CHELSEA STREET BRIDGE AND DRAW TENDER'S HOUSE
Spanning the Chelsea River
Boston
Suffolk County
Massachusetts

HAER No. MA-140

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PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD
National Park Service
Philadelphia Support Office
U.S. Custom House
Philadelphia, PA 19106

HISTORIC AMERICAN ENGINEERING RECORD

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HAER NO. MA-140

Location: Chelsea Street, spanning the Chelsea River, Boston, Suffolk County, Massachusetts.

UTM: 19.333430.4694430

Quad: Boston North, Massachusetts

Date of Construction: 1936-1937; rebuilt 1983

Engineer & Builder: Strauss & Paine, Designing Engineers; Fay, Spofford & Thorndike, Construction Engineers; T. Stuart & Sons, Builder; Bethlehem Steel, Steel Fabricator

Present Owner: City of Boston, Massachusetts

Present Use: Drawbridge for vehicular and pedestrian traffic

Significance: The Chelsea Street Bridge is significant as an example of a bascule bridge, a type of moveable bridge developed in the early 20th century and widely adopted in subsequent years for both railway and highway spans. The Strauss heel trunnion bascule was one of four bascule designs developed by Strauss and may be the only Strauss heel trunnion bascule bridge in Massachusetts. It is the only one in Boston. The Chelsea Street Bridge is also one of the few surviving drawbridges in Boston Harbor. Of the 14 draw bridges in operation in 1940, only nine remain and only two, the Meridian Street Bridge and the Chelsea Street Bridge, both over the Chelsea River, are still operational.

Project Information: Documentation of the Chelsea Street bridge is in accordance with an agreement with the Massachusetts Historic Commission and the United States Coast Guard dated November 27, 1992. Jane Carolan, Architectural Historian and Project Manager, Martin Stupich, Photographer and Connie Brown, Production. Under subcontract to HNTB, Inc. Boston, MA.

INTRODUCTION

The Chelsea Street Bridge was constructed between 1936 and 1937 and connects East Boston in Suffolk County and Chelsea in Middlesex County via Chelsea Street. It was designed by Strauss & Paine, Design Engineers and Fay, Spofford & Thorndike, Construction Engineers and built by T. Stuart & Sons company of Watertown, MA. The bridge is a rare Strauss heel trunnion type bascule.

The Chelsea Street Bridge crosses the Chelsea River and connects East Boston and Chelsea via Chelsea Street. This roadway is a major vehicular connector between East Boston and Chelsea and is often used as a short cut to Logan Airport. The bridge is located in an area historically associated with industrial development. Today the bridge is surrounded by shipping companies, oil storage facilities and a sewerage pumping station. Almost 70% of all jet fuel bound for Logan Airport, and 55% of Boston's gasoline and home heating fuel, are stored in facilities on the Chelsea River. Due to its many out of service periods, coupled with a need for a wider opening for modern tankers, the Chelsea Street Bridge will be replaced with a bridge with a longer span to accommodate a wider opening and deeper channel for the larger oil and fuel tankers presently in use. In addition to the bridge itself, the Draw Tender's House was recorded as well since it is an integral part of the bridge and its operations.

HISTORIC OVERVIEW

Chelsea

The City of Chelsea was settled by Europeans as early as 1625 and grew slowly during the seventeenth and eighteenth centuries. For much of its history, in sharp contrast to its present-day, gritty city image, Chelsea was a sparsely populated farming community. Even during the early nineteenth century Chelsea remained largely agricultural and also became something of a summer resort for wealthy Bostonians.

By the mid-seventeenth century a ferry linked Chelsea and Boston and in 1802 the first bridge over the Mystic River was constructed. In 1834 the first bridge at the location of the current Chelsea Street Bridge was constructed. In 1857 the Meridian Street Bridge to East Boston was built and the same year the Eastern Railroad built a route from East Boston through Chelsea to Everett with a station stop in Chelsea at Washington Street.[1]

With this rise in transportation routes the population of Chelsea begin to soar. With the railroad came industry and an industrial corridor along the railroad developed. Much of the open land began to be subdivided as workers housing began to be built. In only forty years, between 1830 and 1870 the population exploded from 700 people to 18,000.

