APPENDIX F
CULTURAL RESOURCES

GREENVILLE YARD, TRANSFER BRIDGE SYSTEM
AND FREIGHT OPERATIONS
City of Jersey City
Hudson County
New Jersey

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

ARCHITECTURAL DRAWINGS

PHOTOGRAPHS

HISTORIC AMERICAN ENGINEERING RECORD
New Jersey Historic Preservation Office
5 Station Plaza
501 East State Street
Trenton, New Jersey 08625

HISTORIC AMERICAN ENGINEERING RECORD

GREENVILLE YARD, TRANSFER BRIDGE SYSTEM AND FREIGHT OPERATIONS

Location:	Jersey City, Hudson County, New Jersey
Date(s) of Construction:	1902-1904; Enlarged 1910 and 1924; Partially Destroyed by Fire and Rebuilt 1931; Enlarged 1943; Repaired 1945; Partly Demolished 1996
Designer(s)/Engineer(s):	William H. Brown, Chief Engineer; W. C. Bowles, Assistant Engineer of Construction; L. H. Baker, Assistant Chief Engineer; F. L. Du Bosque, Assistant Engineer of Floating Equipment (machinery design)
Builder(s):	New York Bay Railroad, a subsidiary of the Pennsylvania Railroad
Principal Contractor(s):	Henry Steers Incorporated; Cooper-Wigand-Cook Company; Steele & Condict; American Bridge Company
Present Owner (s):	New York New Jersey Rail L.L.C (a subsidiary of the Port Authority of New York and New Jersey) by lease from Consolidated Rail Corporation (Conrail)
Present Use:	Railroad Transportation
Significance:	Built under the auspices of the Pennsylvania Railroad between 1902 and 1904, and modified periodically throughout the twentieth century, the Greenville Yard Transfer Bridges are contributing resources to the National Register-eligible Greenville Yard Piers (DOE: 9/8/1981; SHPO Comments: 9/21/1983). The Greenville Yard Piers are eligible under Criterion A in the areas of engineering and transportation for their role in the development of the Port of New York and for their technological innovations in early freight handling operations. The Greenville Yard Piers (including the contributing Greenville Yard Transfer Bridges) are also key contributing resources to the National Register-eligible Greenville Yard Historic District (SHPO Opinion: 8/21/1998) and the Pennsylvania Railroad New York Bay Branch Historic District (SHPO Opinion: 4/22/2005).
Historian:	Philip A. Hayden, Richard Grubb & Associates, Inc., July 2011

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II. PROJECT INFORMATION

The Port Authority of New York and New Jersey (PANYNJ), acting as co-lead agency with the Federal Highway Administration (FHWA) and using funds provided through the FHWA, is acquiring Greenville Yard in Jersey City, Hudson County, New Jersey and procuring the replacement of the Greenville Yard Transfer Bridges and associated infrastructure. Known as the Greenville Yard Lift [Transfer] Bridge Acquisition and Replacement Project, the undertaking is part of the Cross Harbor Freight Program, an initiative designed to improve regional goods movement. As part of these efforts, in 2008, PANYNJ acquired New York New Jersey Rail, LLC (NYNJR), which leases and operates a rail car float between Greenville Yard and Bush Terminal Yard in Brooklyn, New York from the Consolidated Rail Corporation (Conrail).

This Historic American Engineering Record (HAER) recordation document has been prepared in partial fulfillment of Stipulation IA of a Memorandum of Agreement (MOA) dated March 17, 2011 among the FHWA, the PANYNJ, and the New Jersey Historic Preservation Officer (SHPO) regarding the Greenville Yard Lift [Transfer] Bridge Acquisition and Replacement Project. The history, technical specifications, and significance of the Greenville Yard Piers, Transfer Bridges, and Greenville Yard Historic District were recorded in previous HAER documentation (HAER 1983; 1996). The present recordation supplements these prior studies with additional details and aims to contextualize the engineering of the Greenville Yard Transfer Bridges by comparing it with the design of other transfer bridge structures in the historical record and by discussing the Greenville Yard Transfer Bridges within the framework of the larger Pennsylvania Railroad (PRR) freight network.

Greenville Yard extends approximately 1.7 miles into New York Harbor on made land. At the western extreme, the yard throat crosses over the former Central Railroad of New Jersey (CRRNJ) right-of-way (present day NJ TRANSIT Hudson-Bergen Light Rail) on a two-span, double track through plate girder bridge. A second parallel bridge carrying the former Lehigh Valley Railroad (LVRR) right-of-way (present-day Conrail National Docks Secondary) shares the same substructure. Much of the former yard property has been sold and developed. Remaining railroad operations include a receiving and interchange yard, an auto yard, and a processing plant for Tropicana, all served by Conrail. Two private carriers interchange with Conrail at this point. The Port Jersey Railroad serves several businesses. The PANYNJ, through its NYNJR subsidiary, operates Greenville Yard and the transfer bridge operations.

The Greenville Yard Piers (a.k.a. Greenville Yard Transfer Bridge System) received a SHPO Opinion of Eligibility on July 27, 1978, and the Keeper of the National Register of Historic Places (Keeper) subsequently concurred with a Determination of Eligibility (DOE) on September 8, 1981. The Greenville Yard Piers eligibility was affirmed and further elaborated on in SHPO consultation comments dated September 21, 1983 in connection with the United States Army Corps of Engineer's proposed removal of several contributing structures. The Greenville Yard Piers are eligible under Criterion A in the areas of engineering and transportation for its role in the development of the Port of New York and for its technological innovations in early freight handling operations. At the time of the SHPO Opinion, the historic property included five contributing resources: the transfer bridge structure comprising six bays (or slips); a long open pier with four gantry cranes; a shorter covered pier; a coal loading hopper; and an ice jetty.

In information submitted to the Keeper as part of the request for the DOE, the recommended property boundaries included the intact waterfront and pier structures. The main yard area to the west of the shoreline was deliberately omitted because it lacked integrity. The period of significance was identified only as the "early twentieth century."

The SHPO subsequently identified two additional contributing resources: Car Float Barge #16 and Car Float Barge #29 (SHPO Opinion: 9/15/2010 [Log # 10-1370-5]). Consequently, the period of significance of the Greenville Yard Piers was revised to 1960 to include both car float barges. The Greenville Yard Piers are also key contributing resources to the National Register-eligible Greenville Yard Historic District (SHPO Opinion: 8/21/1998) and the PRR New York Bay Branch Historic District (SHPO Opinion: 4/22/2005).

Of the original contributing resources comprising Greenville Yard Piers, only portions of the transfer bridges and the remains of two piers are standing. The other resources have been demolished.

III. HISTORICAL INFORMATION

In summary, the Greenville Yard transfer bridge system is the last surviving example of the non-pontoon, double-gantry suspension and counterweight-type transfer bridge and car float operation in New York Harbor. Developed initially in the 1880s by engineers in the PRR's Jersey City offices for application at the company's Harsimus Cove Yard in Jersey City, the bridge technology was refined and electrified in conjunction with the opening of Greenville Yard in 1904-1905. The transfer bridge design, incorporating movable bridges, aprons, and counterweights, along with an electrically powered screw lift mechanism, formed the basic design elements employed in nearly every later transfer bridge type used by other railroads (HAER 1996).

The Port of New York and the Pennsylvania Railroad

Accessing the Port of New York in general, and Manhattan in particular, presented serious obstacles to railroad builders approaching from the west. They faced a gauntlet of physical and political barriers (New York, New Jersey Port and Harbor Commission 1920: 62). Overcoming rivers, swamps, and hills of solid rock, not to mention scarce water frontage and the harbor, required skilled engineering, large amounts of capital, and boats. New Jersey's first railroad, the Camden and Amboy Railroad (C&ARR), elected to build its terminal at South Amboy and ferry passengers and freight the remaining distance to Manhattan. The New Jersey Railroad (NJRR), chartered in 1832, was the first to reach the Jersey City riverfront in 1838. Its greatest obstacle, a ridge of hard rock called Bergen Hill, separated the west side of the North (Hudson) River from the interior. The NJRR succeeded in excavating a 40-foot deep channel through the hill called the Bergen Cut and used it to run trains between New Brunswick, New Jersey and the harbor's edge (Burgess and Kennedy 1949: 255; Messer and Roberts 2002: 117). With its terminal located directly across the river from lower Manhattan, the NJRR provided quick communication between the two river banks, and it became the route of choice for moving railroad passengers and freight to and from the city.

The Bergen Cut remained the only practical rail route through the Bergen Hill for over 20 years, and other railroads soon vied for access (Burgess and Kennedy 1949: 257; Cunningham 1997: 60). In conjunction with the NJRR, the C&ARR formed the first all-rail route between the Port of New York and Philadelphia and funneled most of its passenger traffic through to Jersey City. However, the C&ARR continued to send its lucrative freight business through its own terminal at South Amboy terminal, thereby keeping the profits (Messer and Roberts 2002: 17). The Paterson & Hudson River Railroad (P&HRRR), chartered in 1831 to bring rail service from Paterson to Jersey City, accessed the riverfront via the Bergen Cut in 1838 (Messer and Roberts 2002: 115). In 1852, the larger New York & Erie Railroad (NY&ERR), in search of its own route to the Port of New York, leased the P&HRRR and formed the first direct all-rail trunk line between the Great Lakes and New York Harbor by way of the Bergen Cut (Hungerford 1946: 132-133). The Morris & Essex Railroad (M&ERR) made its own connection with the NJRR in Newark in 1853, and sent its trains by way of the NJRR tracks into Jersey City (Taber 1977: 50). Eventually, the PRR achieved its own long-sought-after outlet to the Hudson River via the Bergen Cut, first by way of agreement with the C&ARR and the NJRR, and later in 1871 by means of a 999-year lease of their successor company, the United New Jersey Railroad & Canal Company (UNJRR&C Co) (Burgess and Kennedy 1949: 240).

Moving Freight

The PRR, with its lease of the UNJRR&C Co, worked aggressively to expand harbor facilities for both passenger and freight operations (Droege 1916; Burgess and Kennedy 1949; Condit 1980; Messer and Roberts 2002). Except for the New York Central Railroad (NYCRR) system, which controlled the only direct all-rail link into Manhattan, all other railroads entering the port confronted an established marine system for accessing Manhattan. This system, in place since initial European settlement, relied entirely on boats and other floating vessels and proved both efficient and cost-effective. With the opening of the Erie Canal and the Morris Canal, deliveries of long haul cargo by barge to points anywhere around the port became possible without breaking bulk (Flagg 1994: 6). With this infrastructure in place, railroads developed comparable facilities using ferries, barges, and car floats, and the tidewater terminal became the standard for all major trunk lines operating in the Port of New York (Flagg 1994: 6).

Early rail-marine freight was usually transported on the same ferries as passengers. By the 1860s, many railroads delegated their freight delivery services to lighter operators, who moved barges of goods between transfer points and to the holds of ships at anchor. The lighterage system, while flexible and convenient, added costs to the land-locked railroads, which had to compete with canals serving the Port of New York. Railroads could earn enough money from their long haul freight operations to subsidize the cost of the lighterage delivery charges at the end of the line. But shorter hauls meant less revenue to the railroads and smaller subsidies to support the free lighterage system. Despite these drawbacks, the railroads continued the practice of free lighterage service long after the canals ended operations in order to compete for bulk shipments from consigners and this helped to perpetuate the rail-marine operations around New York Harbor (Flagg 1994: 7).

While lighters served to handle the loading and unloading of freight from ships, car floats allowed railroads to deliver whole cars of freight to and from wharves and waiting ships (Flagg 1994: 8). This avoided the cost of extra handling between cars, barges, and lighters. As coordination between shippers, lighterage operators, and railroads matured, freight handling evolved into a carefully coordinated system by which car floats with loaded cars were moved every day around the harbor to the appropriate railroad terminals for transfer and connection with scheduled freight trains departing to points all around the country (Flagg 1994: 8).

To move rail cars from land to vessels on the water, engineers modified the existing system of adjustable ramps employed for accommodating other wheeled vehicles on ferries. Conventional thought suggests that the first transfer bridges and accompanying car floats in the United States appeared with the operations of the Philadelphia, Wilmington & Baltimore Railroad at its Susquehanna River crossing at Harve De Grace and Perryville, Maryland in the 1850s (Roberts & Messer 2003: 38; 111). By adding rails to the boats, the operators could move entire trains by ferry using a pontoon bridge to effect the transfer. Other evidence suggests that John Henry Starin (1825-1909) perfected the system of freight car floats used in New York Harbor. The Starin City River & Harbor Transportation Company controlled lighterage and freight handling for many of the city's major trunk railroads. Starin's obituary credited him with "the idea of transporting freight cars on floats, and [he] was always very proud of this achievement" (*New York Times* 1909).

Ultimately, transfer bridges included two basic types: the floating pontoon-style and the suspended gantry type. Pontoon transfer bridges relied on buoyant tanks to float one end of a hinged bridge on the water's surface. This system adjusted automatically with the tides, but fluctuated in the loading and unloading process and sometimes required additional vertical adjustments provided by heavy chains and by overhead or side gantries. The bridge was often subjected to heavy diagonal strains as engines were run along one side to bring the corner of the lighter bridge down to the level of the corresponding heavily loaded car float. Once the corners of the bridge and the car float were joined together with heavy iron toggle bars, the engine was run off again, causing the bridge and barge to torque. The procedure was then repeated on the other side of the bridge with similar results. The process took time and usually ended in high maintenance costs (*Engineering News* 1890: 67). Pontoon bridges were also prone to sinking if the tanks were drained of air, and they faced interference from silting action and the movement of heavy seas. Accumulations of frozen water on the pontoons and ice floes also proved a major problem, especially in the upper reaches of the Hudson River where ice was particularly prevalent.

The gantry or gallows system relied on an overhead framework from which to suspend the end of a counterbalanced bridge above the water. This system allowed the bridge to rise and descend independently of the water level. It permitted more flexible adjustments to the height of the bridge during car movements and it eliminated the problem of interference from shallow waters or ice floes. Many gantry-style transfer bridges also utilized a separate apron at the water end of the bridge (Snow 1901: 161). The apron, a light platform, was hinged at one end to the main bridge and suspended by chains or cables at the other end to form a transition point between the main bridge and the car float. The apron provided transfer bridges with three points of vertical articulation: between the bulkhead and the bridge, the bridge and the apron, and the apron and the car float. This allowed for smoother operations and faster transfers of cars. But in both types of transfer bridges, the nature of the structures imposed serious engineering challenges. The rigid connection at the shore and the loose connection to the free-floating car float meant that all bridges faced serious damage from rough handling of the barge and high seas. Dynamic strains and wrenching meant that the structures required a measure of flexibility and could not be overly reinforced (Snow 1901: 164).

The corresponding car floats were nothing more than wooden barges with rails. They came in a variety of configurations depending on the application. The first wooden car floats generally measured 240 feet in length (Brouwer 1990: 143). Some contained covered platforms in the center, which allowed handlers to sort freight or move it from cars to the bulkhead doors of ships while afloat. Many car floats contained two tracks, but three-track car floats gradually became the norm (Brouwer 1990: 144). The third track meant that a string of cars could be loaded onto the center of the float with a minimum of disruption to the barge's center of gravity, and this improved its overall stability. Later, steel hull construction for car floats would begin to replace timber hull floats at the beginning of the twentieth century. Car floats required extra strength as their lengths increased to accommodate larger rolling stock and demands for greater capacity (Flagg 1997: 9). The rising cost of suitable timber also encouraged a shift toward riveted and welded steel floats. Moreover, their maintenance proved less costly than wood. The shift to all steel barges would be delayed by World War II, but by the late 1940s steel car floats became the general rule (Flagg 1997: 9).

Transfer bridges were a necessary part of every trunk line terminal delivering freight to destinations around the harbor or interchanging cars with other railroads for destinations elsewhere. But not all transfer bridge facilities in the Port area were connected to outside rail lines. Some only received and delivered cars at manufacturing establishments or conventional freight warehouses (Flagg 1994: 9).

The PRR operated such facilities in Brooklyn (Flagg 1994: 9). More significant terminals, called contract terminals, comprised large freight handling operations under contract with the railroad freight lines. They agreed to handle terminal freight for the railroads in exchange for a share of the revenue (Flagg 1994: 9). The four main contract terminals were located in Brooklyn and included: New York Dock Company; Bush Terminal; Jay Street Connecting Railroad; and the Brooklyn Eastern District Terminal railroads (Flagg 1994: 9). The contract terminals typically operated their own barges, tugs, and car floats. They also had their own sorting yards and served a wide range of customers, including steam ship piers, warehouses, private sidings, freight houses, and team tracks (Flagg 1994: 9). Most waterfront freight deliveries, however, were made by negotiating a car float up to a pier or riverfront bulkhead from which freight could be loaded and unloaded directly from cars to the adjoining business using movable ramps and hand trucks (Flagg 1994: 9).

Marine delivery became so central to railroad freight operations that the trunk lines began to assemble their own marine operations. The PRR became one of the first to acquire a fleet when it bought out the National Storage Company in 1879. The latter had been handling the PRR's lighterage trade until that point (Flagg 1994: 7). By 1895, the PRR maintained 18 tug boats, 45 barges, and 65 car floats in New York Harbor (*Scientific American* 1895: 16587).

By the end of the nineteenth century, moving freight around the Port of New York relied on the transfer bridge and car float system. Writing about the virtues of the car float system, a writer for *Scientific American* described its adaptability to the conditions of the port:

> The capacity and flexibility of this method of handling freight, the cheapness with which it is done, the ease with which cars can be delivered to any point on the waterfront, the unlimited development of which the system is capable, are all elements which conspire to make any bridge across the North [Hudson] River or any tunnel underneath that river a superfluity, so far as handling freight may go (*Scientific American* 1895: 16587).

<u>Harsimus Cove Yard and Early Transfer Bridge Prototypes</u>

In the years leading up to the PRR's final lease of the lines leading into Jersey City, the railroad maintained reciprocal traffic agreements with the various participating railroads to carry each other's traffic. The advantages of the arrangement were clearly spelled out in the press. "Passengers and freight," noted the *New York Times*, "may be transported from the West by a route so direct as to present advantages to travelers and shippers, equal to those offered by the lines which have hitherto monopolized the trade" (*New York Times* 1869b: 3). The NJRR agreed to rebuild its outdated and ill-equipped terminal facilities at Jersey City in order to accommodate the anticipated traffic. To accomplish the job, it planned to utilize Harsimus Cove, a shallow-water bay adjoining the northern side of the railroad's existing terminal. As early as 1856, the NJRR had been working to secure a stake in this valuable water frontage as a means to expand its terminal facilities and keep out competitors (*The Atlantic Reporter* 1887: 587).

In order to extinguish all claims of the state to the riparian lands and to perfect the title to Harsimus Cove, as well as to obtain authority to build a branch line to the proposed terminal, the newly formed UNJRR&C Co. obtained an official act of the legislature, known at the time as the Harsimus Cove Bill (New Jersey Legislature 1868; *New York Times* 1868a: 5; 1868b: 1). The final bill passed on March 30, 1868 (New Jersey Legislature 1868: 551). The day after the consummation of the

Harsimus Cove purchase from the state on January 4, 1869, the *New York Times* offered the first glimpse of plans for the improvements to the site:

> After filling in the land it is designed by the joint Railroad Companies before enumerated to construct an elevated air line railroad, a mile and a half long from the iron bridge that crosses the old Bergen Road to the water front, where huge depots and machine shops will be built, and whence a ferry will communicate with New-York. The road will be carried over the houses in Jersey City, and in some parts will be built on piles fifty feet deep. It will take as much as five years to complete it, and will cost fully $5,000,000 (*New York Times* 1869a:5).

The work of filling in the Harsimus Cove and building the branch line began under the corporate auspices of the NJRR in 1869, but the project was completed under the guidance of the PRR, following its lease of the UNJRR&C Co in 1871. The Harsimus Cove freight terminus—minus the connecting rail line—was finally placed into service on October 1, 1873 (Pennsylvania Railroad 1874:74). Within three months, the volume of western traffic handled by the PRR increased 60 percent (Pennsylvania Railroad 1874:74). Finally, in 1875, the PRR's annual report noted that the "new railway [branch] to connect with the Harsimus Cove property has been opened for use through a portion of Bergen Hill from its connection with the Main Line" (Pennsylvania Railroad 1875: 46). The effect was immediate. Nearly 200 trains arrived and departed from Jersey City in any day, with over half passing to the freight facilities (Sipes 1875: 45). The yard, in addition to piers for handling ships, included a stock yard and abattoir, a grain elevator, a freight house, transfer bridges, and additional space for warehouses (Sipes 1875: 45).

The first transfer bridges at Harsimus Cove went into service when the yard opened in 1873 (Mordecai 1885: 36; Bensel 1888: 310-311). A chronicler of the Port of New York described the structures as consisting of Howe truss bridges, 100 feet long, hinged at the shore end and suspended from a stationary frame by heavy iron chains near the river end. The chains ran over large sheave wheels mounted on the frame above and were worked by hand gears below to adjust to the height of the tide and the float. The description suggests that the bridges floated on pontoons, but no plans or other contemporary descriptions of the early float bridges at Harsimus Cove have been located. The operation included two-track timber car floats for handling Manhattan bound materials and goods. Three-track floats carried the New England-bound connecting traffic by way of the East River to interchange points on the Long Island Railroad (LIRR) at Long Island City and the New York, New Haven & Hartford Railroad (NYNH&HRR) at Port Morris on the Harlem River (Mordecai 1885: 36). Eastbound coal traffic was also transported to car floats 60 miles up-river to Fishkill-on-the-Hudson (Mordecai 1885: 36; *Scientific American* 1895: 16587). But the Harsimus Cove property posed special problems for the PRR owing to the shallowness of the water. Silting happened rapidly at the reclaimed land, so transfer bridges supported on floating pontoons easily bottomed out within a year or two of operation. Expensive disruptions and dredging operations resulted (Bensel 1888: 310).

Beginning about May 1888, the PRR placed into operation at Harsimus Cove a pair of new transfer bridges (Figures 1 through 6) (Bensel 1888: 309). Changes in the design of this second generation of transfer bridges were subtle but significant. The new structure relied on a heavy timber gallows frame and counterweights to carry most of the dead load from the bridge. It also employed an independently counterweighted apron controlled by a friction gear that held the apron stationary, but provided sufficient movement needed during the loading and unloading process (Bensel 1888: 310). The mechanism allowed for easy adjustments to any height of the float, which made the coupling process between the bridge and the car float both easy and quick and eliminated the need of running a locomotive onto the bridge. This reduced the warping caused by the old loading process and the related strains to the structure (Bensel 1888: 310; *Engineering News* 1890: 68). The chief advantage, however, was freeing the bridge of the pontoon and the corresponding interference from silt and ice in the harbor (Bensel 1888: 310). The new design also gave the bridge an adjustable range totaling over ten feet.

Instead of chains to adjust the height of the bridge, the new mechanism used a vertical screw assembly threaded through a mount in the overhead timber gantry to carry the balance of the dead load and the live loads created by the cars. The screws were attached to the bridges by heavy iron linkages and moved up and down by means of a horizontal worm shaft in the gantry above, which meshed with a sprocketed bronze nut at the base of each screw that raised or lowered the screw when turned (Snow 1901: 165). At first the horizontal drive shaft was geared to a rod and capstan at the bridge deck level and operated by hand. By the end of 1888, however, the railroad switched to steam power using an engine on the platform between the two bridges (Bensel 1888: 310, 311; (*Engineering News* 1890: 68). With belts, the power was transferred from the engine to the horizontal shaft in the gantry above the bridge by way of a friction pulley that, when engaged, turned the shaft and raised or lowered the bridge automatically (Bensel 1888: 311). One man could operate the new bridge using a single lever from the control room. The screw lift mechanism was intended to compensate for changes in the tide and to make the minor adjustments needed during loading and unloading operations (Bensel 1888: 310). The apron, because of the counterbalance, could be raised and lowered by two men working on each side. The entire structure was enclosed in a single wooden shelter to protect the machinery and operating equipment and preserve the timber members from the elements.

The new Harsimus Cove transfer bridges were designed in the Jersey City offices by the Pennsylvania Railroad Company and built using company men and materials (Bensel 1888: 311-312). They proved so successful that the railroad began erecting similar structures in Philadelphia (Bensel 1888: 309). One reporter described the new transfer bridges as altogether "the most scientific in design and convenient in operation of all those described" (Snow 1901: 165).

<u>Initial Plans to Expand Freight Handling Facilities</u>

By the mid-1880s, the PRR's freight handling facilities were widely scattered about the Port of New York. Receiving yards and engine shops were located at Meadows Yard east of Newark. The western freight station, transfer bridges and piers, grain elevators, stock yards and abattoir were all located at Harsimus Cove. The main line freight station and the Red Line and Netherlands Steamship docks were adjacent to the PRR passenger station in Jersey City. Oil yards were located at Communipaw. Coal docks were at South Amboy. Within New York City, five separate locations handled freight (Mordecai 1885 29).

The PRR also faced a shortage of freight capacity. To solve this problem, it began maneuvering quietly to gain control of additional water frontage along the shores of Bayonne, Greenville, and Pamrapo (*New York Times* 1887a: 1). Then on February 25, 1886, interests of the NYCRR, the PRR's arch-rival, incorporated the New Jersey Junction Railroad (NJJRR) (Transportation Corporation Files 1886; New Jersey Junction Railroad 1886). The goal of this short line was to build an eight-mile-long line between the NYCRR's newly leased West Shore Railroad on the north side of the PRR's terminal in Jersey City and the CRRNJ terminal on the south side. If built the NJJRR would give the NYCRR access to all the major shippers along the Hudson River, threatening the PRR's business there (*New York Times* 1895: 8). The NJJRR could also give the NYCRR access to scarce water frontage toward Greenville, and potentially choke off the PRR's own plans for expansion (*New York Times* 1889: 10).

The PRR acted swiftly to block the NJJRR and stake out its own route to the undeveloped areas between Jersey City and Bayonne. Together with the affiliated National Docks Railway (NDR) the PRR filed a survey on September 3, 1886 to construct a connection between the NDR and the PRR's Harsimus branch freight line (National Docks Railway 1886). Although the PRR and the NDR already possessed an interchange via the PRR's old passenger main line near Waldo Avenue, that connection required freight and passenger trains to share the same tracks inside the Bergen Cut, and one of the company's long-range goals in developing its New York port facilities involved separating the two types of traffic through this bottleneck. The planned connection between the Harsimus freight line and the NDR would duck beneath the PRR passenger tracks, adjacent to the proposed route of the NJJRR, thus allowing PRR freight trains to freely travel from Meadows Yard along the Harsimus freight line and beneath the PRR main line near Waldo Avenue to future terminal facilities planned for the lower Jersey City shoreline (Richard Grubb & Associates 2008: Form 3).

Then in November 1887, Jersey City gave its final approval for the PRR to elevate its passenger tracks through that city as part of a large grade separation program (*New York Times* 1887b: 4). To accomplish this, the PRR would have to construct a large passenger car yard on new fill to be deposited next to the PRR's passenger mainline, directly overtop the planned routes of both the NJJRR and the NDR (Messer and Roberts 2002: 196; *New York Times* 1887b: 4). This helped block the NJJRR, but it also forced the PRR to look for another way to run its freight trains to points south, and a little over a year later it announced plans to build a massive new freight terminal at Greenville. On February 8, 1889, the PRR chartered the Waverly & New York Bay Railroad Company to run from the main line near Waverly on the southwest side of Newark, across Newark Bay to the future yard at Greenville (Hayden 2008: 4).

A second line, the Waverly & Passaic Railroad Company, was formed on February 11, 1889, to extend from the main line at Waverly to a new bridge across the Passaic River and on to a link with the Meadows Yard in Kearny (Transportation Corporation Files n.d.; Messer and Roberts 2002: 211). These two freight lines were consolidated on January 30, 1890, to form the New York Bay Railroad Company (NYBRR) (New York Bay Railroad Company: 1890.; Burgess and Kennedy 1949: 434). The combined routes promised to give access to proposed terminal facilities in the Greenville section of Jersey City and improve traffic flow into Meadows Yard and Harsimus Cove by diverting heavy freight traffic off the main line and around the congested bottleneck in downtown Newark (Messer and Roberts 2002: 211).

The Greenville Branch of the newly combined railroads was completed between Waverly and a crossing with the CRRNJ in the middle of the Newark Meadows by September 1890 (Board of

Public Utility 1918). The Passaic Branch of the line was built between Waverly and Newark in 1892 (Board of Public Utility 1918; Messer and Roberts 2002: 228). Then construction stopped. An economic downturn dampened business activity in general, but the PRR also paused to contemplate grander schemes for handling traffic in New York.

The New York Tunnel Extension Project

For years the PRR had been considering the possibility of establishing direct rail communication to Manhattan, Long Island, and New England, thereby reducing ferry operations around the congested waters of New York Harbor. Early plans considered the construction of an enormous bridge across the Hudson to be shared by all the trunk lines, but financial and technical problems proved insurmountable (Jonnes 2007: 20; 38-39). Other plans called for stitching together connections between the PRR and New England by way of Long Island. The New York Connecting Rail Road Company was organized in 1892 by interests of the PRR and the LIRR to build a bridge between Long Island and the mainland (present-day Bronx) at Hell Gate via Ward's Island and Randall's Island (Burgess and Kennedy 1949: 536-537; Sturm and Thom 2006: 7-8). The PRR's acquisition of a controlling interest in the LIRR in 1900 and that railroad's own plans to construct tunnels beneath the East River, provided the PRR with additional linkages and yard facilities in Brooklyn and Queens and helped it bring its grand plan one step closer to fruition (*New York Times* 1900a; 1901a; Jonnes 2007: 51). Shortly after the LVRR acquisition in 1900 the PRR announced its general outline for a comprehensive plan to manage freight operations in New York (*New York Times* 1900a). This included the development of the Greenville property into a new freight terminus for car float interchange with the LIRR at Bay Ridge and eventual connections to New England. On the strength of this plan, the PRR began designing the Greenville improvements. As outlined in the *New York Times*:

> When the new freight terminus of the Pennsylvania Railroad at Greenville, a section of Jersey City, opposite Bay Ridge, is completed, connection with the Long Island system will be made at Bay Ridge by a comparatively short car float ferry. Meanwhile the present transfer barges at Jersey City will be used, but ultimately a tunnel from Staten Island to Bay Ridge may be built. In that case traffic between the Pennsylvania Railroad lines and New England would pass through the tunnel and over the Long Island tracks and the proposed bridge at Ward's Island to a connection with the New York, New Haven and Hartford Railroad (*New York Times* 1900a).

These initial plans were revised again after improvements in electric traction convinced PRR management that drilling tunnels beneath the Hudson River was both feasible and practical. Built in conjunction with the proposed LIRR tunnels beneath the East River and the proposed bridge at Hell Gate, the Hudson tunnels offered the PRR the opportunity to run trains directly into Manhattan and through to Long Island and New England (Figure 7). Renamed the New York Tunnel Extension Project, the newly re-envisioned plan for comprehensive rail service in the Port of New York contained 10 key elements (Raymond 1910: 2):

1. Tunnels to carry passenger traffic using electric locomotives beneath the Hudson River, Manhattan Island, and the East River to a large terminal yard called Sunnyside Yard in Long Island City, Borough of Queens.

2. The electrification of the LIRR within the city limits.

3. Construction of the freight terminal yard and piers at Greenville, connecting by ferry with the Bay Ridge Terminal of the LIRR on the opposite shore of the Upper Bay.

4. Improvements of the Bay Ridge line of the LIRR from East New York to Bay Ridge.

5. New yards for increasing the freight facilities in the boroughs of Brooklyn and Queens.

6. Improvements at Atlantic Avenue, Brooklyn, involving the removal of the steam railroad surface tracks and the extensive improvement of the passenger and freight station at Flatbush Avenue.

7. Construction of the New York Connecting Railroad, extending through a part of the Borough of Queens and crossing the East River at Hell Gate by a bridge via Ward's and Randall's Islands to Port Morris, New York.

8. Creation of the Glendale Cut-off of the LIRR.

9. New piers and docks in Newtown Creek at its confluence with the East River.

10. Electrification of the PRR main line from Newark to Jersey City.

While the PRR had been careful to secure both the legal and technical means to run freight through the new river tunnels if desired, for all practical purposes the new line to Manhattan was intended to serve passenger traffic only (Raymond 1910: 4). In the entire plan, the improvements at Greenville Yard and its sister facility at Bay Ridge were the most important for the handling of freight (Raymond 1910: 7). At the time of the announcement of the Extension Project, the PRR exchanged approximately 1000 freight cars a day with the NYNH&HRR by way of car floats (Sturm and Thom 2006: 4). The roughly 12-mile trip between Harsimus Cove and Port Morris took up to six hours to complete and required navigating around heavily congested waters in the Hudson and East Rivers and through Hell Gate, "one of the most treacherous spots known to eastern navigation" *New York Times* 1910).

The new car float operation between Greenville and Bay Ridge promised to reduce the transfer distance to three miles across the comparatively open waters of the upper bay and take just one hour to complete (Sturm and Thom 2006: 74). Once the New York Connecting Railroad was built, the PRR would then be able to move freight by rail to New England at a substantial savings in time and money (Raymond 1910: 7). With this scheme in mind, construction of the terminal facilities at Greenville Yard began.

<u>Greenville Terminal</u>
Plans for dredging a channel and improving the Greenville property were already well advanced by June 1900 under the PRR's initial plans for the Greenville-Bay Ridge connection. PRR Chief Engineer William H. Brown expected to spend $15,000,000 on the improvements (*New York Times* 1900b). To reach the Greenville property, the company first had to complete the Greenville Branch

of the NYBRR from the PRR main line, but the line had to cross the Newark Bay. The LVRR, which operated an abutting line on the north side of the PRR's right-of-way, had already erected a timber trestle and drawbridge across the bay between 1890 and 1892 (Greenberg and Fischer 1997: 151). The PRR negotiated trackage rights over this bridge and extended the Greenville Branch to the new yard property between 1901 and 1902 (*New York Times* 1902a, 1902b).

