

New York City
Department of Transportation

**Downtown Brooklyn
Traffic Calming Project**

May 2004

FINAL REPORT



*City of New York
Michael R. Bloomberg, Mayor*



*New York City Department of Transportation
Iris Weinshall, Commissioner*

New York City Department of Transportation
Downtown Brooklyn Traffic Calming Project

Final Report

May 2004

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1. INTRODUCTION

The Downtown Brooklyn Traffic Calming Study Final Report is the end product of over three years of work undertaken by Arup, the New York City Department of Transportation, and the Downtown Brooklyn community. This report discusses the context in which the project has been undertaken, the approach adopted for calming traffic in Brooklyn, and the various results – in particular, a pilot program and an area-wide strategy recommendation.

The specific contents of the sections that follow are:

- **Section 2** provides a background on how the project was conceived, initiated, and organized. It discusses community concerns that led to the initiation of the project. Section 2 also provides a description of the scope, objectives, and organization of the study.
- **Section 3** provides a description of traffic and travel issues in the study area.
- **Section 4** discusses traffic calming concepts and the role of traffic calming in a comprehensive transportation management program. Section 4 also discusses individual traffic calming treatments and their applicability to Downtown Brooklyn.
- **Section 5** discusses the approach used to calm traffic in the study area and the Street Management Framework that provided a foundation for the study. Section 5 also describes the public outreach project and discusses how ideas and strategies were developed.
- **Section 6** describes the Pilot Program including its development, review, installation, monitoring and evaluation.
- **Section 7** provides the core of the project – the Action Program, a traffic management strategy for the area. It provides detailed street and corridor recommendations. It includes sketches of proposed project recommendations and discusses costs and a strategy for implementing the proposed improvements.
- **Section 8** discusses how to build on the project and advance the concepts learned to other areas in the city.

The recommendations in this report were developed in response to concerns raised by the community. The recommendations were based on technical analysis; field observations of conditions; experience gained through the pilot program; and discussions between the consultant and Community Boards, citizens, NYCDOT and other agencies. The recommendations, are, in many cases, conceptual and may require more detailed engineering analysis to determine those that can be implemented. Measures that have already been implemented and those whose implementation is imminent are noted as such in the text.

2. BACKGROUND

2.1 Origins of the Downtown Brooklyn Traffic Calming Study

In the past twenty years, Downtown Brooklyn has enjoyed a revitalization that has brought economic growth to this collection of dense, diverse urban neighborhoods. Coupled with regional travel growth, this revitalization has also brought increasing traffic impacts to these neighborhoods. The Downtown Brooklyn Traffic Calming Study is an effort to mitigate those traffic impacts to ensure the area's ongoing vitality, safety, accessibility, and mobility.

2.1.1 Revitalization of Downtown Brooklyn

Downtown Brooklyn is like the downtown areas of many older American cities, in that new development lies adjacent to older land uses. Both old development and new depends on available transport infrastructure, which is old and inflexible. This creates economic and environmental strains. In particular, the Downtown Brooklyn civic and commercial center has undergone considerable renewal and growth over the last twenty years. The resulting traffic must be managed to reduce its impact on the community.

In its 1969 "Master Plan for the City of New York", the Department of City Planning recommended the creation of satellite commercial centers in the City's outer boroughs to complement the growth then concentrated in Manhattan, and to distribute the stimulus and benefits of this growth. Downtown Brooklyn, the civic and business center immediately across the East River from Manhattan and with some of the best subway connections in the City, was well positioned to take advantage of this recommendation. However, much of the area was run-down. Although not subject to widespread abandonment, it faced many of the challenges of urban renewal. In 1983, a Regional Plan Association study asserted that to reverse the deterioration of Downtown Brooklyn required its transformation into the city's third CBD. Today the area has achieved that rank and is still growing.

The opening of Pierrepont Plaza in 1987 marked the beginning of Downtown Brooklyn's revival. Bounded by Pierrepont and Clinton Streets and Cadman Plaza West, it was the first large development project to be completed in this area. Efforts to revitalize the commercial center resulted in the opening of Fulton Mall, between Adams Street and Flatbush Avenue, as a retail counterweight to the auto-dependent Kings Plaza shopping center at Marine Park/Mill Basin. The mall has 200 stores anchored by the Macy's department store. Mall traffic is generally restricted to pedestrians, buses and emergency vehicles. The State court building erected in the 1950s and the many Transit Authority offices that were eventually consolidated at a new building on Livingston Street at Boerum Place during the early 1990s have stabilized the civic center.

The largest contributor to Downtown Brooklyn's resurgence as a viable business nexus has been MetroTech Center. Conceived during the mid 1970s by the president of Polytechnic University as a way to improve the area and attract more students, MetroTech Center is a noteworthy example of the successful collaboration between academia, industry and government. With an investment of over \$1 billion, a five million square-foot development was created with new and renovated buildings around a 4-acre, landscaped and auto-free commons. It is reported that nearly all MetroTech properties are leased.

The revival of Downtown Brooklyn has brought 25,000 new workers to the area. Downtown Brooklyn attracts approximately 100,000 people every day, in addition to an estimated 50,000 office workers in public and private offices. Approximately 10,000 jurors serve each week in the City, State and Federal court system in this area. The five colleges in the area contain an estimated total daily student and faculty population of over 45,000. The Department of City Planning

reports that there are more than 22,000 parking spaces within this area, a number that will grow when Renaissance Plaza and other plans for Downtown are completed¹.

Even before the World Trade Center disaster companies were moving labor-intensive and other businesses out of Manhattan to avoid expensive office space. This process has accelerated since that time. The Downtown Brooklyn area and its traffic will continue to grow, with such projects as Atlantic Center at Flatbush Avenue and Atlantic Avenue, the expansion of the Federal Court, the pending redevelopment of the landmark Post Office building between Cadman Plaza East and Adams Street and the new Renaissance Plaza Hotel in the MetroTech Center, with its 1,100-space parking garage. Recent plans to redevelop other sites in Downtown Brooklyn will add still more traffic pressure on the area.

Along with the emergence of the greater Downtown area as the city's third largest CBD, adjacent historic residential neighborhoods have continued to attract young urban professionals seeking easy walking access to Downtown Brooklyn and transit access to Manhattan. It has been estimated that the seven zip codes including and immediately surrounding this area have a total adult population of over 270,000 within easy walking distance of the civic/commercial center.

