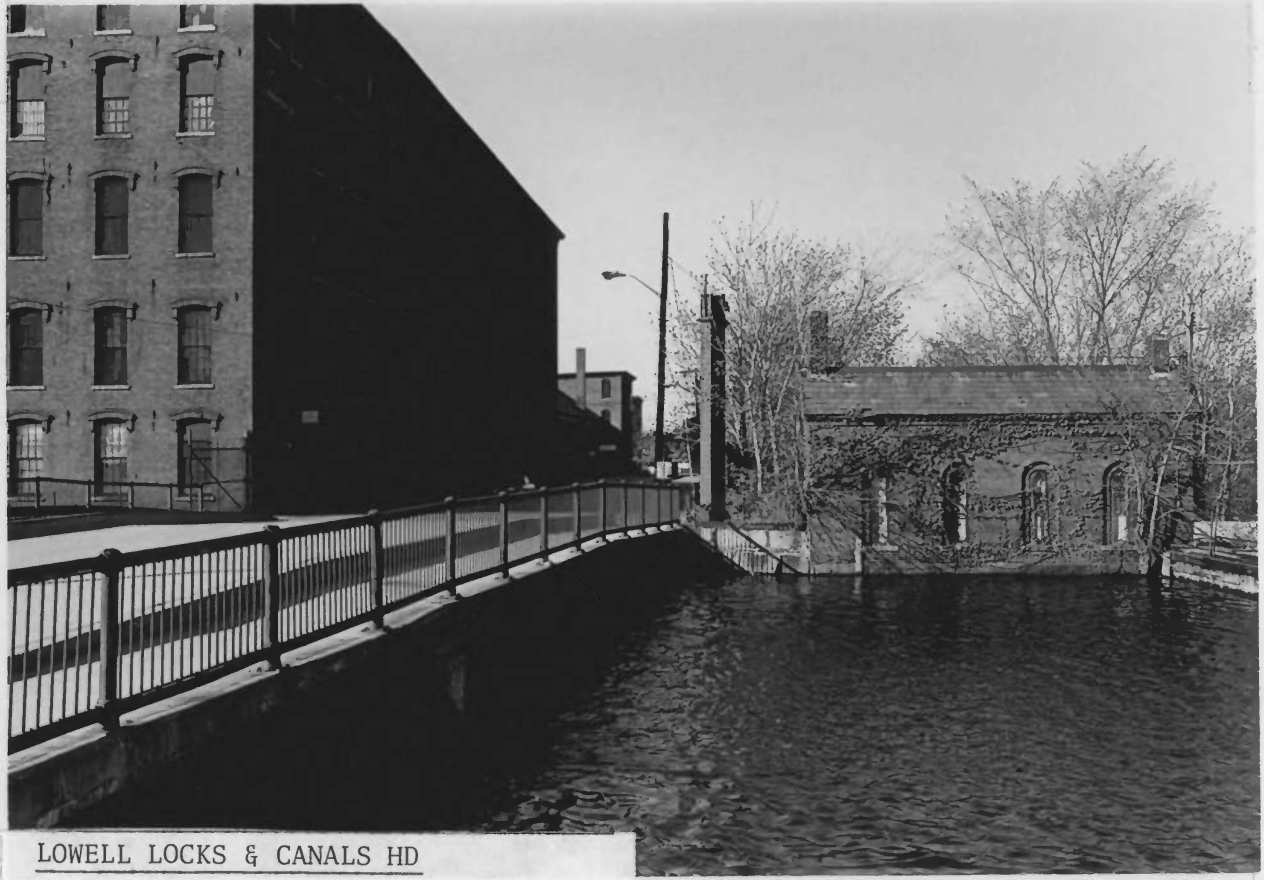
Lowell
Locks and Canals Historic District, Lowell, MA
Joe Orfant, 1975
CDA, 50 Arcand Drive, Lowell
looking northwest from Broadway at the
Western Canal
photo #6 of 6

Middlesex Co. Mass.


LOWELL MFG CO.

LOWELL LOCKS & CANALS HD
Photo credit: AASLH

LOWELL LOCKS & CANALS HD
Photo credit: AASLH



LOWELL LOCKS & CANALS HD

Photo credit: AASLH

LOWELL LOCKS & CANALS HD
Photo credit: AASLH

LOWELL LOCKS & CANALS HD
Photo credit: AASLH

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LOWELL LOCKS & CANALS HD
Photo credit: AASLH

Form No. 1D-306 (Rev. 1D-74)

UNITED STATES DEPARTMENT OF THE INTERIOR
NATIONAL PARK SERVICE

NATIONAL REGISTER OF HISTORIC PLACES INVENTORY -- NOMINATION FORM

FOR FEDERAL PROPERTIES

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RECEIVED SEP 3 1985
DATE ENTERED

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

1 NAME

HISTORIC

AND/OR COMMON
Lowell National Historical Park

2 LOCATION

STREET & NUMBER Multiple
Mailing Address: 169 Merrimack Street — NOT FOR PUBLICATION

CITY, TOWN
Lowell, Massachusetts — VICINITY OF

CONGRESSIONAL DISTRICT
5

STATE	CODE	COUNTY	CODE
Massachusetts	025	Middlesex	017

3 CLASSIFICATION

CATEGORY	OWNERSHIP	STATUS	PRESENT USE	
X DISTRICT	— PUBLIC	X OCCUPIED	— AGRICULTURE	X MUSEUM
— BUILDING(S)	— PRIVATE	— UNOCCUPIED	X COMMERCIAL	X PARK
— STRUCTURE	X BOTH	— WORK IN PROGRESS	X EDUCATIONAL	X PRIVATE RESIDENCE
— SITE	**PUBLIC ACQUISITION**	**ACCESSIBLE**	— ENTERTAINMENT	X RELIGIOUS
— OBJECT	X IN PROCESS	X YES: RESTRICTED	X GOVERNMENT	— SCIENTIFIC
	— BEING CONSIDERED	— YES: UNRESTRICTED	X INDUSTRIAL	X TRANSPORTATION
		— NO	— MILITARY	— OTHER:

4 AGENCY

REGIONAL HEADQUARTERS: *(If applicable)*
National Park Service
STREET & NUMBER
15 State Street
CITY, TOWN
Boston, — VICINITY OF
STATE
Massachusetts

5 LOCATION OF LEGAL DESCRIPTION

COURTHOUSE, REGISTRY OF DEEDS, ETC.
Northern Middlesex County Registry of Deeds
STREET & NUMBER
Gorham Street
CITY, TOWN
Lowell,
STATE
Massachusetts

6 REPRESENTATION IN EXISTING SURVEYS

TITLE Report: Lowell National Historical Park and Preservation District Cultural Resource Inventory by Shepley Bulfinch Richardson & Abbott

DATE
1980 — X FEDERAL — STATE — COUNTY — LOCAL

DEPOSITORY FOR SURVEY RECORDS
National Park Service, 15 State Street
CITY, TOWN
Boston,
STATE
Massachusetts

7 DESCRIPTION

CONDITION		CHECK ONE	CHECK ONE
__EXCELLENT	__DETERIORATED	__UNALTERED	X ORIGINAL SITE
__GOOD	__RUINS	X ALTERED	__MOVED DATE_____
X FAIR	__UNEXPOSED		

DESCRIBE THE PRESENT AND ORIGINAL (IF KNOWN) PHYSICAL APPEARANCE

Lowell National Historical Park, authorized by Congress on June 5, 1978, represents an innovative concept in the National Park System. The concept minimizes federal property ownership and provides for the preservation of historically significant structures through other public agencies and the private sector. The Park's enabling legislation also empowers the Secretary of the Interior to provide funding and technical assistance through the Lowell Historic Preservation Commission to cooperating owners of historic properties in order to develop and/or preserve significant resources according to Department standards and in ways which complement Park development. The Lowell Historic Preservation District surrounds the Park as a buffer zone and enables federal assistance in the preservation and revitalization of Lowell, while the Park consists of the areas intended for intensive visitor use in the interpretation of Lowell and its canal system.

The Park includes within its boundaries the 5.6 mile power canal system, a portion of the central business district, and three major mill complexes. The area within the Park boundaries totals 134 acres, but present plans envision direct National Park Service ownership of only a handful of buildings, with other property remaining in private hands. The District includes the mills or mill sites of most of the rest of the major textile corporations, the remainder of the historic central business district, and areas along the Concord River where smaller factories flourished outside the main waterpower system.

There are 895 properties within the Park and Preservation Districts. They are classified as follows:

308 residential buildings
- 147 single family
- 62 duplexes
- 99 multiple family

210 commercial buildings
130 buildings within textile mill complexes
27 other industrial structures
16 schools
9 churches
24 government buildings
92 vacant lots
33 components of the canal system
11 bridges
37 miscellaneous structures (theaters, parking garages, playgrounds, etc.)

In terms of condition, the properties (excluding the canals) are classified according to 1979 data as follows:

56 excellent
412 good
244 need minor repair
70 need major repair
8 derelict

In terms of period, the properties (excluding the canals) are classified as follows:

3 pre-1820	93 1870s
20 1820s	78 1880s

44 1830s	122 1890s
78 1840s	166 1900-1925
45 1850s	45 1926-1950
27 1860s	67 post-1950

The Park and the District's most important historical resources are the canal system, the remaining major mill complexes, and the central business district's nineteenth century commercial buildings. The District also includes elements of other historic industrial enterprises, particularly along the Concord River. Residential properties within the District represent most of the range of styles, forms, and periods of Lowell's architectural history, but these houses generally fall short of Lowell's historic houses outside the District in quantity, quality, and concentration.

All properties owned or leased by the National Park Service (except one) are included in at least one of three existing historic districts on the National Register of Historic Places: City Hall Historic District, Locks and Canals Historic District, and Merrimack-Middle Street Historic District. Park-owned and leased properties are listed below:

Old City Hall (City Hall H.D.): The most important early municipal building in Lowell, this structure has served combined government/commercial functions. Constructed in 1830 by the town of Lowell, the building served as the town's (and later the city's) principal meeting hall. However, alterations to the building in 1854 resulted in its conversion to a municipal office building. A private party acquired the building in 1896 and made major changes to the interior and exterior of the structure to facilitate its commercial use, and it has continued to serve a commercial function. There are stores on the first floor; the second and the third floors are vacant; and the cellar is used for storage. The building bears little resemblance to its original Greek Revival appearance. In 1854, a third floor was added, and the first floor level was lowered to the present sidewalk elevation. A one-story brick addition was built on the south side in 1886. Ten years later the owner rebuilt the second and third floor partitions, modernized the first floor partitions to include the one-story western addition, and drastically altered the facades to their present Colonial Revival appearance.

Presently, the storefronts have large display windows, enframed with enameled metal panels. A few elements of late nineteenth century cast iron storefronts are still visible beneath the current treatment. Tall openings spanning both floors still accomodate the main windows of the upper floors, but the openings have been changed from the original ones. In addition, the main facade has gained narrow windows at each end and flanking the central window, and a pediment like central facade gable, set with an ornate fanlight. The narrow windows on the second floor display broken-scroll pediments, while the third floor windows either have triangular pediments or are round arch-headed, with keystones. On the central panel between the second and third floor windows is the inscription: "Old City Hall Building 1830-1896." The other panels have swags in relief. Above the central window, just below the fanlight,

is an entablature with relief swags. The panels, pediments, and other trim are painted white. At the corners of the building are brick pilasters with white-painted Doric capitals. Such pilasters were an early feature of the building, topped with a plain, projecting brick frieze. The frieze is now broken by the tops of the third floor windows. The west side of the building is also formally finished. A double central window on the second floor is flanked by projecting bay windows. On the third floor are three small square windows. A cornice enclosing the gable as a pediment, at the center of which is a fanlight window. Visible atop the roof are the lower portions of paired chimneys. The rear wall features a range of double windows on the floors above the projecting first floor addition. On top of the rear addition in the center of the main block is a small, square, second story addition. Fire escapes span the rear wall. The eastern wall features what is apparently original fenestration. Three bricked-up rectangular windows appear on the ground floor, and three longer windows span floors two and three. The lower three quarters of the central window have been bricked over. The flanking windows feature wooden aprons which divide the long narrow openings into two windows. The eastern gable has two small, square windows in its center.

Kirk Street Agents' House (Linus Child House) (City Hall H.D.): Constructed between 1845 and 1847, this 2½-story brick duplex, with basement, is a significant example of early corporate housing in Lowell. The structure was built by mill workers under the supervision of James H. Rand. The structure was a residence for corporate agents of the Massachusetts and Boott Cotton Mills until 1901. Since that time it has served as a roominghouse, YWCA, school offices, medical clinic, and classrooms. A number of changes have been made to the original bearing brick walls and granite foundations. Brick and frame additions were built and later removed, except for the frame addition on the south unit. The addition on the south unit was repeatedly renovated during the 20th century. Partitions on the inside of the building have been added and some have been removed; some mantles have been taken out and replaced; and all finish material in the third floor of the north unit was removed following a fire. A boiler plant and stack were built behind the north unit, and a tunnel was dug under Kirk Street to connect the plant to the high school. The high school and boiler plant have severely altered the setting.

The Linus Child House was built as an agents' house for the Boott and Massachusetts Companies. Greek Revival in style, it is a double house of brick with brownstone trim, set on a high granite basement. The parapet-linked double chimneys at the end walls and at the center of the roof, along with its basic form relate it to the contemporary boarding houses. However, the use of brownstone for its sills, lintels and trabeated doorways distinguishes it. The cornice with its unornamented, projecting frieze and brick dentils adds a decorative touch to an otherwise severe building.

Moody Street Feeder Gatehouse (Merrimack Gatehouse) (City Hall H.D. and Locks and Canals H.D.) One of the finest canal structures in Lowell, the Merrimack Gatehouse was built in 1848 as part of an improvement to the Lowell canal system. The gatehouse contains three sluice gates that controlled the flow of water from the Western Canal through the new Moody Street Feeder to the Merrimack Canal, increasing the water supply to the Merrimack Mills and regulating the flow to the Boott Mills. For a short time in 1972, the structure housed the Dandylion Flowershop. Since 1976 it has been the site of Lowell's Bicentennial headquarters/visitor center, the Lowell tourist center, the NPS visitor information and interpretive center.

