



New York City Department of Transportation Willoughby Pedestrian Priority Street

Concept Design Plan
June 2015





Pearl Street and Willoughby Street Signs (Source: Arup)

Willoughby Pedestrian Priority Street Concept Design Plan

Final Draft - Submitted 6.23.2015

New York City Department of Transportation



Consultant Team

Ove Arup & Partners PC

77 Water Street, New York NY 10005

Tel +212 896 3000 Fax +1 212 229 1056

www.arup.com

ARUP Perkins Eastman



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Introduction





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Willoughby Street looking east towards Fort Greene Park (source: Arup)

Introduction

The Project

In 2014, New York City Department of Transportation (NYCDOT) employed the Arup consulting team, as a part of its Engineering Services Agreement (ESA) on-call contract, to investigate the applicability of a pedestrian-priority street design to a three-block area in the heart of Downtown Brooklyn at the intersection of Willoughby and Pearl Streets. Task Order #12 of the ESA, known here as the Willoughby Pedestrian Priority Street project, included gathering Existing Conditions, exploring three design alternatives, and recommending a final Design Concept. This conceptual level street design aims to reapportion the street to reflect existing pedestrian activity and anticipate future demand. Given these characteristics, a particular focus was placed on prioritizing pedestrians while allowing multiple modes to share roadway space—a concept often referred to as “Pedestrian Priority” or “shared” street.

This report details the outcomes of the Willoughby Pedestrian Priority Street project:

Chapter 1, Introduction, describes the project site, as well as the engagement process that NYCDOT and Arup undertook to complete the study. This chapter also summarizes the existing conditions report from the first phase of the project, and discusses the project stakeholder goals and objectives that directed the conceptual design process.

Chapter 2, Design Concept, provides a detailed review of the final Design Concept and describes circulation for pedestrians and vehicles, commercial loading and passenger pick up/drop off, emergency access, and programming. This chapter will discuss the design solutions that address the identified issues and opportunities of the project site.

Chapter 3, Materials Selection, provides a detailed review of the Design Concept focused on the selection of the streetscape elements and materials that will support the project objectives.



Pedestrians cross Adams Street in Downtown Brooklyn (source: Arup)

Background

Downtown Brooklyn is one of the most robust retail and commercial activity centers in New York City, anchored by the regional retail destination, Fulton Street Mall. Renowned educational institutions, great public transit connections, and a quickly growing downtown residential community all contribute to a mixed-use urban environment that is becoming among the most vibrant in New York City. Stimulated in part by the Downtown Brooklyn Rezoning of 2004, the area has undergone a transformation of increased commercial and residential investment. According to the Downtown Brooklyn Partnership's recent Real Estate Market Report (2015), \$6 billion of private investment in the last

decade has stimulated growth in the area, in addition to the \$300 million in capital investments made by the City.^{1,2} As a result, Downtown Brooklyn's population has grown by 30 percent in the past 10 years, with more than 150,000 shoppers now visiting the area each business day. This growth trajectory is expected to continue, with \$4.23 billion of private investment currently in the pipeline.³

Downtown Brooklyn is also transforming as prime destination for academic institutions. On April 23, 2012, Mayor Bloomberg announced an agreement to create the Urban Sciences and Progress (CUSP), an academic and private-sector partnership led by New York University and NYU-

Poly, in at the city-owned 370 Jay Street Building, directly adjacent to the project site. At present 57,000 post-secondary students currently attend academic institutions in Downtown Brooklyn; the program at CUSP is expected to accommodate an additional 530 students with additional faculty, scientist and researchers. Brooklyn Friends School, also adjacent to the project site, accommodates about 600 elementary students at its Pearl Street location.^{4,5} In addition, the Downtown Brooklyn Partnership's Brooklyn Tech Triangle Strategic Plan (2013) elaborates a tech district vision to continue to generate economic growth and investment in tech, creative and innovation industries.



370 Jay Street will be transformed into the NYU Center for Urban Science + Progress (source: NYU)

As redevelopment has intensified the uses on parcels throughout the area, and ridership at local subway stations has increased pedestrian activity continues to grow. Future redevelopment will likely continue this trend. In support of this enhanced vibrancy at the street level, the City continues its efforts to make Downtown Brooklyn a comfortable place for pedestrians, as both an economic driver and means to efficient transportation. Most recently, Willoughby Plaza which was transformed from a standard city block and service road to a vibrant pedestrian plaza in 2006.⁶

A NYCDOT study in 2008 developed high-level planning concepts for Willoughby Street

between Willoughby Plaza and Fort Greene Park.⁷ The project site was identified to be a high priority for pedestrian-focused improvements. The findings confirmed an active pedestrian environment with a recommendation for a shared street or pedestrian-priority concept. In addition, this project initiated the Willoughby Streetscape Guidelines, which require private developers to construct and maintain the streetscape to an enhanced and uniform standard.

The project site is rich in local assets such as the historic 345 Adams Street building; the Brooklyn Friends School building at 375 Pearl Street; and the

eastern view corridor to Fort Greene Park's Prison Ship Martyrs monument. These assets have been identified since NYCEDC's Brooklyn Downtown Development EIS Report (2004), and should be 'enhanced by the proposed improvements to the streetscape elements.'⁸



From top: Wall Street, Asheville, NC (source: Creative Commons), Exhibition Road, London (source: Arup)



Læderstræde, Copenhagen, Denmark (source: Creative Commons)

Pedestrian Priority Streets

Often referred to as ‘shared street’ a pedestrian priority street is a street that allows all users – pedestrians, bicyclists, and vehicles – to move within the same space. Vehicles are permitted to access shared spaces but no longer dominate the environment, challenging the common concept that vehicular movement should be prioritized over pedestrian flow.

Streets are often described as the most prevalent public spaces in cities but their value to the pedestrian is often restricted given limited space allocation within the overall right-of-way. Pedestrian priority streets propose to redefine the streetscape and apportion

the majority of space to the major user group: pedestrians. Through enhanced urban design and place-making, pedestrian priority streets can become an extension of New York City’s public space network, putting people first and activating Downtown Brooklyn.

As part of the Willoughby Pedestrian Priority Project - *Existing Conditions Report*, included as Appendix A, international and domestic benchmarks were researched to inspire and inform the conceptual design process. Through this research it was evident that street design was the primary influence on symbiotic vehicular and

pedestrian behaviors. Successful pedestrian priority street design increased driver awareness as well as pedestrian safety and enjoyment. Common features included: flush surfaces, distinct paving and materials, removal of traffic signs and signals, as well as additional pedestrian amenities such as seating, landscaping, and lighting, and flexibility for programming and activation.



LEGEND

-  BUS STOP
-  BUS CORRIDOR (4+ LINES)
-  BUS CORRIDOR (LESS THAN 3 LINES)
-  SUBWAY STATION
-  BIKE SHARE STATION

Project site within Downtown Brooklyn



Pearl Street looking north (source: Arup)

The Project Site

Occupying a prominent space in Downtown Brooklyn, the project site includes Pearl Street between Fulton Street and the Brooklyn Renaissance Plaza, and Willoughby Street between Pearl Street and Jay Street.

To the north of the project site is a parcel occupied by the Brooklyn Renaissance Plaza, a hotel and office complex that is managed by Muss Development. The New York Marriott at the Brooklyn Bridge is a major tenant. Pearl Street terminates into a pedestrian walkway that provides an important east-west connection between Adams Street and Jay Street.

To the west, Pearl Street is defined by the 13-story, 345 Adams Street building which is presently occupied by New York City municipal tenants, including the Department of Finance,

Administration for Children's Services, and the Board of Elections. This building has a dual access lobby from Adams Street and Pearl Street. There are a number of restaurants on the first two floors of the 345 Adams Street building with frontage on Adams Street and Willoughby Plaza.

To the east, Pearl Street is bounded by educational institutions such as the Brooklyn Friends School, ASA Institute, and the latest tenant of the 370 Jay Street building: NYU's Center for Urban Studies and Progress (CUSP). The 370 Jay Street building was formerly occupied by MTA-New York City Transit and sits atop the Jay Street - MetroTech subway station, with a generous first floor station atrium. Construction is planned to begin in 2015, and when completed will

be occupied with retail, classroom, and business incubators by 2017.⁹ The Brooklyn Friends School has occupied the historic building at 375 Pearl Street and currently serves roughly 600 elementary and middle school students. The entrance on Pearl Street is the primary access for all students, parents and staff.

Along Willoughby Street are various small businesses, restaurants, and a subway entrance to Jay Street-MetroTech station. The subway station is located underneath the 370 Jay Street building and has a station entrance on the northern Willoughby Street sidewalk. As the second busiest subway station in Brooklyn,¹⁰ it directs a significant pedestrian volumes directly onto the project site.