2.1.2 Transportation Impacts on Downtown Communities

Providing a point of access to Manhattan has always been an important function of the Downtown Brooklyn area. It is served by more bus and subway lines than any other point in New York City. Eleven bus and ten subway train lines converge in the vicinity of Brooklyn Borough Hall and the nearby LIRR Atlantic Terminal. The area serves as a conduit for vehicular traffic to Manhattan via the Brooklyn-Battery Tunnel and the Brooklyn and Manhattan Bridges. Major roads such as Interstate 278 (Brooklyn/Queens Expressway – the BQE), which connects directly to the Prospect Expressway/Ocean Parkway and Gowanus Expressway, and major roads in the street grid system, such as Flatbush, Atlantic, Third and Fourth Avenues, bring traffic to this area from all parts of Brooklyn. Over 200,000 vehicles are estimated to use this area's major roads and surface streets each day.

Traffic conditions deteriorate as the amount of traffic on a road increases. At low traffic volumes, each driver can proceed more or less unconstrained by surrounding vehicles; at higher volumes, each driver is constrained in the choice of speed, travel lane and so on by surrounding vehicles. At high volumes, roads and intersections become congested and drivers find themselves completely constrained by other vehicles in the traffic jams that are a familiar part of street life in Downtown Brooklyn.

This progression from unconstrained travel to extremely constrained travel with increasing traffic volumes is matched by a progression from stable to unstable conditions. At low traffic volumes, a car stopped where it should not be or a traffic accident or construction has little effect on traffic flow: drivers are able to pass without undue problems. At high traffic volumes, even minor interruptions can cause substantial problems of delay. At extreme traffic levels gridlock can result from minor problems.

Nevertheless, except in the case of gridlock, traffic continues to move, even if traffic conditions become unpredictable and frustrating. It is this optimistic expectation that traffic will continue to flow and the resignation when it does not that keeps people getting into their cars each day.

Downtown Brooklyn's intense levels of development and redevelopment over the last twenty years have been a regional success story and a boon to the borough. They have resulted in increased traffic congestion on the major routes. These conditions have diverted traffic to local streets – for many drivers, this congestion is extremely frustrating and the opportunity to avoid the

¹ Source: New York City Department of City Planning

long queues and delays that accompany traffic congestion by taking a different route proves irresistible. This has happened in Downtown Brooklyn with the result that traffic has increasingly utilized local streets not designed to carry it. Many of these pass through residential neighborhoods in the Downtown Brooklyn area. The community has widely reported problems associated with speeding vehicles.

This traffic intrusion has been exacerbated by recent construction work on the Gowanus and Prospect Expressways, the Manhattan and Brooklyn Bridges, arterial roads like Flatbush Avenue, and public and private construction at and around the Atlantic Terminal. The persistent traffic congestion in Downtown Brooklyn has caused this area to become one of New York's severe carbon monoxide hot spots; this poses a potential health burden.

The results are the pervasive presence of both private and commercial vehicles on Downtown Brooklyn's streets, deteriorating air quality, and impacts on safety for all street users. All of these problems contribute to an overall adverse impact on quality of life for those who live in and use the Downtown Brooklyn area.

2.1.3 The role of traffic calming in strengthening Downtown Brooklyn's vitality

The communities of Downtown Brooklyn see their streets as overtaxed with traffic and in need of strong protective measures. The Downtown Brooklyn Traffic Calming Project was conceived through the cooperative efforts of local elected officials and community groups, with additional support from the New York City administration. Elected officials and community groups alike consider revitalization of Downtown Brooklyn and preservation of the historic character of the surrounding residential communities as vital for maintaining a high quality of life locally and citywide. Most importantly, both the Downtown Brooklyn community and New York City administration see this project as signaling a new direction for managing traffic in the city. Thus, the project's goal is to make all types of streets function better for all users of the public space.

2.2 Scope and objectives of this study

2.2.1 Study area

The project area is bounded by the East River to the north, Washington Avenue to the east, 15th Street and Prospect Park to the south and New York Harbor's Buttermilk Channel to the west. The area includes the communities of Clinton Hill, Fort Greene, Prospect Heights, Park Slope, Gowanus, Red Hook, Carroll Gardens, Cobble Hill, Boerum Hill, Columbia Terrace, Brooklyn Heights, Fulton Landing, Downtown Brooklyn and Vinegar Hill. The project area is divided into a 10-square mile primary study area, which contains 254 signalized intersections, and a secondary study area. The primary area has been studied in depth. Consideration has been given to the impacts of the recommended strategy and the pilot program on the secondary area. *Figure 2.1* shows the boundaries of the primary and secondary study areas.

2.2.2 Goals and Objectives

The project's goals are to establish a more equitable balance in the use of area streets by pedestrians, bicyclists and motorists, to rationalize circulation and to maintain or improve mobility for all transportation modes without adversely impacting community access and adjacent area traffic.

The project's objectives are to:

- improve pedestrian safety and access, including safer crossings at problem locations, reduce vehicular speeds and enhance mobility between neighborhoods;
- reduce unwanted traffic impacts, including congestion, excessive vehicle volumes, speeding, noise, air pollution, and damage to infrastructure;
- preserve and improve civic, cultural & institutional, commercial and residential area access by providing a traffic-calmed street network for improved connectivity among these destinations; and
- improve air quality so as to help attain national ambient air quality standards; and
- protect the unique character of historic residential communities.

A complementary list of objectives flowed from the outreach process undertaken for the project:

- improve pedestrian circulation and safety;
- improve surface transit operations and safety;
- develop the local cycling network;
- manage truck access and routing appropriately while reducing trucks' impacts on the community;
- manage through traffic in appropriate locations while reducing its impact in all locations;
- maintain local traffic permeability; and
- maintain or enhance emergency vehicle access.

2.3 Project organization

For years, citizens from neighborhoods within the study area had expressed concern regarding the impacts of traffic (i.e. cut through and diverted traffic) on their neighborhoods. This concern was continuously raised as a serious quality of life issue that was negatively affecting their communities. Elected officials were urged to assist in addressing this issue.

In 1997, a task force was established by Borough President Howard Golden to develop a scope of work for the project. This scope of work provided for the application of an areawide traffic calming plan through a collaborative process involving NYCDOT, the community, and the Task Force described below. The Mayor's Office negotiated an agreement with Brooklyn Borough President Howard Golden and Council Member Kenneth K. Fisher to fund a study including a pilot program that would lead to the development of a traffic management plan for the area. Total funding for the project was \$6 million. Council Member Kenneth Fisher provided \$500,000, and Borough President Howard Golden provided \$1.5 million, for a total of \$2 million. The study and pilot program utilized approximately \$1.2 million of these funds, with an additional \$250,000 provided by Assembly Member Joan Millman to supplement funding for the pilot program. The City has also agreed to provide \$4 million in the future to implement recommendations developed during the study. The consultant team was selected in January 1999 and work began in March 1999.

