## HISTORIC DOCUMENTATION

## 14TH STREET VIADUCT (State Bridge No. 0900-016)

Location: 14th St. spanning Clinton St., Grand St., Adams St., Jefferson St., Madison St., and New Jersey Transit Hudson-Bergen Light Rail West Side Alignment in the City of Hoboken and the City of Union City, Hudson County, N.J.

USGS Weehawken Quadrangle, Universal Transverse Mercator Coordinates: 18.581401.4512004 (west end); 18.581909.4511897 (east end).

Date of Construction: 1907-1912

Engineer/Contractor: J. W. Leahy, Hudson County Engineer; Owego Bridge Co., Owego, N.Y. (general contractor); McClintic-Marshall Construction Co., New York, N.Y. and Pittsburgh, Pa. (steel fabrication and erection); William B. Waldo, New York, N.Y. (concrete, paving, excavation).

Present Owner: Hudson County

Present Use: Vehicular and pedestrian bridge

Significance: The 14th Street Viaduct is one engineering solution among many that have been designed over the course of more than three centuries to solve the transportation challenge of climbing the Bergen Hill, a bluff running north-south along the west side of the Hudson River. The viaduct was built in 1907-1912 as a vehicular bridge from Hoboken to West Hoboken (now part of Union City). Its engineers designed a structure that could negotiate an elevation change of 70 ft. and cross five city streets, a rail line, and a trolley line. The result was a distinctive, asymmetrical, 1,460-ft.-long bridge composed of two Warren deck-truss spans and 27 riveted steel girder spans supported on a substructure of riveted steel bents and towers. The 14th Street Viaduct was representative of the engineering of most steel bridges in the early twentieth century; it was in no way aesthetic and in every way utilitarian and economical.

Project Information: This documentation was undertaken in 2009 on behalf of Hudson County in coordination with the New Jersey State Historic Preservation Office and in compliance with a memorandum of agreement to mitigate the bridge replacement.

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November 5, 2009

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**Introduction**

The 14th Street Viaduct, built in 1907-12, was an improved vehicular route to directly connect the northern section of Hoboken and West Hoboken (now part of Union City). The steel viaduct was a site-specific design with its slanting vertical profile, length of nearly a quarter mile, and asymmetric truss and girder spans supported on variable-height, steel bents and towers (Photos 11, 001).[1] The viaduct crosses five city streets, a railroad, and a trolley line trace before terminating about 80 ft. up the side of the Bergen Hill.

The viaduct lies along a 300-year timeline of wagon roads, turnpikes, ferries, canals, railroads, tunnels, bridges, trolleys, inclined planes, and highways that have been devised to carry people and goods over, around, through, and even under the Bergen Hill. The viaduct's history is an installment in a historical context that stretches over more than three centuries of transportation development in Hudson County. It is one engineering solution among many that have been designed to solve the transportation challenge of climbing the Bergen Hill, a lengthy ridge of very hard trap rock running north-south along the west side of the Hudson River. The bluffs that form the east side of the Bergen Hill rise in some places to over 200-ft. above sea level forming an imposing natural barrier to all overland routes approaching New York Harbor from the west. The Bergen Hill stands squarely between Manhattan and the rest of the continent. The dense transportation network that converged on the harbor and had to contend with the Bergen Hill is arguably one of the most historically important, engineered transportation corridors in the United States. The 14th Street Viaduct is one component of this impressive corridor.

**Setting**

The 14th Street Viaduct is located in Hoboken and Union City, Hudson County, New Jersey (Figure 1, Location Map). The east end of the viaduct is in the City of Hoboken at the intersection of 14th Street and Willow Avenue, approximately 10-ft. above sea level and at grade with Hoboken's street grid. The west end is in the City of Union City at the intersection of 14th Street and Manhattan Avenue on the side of the Bergen Hill, approximately 80-ft. above sea level. The boundary between Hoboken and Union City is located at the foot of the Bergen Hill. Manhattan Avenue, which is perpendicular to the west end of the viaduct, continues upward in both the north and south directions to complete the climb to the top of the Bergen Hill, approximately 150-ft. above sea level. Manhattan Avenue is cut into the side of the hill with high, stone retaining walls to the avenue's uphill face.

[1] See photo index appended to this report. One and two-digit photo numbers refer to large-format, black-and-white archival photos. Three-digit photo numbers refer to digital photos.




USGS Quad: Weehauken, NJ (detail)

*North*

**Figure 1:** Location Map, 14th Street Viaduct
Hoboken and Union City, Hudson County, NJ

The 1,460-ft.-long viaduct crosses five Hoboken city streets (east to west: Clinton, Grand, Adams, Jefferson and Madison) and New Jersey Transit's Hudson-Bergen Light Rail West Side Alignment (located at the base of the Bergen Hill). Historically, it also twice crossed the Hillside Streetcar Line, also known as the Old Hillside Road Trolley Horseshoe Curve, which operated from 1893 to 1928 (Figure 2, Site Map). The abandoned trace of the National Register-eligible streetcar line passes under the 14th Street Viaduct's westernmost span on the side of the Bergen Hill (Photos 071-074). The line had three switchbacks. Physical remains in the vicinity of the viaduct include stone retaining walls and a dirt path that follows the trace (Lichtenstein Consulting Engineers 2006: 17).

The viaduct's urban setting is mixed use with scattered light-industrial, commercial, and residential buildings dating from the 1880s to modern. Extensive redevelopment is underway, including the construction of new condominium blocks to the south of the viaduct between Clinton and Adams streets. The area to the viaduct's north is dominated by surface parking and service buildings related to commercial bus and limousine operations. The area of greatest concentration of older buildings is beyond the bridge's eastern end in downtown Hoboken to the east of the intersection of Willow Avenue and 14th Street. The area to the south of 14th Street and one-half block east of Willow Avenue is within the National Register-eligible Central Hoboken Historic District. Portions of the historic district are within view of the viaduct's roadway but not adjacent to it (Photos 047, 076) (Lynn Dobbin & Associates 1998; Lichtenstein Consulting Engineers 2006: 20).

**Physical Description of the Viaduct**

The 31-span viaduct consists of two, rivet-connected, Warren deck-truss spans; 25 built-up, steel, deck girder-floorbeam spans; and four, steel-stringer spans for an overall length of 1,460 ft. (Photos 11, 001, 002). It carries two, 20-ft.-wide, traffic lanes, and one 6-ft.-wide sidewalk on its north side (Photos 1, 2, 003, 004). The viaduct has an out-to-out width of 49 ft.

Spans 16 and 28 (numbered east to west; see Figure 3, Elevation Drawing) are rivet-connected, Warren with verticals, deck-truss spans measuring 132-ft. and 151-ft. long respectively (Photos 009, 024). The trusses are composed of built-up, riveted members of standard steel sections (Photos 4, 9, 027-031). Warren trusses are characterized by a web configuration of contiguous, equilateral triangles. The design was patented by British engineers James Warren and Willoughby Monzani in 1848. Although used widely in Europe, the Warren truss did not enjoy popularity in the United States until the first decade of the twentieth century mainly due to improvements in pneumatic field riveting equipment. The Warren design was particularly well-suited to riveted (rigid) connections as found in the 14th Street Viaduct.

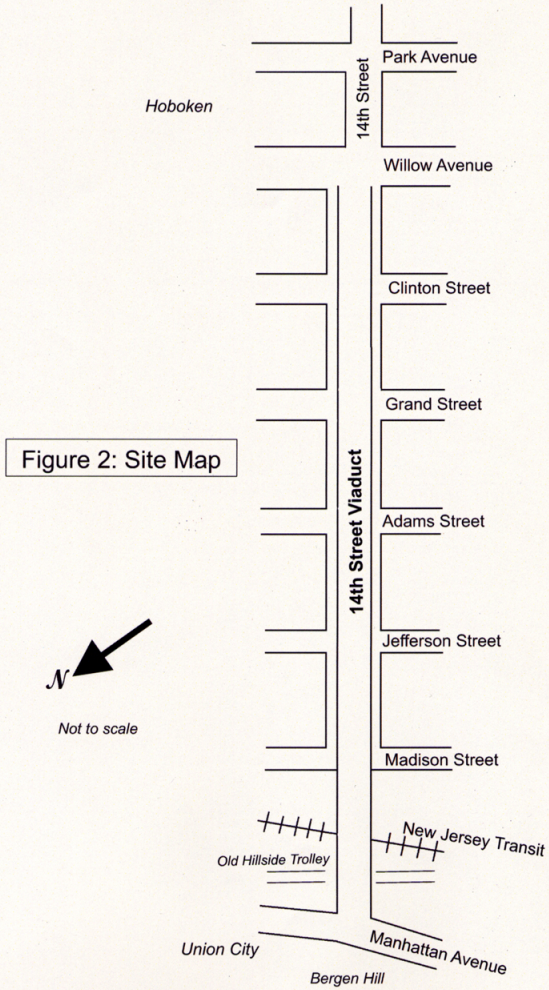
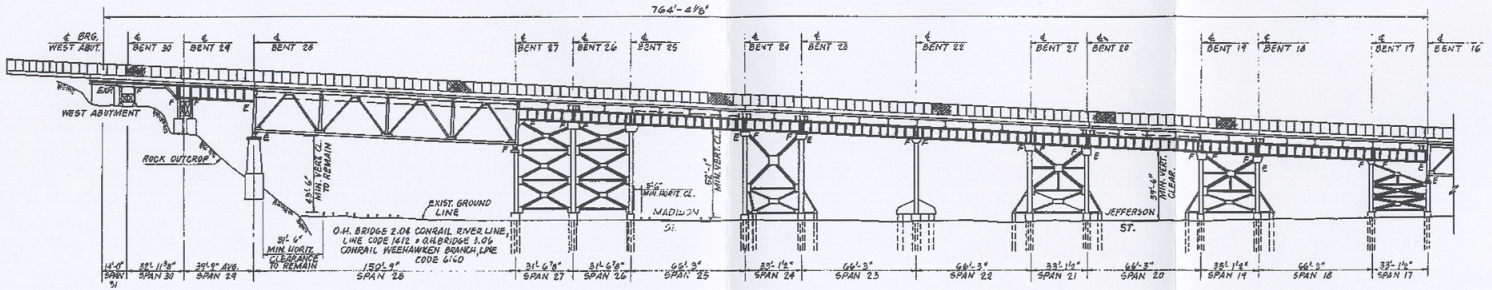
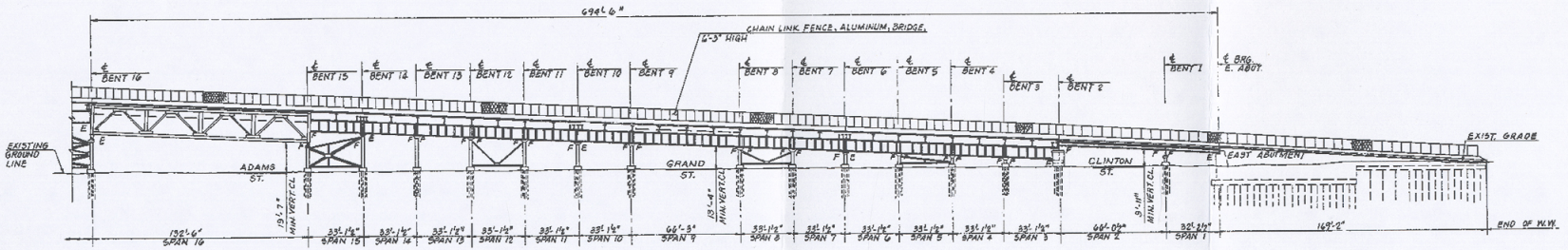



Figure 2: Site Map




**ELEVATION SPANS 17 TO 31**




**ELEVATION SPANS 1 TO 16**

FIGURE 3: 14TH STREET VIADUCT, SOUTH ELEVATION

Spans 3 through 15, 17 through 27, and 29 are deck girder-floorbeam spans varying in length from 31 ft. to 67 ft. (Figure 3, Elevation Drawing, Photos 007, 017, 020, 034). Each of the girder-floorbeam spans consist of two, riveted, longitudinal, main girders supporting transverse, riveted floorbeams, called transverse because they are perpendicular to the main girders and at right-angles to the direction of traffic (Photos 6, 012, 034, 036). The floorbeams transfer live loads to the main girders and support the deck system of rolled steel stringers and concrete roadway. Historically, the girder-floorbeam design developed prior to 1860 for the use of railroads that needed the strong, deep, built-up beams for heavy loads. Thousands of girder-floorbeam bridges from the late-nineteenth century to the mid-twentieth century remain in use on America's railroads. Highway applications were less common prior to 1920, primarily due to the difficulties associated with transportation of the heavy prefabricated girders, but they are still numerous especially in locations with rail access, like the 14th Street Viaduct.

Spans 1, 2, 30, and 31 are rolled-beam steel-stringer spans measuring respectively 32 ft., 66 ft., 33 ft., and 14 ft. (Figure 3, Elevation Drawing, Photos 041, 042). Stringer bridges consist of a series of parallel, longitudinal beams supporting the deck. Spans 1 and 2 were placed in 1990-91. They replaced two steel stringer spans that themselves had replaced two through girder-floorbeam spans in 1938. The successive replacement spans had shallower beams to provide greater vertical clearance over Clinton Street.

All spans have cantilevered deck sections (Photo 040). The deck is a corrugated steel deck pan with concrete roadway and some asphalt overlay. A sidewalk is located on the north side of the viaduct (Photos 038, 053). All material from the deck up was placed during a rehabilitation project in 1990-91.

The original railings were simple pipe railings. These were replaced by standard steel-panel railings in 1938 (Figure 4, Railing Detail). These, in turn, were replaced by the present concrete parapets and chain-link fencing in 1990-91 (Photos 052-053).