By the mid-1840s, paints, oils and varnishes dominated Chelsea's industrial base. Additionally, leather tanning facilities were established and elastic and elastic thread, wallpaper, bricks and art pottery were manufactured as well. Along Chelsea's river banks, on the Mystic and Chelsea rivers, boat builders set up shop.[2]

The late nineteenth century in Chelsea was marked by increasing industrialization with a continually expanding population base. "By 1908 Chelsea had become the most thickly populated city in the United States in proportion to its size, having 40,000 people in less than two square miles."[3]

In 1908 a fire started in a congested area of wood and brick buildings. Chelsea at that time had no fire code and the fire spread rapidly destroying fully half the city and leaving over 15,000 people homeless. It destroyed the Chelsea Street Bridge as well as the adjacent Boston and Albany Railroad Bridge and the East Boston sewerage pumping station as well. Although much of the housing stock and older neighborhoods as well as municipal structures such as city hall were destroyed, many of the industrial buildings, located along the edge of the city, survived. After the fire most of the destroyed area was rebuilt with tenements, triple deckers and two family houses. Because of this the population of the city continued to rise and by 1925 the city peaked in population reaching more than 47,000 people.

In 1973 the city suffered another devastating fire, which started in a abandoned rag company building less than 200 yards from the start of the 1908 fire.[4]

Today, Chelsea is a city struggling to survive, since many of its industries have closed or moved away. Its population has declined by half of what it was in the early part of the century. But the oil storage industry, based along the banks of the Chelsea River in Chelsea and East Boston is still an active and vital businesses in Chelsea and many large tankers ply the Chelsea River's waters today.

East Boston

East Boston originally consisted of five islands, Noddles, Breeds, Governor's, Apple and Bird Islands none of which were settled until the end of the seventeenth century. Land filling began almost immediately after settlement and continued throughout the nineteenth and twentieth centuries. In the 1840s, the Eastern Railroad, serving the North Shore of Boston and extending to Portland, Maine, was routed through East Boston. The Eastern Railroad was the first enterprise to build along East Boston's waterfront and others quickly followed.

Boston had a busy and prosperous harbor but by the 1830s had little room for expansion. East Boston was the perfect spot to develop. By 1835, the East Boston waterfront contained a variety of heavy industries. Between the 1830s and 1870s the transformation of East Boston from island pastures to city was complete. This growth was the direct response to East Boston's prosperous shipbuilding and shipping industries. The waterfront was lined from the Chelsea River to Boston Harbor with shipbuilders and shipping wharfs. Adding to East Boston's success was the establishment in the 1840s of the Cunard Line's Boston Terminal for sail and steam ships from Liverpool. With regular service between Liverpool, London and Boston, East Boston became a major international shipping and passenger center.

By the early part of the twentieth century the population had stabilized and major waterfront and industrial development had evolved into oil and chemical plants along the Chelsea River, brick factories manufacturing a variety of products, and a large railroad yard operated by the Boston and Albany Railroad along the waterfront. Perhaps the most important event in East Boston's early twentieth century history was the opening of the Boston Municipal Airport, forerunner of Logan Airport in 1923. As much of East Boston slowed down due to a shift in shipping by sea to shipping by trucks the airport continued to grow so that today Logan Airport occupies almost two-thirds of East Boston's land mass.[5]

HISTORY OF THE CHELSEA STREET BRIDGE

In 1834, a wooden drawbridge, constructed by the East Boston Company, was the first bridge built at the site of the present Chelsea Street Bridge. Throughout the nineteenth century the wooden draw bridge had repeated periods of decline, followed by repair and rebuilding. It was rebuilt in 1848 and the draw rebuilt in 1868. Yet in 1872 it was described as being in a "dangerous condition."[6] The following year it was substantially rebuilt and described as a wooden draw with a solid filled causeway on the Chelsea side, and solid filled causeway along with an open deck on wood piles on the East Boston side.[7]

In 1887 the Chelsea side of the bridge was damaged in a fire and a temporary span constructed. The bridge, in that year, was described as dangerous and inconvenient although heavily used due to increasing vehicular and ship traffic.[8] In 1894 the bridge was mostly replaced with new approach spans and a new center-bearing draw of iron and steel built by the Boston Bridge Works.[9] In 1908 the bridge was heavily damaged by the famous 1908 Chelsea Fire. Again, the bridge was rebuilt as an operational drawer.