The building extends approximately sixty feet along Dutton Street and the Merrimack Canal. Its southern facade gable faces Merrimack Street. The waters of the Moody Street Feeder flow through the three granite arches on which this structure rests. Incised into a granite block between the southern and central arches is the date "1848." The Merrimack facade has an entrance bay and a single window bay. The Dutton Street facade features a central entrance bay flanked by three window bays. The northern facade is two window bays wide, and the eastern facade has seven window bays. The cornice features brick dentils. Chimneys are situated at the ridge near the end walls. The gate house's three sluice gates are manually operated with counterweighted, rack and pinion equipment, which is original except for the weights. Those were added in 1853. Despite its rather diminutive scale, the Merrimack Gatehouse occupies a commanding position in the downtown streetscape. The effects of its canal-side site is maximized through considerable length compared to width and its crisp detailing (including locally unusual use of Flemish bond brickwork).

Boott Mill (Locks and Canals H.D.): This millyard was constructed and then adapted over a 100-year period by the Boott Corporation, the eighth of ten original major textile corporations in Lowell. Of these original millyards, the Boott Mill complex is the most intact surviving example of the first phase of Lowell's mill construction. All four of the original 1835 mills in the Boott millyard survive as part of an interconnected series of mill buildings. The 1835 company office and counting rooms also survive in their original exterior form. The balance of the complex which is composed of later additions, is also significant because it demonstrates the evolution of the earliest Lowell mills to meet the needs of expanding an increasingly restrictive site, bound by a canal and the river. The Boott Mill complex is one of the few corporations that managed to expand on its site while retaining and enhancing the architectural quality of the mill's principal courtyard. The clock tower and belfry, completed circa 1865, are part of this later phase of construction and survive today as one of the most memorable architectural monuments in Lowell and as a symbol of the park. The Park Service owns two buildings in the complex which (will) house a variety of exhibits. They are Mill #6 and the Countinghouse.

The No. 6 Mill is an "L" plan structure consisting of two sections which are labeled on insurance surveys as No. 6 East (74 feet on the Eastern Canal X 113 feet on Bridge

Street) and No. 6 West (238 feet on the Eastern Canal X 48 feet). Italianate in design, the building contains equal-size bays, each of which contains a single window with an arched brick hood at each story. Octagonal stair towers rise at the northwest corners of No. 6 East and No. 6 West, providing important focal points within the main millyard. Each tower's walls are framed by brick piers and divided horizontally by corbelling at the top of the second and fourth stories; narrow windows with arched hoods are set in the center of the tower's wider faces. Both towers were originally six stories high and had entries with hoods on wooden brackets; only that of No. 6 West remains, that of No. 6 East having been partially blocked by brick. The sixth story and (cast iron) cresting of each tower was removed after 1932 (Insurance Survey). Other alterations to the No. 6 Mill include the rebuilding of the cornice on the west elevation of No. 6 West and the restoration of the mill's windows (12/12 sash). On the mill's millyard (interior) elevation the inner corner of the "L" plan is occupied by a five story brick addition built after 1921. Along the Bridge Street side of No. 6 East is an enclosed railroad bed which enters the building by means of a bridge across the Eastern Canal. Originally the opening for the tracks (which extend to a coal pocket) was one-bay wide, with an arched head resembling window hoods. In 1927, the entry was enlarged into a rectangular opening, one-and-one-half stories high, occupying the eastern three bays of the building's canal elevation. At the same time, the present steel bridge was installed.

Straddling part of the millyard entry, the brick Counting House (100' on Eastern Canal X 30') is the only building to remain substantially unchanged from the millyard's initial development. Fenestration of the structure is irregular, consisting of closely spaced windows at the building's east end and more widely spaced windows at the west end. The building's north elevation also contains irregular fenestration, including some apparent blocking of early doorways and the creation of new entries. Many of the windows may have been added or enlarged. The building's original appearance is unknown. The earliest known view of the Counting House dates to ca. 1875, and shows the south elevation's west end much as it is today. Removed since this photo was taken are an entry hood on brackets, louvered shutters, and an apparent interior chimney which rose north of the roof's ridge.

Boott Mill Boardinghouse (H & H Paper Company) (Locks and Canals H.D.): This building was constructed between 1835 and 1838 as one of a series of boardinghouses for operatives of the Boott Mills and represents the physical relationship between mill operative housing and work locations. The boardinghouses were originally three-story traditional brick buildings with gable roofs. Most of them have been demolished, and the H & H Paper Company had been radically altered. Among other changes, the gable roof and part of the third floor had been removed and replaced by a flat roof; the frame outbuildings had been removed; windows had been bricked in; the interior had been gutted and modified; and a new building had been appended to the rear of the building.

The National Park Service and the Lowell Historic Preservation Commission restored the building to its original appearance in 1984-85 in order to house a series of historical and community exhibits.

Lowell Manufacturing Company (Locks and Canals H.D.): This textile mill was chartered on February 8, 1828, to produce carpets and coarse cotton cloth. In common with the other Lowell textile mills, the Lowell Manufacturing Company complex has a complicated reconstruction history, with current buildings dating from the 1880s to the early 20th century. Part of the complex is currently owned by Market Mills Associates. It is used for housing and lease space. The Park Service leases a portion of the space in Bigelow-Lowell Building #2 for the park's information/orientation center.

Forming the north wall of the millyard, Bigelow-Lowell Building #2 was built on the site of the company's Superintendent's House and on the site of an eight-unit boarding house. Building #2 was constructed in 1902 to enlarge the plant's capacity for weaving Brussels carpets. The structure's plan is irregular, built to conform to the company's property line on Market and Gardner Streets. The building design is uniform on all of its 5-story elevations, consisting of one wide undecorated window surrounded with an arched head, paired sash and paired transoms, in each bay at each story.

Suffolk Manufacturing Company (Wannalancit Mill) (Locks and Canals H.D.): Although the complex was one of the earliest textile manufacturing companies in Lowell, the building that now existsdate to a later period of construction, beginning in 1848 and ending in the 1880s. The existing structural system of the three mill buildings is the same. They have masonry load-bearing exterior walls with wood beams supported by wood columns (cast-iron columns are on the first and second floors of building 6 and 8). The Park Service leases space in the complex's turbine room in Mill #6 from the Wannalancit Office and Technology Center for use as a hydropower exhibit. Mill #6 measures 282 feet by 58 feet.

MANAGEMENT EXCLUSIONS

Listed below are the Park-owned properties which are not historic and do not meet National Register criteria. Management of these properties will require treatments sensitive to surrounding historic resources in keeping with National Park Service standards.

Jade Pagoda and Solomon's Yard Goods (Merrimack-Middle Street H.D.): These one-story structures occupy adjacent lots on Merrimack Street next to Old City Hall. The Solomon Building is a modern commercial structure that incorporates the foundation of an earlier 4-story building into its construction. The earlier building was destroyed by fire in 1962. The present building is constructed of tan brick and

is of a rectangular plan. The main facade features a wide display window. A plaque bearing the incription "Solomon Building 1962" appears in the upper central portion of the Merrimack Street facade. The scale and surface treatments of the structure, along with Jade Pagoda to the west, detract from the character of the nearby Old City Hall, St. Anne's Church, and the Welles Block. The Jade Pagoda Restaurant is a one-story brick commercial structure directly adjacent to the Old City Hall. This structure is of a rectangular plan and has a flat roof. Portions of this building and its foundation are remnants of the 1859 Carlton (Weir) Block. Its main facade features modern display windows and a veneer of concrete slabs.

Dutton Street Parking Lot: This site was excluded from the Locks and Canals Historic District, even though the lot occupies a portion of the former Lowell Machine Shop yard. This company and its corporate ancestors were responsible for equipping Lowell's original textile mills with machinery; the company later became the country's leading manufacturer of textile equipment for a time during the mid- to late-nineteenth century. After several corporate reorganizations, however, machine shop buildings on this site were removed in 1931-33. Following archeological investigations, the existing modern parking lot for National Park Service visitors was constructed in 1982-83.

8 SIGNIFICANCE

PERIOD	AREAS OF SIGNIFICANCE -- CHECK AND JUSTIFY BELOW				
__PREHISTORIC	__ARCHEOLOGY-PREHISTORIC	X COMMUNITY PLANNING	X LANDSCAPE ARCHITECTURE	__RELIGION	
__1400-1499	__ARCHEOLOGY-HISTORIC	__CONSERVATION	__LAW	X SCIENCE	
__1500-1599	__AGRICULTURE	X ECONOMICS	__LITERATURE	__SCULPTURE	
__1600-1699	X ARCHITECTURE	__EDUCATION	__MILITARY	X SOCIAL/HUMANITARIAN	
__1700-1799	__ART	X ENGINEERING	__MUSIC	__THEATER	
X 1800-1899	X COMMERCE	__EXPLORATION/SETTLEMENT	__PHILOSOPHY	X TRANSPORTATION	
X 1900-	__COMMUNICATIONS	X INDUSTRY	__POLITICS/GOVERNMENT	__OTHER (SPECIFY)	
		X INVENTION			

SPECIFIC DATES 1800 - Present BUILDER/ARCHITECT various

STATEMENT OF SIGNIFICANCE

Lowell, Massachusetts, was America's model industrial city during the first half of the 19th century. Lowell offered the hope that the country would profit socially as well as economically by adopting industrialism as a way of life. The early Lowell system was distinguished by its state-of-the-art technology, the engineers and inventors who worked on its canal system, its mill architecture, enormous production capabilities, rational city planning, and most of all, by its much-heralded work force of Yankee "mill girls." But as industry grew in New England, Lowell's factories aged and became less competitive with newer industrial cities. Profits fell, working conditions deteriorated, and wages were cut. The "mill girls" became disillusioned with the system and were replaced by a succession of immigrant groups eager to find work at any price. The city changed, too, as crowded tenements took the place of Lowell's well regulated system of boardinghouses and as Lowell became a city similar to other New England mill towns. Competition within the textile industry increased continually throughout the 19th century. Eventually, the combination of a cheaper, less unionized work force; newer, more efficient factories and machinery; cheaper real estate; and lower taxes persuaded the textile industry to move south. Eight of Lowell's original ten textile firms closed their doors for good during the 1920s, and the city fell into a depression that lasted through the 1960s. Businesses shut down, real estate prices fell, and unemployment rose. Today, however, Lowell is once again a model for urban development. The city's revitalization has capitalized on its working class, immigrant culture and the pride of its citizens, as well as extensive cooperation among local, state, and federal agencies and the private sector.

Lowell is not, as is sometimes claimed, the birthplace of the industrial revolution in America. Most of the developments associated with this phenomenon in the nation's history had their origins elsewhere. But it was in Lowell that these developments converged in a way that made them revolutionary. Lowell National Historical Park commemorates America's most significant planned industrial city, where new forms of technology, power generation, finance, labor, and industrial organization were combined on a scale that portended today's industrialized and urbanized society.

The importance of Lowell extends well beyond the story of its early years as pioneer and symbol of a new era. The Lowell experience offers unique opportunities to interpret the full socioeconomic, technological, and environmental implications of the industrial revolution, from Lowell's bright beginnings through decades of decline to the present revitalization. Lowell's physical resources include the original 5.6-mile power canal system, major cotton textile mill complexes, and evolutionary streetscapes of commercial and residential structures. Lowell's rich cultural heritage, reflected in the ethnic diversity of its citizens, is equally important.

9 MAJOR BIBLIOGRAPHICAL REFERENCES

Shepley Bulfinch Richardson & Abbott Report: Lowell National Historical Park and Preservation District Cultural Resources Inventory (National Park Service, NARO: Boston) 1980

Coolidge, John Mill and Mansion: A Study of Architecture & Society in Lowell, MA, 1820-1865 (Russell & Russell: New York) reissue 1967

10 GEOGRAPHICAL DATA

ACREAGE OF NOMINATED PROPERTY 134

UTM REFERENCES

	ZONE	EASTING	NORTHING		ZONE	EASTING	NORTHING
A	19	309 960	4724 900	B	19	311 290	4723 840
C	19	309 360	4722 680	D	19	308 540	4724 160

VERBAL BOUNDARY DESCRIPTION

The Park includes within its boundaries Lowell's 5.6-mile power canal system, a portion of the central business district, and three major mill complexes. See attached boundary map; area marked in green constitutes the Lowell National Historical Park boundary.

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

STATE	CODE	COUNTY	CODE
STATE	CODE	COUNTY	CODE

11 FORM PREPARED BY

NAME / TITLE
Robert Weible, Historian

DATE
June 1985

ORGANIZATION
Lowell National Historical Park

TELEPHONE

STREET & NUMBER
169 Merrimack Street

(617) 459-1027

CITY OR TOWN
Lowell,

STATE
Massachusetts

12 CERTIFICATION OF NOMINATION

STATE HISTORIC PRESERVATION OFFICER RECOMMENDATION

YES____ NO____ NONE____

STATE HISTORIC PRESERVATION OFFICER SIGNATURE

In compliance with Executive Order 11593, I hereby nominate this property to the National Register, certifying that the State Historic Preservation Officer has been allowed 90 days in which to present the nomination to the State Review Board and to evaluate its significance. The evaluated level of significance is ✓ National ____ State ____ Local.