Public Open House on October 3, 2014 (source: Perkins Eastman)

Project Process

Over the course of ten months, from June 2014 to March 2015, the Arup consultant team researched design solutions, analyzed the existing conditions of the project site, and engaged local stakeholders to inform a design concept for the Willoughby Pedestrian Priority Street.

The first phase of the project focused on an analysis of existing site conditions, including pedestrian and vehicular counts, a traffic study, crash history research, and several site observations. Public engagement also began during this stage. NYCDOT and the Arup consultant team conducted four individual stakeholder interviews and held an initial Stakeholder Meeting

on August 7th, 2014. This phase resulted in the delivery of the *Existing Conditions Report* (included as Appendix A).

In the following phase, the Arup consultant team created three alternative design concepts (included as Appendix B) that explored potential future scenarios. The Alternatives were evaluated using a process that considered traffic impacts, cost estimates and maintenance considerations (included as Appendices C,D,E).

The three Alternatives were presented at the second combined Stakeholder Meeting held on October 3rd, 2014. In addition, the broader community was invited to participate in a Public Open House event held on

October 27th, 2014 at Brooklyn Friends School.

The final phase of the project included the development of the draft Design Concept, which was presented at the third Stakeholder Meeting on January 29th, 2015. The final Design Concept incorporates feedback from this meeting, and is the focus of this final report.



Willoughby Street looking east (source: Arup)

Existing Conditions Summary

The *Existing Conditions Report*, included as Appendix A, is a comprehensive study of the current condition of the project site. Through a process of research and analysis, site observations, and stakeholder interviews, the study informed the design process and provided a solid foundation to develop the Design Concept. The study investigated the existing mobility conditions such as pedestrian, transit, cycling, and motor vehicular conditions; and existing character and environmental conditions, such as architectural assets, gathering areas, landscaping, view corridors, solar exposure, noise, and perception of safety.

The Existing Conditions Report resulted in a list of identified issues and opportunities. Two major themes arose from this process. First, the quantitative analysis of pedestrian and vehicular volumes, existing level-of-service (LOS), and crash history suggests a pedestrian-priority street design is appropriate within the project site. Currently, pedestrian volumes far outnumber vehicle volumes at all times of the day. The pedestrian volume heading west on Willoughby Street across Pearl Street is greater than 1,000 people during the AM peak, and pedestrians were observed to walk within the road bed and cross at mid-block. In contrast, vehicle volumes are low, likely

due to the site's indirect access through Red Hook Lane, and the dead-end nature of Pearl Street. Second, stakeholder interviews and site observations found the site to be somewhat degraded in appearance, with visual clutter, excessive permit parking, and a prevalence of curbside trash. In addition, pedestrian amenities, such as seating and ample lighting, are absent within the project site.



Willoughby Plaza (source: Arup)

Project Goals and Objectives

Local knowledge from NYCDOT and local stakeholders confirmed the Arup consultant team's site observations and informed the design concept process. The project stakeholders comprised of adjacent property owners, business owners, educational institutions, the community board, business improvement districts, and other city agencies. Following the initial stakeholder interviews and a combined Stakeholder Meeting held on August 7, 2014, six key goals and opportunities were identified to guide the design process and reflect the stakeholders' aspirations for the project. These goals and objectives include:

1. **Create a safe, comfortable, and convenient walking environment for all users.** Improvements to the pedestrian environment should accommodate users of all ages and abilities.
2. **Support and enhance economic and retail vitality.** Investment in streetscape improvements helps to attract businesses to an area, increases property values, and supports local revitalization efforts. Pedestrian-priority treatments can be particularly beneficial to retail businesses, as making streets comfortable places to linger can increase retail sales.
3. **Improve street aesthetics and visual quality.** The character and design of the streetscape are determining factors of the success of the corridor. In order to foster an environment for people to visit and gather, aesthetics and visual quality of the street should be enhanced.
4. **Accommodate all legitimate mobility and access needs, including goods deliveries and passenger drop offs, but place a priority on pedestrian needs.** Goods deliveries and passenger drop-offs are essential for adjacent restaurant, retail, office and educational uses to function; however, loading demands need not be a defining characteristic of the street design. Instead, pedestrian movement will be prioritized while allowing for necessary drop offs and loading.
5. **Design for sustainability, maintainability, and resiliency.** Design strategies should be created to help the corridor grow stronger and more vibrant while facing economic, environmental and social challenges. Infrastructure that manages storm water will help to create an area that is resilient from flooding and other severe weather events. The consideration of the design's maintenance features should be considered early in the design process to reduce maintenance cost and improve safety.
6. **Integrate project area into existing streetscape and facilitate connections with surrounding activity centers, such as Willoughby Plaza, Fulton Street Mall, MetroTech, and Columbus Park.** The project site is within one of Downtown Brooklyn's key crossroads and has the opportunity to better link neighboring activity centers in a manner that is more efficient, comfortable, and enjoyable.

These goals and objectives capture the stakeholders' desired outcomes for the Willoughby Pedestrian Priority Street. These have served as guiding posts throughout the development and creation of the Design Concept.



Design Concept



Design Concept

The Design Concept reflects the feedback from the Public Open House, stakeholders meetings, and comments from relevant divisions within NYCDOT. The Design Concept combines the most successful design elements explored in the three design alternative concepts. These Alternatives and the evaluation process that resulted in the Design Concept are included as Appendices B, C, D and E.

This chapter provides an overview of the Design Concept and describes vehicle and pedestrian circulation, accessible and inclusive environments, programming and activated environments, commercial loading and passenger pick-up/drop-off, and emergency access.

The following chapter, Chapter 3, reviews the material selection, including paving, lighting, street furniture, landscaping, and other streetscape elements. This chapter will also discuss maintenance implications for the material selections and provide a high level cost estimate for the concept.

Design Concept Overview

The Design Concept creates a distinguished public space, featuring a flush surface throughout the site and a selection of materials and streetscape elements to improve visual aesthetics and elevate the public realm from the current condition. The safe, comfortable and desirable pedestrian-friendly environment will invite people to linger, increasing economic and retail vitality of the local business, and serving as a place for the community gathering.

The Design Concept employs the circulation pattern that provides maximum flexibility for future development. Pearl Street, south of Willoughby Street, will be closed to traffic and transformed into a new pedestrian-only plaza that will provide a prominent link between Willoughby Plaza and Fulton Street. Although a pedestrian-priority environment, the Design Concept does not impede the necessary vehicular functions. Commercial loading of local business and pick-up and drop-off of Brooklyn Friends School were carefully considered, and provided for with sufficient allowances for current demand. Parking is not permitted at any location within the site, which allows for greater movement of both pedestrians and vehicles.

The pedestrian experience varies within different sub-spaces of the site. The Willoughby Street design provides a transitional space between the pedestrian-only Willoughby Plaza to the west and Willoughby Street to the east. This is achieved by reinforcing the existing streetscape through

Adams St.

Jay St.

Red Hook Ln.

Fulton St.



Design Concept

-  street lighting
-  landscaping
-  seating
-  cafe table and seating
-  loading area
-  trees
-  flowering trees
-  bike rack
-  concession
-  pavement

the use of symmetrical trees and benches, and by allowing for shared use of the roadway, which more closely mimics pedestrian movement within Willoughby Plaza. The intersection of Pearl and Willoughby Streets will be a visual focal point and prime location for people-watching, as the current east-west pedestrian volumes through the space are significant. The placement of seating around the intersection within the site, as well as within Willoughby Plaza, will support the intersection's role as a visual attraction.

Pearl Street, north of the Willoughby intersection, is subtly divided into three "rooms" that help to break up the length of the street segment. The northernmost section is defined by the concession and surrounding seating, as well as its close connection to the Renaissance Plaza pedestrian pathway. This section is psychologically divided from the rest of Pearl Street because of a break in the street wall caused by the 370 Jay Street loading area and the likelihood of vehicular movements which may dominate the space at certain times of the day. The "rooms" within Pearl Street will be further reinforced by pavement design that provides visual breaks between these spaces.

To the south of the loading area, the character of Pearl Street is defined by its interaction with Brooklyn Friends School and benefits from the lively street life provided by the flows of students and parents in and out of the school. Additional lighting and benches are provided in this section of Pearl Street at a different width than the remainder of the street (19 feet from the building line). This wider pedestrian-only space provides a more substantial entrance that complements the historic architecture of the school and allows smoother pedestrian flow in an area with high demand. It also "pinches" the shared space area, which encourages drivers to slow down and creates a visual focal point at the center of the street segment.

The southernmost section of Pearl Street will likely be activated by the high pedestrian volumes flowing through the Willoughby-Pearl intersection and therefore feel the most connected to the rest of the site. However, larger landscape features on either side of Pearl Street will also enclose the space enough to provide a feeling of being buffered from the busy intersection. Throughout Pearl Street, low-lying green space will help differentiate between the pedestrian-only and shared spaces in a manner that does not amplify the cavernous feel of the corridor and that allows for flexibility for programming and play space.