Understanding the high level of community interest in the project, NYCDOT agreed to vary from usual practice and have three neighborhood representatives - as designated by Borough President Golden and Council Member Fisher - served as voting members of the Selection Committee along with four NYCDOT members. The community-based Task Force chaired by the Brooklyn Borough President monitored the study. NYCDOT chaired a Technical Advisory Committee,




which consisted of government agencies, elected officials, and Community Boards. The primary study area and the majority of the secondary study area falls with Brooklyn Community Boards 2 and 6; Community Board 8 encompasses the balance of the secondary study area. Community Board boundaries are shown in *Figure 2.1* (see next page).

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LEGEND

-  Primary Study Area
-  Secondary Study Area
-  Community Board Boundaries

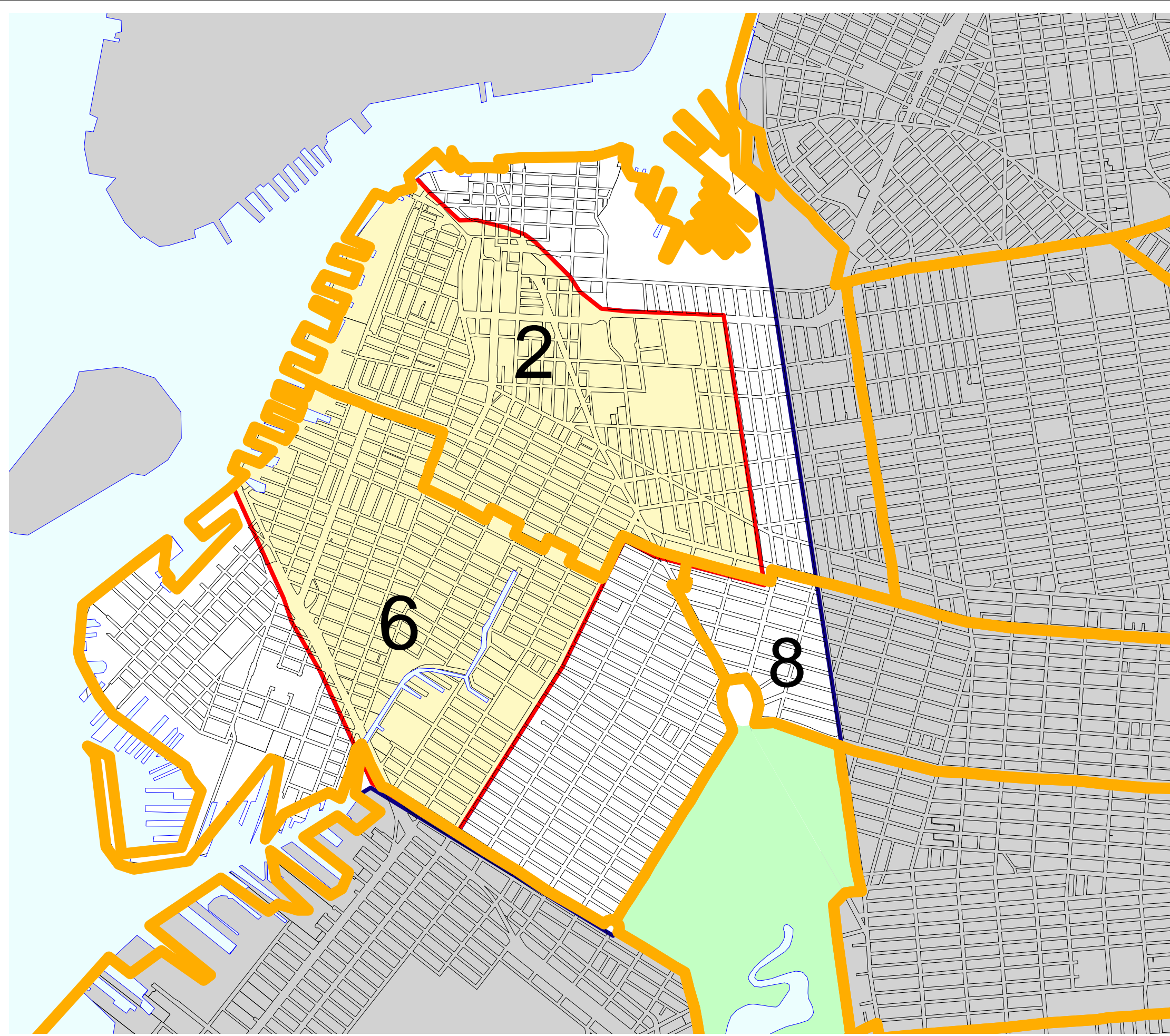


Figure 2.1

Study Area



3. TRAVEL IN DOWNTOWN BROOKLYN

3.1 Traffic Issues

Together with the Brooklyn-Battery Tunnel, the Brooklyn and Manhattan Bridges provide the major points of entry into Lower Manhattan from Brooklyn. As each of these bridges is located at the northern edge of Downtown Brooklyn, traffic traveling to and from Manhattan from southwestern Long Island must pass through the study area. The Brooklyn/Queens Expressway (BQE) is intended to carry regional-scale traffic around the area. However, the BQE runs at capacity for much of each day and many drivers choose alternate routes through Downtown Brooklyn, where such feasible routes exist. *Figure 3.1* (see next page) shows the streets in the project study area.

4th Avenue, and to a lesser extent **3rd Avenue**, provides north-south capacity in the east of the study area. There is no real route through Downtown Brooklyn's street system with equivalent high capacity in the western part of the study area (although the BQE provides a high capacity link with limited access to streets in the area through which it passes), so overflow traffic from the BQE plus north-south traffic originating in or bound for the west of the area is forced onto streets where its presence is obvious and its impact is great – **Columbia/Van Brunt Streets, Hicks Street, Clinton Street, Henry Street, Court Street** and **Smith Street** all share the load of north-south traffic demand. The traffic-carrying role of a number of these streets is at odds with their predominantly residential uses. Also, many of these streets are one-way. This introduces asymmetry into the area's traffic patterns and means that some streets carry significant traffic only in one of the morning and evening peak periods.

Atlantic Avenue, which forms the southern boundary of the commercial core, is heavily congested, with the result that parallel streets to the south in Boerum Hill (**Pacific Street, Dean Street**) and to the north (**State Street, Schermerhorn Street, Livingston Street**) carry through traffic. For those streets to the south of Atlantic Avenue, this traffic intrusion is inconsistent with their predominantly residential nature. There is no other clear east-west route in the study area between Atlantic Avenue and **Hamilton Avenue**, which forms its southern boundary. However, the capacity of Atlantic Avenue is governed by the congested intersections with Fourth and Flatbush Avenues, meaning some opportunities exist to calm the blocks west of these intersections without compromising throughput.