FEDERAL REPRESENTATIVE SIGNATURE Edwin C Bearss

TITLE Chief Historian and Federal Preservation Officer

DATE 8/17/85

FOR NPS USE ONLY

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

DATE 10/18/85

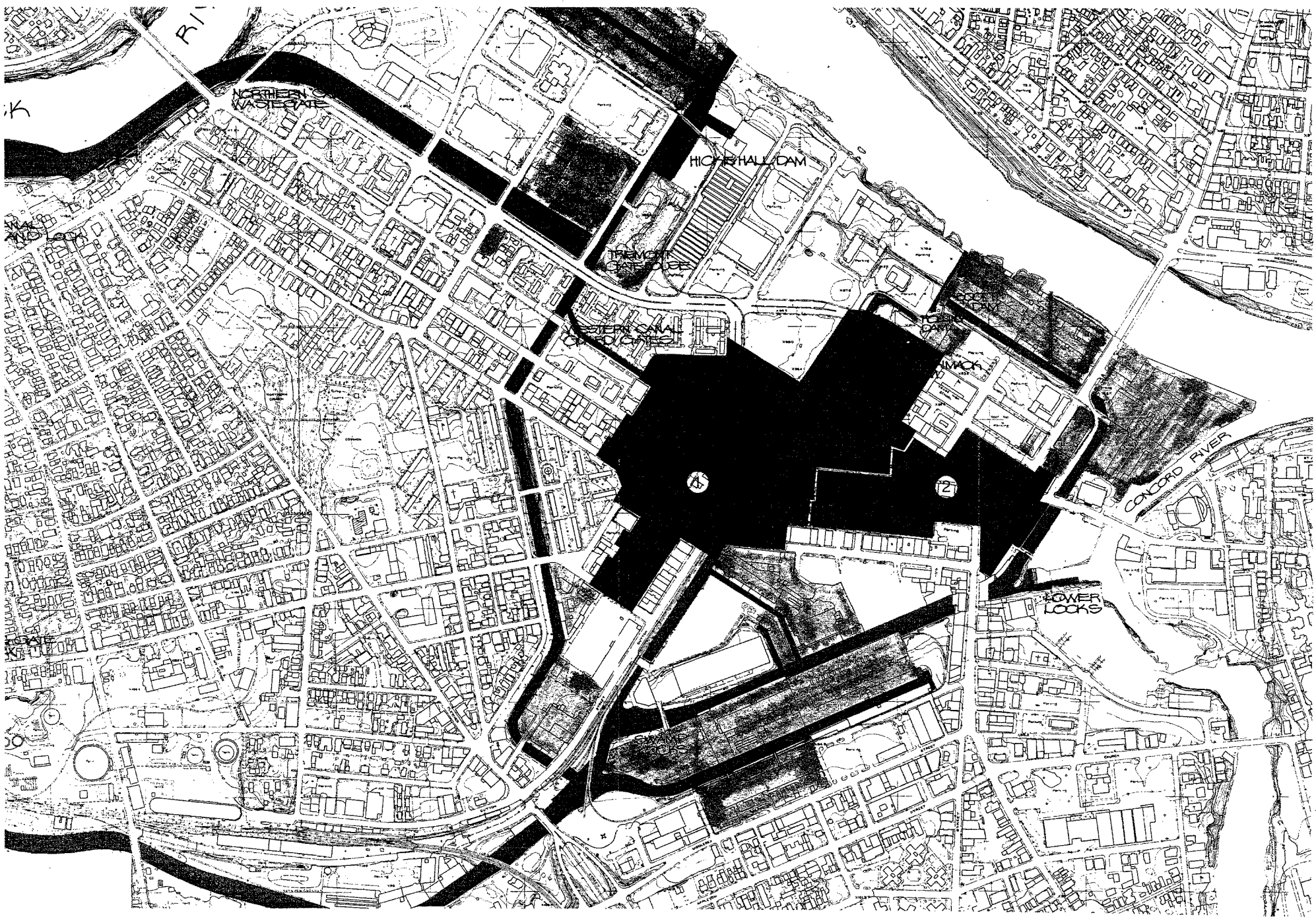
DIRECTOR, OFFICE OF ARCHEOLOGY AND HISTORIC PRESERVATION

ATTEST:

DATE

KEEPER OF THE NATIONAL REGISTER

GPO 899-214



1000 FEET

475 | 40000
DSC | MAY 80

THE INTERIOR
PARK SERVICE

HISTORIC DISTRICTS ■■■ LOWELL NHP


LOWELL'S
FIRST
SAVINGS
BANK
LOWELL
INSTITUTION
ALL DEPOSITS INSURED IN FULL
JADE
PAGODA
RESTAURANT
Chinese & American Food
COCKTAILS
Solomon's
FABRICS
Solomon's
All Merchandise 40 % OFF
GOING OUT OF BUSINESS!
ALL SALES CASH FINAL
All Merchandise 40 % OFF
GOING OUT OF BUSINESS!

LOWELL NATIONAL HISTORICAL PARK

SUBJECT: The Solomon,Jade Pagoda, and Old City Hall buildings.

DATE:

1979

PHOTO CREDIT: Shepley, Bulfinch, Richardson and Abbott.

INFORMATION:

East and North elevations.

LOWELL NATIONAL HISTORICAL PARK

SUBJECT: The Kirk Street Agents' house.

DATE: June, 1985

PHOTO CREDIT: Ed Harley, LNHP

INFORMATION:
West and South elevations

LOWELL NATIONAL HISTORICAL PARK

SUBJECT: Boott Mill Boarding House

DATE: June, 1985

PHOTO CREDIT: Ed Harley, LNHP

INFORMATION: East elevation elevat

LOWELL NATIONAL HISTORICAL PARK

SUBJECT: Boott Mill and Counting House.

DATE: June, 1985

PHOTO CREDIT: Ed Harley, LNHP

INFORMATION:
South elevation. Counting House is on left side of photo. Building #6 Boott Mill is on right side of photo.


WANNALANCIT
WANNALANCIT

LOWELL NATIONAL HISTORICAL PARK

SUBJECT: Suffolk Manufacturing Company

DATE: May, 1984

PHOTO CREDIT: James Higgins

INFORMATION: South and East elevations

LOWELL NATIONAL HISTORICAL PARK

SUBJECT: Lowell Manufacturing Company

DATE: June, 1985

PHOTO CREDIT: Ed Harley, LNHP

INFORMATION: North and West elevations.


5

LOWELL NATIONAL HISTORICAL PARK

SUBJECT: Dutton Street Parking Lot.

DATE: June, 1985

PHOTO CREDIT: Ed Harley, LNHP

INFORMATION: Picture taken facing North towards the Lowell Manufacturing Company.

LOWELL NATIONAL HISTORICAL PARK

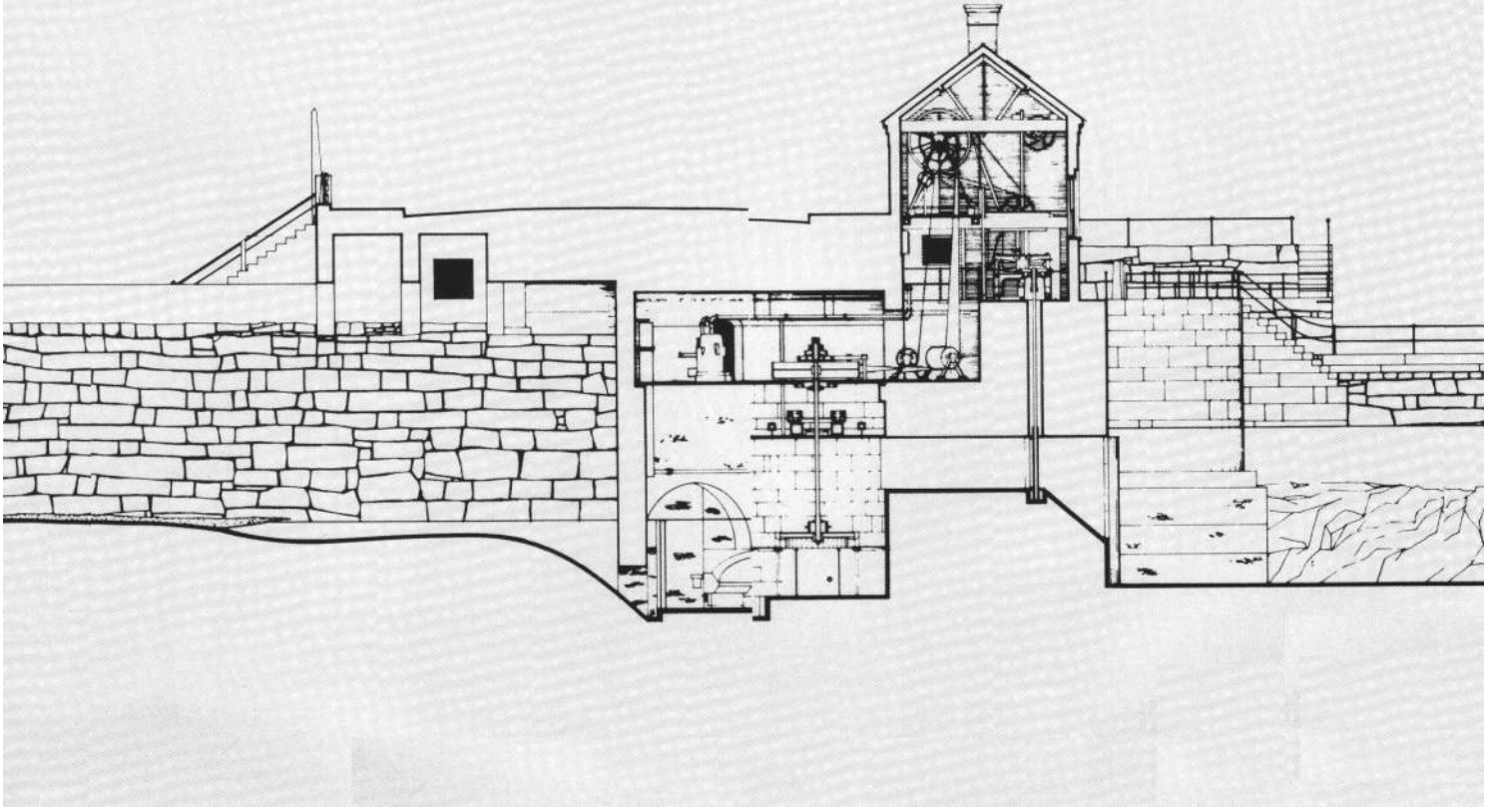
SUBJECT: Moody Street Feeder Gate house

DATE: 1979

PHOTO CREDIT: Shepley, Bulfinch, Richardson and Abbott.

INFORMATION:
East elevation overlooking the Merrimack Canal.

LOWELL



LOWELL WATER POWER SYSTEM

PAWTUCKET GATEHOUSE HYDRAULIC TURBINE

Designated National Historic Civil and Mechanical Engineering Landmarks by the American Society of Civil Engineers and the American Society of Mechanical Engineers, respectively

July 1, 1985
Lowell, Massachusetts

In 1792 shipbuilders and merchants from Newburyport, Massachusetts, incorporated as the Proprietors of Locks and Canals on Merrimack River. This was one of the nation's earliest corporations. It immediately began work on the Pawtucket Canal, which was completed in 1796. This canal by passed Pawtucket Falls and increased the flow of timber and agricultural products from New Hampshire to the sea.

The canal's early success, however, was short lived because the ship building industry at Newburyport had fallen on hard times. Traffic on the Canal decreased with the dwindling demand for New Hampshire timber. In addition the Middlesex Canal was reaching completion, which linked the upper Merrimack with the Charles River and diverted much of the Canal's trade from Newburyport to the larger market at Boston.

It was 1803 and Thomas Jefferson was president. It was a time when America's economy was predominantly agricultural and Jefferson, like many of his countrymen, felt that America's strength lay in its agricultural heritage. It was felt that industrialization, as evidenced by the squalor of European industrial cities, was morally reprehensible. Nevertheless, Jefferson eventually modified his views and came to the conclusion that a certain amount of industrial development was required to maintain economic independence from Europe.

In addition a recent curtailment of trade with Europe sharply reduced the amount of manufactured goods in America. Recognizing the need for such products Jefferson decided that the objectionable aspects of the European industrial experience could be avoided by the dispersal of manufacturing centers throughout the American countryside.

It was under these conditions that Francis Cabott Lowell, a Boston merchant, travelled to England and Scotland in 1811. He toured British textile factories and was impressed with the advanced state of English technology, though he was also deeply affected by the impoverishment of the working classes. Lowell returned to America hoping to perfect a power loom, for use in a factory system of his own. His plans for the power loom, based on his observation of English looms, were developed in 1813 by mechanic Paul Moody. The power loom proved to be a major innovation in American textile manufacture, since it made possible the transformation of raw cotton into finished cloth within a single factory.

This project required large amounts of capital, but fortunately the need came at a time when American merchants were frustrated by Jefferson's embargo of 1807 and the War of 1812. Businessmen were looking for new areas of investment. Lowell was able to find willing investors in the "Boston Associates," a group of businessmen that later formed the Boston Manufacturing Company and began operation on the Charles River at Waltham, Massachusetts. Enthused by the success at Waltham the Boston Associates looked elsewhere for a site with a greater source of power for their new Textile Manufacturing Community.

In 1821 they acquired four hundred acres between the Pawtucket Canal and the Merrimack and Concord Rivers by purchasing the controlling stock of the Proprietors of Locks and Canals.

In 1822 the Merrimack Manufacturing Company was chartered and a rapid construction of textile mills and new power canals followed.

By 1826, construction of new mills was continuing unabated as the former agricultural village of East Chelmsford grew into a town, renamed Lowell for Francis Lowell, who died in 1817. Ten years later, it became the third city incorporated in Massachusetts. By then it had a population of seventeen thousand and included eight major

Society of Civil Engineers, Merrimack Canal, 1875 University of Lowell.

textile mills employing seventy-five hundred workers.

Early Industrial Lowell

Lowell became America's first great industrial city because of the power of the Pawtucket Falls, and the efforts of the amazing group of engineers, industrialists and workers.

It began with the construction of a complex canal system to harness the power of the Pawtucket Falls and the nearby rivers. The 1796 Pawtucket Canal became the feeder for the system begun in 1822. By 1826, two canals branched from the Pawtucket and four additional canals were already envisioned. Ten years later the planned system was complete. Water drove the machinery of mills on two distinct levels, the trailraces of the upper level mills emptied into canals leading to lower level mills.

In 1837, British born James B. Francis became chief engineer, Proprietors of Locks and Canals, a position he held for forty years. Throughout his tenure of office, Francis was primarily concerned with meeting Lowell's demands for increasing amounts of water power.

The Northern Canal

Since 1826, engineers had been able to increase the flow into the Lowell Canal System by constructing dams at Pawtucket Falls. The first was a crude wooden structure, but by 1830 a masonry dam seated on heavy wooden cribbing was helping to maintain a "pond" behind the falls. Three years later, workmen added two more courses of granite headers and raised wooden flashboards above them. This not only raised the level of the upper river but also stilled its current for over eighteen miles.

