

Preliminary Recommendations for Downtown Flushing Parking Guidance System



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Executive Summary

This project is part of the federally funded Parking Information and Demonstration Project (PIDP), which is co-managed by the New York City Department of City Planning (NYCDCP) and the New York City Department of Transportation (NYCDOT). The components of the PIDP include a Parking Guidance System (PGS) for the Shea Stadium park-and-ride facility in Queens that is being implemented by NYCDOT, a PGS for Downtown Flushing, and an off-street parking information web site that is being operated by NYCDCP.

Real-time parking information is a necessary component of an efficient parking management system. This report describes preliminary technical specifications for a real-time parking information system in Downtown Flushing, Queens. Downtown Flushing was selected for the pilot test from among four areas considered because it has characteristics that best meet the needs for a PGS, including large-capacity parking facilities.

This project proposes a system that collects data at parking facilities in Downtown Flushing and uses Variable Message Signs (VMS) and a central communication control to provide drivers with real-time information about parking availability. The PGS will function within the network of the NYCDOT Traffic Management Center (TMC) in Long Island City, Queens. It will be developed after and in coordination with the NYCDOT Shea Stadium PGS, and will comply with National and Sub-Regional Intelligent Transportation System (ITS) Architectures.

The proposed pilot PGS will cover the four municipal lots in Downtown Flushing, Queens. The entry and exit points of these facilities will be equipped with vehicle detectors that will transmit parking availability data to the central control at the NYCDOT TMC, which will in turn transmit data to roadside VMSs.

In advance of the NYCDOT implementation of the Shea Stadium PGS, NYCDCP recommends the following specifications for the Downtown Flushing PGS:

- The PGS should be developed after and share an operational network with NYCDOT's Shea Stadium PGS;
- The PGS should include VMSs that can be installed at locations within Downtown Flushing, and are readable from a minimum distance of 200 feet;
- The PGS should have a life expectancy of 10 years, at minimum;
- Vehicle detectors should maintain a directional counting accuracy of not less than 90%, on average;
- The PGS should be compatible with existing NYC government technology protocols;
- The PGS should be compatible with the National ITS Architecture and the NYC Sub-Regional ITS Architecture;
- The PGS should have the ability to archive parking availability data;
- The PGS should have the ability to transmit real-time parking availability information to a web server for internet dissemination;
- The PGS should be expandable to include additional parking facilities;

- The PGS's real-time differential should be less than one minute;
- The fine tuning of the PGS, after installation, should be completed within six months;
- The vendor should have qualified representatives in the US and provide technical staff located in the region;
- The PGS should be guaranteed against all types of failure; and
- The vendor should be prepared to replace, repair, or remove its respective PGS in the event of major problems.

Evaluation of the pilot PGS will begin at the end of the fine tuning stage. The evaluation will use different platforms and will involve travelers, facility operators, and other stakeholders in the study area. These platforms could include (1) site interviews, (2) mail back surveys, and (3) PGS diagnostics and reporting. The goal of the PGS evaluation will be primarily to establish an appropriate evaluation methodology and evaluate whether the project meets its goals and objectives. This portion of the study will also make recommendations to improve design, implementation, and operation and maintenance guidelines for the ongoing as well as future PGSs. It will also make recommendations for customizing and integrating PGSs with other ITS operations. NYCDOT will conduct the evaluation and include the results in the final project document.

The proposed next steps for the project are as follows:

1. Release of current document to Technical Advisory Committee (TAC) for comments and feedback.
2. Conduct further research to recommend VMS sign locations to NYCDOT.
3. Adjust project scope, specifications and cost estimates for Downtown Flushing PGS based on Shea Stadium PGS procurements and implementation.
4. Finalize PGS sign design and locations in Downtown Flushing based on Shea Stadium PGS, revised cost estimate, and NYCDOT comments.
5. Modify municipal lots within the PGS for counter installation.
6. Procure and install Downtown Flushing PGS components.
7. System integration between Downtown Flushing PGS and Shea Stadium PGS.
8. Testing and Fine Tuning of Downtown Flushing PGS.
9. Development of web site interface for real-time parking data from Downtown Flushing PGS.
10. Evaluation of Downtown Flushing PGS by NYCDOT.
11. Final Project Document issued by NYCDOT.

Introduction

This document describes preliminary recommendations including technical specifications for a real-time parking guidance system (PGS) in Downtown Flushing, Queens, in New York City. The project is part of the federally funded Parking Information and Demonstration Project (PIDP), which is co-managed by the New York City Department of City Planning (NYCDCP) and the New York City Department of Transportation (NYCDOT). The other components of the PIDP include a PGS for the Shea Stadium park-and-ride facility in Queens that is being implemented by NYCDOT, and an off-street parking information website that is being operated by NYCDCP.

Typically in a Central Business District of a larger urban area, a significant number of Vehicle Miles Traveled (VMT) are generated by drivers looking for a parking space. Providing drivers with real-time information on parking availability will reduce their search time, thus reducing congestion.