Flatbush Avenue acts as a major traffic corridor through the study area and to the Manhattan Bridge. It carries a substantial amount of traffic, is congested in many places and acts as a barrier between the commercial core to its west and Fort Greene to the east. Wherever the heavily-trafficked Flatbush Avenue meets another road carrying a high traffic volume, substantial congestion ensues. The Flatbush Avenue/Atlantic Avenue/4th Avenue/3rd Avenue area, which represents the greatest confluence of traffic in the study area, is particularly badly congested. The Flatbush Avenue/Schermerhorn Street intersection is also heavily congested.

Tillary Street forms the northern boundary of the commercial core and performs an important east-west traffic function, linking access to the Brooklyn Bridge, Manhattan Bridge and the BQE to the east of the downtown area. The intersections of Tillary Street with both Adams Street and Flatbush Avenue carry heavy conflicting traffic volumes for much of the day. In this area, connections between the BQE and the access streets to the Brooklyn and Manhattan Bridges need improvement.

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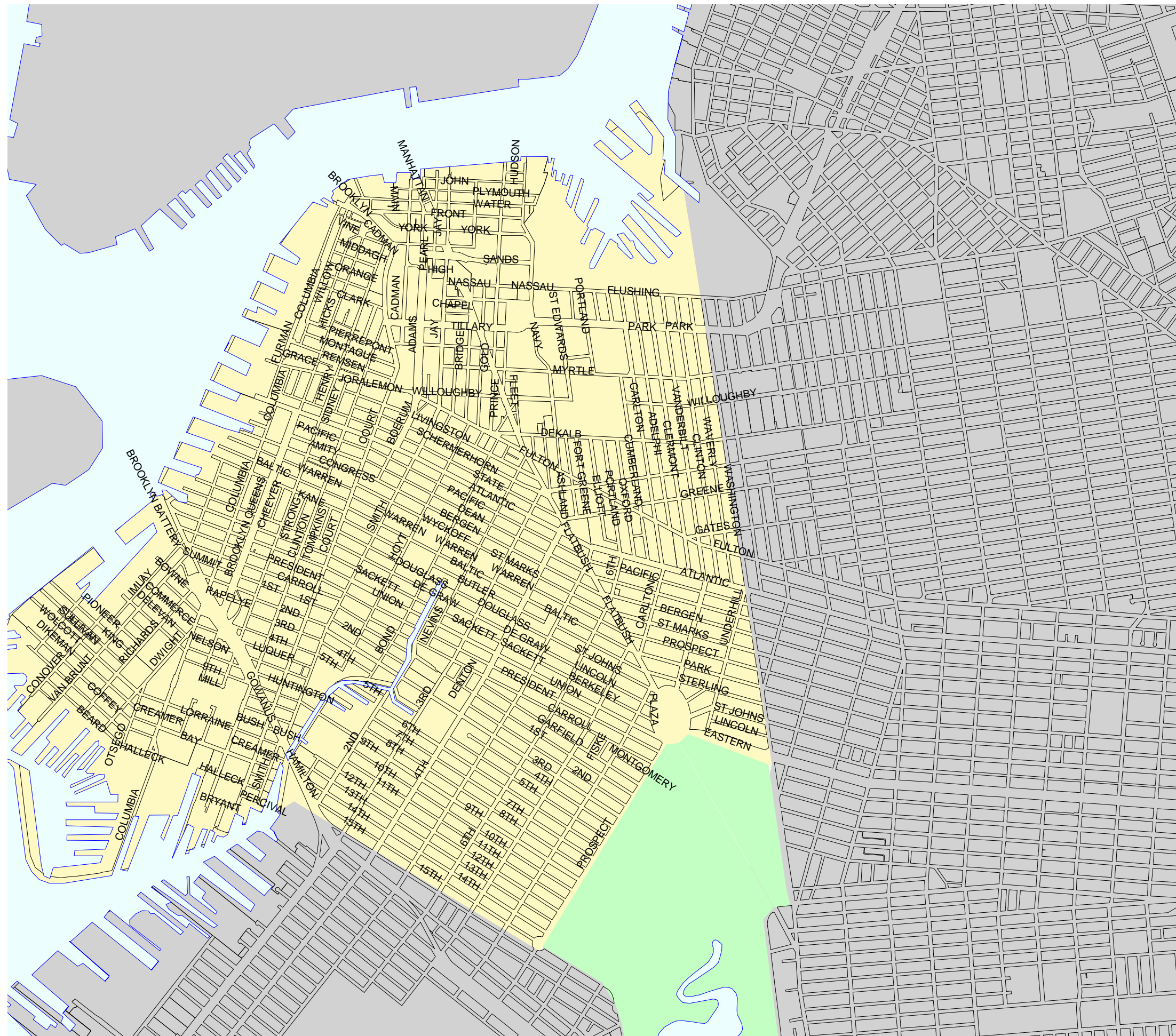
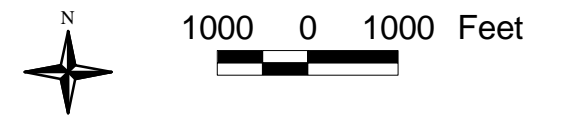


Figure 3.1
Streets in the
Study Area



3.1.1 Morning peak period

In the morning peak period, the major movement of traffic is north- and west bound, as it converges on the commercial core or travels through it to reach either the Brooklyn or Manhattan bridges. *Figure 3.2* (see next page) shows cordons of expected travel time to the Manhattan side of the Brooklyn Bridge for northbound vehicles in the AM peak hour, as measured in 2000.

The congestion that ensues from the confluence of the BQE and Prospect Expressway south of Hamilton Avenue forces some traffic onto local streets. Convenient connections between the southern boundary of the study area and the Brooklyn Bridge are provided by way of Clinton Street and Hicks Street. Both these streets carry substantial traffic volumes despite their 30 foot width, residential natures and low traffic capacity. The substantial congestion that results from this traffic in the morning peak has historically been accommodated through the imposition of morning peak period parking restrictions on sections of Clinton Street, particularly south of Atlantic Avenue and between Atlantic Avenue and Tillary Street, where congestion is particularly severe. These parking restrictions have served to increase the number of vehicles that can queue on this street, without improving its through traffic capacity. As part of this study, the morning peak parking restrictions have been removed from sections of Clinton Street.

Smith Street also carries substantial commuter traffic in the morning peak period. This also forms part of a convenient route from the southern boundary of the study area to the commercial core and the Brooklyn Bridge via Atlantic Avenue, Boerum Place and Adams Street. Morning peak period parking restrictions are also imposed on the northern (congested) section of Smith Street on its approach to Atlantic Avenue.

