Port Authority of New York & New Jersey

Options for Mass Transit Solutions to LGA

This report was prepared by experienced technical consultants from Bechtel, WSP, Nelson\Nygaard, FourSquare, and Ramboll in consultation with Port Authority and MTA personnel with input and guidance from the Expert Panel.

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For Review Only

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Acronyms

Acronym	Definition
ADA	Americans with Disabilities Act
AHJ	Authority having jurisdiction
APM	Automated People Mover
BMT	Brooklyn–Manhattan Transit Corporation
BRT	Bus Rapid Transit
BQE	Brooklyn-Queens Expressway
ConEd	Consolidated Edison
CSO	Combined sewer outfall
DBE	Disadvantaged Business Enterprise
EA	Environmental Assessment
EIA	Environmental Impact Assessment
EIS	Environmental Impact Statement
EWR	Newark Liberty International Airport
FAA	Federal Aviation Administration
FDNY	Fire Department of New York City
FHWA	Federal Highway Administration
FMCP	Flushing Meadows Corona Park
GCP	Grand Central Parkway
GHG	Greenhouse Gas
GP	General-Purpose
GRT	Group Rapid Transit
HOV	High Occupancy Vehicle
IBX	Interborough Express
JFK	John F. Kennedy International Airport
LAIP	LGA Access Improvement Project
LBE	Local business enterprise
LGA	LaGuardia Airport
LIE	Long Island Expressway
LIRR	Long Island Railroad
LVCC Loop	Las Vegas Convention Center Loop
MCF	Maintenance and Control Facility
MoT	Maintenance of Traffic
MT	Metric tons
MTA	Metropolitan Transportation Authority
M/WBE	Minority-/Women-Owned Business Enterprise
NYBPM	New York Best Practice Model
NYC DEP	New York City Department of Environmental Protection
NYC DOT	New York City Department of Transportation

Acronym	Definition
NYC EDC	New York City Economic Development Corporation
NYCT	New York City Transit
NYC Parkland	New York City Department of Parks and Recreation
NYS DOT	New York State Department of Transportation
OMNY	One Metro New York
OMSF	Operations, Maintenance, and Storage Facility
Parks	New York City Parks Department
PM/CM	Project Management/Construction Management
pphpd	passengers per hour per direction
PWB	Port Washington Branch
ROW	Right-of-way
RPZ	Runway Protection Zone (see Glossary)
SBS	Select Bus Service
SDVOB	Service-Disabled Veteran-Owned Business Enterprise
sf	square feet
tph	Trains per hour
TSP	Transit Signal Priority
USTA	United States Tennis Association
VMT	Vehicle miles traveled
VWE	Van Wyck Expressway

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EXECUTIVE SUMMARY

Introduction and Background

This report (the "Report"), undertaken at the request of Governor Kathy Hochul, presents a review of potential alternative mass transit options to LaGuardia Airport (LGA). These options include expanded subway service, fixed guideways with light rail, improved and expanded bus service, ferry service, and new or emerging technologies.

The review encompasses input from specialized technical and planning advisors to the Port Authority. These advisors include an Expert Panel of independent transportation professionals with regional, national, and international expertise, as well as the Metropolitan Transportation Authority (MTA) and other key partner agencies.

The Report focuses on identifying and describing the options, and on exploring the key issues with each through assessment and analysis.

Study Process

The process undertaken for this effort comprised multiple steps. It began with gathering input from various sources and engaging with partners, stakeholders, and the public. It then involved updating the list of mass transit options and developing evaluation factors by which these options could be analyzed. The product of this current study is a detailed description of the individual options, and an assessment against the established evaluation factors.

Assembly of a Team of Independent Study Consultants

To develop the Report, the Port Authority commissioned a multi-disciplinary team of well-recognized independent experts, including:

- Bechtel – Study Lead and Report Preparation
- WSP – Engineering and Estimating
- Nelson\Nygaard Consulting Associates – Bus Planning Technical Lead
- Foursquare ITP – Emerging Technology and Equity
- Ramboll – International Emerging Technology

Review of Prior Studies

Improving transit access to LGA has been studied for many years as the Airport has grown and access to it has become ever more challenging. Some of the studies conducted over the past 30 years include the following:

a. Airport Access Program Draft Environmental Impact Statement, Federal Aviation Administration (FAA), 1994.

b. LaGuardia Airport Subway Access Study, Metropolitan Transportation Authority, 1998 to 2001.
c. Citywide Ferry Study, New York City Economic Development Corporation, 2013.
d. LaGuardia Airport Access Alternatives Analysis, New York City Department of Transportation in collaboration with New York City Transit and the Port Authority of New York and New Jersey, 2011 to 2014.
e. LGA Airport Access Improvement Project Purpose and Objectives and Analysis of Alternatives Report, Port Authority of New York and New Jersey, 2018.
f. NYC Ferry Expansion Feasibility Study, New York City Economic Development Corporation, 2018 to 2019.
g. LaGuardia Airport Access Improvement Project Final Environmental Impact Statement, FAA, 2021.

This study has reviewed the mass transit options analyzed in these reports, which have informed the current inquiry and the search for solutions that are practical and realistic.

Coordination with Partner Agencies and Operators

As the primary operator of bus, subway, and railroad services in New York City, the MTA has been a key member of the study team and has been consulted on all aspects of the Report, with specific focus on the subway and bus options.

Additional agencies and operators consulted during the course of the study include:

a. Amtrak
b. Consolidated Edison (ConEd)
c. Federal Aviation Administration (FAA)
d. New York City Department of Environmental Protection (NYC DEP)
e. New York City Department of Transportation (NYC DOT)
f. New York City Department of Parks and Recreation (NYC Parks)
g. New York City Economic Development Corporation (NYC EDC)
h. New York State Department of Transportation (NYS DOT)
i. NY Waterways

Engagement with the Expert Panel

In November 2021, the Port Authority announced the appointment of three independent transportation experts with regional, domestic, and international experience to consult on and help guide the evaluation process:

- Mike Brown (former Commissioner of Transport for London and former Managing Director of Heathrow Airport)
- Janette Sadik-Khan (Principal at Bloomberg Associates and former Commissioner of the NYC Department of Transportation)
- Phillip A. Washington (CEO of Denver International Airport and former CEO of Los Angeles Metro)

The study team has engaged with the Expert Panel in regular briefings of individual panel members and meetings of the entire panel. The topics covered have included all modes (subways, light rail with fixed guideway, buses, ferries, and emerging technologies) as well as key issues of constructability, cost, schedule, community impacts, stakeholder input, equity, travel time, and ridership.

Engagement with Stakeholders and the Public

The Port Authority reached out to key stakeholders in March 2022[1] for input on the evaluation of potential mass transit options to LGA. A questionnaire describing the options and proposed evaluation factors was sent to more than 70 key stakeholders, including elected officials and community organizations. Stakeholders were engaged by means of a formal invitation to comment upon a summary description of each of the options.

Also in March 2022, the Port Authority hosted two in-person public workshops on the options being evaluated. Graphical representations of each of the options, as well as information on the Expert Panel and the evaluation factors to be used, were displayed. Independent outside consultants were made available to answer questions from attendees regarding the information contained on the display boards, and attendees were able to record comments for consideration in the evaluation process. Interpretation services in Bengali, Mandarin, and Spanish were available at the workshops.

In addition, an independent outside consultant conducted 10 focus group sessions, 7 in-person and 3 virtual, with members of the public. Of the 7 in-person sessions, 5 were held with community groups: 2 with Spanish-speaking participants, 1 with Chinese/Mandarin-speaking participants, and 2 general sessions.

In general, comments received on the subway and bus options were largely supportive, whereas comments received on the fixed guideway with light rail options were split between support and opposed. For the ferry service, comments received were supportive if implemented as a supplementary transit option or if the ferry service included additional stops. Of the few comments received about emerging technologies, most were opposed, expressing concern that emerging technologies would not be feasible. Many comments also suggested advancing multiple options or combining one or more of the options presented (see Table ES-1):

TABLE ES-1: PUBLIC COMMENTS SUMMARY

Mode	Positive Comments	Negative Comments
Subways	78	29
Light Rail with Fixed Guideway	65	55
Buses	115	38
Ferries	61 (12–15 as a supplemental option)	24
Emerging Technology	6	12

[1] Port Authority seeks input from key stakeholders on 14 potential mass transit options to LaGuardia Airport.

Study Options

This section introduces the mass transit options to LGA studied and summarizes their evaluation.

Options Overview

The options evaluated in this study fall into the following broad categories, or transit modes:

- **Subway Services**
  These options would be a branch or extension of the N and/or W-Lines that currently terminate in Astoria.
- **Bus – New Dedicated Bus Rapid Transit (BRT) Routes**

  These options include new services running in dedicated bus lanes or other protected rights-of-way, transit signal priority, and other associated improvements.
- **Bus – Transit Improvements along Existing Routes**

  These options include enhanced services on existing routes, including transit improvements to reduce travel time, improve reliability, increase frequency, and enhance passenger comfort.
- **Fixed Guideways with Light Rail**

  These options consist of guideways, systems, and facilities that use steel-wheeled light rail or associated people-mover technologies, similar to the JFK AirTrain.
- **Ferry Services + Shuttle Bus**

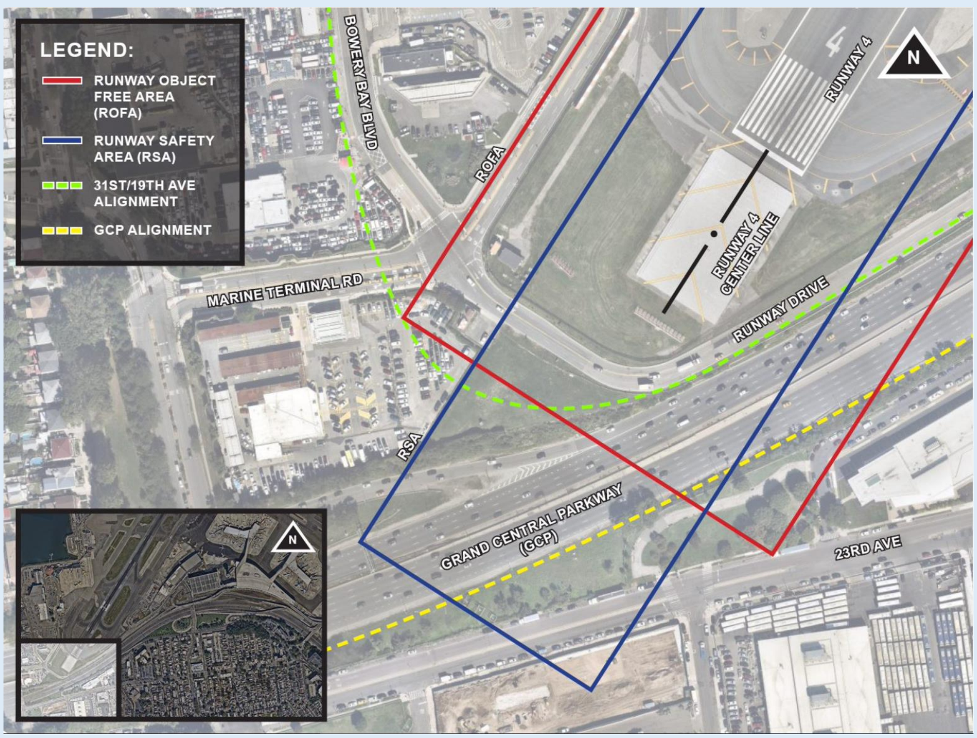
  These options would build on the City's current ferry system and provide access to the Airport from three waterfront locations in Manhattan. The ferry options would require shuttle bus connections from the ferry landings to the Airport passenger terminals.
- **Emerging Technologies**

  These options include various nascent technologies, including hyperloop, electric vehicles in narrow tunnels, and personal/group rapid transit pods.

Major Constructability Challenges for Options Approaching the Airport from the West and Southwest

The subway and other heavy infrastructure options that approach the Airport from the west and southwest face two main challenges.

First, FAA regulations prohibit any new permanent infrastructure at- or above-grade that intersects with the flight path and safety areas of airport runways. The FAA regulations in this area are collectively referred to as "Airport Design Standards" and are depicted, along with the impacted alignments, in the graphic below for LGA Airport Runway 04-22. Since this runway abuts Runway Drive and the Grand Central Parkway, any <u>new</u> at- or above-grade subway or other heavy infrastructure through this corridor would be prohibited based on current FAA Airport Design Standards.



Second, any new tunneled option (for a subway or other heavy infrastructure option) would conflict with major, underground utilities owned by the NYC Department of Environmental Protection, including two combined sewer and storm water structures that provide critical services to hundreds of thousands of Queens residents. These structures are 9–15 ft in diameter and were built over 90 years ago on wooden support piles.

As part of its preliminary engineering, the study team explored multiple approaches (e.g., going under or reconstructing the utilities); however, it was unable to identify a construction approach that it could conclude with confidence would practicably overcome these challenges (described further in Section 3.2.1.1.1 of the Report).

Nevertheless, given the intense public interest, the study team has carried out an evaluation of the heavy infrastructure options from the west and southwest for comparative purposes—even though, as presented, they do not successfully resolve the above challenges.

Description of Options and Summary of Findings

The study evaluated potential mass transit options to LGA within the five transit modes noted above. The description of each option is summarized below, together with a tabulated summary of the study team's findings against key evaluation factors. The data provided in the tables was produced using a common set of principles as a baseline for comparison between the options and sub-options.

Subway Services

The subway options offer the convenience of a single-seat ride from points in Midtown Manhattan directly to LGA, offering Airport passengers access to the established and frequent service of the MTA Subway network. This study focused on linking the existing N/W-Lines to LGA from their terminus in Astoria, the Subway lines closest to the Airport, primarily along an elevated track structure. As these options approach LGA from the west, they face the as yet unresolved challenge of complying with FAA Airport Design Standards while also avoiding disruption to 90-year-old, 15-ft-diameter sewer structures at the end of Runway 04-22 (see details in Section 3.2.1.1.1 of the Report).

The subway options and sub-options evaluated (see Figure ES-1) are described below, followed by a comparison table (Table ES-2) of the options against selected key evaluation factors. A full summary of each option against all evaluation factors can be found in the relevant section of the Report.

FIGURE ES-1: SUBWAY OPTION ROUTES

S-1: W-Line Branch via Grand Central Parkway

Option S-1 would take advantage of the GCP transportation corridor between Astoria and LGA, creating a branch line south of the Astoria Blvd Station to divert W-Line trains directly to the Airport Terminals B and C. Locating the proposed subway within the GCP transportation corridor would minimize the direct impact of the subway on local communities. Two sub-options were assessed with either two on-Airport elevated stations (S-1A) or one off-Airport underground station (S-1B). The on-Airport sub-option offers Airport passengers the convenience of direct access to Airport Terminals B and C but with the complexity of constructing large subway stations within the confines of the Airport, including substantial infrastructure and buildings mandated by MTA requirements for terminus stations. The off-Airport sub-option (south of the GCP) would provide a new subway station closer to the East Elmhurst community but would also require construction of substantial infrastructure and buildings mandated by MTA requirements for terminus stations, and bring significant construction impacts closer to this community.

S-1A: W-Line GCP Branch with Two On-Airport Elevated Stations

This sub-option would require the construction of heavy infrastructure, including elevated and open-trench concrete guideway structures predominantly along the GCP transportation corridor. This sub-option would have to overcome the construction challenges of crossing the Hell Gate rail trestle (90–100 ft above the ground), complying with FAA Airport Design Standards while negotiating the 90-year-old utilities under the GCP at the end of Runway 04-22 (a challenge as yet unresolved as discussed in Section 3.2.1.1.1 of the Report), and traversing the constrained area north of St Michael's Cemetery. For the purpose of cost comparison, the Indicative Capital Cost for this option was developed on the basis of a baseline solution of an open trench south of Runway 04-22 despite this approach not being compliant with FAA Airport Design Standards.

S-1B: W-Line GCP Branch with One Off-Airport Underground Station

This sub-option would require the construction of heavy infrastructure, including elevated and open-trench concrete guideway structures predominantly along the GCP transportation corridor. This sub-option would have to overcome the construction challenges of crossing the Hell Gate rail trestle (90–100 ft above the ground), complying with FAA Airport Design Standards while negotiating the 90-year-old utilities under the GCP at the end of Runway 04-22 (a challenge as yet unresolved as discussed in Section 3.2.1.1.1 of the Report), traversing the constrained area north of St Michael's Cemetery, and constructing one or more deep underground stations. For the purpose of cost comparison, the Indicative Capital Cost for this option was developed on the basis of a baseline solution of an open trench south of Runway 04-22 despite this approach not being compliant with FAA Airport Design Standards.

S-2: N/W-Line Extension via 31st St/19th Ave

Option S-2 would provide a direct link to LGA Terminals B and C by extending the existing subway north from the terminus at Astoria-Ditmars Blvd Station, providing Airport access for all N and W trains.

This option would require the construction of heavy infrastructure, including elevated concrete guideway structures along predominantly city streets of residential and commercial properties, and elevated and below-grade structures on-Airport. This option would have to overcome the construction challenges of complying with FAA Airport Design Standards while negotiating the 90-year-old utilities running under the Airport at the end of Runway 04-22 (a challenge as yet unresolved as discussed in Section 3.2.1.1.1 of the Report) and locating more substantial infrastructure and buildings mandated by MTA requirements for terminus stations. For the purpose of cost comparison, the Indicative Capital Cost for this option was developed on the basis of a baseline solution of a cut-and-cover tunnel under Runway Dr despite this approach not being compliant with FAA Airport Design Standards.

TABLE ES-2: SUMMARY OF KEY CHARACTERISTICS - SUBWAY OPTIONS S-1A, S-1B, AND S-2

Evaluation Factor	W-LINE GCP BRANCH WITH TWO ON-AIRPORT STATIONS (S-1A)	W-LINE GCP BRANCH WITH ONE OFF-AIRPORT STATION (S-1B)	N/W-LINE EXTENSION VIA 31ST/19TH AVE (S-2)
Constructability	• **Major unresolved constructability challenge**: Complying with FAA Airport Design Standards while also avoiding disruption to 90-year-old, large-diameter sewer structures at the end of Runway 04-22 (see details in Section 3.2.1.1.1 of the Report) • Tall (90+ ft) long-span (150–200 ft) structures spanning the Hell Gate rail trestle • Reconstruction of 82nd St Bridge • Total option route length: approx. 3 miles	• **Major unresolved constructability challenge**: Complying with FAA Airport Design Standards while also avoiding disruption to 90-year-old, large-diameter sewer structures at the end of Runway 04-22 (see details in Section 3.2.1.1.1 of the Report) • Tall (90+ ft) long-span (150–200 ft) structures spanning the Hell Gate rail trestle • Reconstruction of 82nd St Bridge • Cut-and-cover tunnel under 102nd St and deep 600-ft station construction adjacent to major utilities • Total option route length: approx. 3 miles	• **Major unresolved constructability challenge**: Complying with FAA Airport Design Standards while also avoiding disruption to 90-year-old, large-diameter sewer structures at the end of Runway 04-22 (see details in Section 3.2.1.1.1 of the Report) • Construction adjacent to residential city blocks along 31st St and 19th Ave • Total option route length: approx. 3 miles
Indicative Capital Cost (2022$)[2]	$5.9 billion[3] (Does not include any additional costs required for an as yet unresolved solution to get past Runway 04-22 in compliance with FAA Airport Design Standards; potentially up to approx. $1–$3 billion)	$6.6 billion[3] (Does not include any additional costs required for an as yet unresolved solution to get past Runway 04-22 in compliance with FAA Airport Design Standards; potentially up to approx. $1–$3 billion)	$5.4 billion[3] (Does not include any additional costs required for an as yet unresolved solution to get past Runway 04-22 in compliance with FAA Airport Design Standards; potentially up to approx. $1–$3 billion)
Indicative Timeline/Schedule	12–13 Years	12–13 Years	12–13 Years
Travel Time[4]	31 mins (Times Square to Terminal B, then C; shuttle to Terminal A)	37 mins (Times Square to Terminal B, then C; shuttle to Terminal A)	32 mins (Times Square to Terminal B, then C; shuttle to Terminal A)
Transfer Experience	Single-seat ride on W-Line, no transfer necessary	Single-seat ride on W-Line, no transfer necessary	Single-seat ride on N- & W-Lines, no transfer necessary
Ridership[5]	Total annual projected ridership for option: 6.3 million Net increase in annual projected transit ridership: 3.7 million	Total annual projected ridership for option: 4.7 million Net increase in annual projected transit ridership: 2.4 million	Total annual projected ridership for option: 5.9 million Net increase in annual projected transit ridership: 3.4 million
Local Community Impacts	<u>Construction:</u> • Heavy civil construction of elevated and at-/below-grade structures for approx. 6.25 years <u>Proximity to communities:</u> • 35–50 ft from one city block of residential and commercial properties on 31st St • 50–135 ft from 12 city blocks of residential and commercial properties along the GCP • 35–50 ft from the north end of St Michael's Cemetery along Astoria Blvd South • Over 500 ft across 8 lanes of the GCP from 9 city blocks of residential and commercial properties opposite the Airport Terminals <u>Permanent impacts:</u> • Acquisition of up to 24 properties (private residential, private commercial, and industrial) • Structures over Columbus Sq Park, Planeview Park, Overlook Park, and to the north of St. Michael's Cemetery[6] • Loss of approx. 20 on-street public parking spaces along 31st St	<u>Construction:</u> • Heavy civil construction of elevated and at-/below-grade structures for approx. 6.75 years. <u>Proximity to communities:</u> • 35–50 ft from one city block of residential and commercial properties on 31st St • 50–125 ft from 12 city blocks of residential and commercial properties along the GCP • 35–50 ft from the north end of St Michael's Cemetery along Astoria Blvd South • 150–275 ft from 11 city blocks of residential and commercial properties along Ditmars Blvd to the south of the GCP <u>Permanent impacts:</u> • Acquisition of up to 28 properties (private residential, private commercial, and industrial) • Structures over Columbus Sq Park, Planeview Park, Overlook Park, and to the north of St. Michael's Cemetery[6] • Loss of approx. 20 on-street public parking spaces along 31st St	<u>Construction:</u> • Heavy civil construction of elevated and at-/below-grade structures for approx. 6 years <u>Proximity to communities:</u> • 30–50 ft from 4 city blocks of residential and commercial properties on 31st St • 25–40 ft from 15 city blocks of residential and commercial properties on 19th Ave, including along the boundary of land with community baseball fields • Over 500 ft across 8 lanes of the GCP from 7 city blocks of residential and commercial properties opposite the Airport Terminals <u>Permanent impacts:</u> • Acquisition of up to 2 properties (industrial) • No impacts to NYC parklands or plazas • Loss of approx. 200 on-street public parking spaces on 31st St and 19th Ave

[2] Indicative Capital Costs should be considered to have a range of estimating uncertainty of –10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).

[3] Costs for heavy infrastructure options approaching LGA from the west/southwest are based on the open-trench construction concept past Runway 04-22 (over the existing 90-year-old utilities), to provide a baseline estimate of the cost of construction. Although this concept does not meet FAA Airport Design Standards, it provides a consistent approach for capital cost comparison purposes. Costs associated with tunnelling and/or relocating utilities would be substantially higher, potentially up to approx. $1–$3 billion.

[4] Standardized Indicative Baseline Off-Peak Travel Time from Midtown Manhattan.

[5] Experience from AirTrain JFK was that actual ridership turned out to be higher than would have been predicted by the AirTrain JFK forecast and underscores the inherent uncertainty of model predictions. The ridership model supporting this effort could also deviate from eventual ridership demand but was utilized to allow ridership comparisons between the options.

[6] Municipal parkland cannot be converted to a non-park use (known as alienation) without State legislative permission. Thus, the acquisition of New York City Parkland for construction of a mass transit option would require legislation authorizing such alienation. Obtaining such legislation is a multi-step process requiring actions by the New York City Council, the Mayor of New York City, the New York State Legislature, and the Governor.

Bus – New Dedicated Bus Rapid Transit Routes

The Bus Rapid Transit (BRT) options would create new dedicated, non-stop bus shuttle services providing two-seat ride access to LGA from existing transit hubs within Queens. BRT options would use Transit Signal Prioritization, convert existing traffic lanes to BRT-only bus lanes, and/or build new separated busway structures to avoid traffic congestion and would introduce a new electric bus fleet. BRT options would offer travel time, reliability, and customer experience benefits over existing bus services. Heavy infrastructure bus options approaching LGA from the west and southwest face the as yet unresolved challenge of complying with FAA Airport Design Standards while also avoiding disruption to 90-year-old, large-diameter sewer structures at the end of Runway 04-22 (see details in Section 3.2.1.1.1 of the Report).

The new BRT shuttle route options evaluated (see Figure ES-2) are described below, followed by comparison tables (Table ES-3 for heavy infrastructure BRT options and Table ES-4 for light infrastructure BRT options) of the options against selected key evaluation factors. A full summary of each option against all evaluation factors can be found in the relevant section of the Report.

FIGURE ES-2: BUS IMPROVEMENTS AND BUS RAPID TRANSIT OPTION ROUTES

BRT-1: BRT Shuttle to/from Astoria Blvd Station via Astoria Blvd/GCP

Option BRT-1 would create a new electric bus shuttle service to LGA Terminals B and C via a two-seat ride from the existing Astoria Blvd Subway station, providing transfer access to N- and W-Line Subway services. BRT bus stops would be located adjacent to the station on either side of Columbus Sq, and buses would use the Astoria Blvd/GCP transportation corridor to reach the Airport. All sub-options would require the construction of a new bus depot on Airport property at Ingraham's Mountain.

The study team evaluated three sub-options of BRT-1:

- BRT-1A would use a combination of bus lanes on Astoria Blvd and a dedicated elevated busway onto the Airport to avoid possible congestion and traffic delays, improving travel time and reliability.
- BRT-1B would further improve these with a separated busway for the full route from Astoria Blvd Station to LGA.
- BRT-1C offers a more cost-efficient option to BRT-1A or BRT-1B, converting bus lanes on Astoria Blvd but avoiding heavy construction, realizing many of the travel time benefits while avoiding both the cost and community impacts of the heavy infrastructure required by the separated busway.

BRT-1A: Astoria Blvd Shuttle with Bus Lanes on Astoria Blvd and Busway Adjacent to the GCP

Sub-Option BRT-1A would offer bus travel time and reliability benefits through the conversion of travel lanes on Astoria Blvd North and South to bus-only lanes with traffic signals revised to prioritize the buses, and a new dedicated busway structure to new elevated bus stops on-Airport, allowing buses direct access to the Airport, bypassing other Airport traffic. This sub-option would offer improvements such as signage, wayfinding, and weather-protected bus stops to the passenger transfer connection at Astoria Blvd Subway station. However, MTA has advised that any new access improvements to platform level would be limited by the space available within the existing constrained station infrastructure.

This sub-option would require a mix of heavy infrastructure, including an at-grade busway structure along the GCP rising to elevated structure on-Airport along with light roadway work at other points (line painting, re-curbing, etc.) for the new bus lanes. The heavy infrastructure sections of this sub-option would have to overcome the construction challenges of complying with FAA Airport Design Standards while negotiating the 90-year-old utilities under the GCP at the end of Runway 04-22 (a challenge as yet unresolved as discussed in Section 3.2.1.1.1 of the Report). For the purpose of cost comparison, the Indicative Capital Cost for this option was developed on the basis of a baseline solution of an at-grade roadway south of Runway 04-22, despite this approach not being compliant with FAA Airport Design Standards.

BRT-1B: Astoria Blvd Shuttle with Full Busway on Astoria Blvd and Adjacent to the GCP

Sub-Option BRT-1B would offer bus travel time and reliability benefits through the construction of a new dedicated busway structure from the Subway station all the way to the Airport. This would consist of the conversion of one lane and construction of an additional lane along Astoria Blvd South (beneath the Hell Gate rail trestle) with traffic signals revised to prioritize the buses, and a new dedicated busway structure to new elevated bus stops on-Airport, allowing buses direct access to the Airport, bypassing other airport traffic. This sub-option would offer improvements such as signage, wayfinding, and weather-protected bus stops to the passenger transfer connection at Astoria Blvd Subway station. However, MTA has advised that any new access improvements at the platform level would be limited by the space available within the existing constrained station infrastructure.

This sub-option would require the construction of heavy infrastructure, including at-grade and elevated concrete busway structures predominantly along the GCP transportation corridor. This sub-option would have to overcome the construction challenges of complying with FAA Airport Design Standards while negotiating the 90-year-old utilities under the GCP at the end of Runway 04-22 (a challenge as yet unresolved as discussed in Section 3.2.1.1.1 of the Report), extending Astoria Blvd South into the GCP embankment, and traversing the constrained area north of St Michael's Cemetery. For the purpose of cost comparison, the Indicative Capital Cost for this option was developed on the basis of a baseline solution of an at-grade roadway south of Runway 04-22, despite this approach not being compliant with FAA Airport Design Standards.

BRT-1C: Astoria Blvd Shuttle with Bus Lanes on Astoria Blvd Only

Sub-Option BRT-1C would offer bus travel time benefits through the adoption of cost-efficient light infrastructure construction through the conversion of travel lanes on Astoria Blvd North and South to bus-only lanes with traffic signals revised to prioritize the buses, and utilization of a new bus-only loop-road and at-grade bus stop at Terminal C, bypassing traffic at the current Terminal C stop. This sub-option would continue on limited-access roadways to the Terminal B at-grade bus stop and then continue to the existing Terminal A bus stop location using the existing on-Airport roadway network. This sub-option would offer improvements to the passenger transfer connection at Astoria Blvd Subway station such as signage, wayfinding, and weather-protected bus stops. However, MTA has advised that any new access improvements to platform level would be limited by the space available within the existing constrained station infrastructure.

This sub-option would require light roadway work (line painting, re-curbing, etc.) for the new bus lanes and new roadway construction on-Airport around Terminal C.

BRT-2: BRT Shuttle to/from Astoria-Ditmars Blvd Station via 31st St/19th Ave

Option BRT-2 would create a new electric bus shuttle service direct to LGA from the existing Astoria-Ditmars Blvd Subway station, providing two-seat ride transfer access to N- and W-Line Subway services to Manhattan at their terminus in Astoria.

BRT-2 would offer peak-hour bus travel time benefits through the conversion of existing travel/parking lanes on 31st St and 19th Ave to peak-hour bus-only lanes and with traffic signals revised to prioritize the buses. In addition, a new, bus-only roadway through ConEd property would create a direct link between 31st St and 19th Ave. Utilization of a new bus-only loop-road and at-grade bus stop at Terminal C would allow buses to bypass traffic at the current Terminal C stop. BRT-2 would construct new vertical circulation from the end of the subway platforms direct to street level and the BRT bus stops on 31st St, providing an LGA-branded customer transfer experience directly to the N/W-Line subway terminus. Accessing LGA from 19th Ave would allow BRT-2 to serve Airport Terminal A on its way to Terminals B/C.

This option would require light roadway work (line painting, re-curbing, etc.) for the new bus lanes, new roadway construction to link 31st St and 19th Ave around the ConEd property, new roadway construction on-Airport around Terminal C, and the construction of a new bus depot on Airport property at Ingraham’s Mountain.

BRT-3: BRT Shuttle to/from Northern Blvd Station via Northern Blvd/94th St

Option BRT-3 would create a new electric bus shuttle service direct to LGA Terminals B and C from the existing Northern Blvd Subway station, providing two-seat ride transfer access to M- and R-Line Subway services (E-Line services are overnight only). BRT bus stops would be provided near the station entrances on Northern Blvd. BRT-3 would provide bus travel time benefits through the conversion of existing travel lanes on Northern Blvd and 94th St to bus-only lanes with traffic signals revised to prioritize the buses, to avoid possible congestion and traffic delays along these roads. Utilization of a new bus-only loop-road and at-grade bus stop at Terminal C would allow buses to bypass traffic at the current Terminal C stop.

This option would require light roadway work (line painting, re-curbing, etc.) for the new bus lanes, new roadway construction on-Airport around Terminal C, and construction of the bus depot on Airport property at Ingraham’s Mountain.

TABLE ES-3: SUMMARY OF KEY CHARACTERISTICS – NEW HEAVY INFRASTRUCTURE BRT OPTIONS BRT-1A AND BRT-1B

Evaluation Factor	ASTORIA BLVD SHUTTLE WITH BUS LANES ON ASTORIA BLVD AND HEAVY INFRASTRUCTURE BUSWAY ADJACENT TO THE GCP (BRT-1A)	ASTORIA BLVD SHUTTLE WITH FULL HEAVY INFRASTRUCTURE BUSWAY ON ASTORIA BLVD AND ADJACENT TO THE GCP (BRT-1B)
Constructability	• **Major unresolved constructability challenge**: Complying with FAA Airport Design Standards while also avoiding disruption to 90-year-old, large-diameter sewer structures at the end of Runway 04-22 (see details in Section 3.2.1.1.1 of the Report) • Reconstruction of 82nd St Bridge • Total option route length: approx. 3 miles	• **Major unresolved constructability challenge**: Complying with FAA Airport Design Standards while also avoiding disruption to 90-year-old, large-diameter sewer structures at the end of Runway 04-22 (see details in Section 3.2.1.1.1 of the Report) • Construction of lane extension in GCP embankment and under Hell Gate rail trestle • Reconstruction of 82nd St Bridge • Total option route length: approx. 3 miles
Indicative Capital Cost (2022$)[7]	$1.3 billion[8] (Does not include any additional costs required for an as yet unresolved solution to get past Runway 04-22 in compliance with FAA Airport Design Standards; potentially up to approx. $1–$3 billion)	$1.9 billion[8] (Does not include any additional costs required for an as yet unresolved solution to get past Runway 04-22 in compliance with FAA Airport Design Standards; potentially up to approx. $1–$3 billion)
Indicative Timeline/Schedule	9–10 Years	9–10 Years
Travel Time[9]	Via N/W-Lines: 38–39 mins (6–7 mins on bus) (Times Square to Terminal B then C; shuttle to Terminal A)	Via N/W-Lines: 37–38 mins (5–6 mins on bus) (Times Square to Terminal B then C; shuttle to Terminal A)
Transfer Experience	• Transfer to the bus stop at Astoria Blvd Subway station would involve two vertical moves via existing stairs or existing elevator from platform to grade, and a short walk, in open air, to the covered bus stop • Circulation space at the mezzanine level of Astoria Blvd Station is constrained • Serves Terminals B and C only; shuttle to Terminal A	• Transfer to the bus stop at Astoria Blvd Subway station would involve two vertical moves via existing stairs or existing elevator from platform to grade, and a short walk, in open air, to the covered bus stop • Circulation space at the mezzanine level of Astoria Blvd Station is constrained • Serves Terminals B and C only; shuttle to Terminal A
Ridership[105]	Total annual projected ridership for option: 3.7 million Net increase in annual projected transit ridership: 2.1 million	Total annual projected ridership for option: 3.8 million Net increase in annual projected transit ridership: 2.2 million
Local Community Impacts	<u>Construction:</u> • Mix of heavy civil construction and light roadway work for approx. 4.25 years <u>Proximity to communities:</u> • Heavy civil construction over 500 ft across 8 lanes of the GCP from 9 city blocks of residential and commercial properties opposite the Airport Terminals • Bus Depot construction 200–300 ft from 4 city blocks of commercial properties near Ingraham's Mountain • Light roadway modification 35–50 ft from 26 city blocks of residential and commercial properties along Astoria Blvd North and South <u>Permanent impacts:</u> • No permanent private property acquisition • Structures over or adjacent to Planeview Park and Overlook Park[11] • Loss of approx. 110 on-street public parking spaces near Astoria Blvd bus stop and along Astoria Blvd North <u>Operations:</u> • Operated with a quiet, zero-emissions all-electric bus fleet • Bus depot on airport property, 200–300 ft from commercial areas	<u>Construction:</u> • Heavy civil construction of elevated and at-grade structures for approx. 4.25 years <u>Proximity to communities:</u> • 35–50 ft from 14 city blocks of residential and commercial properties along Astoria Blvd South • 35–50 ft from the north end of St Michael's Cemetery along Astoria Blvd South • 200–300 ft from 4 city blocks of commercial properties near Ingraham's Mountain • Over 500 ft across 8 lanes of the GCP from 9 city blocks of residential and commercial properties opposite the Airport Terminals <u>Permanent impacts:</u> • No permanent private property acquisition • Construction and permanent structures over or adjacent to Planeview Park and Overlook Park[11] • Permanent loss of approx. 40 on-street public parking spaces near Astoria Blvd bus stop and along Ditmars Blvd <u>Operations:</u> • Operated with a quiet, zero-emissions all-electric bus fleet • Bus depot on airport property, 200–300 ft from commercial areas

[7] Indicative Capital Costs should be considered to have a range of estimating uncertainty of –10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).
[8] Costs for heavy infrastructure options approaching LGA from the west/southwest are based on the open-trench construction concept past Runway 04-22 (over the existing 90-year-old utilities), to provide a baseline estimate of the cost of construction. Although this concept does not meet FAA Airport Design Standards, it provides a consistent approach for capital cost comparison purposes. Costs associated with tunnelling and/or relocating utilities would be substantially higher, potentially up to approx. $1–$3 billion.
[9] Standardized Indicative Baseline Off-Peak Travel Time from Midtown Manhattan.
[10] Experience from AirTrain JFK was that actual ridership turned out to be higher than would have been predicted by the AirTrain JFK forecast and underscores the inherent uncertainty of model predictions. The ridership model supporting this effort could also deviate from eventual ridership demand but was utilized to allow ridership comparisons between the options.
[11] Municipal parkland cannot be converted to a non-park use (known as alienation) without State legislative permission. Thus, the acquisition of New York City Parkland for construction of a mass transit option would require legislation authorizing such alienation. Obtaining such legislation is a multi-step process requiring actions by the New York City Council, the Mayor of New York City, the New York State Legislature, and the Governor.

TABLE ES-4: SUMMARY OF KEY CHARACTERISTICS – NEW LIGHT INFRASTRUCTURE BRT OPTIONS BRT-1C, BRT-2, AND BRT-3

Evaluation Factor	ASTORIA BLVD SHUTTLE WITH BUS LANES ON ASTORIA BLVD (BRT-1C)	BRT SHUTTLE TO/FROM ASTORIA-DITMARS BLVD STATION VIA 31ST ST/19TH AVE (BRT-2)	BRT SHUTTLE TO/FROM NORTHERN BLVD STATION VIA NORTHERN BLVD/94TH ST (BRT-3)
Constructability	• Construction of bus turnaround /layover adjacent to existing Astoria Blvd Station and Columbus Sq Park • Total option route length: approx. 3 miles	• Construction of ADA-compliant passenger access at Astoria-Ditmars Blvd Station • Construction of a bus-only road from 31st St to 19th Ave via ConEd property • Total option route length: approx. 3 miles	• Construction of new bus stops and turnarounds at Northern Blvd and 55th St • Total option route length: approx. 3.5 miles
Indicative Capital Cost (2022$)[12]	$220 million[13]	$340 million[13]	$200 million[13]
Indicative Timeline/Schedule	4–5 Years	4–5 Years	4–5 Years
Travel Time[14]	Via N/W-Lines: 41–46 mins (9–14 mins on bus) (Times Square to Terminal C; serves Terminal C, B, then A)	Via N/W-Lines: 41–44 mins (7–10 mins on bus) (Times Square to Terminal A) Via N/W-Lines: 49–52 mins (15–18 mins on bus) (Times Square to Terminal B then C)	Via M-Line: 49–52 mins (14–17 mins on bus) (Herald Square to Terminal C then B; shuttle to Terminal A)
Transfer Experience	• Transfer to the bus stop at Astoria Blvd Subway station would involve two vertical moves via existing stairs or existing elevator from platform to grade, and a short walk, in open air, to the covered bus stop • Circulation space at the mezzanine level of Astoria Blvd Station is constrained • Serves Terminals A, B and C	• End of line Subway stop: boarding/alighting easier for passengers (usually a train waiting) • Transfer to the bus stop would involve one vertical move to grade from platform level and a short, covered walk to the covered bus stop • Serves Terminals A, B, and C	• Transfer to the bus stop from the Subway station would involve a vertical move via existing stairs to grade • The walk to the covered bus stop would be approx. 500 ft and involve crossing of streets • Serves Terminals B and C only
Ridership[15]	Total annual projected ridership for option: 3.4 million Net increase in annual projected transit ridership: 1.9 million	Total annual projected ridership for option: 3.0 million Net increase in annual projected transit ridership: 1.6 million	Total annual projected ridership for option: 2.0 million Net increase in annual projected transit ridership: 1.1 million
Local Community Impacts	<u>Construction:</u> • Light roadway (e.g., restriping, curb replacements, bypass lanes) for approx. 2 years <u>Proximity to communities:</u> • 35–50 ft from 26 city blocks of residential and commercial properties along Astoria Blvd North and South • 200–300 ft from 4 city blocks of commercial properties near Ingraham's Mountain <u>Permanent impacts:</u> • No permanent private property acquisitions • No impacts to NYC parklands or plazas • Permanent loss of approx. 110 on-street public parking spaces near Astoria Blvd bus stop and along Astoria Blvd North <u>Operations:</u> • Operated with a quiet, zero-emissions all-electric bus fleet • Bus depot on airport property, 200–300 ft from commercial areas	<u>Construction:</u> • Light roadway (e.g., restriping, curb replacements, bypass lanes) for approx. 1.5 years <u>Proximity to communities:</u> • 35–50 ft from 15 city blocks of residential and commercial properties along 31st St and 19th Ave • 200–300 ft from 4 city blocks of commercial properties near Ingraham's Mountain <u>Permanent impacts:</u> • Permanent acquisition up to 6 properties (private commercial and industrial) – Access agreements may be possible rather than acquisition • No impacts to NYC parklands or plazas • Permanent loss of approx. 200 public on-street parking spaces along 31st St and 19th Ave (potentially only during peak-hours) • Increased bus traffic on 31st St and 19th Ave (albeit electric vehicles) <u>Operations:</u> • Operated with a quiet, zero-emissions all-electric bus fleet • Bus depot on airport property, 200–300 ft from commercial areas	<u>Construction:</u> • Light roadway (e.g., restriping, curb replacements, bypass lanes) for approx. 1.5 years <u>Proximity to communities:</u> • 35–50 ft from 40 city blocks of residential and commercial properties along Northern Blvd & 94th St • 200–300 ft from 4 city blocks of commercial properties near Ingraham's Mountain <u>Permanent impacts:</u> • Acquisition up to 3 properties (private commercial) • Operations 200–250 ft from 78th St Plaza • No impacts to NYC parklands or plazas • Loss of approx. 280 on-street public parking spaces along Northern Blvd and 94th St <u>Operations:</u> • Operated with a quiet, zero-emissions all-electric bus fleet • Bus depot on airport property, 200–300 ft from commercial areas

[12] Indicative Capital Costs should be considered to have a range of estimating uncertainty of –10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).
[13] Cost would exclude circulation improvements around Terminal C if the Q-70 Light Improvement Option proceeds, as then such improvements would be implemented regardless of whether this option was selected to proceed.
[14] Standardized Indicative Baseline Off-Peak Travel Time from Midtown Manhattan.
[15] Experience from AirTrain JFK was that actual ridership turned out to be higher than would have been predicted by the AirTrain JFK forecast and underscores the inherent uncertainty of model predictions. The ridership model supporting this effort could also deviate from eventual ridership demand but was utilized to allow ridership comparisons between the options.

Bus – Transit Improvements along Existing Routes

The evaluated bus improvement options would provide improved two-seat ride access to LGA from Manhattan by offering improvements to the current LaGuardia Link Q70 Select Bus Service (Q70-SBS) and/or M60 Select Bus Service (M60-SBS) MTA-operated bus services. The improvements would be intended to reduce current travel times, improve the reliability of bus service, increase service frequency, and increase passenger convenience compared to current operations.

The evaluation considered several potential options for improvements to existing bus services (see Figure ES-3), followed by a comparison table (Table ES-5) of the options against selected key evaluation factors. A full summary of each option against all evaluation factors can be found in the relevant section of the Report.

FIGURE ES-3: BUS IMPROVEMENTS AND BUS RAPID TRANSIT OPTION ROUTES

B-1: LaGuardia Link Q70-SBS Route Improvements

Option B-1 would offer improvements to the existing Q70-SBS bus route operated by the MTA. The Q70-SBS currently provides a two-seat ride link to LGA Terminals B and C, via the BQE and GCP transportation corridors, from the existing Jackson Hts-Roosevelt Av/74 St-Broadway stations (at Jackson Heights), and the existing LIRR Woodside and NYCT 61 St-Woodside stations (at Woodside). These provide transfer access to the E, F, M, R, and 7-Line Subway services at Jackson Heights and the LIRR Main Line (including the Port Washington Branch) and 7-Line Subway services at Woodside, as well as connections to other MTA bus services. Jackson Heights is also the locale for a proposed terminal station for the planned MTA-led Interborough Express (IBX) project.