The bridge has concrete abutments. The eastern abutment has U-shaped wingwalls that form a retaining wall for the approach roadway (Photos 045, 046). The wingwalls extend 169-ft. from the abutment face to the intersection of 14th Street and Willow Avenue (Figure 3, Elevation Drawing).

The piers are a series of built-up steel bents (Figure 3, Elevation Drawing). The bents graduate in height from a low of approximately 9 ft. at Span 1 to a high of over 52 ft. at Span 26 (Figure 3, Elevation Drawing). At Spans 5, 8, 12, 15, 17, 19, 21, 24, 26, and 27, the bents have longitudinal crossbracing forming "tower" sections (Photos 10, 008, 010, 015, 016, 039).

**Bergen Hill – Geography and Geology**

Hudson County's geography is shaped by the Bergen Hill, which forms the spine of a peninsula bounded to the east by the Hudson River and to the west by the Newark Bay

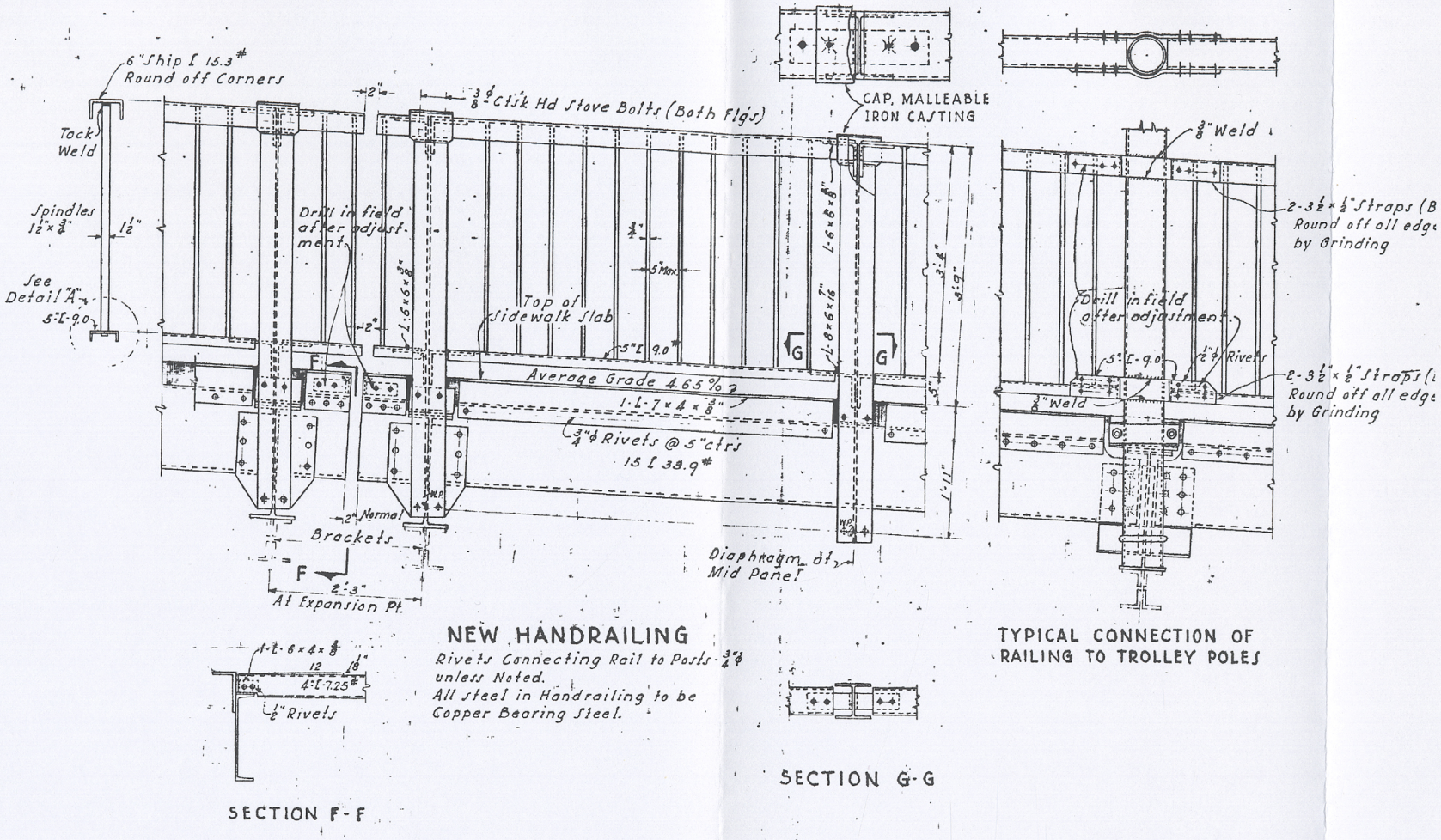



Figure 4: Detail of riveted, metal-panel railing placed on the 14th Street Viaduct in 1938. These railings replaced pipe railings from 1910. Concrete parapets with chain-link fencing replaced the metal-panel railings in 1990-91. The trolley pole referenced on the plan is believed to have been for electric buses (trolley buses) that used the viaduct during the 1930s and 1940s after the Old Hillside Road Trolley was shut down in 1928. Source: Plans for 14th Street Reconstruction of Section One, Sheet 16, 1938.

and Hackensack River (Figure 5, Hudson County Map). The peninsula is approximately 14 miles long north to south and three miles wide east to west. The Bergen Hill is part of a geologic formation known more generally as the Palisades. The rock forming the Palisades is a very hard, erosion-resistant, quartz diabase (dolerite), also called trap rock, which has historically made it difficult to excavate. It is an early Jurassic, igneous intrusion that forms a ridge 40-miles-long parallel to the west bank of the Hudson River from Staten Island to Haverstraw, New York. The formation emerges at sea level in Staten Island and then gradually rises northward through Bayonne. Near the Bayonne-Jersey City line, it becomes a bluff rising to about 50-ft. elevation. As it continues through Jersey City, Hoboken, Union City, and Weehawken, it increases in height to become a towering cliff of 200-ft. elevation. From New York City, the face of the Bergen Hill has a columnar structure that appears like a stockade or palisade. The top of the Bergen Hill forms a level area around 2,000-ft. wide. The west side of the hill gradually slopes down to the Hackensack meadowlands (Wolfe 1977: 89-93).

The geography and geology of the Bergen Hill have long been factors influencing transportation patterns in Hudson County. The Bergen Hill is a challenge to east-west, cross-peninsular through routes, which must negotiate the hill's steep vertical face, as well as find ways to cross the rivers that define the peninsula. In the nineteenth century, the Bergen Hill was a significant barrier to the efficient movement of people and goods between the Port of New York and points west. As the volume and value of travel into and out of the port grew, so did the motivation for improving the routes that crossed the peninsula. By the end of the nineteenth century, Hudson County had become one of the most densely developed and technologically significant transportation corridors in the nation.

**Engineering Around, Over, and Under the Bergen Hill – Precedents to the 14th Street Viaduct in Hudson County**

This section of the historic documentation explores various efforts to transport people and goods across the Bergen Hill from the colonial period to the mid-twentieth century. The 14th Street Viaduct represents one kind of engineering solution – a lengthy bridge, essentially a "ramp." Several viaducts were built at different locations from Jersey City, to Weehawken from the 1880s to 1930s. Other solutions included roads and trolley tracks, some with switchbacks winding their way up the side of the Bergen Hill, deep cuts through the hill for railroads and superhighways, tunnels for railroads, and even an inclined plane for horse-drawn streetcars (Figure 6, Hudson County Map).

The limits of colonial road-building technology meant that early cartways either had to follow the natural topography and go around the Bergen Hill, which was possible by dipping down the peninsula to Bayonne, or they had to take advantage of a few natural breaks in the hill where a road could wind up a ravine or follow along a depression in the ridge. Hudson County's earliest east-west road, the Communipaw Road (now Communipaw Avenue in Jersey City) kept to a shallow depression in the less-steep southern end of the Bergen Hill. It connected the Communipaw (Hudson River) Ferry

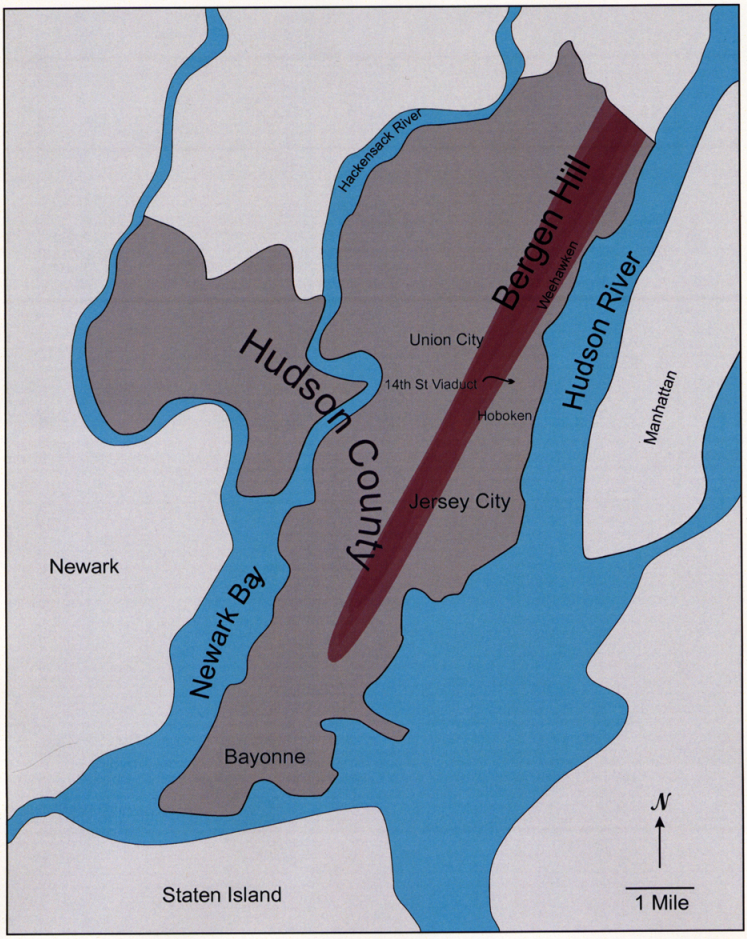



Figure 5: Map of Hudson County showing location of the Bergen Hill.

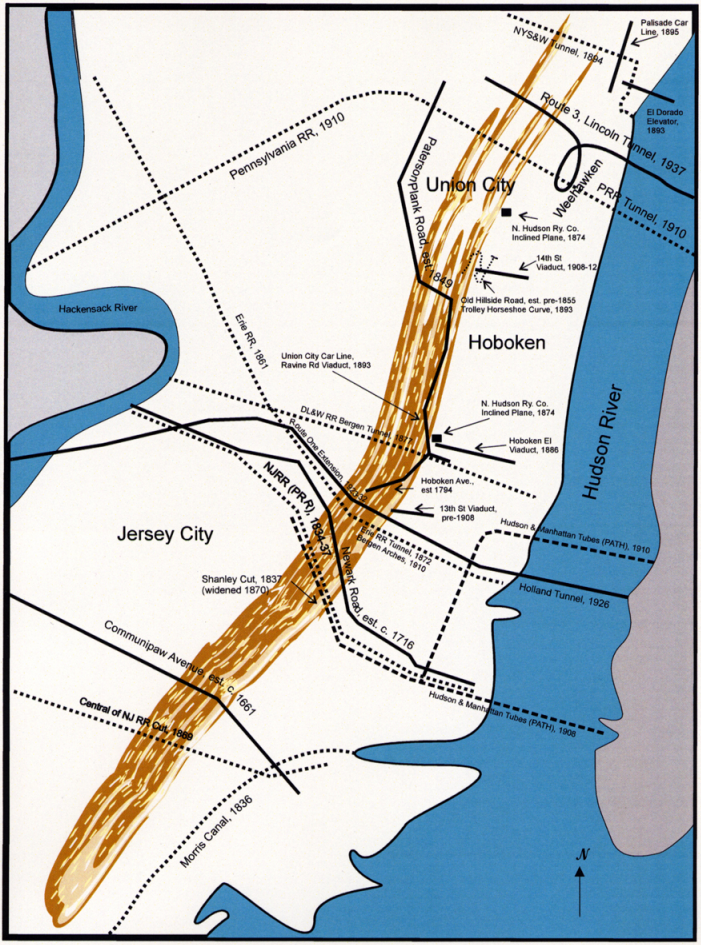



Figure 6: Hudson County transportation routes over, under, and through the Bergen Hill, 1660s-1930s.



Figure 7: View of the Morris Canal in Jersey City. Looking at the crossing of the Grove Street lift bridge. The canal followed a level line and avoided the Bergen Hill by looping south around the hill's tip in Bayonne. Source: Library of Congress, Historic American Engineering Record, NJ-21.

and the village of Bergen, which was located at the modern-day intersection with Bergen Avenue. Another early road was Newark Road (now Newark Avenue in Jersey City). It originally wound its way over the east face of the Bergen Hill by way of a ravine. From the early eighteenth century, Newark Road was the dominant route between Manhattan and Newark by way of the Paulus Hook ferry over the Hudson River (est. pre-1716).

Both the Communipaw and Newark roads illustrate an enduring trend in Hudson County's transportation patterns: the eastern terminals of important east-west through routes were invariably ferries to Manhattan. Only in the first half of the twentieth century would the ferries be superseded by tunnels under the Hudson River, with the first being the Hudson & Manhattan Railroad tubes (now PATH) opened in 1908, followed by the Pennsylvania Railroad tunnel in 1910, the Holland Tunnel in 1926, and the Lincoln Tunnel in 1937 (A. G. Lichtenstein 1994: 155-158).