4th Avenue acts as a major northbound traffic conduit in the morning peak period. It terminates at its intersection with Flatbush Avenue. Traffic traveling north on 4th Avenue generally connects to Flatbush Avenue and from there to the eastern side of the commercial core or the Manhattan Bridge, or to the Atlantic Avenue corridor and then to the southern and western side of the commercial core or the Brooklyn Bridge. **3rd Avenue** acts as an important traffic route parallel to 4th Avenue and suffers significant congestion, especially at its intersection with Atlantic Avenue.

As noted above, the **Flatbush Avenue /Atlantic Avenue /4th Avenue /3rd Avenue** group of intersections is heavily congested in the morning peak and some traffic intrusion is experienced in surrounding streets as a result of northbound drivers avoiding this congested area. Bond Street provides an important northbound connection into the commercial core that avoids the heaviest congestion in the area.

Previously, the congestion at the **3rd Avenue /Atlantic Avenue** intersection has been addressed through imposition of a left turn ban from 3rd Avenue northbound into Atlantic Avenue westbound. This movement is important at this intersection (not least because both 3rd Avenue and Atlantic Avenue are truck routes) and so this turn ban exacerbates the problem of traffic intrusion into surrounding streets.

Atlantic Avenue and **Flatbush Avenue** act as major arteries for northbound and westbound commuter traffic in the morning peak. They provide good connections to both the Manhattan and Brooklyn Bridges, as well as the commercial core. Both suffer substantial congestion in the morning peak period, notably at points where they meet roads carrying substantial traffic volumes: Flatbush Avenue/Atlantic Avenue/4th Avenue/3rd Avenue as noted above, Smith Street/Atlantic Avenue, Boerum Place/Atlantic Avenue, Schermerhorn Street/Flatbush Avenue, Livingston Street/Flatbush Avenue and Tillary Street/Flatbush Avenue.

Tillary Street suffers congestion, particularly at its intersection with Adams Street, the northern extension of Boerum Place. At this point traffic approaching the Brooklyn Bridge from three directions meets: traffic traveling north on Boerum Place/Adams Street, traffic traveling west from Flatbush Avenue and traffic traveling east from the northern terminus of Clinton Street.

In the Fort Greene area, **DeKalb Avenue** is one-way westbound and carries peak traffic to its terminus at Flatbush Avenue. Congestion primarily occurs at the intersection of DeKalb and Flatbush Avenues; traffic flows at higher speeds east of this intersection. Other two-way streets (**Myrtle Avenue** and **Fulton Street**) also carry some inbound volume in the morning peak.

Downtown Brooklyn Traffic Calming Project



Final Report

DESCRIPTION

Each contour line represents a two-minute difference in travel time

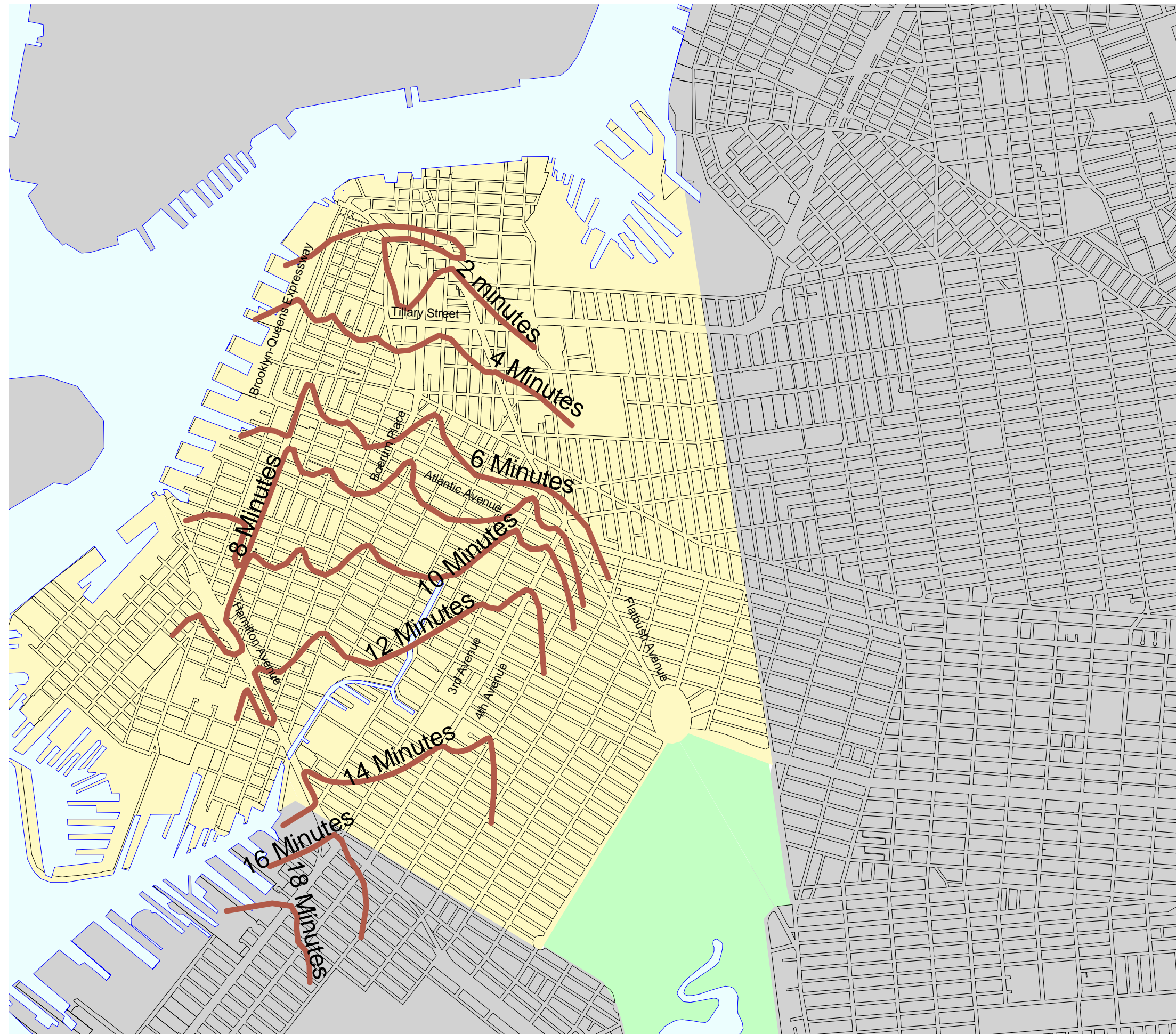
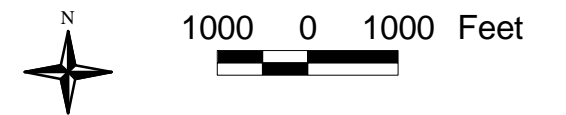