PGS is an area of Intelligent Transportation Systems (ITS) that informs drivers of parking availability within walking distance of their trip destination. Previous evaluation studies have documented that advanced parking information reduces congestion on roads and highways by informing drivers where parking is located and, furthermore, where available parking exists. A PGS is a network, in a defined service area, of electronic vehicular sensors and variable message signs (VMS) connected through a management center. It provides parking space availability and directions to those parking facilities with available parking spaces to drivers, in real-time. Currently in the United States, PGS exists in St. Paul, Minnesota and Pittsburgh, Pennsylvania. Similar systems also exist in Japan and in European countries such as Belgium, Ireland, and Germany.

Project Description

The project seeks a reasonably dependable network which collects data at parking facilities in Downtown Flushing and at Shea Stadium, and transmits this data to a control center, which in turn manipulates and posts information on VMSs. As such, the PGS will comprise various hardware and software components. The life expectancy of the PGS, if the test is deemed successful, should be, at minimum, 10 years.

Project Context and Goals

In June, 2000, Polytechnic University's Urban ITS Center issued a study that identified several areas in NYC as potential candidates where a pilot PGS could be implemented. These areas included Flushing, Queens; Lower Manhattan; Midtown Manhattan; and Downtown Brooklyn. Analysis during the feasibility study indicated that the downtown area of Flushing, Queens, would be the most appropriate area for a pilot project because it has the following characteristics: a manageable (small) number of off-street parking facilities; a well delineated study area with a limited number of access points; and large-capacity parking facilities.

Since the release of that study, NYCDOT and NYCDCP have determined that a PGS would be implemented for the Shea Stadium park-and-ride facility before one is implemented in Flushing Queens, and that these two systems would be coordinated to exchange real-time information. NYCDOT and NYCDCP also determined that the Downtown Flushing PGS would consist of municipal lots in the pilot phase. In July, 2002 the Urban ITS Center issued a document commissioned by NYCDOT entitled "Advanced Parking Information System for Shea Stadium," which describes the proposed PGS for the Shea Stadium park-and-ride. NYCDCP recommends that the initial deployment of a PGS for Downtown Flushing include four municipal lots, and be capable of expansion to include additional parking facilities.

While NYCDOT would implement the Shea Stadium PGS, NYCDCP would lead the effort in the implementation of the PGS project in Downtown Flushing, working in partnership with NYCDOT. Since the PIDP is funded through a federal grant under the category of Congestion Mitigation Air Quality (CMAQ), the PGS design will focus on decreasing air pollution that can be attributed to vehicles driving unnecessary miles in search of available parking.

NYCDCP currently operates an internet web site that provides off-street parking information within New York City (<http://www.nyc.gov/html/dcp/html/parking/pidpindex.html>). Viewers of the site can obtain their trip information by viewing and/or downloading the location of parking facilities on digital maps. This web-based parking information system helps drivers find an available parking space of their preference before leaving home. In the future, NYCDCP proposes that the parking web site be enhanced to include real-time parking information from the Downtown Flushing PGS.

The goals and objectives of the PGS in Downtown Flushing are to:

- Provide pre-trip and en route real-time parking information to travelers;
- Direct travelers to available parking thereby reducing VMT;
- Test the feasibility of a PGS in NYC;
- Evaluate a PGS's effect on driving times to and within NYC;
- Promote alternative transportation modes and services by enhancing management of the parking stock surrounding them;
- Evaluate the parking supply in NYC;
- Recommend improvements in areas where substandard parking characteristics exist in NYC; and
- Observe the effect of a PGS on parking facility operations.

PGS Communications Requirements

The PGS will use Variable Message Signs (VMSs) and a central communication control to provide drivers with information for up to four municipal parking facilities in Downtown Flushing and for the park-and-ride facility at Shea Stadium. The PGS is expected to operate 24 hours, seven days a week. During its operation, the PGS should use dependable technologies to continuously count vehicles entering and exiting each parking facility in order to define and accurately post the total parking availability (i.e., available spaces) of each PGS parking facility in real-time. The project will use a pre-designed VMS that can share real-time information with the Shea Stadium PGS. The combined systems will be able to direct drivers in Flushing to Shea Stadium, or drivers approaching Shea Stadium to Downtown Flushing, depending on parking availability of the facilities within the PGS.

One of the most important principles in guiding motorists to parking facilities is the utilization of consistent, clear and legible signs. From the time that drivers enter the downtown area and see the first sign, until they reach the parking facility, they should see signs that are the same general shape, design, and color. A mix of electronic and static signs should convey parking information and direction.

Electronic signs provide the real-time parking information about spaces available, while the static signs (trailblazers) assist the motorist in finding the parking facility. The signage should provide the driver with sufficient advance notice that a decision point is approaching, but drivers should not be overloaded with so many signs that the desired message gets lost.

Once the PGS is operational, vehicle detectors will take vehicular counts at control sections at each PGS parking facility. A control section is an access point which is an entrance and/or exit point. Vehicle detectors at each PGS parking facility will count vehicles entering and exiting the respective facility so that parking availability can be determined based on these numbers. However, since most existing parking facilities were not designed to be outfitted with vehicle detectors, the project will improve the design of access points at several PGS parking facilities where feasible. Minor modifications to the access points will better channelize the vehicular flow and, consequently, increase the counting accuracy of the vehicular detectors.