In 1935 the city of Boston decided to replace the existing bridge. Despite substantial repairs completed in 1932, the draw still was not functioning properly. In the Public Works Department's Annual Report of 1932 it was stated, "While the operation is now satisfactory, owing to the condition of the wood work extensive repairs will soon be required.[10] The Chelsea River was an active waterway and a reliable modern bridge would be a great improvement over constantly repairing an existing bridge. Using funding and man-power from the Federal Emergency Administration of Public Works Projects (FEA), the city of Boston contracted to build a new bridge of which the city would pay for 55% of the bridge and the FEA 45%.[11]

The bridge was to be built immediately south of the existing wooden one. "The ... bridge will be a steel and concrete structure, the spans supported on masonry piers and the draw crossing a 100-foot waterway, will be a heel trunnion type, built under Strauss patents."[12] A wooden draw tenders house would be constructed on the downstream side of the bridge, on the East Boston side.

The design engineers for the draw span and its operating mechanism were Strauss & Paine, Chicago, IL. Consulting engineers were Fay, Spofford & Thorndike, Boston, MA. The steel was designed and fabricated by the Bethlehem Steel Company and the bridge was constructed by T. Stuart & Son Company, Watertown, MA. Begun in January 1936, the bridge was officially opened to traffic on May 10, 1937.[13]

Throughout the years the bridge has had a series of repairs. In 1945 a steel H-beam was inserted at the end angle of the East Boston approach.[14] In 1950 a operating strut failed making the bridge inoperable. This resulted in repairs and a complete overhaul of the operating mechanism completed in 1951 by the General Ship and Engine Works.[15] In 1956 the concrete sidewalks and timber bascule deck were replaced with steel mesh.[16] In 1956 General Ship again made repairs to the operating machinery of the bridge. A defective main drive shaft on the downstream unit was replaced.[17] In the late 1950s the Boston & Albany Railroad Bridge (immediately upstream from the Chelsea Street Bridge) was taken out of service and finally removed in 1960. The channel opening was only about 70-feet at the B & A Bridge and with it removed, per order of the Corp of Engineers, the channel was widened to 96 feet requiring the widening of the Chelsea Street Bridge's fender piers.

Yet increasingly large ships plied the river. Due to the narrow channel, the bridge and its fenders have been damaged a number of times by passing ships resulting in the bridge being " ... out of service for a total of four years time since 1975."[18] In 1976 the counterweight was replaced along with supporting trusses on either side of the weight.[19] In the early 1980's after being hit by a tanker the bridge was substantially damaged and out of service for almost two years. In this case the tanker struck the western most truss near the heel trunnion. This necessitated the replacement of some bottom cord members, two floor beams, the western sidewalk and supports and the entire steel deck of the bascule.[20] Additionally, the lateral bracing in the western most truss in front of the heel trunnion was replaced and the entire span was straighten.[21] In the mid-1990s a new pile timber fender and concrete dolphins werc constructed on both the north and south side of the bridge. At the same time the bascule span grid deck was repaired to bring the span up to present day loading requirements.[22]

DESCRIPTION OF THE CHELSEA STREET BRIDGE

Substructure

The substructure of the Chelsea Street Bridge is composed of two abutments and five piers. The piers are composed of concrete faced with granite (to an elevation 2' below the mean water line) and have granite capstones. Pier 1, on the East Boston side is built on spread footings. Piers 2-5 are built on wooden piles. Piers are 64 feet wide and 8'8" thick and rectangular in shape. The two abutments are constructed of concrete resting on wood piles.[23] A substantial timber and concrete fender system, on both sides of the channel is in place. A large wooden deck built of pressure treated lumber has been constructed around the upper and lower levels of the tender's house in conjunction with the new fender and dolphin system.

Superstructure

The riveted steel frame Chelsea Street Bridge is 446.5' long and 70' wide with two, 10' sidewalks.[24] The bridge has six spans; 4 steel stringer approach spans, one on the East Boston side and 3 on the Chelsea side with a single leaf Strauss heel trunnion bascule span. The approach spans are 66' long, the tower span 42' long and the draw is 140' long from the heel trunnion to the center of the bearing.[25] The moveable span is a through Warren truss with verticals and a concrete counterweight. Decks on the approach spans are reinforced concrete with granite block wearing surfaces. The drawspan has an open steel grid deck. The bridge has four vehicular lanes. The sidewalks are enclosed with their original simple steel railings and the original sidewalk of concrete mesh is intact on the lift span. A machinery house, supported by one of the stringer spans is supported by a tower truss. The house, which sits above the roadway within the bascule, is approximately 40' wide and sheathed in corrugated galvanized iron sheets. It is reached by staircases on both the east and west side of the bridge.