Figure 3.2

A.M. Peak Travel Time to Manhattan



3.1.2 Evening peak period

Apart from the differences imposed by one-way streets, the traffic problems experienced in the morning peak period are mirrored in the evening peak. The major traffic demand is south and east, with substantial traffic leaving the commercial core and entering Brooklyn from the Brooklyn and Manhattan Bridges and the BQE. **Flatbush Avenue** and **Adams Street/Boerum Place/Atlantic Avenue** carry substantial traffic volumes and experience congestion at various points along their length. The confluence of traffic at the Flatbush Avenue/Atlantic Avenue/4th Avenue/3rd Avenue intersection yields the most significant congestion problem in the study area. This results in significant delays and traffic intrusion into surrounding streets and influences traffic patterns throughout the northern part of the Downtown Brooklyn area. An evening peak period parking restriction serves to increase its ability to store queued vehicles, but not its traffic capacity.

In Brooklyn Heights and Cobble Hill the southbound streets suffer traffic pressure: **Henry Street** (a residential street parallel to Clinton Street) and **Court Street** (a commercial street parallel to Smith Street) carry significant traffic. **Old Fulton Street** and **Furman Street** provide an attractive route for southbound traffic; because Furman Street is one-way southbound and has no nearby northbound twin, this traffic flow is not reflected in the morning peak period. In Fort Greene, the high speeds experienced on DeKalb Avenue in the morning are observed on **Lafayette Avenue** in the evening, while **Myrtle Avenue** and **Fulton Street** also carry peak traffic loads.

3.2 Parking

The shortage of parking is an important issue throughout the study area.

Parking is at a premium through much of the study area. Morning peak period parking regulations reduce the available parking supply for residents and offer an opportunity for those traveling into the area to park on-street provided they arrive at the time that the parking restrictions come to an end. Peak parking restrictions on certain streets ensure extra capacity for peak travel, but this prevents parking in these locations at these times.

Parking by vehicles carrying permits (formally vehicles whose drivers are on official government business) is a problem in some parts of the study area, both because legitimate parking spaces are occupied by permit vehicles and because permit vehicles are able to park with impunity in what would otherwise be illegal spaces. This problem is exacerbated by the apparent problem of control over availability of permits. This is a policy issue whose solution lies beyond the scope of this study, though it is noted that Mayor Bloomberg has already effected a 30% reduction in the number of city employee parking permits.

4. TRAFFIC CALMING

4.1 What Is Traffic Calming?

Agreement about what constitutes traffic calming was an important first step in the process of developing a traffic calming plan for Downtown Brooklyn. Perceptions of what the term encompasses vary not only within the broad community but also within the traffic engineering profession. It became apparent in the course of the study that the perception of the meaning of traffic calming has a clear and important impact on expectations of what can be achieved by a traffic calming plan.

At its most general, the term "traffic calming" describes actions to reduce vehicular traffic's intrusion into and its effects on urban life. One means of achieving this is a citywide reduction in traffic levels through such policies as land use control, road pricing, improving public transport and restricting road travel by limiting road or parking supply. Various suggestions made by the community in the course of the Downtown Brooklyn Traffic Calming project reflected a desire for use of such measures. While such measures can play an important role in urban policy and could well be important tools in limiting the amount of traffic in Downtown Brooklyn, they are not included as key elements of the Downtown Brooklyn Traffic Calming Strategy, as their implementation would require a coordinated city agency effort that would entail significant political, administrative, and community changes that fall outside the scope of this study.

Traffic calming practice typically consists of various forms of physical management of vehicles implemented at a street or neighborhood level. Although the most familiar forms of traffic calming action worldwide involve the use of physical treatments at the local street level, international traffic calming practice is not limited to low-volume neighborhood streets. Traffic calming may also describe traffic management in busier streets and corridors. Indeed, in an area such as Downtown Brooklyn in which the adverse effects of traffic are felt on all streets, it is critical that the traffic calming strategy extends beyond the confines of the local neighborhood, and that it is integrated within some form of traffic management framework.

The range of traffic calming actions is wide. Ewing (1999) distinguishes between traffic control devices, such as "Stop" signs and speed limit signs that require enforcement and traffic calming measures that are *self-enforcing*. Ewing contends that this distinction implies that effective traffic calming actions "rely on the laws of physics rather than human psychology to slow down traffic." While the strategy has been developed with the idea of self-enforcement firmly in mind, it does not exclude any means of improving the street environment that can be effective. Brindle and O'Brien (1999) contend that traffic calming is the end rather than the means. In this context, arguments about what should and should not be considered traffic calming actions are unimportant. The critical motivator of traffic calming is the underlying desire to improve the street environment. This moves the discussion from the kinds of *actions* that can legitimately be grouped under the traffic calming banner to the kinds of *outcomes* being sought.

In an environment such as Downtown Brooklyn, in which the effects of vehicular traffic dominate public space, the obvious and simple response is try to decrease the motorized traffic. Implementing such a strategy may well create a pleasant environment, but by no mean guarantees that other objectives for the use of public space implicit in eliminating traffic will be met.

Traffic calming, as it relates to this project, revolves around the idea of better use of public space. This may be manifested in various ways: it may involve de-emphasizing vehicular traffic in favor of pedestrians and other street users. This type of approach might be appropriate for residential streets. It might also involve ensuring motorized traffic takes its place in the life of a commercial street without dominating it. After all, many successful and vibrant commercial streets

accommodate traffic as an important part of their makeup; the key in such situations is that the traffic does not exclude other users of the space. Traffic calming may also involve optimizing the operations of a major road, such that traffic capacity is maintained or enhanced, without precluding effective use of the space by other users.

Brindle and O'Brien (1999) have defined three levels of traffic calming:

- *Level I traffic calming*: results of actions to restrain traffic speed and lessen traffic impacts at a local level, where traffic volumes, levels of service, and network capacity are *not* an issue.
- *Level II traffic calming*: results of actions to restrain traffic speed and lessen traffic impacts on corridors and traffic routes (district or sub-arterial roads), where traffic volumes, levels of service, and network capacity are or may become an issue.
- *Level III traffic calming*: results of actions on a broader scale, to lessen traffic levels and impacts citywide. This brings traffic calming into the area of urban transport policy and away from its original singular focus on traffic management.

