MINNESOTA HISTORIC PROPERTY RECORD

PART I. PROPERTY IDENTIFICATION AND GENERAL INFORMATION

Common Name: Stillwater Lift Bridge

Bridge Number: 4654

Identification Number: WA-SWC-322

Location:

Feature Carried:	TH 36
Feature Crossed:	St. Croix River, City Street
Descriptive Location:	at Wisconsin State Line
Town, Range, Section:	30N-20W-28
Town or City:	Stillwater
County:	Washington

UTM:

Zone:	15
Easting:	4989254
Northing:	515529

Quad:

Stillwater
7.5 Minute Series
1983

Present Owner:

State

Present Use:

Mainline

Significance Statement:

The Stillwater Lift Bridge is significant under Criterion C: Engineering as a rare surviving example of vertical-lift highway bridge construction of the Waddell and Harrington type. Only six vertical-lift highway bridges were built in Minnesota and Wisconsin prior to World War II, and the Stillwater Bridge is one of three that still survives and features counterweighted, cable-and-tower design. The bridge was declared eligible for listing in the National Register in 1987.

The significance of the Stillwater Bridge is best evaluated within the general context of Minnesota and Wisconsin movable highway bridges. Movable bridges, also known as drawbridges, are constructed over navigable waterways when it is impractical or uneconomical to build fixed bridges of sufficient height to permit the passage of vessels. Human ingenuity has devised numerous systems for lifting, dropping, folding, rotating, and retracting a span to provide temporary clearance. By the early twentieth century, however, American engineers had focused their attention on three, basic, drawbridge categories: swing, bascule, and vertical lift.

Briefly defined, a swing span revolves in a horizontal plane around a vertical axis, a bascule span rotates in a vertical plane around a horizontal axis, and a vertical-lift span rises and descends in a vertical plane. A total of 108 movable highway bridges existed in Minnesota and Wisconsin in 1935, with Wisconsin claiming more than six times the share of its neighbor. Wisconsin's greater dependence on movable bridges was a function of both its canal system along the industrialized Fox water-way and its numerous navigable rivers in major port cities (Green Bay, Manitowoc, Milwaukee, Racine, Sheboygan). In contrast, commercial navigation in Minnesota was largely restricted to the Mississippi River, where elevated bluffs obviated the need for movable spans.

Virtually all nineteenth-century movable bridges were of the swing-span variety and were constructed into the early twentieth century. As late as 1935, a total of 51 highway swing spans were in operation in the Minnesota and Wisconsin. Not one of these structures survives. The demise of the highway swing span was nationwide, reflecting its growing incompatibility with an urban setting. There were two basic problems. First, the central pivot pier increasingly became an obstruction to navigation for the ever-larger vessels of the late nineteenth and early twentieth centuries. Second, the swing span itself squandered valuable space. By requiring a clear turning radius, it prohibited the development of docking facilities adjacent to the bridge site. These shortcomings were especially onerous along highly industrialized urban waterways, where shipping channels tended to be narrow, highway crossings numerous, and real estate prices high. For less crowded sites, the swing span remained a viable form of technology well into the twentieth century. Most surviving swing spans are railroad bridges in rural regions or in relatively un-congested urban areas. But in the downtown waterfronts of late nineteenth-century American cities, the swing span was marked for extinction. Its major adversary was the federal government. No matter how loudly shipping and real-estate interests might denounce the swing span, there was no effective means of regulating movable-bridge design until the early 1890s when Congress authorized the War Department to approve plans for all new bridges over navigable waterways and to seek the alteration of any existing bridge that interfered with "reasonably free, easy and unobstructed" navigation. In 1892 the War Department sent a clear message of future policy by way of Chicago, demanding the removal of a two-year-old swing span from one crossing of the Chicago River and denying permission to build a new swing span at another. The search for an alternate drawbridge technology began in earnest. By 1895, municipal authorities spanned the Chicago River at South Halsted Street with the world's first, modern, vertical-lift bridge.

During the mid-nineteenth century, an occasional vertical-lift span was constructed in Europe and the United States. Although their engineering was often ingenious, the bridges themselves were quite modest, designed mainly for "canals and small navigable streams in cases where it was only necessary to lift the spans a few feet to clear traffic in the channels." The modern, long-span, high-rise vertical-lift bridge dates from the last decade of the nineteenth century. In 1892, the City of Duluth, Minnesota hosted a design competition for constructing a drawbridge over its harbor entrance on Lake Superior, which comprised a clear channel 250-feet in width. Under the rules of the competition, the successful design "would leave the entire width of the canal free to passing vessels," which effectively eliminated traditional, center-pier swing spans.

Most responses to the Duluth competition employed some form of "sliding draw" mechanism, whereby the span moved back and forth on rollers. A striking exception was a design submitted, and later patented, by John Alexander Low Waddell (1854-1938), a consulting engineer based in Kansas City, Missouri, who, during the next forty years, would become "one of the best-known bridge engineers in the United States." Waddell proposed to build "a vertical lift bridge consisting of a simple truss span 260 feet long so constructed and supported as to allow being raised vertically to a height of 140 feet above the surface of the canal.

