DRAFT V4.12
FOR COMMENT ONLY

THE RED HOOK STREETCAR SYSTEM

A STARTER STREETCAR PROJECT FOR THE CITY OF NEW YORK

THE BROOKLYN HISTORIC RAILWAY

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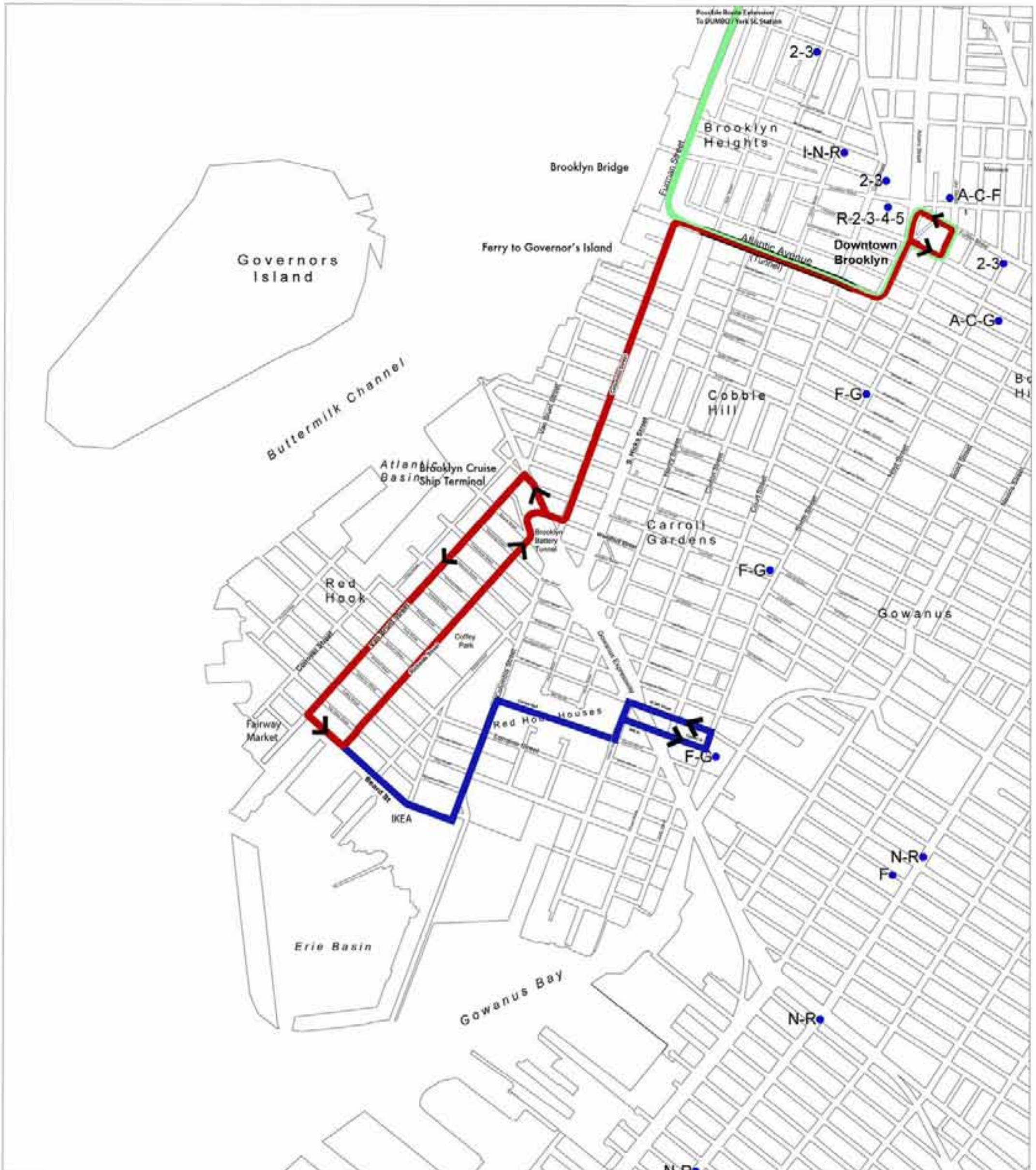


Red Hook To Downtown Brooklyn Streetcar - Base Route

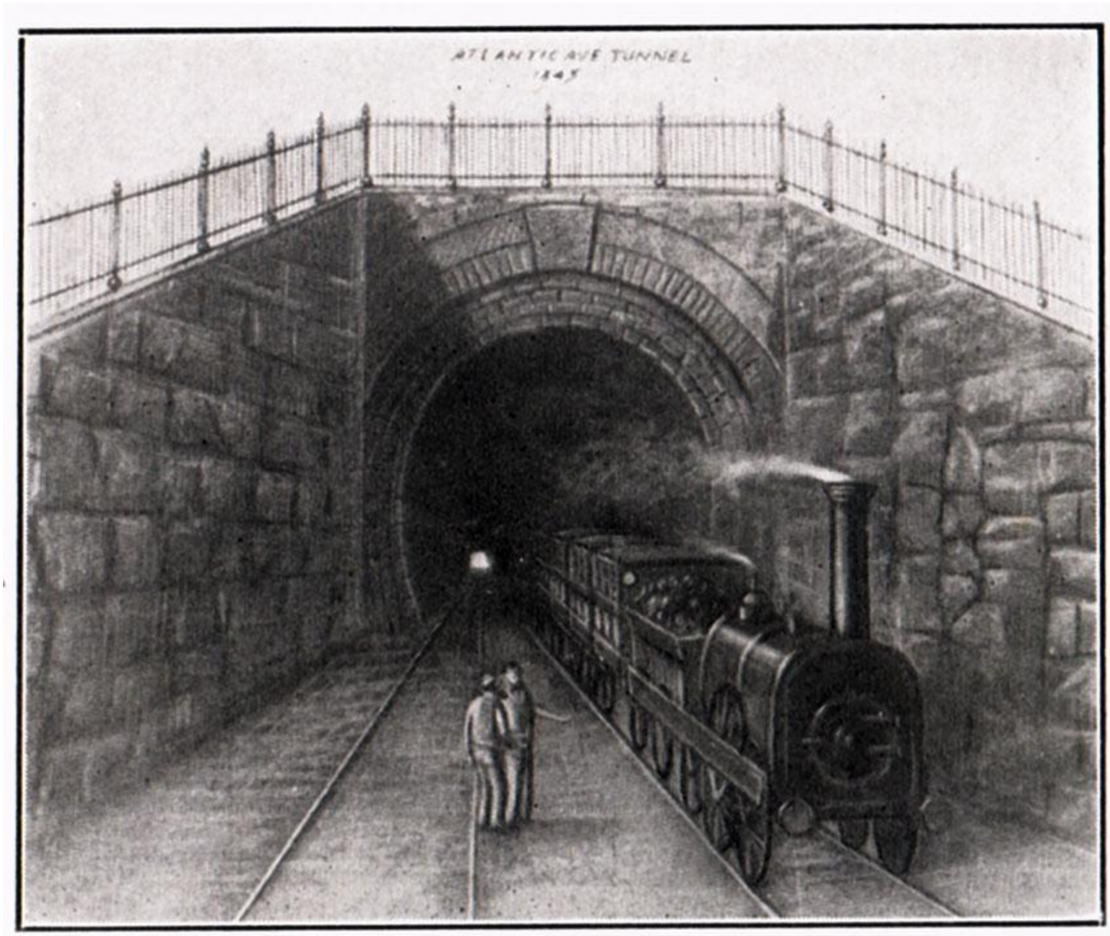
Created by Brian Kassel for BHRA, March 25th, 2013

Streetcar Route B

Streetcar Route A

Single Track Direction

Atlantic Avenue Tunnel (existing 2 track tunnel)



The Atlantic Avenue Tunnel

Built In 1844 by the Long Island Rail Road
Cornelius Vanderbilt, Chairman

the World's Oldest Subway Tunnel - The Guinness Book Of World Records, 2011
The National Register of Historic Places, 1989

Forward

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NYC transit chief eager to see streetcars

Janette Sadik-Khan, Commissioner of Transportation of the City of New York, is in Toronto today to celebrate Earth Day and to see a Toronto icon that she wants to bring back to the Big Apple: the streetcar.

BY NATIONAL POST APRIL 22, 2009

Janette Sadik-Khan, Commissioner of Transportation of the City of New York, is in Toronto today to celebrate Earth Day and to see a Toronto icon that she wants to bring back to the Big Apple: the streetcar.

"I'm very jazzed about my visit," Ms. Sadik-Khan said yesterday from her New York office. "The streetcar program is something that I'm looking at here. We threw away our streetcars, and you kept them. I think it's a great economic development tool."

New York has one of the world's great subway systems, but long ago gave over its surface routes to cars and cabs and trucks. New York Mayor Michael Bloomberg is changing that. When the state blocked his bid for Manhattan road pricing, he retaliated two years ago by hiring Ms. Sadik-Khan, who has an "aggressive agenda to improve air quality, mobility and public space."

New York for 60 years strived for just one thing: to get motor vehicles around as quickly as possible, she says. That plan failed: the average car on Broadway travels at 5 mph. As one joke puts it, the only way to get to midtown Manhattan is to be born there.

And so Ms. Sadik-Khan has chosen a different plan: to increase the space on streets for walking and riding a bicycle. Last summer New York gave two lanes on Broadway in Times Square for pedestrians, bikes, planters, tables and chairs. This August the city will shut Broadway to cars for good in Times Square and in Herald Square, near the Empire State Building.

A cyclist herself, she adds: "We've gone from 220 bike lane miles to 420 lane miles in the last couple of years."

Ms. Sadik-Khan, a guest of Missisauga-based Walk & Bike for Life, will address a lunch at the Chestnut Hotel in Toronto, then meet with Mayor David Miller, and later travel by GO train to Port Credit for an evening speech at Clarke Hall.

Her assault on the lowly passenger automobile is part of a global craze: This Magazine's latest cover story, "Stop Cars," lists cities that put a high price on driving, including London, San Francisco and Vauban in Germany. Toronto is part of this trend. Having widened Jarvis Street in 1946 for cars, by cutting down the trees along its length, the city now plans to narrow Jarvis again. Waterfront Toronto has begun an $8-million study on removing the east stretch of the Gardiner Expressway. And with Transit City, Toronto plans to remove two lanes of car traffic from Sheppard, Finch and Eglinton avenues, for dedicated streetcar tracks.

The irony here is that efforts to promote transit, walking and cycling are most pronounced downtown, where those modes of transportation are already popular. What of the 905, where car is king? Enter Gil Penalosa, founder of Walk & Bike for Life, the hosts of Ms. Sadik-Khan's visit. He says Mississauga, where he lives and works, has more than doubled in population in 30 years, but all its best spots are the ones created before people drove cars.

"Name one community in Mississauga that is as good as Streetsville and Port Credit and Clarkson," he asks me.

I cannot.

"The government is widening the QEW in Mississsauga," he says. "There is not one cent to build a pedestrian bridge across the QEW. Let's spend $10-million on 10 pedestrian bridges across the QEW."

Vauban, Germany, discourages cars in part by giving every new resident a free transit pass. And German transit is very fast and efficient. So is New York transit. Many in Toronto, and not just in the 'burbs, drive cars because the transit is poor.

Still, it's fascinating to hear that our lowly streetcars, overcrowded and slow, have fans in high places. Ms. Sadik-Khan thinks a new streetcar in Brooklyn could encourage people to get on and off, and shop in their local area.

"In Portland they just started a new streetcar and were able to leverage $3-billion in [private] investment," she notes. "We need to rebalance the transportation network and make it as efficient and effective as possible."

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The team that produced this Study.

From left to right: Ray Howell, BHRA; Aashni Shah, Intern; Leuri Serraty, Intern; Pin Ting Lu, Intern; Agustin Lopez, Teacher; Bob Diamond, BHRA.

Executive Summary

Red Hook is an isolated, transportation deprived community, physically cut off from the rest of Brooklyn by the Brooklyn- Queens Expressway and Hamilton Avenue. Served only by the B-61 bus, residents often must suffer a 45 minute travel time to the nearest subway station.

Modern streetcars are making a comeback all around the U.S. These non- polluting, sustainable electric vehicles, spur large scale economic revitalization along their routes.

A modern streetcar would cut travel time from Red Hook to the subway from 45 minutes to 12 minutes.

Our new Red Hook, Brooklyn, NY streetcar study cites a construction cost of $13 million per route mile. This cost is competitive with bus rapid transit systems.

For example, the new bus rapid transit route on Brooklyn's Nostrand Ave costs $10 million per route mile (see the following chart) - and doesn't have any of the economic development capability of a streetcar.

The operating cost of a modern streetcar is less than that of a bus.

Red Hook is grossly under populated. The present population density of Red Hook is only 1/29th that of neighboring Cobble Hill, and 1/25th that of adjacent Carroll Gardens.

If the population density of Red Hook were to be brought to parity with Cobble Hill, the streetcar line could be expected to carry over 16,000 riders per day.

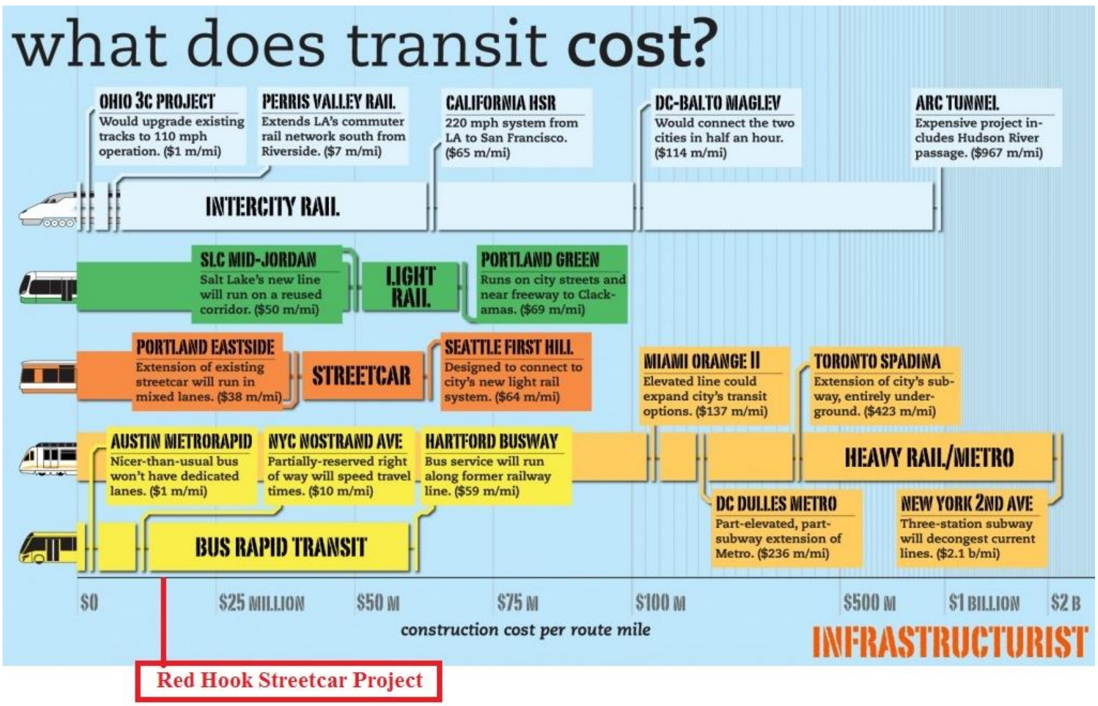
The new streetcar system in Portland, OR, has leveraged $ 3 billion in privately financed Transit Oriented Development (TOD) along the streetcar route corridor.

The historic Atlantic Avenue tunnel - the World's Oldest Subway, built in 1844, enhances a modern streetcar system by providing a "Disney Land effect".

In Short -

To Build: $13 million per mile for a two track line - if done under a non- profit organization, and using our proven construction methodology, customized for Brooklyn. For the full- build, preferred 6.8 mile route: **$87,804,637.**

<u>To Operate</u>: $60 per hour per streetcar, $80 per hour per two streetcar train. Full build project operating cost: **$1,530,500/yr**. **NOTE**: A typical NYCT bus costs over $130/hr to operate.



Introduction


“The Back”

Located in the southwestern corner of the New York City borough of Brooklyn, the neighborhood of Red Hook boasts a long and turbulent history. The neighborhood’s name comes from its shape as a “hook” of land protruding from the coast of Brooklyn. Red Hook is geographically isolated: surrounded by water on three sides and by the Gowanus Parkway and Brooklyn Battery Tunnel on the fourth, it is separated from the rest of Brooklyn and at some distance from local subway lines. With stunning views of the Statue of Liberty, the neighborhood’s western side, nicknamed “the Back,” was a natural location for one of the nation’s busiest ports.

Red Hook is part of Brooklyn Community Board 6. It is also the location where the transatlantic liner RMS *Queen Mary 2* docks in New York City.

From the mid-1800s to the mid-1900s, Red Hook’s port made it a thriving industrial neighborhood of mainly Italian and Irish American dockworkers. It was also home to one of the first Puerto Rican neighborhoods in New York City. By 1950, Red Hook had **21,000 residents**, many of them longshoremen living in the Red Hook Houses, a public housing project built in 1938 to accommodate the growing number of dockworkers and their families. The neighborhood had a tough reputation—with such notorious figures as Al Capone getting their start there as small-time criminals—and its seedy side was immortalized in movies such as the *On the Waterfront* (1954), starring a young Marlon Brando.

When containerization shipping replaced traditional bulk shipping in the 1960s, many businesses at the Red Hook ports moved to New Jersey—as did the jobs. Unemployment increased quickly as industries abandoned Red Hook, and the neighborhood’s economy underwent a rapid decline. By the 1970s and ‘80s, it became known as being a crime-ridden, desolate neighborhood, severed from the rest of Brooklyn.

The Houses

One of the largest public housing projects in New York City and in the country, the Red Hook Houses were first built as a Federal Works Program initiative under former President Franklin Delano Roosevelt. Red Hook has long been divided between the residents of “the Back”—predominantly white homeowners living on the waterfront—and the residents of the Houses, who are predominantly black and Latino and constitute the majority of the neighborhood’s population, outnumbering residents of “the Back” two to one.

In 1990, the towering Houses, comprised of East and West clusters, were home to 11,000 residents, more than a third of which were under the age of 18. Unemployment was high and by the early 1990s, Red Hook was suffering from very serious problems: the deterioration of its physical fabric, abandoned buildings, illegal dumping of trash, poverty, skyrocketing drug use and violence. *Life* magazine named it one of the ten worst neighborhoods in the U.S. and called it “the crack capital of America.” In 1992, beloved school principal Patrick Daly was killed in broad daylight at the Houses, caught in a crossfire when he went to look for a student who had left school upset after a fight that day. This well-publicized incident became a pivotal point in the neighborhood’s history, bringing in a high level of police and criminal justice attention. It was at this time that the idea to establish a community court in Red Hook first began circulating, and by 1995, community outreach efforts and a neighborhood Public Safety Corps were firmly in place.

Today, the Houses are home to 8,000 of **Red Hook’s 11,000 residents**. Crime has dropped dramatically: between 1993 and 2003, homicides were down 100 percent, felony assaults down 68 percent, robberies down 55 percent and rapes down 33 percent, and the neighborhood is continuing to change.

Planned streetcar service to Red Hook – The First Red Hook Streetcar Project

Though electric trolleys have not run in Brooklyn since 1956, activists led by the Brooklyn Historic Railway Association (BHRA) have been trying to revive streetcars in Red Hook since 1989. With permission from New York City’s government to develop a streetcar line running from Beard Street to Borough Hall, in the 1990s BHRA president Robert Diamond collected disused PCC streetcars that had been used in Boston and Buffalo for potential use on the new line. By 1999, Diamond had begun laying new track for the project, but in 2003 transportation officials elected to revoke Diamond’s rights to the route’s right of way, instead intending to sell them to the highest bidder in the event that the project ever moved forward. Diamond’s efforts to secure independent funding were not successful.

The already largely completed track and catenary wires in City streets were removed by the former City administration in 2004.

In 2005, Rep. Nydia Velázquez acquired a $300,000 federal grant for a 6-month streetcar study. Though BHRA had estimated $10-$15 million would be required to complete the project, the New York City Department of Transportation (NYCDOT) streetcar feasibility study (completed in April 2011) concluded that the 6.8 mile line would cost $176 million in capital funding, plus an additional $6.2 to $7.2 million in annual operating funds. A significant portion of the capital cost would be required to make modifications to Red Hook’s narrow streets in order to allow streetcars to make right turns.

Despite finding that Red Hook was underserved by transit, the study concluded that due to a number of factors, a streetcar line would not be an appropriate transit solution for the neighborhood. Because 81.5 percent of Red Hook residents did not own a car and therefore were already dependent on transit, the study estimated that a streetcar would generate only 1,822 daily riders. The study also found that a streetcar would not be a significant upgrade over existing buses in terms of travel times and reliability, and would not likely spur significant economic development unless combined with zoning changes from the New York City Department of City Planning (DCP). Since DCP had designated Red Hook as a “working waterfront,” no such zoning changes appeared to be forthcoming. In June 2013, Diamond partnered with John Quadrozzi, Jr. of Gowanus Bay Terminal (a concrete firm), and the Gowanus Canal Community Development Corporation in an effort to revive the project, which he now envisions running partly underground through a 19th-century Long Island Railroad tunnel. In early 2014, the NYC High School For Arts And Business provided a team of Interns, which made this document possible. Diamond is pursuing federal funding in order to pay for the project, which he estimates would cost $50 million.

It is the purpose of this report to address and correct the factual errors and inconsistencies contained within the April, 2011 study, in order to hopefully pave the way for a fresh, accurate look at a new streetcar system for Red Hook, downtown Brooklyn, and possibly other parts of the City Of New York.

Holland-style factory building in Red Hook


Queen Mary 2 at the pier in Red Hook

IKEA


Statue of Liberty, as seen from the Red Hook Fairway super market. Note the track and overhead wire, remnants from the circa 1990's streetcar project.

Court Street at Brooklyn Borough Hall, ca. 1936

Local History

Red Hook circa 1875

Red Hook has been part of the Town of Brooklyn since it was organized in the 1600s.[1] It is named for the red clay soil and the point of land projecting into the Upper New York Bay. The village was settled by Dutch colonists of New Amsterdam in 1636, and named *Roode Hoek*. In Dutch "Hoek" means "point" or "corner" and not the English hook (i.e., not something curved or bent). The actual "hoek" of Red Hook was a point on an island that stuck out into Upper New York Bay at today's Dikeman Street west of Ferris Street. From the 1880s to the present time, people who live in the eastern area of Red Hook have referred to their neighborhood as "The Point". Today, the area is home to about 11,000 people.

During the Battle of Brooklyn (also known as the Battle of Long Island), a fort was constructed on the "hoek" called "Fort Defiance". It is shown on a map called "a Map of the Environs of Brooklyn" drawn in 1780 by a loyalist engineer named George S. Sproule.

General Israel Putnam came to New York on April 4, 1776, to assess the state of its defenses and strengthen them. Among the works initiated were forts on Governor's Island and Red Hook, facing the bay. On April 10, one thousand Continentals took possession of both points and began constructing Fort Defiance which mounted one three pounder cannon and four eighteen pounders. The cannons were to be fired over the tops of the fort's walls. During May, Washington described it as "small but exceedingly strong". On July 5, General Nathanael Greene called it "a post of vast importance" and, three days later, Col. Varnum's regiment joined its garrison.

The Sproule map shows that Fort Defiance complex actually consisted of three redoubts on a small island connected by trenches, with an earthwork on the island’s south side to defend against a landing. The entire earthwork was about 1,600 feet long and covered the entire island. The three redoubts covered an area about 400 feet by 800 feet. The two principal earthworks were about 150 feet by 175 feet, and the tertiary one was about 75 feet by 100 feet. On July 12, the British frigates *Rose* and *Phoenix* and the schooner *Tyrol* ran the gauntlet past Defiance and the stronger Governor's Island works without firing a shot, and got all the way to Tappan Zee, the widest part of the Hudson River. They stayed there for over a month, beating off harassing attacks, and finally returned to Staten Island on August 18.[1] It would appear that gunfire from Fort Defiance did damage to the British ships. Samuel Shaw wrote to his parents on July 15:

General Howe has arrived with the army from Halifax, which is encamped on Staten Island. On Friday, two ships and three tenders, taking advantage of a brisk gale and strong current, ran by our batteries, up the North River where they at present remain. By deserters we learn that they sustained considerable damage, being hulled in many places, and very much hurt in their rigging. So great was their hurry, that they would not stay to return our salute, though it was given with much cordiality and warmth; which they seemed very sensible of, notwithstanding their distance, which was nearly two miles.

Almost the entire New York Metropolitan area was under British military occupation from the end of 1776 until November 23, 1783, when they evacuated the city.

The Sproule and Ratzer maps show that Red Hook was a low-lying area full of tidal mill ponds created by the Dutch. In 1839 the City of Brooklyn published a plan to create streets, which included filling in all of the ponds and other low-lying areas.

Red Hook Houses East

Red Hook Houses West

PS 15

In the 1840s entrepreneurs began to build ports as the "offloading end" of the Erie Canal. These included the Atlantic, Erie and Brooklyn Basins. By the 1920s, they made Red Hook the busiest freight port in the world, but this ended in the 1960s with the advent of containerization. In the 1930s, the area was poor, and the site of the current Red Hook Houses was the site of a shack city for the homeless, called a "Hooverville".

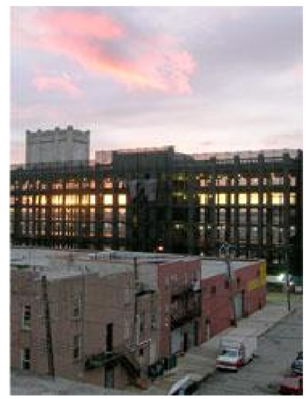
Rapeleye Street in Red Hook commemorates the beginnings of one of New Amsterdam's earliest families, the Rapelje clan, descended from the first European child born in the new Dutch settlement in the New World, Sarah Rapelje. She was born near Wallabout Bay, which later became the site of the

New York (Brooklyn) Naval Shipyard. A couple of decades after the birth of his daughter Sarah, Joris Jansen Rapelje removed to Brooklyn, where he was one of the Council of twelve men, and where he was soon joined by son-in-law Hans Hansen Bergen. Rapelye Street in Red Hook is named for Rapelje and his descendants, who lived in Brooklyn for centuries.

In 1990 *LIFE* named Red Hook as one of the "worst" neighborhoods in the United States and as "the crack capital of America." Patrick Daly, the Principal of P.S. 15, was killed in 1992, in the crossfire of a drug-related shooting while looking for a pupil who had left his school. The school was later renamed the Patrick Daly school after the beloved principal. Red Hook is the site of the NYCHA Red Hook Houses, the largest public housing development in Brooklyn, which accommodates roughly 6,000 residents.Red Hook also contains several parks, including Red Hook Park.

In 2010, Red Hook's first community newspaper, The Red Hook Star-Revue began publication.

In 2012, Red Hook was heavily damaged by the effects of Hurricane Sandy.



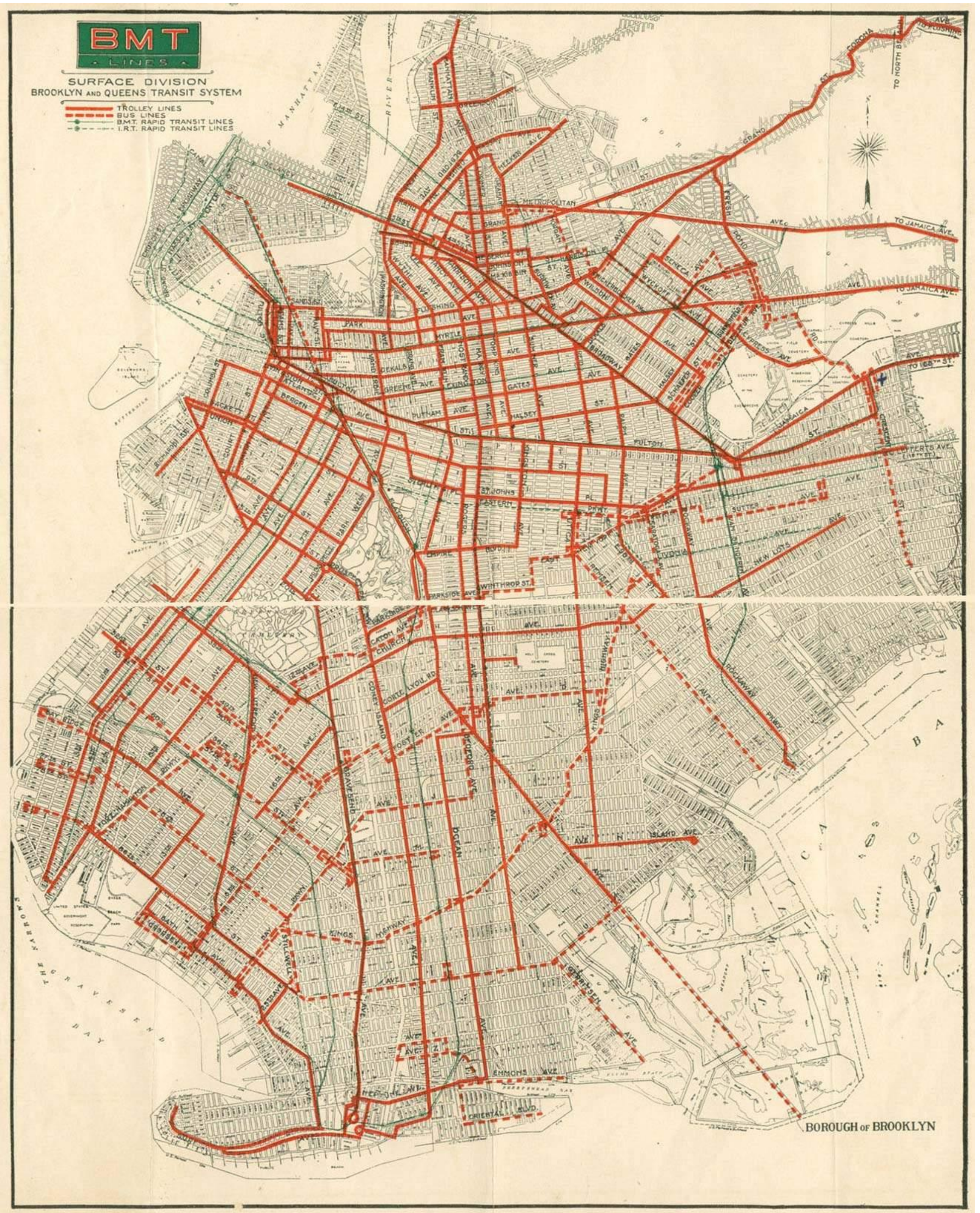
Gentrification and the Future

Like most New York City neighborhoods, Red Hook is enmeshed in the real estate game, with property owners and more affluent renters perpetually looking out for the next big market. But due to its past reputation and physical isolation, an influx of commercial wealth has been slow to come to the neighborhood.

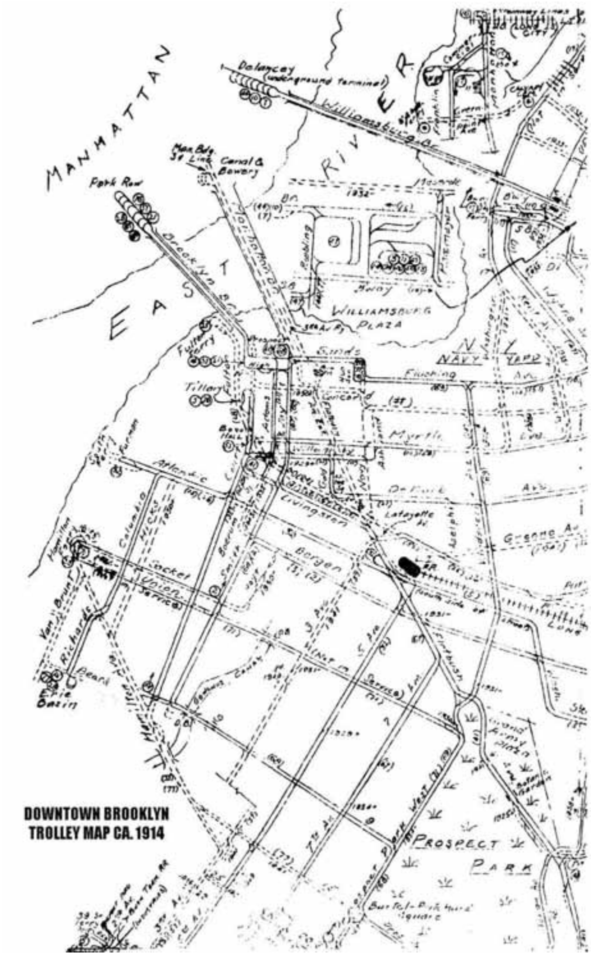
Middle-class artists seeking low rents were the first neighborhood "outsiders" to come to Red Hook in the late 1990s, settling in houses in "the Back's" long-abandoned business strip. The cobblestone streets and Civil War-era warehouses attracted tech firms and creative companies priced out of more expensive neighborhoods and looking for affordable office and studio space. Within a few years, restaurants, shops and bars opened on blocks that had lacked a commercial presence for decades. The formerly decaying waterfront has been rebuilt and now hosts art festivals and other events, and a new water taxi service now connects Red Hook to lower Manhattan and downtown Brooklyn, making it less isolated and more accessible to those who work outside the neighborhood.

Fairway Supermarkets is slated to open its first Brooklyn location on the Red Hook waterfront, and in January 2005 New York City negotiated a long-term lease with the Port Authority to develop a $30-million passenger ship terminal at the Red Hook piers, making it a docking point for cruise ships from around the world. Perhaps the biggest—and most divisive—symbol of the neighborhood's gentrification is the dawning of an Ikea superstore on the Red Hook waterfront. The draw of added jobs to the neighborhood is countered by local concern over the added traffic, as thousands of vehicles could potentially be re-routed onto formerly empty streets. Red Hook's future may be an uncertain one, but its shifting fabric and continuing controversies are as old as the neighborhood itself.

The Borough of Brooklyn developed around its historic streetcar network, which began in 1854 with a horse-drawn line on Myrtle Avenue. The early streetcar lines served both as a mode of transportation and as an organizing tool for new development. They were constructed with the intent of drawing people to live in new, outlying neighborhoods. Before any new development began, developers would first extend a streetcar line into the area. Street railway companies would then add these new streetcar lines to their systems.



BMT Brooklyn Streetcar Map, Ca 1930



DOWNTOWN BROOKLYN TROLLEY MAP CA. 1914

What’s TOD?

Modern streetcars always promote “Transit Oriented Development” or “TOD”. Analogous to the manner in which streetcars transformed disused vacant farm land into vibrant communities during the 19th century, modern streetcar systems serve as a catalyst for economic revitalization.

TOD projects potentially involve a wider variety of stakeholders than other development projects, reflecting in part the more extensive involvement of transit agencies and government funding sources. TOD stakeholders may have a wide range of complementary or competing objectives. Travel-related objectives include:

1. Increasing the opportunities for residents and workers to meet daily needs by taking transit or walking.
2. Attracting new riders to public transit, including so-called "choice" riders—riders who could otherwise choose to drive.
3. Shifting the transit station mode of access to be less reliant on park-and-ride and more oriented to walking.
4. Reducing the automobile ownership, vehicular traffic, and associated parking requirements that would otherwise be necessary to support a similar level of more traditional development.
5. Enhancing the environment, through reduced emissions and energy consumption derived from shifts in commuting, other trip making, and station access to environmentally friendly travel modes.

Non-transportation objectives may include providing desirable and affordable housing choices, enhancing sense of community and quality of life, supporting economic development or revitalization, shifting development from sensitive areas, minimizing infrastructure costs, and reducing sprawl.

For example, in Portland, OR, as development stimulus, the streetcar has been a resounding success. By 2008, private developers had invested $3.5 billion within two blocks of the alignment, including over 10,000 new housing units and 5.4 million square feet of office, institutional, retail and hotel construction. This represents approximately two-thirds of all development in Central Portland during that time. Notably, these developments are utilizing more of the allowed floor area ratio (FAR)* than developments not near streetcar. Developments adjacent to the streetcar have utilized over 90% of its potential FAR, compared to just over 40% for developments not near streetcar.

- Floor area ratio is the amount of floor area in relation to the amount of site area, expressed in square feet. For example, a floor area ratio of 2 to 1 means two square feet of floor area for every one square foot of site area.

Economic analysis has shown a high return on the capital investment of streetcars (140:1 in downtown Portland)

Streetcars encourage development and transit use because of the visible permanence of the transit investment.

Streetcar Benefits To Revitalization Investment

Streetcar Benefits to Investment

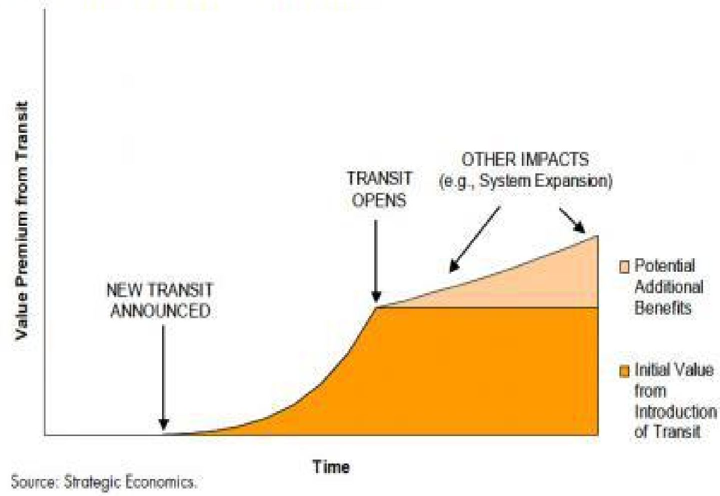
	Start of Service	Initial Track Miles	Initial System Cost Per Track Mile (Millions)	Initial System Cost (Millions)^	Development Investment (Millions)*	Return on Investment (%)
Kenosha	2000	2.0	3.00	6.00	150	2400.00
Little Rock	2004	2.5	7.84	19.60	200	920.41
Tampa	2003	2.3	21.00	48.30	1000	1970.39
Portland(1)	2001	4.8	11.50	55.20	1046	1794.93
Portland(Extension)	2005	1.2	14.83	17.80	1353	7501.12

^ This represents the total costs of the project including maintenance facilities. Tampa total cost is $63.5 million because of a multimodal transportation plaza but was omitted due to the fact that its an extra feature

* This represents planned and existing development investments directly related to the lines. Numbers were through interviews in Little Rock and Kenosha, a development study in Portland, and calculations of new planned development located three blocks or less from the streetcar in Tampa.

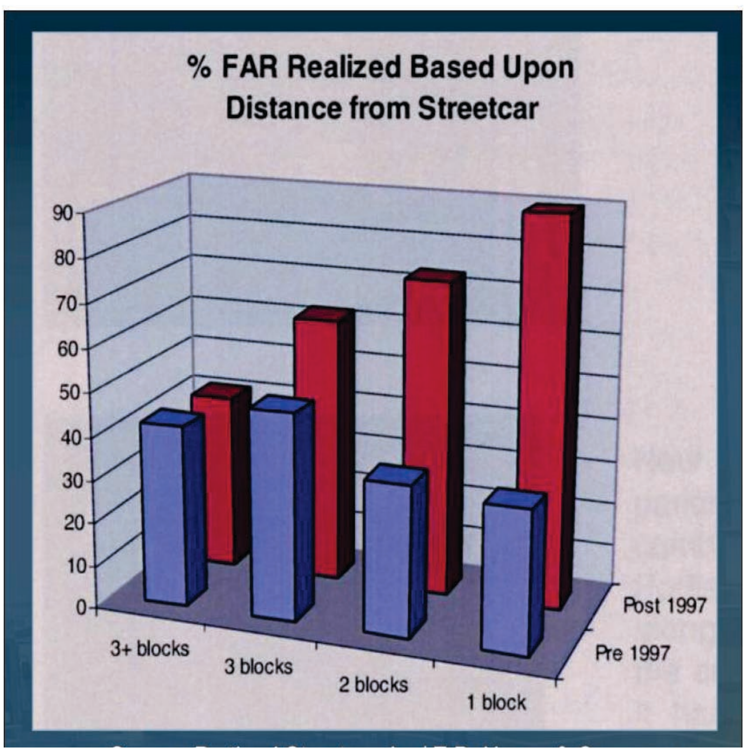
Real Estate Valuation Curve
within 3 blocks of a new Streetcar line

FIGURE 3-1: THE VALUE CURVE IN THEORY



Source: Strategic Economics.

Streetcars promote infill development and new construction



A Clear Example Of “TOD”. Note: Too Dense For Red Hook

When the #7 Line reached L.I.C. in 1916, Queens Blvd was largely undeveloped, disused farm land

By the early 1920's, the Queens Blvd corridor was completely transformed by Transit Oriented Development

Objectives of Transit Oriented Development

Let's take a look at what "TOD-ness" means, as well as the "TOD- Index".:

TOD projects potentially involve a wider variety of stakeholders than other development projects, reflecting in part the more extensive involvement of transit agencies and government funding sources. TOD stakeholders may have a wide range of complementary or competing objectives. Travel-related objectives include:

1. Increasing the opportunities for residents and workers to meet daily needs by taking transit or walking.
2. Attracting new riders to public transit, including so-called "choice" riders—riders who could otherwise choose to drive.
3. Shifting the transit station mode of access to be less reliant on park-and-ride and more oriented to walking.
4. Reducing the automobile ownership, vehicular traffic, and associated parking requirements that would otherwise be necessary to support a similar level of more traditional development.
5. Enhancing the environment, through reduced emissions and energy consumption derived from shifts in commuting, other trip making, and station access to environmentally friendly travel modes.

Non-transportation objectives may include providing desirable and affordable housing choices, enhancing sense of community and quality of life, supporting economic development or revitalization, shifting development from sensitive areas, minimizing infrastructure costs, and reducing sprawl.

Centrally located transit with walking distances no more than 1/4 to 1/2 mile.

6. Superior walkability with small blocks and pedestrian traffic management priority.
7. Extended hours of highly-reliable transit service at 5- to 15-minute intervals.
8. Land use mix to meet daily needs paired with good transit connectivity to other activities.
9. Density sufficient to support cost-effective transit, retail services, and infrastructure.
10. Managed parking with reduced supply relative to standard development.

connectivity to some uses not present in the community, but located close at hand to stops along the primary transit line, such as jobs, entertainment, and destination retail. (See "Response by TOD Dimension and Strategy"—"Response to TOD by Land Use Mix").

<u>Supportive Density</u>
Density is sufficient to enable cost-effective transit service and infrastructure provision, create a market supportive of utility retail, and keep local attractions and destinations within short walking distances. High densities are associated with numerous aspects of TOD success. Residential density guidelines for TOD in Portland, Oregon, as an example, range from 12 to 30 units per acre depending on distance from the station and primary transit mode. In the Puget Sound Region, an employment density guideline of 50 jobs per gross acre is suggested to support LRT TOD (Cervero et al., 2004). (See also "Underlying Traveler Response Factors"—"Land Use and Site Design"—"TOD-Supportive Density" and in Chapter 15, "Related Information and Impacts"—"Transit Service Feasibility Guidelines"—"Density Thresholds for Transit Service" including Tables 15-48 and 15-49.)

<u>Parking Management</u>
Parking minimums are avoided, parking maximums are encouraged, and parking costs are charged to users. Parking requirements are reduced from those of standard development to account for and encourage more transit and walking and take advantage of shared parking

opportunities. Structured parking, satellite parking, underground parking, and parking with street-facing office or retail uses are among the techniques employed to avoid dead blocks and enable clear walking paths providing visibility of the transit station. (See also "Underlying Traveler Response Factors"—"Parking Supply" and "Parking Pricing and Transit Support").

The TOD Index—Essential Indicators:

Centrally Located Transit
Development surrounds the transit station/stop and its primary edge is within 5 minutes or about 0.25 miles of the transit node. Very high quality transit service may support a 10-minute (0.50 mile) walk catchment area. (See"Underlying Traveler Response Factors"—"Land Use and Site Design").

Pedestrian Priority
Block perimeter lengths are walkable (no more than 0.25 miles). By way of example, blocks in downtown Portland are 200 feet on a side (0.15 miles perimeter). Walkways are direct and attractive and buildings are sidewalk-oriented. Moving people rather than cars should be the traffic management priority, with easy street crossings, short signal cycle lengths, right-turn-on-red prohibitions. Lack of street connectivity can lead to much longer walking distances as compared to airline distances. (See "Land Use and Site Design" and case study, "Travel Findings for Individual Portland, Oregon, Area TODs").

High-Quality Transit
Frequent, highly-reliable, and comfortable transit service is provided. Most Transit TODs have very high frequency service during the peak (headways of 5 to 8 minutes or less). Good off-peak service should also be provided to make life without an automobile not only possible, but easy (headways of 15 minutes or less). (See "Underlying Traveler Response Factors"—"Transit Service Characteristics").

Mix of Uses
Development has elements that create a self-sufficient community where daily needs such as grocery shopping can be accomplished without need for a car and preferably by walking. Transit can provide connectivity to some uses not present in the community, but located close at hand to stops along the primary transit line, such as jobs, entertainment, and destination retail. (See "Response by TOD Dimension and Strategy"—"Response to TOD by Land Use Mix").

Supportive Density
Density is sufficient to enable cost-effective transit service and infrastructure provision, create a market supportive of utility retail, and keep local attractions and destinations within short walking distances. High densities are associated with numerous aspects of TOD success. Residential density guidelines for TOD in Portland, Oregon, as an example, range from 12 to 30 units per acre depending on distance from the station and primary transit mode. In the Puget Sound Region, an employment density guideline of 50 jobs per gross acre is suggested to support LRT TOD (Cervero et al., 2004). (See also "Underlying Traveler Response Factors"—"Land Use and Site Design"—"TOD-Supportive Density" and in Chapter 15, "Related Information and Impacts"—"Transit Service Feasibility Guidelines"—"Density Thresholds for Transit Service" including Tables 15-48 and 15-49.)

Parking Management
Parking minimums are avoided, parking maximums are encouraged, and parking costs are charged to users. Parking requirements are reduced from those of standard development to account for and encourage more transit and walking and take advantage of shared parking opportunities. Structured parking, satellite parking, underground parking, and parking with street-facing office or retail uses are among the techniques employed to avoid dead blocks and enable clear walking paths providing visibility of the transit station. (See also "Underlying

Traveler Response Factors"—"Parking Supply" and "Parking Pricing and Transit Support").

Table 17-45 The TOD Index—Supportive Indicators:

Street Widths and Driveways
Streets and walks are scaled to pedestrian comfort and convenience. Overly wide streets and intersections, along with parking between sidewalks and buildings with its associated driveways, can discourage pedestrian trips. Some TODs incorporate narrower streets on the basis of the motorized trip reduction benefits of the TOD itself and/or pedestrian preference policy.

Roadway Access
Good highway access is provided, especially for suburban TODs, to yield sufficient customers for vibrant retail. However, when highway access serves the same travel market as a TOD's transit service, particular attention needs to be paid to parking management to ensure transit is competitive.

Housing Types
A diversity of housing types is incorporated to accommodate residents of different income levels. Inclusion of below-market-rate housing can support higher levels of transit ridership. Lower income residents may be more inclined to forgo ownership of automobiles and use the TOD's transit services.

Ground Floor Transparency
Numerous windows on the ground floor of development are incorporated to create inviting, active, friendly, and defensible pedestrian spaces. Windows on the transit node and its approaches should desirably include 24-hour uses. People may be willing to walk longer distances when the trip is safe, convenient, and interesting (Snohomish County, 1999; Hendricks, 2005).

Car Sharing
Occasional access to automobiles is facilitated through organized car sharing. Such an approach can reduce the need for automobile ownership, leading to a variety of TOD benefits: fewer parking spaces required, higher transit mode share, lower vehicle miles of travel, and greater support for local retail. Car sharing ratios of one car per 20 subscribers have been used.

Transit Support
Transit pass programs and other Travel Demand Management (TDM) measures are applied to tip the balance toward transit, walking, and cycling for TOD residents and workers. Free transit passes may be made part of sales packages to better attract those who will use transit, particularly where the commanding travel advantages of typical HRT or CRR in a central-place city/region are lacking, as with certain LRT, BRT, and conventional-bus oriented TODs.

A pertinent reminder at this juncture is to note once again the interactive nature of factors affecting TOD performance (Hendricks, 2006). It follows that the essential and the supportive indicators proposed in the TOD Index describe characteristics that may work together supportively as well as individually. These characteristics will also interact with factors that are not inherently transportation-related. Previously discussed evidence suggests that such interaction may well be synergistic, leading—with carefully balanced selection of characteristics—to enhanced effectiveness for sensitively designed and implemented TOD

The Red Hook Streetcar System (RHSS) is a strategy for an enhanced streetcar network that is a part of a broader vision to sustainably accommodate future population growth in a manner that will effectively manage the consumption of our limited natural resources and reduce greenhouse gas emissions. Expanding the streetcar system into a network of corridors will help achieve this by:

Delivering an attractive, high-quality transit service that will provide circulation along corridors, connect to and enhance the existing transit network, and link Red Hook with commercial districts and employment centers;

Integrating Red Hook into a comprehensive transportation system, including Brooklyn's existing bus, subway and pedestrian and bicycle networks, which will reduce our dependency on the automobile and increase mobility for all modes of travel; and

Fostering partnerships between neighborhoods, developers and the City to coordinate or combine sustainability initiatives for stormwater management (such as the use of Pervious Concrete, new gravity powered drainage sytems, localized (renewable) power generation, energy conservation, and sustainable (LEED) building design, and low impact urban design that encourages walking and bicycling.

Anticipated Red Hook Growth

By 1950, largely due to the post World War II economic factors such as changes in the maritime shipping industry, and the "suburban exodus" caused by extremely low interest and virtually no down payment home mortgages offered by the "G.I. Bill of Rights" housing laws, Red Hook's population had decreased to roughly 21,000 residents.

In terms of present day redevelopment opportunity, Red Hook offers an unprecedented opportunity for housing and commercial redevelopment. Red Hook is drastically under populated. When compared to its sister neighborhoods of Carroll Gardens and Cobble Hill, Red Hook has **only one twenty- ninth the population density of Cobble Hill, and only one twenty- fifth that of Carroll Gardens. See Population Table.**

The former Todd shipyard site presents vast potential for waterfront redevelopment. The Red Hook upland area contains many vacant lots and disused buildings. The O'Connell Organization pioneered much mixed use waterfront redevelopment during the 1990's. Currently, development firms such as Estates Four, and John Quadrozzi, Jr., are now beginning to take advantage of these opportunities.

Red Hook Population Table

Population Density of Cobble Hill:

SOURCE: http://www.city-data.com/neighborhood/Cobble-Hill-Brooklyn-NY.html

Area: 0.132 square miles

Population: 7,260

Population density:

Cobble Hill:	**54,934 people per square mile**
Brooklyn:	34,917 people per square mile

Population Density of Red Hook:

SOURCE: http://www.city-data.com/neighborhood/Red-Hook-Brooklyn-NY.html

Area: 0.850 square miles

Population: 8,023

Population density:

Red Hook:	**9,436 people per square mile**
Brooklyn:	34,917 people per square mile

The population density of Cobble Hill is 5.8 times greater than Red Hook's. This comparison includes the population and land area of the Red Hook Houses. However, the higher population density of The Houses is anomalous to the rest of Red Hook. Let's subtract the population density of The Houses, and re-calculate the adjusted population density for comparison:

Red Hook Houses East	Red Hook Houses West	Red Hook Houses Total
5,654 Residents	864 Residents	6,518 Residents
33.34 Acres = 0.05 sq mi	5.63 Acres = 0.009 sq mi	0.059 sq mi

Source:
http://www.nyc.gov/html/nycha/html/developments/bklynredhook1.shtml
http://www.nyc.gov/html/nycha/html/developments/bklynredhook2.shtml

Adjusted Red Hook Population Density: 1,505 Residents/ 0.791 sq mi = 1,903 people/square mi.

The adjusted population density of Red Hook is only one twenty- ninth that of Cobble Hill.

IMPROVING ON RED HOOK's EXISTING PUBLIC TRANSIT SERVICE

Red Hook's only form of public land transportation is the B61 bus. This service is grossly inadequate. Travel times of 45 minutes from Red Hook to the subway are common place: "***"It used to take me 45 minutes to get to work, but now it takes an hour and a half!"*** -Rider at 4th Ave/9th St, traveling into Red Hook from Manhattan.

Generally, NYC Transit average bus speeds have decreased from 9.1 mph to 8.1 mph. This is significantly slower than bus speeds in other major U.S. cities.

SOURCE: "**Next Bus Please: Improving the B61 Bus".** This circa 2011 study was conducted by the Office of Council Member Brad Lander, with Congresswoman Nydia Velázquez & Council Member Sara M. González.

The proposed streetcar line would be solely dedicating to serving the Red Hook community, and utilize Traffic Signal Priority to facilitate the streetcar's travel time. The current 45 minute travel time from Red Hook to the subway would be cut to 12 minutes.

Further information on the short comings of the B61 bus service was gleaned from the study...

B61 Performance

The B61 bus is consistently arriving outside its acceptable headway time (the amount of time scheduled between buses) during peak hours.[1] Only 43% of B61 buses arrive within their acceptable headway time in peak hours, compared to a November 23, 2010 count by MTA New York City Transit (NYCT) that found 64% of B61 buses were arriving on acceptable headways.[2]

The B61 bus is most frequently off schedule when traveling to Downtown Brooklyn during evening peak hours of service. Only 26% of northbound B61 buses arrive within 3 minutes of their scheduled headway time at the line's maximum load points (between Columbia/Union & Atlantic/Hicks bus stops) in the evening.

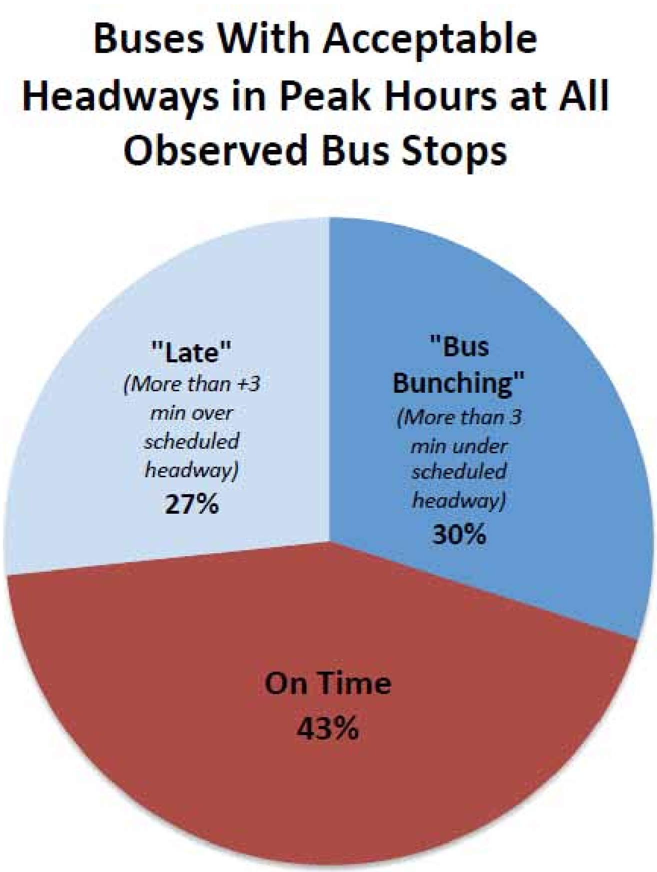
Bus Crowding Findings

There are a large number of buses that arrive at stops too full to take on any more passengers during peak hours. 42% of northbound B61 buses observed bypassed the Columbia/Union bus stop in the 8-9 AM period because they could not take on any more passengers. In addition, 23% of northbound buses in the evening were the second consecutive bus to not take passengers in the same direction.[3] B61 buses traveling northbound in the 8–9 AM and 5–6 PM hours are carrying more passengers than the loading guidelines prescribed by the MTA New York City Transit for peak service — indicating that more buses are required to effectively serve rider demand on the B61.[4]

1 "Acceptable headway time" is defined as a bus arriving +/-3 minutes outside the intended time frame—or headway—between buses during peak hours of service. The scheduled headway for the B61 varies from 8 to 10minutes during peak hours of service and averages at 8.5 minutes.
2 The NYCT-gathered measure on 11/23/10 is for all times.
3 Bus drivers are instructed to not admit more passengers when it is unsafe to do so (typically because passengers cannot fit behind the "white line") or when directed by supervision. For purposes of this study, we conservatively estimated this amount to be 68 passengers based on observation.
4 A "full standing load" of 54 passengers is the MTA's loading guidelines for bus service during peak hours.

Passenger Survey Findings

- 81% of B61 riders surveyed at 4th Ave - 9th St use the B61 bus to commute to/from Red Hook.



Visioning A Revitalized Red Hook- Two Possible Urban Design Paradigms: Fell’s Point Baltimore, and Ybor City, Tampa

Community Design Paradigm 1: Fell's Point, Baltimore

3168 people
0.117188 sq mi
POP. DENSITY: 27,033person/sq mi
Note: Red Hook’s circa 1950 population was 21,000

Fell's Point Historic District	
U S National Register of Historic Places	
U S Historic district	
	
Storefronts along the Belgian blocks of Thames Street	
	
Location	Bounded on the NORTH by Eastern Avenue, on the EAST by Chester Street, on the SOUTH by the Patapsco River and Harbor, and on the WEST by Central Avenue, southeastern Baltimore, Maryland
Coordinates	39°16′59″N 76°35′34″W [1]Coordinates: 39°16′59″N 76°35′34″W[1]
Area	75 acres (30 ha)
Built	1 763
Architect	Multiple
Architectural style	Italianate, Greek Revival
Governing body	Local
NRHP Reference #	69000319
Added to NRHP	March 28, 1969

Fell's Point is a historic waterfront neighborhood in the southeastern area of the City of Baltimore, in Maryland, along the north shore of the Baltimore Harbor and the Northwest Branch of the Patapsco River. There are many shops, including antique stores, restaurants, coffee bars, music stores, a municipal markethouse with individual stalls, and over 120 pubs. Located just east of the famous "Inner Harbor" (formerly "The Basin") adjacent to Baltimore's downtown central business district and the Jones Falls stream (which splits the city), Fell's Point has a maritime past and has the air of a seafaring town, it has the greatest concentration of drinking establishments in the city. This waterfront community is a tourist destination. It can be reached by "water taxi" barges, expressway/interstate highways, local streets and boulevards and several municipal/state transit bus lines. The neighborhood has also been historically the home of large immigrant populations of German, Polish, and other East European nationalities such as Ukrainians, Russians, Czech/Bohemians, and Slovaks, along with Irish, throughout its 250 year-old history. Since the 1970s a steadily increasing number of middle to upper middle income residents has moved into the area, restoring and preserving historic homes and businesses. This has resulted in higher property prices, a safer neighborhood, and improved educational levels. Upper Fell's Point to the north along Broadway has gained a sizable Hispanic population, made up primarily of recent waves since the 1980s of Mexican and Central American immigrants and is sometimes now called "Spanish Town". Fell's Point is one of several areas in and around Baltimore that are listed on the National Register of Historic Districts, the first from Maryland, and is one of the first registered historic districts in the United States to combine two separate waterfront communities (along with Federal Hill to the southwest across the Patapsco River and the Harbor on the "Old South Baltimore" peninsula of "Whetstone Point" at Fort McHenry).[2]

The waterfront at Fells Point

History

First described by a European seafarer as "Long Island Point" in 1670, the area later to be known as Fell's Point was a thin little peninsula jutting out southwestward between the streams of Jones Falls and Harford Run (later covered over by Central Avenue) to the west and Harris Creek to the east (now under the community of Canton) and further east to Colgate Creek (now surrounded by the Dundalk and Sea Girt Marine Terminals). Later land was patented with the title of "Copus Harbor". Nearby Baltimore Town to the west at the headwater of the Patapsco River's Northwest Branch was land patented under the name of "Cole's Harbor" and "Todd's Range" to William Cole and later sold to Charles and Daniel Carroll. This area was later established as a "port of entry" by the General Assembly of the Province of Maryland in 1706. After several local farmers and plantation owners originally planning to establish a town on the northeastern shores of the Middle Branch of the Patapsco (also known as "Ridgeley's Cove") were stymied by the objections of local owner William Moale, who thought the land was too valuable as a site of iron ore deposits. So the new town site was moved further to the northeast to the head of the Northwest Branch. Established as a town by the authority of the Colonial Assembly in 1729, several streets were laid out in the "Original Survey" with the main one being east-to-west called "Long Street" and several others intersecting north-to-south such as Forrest (later Charles), Calvert, north of "The Basin" (today's Inner Harbor) in 1730.

Joined in 1732, to the northeast along the banks of the stream "Jones Falls" (which originates in northern Baltimore County near the Pennsylvania border) by the laying out of several streets on a northwest to southeast angle by David Jones and named "Jones's Town" with streets such as Front, High, and Low. Founded by William Fell, who was

attracted by its beautiful, deep water and proximity to agriculture and thick forests, Fell's Point became a shipbuilding and commercial center. About 1763, William's son Edward Fell laid out streets and began selling plots for homes. The town grew quickly, and eventually incorporated with Baltimore Town and Jones Town in 1773 to form a new Town of Baltimore and later in 1797 becoming the City of Baltimore. The area grew wealthy on the tobacco, flour, and coffee trades through the 18th and 19th centuries.

Some of the first vessels commissioned for the US Navy were built in Fell's Point shipyards, including the USS *Constellation* in 1797. However, the area became best known for producing topsail schooners, sometimes erroneously called Baltimore clippers, renowned for their great speed and handling. They were excellent blockade runners, and were frequently used as armed privateers. The *Pride of Baltimore II* is based on the *Chasseur*, built by Thomas Kemp, which was one of the most successful privateers built in Fell's Point.

Architecture

Fell's Point includes a diversity of historic architecture. Flemish bond brick is used in some of the earliest homes, while row housing is prominent in eighteenth and early twentieth century construction. Gabled roof buildings and Victorian homes are also interspersed with other housing and use types.[10]

Historic buildings include:

- The Robert Long House, built in 1765, is the oldest surviving home in Baltimore.[11]
- The Saint Patrick Catholic Church (founded in 1792, current building completed in 1898) was damaged in the 5.3 magnitude earthquake on August 23, 2011. While the building was condemned and the steeple sustained significant damage, the building reopened for Mass on Ash Wednesday in 2012.[12][13]

Awards

In 2012 Fell's Point was selected by the American Planning Association (APA) [14] as one of the Great Places in America (neighborhood category), which "celebrates places of exemplary character, quality, and planning".[15]

Annual festivals

Fell's Point Fun Festival started in 1966 in response to the proposed I-95 freeway that was to run through the neighborhood. The original purpose of the festival was to raise money to help save Fell's Point and to raise awareness of the historical significance of the neighborhood and its plight. The weekend-long Fun Festival, celebrated in October, has an estimated attendance of over 700,000. The event includes entertainment, arts and crafts vendors, and cultural and culinary offerings.[16]

Fish statue in Fells Point

Fell's Point Privateer Festival is an annual weekend-long festival in April celebrating the privateer and maritime history of Fell's Point. Activities include educational demonstrations, a pub crawl, pet costume contest, and pyrate's ball.[17]

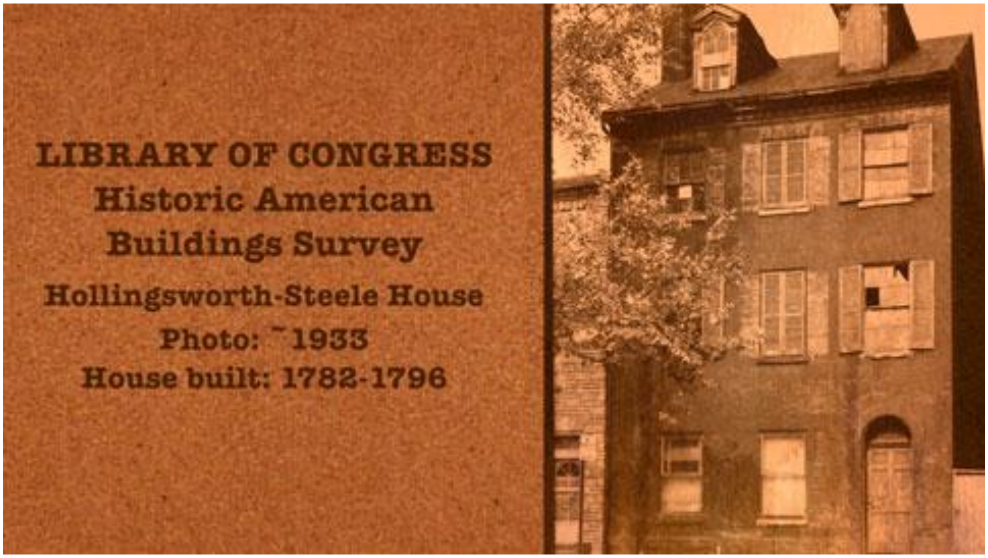
Fell's Point Olde Tyme Christmas Festival is held during the first weekend in December and includes a traditional Christmas market, pet costume contest, and a Reindeer Run pub crawl.[18]

Demographics

At the census[19] of 2010, 3,168 people resided in the neighborhood, 61% white, 24.9% Hispanic, 7.4% African American, and 6.7% other. 37.0% of occupied housing units were owner-occupied, and 17.4% vacant.

68.8% of the population were employed, 3.0% were unemployed, and 27.1% were not in the labor force. The median household income was US$46,167. 7.5% of families and 12.6% of the population were below the poverty line.


Fort Pitt
beer


LIBRARY OF CONGRESS
Historic American
Buildings Survey
Hollingsworth-Steele House
Photo: ~1933
House built: 1782-1796

Community Design Paradigm 2: Ybor City, Tampa

Pop. 4,377 Non- Tourist Residents

Area: 1 sqmi

Pop. Density: 4,377 persons/sqmi

Ybor City

Neighborhood

Nickname(s): Florida's Latin Quarter

[1] [1]

Country	United States
State	Florida
County	Hillsborough County
City	Tampa
Founded	1885
Incorporation into Tampa	1887
Time zone	EST (UTC-5)
• Summer (DST)	EDT (UTC-4)
Website	http:// www yboronline com/

Ybor City (/ˈiːbɔr/ ***EE**-bor*) is a historic neighborhood in Tampa, Florida located just northeast of downtown. It was founded in the 1880s by cigar manufacturers and was populated by thousands of immigrants, mainly from Spain, Cuba, and Italy. For the next 50 years, workers in Ybor City's cigar factories would roll millions of cigars annually.

The neighborhood had features unusual among contemporary immigrant communities in the southern United States, most notably its multi-ethnic and multi-racial population and their many mutual aid societies. A slow exodus out of the area that began during the Great Depression accelerated after World War II, leading to a period of abandonment and decay. After decades of neglect, a portion of the original neighborhood has redeveloped into a night club and


CENTRO YBOR
YBOR CITY

entertainment district.

The neighborhood has been designated as a National Historic Landmark District, and several structures in the area are listed in the National Register of Historic Places. In 2008, 7th Avenue, the main commercial thoroughfare in Ybor City, was recognized as one of the 10 Great Streets in America by the American Planning Association. In 2010 Columbia Restaurant was named a "Top 50 All-American icon" by *Nation's Restaurant News* magazine.[2]

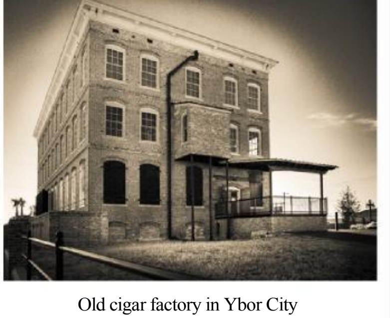
History

Establishment

Ybor's first cigar factory

In the early 1880s, Tampa was an isolated village with a population of less than 1000 and a struggling economy.[3] However, its combination of a good port, Henry Plants new railroad line, and humid climate attracted the attention of Vicente Martinez Ybor, a prominent Spanish-born cigar manufacturer.

Ybor had moved his cigar-making operation from Cuba to Key West, Florida in 1869, due to political turmoil in the then-Spanish colony. But, labor unrest and the lack of room for expansion had him looking for another base of operations, preferably in his own company town.



Old cigar factory in Ybor City

Florida Brewing building in Ybor City

Arturo Fuente Sign in Ybor City

José Martí and cigar workers on the steps of V V Ybor's factory, 1893

Ybor considered several communities in the southern United States and decided that an area of sandy scrubland just northeast of Tampa would be the best location. In 1885, the Tampa Board of Trade helped broker an initial purchase of 40 acres (160,000 m^2) of land, and Ybor quickly bought more.

Cigar making was a specialized trade, and Tampa did not possess a workforce able to man the new factories. To attract employees, Ybor built hundreds of small houses for the coming influx of mainly Cuban and Spanish cigar workers, many of whom followed him from Key West and Cuba. Other cigar manufacturers, drawn by incentives provided by Ybor to further increase the labor pool, also moved in, quickly making Tampa a major cigar production center.

Italians were also among the early settlers of Ybor City. Most of them came from a few villages in southwestern Sicily. The villages were Santo Stefano Quisquina,[4] Alessandria della Rocca, Bivona, Cianciana, and Contessa Entellina.[5] Sixty percent of them came from Santo Stefano Quisquina.[6] Before settling in Ybor City, many first worked in the sugar cane plantations in St. Cloud, central Florida. Some came by way of Louisiana.[7] A number of families migrated from New Orleans after the lynching of eleven Italians in 1891 during the Mafia Riot.[8] Italians mostly brought their entire families with them, unlike other immigrants. The foreign-born Italian population of Tampa grew from 56 in 1890 to 2,684 in 1940.[9] Once arriving in Ybor City, Italians settled mainly in the eastern and southern fringes of the city. The area was referred to as La Pachata, after a Cuban rent collector in that area. It was also called Little Italy.

Unlike Cubans and Spaniards, the Italians arrived in the cigar town without cigar-making skills. When the early Italians entered the factories, it was at the bottom of the ladder, positions which did not involve handling tobacco. Working beside unskilled Cubans, mainly Afro-Cubans, they swept and hauled and were porters and doorkeepers. In time, many did become cigar workers, including Italian women. The majority of the Italian women worked as cigar strippers in 1900, an undesirable position mainly held by women who could find nothing else. However, eventually many of them became skilled cigar makers, earning more than the male Italian cigar makers. Other Italian immigrants started small businesses built around the cigar industry, such as cafés, food stores, restaurants, and boardinghouses.

The least known of the immigrants that came to Ybor City are the Germans,[10] the Romanian Jews, and the Chinese. The Chinese and Jews were employed mainly in service trades and retail businesses.[11] The Germans arrived after the 1890s, and most were businessmen. In the cigar factories, they worked as managers, bookkeepers, and supervisors. Cigar boxes were made by German-owned factories. Several early cigar box labels were made by German lithographers. The Germans formed their own club, the Deutsch Amerikanischer Verein. The club building is still standing on Nebraska and 11th Avenue. It contained a restaurant open to the public that served German food. In 1919, because of anti-German feelings from World War I, they sold the building to the Young Mens Hebrew Association. The building is now used as offices for the City of Tampa.[12]

In 1887, Tampa annexed the neighborhood. By 1900, the rough frontier settlement of wooden buildings and sandy streets had been transformed into a bustling town with brick buildings and streets, a streetcar line, and many social and cultural opportunities. Largely due to the growth of Ybor City, Tampas population had jumped to almost 16,000.[13]

Inside an Ybor City cigar factory ca 1920

The Golden age

Ybor City grew and prospered during the first decades of the 20th Century. Thousands of residents built a community that combined Cuban, Spanish, Italian, and Jewish culture. Ybor City is Tampas Spanish India, observed a visitor to the area, What a colorful, screaming, shrill, and turbulent world. [14]

An aspect of life were the mutual aid societies built and sustained mainly by ordinary citizens. These clubs were founded in Ybor's early days (the first was the Centro Español, established in 1891) and were run on dues collected from their members, usually 5% of a member's salary. In exchange, members and their whole family received services including free libraries, educational programs, sports teams, restaurants, numerous social functions like dances and picnics, and free medical services. Beyond the services, these clubs served as extended families and communal gathering places for generations of Ybor's citizens.


Circulo Cubano de Tampa, one of Ybor City's social clubs

There were clubs for each ethnic division in the community - the Deutscher-Americaner Club (for German and eastern Europeans), L'Unione Italiana (for Italians), El Circulo Cubano (for light-skinned Cubans), La Union Marti-Maceo (for darker-skinned Cubans), El Centro Español (for Spaniards), and the largest, El Centro Asturiano, which accepted members from any ethnic group

Although there was little racism in Ybor City, Tampa's Jim Crow laws at the time forbade Afro-Cubans from belonging to the same social organization as their lighter-skinned countrymen. Sometimes, differences in skin color within the same family made joining the same Cuban club impossible. In general, the rivalries between all the clubs were friendly, and families were known to switch affiliations depending on which one offered preferred services and events.

Cigar production reached its peak in 1929, when 500,000,000 cigars were rolled in the factories of Ybor City.[15] Not coincidentally, that was also the year that the Great Depression began.

Cuban Club in Ybor City

Decline and rebirth

The Depression was a major blow to cigar manufacturers. Worldwide demand plummeted as consumers sought to cut costs by switching to less-expensive cigarettes, and factories responded by laying off workers or shutting down. This trend continued throughout the 1930s as the remaining cigar factories gradually switched from traditional hand-rolled manufacturing to cheaper mechanized methods, further reducing the number of jobs and the salaries paid to workers.

After World War II, many returning veterans chose to leave Ybor City due to a lack of well-paying jobs and a US Veterans Administration home loan program that was only applicable to new homes, of which there were few in the neighborhood. In fact, the home stock was aging poorly, as many of the structures built in the early days of Ybor City were still in use.

As the historic neighborhood continued to empty out and deteriorate through the 1950s and 1960s, the federal Urban Renewal program sought to revitalize the area by demolishing older structures and encouraging new residential and commercial development. The demolition took place, but due to a lack of funds, the redevelopment did not happen. The primary legacy of the program was blocks of vacant lots which would remain empty for decades. The construction of Interstate 4 through the center of the neighborhood during this period also resulted in the destruction of many buildings and cut most of the north-south routes through the area.

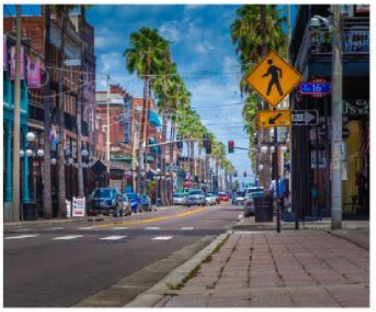
By the early 1970s, very few businesses and residents remained, most notably the Columbia Restaurant and a few other businesses along 7th Avenue.

Recovery

In the early 1980s, an influx of artists seeking interesting and inexpensive studio quarters started a slow recovery, followed by a period of commercial gentrification. By the early 1990s, many of the old long-empty brick buildings on 7th Avenue had been converted into bars, restaurants, nightclubs, and other nightlife attractions.[16] Traffic grew so much that the city built parking garages and closed 7th Ave. to traffic to deal with the visitors.

Since around 2000, the city of Tampa and the Ybor City Chamber of Commerce have encouraged a broader emphasis in development. With financial help from the city, Centro Ybor, a family-oriented shopping complex and movie theater, opened in the former home of the Centro Español social club. New apartments, condominiums and a hotel have been built on long-vacant lots, and old buildings have been restored and converted into residences and hotels. New residents began moving into Ybor City for the first time in many years. The blocks surrounding 7th Avenue also thrive with restaurants, nightlife and shopping. Reflecting the district's status as a party destination, Ybor City is referenced extensively in the lyrics of Brooklyn-based rock band The Hold Steady. The song "Killer Parties," for instance, contains the line "Ybor City is très speedy, but they throw such killer parties."[17] In May 2009 Swedish super-retailer IKEA opened its long-awaited Tampa location in the southern edge of Ybor City.

7th Ave Sign in Ybor City


7th Ave Ybor City


Traffic in Ybor City


Centro Ybor, a restored shopping area on 7th Ave

GaYbor

In late 2007, business organization and district GaYbor was formed. Thearea is centered on 7th Ave. and 16th St., featuring many LGBT-friendly establishments. Every July the district has a street party called "GaYbor Days." The organization is sponsoring a public art display of painted pianos to be scattered around Historic Ybor.

Boundaries

Historically, the boundaries of Greater Ybor City stretched from Tampa Bay on the south to Dr. Martin Luther King Jr. Blvd. (formerly Buffalo Avenue) on the north, and from Nebraska Avenue on the west to 40th Street on the east. This would include all of todays neighborhoods of Historic Ybor, East Ybor, VM Ybor, and Ybor Heights plus a portion of East Tampa. The Ybor City Historic District encompasses the central portion of that area, approximately straddling Interstate 4, which bisected the neighborhood in the 1960s.The official boundaries of the Historic Ybor neighborhood are I-4 to the north, 22nd Street to the east, Adamo Drive to the south, and Nebraska Avenue to the west. The area of this district is about 1 square mile (about 2.6 km^2). Though modern Ybor City also includes some of the surrounding area, its exact dimensions are loosely defined and subject to debate.

Population

At the height of its life as a thriving immigrant community, Ybor Citys population was numbered in the tens of thousands. In the lowest point in the late 1970s, perhaps 1000 residents called the neighborhood home.In recent years, the numbers have begun to climb once more. Ybor Citys population grew an estimated 42.5% between 2000 and 2003, mainly as a result of new condominium and apartment construction. As of 2003, approximately 2,900 residents lived in the area.

Economy

Ybor City is one of the oldest sections of Tampa and is almost entirely an urban, built-up area. Commercial property comprises almost 50% of the land, institutional use (including the Hillsborough County Sheriffs Operations Center and a satellite campus of Hillsborough Community College) 16%, residential use about 23%, and industrial use about 7% [18]According to a 2003 survey, the top five business types in the area were professional services (22.8%), retail (18.4%), manufacturing (14.0%), wholesale/distribution (13.2%), and restaurants & bars (11.4%).

Transportation

For the most part, Ybor City still uses the gridded street system laid out by Gavino Guiterrez in 1885. Many roadways are now paved with modern materials, though a few brick streets remain.Because 21st and 22nd Streets, which cut north-south through the area, are the main traffic routes between Interstate 4 and the Port of Tampa, there is a large volume of truck traffic funneling through the historic district, causing damage to narrow city roads and sometimes colliding with historic buildings. Work on an elevated connector between I-4 and the Lee Roy Selmon Expressway to siphon truck traffic away from the area began in January 2010. The project is scheduled to be complete in 2014.

Public transit

The TECO Line Streetcar System, which links Ybor City, the Channelside District and Downtown Tampa, began operating in October 2002. The Hillsborough Area Regional Transit Authority (HARTline) operates the streetcars as well as the bus system. Small startups have also begun utilizing NEVs to shuttle passengers between Tampa's core neighborhoods including Ybor.[19]

Trolley in Ybor City

Museums

- Cigar Museum And Visitor Center, Ybor City
- Ybor City Museum State Park
- TECO Line Streetcar Museum

Annual Events

- Fiesta - weekend event celebrating Latin culture and food, celebrated mid-February
- Sant'Yago Knight Parade (also known as Gasparilla Night Parade) - usually held the Saturday following the Gasparilla Pirate Festival in late February
- Rough Rider's [20] St. Patrick's Night Parade - illuminated nighttime parade held on or near St. Patrick's Day, mid-March
- Festa Italiana [21] Weekend event celebrating Italian culture and food, celebrated mid-April
- GaYbor Days - four-day long street festival in the GaYbor district, held in July
- Guavaween - daytime events and nighttime parade in October, named for Tampa's "Big Guava" nickname
- Tampa Cigar Heritage Festival [22] - celebrated mid-November

Red Hook Streetcar System Mission Statement

The RHSS can play a key role in shaping south Brooklyn by:

Reinforcing walkable neighborhoods and vibrant main streets.

Encouraging sustainable development and infrastructure.

Supporting reduction of redevelopment related vehicle trips.

Supporting greater accessibility, housing options, employment and economic • development.

- *System Goals*
- Goal 1: Help the City achieve its peak oil and sustainability strategies.
- Goal 2: Provide an organizing structure and catalyst for the City's future growth along streetcar corridors.
- Goal 3: Integrate streetcar corridors into the City's existing neighborhoods.

- *Streetcar Corridor Goals*
- Goal 1: Be a viable transit option with adequate ridership.
- Goal 2: Have redevelopment potential.
- Goal 3: Demonstrate community support to make the streetcar system work well with other
- planning goals and mixed-use street corridors.

Planning for Sustainable Red Hook and downtown Brooklyn Growth

As downtown Brooklyn continues to grow, there are emerging development opportunities that can reduce our carbon footprint, maintain New York City's valued livability, and take advantage of transit must be a part of any plan to accommodate additional commercial and residential growth.

A streetcar system can be an effective tool to help implement a NYC Peak Oil Strategy, should the City decide to promulgate such. For example, implementation of streetcar corridors can help fulfill many requirements of any envisioned NYC Peak Oil Strategy . The following proposals emphasize land use and transportation planning to minimize fossil fuel use and stronger policies and programs to reduce energy use in buildings. These proposals include:

Engaging business, government and community leaders to initiate planning and policy changes;

Supporting land use patterns that reduce transportation needs, promote pedestrian activity and provide easy access to services and transportation options;

Designing infrastructure to promote transportation options, facilitating efficient movement of freight, and preventing infrastructure investments that would not be prudent given fuel shortages and higher prices;

Encouraging energy-efficient and renewable transportation choices;

Expanding energy-efficient building programs and incentives for all new and existing structures;

Preserving farmland and expanding local food production and processing;

Identifying and promoting sustainable business opportunities;

Redesigning the safety net to protect vulnerable and marginalized populations; and preparing emergency plans for sudden and severe shortages of resources

How Does the Streetcar Help Reduce Auto Trips?

Dense, mixed-use development with good transit access results in reduced auto trips. Total daily vehicle miles traveled per capita decreases significantly for residents living in mixed-use, transit-rich neighborhoods because residents have foot, bike and transit access to trip destinations within close proximity. According to Portland, OR, Metro data, residents are almost twice as likely to walk, and are

45 percent more likely to use transit in mixed-use neighborhoods. This is because mixed-use neighborhoods have trip destinations within close proximity, making non-auto modes of travel more convenient and attractive.

Portland Metro data, has demonstrated that areas with good transit and mixed land uses have an estimated 58 percent auto mode use compared to an overall regional average of 87 percent. **This 29 percent reduction in auto trips is referred to as the "trip not taken."**

Analysis of the existing Portland Streetcar experience indicates a savings of 60 million vehicle miles traveled per year due to added urban development, when compared to a similar suburban alternative.

Portland Mode Split by Development Type

Land Use Type	Mode Split: Auto	Mode Split: Walk	Mode Split: Transit	Mode Split: Bike	Mode Split: Other	Daily Vehicle Miles per Capita	Auto Ownership per Household
High Frequency Transit/Mixed Use	58.1%	27.0%	11.5%	1.9%	1.5%	9.8	0.9
High Frequency Transit Only	74.4%	15.2%	7.9%	1.4%	1.1%	12.4	1.5
Remainder of Multnomah Co.	81.5%	9.7%	3.5%	1.6%	3.7%	17.3	1.7
Remainder of Region	87.3%	6.1%	1.2%	0.8%	4.5%	21.8	1.9

Source: Metro 1994 Travel Survey

This table shows data derived from he Metro 1994 Travel Behavior Survey that compares auto and non-auto mode shares. The data was analyzed by small geographic units that allowed for a comparison of areas with good transit and a high mix of uses with o her parts of the region.

The Trip Not Taken

The relationship between land use and transportation choices is well documented in the U.S. Residents living in higher density development with a mix of uses (commercial, civic, entertainment and residential) and good transit service are significantly more likely to use transit, walk, or bike than use an automobile. This net decrease in automobile use, or the "trip not taken", reduces the need to accommodate more cars on city streets and provide parking. It has the potential to reduce development costs, in part because parking requirements may be less. The streetcar has demonstrated its ability to encourage denser development with a population that is less reliant on automobiles because destinations (e.g., home, work, services) are closer and the streetcar, along with other transportation options, are available and desirable.

Streetcar's Role in Making Red Hook More Sustainable- How Can Streetcar Help Achieve Red Hook's Sustainability Goals?

Climate Change

Transportation emissions are considered responsible for nearly 40 percent of all greenhouse gas emissions; yet mobile sources are poorly regulated because of decentralized ownership and regulatory traditions. Given that the anticipated climate change will affect every part of the way we live and plan for the future, we must consider all available options to reduce the impacts generated by our current transportation system.

Red Hook's streetcar system can help balance and integrate sustainable technology with the existing and anticipated neighborhood characteristics to provide a comfortable, convenient transportation choice. The streetcar system would connect the dots of centers by providing an interconnected network of corridors that adds vitality to nodes, maximizes land use and integrates with evolving infrastructure. It can contribute to neutralizing downtown Brooklyn's carbon footprint through the overall reduction of Vehicle Miles Traveled (VMT), reduce trips by single occupant vehicles, and reduce allied greenhouse gases (GHG) through electrification of the transportation system and integration with human-powered modes. Most importantly, it would encourage denser development, which would result in fewer climate emissions from transportation as well as from housing.

Returning to the Portland, OR experience, it is estimated that the new development around Portland's existing streetcar system has resulted in a 60 percent reduction in greenhouse gas emissions, as compared to what emissions would be for a similar capacity of residential and business units developed in the suburbs. This savings is realized through the reduction of motor vehicle trips, consolidation and reuse of building materials, reduction in land consumption and less private and municipal infrastructure.

Source: E.D. Hovee & Company, Portland Streetcar Development Impacts, 2005.

Community Health

Human health is an aspect often overlooked in planning efforts, despite having value that is widely understood. In the last fifty years, remarkable advances in medical treatments have helped reduce the effects of illness and disease, as well as extend our life expectancies. However, as a society, we have incrementally increased our exposure to contaminants while simultaneously removing the daily activities that make us healthy, such as walking, to take care of our basic needs. Walking has ceased to be an integral part of daily activity in places that developed around the automobile. The implementation of the Red Hook streetcar corridor may potentially reduce pollution loads from vehicles of all types, from diesel-powered buses and trucks to cars running on standard petroleum, fostering a support a truly multi-modal lifestyle with fewer emissions.

Social Equity and Access

Implementation of a streetcar network can provide a catalyst for greater social equity and access to an affordable society in terms of transportation, recreation, health care, housing and jobs. Encouraging a lifestyle that reduces vehicle dependency frees additional household income to apply toward better housing or a higher standard of living. By providing convenient access to basic goods and services such as food, employment and healthcare, streetcar corridors can encourage a lifestyle that reduces dependence on motor vehicles. This can in turn reduce overall transportation costs, freeing additional household income to apply toward better housing or a higher standard of living.

Constrained Fossil Fuel Resources

The current global energy system was developed on the presumption of a seemingly unlimited supply of fossil fuel resources such as oil, coal and natural gas. We know now that production of these resources will inevitably peak and, without careful preparation, steep increases in energy prices may disrupt our economies and society.

Secure and sustainable energy supplies are vital to Red Hook's future prosperity. A significant opportunity exists with the implementation of the Streetcar System. The streetcar can promote and organize new compact development within a specific streetcar corridor

Why Streetcars?

The essential quality of streetcars is that they excel at shaping compact, walkable neighborhoods by connecting destinations with a high-quality transit ride over smooth rails. Most importantly, the streetcar offers predictability – the tracks are visible and permanent and won't take an unexpected turn. This results in a transit service that is more attractive to occasional riders, including visitors. It also promotes a "park-once" philosophy, in which a person may use a car to get downtown or to a neighborhood and use a streetcar to reach other destinations in the corridor.

As an example, while TriMet (Portland, OR commuter rail) ridership peaks during the daily commuting times, today's streetcar in Portland has ridership peaks during the work week around lunchtime and on weekends.

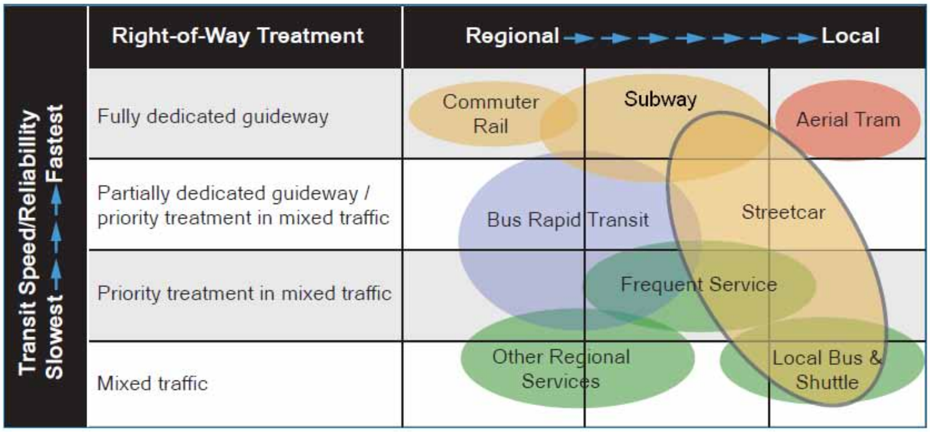
Why are Riders Attracted to Streetcars?

Streetcars are relatively quiet, electrically-powered zero-emission vehicles that can operate in a variety of right-of-way configurations. They offer a smoother ride than buses, as they do not weave back and forth to the curb to make stops, and are available as 100 percent low-floor vehicles for easy boarding. Visitors and tourists are more willing to ride a streetcar because they are easier to understand. When less frequent riders can see the rails in the street, they know a streetcar will come by. In contrast, a bus route is less intuitive without a map.

Because streetcars run on an identifiable trackway infrastructure, they create a sense of permanence that both encourages ridership and can influence development investments. Streetcar systems, implemented in concert with streetscape and pedestrian improvements, can improve the urban environment considerably and contribute to the development or redevelopment of neighborhoods.

Where Does Streetcar Fit in the Red Hook/downtown Brooklyn Transit System?

Streetcar service is one of the newest transit modes in the region's transit system. Each transit mode has its own benefits, but all are necessary to achieve a comprehensive transit system. The chart below illustrates how streetcar complements the region's other transit modes in terms of speed, reliability and type of service (regional versus local). Integrating streetcar and bus operations is an essential component of making the comprehensive transit system work.



What is the Role of a Streetcar System in Red Hook and Downtown Brooklyn?

It is about accommodating growth along transit corridors while respecting the unique character of each neighborhood;

It is about providing an accessible network of transportation options that will reduce our dependency on the automobile;

It is about promoting better health by fostering more pedestrian activity and coordinating with existing and planned bicycle connections;

It is about promoting better air quality and conservation of our natural resources by reducing greenhouse gas emissions and controlling urban sprawl;

It is about finding new ways to utilize our transportation corridors as the region continues to grow

Modern streetcars are an evolution of the "PCC" type streetcar that was designed in Brooklyn in the 1930s, to meet Brooklyn traffic conditions and street layout. Streetcars differ from conventional "light rail" in many ways.

It will be shown later in this report, that the proposed Red Hook Streetcar System can be almost entirely solar powered, sometimes selling electric power back to the Utility Company.

> The Streetcar can operate in mixed traffic with other vehicles, pedestrians and bicycles. The Streetcar does not require dedicated traffic lanes, and can easily keep up with traffic. The use of modern ADA compliant Passenger Boarding Islands eliminates traffic delays due to alighting passenger. Moving traffic passes stopped streetcars in the right hand lane.

Livingston Street, ca 1947

Los Angeles, ca 1949

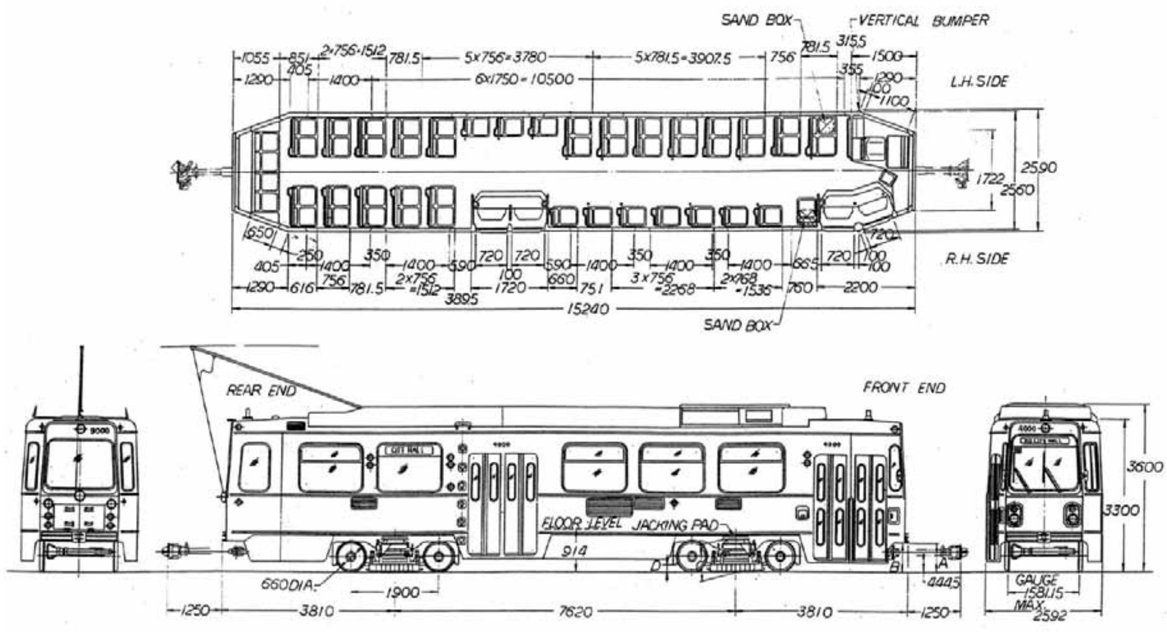
Due to its light weight, the Streetcar uses a simplified form of track construction, which costs only a fraction of conventional light rail track

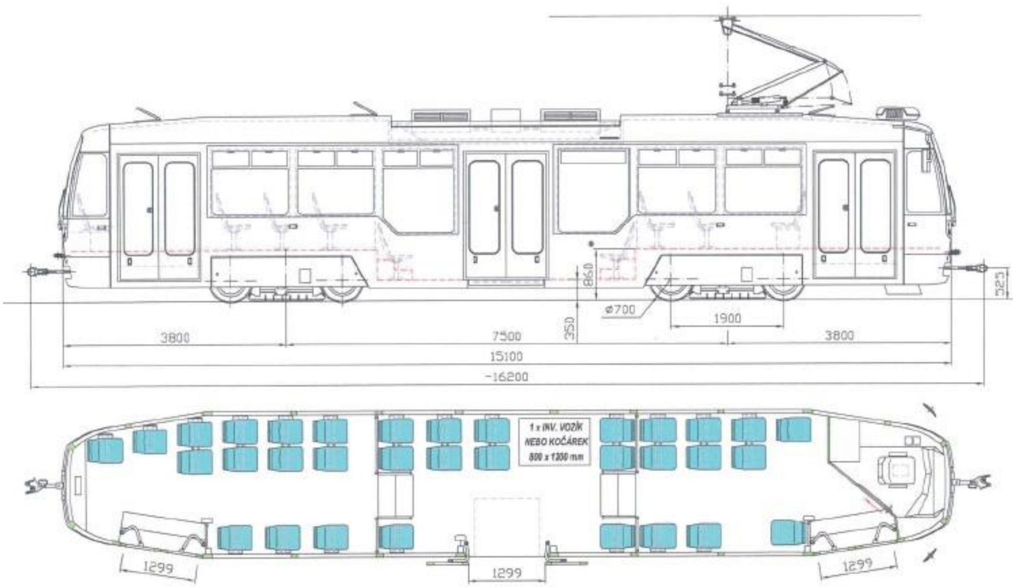
Streetcars uses a simplified form of overhead wire construction, the cost of which is only a fraction of conventional light rail catenary wires. Since Streetcar wires are simplified, the visual impacts of the wires are greatly mitigated over conventional light rail catenary wires.

Because modern Streetcars use a simplified form of track construction not requiring deep excavations, the need for utility relocation is negligible.

Because Streetcars can operate in existing city streets, its rails are flush with the roadway and its turning radii fits into existing street geometries, Streetcars will not divide neighborhoods by presenting physical or psychological barriers, as do divided highways.

Corner buildings do not need to be demolished to accommodate the streetcar's smaller turning radius





Because of our new Streetcar's low weight and unique electrical propulsion package, the modern Brooklyn Streetcar uses only uses a fraction of the electrical power requirement of a conventional light rail vehicle. In fact, the Streetcar spends most of its time coasting and applying brakes. These streetcars do not require the same large scale and costly power substations as do conventional light rail vehicles. Our new streetcars are designed to stop and accelerate quickly.

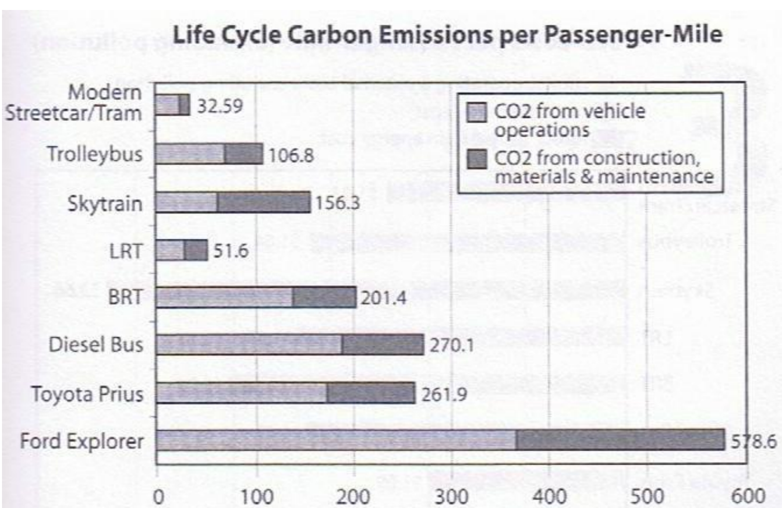


Figure 2.19. Carbon emissions per passenger-mile when electricity source is coal. (Source: Strickland, 2008; U.S. Environmental Protection Agency, 2005; Spadaro, Langlois, and Hamilton, 2000)

gCO2 equivalents/passenger-mile

BENEFITS OF A STREETCAR LINE: Land Use, Community Coherence & Economic Revitalization.

The following are selections from the book: ***Seven Rules for Sustainable Communities Design Strategies for the Post- Carbon World,*** **by Patrick M. Condon, 2010:**

SEVEN RULES FOR SUSTAINABLE, LOW-CARBON COMMUNITIES - Rule # 1: RESTORE THE STREETCAR CITY

The North American city was and is a streetcar city. Streetcar cities are characterized by easy access to transit, a wide variety of house types, and services and job sites very close at hand—the exact elements of a sustainable city. We have largely ignored this fact. It needs rediscovering.

THE STREETCAR CITY AS A UNIFYING PRINCIPLE

The streetcar city principle is not about the streetcar itself, it is about the system of which that the streetcar is a part. It is about the sustainable relationship between land use, walking, and transportation that streetcar cities embody. The streetcar city principle combines at least four of the design rules discussed in the following chapters: (1) an interconnected street system, (2) a diversity of housing types, (3) a five-minute walking distance to commercial services and transit, and (4) good jobs close to affordable homes. For this reason, it is offered as the first of the rules and as a "meta rule" for sustainable, low-carbon community development.

CONTINUOUS LINEAR CORRIDORS, NOT STAND-ALONE NODES

Linear public space is the defining social and spatial characteristic of the streetcar city This obvious fact has been ignored at best and derided at worst. Most planning, urban design, and economic development experts favor strategies that ignore corridors in favor of discrete and identifiable places, key urban "nodes" in planning terms. Their plans focus most often on an identified "downtown" or a key transportation locus, while the thousands of miles of early-twentieth-century streetcar arterials are either allowed to languish or blithely sacrificed for parking lots. Yet, very few of us live within walking distance of a "node," whereas most of us live within a reasonable walk of a corridor, however gruesome it may now be.

Getting people onto transit will not help defeat global warming unless we can find a way to radically decrease the average daily demand for motorized travel of any kind and the per-mile GHG consequences of each trip. Community districts that are complete and that favor short trips over long ones seem an obvious part of the solution. Inexpensive short-haul zero carbon transit vehicles, such as trolley buses and especially streetcars, are a likely feature of a low-energy, low-travel demand solution.

Precious few cities seem to "get it" in this respect. Portland, again, is the exception. Portland is the only U.S city to have made a serious effort to restore its streetcar system. The results could not be more promising. Jobs, housing, and new commercial services are flocking to the line, making the community that much more complete and thus incrementally reducing aggregate per capita trip demand. In Portland, jobs, housing, clubs, and commercial services are coming closer together A ten-minute ride on the Portland streetcar gets you where you want to go. Its speed between these points is irrelevant.

STREETCAR AS AN URBAN INVESTMENT

Most discussions of streetcar focus solely on transit issues, but the implications are much wider. Streetcars stimulate investment and buses don't. This has been powerfully demonstrated in Portland, where the introduction of a modern streetcar line spurred the high-density development that helped the City of Portland recoup construction costs through significantly increased tax revenues. Between 1997 and 2005, the density of development immediately adjacent to the new streetcar line increased dramatically. Within two blocks of the streetcar line, $2.28 billion was invested [Editor's Note: a total of $3.5 billion through a six block wide corridor centered along the streetcar tracks], representing over 7,200 [ibid 10,212] new residential units and 4.6 million [ibid 5.5 million] square feet of additional commercial [office, institutional, retail, hotel] space; even more impressive, new development within only one block of the streetcar line accounted for 55 percent of all new development within the city's core. To put this in perspective, prior to construction of the new streetcar line, land located within one block of the proposed route captured only 19 percent of all development.

Most attribute this impressive increase in investment to the presence of the streetcar line. Developers for the new South Waterfront development at the other end of the downtown from the Pearl District would not proceed before the city guaranteed to extend the streetcar line to the site. These developers, the same ones who had created the highly successful streetcar serving Pearl District, knew from experience how important the streetcar is to success. If the free market tells us anything at all in this case, it is that the economics of the streetcar, when the value of new investment is included, is much more cost effective than an investment in rubber-wheeled diesel buses or heavy transit.

The Environmental Advantages of a Streetcar line over other transit modes:

As stated in the *Seven Rules for Sustainable Communities Design,* we have already read (pg 30) that streetcars have ZERO spot emissions. Furthermore, according to the graph on pg 37 entitled "Life Cycle Carbon Emissions per Passenger Mile", the streetcar comes in at the very lowest carbon lifecycle, of all transportation modes, at 32.59. Note that "Bus Rapid Transit" (BRT) comes in high, at 201.40. This is because the streetcar uses the least possible amount of energy. Note that in NYC, streetcar carbon figures would be even lower, as much of our power is derived from hydro-electric sources, rather than coal.

Anything that runs on rails only requires 5% the energy of anything that runs on rubber tires. Specifically, to move a 1 Ton load of passengers on a bus, requires 30 ft.lbs of force. To move the same 1 Ton weight of passengers on a streetcar, only requires 1-1/4 (1.25) ft lbs of force. See Appendix for detailed explanation.

Modern streetcar systems are “Green”, having zero pollution emissions, and a considerably smaller carbon footprint than all other urban surface transit modes.

Why Build a Streetcar line rather than a simple bus?

Many decision makers fall into the trap of thinking of a streetcar line in terms of "existing ridership justification", and thereby not understanding the basic underlying concept of what any railway does- A properly placed and well designed streetcar line creates its own demand

As the General Manager of the San Francisco transit authority "MUNI" said it back in 2001, "People Who Wouldn't Ride A Bus Will Ride A Streetcar"- (Michael T. Burns, quoted in Railway Age, May, 2001, pg 45). This comment was made regarding a San Francisco electric bus line that was converted to the Embarcadero Streetcar (F Line) circa 1995- the ridership instantly DOUBLED! (and ridership has kept increasing to the present !)

As for Capital Costs, according to the graph "Total Capital Cost Per Passenger Mile" (pg 37), the streetcar comes in at a mere 71 cents ($0.71) per Passenger Mile. Note that "Bus Rapid Transit" (BRT) comes in at a hefty $1.12, fully 1.6 times greater than streetcar!

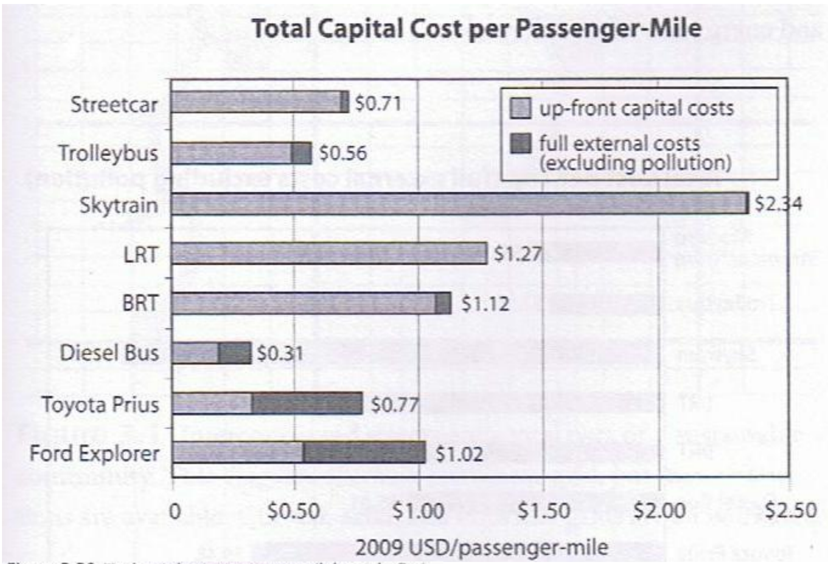


Figure 2.20. Total capital cost per passenger-mile by mode. Capital costs were calculated using construction costs and/or vehicle costs amortized over the expected life of the system. This annualized cost was then divided by the annual passenger-miles reported for each mode. Data from American Automobile Association, 2009; Translink, 2008; TTC, 2007; IBI Group, 2003; National Transit Database, 1998–2007; Portland Bureau of Transportation and Portland Streetcar Inc., 2008; Buchanan, 2008.

Streetcar Vs. Bus Rapid Transit (BRT) - results of an award winning Washington DC streetcar study:

The recent award winning DC sreetcar study states that Bus Rapid Transit (BRT) doesn't make the cut, The study determined that the streetcar is far superior in terms of cost-to-benefit ratio, and local economic development. The D.C. study determined:

"In terms of taxpayers dollars, the “streetcar offers a better ratio of benefits to costs compared to Bus Rapid Transit (BRT) or Light Transit. While BRT is less expensive to implement, it does not generate the real estate investments to the same degree that streetcars can. While light rail can produce similar benefits to streetcars, implementation costs are many times more than that of streetcar.” See Appendix

Streetcars and Buses: Complementary Services

Prior to the 1950s, streetcars provided the backbone of Brooklyn's transit system. In fact, many of today's bus lines operate along routes that were originally defined by where the streetcar tracks were laid in the late 1800s and early 1900s. The development patterns that followed the original streetcar tracks now define activity centers that serve as important transit markets for NYC Transit subway and bus lines. As Red Hook reconsiders the introduction of streetcars to serve South Brooklyn neighborhoods, choices will need to be made about how to best integrate the proposed streetcar routes with existing bus service. This streetcar/bus integration strategy provides an opportunity to create a transit system that meets the needs of the neighborhood by tailoring transit service to facilitate their unique travel requirements.

For example, adding streetcar to the inner portion of an existing radial bus routes can provide an opportunity for the outer portion of the existing routes to operate with limited stops on the inner portion. This operating strategy would provide a faster bus trip for the longer distance trips while providing the inner portion with streetcar service as well as connections to the bus route at key transfer points.

Can I Walk Faster Than a Streetcar?

Typically, streetcars accelerate from platform stops or traffic control points and will generally reach a speed of 15 to 25 miles per hour. Factoring in platform stops and minor delays associated with mixed traffic operations, the average speed from one end to the other is between 15 and 25 miles per hour (Enhanced Streetcar Service). The typical operating speed of a NYC Transit bus is 6- 12 miles per hour. The average speed of a person walking is three miles per hour. Whether a person can walk faster to a destination than taking a streetcar depends on the length of the trip and the amount of time spent waiting at a stop. The convenience of a streetcar trip will then depend more on the frequency of service, known as "headways."

What are the Different Kinds of Streetcar Service?

A streetcar is a smaller vehicle than those used for most light rail transit (LRT) services, and generally operates within the street right-of-way in single-car units. Streetcars can operate in both mixed traffic and reserved rights-of-way. In mixed traffic, a typical streetcar vehicle travels at speeds up to 25 miles per hour. There are typically three levels of streetcar service that can be provided:

Urban Circulator Service

Has frequent stops with spacing similar to a bus

Runs in mixed traffic, usually in the right lane

Minimal priority systems at traffic signals

Typical operating speeds of 10 to 15 miles per hour

* Enhanced Local Service

Expanded service coverage, approximately 3 to 5 miles from the core business • district

Usually runs in mixed traffic

May introduce streetcar priority at traffic signals

Typical operating speeds of 15 to 25 miles per hour

Rapid Streetcar

Has less frequent stops
Primarily runs in a reserved right-of-way•
May have streetcar priority at traffic signals
Typical operating speeds of 20 to 35 miles per hour

Streetcar Headways

Tentatively speaking, streetcars in Red Hook are planned to arrive every 5 to 7 minutes, with a projected travel time from Red Hook to Borough Hall at 13 minutes (20 mph/1.5 mi.). Frequency will generally increase as the system expands. The implementation of any streetcar extension involves an analysis of the appropriate streetcar service and operating headways. More frequent service offers more convenience, which will encourage ridership but will increase overall operating costs. Funding is critical to the equation of providing the appropriate number of streetcars along the line at any one time.

Traffic Signal Priority (TSP)

TSP is an operational strategy that facilitates the movement of streetcars through traffic-signal controlled intersections. At low traffic volume intersections, sensors will adjust the traffic lights, giving right-of-way to the streetcar to expedite its operation.

TSP improves schedule adherence and improved transit travel time efficiency while minimizing impacts to normal traffic operation.

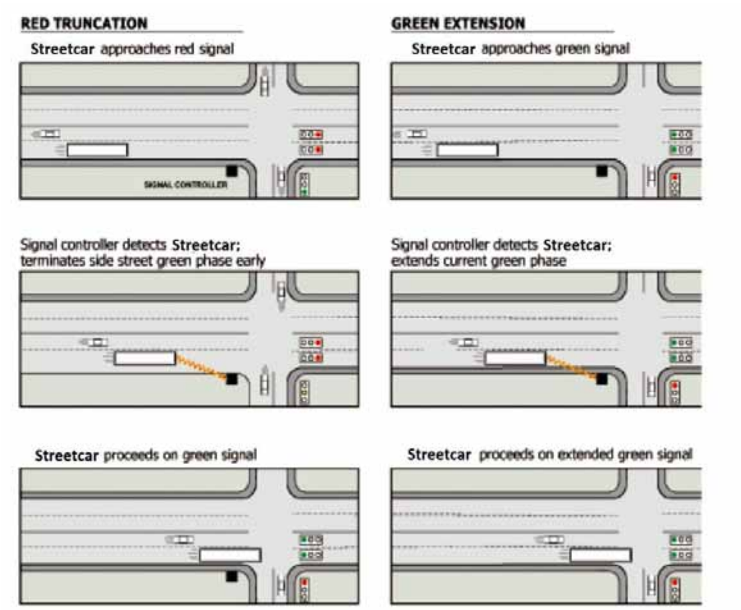
In Tacoma, WA the combination of TSP and signal optimization sped up transit service about 40% in two corridors.

TSP is appropriate along the streetcar route where traffic does not have potential to be adversely impacted by added side street delay.

Examples of streets proposed for Streetcar TSP:

Columbia Street Corridor; Van Brunt Street; Richards Street; Clinton Street; West 9th Street; Boerum Place; Atlantic Avenue

Traffic Signal Priority



San Francisco's Transit Preferential Streets Program

San Francisco's Transit Preferential Streets (TPS) Program is a citywide program designed to make surface transit lines operate more quickly and efficiently on city streets. This makes public transit more attractive to riders and uses the public's investment in transit infrastructure more effectively. Most of San Francisco's transit corridors involve mixed operations within city streets. In this environment, transit vehicles are susceptible to delays caused by automobiles and delivery trucks, and other on-street activities can cause less reliable service. The TPS Program promotes corridors that provide the most efficient transportation function for the most number of people using the street, not necessarily the most number of vehicles.

To accomplish this, San Francisco has developed a toolbox of street treatments that can be applied to streets or street segments within a TPS corridor. The toolbox of potential TPS treatments includes:
Timing signals to match transit vehicle flow
Signal priority systems for buses and streetcars
Bus bulbs (sidewalk extensions at bus stops)
Boarding islands for center lane boarding
Transit lanes
Contra-flow lanes
Exclusive transit rights-of-way (raised or reserved medians or track lanes)

Transit stop spacing and relocation
Transit exceptions to turn restrictions

These treatments are aimed at allowing the transit vehicles to flow more smoothly and quickly between stops; however, implementation of TPS treatments often comes with trade-offs for the use of limited street space.

San Francisco’s Transit-First Policy resolves these trade-offs by favoring transit needs over auto needs. In practical terms, various uses must be accommodated within the limited right-of-way, and this has been resolved in a number of ways. For instance, when bus lanes were installed for the Geary Rapid Bus Project, the number of all-day auto lanes on Geary was reduced from two lanes to one. To ensure that the street functioned effectively with this change, parking was removed at intersections to install dedicated right- or left-turn lanes in the curb lane so that traffic waiting to turn would not block the through movements. On-street parking was converted to metered truck-loading to ensure the availability of truck loading spaces so that trucks would not double park and block either the transit lane or the one remaining auto lane.

- San Francisco’s Transit Preferential Streets Program (TPS) is designed to make streets more transit friendly by giving public transit priority over automobiles on city streets. This is accomplished by providing exclusive right-of-way for transit, signal priority, automobile-turn restrictions, construction of curb extensions at bus stops and targeted enforcement.

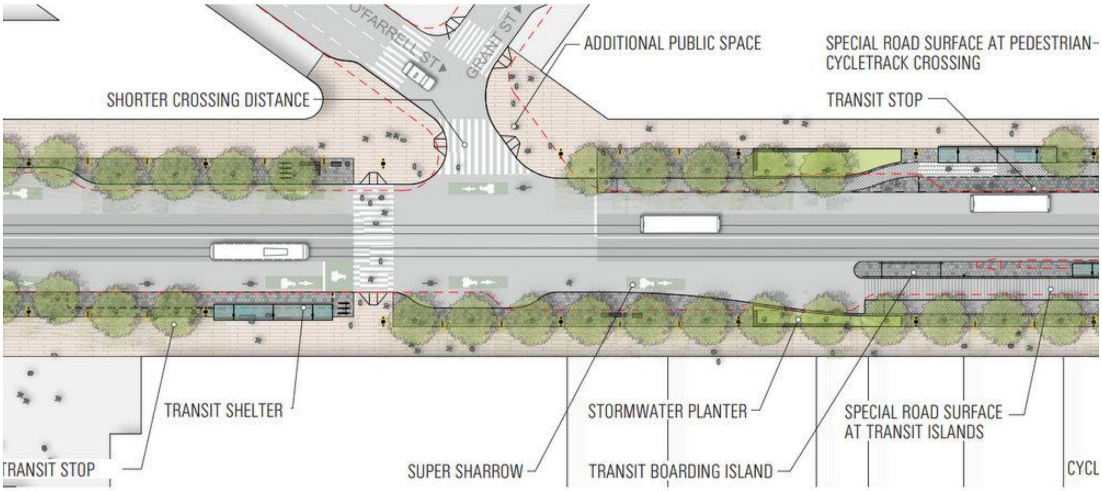
Integration into the Public Right-of-Way

The RHSS will work with community leaders to better plan our redeveloping neighborhood, incorporating a balanced approach to transportation by including more emphasis on public transit, biking and walking.

A balanced neighborhood transportation system is one that manages the demand for circulation within and through the neighborhood while minimizing conflicts between different types of activities that share the public right-of-way. The introduction of streetcar corridors will be implemented to minimize any potential impacts to neighborhood, city, and regional circulation patterns. Streetcar tracks are generally constructed to fit within existing travel lanes. As the streetcar corridors advance into the first stages of design, the location of the streetcar infrastructure (tracks, platforms and poles) will need to integrate into the existing street to complement pedestrians, bicyclists, cars, trucks and buses.

A modern streetcar system has the capacity to enhance the overall transit network while providing circulation along a corridor and connections to local commercial districts. The availability of a streetcar provides a highly effective means to support walkable communities by providing a high quality option for the short transit trip. There are, however, many pressures to accommodate multiple uses within the public right-of-way. Automobile circulation, on-street parking, bike lanes, crosswalks and freight access are all critical for neighborhood vitality.

Portland



Market Street, San Francisco

Modern Streetcars Are ADA Compliant

Sustainable Stormwater

Healthy urban watersheds depends, in part, on restoring the watershed's natural hydrologic function. The goal is to integrate stormwater management and development using natural systems and green infrastructure such as **Pervious Concrete** track bed instead of relying exclusively on expensive underground pipes This is a coordinated approach with streetcar construction and streetcar related development for management of stormwater at the source and on the surface.

With strategic coordination, the community can achieve greater results than planning for implementation independently. Emission-free travel, clean energy distribution and integrated stormwater management can help to leverage more efficient, high performance green buildings, resulting in an overall healthier urban environment for the next generation.

Clean Neighborhood Energy

A new NYC Bureau of Planning and Sustainability Clean Neighborhood Energy program could foster the creation of neighborhood energy districts to capture the potential to produce energy, both thermal energy and electricity, at the neighborhood scale. These districts couldl help to dramatically reduce emissions and our carbon footprint (after construction). Potential sources of thermal energy include solar, ground- or water-source heat exchange, and clean biomass. The thermal distribution systems can be integrated with streetcar construction by installing linear energy vaults under streetcar tracks when the street pavement is removed for construction.

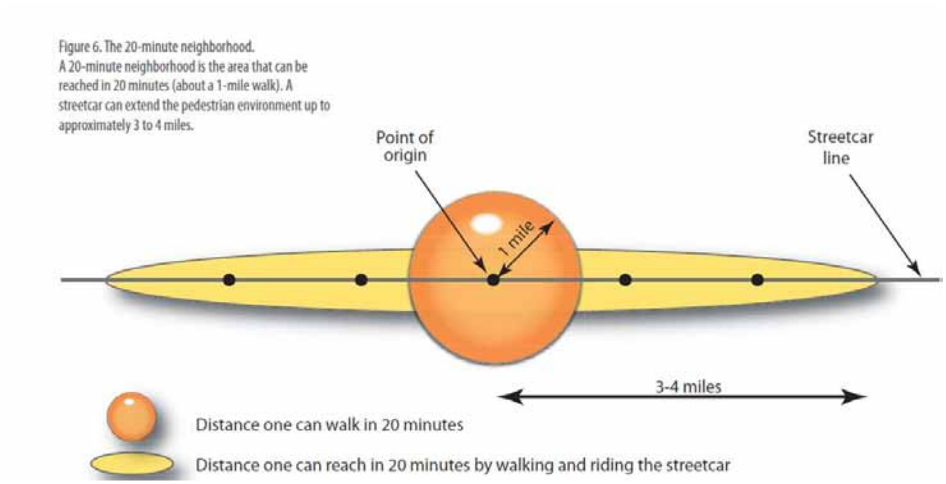
- Stormwater management systems and
- green street design
- Streetscape improvements to emphasize
- pedestrian and bikes as primary modes
- “LEED” Neighborhood Development building
- incentives
- Incentives for efficient building and
- construction processes through the use of
- green and recycled materials
- Affordable housing, affordable living, and
- accessibility goals
- Integrating wind and solar generation
- systems into public right-of-way
- Neighborhood parking strategies
- Car-sharing and other incentives to reduce
- automobile trips

The “20-Minute Neighborhood”: Neighborhoods That Foster Shorter Trips

Portland city planners have defined a potential urban design concept for future growth and health of neighborhoods and communities, known as the “20-minute neighborhood.” The “20-minute neighborhood” promotes an environment where one can walk, b ke or take transit to essential amenities and services in 20 minutes. As illustrated in the graphic below, streetcars can support and enhance this environment by connecting 20-minute neighborhoods to each other and to the regional transit network.

A 20-minute neighborhood is the area that can be reached in 20 minutes (about a 1-mile walk). A streetcar can extend the pedestrian environment up to approximately 3 to 4 miles.

1 mile point of origin, distance one can walk in 20 minutes. Distance one can reach in 20 minutes by wa king and riding the streetcar 3-4 miles.



The essential quality of streetcars is that they excel at shaping compact, wa kable neighborhoods by connecting destinations in a permanent fashion with attractive transit service. In this manner, streetcars can improve livability for higher density environments that support public goals for urban containment, sustainable living and reduced dependence on automobiles. An expanded streetcar system will be important to serve neighborhoods because streetcar service can help:

Create comfortable, convenient connections between housing, employment, services, and recreation.

Encourage local shopping, dining and use of neighborhood services

Reduce automobile dependence, vehicle miles traveled and single occupant vehicle trips

Reduce reliance on fossil fuels

Expand the passenger rail system, and complement subway and bus systems

Reduce emissions and green house gases from transportation and development

Encourage denser urban form where services already exist

Build more walkable neighborhoods and healthier communities

Streetcar System Plan Public Involvement

Streetcar System Concept Plan Mission Statement

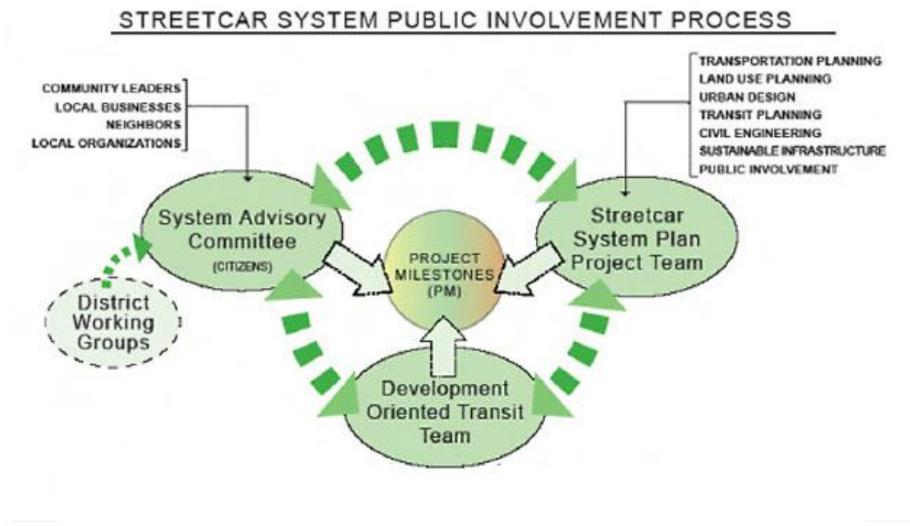
The Red Hook Streetcar System can play a key role in shaping the Community by:

Reinforcing walkable and economically diverse neighborhoods and vibrant main • streets.

Encouraging sustainable and equitable development and infrastructure. •

Supporting reduction of redevelopment related vehicle trips. •

Supporting greater accessibility, housing options, employment, and economic • development.



Streetcar System Plan Goals

A successful streetcar system will:

- Help Red Hook achieve its peak oil and sustainability strategies;.
- Provide an organizing structure and catalyst for Red Hook's future growth along streetcar corridors; and Integrate streetcar corridors into South Brooklyn's existing neighborhoods.

Successful streetcar corridors need to:

Be a viable transit option with adequate ridership.

Have (re)development potential.

Demonstrate community support to make the changes necessary for a successful streetcar corridor.

SOLAR POWERED STREETCAR SYSTEM

Creating a streetcar system that is predominantly solar powered is a technically feasible. By combining old and new technology, the new Brooklyn Streetcar can be entirely powered by pollution free, renewable, solar energy.

Streetcars receive power (typically 600v DC) through an overhead wire. Rather than exclusively utilizing conventionally generated power (from a power plant or line power), solar panels can be used. Solar panels, ("photo-voltaic arrays"), that converts sunlight directly into electricity, can be utilized to power a streetcar system.

24hr power can be derived from the solar power system by utilizing a battery array. Such an array could be built at convenient remote locations. The need for any "static power converters" changing "AC" power to "DC" power for the streetcars, would be completely eliminated. (see end section of this webpage for another power storage solution).

The best place to start, is at the beginning...

About 100 years ago, the Brooklyn Rapid Transit Company devised a move-able storage battery array, to supply extra streetcar power "on demand" to certain key areas, at certain times when streetcar traffic would peak. When streetcar power demand was low, the battery array collected a "trickle charge" from the overhead trolley wire. When rail car power demand was high, the battery array could supply 600 volt power to the rail cars at the following rates: 1,000 amps for one hour, 500 amps for three hours, or 250 amps for seven hours. (Source: Street Railway Journal, June 1, 1901, pp 665- 666)

Circa 1890's, the Atlantic Avenue RR streetcar company built a power station for its new electric streetcars. This power station produced 4,400 kW (4.4 MW). This was enough electric power to simultaneously operate 100 streetcars of 60 HP each. However, those streetcars were probably only 2 axle vehicles. (Sources: The Power Stations and Distribution System of the Brooklyn Rapid Transit Company, Street Railway Journal, October 5, 1901, pp 471-480, and the The Brooklyn Daily Eagle, November 11, 1892, pg 3.)

Let's now assume a 4- axle streetcar, with a 30 HP motor on each axle. This gives us 120 HP, or by using the conversion factor of 1 HP= 0.76 kW, gives us 91.2kW for maximum motoring power. Let's now add an additional 30 kW for Heating, Ventilation and Air Conditioning, as well as interior lighting. This brings us to an estimated maximum power demand of 141.2 kW per streetcar, or 235.3 amps at 600 volts DC, on level track. Let's round this off to 150 kW per streetcar, or 250 amps at 600 volts DC, maximum power demand. Since streetcars are largely "free coasting" once set into motion, this peak power demand will only occur when the streetcar is starting from a dead stop. Because the proposed streetcar line is relatively short in length, we can probably assume that only one streetcar at a time will be starting from a dead stop, and thereby requiring the full 250 amps at 600 volts, or 150 kW.

Taking streetcar "coasting" into account, this 150 kW power demand, represents the major portion of the Red Hook streetcar line's total estimated power demand, which I put at 250 kW (416.6 amps at 600 volts DC). Its assumed that at any given time, 2 of the 3 streetcars will be drawing about 30 kW each while "coasting", the power being used by HVAC, lighting, etc., while the 3rd streetcar will be simultaneously using 150kW, for starting from a dead stop.

Since streetcars spend most of their time "free coasting" on their rails, rather than wastefully, continuously, drawing motor power when in motion, 250 kW should be enough to supply ALL of the power demand for all 3 streetcars (but NOT light rail vehicles) simultaneously.

Now, lets consider where the 250 kW is coming from... This power source is Solar, using photo voltaic cells to convert sunlight directly into electricity. Since photo voltaic cells are not very efficient (about 15%), a fairly large surface area directly exposed to sunlight is required, together with a storage battery array, to produce usable quantities of electric power 24 hours a day, on demand. Typically, the photo voltaic array is located on large surface area roof tops. Good examples, are Brooklyn's Nassau Brewery on Bergen Street, and IKEA on Beard Street. Photo voltaic arrays have also been successfully located above parking fields.

As a working example, the expansive flat roof of Red Hook's Beard Street Pier, could easily provide enough surface area for a photo voltaic array producing 250kW- or rather much, much more...

If the rooftop of the Beard Street Pier were utilized, there is more than enough surface area to make the streetcar line 100% Solar Powered. Together with "regenerative brakes" used on each streetcar (converts the streetcar's braking force to electric power, which is sent back into the overhead power wire), ALL of the streetcar line's electrical power demand could be met with "clean, renewable, solar energy".