Level III traffic calming differs from Levels I and II not just in the matter of scale. At the citywide scale, a different kind of outcome is implied – not just *calming* but rather a *change in travel behavior*. While each of the levels can legitimately lay claim to the term traffic calming, the approach adopted for this study is confined to Levels I and II, as defined above. This has been done not through any assessment of the value of changes in the life of New York implied by strategies designed to achieve Level III traffic calming, but through a desire to confine the study's focus to strategies and underlying actions that can be implemented in a reasonable time within budgets and levels of support likely to be available. This conforms to the mainstream idea around the world of what constitutes practical traffic calming.

Brindle and O'Brien distinguish between those actions that concern engineering techniques and the physical environment from those that imply social and cultural change. They have used a classification matrix they call the "Darwin Matrix" (*Table 4.1*) consisting of three rows for the three levels described above and two columns. The first column covers measures instituted. The second column reflects social or attitudinal changes that may occur over a period, either spontaneously or by intervention, at the local or broader scale.

Table 4.1 Brindle and O'Brien's classification matrix

Scope of measure	Type of Measure	
	Physical/Environmental ('Techniques')	Social/Cultural/Attitudinal ('Ethos')
Local (street or neighborhood)	Level I traffic calming techniques: Speed and accident physical countermeasures; local area/neighborhood traffic management; Low-speed street design	Level I social change: neighborhood speed watch; community action; attitudinal change
Intermediate (zone, traffic corridor regional road)	Level II traffic calming techniques: environmentally-adapted through roads (Denmark); shared zones, lower-speed zones; pedestrianized retail precincts; bike lanes; transit lanes; corridors; precinct road pricing; parking policies	Level II social change: voluntary behavior change: mode choice, speed; acceptance of provisions for cyclists.
City-wide	Level III traffic calming techniques: travel demand management; transport system management; total system measures (fares policy, city-wide road pricing, bike systems, etc); manipulation of urban form and structure; parking policies	Level III social change: cultural change; cycling culture; loss of choice (e.g., energy constraints, significant drop in living standard); population decline; alternative futures

Source: Brindle and O'Brien (1999)

The second key element of traffic calming is the need to adopt an area-wide approach. This is informed by two issues:

- the need to see neighborhoods as systems; and
- the resulting need to follow a systematic planning approach when managing an area.

An area-wide plan for local area traffic management requires more than a catalog of traffic measures; an effective area-wide plan must be designed in a coordinated way. The adaptability of networks is well known to traffic engineers. It is no coincidence that average travel times from Hamilton Avenue (in the south of the study area) to the Brooklyn Bridge approaches (in the north) during the morning commuter peak are approximately the same by all routes. This phenomenon is demonstrated in *Figure 3.2*, which shows observed peak hour travel times. Drivers learn how to travel through an area as quickly as possible and experienced drivers quickly exploit a perceived shortcut so that an area's traffic demand is typically in equilibrium. Any change to traffic conditions modifies this equilibrium point, but not the certainty that equilibrium will occur. Accordingly, implementation of an isolated traffic calming treatment will act to alter traffic patterns; traffic volumes may diminish in the vicinity of the treatment, but only at the expense of streets that provide alternative routes.

In developing a traffic management scheme such as the Downtown Brooklyn Traffic Calming Project it is therefore critical to take account of the effects of physical treatments on travel decisions and driver route choice.

Regardless of the many benefits engineering-based traffic calming techniques can bring, sustainable cities will not be created through such techniques alone. The achievement of traffic calming at a citywide level requires widespread and fundamental changes in the community's attitudes to urban development, travel mode, and driver behavior. Traffic management at a significant level cannot lead social attitudes. Cultural change cannot be completed through traffic engineering alone.

A comprehensive planning approach may well lead to the conclusion that the proper solution to future traffic problems does not lie in engineering treatments, but rather in holistic planning and design. Traffic and roads are only one part of the urban system. At the very least, an attempt should be made to see problems and solutions in the context of the neighborhood as a functioning unit, not just as a site-specific traffic problem.

4.2 Integrated Traffic Management

Transportation planners and engineers have a range of tools available to them. Typical traffic calming tools are shown in *Figure 4.1* (see following pages). Used properly, these and other tools may be integrated to yield an effective means of building and maintaining an efficient and effective transport system.

As in any toolbox, different tools serve different purposes. It is important that appropriate tools are used to address each transport management issue. A traffic calming tool can be used to address a number of the pressing transport issues confronting Downtown Brooklyn, but it is not appropriate for all issues. A number of legitimate transport-related issues were raised in the course of this study for which traffic calming is not the most appropriate tool. These are discussed, together with suggestions regarding appropriate means of addressing them, in *Appendix E* of this report.

However, a traffic calming plan and the integrated traffic management approach that such a plan implies can significantly improve the street environment and the travel experience for people in Downtown Brooklyn. Such a plan and approach are the focus of this study.

Figure 4.1 Typical traffic calming devices



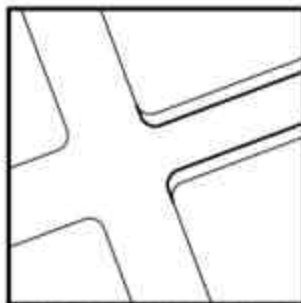
NECKDOWNS

A neckdown (also known as a curb extension) consists of a localized narrowing of the street achieved by widening the sidewalk. They may occur either at intersections or mid-block, and may include landscaping.



BUS BULB

A bus bulb consists of widening the sidewalk at a bus stop location so that buses remain in the travel lane when stopped at that bus stop.



ROADWAY NARROWING

Roadway narrowing involves the reduction of typical pavement width along a roadway. The narrowing can be achieved by removing a portion of the pavement width (typically by widening the sidewalk), or by using pavement markings to indicate narrow travel lanes.



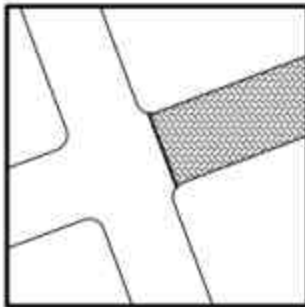
PEDESTRIAN REFUGES

Pedestrian refuges are small islands placed in the center of a two-way street. These islands separate opposing streams of traffic and allow pedestrians to cross the street in stages. They can also be used to narrow the travel lanes at the crossing location.



BIKE LANES

A designated on-street right-of-way that is delineated by pavement markings and signs. For bicycle lanes (Class II Bikeways) the Federal Highway Administration permits a minimum width of five feet when located adjacent to a curb or parking. In New York City, on-street lanes may be supplemented with an adjacent buffer zone to further define the separation of roadway use.