The 1790s to 1850s saw some significant efforts to upgrade the few roads crossing the Bergen Hill, primarily by improving grade, alignment, and road surface. These efforts were invariably in response to travel and commerce associated with Hudson River ferries. In 1794 Hoboken Avenue was laid out from Five Corners (now Jersey City) to the Hoboken Ferry. The road was built into the side of the Bergen Hill for a distance of approximately one-quarter mile, accomplishing a vertical elevation change of 75 ft. with a grade of approximately six percent, easily negotiated by wagons. In 1804 the Newark Turnpike Company took over the Newark Road, straightening and regrading the route through the ravine. This made it suitable for fast stagecoaches that were capable under ideal conditions of covering the eight-miles from the Paulus Hook Ferry to Newark in less than thirty minutes. In 1849 the Paterson & New York Plank Road Company constructed a wood plank-surfaced turnpike from Paterson to the Hoboken Ferry, a distance of 15 miles. The turnpike climbed one of the longer, steeper sections of the Bergen Hill, along the route that is still known as the Paterson Plank Road, although the wood planks that formed its surface are long gone. The road was placed on a rock shelf carved into the Bergen Hill's side from 1st Street in Hoboken to Palisade Avenue in West Hoboken (Figure 11d) (A. G. Lichtenstein 1994: 96, 157; Van Winkle 1924: 209).

Wagons or stagecoaches could, with effort, climb grades exceeding 12 percent, but canals and railroads required nearly level grades making the Bergen Hill a challenge of an entirely different magnitude. The Morris Canal, established in 1836 to bring Pennsylvania's coal to tidewater, was no match for the Bergen Hill. Its builders chose to avoid the ridge altogether, forgoing the locks and inclined planes used to negotiate steep topography in other New Jersey locations. Instead, the canal went many miles out of its way to follow natural levels by looping around the Bergen Hill through Bayonne to enter its Jersey City port basin from the south (Figure 7).

The first significant effort to alter the natural topography of the Bergen Hill began with the New Jersey Railroad's struggle to cut through the hard rock south of Newark Avenue from 1834 to 1837. The resulting excavation, known as Shanley Cut, was blasted out with gunpowder and manual labor. Although a major engineering achievement for its

time, it was nonetheless considered unfavorably winding and steep. Thirty years later, the Pennsylvania Railroad, which had acquired the New Jersey Railroad, went to considerable expense to deepen, widen, and straighten the Shanley Cut (Figure 8) (Eaton 1899: 101; Van Winkle 1924: 106-7; Gabrielan 1999: 106).

With the coming of railroads in the mid-nineteenth century, the county's Hudson River waterfront became prime real estate. By the 1870s, seven major railroads were competing for space to load and unload their cargos. This competitive situation was the breeding ground for engineering ingenuity when it came to solving the challenge of the Bergen Hill. From 1861 to 1872, the Erie Railroad[2] bored a 4,000-ft.-long, double-track tunnel straight through the ridge in Jersey City north of Newark Avenue (Figure 9). By 1897, traffic in the smoky tunnel had increased to the point that the Erie decided to literally build over top of it a 4,400-ft.-long, 75-ft.-deep cut for an additional four lines of track. This engineering marvel, known as the Bergen Arches, for the arch bridges spanning the cut, was completed in 1910 (Figures 9, 10, 13, 14). Another open cut was built by the Central of New Jersey Railroad south of Communipaw Avenue in Jersey City in 1864-69. The Delaware, Lackawanna & Western Railroad pushed its own lengthy tunnel through the Bergen Hill in 1877 and later widened that tunnel and added a second parallel tunnel in 1906-09 (Figure 9). The DL&W tunnel exited the east face of the Bergen Hill near Reservoir Avenue in Jersey City. The New York, Susquehanna & Western Railway took 18 months to tunnel through the Bergen Hill from North Bergen to Weehawken in 1894 (A. G. Lichtenstein 1994: 160-62).

The Jersey City & Bergen Railroad became Hudson County's first streetcar line in 1859, inaugurating a new era in transportation developments. As the streetcars proliferated, they eventually plied nearly every major street in Hudson County, delivering thousands of commuters each day to the Hudson River ferries into the late 1920s. The streetcars were a significant factor in the growth of the residential neighborhoods that eventually covered the top of the Bergen Hill from North Bergen to Jersey City. Although the streetcars typically traveled on tracks placed in existing streets, they also built a number of dedicated facilities for delivering their cars or passengers to and from the top of the Bergen Hill. These included inclined planes, an elevator, and a viaduct.

The North Hudson County Railway built two inclined planes (funiculars) to transfer horse-drawn streetcars in 1873-74. One was located at Ferry Street in Hoboken and the other near 19th Street in Weehawken (Figures 11a, 11b). Both operated into the 1920s, although once the streetcars electrified the inclined planes were relegated to lifting wagons. Perhaps the must unusual of the North Hudson's facilities was the gigantic El Dorado Elevator built in 1893 at about the present-day location of Boulevard East and Liberty Place in Weehawken (Figure 11c). The elevator lifted passengers 148 ft. vertically between the ferry pier and the top of a steel bridge that extended 900 ft

[2] This line will be referred to as the Erie Railroad throughout, but the name has varied over time. The company was chartered as the New York & Erie Rail Road in 1832. It went bankrupt and was reorganized as the Erie Railway in 1861. It was reorganized as the Erie Railroad in 1895. In 1960, the Erie Railroad merged with the Delaware, Lackawanna & Western to become Erie Lackawanna Railroad.

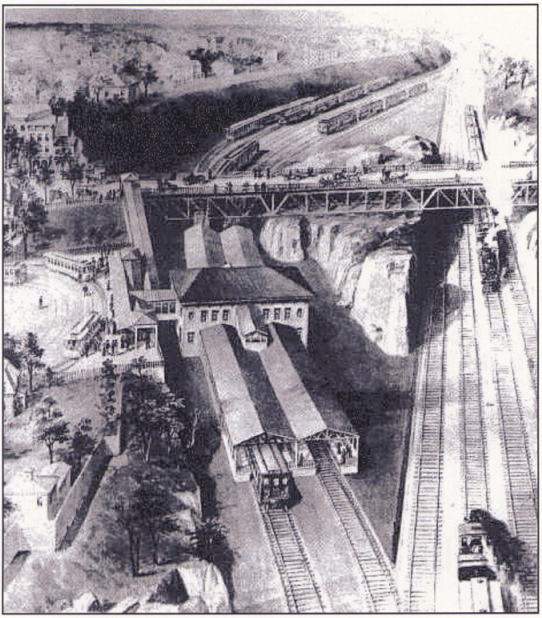


Figure 8: This drawing, c. 1905, shows the four-track cut through the Bergen Hill for the Pennsylvania Railroad (right) and the at-the-time proposed two-track Hudson & Manhattan Railway (left), later PATH, at the Journal Square Station in Jersey City. In 1870, the Pennsylvania RR widened and improved the grade of the original cut opened by the New Jersey Railroad in 1837. The Hudson & Manhattan opened its line along side the Pennsylvania RR in 1908-10. Source: Hudson & Manhattan Tubes Website, www.hudsoncity.net [Mar. 2, 2009].

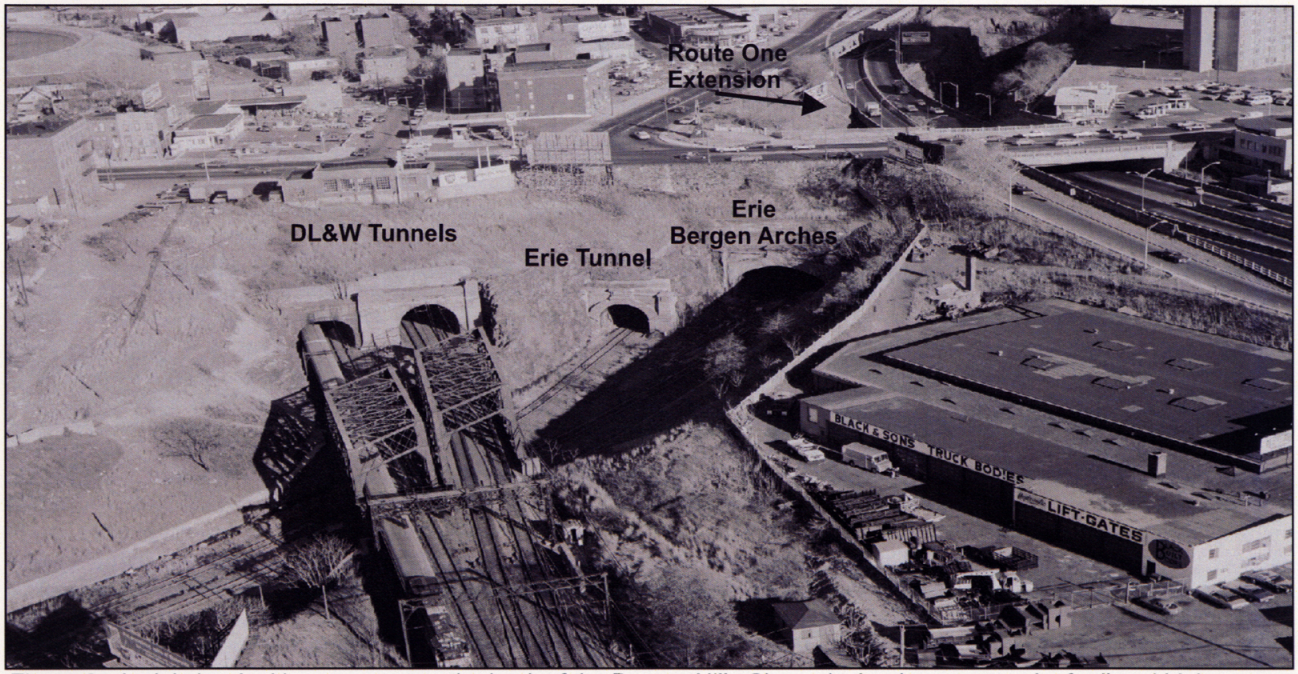



Figure 9: Aerial view looking east across the back of the Bergen Hill. Shown is the dense network of rail and highway making its way through the Bergen Hill. From right to left are the Route One Extension (1923-32), the Erie Rairoad's Bergen Arches (1910), the Erie Railroad's Bergen Tunnel (1861-72), and the Delaware Lackawanna & Western's Bergen Hill Tunnel (1877, 1906-09). Source: Library of Congress, Historic American Engineering Record, NJ-22. Aerial photo by Jack Boucher, 1978.



Figure 10: The Erie Railroad's Bergen Arches. The cut through the Bergen Hill was completed in 1910. Postcard, ca. 1920.

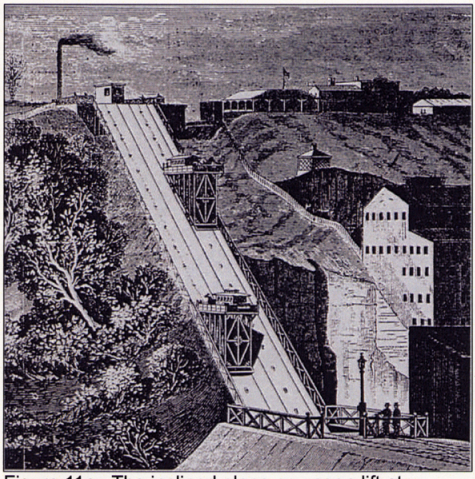


Figure 11a: The inclined plane or wagon lift at Hoboken. Source: Weehawken 150 Years, 2009.




Figure 11b. The inclined plane or wagon lift at Weehawken Postcard, c. 1912. Source: Weehawken 150 Years, 2009.




Figure 11c: The passenger elevator, also known as the El Dorado Elevator, carried passengers between the ferries and streetcars in Weehawken. Source: Scientific American, Oct. 31, 1891).

horizontally from the top of the Palisades out into the Hudson. At the top of the elevator passengers had the choice of streetcars or a steam train with direct service to the El Dorado hotel or the Guttenberg race track ("Gigantic" 1893; Weehawken 150 Years, 2009).

In 1884 the North Hudson County Railway determined that the inclined plane at Hoboken was a bottleneck in its operations, so it was supplemented by the first of the Bergen Hill viaducts, completed in 1886. Known as the Hoboken Elevated (Figure 11d), it extended along the present-day route of Observer Highway from the Hoboken Ferry to the top of the bluffs with a vertical rise of nearly 125 ft. It was initially a cable-car system, but converted to electric trolley in 1892. The inclined plane continued in operation for horse-drawn wagons until it was demolished in 1928, while the Hoboken Elevated was in use until 1949. The Union City Car Line also built a high viaduct over Jersey City's Ravine Road in 1893 on its route that paralleled the old Paterson Plank Road.

Other streetcar lines chose to negotiate the Bergen Hill with serpentine routes or switchbacks cut into the sides of the bluff. The 1893 Hillside Car Line of the Jersey City, Hoboken & Paterson Railway, better known as the Old Hillside Road Trolley Horseshoe Curve (Figures 12, 18, 19), was located above 14th Street in Hoboken (for more on this trolley line, see below). The Palisade Car Line, which opened in 1895, was located at 48th Street in Weehawken. Both of these lines took advantage of electrified trolleys, which could more easily negotiate the steep grades and switchbacks than horsecars (Hamm 1991: 5-7, 193-99, 217, 225, 227; Doherty 1986: 67; Hans 2005: 55; Heaney 1976: n.p.).

With the growth of automobile traffic in the early twentieth century, additional viaducts were built to improve access to the Bergen Hill. Jersey City's 13th Street Viaduct was built prior to 1908, providing a route over the railroad tracks at the foot of the hill and a relief route for traffic on Hoboken Avenue (Figures 13, 14). And, of course, Hoboken's 14th Street Viaduct opened in 1912 offering an improvement over the winding Old Hillside Road (see below for more details). Both of these viaducts, like their predecessor the 1886 Hoboken Elevated, used a combination of metal truss and girder-floorbeam spans supported on metal bents.