The technology of the vehicle detectors should be flexible. Any standard vehicular detector will be acceptable, e.g., inductance loops, microwave detectors, infrared beams, magnetic detectors, etc., as long as they maintain a directional counting accuracy of not less than 90%, on average. Nonetheless, the PGS pilot project in Downtown Flushing should implement a financially and economically efficient PGS and one that is compatible with the PGS that is implemented at Shea Stadium. Efficiencies will result from a solid design which will reduce the need for manual interference, as well as by using dependable products which minimize the need for maintenance and replacement costs.

Interfaced with vehicle detection counters, the vehicle detection controllers, located at each PGS parking facility, will process the entry and exit counts and pass on the information to the PGS's central controller. Data exchange between vehicle detection controllers and the central controller will require the use of standard communication protocols easily integrated with existing systems. The central control component for the PGS will be located at NYCDOT's Traffic Management Center (TMC). Central control will have the hardware and software capability to derive the available number of parking spaces.

The user interface for the PGS at the TMC will be graphical and provide an option to view the operational area through the use of digital maps. Databases at the TMC will manage and store information and the operator of the central control will have the ability to archive and retrieve information from these databases. In addition to processing data and sending real-time information to variable message signs, central control will generate reports and create digital maps. The hardware and software used should allow easy expansion of the PGS system to include additional parking facilities, as well as flexibility to switch to different types of communication technologies if this is deemed to be necessary in the future.

The central control will also provide and manage detailed diagnostics functions of all components of the PGS. It is necessary for the operators to know the operational status of every segment of the PGS at all times and be able to respond effectively before and during system malfunctions. Central control should also have the capability to manually override, or deactivate any VMS from operation.

Variable Message Sign Requirements

The NYCDOT TMC central control component of the PGS will automatically broadcast at determinable intervals information on space availability to the PGS's VMSs located at key points in the study area. The transmissions, traveling through appropriate communication lines, will provide drivers with information about parking availability within PGS facilities. Information appearing on VMSs will change depending on the existing or future needs and conditions. At minimum, the VMSs will post the total number of available parking spaces available at a particular parking facility within the PGS.

In addition to the number of available parking spaces, the VMSs in Downtown Flushing should also be able to display other types of information. For example, an operator may choose to display on the VMSs that the facility is either “open,” “closed,” or “full.” In any event, VMSs should be able to direct travelers to the most feasible PGS parking facility depending on availability of parking spaces, and other factors considered by central control such as accidents, construction, obstructions, special events, and the location of parking facilities.

The VMSs will be installed at key intersections approaching Downtown Flushing where decisions about parking are made. In terms of design, the VMSs operating in other cities have characteristics dependant on the street network and the types of facilities within the PGS. There are differences in the design of these VMS panels, and electronic technology used to display messages (e.g., fiber optics, light emitting diodes, etc.). For example, most of the VMS panels used in St. Paul, Minnesota, contain fixed text as well as an electronic screen (see Figure 1). In this type of panel, an arrow points to a predetermined and identified parking facility. This directional information is static. The number of parking spaces available or status of a given parking facility appears in the electronic screen. Information posted in this section of the sign is dynamic and changes depending on availability conditions at the parking facility.

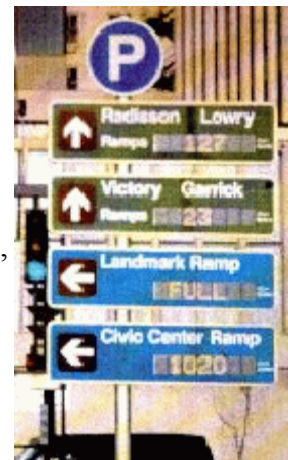


Figure 1 VMS in St. Paul, Minnesota contains fixed text as well as electronic screens.



Figure 2 VMS in Ireland shows all information electronically.

In an urban area of Ireland, on the other hand, a different approach is taken where all pertinent information is provided electronically. In this particular system, as shown in Figure 2, directional arrows, the name of the facility, and the parking availability information posts on electronic screens. In this system, all information is dynamic, so parking facilities that are included on the sign can change over time. Additional parking VMS signs from around the world are shown in Appendix D.

Currently, most VMSs located within NYC are used as traffic control devices to provide motorists en route traveler information. They are commonly installed on full span overhead sign bridges, post-mounted on roadway shoulders, or are overhead cantilever structures.



Figure 3 VMS on the Long Island Expressway, displaying real-time traffic information.

Traveler information displayed on these VMSs in NYC, as seen in Figures 3 and 4, may be generated as a result of a planned or unplanned event, which is programmed or scheduled by operations personnel. The objective of providing the information is to allow the motorist time to avoid an incident, prepare for unavoidable conditions, or receive travel directions. For all information displayed the goal is to have a positive impact on the motorist's travel time.



Figure 4 VMS on the Cross Island Expressway affects motorist behavior to improve traffic flow.

In addition to parking information, if feasible, each VMS for the Downtown Flushing PGS should be equipped with a full matrix display panel which will present additional traffic information, e.g., traffic conditions of major roadways near the study area. This type of data will generate from the NYCDOT TMC.

New York City also has PGS treatments that are in the early deployment stage located at Kennedy and LaGuardia Airports. As seen in Figure 5, signs at the green parking facility, at Kennedy Airport, display the list of levels for the parking facility, each identified by a letter, and contain an electronic panel for parking availability information. Currently, these panels either show information as to whether the level is open, or show no information. Eventually, the number of spaces available will be shown, as indicated by the heading, “Available Spaces,” located above the electronic display panels.