Work on filling in the tidal flats at Greenville began in March 1901 (*Railroad Gazette* 1905: 239; *Railway Age* 1905: 402). A newspaper account in June 1901 noted that the railroad "is constructing a terminal with an area of some 15,000,000 square feet of surface for tracks and storage, and ten piers" (*New York Times* 1901a). By November, 1901, P. Sanford Ross, Inc. was busy driving the pilings for bulkheads that would eventually impound the fill material (*New York Times* 1901b). By March 1902, the work was described as "mammoth," and by December 1902, the *New York Times* reported "the [railroad] company is building immense piers on New York Bay in Greenville, and its principal terminal freight yards will be on the New York Bay Shore, when the improvements are complete" (*New York Times* 1902a; 1902b). The project used more than 22,000,000 cubic yards of materials from numerous sources, including dredge materials, excavations from the New York City subway system, city garbage, and the dirt from the site of the PRR's passenger station in Manhattan (*New York Times* 1904; *Railroad Gazette* 1905: 239). The extent of the fill raised the submerged ground to about 8 feet above water at the bulkhead line and 47 feet above water at the top of the hump yard near the crossing with the Morris Canal (now buried) at the yard's western end. The process of impounding the fill in the submerged areas involved constructing a pair of crib retaining fences out from the high ground to hold the fill in place. An 800-foot-long channel was dredged in from the main channel and the mud deposited in the fill area. Once the track reached the site, the railroad constructed a pile trestle out over the flats and gradually buried the structure and surrounding area with fill. The railroad commenced on the north side of the property to accommodate the planned transfer bridges; filling in of the south side of the yard continued for several years more. In addition to dredge material, the other sources of fill were brought in by scow and dumped onto the soft mud, which caused the north retaining wall to buckle and break during construction. The weight elsewhere displaced huge ridges of mud, which thrust upward between 20 and 30 feet into the air and had to be leveled (*Railroad Gazette* 1905: 239).

The first phase of work on Greenville Terminal ended in 1904, and the facility opened the following year, but work continued into 1907 (Figure 8). When completed, the yard extended 5,200 feet into the bay on man-made land (*Railroad Gazette* 1905: 239). The overall water frontage measured 3,700 feet (*Railroad Gazette* 1905). Westbound departure yards and eastbound receiving and storage yards could hold 1,700 and 4,200 cars, respectively, indicating the vast eastbound traffic destined for New England (*Railway Age* 1905: 399; *Railroad Gazette* 1905: 239). Eastbound trains were broken up and classified on a hump into strings of cars and sorted for their respective destinations. Through cars were sent to the northern storage tracks, which fed directly into the Transfer Bridges. Cars destined for the piers were shifted over to the southern yards for delivery to the wharves for lighters (*Railroad Gazette* 1905: 239). Westbound trains were assembled in the northernmost westbound yards, which led directly to the westbound tracks and the mainline. The entire track layout was designed to permit easy, efficient movement of both road engines and yard engines, while the grades of the respective yard tracks were graded to provide the greatest possible assistance to the cars (*Railroad Gazette* 1905: 241). Waverly Yard, further back on the line near Newark, acted as an initial receiving yard for freights coming in off the PRR main line.

Additional facilities at Greenville Yard included an engine house, turntable, and service area; an ice platform; car repair shops; coal storage and dumping facilities; water supplies; and an electric power plant. When it opened the yard was one of the country's largest rail-water terminals (Messer and Roberts 2002: 211).

A newspaper reporter, recounting the tremendous boon to freight traffic that the PRR's New York extension project allowed, described the process of delivering trains destined for western markets:

> The Greenville yard could have a page written about it without exhausting its interesting possibilities. In the first place, the strings of cars on arriving are received on the most powerful float bridges in the world. It may be said for those who are not familiar with the term that a float bridge is the adjustable roadway which is lowered or raised in a ferry slip to connect the shore with the boats that are coming in or out. For many years the system of control of these float bridges has been something to puzzle engineers, but a scheme of electrical control has now been devised which is applied to the bridges and [sic] the Greenville yards and consequently these mammoth structures which can lift the heaviest carload known to railroading are under the domination of a lever which a child might operate (*New York Times* 1910).

<u>Greenville Transfer Bridges</u>
The new transfer bridges at Greenville Yard (Transfer Bridges #11, #12, and #13) were modeled after the structures at Harsimus Cove, but they included a number of new design features (Figures 9 through 21) (*Railroad Gazette* 1905: 240). The structures were enclosed as before in a single wooden structure, but instead of a timber support frame, the new bridges relied on two distinct gantry frames made up of steel towers and six-foot-high plate girder spans. The bridges themselves were constructed of heavy timber trusses carrying two tracks each and measuring 41 feet in length (*Railroad Gazette* 1905: 240). The outer ends of the bridge trusses were suspended by four hinged iron rods measuring 5 inches in diameter and affixed to the underside of the truss cords and treaded at the top to form the hoisting screws used in raising or lowering the bridge. As in the Harsimus Cove design, the screws were turned by a horizontal worm shaft, but unlike the steam-powered examples at Harsimus Cove, the Greenville Yard Transfer Bridges used two electric motors mounted on top of the plate girder gantry to rotate the shaft and raise or lower the hoisting screw (*Railroad Gazette* 1905: 240). However, unlike the Harsimus Cove examples, which used only three hoisting screws per bridge, the Greenville Yard examples employed four screws (*Railroad Gazette* 1905: 240).

As before, the bulk of the weight of the bridge was carried on counterweights suspended in the legs of adjoining support towers. The aprons measured 32 feet in length and were also made of timber. The inner edge of the apron was hinged to the bridge. The outer edge of the apron hung from eight steel cables suspended over sheaves in the overhead gantry. Two of the apron cables were tied to counterweights and a idler drum and motor, which could raise or lower the apron remotely by electricity (*Railroad Gazette* 1905: 240). The electric controls were all housed in a raised control room located about 20 feet above the floor of the bridge between the two bridge openings. The location gave the operator a clear and unobstructed view of both the bridge and the apron (*Railroad Gazette* 1905: 240). Power for the new electric motors and the rest of the yard came from a powerhouse erected adjacent to the transfer bridges and equipped with five locomotive-style boilers and two Curtis turbines with a 500 kilowatt capacity (*Railway Age* 1905: 402).

The new bridges could travel a maximum of 16 and one half feet, while the end of the apron could move up to 18 feet (*Railroad Gazette* 1905: 240). The usual arrangement of winches and toggle bolts provided the connection between the apron and the car float. Wooden fenders extended out from the bridge slips 125 feet into the open water and helped guide the floats into their respective berths. To control currents and floes of dangerous ice, the company built a 600-foot-long breakwater along the northern edge of the transfer bridge facility (*Railroad Gazette* 1905: 240). With the new bridges, the PRR was able to reduce the time it took to unload and load a single three-track car float from 90 minutes to approximately 35 minutes (*Railway Age* 1905: 401).

William H. Brown, the PRR's Chief Engineer at the time, supervised the initial planning of the yard before his retirement in 1906. William C. Bowles served as Assistant Engineer of Construction and had charge of the Greenville improvements along with L. H. Baker, Assistant Chief Engineer (*Railroad Gazette* 1905: 242). F. C. Richardson served as the principal assistant under Bowles. Francis L. Du Bosque, the assistant engineer of floating equipment at Jersey City was primarily responsible for designing the machinery of the transfer bridges (*Railway Age* 1905: 403). The transfer bridge foundations, steelwork, pile racks, bridges and aprons were built by Henry Steers Incorporated of New York City. The steel gallows frames were built by the Cooper-Wigand-Cook Company. The housing surrounding the gantries and machinery was built by R. P. & J. H. Staats Company of New York. The actual transfer machinery was fabricated by Steele & Condict of Jersey City (*Railway Age* 1905: 403).

<u>Greenville Yard Freight Operations</u>

Before completion of the New York Connecting Railroad and Hell Gate Bridge, car floats out of Greenville continued to interchange principally with the NYNH&HRR by car float at its old facility at Oak Point, Port Morris on the Harlem River (Figures 22 and 23). The Oak Point facility used a bridge-apron and double gantry transfer bridge similar in design to those employed at Greenville Yard (Sturm and Thom 2006: 101). The PRR also maintained car float business with the LIRR, the NYCRR, and individual freight houses and private companies all over the Port (New York, New Jersey Port and Harbor Development Commission 1920: 150). The railroad's freight traffic increased dramatically at the time the terminal opened. Between 1900 and 1906, for example, one measure of volume increased nearly 50 percent from 3,268,330 to 4,742,081 ton-miles per mile of road (Raymond 1910: 29).

Traffic proved so heavy that the PRR added a fourth transfer bridge (bridge #14) at Greenville Yard around 1910 (HAER 1996). The new bridge essentially mirrored the design developed for the first three structures, utilizing the double-gantry system. In the same year, however, a former bridge engineer for the LIRR named James Benton French (1863-1947) applied for a patent of a new transfer bridge design that effectively supplanted the Greenville Yard designs (Figures 24 through 27). French had left the service of the LIRR in 1908, where he must have been familiar with the unpatented transfer bridge designs in use at Greenville, and entered private practice (Leonard 1922: 467). His patent, granted in 1911, pertained largely to changes in the design of the apron, which he integrated into the structure of the main bridge span, thus eliminating the need for the extra machinery, cables, counterweights, and frame comprising the separate apron gantry (United States

Patent Office 1911). The combined weight of both the bridge and integral apron was suspended instead from a single heavy-duty gantry. This gantry contained all the sheaves, cables, and counterweights required for carrying the dead load, as well as the large lifting screws. The screws themselves were not linked directly to the bridge, but were affixed instead to a heavy movable cross beam that was pinned in turn to the bridge girders with substantial steel suspenders.

The structure could be built for one track or two. If the latter, it could be configured with each track able to move independently or combined and built as one (United States Patent Office 1911). The independent action of each track proved especially helpful in compensating for changes in the height of the car float during loading and unloading. The design soon found widespread acceptance around the harbor, with known examples built for the NYCRR (69th Street), the LVRR (Jersey City), and the LIRR (Hunter's Point) (Figures 28 through 30) (Ziel and Foster 1965:102; Greenburg and Fischer 1997: 159; 175). The PRR eventually installed its own pair of French-type bridges at Harsimus Cove (Figure 31) (Messer and Roberts 2002: 223).When the time came to complete the Bay Ridge terminal, the LIRR used the French design for the transfer bridges there (Figure 32) (O'Connor 1949: 79).

Work on the New York Connecting Railroad finally began in 1912, and the bridge opened for traffic in March 1917 (Messer and Roberts 2002: 323). The Bay Ridge terminal opened at about the same time. PRR car float operations then shifted almost exclusively to the LIRR terminal at Bay Ridge. The NYNH&HRR continued to use its Oak Island Yard transfer bridges to interchange with the CRRNJ and the LVRR (Sturm & Thom 2006: 82). Through PRR freight service between Greenville, Bay Ridge, and Port Norris via the new Hell Gate Bridge finally began on January 17, 1918, and it dramatically increased the flow of goods, particularly perishable freight to New England (Pennsylvania Railroad, 1917: 10; Messer and Roberts 2002: 323).

Greenville Yard and its companion facility at Bay Ridge quickly emerged as the busiest transshipment point on the East Coast (Sturm and Thom 2006: 82). Tugs moving between Greenville and Bay Ridge were lashed up between two car floats, which they then shuttled between the transfer bridges at both facilities. Train crews used the "pull, drop and load" method to exchange cars on the car floats. The switching locomotive, pushing a flatbed "reacher" car onto the apron, would couple to the strings of cars and pull them off the float, starting on the outside tracks first and leaving the middle track for last to keep the float's center of gravity stable (Sturm & Thom 2006: 84). The transfer bridge operator constantly adjusted the height of the bridge and apron as cars were loaded and unloaded (Sturm & Thom 2006 85). Unloaded cars were dropped onto lead tracks and then shuttled over to a secondary track to be made up into outbound trains. Empty floats were then reloaded with new cars beginning with the center track for the return trip (Sturm & Thom 2006: 85). The process continued uninterrupted throughout the year, unless extreme weather and water conditions halted the work.

America's entry into World War I spurred freight movements and initiated expansions of the freight yards further inland from Greenville at Waverly Yard. The PRR annual reports recorded constant physical improvements along the NYBRR every year between 1915 and 1920 (Pennsylvania Railroad 1915-1920; Burgess and Kennedy 1949: 548).

By 1920, the PRR's sprawling freight operations in the port district extended through two states

(New Jersey and New York), seven counties (Essex, Hudson, Middlesex, New York, Kings, Queens, and Bronx), and seven municipalities (Newark, Harrison, Kearny, Jersey City, Bayonne, South Amboy, and New York City). It maintained break-up, classification and transfer facilities at Waverly Yard; break-up and classification operations at Meadows Yard; waterfront yards at South Jersey City Yard and Harsimus Cove Yard and the main waterfront yard at Greenville for New England interchange and import/export traffic (New York, New Jersey Port and Harbor Development Commission 1920: 128). The PRR operated Manhattan pier stations along the Hudson River (Piers 3, 4, 5, 27, 28, 77, and 78), the East River (Pier 22); Harlem River (East 125th Street), and the Brooklyn waterfront (N. Fourth Street and Wallabout Basin). In addition to the four transfer bridges then in operation at Greenville for the car ferry service to Bay Ridge and interchange with the NYNH&HRR, the railroad maintained three float bridges at South Jersey City Yard, five at Harsimus Cove, one at West 37th Street in Manhattan serving Piers 77 and 78, and one at Williamsburg serving the two piers there (New York, New Jersey Port and Harbor Development Commission 1920: 128).

Lighterage piers included the three covered and one open air piers at South Jersey City Yard, four open and two covered piers at Harsimus Cove, and one open air and one covered pier at Greenville. The railroad also maintained express stations at Exchange Place in Jersey City and Pennsylvania Station in Manhattan. Coal terminal facilities were located at Greenville, Harsimus Cove, and South Amboy. The railroad also maintained stock yards and poultry yards at Harsimus Cove and a huge steel staging yard at Greenville, where the structural steel used in New York's ceaseless skyscraper and bridge building was received, sorted, and stored before final delivery to the construction site. To keep things moving around the harbor, the PRR maintained a small navy consisting of 23 ferry boats, 27 passenger and freight steamboats, 55 tugs, 124 car floats, 9 steam lighters, 226 barges, 20 steel canal barges, 50 flat dumps and scows, and various smaller vessels and construction boats (New York, New Jersey Port and Harbor Development Commission 1920: 128).

PRR traffic soon reached sufficient levels that in 1924 the company prepared plans for a fifth transfer bridge at Greenville (Bridge # 10). Built onto the north end of the yard, it required removing the old ice breakwater and relocating it further north (HAER 1996). The new bridge essentially copied the form and structure of the others. By the end of the decade, the transfer bridges at Greenville were moving approximately 4,000 cars a day (*New York Times* 1931).

The entire five-bridge structure at Greenville Yard burned on January 1, 1931, destroying the steel gantry superstructures and many of the wooden truss bridge and apron spans. The fire, fanned by a stiff wind, began in the wooden housing near Transfer Bridge # 10 and was blamed on a short circuit in one of the electrical drive motors (HAER 1996: 8). From the Battery and Brooklyn the flames could be seen "leaping out" as described in a *New York Times* article, "and every now and then—in a moment of blackness—the twisted girders were etched against the sky" (*New York Times* 1931). The railroad immediately diverted freight traffic to the transfer bridges at the PRR's Harsimus Cove Yard and the LVRR's Jersey City terminus (HAER 1996). A PRR spokesperson confidently declared "there would be no interruption of New England or Long Island traffic" (*New York Times* 1931).

Reconstruction began immediately. There is some debate about the extent of the rebuilding effort. Some original stone footings underpinning the towers appear to have been reused; others were reinforced or replaced with concrete. The railroad contracted with the American Bridge Company in Trenton, New Jersey to rebuild the facility, essentially duplicating the original design. In a concession to fire safety, however, the new bridge and apron gantries were no longer housed within a single wooden shelter but separated into a gantry tower and apron tower capped by narrow housings made of fire resistant materials. Salvaged wooden truss bridges were placed back into service on Transfer Bridges #11 and #12, while new steel through plate girder bridges were ordered for Transfer Bridges #10, #13, and #14 (HAER 1996).

The reconstruction of the Greenville Yard Transfer Bridges coincided with the PRR's massive long-distance electrification project, carried out in stages between 1928 and 1938 (Burgess and Kennedy 1949: 612-616). In electrifying its freight routes into the Port of New York, the railroad began with the line to Harsimus Cove. In late October 1934, between four and seven tracks were 90 percent wired for service (New Jersey Department of Treasury 1936). Further south, the three main tracks on the Greenville Branch of the NYBRR were wired as far as the Newark Bay Bridge, which carried two wired tracks to the east bank. Work was still underway from the Newark Bay Bridge to Greenville Yard, with poles and wires extending as far as the hump in the east sorting yard, but progress on the classification and make-up yards was well underway (New Jersey Department of Treasury 1936).

By April 1, 1935, crews had made great progress on the remaining electrification in the port area. At least five storage tracks were electrified through Meadows Yard. Extensive work was underway electrifying all of Waverly Yard, and 11 tracks in the outbound classification yards leading to the transfer bridges at the Greenville terminal were also already electrified (New Jersey Department of Treasury 1937). The railroad inaugurated its electric freight service between New York and Washington, D.C. on May 20, 1935, and experienced almost immediate benefits (Pennsylvania Railroad 1935: 5). It reported in 1935 that "freight schedules were…quickened and otherwise improved between important cities and further advances were made in the classifying and dispatching of freight trains" as the result of electrification (Pennsylvania Railroad 1935: 7). Electric power eliminated the need to change out engines or take on fuel and water. Electric engines could pull a train from one end of the electrified territory to the other without stopping. Between 1926 and 1935, one measure of efficiency, the gross ton miles per train hour, grew from 19,983 to 33,119, an increase of almost 66 percent (Burgess and Kennedy 1949: 658).

The outbreak of war in Europe in 1939 fueled still greater demand for the PRR's freight operations. For all its size, the facilities at Greenville Yard were not large enough to handle the increasing volumes of traffic headed to the war effort. The company proposed new yards further back along the Greenville Branch (Messer and Roberts 2002: 236; Burgess and Kennedy 1949: 687). In March 1939, the PRR shifted a portion of the Greenville Branch slightly south, and made room for a facility called Old Garden Yard (Pennsylvania Railroad 1940). In April 1941, the railroad began work on another five-track marshalling yard with a 625- car capacity in the Newark meadows called Bay Line Yard (Pennsylvania Railroad 1942; Messer and Roberts 2002: 236). America's entry into World War II in December 1941 led to even greater expansion at Bay Line Yard, with an additional nine tracks divided into east and west classification yards of 227 and 224 cars, respectively (Pennsylvania Railroad 1943). By 1943, the railroad had added five more tracks in still another facility called New Garden Yard (Pennsylvania Railroad 1944a). All of these facilities served Greenville Yard.

The railroad began work on its last major addition to the Greenville terminal in 1943 with the construction of a sixth and final transfer bridge (Bridge # 9 [a.k.a. # 9 ½] on the north end of the transfer bridge structure (Figures 33 through 40). The new bridge went into service on November 9, 1943 (HAER 1996). The only remaining change of consequence after that date was the complete rebuilding of Bridge #12 and modifications to Bridge #11 in 1945, including all new motors, sheaves, and electrical equipment (Pennsylvania Railroad 1945; HAER 1996). These modifications included the introduction of a hydraulic apron operating strut, which removed the need for the electrically operated cable and drum attachment suspended from the apron gantry (Pennsylvania Railroad 1945; HAER 1996).

From Penn Central to New York New Jersey Rail

At mid-century, the section of the PRR between New York and Trenton was described as the most "phenomenal piece of railroad in the world" (McBride 1953). In any 24-hour period, 475 passenger and 120 freight trains rolled along its length, carrying the wealth of the nation (Figures 41 through 44) (McBride 1953: 11). But all of the eastern carriers faced growing competition from truckers, bus services, and publicly-subsidized roadways, including the Garden State Parkway, the New Jersey Turnpike, and the Interstate Highway system. Airports, built and expanded with public dollars and exempt from many taxes, placed the railroads at a competitive disadvantage. In 1954, the PRR paid 2.5 million dollars in taxes on the Greenville terminal property, far more than the facility actually earned (Prizer 1954: 17). Higher costs, excise taxes, rate controls, and government-mandated passenger/commuter service prevented the railroads from competing, and bankruptcies followed in rapid succession.

Marine freight delivery declined rapidly as result. The railroads quickly found it less expensive to deliver goods by trucks, and they adapted to handle transfers to trucks. The PRR opened "TrucTrain" service in 1954 to trans-ship loaded trucks on flatbed cars for door-to-door service (*The Pennsy* 1954: 1). Soon shippers discovered they could save money by consigning the entire shipment to trucks, and this cut deeply into railroad profits (Flagg 1994: 10).

At the same time, the Port Authority decided to reduce transport costs by eliminating freight movements and shifting the major piers to the New Jersey side of the Hudson River. This project became even more important when containerization changed the way freight was moved, as the containers required large amounts of open space available only in the marshlands around Newark (Flagg 1994: 10). The net result was a decrease in the use of the established marine freight facilities for most railroads.

With the merger of the PRR, the NYCRR, the LIRR and the NYNH&HRR into the Penn Central Railroad on February 1, 1968, the new company inherited excess equipment from the former independent railroads. This included Car Float #29 from the NYNH&HRR. Built around 1953, probably by the Bethlehem Steel Company, the standard 360-foot-long float carried a 40-foot beam and supported three tracks. It saw service throughout the Port of New York until it was officially purchased by the Penn Central Corporation in 1971 (Hutton, personal communication 2010).

The merger ultimately failed, and the Penn Central Corporation filed for bankruptcy protection on June 21, 1970 (Messer and Roberts 2002: 352). At the time, it was the single largest American corporate bankruptcy ever (Penn Central Corporation Records n.d.).

On October 30, 1970, President Nixon signed legislation creating the National Railroad Passenger Corporation (Amtrak). On May 1, 1971, Amtrak took over most of the nation's inter-city train service, including the busy Penn Central passenger routes (Edmonson 1972: 11; Messer and Roberts 2002: 264). Each railroad remained responsible for their respective commuter and freight services. Congress then passed the Regional Rail Reorganization Act in 1973, which expressly conveyed the New York-to-Washington, D.C. segment of the PRR main line to Amtrak for high speed operations, and it established the United States Railway Association (USRA) with the job of reorganizing the numerous remaining Northeast railroads into some sort of cohesive system (Holton 1992: 354). After much study, the USRA found federal control of the eastern railroads the only viable option, and they created the Consolidated Rail Corporation (Conrail) in 1974. The remaining assets of the former PRR/Penn Central—including the Greenville Yard facility—were transferred to Conrail on April 1, 1976.

Conrail ended all water delivery and disbanded its entire rail navy including those once owned by the former Penn Central (Flagg 1994: 10). The Brooklyn Eastern District Terminal, one of the big four contract terminals which maintained extensive car float and warehouse facilities along the Brooklyn waterfront, contracted with Conrail to take over the abandoned Greenville Yard operation and provide car float service for themselves and the neighboring New York Dock Company (Flagg 1994: 9-10). In 1978, the New York Dock Company took over Brooklyn Eastern District along with the Greenville operation. With this development came Car Float #16, which was built for the New York Dock Company about 1957 by the Bethlehem Steel Company (Figure 45) (Flagg 1994: 9). It measured 290 feet long with a 41-foot beam and also carried three tracks.

With no more through-freight service on the former PRR main line, Conrail stopped using electric locomotives and reduced or closed many former Penn Central freight yards to eliminate excess capacity. This included Waverly Yard, Bay Line Yard, Meadows Yard, Harsimus Cove, and the Greenville terminal. Most of the yard track and related support facilities at Greenville Yard were gradually abandoned and removed. Between 1987 and 1995, the single-story warehouse on top of the yard's short pier was removed. Large portions of the former yard area were sold and paved over or developed with modern warehouse buildings. Conrail demolished Transfer Bridge #13 and #14 in 1996 (Figure 46) (HAER 1996). Today, in addition to the remains of the two extensively altered piers, only Transfer Bridges #9, #10, #11, and #12 remain standing. Of these, only Transfer Bridge # 11 is operational.

Conrail eventually became a publicly traded company in 1987. In 1998 the CSX Corporation and the Norfolk Southern Corporation received approval to acquire Conrail's assets, and the final merger occurred on June 1, 1999 (Reilly 2004: 37). Each railroad took control of different parts of the Conrail system. Common property, including the tracks and yards of the former PRR operating in the New York area, was placed in the hands of a jointly owned corporation called Conrail Shared Assets Corporation, which currently operates the former NYBRR and provides interchange service at Greenville Yard.

Meanwhile, the New York Dock Company all but ceased operations in 1982. A new entity called New York Cross Harbor Terminal Corporation successfully petitioned to take over the New York Dock Company franchise in August 1983. New York Cross Harbor continued to run car floats through Greenville Yard until 2006, when its operation was taken over by Mid-Atlantic New England Rail L.L.C. This company was renamed New York New Jersey Rail L.L.C. (NYNJR) and operated independently for two years until it was acquired by the Port Authority of New York and New Jersey (PANYNJ) in 2008.

IV: ARCHITECTURAL INFORMATION

Greenville Yard Transfer Bridges

The Greenville Yard Transfer Bridges comprise four individual transfer bridge structures designated from north to south as Transfer Bridges #9, #10, #11, and #12. Transfer Bridges #9, #10 and #12 are abandoned and dilapidated. Only Transfer Bridge #11 remains in operation.

The four independent transfer bridges are nearly identical and integrated into a single unified structure. The two-gantry and suspension-type system utilizes moveable bridge spans and apron spans using separate steel cables hung from two parallel overhead gantry towers. The principal components of each bridge structure include: a bridge span; an apron span,; an overhead bridge gantry; an overhead apron gantry; cables; counterweights; lift screws; electric motors, related machinery, control room, and car float. The main bridge spans consist of three steel through plate girders carrying two tracks. The landward end of each bridge rests on a concrete abutment. The seaward ends are suspended from the bridge gantry with wire cables and counterweights. The apron span is a shorter deck steel plate girder structure with a solid timber deck. One end is hinged to a large apron girder at the outer end of the bridge and the other suspended over the water from the apron gantry by a similar system of cables and counterweights. Each transfer bridge span is suspended near the outer corners by four steel cables, attached at the outward corners and passed over four-foot diameter sheaves mounted in the gantry to four 53,000 pound counterweights located within the tower legs. The apron span is suspended in a similar manner to a pair of 42,000 pound counterweights. The counterweights support nearly all of the structure's dead load.

Both gantries (bridge and apron) span the transfer bridges and are made up of separate steel deck plate girder structures supported on steel towers with I-beam legs, steel angle cross braces, and rusticated stone and/or poured concrete foundations with timber pilings. Both gantries are fitted on top with long rectangular housings supported by cantilevered bracing and containing the bridge lift mechanism, sheaves, and counterweight system. The gantry houses are framed with steel and include corrugated metal gabled roofs, corrugated metal sheet siding, and rectangular window openings. All window sash has been removed. The towers supporting the apron gantries are similarly clad in corrugated metal sheathing.

Each bridge span is controlled by four vertical screw lift mechanisms powered by horizontal worm gear shafts and electric motors. The lower end of each outer screw is pinned to large flat suspenders that link the screw in turn to the seaward ends of each bridge girder. The two inner screws are attached to a triangular steel yoke they is pinned in turn to the center girder of each bridge. The top of each worm screw extends through the roof of the gantry housing inside a steel sleeve. The screw mount assembly and turning gears are contained in a covered housing.

Originally, each apron span was also independently controlled by a spool and motor assembly located inside the legs of the apron gantry. This mechanism permitted separate movements of the apron, but was abandoned in favor of a hydraulic strut affixed to the end of the center bridge girder and to the top of the apron. The strut helped control movements of the apron during loading and unloading. The aprons feature three long rectangular toggle bars used for linking the bridge to the car float. Each bar rests inside a housing fitted with ratcheted teeth and is moved by hand by placing a long handle into the ratchet slots and using the handle like a fulcrum lever to move the toggle bar back and forth. The aprons are also equipped with capstans and rope at each corner to help pull the car float together with the apron. The entire apron gantry over Bridge # 12 has been removed.

Of the two extant control rooms, only the control room between Transfer Bridges #11 and #12 is currently operational. The control room rests on two girders connecting the bridge gantry tower to the apron gantry tower and features a shed roof of corrugated metal and sheathing of the same material. Each end of the control room overlooking the bridge is finished with a three-sided bay and fitted with industrial metal windows of twelve lights each. The widows provide the control operator with a clear view forward toward the car float, sideways toward the apron, and backwards toward the bridge. The control rooms contain duplicate control consoles for each bridge and massive matching electrical panels of polished slate, which contain the circuits, breakers, and switches used to operate the electrical machinery.

The lift bridge structure also includes a series of severely dilapidated timber piers and fenders.

Car Float Barge #16

Car Float Barge #16 is a steel hull barge built for the New York Dock Company by the Bethlehem Steel Company about 1957. The vessel hull is smooth welded with straight sides and raked ends and measures 290 feet long with a 41-foot beam. The deck is fitted with three stub-end tracks. Each rail is bolted to the deck with one end of the tracks mounted flush to one end to align with the corresponding tracks on the transfer bridges for loading and unloading. The stub end of each track terminates several feet back from the end of the barge and is fitted with steel bumpers. The center track is designed to turn out from the left track at the loading end. The frog of the turnout is mounted on the barge deck while the corresponding points are located on the apron of the transfer bridges. Four heavy steel keepers attached to the deck top at the loading receive the corresponding toggle bolts from the apron. A series of 15 manholes along the right side of the barge deck open into interior bulkheads. Numerous large steel cleats line each side of the barge and are used for lashing the barge to adjoining boats and wharves. There is no gunwale.

Car Float Barge #29

Car Float Barge #29 is a steel hull barge built for the NYNH&HRR around 1953, probably by the Bethlehem Steel Company. The vessel hull is smooth welded with straight sides and raked ends and measures 360 feet long with a 40-foot beam. The deck is fitted with three stub-end tracks. Each rail is bolted to the deck with one end of the tracks mounted flush to one end to align with the corresponding tracks on the transfer bridges for loading and unloading. The stub end of each track terminates several feet back from the end of the barge and is fitted with steel bumpers. The center track is designed to turn out from the left track at the loading end. The frog of the turnout is mounted on the barge deck while the corresponding points are located on the apron of the transfer bridges. Four heavy steel keepers attached to the deck top at the loading receive the corresponding toggle bolts from the apron. Numerous large steel cleats line each side of the barge and are used for lashing the barge to adjoining boats and wharves. There is no gunwale.

V. SOURCES OF INFORMATION

General Sources

The principal secondary sources on the history of the Pennsylvania Railroad include Burgess and Kennedy (1949), Middleton (2002), and the eight-volume "Triumph" series complied by Charles S. Roberts and David W. Messer. The latter contains a comprehensive, up-to-date history of the PRR and many illustrations, including views of Greenville Yard, Harsimus Cove, Bay Ridge, the NYBRR and other facilities in the Port of New York. A snapshot of the condition of railroad freight operations at the end of World War II appears in G. W. O'Connor's illustrated book on the railroads of New York. Jill Jonnes' account of the building of the Pennsylvania Railroad tunnels and station in Manhattan provides an overview of the political and social struggles encountered, while the report of the Tunnel Extension Project in the American Society of Civil Engineers' *Transactions,* offers a detailed account of the physical and legal work involved in the project.

Relevant PRR archives are housed in three key repositories: the Pennsylvania State Archives (Harrisburg), the Hagley Museum and Library (Wilmington), and the New Jersey State Archives (Trenton). Among the useful materials at the New Jersey State Archives are the 1910-11 railroad valuation field notebooks; the Interstate Commerce Commission's valuations records from 1913-1925; assessor's memoranda from the 1930s and 1940s; and numerous annual reports, maps, and plans, which chronicle changes to the railroad system in the New York metropolitan region.

There are a number of organizations and websites that specialize in rail-marine activities in the Port of New York. Two of particular note are the Rail-Marine Information Group and its publication, *Transfer* (http://www.trainweb.org/rmig/index.html) and Philip M. Goldstein's comprehensive website covering the industrial and offline terminal railroads of Brooklyn Queens, Staten Island, The Bronx, and Manhattan (http://members.trainweb.com/bedt/Industrial Locos.html).

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VI. ATTACHMENTS

ATTACHMENT A: FIGURES

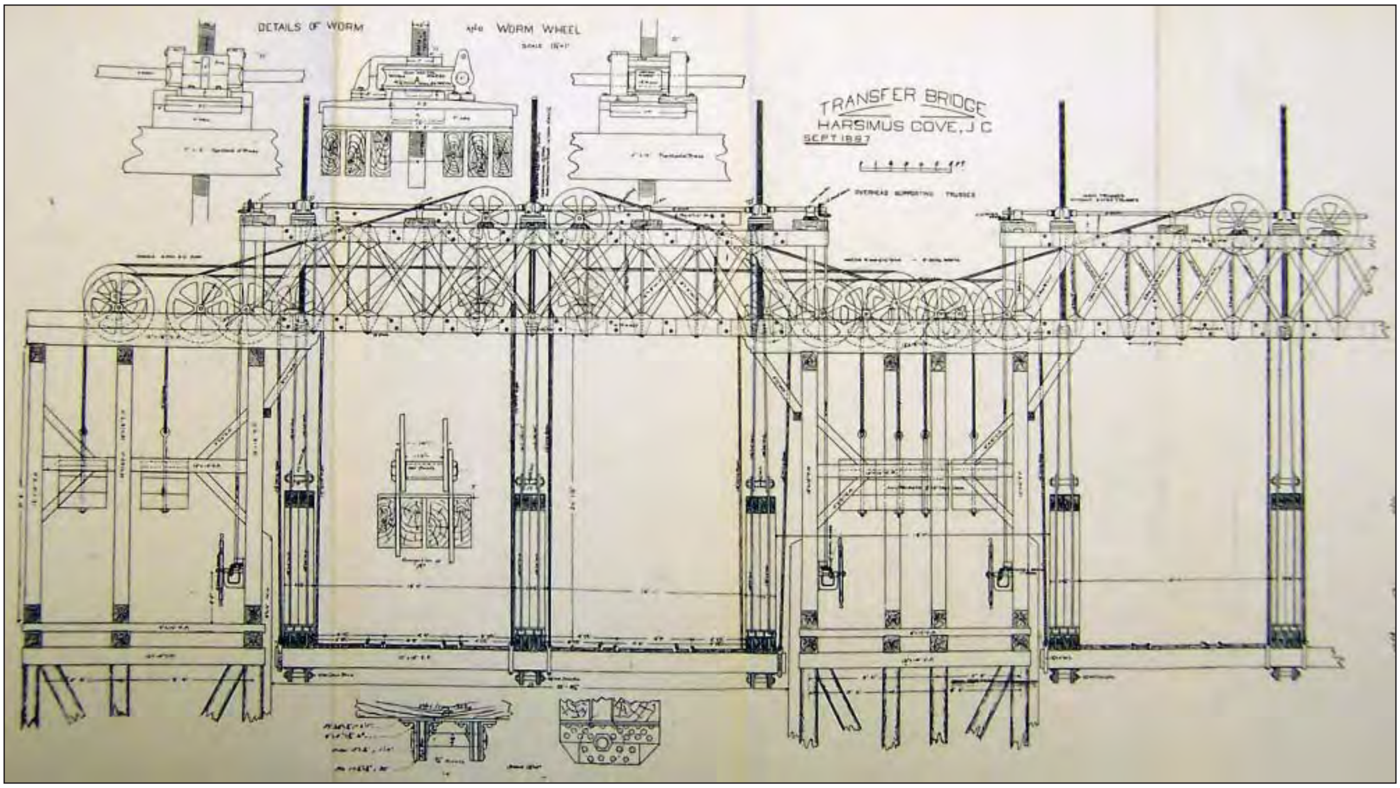


Figure 1

Harsimus Cove Transfer Bridge Gallows Front Elevation, 1888. The design contains the essential components used later at Greenville Yard, including an overhead gantry frame, counterweight system, and lift screws (Source: Bensel 1888).