Three levels of intervention were evaluated for the Q-70 SBS service:

- B-1A, with spot improvements to the Q70-SBS;
- B-1B, with new, heavy construction bus-only infrastructure to avoid peak-hour congestion on the GCP; and
- B-1C, a middle, more cost-efficient option (than B-1B) to improve bus services but with less community impact.

B-1A: Q70-SBS Route with Spot Improvements

Sub-Option B-1A would offer improvements to the existing Q-70 SBS service to improve customer experience and bus travel times. These would include improved wayfinding and signage at existing stops and the introduction of a new “queue jump” at the BQE off-ramp to Broadway and traffic signals revised to prioritize the buses. The service would continue to be operated by the MTA using the current bus fleet and timetable, which MTA can adjust to suit increased demand levels.

This sub-option would require light roadway work (line painting, re-curbing, etc.) for the bus queue jump and stop improvements.

B-1B: Q70-SBS Route with Heavier Infrastructure Improvements

Sub-Option B-1B would offer bus travel time improvements over the existing Q70-SBS service through the introduction of new bus-only heavy infrastructure. In addition to the queue jump and transit signal improvements of B-1A, Sub-Option B-1B would convert the northbound BQE shoulder to a bus-only lane and construct a new dedicated busway structure from the BQE to new elevated bus stops on-Airport, allowing buses to completely bypass traffic on the GCP.

This sub-option would require a mix of light roadway work (line painting, re-curbing, etc.) and heavy infrastructure, including an at-grade busway structure along the GCP rising to elevated structures on-Airport. This sub-option would have to overcome the construction challenges of complying with FAA Airport Design Standards while negotiating the 90-year-old utilities under the GCP at the end of Runway 04-22 (a challenge as yet unresolved as discussed in Section 3.2.1.1.1 of the Report) and would require federal, state and local approvals to convert the BQE shoulder to a bus-only lane (which has been done on other projects involving expedited bus services). For the purpose of cost comparison, the Indicative Capital Cost for this option was developed on the basis of a baseline solution of a new at-grade roadway south of Runway 04-22 despite this approach not being compliant with FAA Airport Design Standards.

B-1C: Q70-SBS Route with Lighter Infrastructure Improvements

Sub-Option B-1C would offer bus travel time improvements over the existing Q70-SBS service through the introduction of new bus-only light infrastructure. In addition to the queue jump and transit signal improvements of B-1A, Sub-Option B-1C would convert the northbound BQE shoulder to a bus-only lane and construct a new bus-only loop-road and at-grade bus stop at Terminal C, bypassing traffic at the current Terminal C stop. The service would continue to be operated by the MTA using the current bus fleet and timetable, which MTA can adjust to suit future demand levels.

This sub-option would require light roadway work (line painting, re-curbing, etc.) and new roadway construction on-Airport around Terminal C. It would avoid the constructability challenge posed by heavy construction at the end of Runway 04-22. This sub-option would require federal, state and local approvals to convert the BQE shoulder to a bus-only lane (which has been done on other projects involving expedited bus services).

B-2: M60-SBS Route with Spot Improvements

Option B-2 would offer improvements to the existing M60-SBS bus route operated by MTA, which originates from Manhattan (providing access to Metro North services to locations in New York and Connecticut), and links LGA with the existing Astoria Blvd Subway station in Queens, providing two-seat ride access to the N and W Subway services. The current M60-SBS uses the GCP/Astoria Blvd transportation corridor to access all three LGA terminals. As the M60-SBS has already benefited from transit signal improvements, the proposed improvements would be limited to improved wayfinding and signage at existing stops. The service would continue to be operated by the MTA using the current bus fleet and timetable, which MTA can adjust to suit future demand levels.

This option would require light roadway work (line painting, re-curbing, etc.) for the stop improvements.

TABLE ES-5: SUMMARY OF KEY CHARACTERISTICS – EXISTING BUS SERVICE IMPROVEMENT OPTIONS B-1A, B-1B, B-1C, AND B-2

Evaluation Factor	Q70-SBS ROUTE WITH SPOT IMPROVEMENTS (B-1A)	Q70-SBS ROUTE WITH HEAVIER INFRASTRUCTURE IMPROVEMENTS (B-1B)	Q70-SBS ROUTE WITH LIGHTER INFRASTRUCTURE IMPROVEMENTS (B-1C)	M60-SBS ROUTE WITH SPOT IMPROVEMENTS (B-2)
Constructability	• Total option route length: approx. 4 miles	• **Major unresolved constructability challenge**: Complying with FAA Airport Design Standards while also avoiding disruption to 90-year-old, large-diameter sewer structures at the end of Runway 04-22 (see details in Section 3.2.1.1.1 of the Report) • Repurpose a 1-mile section of the eastbound BQE connector right shoulder to bus-only lane subject to federal, state, and local approvals • Reconstruction of 82nd St Bridge • Total option route length: approx. 4 miles	• Repurpose a 1-mile section of the eastbound BQE connector right shoulder to bus-only lane subject to federal, state, and local approvals • Total option route length: approx. 4 miles	• Total option route length: approx. 4.2 miles (considering only the Queens to LGA portion)
Indicative Capital Cost (2022$)[16]	$20 million	$1,200 million[17] (Does not include any additional costs required for an as yet unresolved solution to get past Runway 04-22 in compliance with FAA Airport Design Standards; potentially up to approx. $1–$3 billion)	$100 million[18]	$5 million
Indicative Timeline/Schedule	1-2 Years	9–10 Years	2–3 Years	1–2 Years
Travel Time[19]	LIRR via Woodside: 42–51 mins (18–27 mins on bus, up to 5% quicker than current Q70-SBS[20]) (Penn Station to Terminal C then B; shuttle to Terminal A) Subway E-Line via Jackson Heights: 45–53 mins (14–22 mins on bus, up to 7% quicker than current Q70-SBS[20]) (Penn Station to Terminal C then B; shuttle to Terminal A)	LIRR via Woodside: 35–38 mins (11–14 mins on bus, up to 42% quicker than current Q70-SBS[20]) (Penn Station to Terminal B then C; shuttle to Terminal A) Subway E-Line via Jackson Heights: 39–40 mins (8–9 mins on bus, up to 47% quicker than current Q70-SBS[20]) (Penn Station to Terminal B then C; shuttle to Terminal A)	LIRR via Woodside: 39–44 mins (15–20 mins on bus, up to 21% quicker than current Q70-SBS[20]) (Penn Station to Terminal C then B; shuttle to Terminal A) Subway E-Line via Jackson Heights: 42–47 mins (11–16 mins on bus, up to 27% quicker than current Q70-SBS[20]) (Penn Station to Terminal C then B; shuttle to Terminal A)	Via N/W-Lines: 48–57 mins (16–25 mins on bus, up to 6% quicker than current M60-SBS[20]) (Times Square to Terminal C; serves Terminals C, B, then A)
Transfer Experience	• Transfer from Woodside LIRR station to the bus stop would involve two vertical moves via existing stairs and elevators • Transfer from Jackson Heights E, F, M, and R-Lines to the bus stop would involve vertical moves to the subway mezzanine via existing stairs and elevators (3 elevator rides to reach grade) • Transfer from Jackson Heights 7-Line to bus stop would involve vertical moves via existing stairs/elevators from platform to grade • All involve a short walk, in open air, to the covered bus stop • Jackson Heights is a complicated station with 5 Subway lines; improved wayfinding would be provided as part of the option	• Transfer from Woodside LIRR station to the bus stop would involve two vertical moves via existing stairs and elevators • Transfer from Jackson Heights E, F, M, and R-Lines to the bus stop would involve vertical moves to the subway mezzanine via existing stairs and elevators (3 elevator rides to reach grade) • Transfer from Jackson Heights 7-Line to bus stop would involve vertical moves via existing stairs/elevators from platform to grade • All involve a short walk, in open air, to the covered bus stop • Jackson Heights is a complicated station with 5 Subway lines; improved wayfinding would be provided as part of the option	• Transfer from Woodside LIRR station to the bus stop would involve two vertical moves via existing stairs and elevators • Transfer from Jackson Heights E, F, M, and R-Lines to the bus stop would involve vertical moves to the subway mezzanine via existing stairs and elevators (3 elevator rides to reach grade) • Transfer from Jackson Heights 7-Line to bus stop would involve vertical moves via existing stairs/elevators from platform to grade • All involve a short walk, in open air, to the covered bus stop • Jackson Heights is a complicated station with 5 Subway lines; improved wayfinding would be provided as part of the option	• Transfer to the bus stop at Astoria Blvd Subway station would involve two vertical moves via existing stairs or existing elevator from platform to grade, and a short walk, in open air, to the covered bus stop • Circulation space at the mezzanine level of Astoria Blvd Station is constrained
Ridership[21]	Based on 2019 Q70-SBS Ridership, total projected ridership: 2.6 M Net increase in annual projected Q70-SBS ridership: 0.7 million	Based on 2019 Q70-SBS Ridership, total projected ridership: 3.8 M Net increase in annual projected Q70-SBS ridership: 1.9 million	Based on 2019 Q70-SBS Ridership, total projected ridership: 3.5 M Net increase in annual projected Q70-SBS ridership: 1.6 million	Net increase in annual projected M60-SBS ridership: 0.4 million
Local Community Impacts	Construction: • Light roadway work (e.g., restriping, curb replacements, bypass lanes) for approx. 0.5 year Proximity to communities: • No change from existing Q70-SBS service Permanent impacts: • No permanent private property acquisitions • No impacts to NYC parklands or plazas • Minimal, if any permanent loss of on-street public parking spaces	Construction: • Mix of heavy civil construction/light roadway work for approx. 4.25 years Proximity to communities: • Over 500 ft across 8 lanes of the GCP from 9 city blocks of residential and commercial properties opposite the Airport Terminals Permanent impacts: • No permanent private property acquisition • Structures over or adjacent to Planeview Park and Overlook Park[22] • Loss of approx. 30 public on-street parking spaces on 56th St, Broadway, and Boody St	Construction: • Light roadway (e.g., restriping, curb replacements, bypass lanes) for approx. 1 year Proximity to communities: • No change from existing Q70-SBS service Permanent impacts: • No permanent private property acquisitions • No impacts to NYC parklands or plazas • Permanent loss of approx. 20 on-street public parking spaces along Broadway and Boody St	Construction: • Light roadway (e.g., restriping, curb replacements, bypass lanes) for approx. 0.5 year Proximity to communities: • No change from existing M60-SBS service Permanent impacts: • No permanent private property acquisitions • No impacts to NYC parklands or plazas • Minimal, if any permanent loss of on-street public parking spaces

[16] Indicative Capital Costs should be considered to have a range of estimating uncertainty of –10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).

[17] Costs for heavy infrastructure options approaching LGA from the west/southwest are based on the open-trench construction concept past Runway 04-22 (over the existing 90-year-old utilities), to provide a baseline estimate of the cost of construction. Although this concept does not meet FAA Airport Design Standards, it provides a consistent approach for capital cost comparison purposes. Costs associated with tunnelling and/or relocating utilities would be substantially higher, potentially up to approx. $1–$3 billion.

[18] Cost includes potential early enabling work, including road circulation improvements around Terminal C by relocating bus drop-off and pick-up closer to the Terminal C garage.

[19] Standardized Indicative Baseline Off-Peak Travel Time from Midtown Manhattan.

[20] Based on MTA data for actual bus run times.

[21] Experience from AirTrain JFK was that actual ridership turned out to be higher than would have been predicted by the AirTrain JFK forecast and underscores the inherent uncertainty of model predictions. The ridership model supporting this effort could also deviate from eventual ridership demand but was utilized to allow ridership comparisons between the options.

[22] Municipal parkland cannot be converted to a non-park use (known as alienation) without State legislative permission. Thus, the acquisition of New York City Parkland for construction of a mass transit option would require legislation authorizing such alienation. Obtaining such legislation is a multi-step process requiring actions by the New York City Council, the Mayor of New York City, the New York State Legislature, and the Governor.

Fixed Guideway with Light Rail

The evaluated light rail options would provide a two-seat ride to the Airport from Manhattan with a dedicated, LGA-branded transit link to LGA from existing transit hubs within Queens. Predominantly using elevated fixed guideways, light rail options could offer a relatively simpler, but still substantial, infrastructure construction solution than the equivalent MTA Subway structure. Light rail services would be operated as dedicated Airport connections, offering the opportunity to extend the Airport customer experience to the light rail transfer points, but all would require Airport passengers to transfer from the Subway or LIRR to a separate light rail segment to access the Airport. Light rail options approaching LGA from the west and southwest face the as yet unresolved challenge of complying with FAA Airport Design Standards while also avoiding disruption to 90-year-old, large-diameter sewer structures at the end of Runway 04-22 (see details in Section 3.2.1.1.1 of the Report).

The light rail options evaluated (see Figure ES-4) are described below, followed by comparison tables (Table ES-6 for light rail options from the west and Table ES-7 for light rail options from the east) of the options against selected key evaluation factors. A full summary of each option against all evaluation factors can be found in the relevant section of the Report.

FIGURE ES-4: LIGHT RAIL OPTION ROUTES

LR-1: Light Rail to/from Woodside

Option LR-1 would provide a two-seat ride to LGA via a 4-minute light rail ride to/from the existing LIRR Woodside and 61 St-Woodside Subway stations, providing transfer access to both LIRR Main Line (including the Port Washington Branch) and 7-Line Subway services. A new dedicated light rail station would be located adjacent to both existing stations, providing ADA-compliant passenger access between them. The guideway would run above city streets to the BQE and GCP transportation corridors, on to LGA, avoiding city traffic.

This option would require the construction of heavy infrastructure, including elevated concrete guideway structures along predominantly city streets (for approximately 1.5 miles), open-trench concrete structures within the GCP transportation corridor (for approximately 1 mile), and elevated structures on-Airport (for approximately 0.5 mile). This option would have to overcome the construction challenges of constructing within the Amtrak and LIRR rail embankments between Woodside Station and 31st Ave, complying with FAA Airport Design Standards while negotiating the 90-year-old utilities under the GCP at the end of Runway 04-22 (a challenge as yet unresolved as discussed in Section 3.2.1.1.1 of the Report), and constructing a cut-and-cover tunnel at the BQE/GCP intersection. For the purpose of cost comparison, the Indicative Capital Cost for this option was developed on the basis of a baseline solution of an open trench south of Runway 04-22 despite this approach not being compliant with FAA Airport Design Standards.

LR-2: Light Rail to/from Mets-Willets Point

Option LR-2 would provide a two-seat ride to LGA via a 4-minute light rail ride to/from the existing LIRR (Port Washington Branch) station, and the existing 7-Line Subway station located in Willets Point. A new dedicated light rail station would be located adjacent to both existing stations, providing ADA-compliant passenger access between them.

The guideway would run along the existing GCP transportation corridor to LGA from the east, avoiding the construction complexities and community impacts associated with options approaching the Airport terminals from the west.

This option would require the construction of heavy infrastructure, including elevated concrete guideway structures completely within the GCP transportation corridor and within the CitiField parking lots. This option would have to overcome the construction challenges of crossing over the 7-Line at Roosevelt Ave and constructing along the southern edge of Malcom X Promenade and within the GCP ROW. This option is the shortest evaluated at 2 miles in length.

This option was the subject of the 2021 Final Environmental Impact Statement (FEIS) for the LGA Access Improvement Project (LAIP) (Mets-Willets AirTrain, currently on pause).

LR-3: Light Rail to/from Jamaica

Option LR-3 would provide a two-seat ride to LGA via a 9-minute light rail ride to/from the existing Jamaica Transit Hub, providing direct access to the LIRR (Main Line, Atlantic Branch, and Montauk Branch), and connections to the E, J, and Z Subway services. By connecting with AirTrain JFK at Jamaica, this option would also provide the potential of an integrated AirTrain service to both airports via direct cross-platform transfer between the services and the shared use of the existing Airport-branded station. The guideway would run along the existing Van Wyck Expressway (VWE) and GCP transportation corridors, to LGA from the east, avoiding the construction and operational complexities of interacting with the end of Runway 04-22, west of the Airport terminals.

This option would require the construction of heavy infrastructure, including elevated concrete guideway structures predominantly within the VWE and GCP transportation corridors. This option would have to overcome the construction challenges of constructing in the VWE and GCP ROW for approximately 6 miles, including crossing over the triple-stacked Roosevelt Ave/7-Line bridges over the GCP, crossing the recently reconstructed Kew Gardens Interchange, and crossing over the LIRR rail tracks into Jamaica Station. This option is by far the longest subway or light rail option evaluated at 7 miles, 3 miles longer than the next longest.

LR-4: Light Rail to/from Astoria

Option LR-4 would provide a two-seat ride to LGA via a 4-minute light rail ride to/from the existing Astoria Blvd Subway station, providing transfer access to N and W Subway services. A new dedicated light rail station would be located adjacent to the station above Columbus Sq, providing ADA-compliant passenger access between the two. The guideway would run above the GCP transportation corridor, minimizing the direct impact of the light rail on local communities.

This option would require the construction of heavy infrastructure, including elevated and open-trench concrete guideway structures predominantly along the GCP transportation corridor. This option would have to overcome the construction challenges of crossing the Hell Gate rail trestle (90–100 ft above the ground), complying with FAA Airport Design Standards while negotiating the 90-year-old utilities under the GCP at the end of Runway 04-22 (a challenge as yet unresolved as discussed in Section 3.2.1.1.1 of the Report), and traversing the constrained area north of St Michael’s Cemetery. For the purpose of cost comparison, the Indicative Capital Cost for this option was developed on the basis of a baseline solution of an open trench south of Runway 04-22 despite this approach not being compliant with FAA Airport Design Standards.

LR-5: Light Rail to/from Jackson Heights

Option LR-5 would provide a two-seat ride to LGA via a 5-minute light rail ride to/from the existing Jackson Hts-Roosevelt Av/74 St-Broadway stations, providing multiple transfer access to the E, F, M, R, and 7-Line services and the busy community hub around the station. A new dedicated light rail station would be located above Broadway adjacent to the 7-Line station, providing ADA-compliant passenger access. LR-5 could also link to the proposed IBX project’s Jackson Heights terminus. The guideway would run above city streets to the BQE and GCP transportation corridors, on to LGA, avoiding city traffic.

This option would require the construction of heavy infrastructure, including elevated concrete guideway structures along predominantly city streets (for approximately 1.3 miles), open-trench concrete structures within the GCP transportation corridor (for approximately 1 mile), and elevated structures on-Airport (for approximately 0.5 mile). This option would have to overcome the construction challenges of complying with FAA Airport Design Standards while negotiating the 90-year-old utilities under the GCP at the end of Runway 04-22 (a challenge as yet unresolved as discussed in Section 3.2.1.1.1 of the Report), constructing a cut-and-cover tunnel at the BQE/GCP intersection, and constructing the transfer station and guideway above city streets. For the purpose of cost comparison, the Indicative Capital Cost for this option was developed on the basis of a baseline solution of an open trench south of Runway 04-22 despite this approach not being compliant with FAA Airport Design Standards.

TABLE ES-6: SUMMARY OF KEY CHARACTERISTICS – LIGHT RAIL OPTIONS FROM THE WEST LR-1, LR-4, AND LR-5

Evaluation Factor	LIGHT RAIL TO/FROM WOODSIDE (LR-1)	LIGHT RAIL TO/FROM ASTORIA (LR-4)	LIGHT RAIL TO/FROM JACKSON HEIGHTS (LR-5)
Constructability	• **Major unresolved constructability challenge**: Complying with FAA Airport Design Standards while also avoiding disruption to 90-year-old, large-diameter sewer structures at the end of Runway 04-22 (see details in Section 3.2.1.1.1 of the Report) • Construction of elevated light rail station in dense neighborhood adjacent to existing LIRR and subway stations • Reconstruction of 82nd St Bridge • Total option route length: approx. 3.4 miles	• **Major unresolved constructability challenge**: Complying with FAA Airport Design Standards while also avoiding disruption to 90-year-old, large-diameter sewer structures at the end of Runway 04-22 (see details in Section 3.2.1.1.1 of the Report) • Tall (90+ ft) long-span (150–200 ft) structures spanning the Hell Gate rail trestle • Reconstruction of 82nd St Bridge • Total option route length: approx. 3 miles	• **Major unresolved constructability challenge**: Complying with FAA Airport Design Standards while also avoiding disruption to 90-year-old, large-diameter sewer structures at the end of Runway 04-22 (see details in Section 3.2.1.1.1 of the Report) • Construction of elevated light rail station in dense neighborhood and urban hub adjacent to existing subway station • Reconstruction of 82nd St Bridge • Total option route length: approx. 3.2 miles
Indicative Capital Cost (2022$)[23]	\$4.2 billion[24] (Does not include any additional costs required for an as yet unresolved solution to get past Runway 04-22 in compliance with FAA Airport Design Standards; potentially up to approx. \$1–\$3 billion)	\$3.7 billion[24] (Does not include any additional costs required for an as yet unresolved solution to get past Runway 04-22 in compliance with FAA Airport Design Standards; potentially up to approx. \$1–\$3 billion)	\$4.0 billion[24] (Does not include any additional costs required for an as yet unresolved solution to get past Runway 04-22 in compliance with FAA Airport Design Standards; potentially up to approx. \$1–\$3 billion)
Indicative Timeline/Schedule	11–12 Years	11–12 Years	11–12 Years
Travel Time[25]	Via LIRR: 27 mins (4 mins on light rail) (Penn Station to Terminal B, then C; shuttle to Terminal A) Via 7-Line: 35 mins (4 mins on light rail) (Times Square to Terminal B, then C; shuttle to Terminal A)	Via N/W-Lines: 36 mins (4 mins on light rail) (Times Square to Terminal B, then C; shuttle to Terminal A)	Via E-Line: 37 mins (5 mins on light rail) (Penn Station to Terminal B, then C; shuttle to Terminal A)
Transfer Experience	• Transfer from LIRR to light rail station would involve vertical move via stairs, escalator, or elevator up to the mezzanine level and a short walk to the light rail station • Transfer from 7-Line to light rail station would involve vertical move down via stairs, elevator, or escalator to the mezzanine and a slightly longer walk to the light rail station than the LIRR transfer	• Transfer from N/W-Line to light rail station would involve a vertical move down via stairs, elevator, or escalator to station mezzanine and then a second vertical move up to the light rail platform level via stairs, elevator, or escalator	• Transfer from 7-Line to light rail station would involve vertical move down to mezzanine via stair or escalator and then a second vertical move back up to the light rail platform level via elevator or escalator • Transfer from E, F, M, and R-Lines to light rail station would involve a vertical move up to the subway mezzanine level, followed by a short walk to a second vertical move up via escalator or elevator to the light rail platform level
Ridership[26]	Total annual projected ridership for option: 7.4 million Net increase in annual projected transit ridership: 5.7 million	Total annual projected ridership for option: 4.9 million Net increase in annual projected transit ridership: 3.1 million	Total annual projected ridership for option: 7.3 million Net increase in annual projected transit ridership: 5.5 million
Local Community Impacts	<u>Construction:</u> • Heavy civil construction of elevated and at-/below-grade structures for approx. 5 years <u>Proximity to communities:</u> • 30–50 ft from 23 city blocks of residential and commercial properties from 61st St to 58th St, along 38th Ave and 55th St, along 31st Ave, the BQE, and Boody St • Above and within St Michael's Playground • Over 500 ft across 8 lanes of the GCP from 9 city blocks of residential and commercial properties opposite the Airport Terminals <u>Permanent impacts:</u> • Acquisition of up to 73 properties (private residential, private commercial, industrial, and religious) • Structures over or adjacent to Planeview Park and Overlook Park[27] • Loss of approx. 150 on-street public parking spaces along 38th Ave, 55th St, 31st Ave, 68th St, and Boody St	<u>Construction:</u> • Heavy civil construction of elevated and at-/below-grade structures for approx. 5 years <u>Proximity to communities:</u> • 35–80 ft from one city block of residential and commercial properties on 31st St • 40–75 ft from 12 city blocks of residential and commercial properties along the GCP • 35–50 ft from the north end of St Michael's Cemetery along Astoria Blvd South • Over 500 ft across 8 lanes of the GCP from 9 city blocks of residential and commercial properties opposite the Airport Terminals <u>Permanent impacts:</u> • Acquisition of up to 4 properties (private commercial) • Structures over or adjacent to Columbus Sq Park, Planeview Park, Overlook Park, and to the north of St. Michael's Cemetery[27] • Minimal, if any permanent loss of on-street public parking spaces	<u>Construction:</u> • Heavy civil construction of elevated and at-/below-grade structures for approx. 5 years <u>Proximity to communities:</u> • 35–50 ft from 15 city blocks of residential and commercial properties along Broadway, 69th St, 68th St, the BQE, and Boody St • Over 500 ft across 8 lanes of the GCP from 9 city blocks of residential and commercial properties opposite the Airport Terminals <u>Permanent impacts:</u> • Acquisition up to 54 properties (private residential, private commercial, and industrial) • Structures over or adjacent to Planeview Park, Overlook Park[27], and adjacent to Diversity Plaza • Loss of approx. 200 on-street public parking spaces along Broadway, 68th St, 69th St, and Boody St

[23] Indicative Capital Costs should be considered to have a range of estimating uncertainty of –10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).

[24] Costs for heavy infrastructure options approaching LGA from the west/southwest are based on the open-trench construction concept past Runway 04-22 (over the existing 90-year-old utilities), to provide a baseline estimate of the cost of construction. Although this concept does not meet FAA Airport Design Standards, it provides a consistent approach for capital cost comparison purposes. Costs associated with tunnelling and/or relocating utilities would be substantially higher, potentially up to approx. \$1–\$3 billion.

[25] Standardized Indicative Baseline Off-Peak Travel Time from Midtown Manhattan.

[26] Experience from AirTrain JFK was that actual ridership turned out to be higher than would have been predicted by the AirTrain JFK forecast and underscores the inherent uncertainty of model predictions. The ridership model supporting this effort could also deviate from eventual ridership demand but was utilized to allow ridership comparisons between the options.

[27] Municipal parkland cannot be converted to a non-park use (known as alienation) without State legislative permission. Thus, the acquisition of New York City Parkland for construction of a mass transit option would require legislation authorizing such alienation. Obtaining such legislation is a multi-step process requiring actions by the New York City Council, the Mayor of New York City, the New York State Legislature, and the Governor.

TABLE ES-7: SUMMARY OF KEY CHARACTERISTICS – LIGHT RAIL OPTIONS FROM THE EAST LR-2 AND LR-3

Evaluation Factor	LIGHT RAIL TO/FROM METS-WILLETS POINT (LR-2)	LIGHT RAIL TO/FROM JAMAICA (LR-3)
Constructability	• Construction of elevated light rail station over LIRR ROW and Passerelle Bridge • 70-ft-high structures over Roosevelt Ave/7-Line • Constrained construction access adjacent to GCP • Total option route length: approx. 2 miles	• Tall (80+ ft) long-span (250–300 ft) structures over LIRR railroad tracks into Jamaica • Tall (100 ft) structures over LIRR Port Washington Branch and Roosevelt Ave/7-Line • Long-span (250–350 ft) structures over Queens Blvd and Kew Gardens Interchanges with VWE • Constrained construction access along VWE and in GCP median • Total option route length: approx. 7 miles
Indicative Capital Cost (2022$)[28]	$2.4 billion	$6.2 billion
Indicative Timeline/Schedule	6–7 Years	11–12 Years
Travel Time[29]	Via LIRR: 31 mins (4 mins on light rail) (Penn Station to Terminal C, then B; shuttle to Terminal A) Via 7-Line: 50 mins (4 mins on light rail) (Times Square to Terminal C, then B; shuttle to Terminal A)	Via LIRR: 45 mins (9 mins on light rail) (Penn Station to Terminal C, then B; shuttle to Terminal A) Via E-Line: 64 mins (9 mins on light rail) (Penn Station to Terminal C, then B; shuttle to Terminal A)
Transfer Experience	• Transfer from LIRR Mets-Willets Point Station to light rail train would involve a vertical move via large elevators and escalators direct from LIRR platform to light rail station • 8-min walk from 7-Line Mets-Willets Point Station to light rail in enclosed walkway	• Subway or LIRR train to transfer at Jamaica same as existing (possible improvement to subway vertical circulation) • LIRR would involve a single level change via escalator or stairs and a short walk to the light rail fare gates • Subway transfer would involve level change to mezzanine via large high-capacity elevators or escalators and from mezzanine to platform via stairs and/or small elevators, and a greater walking distance to the light rail fare gates than the LIRR
Ridership[30]	Total annual projected ridership for option: 4.7 million Net increase in annual projected transit ridership: 3.4 million	Total annual projected ridership for option: 5.9 million Net increase in annual projected transit ridership: 4.3 million
Local Community Impacts	<u>Construction:</u> • Heavy civil construction of elevated structures for approx. 4 years <u>Proximity to communities:</u> • Over 500 ft across 8 lanes of the GCP from 9 city blocks of residential and commercial properties along the GCP and opposite the Airport Terminals <u>Permanent impacts:</u> • No permanent private property acquisition • Structures within a portion of Flushing Meadows Corona Park currently used for Mets parking, and along the southern border of Malcolm X Promenade • Minimal, if any permanent loss of public parking spaces	<u>Construction:</u> • Heavy civil construction of elevated structures for approx. 5 years <u>Proximity to communities:</u> • 35–60 ft from 12 city blocks of residential and commercial properties along the VWE, including within the Hoover Manton Playground • 150–200 ft from 32 city blocks of residential and commercial properties along GCP • Over 500 ft across 8 lanes of the GCP from 9 city blocks of residential and commercial properties along the GCP and opposite the Airport Terminals <u>Permanent impacts:</u> • No permanent private property acquisition • Construction and permanent structures over or adjacent to Hoover Manton Playground[31], and along the southern border of Malcolm X Promenade • Minimal, if any permanent loss of on-street public parking spaces

[28] Indicative Capital Costs should be considered to have a range of estimating uncertainty of –10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).
[29] Standardized Indicative Baseline Off-Peak Travel Time from Midtown Manhattan.
[30] Experience from AirTrain JFK was that actual ridership turned out to be higher than would have been predicted by the AirTrain JFK forecast and underscores the inherent uncertainty of model predictions. The ridership model supporting this effort could also deviate from eventual ridership demand but was utilized to allow ridership comparisons between the options.
[31] Municipal parkland cannot be converted to a non-park use (known as alienation) without State legislative permission. Thus, the acquisition of New York City Parkland for construction of a mass transit option would require legislation authorizing such alienation. Obtaining such legislation is a multi-step process requiring actions by the New York City Council, the Mayor of New York City, the New York State Legislature, and the Governor.

Ferry Services + Shuttle Bus

Since LGA is located on the northern Queens waterfront, it can be reached via direct ferry service from Manhattan. A ferry from Manhattan would provide access from three piers, Pier 11 (Wall Street), Pier 34 (Midtown), and Pier 90 (Upper East Side). To reach one of the piers, riders would need to either walk or take a bus, taxi, or private vehicle to access the ferry. Once on the ferry, passengers would avoid possible traffic congestion and traffic delays, but this option could be less appealing during inclement weather. Upon arriving at the Airport, ferry passengers would then transfer to an on-Airport shuttle bus to reach their destination terminal. Hence, the ferry options would effectively require three transfers between travel modes (access to Terminal A from the Bowery Bay landing would require two mode transfers). The journey time to complete travel has been estimated at 81–83 minutes (including approximately 19 minutes to reach the ferry terminals at the East River from Midtown Manhattan and 29–37 minutes on the ferry from West 34th St), the longest of all the options considered. As a result, the ridership for the ferry options has been projected to be low, generating an increase of travelers using public transit of about 0.4 million additional (0.7 million total) passengers per year (the lowest of all the options evaluated).

Although the ferries are an attractive option because they would generate few impacts on neighborhoods, the low ridership is a serious limitation on their suitability as a mass transit solution for LGA. In comparison, upgrading the existing Q70-SBS bus (B-1C) route is projected to provide about 1.6 million additional (2.7 million total) transit riders only at the higher range of the cost ($100 million for the improved Q70-SBS versus $130–240 million for the ferry options). In addition, the ferry options face potential impacts from storms and inclement weather that could potentially disrupt ferry operations and affect the reliability of the service.

The NYC EDC has recently sent out a Request for Proposals (RFP) to broaden City ferry services, including the option of providing branded service to LGA, if the operator chooses to do so.

The evaluation considered options operating to/from on-Airport ferry landing locations at either Bowery Bay or Flushing Bay (see Figure ES-5) described below. This is followed by a comparison table (Table ES-8) of the options against selected key evaluation factors. A full summary of each option against all evaluation factors can be found in the relevant section of the Report.

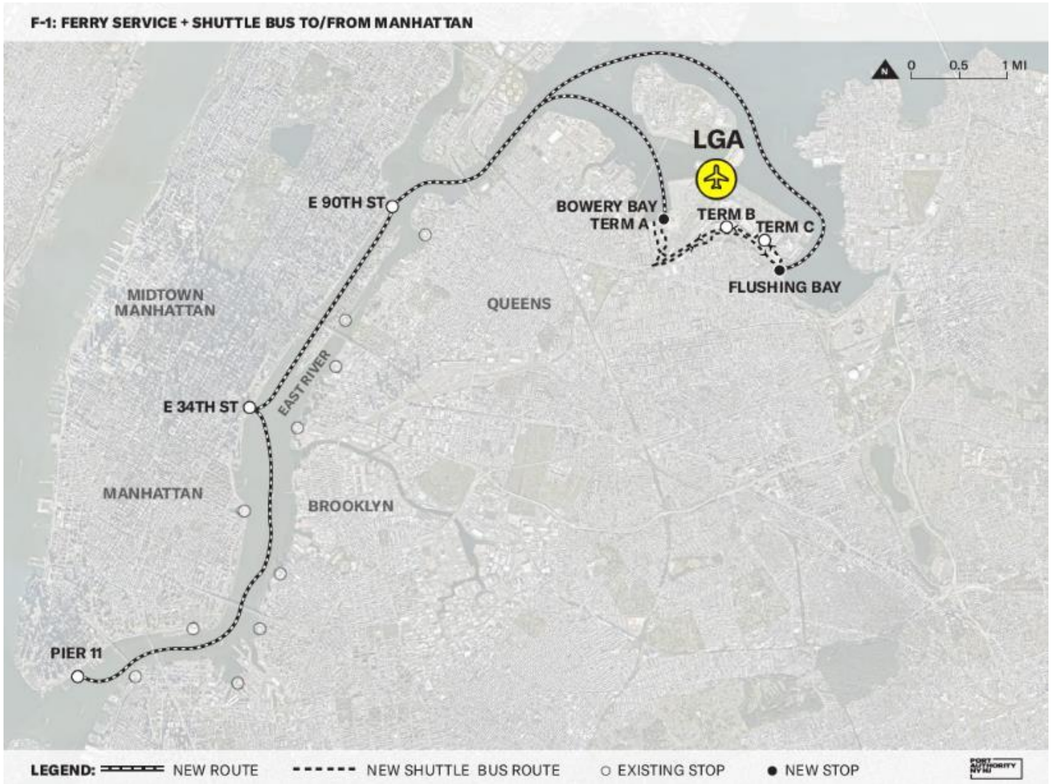


FIGURE ES-5: FERRY SERVICE/SHUTTLE BUS TO/FROM MANHATTAN

F-1: Ferry Service + Shuttle Bus to/from Manhattan

As mentioned above, the ferry options would provide direct access to LGA from waterfront areas of Manhattan by taking advantage of the existing New York waterway network. The ferry would traverse the East River before dropping passengers off at either Bowery Bay (Sub-Option F-1A) or Flushing Bay (Sub-Option F-1B). For the Bowery Bay option, passengers bound for Terminal A would walk from the ferry landing to the terminal. The approximately 90% of Airport passengers utilizing Terminals B and C would need to board a shuttle bus to access those terminals. The Flushing Bay landing would require an on-Airport shuttle to access all three terminals.

F-1A: Express Ferry Service + Shuttle Bus to Bowery Bay

This sub-option would require the construction of a new bus loading area and ferry landing on-Airport and piling and marine dredging in Bowery Bay.

F-1B: Express Ferry Service + Shuttle Bus to Flushing Bay

This sub-option would require the construction of a new bus loading area and ferry landing on-Airport, piling and marine dredging in Flushing Bay, and land reclamation and seawall reconstruction around the new Terminal C facility.

TABLE ES-8: SUMMARY OF KEY CHARACTERISTICS – FERRY OPTIONS F-1A AND F-1B

Evaluation Factor	FERRY SERVICE + SHUTTLE BUS TO BOWERY BAY (F-1A)	FERRY SERVICE + SHUTTLE BUS TO FLUSHING BAY (F-1B)
Constructability	• Construction of new bus loading area and ferry landing on-Airport • Provision and siting of new ferry storage/maintenance facility • Total option route length: approx. 7 miles (from Pier 34 in Midtown Manhattan)	• Dredging in Flushing Bay required • Land reclamation and existing seawall reconstruction around Terminal C required for access to Airport roadways • Provision and siting of new ferry storage/maintenance facility • Total option route length: approx. 10 miles (from Pier 34 in Midtown Manhattan)
Indicative Capital Cost (2022$)[32]	$130 million	$240 million
Indicative Timeline/Schedule	3–4 Years	4–5 Years
Travel Time[33]	Via M34 bus: 80 mins (19 mins on M34 bus to East River ferry stop, 29 mins on ferry) (Penn Station to Terminal A)	Via M34 bus: 82 mins (19 mins of M34 bus to East River ferry stop, 37 mins on ferry) (Penn Station to Terminal C)
Transfer Experience	• Transfer: 3 mode changes and 2 transfers from Midtown Manhattan • Need to walk or take bus from Midtown to get to the pier/ferry landing • Bus stops on Marginal Street are around 150 ft from the East 34th St pier and 300–400 feet from the embarkation gangways • Short walk to Terminal A and on-Airport bus pick-up • Passengers for Terminals B and C would need to board a shuttle bus to those terminals	• Transfer: 3 mode changes and 2 transfers from Midtown Manhattan • Need to walk or take bus from midtown to get to the pier/ferry landing • Bus stops on Marginal Street are around 150 ft from the East 34th St pier and 300–400 feet from the embarkation gangways • Longer walk to Airport bus pick-up (approx. 1,200 ft walk from ferry landing) • Passengers for all LGA terminals would need to board a shuttle bus to those terminals
Ridership[34]	Total annual projected ridership for option: 0.7 million Net increase in annual projected transit ridership: 0.4 million	Total annual projected ridership for option: 0.7 million Net increase in annual projected transit ridership: 0.4 million
Local Community Impacts	<u>Construction:</u> • Marine and on-Airport construction work for approx. 1 year <u>Proximity to communities:</u> • Communities over 300 ft from piling and marine dredging in Bowery Bay • Communities over 300 ft from ferry terminal structures near LGA Terminal A <u>Permanent impacts:</u> • No permanent private property acquisition • No impacts to NYC parklands or plazas • No permanent loss of on-street public parking spaces	<u>Construction:</u> • Marine and on-Airport construction work for approx. 2 years <u>Proximity to communities:</u> • Communities over 500 ft across 8 lanes of the GCP from piling, marine dredging, land reclamation work in Flushing Bay, and ferry terminal structures near Terminal C <u>Permanent impacts:</u> • No permanent private property acquisition • No impacts to NYC parklands or plazas • No permanent loss of on-street public parking spaces

[32] Indicative Capital Costs should be considered to have a range of estimating uncertainty of –10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).
[33] Standardized Indicative Baseline Off-Peak Travel Time from Midtown Manhattan.
[34] Experience from AirTrain JFK was that actual ridership turned out to be higher than would have been predicted by the AirTrain JFK forecast and underscores the inherent uncertainty of model predictions. The ridership model supporting this effort could also deviate from eventual ridership demand but was utilized to allow ridership comparisons between the options.

Emerging Technologies

The study team employed two independent consultants to analyze the current state of emerging technologies in both foreign and domestic markets. These technologies include:

- Heavy infrastructure solutions such as hyperloop, electric vehicles in narrow tunnels, and personal and group rapid transit systems;
- Light infrastructure solutions such as electric scooters and flying drones/taxis; and
- Variants of existing technologies such as connected autonomous vehicles, aerial trams, electric ferries, and gondolas.

The study team considered examples from the US and around the world to determine their applicability to LGA and their capability to deliver the high-volume transit solutions needed to significantly increase transit access to the Airport. After a thorough review the study team found that each of the emerging technologies suffer from one or more of the following flaws:

- By their design, they lack the operating capacity, speed, and/or performance needed to effectively deliver mass transit to the Airport.
- Working prototypes exist but the technology is still years away from being mature enough for implementation.
- Working prototypes that could serve as the basis for proper evaluation are still under development.

Despite these current drawbacks, the study team concluded that some of these technologies are likely to mature into more viable mass transit solutions in the future. Given the rapid development in the autonomous vehicle market, it is likely that mass transit autonomous vehicles will one day be able to successfully navigate in pedestrian-heavy, mixed-flow traffic environments, which would make them suitable for service to a busy airport terminal frontage. Likewise, other technologies explored may also be considered in the future as they become more mature.

1.0 INTRODUCTION AND BACKGROUND

La Guardia Airport (LGA, or the "Airport") is operated by the Port Authority and is located along the northern boundary of the Borough of Queens and approximately 8 miles east of Midtown Manhattan. In 2019, the year previous to the start of the Covid pandemic, it served about 31.1 million passengers according to the Port Authority's 2019 Annual Airport Traffic Report. Almost half of LGA's passengers have origins and destinations within Manhattan (48.6%), with over a quarter of LGA passengers with origins and destinations within Midtown Manhattan (26.3%). About 60% of LGA employees commute to the airport from Queens and Brooklyn.[35]

The need for improved mass transit connectivity to LGA is long-standing. Currently LGA is only accessible by roadway, with 87% of airport passengers traveling to LGA by auto via personal vehicle, for hire vehicle, rental car, or taxi; 6.2% by public bus; and 5.6% by private shuttle buses operated by hotels, rental cars, or off-airport third party entities.[36]

While airport passengers have origins and destinations throughout the New York area, the number of airport passengers travelling to/from Manhattan (and Midtown in general) has led to this study focusing on that market. Vehicular travel between Manhattan and LGA is substantially affected by highway traffic congestion and trips from Times Square to LGA between 2014 to 2019 showed the following significant increases:

- The annual average travel time increased from approximately 31 to 35 minutes.
- The annual average daily maximum travel time increased from approximately 47 to 57 minutes.
- The number of extreme travel days (with at least one trip taking 70 minutes or more) increased from 4 days per year in 2014 to 26 days per year in 2019.

In an effort to increase public transit to the Airport and reduce travel time, the Port Authority undertook a planning study in 2018 called the LGA Access Improvement Project (LAIP), including a detailed alternatives analysis. The LAIP culminated in a proposal to construct a light rail system that would connect LGA to the Long Island Railroad (LIRR) and 7 train at Mets-Willets Point, about 2 miles east of the Airport. In June 2018, New York State passed legislation authorizing the New York State Department of Transportation to acquire public property within a defined corridor for the LAIP and to transfer such property to the Port Authority to construct the light rail system.

The Port Authority's proposed project (a fixed guideway to Mets-Willets Point) was then presented to the Federal Aviation Administration (FAA), which acted as the lead agency for the environmental impact review process pursuant to the National Environmental Policy Act (NEPA) and commenced development of an Environmental Impact Statement (EIS), in May 2019. As articulated by the FAA, the purpose and need set for the EIS was to provide a "time-certain transportation option that connects Airport passengers and employees to and from LGA," as well as to ensure adequate parking for Airport employees. The EIS analysis considered multiple options and concluded that the Mets-Willets Point

[35] LGA Airport Access Improvement Project Purpose and Objectives and Analysis of Alternatives Report, October 2018, Port Authority of New York and New Jersey.
[36] The NYC Taxi and Limousine Commission. Taxi Trip Record Data, 2014–2019. Data was cleaned to remove any days during which construction-related on-airport traffic conditions led to delays on the off-airport roadway network.

fixed guideway best met the purpose and need and was the preferred option. The FAA published the Draft EIS in August 2020, followed by a Final EIS in March 2021. The FAA Record of Decision (ROD) approving the Mets-Willets fixed guideway was issued in July 2021.

In October 2021, following review by the Governor's office, the Port Authority was asked by Governor Kathy Hochul to undertake an updated "review of potential alternative mass transit options to LaGuardia Airport." The Port Authority committed to "work in close consultation with independent experts and stakeholders, and [to] complete its work as expeditiously as possible, consistent with the need for the review to be thorough and rigorous."

As requested by the Governor, this report (the "Report") contains the evaluation of potential options that include expanded subway service, fixed guideways with light rail, bus service, ferry service, and new or emerging technologies. The review has involved input from specialist technical and planning advisors to the Port Authority, as well as from the Metropolitan Transportation Authority (MTA) and other key partner agencies. In addition, the Port Authority has consulted with a panel of independent transportation experts with regional, national, and international expertise.