At each end of the movable span is a tower 170 ft. high, carrying at its top built steel pulleys about 15 ft. in diameter. Over these pulleys steel wire ropes, or chain cables, pass. One end of each cable is attached to the end piers of the trusses, and the other end to counter-weights which exactly balance the dead weight of the span. The only work left for the operating machinery is to overcome the weight due to dirt, water, snow, etc. The power for operating the bridge is supplied by two electric motors placed at mid-span; the upward and downward motion being regulated by racks and pinions communicating with the power by means of steel shafting and spur and mitre wheels.

Although the Duluth authorities selected Waddell's design, the War Department vetoed the construction of any drawbridge at that site at that time. Waddell, however, had devised a seemingly practical solution to the drawbridge problem. His vertical-lift span did not obstruct navigation and dockage like a swing span, nor did it clutter up the shore approaches like a sliding-draw span. A few months after the cancellation of the Duluth project the City of Chicago commissioned Waddell to modify his original design for a 130-foot span capable of 150-foot clearance over the Chicago River at South Halsted Street. This structure was completed in 1894.

In 1907 Waddell formed a partnership with John Lyle Harrington (1868-1942), a skilled civil and mechanical engineer who was largely responsible for reworking Waddell's invention into "a rational, well-integrated design." In its essential form and dynamics the "Waddell and Harrington version" remained true to the original 1892 design: "A simple span equipped with machinery for operation, suspended at each end by wire ropes which pass over sheaves on towers and connect to counterweights about equal to the span weight." Before the partnership dissolved in 1914, Waddell and Harrington de-signed about 30 vertical-lift spans for highway and railroad crossings. After they parted company, both men continued to work in the field, and Harrington's new office -- Harrington Howard, and Ash --became particularly well known as was its successor, Ash, Howard, Needles and Tammen (today the firm is incorporated as HNTB).

Six vertical-lift highway bridges were constructed in Minnesota and Wisconsin before World War II. At least five were designed by Waddell and Harrington or successor firms. All were of the standard Waddell and Harrington type. The Stillwater Bridge was the last of this cohort to be completed. Its predecessor at the site was a timber pontoon, swing-bridge built in 1910. Owned and maintained by the City of Stillwater the bridge was taken over by the Minnesota Department of highways in 1925. By that time, the structure was "fast deteriorating so as to be a source of apprehension for the safety of “...the loads it is obliged to carry." When the bridge was closed to heavy traffic in 1928, the Minnesota Department of Highways prepared preliminary plans for its replacement.

These plans called for a series of fixed concrete-slab and steel-truss spans, which were to be designed by the Minnesota highway agency itself, and a single vertical-lift span, which was to be the responsibility of an engineering firm specializing in such work. In November 1929, a design contract for $3,150 was awarded, on a competitive basis, to Ash, Howard, Needles & Tammen of Kansas City, Missouri. Construction on the bridge proper began the following summer, with the Minneapolis firm of Peppard and Fulton serving as general contractor and the American Bridge Company (Minneapolis and Gary plants) serving as fabricator. The project was completed in August 1931 for a total cost of $460,174, shared on an approximately 50-50 basis by the states of Minnesota and Wisconsin.

At the time of the bridge's completion, the St. Croix River was only lightly used as a navigable waterway. Since most of the traffic was small craft, there was little occasion to operate the lift span. As the Minnesota Department of Highways noted in 1938, "for several years not a single request for its opening was received." Although the bridge was far more intensely involved in highway traffic, it was in the role of maintaining, rather than initiating, patterns of transportation, which, in fact, were already well established by the 1930s.

PART II. HISTORICAL INFORMATION

Date of Construction:

1930-31

Contractor and/or Designer (if known):

Contractor:	Peppard & Fulton – builder; American Bridge Company (Minneapolis & Gary Plant) – fabricator.
Designer:	Minnesota Department of Highways (fixed span); Ash, Howard, Needles, and Tammen (vertical-left span) – engineer.

Historic Context:

National Register Criterion:

C

PART III. DESCRIPTIVE INFORMATION

Descriptive Information:

Connecting Stillwater, Minnesota, on the west with Houlton, Wisconsin, on the east, the Stillwater Bridge is a relatively unaltered 10-span, 2-lane highway crossing of the St. Croix River; it includes a counterweighted, tower-and-cable, vertical-lift span of the Waddell and Harrington type.

At the site of the Stillwater Bridge, the St. Croix River is approximately 1,800 feet wide. The bridge itself, however, spans only about 1,050 feet. The remaining distance is covered by an earthen causeway, which was built out from the Wisconsin shore to reduce the grade difference between the opposing banks, as well as to lower the fabrication costs of the bridge. Resting on reinforced-concrete piers and abutments, the bridge superstructure displays, from east to west, the following sequence of spans: 1 concrete-slab approach span, 5 fixed steel trusses, 1 vertical-lift span, 1 fixed steel truss, and 2 concrete-slab approach spans.