Visualization of reimagined Pearl Street looking north (source: Arup and Perkins Eastman)



Visualization of reimagined Pearl Street looking south (source: Arup and Perkins Eastman)

Pedestrian Circulation

In the Design Concept, pedestrians will be able to circulate freely through all areas of the site, connecting with pedestrian-only spaces such as Renaissance Plaza to the north and Willoughby Plaza to the west, and better accommodating the high pedestrian volumes identified during the Existing Conditions phase of the project. As pedestrian activity is expected to rise due to adjacent redevelopment, including NYU-CUSP, additional space for pedestrians will be critical to creating a successful space.

Pedestrian-only zones, which provide space restricted from vehicles, are incorporated into the concept to increase the perception of safety for children, seniors, or the visually impaired. These zones are located adjacent to buildings and are separated from the shared street 'roadway' by permanent vertical elements. Three pedestrian-only zones have been identified within the project site:

- Willoughby Street northern sidewalk, which accommodates pedestrian traffic from Jay Street - MetroTech Station;
- Pearl Street eastern sidewalk, which accommodates pedestrian traffic to Brooklyn Friends School; and
- Pearl Street western sidewalk that provides a continuous north-south connection in between the pedestrian corridors of Renaissance Plaza and Fulton Mall.

The scheme uses a balanced approach to frequency and spacing of the vertical elements of street lighting, bollards, seating, landscaping, bike parking. The spacing must prevent penetration from vehicular movements, while allowing for an ease of mid-block pedestrian permeability. The spacing should accommodate activation and programming while maintaining safety and accessibility.



Pedestrian Only Zones (source: Arup and Perkins Eastman)



Pearl Street, Existing Condition (source: Arup)



Albert Street, Brisbane, AU (source: Arup)



New Road, Brighton, UK (source: Creative Commons)

Accessibility and Inclusive Environments

The Design Concept envisages an inclusive environment for the local community, providing safety, comfort and amenity to all ages and all levels of ability. The scheme accommodates pedestrian-only zones along existing high pedestrian volume desire lines (see Pedestrian Circulation, page 24) and accommodates the following guidelines from the American with Disabilities Act (ADA)'s Standards for Accessible Design (2010):

- §406 Curb Ramps; curb ramps are required at pedestrian crossings
- §705 Detectable Warnings; detectable warnings are required to indicate location of curb ramps and hazardous vehicle ways

Designing for members of the disabled community

The Design Concept recommends a flush surface treatment that eliminates traditional curb-level changes. For members of the disabled community the pedestrian priority street will function similarly to a pedestrian plaza condition, promoting the easy spread of movement throughout the space. In line with NYCDOT standard practice, curb ramps are recommended at crossings at curbed locations such as the intersection of Jay and Willoughby Streets.

Designing for members of the visually impaired community

Design consideration for members of the visually impaired community are particularly important due to the very nature of pedestrian-priority environments where vehicular and pedestrian environments have the potential to overlap. Pedestrian priority schemes are often designed differently from traditional streets, and may not have the same recognisable cues that communicate potential risks to visually impaired persons. The Design Concept uses flush surfaces throughout the site, where sidewalk and roadway spaces are at the same grade and absent of curbs.

Tactile warning strips have two primary applications in the conceptual Design Concept; as a warning linear element and an indicator of areas of safe crossing.

- Tactile warning pavers act as a continuous linear element to indicate the transition from the pedestrian-only 'sidewalks' into the shared space 'roadway'. These continuous linear pavers will be located on Willoughby and Pearl Street, and will segregate the sidewalk from the roadway and loading areas.
- Tactile warning pavers provide guidance at a safe crossing point. In line with NYCDOT standard practice, warning pavers in the form of truncated domes are recommended at all pedestrian crossings.

Tactile warning strips can be made of any material suitable for foot pavements and color contrast may be considered in order to improve usability by visually impaired.



Exhibition Road, London (source: Arup)



Detectable warnings at Albert Street, Brisbane, AU (source: Arup)



Tactile warning strips at Exhibition Road, London (source: Arup)

Designing for members of the senior community

Design considerations for members of the senior community include:

- Appropriate signal times. Although no signalised intersections are located within the project site, the intersection at Willoughby and Jay Street adjacent to the pedestrian-priority street will need to have pedestrian signals that are appropriately timed for members of the senior community to cross in a comfortable and safe manner.
- Increased pedestrian amenities. Pedestrian-only zones (see Pedestrian Circulation, page 24) along high volume desire lines are equipped with seating at regular intervals to cater to members of the senior community and other mobility impaired users.
- Reduced tripping hazards. Flush paving throughout the project site eliminates the existing curb, creating a space similar to a pedestrian plaza environment. Members of the senior community will no longer navigate the level change and risk tripping. This is also helped by the clutter-free environment, comprising of generous sidewalks and furniture arranged in a way that does not obstruct traffic.

Vehicle Circulation

The transformation of southern Pearl Street into a pedestrian-only plaza, will close off access from Red Hook Lane and direct vehicular access to the Willoughby and Jay Street intersection. This intersection will serve as the gateway into the site, as it will accommodate both entering and exiting vehicular traffic, which converts Willoughby Street into a two-way street. Signage will be located to indicate the change in street environment and regulate a slower entry for vehicles.

The accommodation of vehicular turn-arounds have been integrated into the Design Concept with designated areas for U-turns or three-point turns. Vehicles traveling along Willoughby Street may opt to make a U-turn at the intersection of Willoughby Street and Pearl Street, or instead turn onto Pearl Street and perform a three-point turn or U-turn at the northern terminus of Pearl Street. The elimination of parking will allow for easier movement for turning vehicles when compared to the existing condition.

Dimensions and New Street Design

The new design of Willoughby and Pearl Street will have two-way traffic with a 24 ft. travel zone on Willoughby Street and a 20 ft. travel zone on Pearl Street. The design will accommodate an extension of the pedestrian-only sidewalk spaces which are reflective of pedestrian demand. The sidewalk space varies from 10 ft. at the narrowest to 19 ft. at the widest.



Vehicular circulation (source: Arup and Perkins Eastman)



Willoughby Street, Existing Condition (source: Arup)



Vehicles sharing the right-of-way with pedestrians (source: Arup)



Vehicles drive down Cady's Alley, Washington, D.C. (source: Creative Commons)

Parking

Currently, the project site includes no parking and permit parking zones. On-street permit parking zones will be repurposed as travel lanes to accommodate two-way traffic along Willoughby and Pearl Street. Parking regulations will communicate 'No Standing' except for commercial loading and passenger pick-up/drop-offs at designated times.

Speed Limits and Signage

Due to narrow lanes with two-way traffic, single block lengths flanked by a dead end and a traffic signal, significant street furniture and landscaping, as well as high pedestrian volumes, vehicle speeds may be reduced and often are lower than expected. Research suggests that drivers are more likely to give way to pedestrians when vehicle speeds fall to around 15 mph.¹⁴ Lower speed limits create a more comfortable pedestrian environment and decrease the risk of pedestrian fatality in the event of an incident. Due to the dead-end nature of Pearl Street, vehicular uses will be generally commercial loading and passenger during pick-up/drop at certain intervals throughout the day. Measures along Willoughby Street such as road narrowing, and distinct paving treatments will reinforce lower speed of travel. Speed limits will clearly be signed at the gateway intersection at Willoughby and Jay Street and at the intersection at Willoughby and Pearl Street.

By principle, ideal pedestrian-priority streets have minimal signage, in order to keep the spaces clutter free and increase driver awareness and engagement with their surroundings. Regulatory signage would still be required throughout the project site. The potential location of signage is discussed in following chapter (see Other Elements, page 52).

Commercial Loading and Passenger Pick-up Drop-Off

Commercial loading and school pick-up/drop-off will maintain designated space on both Willoughby Street and Pearl Street. The south side of Willoughby Street has approximately 60 feet designated for both commercial loading and school pick-up/drop-off, or approximately three car lengths or two truck lengths. The east side of Pearl Street has approximately 95 feet designated for both commercial loading and school pick-up/drop-off, or approximately five car lengths or three truck lengths. The loading dock at the rear of 370 Jay Street will continue to provide access to NYU and is approximately 35 feet wide.

Commercial Loading

The Design Concept designates commercial loading along the south side of Willoughby Street, the east side of Pearl Street, and at the rear loading dock for 370 Jay Street. The designated loading space on Willoughby Street is approximately 2 truck lengths, while the designated loading space on Pearl Street can accommodate approximately 3 trucks. Through site observations, preliminary studies and analysis, this should be sufficient to accommodate the needs of the 345 Adams Street building, the predicted uses of NYU-CUSP in



Existing loading on the south side of Willoughby Street (source: Arup)



The project site has significant commercial loading needs that will be accommodated through on-street loading zones and access to existing 370 Jay Street loading dock, pictured above. (source: Arup)



Off peak pedestrian priority street commercial loading, Winthrop Street, Cambridge, MA (source: Arup)

the reoccupied 370 Jay Street building, and the local business along Pearl and Willoughby Street. Restaurants of 345 Adams Street are encouraged to use the loading on Adams Street, however not restricted from the use Pearl Street and Willoughby Street loading areas, when not used by parents during school drop-off times.