The automobile age was a challenge to Hudson River ferries, which did not have the capacity to accommodate the growing number of motorists desiring to cross. The response was two new river tunnels – the 1926 Holland Tunnel and the 1937 Lincoln Tunnel. Providing high-capacity highways to bring traffic from the top of the Bergen Hill to the tunnel portals also proved to be an engineering test. The State Highway Department of New Jersey rose to the challenge by building a landmark through route between Newark and the Holland Tunnel from 1923 to 1932. This route, known as the Route One Extension, was widely regarded as one of America's first superhighways. The 13-mile route featured an innovative combination of viaducts, cuts, and bridges that maintain the grade and limited access through a densely developed urban setting. The




Figure 11d: The Hoboken Elevated Railway was the first major viaduct to provide a connection between Hoboken and the top of the Bergen Hill. It opened in 1886. This drawing also shows the inclined plane (top left and lower right) built in 1874 that had previously lifted the streetcars. The Paterson Plank Road (top right) is also shown. Source: Scientific American, Feb. 20, 1886).

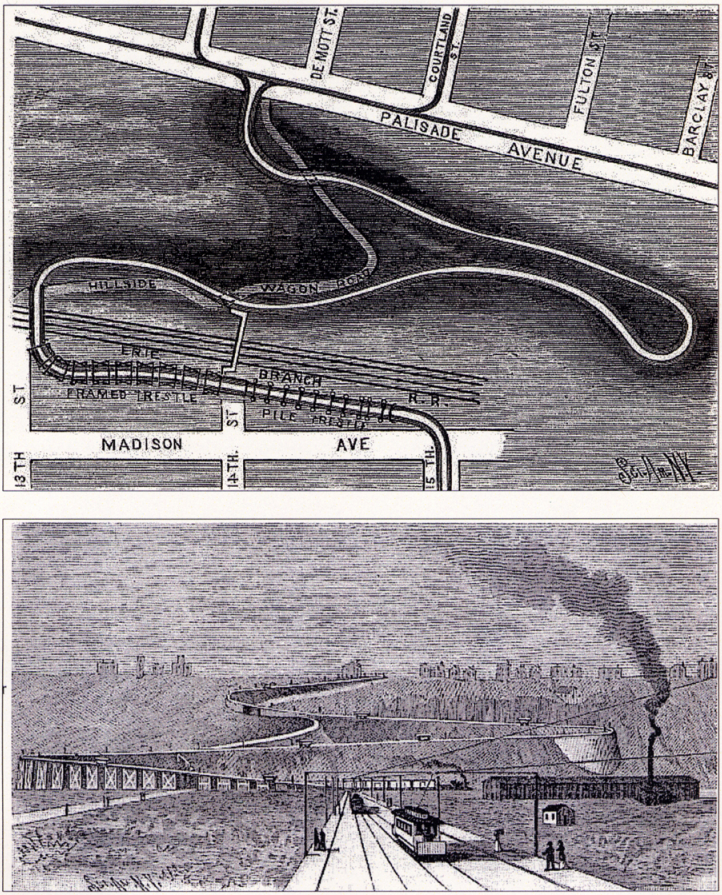
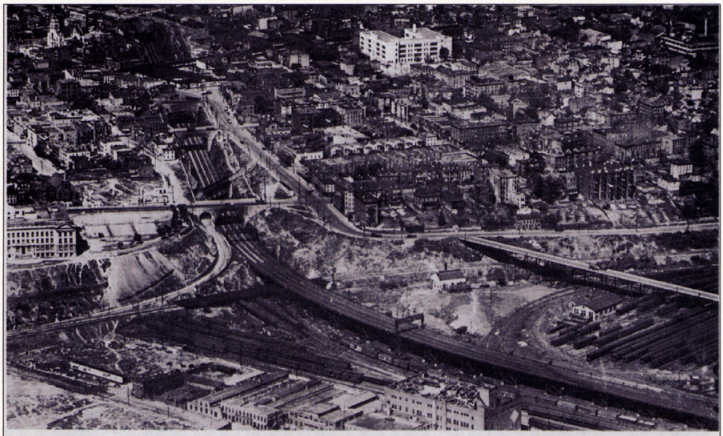



Figure 12. Old Hillside Road Trolley Horseshoe Curve. In the plan view (top), are also shown the Old Hillside Road and a pedestrian bridge and/or stairway located at 14th Street. Source: Scientific American, April 21, 1894.



**The Bergen Cut looking west from Jersey City Coach Yard at lower right.**
**September 24, 1921**

Figure 13: Aerial view (1921) showing the 13th Street Viaduct in Jersey City (right) and the Erie Railway's Bergen Arches.

highway passes through the Bergen Hill in a subway with an open side, parallel to the Erie Railroad's Bergen Arches, and then descends the hill to the portal of the Holland Tunnel on a viaduct composed of a combination of reinforced-concrete arch and steel girder-floorbeam spans (Figure 14). Following in the steps of the Route One Extension was the mid-1930s Route 3 Approach to the Lincoln Tunnel in Weehawken, Union City, and North Bergen. The 2.8-mile-long highway traverses the Bergen Hill through an open cut featuring multi-level ramps and overpasses. Route 3 Approach transitions from the crest of the Bergen Hill to the tunnel via a marvelous, helix-shaped viaduct that allows the approximately 150-ft. descent to the tunnel portal within a limited footprint (Figure 15) (A. G. Lichtenstein 1994: 164-65; Lichtenstein Consulting Engineers 2005).

**Historic Overview of Hoboken's 14th Street Vicinity**

The history of the 14th Street Viaduct, in addition to being part of a larger context of transportation over and under the Bergen Hill in Hudson County, is also specific to the 14th Street vicinity and the nearby neighborhoods in north Hoboken and Union City. This section of the historic documentation explores that local context.

Hoboken was settled by the Dutch in the 1630s, had become a thriving village by the 1810s, and had grown into an industrial city by the 1880s; yet the area immediately surrounding the 14th Street Viaduct in the northwest corner of Hoboken was sparsely developed until the early twentieth century. One factor explaining the delayed development was 14th Street's distance about three-quarter mile north of the historic center of downtown Hoboken, but the primary factor limiting development was a problem with flooding that was not adequately solved until the provision of an improved storm sewer system in the late-1910s.

Hoboken initially grew on a rise of land, adjacent to the Hudson River, and centered around Castle Point, a promontory jutting out into the river, about one mile south of present-day 14th Street. The area to the west, between Castle Point and the Bergen Hill was a marsh, measuring on average a quarter-mile wide east to west, and 1½-miles long north to south, through which flowed Hoboken Creek. The 14th Street Viaduct crosses over what was once the northern end of the marsh. The marsh flooded during high tides and heavy rains; it was a significant factor limiting Hoboken's growth westward beyond the narrow, higher strip of land along the river well into the nineteenth century (Van Winkle 1924: 290).

During the colonial period, the marsh was used to grow salt-hay as feed for livestock, and settlers had little concern with claiming the land for other uses. Both the Dutch and later English landowners built houses and prosperous farms near the river in the vicinity of Castle Point. From the 1710s to the American Revolution, the largest property owners were the Bayards of New York City who had a plantation and summerhouse at Castle Point. The Bayard property consisted of most of modern-day Hoboken east of the Bergen Hill between Observer Highway to the south and Weehawken to the north, inclusive of modern-day 14th Street (Winfield 1874: 318).



Figure 15: New Jersey Route 3 approach to the Lincoln Tunnel loops its way down from the Bergen Hill. Aerial (1991) from the Library of Congress, Historic American Engineering Record, NY-307.

Colonel John Stevens (1749-1838), who purchased the Bayard property in 1784, oversaw Hoboken's early growth from plantation to village. Stevens built the first commercial wharves south of Castle Point at the location of the old Paulus Hook Ferry. He laid out 800 lots for sale in the southern part of Hoboken in 1804. In addition to land development, Stevens and his sons operated one of the nation's first steam ferries in 1811, and they played a pivotal role in the development of steam-locomotive technology.

Prior to the 1860s, Hoboken village was best known as a popular day-trip destination for New Yorkers. The Stevens family sponsored attractions including a picnic ground, a grotto with fortune-teller, and a park and river walk known as the Elysian Fields, located between modern-day 8th (some histories say 10th) and 15th streets. The northwestern corner of the Elysian Fields probably extended to the intersection of 14th and Park, but no evidence of the Elysian Fields remains today having been built over from the 1880s to 1920s. Hoboken was incorporated as a city in 1855 (Winfield 1874: 319; Van Winkle 1924: 285-87, 355; Kraft 1978:13).

Hoboken's proximity to New York City eventually drew it into the urbanization of the metropolitan region with all of the patterns and tendencies associated with a prime location on New York Harbor, especially the important rail connections terminating on the New Jersey side. When Stevens died in 1838, his heirs formed the Hoboken Land & Improvement Company with the expressed interest of developing all of the unsold lands in Hoboken. At the time, Hoboken's population was approximately 1,000. Over the next half century under the guiding hand of the improvement company, which still owned over a third of the land in Hoboken as late as 1893, the population swelled to over 60,000 with much of the new population German and Irish immigrants. In 1862 the improvement company constructed a section of railroad, thereby enabling the Morris & Essex Railroad (later Delaware, Lackawanna & Western) to reach Hoboken. The railroad gained permission to use the Erie Railroad's tunnel to pass under the Bergen Hill and extended its own branch from the tunnel to terminate at the ferry near the foot of present-day Ferry Street (Van Winkle 1924: 285; Kraft 1978: 13-14; Kolva 2002: 12).

As Hoboken grew, development first concentrated south of Castle Point near the ferry and railroad terminal, and then began spreading north along the Hudson River since almost all of the land to the west between Willow Avenue and the Bergen Hill was marsh. The Hoboken Land & Improvement Company's plat favored the typical nineteenth-century, dense, urban pattern of rowhouses and tenements on narrow lots, also further concentrating development in the blocks closest to the Hudson. The improvement company required that all houses be at least three-stories tall and of stone or brick. Residential development had spread northward along the river to about 11th Street by 1873, and it had reached its historic northern limit at 14th Street by 1890 (Photo 076).

The improvement company sold a large tract of land north of 14th Street bordering Weehawken Cove to W. A. Fletcher Company in 1893 for a shipyard. Fletcher soon became the largest industrial employer in north Hoboken. The shipyard was purchased

by the Bethlehem Steel Corporation in 1938 and remained in operation until 1982. It has since been redeveloped as a marina. The 1862 Hoboken Gas Works was located adjacent to the marsh, on the west side of Willow Avenue, just south of 14th Street, but most significant nineteenth-century industries, like the Fletcher shipyard, were located on the Hudson with easier access to water and rail transport (Hopkins 1873; Sanborn 1891; Van Winkle 1924: 288, 294; Deland 1988: 3-4; Kolva 2002: 12).

Hoboken's development to the west of Willow Avenue between 13th and 15th streets, including all of the parcels immediately adjacent to the future 14th Street Viaduct, was retarded by the marsh (Figure 16). This broad flat area at the base of the Bergen Hill may have seemed ideal for development, but it turned out to be a persistent obstacle. John Stevens sold the meadowlands to Samuel and Robert Swartout in 1814. They tried draining and reclaiming the land for agriculture purposes without much success. John G. Coster took the land by foreclosure in 1819 and then simply held on to it over the next 40 years. It is likely that in addition to growing salt-hay, the land also had some value for its access to the trap-rock quarries that ran all along the base of the Bergen Hill, long a source of stone for ship's ballast and building material (Kraft 1979, pp. 14-15; Sanborn 1910).

Coster's heirs, following the lead of the Hoboken Land & Improvement Company, platted the meadowlands in 1860 and began selling lots, mostly to land speculators. Tidal gates were built to prevent high tides from flooding the marsh, but after a short period this scheme exacerbated the problem because the soft soils compacted and sunk nearly two feet creating an area that was well below mean high tide and thus even more prone to flooding and standing water, not to mention foul smells. Water run-off and sewerage from the communities atop the Bergen Hill also collected in the marsh with nowhere else to go. A sewer was proposed at 15th Street in 1866, but not built (Ewen & Ewen 1860; Van Winkle 1924: 288-90, 296-98).

Over the next 40 years, private developers gradually filled in the marsh, often using their own funds to raise the grade. The city tried several makeshift drainage schemes with unsatisfactory results. As late as 1912, the city produced a map showing areas that regularly flooded (Figure 17), which included all of the blocks north and south of 14th Street west of Willow Avenue. The soft soils would eventually also prove a challenge to the 14th Street Viaduct's foundations, which developed a problem with uneven settlement during its first 25 years (see below).

The spotty development pattern of the area reflected the seriousness of the drainage problem. The lots west of Willow Avenue between 13th and 15th streets remained largely vacant prior to 1910 with only a scattering of residences and small industries, including a cooperage, stonecutters, small ironworks, and a junkyard (all non-extant). The development was notably sparse given the huge development pressures that were facing the city by the early twentieth century. The flooding was finally remedied through

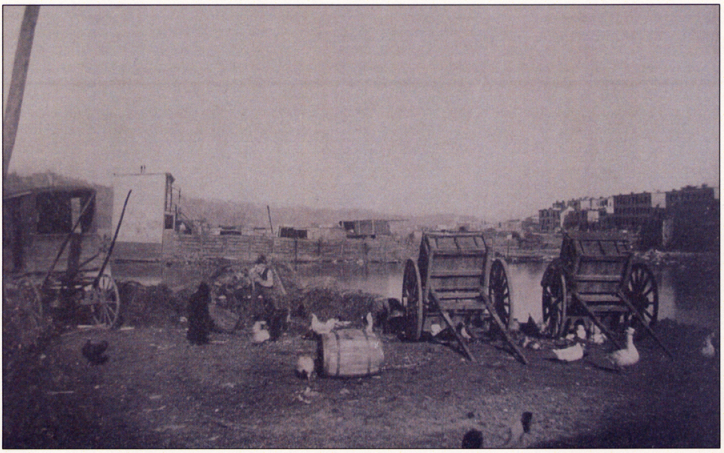


Figure 16: View of Hoboken marshes between town and the Bergen Hill, looking north. Flooding was a persistent obstacle to the development of the marsh until the early twentieth century. Notice the line of buildings (right) marking the edge of the high ground along the Hudson where Hoboken initially developed. Source: Daniel Van Winkle, History of the Municipalities of Hudson County, New Jersey. (1924).