This Report, prepared by a team composed of Bechtel, WSP, Nelson\Nygaard Consulting Associates, Foursquare ITP, and Ramboll in consultation with the Port Authority's Aviation Department and the MTA, has developed a preliminary high-level concept for each option in order to provide sufficient information to assess the options against multiple evaluation factors, such as constructability (including complexity and risk), infrastructure impacts, costs, timelines, and community impacts. This Report does not analyze the potential environmental impacts at the level of detail provided in the FAA EIS.

In the next section of this Report, the process used in developing the evaluation of potential options is explained.

2.0 STUDY PROCESS

The process undertaken for this effort comprised multiple steps. It began with gathering input from various sources and engaging with partners, stakeholders, and the public. It then involved identifying the list of potential options and developing criteria by which these options would be analyzed and compared. The product of this current study is a detailed description of the individual options, and an assessment against the evaluation factors.

Five key steps in the process include:

- Coordination with partner agencies and operators.
- Review of previous studies.
- Engagement of an Expert Panel.
- Engagement with stakeholders and the public.
- Assembly of a team of independent study consultants.

2.1 Review of Previous Studies

The issue of improving transit access to LGA has been studied previously in several reports that assessed multiple options and alternatives. These studies have been reviewed to inform the current study and provide relevant data and information. The studies include:

- Airport Access Program Draft Environmental Impact Statement, Federal Aviation Administration (FAA), 1994.
- LaGuardia Airport Subway Access Study, Metropolitan Transportation Authority, 1998–2001.
- Citywide Ferry Study, New York City Economic Development Corporation, 2013.
- LaGuardia Airport Access Alternatives Analysis, New York City Department of Transportation in collaboration with New York City Transit and the Port Authority of New York and New Jersey, 2011–2014.
- LGA Airport Access Improvement Project Purpose and Objectives and Analysis of Alternatives Report, Port Authority of New York and New Jersey, 2018.
- NYC Ferry Expansion Feasibility Study, New York City Economic Development Corp., 2018–2019.
- LaGuardia Airport Access Improvement Project Final Environmental Impact Statement, FAA, 2021.

2.2 Coordination with Partner Agencies and Operators

As the primary operator of regional public transportation services in the New York metropolitan area, the MTA has been a key partner in the study and has been consulted in development of all options with a focus on subway and bus options, including inter-modal transfers. Meetings with the MTA have been held on a weekly basis throughout the duration of the study and the MTA has made specific contributions to the study, including technical review of alignments, suggested service plans, analysis of route impacts with respect to the other transportation infrastructure, and estimates and/or review of capital and operating costs for the subway and bus options. In addition to its technical review of alignments, the MTA has also made recommendations to inform the methodology for assessing options against the evaluation factors.

Other agencies and private operators have also been consulted during the course of the evaluation on topics listed below relating to the operation of services or proposed changes to existing infrastructure. These agencies and operators include:

- Amtrak – Potential feasibility of building infrastructure that would impact the Hell Gate rail trestle.
- Consolidated Edison (ConEd) – Potential impact to major ConEd utilities/property.
- Federal Aviation Administration (FAA)—Runway operational requirements for building adjacent to Runway 04.
- New York City Department of Environmental Protection (NYC DEP) – Potential impact to major NYC DEP utilities.
- New York City Department of Transportation (NYC DOT) – Potential impact to the local city roadway network and current City projects/programs.
- New York City Department of Parks and Recreation (NYC Parks) – The Port Authority briefed NYC Parks on the options under consideration in this study.
- New York City Economic Development Corporation (NYC EDC) – Feasibility of ferry service.
- New York State Department of Transportation (NYS DOT) – Potential impact to state highways.
- NY Waterways – Feasibility of ferry service.

2.3 Engagement with the Expert Panel

In November 2021, the Port Authority announced the appointment of three independent transportation experts with regional, domestic, and international experience to consult on and help guide the evaluation process:

- Mike Brown (Former Commissioner of Transport for London and former Managing Director of Heathrow Airport).
- Janette Sadik-Khan (Principal with Bloomberg Associates and former Commissioner of the NYC Department of Transportation).
- Phillip A. Washington (CEO of Denver International Airport and former CEO of Los Angeles Metro).

The Expert Panel has been consulted throughout the evaluation both through regular meetings, held on a monthly basis from December 2021 through February 2023, and ad-hoc meetings with individual panel members, as needed. The topics covered have included all modes (subways, light rail with fixed guideway, buses, ferries, and emerging technologies) as well as key issues of constructability, cost, schedule, local community impacts, public and stakeholder input, equity, standardized indicative baseline off-peak travel time, and ridership.

2.4 Engagement with Stakeholders and the Public

The Port Authority reached out to key stakeholders for input on the potential mass transit options to LGA, including suggestions of other options that should be considered. A questionnaire describing the options and the factors being considered in evaluating the options was sent to more than 70 key stakeholders, including elected officials, community organizations and other stakeholder groups. The Port Authority received 58 responses, 28 of which were from other individuals or organizations not on the initial list of stakeholders, to the questionnaire and the full list of stakeholders and the submissions received are included in Appendix Section 1.2.

Additionally, the Port Authority hosted two in-person public workshops on the options being evaluated. The study team presented project summaries to the attendees, and independent outside consultants were made available to answer questions. The workshops were attended by approximately 150 people and interpretation services in multiple languages were available. In addition to the aforementioned questionnaire, the Port Authority received in-person or written comment submissions during the stakeholder outreach period. Many of them addressed multiple options and included other options that should be considered. The full list of the comments received is included in Appendix Section 1.3.

To capture additional community and customer feedback, an independent outside consultant hosted 10 focus group sessions, 7 in person and 3 virtual, with members of the public. Of the 7 in-person sessions, 5 were held with community groups: 2 with Spanish-speaking participants, 1 with Chinese/Mandarin-speaking participants, and 2 general sessions. Summaries of these focus groups, which were prepared by the host of the sessions, are included in Appendix Section 1.4.

In general, comments received on the subway and bus options were largely supportive, whereas comments received on the fixed guideway with light rail options were split between support and opposed. For the ferry service, comments received were supportive if implemented as a supplementary transit option or if the ferry service included additional stops. Of the few comments received about emerging technologies, most were opposed, expressing concern that emerging technologies would not be feasible. Many comments also suggested advancing multiple options or combining one or more of the options presented (see Table 2.4-1):

TABLE 2.4-1: PUBLIC COMMENTS SUMMARY

Mode	Positive Comments	Negative Comments
Subways	78	29
Light Rail	65	55
Buses	115	38
Ferries	61 (12–15 as a supplemental option)	24
Emerging Technology	6	12

2.5 Assembly of a Team of Independent Study Consultants

To develop the Report, the Port Authority commissioned a multi-disciplinary team of well-recognized independent experts, including:

- Bechtel – Study Lead and Report Preparation
- WSP—Engineering and Estimating
- Nelson\Nygaard Consulting Associates – Bus Planning Technical Lead
- Foursquare ITP – Emerging Technology and Equity
- Ramboll – International Emerging Technology

In the next section of this Report the options to be evaluated and the methodology used to assess them are explained.

3.0 METHODOLOGY

3.1 Summary of Options

The mass transit options reviewed in this study are presented in Table 3.1-1 below, including the option/sub-option shorthand references used throughout the Report:

TABLE 3.1-1: MASS TRANSIT OPTIONS

Mode	Section #	Option/Sub-Option Shorthand		Option/Sub-Option Title
Subway Services	4.1	S-1		W-Line Branch via Grand Central Parkway (GCP)
		Sub-Options	S-1A	W-Line GCP Branch with Two On-Airport Elevated Stations
			S-1B	W-Line GCP Branch with One Off-Airport Underground Station
	4.2	S-2		N/W-Line Extension via 31st St/19th Ave
Fixed Guideway with Light Rail	5.1	LR-1		Light Rail to/from Woodside
	5.2	LR-2		Light Rail to/from Mets-Willets Point
	5.3	LR-3		Light Rail to/from Jamaica
	5.4	LR-4		Light Rail to/from Astoria
	5.5	LR-5		Light Rail to/from Jackson Heights
Bus – Transit Improvements Along Existing Routes	6.1	B-1		LaGuardia Link Q70-SBS Route Improvements
		Sub-Options	B-1A	Q70-SBS Route with Spot Improvements
			B-1B	Q70-SBS Route with Heavier Infrastructure Improvements
			B-1C	Q70-SBS Route with Lighter Infrastructure Improvements
	6.2	B-2		M60-SBS Route with Spot Improvements
Bus – New Dedicated Bus Rapid Transit (BRT) Routes	7.1	BRT-1		BRT Shuttle to/from Astoria Blvd Station via Astoria Blvd/GCP
		Sub-Options	BRT-1A	Astoria Blvd shuttle with bus lanes on Astoria Blvd and heavy infrastructure busway adjacent to the GCP
			BRT-1B	Astoria Blvd shuttle with heavy infrastructure full busway on Astoria Blvd and adjacent to the GCP
			BRT-1C	Astoria Blvd shuttle with bus lanes on Astoria Blvd only (Lighter Infrastructure)

Mode	Section #	Option/Sub-Option Shorthand	Option/Sub-Option Title
	7.2	BRT-2	BRT Shuttle to/from Astoria-Ditmars Blvd Station via 31st St/19th Ave
	7.3	BRT-3	BRT Shuttle to/from Northern Blvd Station via Northern Blvd/94th St
Ferry Services + Shuttle Bus	8.1	F-1	Ferry Service + Shuttle Bus to/from Manhattan
		Sub-Options F-1A	Ferry Service + Shuttle Bus to Bowery Bay
		F-1B	Ferry Service + Shuttle Bus to Flushing Bay
Emerging Technologies	9.1	–	Narrow Tunnels with Electric Vehicles

3.2 Evaluation Factors and Methodologies

The following factors have been used in the evaluation of each of the 14 options assessed.

Construction Aspects

- Constructability
- Infrastructure Impacts during Construction
- Permanent/Operational Impacts to Existing Infrastructure
- Indicative Capital Cost
- Indicative Timeline/Schedule

Transportation Aspects

- Increased Mass Transit Access to LGA
- Ridership
- Throughput and Capacity
- Indicative Operating Cost

Community and Environmental Aspects

- Local Community Impacts
- Equity
- Removal of Cars from Local Roadways
- Greenhouse Gas and Other Vehicular Emissions Reductions

The methodologies used to evaluate the factors are described below.

3.2.1 Evaluation of Construction Aspects

Each option was advanced to a high-level conceptual stage; the study has not, at this point, developed preliminary engineering or detailed optimized solutions. For each option, a design approach was conceptualized to identify anticipated construction challenges, complexity, and risks. For instance, an option's route alignment was defined to identify potential interfaces with major utilities in order to determine whether a feasible solution would likely be achieved during any future design development.

Option designs have been presented and discussed with major partner agencies to verify, to the extent practicable given the conceptual nature of the work, the engineering/construction feasibility of the option and identify potential complexities and residual construction risks. As such, options evaluated in this Report have been determined to be buildable at this stage of development, albeit with varying scales of identified residual risk. Further detailed review would be required by each such agency once the designs are further developed to determine the acceptability of various conceptual engineering solutions.

Accordingly, as any option selected for further consideration undergoes more detailed design, such efforts may reveal additional engineering or operational complexities, costs, and/or schedule implications that would ultimately render a particular option (or a solution to a particular engineering challenge posed by an option) impracticable or otherwise unacceptable to one or more of the approving agencies. Concerns or notable risks identified by outside agencies with regard to specific options have been noted in the write-up for that option. These issues would need to be addressed and resolved should the option advance to the next level of study.

The options (and sub-options) were assessed against the following construction-related evaluation factors:

3.2.1.1 Constructability

This evaluation factor includes a qualitative assessment of the potential construction complexity and residual construction risks of each option.

An engineering or construction complexity is considered to be an interface, engineering solution, or construction method that would result in increased construction cost or schedule over 'standard' solutions (described further below) or an increased uncertainty in the solution's viability (i.e., an increased exposure to the risk of scope change).

For each option, notable complexities fall into the following categories:

- Physical interfaces with live operational assets (e.g., New York City Transit [NYCT] Subway stations, highways, airport) that would require complex solutions to maintain operability and minimize impact to the asset.
- Physical interfaces with existing infrastructure that would require protection or modification of that infrastructure to implement the proposed option.
- Constrained or limited access that would result in inefficient, out-of-sequence, or restricted construction practices or working hours.
- 'Non-standard' engineering solutions to achieve the required alignment, e.g., tall or long-span elevated structures, deep excavation, or tunneling.

For the purposes of evaluating the options on a consistent basis, the study has adopted a 'standard' engineering approach for all elevated structures, regardless of mode, of piled foundations, reinforced concrete piers, structure, and deck (similar in structure type to that for the existing AirTrain at John F. Kennedy International Airport [JFK]). Additionally, all studied alignments across modes share vertical and horizontal profiles, to the greatest extent possible, for consistency of evaluation. An elevated structure height of approximately 30–60 ft, with span lengths of approximately 120 ft, has been used as the 'standard' to provide a benchmark for 'non-standard' complexities. There would be an opportunity during more detailed future development to optimize the alignment and structure to use refined mode-specific design criteria that may reduce complexities and mitigate impacts.

To simplify the understanding of the scale of construction activity required for each option, the following definitions have been used as collective terms within the Construction Aspects sections of the Report (and when considering construction impacts in the Community and Environmental Aspects sections):

- **Limited Construction:**
  Construction work that can be undertaken using hand-operated mobile machinery without the need for large or specialized plant or equipment. Examples of limited construction would be restriping of lanes/parking/bike lanes, signage, and potentially curb resetting, etc. Limited construction activities could last several days and could be conducted behind safety protection barriers rather than within an enclosed work site.
- **Lighter Construction:**
  Construction work that can be undertaken using hand-operated or small, mobile machinery (e.g., mini-excavators) without the need for large or specialized plant or equipment. Examples of lighter construction would be roadway resurfacing, shallow excavation without shoring, single-lift concrete pours, building work, etc. Lighter construction activities could last several months and could be conducted behind safety protection barriers rather than within an enclosed work site.
- **Heavier Construction:**
  Construction work that generally involves the use of large or specialized plant or equipment. Heavier construction activities would include piling for foundations, deep excavation requiring shoring, multi-stage concrete pours, overhead work requiring crane lifts, tunneling, etc. Heavier construction activities could last several years, requiring a large, enclosed work site to facilitate the work throughout the period.

The notable and complex engineering and construction challenges and any residual risks associated with each option are identified and described in each option's constructability evaluation. Where applicable, these complexities have been reflected in the option cost as either variations in the base construction cost rates or as 'lump sum' allowances (see "Indicative Capital Cost" section below). However, as noted above, further design work would be required to confirm whether the proposed engineering solutions are both feasible and acceptable to the reviewing agencies. More detailed design work may reveal areas of greater complexity or increased scale of modification to existing infrastructure not identified in this study and present a residual risk of cost escalation or schedule prolongation of varying degrees to each option. Within the constructability evaluation for each option, these areas of remaining scope uncertainty are identified (though not quantified), along with the agencies whose review and acceptance are required, to contextualize the scale of residual scope risk associated with each option.

Specific Constructability Challenges

There are two specific constructability challenges that are common to several of the options evaluated; these are discussed in more detail in this section. The specific challenges and the options impacted are:

- Complying with FAA Airport Design Standards and negotiating 90-year-old utilities at the end of Runway 04-22. Impacted options are the heavy infrastructure options approaching LGA from the west and southwest:
  - Subway: S-1A, S-1B, and S-2.
  - Light rail: LR-1, LR-4, and LR-5.
  - Bus: B-1B, BRT-1A, and BRT-1B.
- Crossing the Hell Gate rail trestle over the GCP. Impacted options are the elevated heavy infrastructure options using the GCP transportation corridor:
  - Subway: S-1A and S-1B.
  - Light rail: LR-4.

3.2.1.1.1 Compliance with Runway 04-22 Protection Zones – Major Constructability Challenges for Options Approaching the Airport from the West

All option alignments that approach LGA from the west (and southwest) cross an area south of Runway 04-22 that is subject to FAA regulations regarding the safe operation of the Airport. Therefore, all the options from the west requiring new infrastructure must comply with the FAA's operational and safety requirements, which include safety restrictions on what at- or above-grade infrastructure can be built in areas close to the runways and strict constraints on the type and timing of any construction activities necessary to build that infrastructure. The existing roadways in that area, namely the GCP and Runway Dr, have been in their present configuration south of Runway 04-22 for at least 50 years and are therefore exempted ("grandfathered") from the present-day FAA Airport Design Standards. Any new infrastructure in this area must meet current standards and any variances are unlikely to be approved by the FAA. In this Report, the totality of these requirements, including the Runway Protection Zone (RPZ), Runway Object Free Area (ROFA), Runway Safety Area (RSA), and others, are collectively referred to as the FAA Airport Design Standards (see Figure 3.2-1, below, for a depiction of the FAA Airport Design Standard zones and the impacted option alignments).

In addition to the at- and above-grade restrictions imposed by the FAA, the area to the south of Runway 04-22 also contains 90-year-old New York City Department of Environmental Protection (NYC DEP) underground storm water and wastewater conveyance structures, 9–15 ft in diameter and approximately 15 ft below-grade, that provide critical services to hundreds of thousands of Queens residents. Construction of any new infrastructure must avoid these utilities without service disruption either by avoiding them or relocating them.

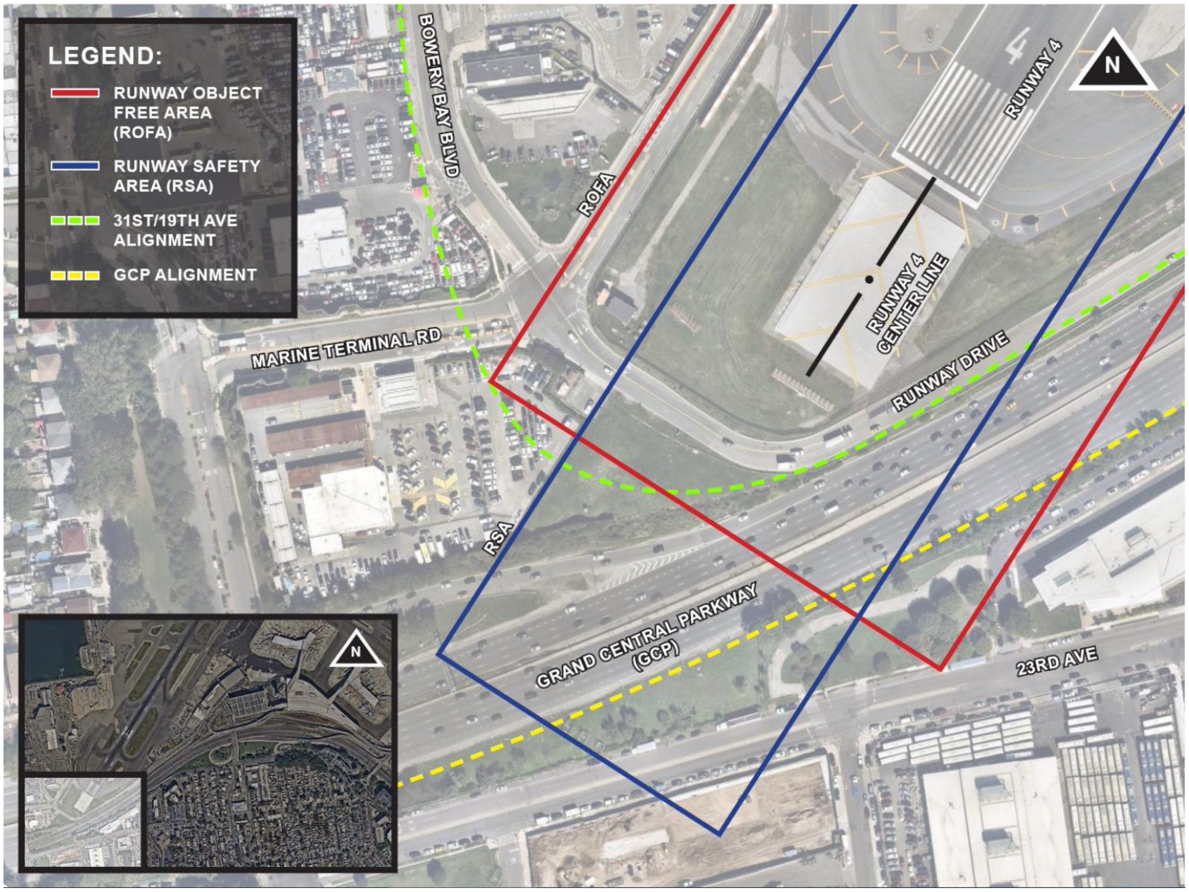


FIGURE 3.2-1: RUNWAY 04-22 PROTECTED ZONES AND IMPACTED OPTION ALIGNMENTS

Options approaching LGA from the west must negotiate the twin constraints of the FAA Airport Design Standards and the existing large-diameter utilities along the GCP. In theory, construction options include (see Figure 3.2-2):

1. Within an open-trench structure, above the existing utilities. This would be the simplest concept to construct but, as discussed in further detail below, is inconsistent with FAA Airport Design Standards.
2. In a shallow cut-and-cover tunnel just below ground level at a depth currently occupied by the NYC DEP utility structures; this approach would require the relocation/reconstruction of those existing utilities. This would be consistent with the FAA Airport Design Standards in its final configuration, but the construction process of

the cut-and-cover tunnel would require the relocation of the NYC DEP underground sewer structures, which would be a significant and complex engineering construction project in and of itself, as described in further detail below. Cut-and-cover tunnel construction would be impracticable given the likely constraints on construction timing and equipment use.

3. In a bored tunnel, just beneath the existing utilities (approximately 50 ft below the surface). This alignment would conflict with the utility's supporting piles and would, therefore, require the underpinning and support of the 90-year-old NYC DEP underground sewer structures. There would also be additional construction complexities locating tunnel portals and reaching the elevated on-Airport stations, as discussed in further detail below.
4. In a bored tunnel in bedrock, approximately 200 ft below the surface and well below the existing utilities. The depth of the tunnel would eliminate the conflict with the utility supporting piles but result in conflicts in being able to reach the required depth without significant reconstruction of existing above-ground structures and overpasses. This would also require the on-Airport station(s) to be located underground.

Open-Trench Structure above the Utilities [Option 1]

An open-trench structure concept would stay above the utilities and result in the top of the transit vehicles extending above ground level. Although the tops of the transit vehicles would be no higher than the vehicles on the existing roadways immediately south of Runway 04-22, the existing condition is "grandfathered," and any new at- or above-grade infrastructure (including the new at-grade busways) would not be compliant with the FAA Airport Design Standards.

In theory, for subway and light rail options running south of Runway 04-22 along the GCP corridor, the alignment could include construction of a new trench structure above the existing 90-year-old utilities with a protective concrete slab (typically 3–5 ft thick) between the new build and the existing utility structures.

The alignment of the subway option running immediately south of Runway 04-22, along Runway Dr (S-2), would include construction of a new open trench structure above the 90-year-old utilities on-Airport, violating the FAA Airport Design Standard's safety requirements where this occurs.

All the above open-trench or at-grade busway solutions, while constructible, would be within the FAA jurisdictional area and would not comply with FAA Airport Design Standards. Therefore, this concept would be highly unlikely to be approved by the FAA. Therefore, the study team concluded the open-trench concept solution to go above the utilities would not be viable.

Shallow Cut-and-Cover Tunnel and Utility Reconstruction [Option 2]

The construction of an underground (near-surface) cut-and-cover tunnel the entire length past Runway 04-22 would comply (in its completed state) with the FAA Airport Design Standards but would require the relocation of the existing 90-year-old major utilities to accommodate the new tunnel. This would entail either the construction of new (replacement) major utilities prior to demolition of the existing ones or significant reconstruction of the existing structures to move or lower them to make way for a cut-and-cover tunnel.

The size, type, and age of these utilities and number of users potentially impacted would make a replacement/reconstruction project like this a significant engineering and construction challenge in and of itself and would add substantially to the cost and overall duration of the program even before the actual transit infrastructure tunneling construction could commence.

After consultation with NYC DEP, the study team concluded that the scale of utility relocation or replacement works required would be of a scale and complexity similar to the construction of the transit infrastructure itself and would render a cut-and-cover construction concept highly risky and neither reasonable nor practicable at this time as a stand-alone project. However, should future NYC DEP work emerge to supplement or replace the 90-year-old sewer infrastructure, an opportunity could arise in the future to coordinate the construction of a cut-and-cover tunnel at the time of any such replacement.

In addition, construction of a cut-and-cover tunnel within any of the FAA's safety zones could be impracticable given the strict constraints to maintain safe airport operations. This could include strict limitations on the timing and duration of construction activities, use of tall equipment, and the need to accommodate out-of-hours airport operations.

In a Bored Tunnel below the Utilities (50 ft below the surface) [Option 3]

The shallower of the two bored tunnel concepts would have an alignment just below the existing utilities and their support piles (approximately 50 ft below the surface) would comply with the FAA Airport Design Standards but would require the underpinning and bracing of the almost 90-year-old NYC DEP underground storm water and wastewater conveyance structures to support them during construction. NYC DEP advised during consultation that underpinning and support of utilities of this type and age has not previously been tried and, therefore, brings with it significant risk and uncertainty.

In addition, geotechnical information based on borings from LGA's redevelopment project suggest the ground conditions at this depth are a mixture of marshy soil, sediment, and clay. It is unclear at this stage whether the risks posed by the 90-year-old sewer infrastructure and relatively poor ground conditions would be acceptable; however, there are further specific construction challenges to be considered for this concept.

First, to accommodate above-ground, elevated stations near the Airport terminals would require the route to pass below the utilities and then above the existing Airport roads and structures. To achieve this would require either tunneling construction at sub-optimal (steeper) gradients than MTA standards recommend, and/or complicated reconstruction of existing Airport roads and support structures recently constructed as part of the LGA redevelopment program.

Second, in lieu of above-ground on-Airport stations, underground on-Airport stations at this depth would have to navigate through the numerous piles and foundations supporting the above ground structures and roadways. The extent of piling and underground support structures at this depth would render underground on-Airport stations the most complex to engineer/construct.

Third, to avoid the complexities of on-Airport stations, an alternate underground off-Airport station solution, located southwest of LGA on the opposite side of the GCP, would place disruptive, deep underground construction work closer to communities. Passenger transfer/walkway structures would have to be constructed across the GCP to link the station to the Airport. This would, however, be the least complex of the station location options to construct.

Finally, west of the Airport, a portal structure (approximately 1,000 ft long and 40 ft wide) would be required to allow the route to transition from within a tunnel to elevated structures. Depending on the option, this portal would need to be located either along the GCP or Brooklyn-Queens Expressway (BQE) transportation corridors and would require significant reconstruction of the existing roadways to accommodate.

To determine practicably that this shallower of the two bored tunneled concepts below the 90-year-old utilities would be viable would require full-scale design, engineering, and field/ground investigations; any such solution would create substantial costs.

In a Bored Tunnel 200 ft below the Utilities [Option 4]

A deeper bored tunnel concept in bedrock (approximately 200 ft below the surface) would comply with FAA Airport Design Standards, avoid the need to underpin and brace the existing utilities, and have tunnel construction predominantly in more stable ground conditions within the bedrock. Such a depth, however, would not allow on-Airport elevated stations, and the presence of the numerous piles and deep foundations from the existing Airport road-network structures would mean any underground stations in this area would need to terminate in an off-Airport location, requiring pedestrian connections to LGA spanning above or below the GCP.

A tunnel alignment this deep, however, brings with it the significant challenge of rising from that depth to pass above the existing streets and overpasses enroute. Even at the maximum gradients that MTA standards recommend, to ascend from this depth would result in reconstruction or permanent removal of some of the road overpasses and (in the case of the subway options to Astoria Blvd station) reconstruction of the Hell Gate rail trestle. This concept, therefore, brings far more significant construction challenges, complexities, risks, and costs than the shallower tunnel concept. Further development of this concept would require extensive engineering studies to even identify any potential practicable engineering solutions, with a low likelihood of success.

Conclusions for the Options from the West

The heavier infrastructure options from the west (subway, light rail, and bus options with new busway structures) present significant challenges and complexities involved in negotiating the twin constraints of the FAA Airport Design Standards and the existing large-diameter utilities along the GCP.

The preliminary engineering work carried out by the study team has not identified a construction approach that, with confidence, would:

a. Comply with the FAA Airport Design Standards.

b. Assure continued viability of the major underground NYC DEP utility structures.

c. Avoid extremely complex, risky, and potentially costly approaches to construction, which require specialized engineering exploration, beyond the scope of this study.

In light of intense public interest in the subway and other options approaching LGA from the west, the study team has nonetheless carried out a full analysis of each option as identified in the Stakeholder Outreach consultation of March 2022[37]. This Report has continued to analyze each option against the stated evaluation factors (costs, schedule, complexities, transportation aspects, community aspects, etc.).

For the purposes of cost comparison between the options, the Indicative Capital Cost of the heavy infrastructure options approaching LGA from the west was costed out on the baseline construction concept described above (open trench or at-grade roadway past the end of Runway 04-22). Although this has been shown not to be in compliance with FAA Airport Design Standards, it provides a consistent basis on which to evaluate and to allow cost comparison between options.

However, on a preliminary engineering basis, the study team is not able to conclude with confidence that any of these alignments is viable. Only detailed engineering, including actual geotechnical field work, could provide a basis for definitive evaluation and cost estimation.

[37] Port Authority seeks input from key stakeholders on 14 potential mass transit options to LaGuardia Airport

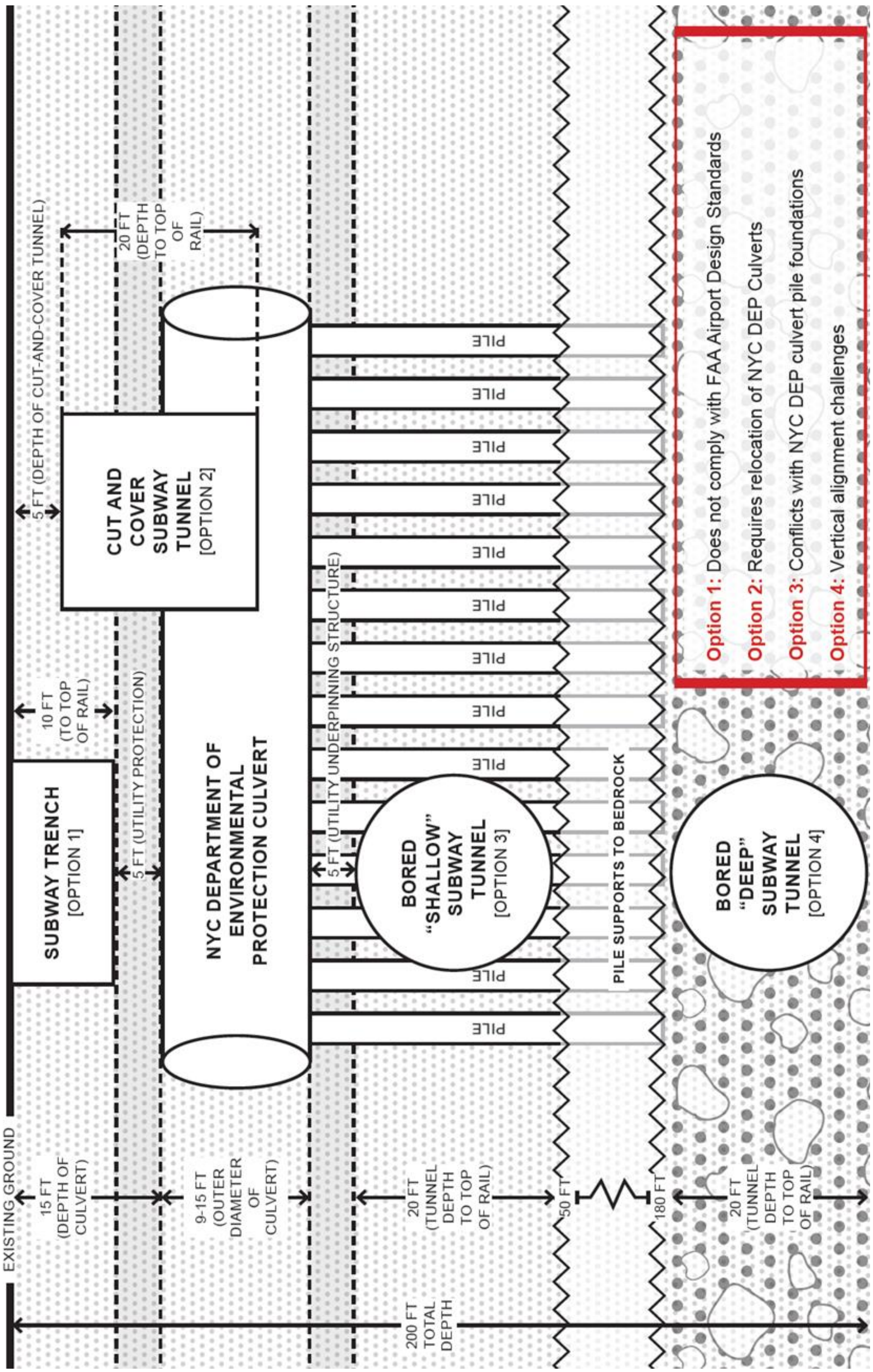


FIGURE 3.2-2: POTENTIAL CONSTRUCTION CONCEPTS TO PASS RUNWAY 04-22

3.2.1.1.2 Crossing the Hell Gate Rail Trestle

The Hell Gate rail trestle, built in 1912, traverses the GCP, Astoria Blvd North, and Astoria Blvd South transportation corridor (Figure 3.2-3). The trestle supports three tracks, generally known as the Northeast Corridor (NEC), that provide critical service for Amtrak (passenger), CSX Transportation (freight), and a planned future use by Metro-North. Because the trestle runs through a densely developed environment and serves a critical route, it is not viable to relocate it. Therefore, the options (and sub-options) that would be constructed within the GCP right of way (ROW) for connection to Manhattan via the N/W-Lines would need to be designed to avoid or minimize impacts to the structure and the operational service it provides.

FIGURE 3.2-3: OVERHEAD VIEW AND VIEW FROM ASTORIA BLVD SOUTH LOOKING NORTHEAST OF THE HELL GATE RAIL TRESTLE

The trestle spans over the existing GCP and the frontage roads. The span over the GCP and frontage roads (GCP Corridor) is supported by two very large piers that are horizontally skewed and not parallel to the road network underneath, which reduces the usable width within the GCP ROW. The width of the GCP Corridor is approximately 280 ft, and the width of the GCP ROW is approximately 200 ft. This study considered potential alignments for the various modes of travel to avoid the Hell Gate rail trestle obstruction while also minimizing impacts to the GCP, frontage road network, and utilities in the area (Figure 3.2-4).

For bus options, there would be adequate clearance for buses to run on the existing Astoria Blvd

FIGURE 3.2-4: VIEW OF THE HELL GATE RAIL TRESTLE FROM THE GCP LOOKING EAST

North and South roadways. Conceptually, it appears that adding one additional new lane for bus travel on Astoria Blvd South would be viable between the trestle bridge piers and the frontage road as proposed in the Higher Infrastructure Astoria Blvd Shuttle concept (BRT-1B).

For subway and fixed guideway with light rail options, the study team considered several possible solutions to negotiate the trestle structure:

Crossing Under the Hell Gate Rail Trestle

Routes under the Hell Gate rail trestle would have to run between the trestle support piers to avoid any reconstruction or modification of the trestle structure itself. Possible concepts, therefore, would run the subway and light rail guideway structures under the trestle and above the GCP roadway, above the Astoria Blvd South roadway, or split the tracks and run them at-grade adjacent to Astoria Blvd North and South roadways.

To pass subway and/or light rail guideway structures beneath the trestle and above the GCP roadway and climb back up to elevation again would not achieve minimum headroom requirements over the adjacent roadway bridges to the east (43rd St) and to the west (Steinway St), even using maximum vertical alignment gradients. Should this solution be advanced, it would require either the reconstruction or elimination of these overpasses to achieve the appropriate alignment. Additionally, to accommodate the guideway structure depth, piers, and to maintain vehicle headroom requirements on the GCP would likely require reconfiguration and reconstruction of the GCP travel lanes. Changes to the GCP travel lanes could possibly lead to a complex lowering of the GCP roadway or splitting of the roadways around the trestle piers and proposed guideway piers. This would require NYS DOT and Federal Highway Administration [FHWA] approval and possibly require modification/underpinning of the trestle pier foundations as part of the roadway lowering.

Routing the subway and fixed guideway with light rail alignments under the rail trestle and above Astoria Blvd would not be viable, because the clearance in that area is approximately 20 ft and, depending on the detail design, a minimum of approximately 35 ft would be required.

Building one track adjacent to Astoria Blvd North and the other adjacent to Astoria Blvd South at the same elevation as the existing roadways would result in the severing of the existing north-south roadway overpasses at Steinway St and 43rd St, requiring either the reconstruction or elimination of these overpasses to achieve the appropriate alignment. This would likely receive significant opposition from NYC DOT and the local community.

Crossing Through the Hell Gate Rail Trestle

The study team also considered removing the bracing from the trestle's 'truss-support structure' sufficient to allow an opening for subway and light rail guideway structure and cars to pass through. The depth of trestle bridge truss-support system is approximately 15 ft below NEC track elevation; therefore, removing the bracing could allow sufficient space for a train to pass under the NEC tracks and maintain vehicle headroom requirements on the GCP, avoiding the need for modification of the roadways below. However, this solution would require a complete shutdown of the rail trestle (and closure to the rail traffic using it) during the complex trestle modification construction work for several months at a minimum. While new supports could be added to the rail trestle to maintain its structural integrity, the operational impacts to the rail service during construction would not be acceptable to Amtrak, the owner of the tracks.

Crossing Over the Hell Gate Rail Trestle

The trestle includes a rigid catenary system with electrical power cables running approximately 20–40 ft above the NEC tracks. Therefore, the total elevation of the Hell Gate rail trestle obstruction is approximately 88 ft above the GCP roadway and approximately 75 ft above the frontage roads. Routing the subway and light rail alignments over the total Hell Gate rail trestle elevation (including above the power cables) would result in a subway/light rail structure higher than anything currently in the MTA's Subway network, requiring substantial structural support to contend with the high elevation. Descending from that elevation using maximum vertical alignment gradients would result in complex horizontal and vertical curve configurations to tie into the existing N/W-Lines (for the subway options) and lead to a light rail transfer station at a higher elevation than the existing Astoria Blvd Subway station.

Although these challenges can be met through engineering and by constructing around obstacles, an overall more structurally efficient and straightforward alignment would be to permanently lower the overhead cabling system allowing a reduced overall height of the subway/light rail guideway structure over the trestle. This would require Amtrak (the owner of the catenary system and cabling) to approve the lowering of their cables and agree to the methodology, length, and frequency of any service outages across the trestle during the lowering work. Consultation with Amtrak during the study identified that the type of cable-lowering work proposed is not without precedent on their network and, although Amtrak would not guarantee approval at this stage, it allowed the study team to determine that lowering the electrical power cables to optimize the proposed structures over the trestle could be possible.

Coordinating and reaching agreement with Amtrak regarding potential service outages on the Hell Gate line, a key right-of-way on Amtrak's Northeast Corridor, to lower the overhead cabling system would be challenging to negotiate and could result in delay to construction activities and add significant cost.

Conclusions to Crossing the Hell Gate Rail Trestle

Crossing the Hell Gate rail trestle poses a significant construction challenge for options linking LGA with Astoria Blvd Subway station. Those challenges significantly increase in scale and risk if the concept to cross the trestle requires modification of the trestle structure itself and/or the GCP roadways beneath. These factors render concepts to pass through the trestle structure or subway/light rail concepts passing under the trestle not practicable nor reasonable for consideration at this stage.

The study team concluded that bus-transit options could pass beneath the trestle along the existing roadways of Astoria Blvd North and South without interaction with the trestle structure. For the subway and light rail options, the optimal concept evaluated as part of the study was to pass over the trestle, but at a lower elevation, requiring the catenary support and electrical power cables to be lowered. This still carries a significant risk of delay and cost increase should Amtrak approval and agreement on service outages fail to be reached, but this is substantially less than the risk associated with going under or through the rail trestle structure.

3.2.1.2 Infrastructure Impacts during Construction

This evaluation factor includes a qualitative assessment of the potential impacts to existing major transportation and/or utility infrastructure during the construction phase.

Using plan and profile alignment drawings and analyzing the constructability of each option allowed interfaces with major infrastructure along the route to be identified. These include physical interfaces with New York State highways (e.g., GCP, Van Wyck Expressway [VWE]); MTA rail, subway, and bus routes; Amtrak Northeast Corridor rail infrastructure; major NYC DEP utilities; ConEd utilities; and LGA infrastructure and facilities.

At each interface, an assessment has been made as to the type and duration of construction activities, and a qualitative assessment of the impacts to the existing infrastructure or modifications required has also been completed. Where these impacts would lead to additional construction complexity (e.g., interstate highway lane width restrictions constraining construction access), they are reflected in the constructability, cost, and schedule factors accordingly.

When periodic closures are required on major roadways to construct each option's infrastructure, standard practice would be to schedule them during off-peak, overnight, and/or during the weekend times when traffic volumes would be typically reduced. However, this may result in increased traffic and congestion on local city streets during the closure periods. For all planned closures, coordination with NYS DOT and/or NYC DOT would be required for approval of the proposed construction methodologies, timing, and traffic diversions. Where work affects interstate highways, FHWA approval would also be required. This would apply to sections of the GCP, BQE, and VWE.

Continuous construction work along and/or adjacent to major roadways (either within the median, shoulders, or adjacent embankments) would typically require temporary narrowing of the travel lanes and shoulders and temporary speed restrictions to provide additional space for safe construction zones while maintaining general traffic flow. For all temporary roadway modifications of this type, coordination with NYS DOT and FHWA (and NYC DOT where applicable) would be required for approval of proposed construction methodologies, allowable temporary lane widths or lane shifting, duration of temporary restrictions, and temporary speed restrictions.

3.2.1.3 Permanent/Operational Impacts to Existing Infrastructure

This evaluation factor includes a qualitative assessment of the potential permanent impacts to the operation of existing major transportation and/or utility infrastructure as well as impacts to MTA subway, rail, and bus service operations, including:

- Identification of the potential for permanent and operational impacts, including identification of impacts upon existing transit services (Subway, Bus, LIRR, etc.). This does not include the potential for change in demand for existing services but does include instances where the new infrastructure may result in changes in existing operational patterns and/or routes.

- Identification of any permanent lane reductions or roadway modifications (e.g., on- or off-ramp relocations) to NYS DOT highways required to accommodate the option's infrastructure, or any future highway widening the option alignments may potentially restrict NYS DOT from undertaking the work. Partner agency coordination with NYS DOT (and FHWA where applicable) would be required during the detailed design stage to develop solutions that would allow future highway work (by NYS DOT) to bring highway elements up to current standards. The highway modifications for any option selected for further development would be designed to the appropriate standards to minimize or avoid any degradation of current traffic flow, accessibility, or driving sight lines. At this stage of development, any potential permanent capacity and traffic safety impacts have not been evaluated, a comprehensive traffic study would need to be undertaken during detailed development to fully understand any potential traffic impacts and concerns along with any mitigations for the permanent condition.
- Identification of potential for permanent operational impacts to utilities resulting from relocation/modification. The study assessed the size of the utilities conflicting with the proposed alignment and determined whether the utilities were major or minor. Based on prior engineering experience, a cost allowance was made to relocate minor utilities, as needed. On the other hand, if it was assessed to be cost-prohibitive to relocate major utilities where conflicts arise, then the existing major utilities must be structurally protected in place. In this case, should the option be selected, additional design would be performed to further define the protection (constructed & permanent) for review/acceptance by the applicable agency/authority.
- Identification of potential for permanent operational impacts to the Airport facilities, terminals, roadways, and runways.

3.2.1.4 Indicative Capital Cost

This evaluation factor provides an indication of what the capital cost required to implement each option could be to allow comparison between the options, herein referred to as the 'Indicative Capital Cost.'

The Indicative Capital Costs given in each option evaluation were produced using a common set of principles (set out below) to allow cost comparison between the options and sub-options. The costs presented in this study are intended to serve as a baseline for comparative purposes and were developed using a consistent methodology, not taking into account current market volatility. Therefore, they are to be taken as a preliminary order of magnitude; any option selected for further study would undergo more thorough design development and cost estimation.

For each option, order-of-magnitude estimates were produced for the costs to construct the infrastructure, provide vehicles, and, where applicable, construct suitable operation and maintenance facilities. Referencing the conceptual plan alignment drawings, each of the options was broken down into its major construction components and priced using unit costs from recent project studies in New York City, applicable to the respective mode:

- Subway option unit costs were based on consultation with MTA and their recent subway project studies.
- Fixed guideway with light rail option unit costs were based on costs developed as part of the October 2019 PA Board Authorization for AirTrain LGA.
- Bus and BRT option unit costs were based on recent area roadway modification/expansion projects and developed in consultation with MTA.
- Ferry option costs were based on an earlier (2013) NYC EDC ferry study, as well as input from NYC EDC on current ferry boat costs.