The roof of the Beard Street Pier, is roughly 700 feet x 150 ft = 11,666.66 Square Yards. The quantity of "insolation" received at the Earth's surface is typically 1 kW/ Square Meter. Since a Square Yard is 83.3% of a Square Meter, and photovoltaic cells are roughly 15% efficient, we can use the conversion formula of 0.833 kW/SY x 0.15 = 0.12495 kW/ SY x 11,666.66 SY = 1,457.749 kW, or 1.457 MW. This is enough electric power to simultaneously start over 6 streetcars from a dead stop- this translates to a medium sized streetcar system.
(Source: http://www.americanenergyindependence.com/solarenergy.aspx)

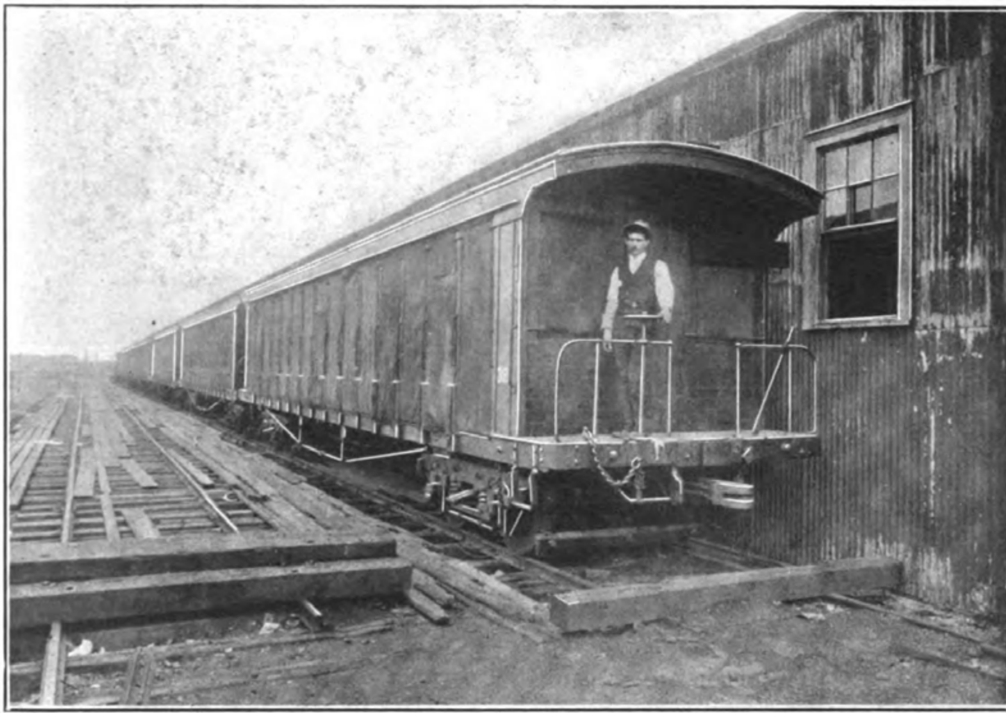
Let's now look at the energy requirements for the Red Hook streetcar. Assuming our "standard constant" power demand of 250 kW (3 streetcars: 1 car starting from a dead stop, and 2 cars coasting simultaneously), then 250 kW/ 0.12495 kW/SY = 2,001 Square Yards, or 18,009 ft ^{2}, or roughly 120 ft x 150 ft of photovoltaic array, converting sunlight directly into electricity.

The 250 kW Lithium- Ion Storage Battery Arrays could be easily located at convenient places along the streetcar route.

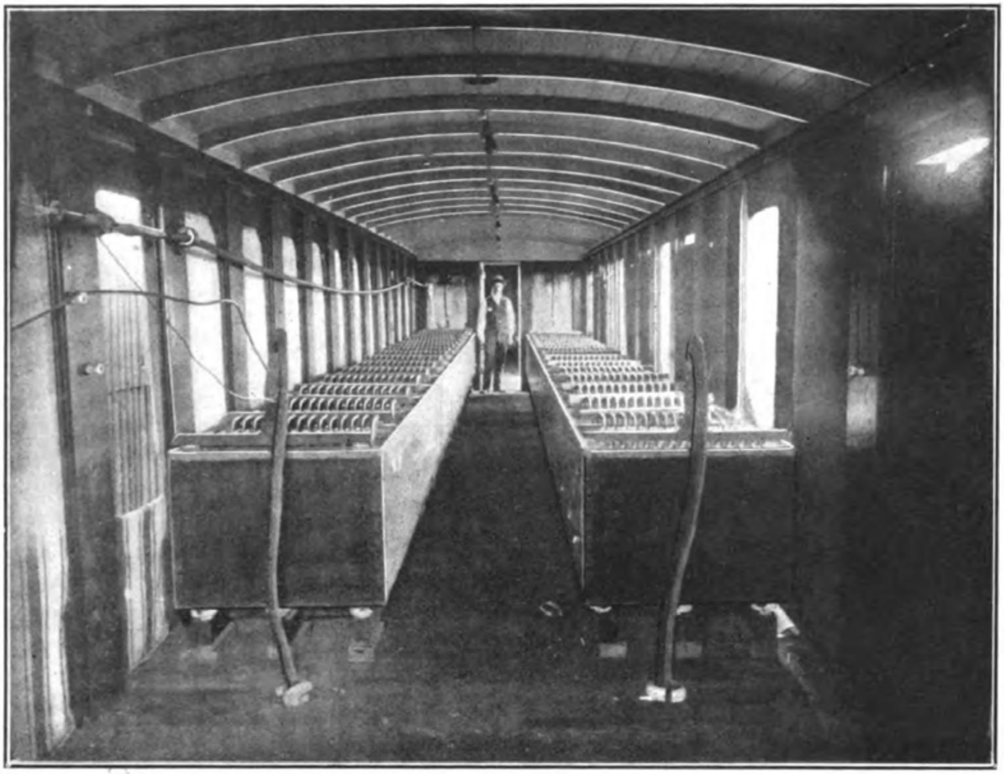
An alternative to utilizing batteries (remote power storage) is to use the power grid itself for power storage. Surplus DC power could be inverted to AC and fed into the municipal power grid.

A Movable Storage Battery Sub-Station

The Brooklyn Rapid Transit Company operates during the summer months a service which, in the winter time, is practically discarded. This is on its Brighton Beach division, which, during the warm weather, takes a great amount of current for a few months. The cost of furnishing a sufficient feeder system to supply the Brighton Beach cars with current would be very great, and the short duration of the season would hardly warrant such an expenditure. The company successfully solved this problem last season by locating a portable storage battery at Sheepshead Bay, a little over a mile from the terminal of the road, and, unless other arrangements are made for this year, it will probably repeat its action. It has taken seven of the old Brighton Beach steam-road cars and transformed them into a moving storage battery sub-station of 248 cells. These cars are of the cross-seat, open type, about 45 ft. long, and, with their seats removed and canvas curtains placed at the side, make excellent box cars for the installation of the batteries, which are placed upon the floor in two rows, with an aisle down the center of the car. The cars, during the summer, were stored in some old car houses at Sheepshead Bay, but during the last winter they have been removed to East New York to double the capacity of the storage battery plant at that point, which maintains the voltage in that section. The battery consists, as stated, of 248 cells, having twenty-seven plates each, and has a capacity of 1000 amps. for one hour, 500 amps. for three hours, or 250 amps. for seven hours. It was fed by a special booster at the South Brooklyn power station of the company, the battery being tapped to the trolley feeders



Train of cars containing storage battery banks, used during peak power demand

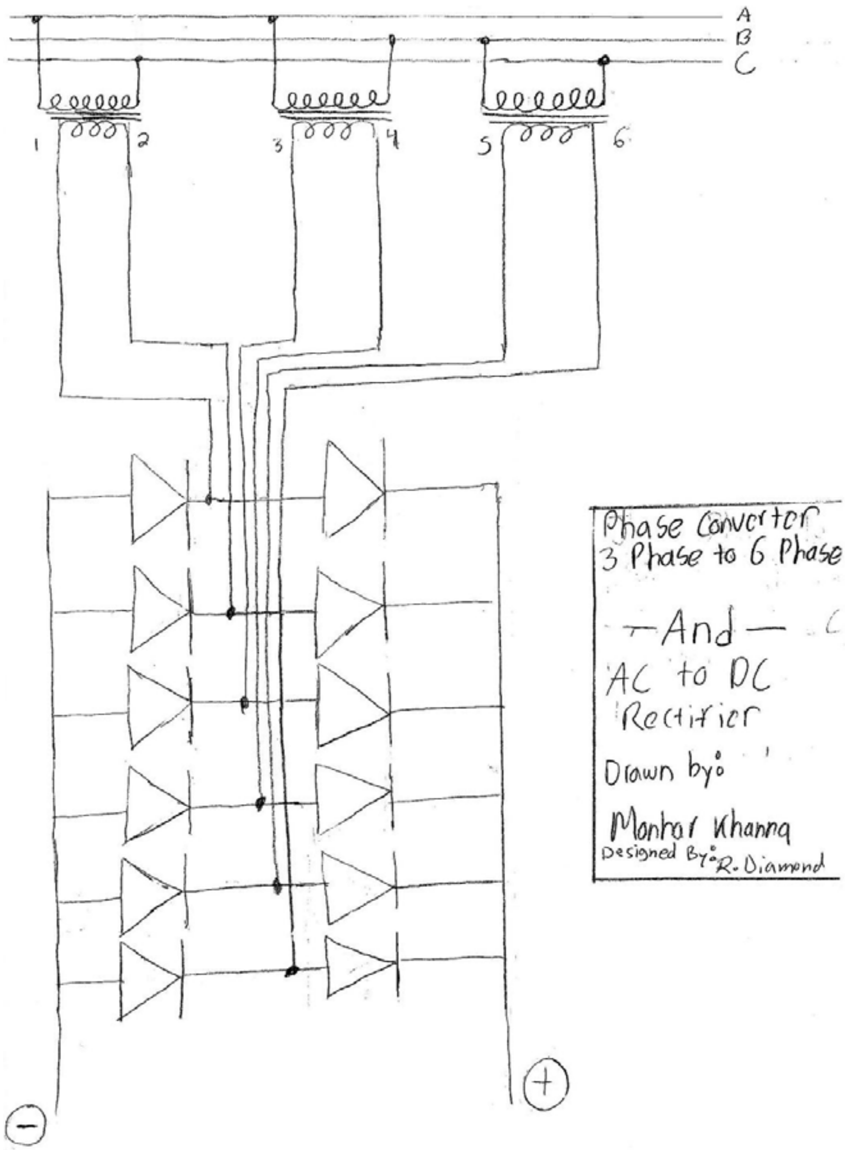


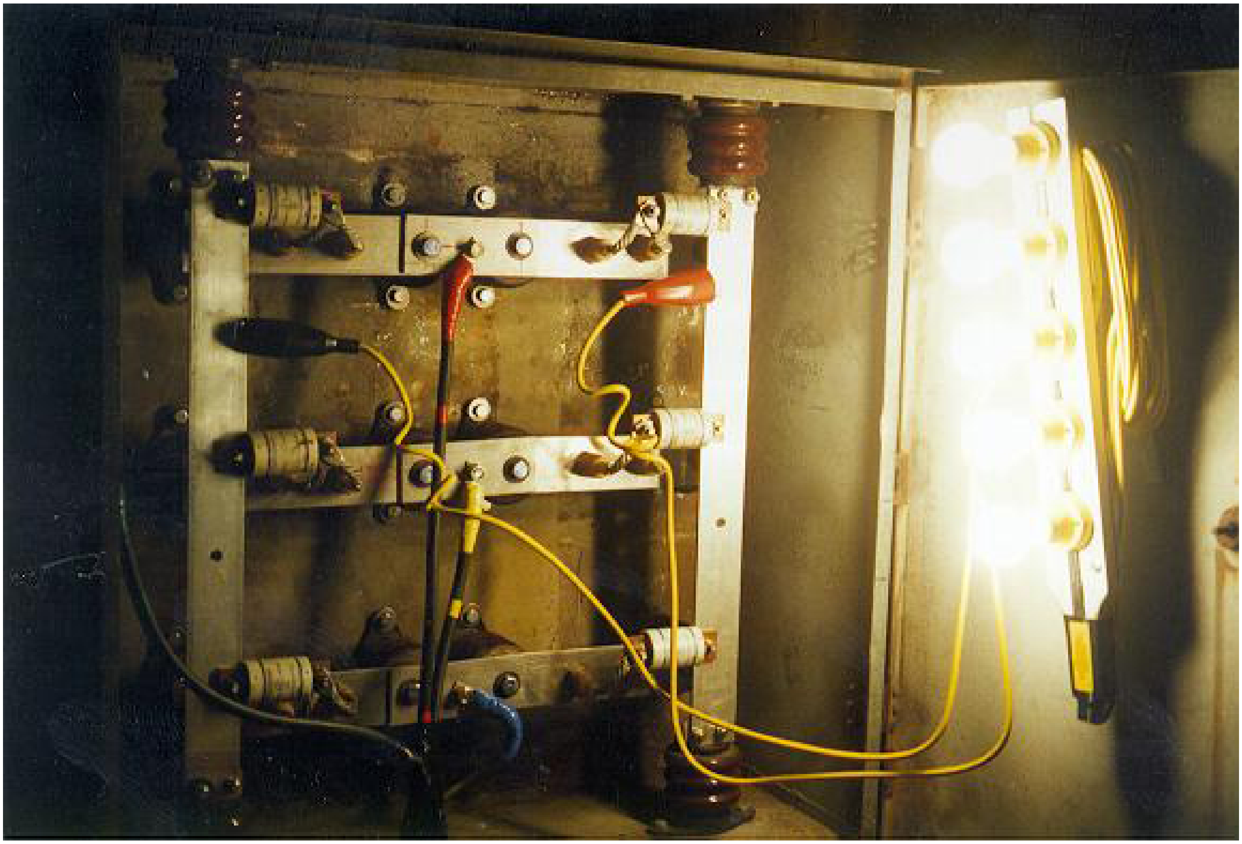
Interior of one of the battery cars, note banks of Edison Cells close to the point of connection of the special feeder coming from the booster.

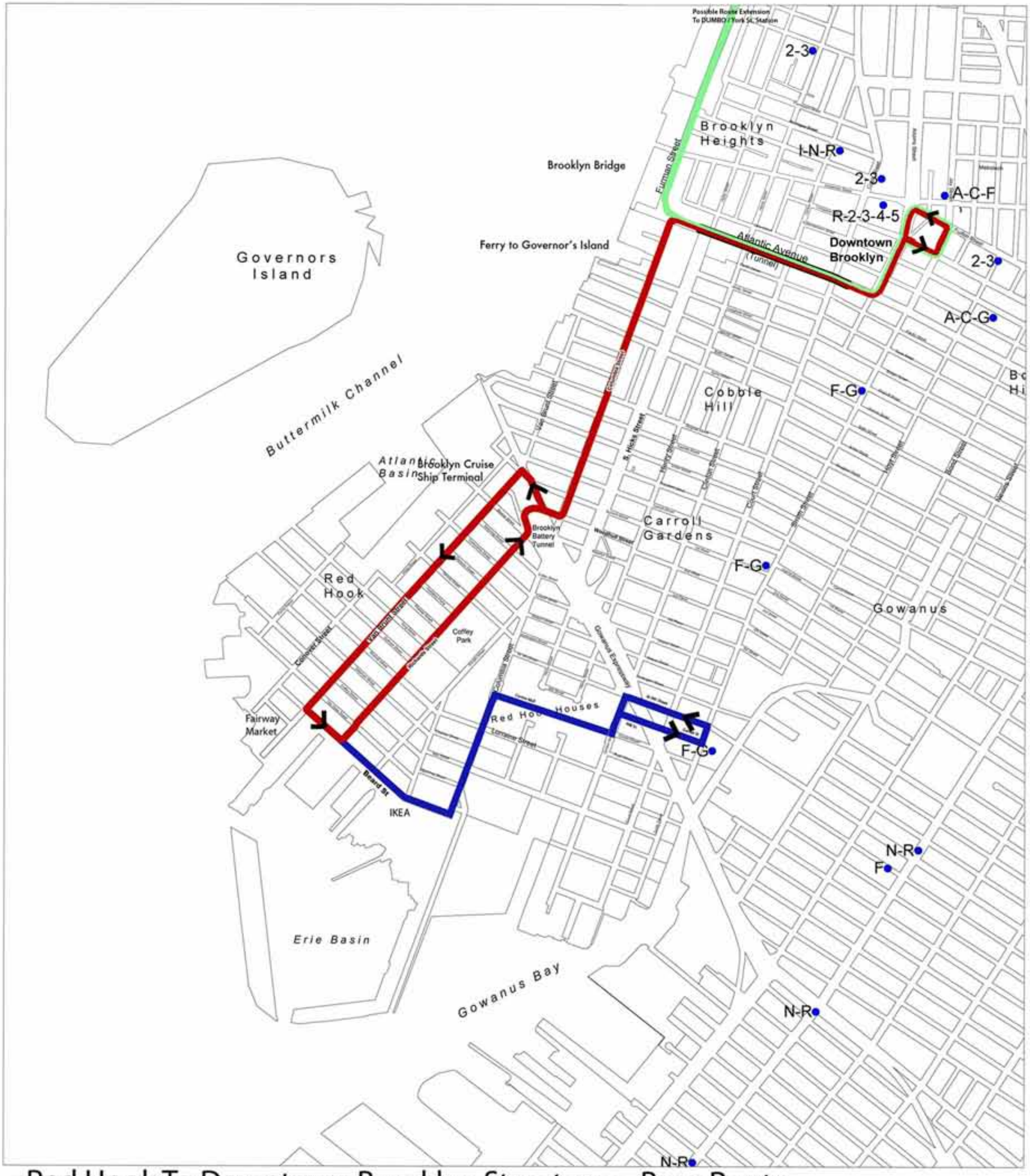
It is of great importance at this point of the line to have some auxiliary power resources, as the large trains of the elevated road, which run down to this section, require a great amount of current. When the road, therefore, is operating at its full schedule, the ordinary provision made for the winter traffic would be entirely insufficient for any regulation on the line, and not only would the equipment losses of the motors be greatly increased, but the annoyance to passengers from the fluctuating of the lights would be a great source of complaint. The storage batteries which were used last summer, however, are needed so badly at the East New York end of the road that the company is now erecting a rotary sub-station at the old Culver Depot, Coney Island, which will obtain its power from the electric lighting station of the Kings County Electric Light & Power Company at Sixty-Fifth Street. The Rapid Transit Company is already successfully operating a station of this kind on the site of the old Ridgewood power station, which was destroyed by fire a few months ago, and it is quite probable that the storage batteries will be allowed to remain where they are during the season.

One of the seven cars is equipped with a switchboard and complete storage battery regulating apparatus. This switchboard was under the charge of an attendant, who was able to watch the operation of the battery and insure its satisfactory performance. The Rapid Transit Company has a storage battery at its Bridge station, for which it makes its own distilled water. Sufficient distilled water is here produced to supply all the battery plants of the company.

Nearly 50% More Efficient Than a "3 - Phase" Power System: Power losses due to heat cut nearly in half. Six Phase "Diametric" wired system







Red Hook To Downtown Brooklyn Streetcar - Base Route

Created by Brian Kassel for BHRA, March 25th, 2013

Streetcar Route B

Streetcar Route A

Single Track Direction

Atlantic Avenue Tunnel (existing 2 track tunnel)

Ridership Estimate

The circa 2011 NYCDOT feasibility study estimated a streetcar ridership of 1,822 passengers per day, based upon the erroneous assumption that Red Hook's population would never significantly increase. Potential "TOD" resulting from the installation of a streetcar system was completely ignored. Conservatively speaking, if by the natural operation of "TOD", Red Hook were to increase its population merely back to it's circa 1950 level of 21,000 persons, we conservatively estimate the streetcar ridership at 5,155 riders a day. Certainly enough to justify a streetcar line, and clearly more than what the B61 bus can accommodate.

For example, the daily ridership of new representative U.S. streetcar lines considered successful, are as follows:

Memphis Streetcar: 2,700 riders per day;

Seattle (South Lake Union Streetcar): 2,300 riders per day

Ybor City (Tampa): 700 riders per day.

Source: http://en.wikipedia.org/wiki/List_of_United_States_light_rail_systems_by_ridership

Method of Estimate A:

Ridership as per Circa 2011 NYCDOT study + (TOD Related Population Increase of 10,000 persons / "A Trip Not Taken Factor" 0.30) =

1,822 riders/day + (10,000 persons / 0.3) = **5,155 Riders Per Day**

Method of Estimate B:

If the population density of Red Hook were to be brought to parity with Cobble Hill (54,000/sqmi) and 30% of trips were by streetcar, the ridership then increases to **16,556 Riders Per Day**

Fare Structure

Several possibilities exist for a fare structure. For example, the fare could be completely free, fully subsidized by the revenue stream generated by a "Transit Improvement District". Another alternative for example, is partially subsidized all day pass for unlimited rides which could be purchased for $2.00, with reciprocal free transfers to MTA subway and bus lines.

What Does It Cost?

To Build: $13 million per mile for a two track line **- if done under a non- profit organization**

To Operate: $60 per hour per streetcar, $80 per hour per two streetcar train *****

NOTE: A typical NYCT bus costs over $130/hr to operate

CAPITAL COST ESTIMATE

JUNE 8, 2011 DOLLARS

Cost Estimate Format Per 100 Feet Of Single Track, as per <u>*ATA Proceedings* , 1936, pg 948, per *Drawing No. 8 – "Brooklyn Method"*, pg 914</u>

<u>Track Material</u>			
Concrete, 3.9 CY @ ($140/CY, 2011) (100' long x 9' wide x1' deep = 33 CY)	>	548.36**	
Angle Bar, 2.5"x2.5"x0.25"x6' (2011 price, 25 pcs	>	1,532.56	
Rail (May 2011 price, new 85 lb ASCE rail, drilled)	>	6,272.26*	
Steel Rod(3/4 inch x 6' rod x $15.18 (2011 price) x 50)	>	759.00	
Rail clips, bolts(Say $10.00/set x 100 sets)	>	1,000.00	
Thermite Rail Joint Welding	>	TBD, But Relatively Minor	
			10,112.18
<u>Track Labor</u>			
Forman $35/hr + 50% Benefits= $52.50/hr x 22 hours	>	1,155.00	
Laborer $20/hr Base Pay+ 50% Benefits = $30/hr x 230 (10 Laborers for 23 hours)	>	7,935.00***	9,090.00
<u>Paving Concrete 12 Inches Thick</u>			
Paving Material:			
Concrete 33.3 CY @ ($140/CY, 2011) (100' long x 9' wide x1' deep = 33 CY)	>	4,662.00**	
Wire Net, 6" Mesh, #6 Gage (867 Sq Ft)	>	487.30(?)	
Other (Rent Screed, Other Paving Material)	>	715.22	
			5,864.52
<u>Paving Labor:</u>			
Forman $35/hr + 50% Benefit = $52.50/hr x 4 hours	>	1,837.50***	
Laborer $20/hr Base Pay+ 50% Benefits = $30/hr x 75 4,811.36 (18.75 Laborers for 4 hours)	>	2,973.86	
SUB TOTAL (TRACK and PAVEMENT) per 100 T.F.			29,878.06
<u>Site Preparation Costs (per San Diego 2009 Unit Cost Book)</u>			
A.C. Saw Cutting	>	141.69	
Concrete Saw Cutting	>	1,360.25	
Demolish and Remove Pavement (per RS Means Heavy Construction Cost Data, 2011) (100' long x 9' wide x 1' deep = 33 CY) Max Rate: 33 CY/day	>	3,630.00	

Relocate Manholes and Valve Boxes	>	20,621.37	
(Per Brooklyn Transit Antic Study, inflated to 2011)			25,753.31
GRAND TOTAL (Per 100 Feet of Track)	>		80,698.07
			x 52.80
For One Mile Of Single Track			4,260,858.09
			x 2
One Route Mile Of Double Track	>		**$ 8,521,716.19**
Trolley Wire Per Double Track Route Mile (Per Brooklyn Transit Antic Study, inflated to 2011)	>		**1,219,464.83**
COST PER DOUBLE TRACK MILE	>		**$ 9,741,181.02**
For The Preferred Route (Routes A + B), Multiply by 6.8 Route Miles	>		**$ 66,240,030.94**
Maintenance Facility (for three vehicles) † †			**+ 3,530,500**
New Streetcars (three vehicles @ $800,000 each) Pragiomex or Gomaco			**2,400,000**
Traffic Signals and Striping			**750,000**
Maintenance and Protection of Traffic			**250,000**
SUB TOTAL			**$ 73,170,530.94**
CONTINGENCY 20%			**14,634,106.18**
GRAND TOTAL			**$ 87,804,637.13**

† Brooklyn Transit Antic Streetcar Study, 1985. Produced for the Brooklyn Economic Development Corp. by STV and Urbitran

†† The Seattle Lake Union Streetcar Project, 2005.
See: http://www.seattle.gov/transportation/docs/slu18FINAL%20SLU%20PE%20Capital %20Cost%20Report.pdf
-and-
http://www.seattlestreetcar.org/about/docs/faqCosts.pdf

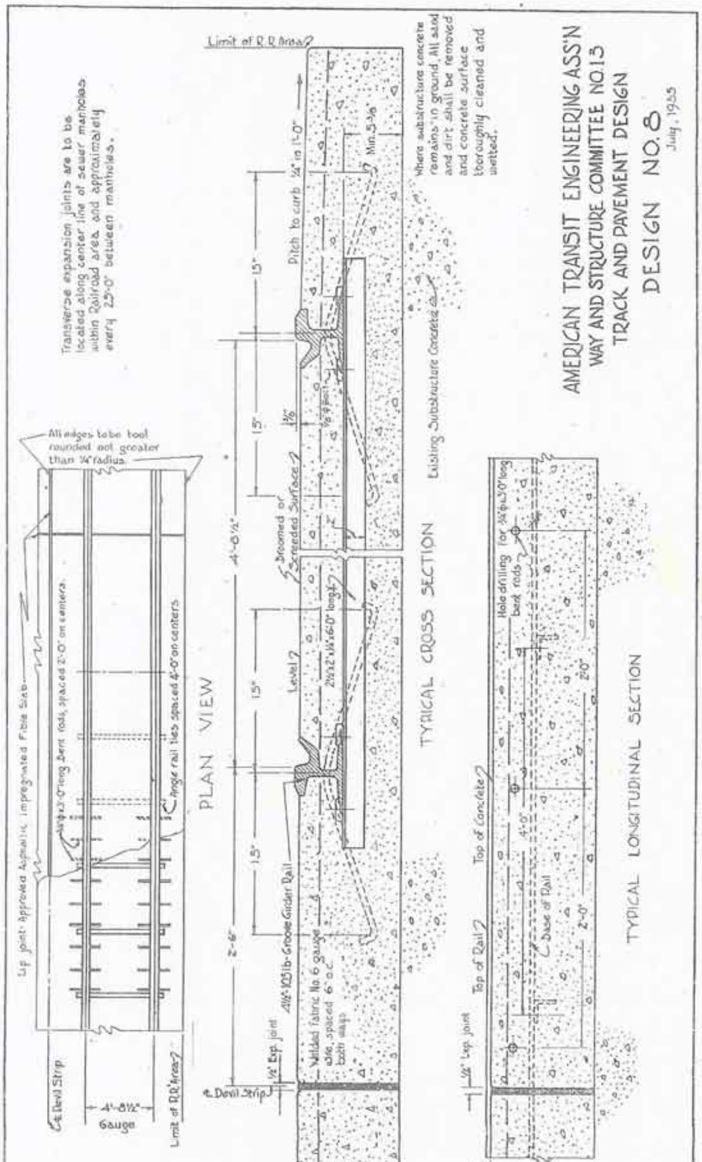
‡ Compound Interest at 3.8% over 16 years.
See: http://www moneychimp.com/calculator/compound_interest_calculator htm

General Notes:
Apparently many current streetcar contractors try to double their actual costs for materials and labor, giving them a profit margin of roughly 100%- USURY perpetrated on the public! However, I think a 25% "markup" is perfectly reasonable- but not 100% !

For recent streetwork costs, we used the *The City of San Diego "Unit Price List", 2009.* The City of New York does not publish such a document.
See: http://www.sandiego.gov/development-services/industry/pdf/pricelist.pdf

APPENDIX

SOURCE:
http://bha-in-la-ca.us/Transit_MAndT/TRAM-UK.HTML



AMERICAN TRANSIT ENGINEERING ASS'N
WAY AND STRUCTURE COMMITTEE NO.13
TRACK AND PAVEMENT DESIGN
DESIGN NO. 8
July, 1935
PLAN VIEW
TYPICAL CROSS SECTION
TYPICAL LONGITUDINAL SECTION
Transverse expansion joints are to be located along center line of sewer manholes within Railroad area, and approximately every 25'-0" between manholes.
Where substructure concrete remains in ground, All sand and dirt shall be removed and concrete surface thoroughly cleaned and wetted.
All edges to be tool rounded not greater than 1/4" radius.
Limit of R.R. Area
Existing Substructure Concrete
Pitch to curb

PLAN No. 8.

A.T.E.A. NEWSREEL—LOCAL TRANSPORTATION ADVANCES—1937

COMMENT BY J. F. NEILD

The A.T.E.A. Transportation Newsreel-1937 shown at this point, covered the following features:

"Half-Soling" of Rail—Depicting a method of rail renewal of the Georgia Power Company in which a strip of steel of the proper hardness is welded on the old rail head to provide a new running surface without disturbing the track structure to lay new rails. The process costs from 50¢ to $1.15 per foot, works equally well on straight and curved tracks and is expected to have particular merit for renewing rails worn at cross stops. Is practiced in Washington, Philadelphia, Brooklyn and Cleveland, as well as in Atlanta. Approximately 10,000 feet of rail have been renewed in this way. (Note: full details of this process may be found in the 1937 report of Way and Structures Committee No. 6—Welding, included elsewhere in these Proceedings).

Low Cost Tieless Track Construction of Brooklyn and Queens Transit Corporation—The particular type of track construction shown in this section of the film is described in detail in the report of Way and Structures Committee No. 13—Track and Pavement Design, Construction and Maintenance (see design No. 8 in 1935 and 1936 reports as included in Proceedings for those years). Construction is of monolithic type but dispenses with the use of ties. Utilizes the new 4½ inch low section girder grooved rail recently adopted as a recommended design by the Engineering Association, which makes it possible to rerail on the old foundation. The cost of this particular type of track construction was $6.50 per foot.

New B-M.T. Snow-Loader—Designed specially to permit operation under trolley wires and elevated structures. Car load 10-15 cubic yards per minute, either at side or rear. Travels 20 m.p.h. over city streets.

Device for Rapid Removal of Line Poles from Concrete Foundations—Showed steps in method developed by the Chicago Surface Lines for jacking steel line poles out of place in three to four minutes per pole. Developed in connection with street widening program which necessitated relocation of several thousand poles.

Application of Ground Sleeves to Line Poles by Split Sleeve Method—Method used by Chicago Surface Lines for applying ground sleeves to poles in service by welding a split sleeve over the corroded section.

Factory Production Methods as Applied to Car Inspection by The Baltimore Transit Company—Scenes in centralized inspection shop of The Baltimore Transit Company where inspection of all cars on the system is carried on like production in the automobile assembly line of a

Paving (1¾ in. asphalt on 6¼ in. concrete, 8 ft. 8 in. wide)

MATERIAL		
Asphalt, 8.4 tons @ $6.00	50.40	
Concrete, 16.7 cu. yd. @ $6.35	106.05	
Other paving material (15%)	23.55	
Total paving material	180.00	180.00
LABOR		
Man hours of foreman, 5 hr. @ $.70	3.50	
Man hours of truck drivers, mechanics, etc., 60 hr. @ $.60	36.00	
Man hours of laborers, 50 hr. @ $.40	20.00	
Miscellaneous paving labor (15%)	8.50	
Total paving labor	68.00	68.00
Minimum watchmen, 50 hr. @ $.40	......	20.00
		$692.00

Engineering, superintendence and other overhead charges are not included in the above costs.

DESIGN NO. 8

4½ in.—105 lb. Grooved Girder Track with light angle ties and transverse rods through the rail webs, in concrete on concrete foundation of old track. Concrete Paving.

COST OF 100 FT. OF SINGLE TRACK

Track

MATERIAL		
Concrete, 3.9 cu. yd. @ $6.35	$24.77	
2½ in. x 2 in. x ¼ in. x 6 ft. 0 in. angles, 543 lb. @ $.026	14.12	
Rail, 4½ in.—105 lb., 3.12 tons @ $54.73	170.76	
Thermit portions, No. 13, 3.2 @ $3.49	11.17	
Clips with bolts, 100 @ $.11	11.00	
¾-in. rods, 450 lb. @ $.024	10.80	
Bonds, 60 in., 1/5 @ $1.20	.24	
Other track material (15%)	36.14	
Total track material	279.00	$279.00
LABOR		
Man hours of foreman, 22 hr. @ $.70	15.40	
Man hours of truck drivers, mechanics, etc., 30 hr. @ $.60	18.00	
Man hours of laborers, 200 hr. @ $.40	80.00	
Miscellaneous track labor (15%)	17.60	
Total track labor	131.00	131.00

Paving (Concrete 8 in. thick, 8 ft. 8 in. wide)

MATERIAL		
Concrete, 21.5 cu. yd. @ $6.35	136.53	
6 in. mesh No. 6 gauge wire net, 867 sq. ft. @ $.0149	12.92	
Rent of screed, 100 ft. @ $.10	10.00	
Other paving material (15%)	23.55	
Total paving material	183.00	183.00
LABOR		
Man hours of foreman, 4 hr. @ $.70	2.80	
Man hours of truck drivers, mechanics, etc., 40 hr. @ $.60	24.00	
Man hours of laborers, 35 hrs. @ $.40	14.00	
Miscellaneous paving labor (15%)	6.20	
Total paving labor	47.00	47.00
Minimum watchmen, 45 hr. @ $.40	....	18.00
		$658.00

Engineering, superintendence and other overhead charges are not included in the above costs.

17. *Treating Old Concrete Base:* Old concrete broomed, washed and coated with neat cement for bonding purposes.
18. *Placing Concrete Under Traffic:* High early strength concrete used and excellent results obtained.
19. *Reinforcement and Joints:* No reinforced concrete used.
20. *Surface Scaling:* No concrete wearing surface pavement used.
21. *Separating Track from Adjacent Structures:* We construct one track at a time with construction joint between track and roadway pavement.
22. *Two Course Concrete:* No two course pavement used.
23. *Concrete Repairs:* No concrete pavement used.
24. *Cement Bound Macadam:* No cement bound macadam used.
25. *Failure Due to Design, Materials, or Construction Methods:* No reply.

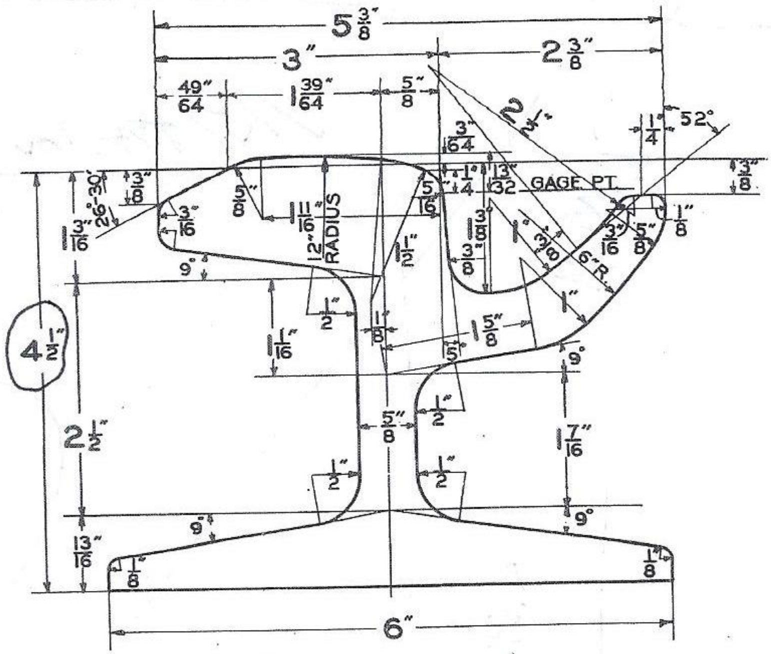
BROOKLYN & QUEENS TRANSIT CORPORATION

H. J. Kolb, Chief Engineer Way and Structure

1. *Specifications for Materials:* Cement and aggregates to meet specification requirements of A.S.T.M. Coarse aggregate to be limestone or trap rock graded from No. 4 to 1 in. sieve sizes. Concrete designed for minimum strengths of 1800 and 3000 lb. per sq. in. at 7 and 28 days respectively. Slump about 2 in. Water-ratio (including moisture in aggregates) varies from 4.7 to 5.25 gal. per sack of cement. Proportions by weight used in 1935 were 1–2.24–3.63. Mixtures using less mortar are to be tried out.
2. *Laboratory Tests:* Concrete materials and mixed concrete are sampled and tested in accordance with A.S.T.M. requirements.
3. *Method of Proportioning:* Weight. Water measured by volume.
4. *Methods of Mixing:* Concrete transported from central proportioning plant in truck mixers or mixed in central mixing plant and conveyed in agitator trucks. Time of haul limited to 1½ hr.
5. *Time of Mix:* Plant mix, 1½ min. Truck mix, 5 min. after water has been added.
6. *Placing of Concrete:* Concrete discharged from trucks through chutes into track, spread by hand to base of rail and vibrated. Concrete then spread to elevation 2½ in. below top of rail; reinforcement and web anchors placed; concrete brought up to top of rail and again vibrated. I.S.T. Co. double rail pulsator is used.
7. *Finishing Concrete Surface:* Surface hand floated and then broomed transversely. Special edging tool used to finish concrete along outside bevel of rail head.
8. *Curing Methods:* Use saturated hay kept wept up to 14 days or "Hunt Process," cut back emulsion, sprayed on immediately after finishing surface. Traffic kept off concrete 7 to 14 days.
9. *Strength Before Opening:* 2000 lb. strength required before allowing rail or vehicular traffic.

10. *Use of High Early Strength Cement:* High early strength cement used with excellent results. In cold weather we have experimented with addition of 1 qt. to 2 gal. of Inten-cement per sack of cement. No ill effects have resulted. Now experimenting with "Pozzolith" admixture made by Master Builders Company.
11. *Colored Concrete:* "Hi-Blak," emulsified carbon black has been used in the top 2 in. or 2½ in. of concrete with very good results (about color of sheet asphalt). Used at rate of 2% by weight of cement or 11.2 lb. per cu. yd. of concrete. Care must be used during vibration that light colored mortar from underlying concrete does not work up through the black top.
12. *Use of Plum Stones:* Not used.
13. *Plant Inspector:* Inspection is maintained at ready mixed plant.
14. *Temperature:* Ordinarily concrete is not permitted to be placed when temperature is below 28 deg. Fahr.
15. *Cold Weather Precautions:* When below 28 deg. Fahr. aggregates are heated, Inten-cement added and concrete protected with 3 in. layer of straw.
16. *Subgrade Protection:* No specification as very little work is permitted during such seasons.
17. *Treating Old Concrete Base:* Where old concrete base is incorporated in the track structure, it is broomed and washed, broken concrete removed and base wet down again before placing new concrete.
18. *Placing Concrete Under Traffic:* In old type construction using wood ties rail traffic was permitted during or immediately following placing of concrete. We have permitted no rail traffic on concrete type track using steel ties for period of 7 to 14 days.
19. *Reinforcement and Joints:* Steel fabric reinforcement is used and transverse expansion joints are spaced at 25 ft. intervals. On one section of track last year reinforcement and expansion joints were omitted and dummy joints installed at 8 ft. intervals over alternate angle cross ties with satisfactory results.
20. *Surface Scaling:* Some scaling has occurred due to excess surface mortar.
21. *Separating Track from Adjacent Structures:* Tracks are separated from each other and from roadway pavement by construction joints; where monolithic concrete type track joins special work or other type construction, expansion joints in rail and concrete are provided.
22. *Two Course Concrete:* Not used.
23. *Concrete Repairs:* Edges of concrete coated with cement grout. Very stiff concrete with maximum stone content is tamped into place and opened to traffic as soon as completed.
24. *Cement Bound Macadam:* Not used.
25. *Failure Due to Design, Materials, or Construction Methods:* There have been no failures of concrete monolithic type track.

Typical streetcar “Girder” or “Tram” rail. No longer manufactured in North America, it can only be obtained from a very small group of eastern European and Asian manufacturers.



A.T.E.A. SEC. NO.	BETHLEHEM SEC. NO.	LORAIN SEC. NO.
	105-418	

AREA	SQUARE INCHES	PER CENT
HEAD	5.91	56.9
WEB	1.03	9.9
BASE	3.44	33.2
TOTAL	10.38	100.0

MOMENT OF INERTIA	25.3
NEUTRAL AXIS FROM BASE	2.24
SECTION MODULUS HEAD	11.0
SECTION MODULUS BASE	11.3
RATIO M.I. TO AREA	2.44
RATIO SEC. MOD. TO AREA	1.06
RATIO HEIGHT TO BASE	.76
RATIO BASE TO HEIGHT	1.32

FIG. 1—PROPOSED RECOMMENDED DESIGN FOR 4½ IN. 106 LB. GIRDER GROOVED RAIL

Section Number 106 ER 4½A

Calculated weight 105.9 lb. per yard.

NOTE (1) The ER in above section number indicates the A.T.E.A. as the sponsor organization. This rail was designed by the Brooklyn and Queens Transit Corporation.

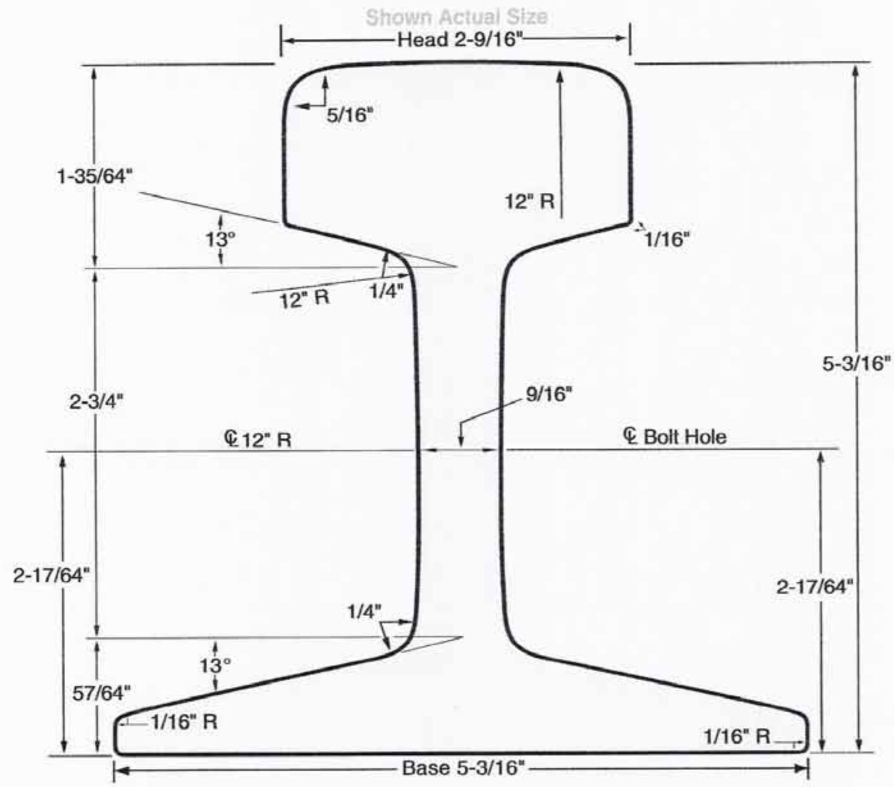
NOTE (2) The position of the gauging point is somewhat difficult to locate on curved head rails and special gauges should be used which will insure exact track gauge at the point indicated in the drawing.

NOTE (3) These rails should be laid on straight track to a distance between gauge points of rail, ⅛ in. less than the nominal gauge.

However, common, domestically produced 85 pound/yd “T” rail has strength comparable to the traditional Brooklyn “Girder/Tram Rail”. Note that both the “Section Modulus” and “Moment of Inertia” ratings are very similar.

85–lb. ASCE

HARMER STEEL

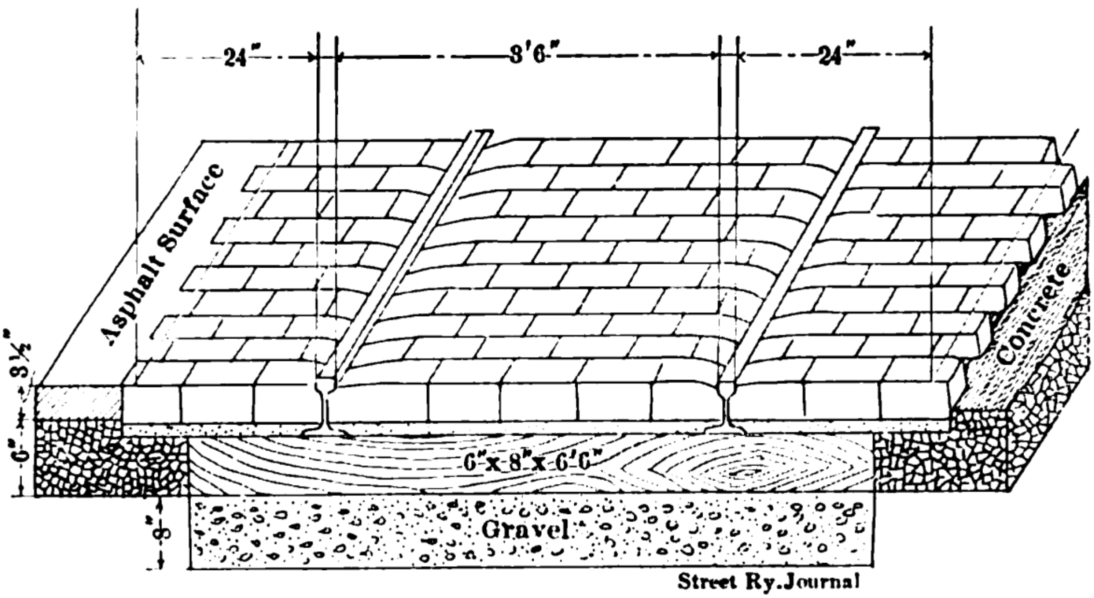


Rail Type:	85 AS
Section Number:	8540
Nominal Weight:	85 lbs/yd
Standard Length:	39’
Standard Drilling:	2-1/2” X 5” with 1” dia. holes
Splice Bar Length:	24”
Splice Bar Weight:	18 lbs/pr **with hardware:** 23 lbs/pr
Track Bolt:	7/8” X 4-1/2”

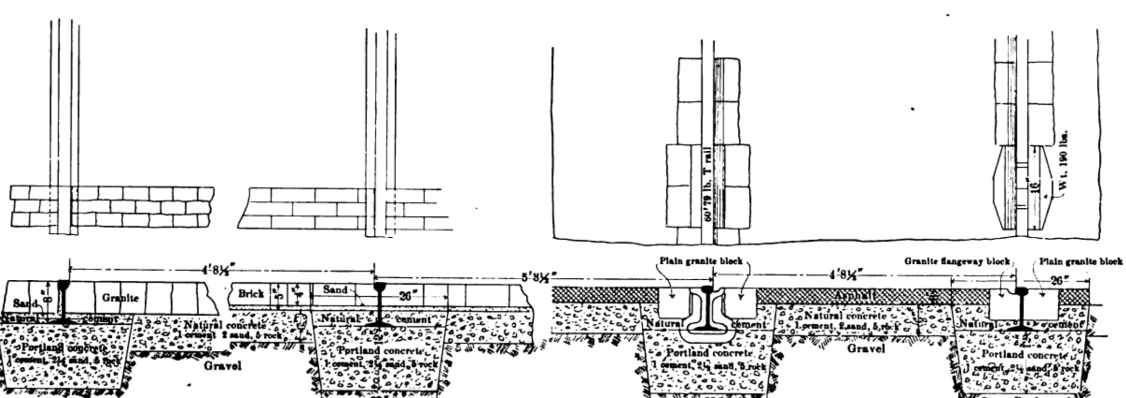
Area in^2: 8.33
Section Modulus in^3:
Head: 11.08
Base: 12.17
Moment of Inertia in^4: 30.07

I – 12

Now less expensive and easier to obtain, domestic “T” rail was once extensively used in many Midwest streetcar systems. T rail is currently being used on the San Diego light rail system



ISOMETRIC DRAWING OF STANDARD TRACK CONSTRUCTION WITH T-RAIL IN DENVER



In Granite and Brick. In Asphalt.

STANDARD TRACK CONSTRUCTION IN BRICK AND ASPHALT PAVED STREETS—TWIN CITY RAPID TRANSIT COMPANY

* Estimated Annual Operating Cost

Operations: $60/streetcar hr x 3 streetcars hr x 15 hours/day x 365 days/yr =	$ 985,500/yr
General Manager	100,000/yr, Incl. Fringe
Deputy Manager/Dispatcher	85,000/yr “
Software/ Computer Systems Engineer	80,000/yr “
Streetcar Mechanic	80,000/yr “
Asst. Mechanic/Car Cleaner	60,000/yr “
Track/Trolley Wire Maintainer	80,000/yr “
Asst. Track/Trolley Wire Maintainer	60,000/yr “
	$ 1,530,500/yr

OPERATING COST

(And Streetcar vs. City Bus Operating Cost Comparison)

Are you old enough to remember Manhattan's iconic "Checker Taxi Cabs"? These vehicles were first built during the 1950's, but served New York City virtually unchanged, until the 1980's. How did they last so long? Answer- they were built out of a conglomeration of all the best parts and techniques available to the automotive industry of that time- regardless of the brand or manufacturer.

We think the new Brooklyn Streetcar should follow the overall design paradigm of the Checker Cab- use all the best aspects of currently available streetcar technology, regardless of where it comes from. For example, the Portland, Oregon streetcar system probably offers us the best design paradigm as far as construction economy is concerned. However, for the most cost effective results, Brooklyn may want to use pages out Memphis, TN 's and Little Rock, AR's play books, in regards to an "operating system model"...

According to the most up to date research available online, a new Brooklyn Streetcar would incur **LESS THAN One-Half (39% – 44%)** the operating costs of a NYC Transit Bus. According to the following research, the 2008 operating costs of a new Brooklyn Streetcar would be on average between **$48.79/hr and $60.02/hr** per streetcar*. The latter figure corresponds perfectly with the circa 2007 hourly operating cost of **$59.40/hr** per streetcar, on the newly built (2004) Little Rock, AR line.

Known as the "River Rail System" (see # 79- LR as per the attached FTA 2007 Operating Cost spreadsheet), this line is 3 miles long, and has 13 stations- similar in scope to our proposed Red Hook-Boro Hall streetcar line of 2 miles. The fare is only 50 Cents for Kids/Seniors, $1.00/Adult, 3 Day Pass is $5.00 and a 20 Ride Pass $15.00. It's operated by the Central Arkansas Transit Authority. For more information, see http://www.cat.org/rrail/ .

For another example, (2009 data), of an efficiently operated modern **streetcar line** (**NOT** a Light Rail), is that of Memphis, TN, operated by MATA: **$70.30/hr** per streetcar. This line consists of seven miles of route, and 18 streetcars, some refurbished, some new at the time of construction. For more information on MATA's streetcar line, see:
http://www.railwaypreservation.com/vintagetrolley/memphis.htm .

On the other hand, as per Federal Transportation Administration (FTA) data, the known circa 2007 operating cost of an MTA NYC Transit Bus was **$136.10/hr** (see #119- MB) as per the attached FTA 2007 Operating Cost spreadsheet.

For further comparison, the MTA NYC Transit Subway operating cost circa 2007, was $155.20/hr (see #33- HR) on the aforementioned FTA spread sheet attached to this writing.

Circa 2000, the operating cost of a NYC Transit Bus was $90.74/hr, followed by an increase in NYCT Bus operating costs of $45.35/hr over 7 years, up to $136.10/hr in 2007- **A NYCT Bus operating cost increase of 50% over only seven years**. The latest (2009) NYCT data shows Bus Operating Cost has risen further to $146/hr. Why? Here's four likely contributing factors:

1. In order to reduce Bus pollution emissions, NYCT has reportedly been running its Buses slower than in former years, increasing hourly operating cost.

2. NYCT Bus contractual labor cost increases.

3. Increased fossil fuel costs.

4. According to a ca. 2002 government report (U.S. Department of Energy), NYCT Hybrid buses had a 46%- 92% HIGHER operating cost over conventional buses, when compared to an RTS diesel. This is reportedly due to higher repair and maintenance costs, not covered by warranty.

And I quote:

"In addition, the following conclusions were reached: • During the evaluation, the NYCT hybrid buses had overall operating costs (excluding driver labor) 46%Ð92% higher than the NovaBUS RTS diesel buses. Much of this difference was caused by higher labor hours required to repair and maintain all bus subsystems on the 10 prototype hybrid buses, including the hybrid propulsion system".

Source: DOE/NREL Report, 2002
www.brooklynrail.net/images/new_brooklyn_streetcar/nyct_hybrid_bus_evaluation.pdf

As a point of reference, it should be noted that on average, **diesel buses get 2.5 MPG (less than 3 MPG), while Hybrid Buses get 3.5 MPG (less than 4 MPG)**. However, certain times of the year, depending on weather conditions, Hydrid Buses get the same 2.5 MPG as their diesel counterparts. Generally, a Hybrid Bus costs $150,000 more than a conventional bus, and has to be scrapped after a life span of 12 years.

METHODOLOGY:

The circa 2008 NYC Transit Bus Operator application is online here:
http://www.nyc.gov/html/dcas/downloads/pdf/noes/200808006000.pdf

A NYC bus operator starts at $18.84/hr, and rises in increments after 3 years to $26.92/hr for a 40 hour week. However, this figure does not reflect benefits. So, let's add 66% to the numbers for the actual labor cost, including benefits, as per the 2010 Public Transportation Fact Book, by APTA, pg 21, Table 18:

Bus Operator hourly pay + benefits (66% / hr) = Total labor cost per hour

For vehicle operator starting pay scale, we get a total hourly labor cost of:
$18.84/hr + $12.43/hr = $31.27/hr.

For vehicle operator pay scale after three years, we get a total hourly labor cost of:
$26.92/hr + $17.77/hr = $44.69/hr

As per SEPTA (Philadelphia Transit Authority) circa 2001 streetcar operating cost breakdown, updated with 2010 data, “Labor” accounts for 77% of the total operating cost of $47.05/hr. "Everything Else" accounts for 23%, or $10.81/hr. Now, lets add $10.81/hr to the actual hourly labor cost for "Power and Everything Else":

Total hourly operating cost per Streetcar, w/a newly appointed operator:
$31.27/hr + $10.81/hr = **$42.08/hr.**

Total hourly operating cost per Streetcar w/an operator having 3 years of service:
$44.69/hr + $10.81/hr = **$55.50/hr.**

A noteworthy point, is that the actual current (2008) SEPTA (Philadelphia) streetcar hourly operating cost of **$47.05/hr** is almost the exact average of the projected Brooklyn streetcar hourly operating cost, which is ($42.08 + $55.50) / 2 = **$48.79/hr**

The current circa 2008, Philadelphia streetcar (Subway-Surface) operating cost of $47.05/hr can be viewed here on page 58: http://www.septa.org/reports/pdf/asp10.pdf

As for the circa 2000 NYC Transit Bus operating cost data, the following is the **Manhattan Institute For Policy Research** Bus Operating Cost Table, circa 2002, created by:

E. S. Savas
Professor, School of Public Affairs, Baruch College
E. J. McMahon E. J. McMahon
Senior Fellow, The Manhattan Institute for Policy Research
http://www.manhattan-institute.org/html/cr_30t2.htm
http://www.manhattan-institute.org/html/cr_30.htm
As we can see in the first row, the circa 2000 operating cost of a NYC Transit Bus, was **$90.74/hr**

Civic Report No. 30 November 2002

Competitive Contracting of Bus Service: A Better Deal for Riders and Taxpayers

Table 2: New York Metropolitan Area Bus Transit Services, Fiscal Year 2000

State	System	Annual Operator Type [a]	Vehicles Ridership [b] (1,000s)	Operating in Max. Service	Total Operating Expenses (1,000s)	Expense per Vehicle Hr.*
NY	New York City Transit Authority	1	821,994.5	3,840	$ 1,323,556.89	$ 90.74
NY	Long Island Bus	1	29,889.4	269	78,887.7	90.50
NJ	New Jersey Transit [c]	1	141,403.9	1,682	439,391.8	88.03
NY	New York City-Franchised	2	111,311	1,084	264,985	86.18
	New York-GTJC	2	*78,729 2*	*601*	*150,295 7*	*83 76*

	Queens Surface Corp	2	*25,746 5*	*280*	*75,167 8*	*99 58*
	New York Bus Tours, Inc		*3,943 9*	*128*	*22,293 9*	*75 00*
	Liberty Lines Express	2	*2,891 3*	*75*	*17,227 8*	*75 48*
NY	Liberty Lines Transit (Westchester Bee Line)	2	23,927.6	273	62,622.3	78.23
NY	Suffolk County Transit [d]	2	4,406.2	130	23,524.6	59.19
NJ	New Jersey Transit (contract service)		8,375.8	143	25,704.3	56.92

<u>Operator type:</u>
1. Public
2. Public-private contract

a. All buses publ cly owned; maintenance and support arrangements may differ by operator
b. Unlinked passenger trips
c. Includes statewide operations
d. County-sponsored service provided by seven private contractors

* Vehicle hours consist of all of the time a bus is on the road, in service and out of service, including "deadhead" per ods most common in express serv ce.

Source: Federal Transit Administration, National Transit Database, 2000.

Let's now breakdown the SEPTA "Everything Else" portion of operating cost further, this time using data from the APTA 2010 Public Transportation Fact Book:

As per the circa 2001 SEPTA operating cost allocation breakdown, labor accounts for 77% of the total operating cost of $47.05. "Everything Else" accounts for 23%, or $10.81. By working ratios on the "light rail" columns of Tables 17 and 18 of the APTA 2010 Public Transportation Fact Book, and using the SEPTA 2008 Subway- Surface figure of $47.05/hr as an overall <u>starting point,</u> this is what we get:

Utilities [Power]:	$3.45/hr
Casualty and Liability:	$1.11/hr
Material & Supplies:	$3.05/hr
General Administration:	$8.18/hr
Maintenance:	$9.70/hr
Subtotal:	$22.04/hr

Or roughly double of the SEPTA "Everything Else" figure of $10.81/hr.

Using this method, the average Brooklyn streetcar operating cost would be:

Average Total Labor Cost: $37.98/hr
"Everything Else": $22.04/hr

Total Operating Cost PER STREETCAR: $60.02/hr

*** If streetcars are operated in 2 car "trains", then the operating cost would be:**

Labor- 1 Operator (average): $37.98/hr
"Everything Else" x 2 : $44.08/hr
Total Operating Cost Per 2 Car "Train": $82.06/hr

1	OPERATING COST RATIOS p. 1									
2						Operating Expense				
3	State	Name	Mode	TOS	VOMS	per Vehicles Operated in Maximum Service	per Vehicle Hour	per Unlinked Passenger Trip	per Passenger Mile Traveled	per Employee Work Hour
4	NV	Las Vegas Monorail Company (LVMC)	AG	PT	32	1,677,779.3	2,005.5	5.8	24.2	0.0
5	FL	Miami-Dade Transit (MDT)	AG	DO	20	1,050,032.6	225.7	2.4	2.4	60.4
6	MI	Detroit Transportation Corporation (Detroit People Mover)	AG	DO	10	1,282,764.4	225.3	5.6	3.6	75.1
7	FL	Jacksonville Transportation Authority (JTA)	AG	DO	7	658,681.6	237.9	7.4	18.0	53.5
8	AK	Alaska Railroad Corporation (ARRC)	AR	DO	57	58,810.9	463.0	25.8	1.4	82.3
9	CA	San Francisco Municipal Railway (MUNI)	CC	DO	28	1,571,915.0	305.2	6.2	5.4	57.3
10										
11	IL	Northeast Illinois Regional Commuter Railroad Corporation (Metra)	CR	DO	1,056	464,656.8	344.0	6.6	0.3	64.8
12	NY	**Metro-North Commuter Railroad Company, dba: MTA Metro-No**	CR	DO	1,051	764,431.9	**435.3**	**10.1**	0.4	**77.8**
13	NY	**MTA Long Island Rail Road (MTA LIRR)**	CR	DO	998	1,036,998.0	**436.7**	**10.1**	0.5	**86.0**
14	NJ	New Jersey Transit Corporation (NJ TRANSIT)	CR	DO	881	822,289.1	335.7	9.0	0.3	76.9
15	MA	Massachusetts Bay Transportation Authority (MBTA)	CR	DO	388	586,376.0	312.3	5.9	0.3	58.0
16	PA	Southeastern Pennsylvania Transportation Authority (SEPTA)	CR	DO	308	640,786.6	311.3	5.9	0.4	55.5
17	CA	Southern California Regional Rail Authority (Metrolink)	CR	PT	173	715,799.4	427.6	10.3	0.3	0.0
18	MD	Maryland Transit Administration (MTA)	CR	PT	132	582,553.4	552.5	10.2	0.3	0.0
19	CA	Peninsula Corridor Joint Powers Board (PCJPB)	CR	PT	96	778,724.0	385.1	7.3	0.3	0.0
20	VA	Virginia Railway Express (VRE)	CR	PT	75	615,899.1	699.1	13.6	0.4	0.0
21	IN	Northern Indiana Commuter Transportation District (NICTD)	CR	DO	66	550,928.0	332.0	8.6	0.3	65.6
22	WA	Central Puget Sound Regional Transit Authority (ST)	CR	PT	35	703,771.3	1,018.8	11.4	0.5	0.0
23	FL	South Florida Regional Transportation Authority (TRI-Rail)	CR	PT	34	1,273,728.9	635.1	12.7	0.4	0.0
24	CA	North County Transit District (NCTD)	CR	PT	24	740,984.5	507.8	11.4	0.4	0.0
25	PA	Pennsylvania Department of Transportation (PENNDOT)	CR	PT	24	512,101.8	419.8	32.7	0.4	0.0
26	CT	Connecticut Department of Transportation (CDOT)	CR	PT	22	496,271.5	589.5	23.4	1.2	0.0
27	TX	Dallas Area Rapid Transit (DART)	CR	PT	21	996,180.8	796.9	14.2	1.3	0.0
28	CA	Altamont Commuter Express (ACE)	CR	PT	18	604,403.3	550.3	15.4	0.3	0.0
29	TX	Fort Worth Transportation Authority (The T)	CR	PT	15	582,407.8	335.7	8.7	0.5	0.0
30	ME	Northern New England Passenger Rail Authority (NNEPRA)	CR	PT	12	937,155.6	236.5	33.0	0.4	0.0
31	TN	Regional Transportation Authority (RTA)	CR	PT	5	730,933.0	594.3	33.8	1.9	0.0
32										
33	NY	**MTA New York City Transit (NYCT)**	HR	DO	5,280	573,581.0	**155.2**	**1.3**	0.3	**63.4**
34	IL	Chicago Transit Authority (CTA)	HR	DO	1,002	534,979.1	129.5	2.8	0.5	72.1
35	DC	Washington Metropolitan Area Transit Authority (WMATA)	HR	DO	782	890,454.5	248.7	2.5	0.4	66.0
36	CA	San Francisco Bay Area Rapid Transit District (BART)	HR	DO	517	887,639.7	213.9	4.2	0.3	84.5
37	MA	Massachusetts Bay Transportation Authority (MBTA)	HR	DO	320	816,090.5	173.5 Q	1.8	0.5	65.6
38	PA	Southeastern Pennsylvania Transportation Authority (SEPTA)	HR	DO	278	517,045.4	174.2	1.6	0.4	53.8
39	NJ	**Port Authority Trans-Hudson Corporation (PATH)**	HR	DO	266	840,479.3	**263.7**	**2.8**	0.6	**108.1**
40	GA	Metropolitan Atlanta Rapid Transit Authority (MARTA)	HR	DO	182	943,001.0	194.5	2.2	0.3	42.6
41	FL	Miami-Dade Transit (MDT)	HR	DO	98	822,744.9	207.3	4.6	0.6	61.4
42	NJ	Port Authority Transit Corporation (PATCO)	HR	DO	78	502,589.0	257.7	4.2	0.5	68.9
43	CA	Los Angeles County Metropolitan Transportation Authority (LACMTA)	HR	DO	70	1,248,116.9	305.9	2.1	0.5	85.7
44	MD	Maryland Transit Administration (MTA)	HR	DO	54	936,117.8	252.9	3.8	0.8	58.5
45	NY	**Staten Island Rapid Transit Operating Authority, dba: MTA State**	HR	DO	46	715,352.4	**299.5**	**4.4**	0.7	**66.2**
46	PR	Puerto Rico Highway and Transportation Authority (PRHTA)	HR	PT	40	1,334,981.3	260.1	6.8	1.3	0.0
47	OH	The Greater Cleveland Regional Transit Authority (GCRTA)	HR	DO	22	1,109,464.6	303.9	3.3	0.5	46.9
48	AG = automated guideway; CC = cable car; CR = commuter rail; HR = heavy rail (subway).									
49	Vehicles Operated in Maximum Service (VOMS) includes directly operated (DO) and purchased transportation (PT) vehicles by mode and type of service (TOS) reported on the Identification form (B-10) under the same NTD identification number.									
50	Source: Federal Transit Administration National Transit Database									

OPERATING COST RATIOS p. 2

State	Name	Mode	TOS	VOMS	Operating Expense per Vehicles Operated in Maximum Service	per Vehicle Hour	per Unlinked Passenger Trip	per Passenger Mile Traveled	per Employee Work Hour
MA	Massachusetts Bay Transportation Authority (MBTA)	LR	DO	150	802,932.5	208.3	1.7	0.7	61.0
CA	San Francisco Municipal Railway (MUNI)	LR	DO	141	876,724.8	216.1	3.0	1.2	64.7
PA	Southeastern Pennsylvania Transportation Authority (SEPTA)	LR	DO	127	444,204.0	**136.0**	2.0	0.8	**51.0**
CA	Los Angeles County Metropolitan Transportation Authority (LACMTA)	LR	DO	102	1,416,329.3	370.7	3.5	0.5	84.3
CA	San Diego Metropolitan Transit System (MTS)	LR	DO	93	601,629.7	**127.6**	1.6	0.3	**59.9**
CO	Denver Regional Transportation District (RTD)	LR	DO	91	445,059.7	**84.9**	2.2	0.3	**50.2**
TX	Dallas Area Rapid Transit (DART)	LR	DO	85	939,010.7	315.7	4.5	0.6	58.5
OR	Tri-County Metropolitan Transportation District of Oregon (TriMet)	LR	DO	81	909,335.5	170.1	2.0	0.4	66.9
NJ	New Jersey Transit Corporation (NJ TRANSIT)	LR	PT	58	1,539,407.7	393.4	6.8	1.2	0.0
PA	Port Authority of Allegheny County (Port Authority)	LR	DO	57	748,521.4	289.2	6.0	1.2	49.5
CA	Sacramento Regional Transit District (Sacramento RT)	LR	DO	56	846,858.1	217.5	3.3	0.6	81.7
MO	Bi-State Development Agency (METRO)	LR	DO	56	917,808.4	196.7	2.4	0.4	72.1
UT	Utah Transit Authority (UTA)	LR	DO	46	569,367.7	105.5 Q	1.6	0.3	44.0
CA	Santa Clara Valley Transportation Authority (VTA)	LR	DO	39	1,434,243.5	260.7	5.4	1.0	84.7
MD	Maryland Transit Administration (MTA)	LR	DO	36	1,104,153.4	278.7	5.9	1.0	64.1
MN	Metro Transit	LR	DO	27	812,105.1	163.7	2.4	0.4	75.9
NY	Niagara Frontier Transportation Authority (NFT Metro)	LR	DO	23	1,013,210.8	305.4	4.0	1.6	88.2
LA	New Orleans Regional Transit Authority (NORTA)	LR	DO	19	652,267.7	297.6	9.0	7.6	69.2
NJ	New Jersey Transit Corporation (NJ TRANSIT)	LR	DO	17	1,083,199.5	322.0	3.1	1.4	60.4
OH	The Greater Cleveland Regional Transit Authority (GCRTA)	LR	DO	17	756,747.7	221.9	4.2	0.7	45.8
TX	Metropolitan Transit Authority of Harris County, Texas (Metro)	LR	DO	17	885,283.7	191.5	1.3	0.5	40.3
TN	Memphis Area Transit Authority (MATA)	LR	DO	12	357,656.2	70.7	4.2	4.9	34.8
FL	Hillsborough Area Regional Transit Authority (HART)	LR	DO	8	300,294.6	131.6	4.3	2.8	39.8
TX	Island Transit (I T)	LR	DO	4	148,957.0	101.5	19.0	14.8	39.9
AR	Central Arkansas Transit Authority (CATA)	LR	DO	3	236,208.3	59.4	4.6	2.8	34.6
WI	Kenosha Transit (KT)	LR	DO	3	106,467.0 Q	106.8 Q	5.1 Q	4.5 Q	48.6 Q
WA	Central Puget Sound Regional Transit Authority (ST)	LR	DO	2	1,489,941.0	291.3	3.5	3.4	94.4
GA	Chatham Area Transit Authority (CAT)	FB	DO	2	433,276.0	88.7	1.9 Q	6.1 Q	32.6
VA	Transportation District Commission of Hampton Roads, dba: Hampton R	FB	PT	2	368,299.5	121.8	1.9	3.8	0.0
WA	Kitsap Transit	FB	PT	2	790,301.5	237.9	3.4	2.1	0.0
LA	Crescent City Connection Division - Louisiana Department of Transporta	FB	DO	3	2,361,636.7	504.8	4.2	8.4	55.8
NJ	**Port Imperial Ferry Corporation dba NY Waterway**	FB	DO	13	1,645,623.5	589.8	**4.5**	1.2	97.9
ME	Casco Bay Island Transit District (CBITD)	FB	DO	4	1,041,282.5	327.5	4.6	1.5	35.7
NY	BillyBey Ferry Company, LLC	FB	DO	5	1,525,470.8	432.2	4.8	1.9	133.8
NJ	Port Authority Trans-Hudson Corporation (PATH)	FB	PT	8	1,142,652.9	430.1	5.0	1.9	0.0
NY	**New York City Department of Transportation (NYCDOT)**	FB	DO	4	25,033,405.3	5,620.7	**5.3**	1.0	60.2
MA	Massachusetts Bay Transportation Authority (MBTA)	FB	PT	9	1,094,116.7	450.4	7.1	0.8	0.0
WA	Washington State Ferries (WSF)	FB	DO	22	9,489,242.2	1,622.8	8.7	1.1	68.2
CA	City of Alameda Ferry Services	FB	PT	3	1,705,594.7	701.0	8.9	1.3	0.0
CA	Golden Gate Bridge, Highway and Transportation District (GGBHTD)	FB	DO	5	3,805,905.8	1,330.5	9.4	0.9	89.7
NY	**Metro-North Commuter Railroad Company, dba: MTA Metro-No**	FB	PT	2	1,370,293.0	597.5	**13.1**	3.8	0.0
WA	Pierce County Ferry Operations (Pierce County Ferry)	FB	PT	1	2,792,242.0	486.9	14.2	1.6	0.0
CA	City of Vallejo Transportation Program (Vallejo Transit, Baylink)	FB	PT	3	3,712,534.7	1,200.8	14.3	0.6	0.0
PR	Puerto Rico Ports Authority (PRPA)	FB	DO	15	1,094,178.9	603.5	16.7 Q	4.6	42.9

LR = light rail (trolley or streetcar); FB = ferry boat.

OPERATING COST RATIOS p. 3

State	Name	Mode	TOS	VOMS	Operating Expense per Vehicles Operated in Maximum Service	per Vehicle Hour	per Unlinked Passenger Trip	per Passenger Mile Traveled	per Employee Work Hour
NY	**MTA New York City Transit (NYCT)**	DR	PT	1,560	177,414.8 Q	**60.4** Q	**70.2** Q	6.7 Q	0.0 Q
CA	San Francisco Paratransit (ATC)	DR	PT	1,555	12,025.8	50.2	16.1	2.8	0.0
IL	Pace - Suburban Bus Division (PACE) - ADA Paratransit Services	DR	PT	705	118,730.0	46.0	31.9	3.6	0.0
CA	Access Services Incorporated (ASI)	DR	PT	561	129,847.7	45.5	30.1	2.4	0.0
MA	Massachusetts Bay Transportation Authority (MBTA)	DR	PT	453	114,762.1	42.4	32.8	2.5	0.0
DC	Washington Metropolitan Area Transit Authority (WMATA)	DR	PT	406	142,411.8	38.9	39.5	3.9	0.0
TX	Metropolitan Transit Authority of Harris County, Texas (Metro)	DR	PT	398	85,821.9	39.5	23.7	2.0	0.0
PA	Access Transportation Systems (ACCESS)	DR	PT	390	84,805.2	45.1	19.4	2.7	0.0
CO	Denver Regional Transportation District (RTD)	DR	PT	354	101,832.5 Q	50.3 Q	30.2 Q	4.6 Q	0.0 Q
WA	King County Department of Transportation - Metro Transit Division (King	DR	PT	354	135,402.9	66.6	42.1	4.2	0.0
NJ	New Jersey Transit Corporation (NJ TRANSIT)	DR	PT	343	160,368.0	82.6	50.6	8.3	0.0
PA	Southeastern Pennsylvania Transportation Authority (SEPTA)	DR	PT	343	134,736.5	43.0	26.3	4.4	0.0
FL	Miami-Dade Transit (MDT)	DR	PT	301	140,195.6	41.7	25.1	1.7	0.0
MD	Maryland Transit Administration (MTA)	DR	PT	275	125,026.1	42.3	31.3	4.1	0.0
NY	**MTA New York City Transit (NYCT)**	MB	DO	3,896	536,985.1	**136.1**	**2.4**	1.2	**63.0**
CA	Los Angeles County Metropolitan Transportation Authority (LACMTA)	MB	DO	2,094	409,658.6	109.2	**2.2**	0.6	**54.0**
IL	Chicago Transit Authority (CTA)	MB	DO	1,846	472,475.6	123.6	2.8	1.1	66.9
NJ	New Jersey Transit Corporation (NJ TRANSIT)	MB	DO	1,785	357,888.0	114.8	4.2	0.7	55.6
DC	Washington Metropolitan Area Transit Authority (WMATA)	MB	DO	1,261	381,263.2	121.4	3.7	1.2 Q	56.0
PA	Southeastern Pennsylvania Transportation Authority (SEPTA)	MB	DO	1,171	403,707.3	110.6	2.8	1.0	54.3
NY	**MTA Bus Company (MTABUS)**	MB	DO	1,137	400,137.2	**127.8**	**4.1**	1.5	**73.1**
WA	King County Department of Transportation - Metro Transit Division (King	MB	DO	942	366,157.3	114.8	4.0	0.7	64.4
FL	Miami-Dade Transit (MDT)	MB	DO	839	380,605.0	99.7	3.8	0.7	47.6
TX	Metropolitan Transit Authority of Harris County, Texas (Metro)	MB	DO	837	270,795.5	95.1	3.3	0.6	41.5
PA	Port Authority of Allegheny County (Port Authority)	MB	DO	813	318,318.1	107.7	4.3	0.9	48.9
MA	Massachusetts Bay Transportation Authority (MBTA)	MB	DO	768	386,419.9	112.1	3.0	1.5	55.8
MN	Metro Transit	MB	DO	740	293,518.4	99.0	3.2	0.7	50.1
TX	Dallas Area Rapid Transit (DART)	MB	DO	559	379,082.1	97.5	4.0	0.9	47.4
CO	Denver Regional Transportation District (RTD)	MB	DO	533	352,692.6	108.8	3.8	0.7	48.3
CA	Alameda-Contra Costa Transit District (AC Transit)	MB	DO	532	505,571.4	135.7	4.0	1.3	67.9
OR	Tri-County Metropolitan Transportation District of Oregon (TriMet)	MB	DO	532	390,415.9	104.9	3.3	0.9	60.1
GA	Metropolitan Atlanta Rapid Transit Authority (MARTA)	MB	DO	522	358,188.6	89.0	2.7	0.9	43.0
OH	The Greater Cleveland Regional Transit Authority (GCRTA)	MB	DO	522	329,422.5	94.7	3.5	1.0	47.3
MD	Maryland Transit Administration (MTA)	MB	DO	510	416,441.4	117.4	2.8	0.9	53.2
NY	**Westchester County Bee-Line System (The Bee-Line System)**	MB	PT	281	384,410.6	**126.2**	**3.5**	**0.7**	**0.0**
NY	**Metropolitan Suburban Bus Authority, dba: MTA Long Island Bu**	MB	DO	279	417,317.0	**124.2**	**3.6**	**0.7**	**57.0**
DR = demand response (paratransit for the handicapped); MB = motor bus.									
NJ	New Jersey Transit Corporation (NJ TRANSIT)	MB	PT	327	220,440.1	88.5	4.8	1.2	0.0
NY	Niagara Frontier Transportation Authority (NFT Metro)	MB	DO	286	298,971.4	99.3	4.7	1.2	52.7
NY	Capital District Transportation Authority (CDTA)	MB	DO	189	254,440.4	81.6	3.9	1.2	43.3
NY	Regional Transit Service, Inc. and Lift Line, Inc. (R-GRTA)	MB	DO	189	263,558.2	101.2	4.1	1.2	50.3
NY	CNY Centro, Inc. (CNY Centro)	MB	DO	130	248,353.3	89.0	2.7 Q	0.9 Q	41.6
NY	Broome County Department of Public Transportation (Broome County)	MB	DO	38	230,198.2	73.5	2.9	1.0	50.1
NY	Suffolk County Department of Public Works - Transportation Division (S	MB	PT	138	243,598.1	83.0	5.7	0.6	0.0
NY	Transport of Rockland (TOR)	MB	PT	62	241,120.9	67.4	4.3	0.7	0.0
NY	Dutchess County Division of Mass Transportation (Loop Bus)	MB	DO	26	128,226.3	56.6	5.6 Q	0.5	32.9
NY	New York City Department of Transportation (NYCDOT)	MB	PT	24	216,714.6	111.5	7.5	1.4	0.0
NY	Huntington Area Rapid Transit (HART)	MB	DO	10	256,866.9	107.9	10.5	2.3	57.2
NY	City of Long Beach	MB	DO	9	160,665.6	54.9	3.0	1.6	27.8
NY	Tompkins Consolidated Area Transit (TCAT)	MB	PT	8	88,937.1	58.9 Q	7.3	1.5	0.0
NY	Metro-North Commuter Railroad Company, dba: MTA Metro-North Railro	MB	PT	7	182,311.0	58.8	3.2	10.0	0.0
NY	City of Poughkeepsie	MB	DO	6	220,023.8	81.7	3.5 Q	1.2 Q	47.1
NY	Hendrick Hudson Bus Lines, Inc. (HHBL)	MB	DO	6	218,057.2	87.3	29.5	0.6	56.1
NY	Newburgh Beacon Bus Corporation (NBBC)	MB	DO	6	128,749.8	54.9 Q	7.6	1.7	32.3
NY	Private Transportation Corporation	MB	PT	6	200,739.8	80.9	2.1	0.3	0.0
NY	Putnam County Transit (PART)	MB	PT	6	246,710.5	76.2	9.8	1.8	0.0
NY	Clarkstown Mini-Trans	MB	DO	5	304,405.8	78.6	10.2	1.9	55.9

THE OREGONIAN - Politifact Oregon
The Truth-O-Meter Says:

Says "streetcars carry more people than buses … you attract more riders who don't ride transit now, and actually the operating costs are not any greater than the bus."

Charlie Hales on Sunday, February 12th, 2012 in an interview.

Do streetcars really beat out buses in capacity, ridership and cost?

Share this story:

Portland mayoral candidate Charlie Hales is well known for his support of streetcar projects. He promoted them in Portland during his time as a city council member, then ended his term early to go help other cities start their own.

Hales hasn't advocated expanding the city's system during his current campaign, but the subject keeps coming up. During an appearance on Oregon Public Broadcasting's "Think Out Loud," Hales explained why he's so keen on street cars.

It comes down to three things, he said: Because "streetcars carry more people than buses. Because you attract more riders who don't ride transit now. And actually the operating costs are not any greater than the bus. The trick is coming up with the very large capital cost."

These sorts of talking points get thrown around a lot by rail-system advocates. We thought it was high time we checked it out.

Our first call was to Hales' campaign. His spokeswoman, Jessica Moskovitz, sent us a thorough e-mail outlining the support for the various pieces of the statement. Before we get to all that, though, let's start with TriMet when spokeswoman Mary Fetsch.

On whether streetcars carry more people than buses, there is no ambiguity. Streetcars have a maximum capacity of 92 riders, according to Fetsch. That's nearly double the 51 or so riders who can fit on a single bus. (It was clear during the interview that Hales was talking capacity here and not the actual number of riders.)

The next part was about whether streetcars have a smaller operating cost. Naturally, our minds went to the huge down payment a city has to make on tracks, whereas a bus can use existing roads. But Hales was careful to take that out of the equation by acknowledging the startup costs. It's clear he was talking about day-to-day operation. On that point, he seems to be right again.

According to Fetsch, the streetcar operations cost $1.50 per boarding ride, while the bus costs $2.82. Now, there are a few important caveats here. Portland's streetcar system is much smaller than TriMet's bus and MAX systems. That's important because those two systems require a command center, which deals with dispatch and customer service. The streetcar also ducks security charges -- Portland police take care of the streetcar while TriMet has to budget for the Transit Police Division.

You also have to consider the fact that the streetcar serves just the city core, while the MAX and bus systems operate in the low-density, outer areas and run both earlier and later.

The last bit of important context here, too, is that the streetcar system requires fewer maintenance expenses: It's younger and it runs at lower speeds, so it has less wear than the MAX and bus system.

That leaves us with the last bit: Do streetcars really attract riders who don't typically take public transit?

Moskovitz, the spokeswoman for Hales, pointed us to a study by Edson Tennyson for the National Research Council on the issue of rail transit. Tennyson concluded that, all things being equal, "rail transit is likely to attract 34 percent to 43 percent more riders than will equivalent bus services."

There was a catch, though: That paper was written more than two decades ago. The only other source Moskovitz had was an article touting the increase in streetcar ridership.

TriMet, however, had two pieces of pertinent information.

First up, between 2000 and 2003, bus stops within a sixth of a mile of the streetcar saw ridership drop by 20 percent when the rail went online. Meanwhile, the streetcar ridership grew well beyond that drop, indicating the system was attracting more people than just those who would have ridden the bus. Second, according to a June 2011 rider study, 38 percent of occasional and infrequent riders exclusively used the MAX, while only 12 percent exclusively used the bus. Of course, the MAX is not the streetcar, but this fact seems to speak to the attractiveness of rail travel over bus for some transit users.

While the data are somewhat old and somewhat tangential, taken together they seem to support Hale's claim that the streetcar attracts more infrequent riders.

So that brings us to the ruling. Hales said "streetcars carry more people than buses … you attract more riders who don't ride transit now, and actually the operating costs are not any greater than the bus." Whether these arguments make a persuasive case for the necessity and usefulness of a streetcar system is, of course, up for debate. The statement itself remains factual. While, there's some missing context, it's nothing significant. We rate this claim True.

FUNDING SCHEMES

Federal Funding for Streetcar Projects

FTA "New Starts" and "Small Starts" Grants, typically 80% of project capital costs.

Summary of the Federal Transit Administration's FY2013 New Starts/Small Starts Report

Overview

On January 31, 2012, the Federal Transit Administration (FTA) issued its FY 2013 Annual Report on Funding Recommendations for the Capital Investment Grant Program. The Capital Investment Grant Program provides funding for new transit systems, or extensions to existing systems, including heavy rail, light rail, commuter rail, streetcars, bus rapid transit (BRT), and ferries. The Capital Investment Grant Program includes two categories of projects, referred to as New Starts and Small Starts. New Starts projects include requests of $75 million or more in Capital Investment Program funds or anticipate a total capital cost of $250 million or more. Small Starts projects include requests of less than $75 million in Capital Investment Program funds and anticipate a total capital cost of less than $250 million.

The total budget recommended for the Capital Investment Grant Program in the President's FY 2013 budget is $2.235 billion. For New Starts, FTA recommended $1.932 billion for allocation to projects with existing or proposed Full Funding Grant Agreements (FFGAs)[1]. Twelve projects have existing FFGAs, for which FTA is requesting $1.17 billion. Six projects are being proposed for a new FFGA in FY2013, for which $765.66 million is requested. The request also includes $120 million for three projects expected to reach the final design stage of project development during 2012. These projects may receive an FFGA if there is necessary progress during FY 2013.

FTA further recommended $127.57 million for allocation to Small Starts projects for Project Construction Grant Agreements (PCGA)[2]. The budget proposal also includes a 2.5 percent set-aside for management and oversight totaling $55.89 million, an increase over last year's set-aside, reflecting the growing number of projects entering the Capital Investment Grant program as well as "FTA's strong desire to enhance its stewardship and oversight of a set of increasingly complex major capital projects."

1 A Full Funding Grant Agreement (FFGA) is a contract between the project sponsor and the Federal Transit Administration that formally establishes the maximum level of New Starts funding and outlines the terms and conditions of federal financial participation.
2 A Project Construction Grant Agreement is a contract that sets the terms and conditions for Small Starts funding, as an FFGA does for New Starts funding.

Quick Facts

- Overall, 30 projects are recommended for funding, in 15 states.
- 12 existing FFGAs are recommended for funding, in 9 states.

- 6 proposed FFGAs are recommended for funding, in 4 states.

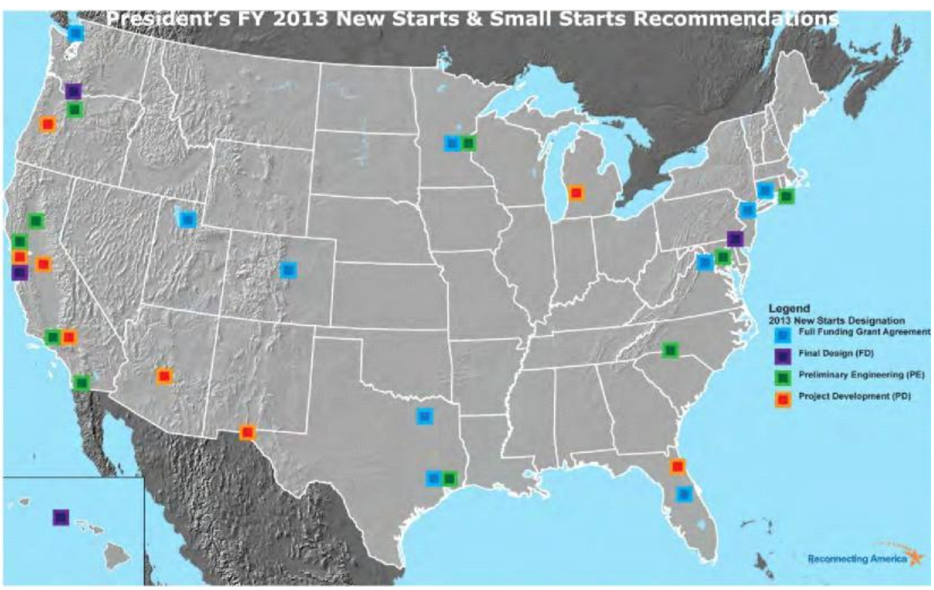
- 9 proposed PCGAs are recommended for funding, in 6 states.

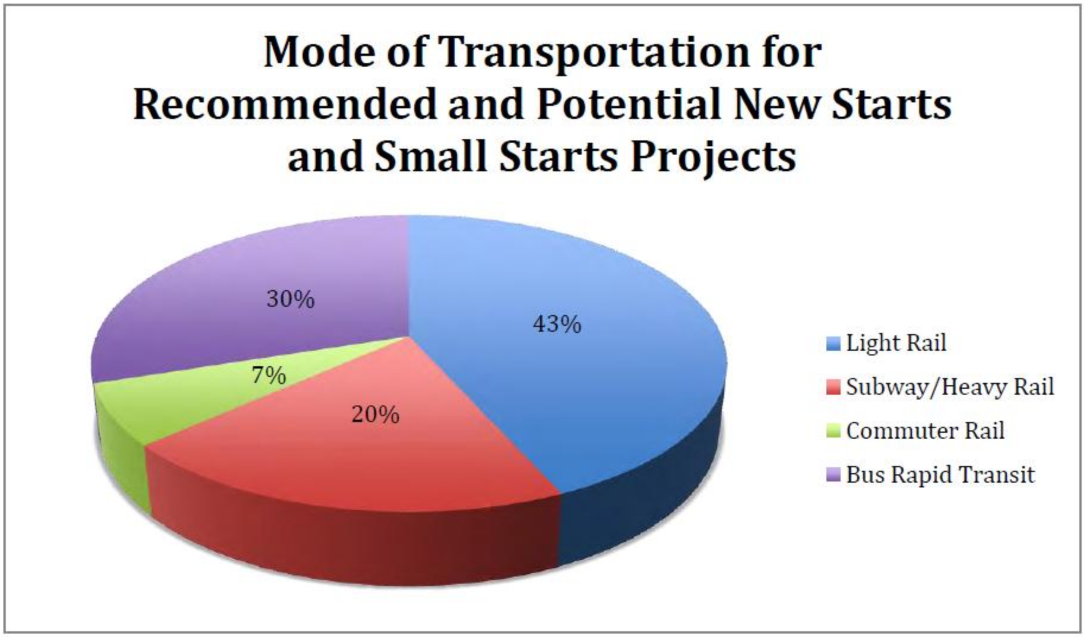
- 3 New Starts projects, in 2 states, are recommended for funding if sufficient progress is made in final design.

- Of the 21 recommended and potential future New Starts projects, 12 are light rail, 6 are subway/heavy rail, 2 are commuter rail, and 1 is bus rapid transit. All of the Small Starts projects are bus rapid transit systems except for one light rail extension in Mesa, AZ.

- For New Starts projects with existing or proposed FFGAs, the average proposed federal FY 2013 allocation is $859 million and the average New Starts share of total capital costs is 45.2 percent. In FY 2012 the average New Starts share of total capital costs was 49 percent.

- For Small Starts projects with existing or proposed PCGAs, the average proposed federal FY 2013 allocation is $48 million and the average Small Starts share of total capital costs is 66 percent. In FY 2012 the average Small Starts share of total capital costs was 57 percent.





Changes Since Last Year

Since the publication of the FY 2012 *Annual Report* in February 2011, several New and Small Starts projects have or will soon receive Full Funding Grant Agreements or Project Construction Grant Agreements:

New Starts Projects Receiving FFGAs

- Denver, Co: Eagle Commuter Rail
- Hartford, CT: New Britain-Hartford Busway
- Orlando, FL: Central Florida Commuter Rail Transit Initial Operating Segment
- Minneapolis-St. Paul, MN: Central Corridor LRT
- Houston, TX: North Corridor LRT
- Houston, TX: Southeast Corridor LRT
- Draper, UT: Draper Transit Corridor

New Starts Project with FFGA Pending Congressional Review

- San Jose, CA: Silicon Valley Berryessa Extension Project

Small Starts Projects that Received PCGAs

San Bernardino, CA: E Street Corridor sBX BRT
Fitchburg, MA: Commuter Rail Improvements

Small Starts Project with PCGA Pending Congressional Review Austin,
TX: MetroRapid Bus Rapid Transit (BRT) Project

In addition, since the publication of the FY 2012 *Annual Report* in February 2011, several New Starts projects have been approved for preliminary engineering or final design. Also, several Small Starts projects have been approved for project development:

New Starts Projects Approved into Final Design
San Jose, CA: Silicon Valley Berryessa Extension Project
Honolulu, HI: High Capacity Transit Corridor Project
Portland, OR: Portland-Milwaukee Light Rail Project

New Starts Projects Approved into Preliminary Engineering
San Diego, CA: Mid-Coast Corridor
Baltimore, MD: Baltimore Red Line
Bethesda to New Carrollton, MD: Maryland National Capital Purple Line
Minneapolis, MN: Southeast Corridor LRT

Small Starts Projects Approved into Project Development

Jacksonville, Fl: JTA BRT Southeast Corridor
Eugene, OR: West Eugene Emerald
Express BRT El Paso, TX: Dyer Corridor BRT

Four exempt projects (those seeking less than $25 million in Capital Investment Program funds) have received all of the appropriations needed for their project since the publication of the FY 2012 *Annual Report* in February 2011. Therefore, the projects are no longer included in the report. These projects are as follows:

Tucson, AZ: Tucson Streetcar
Stamford, CT: Stamford Urban Transitway Phase II
Providence, RI: South Corridor Commuter Rail
Boston, MA: Assembly Square

Discussion

The New Starts and Small Starts programs have been extremely successful in bringing new or improved transit service to communities around the country. These major capital investments in transit infrastructure have stimulated economic development, improved commute times, and in the long-run will reduce costs for both government entities and individual households. As a result, the demand for investment in transit projects like these is significant, and greatly exceeds the current capacity of the New Starts and Small Starts programs. A recent analysis by Reconnecting America found more than 640 major transit projects being planned around the country. The U.S. Congress is currently considering multi-year transportation reauthorization bills that will continue funding the New Starts and Small Starts programs essentially at their current

levels – far less than would be needed to bring even a small percentage of these projects into reality.

As part of the reauthorization, both the FTA and the Congress are proposing changes to the New Starts and Small Starts programs to shorten the time it takes to complete a major transit project (currently estimated at approximately 13 years, on average). The Annual Report on Funding Recommendations explains FTA's proposal that the Capital Investment Program be streamlined into one set of project evaluation criteria rather than separate New Starts and Small Starts categories with different evaluation and rating criteria. Sponsors of projects seeking more than $100 million in Capital Investment Grant funds would receive construction funding through a Full Funding Grant Agreement and sponsors seeking less than $100 million in Capital Investment Grant Program funds would receive construction funding through a simplified Project Construction Grant Agreement. Projects could possibly be "exempt" from the evaluation and rating process if the project sponsors seek less than $100 million in program funds with the request representing less than 10% of the project's anticipated total capital cost. These exempt projects would only be subjected to basic Federal grant requirements. It is important to note, however, that these proposed changes would require Congressional approval to take effect.

At the same time, FTA is revising the methodology by which they evaluate New Starts and Small Starts projects. In a Notice of Proposed Rulemaking issued in January 2012, FTA proposed evaluation changes designed both the streamline the project development process and to capture a broader range of the benefits that transit projects provide. Given the changes being proposed by FTA as well as by the House and the Senate in reauthorization, the New Starts and Small Starts process could change significantly in the next few years, shortening the timeline for project development and potentially creating a different mix of project types than exists today. Still, under no scenario currently on the table do the New Starts and Small Starts programs grow sufficiently to meet the demand for transit in America.

Appendix A

A summary table of FY 2013 projects with existing or proposed FFGAs, their recommendation amount, total project cost and total New or Small Starts funding amount is provided below. More details on these programs can be found read at: http://fta.dot.gov/documents/FY13AnnualReportmaintext13012.pdf

March 01, 2014, 10:57 am

Obama turns to light rail to salvage transit legacy

By Keith Laing

Wikimedia Commons

Republicans have been largely successful in stymieing President Obama's plans to leave behind a legacy of high-speed railways, but Obama's second term could end up being remembered for a boon in light rail and streetcar construction.

Obama spoke frequently in his first term about developing a nationwide network of high-speed railways that could eventually grow to rival the interstate highway system. He included $8 billion in his 2009 economic stimulus package for high-speed rail lines, but Republican governors in states like Ohio, Wisconsin and Florida rejected the money.

However, while the GOP was training its focus on halting high-speed railways, several cities began constructing light rail and streetcar systems with the help of Obama's transportation department.

Obama touted one such DOT-assisted light rail expansion during a trip to St. Paul, Minn. this week to push for a new round of congressional transportation spending.

“I just had a chance to take a look at some of those spiffy new trains,” he said of the expansion of Minneapolis’ Metro light rail system to St. Paul, which is scheduled to open in June.

“They are nice and they’re energy efficient,” Obama said of the Minneapolis light rail cars. “They’re going to be reliable. You can get from one downtown to the other in a little over 30 minutes instead of when it’s snowing being in traffic for two hours."

Light railways and streetcars emerged in the 1980's and 1990's as a cost-effective alternative to building "heavy rail" subway systems like Washington, D.C.'s Metrorail. Light railways are generally operated aboveground, unlike subway systems that require tunnels, and they usually run shorter trains.

Streetcars often use similar train cars to light railways, but they usually operate in existing traffic lanes, so they do not require as many land acquisitions to build.

Both light railways and streetcars are typically powered by overhead power lines instead of electrified third rails on train tracks like subways.

In addition to Minneapolis and St. Paul, cities such as Charlotte, Dallas and Los Angeles are currently building new light rail lines. Washington, D.C. and Atlanta are additionally planning new streetcar lines, as is Charlotte.

Obama's transportation secretary, Anthony Foxx, was a member of Charlotte’s city council when that city opened its light rail line in 2007, and he pushed to expand the system as mayor.

Foxx regularly touts the success of Charlotte's LYNX light railway when he is arguing now for increasing transportation funding.

The DOT chief maintains that the Obama administration has not given up on high-speed rail though.

"2014 is shaping up to be our busiest construction year since our high-performance rail program began," Foxx said in a speech to the U.S. High Speed Rail Association this week.

"Right now, 47 projects representing $4.4 billion are either under construction or are about to be," Foxx continued.

Foxx said funding from the Obama administration helped pay for doubling the amount of railways in U.S. that can operate at speeds between 90 and 125 miles-per-hour, though Republicans have disputed the definition of trains that run that fast as high-speed.

The GOP argues that true high-speed rails are capable of running over 200 miles-per-hour, citing popular fast trains in European nations. Republicans have also sought to cut off funding for a proposed high-speed railway in California for which the Obama administration has contributed more than $3 billion, expressing doubt about cost and ridership estimates.

Despite the GOP's objections to its high-speed rail plans, Foxx said the Obama administration has drastically increased the availability of faster trains in the U.S.

"Over the past five years, we've invested more than $12 billion in high-performance rail," Foxx said. "Our High-Speed and Intercity Passenger Rail program is the largest grant program for passenger rail in our nation's history. Compared to 2009, over 24 million more Americans – a population about as big as Texas' – now have access to upgraded rail service – or soon will."

Eno Center for Transportation President Joshua Schank said the development of light railways under Obama has been less contentious because they are generally cheaper to build.

"The reason they're able to do this is that it's not very much money, compared to high-speed rail," Schank said. "Trolleys [and streetcars] don't even have their own right-of-way. That's the most expensive thing about transportation projects. High-speed railways are hugely expensive."

Schank added that many cities' light rail proposals are able to qualify for the Transportation Department's "new starts" program that allows local governments to apply for matching funds to get new projects off of the ground quickly because their construction costs are lower than other types of railways.

Schank said the "new starts" development began before Obama first took office.

But he said the Obama administration's push for light rails and streetcars has been quietly effective, however.

"It's really interesting how they've kind of snuck it under the radar," he said. "They cobbled together some existing funds and got some trolleys going."

In his speech touting the new Minneapolis-to-St. Paul light railway this week, Obama said he was for expanded public transportation access in whatever form is possible.

"More Americans should have access to the kind of efficient, affordable transit you're going to have with the Green Line," Obama said during his appearance at St. Paul's Union Depot train station.

"There's no faster way or better way for Congress to create jobs right now and to grow our economy right now, and have a positive impact on our economy for decades, than if we start more projects and finish more projects like this one," Obama said.

FHWA "TIFIA" federal loan guarantees for low interest 30 year construction bonds

Recent Examples:

Dallas, TX light rail project: $120 million

Los Angeles, CA light rail/streetcar $546 million

Other Funding for Streetcar Projects

New Tax Revenue Generated by Transit Oriented Development along the New Streetcar Line.

Example: Portland, OR

The City of Portland advanced the funding for the construction of the new streetcar line in the form of City Bonds, and then recouped the investment from the additional tax revenue generated by new development along the streetcar line

Create a "Transit Improvement District"

Example: Kansas City, MO.

The city advances the funding for the construction of the new streetcar line in the form of Bonds, then recoups the funds:

Recently, by nearly a 2/3 majority, voters within the "Transit Improvement District" approved a 1% sales tax, and a modest real estate tax increase to fund construction and operation of their new streetcar project. The project is also funded by parking assessments and federal funding.

Construction for the Downtown Kansas City streetcar starter line officially begins in Spring 2014. The completed starter line will include a two mile round trip streetcar route (four miles of track) along Main Street connecting Kansas City's River Market area to Crown Center and Union Station. It will serve the city's Central Business District, the Crossroads Art District, the Power and Light District and numerous other businesses, restaurants, art galleries, educational facilities and residential neighborhoods. The starter line will include 16 stops spaced approximately every two blocks. Additionally, the Singleton Yard Streetcar Vehicle Maintenance Facility and Park & Ride lot will be built at 3rd Street and Grand Blvd. in the River Market.

Construction will take approximately 18 months and create hundreds of local jobs. The KC Streetcar Constructors and the City of Kansas City are committed to minimizing impacts to those who live and work downtown during construction.

The Downtown KC Streetcar starter line is the next step in a longer-range plan to create a regional, integrated transit system to uniquely connect the Greater Kansas City area like never before. Progressive regions around the country with streetcar systems have seen significant economic growth and the Downtown KC Streetcar starter line is a step in effort to realize an even more vibrant, vital and livable urban center. Streetcar systems attract new residents, businesses and workforce and provide an improved and more efficient travel option. It is envisioned that the downtown KC Streetcar starter line will bring new investment and increased property values to downtown along with an increased economic impact during construction and after.

The completion of the Downtown KC Streetcar starter line project is anticipated in summer of 2015 followed by a period of testing. It is expected that by the end of

2015 the first streetcar rides will occur through Downtown Kansas City in over a half a century, putting the region *On the Forward Track*.

Rendering of type of streetcar that will run on the starter line.

Detroit "M-1 Rail" Streetcar

Hope For Detroit: Rail Transit On The Way

Posted: 07/27/13

By: Natalie Burg | Forbes

No place exemplifies the power of innovation and optimism better than Detroit. Skeptical? Then explain how a city that recently filed for the largest municipal bankruptcy in U.S. history is also celebrating a long-fought-for green light on a $137 million infrastructure project that will create 3.3 miles of circulating rail service, and is expected to bring $500 million worth of economic development to the city.

It doesn't seem possible — and it wouldn't have been, were it not for some bold thinkers who believe in Detroit.

Infrastructure is a complicated endeavor, and is typically the purview of local government or a regional transportation authority. Until this year, Detroit didn't have the latter, and the former has been otherwise occupied for some time. That didn't stop some prominent Detroiters from prioritizing public transit themselves.

"The need was there," said Heather Carmona, chief administrative officer of M-1 RAIL, the nonprofit responsible for managing the design, construction and operation of the future streetcars. M-1 RAIL was established in 2007 as part of a regional plan to create public transit in Detroit and its metro area. When local public funding for the vision didn't seem likely, philanthropists stepped in instead. "[Local business leaders] Roger Penske and Dan Gilbert came together and said, 'How can we advance this?'"

All told, private businesses, nonprofits and local government entities committed $100 million to the project. Though private investment in public infrastructure is far outside the norm — not to mention project management from an independent nonprofit — the innovative approach caught the attention of an important supporter.

"U.S. Transportation Secretary Ray LaHood has been a real friend of the project," said Carmona. That support eventually translated to $25 million in federal funding for the project. "This isn't something that has been done before. The courage our leaders have exhibited to get this done is incredible."

That courage went beyond simply committing to an outside-the-box funding and management structure for a public transit project. The very culture of innovation that eventually led to the M-1 RAIL project can also be traced back to the root of the issue. The Motor City has always been deeply committed to its car culture. The very Woodward Avenue on which the M-1 RAIL streetcars will circulate was the birthplace of Henry Ford's Model T and early assembly lines. Though a number of factors contributed to Detroit being the only major U.S. city without a regional transit until this year, the city's car-focused ethic certainly played a role.

"There have been attempts to bring some sort of transportation to Detroit for 30 years," Carmona said. "I remember even 10 years ago, if you even mentioned transit in conversation, people just cringed. It's just part of the repertoire now."

That cultural change was no easy fix, but bringing people into the fold and earning the buy-in from Detroiters has been a central task for M-1 RAIL. The message that the 3.3 miles of circulating streetcar service on Woodward Avenue will better connect the 27,000 residents to the 140,000 jobs along the same corridor and could bring between $500 million and $1 billion in economic development was a powerful one for a city in need of those kinds of numbers.

"Challenges are also opportunities," said Carmona. "The economic climate in Detroit is not good, and this will help in terms of jobs, and in terms of access to those jobs."

M-1 RAIL streetcars on Woodward Avenue are only the first step in the vision for mass transit in Metro Detroit. Future rail lines to farther reaches of the city and its suburbs are planned, but none of that can begin before the shovels go into the ground for the streetcar project this year.

And after years of talk about better public transit options, that shovels-in-the-ground moment will mean a great deal to a city that has suffered a number of broken promises.

"Seeing is believing," said Carmona. "Part of the message is that Detroit is open for business. Nationally, you hear that nothing is happening in Detroit, but business is really thriving here. And this is a tangible good."

Brookings Institution Study:

ABOUT THE REPORT

D.C. Surface Transit (DCST) commissioned the Brookings Institution to conduct a preliminary assessment of the funding alternatives, beyond Federal and DC government financing, for a streetcar system. The Brookings Institution study “Value Capture and Tax-Increment Financing Options for Streetcar Construction” used H Street,NE, and Benning Road, NE, from the Minnesota Avenue Metro station to Union Station as the study corridor. Brookings subcontracted with Robert Charles Lesser Company (RCLCO), HDR Inc, and Re-Connecting America to assist in the effort.

The Brookings study shows that it is hypothetically possible, using three forms of value capture financing and NOT using the federal government sources or the current general fund of the DC government, to pay for 100% of the construction costs ($140 million) of the proposed H Street/Benning Road streetcar. In all probability, there would be federal and local DC government investment but it demonstrates there are other options to consider. The hypothetical approach includes:

1. $46.6 million of Tax Increment Financing (TIF),

2. $46.6 million of a traditional special assessment district and

3. $46.6 million from a “never-done-before” sharing of private property value increases.

Capturing the increases in property values and related tax revenues created by a pubic transit investment can provide financing for additional community benefits.

Affordable housing, energy and environment enhancements, parks and open space can be part of a plan that spreads the benefit of streetcar investments throughout the community. These benefits were not explored in this study but should be part of a DC streetcar plan.

This study uses the economic growth experienced in Portland, Oregon and Seattle, Washington after the development of streetcar service in those cities. Additional analysis should evaluate this study’s projected value increases in the context of the economic redevelopment that has taken place other DC neighborhoods. The report findings should also be filtered through the current financial and economic crisis.

The possibility of funding streetcars and other related community improvements in DC with modest direct support from the federal or DC government is encouraging. It should be noted that the DC government would be asked to provide significant support in terms of credit-enhancement, or direct bond issuance, backed by future revenues from increased taxes revenues or the sharing of private property value increases.

DCST hopes that this work will stimulate the public's and policymakers’ interest in a DC streetcar system. Funding to complete a streetcar system plan is needed and a public's benefit. The DC Circulator is the result of a partnership between DCST, DDOT, and WMATA. The Circulator was envisioned as new form of surface transit in the city when it was introduced in 2005 and has succeeded in attracting over 10 million customers since that time. For more information about DCST contact Ellen Jones, Executive Director, DC Surface Transit Inc.

DC Surface Transit, Inc.
Board of Directors

CYCLING WITH STREETCARS

How bicyclists can safely share the road with streetcars

Streetcar tracks require special consideration from cyclists

When riding near streetcar lines, cyclists should keep a safe distance from the tracks in order to prevent wheels from falling into spaces between rails.

Cyclists must also maintain adequate space from parallel parked cars to avoid striking open car doors or pedestrians entering or exiting their vehicles.

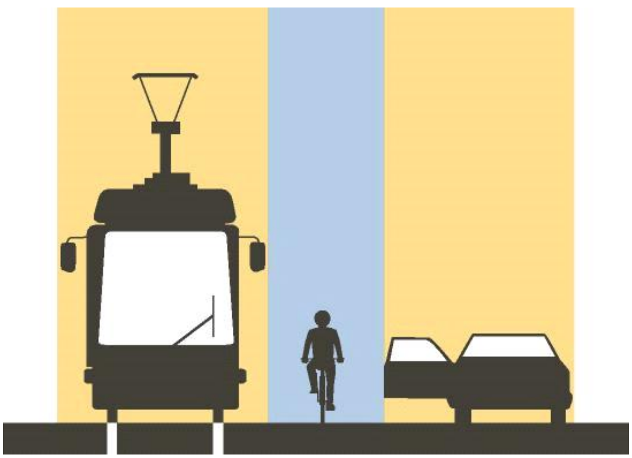


Photo: Richard Masoner

Crossing streetcar tracks

A cyclist may have to cross streetcar tracks in the following situations:

- Making left-hand turns
- Crossing tracks at intersections
- Passing parked vehicles that protrude into the road

Cyclists should make every effort to cross streetcar tracks at right angles. The most common streetcar-related bike crashes are from:

- The front wheel sliding out from under cyclists on streetcar tracks
- One or both wheels falling into streetcar tracks and getting stuck

Discuss at ideas nextrailkc.com

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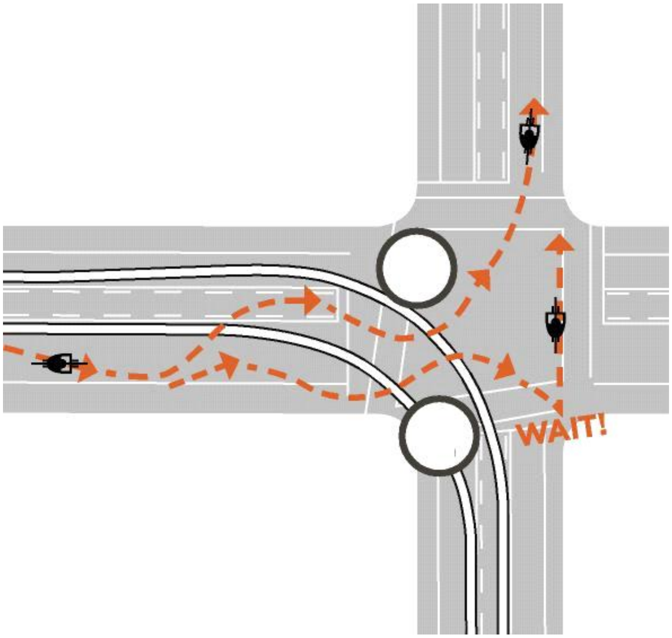


1

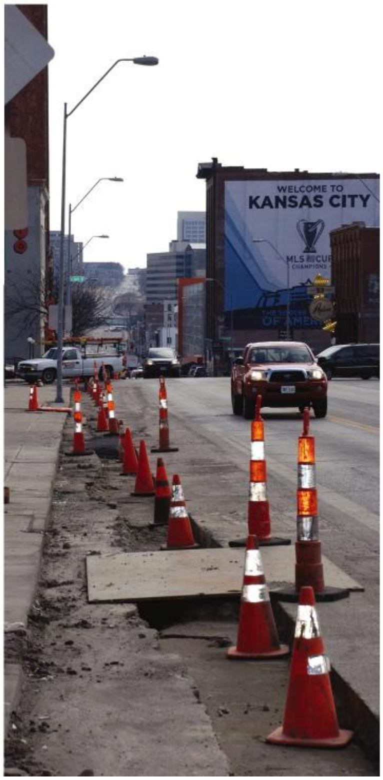
2

Making left turns across streetcar tracks:

Cyclists should use special techniques when making a left hand turn in an intersection where streetcar tracks make a right hand turn.
There are two main strategies for these situations:

1. "Vehicular" Left Turn: Similar to making a left turn in a car. Signal properly and scan for vehicles approaching from behind. Swing to the right in order to cross tracks at an adequate angle. When moving into the intersection, take special care to position your bicycle at an appropriate angle when crossing the second set of tracks.

2. "Box" Left Turn: When a cyclist crosses through the intersection as if they were continuing straight, but stops at the crosswalk of the intersecting street. The cyclist then turns 90° and waits for a green light to continue on in the direction they are turning.



Bicycles and streetcar construction

Constructing a streetcar system does not happen over night. There will be months of phased construction and vehicle testing on streetcar alignments, now and in the future. For the safety of cyclists, motorists, and construction crews, everyone must pay close attention and follow all warning signs in live construction zones. Cyclists especially should stay informed of construction plans, plan bike trips in advance, and anticipate trouble spots.

Learn more, and track Phase I streetcar construction progress at: www.kcstreetcar.org

Appendix I

What is the Streetcar Experience in Other Cities?

More than a dozen North American cities have streetcar systems that have either expanded or started operations in the past 15 years. Additionally, at least twice as many other cities have new systems or new lines under active planning. The primary attractions of streetcars are the ability to add a visible rail system at a relatively low capital investment, and the ability to create a highly attractive circulator that connects into a high-capacity network without requiring additional extension or expansion of a more expensive high-capacity mode. Streetcars are also popular because, as they once did, they can still fit into densely developed, pedestrian-oriented, urban neighborhoods.

Portland

Portland Streetcar

Began Operation: **2001**

Route Miles: **3.6** **(7.2 one-way loop)**

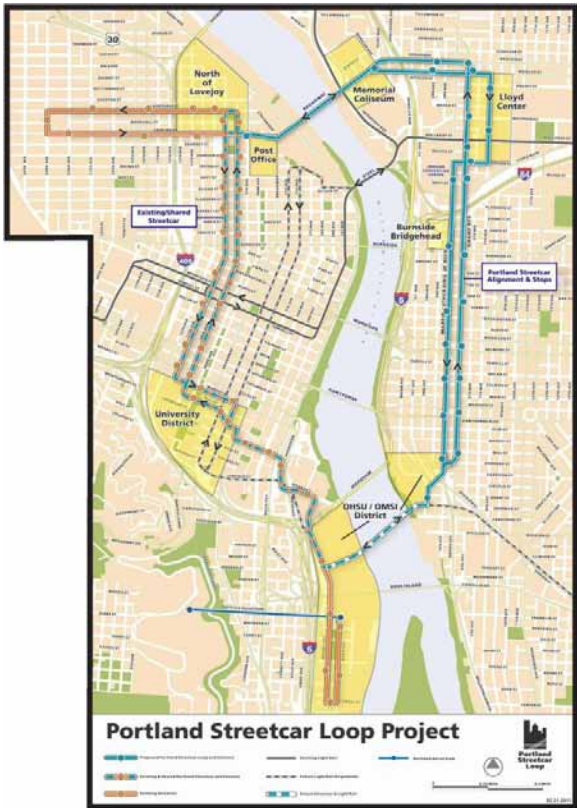
Stops: **42**

Org: **Transit Agency + Non-Profit**

Schedule: **Daily**

Opening in July 2001, the Portland Streetcar heralded the arrival of the Modern Streetcar to the United States. The system has been extended four times since its opening, and now provides daily service along a 3.6 mile route (soon to be extended). The majority of the line runs along pairs of one-way streets, separated by one or two blocks. Total one-way mileage for the complete loop is currently 7.2. Much of the line operates within TriMet's "fareless square" zone in the downtown area, so most trips are actually free to riders. Portland made use of an off-the-shelf European streetcar vehicle design, providing a modern, air-conditioned vehicle with level boarding.

The system is operated by the non-profit "Portland Streetcar Inc.", with service delivery contracted to local transit provider Tri-Met, who also operates the region's extensive light rail system. The streetcar is seen as "a unique public/private strategy to link investment in high quality transit service with major development". A January 2006 report by PSI entitled "Development Orientated Transit" notes that since 1997, **more than 2.28 Billion dollars has been invested within two blocks of the streetcar alignment. As of late 2008, the system was carrying 4.3 million riders annually.**



The next system extension will extend service from the Pearl District in NW Portland, across the existing Broadway Bridge, serving the eastern half of the Portland Central City. In May of 2009, it was announced that $75M in federal funding had been obtained towards the $127M project, and construction of the new 3.3 mile loop began in January 2010. Construction was substantially completed in January 2012 and testing is now underway, with service expected to start in Fall 2012

The Portland Streetcar Loop Project

in Portland, Oregon, will be a 3.3-mile extension of theexisting and highly-successful Portland StreetcarProject, which was constructed using all local funds.
The Portland Streetcar Loop Project will extend streetcar tracks, stations, and service from the Pearl District in NW Portland, across the existing Broadway Bridge, serving the eastern half of the Portland Central City.

The Portland streetcars will serve 28 new streetcar stops. Later, as a separate project, the Loop will be completed via a new bridge at the south end, allowing continuous connections around the entire Loop.On October 22, 2009, Federal Transit Administrator Peter Rogoff signed the Project Construction Grant Agreement for $75 million.

Cost Estimate: 128.27 million
Federal Project:
Federal Transit Administration $ 75.00 M
Local Improvement District $ 15.50 M
Portland Development Commission $ 27.68 M
Regional Funds $ 3.62 M

SDC/Other City Funds $ 6.11 M
Stimulus Funds $ 0.36 M
TOTAL FEDERAL PROJECT $ 128.27 M
VEHICLES FROM STATE OF OREGON $ 20.00 M
TOTAL PROJECT $ 148.27 M

Highlights

Extends the existing Westside Portland Streetcar Project

Increases project area housing units to meet goals outlined in Central City Plan

Attracts 2.4 million square feet of new development into the project area

Transports 3.5 million new riders per year beginning in early 2012

Reduces regional vehicle miles traveled by 28 million miles per year

Creates no significant environmental Impacts

Achieves and supports regional and local transit, environmental and development goals,

Detroit M-1 Rail Line

Detroit M-1 Rail Line

Artist's rendering of the Grand Circus Park station for the M-1 Rail project	
Background	
Locale	Downtown Detroit
Transit type	Streetcar
Number of stations	11
Annual ridership	5,400 daily *forecast*[1]
Headquarters	600 Renaissance Center, Suite 1740 Detroit, MI 48243
Operation	
Began operation	February 2016 *(expected)*
Operator(s)	M-1 Rail
Technical	
System length	3.3 mi (5.3 km)

The **M-1 Rail Line** (also known as the **Woodward Avenue Streetcar** by MDOT) is a 3.3-mile-long (5.3 km) streetcar line to run along Woodward Avenue in Detroit, Michigan. In December 2011, city and state leaders announced a plan to offer bus rapid transit service for the city and metropolitan area instead of light rail.[3] Soon afterwards, M-1 Rail, a consortium of private and public businesses and institutions in the region, announced the plan for a 3.3-mile-long (5.3 km) streetcar line along part of the same route, connecting the downtown Detroit People Mover to the railway station in New Center which serves Amtrak and the proposed SEMCOG commuter rail system.

9.3-mile plan

The proposed line ran 9.3 miles (15.0 km) along Woodward Avenue from the Rosa Parks Transit Center to the old State Fairgrounds along 8 Mile Road.[4] The line would have had 19 stops with 10 cars running at a time in two-car trains; each train would carry 150 people. The trains would run in a dedicated right-of-way in the median from 8 Mile to Adams Street at the north end of downtown. South of Adams, the trains would run in traffic along the sides of the street.

Rolling stock

According to real estate blog *Curbed Detroit,* bids from manufacturers willing to build the rolling stock for the line have been received, but the choice has not been made public.[5] *Crain's Detroit Business* reported the line would require six vehicles.[6] Bids were expected to include low-floor, air-conditioned vehicles, capable of transporting passengers in wheelchairs. The vehicles will have operator's controls at both ends—eliminating the need for the vehicles to turn around for their return trips.

History

Detroit had streetcar service from 1892 to 1956.[7][8] Planning for the return to rapid transit to Detroit began in 2006 when the Detroit Department of Transportation (DDOT) commissioned a study to determine expanded mass transit options along Michigan Avenue.[9] Concurrently, a private group of local business leaders decided to provide matching funds to government dollars to develop a $125 million, 3.4-mile (5.5 km) line through central Detroit (similar to the Tacoma Link) called the M-1 Rail Line. After much wrangling between the private investors and the DDOT, the two groups decided to work in tandem on developing DDOT's 9.3-mile (15.0 km) line.

The estimated cost for the proposed line was $500 million.[4] The Kresge Foundation awarded a $35 million grant to the city for the project in March 2009.[10] It received $25 million in funding from the United States Department of Transportation in February 2010. The Detroit City Council approved the sale of $125 million in bonds on April 11, 2011.[11] The Federal Transit Administration (FTA) and the City of Detroit signed an environmental impact study on July 1, 2011.[9] Finally, on August 31, 2011, the FTA signed a record of decision allowing the project to move forward.[12]

In December 2011 the federal government withdrew its support for the proposed line, in favor of a bus rapid transit system which would serve the city and suburbs. This decision arose out of discussions between federal Secretary of Transportation Ray LaHood, Detroit Mayor Dave Bing and Governor Rick Snyder. The private investors who supported the smaller three-mile (4.8 km) line to New Center stated that they would continue developing that project.[13]

On January 18, 2013, U.S. Department of Transportation Secretary Ray LaHood announced that M-1 Rail would receive $25 million in federal grant support for the streetcar project.[14] In April, the project received final environmental clearance from the federal government, with construction expected to start in the fall.[15] A tentative schedule projects service for paying customers to begin February 2016.[16]

M-1 construction broke ground in December 2013 with utility relocation on Woodward Avenue.[17]

The Kansas City Downtown Streetcar

is a planned streetcar system in downtown Kansas City, Missouri.[1]

Operating authority

The streetcar will be operated by the **Kansas City Streetcar Authority**, a not-for-profit corporation. The authority was incorporated in August 2012 after voters approved creation of the Kansas City Downtown Transportation Development District,[2] a special taxing district that will fund construction and operation of a two-mile streetcar route through downtown Kansas City. Final design for this starter line is underway, and construction is expected to begin in 2013. The streetcar is expected to begin carrying passengers in 2015.[3]

The streetcar authority's 13 directors, a mix of public officials, business people, and transit advocates, were appointed in late 2012 and met for the first time as an officially sanctioned body in early 2013.[4] The authority's oversight of the streetcar's operation and maintenance is modeled on that of the Portland Streetcar. The city council has the power to appoint the authority's directors and retains ultimate control over the system.

Planning and construction

After earlier efforts to create a metro- or city-wide rail transit system failed at the ballot box, voters in downtown Kansas City approved funding for a two-mile streetcar line in December 2012.[5] This line, which will run between the River Market and Union Station, is envisioned as the trunk of a wider system of streetcar routes in the city. The possibility of extending the line south to the Country Club Plaza and north of the Missouri River, as well as along several east-west routes, is already being studied.[6]

In December 2012, the city council awarded a contract to HDR, Inc. to complete a final design for the downtown streetcar line.[7] HDR had previously performed preliminary engineering work. In October 2013, the mayor announced that the system will use Urbos 3 streetcars made by the American subsidiary of Construcciones y Auxiliar de Ferrocarriles.[8] Construction is scheduled to begin in 2013 and to be completed by the end of 2014. The streetcar is expected to begin carrying passengers in 2015.[9]

Funds for constructing and operating the downtown streetcar will come from a special assessment and one-cent sales tax collected inside a transportation development district approved by voters in 2012. Both levies will be assessed only within the taxing district, which encompasses downtown neighborhoods along the streetcar route. Additional funding includes a $4.5 million utility contribution and two federal grants totaling $17.1 million.[10] The project received another $20 million federal grant, through the TIGER program, in August 2013.[11] Passengers will ride free of charge.[12]

Route and stops

The downtown streetcar will run between the River Market and Union Station, through the central business district and the Crossroads, mostly along Main Street. It will make stops about every two blocks.[12] Along the way it will connect directly with Amtrak, Megabus, local and commuter bus services (including a direct route to Kansas City International Airport, and several B-cycle bike share kiosks. Proponents tout this initial linear segment as one of the simplest and straightest modern streetcar routes in the United States.

Why a streetcar? What is a streetcar?

A modern streetcar functions as an urban circulator with more frequent stops and simpler stop design than light rail, which typically serves more regional destinations. Streetcars are smaller vehicles in size and typically operate with mixed traffic. Modern streetcar systems are simpler to construct compared to light rail, requiring less infrastructure and time. Construction of streetcar lines is usually confined to the track way and stop locations, and has a limited impact on surrounding sidewalks or streetscape character. A modern streetcar is different from historic trolleys: modern streetcar systems employ state of the art vehicles and amenities for a quiet, clean and efficient ride. In Kansas City, level boarding will be utilized so you can walk straight from the station platform onto the vehicle without stepping up or down like you would do now with a bus.

A wide range of studies and experience in other cities demonstrate that fixed rail investments like a streetcar spur new investment and development along the route in a way that bus transit can and does not. Fixed rail transit also attracts a broader pool of potential riders than buses. You can view some case studies **here**. At the same time, modern streetcars are much less expensive than light rail, and create far fewer impacts from construction and operation.

Is it worth it?

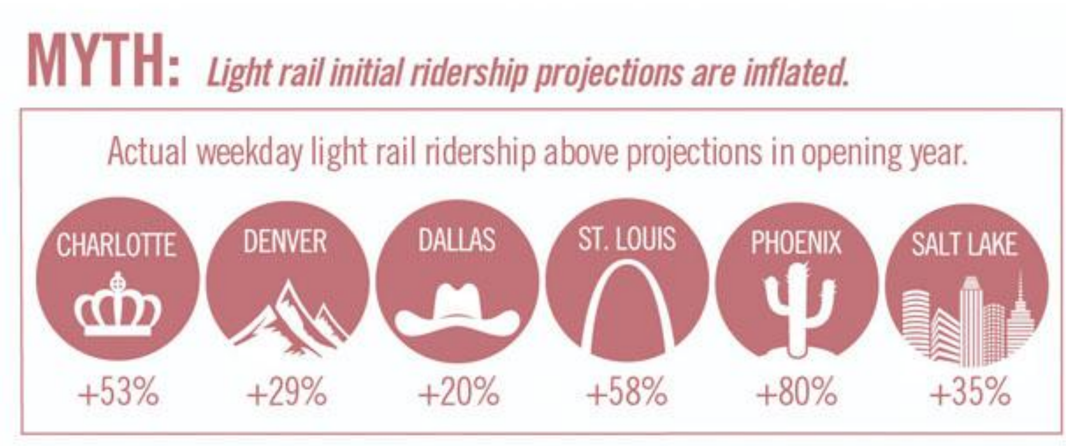
Streetcars do more than simply improve mobility. Streetcars are about fueling economic growth. By promoting development, raising property values, attracting businesses and residents, and helping to redefine our city, streetcars benefit everyone. Streetcars function as an urban amenity that increases vitality, commerce and activity along the corridor route(s). Support for the streetcar is an investment with demonstrated returns for residents, businesses, property owners, neighborhoods and the entire region. Benefits of a streetcar include:

1. *Attracting new residents and businesses.* There is a growing body of research that indicates there is a large portion of the population that wants to live and work in walkable, urban areas. In recent years, a huge investment has been made in the revitalization of Downtown Kansas City, with ongoing efforts to increase the downtown residential population, and attract creative, high-tech and other knowledge-based businesses that are positioned to sustain and enhance Kansas City's economic vitality in the 21st century. The city's success in economic development is dependent on its ability to attract and retain highly educated professional employees and entrepreneurs. Because knowledge-based companies and employees have flexibility in choosing where to locate, creating an urban core that provides a high quality of life with major urban amenities such as the streetcar is critical to the long-term success of Kansas City.
2. *Improving quality of life.* Streetcar transit allows people to live, work and visit in an urban environment and make many of their daily trips conveniently without the use of an automobile, which will have a positive impact on air quality while simultaneously increasing property values along its route. In addition to improving mobility, streetcars help to strengthen existing neighborhoods, enhance the unique character of an area, encourage high-density mixed-use development along the route, and increase visibility and access to corridor businesses.
3. *Spurring new investment.* The track record from streetcar projects around the country is clear: streetcars are a major catalyst for new development and investment along the corridor route as they create certainty in the market place by exhibiting significant public support for private investment.

4. *Adding value to properties.* In city after city, rail transit is proven to add value for all types of property in the form of higher property values, lower vacancies, faster leasing, and premium rents. For example, Dallas' streetcar has been attributed to $4.3 billion of real estate development. In Portland, Oregon, the streetcar system has attracted over $3.5 billion in investment within a three block area, including, 10,000 housing units and 5.4 million square feet of commercial space. Additionally, in Seattle's South Lake Union neighborhood, the streetcar line has generated over $2.4 billion in investment within three blocks of the streetcar line, including 2,500 housing units and 12,500 jobs.