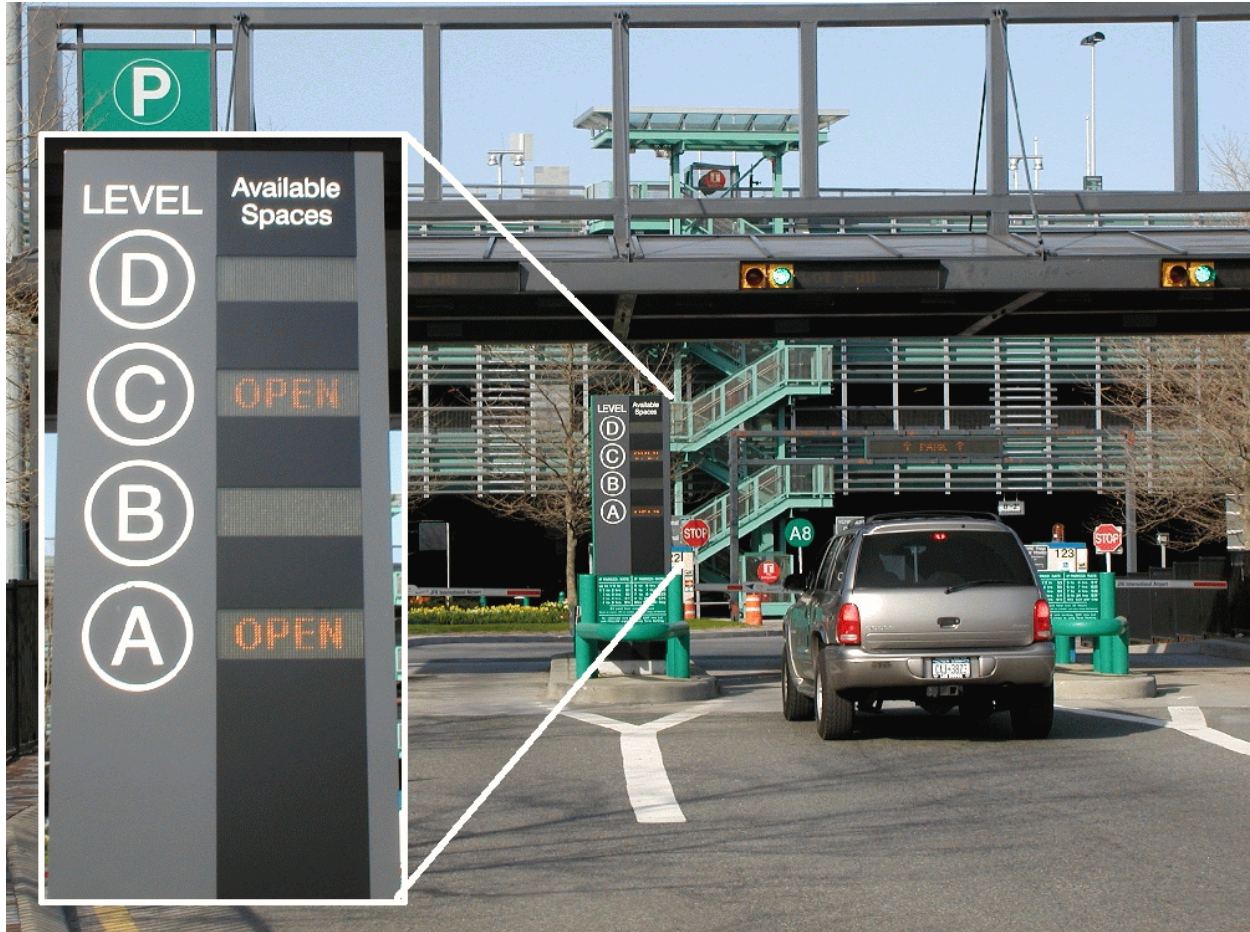


Figure 5 JFK Airport's PGS Sign. Inset shows a close-up view of the sign.

At LaGuardia Airport, a different type of sign is used, as seen in Figure 6. Here, signs located at each parking facility have one large electronic display panel that will be able to provide parking availability information for that facility (currently nothing is displayed on these panels - however, some VMS signs do display directional information).

The two airports use different types of signs, due to the layout of the parking facilities, transportation network, available real estate, and where the decision making points are located. All these are considerations for the PGS in Downtown Flushing and will affect the look and location of the VMS signs.



Figure 6 LaGuardia Airport's PGS sign.

The VMSs chosen to operate within the Downtown Flushing PGS must be consistent with each other in their layout, format, and technologies. In essence, the directional and parking availability information should be simple and clear to a driver driving relatively slowly (15mph or less) and visible from a minimum distance of 200 feet. The electronic indication of the signs should also be visible at day and night, as should all other pertinent information. The design of the VMS panels must adhere to rules outlined in the Manual on Uniform Traffic Control Devices (MUTCD). Static parking signs will fill gaps in the network by directing drivers to PGS parking facilities as well identifying the access points of those facilities.

Design and construction of VMSs should be such that they tolerate acts of vandalism. In order to determine the final locations of the signs, existing street signs and furniture may need to be moved in order to minimize the effects of clutter and obstructions.