Design services, project management, construction management, and other 'owner costs' have been accounted for by applying common 'pro forma' percentage multipliers to the construction costs. The common pro forma inclusions, exclusions, and percentages were developed in conjunction with MTA, with the same percentage multipliers applied across all options assessed.

Constructability complexities that would increase costs over the base rates used have been identified (e.g., taller, or longer-span structures, more constrained construction conditions), and percentage adjustments to the applicable unit rate have been applied, based on the study team's experience. If no equivalent unit rate was available within the study estimates (e.g., bridge demolition, intersection reconstruction, or unique features such as depots or storage facilities), order of magnitude cost allowances were added to the cost. For clarity, where these costs adjustments have been made, they are noted in the constructability evaluation.

To make costs comparable between options, the construction costs have been adjusted to a common dollar-year basis, using 2022 as the common year. This has been completed by applying publicly available *Engineering News-Record* average annual Building Cost Index rates to escalate the option's construction costs from the respective date of estimate to 2022. The common dollar-year (2022) construction cost, plus design and owner's costs, thus provides the 'Indicative Capital Cost' quoted, to be used as a baseline comparison between options. Each option's Indicative Capital Cost excludes any future (beyond 2022) cost inflation and/or cost escalation and should not be interpreted as the final cost to deliver the concept.

Within the option evaluations, the Indicative Capital Cost is expressed as a single number, rounded to two significant digits. However, estimated cost values are unrepresentative of the option's potential final cost at this early stage of design development (with less than 1% of any engineering design complete) and again, should only be used for comparative purposes. For the level of detail contained in this study, a cost range of between –10% and +30% should be applied to each option's Indicative Capital Cost to better represent cost variations resulting from evolution of the proposed design (but not scope changes) and/or variability on the design quantities (but not cost escalation and variation in the material rates). For simplicity, a dollar range is not provided for the Indicative Capital Costs in this report but rather a single dollar amount.

The possibility of any residual construction risk considered as out of the –10% to +30% capital cost range is noted separately in each option's Constructability evaluation to indicate the scale of residual risk attendant to each option and the potential implications should the risk be realized.

3.2.1.5 Indicative Timeline/Schedule

This evaluation factor provides an indication of the length of time required to take each option from early planning through operational implementation to revenue service, herein referred to as the "Indicative Timeline/Schedule."

The Indicative Timeline/Schedule provided for each option was produced using a common set of principles (set out below) to allow for comparison between options and sub-options. The timelines presented in this study are a baseline solely for comparative purposes, developed using a consistent methodology. Therefore, they are to be taken as preliminary since any option selected for further study would undergo more thorough design development and schedule estimate.

Each schedule includes the following four high-level project stages with a breakdown of activities within each stage summarized:

- **Planning, Approvals, and Acquisitions**. This stage involves the further development of the option's design to support any funding application(s), the applicable reviews, and/or permitting and other approvals required for the option to proceed into the delivery stages. The activities to support this stage, when applicable, are as follows:
  - Preliminary design.
  - Reviews, permitting, and agency approvals, as necessary.
  - Funding approval process.
  - Property acquisition.

For purposes of comparison, this Report adopts durations for the review, permitting, and approval as follows: options with 'limited construction' (see definition in Section 3.2.1.1 above), up to 2 years; options with 'lighter construction' (as defined in 3.2.1.1 above), 2–3 years; and options with 'heavier construction' (as defined in 3.2.1.1 above), 4 years or more to complete.

- **Engineering and Procurement.** This stage includes engineering and procurement activities required to support the start of construction of each option. The activities to support this stage, when applicable, are as follows:
  - Procurement of a reference designer.
  - Reference design to support procurement of construction contracts.
  - Procurement of all project-related services contracts (i.e., management, consultation, design, construction).
  - Conduct enabling work (e.g., utility relocations, site clearance).

    - Procurement of long-lead items such as electric or zero-emission buses and/or other vehicles.

- **Construction**. This stage includes the timeline to complete detailed design and construct the physical infrastructure and systems for each option to be ready to hand over for final commissioning and trial running. The construction stage activities have been broken down into the following when applicable:
    - Detailed design (multiple phased deliverables).
    - Temporary work required to allow for the construction of permanent infrastructure.
    - Permanent infrastructure construction (notable construction work areas included to reflect critical activities).
    - Systems installation.
    - Systems testing.

- **Commissioning and Bringing into Service**. This stage includes the time to integrate and commission the option prior to handover to the owner and entry into revenue service. The commissioning durations used in the study vary depending on the mode:
    - Subway options: the longest duration (approximately 1.5 years) to account for the complexity of integrating with existing NYCT Subway stations, systems, and controls.
    - Fixed guideway with light rail options: a slightly shorter duration (approximately 1 year) given that they are independent and rely on their own automated, stand-alone systems.
    - Bus, BRT, and ferry options: the shortest duration (0.25–0.5 year, depending on complexity of option) due to the commissioning being limited to the vehicles and any existing traffic signaling updates.

Where constructability complexities have been identified that impact schedule, the duration incorporates these complexities for each option.

3.2.2 Transportation Aspects

3.2.2.1 Increased Transit Connectivity to LGA

This includes three categories: Standardized Indicative Baseline Off-Peak Travel Time, Reliability, and Transfer Experience.

3.2.2.1.1 Standardized Indicative Baseline Off-Peak Travel Time

Approximately 26% of Airport passengers to LGA are traveling to/from Midtown Manhattan. Accordingly, and to facilitate objective comparison of options, an approximation for the total travel time has been developed using a standardized calculation to derive a baseline “standardized indicative baseline off-peak travel time” solely to allow comparison of the different options during weekday, midday off-peak times. Such a baseline does not take into account variability caused by peak-time delays or other variability factors.

To achieve this construct, one or more baseline travel times have been calculated on a consistent basis for each option, with journeys starting from outside a suitable station in the core Midtown Manhattan business area (Penn Station, Herald Square, Times Square, or Grand Central Terminal), and ending at the associated transit stop for Terminals B and C at LGA. Use of several Manhattan starting points avoids distortion of results in favor of those options that use a connecting service running directly from any chosen single starting point. Timings of journeys toward the Airport were determined to be more sensitive than those from the Airport, and therefore formed the subject of the analysis.

The standardized indicative baseline off-peak travel times use the following standardized process to calculate the various components that make up the total journey – solely for the purposes of a comparison of the options:

- Walk time from starting station to the Subway/LIRR platform.
- Wait time at Subway/LIRR platform (taken as half the average scheduled service headway or maximum 5 minutes).
- Trip time on existing services (based on MTA/LIRR timetable data).
- Transfer walk time from existing service to new service platform.
- Transfer wait time (taken as half the new service headway).
- Trip time on new service (see notes below).

Walking, vertical travel, average wait or presentation allowance (see below), and trip times have been estimated for a Monday–Friday midday off-peak (meaning the period between weekday morning and evening peaks) journey.

Additionally, the following should be noted in connection with the calculation of standardized indicative baseline off-peak travel times:

- For options that have a stop at Terminal A, baseline travel times have been included; however, for those that do not, a separate on-Airport shuttle trip would be required, running at 10-minute intervals and with a trip time of around 7 minutes from Terminal B.
- Peak extension of rail trip times is limited and anyway generally counterbalanced by reduced headways and is not, therefore, the subject of any separate calculation.
- In all cases where journeys start at a station, an allowance of 2 minutes is made for walking from the street to the relevant platform.
- The assessment is based on a) passengers having prior knowledge of the timetable when travelling to LGA by LIRR or ferry, and when travelling by subway or bus where the average scheduled headway exceeds 10 minutes, and b) in all such cases, passengers presenting themselves in good time at the platform, stop, or pier 5 minutes in advance of the advertised departure time and waiting for this period. In all other cases, the assessment is based on passengers presenting themselves without prior knowledge of the timetable and waiting time is calculated as half of the average scheduled headway.
- Subway and LIRR trip times and headways were taken from current MTA public timetables, with adjustments for extensions and for stops not shown in timetables.
- Fixed guideway with light rail trip times, transfer times, airport walking times, and airport walking times from planned Subway stations were estimated by specialist advisor WSP.

- Bus trip times, transfer, and airport walking times were estimated by specialist advisor Nelson\Nygaard Consulting Associates (with the exception of M34-SBS times, which are as currently advertised by MTA).
- Standardized Indicative Baseline Off-Peak Travel Times for ferry options incorporate timings for a connecting bus trip between Penn Station and E34th St Pier as well as required bus transfers between Airport pier and terminals.
- The 11-minute wait for ferry departure from E34th St Pier is the sum of the 5-minute presentation time and half of the scheduled 12-minute M34-SBS headway.
- Ferry and Airport shuttle bus trip times were estimated on the basis of information provided by the Port Authority and NYC EDC. Airport shuttle buses are assumed to be timed to meet ferries.
- All baseline travel time values are stated to the nearest whole minute, with half-minutes rounded upward.

Naturally, passengers making journeys via the routes examined will experience variations to the baseline times calculated. This will occur even where services are running exactly as planned, for reasons as simple as variations in walking speeds, whether a traveler arrives just before a scheduled departure or just misses a departing train, or variations in service frequencies at different times of the day.

For bus options, an indication of potential peak-time traffic congestion variability is given as a time extension to the bus trip times. These estimates were provided by Nelson\Nygaard Consulting Associates, using standardized percentage increases and reductions to estimate average bus trip times and to calculate the spread of predictable times. Variations arising from conditions that cannot be foreseen and, therefore, cannot be reflected in advertised timetables and other journey planning information are discussed separately under Reliability.

3.2.2.1.2 Reliability

Assessment of reliability of travel has been based on the characteristics of the mode concerned, primarily its susceptibility to outside influences, and accounts for the variability in travel times due to external forces, such as weather conditions, holidays, accidents, road construction, etc. Modes that travel along a dedicated right-of-way or separated from general-purpose road traffic have a higher degree of reliability because they generally will not be subject to such external influences.

Of the modes considered, buses travelling in general purpose lanes are the most vulnerable to outside forces given the relatively higher probability of events leading to unexpected roadway congestion and consequent unscheduled increases in trip times. The reliability discussion for each option centers around how much of its route is in designated infrastructure.

3.2.2.1.3 Transfer Experience

Each of the options for connections to LGA identified and discussed in this Report is considered principally in terms of the improvements it would offer to Airport passengers making journeys to or from Midtown Manhattan, the origin or destination of approximately 26% of them. Except for the one-seat ride subway options, all options require at least one transfer to connect from the Airport to Midtown Manhattan.

To allow comparison between options, the customer experience component of the analysis is focused on the nature of the experience at the point of transfer between existing services and any new service. The study notes proposed design interventions to improve the transfer experience such as lighting, wayfinding and accessibility improvements.

3.2.2.2 Ridership

Estimating ridership for each option is an inexact and difficult challenge. The approach to addressing this challenge was to utilize both a stated preference survey and the results of a ridership model developed to analyze ground access mode choice as the basis for understanding the general preference and likely ridership outcomes for each of the broad categories of modal options.

Although employees constitute an important segment of the Airport travel market, less than 1% of LGA employees commute from Midtown Manhattan which is a key market for improving transit connectivity to LGA. Whereas more than 40% of LGA workers already commute via public transit with the vast majority of those trips originating in Queens, Brooklyn, the Bronx, and Long Island, only 6% of air passengers use public transit to access LGA. The stated preference survey therefore focused on Airport passengers. The ridership model estimates the anticipated impacts of the various transit options on both Airport passenger and LGA employee mode choice.

Passenger Survey (2022)

A survey of LGA passengers was conducted from Sunday April 24, 2022 to Sunday May 1, 2022. The survey was administered as an in-person interview by trained market research staff who intercepted Airport passengers waiting at departure gates and collected responses using electronic tablets. A total of 1,872 completed surveys were collected from all the LGA terminals.

Respondents were ultimately asked to consider various hypothetical LGA transit access options (bus rapid transit, fixed guideway with light rail, direct subway service, or ferry service), and to rate their likely use of each option using a 5-point scale. The survey provided respondents with detailed descriptions of the travel experience (e.g., types of connections, availability of luggage racks). The results of the survey are summarized in Table 3.2-1 and more detailed information can be found in Appendix Section 3.1.

TABLE 3.2-1: AIRPORT PASSENGER SURVEY SUMMARY

Mode Option	Reported Interest in Hypothetical LGA Transit Option						
	Definitely	Probably	Possibly	Probably not	Definitely not	I do not know	Not eligible
Subway	**41.4%**	**19.4%**	11.6%	13.0%	7.0%	2.6%	5.1%
Fixed Guideway (Connect to Subway)	**25.1%**	**23.8%**	17.2%	18.5%	11.3%	4.1%	0.0%
BRT (Connect to Subway)	**14.0%**	**18.5%**	17.6%	28.2%	14.7%	7.0%	0.0%
Ferry to Shuttle Bus	**9.3%**	**4.2%**	8.5%	18.1%	10.3%	1.3%	48.4%

Although most survey respondents were asked to rate their interest in the four mode options presented in Table 3.2-1, some hypothetical transit options were not presented to respondents based on their reported trip origin/destination. For instance, Airport passengers who did not begin their airport access trip in Manhattan were not asked to rate their preference for a hypothetical Ferry option since that service would likely be an impractical consideration for non-Manhattan airport access/egress trips. Subway service would similarly be impractical for Airport passengers with airport access trip originating from points east of LGA.

The sum of the positive reactions ("definitely" and "probably" in Table 3.2-1) to each hypothetical mode option reveals ferry service to be the least preferred or eligible mode option while subway (60% positive) and fixed guideway with light rail (49% positive) are generally more popular options. Interest in bus rapid transit lies in between ferry and rail service.[38]

Ridership Model

A model of airport ground access mode choice was developed by WSP USA and used to analyze the potential ridership demand associated with each transit category described above as well as the different variations and sub-options within each group.

The ridership model utilizes several parameter and input assumptions in estimating expected mode share and ultimately forecasting resulting ridership[39]. These include but are not limited to:

- Forecasts of Airport passenger volume growth and corresponding implications for Airport employee levels.
- Travel conditions to LGA, including travel times and costs of all mode options providing access to the Airport.
- Estimates of Airport passenger and Employee mode preferences and sensitivity to travel time and cost based on analysis of previous surveys and observed mode choices.

[38] Respondents were not asked about interest in existing bus service as this preference could be ascertained by the actual recorded mode choice of passengers captured in the survey, approximately 10% of whom reported using public transportation to travel to the Airport during the survey period (Appendix Section 1.1).
[39] Mode details are described in an October 2018 LGA AirTrain Ridership Report (and App

- Market segmentation to account for differences in trip purpose (business vs. leisure) and residency status (residents vs. visitors) that in turn would affect various aspects of mode choice, including but not limited to:
  - Geographic distribution of Airport passenger and Airport employee trips in the region based on patterns observed in recent surveys.
  - Familiarity with, and propensity to, use transit.
  - Behavioral responses to the mix of travel options, and the sensitivity of travelers to changes in travel time and travel cost.

While ridership models provide a basis for evaluating the tradeoffs between travel time and cost in the mode choice decision, they are less effective at capturing the impact of other important factors that also affect the mode choice decision (e.g., difficult transfers and wayfinding, branding).[40]

The outputs of the model provide estimates of potential ridership, but these projections are subject to uncertainty, as actual performance may differ from the estimated ridership due to differences in the various forecasting assumptions. For example, 2019 actual paid ridership on AirTrain JFK exceeded ridership projections estimated by that effort's model outputs by more than 30%.[41] Computer-simulated ridership estimates were nonetheless utilized, recognizing the wide range of uncertainty that exists with respect to their output.

Given the potential forecasting uncertainties, the ridership model outputs should be used in conjunction with the survey results previously described. The ridership model, however, utilizes a systematic and consistent approach that allows a comparison across the different mass transit options – including variations within each group of potential concepts.

The ridership model's mode share predictions for each option were applied to the volume of Airport passengers and workers projected to access LGA in 2025. These travel market assessments were based on the most recent long-range activity forecasts developed by the Port Authority's Aviation Department. The resulting estimates of each option's ridership is provided in the subsequent evaluations.

3.2.2.3 Throughput and Capacity

This includes the evaluation of potential peak passenger throughput for each option, the capacity to carry passengers in reasonable comfort, and the ability of downstream transit systems to accommodate the travel demand to/from LGA.

The table (Table 3.2-2) and bar charts (Figures 3.2-5 and 3.2-6), below, support this assessment. They summarize average hourly provision of seats on arriving and departing aircraft at LGA

[40] The ridership model is limited in its ability to reflect the impact of quality-of-service factors on mode choice, unlike the passenger survey that allowed detailed descriptions of the travel experience including the types of transfers.
[41] The AirTrain JFK ridership analysis was conducted in 1994 with a forecast horizon of 2003. Ridership estimates, derived by applying that effort's model predictions of AirTrain ground access market capture to extrapolations of corresponding Airport passenger volume growth assessments beyond 2003, could potentially have understated actual ridership by approximately 2 million annual riders in 2019 – the last full year of normal passenger activity prior to the COVID-19 pandemic.

during the last full pre-pandemic year in 2019, as recorded by the Port Authority. The values listed provide a clear indication of the potential overall size of the airport passenger surface access market by hour. Given an estimation of market share for any airport connection, along with estimations for airport staff and airline traffic growth, these figures provide a good indication of demand and demand patterns throughout the day.

The data in Table 3.2-2 shows that airport passenger surface access traffic between Manhattan and the Airport offers potential for healthy transit demand in both directions throughout the day. Daytime and early evening hourly provision of airline seats for arrivals and departures on weekdays at LGA during 2019 fell mostly within a range between 3,000 and 4,000 in each direction.

TABLE 3.2-2: HOURLY PROVISION OF AIRLINE SEATS AT LGA, 2019

	Monday - Thursday		Friday - Sunday	
Hour	Weekday Departing	Weekday Arriving	Weekend Departing	Weekend Arriving
00:00 – 01:00	500	1100	300	800
01:00 – 02:00	800	600	300	400
02:00 – 03:00	300	300	200	200
03:00 – 04:00	200	200	100	100
04:00 – 05:00	0	100	0	100
05:00 – 06:00	135	300	200	100
06:00 – 07:00	3800	600	2500	100
07:00 – 08:00	3200	2400	2300	800
08:00 – 09:00	3500	3300	3000	2000
09:00 – 10:00	4300	3300	2600	2300
10:00 – 11:00	3700	3500	2700	2900
11:00 – 12:00	3700	3000	3100	2500
12:00 – 13:00	3500	2900	2900	2300
13:00 – 14:00	2100	3100	2500	2600
14:00 – 15:00	3000	3500	2400	3100
15:00 – 16:00	3100	3300	2500	3000
16:00 – 17:00	3400	3400	3100	2900
17:00 – 18:00	3300	3300	2700	3800
18:00 – 19:00	3300	3300	2500	2600
19:00 – 20:00	3300	3200	2300	2400
20:00 – 21:00	3200	3200	2000	2400
21:00 – 22:00	2600	2400	1500	2700
22:00 – 23:00	1800	3200	1000	2300
23:00 – 24:00	800	3000	400	2000

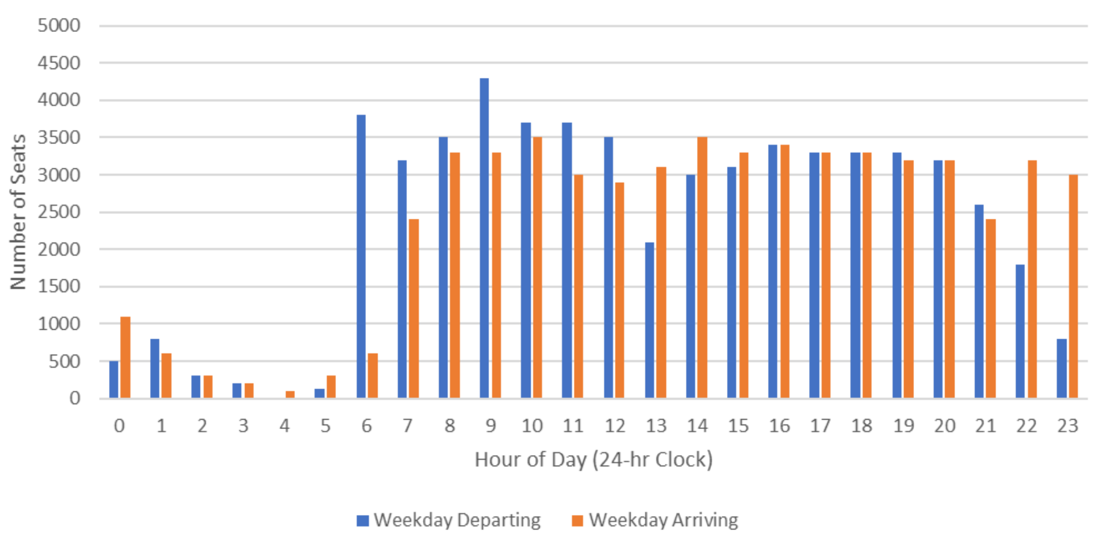


FIGURE 3.2-5: WEEKDAY SEATS ARRIVING AND DEPARTING LGA BY HOUR

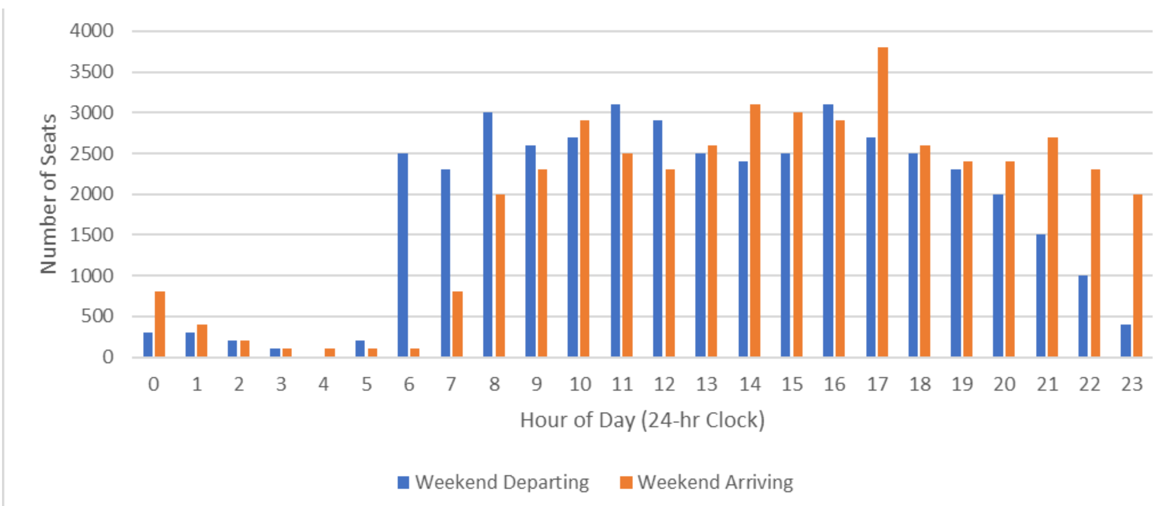


FIGURE 3.2-6: WEEKEND SEATS ARRIVING AND DEPARTING LGA BY HOUR

In the morning, departing airline capacity increases quickly after 6 AM generating demand for travel toward the Airport from Manhattan when most transit riders are traveling toward Manhattan. Airline arrivals escalate to their highest volumes after 8 AM with most arriving airline passengers reaching the busiest sections of the transit network approaching Manhattan after 9 AM.

During the midday off-peak period, arriving and departing airline seat capacity remains steady with even flows in and out of LGA coinciding with times of generally lower transit ridership creating a capacity surplus on the rail and subway networks.

Early- and mid-evening airline capacity provision is again balanced in each direction with flight departures generating passenger traffic coinciding with evening peak flows out of Manhattan. However, transit flows are less dense than those of the morning peak, and capacity margins are sufficient to accommodate expected airline passenger volumes.

Throughput

To estimate the potential passenger throughput, the peak airport passenger numbers (taken from the peak airline seats in Table 3.2-9: 4,300 weekday departing seats between 9 AM and 10 AM) are factored by each option's potential passenger ridership percentage.

This provides a potential peak number of passengers per hour for each option which would then be used to assess the capacity of the proposed option's new transit system and the potential impact of the additional passenger loading on the existing capacity of other transit services.

Capacity of New Transit Option

For each option, the potential hourly passenger capacity per direction for the new LGA connection has been calculated based on plans or existing parameters relating to service frequency, vehicle size, and acceptable loading density. Capacity and potential capacity of each new LGA connection is compared with the estimated passenger throughput to give an indication of suitability of the proposed system.

Impact on Capacity of Existing Downstream Transit Systems

In addition, consideration is given in each case to the capacity of existing transit services, namely the MTA Subway and LIRR, to carry additional demand generated by the new LGA connection.

The approach has used the MTA 2017/2018 peak load point ridership and capacities data for the NYCT Subway lines to identify the peak capacity ratio, location, and time of day where existing downstream transit systems experience their peak passenger demand (typically in the morning peak, 8 AM to 9 AM, toward Manhattan). The corresponding airport passenger throughput that would coincide with this peak was taken from Table 3.2-9 (based on weekday arriving seats) with a one-hour allowance for passengers to reach to the Subway peak capacity location.

This peak figure was then determined for the option's potential ridership and expressed as percentage of the available Subway capacity to give an indication of the relative impact of the additional passenger loading on the Subway system.

Where possible, options with multiple transit alternatives (i.e., multiple Subway lines and/or LIRR services) were expressed as a percentage of the combined capacity (in the case of multiple Subway lines) or noted that options exist that would further accommodate airport passengers.

3.2.2.4 Indicative Operating Cost

An initial indicative estimate is offered of annual operating costs for each option. With, in most cases, several years before such costs would be incurred the values offered and their basis are inevitably uncertain, but they provide an indication of the relative operational costs of each of the different modes and options.

Operating cost estimates should not, of course, be construed as indicators of the long-term financial performance of each option given the absence of revenue forecasts. The latter would require, in association with the ridership forecasts, some definition of fares policy applicable to each option, and this will necessarily have to await selection and implementation. Naturally, those options that appeal most strongly to the market will have the greatest revenue potential, through both higher volumes and the potential for higher fares to be charged. Such options may also have higher operating costs.

Subway Operating Costs

Operating costs for each of the two subway options were prepared by MTA. They include:

- Maintenance costs for all assets forming the proposed new branch or extension, including those for track, electrical distribution, signaling equipment, fare collection equipment, electronic systems, structures, stations, and building services.
- Maintenance of additional trains required to operate over the extended network.
- Additional traincrews and their supervision.
- Additional Switching Train Operators.
- Additional control resources.

In the case of the Option S-1 train, traincrew and control costs include those associated with the operation of additional trains to limit frequency reductions at Astoria Blvd and Astoria-Ditmars Blvd arising from diversion of part of the W train service to LGA.

Fixed Guideway with Light Rail Operating Costs

Estimation of indicative operating costs for the fixed guideway with light rail options utilized estimates prepared in December 2020 by the Port Authority as a basis for the LAIP concept (Mets-Willets AirTrain, currently on pause).

Estimated costs in this case include:

- O&M contractor “Train System” costs, including labor, materials, utilities, and technical assistance.
- O&M contractor facilities costs, including passenger circulation (elevators, etc.) and other building systems, janitorial, utilities, and communication.
- O&M contractor other costs, including administration overheads, profit, insurance, and contingency.

- Port Authority O&M costs, including labor, supporting bus operation, administration, and specialist advice.

The operating cost value thus estimated is shown rounded but otherwise unadjusted as the indicative annual operating cost for the Mets-Willets fixed guideway with light rail Option LR-2.

For the other fixed guideway with light rail options, the December 2020 estimates for O&M contractor facilities (and other costs) and Port Authority costs were used unchanged, reflecting similarity of all options in terms of the number and nature of stations and the required operational processes. To reflect variations relating to guideway length and with this trip time and therefore fleet size, 50% of Train System costs estimated in December 2020 were adjusted in proportion with guideway length, rounded to the nearest mile. This portion of LR-2 costs (approximately two miles long) was therefore inflated by 50% for LR-1, LR-4, and LR-5 (each approximately three miles long) and by 250% for LR-3 (approximately 7 miles long). The resulting values, after rounding, are shown as the indicative annual operating cost in each case.

Bus Operating Costs

Bus operating costs have been prepared by Nelson\Nygaard on the basis of calculations for each option of numbers of vehicles required (including spare vehicles) and their operating time and mileage. Against these basic operating requirements, unit costs provided by MTA relating to the existing New York City articulated bus fleet have been used to calculate direct costs. Unit costs include:

- Hourly pay per bus operating hour.
- Hourly vehicle costs.
- Per mile operating costs.
- Per vehicle annual costs.
- Other full time staff costs per run.

Calculation of the number of vehicles required for each option included allowances for additional empty running and depot time required for battery charging. To this extent, the operating cost estimates allow for additional costs associated with battery-electric articulated buses, notwithstanding their absence from the current MTA fleet and concomitant cost information.

Calculated direct costs were subject to a multiplier of 1.927 in line with MTA practice.

Ferry Operating Costs

Ferry operating costs were drawn from the 2013 Citywide Ferry Study, which considered a four-vessel, half-hourly service similar to that proposed in this study. An hourly per vessel operating cost of $527 was estimated in 2013; this value was inflated by 20% to give a 2022 cost of $632. The costs were then applied to a four-vessel fleet over a 12 hour daily operating period to arrive at the annual indicated operating cost.

3.2.3 Community and Environmental Aspects

3.2.3.1 Local Community Impacts

The local community impacts assessment was conducted at a high level consistent with the conceptual engineering that was performed. Accordingly, this assessment estimated the location, nature, and extent of construction activities, permanent infrastructure, and operational vehicles to determine the following potential impacts, which have been presented for comparison purposes only.

3.2.3.1.1 Temporary Impacts during Construction on the Local Neighborhoods Directly Affected

For each option, the following characteristics are described to indicate the potential for air quality, noise, vibration, or visual impacts during construction to allow comparison between the options:

- Intensity and nature of construction activity (limited, lighter, or heavier as defined in the "Constructability" section above).
- Duration of construction (defined by the "Indicative Timeline/Schedule").
- Proximity of construction to private residential, private commercial, industrial, religious, parking lots, NYC Parklands, and NYC Plazas.

As the Study options are in a very early stage of development, detailed construction activity modelling and impacts analyses have not been undertaken, so the specific type and scale of temporary impact and details of potential receptors are not presented. Should any of these options be selected for further detailed development, more comprehensive impacts analyses can be conducted.

In regard to local neighborhood traffic, Maintenance of Traffic (MoT) plans are developed to identify potential traffic impacts with possible mitigation for review/approval by the authorized agency (NYC DOT); however, these Study options are too early in the design cycle to propose such MoT plans and therefore, they are not included in this Report. Should any of the Study options be selected for further consideration, preparation of MoT plans could be performed.

3.2.3.1.2 Permanent Operational Impacts on the Local Neighborhoods Directly Affected

For each option, the following characteristics are described to help identify the relative potential for permanent noise, vibration, or visual impacts during the operational condition to allow comparison between the options:

- Type (subway, light rail, bus, BRT, or ferry) and frequency of service operations associated with proposed options and facilities.
- Situational context of the proposed service operations (e.g., on a structure, in a tunnel, within an existing transportation corridor).

- Proximity of proposed operations and facilities to residential, commercial, and other uses.

As the Study options are in a very early stage of development, detailed operational modelling and impacts analyses have not been undertaken, so the specific type and scale of permanent impact and details of potential receptors are not presented. Should any of these options be selected for further detailed development, more comprehensive impacts analyses (including a comprehensive traffic study) can be conducted.

Additionally, for the permanent condition, the following details were described to identify the relative potential for permanent impacts to the local community:

- Pedestrian sidewalk/walkway/bridge removal.
- Bike lane removal or reconfiguration.
- Potential private property acquisition (methodology described further below).
- Potential partial acquisition of public spaces, including NYC Parkland and NYC DOT Plaza areas (methodology described further below). Additional impacts to non-public green spaces and tree removal/restitution are not included in the study.
- Parking removal or reconfiguration (methodology described further below).

Assessment of property acquisitions covers private property and public spaces (including NYC Parkland and NYC DOT Plazas). Public rights of way that are existing transportation corridors, such as those owned by NYC DOT or NYS DOT, were not considered as part of this analysis; however, acquisition or easement would need to be addressed as part of any option advanced to further study.

For the permanent condition, the methodology that was used to identify properties that may need to be acquired for each option, as well as the qualitative traffic assessment and parking, are described further below.

3.2.3.1.3 Potential Private Property Acquisitions

This Report provides a preliminary assessment, for comparative purposes, of the number and type of properties that may need to be acquired to site the option's permanent infrastructure, although final property requirements would be refined upon further planning and design work.

The following factors were used to determine the need for potential property acquisitions:

1. The option's permanent infrastructure is positioned directly on and/or above the property, creating a potential "physical conflict." Permanent fixtures to consider are columns, retaining walls, facilities (including Operations, Maintenance, and Storage Facilities – OMSF), etc.
2. The option would not directly interfere with the structures on the property, but the permanent infrastructure would prevent required Fire Department of New York City (FDNY) access to the property in the event of an emergency, i.e., a potential "FDNY access conflict."

The properties located within the width of the option's permanent infrastructure (i.e., guideway structure) were identified as potentially affected and grouped as having a "physical conflict."

For the purposes of comparison between options, the properties located within 30 ft of the option's permanent infrastructure were identified as potentially affected and grouped as having an "FDNY access conflict."

Land-use types have been estimated using the current zoning for each identified parcel. At this time, due to the preliminary nature of the engineering and planning for these options, a comprehensive building inventory has not been completed. Therefore, the Report reflects the parcel land use designation per the New York City zoning code.

The Report does not consider acquisitions resulting from conflict with, or being in close proximity to, temporary construction zones or storage areas, or acquisitions in close proximity to, but greater than 30 ft from, the permanent operations. Acquisitions of this kind could only be determined after more detailed design development, construction planning, and engineering studies.

The process for acquisition of a property (or property interest, such as an easement) could entail negotiations culminating in an agreement between the property owner and relevant agency. If no agreement can be reached, property would need to be acquired pursuant to the New York State Department Procedure Law (Eminent Domain Procedure Law).

3.2.3.1.4 Potential Public Property Acquisitions (NYC DOT Plazas and NYC Parks Parkland)

Options were assessed to determine the permanent impacts associated with the loss of NYC Parkland and/or NYC DOT Plaza Program areas after construction is complete.

3.2.3.1.5 Removal/Reconfiguration of Parking Spaces

Options were assessed to determine the approximate number of on-street public parking spaces removed in the permanent condition after construction is complete.

3.2.3.1.6 Environmental Justice Communities Mapping Analysis

The Environmental Justice communities mapping analysis was conducted to provide a high-level overview of the minority and low-income populations who live near the option alignments. Following standard industry practice, the study team used a 0.25-mile offset from the option alignments—an appropriate distance within which to identify Environmental Justice communities. The demographic dataset in this analysis is based on data from the American Community Survey 2019 5-Year Estimates, the most recent Census data available at the time the analysis was performed.

Minority populations and low-income populations are defined as follows:

- Minority population: A population that is identified or recognized by the United States Census Bureau as all people who are non-Caucasian.

- Low-income population: A population having an annual income that is less than the poverty threshold established by the United States Census Bureau.

For this study, the identification of Environmental Justice communities is based on the FAA March 2021 LGA Access Improvement Project Final EIS. The classification of minority and/or low-income communities was determined at the block group level. Minority communities are defined as block groups that have minority populations greater than 50% of the total block group population, and low-income communities are defined as block groups that have low-income populations of greater than 50% of the total block group population.

The results are presented in maps that depict block groups within a 0.25-mile buffer of each of the options that are in minority and/or low-income communities.

Each map is accompanied by text stating whether more or less than half of the block groups within the buffer are considered minority or low-income communities.

3.2.3.2 Equity

The intent of the equity evaluation factor is to identify opportunities to improve transit access and provide other benefits in the local neighborhoods that may be affected by each of the LGA options under evaluation.

The equity evaluation factor covers three general categories: transit access from LGA, transportation opportunities and benefits for the surrounding community, and economic opportunities and benefits for the surrounding community.

3.2.3.2.1 Transit Access from LGA

- **Additional Minority and Low-Income Populations Reached within 45 minutes from LGA via Transit (Population Access Analysis):**

  The results of the Population Access Analysis illustrate how many people, specifically from low-income and minority populations, could travel via transit from LGA to residences within 45 minutes from LGA. Airport passengers or Airport employees living within these areas could potentially benefit from expanded access to these destinations. This analysis estimates how many additional people would live within 45 minutes from LGA by transit (otherwise known as a 45-minute travel shed)[42] under each option as compared to the baseline condition (no build scenario). These estimates are provided for the total, low-income, and minority populations. Low-income and minority populations have historically had lower access to high-quality and high-capacity transit service.[43] Although minority and

[42] Average travel times by public transit in the United States are approximately 45 minutes, which make 45 minutes a common threshold for travel shed analyses. Burd, Charlynn, et al. *Travel Time to Work in the United States: 2019, American Community Survey Reports*. 2021. https://www.census.gov/content/dam/Census/library/publications/2021/acs/acs-47.pdf. Transit Center uses 45 minutes as the default threshold in their *Equity Dashboard*: https://dashboard.transitcenter.org/map/nyc?key=C000_P_c45_AM_autoN_fareN&zone=msa&date=2021-09-12&demo=none.
[43] TransitCenter Equity Dashboard: The New York Story. https://dashboard.transitcenter.org/story/nyc

low-income populations are referenced separately in the analysis results, it may be the case that such populations overlap.

- **Additional ADA-Accessible Stations within 45 minutes from LGA via Transit (ADA Analysis):**

  The results of the American with Disabilities Act (ADA) Analysis illustrate how Airport passengers and Airport employees, specifically those requiring ADA-compliant stations, traveling from LGA to other locations could potentially benefit from expanded access to ADA-compliant stations within 45 minutes via transit. This analysis examines how many ADA-compliant stations/stops are located within each transit option's 45-minute transit travel shed from LGA to assess accessible transit travel options from LGA compared to the baseline condition (the number of ADA-compliant stations currently reached within a 45-minute transit trip from LGA, as well as Subway stations that are currently planned to receive an ADA upgrade). Subway, ferry, LIRR, and Metro North Railroad stations/stops are included in this analysis.

3.2.3.2.2 Transportation Opportunities and Benefits for the Surrounding Community

- **Transportation Opportunities for Neighbors:**

  The Transportation Opportunities for Neighbors analysis considers whether residents from the surrounding community would have access to the broader transit network as the result of the implementation of transit options. Because there is limited pedestrian access to LGA from adjacent residential areas and walking distance exceeds 0.25 mile, the study team did not consider there to be a significant market for use of the final on-Airport stops by the surrounding community to connect to the broader transit network. Of the transit options being considered, only one of the transit options was identified as having a potential new off-Airport stop[44] (S-1B: Subway Service – W-Line GCP Branch with One Off-Airport Underground Station). The purpose of this analysis for this option is to estimate the benefits of new service to residents who live near the potential new off-Airport stop. For this transit option, the following analyses are conducted for the potential new off-Airport stop:

  - Estimates how many jobs are reachable within a 45-minute transit trip from the stop location compared to the baseline condition.
  - Indicates whether existing transit services are currently provided within 0.25 mile and 0.5 mile of the stop.

  In addition, for the subway option with an off-Airport stop (S-1B), the study team compared the proposed route with the areas served by existing MTA bus routes and subway lines, as well as onto MTA Equity Priority Areas, as identified by MTA NYCT using a weighted average

[44] For final on-Airport stops, because there is limited pedestrian access to LGA from adjacent residential areas and walking distance exceeds 0.25 mile, it is assumed that there is not a significant market for use of the final on-Airport stops by the surrounding community to connect to the broader transit network.

of 13 socioeconomic variables. The MTA Equity Priority Areas consider high concentration of a low-income, minority, housing-cost-burdened, children and seniors, people with disabilities, and transit-dependent population. The study team also conducted a rough spatial analysis of census data to determine the number of residents within 0.5 mile of an off-Airport stop and assessed what percentage of these residents fall within MTA NYCT Equity Priority Areas. Based on these analyses, the study team determined whether the potential new off-Airport stop would fall within the service area of the current MTA bus and subway network and if it would serve any additional MTA Equity Priority Areas.

- **Cars Removed from Local Roadways and Emissions Reductions:**

  The applicable sections within the Report that estimate the number of cars removed from local roadways and Greenhouse Gas (GHG) and other vehicular emissions reductions are cross-referenced for each option. These analyses estimate the number of surface vehicle trips for Airport passengers and employees to/from LGA that would be removed from roadways around the Airport for each option, along with associated reductions in vehicular emissions. The emissions reductions analysis is limited to emissions directly related to vehicular traffic to/from LGA and is not related to emissions from aircraft, vehicular traffic in general, or other sources.

3.2.3.2.3 Economic Opportunities and Benefits for the Surrounding Community

- **Opportunities and Support for Minority/Women-Owned and Local Business Enterprises, including Small Businesses:**

  There will be a strong commitment to minority business enterprise (MBE), women-owned business enterprise (WBE), and local business enterprise (LBE) participation, consistent with applicable policies, laws, and regulations. Participation in contracting opportunities for minority/women-owned business enterprises (MWBEs) will be maximized, with a target of achieving at least 30% participation, and local, Queens-based firms will also be prioritized. This would apply to all options being studied and, therefore, the MBE, WBE, and LBE opportunities are not used to compare options to one another.[45]

- **Workforce Development Opportunities:**

  There will be an equally strong commitment to workforce development opportunities for local residents, and participation will be maximized. The contractor would be required to develop and implement a workforce development program targeting local residents for construction, operations, maintenance, and management careers. A contractor would also be required to work closely with the construction trades unions and affiliated organizations to better prepare local candidates for construction careers. This would apply to all options

[45] These commitments could be augmented by collaborating with local community-based organizations and monitored with a robust tracking and reporting requirement.

being studied and, therefore, the workforce development opportunities are not used to compare options to one another.[46]

3.2.3.3 Cars Removed from Local Roadways

For each of the options, the WSP ridership model was used to develop approximations of the number of cars that would be removed from the local roadways. The model estimates the Airport passenger and employee trips expected to shift from current ground transportation modes accessing LGA to the options as a result of implementing any of the options under study. Among all modes available from the model, this analysis identified the types of ground access modes that switched specifically from cars to each option and then extracted them.

When extracting the data, the results were processed in the unit of vehicle trips. Since the ridership model was developed based on the 2017 LGA ground access survey records, which represent travel parties consisting of one, two, or three or more people who traveled in the same vehicle, the model was utilized to compute the number of total vehicle trips by counting the number of survey records. According to the 2017 LGA ground access survey, a passenger occupancy factor was on average 1.67 passengers per vehicle.

3.2.3.4 Greenhouse Gas and Other Vehicular Emissions Reductions

GHG Reduction Analysis

The study team post-processed the ridership model and estimated the number of cars off the road and resulting vehicle miles traveled (VMTs) for each option. The team then computed GHG emissions in metric tons of carbon dioxide equivalent (MT CO_2e).[47] GHGs associated with mobile sources are primarily carbon dioxide (CO_2), methane (CH_4), and nitrous oxide (N_2O). CO_2, CH_4, N_2O, and CO_2e emissions were estimated using emissions factors adopted from the LGA Access Improvement Project EIS, which used USEPA emission factors from MOVES2014b.

Detailed analysis steps are described as follows:

- **Step 1** – The ridership analysis projected the shift in demand from cars to each option. The demand expressed in Airport passenger and employee trips was converted to vehicle trips using the total number of survey records that switched from cars to each option, because the ridership model was applied to each survey record of travel parties who traveled in the same vehicle.
- **Step 2 –** The resulting annual vehicle trips were then converted to annual VMTs by multiplying the distance that each vehicle drove on the roadways. The distances between trip origin/destination and LGA by each travel party for Airport passengers and employees were estimated by joining zone-to-zone highway distance skim tables from New York Best Practice Model (NYBPM).

[46] These commitments could be augmented by collaborating with local community-based organizations and monitored with a robust tracking and reporting requirement.
[47] MT CO_2e is the number of metric tons of CO_2 emissions with the same climate change potential as one metric ton of another Greenhouse Gas, calculated using Equation A-1 in 40 CFR Part 98.

- **Step 3 –** The emission factors were applied to the annual VMTs obtained from Step 2 for each of the options in this Report. Annual emissions were calculated for CO_2, CH_4, and N_2O to generate MT CO_2e in units of metric tons per year.

MOVES2014b emissions factors were applied as used in the LGA Access Improvement Project EIS. Climate change factors were also adopted from the EIS.