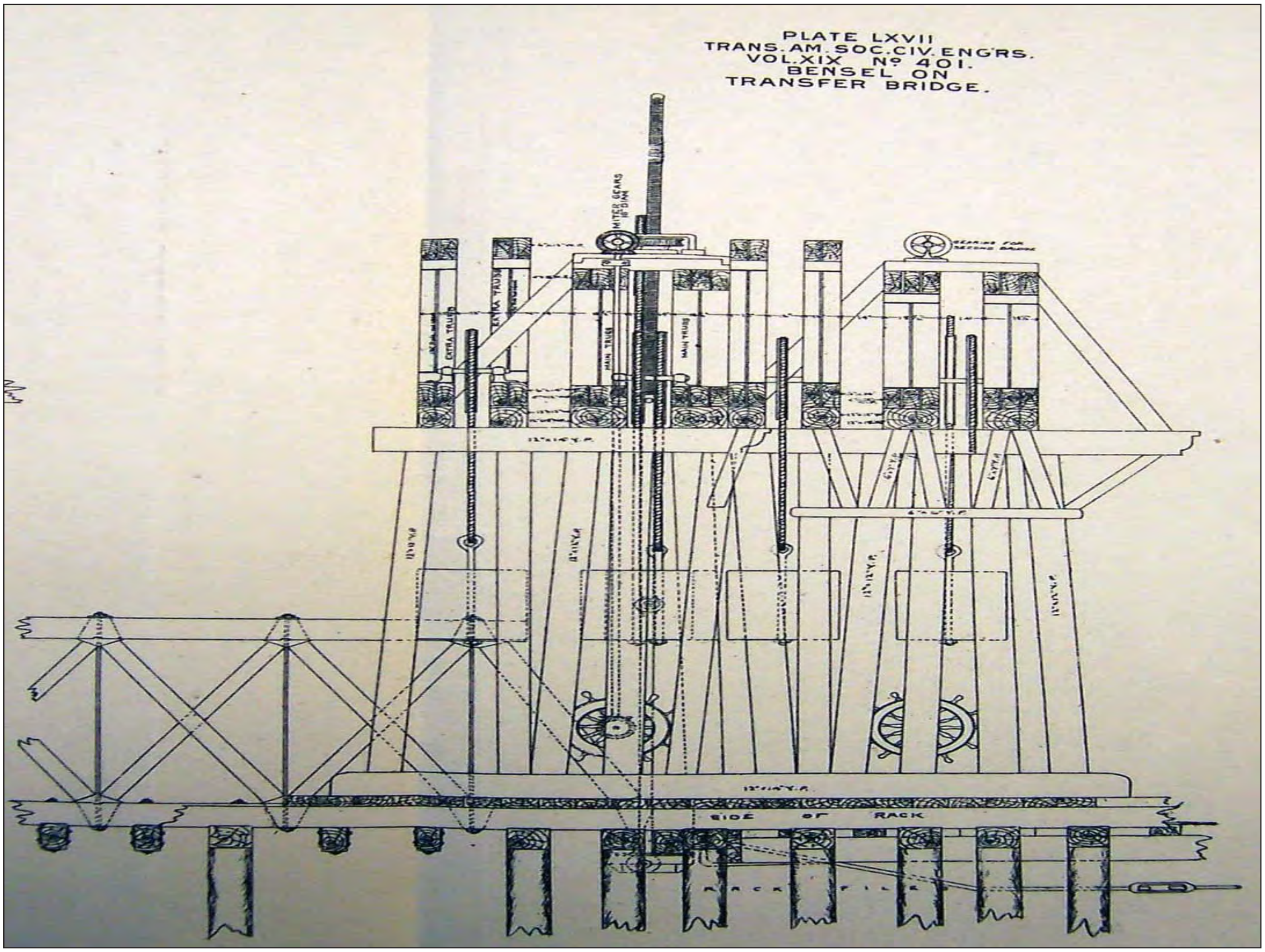


Figure 2

Harsimus Cove Transfer Bridge Gallows, Side Elevation, 1888. The key innovation was the use of separate counterweighted apron without a pontoon. The single gallows structure supported both the bridge and the apron (Source: Bensel 888).

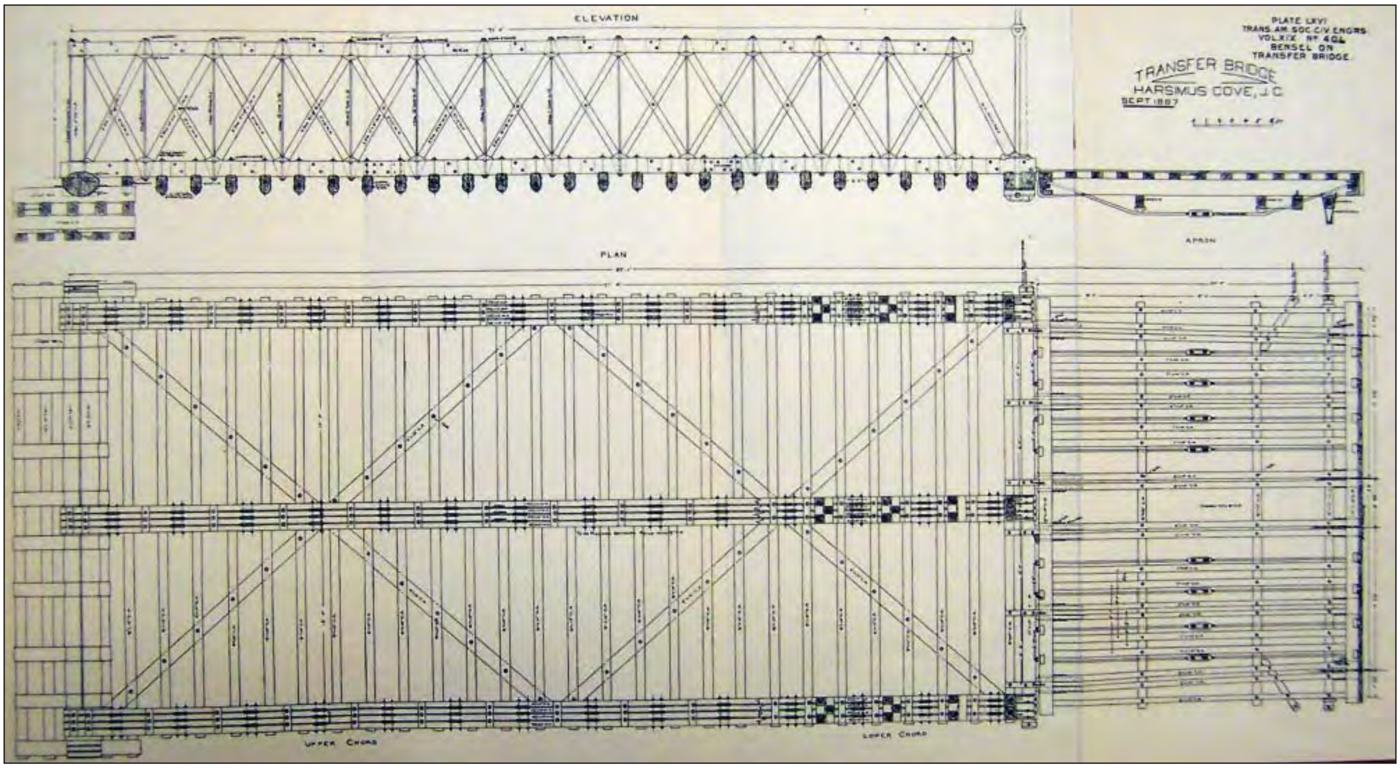


Figure 3

Harsimus Cove Transfer Bridge and Apron, Elevation and Plan, 1888. The timber structure consisted of a truss bridge and deck apron without pontoon (Source: Bensel 1888).

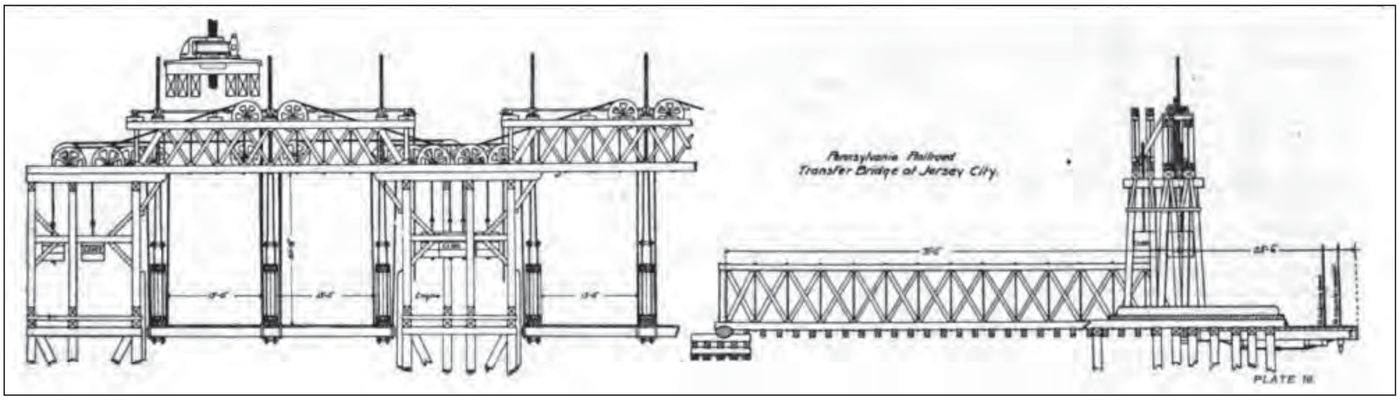


Figure 4

Harsimus Cove Transfer Bridge Elevation , 1901. The bridge design was widely circulated in the railway press (Source: Railway Age 1901).

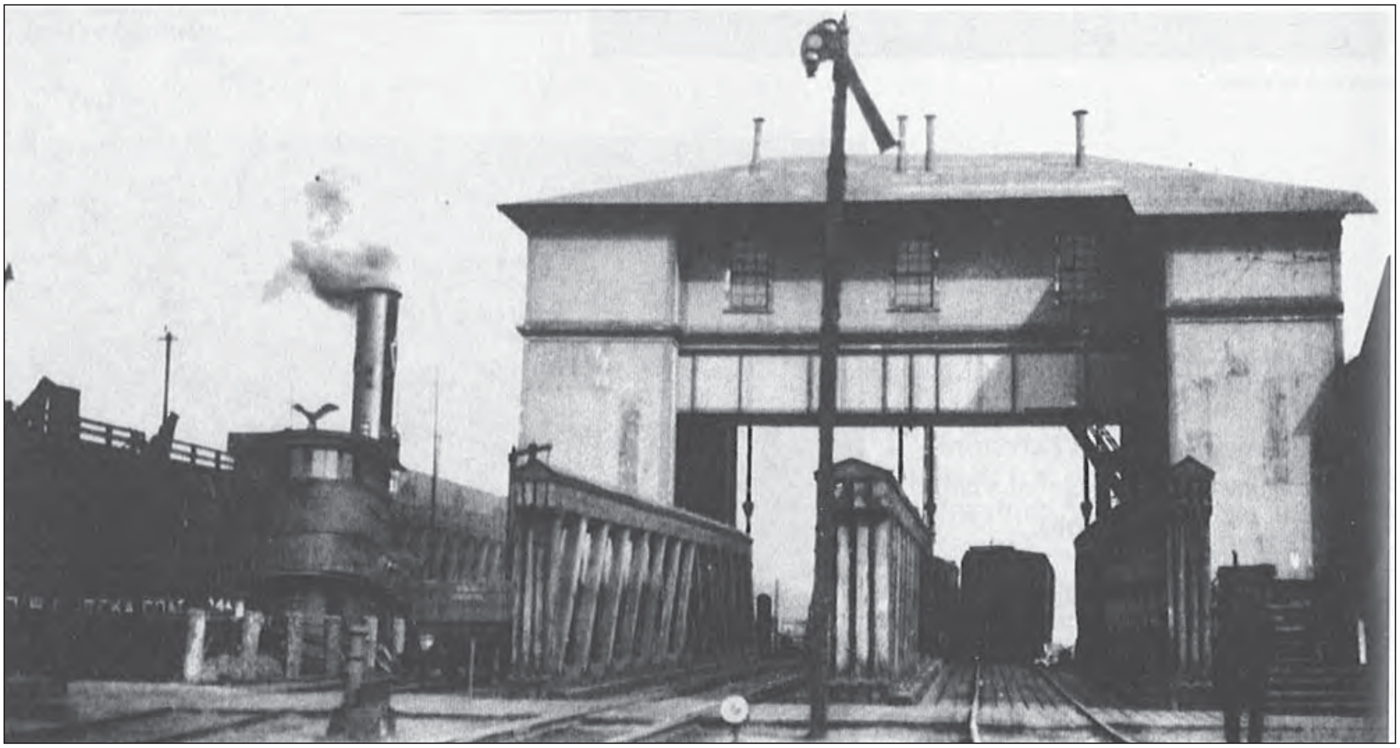


Figure 5

Harsimus Cove Transfer Bridge No. 7, 1917. Later transfer bridges at Harsimus Cove employed the designs utilized at Greenville Yard. Note the steel girder construction and the presence of four lift screws in the roof (Source: Messer and Roberts 2002: 218).

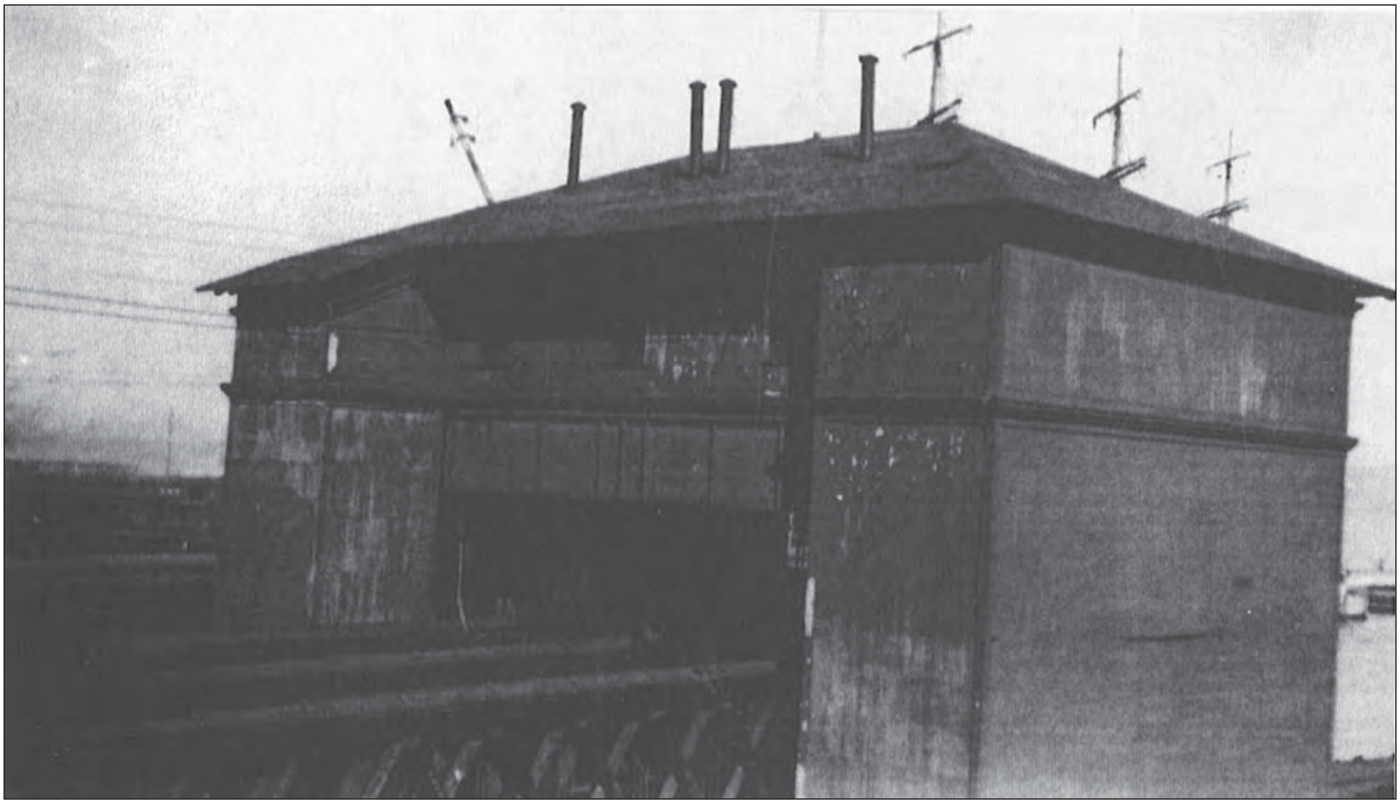


Figure 6

Harsimus Cove Transfer Bridge No. 2 ½, 1917 (Source: Messer and Roberts 2002: 218).

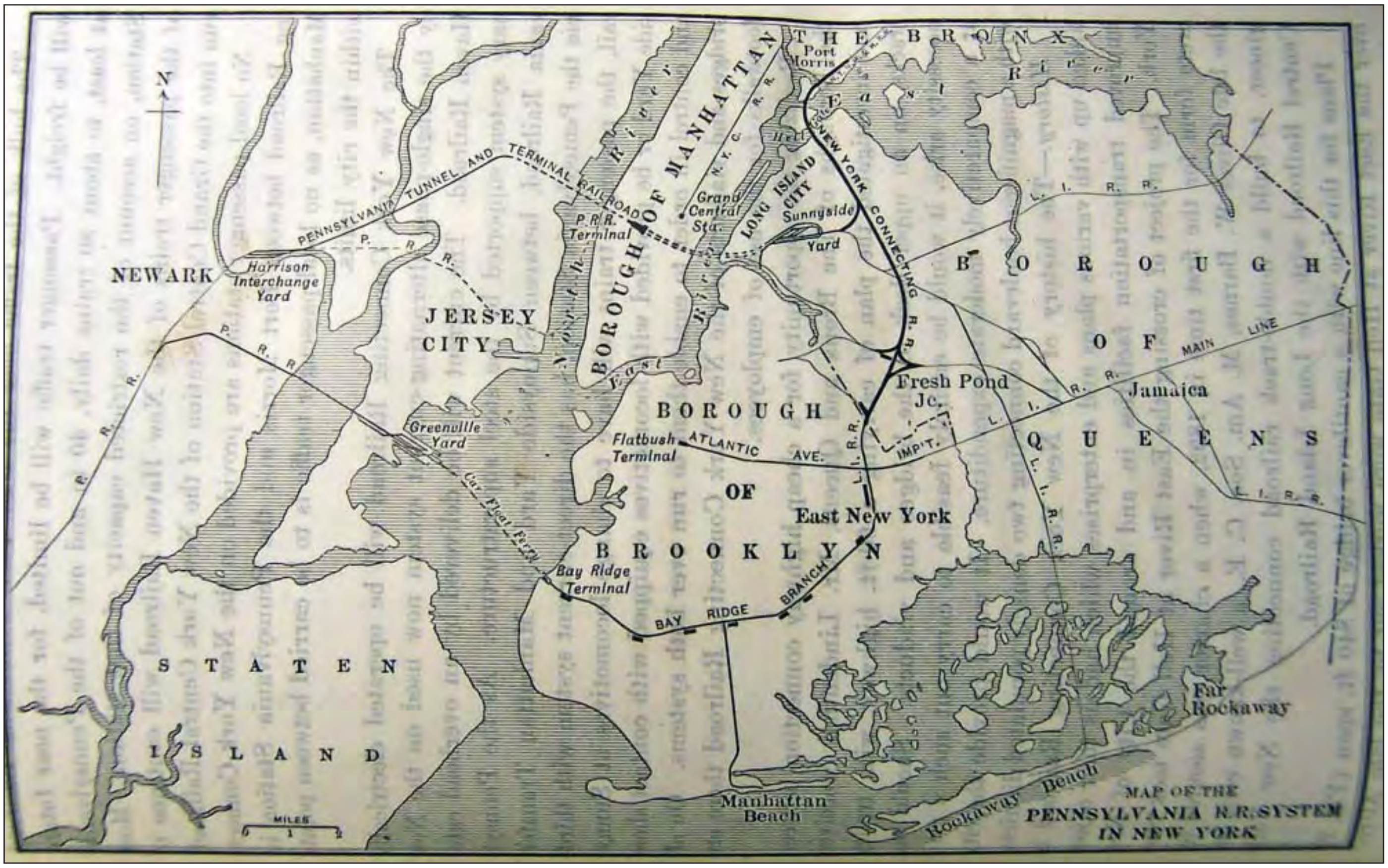


Figure 7

Map of New York Tunnel Extension Project, 1910. The map depicts the railroad's comprehensive plan for entering Manhattan and integrating its passenger and freight operations with connections to Long Island and New England (Raymond 1910: 5).

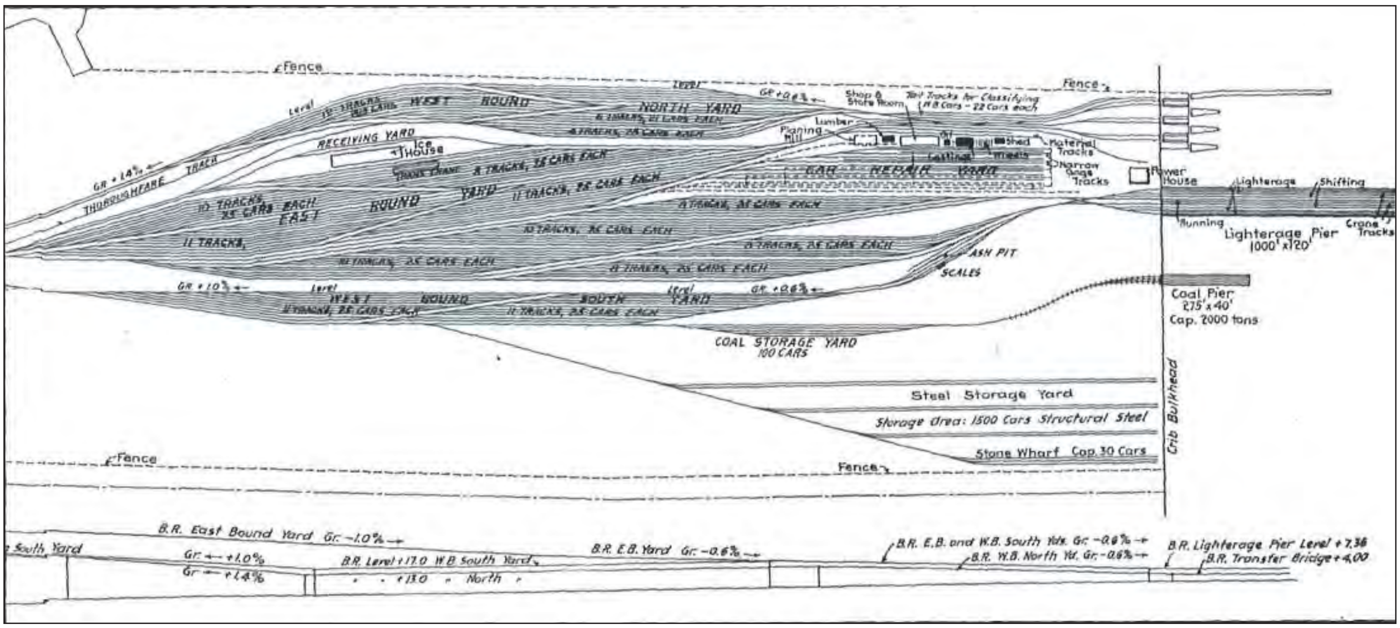


Figure 8

Plan, Greenville Yard, 1910. As originally designed, the yard included three transfer bridges at the northern end of the yard (Source: Railroad Gazette 1905: 239).

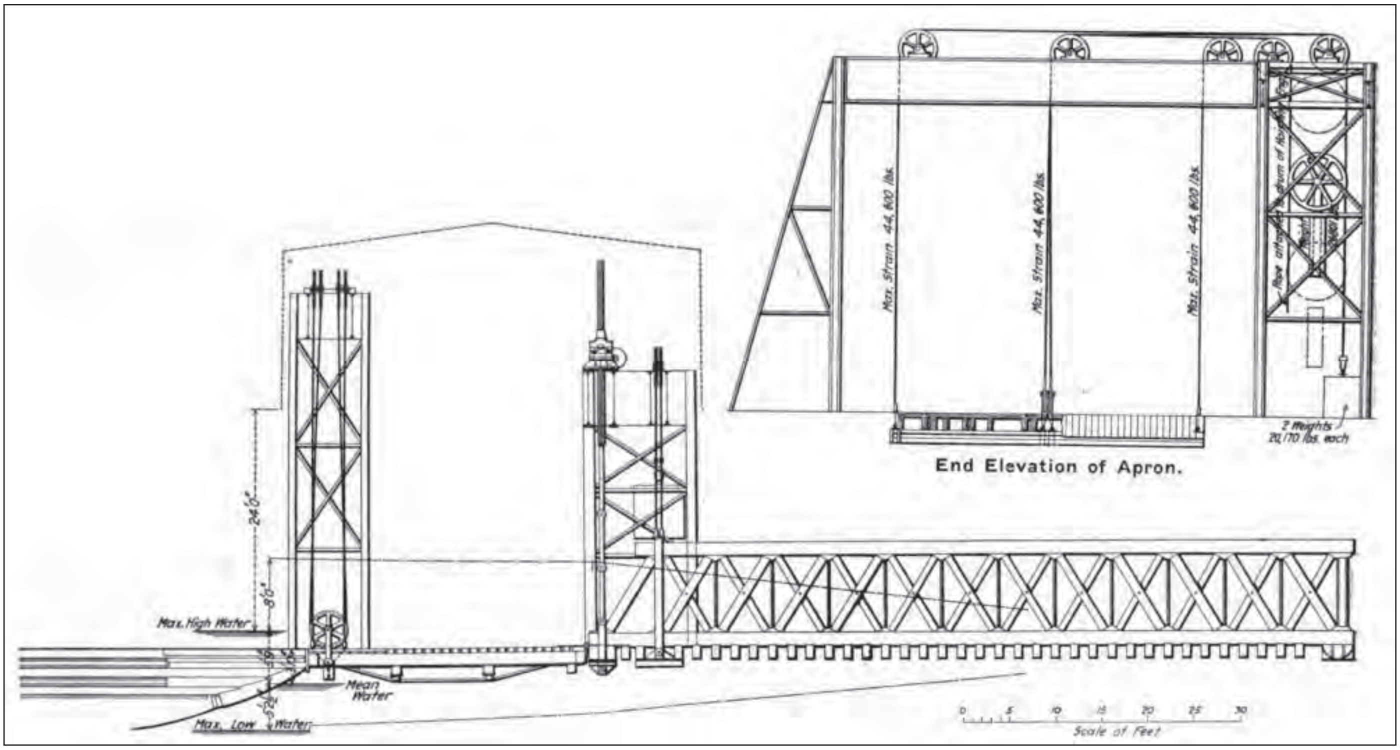


Figure 9

Greenville Yard Transfer Bridge Gantry Front and Side Elevations, 1905. The Greenville Yard bridges separated the gantry into two distinct structures: one for the bridge and one for the apron (Source: Railroad Gazette 1905: 240).

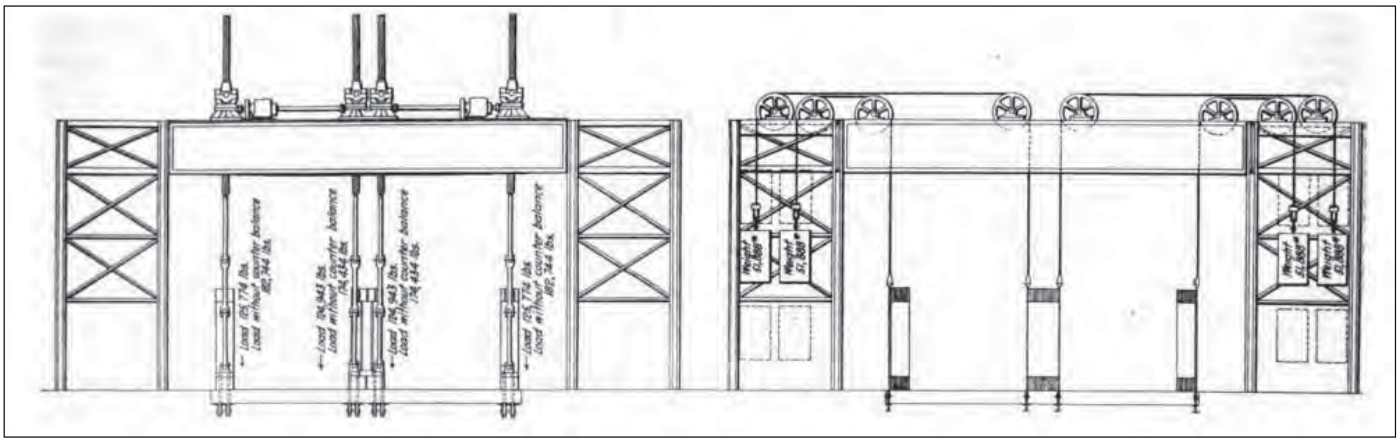


Figure 10

Greenville Yard Transfer Bridge Gantry Elevation, 1905. The bridge gantry contained two components: the bridge counterweight system and the electrified lift screw mechanism (Source: Railroad Gazette 1905: 240).

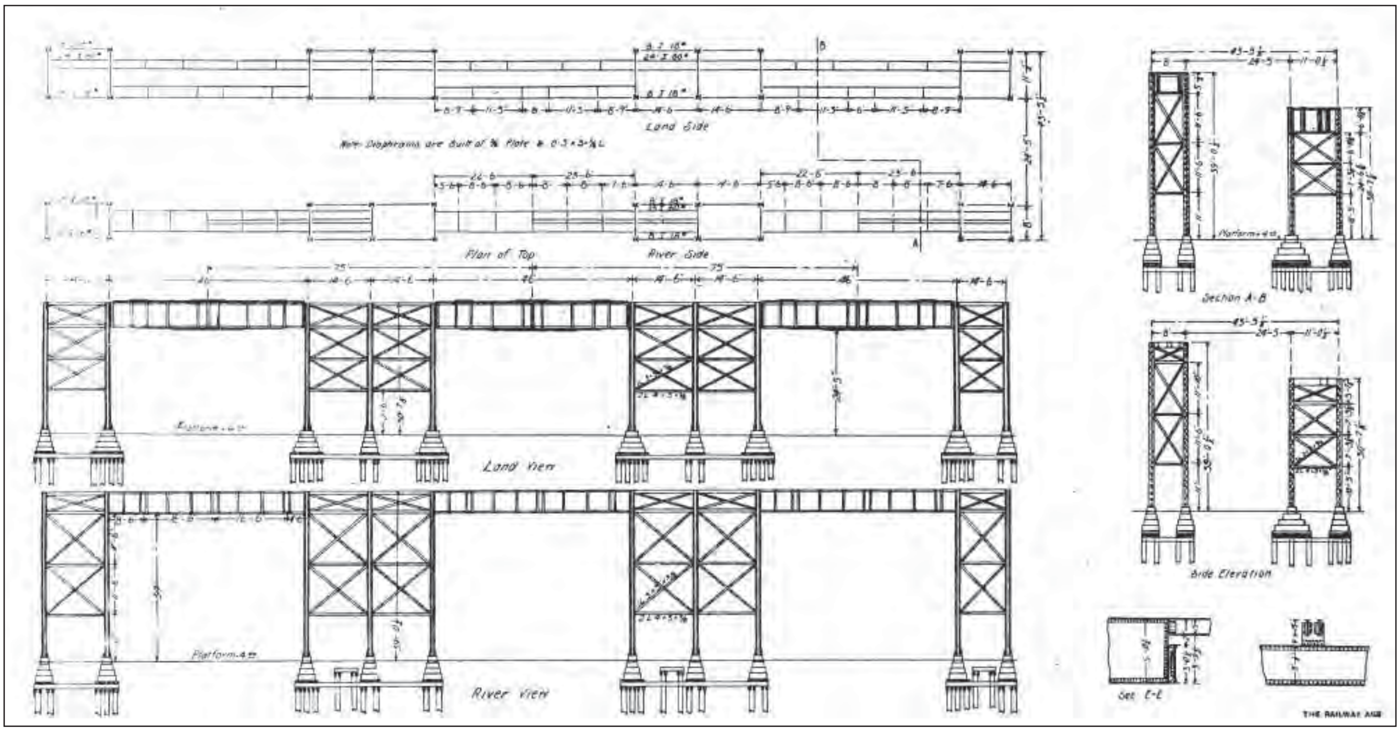


Figure 11

Greenville Yard Transfer Bridge and Apron Gantry Framing Plan, 1905. The Greenville Yard bridges were built of steel and housed within a wooden structure (Source: Railway Age 1905: 400).