Since Pearl Street south of Willoughby Street is converted into a public plaza, trucks must enter from two-way Willoughby Street and turn right onto Pearl Street and make a U-turn at the northern terminus of Pearl Street to access the loading spaces on Pearl Street and Willoughby Street. The roadway allowances on Willoughby and Pearl Street permit a 30' truck to make three-point movements.

A detailed study confirming commercial loading capacities will be developed in detail in future phases of design. Additional commercial loading area locations have been identified outside of the study area such as along Jay Street, south of Jay and Willoughby Street intersection. Within the site, the Design Concept design may adapt to accommodate additional space if required; for example, street trees along Willoughby Street may be reordered to add additional loading space.

Passenger Pick-up and Drop-off

The Design Concept designates school drop-off/pick-up areas along the south side of Willoughby Street and the east side of Pearl Street. The designated space on Willoughby Street is approximately 3 car lengths, while the designated space on Pearl Street can accommodate approximately 5 cars. Through site observations, preliminary studies and analysis these allowances should be sufficient to accommodate the needs of the Brooklyn Friends School.

The present condition of school bus loading at Adams Street is encouraged in the Design Concept. While the roadway allowances on Willoughby and Pearl Street permit the navigation of a 40-foot school bus, in order to turn around at the terminus of Pearl Street, buses would need to utilize the NYU loading dock for 3-point turning maneuvers.

Since Pearl Street south of Willoughby Street is converted into a public plaza, vehicles must enter from two-way Willoughby Street and turn right onto Pearl Street and make a U-turn at the northern terminus of Pearl Street to access the loading spaces on Pearl Street. Vehicles can also make a U-turn at the intersection of Willoughby Street and Pearl Street to access the space along Willoughby Street.

A detailed study confirming passenger drop-off and pick-up capacities should be developed in detail in future phases of design. Additional school pick-up/drop-off area locations have been identified outside of the study area such as along Jay Street, north of Jay and Willoughby Street intersection. Parents and children could connect to Pearl Street through Renaissance Plaza.



School pick-up/drop-off (source: Arup and Perkins Eastman)



Entrance to the Brooklyn Friends School, Pearl Street (source: Arup)



Existing school drop off on the east side of Pearl Street (source: Arup)



Child-friendly pedestrian priority street, Winthrop Street, Cambridge, MA (source: Arup)

Emergency Access

The Design Concept conforms to City standards for emergency and maintenance vehicles. The roadway allowances on Willoughby and Pearl Street permit the navigation of a 45.42' fire truck with turning movements similar to the existing condition at the terminus of northern Pearl Street. The southern Pearl Street plaza was designed with a 16-foot clearance for emergency and maintenance vehicle. Placement of permanent infrastructure such as street furniture and landscaping were carefully considered to accommodate emergency access.



Emergency vehicle access and circulation (source: Arup and Perkins Eastman)

Programming and Activated Environments

Programming, activation strategies and street operations are discussed below because they help to meet project goals and objectives and helped to inform the Design Concept selection. However, other than concession locations, these elements are not included in the Design Concept conceptual plan because they do not require capital funding expenditures.



Location of concessions (source: Arup and Perkins Eastman)

Concessions

Concessions generate activity in public spaces; they are opportunities for cafes, food vendors, and information display and small retail. The Design Concept has two locations for concession structures that would likely be surrounded by movable seating: 1) the northern Pearl Street terminus, and 2) the plaza on southern Pearl Street. Concessions not only activate public spaces but can also generate revenue that can contribute to maintenance costs. The NYCDOT standard concession footprint is 9 by 12 feet.

The northern Pearl Street concession was designed to increase pedestrian activity in what is currently a dead zone and to visually attract pedestrians to walk north of Pearl Street. The concession footprint is located towards the east side of the street to maximize the turning movement of larger trucks, but can still accommodate a 600 square foot seating area. The southern Pearl Street concession harnesses the activity of Fulton Mall and creates a focus in the center of the southern Pearl Street plaza. This concession can accommodate a much larger 1,100 square foot seating area.

The concessionaire would be responsible for the maintenance, and would be stipulated in an agreement with NYCDOT.

Play Streets

Play Streets operate throughout the school year and provide children and communities with space for engaging in active play and physical activity. There is an opportunity for Pearl Street to operate as a play street at certain times, as a means to assist Brooklyn Friends School's need for active play spaces.

Play Streets are observed by NYCDOT and require approval from the Community Board and local police precinct. During play street times, restrictions to vehicle access will be applied to increase children safety. Play Street times will be determined through future engagement between NYCDOT and local stakeholders.

Programming

There is an opportunity for the project site to use programming as a way to activate the space and reinforce its unique attributes. Farmer's markets, movie nights, block parties and street festivals could be programmed during designated times, where the street is restricted to vehicular access, and the shared roadway become pedestrianized areas. These can operate on weekends, seasonal times and special occasions, or at regularly scheduled times during the day or week. Commercial loading areas along Willoughby and Pearl Street could be adapted to accommodate food trucks or market stalls as a way to incorporate programming without requiring street closure to vehicles.



Outdoor movie programming on Davis Street, Portland (source: Creative Commons)



Material Selection



Material Selection

The areas surrounding the project site have a variety of street element styles, which create distinguished public spaces such as MetroTech Plaza, Renaissance Plaza, Cadman Plaza, Willoughby Plaza, Fulton Street mall, and Flatbush Avenue. The Design Concept opted to tie in elements from these surrounding locations, while creating a distinguished public space. Both Willoughby and Pearl Street use a common palette of flushed paving, street furniture, and landscaping to create a unified space. This chapter speaks to the material selection and placement of the following elements:

- Paving
- Lighting
- Street Furniture
- Landscaping, and
- Other Elements

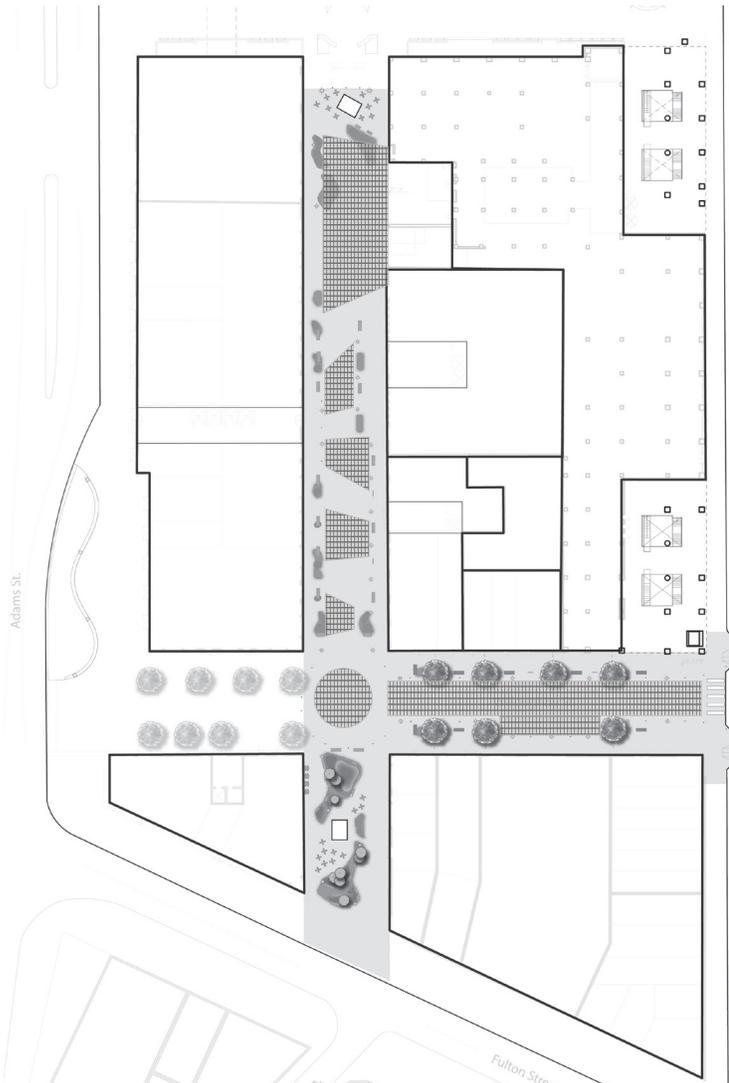
The selection of materials and design elements has implications on long-term maintenance in the area. The design team were careful to select standard elements per the NYCDOT Street Design Manual (2013) and propose strategies for maintaining any non-standard items.

Paving Design

Paving materials were chosen to create a change in the public realm environment that will cause the driver to react and increase awareness to the other modes. The following discusses paving options for the pedestrian safe zones and shared spaces.