Do streetcar/light rail projects really meet their potential ridership projections?

The public is flooded with misinformation about transit across the country. In Charlotte, North Carolina, civic leaders and light rail proponents developed a campaign to educate the public and raise the public discourse. You can vie there efforts **here**. The pictures speak for themselves.



TRUTH: Actual results from light rail lines opened in the past 10-15 years show that ridership exceeds projections.

TRUTH: In regions with both rail and bus options, there are fewer vehicle miles traveled per capita than in bus only or limited transit cities.

NEXTRAIL KC PROJECT FAQ

What is the Streetcar Expansion Plan?

The City of Kansas City, Missouri has contracted with BNIM and its sub-consultant team ("**Project Team**") to conduct a 10-month study of an expansion to the Downtown Streetcar starter line. The City of Kansas City, Missouri in collaboration with the Mid-America Regional Council (MARC), the Kansas City Area Transportation Authority (KCATA), Jackson County and the Kansas City Streetcar Authority (KCSA) are developing the expansion plan. The project will prioritize future rail-transit capital expenditures and identify federal funding opportunities for implementation.

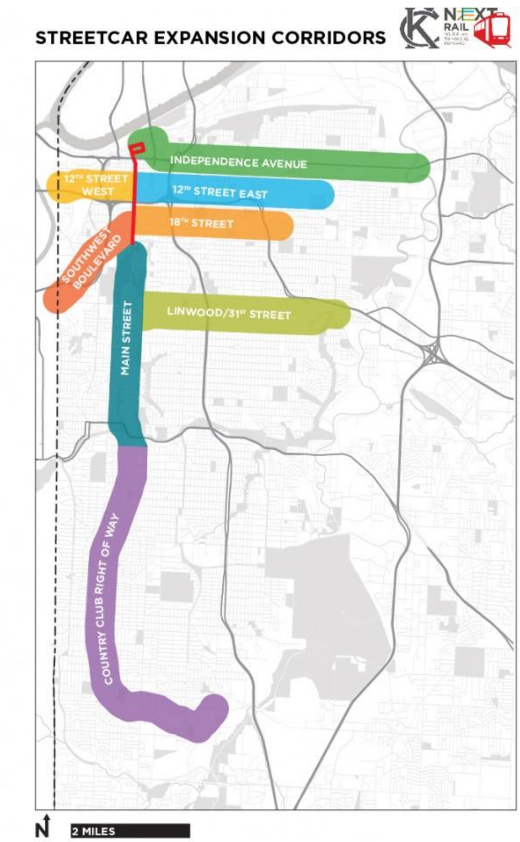
The streetcar expansion plan will evaluate the potential impact and cost of new streetcar alignments, recognize and plan for long-term system integration (i.e. bus), and most importantly craft a path to implementation. The overarching goals of the project are to increase population and economic density in the urban core, support existing residential and commercial activity, develop under-utilized or vacant properties, connect existing activity centers, and provide efficient, reliable and effective transit service.

Is NextRail KC related to the Downtown Streetcar Starter Line?

Yes. The Downtown Streetcar starter line was built to "start" the development of a streetcar system. NextRail KC is developing a plan to expand the starter line and prioritize the corridors for future implementation. The expansion of the streetcar line is a long process from proposal to construction. This study will prepare the City and its future efforts to build upon the starter line's success one corridor at a time.

With that said, NextRail KC is also not the end of future streetcar studies nor are these eight corridors the only areas that will someday have a streetcar. This is only the start. For example, the Northland Streetcar Study, a MARC sponsored streetcar study to expand the starter line into North Kansas City is also being developed simultaneously.

What are the corridors to be studied?



The eight corridors identified by this study for potential streetcar expansion routes are listed below. These corridors are not in competition with one another as the plan is intended to lay the groundwork for a city-wide streetcar system and prioritize routes for implementation based on community support, cost, engineering constraints and impact on the adjacent community (among other measures):

1. Independence Ave: Main Street to appropriate eastern terminus / loop;
2. 12th Street West: Main Street to appropriate western terminus;
3. 12th Street East: Main Street to appropriate eastern terminus / loop;
4. 18th Street: Main Street to appropriate eastern terminus / loop;
5. Southwest Boulevard: Main Street to State Line;
6. Main Street: Pershing Road to UMKC;
7. 31st / Linwood: Main Street to appropriate eastern terminus; and,
8. Country Club Right-of-Way: UMKC to the Dodson Industrial Area.

Are these the only corridors to be studied?

These corridors were selected by the City of Kansas City, Missouri and no route has yet been selected. The specifics of these corridors will be determined based on an engineering study constrained by various environmental and physical conditions, potential impact on neighborhoods adjacent to the route, the cost of building the proposed line, and most importantly public input. No termini has been decided for any of the routes, except for the Missouri State Line for the 12th Street West and Southwest Boulevard corridors. All alternatives and routes are on the table during the initial screening phase of the project.

What is the process? What are the milestones?

The eight corridors listed above are currently undergoing an extensive public outreach and engagement process. These corridors are simultaneously being analyzed for their engineering constraints (underpasses, bridges, grade changes, intersections, turning radius, etc…), potential economic impacts on the community, financial cost, impact on the community and public input. For more information about the project phases, please click **here**.

The eight corridors will undergo a screening process that will narrow the selection from eight to up to four corridors for an additional detailed study by November 2013. Another round of stakeholder outreach and meetings will work through this more detailed analysis for these four corridors. The Project Team will provide its final recommendation to the Kansas City, Missouri City Council by March 2014. Additional information on the project timeline can be found **here**.

The streetcar expansion plan will review related plans and projects throughout the region to ensure compatibility, coordination and collaboration with all the relevant municipalities and transit service providers.

How will I be engaged?

The streetcar expansion project has developed a wide range of community engagement and outreach tools and approaches to maximize public participation. An interactive model will be used throughout the process to encourage participation and engage stakeholders in the design and transformation of their neighborhoods. A project website will be the single source for all project information and announcements, including an interactive MindMixer-based online survey and public discussion forum. The project team will employ an innovative text messaging survey to bridge the digital divide and access the widespread use of cell phones in each corridor. Finally, a series of public outreach meetings, focus groups, one-on-one discussions and attendance of community events will ensure unprecedented personal contact with corridor stakeholders.

When will I be engaged?

There are many ways to engage in the process. In addition to attending various community meetings, forums and other events, the NextRail KC Project Team will host three major outreach events, including the initial Kick-Off Event on Thursday, August 8, 2013 in Union Station's East Hall, and two corridor workshops (one each for the eight corridors, and then one each for the narrowed down four corridors selected for detailed analysis). In between all of these milestones, intensive outreach efforts will keep the public up to date and engaged in the process. Additionally, the project website is always available to provide input, including a custom MindMixer (online forum) discussion board and social media. Later in the process, a text messaging system will be set up as another resource to collect input and ideas from the public.

For more information about the project events click **here**.

What is up with your interactive model?

The interactive model used by NextRail KC to engage the public about the streetcar expansion project was designed and built by the **Project Team** in the two weeks prior to NextRail KC's **Kick-Off Event**. You may have seen the model in Union Station for the month after the Kick-Off Event, or on **18th and Vine** in recent weeks. The Project Team will reuse the model throughout the project so stay tuned about its location on **Facebook** and **Twitter**. This scaled model of the Downtown Streetcar starter line and the 8 corridors begin studied is successful as it gathers your input in a dynamic, engaging and fun way while breaking down age, ethnicity, language, sex and other socioeconomic barriers by asking each individual to think about the design of their community.

Who will make all the decisions?

This is a community and data driven planning process. Community input collected throughout the engagement process will shape the route screening and final recommendation. The Kansas City, Missouri City Council makes all final decisions.

STREETCAR OPERATIONS FAQ

Will the streetcar be integrated with bus service?

Yes. The Detailed Alignment Analysis will include a transit integration plan, coordinated with KCATA, that will recommend how the planned streetcar lines and existing bus and MAX services can best work together. This will include looking at how existing and future bus routes and transit infrastructure can be integrated to maximize benefits to the entire community and to the users of a coordinated bus, MAX, and streetcar system.

What will happen to the Main Street MAX?

New streetcar service on Main Street will likely result in a need to revise portions of MAX service on Main Street to avoid redundancy and to maximize transit benefits. The streetcar team, working with the KCATA, will develop the transit service integration plan that will recommend how Main Street MAX might be revised to create the most effective overall system. This will take into consideration the streetcar alignment, streetcar stops, and the yet to be defined southern terminus of the Main Street Plus extension. There may also be an opportunity to redeploy existing Main Street MAX assets to other corridors.

How will this function with the proposed Prospect MAX?

NextRail KC has been working with the KCATA in order to maximize the coordination of efforts into a more comprehensive and integrated public transportation system. The proposed Prospect MAX line is a good example of this coordination as it will function as a companion line and feeder system into the proposed streetcar corridor on 31st Street/Linwood Boulevard.

How noisy is a streetcar compared to a bus or car?

You can view the video at the top of this FAQ to hear the difference between a streetcar and diesel bus in Seattle, Washington. Modern streetcars run with electric motors, which are much less noisy than internal combustion engines (the decibel level for a modern streetcar is 82 dBa compared to a hybrid bus like the MAX which is 83 dBa). Additionally, streetcars operate on a seamless track that significantly reduces the noise attributed to trains on a track. The City of Kansas City, Missouri purchased four CAF Urbos trams for the Downtown starter line.

The ambient noise of a streetcar running 20 miles per hour from 50 feet away (measured by the EPA in Equivalent Continuous Sound Level, “Leq”), is less than 2-lane suburban arterial street. That same train at 40 miles per hour is less than a 4-lane urban arterial like Brookside Boulevard and Wornall Road. See the chart below from the Federal Transit Administration’s Transit Noise and Vibration Impact Assessment, May 2006.

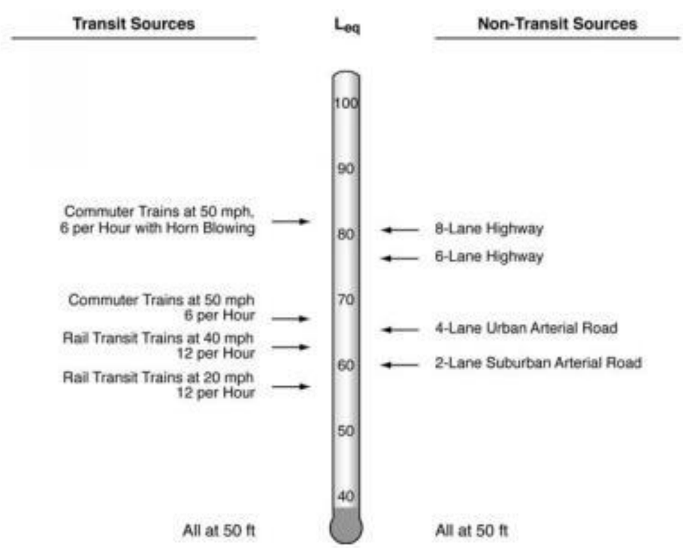


Figure 2-16. Typical Hourly L_{eq}’s

How will a streetcar interact with existing bicycle facilities and trails?

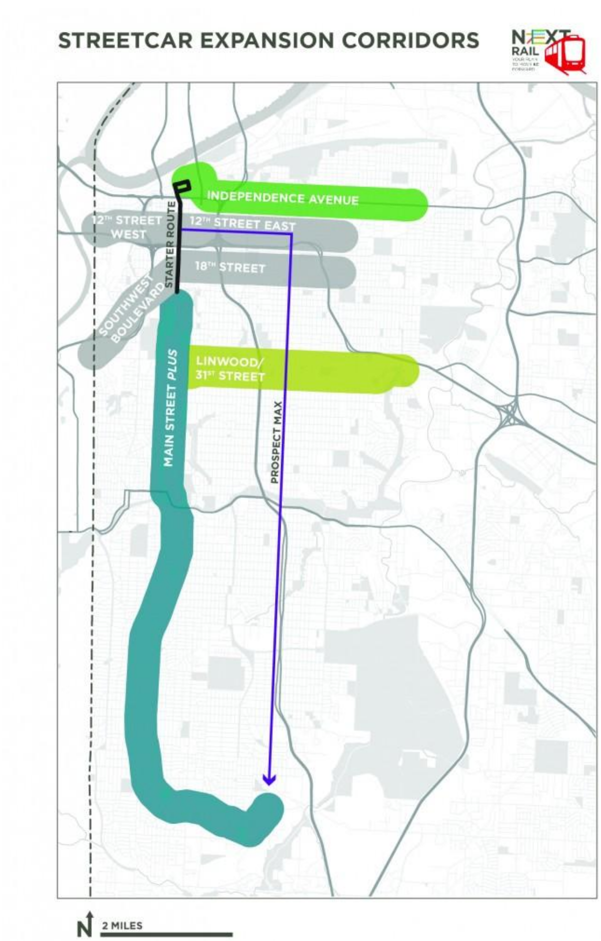
Integrating streetcars with bicycle and pedestrian facilities is critical to maximizing the streetcars potential of becoming a true pedestrian accelerator. Coupling these facilities together can expand the ridership shed of those willing to walk and bike to a future streetcar stop and improve the

City’s overall walkability. For more information about how bicycles and streetcars will operate together, please visit the BikeWalk KC FAQ **here** and in the PDF below:

Cycling with Streetcars (PDF)

NEXTRAIL KC DETAILED ANALYSIS FAQ

What lines will be chosen for the detailed alignment analysis?



- Following the recommendations of the Advisory Committee, Steering Committee and Technical Committee, a resolution was introduced to the City Council and referred to a Joint Committee of Planning, Zoning, and Economic Development and Transportation and Infrastructure committees. Resolution 130884 was approved by City Council on

November 21, 2013. The resolution advances the detailed study of the following corridors:The resolution advanced the detailed study of the following corridors:

  - Independence Avenue east from River Market
  - 31st Street/Linwood Boulevard east from Main Street
  - Main Street *Plus*, from the south end of the starter line at Pershing Road to some terminus beyond 51st Street on the Country Club Right of Way.

- The resolution also also proposes a joint corridor plan for Southwest Boulevard and 18th Street that would study enhanced transit service, land use and other improvements.
- The detailed alignment analysis began on November 21, 2013 when the City Council passed Resolution **130884**.
- NextRail KC's Initial Analysis, the information that led to the above recommendations can be found **here**.

What will be studied in the detailed alignment analysis?

- The project team will define potential stop locations in order to develop detailed ridership projections for future streetcar expansion routes. With community input, the project team will also define the termini of each of the three proposed streetcar lines.
- Once station locations and termini are defined, a more detailed analysis of the impacts of a streetcar, as well as a more detailed assessment of engineering constraints, will be conducted. Preliminary engineering concepts will be developed showing conceptual track alignments and stop locations.
- The detailed analysis will include a more refined study of streetcar operations, as well as its impact on vehicular traffic capacity and operations, and its integration with other transit and bicycle/pedestrian infrastructure.
- As cost estimates are refined with more detail regarding the design and operation of the streetcar system, the project team will develop a financing strategy. The financing strategy will examine a combination of local, state, and federal sources, as well as the opportunity for private partnerships and other funding sources.

Is the Country Club Right of Way (former streetcar line) going to be included in the detailed alignment analysis?

For the purposes of comparing eight unique corridors, assumptions were made regarding the alignments and termini of each streetcar corridor. During the detailed phase of this study and beyond, these assumptions will be refined as more analysis is completed for each corridor. Although 51st Street (UMKC) was chosen as the initial terminus for Main Street for the purposes of comparison to other corridors, Main Street may perform better according to the criteria established in the initial screening phase, including federal funding criteria, if a terminus to the south of 51st Street (e.d. 63rd or 75th) is chosen. The costs and benefits of various stops, alignments, and termini will be evaluated for all corridors selected for detailed analysis.

Will the trail remain on the Country Club Right-of-Way?

Yes. If a streetcar operates within the Country Club Right-of-Way, the Trolley Track Trail will remain. The precise location of the trail within the right-of-way, however, may be modified to create a system that is safe and convenient for both trail and transit users. When the City Council directed NextRail KC to move forward with three corridors in the detailed analysis, their Resolution (**Resolution 130884**) included language to preserve and potentially enhance the Harry Wiggins Trolley Track Trail.

NEXTRAIL KC FINANCING PLAN FAQ

Proposed Expansion Transportation Development District FAQ (PDF)

How will this be implemented?

The streetcar expansion plan is not intended to become a document that sits on a shelf. The City is determined to move through this planning process in a manner that will best prepare an implementation package, including route selection, detailed engineering, economic impact study and financing plan.

Can we afford to build three of these streetcar lines?

The consultant team is in the early stages of developing a financing plan for an expanded streetcar system. A Transportation Development District (TDD) is one local funding alternative that has been considered to determine if the streetcar expansion is financially feasible. Assuming a 50% non-local component, which could include funding through the federal New Starts/Small Starts program, state funds, and other sources, preliminary funding estimates show that a TDD with a one-cent sales tax and special assessments, at rates no higher than the special assessments employed for the starter line TDD, can adequately fund the debt service and operations of a streetcar on some length of all of these corridors. A TDD, if found to be the most feasible local funding option, would require a public vote.

What areas within a TDD would pay a special assessment on real estate?

Properties within a reasonable distance from an expansion line (in addition to the Downtown properties currently being assessed in connection with the starter line) would be subject to a special assessment.

If a TDD were chosen to fund a portion of the streetcar expansion, what would be the impact on the existing TDD?

Preliminary funding models for the streetcar expansion assume that the existing TDD for the Downtown starter route would be dissolved and that a new TDD would be established for a larger area that incorporates the area of the starter route TDD.

Will the federal government fund a streetcar route without a local funding commitment?

No. Local governments must first demonstrate their commitment and capacity to fund a portion of both the capital costs and operating costs of any system receiving federal money under the New Starts/Small Starts program and/or other comparable federal programs.

How long will construction take?

The only comparison for construction of future streetcar lines in Kansas City is the Downtown Streetcar starter line. Construction is set to begin in the Fall of 2013 as crews finish all the necessary utility work. The Downtown Kansas City starter line will be constructed in three block segments in three weeks time. This model was used in Portland, Oregon where a 24-hour emergency room remained open during construction. The Kansas City Streetcar Authority will simultaneously launch an advertisement and media campaign for local businesses to let the public know that businesses will remain open during construction.

Based on the process that occurred for the Downtown Streetcar starter line, it took approximately 5 years from the announcement of the planning process to operation (2010 to an anticipated start in Spring 2015).

MEMPHIS

In Memphis, Saturday is the highest ridership day, contrary to common transit experience.

MATA Began Operation: **1993**
Route Miles: **7**

Stops: **Main St 12**
Organization: **Transit Agency**
Schedule: **Daily**

The Memphis trolley system is operated by the local transit agency and currently transports more than 800,000 passengers a year over three lines radiating from the downtown area. Conceived as part of a plan to resuscitate a failing pedestrian mall in a fading downtown, the trolley has grown into an effective transit circulator system. The 2.5 mile Main St. Line line opened in 1993 and travels the length of Main St., linking the South Main and Pinch historic districts with numerous downtown attractions. The 2 mile Riverfront Trolley Loop connects together the two ends of the Main St. Line, primarily using a railroad right-of-way shared with Amtrak. The 2.5 mile Madison Line opened in 2004 and was intended as the starter line for a future light rail system. Service is offered 7 days a week, and the base fare is One Dollar, with a lunchtime fare of 50 cents. An all-day pass is available for $3.50, or a 3-day pass for $8.00.

Main St. Trolley: This double track line has .8 miles of track on an exclusive trolley/ pedestrian mall, with the remainder sharing the street with traffic. Boarding is at street level, via rather elaborate stations which project out from the sidewalk. Initial cost was $34.9 Million, $3 million of which was vehicle costs. Funding was 77.2% Federal, 7.1% State, 7.1% City and 8.6% private. In 1998, MATA completed its $5.4 Million North End Terminal project, providing parking and transfer facilities between bus and trolley lines.

Riverfront Trolley Loop: In 1997, another 2 miles of parallel line (with 6 stations) wasopened, primarily on a double-track railroad right-of-way running along the edge of downtown close to the Mississippi River. One of the tracks is dedicated to MATA use, and the other to Amtrak. Riverfront cars operate in a one-way loop, using the Main St. Line as one leg of the circle. Project cost was $9.4 Million.

The infrastructure for both the Main St. and Riverfront lines is quite impressive. The .8 mile Main St. trolley/pedestrian mall features a track area covered with paving blocks and sidewalks paved with bricks in attractive herringbone patterns. A line of reproduction light poles runs down the middle of the street, also equipped with bracket arms to support the trolley wire. The tops of many of the poles are also equipped with lighting units that provide for night-time illumination of adjacent building facades. The steel and concrete waiting shelters are all built to a common theme, and present an attractive appearance. Benches, planters, information kiosks, and other pedestrian-friendly features line the length of the mall, and there is also a booming horse and buggy business. The "Main Street Trolley" logo appears on all of the stations on the mall as well as on the street signs themselves.

Equally impressive is all of the development going on around the trolley lines. On Main St., a great deal of commercial development is apparent along the tracks. Although there are still many vacant storefronts, there are also plenty of rehabilitated historic buildings as well as significant new construction. Along the Riverfront line there are great number of new homes in evidence as well as a flurry of loft conversions underway in some truly incredible historic industrial buildings. The Memphis Center City Commission values the current building boom at over $2 billion dollars.

Madison Avenue Line: In March 2004, MATA opened a 2.5 mile extension on Madison Avenue, connecting the existing downtown system with the Medical Center complex, thus linking the city's two largest employment centers by rail. The line operates in mixed traffic along Madison Avenue generally on tracks located in the inside travel lanes. The extension included two major bridge projects. The first was comprised of two new rail-only bridges at Danny Thomas Blvd. (one on each side of the existing street bridge) and the second was a reconstruction of the existing bridge at I-240, with tracks placed on the bridge. The line adds six new stations and a small park-and-ride facility at the eastern terminus. Five of the six stations are located in the center of the street, and all feature platform based lifts to accommodate wheelchairs.

The Gomaco Trolley Company won a contract to refurbish three additional vintage trolleys for use on the line, and to supply one new replica trolley. An upgrade to light rail vehicles is planned when the new LRT system comes on line. The project is proposed as the last segment of the downtown rail circulation system as well as the first segment of a regional light rail line.

Total cost of the Madison Avenue Line was $60 million with eighty percent (80%) of the funding provided by the Federal Transit Administration (FTA) and the remaining 20% split between the City of Memphis (10%) and the Tennessee Department of Transportation (10%).

Equipment: Service is provided with 18 rehabilitated cars imported primarily from Portugal and Australia, as well as two replica cars. There are six single-truck cars from Oporto, Portugal, ten double-truck cars from Melbourne Australia, a single- truck Gomaco replica car, a double-truck Gomaco replica car, and a double-truck car rebuilt by MATA from a former Rio de Janeiro open car. Each of the cars is painted in a unique paint scheme.

ADA Accommodations: The entire system is ADA accessible. The ex-Melbourne cars, with their wide center section doorways, lend themselves very well to ADA access, which is accomplished via high-level island platforms on the Riverfront Loop, and wayside lifts on Main St. and Madison Avenue. In order to accommodate wheelchairs inside the relatively narrow ex-Oporto cars, a substantial rebuild was required. The cars had their platforms modified to achieve a level floor inside the car. All cars are equipped with a steel plate to bridge the gap between the floor and the wayside lift or platform.

The Main Street Line, the first and most iconic rail line in Memphis, began operating in April 1993. In the next four years, MATA introduced the Riverfront Line that runs along the Mississippi River and on Main Street. The latest addition to the trolley rail system was the Madison Avenue Line, which began operating in March 2004.

MATA's trolley rail system was recently named among the top tourist attractions in Memphis and celebrates its 20th anniversary this year.

VINTAGE TROLLEY CARS A total of 19 vintage trolleys are in service, covering over 259,000 revenue miles annually on 10 route miles of track. Each vintage trolley is over 40 years old and has been restored to its original elegance - down to the solid brass seats and window accents, rare "glue-chip" glass transom windows, hand-carved mahogany corbels, and antique lighting fixtures

The Toronto Transit Commission estimates that 60 percent of streetcar riders are "choice" riders - those who have a car, but choose to take the streetcar instead.

Since Tacoma began revitalizing its downtown and planning around the light rail/streetcar stops, more than 2,000 new housing units have been permitted.

Tacoma

1. **Tacoma Link** Began operation: **2003**
1. Route Miles: **1.6**
2. Stops: **6**
3. Org: **transit agency**

4. Schedule: **daily**

Tacoma is located about 35 miles south of Seattle, both cities being served by the Sound Transit regional transit system. Tacoma's modern streetcar system opened in 2003, connecting the Tacoma Dome station (a regional bus and commuter rail hub) with Downtown Tacoma. Downtown is also home to a new convention center, museums, and a University of Washington campus. This relatively short line does not charge a fare and provides service on twelve minute headways throughout most of the day, with 24 minute headways off-peak and on Sundays. Two cars operate on the line at one time, with the trip from the Tacoma Dome station to the Theater District terminus originally taking only 7 minutes, lengthened to just under 10 minutes in 2011 when a sixth station stop was added. The fast, convenient service is currently (2Q 2011) attracting about 996,000 riders annually (*source: Sound Transit*).

The current is line is about half single-track and half double-track. Through downtown, the line is double track, with single track on the southern end towards the Tacoma Dome station. Most of the line is in either a center median or a reserved line, a condition which is reflected in its relatively fast running time. The single-track southern end of the line provides a good example of how bi-directional operation can be implemented on streets with relatively low traffic volumes. Some interesting active warning signs (as seen in the photos below) have been implemented along this section of the line.

In addition to the Link service, a grass-roots streetcar movement has emerged in Tacoma, generating interest in a city-wide streetcar network including a Vintage Trolley operation. Check the [Streetcar Stakeholders Group page]() on the City's website for more details on potential system expansions.

Los Angeles Streetcar

About The Downtown L.A. Streetcar

WHAT IS A STREETCAR?

This is NOT a trolley, tram, bus or people mover.

The Downtown L.A. Streetcar is planned as a modern, fixed-rail streetcar system that will offer an easy to navigate and convenient mode of transportation connecting many of Downtown's bustling locales.

Modern Streetcars are designed to integrate with the existing urban environment, can be constructed quickly, and flow with traffic in a shared right-of-way. It will operate 7 days a week for approximately 18-hours a day and accessible to wheelchairs, parents with strollers, and cyclists with bikes. At four miles in length the Streetcarwill pass through many of Downtown's neighborhoods including South Park, the Financial District, Fashion District, Historic Core and Broadway.

WHAT WILL STREETCAR ACCOMPLISH?

It has been proven in communities around the world that pedestrian circulation drives urban development.

The Streetcar will spur employment, increases in property value, and general economic growth by stimulating movement to Downtown's historic resources and entertainment facilities. Downtown has come a long way in the last 10 years and Streetcar is integral to promoting the revitalization and reactivation of this city.

- **The streetcar will primarily run on Broadway, 11th, Figueroa, 7th & Hill Streets.**

- he streetcar will provide access to the Civic Center, Broadway and the Historic Core, the Fashion District, South Park, L.A. Live and the Convention Center, the financial District, and restaurant row through the Jewelry District.
- The streetcar will run 7-days a week, approximately 18-hours a day.
- The streetcar is carbon emissions free and fully accessible for people with disabilities, parents with strollers, or cyclists with their bikes

The Results Are In!

Plans to bring a streetcar system back to Downtown Los Angeles took a giant leap forward when voters approved $62.5 million in local funding for construction of the project in the highly anticipated December vote. The CFD (special tax) was passed with an astounding 73% "YES," far surpassing both expectations and the required ⅔ supermajority.

In addition, the Streetcar achieved an impressive 19.4% voter turnout that far trumps the 10% turnout of other recent local elections.

The CFD

Last summer, the Los Angeles City Council voted to form a Community Facilities District (CFD) for the project that would levy a special tax on Downtown properties within a three block radius of the proposed Streetcar route to cover approximately half of the Streetcar's capital construction costs.

Learn more about the recently passed CFD.

The Campaign

In August of 2012, LASI launched a marketing campaign focused around Streetcar education and voter registration. It worked. Voter registration skyrocketed within the boundaries of the proposed Streetcar CFD as the number of registered voters increased by a significant 37.2%.

Social Benefits of Streetcar

STREETCAR WILL CONNECT NEIGHBORHOODS

Problem: Hard to reach neighborhoods

In the last decade, Downtown L.A. has experienced tremendous revitalization – from a quadrupled residential population and urban neighborhood growth, to major office and commercial developments, and the incredible success of entertainment and cultural destinations. However, connecting all of these great resources and destinations so that residents, workers and visitors can easily access them remains a challenge.

Solution: Streetcar as a Connector

In the last decade, Downtown L.A. has experienced tremendous revitalization – from a quadrupled residential population and urban neighborhood growth, to major office and commercial developments, and the incredible success of entertainment and cultural destinations. However, connecting all of these great resources and destinations so that residents, workers and visitors can easily access them remains a challenge.

The Streetcar route has been designed to link with regional transit to serve Downtown's many districts, including:

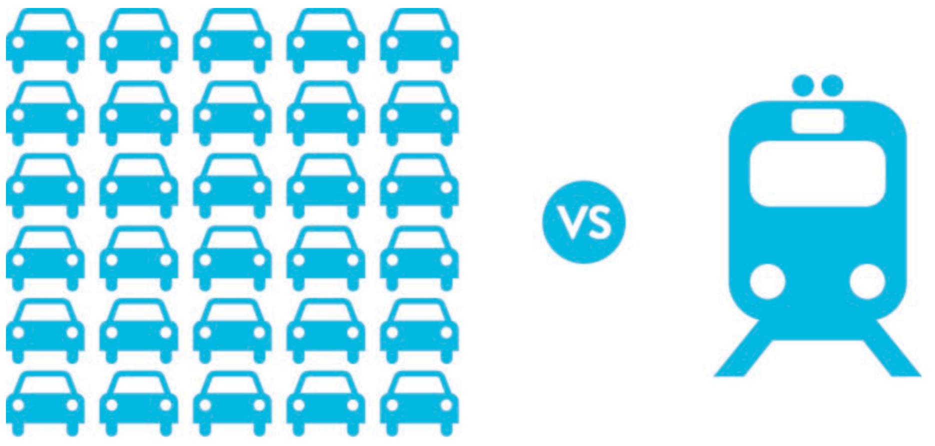
- **Civic Center**
- **Broadway and the Historic Core**
- **Fashion District**
- **South Park**
- **L.A. Live and the Convention Center**
- **Financial District**
- **Restaurant Row**
- **Jewelry District**

Having this level of connectivity will enable people to visit entertainment, cultural, and civic destinations while being able to park once, and then have fun in Downtown's ever growing arts, entertainment, and business districts.

STREETCAR WILL DECREASE CONGESTION

Problem: Parking Lot to Parking Lot Travel

With so many awesome things to do Downtown, it's no surprise that much of its traffic is caused by internal circulation – people driving around Downtown looking for a place to park (or repark) their car near the destinations they want to reach.

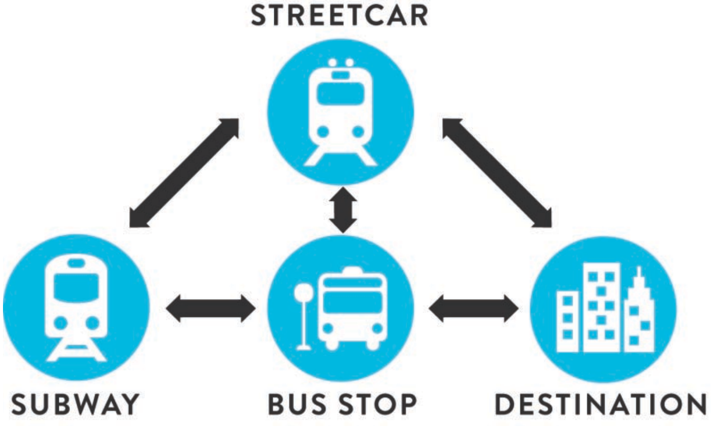


Solution: Streetcar as an Urban Circulator

Gridlock be-gone. The Streetcar, curb running and traveling at the same speed and in the same lane of traffic as other vehicles, will decrease the need for lot-to-lot travel and provide a pedestrian friendly alternative to driving. Without the hassle of parking, a streetcar encourages pedestrian travel and takes cars off busy Downtown streets thereby easing the dreaded pangs of gridlock.

Not to mention, walking from place to place also becomes a much more comfortable and preferable option when you know you can depend on the Streetcar to make up the majority of the distance.

STREETCAR WILL DELIVER SEAMLESS PUBLIC TRANSIT



Problem: Current Transit is Disconnected

Despite the availability of the commuter train, subway, light rail, and bus service, our current system's ability to connect the dots between regional transit and Downtown destinations leaves a lot to be desired.

Solution: Streetcar as Front Door Delivery

The Streetcar will provide the first and last mile solution needed to integrate Downtown's current and future rail, bus, and parking facilities together into an innovative, efficient, and modern circulation system. With this level of connectivity, residents and visitors will be able to seamlessly flow from one venue to the next on a nearly customizable schedule thanks to real-time screens at the stops and an easy to operate smartphone app. The Streetcar helps to increase the area people can cover while traveling on foot or bike. Stop waiting, stop driving. Enjoy front door delivery.

The Streetcar will directly connect to:

- **Red / Purple Line**
- **Gold Line**
- **Regional Connector**
- **Expo Line**
- **Blue Line**
- **Numerous local and regional bus lines**

STREETCAR WILL BUILD DOWNTOWN'S SENSE OF COMMUNITY

Problem: Downtown can feel stressful, hectic, and hurried

As much as we may love living, working and enjoying our vibrant, active city, sometimes urban chaos can get in the way of community development and camaraderie.

Solution: Streetcar as a quiet, affordable, and convenient community builder

By increasing walkability and street activity the Streetcar will ease common concerns associated with Downtown living. Without stressing over expired meters and parking tickets, the Streetcar encourages leisurely strolls, friendly chit chat, and some potentially fantastic elbow rubbing, too. By extending the distance a person can comfortably walk, streetcars amplify the benefits of pedestrian-scale communities and promote healthy urban living by encouraging active lifestyles, creating connections between community members and neighborhood services, and promoting safety. With the Streetcar, take your time and get to know your city... there's no rush.

And Another Note

- Did we mention that the Streetcar is virtually silent (think Prius-on-rails)?
- The noise pollution on heavily traveled bus corridors is often unbearable to residents, businesses, and visitors. In Downtown L.A., this audible barrier stifles not only economic investment, but prevents a mixed and varied collection of uses in public areas and along sidewalks. The electric motors streetcars employ are virtually silent, and will encourage more active uses and outdoor activities.

STREETCAR WILL PUT EYES ON THE STREET

Problem: Some streets don't always feel safe

Downtown Los Angeles has a number of remarkable streets and pedestrian spaces, but some areas lack activity and can feel unsafe -especially at night.

Solution: Streetcar as neighborhood watch

Not only will the streetcar put eyes on the street by running 18 hours a day, but it will play a pivotal role in rehabilitating these streets to make Downtown feel safer, more vibrant, and more active – day and night.

Tampa

TECO Line Streetcar System

Began Operation: **October, 2002**

Route Miles: **2.7**

Stops: **11**

Org: **transit agency + non-profit**

Schedule: **daily**

Tampa's 2.7 mile TECO Line Streetcar System links downtown with numerous tourist attractions and remote parking areas. The line serves the so-called 'visitors crescent' that encompasses the Convention Center, Ice Palace, Garrison Seaport, Florida Aquarium and the historic Ybor City district. The single-track line uses primarily segregated rights-of-way in city streets, with several passing sidings installed to permit operation of up to eight cars at one time. The line operates with "hard meets", and the location of the meets depends upon the number of streetcars operating at any one time. The line carried 420,000 passengers in its first year of operation, about 20% over projections. Ridership has remained over the 400,000 mark each year since. The one-way cash fare is $2.50, with various discounts available, and a $5.00 all-day pass. In December 2010, a 0.3 mile extension opened, allowing the line to penetrate further into Downtown Tampa.

According to the Tampa Downtown Partnership, more than $800 million in new, privately funded construction projects are recently completed, under construction, or have been approved within two blocks of the streetcar line since its inception. Many of these projects feature the streetcar system in their marketing and advertising. Half the funding for construction of the $31.5 million dollar system came from a federal TEA-21 grant, with the city and the Florida DOT also making substantial contributions. To provide for ongoing funding, a unique partnership was formed between Hillsborough Area Regional Transit (HART), the City of Tampa, and the local business community.

The system is managed by Tampa Historic Streetcar, Inc. (THS), a non-profit corporation created by an interlocal agreement between the City of Tampa and HART to manage day-to-day operations and maintenance. HART was then retained under contract with THS to perform these functions. To do so, HART created a Streetcar Division under its Operations Department. The THS board consists of seven City of Tampa appointees and six HART appointees, whose mission statement is to "offer a dynamic new component to Tampa's transportation system by providing attractive, reliable, comfortable, convenient and safe streetcar service to local residents and visitors alike".

Revenue is generated from three primary sources; a special assessment district comprising the area served by the streetcar; an endowment fund fueled by private sector contributions for naming rights of the system, and advertising and fares. The original streetcar business plan called for operation of the system without subsidy by HART or the City. Annual operating expenses are about $2.4 million. At the start of operations, the endowment fund had approximately $5 million earning a return and an additional $1.5 million in commitments. The naming rights for the system were sold to the Tampa Electric Company for $1 million, and the price tag for vehicle naming rights is $250,000. Naming rights for stations are offered at between $75,000 and $150,000.

 Interns/Interns/streetcar_phase_2a_800px.jpg	The line also has a pair of volunteer groups (which are also non-profits) serving in a "friends of the streetcar" support role. The Tampa & Ybor City Street Railway Society and the offshoot Tampa Streetcar Preservation and Restoration, Inc have restored original Tampa Birney car No. 163 and are working on a second car. Car 163 is available for charters on the system.

Equipment: Service is provided with nine new double-truck Birney replica cars built by the Gomaco Trolley company of Ida Grove, Iowa. The cars utilize rebuilt running gear and othercomponents from Gomaco's inventory of former Milan streetcar parts. The cars are constructed with welded steel bodies, although cosmetic rivets were added to provide a more appropriate appearance up close. The interiors feature such modern conveniences as air conditioning and automated stop announcements. Each car has two wheelchair spaces, and stations feature mini high-block platforms with folding ramps that are lowered into the open doorway of a car when required by mobilityimpaired passengers. In 2004, a restored Birney Car from the original Tampa trolley system joined the fleet, and in 2005 an open-air "Breezer" replica car was added

San Francisco

San Francisco Muni "F" Line Began Operation: **1995**

Route Miles: **5.8**

Stops: **numerous street stops**

Org: **transit agency + non-profit**

Schedule:**daily**

PCC In Historic Brooklyn Paint Scheme

Market Street, San Francisco

Operated as part of the city's municipal transit system, San Francisco Municipal Railway, the "F" line provides a direct rail link between Downtown and the Fisherman's Wharf area. The line operates from Market and Castro, down the surface tracks on Market St., and along the northern waterfront to Fisherman's Wharf at Jones and Beach Streets (near the terminus of the Powell-Hyde cable car line). The "F" line has the highest ridership of any U.S. streetcar line, with 25,000 daily riders by 2007 (well over 8 million riders a year). Muni is in the process of completing additional cars to increase capacity on the "F" Line and expand service with the creation of the new "E"-Embarcadero Line.

The "F" Line is public transportation with a definite historic flavor; base service is provided with 17 refurbished PCC cars and 10 'Peter Witt'-type cars imported from Milan, with a variety of other historic cars from around the world filling in where needed. Each of the PCC cars is painted in a different "vintage" color scheme, representing classic paint schemes from cities around the country. It should also be noted that while operating to and from the maintenance facility where they are kept, the "F" line streetcars also share tracks with modern streetcars. The new "E" Line service will also feature old and new cars sharing the same tracks.

Serving in a "friends of the streetcar" support role is the volunteer Market Street Railway, providing assistance with historic car acquisition, restoration, interpretation and serving an important general advocacy role. Through their cooperative arrangement with the Muni, the MSR has a small office and work area at Muni's Duboce Yard on Market Street, where volunteers take on a variety of projects. In 2007, the MSR also opened the San Francisco Railway Museum in a storefront at the foot of Market St.

There's nothing quite like riding one of Muni's historic cars down Market St. Especially during rush hour when the street is packed with traffic and the sidewalks crowded with humanity. The buildings at the Embarcadero end of the line tower over the scene, creating a canyon below for the the artery that is Market Street. It's a once commonplace scene that was repeated daily in every big city in the United States- streetcars faithfully moving the masses through the crowded urban center. And with the public's overwhelming response to the new service, its a scene that will be repeated daily for many years to come!

"F" Line- Market Street

"F" Line streetcars operate along the length of Market Street, a total of three miles from the Castro Street terminal to the Embarcadero. Market Street is one of the country's most famous "streetcar thoroughfares", and was equipped with four tracks from the late 'Teens into the 1950's. Following completion of the BART heavy rail subway and the streetcar subway above the BART tracks, surface operation of streetcars on Market was scheduled to end altogether in 1982. However, the start of the San Francisco Historic Trolley Festival the following year changed that. The Trolley Festival had been created to provide an interim replacement for the cable car system that was then being rebuilt. The festivals were such a success, however, that they continued even after the cable car system returned to operation. Regular "F" Line historic streetcar service on Market began in 1995.

"F" Line- Embarcadero

The long-awaited extension of San Francisco's "F" historic streetcar line opened on March 4, 2000, combining the existing service on Market St. with an additional 2.8 miles of new trackage along the waterfront Embarcadero. Prior to the 1989 Loma Prieta earthquake, the Embarcadero had been covered with a freeway. Instead of rebuilding the heavily damaged freeway after the earthquake, the City instead re-visioned the area and created a grand waterfront boulevard, with accommodation for streetcar service in the median.

"E" Line- Embarcadero

The southern portion of the Embarcadero was rebuilt with a connection to the Muni Metro Subway, and currently hosts modern streetcars operating to the Caltrain commuter rail station, a new ballpark, and the new Third Street "T" Line. Plans call for extension of historic streetcar service to the ballpark / Caltrain terminus, pending funding and the availability of additional historic cars. Click here for more information on the "E" Line.

News & Updates

12/10 Update: The first of the rewired PCC cars returned to San Francisco from Brookville Equipment during November. The car's original GE PCC propulsion system has been completely replaced with a new Westinghouse-type PCC system supplied by Bombardier through their Woltan subsidiary in Poland. The new system remains basically true to the original Westinghouse PCC electrical design, although the original MG set / blower has been replaced with a modern low voltage power supply / inverter / blower package.

Washington, DC

DC Streetcar Began Operation: 2013

Route Miles: **2.75**

Stops: **10**

Organization: **public agency**

Note: There are currently three streetcar projects in development in the Metro DC area. This page covers the DC Streetcar being developed by DDOT. We are developing pages on the other two initiatives, for now check out these links to the Columbia Pike Streetcar and the Crystal City-Potomac Yard Streetcar proposals

The District Department of Transportation (DDOT) has initiated construction on two streetcar lines, H St/ Benning Rd and the Anacostia Initial Line Segment. DDOT is also conducting detailed planning for two extensions. DDOT has also completed the *DC Transit Future System Plan* – the District's first comprehensive streetcar system plan, envisioning an ultimate build-out of eight lines that blanket the city.

The DC Streetcar is the product of over a decade long series of studies and plans beginning in 1997 with the completion of the *Transportation Vision, Strategy and Action Plan* by the District Department of Public Works. The 1997 plan identified the continued need for better internal cross-town travel by transit. The plan also identified the key corridors that would benefit from increased transit investment. In 2001, the *DC Transit Development Study* further assessed the feasibility of the candidate corridors for high-capacity transit investment.

In 2003, DDOT initiated the *DC's Transit Future* (DCTF) *System Plan and Alternatives Analysis* (AA) which consisted of a comprehensive assessment and evaluation of alternative modes and levels of investment in 14 corridors across the District. The evaluation compared the performance of Bus Rapid Transit (BRT) and streetcar modes to no-build options in each of the system corridors. The evaluation considered more than 30 individual measures that addressed the following four primary goals established for the project:

Improve Access and Mobility

Encourage Community and Economic Development

Enhance System Performance

Promote Environmental Quality

A key goal of the multi-corridor, multi-modal system plan was to identify additional connections between the existing Metrobus and Metrorail lines and between key activity centers within the District. The process resulted in an integrated system of recommended transit service investments in the District, including combinations of streetcar, Bus Rapid Transit (BRT), and enhanced bus service in appropriate corridors. The *DCTF System Plan and Alternatives Analysis (AA)* was substantially completed in 2005 and updated in 2008 and 2010. Implementation of the recommended streetcar element of the plan was divided into three major phases. The District is currently constructing two Phase 1 streetcar projects: H Street / Benning Road and the Anacostia Initial Line Segment (see below).

Wireless Operation

Plans call for the DC streetcar system to introduce large-scale wireless streetcar operation to North American transit systems. The streetcar will utilize overhead wires on the first two lines The District has already purchased three conventionally-powered Skoda-Inekon streetcars, using an option from an earlier Portland Streetcar contract. Historically, a large portion of the District's original streetcar system (converted to buses by 1962) was operated with an underground conduit system, the streetcars switching to overhead wire when they reached the outer parts of the District.

	The H Street / Benning Road corridor hosts the region's busiest bus line and demand continues to grow as the District's population continues to ncrease. The H St / Benning Road streetcar project s a 2-mile streetcar line operating in shared traffic anes from from 1st Street NE and H Street NE to the intersection of Benning Road NE and Oklahoma Avenue NE. The line will connect Union Station to the H Street NE business district, as well as the Benning Road business and residential area. It will have seven stops.

Initial work on the line took place as part of the "Great Streets Initiative", a multidisciplinary approach to corridor improvements composed of public realm investments, strategic land use plans, public safety strategies, and economic development assistance. It is a partnership between multiple District government departments and offices with six target corridors for improvement. The Great Streets project along H Street / Benning Road is a complete reconstruction of the right of way from building face to building face. Given the need to reconstruct H Street and Benning Road, and the need to construct streetcar tracks, DDOT elected to pursue both projects simultaneously. These projects comprise the first phase of streetcar construction. The second phase of construction will complete an operable streetcar line in the corridor, providing high-capacity and high-quality transit service to District residents.

The District's investment in transit infrastructure is intended to catalyze economic development in the emerging commercial and residential corridor. DDOT anticipates the H St/ Benning Rd Line will provide critical transportation linking Union Station with the H Street and Benning Rd corridor providing a transit alternative to overcrowded Metrobus lines while simultaneously linking low-income residents with critical social services and access to jobs in downtown DC, the largest job center in the region.

The Benning Road component of the project began in December 2007 and is substantially complete. The H Street component began in September 2008 and is scheduled for completion in 2011. Work includes reconstruction of the travel lanes and parking areas with composite pavements, new brick gutter and granite curbs; streetcar track installation; sidewalk restoration; upgrading of pedestrian street lighting and signals; installation of bulbouts, crosswalks, and wheel chair ramps; landscaping upgrades; and a new pedestrian plaza.

Anacostia Initial Line Segment

In 2009 DDOT initiated the construction of the 0.75 mile Anacostia Initial Line Segment (AILS), with the goal of providing an opportunity for the public to see and experience streetcar vehicles in operation. The project connects the Navy Annex with the Barry Farms Residential Area to Anacostia Metro Station. The project also connects the streetcar to the first maintenance and storage facility for the system east of the Potomac River. Check out the Fullertography Blog for continuing coverage of the line construction.

The original planning for this line segment called for use of an existing rail right-of-way. However, acceptable terms could not be reached with the owning railroad and so the alignment was relocated into an in-street and side-of-road alignment. The planned Anacostia Extension will link the Initial Line Segment to the to the 11th St Bridge, which will allow future streetcar extensions to cross the Anacostia River to the developing Navy Yard/ Near Southeast activity center and Capitol Hill.

D.C. wants streetcars to roll by mid-2013

The Washington Post**By Ashley Halsey III, Published: August 22, 2011**

Streetcars should be bustling along H Street by the summer of 2013 as the corridor between Benning Road NE and Union Station rebounds from decades of decline and neglect, the District Department of Transportation said Monday.

With the last phases of paving, curb and sidewalk reconstruction nearing completion, the District is moving forward with contracts that will put newly installed streetcar rails to use.

Four companies have emerged in the bidding process to complete the remaining pieces necessary to begin trolley service, and DDOT is seeking a company to operate and maintain the system.

Eventually trolleys may run farther out Benning Road to the Benning Road Metro station, and it's possible they could run up to K Street and west out to Washington Circle.

With 2.2 miles of tracks in place on H Street, overhead power lines are needed as well as designs for the area where streetcars will reverse direction at either end of the line. A car barn and maintenance facility must be constructed along with three brick power substations to power the trolleys.

Platform trolley stops were built during the reconstruction of H Street and Benning Road.

A decision also must be made on how the cars are going to traverse the Amtrak rail lines out of Union Station.

A bridge carries H Street over the rail lines. Original plans called for punching an opening through at the foot of the bridge so that streetcars could pass under the railway tracks. Space under the tracks already exists, much of it now used to house DDOT equipment.

A trolley station constructed under the bridge on the west side of the Amtrak tracks would have allowed trolley passengers to walk directly into Union Station.

That plan was abandoned recently after Amtrak said it might need some of that space to accommodate envisioned high-speed rail service.

Now DDOT is giving preliminary consideration to several options. One would put the streetcars on the bridge, another would reroute them north to connect with Metro's Red Line at the New York Avenue station and the third would be a variation on the original but the streetcars would turn around under the railroad tracks rather than connecting to Union Station on the west side.

"Whoever gets the contract will help us decide how to do it," DDOT spokesman John Lisle said.

The car barn and maintenance facility would be constructed near the eastern end of H Street and may house a training program that would instruct public school students in the principles of streetcar operations and maintenance, DDOT said.

The H Street line is an initial part of a streetcar system designed to cover 37 miles in the District, with the goal of serving about 150,000 riders a day in all eight of the city's political subdivisions.

Plans to revitalize H Street from Third to 14th streets NE have been discussed for years, with city planners envisioning that the more affluent Capitol Hill populace would creep north to H Street. As new shops and restaurants have begun to open on the street, the city has invested in creation of a proper boulevard with wide sidewalks, granite curbs, freshly paved traffic lanes and new landscaping.

Appendix II

Red Hook Streetcar Project
Ca. 1994 - 2002


HISTORIC TROLLEY
PROJECT
THE WATERFRONT PROMENADE

D HOOK TO DOWNTOWN BROOKLYN
SUBWAY NEXUS SERVICE

This route would use Conover to Reed; Reed to Van Brunt; Van Brunt to Beard; Beard to Richards; Richards to Woodhull; Woodhull to Columbia; Columbia to Atlantic and the Tunnel thru to Court Street.

Formula:

Distance= Rate x Time;

Time = Distance/Rate

Given:

Distance= 2 miles

Rate= 12 mph average speed

Calculation:

T= 2/12 x 60= 10 minutes

This gives a round trip time of 20 minutes.

For some examples, a 5 minute headway can be maintained by 4 PCC cars; a 7 minute headway by 3 cars and a 10 minute headway by 2 cars. Keep in mind, each single PCC trolley is the passenger load equivalent of 2 buses.

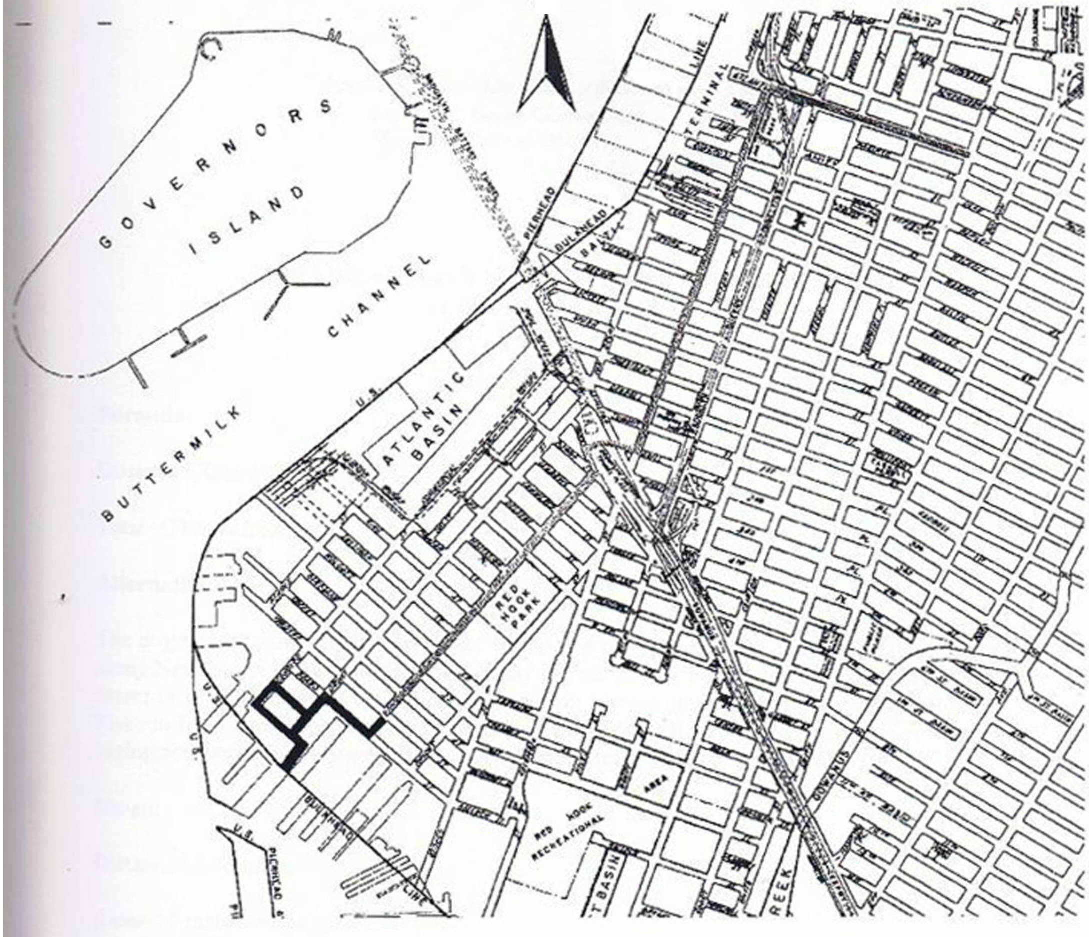
If there are lots of passengers, the trolleys can be run in 2 car "trains" using only 1 operator per "train". Each "train" is the passenger carrying equivalent of 4 buses.

So, for a 5 minute headway with a 2 car "train" you would need 8 cars but only 4 operators. Each 2 car "train" could carry up to 300 passengers, with only 1 operator.

From observation, the existing bus service seems to be operating on a 15 minute headway during peak hours. Off peak, it seems to be less.

Transfers:

A "reciprocal transfer" agreement could be worked out with the MTA through use of the MetroCard system on the trolley. Trolley passengers would benefit from this, as they would get a free transfer to the NYC Subway and MTA bus routes.



Current project, sponsored by NYCDOT, funded through the ISTEA enhancements program.

Proposed connection to Atlantic Avenue.

"People Who Wouldn't Ride A Bus Will Ride A Streetcar" --

Michael T. Burns, General Manager
San Francisco Municipal Railway (MUNI) --

RAILWAY AGE, MAY, 2001

DESIGN APPROVAL DOCUMENT

ISTEA TRANSPORTATION ENHANCEMENT PROJECT

P.I.N. X550.01.321

Comptroller's Contract Number D009817

BROOKLYN HERITAGE TROLLEY PROJECT

KINGS COUNTY

Sponsor: New York City Department of Transportation

BACKGROUND AND PROJECT EVOLUTION

This is an Intermodal Surface Transportation Efficiency Act (ISTEA) Transportation Enhancement Project, Sponsored by the New York City Department of Transportation (NYCDOT), with materials and labor donated by the Applicant, the Brooklyn Historic Railway Association (BHRA). The project is located in the Red Hook section of Brooklyn (see location map). Antique trolley cars refurbished by the BHRA will serve as a historical exhibit on tracks laid on private land and public streets. The project qualified under the Enhancement Program in the category of Historic Preservation because part of the route will follow historic routes, the trolleys themselves are being accurately restored, and the Beard Street Piers in which the trolleys are housed is a property determined to be eligible for the National Register of Historic Places.

The NYCDOT has contracted with the BHRA to obtain and install the track, overhead wire and other appurtenances for operation on public streets. The ISTEA federal allocation of $209,970, matched by $52,493 of local funds in the form of additional materials provides much of the funding for the construction of the track. NYCDOT is adding additional matched funds from its STP allocation to bring **the total project cost for materials to $315,843.** Donated supplies, materials, and money from private individuals, local businesses, other trolley museums, and transit authorities will be used to build the trolley route. Volunteer labor will be supplied by the BHRA and community residents. as it was in building the existing portion of the trolley system.

A small portion of the trolley system has already been built, operating on private land along the Brooklyn waterfront. It is part of the BHRA's trolley museum dedicated to the history of trolley transportation in Brooklyn, on Red Hook's Warehouse Pier, which also houses community and art spaces. As a historic exhibit, it is hoped that the extended trolley system will serve to enhance the draw of the existing museum by bringing visitors into an area of Brooklyn that may be undergoing redevelopment in the near future. The project is also seen as a way to demonstrate the feasibility of operating a trolley system in present-day New York City.

Although federal funds are being used only for materials purchase, as the Municipal Agreement for this project indicates NYCDOT's commitment to have the route built on street, The New York State Department of Transportation will be granting approval of this DAD and the final Plans, Specifications and Estimate.

ALTERNATIVES

Standards: The standards for construction were derived from several sources, both current and historical:

- Construction standards of the American Electric Railway Association

- Standard texts used for the construction of electric street railways

- Construction practices of the Brooklyn Rapid Transit Company
- Safety requirements of NYC agencies (NYFD, CDOT, DCP) promulgated during the CEQR and ULURP processes. These include the special signals and electrical safety devices described under "**Traffic/ Safety Considerations**".

Alternatives considered: The route submitted as part of the original ISTEA application was "Y" in shape, and is shown in Figure "A". Because of waterfront access issues raised by NYCDCP, this route was modified to a "loop" configuration, as shown in Figure "B". Due to the fact that this route relied on very narrow and congested residential streets, the route was again amended to a modified version of the original "Y" shaped route shown in Figure "C". This current version "C" of the route is the preferred alternative.

The Preferred Alternative:

The proposed trolley route would run on approximately three-quarters of a mile of track. It will be located on and about the waterfront in Red Hook, which lies in Brooklyn's Community Planning District 6. The proposed route originates and terminates at the foot of Van Brunt Street at the Waterhouse Pier (499 Van Brunt Street). The route runs along a loop formed by Conover Street, Reed Street, and Van Brunt Street. Both single-ended trolleys (i.e., trolleys that can run in only one direction) and double-ended trolleys (i.e., trolleys that can run in two directions) will run along this loop.

A second portion of the proposed route branches off from the route described above at the intersection of Reed and Van Brunt Streets in a general northward direction down Van Brunt Street, Beard Street, and Richards Street, ending at the intersection of Richards Street and Coffey Street. Double-ended trolleys will run along this portion of the route.

Passengers will be permitted to board and alight the trolley at 499 Van Brunt Street (the foot of that street), at the intersection of Richards and Van Dyke Streets, and at the intersection of Richards and Coffey Streets. The trolley will run, at a minimum, twice an hour for eight hours on Sundays only. No fare will be required; however, a donation will be suggested. .

Engineering Considerations of Preferred Alternative:

The proposed trolley will run on rails lying flush with the surface of the street. (Please refer to the Final Plans). Electricity will power the trolleys, provided by a catenary system. This system consists of an overhead wire running down the center of the street, which is supplied with electricity through perpendicular span wires supported by steel columns installed in the sidewalk amenity strip on both sides of the street. The height of the columns will vary from 22 to 24 feet. The rails themselves will be 56-1/2 inches (standard gauge) apart; the widest trolley car will be eight feet eight inches wide. The track for the most part runs on the right side of the street, following the flow of traffic, although in some stretches the route runs down the middle of the street. A ten-foot strip will house the rails; this strip will be paved with paving blocks and/or concrete, rather than asphalt. The streets along the proposed route vary in width from 28 to 34 feet.

Maintenance Responsibility/Operations Plan: The Brooklyn Historic Railway Association has a fully equipped shop on premises for the restoration, repair and maintenance of the rail cars. BHRA also has equipment necessary for the construction, repair and maintenance of the structure. BHRA will perform the maintenance and operation of the project.

Traffic/Safety Considerations: A detailed project Safety Plan was developed, in order to ensure the safe operation of the project. Highlights of the Safety Plan include:

- Special "Trolley Turns" signals to warn pedestrians and other vehicles of the approach of a trolley from around a corner. These signals consist of special flashers and illuminated signs, activated by the movement of an approaching trolley
- Special "Trolley Station" signals which will stop traffic while passengers board or debark the trolley. These signals are comprised of special flashers and illuminated signs, activated by the presence of the trolley.
- Special Pavement Treatment at passenger boarding areas.
- Pavement markings to delineate the dynamic envelope of the trolley as it moves.
- The trolley will obey traffic rules, traffic control devices and the NYS VTL.
- Power cut-off switches on each corner that permit emergency services personnel to turn off trolley power on a block by block basis in the event of an emergency condition.
- A new type of power system that uses minimal amounts of electrical current to propel the trolley.
- Ground fault relay, circuit breaker and fuse protection.

Adjacent Land Use, Ownership and Right-of-Way Issues

This area of Red Hook is generally zoned for manufacturing uses. The proposed route runs through four manufacturing districts: it originates in an M3-1 district and travels through an M1-1 district, and M2-1 district, and an M1-2 district. The area directly to the north of the intersection of Richards and Coffey streets, where the route ends, is an R5 residential district.

The area through which the proposed route would run is a mix of large one- to four-story manufacturing buildings, three- and four-story residential tenement buildings, and vacant land.

The route runs through privately-owned land as well as over public streets. The portion of the route running west from 499 Van Brunt Street to the foot of Conover Street lies on private land. The route enters public land when it turns onto Conover Street. ISTEA funds will be and have been used for material already placed or to be placed on both public and private property; therefore the entire trolley route must be available to the public at all reasonable hours for the life of the project.

Kings Harbor View Associates owns the waterfront land at the foot of Van Brunt and Conover Streets, along the proposed route, and the Waterhouse Pier, where BHRA will store and maintain their trolleys. The BHRA entered into a five-year agreement with Kings Harbor View Associates in February of 1998. This agreement terminates in February of 2003. This agreement has been reviewed by the NYSDOT Office of Legal Affairs, who issued comments to ensure an adequate degree public access will be secured for the life of the project. The agreement will be modified to their satisfaction.

ENVIRONMENTAL REVIEW AND APPROVALS

This project is being progressed as a "Type II" project for purposes of the New York State Environmental Quality Review Act (SEQRA), and as a "Categorical Exclusion" for purposes of the National Environmental Policy Act (NEPA). A copy of the NEPA checklist is being forwarded to the NYSDOT Main Office Environmental Analysis Bureau and the Federal Highway Administration.

Uniform Land Use Review Process and Revokable Consent

The mechanism by which the NYCDOT will allow BHRA to construct the on-street portion is by a Revokable Consent Order. As part of this process, New York City Department of City Planning determined that a ULURP application was required.

The revised application for revocable consent to construct and operate an electric trolley on public streets was filed by Brooklyn Historic Railway Association (BHRA) on July 15, 1999.

The application (C 980267 GFK) was certified as complete by the Department of City Planning on July 19, 1999, and duly referred to Community Board 6 in Brooklyn, and the Brooklyn Borough President and the Brooklyn Borough Board in accordance with Article 3 of the Uniform Land Use Review Procedure (ULURP) rules.

CEQR: As part of the ULURP procedure, the application (C 980267 GFK) was reviewed pursuant to the City Environmental Quality Review (CEQR) Rules of Procedure of 1991 and Executive Order No. 91 of 1977. The designated CEQR number is 98DOT001K. The lead agency is New York City Department of Transportation.

After a study of the potential environmental impact of the proposed action, a negative declaration was issued on June 14, 1999.

Community Board Public Hearing: Brooklyn Community Board 6 held a public hearing on August 19,1999 and, on September 8, 1999 by a vote of 31 to 0 with 5 abstentions, adopted a resolution recommending approval of the application, with conditions.

Borough President's Recommendation: The application (C 980267 GFK) was considered by the Borough President, who issued a recommendation on October 27, 1999 approving the application with conditions.

City Planning Commission Public Hearing: On October 20, 1999, (Calendar No. 3), the City Planning Commission scheduled November 10, 1999 for a public hearing on this application (C 980267 GFK). The hearing was duly held on November 10, 1999. There was one speaker in favor of the application and no speakers in opposition.

The speaker in favor of the project was the President of BHRA. He introduced the project, stating that the project is a light-rail demonstration project federally funded and sponsored by the New York City Department of Transportation. The speaker also stated that the project will benefit the community by enhancing its historical identity through the reintroduction of light rail to the area, which operated in Brooklyn until the 1950's. Through operating historic trolley cars, the project will help reinvigorate the community by attracting new visitors to the Warehouse Pier in Red Hook, which currently houses the Trolley Museum as well as art and community spaces. The speaker described the historic nature of the materials which will be used in construction and operation including paving blocks, poles, tracks, and single- and double-ended trolley cars. There were no other speakers and the hearing was closed.

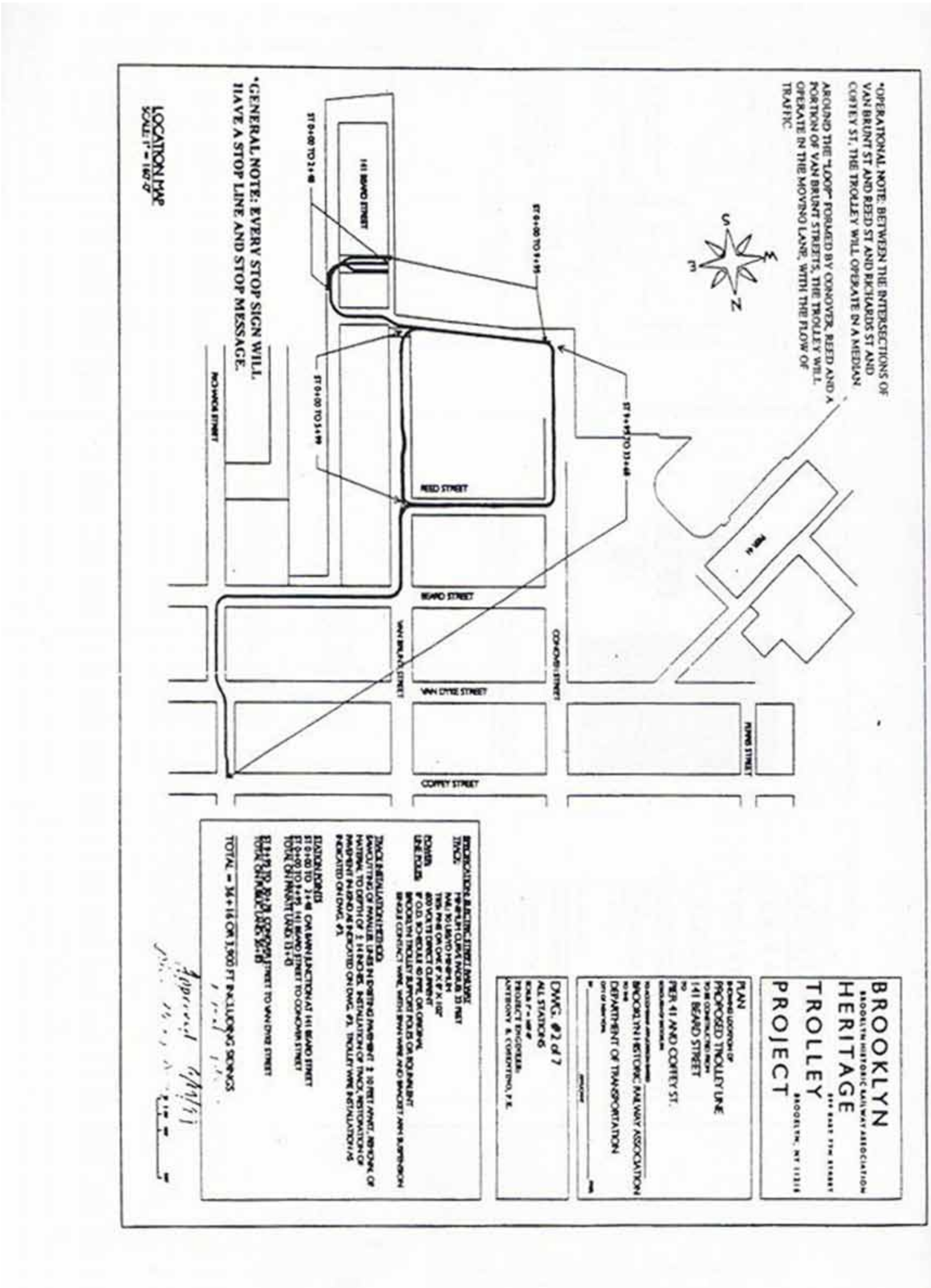
NYCDOT Public Hearing: A Public Hearing was held by the NYCDOT on April 12, 2000, on the matter of the application of the BHRA for a Revocable Consent to construct, maintain and operate the trolley line on City streets (Phase II). The item was Calendar number 7. There were no speakers, and the hearing was duly closed.

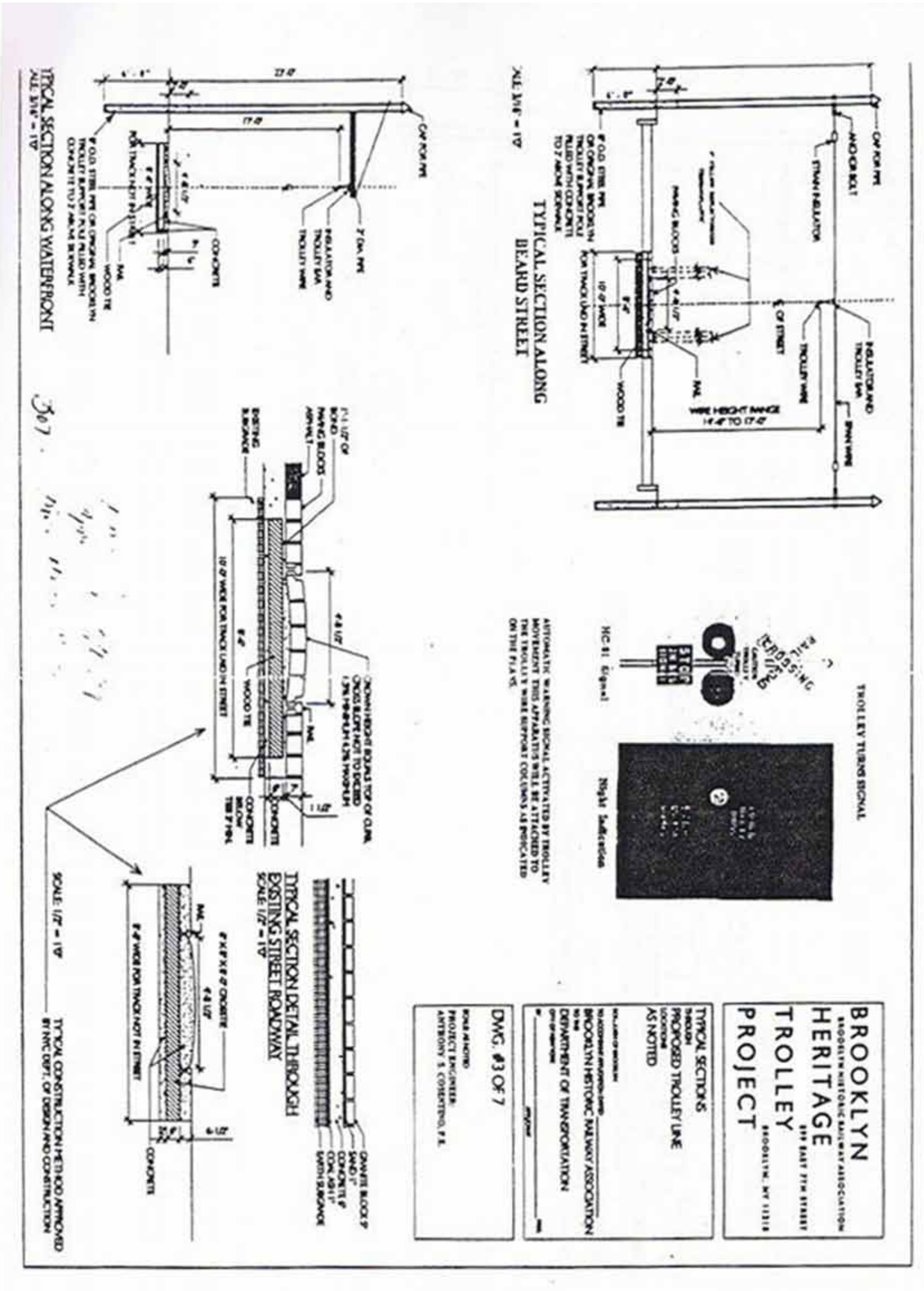
Waterfront Revitalization Program Consistency Review: This application was reviewed by the Department of City Planning for consistency with the policies of the New York City waterfront Revitalization Program (WRP), adopted by the Board of Estimate on September 30, 1982 (Calendar No. 17), pursuant to the New York State Waterfront Revitalization and Coastal Resources Act of 1981 (New York State Executive Law, Section 910 et. seq.). The designated WRP number is 96-044.

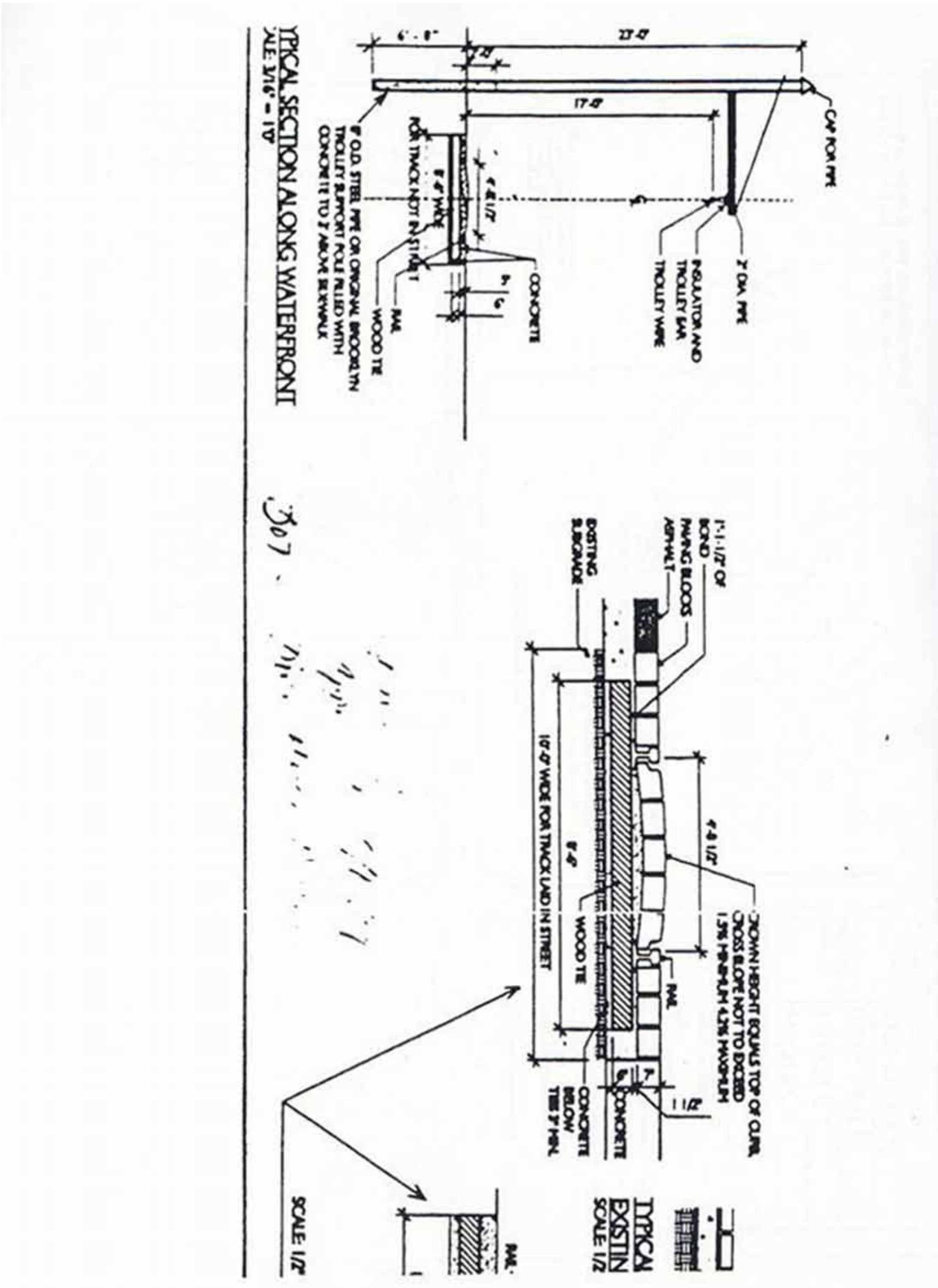
The action was determined to be consistent with the policies of the New York City Waterfront Revitalization Program.

The project was also submitted to the New York State Department of State for Statewide Coastal Consistency and was determined to be consistent.

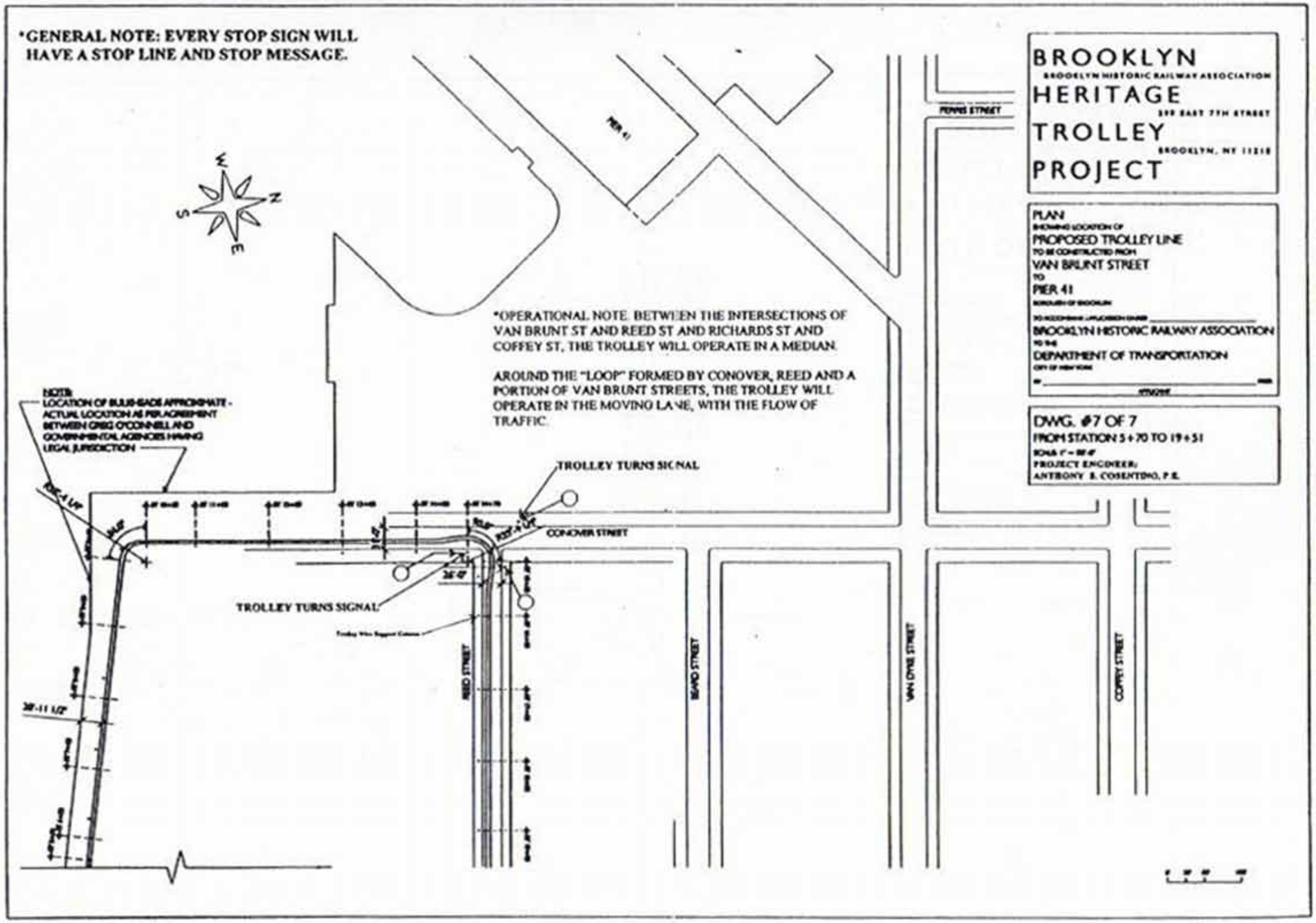
Historic Resources: The SHPO has determined that the Brooklyn Heritage Trolley Project is eligible for listing on the National Register Of Historic Places. This is the reason the project was deemed eligible for ISTEA Enhancement funding. The SHPO has also determined that the Warehouse pier is eligible for listing on the National Register of Historic Places. Phase II of the project will include track and/or right of way of the original Brooklyn trolley system: Richards Street- Brooklyn Rapid Transit Crosstown Line; Beard Street and Van Brunt Street- Van Brunt Street and Erie Basin Railway.

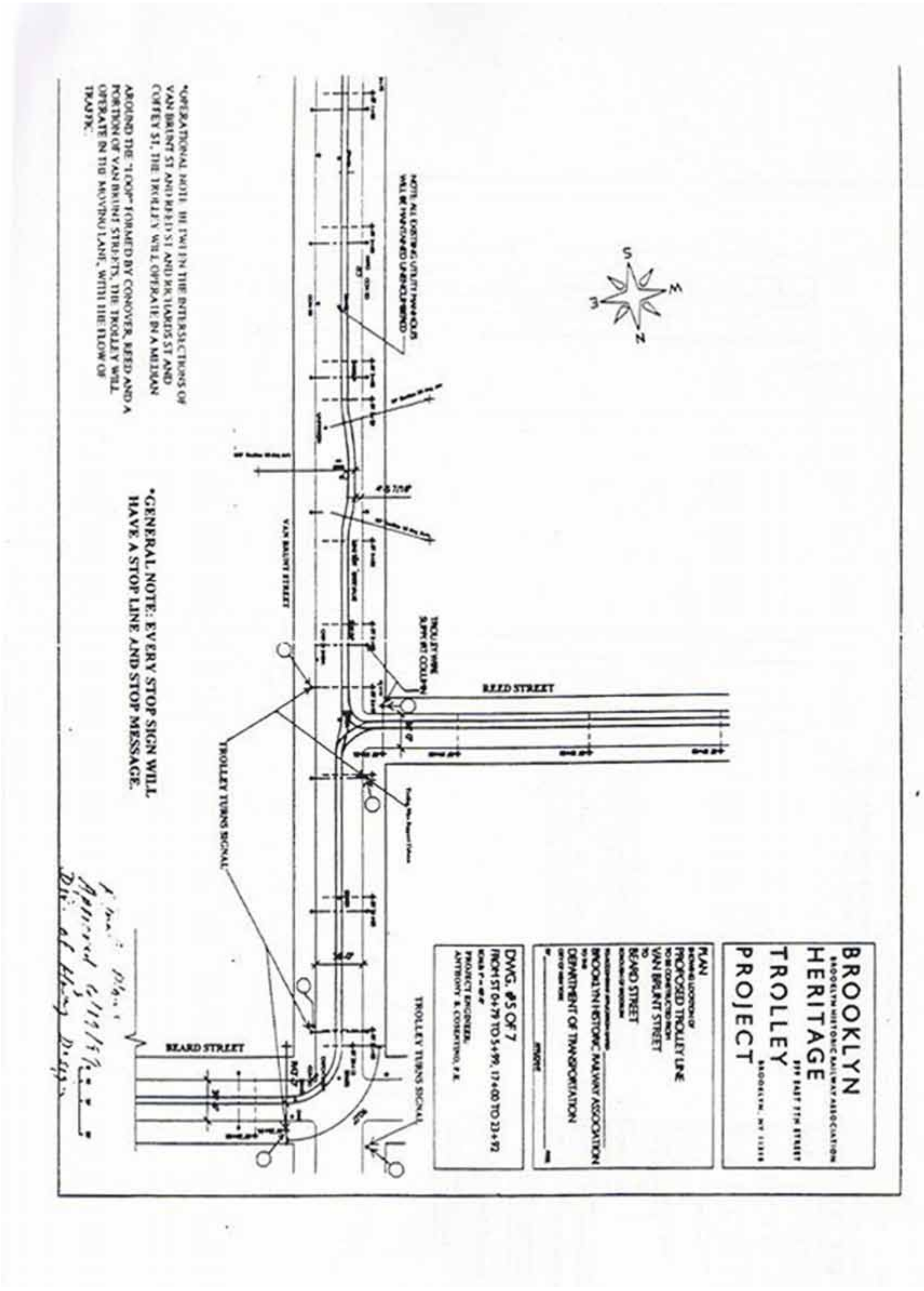

*OPERATIONAL NOTE: BETWEEN THE INTERSECTIONS OF VAN BRUNT ST AND REED ST AND RICHARDS ST AND COFFEY ST, THE TROLLEY WILL OPERATE IN A MEDIAN.
AROUND THE "LOOP" FORMED BY CONOVER, REED AND A PORTION OF VAN BRUNT STREETS, THE TROLLEY WILL OPERATE IN THE MOVING LANE, WITH THE FLOW OF TRAFFIC.
W
N
S
E
PIER 41
FERRIS STREET
CONOVER STREET
REED STREET
BEARD STREET
VAN DYKE STREET
COFFEY STREET
VAN BRUNT STREET
RICHARDS STREET
141 BEARD STREET
ST 9+95 TO 33+68
ST 0+00 TO 9+95
ST 0+00 TO 2+48
ST 0+00 TO 5+99
*GENERAL NOTE: EVERY STOP SIGN WILL HAVE A STOP LINE AND STOP MESSAGE.
LOCATION MAP
BROOKLYN
HERITAGE
TROLLEY
PROJECT
PLAN
PROPOSED TROLLEY LINE
141 BEARD STREET
PIER 41 AND COFFEY ST.
BROOKLYN HISTORIC RAILWAY ASSOCIATION
DEPARTMENT OF TRANSPORTATION
DWG. #2 of 7
ALL STATIONS
TOTAL = 36+16 OR 3,900 FT INCLUDING SIDINGS


BROOKLYN
HERITAGE
TROLLEY
PROJECT
TYPICAL SECTIONS
PROPOSED TROLLEY LINE
AS NOTED
BROOKLYN HISTORIC RAILWAY ASSOCIATION
DEPARTMENT OF TRANSPORTATION
DWG. #3 OF 7
TYPICAL SECTION ALONG BEARD STREET
TYPICAL SECTION ALONG WATERFRONT
TYPICAL SECTION DETAIL THROUGH EXISTING STREET ROADWAY
TROLLEY TURNS SIGNAL
WIRE HEIGHT RANGE
WOOD TIE
CONCRETE

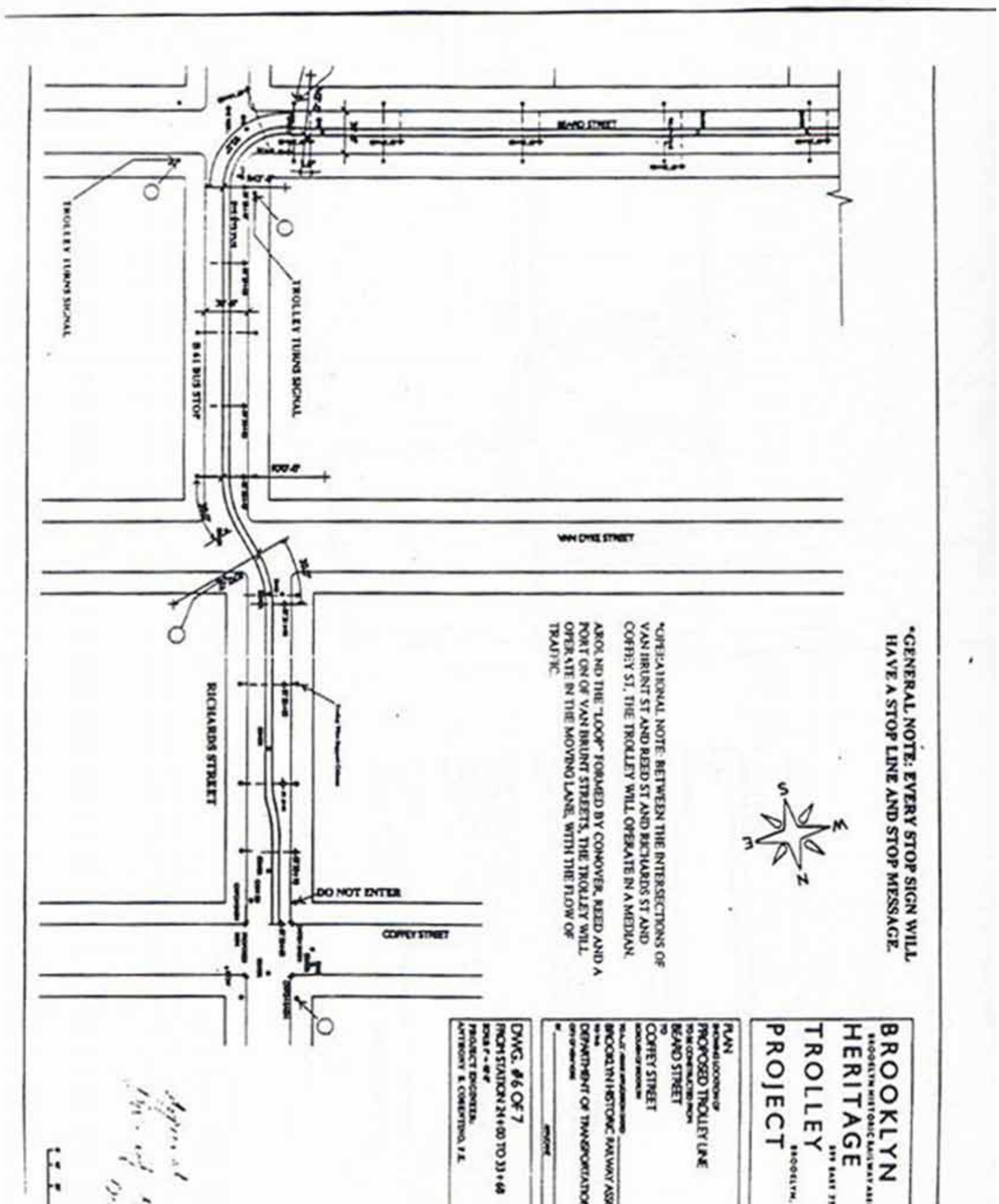


TYPICAL SECTION ALONG WATERFRONT
CAP FOR PIPE
2" DIA. PIPE
INSULATOR AND TROLLEY BAR
TROLLEY WIRE
CONCRETE
RAIL
WOOD TIE
CROWN HEIGHT EQUALS TOP OF CURB. CROSS SLOPE NOT TO EXCEED 1.5% MINIMUM 4.2% MAXIMUM
PAVING BLOCKS
ASPHALT
EXISTING SUBGRADE
10'-0" WIDE FOR TRACK LAID IN STREET
CONCRETE BELOW TIES 3" MIN.
TYPICAL
SCALE 1/2"

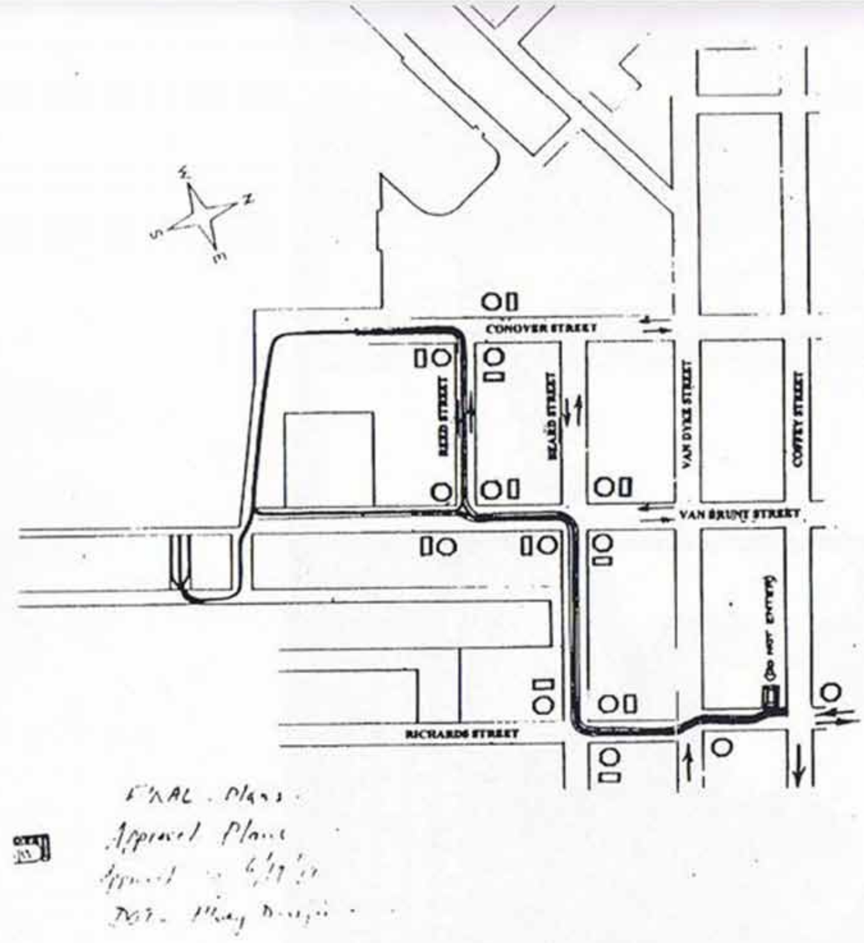

*GENERAL NOTE: EVERY STOP SIGN WILL HAVE A STOP LINE AND STOP MESSAGE.
BROOKLYN
BROOKLYN HISTORIC RAILWAY ASSOCIATION
HERITAGE
TROLLEY
BROOKLYN, NY
PROJECT
PLAN
PROPOSED TROLLEY LINE
TO BE CONSTRUCTED FROM
VAN BRUNT STREET
TO
PIER 41
BROOKLYN HISTORIC RAILWAY ASSOCIATION
DEPARTMENT OF TRANSPORTATION
DWG. #7 OF 7
FROM STATION 5+70 TO 19+51
PROJECT ENGINEER:
ANTHONY J. COSENTINO, P.E.
PIER 41
PENNS STREET
*OPERATIONAL NOTE: BETWEEN THE INTERSECTIONS OF VAN BRUNT ST AND REED ST AND RICHARDS ST AND COFFEY ST, THE TROLLEY WILL OPERATE IN A MEDIAN.
AROUND THE "LOOP" FORMED BY CONOVER, REED AND A PORTION OF VAN BRUNT STREETS, THE TROLLEY WILL OPERATE IN THE MOVING LANE, WITH THE FLOW OF TRAFFIC.
NOTE:
LOCATION OF BULKHEADS APPROXIMATE - ACTUAL LOCATION AS PER AGREEMENT BETWEEN GREG O'CONNELL AND GOVERNMENTAL AGENCIES HAVING LEGAL JURISDICTION
TROLLEY TURNS SIGNAL
CONOVER STREET
TROLLEY TURNS SIGNAL
REED STREET
BEARD STREET
VAN DYKE STREET
COFFEY STREET
38'-11 1/2"
26'-0"



BROOKLYN
BROOKLYN HISTORIC RAILWAY ASSOCIATION
HERITAGE
TROLLEY
PROJECT
PLAN
PROPOSED TROLLEY LINE
VAN BRUNT STREET
BEARD STREET
BROOKLYN HISTORIC RAILWAY ASSOCIATION
DEPARTMENT OF TRANSPORTATION
DWG. #5 OF 7
FROM ST 0+79 TO 5+99, 17+00 TO 23+92
PROJECT ENGINEER:
ANTHONY R. COSENTINO, P.E.
S
W
N
E
REED STREET
VAN BRUNT STREET
BEARD STREET
NOTE: ALL EXISTING UTILITY MANHOLES WILL BE MAINTAINED UNENCUMBERED
TROLLEY WIRE SUPPORT COLUMN
TROLLEY TURNS SIGNAL
TROLLEY TURNS SIGNAL
*OPERATIONAL NOTE: BETWEEN THE INTERSECTIONS OF VAN BRUNT ST AND REED ST AND RICHARDS ST AND COFFEY ST, THE TROLLEY WILL OPERATE IN A MEDIAN
AROUND THE "LOOP" FORMED BY CONOVER, REED AND A PORTION OF VAN BRUNT STREETS, THE TROLLEY WILL OPERATE IN THE MOVING LANE, WITH THE FLOW OF TRAFFIC.
*GENERAL NOTE: EVERY STOP SIGN WILL HAVE A STOP LINE AND STOP MESSAGE.



*GENERAL NOTE: EVERY STOP SIGN WILL HAVE A STOP LINE AND STOP MESSAGE.
*OPERATIONAL NOTE: BETWEEN THE INTERSECTIONS OF VAN BRUNT ST AND REED ST AND RICHARDS ST AND COFFEY ST, THE TROLLEY WILL OPERATE IN A MEDIAN.
AROUND THE "LOOP" FORMED BY CONOVER, REED AND A PORTION OF VAN BRUNT STREETS, THE TROLLEY WILL OPERATE IN THE MOVING LANE, WITH THE FLOW OF TRAFFIC.
BEARD STREET
VAN DYKE STREET
RICHARDS STREET
COFFEY STREET
B 61 BUS STOP
TROLLEY TURNS SIGNAL
DO NOT ENTER
BROOKLYN
HERITAGE
TROLLEY
PROJECT
PLAN
PROPOSED TROLLEY LINE
BEARD STREET
TO
COFFEY STREET
BROOKLYN HISTORIC RAILWAY ASSOCIATION
DEPARTMENT OF TRANSPORTATION
DWG. #6 OF 7
FROM STATION 24+00 TO 33+60
PROJECT ENGINEER:
ANTHONY R. CORENTINO, P.E.



○ - "STOP" SIGN

□ - "CAUTION! TROLLEY TURNS" SIGN

| - PROPOSED YELLOW STRIPE PAVEMENT MARKING

| - PROPOSED TROLLEY ROUTE

CURRENT AND PROPOSED PARKING REGULATIONS

Conover Street-
Current- Regulations between Reed Street and foot of Conover Street not posted.
Proposed- West Side: Same as Current. East Side- No Parking Sat & Sun 11 AM to 8 PM.

Reed Street-
Current- Regulations between Conover Street and Van Brunt Street not posted.
Proposed- North Side- Same as Current. South Side- No Parking Sat & Sun 11 AM to 8 PM between Conover Street and Van Brunt Street

Van Brunt Street-
Beard St to Reed St:
Current-West side: No Parking 7 AM to 7 PM Except Sundays, and No Parking 8 AM to 11 AM Mon and Thurs. East side: No Parking 7 AM to 7 PM Except Sundays, and No Parking 8 AM to 11 AM Tues and Fri.
Proposed- No Parking Anytime, both sides. This is to establish a median for the trolley.

Reed St to foot of Van Brunt St-
Current- West side: No Parking 8 AM to 11 AM Mon and Thurs. East Side: No Parking 8 AM to 11 AM Tues and Fri.
Proposed- West side: Same regulations as Current, with the added restriction No Parking Sat & Sun 11 AM to 8 PM from Reed St to mid-block. East Side: same as current.

Beard Street-
Current- No Parking Anytime Between Van Brunt Street and Richards Street (This is the only posted parking regulation).
Proposed- No Parking Anytime, both sides. This is to establish a median for the trolley.

Richards Street-
Beard St to Van Dyke St:
Current- West Side: No Parking 8 AM to 6 PM Mon Thru Fri. East Side: No Standing, Bus Stop.
Proposed- West Side: No Parking Anytime. East Side: Same as Current. This is to establish a median for the trolley.

Van Dyke St to Coffey St:
Current- West Side: No Parking 8 AM to 6 PM Mon, Wed, Fri. East Side: No Parking 8 AM to 6 PM Tues & Thurs.
Proposed- No Parking Anytime, both sides. To establish a median for the trolley.

NOTES: Stop Signs Are Currently The Only Traffic Control Devices Along The Proposed Route.

There are No buildings fronting the trolley route along Richards Street. Buildings fronting on the trolley route on Beard Street are Vacant.

BHTP CONSTRUCTION PLAN
August 2001

GENERAL RULES:

1. "Code 53" to be used at all times.

2. All MTP's specified by CDOT will be observed.

3. All directions from HIQA will be observed

General Construction Plan For NYC Streets:

I- Track Work

1. Since all utilities are buried at least 2 feet below the underside of the roadway, and BHRA will be only removing the paving blocks and concrete sub-base, no interference with any underground utilities is anticipated.

2. When excavating within 1 foot of any street casting, hand held equipment only will be used.

3. BHRA will only open the roadway in 80 foot long sections. All track and necessary paving will be completed in that section, prior to the opening of the next 80 foot long section.

4. Straight (tangent) track sections will be built first, followed by curved track sections. Time consuming "special work" such as turnouts, will be inserted last.

II-Traction Power & Signals

1. Pole sleeves to be inserted first.

2. Poles inserted into the pre-installed sleeves.

3. Bracket Arms or span wires installed.

4. Contact Wire, Section Breaks and Power- Cut-Offs installed.

5. Signal Systems installed.

Construction Time for Phase II is already specified in the existing contract between BHRA and CDOT.

Brooklyn Historic Railway Association

Bringing the trolleys back to Brooklyn

499 Van Brunt Street, Suite 3A
Brooklyn, New York 11231
Voice and Fax: (718) 246-2921

SOME COMPARISONS BETWEEN LIGHT RAIL AND BUSES

By Bob Diamond
2/01

Trolleys are a new concept to many New Yorkers, even though they existed in our City up until the late 1950's. I've put together some figures comparing them to buses, both electric and fossil fueled, which does of course, include natural gas and "hybrid".

For the purposes of this comparison, the term "trolley" can be taken to mean a PCC type light rail car, which is the type BHRA has, and is planning to operate.

OPERATING COSTS PER 1000 PLACE MILES

Fossil Fueled Bus- $ 60

Electric Bus- $ 83

Trolley- $ 18

* Note- a "Place Mile" is defined as vehicle miles x average passenger capacity. Trolley is superior because each trolley holds more passengers than a bus. Also, because a trolley runs on steel rails, it can spend most of its time coasting, not using any traction power. Rubber tired vehicles (which include electric buses) cannot "coast" effectively because of too much friction.

EMPLOYEES/ 1000 REVENUE VEHICLE MILES

Fossil Fueled Bus- 0.073

Electric Bus- 0.16

Trolley- 0.0625

Again, trolleys come out ahead. Note that electric buses require the most employees.

VEHICLE LIFE

Fossil Fueled Bus- less than 12 years

Electric Bus- around 18 years maximum

Trolley- 100 years

ALL WEATHER CAPABILITY

Trolleys can operate in all weather, as they are grounded to the earth. Electric buses cannot be used in snow, and cannot use snow chains, because they cannot be grounded to the earth. Electric buses need to be replaced by regular buses during snowy conditions. Electric buses have an electric shock potential, created by the mix of road salts, snow, slush and other moisture.

OPERATING CHARACTERISTICS

<u>Acceleration</u>

Bus- 2.75 mph/sec in the 0-20 mph range (at higher speeds, acceleration gets even worse)

Trolley- 4.75 mph/sec, through all speeds

*Note- in this case "Bus" means both electric and fossil fueled.

<u>Braking</u>

Bus- 2-3 mph/sec

Trolley- Normal Service Braking- 4.75 mph/sec
Emergency Braking- 9.00 mph/sec

The old tale of trolleys not being able to keep up with traffic is simply not true of PCC cars. Again, the trolley is superior to buses. Trolleys accelerate twice as fast as a bus, and can stop three times faster than a bus.

VEHICLE CAPACITY

Bus- 30 foot- 55 passengers

35 foot- 70 passengers

Trolley- 148 passengers (46 foot length, 8'-8" width)

Note: PCC cars of the type used by BHRA can, if desired, be used in pairs, so one trolley operator can move 256 passengers.

ENERGY REQUIREMENTS AND COSTS

Assume Diesel Fuel costs \$ 1.88/gal, and Electricity costs \$ 0.17/kWh. Natural gas was once in the same price range as diesel, but is now skyrocketing. A natural gas bus actually consumes more fuel than a diesel bus.

Bus-

Requirement: 1 gal/mi

17 gal/hr

Note: Fossil fuel buses burn fuel even when they are not moving.

Cost: 1 gal/mi x \$ 1.88/gal = \$ 1.88/mi

17 gal/hr x \$ 1.88/gal = \$ 31.96/hr

Trolley-

Requirement: 3.89 kWh/mi

35 kWh/hr

Cost: 3.89 kWh/mi x \$0.17/kWh = \$ 0.66/mi

35 kWh/ hr x \$ 0.17/kWh = \$ 5.95/hr

Trolleys use much less energy than a bus, and its energy costs are far cheaper than a bus.

POLLUTION EMISSIONS-

A pure electric vehicle, such as a trolley, has zero pollution emissions. A natural gas bus, or a hybrid electric bus, may burn fuel somewhat cleaner than a diesel powered bus, but unfortunately, both these types of buses produce nearly as much Carbon Dioxide as a standard diesel powered bus. Also, since nitrogen is present in our atmosphere, and bus engines use air as an oxidizing agent, NOX is still produced as a combustion byproduct.

Carbon Dioxide is among the most prevalent and dangerous of Green House Effect Gasses.

PASSENGER BOARDING

Bus -

Passengers board buses from the curbside. However, this form of passenger loading creates delay to the bus itself, and in fact, worsens traffic congestion (delay), due to the fact that buses have to weave in and out of traffic lanes to reach the bus stop. Buses have to cut off other vehicular traffic to pull into and out of the bus stop. This causes delay, and worsens congestion and pollution.

Trolley-

A very long time ago, trolleys would simply stop in the street, and board/discharge passengers. While this worked well enough with the horse-drawn traffic of the 19th century, it posed a traffic flow problem with the advent of the automobile in the early 20th century. Trolleys would stop in the roadway to board and discharge passengers, while all traffic behind the trolley would come to a total halt.

The problem of trolley passenger loading was solved in the late 1920's. The solution was the Passenger Boarding Island. In this system, a concrete boarding island is created, 5 feet wide, 6 inches high, and slightly longer than the length of the trolley (about 50 feet). Curbside parking adjacent to the Boarding Island is eliminated, creating a traffic bypass around the Boarding Island.

When the trolley stops at the Boarding Island, all vehicular traffic behind it simply flows through the bypass around the island. No delay is created for the trolley, or other vehicular traffic.

Passengers in the Boarding Island are protected from vehicular traffic, by a wedge shaped concrete traffic barrier located on the end of the Boarding Island which faces into on coming traffic. The wedge shaped barrier contains flashing warning lights to alert oncoming motorists. Traffic signs are also mounted in appropriate locations to advise motorists that they are approaching a Boarding Island, and they will be flowing to the right around it. Pavement markings also indicate the flow of traffic to the right around the Boarding Island. The other end of the Boarding Island is perpendicular to the pedestrian crosswalk. Passengers access and leave the Boarding Islands during the crosswalk green light phase.

Trolley Passenger Boarding Islands are more efficient than bus curbside boarding, because it creates no delay, and reduces traffic congestion and pollution, as buses are not weaving through and cutting off traffic to reach and leave the curbside.

VISUAL IMPACTS

Trolley wires, as built by BHRA, are supported by historic steel poles, similar to the "bishop's crook" street lights which fit into the historical context of the downtown Brooklyn community. The wires are of the "direct suspension" type, keeping visual impacts to a bare minimum.

Electric bus lines are supported by heavy concrete and steel columns, the wires are "doubled up" and of an extremely obtrusive form of construction. Electric buses have an extremely high level of visual impact, which would be unacceptable in downtown Brooklyn.

COST

Recently, the cost of installing light rail track and wire has been in the area of $ 20- 100 million per mile, and even higher. BHRA's combination of traditional and modern construction techniques, as well as BHRA's non-profit status, has drastically lowered this cost to under $ 2 million per mile. This is only a fraction of the installation cost of an overhead wire system for an electric bus.

RIDERSHIP

The "F" line in San Francisco was originally serviced by electric buses. That line was destroyed during the last earthquake. It was replaced by a new trolley line, featuring a fleet of restored PCC cars. Amazingly, the ridership on the "F" line tripled because of the historic trolleys. This is because the PCC cars are not simply public transit, they are also an attraction in themselves, and draw riders. In fact, the trolley operators are so enthused, they volunteer to clean and polish their cars, as if they were their own vintage vehicles.

In fact, the General Manager of MUNI, Michael T. Burns was quoted in the May 2001 issue of *RAILWAY AGE* "People Who Wouldn't Ride a Bus Will Ride a Streetcar".

Michael Strasser
Assistant Commissioner
Bureau of Transit Operations
Battery Maritime Building, 3rd Floor
New York, New York 10004-1498
(212) 806-6900 Extension 6719

New York City
Department of Transportation

Elliot G. Sander, Commissioner

June 19, 1996

Peter Dunleavy
New York State Department of Transportation
Region XI - Design Department
47-40 21st Street - 4th Floor
Long Island City, NY 11101

RE: **Brooklyn Heritage Trolley Program (PIN # 84196BK889TR): Funding**

As per my letter of June 12, 1996, the total cost of the Brooklyn Heritage Trolley Program is $262,463, of which 80% ($209,767) is Federal funds and 20% ($52,696) is local matching funds to be provided by the local contractor, Brooklyn Historic Railway Association, in the form of materials such as: rails, ties, track bolts, etc.

If you have any questions, please do not hesitate to contact me at 212-806-6833.

Sincerely,

Richard A. Cohen

Richard A. Cohen

cc: F. Farber, J. Therattil, B. Selwyn, P. Stanton, D. Orlando

E\SELWYN\BKTROLLE\DNLVY619

DEPT.OF.CITY PLANNING Fax:7185962609 Aug 28 '96 11:53 P.01

DEPARTMENT OF CITY PLANNING
CITY OF NEW YORK

LAND USE AND ENVIRONMENTAL REVIEW

Joseph B. Rose, *Director*
Department of City Planning

August 15, 1996

Brian Selwyn
Bureau of Transit Operations
Battery Maritime Building - 3rd flr.
New York, NY 10004-1498

Dear Mr. Selwyn:

I write in reference to the Brooklyn Heritage Trolley Program.

We have reviewed the plans you sent us and have determined that Phase One of your proposal, in so far as it only impinges on a public street (Conover Street) for a very limited length, does not require ULURP. We have also determined that Phase Two of your project, which is almost completely in the bed of mapped streets open to public use, does require ULURP.

Please note that our approval for Phase One is on the assumption that the only use of a public street occurs at Conover Street. Your drawing, # 5, is misleading as to this point.

If you have any questions please do not hesitate to contact me.

Sincerely,

Lance I. Michaels

Lance I. Michaels

c: Andy Lynn
Mike Weil
Larry Parnes
Melanie Meyers
Floyd Lapp

Lance Michaels, *Deputy Executive Director*
22 Reade Street, New York, N.Y. 10007-1216 Room 2E (212) 720-3366
FAX (212) 720-3356

cXhis

STATE OF NEW YORK
DEPARTMENT OF STATE
ALBANY, NY 12231-0001

ALEXANDER F. TREADWELL
SECRETARY OF STATE

September 9, 1996

Robert Diamond, President
Brooklyn Historic Railway Association
599 East 7th Street
Brooklyn, NY 11218

Re: F-96-291
U.S. DOT Funding Assistance Application - Brooklyn Historic Railway Association, Upper New York Bay, Kings/NYC
WRP #96-044

Dear Mr. Diamond:

The Department of State has completed its review of the information describing the above proposed project. Based upon the information submitted, the Department of State finds that the proposed action is consistent with the New York State Coastal Management Program.

The U.S. Department of Transportation is being notified of this decision by copy of this letter.

This consistency finding is applicable to this Federal financial assistance activity only, and is based upon all information and data submitted at this time. Any other Federal agency involvement with this same project will be reviewed independently for its consistency, based upon all information available at that time.

Sincerely,

William F. Barton for

George R. Stafford
Director
Division of Coastal Resources
and Waterfront Revitalization

GRS:GJH:dlb
cc: U.S. Department of Transportation
NYS Clearinghouse - Mary Sampson
NYC LWRP - Wilbur Woods

STATE OF NEW YORK
DEPARTMENT OF TRANSPORTATION
HUNTERS POINT PLAZA
47-40 21ST STREET
LONG ISLAND CITY, N.Y. 11101

RICHARD A. MAITINO
REGIONAL DIRECTOR

JOHN B. DALY
COMMISSIONER

December 19, 1996

Mr. Michael Strasser
Assistant Commissioner
New York City Department of Transportation
Division of Transportation Policy & Systems Operations
Battery Maritime Building, 3rd Floor
New York, New York 10004-1498

Re: Brooklyn Heritage Trolley Project
PIN X550.01, D009817, NYCDOT PIN 84196BK889TR
Kings County

Dear Mr. Strasser:

You are hereby notified to proceed in the award of the BROOKLYN HERITAGE TROLLEY PROJECT, PIN X550.01, D009817, Kings County to the Brooklyn Historic Railway Association for $262,463.

Attached is a copy of the concurrence in award from our Contract Management Bureau.

Please notify Peter Pomeranz of my staff as soon as possible of the proposed start of work. We would like to attend the pre-construction meeting with the contractor. The pre-construction meeting with the contractor should take place prior to the delivery of materials.

Sincerely,

SUBIMAL CHAKRABORTI
Director of Construction, R-11

SB:PP:pw

NEW YORK CITY DOT New York City
Department of Transportation

Christopher R. Lynn, Commissioner

Division of Transportation
Planning & Transit Operations
Battery Maritime Bldg, 3rd Floor
New York, New York 10004-1498
(212) 806-6900 Fax (212) 806-6885

June 6, 1997

Robert Diamond, President
Brooklyn Historic Railway Association
599 East 7th Street
Brooklyn, NY 11218

Re: Brooklyn Heritage Trolley Project (PIN # 84196BK889TR)

Dear Mr. Diamond:

The above referenced contract, which was awarded to the Brooklyn Historic Railway Association on April 15, 1997, has been registered with the Comptroller of the City of New York, effective June 5, 1997. The registration number is 97C3568.

You are hereby notified to proceed with work on this contract on June 6, 1997. Payment for material purchased pursuant to the terms of the contract will not begin until all applicable requirements of the contract are fulfilled and, as previously agreed, the following submitted to my office:

1. A notarized letter from Greg O'Connell of *Pier 41* permitting construction and operation of those portions of the trolley on his property and ensuring the trolley's availability to the public at all reasonable times. This letter should also state that the reconstruction work planned by Mr. O'Connell's *Kings Harbor View Associate's* on the Beard Street Pier will not interfere with the building and eventual operation of the trolley project.

2. A final set of revised project plans reviewed, authorized, and signed by the trolley project engineer, Anthony Cosentino.

The time for the completion of the purchase of all trolley equipment and the construction of the trolley line under this contract is June 5, 1999.

The contract is funded in part by the Federal Highway Administration (FHWA) and all its rules and regulations apply.

The executed contract will be sent to you shortly. Please utilize the aforementioned registration number for all future correspondence. Please call me at 212-806-6833 or Brian Selwyn at 212-806-6830 in order to set up a meeting to discuss future steps in the project.

Thank you.

Sincerely,

Richard A Cohen

Richard Cohen
Project Director

cc: J. McDonald, J. Murin, P. Castagnola, J. Therattil, B. Selwyn, P. Stanton, D. Lucchese, A. Cosentino (DEP), P. Dunleavy (NYSDOT), G. O'Connell

E:\BRIANS\BKTROLLE\LETTERS\notprocd.doc

HIS DREAM IS RIGHT ON TRACK BUFF'S WORKING TO REVIVE TROLLEY

BY BILL FARRELL / NEW YORK DAILY NEWS

TUESDAY, NOVEMBER 9, 1999, 12:00 AM

The ride was short, but for a few shining moments, a trolley car once again rolled in Brooklyn. Forty-three years to the day the last Brooklyn trolley cars from the Church Ave. and McDonald Ave. lines rolled into their yards for good, transit buffs cheered the clang of the trolley in Red Hook. "It was great," raved Bob Diamond, 40, the man behind the new trolley movement and also behind the controls of the trolley. "We only ran it along 1,500 feet of track, but everything went perfectly. It was terrific.

" In all, some 100 passengers hopped aboard to ride up and back along the waterfront at the end of Van Brunt St. They seemed to agree unanimously with Diamond's assessment. "Unbelievable," said one passenger. "It was like riding on the world's biggest little toy train set.

" Sunshine as well as the fabulous view of the Statue of Liberty only added to the enjoyment. "I can't tell you how many people come up and say the ride was like being on a smooth boat, because it's so close to the water," Diamond said. And if the man who rediscovered the 155-year-old train tunnel under Atlantic Ave. more than 120 years after it was abandoned has his way, the trolley will once more roll from Red Hook to the Brooklyn Bridge. "One day, I'd like to see the trolley run along the waterfront, under the old tunnel on Atlantic Ave., and past the piers," Diamond said. "The trolley would be a combination tourist attraction and a viable transit option for the people in downtown Brooklyn and Red Hook.

" While that notion may sound like pie in the sky to some, don't sell Diamond's concept short. People laughed when Diamond started looking for the Atlantic Ave. tunnel, and now he already has at least one of his three trolley cars rolling. Tomorrow, the City Planning Commission will hold a hearing on the Brooklyn Historic Railway Association's plan to construct and operate the trolley service. "We haven't brought the Dodgers back to Brooklyn," said Diamond, "but we do have the trolleys.

LR

Land Use Review Application

Department of City Planning — 22 Reade Street, New York, NY 10007-1216

RECEIVED

CITY PLANNING WILL ASSIGN AND STAMP REFERENCE NUMBERS HERE

APPLICATION NUMBER: 980267GFK

APPLICATION NUMBER: DEC 29 1997

CENTRAL INTAKE
DEPT. OF CITY PLANNING

APPLICATION NUMBER

APPLICATION NUMBER

1. PRIMARY APPLICANT AND APPLICANT'S REPRESENTATIVES

APPLICANT (COMPANY, AGENCY OR OTHER ORGANIZATION): Brooklyn Historic Railway Assn.

APPLICANT'S PRIMARY REPRESENTATIVE AND PROFESSIONAL AFFILIATION: Robert Diamond, Pres.

STREET ADDRESS: 599 East 7th Street

REPRESENTATIVE'S COMPANY/AGENCY OR OTHER ORGANIZATION: SAME

CITY / STATE / ZIP: Brooklyn, NY 11218

STREET ADDRESS

AREA CODE TELEPHONE #: 718-941-3160 — FAX #: SAME

CITY / STATE / ZIP

AREA CODE TELEPHONE # / FAX #

OTHER APPLICANT REPRESENTATIVES:

NAME AND PROFESSIONAL AFFILIATION (ATTORNEY/ARCHITECT/ENGINEER ETC.): NONE — TELEPHONE # — FAX #

NAME AND PROFESSIONAL AFFILIATION (ATTORNEY/ARCHITECT/ENGINEER ETC.) — TELEPHONE # — FAX #

SITE DATA

STREET ADDRESS: NA — PROJECT NAME (IF ANY): Brooklyn Heritage Trolley Project

DESCRIPTION OF PROPERTY BY BOUNDING STREETS OR CROSS STREETS: See Attached Sheets

EXISTING ZONING DISTRICT (INCLUDING SPECIAL ZONING DISTRICT DESIGNATION, IF ANY): M1-1, M-3 — ZONING SECTIONAL MAP NUMBER(S): 16A

TAX BLOCK AND LOT NUMBERS (OR SEPARATE SHEET IF NECESSARY): See Attached Sheets — BOROUGH: Brooklyn — COMM. DIST: 6

URBAN RENEWAL AREA, HISTORIC DISTRICT OR OTHER DESIGNATED AREA (IF ANY): NO

IS SITE A NEW YORK CITY OR OTHER LANDMARK? NO ☒ YES ☐ IF YES, IDENTIFY

DESCRIPTION OF PROPOSAL

(If entire project description does not fit in this space, enter "see attached description" below and submit description on a separate sheet, identified as "LR item 3, Description of proposal".

Applicant proposes to construct an historic electric trolley line in Red Hook, Brooklyn. See attaced map for route. Trolley will operate on rails laid flush with street surface, and draw power from an overhead wire supported by historic steel columns. The project will serve as an historic and cultural attraction for Red Hook, thereby assisting with the economic redvelopment of the area.

ACTIONS REQUESTED AND FEES (check appropriate actions and attach supplemental forms)

☐ CHANGE IN CITY MAP ... MM	$	☐ MODIFICATION (APPLICATION NO.)	$
☐ ZONING MAP AMENDMENT ... ZM	$	☐ FOLLOW-UP (APPLICATION NO.)	$
☐ ZONING TEXT AMENDMENT ... ZR	$	☐ RENEWAL (APPLICATION NO.)	$
☐ ZONING SPECIAL PERMIT ... ZS	$	☐ OTHER (SPECIFY)	$
☐ ZONING AUTHORIZATION ... ZA	$		
☐ ZONING CERTIFICATION ... ZC	$		

Notice of Certification
Pursuant to the Uniform
Land Use Review Procedure

DEPARTMENT OF CITY PLANNING
22 Reade Street, New York, NY 10007

APPLICATION # C 980267 GFK

CEQR # 98DOT001K

(Please use this number on all correspondence concerning this application)

DOCKET DESCRIPTION

IN THE MATTER OF an application submitted by Brooklyn Historic Railway Association pursuant to Section 197-c of the New York City Charter, for a revocable consent to construct, maintain and operate an electric trolley on Richards Street between Coffey Street and Beard Street, on Beard Street between Richards Street and Van Brunt Street, on Van Brunt Street from Beard Street to its southerly terminus, on Reed Street Between Van Brunt Street and Conover Street and on Conover Street from Reed Street to its southerly terminus, Borough of Brooklyn, Community District 6.

RELATED APPLICATIONS ______

COMMUNITY DISTRICT NO. 6

BOROUGH Brooklyn

APPLICANT
Brooklyn Historic Railway Assoc.
599 E. 7th Street
Brooklyn, NY 11218

APPLICANT'S REPRESENTATIVE
Robert Diamond, President
Brooklyn Historic Railway Assoc
599 E. 7th Street
Brooklyn, NY 11218

QUESTIONS ABOUT THIS APPLICATION SHOULD BE ADDRESSED TO THE FOLLOWING DCP OFFICE:
Transportation Division *AT* (212) 442-4657

ON July 19, 1999 *THE ABOVE LISTED APPLICATION WAS CERTIFIED AS COMPLETE BY THE DEPARTMENT OF CITY PLANNING. THE PERIOD FOR COMMUNITY BOARD REVIEW BEGINS ON* July 28, 1999 *AND MUST BE COMPLETED BY* September 27, 1999

* *Indicates application was certified by the City Planning Commission, pursuant to Section 197-c (c.) of the City Charter.*

10/98

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Application Summary | Project Address/Geography | Milestones

Land Use Application ID: C 980267 GFK

Project Name:	HISTORIC RED HOOK TROLLEY	
Borough:	BROOKLYN	
CEQR #:	98DOT001K	
Related Items:		
CP/DCA/LPC Items:		
Location:	VAN BRUNT ST, COFFEY ST, CONOVER ST	
Applicant:	BROOKLYN HISTORIC RAILWAY ASSOC	
Applicant Rep.:		
Description: (Land Use)	REVOCABLE CONSENT TO CONSTRUCT AND OPERATE AN HISTORIC ELECTRIC TROLLEY LINE TO SERVE AS AN HISTORIC & CULTURAL ATTRACTION	
Community Districts:	K06	
Zoning Resolution Sections:		
Zoning Maps:	16A	
Alteration Maps:		
Zoning Districts:		
CPC Action:	12/8/1999	APPROVAL
CPC Calendar #:	13	CPC Report
City Council Action:		

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Application Summary | Project Address/Geography | Milestones

Land Use Application ID: C 980267 GFK

CEQR #: 98DOT001K

Milestones include Land Use application milestones as well as related CEQR application milestones. Some milestones may have links to related documents.

Milestone Date(s)	Milestone Detail
12/29/97	PROPOSAL RECEIVED BY DEPT. OF CITY PLANNING
02/18/98	EAS (PDS) RECEIVED IN DEPT CITY PLANNING
06/14/99	CEQR DETERMINATION: NEGATIVE DECLARATION ISSUED
07/14/99	REVIEW SESSION SCHEDULED FOR
07/19/99	APPLICATION CERTIFIED
07/19/99	NOTICE OF CERTIFICATION TO COMM/BORO BOARDS, BORO PRES., CITY COUNCIL
07/28/99 - 09/27/99	60-DAY COMMUNITY BOARD REVIEW PERIOD
08/05/99	COMMUNITY BOARD PUBLIC HEARING SCHEDULED FOR
09/08/99	COMMUNITY BOARD ISSUES CONDITIONAL FAVORABLE RECOMMENDATION
09/28/99 - 10/27/99	30-DAY BOROUGH PRESIDENT REVIEW PERIOD
09/28/99	COMMUNITY BOARD RECOMMENDATION RECEIVED BY CITY PLANNING COMMISSION
09/28/99	CB PUBLIC HEARING NON-COMPLY/RECOMMENDATION RECVD AFTER CLOCK EXPIRED
10/18/99	CITY PLANNING PUBLIC MEETING SCHEDULED FOR
10/20/99	CITY PLANNING COMMISSION PUBLIC HEARING SCHEDULED/POSTED/NOTICE SENT
10/27/99	BOROUGH PRESIDENT ISSUES CONDITIONAL FAVORABLE RECOMMENDATION
10/27/99	BOROUGH PRESIDENT RECOMMENDATION RECEIVED
10/28/99 - 12/27/99	60-DAY CITY PLANNING COMMISSION REVIEW PERIOD
11/03/99	REVIEW SESSION SCHEDULED FOR
11/10/99	CITY PLANNING PUBLIC MEETING SCHEDULED FOR
12/08/99	APPROVAL BY CITY PLANNING COMMISSION
12/09/99	CITY PLANNING COMMISSION FAVORABLE REPORT FILED WITH CITY COUNCIL
12/10/99 - 12/29/99	CITY COUNCIL 20-DAY CALL-UP PERIOD
12/29/99	CITY COUNCIL DID NOT ASSUME JURISDICTION
12/29/00	CITY PLANNING COMMISSION ACTION FINAL
12/29/00	CITY PLANNING COMMISSION PROCESSING COMPLETED
12/29/00	APPLICATION COMPLETED/TERMINATED

Youth

ANYTHING BUT KID STUFF

Teens take trip back to city's trolley times

By CHRISTOPHER POLICANO
Special to The News

They are far too young to remember when trolleys ran through New York.

But as winter approaches, three Brooklyn teenagers can't help but remember what they consider the best summer jobs of their lives — jobs that gave them a railway buff's quixotic desire to revive the good old days of urban transportation.

The three — Armando Cruz, 17, Dashawn Gilfillian, 15, and Luiz Marquez, 17 — spent much of the summer in a dusty, 1869-issue cargo warehouse off the Beard St. pier in Red Hook, helping Brooklyn Historical Railway Association President Robert Diamond restore three deteriorating trolley cars.

One of the cars is the last Pullman trolley car manufactured in America.

Since 1984, Diamond has been leading a small, grassroots movement to bring trolleys back to Brooklyn. Earlier this year he purchased the three cars from the Massachusetts Bay Transportation Authority for the bargain price of $9, though it cost an additional $5,000 to move them to Brooklyn on a special flatbed truck.