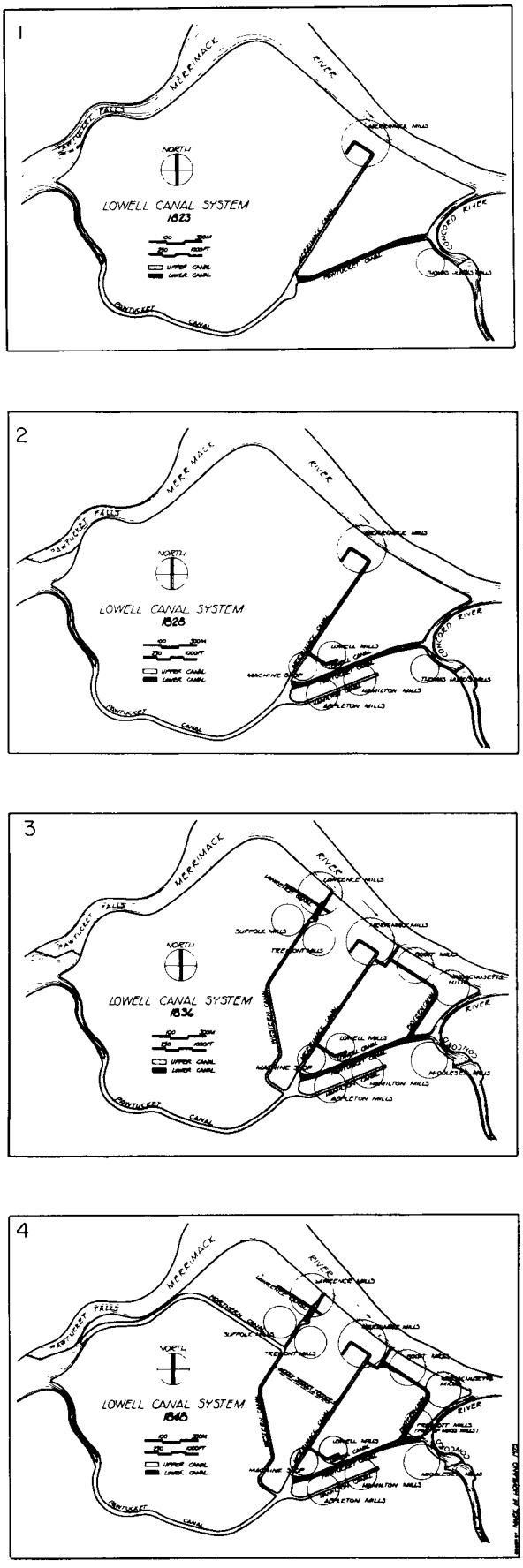
The dam did not, however, satisfy the water needs of the growing industrial city for long. The demand for water power increased each year in Lowell as textile corporations expanded their manufacturing operations. Power was always scarce in the dry summer months, and by the 1840s shortages were common throughout the year. One problem was the severe friction losses in the canals created by greater flow rates. When mills needed more water, the current had to increase to supply this demand.

Increased current produced friction which actually dropped the level of water in the canals, reducing its head, or potential to generate power. Thus, the mills could only get a greater flow of water by giving up some of the head they also needed.

In times of freshet, river water rose into the trailraces of mills impeding their wheels. Such "backwater" conditions placed excessive demands on the canal system, for only a tremendous flow of water could keep wheels turning in flooded wheel pits. Francis proposed the construction of a second feeder canal. This huge waterway would bring additional water into the system and allow a reduction of current in most of the canals.

In order to make such a plan effective, however, two conditions had to be met. First, Locks and Canals would have to prohibit the use of water for manufacturing at night, so that the river's flow could be "ponded" until the morning. Second, the power company would have to control the outlets of the major lakes which fed the Merrimack River.

Using the lakes as reservoirs, Lowell would then have a source of extra water in dry seasons. Economic conditions in the 1840s, a "boom" period of nineteenth-century American textile manufacture, made the attempt at this bold plan both possible and urgent. In combination with the Essex Company of Lawrence, Locks and Canals acquired control of over one hundred square miles of lake surface in New Hampshire, and Francis began work on the greatest engineering challenge



Lowell Canal System. Courtesy of HAER.

of his career, the construction of the Northern Canal.

Recognized as one of the most impressive achievements in the history of American engineering when completed in 1847, the project set new standards in civil and hydraulic engineering and introduced the famous "Francis" turbine to the world.

The canal system had become a complex affair fed entirely by the Pawtucket Canal, which avoided the high ground downstream of the falls. The route Francis chose for his new feeder canal ran parallel to the river for over 2000 feet, then turned inland to join the Western Canal. He had to cut through part of the difficult, rocky terrain which the Pawtucket Canal missed, and he had to place a major section of his canal in the bed of the river.

To overcome the topographical obstacles required heroic measures, great ingenuity, and much capital. Not only did Francis have to build a "Great River Wall" to hold his canal above the Merrimack rapids, but he also had to rebuild a large part of the Pawtucket Dam, construct sophisticated gate controls, and modify the existing system to integrate it with the new canal.

The Northern Canal brought water into the system with a higher head than had been previously possible, and it reversed the current in the Western Canal from the junction to the Swamp Locks Basin. Water from the Northern supplied the demands of the Tremont, Suffolk, and Lawrence Mills. Once Francis had completed the Moody Street Feeder in 1848, the Northern also fed the Merrimack Canal through three brick-vaulted tunnels. A smaller underground passage, known as the Boott Penstock, transferred some of this flow from the Merrimack Canal to the end of the Eastern Canal, where an adequate water level had always been hard to maintain.

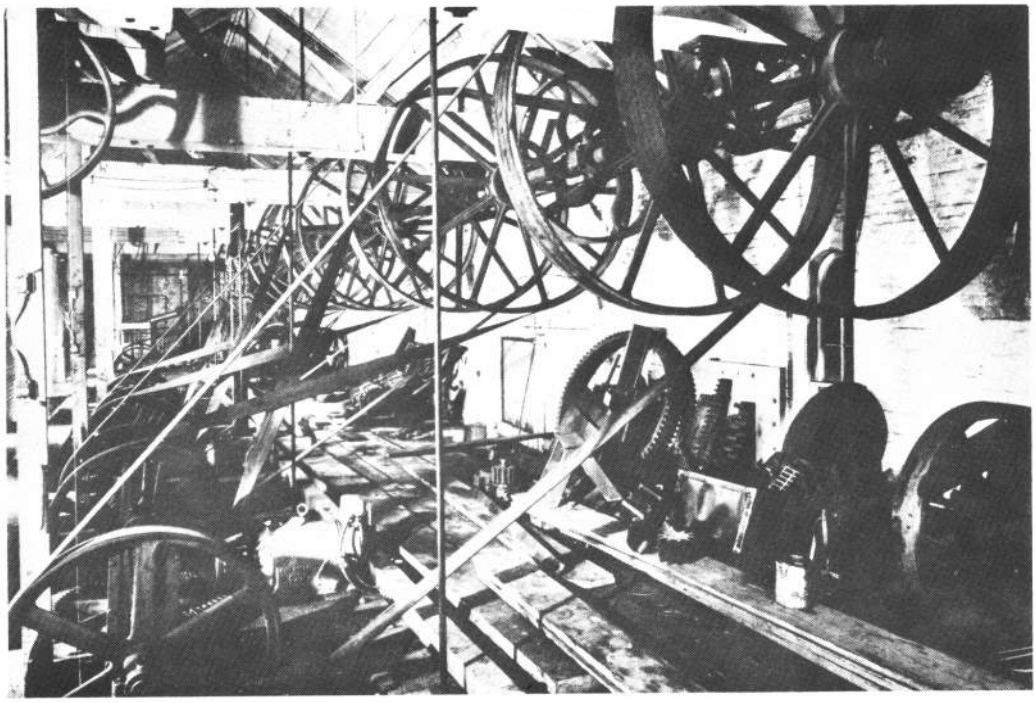
Locks and Canals had spent $551,585 on the Northern Canal and $86,132 on the Moody Street Feeder. The Boott Penstock and the necessary widening of the Western Canal had added another $15,000 of expenses. Yet, the power gained by the various Lowell corporations was easily worth the cost.

After testing the results of his physical improvements to the system, Francis arranged for redistribution of power and an increase in the number of "mill powers" leased to each company.

Because of the limitations of the old Pawtucket Canal as the sole feeder, only ninety-one mill powers had been leased up to that time. The Northern Canal enabled the chief engineer to lease 139 mill powers, a gain of more than 50 percent. These "permanent mill powers" were to be supplied in all seasons; for most of the year, the corporations could also purchase "surplus" mill powers at an inexpensive rate.

The mill complexes were assured of almost twelve thousand gross horsepower, even in summer. Francis, acting as "The Chief of Police of Water," tried to prevent waste in the system and developed techniques to monitor the water used by individual corporations. When river flow was low, he even closed the gates of the Northern Canal during the noon break.

His 1846 tests of Uriah Boyden's outward-flow turbines in the Appleton Mills convinced him that the corporations should switch from breast wheels to more efficient hydraulic turbines. In this way, they could produce more net horsepower from each "mill power" delivered to their sites. Also, turbines, which ran well under water, could generate during the "back-water" conditions that ruined the efficiency of breast wheels.



Line shaft for gate-hoisting mechanisms in the Pawtucket Gatehouse. Courtesy of HAER.

The widespread conversion to turbines in Lowell took place during and immediately following the construction of the Northern Canal.

The Pawtucket Gatehouse

Some of Francis' most famous studies of turbine operation and of the flow of water over weirs took place in the Pawtucket Gatehouse. The great engineer actually designed the gatehouse with special testing chambers and other features associated with scientific experimentation. Thus it deserves special attention as one of our nation's first industrial research laboratories. The results of Francis' research won international acclaim with the publication of his *Lowell Hydraulic Experiments* in 1855. The turbine in the Pawtucket Gatehouse was the first that Francis built for practical use. It is almost nine feet in diameter and is installed in a vertical setting within a granite ashlar wheel pit of cylindrical form. It is an inward-flow type, an improvement on the wheel patented by Samuel Howd in 1838.

Francis used his experiments on his 1847 turbine to design a much improved model with curved guides and buckets for the Boott Mills in 1849. The development of the modern, mixed-flow reaction turbine was a lengthy process involving many inventors, but Francis was a pioneer in this field. Most turbines in use today for hydroelectric generation are called "Francis" types in his honor.

Environment

From the very beginning of industrial development in Lowell, the corporations were concerned about their public image and about the aesthetic and recreational aspects of the built environment which they were creating. Whenever industrial necessity permitted, the corporations tried to beautify their structures and the landscape around them.

Francis, who studied botany as well as engineering, took personal charge of landscaping along the Northern Canal. Records of his plantings remain in the papers of the Proprietors of Locks and Canals, and these might be a basis for determining what of the present vegetation of the island area is due to his selection.

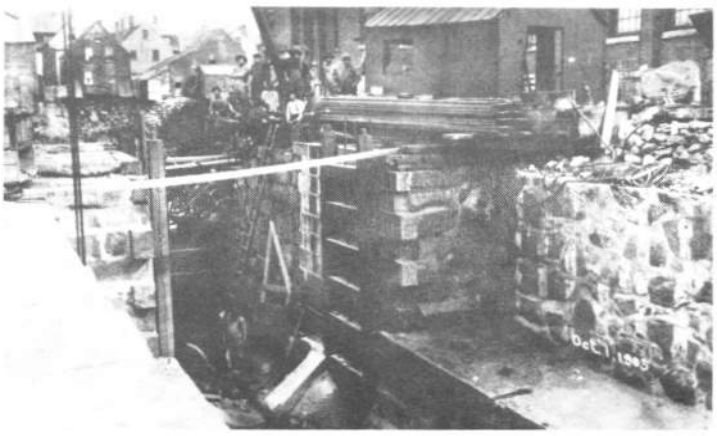
Lowell's Female "Operatives"

In their search for model workers and a reliable labor source, the Boston Associates recruited the daughters of Yankee farmers. Lowell's mills provided young New England farm women a respectable way to earn money and an opportunity to improve their lives. Hired by company agents, women came to earn dowries for future husbands, to send a brother to college, to help support their family's farm or to become self-sufficient.

Living in company boarding houses, their lifestyle was controlled by strict company codes. A twelve-hour day and a six-day work week were normal. Every waking hour was regulated by a bell. Wages for female operatives were set at a rate of $2.25 to $4.25 per week with $1.25 deducted for room and board.

Della Braga, spinner, Appleton Mills, 1910
Lowell Historical Society.

Eva and Alvana Desroches, weavers, Boott Mill, 1903
Lowell Museum.



Lower Locks, Pawtucket Canal, 1905
University of Lowell.

Birth of a Park

Rise and Fall of Lowell

By the middle of the 19th century industrial structures dominated the urban landscape of Lowell. Many manufacturers had come to supply the needs of the great textile corporations for belts, shuttles, card clothing, rollers, and hundreds of other items. Companies with products unrelated to textiles located in the city because of its pool of skilled workers, its excellent transportation links to widespread markets, or its reputation as a clean or orderly industrial community with an unlimited future. The population had soared from 2500 in 1826 to 33,000 in 1850.

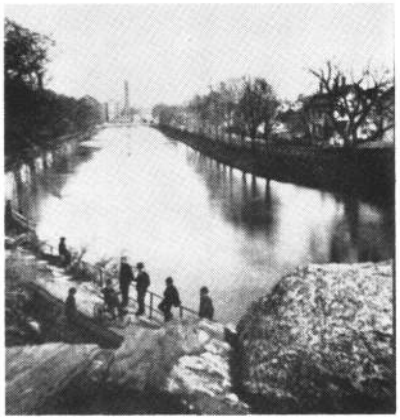
Lowell's continuing growth was impressive, but the city was losing ground to other rising industrial centers. By 1875 it was no longer the largest cotton textile producer in Massachusetts; Fall River was. By 1880 Lowell had begun to slip from the limelight in engineering as well as in textile manufacture.

Francis was still a giant in his profession, but, after working on the dam and on several systems of gate control in the 1870s, he faced no further significant challenges on the network of canals.

As Lowell struggled with its declining economy in the middle of the twentieth century, "modernization" and urban renewal threatened to destroy the city's historic districts. Late in the 1960s a community based federal program, Model Cities, proposed to revitalize the city through the rediscovery of its heritage. The Lowell City Council adopted a resolution in response to this proposal in 1972 which designated a "historical park concept" as a focal point of future urban development.