Other Vehicular Emissions Reduction Analysis

The similar methodology applied for the GHG reduction analysis has been used in this analysis of other vehicular emissions reduction. The study team post-processed the ridership model and estimated the number of cars off the road and resulting VMTs for each option. The team then computed emissions reduction for relevant National Ambient Air Quality Standards (NAAQS) pollutants. Criteria pollutants associated with mobile sources are primarily carbon monoxide (CO), ozone (O_3), nitrogen dioxide (NO_2), particulate matter (PM), and sulfur dioxide (SO_2). CO, ozone precursors of VOC and NOx, NO_2, PM_{10}, $PM_{2.5}$, and SO_2 emissions were estimated using emissions factors adopted from the March 2021 LGA Access Improvement Project EIS, which used USEPA emission factors from MOVES2014b.

Surface vehicles considered in the analysis include private cars, rental cars, and taxi/for hire vehicles used by Airport passengers and employees traveling to and from the LGA. The vehicular emissions reduction analysis did not analyze the construction activities of the options.

Detailed analysis steps are described as follows:

- **Step 1 –** The ridership analysis projected the shift in demand from cars prompted by each option. The demand expressed in Airport passenger and employee trips was converted to vehicle trips using the total number of survey records that switched from auto modes to public transportation since the ridership model was applied to each survey record of travel parties who traveled in a same vehicle.

- **Step 2 –** The resulting annual vehicle trips were then converted to annual VMTs by multiplying the distance that each vehicle traveled on the roadways. The distance between trip origin/destination and LGA by each travel party for Airport passengers and employees was estimated by joining zone-to-zone highway distance skim tables from NYBPM.
- **Step 3 –** The emission factors were applied to the annual VMTs obtained from Step 2 for each of the options in this Report. Annual emissions were calculated for carbon monoxide (CO), volatile organic compounds (VOC), oxides of nitrogen (NOx), nitrogen dioxide (NO_2), coarse particulate matter (PM_{10}), fine particulate matter ($PM_{2.5}$), and sulfur dioxide (SO_2).

3.2.4 Summary of the Evaluation

At the end of each option, the evaluation factors and relevant data are summarized to provide an overview of the option.

4.0 SUBWAY SERVICES

Subway options offer the convenience of a single seat ride from points in Midtown Manhattan directly to LGA, offering Airport passengers access to the established and frequent MTA Subway network. This study focused on linking the existing N/W-Lines to LGA from near their terminus in Astoria, being the Subway lines closest to the Airport, primarily along an elevated track structure.

For the purposes of the subway option evaluation, existing MTA requirements for the guideway, track, systems, and facilities that support 600-ft train operations were adopted. Each subway option, either being a branch of the W-Line or an extension of the N- and W-Lines, was evaluated on the basis that any new subway car maintenance and storage infrastructure would not be required, vehicles operating on these services would be stored and maintained at the existing MTA car equipment facilities. New subway stations serving the Airport were sized using MTA space requirements for intermediate and terminus stations to evaluate suitable station positioning for Airport terminal access. MTA space requirements normally require ordinary car maintenance, cleaning, and crew change-over facilities at subway terminal stations, this was considered when evaluating the constraints of available space for the on-Airport stations.

The subway option alignments were developed utilizing WSP's track experts working in close coordination with the MTA to confirm that, at the conceptual level, the vertical and horizontal track profiles selected would be acceptable for MTA operations. To maneuver the subway in an environment constrained by obstacles such as the Hell Gate rail trestle and LGA's Runway 04-22, it was necessary in certain locations to reflect grades steeper than MTA's standard maximum of 3%. At this study's level of conceptual design, the design team at WSP and the planning team at MTA reviewed the proposed vertical profiles and found them to be within the range of variances that, on a case-by-case basis, have been previously authorized by MTA Maintenance-of-Way Engineering. Should any of the subway options advance beyond the conceptual level, additional review and authorization would be required by MTA Maintenance-of-Way Engineering to ensure that the track alignment would meet all of the MTA's operational requirements.

The evaluation considered the following subway options (and sub-options) as described below:

- S-1: W-Line Branch via the Grand Central Parkway:
  - S-1A: W-Line GCP Branch with two on-Airport elevated stations.
  - S-1B: W-Line GCP Branch with one off-Airport underground station.
- S-2: N/W-Line Extension via 31st St/19th Ave.

Each subway option was initially evaluated with either two elevated stations on-Airport serving Terminals B and C or one subterranean station to the south of the GCP. The off-Airport, underground station solution for Option S-2 was deemed unviable during assessment and dropped from the evaluation; further details are included in this option's description later in this section.

For the branch service to the Airport, service frequencies of 15 minutes could be achieved, whereas for a subway extension, the frequencies would range between 4 to 12 minutes depending on time of day. For both the branch option and the extension option, the overnight headway would be the standard 20-minute headway for overnight Subway services on all lines.

In all cases Subway services would be operated, as they are now, by MTA and would be expected to retain their existing customer experience characteristics. These would make them generally straightforward for users to negotiate, though there would be potential to develop signage and information systems to assist Airport passengers traveling to or from LGA and unfamiliar with the Subway system.

New stations to serve LGA would be built ADA-compliant and equipped for the handling of Airport passengers and their luggage.

Plan and profile alignment drawings for each of the subway alignments can be found in Appendix Section 2.1, which includes the proposed layouts of the options as evaluated.

4.1 S-1: W-Line Branch via the Grand Central Parkway

Option S-1 would take advantage of the GCP transportation corridor between Astoria and LGA, creating a branch line beginning south of the Astoria Blvd Station to divert some W-Line trains directly to the Airport. Locating the proposed subway within the GCP transportation corridor would minimize the direct impact of the subway on local communities. Two sub-options were assessed with either two on-Airport elevated stations (S-1A) or one off-Airport underground station (S-1B). The on-Airport sub-option offers Airport passengers the convenience of direct access to Airport Terminals B and C but with the complexity of constructing large Subway stations within the confines of the Airport, including substantial infrastructure and buildings mandated by MTA requirements for terminus stations. The off-Airport station (south of the GCP) would provide a new subway station closer to the East Elmhurst community but bring significant construction impacts closer to these communities.

Option Route Description

This option would connect the Airport to the existing Subway W-Line by constructing a new dual-track branch between the existing 30th Ave and Astoria Blvd Subway stations. The new northbound track would branch just south of the existing Astoria Blvd Subway station, requiring reconfiguration of the existing northbound station platform approximately 100 ft further north, and turn east over Columbus Sq Park. The new southbound track would branch further south and would run adjacent to the western edge of the existing line, rising to pass over the existing Astoria Blvd Station as it turns to the east. The two tracks would rejoin in the GCP ROW. The route would then follow the ROW of the GCP on an elevated guideway for approximately 2 miles.

Along the GCP, the route would pass over multiple GCP overpasses, and would have to contend with the construction challenges of crossing the Hell Gate rail trestle and complying with FAA Airport Design Standards at the end of Runway 04-22 while negotiating the 90-year-old utilities under the GCP. As discussed in more detail in Section 3.2.1.1.2, the alignment as evaluated for this option would pass above the Hell Gate rail trestle. As discussed in detail in Section 3.2.1.1.1, the heavier infrastructure options from the west must overcome the significant challenges and complexities presented by the twin constraints of the FAA Airport Design Standards and the existing large-diameter, 90-year-old utility structures along the GCP. The preliminary engineering work carried out by the study team has not identified a construction approach that, with confidence, could do this without more complex, risky, and costly approaches to construction that would require greater engineering exploration beyond the scope of this study. To provide a consistent basis on which to evaluate the option and to allow cost comparison between the options, Option S-1 is based on the baseline, simpler construction, concept of an open trench structure located in the embankment to the south of the eastbound GCP roadway, despite this being shown to be not compliant with the FAA Airport Design Standards.

Once east of Runway 04-22, two variations of this option were evaluated:

Sub-Option S-1A: W-Line GCP Branch with Two On-Airport Elevated Stations

The Sub-Option S-1A route would ascend east of Runway 04-22 back to an elevated structure, crossing over the GCP to connect to two elevated on-Airport Subway stations: one serving Terminal B and one serving Terminal C (see Figure 4.1-1 below).

Sub-Option S-1B: W-Line GCP Branch with One Off-Airport Underground Station

The Sub-Option S-1B route would descend east of Runway 04-22 into a tunnel to a single underground Subway station south of the GCP with passenger bridges over the GCP connecting the station with each terminal (see Figure 4.1-2 below).

The proposed subway stations (elevated on-Airport or underground off-Airport) would be sized to support 600 ft subway train lengths and, following MTA guidelines, provide 35,000 sf (intermediate station) and 70,000 sf (terminus station) of back-of-house space for staff accommodation, and plant, maintenance, and operations room requirements. The resulting size and layout of the station areas dictated the selected on-Airport station positions in relation to the Airport Terminals B and C (see Appendix Section 2.1 for detailed route alignments with indicative station positions), utilizing below-track mezzanine areas to accommodate the necessary space requirements.

FIGURE 4.1-1: SUB-OPTION S-1A

This option being a branch of the N/W-Lines would split existing subway service with four W-trains per hour (tph) terminating at LGA at all times except overnight. The remaining W- and all N-trains would terminate at Astoria-Ditmars Blvd Station. This would reduce the N/W-Line service to Astoria Blvd and Astoria-Ditmars Blvd Stations to 11 tph during the weekday peak, and 6 tph during the weekday off-peak, a reduction of 27% and 33% respectively. As a new branch extension of the Subway W-Line, the terminus station at LGA would be sized to accommodate MTA 'back-of-house' requirements for service and systems operations, crew change, etc. (resulting in the 70,000-sf space allowance described above). The existing MTA operations, maintenance, and storage yards would continue to be used for vehicle maintenance and storage with this option.

The branch length would be approximately 3 miles, including the on-Airport portion.

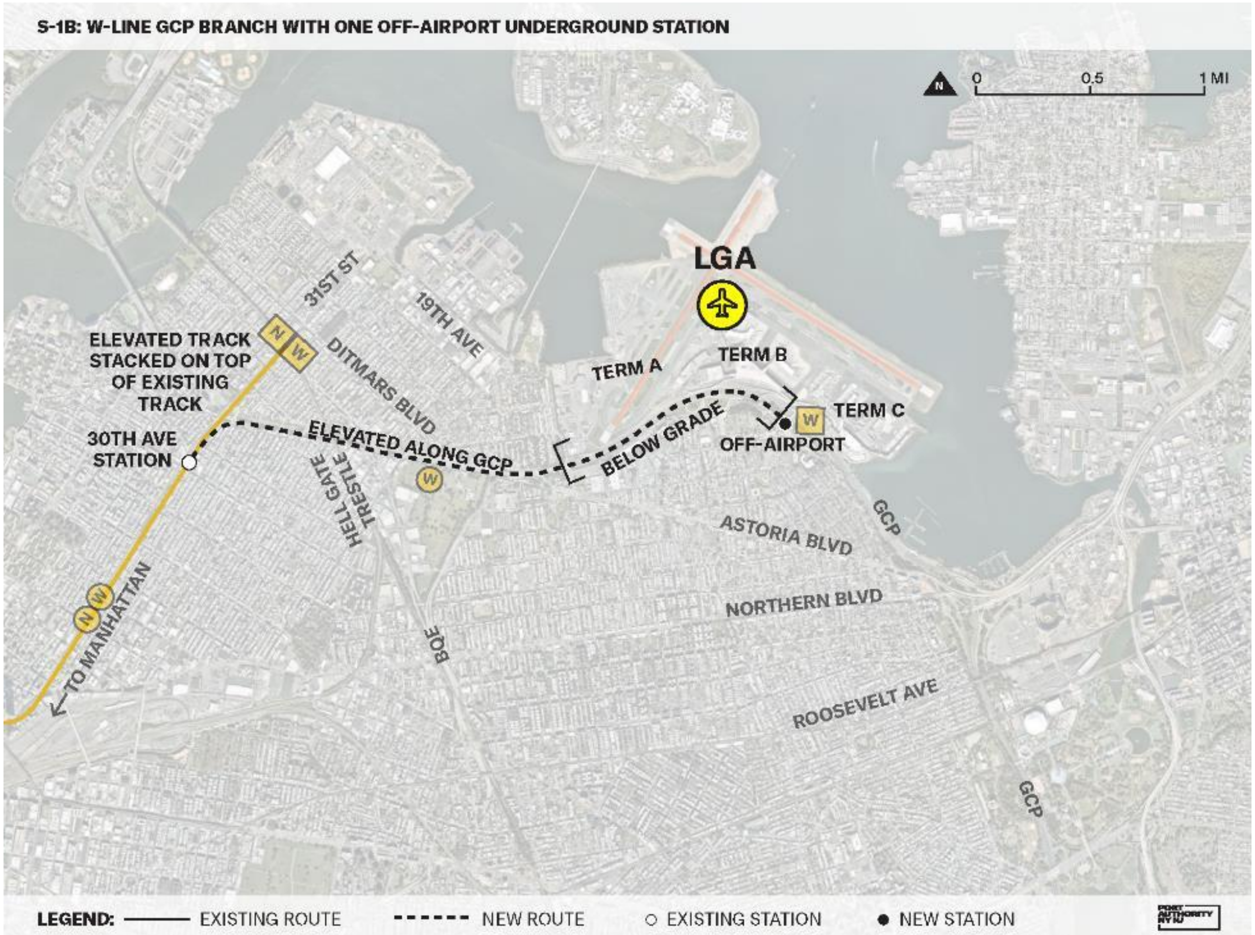


FIGURE 4.1-2: SUB-OPTION S-1B

4.1.1 Evaluation of Construction Aspects

4.1.1.1 Constructability

This option would require major heavy civil construction activities to build the aerial guideway foundations, structures, and stations along the route.

<u>Sub-Options S-1A and S-1B</u>

The notable construction challenges and complexities common to both the option variations of two on-Airport stations (S-1A) and one underground off-Airport station (S-1B) are summarized below.

- **Construction of the Tie-in to the Existing NYCT N/W-Lines South of Astoria Blvd Station**
  - The proposed subway line branches would transition from the existing outside tracks south of Astoria Blvd Station. The southbound track would ascend over the existing tracks and station canopy to branch into the GCP, and the northbound track would transition flat into the GCP. Construction would be within 50 ft of residential and

commercial properties. To enable the northbound branch to curve further than 35 ft around the existing buildings on 31st St and Astoria Blvd, preliminary analysis identified the existing northbound platform of Astoria Blvd Subway station would have to be relocated approximately 100 ft north. An allowance is included in the construction cost estimate for this work.

- Track switches, station platform relocation, and structural modification work to the existing Subway structure would require full track and station closures with trains terminating at a station earlier on the lines as described in the "Infrastructure Impacts during Construction" section. All modification work to the existing station, construction work around and interfacing with the existing lines, integration, commissioning, and trial operations would require working within and on a live operational rail environment. These would require construction activities to be undertaken during limited hours and under strict safety protocols agreed to by MTA, which would prolong construction; these factors have been reflected in the construction cost estimate and program for this work.
- MTA would require review and approval of all work to their station and the proposed methods to undertake that work.
- Constrained access along 31st St under and around the existing Subway structure, within 50 ft of residences and businesses, would constrain the use of large construction equipment and cranes except for short periods; it would also limit any overnight work. This is reflected in the Indicative Timeline/Schedule as increased durations for these activities.

- **Locating Piers in GCP between 31st St and Hell Gate Rail Trestle**
  - The aerial branch track turnouts to LGA begin south of Astoria Blvd Station, pass into the GCP ROW, and over 33rd St Bridge and Astoria Blvd North before following the GCP median between 35th St and the Hell Gate rail trestle. The elevated southbound track would require tall piers and long-span structures to reach the necessary elevation as it passes above Astoria Blvd Subway station. Additional costs are included in the construction cost estimate for these structures.
  - The aerial subway structure supports would straddle the GCP roadways and the GCP off-ramp to Astoria Blvd North with columns located in the median and embankments as required. GCP and Astoria Blvd North roadway modifications would be required to accommodate the piers in the median; preliminary analysis determined that modification of the GCP off-ramp to Astoria Blvd North could be avoided. An allowance for the roadwork is included in the construction cost estimate for this option.
  - Construction of the guideway along the GCP median would occur in a very constrained, narrow area with limited access for construction vehicles and materials and would lead to inefficient working practices and design solutions. This is reflected as an increase in the construction cost estimate over standard rates in this area and in the durations used for the schedule activities.

- **Feasibility of Going over the Hell Gate Rail Trestle**
  - As discussed in Section 3.2.1.1.2, the proposed solution for this evaluation would be to go over the trestle structure but with the permanent lowering of the electrical power transmission and messenger wires above the catenary to minimize the overall height of the subway guideway structure. The resultant gradient of the final alignment would exceed the MTA design standards for subway tracks; however, after consultation with MTA's track operations and maintenance departments, the study team was confident the proposed track gradient could be found acceptable after a detailed review.
  - The structure over the trestle would require complex engineering solutions involving tall (approximately 90–100 ft above the GCP roadway – highest in the MTA Subway system), and long-span (approximately 150–200 ft) structures and re-routing of the overhead electrical power lines and messenger wires. An additional cost allowance has been included in the construction cost estimate for this option to account for the increased complexity.
  - The required modifications to the electrical power transmission and messenger wires would require periodic closure of the NEC rail operations. Scheduling these 'outages' and receiving agreement from Amtrak would be very challenging due to the 24-hour operation of the passenger and freight services using the lines. Outages would need to occur during off-peak, overnight, or weekend line closures or during planned Amtrak maintenance periods, resulting in an extended construction period for this work. This is included in the Indicative Timeline/Schedule for this option.

- **Locating Piers between GCP and Astoria Blvd South to the North of St Michael's Cemetery**
  - The aerial subway structure would remain south of the GCP and continue east until reaching St Michael's Cemetery where it would run above ground adjacent to the cemetery. At this point, the available ROW is not sufficient to locate the structure piers and foundations without permanently impacting either the GCP or Astoria Blvd South roadways. Therefore, the study team located the piers in the northernmost lane of Astoria Blvd South, thus avoiding any reduction in the GCP lanes and shoulder widths. However, this would remove the use of one traffic lane along this stretch of Astoria Blvd South. Traffic impacts would need to be carefully studied.
  - Locating piers along the north side of Astoria Blvd South would require reconstruction of the Astoria Blvd South roadways, shoulder, and retaining wall along the south side of the eastbound GCP; a cost allowance for this work is included in the construction cost estimate for the option. The available space to safely conduct construction activities within Astoria Blvd South and adjacent to the GCP is very constrained, restricting efficient working conditions and prolonging construction durations. This is included in the schedule duration for this construction activity.

- **Major Constructability Challenge of Compliance with FAA Airport Design Standards while also Avoiding Disruption to 90-year-old NYC DEP Underground Sewer Structures (See also Section 3.2.1.1.1)**
  - This option's alignment crosses an area south of Runway 04-22 that is subject to FAA regulations regarding the safe operation of the Airport. This presents a major constructability challenge (described in greater detail in Section 3.2.1.1.1) to negotiate the twin constraints of the FAA Airport Design Standards (governing the construction of new infrastructure in this area) and the existing large-diameter utilities located along and beneath the GCP.
  - The preliminary engineering work carried out by the study team has not identified a construction approach that it could conclude with confidence would practicably overcome these challenges.
  - For the purposes of providing a basis on which to compare options that must pass the end of Runway 04-22, this option was evaluated using the baseline construction concept of an open trench structure located in the embankment to the south of the eastbound GCP roadway, despite this concept being shown to be not compliant with the FAA Airport Design Standards. To provide the Indicative Capital Cost and Timeline/Schedule, the following construction elements for this construction concept:
    - A transition structure taking the subway alignment from an elevated structure into the open trench between the Eastbound BQE Connector/GCP intersection and Astoria Blvd North overpass. The transition structure would be constrained between Astoria Blvd South, the GCP, and the Eastbound BQE Connector northbound roadway.
    - Reconstruction of the GCP on-ramp from Astoria Blvd South at 77th St over the guideway to re-provide traffic access to the GCP around the new transition structure.
    - Reconstruction of the 82nd St Bridge. The open trench structure would have to pass through the existing south abutment of the 82nd St Bridge over the GCP, requiring the bridge to be demolished and reconstructed to accommodate the open trench structure.
    - Construction of a below-grade, open-trench structure south of Runway 04-22, staying above the existing major utilities along the GCP.
    - Strengthening of the existing utilities and/or construction of concrete protection slabs above them.
    - Relocation of the existing runway lights (located between the GCP and Ditmars Blvd).

- **Constructability Risks Not Included in the Cost Estimate Range (–10% to +30%) Common to Both Sub-Options S-1A and S-1B**
  - Scale of construction work required to cross the Hell Gate rail trestle: While the proposed relocation of the electrical lines has been determined to be a technically feasible solution, it would require an iterative detailed design process with Amtrak, CSX,

and other involved partner agencies, with an uncertain likelihood of success in finding an acceptable solution. There is a residual risk that such coordination could lead to a requirement for the alignment to pass higher over the trestle (to avoid the power transmission and messenger wires). This would force the alignment to go higher over the trestle than in the current evaluation, requiring substantially taller support structures and deeper foundations and necessitate using larger cranes and other construction equipment to build. Although this could still be technically feasible, it would require more complex construction methodologies or the need for longer construction outages. This could result in significantly greater construction costs and longer construction schedule than currently accounted for in the evaluation, possibly resulting in the inability to pursue this option.

- Reaching an agreement with Amtrak on timing and length of outages for work on the Hell Gate rail trestle: There is a residual risk that service outages on the Hell Gate rail trestle take longer to acquire or are shorter or less frequent than requested. This could lead to delay in the lowering of the overhead cables and subsequently delay the construction of the elevated sections over the trestle structure. This could negatively impact timely completion of construction for the elevated guideway, leading to prolongation cost increases.
- Permanently reducing the travel lanes in Astoria Blvd South from three to two along St Michael's Cemetery (between 49th St and the Eastbound BQE Connector overpass): Discussions with NYC DOT during this study indicated they would accept the permanent lane reduction to accommodate the structure piers along this stretch of Astoria Blvd South subject to full review and approval during more detailed design development. There remains a residual risk if during the detailed review time, the proposal to permanently reduce the travel lanes is not accepted. Alternative solutions to support an elevated structure along this constrained stretch of the Astoria Blvd/GCP corridor could require much more complex structures straddling over the roadways and/or permanent shifting of the roadways themselves. Although the study team participants consider this risk to have a lower probability of occurring, the potential construction cost and schedule implications could be significant.
- Scale of track and systems tie-in work required to construct the branch connection: There is a residual risk that, as engineering design matures and through coordination with the MTA, further constraints to construction methods and/or greater construction complexities are identified for the tie-in at Astoria Blvd Subway station. The study team concluded that this is a risk that would be considered typical of interface work of this type but could still have the potential to result in large increases in construction costs and schedule prolongation.
- Accommodating the proposed Subway structures, piers, and foundations within the GCP ROW: There is a residual risk that, during detailed design coordination with NYS DOT (and FHWA where applicable), more complex support structures than currently envisaged could be required to avoid introducing non-standard roadway elements to the existing highways or to allow existing non-standard elements to be brought up to current standards (in the future by NYS DOT). The study team concluded that is a risk

typical of work in and around existing major highways but one that still has the potential to result in large increases in construction cost and schedule prolongation.

- Scale of utility strengthening and/or replacement work needed along the GCP: There is a residual risk that, once condition surveys of the existing large-diameter utilities under the GCP can be undertaken, the results identify the utilities to be in a poorer condition than currently evaluated. This could result in more intrusive strengthening or even replacement of the existing utilities before construction work can commence. This is a risk typical for major infrastructure work in close proximity to large legacy utilities; however, it could result in large increases in construction costs and delay to the start of construction, prolonging the overall schedule.

Sub-Option S-1A Only

From the end of Runway 04-22, Sub-Options S-1A and S-1B vary in their station locations (on- or off-Airport). The notable construction challenges and complexities specific to S-1A, with two on-Airport stations, are summarized below.

- **Constructing over 94th St and the GCP into the Airport**
  - Once past Runway 04-22, the alignment would ascend back to an elevated guideway structure to pass over the GCP onto the Airport.
  - The GCP eastbound off-ramp onto Ditmars Blvd near 90th St would require reconstruction to accommodate the aerial guideway in this area. An allowance has been included in the construction cost estimate for this work.
  - The aerial guideway crossing over 94th St and both roadways of the GCP into the Airport would require long-span (approximately 250–300 ft) bridge structures. These would require complex engineering solutions and construction methods to span the roads while maintaining traffic mobility on the GCP and into the Airport on 94th St. This introduces increased construction costs over standard rates, which is reflected in the construction estimate.

- **On-Airport Elevated Stations: Constrained Construction Site Conditions**
  - Once on-Airport, the proposed subway serves two elevated Subway stations, sized to support 600-ft train operations, with fare control (turnstiles)/fare vending, customer information, circulation, and other ancillary facilities that would be constructed and integrated with the existing Airport terminal buildings. The stations would be environmentally conditioned and require approximately 35,000 sf and 70,000 sf of back-of-house space for the intermediate and terminal stations, respectively (following MTA guidelines for suitable staff accommodation and plant, maintenance, and operations room requirements). This is reflected in the construction cost estimate for the option.
  - Long-span (approximately 350-ft) bridge structures would be required over 102nd St and the newly constructed departures roadway. This would require structures to

elevate the guideway to approximately 70 ft above-grade to clear the multi-level roads while maintaining airport operability, resulting in complex engineering solutions and construction methods. This introduces increased construction costs over standard rate and is reflected in the construction estimate.

- Constructing the stations and elevated structures within a constrained, operational airport environment would reduce the construction sequence efficiency, introducing construction complexities and prolonging construction activities. This is reflected in the Indicative Timeline/Schedule for this area of the option.
- Construction work in and around the Airport terminals and over Airport roadways would be subject to acceptance by the FAA.

- **Constructability Risks Not Included in the Cost Estimate Range (–10% to +30%) Specific to Sub-Option S-1A Only:**

  - Scale of on-Airport structures or modifications to on-Airport roads required to accommodate new Subway stations and elevated track: The study has evaluated an alignment that, at this stage of development, can be accommodated within the existing Airport buildings and roadway structures. There remains a residual risk that, once more detailed surveys of the existing structures and their foundations are conducted, more complex or longer span structures are required than currently evaluated and/or structural modifications could be required to the existing on-Airport roadways and support structures. This risk is typical for infrastructure of this type in such constrained and highly built-up areas; however, considering the relatively large size requirements of the Subway stations it could still result in large increases in construction costs over those accounted for in this evaluation.

Sub-Option S-1B Only

Sub-Option S-1B, with one off-Airport station, has the following notable challenges and complexities associated with the different construction activities required for the underground station. These vary from those for Sub-Option S-1A east of the Runway 04-22 RPZ constraint and are summarized as:

- **Constructing over Existing Below-Ground Sewers**

  - The alignment adjacent to the GCP would descend to a cut-and-cover tunnel before reaching 94th St and the on-ramp to the GCP. In addition to the interfaces with the 11- by 5-ft double-barrel storm reinforced concrete sewer (80th St), 11.75- by 8-ft double-barrel combined sewer (82nd St), and 10- by 9-ft interceptor (90th St), the cut-and-cover section required for the underground station option would run adjacent to another 7- by 5.5-ft combined sewer outfall (CSO).
  - At this stage of development, it has been determined that the elevation of the below-grade guideway could be designed to avoid reconstruction or replacement of existing utilities, although strengthening and/or protection slabs would be required to prevent

damage. An allowance for the cost of strengthening has been included in the construction cost estimate.

- All construction work proposed near these major utilities would require coordination with and acceptance by the NYC DEP before work can commence (which has been included in the Indicative Timeline/Schedule).

- **Constructing beneath 94th St and the GCP On-Ramp from the Airport**
  - The GCP eastbound off-ramp onto Ditmars Blvd near 90th St would require reconstruction to accommodate the aerial guideway in this area. An allowance has been included in the construction cost estimate for this work.
  - The cut-and-cover tunnel crossing beneath 94th St and the eastbound GCP on-ramp would require demolition and reconstruction of these roadways over the completed tunnel. These would require complex engineering solutions and construction methods to construct the tunnel while maintaining traffic mobility on the GCP and into the Airport on 94th St. This introduces increased construction costs over standard rates, which is reflected in the construction estimate, and construction duration prolongation, which is included in the schedule.

- **Off-Airport Underground Station and Passenger Connection to LGA**
  - The single off-Airport station would be located south of the GCP, between the GCP and Ditmars Blvd underneath 102nd St and sized to support 600-ft train operations. The station would be environmentally conditioned and require approximately 70,000 sf of back-of-house space (following MTA guidelines for suitable staff accommodation and plant, maintenance, and operations room requirements). Connectivity to LGA would be provided by two vertical circulation towers from the station to elevated, environmentally conditioned, passenger walkway structures with fare control (turnstiles)/fare vending, customer information, circulation, and other ancillary facilities, linking each to Terminal B at the Central Hall and Terminal C at the Delta Connector. An allowance for the cost of these structures and space is included in the construction cost estimate for this sub-option.
  - Construction of the underground station would require protection and temporary support of an existing 3’-9” by 5’-7” egg-shaped sewer. These costs are included in the construction cost estimate for the sub-option.
  - Access to and from the Airport via 102nd St would be maintained in part for as long as is practicable during construction. This would constrain the construction activities on either side of 102nd St and/or require construction of a temporary access during station box excavation. This would reduce the construction sequence efficiency, introducing construction complexities, and prolong construction activities. This is reflected in the Indicative Timeline/Schedule for this area of the option.
  - Construction work in and around the Airport terminals and over Airport roadways for the passenger connectors would be constrained and limited to off-peak periods to

minimize airport disruption. This is included in the schedule durations used for this work.

- **Constructability Risks Not Included in the Cost Estimate Range (–10% to +30%) Specific to Sub-Option S-1B Only**
  - Scale of work required to construct underground station: There remains a risk that, once ground surveys and condition surveys of existing utilities can be undertaken, they identify additional complexities and constraints on construction methodologies not covered in the current evaluation. This is a risk that could be considered typical for large-scale and deep excavations of this type but could result in large increases in construction costs and program delays from additional work required to mitigate poor ground conditions or strengthen/relocate utilities.

4.1.1.2 Infrastructure Impacts during Construction

Sub-Options S-1A and S-1B

Construction of these sub-options would result in temporary disruption to other major infrastructure along the route, which would last over 2–3 years for S-1A or 3–4 years for S-1B. The notable areas of temporary infrastructure disruption common to both Sub-Options S-1A and S-1B are summarized below. The durations given below are indicative and based on preliminary assessment.

- **Operational Disruption to N- & W-Line Subway Services**
  - 10–20 off-peak, overnight, or weekend single (alternating) track and full station closures would be expected over a period of 6–9 months to conduct intrusive construction modification work to the existing Subway structure and tracks.
  - Up to 5 off-peak, overnight, or weekend station closures would be expected over a period of 2–4 months to provide safe operations for bridge structure erection over the track and platforms.
  - 20–30 off-peak, overnight, and/or weekend single track and full station closures over a period of 9–18 months would be necessary to relocate the northbound platform approximately 100 ft further north.
  - 5–10 off-peak, overnight, or weekend single (alternating) track and full station closures would be expected over a period of 3–6 months to install systems links to the extension.
  - 5–10 off-peak, overnight, or weekend full track and station closures would be expected over a period of 4–8 months to conduct systems integration tests and trial operations. During trial operations, services would terminate for passengers at 30th Ave Station and continue in non-revenue service along the new branch.
  - Coordination with MTA during more detailed development may be able to combine activities to reduce the impact to the service or assess that a full closure of the station over a longer duration (vs shorter weekend closures over a prolonged period) would be more effective.

  - During the (cumulative 40–75) planned periodic closures, to avoid full line closure and terminating all services back to Queensboro Plaza Station, services would bypass the single closed track using the other one or more available tracks. Five stations (39th Ave, 36th Ave, Broadway, 30th Ave, and Astoria Blvd) would be bypassed in the direction of the bypass during these periods, with replacement transit (shuttle bus) services needed to serve all these stations. In the non-bypass direction, only Astoria Blvd would be bypassed in the case of a full-station closure. This would need to be coordinated with and agreed to by MTA.

- **Lane Narrowing, Traffic Diversions, and Speed Restrictions on GCP and Astoria Blvd South**
  - Narrowing of the east- and westbound GCP lanes, traffic speed restrictions, and temporary closure of the shoulder between 31st St and the Hell Gate rail trestle would be required for 9–18 months to provide safe construction access for piling, foundation, and pier work in the GCP median and embankment between Astoria Blvd North and the westbound roadway.
  - 10–20 overnight lane closures and speed restrictions would be anticipated on the eastbound GCP roadway over a period of 6–12 months during erection of overhead bridge structures and deck.
  - Up to 5 overnight or weekend closures of the GCP off-ramp to Astoria Blvd North at 33rd St would be required over a period of 3–6 months during erection of overhead bridge structures and deck.

- **Temporary Periods of Operational Disruption to Rail Services on the Hell Gate Rail Trestle**
  - The (11–22 cumulative) periodic closures described below would result in suspended Amtrak Northeast Corridor passenger, and CSX freight services requiring alternate travel and freight arrangements, generating disruption and inconvenience during these times. This would require careful coordination with both Amtrak and CSX (and any other users of the Northeast Corridor tracks) to agree the timing and length of proposed closures in advance of the work.
  - 5–10 off-peak, overnight, or weekend full track closures of the Amtrak and CSX rail lines would be expected over a period of 6–9 months during work to tie-in new overhead power and messenger wires and remove the redundant cabling.
  - 4–8 off-peak, overnight, or weekend partial track closures of the Amtrak and CSX rail lines would be expected over a period of 4–6 months while cranes and other tall equipment are used to construct the guideway piers adjacent to the trestle.
  - 2–4 off-peak, overnight, or weekend full track closures of the Amtrak and CSX rail lines would be expected over a period of 2–4 months during erection of overhead guideway bridge structures and deck.

- **Off-Peak Closures of the Westbound BQE Connector with the GCP**
  - 5–10 off-peak, overnight, or weekend alternating closures of the north- and southbound Westbound BQE Connectors would be expected over a period of 2–6 months during erection of overhead bridge structures and deck.

- **Lane Narrowing, Traffic Diversions, and Speed Restrictions on GCP and Astoria Blvd South**
  - Narrowing of the eastbound GCP lanes, traffic speed restrictions, and temporary closure of the shoulder between 49th St and the Eastbound BQE Connector intersection would be required for 9–18 months to provide safe construction access for adjacent piling, foundation, and pier work in Astoria Blvd South.
  - 10–20 overnight lane closures and temporary speed restrictions on the eastbound GCP would be required over a period of 6–12 months during erection of overhead bridge structures and deck.

- **Lane Narrowing, Traffic Diversions, and Speed Restrictions at the Eastbound BQE Connector/GCP Intersection**
  - Up to 5 overnight or weekend closures of the Eastbound BQE Connector northbound roadway to the GCP would be required over a 2- to 4-month period during erection of overhead bridge structures. Traffic would be diverted via the off-ramp to Boody St, Astoria Blvd South, and the on-ramp to the GCP at 77th St.
  - Closure of the GCP on-ramp from Astoria Blvd South and 77th St for 1–2 months would be necessary while transitioning to the new, relocated on-ramp. Traffic diversions would be required via 23rd Ave and Ditmars Blvd.

Sub-Option S-1A only

Sub-Option S-1A would have the following notable areas of temporary infrastructure disruption specific to the two elevated stations on-Airport, summarized below. The durations given below are indicative and based on preliminary assessment.

- **Lane Narrowing, Traffic Diversions, and Speed Restrictions on the GCP**
  - Narrowing of the eastbound GCP lanes and traffic speed restrictions between the Astoria Blvd North overpass and 94th St would be required for 9–18 months to provide safe construction access to the eastbound shoulder during construction of the at- and below-grade guideway located between the GCP and 23rd Ave.
  - Full closure of the Ditmars Blvd GCP off-ramp for 1–2 months would be required while transitioning to a new, relocated off-ramp. Traffic diversions would be required via the Astoria Blvd South off-ramp.
  - 2–4 overnight road closures and traffic diversions would be required over a period of 1–2 weeks to erect long-span bridge sections over the GCP into the Airport.

- 10–15 off-peak, overnight, and/or weekend road closures on the GCP and traffic diversions would be needed over a period of 12–18 months to demolish the 82nd St Bridge deck and erect new deck structure.
- Lane closures over a period of 12–18 months on the 82nd St crossing of the GCP would be needed; these would be conducted one roadway at a time so that two-way traffic could still cross the bridge, albeit via a reduced number of traffic lanes.

- **Disruption to Intra-Airport Services and Facilities**
  - Increased construction traffic around Terminals B and C for 1–2 years would require a coordinated traffic management plan to avoid/minimize potential on-Airport traffic disruption.
  - 20–50, off-peak overnight, and/or weekend lane and road closures of on-Airport access roads would be necessary for up to 3 years during long-span bridge section erection and other elevated structure and station work.
  - Airport user inconvenience could potentially occur to certain portions of Airport facilities for 2–4 months during construction of customer transfer connections and circulation. This would require a coordinated traffic management plan to avoid/minimize potential traffic disruption.

Sub-Option S-1B Only

The notable areas of temporary infrastructure disruption are summarized below for Sub-Option S-1B, with one off-Airport station. These vary from those for Sub-Option S-1A east of the Runway 04-22 RPZ constraint. The durations given below are indicative and based on preliminary assessment:

- **Lane Narrowing, Traffic Diversions, and Speed Restrictions on GCP**
  - Narrowing of the eastbound GCP lanes and traffic speed restrictions between the Astoria Blvd North overpass and 94th St would be required for 9–18 months to provide safe construction access to the eastbound shoulder during construction of the at- and below-grade guideway located between the GCP and 23rd Ave.
  - Full closure of the Ditmars Blvd GCP off-ramp for 1–2 months would be required while transitioning to a new, relocated off-ramp. Traffic diversions would be required via the Astoria Blvd South off-ramp.
  - Full closure of the 94th St GCP on-ramp for 1–2 months would be required while transitioning to a new, relocated on-ramp. Traffic diversions would be required via Ditmars Blvd.
  - 2–4 overnight road closures and traffic diversions would be required over a period of 1–2 weeks to erect pedestrian walkway bridge sections over the GCP into the Airport.
  - 10–15 off-peak, overnight, and/or weekend road closures on the GCP and traffic diversions would be needed over a period of 12–18 months to demolish the 82nd St Bridge deck and erect new deck structure.

  - Lane closures over a period of 12–18 months on the 82nd St crossing of the GCP would be needed. These would be conducted one roadway at a time so that two-way traffic could still cross the bridge, albeit via a reduced number of traffic lanes.

- **Disruption to Intra-Airport Services and Facilities**
  - 5–10 off-peak, overnight, and/or weekend lane and road closures of on-Airport access roads would be expected over a period of up to a year during erection of the elevated passenger walkway and other elevated structures. This would require a coordinated traffic management plan to avoid/minimize potential On-Airport traffic disruption.
  - Airport user inconvenience could potentially occur to certain portions of Airport facilities for 2–4 months during construction of customer transfer connections and circulation.
  - Reduced airport hotel capacity is likely for up to 6 years following demolition of hotels adjacent to 102nd St and Ditmars Blvd to make way for the underground station. Patrons would use hotels further from the Airport and require transportation to/from the Airport. This would require a coordinated traffic management plan to avoid/minimize potential traffic disruption.

4.1.1.3 Permanent/Operational Impacts to Existing Infrastructure

<u>Sub-Options S-1A and S-1B</u>

Once completed, the following permanent/operational impacts on other infrastructure would be common to both Sub-Options S-1A and S-1B:

- **Splitting of W-Line Subway Services**
  - MTA would operate the new subway service to the Airport as a branch of the Broadway Astoria W-Line Subway service; current MTA plans envisage 4 tph (3 tph night).
  - Service frequency to stations at Astoria-Ditmars Blvd and Astoria Blvd would suffer some reductions, although MTA plans to mitigate this by provision of some additional W services (doubling of the overnight service to 6 tph in each direction south of Astoria Blvd), with N services unchanged.
  - Splitting the line south of Astoria Blvd would add additional complexity to the operation of the BMT Broadway Line services, which include the Q, N, W, and R services operating over six branches and a central section incorporating two routes between Brooklyn and Manhattan. W trains do not normally run on weekends at present; revisions to the service would be required to either extend the W trains or run selected N trains to the Airport into the weekend. Modification of weekend services may at times be necessary in response to the planned construction and maintenance work.
  - Future modernization of train control systems may offer opportunities to increase overall service levels on the system, though capacity to handle the additional Airport traffic is not in doubt.

- **Grand Central Parkway**
  - The permanent location of elevated structure piers in the GCP median and embankment between 33rd St and 49th St and on Astoria Blvd South to the north of St Michael's Cemetery could restrict any future NYS DOT roadway improvement plans to widen or adjust the GCP in these areas.
  - The on-ramp to the eastbound GCP from Astoria Blvd South and 77th St would be permanently relocated to accommodate the subway transition structure.
  - The off-ramp from the eastbound GCP to Ditmars Blvd would be permanently relocated to accommodate the elevated structure over 94th St.
  - The completed subway structure would restrict any future NYS DOT roadway improvement plans to widen or adjust the GCP between 77th St and 90th St.

- **Astoria Blvd South**
  - The elevated subway structure piers in Astoria Blvd South to the north of St Michael's Cemetery would require the permanent reduction of Astoria Blvd South from three to two traffic lanes between 49th St and the GCP off-ramp. Discussions with NYC DOT indicate this could be possible but would require NYC DOT review and approval during future detailed development should this option be selected for further study.

Sub-Option S-1A

Once completed, the following permanent/operational impacts on other infrastructure would be specific to Sub-Option S-1A only:

- **Impacts on LGA (Sub-Option S-1A Only, Two On-Airport Stations)**
  - The location of the aerial guideway and Subway station in front of Terminal B would result in the construction of structure piers and frames in the area that has currently been identified to be the future permanent Terminal B taxi hold. This could prevent the taxi hold from using this location, requiring an alternate location, which may not be as operationally efficient.

4.1.1.4 Indicative Capital Cost

Sub-Option S-1A

The Indicative Capital Cost for Sub-Option S-1A is $5.9 billion (in 2022$, excluding future escalation and solely for approximate comparison between study options).

Indicative Capital Costs should be considered to have a range of estimating uncertainty of -10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).

As discussed in more detail in Section 3.2.1.1.1, the preliminary engineering work carried out by the study team has not identified a construction approach that, with confidence, could overcome the significant challenges and complexities presented by the twin constraints of the FAA Airport Design Standards and the existing large-diameter, 90-year-old utility structures along the GCP without more complex, risky, and costly approaches to construction that would require greater engineering exploration beyond the scope of this study. Therefore, to provide a basis of an order-of-magnitude cost on which to compare between options, this option was costed out using the (least cost) baseline solution of an open trench south of Runway 04-22, despite this approach not being compliant with FAA Airport Design Standards. Costs associated with an FAA compliant tunneled solution which could require replacement or relocation of existing sewer structures could result in additional costs of between $1–3 billion.

The following are the notable cost drivers for the option:

- New elevated intermediate and terminal Subway stations, back-of-house, and connectors at LGA.
- Aerial guideway structure along GCP and on-Airport.
- Transition structure and at- and below-grade guideway along GCP (open trench structure south of Runway 04-22).
- Additional subway vehicles.
- Replacement of the 82nd St Bridge (to accommodate open trench structure south of Runway 04-22).
- Long-span crossings on-Airport.
- Tall, long-span structure over Hell Gate rail trestle.
- Relocation of existing Astoria Blvd Station platform 100 ft further north.
- Long-span structure over Astoria Blvd Station.
- Relocation of the GCP off-ramp to Ditmars Blvd.
- Relocation of the Astoria Blvd South on-ramp to GCP (at 77th St).
- Track tie-in into existing subway lines before Astoria Blvd Station and new elevated structure over station platforms and Columbus Sq Park.

Sub-Option S-1B

The Indicative Capital Cost for Sub-Option S-1B is $6.6 billion (in 2022$, excluding future escalation and solely for approximate comparison between study options).

Indicative Capital Costs should be considered to have a range of estimating uncertainty of -10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).

As discussed in more detail in Section 3.2.1.1.1, the preliminary engineering work carried out by the study team has not identified a construction approach that, with confidence, could overcome the significant challenges and complexities presented by the twin constraints of the FAA Airport Design Standards and the existing large-diameter, 90-year-old utility structures along the GCP without more complex, risky, and costly approaches to construction that would require greater engineering exploration beyond the scope of this study. Therefore, to provide a basis of an order-of-magnitude cost on which to compare between options, this option was costed out using the (least cost) baseline solution of an open trench south of Runway 04-22, despite this approach not being compliant with FAA Airport Design Standards. Costs associated with an FAA compliant tunneled solution which could require replacement or relocation of existing sewer structures could result in additional costs of between $1–3 billion.