His group is preparing an environmental impact statement for the city, with the hope of obtaining a trolley franchise for the borough.

The youths began working with Diamond through a nonprofit organization called Red Hook Arts, which is sponsoring The Trolley Project.

Gilfillian and Cruz arrived at the pier the hard way: At the end of July, they were fired as park sweepers in the city's Summer Youth Employment Program.

"I know it's not good to get fired, but I've got to say, 'Thanks a lot,' to the boss who let us go," said Cruz, whose childhood fascination with subways has led him to Transit Tech High School, where he is a sophomore.

"Unlike sweeping, this job has been educational," he said. "I didn't know there were once trolleys in Red Hook. I've seen tracks here and there, but I never really paid attention to what they were for."

The teens diligently scraped rust and old paint off the cars with wire brushes, removed decaying seats and windows, and finally primed and painted them.

"I'm surprised we got this done," marveled Gilfillian, a High School of Art and Design student, as he showed a visitor the first completed car. "At first I thought, 'How are we going to get this thing fixed?' The whole thing was rotting and in broken condition."

"We did it together, as a team," said a proud Marquez, who credited the project with motivating him to reenroll in John Jay High School. He had dropped out in the spring of 1992.

"These kids have an appreciation for the history of the city," said Diamond. "They want to learn about the city's past in order to get a handle on its future." They often showed up a few minutes early and wanted to stay late, he said.

With school back in session, Diamond and Red Hook Arts are looking for corporate/foundation sponsorship so the young people can keep working on the trolley cars. Still to be completed are the cars' electrical and mechanical systems.

In the meantime, the cars will be used by Red Hook Arts to exhibit the work of local elementary, junior and senior high school artists.

"The idea has been to create an arts and education project around the trolleys," said Dorothy Gray, the group's executive director. "Teenagers will be involved with their maintenance, and classes will be invited to come and learn more about their history."

Those interested in participating should contact Red Hook Arts at (718)-852-8058.

OLD-FASHIONED ELBOW GREASE is put to good use as teens restore trolley car.
KEN MURRAY DAILY NEWS

The City of New York

FIRE DEPARTMENT

9 MetroTech Center Brooklyn, N.Y. 11201-3857

PETER J. GANCI, Jr.
Chief of Operations
Bureau of Operations Room 7W4

May 27, 1999

Marjorie Bryant
NYC Dept. of Transportation
40 Worth Street, Room 928
New York, N.Y. 10013

RE: Brooklyn Heritage Trolley

The Fire Department has reviewed your proposal for the above referenced project and offers no objection as long as the following conditions are met:

1. A pole mounted manual shut-off will be located at each street corner along the trolley path. The location of these shut-offs will be identified by yellow stripes painted on the applicable poles. These shut-offs will kill the power to all lines on the blocks on both sides of the shut-off (total of two blocks per shut-off).

2. The spacing between poles will be approximately 100 feet.

3. The height of the poles will be 20' - 23' and the height of the proposed trolley wire will be a minimum of 17' above grade.

4. The 600 volt DC power should be shut down, from its source, during non-operating hours. This would greatly reduce our chances of dealing with energized wires in the street.

5. The Fire Department must be supplied with a 24 hour access phone number for contacting a knowledgeable and responsible person in the event of an emergency.

It is understood that this approval pertains only to the initial segment of this trolley line which begins at the station on the Van Brunt Street pier and terminates at the corner of Richards and Coffey Streets.

If you have any questions, please call Captain Gerald F. Wren at (718) 855-8571.

Very truly yours,

Peter J. Ganci, Jr.
Chief of Operations

PJG:GFW:ep
BrooklynTrolly

cc: Battalion 32

CITY ENVIRONMENTAL QUALITY REVIEW PROCESS
Negative Declaration
Notice of Determination of Non-Significance

APPLICANT NAME AND ADDRESS: **DATE SENT:** June 14, 1999

New York City Department of Transportation
40 Worth Street - Room 928
New York, NY 10013

Pursuant to Sections 5.03 and 5.05 of the Rules of Procedure for the City Environmental Quality Review (CEQR) as adopted June 26, 1991, the New York City Department of Transportation has determined that the proposed action described below will not have a significant effect on the environment. NYCDOT hereby issues a Negative Declaration on this action.

NAME/LOCATION OF PROPOSAL:

Brooklyn Historic Railway Association
DOT CEQR No. 98-DOT-001K

CEQR STATUS: Unlisted

DESCRIPTION OF PROPOSAL:

The applicant, Brooklyn Historic Railway Association, proposes to construct and operate an historic electric trolley in the Red Hook section of Brooklyn, Community Planning District 6. The applicant is requesting a revocable consent to operate this trolley which receives funding through a NYS Intermodal Surface Transportation Efficiency Act (NYS ISTEA) enhancement grant. The trolley would function as an historic exhibit and serve as a cultural resource for the Red Hook community and the City of New York. The proposed trolley will operate on rails laid flush with the street surface, receiving power from an overhead wire supported by steel columns.

The proposed trolley route begins at the foot of Van Brunt Street at the Warehouse Pier (499 Van Brunt Street), then continuing west along the waterfront on right-of-way to the foot of Conover Street where it will exit on to Conover Street. At the foot of Conover Street, the trolley will continue north along Conover Street to Reed Street, then right onto Reed Street proceeding east to Van Brunt Street, then south along Van Brunt Street to the point of origin at 499 Van Brunt. Furthermore, a branch of the proposed route originates at the intersection of Reed Street and Van Brunt Street, continuing north along Van Brunt Street to Beard Street, turning right onto Beard Street, continuing east on Beard Street to Richards Street, then north along Richards Street to Coffey Street, which is the termination point.

Passengers will be allowed to board and alight the trolley at 499 Van Brunt Street (foot of Van Brunt Street), Richards Street at Van Dyke Street, and Coffey Street at Richards Street.

STATEMENT OF NO SIGNIFICANT EFFECT:

NYCDOT, as lead agency for this project, has determined, pursuant to 6 NYCRR617.11, that the proposed action will have no significant effect on the quality of the environment.

SUPPORTIVE STATEMENT:

The above determination is based on an environment assessment and supporting documentation which conclude no significant impact on the quality of the environment as a result of the proposed project.

Peter A. Pennica
Chief of Planning

New York City
Department of Transportation

Wilbur L. Chapman, Commissioner

Highway Design and Construction
28-11 Queens Plaza North, Room 715
Long Island City, NY 11101
Tel: 718/433-3160 Fax: 718/433-3169

June 19, 1999

Mr. Robert Diamond
Brooklyn Historic Railway Association
599 East 7th. Street
Brooklyn, NY 11218

RE: Brooklyn Heritage Trolley Project
NYC DOT Contract No. 97C3568
NYCDOT- Highway Design' Approval letter

Dear Mr. Diamond:

We have reviewed your submission of June 17, 1999 for the final design plans and found the plans satisfactory and meet with our approval.

Enclosed you will find the Approved final plans for the record.

Truly yours,

Mousa Nazif, P.E.
Chief
Division of Highway Design

Enclosure

cc: A/C Hirsch, P. Pennica, J. Jaber, Naim Rasheed, Robin Frazier
Anthony S. Cosentino, P.E. , Project Engineer, BHRA

File :8443d3

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TTY Deaf or Hearing-Impaired, Dial 212/442-9488

The City of New York

Department of Environmental Protection

59-17 Junction Boulevard
Corona, New York
11368-5107

Joel A. Miele Sr., P.E.
Commissioner

Douglas S. Greeley, P.E.
Deputy Commissioner

Bureau of Water and Sewer Operations

Tel (718) 595-5330
Fax (718) 595-5342
dgreeley@nysnet.net

February 10, 2000

Mr. Carlos J. Marcial
New York City Department of Transportation
Division of Franchises, Concessions and Consents
40 Worth Street, 9 South
New York, NY 10013

RE: Franchise Revocable Consent for: Brooklyn Historic Railway Association, Borough of Brooklyn

Dear Mr. Marcial:

This is in reply to your letter dated January 7, 2000 requesting examination of a petition of a revocable consent from NYC Department of Transportation to construct, maintain and use a railroad track and catenary wire over certain streets in the Borough of Brooklyn.

This Division has completed the examination as requested. There are no objections to the consent since no existing water mains and/or sewers are affected.

Very truly yours,

Herbert M Kass

HERBERT M. KASS, P.E., CHIEF
Permitting & Connections

DEP

www.ci.nyc.ny.us/dep
(718) DEP-HELP

New York City
Department of Transportation

Iris Weinshall, Commissioner

Division of
Franchises, Concessions and Consents
40 Worth Street, 9th Floor South
New York, NY 10013
Tel: 212/442-8040 Fax: 212/442-8070

October 17, 2000

Mr. Robert Diamond, President
Brooklyn Historic Railway Association
599 East 7th Street
Brooklyn, NY 11218

Dear Mr. Diamond:

Transmitted herewith is a duly executed revocable consent agreement granting Brooklyn Historic Railway Association consent to construct, maintain and use an electrically operated trolley lie, together with tracks, catenary system, signals and appurtenances, along Canover Street, Reed Street, Coffey Street, Van Brunt Street, Beard Street and Richards Street, all in the Borough of Brooklyn.

Under the terms of the new agreement, the grantee is required to provide insurance. A general liability policy in the amount specified in Section 19, paragraph 1, should be filed immediately with this office.

The insurance policy should contain the following:

1. The City of New York Department of Transportation as additional insured.
2. A description of the structures permitted.

You will receive an invoice in the near future, which will reflect the terms of the agreement for the first year. If you have any questions regarding this invoice, please contact Mr. Syed Rahman at (212)442-8032.

If you have any questions, please call me at (212) 442-8060.

Sincerely,

Carlos J. Marcial
Director, Revocable Consents

CJM:cjp

City of New York
Department of Transportation
Bureau of Permit Management and Construction Control
Office of OCMC
40 Worth Street-Room 905
New York, New York 10013
(212) 442-8580

Date: 10.24.2000 Time: 1 30PM

Contract No: ____________

Subject: Brooklyn Heritage Trolley Project OCMC No. BNEC-00-066

Name	Affiliation	Telephone No:
[illegible]	NYCDOT OCMC	(212) 442-6777
[illegible]	BHRA	(718) 871-2001
Bill Diamond	BHRA	718 246 178
CARLOS J. MARCIAL	DOT-	beeper 917 829 4009
FRANIC PUCCIO	DOT Permits	442-8060
		442-7922

Franchise #

Project Approved

MEMORANDUM
DEPARTMENT OF TRANSPORTATION

TO: P.J. Bellair, Design Quality Assurance Bureau, 5-410 0750

FROM: A. Jablowsky, P.E., Regional Design Engineer, R-11 AJ 5/2

RE: **CATEGORICAL EXCLUSION DETERMINATION**
ISTEA Transportation Enhancement Project
PIN X550.01 (Contract # D009817) Brooklyn Heritage Trolley Program

DATE: May 1, 2001

Attached for your information is a copy of the Design Approval Document (Final Design Report) for the subject project as well as the NEPA Checklist. Based upon the criteria in the NEPA checklist, the subject project meets the requirements of a programmatic Categorical Exclusion.

One item on the checklist, item 6, was marked with an asterisk for the following reason: the project will reintroduce a portion of a trolley line into city streets. This can technically be considered the introduction of a travel option which has not existed for decades. The question was answered "no", however, because the primary purpose at this time is the operation of the trolley as a living cultural artifact, which will enhance the experience of visitors to the historic Beard Street piers who come for concerts, art shows, etc. This will not affect travel patterns in the neighborhood or commuting patterns to the neighborhood. The Applicant hopes to generate interest in the trolley and extend its reach in the future, possibly even as a commuting option. Any such action is far beyond the scope of X550.01, is not funded at this time and would require separate environmental reviews.

This project has been progressed as a NEPA Class II project in accordance with the NYSDOT Design Procedure Manual (DPM). All requirements requisite to these actions and approvals have been met, the required independent quality control reviews separate from the functional group reviews have been accomplished, and the work is consistent with established standards, policies, regulations and procedures, except as otherwise noted and explained.

PD:pd - attachment

c: J.L. Church, Project and Letting Management, 5-520 0520 (memo only)
M. Ivey, Environmental Analysis Bureau 5-303 (memo only)
R. Laravie, NYSDOT R-11 (memo only)
J. Morrone/ P. Fox, Project and Letting Management Bureau 5-520 (memo only)
R. Frazier/ G. Perlman/ K. Costa/ P. Stanton, NYCDOT (memo only)
R. Backlund, FHWA (w/att.)
Project File (file/path: C:\PD\TEP\CDOT\TROLLEY\X55001.PKG.wpd)

MEMORANDUM
DEPARTMENT OF TRANSPORTATION

TO: A. Jablowsky, P.E., Regional Design Engineer, R-11

FROM: R. Laravie, Landscape/Environmental Unit, Region 11

SUBJECT: **SEQR Determination**
ISTEA Transportation Enhancement Project
PIN No. X550.01 Brooklyn Heritage Trolley Program
(Comptroller's Contract No. D009817)

DATE: May 1, 2001

The above referenced project has been analyzed and has been found to be accurately described by paragraph 14 of subsection 15.14(e) of the Department's SEQR Regulations. This subparagraph provides that: "Any action that rebuilds or restores a previously existing transportation facility or structure, at its prior site, where the prior size and usage of such facility will not be significantly exceeded, where the property involved has not been developed or converted to other uses and where paragraph (3) of subdivision (d) of this section is not violated," constitutes a type II action. The criteria of subdivision (d) has been reviewed and the following conclusions have been made:

- The proposed project will involve no acquisition of any occupied dwelling unit or principal structures of businesses.
- The proposed project will create no significant change in passenger or vehicle traffic volume, vehicle mix, local traffic patterns or access. There will be slightly enhanced mass transit connections, as the trolley will meet the end of a bus line.
- The proposed project will have no more than minor social, economic or environmental effects on occupied dwelling units, businesses, abutting properties or other established human activities.
- The proposed project is not inconsistent with any current plan or goal that has been adopted by Local Government bodies.
- The proposed project involves no more than minor alteration of publicly-owned or operated park land, recreation area or designated open space.
- The proposed project will have no Adverse Effect on any district, site, building, structure or object that is listed, or may be eligible for listing on the national register of historic places. Historic Register buildings and structures exist on the site, but, pursuant to section 106 Of the National Historic Preservation Act of 1966, the project has been reviewed by both the New York City Landmarks Commission and the State Historic Preservation Officer, both of which determined that the project would have "No Adverse Effect" on any of these properties.

- The proposed project will have no adverse effect on any protected area or natural or man-made resource of national, state or local significance, including freshwater and tidal wetlands and associated areas, flood plain areas, agricultural lands or districts, water resources, water supply sources, designated wild scenic and recreational rivers, unique ecological, natural wooded or scenic areas, rare or endangered species, or any area officially designated as a critical environmental area.

- The proposed project will not require an Indirect Source Air Quality Permit.

Since the project is accurately described in paragraph 14 of the Type II list, and since the project does not violate any of the criteria contained in subdivision (d) of Section 15.14, I conclude that this proposed action is a Type II action for the purposes of SEQR.

Concur: ______________________________
A. Jablowsky, P.E., Regional Design Engineer, Region 11

c: J. Manzolillo, RPPM, R-11
J. Morrone/ P. Fox, Project and Letting Management Bureau 5-520
R. Frazier/ G. Perlman/ K. Costa/ P. Stanton, NYCDOT
R. Backlund, FHWA
File (C:\PD\TEP\CDOT\TROLLEY\X55001.PKG.wpd)

MEMORANDUM
DEPARTMENT OF TRANSPORTATION

TO: D. A. Currey, P.E., Regional Director, Region 11

FROM: A. Jablowsky, P.E., Regional Design Engineer, R-11 AJ 5/2

SUBJECT: **Design Approval** - ISTEA Transportation Enhancement Project
PIN X550.01 (Contract # D009817) Brooklyn Heritage Trolley Program

DATE: May 2, 2001

This unique project, which will result in a fully-operational historic trolley line in waterfront streets and publicly-accessible private waterfront in the Red Hook neighborhood of Brooklyn, is sponsored by the New York City Department of Transportation, with materials and labor donated by the Applicant, the Brooklyn Historic Railway Association (BHRA).

The Sponsor has contracted with BHRA to obtain and install the track, overhead wire and other appurtenances for operation on public streets and private property. The ISTEA federal allocation of $209,970 is matched by $52,493 of local funds in the form of additional materials and an additional NYCDOT STP allocation to bring **the total project cost for materials to $328,463.** Antique trolley cars refurbished by the BHRA will serve as a historical exhibit and a useful transit link for visitors to the historic waterfront.

The project and its impacts are described in the attached Design Approval Document developed by the project Sponsor and Applicant. The DAD was circulated within the Region for review. All comments have been addressed. As federal funds are being used only for materials purchase, the Region allowed the Sponsor to solicit bids for purchase of the equipment, subject to our subsequent review and approval of this DAD and final Plans, Specifications and Estimate.

Procedurally this project has been advanced as a Type II project under SEQRA, and is a programmatic categorical exclusion under FHWA 23 CFR 771.117 regulations. The Regional Environmental Unit has also concurred that there will be no significant impact on the environment due to the construction of this project. Please indicate your approval of design by signing this memorandum.

Approved by

D. A. Currey, P.E.
Regional Director

c: J. Manzolillo, RPPM / P. Pomeranz, Construction, NYSDOT R-11
J. Morrone/ P. Fox, Project and Letting Management Bureau 5-520
R. Frazier/ G. Perlman/ K. Costa/ P. Stanton, NYCDOT
R. Backlund, FHWA
File (C:\PD\TEP\CDOT\TROLLEY\X55001.PKG.wpd)

NEW YORK STATE DEPARTMENT OF TRANSPORTATION

INSPECTION REPORT * TRANSPORTATION ENHANCEMENT PROJECTS

PROJECT DESCRIPTION: Brooklyn Heritage Trolley Project		PIN X 550.01.321 D 009817
REPORT # 19	DATE: 12/19/01	FHWA #
TIME ELAPSED: 100 %, Phase I 25 %, Phase II	WORK COMPLETED: 100%,Phase I 25%,Phase II	NYCDOT # 97C3568
IN COMPANY WITH: B.Diamond, President, B.H.T.A. G.Castillo, Curator, B.H.T.A.		COUNTY: Kings PROGRESS OF WORK: Satisfactory
INSPECTION MADE BY: M.Parker,B.Vygodner, NYSDOT.		

COMMENTS:

An inspection was conducted today to review the progress of construction for the Brooklyn Heritage Trolley Association. The following was observed :

1) The B.H.T.A. is continuing work on installing the track and related hardware on New York City streets.Track and ties have been installed on Conover Street.

2) The B. H. T. A. is compacting the subgrade at the excavation they recently performed on Reed Street. The existing road is also being sawcut for further excavation.Both locations are being lined by timber curb and wooden barricades to protect traffic.

3) The Association is working on sheet metal repair of PCC car # 70.

All work appeared satisfactory.
The Maintenance and Protection of traffic is satisfactory.
Total work completed to date is $ 475,000, of which $321,079 has been processed as reimbursement requests thus far.

CC. M. Strasser, N.Y.C.D.O.T.
Project File.

Michael Strasser
Assistant Commissioner
Bureau of Transit Operations
Battery Maritime Building, 3rd Floor
New York, New York 10004-1498
(212) 806-6900 Extension 6719

NEW YORK CITY DOT

New York City
Department of Transportation

Elliot G. Sander, Commissioner

Minutes of Meeting Between NYCDOT and BHRA
May 21, 1996, 10:00 AM
Battery Maritime Building

Attendees: Paul Stanton, NYCDOT, Richard Cohen, NYCDOT, Daniel Orlando, NYCDOT, Brian Selwyn, NYCDOT, Bob Diamond, BHRA.

The listed parties met to discuss the remaining steps and timetable required for NYCDOT/BHRA to obtain NYSDOT funding for reimbursement of the cost of materials needed to construct the Brooklyn Heritage Trolley Project.

Bob Diamond voiced frustration with the slow pace of the funding process and expressed concern that without immediate funding he may not be able to continue with the project.

NYCDOT realizes the amount of time, materials and work that BHRA and its supporters have devoted to this project.

With the earliest possible date for a registered contract between NYCDOT and BHRA anticipated in late summer, all recognized the need to expedite the following critical steps necessary to accomplish that mutual goal.

1. NYCDOT will submit to OMB, at the earliest possible date, a budget request to ensure that City Funds will be available for a timely registration of the contract between BHRA and NYCDOT. Richard Cohen will prepare the GA-1 form to start this process.

2. NYCDOT will recognize BHRA's invoice dated February 15, 1996 and later as reimbursable. (Date that NYS approved funding for this project.) BHRA will be able to invoice for a maximum contract amount of $209,970. NYCDOT recognizes that BHRA has apparently already raised and expended funds in excess of the ISTEA program required local match.

3. NYCDOT will provide Bob Diamond with a recent "sole source" contract as a guide in preparing the first contract draft. This contract will ultimately need to be approved by BHRA, NYCDOT Legal, NYC Law Department, and NYSDOT. It is not known yet what contract legals will be necessary to satisfy each review: i.e. insurance requirements, NYS boilerplate, etc. At the earliest possible date -June 11- NYCDOT will place an "Intent to Enter Into Sole Source Negotiations" public Notice in the *City Record*. This is the first step in satisfying the NYC procurement requirements.

Meeting Between NYCDOT and BHRA (May 21, 1996)

4. NYCDOT will request that the proposed contract be scheduled for the earliest possible Contract Public Hearing. Note: It is necessary for BHRA to complete and submit VENDEX and OLS forms before NYCDOT can submit the draft RFA package to the Mayor's Office of Contracts to request a public hearing calendar date. (DOI has thirty days to complete their VENDEX Search). The draft proposed contract must be available for public inspection and be transmitted to elected officials at least 10 days before the date of the Public Hearing. NYCDOT must prepare and have its agency head sign a "Peter Powers" memo as part of the Public Hearing request package. (MOC requires 30 days to schedule a contract public hearing - usually held bi-weekly on Thursdays.)

5. Following the Public Hearing, NYCDOT shall provide BHRA with a contract award letter.

6. Mayoral oversight approvals and registration of the contract by the Comptroller's Office are currently taking a minimum of two months. NYCDOT will seek an expedited registration by the Comptroller. (The Comptroller's Office has 30 days to register or reject a contract submitted for registration - a walk thru registration can shorten this to several days. We have no control over how long it takes the Mayor's Office or Deputy Mayor take to sign off approval of the *Certificate of Procedural Requisites*.)

7. NYCDOT will endeavor to compress these required steps, usually requiring a minimum of six months, into a process of three months. NYCDOT also offered to do anything within reason to assist BHRA in securing a bridge loan in the interim period.

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IV. OTHER SAFETY PROCEDURES (cont)

INTRODUCTION

Adherence to the procedures set forth in this Safety Plan is vital to the existence of the Brooklyn Historic Railway. For this Manual the BHRA has looked beyond the operation here in Brooklyn to many other cities and to commercial railroads. Many of the rules and regulations of service remain pertinent more than one hundred years later. For the operation of the Brooklyn Historic Railway in Red Hook we have both updated them as well as added new ones.

Please join in the spirit of safety and enjoyment these safety procedures are intended to bring to our service and our community.

ACKNOWLEDGMENTS

The Brooklyn Historic Railway Association would like to thank the following for their support of this operation: Community Board 6, Brooklyn; New York City Department of City Planning, New York City Department of Transportation, New York State Department of Transportation; Greg O'Connell; Harry Nicholls; William Beard and the Internet.

GENERAL NOTICE

The Brooklyn Historic Railway is a not-for-profit organization, registered under Section 501c(3) of the Internal Revenue Code. Its future depends upon safe and competent operation of the Railway.

Any person who sets equipment in motion accepts the full responsibility for the resulting actions. Those who accept this responsibility hold the future of this Railway in their hands.

To enter or remain in the Operating Department is an assurance of willingness to obey the rules. The Railway demands the faithful, intelligent and courteous discharge of duty.

As a responsible organization, the Brooklyn Historic Railway Assn, Inc. cannot support or condone any act that might discredit or bring legal action against the Railway. This applies to the personal conduct of individual patrons as well as the operation of the Railway. The proper observance of this Safety Plan is a prerequisite to enjoying the rights and privileges of work on the Railway. Any infraction thereof or abuse of the Railway's property will result in swift and appropriate disciplinary action.

This Safety Plan is designed to promote consideration and respect not only for the Railway's equipment but also for riding and general public.

The proper observance of this Safety Plan should therefore improve our safety habits and should impress on the public that the BHRA is an institution worthy of their interest and support.

I. GENERAL SAFETY PROCEDURES

1.0 APPLICATION OF SAFETY PLAN

1.1 These procedures, bulletins, and other written instructions or notices published or adopted by the Railway apply to all Railway personnel whose duties they affect, and must be obeyed. Adherence to the Rules is essential to safety, and safety is of primary importance in the performance of duties. Violation of a rule or rules may be sufficient cause for termination, suspension or other disciplinary action.

1.2 Operating personnel must be conversant with the Safety Plan and obey the rules, special instructions, bulletin notices and train orders. If in doubt as to their meaning they must request an explanation from the proper authority. When in doubt or uncertain in any situation take the safe course of action.

1.3 The Railway will maintain a program of training, testing, certification, inspection and periodic re-instruction of operations personnel in the Safety Plan. Also, there will be a periodic review of the Safety Plan itself to ensure it is current and meaningful. Suggestions designed to improve any rule should be submitted to the Director/General Manager or to the Safety and Training Committee of the BHRA.

1.4 Personnel working in any service connected with the movement of rail equipment are subject to the Safety Plan and special instructions:

1.5 Any violations of any Procedure, Rule or other instructions must be reported promptly to the Director/ General Manager or Designated Authority.

1.6 The following age requirements apply to those who operate under these rules:

A. The minimum age for qualification as an OPERATOR shall be 21. Individuals under 21 who pass the Museum's training program shall be qualified as JUNIOR OPERATOR.

B. A JUNIOR OPERATOR may not operate in passenger service until reaching the age of 18 AND having a minimum of one year of experience as a Junior Operator.

C. When a JUNIOR OPERATOR operates in passenger service under the provisions of Rule 1.6(B), there must also be a qualified Operator over 21 years of age assigned to the car by the Dispatcher.

2.0 REPORTING FOR DUTY

2.1 Operating personnel must have up-to-date copies of the Safety Plan and any other prescribed rules or instructions on their persons when reporting for duty. A current copy of the Safety Plan is also kept at the Dispatcher's station. The Safety Plan book must be surrendered for examination to proper authorities Upon request.

2.2 Operating personnel must read the information in the Safety Plan, initial each Posting in the designated location and are accountable for compliance with posted instructions. Operators should review the Postings each day to check for new notices.

2.3 All operating personnel must report for duty at least one (1) hour prior to the start of public operation on their assigned duty day unless prior arrangements have been made with the Designated Authority.

2.4 All operating personnel reporting for duty must sign the Duty Roster signifying they have read and understood the Postings, special orders, and other information in the Safety Plan book.

2.5 All operating personnel must be clean and neatly groomed. In order to create the proper atmosphere for the general and riding public, they must wear a uniform consisting of regulation shirt and slacks or skirt, BHRA identification card, and black shoes (polishable preferred). The wearing of a matching uniform jacket or sweater is optional. A full uniform is expensive and thus the minimum requirement prevails, however, staff and crew are encouraged to acquire a full uniform over time.

3.0 CONDUCT OF RAILWAY PERSONNEL

3.1 Railway personnel must engage only in museum business while on duty and perform their duties thoroughly, efficiently and in compliance with the Safety Plan and instructions. They must render every assistance in carrying out Railway rules and instructions.

3.2 Civil, proper behavior is required of all personnel in their dealings with the public, their co-workers and other members.

3.3 All personnel are expected to perform as Docents when dealing with the public.

3.4 Railway personnel must continually exercise care to avoid injuring themselves or others. They must know the locations of restricted clearances and must be alert for the movement of equipment on any track in either direction. They must not stand on the track in front of an approaching car or walk in front of a moving car for any purpose.

3.5 Boarding or riding the leading or trailing foot board, steps, ladders or running boards of a moving engine, car or any rolling stock is prohibited. Personnel and passengers on any moving vehicle must keep body extremities inside the framework of the vehicle.

3.6 While on duty or on the Railway grounds, participation in any unauthorized activity that may interfere with the proper performance of other Railway personnel in their duties is prohibited.

3.7 The use, possession, or influence of intoxicants or narcotics by personnel available for or on duty is prohibited. No person who has taken intoxicants, narcotics, or other undisclosed prescription drugs in the preceding eight (8) hours shall be engaged in any way in the operation of a car. Any use of prescription drugs should be noted in the Duty Roster before the beginning of each shift.

A Designated Authority having reason to suspect that a person is under the influence of intoxicants or narcotics or has taken same within the preceding eight (8) hours shall not permit such person to be engaged in the operation of a car, nor shall any other person permit himself to be relieved by such a person. Violators of this rule shall be suspended or shall have their employment and association with the BHRA terminated.

3.8 Any person taking medication that may affect his or her judgment or faculties must not be engaged in the operation of a train in any way.

3.9 The use of tobacco by crew members while operating cars in passenger service, or in any cars, carbarns or other designated non-smoking areas is prohibited.

3.10 Members must keep the premises in a neat and orderly condition. They must use care and economy in the use of the Railway's property and energy

3.11 Railway personnel must not occupy seats in trains or cars if passengers are standing. Railway personnel wearing badly soiled or greasy clothes must not occupy seats at any time.

4.0 VISITORS IN DANGER/ TRESPASSERS

4.1 Personnel discovered in locations where they are not permitted or where they are in immediate danger must be warned at once. If they do not respond positively reports the incident to a Railway Conductor, Crew, Dispatcher, or Designated Authority as quickly as possible.

II. SIGNALS AND COMMUNICATIONS

5.0 HAND SIGNALS

5.1 Hand signals are as illustrated below. The speed of the hand movement is proportionate to the manner in which the signal is to be observed. For example: when the stop signal is observed the train must be stopped immediately at a rate proportionate to the speed of the hand movement. Operators must not assume that the person giving this signal is simply "flagging down" his train.

1. STOP
Swung horizontally at a right-angle to the track

2. PROCEED FORWARD
Made in relation to the operator's position - i.e: put the reverse key in the forward position.

3. REVERSE
Made in relation to the operator s position - i.e: put the reverse key in the reverse position. Swung in a circle.

4. SLOW DOWN One hand extended horizontally at arms length.

5.2 The following must always be regarded as a signal to stop:
a) A signal whose meaning is unclear. b) Any object waved violently by anyone on or near the tracks or on a train on an adjacent track. c) Disappearance of a person giving hand signals, or of the light by which such signals are given.

5.3 Operating personnel must keep a constant lookout for hand signals. Persons giving hand signals must locate themselves so as to be plainly seen and give signals so as to be plainly understood. Those to whom hand signals are given must act on them promptly and properly.

5.4 The person giving hand signals during yard, switching, backing or other such operations is in charge of the operation and their instructions are to be obeyed.

5.5 Operators must not move a train on a hand signal unless positive that the signal was intended for them.

6.0 THE RADIO SYSTEM

6.1 The primary communication system for operating the BHRA main line and associated trackage is our two-way radio system. Constant contact is maintained between the Dispatcher and the Car Crews through the use of this system. In addition, the radio affords the Dispatcher greater control in maintaining schedules and the flexibility to change orders even after the main line trip is under way.

6.2 All Conductors and Motormen will carry battery-operated portable radios to communicate with each other and Base.

6.3 The National Transportation Safety Board has recommended that organizations which offer rides to the public, equip each vehicle in use with radio capability in order to be able to summon local emergency services for those persons on the vehicle that may require emergency assistance. This link is maintained at the Railway by the Dispatcher, who will relay all radio requests for assistance to the proper authorities via telephone.

6.4 BHRA shall operate its radios in accordance with the rules of the Federal Communications Commission.

6.5 The following rules govern the operation of the radio equipment at the Railway:

A. The Dispatcher is in charge of all railway radio communications. Channel 1 is reserved for the operation of the Railway and all communication on this channel must be directed to the Dispatcher. Do not communicate directly with other car crews. The Dispatcher shall relay all necessary communications to those car crews. Channel 2 is used for secondary communications between two members of a train crew for switching moves, between members of a work detail or other such communications. The Dispatcher is not involved with these communications directly but may intercede when required. In the event of communications failure on channel 1, channel 2 may become the operations channel and all other normal communication shall yield to operations.

B. Radios must be used exclusively for Railway operations (no private conversation) and, in the event of failure of such communications, other means must be used to avoid delay. The radios are not to be used for personal messages or phone calls not related to the immediate duties of the Operator.

C. Before transmitting by radio, the individual must listen to ensure that the channel on which he/she intends to transmit is not in use. When an employee or volunteer is issued a radio for use a voice test should be made immediately upon taking charge of that equipment.

Cars, trains, engines, or other equipment (including fixed locations), when attended and equipped with radio capability, must have the radio on and tuned to the proper channel at all times, with the volume and squelch controls adjusted to ensure reception.

D. No one shall knowingly transmit any false distress communication, any unnecessary, irrelevant, or unidentified communication or utter any obscene, indecent or profane language.

E. Procedures governing identification and content of radio messages:

1. To originate a call, the first word in the transmission shall be "Brooklyn."

2. Any person making a transmission will identify themselves by the name of their function, location and/or equipment and the destination of the transmission. (e.g.: "Brooklyn Conductor,

car 14, at Coffey Street, to Dispatcher."

3. Final sign off of a series of transmissions will be accomplished by either stating the call sign, indicating the transmissions were either understood or accurate and the frequency is clear. In passenger operation this will be exclusively done by the Dispatcher. For example, the dispatcher responding to a crew at Coffey Street that has just correctly repeated the inbound orders would say: ""XXXX-712"indicating the crew member was correct in the transmission and the Dispatcher is clear. This would end this transmission series. For other radio communications the individual making the final transmission would state the call sign.

4. "EMERGENCY" must be transmitted three (3) times to obtain the use of radio channels for the initial report of conditions endangering train movements.

E. Everyone shall give absolute priority to emergency communications and, except in answering or aiding a station in distress, shall refrain from sending any communications until there is assurance that no interference will result to the station in distress.

F. When radio communications are used in lieu of hand signals in connection with the switching, backing or pushing of a train, engine or car, the individual directing the movement shall give complete instructions or keep in frequent radio contact with the individual receiving the instructions. If the instructions are not understood or frequent radio contact is not maintained, the movement of the train must be stopped immediately and may not be resumed until the misunderstanding has been resolved or communication has been restored.

G. Persons must ensure that there is communication with the proper persons and must not take action until they are certain that all conversation concerning them has been heard, understood and acknowledged. All transmissions must be repeated by the person receiving them except those used in Yard switching where repetition is unnecessary.

For example: The instructions from the Dispatcher should be repeated exactly as given, by the crew member receiving the instruction, assuring that the Dispatcher's order has been heard and clearly understood. The Dispatcher will then confirm acknowledgment of the orders by stating the radio station call sign or restate the orders if the crew member has not repeated the orders correctly. Replies such as "ROGER", "Ten-four", or "Understood" are not sufficient to determine accurate understanding of the radio transmission by the car crew.

Any radio communication which is not fully understood or completed in accordance with the requirements of these rules shall not be acted upon and shall be treated as though not sent.

H. All transmissions must be kept as brief as possible, without being curt or rude. If more information is required or a misunderstanding develops, you may be asked to repeat or clarify your transmission.

I. Individuals using radio equipment must exercise care to prevent damage to or loss of such equipment. Those individuals assigned a portable radio will be responsible for the care and protection of such a radio while in their possession.

J. Radio communications are often monitored by the Federal Communications Commission to ensure rules are followed and proper operation is maintained. Be sure to follow the rules as stated within this procedure at all times.

It is important to note that the Federal Communications Commission has very strict rules governing the use of these frequencies and great care must be given not to misuse the radio as this would cause the Railway to lose its license, be fined or both (fines of up to $10,000 per day of violation and/or jail). All radio equipment operating on the Railway's assigned frequencies must be authorized by the Director/ General Manager or the Board of Trustees. All such radio equipment must be owned by the Railway or on loan to the Railway and under its direct control in order to operate under the terms of the Railway's license.

6.6 As part of the operation of the Railway, it is expected that when a car crew has reached the end of the line at Coffey Street and has prepared the car for the return trip, the Conductor (or Motorman) shall call for clearance to proceed inbound. This is to ensure the line is clear or allow the Dispatcher to notify the inbound crew of potential hazards that were unknown to the crew upon departure. (This requirement may be modified by the Dispatcher on duty but, if in doubt at anytime, call for clearance to be sure. If radio contact cannot be made, motorman shall attempt contact to Dispatcher by cellular telephone. If no contact can be made, motorman shall use direct call box mounted to last line pole at Coffey Street. In no event, shall motorman move train without permission of dispatcher.

If train is more than 15 minutes overdue, Dispatcher shall investigate in person to ascertain location and disposition of train, and issue appropriate instructions for its movement.

7.0 FIXED SIGNALS (EXCEPT TRAIN MARKERS)

7.1 Fixed signals are flags, boards, cones, painted pipe devices and common street signs whose meanings have become convention. (See Appendix ~ for illustrations}

7.2 Flags are often used as temporary signals that can be left in place until a problem is quickly corrected or a more permanent sign can be installed.

7.3 Signal colors are as follows:

COLOR	INDICATION
Red	STOP
Yellow	Proceed at Restricted speed - also work zone.
Green	Proceed per orders
Any Color	Flag or cone placed between the running rails means STOP
Blue	Workmen on or about the train. (Train must not be moved, See Section 15)

8.0 GONG BELL AND WHISTLE SIGNALS

8.1 The gong and whistle must be sounded where required by Rules or operating conditions. Refrain from excessive use of the whistle, especially in the residential or low traffic areas. Use the gong.

8.2 Whistles are not to be sounded after 8:30 p.m. or after dark, whichever comes first, or before 8:30 a.m., unless an emergency demands their use. (This is out of consideration for our neighbors)

8.3 Signaling conventions for warning and communication:

SOURCE	GONG	WHISTLE (HORN) — = LONG, 0 = SHORT	INDICATION
Conductor	1	0	When moving, stop at next regular stop
Conductor or Motorman	2	00	When standing, release brakes proceed.
Conductor or Motorman	3	000	When moving, STOP NOW! When standing, back up.
Motorman	4	0000	Call for signal
Motorman	5+	— — 0 —	Approaching Grade Crossing
Motorman	1	—	Approaching point of Limited Visibility
Motorman	5+	Succession of Short Blasts	Warning to Persons or Vehicles on Track

NOTE: The Motorman must always return the Conductor's signals!

8.4 Operating crews shall not permit unauthorized personnel to operate whistles or gongs.

1. Operator Signals

* 1 gong - Ready to go forward. Answer is 2 bells by Conductor if all is clear.

* 2 gongs - Ready to back up. Answered by 3 bells from Conductor if all is clear.

2. Conductor Signals

1 bell - Loading /unloading completed, ready to proceed - "All Clear." Answer is 2 gongs by Operator.

[2 bells] - Operator is to stop at the next passenger stop. No answer by Operator is required.

[3 bells] - If moving, this is an "Emergency Stop" signal from the Conductor to the Operator. If already stopped, it is an OK signal to start backing. No answer is required for an emergency stop. Three gongs must be sounded before any backup movement.

NOTE: If the bell is sounded for no apparent reason, or at an unusual time or location, the Operator is to check the welfare of the Conductor.

The Conductor is responsible for observing the surrounding conditions and notifying the Operator of any unsafe conditions or impending danger or emergencies. The Operator is committed to looking forward and observing traffic most of the time. Team effort is necessary for safe operation and passenger comfort.

9.0 AUTOMATIC BLOCK AND INTERLOCKING SIGNALS

An automatic block signal system actuated by continuous track circuits enhances the safety of any railroad operation. In an environment of fragile, historic cars of different materials, different sizes, different masses, different structural systems and different safety systems such a signal system is a necessity. If an emergency arises the signal system alerts other operators about an impending problem which they can take steps to avoid or mitigate. It is this spirit of providing warning to operators of conditions that warrant attention that generated the rules that follow.

9.1 GENERAL SIGNAL RULES

A. The extent of the railroad subject to signal system rules shall be defined in The Book.

B. The signal system shall be turned on whenever there is any car movement on the main line beyond the Shop switch. The signal power control switch box is located on the wall of the Car Barn near the chalkboard, contains instructions on its use, and is locked by a standard RAYCO signal padlock.

C. Signal indications do not constitute authority for the movement of trains; only the Dispatcher shall authorize the movement of trains.

The signal system is a safety system only, NOT a traffic control system; it provides only one source of information to operators for the safe movement of trains.

D. Operators shall obey all signal indications shown in these rules insofar as they do not conflict with the Dispatcher's orders; in case of conflict, the Dispatcher's orders shall govern.

As a simple rule, operators shall stop at STOP signals and shall reduce speed at APPROACH and DIVERGING ROUTE signals

E. Signals shall be located to the right of the track that they govern, from the operator's point of view. Any exceptions shall be noted in The Book.

F. A signal indicating a restriction of speed shall be acted upon as soon as it becomes visible, but a signal indicating CLEAR shall not take effect until the train reaches the signal. Trains shall stop at a signal that indicates STOP AND PROCEED or STOP AND STAY.

G. If a STOP sign is located at a signal, the train shall come to a complete stop, and then upon the Conductor's signal. shall continue in accordance with the signal's indication. If the signal indicates STOP AND PROCEED, the train need not stop a second time; one stop is sufficient. However, if the signal indicates STOP AND STAY, the train shall remain stopped until the signal changes to give a more favorable indication.

H. Once a train has passed a signal, or a switch or derail has been operated in response to a signal indicating that it was safe to do so, the indication resulting from that action does not apply to the train at that location.

I. A train shall not pass a signal giving a STOP AND STAY indication without one of the permissions listed below. The train shall come to a full stop and remain stopped until such permission has been given, or until the signal has changed to give a more favorable indication.

J. A train shall not pass a defective signal without one of the permissions listed below. The train shall come to a full stop and remain stopped until such permission has been given. A defective signal is defined as one, which does not give a distinct and unambiguous indication.

Examples of defective signals are a semaphore with the arm missing, a color-light or searchlight showing no light at all, a two-headed interlocking signal showing a light only in the lower head, or a color light showing more than one light in the head (except a signal territory marker).

K. Permission to pass a STOP AND STAY indication or a defective signal shall be given by one of the following methods:

1. Dispatcher's order transmitted by radio or telephone

2. Flag or hand signal by flagperson authorized by Dispatcher or Superintendent of Signals

3. Dispatcher's written order (SIGNAL CLEARANCE FORM)

4. Flag or hand signal by car crew's own flagperson.

L. In the event of a signal failure and the inability to communicate with the Dispatcher, all movements shall be protected by flagging. See section 22.0 PROTECTION OF TRAINS BY FLAGGING.

M. Any person noticing an imperfect signal shall report the facts to the Dispatcher. An imperfect signal is defined as one that has had some noticeable failure but is still able to give a distinct and unambiguous indication.

Examples of imperfect signals are a semaphore with a burned-out lamp, a color-light or searchlight with a dim aspect, or a two-headed interlocking signal showing a light only in the upper head.

N. The Dispatcher shall report all defective and imperfect signals to the Superintendent of Signals and the Dispatcher.

O. A signal, or the entire signal system, shall be declared to be out of service, when necessary, by written order by the Dispatcher or the Superintendent of Signals. The Dispatcher shall use the SIGNAL CLEARANCE FORM for this purpose, following the instructions printed on the form. The Superintendent of Signals shall post written notice in The Book. Except as provided below, the Dispatcher shall issue SIGNAL CLEARANCE FORMS each day that the signal(s) is (are) out of service.

P. When the entire signal system is out of service for an extended period of time, each signal shall be marked by a "SIGNAL OUT OF SERVICE" device. (See illustration in Appendix A.) The use of this device relieves the Dispatcher from issuing SIGNAL CLEARANCE FORMS and relieves operators from stopping at each marked signal.

9.2 SIGNAL ASPECT'S AND INDICATIONS

A. Every signal shall have a number plate, and the presence of a number plate is not part of any aspect.

B. For illustrations of the signal aspects, names or indications see Appendix A. In those illustrations:

1. the colors used are green, yellow, red, purple, and lunar white (shown as pale blue);
2. is used to indicate a rectangular opening containing an illuminated sign;
3. is used to indicate the aspect is flashing;
4. if a device attached to the signal appliance does not contribute to the particular aspect being illustrated, the device is not shown in the illustration.

9.3 ABSOLUTE PERMISSIVE BLOCK SIGNAL RULES

An Absolute-Permissive Block (APB) signal system is used on a single-track railroad to protect movements in both directions. The absolute block extends the entire length of the single-track section (between head block signals) for opposing movements; permissive blocks extend between intermediate automatic block signals for following movements. "Absolute" and "permissive" refer to the types of stop required by a red light (classic usage - this railroad uses different aspects to distinguish between the types of stops). All APB signals operate automatically by the passage of the trains (by the use of electric track circuits).

A. Head block signals shall control the entrance to each section of single track, and automatic block signals shall govern train movements between each head block location

B. Head block signals may give a STOP AND PROCEED only when the signal is taken out of service; however, the indication is still STOP AND PROCEED.

C. Head block signals shall operate as follows:
1. The normal indication for a head block signal is CLEAR. Do not enter the single-track section without the Dispatcher's explicit order!

When a train enters the single-track section, passing the head block signal, all of the opposing signals "tumble down" to STOP AND STAY. As the train progresses along the single-track, signals following the train change to STOP AND PROCEED, then to APPROACH, and then to CLEAR, for following movements.

If two opposing trains pass their head block signals showing CLEAR simultaneously the next signals in will both show STOP AND STAY. Even though the trains might not be able to stop at these STOP AND STAY signals, sufficient braking distance with a normal service brake application has been allowed between these signals for both trains to stop without collision.

2. If the head block signal or an automatic block signal should suddenly change to indicate STOP AND STAY, the operator shall stop the train immediately and call the Dispatcher for orders. Do not back up while still on a spring switch! Do not back up without the Dispatcher's explicit order!

9.4 AUTOMATIC BLOCK SIGNAL RULES

Since an Absolute-Permissive Block signal system is a special case of Automatic Block Signal (ABS) system all of these rules apply to APB territory as well.

An Automatic Block signal system means that the signals governing the entrance to the blocks are operated automatically by the passage of the trains (by the use of electric track circuits).

A. A spur switch on the main line provided with a switch indicator shall be lined for the spur track to allow movement onto the main line only upon the Dispatcher's order, and only when the switch indicator indicates SAFE TO ENTER. The switch (or derail) may be operated first, before the train enters the track circuit, or the train may enter the track circuit first. After the train moves onto the main line, the switch shall be lined for the main line and locked, and the Dispatcher shall be so notified. The train shall proceed at restricted speed until passing a signal giving a more favorable indication.

B. A spur switch on the main line lacking a switch indicator shall be lined for the spur track to allow movement onto the main line only upon the Dispatcher's order, and after observing that no train is approaching the switch. The switch shall be lined for the spur, but no train shall he moved onto the main line until two (2) minutes have elapsed since operating the switch. No delay is necessary where signals giving indications more favorable than STOP AND STAY can be seen in both directions. The crew shall be prepared to line the switch, for the main line if a train approaches. If a train does approach, the crew shall obtain new orders from the Dispatcher before moving. After the required time has elapsed, the train shall move onto the main line, the switch shall be lined for the main line and locked, and the Dispatcher shall be so notified. The train shall proceed at restricted speed until passing a signal giving a more favorable indication.

C. A train shall not reverse direction past a signal without the Dispatcher's explicit order. After the Dispatcher's order has been obtained, the train shall reverse direction and proceed at restricted speed until passing a signal giving a more favorable indication.

Reversing direction past a signal is the most dangerous action that can be taken in signal territory. This action deprives any following train of its guaranteed braking distance, and has been the cause of many serious accidents throughout railroad history.

E. Crews of vehicles that do not operate signal circuits (track cars) shall request and receive the Dispatcher's order to operate on signaled track. A train authorized to follow track cars shall be required to proceed at restricted speed, until the crews of the track cars report in the clear. See also paragraph 19.7 "Approaching Other Rolling Stock."

Allow plenty of distance when following track or overhead line maintenance vehicles, as tools or materials might fall suddenly from a vehicle onto the track, creating a hazard to your train.

F. Any train delayed in a block shall proceed at restricted speed until passing a signal giving a more favorable indication.

9.5 INTERLOCKING (AND ROUTE-INDICATING AUTOMATIC BLOCK) RULES

An interlocking is used to protect a location at which there are one or more diverging or crossing tracks, and through which there are two or more possible routes which might conflict. In the interlocking, the switches and signals are interconnected so that no conflicting routes can be established and cleared simultaneously.

Route-indicating automatic block signals are interconnected with switches to indicate which is established, but the operating of track switches cannot be prevented.

A. Interlocking signals (and route-indicating automatic block signals) have two heads, aligned vertically.

1. The top head (home signal) gives track occupancy information by giving CLEAR, APPROACH, STOP AND PROCEED, and STOP AND STAY indications.

2. The bottom head (route signal) gives track switch position information. Green indicates that the switch(es) is (are) lined for the MAIN ROUTE, and yellow, the principal DIVERGING ROUTE. Red indicates that the switch(es) is (are) improperly lined, and will be accompanied by red on the top head as well (STOP AND STAY indication).

Note that a DIVERGING ROUTE indication requires a reduction of speed to slow speed, and that trailing through a spring switch on any route also requires slow speed.

3. A rectangular opening capable of displaying an illuminated sign will, when illuminated, indicate that the switch(es) is (are) lined for the NAMED DIVERGING ROUTE, and will always be accompanied by yellow on the route signal.

B. At the present time all track switches are hand operated. If a train encounters a switch not lined for the desired route, the operator shall stop the train and a crew member shall line the switch for the desired route. The operator shall then observe (where practicable) that the signal indicates the correct route before proceeding through the switch.

9.6 SIGNAL LOCATION MARKERS AND SIGNAL CIRCUIT BOUNDARY MARKERS

A. Signal location markers have the sole function of marking the position of a signal, and are used on tall semaphores, other head block signals, and the last signals before sharp curves.
B. Signal circuit boundary markers have the function of marking the boundaries of important signal circuits, such as the locking zone before an automatic power switch.

9.7 SWITCH INDICATORS

A. Switch indicators (indicators at switches) have the location and appearance of dwarf color-light signals, but have the function of indicating whether there are trains approaching on the main line.
B. Where switch indicators are used, there are special track circuits, which, when entered upon, have the same effect as lining the track switch for the spur.

9.8 SPRING SWITCH POSITION INDICATORS

A. Spring switch position indicators indicate the position of the switches only; they do not convey track occupancy information.

9.9 GRADE CROSSING SIGNAL RULES

A. Operators shall observe that each grade crossing signal is functioning before moving their trains across the crossing without stopping.

1. A grade crossing signal shall be considered to be functioning if the operator observes that the light in the side of the flasher head goes on and off periodically, and that the bell rings continuously.

2. If a grade crossing signal is not functioning, the train shall stop at the crossing before proceeding. The operator shall notify the Dispatcher of the non-functioning grade crossing signal.

3. If a grade crossing signal is reported to be not functioning, the Dispatcher shall have a crew member check the Manual Control box for the proper position of the switch. The switch should be in the "ON" position in order for the signal to function automatically. If moving the switch to

the "ON" position does not cause the signal to function, the Dispatcher shall so notify the Superintendent of Signals.

4. Vehicles known not to operate signal circuits (track cars) shall make a full stop before proceeding across the roadway.

5. When the Dispatcher has been notified that a particular grade crossing signal is not functioning, the Dispatcher shall so notify the operating crews and order them to stop before proceeding across the roadway (SIGNAL CLEARANCE FORM).

B. The operator of the inspection train on the main line each day shall pay particular attention to whether the grade crossing signals are functioning. If any grade crossing signal does not function, a crew member shall take corrective action as stated above.

C. If a train will be standing on the actuating circuit of a grade crossing signal for a long period of time a crew member shall place the Manual Control switch in the "OFF" position, to stop the signal from functioning. Before the train leaves the location a crew member shall return the Manual Control switch to the "ON" position.

III. OPERATION OF TRAINS AND CARS

10.0 TIME

10.1 The Railway operates on prevailing local time (Eastern Standard Time, or E.S.T.). This will be known as "Standard Time".

10.2 The correct Standard Time will be indicated by the clock in the Car Barn or other such other clock as designated by the Director/ General Manager. Personnel on duty must adjust their watches to this time when beginning duty.

10.3 Railway personnel involved in any way with train and car operation must wear a reliable watch while on duty.

10.4 To be sure of the schedule on a given day, consult the operating schedule. The Dispatcher has the authority to change, advance or delay this schedule for special operations. This would be accomplished through train orders or special posted notice.

10.5 Passengers must be informed immediately of any delays or disruptions in service.

11.0 PREPARATION

When preparing a streetcar for service, the Operator is to:

1. Obtain brake handle, reverse key, light key and portable radio from the office. Make sure no one is in, beneath, or beside the streetcar. Make sure that all switches are off and the reverse key

is NOT in the controller. Check to see that the front trolley pole is hooked down and place the rear pole on the proper wire. Do not raise more than one pole at a time when in or near the car barn, especially when the streetcar is located beneath the insulators above the car barn doors. Trolley poles are "live".

2. Turn on all switches required to be in the "On" position: circuit breaker, light switches, air compressor, and change-over switch for intended direction of travel.

3. Visually check all lights, including the headlights, brakes and turn signals by operating the changeover switches. Check operation of the sanders. Check air brake pressure (60 psi minimum); normal air brake pressure is 60-70 psi.

4. Inspect interior and exterior of the car for any damage. Report all defects to Master Mechanic by use of the "bad order" form.

5. Set air brakes, release hand brakes, sound gong to warn anyone working in the vicinity, release air brakes, apply first notch of power, operate a short distance and test air brakes for normal operation.

6. If the streetcar is operating normally, proceed on assignment. Be sure the car barn door is open.

CAUTION: Do not move the air (service) brake valve handle too slowly, or little by little. This causes the streetcar to approach too close to the stop mark before sufficient air pressure has been applied to check its speed. It is then necessary for the Operator to increase the air pressure to avoid overrunning the stop mark. This causes the brakes shoes to grip, skidding the wheels and stopping the streetcar with a jolt - to the discomfort of the passengers. When the brakes lock the wheels, they skid, and this produces flat spots on the wheels. Flat spots are noticeable as a banging noise when the wheel turns, and are both difficult and costly to repair. "Fanning" the brake handle (alternately applying and releasing air), is a bad practice. It is much less effective than the correct method and it increases wear and tear on the brake valve.

12.0 LEAVING THE YARD

The following steps (in about the same order) should prove helpful and also help avoid unnecessary damage to equipment.

1. Place the trolley pole on the line.

2. If the compressor does not start turn on the compressor switch.

3. Turn the lights on with light switch

4. Find the control, brake, and reverse handles

5. Check the car for clearance of ground and switches for proper alignment.

6. Remove any trig from under wheels;

7. Make sure that both hand brakes are released.

8. When air pressure reaches more than 70 psi but less than 90 psi and the line is clear, start on the first notch, in a PCC car, depress accelerator pedal lightly.

9. Attain sufficient momentum for the trolley wheels to coast.

10. When traveling over switches, coast or use first notch

11. After main line has been reached, realign the switch as required.

12. Always leave the car with the brakes in full application and take the Reverse Key with you.

13.0 MAIN LINE OPERATION

13.1 The operation of any train or car in revenue passenger service or for special events must not begin until the Conductor has determined that all visitors have been seated. Passengers or other members of the public are not permitted to stand on moving trains or cars.

13.2 Prior to the beginning of public operation or special events the Dispatcher shall have a brief safety review with the car crews along with a discussion of the cars to be operated and their unique features.

13.3 It is requested that Motorman stand while operating a train or car except where visibility its hampered by standing or the controls are positioned for a sitting operator such as a PCC car.

13.4 It is requested that car crews in revenue passenger service assist passengers in boarding and exiting trains and cars as well as help them to be seated and feel welcome. Extra operators waiting for assignment should assist assigned crews in this endeavor to ensure maximum safety and service to our patrons.

13.5 Operation of the railway at times when the Railway is closed to the public must follow all Rules and Procedures including having a Dispatcher on duty.

A. OPERATING ON THE LINE

1. The Motorman should always remain at his/her post while passengers are boarding or leaving the train.

2. If you leave the platform, take the Reverse Key.

3. When making a prolonged stop, place the Reverse Key in the neutral position

4. Always have the Air Brake in Full application when standing (“Park” mode in a PCC car).

5. Wait for the Conductor's signal and check on both sides of the car and ahead before starting.

6. When starting, notch up as quickly as possible to full series or parallel.

7. Coast as much as possible, especially under insulators and slowly over switches.

8. Keep the air brake in full release while underway.

9. Run at moderate speed and use the brake sparingly.

10. Watch the track ahead for obstructions, ESPECIALLY on the first trip of the day.

11. Stop with one application and two releases.

12. Avoid talking to passengers while car is in motion. THIS IS VERY IMPORTANT.

13. Watch for autos turning in front of streetcar. Come to a full stop at stop signs. Obey all traffic regulations.

14. When any operations are complete all vehicles and equipment MUST be returned to their proper storage locations.

14.0 DANGEROUS CONDITIONS

14.1 Whenever an Operator, Conductor, or other Railway Personnel becomes aware of any obstruction on or near the tracks that could create an accident, immediately take action to stop the streetcar before it reaches the obstruction.

14.2 Immediately inform other operating personnel of any dangerous condition observed on or likely to affect their trains or cars, ordering them to stop if necessary. Then notify the Dispatcher or, if no Dispatcher is on duty, another Designated Authority.

14.3 Immediately inform the Dispatcher or, if no Dispatcher is on duty, another Designated Authority of workmen on or fouling any main track not protected by proper work zone signals.

15.0 PROTECTION FOR MEN WORKING ON CARS OR ON THE RIGHT OF WAY.

15.1 Men Working on Cars:

A. A Blue flag must be displayed at both ends (one end, if other end of car is at the end of track) of rolling stock on main station, or yard tracks to indicate that workmen are about. Rolling stock so protected must not be coupled or moved. Other cars must not be placed where they obstruct this signal without first warning the workmen.

B. The operator of rolling stock so protected must be verbally notified when the signals have been displayed and when they have been removed. If possible, the workmen will obtain the reversing key from the operator before displaying the signals and will return it when the signals have been removed.

C. Only the workmen displaying a blue flag or light shall remove it. It must be removed by the workmen who placed it, and only once all other workmen are clear.

D. Under no circumstances may a blue flag be used to "bad order" rolling stock.

E. Operating personnel must assume that workmen are on or about rolling stock in shops or carbarns even in the absence of a blue flag. Rolling stock in carbarns must not be moved until it is determined that all workmen are clear. Rolling stock in shops must not be moved without approval from a Designated Authority.

15.2 Men Working on Right of Way

A. Trains must not pass workmen on or about the track until signaled by the workmen to proceed.

B. Workmen on or about the track, upon being approached by a train, shall stand clear of the track and signal the train to proceed as promptly as circumstances will permit.

C. Workers on the main line shall protect "for and against" trains or cars. Protecting "for" a car means protecting passing cars from danger or damage by equipment, materials, or conditions at the work area. Protecting "against" cars means protecting workers from danger or injury and equipment from danger or damage caused by passing trains.

D. The following is the minimum flagging equipment that shall be carried and used by work crews on the main line:

  2 red flagging devices (painted pipes, flags, or cones).
  2 yellow flagging devices (as above)

The following must be used when working between sunset and sunrise, or when the work area cannot be secured safely during these hours in addition to the flagging devices.

  2 Red lanterns or lights of equivalent colors
  2 Yellow lanterns or lights of equivalent colors

16.0 TESTING BRAKES

16.1 Prescribed standing brake test must be made before moving trains or cars for the first time of the day and in such other circumstances as may he otherwise provided.

16.2 Prescribed rolling brake test must be made for each outbound and each inbound Main Line Railway trip as denoted in the Procedures for Streetcar Operation, Section III. Main Line Ride

17.0 AIR BRAKE FAILURES

17.1 In case of brake failure bring car or train to an immediate stop by the prescribed method and upon stopping trig the wheels and notify the Dispatcher or Designated Authority immediately thereafter. This Rule also applies to loss of electric power.

18.0 COUPLING AND UNCOUPLING

18.1 Coupling and Uncoupling procedures must only be performed by personnel specifically trained in those procedures.

18.2 Couplings should not be made at a speed greater than the minimum speed required to effect coupling, but no faster than 4 mph.

18.3 Do not uncouple cars while they are in motion. "Kicking" and "Dropping" cars is prohibited.

18.4 When coupling, stop within 15 feet of the car or cars to be added. Visually examine the couplers and do not attempt a coupling until they are properly aligned and all personnel are in the clear.

18.5 Cars which have been uncoupled should be secured with trigs so they cannot roll free. Do not leave cars with only hand brakes in the apply position.

19.0 PUSHING OR PULLING OF CARS

19.1 Trains or cars must not be operated with the operator in a position other than the leading or forward position on the train or car unless a member of the crew is stationed on, or in, a position from which he/she can observe the leading end of the train or car being pushed or backed. This person is in charge of the train move and will act as lookout for the operator, guiding by hand signal or radio communication. The movement must be stopped immediately if communication is lost or danger threatens. When back poling a car, a crew member must tend the trolley rope.

19.2 If a streetcar is to be pushed or pulled, all passengers must leave the car. If a wheelchair passenger or other disabled passenger is aboard a disabled streetcar, and providing there is no imminent danger to the passenger, the Conductor is to remain with the passenger while the disabled car is pushed or pulled to the first safe location where the passenger may be unloaded.

19.3 If the air brake is working, keep the air compressor switch "On" so the air brake may be used. If the air brake is not working, place the air compressor switch in the "Off" position and use the handbrake.

19.4 The signal to start (two strokes on the gong) must be given by the streetcar that is pushing or pulling the disabled car. The disabled car is to repeat the gong signal before the car under power starts. Do not exceed series speed on the controller. If the car is being pushed, the Operator of the front car must keep a sharp lookout for any emergency stop situations. Three strokes on the gong is the Emergency stop signal. After sounding the gong, the air (service) and/or handbrakes are to be applied. The Conductor or some other official person is to stand at the rear end of the car being pushed and keep the Operator's compartment door open to allow clear vision for the Operator in the rear car.

19.5 LOOP SWITCH OR CUTOUT SWITCH: Under no circumstance, shall a car be pushed or pulled, unless the loop switch or motor cutout switch is OPENED. Cars being moved by outside force above 3 mph may internally develop 600 volts DC, unless the loop switch or cutout switch is open. Cars with closed switches are also much more difficult to move.

20.0 HEADLIGHTS AND TAILLIGHTS

20.1 At night, and during periods of poor visibility, trains and cars with operable headlights must display it at the leading end of the train. If the train is not equipped with an operable headlight, the leading end of the train must be protected by a white light. Only trains or cars with operable headlights may be used for passenger operations at night and in times of poor visibility.

20.2 At night, and during times of poor visibility, the rear end of a train or car must be illuminated by a red marker lamp.

21.0 AUTHORITY FOR MOVEMENT OF TRAINS

21.1 Main tracks are those tracks used for public revenue operation as shown on the maps in Appendix B. All other tracks are considered to be yard tracks except as may be otherwise provided by the Superintendent

21.2 Main Track Movements

A. When a Dispatcher is on duty, main tracks must not be occupied or fouled without authority from the Dispatcher. Dispatcher must always be on duty during rail operations of any kind.

B. During times other than regular public operation or special event only trains or cars under the control of an authorized pilot may occupy or foul main tracks without authority from a Designated Authority. This authorized pilot will act as Dispatcher if a Qualified Dispatcher is not on duty. The Superintendent will maintain a list of authorized pilots and Dispatchers.

C. Whenever a person comes on duty as Dispatcher, he/she shall write his/her name and date on the Dispatcher Board located on the wall of the car barn. This person shall erase the Dispatcher Board when he/she goes off duty. No other person other than the person whose name appears on the Dispatcher Board may erase the board on the date indicated.

EXCEPTION: A Designated Authority may erase the Dispatcher Board after determining that the person whose name appears on the board has gone off duty without removing his or her name and all main tracks are clear.

21.3 Yard and Shop Movements

A. Except as provided in Rule 19.5, no authority is necessary for after hours movements operated solely on yard tracks and which do not foul main tracks. During the hours of public and special event operations the Dispatcher must be aware of all moves because of power demand concerns and overall power usage.

B. Trains and cars must make a full stop before entering or leaving any building or work facility and sound gong before proceeding.

C. Yard movements must stop short of track clearance points when necessary to clear other yard movements. When yard movements conflict, all must be stopped short of track clearance points unless there is a definite understanding as to order of movement.

21.5 During after hours or periods of non-revenue operation, cars must not be operated unless authorized by one of the persons listed below.

The Railway Director/General Manager
Dispatcher
Track and Overhead Personnel

This Rule applies to all train operations whether over main tracks or yard tracks.

21.6 There must be at least two people present for any railway operations to begin and at least one of those individuals must be a qualified Operator. There cannot be any one-person operation of the railway (this does not apply to one-person operation of a car but to the overall railway).

21.7 Approaching Other Rolling Stock: A train approaching other rolling stock on the same track or approaching rolling stock fouling that track must not operate closer than 2 to 3 line pole distances (200 feet) to the rolling stock being approached except at Restricted Speed and must make a safety stop at least one car length (50 to 100 feet) from the rolling stock being approached.

22.0 CHANGING CONTROL ENDS

A:

1. When changing control ends, the Operator is to set the air brake in the "Emergency" position (making sure that the air pressure is at 90 psi or below).

2. Place the controller in the "Off" position. Place the reverse key in the "Neutral" position.

3. Remove the brake handle and reverse key.

4. Switch the light control key to the proper position and remove the key. The change over switch is located in the #1 end only, so it is to be changed when entering or leaving the #1 end.

5. Place the, circuit breaker switch in the "Off" position. Secure the Operator's area. 6. Place the trolley pole on the wire overhead.

7. Proceed to the opposite end and remove the trolley pole from the overhead wire and secure it.

8. Enter the Operator's area and make sure the controller is in the "Off" position.

9. Insert the reverse key and brake handle.

10. Place the air brake in the normal braking position and the circuit breaker in the "On position.

11. If there is no Conductor, flip all seats to the proper position before inserting the controller handle or reverse key.

12. Proceed to operate the streetcar as normal.

B:

When changing ends while in or near the car barn area, especially when the streetcar is beneath the insulators located above the car barn doors, do not raise more than one trolley pole at a time. Trolley poles are "live."

23.0 POWER STATION OPERATION

23.1 A qualified power station operator must receive training in all methods of the Railway's power generation, station systems and equipment operation and hold a current certificate of training. A current list of trained individuals is posted at the power station.

23.2 Power shall be turned off after the last run of the day. Traction power line cut off switches are located on trolley line poles every 500 feet. Yellow striping marks this pole. Trolley Dispatcher and the local Fire Department have a copy of the emergency power cut off key. In the event of an emergency, the motorman may also request a power shutdown by radio. Magnetic circuit breakers and Ground Fault Relays shall be used to shutdown power automatically in the event of a fallen wire or short circuit.

23.3 Circuit breakers are of the pneumatic-magnetic type or straight magnetic. Circuit breakers will be set and maintained at the correct dropout current.

23.4 Monitoring of AC leakage into the DC traction system will be provided, along with a protection circuit to cut off traction power in the event of excessive AC leakage into the DC traction power system.

23.5 Any qualified motorman who has authority to operate a train or car must seek a qualified power station operator to turn on the power if that person is not qualified. If a qualified power station operator cannot be found no railway operations may take place.

24.0 TRAIN ORDERS

24.1 Where authority of the Dispatcher is required it must be given in the form of a train order.

24.2 When a Dispatcher is on duty he/she is the only person who may issue train orders.

24.3 Train orders must he brief and clear and must contain only such information as is essential to the involved movement. Train orders must include the following information: An identification of the train to which the order is directed in a manner that cannot be misunderstood. Identification of a train by the number of the leading car or locomotive is acceptable. Identification of trains by descriptions such as "Downtown Train" or "Work Train" is acceptable if the description can only pertain to one train then in service.

24.4 A description of the movement being authorized including identification of any other trains involved in the movement.

Example of a Correct Train Order: "Car 3 proceed westbound to Van Brunt Switch and wait for work train to clear switch eastbound before proceeding. When returning eastbound, wait at Coffey Street Station for locomotive 10 to clear Beard Street westbound before returning to Shop."

24.5 Train orders must be issued in writing whenever the person issuing the order believes that an operator is likely to forget or misinterpret a verbal order, whether because of the complexity of the movement being authorized or otherwise. Written orders must be neat and clean, without erasure, alteration or annotation. In other cases, train orders may be issued verbally.

24.6 Train orders must be issued to the person or persons who are to execute them. Train orders affecting the movement of trains or cars shall be issued to the Conductor who will relay them to the Motorman. If practical, orders should also be given to the Motorman. In the case of one-man operation the orders shall be given to the operator.

24.7 Where a train order or series of train orders restricts one train in favor of another, the order or orders should be given simultaneously to each train. If not practical, the orders must first be given to the train being restricted.

24.8 A train order must be acknowledged by the person receiving it. Train orders are acknowledged by repeating the order to the person issuing them.

24.9 Train orders remain in effect until fulfilled, superseded, or annulled,

24.10 When train orders are transmitted by radio, the train receiving the order must be brought to a full stop before receiving the order.

24.11 When a conductor or motorman (or both) is relieved before the completion of a trip, all train orders and instructions must be communicated to the relieving Conductor or Motorman. Such orders or instructions must be compared by the Conductor and Motorman before proceeding.

25.0 PROTECTION OF TRAINS BY FLAGGING

25.1 Flag protection is required for trains on or fouling main tracks whenever the train, in the opinion of its operator or conductor, would not clearly be visible from a distance of 1,000 feet from either end of the train to the operator of an approaching train and either the conductor or operator feels that the train is in danger of being overtaken.

25.2 A person providing flag protection must go out a sufficient distance to ensure full protection and station himself no further than ten (10) feet from the center line of the track being flagged. This position must be a sufficient distance so as to be clearly visible to the operator of another train approaching within 1000 feet of the train being protected. When a train is seen or heard approaching before the flagperson has reached a sufficient distance, the flagperson must continue toward the approaching train giving a stop signal

25.3 When a train has been flagged, the flagperson must inform that operator why the train has been flagged.

25.4 When recalled, and safety of the train will permit, the flagperson may return to the train being protected.

26.0 SPEED POLICY

The streetcar is not to be operated in a manner so as to attempt to intimidate vehicle or pedestrian traffic. Defensive driving techniques must be practiced in this operation.

26.1 Motormen shall obey NYS VTL (vehicle and traffic law) applicable regulations.

26.2 The maximum speed permitted of any streetcar in operation is 20 mph. The maximum speed permitted of any car moving through the yard is 5 mph.

26.3 Operators are responsible for the speed of the streetcars and will be cited by the police if found speeding faster than allowed in the areas named. Two convictions for moving violations in one year may be grounds for dismissal.

26.4 Any Designated authority may order a slower speed limit than the maximum permissible speeds (provided for in Rule 24) on any track.

26.5 In no event shall a train be operated at a speed greater than that which will permit the operator to bring the train to a controlled stop within his/her range of vision at a speed which because of circumstances (whether track conditions, traffic conditions, persons on or about tracks, or any other reason) the operator believes necessary.

A permanent 5 mph slow order is in effect when in movement near the Church on Richards and Coffey Street, the bus stops on Beard, Van Brunt, Richards, and Coffey Streets. This is a requirement of UMTA and the City of New York.

27.0 TURNOUTS

27.1 During switching operations, an unattended main track switch must be returned to its main track position.
27.2 When a train is closely approaching or passing over a track switch the switchman must keep

not less than 20 feet from the switch stand, and when practicable, must stand on the opposite side of the track.
27.3 Persons handling switches must know that the switches are properly lined for the movement to be made and that the switch points are properly closed. Switches must be left in proper position after having been used.
27.4 Persons changing the position of a switch must not remove the lock from, or attempt to operate the switch while a train is passing over the switch.
27.5 If a switch is damaged, an immediate report must be made to the Dispatcher or another Designated Authority. If it cannot be made safe, protection must be provided to prevent trains from operating over the switch.

28.0 SPECIAL RULES GOVERNING SPRING SWITCHES

28.1 Spring switches are identified by an "SS" marker plate attached to the switch stand below the target, the yellow arrow portion of the switch stand target, or on adjacent signal mast, or trolley line.

28.2 A train or car, stopping on a spring switch while trailing through and actuating the switch points, must not make a reverse movement until it is known that the switch points are in proper alignment for safe movement.

28.3 Trains must never trail through and actuate the switch points when the points may be frozen or when movement of the points may be impeded by snow, ice, gravel, or in any other way whatsoever. In such cases, switch points must be operated by hand.

29.0 DERAILS

29.1 Derails, a cast mechanical devise covering the rail preventing access to main tracks, are identified by being painted yellow. Derails are sometimes actuated manually or through linkages attached to a switch stand with appropriate markings either on the stand or between the rails.

29.2 Except when changed to permit movement, derails must be set in derailing position, and those equipped with locks must be locked.

30.0 SECURING STREETCAR FROM SERVICE

1. Stop the car at designated location.
2. Set any handbrake.
3. Check the interior and exterior for vandalism and lost articles.
4. Close all windows and turn off all switches.
5. Remove brake handle, reverse key and remove light control key after turning key to off.
6. Remove trolley pole from overhead wire and secure.
7. Close all doors.
8. Turn in B.O. slip if needed.
9. Put the reverse key, brake handle and light control key in designated location.
10. Turn in radio.

31.0 TROUBLESHOOTING: WHAT TO DO IN CASE OF A DEFECTIVE CONDITION

A. FAILURE TO START
If the streetcar fails to start, you can check for power by turning on the interior lights. If they burn, this indicates the wheels are not insulated from the rails by dirt or other material. If the lights do not burn, make sure the trolley pole is on the overhead wire. If it is necessary to leave the car, jump to the ground without touching the car.

1. Electrical
A. If the car will not start when the controller handle is moved to the first point, then it can be due to a number of different causes. The following is a list of things to check if the above occurs.

1. Return the controller handle to the "Off" position, in a PCC car release accelerator pedal, place car in “Park” mode..
2. See that the main breaker is in the "On" position
3. Reset the overload trip
4. See that the brakes are released
5. See that the car is receiving power from the line (Check for lights)
6. See that all switches affecting control and motor circuits are in the proper position
7. If the car fails to start when the power is on, make sure that the track is clear for at least one car length and cut the notches on the controller to full series. If the streetcar will not start on the first notch, but will start on a later notch up to full series (this indicates broken resistance), the streetcar must not be operated beyond the full series position.

If the car will still not start, contact the mechanical section or Supervisor immediately.

B. If the compressor fuse blows, then the car should be stopped with the air brake. The hand brake should be applied when the car is at a complete stop. Report the problem to the Supervisor or Mechanical section immediately.

C. If the controller is returned to the "Off" position and the current still flows to the motors, then the main breaker should be immediately moved to the "Off" position. If this action does not break the circuit, then it will be necessary to remove the trolley pole from the wire as quickly as possible. After the car is stopped, immediately notify the Base and/ or Designated Authority of the Bad Order car and the problem.

2. Air Pressure Problems

A. If the brake valve handle is moved to service position, or if the PCC brake pedal is depressed and the brakes fail to apply, then it should be moved to the emergency position immediately. If the brakes still fail to apply, then the handbrake should be used to stop the car. The motors may be reversed to stop the car if the handbrake, or the lack of a handbrake, cannot stop the car safely. The procedure for reversing the motors is as follows:

1. Move the main breaker to the "Off" position
2. Move the controller handle to the "Off" position
3. Move the reverse handle to the opposite direction

4. Move the controller handle to the first point and leave it there until the car stops.
5. Chock the wheels or set the hand break to keep the car from moving
6. Immediately radio for help and the locomotive.

CAUTION: Do not move the car under any circumstances until the car is secured by attaching the tow vehicle or another streetcar to the Bad Order car.

If the car is a two-motor car, the controller handle must be moved to the first point in parallel instead of the first point and leave it there until the car comes to a stop. This is because the resistance is higher in the first parallel point on a two-motor car.

B. If the compressor governor fails to cut out (as indicated by the compressor continuing to run and the air pressure indicating over 90 lbs. on the air gauge), the Operator should turn off the compressor switch. The car can be run to its destination by governing the compressor by hand using the compressor switch itself. When the car reaches its destination, it should be taken out of service. The car defect should be reported to the Supervisor or mechanical section when the Bad Order condition is first observed. Then a replacement car may be provided to the Operator so s/he may continue his/her shift.

C. If the air compressor does not start when the air pressure drops below 60 psi, the streetcar is to be stopped if in motion. If the air brake is not effective, use the handbrake. If the air brake has been used to stop-the streetcar, apply the handbrake and then release the air brake. Check to see that the compressor switch is on by moving it to "Off" and then "On" again, to be sure it is making good contact. If the compressor still does not start, notify the Base.

1. Air Pressure 70-90 psi
If the air pressure exceeds 70 psi but does not exceed 90 psi, it is safe to continue operation. Notify the Base. Submit a Bad Order ticket to the Mechanical department.

2. Air Pressure Above 90 psi
If the air pressure, as shown by the red needle in the gauge, does go over 90 psi as a result of the air compressor failing to cut out, notify the Base. Put the compressor switch to the "Off" position and reduce the air pressure by making several service applications until the red needle falls below 90 psi. It is safe to continue operation as long as the air pressure stays below 90 psi.

CAUTION: When changing ends, the air pressure must be reduced to below 90 psi (see Section 22 "CHANGING CONTROL ENDS) before putting the air brake handle to the emergency braking position. When the air pressure is over 90 psi, application of the emergency brake is liable to lock the wheels and also seriously damage the brake rigging.

3. Sudden Pressure Drop: If the air pressure suddenly drops below 60 psi and air can be heard escaping beneath the car, a drain cock on the air reservoir has been struck and opened or broken by an obstruction on the roadbed. The Operator should stop the car, using the handbrake if necessary, and close the drain cock. Notify the Base if it is not an open drain cock and the Operator cannot repair it promptly. The air compressor must be turned to the "Off" position while waiting for the locomotive.

3. LINE BREAKER BLOWS

If the line breaker blows more than once while the controller is being operated correctly, call the Base before there is serious damage to equipment.

NOTE: Operators are not to open controller doors at any time.

4. WHEELS LOCKED
If the wheels of the streetcar seem to be locked, check to see that the handbrakes at each end have been released. If this has no effect, notify the Base.

5. LIGHTS OUT
If all lights on the streetcar should fail, check the lighting switch and ensure that the fuses are good. If there are no blown fuses then notify the Base for instruction. Under no circumstance, shall light bulbs be changed or removed while the trolley pole is up.

6. TROLLEY POLE ROPE BROKEN
If the trolley pole rope breaks, notify the Supervisor. It is possible to use the emergency rope to retrieve the pole and place it on the overhead wire, and to continue operation until the normal operating rope is replaced.

7. OVERHEAD DOWN
If the trolley overhead should break and come to the ground, the wire should be treated as "hot, live, and dangerous." Stop the streetcar, notify the Base and shut off the power by pulling section switch on the yellow stripped pole, or by radio request to base. Stand by to warn pedestrians and other traffic until assistance arrives. If possible, and motorman is not placed in danger, motorman should use the special wooden “scissors” carried on the car to capture the wire, and using the attached rope, pull the wire up and out of danger, and tie it off securely.

8. OVERHEAD POWER FAILURE
In the event of power failure in the overhead, the Operator should stop the streetcar with the service brake, then apply the handbrake. Notify the Base, remove the pole from the overhead and await further instructions.

9. CAR POWER FAILURE
If the wheels of the streetcar become insulated from the rails by dirt, sand or other material, chances are there will be no movement of the car when releasing the brakes and notching the controller. Also, the lights will not burn and the air compressor will not run. If this situation is encountered, notify the Base. The Operator must then remove the trolley pole from the overhead.

10. LINE CREW ENCOUNTERED
When you encounter the Line Crew working on or in close vicinity to the overhead, you must stop the car no closer than 100 feet (just over two streetcar lengths) from the crew and wait for a signal to proceed. Maintain slow speed until completely clear of the area where work is being performed. Obey all special instructions given by the Line Crew.

IV. OTHER SAFETY PROCEDURES

32.0 ELECTRICAL

32.1 All wires and any object in contact with them must be considered to be energized at all times. Unauthorized persons must not touch or come in contact with them.

32.2 To remove a person from contact with an energized electrical conductor, grasp their dry clothing or use a dry non-conducting object to push or pull the person away. Do not touch the person's bare skin or stand in water or on wet ground.

32.3 If electrical storms are in the immediate proximity of the Railway grounds, traction power must be shut off or the power station converted to the generator set for power. When the power is interrupted for these reasons, operators of cars must bring their cars to a stop in a safe location and lower their trolley poles until the storm has passed.

32.4 Should traction power be interrupted for any reason, operators of electric trains must wait a short time following restoration of traction power before moving and then accelerate slowly.

32.5 Any defect, abnormality or unusual condition affecting trolley wire or other electric power distribution devices must be reported to the Dispatcher or another Designated Authority at once.

32.6 A tag and lock must be applied to controls governing the power supply of areas de-energized for work or other abnormal conditions, or to controls governing defective or out of service power distribution equipment. The tag shall specify the condition requiring it to be applied and the name of the person applying it.

32.7 Power distribution devices with tag and lock applied must not be operated except by the person who placed the tag or by the Superintendent of Overhead Construction and Maintenance or his designate.

32.8 Traction power must not be restored to trolley wires following an emergency, work, or abnormal conditions requiring them to be shut off until it is known all persons and foreign objects are clear of electrical conductors.

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33.0 ACCIDENTS, FIRES AND OTHER EMERGENCIES

All Railway personnel must unite to protect human life and property in case of an accident or emergency. Primary effort must be aimed at preventing injury to any person, and obtaining aid for anyone already injured

33.1 The Designated Authority in cases involving the operation of the railroad (or in other cases, a Railway officer) must be fully informed immediately of any injury or accident or of any situation likely to cause injury or accident or endanger Railway or other property.

1. When there is evidence of a car being on fire, its train must be brought to a stop immediately.

2. The operating crew must use every effort to prevent passengers from becoming panic-stricken or leaving the car until it is brought to a full stop

3. Once fully stopped, the crew must evacuate passengers and attempt to extinguish the fire and obtain assistance.

4. Where fire occurs on a car, the operator should immediately throw the overhead switch (main breaker) to "OFF" and cause the trolley to be pulled down as quickly as practicable.

33.2 In case of a fire on the streetcar:

A. Operator Responsibilities

1) If the car is between stops, stop the car immediately in a safe location. Set air and hand brakes.

2) Quickly determine the extent of the fire and notify Base by radio. Phone Fire Department (911) if necessary.

3) Remove the trolley pole from the wire overhead.

4) Evacuate all passengers immediately if there is no Conductor on board

5) Use the fire extinguisher and attempt to put out the fire. Aim nozzle at the base of the fire, when possible.

6) Do not move a car after a fire without proper authority from the Supervisor.

B. Conductor's Responsibilities

1) Assist all passengers from the car.

2) Assist the Operator by removing the trolley pole from the overhead wire.

3) Assist in fire fighting by use of second fire extinguisher, if possible.

4) Keep crowd away from streetcar until relieved by fire or police personnel.

33.3 Follow all other rules as per Sections: 35.1, 35.2, 35.3, and 35.4.

34.0 EMERGENCY BRAKING

This form of braking is to be used when it is necessary to make a sudden stop to avoid an accident. The proper way to apply the brake is:

1. Apply sand with the sander button, if car is so equipped.

2. Put the controller handle to the full "Off" position. In the case of a PCC car, remove feet from deadman pedal and accelerator pedal.

3. Move the controller handle fully clockwise (full dynamic brake), and turn brake wheel fully

clockwise. In the case of a PCC car, step hard on brake pedal, quickly pushing down to the floor. Use hand brake handle by ratcheting up and down.

These three actions should be performed automatically and without delay.

35.0 ELECTRICAL EMERGENCIES, DERAILMENTS AND SICK PASSENGERS

If the streetcar becomes derailed, contact between the wheels and the rails is broken and all metal parts of the streetcar may become "live." It is then highly dangerous to make contact between the streetcar and the ground by passengers or crew until the pole has been removed from the overhead.

1. The Operator and Conductor are to warn all passengers to remain on board and all intending passengers to stand clear.

2. The Operator is to apply both the air and the handbrakes, notify the Base of the situation, and jump to the ground making sure not to touch the car and the ground at the same time.

3. The pole should be lowered from the overhead using the rope. Secure the pole under the hook.

4. At this time, all passengers should be asked to leave the car and be directed to a safe area.

5. Notify the Base that the car has been evacuated and stand by to assist. Keep any unauthorized persons away from the car.

If the streetcar becomes "hot" (electrical shocks received from metal parts), the Operator is to apply the air brake and the handbrake and warn all passengers to remain on the streetcar and intending passengers to stand clear. Notify the Dispatcher of the situation, jump to the ground, making sure not to touch the car, remove the pole from the overhead, secure it under the hook and request all passengers to leave the car. The Operator and Conductor are then to stand by until assistance arrives.

If the controller becomes locked in the operating position, the Operator is to place the line breaker in the "Off" position, apply the brakes and stop the streetcar. Contact the Base by radio and report the malfunction.

If the controller is locked in the "Off" position, make sure that the reverse key is in the full forward position. If this is not the problem, notify the Dispatcher and put the reverse key in the neutral position, so the car can be either pushed or pulled by another car or tow truck.

35.1 When there is an emergency or persons are injured or taken ill on a Railway vehicle contact:

Dispatcher
Fire
Police
Ambulance

35.2 Immediately following any accident on the Railway or the Railway grounds, an accident report must be filled out by the involved party, the authority coordinating the stabilization of the accident, or, in the case of an employee, the department supervisor and filed with the Director/ General Manager or Designated Authority. Forms are available in the Railway Office, the Dispatcher's station or the car barn. This form requires specific information about the accident and the persons involved such as: names, addresses, date, time, etc. To be sure you obtain this information it must be filled out with those involved or witnessing at the accident site.

35.3 Sick or injured passengers shall not be moved except by qualified EMERGENCY SERVICES personnel, (NYFD, NYPD or other EMT personnel). The train shall not be re-started until the sick or injured person has been removed for assistance, and authorization has been issued by the dispatcher or designated authority.

35.4 Motormen, conductors and any other railway personnel, shall cooperate with and render any reasonable assistance requested by Emergency Services personnel.

36.0 GENERAL SAFETY

36.1 All personnel engaged in repair, maintenance, or construction activities must use the necessary safety gear for that activity. The Safety Officer or Shop Superintendent will answer any questions and are responsible for the enforcement of this rule in their respective areas.

36.2 All Staff and Volunteers must be observant of any unsafe conditions on the Railway and report it immediately to the Designated Authority.

36.3 All Staff and Volunteers can help to improve Railway safety discipline by pointing out each other's unsafe practices when appropriate and make helpful suggestions to correct them.

36.4 Staff and Volunteers are responsible for the actions of their guests and must ensure that their guests follow all Railway Rules, Policies and Safety Practices.

36.5 All motor vehicles driven on the Railway grounds must observe the speed limit.

36.6 All Staff who operate Railway equipment on the Railway grounds must have received proper training in their operation and use by a Designated Authority or be accompanied by a qualified operator. If this equivalent is to be operated off the Railway grounds the operator must possess the proper current operators license for that equipment.

37.0 SANDING RAILS IN SIGNAL TERRITORY

37.1 The use of excessive sand on the rails in signal territory is dangerous, because it can cause a loss of shunt in the track circuits, making a car "disappear" from the signal system.

37.2 When weather or other conditions (e.g. excessive grease on the rails) makes it likely that sand will be used, the Dispatcher shall make all operators aware of the circumstances and advise operators to anticipate difficulties both in stopping and starting, and to adjust their operating techniques accordingly.

37.3 All persons who apply sand to the rails in signal territory shall do so sparingly, knowing the possible consequences.

37.4 Any person who notices excessive sand on the rail shall inform the Dispatcher, and if possible, remove the excess.

38.0 GREASING RAILS IN SIGNAL TERRITORY

38.1 Persons applying grease to rails shall grease one rail only, and only on curves. Grease shall be applied sparingly only to the inside face of the outside rail if there is no close guardrail, or to the inside face of the guardrail.

38.2 Grease shall not be applied within one rail length either side of insulated signal joints.

APPENDIX A: GLOSSARY

AIR BRAKE CYLINDER - The air brake cylinder operates the brake levers connected to the brake shoes.

AIR BRAKE PRESSURE GAUGE-Indicates amount of air pressure in the reservoir, and amount of air being applied to the brake cylinder when brakes are applied. (See Brakes, Air - Service)

AIR COMPRESSOR - The air compressor provides and maintains air pressure to operate certain features of the cars such as brakes, sanders, and windshield wipers.

AIR COMPRESSOR GOVERNOR - Automatically switches on the air compressor motor when the air pressure in the reservoir falls below 60 psi (pounds per square inch) and switches the motor off when the air pressure reaches 70 psi.

AIR COMPRESSOR SWITCH - The switch controls the air compressor circuit and the fuse protects it.

AIR RESERVOIR SAFETY VALVE - The air reservoir (air tank) contains compressed air provided by the air compressor. A safety valve is located on the reservoir to vent excessively high air pressure (in case the air compressor governor should fail to shut off the compressor). There is also a valve to drain both air and water from the tank.

BAD ORDER (BO) - a slip or card indicating repairs needed to the car, or defects noticed in track, signals, overhead or other system.

BASE - The office is considered the Base of Operations ("Base") for all purposes in this manual.

A radio call to the Base may be answered by the Railway Director/ Manager, Dispatcher, Master Mechanic, or anyone else stationed at the time in the office area.

BLOCK - A length of track of defined limits, used by trains or cars.

BRAKES, AIR CYLINDER - Brakes applied by movement of air brake valve handle. This is the normal operating brake while in service.

BRAKE, ELECTRIC - The electric brake is applied by placing the "Reverse" key on the controller in the reverse position while the controller is in the "Off" position.

BUG - Special cable used to transmit power to a rail vehicle on tracks not equipped with overhead wire.

CAR -- Any vehicle operating on tracks

CHIEF INSTRUCTOR/INSPECTOR - The individual who in addition to the duties of an instructor/inspector is responsible for mediating, determining and implementing disciplinary action.

CONDUCTOR - The individual in charge of movement and safety of a given car or train including the care and safety of the passengers when there is a crew of two or more members. Conductors in passenger service must be at least 18 years old and must have passed a current operations training or re-qualification course. If the Conductor is under 21, the Motorman will be in charge of the car or train.

CONTROLLER - The controller is used to control the current to the motors. Five (5) series notch positions and three (3) parallel notch positions are available. Each notch represents a different amount of current. A different current represents a different car speed.

DERAIL - A mechanical device that fouls trackage connecting with mainline track(s) to prevent runaway car(s) or engine from entering the mainline by derailing the car or engine.

DESIGNATED AUTHORITY - A person designated by the Superintendent of Railway Operations as having continuing authority to issue instructions governing the operation of trains or cars.

DISPATCHER - The individual having the authority to issue instructions governing the operation of trains and cars. The Dispatcher in passenger service must be an experienced member of the Railway's car crew, an experienced Motorman in passenger service, passed a current operations training or re-qualification course and hold a certificate of training in power station operation.

DOCENT - A guide or interpreter. Each Staff, Crew or Volunteer in all fields of endeavor at the Railway must perform this duty.

ENGINE & CAR - A railborne vehicle or a combination of vehicles propelled by electricity or other form of energy operated by a single control. The term "engine" includes motor cars.

FIXED SIGNAL - A signal in a fixed location. It may be a sign, switch position indicator, or any other means of indicating a condition affecting movement.

FOOT GONGS - Located under Operator's floor platform and operated by foot. Used as a warning device to motorists and pedestrians. Also used to communicate with Conductor and persons pushing or pulling a disabled streetcar.

GRADE CROSSINGS - Grade crossings are locations where vehicle and pedestrian traffic cross the railroad (streetcar) tracks.

HAND BRAKES - (See Brakes, Hand)

INSTRUCTOR/INSPECTOR - An authorized person who instructs individuals in the operation of the railway and the equipment and vehicles used to operate the railway This person(s) maintains general supervision over qualifications and performance of personnel engaged in all phases of operation.

JUNIOR OPERATOR - A Qualified Operator under the age of 21.

LAMPS, SWITCH- The lighting switch is located at the No. 1 end of the car. The lighting switch controls the electrical current for all the lights on the car (headlights, tail lights, destination signs, interior lights).

CHANGEOVER SWITCH - The changeover switch determines which combination of headlight and tail lights are on and must be changed by the Operator in accordance with the direction of travel. The changeover switch is located at the No. 1 end of the car.

LIFEGUARD EQUIPMENT -- Consists mainly of a safety gate which when activated drops a tray to the tracks to prevent individuals from getting run over by the streetcar wheels. Reset by pushing "Reset" pedal with foot. To be checked by Operator for serviceability at start of service. Prior to each trip the Operator is to check that it is set for operation.

LINE BREAKER - A breaker is an electrically operated device, located under the Streetcar, which closes and completes the main power circuit when the Operator moves the controller handle from the "Off" position to the first power notch. It opens (breaks) the main power circuit when the controller is moved towards the "Off" position from any "On" position. It also opens the main power circuit automatically in case of overload (excessive current flow), due either to faulty operation of the controller (by Operator) or to some defect of the electrical equipment.

LINE BREAKER SWITCH AND FUSE - The Line Breaker Switch and Fuse is used to manually open and close the line breaker control circuit. The fuse automatically opens the control circuit in the event of electrical overload.

MAIN TRACKS - A track or tracks extending through yards and between stations, upon which regularly scheduled trains are operated (Also denoted by Rule 19.1).

MAIN LINE -- Track and track switches within signal territory. Commonly understood to be the main trackage from Van Brunt Street switch to Richards Street.

MOTORMAN - Operator of the train or car under the direction of the Conductor, when there is more than one person in the crew. The Motorman must be at least 21 years of age, must have passed a current operations training or re-qualification course and be physically fit to operate a car safely.

MOTORS - two (2) each to a truck, four (4) to each car provide motive power to the wheels of the trucks in order to move the cars.

No. 1 END - The No. 1 end- end of a double ended car is marked by a No. 1 on bulkhead, and has interior and headlight switches at this end.

OPERATOR - The person responsible for the movement of a train or car through direct manipulation of the operating controls. (One man operation serving as both motorman and conductor)

OPERATOR'S AIR BRAKE VALVE - Operates the air brakes. As the valve handle is moved to the right, air under pressure is applied to the brake cylinders. Moving the handle to the left releases air from the brake cylinders.

PILOT - A qualified operator assigned to a train or car when the motorman or conductor, or both are not fully acquainted with the physical characteristics or rules of the railway, or portion of the railway, over which the train is to be moved. Additionally, a pilot can be assigned to supervise the operation of the train itself, if one or more of the crew members are not qualified. The Pilot may also offer instruction.

QUALIFIED) OPERATOR - An individual who has successfully completed all phases of training at the level in which he/she is currently, performing his/her duties. Currently there are three qualification levels for railway operation: Basic (straight air), intermediate, and Advanced.

RELEASE - venting of air from brake cylinder to cause brake shoes
to release so as to prevent trolley from skidding.

RESISTANCE - Resistance grids are placed in circuit with the traction motors. As the controller notches are cut, the resistances regulate the current to the traction motors.

RESTRICTED SPEED (OR CAUTION SPEED) - To operate a train or car at a speed at which the motorman or operator can bring that vehicle to a complete stop within one half (1/2) the distance of vision, short of an obstruction, other rolling stock, switch not properly aligned, opposing or converging traffic, or anything else that may require the train to be stopped, or its speed reduced, in no case to exceed 15 MPH.

REVERSE KEY - Lever located on controller that is used to determine direction of travel (forward-neutral-reverse).

ROLLING STOCK - Any vehicle operating on tracks

SANDERS - Sanders are located at both ends of the streetcars and are positioned to drop sand just ahead of the leading wheels of the trucks. Sanders are air-operated by means of a foot valve located to the right of the foot gong button. Sand should be used with service braking and starting when rails are greasy and should be used sparingly. Sand must be applied at the beginning of braking, otherwise the wheels may lock before hitting the sand. Sand is used to increase friction and thereby reduce the risk of skidding. If the wheels lock when making a service stop, the brakes should be released immediately, sand applied, and then the brakes reapplied. Sand must always be used first when applying emergency braking and kept on until the car stops. Under some conditions, sand can be removed by hand from the sand boxes and spread on the rail in front of the wheels.

SIGNAL - A device, movement or other form of communication which conveys to the operator information concerning conditions affecting the movement of the train. The appearance of a signal as viewed by the operator is its aspect. The information conveyed by the aspect is the signal's indication. The description of the indication is the signal's name.

SIGNAL CLEARANCE FORM - Used to indicate and bring attention to a signal which is currently being serviced or otherwise temporarily not in service. A SIGNAL CLEARANCE FORM is a written verification of this condition signed by the Dispatcher currently on duty and given to a Motorman before the beginning of a run.

SLOW SPEED - A speed not to exceed six (5) miles per hour (approximately nine (9) feet per second)

SPRING SWITCH - A track switch or wire frog which is constructed with a spring that allows the point to move to a different position and then return to a preselected position. Such a switch is normally set for traffic to move in one direction but, when the traffic flows in the opposite direction, will direct the traffic to an alternate route

SPUR (track, switch) - A stub ended track or diverging route.

STARTER - An individual assigned by the Dispatcher to relay train movement orders, at a site other than the Dispatcher's location, at the direction of the Dispatcher.

SUPERINTENDENT - Superintendent of Railway Operations, the individual appointed by the President or the Board of Trustees the BHRA, Inc. to oversee all rail operations.

'THE BOOK' - A loose leaf notebook used for the posting of notices affecting the operation of trains and cars. During times of public operation it is located at the dispatcher's station. At other times it is located in the Railway office.

TRAIN - A car or cars coupled or an engine, with or without cars.

TRAINMAN - Any member of a car crew, other than a motorman, that has had responsibilities delegated to him or her by the (Conductor to tend to the passengers or operation of the train or part of the train. This generally occurs in a train of several cars where it is necessary to have a crew member in authority in each car.

TRIG - Wheel chock used to prevent vehicle from rolling.

TROLLEY POLE - On the roof of the vehicle. Located on the upper end is a carbon insert shoe that slides on the overhead wire that provides the power source. The pole is spring-loaded to maintain pressure against the wire. The rope is used to raise and lower the pole and to retrieve the pole in the event of a dewirement.

TRUCK - Name given to each set of four (4) car wheels. Each truck contains two (2) traction motors. (May also be called "bogies").

WINDSHIELD WIPERS - controlled by a switch located on the inside frame of the windshield.

WORK EQUIPMENT' - Trains, cars or other equipment operated on track for maintenance or construction purposes.

YARD LIMIT - Denotes a maximum speed of 10 MPH and a reminder for the operator to be observant of the surroundings as well as track and wire conditions.

YARD TRACK - A track or system of tracks within defined limits provided for the making up of trains, storing of cars, or other purposes. (Also denoted by Rule 19.1)

ILLUSTRATIONS OF SIGNALS

Illustrations of the signal aspects, names and indications see Appendix A.

DRAFT CMAQ APPLICATION
DEC. 20, 1998

ASSUMPTIONS FOR METHODOLOGY
FORM 6

Current Single Occupant Auto Rate is 38% of trips.

The trolley will capture 10% of single occupant auto trips (SOA).

The trolley is intermodally connected to 16 subway lines, 10 bus lines and the LIRR. Therefore, the trolley has connectivity to all boroughs and Long Island.

The trolley will be on the Metrocard system.

The trolley will operate between 6 AM and 10 PM.

The trolley catchment area is assumed to be 1,600 feet (4 blocks) on either side of the trolley line.

The trolley produces zero (0) emissions.

The basis for estimating population and square footage of retail, commercial and recreational space in the catchment area for the solution of Vehicles Eliminated and VMT was calculated in the following manner:

A.) PHYSICAL DESCRIPTION OF THE CATCHMENT AREA

The physical dimensions of City Block and Building Lot sizes were directly observed to be on a standardized plan as follows:

1. Typical Block of old Brooklyn- 21 lots along the long side of the block, and 9 lots along to short side of the block, or 60 lots per block. The standard lot width is 20 feet.

2. Apartment Dwellings- 4 stories, and contain an average of 2 apartments per floor. Buildings along commercial streets also contain a storefront. Storefronts were observed to average 50 feet in depth, or 1,000 square feet each. This was obtained by direct observation of the catchment area along Atlantic Avenue. The apartment vacancy rate is extremely low, so we assumed full occupancy.

3. Catchment Area- is assumed to be 1,600 feet on either side of the trolley line. This distance was selected because it is common of bus stop spacing.

B.) 1990 CENSUS DATA FOR RESIDENTIAL POPULATION

Based on Census figures, 2.74 persons per household live in the catchment area. We are assuming that 2.00 persons per household Journey to Work.

According to the 1990 Census, the single occupancy auto rate (SOA) was 24%. In 1980, it was about 15%. We assume SOA currently to be 38%.

1.) CASE I: All Residential Block
60 lots/block x 4 floor/lot x 2 household/floor x 2.00 workers/household = 960 workers/ block

2.) CASE II: Mixed Use Block- Number of households per block is discounted to reflect commercial space:
438 household/block x 2.00 workers/ household = 876 workers/block

C.) JOURNEY TO WORK RESIDENTIAL TRIP GENERATION- Assumed Travel Radius [R(c)] = 11.7 mi (1990 Census)

We assume the current single occupancy auto rate (SOA) = 38%

1.) CASE I BLOCK: 960 workers/block x 2 trips/day x 0.38 (SOA) x 220 work days/year = 160,000 single occupant vehicle trips to work per year/ block. There are assumed to be 42 Case I blocks.

42 blocks x 160,000 SOA trips/ year per block = 6,720,000 SOA trips/ year

2.) CASE II BLOCK: 876 workers x 2 trips/day x 0.38 (SOA) x 220 work days/year = 146,467 SOA trips to work per year/ block. There are assumed to be 28 Case II blocks.

28 blocks x 146,467 SOA trips/ year per block = 4,101,076 SOA trips/ year

3.) RED HOOK: According to the South Brooklyn Local Development Corporation, there are about 12,500 residents in Red Hook. Using the same ratio as before, 73% are assumed to be workers: 9,125 workers x 2 trips/day x 0.38 (SOA) x 220 work days/year = 1,525,700 SOA trips to work/ year

TOTAL RESIDENTIAL SOA JOURNEY TO WORK TRIP GENERATION = 12,346,776 SOA TRIPS/ YEAR

D.) RETAIL TRIP GENERATION- Assumed Travel Radius [R(d)]= 3 mi. (Brooklyn Commons Study)

Within the Catchment area, the following streets have storefronts along both sides of the street- Atlantic Avenue, Court Street, Livingston Street and portions of Columbia Street and Van Brunt Street. Based on the average of 1000 square feet per storefront, and 21 storefronts on the long side of the block, and 9 storefronts along the short side-

Each long side block contains 21,000 square feet
Each short side contains 9,000 square feet

We assume the single occupancy auto rate (SOA) = 38%

According to the MetroTech EIS, Table IV-2, Commercial Retail (non shopping mall) daily generates 22 trips/1000 square feet.

According to the Brooklyn Commons Transportation Study, Commercial Retail (Mall type) generates 111 trips/weekday and 147 trips per Saturday (which we assume to be a weekend day).

I.) Existing:

1.) For Long Side Block:

21, 000 square ft/block x 22 trips/1000 square feet x 0.38 SOA rate x 312 retail days/year = 54,775 SOA trips per Year/ block. There are assumed to be 24 blocks of this type.

a.) 24 blocks x 54,774 SOA trips per Year/ Block = 1,314,600 SOA trips/ year

2.) For Short Side Block:

9,000 square feet/block x 22 trips/ 1000 square feet x 0.38 SOA rate x 312 retail days/ year = 23,475 SOA trips per year/ block. There are assumed to be 26 blocks of this type.

a.) 26 blocks x 23,475 SOA trips per Year/ Block = 610,350 SOA Trips/ Year

3.) Atlantic Terminal:

a.) 1,000,000 sq ft (shopping mall type) x 111 trips/ 1000 sq ft/ dy (weekday) x 0.38 x 260 days/ Year = 10,966,800 SOA Trips/ Year (Weekday)

b.) 1,000,000 sq ft x 147 trips/1000 sq ft/ dy (weekend) x 0.38 (SOA) x 110 days/ year = 6,144,600 SOA Trips/ Year

SUB TOTAL: 17,111,400 SOA Trips/ Year

II.) Planned:

a.) Brooklyn Commons :
206,000 sq ft x 111 trips/1000 sq ft (weekday) x 0.38 (SOA) x 260 days/ Year = 2,259,161 SOA Trips/ Year

b.) 206,000 sq f t x 147 trips/1000 sq ft (weekend) x 0.38 (SOA) x 110 days/ Year = 2,531,575 SOA Trips/ Year

SUB TOTAL: 4,790,736 SOA Trips/ Year

TOTAL RETAIL SOA TRIP GENERATION: 23,827,086 SOA Trips/ Year

E.) COMMERCIAL TRIP GENERATION- (Non Retail) Assumed Travel Radius [R(e)] = 11.7 miles (Census). According to Table IV- 2 of the MetroTech EIS, office space generates 17.3 trips/ 1000 sq ft.

I.) Existing:

1.) MetroTech: 5,000,000 sq ft x 17.3 trips/ 1,000 sq ft x 0.38 (SOA) x 220 days/ Year = 7,231,400 SOA Trips/ Year

2.) Central Commercial Core: 1,685,000 sq ft (includes TA building and Courts)
1,685,000 sq ft x 17.3 trips/ 1000 sq ft x 0.38 (SOA) x 220 days/ Year = 2,436,982 SOA Trips/ Year

3.) Red Hook- According to the SBLDC, there are 5,500 persons at jobs in Red Hook/ day.
5,500 jobs x 2 trips/ day x 0.38 (SOA) x 220 work days = 919,600 SOA Trips/ Year

TOTAL NON- RETAIL COMMERCIAL SOA TRIP GENERATION = 10,587,982 SOA Trips/ Year

F.) RECREATIONAL TRIP GENERATION- Assumed Travel Radius [R(f)] = 3 mi (Brooklyn Commons Study)

I.) Planned:

1.) Court St Multiplex

a.) 2,500 seats x 3.26 trips/seat (weekday) x 0.38 (SOA) x 260 days/ Year = 805,220 SOA Trips/ Year (weekdays)

b.) 500 seats x 6.25 trips/seat (weekend) x 0.38 (SOA) x 110 days/ Year = 653,125 SOA Trips/ Year (Weekend)

SUB TOTAL: 1,458,345 SOA Trips/ Year

2.) Brooklyn Commons:

a.) Multiplex

5,100 seats x 3.26 trips/ seat (weekday) x 0.38 (SOA) x 260 days/ Year = 1,642,649 SOA Trips/ Year

5,100 seats x 6.25 trips/ seat (weekend) x 0.38 (SOA) x 110 days/ Year = 1,332,375 SOA Trips/ Year

b.) Bowling Alley

45,000 sq ft x 30 trips/1000 sq ft x 0.38 (SOA) x 300 days/ Year = 153,900 SOA Trips/ Year

SUB TOTAL: 3,128,924 SOA Trips/ Year

3.) Brooklyn Brewery (Beard Street Pier)-

2,000 patrons/wk x 2 trips x 0.38 (SOA) x 52 weeks = 79,040 SOA Trips/ Year

4.) Waterfront along Piers 1-6 : 51 Acres. However, precise nature of development not known, so a numerical value is not assigned.

II.) Existing:

1.) Hudson River Waterfront Museum and Red Hook Fishing Pier:

50,000 visitors/ Year x 2 trips x 0.38 (SOA) = 38,000 SOA Trips/ Year

2.) Transit Museum: 100,000 visitors/ yr x 2 trips x 0.38 (SOA) = 76,000 SOA Trips/ Year

TOTAL RECREATION SOA TRIP GENERATION: 4,780,309 SOA Trips/ Year

TOTAL SOA TRIP GENERATION/ YEAR = C + D + E + F =

	12,346,776
+	23,827,086
	10,587,982
	4,780,309

TOTAL SOA TRIPS/ Year: 51,542,153

It is assumed the trolley would capture 10% of annual SOA trips, or:

5,154,215 Captured SOA Trips/ Year

NUMBER OF SOA TRIPS ELIMINATED OVER LIFE OF THE PROJECT:

5,154,215 Captured SOA Trips/ Year x 20 Years =

103,084,300 TRIPS ELIMINATED OVER LIFE OF PROJECT

NUMBER OF VEHICLES ELIMINATED PER YEAR:

5,154,215 captured SOA Trips/ Year/ 2 trips = 2,577,108 Vehicles/ Year

NUMBER OF VEHICLES ELIMINATED OVER A 20 YEAR PERIOD (LIFE OF PROJECT):

5,154,215 captured SOA Trips/ Year x 20 Years / 2 trips =

51,542,150 VEHICLES ELIMINATED OVER LIFE OF THE PROJECT

VMT ELIMINATED OVER LIFE OF THE PROJECT (20 YEARS):

Again assuming a trolley SOA capture rate of 10%

VMT Eliminated/ Year =

[C x 0.10 x R(c)] + [D x 0.10 x R(d)] + [E x 0.10 x R(e)] + [F x 0.10 x R(f)] =

	12,346,776 x 0.10 x 11.7 mi	= 14,445,728
	23,827,086 x 0.10 x 3 mi	= 7,148,126
+	10,587,982 x 0.10 x 11.7 mi	= 12,387,939
	4,780,309 x 0.10 x 3 mi	= 1,434,093

35,415,886 VMT Eliminated / Year x 20 Years =

708,317,720 VMT ELIMINATED OVER LIFE OF THE PROJECT

FORM 6 **CONGESTION REDUCTION**

II:

1. VMT Eliminated: 708,317,720 VMT/$5,280,000 CMAQ = **134 VMT/ $1 CMAQ**

2. Auto Trips Eliminated: 103,084,300 captured SOA/ $5,280,000 = **20 trips/ $1 CMAQ**

3. Are congested travel conditions or times of day affected? **YES.**

The trolley is expected to help reduce congestion during the AM and PM Journey To Work, Midday for retail/ Commercial and PM discretionary/ recreational. The number of single occupant autos in the catchment area eliminated in our calculations averages 7,061 autos per calendar day.

4. Does the project support regional coordination? **YES.**

The trolley has intermodal tie-ins to other parts of the transportation matrix. The trolley has coordination with development along its route. The trolley dovetails with other projects currently part of the long- range program under ISTEA, and will continue to be a part of it.

5. Does the project support multi- modal coordination? **YES**.

The trolley ties- in with 16 subway lines, 10 bus routes and the LIRR terminal at Flatbush Ave.

6. Will secondary negative impacts be mitigated? **YES.**

The trolley produces zero emissions.

The trolley will not encourage insatiable latent demand on the Gowanus or local roads.

The trolley project will not impact truck routes, as the trolley does not carry freight.

The scale of trolley project is insufficient to effect capacity or LOS on the Gowanus or local roads.

References

<u>Objectives of Transit Oriented Development (excerpts from *TCRP Report 95,* pg 17-2, 17-3):</u>

(Excerpts from *TCRP Report 95,* pg 17-2, 17-3):

Why Rail Has 20X Energy Saving Advantage Over Rubber Tire Road Vehicles - The Science of Locomotion

S*even Rules for Sustainable Communities Design Strategies for the Post-Carbon World,* by Patrick M. Condon, 2010

TCRP Report 95, TRB, Chapter 17:

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Peak Passenger Capacity per Lane per Hour:
http://www.lightrailnow.org/facts/fa_lrt010.htm

Traffic Signal Priority (TSP): http://www.fta.dot.gov/documents/TSPHandbook10-20-05.pdf

Thanks to www.lightrailnow.org for some images and data borrowed for this slideshow.

More Streetcar Facts side – streetcar passenger capacity :
www.railwaypreservation.com

Appendix III

The Atlantic Avenue Tunnel

DAILY NEWS

BROOKLYN

Urban legend could be true, study finds: Proof of locomotive under Atlantic Ave. unearthed in documents

"It's like finding a piece of Atlantis under Atlantic Ave.," says train buff Bob Diamond.

BY MARK MORALES / NEW YORK DAILY NEWS

WEDNESDAY, DECEMBER 26, 2012, 6:34 PM

THEODORAKIS, ANDREW

Bob Diamond shows off the entrance to the old Atlantic Ave. tunnel at the corner of Court St. that was used for trains and wagons.

An urban legend about a long-lost 19th century locomotive rumored to have been buried under Brooklyn's busy Atlantic Avenue may turn out to be true after all.

Engineers have identified a large 20 ft. long metallic structure under Atlantic Ave. and Hicks St. that could be a locomotive buried underground since 1861.

"It's like finding a piece of Atlantis under Atlantic Ave.," said Bob Diamond, founder of the Brooklyn Historic Railway Association.

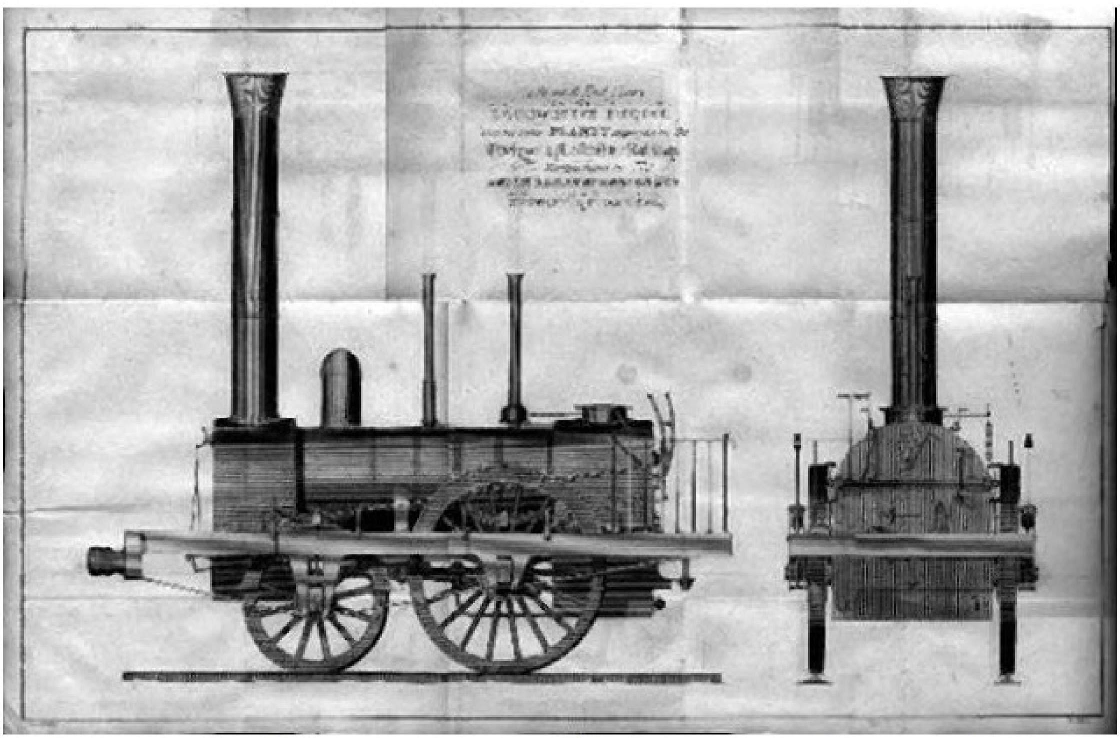
The transit buff, who is suing the city after his abandoned underground tunnel tour was shut down by FDNY officials in 2010 for being unsafe, was given documents last week proving that something was found.

Engineers from the Brinkerhoff Environmental Group used high-tech tools to find a structure that had a "great deal of magnetic energy.

"It is conceivable that the suspect locomotive is located between the middle and south side of Atlantic Ave..." wrote Matthew Powers, Geophysical Services Director for the group, in internal documents.

"...There is no question that something(s) metallic is buried under Atlantic Ave., it's just a matter of what and in what orientation," Powers wrote.

Diamond, 53, said a single Planet steam locomotive was used by the Long Island Rail Road in 1861 to pull dirt from one end of the tunnel to fill it up and close it. When the locomotive - which was obsolete by then - broke down, workers decided to bury it.



The Planet steam locomotive Bob Diamond believes is buried under Atlantic Ave. Image from the book A Practical Treatise On Locomotives Upon Railways, by Chev. F. M. G. De Pambour, 1832

"The only thing they had back in those days that was 20 ft. long and highly magnetic was the locomotive itself. Everything else on the railroad was made out of wood," said Diamond.

Officials for National Geographic, who were considering doing a story on the locomotive, hired Brinkerhoff in 2010 to find out if the train really was sealed in the tunnel.

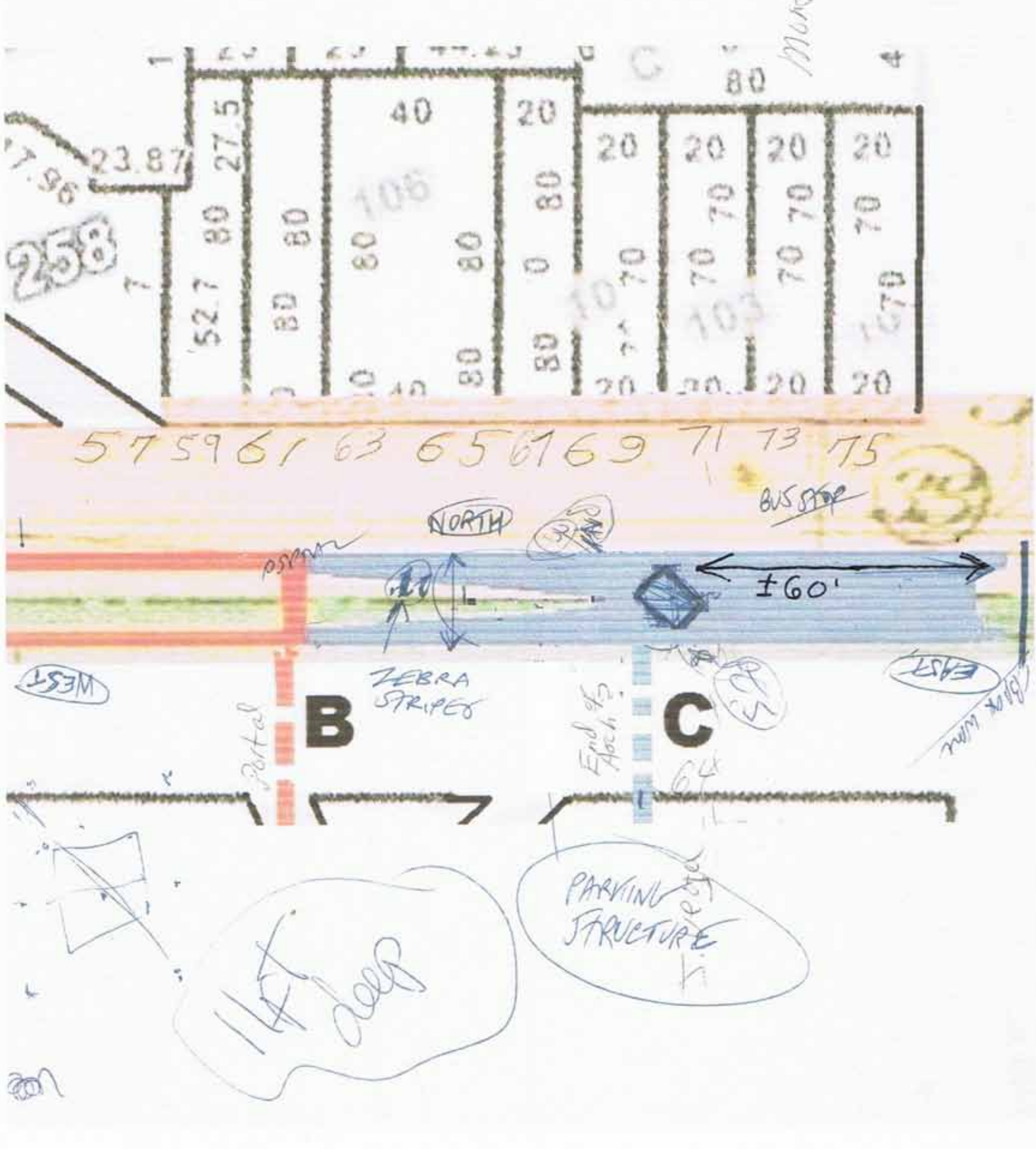
Diamond got a copy of the report as part of his lawsuit against the city.

Brinkerhoff officials declined to comment because of Diamond's lawsuit, but a source at the company said it was a strong possibility that the locomotive was found by their engineers..

"I would be willing to wager that it [the locomotive] was identified, but everything is subject to identification in the scientific world," said the source.

City lawyers said they could not comment on whether or not Transportation Dept. officials would going into the tunnel to determine of the locomotive is there.

Atlantic Avenue Tunnel
Location of Iron "Anomoly"



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RE: Atlantic Avenue Tunnel - Proposed Boring Location Plan

From: **Matt Powers**
Sent: Fri 1/28/11 5:12 PM
To:
Cc:

Lynn,

Based upon Brinkerhoff's interpolation of the geophysical data, the "heart of the anomaly radiates around the center of the street and slightly skewed towards the south. Brinkerhoff is finding it extremely difficult to determine if the large geomagnetic response is due to one (1) very large subsurface anomaly or a couple large anomalies. The actual anomaly is not as large as the image map portrays it. The is due to the anomaly containing a great deal of magnetic energy resulting in an elongated visual response. It is conceivable that the suspect locomotive is located between the middle and south sides of Atlantic Ave. and a separate smaller anomaly is located on the northern side of Atlantic Ave. Based upon Brinkerhoff's interpretation of the geophysical data, there is no question that something(s) metallic is buried under Atlantic Ave., its just a matter of what and in what orientation.

I as well found it odd for the signature to extend past the tunnels walls however; I am going to have to revert back to the shear size of the magnetic response as I mentioned above.

The blip to the east represents a magnetic response and may represent additional artifacts however; I do not feel that this response is large enough to represent a locomotive.

Brinkerhoff does not believe that the response is due to any surficial utilities that InfraMap identified.

Lynn, I hope I answered your questions but if I haven't, please feel free to contact me at anytime.

I hope you have a happy weekend as well.

Thank you,

Matthew D. Powers
Director of Geophysical Services

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BRINKERHOFF
ENVIRONMENTAL SERVICES, INC.

1913 Atlantic Avenue, Suite R5
Manasquan, New Jersey 08736
Tel: (732) 223-2225
Fax: (732) 223-3666

January 18, 2011

Janine Hildebrand, EIT
S. Harris, Ltd.
2601 Pennsylvania Avenue, Suite Eight
Philadelphia, PA 19130

Re: Geophysical Investigation Report
Atlantic Avenue
Brooklyn, New York
Brinkerhoff Project No. 10BR194

Dear Ms. Hildebrand:

Brinkerhoff Environmental Services, Inc. (Brinkerhoff) is pleased to present the following summary report of the Geophysical Investigation conducted on January 11 and 14, 2011 at the above-referenced property (herein referred to as the subject property). Refer to Figure 1 – Site Location Map. Electromagnetic induction, electromagnetic soil conductivity, total field magnetics and ground penetrating radar (GPR) were employed for the investigation.

Introduction

On January 11 and 14, 2011, Brinkerhoff conducted a geophysical investigation on the subject property. The purpose of the geophysical investigation was to evaluate the potential presence of subsurface anomalies indicative of a buried 19th century locomotive and associated artifacts. The subject property is currently an active urban roadway surrounded by buildings to the north, south and east, while a large steel overpass (I-278) borders the subject property to the west.

Methodology and Limitations

A. ***Electromagnetic Induction*** – Electromagnetic data were collected using a Geonics EM61-MK2A High Sensitivity Metal detector (EM-61). The EM-61 was operated in the differential mode while recording magnetic metallic response measurements. The effective depth of data collection was approximately 10 feet. The field procedure involved device calibration, data collection and recording, and data storage for analysis in the office. Data were recorded on the Allegro Field Computer. Magnetic data and Differential Global Positioning System (DGPS) data, were simultaneously recorded at zero-point-two (0.2) second intervals (approximately every zero point five [0.5] feet) along survey lines at approximately two-point-five (2.5)-foot intervals. The data were downloaded to a personal computer for processing and the creation of an EM61 response contour map. Refer to Figure 2 – EM-61 Data Map

B. ***Electromagnetic Soil Conductivity Survey*** – Electromagnetic data were collected using a Geonics EM-31 Terrain Conductivity Meter. The EM-31 was operated in the vertical dipole mode while recording ground conductivity measurements. The effective depth of data collection was approximately 15 feet. The field procedures involved device calibration, data collection and recording, and data storage for analysis in the office. Data were recorded on the Allegro Filed Computer. Conductivity data and DGPS data, were recorded at zero-point-two (0.2) second intervals (approximately every zero point five [0.5] feet) along survey lines at approximately five (5)-foot intervals. The data were downloaded to a personal computer for processing and the creation of a conductivity contour map. Refer to Figure 3 – EM-31 Data Map.

C. ***Total Field Magnetics*** - The G-859 Self-oscillating split-beam Cesium Vapor Magnetometer (G-859) was operated in the simple survey mode while recording magnetic metallic response measurements. The effective depth of data collection was approximately 20 feet. The field procedure involved device calibration, data collection and recording, and data storage for analysis in the office. Data were collected in two (2) separate survey files, recorded on the G-859 console data logger and transferred via high speed USB cable to a portable computer for further analysis and map generation within the field. Magnetic data and integrated Wide Area Augmentation System (WAAS) GPS data were simultaneously collected throughout the total field magnetic survey with survey lines spaced approximately 10 feet apart. The data were downloaded to a personal computer for processing and the creation of a G-859 response contour map. Refer to Figure 4 – G-859 Data Map

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D. ***Ground-Penetrating Radar (GPR) Survey*** - GPR data were collected with a Sensors and Software Inc. Noggin^{plus} SmartCart GPR System (SmartCart) utilizing a 250 MHz antenna. Data were collected continuously on 38 survey lines across selected open areas of the subject property. The survey lines were spaced approximately two (2) feet apart and oriented perpendicular to each other. The depth of investigation was from zero (0) to approximately three-point-five (3.5) feet with this antenna. The data were processed using Ekko View Deluxe software. Refer to Figure 5 – GPR Line Map.

E. ***Limitations*** - Limitations encountered during the investigation included the presence of possible subsurface utilities, metallic light poles, suspect concrete road bedding, vehicles, vegetation, snow, refuse piles, adjacent structures and the I-278 overpass. Please note that Electromagnetic Induction, Terrain Conductivity, Total Field Magnetics and GPR measurement are remote sensing methods and in some instances, due to interference or other geophysical limitations, do not reveal data which may be indicative of subsurface anomalies. The findings of this investigation should only be used as a tool in evaluating the possibility that a locomotive is present on the property and should not be considered a guarantee regarding the presence or absence of a locomotive.

Geophysical Results

EM-61 Results: The EM-61 survey was limited to all outside accessible areas of the subject property. Several areas of anomalous change in magnetic susceptibility gradient were seen in the EM-61 data. Analysis of the EM-61 data showed that these anomalies coincided with observable surface features and/or the location of possible building materials.

EM-31 Results: The EM-31 survey was limited to all outside accessible areas of the subject property. Several areas of anomalous change in magnetic susceptibility gradient were seen in the EM-31 data. Analysis of the EM-31 data showed that these anomalies coincided with observable surface features and/or the location of possible building materials. One (1) large anomaly was identified within the EM-31 data and the location of the anomaly is shown on Figure 3. Brinkerhoff then further investigated anomaly A-1 with GPR.

G-859 Results: G-859 survey was limited to all outside accessible areas of the subject property. One (1) area of anomalous change in magnetic susceptibility gradient was seen in the G-859 data. Analysis of the G-859 data revealed a large metallic anomaly measuring approximately 20 feet in length. The location of the anomaly is shown on Figure 4. Brinkerhoff then further investigated anomaly A-1 with GPR.