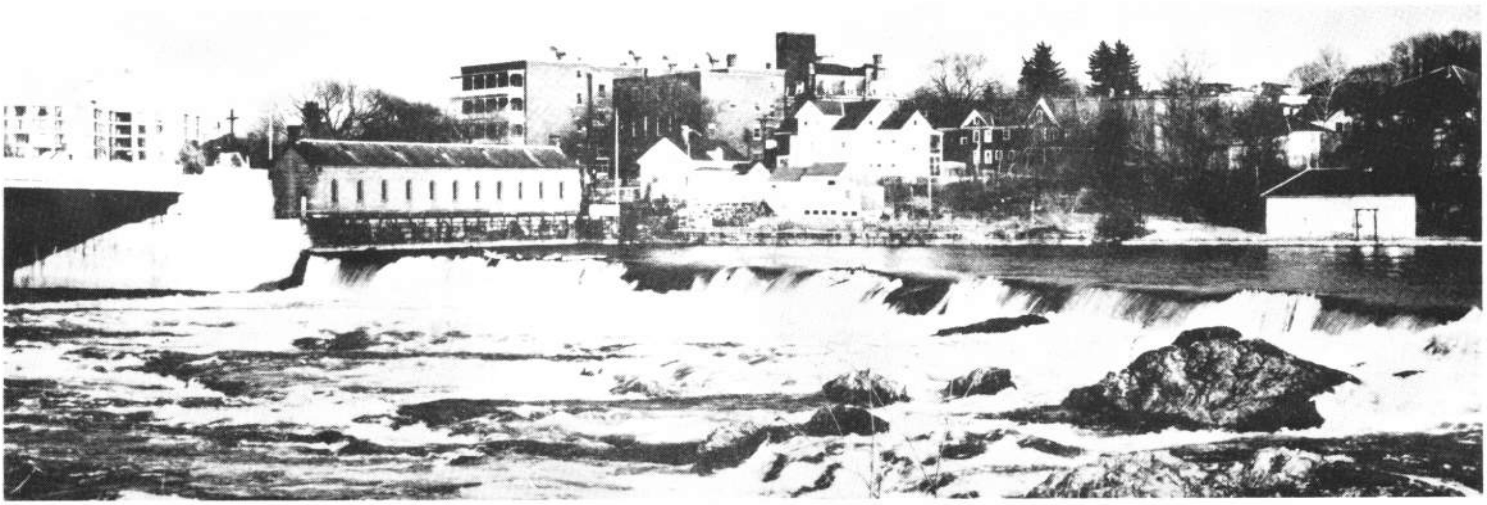
Subsequent to Congressional approval, President Carter signed the law establishing Lowell National Historical Park and the Lowell Historic Preservation District on June 5, 1978. The National Park Service administers the Park in cooperation with the Commonwealth of Massachusetts, the City of Lowell, and other local and private organizations, under the direction of the Secretary of the Interior.

The historic engineering and industrial structures in Lowell today reflect the technical skill which created them. Lowell's engineers, technicians, and workers have left a lasting heritage in the man-made environment of their City. Lowell was not only a leader in textile production but also a showpiece of engineering expertise.



Northern Canal Walkway, date unknown Lowell Historical Society.

Pawtucket Dam and Pawtucket Gatehouse. Courtesy of HAER.



Present Conditions

The Northern Canal

From its entrance to the point where it intersects with the Western Canal, the Northern Canal is 4,373 feet in length. It averages 100 feet in width and is 15 to 21 feet deep. The cross section is basically a shallow rectangle, although there is often a slight slope to the masonry walls and cut ledge forming the sides of the channel.

The canal has one bend, a curve which does not seriously affect the smooth flow of water. Francis designed the canal to deliver water with very little friction head loss, and it still performs that function very well.

The "wall" between the canal and the river varies in form but has three distinct sections.

The first 130 feet downstream from the School Street Bridge consists of a concrete spilling wall encased by a battered, dry-laid, squared rubble wall.

The next section, approximately 1000 feet long, was built on an island formed by the excavation of the canal parallel to the river. It contains a spilling wall of random coursed rubble laid in cement, encased in a backfill of puddle clay, and further backfilled with earth which is retained by two battered, dry-laid, squared rubble walls.

The third section is the famous Great River Wall, which can be reached by a walkway from the School Street Bridge and along the island.

Pawtucket Gatehouse

The guard sluice gates, the brick gatehouse, and a navigation lock were all constructed as a part of the 1846-47 Northern Canal project. The gatehouse shelters and supports the gate hoisting machinery.

Its attenuated plan dimensions of 22 feet by 122 feet relate to the rank of ten sluice gates and the single Penstock gate for the turbine chamber. Each longitudinal elevation contains eleven fenestration openings (now filled with brick on the north elevation), indicating the eleven gates inside.

Vaguely Romanesque revival in style, the building is constructed of red pressed brick on a granite ashlar foundation and is covered by a gable roof of slate.

Distinctive decorative features are the corbeled brick raking cornices and the quarter rounded southwest corner with its corbeled transition into the right-angled cornice. This rounded corner was intended to facilitate the passage of flood water and flotsam without damage to the brick.

The ten sluice gates which control the flow of water into the Nothern Canal were first operated by a complex mechanical system. Most of the power equipment, including belt, pulley, line shafting to the hoisting machinery, and the 1847 turbine and twin hoisting screws for each gate, remain intact. Among other notable features is Lowell's last surviving main belt drive for a mechanical power transmission system.

Experimentation with electric motor drive at the gatehouse began in 1891, but the turbine was apparently not retired from operation until 1923. One of the early motors survives, but the line shaft has stood idle since small, modern motors were installed on each set of hoisting machinery.

Great River Wall

Great River Wall was built in the natural bed of the river, and rises as much as thirty-six feet above the rapids. At times over a thousand men were employed at once in its construction. This thousand-foot retaining wall is founded on ledge and is made primarily of granite blocks, roughly squared in the interior and quarry-faced, coursed ashlar on the exterior.

Both sides of the wall are battered, and the wetted area of the inside surface is made impermeable by a lining of small-sized rubble set in cement. A pedestrian walkway crowns the massive stone wall.

Pawtucket Dam

The Pawtucket Dam was built and rebuilt piecemeal over the previous half century. The present masonry dam was built in two sections, the first in 1847 and the second in 1875. This dam replaced an earlier masonry dam built between 1830 and 1833. As the date suggests, the 1847 section was constructed as part of the Northern Canal project. It represents roughly one-third of the present dam stretching from the Northern Gatehouse.

The dam as a whole is 1,093.5 feet long, following the irregular outline of the natural ledge of the falls. Its foundation consists of granite blocks laid in a trench. The face of the dam is constructed of quarry-faced granite blocks, and the interior is granite rubble set in hydraulic cement. The dam has no spill way.

Atop the granite dam is a row of flashboards running the entire length of the structure and held in place by iron pins set in the capstones. These boards raise the level of the pond significantly with a minimum of capital investment.

The fishway at the northern end of the Pawtucket Dam was installed in 1921 and will be replaced during construction of a new power station, without adverse effect to any historic feature of the dam.

Navigation Lock

Francis added a navigation lock to the entrance of the Northern Canal when he built the Pawtucket Gatehouse. The lock has not been used since 1871, and is now blocked by a concrete wall built in 1939. The National Park Service plans to reopen the lock in the near future.

Waste Gatehouse and Waste Weir

The most sensitive historic feature of the Northern Canal is the Waste Gatehouse, or High Bridge Gatehouse, immediately upstream from the bend of the canal. Here Francis installed four manually operated waste gates to draw the canal and two scouring holes to remove silt from it.

Francis also built a waste weir with multiple bays at the top of the wall and next to the scouring holes.

Major modifications took place in 1872, when one of the scouring holes was converted into a wheel pit for a turbine. Francis installed a small, scroll-cased turbine with a mixed-flow runner and no guides. This turbine and almost all of the mechanical drive system are still intact.

Acknowledgments

The American Societies of Civil and Mechanical Engineers wish to acknowledge the efforts of all who cooperated on the Landmark designation of the Lowell Canal System and Pawtucket Gatehouse Hydraulic Turbine, particularly Lowell's National Park Service Staff; Dr. Patrick M. Malone of the Slater Mills, whose material was used to prepare this brochure, and Ensign John H. Gale, III, of the ASME Student Section at Lowell Institute of Technology, for his early research and preparation of material for the Landmark nomination.

Photo credits: The Historic American Engineering Record, Lowell Historical Society, and Lowell University.

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Appendix E – Photographic Documentation Log

PHOTOGRAPHIC LOG

Client Name:	**Project Name/Site Location:**	**Project No.**
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	**Date:**
1	10/07/21

Direction Photo Taken:
Southeast

Description:

View of Francis Gatehouse (Guards Locks Great Gate) on the Pawtucket Canal.

Photo No.	**Date:**
2	10/07/21

Direction Photo Taken:
North

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
3	10/07/21

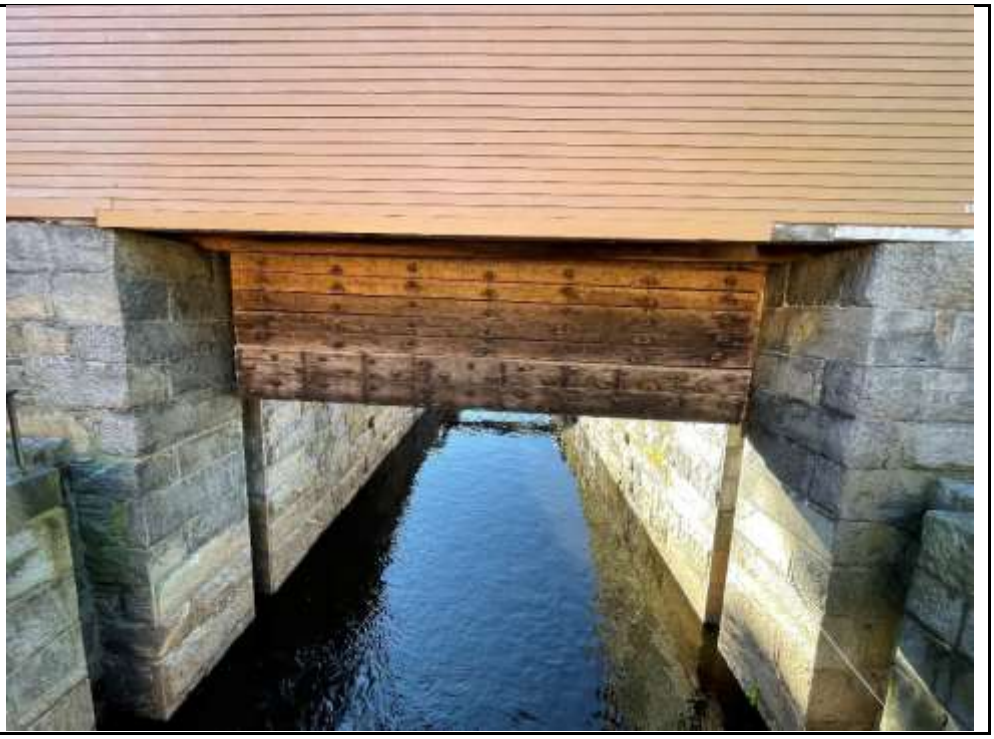
Direction Photo Taken:
East

Description:

View of Francis Gatehouse (Guards Locks Great Gate) on the Pawtucket Canal.

Photo No.	Date:
4	10/07/21

Direction Photo Taken:
South



PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
5	10/07/21

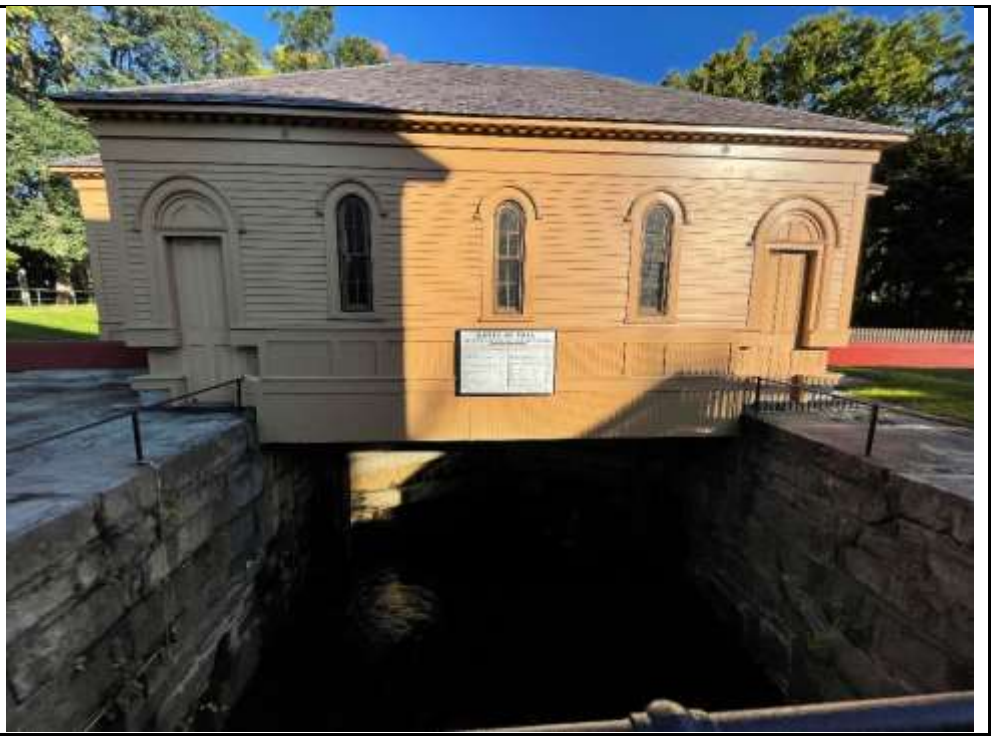
Direction Photo Taken:
East

Description:

View of Guard Locks Lock House on the Pawtucket Canal. The Francis Gatehouse is located south of this photo.

Photo No.	Date:
6	10/07/21

Direction Photo Taken:
North



PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
7	10/07/21

Direction Photo Taken:
South

Description:

View of Guard Locks Lock House on the Pawtucket Canal.

Photo No.	Date:
8	10/07/21

Direction Photo Taken:
West

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
9	10/07/21

Direction Photo Taken:
North

Description:

View of Hydraulic Gatehouse (Guard Locks Gate House) on the Pawtucket Canal.