System Architecture Requirements

It is important that the PGS system architecture for Downtown Flushing is easy to modify and integrate with existing systems. This is necessary to fulfill federal guidelines for the deployment of new Intelligent Transportation Systems, and to exchange information with the Shea Stadium PGS.

The operation of the Downtown Flushing PGS will function within the operational network of the TMC in Long Island City, Queens, with the central control workstation residing at the TMC. NYCDCP will also require a workstation in order to view various segments of the operation of the PGS and retrieve archived data for its planning work. PGS data should be archived at the TMC for future analysis by transportation and land use planners.

In terms of non-VMS data transmission, NYCDCP would require that the PGS have the ability to transmit real-time parking availability information to a web server for internet dissemination. This would allow NYCDCP to feed data to its NYC Parking web site. In addition to links through the internet, the PGS architecture should allow for seamless export of parking information to other media, e.g., personal digital assistants and in-vehicle navigation systems.

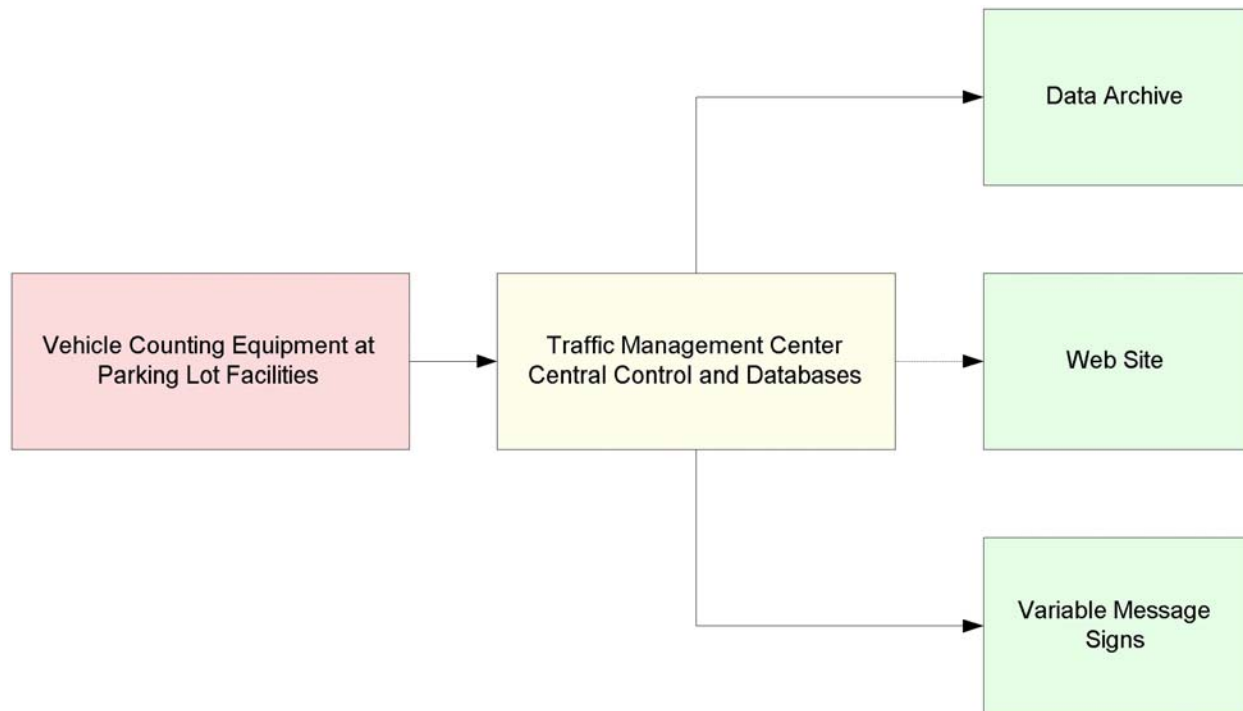


Figure 7 Proposed data flow for the PGS.

Figure 7 shows the proposed data flow for the PGS that will be created by these communication networks. This data flow is similar to that of the proposed Shea Stadium PGS in that vehicle counts are transmitted from parking lot facilities, to the TMC, which in turn transmits parking

availability data to VMSs. For the Downtown Flushing PGS, additional data flows would be required for data archiving and web site dissemination.

The PGS in Downtown Flushing should use communications technologies that are compatible with those of the Shea Stadium PGS. Given NYCDOT's proposal for the Shea Stadium park-and-ride PGS, the Downtown Flushing PGS will likely use fiber optics for data transmission. Regardless of the type of communications, the performance of the PGS should be such that the real-time differential, i.e., detection of vehicle entering or exiting a parking facility, and that information reflected on the VMSs, should be less than one minute.

Existing Conditions in the Downtown Flushing Study Area

Overview of Study Area and Existing Street Network

The study area for the Downtown Flushing PGS, as seen in Figure 8, is bounded on the north by Northern Boulevard, on the south by Sanford Avenue, on the west by College Point Boulevard and on the east by Bowne Street. This study area was selected to include the main traffic routes to and from the Downtown Flushing central business area as well as major public parking facilities.



Figure 8 Study areas of Downtown Flushing and Shea Stadium.