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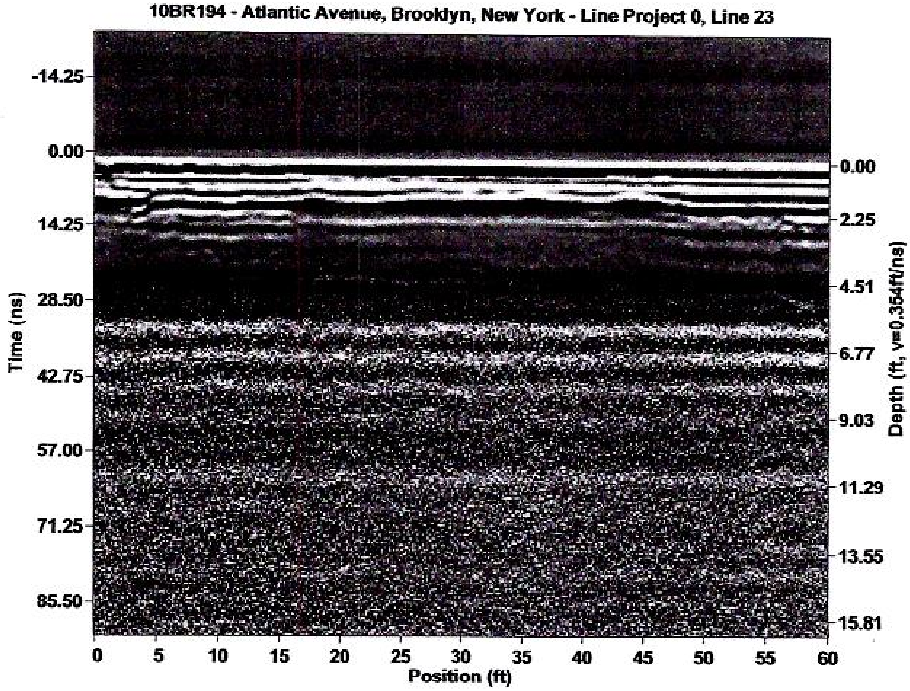
GPR Results: GPR data was collected from the areas of anomaly A-1. Due to the assumed unconsolidated geology, brick and assumed concrete below the surface of the roadway, GPR was unable to penetrate further then three-point-five (3.5) feet below grade. Brinkerhoff was unable to verify the presence of the large magnetic anomaly which was detected in both the EM-31 and G-859 surveys. Representative GPR profiles are presented below.

Anomaly A-1 – GPR data was collected from the area of Anomaly A-1, as noted in the EM-31 and G-859 data. Based upon the EM-31 and G-859 data images, the anomaly is located largely on the eastern side of Atlantic Avenue; however; the anomaly's large response extends across Atlantic Avenue encompassing the western lanes as well. GPR data collected in the area of A-1 is inconclusive due to restricted GPR signal penetration within the subsurface geology. A representative GPR profile collected from this area showing A-1 and the GPR's restricted signal is shown below.

10BR194 - Atlantic Avenue, Brooklyn, New York - Line Project 0, Line 23



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Janine Hildebrand, EIT
Re: Geophysical Investigation Report
Atlantic Avenue
Brooklyn, New York
Brinkerhoff Project No. 10BR194
January 18, 2011

GEOPHYSICAL CONCLUSIONS

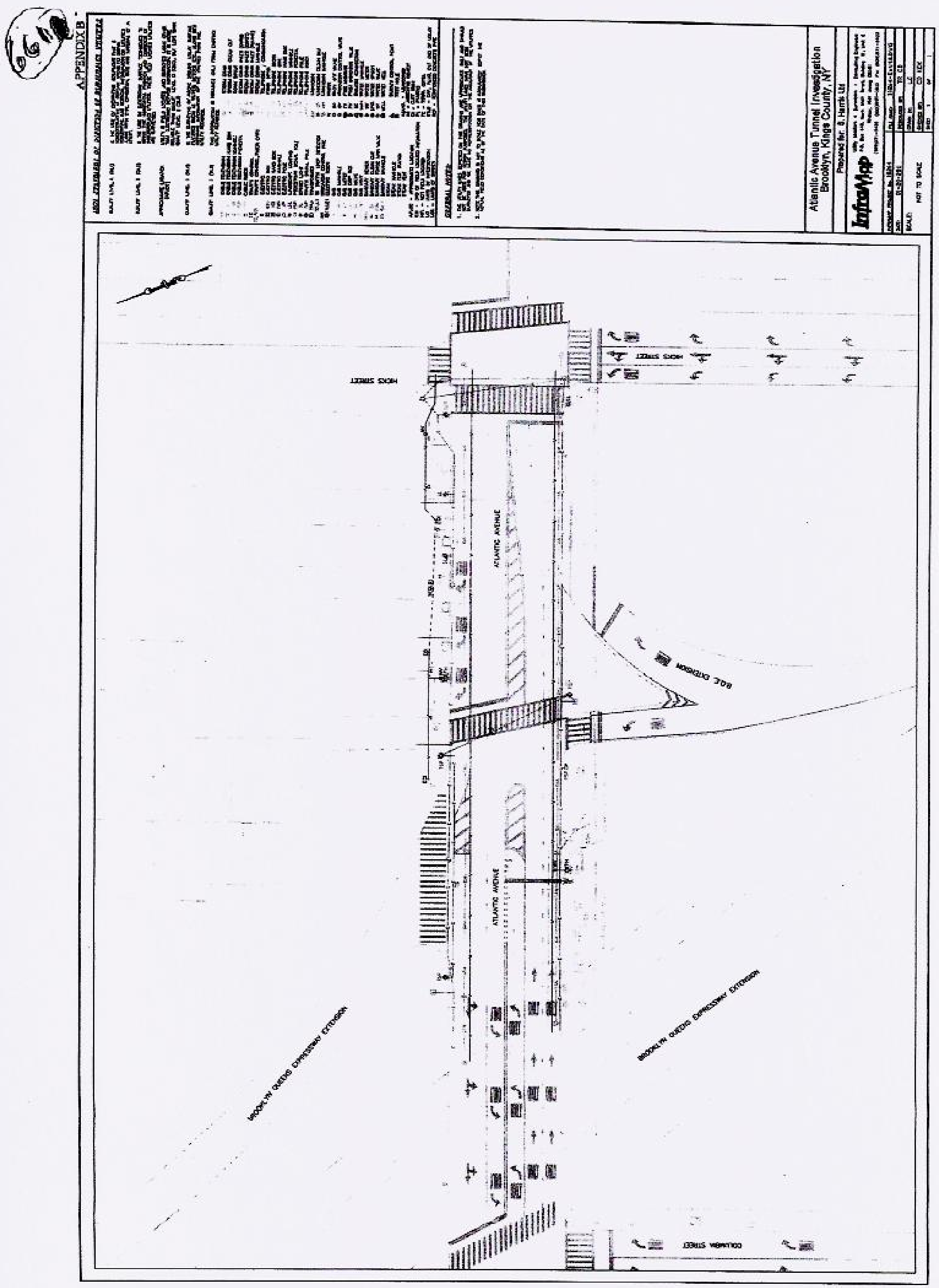
On January 11 and 14, 2011, Brinkerhoff performed a geophysical investigation in open and accessible areas of the subject property. Limitations encountered during the investigation included the presence of possible subsurface utilities, metallic light poles, suspect concrete road bedding, vehicles, vegetation, snow, refuse piles, adjacent structures and the I-278 overpass. Please note that Electromagnetic Induction, Terrain Conductivity, Total Field Magnetics and GPR measurement are remote sensing methods and in some instances, due to interference or other geophysical limitations, do not reveal data which may be indicative of subsurface anomalies. One (1) large subsurface metallic anomaly was identified extending across Atlantic Avenue and encompassing both the west bound and east bound roadway. Brinkerhoff was able to estimate the metallic anomaly's length at 20 feet based upon the response of the G-859 data. The anomaly was outlined in white spray paint in the field and is noted on the attached Figure 3 and Figure 4.

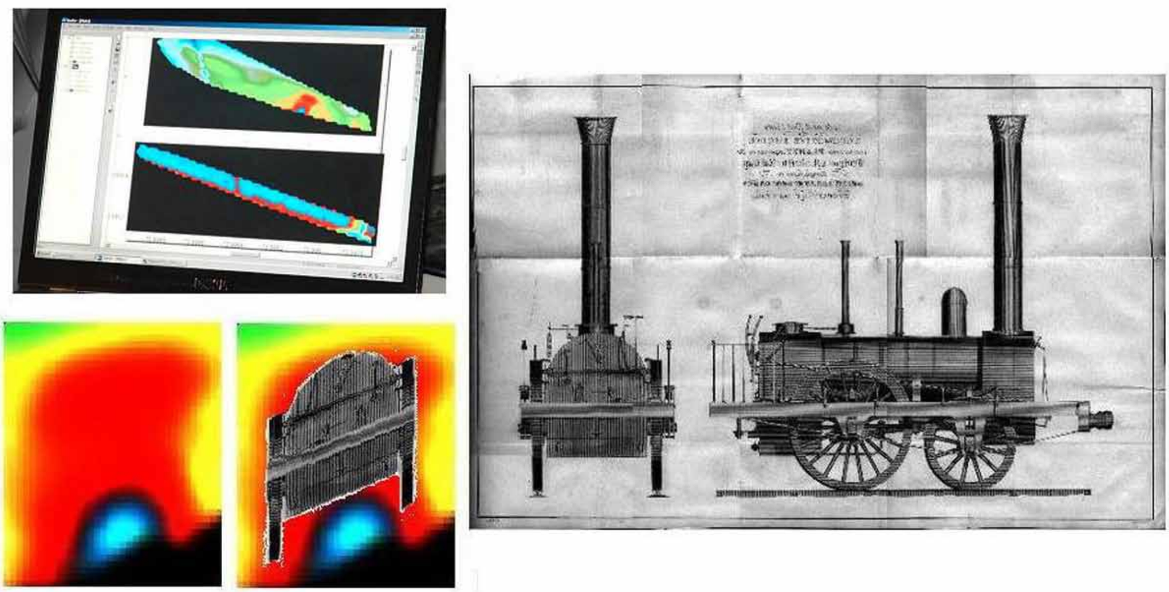
This report has been prepared and is respectfully submitted by

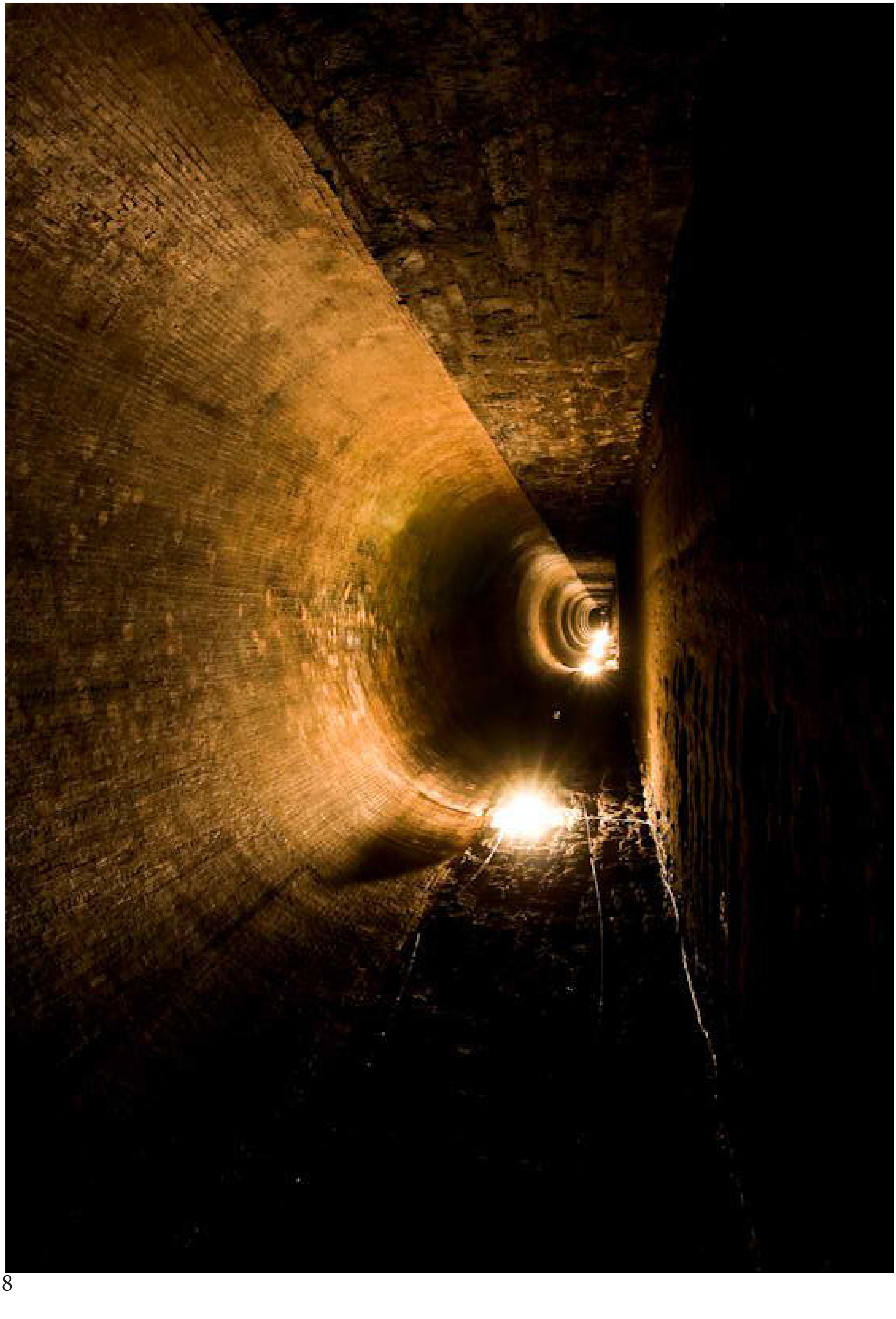
BRINKERHOFF ENVIRONMENTAL SERVICES, INC.

January 18, 2011

MATTHEW D. POWERS — Date
Director of Geophysical Services


APPENDIX B
Atlantic Avenue Tunnel Investigation
Brooklyn, Kings County, NY
Prepared for: B. Hamil Ltd
InfraMap
NOT TO SCALE
HICKS STREET
ATLANTIC AVENUE
B.Q.E. EXTENSION
BROOKLYN QUEENS EXPRESSWAY EXTENSION
COLUMBIA STREET





THE ATLANTIC AVENUE TUNNEL.

By Bob Diamond
Transcribed and edited by J. Keen

You're inside the world's oldest subway tunnel which was built back in 1844 by the Long Island Railroad. My name is Bob Diamond. I'm the one who found it a few years back. That section of passageway up there that you just walked through was originally filled in with dirt up to within about a foot and a half of the ceiling when I first found it. The stairway wasn't there and the pile of dirt under the stairway wasn't there. Back in 1982, I came here with some of my friends from school and we dug out that passageway using a homemade mine railroad that we copied off *The Great Escape* movie. It worked out pretty good. It took four months of weekends to dig that all out and that hundred yards of dirt under the stairway is what we pulled out of that passageway to make it walkable and then we put the stairway on top. Now, before the stairway and the pile of dirt was there when I first found the tunnel it was just a fifteen-foot drop down to the floor. So, to get in we had to use that chain ladder which is hanging on the wall over there. That was the original entrance from that wall back in 1980.

The only time anyone had been in this tunnel before me was in 1916. In 1916 there was a big spy scare in New York because there was an ammunition factory in back of the Statue of Liberty called Black Tom Island and German saboteurs blew it up. The concussion was so great that it almost knocked down the Statue of Liberty. It also broke all the glass in the tall buildings in lower Manhattan and lots of people were killed by falling glass. So the old timers who lived in this neighborhood went to the predecessors of the FBI and the FBI then got hold of the highway department and they then got this whole story concocted in their minds about how there were German saboteurs down in this tunnel brewing mustard gas. They didn't know how to get inside so they just dug holes in the street until they hit it like the one over there and also like the one down there. That's how they climbed in. And then they said, "Wow, what's this tunnel doing here-- it looks like a subway tunnel. Who built it?" Well, they didn't know. But they had to hang up some temporary work lights so they could photograph the place and that's one of the insulators they used on the ceiling. On that stone over there it says, "T. Lynch put first electric light in the subway" and the date is "3-11-16"-- March 11, 1916. They were here for about two weeks looking around and then they left. They didn't find anybody in spiked helmets running around, so they just wrote a report saying they found an unknown tunnel in good condition.

Where did the tunnel come from? Back in the 1830's they wanted to extend the Erie Canal system out to Boston. Why would you want to extend the Erie Canal system to Boston? The answer is international trade. The Erie Canal had been completed in the 1820's and it was bringing foodstuffs, fuel, and raw materials out of the Midwest and dropping them off right over at the foot of Atlantic Ave. It was a big boon to commerce, a big deal. They wanted to sell this raw material and fuel out in European markets and the way to get it there was you had to bring the stuff to Boston because the boats that were coming from England couldn't carry enough fuel to make it all the way to New York harbor. New York was five days' extra sailing time back then from Boston. So, if the ships carried enough fuel to make it to New York they couldn't carry anything back as a payload to Europe. So they had to find a way to extend the canal system to Boston. By the 1830's, railroads had supplanted canals as the main mode of transportation because they were cheaper to build and they moved a lot faster. Trains went thirty miles an hour and canal boats went two miles an hour, pulled by mules-- there was a big difference. What they did was to charter the Long Island Railroad in 1834 to form a land bridge between New York harbor and Connecticut. The way it worked was that the intermodal transfer to the ships and the canal boats was at the foot of Atlantic Ave. Everything got put onto trains, passengers and freight both, and got taken out to a place 96 miles that way called Greenport in Suffolk County. At Greenport there was a ferry across Long Island Sound to Stonington, CT, and then they'd take the Boston & Providence Railroad up to Boston to South Street Station. The whole thing, including the ferry connection, took eight hours, which was a huge achievement back then for international trade and local commerce.

The problem that they had is they became a victim of their own success. By the time the railroad became functional to Boston in 1844, the unopened dirt road at the southern end of town where they built their right-of-way, Atlantic Street as they called it then, had become the main commercial strip for the city of Brooklyn. So it was all choked up with pedestrians and horse-drawn vehicles on the surface. Now, the pine barrens, where the forest began, ended two blocks that way near Smith St., and the trains would come out of the woods at thirty miles an hour and they didn't have any brakes. Trains didn't have air brakes until after the Civil War. The way you'd make a train stop back in those days is the engineer would blow his train whistle a certain number of times, like a code, and these guys called "brakemen" would climb up to the roofs of all the cars and turn these big cast-iron wheels by hand that would pull on cables and chains and push wooden blocks up against the train wheels to slow it down. It took 800 feet to stop a train going thirty miles an hour, and in the process you'd run some people over and plow through some horse-drawn wagons. But they didn't care about that because you couldn't sue railroads back then; what they cared about is that it messed up their schedules for the intermodal connection to their ferryboats because time and tide wait for no train. So they had to get grade separation, which means taking the trains off the surface of the street and giving them their own level to operate in, which is where the whole idea of a subway line came from. It's to get trains off the street and give them their own subterranean level to be on. That's the whole concept behind building subways.

The tunnel had to be built by the cut-and-cover method, which was developed by the Romans about 2000 years ago for highway underpasses and also for underground aqueducts that brought water from the outskirts of Rome into the city. How it works is that you dig a big trench in the street, put the walls in, build a roof, and put the street back on top. That's what cut and cover is in a nutshell. Now, in this case what they had to do was get rock from Manhattan because Long Island has no rock in it. Long Island, which Brooklyn is part of, is called a terminal moraine, which is just a pile of dirt that was pushed here by a glacier 14,000 years ago. This glacier was a sheet of ice that went all the way back to the North Pole and was twice as high as the World Trade Center was tall, so it was a pretty good piece of ice. As it moved south through Canada and New England it pushed dirt ahead of itself, and where it ended it left a deposit which became Long Island and Brooklyn and Queens. So what we're standing on is the scrapings off the surface of New England and Canada. There is no rock or clay to mine through using typical tunneling techniques so the tunnel had to be done by cut and cover. This was the way all the other subway lines in Brooklyn were built sixty or seventy years after this one was. Manhattan, though, is a different story. Millions of years ago there were two mountain ranges in Manhattan, which is why they're able to build those really tall buildings over there. The foundations of those buildings are tapped into the bases of these old mountain ranges and that holds everything together. So, they hired a contractor named William Beard, who two years earlier in 1842 built part of the first Croton Aqueduct, which brought water from Westchester County into Manhattan. Part of that aqueduct was copied from Emperor Claudius's aqueduct from 2000 years ago, which was a cut-and-cover water tunnel. So they took the dimensions of that water tunnel, multiplied it out by 2.8, and got a tunnel that was wide enough to accommodate two railroad tracks and two railroad trains passing each other side by side. It's 21 feet wide on the internal dimension and 17 feet high at the center, which is called the crown. The walls are 6 1/2 feet thick at the base, 4 1/2 feet thick at the springline where the brick begins, and the brick tapers to two feet thick at the crown. All the rock was brought over from Manhattan by Beard. Simultaneously, he had jobs to build Third Ave. and Broadway in Manhattan. Every time he ran into rocks, he'd cut them up, put them on barges, and feed them into the tunnel project in Brooklyn. The rock all came from around the area where the U.N. building is now, which was called Turtle Bay back then, and it also came from up in Harlem. That's where the rock was harvested. Now, the whole tunnel cost $66,000 to build, which was a gigantic amount of money back then; it was like $500 million today. Back then you have to realize there was no compressed air, there was no hydraulic machinery, no excavating machines, no diamond saws, nothing. But they had something better-- 800 Irishmen. They used picks and shovels, pack mules and horses. The only machines they had were block and tackles and screw jacks, that was it. The ditchdiggers who dug out the cut part of the tunnel originally through the earth-- the predecessors of the "sandhogs" who dug out the subways-- were paid 13 cents a day. The outside width of the cut is 35 feet. Over here, for example, is the deepest point in the tunnel. If you look up in that airshaft, you can see how deep we are. That stone slab has four feet of fill on top of it, and then there's the base of Atlantic Ave., so we're about four stories under Atlantic Ave. right now. So we're talking about a cut that was 35 feet wide and four stories deep at this particular location. The stone masons who put the stone blocks together got 83 cents a day. But don't feel bad for these guys because the best steak dinner in town was 25 cents back then. The tunnel only took seven months to build. That length of time for building something like this is amazing. If you tried to build something like this today it would take fifteen years just to get the environmental approvals, if you could even get that far, and they'd be messing around here for ten years with machines trying to build it. Back then, to get the franchise to build this tunnel, all that happened was Cornelius Vanderbilt, who was the operations director for the Long Island Railroad, went into a closed session of the Brooklyn City Council meeting, closed the door behind him, had a carpet bag filled up with railroad stock and money, and when he left the closed meeting there was no more money left in his bag but he had this perpetual franchise to Atlantic Ave. Contrary to what most people think, the New York Central Railroad, where Grand Central Terminal and the Metro North line exist today, was not Vanderbilt's first railroad project-- this was. This is Cornelius Vanderbilt's first railroad line, all the way back in 1844. Now, getting back to how the tunnel was built, first the sandhogs would dig out the cut in the street, then the stonemasons would lay in the stone walls. But the next step was not the roof, because building the roof was the whole trick to this thing. After they put the stone walls in, they built two railroad tracks side by side. On top of the railroad tracks came two railroad flatcars that were bolted together side by side, and on top of that was this wooden form called a barrel vault. The reason it's called a barrel vault is because it looks basically like a big barrel that's slit in half lengthwise and laid flat. That's how a barrel vault ceiling gets its name. What they would do with this barrel vault form, which was made out of giant timbers 18 inches thick that could take all the dead weight of the brick lying on it, was to lift it up with screw jacks off these railroad cars to the right position. Once they got it lined up the right way, they laid bricks on it from one wall across to the other wall and just kept going back and forth until they built up the thickness of the arch they wanted. Then they waited for a day for the cement to harden up in the joints, they lowered the screw jacks, moved the railroad cars up 50 feet because the form was 50 feet long , lifted it up, laid another 50 feet of arch, waited for that to harden, dropped it down, moved it up, and just kept repeating the process. So you had a 2000 foot long tunnel made in 50-foot rings, but they're put together like LEGO blocks so there's no seams and no places for it to leak or move around. The cement that it's made out of is not mortar. It's made out of concrete called Portland cement, which is Roman cement from 2000 years ago. In the Middle Ages they lost the formula for the Roman cement that was able to harden under water and got harder with age instead of weaker. Some guy was experimenting in Easton, PA, back in the 1820's and he rediscovered what Roman concrete was made out of. The secret ingredient was this special type of volcanic clay which gets burned in a kiln at a certain temperature and that's what makes the cement waterproof. So this was laid up using Portland cement, which is the same stuff they build highways out of now. It doesn't get weaker with age, it gets stronger. And it doesn't have any reinforcing bar, and that makes it stronger, too, because reinforcing bar is what destroys concrete because the reinforcing bar rusts and makes the concrete fall out. So, because this has no rebar in it it's much stronger than a modern-day subway tunnel. When they ended up building the IRT subway line 60 years after this place, they didn't use the brick arch construction anymore because the labor costs were so high, and because reinforced concrete and steel lends itself to mechanized mass production. That's why the rest of the subway system in New York was built out of that steel skeleton box frame with the reinforced concrete in between the columns-- because that's readily built by machinery rather than human labor. So that's how the tunnel was built, and it held up pretty well. There were structural engineering tests which we had done a few years back, and they came up saying that the tunnel could hold up six times the weight of Atlantic Ave. right now, even though at the time it was designed it was just made to hold up horse-drawn carriages. It was overbuilt, just like the Brooklyn bridge was. The roof of the tunnel was painted white, and the reason for that is because they didn't have illumination back in those days, so they painted the roof white so they'd get some light coming down the airshafts and reflecting off the train headlight. The black stuff on the roof on top of the white paint is actually the steam locomotive exhaust from the trains that ran through here between 1844 and 1861. If you look around the corner of the walls at the floor level , you might find little pieces of coal floating around that fell off the trains that ran through here. I should mention that this masonry I'm sitting on and these loose bricks originally were up at the street level. Where these air shafts came out to the street there was a wall about four feet high around the opening into the airshafts so people wouldn't fall in, and when they sealed off the tunnel they broke off the top of that shaft and threw it in. So that's where this brick came from that I'm sitting on right now.

Right now we're geographically in the center point of the tunnel. The whole tunnel is 2570 feet long, which is a shade less than half a mile. It had portals at both ends, obviously, that the trains came in and out of. At that end of the tunnel where you came in through the ladder, if you were to go another 115 feet you'd get to the point where there'd be an opening in the street, the roof of the tunnel would end, and then there'd be a short, open-cut ramp where the trains would come up to the surface of the street by Boerum Place. That ramp would be lined by stone blocks, not like these but made out of granite. At the other end of the tunnel, that portal is halfway between Hicks St. and Columbia St. in the middle of Atlantic Ave. Now, the whole train facility they have at Flatbush and Atlantic today with the station and all the trainyards didn't exist back then. That was just the woods in those days. The pine barrens came up to where Smith St. is now, two blocks up Atlantic Ave. from where you came into the tunnel. The whole big railroad facility was at Columbia St. and Atlantic Ave. That's where you had the big pier; that was the intermodal transfer connection to the ferryboats and to the Erie Canal boats where pier seven is today, and then the upland area between Columbia St., Congress St., and Atlantic was all the trainyard. They had space for a hundred passenger cars, a hundred freight cars, two turntables for spinning the locomotive ends around, and they also had the fuel facilities for wood and coal for the locomotives. They also had water to put in the trains to make steam that came from an underground spring they found which was near the mouth of the tunnel near Columbia St. That was the whole setup back then. It was an interesting operation. The rails they used were not made out of steel; they were made out of cast iron. Very often the locomotive would be chugging along and find a weak spot in the cast iron and the rail would fracture. The weight of the locomotive wheel would push the rail down at one end, making it pop up through the bottom of the passenger car at the other end, and impale you while you were sitting in your seat. That was called getting a "snake head." So it was kind of rough riding trains back then. They were all like that; it was just a hazard of riding trains. And then very often if the engineer used up his fuel too quick and the train ran out of fuel, they'd hand out axes to the men and tell them to go out and chop down trees for fuel, and if they ran out of water they'd hand out buckets and tell you to go to farmers and beg to use their wells. So it was kind of rough and ready using trains, but that was the best mode of transportation they had back then.

The tunnel was a big success commercially. It functioned great for the first couple of years. It was a whole big deal for international trade and local commerce for a few years, but much fewer than you might think, because by 1850 the whole thing was pretty much gone. As I mentioned, Vanderbilt was the operations director of this line. He was originally told by the city, "You can go and take over Atlantic Ave. but you have to finish building that tunnel in four months" because they didn't want traffic to be held up and damage commerce by having a giant hole in the street for years. So he went out and got these 800 Irishmen and they tried to do it, but they only got up to over here after the four months were up. So then they got together and decided to have a meeting about what to do. Vanderbilt called in this construction supervisor which was called an overseer, and as the name implies, it was kind of an unpleasant type of construction supervisor. He was English, and he got together the 800 Irishmen and told them that they had the privilege of working for free on Sundays. They were working six days; now they were going to work for seven days and only get paid for six. One of the workers didn't like the way this labor negotiation was going, so he pulled his Derringer out of his boot, shot the overseer in his head, and then his buddies chopped him up into pieces and hid him behind the wall right in this area. And it's all written in the newspaper articles, in the Brooklyn Eagle, so it has to be real! So if you see a green orb floating around it's just this foreman looking for his head. Getting back to the story of how the tunnel ended up failing, it's because of Cornelius Vanderbilt and the Gold Rush. In 1848 they found gold out in California and Vanderbilt decided that he was going to go back full time into the steamboat business and run a steamship line from New York to San Francisco. Now, going from New York to San Francisco was a real big deal back then because there was no Panama Canal yet. So to go from New York to San Francisco you had to take a boat all the way down to Antarctica where South America ends at Cape Horn and then come up the other side in the Pacific Ocean to San Francisco, which took six months. And you were lucky if you didn't get killed in the process because the ships would often run into weird storms near Antarctica and sink. So Vanderbilt went into that steamship business and made a huge killing. Meanwhile, he was supplying the ferryboats to the Long Island Railroad to make it work. He supplied the ferries that ran between Greenport and Stonington, CT, and he supplied the other ferry that ran from Brooklyn to Manhattan and to New Jersey. But he withdrew those, so all of a sudden this line couldn't function anymore because the ferries were gone, and nobody else had ferryboats that could have that kind of capacity. So right away, after only functioning for four years, this line no longer could connect up with Boston anymore because Vanderbilt left and took his ferryboats with him. After that, there was a whole big problem with international trade, and it was so screwed up that the powers that be back then had to build another railroad to replace this one. So they built the New Haven Railroad in 1849-50 to replace the Long Island Railroad. The New Haven Railroad still exists as Metro North from Grand Central Terminal to the south shore of Connecticut to New Haven, and at New Haven it connected with a different railroad that went up to Boston. So that's where that came from. So, this whole thing flopped as an international trade mechanism in 1848. Now in 1850, the bonds came up for building the tunnel, $66,000, which was like four or five hundred million today. Meanwhile, this place isn't making money because it doesn't go to Boston anymore, so they couldn't pay their bonds. So they went into foreclosure and got sold off at a sheriff's auction. These scrap guys from Philadelphia bought the Long

Island Railroad, and they came up here. The first thing they did was rip out the second track. This line was all double tracked from Brooklyn through Queens. They sold the rails for scrap, and they also took the rails and used them to patch up places on the line where the other rails were breaking from being worn out and having too many snakeheads. So, after they ripped the track out on the side that you're walking on now, they then let horse-drawn wagons and pedestrians come through the tunnel as a traffic bypass for Atlantic Ave., and on this side over here they retained working steam trains. That must have been a real trip back then, with working steam trains over here, and horses flipping out over there from the steam engines. If you take your flashlight and glance it off the floor of the tunnel along that side, laterally with the wall, you'll see wagon wheel ruts on the floor of the tunnel in some places. The notches on the floor on this side are where the railroad ties used to go. That's why this is all rippled and corrugated on this side. Now after these scrap guys bought the place, they still kept it running through Brooklyn as a local transit line and also through central Long Island because before it became a suburban community, it was the main farm produce area of the U.S. Something like 70% of all the potatoes eaten in America came off of Long Island back then, and also most of the milk. So there were milk trains and farm produce trains running through here all the time and they also maintained a local passenger service for people who lived along Atlantic Ave. So it kept running that way.

But then the end of the line came when the Litchfield brothers showed up. There were several Litchfield brothers, but two of them had to do with shutting down this rail line. One was Edwin Litchfield, who bought the Jacques Cortelyou farm, where Park Slope is now, and cut it up into brownstone-sized lots around 1852. Then he tried to get people to move into the area by taking the backyard of his mansion, where Prospect Park West is now, and making Prospect Park out of it as an amenity. But that still couldn't get people to move in because there were no paved roads, there was no running water; it was like living in the middle of a desert island. So he was talking to his brother, Alexis Litchfield, who was a railroad developer in Michigan. He said what was needed was a railroad line to run from Park Slope down to Fulton ferry and down to the Atlantic Ave. ferry. Now the ferries were very important back then because there were no bridges over the East River yet. The Brooklyn Bridge was still thirty years away. So they built a horse-drawn streetcar line to run from Park Slope to Fulton Ferry and Atlantic Ave. ferry, and all of a sudden Park Slope became a big success. People were flocking to move into the area because now they had a railroad line to service them. So Park Slope became a big bedroom community for people who worked in Manhattan.

Sreetcars are not necessarily trolleys. The streetcars that Litchfield used to get people to Park Slope were pulled by horses. They basically looked like small trolley cars, but they had no motors in them. They were pulled by a team of four horses. Now, it was common all over the country at that time to have horse-drawn streetcars like that. But in the 1870's this virus came around called the Great Epizootic and that killed all the horses, so they had to find some other way to do it mechanically since the horses were dead. So they invented the cable car system like they have in San Francisco. For a while Manhattan and Brooklyn had cable car lines. Now, a cable car line is still not a trolley. Between the running rails of a cable car line is an underground conduit built under the track, and inside this conduit, which is like a pipe made out of brick and cement, there's a steel cable like a bridge cable, and it's being pulled by a powerhouse at twelve miles an hour. So this wire cable is moving twelve miles an hour under the street, and the car has a latch inside of it called the grip, which goes down through a slot in the street between the running rails into the conduit, and this grip latches onto the wire rope. So then the cable car is pulled along at the same speed as the rope, and when you want to stop going you unclamp off the wire using a hand brake. That's how the cable cars ran. But they were tremendously expensive to build and a huge amount of trouble to maintain. If you can imagine, at every curve in the track you have to have pulleys and sheaths and tensioning springs and all sorts of weird mechanical devices to maintain tension in this cable and keep it in the right shape as it moves under the street. So they got rid of them in the 1890's when they invented the first practical electric motors, and that's where electric trolleys came from. An electric trolley is set up just like the battery in your car: The positive lead goes to a wire that runs above the trolley car, and there's a pole that makes contact with the wire, which is the positive lead where the power comes in from, and the track itself is the negative lead that goes back to the powerhouse, like the negative lead on a car battery. It's a very simple machine. That's how these things evolved in Brooklyn and everywhere else at the same time period.

Now what the Litchfields did after they had the big success in Park Slope was they said, "Hey, let's see if we can make lightning strike twice! Let's go and build a copy of the Champs-Elysees along Atlantic Ave." So they got Vaux and Olmstead, the designers of Central Park, to design Prospect Park and they got them to come up with plans for the Atlantic Ave. boulevard and drive. If you want to know what that was supposed to look like, just look at Eastern Parkway and Ocean Parkway because they ended up using those plans twenty years later. So they went and made this beautiful plan, and then Alexis Litchfield got himself elected to be the city council member for downtown Brooklyn. He took over the transportation committee and began awarding streetcar franchises to him and his brother to build these streetcar lines to service all the real estate development sites. At the same time, he began passing ordinances against the Long Island Railroad to get them out of Brooklyn. If they exceeded five miles an hour they got a $500 fine. If they blew the steam whistle-- another $500 fine. Why? Because the Long Island Railroad, because of that perpetual franchise they got in 1844, essentially owned the street itself. They wanted to get the Long Island Railroad out, take away the steam trains, replace them with horse-drawn streetcars, and they would then take the empty farmland on both sides of the street and build six-story apartment houses and control the real estate and transportation and have a monopoly on everything. That was their big goal. They had to get the Long Island Railroad out of town. The main reason they wanted the railroad out of town, though, wasn't just the fact that it owned the street, it was also because they knew the tunnel could become a cash cow for them by saying they're demolishing it. So what Litchfield finally wound up doing in 1859 was pushing a law through the state legislature called the Tunnel Act, which declared that underground tunnels and steam trains in the city of Brooklyn are a public nuisance, and they'd create a special assessment district, and all the adjacent property owners had to pay a total of $130,000 directly to Litchfield, who became his own contractor for demolishing the tunnel, removing the "nuisance." The $130,000 was like many million dollars today, and if you didn't have the money he would take your land, which is what he was after anyway. So he shut the railroad line down and got them to move to Hunter's Point in Long Island City instead, and all the commerce and business that was in downtown Brooklyn followed the railroad to Long Island City. So basically what Long Island City is is the displacement of businesses from downtown Brooklyn in 1861. That's where Long Island City came from. Now there were some businesses still left over here but they suffered from the loss of transportation. What Litchfield did was to fill in 200 feet of tunnel at both ends, and then filled it up to street level and put cobblestones in so you couldn't tell where the entrances were, and then he capped off the three airshafts and sealed them up on top, too. Then he got three of his business associates who were supposed to be impartial commissioners to sign a notarized document saying the tunnel was demolished from one end to the other, and he pocketed the money for demolishing the tunnel. So what you're standing in is a monument to New York City corruption in the 19th century. Things haven't changed all that much. Then Litchfield went out and did his real estate project. Now if you go to the corner of Flatbush and Atlantic and look up Atlantic Ave. you'll see it's like twice as wide. That's because they actually began building that street, cutting through the pine barrens and making room for a big boulevard. Now the reason it's not there is because the remaining people who owned property and businesses in Atlantic Ave. formed a lynch mob and went to Litchfield's office at Atlantic Ave. and Furman St. one day to shoot and hang him, but not necessarily in that order. They began having a gunfight with Litchfield and his four sons against all of these angry property owners. This went on for six hours. Of course, there's no cops around when you need them. According to the legend, he escapes after this gunfight in 1861 and goes south and loses his money buying Confederate war bonds. So that's why there's no boulevard on Atlantic Ave. and why there was no transportation access into this part of Brooklyn for many years. The reason all the brownstones sitting on top in Brooklyn Heights and Cobble Hill are still there is because after this rail line was shut down nobody wanted to be here. This became like a no man's land for commercial development and people wouldn't even live here because there was no transportation access. Litchfield took out the track in the tunnel, put it on the surface of the street, and tried running his horse-drawn streetcars, but that didn't help the area too well because it doesn't help the commerce at all. So that's why this area is preserved up on top-- a by-product of closing off the railroad was the brownstones got saved.

Everyone thought the tunnel was sealed up and totally filled in in 1861. They even fooled Walt Whitman. In some of his writings, he put down some of his reminiscences about riding the train through this tunnel. He said that he used to go down to the terminal by the waterfront and buy oranges from the concession stand and they'd be rotten, and that they would sell cornbread on the train but it would be stale. He said that the tunnel was all filled up with sulfurous smells and must be a lot like hell is, and he said people who didn't like their lives should be forced to live in here for a week. They fooled him, too. So everyone thought the thing was gone; it's O.K., it's an old tunnel, it gets closed up and forgotten. So what? The place is shut down and should have just gone away in 1861. But it didn't. The odd thing is that this place kind of took on its own personality after that, and began coming up in the news media every few years. The first instance that I was able to find was in a newspaper article from 1893 in the *New York Times.* Now, New York harbor had a very bad piracy problem back in those days, believe it or not. Because there was so much trade coming into this harbor-- this was the main shipping harbor of planet Earth-- there were ships with gold and silver and valuable stuff coming in from all over the world back then. To give you an idea of how packed it was, you could walk from Brooklyn to New Jersey by jumping across the decks of all the ships that were parked in the harbor-- that's how congested it was. So there was a huge problem with piracy with people going onto the boats at night, killing the crew, and taking the valuable stuff off and selling it. Now these groups still existed for years afterwards, except during Prohibition they became Murder, Inc. and the Westies. The Westies still existed up until the 1980's in Manhattan. The *Times* article in 1893 was about the river pirate problem they were having here in New York, and they said the worst pirate gang was located in Brooklyn and had their clubhouse in a certain bar along Atlantic Ave., and that they had their Aladdin's cave of pirate booty hidden under the street in this old train tunnel. They said there was so much gold and silver in here that you didn't have to bring a light with you; it just glowed in the dark by itself. And then they said the way into this tunnel was through the basement in a barroom through a secret passageway which was guarded by two seven-foot Turks with scimitars. This was the *New York Times* writing this, so people began believing these stories. Where they were getting them from, I don't know. And then there were other stories about the tunnel in the 1930's where people wrote to the District Attorney of New York anonymously saying that Murder, Inc. was dumping bodies down here. The police department spent days going through all these basements along Atlantic Ave. trying to find the secret entrances, but there weren't any, although they probably had a good time looking through all the bars.

The way I got involved with this thing was back in December of 1979 I was studying Electrical Engineering at Pratt Institute, back in the days when they still had engineering over there. I had just started my sophomore year, and they came up to me and said, "We want you to get this scholarship from Eastman Kodak." I asked, "Well, what is it?" And they said it's good; there's no strings attached, it's going to pay your tuition and it looks good on your resume. So I said O.K. and signed up for it. But as soon as I sign up for it, all of a sudden the strings all come out. I start getting phone calls from people in Rochester at Kodak saying now you have to come out of school for a while and work for us at our facility. It turned out they were doing spy satellites. And I asked where am I going to be working, what are you paying me, what's the arrangement going to be, and they said, "Oh, we can't tell you." So I said, "If you can't tell me, get somebody else; I'm not doing that." So they just kept pressuring me to go until the whole thing came to a head in December of 1979 when I told them where to go. And then I came home from school and it was raining and snowing out and I put on some background noise on the radio so I could do my differential equations homework until four in the morning, and there was a guy talking on this radio show, Gill Gross, and he said this book called The Cosgrove Report just came out about the assassination of Abraham Lincoln. In this book, it says the missing pages of John Wilkes Booth's diary, which are the ones that are supposed to tell who put him up to killing Lincoln and name all these people in this grand conspiracy, are supposed to be hidden in a metal box behind a wall near Columbia St. in this train tunnel under Atlantic Ave. that nobody can find. And it says right next to John Wilkes Booth's diary, there's a steam locomotive from the 1830's lying there thrown over on its side. So I'm like, "What did you say? Got a conspiracy theory and an old train? Oh, I'm right on it!" To me that was a great thing because it got my mind off of Pratt and Kodak for awhile. So I went down to the library the next day and tried finding information on the tunnel but there was very little there, like nothing really. So I called up the radio station and talked to Gill Gross, and he said, "I don't know anything about this book. I just read what came over the teletype. Why don't you call the guy who wrote it, G. J. A. O'Toole. He lives up in Connecticut." So I called him up and said, "Hey, what's up with this tunnel under Atlantic Ave.?" So he says, "Oh, I read about it in a book and it told about bootleggers and smugglers being in there, so I thought it would be interesting to mention it in my story about Lincoln." So I said, "Well, is the tunnel there?" and he says, "I don't know. You're a young guy. Why don't you go and try to find it?" So I said, "O.K. I could do that." So I went down to the library and began pulling out newspaper articles that were printed in Brooklyn from 1830 to the 1880's. Luckily they were like one page long once a week or I'd still be there going blind right now. So that's where all this stuff I'm telling you is coming from; it's coming out of the old newspapers from back then. I kept digging up more interesting anecdotal stories about the tunnel, but there was nothing about whether it was still here or not. The only thing I could find out is that in 1876 the Long Island Railroad came back into Brooklyn by popular demand by a campaign led by the *Brooklyn Eagle* newspaper. They were only allowed to come back as far west as Flatbush and Atlantic Ave. because they didn't want anyone to find out this tunnel was still here because Litchfield was still around at that time along with his crooked cronies who stole all that money a few years back. So that's why they didn't let them come all the way to the waterfront because they'd find the tunnel was still here and not demolished. That's why the Long Island Railroad terminal is in that middle-of-nowhere, dumb location right now-- it was all politics to protect Litchfield back then, basically a coverup for a crime. So that's another thing I found out but nobody could tell me if the tunnel was still here. I went to see the guy who started the transit museum, and I said to him, "What's up with that tunnel? Is it still there?" And he says to me, "Oh, don't bother looking for that tunnel. There's nothing there. I can guarantee you that." I asked him why, and he says, "Well, I looked for it, too, and there's nothing there." So I said, "Wait a minute. You're telling me I shouldn't look for it because you couldn't find it?" and he goes, "Right." So then I went to other people who were supposed to be experts, like the Borough Historian at that time, and they all said the same thing: "Don't bother looking for that tunnel. I tried finding it when I was your age, too, and there's nothing there." Finally, one guy says to me, "Oh, it was definitely destroyed in 1936 as part of a W.P.A. project." So I said, "O.K., where's the budget line for this W.P.A. project?" and he goes, "I don't know. I lost it." So that never even happened-- it was just something he made up to discourage me. Meanwhile, the more these people told me not to look for it, the more pissed off I got, so I just kept looking for it harder. So one day I go into the book store at Sixth Ave. and St. Mark's Place to buy a book for someone's birthday, and there was this book half hanging out of a shelf that fell out and it said Old Brooklyn Heights by Clay Lancaster, so I picked it up and looked through it.

Basically what it is is a reprint from a landmarks commission report from 1960 that made Brooklyn Heights into an historic district. So I'm thumbing through this book, and I come to this page that has a woodcut drawing of a train coming out of a tunnel, and it says, "Atlantic Avenue Tunnel, 1844." So I'm like, "Whoa! What's this?" I look in the back of the book in the index, and it says the source was the *Brooklyn Eagle*, July 23, 1911. So I went over to pull that out of the library, and there was a full-page article entitled, "Brooklyn Has the World's Oldest Subway." So when I tell you this is the world's oldest subway, it's not just me saying it, it's them saying it who were building subways at that time. They knew what they were looking at. So in the article, it tells how a newspaper reporter for the *Eagle* was going through the Borough President's garbage trying to get something on him, but instead he found the plans to this tunnel. So he showed them to his editor, and the editor says, "Wait a minute. When I was a copy boy and Walt Whitman was the editor years ago, he was always going off about this train tunnel which he couldn't stand. This must be it." So they went and got together some oldtimers, and the oldtimers said, "Yeah, we remember riding through it, and there's secret entrances coming off of the barrooms on Atlantic Ave." So they organized a fifty-man search party to look for a way in, but they couldn't find anything. But they must have had a good time doing the Atlantic Ave. bar crawl for a few days. In the newspaper article, it opens up by saying that there's an old locomotive sealed up near Columbia St., and then it goes on to talk about the river pirates and the bootleggers. All that stuff turned out to be real. There was a bootlegger down here, but not during Prohibition. He was in here from September to December, 1861, and he had the liquor concession in the ticket office for this railroad line. After the last train ran through in September, they didn't seal it up until December. We found the remains of his still and pieces of pottery that said, "Daniel Cavanaugh, Liquor Dealer, 20 Atlantic St." The reason he was bootlegging is because there was no income tax back then, and the way the city got money was by a 30% tax on alcohol. So that part was real, the river pirates were real, and all the other stuff in that article was real. The only thing they got wrong was the date of when they started to build it. Also, there's a book called "Steel Rails to the Sunrise" which lists all the old locomotives that belonged to the Long Island Railroad and tells what happened to them. There is, in fact, a locomotive that disappeared off the line at the same time this place was closed up. And they didn't have acetylene torches to cut things up back in those days, so it was very common to bury things to get rid of them. This is supposed to be an old wood-burning engine built in England in 1831, and by the time 1861 came along it was obsolete and couldn't pull around the bigger trains anymore. So that's how they got rid of the thing; they just buried it in the fill. So anyway, this article had a map in it that showed different cross-sectional views of the tunnel at different spots on Atlantic Ave. in relation to the street, and it said, "Nassau Water Commissioners Map, 1868," and said it came from the Borough President's office. So the next day I walk into the Borough President's office with this newspaper from 1911 and said, "Hi. Can I see the Nassau Water Commissioners Map from 1868?" And the Borough Engineer looks up from his racing form, and he says, "Oh, you're looking for that tunnel under Atlantic Ave.? Don't bother. It's not there." So I'm like, "How do you know?" and he says, "Well, when I was your age I tried to find it"-- the same thing everyone else said. And I said, "Well, what about this map? Do you have that?" And he goes, "Well, I've heard of it but we've never seen it." And I said, "Well, do you have any place here where you keep old things that you never look at?" And he said there's a trunk that doesn't open up with a broken lock. So he jimmies open the lock, and on top there's a deed from the Canarsie Indians where they sold Brooklyn to the Dutch with feathers on it, then under that there's some other Dutch stuff, and at the very bottom there's a scroll which he opens up and it says "Atlantic Avenue Tunnel" on it. So there it is-- there's the map. So they give me a copy of it, and I took it home to my Mom's dining room table and I looked at it for about a second or two and I saw a little blue dot near Court St. and Atlantic Ave. I just assumed that the blue dot meant a manhole cover, and because the cross-sectional view of the roof of the tunnel at that spot showed the roof was like a foot below the surface of the street, I figured that if that was the manhole it had to go into the tunnel. When you came down here you could see that the tunnel roof was right close to the street over there. So the next day I took a ride out here on the train-- I had never been here before-- and I took a steel tape with me. So it was like reading a treasure map: 15 feet west off the corner and 30 feet north, and you're standing in the middle of the street on top of this small, round manhole cover different from all the other ones. It had nothing written on it. So my first idea was to call my friend and just pick this thing up with a tire iron to see what was under it, but then I saw there's a six or seven-story building up the road with bars on the windows, so I was like, "Uh-oh. They're going to think it's *The Great Escape*." Instead, the next day I went to people who I knew from the gas company. Before it was Keyspan, it was called the Brooklyn Union Gas Company and it had been around since the 1850's. So I went to Alan Smith, who was a big guy at the gas company. I knew him because when I was a senior in high school, I won a science fair that he sponsored for alternative energy sources. I came up with a working model of a satellite that would pick up sunlight in orbit, convert it to microwaves, and send them down to the surface where they would get made into regular electricity to use. So he says to me, "What are you doing here? Did you finish college in a year or something and you need a job?" I said, "No, no. I think I found the world's oldest subway." And he says, "I thought you were into satellites and stuff." I said, "I'm not doing that anymore. I'm going underground now." And he says, "Well, how can we help you? What would you like us to do?" I said, "Well, I need an air tank and a gas mask because people told me it's filled up with poison gas, and I need a rubber raft because they said there's fifteen feet of water in it, and then I need a big crowbar to beat up the five-foot rats that supposedly lived in here." And he says, "O.K., what else do you need?" And I said, "Well, I need you to block off all of Atlantic Ave." And he says, "O.K., meet me at nine o'clock tomorrow morning." So that night I go and I see *Raiders of the Lost Ark*, which was lucky. My mother wakes me up like 5:30 or 6 o'clock in the morning, and she says, "You'd better go over there now." And I'm like, why? She says, "I don't know. Just go over there. There's something going on." So I take the train, I walk down Atlantic Ave., and sure enough, Atlantic Ave. is blocked off. The gas company truck is there, the manhole cover is open, and the head engineer of the gas company is walking away shaking his head in disgust. And I walk up to him and I'm like, "Hey, Ted, what's going on? I thought you told me to get here at nine o'clock!" And he says, "Well, we thought we'd just get here early and find the tunnel ourselves." And I said, "You couldn't find anything, could you?" He says, "No, you drew a blank. There's no tunnel under there. There's just a three-foot drop with dirt underneath. There's nothing under there. We're packing up and we're leaving." So I said to him, "Well, I've been working on this for like a year now. Can I take a look?" And he says, "O.K., you can have ten minutes because it costs us a lot of money to be here." So they tie a cable around me, they give me an air tank and a gas mask and a seven-foot crow bar to beat up the five-foot rats, and they give me a walkie-talkie and they say, "Here... go." So I go in there and I jump in and I'm standing on top of the dirt and the top half of me is sticking out into the street and people are walking by starting to look. People are going to work and they're like, "What's he doing in there?" I'm starting to feel like a dope, thinking maybe this guy's right, there's nothing there. So then I move my feet around and saw there was a space underneath. Remember I was saying there was a foot-and-a-half of space between the top of the dirt and the inside of the roof? So I squeezed in there with this air tank banging on the ceiling, and in about two seconds I went from that manhole area down to the opposite side of the concrete wall. Now, you couldn't see the concrete wall because right in front of the wall on the other side the dirt went up and touched the ceiling, so it looked like there was nothing there. So I'm sitting there in this little crevice 70 feet under Atlantic Ave. wondering what I'm going to do next and how did I get myself into this situation-- everyone's going to think I'm an idiot now. Then I remembered seeing *Raiders of the Lost Ark* from the night before. When Indiana Jones was in a similar situation he started digging with his hands to get into that place where the ark was hidden, so I just started digging with my hands. In about two seconds I find the concrete wall is there. I dug a little bit more and found that there was an opening cast into the concrete wall, but the opening is plugged up with bricks and cobblestones that are cemented in. So I pull out the radio the tell the gas company guys that there's a way in, but I couldn't talk-- all that went through my head were all these images of all these people telling me there's nothing there and not to look. I was laughing into the radio, so they figured that I'd found something. So they came in there with a bunch of these seven-foot crowbars, which they called "Sicilian toothpicks," and after about an hour of breaking through those rocks, we got through the wall and a blast of cold air came out just like in the movie. So then the head engineer of the gas company says, "Oh, well that's nice, we can't go in." I'm like, "Why? Why can't we go in?" He says, "Oh, there's a fifteen-foot drop down to the floor and because there's no room in this space up here because of the geometry you can't bring a ladder in. So we can't do anything with it. We're going to leave again." I said, "Give me 20 bucks." And he's like, "For what?" I said, "Just give me 20 bucks!" So I got the money and I went to Bruno's hardware store two blocks away and I bought the chain ladder, which is still sitting there. So we took an old piece of pipe, hung the chain ladder up, and climbed down. And that's how the tunnel was found. [APPLAUSE...]

So then, we walked through the tunnel. And we're walking and we're walking and we come to a stone wall at the end. So the head engineer of the gas company says to me, "Oh, Bob, I've got to call the Port Authority when we go back to my office later." And I'm like, "Why?" He says, "Well we're walking for hours and I think we're in New Jersey now." So it turned out just to be Hicks St. Meanwhile, all these people from the cultural establishment of Brooklyn from all these different museums and historical groups, who normally you'd think would have gotten involved with this thing and said, "Wow! What a great thing! Let's make something out of it," refused to do anything. Instead, none of them would come near it because they're all the same people who said it's not there. It all became sour grapes for them after that. So I was on my own. That's when I got the idea to form my own non-profit group, Brooklyn Historic Railway, to preserve and interpret the tunnel, and also try to put it back to its original use for transportation. So that's how that all started in 1982 with the non-profit group, and then we came down and dug out the entranceway and had the first tour in October of '82. And it's been going on ever since. Then, a short time after that I got approached by the people from the Rotary Club and the Chamber of Commerce for downtown Brooklyn. They wanted me to tell them about the tunnel, so I went down there, gave them my slide show, and they said, "You know, we're planning to build a light rail line from the Long Island Railroad terminal through Fulton Mall and then down to DUMBO and this tunnel should be made part of that." That's because the tunnel brings this "Disneyland" effect to the whole thing. And they said, "Well, we're getting loads of money. We have this congressman named Freddy Richmond who's paying for everything with federal money and it's all ready to go and everything's beautiful." So a couple of months later I'm watching T.V. and they show Freddy Richmond resigning because he had some kind of "indiscretion" with somebody somewhere in the capitol building, and because of that there's no more trolley project. So the Chamber of Commerce people said, "Hey, you're a young guy. Here's all our stuff on trolleys. Figure something out." So I came up with a route that would go from the Long Island Railroad terminal out to Grand Army Plaza and down Fulton Mall and then into the tunnel and around Borough Hall and through a tunnel and out the other end up Furman St. to service the park they wanted to build and down into Red Hook using Columbia and Richards St. and up into DUMBO. Everyone liked the route and thought it was a great thing. So then in the late 1980's/ early 1990's I began collecting trolleys. First, I got one from 1897 because someone heard me talking about the tunnel on the radio. They showed up the next day with a trolley from 1897 which I fixed and got to work. And then we got 15 more trolleys from Buffalo and Boston and we had those stored in the Navy Yard. Meanwhile, the people from the city D.O.T. came around and said there was a federal grant called "ISTEA enhancements" and we're going to give you some money to buy material to go and build a trolley line on Greg O'Connell's property down in Red Hook on Beard St. Greg O'Connell's the guy who put that Fairway supermarket down there in Red Hook. So in his plans for the Fairway, he put down that the trolley line from Red Hook to downtown Brooklyn was going to ameliorate the traffic congestion, but as soon as he got the permits to build that, he said, "Oh, we don't need the trolley now because we've got our permits. Get out." So after we built a perfectly reproduced half-mile trolley line on the waterfront, built out of stuff that was scavenged from all over the East Coast and Pennsylvania and Ohio-- of original parts that are still good, like the original steel poles, original wires, all the fittings, paving bricks from Baltimore from 1908, exactly identical, made off of Brooklyn blueprints from the trolley lines they had here in 1899, a perfectly operating trolley from 1897 using a power supply which I came up with which was only this big but would move a trolley car, that plugged into the wall socket-- so everything was beautiful-- he gets his thing for Fairway and says, "Oh, I'm done with you. Get out of here." Meanwhile, there's a million dollars worth of equipment in the building-- that all disappears. No one knows what he did with it. And then twelve trolleys we had in the Navy Yard disappeared over Labor Day weekend in 2005-- no one saw a thing. No one knows where THEY went. Meanwhile, the city had a turnover in its political structure in 2000 and 2001. Somebody was asking me how I got the permission to use this place. It was Howard Golden, who was the Borough President back then for a million years; it was Abe Gerges, who was a city councilman for downtown Brooklyn who's now a judge; it was Ed Koch, the mayor; and it was Giuliani in his first term and also David Dinkins. So we had all these people who loved this thing and thought it was great, and then in 2000 and 2001 they all got term-limited out of office. So every politician that we knew is gone all at the same time; the new ones coming in don't know what the whole thing is about; and then meanwhile the people who were career civil service people at D.O.T. all retire at the same time Giuliani left office. So everyone we knew everywhere is gone all at once. So the new people come in and say, "What's this stupid thing? Who needs it!" And meanwhile we build track in the street in Red Hook. The city came back in 1999 after we built the part on O'Connell's property and had it running and said, "We're going to give you more ISTEA money. Start ripping up Conover St. and Reed St." and they gave us a franchise to work in the street-- same as they gave us for this tunnel-- and they said, "Start putting the tracks in." So I started paying for that out of my own pocket, to build those tracks in the street, and they said, "Don't worry. We're going to buy you concrete." Now, concrete is something no one is going to give you for free. It's a hundred dollars a yard, and a yard gets you about this much of track, so there's a lot of concrete that you need. And we had two streets ripped out, the track put in, and I'm starting to pay for concrete out of my own pocket to fill it back in again. We put the poles up and the wires up, and then the new people from D.O.T. came in and said, "Well, we're not the ones who promised to give you money for concrete." And they said, "Who needs this whole thing? It's stupid!" So they paid a contractor $800,000 to rip out what we just built six months earlier. THEN, they got a federal grant for $300,000 more from a congresswoman around here to do a study to put it back in again! That was in 2004. And now she says she doesn't know anything about it, she doesn't recall it, but I have a copy of her newsletter where she's bragging about getting the money. But she says she doesn't remember having it and she doesn't know who she gave it to or for what. So figure that one out. So meanwhile, the city goes and encourages people who were volunteers for me at that time to go out and start a different group to go and do it in Brooklyn Bridge Park instead. I didn't even know-- no one told me that they wanted to have a trolley in Brooklyn Bridge Park. So the city goes and gets people who were volunteers for me who were supposed to go and put the trolley in that park then because they were going to pay people a million dollars a year to operate a trolley in that park as an operating subsidy. I didn't know anything about it-- I just found out about this recently. And so all these people were running around trying to go and get into that park to put a trolley line in. But they didn't know what they were doing because the volunteers that they took out of my group to make this other group were just the ones who could, like, paint a little bit. Or make fliers. They didn't know how to build anything. So nothing ever happened, so they ended up dropping the trolley out of their plan for that park because these folks didn't know what they were doing. So anyway, about a year ago I get a call from the one person who I still knew at D.O.T. He called up last summer and said, "You know, we have a new commissioner now and she's very progressive and she's an engineer and she knows all about transportation and she likes interesting things, and you should come back and start doing your tours again." Because for five years I didn't bother doing the tours anymore after what happened with Red Hook and the stuff disappeared from the Navy Yard. They said come back and do tours again, so I said, "O.K., if no one bugs me I will." So I've been doing the tours and been getting these great crowds of people coming in, and I'm sure it's not going unnoticed by the city that a couple of hundred people are going through a manhole on the weekends. So by you folks coming down here, something is going to happen.

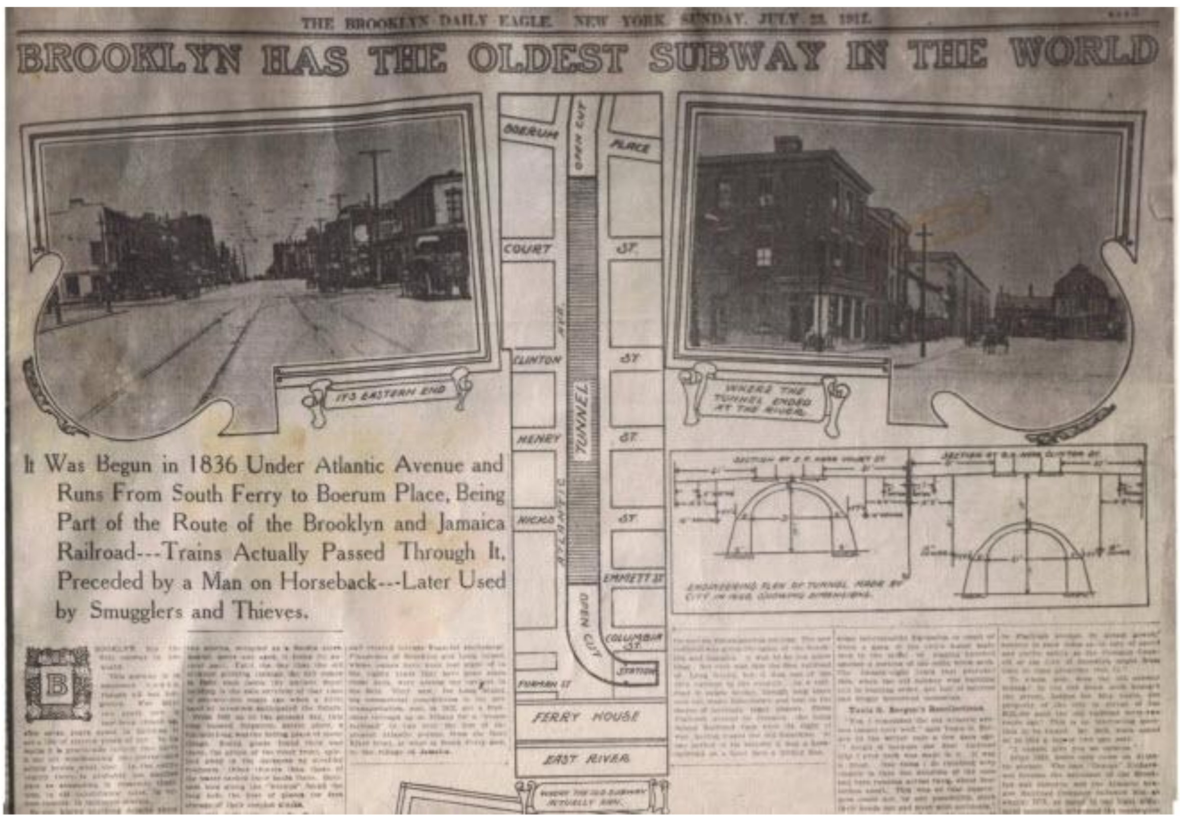
This is as far as we can walk for the time being, thanks to Mr. Litchfield. This is one of the bogus walls he put up in 1861 and then filled in 200 feet going out towards the opening to make it seem like he filled the whole thing in. And these big stones that we're sitting on, they're not the same mica schist that the wall's made out of. This is all granite that was sent down from a special quarry up in New Hampshire. Some of them are cut like triangles, some of them are cut like keystones, and that's because these stones used to be the upper part of the entranceway into the tunnel that was above street level a little bit. So 200 feet behind that wall is where the original entrance to the tunnel is, and then the ramp up to the street, and it came up flush to the roadway by Columbia and Atlantic and then veered over to where Pier 7 is now and ran right onto the pier-- that was the intermodal transfer connection directly to the boat. As I mentioned, this part is sealed in; it's all filled in with dirt just like the other end was, and you can see that there's some utility intrusion over here from back in the 1880's or 1890's when they first strung through the water pipes and the terra cotta ducts for the phone company wires, and you can see the white PVC plastic in the terra cotta. That wasn't pulled through until fairly recently-- that's all fiber optic stuff. But all that junk can be pulled up out of the way.

Now, somebody was asking me how it was I got the permission to use this place. It's because the Borough President, Howard Golden, Abe Gerges the councilman, Ed Koch, Giuliani, all those people were into this. So originally the Board of Estimate gave me the franchise for this place but that's now continued under the city D.O.T. So that's how that was done. Now back in those days, if a politician saw you in a newspaper and they liked what you were doing, they'd call you up and say, "What can we do for you?" Not anymore. The politicians they have now are not the same kind that we had around years ago. The ones now know that they're limited to eight years or four years or whatever and they don't do anything. They get in, they get out, and that's it. They don't do too much for the community. So it's really odd. I tried getting in touch with David Yassky about the tunnel, and he said he'd never heard of it. He didn't know what it was even though it's on T.V. and it's on the History Channel and it's in the newspaper-- he doesn't know what it is.

There's also people who want to make a documentary about me looking for this locomotive to see if it's back there. They're already pretty far along in the process of putting what's called a "treatment" together, which is their pitch to get funding. So in about two weeks they're supposed to make their big pitch to get funding to look for that train back there. So they want to start making this film in July and finish it up by

November. So if they can get their funding intact between now and July, we could be digging a hole back there to see what's in that tunnel. Now, back in around 1990, the city D.O.T. got a contractor who they knew, as a favor, to dig holes in Atlantic Ave. where I told them to dig to see what's under there. So using Litchfield's map from 1859 that he used to rob the property owners, and finding the property line that's still the same as it was back then on the corner by Hicks and Atlantic, we took some measurements off Montero's Bar and projected lines out into the street, and I was able to pinpoint exactly where the mouth of the tunnel is. So he brought out a backhoe and dug holes in the street and we had permits for it, and we went down and found the roof. The roof of the tunnel is there, the walls are there made out of granite and marble, and we went down 18 feet and hit what seemed to be a brick station platform. Eighteen feet is as far as the machine could reach. So we had this thing done very fast-- this was all done in one day. And the next thing you know, this guy shows up from the Highway Inspections Department-- it's like a different part of D.O.T., so it's like one hand didn't know what the other one's doing. One hand is getting us the contractor; the other hand is coming over saying, "Oh, are you the guy looking for that train under the street?" And I'm like, "Yeah." He says, "Oh, archaeology is stupid, and you'd better fill that hole in right now, otherwise we're giving the contractor a $50,000 ticket." I said, "Why? We've got all the permits to do this." And he says, "Well, we don't like that contractor." So we had to fill the holes in. But this time, hopefully, that's not going to happen. So now the guys who are getting the money for the documentary are going to get money to get a contractor, dig the holes in the street, and this time one hand WILL know what the other hand is doing and we'll find out what's back there once and for all. And the plan is to make the opening for the locomotive big enough so that we can get some of the trolleys that are left in Red Hook behind the Fairway into the tunnel because then we could restore them in here, put a track in, and have them running around inside the tunnel, and this could be the demonstration project. And it's all on city property, so that way you can't have any developers stabbing you in the back and kicking you out when he's done with you. So that's the plan.

There's one more anecdotal story I want to tell you. This tunnel is on the National Register of Historic Places. That was done at the suggestion of Ed Koch back in 1989 or 1988. So I wrote all the reports up and did all the research to get on the register, and it was a good thing we did. In 1999, I got a phone call from Community Board Two saying, "Hey, Bob, did you hear about that new sewer pipe that they're building up Atlantic Ave.?" I'm like, "No." They said, "Did you see the plans for it?" I said no. They said, "You'd better come up to the office and look at these plans quick." So the Department of Design and Construction, which is the same place that ripped out our tracks for $800,000 in Red Hook, they knew about the tunnel. They came on the tour and took pictures of it at that time. So they drew up blueprints to take all these sewer pipes from Atlantic Ave. and run them through this tunnel, and underneath was written in with a red pencil, "Atlantic Ave. Sewer Pipe Museum. Ha Ha." And so I got in touch with the people I knew at D.O.T. This was six months before they all left in 2000. They called a meeting with the people from Design and Construction, and the D.O.T. people said, "Well, you know, this is our tunnel, and you're not putting sewer pipes through it." And the guy from Design and Construction goes, "Oh, I can do whatever I want 'cause I'm a city agency, too. You can't tell me what to do." So then I remembered the fine print in the paperwork for the National Register of Historic Places. So I told the D.O.T. guy to ask them where they're getting money from for the sewer pipes. So he says, "Oh, we get federal money for that." So then I show them the fine print in the designation for the National Register. It said if something's on the National Register of Historic Places you cannot use federal money to destroy it or damage it in any way. So we stopped them dead in their tracks. But do you know what they did to get even? To get even, they paved over the manhole cover! So the next time we had a tour, I came to do a tour with a hundred people and there's no manhole cover. But then D.O.T. got a hold of the contractor and forced him to put it back in. So that's the last little story for today; I'm all talked out now. Thanks for coming.



THE BROOKLYN DAILY EAGLE. NEW YORK SUNDAY, JULY 23, 1911.

BROOKLYN HAS THE OLDEST SUBWAY IN THE WORLD

It Was Begun in 1836 Under Atlantic Avenue and Runs From South Ferry to Boerum Place, Being Part of the Route of the Brooklyn and Jamaica Railroad---Trains Actually Passed Through It, Preceded by a Man on Horseback---Later Used by Smugglers and Thieves.

643-2051

The City of New York
President of the Borough of Brooklyn
BOROUGH HALL
BROOKLYN CIVIC CENTER
BROOKLYN, N. Y. 11201

HOWARD GOLDEN
PRESIDENT

June 12, 1980

Mr. Robert Diamond
599 East 7th Street
Brooklyn, New York 11218

Dear Mr. Diamond:

Ms. Mary Taintor, of my staff, has advised me that you have done extensive research on a train tunnel under Atlantic Avenue which contains a train from 1830 with a wood burning engine.

Given your deep involvement in Brooklyn history, I would like to invite you to join my History Advisory Committee. The History Advisory Committee is comprised of Brooklynites active in local history and local historical societies. By sponsoring projects to promote Brooklyn history and by creating a link among our many local history societies, the Committee focuses community attention on our fascinating heritage.

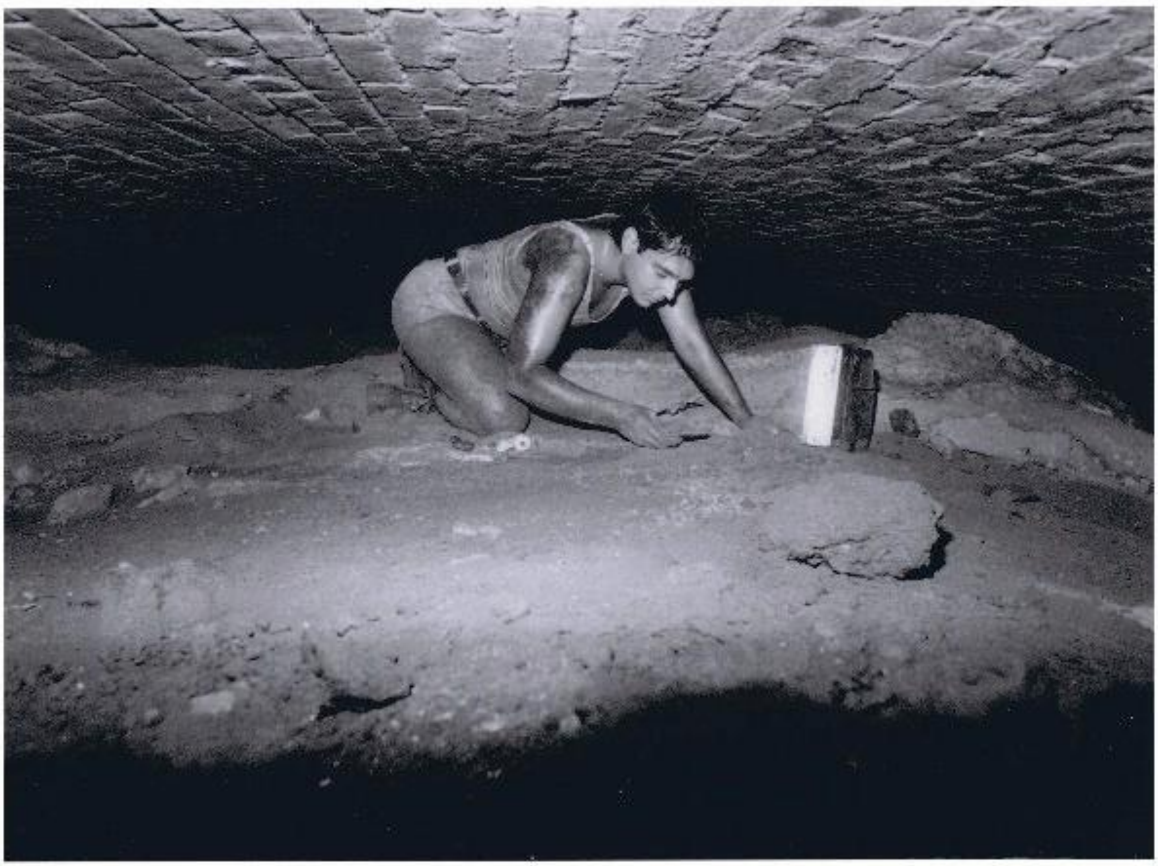
I have requested Mr. Donald Simon, Chairperson of the History Advisory Committee to write to you inviting you to the Committee's next meeting.

We look forward to working with you on promoting Brooklyn history.

Sincerely,

Howard Golden

Howard Golden



MEMO From **HERBERT M. KASS, P. E.**
DISTRIBUTION ENGINEER
Department of Water Resources
Bureau of Water Supply
Brooklyn, N. Y. 11201

7/28/80

This will certify that Mr. Robert Diamond and a Water Supply crew investigated an old abandoned tunnel under Atlantic Avenue at Court Street.

A manhole cover was removed at that location and the tunnel was photographed by Mr. Diamond.

BOROUGH PRESIDENT'S HISTORY ADVISORY COMMITTEE
Borough Hall, Brooklyn, New York 11201

October 14, 1980

To: Members of the Borough President's History Advisory Committee

From: Donald E. Simon, Chairman

Re: Minutes of the September 23, 1980 Meeting

The meeting was called to order at 5:40 pm in the 2nd Floor Court Room of Borough Hall.

1- Passing of Col. Milton Skelly announced. The first order of business was the announcement of the passing of committee member Col. Milton Skelly. The membership voted unanimously to convey condolances to Col. Skelly's family and at the conclusion of the meeting to adjourn in respect to his memory.

2- Fort Greene Marker. Susan Bonhomme reported that the design and text of the marker have been submitted to the Department of Parks which will arrange for the necessary approvals. This process will take about two months. Following that, the plaque can be cast. It is reasonable to think in terms of an installation and ceremony in the spring.

3- Memorial Arch, Grand Army Plaza. Susan Bonhomme reported that the Arch should be completed in the spring.

4- Atlantic Avenue Tunnel. The events of the past few weeks were discussed. The primary problem is safety. We do not know what poisonous or explosive gases are in the tunnel, whether there are dangerous rodents, or whether water and mud will pose a hazard.

It is the opinion of the committee that, if possible, an expedition should be formed to enter and investigate the tunnel.

Accordingly, the committee resolved to recommend to the Borough President that, if possible and prudent, an expedition be organized to enter and explore the abandoned Atlatic Avenue railroad tunnel.

5- Miscellaneous. John Manbeck recommended that a visitors center be established near Fort Hamilton much the same as the one in Golden Gate Park. Robert Walsh discussed the recently published history of Sunset Park.

The meeting was adjoured at 6:30 pm in respect to the memory of Col. Milton Skelly.

Donald E. Simon

Students in the News

Midwood is proud to congratulate those students who have received awards for their recent achievements in academics, service and athletics.

Marie Milford and Rudolf Rosefort received **prizes of $50** in the **Societe des Professeurs Francais Contest** in the "native speaker" category...**The Columbia Association of New York awarded a $50 savings bond to Anthony Voce** for proficiency in Italian...The same Association **awarded a medal to Janet Perrotta...Randy Roberts** has received the **District Attorney "Citation of Honor" Award** in recognition of his "Progress Through Justice" in service to the school and community...**Myron Diftler has won the Rensselaer Medal,** awarded to a junior who is outstanding in Math and Science...**Robert Diamond,** an outstanding science student at Midwood, has won many awards, cash, and trips including **first prize in SEER Science Contest,** and a science award to be presented by **Nelson Rockefeller.** Midwood is extremely proud of Robert...**Laurie Walker and Alison Kaluber** won the **Student Representative Contest** sponsored by the **Times College and School Service.** Each received a **cash award of $500.00.**

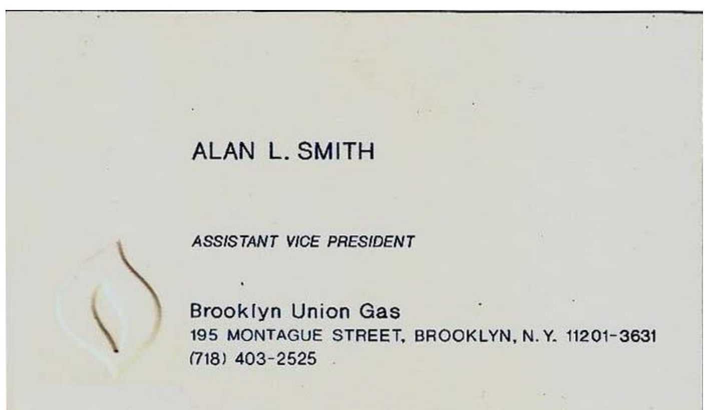

SATELLITE
SOLAR
POWER
STATION
I'm a SEER

Robert Diamond

SATELLITE SOLAR POWER STATION

A satellite equipped with extensive banks of solar cells is put into geosynchronous orbit. This keeps it continuously above the same point of the earth where there is a receiving station. The sun's energy is absorbed by the banks of solar cells and is converted into electric energy. This energy is then converted to radio microwaves and beamed to the receiving station on earth. Here it is reconverted into electrical energy for transmission to homes, offices, farms and factories. Since the satellite is at altitudes much higher than the cloud levels, its reception of energy from the sun is uninterrupted by adverse weather conditions.

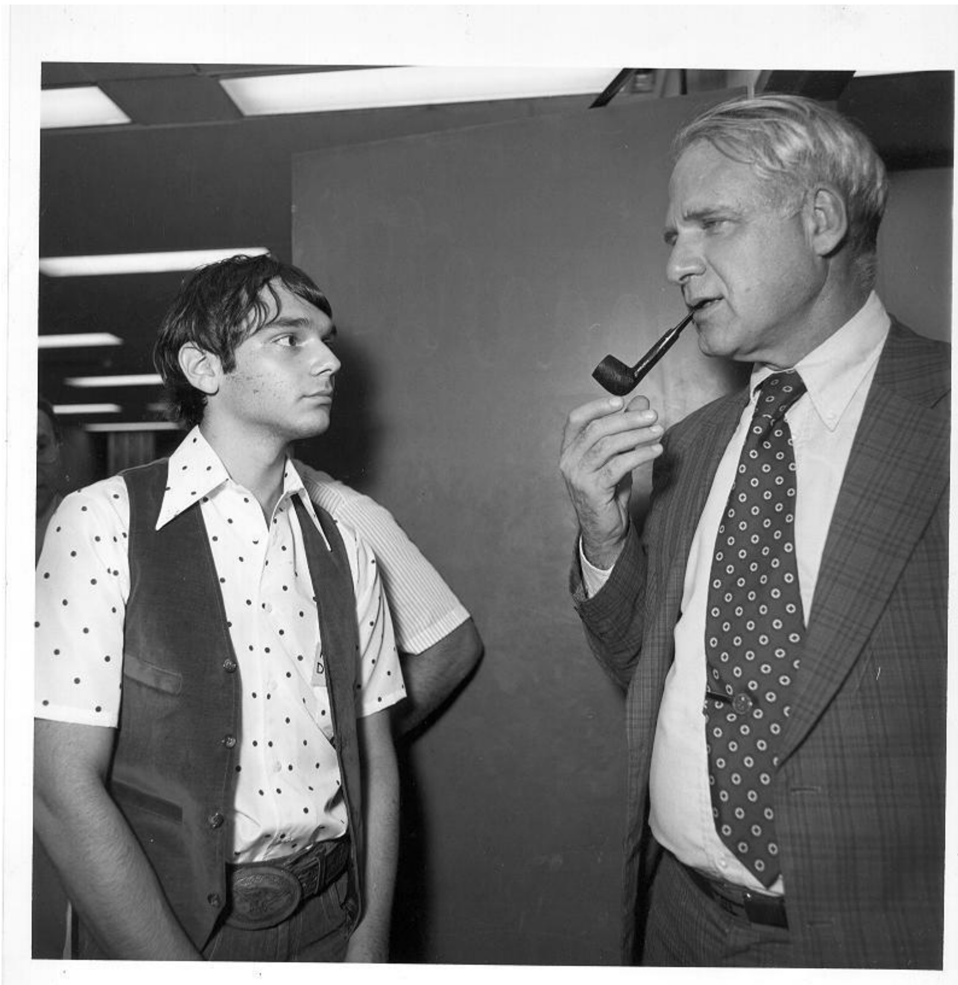
Robert Diamond shows his entry to NEF President Alan L. Smith.

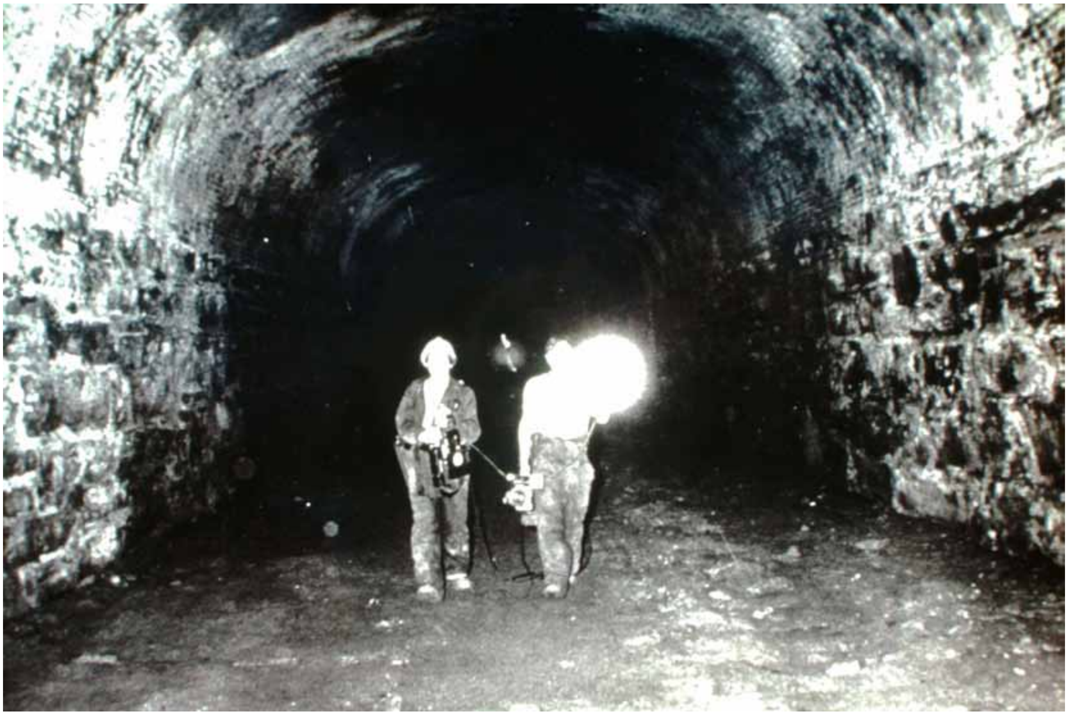


ALAN L. SMITH

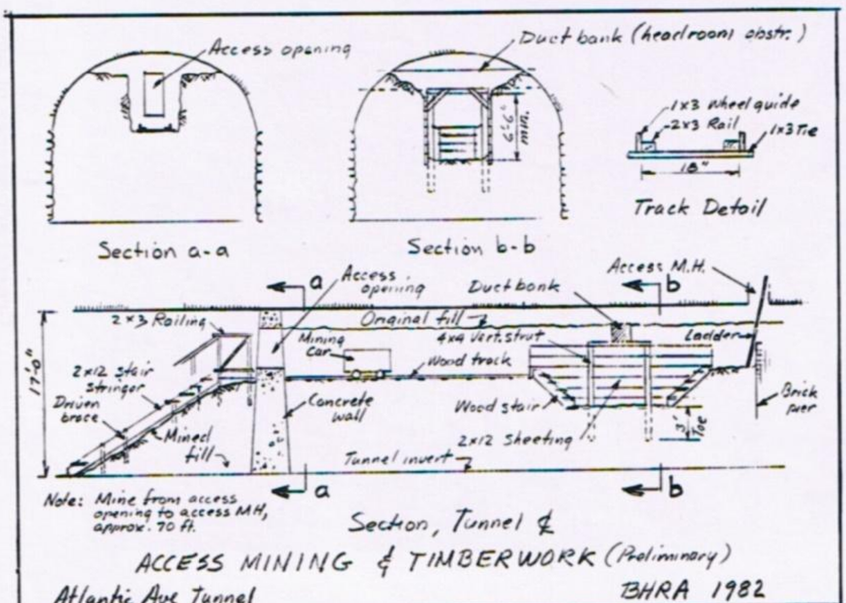
ASSISTANT VICE PRESIDENT

Brooklyn Union Gas
195 MONTAGUE STREET, BROOKLYN, N.Y. 11201-3631
(718) 403-2525

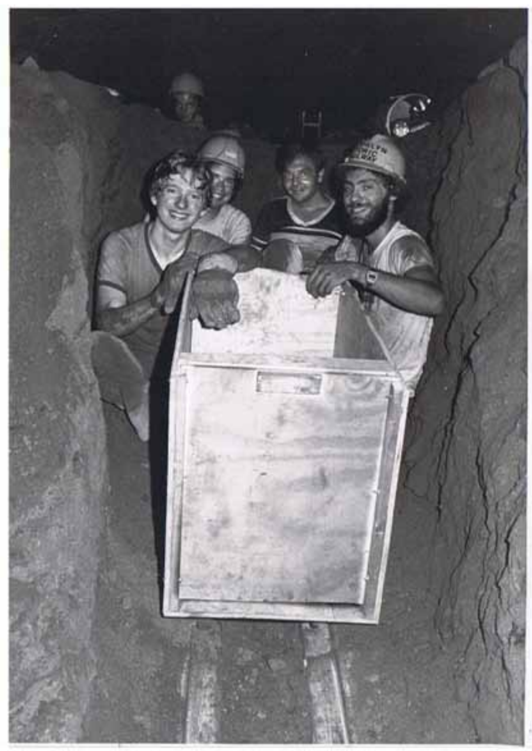




View of west side of concrete wall before installation of wood stair. Note chain ladder and access opening



Temporary track and mining car used in trenching phase.



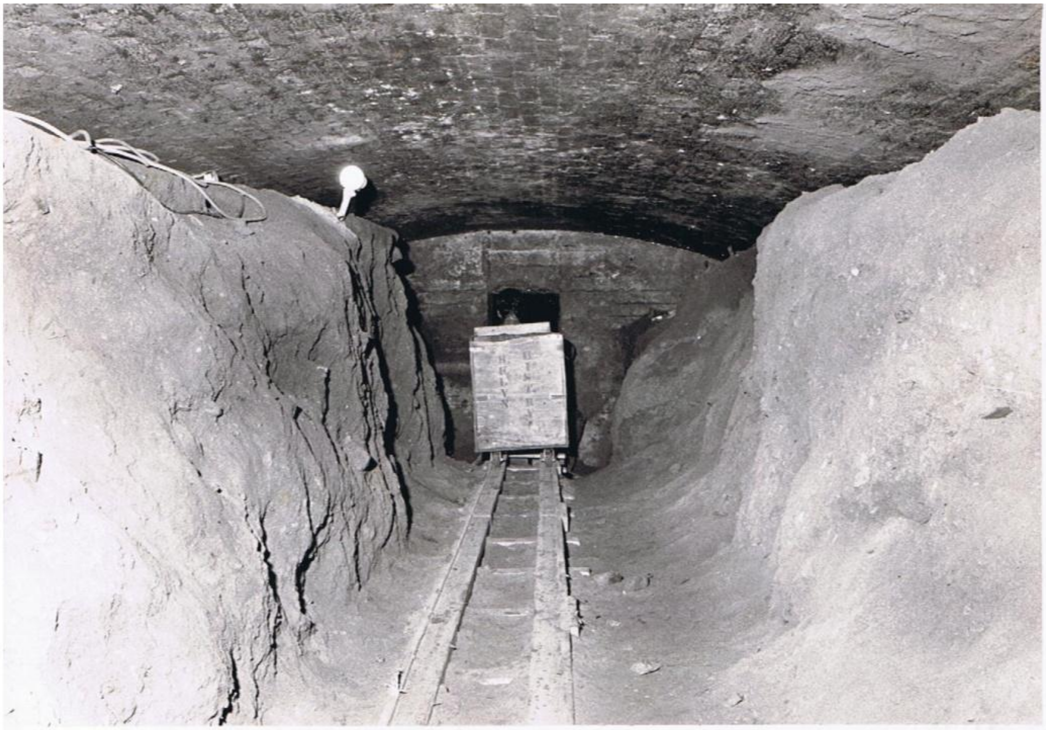


Exhibit 9

Volunteer crew in completed trenched and sheeted area under Con Ed duct bank

BROOKLYN HeightsPress & COBBLE HILL NEWS

46TH YEAR, NUMBER 2,171 THURSDAY, OCTOBER 14, 1982 25 CENTS

Armed Robbers Hit Two Heights Stores

TWO STORE ROBBERIES marked an active week of crime in the Heights.

Joralemon Cleaners and Launderers at 107 Clinton Street was robbed Friday at 6:25 P.M. by two men with a gun.

They entered the store and pulled out a handgun, knocking the employee down to the floor.

"Get up real fast or I'll shoot you," said one of the robbers. They struck him again and forced him up on the counter.

Crime Beat

They went through his pockets, taking his money. The cash register was also emptied, though it is not known how much money was in it.

The robbers demanded more money, but the victim said there wasn't any more. Both robbers then fled.

Atlantic Ave. Tunnel Is Open To Public, Admits 700 Sunday

Using Single Manhole Access At Court Street, Visitors Descended Into 'World's First Subway'

1844 TUNNEL WAS SEALED SHUT IN 1861

By William Terdoslavich

About 700 curious people gave up a sunny, cool autumn afternoon for a chance to walk through the damp, dark but legendary Atlantic Avenue tunnel Sunday.

They assembled at the corner of Court Street and Atlantic Avenue, paying three dollars apiece to squeeze through a manhole in the middle of the street and walk back into time.

The tours were coordinated by the newly-formed Brooklyn Historic Railroad Society (BHRS). The tunnel was re-discovered by BHRS president Robert Diamond, who started doing re-

lined railroad cut dug out by the Long Island Railroad in 1834.

The cut connected the LIRR's harbor facilities with its terminal at Atlantic and Flatbush Avenues farther east. In 1844, according to Diamond, the cut was covered by a brick arch three feet thick to form the tunnel. Three air shafts were placed roughly a block apart to suck air in with each passing train. One of the capped shafts reaching the street is about 40 feet high.

One legend Diamond uncovered had to do with the Irish workers who did the

AT A GLANCE

DOWNTOWN — Artist Ilana Halperin, anthropologist Karen Holmberg and art historian Andrew Patrizio offer an evening of lectures that examine the status of volcanoes in contemporary culture tomorrow at 7 p.m. at Triple Canopy, 177 Livingston St.

The Hand Held Lava event explores the intersections of geology, archaeology, history and the visual arts.

The team will present field notes from volcanic sites across the world and will attempt to make sense of our ongoing desire to explore volcanoes. There is a $5 donation. For info, visit canopycanopycanopy.com.

MARINE PARK — Explore the differences between song sparrows and swamp sparrows, and take a look at the other little brown birds in and around Marine Park at noon on Sunday.

Meet at the Salt Marsh Nature Center, 332 Avenue U. It's free and fun for all ages. For more info, visit www.nyc.gov/parks/rangers.

FORT GREENE — MoCADA presents a film screening and discussion on "Road to Resistance" today from 6:30 p.m. to 8 p.m. at 80 Hanson Place.

The film explores the global citizens' movement that took on South Africa's apartheid regime. Call (718) 230-0492.

BAY RIDGE — The Sean Casey Animal Rescue Benefit will be held at 7 p.m. Sunday at the Wicked Monk Irish Pub, 8415 Fifth Ave.

Live performances include Two for the Road at 7 p.m.; Ghosts of Eden at 8 p.m.; HollaSnatched at

TUNNEL GETS LOVE

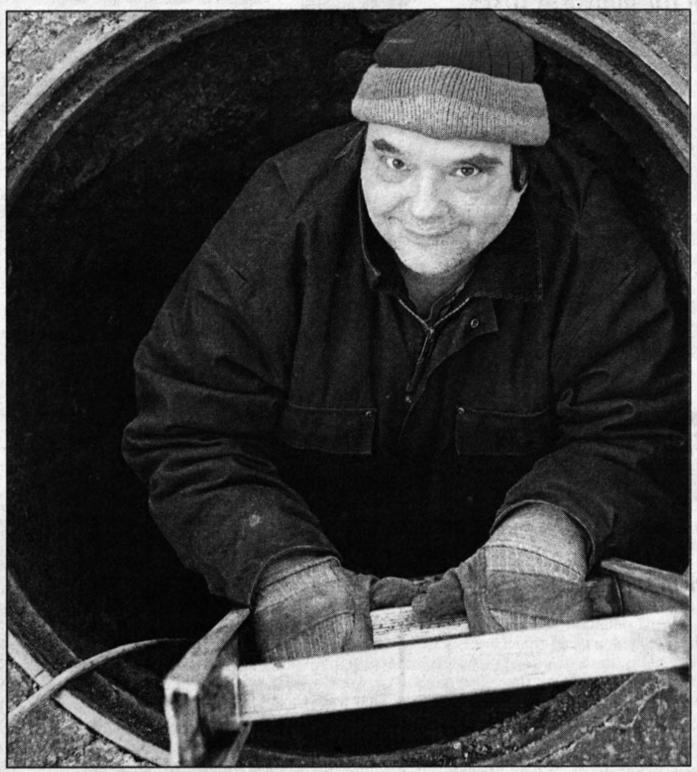
Guinness world record for an 1844 LIRR relic

BY MIKE McLAUGHLIN
DAILY NEWS WRITER

IT'S DARK, dirty and neglected, but a train tunnel beneath Atlantic Ave. is basking in glory after being dubbed the world's oldest in the new "Guinness World Records."

The half-mile long passage was built in 1844 – making it 60 years older than the city's subway system.

"The tunnel was the first in the world built underground in order to improve urban congestion, public safety and rail operations," said the entry from the 2011 Guinness book, which went on sale Sept. 15.



Bob Diamond, at the entrance leading to 1844 Long Island Rail Road tunnel beneath Atlantic Ave. in Cobble Hill, is proud curiosity he rediscovered is getting just due. Photo by Andrew Theodorakis/Daily News

Though Guinness calls it a subway tunnel, the passageway actually was part of a network for trains that ran to Greenport, L.I.

The tunnel, which reaches from Columbia St. almost to Boerum Place in Cobble Hill, made the area safer for pedestrians.

In other parts of Brooklyn farther east, tracks rose above ground and ran on the street, creating sometimes deadly hazards.

The underground route was sealed off in 1861 and was practically forgotten until transit buff Bob Diamond of Kensington rediscovered it in 1980, when he was 19.

"Now, the tunnel finally has the recognition that it deserves," said Diamond, who founded the Brooklyn Historic Railway Association, which gives monthly tours of the subterranean passage.

A Guinness researcher contacted Diamond earlier this year for documents about the tunnel's history, he said.

But Diamond only found out that it landed in the record book this past Sunday from a volunteer with his tour group.

"I jumped about 3 feet in the air," Diamond said. "I've been advocating for this tunnel for the last 30 years."

Many world records are submitted by readers to Guinness officials for verification, but a spokeswoman said the book's staff created the subway tunnel category themselves.

Today, the tunnel is city-owned property, but it was immaculately built by the Long Island Rail Road, said railroad historian David Morrison.

The arched ceiling is 17 feet tall and made of brick. The walls, 21 feet apart, feature large stones.

But the tunnel's craftsmanship was lost on train riders who couldn't see it because it was too dark.

"The people would see nothing but darkness," said Morrison. "For something that nobody was going to see, the work was extraordinary."

Today's MTA straphangers have nothing to complain about compared to those early riders, Morrison said, adding: "In those days, you got dirty from riding trains with cinders from the locomotives."

★OLDEST SUBWAY TUNNEL

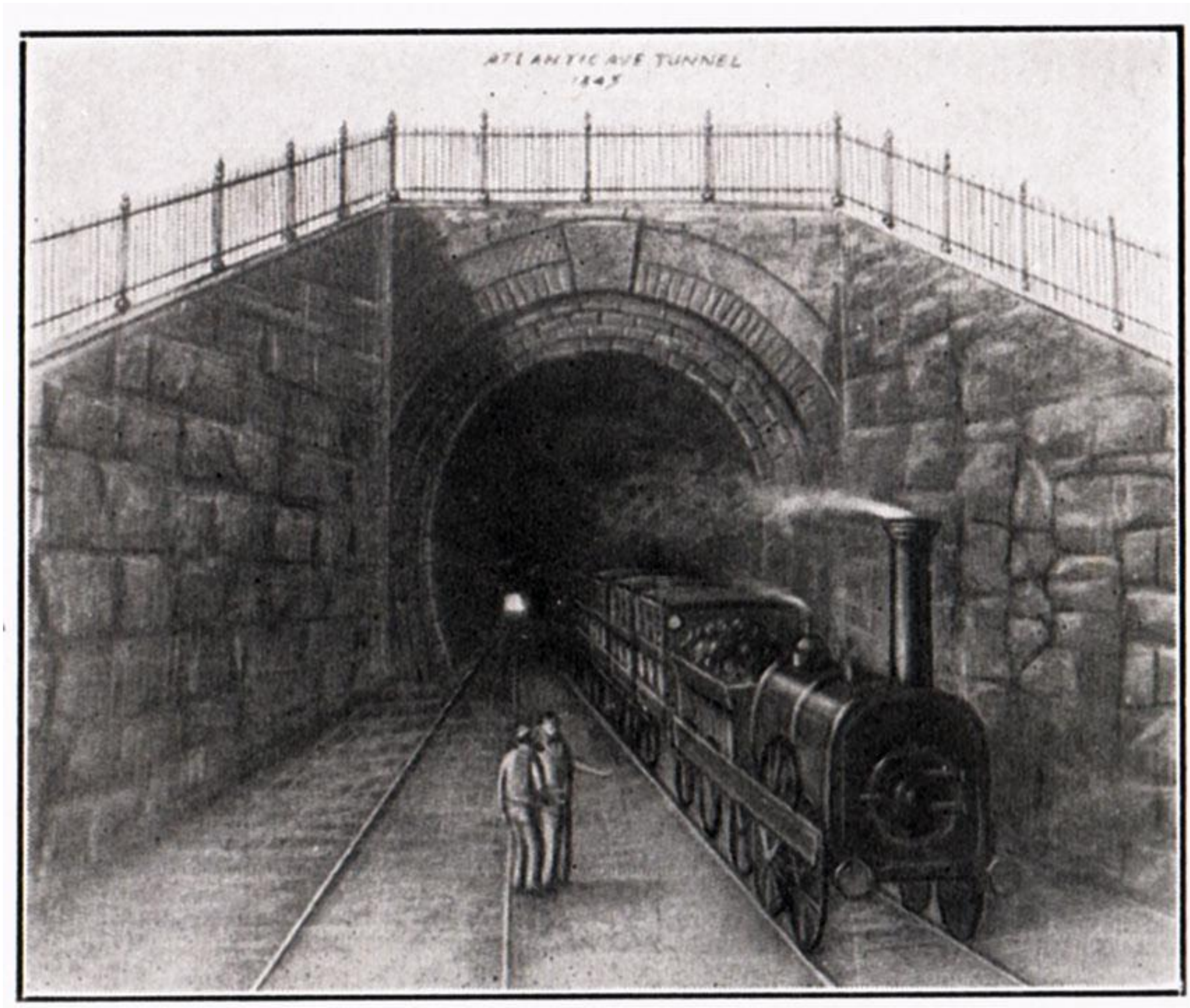
The Atlantic Avenue Tunnel beneath Brooklyn, USA, was built over a period of seven months in 1844. Running for 2,517 ft (767 m), it is 21 ft (6.4 m) wide and 17 ft (5.2 m) high. The tunnel was the first in the world built underground in order to improve urban congestion, public safety, and rail operations. It operated until 1861, when the ends were sealed off, and was rediscovered in 1981.

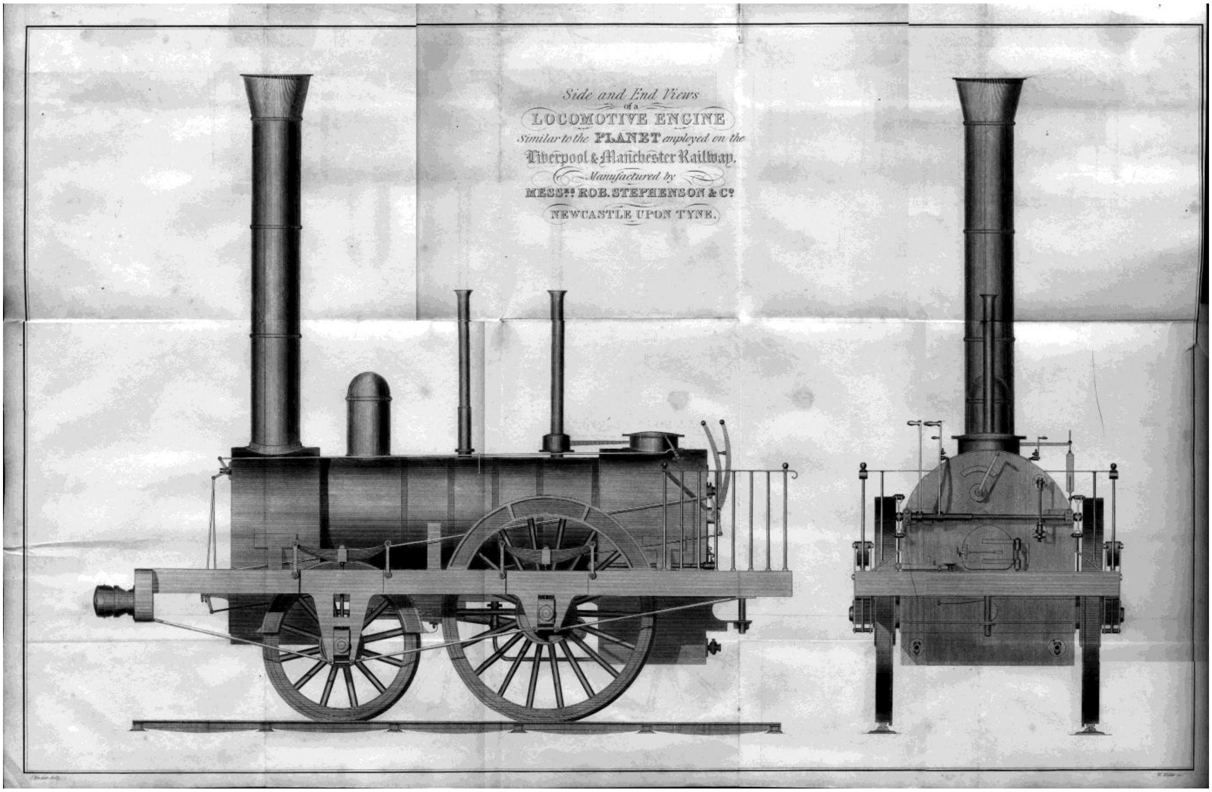
THE ATLANTIC AVENUE TUNNEL

THE WORLD'S OLDEST SUBWAY
1844

A Project Of
The Brooklyn Historic Railway Assn. (BHRA)
599 East 7 Street, Ste 5A
Brooklyn, NY 11218

Bob Diamond, Chairman
Rdiamond@brooklynrail.net
718-941-3160


ATLANTIC AVE TUNNEL
1845



Atlantic Avenue Tunnel Project Prospectus
Version 6, October 25, 2011

PROJECT OBJECTIVE

A very exciting proposal is now being put forth by the Brooklyn Historic Railway Association (BHRA), a non-profit education corporation. The idea is to reopen the historic Atlantic Avenue Tunnel, the oldest subway tunnel in the world, built in 1844, improving public access and restoring the tunnel as a museum and historic attraction.

BRIEF HISTORY OF THE TUNNEL

An ordinance of the Brooklyn Common Council dated March 29, 1844, granted authority to the Long Island Railroad to construct the Atlantic Avenue Tunnel. The railroad planned to use the Tunnel as a major artery in their rail service between New York and Boston. This rail line was part of a much larger system of railroads that extended from Boston to Charleston, S.C. The Tunnel was a major breakthrough in transportation technology and city planning. It carried trains under Atlantic Avenue, thereby preserving the then fashionable shopping street and its inherent pedestrian and vehicular traffic. It was the prototype of "cut and cover" subway construction, the method still used today, in which long trenches are dug in the street and then covered to form the tunnel corridors. The development of this process had an historic impact on urban planning and development; it enabled planners to integrate railroads into complex urban landscapes and led directly to the creation of metropolitan subway systems.

After the Tunnel was completed in 1844, Brooklyn became a major transportation and commercial center to rival New York, and grew to be the third largest city in the country (a distinction it held until 1898 when it became a borough of greater New York). In 1848, competition from New York in the form of the New Haven Railroad caused the LIRR to lose its monopoly on rail service to Boston, and led to substantial financial losses and the abandonment of its interstate service.

Only a few years later a prominent developer, Mr. Electus Litchfield, schemed to close the Tunnel and remove the LIRR from Brooklyn in order to create an Atlantic Avenue Boulevard and Promenade, a grandiose project inspired by the *Champs-Élysées* in Paris. With the help of corrupt politicians, Litchfield pushed the illegal legislation which permitted him to tax Atlantic Avenue merchants and property owners for the removal of the Tunnel and the LIRR, which he had branded as a "public nuisance." As a result, steam locomotives were banned in Brooklyn in 1859 and the Tunnel was finally closed and sealed in 1861. In only a few short years the Tunnel had gone from a technologically advanced project which would benefit all of Brooklyn, to a scapegoat for the corrupt plans of a robber baron. Litchfield then used the ill-gotten money to initiate his real estate project in what would become Park Slope, and build a new rail line from Jamaica to Hunters Point, the line the LIRR presently uses. However, no Boulevard was built due to the ensuing lawsuits brought by the merchants and property owners against Litchfield. The elimination of rail service left downtown Brooklyn in economic chaos, causing it to be transformed from an economic rival of New York to one of its most prized and diversified residential areas.

REDISCOVERY OF THE TUNNEL

For over one hundred years, the Atlantic Avenue Tunnel remained sealed and largely forgotten, the subject of fantastic myths and legends which seemed to crop up with each generation-- many of which turned out to have some truth. Despite the recurrent rumors, numerous attempts to locate an entrance had failed. Finally, in early 1980, Robert Diamond first heard of the legendary tunnel on a radio broadcast about *The Cosgrove Report*, which claimed there was an old steam locomotive buried in a forgotten tunnel in downtown Brooklyn. The book also mentioned a legend that the missing pages of John Wilkes Booth's diary had been hidden there. Intrigued, Diamond spent seven months researching the tunnel's history, eventually locating an unmarked manhole in the middle of Atlantic Avenue and Court Street he was sure would lead to the long-abandoned tunnel beneath. Yet when the manhole was opened, there was nothing to be seen but a three-foot drop. The dirt fill came up to about two feet from the underside of the pavement. Diamond knew at that moment he was standing on a backfilled portion of the tunnel. Looking around with a flashlight, he noticed what appeared to be a wall some seventy feet to the west. He was separated from this wall by a crawlspace less than two feet high. For the next year he searched the area, pleaded with skeptical, sometimes indifferent officials, researched, probed and slowly raised the curiosity of enough influential people to continue the exploration. In the summer of 1981, Mr. Diamond was able to crawl the seventy foot distance to the wall where he noticed the outline of a blocked-up opening in the concrete wall. The access was sealed with brick and Belgian paving blocks. After several hours of hard work with pick and shovel, Diamond and several men from Brooklyn Union Gas Company (now National Grid), who had agreed to help him on his underground mission, broke through the opening and finally saw the full expanse of the Tunnel before them, exactly as it was when sealed up 120 years earlier.

In 1982, Mr. Diamond founded a not-for-profit corporation, the Brooklyn Historic Railway Association (BHRA), to preserve and restore the tunnel, and establish a museum and scenic railway. For the past twenty-nine years, BHRA, in conjunction with elected officials, city agencies, community groups and local businesses, has been working to develop the Tunnel as a valuable public asset. BHRA received all the necessary approvals for a franchise from the City of New York to occupy and operate the tunnel as a museum devoted to the study of early railway transportation. BHRA has also been fostering public awareness and support for this forgotten municipal treasure, hosting public tours which have been enjoyed by thousands of city residents and tourists alike. During this time Mr. Diamond has further explored the tunnel's history and its significance to New York. Because it is the earliest known example of the cut-and-cover technique of railroad tunnel building in the world, and because it was part of New York's earliest train service, the tunnel has been listed on the National Register of Historic Places since 1989.

The tunnel is also recognized by the *Guinness Book of World Records* as the "World's Oldest Subway Tunnel", starting in the 2011 edition.

TUNNEL CONDITION

After being sealed for over a century, the Tunnel is a perfectly preserved, truly magnificent structure. It is a half-mile long, twenty-one feet wide and seventeen feet high. Its walls are six-foot thick granite blocks and the roof is a three-foot thick brick arch. Several prominent civil engineers have been actively engaged in determining the tunnel's structural soundness and architectural and engineering significance, and have concluded that it is structurally perfect. In fact, they have compared it to the pyramids of Egypt. An evaluation performed by LMW Engineering Group, LLC, in March 2009, found the tunnel "impressively devoid of any sign of deterioration." Their report further concludes that:

> *The structural integrity of the tunnel is sound and has not been compromised by aging.
>
> *The tunnel can be considered safe under its current use for visitors and tourist attraction.
>
> *There is no evidence that any form of maintenance or repair work is necessary at this stage.
>
> *The tunnel can be safely, with relatively minimum rehabilitation effort, mostly esthetic, be utilized as a museum or similar facility.
>
> *In summary, the tunnel, as inspected by us, is a safe and sound structure.

Studies conducted by prominent consultants as well as by the City departments of Sewers, Water Supply, Transportation, Fire and Electrical Control, and a study by the National Historic Register have led to the following appraisal: The tunnel is a marvel of early engineering techniques, historically one of the most important architectural structures of the 19th century.

PUBLIC INTEREST

Since 1982, BHRA has offered both public and private tours of the tunnel which have been enjoyed by thousands of visitors. Many private and public schools have sent hundreds of students on class trips. Most recently, at the behest of the city Department of Transportation, regular public tours were reinstated in 2007 and given about twice per month through the end of 2010. During this time public interest in the tunnel and its history increased dramatically, and hundreds of people were safely led through the tunnel on guided tours given by Mr. Diamond. The Tunnel received over 12,000 visitors in 2010. Both New Yorkers and tourists from all fifty states and many foreign countries lined up for the adventure of seeing the legendary underground expanse for the first time. The response was overwhelmingly positive. Visitors reported feeling a strong sense of mystery and intrigue, as well as the sensation of travelling back in time to the 19th century. Teachers commented afterwards that students were highly motivated by the visit.

Numerous newspaper and magazine articles have been written about the Tunnel, including feature stories in The New York Times, Daily News, National Geographic, Science Digest, and The New Yorker. The project has also been covered by local television and radio as well as national exposure on CNN and the Canadian Broadcasting Corporation. In 2009, the tunnel was featured on the History Channel TV show Cities of the Underworld. In addition, National Geographic has begun work on a documentary focused on the historic locomotive buried at the western end of the tunnel.

PUBLIC BENEFITS

The Atlantic Avenue Tunnel Museum will be designed to appeal to the general public as well as to engineering, history, and architectural buffs. With its dramatic subterranean location and exhibits which will include historic train cars and railroad artifacts, the museum should prove of particular interest to children.

The museum will have both local and international appeal. The Brooklyn Historic Railway Association estimates it will draw at minimum 10,000 visitors per year during our proposed "Phase I" from the tri-state area, as well as tourists sightseeing in New York City. The museum, located beneath a busy Brooklyn thoroughfare, will also draw visitors from its immediate neighborhood, a melting pot of African Americans, Hispanics, Middle Eastern émigrés and families of Italian American descent.

Since future development in downtown Brooklyn will rely on the intrinsic assets of the area, it is the old Atlantic Avenue Tunnel which highlights the primary asset of the community—easy access and unparalleled transportation facilities. The museum, in the heart of downtown Brooklyn, is just a short walk from federal courts, office buildings, city government offices, and the historic homes of Brooklyn Heights, the first designated landmark district in the United States. The Atlantic Avenue Tunnel can thus serve as an historic symbol for today's public and private sector leaders as they reemphasize downtown Brooklyn as a business and transportation center now, as it was 160 years ago.

This project will enhance the quality of life in an area now experiencing a major renaissance, as well as ensuring the redevelopment of downtown Brooklyn from both an economic and social standpoint. It would have a synergistic impact on several other projects currently underway downtown.

As well as providing a new cultural resource and tourist attraction for the state and city, this project will stimulate business in the many restaurants, specialty food shops, antique stores, art galleries, and other retailers in the area. In addition, the project will generate a variety of jobs in its implementation, and serve as a centerpiece for the much publicized redevelopment of downtown Brooklyn.

Once accessible to the public, the Tunnel would have immediate public benefits. Current uses would include:

1. Guided walking tours to groups of up to 50 people at a time. These tours would take place on Sundays from 11:00 AM to 5:00 PM, and on Saturdays when demand warrants. Special weekday events may be planned.
2. Cultural gatherings.
3. Site location for media productions.

Possible additional future uses as per NYC Board of Estimate resolution adopted on October 9, 1986:

1. Historical exhibits.
2. Streetcar/railway museum and/or railway vehicle storage "barn."
3. Partial use as part of a future streetcar line.

PROJECT PLAN

TUNNEL DESIGN

The design work for the Atlantic Avenue Tunnel Museum will include:

Site documentation:

Gathering and obtaining scale drawings and photographs along with field measurements of existing conditions.

Schematic design:

Preparation of designs for sidewalk kiosk entrance to the tunnel at the intersection of Court Street and Atlantic Avenue; underground passage to the tunnel; underground entry hall to the museum, including location of sales office, ticket booth, and concession stand; exhibition installation within tunnel; and portal entrance and approach ramp at Columbia Street.

Presentation Drawings:

We will use existing scale plans, sections, and elevations to describe the schematic design of the project components. The final package will include scale drawings, and/or renderings, and possibly a model of the project, as needed.

PHASE I

FIRE AND SAFETY IMPROVEMENTS

Current access to the tunnel will be improved as follows:

Egress:

A second Egress will be installed in the center of Atlantic Avenue, approximately 30 feet to 60 feet west of the current manhole entrance at Court Street and Atlantic Avenue, depending on site geometry within the tunnel. This egress will come in the form of a new manhole casting and frame. There are two alternatives: a double leaf rectangular manhole casting and frame, 6 ft x 3 ft inside clearance. The second alternative utilizes a four foot inside diameter round manhole casting and frame. The installation of this new 48 inch clearance manhole, with a stair underneath, had already been approved by the DOT, in a letter to BHRA, dated November 17, 1989. See Exhibits A and B.

The extant concrete bulkhead opening near the tunnel entrance will be enlarged to a new preferred size of 78 inches x 36 inches, or as close to those dimensions as is feasible, in order to meet codes and improve access to the main body of the tunnel.

The existing wood stair will be replaced by a steel stair of similar vertical rise and angle, with a tread length of 4 feet, tread 12 inches, and 8 inch risers. A 4 ft x 4 ft steel platform will be provided at the top of the stair. Handrails of standard type will be provided along both sides of the stair and platform. The existing wooden stair will be removed, together with any other flammables. The estimated cost of this steel stair, delivered and installed, is $4,200, based upon a bid we received.

The new manhole entrance will also utilize a second steel stairway. This new second stair is partly patterned after a traditional NYC Fire Escape stair. However, OSHA now categorizes this type of stair as “Ship's Stairs.” Since the current NYC Building Code is silent on new Fire Escape design, other sources were used. See Appendix, and Exhibits C and D. Subject to final design, in the first alternative a new steel stair would be utilized of approximately 11 feet (132 inches) vertical rise (providing minimum interior headroom of 80 inches), approximately 61 degree angle, tread length 36 inches, tread 6 inches, risers 9 inches, with 14 risers total. In the second alternative, a new steel stair would be utilized of approximately 11 feet vertical rise, at an angle of approximately 70 degrees, tread length 24 inches, tread 6 inches, risers 12 inches, with 11 risers total. Both alternatives would be equipped with steel handrails. However, the stair described in the second alternative will be provided with appropriate steel handrails that in cross section will be spaced a minimum of 36 inches apart. The cost of this steel stair, delivered and installed, is estimated at $3,000.

Final location of the new manhole and the second steel stair depends on obtaining exact measurements of existing tunnel geometric conditions. These measurements must be done immediately, in order to finalize this plan.

We anticipate the implementation of this plan will make the entire tunnel fire proof, and that Emergency Personnel entering the tunnel on a job will need to carry only a minimum of appropriate equipment, and traditional “gurneys” will easily fit within the tunnel.

Lighting:

We have examined § [C26-605.1] 27-381, of the NYC Building Code of 1968, as amended. We believe the existing ambient lighting within the tunnel exceeds the minimum requirement of 2 foot candles. Emergency lighting is provided by each and every visitor to the tunnel being required to furnish their own working flashlights. Visitors to the tunnel travel in specific groups, led by a long experienced guide. No "independent exploration" in the tunnel is permitted. Please note that the tunnel is only open a few hours, on a handful of days per month. It is otherwise unoccupied.

Wiring within the tunnel is of construction site type, industrial grade, consisting of insulated, weather proof and oil resistant No. 2, 3-conductor and No. 6, 3-conductor wire. All wiring connections are made to NYC Subways 3rd Rail Dept. specifications: Each connection is made with copper "bug nuts,” with 3 wraps of rubber high voltage tape, 3 wraps of friction tape, and 3 wraps of PVC tape. Our wiring and generator are properly protected by appropriate circuit breakers.

An in-house electrical connection will also be provided to eliminate the need for an external generator. Hard wired Emergency lighting will be installed as required.

Communications:

A combination of cell phones and walkie-talkies will be carried by each BHRA staff person present at the tunnel. It’s anticipated that once the new, enlarged Egress is installed, and the existing concrete bulkhead opening widened, radio reception inside the tunnel will be greatly improved. Landline telephone access will be installed as required.

Defibrillator:

BHRA will provide an *Elevaed* model "Life Pad Express,” or equivalent. See Exhibit E. CPR certification will also be obtained for appropriate tunnel personnel.

Tunnel Event Scheduling Notice:

BHRA will provide our DOT designated contact person___________________, with an advance tunnel event schedule for time periods of 60 days at a time. BHRA reserves the right to add on unanticipated additional tunnel events upon 3 working days notice to DOT.

PHASE I WORK TASK SEQUENCE:

1. Verify all measurements and dimensions by immediate site visits to the tunnel, as required.
2. Locate and mark any utilities within the planned work area. Generate and file with DOT any necessary MPT Plans for the planned work in the street.
3. Obtain Work Permits from DOT, as required.
4. Saw-cut roadway for new manhole casting, and saw-cut tunnel arch to accept manhole casting, as required. Saw-cut existing opening in concrete bulkhead to enlarge.
5. Install new manhole casting.
6. Install the new 70 degree steel stair.
7. In-load components for the new steel replacement of the existing wood stair. Dismantle existing wood stair.
8. Dispose of existing wood stair.
9. Install the replacement steel stair.

PHASE I PROJECTED COST

The projected total costs of Phase I improvements is approximately $20,000 to $25,000. Cost was based upon actual verbal bids solicited and received by BHRA, during February 2011.

PHASE II

NEW ENTRANCES AND MUSEUM

New entrances will be constructed and the tunnel will be restored as a museum and historic attraction. Project components will include:

1. Construction of one or more subway-style sidewalk entrances to the tunnel at Court Street and Atlantic Avenue, as per attached drawings. A kiosk will also be built to protect the entrance and provide shelter. One or more existing ventilation shafts will be reopened and activated to provide forced-air ventilation. Also to be installed are standpipes for fire protection and an improved museum-style lighting system.

   Estimated construction costs for these improvements is approximately $3 million. This is based upon ***Engineering News Record*** Construction Cost Indices (CCI), inflating a circa 1985 “Phase II” engineer’s cost estimate, to current October 2011 dollars.

2. BHRA may also obtain the rights to access the tunnel from the basement of a suitable building on Atlantic Avenue. There is a candidate building on the SW corner of Atlantic Avenue and Clinton Street which is home to the Tripoli Restaurant. This is a very unusual structure, as it has three levels of sub-basements. There is reason to believe (subject to access to relevant City records) that the floor level of the lowest sub-basement lines up with the floor level inside the tunnel. A 19th century plan for connecting the tunnel with an entrance located in this building could be realized by soliciting the assistance of the local "Sand Hog" union as well as the expertise of one of the many coal mine construction firms of Pennsylvania and West Virginia. Of course, the appropriate written consent of the building owner would have to be obtained, which would clearly entail some form of remuneration for the use of the building. It is estimated, subject to actual bid solicitations, that this thirty-foot long pedestrian connecting tunnel could be driven just below existing utilities, right from the basement into the tunnel, within a total project budget of $750,000. Any one of many local concrete saw cutting firms, such as the J.P. Hogan firm, could readily cut through the tunnel's stone wall with relative ease, using a diamond blade hydraulic powered chain saw, or by the use of a large diameter, electric powered, wall mounted, diamond blade circular saw concrete wall cutting system that could be readily set up inside the tunnel. If this plan were implemented, the improved entrance and steel stair already proposed for the middle of Atlantic Avenue just west of Court Street would then serve as the tunnel's Emergency Exit.

3. Construction of a museum within the tunnel. Exhibits will highlight the impact the tunnel had on the economic and social development (Transit Oriented Development) of Brooklyn; in particular, the reason it was built, how it was built and why it was closed. Various eclectic scientific and historical principles, and cutting edge theories relating to rail transit science and local history will also be included in the educational presentation

within the tunnel. The centerpiece of the museum will be the circa-1830's steam locomotive discovered in the tunnel. Other exhibits will include artifacts from the tunnel and various media illustrating the tunnel in use, and Brooklyn in general during that period of time. Another major attraction will be a fully restored antique streetcar which people can ride from one end of the tunnel to the other.

Phase IIA

Phase IIA was a plan BHRA developed circa 1990, to make the early 19th century steam locomotive said to have been buried behind a tunnel wall, a major feature of the overall tunnel tour/museum experience. At that time, a method was devised to drive an approximately 60 foot long "connecting tunnel" between the buried locomotive, and the interior of the tunnel under Atlantic Avenue and Hicks Street. This work is anticipated to be accomplished without any contact with existing underground utilities, through the use of pure tunneling, and by not employing the "cut and cover method" at all.

A similar connecting tunnel, of less than half the length cited above, could be used to connect the tunnel's interior with a suitable sub-basement along Atlantic Avenue. See Appendix IIA preliminary design documents attached below.

REVENUE PROJECTION

On any typical 2010 Sunday afternoon tunnel tour date, regardless of season or weather conditions, BHRA received on average, about $5,000 in free will contributions ($4,000 low, and over $6,000 high).

We base our future Phase II- IIA Revenue Projection upon past performance over the last three years, and the assumption that the suggested contribution for tunnel tours will be raised to $20 per person (a 30% increase), and that the planned Phase II-IIA improvements would allow the operation of tunnel tours/museum to be expanded to 7 days a week, with the circa-1830's locomotive discovered in the tunnel made part of the exhibit. Based upon the foregoing, we project "Phase II- IIA" gross revenue would be in the neighborhood of:

$6,500 per day x 360 days = $2,340,000 per year gross project revenue

PHASE III

OPENING THE WESTERN TUNNEL PORTAL- Long Term Planning

There appears to be significant community interest in the future construction of a downtown Brooklyn streetcar system, based upon certain cost effective technology for the purposes of fostering "Transit Oriented Development". The tunnel may well be determined to be an asset in the development of such a transportation improvement program, as a "trolley barn" to house the streetcars when not in use.

Circa 1989, BHRA working closely with the Brooklyn Borough President's Topographical Office, and with the NYC Department of Transportation, Department of Highways, developed a set of "Builder's Pavement Plans" (NYC DOT Plan # BNP 88-262) for the implementation of the re-opening of the tunnel's extant western portal at Columbia Street.

Approximated October 2011 cost, based upon a circa 1989 Cost Estimate, and the *Engineering News Record* "CCI" tables: $5.56 million.

APPENDICES:

<u>Phase I</u>

A- Double leaf manhole casting detail, 6ft x 3ft, March 2011, 2 pages

B- Circa November 17, 1989 letter from George Holuka, P.E. (Chief, NYC DOT Highway Design) and a circa September 28, 1988 letter from Dr. Michael Horodniceanu (Second Deputy Commissioner, NYC DOT) to BHRA, stating that DOT gives it permission for the current manhole to be replaced by a larger manhole, and that the DOT itself would provide a painted in pedestrian safety island around the new manhole. Three pages, and a separate plan view drawing, which had been prepared by DOT at that time.

C- **Safety and Survival on the Fire Ground**, by Vincent Dunn, 1992, Published by Fire Engineering Books, pg 261, 2 pages

D- **The Tenement House Laws of the City of New York**, Published by the City Of New York, 1903, pg 5, 2 pages, and **Ship's Stair Design Description** (including OSHA interpretation letter, dated 2/10/06), FS Industries, 2011, 5 pages

E- Preferred defibrillator unit, manufacturer's description sheet, 1 page

F- Flyers of candidate concrete wall cutting firms

G- Extracts of the circa 2008 NYC DOT tunnel consent renewal, highlighting certain key errors and other defects contained therein

H- Circa 2009 consent modification made by NYC DOT, to our circa 2008 tunnel consent renewal, requiring the creation and implementation of "MPT Plans" at the sole cost of BHRA. Letter from Emma Berenblit Director of DOT Consents, to BHRA dated July 22, 2009 and the executed Consent Modification document, dated September 9, 2009.

I- Phase 1 design documents prepared by LMW Engineering Group, June 2011. Three sheets.