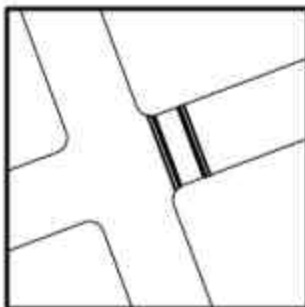
ROADWAY COLOR AND TEXTURE

Construction of roadway surfaces with materials that introduce surface texture to the roadway, such as paver stones, bricks, surface concrete patterns or stamped asphalt. Surface texture can create visual, vibratory and auditory effects. Texture can be utilized in a variety of applications, from treating entire streets, sidewalks or intersections to accenting and defining pedestrian crossing locations.



SPEED HUMP

A speed hump is a raised area in the roadway pavement extending across the road. Speed humps generally have a maximum height of 3 or 4 inches, with a travel length of 12 to 22 feet. The profile can be circular, parabolic or flat topped with sloping approaches. Longer, flat-topped speed humps are also known as speed tables, and may be combined with raised crosswalks



RAISED CROSSWALK

Raised crosswalks are constructed 2-4 inches above the normal roadway surface. Raised crosswalks are essentially flat-topped speed humps (speed tables). They are often constructed with concrete ramps and may also incorporate textured pavements in the crosswalk. Raised crosswalks can be placed mid-block or at intersections.



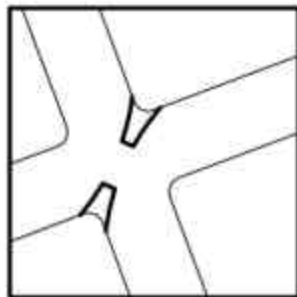
ROADWAY MEDIANS

A roadway median is defined as a raised island on the centerline of the street. A roadway median can include landscaping, space for pedestrian refuges and storage lanes for left turning vehicles.



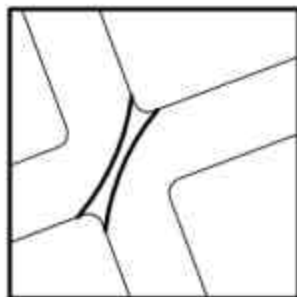
CHICANE

Chicanes introduce horizontal deflection by building out curb lines on alternating sides of the roadway. These built-out areas may be landscaped. A chicane-like effect can also be achieved by alternating on-street parking from one side of the street to another.



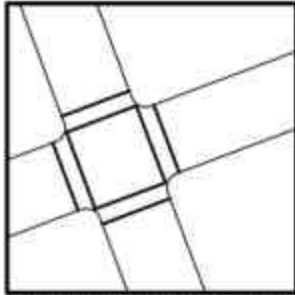
PARTIAL DIVERTER

A partial diverter consists of a curb extension or island that blocks one direction of travel at an intersection. It often includes landscaping and can be designed to retain bicycle access in both directions. Typically used on minor two-way streets.



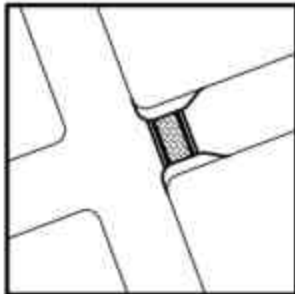
DIAGONAL DIVERTER

Diagonal diverters consist of a physical barrier placed diagonally across an intersection, forcing all traffic to turn.



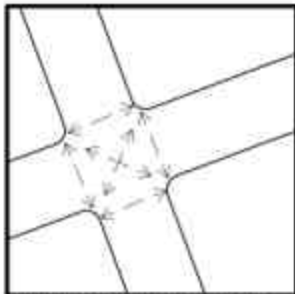
RAISED INTERSECTION

Raised intersections are flat raised areas covering entire intersections with ramps on all approaches. They typically rise to the sidewalk level or just below. Raised intersections are often constructed with textured pavement materials on the flat portion.



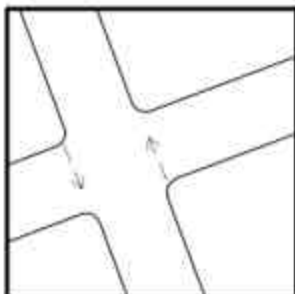
GATEWAY TREATMENT

Gateway treatments consist of a combination of physical traffic calming measures (such as curb extensions, raised crosswalks and textured surfaces) to create a threshold effect at entrances to streets and neighborhoods.



ALL PEDESTRIAN PHASE (APP)

An all-pedestrian phase (also known as Barnes Dance) is a signal phase that gives all vehicles a red indication, but gives all pedestrians a green "WALK" indication. It is used at intersections with heavy traffic in all directions to increase pedestrian visibility and confidence.



LEADING PEDESTRIAN INTERVAL (LPI)

A leading pedestrian interval is a signal phase that holds all vehicles at a red indication while giving pedestrians on at least one approach a green "WALK" indication. The vehicles are typically held for 5-10 seconds - just long enough for pedestrians to enter the crosswalk ahead of turning vehicles. Once pedestrians have begun crossing, vehicles on the parallel legs are given a green indication. LPIs are used at intersections with heavy traffic in at least one direction to increase pedestrian visibility and confidence.

Table 4.2 summarizes the traffic calming measures described in this report. It includes the primary objective of each measure, as well as a general assessment of suitability for use in the study area. More detailed descriptions of each measure are provided in Figure 4.1 above.

Table 4.2 Traffic calming measures and their suitability for Downtown Brooklyn

Traffic Calming Measure	Primary Desired Impact			Generally Suitable for Downtown Brooklyn?
	<i>Lower Traffic Speed</i>	<i>Lower Traffic Volume</i>	<i>Other (Pedestrian Safety, Street Environment, etc)</i>	
Physical Measures				
Speed Humps	X			X
Rumble Strips	X			
Speed Cushions	X			
Surface Texture	X			X
Raised Crosswalks	X		X	X
Traffic Circles	X			
Chicanes	X			
Street Narrowing	X		X	X
Curb Extensions (Neckdowns)			X	X
Gateway Treatments	X	X	X	X
Partial Diverters		X		
Diagonal Diverters		X		
Street Closures		X		
Median Barriers		X	X	
Roadway Medians			X	X
Pedestrian Refuges			X	X
Bicycle Lanes			X	X
Raised Intersections	X		X	X
Management Measures				
Signing and Striping	X	X	X	X
Traffic Signal Timing	X	X	X	X
Speed Enforcement	X			X
Safety Zones	X			X
Truck Restrictions		X		X
Street Direction		X		X
Educational Measures				
MUTCD-compliant Warning Signs	X			X
Road Safety Programs	X		X	X
Speed Watch Programs	X			X
School Safety Programs	X		X	X