The Strauss heel trunnion draw is operated by means of two operating struts. The strut is attached to the moving leaf and fitted with a rack engaging the pinon which is rigidly fastened to the fixed tower. The main pinons are driven through a train of reducing gears by two 50-horse power motors with direct current. A differential automatically equalizes the loads on the operating struts. The heel trunnions are 21" in diameter, the counterweight trunnions are 38" and the counterweight weights 1100 tons.[26] The draw pivots around the heel trunnion which is located at the base of the bascule truss. As the moving leaf rises, the rocker arm lowers which causes the concrete counterweight to move downward. Pier 2 supports the counterweight, Pier 3 the moving leaf. When the bascule span is in the full open position it provides a vertical clearance of 112'9" above mean high tide.[27] Additional motors power the end locks which can also be operated manually.

Draw Tender's House

The Chelsea Street Bridge has one of the few surviving, intact, and in-use, draw tender's house in the Boston area. It retains much of its original fabric and layout. The building is a wood-frame, rectangular structure, with a rear rectangular ell. The main block is 30' 10" x 40' 9" feet and one story high with a hipped roof. Its long axis runs parallel to the bridge. The rear block is 15' 6" x by 15' 4".[28] A three-sided, hipped roof windowed bay, from which the tender operates the bridge, sits at the northwest corner of the house. The building is sided in its original asphalt shingles and has its original slate covered roof. The structure has a simple brick chimney. Windows are the original 2/1. The original entrance door has been replaced with a steel door and a new door has been installed leading to the operator's room. Below the house is a wood enclosed storage room resting on piles.

The interior plan is remarkably intact with only minor changes. The space is divided into a work room, office, toilet room, tender's space, and locker room with adjoining shower room. The operator's room still contains the original electric panel now behind a glass and wood partition and the original wooden lockers are intact. The only change to the building's floor plan is the removal of a toilet from its original location and its installation in what was formerly a closet. The former toilet room is used for storage.[29]

JOSEPH BAERMANN STRAUSS, BRIDGE ENGINEER, AND THE STRAUSS TRUNNION HEEL BRIDGE

Joseph Baermann Strauss (1870-1938) was a talented and versatile engineer who took his bridge theories and inventions and applied them to other disciplines as well. Strauss was the son of a artist and musician and received an engineering degree from the University of Cincinnati. Upon graduation, in 1892, he worked at the New Jersey Steel & Iron Company in Trenton, New Jersey and learned all the aspects of bridge building including designing, estimating and conducting inspections. During the early part of the twentieth century, he worked for the Chicago Sanitary District of Chicago and a number of engineering firms in the Chicago area. During this time he gained a broad knowledge of railroad bridges and viaducts. Chicago is the home of bascule bridges due to the Chicago River and the many man-made canals which run through the city. Strauss soon began to study the dynamics of moveable bridges and at the same time worked for the Universal Portland Cement Company. He developed a concrete house for the company and became familiar with the strength, plasticity and relative cheapness of concrete as a building material.[30]

In 1902, Strauss founded the Strauss Bascule Bridge Company of Chicago (later named the Strauss Engineering Corporation). Through his company Strauss disseminated his innovative ideas all over the country. The actual construction of his designs were completed by other engineering or bridge fabrication firms.

The young engineer began work in a field that was new and rapidly growing: bascule bridge design and construction. Bascule bridges had an advantage over other moveable bridges since they could be built in tight spaces where a swing bridge would have been impracticable and they provided an obvious vehicular traffic barrier. They also could be made in any width and length. In the early 20th-century bascule bridges were relatively rare and limited in length because of the prohibitive cost of building them, primarily due to the cost of the large counterweights which were fabricated of cast iron. Based on his work at Universal Portland Cement, Strauss was able to design a concrete counterweight which resulted in a significant reduction of weight on the drawspans. He then went on to design a pin-connected counterweight system that took much of the stress off the bridge superstructure. Therefore, the spans could be lighter in weight and longer in length. These were major innovations in bascule bridge design and they allowed bascules to be used in a variety of situations all over the world. The design was particularly popular with railroads.[31]

The first Strauss bascule was a railroad bridge constructed in 1905, in Cleveland Ohio. By 1911 Strauss had worked out the designs for his four distinctive types of moveable bridges: the heel trunnion, the vertical overhead counterweight, the underneath counterweight and the simple span. Strauss' major innovation, in addition to introducing concrete counterweights, was the concept of "...balancing the bridge with a pivoting counterweight linked so as to form a parrallelogram with pinions at the vertices."[32]

Although Strauss was an innovator in moveable bridges, perhaps his greatest achievement, and one for which he is most well known, is his design for San Francisco's Golden Gate Bridge. The Golden Gate, was, at the time it was built, the longest single-span suspension bridge in the world. It is 4,200 feet long and opened in 1937. In addition to designing the bridge, Strauss worked through the complicated political maneuvering it takes to get a project this size completed.