Pedestrian Only Zones

The pedestrian-only zones through the project site will use pigmented scored concrete in a 5x5 foot flag pattern. Concrete is a durable sidewalk surface, widely available and cost efficient; and it is the responsibility of the adjacent property owners to maintain.



Paving location plan (source: Arup and Perkins Eastman)

 pavement



Pigmented Concrete (source: NYCDOT)



Granite Cobblestone (source: NYCDOT)



Porous Concrete (source: NYCDOT)



Scored Concrete, Washington DC (source: NYCDOT)

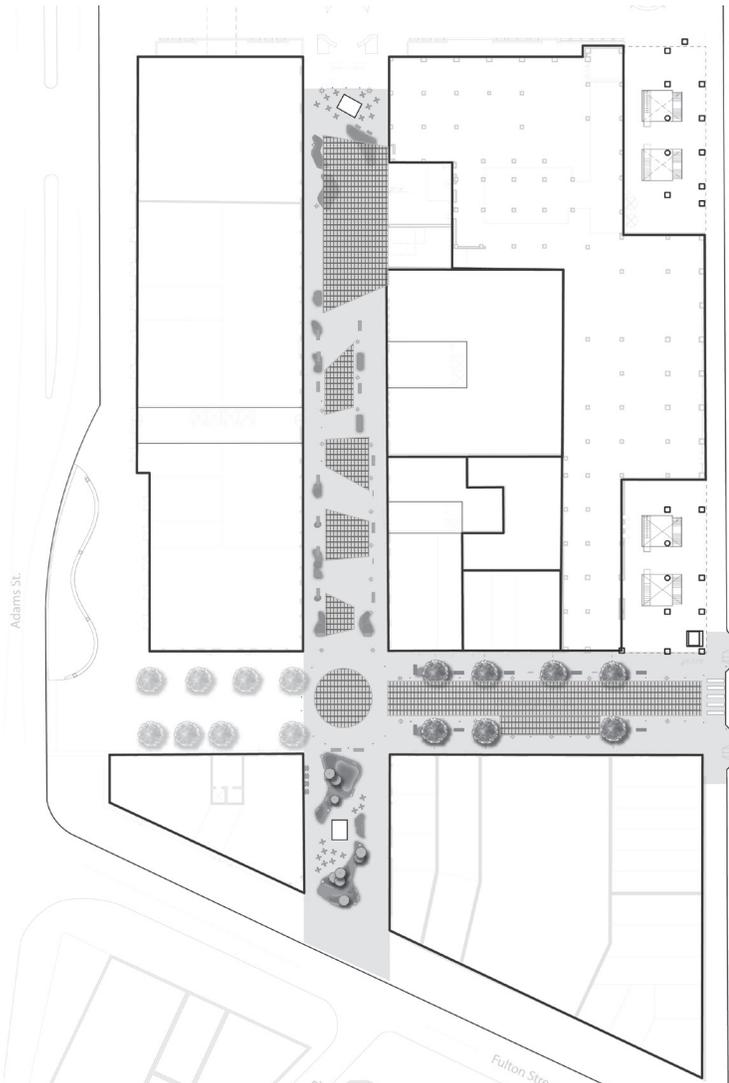
Shared Spaces

The Design Concept will have a continuous flush surface throughout the project site. Two material options for the roadway area were explored. Both options are durable materials, resistant to wear of regular private vehicles and commercial loading vehicles, and will be designed to accommodate ADA accessibility requirements.

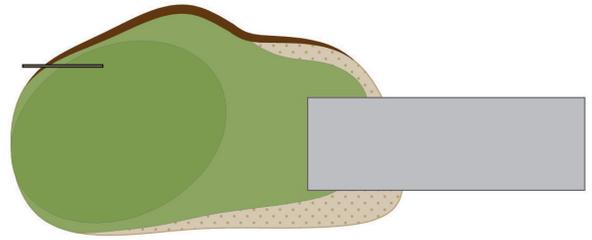
- Option One: Scored Concrete. Scored concrete is included in the NYCDOT Street Design Manual and can be enhanced with distinctive scoring patterns. Concrete can be pigmented in a variety of colors to assist in disguising staining incurred by vehicular use. Two to three pigment shades in combination may suffice. Concrete is durable, widely available and cost efficient, however, may be difficult to repair or patch in sections for utility access. Scored concrete is generally maintained by NYCDOT which may need an agreement with a maintenance partner. Minimal cleaning required. Street sweeper or jet washer can be used when necessary.
- Option Two: Granite Cobblestone. Granite cobblestone is featured in the NYCDOT Street Design Manual but is typically limited to historic areas. The use of a different material for the shared space, relative to the pedestrian only zones, may help in visually delineating the separation of modes. Granite cobblestones come in a variety of color, texture and veining which will assist in disguising staining incurred by vehicular use. Granite cobblestone is relatively easy to remove and reset for utility access, however may become loose over time. Their use may require the need for a maintenance agreement between NYCDOT and a maintenance partner.

Permeable Paving and Porous Concrete

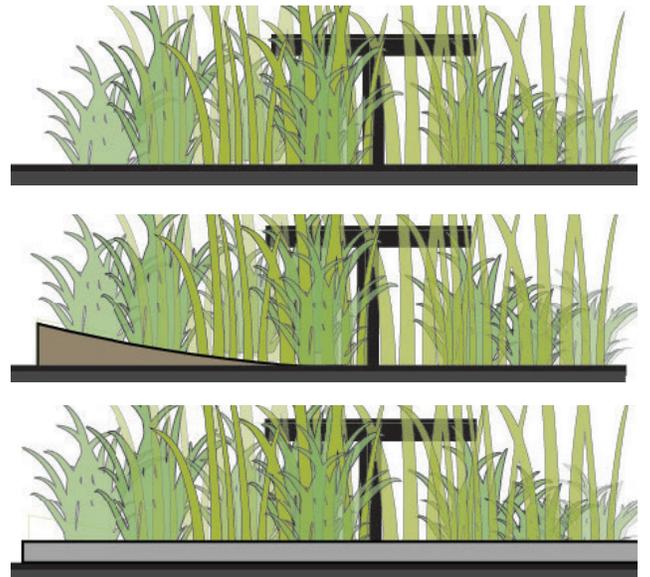
There is an opportunity to use Permeable Paving and Porous Concrete along Pearl Street, either as part of the shared space, as delineator strips, or integrated into the landscape features. Though encouraged by the NYCDOT Street Design Manual, they are classified for pilot use and would require a maintenance agreement between NYCDOT and a maintenance partner. Further soil type analysis and investigation of MTA water sensitive sub surface infrastructure are needed to confirm viability, however, a desktop survey of existing public records indicated potential to safely integrate green infrastructure in many areas along Pearl Street. Willoughby Street is not a viable option due to subsurface subway tracks. Appendix E, Green Infrastructure, includes Arup's analysis of green infrastructure potential within the site.



Paving location plan (source: Arup and Perkins Eastman)



Curb and landscaping detail (source: Arup and Perkins Eastman)



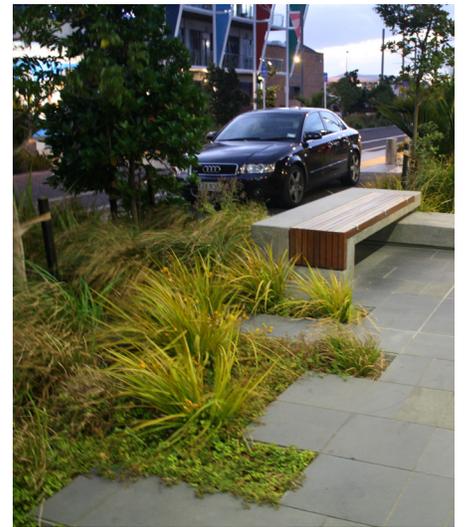
Curb and landscaping detail options (source: Arup and Perkins Eastman)



Curb detail - Seat wall
New York (source: Arup)



Curb detail - Landscaping
New York (source: Arup)



Curb detail - Integrated landscaping
Auckland (source: Arup)

Lighting Design

The existing conditions analysis identified the need for additional pedestrian-scaled lighting. Willoughby Street features street lighting at 18-foot spacing (street light-to-street light), and are located as such to create generous sidewalks; 11.5- to 13-foot widths on the north and 14.5-foot widths on the south.

Due to Pearl Street's narrow 50-foot street width, a single row of street lights at 18-foot spacing (street light-to-street light) were selected to flank the eastern sidewalk. Special attention was given to increase lighting at the entrances of prominent building locations such as the entry into Brooklyn Friends School and the Pearl Street entrance to the 345 Adams Street building.