The following are the notable cost drivers for the option:

- Aerial guideway structure along GCP.
- Cut-and-cover tunnel along GCP.
- New underground terminal Subway station and back-of-house south of the GCP.
- Transition structure and at- and below-grade guideway along GCP (open trench structure south of Runway 04-22).
- Additional subway vehicles.
- Replacement of the 82nd St Bridge (to accommodate open trench structure south of Runway 04-22).
- Vertical circulation and elevated passenger connectors over GCP to the Airport.
- Tall, long-span structure over Hell Gate rail trestle.
- Relocation of existing Astoria Blvd Station platform 100 ft further north.
- Allowances for utilities protection adjacent to tunnels.
- Long-span structure over Astoria Blvd Station.
- Track tie-in into existing subway lines before Astoria Blvd Station and new elevated structure over station platforms and Columbus Sq Park.
- Relocation of GCP off-ramp to Ditmars Blvd.
- Relocation of Astoria Blvd South on-ramp to GCP (at 77th St).

4.1.1.5 Indicative Timeline/Schedule

Sub-Option S-1A

The Indicative Timeline/Schedule (for comparison between study options) for Sub-Option S-1A is approximately 12–13 years from a decision to take the option forward to revenue service. This includes the following notable schedule drivers:

- Planning, approvals, and acquisitions.
- Procurement of design-build contractor(s) for heavy civil construction.
- Track tie-in before Astoria Blvd Station.
- Elevated guideway construction along GCP.
- Construction over Hell Gate rail trestle.
- Transition and 82nd St Bridge reconstruction (longest construction activity).
- On-Airport elevated stations and structure.
- Systems installation and testing.
- 18 months of integration testing and commissioning.

Figure 4.1-3 illustrates the indicative timeline/schedule for Sub-Option S-1A. The key drivers are the major civil construction work, which may trigger longer permitting, approvals, and procurement processes, and the integration and commissioning with existing NYCT systems.

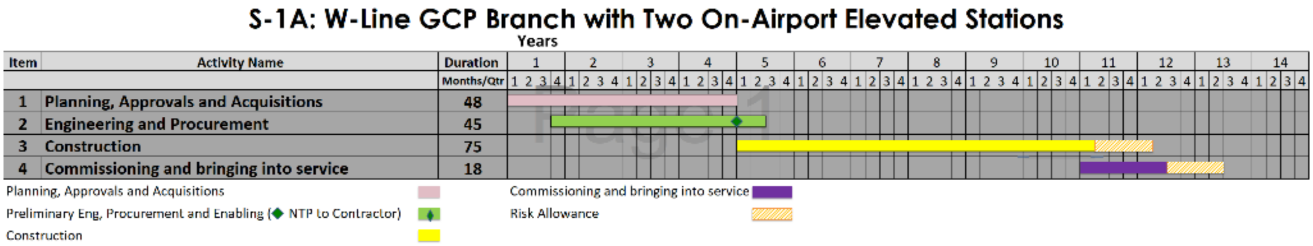


FIGURE 4.1-3: INDICATIVE TIMELINE/SCHEDULE (S-1A)

Sub-Option S-1B

The Indicative Timeline/Schedule (for comparison between study options) for Sub-Option S-1B is approximately 12–13 years from a decision to take the option forward to revenue service. This includes the following notable schedule drivers:

- Planning, approvals, and acquisitions.
- Procurement of design-build contractor(s) for heavy civil construction.
- Track tie-in before Astoria Blvd Station.
- Elevated guideway construction along GCP.
- Construction over Hell Gate rail trestle.
- Transition and 82nd St Bridge reconstruction.
- Cut-and-cover tunnel to station.
- Off-Airport underground station and track (longest construction activity).
- Systems installation and testing.
- 18 months of integration testing and commissioning.

Figure 4.1-4 illustrates the indicative timeline/schedule for Sub-Option S-1B. The key drivers are the major civil construction work, which may trigger longer permitting, approvals, and procurement processes, and the integration and commissioning with existing NYCT systems.

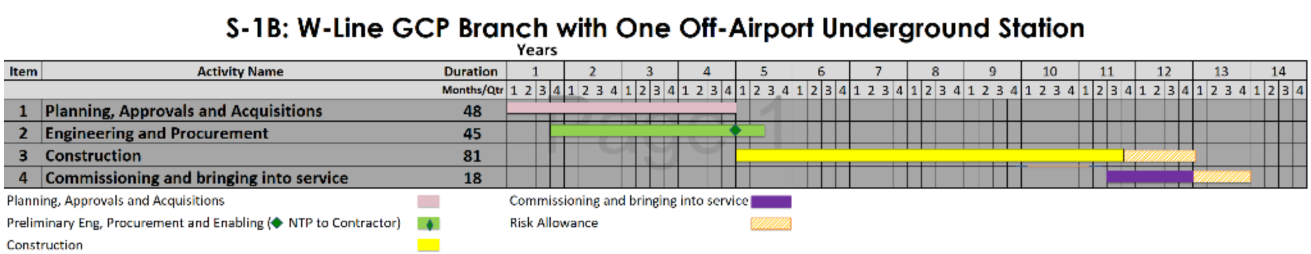


FIGURE 4.1-4: INDICATIVE TIMELINE/SCHEDULE (S-1B)

4.1.2 Transportation Aspects

4.1.2.1 Improved Access to LGA

Three factors have been considered in this category: Standardized Indicative Baseline Off-Peak Travel Time, Reliability, and Transfer Experience.

4.1.2.1.1 Standardized Indicative Baseline Off-Peak Travel Time

<u>Sub-Options S-1A and S-1B</u>

- Table 4.1-1, below, provides the Standardized Indicative Baseline Off-Peak Travel Times for the weekday, midday off-peak journeys to be used solely as a baseline for comparison between options. Table 4.1-2 provides a breakdown of the components that make up the total journey, the general approach to the estimation of which is described in Section 3.2.2.1.1.
- Passengers making the journeys described would, naturally, experience variations to the baseline timings calculated even where services are running as planned, for reasons as simple as variations in walking speeds or whether a traveler arrives just before a scheduled departure or just misses a departing train.

TABLE 4.1-1: STANDARDIZED INDICATIVE BASELINE OFF-PEAK TRAVEL TIMES, OPTION S-1

Times Square to LGA (minutes to first terminal reached)	S-1A	S-1B
Via direct Subway (W train)	31	37

TABLE 4.1-2: STANDARDIZED INDICATIVE BASELINE OFF-PEAK TRAVEL TIMES BY SEGMENT, OPTION S-1

Times Square to LGA via direct Subway (minutes)	S-1A	S-1B
START Times Square (street level)		
walk/wait time	7	7
W Subway platform (dep)		
Subway trip time	24	25
1st On-Airport station (arr)	new elevated	-
Off-Airport station (arr)	-	new sub-surface
walk time to Airport (S-1B only)	-	5
END Terminal subway stop	Terminal B	Terminal C
Total travel time =	31	37
trip time to next Terminal subway stop	2	-
2nd on-Airport station	new elevated	-
walk time to Airport (S-1B only)	-	8
END Terminal subway stop	Terminal C	Terminal B
Total travel time =	36	45

- Passengers for Terminal A would transfer to an existing on-Airport shuttle service running every 10 minutes and with an additional trip time of around 7 minutes from Terminal B.

4.1.2.1.2 Reliability

Sub-Options S-1A and S-1B

- Sub-Options S-1A and S-1B operate exclusively on dedicated infrastructure separate from general roadway conditions.

4.1.2.1.3 Transfer Experience

Sub-Options S-1A and S-1B

- Riders bound for Terminals B or C from Midtown would have a one-seat ride to travel directly to LGA without requiring any transfers. Riders bound for Terminal A would have an additional transfer to an existing on-airport shuttle once they reach the airport.
- The sub-option with Subway stations located on-Airport (S-1A) would include two new fully enclosed, elevated Subway stations: one serving Terminal B and one serving Terminal C.
- The sub-option with a single Subway station located off-Airport (S-1B) would terminate in a new, underground Subway station south of the GCP. Riders would use elevators or escalators to ascend to elevated pedestrian connectors spanning the GCP to access Terminals B and C, an approximately 700 ft to 800 ft walk, depending on the terminal.

4.1.2.2 Ridership

Sub-Options S-1A and S-1B

- Stated preference survey results indicate that 61% of airport passenger respondents are "definitely" or "probably" interested in subway service to the Airport.
- The ridership model projects 6.3 and 4.7 million total riders using Sub-Options S-1A and S-1B, respectively, with corresponding increases in net transit ridership of 3.1 and 2.4 million riders in 2025 (Table 4.1-3).

TABLE 4.1-3: RIDERSHIP MODEL RESULT SUMMARY

Transit Option			Riders on Current Bus Services to LGA (Millions) (No Action)	New Transit Option Impact (Millions)		
Mode Category & Scenario Label		Description		Riders on New S-1 Subway Service	Net Increase in Total Transit Ridership	Total Transit Ridership (S-1 Subway Service + Other Bus Services)
Subway	S-1A	W GCP Branch, On-Airport	4.1	6.3	**3.7**	**7.7**
	S-1B	W GCP Branch, Off-Airport	4.1	4.7	**2.4**	**6.5**

4.1.2.3 Throughput and Capacity

Throughput

Sub-Options S-1A and S-1B

- Using the highest hourly single-direction provision of airline seats at LGA in 2019 (4,300 seats on weekday departing flights 9 AM to 10 AM – see Figure 3.2-1, in Section 3.2.2.3), the estimated single-direction peak passenger demand for each sub-option could be:
  - Sub-Option S-1A: approx. 690 passengers per hour.
  - Sub-Option S-1B: approx. 520 passengers per hour.
- This peak passenger throughout would occur Airport-bound in a 1–2-hour morning period in the opposite direction to the Manhattan-bound Subway passenger peak at that time of day. Peak passenger throughput during the Subway peak is considered below.

Capacity of New Transit Option

Sub-Options S-1A and S-1B

- MTA has indicated an intention to operate four services per hour to LGA at 15-minute average intervals along the branch. Using the current W Subway service configuration of 8-car trains and the MTA Rapid Transit Loading Guideline maximum passenger loadings per-car of 140 passengers (where headways extend to 10 minutes or more), gives a potential capacity of the proposed new subway branch between LGA and 30th Ave Station of:
  - 4,500 pphpd at peak.
- This is sufficient to support the estimated single-direction peak passenger demand from the ridership model, equating to approximately 175 passengers per train (Sub-Option S-1A) at peak with this proposed frequency.

Impact on Capacity of Existing Downstream Transit Systems

Sub-Options S-1A and S-1B

- Generally, airport passenger loadings are constant through the day both to and from the Airport with the peak passenger loadings occurring outside of the morning Manhattan-bound subway peaks or in the opposite direction (i.e., Airport-bound).
- The existing N- and W-Subway lines currently operate close to their peak capacity during the 8 AM to 9 AM Manhattan-bound commuting peak. While most Manhattan-bound Airport passengers would travel outside this peak, those passengers (including non-Airport passengers) traveling during this peak could experience some crowded conditions.

4.1.2.4 Indicative Operating Cost

Sub-Options S-1A and S-1B

- The W GCP Subway branch option would add one (Sub-Option S-1B) or two (Sub-Option S-1A) new stations to the Subway network and about 3 miles of new double-track line. An additional crew relief point with associated facilities would be required at the LGA Terminal C terminus in line with current MTA policy. MTA's service plans for this option include enhancement of off-peak W services on the Astoria line to limit frequency reduction at the two existing stations north of the new junction. Over the new branch an all-day service of 4 tph would be provided over the new branch, reduced to 3 tph at night.
- Taking these factors into account, MTA has indicated that operation of a new LGA branch will require six additional trains in service resulting in an indicative operating cost of $55 million annually.

4.1.3 Community and Environmental Aspects

4.1.3.1 Local Community Impacts

A new branch line on an elevated subway structure from before Astoria Blvd Station to LGA would require major heavy civil construction activities to build the aerial guideway foundations, structures, and stations along the route.

This option would be located within and adjacent to densely developed neighborhoods mainly along Astoria Blvd and consisting of a wide range of properties, including single-family (row and detached) and 3- to 6-story residential buildings, commercial businesses, mixed-use (residential above commercial) and public community buildings, and NYC Parkland (Columbus Park, Planeview Park, and Overlook Park). The approximately 3-mile route goes through/along the following neighborhoods: Astoria, Ditmars Steinway, Woodside, Jackson Heights, and East Elmhurst.

The potential for temporary (during construction) and permanent (once operational) impacts is summarized below for specific areas of the alignment.

4.1.3.1.1 Temporary Impacts during Construction on the Local Neighborhoods Directly Affected

The elevated subway structure from Astoria Blvd Station to LGA would require major heavy civil construction activities to build the elevated guideway foundations, structures, and stations along the route. Construction activities are anticipated to occur along the approximately 3-mile route for approximately 6.25 years for S-1A and approximately 6.75 years for S-1B.

As discussed in more detail in Section 3.2.1.1.1, the preliminary engineering work carried out by the study team has not identified a construction approach that, with confidence, could overcome the significant challenges and complexities presented by the twin constraints of the FAA Airport Design Standards and the existing large-diameter, 90-year-old utility structures along the GCP without more complex, risky, and costly approaches to construction that would require greater engineering exploration beyond the scope of this study. Therefore, to provide a consistent basis on which to evaluate them, this assessment was based on the baseline solution of an open trench south of Runway 04-22, despite this approach not being compliant with FAA Airport Design Standards.

Sub-Options S-1A and S-1B

During construction, the following neighborhoods would have the potential for air quality, noise, vibration, or visual impacts, common to both sub-options. For the frequency and duration of construction activities refer to Section 4.1.1.2 “Infrastructure Impacts during Construction” above.

- **Existing NYCT W-Lines South of Astoria Blvd Station**
  - The proposed subway line branches would transition from the existing outside tracks south of Astoria Blvd Station. The southbound track would ascend over the existing tracks and station canopy to branch into the GCP, and the northbound track would transition flat into the GCP. The elevated subway structure and the station would require major heavy civil construction activities to build the elevated guideway foundations, structures, and stations on 31st St and Astoria Blvd along this segment of the route.
  - The construction would occur approximately 35–50 ft from 1 long city block of residential and commercial properties.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - Planned periodic closure of sidewalks, bike lanes, and parking spaces would be required.
  - Planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.
  - Planned periodic closure of Columbus Sq Park (NYC Parkland) would potentially be required depending on the final detailed design.

- **Constructing in the GCP between 31st St and Hell Gate Rail Trestle**
  - The aerial branch track turnouts to LGA start before Astoria Blvd Station, pass into the GCP right-of-way (ROW), and over 33rd St Bridge and Astoria Blvd North before following the GCP median between 35th St and the Hell Gate rail trestle. The track turnouts would require tall piers and long-span structures to reach the necessary elevation above Astoria Blvd Subway station along this approximately 0.5-mile segment of the route.
  - The construction would occur approximately 50–135 ft from 10 short city blocks of residential and commercial properties.
  - Planned overnight or weekend closures of Astoria Blvd South and the GCP would be required. This could lead to traffic increases on local roads, including potential impacts to local bus routes during road closures.

- Planned periodic closure of sidewalks, bike lanes, and parking spaces would be required.
- Planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.
- Planned periodic closure of Columbus Sq Park (NYC Parkland) would be required during the construction of elevated track over the square into GCP.

- **Construction over the Hell Gate Rail Trestle**
  - The elevated subway structure crosses the Hell Gate rail trestle as it transitions from running in the GCP median to south of the GCP, between the eastbound roadway and Astoria Blvd South. The guideway over the trestle would require tall (approximately 90–100 ft above the GCP roadway) and long-span (approximately 150–200 ft) structures and re-routing of the overhead electrical power lines and messenger wires. To erect the elevated subway structure piers, bridge structure and deck would involve tall cranes and other equipment adjacent to and over the Amtrak rail lines along this 0.25-mile segment of the route.
  - The construction would occur approximately 50–135 ft from 2 short city blocks of residential and commercial properties.

- **Construction to the North of St Michael's Cemetery**
  - The construction (piling, piers, and bridge structure) of the elevated subway structure that runs to the south of the GCP eastbound roadway to the north of St Michael's Cemetery, would occur over an approximately 0.5-mile segment of the route.
  - Construction would occur approximately 35–50 ft from the cemetery's northern boundary.
  - Planned periodic lane closures and diversions on Astoria Blvd South would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.

- **Construction at the Eastbound BQE Connector to GCP Intersection**
  - The construction (piling, piers, and bridge structure) of the elevated subway structure would occur over an approximate 0.25-mile segment of the route.
  - The construction would occur approximately 250–350 ft from 1 city block of commercial properties.
  - Planned overnight or weekend closures of Astoria Blvd South, the GCP, and the Eastbound BQE Connector northbound roadway would be required. This could lead to traffic increases on local roads, including potential impacts to local bus routes during road closures.
  - Planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.

- **Reconstruction of 82nd St Bridge**
  - Lane closures and contra-flow traffic on 82nd St Bridge would be continuous throughout the construction as bridge sections would be demolished and reconstructed one half at a time.
  - The construction would occur approximately 150–200 ft from 2 short city blocks of residential and commercial properties.
  - Planned periodic lane closures, contra-flow traffic on the bridge, and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - Planned night closures of the GCP could be required for the long-span bridge erection.

Sub-Option S-1A

During construction, the following neighborhoods would have the potential for air quality, noise, vibration, or visual impacts. For the frequency and duration of construction activities refer to Section 4.1.1.2 “Infrastructure Impacts during Construction” above:

- **Constructing over 94th St and the GCP into the Airport**
  - Reconstruction of the GCP eastbound off-ramp onto Ditmars Blvd near 90th St and construction of the elevated subway structure (30 ft above 94th Street) with long-span (approximately 250–300 ft) bridge structures crossing over 94th St and the GCP into the Airport would be required along the approximately 0.5-mile segment of the route.
  - The construction would occur approximately 100–350 ft from 4 short city blocks of residential and commercial properties.
  - Planned night closures of the GCP would be required for the long-span bridge erection.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - There could be increased construction/haul traffic on local roads because trucks are not allowed on the GCP.

- **Constructing On-Airport Elevated Stations**
  - Construction activities associated with the erection of long-span (approximately 350 ft) elevated subway structure over an approximately 0.5-mile segment of the route over 102nd St and the newly constructed departures roadway at the Airport would be required.
  - The construction would occur over 500 ft from 5 city blocks of residential and commercial properties in the East Elmhurst community located on the other side of 8 lanes of the GCP.
  - Planned night closures of the GCP would be required for the long-span bridge erection.

- Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
- There could be increased construction/haul traffic on local roads because trucks are not allowed on the GCP.

Sub-Option S-1B

During construction, the following neighborhoods would have the potential for air quality, noise, vibration, or visual impacts. For the frequency and duration of construction activities refer to Section 4.1.1.2 "Infrastructure Impacts during Construction" above:

- **Constructing beneath 94th Street and Off-Airport Underground Station**
  - Construction activities associated with the cut-and-cover tunnel crossing beneath 94th St and the eastbound GCP on-ramp and the single off-Airport underground station located south of the GCP, between the GCP and Ditmars Blvd underneath 102nd St would occur along the approximately 0.5-mile segment of the route.
  - The construction would occur approximately 150–275 ft from 8 short city blocks of residential and commercial properties in the East Elmhurst community.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - There could be increased construction/haul traffic on local roads because trucks are not allowed on the GCP.

4.1.3.1.2 Permanent Operational Impacts on the Local Neighborhoods Directly Affected

Subway trains of 600-ft length, similar in size and characteristics as the trains that currently operate on the NYCT N- and W-Lines, would operate between Astoria Blvd Station and LGA at a peak frequency of 4 tph in each direction. They would operate along a predominantly elevated aerial guideway, descending to get past Runway 04-22, ranging approximately 35–500+ ft from residential and commercial properties.

Sub-Options S-1A and S-1B

The following local neighborhoods and areas, common to both Sub-Options S-1A and S-1B, would have the relative potential for permanent noise, vibration, or visual impacts as a result of these sub-options' proposed subway operations:

- **New NYCT W-Lines South of Astoria Blvd Station**
  - The proposed subway line branches would transition from the existing outside tracks south of Astoria Blvd Station. The southbound track would ascend over the existing

tracks and station canopy to branch into the GCP, and the northbound track would transition flat into the GCP. Subway trains would operate in each direction along the existing Subway route approximately 35–50 ft from residential and commercial properties.

- **New Elevated Subway in the GCP between 31st St and Hell Gate Rail Trestle**
  - After the aerial branch track turnouts to LGA, the Subway trains would pass into the GCP ROW, over 33rd St Bridge and Astoria Blvd North, before entering the GCP. Subway trains would operate in each direction on an elevated Subway structure within the GCP transportation corridor approximately 50–135 ft from residential and commercial properties.

- **New Elevated Subway over Hell Gate Rail Trestle**
  - At the Hell Gate rail trestle, the aerial guideway would need to rise over the trestle (approximately 90–100 ft above the GCP roadway, the highest in the MTA Subway system) on long-span (approximately 150–200 ft) structures. Subway trains would operate in each direction on an elevated Subway structure within the GCP transportation corridor approximately 50–135 ft from residential and commercial properties.

- **New Elevated Subway to the North of St Michael's Cemetery**
  - The elevated subway structure would run south of the GCP eastbound roadway to the north of St Michael's Cemetery. Subway trains would operate in each direction on an elevated Subway structure within the GCP transportation corridor approximately 35–50 ft from the cemetery boundary.

Sub-Option S-1A

The following local neighborhoods and areas, specific to Sub-Option S-1A, would have the relative potential for permanent noise, vibration, or visual impacts as a result of this sub-option's proposed subway operations:

- **New Elevated Subway over 94th St and the GCP into the Airport**
  - Once past the RPZ at the end of Runway 04-22, Subway trains would rise to operate in each direction on an elevated subway structure over the GCP into the Airport approximately 100–350 ft from residential and commercial properties.

- **New On-Airport Elevated Subway Stations**

- On-Airport, Subway trains would operate in each direction on an elevated subway structure between the two proposed stations over 500 ft from residential and commercial properties in the East Elmhurst community located on the other side of 8 lanes of the GCP.

Sub-Option S-1B

The following local neighborhoods and areas, specific to Sub-Option S-1B, would have the relative potential for permanent noise, vibration, or visual impacts as a result of this sub-option's proposed subway operations:

- **New Off-Airport Underground Subway Station**
  - Once past Runway 04-22, Subway trains would descend into a cut-and-cover tunnel crossing beneath 94th St and the eastbound GCP on-ramp into the single off-Airport underground station located south of the GCP, between the GCP and Ditmars Blvd underneath 102nd St. Subway trains would operate underground approximately 150–275 ft from residential and commercial properties in the East Elmhurst community.

4.1.3.1.3 Potential Private Property Acquisitions

For the purposes of comparison between options, the elevated subway from Astoria Blvd Station to LGA may require permanent acquisition of the following:

Sub-Option S-1A

- Up to 18 private residential, 4 private commercial, and 2 industrial properties.

Sub-Option S-1B

- Up to 18 private residential, 8 private commercial, and 2 industrial properties.

4.1.3.1.4 Potential Public Property Acquisitions (NYC DOT Plazas and NYC Parks Parkland)

The new subway branch from Astoria Blvd Station may result in permanent impacts to the following:

Sub-Option S-1A and S-1B

- New support columns for the permanent elevated subway structure would be located within Columbus Park and Planeview Park, and the below-grade structure within Overlook Park.
- No structures would be sited within NYC DOT Plazas.

4.1.3.1.5 Removal/Reconfiguration of Parking Spaces

Sub-Options S-1A and S-1B

- A total of approximately 20 on-street public parking spaces would be lost on the following street:
  - 31st St, between 30th Ave Station and Astoria Blvd Station.

The numbers are approximate and are preliminary estimates based on the alignment.

4.1.3.1.6 Environmental Justice Communities Mapping Analysis

The Environmental Justice communities mapping analysis provides an overview of the minority and low-income communities within 0.25 mile of the transit options being evaluated.

Sub-Option S-1A

For Option S-1A, less than half of the block groups within the 0.25-mile buffer of the option alignment are Environmental Justice block groups.

See Figure 4.1-5 below for the analysis map for Option S-1A.

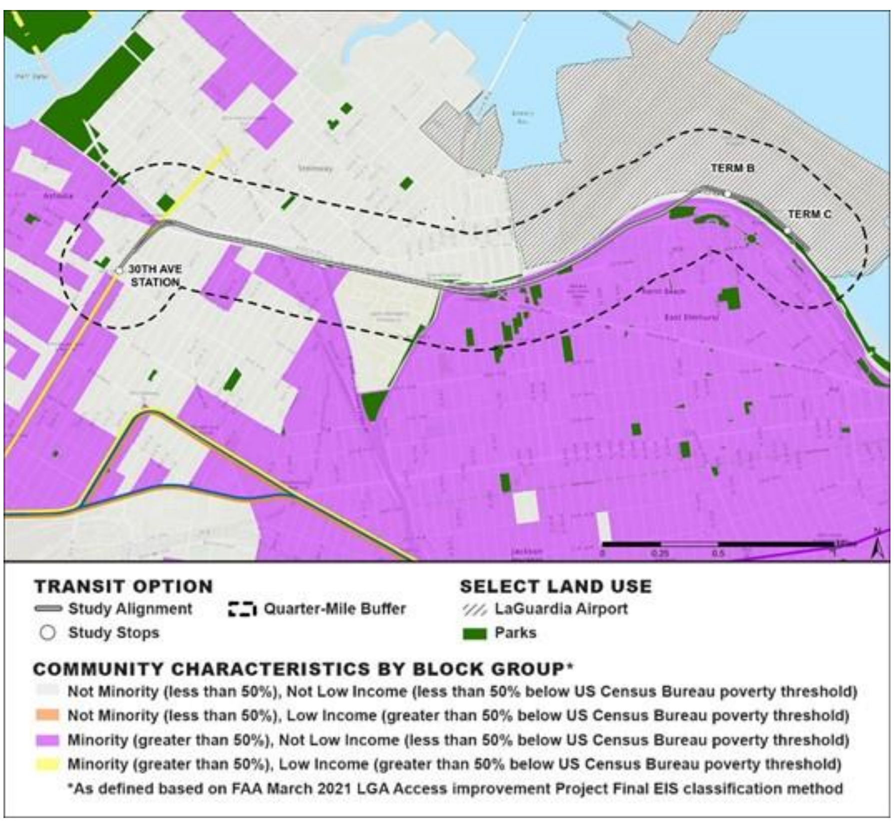


FIGURE 4.1-5: OPTION S-1A – ENVIRONMENTAL JUSTICE COMMUNITIES MAPPING ANALYSIS (AS DEFINED BASED UPON FAA MARCH 2021 LGA ACCESS IMPROVEMENT PROJECT FINAL EIS CLASSIFICATION METHOD)

Sub-Option S-1B

For Option S-1B, less than half of the block groups within the 0.25-mile buffer of the option alignment are Environmental Justice block groups.

See Figure 4.1-6 below for the analysis map for Option S-1B.

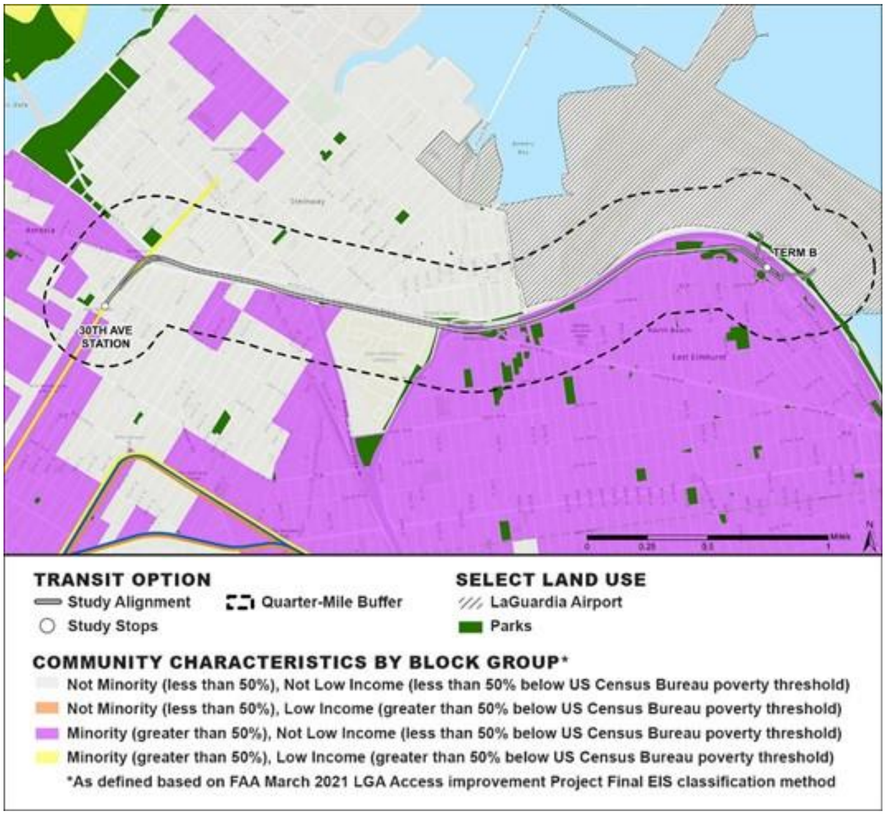


FIGURE 4.1-6: OPTION S-1B – ENVIRONMENTAL JUSTICE COMMUNITIES MAPPING ANALYSIS (AS DEFINED BASED UPON FAA MARCH 2021 LGA ACCESS IMPROVEMENT PROJECT FINAL EIS CLASSIFICATION METHOD)

4.1.3.2 Equity

4.1.3.2.1 Transit Access from LGA

Sub-Option S-1A

- **Additional Minority and Low-income Populations Reached within 45 Minutes from LGA via Transit (Population Access Analysis)**
  - The results of the Population Access Analysis illustrate how many people, specifically from low-income and minority populations, could travel via transit from LGA to homes within 45 minutes from LGA. Airport passengers or Airport employees living within these areas could potentially benefit from expanded access to these destinations.
  - Sub-Option S-1A is expected to expand transit access from LGA to regional destinations within 45 minutes, as shown in the blue area of "Additional Access Provided by Transit Option" in Figure 4.1-7. Compared to the baseline, the minority population reached within a 45-minute transit trip would increase by 61.0% and the low-income population reached within a 45-minute transit trip would increase by 86.7% as shown in Table 4.1-4.
  - This represents a medium increase in transit access to LGA within 45 minutes for minority and low-income communities.

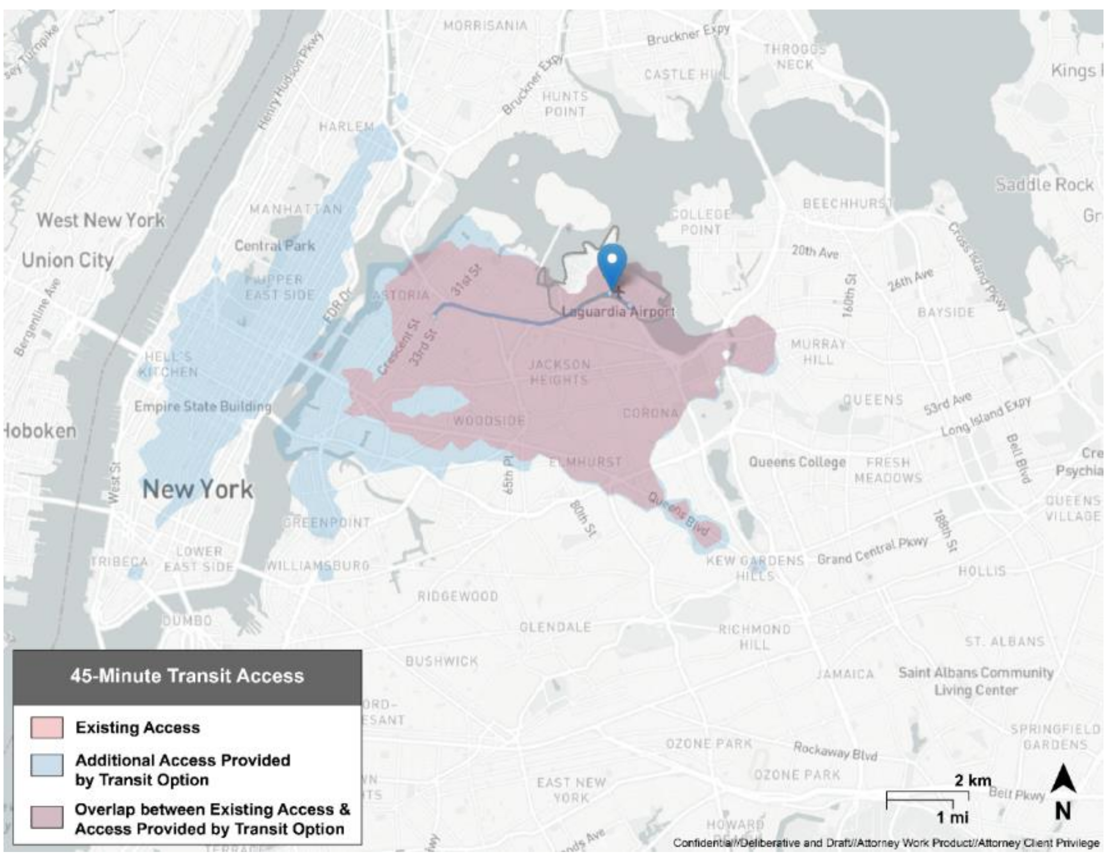


FIGURE 4.1-7: W GCP BRANCH S-1A – POPULATION ACCESS ANALYSIS

TABLE 4.1-4: W GCP BRANCH S-1A – POPULATIONS REACHED WITHIN 45-MINUTE TRANSIT TRIP

		Total Population Reached	Minority Population Reached	Low-Income Population Reached
Baseline	Existing Condition	551,434	422,981	76,750
S-1A	With Option	1,187,199	681,156	143,281
	Net Change	+635,765	+258,175	+66,531
	% Change	115.3%	61.0%	86.7%

- **Additional ADA-Accessible Stations within 45 Minutes from LGA via Transit (ADA Analysis)**
  - The results of the ADA Analysis illustrate how Airport passengers and Airport employees, specifically those requiring ADA-compliant stations, traveling from LGA to other locations could potentially benefit from expanded access to ADA-compliant stations within 45 minutes via transit.
  - More ADA-accessible stations/stops can be reached within a 45-minute transit trip for this option compared to the baseline of existing transit service (Table 4.1-5). This echoes the results from the Population Access Analysis, in which Sub-Option S-1A's 45-minute transit travel shed provides an increased amount of access over the baseline transit service. Compared to the baseline, an additional 67 ADA-accessible stations can be reached within a 45-minute transit trip from LGA for Sub-Option S-1A.

TABLE 4.1-5: W GCP BRANCH S-1A – ADA ANALYSIS

Subway, Ferry, LIRR, and MNR Stations Reached within 45-Minute Transit Trip from LGA	Baseline	S-1A	Difference between Baseline and S-1A
Total Stations	*43*	*147*	*+104 stations*
ADA-Accessible Stations (Accessible Stations as % of Total)	*20 (47%)*	*87 (59%)*	*+67 stations*

Sub-Option S-1B

- **Additional Minority and Low-income Populations Reached within 45 Minutes from LGA via Transit (Population Access Analysis)**
  - The results of the Population Access Analysis illustrate how many people, specifically from low-income and minority populations, could travel via transit from LGA to homes within 45 minutes from LGA. Airport passengers or Airport employees living within these areas could potentially benefit from expanded access to these destinations.
  - Sub-Option S-1B is expected to expand transit access from LGA to regional destinations within 45 minutes, as shown in the blue area of "Additional Access Provided by Transit Option" in Figure 4.1-8. Compared to the baseline, the minority population reached within a 45-minute transit trip would increase by 18.3% and the low-income population reached within a 45-minute transit trip would increase by 23.6% as shown in Table 4.1-6.
  - This represents a lower increase in transit access to LGA within 45 minutes for minority and low-income communities.

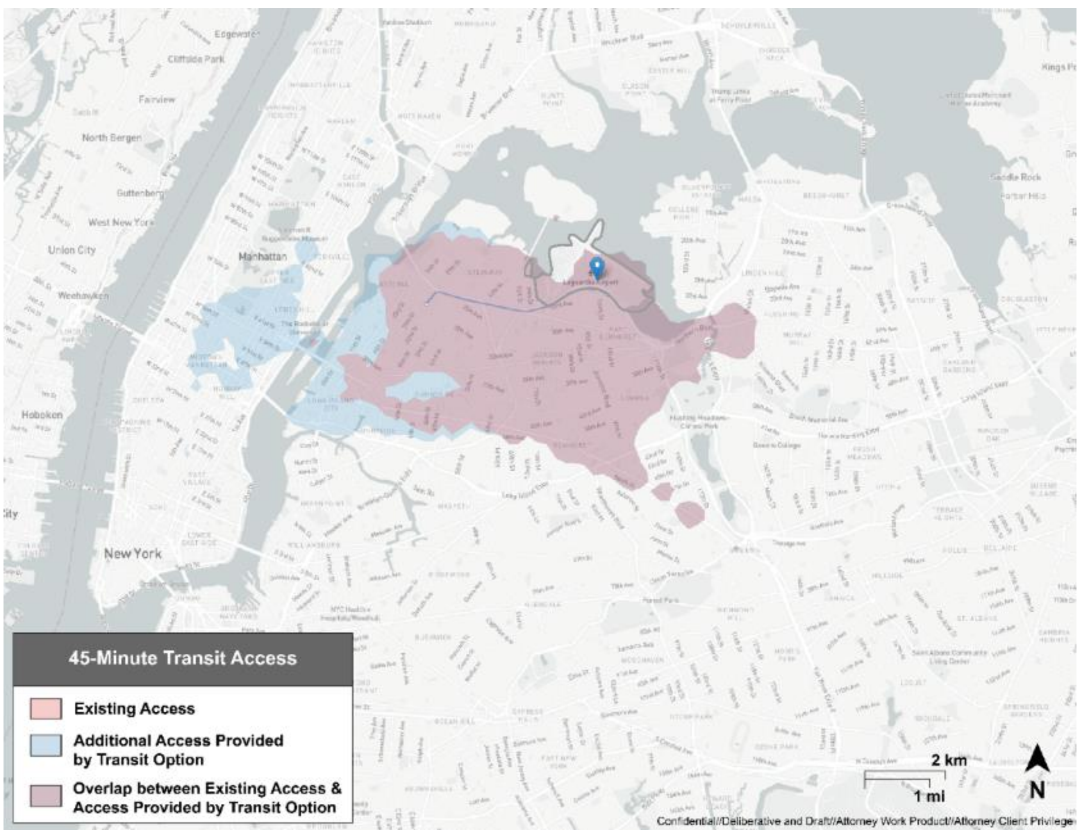


FIGURE 4.1-8: W GCP BRANCH S-1B – POPULATION ACCESS ANALYSIS

TABLE 4.1-6: W GCP BRANCH S-1B – POPULATIONS REACHED WITHIN 45-MINUTE TRANSIT TRIP

		Total Population Reached	Minority Population Reached	Low-Income Population Reached
Baseline	Existing Condition	551,434	422,981	76,750
S-1B	With Option	745,669	500,228	94,883
	Net Change	194,235	77,247	18,133
	% Change	35.2%	18.3%	23.6%

- **Additional ADA-Accessible Stations within 45 Minutes from LGA via Transit (ADA Analysis)**
  - The results of the ADA Analysis illustrate how Airport passengers and Airport employees, specifically those requiring ADA-compliant stations, traveling from LGA to other locations could potentially benefit from expanded access to ADA-compliant stations within 45 minutes via transit.
  - More ADA-accessible stations/stops can be reached within a 45-minute transit trip for this option compared to the baseline of existing transit service (Table 4.1-7). This echoes the results from the Population Access Analysis, in which Sub-Option S-1B's 45-minute transit travel shed provides an increased amount of access over the baseline transit service. Compared to the baseline, an additional 33 ADA-accessible stations can be reached within a 45-minute transit trip from LGA for Sub-Option S-1B.

TABLE 4.1-7: W GCP BRANCH S-1B – ADA ANALYSIS RESULTS

Subway, Ferry, LIRR, and MNR Stations Reached within 45-Minute Transit Trip from LGA	Baseline	S-1B	Difference between Baseline and S-1B
Total Stations	*43*	*91*	*+48 stations*
ADA-Accessible Stations (Accessible Stations as % of Total)	*20 (47%)*	*53 (58%)*	*+33 stations*

4.1.3.2.2 Transportation Opportunities and Benefits for the Surrounding Community

<u>Sub-Option S-1A</u>

- **Transportation Opportunities for Neighbors**

  This option does not include intermediate/off-Airport stops. Because there is limited pedestrian access to LGA from adjacent residential areas and walking distance exceeds 0.25 mile, the study team did not consider there to be a significant market for use of the final on-Airport stops by the surrounding community to connect to the broader transit network.

- **Cars Removed from Local Roadways and Emissions Reductions**

See "Cars Removed from Local Roadways" section and "GHG and Other Vehicular Emissions Reductions" section of this evaluation below.

Sub-Option S-1B

- **Transportation Opportunities for Neighbors**

  The terminus for Sub-Option S-1B would be located south of the GCP and within walking distance of the adjacent neighborhood. This stop is within 0.25 mile of existing bus service. There is no existing subway service within 0.5 mile of the stop. Accordingly, this stop would provide potential transportation opportunities to connect to the broader transit network for residents living in the surrounding community.

- **Jobs Accessible within 45-Minute Transit Trip**

  Sub-Option S-1B is expected to expand transit access from the Ditmars Blvd and 102nd St stop to regional destinations within 45 minutes via transit. As a result, the Job Access Analysis (Table 4.1-8) indicates a large increase in jobs accessible from the off-Airport station within a 45-minute transit trip compared to the baseline, as the travel shed expands to encompass a large portion of midtown Manhattan as shown in Figure 4.1-9.

TABLE 4.1-8: W GCP BRANCH S-1B – JOB ACCESS ANALYSIS

Stop	Baseline (Existing) Jobs Accessible within 45 Minutes by Transit from Stop	S-1B Jobs Accessible within 45 Minutes by Transit from Stop	Net Change	% Change
Ditmars Blvd and 102nd St	180,053	1,110,186	+930,133	517%

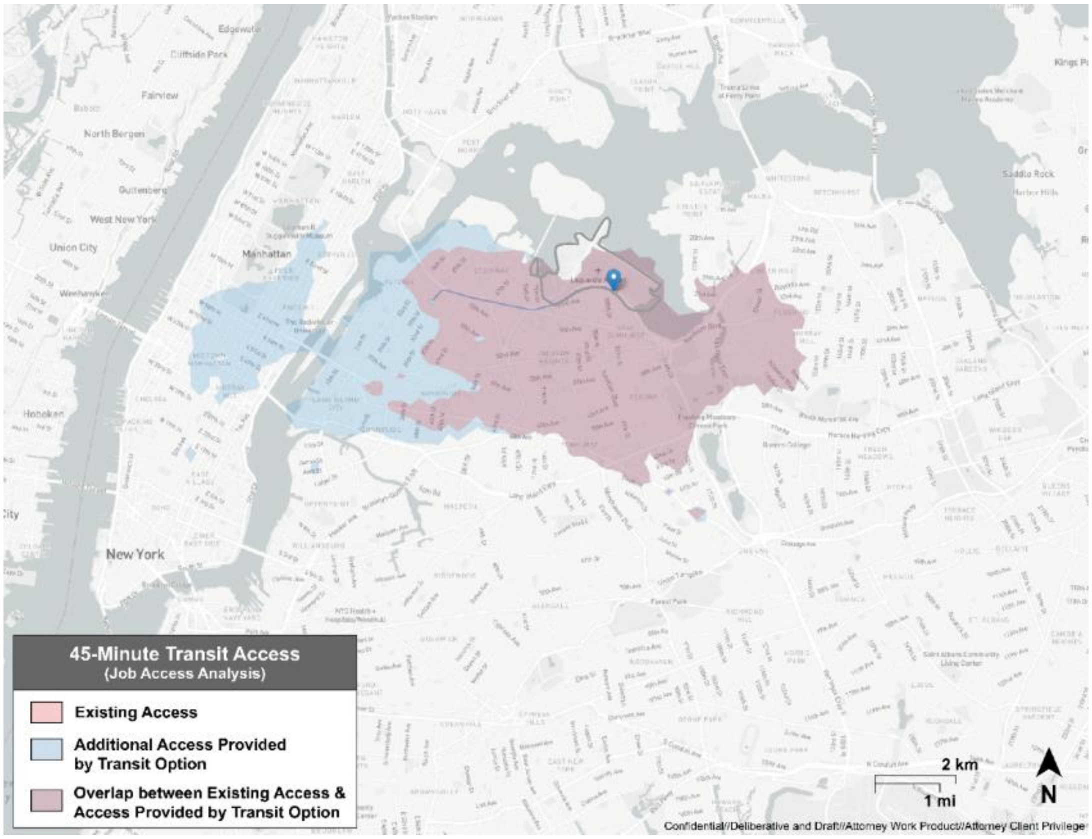


FIGURE 4.1-9: W GCP BRANCH S-1B – JOB ACCESS ANALYSIS

- **MTA Equity Priority Area Analysis**

  For S-1B, the proposed route was overlaid onto the areas served by existing MTA bus routes and subway lines as well as onto MTA Equity Priority Areas. Based on a rough spatial analysis of census data, it was estimated that there are approximately 5,277 residents within 0.5 mile of a potential off-Airport Subway station located adjacent to the Airport just to the south of the GCP. Approximately 55% of these residents fall within NYCT's Equity Priority Areas. Although all these residents are within 0.25 mile of existing bus services, the addition of a subway entrance to a potential LGA Subway station from the neighborhood to the south would provide a measure of additional access for those residents who travel by subway.