In 1935, during the building of the Golden Gate Bridge, Strauss went into partnership with Engineer, Clifford E. Paine who worked with him on the Golden Gate as well as on the Chicago firm's other projects, most of which were bascule bridges. Strauss also designed the Arlington Memorial Bridge, Washington, DC and was a consultant on the designs of the Bayonne Bridge and the George Washington Bridge, both in New York City.[33]

Strauss was an innovative designer and often turned his expertise to other fields. In 1915 he designed a ride called the Aeroscope for the Panama-Pacific International Exposition; it was essentially a revolving bascule bridge. He used his movable bridge experience to devise portable search lights for World War I, a rotating tower restaurant, a steel glass building system and a rapid transit system called an Airtram. A creative writer, as well, Strauss produced books, essays, poems and music. He died in California in 1938, just one year after the completion of the Golden Gate Bridge.[34]

ENDNOTES

1. Massachusetts Historical Commission, Town Report, Chelsea, pp.3-8); City of Boston, Annual Report of the City Engineer, 1873, p.24.

2. Massachusetts Historical Commission. Historical and Archaeological Resources of the Boston Area, 1982, pp. 192, 213, 225.

3. Town Report, Chelsea, p. 9.

4. The Boston Globe. "Heroic Battle in East Boston," April 13, 1908, p. 1; Town Report, Chelsea, pp. 11-12.

5. Town Report, East Boston, pp. 2-8.

6. City of Boston. Annual Report of the City Engineer, 1872, p. 41.

7. Annual Report of the City Engineer, 1872, pp. 24-25.

8. Annual Report of the City Engineer, 1891, p. 15.

9. Annual Report of the City Engineer, 1894, p. 38.

10. City of Boston, Annual Report of the Public Works Department, 1932, p.20.

11. Annual Report of the Public Works Department, 1936, pp. 20-21.

12. Ibid.

13. Annual Report of the Public Works Department, 1937, pp. 14-15, 16.

14. Annual Report of the Public Works Department, 1945, pp. 15-16.

15. Annual Report of the Public Works Department, 1951, p. 38.

16. Annual Report of the Public Works Department, 1956, p. 23.

17. Annual Report of the Public Works Department, 1956, p. 25.

18. STV/Seelye Stevenson Value & Knecht. Conceptual Study for A New Vertical Lift Bridge, p.1.

19. Stephen Roper. Massachusetts DPW Bridge Inventory., Chelsea Street Bridge Survey Form.

20. Massachusetts DPW Bridge Inventory, Chelsea Street Bridge Survey Form; Conceptual Study for A New Vertical Lift Bridge, p.10.

21. Massachusetts DPW Bridge Inventory

22. Conceptual Study for A New Vertical Lift Bridge, p.6.

23. Chelsea Street Bridge Drawings, Abutments Sheet No.4, 6154, Oct. 1935; Pier 1, Sheet No. 5, 6155, Oct. 1935; Piers 2 & 3, Sheet No. 6, 6156, Oct. 1935; Pier 4, Sheet No. 7, 6157, Oct. 1935; Pier 5, Sheet No. 7, 6158, Oct. 1935; Conceptual Study for A New Vertical Lift Bridge, p.6.

24. Annual Report of the Public Works Department, 1937,p. 15; Conceptual Study for A New Vertical Lift Bridge, pp.5, 6.

25. Annual Report of the Public Works Department, 1937, p. 15; Conceptual Study for A New Vertical Lift Bridge, p.5.

26. Annual Report of the Public Works Department, 1937, p. 15; Massachusetts DPW Bridge Inventory.

27. Conceptual Study for A New Vertical Lift Bridge, p.5.

28. Chelsea Street Bridge Drawings, Abutments Sheet No. 13, 6163, Oct. 1935.

29. Ibid.

30. Bruce Clouette. Historic American Engineering Record, Grand Street Bridge, (Bridge no. 4250) HAER No. CT-148, p.8.

31. National Cyclopedia of American Biography. "Strauss, Joseph Baermann,"p. 30; Henry Petroski, Engineers of Dreams, p. 30.

32. Historic American Engineering Record, Grand Street Bridge, p.7.

33. "Strauss, Joseph Baermann," p. 30; Engineers of Dreams, pp. 276-277.

34. "Strauss, Joseph Baermann," p. 31; Engineers of Dreams, pp. 273.