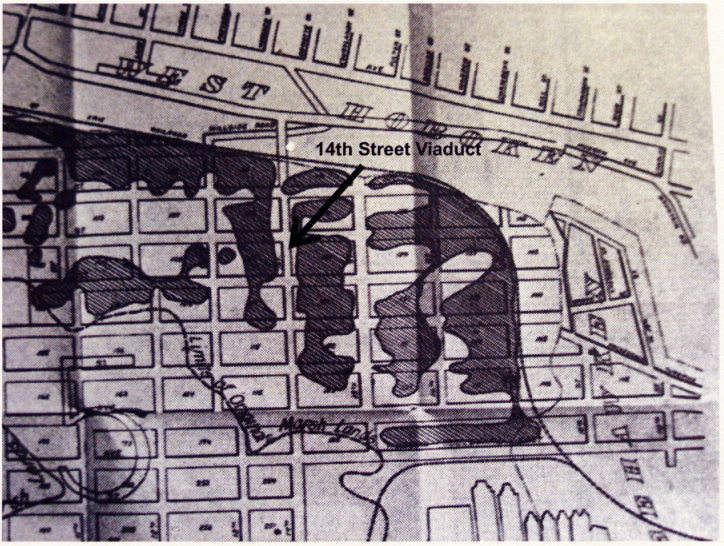



Figure 17: Detail from drainage map of Hoboken, 1912. The dark shaded areas are those that were still prone to flooding. They surround the 14th Street Viaduct. The map also shows the Old Hillside Road, although the competed viaduct would make it obsolete. Source: Herbert Kraft, "Hudson County Sewerage Authority, Facilities Plan, Area III, Historical and Archaeological Survey," 1978.

a comprehensive sewer system that went under construction in 1915. Completion was delayed several more years due to a series of political scandals involving kickbacks and bribes to city officials (Van Winkle 1924: 297-98; Foster and Clark 1976: 68; Hopkins 1908).

Once the drainage problem was solved, more manufacturers moved into the 14th Street area during the 1910s and 1920s, but it never became prime industrial property probably due to its late development and the onset of the Great Depression. Today, a few remnants of this modest industrial expansion are still found in operation including a *circa* 1925 aluminum foundry in the 1300 block of Adams Street (Photo 083, American Magnesium Aluminum, 1316 Adams Street) and a *circa* 1925 soap works in the 1400 block of Willow Avenue (Photos 049, 084; Stahl Soap Works). Most pre-WWII industries have been lost during the past thirty years as part of urban renewal and redevelopment projects. Prominent among the lost industries are a paint factory at 14th and Willow, a textile mill at 13th and Clinton, and a casket factory at 14th and Grand. Buildings associated with a few of the concerns, for example the *circa* 1900 brass foundry at 14th and Clinton (Photo 085, 1405 Clinton Street) and the *circa* 1925 pipe bending works at the 1300 block of Jefferson and Madison (Photo 086, 1300-30 Jefferson Street), have been re-used for other purposes but highly altered in the process. Other former industrial buildings are vacant, like the five-story brick factory at the corner of 15th and Grand that produced gravure cylinders for printing presses (Photo 087, 1422 Grand Street). (Sanborn 1910, 1937, 1951).

During the 1960s and 1970s, the area north of 14th Street became a prime area for commercial bus maintenance and service facilities, no doubt because several square-blocks remained un-built, thus providing the necessary off-street parking and maintenance areas, as well as reasonably close access to the Lincoln Tunnel in Weehawken (Sanborn 1979). These modern commercial bus and limousine operations dominate the area north of the 14th Street Viaduct.

Over the course of the 1990s and 2000s, Hoboken's resurgence as prime residential real estate has created opportunities for modern development to replace or move in along side some of the older businesses remaining in the 14th Street Viaduct area. Perhaps most striking are the blocks to the south of 14th Street, once industrial, that have been built upon with new, square-block-size, four-to-six-story condominium complexes and a shopping center (Photo 054).

**History of Local Transportation Patterns in the 14th Street Vicinity**

The Bergen Hill rises steeply at 14th Street and throughout north Hoboken but then gradually descends to become less steep in south Hoboken. Naturally, the earliest roads connecting Hoboken and the top of the Bergen Hill were in south Hoboken, which afforded the easier grades and access to the center of population. These early roads, lying along the present-day routes of Newark Road and Paterson Plank Road, about three-quarters of a mile south of 14th Street, remained adequate as long as Hoboken was a

small city concentrated at its south end, but as the city grew north toward Weehawken in the late-nineteenth century another more northerly route became increasingly desirable.

A transportation connection between north Hoboken and the Heights was also desirable because of the growth of the communities on the top of the Bergen Hill. Union City, which lies above the west end of the 14th Street Viaduct, was known as West Hoboken prior to 1924 (West Hoboken and Union Hill merged in 1924 to become Union City.) It was an area of farms and small villages up until the 1850s, after which it became a popular location for German immigrants to settle. By no coincidence, West Hoboken, incorporated in 1861, also became a center of the brewing and embroidering industries, occupations in which the Germans traditionally excelled. Growth was delayed in West Hoboken as compared to Jersey City to the south, in large part because it was just that much higher above the port. Nonetheless, West Hoboken became increasingly urban during the late-nineteenth century with rowhouses, tenements, and industries. These residents and businesses desired improved access to the harbor, railroads, warehouses, and manufacturers below in north Hoboken (Van Winkle 1924: 399).

The Old Hillside Road

The Old Hillside Road, a winding road replaced by the 14th Street Viaduct after it opened in 1912, dated to at least the mid-nineteenth century (Figures 12, 17). Wood's 1855 map shows a steep cartway climbing the Bergen Hill beginning at the west end of 13th Street in Hoboken and ascending steeply north beyond 14th Street before turning sharply southwest along the alignment of what is today the Yardley Stairs, which replaced that section of road after the 14th Street Viaduct was completed in 1912. Early twentieth century maps dubbed this road the "Old Hillside Road." Whatever one might say about it, the grade could hardly have been satisfactory for laden wagons, and it must have been a strenuous climb and potentially perilous descent for just about any type of wheeled conveyance in those days (Wood 1855; Hopkins 1909).

The Hillside Streetcar Line (Old Hillside Road Trolley Horseshoe Curve)

The first significant transportation improvement between north Hoboken and West Hoboken (Union City) was built in 1893 by the Jersey City, Hoboken & Paterson Railway. The streetcar company dated to the early 1860s and was the consolidation of several separate lines, including a five-mile-long route along Bergenline Avenue and other streets in West Hoboken and Union Hill. The company decided in 1893 to extend its route with a line that could scale the Bergen Hill, thus connecting it with the harbor below. The decision may have been prompted in part by the decision to electrify the streetcars, thus providing the motive power necessary to negotiate the steep grade ("The Hillside Line" 1894; Francis & Walrath 1946; Bzdak 1992).

The Hillside Trolley Line was literally cut into the hard rock of the Bergen Hill with a lengthy system of stone retaining walls and two switchbacks (hairpin turns) (Figures 12, 18, 19). It descended the Bergen Hill beginning at Palisade Avenue and 6th Street in

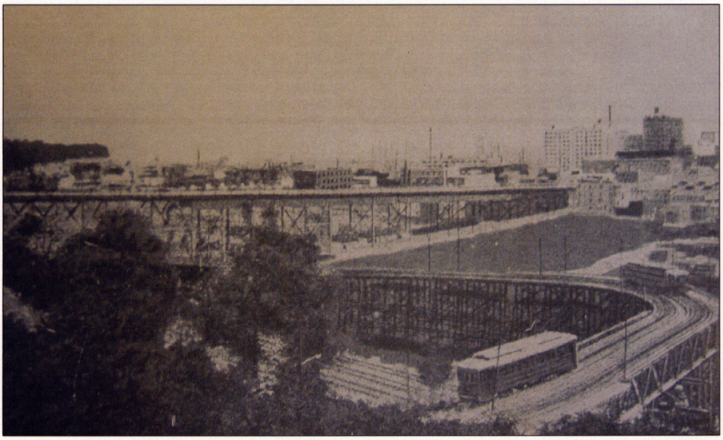


Figure 18: The 14th Street Viaduct and the Hillside Trolley line. Source: Daniel Van Winkle, History of the Municipalities of Hudson County, New Jersey, (1924)

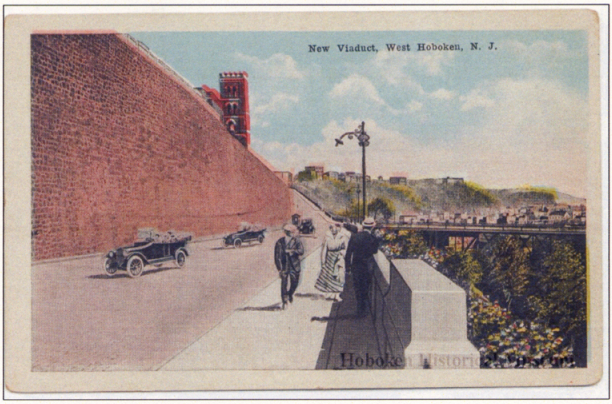






Figure 19: 14th Street Viaduct. Postcards, ca. 1920-30. Source: Hoboken Historical Museum.

Union City winding down the hill in a northerly direction before coming to the first of the switchbacks to turn south. It then passed under the present-day alignment of the westernmost span of the14th Street Viaduct (which was not there when the trolley line was built) before coming to the second switchback about one third of the way up the bluff and west of 13th Street in Hoboken. The second switchback featured an iron bridge (non-extant) to carry the trolley high over the lines of the Jersey Junction and Erie railroads (now New Jersey Transit), which ran at the base of the hill, before making its final descent to the north on a two-block-long timber trestle (non-extant) that again passed under the present-day alignment of the 14th Street Viaduct just west of where it crosses Madison Street. At the bottom of the hill, the trolley line turned east onto 15th Street, which it then followed to the river and the 14th Street Ferry. This impressive structure crisscrossing the Bergen Hill soon became known as the Old Hillside Road Trolley Horseshoe Curve ("The Hillside Line" 1894; Hopkins 1909; Hamm 1991: 225; Bzdak 1992).

The precise impact of the 1893 Hillside Trolley Line on the development of West Hoboken is difficult to gauge since the town was already booming, but it was an important factor improving the convenience of local passenger travel and was applauded as such. Of course, it did nothing to improve the climb for horse-drawn vehicles, nor would it pave the way for motor vehicles in the next century. In fact, the trolley was very short-lived. With the opening of the 14th Street Viaduct in 1912 followed by the advent of bus service during the late-1910s and 1920s, the streetcar line became increasingly obsolete and was abandoned in 1928, having operated 35 years. The trolley was replaced by buses, some of which were electrified (i.e., trolley buses), which plans show were running on the 14th Street Viaduct during the 1930s and 1940s (Hudson County Engineer 1938; Hamm 1991: 225).

Today, the Old Hillside Road Trolley Horseshoe Curve is discernible where it passed under the westernmost span of the 14th Street Viaduct and for some distance north and south along the hillside, but it is merely a trace, not a complete trolley line. Gone are the double tracks and trolley poles, and the roadbed has been greatly disturbed by the burial of a modern storm sewer in the old right-of-way. There are several sections of stone retaining wall in poor condition. Gone too are the bridge and trestle at the foot of the Bergen Hill.

**Planning and Construction of the 14th Street Viaduct**

The logic of building a viaduct to improve on the Old Hillside Road is self evident in historical perspective. The growth of Hoboken and West Hoboken, as well as the expanded use of motor vehicles, provided motivation for improving roads connecting the two cities. Plans for a viaduct began gestating as early as the late 1890s, although it would take nearly a decade more before the first spade of earth was turned. In 1897, Mayor Lawrence Fagan of Hoboken advocated the construction of a new viaduct to connect the city with the Heights. In 1898, the Board of Chosen Freeholders of Hudson County incorporated a viaduct in already existing plans for Hudson Boulevard, a major

north-south route then under construction from Bayonne to Weehawken connecting a series of parks along the west side of the Bergen Hill. The proposed viaduct was to be a branch of the boulevard beginning in Hoboken and climbing the Bergen Hill in the vicinity of 13th Street and then connecting to the boulevard's main branch. Hudson Boulevard, however, was not completed until 1908 after a major reconstruction by the New Jersey State Highway Department to better accommodate automobiles, and the proposed branch to Hoboken never materialized ("Mayor Fagin's Message, 1897; "Hudson Boulevard Branch," 1898; A. G. Lichtenstein 1994: 162).