- **Cars Removed from Local Roadways and Emissions Reductions**

  See "Cars Removed from Local Roadways" section and "GHG and Other Vehicular Emissions Reductions" section of this evaluation below.

4.1.3.3 Cars Removed from Local Roadways

Sub-Option S-1A

- Sub-Option S-1A would be expected to remove 1,561,000 Airport passenger vehicles, and 238,000 Airport employee vehicles, from the road each year.

Sub-Option S-1B

- Sub-Option S-1B would be expected to remove 951,000 Airport passenger vehicles, and 159,000 Airport employee vehicles, from the road each year.

4.1.3.4 GHG and Other Vehicular Emissions Reductions

Sub-Option S-1A

- Sub-Option S-1A would be expected to remove 7,739 metric tons of CO_2 equivalent each year.

Sub-Option S-1B

- Sub-Option S-1B would be expected to remove 5,132 metric tons of CO_2 equivalent each year.

Other vehicular emissions reductions are given in Table 4.1-9:

TABLE 4.1-9: OTHER VEHICULAR EMISSIONS REDUCTION (METRIC TONS PER YEAR)

Option	CO	VOC	NOx	SO_2	PM_{10}	$PM_{2.5}$
[S-1A] N/W GCP, On-Airport	36.5	0.5	2.4	0.1	1.4	0.3
[S-1B] N/W GCP, Off-Airport	24.2	0.3	1.6	0.1	0.9	0.2

4.1.4 Summary of Evaluation

Option S-1 would take advantage of the GCP transportation corridor between Astoria and LGA, creating a branch line south of the Astoria Blvd Station to divert W-Line trains directly to the Airport. Locating the proposed subway within the GCP transportation corridor would minimize the direct impact of the subway on local communities. Two sub-options were assessed with either two on-Airport elevated stations (S-1A) or one off-Airport underground station (S-1B). The on-Airport sub-option offers Airport passengers the convenience of direct access to Airport Terminals B and C but with the complexity of constructing large subway stations within the confines of the Airport, including substantial infrastructure and buildings mandated by MTA requirements for terminus stations. The off-Airport station (south of the GCP) would provide a new subway station closer to the East Elmhurst community but would also require construction of substantial infrastructure and buildings mandated by MTA requirements for terminus stations, and bring significant construction impacts closer to this community.

S-1A: W-Line GCP Branch with Two On-Airport Elevated Stations

This sub-option would require the construction of heavy infrastructure, including elevated and open-trench concrete guideway structures predominantly along the GCP transportation corridor. This sub-option would have to contend with the construction challenges of crossing the Hell Gate rail trestle (90–100 ft above the ground), complying with FAA Airport Design Standards while negotiating the 90-year-old utilities under the GCP at the end of Runway 04-22 (a challenge as yet unresolved as discussed in Section 3.2.1.1.1), and traversing the constrained area north of St Michael’s Cemetery. For the purpose of cost comparison, this option was costed out on the basis of a baseline solution of an open trench south of Runway 04-22 despite this approach not being compliant with FAA Airport Design Standards.

Table 4.1-10 summarizes the output from all the factors used to evaluate this option.

TABLE 4.1-10: SUMMARY OF KEY CHARACTERISTICS – W-LINE GCP BRANCH WITH TWO ON-AIRPORT STATIONS (S-1A)

	Evaluation Factor	Assessment
CONSTRUCTION ASPECTS	Constructability	• **Major unresolved constructability challenge**: Complying with FAA Airport Design Standards while also avoiding disruption to 90-year-old, 15 ft diameter sewer structures at the end of Runway 04-22 (see details in Section 3.2.1.1.1) • Tall (90+ ft) long-span (150–200 ft) structures spanning the Hell Gate rail trestle • Construction of track tie-ins to existing subway line along 31st St • Tall structures to clear Astoria Blvd Station • Constrained construction access within and adjacent to GCP • Reconstruction of 82nd St Bridge • Long spans (250-300 ft) over 94th St Bridge and 102nd St Bridges on-Airport • Constrained on-Airport sites for new elevated subway structure and 600 ft stations • Total option route length: approx. 3 miles
	Infrastructure Impacts during Construction	• Operational impacts to N/W services • Lane narrowing, traffic diversions, speed restrictions on BQE, GCP and Astoria Blvd • Disruption to services (Amtrak, Metro-North) on Hell Gate rail trestle
	Permanent/Operational Impacts to Existing Infrastructure	• 33% (12 to 8 tph) reduction of subway service at Astoria Blvd and Astoria-Ditmars Blvd station • Permanent loss of travel lane on Astoria Blvd South along St. Michael's Cemetery • Inhibits future widening of the GCP
	Indicative Capital Cost (2022$)[48]	$5.9 billion[49] (Does not include any additional costs required for an as yet unresolved solution to get past Runway 04-22 in compliance with FAA Airport Design Standards; potentially up to approx. $1–$3 billion)
	Indicative Timeline/Schedule	12–13 Years
TRANSPORTATION ASPECTS	Standardized Indicative Baseline Off-Peak Travel Time (From Midtown Manhattan)	31 mins (Times Square to Terminal B, then C; shuttle to Terminal A)
	Transfer Experience	Single seat ride on W-Line, no transfer necessary
	Ridership[50]	Total annual projected ridership for option: 6.3 million Net increase in annual projected transit ridership: 3.7 million
	Throughput & Capacity	4,500 pphpd (peak)
	Indicative Operating Cost	$55 million per annum in addition to current W train operation

[48] Indicative Capital Costs should be considered to have a range of estimating uncertainty of –10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).
[49] Costs for heavy infrastructure options approaching LGA from the west/southwest are based on the open-trench construction concept past Runway 04-22 (over the existing 90-year-old utilities), to provide a baseline estimate of the cost of construction. Although this concept does not meet FAA Airport Design Standards, it provides a consistent approach for capital cost comparison purposes. Costs associated with tunnelling and/or relocating utilities would be substantially higher, potentially up to approx. $1–$3 billion.
[50] Experience from AirTrain JFK was that actual ridership turned out to be higher than would have been predicted by the AirTrain JFK forecast and underscores the inherent uncertainty of model predictions. The ridership model supporting this effort could also deviate from eventual ridership demand but was utilized to allow ridership comparisons between the options.

TABLE 4.1-10, CONTINUED.

	Evaluation Factor	Assessment
COMMUNITY AND ENVIRONMENTAL ASPECTS	Local Community Impacts	<u>Construction:</u> • Heavy civil construction of elevated and at-/below-grade structures for approx. 6.25 years <u>Proximity to communities:</u> • 35–50 ft from one city block of residential and commercial properties on 31st St • 50–135 ft from 12 city blocks of residential and commercial properties along the GCP • 35–50 ft from the north end of St Michael's Cemetery along Astoria Blvd South • Over 500 ft across 8 lanes of the GCP from 9 city blocks of residential and commercial properties opposite the Airport Terminals <u>Permanent impacts:</u> • Acquisition of up to 24 properties (private residential, private commercial, and industrial) • Structures over Columbus Sq Park, Planeview Park, Overlook Park, and to the north of St. Michael's Cemetery[51] • Loss of approx. 20 on-street public parking spaces along 31st St
	Equity	• Medium increase to low-income and minority populations within 45 minutes of the Airport via transit versus the no-build scenario • +67 additional ADA-compliant stations reachable within a 45-minute transit trip from LGA versus the no-build scenario
	Cars Removed from Local Roadways	1,561,000 airport passenger vehicles and 238,000 airport employee vehicles from the road each year
	GHG and other Vehicular Emissions Reductions	7,739 metric tons of CO_2 equivalent each year

[51] Municipal parkland cannot be converted to a non-park use (known as alienation) without State legislative permission. Thus, the acquisition of New York City Parkland for construction of a mass transit option would require legislation authorizing such alienation. Obtaining such legislation is a multi-step process requiring actions by the New York City Council, the Mayor of New York City, the New York State Legislature, and the Governor.

S-1B: W-Line GCP Branch with One Off-Airport Underground Station

This sub-option would require the construction of heavy infrastructure, including elevated and open-trench concrete guideway structures predominantly along the GCP transportation corridor. This sub-option would have to contend with the construction challenges of crossing the Hell Gate rail trestle (90–100 ft above the ground), complying with FAA Airport Design Standards while negotiating the 90-year-old utilities under the GCP at the end of Runway 04-22 (a challenge as yet unresolved as discussed in Section 3.2.1.1.1), traversing the constrained area north of St Michael's Cemetery, and constructing deep underground station(s). For the purpose of cost comparison, this option was costed out on the basis of a baseline solution of an open trench south of Runway 04-22 despite this approach not being compliant with FAA Airport Design Standards.

Table 4.1-11 summarizes the output from all the factors used to evaluate this option.

TABLE 4.1-11: SUMMARY OF ASSESSMENT – W-LINE GCP BRANCH WITH ONE OFF-AIRPORT STATION (S-1B)

	Evaluation Factor	Assessment
CONSTRUCTION ASPECTS	Constructability	• **Major unresolved constructability challenge**: Complying with FAA Airport Design Standards while also avoiding disruption to 90-year-old, 15 ft diameter sewer structures at the end of Runway 04-22 (see details in Section 3.2.1.1.1) • Tall (90+ ft) long-span (150–200 ft) structures spanning the Hell Gate rail trestle • Construction of track tie-ins to existing subway line along 31st St • Tall structures to clear Astoria Blvd Station • Constrained construction access within and adjacent to GCP • Reconstruction of 82nd St Bridge • Cut-and-cover tunnel under 102nd St and deep 600-ft station construction adjacent to major utilities • Total option route length: approx. 3 miles
	Infrastructure Impacts during Construction	• Operational impacts to N/W services • Lane narrowing, traffic diversions, speed restrictions on BQE, GCP and Astoria Blvd • Disruption to services (Amtrak, Metro-North) on Hell Gate rail trestle
	Permanent/Operational Impacts to Existing Infrastructure	• 33% (12 tph to 8 tph) reduction of subway service at Astoria Blvd and Astoria-Ditmars Blvd station • Permanent loss of travel lane on Astoria Blvd South along St. Michael's Cemetery • Inhibits future widening of the GCP
	Indicative Capital Cost (2022$)[52]	$6.6 billion[53] (Does not include any additional costs required for an as yet unresolved solution to get past Runway 04-22 in compliance with FAA Airport Design Standards; potentially up to approx. $1–$3 billion)
	Indicative Timeline/Schedule	12–13 Years

[52] Indicative Capital Costs should be considered to have a range of estimating uncertainty of –10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).

[53] Costs for heavy infrastructure options approaching LGA from the west/southwest are based on the open-trench construction concept past Runway 04-22 (over the existing 90-year-old utilities), to provide a baseline estimate of the cost of construction. Although this concept does not meet FAA Airport Design Standards, it provides a consistent approach for capital cost comparison purposes. Costs associated with tunnelling and/or relocating utilities would be substantially higher, potentially up to approx. $1–$3 billion.

TABLE 4.1-11, CONTINUED.

	Evaluation Factor	Assessment
TRANSPORTATION ASPECTS	Standardized Indicative Baseline Off-Peak Travel Time (From Midtown Manhattan)	37 mins (Times Square to Terminal C, then C; shuttle to Terminal A)
	Transfer Experience	Single seat ride on W-Line, no transfer necessary
	Ridership[54]	Total annual projected ridership for option: 4.7 million Net increase in annual projected transit ridership: 2.4 million
	Throughput & Capacity	4,500 pphpd (peak)
	Indicative Operating Cost	$55 million per annum in addition to current W train operation
COMMUNITY AND ENVIRONMENTAL ASPECTS	Local Community Impacts	Construction: • Heavy civil construction of elevated and at-/below-grade structures for approx. 6.75 years. Proximity to communities: • 35–50 ft from one city block of residential and commercial properties on 31st St • 50–125 ft from 12 city blocks of residential and commercial properties along the GCP • 35–50 ft from the north end of St Michael's Cemetery along Astoria Blvd South • 150–275 ft from 11 city blocks of residential and commercial properties along Ditmars Blvd to the south of the GCP Permanent impacts: • Acquisition of up to 28 properties (private residential, private commercial, and industrial) • Structures over Columbus Sq Park, Planeview Park, Overlook Park, and to the north of St. Michael's Cemetery[55] • Loss of approx. 20 on-street public parking spaces along 31st St
	Equity	• Lower increase to low-income and minority populations within 45 minutes of the Airport via transit versus the no-build scenario • +33 additional ADA-compliant stations reachable within a 45-minute transit trip from LGA versus the no-build scenario
	Cars Removed from Local Roadways	951,000 airport passenger vehicles and 159,000 airport employee vehicles from the road each year
	GHG and other Vehicular Emissions Reductions	5,132 metric tons of CO2 equivalent each year

[54] Experience from AirTrain JFK was that actual ridership turned out to be higher than would have been predicted by the AirTrain JFK forecast and underscores the inherent uncertainty of model predictions. The ridership model supporting this effort could also deviate from eventual ridership demand but was utilized to allow ridership comparisons between the options.

[55] Municipal parkland cannot be converted to a non-park use (known as alienation) without State legislative permission. Thus, the acquisition of New York City Parkland for construction of a mass transit option would require legislation authorizing such alienation. Obtaining such legislation is a multi-step process requiring actions by the New York City Council, the Mayor of New York City, the New York State Legislature, and the Governor.

4.2 S-2: N/W-Line Extension via 31st St/19th Ave

Option S-2 would provide a direct link to LGA by extending the existing subway north from the terminus at Astoria-Ditmars Blvd Station, providing Airport access for all N and W trains.

Option Route Description

This option would connect the Airport to the Subway N-/W-Line by extending the existing elevated track above 31st St, north of the existing Astoria-Ditmars Blvd Subway station, through a residential area for approximately 0.4 mile. At 20th Ave, the route would enter a restricted access property owned by ConEd and subject to several easements, turning east toward 19th Ave around the existing buildings, a sports field, and above Luyster Creek. East of the intersection of 19th Ave and 37th St, the route would run above 19th Ave through a light industrial area for 0.6 mile, and another 0.2 mile above 19th Ave with airport property on the north side and residential properties on the south side, until it enters airport property after crossing 81st St.

FIGURE 4.2-1: OPTION S-2

Once on-Airport, the route would need to contend with the construction challenge of complying with FAA Airport Design Standards at the end of Runway 04-22 while negotiating the 90-year-old utilities running under the airport. As discussed in detail in Section 3.2.1.1.1, the heavier infrastructure options from the west must overcome the significant challenges and complexities presented by the twin constraints of the FAA Airport Design Standards and the existing large-diameter, 90-year-old utility structures along the GCP. The preliminary engineering work carried out by the study team has not identified a construction approach that, with confidence, could do this without more complex, risky, and costly approaches to construction that would require greater engineering exploration beyond the scope of this study. To provide a consistent basis on which to evaluate the option and to allow cost comparison between the options, Option S-2 is based on the baseline, simpler construction, concept of a predominantly an open trench structure with some cut-and-cover sections located along Runway Dr, despite this being shown to be not compliant with the FAA Airport Design Standards. Once east of Runway 04-22, the route would ascend to an elevated structure to connect to two on-Airport Subway stations, one serving Terminal B and one serving Terminal C (Figure 4.2-1).

As an extension of the NYCT N-/W-Lines, all N/W services would terminate at LGA. The proposed elevated subway stations would be sized to support 600 ft subway train lengths and, following MTA guidelines, provide 35,000 sf (intermediate station) and 70,000 sf (terminus station) of back-of-house space for staff accommodation, and plant, maintenance, and operations room requirements. The existing MTA operations, maintenance, and storage yards would continue to be used for vehicle maintenance and storage with this option.

The length of this extension is approximately 3 miles, including the on-Airport portion.

The feasibility of serving a single, underground, off-Airport station was considered during the evaluation of this option. To achieve this would require the subway to descend into a tunnel within LGA's western facilities area, passing beneath the GCP and commercial and residential streets in East Elmhurst before reaching the proposed off-Airport station location between Ditmars Blvd and the GCP at 102nd St. This results in a proposed underground subway alignment that would not follow any existing ROW (e.g., the GCP), requiring the acquisition of commercial and residential properties in East Elmhurst between 23rd Ave and Ditmars Blvd for ventilation, intervention shafts, and the tunnel itself.

Although technically achievable, the complex logistics and prohibitive cost of a bored tunnel, and scale of impact on East Elmhurst residents, meant the off-Airport station solution for this option was deemed unviable and taken no further in the evaluation.

4.2.1 Evaluation of Construction Aspects

4.2.1.1 Constructability

Extension of the elevated subway structure from Astoria-Ditmars Blvd Station to LGA would require major heavy civil construction activities to build the aerial guideway foundations, structures, and stations along the route.

The notable challenges and complexities associated with construction of this option, with two elevated on-Airport stations, are summarized below.

- **Construction of the Tie-in to the Existing Subway Station at Astoria-Ditmars Blvd**
  - The proposed extension to the NYCT N-/W-Lines would continue the elevated guideway structure to the north of the existing subway platforms, along 31st St. This would require modification to the existing subway support structure, tracks, platforms, and systems.
  - Major construction activities would require the periodic partial closure of the Astoria-Ditmars Station to passengers (for frequency, see Section 4.2.1.2 below); however, N and W trains would enter the station beyond the interlocking to switch tracks, allowing services to continue up to Astoria Blvd Station (see "Infrastructure Impacts during Construction" section). Integration, commissioning, and trial operations would require working within and on a live operational rail environment. This requires construction activities to be undertaken during limited hours and under strict safety protocols agreed to by MTA, which would prolong construction. This has been reflected in the construction cost estimate and program for this work.
  - Constrained access along 31st St under and around the existing Subway structure, within 50 ft of residences and businesses, would restrict the use of large construction equipment and cranes to short pre-arranged periods (e.g., for guideway beam lifting); it would also limit any overnight work. This is reflected in the Indicative Timeline/Schedule as increased durations for these activities.

- **Construction of Elevated Structure in Constrained Residential Areas**
  - The subway aerial structure would run down the center of 31st St, between 21st Ave and 20th Ave, and construction of the guideway would be within 50 ft of residential properties. This would restrict the use of large construction equipment and cranes except to short pre-arranged periods (e.g., for guideway beam lifting); it would also limit any overnight work. This is reflected in the Indicative Timeline/Schedule as increased durations for these activities.

- **Construction over ConEd Property on 20th Ave and Luyster Creek on 19th Ave**
  - The subway aerial structure would cross over the end of Luyster Creek to reach 19th Ave, and this would require long-span (approximately 300-ft) structures to avoid placing support piers in or adjacent to the creek. The increased costs over standard rates are included in the construction estimate for the option.
  - The ConEd and Luyster Creek properties likely have hazardous soils that would need to be handled and disposed of properly. An allowance has been provided for this in the construction cost estimate for the option.

- **Existing Major Utilities along and Crossing 19th Ave**
  - 19th Ave contains many existing major water, sewer, and electrical utilities, including large-diameter sewer outfalls and interceptors, water mains, and high-voltage power.

Preliminary assessment indicated that either the support piers can be located to avoid the utilities or minor protection solutions would be used to avoid any relocation or reconstruction of the utilities.

- Any utility interface would require review with and acceptance by NYC DEP, or other utility owners, of any proposed bridging or protection solutions and agree monitoring regimes throughout construction. Allowances are included in the aerial guideway construction cost estimate and Indicative Timeline/Schedule to account for utilities protection and/or varied span lengths.

- **Major constructability challenge of compliance with FAA Airport Design Standards while also avoiding disruption to 90-year-old NYC DEP underground sewer structures (See also Section 3.2.1.1.1)**
  - This option's alignment crosses an area south of Runway 04-22 that is subject to FAA regulations regarding the safe operation of the Airport. This presents a major constructability challenge (described in greater detail in Section 3.2.1.1.1) to negotiate the twin constraints of the FAA Airport Design Standards (governing the construction of new infrastructure in this area) and the existing large-diameter utilities located along and beneath the GCP.
  - The preliminary engineering work carried out by the study team has not identified a construction approach that it could conclude with confidence would practicably overcome these challenges.
  - For the purposes of providing a basis on which to compare options that must pass the end of Runway 04-22, this option was evaluated using the baseline construction concept of a predominantly open trench structure along Runway Dr, at the end of Runway 04-22, despite this concept being shown to be not compliant with the FAA Airport Design Standards. To provide the Indicative Capital Cost and Timeline/Schedule, the following construction elements for this construction concept:
    - A transition structure taking the subway alignment from an elevated structure into the open trench along Bowery Bay Blvd north of Marine Terminal Rd.
    - Strengthening and/or construction of concrete protection slabs over a 9- by 8-ft combined sewer outfall (CSO), which runs east-west to the north of Marine Terminal Rd.
    - Construction of a below-grade, open-trench structure with a section of cut-and-cover tunnel south of Runway 04-22, along Runway Dr.

- **On-Airport Elevated Stations: Constrained Construction Site Conditions**
  - The proposed subway transitions from an at- and below-grade structure to aerial guideway along Runway Dr, ascending over 94th St and the Airport access roads to the elevated stations. Long-span (approximately 350-ft) bridge structures would be required over 102nd St and the newly constructed departures roadway. This would require structures to elevate the guideway to approximately 70 ft above-grade to clear the

multi-level roads while maintaining Airport operability, resulting in complex engineering solutions and construction methods. This introduces increased construction costs over standard rates, which are reflected in the construction cost estimate for the option.

- Two elevated Subway stations, sized to support 600-ft train operations, with fare control (turnstiles)/fare vending, customer information, circulation, and other ancillary facilities would be constructed and integrated with the existing Airport terminal buildings. The stations would be environmentally conditioned and require approximately 35,000 sf and 70,000 sf of back-of-house space (following MTA guidelines for suitable staff accommodation and plant, maintenance, and operations room requirements for the intermediate and terminal stations, respectively). This is reflected in the construction cost estimate for the option.
- Constructing the stations and elevated structures within a constrained, operational airport environment would reduce the construction sequence efficiency, introducing construction complexities and prolonging construction activities. This is reflected in the Indicative Timeline/Schedule for this area of the option.
- Construction work in and around the Airport terminals and over Airport roadways would be subject to acceptance by the FAA.

- **Constructability Risks Not Included in the Cost Estimate Range (–10% to +30%) for this Option**

  - Scale of on-Airport structures or modifications to on-Airport roads required to accommodate new Subway stations and elevated track: The study has evaluated an alignment that, at this stage of development, can be accommodated within the existing Airport buildings and roadway structures. There remains a residual risk that, once more detailed surveys of the existing structures and their foundations are conducted, more complex or longer span structures are required than currently evaluated and/or structural modifications could be required to the existing on-Airport roadways and support structures. This risk is typical for infrastructure of this type in such constrained and highly built-up areas; however, considering the relatively large size requirements of the Subway stations it could still result in large increases in construction costs over those accounted for in this evaluation.
  - Scale of utility strengthening and/or replacement work needed along 19th Ave: There is a residual risk that, once condition and location surveys of the existing utilities along and crossing 19th Ave can be undertaken, the results identify the utilities to be in a poorer condition or different location than currently evaluated. This could result in more intrusive strengthening or replacement of the existing utilities before construction work can commence, or different structure support arrangements to avoid the utilities. This is a risk typical for major infrastructure work in close proximity to multiple legacy utilities; however, it could result in increases in construction costs and delay to the start of construction, prolonging the overall schedule.
  - Scale of track and systems tie-in work required to construct the extension: There is a residual risk that, as engineering design matures and through coordination with the MTA, further constraints to construction methods and/or greater construction

complexities are identified for the tie-in at Astoria-Ditmars Blvd Subway station. The study team concluded that this is a risk that would be considered typical of interface work of this type but could still have the potential to result in large increases in construction costs and schedule prolongation.

- Proposed route through ConEd and Luyster Creek properties: There is a risk that detailed development further uncovers or identifies issues that prevent locating the elevated subway structure through the ConEd and Luyster Creek properties. Should this not be possible, an alternate route avoiding the properties could be developed using existing public streets parallel to the properties. This would require re-assessment of the potential permanent impacts to properties affected by an alternate alignment.
- Scale of constraints on construction activities along residential streets: There is a residual risk that, during detailed engineering design and community consultation, greater constraints to construction methods and working hours may be imposed than currently evaluated. This risk would likely affect the efficiency of construction, increasing overall project duration.
- Proposed route through ConEd property: There is a risk that one or more parties with existing rights could reject the proposed route through the ConEd property, necessitating alternative land right transfer options. This risk could result in delays to the start of detailed engineering and construction while the land rights are resolved.

4.2.1.2 Infrastructure Impacts during Construction

Construction of this option would result in temporary disruption to other major infrastructure along the route, which would last over 2–3 years. The notable areas of temporary infrastructure disruption are summarized below. The durations given below are indicative and based on preliminary assessment.

- **Operational Disruption to N- and W-Line Subway Services**
  - 5–10 off-peak, overnight, or weekend partial track and full station closures would be expected over a period of 3–6 months to conduct intrusive construction modification work to the existing Subway structure.
  - 5–10 off-peak, overnight, or weekend partial track and full station closures would be expected over a period of 6–9 months to conduct deck structure and track integration work to link the existing Subway structure with the new extension.
  - 5–10 off-peak, overnight, or weekend partial track and full station closures would be expected over a period of 3–6 months to install systems links to the extension.
  - Astoria-Ditmars Blvd Station would be closed for passengers during this work. N- and W-trains would be able to enter the station beyond the track switches, allowing train turnaround and avoiding terminating services back at Queensboro Plaza Station. Replacement transit (shuttle bus) services between Astoria Blvd and Astoria-Ditmars Blvd stations would be required during these closures.
  - 5–10 off-peak, overnight, or weekend partial track and station closures would be expected over a period of 4–8 months to conduct systems integration tests and trial

operations. During trial operations, services would terminate for passengers at Astoria Blvd Station and continue in non-revenue service along the new extension.

- **Disruption to ConEd Property Access Roads**
  - The primary entrance to the site at 20th Ave could be closed for up to a year during construction to accommodate the construction of new infrastructure. During this time, temporary access means (and associated costs) would be coordinated with ConEd and other stakeholders to maintain site access rights.

- **Disruption to Western Airport Facilities and Operations**
  - Limited access within the fuel farm and disruption to fuel operations would be expected for 9–18 months while piling, foundation work, and guideway pier construction occur. Access to and from the fuel farm would be maintained throughout the period but there would be a reduction in overall vehicle maneuvering space within the facility.
  - Up to 5 overnight closures would be needed to the fuel facility over a 2- to 4-month period during erection of aerial guideway beams using cranes and other tall construction equipment. Work would need to be coordinated with and agreed to by the FAA to occur in off-peak operational periods.
  - Increased construction traffic would cause potential congestion to on-Airport roads for 9–18 months, leading to potential longer journeys on-Airport and traffic delays.
  - Disruption to Terminal A traffic access along Marine Terminal Rd would be expected during work to re-position Marine Terminal Rd to the north. Road diversions and alternate routes would be put in place to maintain access to Terminal A; however, congestion and reduced access would result in potential traffic delays during this time.
  - Temporary closure of car rental facilities north of Marine Terminal Rd would be likely for 9–18 months during reconfiguration of Marine Terminal Rd further north. Facilities would be restored once construction is complete but would be reconfigured to fit around the new road layout (see “Permanent/Operational Impacts to Existing Infrastructure”).

- **Disruption to Intra-Airport Services and Facilities**
  - Increased construction traffic around Terminals B and C for 1–2 years would require a coordinated traffic management plan to avoid/minimize potential on-Airport traffic disruption.
  - 20–50 overnight and/or off-peak lane and road closures of on-Airport access roads would be expected for up to 3 years during long-span bridge section erection and other elevated structure and station work.
  - Airport user inconvenience could potentially occur to certain portions of Airport facilities for 2–4 months during construction of customer transfer connections and

circulation. This would require a coordinated traffic management plan to avoid/minimize potential traffic disruption.

4.2.1.3 Permanent/Operational Impacts to Existing Infrastructure

Once completed, this option would have the following permanent/operational impacts on other infrastructure along the route:

- **Impacts on LGA**
  - As the subway transitions from a cut-and-cover tunnel to elevated once past Runway 04-22, placement of the support columns would permanently reduce the roadway lanes in Runway Dr from three to two, reducing the capacity of this road for intra-airport traffic.
  - The subway transition to the retained-cut section would require permanent reconfiguring of Marine Terminal Rd and Bowery Bay Blvd, reducing the available area for rental car and gas station facilities. These would need to be permanently reconfigured to the new space and may require off-site storage for vehicles.
  - The location of the aerial guideway and Subway station in front of Terminal B would result in the construction of structure piers and frames in the area that has currently been identified to be the future permanent Terminal B taxi hold. This could prevent the taxi hold from using this location, requiring an alternate location, which may not be as operationally efficient.

4.2.1.4 Indicative Capital Cost

The Indicative Capital Cost for Option S-2 is $5.4 billion (in 2022$, excluding future escalation and solely for approximate comparison between study options).

Indicative Capital Costs should be considered to have a range of estimating uncertainty of -10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).

As discussed in more detail in Section 3.2.1.1.1, the preliminary engineering work carried out by the study team has not identified a construction approach that, with confidence, could overcome the significant challenges and complexities presented by the twin constraints of the FAA Airport Design Standards and the existing large-diameter, 90-year-old utility structures along the GCP without more complex, risky, and costly approaches to construction that would require greater engineering exploration beyond the scope of this study. Therefore, to provide a basis of an order-of-magnitude cost on which to compare between options, this option was costed out using the (least cost) baseline solution of an open trench south of Runway 04-22, despite this approach not being compliant with FAA Airport Design Standards. Costs associated with an FAA compliant tunneled solution which could require replacement or relocation of existing sewer structures could result in additional costs of between $1–3 billion.

The following are the notable cost drivers for the option:

- New elevated intermediate and terminal Subway stations, back-of-house, and connectors at LGA.
- Aerial guideway structure along 31st St, 19th Ave, and on-Airport.
- Transition structure, open trench, and cut-and-cover tunnel section past Runway 04-22.
- Additional subway vehicles.
- Long-span crossings on-Airport.
- Tie-in to existing Subway station.

4.2.1.5 Indicative Timeline/Schedule

The Indicative Timeline/Schedule (for comparison between study options) for Option S-2 is approximately 12–13 years from a decision to take the option forward to revenue service. This includes the following notable schedule drivers:

- Planning, approvals, and acquisitions.
- Procurement of design-build contractor(s) for heavy civil construction.
- Astoria-Ditmars Blvd Station tie-in.
- Elevated guideway construction along 31st St and 19th Ave.
- On-Airport transition and cut-and-cover tunnel (longest construction activity).
- On-Airport elevated stations and structure.
- Systems installation and testing.
- 18 months of integration testing and commissioning.

Figure 4.2-2 illustrates the indicative timeline/schedule for Option S-2. The key drivers are the major civil construction work, which may trigger longer permitting, approvals, and procurement processes, and the integration and commissioning with existing NYCT systems.

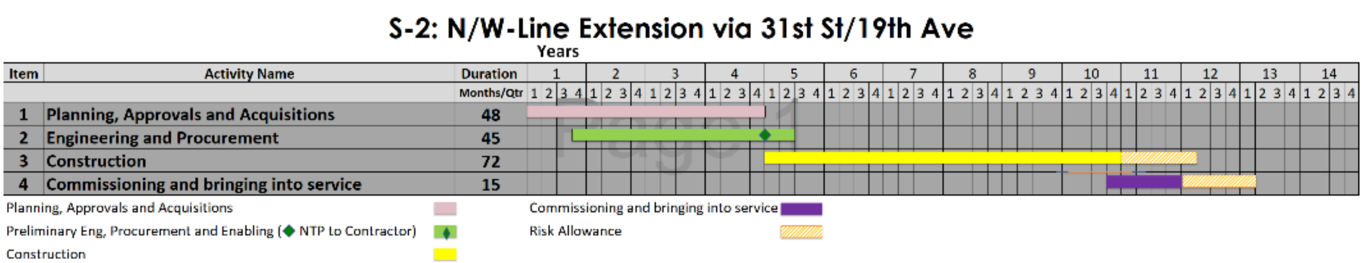


FIGURE 4.2-2: INDICATIVE TIMELINE/SCHEDULE (S-2)

4.2.2 Transportation Aspects

4.2.2.1 Improved Access to LGA

Three factors have been considered in this category: Standardized Indicative Baseline Off-Peak Travel Time, Reliability, and Transfer Experience.

4.2.2.1.1 Standardized Indicative Baseline Off-Peak Travel Time

- Table 4.2-1, below, provides the Standardized Indicative Baseline Off-Peak Travel Times for the weekday, midday off-peak journeys to be used solely as a baseline for comparison between options. Table 4.2-2 provides a breakdown of the components that make up the total journey, the general approach to the estimation of which is described in Section 3.2.2.1.1.
- Passengers making the journeys described would, naturally, experience variations to the baseline timings calculated even where services are running as planned, for reasons as simple as variations in walking speeds or whether a traveler arrives just before a scheduled departure or just misses a departing train.

TABLE 4.2-1: STANDARDIZED INDICATIVE BASELINE OFF-PEAK TRAVEL TIME, OPTION S-2

Times Square to LGA (minutes to Terminal B)	S-2
Via direct Subway (N or W train)	32

TABLE 4.2-2: STANDARDIZED INDICATIVE BASELINE OFF-PEAK TRAVEL TIME BY SEGMENT, OPTION S-2

Times Square to LGA via direct Subway (minutes)	S-2
START Times Square (street level)	
walk/wait time	5
N/W Subway platform (dep)	
Subway trip time	27
1st on-Airport station (arr)	new elevated
END Terminal subway stop	Terminal B
Total travel time =	32
trip time to next Terminal subway stop	2
2nd on-Airport station	new elevated
END Terminal subway stop	Terminal C
Total travel time =	34

- Passengers for Terminal A would transfer to an existing on-Airport shuttle service running every 10 minutes and with an additional trip time of around 7 minutes from Terminal B.

4.2.2.1.2 Reliability

- Option S-2 would operate exclusively on dedicated infrastructure separate from general roadway conditions.

4.2.2.1.3 Transfer Experience

- Riders bound for Terminals B or C would have a one-seat ride to travel directly to LGA without requiring any transfers. Riders bound for Terminal A would have an additional transfer to an existing on-airport shuttle once they reach the airport.
- This option would include two new, fully enclosed, elevated on-Airport Subway stations, one serving Terminal B and one serving Terminal C.

4.2.2.2 Ridership

- Stated preference survey results indicate that 61% of airport passenger respondents are "definitely" or "probably" interested in subway service.
- The ridership model projects 5.9 million total riders using Option S-2, with a corresponding increase in net transit ridership of 3.4 million riders in 2025 (Table 4.2-3).

TABLE 4.2-3: RIDERSHIP MODEL RESULT SUMMARY

Transit Option			Riders on Current Bus Services to LGA (Millions) (No Action)	New Transit Option Impact (Millions)		
Mode Category & Scenario Label		Description		Riders on New S-2 Subway Service	Net Increase in Total Transit Ridership	Total Transit Ridership (S-2 Subway Service + Other Bus Services)
Subway	S-2	N/W Ext. (31st St & 19th Ave)	4.1	5.9	**3.4**	**7.4**

4.2.2.3 Throughput and Capacity

Throughput

- Using the highest hourly single-direction provision of airline seats at LGA in 2019 (4,300 seats on weekday departing flights 9 AM to 10 AM – see Figure 3.2-1, in Section 3.2.2.3), the estimated single-direction peak passenger demand for this option could be approximately 650 passengers per hour.
- This peak passenger throughout would occur Airport-bound in a 1–2-hour morning period in the opposite direction to the Manhattan-bound Subway passenger peak at that time of day. Peak passenger throughput during the Subway peak is considered below.

Capacity of New Transit Option

- MTA has indicated an intention to continue the existing service pattern to LGA along the extension of 15 tph during peak times (this would reduce off-peak and at weekends, but the peak is used to correspond with the peak throughput time). Using the current N/W Subway service configuration of 8-car trains and the MTA Rapid Transit Loading Guideline maximum passenger loadings per-car of 175 passengers (for high-frequency services), gives a potential capacity of the proposed new subway branch between LGA and Astoria-Ditmars Subway Station of:
  - 21,000 pphpd at peak.
- This is sufficient to support the estimated single-direction peak passenger demand from the ridership model, equating to approximately 45 passengers per train at peak with this proposed frequency.

Impact on Capacity of Existing Downstream Transit Systems

- Generally, airport passenger loadings are constant through the day both to and from the Airport with the peak passenger loadings occurring outside of the morning Manhattan-bound subway peaks or in the opposite direction (i.e., Airport-bound).
- The existing N- and W-Subway lines currently operate close to their peak capacity during the 8 AM to 9 AM Manhattan-bound commuting peak. While most Manhattan-bound Airport passengers would travel outside this peak, those passengers (including non-Airport passengers) traveling during this peak could experience some crowded conditions.

4.2.2.4 Indicative Operating Cost

- The 31st St/19th Ave Subway option would add two stations to the NYCT network and about 3 miles of new double-track line.
- The current train crew booking on and relief point at Astoria-Ditmars Blvd would be relocated in line with MTA operating policy to the new terminus at LGA, with its associated operating costs remaining unchanged.
- MTA has indicated a requirement for four additional trains in daytime service to operate the extended line.
- Total additional operating and maintenance costs, including train and station operations, and train, station, and infrastructure maintenance, have been estimated by MTA at $44 million per annum at current prices.

4.2.3 Community and Environmental Aspects

4.2.3.1 Local Community Impacts

This option would connect the Airport to the Subway N-/W-Line by extending the existing elevated track above 31st St, north of the existing Astoria-Ditmars Blvd Station.

It would be located within densely developed neighborhoods (properties on both sides of the structure) along 31st St and 19th Ave. 31st St is mainly commercial businesses from the Astoria-Ditmars Blvd Subway station to Ditmars Blvd and then transitions to mainly residential, consisting of a variety of single-family (row & detached) and 3- to 6-story residential buildings, and mixed-use (residential above commercial) buildings. 19th Ave is mainly commercial businesses. The approximately 3-mile route goes through/along the following communities: Astoria, Ditmars Steinway, Astoria Heights, and East Elmhurst.

The new extension of the subway line on an elevated structure and within tunnel (past Runway 04-22) would require major heavy civil construction activities to build the foundations, structures, and stations along the route.

The potential for temporary (during construction) and permanent (once operational) impacts is summarized below for specific areas of the alignment.

4.2.3.1.1 Temporary Impacts during Construction on the Local Neighborhoods Directly Affected

The subway from Astoria-Ditmars Blvd Subway station to LGA would require major heavy civil construction activities to build the elevated structures, foundations, tunnel, and stations along the route. Construction activities are anticipated to occur along the approximately 3-mile route for approximately 6 years.

As discussed in more detail in Section 3.2.1.1.1, the preliminary engineering work carried out by the study team has not identified a construction approach that, with confidence, could overcome the significant challenges and complexities presented by the twin constraints of the FAA Airport Design Standards and the existing large-diameter, 90-year-old utility structures along the GCP without more complex, risky, and costly approaches to construction that would require greater engineering exploration beyond the scope of this study. Therefore, to provide a consistent basis on which to evaluate it, this assessment was based on the baseline solution of a predominantly open trench south of Runway 04-22, despite this approach not being compliant with FAA Airport Design Standards.

During construction, the following neighborhoods would have the potential for air quality, noise, vibration, or visual impacts. For the frequency and duration of construction activities refer to Section 4.2.1.2 “Infrastructure Impacts during Construction” above.

- **Construction of the Tie-in to the Existing Subway Station at Astoria-Ditmars Blvd**
  - The proposed extension to the NYCT N-/W-Lines would continue the elevated guideway structure to the north of the existing subway platforms, along 31st St. This would require modification to the existing subway support structure, tracks, platforms, and systems. The elevated subway structure and the station would require major heavy civil construction activities to build the elevated guideway foundations, structures, and stations on 31st St and Astoria Blvd along this segment of the route.

- The construction immediately adjacent to the station would occur approximately 30–50 ft within 1 long city block of residential and commercial properties.
- Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
- Planned periodic closure of sidewalks, bike lanes, and parking spaces would be required.
- Planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.

- **Construction of the Elevated Structure along 31st Street**
  - The elevated subway structure would run down the center of 31st St, between 21st Ave and 20th Ave. The elevated subway structure would require major heavy civil construction activities to build the elevated guideway foundations and structures along this approximately 0.5-mile segment of the route.
  - The construction would occur approximately 30–50 ft from 3 long city blocks of residential and commercial properties.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - Planned periodic closure of sidewalks, bike lanes, and parking spaces would be required.
  - Planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.
  - Planned periodic suspension of truck deliveries for loading/unloading at commercial businesses would be expected.

- **Construction over ConEd Property on 20th Ave and Luyster Creek on 19th Ave**
  - The elevated subway structure would continue along 31st St through private, commercial land within the ConEd property to cross over the end of Luyster Creek to reach 19th Ave, and this would require long-span (approximately 300 ft) structures to avoid placing support piers in or adjacent to the creek along this approximately 0.1-mile segment of the route.
  - The construction would occur approximately 35–50 ft around 1 city block of commercial properties and approximately 125–150 ft from sports fields located within the ConEd property.

- **Construction of the Elevated Structure along 19th Ave**
  - The elevated subway structure would run down the center of 19th Ave, between Luyster Creek and Hazen St. The elevated subway structure would require major heavy civil construction activities to build the elevated guideway foundations and structures along this approximately 0.5-mile segment of the route.

- The construction would occur approximately 25–40 ft from 11 short city blocks of commercial properties.
- Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
- Planned periodic closure of sidewalks, bike lanes, and parking spaces would be required.
- Planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.
- Planned periodic suspension of truck deliveries for loading/unloading at commercial businesses would be expected.

- **Construction of the Elevated Structure Adjacent to the Astoria Heights Community**
  - The elevated subway structure would require major heavy civil construction activities to build the elevated guideway foundations and structures along this approximately 0.2-mile segment of the route.
  - The construction would occur approximately 25–40 ft from 3 short city blocks of one- and two-family homes and blocks of multi-family apartments.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - Planned periodic closure of sidewalks and parking spaces would be required.
  - Planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.

- **Construction of the Elevated Structure Adjacent to the Elmjack Baseball Fields**
  - The elevated subway structure would require major heavy civil construction activities to build the elevated guideway foundations and structures along this segment of the route.
  - The construction would occur approximately 50–75 ft from the boundary of land with community baseball fields.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - Planned periodic closure of sidewalks and parking spaces would be required.

- **On-Airport Construction Past Runway 04-22**
  - The subway alignment would enter the Airport property at elevation over 81st St, following Bowery Bay Blvd southward. To attempt to comply with the regulatory safety constraints at Runway 04-22, the aerial guideway would transition to a retained-cut along Bowery Bay Blvd, north of Marine Terminal Rd, and then into a cut-and-cover

tunnel for approximately 300 ft at the end of Runway 04-22 over an approximately 0.5-mile segment of the route (see commentary in Section 3.2.1.1).
- The construction would occur approximately 150–200 ft from commercial properties and over 500 ft from 2 long city blocks of residential properties.

- **Constructing On-Airport Elevated Stations**
  - The proposed subway transitions from an at- and below-grade structure to aerial guideway along Runway Dr, ascending over 94th St and the Airport access roads to the elevated stations. Long-span (approximately 350-ft) bridge structures would be required over 102nd St and the newly constructed departures roadway (approximately 70 ft above-grade) over an approximately 1.2-mile segment of the route.
  - The construction would occur over 500 ft from 5 city blocks of residential and commercial properties in the East Elmhurst community located on the other side of 8 lanes of the GCP.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - There could be increased construction/haul traffic on local roads because trucks are not allowed on the GCP.

4.2.3.1.2 Permanent Operational Impacts on the Local Neighborhoods Directly Affected

Subway trains of 600-ft length, similar in size and characteristics as the trains that currently operate on the NYCT N- and W-Lines, would operate between Astoria-Ditmars Blvd Station and LGA throughout the day, ranging from a frequency of 15 tph during peak times to 3 tph at night. They would operate on a predominantly elevated aerial guideway, descending to get past Runway 04-22, ranging approximately 25–500+ ft from residential and commercial properties.