J- Circa 1916 scale engineering drawings made by the City of New York

K- Approved NYC Board of Estimate Resolution, Calendar # 47, October 9, 1986

L- Tunnel safety report issued by LMW Engineering Group, March 2009

M- Building Code , City of New York, 1968, Title C Part 1, "Building Construction", § [C26-10.0]; Inapplicability of the NYC Building Code to tunnels or subways. The BHRA tunnel project, Phase I- II inclusive, was defacto "permitted" by a vote of the NYC Board of Estimate on October 9, 2011, Calendar No. 47, and by a vote of the NYC Planning Commission, prior to July 1, 2008. The tunnel project is therefore "grandfathered in" under the aegis of the original NYC Building Code of 1968. Reference source: NYC Building Code, as revised July 1, 2008, Preface Section, page IIB. Needless to say, the current (July 1, 2008) NYC Building Code will be strictly adhered to where ever technically feasible, given the unique nature of the tunnel site.

Phase II

1). Complete "Plans, Specification & Estimates" package (PS&E) prepared by Steven Carroll, P.E. circa 1985.

2). *Engineering News Record* "CCI" tables, 1978- Oct 2011

Phase IIA

Connecting tunnel design concepts, circa 1990

<u>Phase III (Re-Opening of Original Western Tunnel Portal Near Columbia Street)</u>

1). Completed circa 1989 NYC DOT Builder's Pavement Plan # BNP 88-262. Three sheets.

2.) Circa June 9, 1988 letter from Bob Diamond (BHRA) to NYC DOT Commissioner Ross Sandler

3.) Circa July 25, 1988 letter from Thomas Markham, PE. (NYC DOT) to Bob Diamond (BHRA)

4.) Circa January 13, 1989 meeting letter from Gerard Renninger, P.E. (NYCDOT)

5.) Circa February 9, 1989 meeting minutes (NYCDOT, State DOT, BHRA)

6.) Circa March 9, 1989 letter from Anthony Cosentino, P.E. (NYCDOT)

This Space Left Intentionally Blank

Long Island Rail-Road Office,
27th Nov. 1844.

The Directors of the Long Island Rail-Road Company request the favour of your attendance at Brooklyn, on Tuesday the 3 of December, on the occasion of opening their Tunnel for use.

The Trains will leave the Depot at the South Ferry at 12 o'clock, noon.

Should the weather prove unfavourable, the ceremony will be postponed to the first fair day.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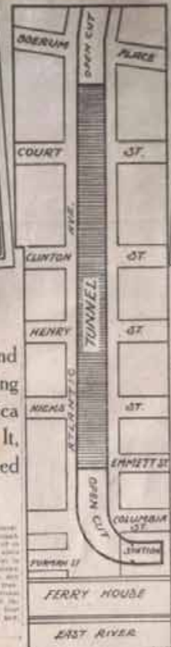
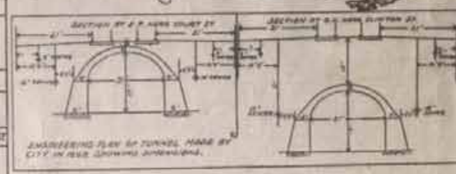
BROOKLYN HAS THE OLDEST SUBWAY IN THE WORLD

ITS EASTERN END



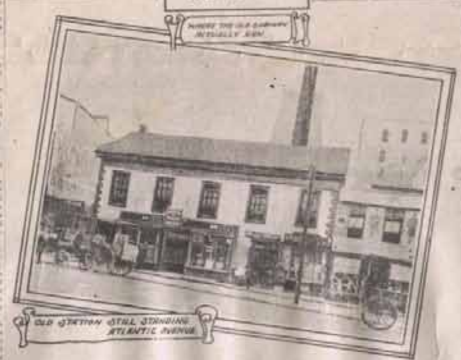
WHERE THE OLD SUBWAY ACTUALLY RAN

WHERE THE TUNNEL ENDED AT THE RIVER.



ENGINEERING PLAN OF TUNNEL MADE BY CITY IN 1868 SHOWING DIMENSIONS.

It Was Begun in 1836 Under Atlantic Avenue and Runs From South Ferry to Boerum Place, Being Part of the Route of the Brooklyn and Jamaica Railroad---Trains Actually Passed Through It, Preceded by a Man on Horseback---Later Used by Smugglers and Thieves.



OLD STATION STILL STANDING ATLANTIC AVENUE.

June 28, 1916

6

THE BROOKLYN DAILY EAGLE. NEW YORK. SUNDAY, JUNE 28, 19

RAZING LANDMARK ON ATLANTIC AVE.

Old Terminal of Brooklyn and Jamaica Railroad Coming Down.

ONCE USED AS A MUSEUM.

Built in 1836, Flimsy Old Structure Now Yields Memories and Relics.

Many old Brooklynites will remember with interest the old building shown in the illustration and located near the South Ferry on Atlantic avenue, which for many years was used as the terminal of the Brooklyn and Jamaica Railroad, which was operated from the ferry along Atlantic avenue to Jamaica. The old building, a three-story frame structure, is being torn down. The wrecking did not come too soon, for the building was beginning to fall apart. In fact, the wreckers at work on the landmark say that it was one of the flimsiest old buildings they have ever demolished, and it is almost a miracle that it did not collapse months ago.

The terminal was built early in May, 1836, and later on, to make room for the enlargement of the ferry, it was removed to its present site, 20 Atlantic avenue. When the building was abandoned as a railroad terminal and the old tunnel under Atlantic avenue, extending from Columbia street to a point between Boerum place and Smith street, was closed, Squire Collins purchased the depot and opened a museum on the first and second floors. Collins' Museum was one of the most interesting amusement places in Brooklyn in its day, for most of the exhibits were of freak animals, stuffed and mounted.

Among the exhibits was also Flora Temple, the trotting horse that had won many races and had become a national celebrity. Dexter, another prominent trotter of the early sixties, stood on a bronze pedestal near the door. Molly, the two-headed cow, born in Hempstead, and exhibited all over the world, stood silent "and natural as life" on a platform at the rear of the Atlantic avenue museum.

Birds of every description and from every corner of the earth, snakes and insects, fish and poultry, made up the wonderful collection which for many years occupied the old terminal building. The admission was "two bits," and some of the old residents of Atlantic avenue still recall that the place was always crowded on Sundays and holidays.

Many interesting old relics were picked up by the wreckers in the cellar of the building. Conductor's trip sheets, feed bills, coal bills and railroad tickets were among the discoveries. A curious stipulation on the tickets specified that no passenger, "while the cars were on Atlantic avenue" was allowed to stand or remain on the platform of the car. Passengers were also cautioned against "getting on the steps while the car is in motion."

The terminal for some years was a boarding house, and at one time, Stephen M. Kernan, who has lived in the neighborhood for the past fifty years, says it had as "guests" more than thirty sailors and soldiers of the Civil War, whose stories of the war were told and retold to habitues of the place.

IN GERMAN CIRCLES

Everything is in shape at Gerken's Glendale Schuetzenpark today for the

OLD ATLANTIC AVENUE R. R. TERMINAL BEING DEMOLISHED

Social Events of Note

Miss Lillian M. Baird rendered a programme of delightful readings at the studio of her teacher, Grace Stewart Godfrey, 142 Clinton avenue, on Friday, June 19. Miss Baird was assisted by Miss Jessie Hoofield, reader, and Miss Frances Heimberg, pianist. Miss Baird shows marked ability for her years and promises great success in the future.

On Saturday evening last the Mozart String Quartet of Brooklyn, consisting of Jeanne Little Wildig, first violin; Fanny A. Bell, second violin; Clarina Matson, viola; Frances Christman, cello; gave a concert at the Presbyterian Church of Mahopac Falls, Putnam County, N. Y. They were assisted by Miss Florence M. Bell, soprano, and Miss Marjorie D. Arthe, pianist; two soloists of unusual merit. The cellist, Miss Christman, played a group of solos with breadth and beauty of tone and much spirit. In response to a request, she whistled delightfully, several ballads with piano accompaniment.

At a regular meeting and election of the Eastern District Club, held at the clubhouse, 728 Driggs avenue, on Tuesday evening, June 24, the following officers were elected: President, Harry Levy; second president, Andrew Duke; treasurer, Dr. Theodore Salstan; financial secretary, Ted Leveen; recording secretary, Louis Leveen; sergeant-at-arms, Moe Weinberger; trustees, Harry Kunstler, chairman; Dr. H. M. Zahler, William Hadhart. The installation of officers, followed by a banquet, will take place on Saturday evening, July 4, at the summer clubhouse at Highlands, N. J. Elaborate preparations are being made for this occasion and it promises to be one of the big social affairs of the season.

Miss Arline Hammer of 1321 Bedford avenue will soon leave the city for Highmount in the Catskills, to remain until July 12, when she will join her mother, who will summer in Stamford, N. Y., until the middle of September.

The Gaelic Language and Irish Dancing classes will continue to meet all summer on Wednesday evening in St. Mary's Hall, Shelton and Flushing avenues, Jamaica, under the auspices of the Jamaica Gaelic Society. An entertainment of singing and dancing follows the classes. The music is rendered by Professors O'Reilly, Fitzgerald, McCaffrey and Haggerty.

have made early reservations of tickets.

Those who attend will be served with an excellent shore dinner at 1 p.m., the euchre games will follow and a suitable selection of prizes will be awarded.

At the regular weekly matinee euchre on Monday afternoon last at the clubhouse, 1033 Greene avenue, a series of euchre games, enthusiastically played, resulted in prizes being awarded to the following: Mrs. B. Vanderwater, Mrs. George Vannatten, Mrs. Walter Brower, Mrs. Thomas B. Luneburgh, Mrs. Fleming, Mrs. James Scott, Mrs. James Clarke, Mrs. Joseph Fessler, Mrs. H. Acker, Mrs. Charles E. Tallman.

William A. Nelson, jr., chief clerk of the Fourth Municipal Court, with his family will leave the city on July 1 to spend the summer at Camp Martin, Milton, Vermont.

Mrs. P. Moorman and daughter of Stapleton, N. Y., will spend the summer at Saranac Inn on the Upper Saranac Lake.

Linen Shower For Miss Reilly.

Miss Lillie Reilly, who is soon to become the bride of William Maloney of the Finance Department, was showered with linen by her friends at the home of the Misses McGuire, 253 Harrison street, on Saturday, June 6. Miss Reilly was the recipient of many pretty and useful gifts. Mrs. Mae Paden McGuire and Miss Helen McGuire, both well known in musical circles in Brooklyn, entertained with vocal selections. In the evening the guests assembled in the diningroom, where a collation was served. The table was artistically decorated in red, and Cupids and hearts were strung from a large red bell suspended from the chandelier. The favors were dainty candy-filled gold baskets. Among those present were the Misses Matty McNally, Elizabeth McGuirk, Helen McGuirk, Margaret Gray, Elizabeth King, Dolly King, Eleanor King, Agnes O'Rourke, Anna Mulligan, Adeline Cullen, Ethel Cullen, Frances Commerford, Lillie Reilly, Anna Duddy, Elizabeth Kearney, Mae Burns, Florence McInerney, Mrs. Mae Paden McGuire, Helen McGuire, Bessie McGuire.

BROOKLYN COMPOSER'S SONG.

TRAFFIC IN TITLES SETS GERMANY AGOG

Revelations by Socialist Leader Show Grafting in High Circles.

HOW TO WIN PROFESSORSHIP.

Print Scientific Article and Pay $10,000 "in a Certain Quarter" for Honor.

Berlin, June 27—Karl Liebknecht, the Socialist leader and member of the Reichstag, whose revelations last year resulted in the conviction of a number of Krupp officials and army officers of bribery, has again unearthed affairs that are engaging the attention of the prosecuting attorney and seem likely to result in criminal prosecutions.

Liebknecht charges—and supports his charges with strong evidence—that trafficking in titles on a commission basis is carried on in Prussia, and that certain titles are, or were, up to two years ago, granted for money considerations. The Minister of Education has made a public denial of the latter part of the accusations, declaring that titles, or at least that of professor, are not to be had for money. He has, however, directed an investigation of the other charges and it is now under way.

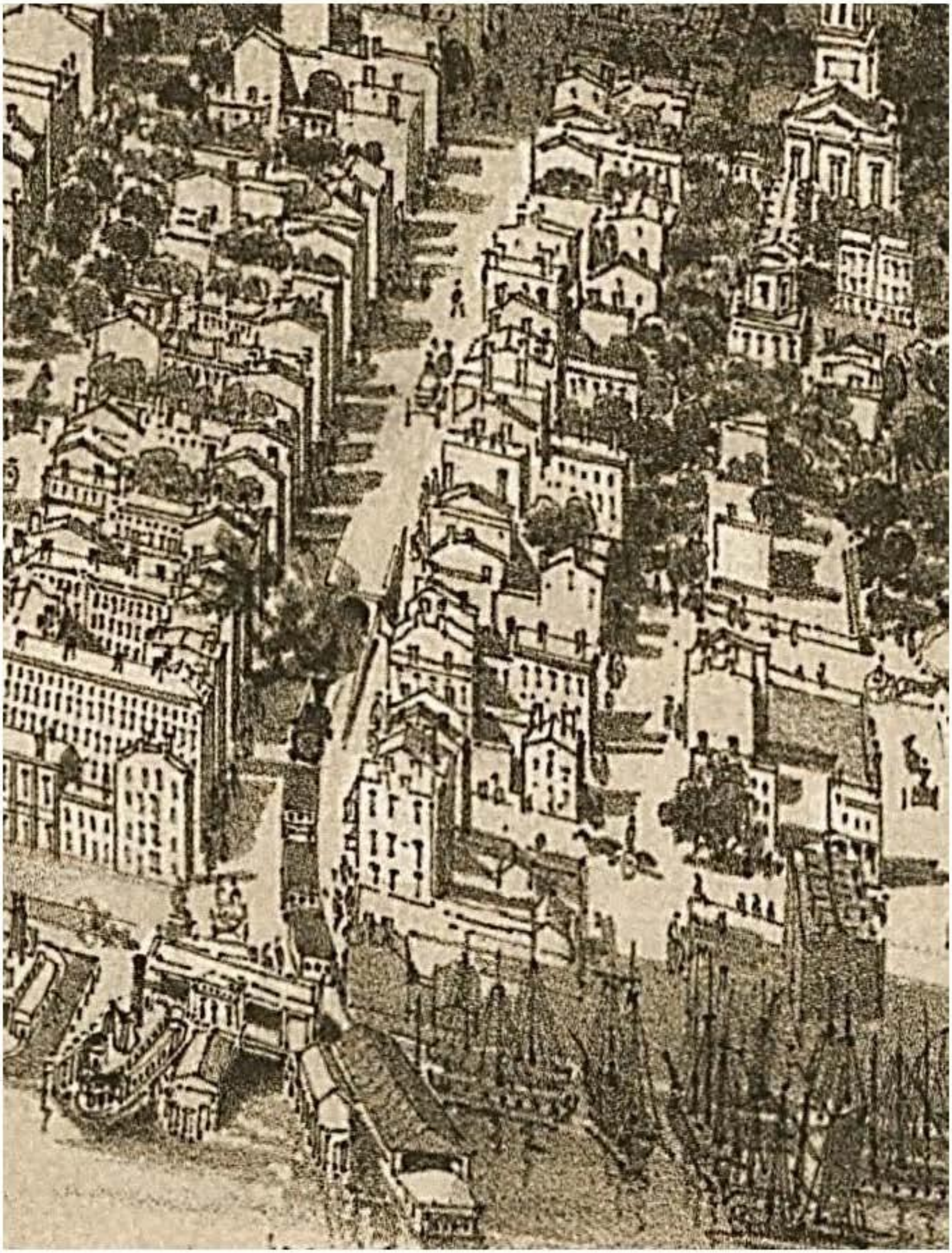
Liebknecht tried to make his disclosures at the conclusion of his speech in the Reichstag on the armaments trust, but was ruled out of order by the Speaker. Two or three days later he published the first installment of his charges in Vorwaerts, the central organ of the Socialist party. It had to do with the late General von Lindenau, one of the most distinguished military men in the empire. Von Lindenau was for a long time chief of the Great General staff; he was appointed Governor of Metz shortly before his death, and it is declared that he might have become Prussian War Minister had he lived. He enjoyed the especial confidence and esteem of the Emperor.

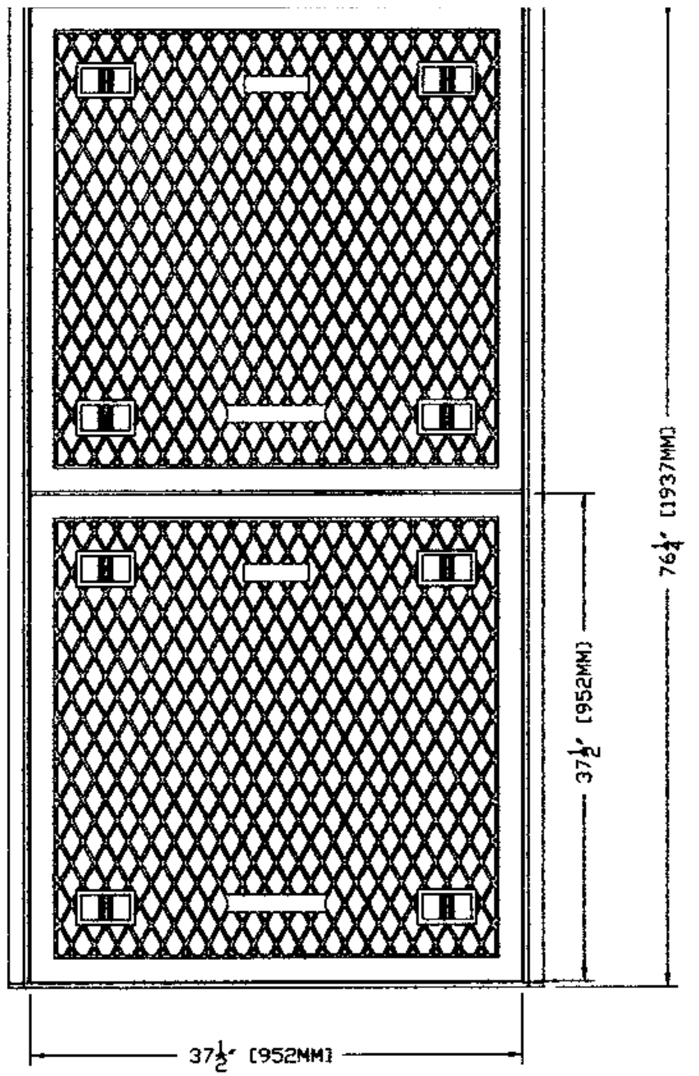
Liebknecht published extracts from

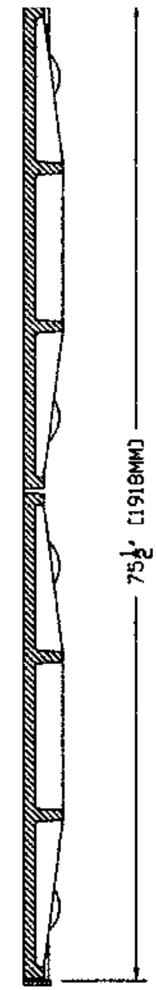
took place at St. [illegible] Church here, the Rev. Charles [illegible] was officiating. After a short honeymoon trip the couple will reside in [illegible] Bay.

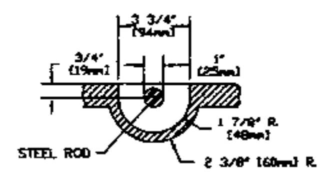
TO TALK OF MEXICAN PEACE.

Locust Valley, L. I., June 27—Residents of Locust Valley will hear of Mexico and International Peace on Sunday morning, when William H. Short, executive secretary of the New York Peace Society, will speak at the Locust Valley Reformed Church, of which the Rev. Fred Hartman is pastor. Mr. Short spoke last Saturday

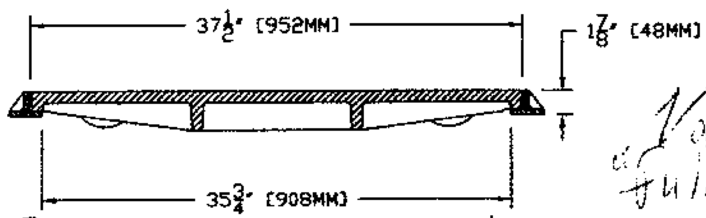








Interior (4) TYPE 4 STEEL PICKBARS
PICKBAR DETAIL



Note: Rims supporting covers must have "full moment" welds

Frame Steel used should be A36

NOTES:

1.) MATERIAL FOR COVER SHALL BE GRAY CAST IRON CONFORMING TO A.S.T.M. A48 (LATEST REVISION) CLASS 35B.

2.) UNITS DESIGNED HEAVY DUTY FOR A.A.S.H.T.O. HS20-44 WHEEL LOADS.

3.) FRAME SHALL BE FABRICATED FROM HOT ROLLED STEEL.

2804
CUSTOM FRAME AND COVER

DRAWING # 2804-STLFR-CICR			
Drawn By: TJM	DATE: 2/28/11	Revised By:	Revised:

Syracuse Castings — Better By Design
P.O. Box 1821
6177 South Bay Rd.
Cicero, N.Y. 13039

From: Penny Urquhart (penny@syrcast.com)
To: rdiamond@brooklynrail.net;
Date: Tue. March 1, 2011 4:00:06 PM
Cc:
Subject: FW: Special Manhole Castings

Bob.

I have attached a drawing of what I hope is what you are requiring.

Price per unit = Frame & (2) Covers @ $1 443.00/SET.

Delivery to be determined when address is supplied.

Thanks. Penny

From: Robert Diamond [mailto:rdiamond@brooklynrail.net]
Sent: Friday, February 25, 2011 4:52 PM
To: sales@syrcast.com; sales@syrcast.com
Subject: Special Manhole Castings

Hi,
We need a doubled sized version of your 2804A, measuring a total of 72 x 36 inches, with two cover leaf castings of 36 x 36 each. Can you supply, and how much would it cost?
Thanks
Bob Diamond

This Email has been scanned for all viruses by PAETEC's Hosted E-mail Security Services, utilizing MessageLabs proprietary SkyScan infrastructure. For more information on a proactive anti-virus service working around the clock, around the globe, visit http://www.paetec.com.

NEW YORK CITY
DEPARTMENT OF TRANSPORTATION
Ross Sandler *Commissioner*
Samuel I. Schwartz, P.E. *First Deputy Commissioner*
BUREAU OF TRAFFIC
DIVISION OF TRAFFIC ENGINEERING
28-11 QUEENS PLAZA NORTH • L.I.C., N.Y. 11101

Dr. Michael F. Horodniceanu
Second Deputy Commissioner

Elizabeth H. Theofan, P.E.
Assistant Commissioner

November 17, 1989

Mr. Robert Diamond
President
Brooklyn Historic Railway Assn.
599 E. 7th Street
Brooklyn, NY 11218

Re: BN-AACRD-BLG-HWK197F
BT 89-2225
Atlantic Ave. Railway
Tunnel, Bklyn.

Dear Mr. Diamond:

We have reviewed your request concerning enlarging the existing access into the tunnel at Atlantic Avenue and Court Street, and have the following comments:

The center of the staircase opening should be on the centerline of Atlantic Avenue, or as close as possible.

The length (4 ft. dimension) should start at the East edge of the existing manhole, and go West toward Clinton Street.

If these two comments are included into your final plan for the tunnel access, our approval for this location is hereby given.

The roadway casting and staircase should be in compliance with Bureau of Highways specification for roadway grating.

Upon receiving the Bureau of Highways approval, you should submit your plan to the MTCCC for the specifications and permit for working in the intersection of Atlantic Avenue and Court Street.

Feel free to contact me at (718) 830-7511 if you have a question regarding this matter.

Very truly yours,

GEORGE HOLUKA
Chief, Division of Highway Design

GH:js/sw

cc: D/C David Gurin
A/C Barney La Greca, P.E.
D/A/C P. Kaneshiro
M. Benson
K. Keegan
File

NEW YORK CITY
DEPARTMENT OF TRANSPORTATION
BUREAU OF TRAFFIC
28-11 QUEENS PLAZA NORTH L.I.C., N.Y. 11101

Ross Sandler
Commissioner

Samuel I. Schwartz, P.E.
Chief Engineer First Deputy Commissioner

Dr. Michael F. Horodniceanu
Deputy Commissioner

September 28, 1988

Mr. Robert Diamond
President
Brooklyn Historic Railway Assn.
509 E. 7 Street
Brooklyn, NY 11218

Re: DOT 053881
BT 88156
881517

Dear Mr. Diamond:

This is in response to your letter to Commissioner Ross Sandler concerning the historic railway tunnel entrance at Atlantic Avenue and Court Street, Brooklyn.

Your request has been reviewed by the Highway Design Division of the Traffic Bureau. It has been determined that a channelization could be designed which would safely divert vehicles around the tunnel entrance while not adversely affecting traffic flow.

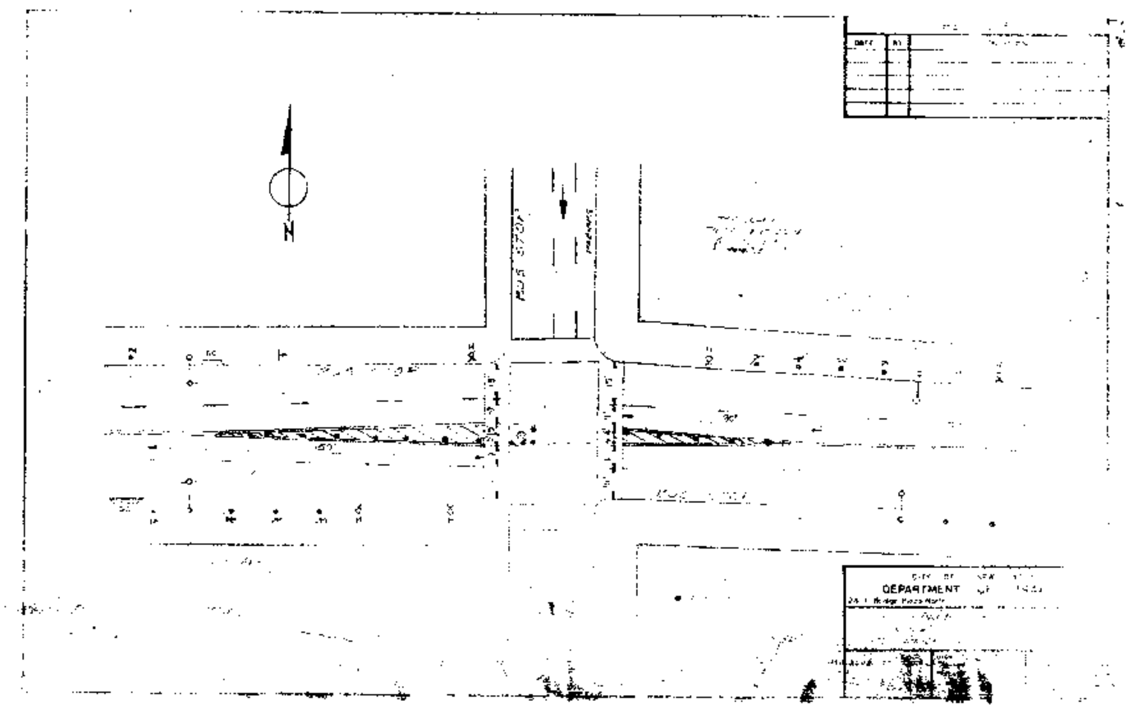
As Mr. Holuka of the Highway Design division previously informed you, the installation of this painted island will necessitate the removal of a number of parking meters. Since your discussion with Mr. Holuka indicates that the historic railway tunnel will receive limited usage during the winter months, the work required for installation has been scheduled for the spring of 1989.

Please contact Mr. Holuka at least one month before the active use of the tunnel entrance begins, so that the various phases of the work may be properly coordinated.

Very truly yours,

Dr. Michael F. Horodniceanu
Second Deputy Commissioner

MFH:mpd/sw



N
BUS STOP
DEPARTMENT

Exhibit "C"

Angle of Fire Escape Ladder

A hidden danger in a standard fire escape is the angle of its stairway and ladders. The climbing angles of a gooseneck ladder, drop ladder, and intermediate stair between fire escape balconies are much steeper than that of a normal building stairway. To compensate for these larger angles, exercise greater caution when ascending or descending a fire escape.

A typical stairway in a building rises at a 30- or 45-degree angle from the horizontal floor level. A standard fire escape stairway rises at a 60- or 75-degree angle from the horizontal floor level: the gooseneck and drop ladder rise straight up, at a 90-degree angle.

The SCBA on a firefighter's back changes his center of gravity—there is actually a constant force pulling the firefighter backward (Figure 15.17). He must be conscious of this force at all times during the climb up or down a 90-degree-angle gooseneck or drop ladder. Momentary release of a grip when climbing hand over hand on the rungs of a fire escape drop ladder will cause the firefighter to fall backward.

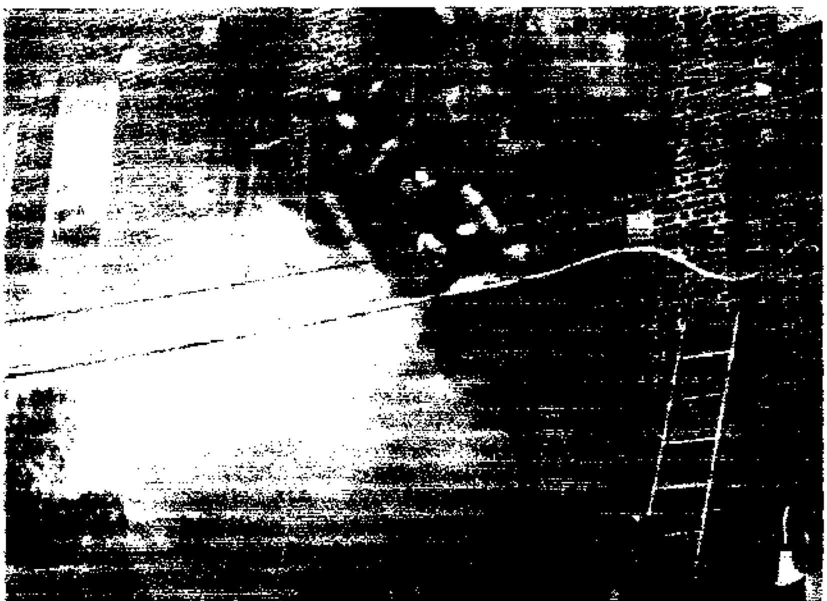


Figure 15.17. *The weight of the SCBA air tank on one's back changes a firefighter's center of gravity. The weight of the air tank can cause a firefighter to fall backward when climbing a steep stair or a ladder on a fire escape.*

About the Author

Vincent Dunn is a deputy chief serving with the New York City Fire Department—a 35-year veteran who rose through the ranks of the department: seven years a firefighter, nine years a company officer, 19 years a chief.

Attending college at night with the assistance of the G.I. Bill, he received an A.A.S., B.A., and M.A. from Queens College, City University of New York.

An adjunct professor of Manhattan College, he taught fire engineering in the civil engineering department: currently an adjunct instructor with the National Fire Academy, he developed and teaches a residence course, "Command and Control of Fire Department Major Operations."

A contributing editor with *Fire Engineering* magazine and *Firehouse* magazine, he has authored many articles on firefighting safety and survival.

He is the author of the book and video series, "Collapse of Burning Buildings."

twelve inches apart and not less than fift... length.

(1) The fire escapes shall open directly from at least one room in each apartment at each story above the ground floor, and no fire escape shall be placed in a court except as provided in section fifty-seven of this act. Fire escapes may project into the public highway to a distance not greater than four feet beyond the building line.

(2) The fire escapes shall consist of outside open iron balconies and stairways. The stairways shall be placed at an angle of not more than sixty degrees, with steps not less than six inches in width and twenty inches in length, and with a rise of not more than nine inches. The balcony on the top floor, except in case of a front fire escape, shall be provided with a goose-neck ladder leading from said balcony to and above the roof.

(3) Balconies.—The balconies shall not be less than three feet in width, taking in at least one window of each apartment at each story above the ground floor. They shall be below and not more than one foot below the window sills and extend in front of and not less than nine inches beyond each window. There shall be a landing not less than twenty-four inches square at the head and foot of each stairway. The stairway opening on each platform shall be of a size sufficient to provide clear headway.

(4) Floors of balconies.—The floors of balconies shall be of wrought iron or steel slats not less than one and a half inches by three-eighths of an inch,

THE TENEMENT HOUSE LAWS

OF

THE CITY OF NEW YORK.

THE TENEMENT HOUSE ACT.

(Chapters 334 and 555, Laws of 1901: Chapter 352, Laws of 1902.)

THE GREATER NEW YORK CHARTER.

(Chapter 466, Laws of 1901.)

Prepared for the Tenement House Department.

1903.

fs [industries

ENGINEERED STEEL PRODUCTS

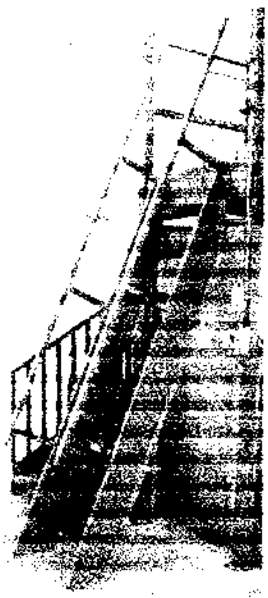
Priced Full Line Products Catalog

PO Box 72355 Providence, RI 02907

Categories >>> Select a Product Category [redacted] Thursday, March 3, 2011

GSA Schedule

SHIPS LADDER - 68° STEEP INCLINE



(C) Standard Extended Handrail Models

STRUCTURAL STEEL STAIRWAYS SHIPS LADDER DESIGN

safe access with minimum space requirement

- Quality engineered to your specific height requirement.
- Designed for safety and convenience.
- Heavy duty bar grating stair treads won't sag or dish (supplied as standard).
- Factory welded handrails of 1 1/2" x 14 ga. square tubing.
- 10" structural channel stringers.
- Fire proof construction.
- Standard finish gray enamel, others available upon request.
- Standard 24" wide treads, 27" overall stair width. Other widths available upon request.
- Tread depth is 6".
- Our standard finish is a quick dry gray enamel. Other colors available.

(D) Hatch Access Models (Short Handrail)

OSHA CONFORMANCE

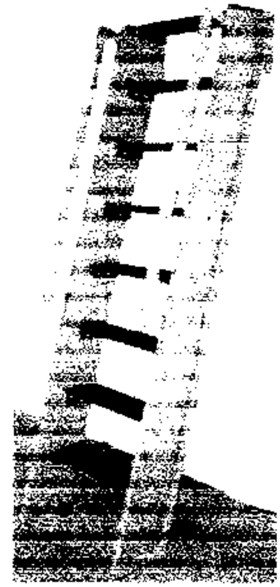
See Details Below Price Tables

NEW! Optional Finishes!

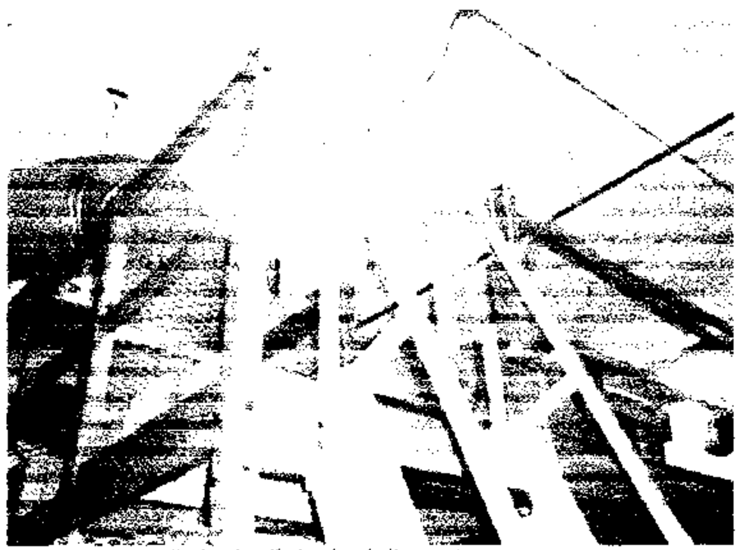
Now we are pleased to offer our products with a [illegible] or in a [illegible] which is paint over a hot-dipped galvanized undercoat.

CUSTOM SIZES - SAME DAY QUOTES

Custom sizes and configurations are readily available. We provide same day price quotes if you require a special stair angle, specific tread rise/run, or a maximum horizontal stair run to satisfy available floor space constraints.



Optional Vertical Handrail to 42" guard height quoted upon request.

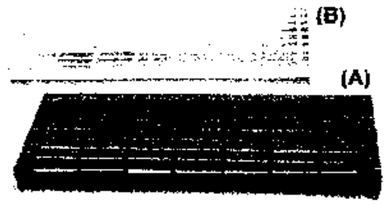


Optional walk-thru handrail quoted upon request.

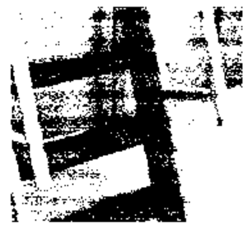
Add $100.00 to standard pricing and add -VHR to Model No.

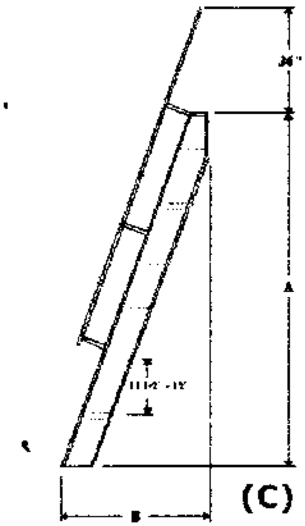
Add $150.00 to standard pricing and -WTHR to Model No.

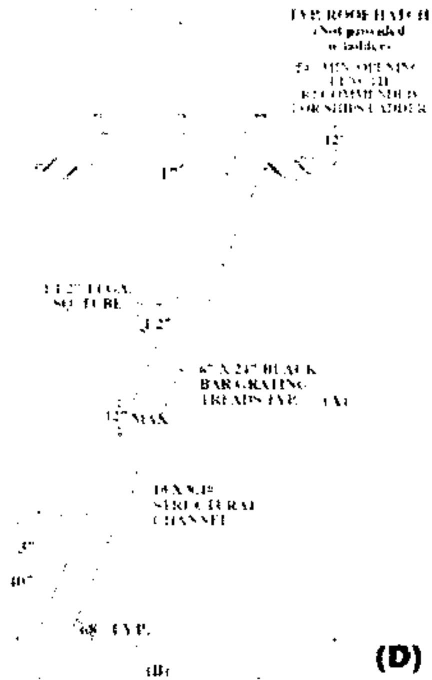
Steel Stair Treads



Bar grating stair treads are safe, self-cleaning, skid-resistant and economical.







Important Note When Ordering: Specify actual floor to floor height when ordering. stairways are custom designed to meet your height requirements. (A Dimension) ***Other sizes available upon request.**

(C) PRICING FOR STANDARD EXTENDED HANDRAIL MODELS

Type Model No.	(A) Height Range		(B) Horizontal Run	Tread Width	Nominal Overall Width	Price w/Gray Enamel & Black Bar Grating Treads (A)	Price with all Galvanized Finish (B)	Price with all Duplex Paint System
	Low Ht. (in.)	Upper Ht. (in.)						
SL2438	36"	41"	19.47" - 21.49"	24"	27"	[illegible]	[illegible]	$1,320
SL2444	42"	47"	21.90" - 23.92"	24"	27"	$798	$1,300	$1,436
SL2450	48"	53"	24.32" - 26.34"	24"	27"	$879	$1,398	$1,554
SL2456	54"	59"	26.74" - 28.76"	24"	27"	$960	$1,496	$1,669
SL2462	60"	65"	29.17" - 31.19"	24"	27"	$1,042	$1,595	$1,786
SL2468	66"	71"	31.59" - 33.61"	24"	27"	$1,124	$1,698	$1,900
SL2474	72"	77"	34.02" - 36.04"	24"	27"	$1,204	$1,792	$2,016
SL2480	78"	83"	36.44" - 38.46"	24"	27"	$1,285	$1,892	$2,132
SL2486	84"	89"	38.87" - 40.89"	24"	27"	$1,366	$1,990	$2,248
SL2490	90"	95"	41.29" - 43.31"	24"	27"	$1,447	$2,090	$2,364
SL2498	96"	101"	43.71" - 45.73"	24"	27"	$1,531	$2,187	$2,481
SL24104	102"	107"	46.14" - 48.16"	24"	27"	$1,612	$2,287	$2,597
SL24110	108"	113"	48.56" - 50.58"	24"	27"	$1,693	$2,385	$2,714
SL24116	114"	119"	50.99" - 53.01"	24"	27"	$1,773	$2,484	$2,828
SL24122	120"	125"	53.41" - 55.43"	24"	27"	$1,857	$2,582	$2,944
SL24128	126"	131"	55.83" - 57.85"	24"	27"	$1,939	$2,681	$3,060
SL24134	132"	137"	58.26" - 60.28"	24"	27"	$2,021	$2,780	$3,177
SL24140	138"	143"	60.68" 62.70"	24"	27"	$2,102	$2,877	$3,294
SL24146	144"	149"	63.11" - 65.13"	24"	27"	$2,184	$2,977	$3,410
SL24152	150"	155"	65.53" - 67.55"	24"	27"	$2,263	$3,076	$3,526
SL24158	156"	161"	67.95" - 69.97"	24"	27"	$2,346	$3,174	$3,642

SL24164	162"	167"	70.38" - 72.40"	24"	27"	$2,425	$3,273	$3,758
SL24170	168"	174"	72.80" - 75.23"	24"	27"	$2,508	[illegible]	$3,8[illegible]4
SL24178	174"	179"	75.23" - 77.25"	24"	27"	$2,590	$3,470	$3,991
SL24184	180"	185"	77.65" - 79.67"	24"	27"	$2,676	$3,568	$4,107
SL24190	186"	191"	80.08" - 82.10"	24"	27"	[illegible]	$3,66[illegible]	$4,222

(D) PRICES FOR FLUSH TREAD HATCH ACCESS MODELS

Type Model No.	(A) Height Range Lower Ht. (in)	Upper Ht. (in)	(B) Horizontal Run	Tread Width	Nominal Overall Width	Price with Gray Enamel & Black Bar Grating Treads (A)	Price with all Galvanized Finish (B)	Price with all Duplex Paint System
FTHASL2438	36"	41"	24.32" - 26.34"	24"	27"	$1,022	$1,748	$1,929
FTHASL2444	42"	47"	26.74" - 28.76"	24"	27"	$1,058	$1,752	$1,941
FTHASL2450	48"	53"	29.17" - 31.19"	24"	27"	$1,125	$1,849	$2,025
FTHASL2456	54"	59"	31.59" - 33.61"	24"	27"	$1,183	$1,868	$2,099
FTHASL2462	60"	65"	34.02" - 36.04"	24"	27"	[illegible]	$1,951	$2,169
FTHASL2468	66"	71"	36.44" - 38.46"	24"	27"	[illegible]	$2,022	$2,270
FTHASL2474	72"	77"	38.86" - 40.88"	24"	27"	$1,403	$2,108	$2,377
FTHASL2480	78"	83"	41.29" - 43.31"	24"	27"	$1,475	$2,189	$2,473
FTHASL2486	84"	89"	43.71" - 45.73"	24"	27"	$1,554	$2,281	$2,583
FTHASL2490	90"	95"	46.14" - 48.16"	24"	27"	$1,626	$2,366	$2,683
FTHASL2498	96"	101"	48.56" - 50.58"	24"	27"	[illegible]	$2,461	$2,795
FTHASL24104	102"	107"	50.99" - 53.01"	24"	27"	$1,786	$2,549	$2,899
FTHASL24110	108"	113"	53.41" - 55.43"	24"	27"	$1,865	$2,645	$3,015
FTHASL24116	114"	119"	55.83" - 57.85"	24"	27"	$1,944	$2,735	$3,118
FTHASL24122	120"	125"	58.26" - 60.28"	24"	27"	$2,026	$2,830	$3,233
FTHASL24128	126"	131"	60.68" - 62.70"	24"	27"	$2,102	$2,922	$3,341
FTHASL24134	132"	137"	63.11" - 65.13"	24"	27"	$2,185	$3,029	$3,457
FTHASL24140	138"	143"	65.53" - 67.55"	24"	27"	$2,263	$3,111	$3,566
FTHASL24146	144"	149"	67.95" - 69.97"	24"	27"	$2,344	[illegible]	$3,682
FTHASL24152	150"	155"	70.38" - 72.40"	24"	27"	$2,422	$3,303	$3,792
FTHASL24158	156"	161"	72.80" - 74.82"	24"	27"	$2,505	$3,356	$3,909
FTHASL24164	162"	167"	75.23" - 77.25"	24"	27"	$2,581	$3,495	$4,020
FTHASL24170	168"	174"	77.65" - 80.08"	24"	27"	$2,664	$3,593	$4,135
FTHASL24178	174"	179"	80.08" - 82.10"	24"	27"	$2,743	$3,688	$4,247
FTHASL24184	180"	185"	82.50" - 84.52"	24"	27"	$2,824	$3,796	$4,363
FTHASL24190	186"	191"	84.92" - 86.94"	24"	27"	[illegible]	$3,882	$4,474

SAFETY WARNING: These ladders are to be ascended and descended with the user always facing the ladder. Never descend the ladder facing away from the ladder.

[illegible]

A frequently asked question is whether a ships ladder conforms to OSHA. The answer is somewhat complicated. There is no single OSHA standard which specifically relates to the ships ladder design shown here. This product is a hybrid which is neither a stair nor ladder and therefore has dimensions and design parameters which overlap and/or conflict with OSHA standards for fixed stairways (Standard 1917.120) and fixed ladders (Standard 1910.27). Also included below is a reprint of a standard interpretation letter from OSHA dated 2/10/2006.

Does this product meet OSHA requirements? We believe the answer is yes when restricted areas preclude alternatives and a due diligence safety review of the intended use and application has been performed by the end user. These ships ladders are not intended to replace applications which require regular stairways but rather to fulfill the needs created by restricted areas. Responsibility for determining the suitability of a particular use and application rests with the purchaser.

02/10/2006 - The use of ship's stairs instead of fixed stairs in general industry.

• **Standard Number:** 1910.27

February 10, 2006

Ms. Erin Flory
Indiana Department of Labor
402 W. Washington Street, Room W195
Indianapolis, IN 46204

Dear Ms. Flory:

Thank you for your July 20, 2005, fax to the Occupational Safety and Health Administration (OSHA). Your letter was forwarded to the Directorate of Enforcement Program's (DEP's) Office of General Industry Enforcement for response. This letter constitutes OSHA's interpretation only of the requirements discussed and may not be applicable to any questions not delineated within your original correspondence. You had specific questions regarding the use of ship's stairs in general industry.

The questions below have been restated for clarity.

Question 1: Are ship's ladders (also known as ship's stairs) required to meet the fixed ladder requirements in 29 CFR 1910.27?

Response: No. The standards for fixed ladders in §1910.27 do not apply to ship's stairs.

Question 2: Can ship's stairs be used in general industry?

Response: Existing §1910.27 does not address ship's stairs. However, the 1990 Proposed Rule for Subpart D, Walking and Working Surfaces, 55 Federal Register 13360, addresses this issue at proposed §1910.25, Stairs, paragraph (e)(1), which states, "Ship's stairs shall be installed at a slope between 50 degrees and 70 degrees from the horizontal." Where an employer is in compliance with the provisions of a proposed standard, it is OSHA's general policy to treat the violation of an existing requirement as a de minimis violation. Therefore, in areas where conventional industrial stairs cannot be installed due to limited space availability, then OSHA would consider the installation of fixed industrial stairs with a slope between 50 degrees to 70 degrees from the horizontal to be a de minimis violation. De minimis violations are violations of standards which have no direct or immediate relationship to safety or health, and do not result in a citation, or penalty and need not be abated.

Thank you for your interest in occupational safety and health. We hope you find this information helpful. OSHA requirements are set by statute, standards, and regulations. Our interpretation letters explain these requirements and how they apply to particular circumstances, but they cannot create additional employer obligations. This letter constitutes OSHA's interpretation of the requirements discussed. Note that our enforcement guidance may be affected by changes to OSHA rules. Also, from time to time we update our guidance in response to new information. To keep apprised of such developments, you can consult OSHA's website at http://www.osha.gov. If you have any further questions, please feel free to contact the Office of General Industry Enforcement at (202) 693-1850.

Sincerely,

Richard E. Fairfax, Director
Directorate of Enforcement Programs

ElevAED

Shopping Cart

0 item(s) in cart/ total: $0.00

Home | | | | search by keyword

Products

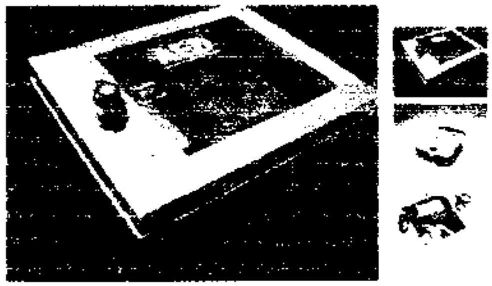
AED Packages

Cabinets & Enclosures

Home > AED Packages

LifePAD Express

Part Number LifePAD_Express



Price

Your Price: $1,345.00

Choose Options

Choose Carrying Case With Carrying Case [+$50.00]

Quantity 1 Add to Cart

Description

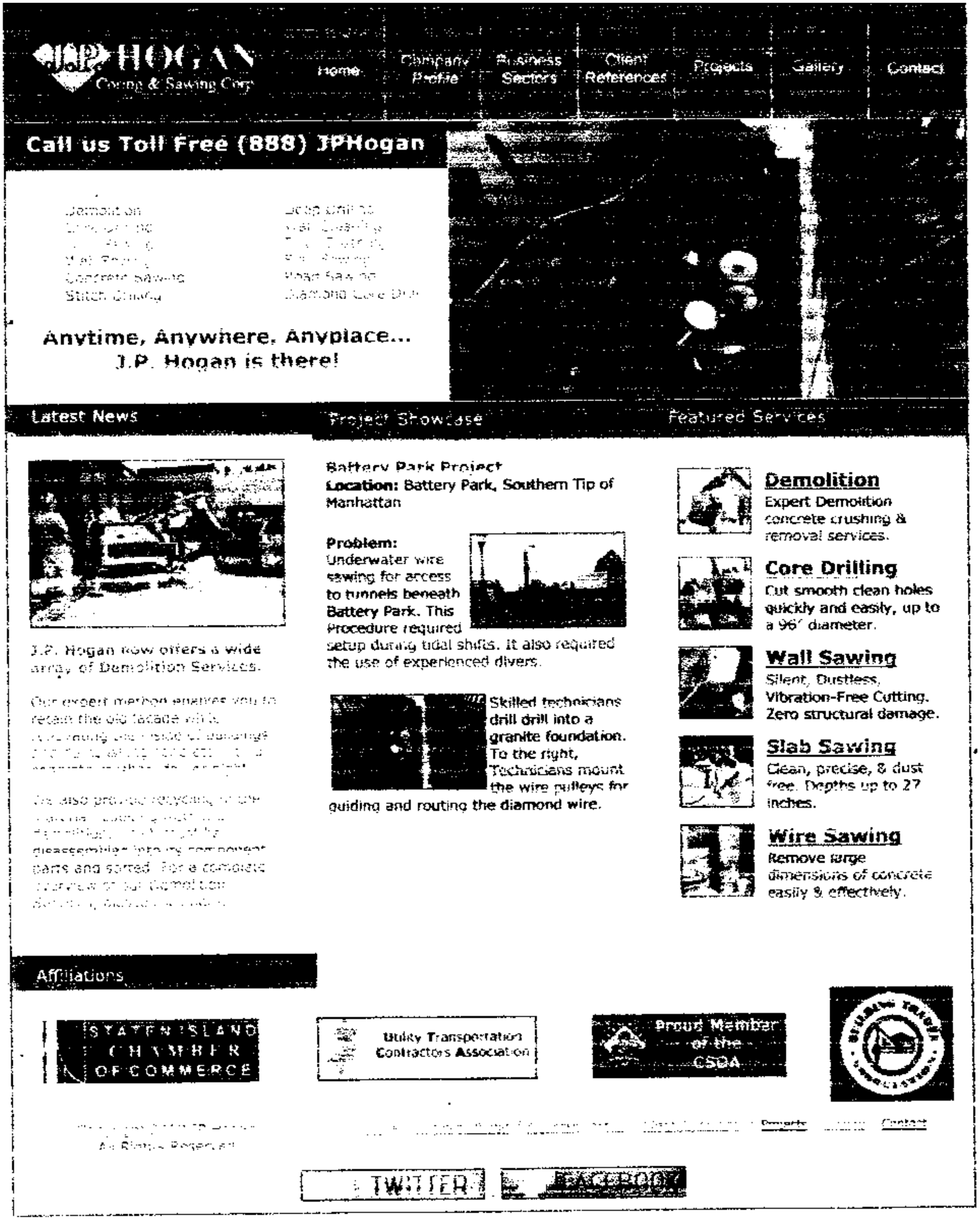
LIFEPAD© EXPRESS Package includes:

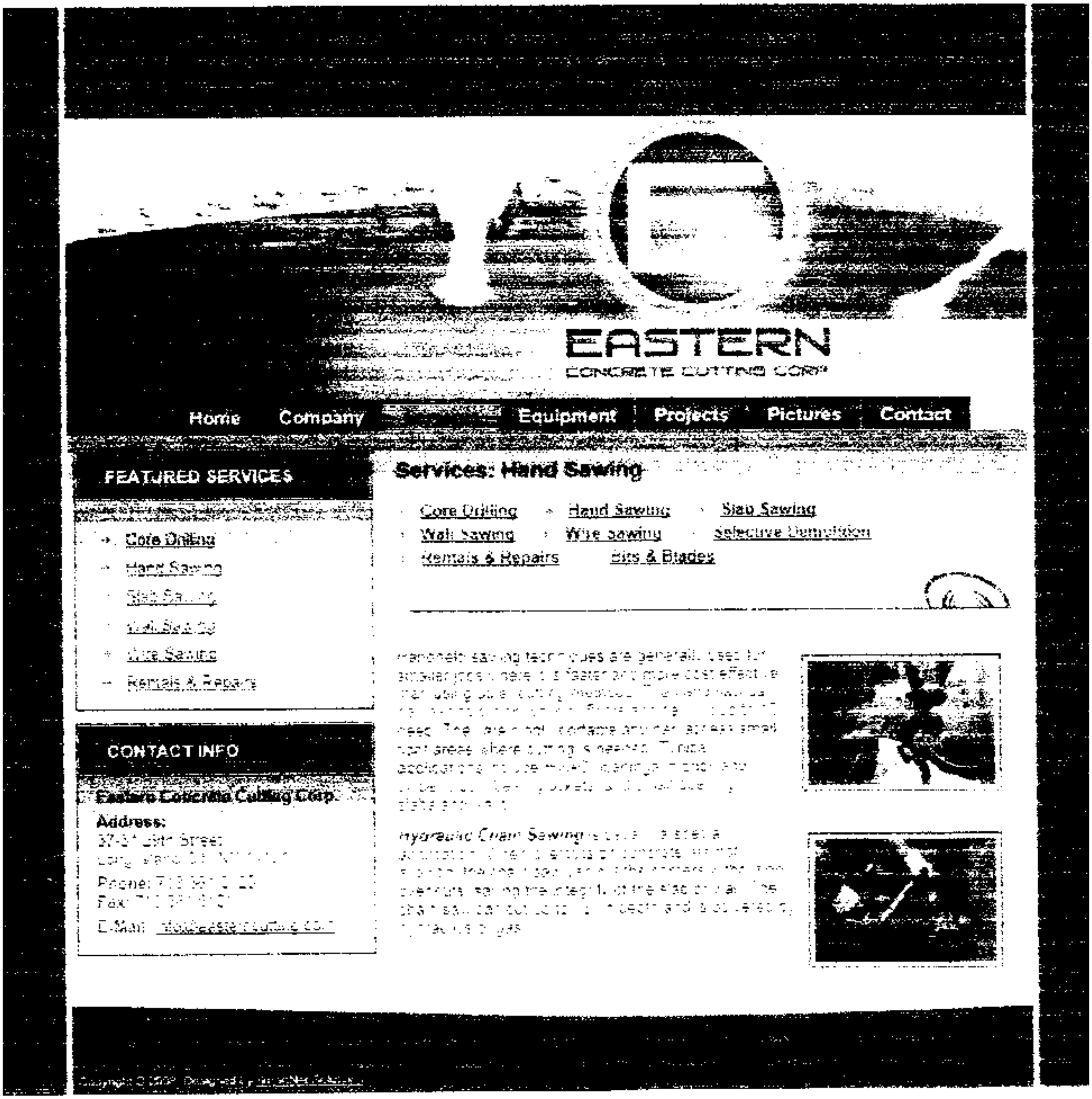
- PHYSIO-CONTROL LIFEPAK® EXPRESS - with one set of adult electrode pads, battery, and quick reference card. Brochure
- **Compact Stainless Wall Cabinet** - *All weather* surface mount corrosion resistant 304 stainless steel enclosure.
- Windowed, *lockable*, polyurethane *gasketed* door resists moisture, dust. Rain gutter.
- Wireless alarm has *3 levels* - 110 dB, chime, or off.
- *Genuine* Physio-Control AED & CPR responder kit.
- Two "AED on-premises" window decals
- *Dial-out capability* with alarm host kit. ($95 option)

Five year warranty on all components.

Related Items

Defibrillator


HOGAN
Coring & Sawing Corp
Home
Company Profile
Business Sectors
Client References
Projects
Gallery
Contact
Call us Toll Free (888) JPHogan
Anytime, Anywhere, Anyplace...
J.P. Hogan is there!
Latest News
Project Showcase
Featured Services
J.P. Hogan now offers a wide array of Demolition Services.
Battery Park Project
Location: Battery Park, Southern Tip of Manhattan
Problem:
Underwater wire sawing for access to tunnels beneath Battery Park. This Procedure required setup during tidal shifts. It also required the use of experienced divers.
Skilled technicians drill drill into a granite foundation. To the right, Technicians mount the wire pulleys for guiding and routing the diamond wire.
Demolition
Expert Demolition concrete crushing & removal services.
Core Drilling
Cut smooth clean holes quickly and easily, up to a 96" diameter.
Wall Sawing
Silent, Dustless, Vibration-Free Cutting. Zero structural damage.
Slab Sawing
Clean, precise, & dust free. Depths up to 27 inches.
Wire Sawing
Remove large dimensions of concrete easily & effectively.
Affiliations
STATEN ISLAND CHAMBER OF COMMERCE
Utility Transportation Contractors Association
Proud Member of the CSDA
TWITTER
FACEBOOK


EASTERN
CONCRETE CUTTING CORP
Home
Company
Equipment
Projects
Pictures
Contact
FEATURED SERVICES
Core Drilling
Services: Hand Sawing
Core Drilling
Hand Sawing
Slab Sawing
Wall Sawing
Wire Sawing
Selective Demolition
Rentals & Repairs
Bits & Blades
CONTACT INFO
Eastern Concrete Cutting Corp.
Address:

Schedules A and B

Schedule A

N/A

Schedule B

Prior to the commencement of the construction herein authorized, the Grantee shall submit to the Department of Environmental Protection , for review and approval, engineers scale drawings showing the proposed water main work and relocation of the manhole.

Prior to the opening of the museum, the Grantee shall submit to the Fire Department, for approval, a fire protection plan.

The Grantee shall submit plans of the construction herein authorized to the Art Commission for approval in accordance with the provisions of the New York City Charter and said construction shall not be commenced until such approval has been granted and a copy thereof filed with the Division of Franchises, Concessions and Consents of the Department of Transportation.

The Grantee shall file inspection reports with the Grantor at five-year intervals certifying the following:

a) The structural members were inspected by a professional engineer within the last six (6) months.

b) The load carrying capacity is sufficient to support the anticipated loading.

c) The non-load carrying members have been inspected and are secure.

The Grantee shall properly maintain all fire protection equipment and devices such as sprinkler systems, fire extinguishers, fire-proof self-closing doors, etc.

APPROVAL AS TO FORM OF A REVOCABLE CONSENT AGREEMENT BY STANDARD TYPE OF CLASS

AGENCY: Transportation

REVOCABLE CONSENT AGREEMENT: Owner

I hereby approve as to form the annexed revocable consent agreement by standard type of class. This approval is valid for one year and for a maximum of 300 consents.

The above approval is made on the express understanding that the substantive language of the subject revocable consent agreements will not be altered or changed in any way without prior submission to the office of the Corporation Counsel for approval, provided, however, that blank spaces in the revocable consent agreements requiring names, dates, locations, dollar amounts or other similar details may be completed.

ACTING CORPORATION COUNSEL

[illegible] 6/15/20

Schedule

The Grantee is required to have the tunnel inspected by qualified inspection personnel in accordance with the provisions of the New York State Department of Transportation Bridge Inspection Manual and file inspection reports with the Grantor at two-year intervals certifying the following:

a) The structural members were inspected by a professional engineer within the last six (6) months.

b) The load carrying capacity is sufficient to support the anticipated loading.

c) The non-load carrying members have been inspected and are secure.

The Grantee shall properly maintain all fire protection equipment and devices such as sprinkler systems, fire extinguishers, and fire-proof, self-closing doors etc.

DOT Staff may regularly inspect and photograph consented Structure to ensure that it is maintained properly.

NEW YORK CITY

Department of Transportation

JANETTE SADIK-KHAN, Commissioner

July 22, 2009

Mr. Robert Diamond
Brooklyn Historic Railway Association
599 East 7th Street, apt. 5A
Brooklyn, NY 11218

Re: Operations at site of revocable consent structure

Dear Mr. Diamond:

We have been made aware of the measures you take when conducting tours of the railroad tunnel that is the subject of the revocable consent entered into between the City of New York and the Brooklyn Historic Railway Association on July 1, 2009. In order to conduct any such further tours it will be necessary for a licensed engineer to draw up and submit to us for approval a certified maintenance and protection of traffic plan that will be implemented during any such scheduled tour. In order to assist you, we have put together a preliminary plan to be used as a guide for creating your plan. Please be advised that the plan that you submit to us will have to comply with the Manual of Uniform Traffic Control Devices.

Once approved by us, the plan will be incorporated into your revocable consent agreement and therefore all provisions of your revocable consent agreement shall apply to the plan, including but not limited to, the indemnity and hold harmless provisions, and insurance. No further tours may be conducted until this plan has been approved.

Please be further advised that you are not permitted to charge those who take your tours but you may accept voluntary donations.

Sincerely,

Emma Berenblit
Director of Revocable Consents

Encl.
EB:rs

NYC Department of Transportation
Office of Franchises, Concessions and Consents
55 Water Street, 9th Floor West, New York, NY 10041
T 212.839.6551 F. 212.839.9695
www.nyc.gov/dot

R.P. No: 1289

THE CITY OF NEW YORK
DEPARTMENT OF TRANSPORTATION
55 Water Street
New York, New York 10041

REVOCABLE CONSENT AGREEMENT (Owner)
(Modification)

WHEREAS The New York City Department of Transportation (the "Grantor"), by a revocable consent agreement dated July 1, 2008 (the "Consent") granted the Brooklyn Historic Railway Association, having its principal place of business at 599 East 7th Street, Brooklyn, NY 11218 (the "Grantee") consent to use and maintain a railroad tunnel, together with two public entrances, a manhole and ventilators, (the "Structure") in Atlantic Avenue from east of Columbia Street to west of Boerum Place, in the Borough of Brooklyn. The Consent will expire by limitation on June 30, 2018; and

IT IS HEREBY AGREED:

1. The Consent is hereby modified as follows:

(a) The Consent is amended to include the attached Maintenance and Protection of Traffic Plan submitted by Grantee (the "MPT Plan"). The Grantee shall comply with all provisions of the MPT Plan every time that Grantee accesses the Structure through the entrance on the roadway. Should Grantee fail to do so, Grantor may exercise all rights available to it, including its right to terminate the Consent. Grantee shall be solely responsible for all costs and expenses related to its operations, including implementation of the MPT Plan.

(2) The terms of this amendment shall be effective on the date of execution of this amendment and shall continue in full force and effect for the life of the Consent.

(3) Except as modified herein, the terms and conditions of the Consent shall remain in full force and effect throughout the term of the Consent.

(4) All provisions of the Consent shall apply to the MPT Plan, including but not limited to, the indemnity and hold harmless provision, and the insurance provisions.

2009-031222

In Witness Whereof, the parties hereunder have caused this amendment to a revocable consent to be executed.

GRANTOR:
NYC DEPARTMENT OF TRANSPORTATION
DIVISION OF FRANCHISES, CONCESSIONS & CONSENTS

By: ______________________
Anne Koenig
Executive Director

Accepted and agreed to:
GRANTEE:

By: Robert Diamond
(Signature)

Robert Diamond
(Print Name of Signatory)

President
(Title)

August 25 2009
(Date)

The foregoing amendment is hereby approved.
MICHAEL R. BLOOMBERG, MAYOR

By: ______________________
David Taylor-Fink, Associate Director for Program Administration
Mayor's Office of Contract Services

Dated, New York 9/8/, 2009

Approved as to form
Certified as to legal authority.

By: Sharon Carter
Acting Corporation Counsel

AUG 21 2009
(Date)

Acknowledgment by Executive Director

State, City and County of New York, ss.:

On the 4 day of September, in the year 2009, before me, the undersigned, personally appeared Anne Koenig, personally known to me or proved to me on the basis of satisfactory evidence to be the individual(s) whose name(s) is(are) subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their capacity(ies), and that by his/her/their signature(s) on the instrument, the individual(s), or the person upon behalf of whom the individual(s) acted, executed the instrument.

Roxanne Gair

Notary Public or Commissioner of Deeds

ROXANNE GAIR
Commissioner of Deeds
City of New York No. 2-10225
Commission Expires 2-1-10

Acknowledgment by Corporation

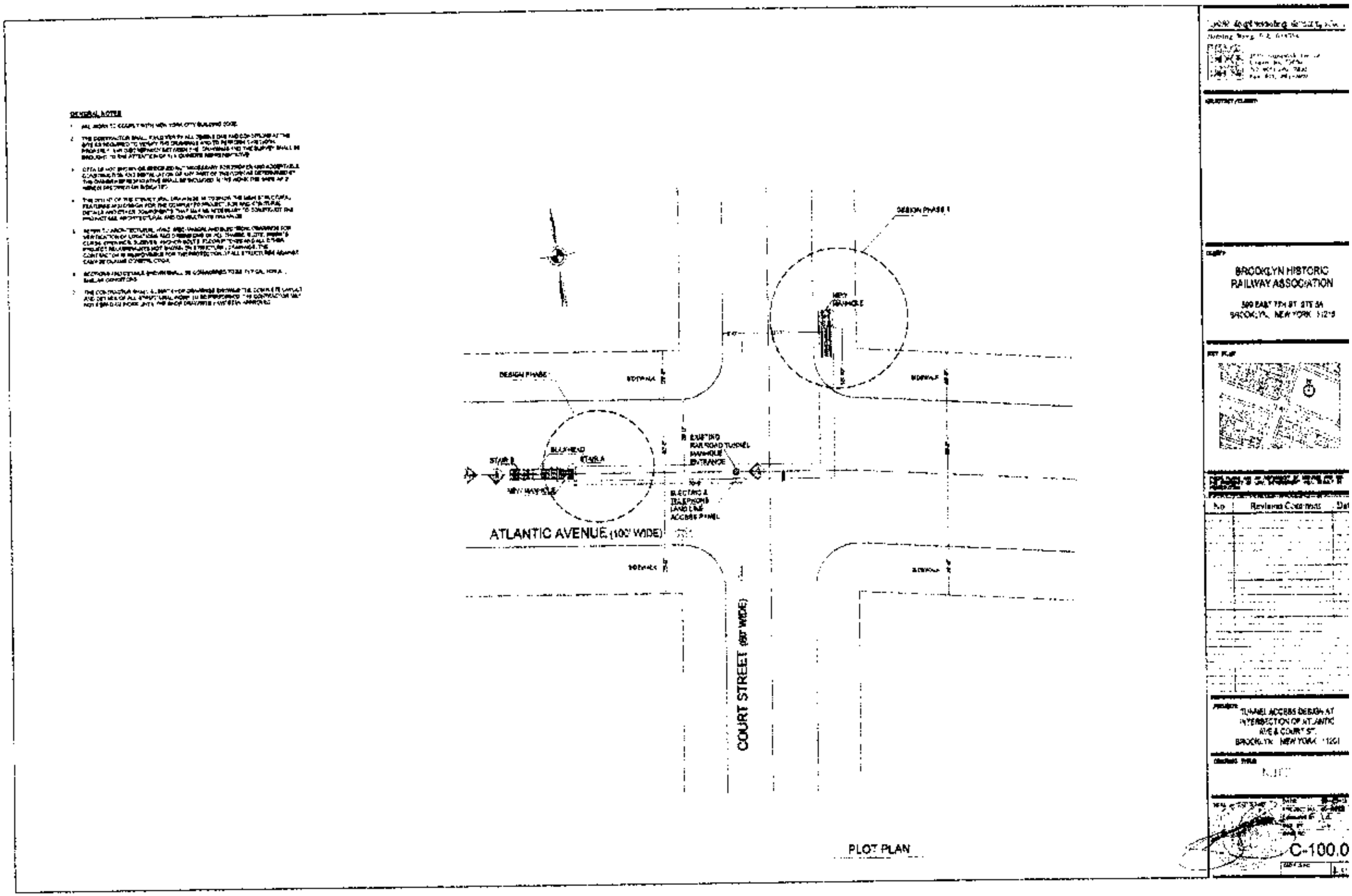
State, City, and County of New York, ss.,

On the 25th day of August, in the year 2009 before me, the undersigned, personally appeared Robert Diamond, personally known to me or proved to me on the basis of satisfactory evidence to be the individual(s) whose name(s) is(are) subscribed to the within instrument and acknowledged to me that he/she/they executed the same in his/her/their capacity(ies), and that by his/her/their signature(s) on the instrument, the individual(s), or the person upon behalf of whom the individual(s) acted, executed the instrument.

Velma Lewis

Notary Public or Commissioner of Deeds

VELMA P. LEWIS
Commissioner of Deeds
City of New York No. 4-5169
Certificate Filed in New York County
Commission Expires Feb. 1, 20 10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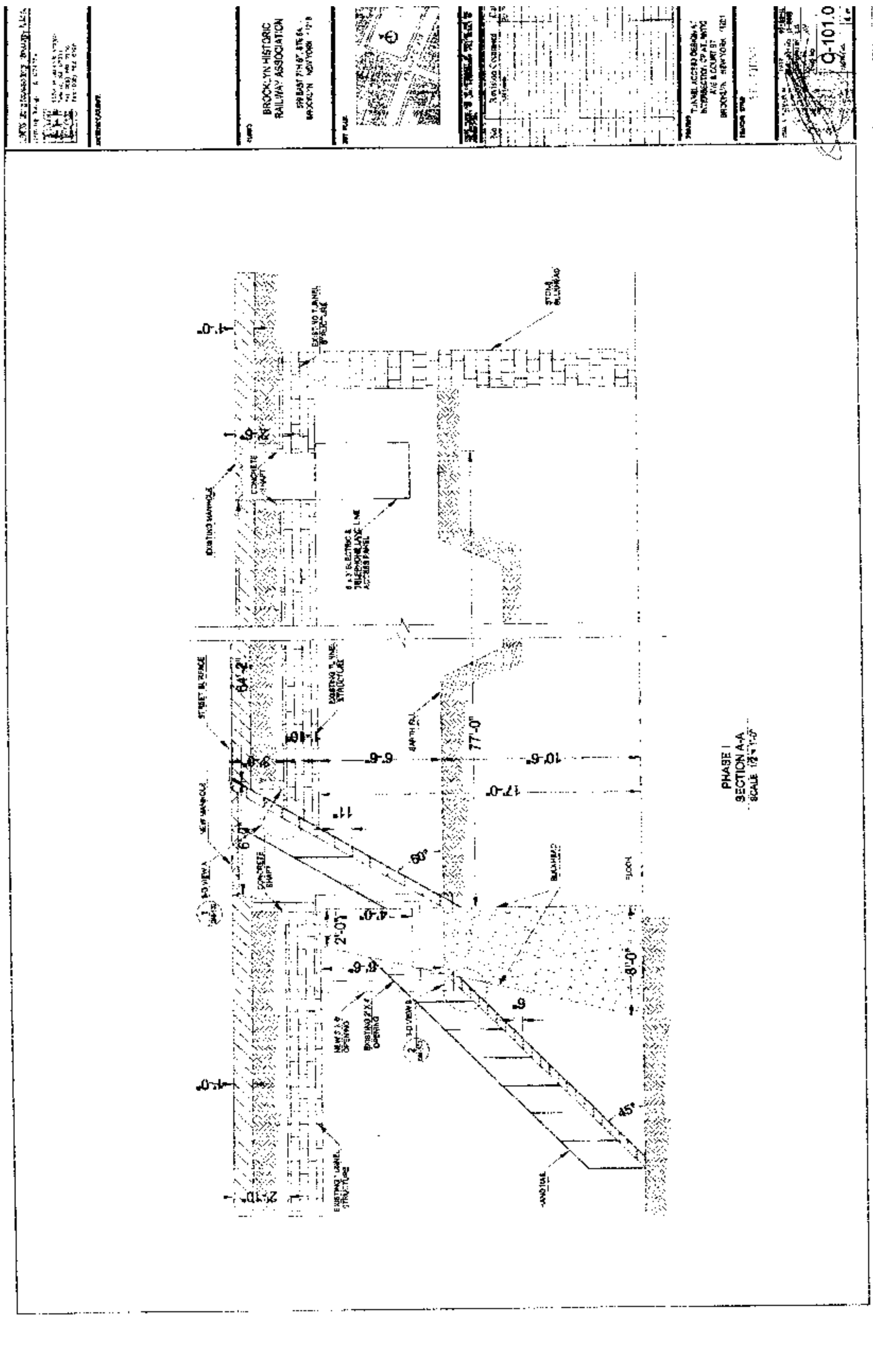
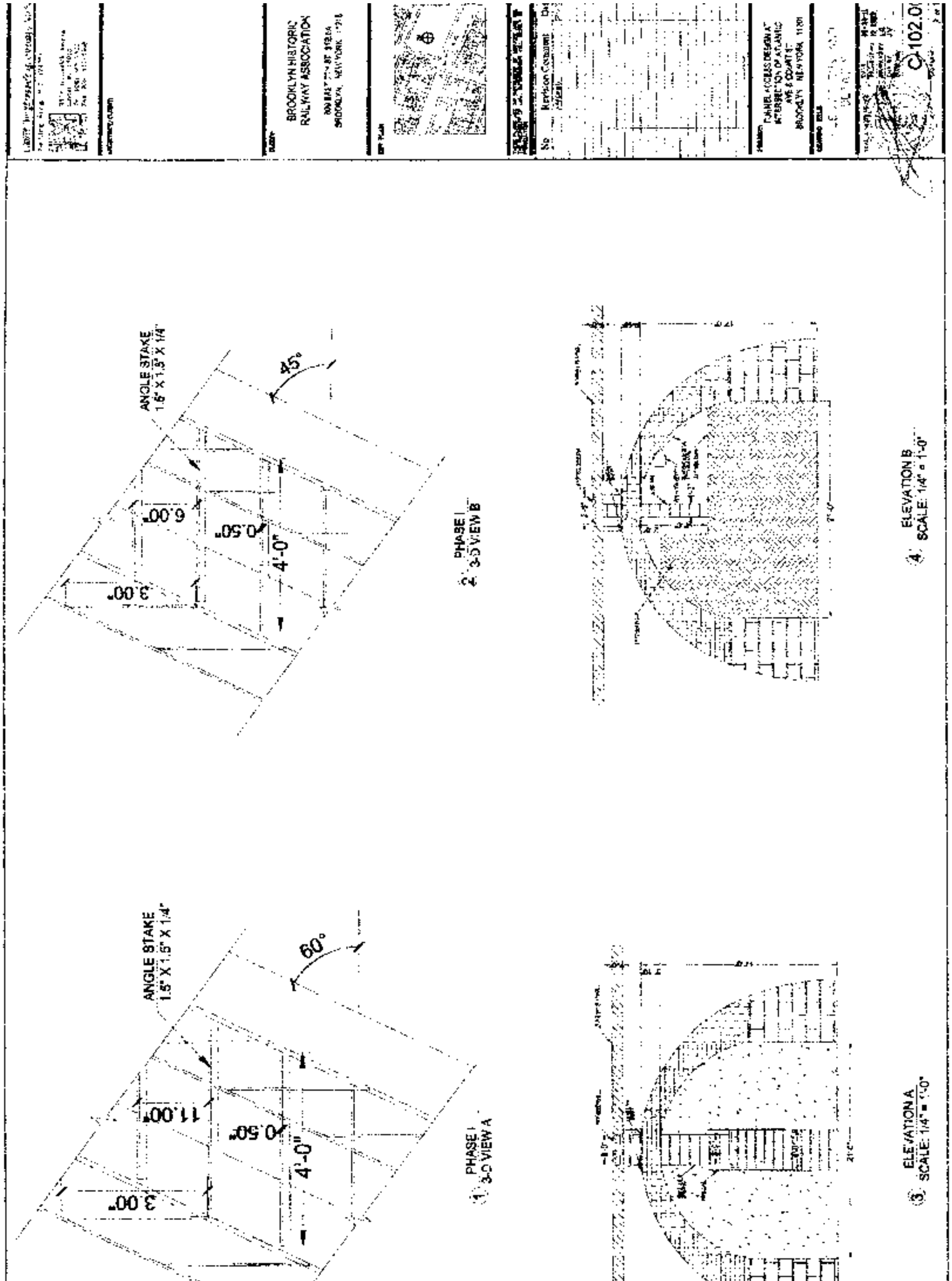
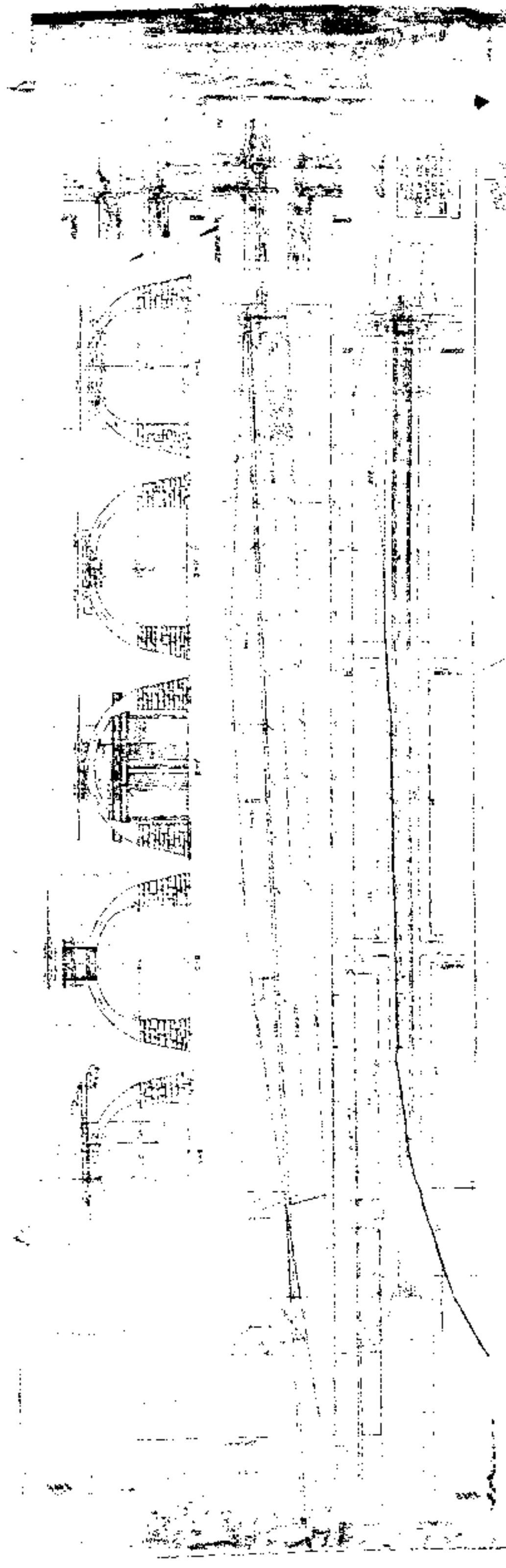
NEW MANHOLE
DESIGN PHASE
SIDEWALK
BULKHEAD
STAIR A
STAIR B
EXISTING RAILROAD TUNNEL MANHOLE ENTRANCE
ELECTRIC & TELEPHONE LAND LINE ACCESS PANEL
ATLANTIC AVENUE (100' WIDE)
COURT STREET (60' WIDE)
PLOT PLAN
BROOKLYN HISTORIC RAILWAY ASSOCIATION
BROOKLYN, NEW YORK
No. Revisions Comments
TUNNEL ACCESS DESIGN AT INTERSECTION OF ATLANTIC AVE & COURT ST.
BROOKLYN, NEW YORK
C-100.0


BROOKLYN HISTORIC RAILWAY ASSOCIATION
STREET SURFACE
EXISTING MANHOLE
CONCRETE SHAFT
NEW MANHOLE
EARTH FILL
BULKHEAD
HANDRAIL
PHASE I
SECTION A-A
Q-101.0



BROOKLYN HISTORIC
RAILWAY ASSOCIATION
ANGLE STAKE
1.5" X 1.5" X 1/4"
60°
11.00"
0.50"
3.00"
4'-0"
PHASE I
3-D VIEW A
ANGLE STAKE
1.5" X 1.5" X 1/4"
45°
6.00"
0.50"
3.00"
4'-0"
PHASE I
3-D VIEW B
ELEVATION A
SCALE: 1/4" = 1'-0"
ELEVATION B
SCALE: 1/4" = 1'-0"
C-102.00



CALENDAR

of the

Board of Estimate

The City of New York

THURSDAY, OCTOBER 9, 1986

MEETING at 10:30 A.M.

in the

CITY HALL

Borough of Manhattan

(Volume No. 5)

Prepared by Miss Jacqueline Galory, Calendar Clerk, under the direction of Theodore H. Meekins, Secretary, Board of Estimate

SAVE WATER

by the Bureau of Highways. The proposed lampposts are identical in design to the lampposts now in Central Park and Battery Park. They will have a 175 watt metal halide lamp and will be operated by time clock from dusk to 1:00 a.m. The 8 existing city street lamps along 23rd Street between 5th and 6th Avenue provide ample illumination allowing the decorative lamps to be turned off at 1 a.m.

The 9 lampposts are 13 feet high and are placed along the street side of the sidewalk at an interval of approximately 22 feet. Their placement will not conflict with the existing street lights. Because the sidewalk is 17'5" wide, the posts will not interfere with pedestrian use of the sidewalk.

Community Board No. 5 voted in favor of the application.

At the public hearing held by the City Planning Commission on August 6, 1986, there were no speakers.

The City Planning Commission finds the proposal to be in the public interest and has approved the grant of a revocable consent.

NOTE: Pursuant to Section 197-c of the New York City Charter, the Board of Estimate shall hold a public hearing and take final action on this matter on or before November 1, 1986.

Close the hearing.

Resolution for adoption.

No. 47

R-5477, 5812

PUBLIC HEARING on the petition of the Brooklyn Historic Railway Association for consent to maintain and use an abandoned railroad tunnel in Atlantic Avenue from east of Columbia Street to west of Boerum Place, together with an existing manhole, and to construct, maintain and use entrances and ventilators, Borough of Brooklyn.

On September 25, 1986 (Cal. No. 187), the Board of Estimate set October 9, 1986 as the date for a public hearing on the petition.

NOTICE of this hearing has been duly advertised in The City Record, as required by law.

REPORT of the Director of Franchises, dated September 26, 1986, stating that the tunnel will be used as a museum and exhibition space.

The Department of Environmental Protection, Bureau of Water Supply and Bureau of Sewers, the New York City Department of Transportation, the Bureau of Electrical Control and the Fire Department have advised the Bureau of Franchises that they have no objections to the petition.

The Bureau of Franchises has no objections to offer, and as the administrative departments of City government having jurisdiction find none, it is recommended that the consent be granted, only during the pleasure of the Board, revocable at any time, but in no event to extend beyond a term of ten years from the date of the approval of the consent by His Honor, the Mayor.

Compensation—Five percent of gross receipts, but not less than $2,000 per annum.

Security Deposit—$2,000.

Insurance—The grantee shall maintain insurance coverage in the minimum amount of $1,000,000 for bodily injury and property damage, until commencement of construction. Thereafter, in the minimum amounts of $5,000,000 for bodily injury, including death, and $1,000,000 for property damage.

REPORT of the City Planning Commission (C 850022 GFK), dated August 27, 1986, stating that the site is located between the Brooklyn Heights Historic District to the north, and the Cobble Hill Historic District to the south. Both communities are predominantly residential, with local commercial uses. The zoning of the site is R6 with C1-3 and C2-3 mapped within the R-6 District, and it is partly within the Special Atlantic Avenue District. Atlantic Avenue is low scale, predominantly commercial (restaurants, antique stores, local convenience shopping), along with some residential uses on the upper floors.

This railroad tunnel was completed in 1844, and is believed to be the first time that the cut and cover method of tunnel construction was used. Sixty years later the first New York City Subway Line was constructed in this way. The Long Island railroad was built on the surface of Atlantic Avenue, crossing through Queens and the then City of Brooklyn, until the tracks reached Boerum Place. Because of the relative steep grades and heavy surface traffic on Atlantic Avenue, the portion of the line from Boerum Place to Columbia Street was constructed under the street. The tunnel was used until it was abandoned and sealed up in 1861. In August, 1980, the current President of the Brooklyn Historic Railway Association rediscovered this tunnel. The abandoned tunnel is 2,517 feet in length, of which approximately 1,500 feet is open for use. The tunnel, of brick construction, is 21 feet in width and 17 feet in height.

The Atlantic Avenue tunnel would be operated by the Brooklyn Historic Railway Association as a non-profit museum, with exhibition space for transportation and historical subjects. An electric trolley would be used in the tunnel, moving passengers along tracks from Court Street to Hicks Street and back.

Entrance will be from a subway type kiosk on the northeast corner of Atlantic Avenue and Court Street. There will be an emergency exit at the southwest corner of Atlantic Avenue and Hicks Street. The tunnel will be vented mechanically through three capped air shafts located on Atlantic Avenue, which will lead to six air vents, three on the south side of Atlantic Avenue and three on the north side.

The vents will be approximately twelve feet high and will be located in the sidewalk.

The rediscovery of the long abandoned Long Island Railroad tunnel under Atlantic Avenue is a significant event in the history of Brooklyn and of railroad technology. The Long Island Railroad was originally constructed to provide a part of a Boston to New York link, emanating from Boston by rail, crossing Long Island Sound by steamboat, and then traversing Long Island by the L.I.R.R. to its western tip at Columbia Street near the Brooklyn waterfront. From here passengers could take a ferry to South Ferry, in Manhattan. The tunnel was used by steam trains until 1861, when it was abandoned by the Railroad and sealed. In that year the L.I.R.R. moved its western terminus to Hunter's Point in Queens, where passengers could take a ferry to Manhattan. By that time the New York, New Haven and Hartford Railroad had been constructed and the Boston to New York link by way of Long Island was abandoned, with the Long Island Railroad becoming a commuter railroad for Long Island, which it remains today. The Atlantic Avenue tunnel was gradually forgotten, but became famous in local Brooklyn lore.

The application was reviewed by the Department of Environmental Protection and the Department of City Planning pursuant to the New York State Environmental Quality Review Act and the New York City Environmental Quality Review regulations. A Conditional Negative Declaration was issued on February 20, 1986. The Conditions require archaeological investigation of the site of the proposed project prior to commencement of any preconstruction or construction work taking place on the site.

Brooklyn Community Boards Nos. 2 and 6 and the Brooklyn Borough Board voted in favor of the application.

At the public hearing held by the City Planning Commission on August 6, 1986 two speakers, including the applicant, appeared in favor of the application. The speakers said this project was important to the history of transportation in Brooklyn and the economic development of downtown Brooklyn.

Downtown Brooklyn is currently experiencing an increase in development activity, including a number of large development projects such a Atlantic Terminal, Brooklyn Center, and Metrotech and others. This tunnel is located near these projects, and it is expected to contribute to the overall increase of the economic and cultural development of this area. The tunnel will also be used as a transportation museum. Exhibits will show the history of transportation and of the old City of Brooklyn. The Brooklyn Historic Railway Association will be placing an 1890's vintage electrically operated trolley in the tunnel, moving visitors past the educational exhibits as the trolley moves on tracks from one end of the tunnel to the other, and back again. This tunnel will be a unique educational center for the residents and visitors to New York City.

The funding of the tunnel opening, kiosk, and the exhibits is expected to be provided by the Atlantic Avenue Association Local Development Corporation. The applicant has indicated that once this revocable consent is granted, the applicant, the Brooklyn Historic Railway Association, will ask the Board of Estimate, Bureau of Franchises, to include the Atlantic Avenue Association Local Development Corporation on the revocable consent. The applicant will also be required by the Bureau of Franchises to post the appropriate insurance for liability against personal injury and property damage. The New York City Department of Transportation will require the applicant to post a bond so that if the proposed construction work is not complete, the sidewalk and streets will be restored to their prior condition, and the tunnel would be bulkheaded and backfilled, as it presently is.

The City Planning Commission has approved the grant of a revocable consent for a period of fifty years to use and maintain an abandoned railroad tunnel in Atlantic Avenue from east of Columbia Street to west of Boerum Place, including construction, operation and maintenance of necessary public entrances, ventilators and facilities for the accommodation of the public, for use as a museum and exhibition space.

NOTE: Pursuant to Section 197-c of the New York City Charter, the Board of Estimate shall hold a public hearing and take final action on this matter on or before November 1, 1986.

Close the hearing.

Resolution for adoption.

Matters Laid Over

No. 48

R-9318

IN THE MATTER OF a

COMMUNICATION dated May 16, 1986, from the Acting Corporation Counsel, transmitting resolution and Supplemental Agreement and stating that the Board at its meeting on September 18, 1980 (Cal. No. 53-B), adopted Map No. 11962 showing the elimination, discontinuing and closing of portions of Caroll and Schofield Streets and Fordham Place, in the Borough of The Bronx.

The Board at its meeting of May 26, 1983 (Cal. No. 511), accepted an agreement between City Island Boatyard Limited Partnership (the applicant) and the City of New York relating to said map change.

This office has been informed by the Topographical Bureau of the Office of the President, Borough of The Bronx, that said map contains technical and mathematical errors. Said bureau prepared a revised map correcting such errors and submitted same to this office for submission to the Board.

LMW Engineering Group, LLC WWW.LMW-ENG.COM

2539 Brunswick Ave. Linden, NJ, 07036 Tel.(908) 862-7600 Fax(908) 862-8998

March 25, 2009

BROOKLYN HISTORIC RAILWAY ASSOCIATION
599 E 7th Street, Suite 5A
Brooklyn, NY 11218

ATTN.: Robert Diamond, President

RE: Atlantic Avenue Tunnel,
between Boerum Place and Columbia Street

SUBJECT: Structural Integrity Evaluation

Dear Mr. Diamond;

Pursuant to your request, we have performed an evaluation of the structural integrity of the referenced tunnel structure, based on visual inspection tour of the tunnel site, and review of reports of previews evaluations performed by others. This letter-report presents the results of our evaluation.

The inspection tour of the tunnel was performed by our senior engineer, Mr. Tony Onyeagoro, P.E., in the afternoon hours of Wednesday, March 25, 2009, assisted by one of your associates. Access and egress to the site were through a manhole located at the middle of the roadway, intersection of Atlantic Avenue and Court Street, Borough of Brooklyn. Visibility in the tunnel was generally subdued, but details of the structural elements were clearly observable using a flash light. Select, typical portions of the structure details were captured using flash-enabled *Canon PowerShot A540* camera.

The tunnel structure consists of a masonry block arched dome upper section, supported on either side by a wall made of varying-size stone or rock quarry, embedded in a matrix of very strong grout mix. The composition of the structural elements is relatively consistent for the entire length of the tunnel. Evidence of removed rail lines and ballasts are observable through out the general grade of the tunnel, which is firm with no sign of moisture or subsidence. The general condition of the tunnel structural elements, relative to previous reports, is impressively devoid of any sign of deterioration. All masonry block units appear to be intact, with no visible loosening of joints. Similarly, there was no observable loss of filler materials within the walls' stone matrices.

Accordingly, in concurrence with the findings of previous evaluations, please be advised that:

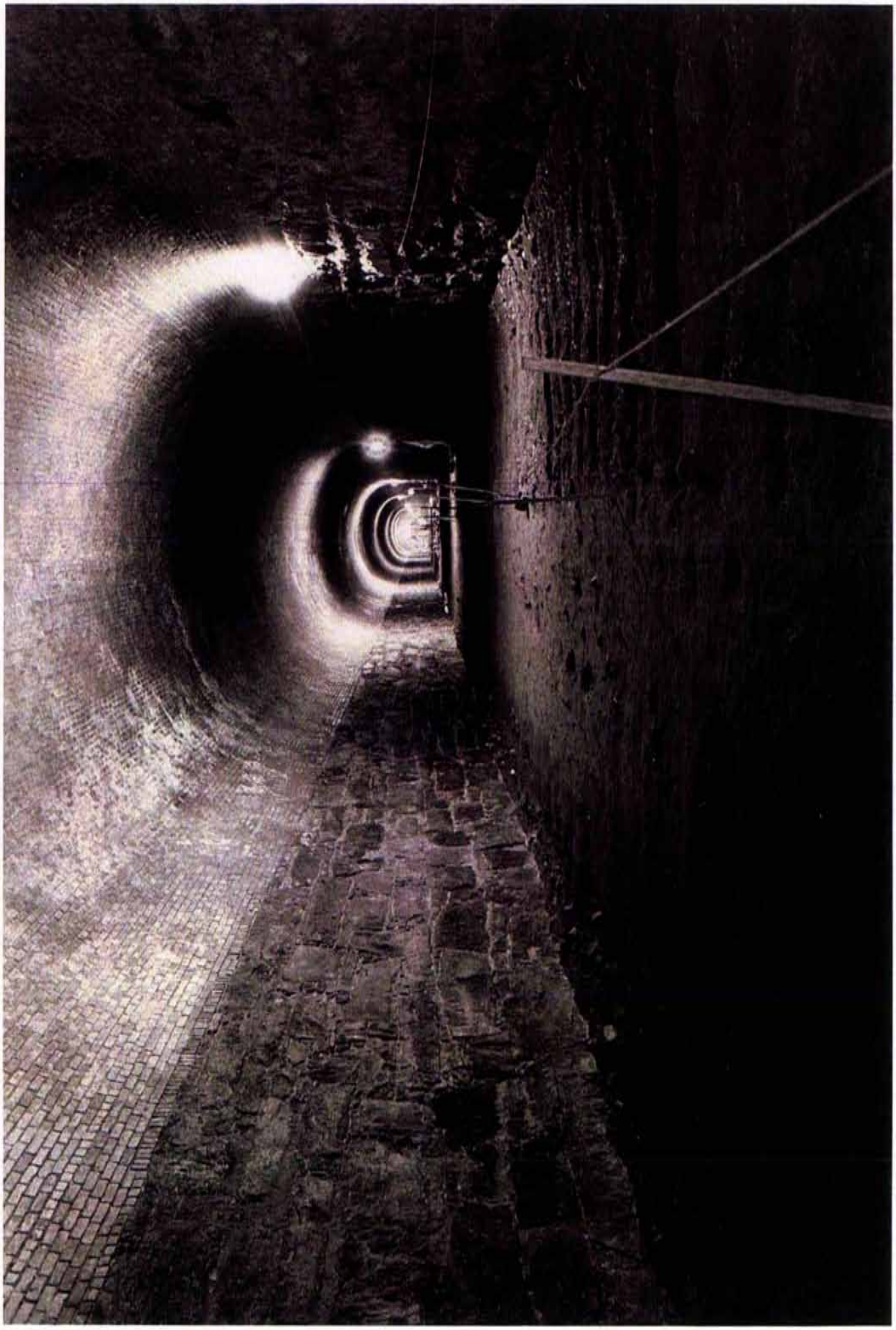
1. The tunnel structural members were inspected by our engineer.
2. The load carrying capacity of the tunnel is sufficient to support the anticipated loading (overburden and live load).
3. The non-load carrying members are secure.
4. The structural integrity of the tunnel is sound and has not been compromised by aging.

5. The tunnel can be considered safe under its current use for visitors and tourist attraction.
6. There is no evidence that any form of maintenance or repair work is necessary at this stage.
7. The tunnel can be safely, with relatively minimum rehabilitation effort, mostly esthetic, be utilized as a museum or similar facility.
8. In summary, the tunnel, as inspected by us, is a safe and sound structure.

We appreciate the opportunity to provide this service for you, and look forward to continuing involvement in this extraordinarily noble venture. If you have any questions regarding this letter-report, please feel free to call us.

Very truly yours,
LMW ENGINEERING GROUP, LLC

Tony C. Onyeagoro, P.E.
Senior Project Engineer
NYS P.E. License # 063593



1968 BUILDING CODE
OF THE CITY OF NEW YORK

Plus Selected Rules of the Department of Buildings
LOCAL LAW NO. 76 Effective Dec. 6, 1968
INCLUDES AMENDMENTS To July 1, 2008

MICHAEL R. BLOOMBERG
MAYOR

ROBERT D. LiMANDRI
Commissioner

PREFACE

This revision brings the 1968 Building Code current to July 1, 2008.

When enacted by the City Council on October 22, 1968, the 1968 Building Code was hailed as a great improvement over the anachronistic 1938 Building Code and included what was then the latest thinking in building code science, incorporating advances in technology and construction that had been made following the Second World War. Over the years, the Council amended the 1968 Building Code to address certain changes as needed; however, the 1968 Building Code never enjoyed a complete overhaul, gradually falling behind and becoming increasingly outdated. By the turn of the 21st Century, the 1968 Building Code had become an antiquated, complicated tangle of provisions.

In 2003, the Department of Buildings began a multi-year effort to replace the 1968 Building Code, culminating with Mayor Michael R. Bloomberg's signing of Local Law 33 of 2007. The result was the 2008 New York City Construction Codes, which replaced the 1968 Building Code with a new set of codes that increases public safety, incorporates the latest in engineering and technology, and contains progressive ideas on sustainable development. Most importantly, the new Construction Codes must be thoroughly reviewed and updated every three years, ensuring that New York City's construction regulations never again become outdated.

While the 2008 New York City Constructions Codes will apply to all new buildings beginning July 1, 2009, the 1968 Building Code, and its predecessor from 1938, will continue to remain relevant for years to come. First, certain new buildings filed prior to July 1, 2009 will continue to be subject to the 1968 code. Additionally, provisions of the 1968 code will apply to most alterations to existing buildings. Lastly, buildings constructed in accordance with the 1968 code generally must maintain compliance with its provisions.

The flowchart that follows the editor's note illustrates the circumstances under which the 1968 code remains applicable for alteration projects.

Robert D. LiMandri
Commissioner

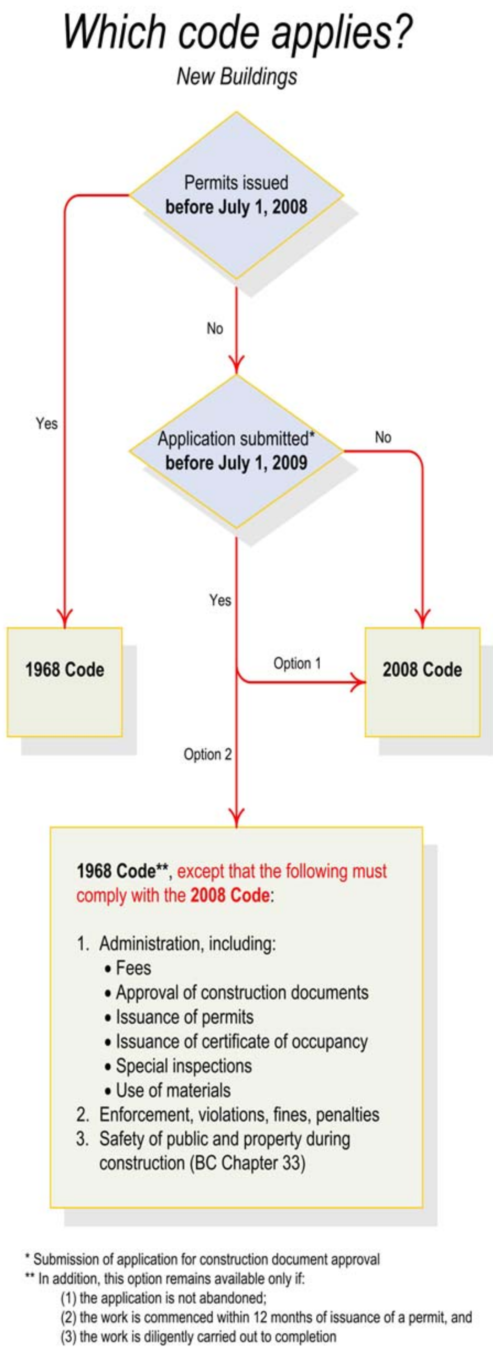
EDITOR'S NOTE:

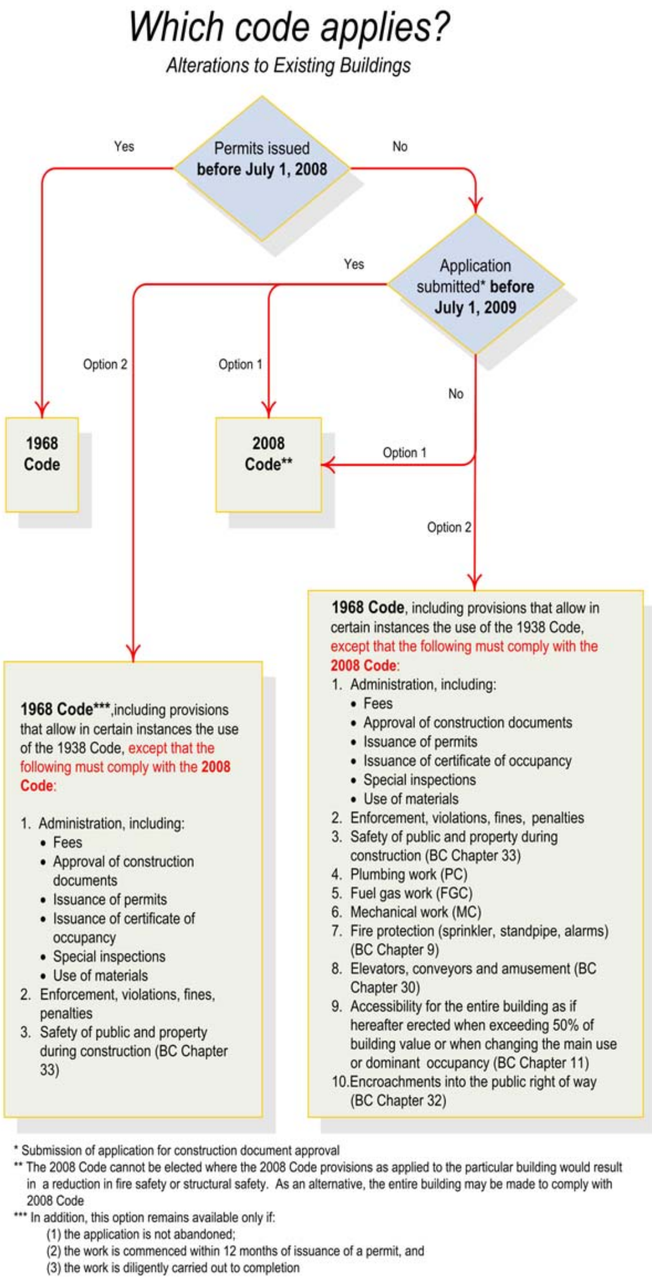
For further information, readers may wish to refer to the published series of the Department of Buildings' Directives and Memorandums, which are available at CityStore (NYC gov/citystore) or visit the Department of Buildings website at NYC.gov/buildings for the latest policy and procedure notices.

The legislature enacted, effective September 1, 1986, Chapter 839 of the state laws of 1986, which made certain technical corrections and changes to the recodification.

Within the Reference Standards Appendix of this volume are references to specific sections in the Building Code. Standards enacted prior to the recodification of the Building Code refer to the code using the old section numbers. Editorial notes pointing out discrepancies between the former code and the recodified version not specifically indicated as changes, or references to laws that have amended the code since recodification, are indicated with asterisks and corresponding footnotes in bold italics at the following the section. Obvious errors (such as misspellings) are corrected and noted within the text with a [*sic*] following the particular word.

Page Setup:
Where text is interrupted by a table, left column above the table will continue unto the right column above the table. Text below the table will follow the same pattern.


Which code applies?
New Buildings
Permits issued before July 1, 2008
No
Yes
Application submitted* before July 1, 2009
No
Yes
Option 1
1968 Code
2008 Code
Option 2
1968 Code**, except that the following must comply with the 2008 Code:
1. Administration, including:
• Fees
• Approval of construction documents
• Issuance of permits
• Issuance of certificate of occupancy
• Special inspections
• Use of materials
2. Enforcement, violations, fines, penalties
3. Safety of public and property during construction (BC Chapter 33)
* Submission of application for construction document approval
** In addition, this option remains available only if:
(1) the application is not abandoned;
(2) the work is commenced within 12 months of issuance of a permit, and
(3) the work is diligently carried out to completion


Which code applies?
Alterations to Existing Buildings
Permits issued before July 1, 2008
Yes
No
Application submitted* before July 1, 2009
Yes
No
Option 2
Option 1
Option 1
Option 2
1968 Code
2008 Code**
1968 Code***,including provisions that allow in certain instances the use of the 1938 Code, except that the following must comply with the 2008 Code:
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• Issuance of certificate of occupancy
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• Use of materials
2. Enforcement, violations, fines, penalties
3. Safety of public and property during construction (BC Chapter 33)
4. Plumbing work (PC)
5. Fuel gas work (FGC)
6. Mechanical work (MC)
7. Fire protection (sprinkler, standpipe, alarms) (BC Chapter 9)
8. Elevators, conveyors and amusement (BC Chapter 30)
9. Accessibility for the entire building as if hereafter erected when exceeding 50% of building value or when changing the main use or dominant occupancy (BC Chapter 11)
10.Encroachments into the public right of way (BC Chapter 32)
* Submission of application for construction document approval
** The 2008 Code cannot be elected where the 2008 Code provisions as applied to the particular building would result in a reduction in fire safety or structural safety. As an alternative, the entire building may be made to comply with 2008 Code
*** In addition, this option remains available only if:
(1) the application is not abandoned;
(2) the work is commenced within 12 months of issuance of a permit, and
(3) the work is diligently carried out to completion

~~SUBCHAPTER 3~~
~~BUILDING CONSTRUCTION~~

~~TABLE OF CONTENTS~~

~~*"C26" omitted from section numbers in this column.~~

~~**"26" omitted from section numbers in this column.~~

~~ARTICLE 1~~
~~GENERAL PROVISIONS~~

~~§[C26-10.0] 26-205 Matters covered.~~ ~~All matters affecting or relating to the construction, alteration, repair, demolition, removal, maintenance, occupancy and use of new and existing buildings in the city, including the erection, installation, alteration, repair, maintenance, use and operation of signs and service equipment used in or in connection therewith, are presumptively provided for in this subchapter and in the building code of the city. This subchapter does not presumptively provide for matters that are contained in the charter, the labor law, the multiple dwelling law, subchapters one and two of this chapter and chapter two of title twenty-seven, the zoning resolution, or the general city law; nor does this subchapter apply to structures on waterfront property used in conjunction with and in the furtherance of waterfront commerce and/or~~

~~navigation, or to bridges, tunnels or subways, or to structures appurtenant thereto.~~

~~§[C26-11.0] 26-206 All new work to conform.~~
~~All building work performed in the city on and after December sixth, nineteen hundred sixty-eight, shall conform to the provisions of this subchapter except that any work for which an application for a permit was filed prior to December sixth, nineteen hundred sixty-eight, and any work for which an application for a permit is filed within twelve months after the effective date of this subchapter, may be performed, at the option of the owner, in its entirety either in accordance with and subject to the requirements of this subchapter or in accordance with and subject to the requirements of the building laws and regulations previously in force in the city, provided that such work is commenced within twelve months after the date of issuance of a permit therefor and is continuously carried on to completion. This section shall not apply to the requirements of article ten of subchapter nineteen of title twenty-seven of the code which shall become effective December twenty-ninth, nineteen hundred sixty-nine.~~

~~ARTICLE 2 PERMITS~~

~~§[C26-20.0] 26-207 Requirement of permit.~~
~~It shall be unlawful, on and after December sixth, nineteen hundred sixty-eight, to construct, alter, repair, demolish, or remove any building in the city, or to erect, install, alter, repair, or use or operate any signs or service equipment in or in connection therewith, unless and until a written permit therefor shall have been issued by the commissioner in accordance with the requirements of this subchapter and the requirements of the building code, subject to such exceptions and exemptions as may be therein provided.~~

~~§[C26-21.0] 26-208 Approval of plans.~~
~~Whenever plans are required to be filed in connection with an application for a permit, as provided in the building code, all such plans shall be approved by the commissioner prior to the commencement of any work thereunder. All plans and all applications for approval thereof, shall comply with the requirements of the building code, subject to such exceptions and exemptions as may be therein provided; and all elevations on plans shall be referred to the United States coast and geodetic survey mean sea level datum of nineteen hundred twenty-nine, which is hereby established as the city datum.~~

~~§[C26-22.0] 26-209 Signature to permit.~~ ~~Every permit issued by the commissioner shall have his or her signature affixed thereto; but the commissioner may authorize any subordinate to affix such signature.~~

~~ARTICLE 3 FEES~~

~~§[C26-30.0] 26-210 Requirement of fee.~~ ~~No work permit or equipment use permit, when required by the provisions of the building code, shall be issued, and no plans or other statement describing building work, when required by the provisions of the building code, shall be approved, unless and until the required fee or fees therefor shall have been paid to the department in accordance with the provisions of this article, except that no fees shall be payable for work permits, equipment use permits or places of assembly permits if the owner of the building or property affected is a corporation or association organized and operated exclusively for religious, charitable or educational purposes, or for one or more such purposes, no part of the earnings of which enures to the benefits of any private shareholder or individual, and provided that the property affected is to be used exclusively by such corporation or association for one or more of such purposes.~~

~~*§[C26-31.0] 26-211 Fee for approval of plans and work permits.~~
~~The fees required to be paid under this section, and under section 26-212 of this article, are for the filing and processing of applications for the approval of plans or other statement describing building work, the filing and processing of permit applications, the issuance or renewal of work permits, the inspection of building work, and the issuance of certificates of occupancy. Fifty percent of the total fee for the work permit, but not less than one hundred dollars, or the total fee for the work permit where such fee is less than one hundred dollars, shall be paid by or on behalf of the owner or lessee of the building premises or property affected and shall accompany the first application for the approval of plans or other statement describing the building work when submitted prior to submission of the permit application; and the whole or remainder of the total fee shall be paid before the work permit may be issued. A fee of one hundred dollars shall be paid with an application for renewal of a work permit. Foundation work, plumbing work, sign and service equipment work are included in the term "building" whenever plans for such work are required to be filed with construction or alteration plans; otherwise, separate fees shall be applied and collected for such work in accordance with the provisions of this section and section 26-212 of this article.~~
*~~*Local Law 38-1990.~~*

~~*§[C26-32.0] 26-212 Computation of fees for work permits.~~
~~Fees for work permits shall be computed as hereinafter provided:~~
~~*1. New buildings~~**~~. The fees for permits to construct new buildings and open air stadia shall be computed as follows:~~
~~(a) Except as otherwise provided in paragraph (b),~~

Telephone 718-356-6245

Steven L. Carroll, P.E.
Consulting Engineer

226 Woodrow Road
Staten Island, New York 10312

February 6, 1985

Mr. Robert Diamond
Brooklyn Historical Railway Association
599 East 7th Street
Brooklyn, New York 11218

Dear Robert,

Enclosed is a summary of my cost estimate with the appropriate backup calculations and references for all items of construction concerning the Atlantic Avenue Tunnel Project.

I can be reached at the above address and telephone number if any questions arise or if my professional services are again needed. Good luck on this exciting project.

Sincerely yours,

Steven L. Carroll, P.E.
Steven L. Carroll, P.E.

SLC:flc
Enc.

cc: S. Scialabba

<u>Summary of Estimate</u>

Mobilization	$	15,000
Excavation	$	277,531
Concrete	$	106,883
Tunnel Work	$	116,210
Restorations	$	17,328
Removals	$	14,050
Misc. Metal Work	$	38,484
Moisture Protection	$	6,667
Mechanical	$	96,791
Electrical	$	48,000
Utility Protection	$	128,000
Communications	$	4,000
Miscellaneous	$	8,000
Borings and Test Pits	$	3,446
Bond @ 1%	$	8,804
Contingency @ 20%	$	176,078
Adm. and Engineering Fees	$	125,000
Total Cost of Project =	$1,190,272	
SAY	$1.2 Million	

Note that the entrance cost, which is included above, but consists of a variety of items, is estimated as follows:

Court St. Entrance, $389,000

Hicks St. Entrance, $352,000

STATE OF NEW YORK
STEVEN L CARROLL
052425
LICENSED PROFESSIONAL ENGINEER

Summary of Estimate

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CITY OF NEW YORK
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF WATER SUPPLY
1250 BROADWAY, NEW YORK, N.Y. 10001 (212) 971-6796

JOSEPH T. McGOUGH, JR.
Commissioner

JOSEPH P. CONWAY, P.E., Director
Assistant Commissioner

September 13, 1984

Mr. Morris Tarshis, Director
Bureau of Franchises
Board of Estimate
Municipal Building, Room 1307
New York, New York 10007

Re: Proposed Entrances to Railroad Tunnel
on Atlantic Avenue, Borough of Brooklyn.

Dear Sir:

This is in response to your letter dated June 22, 1984 submitting a petition on the above subject. The Bureau was to review the petition to see if there were any objections to maintain and use an abandoned railroad tunnel, including the construction of entrances and facilities under, along and across Atlantic Avenue from east of Court Street to Hicks Street, Borough of Brooklyn.

The Bureau does have objections to these new entrances as shown on the plans. As proposed the petitioner would be required to replace sections of the sixteen (16) inch low pressure main on Court Street; the eight(8) inch low pressure main, the twelve (12) inch high pressure fire main, the twenty (20) inch low pressure main and finally the forty-eight (48) inch trunk main all crossing the proposed entrance at Atlantic Avenue. The cost of these replacements would be approximately one-hundred thousand ($100,000) dollars.

Therefore at Court Street it is suggested that the proposed entrance be placed along the south sidewalk of Atlantic Avenue east of Court Street. This would reduce the water mains to be replaced to sections of a twenty (20) and twelve (12) inch low pressure mains which approximately would cost sixteen thousand ($16,000) dollars.

At Hicks Street the new entrance would require the replacement of two (2) twenty (20) inch high pressure fire mains and one (1) twelve (12) inch low pressure main. The replacement costs of these would be eighteen thousand ($18,000) dollars. The south-west corner site for the proposed entrance does minimize the water main replacement.

As far as the proposed use of the manhole at Court Street this Bureau must object since there is a sixteen (16) inch high pressure water main exposed which would be in danger of being damaged. Therefore this manhole shall have to be removed and the area below backfilled to protect this main.

If the proposal is to be done this Bureau would require a bond to be posted for the replacement water main work. If the proposal is done as the petitioner decribes in his drawing the bond would be one-hundred eighteen thousand dollars ($100,000 for Court Street plus $18,000 for Hicks Street). If the petitioner changes the Court Street location as suggested to the south side of Atlantic Avenue the bond would be thirty-four thousand dollars (Court Street $16,000 plus Hicks Street $18,000).

All water main work shall be done under the inspection of Bureau inspectors after plans have been approved by the Construction Division of the Bureau.

Very truly yours,

Martin E. Engelhardt

MARTIN E. ENGELHARDT, P.E.
Chief, Planning & Programs
Bureau of Water Supply

GDeF/lb

bcc: Engelhardt, Dorf, Kushner, Kass, Brooklyn Borough Office
w/original submission

Schrader

The City of New York

FIRE DEPARTMENT

250 LIVINGSTON STREET BROOKLYN, N.Y. 11201-5884

BUREAU OF FIRE PREVENTION

BOARD OF ESTIMATE
BUREAU OF FRANCHISES
RECEIVED

109193 SP 26 84

NUMBER
ASSIGNED TO:
CHARNG-SHYONG WU

September 25, 1984

Mr. Morris Tarshis
Director Bureau of Franchises
Room 1307
Municipal Building
One Centre Street
New York, N.Y. 10007

Subject: Bureau of Franchise No. 108062

Dear Mr. Tarshis:

The Fire Department has reviewed the tentative proposal made by the Brooklyn Historic Railroad Association relative to the use of the abandoned railroad tunnel under Atlantic Avenue running from a point West of Boerum Place to a point East of Columbia Street, borough of Brooklyn.

This department will not oppose the project, provided that the safety of the public is paramount. We have discussed with Mr. Robert Diamond, President of the Brooklyn Historic Railroad Association, the requirements essential for public safety. These requirements include the submission of a Fire Protection Plan through the Department of Building from which the Fire Department will receive a copy for review and approval. We have outlined to Mr. Diamond the necessity for automatic sprinklers, a local alarm system, emergency lighting, standpipe, smoke and gas detectors, and forced ventilation system with proper controls and safeguards under fire conditions. We have also indicated the need for additional exit facilities suitable for the use of the public and in accordance with law.

Mr. Diamond has assured this department that he will meet the above requirements and, if possible, exceed them. Mr. Diamond will have a registered architect submit the required building and Fire Protection Plans through the proper channels outlined above. When suitable plans have been submitted and any recommendations for change have been complied with in the interest of public safety, the Fire Department will approve this project.

Very truly yours,

Robert E. Manson

Robert E. Manson
Deputy Assistant Chief
Technology Management
Bureau of Fire Prevention

REM:MJB:mr

CITY OF NEW YORK
DEPARTMENT OF ENVIRONMENTAL PROTECTION
BUREAU OF SEWERS
40 WORTH STREET, NEW YORK, N.Y. 10013 (212) 566-2104/5

JOSEPH T. McGOUGH, JR.
Commissioner

AUG 23 1984

JOHN L. DiMARTINO, P.E., Director
Assistant Commissioner

Morris Tarshis, Director
Bureau of Franchises
Board of Estimate
Room 1307, Municipal Building
New York, NY 10007

Re: Petition by: The Brooklyn Historic Railway Association, Brooklyn, K235

Dear Mr. Tarshis:

This is in reply to your letter dated 22 June 1984 which referred to a petition by The Brooklyn Historic Railway Association requesting consent to maintain, and use an abandoned railroad tunnel, including the construction of an entrance and facilities to accommodate the public, under, along and across Atlantic Avenue from east of Court Street to Hicks Street, Borough of Brooklyn.

Please be advised that the Bureau of Sewers has no objection to the petitioner's request. This approval is predicated upon a similar favorable response from the Bureau of Water Supply which is required to comment separately.

Approval by the Department of Environmental Protection is valid only when approvals have been conveyed to your office by both the Bureaus of Water Supply and Sewers.

Very truly yours,

FRANK OLIVERI, P.E.
Acting Director
Bureau of Sewers

CITY OF NEW YORK
DEPARTMENT OF GENERAL SERVICES
DIVISION OF PUBLIC STRUCTURES
MUNICIPAL BUILDING
16TH FLOOR
NEW YORK, N.Y. 10007

ROBERT M. LITKE
COMMISSIONER

GREGORY JOHNSON
DEPUTY COMMISSIONER

September 12, 1984

Re: BROOKLYN HISTORIC RAILWAY ASSOCIATION
Petition dated June 18, 1984 to the
BOARD OF ESTIMATE for consent to
maintain and use an abandoned railroad
tunnel, including the construction of an
entrance and facilities to accommodate
the public under; along and across
Atlantic Avenue from east of Court Street
to Hicks Street
Bureau of Franchises #108062
Borough of Brooklyn

Mr. Morris Tarshis
Director.
Bureau of Franchises
1307 Municipal Building
1 Centre Street
New York, N.Y. 10007

Dear Mr. Tarshis:

This is in reply to your June 22, 1984 letter regarding the above matter.

Please be advised that we have no objections to the above consent.

Very truly yours,

M Burrell

Martin Burrell, P.E.
Director
Bureau of Electrical Control

HT/EC:341/ip

BOARD OF ESTIMATE
BUREAU OF FRANCHISES
RECEIVED

109076 SP 14 84

NUMBER
ASSIGNED TO: CHARNG-SHYONG WU

1883 BROOKLYN BRIDGE 1983

CITY OF NEW YORK
DEPARTMENT OF TRANSPORTATION

OFFICE OF THE COMMISSIONER
40 WORTH STREET • NEW YORK, N.Y. 10013

ANTHONY R. AMERUSO, P.E.
COMMISSIONER

BOARD OF ESTIMATE
BUREAU OF FRANCHISES
RECEIVED

OCT 1 1984

BK-10DM-3S-E-600 OC 15 84

CHARNG-SHYONG WU

Honorable Morris Tarshis
Director of Franchises
Board of Estimate
Municipal Building
New York, New York 10007

Dear Mr Tarshis:

Regarding the petition to the Board of Estimate from The Brooklyn Historic Railway Association dated June 13, 1984 requesting consent to construct, maintain and use an abandoned railroad tunnel, including the construction of an entrance and facilities to accommadate the public, under, along and across Atlantic Avenue from East of Court Street to Hicks Street, in the Borough of Brooklyn, please be advised that the Department of Transportation has no objection to the petition provided the following conditions are observed:

1) Permits are secured from the Brooklyn Borough Office before starting work.

2) The applicant will restore any existing curb, sidewalk or roadway damaged during construction in accordance with Bureau of Highway Operations Standard Specifications.

3) Within thirty (30) days of completion of construction the petitioner shall submit one set of certified revised "as built drawings" and microfiche card of drawings and related correspondence. Certification to be made by a licensed P.E.

4) The petitioner shall notify utility companies and agencies having existing underground facilities in the proposed construction area for their review and approval.

5) The applicant shall comply with applicable sections of Industrial Code Rule 53 of the State of New York (construction, Excavation and Demolition Operations at or near underground facilities).

6) Inspection Reports must be filed with the Bureau of Highways-Operations Mangement at five year intervals certifying the following:

   A) The structural members were inspected by the engineer within the last six (6) months.

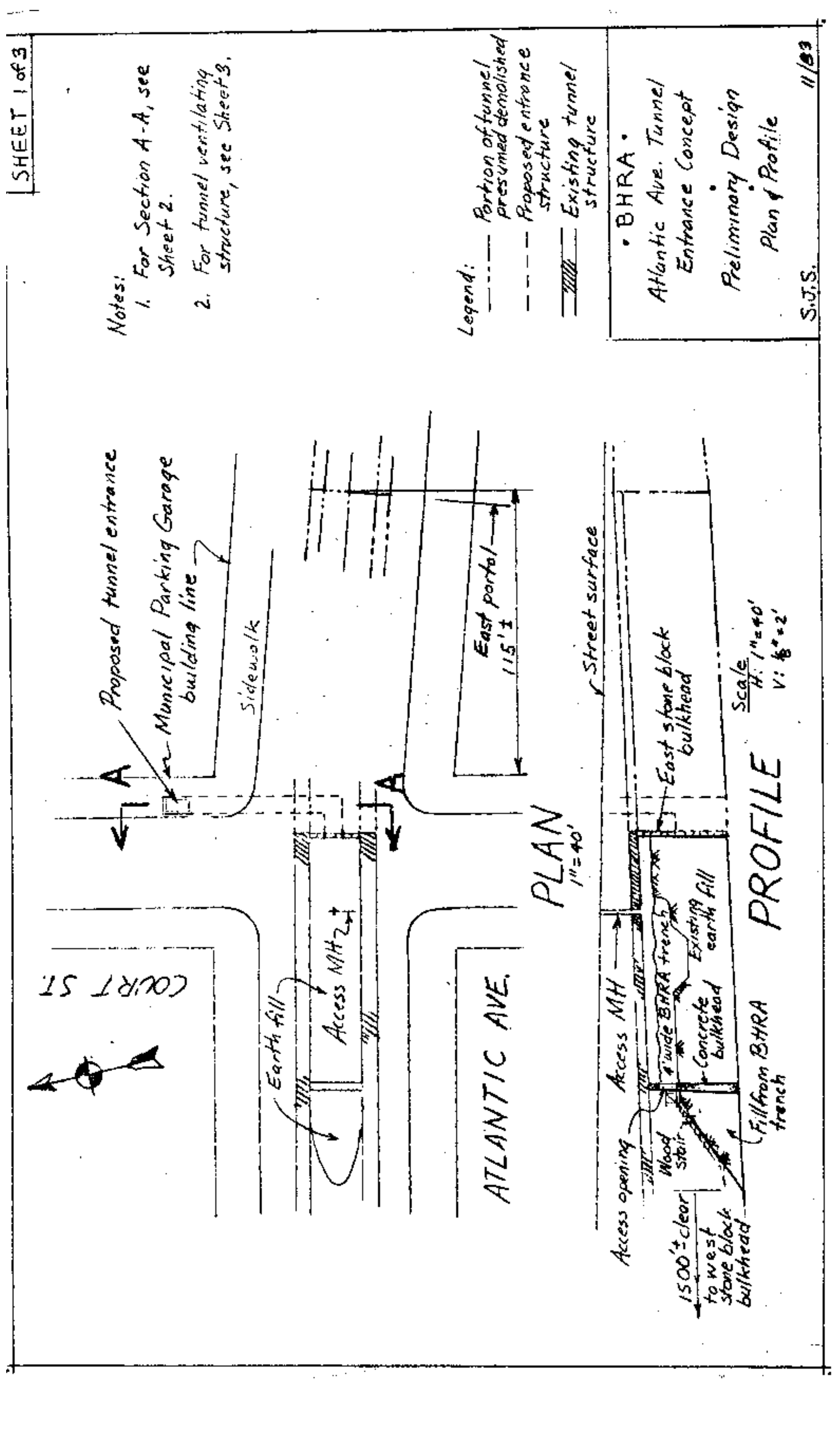
   B) The load carrying capacity is sufficient to support the anticipated loading.

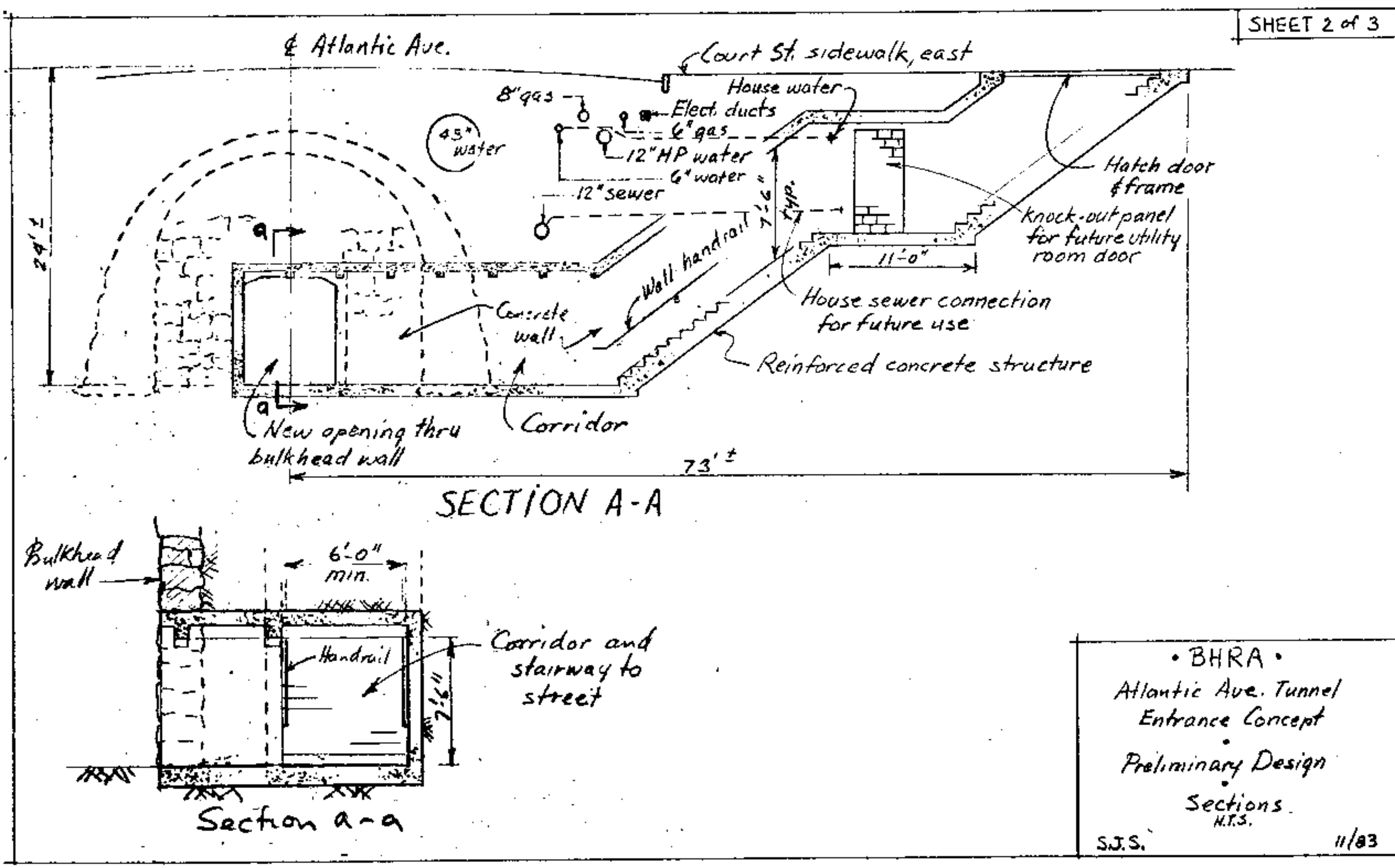
   C) The non-load carrying members have been inspected and are secure.