The following lighting types are recommended for the project site:

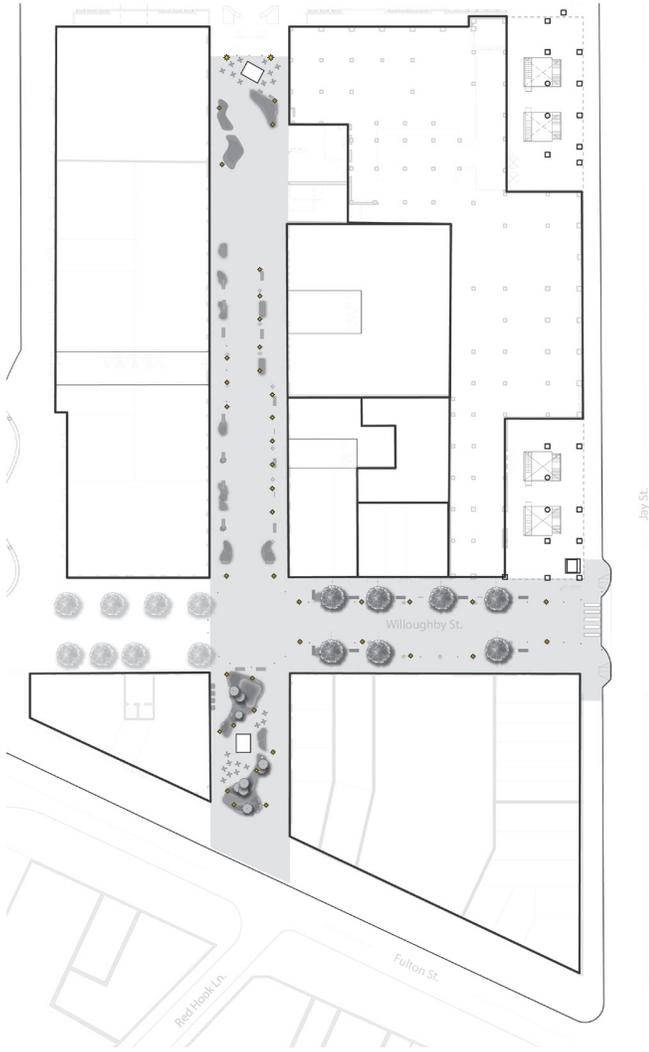
- Type B-Poles and Fixtures: The NYCDOT Street Design Manual's Type B-Pole with NYCDOT standard LED fixture were selected for the project site for the linear arrangements along Pearl and Willoughby Streets and may also be used for the lush landscaped areas at the northern and southern ends of Pearl Street.
- Other Lighting Types: Other light fixtures, such as those on Flatbush Ave, were investigated and may be a feasible option in the landscaped areas at the northern and southern ends of Pearl Street. Other options that were investigated include bollard light fixtures, ground lighting, catenary lighting, and façade lighting may be feasible upon agreement with a local maintenance partner.

Lighting Levels

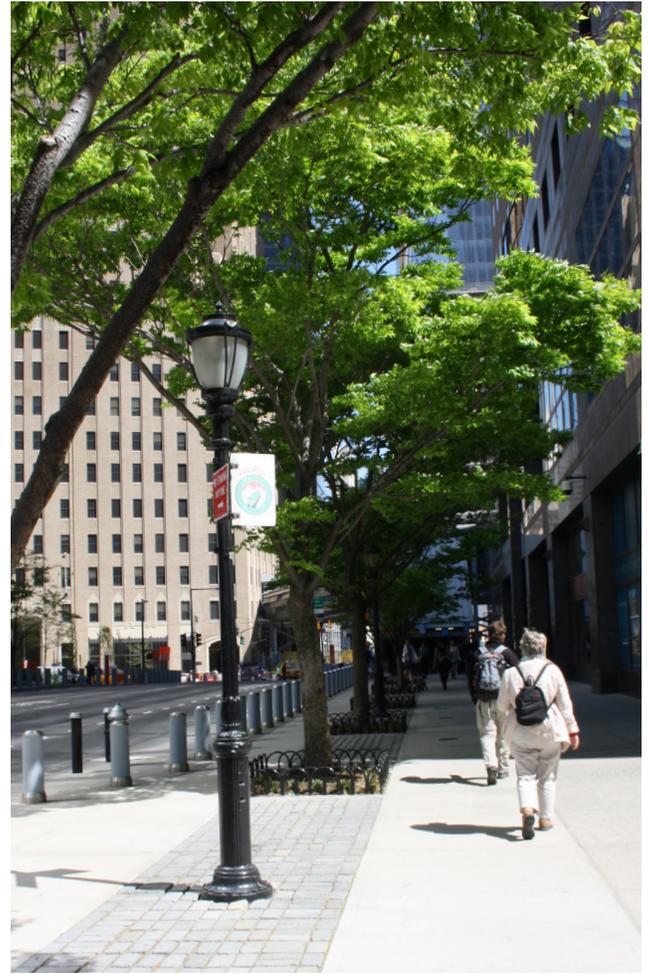
The Design Concept removes the existing street lights and replaces them with a pedestrian lighting scheme to illuminate the pedestrian-priority space. Preliminary high-level calculations show that the Design Concept concept illuminance levels range between 5 and 10 lux, which is in the general range of NYCDOT requirements (see below). Other factors, such as lighting from adjacent buildings, may influence the illuminance levels of the space. Further lighting analysis will be needed in later design development.

NYCDOT requirements:

- Street (Local road, Concrete surface) : 3 to 6 Lux depending on pedestrian conflicts.¹⁵
- Plaza : 5 to 10 Lux depending on use and pedestrian conflicts.¹⁶



Lighting location plan (source: Arup and Perkins Eastman)



Mode segregation using bollards, trees and lighting, New York (source: Arup)

Lighting Levels		
Light Fixture and Spacing	Proposed Use	Approximate Illumination
Type B –Pole, 18 ft spacing, single row	Along Pearl Street	~ 5 Lux
Type B –Pole, 18 ft spacing, double row	Along Willoughby Street	~ 10 Lux

The Design Concept uses standard NYCDOT fixtures, maintenance will involve occasional bulb replacement and graffiti removal. LED fixtures were chosen and would involve less replacement than the High Pressure Sodium (HPS) alternative.



Type B Fixture & Pole (source: NYCDOT)

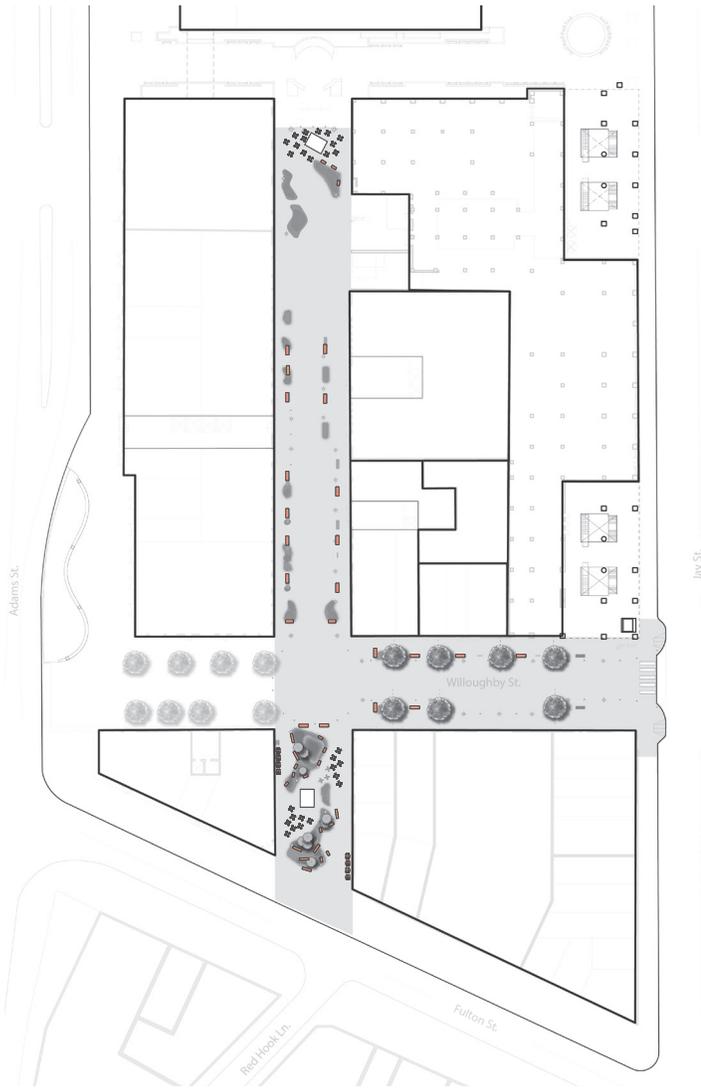
Street Furniture

Street furniture provides public spaces with pedestrian amenities equipping places with comforts and essentials to encourage people to linger and gather. In shared street environments, street furniture also delineates shared and pedestrian only spaces. The selection of street furniture is an opportunity to distinguish the place. For relevant furniture types, the Design Concept used standard materials from the NYCDOT Street Design Manual.