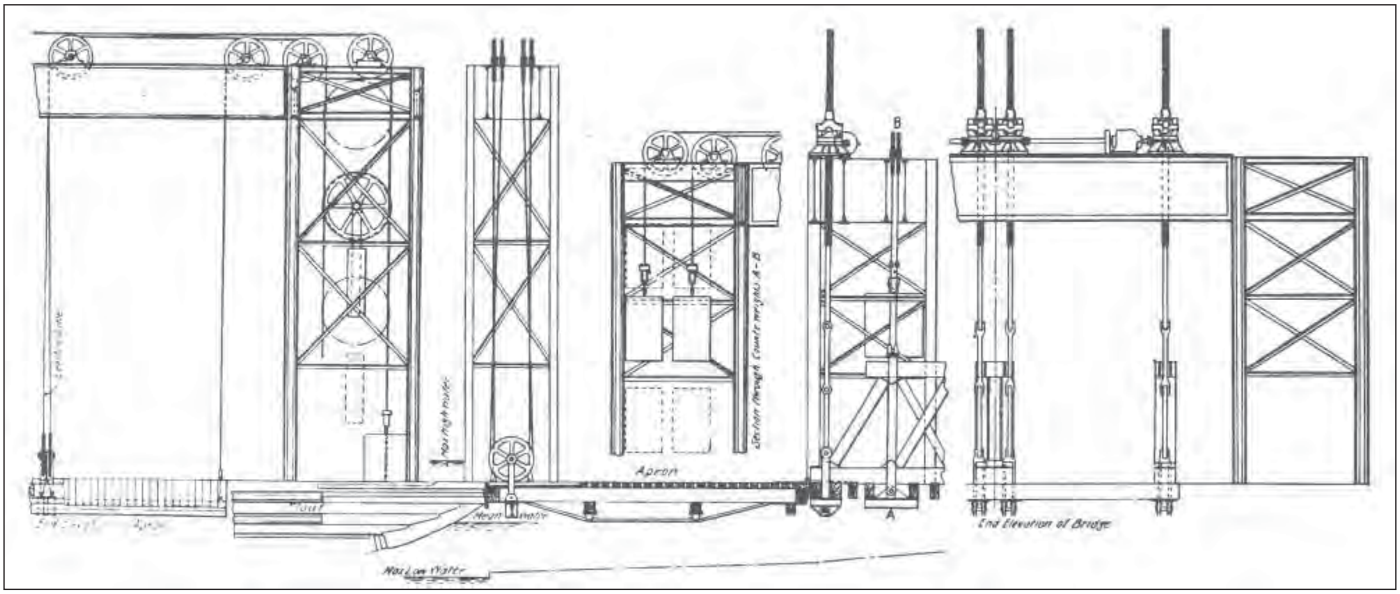


Figure 12

Detail, Greenville Yard Transfer Bridge and Apron Gantry Framing, 1905
(Source: Railway Age 1905: 401).

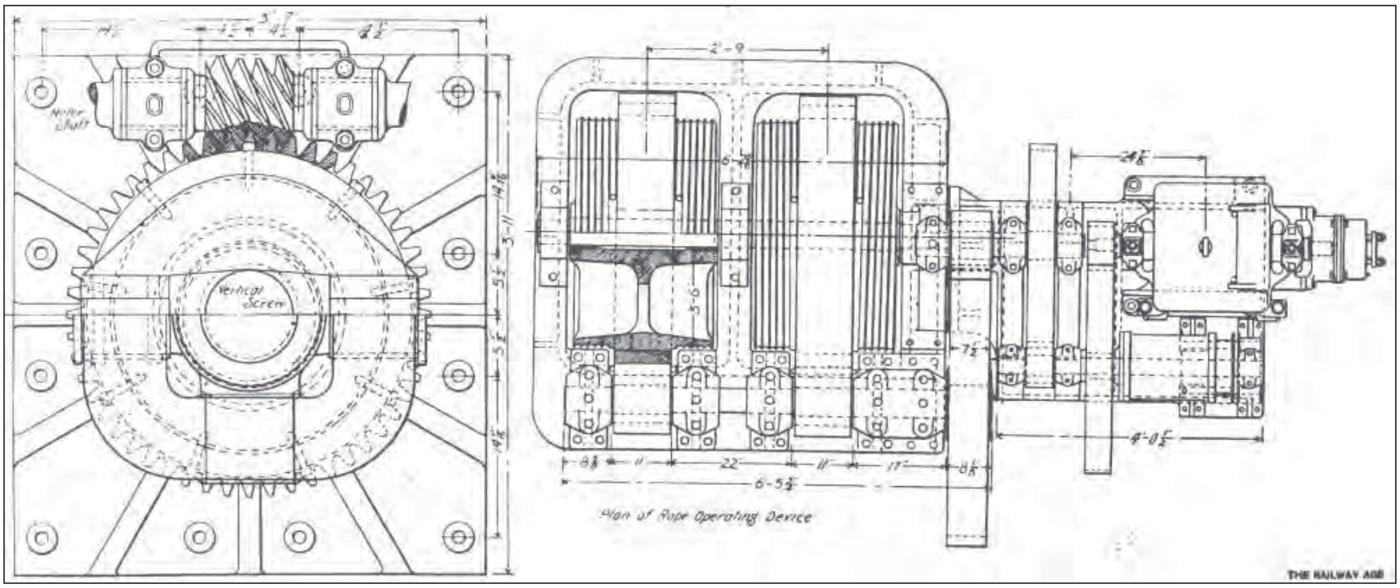


Figure 13

Detail, Greenville Yard Transfer Bridge Screw Lift Mechanism, 1905 (Source: Railway Age 1905: 401).

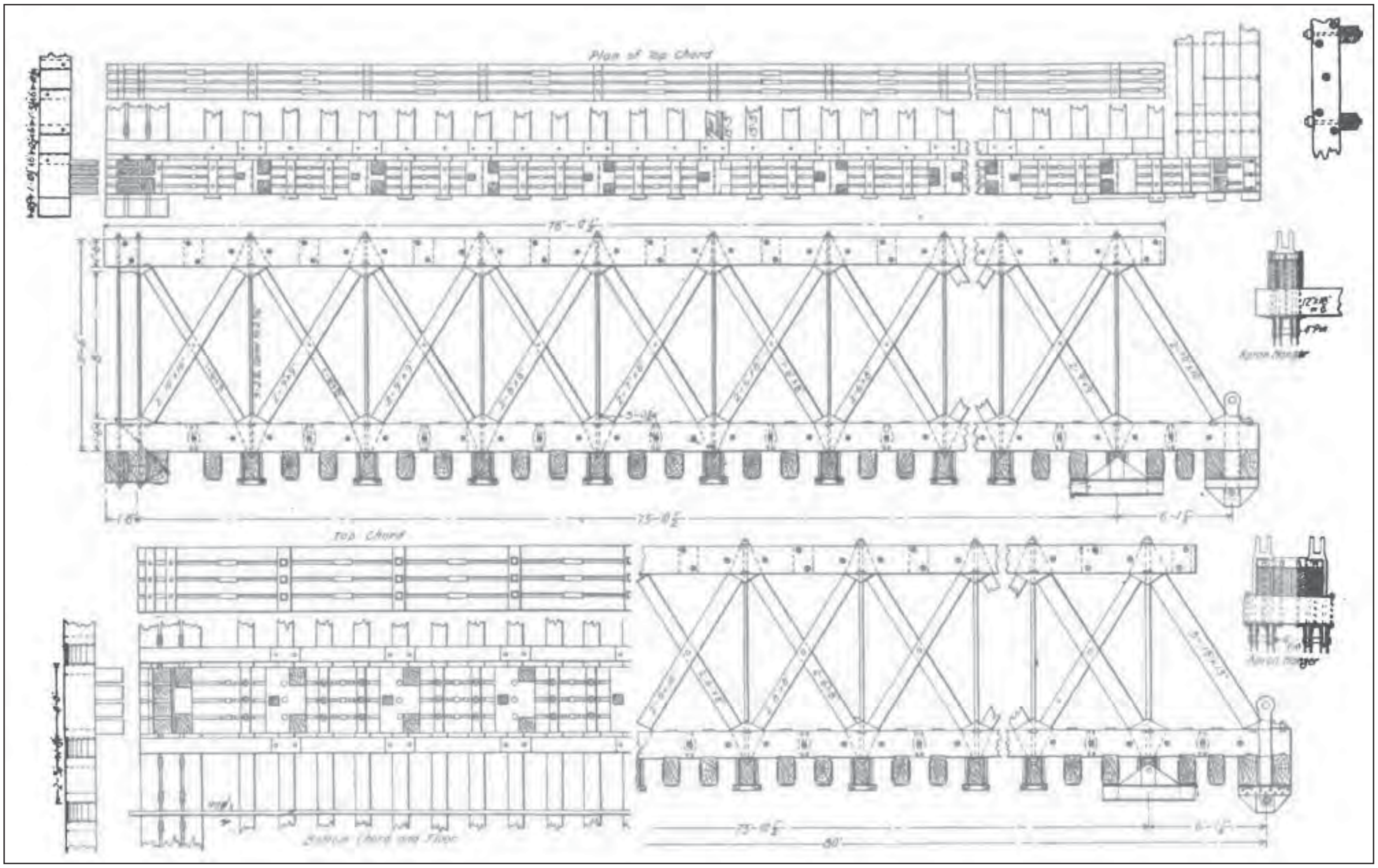


Figure 14

Greenville Yard Transfer Bridge Truss Plan and Elevation, 1905. While the bridge gallows were made of steel, the bridge and apron were constructed in wood
(Source: Railway Age 1905: 402)

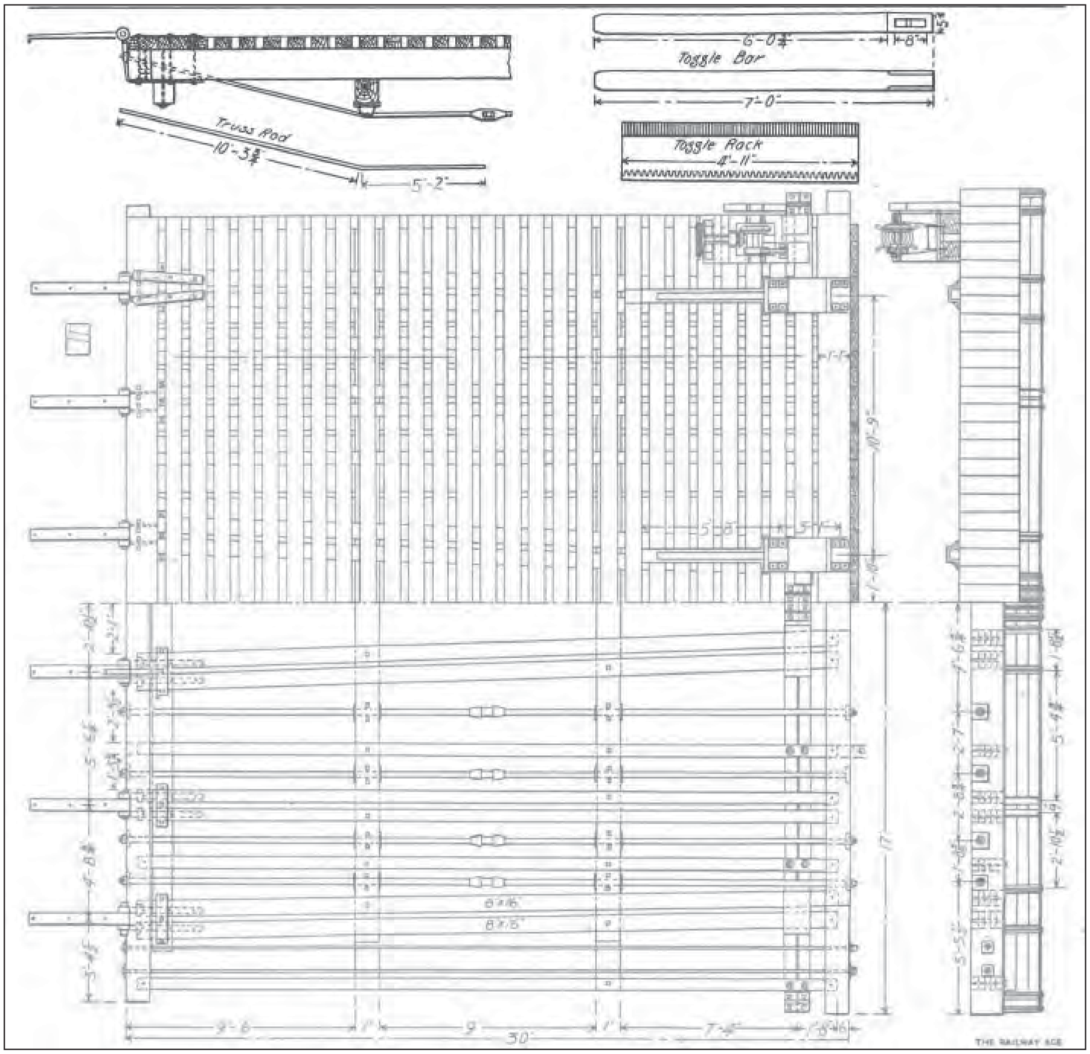


Figure 15

Detail, Greenville Yard Transfer Bridge Apron Plan and Elevation, 1905
(Source: Railway Age 1905: 399).

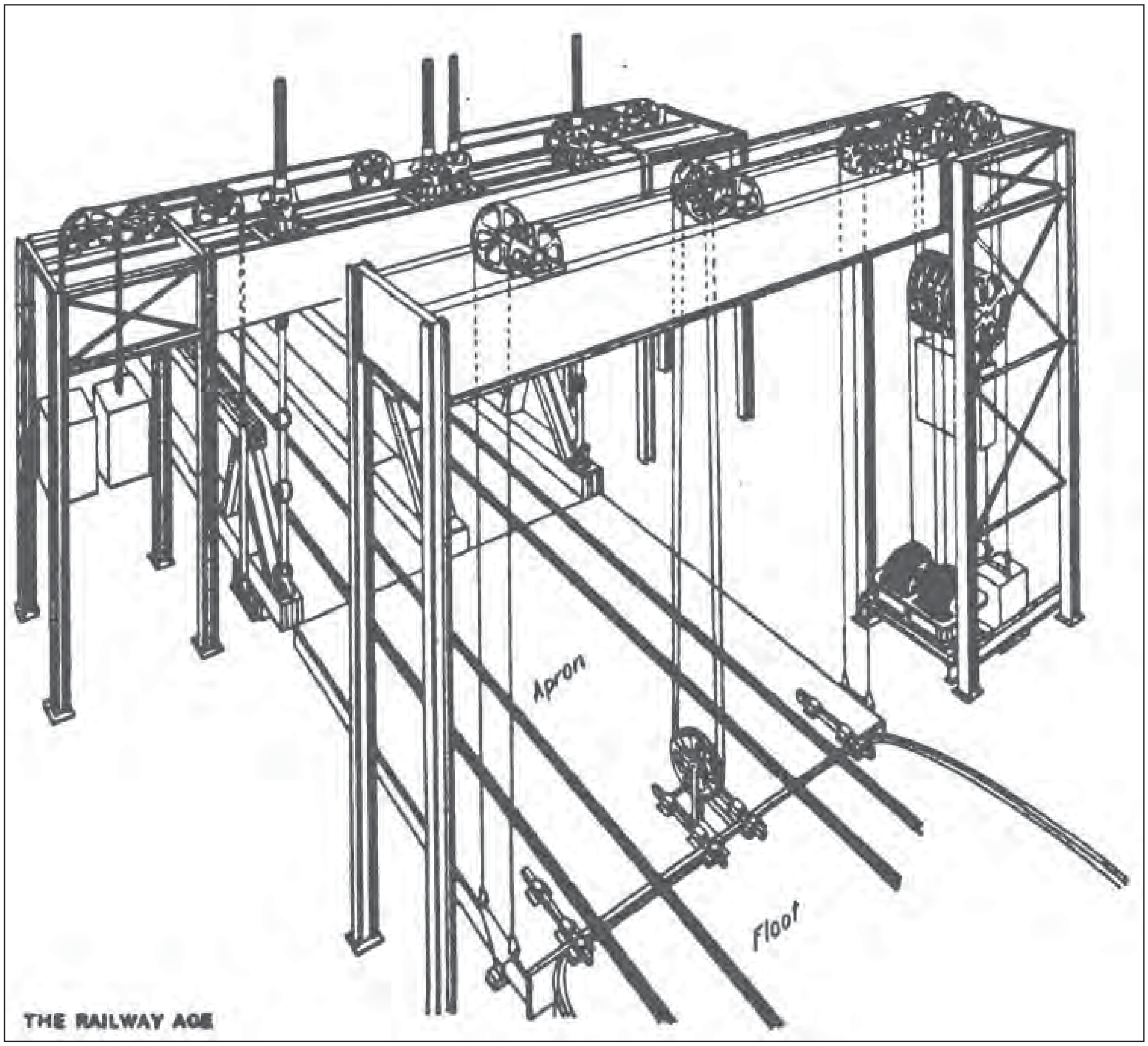


Figure 16

Greenville Yard Transfer Bridge Axonometric View, 1905. The drawing shows the relationship between the bridge, apron, and car float. Note the apron lift motors located at the base of the apron gantry tower (Source: Railway Age 1905: 403).

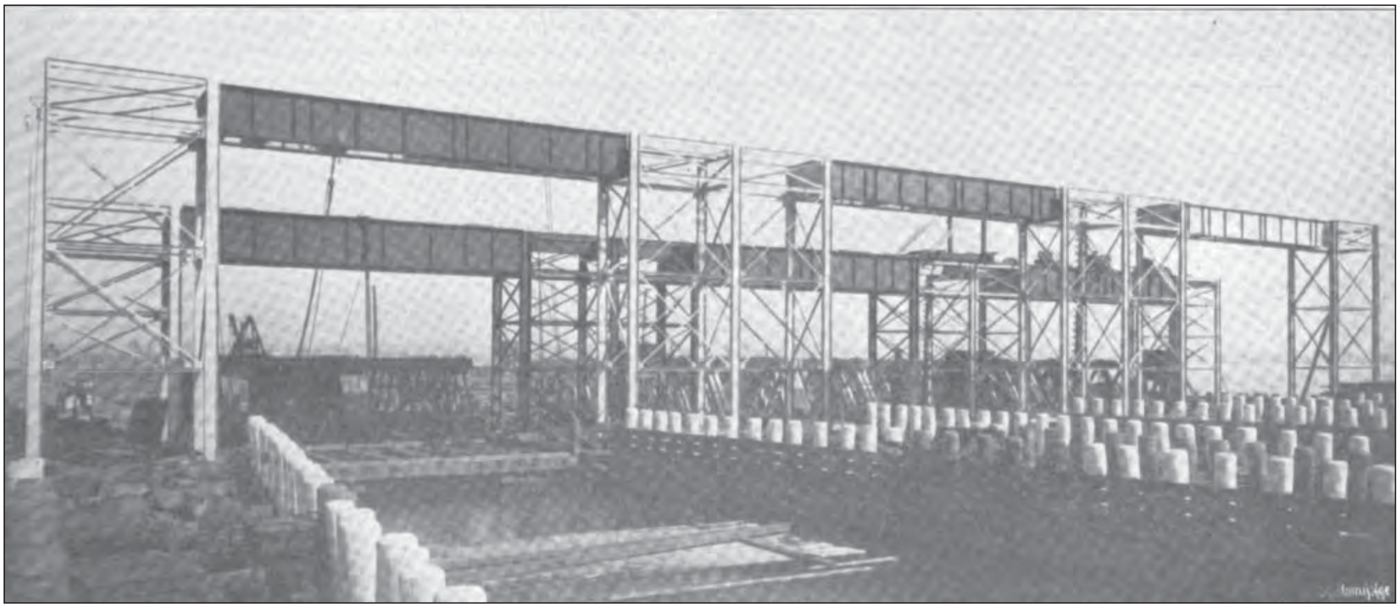


Figure 17

Greenville Yard Transfer Bridge Under Construction, circa 1905. The steel legs and gantry girders are clearly depicted. The apron gantry (foreground) is taller to accommodate the wider arc of the apron as it moves up and down (Source: Railway Age 1905: 397).

Figure 18

Exterior Landward View, Greenville Yard Transfer Bridge, 1905. The entire structure was enclosed in a wooden housing. Note the timber truss bridges, which are also sheathed in wood siding (Source: Railway Age 1905: 397).

Figure 19

Exterior Seaward View, Greenville Yard Transfer Bridge, 1905. Note the loaded three-track car float in the right berth (Source: Railway Age 1905: 402).

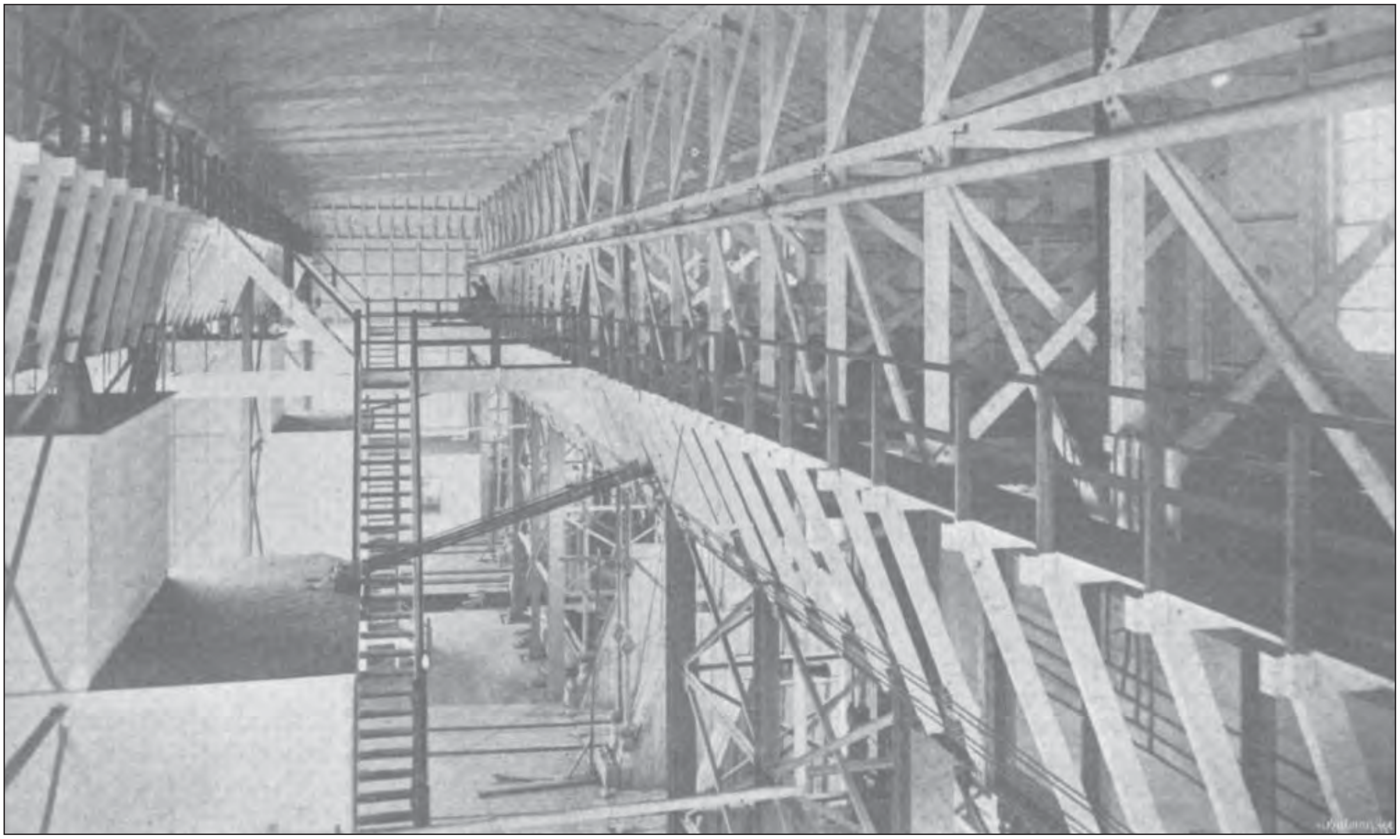


Figure 20

Interior, Greenville Yard Transfer Bridge, 1905. The bridge gantry is right; the apron gantry and control rooms are left (Source: Railway Age 1905: 398).

Figure 21

Greenville Yard Under Construction, 1905. The view is taken from the top of the hump at the western (inland) end of the yard (Source: Railway Age 1905: 398).

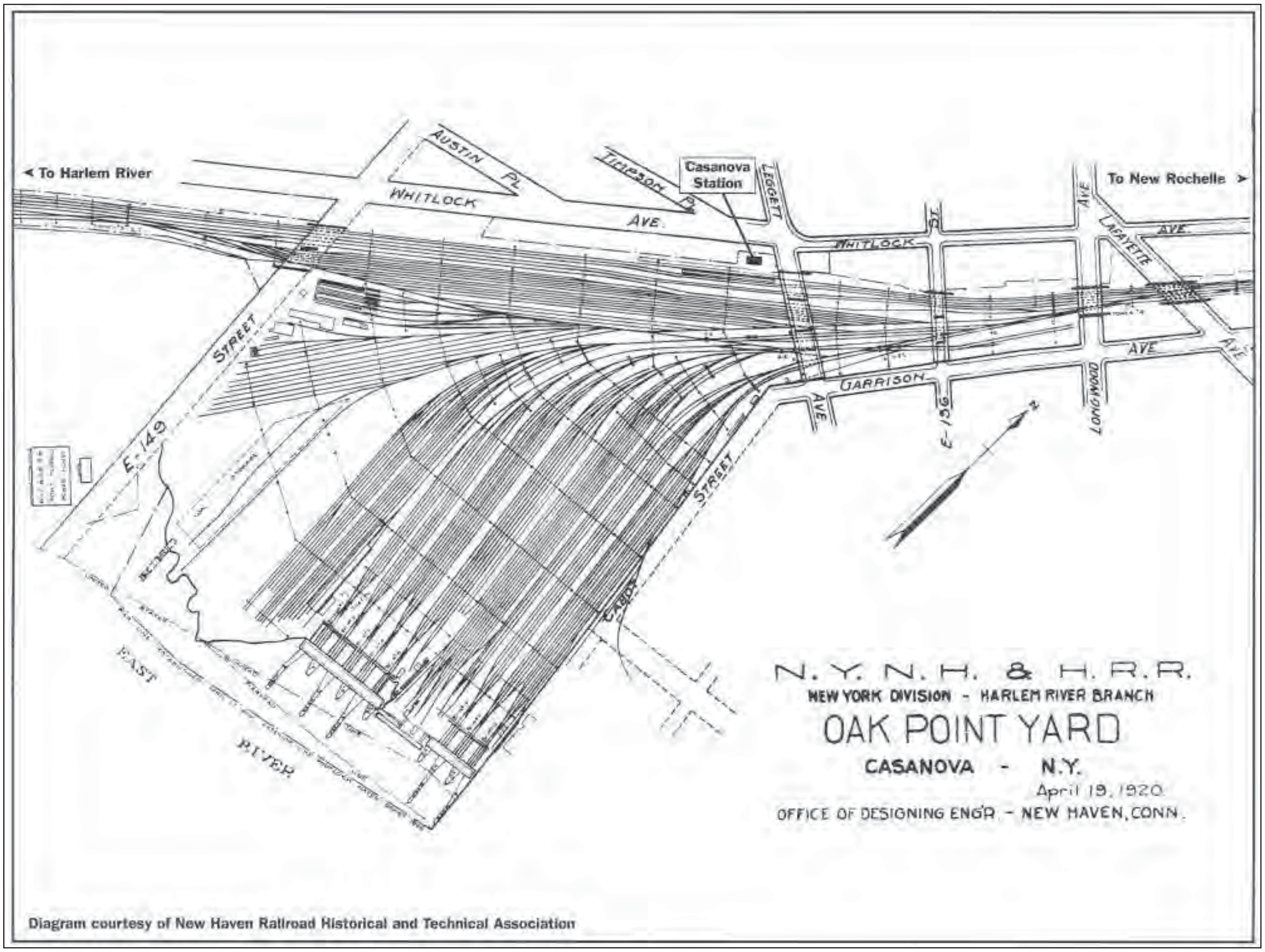


Figure 22

Oak Point Terminal, NYNH&HRR, 1920. Oak Point served as the principal interchange place for all Greenville Yard car float traffic until completion of the New York Connecting Railroad bridge at Hell Gate and the opening of the Bay Ridge terminal (Source: Strum and Thom 2006: 83).

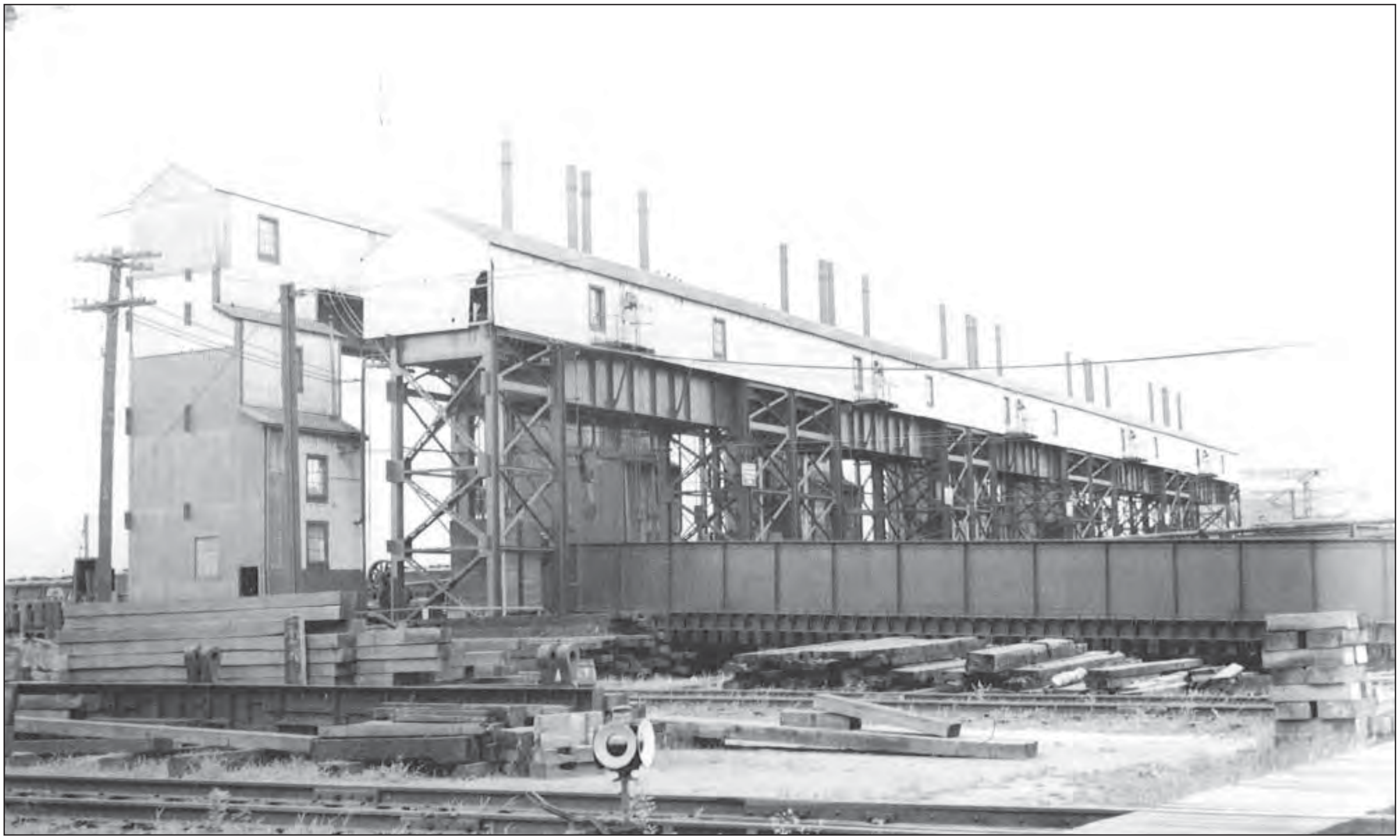


Figure 23

Oak Point Transfer Bridges, undated. The NYNH&HRR transfer bridges at Oak Point were identical to the structures erected at Greenville Yard (Source: Strum and Thom 2006: 101).

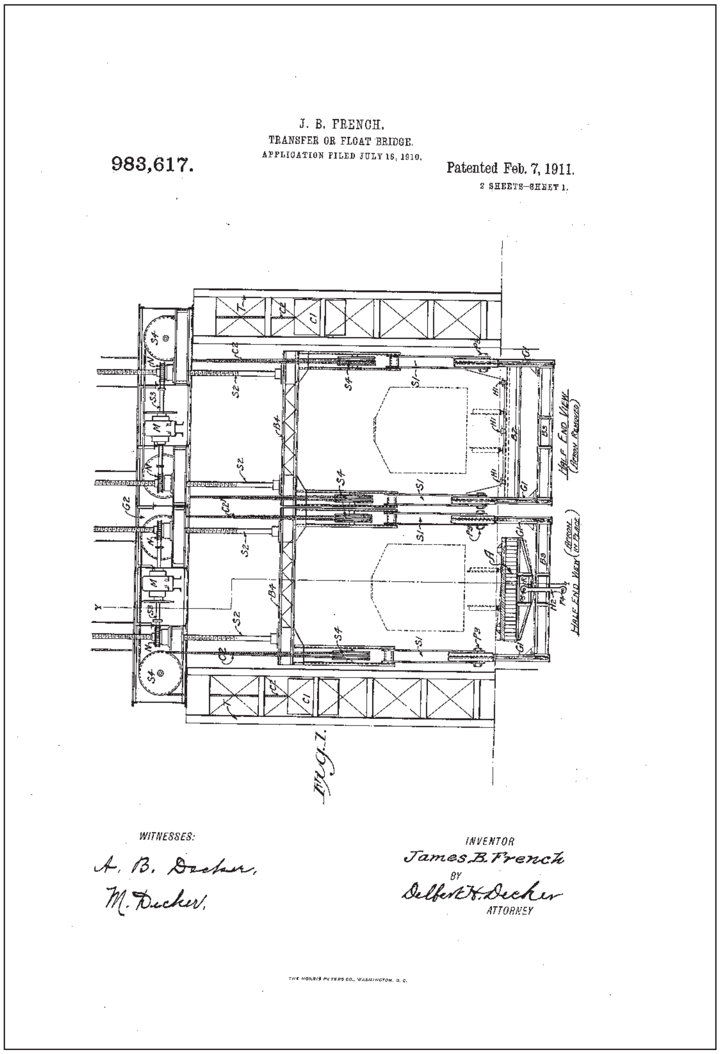


Figure 24

J. B. French Transfer Bridge Patent Front Elevation, 1910.
The French patent consolidated the apron into a steel bridge structure, eliminating the need for the separate bridge gantry (Source: United States Patent Office 1911).