   D) In addition, a microfiche card of above mentioned "as built drawings" and of related correspondence shall be submitted by the petitioner.

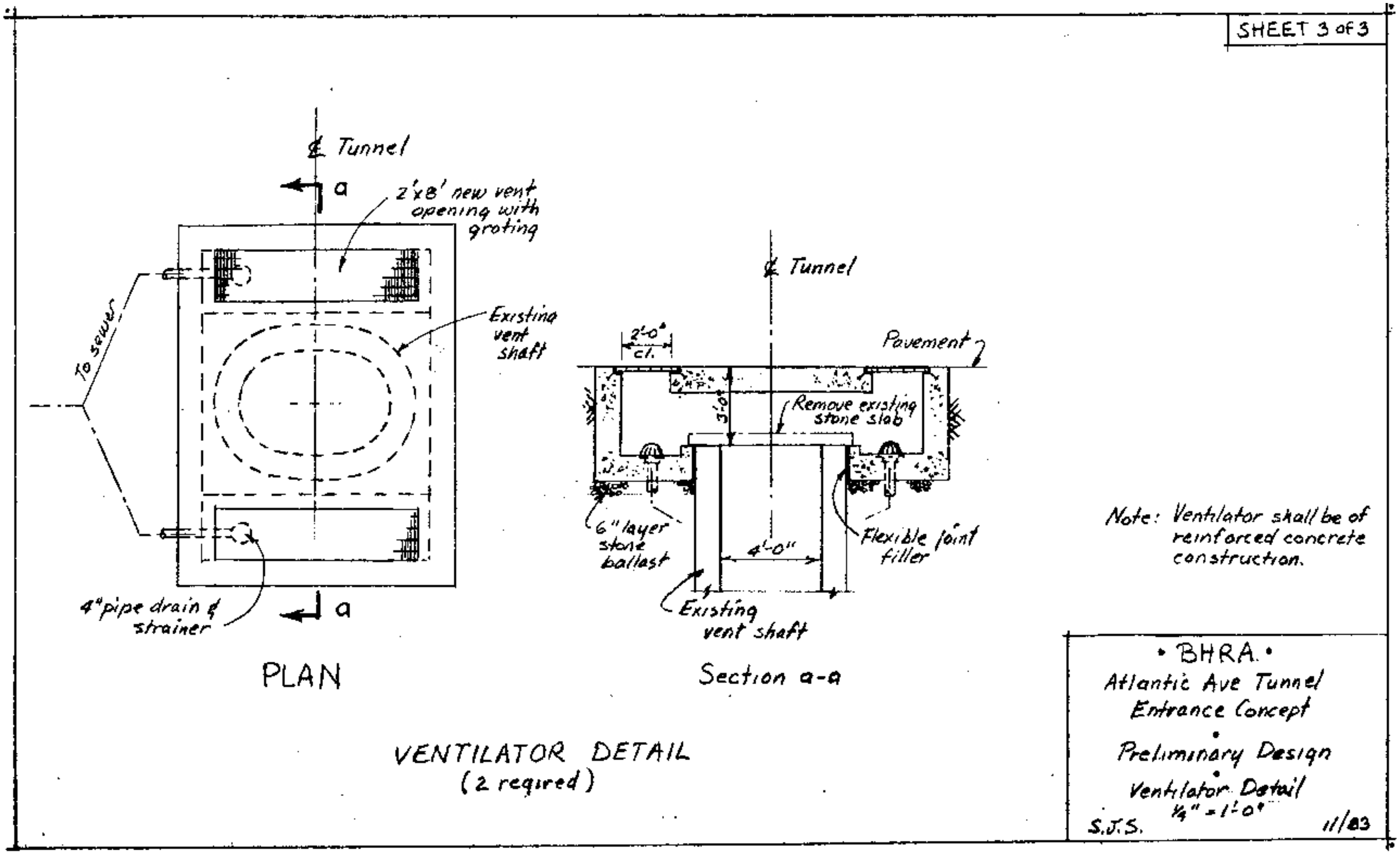
Very truly yours,

Anthony R. Ameruso, P.E.
Commissioner


SHEET 1 of 3
Notes:
1. For Section A-A, see Sheet 2.
2. For tunnel ventilating structure, see Sheet 3.
Legend:
Portion of tunnel presumed demolished
Proposed entrance structure
Existing tunnel structure
• BHRA •
Atlantic Ave. Tunnel Entrance Concept
Preliminary Design
Plan & Profile
S.J.S.
11/83
Proposed tunnel entrance
Municipal Parking Garage building line
Sidewalk
East portal 115'±
COURT ST
ATLANTIC AVE.
Earth fill
Access MH
PLAN
1"=40'
A
A
Street surface
East stone block bulkhead
Scale
H: 1"=40'
V: 1/8"=2'
PROFILE
Access MH
4' wide BHRA trench
Existing earth fill
Concrete bulkhead
Fill from BHRA trench
Access opening
Wood stair
1500'± clear to west stone block bulkhead



SHEET 2 of 3
℄ Atlantic Ave.
Court St. sidewalk, east
House water
8"gas
Elect. ducts
6"gas
45" water
12"HP water
6"water
12"sewer
Hatch door & frame
Knock-out panel for future utility room door
Wall handrail
7'-6" typ.
11'-0"
Concrete wall
House sewer connection for future use
Reinforced concrete structure
New opening thru bulkhead wall
Corridor
24'±
73'±
SECTION A-A
Bulkhead wall
6'-0" min.
Handrail
Corridor and stairway to street
7'-6"
Section a-a
• BHRA •
Atlantic Ave. Tunnel Entrance Concept
Preliminary Design
Sections
N.T.S.
S.J.S.
11/83


SHEET 3 of 3
℄ Tunnel
a
2'x8' new vent opening with grating
Existing vent shaft
To sewer
4" pipe drain & strainer
PLAN
℄ Tunnel
2'-0" c.l.
Pavement
3'-0"
Remove existing stone slab
6" layer stone ballast
4'-0"
Flexible joint filler
Existing vent shaft
Section a-a
VENTILATOR DETAIL
(2 reqired)
Note: Ventilator shall be of reinforced concrete construction.
• BHRA •
Atlantic Ave Tunnel
Entrance Concept
Preliminary Design
Ventilator Detail
1/4" = 1'-0"
S.J.S.
11/83

Item		Description	Unit	Quantity	Price	Amount
1.		Mobilization	L.S.	—	—	$15,000
2.	Excavation	Sheeting	Sq. ft.	7,260	28.51	$206,98
3.		Decking Timber	B.M.	22,303	1.59	$35,46
		Steel	lbs	9,000	.96	$8,640
4.		Earth Excavation	cu yd	1,476	7.55	$11,147
5.		Excav. of Exist Tunnel Fill	cu yd	195	49	$9,575
6.		Stone Ballast	cu yd	56	27.80	$1,577
7.	Concrete	Backfill	cu yd	650	6.38	$4,147
8.		Concrete for Entrances	cu yd	255	381	$97,155
9.		Concrete for Vents	cu yd	28	276	$7,728
10.		Steel Reinforcing	lbs	28,454	.65	Included
11.	Tunnel wk	Sleeves in Concrete	each	100	20	$2,000
12.		Tunnel Flooring	sq. ft.	10,000	2.00	$20,000
13.		Handrail	L.F.	1,000	16.21	$16,210
14.	Restorations	Railroad Track	L.F.	1,000	80	$80,000
15.		Saving Excav. Tunn. Fill	Stone	Unknown	5.00	unknown
16.		Record Stone Block Walls	sq. ft.	1,268	2.70	$3,424
17.		Entrance Sculpture	L.S.	2	5,000	$10,000
18.		Restoration of Sidewalk	sq. ft.	840	3.49	$2,932
19.		Restoration of Pavement	sq. yd.	134	7.25	$972
20.	Removals	Concrete Excavation	cu yd	36	183	$6,588
21.		Pavement Excavation	sq yd	215	4.90	$1,054
22.		Remove Stone Block Wall	cu. ft.	600	3.07	$1,842
23.		Remove Concrete Bulkhd	cu. ft.	1,512	3.02	$4,566
24.	Misc. Metal wk	Entrance Handrails	L.F.	160	34.99	$5,598
25.		Non slip Stair treads	L.F.	608	12.97	$7,886
26.		Entrance Hatch Doors	each	2	7,000	$14,000
27.		Vent Stacks @ Entrance	L.F.	56	89.30	$5,000
28.		Steel Ladders @ Vents	lbs	6000	1.00	$6,000
29.	W.P.	3 ply Waterproofing	Sq. ft.	1,692	1.69	$2,860
30.	Mechanical	4 ply Waterproofing	Sq. ft.	1,1692	2.25	$3,807
31.		Fire Line Standpipes	L.F.	1,663	34	$56,542
32.		Exhaust Fans	each	3	4,083	$12,249
33.		Plumbing	L.S.	—	—	$28,000
34.	Electrical	Electrical a) lighting	L.S.	—	—	$48,000
		b) Emerg. Light				
		(included above) c) Clock outlets				
		d) Burg. Alarms				

Item		Description	Unit	Quantity	Price	Amount
35.	Utility protect	Replacement of Mains	L.S.	—	—	$118,000
36.		Maint. and Supp (Utilities	L.S.	—	—	$10,000
37.	Comm.	Public Address	L.S.	—	—	$3,000
38.		Telephone	L.S.	—	—	$1,000
39.	Misc.	Crane to Lower Trolley	L.S.	—	—	$1,000
40.		Refr., Souvenir, + Exhibit Stds	L.S.	—	—	$7,000
41.		Borings (4) + Test pits (8)	L.S.	—	—	$3,446
42.		Bond @ 1%	L.S.	—	—	$8,804
43.		Contingency (20%)	L.S.	—	—	$176,07
44.		Adm. and Engineering Fees	L.S.	—	—	$125,000
				TOTAL	=	$1,190,2
45		Exterminator	?			?

STATE OF NEW YORK
STEVEN L CARROLL
052425
LICENSED PROFESSIONAL ENGINEER

1

Costs

1982 Means

Steven L. Carroll
12/5/83

Concrete:

Bms - 2 cuyds
Roof - 27 cuyds

82 29 cuyds × \$345/cuyd × 1.15 × 1.2 = \$13,807 (NY fact escal)
3-275

82 Mat - 37 cuyds × \$190/cuyd × 1.15 × 1.2 = \$9,701
3-400

82 Walls - 46 cuyds × \$300/cuyd × 1.15 × 1.2 = \$19,044
3-427

Vent - 28 cuyds × \$200/cuyd × 1.15 × 1.2 = \$7,728

TOTAL = \$50,280

Sheeting:

33 3080 sq. ft. × \$22/sq ft. × 1.08 × 1.2 = \$87,817
3-40-980

Excavation:

29 609 cuyds (+54 cuyds) × \$1.98/cuyd × 1.08 × 1.2 = \$1,563 +\$139
3-025

hauling - heavy traffic
32 609 cuyds (+54 cuyds) × (1.3 × \$2.96)/cuyd × 1.08 × 1.2 = \$3,037 +\$269
3-050
+140

\$4,600 + \$408 = \$5,008

Backfilling:

27 264 cuyds × \$4.92/cuyd × 1.08 × 1.2 = \$1,683
3-200

Stone Ballast :

P.31 2.3-110 + 320 — 26 cuyds x $(1.5x^{\$})$ compaction $14.30/cuyd x 1.08 x 1.2 = $723

Pavement Removal :

P. 26 2.1-170. - P.25 — 95 sqyds x (3 x) ← congested site + small amt. $1.26/sqyd x 1.08 x 1.2 = $465

Concrete Removal :
(Street)

P. 25 2.1-030 + -039 — 16 cuyds x 3x $47/cuyd x 1.08 x 1.2 = $2,924

Roadway Decking :
(12"x12" Timbers)

P. 153 6.1-140 — 810 cuft. x LBF x $1.18/BF x 1.12 x 1.2 = $15,571
.0825

(12 WF 25#)

P. 131 2.1-151 — 4,250 lbs/2000 lbs x $1,475/ton x 1.08 x 1.2 = $4,062

$19,633

Removal of Concrete Bulkhead :

P. 25 2.1-010 — (756 cuft)/27 x $63/cuyd x 1.08 x 1.2 = $2,286

Removal of Stone wall :

P. 26 2.1-140 — 300 cu ft x $2.37/cu ft. x 1.08 x 1.2 = $921

Tunnel Flooring : (OMITT Calculations Below)
— See Pages 10 + 11 —

(4"x8")

P. 158 6.2-020 — 760 L.F. x $4.07/ft x 1.12 x 1.2 = $4,157

(plywood) 5/8"

P. 156-010 — 1200 sq ft. x $.71/sq ft x 1.12 x 1.2 = $1,145

$5,302

Reinforcement:

P.78 Mat - 4534 lbs / 2000 lbs × $915/ton × 1.18 × 1.2 = $2,93
3.2-060

P.78 Roof - 2,748 lbs / 2000 lbs × $840/ton × 1.18 × 1.2 = $1,634
3.2-040

P.77 Beams - 2975 lbs / 2000 lbs × $1,100/ton × 1.18 × 1.2 = $2,317
3.2-010

P.78 Walls - 3,142 lbs / 2000 lbs × $835/ton × 1.18 × 1.2 = $1,858
3.2-070

Total = $8,746

Restoration of Sidewalk:

(6")
P.49 concrete - 420 sq ft. × $2.37/sq ft. × 1.08 × 1.2 = $1,290
2.6-040
P.49 (4")
2.6-045 Stone - 420 sq ft × $.32/sq ft. × 1.08 × 1.2 = $174

$1,464

Restoration of Pavement:

P.47 67 sq yds × $5.60/sq yd × 1.08 × 1.2 = $486
2.6-010

Handrail:

P.138 80 ft. × $27/ft. × 1.08 × 1.2 = $2,799
5.4-240

Stair Treads:

(4" wide)
P.86 38 tr × 8 ft/tr × $9.40/ft. × 1.15 × 1.2 = $3,944
3.3-002

Recondition Stone Block wall:

P. 372 18.1-055 634 Sq ft. × $2.25/Sq ft. × 1.0 × 1.2 = $1,712

Excavating Tunnel fill:

Hand excavate-

P.30 195 cuyds × $30/cuyd × 1.08 × 1.2 = $7,582

2.3-140 + 150 Backhoe Rental -

P.8 1.5-020 $\underbrace{\text{1 Day/36 cuyds}}_{\text{out put of hand Excavators above (USE 6 Laborers) ∴ daily output = 36 cuyds}}$ × 195 cuyds × $5,650/mo × 1/30 days = $1,020

Labor (oper Eng + oiler) -

Inside cover 1 day/36 cuyds × 195 cuyds × $25.65/hr × 7hrs/1day = $973

Total = $9,575

---

3 & 4 ply water proofing:

P.172 7.1-070

3 ply 736 Sq ft. × $1.42/Sq ft. × .99 × 1.2 = $1,242

4 ply 736 Sq ft × $1.89/Sq ft. × .99 × 1.2 = $1,653

$2,895

Borings:

P. 24 2.1-080 2 × 50' × $9.45/ft. × 1.08 × 1.2 = $1,225

Test Pits:

P. 26 2.1-050 + 010 Avg 4 × $\frac{(3' \times 3' \times 6')}{27}$ × $48/cuyd × 1.08 × 1.2 = $498

Electrical Work:

$\$244{,}381 \times \dfrac{\$200{,}000 \text{ (Elect. work on Similar proj.)}}{3{,}000{,}000 \text{ (Gen Const. cost on Similar proj.)}} \cong \$16{,}000$

(Gen Const. Cost) This project

Plumbing Work:

$\$244{,}381 \times \dfrac{\$121{,}000 \;(\;\;\text{"}\;\;)}{\$3{,}000{,}000 \;(\;\;\text{"}\;\;)} \cong \$9{,}000$

USE \$25,000

Public Address:

R355
16.8-030 Microphone – 1x \$65 → \$65
" -040 speakers – 3x \$72 → \$216
" -100 Monitor Panel – 1x \$185 → \$185
" -140 Volume Control – 1x \$51 → \$51
" -160 amplifier – 1x \$925 → \$925
" -180 Cabinets – 1x \$525 → \$525

$\$1{,}967 \times 1.06 \times 1.2 = \$2{,}502$

USE \$3,000

(For total see Summary Sheet)

1982 Means
Reference for prices are in the "costs" section of these calculations

1/10/84 6
Steven L. Carroll

2nd Reference

Concrete - $42,552

Sheeting - $87,817

Excavation - $4,600

Backfilling - $1,683

Stone Ballast - $723

Pavement removal - $553

Concrete removal - $2,924

Roadway Decking - $19,633

Removal of concrete bulkhead - $2,286

Removal of Stone wall - $921

Restoration of Sidewalk - $1,464

Restoration of pavement - $486

Handrail - $2,799

Stair treads - $3944

3+4 ply waterproofing - $2,895

Borings - $1,225

Test pits – \$498

Electrical ≃ \$48,000

Plumbing ≃ \$29,000

Additional ~~30~~ 22 ft. of corridor –

Concrete

Mat – $\frac{1' \times 22' \times 11'}{27} \times$ \$190/cuyd $\times 1.15 \times 1.2 =$ \$2350

Bms – 4 Bms $\times \frac{9'' \times 7.5' \times 8''}{12 \times 27 \times 12} \times$ \$345/cuyd $\times 1.15 \times 1.$ = \$26

Roof – $\frac{1' \times 10' \times 22'}{27} \times$ \$345/cuyd $\times 1.15 \times 1.2 =$ \$3,874

Walls – $\frac{1' \times 8.25' \times 22' \times 2}{27} \times$ \$300/cuyd $\times 1.15 \times 1.2$ = \$556

Sheeting

32 ft. drive for 25 ft. excavation –

25 ft. × 22 ft. × 2 sides × \$22/sq ft. × 1.08 × 1.2 = \$31,363

Excavation

$\frac{10 \text{ ft.} \times 25 \text{ ft.} \times 22 \text{ ft.}}{27} \times$ (\$1.98 + 1.3 × \$2.96)/cuyd × 1.2 × 1.08 = \$1,539

Backfill

$\frac{15 ft. \times 10 ft. \times 22 ft.}{27} \times \$4.92/cuyd \times 1.08 \times 1.2 =$ \$ 779

Stone Ballast :

$\frac{6'' \times 10' \times 22'}{12 \times 27} \times \$14.30/cuyd \times 1.5 \times 1.08 \times 1.2 =$ \$ 113

Pavement Removal

$\frac{10' \times 22'}{9} \times \$1.26/cuyd \times 3 \times 1.08 \times 1.2 =$ \$ 120

Concrete Removal

$\frac{6'' \times 10' \times 22'}{12 \times 27} \times \$47/cuyd \times 1.08 \times 1.2 =$ \$ 248

Roadway Decking

Timber 2×12

$\frac{10' \times 22' \times 1 ft}{.0825 cu ft./B.F.} \times \$1.18/B.F. \times 1.12 \times 1.2 =$ \$ 4,229

2WF25

$\frac{2 Bms \times 10' \times 25 plf}{2000 lbs} \times \$1,475/ton \times 1.08 \times 1.2 =$ \$ 478

3 + 4 ply Waterproofing

10 ft. x 22 ft. x $1.42/sq.ft. x .99 x 1.2 = $371

(Total for 22 ft. of Additional Corridor)

= $51,300

(Total for Duplicate or 2nd Entrance) -

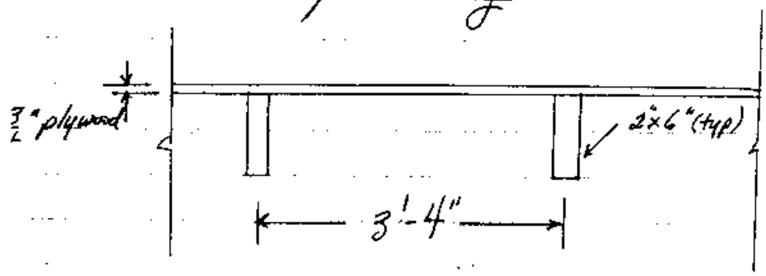
= $224,003

ToT (Entire 2nd Entrance) = $275,303

Tunnel Flooring

Delete the item "Tunnel Flooring" in the previous calculations in the "Costs" section - ($5,302) + 20% (cont.) = ($6,362)

add the following:



Means 1982 Platform 10 ft. wide x 1000 ft. long

2"x6"'s - 3'-4" o.c. or 4 in 10 ft.

4 x 1,000 ft. = 4,000 L.F. or B.F.

3/4" plywood

10 ft. x 1,000 ft. = 10,000 sq. ft.

(NY fact) (escal) to 1984

P. 152 $.90/BFt. x 4,000 BFt. x 1.12 x 1.2 = $4,838

6.L-410

P. 155 $.82/sq.ft. x 10,000 sq ft. x 1.12 x 1.2 = $11,021

6.1-030

Total for Tunnel flooring = $15,859
without cost of creosote
or fire retarder

Wood treatments :

(Material only) -

Fire Retardant -

P.154 2"×6", \$.150/B.F. × 4,000 B.F. × 1.12 × 1.2 = \$806
6.1-040
P.154 3/4" Ply, \$.18/Sq.ft. × 10,000 Sq.ft. × 1.12 × 1.2 = \$2,419
6.1-010

Fire Ret. TOT = \$3225

Creosote -

P.154 2"×6", \$ .15/B.F. × 4,000 B.F. × 1.12 × 1.2 = \$806
6.1-030

TOT. Treatment = \$4,031

TOT for Treated Tunnel Floor = \$19,890

Metal Railing (mild steel, economy)

P.138 \$12.55/ft. × 1,000 ft. × 1.076 × 1.2 = \$16,205
5.4-191

N.Y.C. Building Code
Standards for Natural Ventilation

(Article 12, Subarticle 1205.0)

Floor area:

Tunnel - 21 ft. × 1,667 ft. = 35,007 sq. ft.
Entrances - (6 ft. × 76.75 ft. + 8 ft. × 7.5 ft.) × 2
+ 7.5 ft. × 22 ft. = 1,206 sq. ft.

Total floor Area = 36,213 sq. ft.

paragraph C-26-1205.5 Min Ventilation area:

A_{min} = .05 × 36,213 sq. ft. = 1,811 sq. ft.

Para C26-1205.6 - $\frac{1}{2}$ of above area is permissable if mechanical means of ventilation is used:

∴ Min Ventilation area = $\frac{1,811 \text{ sq. ft.}}{2}$
= 906 sq. ft.

Area furnished:

Tunnel Vents = $3\pi ab$ (ellipse) = 3 Vents × π × 4 ft. × 6 ft.
= 226 sq. ft.
2 Entrance doors = 2 × 12.5 ft. × 8 ft. = 200 sq.

Para C26-1205.6 - Min Vent opening = 3 sq. ft.

∴ Install 4 Vents - 2ft. ϕ each
- Ductile Iron -

$A = \frac{\pi D^2}{4} = \frac{\pi (2 ft.)^2}{4} = 3.14$ sq ft. > 3 sq. ft.
O.K.

A (vents) = 4×3.14 sq. ft. = 12.6 sq. ft.

Total Vent. Area Furnished = 438.6 sq ft. > 906

N.G.

∴ Use Mechanical means as supplemen
Ventilation

Standards for Mechanical Ventilation

Article 12, Subarticle 1206.0

Vent. Index :
Para C26-1206.2 $\quad$ Max Occup. = $\frac{A_{min}}{V.I.} \times 200$

Max Occup = $\frac{906 \text{ sq ft.} \times 200}{301}$ = 601 person

Para C26-1206.3, table 12-2

Req'd Supply = 2 cfm/sq.ft

Q_{in} = 2 cfm/sq.ft. $\times$ 36,212 sq. ft. = 72,424 cfm

Req'd Exhaust = 1.5 cfm/sq ft. × 36,212 sq ft.
= 54,318 cfm

Q_{out} = 54,318 cfm req'd

furnished:

3 fans @ Q_{out} = 21,600 cfm each

Q_{out} furnished = 3 × 21,600 cfm = 64,800 cfm
> 54,318 cfm req'd

o.k.

Exhaust fans

21,600 CFM, 40 sqin damper

P. 327 3 fans × $3,250/fan × 1.047 × 1.2 = $12,250
57-730

Railroad Track

100lb rail
6" × 8" × 8'-6" wooden ties
6" of stone ballast

P. 65 $58.05/L.F. × 1000 ft. × 1.077 × 1.2 = $75,024
27

2nd distribution, add ⟶ $5,000

TOT. R.R. Track = $80,000

Utility connections

water and electric hook up - $1000 each

TOT = $2,000

Vent Stacks

P. 44 4 Vents × 14 ft./Vent × $59/ft. × 1.077 × 1.2 = $4270
2.5-149

plates, bolts, etc - Say $5,000

Sprinkler Requirements
(Art. 3)
occupancy classification - F-3

as per subarticle 307.0, para C26-307.4

construction group - I-A or I-B or
at least I-C
as per sub art - 314.0, paras C26-314.2, .3, .4

No Sprinkler Req'd as per

Article 4, table 4-1, Page 4-4

Fire Standpipe Requirements

(Article 17)

No. of Standpipes required - Subarticle 1702.C
para C26-1702.4

125 ft. of hose (max.)
20 ft. of water stream (min)

Total radius = 145 ft.

distance in both directions from standpipe
= 290 ft. between standpipes (MIN)

2 Entrances + tunnel = 1,751 ft.

No. of Std pipes Req'd = $\frac{1,751 \text{ ft.}}{290 \text{ ft./St Pipe}}$ = 6

<u>Size of Standpipe Req'd</u>
(article 17)

Subarticle 1702.0, para C26-1702.7, and table 17-1.

hieght < 150 ft. ∴ <u>Min ϕ = 4"</u>

Reference Standard RS-17
table RS 17-1-1

hieght < 115 ft.

∴ Use - 2 ½" hose + outlet valves, class A
pipe - Schedule 40 mild steel
fittings - steel (350 psi)
Valves - check or gate valves (150 psi)

<u>Design</u>

6 class A hoses, racks, etc
1,645 ft. of schedule 40 steel pipe (4"ϕ)
10 Steel tees (4"ϕ)
10 steel elbows (4"ϕ)
18 ft. of branch pipe 4"ϕ sched 40
7 - 4" steel valves

Pour 1 ft. × 1 ft. cradle (conc.) 1,600 long

Fire Standpipe

P.293 (1,645 + 18) ft. × $14.15 ft. × 1.047 × 1.2 = $29,56
15.1-191
P.293 10 × $50/tee × 1.047 × 1.2 = $ 628
15.1-480
P.293 10 × $35/elbow × 1.047 × 1.2 = $ 440
15.1-480
P.299 7 × $840/valve × 1.047 × 1.2 = $ 7,388
15.1-195
P.307 6 × $180/hose cabinet × 1.047 × 1.2 = $ 1,357
15.4-410
P.308 125 ft. of Hose × 2 × 6 × $1.80/ft.
15.4-238 × 1.047 × 1.2 = $3,392
P.82 1600 ft. (conc. cradle) × 1'×1' / 27 ft. × $170/cuyd
3.3-390
× 1.152 × 1.2 = $13,926

TOTAL = $ 56,696

Steven L. Carroll
12/5/83

Quantities

Concrete: TOTAL – 126 cu yds
(Incl. vent shaft)

Mat

1st Stair —
1' x 21' x 11' = 231
1st Landing —
1' x 10' x 11' = 110
2nd Stair —
1' x 18.6' x 11' = 205
2nd Landing —
1' x 32' x 11' = 352
Entrance —
1' x 8' x 11' = 88
986/27 ⟶ 37 cu yds

Roof

1st Stair —
1' x 6' x 10' = 60
1st Landing —
1' x 10' x 10' = 100
2nd Stair —
1' x 18.6' x 10' = 186
2nd Landing —
1' x 28' x 10' = 280
Entrance —
1' x 8' x 10' = 80
Drop — 2 x 10' x 1' = 20 726/27 ⟶ 27 cu yds

Beams – 8x18", 12" incl above, use 6" x 8"
19 bms x 6x8" x 8' = 51/27 ⟶ 2 cu yds
144"

Walls

1st Stair —
(14 1/2' x 12')/2 + 2' x 12' = 111
1st Landing —
10' x 8' x 1' = 80
2nd Stair —
15 x (8' + 8')/2 x 1' = 120
2nd Landing —
8' x 22' x 1' = 176
Entrance — (seperate) 551 x 2/27 = 41 cu yds
8' x 8' x 1' = 64, 8 x 10 x 1 = 80, 8 x 8 x 1' = 64 + 5 cu yds

Reinforcement: TOTAL – 13,400 lbs

Mat –

Long – 89.6' × 1.1 (For splices) × 11 bars × (#5) 1.043 plf × 2 (Top + bott) = 2,262 lbs
Short – 11' × " × 90 bars × (#5) 1.043 " × 2 = 2,272 lbs
4,534 lbs

Roof –

Long – 73' × 1.1 (splices) × 10 bars × (#4) .668 plf × 2 (Top + bott) = 1,073 lbs
Short – 10' × " × 73 bars × (#5) 1.043 plf × 2 = 1,675 lbs
2,748 lbs

Beams –

19 beams × 8' × 4 bars × (#9) 3.4 plf = 2,067 lbs
10' × 52"/12 × 19 beams × (#4) .668 plf × 1.1 = 908 lbs
8"/12
2,975 lbs

Walls –

1st Stair –
Horz – 16'/2 × 12 bars × (#5) 1.043 plf × 1.1 = 110 lbs
Vert – 13'/2 × 16 bars × (#5) 1.043 plf × 1.1 = 119 lbs
1st Landing –
Horz – 10' × 8 bars × (#5) 1.043 plf × 1.1 = 92 lbs
Vert – 9' × 10 bars × (#5) 1.043 plf × 1.1 = 103 lbs
2nd Stair –
Horiz – 18.6' × 8 bars × (#5) 1.043 plf × 1.1 = 171 lbs
Vert – 9' × 19 bars × (#5) 1.043 plf × 1.1 = 196 lbs
2nd Landing –
Horiz – 32' × 8 bars × (#5) 1.043 plf × 1.1 = 294 lbs
Vert – 9' × 32 bars × (#5) 1.043 plf × 1.1 = 330 lbs
Entrance –
Horiz – 8' × 8 bars × (#5) 1.043 plf × 1.1 = 73 lbs
Vert – 9' × 8 bars × (#5) 1.043 plf × 1.1 = 83 lbs
1571 × 2 = 3,142 lbs

Sheeting: Total - 3080 Sq.ft.

1st Stair -
$(15\frac{1}{2}' \times 14')/2 + 2' \times 14' = 137$ sq.ft.
1st Landing -
$8' \times 14' = 112$ sq.ft.
2nd Stair -
$(14' + 26')/2 \times 15' = 225$ sq.ft.
2nd Landing -
$22' \times 26' = 572$ sq.ft.
Entrance -
$8' \times 26' = 208$ sq.ft. $\overline{1{,}254}$ sq ft $\times 2 = 2{,}508$ sq.ft.
$10' \times 26' = 260$
$10' \times 26' = 260$ separate → + 572 sq.ft.
$2 \times 26' = 52$

Roadway Decking:

$\frac{12'' \times 12''}{144 \text{ ft}^2} \times 10' \times 81$ timbers $= 810$ cu.ft.
$\approx 170' \times$ 12WF 25plf sect $= 4{,}250$ lbs

Concrete for Vent Shaft:

$52' \times 4.3' \times 1' = 224$ cu ft
$9' \times 9' \times 1' = 81$ cu ft
$2 \times 3\frac{1}{2}' \times 9' \times 1' = 63$ cu ft
$4''/12 \times (16' + 20') \times 1' = 12$ cu ft
$380/27 = 14$ cuyds $\times$ 2 Vents $= 28$ cuy

Excavating Existing Tunnel Fill: Total = 195 cuyds

Between bulkheads -
$\frac{1}{2}(20' + 20') \times 100' \times 21' = 4200$ cuft
After 2nd Bulkhead -
$(15' + 8')/2 \times 20' + (8' \times 21')/2 \times 20/2 = 1070$ cu ft
$\frac{5270 \text{ cu ft}}{27} = 195$ cuyd

<u>3+4 ply Water proofing</u>:

$10' \times (6' + 10' + 18.6' + 28' + 8' + 3') = 736$ sq.ft.

<u>Restoration of Sidewalk</u>:

$12' \times 35'' = 420$ sq ft

<u>Restoration of Pavement</u>:

$50' \times 12' = 600$ sq ft $\times 1/9$ sq.ft. $= 67$ sq yds

<u>Handrail</u>:
(3 ft high)
2 sides $\times (18.6' + 21') \cong 80$ ft.

<u>Non Slip Stair Treads</u>:
(8' Long)
$31' / (10''/12) \cong 38$ treads

<u>Removal of concret Bulkhead</u>:

$(3' + 1')/2 \times 18' \times 21' = 756$ cu ft

<u>Entrance opening in stone wall</u>:

$10' \times 10' \times 3' = 300$ cu ft.

<u>Recondition Stone Block walls</u>:

(opening)
$[9' \times 21' + (\pi \times 21^2)/8] \times 2$ walls $= 724$ sq ft $- 90$ sq ft
$= 634$ sq.ft.

<u>Entrance sculpture</u>:
7.75
$[((5' + 3\frac{1}{2}')/2) \times 9' \times 2 + \pi(20^2 - 8^2)/8] \times 2$ walls $= 237$
OMIT ABOVE Calculations
<u>Tunnel Flooring</u>: + Below

$31 \times (4'' \times 8'')/144 \times 18.7' + 2 \times (4'' \times 8'')/144 \times 60' =$ (USE 760 L.F.
Plywood 5/8" $- 60' \times 20' = 1200$ sq ft

Backfill: Total = 264 cuyds

1st Landing -
10' x 3' x 12' = 360 cu ft
2nd Stair -
(3' + 15')/2 x 12' = 108 cu ft
2nd Landing -
15' x 29' x 12' = 5220 cu ft
Entrance -
15' x 8' x 12' = 1440 cu ft
7128/27 = 264 cu yds

Stone Ballast: Total ≅ 26 cuyds

1st Stair -
6"/12 x 21' x 11' = 116 cu ft
1st Landing -
6/12 x 10' x 11' = 55 cu ft
2nd Stair -
6"/12 x 18.6' x 11' = 102 cu ft
2nd Landing -
6"/12 x 32' x 11' = 176 cu ft
Entrance
6"/12 x 9' x 11' = 50 cu ft
499/27 ≅ 20 cuyds + 6 cuyds (2 Vents)
= 26 cuyds

Excavation: Total = 609 cuyds

1,566 sq ft. x 10.5 ft = 16,443 cu ft. / 27 = 609 cuyds

2 Vents - (11 x 15 x 4.33')/27 = 54 cuyds

Pavement Removal:

3" thick, (10.5' x 81')/9 = 95 sqyds

Concrete Removal:

(6"/12 x 10.5' x 81')/27 = 16 cuyds

Time Estimate

Concrete:

Roof - 29 cuyds × $\frac{1 \text{ day}}{10.7 \text{ cuyds}}$ = ----------> 3 days

Mat - 37 cuyds × $\frac{1 \text{ day}}{20.3 \text{ cuyds}}$ = ----------> 1 1/3 days

Walls - 46 cu yds
Vent - 28 cu yds } 74 cuyds × $\frac{1 \text{ day}}{11.2 \text{ cuyds}}$ = 7 days

Total = 11 1/3 days

Sheeting:

3080 sqft. × $\frac{1 \text{ day}}{295 \text{ sqft.}}$ = 10 1/2 days

---

Excavation:

609 cuyds × $\frac{1 \text{ day}}{480 \text{ cuyds}}$ = 1 1/3 days USE 2 days

---

Backfilling:

264 cuyds × $\frac{1 \text{ day}}{235 \text{ cuyds}}$ = 1 1/8 days USE 2 days

---

Stone Ballast:

26 cuyds × $\frac{1 \text{ day}}{160 \text{ cuyds}}$ = USE 1 day

Pavement Removal :

$75 \text{ sq yds} \times 1.3 \times \frac{1 \text{ day}}{690 \text{ sq yds}}$ = use 1/2 day

Concrete Removal :

$16 \text{ cu yds} \times \frac{1 \text{ day}}{45 \text{ cu yds}}$ = use 1/2 day

Roadway Decking :

12"x12" Timbers – $9818 \text{ B.F.} \times \frac{1 \text{ day}}{800 \text{ B.F.}}$ = 12 1/4 days

Steel –

$2.125 \text{ tons} \times \frac{1 \text{ day}}{7.5 \text{ tons}}$ = 1/4 day

Removal of Concrete Bulkhead :

$28 \text{ cu yds} \times \frac{1 \text{ day}}{34 \text{ cu yds}}$ = use 1 day

Removal of Stone Wall :

$300 \text{ cu ft.} \times \frac{1 \text{ day}}{900 \text{ cu ft.}}$ = use 1 day

Tunnel Flooring :

4"x8" – $760 \text{ L.F.} \times \frac{1 \text{ day}}{160 \text{ L.F.}}$ = 4 3/4 days

plywood – $1{,}200 \text{ sq ft.} \times \frac{1 \text{ day}}{1{,}350 \text{ sq ft.}}$ = use 1 day

Excavate Existing Tunnel Fill:

$195 \text{ cuyds} \times \frac{1 \text{ day}}{6 \text{ cuyds}} = 32\tfrac{1}{2} \text{ days}$

Electrical + Plumbing Work:

$.10 \times 81 \text{ days} = 8 \text{ days}$ say 10 days

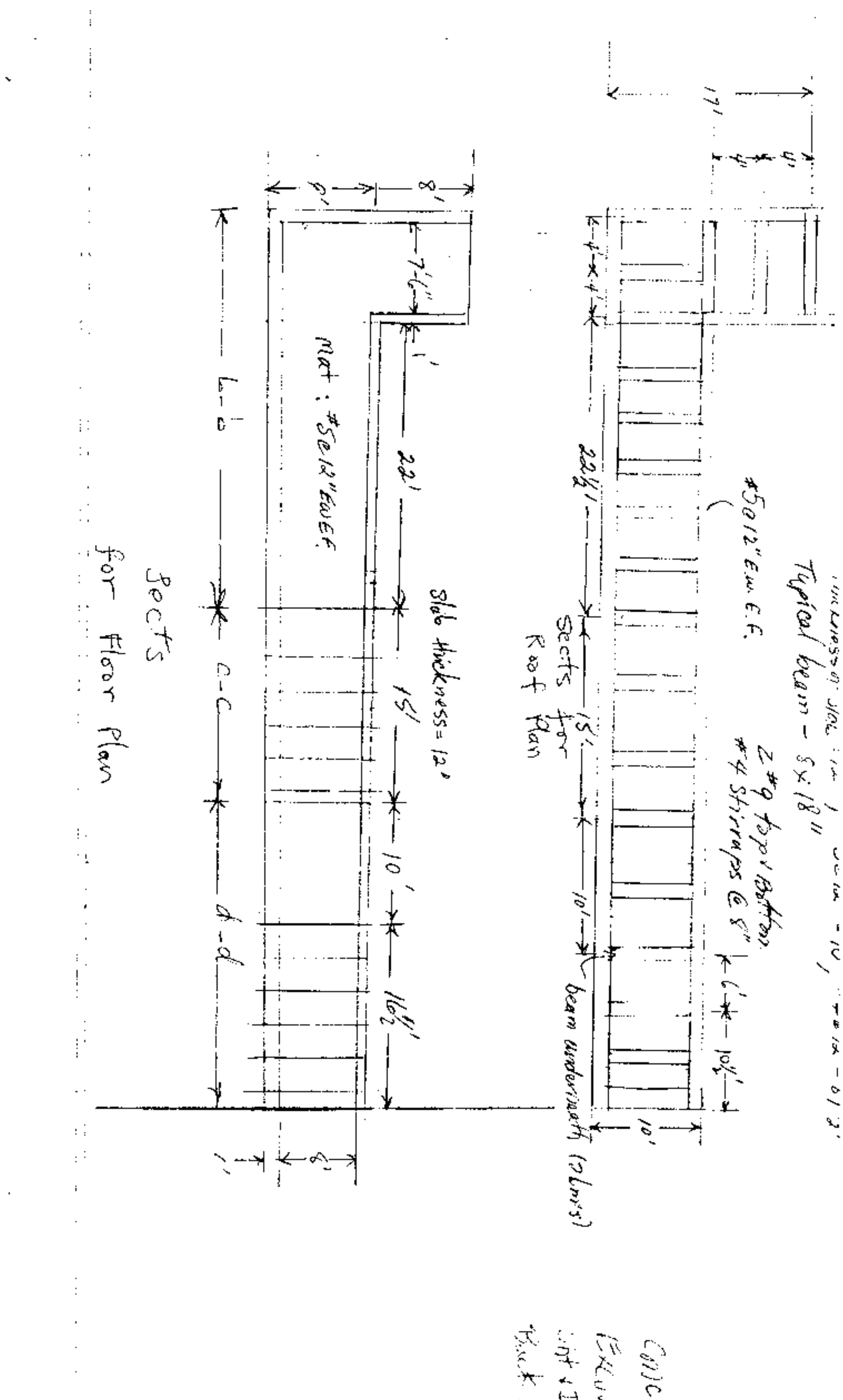
Total = 91 working days

$\frac{91 \text{ days}}{20 \text{ days/month}} = 4.55 \text{ months} \times 1.2 = 5.5 \text{ mos}$

contingency

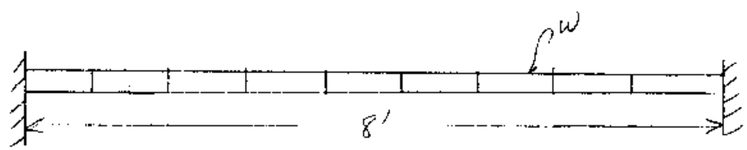
Say 6 months

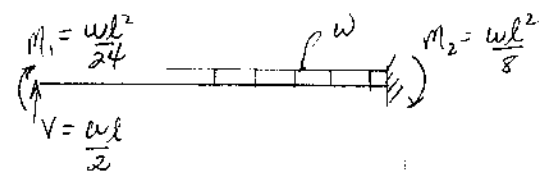
× 2 = 1 YEAR


Typical beam - 8x18"
#5@12" Ew E.F.
2 #9 top & Bottom
#4 Stirrups @ 8"
Sects for Roof Plan
beam underneath (2 bm's)
slab thickness = 12"
Mat: #5@12" EwEF
Sects for Floor Plan
Conc
Exc
Back fill

1. $w = \frac{1}{2}$ K/ft. @ 0' depth
2. $w = 1^K$/ft. @ 10' depth
3. $w = 2^K$/ft. @ 16' depth

$f'_c = 4000$ psi





1. $w_t = \frac{1}{2}\,(1000/ft) \times 8' = 4000$ lbs, $M_1 = .5^K/ft \times 8^2/24 = 1.33^{K\text{-}ft}$, $M_2 = .5^K/ft \times 8^2/8 = 4^{K\text{-}ft}$
2. $w_t = 1000$ lbs/ft. $\times 10' = 10{,}000$ lbs, $M_1 = 1^K/ft. \times 8^2/24 = 2.67^{K\text{-}ft}$, $M_2 = 1^K/ft. \times 8^2/8 = 8^{K\text{-}ft}$
3. $w_t = 2000$ lbs/ft. $\times 16' = 32{,}000$ lbs, $M_1 = 2^K/ft. \times 8^2/24 = 5.33^{K\text{-}ft}$, $M_2 = 2^{K\text{-}ft} \times 8^2/8 = 16^{K\text{-}ft}$,

$V_1 = 2\sqrt{f'_c}\,b_w d = 2 \times \sqrt{4000} \times 8/12 \times 1' = 84$ psi, $V_2 = 84$ psi, $V_3 = 84$ psi

City Cost Index - New York - As of November 2011

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Text size A A

The building and construction cost indexes for ENR's individual cities use the same components and weighting as those for the 20-city national indexes. The city indexes use local prices for portland cement and 2 X 4 lumber and the national average price for structural steel. The city's **BCI** uses local union wages, plus fringes, for carpenters, bricklayers and iron workers. The city's **CCI** uses the same union wages for laborers.

ENR COST INDEXES IN NEW YORK (1978-2011)

YEAR	MONTH	BCI	%CHG	CCI	%CHG
2011	Nov	7242.23	3.4	13807.28	3.0
2011	Oct	7237.23	3.5	13802.28	3.0
2011	Sep	7230.73	3.6	13795.78	3.1
2011	Aug	7229.48	3.2	13794.53	2.9
2011	Jul	7216.73	3.0	13781.78	2.8
2011	Jun	7205.23	2.9	13770.28	2.7
2011	May	7039.93	0.8	13441.53	0.4
2011	Apr	7038.93	3.2	13440.53	3.8
2011	Mar	7029.43	3	13431.03	3.7
2011	Feb	7026.43	3.1	13428.03	3.7
2011	Jan	6994.68	2.7	13396.28	3.5
2010	Dec	6998.68	2.7	13400.28	3.5
2010	Nov	7001.93	2.8	13403.53	3.6
2010	Oct	6993.43	2.7	13395.03	3.5
2010	Sep	6982.93	2.4	13384.53	3.4
2010	Aug	7008.52	2.8	13410.12	3.6
2010	Jul	7008.02	2.8	13409.62	3.6
2010	Jun	7001.52	2.5	13403.12	3.4
2010	May	6984.77	2.1	13386.37	3.2
2010	Apr	6824.18	-0.4	12951.62	-0.2
2010	Mar	6822.18	-0.4	12949.62	-0.2
2010	Feb	6816.18	-0.5	12943.62	-0.3
2010	Jan	6814.43	-0.7	12941.87	-0.4
2009	Dec	6816.18	-0.9	12943.62	-0.5
2009	Nov	6813.43	-1.7	12940.87	-0.9
2009	Oct	6813.18	-1.9	12940.62	-1
2009	Sep	6817.93	-1.9	12945.37	-1
2009	Aug	6818.68	-1.2	12946.12	-0.6
2009	Jul	6816.93	-1.1	12944.37	-0.6
2009	Jun	6829.68	2.6	12957.12	3.5
2009	May	6842.43	3.5	12969.87	3.9

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- A Cautionary Digital Tale of Virtual Design and Construction

Video

2009	Apr	6849.93	3.9	12977.37	4.1
2009	Mar	6851.68	4	12979.12	4.2
2009	Feb	6849.18	4.2	12976.62	4.3
2009	Jan	6863.43	4.4	12990.87	4.4
2008	Dec	6875.68	4.6	13003.12	4.5
2008	Nov	6928.68	5.5	13056.12	5
2008	Oct	6947.43	5.6	13074.87	5.1
2008	Sep	6952.68	5.7	13080.12	5.1
2008	Aug	6900.93	4.9	13028.37	4.7
2008	Jul	6894.18	4.9	13021.62	4.7
2008	Jun	6655.53	1.3	12523.87	0.7
2008	May	6613.53	0.7	12481.87	0.4
2008	Apr	6594.28	0.6	12462.62	0.3
2008	Mar	6589.28	1.1	12457.62	0.6
2008	Feb	6573.28	0.9	12441.62	0.5
2008	Jan	6573.28	0.9	12441.62	0.5
2007	Dec	6571.53	0.8	12439.87	0.4
2007	Nov	6569.03	0.5	12437.37	0.3
2007	Oct	6578.03	1	12446.37	0.6
2007	Sep	6577.03	3.6	12445.37	3.3
2007	Aug	6576.78	3.7	12445.12	3.4
2007	Jul	6574.78	3.7	12443.12	3.4
2007	Jun	6568.28	3.3	12436.62	3.1
2007	May	6567.28	4.3	12435.62	3.7
2007	Apr	6553.28	4.1	12421.62	3.6
2007	Mar	6515.56	3.6	12383.9	3.3
2007	Feb	6513.06	3.4	12381.4	3.2
2007	Jan	6513.56	3.2	12381.9	3.1
2006	Dec	6520.06	3.4	12388.4	3.2
2006	Nov	6535.31	4	12403.65	3.6
2006	Oct	6510.56	4.4	12378.9	3.7
2006	Sep	6349.46	2.5	12045.4	1.3
2006	Aug	6347.21	2.6	12043.15	1.3
2006	Jul	6340.21	2.8	12036.15	3.2
2006	Jun	6361.79	2	12057.73	2.8
2006	May	6298.56	1.1	11994.49	2.3
2006	Apr	6293.54	1.9	11989.47	2.2
2006	Mar	6290.54	2.2	11986.47	2.4
2006	Feb	6296.54	1.9	11992.47	2.2
2006	Jan	6310.51	1.9	12006.44	2.2
2005	Dec	6304.51	3.2	12000.44	2.9
2005	Nov	6281.61	2.8	11977.54	2.7
2005	Oct	6239.32	2	11935.25	2.3
2005	Sep	6194.31	0.9	11890.24	1.7
2005	Aug	6188.06	5	11883.99	7
2005	Jul	6169.29	3.3	11667.99	4.3
2005	Jun	6235.19	4.7	11733.89	5
2005	May	6230.38	4.9	11729.08	5.1
2005	Apr	6179.09	5.3	11729.08	5.6
2005	Mar	6154.37	6.2	11704.36	6.3
2005	Feb	6179.22	7.1	11729.21	6.8
2005	Jan	6193.86	8.7	11743.85	7.2
2004	Dec	6112.26	9.5	11662.25	12.3
2003	Dec	5583.09	2.7	10386.73	3.8
2002	Dec	5438.2	2	10009.06	-0.9

00:09 / 00:00

Caterpillar CT660

We review Cat's first work truck

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2001	Dec	5330.03	6.2	10101.24	7.7
2000	Dec	5018.67	-2.5	9379.14	0.3
1999	Dec	5147.21	5.3	9355.77	5.1
1998	Dec	4890.13	0.2	8899.59	1.8
1997	Dec	4880.61	2.2	8742.88	2.2
1996	Dec	4774.23	4.8	8554.47	2.1
1995	Dec	4557.44	2.2	8378.68	3.2
1994	Dec	4458.36	2.5	8117.64	4.9
1993	Dec	4349.2	4.8	7737.11	5
1992	Dec	4151.28	3.8	7367.49	3.6
1991	Dec	3997.91	3.9	7110.37	3.9
1990	Dec	3847.21	3.6	6846.49	6.1
1989	Dec	3712.2	5.4	6453.56	3.6
1988	Dec	3522.07	4.5	6231.12	4.5
1987	Dec	3369.28	4.7	5961.27	6.1
1986	Dec	3217.83	4.6	5621.15	4.3
1985	Dec	3076.19	3.1	5388.08	4.4
1984	Dec	2983.27	6.8	5160.95	5.6
1983	Dec	2792.67	7.3	4887.55	7.3
1982	Dec	2603.28	6.9	4553.93	10.4
1981	Dec	2434.62	11.3	4125.68	9.3
1980	Dec	2188.06	4.6	3774.64	5.4
1979	Dec	2091.82	11.5	3580.5	7.7
1978	Dec	1875.62	2	3325.43	7.4

Reader Comments:

Add a comment

Submit

Phase IIA

Design to construct an approximately 60 foot long tunnel, internal height 6'-6", internal width 6', to connect the buried steam locomotive under Atlantic Avenue, west of Hicks Street, with the tunnel interior space below Atlantic Avenue and Hicks Street.

The same concept may be used to connect the tunnel interior space with a sub-basement access point in a suitable building along Atlantic Avenue.

It is anticipated this short connecting tunnel will pass below existing underground utilities.

FERRAN ENTERPRISES, INC.
44-05 55th Avenue
MASPETH, NEW YORK 11378
(718) 937-0303

JOB Atlantic Ave Tunnel

SHEET NO. ______ OF ______

CALCULATED BY ______ DATE ______

CHECKED BY ______ DATE ______

SCALE ______

Practical Tunnel Driving
H.W. Richardson
Robert S. Mayo, 1983

rib is entirely encased in concrete and may be considered as reinforcing for the permanent lining.

If the ribs are to rest on the bench, large foot plates must be welded to the bottom end to distribute the load to the footing block. Most failures of liner plates in soft ground can be attributed to foot blocks of insufficient size or to the rib slipping off the foot block. Straight ribs are to be avoided. If the walls of the tunnel are plumb, the ribs should be curved on a 200-in. radius to resist side pressure better. Plumb ribs on one section

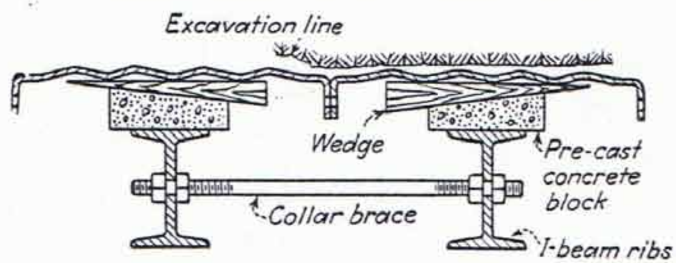


FIG. 197.—Ribs set inside of liner plates; rings of liner plates bolted to each other.

of the Chicago subway tunnels were trussed with light sets of hog rods to resist horizontal load.

SELECTING THE PLATE AND RIB

There is no way of accurately estimating the load to be carried by the primary lining. Methods have been outlined in Chap. 2 for determining the loading on the permanent lining, but it may be days or even months before this pressure develops fully. In driving through bad ground, most contractors organize to concrete every day and keep the concrete close behind the miners. In such cases, the liner plates actually support the ground from one to three days only.

The following empirical rules will serve as a guide in estimating plates and ribs required for the average tunnel in soft ground. The diameter is the excavated width of tunnel.

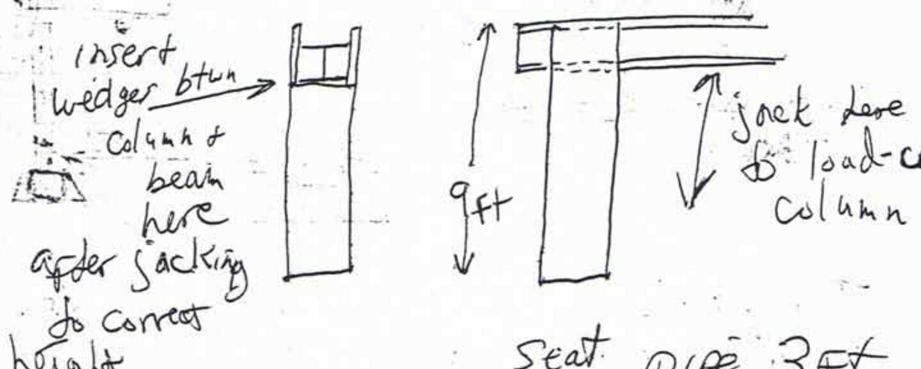
For tunnels 6 or 7 ft. in diameter: use $\frac{1}{8}$-in. or $\frac{3}{16}$-in. liner plates without ribs.

For tunnels 8 to 10 ft. in diameter: use $\frac{1}{4}$-in. or $\frac{5}{16}$-in. liner plates without ribs.

For tunnels larger than 10 ft. in diameter: use $\frac{1}{8}$-in. liner plates with I-beam ribs at 16-in. centers, the I-beams to be 1 in. in depth for every 3 ft. of diameter.

Beam Size: W-4-13   7 ft long
2 kip / ft capacity
Insert beam thru 5" dia hole drilled in rock

Column: use 6" dia pipe filling w/concrete. make Beam seat into pipe as follows:



Seat pipe 3 ft into floor w/grout around it.

Materials required to open Wall

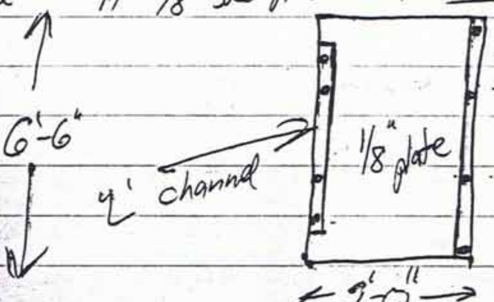
1- french jack
1- rotary impact drill 5" bit + extension Shafts to drill about 4 ft.
2- bag cement
1- W-4-13 7 ft long
1- 6" pipe 9 ft long

Typical Frame joints

Total 'L' channel: 262 1/2"
2x2 'L' chan[nel]

Total plate
Area needed:
side: 195
roof: 105
total: 300 ft² 1/8" steel plate

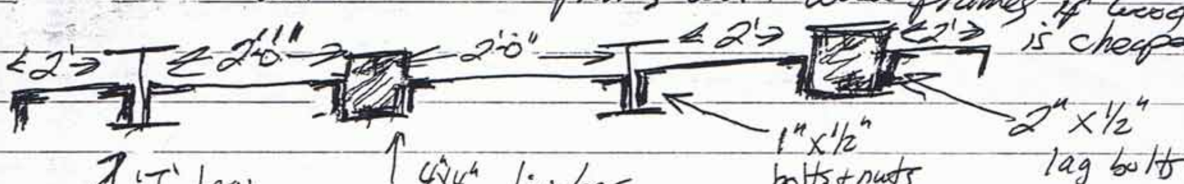
Typical Plate – side panels #plates needed: 30



need 12ft 'L' channel/plate side
need 5 1/2' 'L' chanel/roof plate

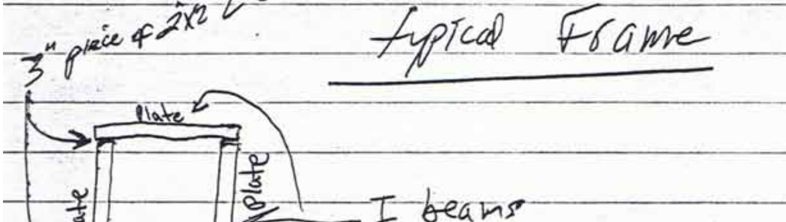
plates needed: 30
Note: roof panel same, except 2'-0" X 3 1/2'

alternate steel frames with wood frames if wood is cheaper



typical box frame to plate section

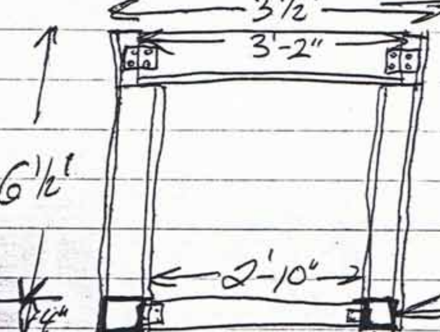
typical Frame



Note: Plate only reqrd on 2 sides

Note: 4"x4" frames assembled same way

Method of Jointing
Metal BOX frames # frames needed: 15

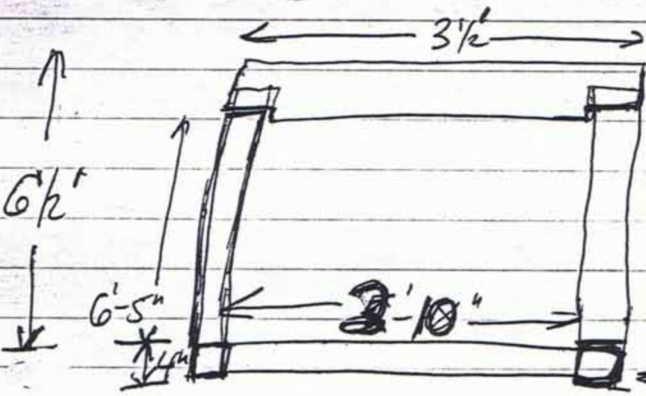


need 19 ft of W-4-13 per frame

total W-4-13 needed:
285' - frames
7' - wall
292 ft W-4-13

4X4 longitudinal sill

Method of Jointing
Wood Box frames # frames needed: 15



need 18.6 ft of 4"X4" wood per fram

4X4 longitudinal sill

Total 4X4 needed: 279 ft
+ 120 ft (sill)
399 ft treated 4X4

Materials Summary to go 60 feet

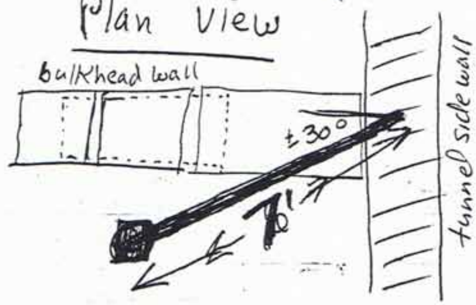
6" pipe – 450'
2"x2" steel 'L' channel – 262 1/2 ft
1/8" steel plate – 300 ft^2
4"x4" pressure treated wood – 399 ft
W-4-13 'I' Beam – 292 ft
fasteners not included – 1/2"x1" nuts + bolts
1/2"x2" lag bolts

To Open Stone Wall

Between Stone rows #5 and #6 on right corner, Insert beam at angle thru hole drilled into sidewall knee, support other end of beam on wood or metal column. Then undermine slighty blocks directly below and remove same

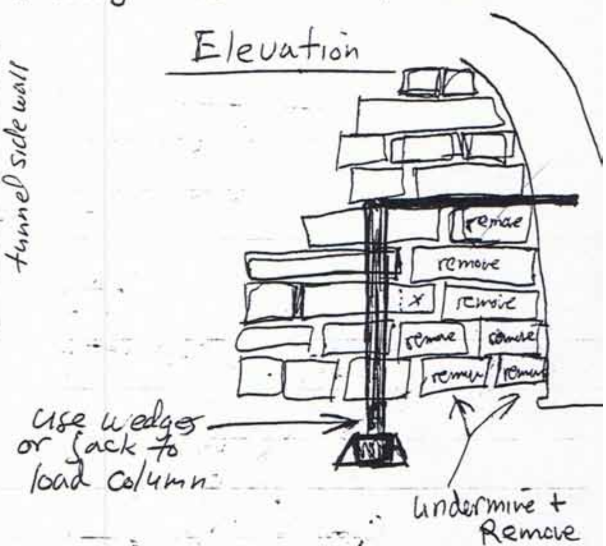
beam would carry ± 500 lbs/ft.

Plan View



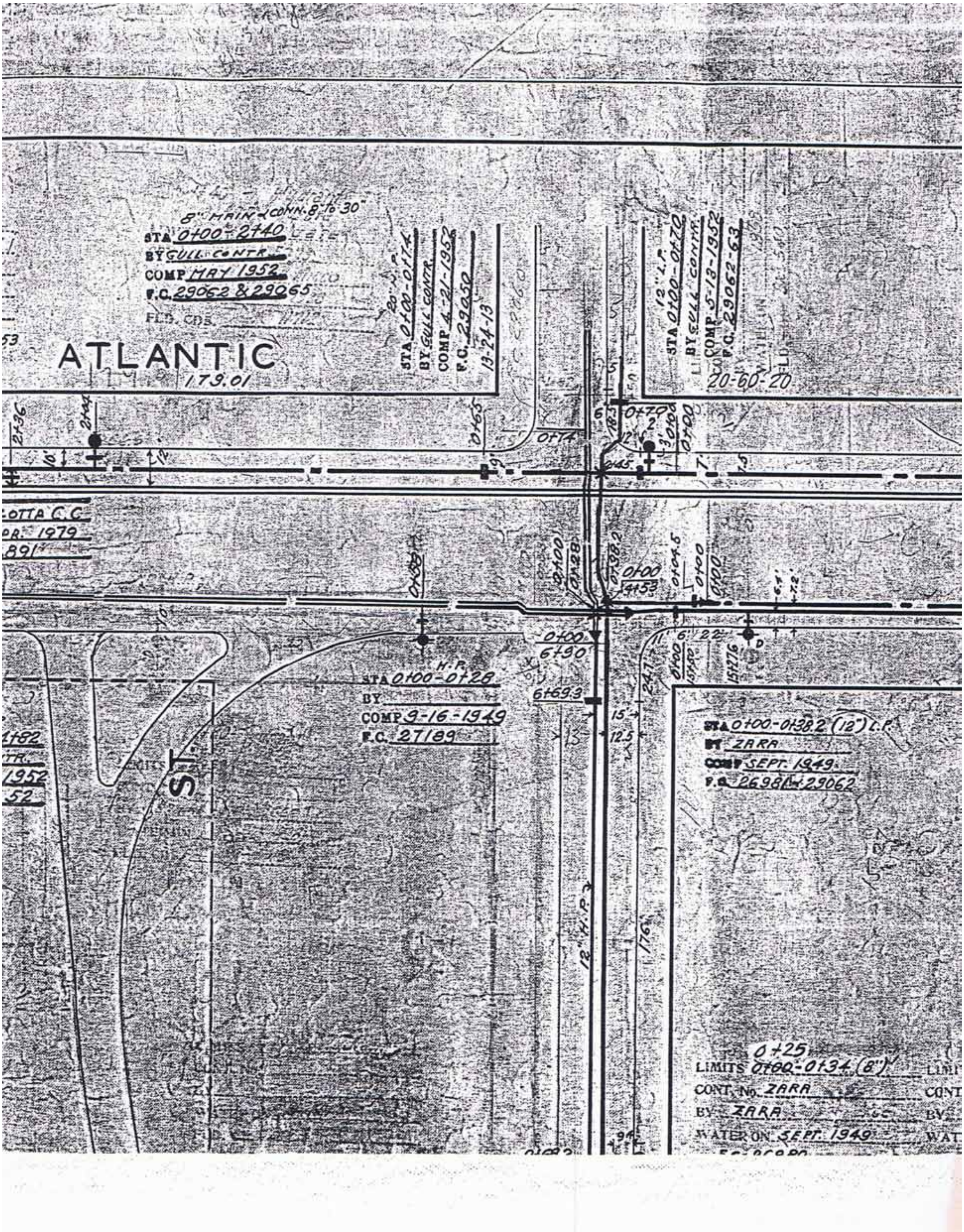
insert beam 2 ft into sidewall.

Elevation

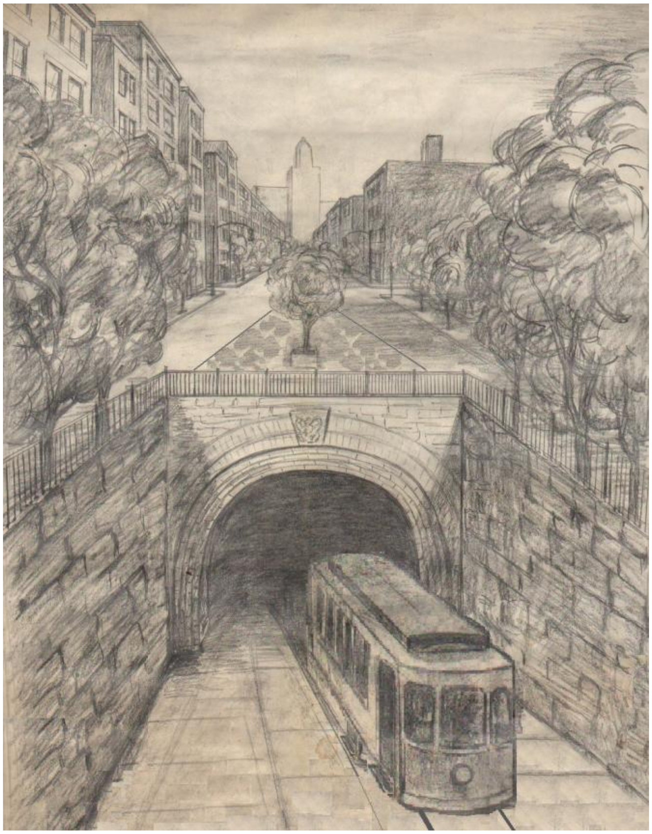


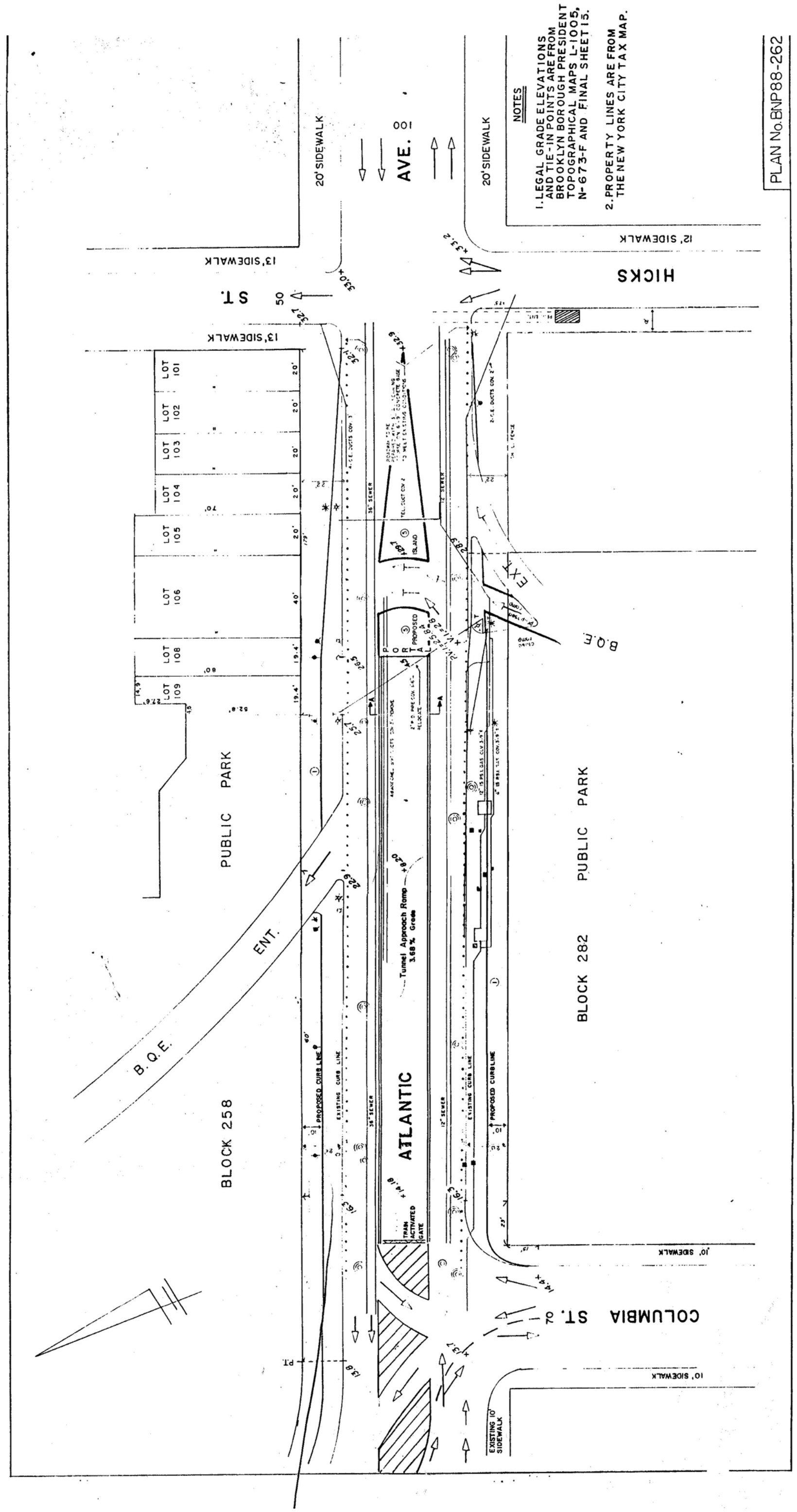
This particular point for inserting the beam was selected because the right side of the block to be supported would be held by the beam and the left side of the block supported by cantilever action of the block under its left side. In effect, a lintel is being created.

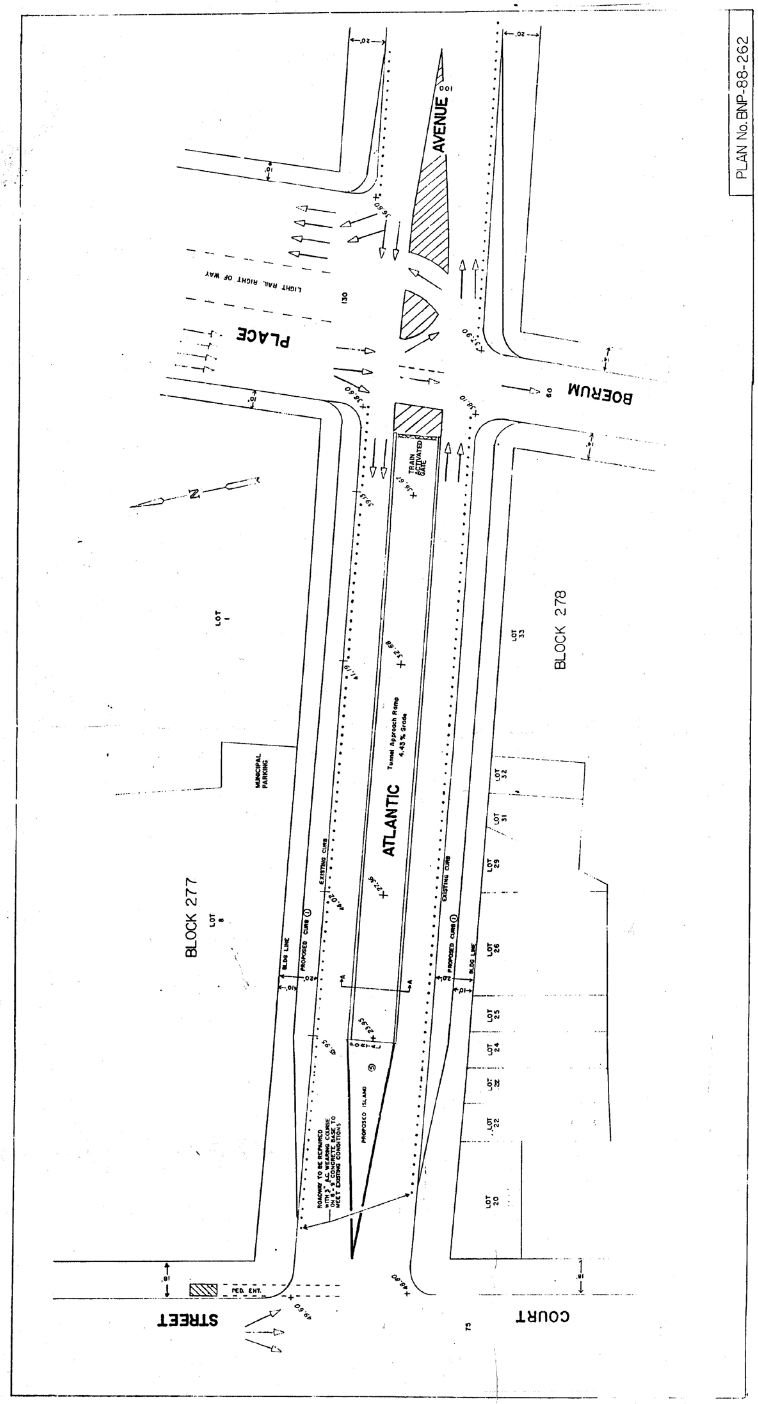
After wall is opened breast boards would be placed to retain fill behind wall, and drift begun.


8" MAIN & CONN. 8 to 30"
STA 0+00-27+40
BY GULL CONTR.
COMP MAY 1952
F.C. 29062 & 29065
FLD. CDS.
ATLANTIC
179.01
20" H.P.
STA 0+00-0+17.4
BY GULL CONTR.
COMP 4-21-1952
F.C. 29050
13-24-13
12" L.P.
STA 0+00-04+70
BY GULL CONTR.
COMP 5-13-1952
F.C. 29062-63
20-60-20
STA 0+00-0+28
BY
COMP 9-16-1949
F.C. 27189
0+00
6+90
6+69.3
STA 0+00-0+38.2 (12") L.P.
BY ZARA
COMP SEPT. 1949
F.C. 26981 & 29062
ST.
12" H.P.
0+25
LIMITS 0+00-0+34 (8")
CONT. No. ZARA
BY ZARA
WATER ON SEPT. 1949

Conceptual Of West Tunnel Portal Re-opened For Streetcar Use



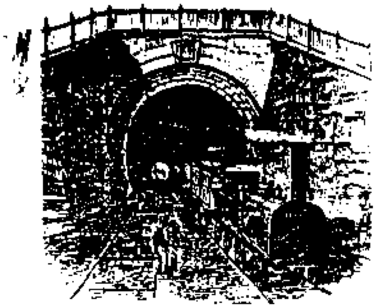

NOTES
1. LEGAL GRADE ELEVATIONS AND TIE-IN POINTS ARE FROM BROOKLYN BOROUGH PRESIDENT TOPOGRAPHICAL MAPS L-1005, N-673-F AND FINAL SHEET 15.
2. PROPERTY LINES ARE FROM THE NEW YORK CITY TAX MAP.
PLAN No.BNP88-262
HICKS ST.
AVE.
20' SIDEWALK
13' SIDEWALK
12' SIDEWALK
10' SIDEWALK
EXISTING 10' SIDEWALK
ATLANTIC
COLUMBIA ST.
BLOCK 258
BLOCK 282
PUBLIC PARK
PUBLIC PARK
B.Q.E. ENT.
B.Q.E.
EXIT
LOT 101
LOT 102
LOT 103
LOT 104
LOT 105
LOT 106
LOT 108
LOT 109
ISLAND
PROPOSED PORTAL
Tunnel Approach Ramp 3.68% Grade
TRAIN ACTIVATED GATE
PROPOSED CURB LINE
EXISTING CURB LINE
36" SEWER
12" SEWER


PLAN No. BNP-88-262
ATLANTIC
AVENUE
BOERUM
PLACE
STREET
COURT
BLOCK 277
BLOCK 278
LIGHT RAIL RIGHT OF WAY
TRAIN ACTIVATED GATE
MUNICIPAL PARKING
PROPOSED ISLAND
EXISTING CURB
PROPOSED CURB
BLDG LINE
PED. ENT.

BROOKLYN HISTORIC RAILWAY ASSN.

599 E. 7th Street, Brooklyn, New York 11218
tel. 941-3160

Robert Diamond
President



Tunnel as it appeared in 1844.

June 9, 1988

Hon. Ross Sandler
Commissioner
NYC Dept. of Transportation
40 Worth Street
New York, NY 10013

Dear Commissioner Sandler:

Some time ago, our non- profit group was given a franchise to an abandoned subway tunnel under Atlantic Avenue, in Brooklyn Heights. This tunnel, was built in 1844, and sealed and abandoned in 1861. The franchise was granted by the Board of Estimate.

Recently, the City placed $2.6 million in the capital budget, for the reconstruction of the original tunnel portals. We are currently in the process of completing the final design of these entrances, and we need to confer with either yourself, or someone from your department who you designate, as these entrances are in a City street.

The tunnel will be used as a museum, and as part of a planned light rail link, between the LIRR terminal at Flatbush Avenue, and Pier 6 in Brooklyn, which would be the site of a ferry to Manhattan. The light rail would also interconnect Metrotech, Atlantic Terminal, Fulton Landing, the Brooklyn Academy of Music, and other Brooklyn sites with Manhattan.

As I mentioned, we are on a very tight schedule for the completion of the entrance design, so we would be grateful if we could here from you, or someone in your department as soon as possible. I have enclosed a very rough sketch of the proposed tunnel entrance.

Thank you in advance for your attention.

Sincerely,

Robert Diamond

cc: Jack Lusk

NEW YORK CITY
DEPARTMENT OF TRANSPORTATION
OFFICE OF THE FIRST DEPUTY COMMISSIONER
40 Worth Street New York, N.Y. 10013

Ross Sandler
Commissioner

Samuel I. Schwartz, P.E.
Chief Engineer/First Deputy Commissioner

BN-DEM-THM-L-285

Mr. Robert Diamond
President
Brooklyn Historic Railroad Assn.
599 East 7th Street
Brooklyn, New York 11218

JUL 25 1988

RE: Atlantic Ave Tunnel
Museum & Cultural Inst.
Capital Project PV515
Borough of Brooklyn

Dear Mr. Diamond:

Your letter of June 9, 1988 to Comm. Sandler is acknowledged. In order to excavate the entrance to the subject tunnel, it will be necessary for you to obtain street opening permits.

Due to the nature of your project the existing traffic patterns on Atlantic Avenue will have to be altered, consequently engineering drawings will have to be reviewed and approved by various entities in this department.

In order to begin this process of plan review and approval, please submit your site plans to Mr. Anthony Consentino, P.E., Engineer In Charge, of our Builders Pavement Section. Mr. Consentino will advise you in the required procedures in help to coordinate your project among the various divisions of Department of Transportation who must be involved. Mr. Consentino is located in room 1101 at 40 Worth Street, and can be reached at 566-3636, or 5718.

I am enclosing a copy of Highway Paving Plan for Contract BN 64-14. This widening and resurfacing of Atlantic Avenue was completed on July 5, 1966. Please note that this plan indicates that the trolley tracks over the entrance to the portal were not removed but were covered over in 1951.

We look forward to working with you on this Historic restoration project.

Very truly yours,

Thomas H. Markham

THOMAS H. MARKHAM, P.E.
Director-Engineering Management
Bureau of Highway Operations
Department of Transportation

Attachment:

NEW YORK CITY
DEPARTMENT OF TRANSPORTATION
OFFICE OF THE COMMISSIONER
40 Worth Street New York, N.Y. 10013

January 13, 1989

BN-AAC-CC-HK-GFR-465

Ross Sandler
Commissioner

HARRY KAMAMIS, P.E.
Acting Assistant Commissioner

NYC Dept. of Transportation - Builder's Pavement
NYC Dept. of Transportation - Planning
Borough President - Brooklyn
NYC Dept. of Transportation - Arterial Coordinator
Consultant Engineer - Robert Diamond

RE: NYCDOT Builder's Pavement Plan
BNP 88-262
Atlantic Avenue Tunnel
Boerum Place to Furman Street
Borough of Brooklyn

Meeting to Receive Review of Proposal

Gentlemen:

Transmitted herewith ~~separately on 10 Jan. '89~~ by the undersigned ~~is~~/are 20 set(s) of the proposed plans for the above work. Your review of this submission is requested.

A meeting has been scheduled for Thursday, February 9, 1989, at 10 AM in Room 1225, 51 Chambers Street, New York, New York 10007, to receive your input and comments on this submission.

Your cooperation in reviewing the project and supplying comments is most appreciated.

Very truly yours,

GERARD F. RENINGER, P.E.
Director
Arterial Highways Coordination

Minutes of Meeting Held

Regarding Atlantic Avenue Tunnel Reopening

Interface With Other Proposed Work

Meeting Held On February 9, 1989,

10AM At 51 Chambers Street

Participants:

Gerard Reninger, Director, NYC Arterial Highways, NYC DOT

Robert Diamond, Brooklyn Historic Railway Assn.

Nayan Basu, NYS DOT Planning & Development

Jerry Blaustein, Builders Pavement, NYC DOT

Anthony Consentino, Chief, Builders Pavement, NYC DOT

Richard Pressel

The meeting was chaired by G. Reninger.
G. Reninger: The intent of this meeting is to provide an opportunity to the Dept. of Transportation and the State to comment on the effect of the reopening of the tunnel entrances as to the cost and viability of State projects near the tunnel entrances, in particular, the reconstruction of the BQE bridge over Atlantic Avenue, and the planned widening of the BQE in this area.

N. Basu: The State's concern is the BQE exit ramp at Atlantic Avenue. The State would like this particular branch of the exit to remain in its present configuration. They propse moving the western tunnel portal a short distance to the west. Mr. Basu also indicated that the narrowing of the sidewalk from 20' to 10' would slightly increase the gradient in the BQE entrance ramp on Atlantic Avenue, but felt that this would not be a problem.

R. Diamond: Mr. Diamond indicated that he would be glad to work with the State to fine tune the planning of the western tunnel portal in relation to the BQE exit ramp.

N. Basu: Indicated that he is in the process of an investigation to determine if there were any tie beams placed under Atlantic Avenue when the BQE overpass was built. He will have more information soon. So far, no tie beams have been found in the available records.

G. Reninger: Described in detail the method which will be used to reconstruct the BQE overpass at Atlantic Avenue, and the widening of the BQE. He indicated that if the west tunnel portal could not be moved further west, that a Bailey Bridge could be built over the tunnel approach ramp. DOT will need to use part of the area in the vicinity of the tunnel ramp and portal through the 1990's for their BQE project. The first project ready to go into construction must be willing to accomodate the other project. The tunnel project must be planned out so as not to preclude the BQE project, and vice versa. Mssrs. Reninger, Basu and Diamond indicated that this planning could and would be done, and that one project would not preclude the other.

J. Blaustein: Asked if Mr. Diamond's plans would be approved by the State, if so, what would be the process.

G. Reninger and N. Basu: They stated to Mr. Blaustein that they felt that Mr. Diamond's concept for the ramp & portal near the BQE would basically work.

G. Reninger: Assured Mr. Blaustein the he and the State would work with the tunnel project. They will review the pre final plans. He will accept plans on behalf of the State for the tunnel project along Atlantic Avenue between Hicks Street and Furman Street. He wants to see that other responsible agencies have signed off also, so that the sign off from Arterial Highways and the State will be significant.

J. Blaustein: Asked what aspects of the tunnel portal plans the State will review.

N. Basu: Four areas:

1) Traffic and Safety
2) Structural
3) Design (utilities)
4) Construction

G. Reninger: Indicated that they are in the process of rehiring their BQE project design consultant, Daniel Frankfurt. Also indicated that a large diameter sewer line by cross through the west tunnel approach ramp. Daniel Frankfurt has information on the exact location of this sewer. Mr. Reninger will contact him, and provide the information to Mr. Diamond.

R. Pressel: Indicated that this sewer may already be abandoned, or may become abandoned when the Red Hook interceptor comes on line. In this case, the section of sewer through the tunnel ramp (if any) could be collapsed and bulkheaded. If the sewer does cross the ramp, and cannot be abandoned, a siphon would have to be installed, or the sewer relocated.

A. Consentino: Stated that a change in the City Map would not be required in relation to the opening of the tunnel entrances, as there will not be any change in the width of Atlantic Avenue between buildin lines. He stated that the changes in the sidewalk and roadway can be approved by DOT alone with a Waiver of Grade and Alignment.

A. Consentino: Stated that he is formally requesting an All Agency Conference, so that the plans for the tunnel may be reviewed by all responsible Agencies, and comments be given.

J. Blaustein: Indicated that a structural analysis will need to be performed on the tunnel approach ramp walls to determine if when excavated, they can support the load of the BQE bridge abutments.

Respectfully Submitted,

Robert Diamond

NEW YORK CITY
DEPARTMENT OF TRANSPORTATION

40 Worth Street New York, N.Y. 10013

Ross Sandler
Commissioner

HARRY KAMAMIS, P.E.
Acting Assistant Commissioner

SUBJECT: NYCDOT Bridges Pavement Plan
BNP - 88 - 262
Atlantic Ave Tunnel Reopening
Interface with other Proposed Work.

DATE: 9 Feb 89
TIME: 10 AM
ROOM: 1225 - 51 Chambers St.

ATTENDANCE

NAME	TITLE	AFFILIATION & ADDRESS	TEL. NO.
GERARD F. RENINGER	Director	NYC DOT	212-566-6[illegible]
Robert S. Diamond		B'klyn Historic Railway 599 E. 7 ST B'klyn, NY 11218	718 941 3[illegible]
NAYAN K. BASU		NYS DOT Planning & Development L.I.C.	718-482-45[illegible]
Jerry Blaustein		N.Y.C. DOT.	566-3636-

NEW YORK CITY
DEPARTMENT OF TRANSPORTATION

OFFICE OF THE FIRST DEPUTY COMMISSIONER

40 Worth Street New York, N.Y. 10013

Ross Sandler
Commissioner

Samuel I. Schwartz, P.E.
Chief Engineer/First Deputy Commissioner

BN-DSE-ASC-C-88-262

Mr. Robert S. Diamond
599 East Seventh Street
Brooklyn, New York 11218

MAR 9 1989

RE: Atlantic Avenue Tunnel Project
Builders Pavement Plan No. BNP88-262
Borough of Brooklyn

Dear Mr. Diamond:

Our continued review of your preliminary Builders Paving Plans and the assistance which we have given you in preparing these plans to revitalize the abandoned railroad tunnel in Atlantic Avenue has now exceeded the expertise and limits of my office. We believe that this project because of its complexity must involve a comprehensive review by a number of different City, State, and possibly Federal Agencies including but not limited to a review by the private utility companies and by the community. The specialized comments and concerns of the different Agencies and groups who must become directly involved with this project are now required by my office so that their comments may be incorporated into the Paving Plans prior to consideration of final approval.

The City Planning Commission is the appropriate forum for conducting an "All Agency Conference" where the project will be discussed in depth and given further direction.

It is therefore our recommendation that you contact Mr. Andrew Karn, P.E., Assistant Chief Engineer, City Planning Commission, 22 Reade Street - Room 3N, New York, New York 10007, (212)720-3253 to assist you in filing and preparing for an "All Agency Conference."

Very truly yours,

ANTHONY S. COSENTINO, P.E.
Chief
Builders Pavement Section

A History of the Urban Underground Tunnel (Draft Version #2 - 7/30/2010)

Introduction:

One of the problems of correctly interpreting history, is that the original meanings of words and phrases are sometimes lost, or at least distorted. For example, the New York word “subway” is a contraction of a two word phrase: “Sub[terranean] [passage] way”.

In addition to the term subway's most prevalent use in the NY area (as a label we affix to our urban rail transit system), the term “subway” can also refer to any underground passageway. Things such as an underground pipe gallery, utility area or water conduit. For example, in Manhattan “The Empire City Subway” is not a railway- it is underground vaulting, built to contain telephone company cables.

Linguistic terms, like technology itself, does not arise within a vacuum; there is always something similar that came before. We now present a brief outline on the evolution of the “Subway”, or “Underground Passageway”, covering a time period of roughly 2,700 years, starting with its ancient uses in Babylonia, Jerusalem, Greece, Bagdad and Rome, and then culminating with the modern urban underground railway tunnel

The Earliest Known Urban Underground Passageways (Mesopotamia & Greece):

Curt Merckel, in his circa 1899 German language book, gives us perhaps the most technically detailed description of the earliest known urban underground passageways and similar ancient structures. Keep in mind, all of Merckel's measurements are in Meters, and that 1 Meter ≈ 3.28 feet. Further, his particular use of a “comma” when citing dimensions, is equivalent to our decimal point.

Curt Merckel: Die Ingenieurtechnik im Altertum. Berlin: J. Springer 1899.Translated from the German by Ingmar Arnold.

Selected pages of Merckel's book follow (the indented section over the next few pages):

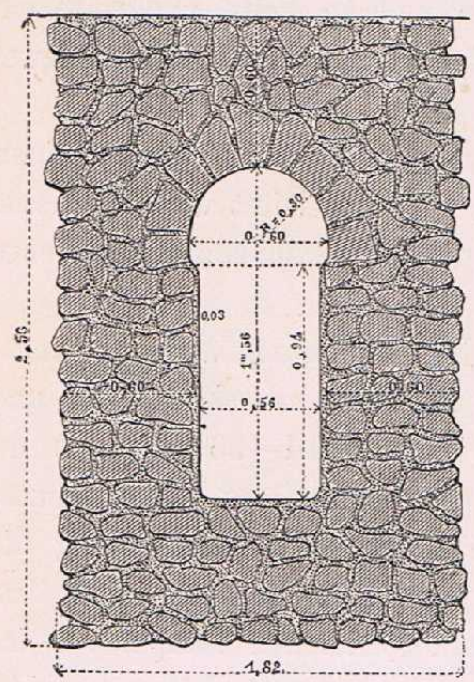


Abb. 254.
Querschnitt des Aquädukts von Sens.

Drainage of Cities and Street Cleaning) Canalization (p. 450):

At the moment when a larger group of humans started dwelling together at the same place over a longer period of time, unavoidably the question of water supply and the surface discharge of the service water masses and the garbage had to be solved. This is the reason why the history of water supply and drainage of cities (i.e. Canalization) goes back into the earliest times. Our knowledge about the earliest drainage systems is rather meager. The oldest reference concerning the existence of a drainage system known today so far has been discovered on an older sealing inscription. It was referred to as the construction of a palace and the drainage system of a warehouse. Other information concerning drainage systems in Mesopotamian cities is much younger.

Layard mentions in his writings that Babylon was in possession of very big watering sewers, that the private houses were connected via by-pass channels with the main sewers. In Nimrud, this scholar discovered a vaulted, pointed arched drainpipe beneath a building from the 7 th century B.C.

The vault was made out of big burnt brick. The side walls are resting on the same material. The brick is quadrangular but not wedge-shaped. The central space (cf. fig. 166) is filled up with brick, laid down in linear length.

p. 451:

Vertical stand-pipes are discharged into this by-pass channel. This can be seen on page 270, fig. 77. They were used to discharge the waters into the drainpipe. Beneath the north-western palace in Nimrud, Layard discovered also a vaulted drainpipe. Beneath the road pavement of the ruins of the elder Palace in Nimrud several quadrangular drainpipes, made of burnt brickstone, led into different parts of this building. Round pipes, ending in a perforated plaster plate and normally situated in a corner, were connecting the drainpipes with those floors in different rooms which had to be drained. All junctions were united in a main sewer, and this one was emptied in the river.

In Bagdad, the above mentioned scholar [Layard] reports, the only remaining relics from the Babylonian times are the ruins of an imposing drainage ditch. A subterranean channel, made out of big quadrangular brick, and connected with the name of "Nebudkadnezar".

In Jerusalem, several drainpipes from ancient sewer systems have been preserved. They have been pushed, tunnel-like, into the rocky underground. Schlick discovered a pipe, big enough for a man to enter, just a few meters beneath the soil. This channel is 60 cm wide and ca. 2 meters high. Initially, it was equipped with a vaulted ceiling This ceiling was composed of just a few worked stones; later, it was covered with bit flat stones. The channel leads towards the Kidron Valley, the outlet is blocked.

Some minor drainpipers are ending here also, close to the ceiling. Schlick considers that this gangway is much younger – dating from the times of Herod or Hadrian. The purpose of this channel was, obviously, to discharge the brackish sewers from the north-eastern part of the city. Schlick writes the following words about the sewer conditions during the old times of Jerusalem, before King David invaded the city: "Between the caves, rocks and stony houses pipes or trenches were proceeding, broken out of the rock, and completed by brickwork when the rock was lacking These pipes led all the rain and dirty waters towards the edge of the rock. In General, these "alleys" were small and sinuous; but the main sewer which came from the North, from Millo, was comparitively more spacious and more in a linear slope than the many short by-pass channels branching off to the left or to the right. Naturally, the outlets of these channels at the edge of the rocket were lower than the alley and the houses. But Joab entered Jerusalem through these channels, and David came into the possession of this City, without any bloodshed."

Among the many alleyways that traverse the Underground of Jerusalem in various directions, one tunnel, discovered by Warren, in the South-East of Siloah, is believed to be recognized as a drainpipe.

<u>Ancient Rome</u>

The first large scale urban "underground passageway", was Rome's *Cloaca Maxima* (The Great Sewer). This drainage system, originally built for the purpose of transporting flood waters, predates Rome's famous aqueducts, and was the start of the "cut and cover" underground tunneling practice in urban environments.

This structure, is at the very least, approximately 531 meters (1,742 feet) in length (as per Merckel's drawing, pg 459), with a typical cross section of roughly 9 ft x 12 ft. Compare these figures with the Atlantic Avenue tunnel: 2,000 ft x 21 ft x 17 ft.

It was built by two Etruscan Kings of Rome. Construction is said to have started about 600 BC, and said to have been completed sometime around 500 BC, after a long political delay.

The Cloaca Maxima is also said to have been "the earliest application of the arch [vault] in Rome" (Italy. Handbook for Travellers, by Karl Baedeker, Ninth revised edition, 1886, pg 245).

"It goes without saying that such a vast and solid network of drainage involved enormous labor, and points to a despotic authority. The work was begun by the first Tarquin [Priscus]; it seems to have been in a degree suspended in the reign of Servius Tullius ; and it was completed by Tarquin the Proud [Tarquin Superbus]". (from: Rome Today and Yesterday: The Pagan City, by John Dennie, 1904, p 50)

Executing such a large construction undertaking with nothing more than human labor and hand tools, must have been an extremely formidable, and unpleasant task. Dennie continues:

"In an address, which one of the old historians represents [Lucius Junius] Brutus [founder of the Roman Republic], as making to the people of Rome after the expulsion of the royal house [509 BC], occur these words, which plainly refer to the Cloacae" :

" He compelled you like slaves to lead a miserable life, hewing stone, cutting wood, carrying enormous loads, and passing your lives underground."

Compare this to Walt Whitman's writing on the Atlantic Avenue tunnel, some 2,300 years later: "***A Passage of Solemnity and Darkness***"

Dennie concludes: "Nevertheless, it is certainly true that no public work ever done in Rome surpasses in utility the Tarquinian sewers, for they rendered all the future possible. If the cloacae are, as they have been called, a monument of tyranny, they are also a monument of statesmanship".

Vitruvius, sometimes referred to as the world's first known engineer, wrote of the "cut and cover" method in his 1st century BC work *The Ten Books on Architecture,* Book VIII, chapter VI. **"*Parietes cum camera in specu struanter*". In English: "If the tunnel (specus) was driven through...earth or sand, there must be massive vaulted masonry walls".**

Cross-sectional drawings of Rome's Cloaca Maxima

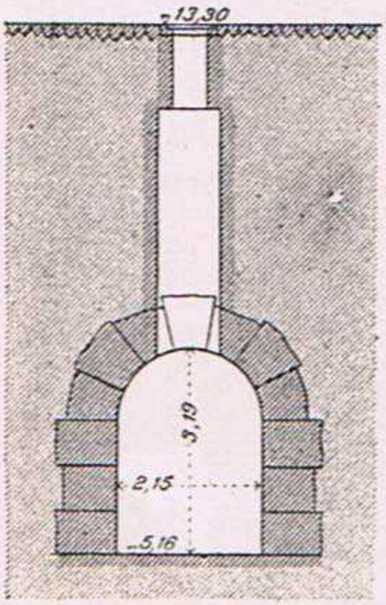


Abb. 176.
Querschnitt der Cloaca maxima bei Punkt 8.

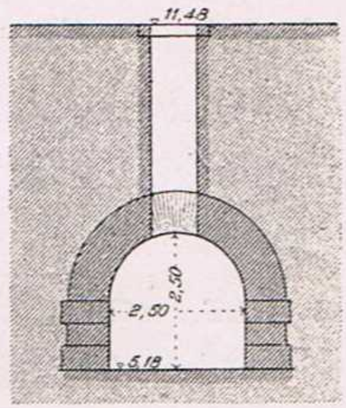


Abb. 178.
Querschnitt der Cloaca maxima bei Punkt 9.

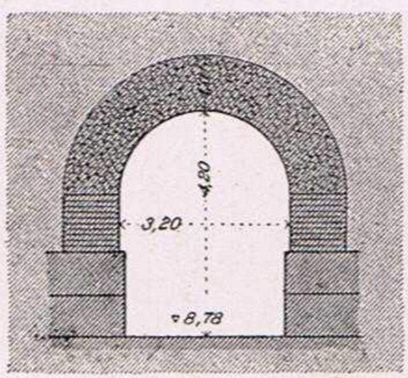


Abb. 173.
Querschnitt der Cloaca maxima bei Punkt 2 des Lageplans.

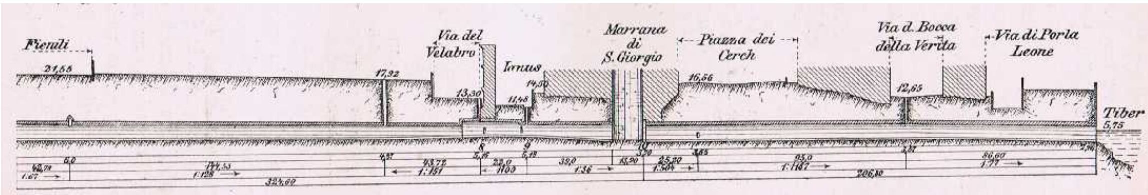


Abb. 175.
Längenschnitt des unteren Theils der Cloaca maxima.

Merckel's longitudinal view of the Cloaca Maxima. Notice what seems to be a venturi accelerator mechanism (no moving parts) in the midsection of the above drawing (Use zoom tool to see detail).

Continued extracts of Curt Merckel's book follow:

Curt Merckel, in his circa 1899 German language book, gives us perhaps the most technically detailed description of the Cloaca Maxima:

p. 454:

> There was a concept made by the chief engineer who, according to the legend, was commissioned by Tarquinius Priscus to create a drainage system. As a result, a discharge should be given in the plains between the seven hills to lead heavy rainfalls away. The plain part between the hills was exposed to many floods because it was situated so close to the river. The drainpipe should prevent the heightening of the waters and eliminate the sources of infection of the devastating fever. The plague of fever was known in Rome for a very long time, as can be seen by the fact that the earliest settlers dedicated their chapels and altars to the deity of fever and related gods of the household, for instance of Cloacina, Mala Fortuna and Mefitis. In this context, the old drainage systems of the Campagna should not be forgotten. Even in Rome, at the Capitol Hill, at the south-west corner of the Palatine Hill, and at the west side of the Aventine Hill, similar drains have been found. By erecting these important drainage channels, the further development of Rome was made possible. The water amount flowing of from the Quirinal, Viminal, Esquiline, Caelius, Palatine and Capitol Hills to the old Roman Forum were combined into a bundle and discharged into the Tiber River.
>
> **p. 455:**
>
> Jordan holds the view that by building the Cloaca and erecting the surrounding wall which was accomplished – due to popular belief – by the Tarquinii as well, Rome received its' specific imprint. The surrounding wall with all its' gates was for centuries the boundary of the City of Rome; it established the major traffic routes. The Cloaca Maxima enabled the agricultural cultivation of the plains between the hills and the river. Presumably, most of the Cloaca was uncovered in the beginning, at least a great deal of it. Draining was the major purpose; in the course of time the system was used step by step to discharge human and animal garbage as well. To a certain degree, there is a point in regarding this dual use as a disadvantage. Probably, the ancient engineers did not know anything about how to avoid the escape of sewer gas. Thus, the Roman population was permanently exposed to the deleterious evaporation because no cut-off devices existed. Some of the big entrances, close to the streets, have been preserved until our days. In Pompeii, for instance. Best known is the Bocca della verita in Rome – a marmoreal disc, five feet in diameter, with the face of Oceanus, the rain waters were streaming through his mouth into the drainage channels.
>
> Dionysius tells us that the drains had to be cleaned and restored due to their congestion. The censors spent a sum of about 1.000 Talents (ca. 4 ½ Million Mark) to solve this problem. According to Hirt, the extension of this sum is a sign that these works must have been much more than just cleaning and repairing.
>
> Among the sewer channels of Rome there are some that were used already in ancient times. Among others, the drainpipes of the Circus Flaminius are still in use. The most famous among the ancient drains is the Cloaca Maxima. Her outlet is mapped by figure no. 168.

The course of the Cloaca Maxima shows a great many of windings and lay-bys that might be caused partly because the constructors tried to avoid existing buildings. The whole trace is similar to a watercourse in the Campagna Region. It is highly probably to regard the Cloaca Maxima as a channeled river which flows into the Merrana at St. Giorgio in Velabro (cf. fig. no. 169). In that respect, the development in Rome must have been rather similar to the development in Athens. In Rome, the river bank was fixed. Then the watercourse was overbuilt. The accuracy of this statement might be given by the fact that 22 meters behind the Basilica Julia,

p. 457:

… the ordinary Cloaca suddenly ends and an open conduit must have existed here for a certain time. The waters of the Palatine Hill were flowing into this conduit. A theory which is supported by the fact that the living condition in this area of miasmas were rather awkward, if not precarious.
The exact survey of the Roman sewer network is due to the Italian Engineer Pietro. Due to him, the Cloaca Maxima consists of big Gabine ashlars stones with the following measurements: Length: 2, 50 meters, Height: 0, 80 meters, width: 1, 00 meters. The stones had been connected without grout and mortar. The walls consist of 3 -4 ashlars layers. A semi-circular shaped arch is based upon them. This barrel vault has 7 to 9 ashlars layers formed by accurately arranged key stones. The river bed is paved with polygonal lava stones. The figures nos. 170 – 172 are illuminating the cross section resp. the longitudinal section of the Cloaca segment (up to the Forum Augustum) that was discovered in 1889.

Figure No. 173 shows the cross section of Point No. 2 from the fig. no. 169 site map. Here, as it can be seen in figure no. 173, only two original ashlars stones still exist. Above them, there is a semi-circular vault based upon brick layers. The width of the channel is variable, depending upon the hydraulic gradient conditions. Towards the estuary mouth, the cross section widens. This is an appropriate constellation because the quantity of water that has to be drained is also increasing. At this point, south of the Forum Romanum, the Channel leads into the area beneath the stairways of the Basilica Julia, and the vault has been replaced to make the construction of the stairway's bottom section possible. At this point, the Channel has a width of 1, 20 meters and is covered with 30 cm travertine ashlars stones. But where the Cloaca meets the Basilica Julia, the cross section is suddenly widening, the ashlars layers on both sides meet stumpy, without any sign of an integration. Due to Narducci, this section of the Cloaca Maxima, between points Nos. 6 & 7, with a length of about 180 meters, must have been uncovered originally. Also due to the opinion of Narducci, a by-pass channel leading into the Cloaca Maxima beneath the western pillars of the Janus quadrifons brought the waters flowing from Capitoline Hill in eastbound direction directly into the Cloaca Maxima.

From Point No. 9 until the confluence of the Cloaca Maxima into the Marrana at St. Giorgio (fig. no. 175), the sewer has a brick vault. Throughout the length of 13, 9 meters, the sewer is interrupted. But then it goes on another 207 meters. The width rises from 3, 7 to 4, 5 meters. The discharge shows three vaulted Peperin layers. This material was used during the time of construction of the outflow to cover the adjacent river bank also. Approx. 9 meters before the Cloaca comes to pass the so called Janus quadrifons in Velabrum, the sewer comes to an end,

p. 459:

having a height of about 1, 99 meters and a perpendicular front of travertine (fig. 174). The sequel section, 3, 19 meters high, is built with different layers. The by-pass channel mentioned above, emptying into the Cloaca Maxima at this point, has almost the same cross section as the lower section of the Cloaca. The air shafts in fig. 176 & 178 are from a later date. Just after the Cloaca has passed the Janus quadrifons, the same covering vault of key stones ends into a perpendicular front (fig. 177).

The adjacent 39 meters show a brick vault. Fig. 179 reproduces the longitudinal section of the Cloaca; fig. 180 is the view of the sewer at Point No. 10.

In many cases, the extensive drainage networks built in many cities in antiquity were of use only to a very small part of the population. In Rome, for instance, it was not an obligation to connect the houses ("insulae") with the drainage system. Real estate speculations were running wild in those days, so it is not very probable that the landlords did more investments than it was regulated by law. According to Livy, it was only regulated that the drainage channels in private homes had to be built on the landlords' own expenses, they had to pay the cloaricum exactly for that purpose. Initially, the sewers were put under the control of the censors, later of the aedils and eventually of the Curatores cloacorum.

Concerning the canalization, Pompeii allows us a good insight into the conditions of Ancient Roman rural towns. Nissen's opinion is that this city never ever had a Cloaca system like in Rome. Almost every house led the drainage directly into the streets. The pavement was continuously curved; so the waters were gathering at the curbstones. To cross the pavement – which was probably wet very often – on dry ground, special stepping stones were placed in the middle of the street. The tenants were responsible both for …

p. 460:

… the maintenance of the plaster and the unrestricted drainage of the waters. Before the invention of the sidewalks, the kennel must have been situated in the middle of the road. The waters flew off through discharge apertures – sometimes, here and there, they are still visible today in the sidewalks. But Nissen thinks that subterranean drainpipes were erected only at those places where greater amounts of waters were flowing off – for instance, at the Forum Romanum or at the Stabian therms. These drainpipes are in evidence to be seen on page 442, fig. 165.

Numerous drainpipes are to be found beneath the ruins of Nicomedia. This city is situated at the flank of a hill. She was built terraced. The various terraces were separated from each other by supporting walls. The lowermost terrace, initially situated directly at the sea, disposes of three flying buttresses with a distance of approx. three meters to each other. Drain pipes are leading to these buttresses. These pipes are big enough in their cross section that a man can walk into them without any problems. These pipes were made first and foremost to discharge the rain waters safely.

At the bottom of a hill in Orange, the ancient Arausio, there used to be a marsh. The sewage water of this city was lead into the marsh. To protect the lower districts of Arausio from flooding in case of heavy rainfall, a drainpipe was laid. Via the Meague River the waters were discharged into the Rhone. The width of this main collector was up to two meters.

In Aosta, a consistent sewer system was available. The pipe disposes of a clear width of 0, 64 meters to 0, 85 meters...

p. 461:

… and a height of 1, 68 meters. On the back side, the pipe is 1, 33 meters beneath the road bed. The upper part is vaulted in a semi-circular shape.

In Paris, fragments of the former drainpipes from Roman Times are still preserved upon the isle of Notre Dame. The height of these pipes is 0, 60 meters, the width 0, 50 meters.

Remnants of Roman drainpipes have been found in Cologne and in Treves, Germany. Fig. 181 shows the cross section of the channel which was exposed in the neighborhood of Alteburg in Cologne. Interestingly enough are the applied forms of the cross section as well as the embedding of the pipe in blue colored clay. Another drainpipe, exposed in the Budengasse Alley, was made out of tufa ashleys and sealed with a semi-circular vault. The height is 2, 45 meters, the width 1, 20 meters. Most scholars believe that this channel was presumably made for the purpose of defense.

Like in modern big cities, Ancient Rome was provided with public latrines. In a famous speech concerning the lex Fannia, Titius mentioned the public convenience already. Also, private house-owners were designating latrines for public use. This undertaking was charged with a tax by Emperor Vespasian. Overbeck's opinion is that the therms in Pompeii were equipped with closets and flush lavatories.

These public latrines were used almost exclusively by the poor population. There was a debate whether private houses had latrines as well – but there were many different answers to that question. Some writers believe that vases were in use to take over the excrements, and that they were cleaned by slaves. About the place where this clearance took place the opinions also differ.

p. 462:

But in the case of Pompeii, it has been proven that almost all the houses were equipped with latrines, which were situated pretty close to the kitchens. The feces were gathered in pit latrines, but nothing has been found out so far about a direct connection with the drainpipes. In most cases, the plebs got rid of the feces by throwing it simply into the streets. This was the same habit like in Medieval times.

The sewage of the houses went directly into the streets. From there, they were discharged into channels, drainpipes or ditches.

We do not have any information so far concerning the down-grade conditions, the ventilation within the urban channels, or a potential prevention of the escape of sewer gas. But we know that in Rome and in other cities (in Seleucia Pieria, for instance) the regular clearance of the sewer system was an obligation. The waterworks authorities in Rome were obliged to provide back-up facilities of mains waters for exact this purpose.

An act of disposal, written down by Sextus Julius Frontinus, refers to this constellation and has the following wording: "My will is that no one who has not got permission by me or my predecessors, may discharge surplus waters because it is necessary that a certain part of the water volume delivered by the water basins is used not only for the purpose of the city's maintaining and clearance but also for the purpose of rinsing the drainpipes."

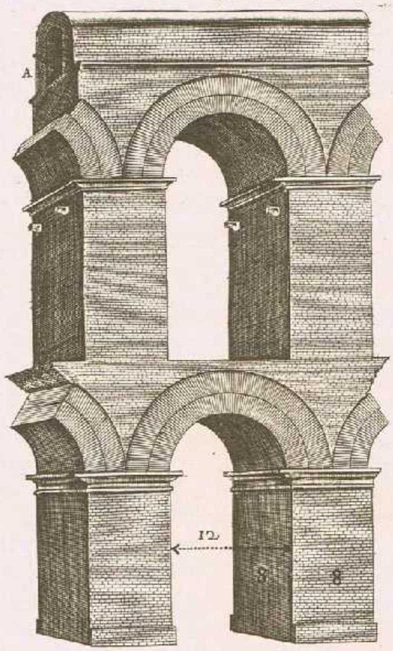
In antiquity, the flowing off points of the sewers into the rivers were situated without exception within the cities' borders. Such an constellation must have had various evils as a result. In Rome, when the water level of the Tiber River was high, every now and then the waters of the Cloaca Maxima were blocked back. As the river itself was pretty heavily polluted, the so called swimming pond was established".

The Romans quickly made extensive use of these "vaulted underground passageways", in their system of aqueducts.

Lofty masonry arches were built by the Romans to carry the Aqueducts over valleys
Top Picture: Roman Aqueduct structure in Segovia, Spain

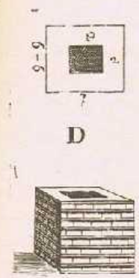
Illustrations: De Aqvs Et Aqvaedvctibvs Veteris Romae, by Raphael Fabretti, published in 1680, pgs 8-9

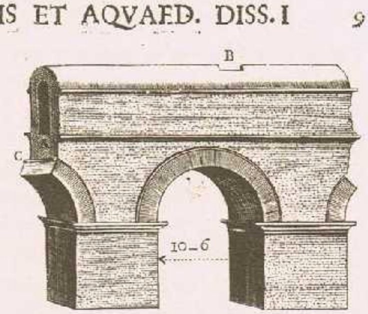
minutiora, binæ quas adiungimus delineationes meliùs exhibebunt: quarum ea quæ prior eſt, opus Vrbi propinquius; ſecunda, arcus in vltimâ, & vliginosâ Valle, dictâ *di Pantano* repræſentat;



A *Specus, latus ped. ij. & ſemis, altus vſque ad curuaturam fornicis ped. iv. & ſemis. Fornix ipſe ped. i. vnc. iv. Latera hinc indè craſſa ped. ij. vnc. ij*

A Spe-

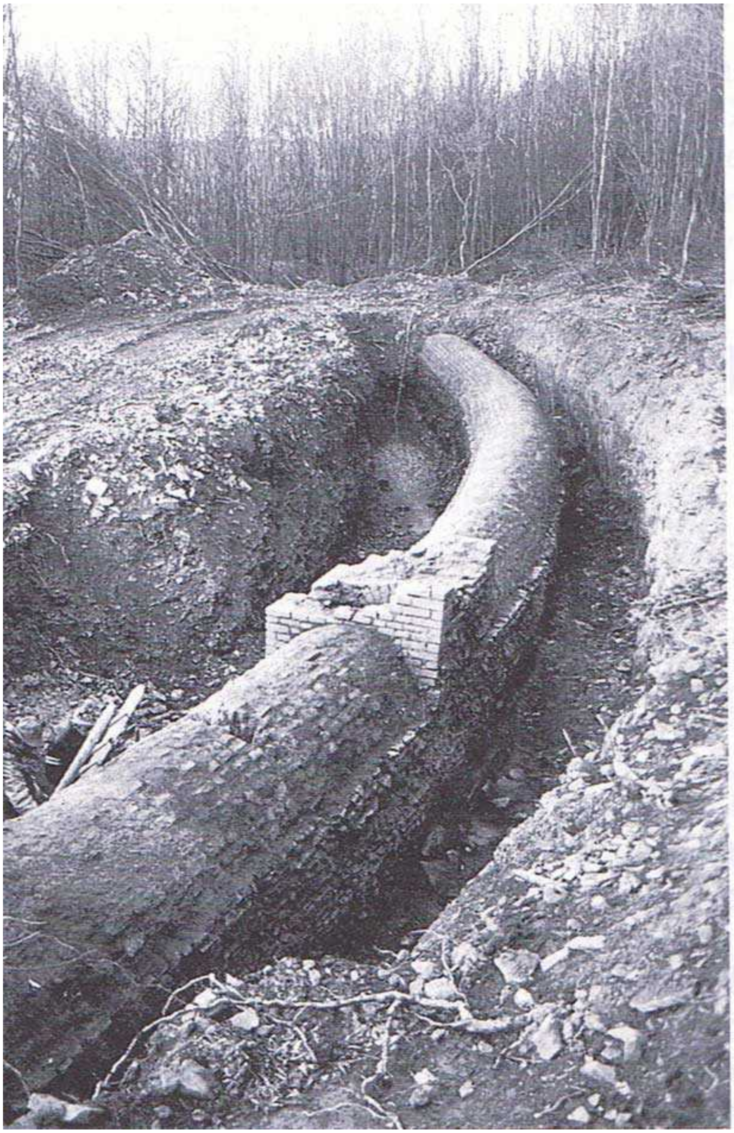




A *Specus, latus ped.ij.vnc.viij. Latera eiuſdem craſſitiei*
B *Spiramina varijs interuallis diſtributa, patent in quad.p.ij.*
C *Supercilium lateritium circa lateres arcuum (& ſem.*
D *Forma Puteorum ad terræ egeſtionem, & ſpiramentum Aquæ ſuper Ductu excauatorum, foraminibus lateralibus ad ſcanſionem diſpoſitis*
Opus eorum ex topho, & latere alternatim compoſitum eſt. *

quibus tertiam, *Piſcinam Limariam num. 24. adie- 7

“cut and cover” aqueduct tunnels were extensively used where the waters would best flow underground.
(Eifel Aqueduct, Germany, circa 70 AD, (from Roman Aqueduct & Water Supply, By A. Trevor Hodge)



46. Cologne, Germany: a stretch of the Eifel aqueduct, showing vaulted roof and an inspection manhole; normally subterranean, this section was uncovered during road-building (photo: K. Grewe, Bonn).

The Roman Cryptoporticus:

From the Cloaca Maxima, the Romans then developed a residential/commercial use for “cut and cover” vaulted underground passageways: the *Cryptoporticus*. See photos of the Palatine Cryptoporticus (Dennie), and the Bosra Cryptoporticus (MacDonald).

112. Bosra, cryptoportico

“Sometimes connective, functioning as covered passageways, Cryptoporticus are vaulted corridors. Cool and shaded, they are occasionally found alongside streets, sunken below pavement (Bosra) [Syria], but much more often they lined platforms or terraces erected to support major buildings and functioned as ambulatories (Arles [France]; Aeminium [Portugal]; Aosta [France]; Smyrna [Turkey]). The street type is lit by smallish, raking windows set in the haunch of the vault along one side”. (From: *The Architecture of the Roman Empire Volume II: An Urban Appraisal*, by William L. MacDonald, 1986, pg 117, 118)

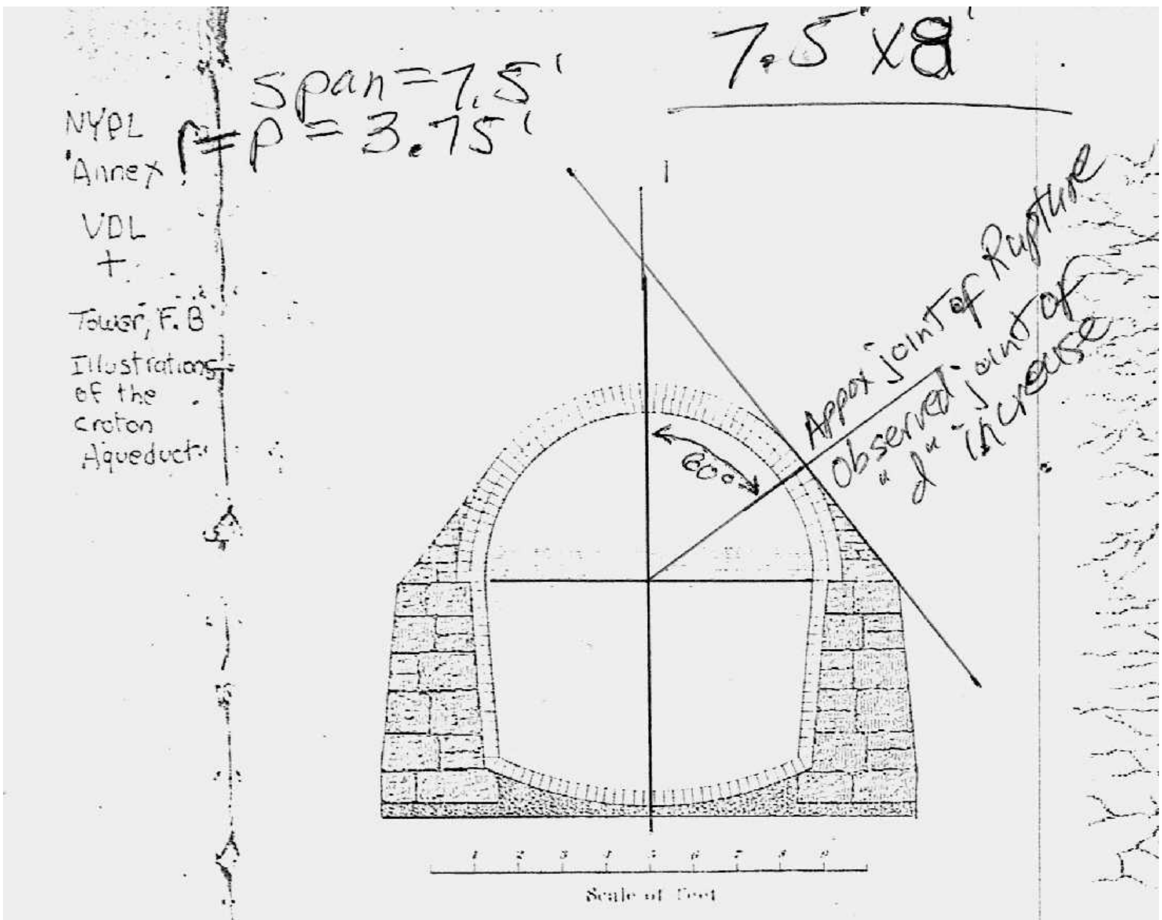
The Cryptoporticus of the Palatine

Source: The Rome Of Today And Yesterday: The Pagan City, By John Dennie, 1904, pg 162

Fast Forward To The Nineteenth Century:

Next, we jump about 2,000 years to New York City's first Croton Aqueduct, originally designed by Maj. David Bates Douglass circa 1833- 5, and later completed by noted engineer John B. Jervis in 1842.

While this mid nineteenth century American version of a Roman “underground vaulted passageway” was built to convey water from Westchester County, NY to Manhattan, its relatively large cross sectional design (7.5 ft x 9 ft) is clearly based upon the Roman Cloaca Maxima, the Aqueduct Arcade, or the Cryptoporticus, rather than a typical, small cross section (roughly 2 ft x 4 ft), classical Roman aqueduct “specus”.



What's An Arch, How Does It Work?

Before we go any further, let's take a brief look at precisely what an arch is, and how it works. In shape, arches can be circular, elliptical, horse shoe shaped (basket), skew, pointed, corbel- and even perfectly flat. From: ***A Dissertation On The Construction Of Arches***, By G. Atwood, 1801, pg iii,v, vi, 1, 19, 20

> “AN arch being formed (according to the usual modes of construction) by the apposition of wedges, or sections of a wedge-like form, the pro perties of arches seem to be naturally derived from those of the wedge, on which principle the inquiries in the ensuing Tract are founded.
>
> Supposing an arch to consist of any number of sections or wedges, adjusted to equilibrium ; this arch resting on the two abutments, may be considered analagous to a single wedge, the sides of which are in - clined at an angle equal to the inclination of the two abutments the forces therefore which would be necessary to sustain such an arch or wedge when applied perpendicularly to the sides, ought to be equal to the reaction of the pressures on the two abutments ; this principle is found on examination to be verified by referring to the tables annexed ;f whether the arch consists of sections, without, or with the load of super- incumbent weight, and whether the angles of the sections are equal or unequal : For according to all these tables, the weight of the semiarch is to the pressure on the corresponding abutment, or the reaction there.. of, as the sine of half the angle between the two opposite abutments, is to the radius; which is a proportion equally applicable to the wedge, and to the arch, when adjusted to equilibrium.
>
> From the second of these rules it appears, that the lateral or hori zontal pressure of any arch adjusted to equilibrum depends wholly on the weight and angle between the sides of the highest, or middle section : If therefore the weight and angle of this highest section should continue unaltered, the lateral force or pressure will be invariably the same, however the height, the length, the span; and the weight of the whole arch may be varied. This lateral force is called, in technical language, the drift or shoot of an arch, and the exact determination of it has been considered as a desideratum in the practical construction of arches.
>
> As the exterior termination of an arch always exceeds the interior curve (usually called the curve of the arch), the sections or wedges of which it is composed will partake of a similar dispro portion, the length of the exterior boundary in each wedge always exceeding that of the interior. A consequence of this wedge-like form is, that the weight of each section by which it endeavours to descend towards the earth, is opposed by the pressure the sides of it sustain from the sections which are adjacent to it. If the pressure should be too small, the wedge will not be supported, but will descend with greater or less obliquity to the horizon, according to its place in the arch. If the pressure should be too great, it will more than counterpoise the weight of the section, and will force it upward. The equilibrium of the entire arch will consequently depend on the exact adjustment of the weight of each section or wedge, to the pressure it sustains, and the angular distance from the vertex, measured by the inclination of the lowest surface to the vertical line. This equilibrium is understood to be established by the mutual pressure and gravity of the sections only, independent of any aid from friction, cohesive cement, or fastenings of any kind".

The following general rules are derived from the proportions, which have been inferred in the preceeding pages:

RULE I. The initial pressure is to the weight of the first section, including the weight superincumbent on it, as radius is to twice the sine of the semiangle of the middle, or highest wedge, or $p = \frac{w}{2 \times \text{sin.} \frac{1}{2} A^{\circ}}$.

RULE II. The horizontal force, which is nearly the same in every part of the arch, is to the weight of the first section, as radius is to twice the tangent of the semiangle of the first section, or $p' = \frac{w}{2 \times \text{tang.} \frac{1}{2} A^{\circ}}$.

RULE III. The horizontal or lateral force is to the pressure on the abutment, as radius is to the secant of the inclination of the abutment to the vertical, or $Z = p' \times \text{sec. } V^{n}$.

RULE IV. The horizontal force is to the weight of half the arch as radius is to the tangent of the inclination of the abutment to the vertical, or $S = p' \times \text{tang. } V^{n}$.

RULE V. The weight of the semiarch is to the pressure on the abutment, as the sine of the said inclination of the abutment is to radius, or $S = Z \times \text{sin. } V^{n}$.

RULE VI. The horizontal force is to the pressure on the abutment as the cosine of the inclination of the abutment is to radius, or $p' = Z \times \text{cos. } V^{n}$.

By these rules, the principal properties of the arch of equilibration are expressed in simple terms, and are easily applicable to practical cases.

Rule 3d. The horizontal force, or p', being the weight divided by twice the tangent of the semiangle of the first section, determines the pressure on any abutment of which the inclination to the vertical line is V^{n}; the pressure being $= p' \times \text{secant } V^{n}$.

Rule 4th. The weight of the semiarch, when adjusted to equilibrium, is found by the fourth rule to be $= p' \times \text{tang. } V^{n}$; or the horizontal pressure increased, or diminished, in the proportion of the tangent of the vertical distance of the abutment to radius. From this property, the reason is evident, which causes so great an augmentation in the weights of the sections, when the semiarch, adjusted to equilibrium, approaches nearly to a quadrant, and which prevents the possibility of effecting this adjustment by direct weight, when the entire arch is a semicircle.