Northern Boulevard is a major two-way arterial extending through the entire borough of Queens in an east-west direction. A truck route, it connects the Queensboro Bridge to the west with the Queens-Nassau Counties' border to the east. Northern Boulevard provides access to the following expressways and parkways: Brooklyn Queens Expressway, Grand Central Parkway, Clearview Expressway, and Cross Island Parkway. On Northern Boulevard there are two to four travel lanes and a curb lane in each direction. Within the study area, there are left turn lanes at

the major intersections: Prince Street, Main Street, Union Street, Bowne Street and Parsons Boulevard.

College Point Boulevard also serves truck traffic with two effective travel lanes and a curb lane in each direction. At most intersections within the study area, there are left turn lanes.

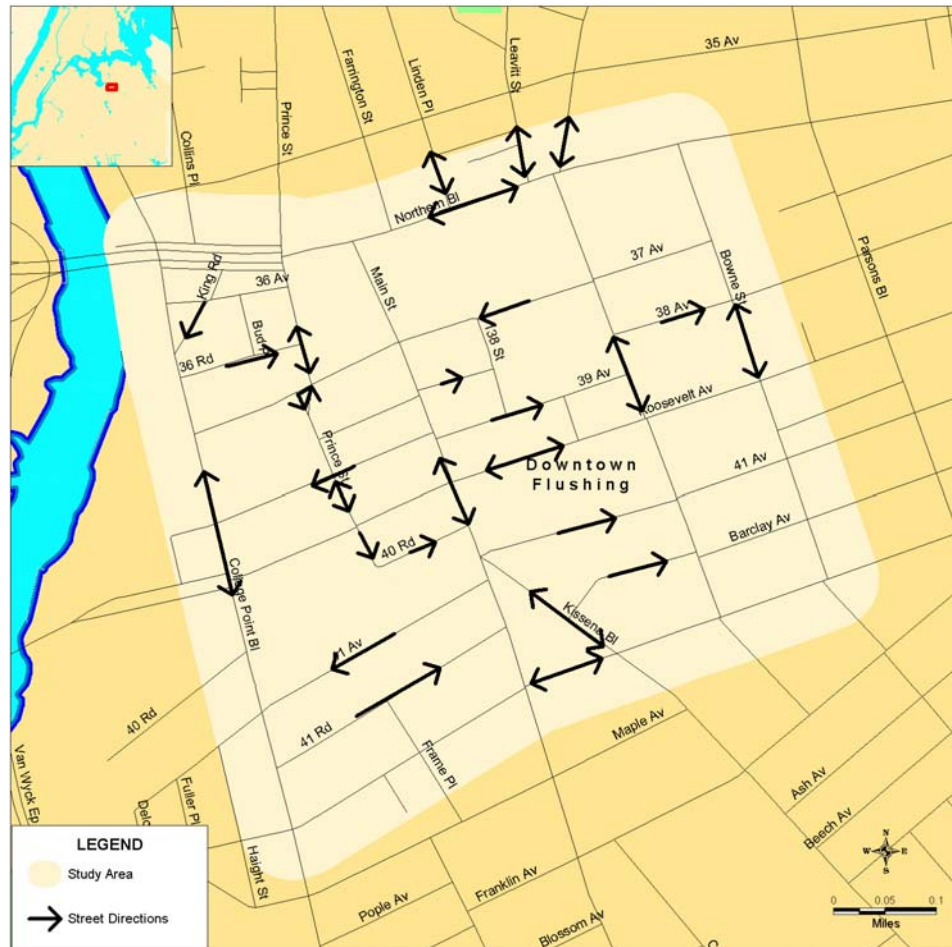


Figure 9 The street network within the study area.

Main Street extends through the study area in a north-south direction. Its two effective travel lanes and a curb lane connect the Long Island Expressway, to the south, with Northern Boulevard to the north.

Roosevelt Avenue is an east-west arterial traveling between Long Island Expressway and Northern Boulevard. Within the study area, it has two effective travel lanes in each direction at Prince Street and Main Street, whereas there is one effective travel lane in each direction and curb lane at Union and Bowne Streets and Parsons Boulevard.

Neighborhood Character and Socio-economic Conditions

Downtown Flushing is one of New York City's largest retail and commercial districts, and is home to a growing and diverse residential population. It is also one of the busiest mass transit commuter transfer points between buses and subway in New York City.

Flushing, which historically was a predominantly Jewish community, saw an influx of Asian immigrants in the last two decades. Estimated Asian population in 2000 was 36 percent while White Nonhispanic population was 41.3, according to the 2000 U.S. Census Bureau. The largest ethnic groups in the area are the Chinese and the Koreans, making up 17 and 11 percent of the population respectively.

Flushing is the fourth largest shopping area in Queens and employs more than 50,000 people or roughly 11.7 percent of all Queens' workers, according to a 2001 report from the Queens County Overall Economic Development Corporation. The median household income in Flushing was \$43,480, according to the Census Bureau, well above the borough's average of \$35,226.

Downtown Flushing is one of the three major transportation hubs in Queens. Cars, delivery trucks, delivery bicycles, commuter vans, 23 bus routes, livery cab drivers, one subway line, and a commuter rail line all converge in this area. The sidewalks in this area have some of the heaviest foot traffic in New York City.