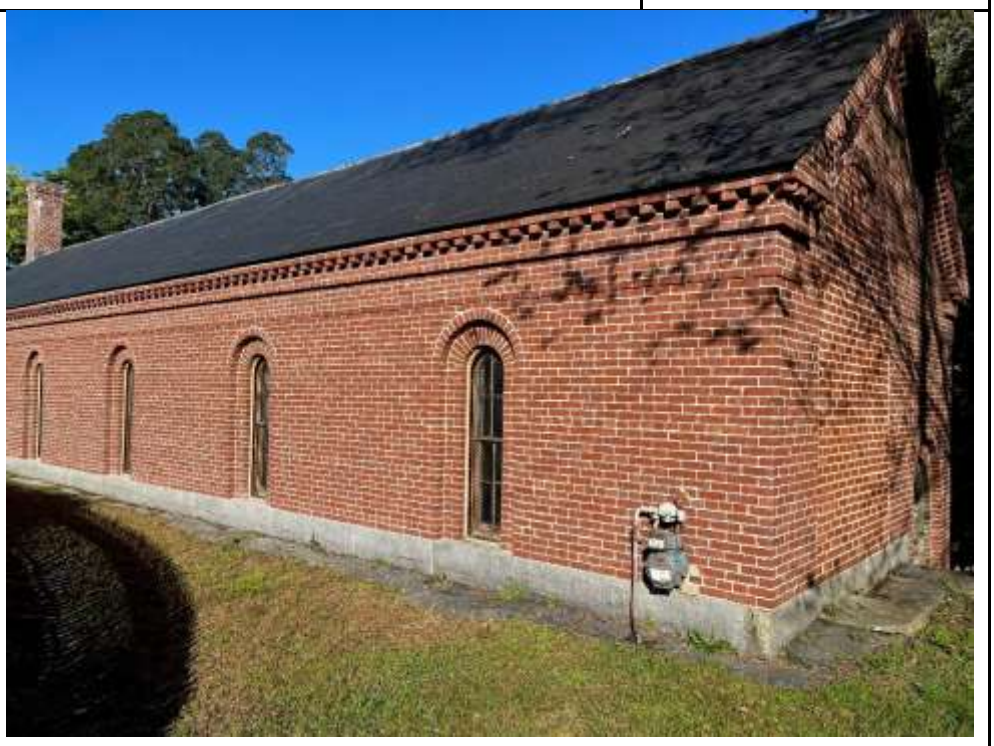


Photo No.	Date:
10	10/07/21

Direction Photo Taken:
Southeast

Description:
View of Hydraulic Gatehouse (Guard Locks Gate House) on the Pawtucket Canal.

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
11	10/07/21

Direction Photo Taken:
East

Description:

View of Hydraulic Gatehouse (Guard Locks Gate House) on the Pawtucket Canal.

Photo No.	Date:
12	10/07/21

Direction Photo Taken:
East

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
13	10/07/21

Direction Photo Taken:
East

Description:

Interior view of Hydraulic Gatehouse (Guard Locks Gate House) on the Pawtucket Canal.

Photo No.	Date:
14	10/07/21

Direction Photo Taken:
East

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
15	10/07/21

Direction Photo Taken:
Northeast

Description:

Interior view of Hydraulic Gatehouse (Guard Locks Gate House) and associated equipment.

Photo No.	Date:
16	10/07/21

Direction Photo Taken:
West

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
17	10/07/21

Direction Photo Taken:
West

Description:

Interior view of Hydraulic Gatehouse (Guard Locks Gate House) and associated equipment.

Photo No.	Date:
18	10/07/21

Direction Photo Taken:
Northeast

Photo No.	Date:
19	10/07/21

Direction Photo Taken:
West

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
20	10/07/21

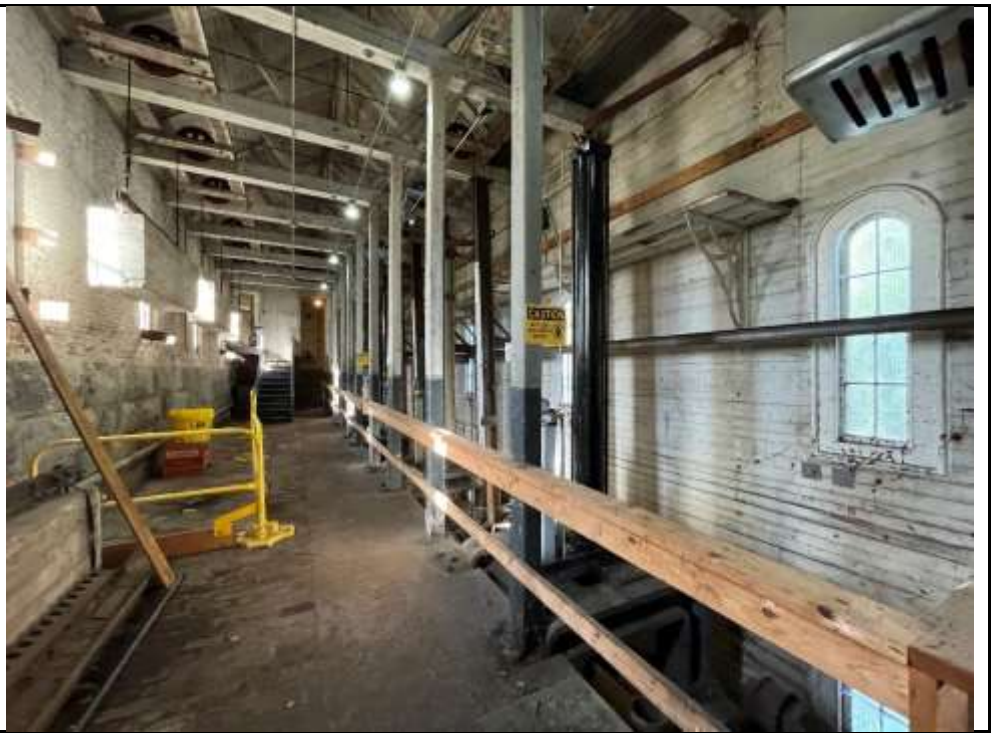
Direction Photo Taken:
North

Description:

Interior view of Hydraulic Gatehouse (Guard Locks Gate House) and associated equipment.

Photo No.	Date:
21	10/07/21

Direction Photo Taken:
West



PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
22	10/07/21

Direction Photo Taken:
West

Description:

Interior view of Hydraulic Gatehouse (Guard Locks Gate House) and on the Pawtucket Canal.

Photo No.	Date:
23	10/07/21

Direction Photo Taken:
Southeast

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
24	10/07/21

Direction Photo Taken:
North

Description:

View of Guard Locks Complex on the Pawtucket Canal from the Broadway Street sidewalk and stairway entrance.

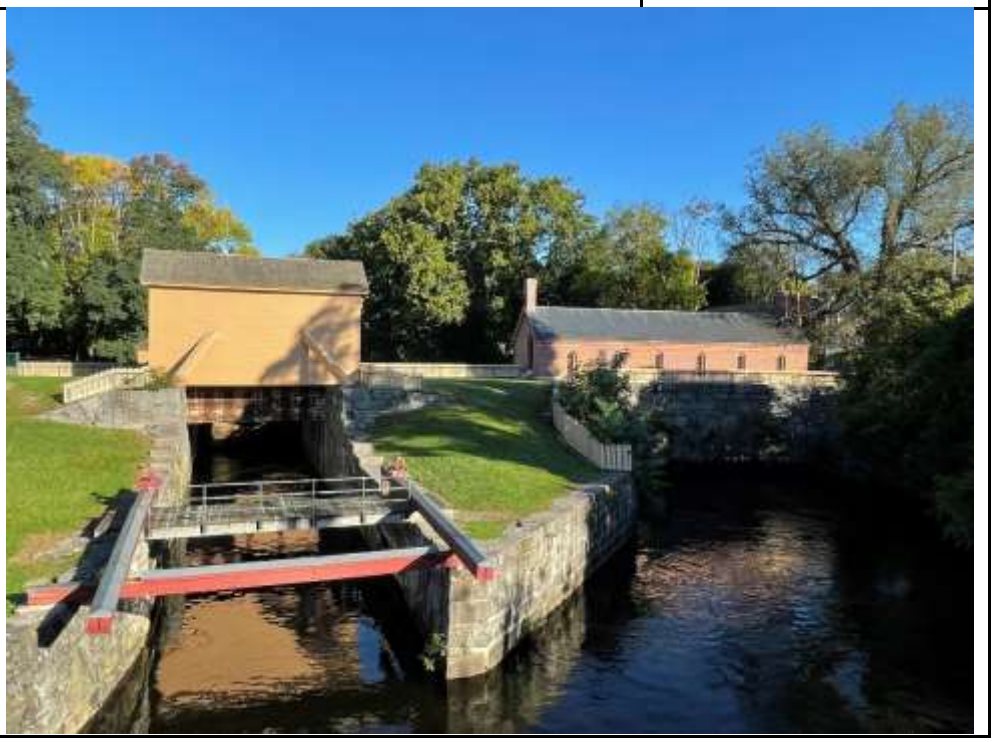


Photo No.	Date:
25	10/07/21

Direction Photo Taken:
East

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
26	10/07/21

Direction Photo Taken:
East

Description:

View of Great Gate signage and historical dates.

Photo No.	Date:
27	10/07/21

Direction Photo Taken:
Southeast

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
28	10/07/21

Direction Photo Taken:
East

Description:

Additional views of Guard Locks Complex signage.

Photo No.	Date:
29	10/07/21

Direction Photo Taken:
East

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
30	10/07/21

Direction Photo Taken:
Northeast

Description:

View of Pawtucket Gatehouse and on the Northern Canal.

Photo No.	Date:
31	From Archives

Direction Photo Taken:
Original belt-and-line shafting system mounted on the Francis Turbine

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
32	From Archives

Direction Photo Taken:
Southeast

Description:

Original belt-and-line shafting system in the Pawtucket Gatehouse

Photo No.	Date:
33	July 2020

Direction Photo Taken:
Original belt-and-line shafting system in the Pawtucket Gatehouse, note the electric motor in foreground

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
34	10/07/21

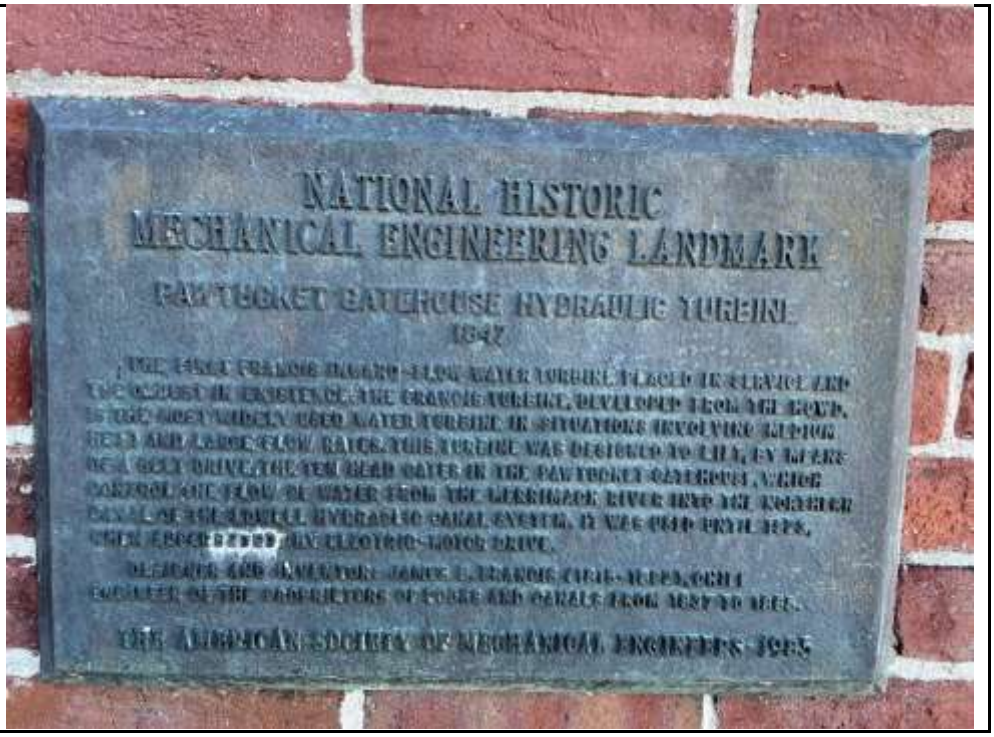
Direction Photo Taken:
Northeast

Description:

View of the Northern Canal from Pawtucket Gatehouse.

Photo No.	Date:
35	10/07/21

Direction Photo Taken:
Northeast



PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
36	10/07/21

Direction Photo Taken:
Southeast

Description:

Views of historical gauge at Pawtucket Gatehouse on the Northern Canal.

Photo No.	Date:
37	10/07/21

Direction Photo Taken:
Northeast

Description:

Views of Swamp Locks Gate House on the Pawtucket Canal.

Photo No.	Date:
38	10/07/21

Direction Photo Taken:
Southwest

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
39	10/07/21

Direction Photo Taken:
Southeast

Description:

Views of Swamp Locks Gatehouse on the Pawtucket Canal.

Photo No.	Date:
40	10/07/21

Direction Photo Taken:
Southeast

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
41	10/07/21

Description:

Views of Lower Locks Gatehouse on the Pawtucket Canal.

Photo No.	Date:
42	10/07/21

Direction Photo Taken:
Southwest

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
43	10/07/21

Direction Photo Taken:
Southeast

Description:

Views of Lower Locks Gatehouse on the Pawtucket Canal.

Photo No.	Date:
44	10/07/21

Description:

Interior views of Lower Locks Gatehouse on the Pawtucket Canal.

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
45	10/07/21

Direction Photo Taken:
Southeast

Description:

Interior views of Lower Locks Gatehouse on the Pawtucket Canal.

Photo No.	Date:
46	10/07/21

Direction Photo Taken:
Northwest

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
47	10/07/21

Direction Photo Taken:
Northeast

Description:

Views of Lower Locks Gatehouse on the Pawtucket Canal.

Photo No.	Date:
48	10/07/21

Description:

Views of Lower Locks Locking Chamber on the Pawtucket Canal.

Direction Photo Taken:
East

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
49	10/07/21

Direction Photo Taken:
Northwest

Description:

Views of Lower Locks Complex on the Pawtucket Canal.