Seating

The existing conditions analysis identified a lack of seating, as evidenced through the observation of its generally absence and makeshift seating on planters and service infrastructure. In the Design Concept seating has been carefully placed on site with attention to spacing and frequency. Along Pearl Street there is a concentration of seating near the entry of Brooklyn Friends School for waiting parents and children, along pedestrian-only zones to support the elderly and physically impaired, at the intersection at Willoughby and Pearl Street, and at the southern Pearl Street plaza.

- CityBenches along Willoughby Street: Because Willoughby Street has a more traditional streetscape feel, the NYCDOT Street Design Manual CityBench was selected for this space. CityBench has a back and backless variation. Seating parallel to the roadway was incorporated to maximize pedestrian thoroughfare, with the exception of seating that faces the intersection of Willoughby and Pearl Street, a visual focal point. Maintenance will involve periodic cleaning, such as a wash down and graffiti removal when needed.
- Seat wall benches along Pearl Street: Non-standard seat wall benches will be integrated as part of the landscaping features along Pearl Street. On southern Pearl Street plaza, the benches are immersed into the lush green spaces, and along Pearl Street benches can either stand alone or touch upon green spaces. Further, benches are responsive to the spatial context and are generally more rectilinear along Pearl Street, and have more organic forms from within Pearl Street Plaza. Seating material could either be granite or concrete options. Seating parallel to the roadway was considered to maximize the pedestrian thoroughfare. Maintenance will involve a similar process to standard benches such as periodic cleaning, wash down and graffiti removal when needed for both concrete and granite options.

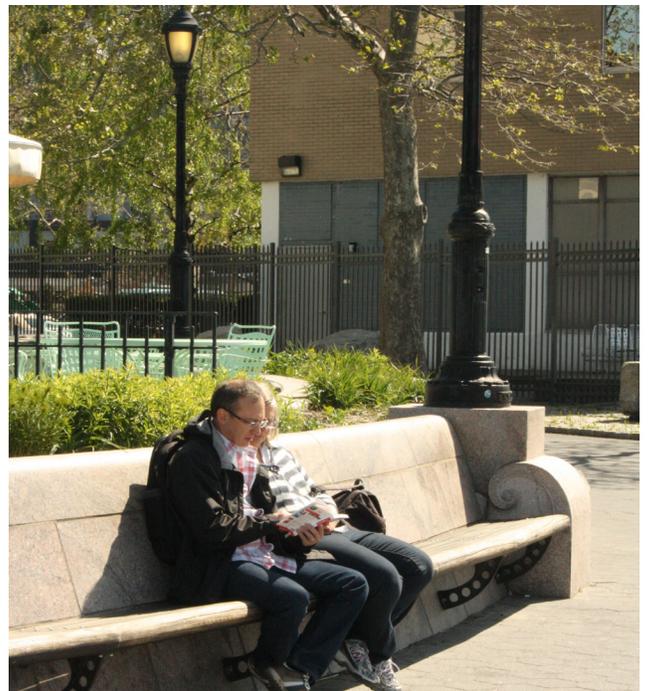


- seating
- ⊗ cafe table and seating

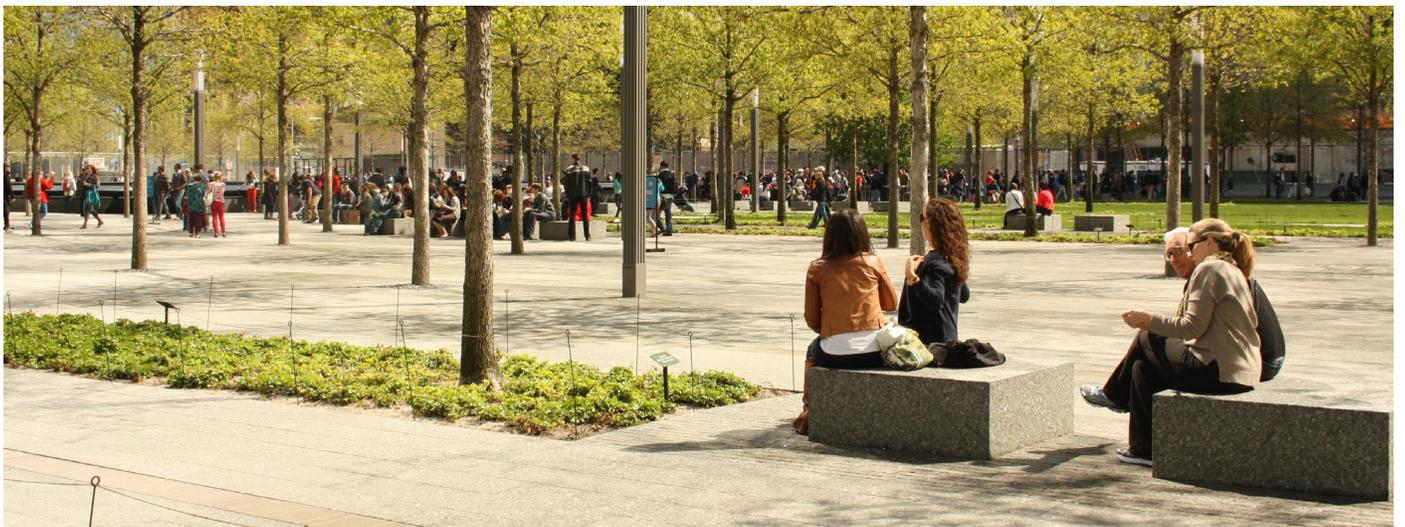
Seating location plan (source: Arup and Perkins Eastman)



CityBench, New York (source: NYCDOT)



Landscaping and seat wall, New York (source: Arup)



Landscape elements used as seating (source: Arup)

Bollards

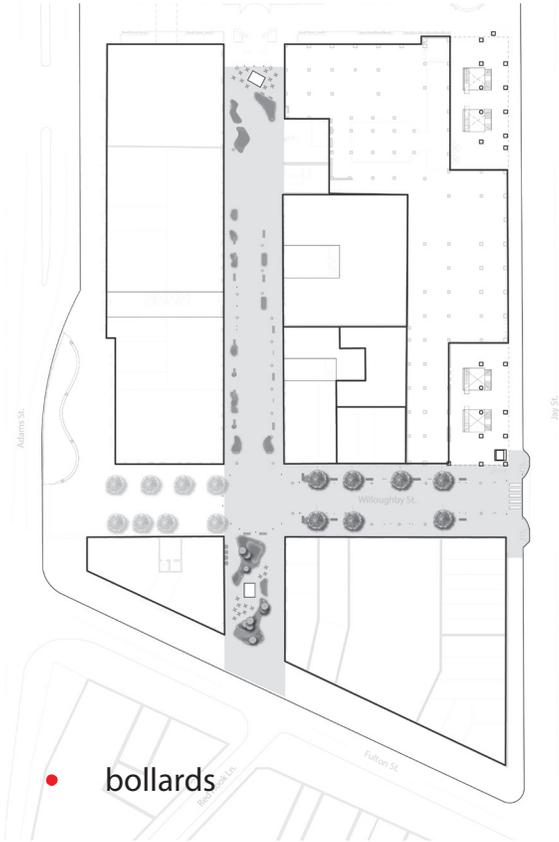
Bollards, of an 18ft spacing (bollard-to-bollard), have been used as a clear message of ‘no entry’ to vehicles at areas where there may be safety issues. In particular, where a pedestrian priority street directly terminates into a pedestrian-only plaza at the following locations:

- Pearl Street northern terminus at Renaissance Plaza;
 - Willoughby Street site boundary at Willoughby Plaza; and
 - Southern terminus of Pearl Street plaza at Fulton Street.
- Bollards have been used in other places in the project site that may experience the occasional pedestrian overflow, such as:
- Pearl Street lobby entrance to 345 Adams Street building; and
 - Gateway at the intersection of Willoughby and Jay Street, near the entrance of the Jay Street-MetroTech station

Bollards, if painted, will need an occasional touch up and will require replacement on impact.