SOURCES OF INFORMATION

A. **Engineering drawings**: City of Boston, Bridge Division, Department of Public Works. Drawings for Chelsea Strect Bridge, 1935.

B. **Historic views:** No historic photographs were found at this time, except for a recent newspaper photograph.

C. **Interviews:** Bridge Tender (name not given), interviewed in Tender's House, June 1996.

D. **Bibliography:**

1. **Primary and Unpublished Sources**:

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2. **Secondary and Published Sources**

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E. Likely Sources Not Yet Investigated: Fine Arts Division, Boston Public Library

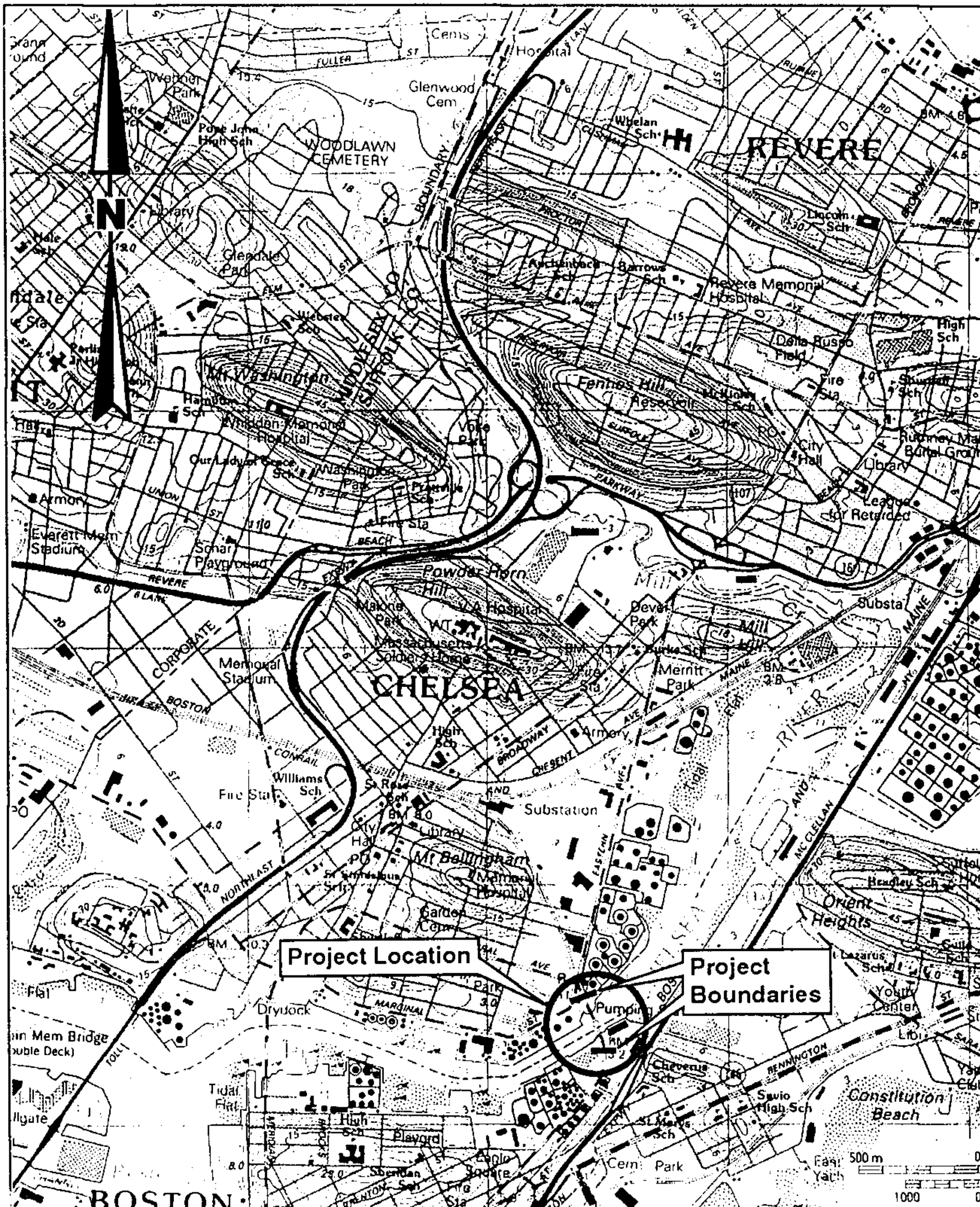

Figure 1 - Location of project area on USGS quad.