In 1907, the Hudson County Board of Chosen Freeholders awarded a contract to the Owego Bridge Company of Owego, N.Y. to build the viaduct at 14th Street. The Owego Bridge Company assigned the contract to the affiliated Syracuse Bridge Company of Syracuse, N.Y. in 1908, which in turn subcontracted to the McClintic-Marshall Construction Company of New York, N.Y. and Pittsburgh, Pa. for the steel work, and to William B. Waldo of New York, N.Y. for concrete, paving, and excavation (see below for brief histories of the companies involved). County engineer J. W. Leahy ordered work to commence in September 1907, but the Owego Bridge Company reported back that work could not commence efficiently because the county had yet to purchase all of the required right-of-way. Property condemnation and eviction proceedings were not complete until June 1909 causing considerable delay. This became a contentious issue after the viaduct was officially completed in November 1912 when Hudson County assessed damages against the bridge company and its subcontractors for delays in performance. The contract with the county specified significant monetary damages for not completing the work within 18 months. The Court of Chancery of New Jersey eventually found in favor of the contractors based on evidence that the county had not completed the necessary right-of-way acquisition in a timely manner and had not provided the contractors with sufficient written notice of the place and time that work was to commence (McClintic-Marshall, 1915).

Unfortunately, no original 14th Street Viaduct contract files have been found at Hudson County offices, and only one of the original plan sheets dated 1908 is known to survive. There are no identified construction photos among the few historic photos, most from the collection of the Hoboken Historical Museum (Figures 19-21). Newspaper sources confirm that construction was underway by 1908 and was nearly complete by the end of 1911. The steel viaduct proper appears to have been finished during 1911 with the Manhattan Avenue connecting wingwalls being the last sections completed in 1912. The Hopkins atlas of 1909 shows the viaduct but conjecturally illustrates it extending all the way to the top of the Bergen Hill, suggesting that the map was drawn when the viaduct was still in the early construction phases and the Manhattan Avenue connections were not complete (Figure 22) (Hudson County 1938; Hopkins 1909).

Some logical conclusions can be made about the engineering considerations that shaped the viaduct's design. The topography and the site conditions were the driving factors. As ever, conquering the Bergen Hill was the challenge, and therefore a lengthy viaduct was required to minimize the grade. Tempering this consideration was the fact that the longer



Figure 20: 14th Street Viaduct. View looking east (top) and north elevation from Manhattan Avenue (bottom). From: Portfolio of Hoboken, ESEA Board of Education, 1972. Collection of the Hoboken Historical Museum.




Figure 21. View of debris adjacent to the 14th Street Viaduct (in background), ca. 1970. Source: Hoboken Historical Museum




Figure 22: Detail from Hopkins Plat Book of Hudson County, New Jersey. Vol. 2. Philadelphia: G. M Hopkins Co., 1909. The viaduct must still have been in planning or under construction because it is shown extending to the top of the Bergen Hill.

the viaduct the more expensive it would be, and this set some practical limits on the project. Existing land-use patterns in Hoboken were also a consideration; it must have been decided to keep the viaduct within the existing street pattern to prevent having to acquire additional property. Furthermore the further east the viaduct extended, the more likely it was to impact prime real estate nearer to the river and to extend into, and possibly obstruct, the city's busier north-south arterial streets, like Park Avenue. The final decision therefore was to place the viaduct's eastern terminus at Willow Avenue, just northwest of and beyond the most densely developed residential area in north Hoboken. This resulted in a bridge with a steep grade (about five percent), but not so steep as to be impractical.

The viaduct's western terminus on the side of the Bergen Hill required the construction of the Manhattan Avenue wing roads to carry traffic between the west end of the viaduct and the top of the hill. This work included another bridge called the Manhattan Avenue Viaduct over the northern hairpin turn of the Old Hillside Road Trolley and a ravine. The Manhattan Avenue Viaduct superstructure was replaced in 1939. Another practical consideration during construction must have been avoiding streets already in use by the trolley, which traveled 15th Street in Hoboken and had an overpass of the Jersey Junction and Erie rail lines at 13th Street. With those two streets obstructed, placing the viaduct on the alignment of 14th Street was a logical decision.

Once the constraints of the viaduct's site were understood, other factors came into play. The viaduct had to provide adequate vertical and horizontal clearance for the streets and rail lines that it crossed. This to some degree dictated the spacing of piers and span lengths. Another consideration was the foundation, known to be mostly an accumulation of soft sediments up to 100-ft. deep in the area that had once been a marsh between Willow Avenue and the base of the hill. These foundation conditions required deep piles to bypass the soft material. Large heavy stone or concrete piers were not a realistic possibility, but open steel towers and bents were.

The original live-load design loading of the viaduct is unknown, but the engineers probably based it on the heaviest wheeled vehicles of the day, which were usually considered to be 15-ton steam tractors and heavy rollers. The engineers would also have been aware of the cost of building materials and labor, and probably knew per-unit costs of various span types. The final selection was an economical conservative design with the two longest spans being riveted Warren deck trusses of 151-ft. long (over the Jersey Junction and Erie rail lines and the trolley-line trestle) and 132-ft. long (over Adams Street). The remaining spans were steel girder-floorbeams, measuring between 31 ft. and 67 ft. long. The entire structure was supported on a series of built-up single and double steel towers increasing in height from east to west. The engineers used bridge technology that had been well established since at least the 1880s, so there was nothing innovative; it was nonetheless an impressive and complex bit of engineering.

**The Contractors and Engineers**

Owego Bridge Company

The Owego Bridge Company of Owego, N.Y., was the general contractor that won the bid for the 14th Street Viaduct. Founded in 1892 by Ellery Colby, Owego was a mid-sized company with a workforce of about 150 men and a fabricating capacity of about 9,600 tons per year in 1903. Most of Owego's work was supplying the everyday steel-truss and girder bridges required by town and county governments to maintain local road networks. It did, however, build a number of long span bridges including the extension of Pennsylvania Avenue over the Potomac River at Washington, D.C. and a 360-ft.-long truss span at Mount Morris, N.Y. in 1893 (claimed to have been the longest single-span highway truss bridge in the U.S. at the time). Owego's market region was mainly the East Coast, and surviving examples of its work are known from North Carolina to Maine. Most of these bridges are short-span trusses, not of the scale of the 14th Street Viaduct. Owego went out of business prior to 1924.

Although Owego had its own shops, the work of fabricating and erecting the 14th Street Viaduct was assigned by Owego to the Syracuse Bridge Company of Syracuse, N.Y., which in turn subcontracted that work to the McClintic-Marshall Construction Co. The reasons for this arrangement are unknown, but one likely scenario is that Owego did not have the available capacity to complete the work. It is also possible that Owego may have acquired Syracuse Bridge since this was an era of consolidation and merger in the industry (Yeatby 1987: 2-3).

McClintic-Marshall Construction Company

The McClintic-Marshall Construction Company that provided the steel fabrication and erection for the 14th Street Viaduct was formed in 1900 by two former officials of the Shiffler Bridge Works of Pittsburgh. McClintic-Marshall had the financial backing of the Bethlehem Steel Corporation, which fashioned McClintic-Marshall as a bridge subsidiary in response to U.S. Steel's acquisition of the American Bridge Company in 1901 (McClintic-Marshall would never rival American Bridge in output). McClintic-Marshall purchased the former bridge works of the Pottstown (Pa.) Bridge Company in 1900 and had also opened a fabricating shop in Pittsburgh by 1903. With the backing of Bethlehem Steel, McClintic-Marshall grew quickly and comprised 13 individual works from Boston to Los Angeles by 1932, with a capacity of a million tons of steel work per year. The company listed offices in Pittsburgh and New York. McClintic-Marshall was best known as a contractor on large bridge projects, although it fabricated its share of smaller standardized spans. The company was particularly noteworthy as the fabrication contractor for several long-span bridges in the New York City metropolitan area, including the Pulaski Skyway, the George Washington Bridge, the Outerbridge Crossing, and the Goethals Bridge. The 14th Street Viaduct is representative of the company's body of work (McClintic-Marshall 1932).

William B. Waldo

William B. Waldo was a contractor and consulting engineer with offices at 149 Broadway in New York, N.Y. He was responsible for the 14th Street Viaduct concrete work including paving and foundations, as well as excavation. In January 1913, Waldo filed for bankruptcy, citing as reasons the failure of the Woodhaven Bank and the refusal of Hudson County to pay for work completed due to contractual disputes.

J. W. Leahy, Hudson County Engineer

J. W. Leahy, Hudson County Engineer approved and signed the plans for the viaduct in his official capacity as county engineer. Leahy's background was primarily related to railroads, including work as a superintendent of track for the Pennsylvania Railroad in Tacony, Pa., and work for the North Jersey Street Railway prior to becoming county engineer in about 1905. Leahy died in 1909 before the viaduct was completed (Proceedings of the American Railway Engineers Association, 1909: 16; The Official Railway List, 1890: 168; Report of the Annual Meeting of the American Street Railway Association 1902).

Thomas J. Wasser, Supervising Engineer

Thomas J. Wasser (1871-1933) was the supervising engineer (site manager) at the 14th Street Viaduct construction site and the most distinguished engineer to have direct involvement with the bridge. Wasser later served as the Hudson County Engineer (1913-33) and served a two-year term as State Highway Engineer of the New Jersey State Highway Commission (1920-22). He was an able administrator and a dedicated public servant with responsibility for numerous public works in Hudson County and New Jersey.

Wasser was born in Philadelphia in 1871 and attended the Philadelphia Manual Training School, supplementing his training as a civil engineer with private courses. His early career was as an engineer supervising the construction of macadam and telford (stone-paved) roadways with the B. M. and J. F. Shanley Company of Newark, N.J. From 1903 to 1913, he was employed by the Robert W. Hunt Company, which was engaged by Hudson County to provide construction supervision and management. It was during this period that Wasser managed the construction of the 14th Street Viaduct. In 1913 he became the Hudson County Engineer. A notable achievement during his tenure as county engineer was the reconstruction of Newark Road. The New Jersey State Highway Commission appointed Wasser to a two-year term as the State Highway Engineer, in charge of the administration of the highway department in 1920. In the late 1920s and early 1930s, Wasser became heavily involved in addressing northern New Jersey's water pollution problems. He advocated a regional approach to sanitary engineering that resulted in the formation of the Hackensack Valley Sewerage Commission. Wasser was the commission's first chairman. (Dullard 1922: 423-24; Thomas J. Wasser 1933: 393).

**Labor Unrest and the Dynamiting of the 14th Street Viaduct**

At about 3 a.m. on March 31, 1909, a charge of dynamite was set off at the base of one of the viaduct's piers at about 14th and Grand streets, blasting apart one of the steel bent columns (Figure 23). Although by all reports the blast was deafening and shook buildings for miles around, the damage to the viaduct was actually relatively minor. The bent was repaired in short order. The greatest damage was to the shattered windows of surrounding buildings. Debris flew for hundreds of yards causing minor injuries, mostly from broken window glass. Police arrived on the scene quickly, comforting the frightened inhabitants, most of whom had been asleep in their homes, but the culprits had escaped. The mood at the work site, however, was grim.

News reports attributed the bombing to either disgruntled workers or to "union labor sympathizers" protesting the use of non-union labor on the job. The contractors reported receiving threatening letters prior to the attack. The letters had been received after two Italian laborers had been killed during blasting for the viaduct's foundations several months prior to the bombing. In response, the contractors had begun employing watchmen, who had been patrolling the viaduct the night of the attack but had failed to detect the bombers. The watchmen did, however, apparently thwart an attempted bombing of the Manhattan Avenue Viaduct about five months later in early September 1909. In that case, the watchmen scared off three or four men who dropped a bundle of dynamite while making their escape ("Explosion in Hoboken" 1909; "Dynamiter Tries to Blow Up Viaduct" 1909; "Tried to Blow Up Bridge" 1909).

The dynamiting of the 14th Street Viaduct was not an isolated incident. There were reports of up to 150 bombings at structural-steel work sites nationwide from 1908 to 1912. It was a turbulent era in labor relations within the steel construction industry with a nationwide labor "war" waged between the National Erectors' Association (NEA), representing the industry, and the Iron Workers Union, representing labor. McClintic-Marshall Construction Company had a reputation for its strong anti-union stance, including a policy of employing an open shop on all of its jobs and firing any workers suspected of union sympathies. The company defended its employment practices by stating that it paid union wages. Within the labor movement, the NEA was despised for its efforts to break up unions including the use of police and hired security to forcibly smash picket lines. The NEA also worked to pass laws that outlawed strikes and labor meetings, and it rebuffed worker demands for improved safety measures, like life nets (At least three works died building the 14th Street Viaduct, the two Italian laborers killed in the blast previously mentioned, and a third worker who was thrown into a stone crusher by a broken driving belt.) The explosions at work sites across the United States were largely believed to be retaliation against NEA members as part of an organized campaign to force them to recognize the union. The union's official position was that the bombs were set by individual workers disgusted with the treatment they were receiving. There were also allegations that detective agencies and spies hired by the NEA to fight unionism staged the bombings to whip up anti-union sentiment.



*Courtesy of The New York Evening Journal*

A typical "Peace" argument. On March 31, 1909, six persons were injured and several houses in Hoboken (N. J.), partly demolished by the explosion of a nitro-glycerine bomb placed under a new $350,000 traffic viaduct being built by a construction company involved in labor troubles.

Figure 23: Photo of the damage from the March 31, 1909, dynamiting of the 14th Street Viaduct. Source: "Lawless Unionism," American Industries (October 1911), p. 15.

The dynamiting was front-page news, and the press was largely pro-business in its attitude. The business community's desire to identify and punish the perpetrators reached a high pitch when an explosion at the Los Angeles Times Building in California killed twenty newspaper employees in 1910. The newspaper had been strongly anti-union in its editorials. In the wake of that bombing, the leaders of the Iron Workers Union were forcibly rounded up by police and private security. In the most notable instance, private detectives hired by the NEA entered the union's headquarters in Indianapolis, Indiana, kidnapping the secretary-treasurer of the union, John McNamara, and transporting him without hearing or due process to stand trial in California. The star witness was Ortie E. McManigal, who turned state's evidence, confessing to being paid by an official of the union's Detroit local to dynamite about a dozen or so work sites throughout the country, including the 14th Street Viaduct. How much of McManigal's confession was fact or fabrication remains in doubt because of his collaboration with detectives hired by the NEA.