The six fixed truss spans are of similar size and configuration. Measuring approximately 140 feet in length, each is a 7-panel, riveted, through Parker truss with angle-iron portal, top-lateral, and sway bracing. The webs are further stiffened by horizontal, angle-iron bracing across the four center pan-els. Except for the top chord --which consists of heavy paired channels tied with cover plate above and X-lacing below --the web members are built of paired, back-to-back angles tied with batten plates (as in the bottom chord and diagonals) or V-lacing (as in the verticals).

The vertical-lift span is also a 140-foot, 7-panel, Parker Through Truss. In its method of operation, the span embodies a design originally developed by J. A. L. Waddell in 1892, and subsequently refined in partnership with John Lyle Harrington. The general type is customarily known as a "Waddell and Harrington vertical lift." The span is raised and lowered by steel cables passing over sheaths at the top of steel towers mounted on the span's piers. To ensure easy movement, the span is counterweighted by concrete blocks that travel up and down within the tower framework. Originally, the motive force was supplied by a gasoline engine, which was replaced by a 25-horsepower electric motor in 1980. The control machinery is sheltered in a welded, plate-steel, gable-roofed "operator's house" mounted at roadway level on a steel framework at mid-span on the north (upstream) side. Reduction gears and winding drums for the cables are located beneath the house. With the span in raised position, vertical navigational clearance is 57 feet above normal pool elevation. The span itself is engineered for a rise of 48 feet, although an additional 3 feet of lift are available for emergency situations.

Measuring 23 feet in width, the bridge's concrete deck is bordered on the north by an angle-iron railing and on the south by a concrete sidewalk with an ornamental metal railing. The sidewalk is cantilevered on metal brackets. Although ornamental street lights have been removed from their newel posts along the sidewalk, a few of the original lighting fixtures remain on the concrete railings at the westernmost, concrete-slab, approach span. The concrete deck was rebuilt in 1973, as was the east-shore, concrete-slab, approach span in 1979. None of these alterations has significantly affected the bridge's integrity. The vertical-lift span remains in operation during the May-October navigation season. The bridge is undergoing substantial rehabilitation in 2005, including removal of the original operator's house and replacement with a new house.

PART IV. SOURCES OF INFORMATION

References:

Becker, Donald N. "Development of the Chicago Type Bascule Bridge" American Society of Civil Engineers Proceedings (February 1943), 263-293; Black, W. M. "Bridges Over Navigable Waters of the United States." Engineering News (April 13, 1893), 341-342; "Competitive Designs for a Drawbridge Over the Duluth Ship Canal, Duluth, Minn." Engineering News (October 27, 1892), 390-391; "The De-sign of Movable Bridges." Engineering News 36 (November 5, 1896), 296-297; "Direct-Lift Bridges." Engineering Record 68 (October II, 1913), 403; Hardesty, Egbert R. and others, "Fifty-Year History of Movable Bridge Construction -- Part I." Journal of the Construction Division, Proceedings of the American Society of Civil Engineers 101 (September 1975), 511-527; Howard, Ernest E. "General Elements in the Design of Vertical Lift Bridges," Railway Age 70 (June 17, 1921), 1393-1394; Hovey, Otis Ellis. Movable Bridges. New York: John Wiley and Sons, 1926. 2 vols; New Richmond (WI) News. November 28, 1928; Office of the Chief of Engineers, United States Army. List of Bridges Over the Navigable Waterways of the United States…Revised to January 1, 1935. Washington, D.C.: Government Printing Office, 1936; "The Proposed Bridge Over the Harbor Entrance at Duluth." Engineering Record 25 (May 14, 1892), 398-399; Schneider, C. C. "Movable Bridges." American Society of Civil Engineers Transactions (1907). Paper No. 1071; "The South Halsted Street Lift Bridge, Chicago." Engineering Record 27 (March 4, 1893), 273-276; Stillwater (MN) Gazette. April 1, 1925; "The Strauss Direct Lift Bridge." Railway Age Gazette, 54 (March 18, 1913), 553-554; Tyrrell, H. G. "A Comparison of Old and New Designs for Vertical-Lift Bridges." Engineering News 70 (July 31, 1913), 225-226; Tyrrell, H. G. "Lift Bridges of Milwaukee." Municipal Engineering 45 (July 1913), 2-7; Tyrrell, H. G. "A Vertical-Lift Drawbridge Without Cables." Engineering News, 69 (June 5, 1913), 1170; Waddell, J.A.L., Bridge Engineering. New York: John Wilesy and Sons, 1916. 2 vols; Waddell, J.A.L.. Economics of Bridgework. New York: John Wiley and Sons, 1921; Waddell, J.A.L. "The Halsted Street Lift-Bridge." American Society of Civil Engineers,Transactions, 33 (January 1895), Paper No. 742; "The Vertical Lift Bridge." Journal of the Western Society of Engineers, 29 (May 1924): 209-216; Bridge Files, Minnesota Department of Transportation; Bridge Files, Wisconsin Department of Transportation.

PART V. PROJECT INFORMATION

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