Rule 5th. The fifth rule exemplifies the analogy between the entire arch when adjusted to equilibrium, and the wedge. For let the angle between the abutments be made equal to the angle of the wedge, the weight of which is equal to the weight of the arch; and let Z be either of the equal forces, which being applied perpendicular to the sides of the wedge, sustain it in equilibrio: then by the properties of the wedge, the force Z is to half the weight of the wedge as radius is to the sine of the semiangle of the wedge, which is precisely the property of the arch; substituting the angle between the abutments instead of the angle of the wedge, and the pressure on either abutment instead of the force Z.

Rule 6th. The lateral pressure, or the pressure on the abutment, reduced to an horizontal direction, is nearly the same in all parts of the arc; being to the weight of the first section, as radius is to twice the tangent of the semiangle of the wedge.

The force of pressure on the abutment is therefore at every point resolvable into two forces; one of which is perpendicular to the horizon, and is equal to the weight of the semiarch; and the other is a horizontal or lateral force, which is to the weight of the first section, as radius is to twice the tangent of the semiangle of that section.

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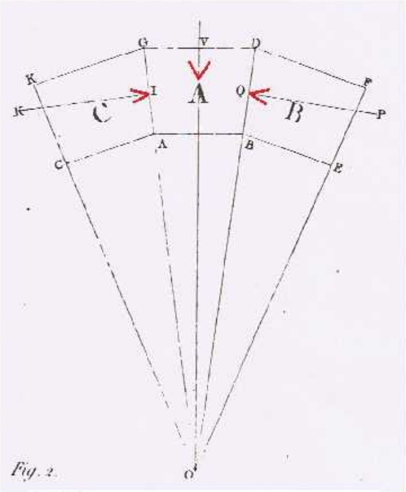
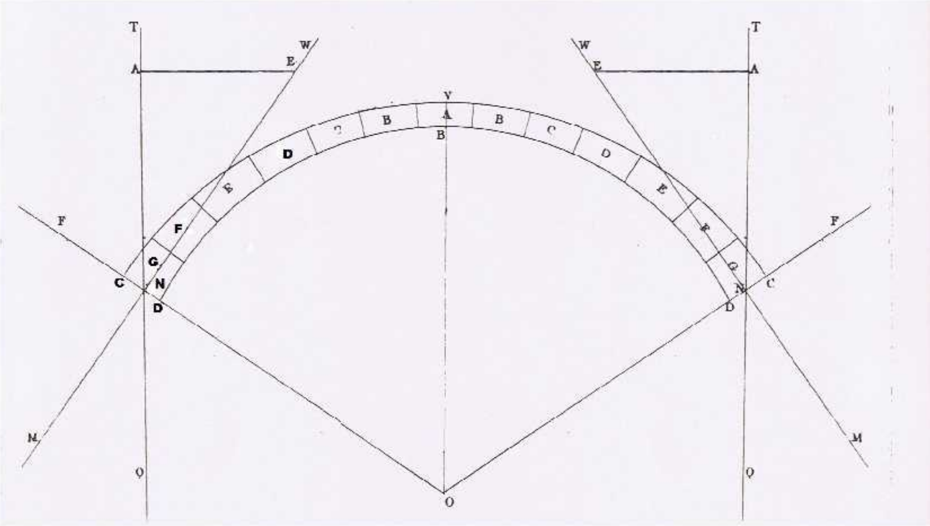


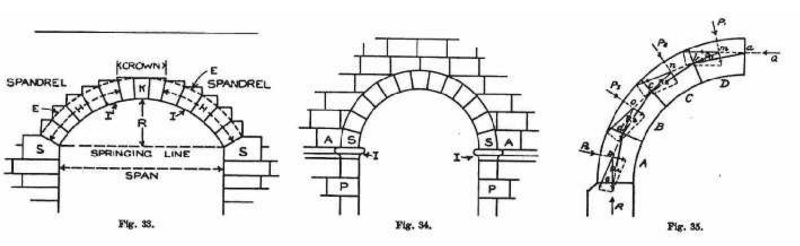
NOTES:

Angle formed by VOD = 1/2A° in equations above.

The tendency of the Weight at "A" is to fall along the vertical axis line VO. However, this tendency is counterbalanced by the horizontal vectors PQ and KI, which prevent the arch from moving vertically.



Atwood, Fig 4



From: The Builder, Jan 30, 1904, pg 113

Now that we have a basic idea of what an arch is, and how it works, lets look at some simple equations for calculating the key dimensions of a 19th century masonry arch tunnel.

From " *A Treatise On Masonry Construction*, By I. O. Baker, 1909, pg 641- 646, we glean three important "empirical" formulas for designing a masonry arch, credited to Rankine, and known as "the English Method". Since the entire concept of the "empirical method" is based upon observation, we'll pick the formulas that fit best for both the Croton Aqueduct, and the Atlantic Avenue tunnel.

Let's first take the case of the circa 1842 Croton Aqueduct:

First, for calculating the thickness of the arch at its highest point, or crown, we'll use Rankine's method:

d(crown) = $\sqrt{(0.12 \cdot r^2/s)}$

Where span "s" = 7.5 ft
And rise "r" = 3.75 ft

d = $\sqrt{0.225}$

d(crown) = 0.47434 ft x 12"/ ft = 5.69 inches by Rankine's method.

Since the y axis of a typical period brick laid longitudinally on its edge is about 3- 1/2 ", two layers of brick arch would be required. In fact, according to a circa 1842 scale drawing, the arch of the Croton Aqueduct is in fact 2 layers of brick thick, and adding 0.5" for a single cement mortar joint, making the crown of the Croton Aqueduct a total of 7.5" thick. This matches perfectly with the contemporary scale drawing.

Next, we must calculate the thickness of the arch at the ***springing line***: To understand this particular equation, one must first appreciate the concept of the "joint of rupture".

Essentially, this is the joint along any arch, that is subjected to the greatest force. Since taking the sum of moments around an arch is somewhat beyond the scope of this article, we'll use the simple fact that according to Baker, this "joint of rupture" usually forms an angle with the vertical, between 45º and 60º. The "joint of rupture" is also considered to be the point where the arch technically ends, and the abutment theoretically begins. The continuation of the arch from the joint of rupture to the spring line, is considered to be a prolongation of the abutment, rather than the arch.

By measuring the original scale drawings of the structures, and taking the joint of rupture to coincide with the joint at which the thickness of the arch begins to increase; on the Croton Aqueduct of 1842, this angle appears to be 60º from the vertical. For the Atlantic Avenue tunnel of 1844, this angle appears to be the average of the maxima and minima, as cited by Baker, or 52.5º from the vertical.

So, we now have the equation for calculating the thickness of the Croton Aqueduct at its spring-line:

d(spring-line) = **d(**crown) • Secant Θ

where Θ = angle made by joint of rupture with the vertical.

Using the trigonometric identity **Secant Θ = 1 / Cosine Θ**, our equation can be rewritten as:
d(spring-line) = **d**(crown) / Cos Θ

Plugging in the numbers, we have:

d(spring-line) = 7.5" • (1/Cos 60°) = 7.5" • 2 = **15"**

According to the contemporary scale drawing, the Croton is 21” thick at its spring line. The additional 6” of thickness, is taken to be the safety margin (40%).

Finally, for the thickness of the Croton's abutments ***at their base***:

d(abutment**)** = 2/3 h

where h = clear height of abutment

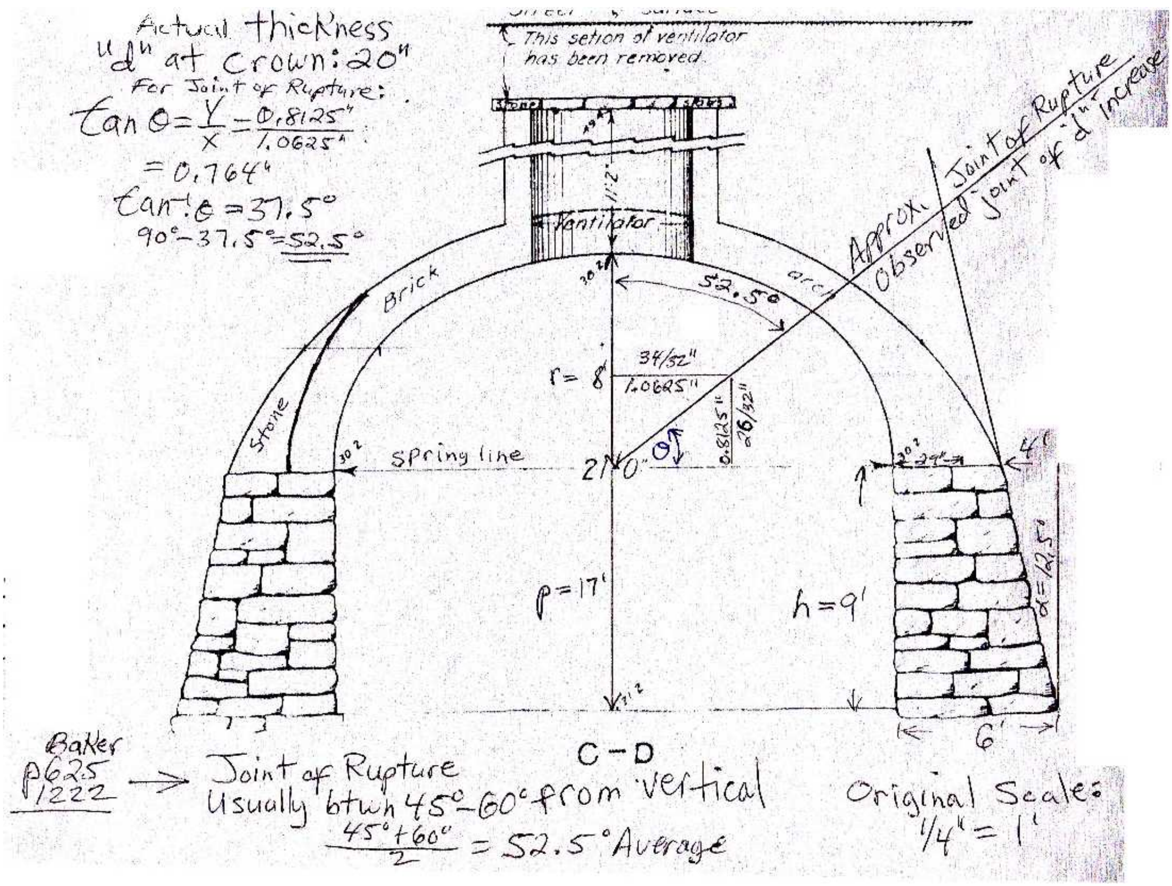
Plugging in the numbers, we have:

d(abutment**)** = (2/3 • 3.75 ft) = 2.5 ft thick at the base

Measuring from the contemporary scale drawing, the Croton's abutments are 2.6 ft thick at their base.

<u>The Atlantic Avenue Tunnel</u>

In Brooklyn, circa 1844, the ancient concept of the Roman “Underground Passageway” made the technological “jump” from water tunnels and cryptoporticus to the urban underground railway...



Since the Atlantic Avenue tunnel was built under a city street, by the “cut and cover method”, for the specific

purpose of attaining grade separation for the LIRR, this structure is therefore the world's first transportation Subway: urban underground railway line.

See the following link for contemporary historical documentation:

http://brooklynrail net/images/aa_tunnel/new_research/oct_09/events_leading_to_tunnel_creation.pdf

The ½ mile arch of the tunnel consists of 5 layers of high quality red burned brick, laid in bond with headers and stretchers, and additional external Spandrel material- Mica Schist rubble masonry (Manhattan bedrock) between the joint of rupture and the spring line, all layed in a Portland cement/sand mortar. The brick headers interconnect the 5 layers of the brick arch, thereby further strengthening the arch. The tunnel's abutments (walls) consist of massive Mica Schist rubble masonry, thoroughly grouted with Portland cement/sand mortar.

Lets now apply these formulas to the Avenue tunnel of 1844:

Applying Rankine's formulas, we get:

$\mathbf{d}_{(crown)} = 2 \cdot \sqrt{(0.12 \cdot r^2/s)}$

Where span "s" = 21 ft
And rise "r" = 8.0 ft

Note that in this particular application of Rankine's tunnel arch formula, we have doubled the result, as per Baker's instructions, to account for the fact that the tunnel is built within a sand matrix.

$d_{(crown)} = 2 \cdot \sqrt{(0.12 \cdot 8^2/21)}$

$\mathbf{d}_{(crown)} = 2 \cdot 0.604743$ ft

$d_{(crown)} = 1.209486$ ft = 14.50 inches by Rankine's method.

The actual measured thickness at the crown, is 20" (1.60 ft). It's assumed that the difference of 5.5 inches, is a safety factor of 38% at the crown.

For calculating the thickness of the Atlantic Avenue tunnel at its spring-line:

$\mathbf{d}_{(\mathbf{spring\text{-}line})} = \mathbf{d}_{(crown)} \cdot \text{Secant } \Theta$

where Θ = angle made by joint of rupture with the vertical.

Again, using the trigonometric identity **Secant Θ = 1 / Cosine Θ**, our equation can be rewritten as:

$\mathbf{d}_{(spring\text{-}line)} = \mathbf{d}_{(crown)} / \text{Cos } \Theta$

plugging in the numbers, we have:

$\mathbf{d}_{(\mathbf{spring\text{-}line})} = 14.50 \text{ inches} \cdot 1/\text{Cos } 52.5^\circ$

$\mathbf{d}_{(\mathbf{spring\text{-}line})} = 23.819$ inches, say 24 inches.

The actual as built measured thickness at the spring-line, is 48 inches. It is assumed the 24 inch difference is a safety margin of 100% at the spring- line.

Now let's calculate the volume of masonry building material used in the Atlantic Avenue tunnel.

In mathematical terms, the arch of the tunnel is "an ellipse of the semi major axis (a) and semi minor axis (b)". Since the ellipse is centered at the origin (0,0), polar equations can be used.

The area of an ellipse centered at (0,0) = πab

Sources: Schaum's Outline Mathematical Tables and Formulae, 2 nd Edition, pgs 15, 23.
CRC Standard Mathematical Tables and Formulae, 31 st Edition, pg 330- 331.

Therefore, the general formula for the area of our arch of a single elliptical hemisphere is:

Area Tunnel Arch = $\pi ab/2$

To obtain the area of our arch, we must subtract the area of the inner arch surface (intrado) from the area of the outer arch surface (extrado):

Area intrado = $(3.14 \cdot 8 \cdot 10.5)/2 = 131.88$ ft²
Area extrado = $(3.14 \cdot 9.6 \cdot 14.5)/2 = 218.54$ ft²

Area tunnel arch = 218.54 ft² – 131.88 ft² = 86.66 ft²

Multiplying 86.66 ft² by 2000 ft, and then dividing by 27 ft³/ Yd³, **we obtain an arch volume of 6,419 Yd³.**

However, as we know from our core samples, the arch is not made entirely of brick. The arch is a constant thickness of 20 inches of brick, and supplemented in depth with mica schist rip rap laid in Portland cement mortar, from the joint of rupture to the spring line, as per the cross sectional view.

This was no doubt done as an economizing measure, as the Mica Schist was free, except for the cost of cutting in Manhattan and transport to Brooklyn. The brick on the other hand, had to be purchased and transported.

Lets now calculate the volume of brick in the arch, and then subtract this volume from the total arch volume:

Area brick extrado = $(3.14\ ((10.5 + 1.6)) \cdot (8 + 1.6)/2 = 182.37$ ft²

Area brick arch = Area brick extrado - Area Intrado = 182.37 ft² – 131.88 ft² = **50.49 ft²**

Volume brick masonry in arch = 50.49 ft² • 2,000 ft = 100,980 ft³/27 = 3,740 CY.

Deducting 20% of this volume to account for the Portland cement mortar, we get:

Sample brick taken from the tunnel, give us the following dimensions:

Length: 8 inches = 0.666 ft

Height: 2- 3/8 inches = 0.1979 ft
Depth: 3- 5/8 inches = 0.30208 ft

Therefore, **1 brick = 0.04 ft^3**, making exactly 25 bricks per cubic foot, exclusive of mortar joints, which are approximately 3/8 inch each.

By deducting 1/5 of the total volume volume of Brick masonry, to account for the volume of the hydraulic cement mortar per cubic foot, and then dividing the result by 0.04 ft^3 per brick, we get a grand total of 2,019,600 bricks in the Arch of the tunnel, exclusive of mortar joints:

100,980 ft^3 – (100,980 ft^3/5) = 80,784 ft^3 Brick = 2,992 CY Brick, and 748 CY Portland cement mortar (for brick) in arch.

Finally, 80,784 ft^3/0.04 ft^3 per Brick = **2,019,600 Bricks in the Tunnel's arch.**

To calculate the volume of stone rubble masonry in the tunnel's arch:

6,419 $CY_{(\text{total arch})}$ – 3,740 $CY_{(\text{brick masonry})}$ = **2,679 CY Stone Rubble masonry in the arch, of which 2,143.2 CY is Mica Schist rubble, and 535.8 CY Portland cement mortar.**

Finally, lets calculate the the thickness of the abutment walls at the base, and then the volume of stone masonry contained in each of the tunnel's abutments (exclusive of the approach ramps):

$\mathbf{d_{(abutment)}}$ = 2/3 h = 2(9 ft)/3 = **6 ft thick at the base of abutment**. This precisely matches the as built condition.

Area per Abutment = (9 • 4) + (9 • 2)/2 = 45 ft^2/ (9 ft^2/Yd^2) = 5 Yd^2

5 YD^2 • 2,000 ft/ (9 ft^2/YD^2) = 3,333 Yd^3 per abutment • 2 = 6,666 Yd^3 total volume. Our ratio of stone to mortar per cubic yard then gives us:

6,666CY – (6,666 CY/5) = 5,332.8 CY Stone Rubble and 1,333.2 CY Portland cement mortar total abutments.

Then total masonry work excluding approach ramps:

Stone Work:
Abutments: 6,666 Yd^3
Arch: 2,679 Yd^3
Sub Total Stone Work: 9,345 Yd^3

Brick Work (Arch): 3,740 Yd^3

Atlantic Avenue Tunnel Total Masonry Work (excluding approach ramps): 13,085 CY, of which 10,468 CY is Stone Rubble and Brick, and 2,617 CY is Portland cement mortar.

Using our proper definition of a railway subway, the second example of such a structure, is the the extant NY & Harlem River RR tunnel located in Park Avenue South between East 33 rd Street and Grand Central Terminal (now a vehicular tunnel). Originally, this tunnel was begun about 1836, only as an open cut through a major rock obstruction, called “Murray Hill”, rather than for attaining grade separation.

This open cut rock structure was later arched over with brick circa 1850, thereby converting it to an urban grade separation tunnel, to facilitate and accommodate the real estate development, and the increased volume of pedestrian and horse drawn vehicular traffic, occurring all around it.

Innovation doesn’t happen in a vacuum...

The third railway “subway” constructed, was **London's [North] Metropolitan Railway**, first proposed circa 1853, and completed circa 1863.

Essentially a 2-1/4 mile short line railroad extension of the Great Western Railway, by necessity (traffic congestion), parts of this route had to be built in both open cut and tunnel (grade separation). It **was not** an isolated rapid transit line.

Originally proposed by the City of London's tenacious Corporation Solicitor, Charles Pearson, Esq., I suspect that he and his adherents were inspired by the tunnels in Brooklyn and Manhattan, which he, or an associate, probably studied on a trip to New York in the late 1840's or early 1850's.

This short line railway extension was built using the “cut and cover”, as well as the “open cut” methods, under both streets and private property, **to attain grade separation (congested streets)** for the Great Western Railway's new passenger and freight access to the Thames River via downtown London.

This structure is virtually identical in concept and execution to the Atlantic Avenue tunnel. However, the Metropolitan line tunnel was built to accommodate the 7 foot gauge trains of the GWR.

It needs to be adequately noted, however, that London's Metropolitan Railway wasn’t originally all contained within a tunnel, nor was it built as a strictly local, self contained, rapid transit line...

Writing of London's original Metropolitan Railway line, the Encyclopedia Britannica, 1911, Vol 22, page 856, states: **“Wherever possible the lines were constructed in open cutting...where this was not possible, they were built by a method suggestively called “cut and cover”**. Essentially, this first line of the London Underground ***is*** the Atlantic Avenue tunnel, but lengthened accordingly to suit its particular route.

As to its original purpose, London's Metropolitan Railway line was in fact part of a much larger system of railways (as was the Atlantic Avenue tunnel/ LIRR). London's Metropolitan Railway was also built to provide rail freight service to the massive Smithfield cattle stockyards and meatpacking facilities, pictured below. The original function of this London “underground” line was “mixed use” to say the least... I quote from Slaughter (1860):

> The main purpose of the Metropolitan Railway, as is well known, is the making [of] a line from the Great Western at Paddington to a point on the eastern side of Victoria Street (Holborn) “. Slaughter goes on to write: “the...Metropolitan Railway will be thus placed in direct railway communication not only with Dover and the Continent, but also with the southern portions and suburbs of the metropolis [London]”, and further, “Arrangements have been made by ***this Company* [Metropolitan Railway]*, and the Great Western Railway Company,*** with the Corporation [City of London] for the use of the ground under the [Smithfield] market for the purposes of a goods' station “. Also of note, is this Wikipedia article on the history of the Smithfield market: http://en.wikipedia.org/wiki/Smithfield,_London

Above Picture: "before the Metropolitan line was built, herds of cattle were driven through the streets of London to Smithfield Market, causing massive traffic congestion problems" (London, a Social History, Roy Porter, 2001, p193)

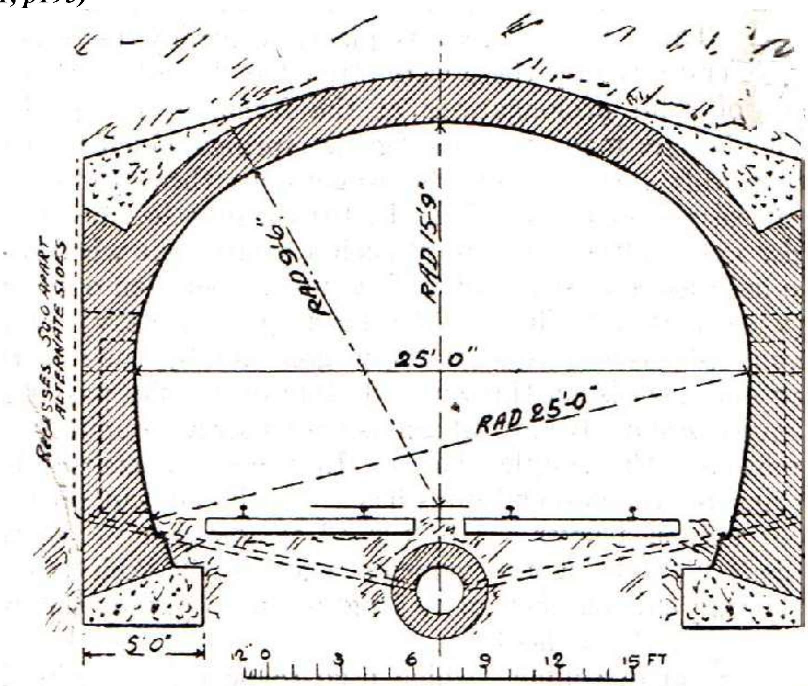


FIG. 30.—Type-Section of Arched Covered Way,
Metropolitan District Railway, London

Railway Intelligence, by Mihill Slaughter, No XI, Dec 31, 1860, pg 114- 115 gives us a detailed, first hand account, as to the origins and purposes, of the first of the London Underground lines:

METROPOLITAN.

Incorporated by 16 and 17 Vict., cap. 186, passed 15th August, 1853.

POSITION AND PROSPECTS OF THE UNDERTAKING.

The North Metropolitan (as the Company was originally called) became incorporated as far back as 1853, but until 1859 could scarcely be said to have taken any firm hold on the investing public. That it has at length done so is principally owing to the tact, perseverance, and influence of Mr. Charles Pearson, the City Solicitor, who having induced the Corporation to recognise their own interests in furthering the scheme, was at last able to conclude a subscription in their name for 20,000 £10 shares. From this period the undertaking has made steady progress, and its complete realisation is now a mere question of time.

The main purpose of the Metropolitan Railway, as is well known, is the making a line from the Great Western at Paddington to a point on the eastern side of Victoria Street (Holborn) Other objects more or less tending to the advantage of the Company have since been added, and these may be best explained in the following summary, compiled from the August (1860) Report of the Metropo litan Board :-

The Corporation of London have obtained the sanction of Parliament to establish extensive markets in Smithfield for the sale of meat and provisions, and to afford to Railway Companies facilities there, not only for traffic for the purposes of the markets, but also for receiving and delivering goods for the general trade of the city and the central districts of the metropolis.

An Act has been passed for a short line to connect the railway with the new markets, and with the large and convenient railway station which will there be formed.

Arrangements have been made by ***this Company, and the Great Western Railway Company,*** with the Corporation for the use of the ground under the market for the purposes of a goods' station

[Editor's Note: sounds a lot like the original LIRR passenger/ freight terminal at Atlantic Avenue & Columbia Street, and later at Flatbush & Atlantic Ave].

The rent to be paid by the two Companies for this large space is fixed at £ 2,000 per annum; the Companies bearing the cost of excavating the substructure and its retaining walls and also a portion of the cost of the roof, the Corporation defraying the larger portion of the latter outlay, and all charges incidental to the erection of the market.

The London Chatham and Dover Company having obtained powers to extend their line to join the railway of the Company at its present terminus in Victoria Street (Holborn), the system of the Metropolitan Railway will be thus placed in direct railway communication not only with Dover and the Continent, but also with the southern portions and suburbs of the metropolis.

Considering the enormous traffic which the Metropolitan Railway will undoubtedly be required to accommodate, and more especially the need of space near the proposed goods' depot at Smithfield, the Company have purchased the whole of the vacant land belonging to the Corporation of London on the eastern side of Victoria Street (Holborn), and north of West Street. For this land, in quantity 5 acres 19 perches the purchase money has been agreed at £ 179 157 of which £60 000 will ***be*** paid in money during the next 12 months, from August, 1860, and the remainder by a rent-charge at the rate of **41 per cent. per annum, redeemable in 40 years.**

PROGRESS OF WORKS.

The works have been satisfactorily let on guaranteed contracts to experienced Contractors, who have promptly commenced operations. Speaking generally, the works, both at King's Cross and at Paddington, are in full progress, and a very considerable portion of the land **for the line and stations has been purchased, and the buildings thereon are being rapidly cleared**

PROPOSED EXTENSION TO (OR NEAR) THE BANK.

Although the stations at Victoria Street (Holborn), and Smithfield will no doubt be sufficient for the previously contemplated traffic of the railway, it is felt that a station nearer to the Bank is a public requirement; and an application will be made to Parliament in the 1861 session for an extension from Smithfield to Finsbury **Circus. The length of this extension** will scarcely exceed half-a-mile, and it is considered that the property through which it would pass is not of a costly description.

It is believed that no preference stock need be created for this purpose, but that the necessary cost may be readily provided for by means of a separate capital of the Metropolitan Company, as the vast traffic over this portion of the line, comprising the combined traffic of both the Metropolitan and London, Chatham, **and Dover Railways, will, it** is believed, **secure a satisfactory dividend on the capital expended.**

Great Innovations in the history of “subways” 1886 – 1904

1. the next major innovation in subway construction was: The “deep tubes” built for the London Underground, circa 1886, using the Greathead Shield (a very early form of a tunnel boring machine).

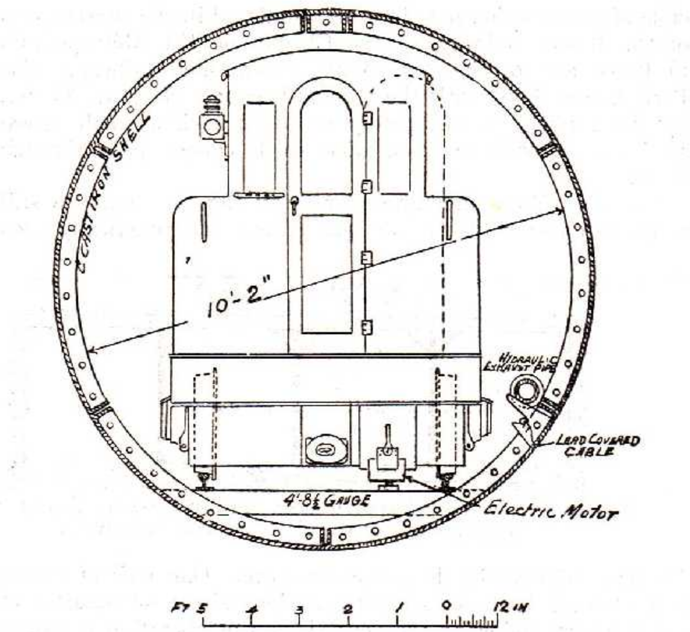
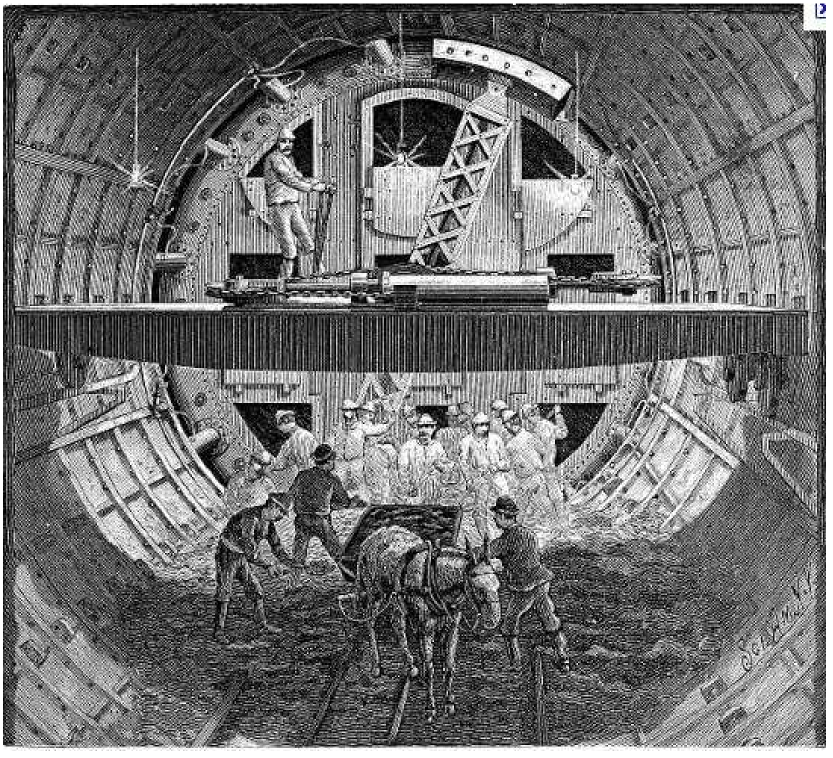


FIG. 33.—Section of Tunnel and Electric Locomotive, City & South London railway.

Illustration of the “Beach / Greathead Shield”



Picture of the “Beach / Greathead Shield”

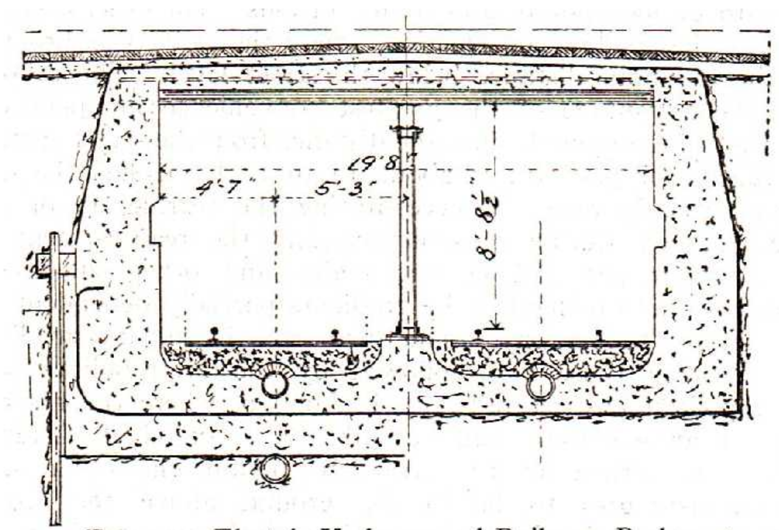


FIG. 34.—Electric Underground Railway, Budapest.

2. Circa 1893, the Budapest (Hungary) subway was opened, the first to utilize steel beams and reinforced concrete as its major structural “cut and cover” elements, rather than brick and stone masonry work.

The drastically increased cost of labor during the 1890's, precluded any further great works of brick and stone construction, the cost of which had become prohibitive. Steel and concrete lent themselves well to mechanized mass production methods.

The Boston Subway:

In January, 1894, the concept of an urban underground railway, pioneered under Brooklyn's Atlantic Avenue in 1844, made a full circle back to the U.S...

Boston's Board of Subway Commissioners was appointed, with certain authority, to build “an elongated cellar" as it was called at the time, under Boston Commons, known as the “Hub”.

Built to remove 67 distinct streetcar lines from the surface (grade separation once again, as it always is with subways), this tunnel, built of concrete and steel using the “cut and cover” method (as per the Budapest subway), was only ¾ of a **mile in length when first opened to the public on September 1, 1897**. On the

Boylston Street side of the Common, it cuts through a an old cemetery. A total of 910 bodies were dug up, and reburied.

(**Sources:** The Journal of the Franklin Institutute, November, 1897, pg 393; Elliott's Magazine, August, 1899, pg 45- 46.)

3. New York City's first IRT subway line, which opened circa 1904. The line's designer, William Barclay Parsons, innovated the concept of a 4 track subway route. In this way, two distinct services could be operated simultaneously along the same route: both an “Express” and a “Local” line. See fig # __, encyclopedia Britannica

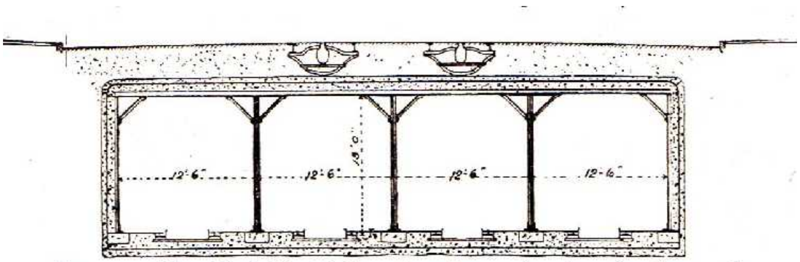


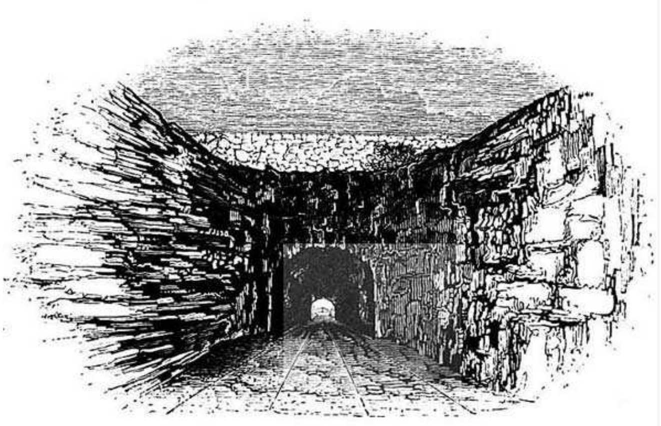
FIG. 35.—New York Rapid Transit railway, showing also the tracks and conduits of the electric surface tramway.

EPILOGUE:

As this piece is partially "New York City Centric", I think it proper to mention three "pioneer" NYC tunnels, that while not built as grade separation subways by "cut and cover", are still historically note worthy in themselves:

I) New York & Harlem RR, circa 1837 (MTA Metro-North Tunnel in Manhattan)

First, is the tunnel blasted through very tough rock in northern Manhattan, by the New York & Harlem RR, circa 1837. The NY&H RR, was the world's first horse drawn streetcar operation. Built by hand with nothing more than gun powder, the Mt. Prospect tunnel is still in constant use, containing the MTA's Metro North center express tracks, under Park Avenue between 92nd- 94th St.


HARLEM RAILROAD TUNNEL.

Page 93.

Mt. Prospect Tunnel, built 1837, NY & HR RR
Source: Pictures Around New York, 1846

2) Haskins Hudson River Tunnel (PATH Train Tunnels) 1874

Next, we have the very tragic "Haskins Hudson River Tunnel", begun in 1874, now PATH's uptown north tunnel. The following narration is extracted from the Encyclopedia Americana, 1920, Vol. 27, pg 152- 153:

Haskins Tunnel.— The early history of the up-town twin-tunnels under the Hudson River is a tragic one. D. C. Haskins, a westerner of wealth, conceived the idea that the Hudson River could be crossed by a tunnel formed by boring in the bed of silt deep below the surface, maintaining an air pressure in the heading equal to the hydrostatic head outside and retaining the excavated space by insertion of a series of iron rings as fast as the boring progressed. Work was commenced in 1874 from the New Jersey side; it was the first attempt to tunnel the Hudson River. A shaft was sunk to 54 feet below mean high water, an air lock was built and the regular tunneling began with an air pressure of about 18 pounds at the shaft, increasing to 36 pounds at 1,600 feet distance. After carrying this north heading a quarter of a mile, the south tunnel was started. Then the New York end was commenced with sinking a timber caisson to a depth of 56 feet below high water. Blow-outs occurred with flooding and letting in of silt, which ended in a serious blow-out in 1880, cutting off the escape of the excavating crew and drowning 20, thereby ending operations. In 1888 S. Pearson and Son of England took up the contract, and the shield method of driving was used, but financial troubles closed out operations till 1902, when the plant and franchise were acquired by the New York and New Jersey Railroad Company, who renewed the effort. In 1905 the Hudson Company obtained the tunnel interests and the operation became part of what is known as the McAdoo System.

McAdoo Tunnels.— With the amalgamation of the New Jersey Railroad Company and the Hudson-Manhattan Railroad Company in 1903, the McAdoo System started in operation. Leaving out consideration of the great terminal and other works, the great tunneling feat alone is featured here. The overcoming of the many very difficult engineering problems was placed under the management of Charles M. Jacobs and J. Vipond Davies, and they determined on the employment of compressed air as a medium for operating drills, shields and all mechanism used in construction. On the Jersey City side the former shield service was used with certain necessary changes, such as heavy hood or apron to protect the workers. Pressure of 33 pounds was carried, as the upper stratum of the tunnel was of silt. Blow-outs were closed with clay blankets supplied from scows waiting in readiness. The shield was driven by hydraulic jacks with 2,500 tons aggregate thrust to make passage through the silt, thus making excavation unnecessary. A rock reef at one time was struck that reached 16 feet above the bottom of the space to be tunneled, the upper part being of clay so fluid as to slip into the pockets of the shield. Gigantic blow-pipes supplied with fuel from tanks of kerosene were used to bake the clay to sufficient hardness as to permit the excavators to work on the rock beneath. The tunnel diameter of 15 feet 3 inches was lined with cast-iron plates bolted together in circular section. The greatest engineering feat in this great undertaking was the construction of the tunnels at the junction of the Christopher street, 9th street and 6th avenue, New York City. At this point two tunnels run east under 9th street and two north under 6th avenue. Overhead here were the surface car lines of the Metropolitan Street Railway, and above this the Elevated railroad, both in operation. An arch, to accommodate two tubes approaching from the south and four tubes diverging east and north had to be constructed with 68 feet maximum width, and the soil was a «running sand.» The enormous difficulty was overcome by constructing two iron-lined temporary tunnels and the side walls being built in. Then, through openings on top of the tunnels, heavy false work was constructed strong enough to permit springing the arch. The temporary tunnels were then eliminated. Any accidental disturbance of the timbering meant that the surface lines and Elevated structure must fall into the excavation. Tunnels from Jersey City to Morton street, New York City, started 1874, opened for traffic 1908, consisting of two single-track tubes 5,000 feet long with minimum diameter 15 feet 3 inches. The two down tunnels connecting Jersey City with Cortland, Church and Fulton streets, New York City, were commenced in 1905 and opened for traffic operation in 1909. These consist of two tubes 5,950 feet long and 15 feet 3 inches inside diameter. As to the land sections of the Hudson-Manhattan tunnels, one connects, by two single-track tubes, the Hoboken terminal with the Jersey City Pennsylvania Railroad station, running parallel with the Hudson River. This was completed in 1911. Another land subway connection runs from Morton and Christopher streets to connect with 33d street, running along 6th avenue. This was opened to the public in 1910 and was constructed with shield to 12th street, then cut-and-cover to 33d street.

3) Beach Pneumatic Subway Tunnel (1869)
No discussion on the New York City "underground", would be complete without mentioning the circa 1869 Beach Pneumatic Tube. The following is an illustrated article on "Beach's Tube", which appeared in the February 24, 1912 edition of Scientific American. At that time, it was rediscovered- and said to have been completely destroyed, by the City's subway contractor, Degnon Underpinning.

As per the photograph and caption at the center of Scientific American page 176, Beach's tunnel extended under City Hall park, to a certain metal grating. As the photos were made in 1912, this entrance to Beach's tube, and section of tunnel, obviously survived the construction of the IRT City Hall loop, circa 1904.

Could a section of Beach's tube still exist today, under City Hall park? The photo gives us 2 geometric reference points: the windows on the building in the background, and the tree in the foreground...anyone care for a stroll in the park?

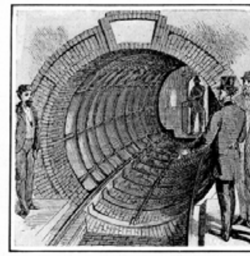
Continued on next Page:

The car.
From the *Scientific American* of March 5th, 1870.

New York's First Subway

How Alfred E. Beach, Editor of the Scientific American, Secretly Built a Pneumatic Railway Beneath Broadway in 1869

By Waldemar Kaempffert



The tunnel.
From the *Scientific American* of March 5th, 1870.

IT took New York forty-three years to carry out an idea first proposed and experimentally executed by the SCIENTIFIC AMERICAN. Broadway will soon be tunneled for a subway, tunneled, moreover, by almost the exact methods advocated by A. E. Beach in the days when New York thought cars drawn by horses marked the limit of human ingenuity in providing quick transportation for a congested population. Section No. 2 of the new subway is soon to be dug. Part of it the engineers will find tunneled for them.

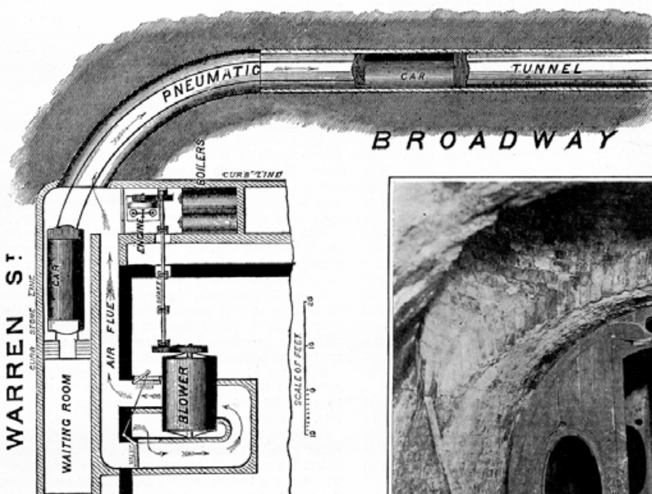
It is difficult for us to realize that small as New York was fifty years ago the transportation problem was almost as pressing as it is now. When hardly four years old the SCIENTIFIC AMERICAN fought strenuously for a rational solution of that problem. In the issue of November 3rd, 1849, appeared an editorial entitled "An Underground Railroad in Broadway," in which we read:

> "The plan is to tunnel Broadway through the whole length, with openings and stairways at every corner. This subterranean passage is to be laid down with a double track, with a road for foot passengers on either side—the whole to be brilliantly lighted with gas. The cars, which are to be drawn by horses, will stop ten seconds at every corner—thus performing the trip up and down, including stoppages, in about an hour."

It is a far cry, from a horse-drawn railway and a tunnel "brilliantly lighted with gas," to a high-speed, electrically illuminated subway; but it was all that the engineering facilities of the year 1849 could offer. Crude as the system was, it was infinitely better than

The grating in City Hall Park, covering a ventilating opening leading to the Scientific American tunnel.

In the picture Mr. F. C. Beach, son of A. E. Beach, is shown, holding a small model of the shield with which the tunnel was dug.



Plan of New York's first subway, built by the editor of the *Scientific American* in 1869-1870.

From a wood cut published in the *Scientific American*, March 5th, 1870.

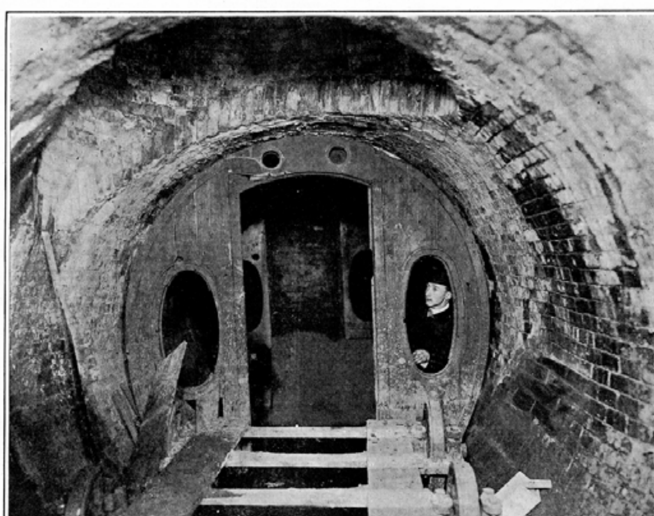
anything that New York, or for that matter, any civilized city in the world, could offer.

Year after year the SCIENTIFIC AMERICAN, in company with the newspapers of the day, berated the city authorities for their negligence in providing adequate transportation. Finally, Mr. A. E. Beach, who, with Mr. O. D. Munn, founded the SCIENTIFIC AMERICAN, determined to attack the problem himself. He had been an earnest advocate of the pneumatic system of transmitting packages, above all, packages of letters. Experiments had shown that a carrier containing letters could be blown through a tube. If a package of letters could be blown through a tube, why not a package of human beings in a car?

The idea bore fruit. In 1867 he exhibited at the American Institute Fair, held at the old Fourteenth Street Armory, a model of a pneumatic railroad suspended from the roof of the building and running from Fourteenth to Fifteenth streets. Through a tube six feet in diameter, with walls one and one-half inches thick, composed of fifteen layers of wood glued together, a car open at the top with a piston end was drawn in and forced back by suction and pressure by a propeller fan, ten feet in diameter and twelve inches in pitch, turning at the rate of 200 revolutions per minute. All New York came to see the model railway. The car was kept in constant operation. Hundreds of people traveled in it back and forth.

After that brilliant success the Editor of the SCIENTIFIC AMERICAN came out more strongly than ever in favor of a subway for New York. Despite his success at the American Institute Fair, his proposals were received with derision by the public press. That they must have been very exciting may be gathered from the newspaper comments of the day.

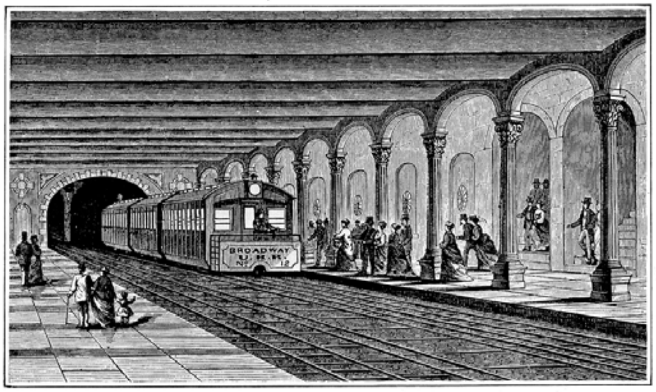
Eventually, legislative authority to build a pneumatic tube from Warren to Cedar Street was secured, and subsequently by an amended charter permission was obtained to construct one large tube for holding a group of small tubes for the pneumatic transmission of parcels and the like. Under the management of the Beach Pneumatic Transit Co., and under the supervision of Croton Aqueduct Commissioner Gen. George S. Greene, the work was begun in a quiet way and the tunnel bored by means of an hydraulically propelled shield around a curve from the southwest corner of Warren Street south down Broadway to a point nearly opposite the south side of Murray Street. The dirt was carried to the cellar of the structure at 260 Broadway, the sub-basement and basement of which had been



The Murray Street end of New York's first subway, built in 1869-1870 by the editor of the *Scientific American*.

The picture shows the ruins of the old car. The opening at the top is the beginning of a bricked ventilating conduit passing from Murray Street and terminating in the grated opening shown above.

rented for the purpose at Murray Street. The wall of a supposed old Dutch fort was encountered. To penetrate it, the stones had to be removed so as to leave an arched way for the shield. There was some doubt whether the street would not cave in. Editor Beach took the chance, however. One day a New York



This is a design for a subway station, by Alfred E. Beach, editor of the *Scientific American*, published by him in the *Science Record* for 1874, an annual compendium of scientific progress and discovery, of which he was the editor.

Tribune reporter, disguised as a workman, gained access to the subway. On the following day his paper published a description of the work which created considerable interest. Not long after this publication the tunnel was completed as far as it was intended to go at that time, and was thrown open for the inspection of the public. An admission fee of 25 cents was charged. The proceeds were given to charity.

To counteract the *Tribune's* attacks and to prove to the public that it was not utterly impracticable, Mr. Beach decided to throw the subway open to the public and to permit a general inspection of the tunnel, with its car and the big machine that blew the car from one end of the tunnel to the other.

What New Yorkers saw is thus described in the Scientific American of February 19, 1870:

"Let the reader imagine a cylindrical tube, 8 feet in the clear, bricked up and whitewashed, neat, clean, dry and quiet. Along the bottom of this tube is laid a railroad track, and on this track runs a spacious car, richly upholstered, well lighted, and with plenty of space for exit. The whole arrangement is as comfortable and cozy as the front basement dining room of a first-class city residence. The tunnel has not only the positive comforts described, but is absolutely free from the discomforts of surface car traveling. The track is single and level; it is not cold in winter. It will be delightfully cool in summer. . . . The air will be constantly changed in it by the action of a blowing machine. The filthy, health-destroying, patience-trying street dust of which uptown residents get not only their fill, but more than their fill, so that it runs over and collects on their hair, their beards and eyebrows, and floats in their dress like the vapor on a frosty morning, will never be found in the tunnel."

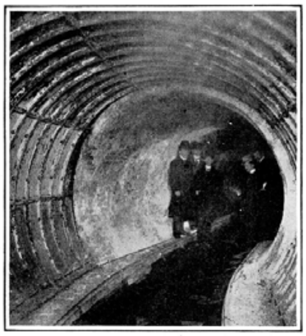
For two months and more streams of people walked through the tunnel, twenty-one feet below Broadway. The tunnel itself was "brilliantly illuminated by gas," as the Scientific American dreamed twenty years before.

Later the blowing machinery and the car were installed. All the big men in New York came to ride on the new railway, among them Horace Greeley, its one-time opponent.

At the Warren Street end stood the car. It fitted the tunnel like a carrier of a pneumatic tube, which it really was. Eighteen persons at a time took their seats in the car, were blown from one end of the tunnel to the other by compressed air from a 100-horse-power plant, and were sucked back when the valves in the blowing apparatus were reversed.

For a year the car traveled back and forth beneath Broadway. Day after day its waiting room, forty-six feet by twenty feet, held people waiting their turn to take a ride. The newspapers which had attacked the system advocated by the Scientific American now applauded it. When Mr. Beach tried to have a bill passed through the legislature authorizing him to complete his scheme, he found himself face to face with a Tammany measure. His bill was passed. So was the Tammany bill, authorizing the construction of an elevated railroad at a cost of $5,000,000 to be paid out of the city treasury. A Tammany governor vetoed the Beach measure and signed the Tammany bill. The very newspapers which had attacked the subway most bitterly now raged most furiously. There was nothing for it but to close the tunnel that had actually been built single-handed by the Editor of the Scientific American at a cost of over $350,000.

The manner of constructing the subway is of historical interest, because it is a complete anticipation of modern methods. Mr. Beach invented an hydraulically propelled shield, for his purpose. The shield was designed in 1865, tried in 1868 and patented in 1869. It consisted of a strong cylinder very much like a huge



Where the tunnel curved from Warren Street into Broadway, bricks were used instead of iron segmental plates.

The iron construction is almost identical with that followed to-day in subway construction.

barrel in appearance, with both heads removed. Staves were clamped endwise between two cast iron rings, the front ring being tapered to a cutting edge. A series of hydraulic rams, all operated from a common pump, were arranged along the main walls of the cylinder.

By means of these rams the shield was pushed forward for a distance equal to the length of the pistons. Each ram could be cut off from the pump independently. Hence it was possible to give the shield any desired tilt, up or down or from side to side. As the work advanced the laborers dug out and carried the earth back through the shield. The rear end of the cylinder, called the "hood," within which the iron or masonry tunnel was built, was partly drawn off from and ahead of the constructed tunnel. The pistons of the hydraulic rams were then shoved back into their cylinders and a new section of tunnel was built up within the hood.

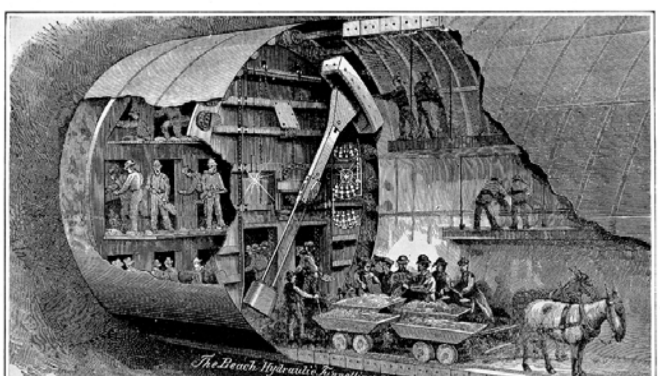
The length of the tunnel which was thus excavated beneath Broadway was about 400 feet. The exterior diameter was nine feet four inches. Starting at the head of Warren Street the tube curved down Broadway on a radius of about fifty feet. The curved portion was walled with cast iron plates, put up in segments and united by screw bolts, very much in the modern way. The straight portion was walled with brick masonry.

Why, it may be asked, why did not New York carry out the Beach project after the conspicuous success of the experimental section? It seems ridiculous now to learn that the chief objection was the fear that buildings would topple. In 1869 Trinity Church was the tallest structure in New York. Surely, thought the engineers of the day, surely the foundation of that enormous spire would crumble if Broadway is burrowed. Since then skyscrapers have been erected along the main thoroughfare of New York, and yet the subway that runs beneath them does not affect their stability.

Long after the tunnel between Warren and Murray streets was closed, the Scientific American fought for the subway idea. Mr. Beach planned a road beginning at the Battery and extending under Broadway to Central Park. A short lateral branch, east from 42nd Street, was to form a connection with the tracks of the Harlem Railway at the Grand Central Depot. The total distance was to be about five miles, and the estimated cost was $10,000,000.

Seismology in Russia

The seismological service of Russia has been reorganized and placed upon a most satisfactory basis, owing to the liberal funds voted for this purpose last year by the national legislature. An annual allowance of $24,000 has been granted, and, in addition, a special fund of $37,500 for the purchase of new apparatus and for the erection of a central station, with dwelling-house, laboratories, etc., at Pulkova. The work of this service throughout the empire is carried on under the Central Seismological Commission, which is attached to the Imperial Academy of Sciences at St. Petersburg, and is, like the Academy itself, an official organization. Its president is Prof. Backlund, director of the Pulkova Observatory. When the reorganization is complete Russia will possess seven seismological stations of the first order, and eighteen of the second order, besides the central observatory at Pulkova. The service is carrying on, besides the ordinary routine of recording earthquakes, many special investigations of great practical interest; thus the station at Makejevka is studying the connection between seismic disturbances and the liberation of fire-damp; that at Baku—in the heart of a world-renowned petroleum district—is paying special attention to the effects of earth tremors on the flow of the petroleum wells, etc.



An improved Beach hydraulic shield as used in building the tunnel under the St. Clair River.

This was patterned after the smaller and cruder shield used by Mr. Beach in building New York's first subway. (From a wood cut published in the *Scientific American* January 25th, 1896.)

Why Rail Has 20X Energy Saving Advantage Over Rubber Tire Road Vehicles - The Science of Locomotion

Introduction

The study of the old and largely forgotten scientific principals behind what makes trains and railroads work, is an interesting field. For example, one would think that the heavier the train, the more energy per unit weight would be needed to move it. In reality, the reverse is true: as the weight of the rail cars goes up, the energy per ton required to propel the train goes down. It takes much less energy per unit weight (lbs f/Ton) to move a 20 car train, than to move a 5 car train- and still even less energy per ton, than a locomotive running by itself ! (See the graph from the circa 1911 Encyclopedia Britannica). Note: this phenomenon DOES NOT apply to rubber tire vehicles, because of certain factors due to friction, such as "fractional hysteretic energy loss" and "contact modulus [elastic stiffness] ".

The Physics Behind Transportation Energy Efficiency

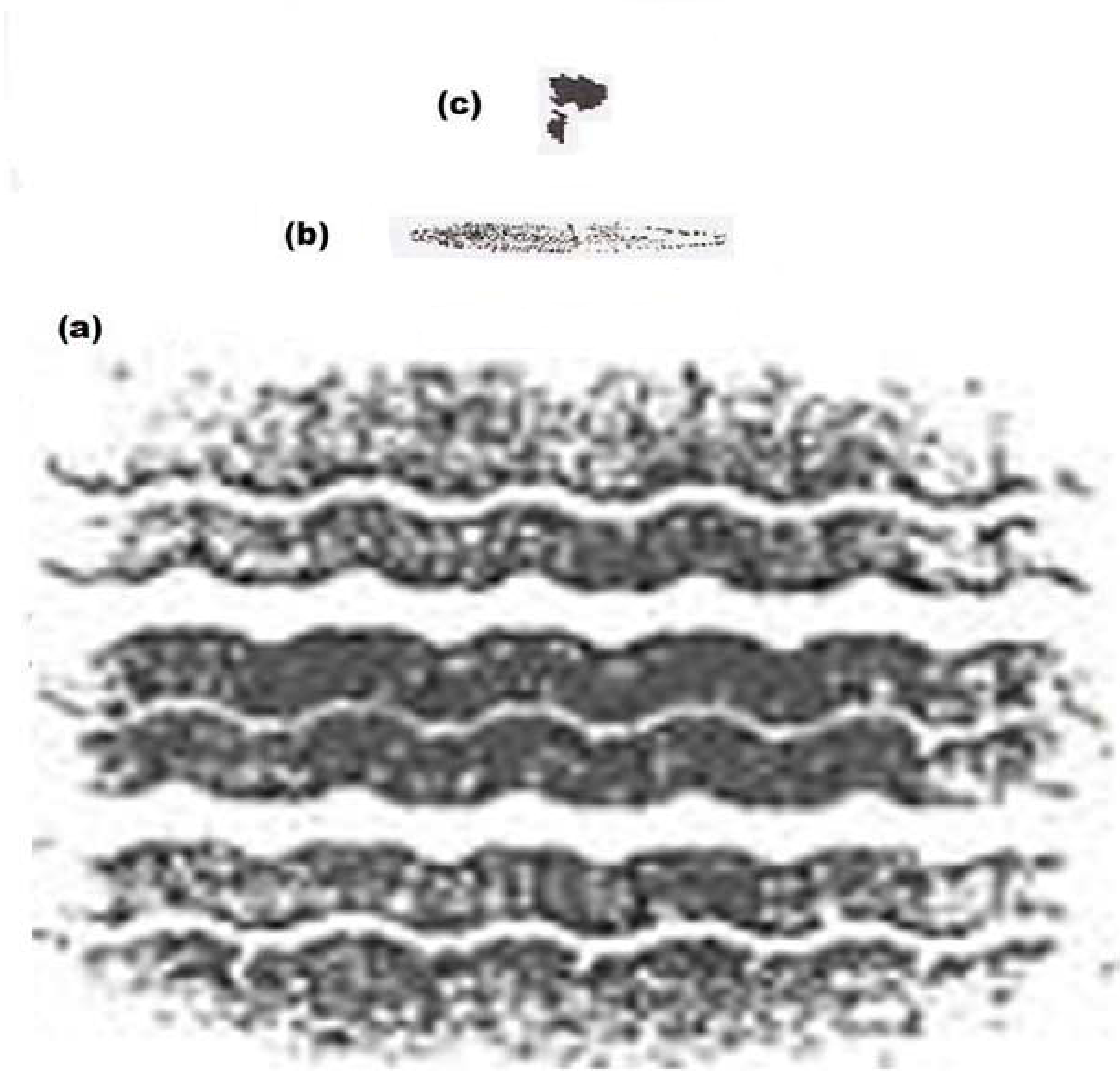
On the Atlantic Avenue tunnel tour, one of the many things we discuss, is the contemporary soot deposits left on the interior of the tunnel's arch. There is surprisingly little. Why? Low powered steam engines = small soot deposit.

Some of the LIRR's locomotives, such as their "Planet" types (Hicksville, John A. King), produced as little as 30 HP, the same amount of work energy produced by a modern "ride on top" lawn mower. At the time (1844), the LIRR was the fastest railroad in the U.S., operating trains at peak speeds of 50- 60 mph (average speed 38 mph). **How could a fast, heavy train possibly be moved by a force of only 30 HP?**

In the early 19th century, it was discovered by empirical observation, that it only took 8 (eight) pounds of force to move a one- ton weight (or 1/248th part of the whole weight) on a level railroad. (Note: This value was formerly called "Train Resistance". The modern term is "Starting Resistance", which can also apply to highway vehicles). The value cited reflected the primitive friction bearings of the time. It was also discovered, that a force 20 times greater, or 160 pounds (1/12th part of the whole weight) was required to move a one- ton weight on a contemporary [level] common road. Source: American Railroad Journal (ARJ), June 2, 1832, pg 354.

It should be further noted, that "Starting Resistance" is the force required to get an object at a dead stop moving, and is substantially greater than "Rolling Resistance", which is the force required to keep an object already rolling, moving at the same final rate. However, our immediate interest is only in the force required to start a train or truck from a dead stop- simply the "Starting Resistance" aka "Train Resistance". We will take up the topic of the comparative

Why Railways Are 20X Energy Superior To Pneumatic Tire Vehicles
"Footprint" Comparison:
The "Contact Print" of a 22.5" x 8.25" Truck Tire (a), Compared to a 27" Bicycle Tire (b), and a Typical 35" Steel Railway Wheel (c).



Source (c), (b):
Bicycling Science, by David Wilson, pg 218

Source (a):
Vehicle, Tire, Pavement Interface,
Henry/Wambold ASTM STP 1164,
1992, pg 143

"Rolling Resistance" between steel wheeled railway vehicles, and large rubber tire road vehicles, and its direct effects on energy efficiency (rail is far superior), towards the end of this piece.

First, we're going to perform our calculations in the strictly old school way, only accounting for the factor “Starting Resistance”, reflected at different operating speeds. While this original method accounts for the energy required to accelerate from a dead stop to operating speed, in which a modern diesel electric locomotive has about a 10X energy demand advantage over a truck accelerating to 50 mph (a circa 1830's steam locomotive had a 6X advantage over a truck accelerating to 50 mph), it literally only tells half the story. Later, we'll re-calculate using a modern approach, which will reveal the extreme 20X energy efficiency advantage rail has over all types of large rubber tire road vehicles. The advantage in efficiency that railroads have over road transport, is in the rail itself rather than the motive power. There's less friction on account of the relative inelasticity of the wheel and rail.

The key common factor between these physical relationships, is a level surface, which the LIRR has, by way of its natural geology. In general practice, railroad grades are kept as low as possible. This sometimes led to circuitous routes around mountains, or the use of bridges, tunnels, cuttings, embankments or "switchbacks". At the other extreme, some coal railroads in Pennsylvania were powered by gravity.

A look at the specifications and capabilities of some of the very earliest railway locomotives, and comparisons to modern trucks and locomotives:

In the formulas used in this piece, the results are expressed in terms of Power, Speed, Weight and Force. For example, we refer to the formula HP = PLAN / 33,000, which comes into play a little bit later.

To clarify, Work = (force x distance). However, HP and TP (Tractive Power) are measures of Power = (force x distance) / time.

A less descriptive, but simpler and more versatile (steam, diesel or electric) method of determining locomotive HP, other than HP = PLAN/33,000, which only worked for steam locomotives, is as per the mathematical relationship between HP, TP and Speed “S” (mph), described (in the Brotherhood of Locomotive Fireman's and Enginemen's Magazine, Vol XLVI, Jan- June 1909) by the following formula:

HP =(TP x S) / 375

For a brief, but good, explanation of the inter-relationship between HP, TP, Speed, “Train Resistance”, “Speed Resistance” and “Grade Resistance”, see the ca 1909 writing cited above, pg 841- 842 here.

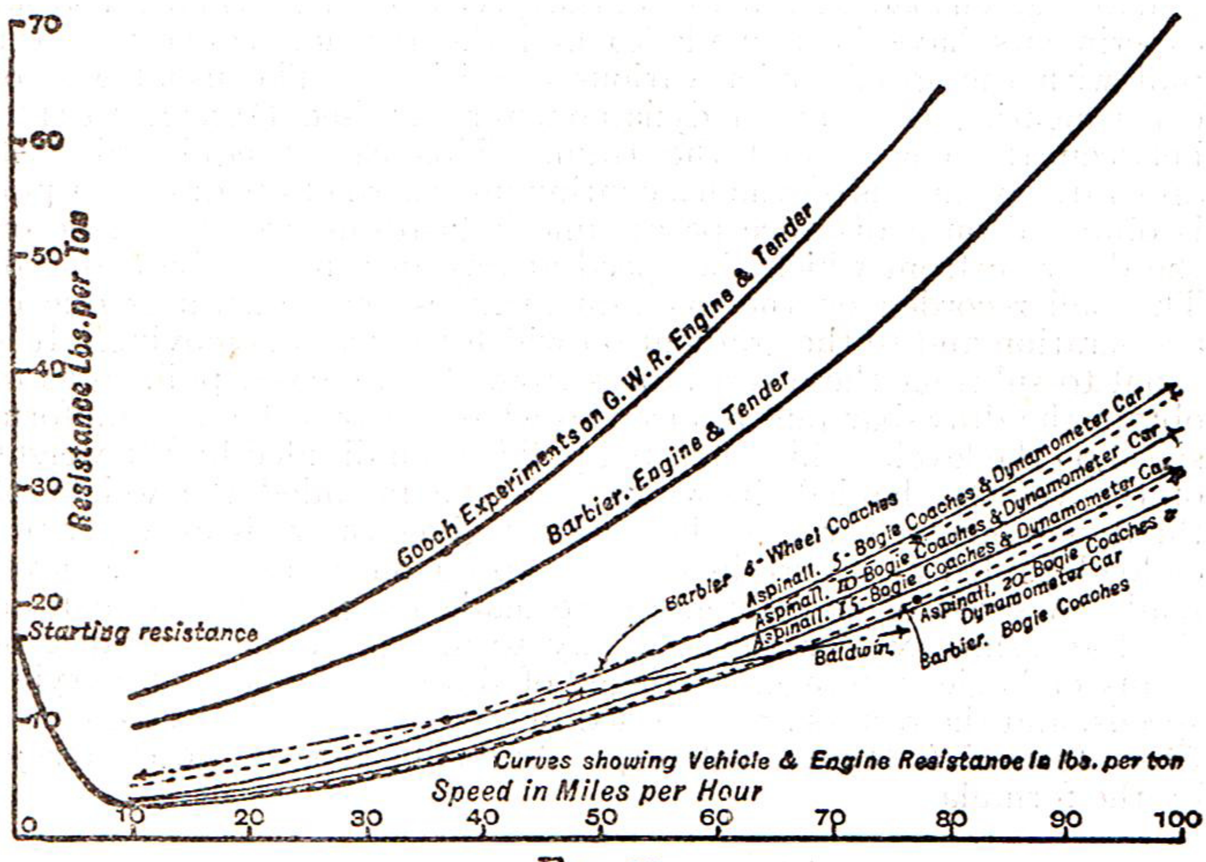

70
60
50
40
30
20
10
0
Resistance Lbs. per Ton
Starting resistance
Gooch Experiments on G.W.R. Engine & Tender
Barbier. Engine & Tender
Barbier 6-Wheel Coaches
Aspinall. 5-Bogie Coaches & Dynamometer Car
Aspinall. 10-Bogie Coaches & Dynamometer Car
Aspinall. 15-Bogie Coaches & Dynamometer Car
Aspinall. 20-Bogie Coaches & Dynamometer Car
Baldwin
Barbier. Bogie Coaches
Curves showing Vehicle & Engine Resistance in lbs. per ton
Speed in Miles per Hour
10
20
30
40
50
60
70
80
90
100

FIG. 17.

It is known*, that the small "Planet" type engines of the period, [at 30 HP power output], produced a Tractive Effort (T.E.) in the range of 1,450 lbs to 1,550 lbs. on level track. Let's do the arithmetic: 1,550 lbs / 8 lbs / Ton = 193.75 Tons total train weight.

Using the equation**

S = (375 x HP) / T.E. (lbs.)

Where:

S = Speed in mph,
HP = Horsepower,
T.E. (lbs) = (Train Weight (Tons) x 8 lbs/Ton)

And Setting:

HP = 30
T.E. (lbs) = (193.75 Tons x 8 lbs) /Ton = 1,550 lbs.

S = 7.2 mph

Let's now speed things up a bit, to 20 mph...and further define Tractive Power (TP):

Tractive Power (TP), also known as Tractive Effort (TE) is only one of the factors used in calculating the relationships between HP, gross train weight and speed. Refer back to the formula HP = (TP (lbs) x S) / 375.

The required TP in lbs, is the (gross train weight in Tons x Train Resistance in lbs/Ton).

On level track, “Train Resistance“ was cited as 8 lbs/Ton back in 1832, and was about the same in the ca 1909 writing. The ca 1909 writing cited basic “Train Resistance”, (or "Friction Resistance" as they referred to it) as 6 lbs/Ton, but then they added a minimum of an additional 2lbs/Ton for "Speed Resistance", bringing us back to a total “Train Resistance” of 8 lbs/Ton.

By substitution, we get gross train weight

GCW (Tons) = (375 x HP) / (S x 8),

Or,

HP = [GTW (Tons) x 8 lbs/Ton x S] / 375

Tractive Power (TP) of a steam locomotive can also be expressed by the following formula:

Tractive power equals the square of cylinder diameter, times stroke in inches, times mean effective pressure per square inch [boiler psi x 0.85], divided by the diameter of the driving wheel in inches. Put in the shape of a formula this is :

Tractive power in pounds = $(d^2 \times S \times P) / D$

Where:

d = diameter of cylinder
S = length of stroke in inches,
P = mean effective pressure.
D = diameter of driving wheel.

Source: The Americana Encyclopedia, 1912, Vol 13, pg 51

Now, lets look closer at a key factor in both TP and HP: level track.

As per the the American RR Journal of 1832, once grades are introduced, the railroad starts to lose its efficiency. This is why railroads had to be laid on as level right of way as possible. Otherwise, circuitous routes, tunnels, bridges, cuts, embankments, inclined planes or switchbacks had to be used. This concept is also restated in the ca 1909 writing.

If you incorporate grades (causes power requirement spiking) on your railroad route, the HP required increases drastically, by a factor of [20 lbs for each per cent of grade]. As per the ca 1909 writing, assuming a grade of 3.6%, we then get the following formula:

HP = (70 x 20 x [20 x 3.6]) / 375 = 268.8

Where:

70 = gross train weight in Tons
20 = Speed in mph
[20 x 3.6] = "Grade Resistance" factor

What this means, is if the maximum grade on your railroad is 3.6%, your engine must be able to produce 268.8 HP, but only while its pulling the train over the hill at 20 mph. However, the same engine only needs to produce 30 HP to pull the same 70 Ton train at 20 mph on level track.

Here's an electrical analogy. My High School music teacher had a particular stereo amp that could put out a maximum 200 watts / channel (1 HP = 746 Watts). It had Watt meters on its speaker outputs. At normal volume, the amp never put out more than 3 to 5 watts / channel into the big speakers. However, at the loudest crescendos, it sometimes momentarily spiked up to 100 + watts / channel. They key thing, is the amp had to have enough reserve power to get over the momentarily increased peak power demand requirements, which corresponds to the grades on a railroad.

To improve efficiency in any system, get rid of the "demand peaks", and a lower constant power level will be enough to keep things flowing at a “high” constant rate.

The following calculations were empirically confirmed by runs made in 1830 and 1831 on the Liverpool and Manchester Railway. The original (and most primitive) Planet locomotive (9 Tons) drew a train of 18 "waggons" (four wheel rail cars) weighing some 80 Tons at 14 mph on level track. According to the formula HP = (80 Ton x 8 lbs/Ton x 14 mph) / 375, the Planet engine was exerting 23.8 HP. The Planet had only two driving wheels (2-2-0) wheel arrangement.

The equally primitive engine Samson (10 Tons), drew a train of 30 "waggons" weighing 164.5 Tons, at a speed of 20 mph on level track. According to the same formula, the Samson was exerting 70 HP. The Samson had 4 driving wheels, of smaller diameter than the Planet's, they were of coupled (0-4-0) wheel arrangement, and also had larger cylinder bore (larger engine displacement) than the Planet.

The Samson consumed its coke fuel at a rate of slightly less than 1/3 pound/mile/Ton.

Note, the Samson was the same basic machine as the John Bull rebuild/replica locomotive currently on display at the Smithsonian.

Further, the American Railroad Journal of Aug 1, 1842, pg 90, states a train carrying 1,608 barrels of flour, of 200 Tons weight, was drawn from Albany to Boston.

Let's now calculate the HP output of the Samson locomotive, at 20 mph and a train weight of 164.5 Tons.

Using the formula***

HP = (PLAN) / 33,000, where:

P = 0.85 x Boiler Pressure in psi.
L = 2 times the stroke length in feet
A = area of piston in inches sq
N = rpm = revolutions / minute

Plugging in the data****;

P = 0.85 x 60 psi = 51 psi
L = (2 x 16") / 12" = 2.6 ft
A = 3.14 x [7" squared] = 154 inch sq
N = 123 rpm - how did we get this number? 1 mi/hr = 5,280 ft / 60 min = 88 ft/min; 20 mph = 20 x 88 ft/min = 1,760 ft/min; the driver diameter is 4.5 ft; driver circumference = 3.14 x 4.5 =

14.13ft / 1 revolution; (1,760 ft/min) / 14.31 ft/rev. = 123 rpm.

We get the following results for the Samson engine:

HP = (51 x 2.6 x 154 x 123) / 33,000 = 76 HP. Lets say 70 HP, to agree with formula 1.

Using the same formula, with the Planet engine's empirical and specification data; (same pressure= 51, same stroke= 2.6, 11" diameter piston; radius = diameter/2; A= 3.14 x (5.5 squared)= 95 inch sq; with 5 ft drivers at 14 mph, we have 3.14 x 5 ft/rev= 15.7 ft/rev and 14 x 88 ft/min= 1,232 ft/min, rpm= (1,232ft/min) / (15.7 ft/rev) = 78.5

Therefore, we get 29.96 HP for the Planet type engine. Lets say 30 HP, to agree with the historical information cited above.

As we can see from the formula HP = (TP x S) / 375, circa 1830's locomotives could pull a 70 ton train on level track at 20 mph, with only 29.8 HP.

Let's compare the ratios of horsepower to maximum weight, on level ground, and at 20 mph. Using the same formula above, setting the speed of the Planet type engine to 20 mph, at 30HP we get a maximum train weight of 70.3 Tons.

Therefore, for the circa 1830 Planet type railway steam engine, at 20 mph, the horsepower to weight ratio was: 30 HP/70.3 Ton = 0.4267 HP/Ton. For the circa 1831 Samson type locomotive, the horsepower to weight ratio was 70 HP/164.5 Ton = 0.425 HP/Ton.

Efficiency comparison between Primitive Locomotives and Modern Tractor Trailers (at 20mph Speed)

Compare the above weight ratios to those of a modern highway tractor- trailer. For example, a typical popular make of truck tractor, has a "GVW" (gross vehicle weight) of 39 Tons. Its modern diesel engine produces 440 HP. Its GCW (gross combined weight = tractor + trailer + load) is 70 Tons. This means the modern highway truck tractor can only draw less than 2 times (1.79) its own weight.

Compare the tractor- trailer weight ratio numbers to those of the small, light weight (10 Ton) Samson steam locomotive drawing 16.45 times its own weight, with only 70 HP. In terms of comparative "weight only" ratios, the early 19th century railway steam locomotive was 9.2 times more efficient than today's highway tractor- trailers [16.45 Samson locomotive weight ratio / 1.79 tractor- trailer (Mack "Granite Elite") weight ratio] !

For the modern tractor- trailer the horsepower to weight ratio is 440 HP/70 Ton = 6.285 HP/Ton.

By dividing 6.285 HP/Ton (tractor- trailer) by 0.4267 HP/Ton (Planet type steam engine), we find that at 20 mph, in terms of the comparative horse power to maximum weight ratio, the circa

1830 railway steam engine is 14.7 times more efficient than a modern tractor- trailer !

To restate our data back into the original circa 1832 terms of "force per Ton" required to move 1 ton on a railroad, compared to the "force per ton" currently required to move 1 ton on a highway, we perform the following conversions:

Using James Watt's definition of a horsepower (circa 1783), I derived these conversion factors:

As per Watt, 1 HP = 33,000 (ft x lbsf) / min

Therefore,

In the case of the circa 1830 steam locomotives, plugging in data from above, we have:

0.43 Hp / Ton = (33,000 x [0.43 (ft x lbsf)/min]) / (1 Ton/2,000 lbs) = 7.1 lbs / Ton "Starting Resistance"- not accounting for bearing friction

Assuming bearing friction accounts for an additional 11.25 %, we get 7.1 lbs/ Ton x 1.1125 = 7.9 lbs/ Ton, "Starting Resistance" or 1/253 part of the gross combined train weight (locomotive + cars + payload). Note the ca. 1832 empirical values for "Starting Resistance" (train) as cited above, were 8 lbs/ Ton, and 1/248th of the GCW.

For the modern truck tractor (Mack "Granite Elite"), plugging in data from above, we have:

6.285 HP / Ton = (33,000 x [6.285 (ft x lbsf]) / (1 Ton/2,000 lbs) = 103.7 lbs / Ton "Starting Resistance"- not counting bearing friction:

103.7 lb / Ton x 1.1125 = 115.4 lbs / Ton "Starting Resistance", or 1/17th part of the Gross Combined Weight (GCW)

It appears that at a speed of 20 mph, the efficiency of a standard highway vehicle has not improved much from the cited circa 1832 value of 1/12 part of the GCW !!

Therefore, during the days of primitive steam powered railroads circa 1830's, moving a ton by rail at 20 mph was 14.6 times more efficient than moving a ton at 20 mph by modern truck !!

Efficiency comparison between Primitive Locomotives and Modern Tractor Trailers (at 40mph Speed)

Let's now consider a speed of 40 mph:

Its seems obvious from the formulas, that if you want to double the train speed from 20 mph to 40 mph, you have to double the horsepower, and so forth.

Doubling the speed (and thereby the HP) of the American made "tea kettle"engines of the 1830's, from 20 mph to 40 mph, was easy thanks to Matthias Baldwin and his improved steam fitting joint (ca 1834).

Overnight, boiler pressure in Baldwin's American made locomotives was doubled, from 60 psi to 120 psi, thereby doubling the engine HP- and the possible speed. Source: History of the Baldwin Locomotive Works, 1907, pg 20: . Refer to the formula HP = (PLAN) / 33,000.

Efficiency comparison between Primitive Locomotives and Modern Tractor Trailers (acceleration from 0 to 50 mph Speed)

When moving freight, high speed is not the main priority. Fifty mph is plenty. Some truckers like to use excessive speed, because they want to do the most runs in the least time possible, to satisfy their own personal economic reasons- and they waste lots of fuel and peoples lives doing it.

For empirical data, tests were done on a British railroad (Grand Junction Rwy) during 1839. Due to their notoriously level track, the British commonly achieved both high speed, and a high payload, [30 mph average (includes starting and stopping time at 8 “stoppages”- about 40- 50 mph peak), 82 Ton gross train weight (GCW), over a 190 mile distance) using a common locomotive of the period, exerting 87 HP (using the formula HP = [(GCW (Tons) x 8 lbs/Ton) x S] / 375.

This data yields a steam locomotive power to weight ratio of 87 HP / 82 Ton = 1.06 HP / Ton at 50 mph

Source: Railway Machinery, by Daniel Kinnear Clark, 1855, see pg 11, 17, and the table on pg 20, columns 1 and 7: The LIRR, and later the high speed (for the period) Hudson River RR, were built according to this British design paradigm.

A modern truck will use 440 HP to pull a 70 Ton GCW (6.285 HP/Ton) at about the same speed: **nearly 6 times more horsepower is required per Ton by truck, than the circa 1830's locomotive at 50 mph,** as per the formula 6.285 HP/Ton (truck) / 1.06 HP/Ton (locomotive).

Since 1 HP equals approximately 2,545 BTU/hour, in terms of thermal energy required at 50 mph, the modern tractor- trailer requires 1,119,800 BTU/hour to draw a GCW of 70 Tons. This corresponds to 6.285 HP / Ton x (2,545 BTU / hour) = (15,995.325 BTU / hour) / Ton (truck).

The circa 1830's steam locomotives required only 189,857 BTU's/hour (16%), to draw the same GCW at the same speed. This corresponds to 1.06 HP / Ton x (2,545 BTU / hour) = (2,697.7 BTU / hour) / Ton (steam locomotive).

In summary, **if you keep your railroad track as close to a zero grade as possible, you**

never need to produce more than 30 HP to pull your 70 Ton train at up to 20 mph, or 87 HP to pull an 82 Ton GCW train at up to 50 mph (1.06 HP / Ton). This corresponds to 74.6 HP required to draw a 70 Ton GCW train at 50 mph, (1.06 HP/Ton) as per HP = [(GCW (70 Tons)) x 8 lbs/Ton x 50 mph] / 375.

Modern diesel electric railroad locomotives have a much greater energy efficiency advantage over diesel trucks.

According to the current AREMA Manual, Volume 1, Chapter 2, pg 55- 57, a typical diesel electric locomotive will produce 3,000 HP, and the "Starting Resistance" (our "Train Resistance" of ca. 1830's) for roller bearing wheels (above 32° F), is cited as 5 lbs/ Ton. Using our simplified HP equation, we get:

TP = (3,000 HP x 375) / 50 mph = 22,500 lbs

Then,

GCW (Tons) = (375 x HP) / (S (mph) x 5 lbs/Ton),

GCW (Tons) = (375 x 3,000) / (50 x 5) = 4,500

Therefore, the power to weight ratio of a modern railroad locomotive at 50 mph, is 3,000 HP / 4,500 Ton = 0.666 Hp /Ton (diesel locomotive).

Since 1 HP equals approximately 2,545 BTU/hour, in terms of (energy consumed per hour) per horsepower, for the modern locomotive, we get:

0.666 HP / Ton x 2,545 BTU / hour = (1,694.97 BTU / hour) / Ton (diesel locomotive), as compared to (15,995.325 BTU / hour) / Ton (diesel truck).

Therefore, in terms of energy demand at starting and acceleration from 0 to 50 mph, as per the formula [(15,995.325 BTU / hour) / Ton (truck)] / [(1,694.97 BTU / hour) / Ton (locomotive)], **the modern diesel electric locomotive is 9.4 (say 10X) times more energy efficient than a diesel truck or bus (upon starting and initial acceleration) !** See: The Next Progressive Era: A Blueprint for Broad Prosperity", by Phillip Longman, pg 151.

Trucks Vs.Trains : Energy required to keep objects moving at a constant speed

So far, all of our calculations have been based strictly on "old school" methods of calculating energy requirements, which do not differentiate between the energy needed to start a train or a truck from a dead stop, and the much lower energy input needed to then keep it moving at a constant speed.

All the foregoing calculations have essentially been functions of "Starting Resistance". Now, let's *be more specific, and take a look at the energy required to overcome "Rolling Resistance", and thereby maintain an already moving vehicle at a constant speed:*

Rolling Resistance- the force needed to keep a rolling vehicle moving at a constant speed:

Once any vehicle starts moving, it takes a lot less force (energy) to keep it moving at the same rate, than what it required to start it moving in the first place. To keep things simple, by avoiding the use of trigonometric functions, we will again assume a level surface in all instances.

At the same speed, same load (GCW) and on level ground, any steel wheeled railway vehicle is 24.6 times more energy efficient than any large rubber tire road vehicle, regardless of the type of power source.

Let's see why:

We start off with Newton's famous second law :

$F = ma$

setting $a = g = 32$ ft/second^2

We now have

F = W (weight) = mg

Coulomb's classic model of friction is given as:

$$F_f \leq \mu F_n$$

Where F_f is the force exerted by friction (in the case of equality, the maximum possible magnitude of this force), μ is the coefficient of friction, which is an empirical property of the contacting materials, and F_n is the normal force exerted between the surfaces.

Since in our case the track/road is level,

Normal Force = F = W (weight)

And let

μ = Crr

Therefore, the formula for calculating "Rolling Resistance" is given as:

F_f (lbs) = [W (lbs)] x Crr

Where:
W = weight (lbs) = "GCW" (lbs)
Crr = coefficient of rolling resistance (dimensionless)
F_f = Rolling Resistance

Let's now apply the following data: (for sources see ***** end note)

W = 70 tons (140,000 lbs)
Crr (road truck rubber tires on pavement) = 0.01479
Crr (Railway steel wheels on steel rails) = 0.0006

Therefore, in the case of any large rubber tire road vehicle, no matter what the energy source:

F_f (truck) = 140,000 lbs x 0.01479 Crr (*truck*) = 2,070.6 lbs / 70 Tons = *29.58 lbs/ Ton*, is required to keep any large rubber tire road vehicle moving at a constant speed, no matter what the power source.

In the case of any steel wheel railway vehicle, no matter what the power source:

F_f (Railway) = 140,000 lbs x 0.0006 Crr (*Railway*) = 84 lbs / 70 Tons = *1.2 lbs/Ton*, required to keep any steel wheel railway vehicle moving at a constant speed, no matter what the power source.

Next, we need to derive a multiplying factor:

0.01479 Crr (truck) / 0.0006 Crr (Railway) = 24.65

As we can easily see from the formula HP = (TP x S) / 375, HP is directly proportional to TP. As we already know, as per the formula TP = [GCW x Train Resistance], TP is directly proportional to Train Resistance (TR) when starting/accelerating, and also directly proportional to Rolling Resistance TP = (F_f = GCW x Crr) when already moving at operating speed. As we have seen, Energy Demand (BTU/hour) is also directly proportional to HP (1 HP = 2,545 BTU/hour). *Therefore, if weight (GCW) and speed are held constant, energy demand is directly proportional to Crr.*

Therefore, any steel wheel railway vehicle is 24.65 times more energy efficient than any large rubber tire road vehicle, no matter what the power source is, as long as speed and

GCW are held constant.

So, why is rail so much more energy efficient than pneumatic tire road vehicles? Let's refer back to Engineering Tribology, By John Austin Williams, 2005, pg 409, and the equation for μR:

$$\mu_R = \frac{4\alpha}{3\pi} \left\{ \frac{W}{\pi R E} \right\}^{1/2},$$

Referencing the formula directly above, "the rolling resistance of a pneumatic tire road wheel is very much greater than that of a steel wheel on a steel rail, because of the very much lower value of the "contact modulus" **E** [elastic stiffness] of a rubber tire on a concrete road, as well as its much greater value of "fractional hysteretic energy loss" **α** [the energy loss expressed as a fraction of the total input energy], when compared to those of a steel wheel on a steel rail".

Now lets calculate the relative amount of energy required by any steel wheel rail vehicle Vs. any large rubber tire road vehicle, as long as speed and GCW are held constant:

[(1.2 lbs/Ton (rail) / 29.58 lbs/Ton (truck)] x 100 = 4.06%

The steel wheel rail vehicle will require less than 5% (1/20) the energy required by a rubber tire road vehicle, to do the same amount of work.

However, this calculation does not include bearing friction, grade and curve friction, or aerodynamic friction.

If we deduct 1/5, or 20% of our multiplying factor of 24.55 to account for the other forms of mechanical friction, rail still enjoys precisely the same 20X energy advantage over highway vehicles that it had back in 1832 !

CONCLUSION:

At the same constant speed, on level ground, drawing the same load, any steel wheeled railway vehicle already in motion, will use only 5% (1/20) of the energy consumed by any large pneumatic tire road vehicle already in motion. Upon starting and initial acceleration, any steel wheeled railway vehicle will only use 10% (1/10) of the energy demanded by any large pneumatic tire road vehicle. Further, only in the case of railroads, Train Resistance, or Rolling Resistance, is inversely proportional to GCW (train weight). This means, the heavier the train, the more energy efficient it becomes.

As a nod to the Electric Automobile industry, its noteworthy that theoretically, the energy efficiency (range) of any electric automobile on any paved asphalt or concrete road, can be increased up to 2X (doubled), through improved tire design (i.e., by using "special

pneumatic" or "special solid" rubber tires, or a hybrid of the two).

For example, a modern light weight automobile with small "footprint" pneumatic tires, has a rolling resistance of about 20 lbsf/ Ton on pavement. Back in 1909, they had the standard rolling resistance of an electric car down to 15 lbsf/ Ton on asphalt. With our modern materials, it could come down still lower.

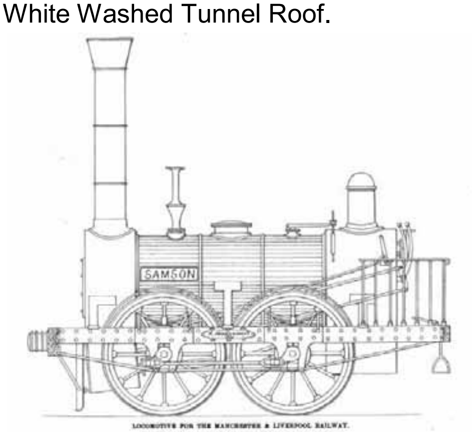
This information has been publicly available for over a hundred years (since at least 1909). However, historical events in the early 20th century led to an abundant, plentiful and seemingly inexhaustable oil supply. The British, in dire need of an oil supply to fuel their Navy, discovered oil in the Persian Gulf, and by 1911, (then) cheap oil was being pumped out of Iran. After World War I, the Standard Oil Company of California followed suit, and began pumping vast quanities of oil out of the politically unstable countries all around the Persian Gulf. Accordingly, anything electrically powered or "energy efficient" was immediately relegated to the scrap heap of history- along with all the scientific know- how and technology that went with it.

See Standard Handbook for Electrical Engineers, by Frank F. Fowl, 1916, pg 1,461 (you have to download the entire PDF to view this page). Also see: Electric Traction, by E.H. Armstrong, 1909, pg 807- 808: And Alexander Churchward's original 1909 paper on the Energy Consumption of Commercial Vehicles (rubber tires: pneumatic, solid and vehicle resistance), presented before the SAE. See Norton's (of B.F. Goodrich Tire Co.) circa 1916 paper on Tires for Electric Vehicles, presented before the Electric Light Institute, on pg 96- 113. If you can find it, also see the paper Electric Vehicle Tires, presented before the Electric Vehicle Association of America, by F. E. Whitney, Oct. 27, 1913

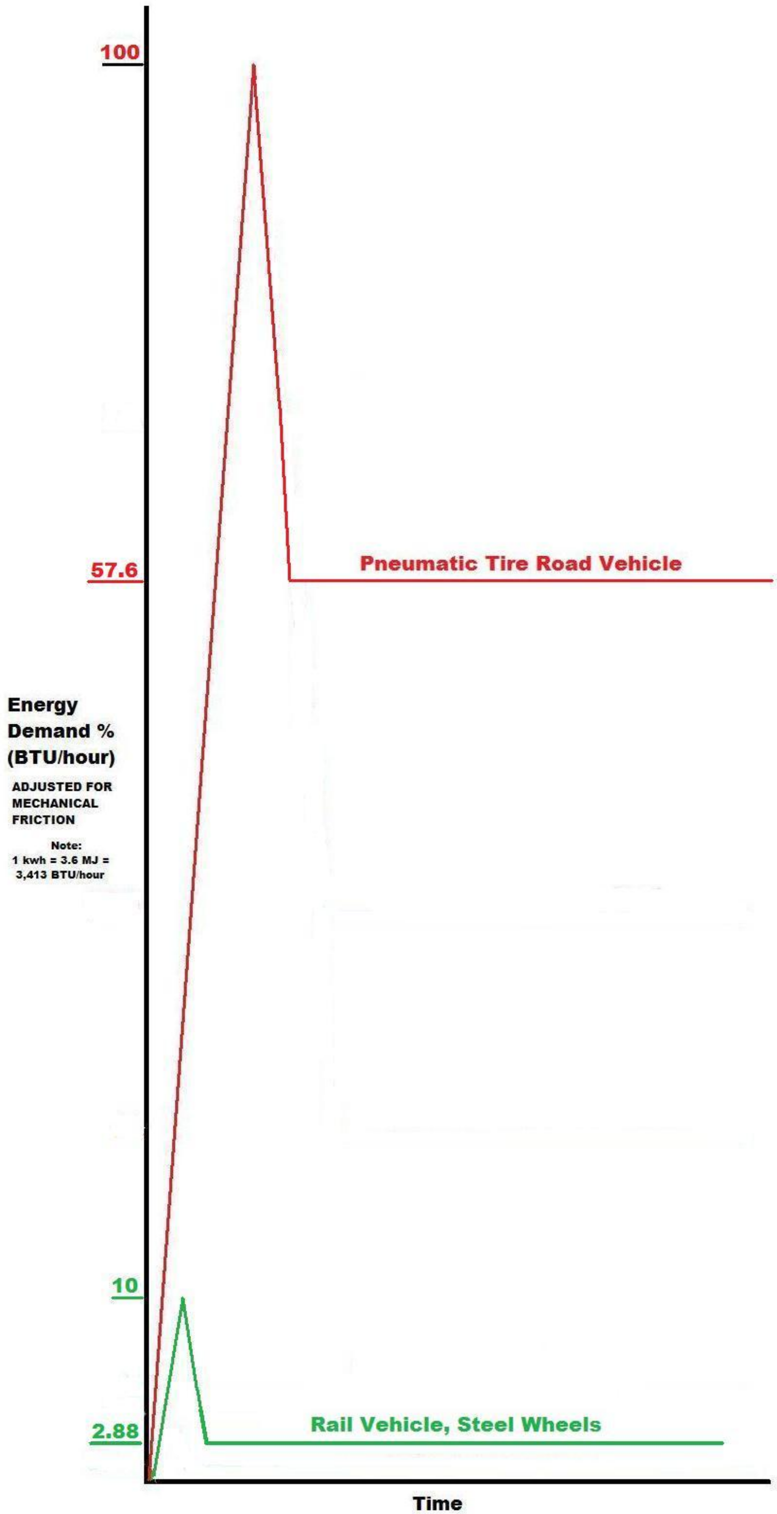
* Steam Passenger Locomotives, by Brian Hollingsworth, 1982, pg 20- 22
** Source: Locomotive Fireman and Engineers Magazine, 1909, pg 841.
*** Source: Railway and Locomotive Engineering, Dec. 1907, pg 548.
**** Source: English Mechanic and World of Science, Oct. 18, 1889, pg 158
***** Note: Truck tire Crr is the average of data from SAE Technical Paper 880584, 1988, pg 4, Table 6. The average Railway Crr is from these sources: Engineering Tribology By John Austin Williams, 2005, pg 409- 410, and Bicycling Science By David Gordon Wilson, 2004, pgs 217 & 218, and Tractive Resistance of Rolling- Stock, by J.L. Koffman, British Railways Board, Railway Gazette International, Vol. 120, Nov. 1964, pg 899- 902.

Replica of the "Planet" type steam engine.

Early Wood Burning Locomotive Exhaust Partially Covering White Washed Tunnel Roof.



"Samson" type steam engine.



Generic Curve Representing Starting Energy Demand and the Subsequent "Cruising" Energy Demand at a Constant Speed and level track or road

Pervious concrete

A pervious concrete street

Pervious concrete (also called porous concrete, permeable concrete, no fines concrete and porous pavement) is a special type of concrete with a high porosity used for concrete flatwork applications that allows water from precipitation and other sources to pass directly through, thereby reducing the runoff from a site and allowing groundwater recharge. Pervious concrete is made using large aggregates with little to no fine aggregates. The concrete paste then coats the aggregates and allows water to pass through the concrete slab. Pervious concrete is traditionally used in parking areas, areas with light traffic, residential streets, pedestrian walkways, and greenhouses.[1] It is an important application for sustainable construction and is one of many low impact development techniques used by builders to protect water quality.

History

Pervious concrete was first used in the 1800s in Europe as pavement surfacing and load bearing walls. Cost efficiency was the main motive due to a decreased amount of cement. It became popular again in the 1920s for two story homes in Scotland and England. It became increasingly viable in Europe after the Second World War due to the scarcity of cement. It did not become as popular in the US until the 1970s.

Stormwater management

The proper utilization of pervious concrete is a recognized Best Management Practice by the U.S. Environmental Protection Agency (EPA) for providing first flush pollution control and stormwater management.[2] As regulations further limit stormwater runoff, it is becoming more expensive for property owners to develop real estate, due to the size and expense of the necessary drainage systems. Pervious concrete reduces the runoff from paved areas, which reduces the need for separate stormwater retention ponds and allows the use of smaller capacity storm sewers. This allows property owners to develop a larger area of available property at a lower cost. Pervious concrete also naturally filters storm water and can reduce pollutant loads entering into streams, ponds and rivers.

Pervious concrete functions like a storm water infiltration basin and allows the storm water to infiltrate the soil over a large area, thus facilitating recharge of precious groundwater supplies locally. All of these benefits lead to more effective land use. Pervious concrete can also reduce the impact of development on trees. A pervious concrete pavement allows the transfer of both water and air to root systems allowing trees to flourish even in highly developed areas.

Construction

Pervious concrete consists of cement, coarse aggregate and water with little to no fine aggregates. The addition of a small amount of sand will increase the strength. The mixture has a water-to-cement ratio of 0.28 to 0.40 with a void content of 15 to 25 percent.

The correct quantity of water in the concrete is critical. A low water to cement ratio will increase the strength of the concrete, but too little water may cause surface failure. A proper water content gives the mixture a wet-metallic appearance. As this concrete is sensitive to water content, the mixture should be field checked. Entrained air may be measured by a Rapid Air system, where the concrete is stained black and sections are analyzed under a microscope.

A common flatwork form has riser strips on top such that the screed is 3/8-1/2 in. (9 to 12 mm) above final pavement elevation. Mechanical screeds are preferable to manual. The riser strips are removed to guide compaction. Immediately after screeding, the concrete is compacted to improve the bond and smooth the surface. Excessive compaction of pervious concrete results in higher compressive strength, but lower porosity (and thus lower permeability).

Jointing varies little from other concrete slabs. Joints are tooled with a rolling jointing tool prior to curing or saw cut after curing. Curing consists of covering concrete with 6 mil. plastic sheeting within 20 minutes of concrete discharge. However, this contributes to a substantial amount of waste sent to landfills. Alternatively, preconditioned absorptive lightweight aggregate as well as internal curing admixture (ICA) have been used to effectively cure pervious concrete without waste generation.

Testing and inspection

Pervious concrete has a common strength of 600 pounds per square inch (4,100 kPa) to 1,500 pounds per square inch (10,000 kPa) though strengths up to 4,000 pounds per square inch (28,000 kPa) can be reached. There is no standardized test for compressive strength.[3] Acceptance is based on the unit weight of a sample of poured concrete using ASTM standard no. C1688.[4] An acceptable tolerance for the density is plus or minus 5 pounds (2.3 kg) of the design density. Slump and air content tests are not applicable to pervious concrete because of the unique composition. The designer of a storm water management plan should ensure that the pervious concrete is functioning properly through visual observation of its drainage characteristics prior to opening of the facility.

Cold climates

Concerns over the resistance to the freeze-thaw cycle have limited the use of pervious concrete in cold weather environments.[5] The rate of freezing in most applications is dictated by the local climate. Entrained air may help protect the paste like in normal concrete. The addition of a small amount of fine aggregate to the mixture increases the durability of the pervious concrete. Avoiding saturation during the freeze cycle is the key to the longevity of the concrete. Related, having a well prepared 8 to 24 inch (200 to 600 mm) sub-base and drainage will reduce the possibility of freeze-thaw damage.

Maintenance

To prevent reduction in permeability, pervious concrete needs to be cleaned regularly. Cleaning can be accomplished through wetting the surface of the concrete and vacuum sweeping.

References

[1] Report No. 522R-10.
[2] "Storm Water Technology Fact Sheet: Porous Pavement." (http://www.epa.gov/npdes/pubs/porouspa.pdf) United States Environmental Protection Agency, EPA 832-F-99-023, September 1999.
[3] "Specification for Pervious Concrete." (http://carolinabomanite.com/custimages/PerviousSpecificationACI522108.pdf) ACI 522.1-08. American Concrete Institute, Farmington Hills, MI, 7pp.
[4] ASTM International. "Standard Test Method for Density and Void Content of Freshly Mixed Pervious Concrete." (http://www.astm.org/Standards/C1688.htm) Standard No. C1688.
[5] National Concrete Pavement Technology Center. Report No. 2006-01.

Further reading

- US EPA. Office of Research and Development. "Research Highlights: Porous Pavements: Managing Rainwater Runoff." (http://www.epa.gov/nrmrl/news/news102008.html) October 17, 2008.

External links

- National Pervious Concrete Pavement Association (http://npcpa.org/)
- Pervious Concrete Blog (http://www.perviousblog.com/)
- Pervious Concrete Design Resources (http://www.perviouspavement.org/)
- American Concrete Institute (http://www.concrete.org/technical/green-building-resources.htm)

CITY OF SAN DIEGO

DEVELOPMENT SERVICES DEPARTMENT

UNIT PRICE LIST

January 2009

INTRODUCTION

The purpose of the Unit Price List is to provide a resource for the preparation of cost estimates for subdivisions and permit projects and should be used only for bonding and permitting purposes. This price list does not reflect the actual project costs. The Unit Price List contains eleven separate sections, which include Private and/or Public items for Earthwork, Drainage, Surface Improvements, Traffic, Water/Wastewater Utilities, Landscaping, and Miscellaneous items.

All bond estimates for land development and public improvement must follow the format and requirements of the current City of San Diego Land Development and Public Improvement Preparation Manual. Please note that a 10% contingency factor must be applied for all public improvements and private encroachments within the public R.O.W.

The unit price information contained in this publication has been complied from various sources. These sources include private consultants and developers, other city sections and departments, other public agencies and previous City project bid items.

If a project proposes improvements that are not included in this Unit Price List, it is the engineer's responsibility to assess the value of the improvements (including labor and mobilization and restoration as applicable) and include the unit cost with respective quantities in the cost estimate. Provisions have been made for adding items to the City's Construction Cost Estimate template within rows labeled "ADDITIONAL ITEM".

This Unit Price Listing will be updated periodically as needed. If you have any suggestions or comments please contact the Land Development Review Division, plan check section.

For those with internet access, a Microsoft® Office Excel 2003 spreadsheet has been provided for the industry's use on the City of San Diego website (www.SanDiego.gov) Development Services/Guidelines and Template links. This spreadsheet has been prepared as part of a continuing effort to enhance the timely completion of the review and permit process for grading and public improvements within the City of San Diego. The intent is to provide a tool to foster consistency, minimize the duplication of effort by the industry and standardize the policy for preparation and review of cost estimates to be used in the determination of bonding costs and permitting and inspection fees for grading and public improvement permits.

UNIT PRICE LIST-2009

SECTION 1-EARTHWORK

GRADING

CLEAR AND GRUB		SF	$0.72
CONTAMINATED SOIL REMOVAL AND DISPOSAL		CY	$169.05
EXCAVATE AND EXPORT		CY	**GRADED**
	0-1,000	CY	$44.28
	1,001-20,000	CY	$35.42
	20,001-100,000	CY	$26.57
	100,001-350,000	CY	$17.71
	>350,000	CY	$11.51
EXCAVATE AND FILL		CY	**GRADED**
	0-1,000	CY	$32.20
	1,001-20,000	CY	$18.52
	>20,000	CY	$10.47
IMPORT AND FILL		CY	**GRADED**
	0-1,000	CY	$45.08
	1,001-20,000	CY	$35.42
	>20,000 CY $ 12.00	LF	$19.32
SUB DRAIN (4" DIAMETER)		LF	$45.08
SUB DRAIN (6" DIAMETER)		LF	$48.30
SUB DRAIN (8" DIAMETER)		LF	$56.35
SUB DRAIN HEADWALL		EA	$4,025.00
SHORING (SUBSURFACE STRUCTURE)		SF	$40.25

BEST MANAGEMENT PRACTICES (BMP"S)

GRAVEL BAG	EA	$1.82
JUTE MAT	SF	$0.66
STRAW MAT	SF	$0.46
STRAW BALES	EA	$8.25
SILT FENCE	LF	$2.64
FIBER ROLLS	LF	$3.71
FIBER MATT	SF	$0.66
HYDRO-SEED	SF	$0.33
HYDRAULIC MULCH	SF	$0.50
STABILIZED CONSTRUCTION ENTRANCE	SF	$8.66
CONCRETE WASHOUT	EA	$825.00
INLET PROTECTION (SEDIMENT)	EA	$247.50
INLET MARKER	EA	$165.00

SECTION 2- DRAINAGE

RCP CULVERTS

18" RCP STORM DRAIN	LF	$123.50

24" RCP STORM DRAIN	LF	$143.00
30" RCP STORM DRAIN	LF	$156.00
36" RCP STORM DRAIN	LF	$188.50
42" RCP STORM DRAIN	LF	$214.50
48" RCP STORM DRAIN	LF	$227.50
54" RCP STORM DRAIN	LF	$260.00
60" RCP STORM DRAIN	LF	$331.50
72" RCP STORM DRAIN	LF	$370.50

RCP CULVERTS (WITH WATER TIGHT JOINTS)

18" RCP STORM DRAIN (WATER TIGHT JOINTS)	LF	$129.68
24" RCP STORM DRAIN (WATER TIGHT JOINTS)	LF	$150.15
30" RCP STORM DRAIN (WATER TIGHT JOINTS)	LF	$163.80
36" RCP STORM DRAIN (WATER TIGHT JOINTS)	LF	$197.93
42" RCP STORM DRAIN (WATER TIGHT JOINTS)	LF	$225.23
48" RCP STORM DRAIN (WATER TIGHT JOINTS)	LF	$238.88
54" RCP STORM DRAIN (WATER TIGHT JOINTS)	LF	$273.00
60" RCP STORM DRAIN (WATER TIGHT JOINTS)	LF	$348.08
72" RCP STORM DRAIN (WATER TIGHT JOINTS)	LF	$389.03

MISCELLANEOUS DRAINAGE

AC SPILLWAY (D-22)	EA	$512.00
PCC BOX CULVERT	CY	$1,760.00
CATCH BASIN, PER D-7 (TYPE F)	EA	$5,680.00
'CATCH BASIN, PER D-8 (TYPE G)	EA	$6,240.00
'CLEAN OUT, PER D-9 (TYPE A)	EA	$6,368.00
'CLEAN OUT, PER D-10 (TYPE B)	EA	$7,200.00
CATCH BASIN, PER D-29 (TYPE I)	EA	$6,160.00
CONCRETE (STRUCTURAL)	CY	$880.00
CONCRETE ENERGY DISSIPATER, PER D-41	EA	$13,120.00
CONCRETE LUG, PER D-63	EA	$1,920.00
CONCRETE PIPE COLLAR, PER D-62	EA	$4,000.00
CURB INLET, PER D-1 (TYPE A)	EA	$6,160.00
CURB INLET, PER D-2 (TYPE B)	EA	$6,160.00
CURB INLET, PER D-3 (TYPE C)	EA	$7,200.00
CURB INLET, PER D-45 (TYPE J)	EA	$5,680.00
CURB OUTLET, PER D-25 (TYPE A)	EA	$4,000.00
CURB OUTLET-SIDEWALK UNDER DRAIN, PER D-27 EA	EA	$800.00
CURTAIN WALL, PER D-38	EA	$960.00
CUTOFF WALL , PER D-72	EA	$760.00
PCC DRAINAGE CHANNEL, PER D-70 & 71	LF	$1,040.00
DRAINAGE DITCH, PER D-75	LF	$24.00
HEC-2 STUDY & FEMA REVISION	LS	$48,000.00
STRAIGHT HEAD WALL PER D-30&31 (TYPE A)	EA	$4,800.00
STRAIGHT HEAD WALL PER D-32&33 (TYPE A-GRAVITY) EA	EA	$4,320.00
WING/U TYPE HEAD WALL PER D-34/35A&B (18" TO 36"/36" TO 60")	EA	$6,880.00
WING/U TYPE HEAD WALL PER D-35A&B (60" TO 84") EA	EA	$7,360.00

L TYPE HEADWALL PER D-36 & 37	EA	$6,560.00
INLET APRON, PER D-39	EA	$2,560.00
CONCRETE ENERGY DISSIPATER, PER D-41	EA	$13,120.00
RIP RAP , PER D-40 (2 TON)	EA	$4,000.00
RIP RAP , PER D-40 (0.25 -1.0 TON)	EA	$3,360.00
RIP RAP , PER D-40 (NO. 2 BACKING)	EA	$2,800.00
CONNECT TO EXISTING S.D.	EA	$320.00

SECTION 3- SURFACE IMPROVEMENTS

CURB AND GUTTER

CURB & GUTTER REMOVAL AND DISPOSAL	LF	$3.30
MEDIAN CURB & GUTTER, PER G-6 (TYPE B-1)	LF	$13.20
MEDIAN CURB & GUTTER, PER G-6 (TYPE B-2)	LF	$22.00
6" CURB & GUTTER PER G-2 (TYPE G)	LF	$22.00
8" CURB & GUTTER PER G-2 (TYPE G)	LF	$26.40
6" CURB & GUTTER, PER G-2 (TYPE H)	LF	$27.50
8" CURB & GUTTER, PER G-2 (TYPE H)	LF	$33.00
ROLLED CURB, PER G-4	LF	$28.60
4" AC BERM, PER G-5	LF	$8.80
6" AC BERM, PER G-5	LF	$10.45
8" AC BERM, PER G-5	LF	$12.10

PAVEMENT

PAVEMENT DESIGN, PER SDG-113 (SCHEDULE J)	SF	$8.40
AC PAVING (1" SURFACE)	SF	$1.26
AC PAVING (2" SURFACE)	SF	$1.68
AC PAVING (3" SURFACE)	SF	$2.18
AC PAVING (4" SURFACE)	SF	$2.94
AC PAVING (5" SURFACE)	SF	$3.61
CTB PAVING (4" SURFACE)	SF	$1.68
CTB PAVING (6" SURFACE)	SF	$1.76
CTB PAVING (8" SURFACE)	SF	$2.10
CTB PAVING (12" SURFACE)	SF	$2.69
CTB PAVING (14" SURFACE)	SF	$2.77
CTB PAVING (16" SURFACE)	SF	$2.94
CTB PAVING (18+" SURFACE)	SF	$3.11
PCC PAVING (5" THICK)	SF	$8.40
PCC PAVING (5.5" THICK)	SF	$9.24
PCC PAVING (6" THICK)	SF	$10.08
PCC PAVING (8" THICK)	SF	$10.92
PCC PAVING (9" THICK)	SF	$12.60
PAVING SUBGRADE PREPARATION	SF	$0.84
AC PAVEMENT REMOVAL	SF	$3.36

CURB RAMPS & SIDEWALK

CURB RAMPS, PER SDG132 (TYPE A & B, NEW CONSTRUCTION)	EA	$1,876.00
CURB RAMPS, PER SDG134-135 (TYPE C1, C2 & A-EXIST SIDEWALK)	EA	$2,948.00
CURB RAMPS, ALLEY, PER SDG-136 (TYPE D)	EA	$2,144.00
SIDEWALK REMOVAL AND DISPOSAL	SF	$2.01
4" PCC SIDEWALK, PER G-7	SF	**GRADED**
0-5000	SF	$8.00
>5000	SF	$6.40
RELOCATE CONTRACTOS/HISTORIC STAMP	EA	$300

MISCELLANEOUS SURFACE IMPROVEMENTS

CUT-OFF WALL @ END OF PAVEMENT, PER G-22 & 23	EA	$1,650.00
CROSS-GUTTER, PER G-12 & 13	SF	$13.20
DRIVEWAY, PER G-14A,B,C, & SDG-114	SF	$11.55
MEDIAN, PER SDG-112 (STAMPED CONCRETE)	SF	$8.25
MEDIAN, PER SDG-112 (DECORATIVE CONCRETE)	SF	$10.73
MEDIAN, PER SDG-112 (PAVERS)	SF	$17.33
TRENCH RESURFACING, PER SDG-107&108	LF	$41.25
NARROW TRENCHING, PER G-33-35	LF	$18.98
4" AC BERM, PER G-5	LF	$12.46
6" AC BERM, PER G-5	LF	$13.53
8" AC BERM, PER G-5	LF	$15.43
AC OVERLAY (1"-2")	SF	$0.74
AC SLURRY SEAL	SF	$0.99
ALLEY APRON, PER G-17	SF	$11.55
ADJUST TO GRADE	EA	$1,650.00
AGGREGATE BASE (AB)	SF	$1.65
MEDIAN PCC, PER SDG-112 (DECORATIVE)	SF	$18.15
MEDIAN PCC, PER SDG-112 (STAMPED CONCRETE)	SF	$13.20
MEDIAN PCC, PER SDG-112 (INTERLOCKING PAVERS)	SF	$19.80
GRIND & OVERLAY	SF	$4.13
COLD MILLING AC PAVEMENT (SDG 139)	LF	$2.38
PAVEMENT FABRIC FOR ASPHALT	SF	$2.60
AC PATCHING	TON	$150.00
CRACK SEALING	LF	$2.50

SECTION 4- TRAFFIC

TRAFFIC CONTROLS

DETECTOR LOOPS	EA	$ 544.50
PULL BOX, PER SDI-105 (ALL TYPES)	EA	$ 314.60
PULL BOX RELOCATION	EA	$ 484.00
REMOVE STRIPING	LF	$ 3.63
STREET LIGHT, PER SDE-101, E-2 L.P. SODIUM	EA	$ 7,260.00
STREET LIGHT, PER SDE-101, E-2 H.P. SODIUM	EA	$ 7,260.00
STREET NAME SIGN, PER SDM-102	EA	$ 484.00
STREET STRIPING (More than 4000 L.F)	LF	$ 0.61
STREET STRIPING	LF	$ 0.79
TRAFFIC SIGNAL (2X2 INTERSECTION)	LS	$ 127,050

TRAFFIC SIGNAL (4X2 INTERSECTION)	LS	$ 139,150
TRAFFIC SIGNAL (4X4 INTERSECTION)	LS	$ 145,200
TRAFFIC SIGNAL (4X6 INTERSECTION)	LS	$ 157,300
TRAFFIC SIGNAL (6X6 INTERSECTION)	LS	$ 169,400
TRAFFIC SIGNAL (8X6 INTERSECTION)	LS	$ 278,300
TRAFFIC SIGNAL INTERCONNECTION	LF	$ 18.15
BIKE LANE SIGNING AND STRIPING	MI	$ 2,420.00
FLASHING ARROW BOARD/ELECTRIC MESSAGE SIGN	LS	$ 2,000.00

SECTION 5- WATER/WASTEWATER UTILITIES

WASTEWATER

CONCRETE ANCHOR, PER S-9	LF	$ 1,691.08
CONCRETE CRADLE, PER S-6 (8" SWR MAIN)	LF	$ 18.69
CONCRETE CRADLE, PER S-6 (10" SWR MAIN)	LF	$ 20.64
CONCRETE CRADLE, PER S-6 (12" SWR MAIN)	LF	$ 23.58
CONCRETE CRADLE, PER S-6 (15" SWR MAIN)	LF	$ 27.27
CONCRETE CRADLE, PER S-6 (18" SWR MAIN)	LF	$ 33.30
CONCRETE CRADLE, PER S-6 (21" SWR MAIN)	LF	$ 38.86
CONCRETE CRADLE, PER S-6 (24" SWR MAIN)	LF	$ 26.80
CONCRETE CRADLE, PER S-6 (27" SWR MAIN)	LF	$ 46.10
CONCRETE CRADLE, PER S-6 (30" SWR MAIN)	LF	$ 55.21
CONCRETE CRADLE, PER S-6 (36" SWR MAIN)	LF	$ 70.95
CONCRETE CRADLE, PER S-6 (42" SWR MAIN)	LF	$ 92.06
CONCRETE CRADLE, PER S-6 (48" SWR MAIN)	LF	$ 104.86
CONCRETE ENCASEMENT, PER S-7 (8" SWR MAIN)	LF	$ 29.41
CONCRETE ENCASEMENT, PER S-7 (10" SWR MAIN)	LF	$ 34.30
CONCRETE ENCASEMENT, PER S-7 (12" SWR MAIN)	LF	$ 39.13
CONCRETE ENCASEMENT, PER S-7 (15" SWR MAIN)	LF	$ 46.03
CONCRETE ENCASEMENT, PER S-7 (18" SWR MAIN)	LF	$ 53.87
CONCRETE ENCASEMENT, PER S-7 (21" SWR MAIN)	LF	$ 60.43
CONCRETE ENCASEMENT, PER S-7 (24" SWR MAIN)	LF	$ 67.54
CONCRETE ENCASEMENT, PER S-7 (27" SWR MAIN)	LF	$ 79.86
CONCRETE ENCASEMENT, PER S-7 (30" SWR MAIN)	LF	$ 98.22
CONCRETE ENCASEMENT, PER S-7 (36" SWR MAIN)	LF	$ 112.83
CONCRETE ENCASEMENT, PER S-7 (42" SWR MAIN)	LF	$ 128.10
CONCRETE ENCASEMENT, PER S-7 (48" SWR MAIN)	LF	$ 156.04
CUTOFF WALL, PER S-10 (TYPE B)	EA	$ 1,975.16
SEWER MANHOLE, PER S-2 (3'x5')	EA	$ 4,803.90
SEWER MANHOLE, PER S-2 (3'x5' W/LOCKING COVER)	EA	$ 5,905.38
SEWER MANHOLE, PER S-2 (3'x5' PVC-LINER)	EA	$ 7,403.50
SEWER MANHOLE, PER S-2 (3'x5' W/PVC-LINER & LOCKING COVER)	EA	$ 8,504.98
SEWER MANHOLE, PER S-17 (3'x4')	EA	$ 4,254.50
SEWER MANHOLE, PER S-17 (3'x4' W/LOCKING COVER)	EA	$ 6,030.00
SEWER MANHOLE, PER S-17 (3'x4' PVC-LINER)	EA	$ 5,355.98
SEWER MANHOLE, PER S-17 (3'x4' W/PVC-LINER & LOCKING COVER)	EA	$ 7,131.48
SEWER MANHOLE LOCKING COVER, PER M-4	EA	$ 1,101.68
4" PRESSURE PVC SEWER	LF	$ 70.62
6" PRESSURE PVC SEWER	LF	$ 96.15
SEWER ACCESS ROAD (4" DECOMPOSED GRANITE)	SF	$ 7.04

SEWER ACCESS ROAD, PER SDG-113 (AC)	SF	$ 15.14
SEWER ACCESS ROAD, PER SDG-113 (CONCRETE)	SF	$ 60.30
STREET SEWER LATERAL, PER S-13 (4", 40' LONG)	EA	$ 1,788.90
STREET SEWER LATERAL, PER S-13 (6" - 40' LONG)	EA	$ 3,363.40
STREET SEWER LATERAL, PER S-13 (8" - 40' LONG)	EA	$ 4,937.90
ALLEY SEWER LATERAL, PER S-13 (4" - 40' LONG)	EA	$ 1,496.78
ALLEY SEWER LATERAL, PER S-13 (6" - 40' LONG)	EA	$ 2,278.00
6" PVC SEWER MAIN, PER S-4	LF	$ 82.88
8" PVC SEWER MAIN, PER S-4	LF	$ 96.75
10" PVC SEWER MAIN, PER S-4	LF	$ 107.07
12" PVC SEWER MAIN, PER S-4	LF	$ 118.79
15" PVC SEWER MAIN, PER S-4	LF	$ 131.19
18" PVC SEWER MAIN, PER S-4	LF	$ 144.79
21" PVC SEWER MAIN, PER S-4	LF	$ 157.12
24" PVC SEWER MAIN, PER S-4	LF	$ 167.37
27" PVC SEWER MAIN, PER S-4	LF	$ 178.35
30" PVC SEWER MAIN, PER S-4	LF	$ 188.61
36" PVC SEWER MAIN, PER S-4	LF	$ 209.04
8" ESVC SEWER MAIN, PER S-4	LF	$ 100.50
10" ESVC SEWER MAIN, PER S-4	LF	$ 113.90
12" ESVC SEWER MAIN, PER S-4	LF	$ 120.60
15" ESVC SEWER MAIN, PER S-4	LF	$ 127.30
18" ESVC SEWER MAIN, PER S-4	LF	$ 147.40
21" ESVC SEWER MAIN, PER S-4	LF	$ 160.80
24" ESVC SEWER MAIN, PER S-4	LF	$ 174.20
27" ESVC SEWER MAIN, PER S-4	LF	$ 180.90
30" ESVC SEWER MAIN, PER S-4	LF	$ 187.60
42" ESVC SEWER MAIN, PER S-4	LF	$ 207.70
48" ESVC SEWER MAIN, PER S-4	LF	$ 254.60
16" STEEL CASING	LF	$ 130.65
19" STEEL CASING	LF	$ 167.50
21" STEEL CASING	LF	$ 190.28
24" STEEL CASING	LF	$ 215.74
30" STEEL CASING	LF	$ 250.58
33" STEEL CASING	LF	$ 265.32
36" STEEL CASING	LF	$ 284.08
39" STEEL CASING	LF	$ 301.50
42" STEEL CASING	LF	$ 347.06
48" STEEL CASING	LF	$ 383.24
52" STEEL CASING	LF	$ 419.42
60" STEEL CASING	LF	$ 482.40
SEWER PUMP STATION	EA	$ 335,000
ADJUST MANHOLE FRAME & COVER TO GRADE	EA	$450
6" SEWER MAIN CLEANOUT	EA	$633
CONNECT TO EXISTING MANHOLE AND RECHANNEL IF NEEDED	EA	$1,883
ABANDON EXISTING MANHOLE (OUTSIDE TRENCH)	EA	$1,616

WATER

AIR & VACUUM VALVE, PER W-4 (1")	EA	$ 2,247.50
AIR & VACUUM VALVE, PER W-4 (2")	EA	$ 3,190.00
BLOW-OFF ASSEMBLY, PER W-6 (2" TYPE A)	EA	$ 1,254.25
BLOW-OFF ASSEMBLY, PER SDW-106 (3" TYPE A)	EA	$ 2,320.00
BLOW-OFF ASSEMBLY PER W-7 (2" TYPE B, C & D)	EA	$2,718.75
RELOCATE FIRE HYDRANT	EA	$3,190.00
BACKFLOW PREVENTION ASSEMBLY (W/ENCLOSURE)	EA	$2,392.50
FIRE HYDRANT ASSY PER W-10 (2-WAY)	EA	$5,075.00
FIRE HYDRANT ASSY PER W-10 (3-WAY)	EA	$5,800.00
MULTIPLE SERVICE PER W-23	EA	$797.50
THRUST BLOCK, PER W-17	SF	$253.75
WATER METER BOX	EA	$406
THRUST ANCHOR	EA	$447
DUAL ABOVE GROUND METER & B.F PREVENTER (SDW119)	EA	$5,000
ADJUST VALVE COVER TO GRADE	EA	$300
4" FIRE SERVICE	EA	$800
WATER SERVICE CONNECTION	EA	$1,000

WATER VALVES

4" GATE VALVE	EA	$550.00
6" GATE VALVE	EA	$1,000.00
8" GATE VALVE	EA	$1,800.00
10" GATE VALVE	EA	$2,850.00
12" GATE VALVE	EA	$3,700.00
16" GATE VALVE	EA	$4,650.00
20" GATE VALVE	EA	$5,900.00
8" PRESSURE REDUCER W/BOX	EA	$9,820.00

PVC WATER MAINS (ALL MATERIALS)

4" PVC WATER MAIN PER W-21	LF	$48.64
6" PVC WATER MAIN PER W-21	LF	$64.00
8" PVC WATER MAIN PER W-21	LF	$74.24
10" PVC WATER MAIN PER W-21	LF	$80.64
12" PVC WATER MAIN PER W-21	LF	$89.60
16" PVC WATER MAIN PER W-21	LF	$113.92
20" PVC WATER MAIN PER W-21	LF	$128.00

WATER SERVICE

WTR SERV. PER W-1 (1" W/1"X 0.75" METER)	EA	$2,389.00
WTR SERV. PER W-1 (1" W/1"X 1" METER)	EA	$ 2,478.00
WTR SERV. PER W-2 (2" W/1.5" METER)	EA	$ 2,782.00
WTR SERV. PER W-2 (2" W/2" METER)	EA	$2,866.00
WTR SERV. PER W-2 (2-2" W/2-2" METER, MANIFOLD)	EA	$4,561.00
WTR SERV. PER W-1 (1" W/O METER)	EA	$2,267.00
WTR SERV. PER W-2 (1" W/O METER)	EA	$2,453.00

WTR SERV. PER W-2 (2-2" W/O METER)	EA	$3,183.00
RELOCATE WATER SERVICE (k093345a)	EA	$2,400
WATER SERVICE ABANDONMENT	EA	$500

SECTION 6-MISCELLANEOUS IMPROVEMENTS

MISCELLANEOUS ITEMS

VEHICULAR BRIDGE	SF	$ 352.00
PEDESTRIAN BRIDGE	SF	$ 320.00
CRASH CUSHION (G.R.E.A.T.)	EA	$ 47,104
EXCAVATION (FOR STRUCTURES)	CY	$ 39.68
FENCE, PER M-6 (4' HIGH CHAIN LINK)	LF	$ 16.00
FENCE, PER M-6 (5' HIGH CHAIN LINK)	LF	$ 17.92
FENCE, PER M-6 (6' HIGH CHAIN LINK)	LF	$ 20.48
GUARD RAIL METAL BEAM, PER M-30-38	LF	$ 38.40
GUARD RAIL POST, PER M-9	EA	$ 307.20
GUARD BARRICADE, PER M-9	EA	$ 576.00
PCC MEDIAN BARRIER (TYPE 50)	EA	$ 70.40
SAW CUT EXISTING (AC/PCC)	LF	$ 5.12
TRENCH SHORING (5'-10' DEEP)	LF	$ 14.34
TRENCH SHORING (11'-15' DEEP)	LF	$ 22.27
TRENCH SHORING (16'-20' DEEP)	LF	$ 32.00
SURVEY MONUMENT, PER M-10	EA	$ 1,024.00
MASONRY RETAINING WALL	SF	$ 37.95
CAST IN PLACE RETAINING WALL	CY	$ 864.00
GRAVITY RETAINING WALL	SF	$ 28.16
CRIB-BLOCK RETAINING WALL	SF	$ 32.00
PEDESTRIAN BARRICADE, PER SDE 103	EA	$ 192.00
CONSTRUCTION FENCING	LF	$4.00

SECTION 7-LANDSCAPE & IRRIGATION

LANDSCAPE PLANTING

SHRUBS (1 GALLON)	EA	$6.00
SHRUBS (5 GALLON)	EA	$20.00
SLOPE PLANTING (GROUND COVER)	SF	$ 0.48
SLOPE PLANTING (GROUND COVER + TREES)	SF	$ 0.79
SLOPE PLANTING (HYDRO-SEEDING)	SF	$ 0.20
TREE (5 GALLON)	EA	$ 15.00
TREE (15 GALLON)	EA	$ 85.00
TREE (24" BOX)	EA	$250.00
TREE (36" BOX)	EA	$350.00
TREE (48" BOX)	EA	$650.00
TREE GRATE (W/2FRAME)	EA	$480.00
TREE MAINTENANCE (TREES/YEAR)	TREE/YR	$200.00
TREE RELOCATION	EA	$1,666.00
TREE REMOVAL AND DISPOSAL	EA	$500.00

LANDSCAPE IRRIGATION

IRRIGATION BACKFLOW PREVENTION ASSEMBLY (W/ENCLOSURE)	EA	$1,650.00
SLOPE IRRIGATION	SF	$0.59