In 2003, NYCEDC, NYC DCP, and community and business leaders formed the Downtown Flushing Task Force (FTF) that was guided by Deputy Mayor Doctoroff. The Task Force organized numerous workshops in order to obtain ideas regarding the problems and possible solutions for Downtown Flushing. As a result of those workshops, planning studies and other meetings with the community, the FTF released the report "Downtown Flushing Development Framework," which can be accessed online at www.downtownflushing.com. In the Reconnect & Renew Downtown section of this report, goals for the area and recommendations are suggested.

Goals related to transportation and parking include:

- Enhance mobility and reduce vehicular and pedestrian conflicts
- Improve the efficiency and capacity of parking Downtown for commercial and residential use
- Reduce transit-generated congestion Downtown and enhance mass transit proximity to the waterfront
- Achieve a significant improvement of the pedestrian environment, including increased sidewalk capacity where feasible and increased pedestrian safety and amenities.

Recommendations and implementation related to these goals:

- Relocate commuter parking currently downtown to Shea Stadium
- Convert Main Street to one-way northbound
- Convert Union and Prince Streets to one-way southbound
- Establish right-hand turn from Northern Boulevard onto Prince Street
- Reroute buses to respond to these changes and decongest Main Street
- Add an entrance to the 7 subway station at the corner of Prince Street and Roosevelt Avenue
- Maintain displaced short-term spaces within walking distance of Downtown Flushing
- Utilize Intelligent Transportation Systems to direct drivers to available spaces

The proposed PGS for Downtown Flushing is supportive of and consistent with the parking strategy described in the Framework report. After the Shea Stadium PGS is implemented, and before specific details of the Flushing PGS are developed (such as Variable Message sign locations and how municipal lots will be monitored for parking availability), traffic and land use conditions in Downtown Flushing will be re-evaluated with regard to the redevelopment of Flushing Lot 1 and the in-depth traffic analysis described in the Framework document.

As Downtown Flushing continues to grow as both a residential and commercial area, parking availability and traffic will become more important as planning issues. The proposed PGS seeks to address these issues by reducing traffic and increasing parking convenience for residents, workers, consumers, and commuters.

Land Use Characteristics

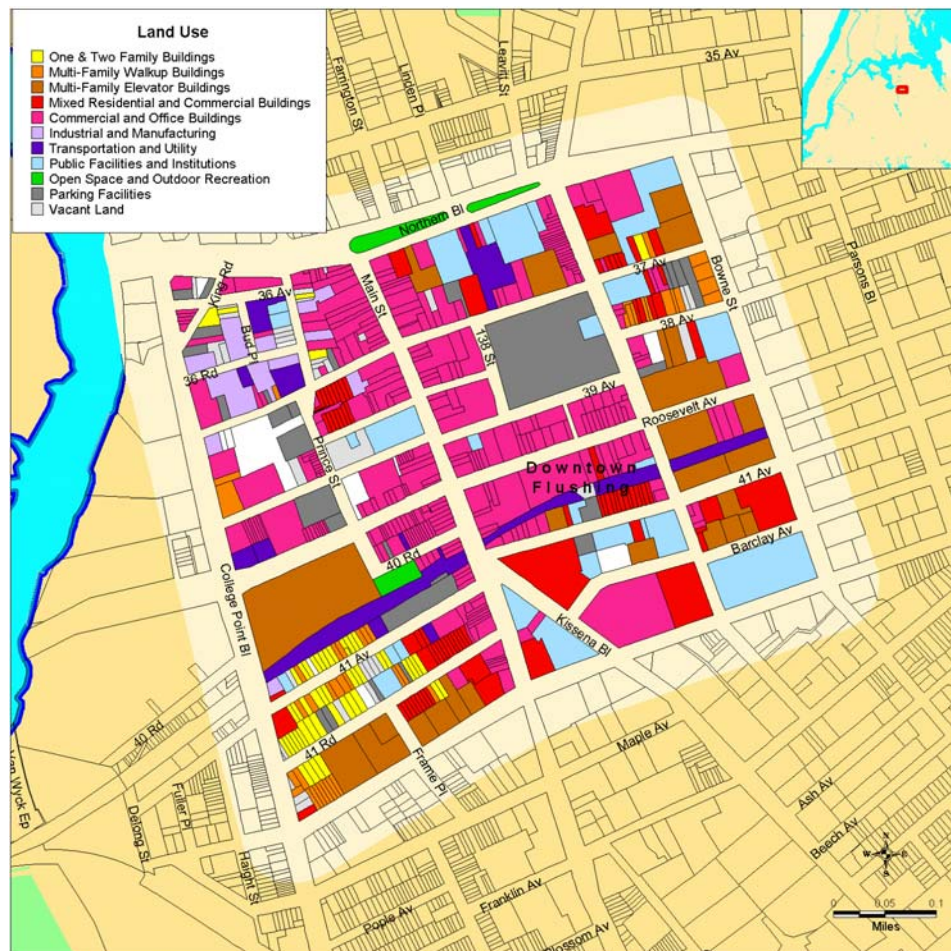


Figure 10 Land uses in the study area.