After being kidnapped to California, McNamara, the union's secretary-treasurer, was represented by the famed attorney Clarence Darrow. McNamara eventually pleaded guilty to murder in the case of the Los Angeles Times Building on condition that the charges would be dropped against more than forty other indicted unionists. After McNamara's conviction, charges were not dropped and several of the codefendants were sent to prison on circumstantial evidence. This led many observers to believe that McNamara had been framed. The evidence in the particular case of the Los Angeles Times Building was never clear whether the explosion was deliberate or whether it was an accident caused by a gas leak. McNamara spent the rest of his life in Alcatraz prison (Robertson 1996: 45-47; "Almost Blew Up Night Watchmen," 1912; "Dynamiter Makes Amazing Confession," 1912; New Jersey Bureau of Industrial Statistics, 1909: 326; "Lawless Unionism" 1911: 11-18).

**Urban Politics and the 14th Street Viaduct**

In 1911, as the 14th Street Viaduct was nearing completion, the Senate of the State of New Jersey launched an investigation into Hudson County's financial dealings. Primarily focused on a documented case of bribery and kickbacks related to the construction of the new county court house in Jersey City, the investigation spread to other county projects including the viaduct and the tuberculosis sanitarium. A factor influencing the investigation of the viaduct was its final cost of $750,000, well above the original 1907 estimate of $300,000.

The history of the urban politics of Hudson County, particularly from the 1880s to 1910s, is a classic example of the widespread American phenomena of "bossism" – urban political machines headed by charismatic leaders who held office and electoral power due to their ability to regularly deliver votes from immigrant populations. Hudson County's Irish Democratic machine was headed by Sheriff Robert Davis from 1887 to 1911. Davis was best known for his close contacts with local police and firemen's organizations, and his ability to win elections and deliver votes through various tactics, like stuffing ballot

boxes, best categorized as voter fraud. As was typical of the period, the evidence is also strong that Davis sought to influence county contracts based on patterns of favoritism, fraud, and bribery. By the early twentieth century, middle-class urban reformers, known as the Progressives, were seeking out ways to break up the political machines by establishing investigative commissions and restructuring county government to make it more difficult for the bosses to control the apparatus of local governance. The natural death of Robert Davis in 1911, and some irregular dealings in distributing his estate, set off an investigation focused on his role in distributing contracts to build the new county courthouse, and that investigation eventually spread to include the county's new 14th Street Viaduct. The finding of the state investigative commission was that irregularities had occurred by Stephen M. Egan, the County Collector, and Robert Davis in the handling of the county's accounts, including illegal personal loans, but no direct evidence was found of fraud in the handling of the viaduct's construction contracts (New Jersey Supreme Court 1912; Hogarty 2000: 268-69)

**Impact of the 14th Street Viaduct on Local Transportation and Development Patterns**

With the opening of the 14th Street Viaduct in 1912, the impact on local transportation patterns was immediate, soon making 14th Street and the intersecting streets – Manhattan Avenue in Union City and Willow Avenue in Hoboken – busy thoroughfares. As early as December 1912, an article in the *New York Times* mentioned the viaduct as a desirable route for automobile travelers heading west into New Jersey from Manhattan via Hoboken's 14th Street Ferry ("Jersey Road Conditions" 1912).

Shortly after the viaduct opened, a small commercial building boom occurred at the east end of the 14th Street Viaduct on Willow Avenue between 13th and 15th streets. It was in response to the increased traffic and the improved storm sewer system that remedied problems with frequent flooding. This area had formerly been home to a ramshackle collection of livery stables, a few rowhouses, a lumberyard, and the county gasworks on the edge of the marsh. During the late 1910s and 1920s, this earlier development along Willow Avenue gave way to about one-half-dozen, two-to-five-story buildings with first-floor storefronts and upstairs apartments (Photos 089, 1300 Block Willow Avenue). Most were minimally adorned brick masses, but the *circa* 1915 Viaduct Apartments, a five-story apartment building in the late Renaissance Revival taste, at least attempted to add some style to the busy corner of 14th and Willow (Photos 088, 089; The Viaduct Apartments, 1327 Willow Avenue) (Sanborn 1937).

In late 1908, as the viaduct project was getting underway, the Delaware, Lackawanna & Western RR expanded its ferry house at the foot of 14th Street (The DL&W had two ferry houses in Hoboken: the main one at Newark Avenue near the original terminus of Stevens' ferry dating from the colonial period, and another at 14th Street, established during the 1880s). The viaduct project probably had some influence on the decision to expand the 14th Street Ferry, but no direct evidence has been found. The improved ferry house and the viaduct reportedly greatly increased the attractiveness of West Hoboken as

a commuter suburb and spurred a new round of residential development (Reisser 1915: 25-26; Sanborn 1910, 1937; Doherty 1986: 22).

The growing number of automobiles using the 14th Street Viaduct also had their impact on local land use. Several auto sales, repair, and service stations were located at the viaduct's east end by the 1920s, and some offered off-street, covered parking for commuters. None of the original pre-WWII automobile service buildings have survived unaltered, but auto repair shops and gas stations are still numerous within a one-block radius of the east end of the viaduct (Photo 051). Most are modern facilities, like the BP station at 14th and Willow that replaced an earlier station in the mid-1990s (Sanborn 1951, 1979, 1990, 1995).

**Alterations and Repairs to the 14th Street Viaduct, 1938-2002**

In 1938, the 14th Street Viaduct underwent a major rehabilitation due to settlement of the piers. Much of the settlement could be attributed to the soft soils upon which the viaduct had been built. Borings discovered that bedrock was more than 100 ft. below ground level in some locations between the base of the Bergen Hill and Willow Avenue. The rehabilitation project, designed by Waddell & Hardesty, consultant engineers of New York City, resulted in the addition of new steel-pipe piles and footings; heavier, strengthened bents with steel crossbracing, the addition of floorbeams; and new deck and railings. The through girder-floorbeam spans at the east end of the viaduct over Clinton Street were replaced with steel stringer spans to improve vertical clearance (Figure 3). The project was funded by the Public Works Administration, a federal New Deal agency (Hudson County Engineers Office, 1938).

A second major rehabilitation project, designed by A. G. Lichtenstein & Associates of Fair Lawn, New Jersey, was undertaken in 1990-91. That project included a complete deck replacement; removal of the railings and installation of new barriers and fences; new roadway lighting; replacement of the Span 1 and 2 superstructure with steel stringers; installation of supplementary end floorbeams at the expansion ends of the girders; installation of new stringers and crossbeams at Spans 15 to 17 and 27 to 29; replacement of the column caps and bearings at the expansion ends of the girders; replacement of the diagonal cross-bracing members in most longitudinal and transverse bents; repair of broken and bent lacing bars and gusset plates; cleaning and painting of the entire superstructure and steel substructure elements; numerous substructure concrete repairs; and other miscellaneous items. Additional rehabilitation projects were performed in 1998 and 2002 to repair or replace deteriorated structural members.

As a result of the alterations, the bridge is all modern fabric from the deck up. The main superstructure and substructure members have been retained, so the overall appearance and proportions in elevation view have not significantly changed from the original 1907-12 configuration.

**Replacing the Viaduct**

In 2008 Hudson County completed a study to select alternatives for correcting structural and safety deficiencies, as well as increasing structural capacity. A traffic study indicated the need for an additional lane to accommodate turning movements at the ends of the viaduct. The result was the decision to replace the nearly 100-year-old viaduct with a new bridge, 12-ft. wider and on the same horizontal and vertical alignments. The replacement alternative, which was weighed against various rehabilitation options, was preferable from the standpoint of constructability, construction costs, and life-cycle maintenance costs. Significant factors limiting the ability to rehabilitate were the viaduct's fracture-critical status and inability to widen the existing structure. (Fracture critical is when the failure of one member could cause the entire structure, or a portion thereof, to fail.) There was no prudent way to remedy the fracture-critical status and increase the roadway width by 12 ft. without removal of significant amounts of historic fabric. The viaduct deck had already been widened once in 1990-91; it could not structurally support further widening without replacing most of the existing steel superstructure.

In 2008, following public participation meetings and consultation with the New Jersey Historic Preservation Office, a mitigation plan was developed to address replacement and meet conditions necessary for receiving federal aid. In addition to this historic documentation, the viaduct's history is to be displayed on interpretive signs to be placed at the new viaduct. The history is also to be made available on the World Wide Web. The new viaduct's context-sensitive design will take into account the viaduct's history (KS Engineers 2004; Lichtenstein Consulting Engineers 2006: 51-53; Memorandum of Agreement 2008).

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Photographer: David Haas Date: April 2009

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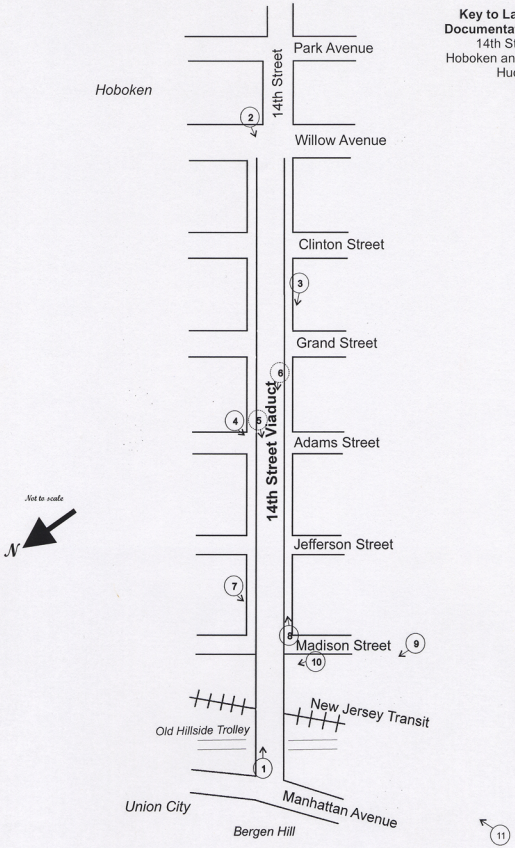
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Photographer: Patrick Harshbarger Date: March 2009

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007 VIEW LOOKING NORTH ON MADISON STREET AT SOUTH ELEVATION OF SPAN NOS. 25 TO 27. SPAN 25 IS THE DECK GIRDER OVER MADISON STREET. BERGEN HILL IN THE BACKGROUND.

008 VIEW OF SOUTH ELEVATION OF SPAN NOS. 26 AND 27, THE TOWER SPANS WEST OF MADISON STREET. LOOKING NORTH FROM MADISON STREET.

009 VIEW OF SOUTH ELEVATION OF DECK TRUSS SPAN NO. 28 OVER NEW JERSEY TRANSIT'S WEST SIDELINE. LOOKING NORTH FROM MADISON STREET.

010 DETAIL VIEW OF BUILT-UP STEEL BENT TOWER AT SPAN NOS. 26 & 27. LOOKING NORTH FROM MADISON STREET.

011 VIEW OF NORTH ELEVATION OF SPAN NOS. 24 TO 28. LOOKING SOUTH ON MADISON STREET.

012 UNDERNEATH VIEW OF GIRDER-FLOORBEAM SPAN NO. 25 OVER MADISON STREET. FRAMING PATTERN IS TYPICAL OF ALL GIRDER-FLOORBEAM SPANS.

013 UNDERNEATH VIEW OF GIRDER-FLOORBEAM SPAN NOS. 26 & 27. LOOKING SOUTHWEST FROM MADISON STREET. FRAMING PATTERN IS TYPICAL OF ALL TOWER SPANS.

014 VIEW LOOKING EAST AT SOUTH ELEVATION OF VIADUCT ON SOUTH SIDE OF MARGINAL 14TH STREET FROM EAST OF INTERSECTION WITH MADISON STREET. BELGIAN BLOCK MARGINAL STREET.

015 DETAIL VIEW OF BUILT-UP STEEL BENT TOWER AT SPAN NO. 24. LOOKING NORTH FROM SOUTH MARGINAL 14TH STREET BETWEEN MADISON AND JEFFERSON STREETS.

016 DETAIL VIEW OF BUILT-UP STEEL BENT SUPPORTING SPAN NOS. 23 & 24. LOOKING NORTH FROM SOUTH MARGINAL 14TH STREET BETWEEN MADISON AND JEFFERSON STREETS.

017 VIEW OF SOUTH ELEVATION OF SPAN NO. 20 OVER JEFFERSON STREET. LOOKING NORTH ON JEFFERSON STREET.

018 VIEW OF SOUTH ELEVATION OF SPAN NOS. 19 TO 21. SPAN NO. 20 IS THE GIRDER SPAN OVER JEFFERSON STREET. LOOKING NORTH FROM SURFACE PARKING LOT BETWEEN JEFFERSON AND ADAMS STREETS.

019 VIEW OF NORTH ELEVATION OF SPAN NOS. 24 T0 27. LOOKING SOUTH ON MADISON STREET.

020 VIEW OF NORTH ELEVATION OF SPAN NOS. 20 TO 24. LOOKING SOUTH ON JEFFERSON STREET.

021 VIEW OF NORTH ELEVATION OF SPAN NOS. 20 TO 24. LOOKING SOUTH ON JEFFERSON STREET

022 VIEW OF SOUTH ELEVATION OF SPAN NOS. 19 TO 12. LOOKING EAST FROM JEFFERSON STREET.

023 VIEW OF SOUTH ELEVATION OF SPAN NOS. 24 TO 16. LOOKING NORTH FROM ADAMS STREET. BERGEN HILL IN THE BACKGROUND.

024 VIEW OF SOUTH ELEVATION OF SPAN NO. 16 (DECK TRUSS OVER ADAMS STREET). LOOKING NORTH ON ADAMS STREET.

025 VIEW OF NORTH ELEVATION OF SPAN NOS. 15-16. LOOKING SOUTH ON ADAMS STREET.

026 VIEW OF NORTH ELEVATION OF VIADUCT SHOWING SPAN NOS. 18 TO 31 AND THE BERGEN HILL (WEST END OF VIADUCT). LOOKING SOUTHWEST FROM ADAMS STREET.