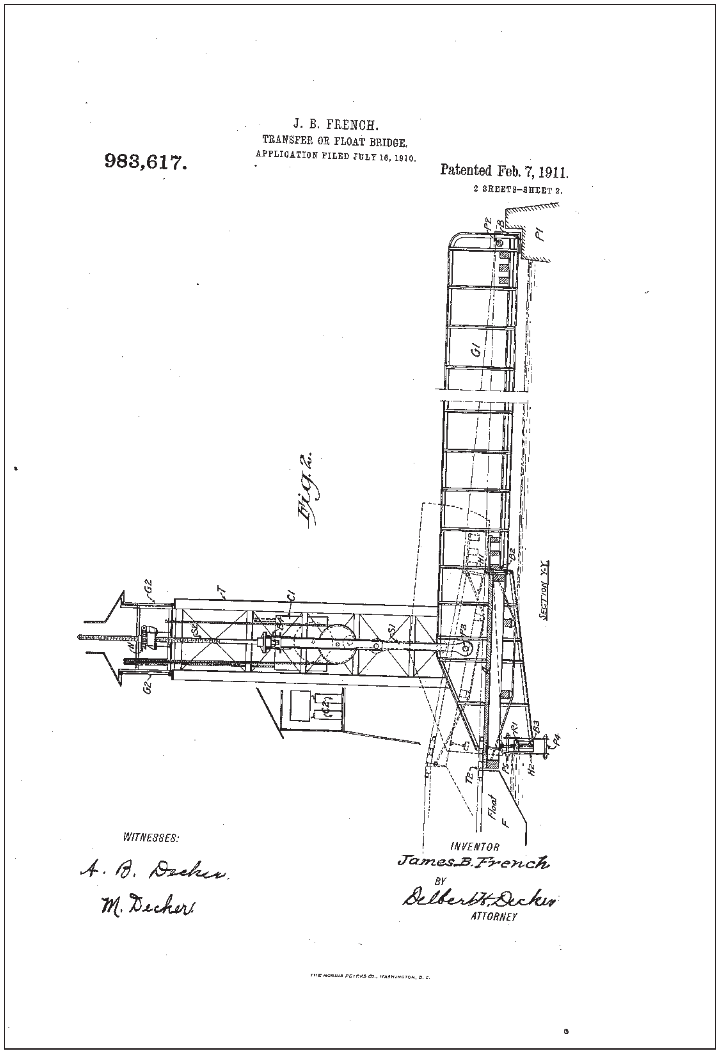


Figure 25

J. B. French Transfer Bridge Patent Side Elevation, 1910
(Source: United States Patent Office 1911).

UNITED STATES PATENT OFFICE.

JAMES B. FRENCH, OF JAMAICA, NEW YORK.

TRANSFER OR FLOAT BRIDGE.

983,617. Specification of Letters Patent. Patented Feb. 7, 1911.

Application filed July 16, 1910. Serial No. 572,362.

To all whom it may concern:

Be it known that I, JAMES B. FRENCH, a citizen of the United States, residing at Jamaica, in the county of Queens and State of New York, have invented certain new and useful Improvements in Transfer or Float Bridges, of which the following is a specification.

This invention relates to the construction and operation of bridges for the transfer of railroad cars from floats to land and from land to floats, where the elevation of the floats is subject to variation on account of tides and conditions of loading.

In the accompanying drawings a suspended transfer bridge embodying this invention is illustrated.

Figure 1 is an end view with one of the overhead girders removed to show the arrangement of the operating machinery. Fig. 2 is a longitudinal section taken along line Y—Y in Fig. 1. In these drawings the bridge is shown in two parts, one for each track, but it is to be understood that these two parts may be combined and built as one.

Fig. 2 shows the inner or shore end of the main girders of the bridge G_1 pivoted on the pin P_2 carried by the bolster B resting on a fixed pier P_1: and the outer or "water" end, carried by the suspenders S_1 and screws S_2 to the overhead girders G_2 and thence to the towers T which rest on fixed foundations. This figure also shows a longitudinal section of the apron A supported at its inner or "shore" end by the hinges H_1 carried by the floorbeam B_2 connected at each end to the main girders G_1: and at its outer end supported either by the end floorbeam B_3 through the rocker bearing R_1 or during operation, by the end of the float F by means of the toggle bars T_2. The controllers C_2 for the control of the operating machinery appear in Fig. 2 but the latter is more clearly shown in Fig. 1.

In Fig. 1, one-half of the bridge is shown with the apron A in place, and the other half is shown with the apron removed. This figure also shows the counterweights C_1 attached by means of the cables C_2, sheaves S_4, suspenders S_1 and pins P_3 to the main girders G_1. The purpose of these counterweights is to balance the major part of the dead load reaction in suspenders S_1 due to the weight of the bridge and the apron, and thereby to reduce the load carried by the screws S_2 and the wear on the operating machinery: but their use is not necessary in all cases. Fig. 1 also shows the motors M which raise or lower the outer end of the bridge by actuating the shafts S_3 and, by means of worm and worm-wheel connection, turning the nuts N on the screws S_2, which are connected, through the cross beams B_4, to the suspenders S_1.

The outer end of the apron A, after it is connected to the float, is free to move vertically in the arc of a circle, of which the axis of the hinges H_1 is the center, independently of any movement of the girders G_1. This independent vertical movement is limited in the downward direction when the rocker bearing R_1 strikes the top of the end floorbeam B_3 and in the upward direction when the lower pin P_4, in the hanger H_2, strikes the bottom of the same end floorbeam B_3, the upper end of the hanger H_2 being connected to the outer end of the apron by the pin P_5. It is to be noted that by making the hanger H_2 shorter, the movement of the outer end of the apron, independent of the girders G_1, can be reduced to as small limits as desired: that by making the hanger H_2 longer, this movement can be given a greater range; and that by removing the hangers altogether, all restraint to independent upward movement is taken away, while downward movement is still limited by the floorbeam B_3.

The raising or lowering of the water end of the girders G_1 by means of the screws S_2, motors M, etc., raises or lowers the hinges H_1 which hold the inner or shore end of the apron in a constantly fixed relation to the main girders G_1 and therefore the relative position of the outer end of the apron, (when toggled to the float) and the end floor-beam B_3 will depend on the relative speeds at which the float and bridge rise or fall during operation, it being understood that when cars are moved from floats to land, the floats rise as the loads go off the float and onto the bridge and vice versa when the cars are moved from the land to the floats, the latter sink in proportion to the load they receive. It therefore follows that if the motors and operating machinery are made sufficiently powerful to raise or lower the outer end of the bridge as fast as the float rises or falls during unloading or loading operations, the relative position of the rocker bearing R_1 and the floorbeam B_3 can be fully controlled at all times by the

Figure 26

J. B. French Transfer Bridge Patent Explanatory Text, 1910 (Source: United States Patent Office 1911).

operator, in which case telltales could be provided showing continuously the relative positions of these parts. For the method of operation just described the hanger H_2 would be omitted and the load transferred to the end of the float, through the toggle bars T_2, need never exceed one-half of the weight of the apron and the live load resting on it. In cases, however, where it is not considered necessary or desirable to make the motors and operating machinery sufficiently powerful to raise or lower the bridge as fast as the float rises or falls during loading and unloading operations, the addition of the hangers H_2 makes it possible to confine the movement of the outer end of the apron within any limits desired. It is also to be noted that the rocker bearings R_1, at the outer ends of the apron A, deliver the load into the floorbeam B_3 centrally and thus prevent transverse torsion in the main bridge, regardless of the transverse listing or tilting of the floats to which the aprons are attached, all torsion of this sort being taken up in the aprons, which are made flexible on that account.

The gist of the invention resides primarily in the structure of the outer end of the bridge and in the manner of supporting the outer end of the apron portion thereof. Through this invention also, the independent towers, cables, counterweights and extra operating devices, now commonly used, for the support and operation of the outer end of the apron may be dispensed with, while all the advantages of flexible aprons are retained and their disadvantages largely eliminated.

It is not intended to definitely describe the special construction of the parts enumerated as they can be greatly varied without affecting the general arrangement and relation of parts herein contemplated.

Having thus described my invention, I claim as new and wish to secure by Letters Patent:—

1. In a transfer bridge hinged at its shore end and consisting of a single span of girders, the combination with the inner portion of the floor fixed to the girders, of the outer portion of the floor hinged to the inner portion to form an apron, and a loose connection between the free end of said apron and the outer end of the span permitting within limits an independent movement of the free end of said apron.

2. In a transfer bridge at its outer end, an apron or platform having its inner end attached to the bridge by hinges and its outer end, when not attached to a float, resting centrally by means of a rocker bearing on an end floor-beam built as part of the main bridge, substantially as described.

3. In a transfer bridge with apron and end floorbeam, a hanger or link attached at its upper end to the outer end of the apron and shaped at its lower end to engage the end floorbeam of the bridge and limit the upward movement of the outer end of the apron relative to the bridge, substantially as described.

In testimony whereof I have affixed my signature in presence of two witnesses.

JAMES B. FRENCH.

Witnesses:
K. J. CUSACK,
JOHN C. WAIT.

Figure 27

J. B. French Transfer Bridge Patent Explanatory Text, 1910
(Source: United States Patent Office 1911).

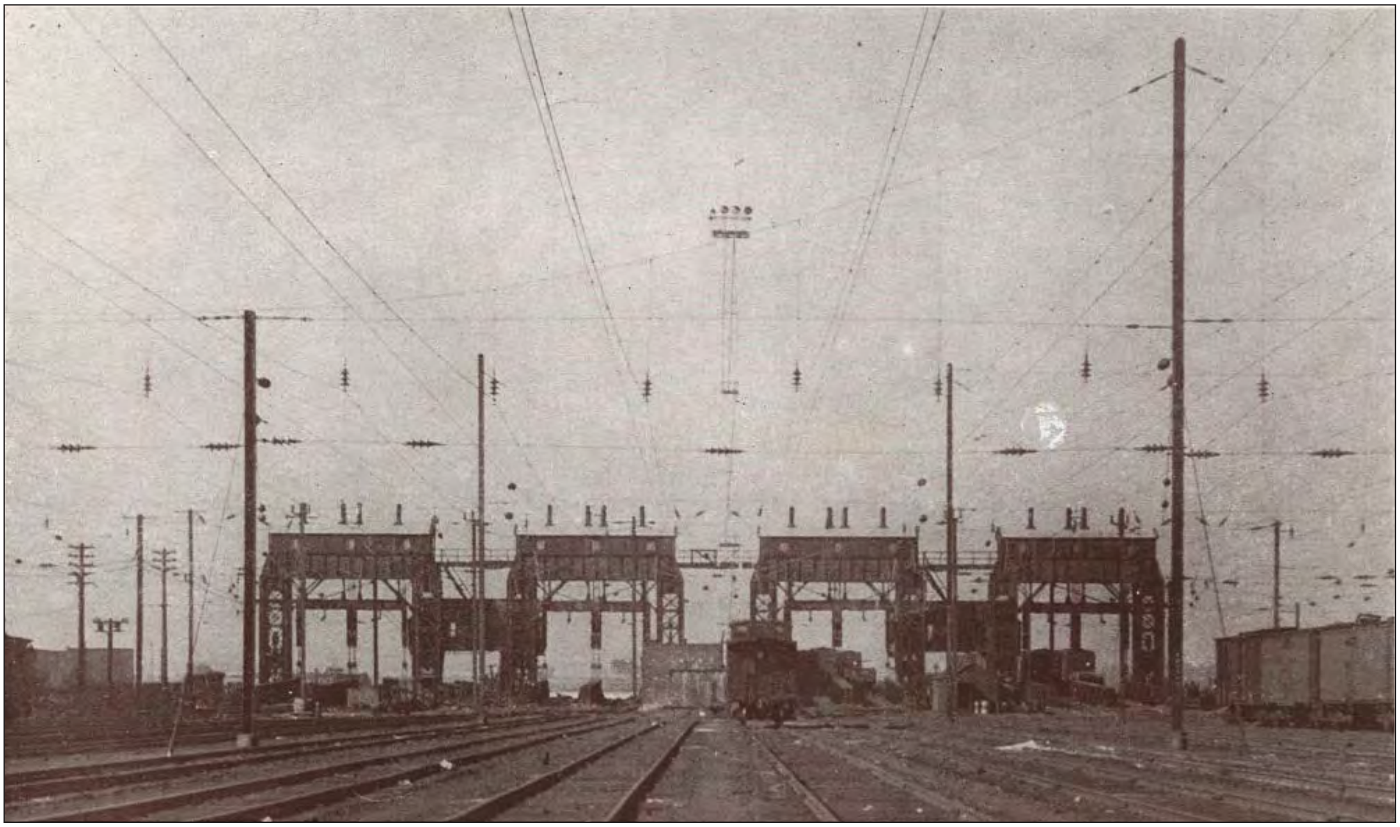


Figure 28

French-style Transfer Bridges at Bay Ridge Yard, LIRR, 1947 (Source: O'Connor 1949: 79).

Figure 29

French-style Transfer Bridges at Hunter's Point, LIRR, circa 1960
(Source: Ziel and Foster 1965: 102).

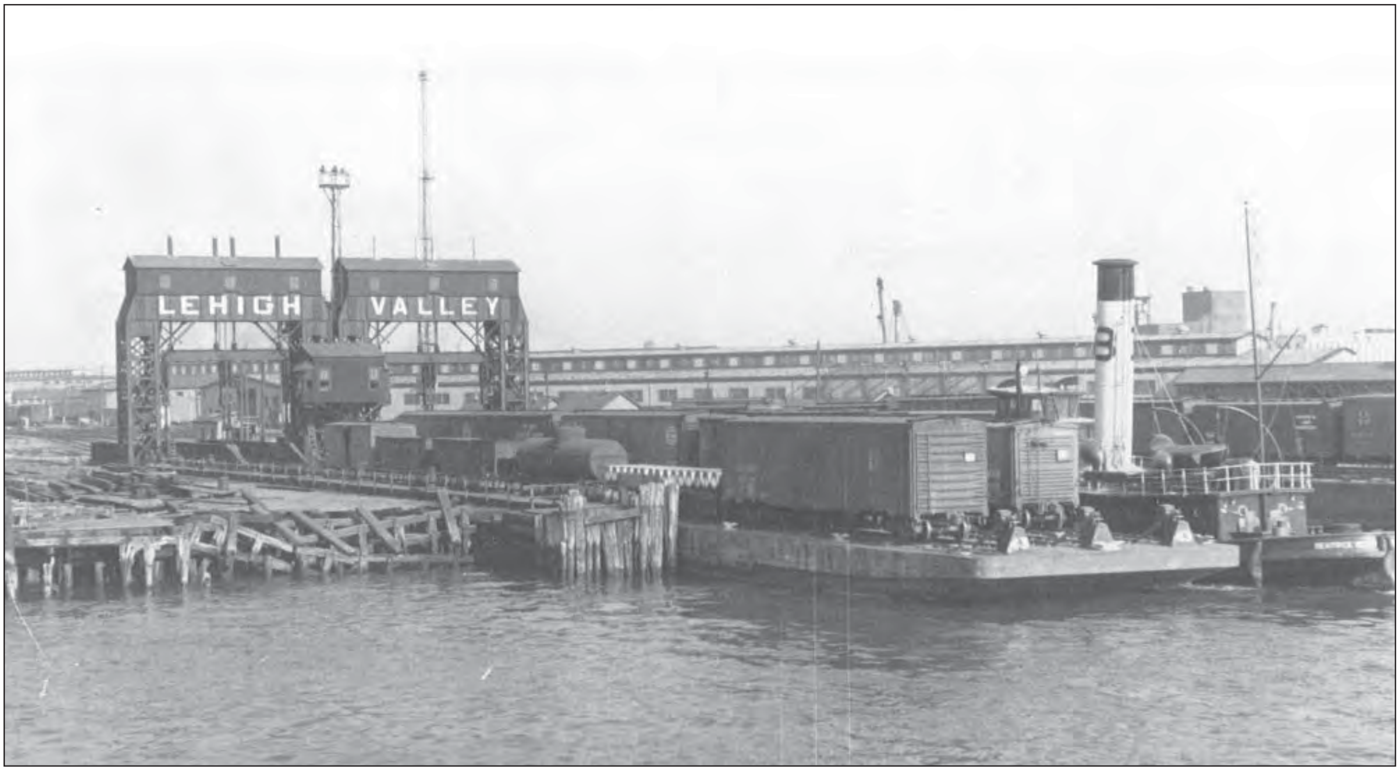


Figure 30

French-style Transfer Bridges at Jersey City, LVRR, 1949
(Source: Greenburg nad Fischer 1997: 175).

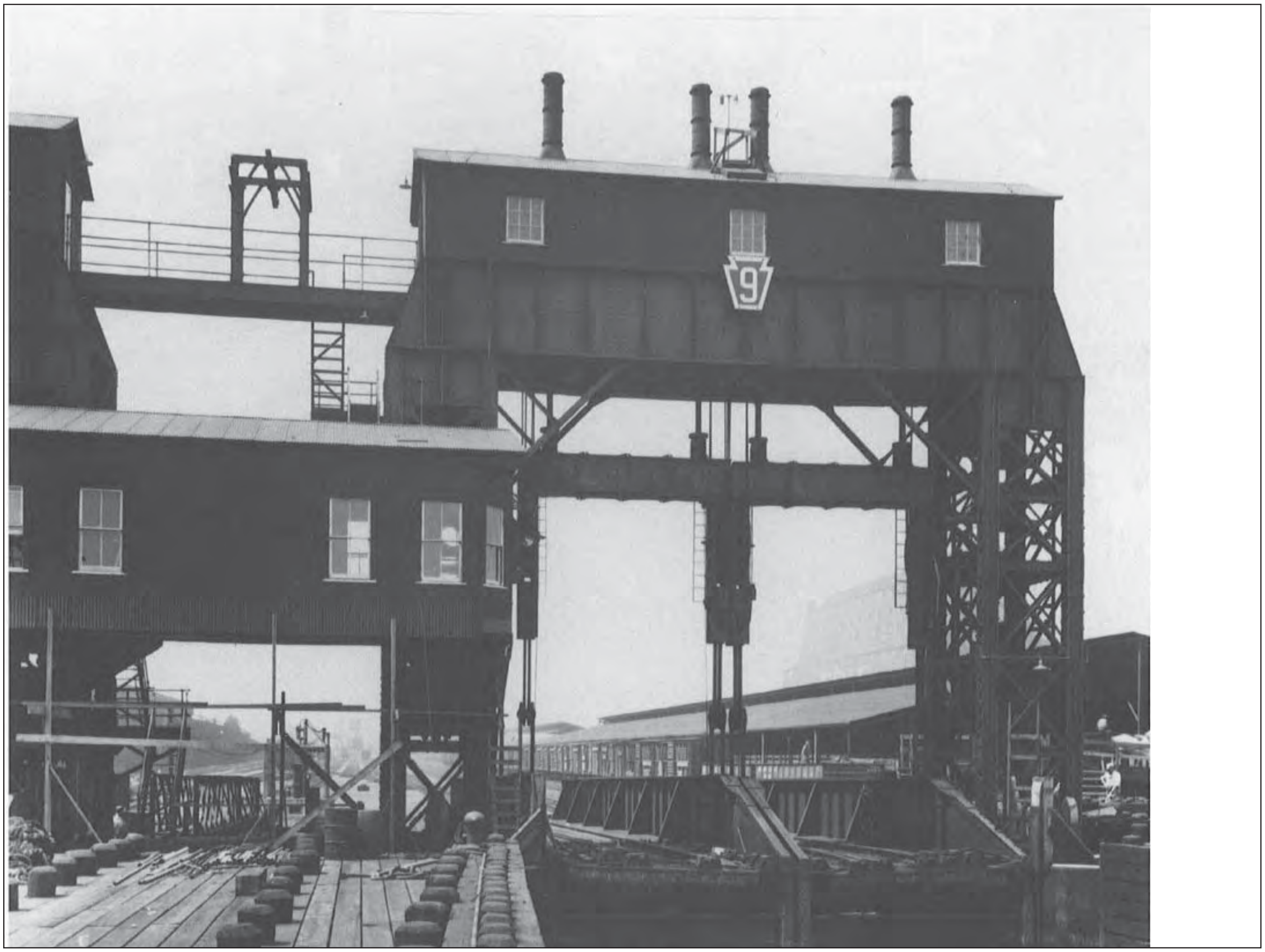


Figure 31

French-style Transfer Bridges # 8 and # 9 at Harsimus Cove, PRR, circa 1930
(Source: Messer and Roberts 2002: 223).

Figure 32

Panoramic View, Greenville Yard Transfer Bridges, circa 1940. The view depicts the condition of the bridges just prior to the addition of Bridge # 9 (Source: Pennsylvania Railroad 1945).

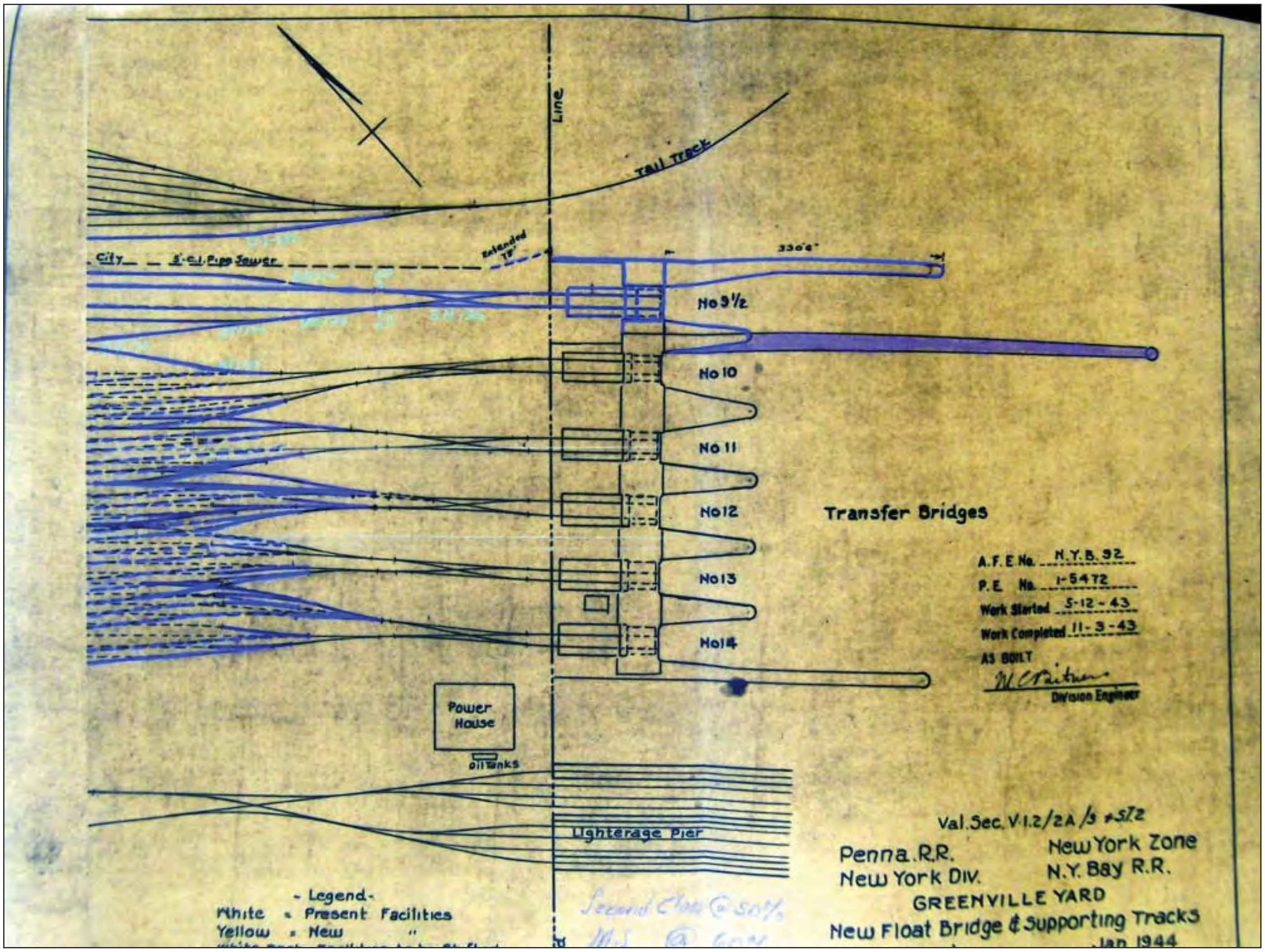


Figure 33

Greenville Yard Transfer Bridge Track Plan, 1944. The plan depicts the proposed addition of Bridge # 9 and related changes to the tracks serving each bridge. Color inverted for clarity (Source: Pennsylvania Railroad 1944b).

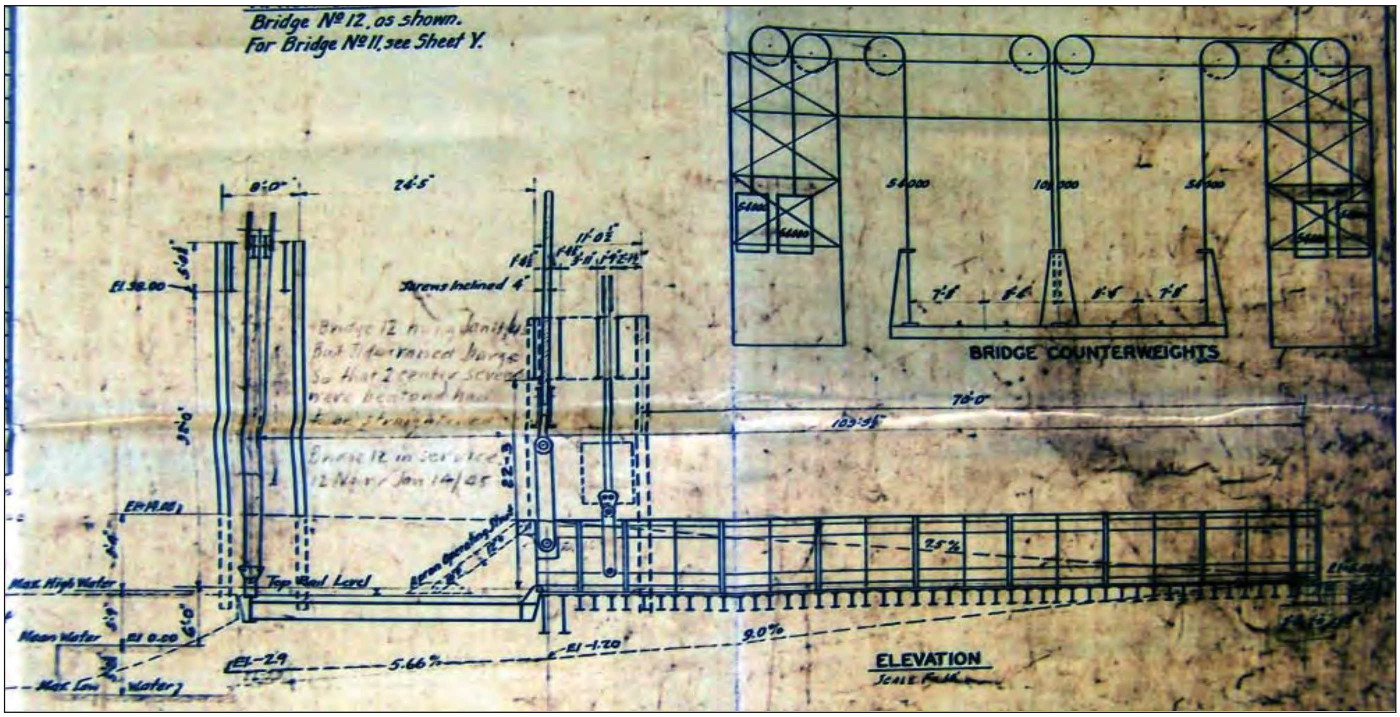


Figure 34

Detail, Greenville Yard Transfer Bridge Front and Side Elevations, 1939. These plans were prepared prior to constructing Bridge # 9 (Source: Pennsylvania Railroad 1945).

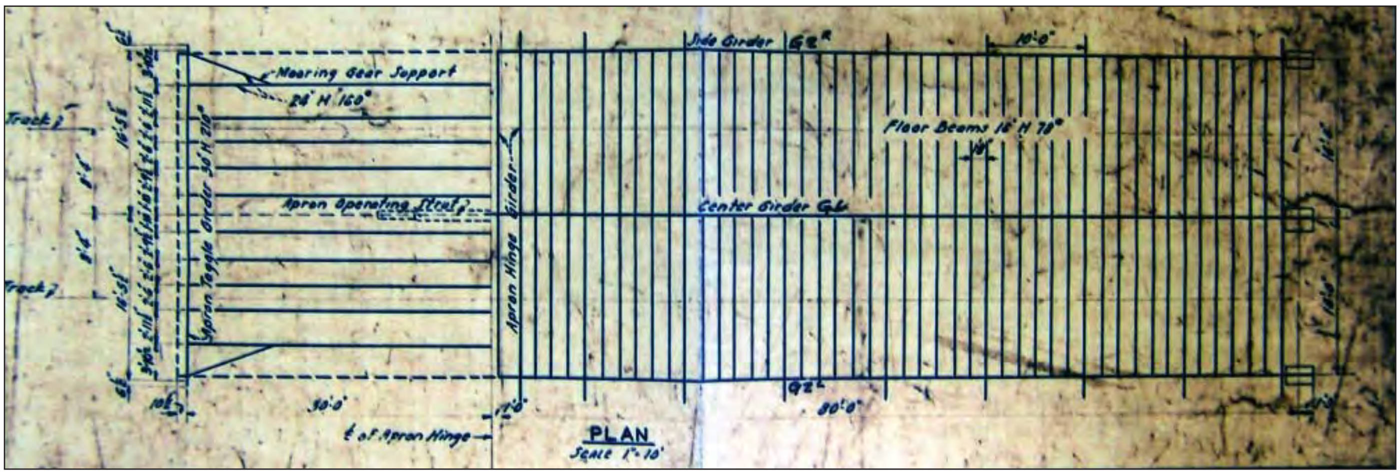


Figure 35

Detail, Greenville Yard Transfer Bridge Plan, 1939 (Source: Pennsylvania Railroad 1945).

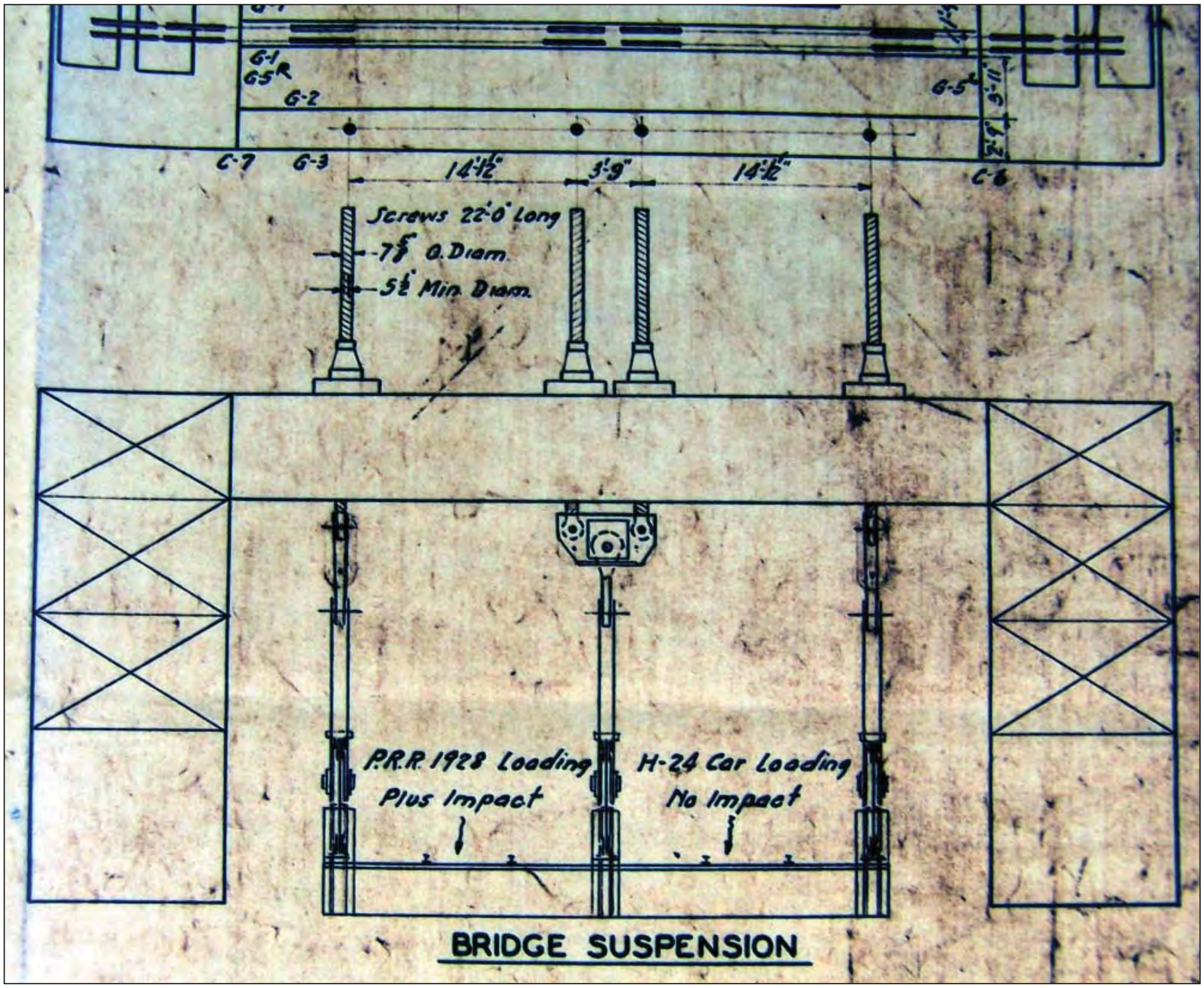


Figure 36

Detail, Greenville Yard Transfer Bridge Gallows Plan and Front Elevation, 1939 (Source: Pennsylvania Railroad 1945).