As seen in Figure 10, the study area has a mix of residential, industrial, institutional, and commercial land uses. Commercial and business uses predominate the center of the PGS study area with most retail activity occurring along Main Street and Roosevelt Avenue. Industrial land uses are found in the northwest corner of the study area, while residential use is concentrated in the southwest corner and along the eastern edge of the study area. Parking facilities are located throughout Downtown Flushing, the largest one being Lot 1 occupying an entire city block east of Main Street.

In terms of new development in Downtown Flushing, the New York City Economic Development Corporation (NYCEDC) has issued an RFP for the sale and redevelopment of Flushing Municipal Lot 1. The RFP area, approximately 213,000 square feet or 5 acres, is bounded by 37th Avenue, Union Street, 39th Avenue, and 138th Street, currently contains a two level municipal parking facility. In the RFP, EDC is seeking proposals to create a mixed-use development. There will be an open space element that will have a town square feel to it, street

level retail, residential units, ample parking, and buildings intended for civic and cultural uses. EDC has received responses and plans to select a developer in October, 2004.

Public Transportation

Downtown Flushing is served well by public transportation. It is a major transfer point for bus, commuter rail, and subway travelers. New York City Subway's 7 line runs between Times Square in Manhattan and Main Street in Downtown Flushing. At the Main Street stop, passengers connect to thirteen New York City Transit Bus routes, five Queens Surface Bus routes, two Long Island Bus routes and the Long Island Rail Road (LIRR). The majority of the connections to and from the buses take place on Roosevelt Avenue.

Characteristics of Off-street Parking Facilities

As seen in Figure 11, within the PGS study area, there are four municipal off-street parking facilities, operated by the Parking Division of NYCDOT, and seven privately-owned facilities that offer off-street parking to the public. There are 1,440 parking spaces in municipal lots and 1,810 spaces in the privately-run parking facilities. Cumulatively, municipal lots house 44 percent of the total parking spaces offered in the study area, most of which are located in Flushing Municipal Lot 1.

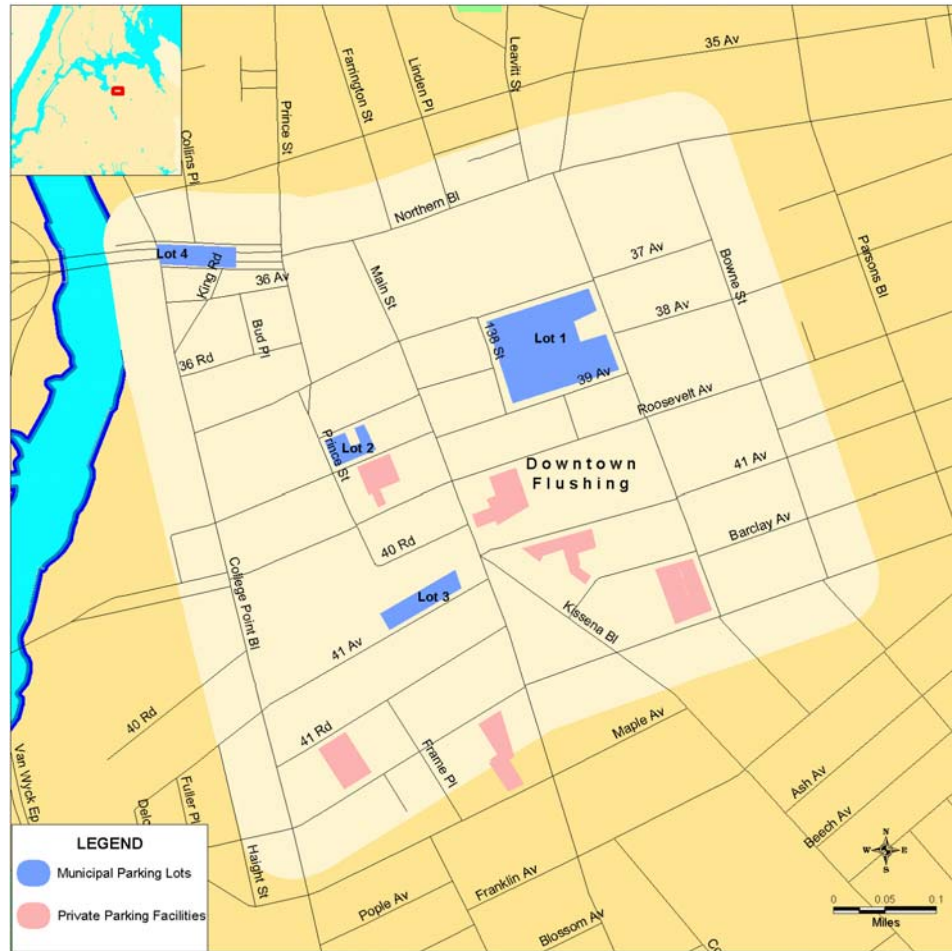


Figure 11 The municipal and private parking facilities within the study area.

The access points for the four municipal lots are open (there are no barriers or fare taking devices). Rates at these facilities are relatively less expensive than those at private lots, making them an attractive choice for parking. Payment is collected by MuniMeters located in the lots. Parking space numbers or stall numbers are used in payment collection, preventing the customer from returning the vehicle to a parking space after leaving the lot. Below is a detailed description of the four municipal lots. Appendix A contains descriptions of the privately-run facilities in the PGS study area.