027 DETAIL OF EXPANSION BEARING AND LOWER PANEL POINT CONNECTION OF DECK TRUSS SPAN NO. 16. LOOKING NORTH AT SOUTHWEST BEARING FROM ADAMS STREET.

028 DETAIL OF LOWER CHORD CONNECTION AND LOWER LATERAL BRACING OF DECK TRUSS SPAN NO. 16. LOOKING NORTH AT CENTER SPAN FROM ADAMS STREET.

029 DETAIL OF RIVETED CONNECTION AT LOWER CHORD PANEL POINT OF DECK TRUSS SPAN NO. 16. LOOKING NORTH FROM ADAMS STREET.

030 DETAIL OF FIXED BEARING OF DECK TRUSS SPAN NO. 16. LOOKING NORTH AT SOUTHEAST BEARING FROM MARGINAL 14TH STREET.

031 DETAIL OF RIVETED UPPER PANEL POINT CONNECTION OF DECK TRUSS SPAN NO. 16. LOOKING NORTH FROM ADAMS STREET.

032 VIEW LOOKING WEST FROM UNDERNEATH SPAN NO. 12 BETWEEN ADAMS AND GRAND STREETS.

033 UNDERNEATH VIEW OF SPAN NO. 12 SHOWING TYPICAL BENT CAP AND FLOORBEAM FRAMING WITH BEAMS DOUBLED-UP FOR STRENGTHENING. LOOKING WEST.

034 VIEW OF SOUTH ELEVATION OF SPAN NO. 9 OVER GRAND STREET. LOOKING NORTH ON GRAND STREET.

035 VIEW OF NORTH ELEVATION OF SPAN NO. 9 OVER GRAND STREET. LOOKING SOUTH ON GRAND STREET.

036 DETAIL OF GIRDERS AND EXPANSION JOINT ON SOUTH ELEVATION BETWEEN SPAN NOS. 8 AND 9. LOOKING NORTHEAST FROM GRAND STREET.

037 VIEW LOOKING WEST ON SOUTH MARGINAL 14TH STREET ALONG THE SOUTH SIDE OF THE VIADUCT. VIEW TAKEN FROM BETWEEN GRAND AND CLINTON STREETS.

038 UNDERNEATHVIEW OF GIRDER SPAN NO. 8 SHOWING GIRDERS, FLOORBEAMS, AND CORRUGATED STEEL DECK. LOOKING NORTH.

039 UNDERNEATH VIEW LOOKING EAST FROM SPAN NO. 5 TOWARD CLINTON STREET. DETAILS OF BENT CROSSBRACING.

040 DETAIL OF BUILT-UP BRACKET AND CANTILEVERED DECK SECTION AT SPAN NO. 5, SOUTH ELEVATION, WEST OF CLINTON STREET. TYPICAL OF ALL SPANS.

041 VIEW OF SOUTH ELEVATION OF SPAN NOS. 1-2. SPAN NO. 2 IS STRINGER SPAN OVER CLINTON STREET. LOOKING NORTH ON CLINTON STREET.

042 VIEW OF NORTH ELEVATION OF SPAN NO. 2-3. SPAN NO. 2 IS STRINGER SPAN OVER CLINTON STREET. LOOKING SOUTH ON CLINTON STREET.

043 VIEW LOOKING EAST ON NORTH MARGINAL 14TH STREET FROM EAST OF CLINTON STREET TOWARD WILLOW AVENUE. SPAN NO. 1 AND CONCRETE ABUTMENT AND NORTH SIDE OF WINGWALL ARE SHOWN.

044 VIEW LOOKING WEST ON NORTH MARGINAL 14TH STREET FROM CLINTON STREET. NORTH SIDE OF VIADUCT.

045 VIEW LOOKING EAST ON SOUTH MARGINAL 14TH STREET FROM NEAR CLINTON STREET. SOUTH CONCRETE WINGWALL SHOWN. INTERSECTION OF WILLOW AVENUE AND 14TH STREET IN BACKGROUND.

046 VIEW LOOKING WEST ON SOUTH MARGINAL 14TH STREET FROM WEST OF WILLOW AVENUE. SOUTH CONCRETE WINGWALL AND SOUTH SIDE OF VIADUCT SHOWN. BERGEN HILL IN THE BACKGROUND.

047 VIEW LOOKING EAST ON 14TH STREET FROM EAST END OF THE VIADUCT. SHOWN ARE THE INTERSECTIONS OF 14TH STREET AND WILLOW AVENUE (CLOSEST) AND 14TH STREET AND PARK AVENUE. THE FOUR-STORY BRICK BUILDING IN THE CENTRAL HOBOKEN HISTORIC DISTRICT IS VISIBLE BEYOND PARK AVENUE.

048 VIEW LOOKING SOUTH ON WILLOW AVENUE TOWARD CENTRAL HOBOKEN FROM EAST END OF THE VIADUCT.

049 VIEW LOOKING NORTH ON WILLOW AVENUE FROM EAST END OF THE VIADUCT. STAHL SOAP FACTORY (RIGHT).

050 VIEW LOOKING WEST ON NORTH MARGINAL 14TH STREET. YARDLEY SOAP FACTORY IS SHOWN IN BACKGROUND ATOP BERGEN HILL. NORTH WINGWALL AND NORTH SIDE OF VIADUCT SHOWN.

051 VIEW LOOKING EAST FROM EAST END OF 14TH STREET VIADUCT. LOOKING ACROSS WILLOW AVENUE TO GAS STATION AT THE NORTHEAST CORNER OF WILLOW AND 14TH STREET.

052 DETAIL OF CONCRETE BARRIER AND FENCE ON SOUTH SIDE OF VIADUCT. TYPICAL OF ALL SPANS. VIEW TAKEN FROM VIADUCT ROADWAY LEVEL LOOKING SOUTH FROM BETWEEN CLINTON AND GRAND STREETS.

053 DETAIL OF SIDEWALK, CONCRETE BARRIER, AND FENCE ON THE NORTH SIDE OF THE VIADUCT. TYPICAL OF ALL SPANS. VIEW TAKEN LOOKING WEST AT VIADUCT ROADWAY LEVEL FROM BETWEEN CLINTON AND GRAND STREETS.

054 VIEW FROM VIADUCT ROADWAY LEVEL LOOKING SOUTH ON GRAND STREET.

055 VIEW FROM VIADUCT ROADWAY LEVEL LOOKING NORTH ON GRAND STREET.

056 VIEW FROM VIADUCT ROADWAY LEVEL FROM WEST OF GRAND STREET LOOKING NORTH TOWARD UNION CITY AND BERGEN HILL.

057 VIEW FROM VIADUCT ROADWAY LEVEL LOOKING SOUTH ON ADAMS STREET.

058 VIEW FROM VIADUCT ROADWAY LEVEL LOOKING NORTH ON ADAMS STREET.

059 VIEW FROM VIADUCT ROADWAY LEVEL LOOKING SOUTHWEST TOWARD BERGEN HILL AND JERSEY HEIGHTS NEIGHBORHOOD.

060 VIEW FROM VIADUCT ROADWAY LEVEL LOOKING SOUTH ON JEFFERSON STREET. DOWNTOWN HOBOKEN IN BACKGROUND.

061 VIEW FROM VIADUCT ROADWAY LEVEL LOOKING NORTH ON MADISON STREET.

062 VIEW FROM VIADUCT ROADWAY LEVEL LOOKING NORTH ON NEW JERSEY TRANSIT'S WEST SIDE ALIGNMENT.

063 VIEW FROM WEST END OF VIADUCT LOOKING WEST AT STONE RETAINING WALL ON UPHILL SIDE OF MANHATTANVE AVENUE.

064 VIEW FROM WEST END OF VIADUCT LOOKING NORTH ON MANHATTAN AVENUE.

065 VIEW FROM WEST END OF VIADUCT LOOKING SOUTH ON MANHATTAN AVENUE.

066 VIEW FROM MANHATTAN AVENUE LOOKING WEST AT THE YARDLEY STAIRS ON THE OLD ALIGNMENT OF OLD HILLSIDE ROAD, LOCATED NORTH OF THE WEST END OF THE VIADUCT.

067 VIEW LOOKING SOUTH ON MANHATTAN AVENUE TOWARD THE WEST END OF THE VIADUCT WHERE IT INTERSECTS MANHATTAN AVENUE.

068 VIEW LOOKING NORTH ON MANHATTAN AVENUE TOWARD THE WEST END OF THE VIADUCT WHERE IT INTERSECTS MANHATTAN AVENUE.

069 VIEW OF INTERSECTION OF 14TH STREET AND MANHATTAN AVENUE AT THE WEST END OF THE VIADUCT. VIEW LOOKING NORTH FROM THE SOUTH SIDE OF THE INTERSECTION.

070 VIEW OF NORTH ELEVATION OF SPAN NOS. 30 AND 31 AT WEST END OF VIADUCT. LOOKING SOUTH.

071 VIEW OF OLD HILLSIDE TROLLEY STONE RETAINING WALL ON THE UPHILL SIDE OF THE TRACE, NORTH OF SPAN NO. 31. LOOKING NORTH.

072 VIEW OF OLD HILLSIDE TROLLEY TRACE, LOOKING SOUTH FROM NORTH OF THE VIADUCT.

073 DETAIL VIEW OF OLD HILLSIDE TROLLEY STONE RETAINING WALL ON THE UPPHILL SIDE OF THE TRACE, NORTH OF SPAN NO. 31. LOOKING SOUTH.

074 VIEW OF OLD HILLSIDE TROLLEY STONE RETAINING WALL AT THE NORTH END OF THE HORSESHOE CURVE. LOOKING NORTHWEST FROM MADISON STREET IN HOBOKEN. LOOKING UPHILL TOWARD UNION CITY. MANHATTAN AVENUE IN THE BACKGROUND.

075 VIEW OF 14TH STREET AND WILLOW AVENUE INTERSECTION AT THE EAST END OF THE VIADUCT. LOOKING SOUTH FROM WILLOW AVENUE.

076 VIEW LOOKING SOUTH AT THE PARK AVENUE AND 14TH STREET INTERSECTION, ONE BLOCK EAST OF THE VIADUCT. FOUR-STORY BRICK BUILDING AT THE SOUTHEAST CORNER OF THE INTERSECTION (201 14TH STREET) IS IN THE CENTRAL HOBOKEN HISTORIC DISTRICT.

077 VIEW LOOKING WEST ON 14TH STREET FROM THE WEST SIDE OF THE PARK AVENUE INTERSECTION. EAST END OF VIADUCT AT WILLOW AVENUE IS VISIBLE. BERGEN HILL IN THE BACKGROUND.

078 VIEW LOOKING WEST ON 14TH STREET FROM THE EAST SIDE OF THE WILLOW AVENUE INTERSECTION. EAST END OF VIADUCT AND OBLIQUE VIEW OF VIADUCT'S SOUTH ELEVATION.

079 VIEW LOOKING NORTH ON WILLOW AVENUE FROM THE SOUTH SIDE OF THE 14TH STREET INTERSECTION AT THE EAST END OF THE VIADUCT.

080 VIEW OF SOUTH ELEVATION OF GIRDER SPAN NOS. 3 T0 8, LOOKING EAST FROM THE SOUTH MARGINAL 14TH STREET BETWEEN CLINTON AND GRAND STREETS.

081 VIEW LOOKING EAST FROM THE OLD HILLSIDE TROLLEY TRACE ALONG 15TH STREET IN HOBOKEN. MANHATTAN SKYLINE IN THE BACKGROUND. BUS SERVICE LOTS IN HOBOKEN.

082 VIEW FROM MADISON STREET LOOKING WEST TOWARD BERGEN HILL. BUS SERVICE LOT IN FOREGROUND, ALSO TRACKS OF NEW JERSEY TRANSIT'S WEST SIDE ALIGNMENT. VISIBLE IS THE WEST END OF THE VIADUCT AS WELL AS THE TRACE OF THE OLD HILLSIDE TROLLEY LINE.

083 AMERICAN MAGNESIUM ALUMINUM FOUNDARY, 1316 ADAMS STREET. LOOKING NORTH FROM ADAMS STREET WITH VIADUCT TRUSS SPAN NO. 16 IN THE BACKGROUND.

084 STAHL SOAP WORKS, 1400 BLOCK OF WILLOW AVENUE. LOOKING EAST FROM WILLOW AVENUE, NORTH OF THE EAST END OF THE VIADUCT.

085 FORMER BRASS FOUNDRY, NOW REHABILITATION CENTER, 1405 CLINTON STREET. LOOKING EAST FROM CLINTON STREET AT SOUTHWEST CORNER OF BUILDING.

086 PIPE BENDING WORKS AT 1300-1330 JEFFERSON STREET. VIEW LOOKING EAST OF SOUTHWEST CORNER OF BUILDING FROM MADISON STREET.

087 FORMER GRAVURE CYLINDER FACTORY (NOW VACANT) AT NORTHEAST CORNER OF GRAND STREET AND 15TH STREET. VIEW FROM 15TH STREET LOOKING SOUTHWEST.

088 THE VIADUCT APARTMENTS, 1327 WILLOW AVENUE. VIEW LOOKING SOUTH FROM NORTHEAST CORNER OF WILLOW AVENUE AND 14TH STREET.

089 THE EAST SIDE OF THE 1300 BLOCK OF WILLOW AVENUE. VIEW FROM 14TH STREET, EAST END OF VIADUCT, LOOKING SOUTH.

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