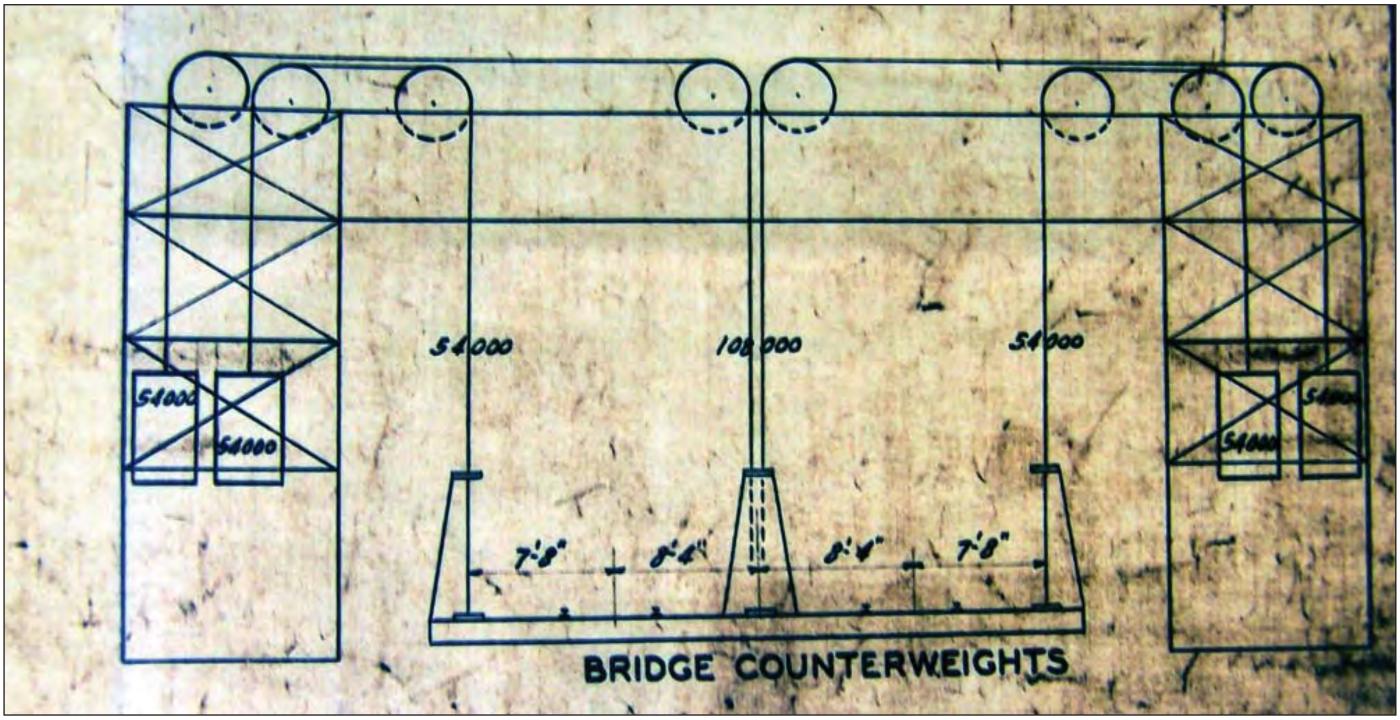


Figure 37

Detail, Greenville Yard Transfer Bridge Counterweight System, 1939
(Source: Pennsylvania Railroad 1945).

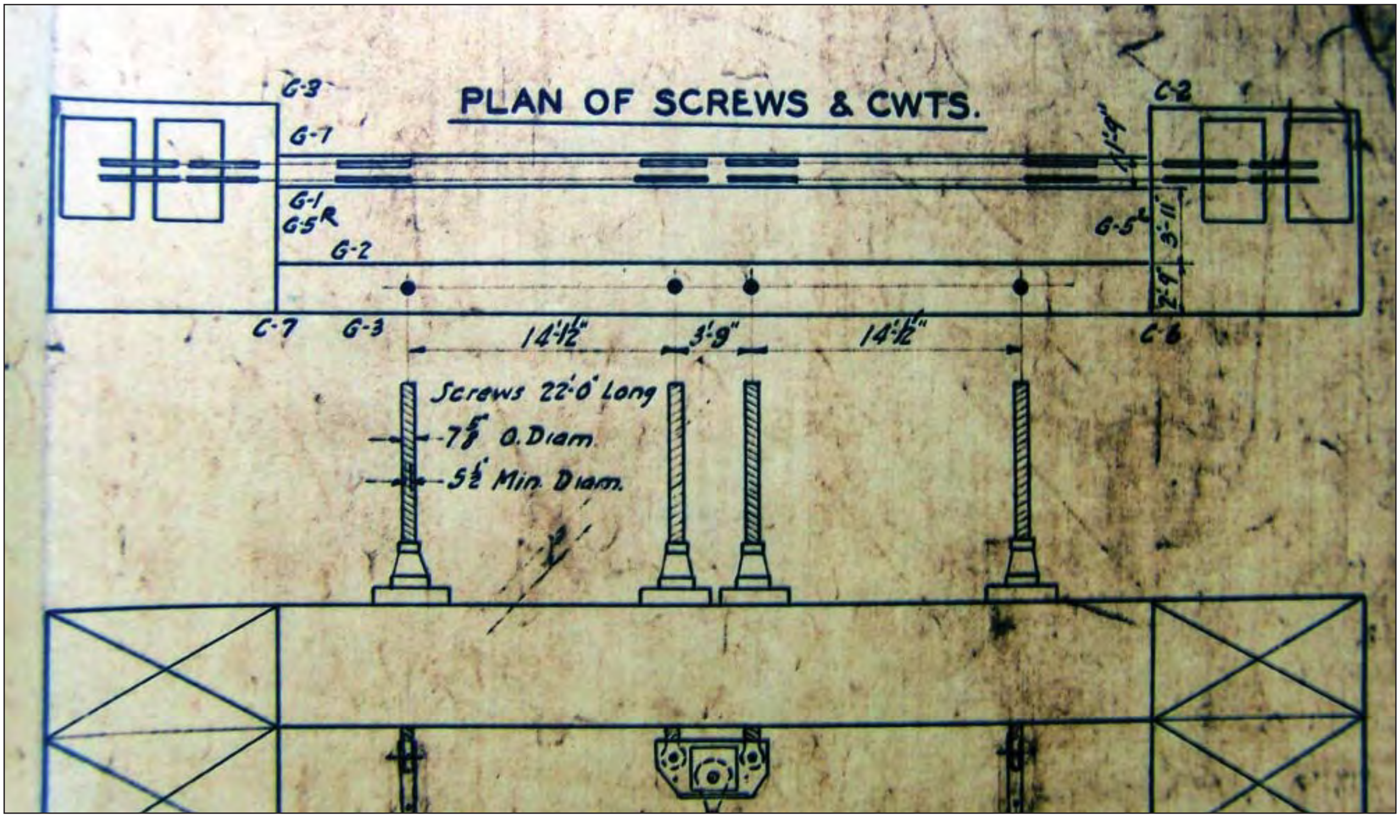


Figure 38

Detail, Greenville Yard Transfer Bridge Gallows Plan, 1939
(Source: Pennsylvania Railroad 1945).

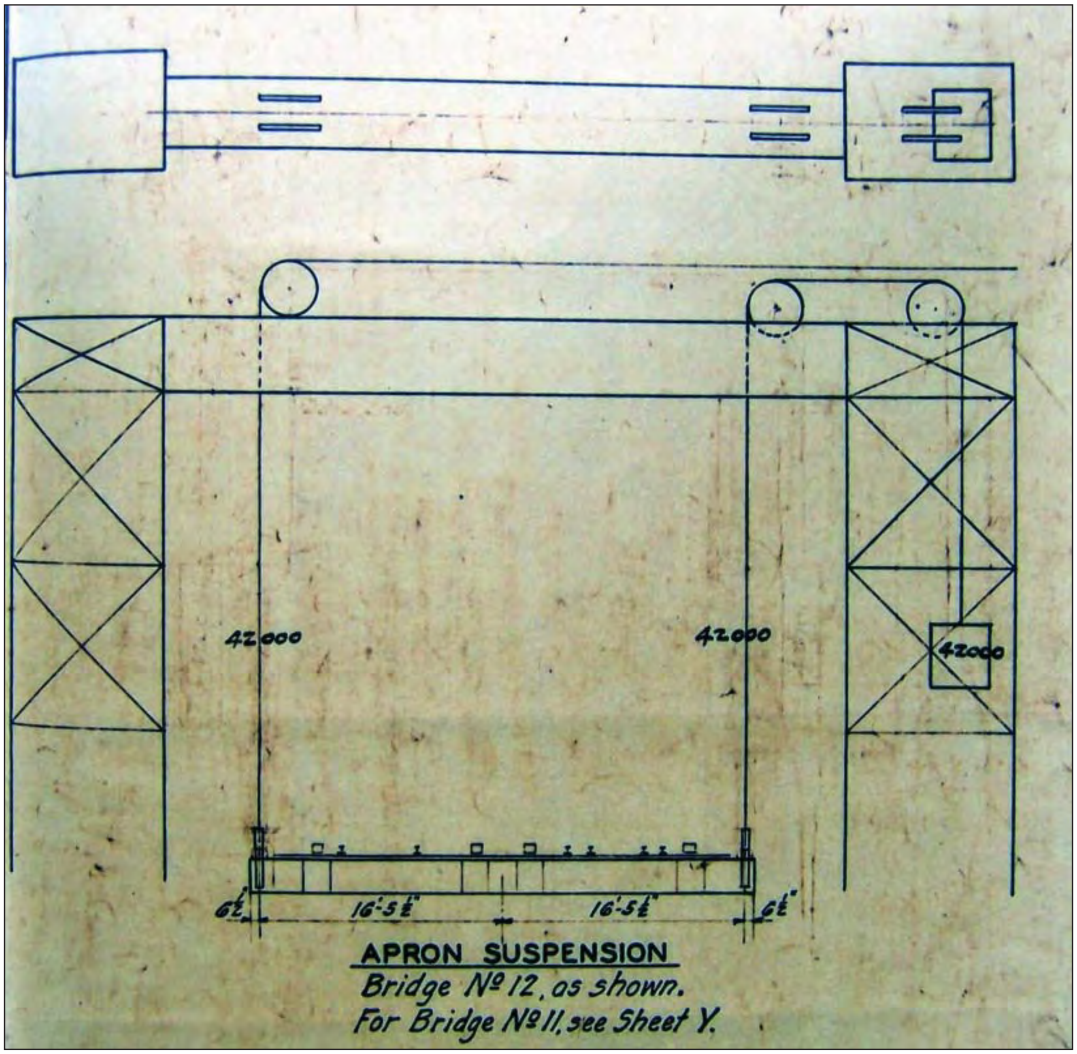


Figure 39

Detail, Greenville Yard Transfer Apron Counterweight System, 1939
(Source: Pennsylvania Railroad 1945).

Figure 40

Seaward View of Greenville Yard Transfer Bridges, circa 1942. The view is taken from the end of the long pier just prior to construction of Bridge # 9. Note damage to the pier in the foreground. Also Note the power plant (with smoke stack) immediately of the transfer bridges. The plant supplied all the power for the bridges and yard (Source: Pennsylvania Railroad 1945).

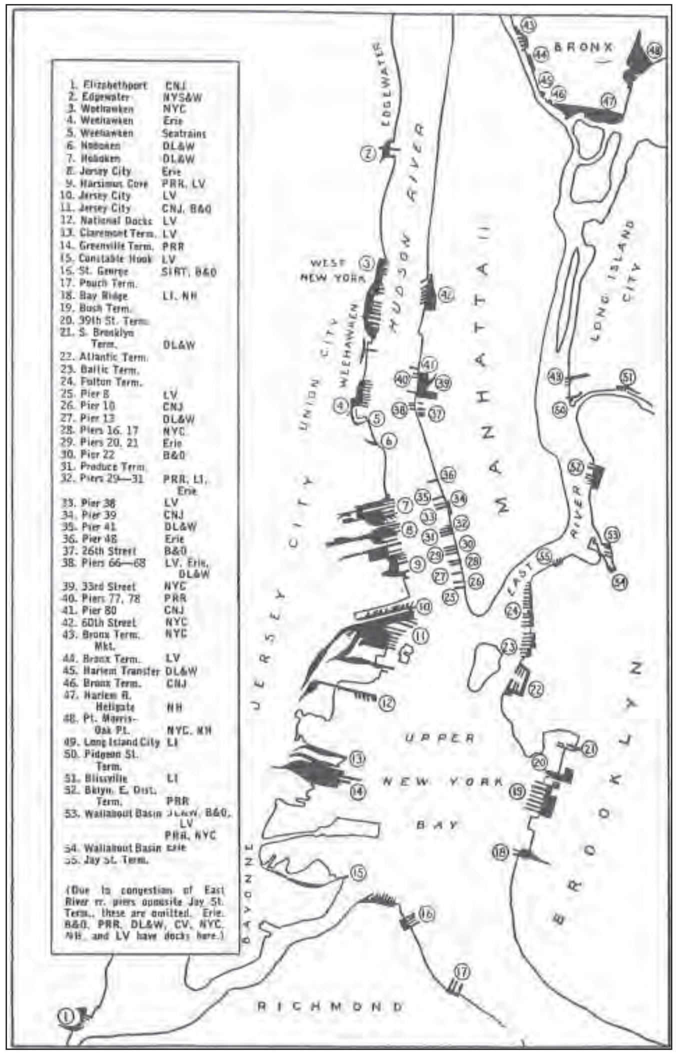


Figure 41

Map of Railroad Marine Facilities in the Port of New York, circa 1920. The map was originally published in Railroad magazine in September 1945 (Source: Flagg 1994: 17).

Figure 42

Birdseye View, Greenville Yard Transfer Bridges and Car Floats, circa 1950. Bridge # 9 is visible in the lower foreground. Note the volume of car floats in use (Source: Messer and Roberts 2002: 248).

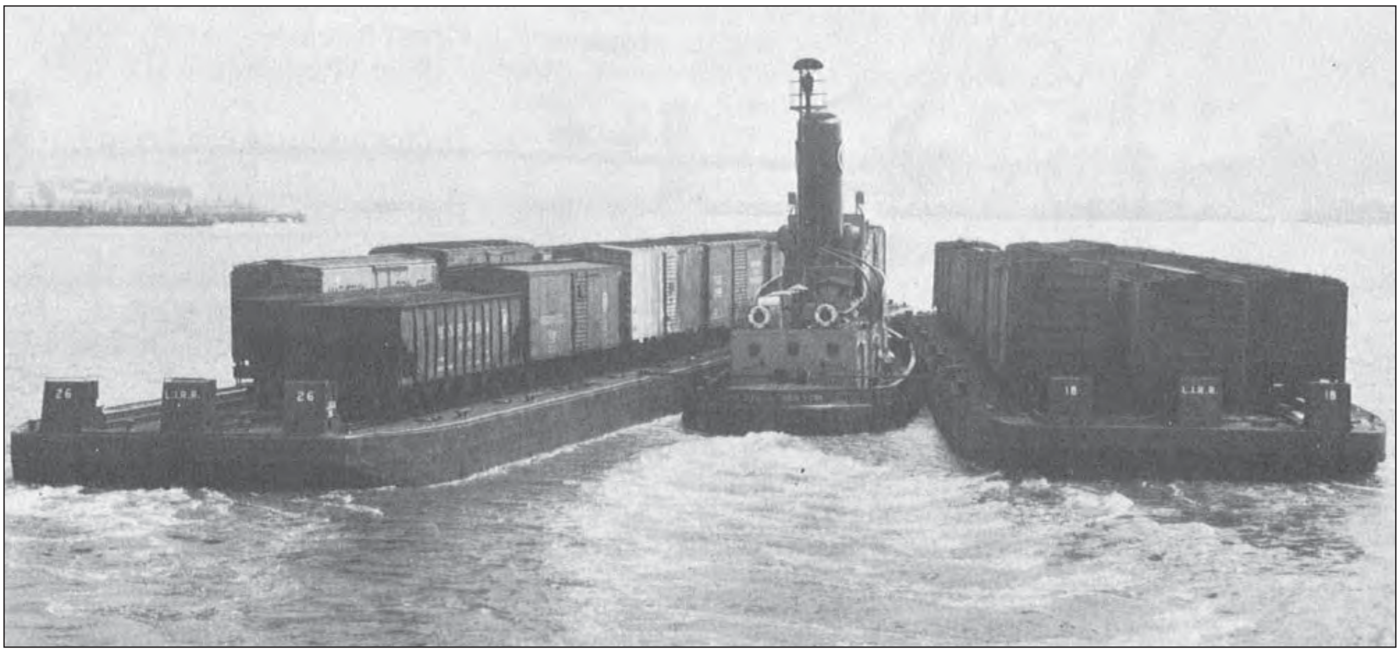


Figure 43

Car Floats #26 and #18, LIRR En Route, 1963. Car floats were typically loaded and transported in pairs, with the tug lashed in the middle (Source: Ziel and Foster 1965: 311).

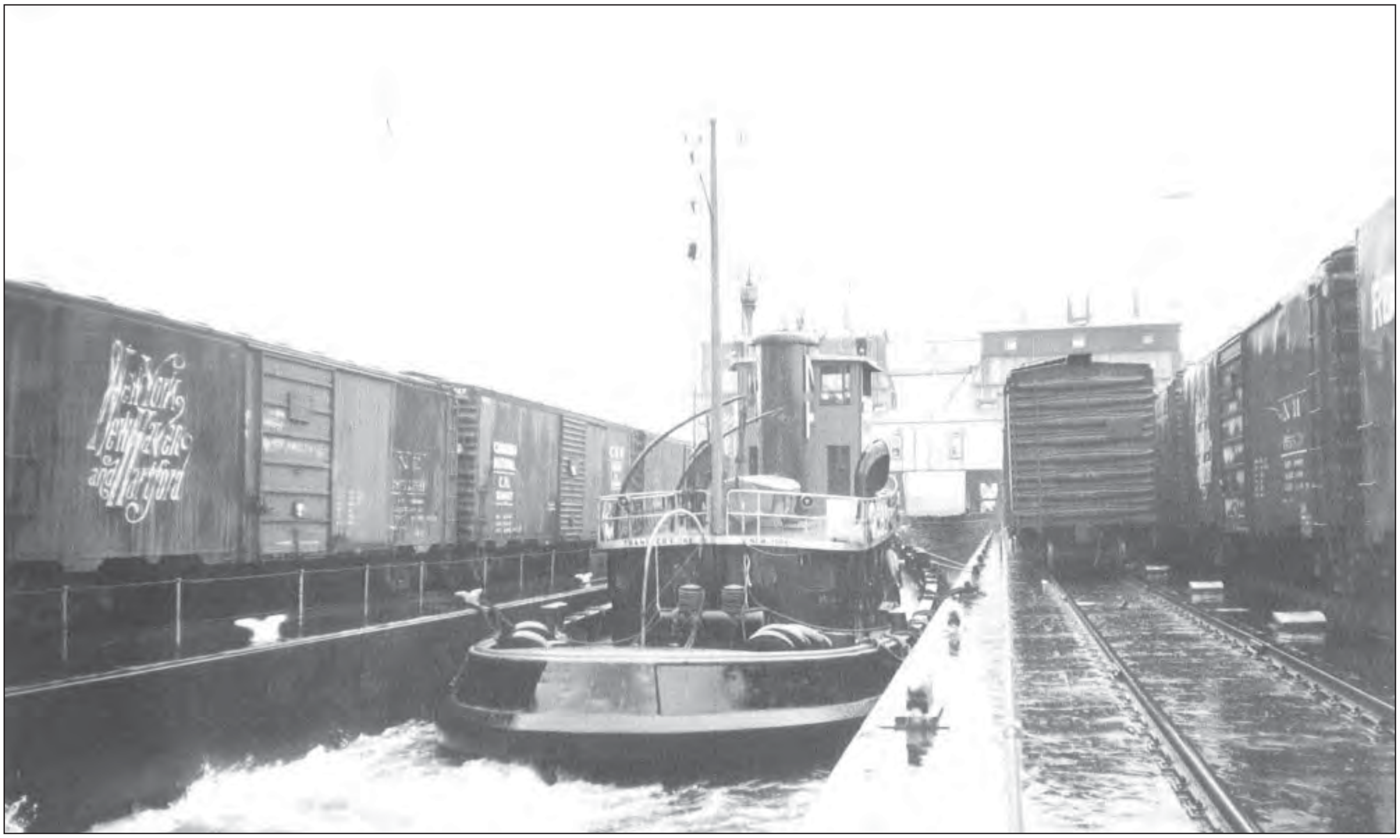


Figure 44

Tug and Car Floats Arriving at Bay Ridge Terminal, undated. Tugs typically eased pairs of car floats into adjoining berths simultaneously (Source: Sturm and Thom 2006: 53).

Figure 45

Car Float # 16, New York Dock Company, circa 1970. This float was eventually transferred to New York New Jersey Rail L.L.C. and is in operation today (Source: Goldstein 2011).

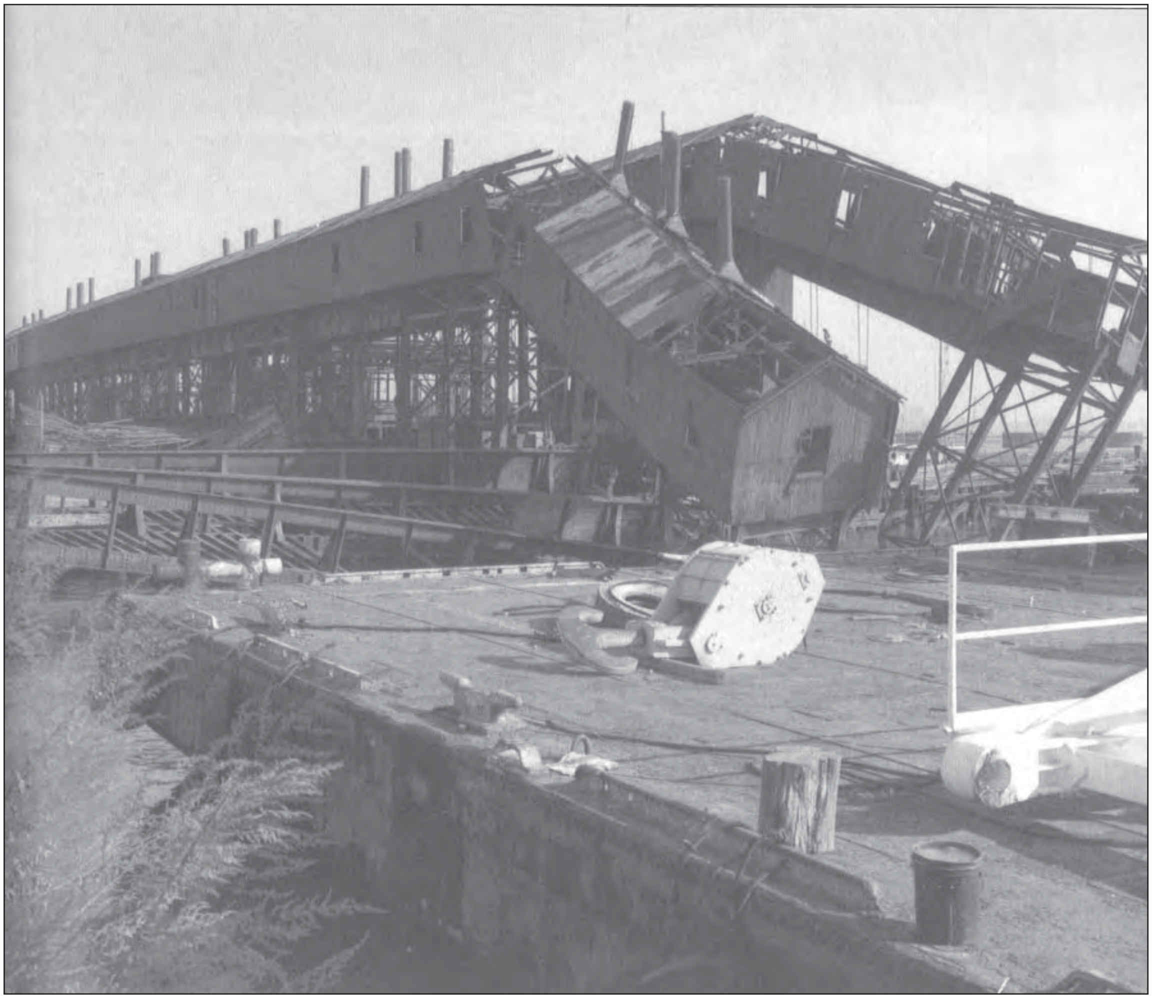


Figure 46

Greenville Yard Transfer Bridges # 13 and # 14 Prior to Demolition, circa 1995
(Source: French 2002: 101).

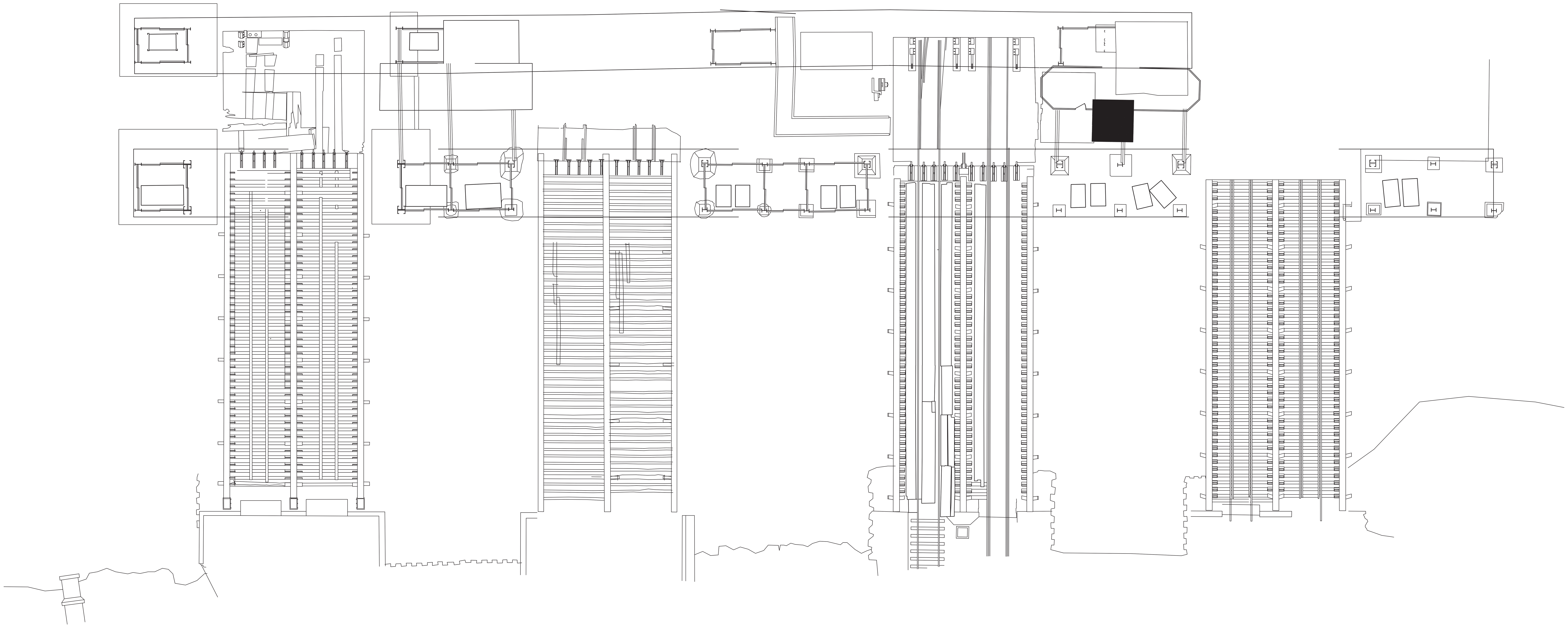
ATTACHMENT B: SUPPLEMENTAL MATERIAL

[TO COME]

ATTACHMENT C: PHOTO RECORDATION

[TO COME]

3.25.13



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LIFT BRIDGE PLAN VIEW
GREENVILLE YARD TRANSFER BRIDGE
SYSTEM AND FRIEGHT OPERATIONS
HAER NO. NJ-49-A

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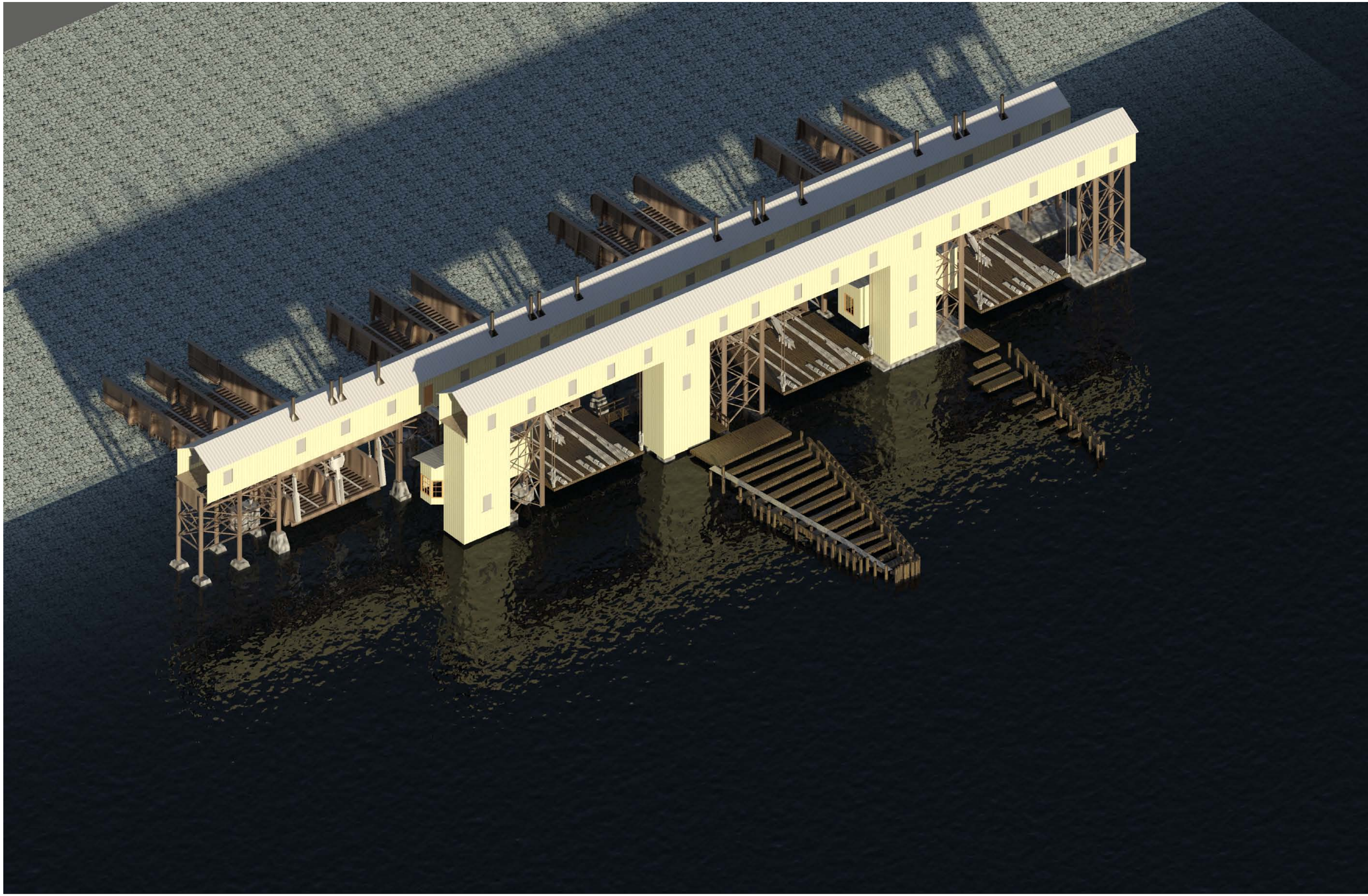
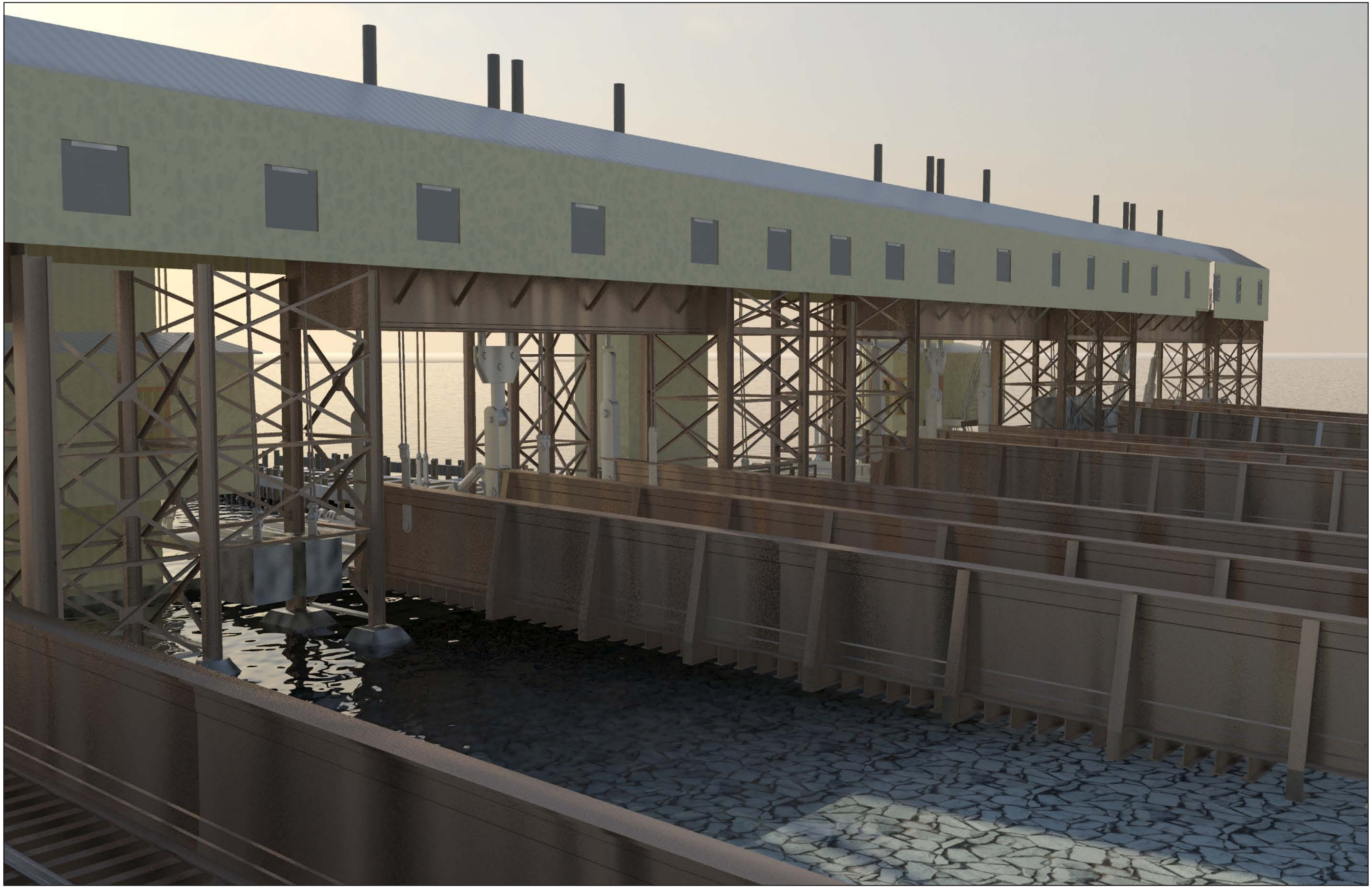