Bike Parking

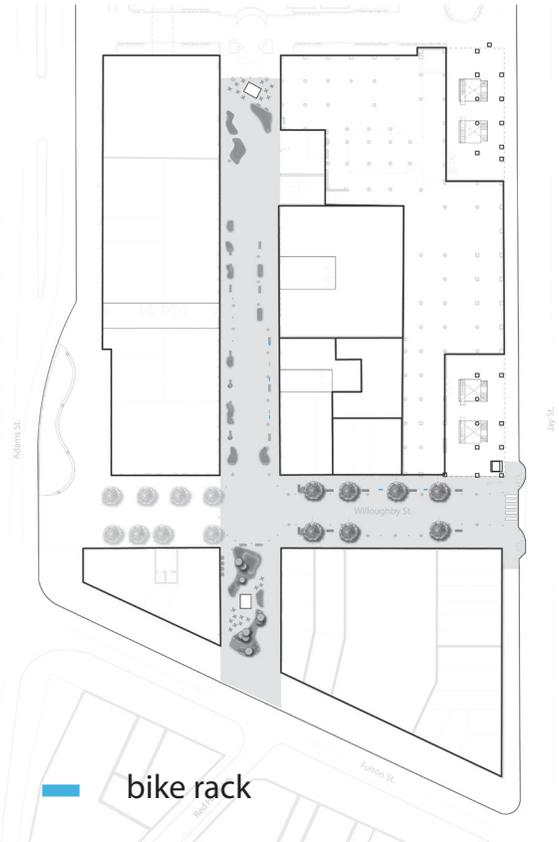
The existing conditions analysis identified a lack of bike parking, as evidenced by the observation of makeshift parking occurring around the project site, i.e. on scaffolding, traffic signage, and street lighting. The NYCDOT Street Design Manual CityRack was selected for periodic placement along Willoughby and Pearl Streets. Bike racks may require replacement on impact.



Bollard location plan (source: Arup and Perkins Eastman)



Mode segregation using bollards, trees and lighting, New York (source: Arup)



Bike rack location plan (source: Arup and Perkins Eastman)



CityRack, New York (source: NYCDOT)

Landscaping

The project site is an opportunity to inject additional green space into the Downtown Brooklyn urban environment. Trees and landscaping have numerous benefits including an improved aesthetic, reversal of the urban heat-sink effect, improving run-off water quality and providing green infrastructure areas.

The project site is constrained by the subway line that runs directly underneath Willoughby Street. MTA policy restricts the use of permeable green infrastructure above subway infrastructure to reduce the risk of flooding to the station box. Previous studies have indicated that the subway structure roof is approximately 39' below the compacted granular fill layer of Willoughby Street. For this reason, Pearl Street explores lush, generous areas of landscaping, and Willoughby Street was limited to smaller tree pits.

Street Trees along Willoughby Street

Two rows of street trees are located along Willoughby Street, continuing the avenue of Honey Locusts which presently line the adjacent Willoughby Street Plaza. These trees are part of the local character of the greater Willoughby Street and serve to enhance the view corridor to Fort Greene Park. The street trees increase shade along Willoughby Street and are easily accommodated in the 60-foot space. Larger trees were intentionally omitted from Pearl Street, so as not to exacerbate the shaded quality of the narrow 50-foot space. To conform to NYCDPR guidance, trees were spaced at 30 feet center-to-center intervals and located 35 feet away from intersections so as to not interfere with driver visibility.¹⁷ Maintenance will involve leaf clearing in the fall, pruning, fertilizer and supplemental watering. During establishment, additional watering and staking may be needed.

Landscaping along Pearl Street

Pearl Street is contained within the project site and bound by Renaissance Plaza and Fulton Mall, and is an opportunity to define its own character. Seating and landscaping were inspired by the organic shaped planter and river bench seating found on nearby Adams Street within the Willoughby Plaza.

The landscaping informs a series of spatial experiences along Pearl Street:

- At the northern end, landscaping provides a green buffer around the concession, providing physical separation from loading vehicles and mitigating noise and unpleasant visual aesthetics of the loading dock activities.
- Along Pearl Street, the landscaping is located in a rhythm of spaced clusters. Careful consideration was taken to ensure the



Street tree location plan (source: Arup and Perkins Eastman)



Street trees (source: Arup)

-  trees
-  flowering trees



Landscaping location plan (source: Arup and Perkins Eastman)



Rain Gardens (source: NYCDOT)



Flowering Understory (source: NYCDOT)

-  planters
-  landscaping

right balance of spacing, providing protection to the pedestrian-only zones while not impeding the ease of mid-block crossing movements. These clusters accommodate seat wall benches and detailed edging treatments. The edging treatment featured a walkable, permeable aggregate edge toward the pedestrian-only zones;¹⁸ and a raised border along the shared roadway to deter private vehicles from driving on the landscape clusters, as well as reducing the maintenance loads. Mirrored clusters at the intersection of Willoughby and Pearl Streets serve as a gateway feature for Pearl Street.

- At the southern end, Pearl Street plaza is an opportunity for a lush, green oasis in an otherwise very urbanized environment. Large areas of landscaping surround the concession stand in the center inspired by the organic landscaping on nearby Adams Street. This creates a destination that welcomes people to sit, linger, and enjoy the activity of Downtown Brooklyn.

The plaza will showcase a robust variety of planting (flowering understory, perennials and grasses) and create an experience of permeable layers that encourage interaction with nature. There is a potential for storm water retention and rain gardens to be incorporated into the plaza design.

Maintenance will involve topdressing and mulching, weed control, pest inspection, leaf clearing in the fall, pruning, fertilizer and supplemental watering.

Other Elements

Traffic Signage

Signage at the gateway of Willoughby and Jay Street is recommended to indicate transition into the pedestrian-priority space. Signage may also be located on the intersection of Willoughby and Pearl directing vehicular traffic to be aware of the ‘no outlet’ condition of Pearl Street and the option to turnaround at the northern terminus. Regulatory signs for commercial loading, passenger pick-up and drop-off, and play street times could also be incorporated. Specific location, times, and text to be determined at a future design development. Maintenance would involve occasional graffiti removal.

Wayfinding

It is clear that there is a lack of navigability within the project site, especially given the dead-end nature of Pearl Street and lack of subway entrance visibility. The WalkNYC Wayfinding system can be incorporated into the project site with specific locations determined at a future design stage. Maintenance would involve occasional graffiti removal.

Design Concept Cost Estimate

The following conceptual cost estimates for the Design Concept was based a conceptual list of materials and quantities and priced by the NYC Department of Design and Construction (DDC) price per unit guide.¹⁹ The following cost categories were taken into account for estimation: demolition, site set-up, utilities, pavement treatment, street furniture, lighting, and concessions. Each category contains specific items, for which costs were estimated based on total number of units required.

The Design Concept cost estimate is presented in a high cost option and low cost options. Both are within a similar range and are dependent on the final material selection of granite or concrete elements.

	Total	Total with 25% Contingency
Design Concept (high)	\$1,427,000	\$1,784,000
Design Concept (low)	\$1,208,000	\$1,509,000



Visualization of reimagined Willoughby Street looking east (source: Arup and Perkins Eastman)

References

1. <http://downtownbrooklyn.com/posts/community/introducing-our-new-real-estate-market-report>
2. http://www.nyc.gov/portal/site/nycgov/menuitem.c0935b9a57bb4ef3daf2f1c701c789a0/index.jsp?pagelD=mayor_press_release&catID=1194&doc_name=http%3A%2F%2Fwww.nyc.gov%2Fhtml%2Fom%2Fhtml%2F2012a%2Fpr147-12.html&cc=unused1978&rc=1194&ndi=1
3. <http://downtownbrooklyn.com/posts/community/introducing-our-new-real-estate-market-report>
4. <http://downtownbrooklyn.com/posts/community/introducing-our-new-real-estate-market-report>
5. http://www.nyc.gov/portal/site/nycgov/menuitem.c0935b9a57bb4ef3daf2f1c701c789a0/index.jsp?pagelD=mayor_press_release&catID=1194&doc_name=http%3A%2F%2Fwww.nyc.gov%2Fhtml%2Fom%2Fhtml%2F2012a%2Fpr147-12.html&cc=unused1978&rc=1194&ndi=1
6. Initially using temporary materials, the plaza was reconstructed as a permanent plaza in 2012.
7. NYDOT's Brooklyn Borough Commissioner's Office and Capital Program Management division
8. Section 8-12, Brooklyn Downtown Development EIS Report (2004)
9. Stakeholder Interview, June 26, 2014
10. http://web.mta.info/nyct/facts/ridership/ridership_sub_annual.htm
11. When Downtown Brooklyn was rezoned by the City in 2004, the rezoning action enabled the de-mapping of Pearl Street between Willoughby and Fulton Streets within the project site, as well as Red Hook Lane to the south of the project site. The de-mapping is currently incomplete and further action would be required to develop these street segments as private sites.
12. New York City Department of Design and Construction, Division of Infrastructure - Bureau of Program Management Bid Scope Item Price List Report (March 12, 2013).
13. This cost estimate does not include any utility upgrades or replacement.
14. https://www.gov.uk/government/uploads/system/uploads/attachment_data/file/3873/ltn-1-11.pdf
15. IESNA RP-8
16. Page 136, Chapter 4 – Lighting, NYCDOT Street Design Manual (2013)
17. NYCDOT's minimum center to center distance between trees is 25 feet
18. The permeable aggregate edge is a non-standard detail, unavailable in the NYCDOT Street Design Manual, and will require agreement with local maintenance partner.
19. New York City Department of Design and Construction, Division of Infrastructure - Bureau of Program Management Bid Scope Item Price List Report (March 12, 2013).