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
50	10/07/21

Direction Photo Taken:
Southwest

Description:

Views of Lower Locks Gatehouse on the Pawtucket Canal.

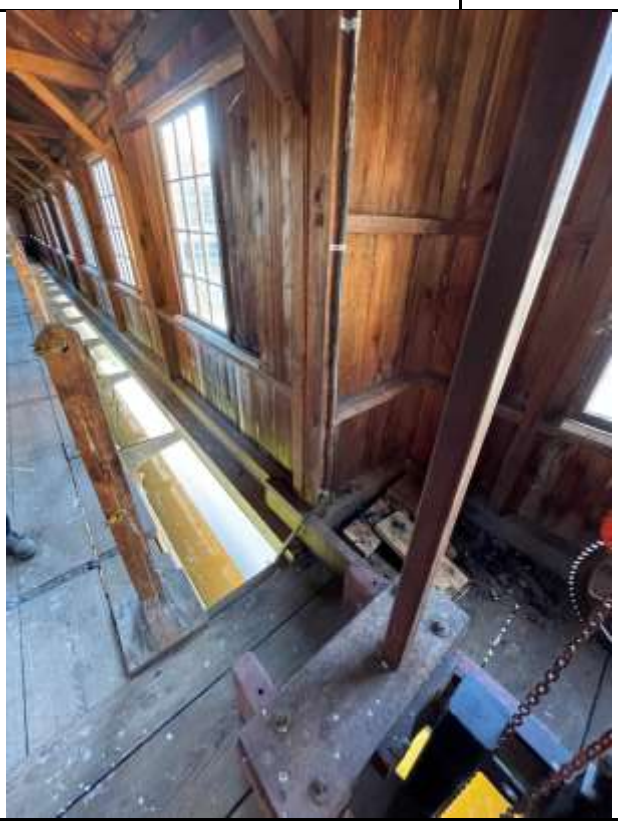


Photo No.	Date:
51	10/07/21

Direction Photo Taken:
West

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
52	10/07/21

Direction Photo Taken:
Southeast

Description:

Views of Massachusetts Wasteway Gatehouse on the Eastern Canal.

Photo No.	Date:
53	10/07/21

Direction Photo Taken:
Northeast

PHOTOGRAPHIC LOG

Client Name:	**Project Name/Site Location:**	**Project No.**
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	**Date:**
54	10/07/21

Direction Photo Taken:
North

Description:

Views of Boott Dam Gatehouse on the Eastern Canal.

Photo No.	Date:
55	10/07/21

Direction Photo Taken:
Northeast

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
56	10/07/21

Direction Photo Taken:
Northeast

Description:

Views of historical structures and Rolling Dam located west of Boott Dam Gatehouse on the Eastern Canal.

Photo No.	Date:
57	10/08/21

Direction Photo Taken:
South

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
58	10/08/21

Direction Photo Taken:
West

Description:

Views of the Merrimack Dam on the Eastern Canal.

Photo No.	Date:
59	10/08/21

Direction Photo Taken:
East

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
60	10/07/21

Direction Photo Taken:
Southwest

Description:

Views of Northern Canal Waste Gatehouse on the Northern Canal.

Photo No.	Date:
61	10/07/21

Direction Photo Taken:
Southwest

PHOTOGRAPHIC LOG

Client Name:	**Project Name/Site Location:**	**Project No.**
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	**Date:**
62	10/07/21

Direction Photo Taken:
North

Description:

Interior Views of Northern Canal Waste Gatehouse and associated equipment

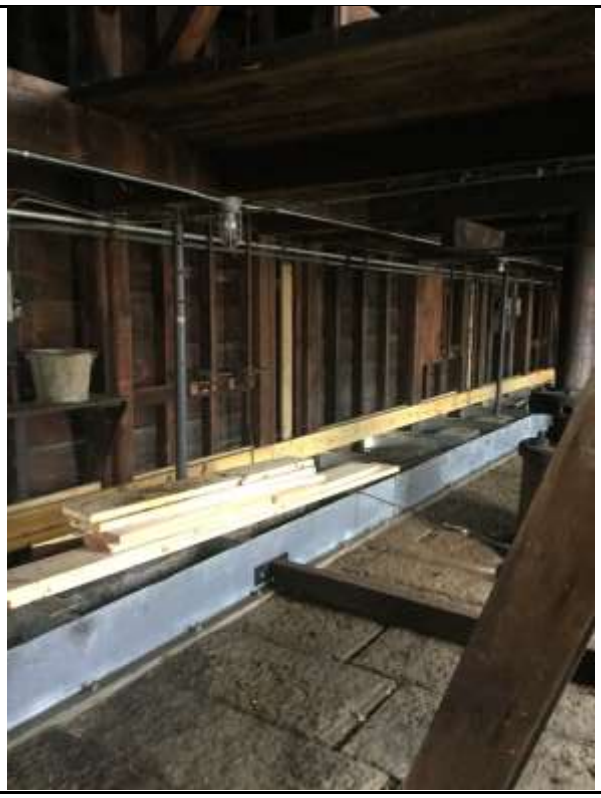


Photo No. 63 **Description:** Interior Views of Northern Canal Waste Gatehouse and associated equipment **Direction Photo Taken:** Northwest	

Photo No. 64 **Description:** Interior Views of Northern Canal Waste Gatehouse and associated equipment **Direction Photo Taken:** Northwest	

Photo No. 65	
Description: Interior Views of Northern Canal Waste Gatehouse and associated equipment **Direction Photo Taken:** Northwest	

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
66	10/08/21

Direction Photo Taken:
Northeast

Description:

Views of Northern Canal Waste Gatehouse and the Great Wall from University Bridge on the Northern Canal.

Photo No.	Date:
67	10/08/21

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
68	10/07/21

Direction Photo Taken:
North

Description:

Views of Tremont Gatehouse on the Western Canal.

Photo No.	Date:
69	10/07/21

Direction Photo Taken:
Southeast

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
70	10/07/21

Direction Photo Taken:
Southwest

Description:

Views of Tremont Gatehouse on the Western Canal.

Photo No.	Date:
71	10/07/21

Direction Photo Taken:
North

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
72	10/07/21

Description:

Views of Moody Street Feeder Gatehouse

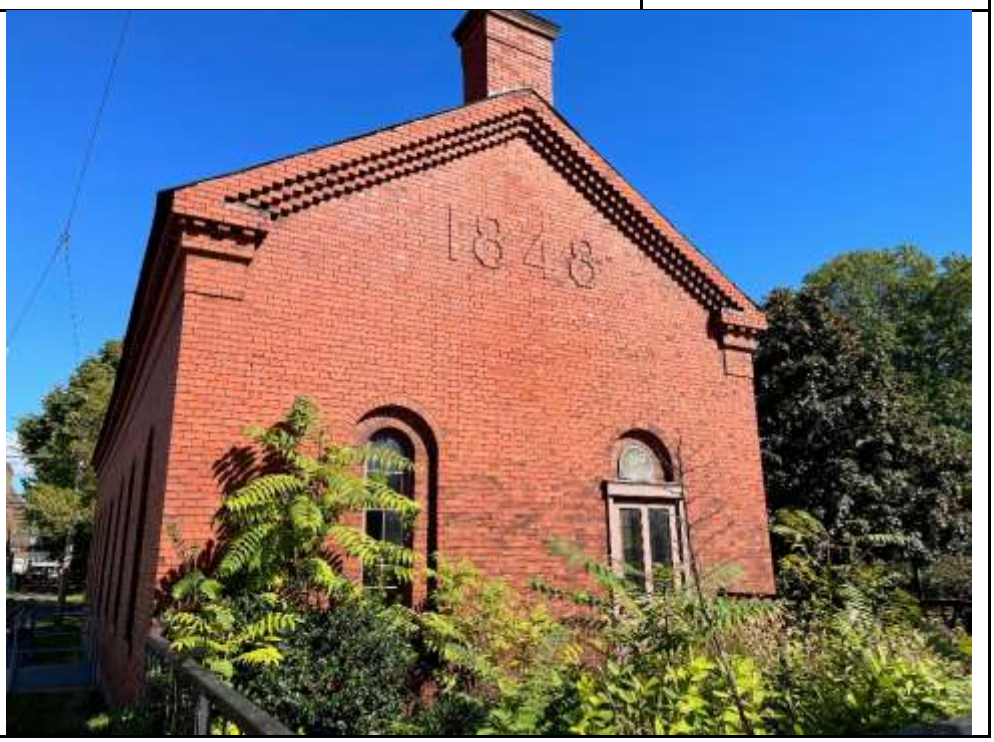
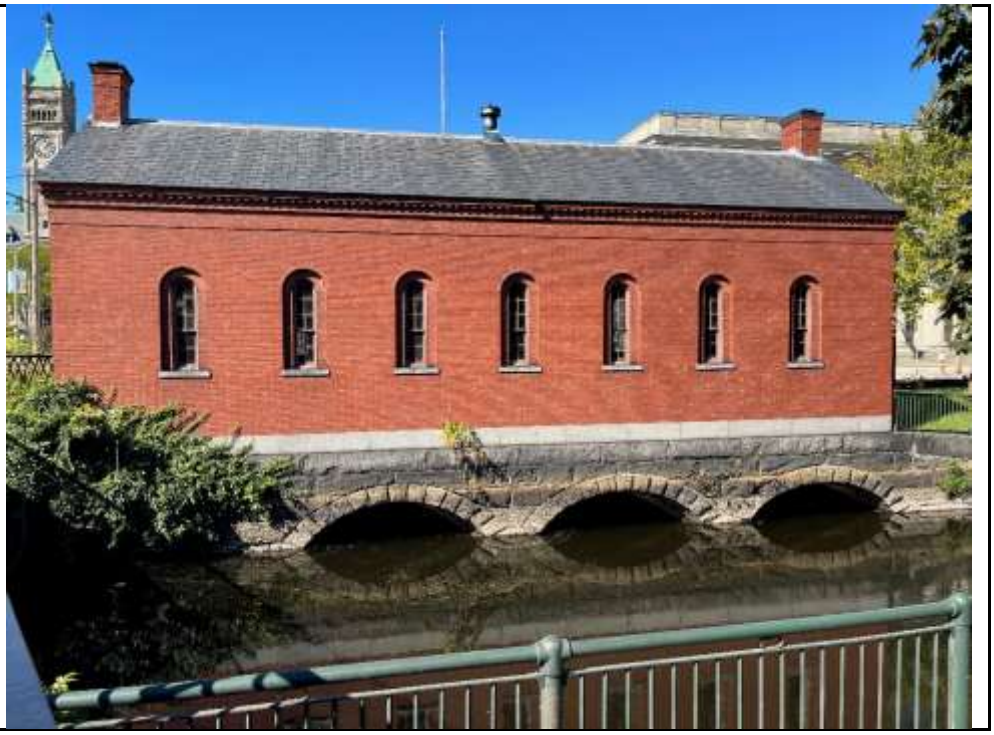


Photo No.	Date:
73	10/07/21

Description:

Views of Moody Street Feeder Gatehouse



PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
74	10/07/21

Description:

Views of Moody Street Feeder Gatehouse

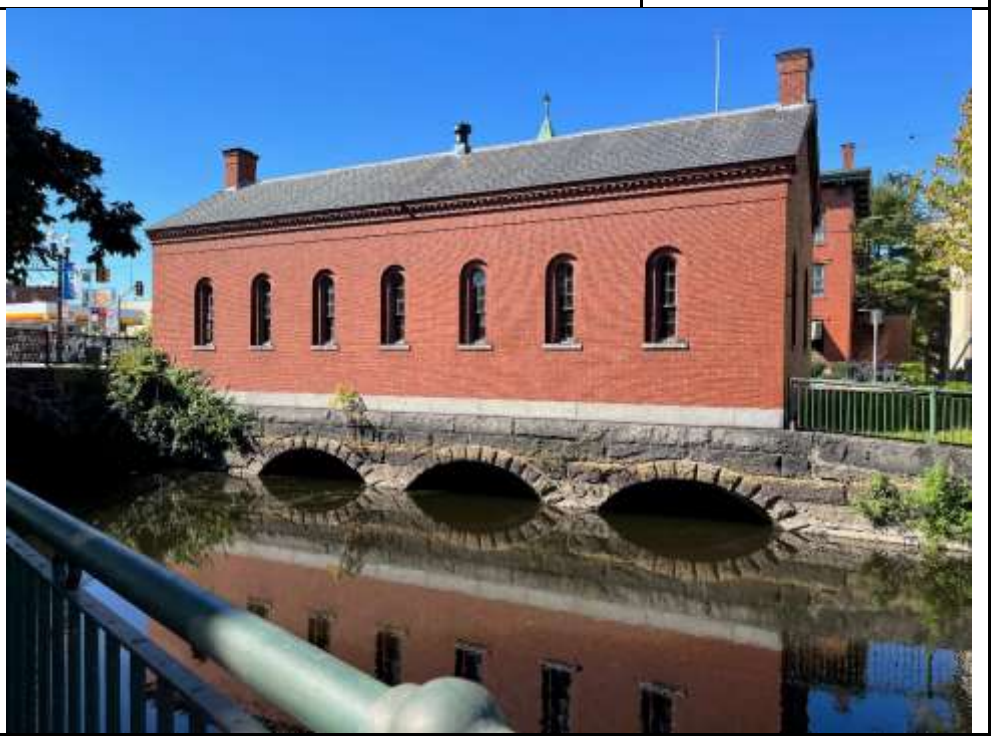


Photo No.	Date:
75	10/07/21

Description:

Views of Moody Street Feeder Gatehouse

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
76	10/07/21

Description:

Views of Moody Street Feeder Gatehouse

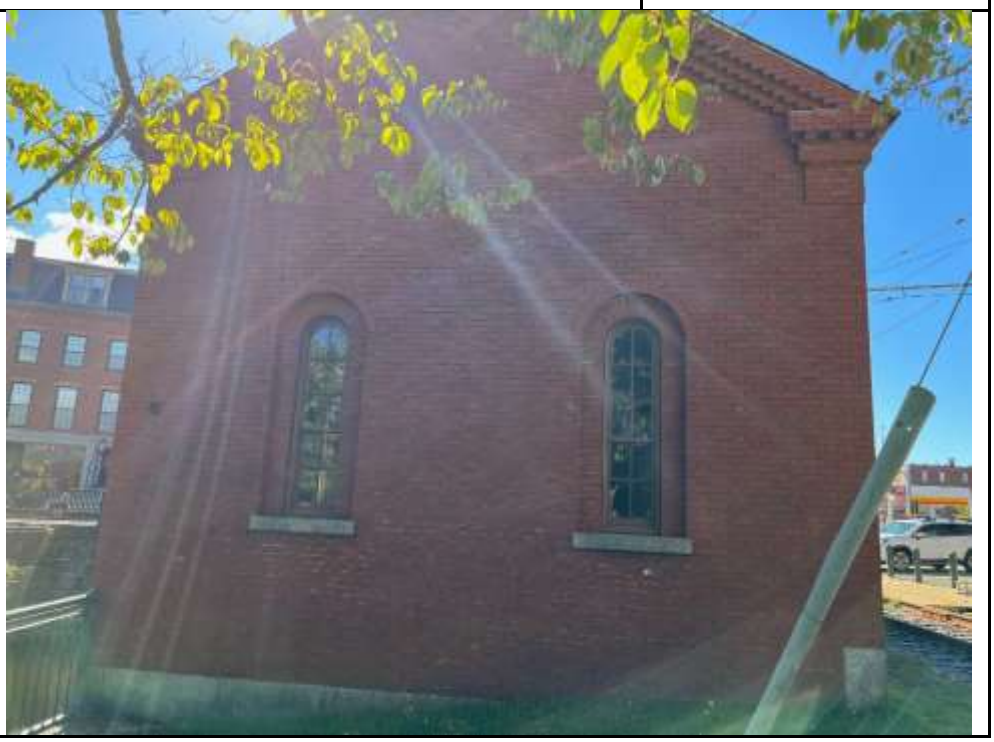
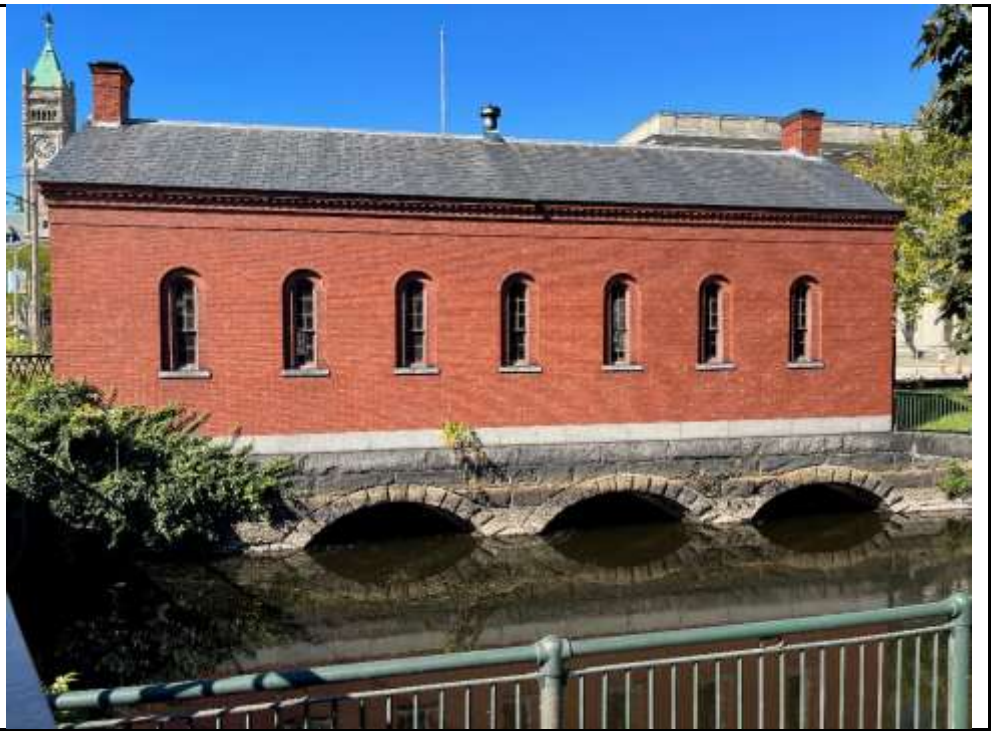


Photo No.	Date:
77	10/07/21

Description:

Views of Moody Street Feeder Gatehouse



PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
78	July 2020

Description:

Views of Moody Street Feeder Gatehouse and associated equipment

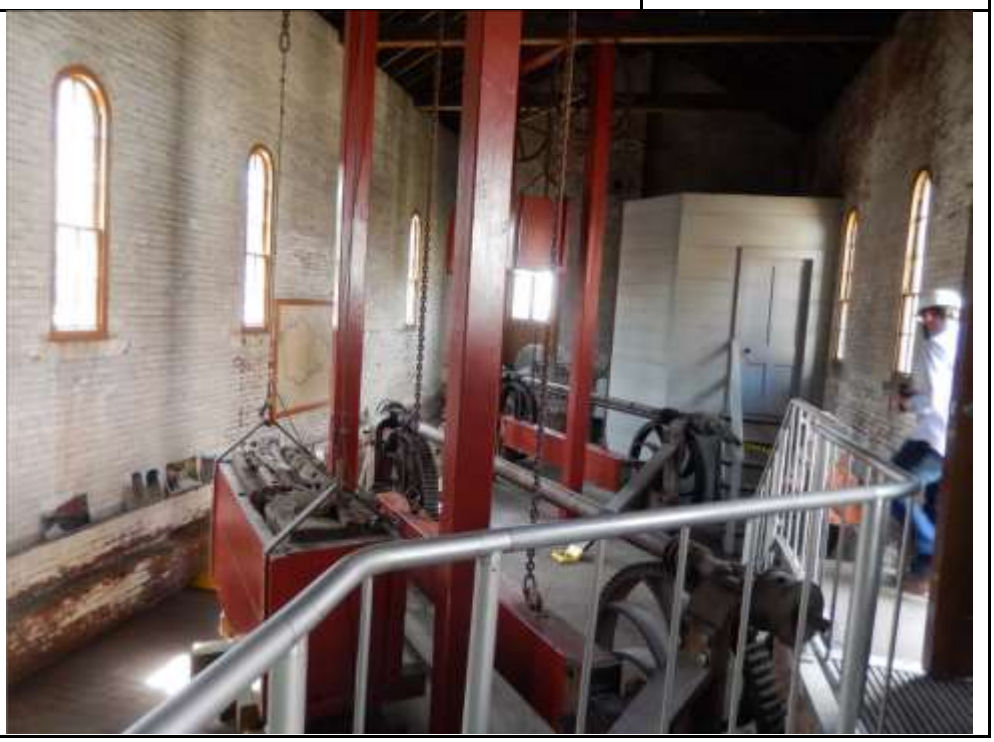


Photo No.	Date:
79	July 2020

Description:

Views of Moody Street Feeder Gatehouse and associated equipment

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
80	10/07/21

Direction Photo Taken:
South

Description:

Views of Hamilton Gatehouse on the Hamilton Canal.

Photo No.	Date:
81	10/07/21

Direction Photo Taken:
West

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
82	10/07/21

Direction Photo Taken:
Northwest

Description:

Views of Hamilton Gatehouse on the Hamilton Canal.

Photo No.	Date:
83	10/07/21

Direction Photo Taken:
West

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
84	10/8/21

Direction Photo Taken:
Southwest

Description:

Views of Hall Street Dam and Lawrence Lawrence Wasteway of the Western Canal.

Photo No.	Date:
85	10/08/21

Description:

Views of Lawrence Dam on the Western Canal.

PHOTOGRAPHIC LOG

Client Name:	**Project Name/Site Location:**	**Project No.**
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	**Date:**
86	10/08/21

Direction Photo Taken:
Northeast

Description:

Views of Hall Street Dam and Lawrence Lawrence Wasteway of the Western Canal.

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
87	10/08/21

Direction Photo Taken:
Northeast

Description:

Views of the Western Canal.

Photo No.	Date:
88	10/08/21

Direction Photo Taken:
Northwest

Description:

Views of Northern Canal Waste Gatehouse.

PHOTOGRAPHIC LOG

Client Name:	Project Name/Site Location:	Project No.
Boott Hydropower, LLC	Lowell Hydroelectric Project, Lowell, MA FERC No. 2790 Historically Significant Waterpower Equipment Study Report	N/A

Photo No.	Date:
89	10/07/21

Direction Photo Taken:
Northeast

Description:

Views of historical markers at the Tremont Gatehouse and Lower Locks Gatehouse.

Photo No.	Date:
90	10/07/21

Direction Photo Taken:
Northeast

Appendix F – Deed Between Proprietors of the Locks and Canals and National Park Service

3?? (C??)

Prop. address: Dutton St. Gatehouse

DEED

THIS INDENTURE, made this 6th day of July, 2001, by and between **PROPRIETORS OF THE LOCKS AND CANALS ON MERRIMACK RIVER**, a corporation organized and existing under the laws of the Commonwealth of Massachusetts and having its principal place of business at Nine Central Street, Lowell, Massachusetts 01852, hereinafter referred to as the **GRANTOR**, and the **UNITED STATES OF AMERICA**, 1849 C Street NW, Room 2444, Washington, D.C. 20240, hereinafter referred to as the **GRANTEE**.

WITNESSETH:

WHEREAS, the GRANTOR is the owner of certain property known as the Merrimack Gatehouse located at 269 Merrimack Street, City of Lowell, Middlesex County, Massachusetts, and identified as Tract Number 102-05 containing 0.05 of an acre, more or less, within the boundaries of Lowell National Historical Park; and

WHEREAS, the Secretary of the Interior is authorized to acquire the Merrimack Gatehouse, 269 Merrimack Street, within said Park pursuant to section 202(a)(2)(D) of Public Law 95-290, (92 Stat. 291), as amended;

NOW THEREFORE, the GRANTOR, in consideration of the sum of SIXTY-FIVE THOUSAND AND NO/100 DOLLARS ($65,000.00), the receipt and sufficiency whereof are hereby acknowledged, does hereby grant, bargain, sell and convey with QUITCLAIM COVENANTS unto the GRANTEE and its assigns, in fee simple, forever, the following-described property:

TRACT NO. 102-05

All that certain tract or parcel of land under, around and including the Merrimack Gate House, also known as the Moody Street Feeder Gate House, a one-story brick structure located on the westerly side of the Merrimack Canal and the northerly side of Merrimack Street, said building being approximately twenty-two feet (22') by sixty-two feet ten inches (62' 10") in dimension, said tract or parcel of land lying and being situated in the City of Lowell, County of Middlesex, Commonwealth of Massachusetts, and being more particularly described as follows:

Beginning at the intersection of the southeasterly sideline of a right-of-way of the Boston and Maine Railroad and the northeasterly sideline of Merrimack Street;

Thence northeasterly along said southeasterly sideline of the right-of-way of the Boston and Maine Railroad seventy-nine feet (79') more or less;

Thence southeasterly along property of the City of Lowell twenty-eight and five tenths feet (28.5') more or less to the wall of the Merrimack Canal;

Thence southwesterly along the westerly wall of the Merrimack Canal seventy-one feet (71') more or less to the northerly sideline of Merrimack Street;

Thence westerly along said northerly sideline of Merrimack Street fifteen feet (15') more or less;

Thence northwesterly along said northerly sideline of Merrimack Street fourteen feet (14') more or less to the point of beginning;

Containing 0.05 of an acre more or less.

The above described parcel, designated Tract No. 102-05 in Lowell National Historical Park, was granted to Proprietors of the Locks and Canals on Merrimack River by the instrument from Merrimack Manufacturing Company dated June 5, 1848, recorded with Middlesex South District Registry of Deeds in Book 542, Page 520, and with Middlesex North District Registry of Deeds in Copies Book 61, Page 576.

TOGETHER with all rights, hereditaments, easements and appurtenances thereto belonging unto and to the GRANTEE and its assigns, forever, in fee simple, free and clear from all liens and encumbrances except as specifically reserved hereinbelow, together with all right, title and interest which the GRANTOR may have in and to water rights, banks, beds, and waters of any stream or river bordering or traversing the land, and in and to any alleys, roads, streets, ways, strips, gores or railroad rights-of-way abutting or adjoining said land.

SUBJECT only to those rights outstanding in third parties for existing easements for public roads and highways, public utilities, railroads and pipelines; and subject to the rights, privileges and easements of Boott Hydropower, Inc., and all those claiming by, through or under Boott Hydropower, Inc., for the maintenance and operation of hydroelectric power production facilities as set forth in a Deed from Proprietors of the Locks and Canals on Merrimack River dated January 16, 1984, recorded with the Middlesex North District Registry of Deeds in Book 2690, Page 542.

TO HAVE AND TO HOLD the said premises together with all and singular the rights and privileges thereto belonging unto the GRANTEE and its assigns in fee simple forever.

THE GRANTOR COVENANTS that it has the right to convey said land; that it has done no act to encumber the same; that the GRANTEE shall have quiet and peaceful possession of the same, free and clear from any and all encumbrances; and that it, the GRANTOR, will execute such further assurances of the said land as may be requisite.

THE ACQUIRING FEDERAL AGENCY is the National Park Service, United States Department of the Interior.

IN WITNESS WHEREOF, PROPRIETORS OF THE LOCKS AND CANALS ON MERRIMACK RIVER, the said GRANTOR, has caused its name to be signed hereto by MARSHALL L. FIELD, its PRESIDENT, and its' treasurer XXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXXX being duly authorized to do so, on the day and year first above written, as the free and voluntary act of the corporation.

Signed and Sealed in the presence of:

PROPRIETORS OF THE LOCKS AND CANALS ON MERRIMACK RIVER

WITNESS

By:
Its: President Marshall L. Field and Treasurer

COMMONWEALTH OF MASSACHUSETTS

Middlesex, ss.

On this 6th day of July, 2001, personally appeared the above-named MARSHALL L. FIELD, President, and Treasurer, ________, and acknowledged the foregoing to be the free act and deed of PROPRIETORS OF THE LOCKS AND CANALS ON MERRIMACK RIVER, before me.

Notary Public Sandra M. Boulay

My commission expires: 09/03/04

This deed was prepared by: National Park Service, Northeast Region
Land Resources Program Center, New England Office
222 Merrimack Street, 4th Floor
Lowell, MA 01852

END OF DOCUMENT