THREE-DIMENSIONAL MODEL: AERIAL VIEW
GREENVILLE YARD TRANSFER BRIDGE
SYSTEM AND FRIEGHT OPERATIONS
HAER NO. NJ-49-A

3.25.13

THREE-DIMENSIONAL MODEL: EAST ELEVATION
GREENVILLE YARD TRANSFER BRIDGE
SYSTEM AND FRIEGHT OPERATIONS
HAER NO. NJ-49-A

3.25.13



THREE-DIMENSIONAL MODEL: WEST ELEVATION
GREENVILLE YARD TRANSFER BRIDGE
SYSTEM AND FRIEGHT OPERATIONS
HAER NO. NJ-49-A

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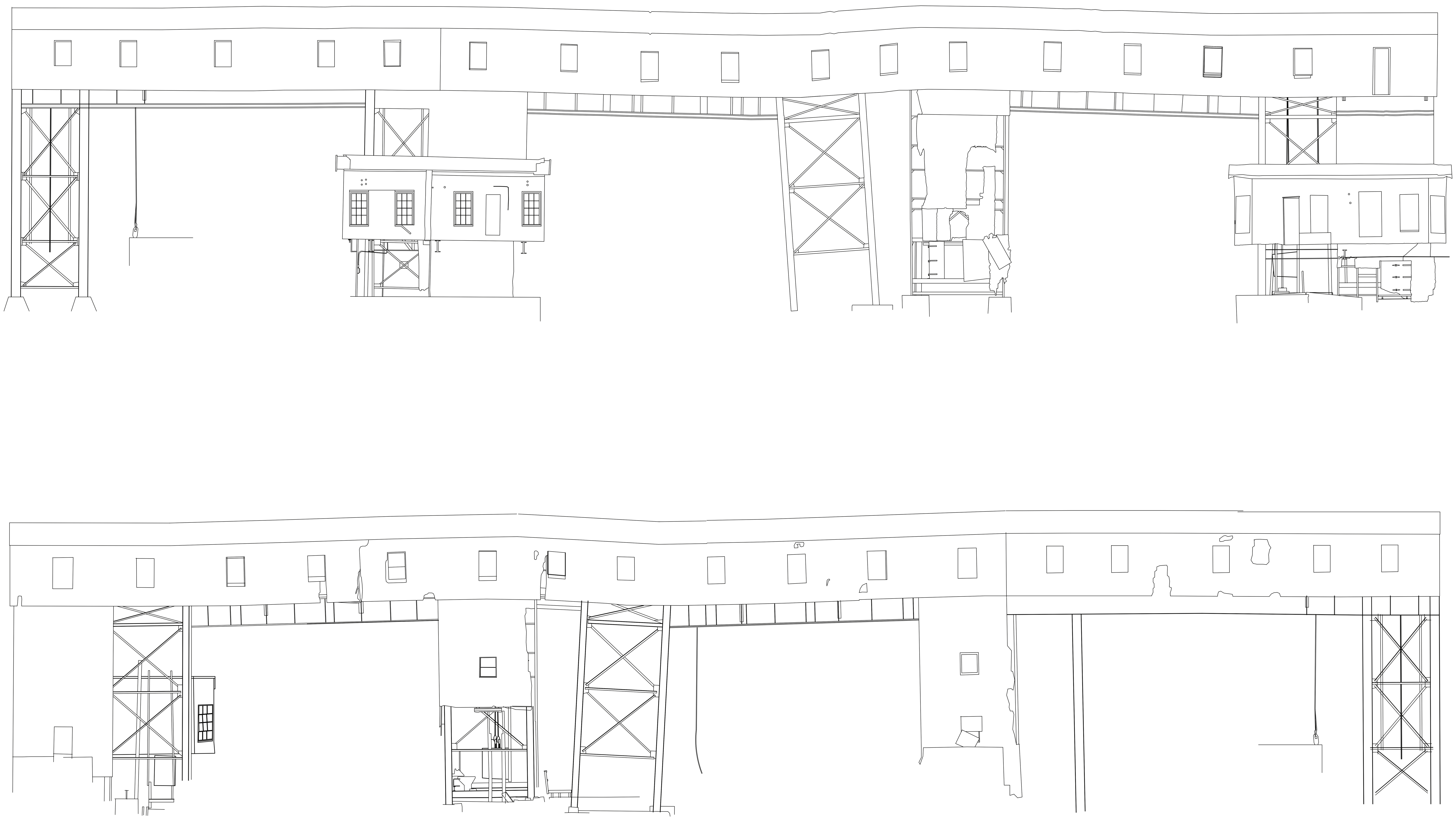

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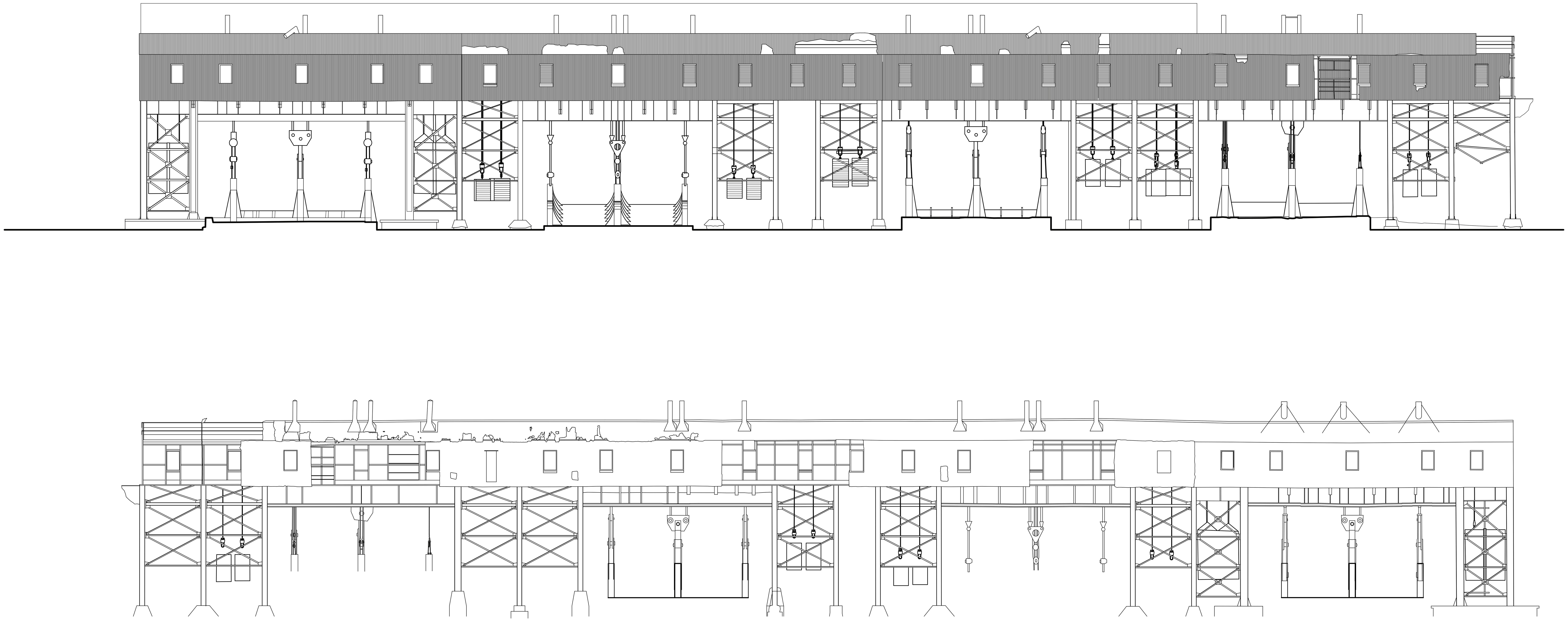
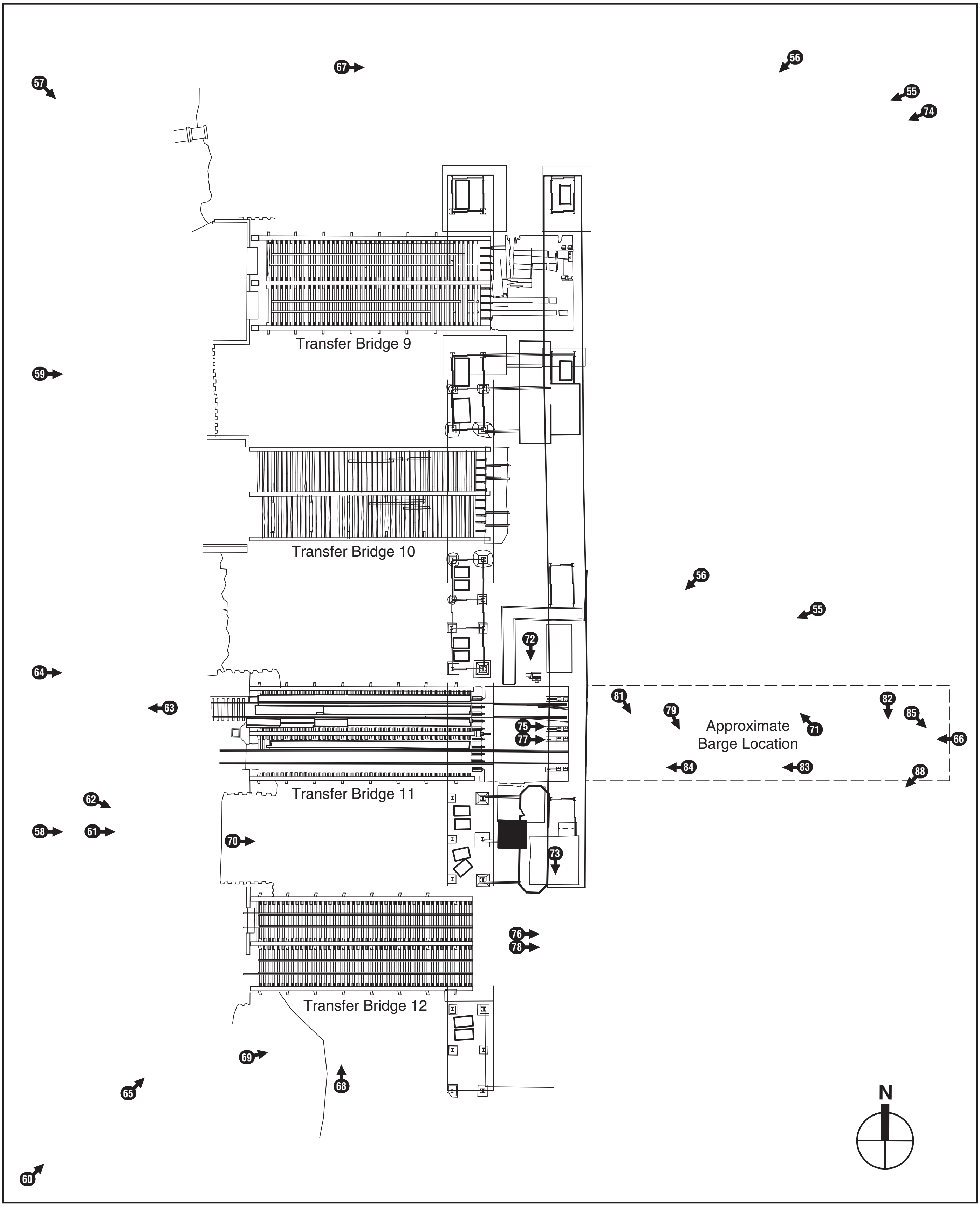
APRON GANTRY: WEST ELEVATION (ABOVE)
AND EAST ELEVATION (BELOW)
GREENVILLE YARD TRANSFER BRIDGE
SYSTEM AND FRIEGHT OPERATIONS
HAER NO. NJ-49-A

4.15.13



Data Collected 11/2010 - 2/2011

BRIDGE GANTRY: WEST ELEVATION (ABOVE)
AND EAST ELEVATION (BELOW)
GREENVILLE YARD TRANSFER BRIDGE
SYSTEM AND FRIEGHT OPERATIONS
HAER NO. NJ-49-A



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GREENVILLE YARD TRANSFER BRIDGE
SYSTEM AND FRIEGHT OPERATIONS
HAER NO. NJ-49-A

4.15.13

Data Collected 11/2010 - 2/2011

LIFT BRIDGE INTERIOR PLAN
GREENVILLE YARD TRANSFER BRIDGE
SYSTEM AND FRIEGHT OPERATIONS
HAER NO. NJ-49-A

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fax: 212 213-3191
www.akrf.com

10-1370-25 MH
HPO-D2015-288

APR 16 2015

April 15, 2015

Caroline Scott
Mail Code 501-04B
State of New Jersey
NJ Dept. of Environmental Protection
Historic Preservation
PO Box 420
Trenton, NJ 08625-0420

Re: Marketing & Implementation Plan
Cross Harbor Freight Program
Greenville Yard Lift Bridge
Jersey City, Hudson County, New Jersey

Dear Caroline:

As you know, the Port Authority of New York & New Jersey (PANYNJ), acting as co-lead agency with the Federal Highway Administration (FHWA), has undertaken the Greenville Yard Replacement Project and to replace the Greenville Yard Lift Bridge (also known as the Greenville Yard Transfer Bridge) and associated infrastructure at Greenville Yard, Jersey City. The project is part of the larger Cross Harbor Freight Program, an initiative designed to improve goods movement across New York Harbor.

Previous consultation with your office determined that the replacement of the Greenville Yard Lift Bridge with a modern hydraulic structure would result in adverse impacts on the State and National Registers of Historic Places (S/NR)-eligible bridge and surrounding historic districts. As a result of this finding, in March 2011, a Memorandum of Agreement (MOA) was signed by representatives of FHWA, PANYNJ, and New Jersey Historic Preservation Office (NJHPO), stipulating the preparation of a Relocation/Salvage Plan to investigate the relocation of portions of the lift bridge structure and/or salvage of its components for incorporation into an educational display. However, as you know, before the MOA provisions were implemented, the Greenville Yard Lift Bridge was removed due to extreme life/safety concerns in November 2012 in an emergency action following severe damage from Superstorm Sandy. Certain electrical and mechanical components of the lift bridge were salvaged prior to demolition.

The enclosed Salvage and Marketing Plan has been written in fulfillment of the MOA provision pertaining to salvage, marketing, and implementation as agreed in subsequent correspondence and coordination with your office. This Plan inventories salvaged components; identifies potential placement sites; documents marketing strategies; and recommends implementation measures for transfer of specific salvaged elements. We would like to request your review and concurrence with the enclosed plan. If you have questions or require additional information, please contact me anytime at 917.566.0525 or via email at mmcdonald@akrf.com.

Sincerely,

Molly McDonald
Technical Director/ Architectural Historian & Archaeologist
AKRF, Inc.

CONCUR

4/24/15
DATE
DEPUTY STATE HISTORIC PRESERVATION OFFICER
DANIEL D. SAUNDERS

A. INTRODUCTION

The Port Authority of New York & New Jersey (PANYNJ), acting as co-lead agency with the Federal Highway Administration (FHWA), is advancing the Cross Harbor Freight Program with the goal of improving goods movement across New York Harbor and the Hudson River. As part of the overall Cross Harbor Freight Program, PANYNJ is undertaking several near-term freight network improvements in various locations in New York and New Jersey, including the rehabilitation and improvement of Greenville Yard in Jersey City, New Jersey. Previous environmental review has determined that the replacement of the Greenville Yard Lift Bridge with a modern hydraulic structure would result in adverse impacts on the State and National Registers of Historic Places (S/NR) eligible bridge and surrounding historic districts. As a result of this finding, in March 2011, a Memorandum of Agreement (MOA) was signed by representatives of FHWA, PANYNJ, and New Jersey Historic Preservation Office (NJHPO), stipulating the preparation of a Relocation/Salvage Plan to investigate the relocation of portions of the lift bridge structure and/or salvage of its components for incorporation into an educational display. However, before the MOA provisions were implemented, the Greenville Yard Lift Bridge was demolished in November 2012 in an emergency action following severe damage from Superstorm Sandy.

Several electrical and mechanical components of the lift bridge were salvaged prior to demolition. The following Salvage and Marketing Plan (the Plan) has been written, in partial fulfillment of the MOA provision, with the goal of identifying repositories that could display components of the bridge salvaged prior to its demolition. This Plan inventories salvaged components; identifies potential placement sites and entities that may be appropriate locations and/or stewards for salvaged elements; and documents marketing strategies explored to transfer salvaged elements.

B. PROJECT OVERVIEW AND ENVIRONMENTAL COMPLIANCE SUMMARY

In 2008, PANYNJ acquired New York New Jersey Rail, LLC (NYNJR), which operates the only rail car float facility across New York Harbor, between Greenville Yard in Jersey City, NJ and 65th Street Yard in Brooklyn, NY (see **Figure 1**). At that time, the Greenville Yard Lift Bridge comprised four transfer bays (see **Figure 2**), referred to as Bridges #9 through #12, however, only Bridge #10 remained operational. PANYNJ planned for a near-term replacement of the seriously deteriorated Greenville Yard Lift Bridge with a modern hydraulic structure and prepared two categorical exclusion documents to evaluate its repair and replacement actions[1].

[1] *Categorical Exclusion for Immediate Rehabilitation and Repair* (CatEx 1A; September 2010) and *Categorical Exclusion for the Greenville Yard Lift Bridge Acquisition of Private Property and Replacement* (CatEx 1B; March 2011). A NEPA re-evaluation of CatEx 1B was prepared in November

Throughout the environmental review process, PANYNJ and FHWA engaged in consultation with the New Jersey State Historic Preservation Office (NJHPO). In consultation with NJHPO, PANYNJ and FHWA concluded that the removal of the Greenville Yard Lift Bridge would adversely affect three New Jersey State and National Register of Historic Places (S/NR)-eligible historic properties within which the Greenville Yard Lift Bridge was a contributing element: the Greenville Yard Piers; the Greenville Yard Historic District; and the Pennsylvania Railroad (PRR) New York Bay Branch Historic District. As noted above, an MOA between NJHPO, FHWA, and PANYNJ was signed on March 17, 2011. The MOA identified measures to mitigate the aforementioned adverse effects. These measures included: a Historic American Engineering Record (HAER)-level recordation of the Greenville Yard Lift Bridge; preparation of a Relocation/Salvage Feasibility Study; and preparation of a Marketing/Implementation Plan which builds upon the relocation/salvage assessment to identify an implementation strategy.

PANYNJ proceeded to advance the actions prescribed by the MOA, submitting a Preliminary Draft Relocation Feasibility Study to the NJHPO on October 31, 2011. The Draft Relocation Feasibility Study assessed the feasibility of relocating the entirety of the Lift Bridge or substantial portions of the Lift Bridge to another site for preservation. In addition, PANYNJ commenced preparation of HAER documentation to supplement earlier recordation.

SUPERSTORM SANDY

On October 29, 2012, while the provisions of the MOA were still being implemented, the Greenville Yard Lift Bridge suffered extensive structural, mechanical, and electrical damage as a result of Superstorm Sandy. Post-storm inspection revealed that the gantries of the Greenville Yard Lift Bridge had shifted considerably (nearly 9 feet), largely due to a buckling of the apron gantry main support columns. Several other support columns lost their concrete footing; bracing members were also weakened by debris impacts. A contractor’s drill barge, moored nearby, was slammed into Bridge #10 by the storm surge and was impaled on the fender piles. The fender system around Bridge #11 and the mooring cells north of the lift bridge were also significantly damaged (see **Figure 3**).

The upland portions of Greenville Yard sustained minimal damage. However, the tidal surge deposited a significant amount of debris and caused some local erosion. A new electrical house installed at Bridge #11 as part of previous PANYNJ repairs was found intact, having suffered electrical damage from water inundation. Barge #29, the 14-railcar carfloat used in NYNJR operations, had been moored nearby for repairs; the barge was damaged irreparably and sunk near the south side of Bridge #12, partially blocking access to Bridge #11.

The post-storm field inspection conducted by the PANYNJ Engineering Department determined that it was necessary to demolish and remove the Greenville Yard Lift Bridge gantry structures immediately due to extreme life/safety concerns. The NJHPO was notified of the required emergency demolition in correspondence and telephone conversations on November 16, 2012. In a letter dated April 4, 2013 (see Appendix A), PANYNJ requested that it be released from the provisions of the MOA analyzing the feasibility of relocating all or substantial portions of the

2013 to assess changes in project elements post- Superstorm Sandy (*Greenville and 65th Street Yards Categorical Exclusion Re-evaluation Statement*; November 2013).

Lift Bridge, since systematic salvage efforts had not been possible during demolition process due to safety concerns and the time-sensitive nature of the process. However, NYNJR staff members were able to salvage a number of discrete components of the Lift Bridge that are considered to be of historic interest. PANYNJ has therefore committed to completing remaining feasible MOA provisions, such as the supplemental HAER documentation, and the preparation of this Salvage and Marketing Plan for the following salvaged components of the Lift Bridge.

ONGOING IMPLEMENTATION OF MOA PROVISIONS

As noted above, the MOA for the Project included detailed stipulations for: (1) the preparation of HAER documentation; and (2) preparation of a Relocation/Salvage Plan and a Marketing/Implementation Plan. Pursuant to PANYNJ's April 4, 2013 letter described above and subsequent conversations with NJHPO, the present Salvage and Marketing Plan has taken the place of the Relocation/Salvage Plan and Marketing/Implementation Plan described in the MOA.

The HAER documentation prescribed by the MOA, which was designed to supplement earlier HAER documentation of the Greenville Yard Lift Bridge, has been completed and its content and implementation is summarized briefly below. The majority of the HAER documentation was prepared prior to Superstorm Sandy and consisted of the following components, as set forth in the MOA:

a. Measured drawings, including a plan, four exterior elevations, and plans and elevations of interior spaces: Corinthian Data Capture visited the Greenville Yard Lift Bridge to perform three-dimensional (3D) laser scans of the structure. The point cloud data that was produced from these scans was used to create measured drawings as stipulated in the MOA. The measured drawings represented the actual conditions of the Lift Bridge at the time that the scanning was undertaken.
b. Three-dimensional computer model: Using the laser scanning data created by Corinthian Data Capture (see above), a 3D computer model using Revit software was produced which allows the viewer to see and manipulate an image of the entire Lift Bridge structure. Still images and brief animations of the 3D model were also created to allow the model images to be viewed in other formats.
c. Archival photography of the Greenville Yard Lift Bridge: Black and white archival photographs of the bridge were taken, produced and formatted to appropriate HAER standards by photographer and industrial archaeologist, Rob Tucher. The views represented were chosen in consultation with NJHPO.
d. A narrative that describes in detail the physical and historical characteristics of the Greenville Yard Lift Bridge and associated infrastructure, including Car Float Barges #16 and #29: Richard Grubb & Associates in coordination with AKRF, performed extensive historical research on the Greenville Yard Lift Bridge and associated infrastructure to produce a detailed narrative that described the history and engineering associated with the Greenville Yard Lift Bridge System as specified in the MOA.

In addition to these components, the project sponsors agreed to perform additional historical documentation tasks to achieve more complete documentation of the Greenville Yard Lift Bridge. These efforts included the transcription of earlier HAER film footage to a digital format and the production of a short (roughly 30-minute-long) film that documented the history and operation of the Greenville Yard Lift Bridge. This film, created by Adam Karsten and AKRF, used new footage of interviews with project historians and Lift Bridge operators, in combination with the earlier transcribed footage, historic photographs, and images of the 3D computer models of the structure, to present a complete interpretation of the history and operation of the Greenville Yard Lift Bridge. These videos were included with the HAER package on a compact disc.

A complete draft of the HAER package was submitted to NJHPO for review on July 25, 2013 and was accepted as complete by Caroline Scott of NJHPO. In consultation with NJHPO, AKRF produced four archival copies of the HAER package to appropriate standards. As requested by Ms. Scott, on August 14, 2014, one archival copy was sent to the Rutgers University Library Special Collections and University Archives; another archival copy was sent to the Jersey City Free Public Library's New Jersey Room; and two copies were sent to NJHPO. AKRF also produced three non-archival copies of the HAER documentation, which were sent to the New York City Transit Museum; the Pennsylvania Railroad Technical & Historical Society; and the Society for Industrial Archaeology.

C. SALVAGE PLAN AND IMPLEMENTATION

As noted previously, unforeseen events resulted in damage to the Lift Bridge, and swift action was required to remove the accessible electrical components in Bridge #11 before the structure fell into the harbor. After the determination of the structure resulting from the Storm damage, a brisk removal of accessible electrical components in Bridge #11 by NYNJR Staff took place. Given safety concerns, as many of the electrical components as possible were physically carried out of the structure by hand and secured in a shipping container for storage on site. In the sections that follow, the items that were salvaged during the emergency demolition are briefly described and the process and results of outreach to Interested Parties and Potential Host Sites is summarized.

SALVAGED ITEMS

The following electrical and mechanical components, associated with Bridge #11 were salvaged in November 2012. **Figures 4-5** illustrate the previous locations of these components within the control house for Bridges #11 and #12:

1. Operator's Control Stand for Number #11 Lift Bridge, including bridge motor and winch control (with amp meters). Component measures 37"(W) x 30" (L) x 40"(H).
2. South Side "Control Circuit Board" for Apron and Lift Gear Assemblies. Component measures 30" (W) x 36" (H).
3. Control Circuit with Red Speed Control Coils. Component measures 16" (W) x 36" (H)
4. North Side Control Circuit Board for Apron and Lift Gear Assemblies. Component measures 30" (W) x 36" (H).
5. North Side Speed Control with Circuit Breaker Board. Component measures 28" (W) x 28" (H).
6. Circuit Breaker Board with Speed Control Winch. Component measures 28" (W) x 28" (H)
7. Circuit Breaker Board with Manual Control. Component measures 36" (W) x 28" (H)
8. 3-Phase Knife Switch. Component measures 24" (W) x 14" (H)

9. 3-Phase Knife Switch. Component measures 24" (W) x 14" (H)
10. Four (4) – Transfers. Component measures 6" (W) x 15" (H)
11. Two (2) – Lift Bridge Motors 100 HP that raised the #11 Bridge Section to Apron. Component measures 3' (W) x 6' (L) x 3' (L)
12. Set of Ceiling Resistors (to dissipate heat). Components measure 1' (W) x 2'(H)

OUTREACH AND POTENTIAL HOST SITES

Consultation with Potential Interested Parties

The outreach process began by contacting groups and individuals that were identified as potential Interested Parties as part of the initial Section 106 consultation for the project, whether or not these entities responded to the earlier Section 106 outreach. The purpose of contacting the potential Interested Parties was to inform them of the status of the Project, present the proposed marketing strategy for the salvaged items; and request their assistance in identifying Potential Host Sites (locations or entities that might be appropriate and willing to acquire the salvaged elements for preservation and possible public display). The following entities were originally identified as potential Interested Parties:

- Anthracite Railroads Historical Society, Inc.
- City of Jersey City Historic Preservation Commission
- North Jersey Chapter, National Railway Historical Society, Inc.
- Tri-State Chapter, National Railway Historical Society
- Rail-Marine Information Group
- Working Harbor Committee for the Heritage and Future of the Harbor of NY & NJ
- Hudson County Office of Cultural Affairs & Tourism
- City of Jersey City Landmarks Conservancy
- Pennsylvania Railroad Technical and Historical Society
- Roebling Chapter, Society for Industrial Archeology
- National Headquarters, Society of Industrial Archaeology
- United Railroad Historical Society of New Jersey
- Thomas Flagg, Industrial Archaeologist
- New York Chapter, Railway and Locomotive Historical Society

The fourteen potential Interested Parties were contacted via phone or email for feedback regarding the marketing strategy and potential host sites. The host sites that had been initially identified by the project team were presented to the potential Interested Parties and the latter were invited to suggest additional potential host sites. The majority of the Interested Parties that were contacted offered suggestions and positive feedback and concrete responses regarding the information presented. Several made suggestions of other organizations that might serve as potential host sites. In all, three additional potential host sites were added to the existing list of organizations to contact as a result of the marketing outreach.

Outreach to Potential Host Sites

Potential host sites were initially identified by the project team in consultation with NJHPO. Sites considered appropriate to host the salvaged components are (1) sites accessible to the public and (2) sites related in some way to railroad history or associated themes. Sites in New Jersey were considered ideal, however, locations throughout the New York/New Jersey metro area and Pennsylvania were also considered. The nine sites initially identified by the project team as potential host sites were the following:

Liberty State Park/Central Railroad of New Jersey Terminal
New Jersey State Department of Environmental Protection
1 Audrey Zapp Drive
Jersey City, NJ 07305
201-915-3440

Gantry Plaza State Park, Brooklyn
New York State Office of Parks, Recreation, and Historic Preservation
4-09 47th Street
Long Island City, NY 11101
718-786-6385

Liberty Science Center
Liberty State Park
222 Jersey City Boulevard
Jersey City, NJ 07305
201-253-1208

Paterson Museum
2 Market St
Paterson, NJ 07501
973-321-1260

Whippany Museum
1 Railroad Plaza
Whippany, NJ 07981
973-887-8177

New Jersey Transportation Heritage Center
P. O. Box 147
Phillipsburg, NJ 08865
admin@njthc.org

Railroader's Memorial Museum
1300 Ninth Avenue
Altoona, PA 16602
814-946-0834
888-425-8666

Railroad Museum of Pennsylvania
Route 741
P. O. BOX 15
Strasburg, PA 17579
717-687-8628

Railroad Museum of Long Island
416 Griffing Avenue
P.O. Box 787
Riverhead NY 11901-0787
631-765-2757

Three additional potential host sites were suggested by the Potential Interested Parties:

New York City Transit Museum
Boerum Place
Brooklyn, NY 11201
718-694-1787

Friends of East River State Park Natural Heritage Trust
49 N. 8th Street 6G
Brooklyn, NY 11249
212-674-7162

Hoboken Historical Museum
1301 Hudson Street
Hoboken, NJ 07030
201- 656-2240

The initial step in marketing the salvaged components to potential host sites was to contact an appropriate representative of each host site by telephone and/or email to familiarize them with the project, communicate basic information relating to the salvage and marketing effort, and to offer to send them more documentation. If the host site representative/s expressed interest in continuing a dialogue and/or receiving more information, an information package was offered to them via email, webfolder, or mail. Depending on the information requested by the potential host site, packages included photographs and brief descriptions of the salvaged elements; copies of the HAER documentation, which includes historical information on the Greenville Yard Lift Bridge and a description of its significance; and the components of the draft Salvage and Marketing Plan (with attachments and photographs).

Communication via telephone and/or email continued with any entities expressing interest in the salvaged components or requesting more information. As part of the outreach, it was explained that funds would be made available by PANYNJ to sponsor the transport of the salvaged components and (depending on circumstances and costs) their installation into an exhibit.

SUMMARY OF RESPONSES

The New Jersey Transportation Heritage Center; the Liberty Science Center; and the New York City Transit Museum gave serious consideration to acquiring the salvaged items. Additional information was provided and multiple follow-up communications occurred with each of these entities before each ultimately declined to acquire the salvaged items. A brief summary of the communications with each potential host site is provided below.

Liberty State Park/Central Railroad of New Jersey Terminal
In January 2014, a voicemail was left for the curator of the Central Railroad of New Jersey Terminal associated with Liberty State Park. The Terminal has served as the facility within the park that presents exhibits relating to railroad history. The Terminal was damaged during Superstorm Sandy and remains closed. The voicemail was not returned. The Interpretive Center within the park is devoted to natural history and is housed in a small building and was

therefore not considered a potential host site within the park. Other portions of the park are limited to outdoor spaces. Ellen Lynch of the Liberty Science Center provided a contact name and number for someone associated with Liberty State Park/ CRRNJ Terminal, but this proved to be a non-working number.

AKRF subsequently contacted the Deputy Superintendent of Liberty State Park, John Luk. Based on the information provided verbally, Luk was doubtful that the items would be appropriate for acquisition by the State Park. He noted that the Central Railroad of New Jersey Terminal would be the most appropriate place to house them, however, the Terminal was currently closed for extensive repairs following Superstorm Sandy. Further, the Terminal houses only temporary exhibits and generally makes it a policy to avoid taking on objects for permanent curation. The paper materials and objects in the Terminal's collections are currently being housed off-site while the facility is repaired, a process that may take approximately two years. Luk also noted that if the objects were more directly related to the Central Railroad of New Jersey, there would likely be more interest in acquiring them for the Terminal. However, Luk requested that AKRF forward additional information on the history of the structure and the details of the salvaged components so that he could have the opportunity to review and discuss with his colleagues. AKRF sent these materials on July 28, 2014.

As described below under New Jersey Transportation Heritage Center, AKRF contacted John Luk again via email on October 27, 2014 at the urging of Bill McKelvey of the Heritage Center. As proposed by McKelvey, AKRF noted that the New Jersey Transportation Heritage Center would be willing to undertake the long-term storage of the items and that if Liberty State Park would be willing to present a temporary exhibit regarding cross-harbor rail freight movement and incorporating the salvaged items, they would be under no obligation to store the salvaged items beyond the period of the exhibit. Further, AKRF noted that PANYNJ would be willing to set aside $20,000 to fund the design, installation, and/or maintenance of a public exhibit. This offer was made after coordination with NJHPO to ensure that the terms of the proposal were adequate. AKRF did not receive a response from the Liberty Science Center.

New Jersey Transportation Heritage Center

The New Jersey Transportation Heritage Center, represented by Bill McKelvey, maintains a small facility in Phillipsburg, New Jersey. McKelvey responded with interest in additional information and a potential interest in acquiring items for future public display. Several phone calls and emails were exchanged with McKelvey and information, including photographs and descriptions of the salvaged elements were shared. After reviewing this information, McKelvey determined that he would be willing to acquire some of the salvaged elements and store them for possible future use, but would not be able to display them in the foreseeable future. He also said that he did not feel it was feasible for him to acquire larger items, such as the electric motors, due to limited storage space. AKRF contacted McKelvey again in October 2014 on behalf of PANYNJ to formally propose that PANYNJ would transfer the salvaged items to the New Jersey Transportation Heritage Center and would set aside $20,000 to fund the design, installation, and/or maintenance of a public exhibit at the Heritage Center. This offer was made after coordination with NJHPO to ensure that the terms of the proposal were adequate. After consideration, McKelvey replied in emails dated October 12 and October 23, 2014, that the New Jersey Transportation Heritage Center was not interested in entering into any agreement with the expectation that the salvaged materials would be exhibited publically at their facilities.

McKelvey noted that the organization lacked a proper exhibit venue and had little expectation of obtaining such a venue in the near future. Further, McKelvey noted that there was “very little among all this salvaged equipment that would be economically useful for improving an interactive, interpretive exhibit” despite the funds offered by PANYNJ. McKelvey did offer “free covered storage space for the operator's control stand in … a shipping container which we have at our Phillipsburg yard.” Ken Miller, Vice President and Treasurer of Friends of the New Jersey Transportation Heritage Center, who had been copied on some of the correspondence, also wrote in support of the offer to store the control stand and noted that additional items might be stored in other containers on the site provided the approval of the Board. McKelvey urged AKRF to contact John Luk at Liberty State Park once more to confirm that Liberty State Park would not be willing to incorporate the items into a temporary exhibit at the Central Railroad of New Jersey Terminal, since McKelvey felt this would be the most appropriate place for an exhibit relating to cross-harbor rail freight movement. McKelvey noted that Luk’s unwillingness to acquire the salvaged items might be due to a lack of storage space at Liberty State Park, but noted that if the New Jersey Transportation Heritage Center agreed to take on the responsibility of long-term storage, the State Park might be willing to borrow them for a temporary exhibit. As noted above under Liberty State Park, AKRF sent Luk a follow-up email on October 27, 2014 proposing this scenario, but did not receive a response.

Gantry Plaza State Park, Brooklyn

A representative of Gantry Plaza State Park (a New York State Park located in Long Island City, Queens, which contains multiple outdoor gantries along the shoreline) was reached by telephone in July 2014. Based on the description of the salvaged items, the representative stated that while the items were thematically related to the park, he did not believe that they were well suited for incorporation into the park. He felt that they would not be suitable for outdoor installation and that the park has no indoor display locations. Noting that the operator’s box components constituted the majority of the salvaged items, he pointed out that the operator’s boxes in the existing park gantries were not accessible to the public at any time.

Railroader’s Memorial Museum

The Railroader’s Memorial Museum is located in Altoona, Pennsylvania, and is dedicated to interpreting the significant contribution of railroaders and their families to American history. AKRF left a detailed message for the Railroader’s Memorial Museum’s curator on July 15, 2014, and have not yet received a reply.

Liberty Science Center

The Liberty Science Center is an interactive science museum located within Liberty State Park in Jersey City, New Jersey. AKRF exchanged several communications with representatives of the Liberty Science Center, particularly Ellen Lynch, Exhibit Operations Lead, in February and March 2014. Lynch expressed interest in learning more about the Lift Bridge and salvaged items based on initial information provided by AKRF. Ultimately, AKRF supplied a number of materials to Lynch and her colleagues for consideration, including the HAER documentation, samples of the three-dimensional electronic model of the Lift Bridge, the short film documenting the Lift Bridge function, and photographs and descriptions of the salvaged components. After consideration and discussion with colleagues, Lynch ultimately declined to acquire any of the salvaged components and expressed appreciation for the opportunity. She suggested that the

Jersey City Landmarks Conservancy or the New Jersey Historical Society might offer other suggestions of potential host sites to contact.

Railroad Museum of Pennsylvania
The Railroad Museum of Pennsylvania, located in Strasburg, Pennsylvania, is devoted to interpreting railroad history and according to their website "houses one of the most significant collections of historic railroad artifacts in the world," including over a hundred locomotives and rail cars. AKRF reached the Collections Manager of the Museum, Dodie Robbins, on July 15, 2014. At her request, AKRF followed up with an email to her containing additional information about the Greenville Yard Lift Bridge (the HAER documentation) and photographs and details on the salvaged components. Robbins replied on July 28, 2014 and declined to acquire the components. She stated: "While the lift bridge parts represent an interesting part of transportation technology, we feel that they are a bit tangential to our museum's overall mission and that due to our limited space and resources, we do not have the capability to properly care for them at this time." Robbins went on to note that she had printed a copy of the HAER report and added it to their library for researchers to reference.

Paterson Museum
The Paterson Museum is largely dedicated to interpreting the history of Paterson and includes exhibits relating to railroad history, particularly as relates to Paterson's role in locomotive manufacturing. In July 2014, AKRF reached a representative of the Museum by phone, who stated that the Museum's mission relates exclusively to Paterson's history and they are not interested in acquiring items that are not directly related to the history of that city.

Railroad Museum of Long Island
The Railroad Museum of Long Island is a non-profit organization dedicated to preserving and interpreting railroad history relating to Long Island. The organization maintains public museums in both Greenport and Riverhead in Suffolk County, New York. Although the Greenville Yard Lift Bridge was located in New Jersey, the Railroad Museum of Long Island was considered a potential host site because the Greenville Yard operation moved freight to a similar Lift Bridge on the Bay Ridge Branch and to connections with the Long Island Railroad. AKRF exchanged multiple emails with Don Fisher, President of the Museum in July 2014, also transmitting copies of the HAER Report and photographs and descriptions of the salvaged items. Fisher was very enthusiastic about the historical interest of the Lift Bridge and the potential for the salvaged items to be incorporated into possible incorporation into an exhibit. Ultimately, Fisher declined the items, stating in a July 15, 2014 email, "Sadly, the RMLI will have to decline these excellent industrial pieces. They do not lend themselves to outside display and should be in a controlled space large enough to do them justice and tell the story of rail in the NYC harbor. We do not have an appropriate space to set up a permanent exhibit." Fisher went on to recommend that AKRF contact the Friends of East River Park, an organization, which he said was actively seeking large industrial artifacts relating to cross-harbor freight movement for installation in the Park. He also suggested that AKRF contact the New York City Transit Museum, and provided points of contact at both organizations.

Whippany Railway Museum
The Whippany Railway Museum in Whippany, New Jersey, interprets the history of New Jersey's railroads and offers excursions on historic trains as well as exhibits in a relatively small museum. AKRF exchanged emails and information with Museum representative Steven Hepler in July 2014. Hepler ultimately responded that while his organization appreciated the offer, the Museum did not have the space to house items as large as the salvaged components of the Greenville Yard Lift Bridge. Hepler recommended that we contact the Liberty Historic Railway and the United Railroad Historical Society of New Jersey. Both of these organizations are represented by Bill McKelvey, who had already been contacted.

New York City Transit Museum
The New York City Transit Museum, located in Brooklyn, New York, is an organization and public museum that presents the history of transit in the New York City metropolitan area. Recently, their focus has expanded beyond the subways and buses of the New York City Transit system to include Metro North and Long Island Railroad-related infrastructure. Within their museum in Downtown Brooklyn, the Transit Museum has several historic subway cars and other components relating to transportation in the area. Don Fisher, President of the Long Island Railroad Museum, suggested contacting the New York City Transit Museum as a potential host site due to the connection between the Long Island Railroad and freight moving across the harbor from Greenville Yard.

AKRF contacted representatives of the New York City Transit Museum in July 2014 and exchanged several emails with representatives including Gabrielle Shubert, Robert Delbagno, Brett Dion, and Carey Stumm. The representatives requested additional information regarding the history of the Lift Bridge, its historical connections with the Long Island Railroad, and the salvaged components, and this information was provided by AKRF. Ultimately, the New York City Transit Museum declined to acquire any of the salvaged items. As explained in a July 23, 2014 email from Carey Stumm: "We all learned so much about the Greenville Yard and the process by which these cars were transported. It is a very interesting topic, but our collection committee decided that the individual components of the lift bridge itself fall a bit outside the scope of our collection. As Gabrielle also mentioned, housing large artifacts that have marginal use for exhibit or research are difficult for us to maintain. The lift bridge operator control stand is very interesting, but we do actually have similar items related to the Triborough Bridge and the electrification story can be told through our artifacts related to substations and powerhouses." The email went on to state that the electronic version of the HAER documentation that AKRF provided would be kept in the New York City Transit Museum reading room to benefit researchers. Stumm also requested that a copy of the short film created as part of the Greenville Yard mitigation be transmitted to the New York City Transit Museum as well as any other photographs or other information for retention in the reading room. She noted that their reading room receives visits from approximately 50 researchers per month.

Friends of East River State Park
At the recommendation of Don Fisher, President of the Railroad Museum of Long Island, AKRF contacted Jackie Meyer of the Friends of East River State Park, an organization that according

to Fisher was actively seeking large industrial artifacts relating to cross-harbor freight movement for installation in the Park. AKRF exchanged several emails with Jackie Meyer in July 2014, providing historical information on the Greenville Yard Lift Bridge, and photographs and brief descriptions of the salvaged items. Meyer ultimately indicated that the salvaged elements were likely not suitable for the Park, but noted in a July 15, 2014 email, “It would be great if someone could assemble all of this historical imagery and text for a web site linked to the ERSP web site as part of the Historical Preservation record. I sent your information to our local elected and the ERSP Regional Architect. If I get any other suggestions I will forward to you.” No further response from parties affiliated with the East River State Park has yet been received.

Hoboken Historical Museum

Located in downtown Hoboken, New Jersey, the Museum presents a wide variety of exhibits relating to the history of both the City and the region. On July 9, AKRF sent a detailed message to the Hoboken Historical Museum containing information about the Greenville Yard Lift Bridge, the ongoing project, and the salvaged components. No reply has yet been received. AKRF attempted to follow up with a phone call, however, the Museum was closed for the installation of new exhibits and no one was available to take the call. On August 13, 2014, AKRF reached David Webster of the Collections Department, who stated that he and his colleagues had reviewed the emailed materials and had determined that they did not have the facilities to acquire the Greenville items and also noted that with a few exceptions, the Historical Museum tries to focus its exhibits and collections on materials relating directly to Hoboken.

D. CONCLUSION AND NEXT STEPS

As described above, on behalf of PANYNJ and FHWA, AKRF conducted an extensive outreach process with the goal of identifying an appropriate entity for the acquisition and display of components of the historic Greenville Yard Lift Bridge. The outreach process began by contacting entities identified as potential Interested Parties as part of the initial Section 106 consultation for the project and requesting their input in identifying potential host sites. AKRF compiled a list of potential host sites (locations or entities that might be appropriate and willing to acquire the salvaged elements for preservation and possible public display) in consultation with the project team, NJHPO, and the potential Interested Parties. AKRF then contacted each host site to communicate information relating to the salvage and marketing effort. If the host site representative expressed interest, additional information was provided to them. It was explained to the host sites that funds would be made available by PANYNJ to sponsor the transport of the salvaged components and (depending on circumstances and costs) their installation into an exhibit.

The result of the outreach effort was that several entities (in particular the New Jersey Transportation Heritage Center; the Liberty Science Center; and the New York City Transit Museum) gave serious consideration to acquiring the salvaged items. However, ultimately each organization declined to acquire the salvaged items for the purposes of creating a public exhibit. As reasons for their decision to decline the salvaged items, entities most often cited a lack of storage space; the items’ incompatibility with the central themes of their organization; and the concept that the specific physical characteristics of the items being offered did not lend themselves to an exhibit in their venue.

One entity, the New Jersey Transportation Heritage Center, which is chiefly represented by Bill McKelvey, declined to enter into any agreement to display the items, but did offer to store select items in a container at their facility in Philipsburg, New Jersey. The Transportation Heritage Center offered to store the items at their own cost if PANYNJ transported the items to their site. PANYNJ agreed to transfer the items to the New Jersey Transportation Center for long-term storage. PANYNJ intends to execute an Agreement with New Jersey Transportation Heritage Center to establish specific terms of this transfer. Following the transfer of any salvaged items that the New Jersey Transportation Heritage Center chooses to acquire, PANYNJ understands that PANYNJ will be at liberty to either retain or discard the remaining salvaged items as it sees fit, since no home could be found for these items. Further, PANYNJ believes that the salvaged items have been sufficiently documented in this Plan and as components of the HAER-recorded Greenville Yard Lift Bridge and that no further documentation or recordation of these elements is necessary prior to PANYNJ divesting itself of the items. Lastly, PANYNJ and FHWA understand that following the successful transfer of the selected salvaged items to the New Jersey Transportation Heritage Center, the stipulations of the MOA for the Project will be fulfilled in their entirety and the Section 106 compliance process will be complete.

9.26.13

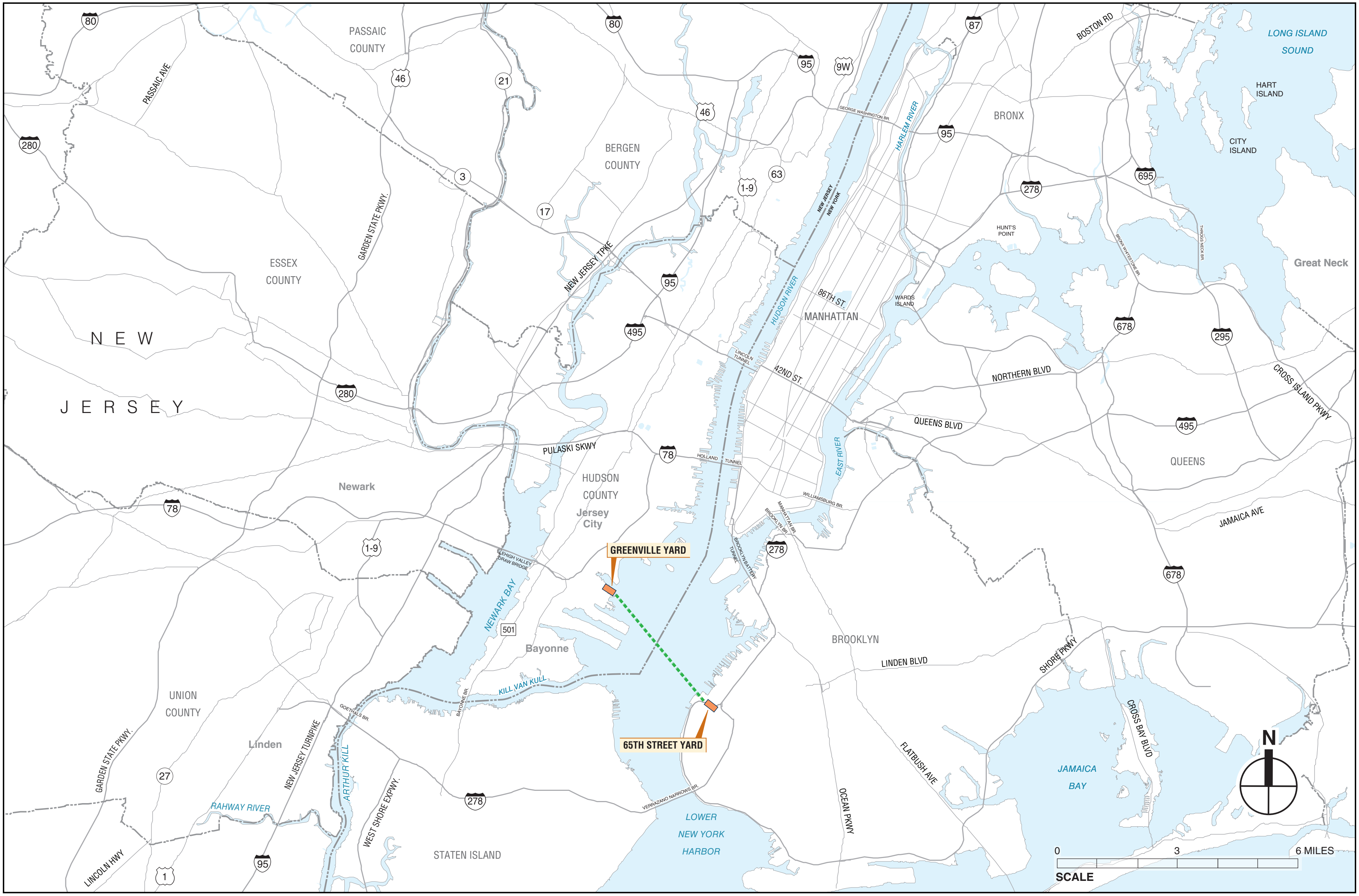


Figure 1
Study Area

CROSS HARBOR FREIGHT PROGRAM • Greenville Yard Salvage and Marketing Plan

9.26.13

Figure 2
Existing Conditions

CROSS HARBOR FREIGHT PROGRAM • Greenville Yard Salvage and Marketing Plan

Before Storm Sand Surge **1**

During Storm Sandy Surge **3**

After Storm Sandy Surge **2**

After Storm Sandy Surge - Barge Impact Area **4**

Figure 3a

NYNJR Storm Sandy Damage

CROSS HARBOR FREIGHT PROGRAM • Greenville Yard Salvage and Marketing Plan

Figure 3b
Greenville Yard and Lift Bridge Before Storm Sandy

Figure 3c
Greenville Yard and Lift Bridge After Storm Sandy

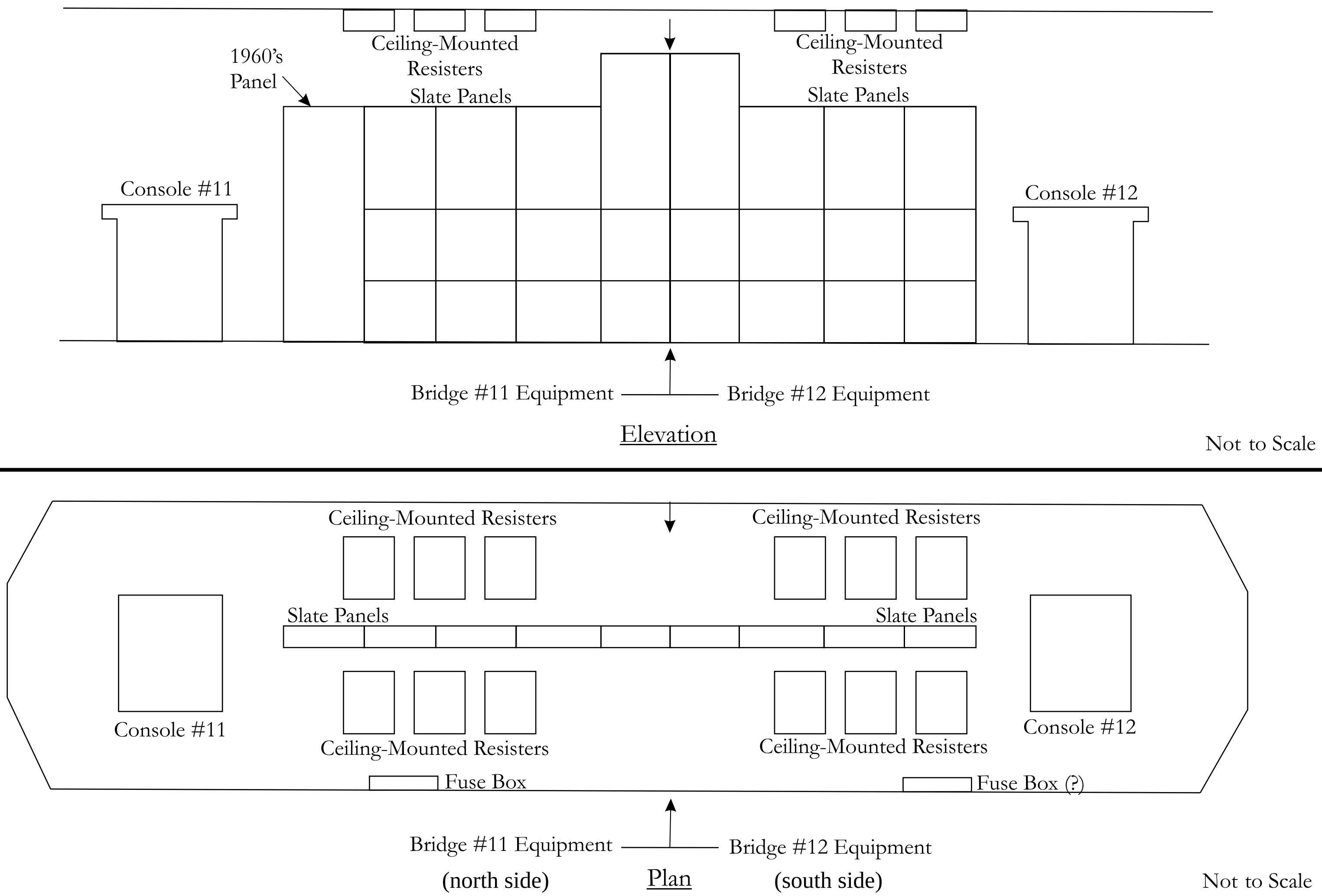


FIGURE 4

Elevation and Plan of Electrical Equipment, Transfer Bridges #11 and #12

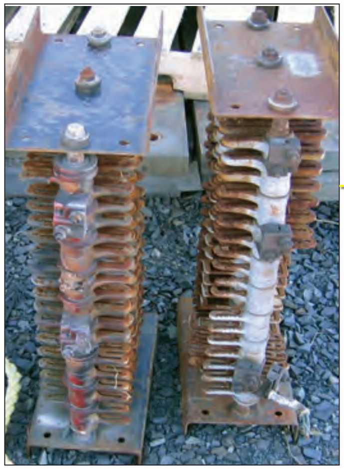
Operator's Control Stand in Situ

Operator's Control Stand, Bridge Motors and Winch Control

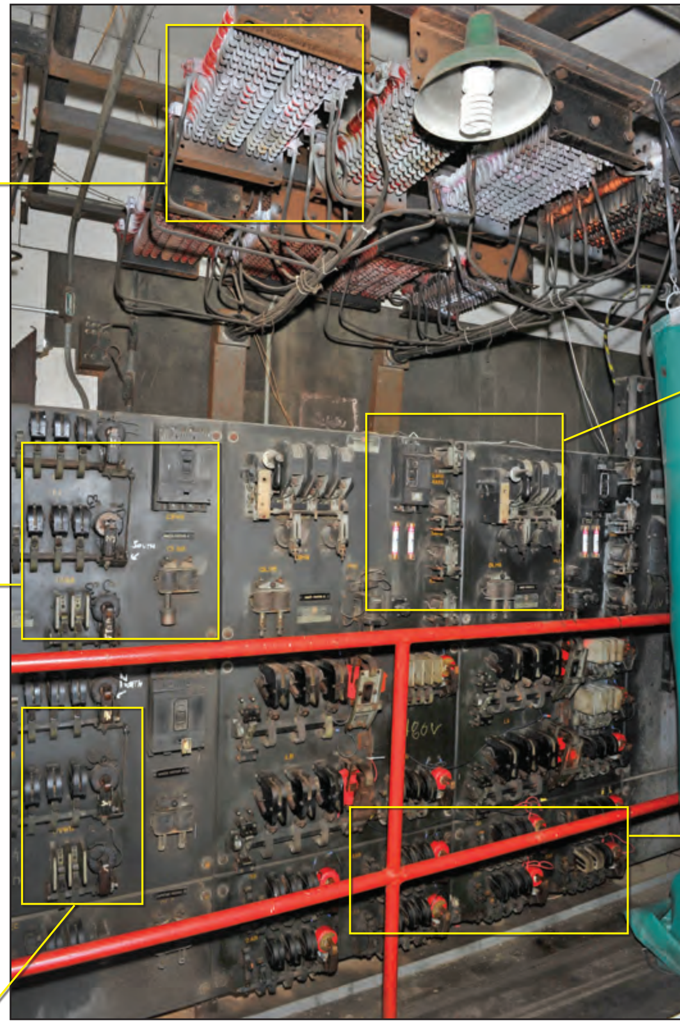
Control Room of Bridges #11 and 12

Figure 5a
Photographs

9.26.13



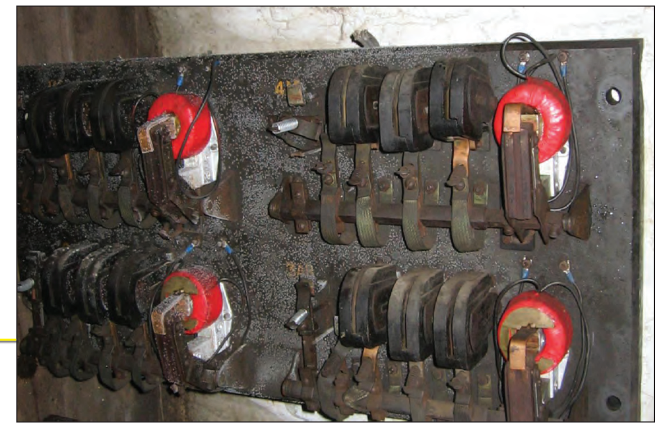
Ceiling Mounted Resistors



Front Slate Panel

Circuit Breaker with Manual Control

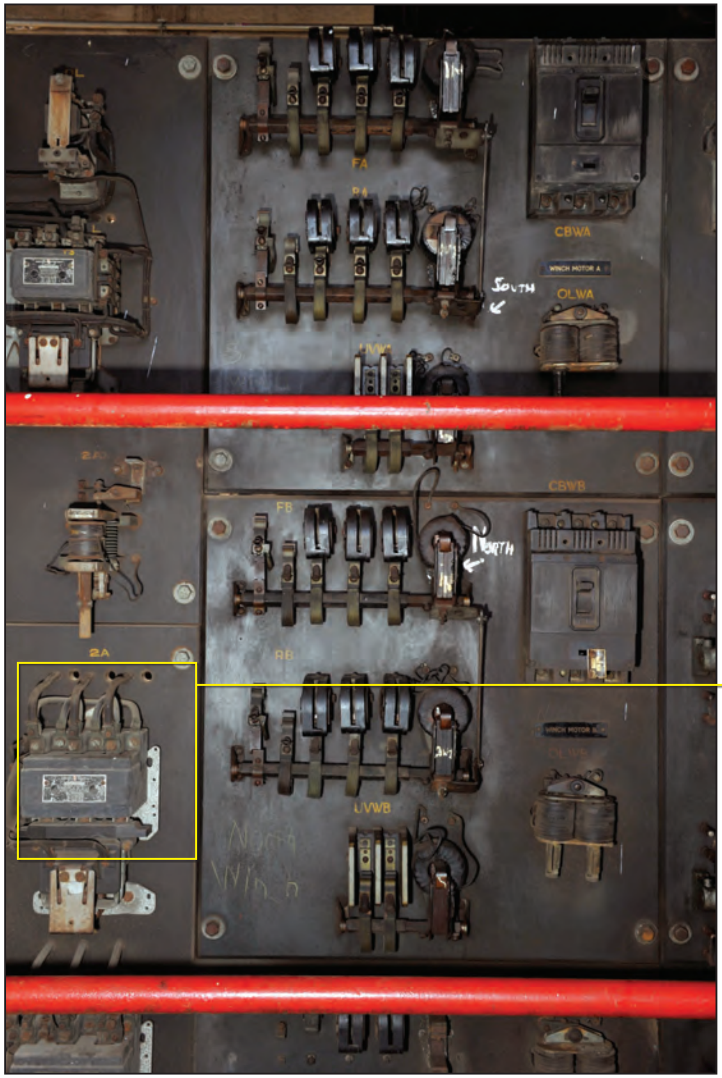
Circuit Breaker with Speed Control Winch



Circuit Breaker with Red Speed Control Coils

North Side Speed Control with Circuit Breaker Board

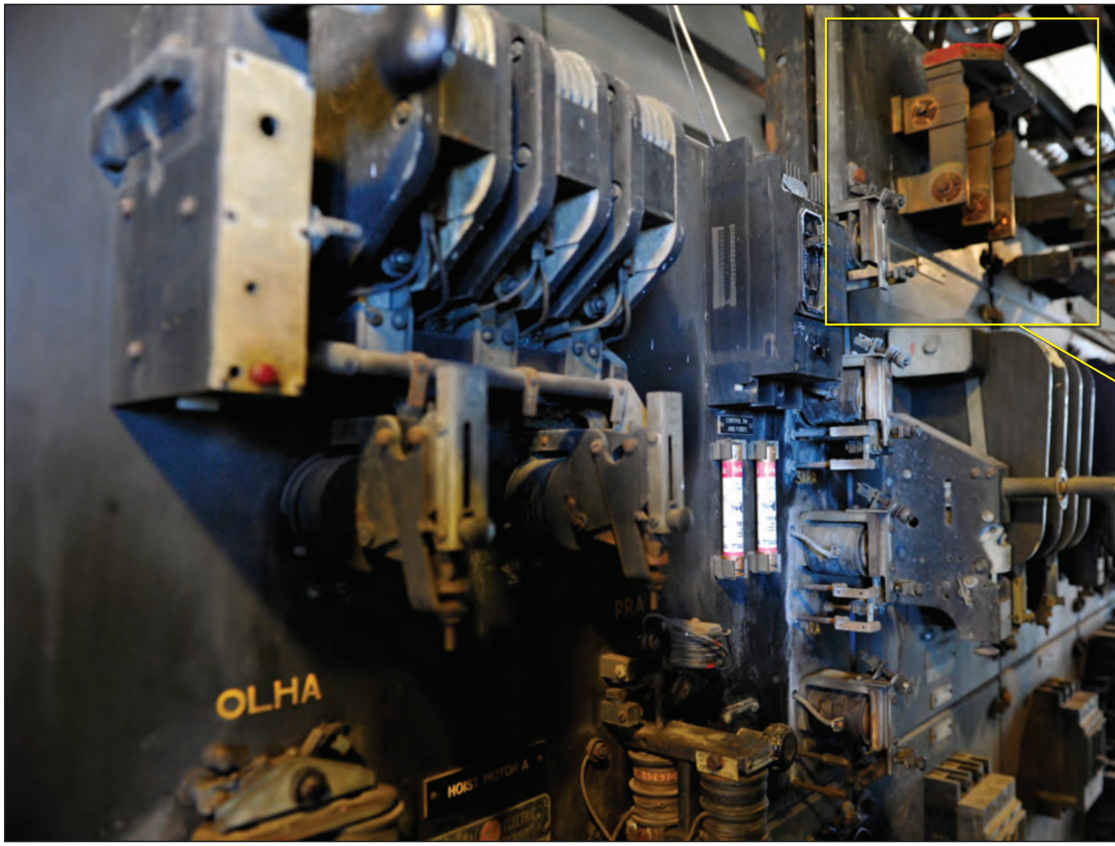
Figure 5b
Photographs



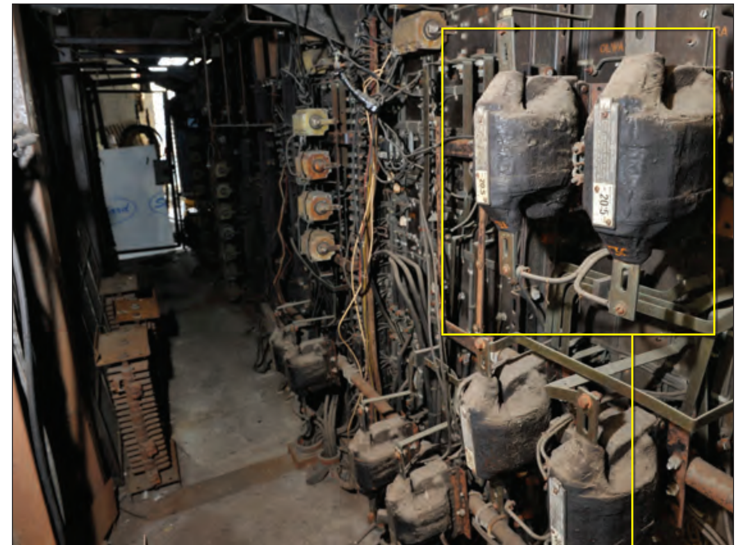
North Side Circuit Control Board in Situ

North Side Control Cicuit Board

Figure 5c
Photographs



Phase Knife Switch in Situ



Back Slate Panel with Four Transfers in Situ

Phase Knife Switch and Transfers

Figure 5d
Photographs

Lift Bridge Motors in Situ

Liftbridge Motors

Figure 5e
Photographs