The following local neighborhoods and areas would have the relative potential for permanent noise, vibration, or visual impacts because of this option’s proposed subway operations:

- **New Elevated Subway along 31st Street**
  - From Astoria-Ditmars Blvd Subway station, Subway trains would operate in each direction on an elevated Subway structure along the center of 31st St approximately 30–50 ft from residential and commercial properties.

- **New Elevated Subway over ConEd on 20th Ave and Luyster Creek on 19th Ave**
  - Once on ConEd property, Subway trains would operate in each direction on an elevated Subway structure approximately 35–50 ft from commercial properties and 125–150 ft from sports fields located within the ConEd property.

- **New Elevated Subway along 19th Ave**
  - East of the ConEd property, Subway trains would operate in each direction on an elevated Subway structure along the center of 19th Ave approximately 25–40 ft from commercial properties.

- **New Elevated Subway Adjacent to the Astoria Heights Community**
  - Between Hazen St and 81st St, Subway trains would operate in each direction on an elevated subway structure along 19th Ave approximately 25–40 ft from approximately 3 short city blocks of one-/two-family homes and blocks of multi-family apartments.

- **New Elevated Subway Adjacent to the Elmjack Baseball Fields**
  - Subway trains would operate in each direction on an elevated Subway structure approximately 50–75 ft from the boundary of land with community baseball fields.

- **New Tunneled Subway Past Runway 04-22**
  - Once on-Airport, Subway trains would operate in each direction in a Subway tunnel within the Airport boundary underground approximately 150–200 ft from commercial properties and over 500 ft from residential properties.

- **New On-Airport Elevated Subway Stations**
  - Subway trains would operate in each direction on an elevated subway structure between the two proposed stations over 500 ft from residential and commercial properties in the East Elmhurst community located on the other side of 8 lanes of the GCP.

4.2.3.1.3 Potential Private Property Acquisitions

The elevated subway structure from Astoria-Ditmars Blvd Subway station to LGA may require permanent acquisition of the following:

- Up to 2 industrial properties.

4.2.3.1.4 Potential Public Property Acquisitions (NYC DOT Plazas and NYC Parks Parkland)

No structures would be sited within NYC Parks Parkland or NYC DOT Plazas.

4.2.3.1.5 Removal/Reconfiguration of Parking Spaces

- A total of approximately 200 on-street public parking spaces would be lost on the following streets:
  - 31st St.
  - 19th Ave.

  The numbers are approximate and are preliminary estimates based on the alignment.

4.2.3.1.6 Environmental Justice Communities Mapping Analysis

The Environmental Justice communities mapping analysis provides an overview of the minority and low-income communities within 0.25 mile of the transit options being evaluated.

For Option S-2, less than half of the block groups within the 0.25-mile buffer of the option alignment are Environmental Justice block groups.

See Figure 4.2-3 below for the analysis map for Option S-1A.

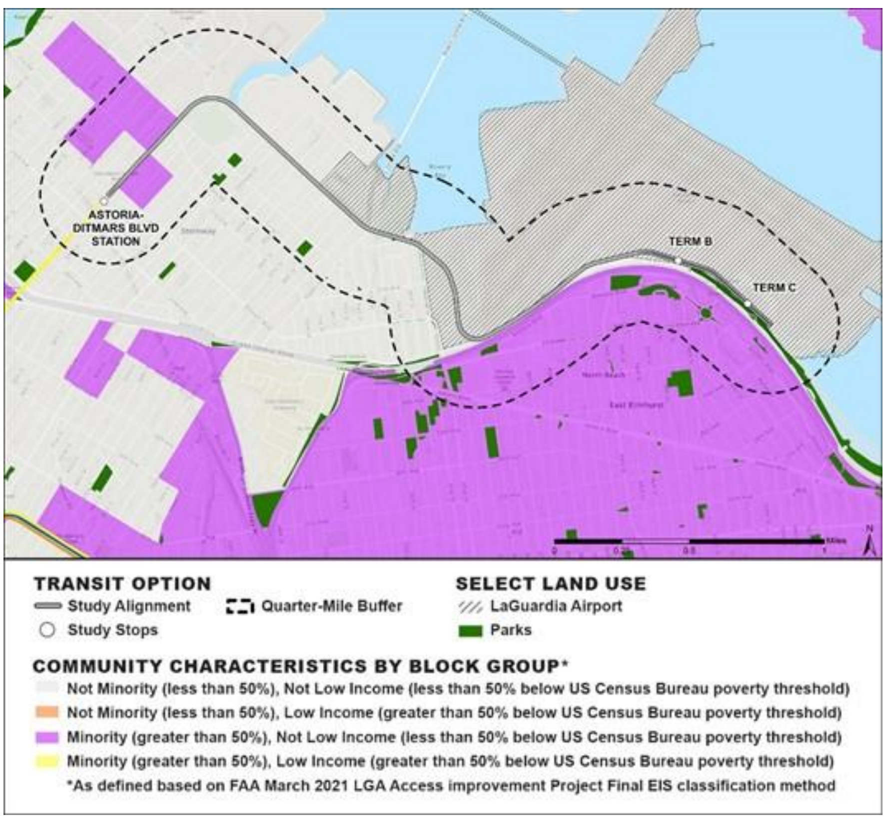


FIGURE 4.2-3: N/W EXTENSION ALONG 31ST ST. & 19TH AVE – ENVIRONMENTAL JUSTICE COMMUNITIES MAPPING ANALYSIS (AS DEFINED BASED UPON FAA MARCH 2021 LGA ACCESS IMPROVEMENT PROJECT FINAL EIS CLASSIFICATION METHOD)

4.2.3.2 Equity

4.2.3.2.1 Transit Access from LGA

- **Additional Minority and Low-Income Populations Reached within 45 Minutes from LGA via Transit (Population Access Analysis)**
  - The results of the Population Access Analysis illustrate how many people, specifically from low-income and minority populations, could travel via transit from LGA to homes within 45 minutes from LGA. Airport passengers or Airport employees living within these areas could potentially benefit from expanded access to these destinations.
  - Option S-2 is expected to expand transit access from LGA to regional destinations within 45 minutes, as shown in the blue area of “Additional Access Provided by Transit Option” in Figure 4.2-4. Compared to the baseline, the minority population reached within a 45-minute transit trip would increase by 92.2% and the low-income population reached within a 45-minute transit trip would increase by 143.6% as shown in Table 4.2-4.
  - This represents a higher increase in transit access to LGA within 45 minutes for minority and low-income communities.

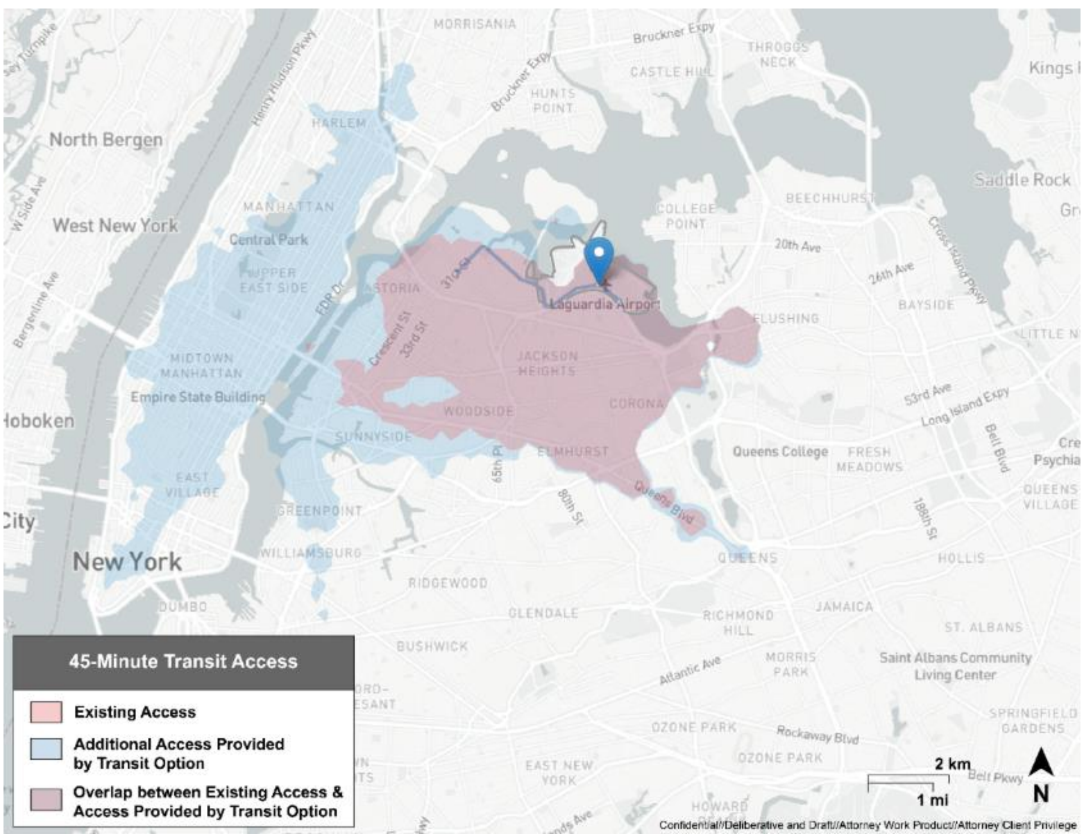


FIGURE 4.2-4: N/W EXTENSION ALONG 31ST ST AND 19TH AVE S-2 – POPULATION ACCESS ANALYSIS

TABLE 4.2-4: N/W EXTENSION ALONG 31ST ST AND 19TH AVE S-2 – POPULATIONS REACHED WITHIN 45-MINUTE TRANSIT TRIP

		Total Population Reached	Minority Population Reached	Low-Income Population Reached
Baseline	Existing Condition	551,434	422,981	76,750
S-2	With Option	1,452,224	812,969	186,949
	Net Change	+900,790	+389,988	+110,199
	% Change	163.4%	92.2%	143.6%

- **Additional ADA-Accessible Stations within 45 Minutes from LGA via Transit (ADA Analysis)**
  - The results of the ADA Analysis illustrate how Airport passengers and Airport employees, specifically those requiring ADA-compliant stations, traveling from LGA to other locations could potentially benefit from expanded access to ADA-compliant stations within 45 minutes via transit.
  - More ADA-accessible stations/stops can be reached within a 45-minute transit trip for this option compared to the baseline of existing transit service (Table 4.2-5). This echoes the results from the Population Access Analysis, in which Option S-2's 45-minute transit travel shed provides an increased amount of access over the baseline transit service. Compared to the baseline, an additional 82 ADA-accessible stations can be reached within a 45-minute transit trip from LGA for Option S-2.

TABLE 4.2-5: N/W EXTENSION ALONG 31ST ST AND 19TH AVE S-2 – ADA ANALYSIS

Stations Reached within 45-Minute Transit Trip from LGA	Baseline	S-2	Difference between Baseline and S-2
Total Stations	*43*	*181*	*+138 stations*
ADA-Accessible Stations (Accessible Stations as % of Total)	*20 (47%)*	*102 (56%)*	*+82 stations*

4.2.3.2.2 Transportation Opportunities and Benefits for the Surrounding Community

- **Transportation Opportunities for Neighbors**

  This option does not include intermediate/off-Airport stops. Because there is limited pedestrian access to LGA from adjacent residential areas and walking distance exceeds 0.25 mile, the study team did not consider there to be a significant market for use of the final on-Airport stops by the surrounding community to connect to the broader transit network.

- **Cars Removed from Local Roadways and Emissions Reductions**

  See the "Cars Removed from Local Roadways" section and the "GHG and Other Vehicular Emissions Reductions" section of this evaluation below.

4.2.3.3 Cars Removed from Local Roadways

- Option S-2 would be expected to remove 1,417,000 Airport passenger vehicles, and 211,000 Airport employee vehicles from the road each year.

4.2.3.4 GHG and Other Vehicular Emissions Reductions

- Option S-2 would be expected to remove 6,945 metric tons of CO_2 equivalent each year.
- Other vehicular emissions reductions are given in Table 4.2-6:

TABLE 4.2-6: OTHER VEHICULAR EMISSIONS REDUCTION (METRIC TONS PER YEAR)

Option	CO	VOC	NOx	SO_2	PM_{10}	$PM_{2.5}$
[S-2] N/W 31st St and 19th Ave	32.7	0.5	2.2	0.1	1.2	0.2

4.2.4 Summary of Evaluation

S-2: N/W-Line Extension via 31st St/19th Ave

Option S-2 would provide a direct link to LGA by extending the existing subway north from the terminus at Astoria-Ditmars Blvd Station, providing Airport access for all N and W trains.

This option would require the construction of heavy infrastructure, including elevated concrete guideway structures along predominantly city streets of residential and commercial properties, and elevated and below-grade structures on-Airport. This option would have to contend with the construction challenges of complying with FAA Airport Design Standards while negotiating the 90-year-old utilities running under the airport at the end of Runway 04-22 (a challenge as yet unresolved as discussed in Section 3.2.1.1.1) and locating more extensive MTA regulation-led subway-length stations at the terminals. For the purpose of cost comparison, this option was costed out on the basis of a baseline solution of a cut-and-cover tunnel under Runway Dr despite this approach not being compliant with FAA Airport Design Standards.

Table 4.2-7 summarizes the output from all the factors used to evaluate this option.

TABLE 4.2-7: SUMMARY OF KEY CHARACTERISTICS – N/W-LINE EXTENSION VIA 31ST/19TH AVE (S-2)

	Evaluation Factor	Assessment
CONSTRUCTION ASPECTS	Constructability	• **Major unresolved constructability challenge**: Complying with FAA Airport Design Standards while also avoiding disruption to 90-year-old, 15 ft diameter sewer structures at the end of Runway 04-22 (see details in Section 3.2.1.1.1) • Construction through residential city blocks along 31st St and 19th Ave • Construction of track tie-in to Astoria- Ditmars Blvd Station • Construction through ConEd property and over and Luyster Creek • Construction over utilities on 19th Ave • Constrained on-Airport sites for new elevated subway structure and 600 ft stations • Total option route length: approx. 3 miles
	Infrastructure Impacts during Construction	• Operational disruption to N and W services • Access disruption to ConEd property • Disruption to western Airport facilities and operations
	Permanent/Operational Impacts to Existing Infrastructure	• On-Airport tunnels and structures permanently reconfigures Airport facilities and roads • Runway Dr permanently reduced from 3 to 2 lanes • Columns and piers in site of future Terminal B taxi hold
	Indicative Capital Cost (2022$)[56]	$5.4 billion[57] (Does not include any additional costs required for an as yet unresolved solution to get past Runway 04-22 in compliance with FAA Airport Design Standards; potentially up to approx. $1–$3 billion)
	Indicative Timeline/Schedule	12–13 Years

[56] Indicative Capital Costs should be considered to have a range of estimating uncertainty of –10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).

[57] Costs for heavy infrastructure options approaching LGA from the west/southwest are based on the open-trench construction concept past Runway 04-22 (over the existing 90-year-old utilities), to provide a baseline estimate of the cost of construction. Although this concept does not meet FAA Airport Design Standards, it provides a consistent approach for capital cost comparison purposes. Costs associated with tunnelling and/or relocating utilities would be substantially higher, potentially up to approx. $1–$3 billion.

TABLE 4.2-7, CONTINUED.

	Evaluation Factor	Assessment
TRANSPORTATION ASPECTS	Standardized Indicative Baseline Off-Peak Travel Time (From Midtown Manhattan)	32 mins (Times Square to Terminal B, then C; shuttle to Terminal A)
	Transfer Experience	Single seat ride on N- & W-Lines, no transfer necessary
	Ridership[58]	Total annual projected ridership for option: 5.9 million Net increase in annual projected transit ridership: 3.4 million
	Throughput & Capacity	21,000 pphpd (peak)
	Indicative Operating Cost	$44 million per annum in addition to current N and W train operation
COMMUNITY AND ENVIRONMENTAL ASPECTS	Local Community Impacts	<u>Construction:</u> • Heavy civil construction of elevated and at-/below-grade structures for approx. 6 years <u>Proximity to communities:</u> • 30–50 ft from 4 city blocks of residential and commercial properties on 31st St • 25–40 ft from 15 city blocks of residential and commercial properties on 19th Ave, including along the boundary of land with community baseball fields • Over 500 ft across 8 lanes of the GCP from 7 city blocks of residential and commercial properties opposite the Airport Terminals <u>Permanent impacts:</u> • Acquisition of up to 2 properties (industrial) • No impacts to NYC parklands or plazas • Loss of approx. 200 on-street public parking spaces on 31st St and 19th Ave
	Equity	• Higher increase to low-income and minority populations within 45 minutes of the Airport via transit versus the no-build scenario • +82 additional ADA-compliant stations reachable within a 45-minute transit trip from LGA versus the no-build scenario
	Cars Removed from Local Roadways	1,417,000 airport passenger vehicles and 211,000 airport employee vehicles from the road each year
	GHG and other Vehicular Emissions Reductions	6,945 metric tons of CO2 equivalent each year

[58] Experience from AirTrain JFK was that actual ridership turned out to be higher than would have been predicted by the AirTrain JFK forecast and underscores the inherent uncertainty of model predictions. The ridership model supporting this effort could also deviate from eventual ridership demand but was utilized to allow ridership comparisons between the options.

5.0 FIXED GUIDEWAY WITH LIGHT RAIL

Fixed guideway with light rail options would provide a two-seat ride to the Airport with a dedicated, Airport-branded transit mode from existing transit hubs within Queens. Predominantly using elevated fixed guideways, light rail options could offer a simpler construction than the equivalent NYCT Subway structure. Light rail services would be operated on behalf of the Port Authority as dedicated Airport connections, offering the opportunity to extend the Airport customer experience to the light rail transfer points, but all would require Airport passengers to transfer from the Subway or LIRR to a separate light rail segment to access the Airport.

The fixed guideway with light rail option evaluation is based on the construction of the guideway, systems, and facilities required to support electrically powered, steel-wheeled, bi-directional, coupled formations of ‘light rail’ vehicles, typically using elevated structures. Each option would require a customer transfer station at the connection point with the existing transit services, including vertical circulation and pedestrian connectors. These connectors would include enhanced transfer facilities, including climate-controlled space, storage, travel information, concession stands, and amenities, tailored to the Airport passenger.

Each option also includes the provision of a new maintenance and storage facility, and related back-of-house facilities, for its fleet.

While the evaluation in this section was conducted based on light rail technologies on a fixed guideway, this approach could adopt different vehicular technologies, including rubber-tired, cable-pulled, or autonomous vehicles. Alternate vehicular technologies for a fixed guideway would have different functional requirements. The variations between different technologies have not been individually evaluated; however, it is not anticipated that they would have a material effect on the overall option evaluation compared to the infrastructure required for light rail.

The study evaluation considered fixed guideway with light rail options operating at 4-minute headways to/from the following locations in Queens:

- LR-1: Light rail to/from Woodside.
- LR-2: Light rail to/from Mets-Willets Point.
- LR-3: Light rail to/from Jamaica.
- LR-4: Light rail to/from Astoria.
- LR-5: Light rail to/from Jackson Heights.

A model for fixed guideway with light rail options is provided by the existing AirTrain JFK, connecting the Airport terminals to parking areas and to MTA subway services at Howard Beach and to LIRR at Jamaica. Passengers board automatically operated trains at enclosed stations equipped with platform screen doors. Cars are air-conditioned and provided with padded peripheral seating and luggage racks.

Fare policy and all other aspects of service definition would be determined by the Port Authority, which would be able to extend airport customer experience to the light rail transfer points.

Plan and profile alignment drawings for each of the fixed guideway alignments can be found in Appendix Section 2.2; they show the proposed layouts of the options as evaluated.

5.1 LR-1: Light Rail to/from Woodside

Option LR-1 would link LGA via a 4-minute light rail ride to the existing LIRR Woodside and 61 St-Woodside Subway stations, providing transfer access to both the LIRR Main Line (including the Port Washington Branch) and 7-Line Subway services. A dedicated Airport transfer station would be located adjacent to both existing stations providing ADA-compliant passenger access between them. The guideway would run above city streets to the BQE and GCP transportation corridors, on to LGA, avoiding city traffic.

Option Route Description

The route (Figure 5.1-1) would travel from Woodside on an elevated guideway adjacent to the existing LIRR ROW for 0.3 mile, over commercial and residential properties, and would then turn north onto 55th St. The route would then run above 55th St, through a light industrial corridor, for 0.3 mile, passing over Broadway and Northern Blvd, and then continue north within the Amtrak ROW for 0.3 mile. It would then turn east above 31st Ave, a commercial area, passing over the BQE before turning north to continue above 68th St and then Boody St for a total of 0.8 mile. This stretch of the alignment would be immediately adjacent to the BQE on the west. On the east side of this portion of the alignment, there are residences or other private properties located on 68th St and where Boody St intersects with 70th St

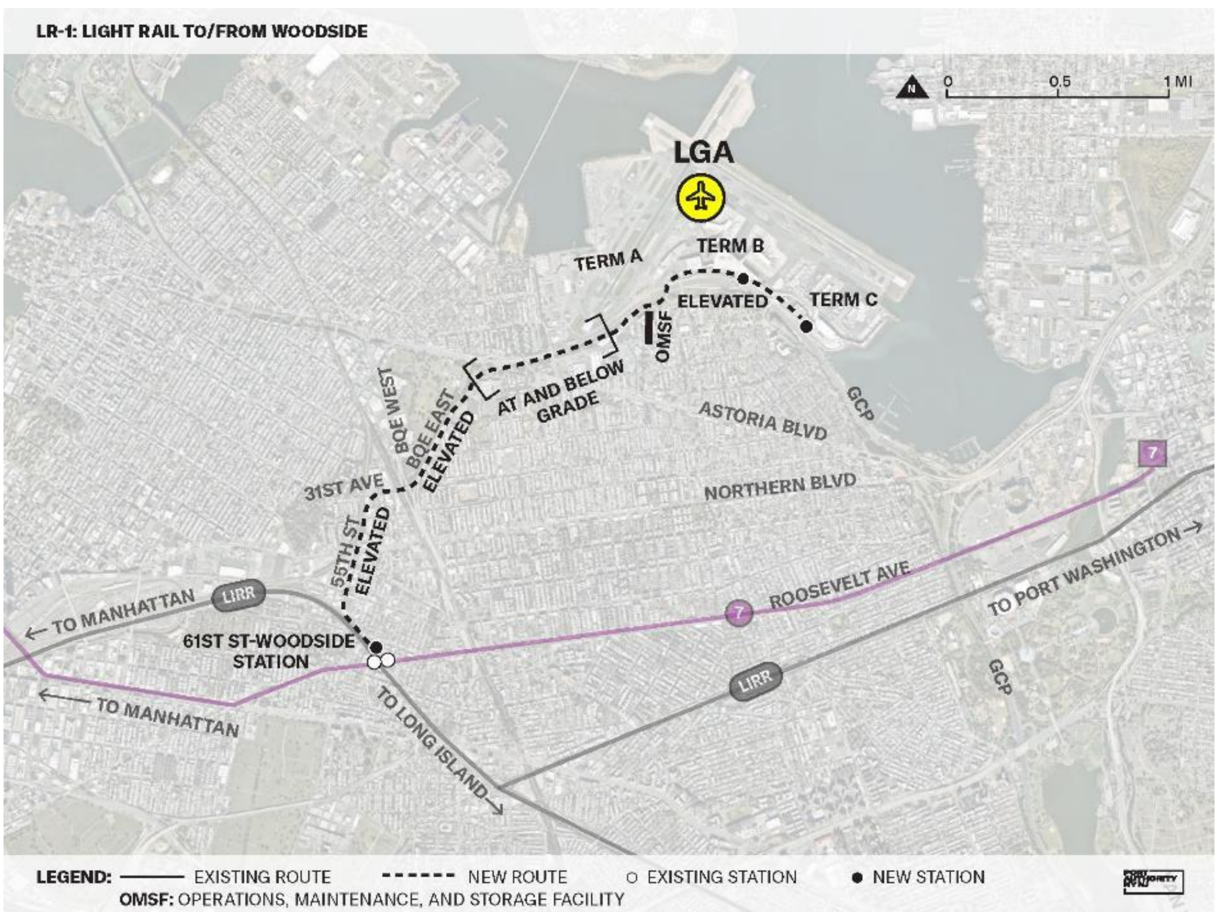


FIGURE 5.1-1: OPTION LR-1

and 71st St. The route then would turn east to navigate the ramps of the BQE and GCP interchange, in a cut-and-cover tunnel beneath Astoria Blvd South.

The route would then run at-grade inside the southern edge of the GCP ROW before needing to descend below-grade for 0.3 mile to contend with the construction challenges of complying with FAA Airport Design Standards at the end of Runway 04-22 while negotiating the 90-year-old utilities under the GCP. As discussed in detail in Section 3.2.1.1.1, the heavier infrastructure options from the west must overcome the significant challenges and complexities presented by the twin constraints of the FAA Airport Design Standards and the existing large-diameter, 90-year-old utility structures along the GCP. The preliminary engineering work carried out by the study team has not identified a construction approach that, with confidence, could do this without more complex, risky, and costly approaches to construction that would require greater engineering exploration beyond the scope of this study. To provide a consistent basis on which to evaluate the option and to allow cost comparison between the options, Option LR-1 is based on the baseline, simpler construction, concept of an open trench structure located in the embankment to the south of the eastbound GCP roadway, despite this being shown to be not compliant with the FAA Airport Design Standards.

Once east of Runway 04-22, the route would ascend to cross over the GCP and ramps associated with the 94th St interchange to connect to two fixed guideway stations, one serving Terminal B and one serving Terminal C. The OMSF for this option is proposed to use the location of the vacant former Courtyard by Marriott site at 90-10 Ditmars Blvd. This site on Ditmars was used for this purpose in the analysis; however, due to the hotel’s recent change of ownership, it may no longer be available for this purpose. Should this option be advanced, further study would be needed to determine a suitable location for the OMSF. This location was determined to be appropriate due to its proximity to the proposed fixed guideway alignment (common to LR-1, LR-4, and LR-5), size, and potential availability.

The length of this route is approximately 3.4 miles, including the on-Airport portion.

5.1.1 Evaluation of Construction Aspects

5.1.1.1 Constructability

The fixed guideway from Woodside to LGA would require major heavy civil construction activities to build the elevated guideway foundations, structures, and stations along the route. The proposed guideway for this option would extend over existing private property to reach the station at Woodside, as discussed in the “Community and Environmental Aspects” section.

The notable challenges and complexities associated with construction of this option are summarized below.

- **Construction of New Fixed Guideway Station at Woodside and Connectivity Interface with LIRR and Subway Station Infrastructure**
  - The proposed fixed guideway station would be located adjacent to the existing Woodside LIRR Station on the northeast side at elevation and would extend over existing properties between 61st St and 59th St (impacts to these properties, permanent

and during construction, are discussed in the "Community and Environmental Aspects" section of this option). Passenger connectivity between the LIRR Station, Subway station, and the light rail station is provided via a 'conditioned space' connector built over the LIRR Station platforms and under the existing subway tracks.

- Construction of the proposed light rail station and environmentally conditioned connector in a highly constrained urban location reduces the efficiency of construction work. This has been reflected in the durations used in the Indicative Timeline/Schedule and the cost estimate.
- Constructing the passenger access over the LIRR platforms and the intra-station connection mezzanine would require careful planning and coordination with LIRR and NYCT to minimize disruption to the existing station operations. This would increase the construction durations for this type of work over standard durations and has been reflected in the Indicative Timeline/Schedule.
- Structural modification of the existing LIRR and Subway stations steelwork would be required to accommodate the proposed mezzanine connection. An allowance has been included in the cost estimate for the station work.

- **Construction in Railroad Embankments adjacent to Live Rail Operations**
  - The proposed guideway alignment would require support piers to be located in the LIRR embankment between 58th St and 55th St and the Amtrak Northeast Corridor embankment between Northern Blvd and 31st Ave.
  - Complex enabling work would be required to shore up the embankment and ensure stability during guideway construction to avoid potential damage to the operational railroads. The enabling work would occur in off-peak, planned rail operation shutdowns. This is reflected in the Indicative Timeline/Schedule as increased durations for these activities.

- **Construction of the Elevated Guideway over the CSX Freight Railroad and BQE Split**
  - The elevated guideway transitions from running above 31st Ave to running adjacent to the Eastbound BQE Connector northbound roadway north of the BQE West and East split. This is a congested area of road and rail infrastructure requiring the guideway to span over the CSX railroad, three levels of road structures (Westbound BQE Connector, Eastbound BQE Connector, and 31st Ave), and the St Michael's Playground.
  - Complex engineering solutions would be required to locate the column piers, avoiding modification to the existing roadway structures. This would require approximately 150- to 200-ft long-span bridges and support frames straddling the roadways. The increased cost of the guideway over the standard rates has been included in the option cost estimate.
  - Access to construct the support piers is restricted and heavily constrained, and large construction equipment would have to be located in tight spaces between the BQE and 31st Ave roadways resulting in inefficient sequencing and methodologies. This

complexity is reflected in an increase over standard construction costs in the estimate, and extended durations in the schedule for work in this area.

- **Construction of the Elevated Guideway between Eastbound BQE Connector and Boody St**
  - Guideway piers would be located in the 68th St and Boody St roadways, running adjacent to the Eastbound BQE Connector northbound roadway for approximately 0.5 mile. This avoids impacting the Eastbound BQE Connector roadway support structure and Eastbound BQE Connector traffic lanes.
  - Construction of the guideway piers along 68th St and Boody St would require modification and reconstruction of the existing soundwall along the Eastbound BQE Connector. An allowance has been included in the cost estimate for this work.
  - The elevated guideway structure would require reconstruction of one overhead signage gantry along the Eastbound BQE Connector. An allowance has been included in the cost estimate for this work.
  - Construction work and access along 68th St and Boody St and adjacent to the Eastbound BQE Connector would be constrained for large equipment and vehicles, resulting in inefficient sequencing and methodologies. This complexity is reflected in an increase over standard construction costs in the estimate, and extended durations in the schedule for work in this area.

- **Major constructability challenge of compliance with FAA Airport Design Standards while also avoiding disruption to 90-year-old NYC DEP underground sewer structures (See also Section 3.2.1.1.1)**
  - This option's alignment crosses an area south of Runway 04-22 that is subject to FAA regulations regarding the safe operation of the Airport. This presents a major constructability challenge (described in greater detail in Section 3.2.1.1.1) to negotiate the twin constraints of the FAA Airport Design Standards (governing the construction of new infrastructure in this area) and the existing large-diameter utilities located along and beneath the GCP.
  - The preliminary engineering work carried out by the study team has not identified a construction approach that it could conclude with confidence would practicably overcome these challenges.
  - For the purposes of providing a basis on which to compare options that must pass the end of Runway 04-22, this option was evaluated using the baseline construction concept of an open trench structure located in the embankment to the south of the eastbound GCP roadway, despite this concept being shown to be not compliant with the FAA Airport Design Standards. To provide the Indicative Capital Cost and Timeline/Schedule, the following construction elements for this construction concept:
    - Construction of a cut-and-cover tunnel beneath Astoria Blvd South for the guideway transition from parallel to the Eastbound BQE Connector northbound roadway to south of the GCP eastbound roadway.

- Reconstruction of the Eastbound BQE Connector northbound off-ramp to Astoria Blvd South and Boody St approximately 300–400 ft south of its current location.
- Reconstruction of the GCP on-ramp from Astoria Blvd South at 77th St over the guideway to re-provide traffic access to the GCP around the new transition structure.
- Reconstruction of the 82nd St Bridge. The open trench structure would have to pass through the existing south abutment of the 82nd St Bridge over the GCP, requiring the bridge's demolition and reconstruction to accommodate the structure.
- Construction of a below-grade, open-trench structure south of Runway 04-22, staying above the existing major utilities along the GCP.
- Strengthening of the existing utilities and/or construction of concrete protection slabs above them.
- Relocation of the existing runway lights, located between the GCP and Ditmars Blvd.

- **Constructing over 94th St and the GCP into the Airport**
  - Once past Runway 04-22, the alignment would ascend back to an elevated guideway structure to pass over the GCP onto the Airport.
  - The GCP eastbound off-ramp onto Ditmars Blvd near 90th St would require reconstruction to accommodate the elevated guideway in this area. An allowance has been included in the construction cost estimate for this work.
  - The guideway crossing over 94th St and both roadways of the GCP into the Airport would require long-span bridge structures of approximately 250–300 ft. These would require complex engineering solutions and construction methods to span the roads, while maintaining traffic mobility on the GCP and into the Airport on 94th St. This introduces increased construction costs over standard rates, which is reflected in the construction estimate.

- **On-Airport Elevated Stations, Constrained Construction Site Conditions**
  - Long-span (approximately 350 ft) bridge structures would be required over 102nd St and the newly constructed departures roadway. This would require structures to elevate the guideway to approximately 70 ft above-grade to clear the multi-level roads while maintaining Airport operability, resulting in complex engineering solutions and construction methods. This introduces increased construction costs over standard rates, reflected in the construction estimate.
  - Two elevated light rail stations (each up to 300 ft long) with features such as escalators, elevators, stairs, and signage would be constructed and integrated with the existing Airport terminal buildings. Constructing these within a constrained, operational airport environment would reduce the construction sequence efficiency, introducing construction complexities. This is reflected in the Indicative Timeline/Schedule and cost estimate.

- **Locating the OMSF**
  - The fixed guideway with light rail solution would require a facility of approximately 115,000 sf adjacent to the ROW to store and maintain the fleet of vehicles and conduct system operations. The site of the formerly vacant Courtyard by Marriott hotel on Ditmars was used for this purpose in the analysis; however, due to the hotel's recent change of ownership, it may no longer be available for this purpose. Should this option be advanced, further study would be needed to determine a suitable location for the OMSF.

- **Constructability Risks Not Included in the Cost Estimate Range (–10% to +30%) for this Option**
  - Scale of construction work required to transition the alignment at the BQE/GCP intersection from elevated to cut-and-cover tunnel under Astoria Blvd South: This complex interface would require careful partner agency coordination with NYC DOT, NYS DOT, and FHWA during the design stage. There is a residual risk that gaining the necessary approvals, keeping all roads open to traffic, and maintaining access to adjacent businesses during construction requires more complex temporary access arrangements or greater working constraints on construction sequencing than currently evaluated. This risk is typical for such a complex transition where multiple highways and other roads converge; however, should the process to gain approval prove more complex, it could result in prolongation to the current construction schedule and high increases in construction cost.
  - Scale of structural modification required to tie-into the existing Woodside LIRR and Subway station mezzanines: There is a residual risk that, due to the complex layout of the two existing stations, detailed design and partner agency coordination could identify that to tie-in the proposed light rail connector to the existing station structures, more complex new structures or more strengthening of existing structures would be needed than currently accounted for in the evaluation. The study team concluded that this is a risk that would be considered typical of interfacing with an existing facility but could still have the potential to result in large increases in construction costs and prolonging the overall project schedule.
  - Construction methodology for working in and over existing Amtrak, LIRR, and/or CSX rail ROWs: There is a residual risk that partner agency coordination, during detailed design with Amtrak, LIRR, and/or CSX, results in more stringent constraints being imposed on construction methodologies than currently evaluated. This could include fewer line blockades, shorter working windows, or smaller construction zones. This risk is typical for construction work adjacent to operating railroads; it could result in prolongation of the construction schedule with associated cost increases.
  - Implications of potential property impacts from proposed alignment to Woodside Station: The proposed guideway alignment from Woodside Station to 31st Ave crosses over commercial, residential, and community property boundaries, requiring the acquisition of these properties for the permanent alignment ROW. This leaves a residual

risk that, during more detailed design development and community consultation, revisions to the proposed alignment may be required to minimize or avoid acquisitions (for example, by locating the guideway and station above the LIRR railroad). The study team concluded that there would be a low probability of the risk of relocating the alignment occurring but there would still be a high risk of delay to the preliminary design and approval process (delaying the overall program) while acquisitions are resolved.

- Accommodating the proposed guideway structures, piers, and foundations within the GCP ROW: There is a residual risk that, during detailed design coordination with NYS DOT (and FHWA where applicable) more complex support structures than currently envisaged are required to avoid introducing non-standard roadway elements to the existing highways or to allow existing non-standard elements to be brought up to current standards (in the future by NYS DOT). The study team concluded that is a risk typical of work in and around existing major highways but one that still has the potential to result in large increases in construction cost and schedule prolongation.
- Scale of on-Airport structures or modifications to on-Airport roads required to accommodate new light rail stations and elevated track: The study has evaluated an alignment that, at this stage of development, can be accommodated within the existing Airport buildings and roadway structures. There remains a residual risk that, once more detailed surveys of the existing structures and their foundations are conducted, more complex or longer span structures are required than currently evaluated and/or structural modifications could be required to the existing on-Airport roadways and support structures. This risk is typical for infrastructure of this type in such constrained and highly built-up areas; however, considering the light rail station’s more modest size requirements, it could still result in moderate increases in construction costs over those accounted for in this evaluation.
- Scale of utility strengthening and/or replacement work needed along the GCP: There is a residual risk that, once condition surveys of the existing large-diameter utilities under the GCP can be undertaken, the results identify the utilities to be in a poorer condition than currently evaluated. This could result in more intrusive strengthening or even replacement of the existing utilities before construction work can commence. This is a risk typical for major infrastructure work in close proximity to large legacy utilities; however, it could result in large increases in construction costs and delay to the start of construction, prolonging the overall schedule.

5.1.1.2 Infrastructure Impacts during Construction

Construction of this option would result in temporary disruption to other major infrastructure along the route, which could last for 2–3 years. The notable areas of temporary infrastructure disruption are summarized below. The durations given below are indicative and based on preliminary assessment.

- **Operational and Passenger Disruption to NYCT 7-Line and MTA Bus Services at 61 St-Woodside Station**
  - 5–10 overnight single-line track and potential station closures, restricting train running, would be expected over a period of 4–8 months while modification/strengthening work is conducted to the existing subway structure for the proposed mezzanine passenger connector. Work would occur one track at a time to allow trains to bypass the station on the other track(s). Trains would not stop at the station during the work (for safety), subject to MTA review. NYCT runs a continuous service throughout the day, requiring this work to be conducted during planned outages coordinated with the MTA in advance.
  - Disruption would be expected to passenger access to 61 St-Woodside Station for 1–2 years during construction work around the station entrances. Periodic disruption and reduced passenger circulation access at the mezzanine interface points are also expected for 1–2 months during construction of the mezzanine connections. The study considered that passengers would still be able to access and use the station throughout this period, although their journey would be inconvenienced or re-routed by the presence of construction activity. Further development of engineering solutions, including detailed analysis of passenger flows, would be needed to identify the extent of station disruption and any potential mitigations, like temporary exit stairs.
  - Disruption to the various MTA bus services with bus stops located along 61st St for 1–2 years would be likely during construction work for the proposed light rail station and passenger connector.

- **Operational Disruption to Rail Services Using the LIRR Railroad into Woodside Station**
  - 2–4 overnight closures would be likely to the LIRR rail line between 55th St and 57th St over a period of 6–9 months to construct enabling work (sheet piling retaining structures) within the LIRR embankment. This would stabilize the embankment and allow construction of the future guideway piling and foundation construction with fewer long closures of the railroad. Closures would have to be accepted by LIRR and coordinated in advance to coincide with other planned activities.
  - 5–10 overnight closures would be likely of the LIRR rail line between 55th St and 61st St over a period of 6–9 months for guideway foundations and pier construction when using piling rigs and other tall equipment. These closures would be in addition to the enabling work closures and would also have to be planned in advance requiring LIRR acceptance.
  - 5–10 overnight closures of the LIRR rail line would be expected between 55th St and 61st St over a period of 6–9 months for guideway bridge structure erection using tall cranes and other equipment. These closures would be in addition to the enabling work and piling closures and would also have to be planned in advance requiring LIRR acceptance.
  - 2–4 overnight closures of Woodside LIRR Station and its platforms would be likely to occur over a 2- to 4-week period to erect an overhead protection structure so that the subsequent construction of the passenger connection structure can occur without

further closure. This would require the part closure of LIRR services to Manhattan with passengers using alternate (NYCT) stations and would be timed to coincide with planned LIRR (maintenance or improvement) outages or closures.

- **Operational Disruption to Rail Services Using the Amtrak Northeast Corridor Railroad and CSX Freight Railroad**
  - 2–4 overnight closures to the Amtrak rail line would be expected between Northern Blvd and 31st Ave over a period of 6–9 months to construct enabling work (sheet piling retaining structures) within the Amtrak embankment. This would stabilize the embankment and allow construction of the future guideway piling and foundation construction without the need for additional, longer closures of the railroad.
  - 4–8 overnight closures would be likely to the Amtrak rail line between Northern Blvd and 31st Ave over a period of 6–9 months for guideway foundations and pier construction using piling rigs and other tall equipment. These closures would be in addition to the enabling work.
  - 4–8 overnight closures would be likely to the Amtrak rail line between Northern Blvd and 31st Ave over a period of 6–9 months for guideway bridge structure erection using tall cranes and other equipment. These closures would be in addition to the enabling work and piling closures.
  - The above (10–20 cumulative) periodic closures would have to be accepted by Amtrak and coordinated in advance and require careful coordination with both Amtrak and CSX (and any other users of the Northeast Corridor tracks) to agree the timing and length of proposed closures in advance of the work.
  - 1–2 overnight closures would be likely to the CSX freight line at 31st Ave over a 2- to 4-week period during erection of elevated guideway bridge sections. Closures would need to be planned in advance and accepted by CSX (and other freight line users). Closures would ideally be timed to occur during non-freight-use periods; however, freight traffic may operate on the railroad throughout the day, requiring a periodic closure of the railroad.

- **Overnight Closures, Traffic Diversions, and Speed Restrictions on BQE East and West Split**
  - 5–10 overnight road closures would be likely to the north- and southbound roadways of both the Eastbound BQE Connector and Westbound BQE Connector over 31st Ave over a 3- to 6-month period during erection of elevated guideway bridge sections. Closures could be phased to minimize impacts to the BQE.

- **Lane Closures and Speed Restrictions on Eastbound BQE Connector**
  - Temporary removal of the Eastbound BQE Connector northbound shoulder and traffic speed restrictions between 31st Ave and 25th Ave would be expected for 9–18 months

to provide safe construction access to the northbound shoulder for adjacent piling, foundation, and pier work in 68th St.

- 15–30 overnight lane closures and speed restrictions on the northbound roadway would be likely over a period of 9–18 months during elevated bridge deck erection.
- There would be overnight full road closures and traffic diversions for up to a week to replace four overhead signage gantries. These would be coordinated with lane closures for bridge deck beam erection.

- **Lane Narrowing, Traffic Diversions, and Speed Restrictions at the Eastbound BQE Connector/GCP Intersection**
  - There would be a closure of the Boody St Eastbound BQE Connector off-ramp for 1–2 months while transitioning to a new, relocated off-ramp. Traffic diversions would be required and could be provided via a temporary access roadway further south onto Boody St.
  - Speed restrictions on the Eastbound BQE Connector northbound lanes for 9–18 months would be likely, to provide safe construction access to the adjacent cut-and-cover tunnel construction under Boody St.
  - A realignment of Boody St would likely be required at the intersection with Astoria Blvd South for 9–18 months during construction of the cut-and-cover tunnel. The temporary diverted road could be provided through the parking area north of the Bulova Building.
  - There would be temporary lane closures and traffic detours expected on Astoria Blvd South between the intersections of Boody St and 77th St for 9–18 months during construction of the cut-and-cover tunnel. Astoria Blvd South would be reduced from two lanes to one to avoid full road closures during this time.
  - Closure of the GCP on-ramp from Astoria Blvd South and 77th St for 1–2 months would be necessary while transitioning to the new, relocated on-ramp. Traffic diversions would be required via 23rd Ave and Ditmars Blvd.

- **Lane Narrowing, Traffic Diversions, and Speed Restrictions on GCP**
  - Narrowing of the eastbound GCP lanes and traffic speed restrictions between the Astoria Blvd North overpass and 94th St would be required for 9–18 months to provide safe construction access to the eastbound shoulder during construction of the at- and below-grade guideway located between the GCP and 23rd Ave.
  - Full closure of the Ditmars Blvd GCP off-ramp for 1–2 months would be required while transitioning to a new, relocated off-ramp. Traffic diversions would be required via the Astoria Blvd South off-ramp.
  - 2–4 overnight road closures and traffic diversions would be required over a period of 1–2 weeks to erect long-span bridge sections over the GCP into the Airport.
  - 10–15 off-peak, overnight, and/or weekend road closures on the GCP and traffic diversions would be needed over a period of 12–18 months to demolish the 82nd St Bridge deck and erect new deck structure.

- Lane closures over a period of 12–18 months on the 82nd St crossing of the GCP would be conducted one roadway at a time so that two-way traffic could still cross the bridge, albeit on a reduced number of traffic lanes.

- **Disruption to Intra-Airport Services and Facilities**
  - Increased construction traffic around Terminals B and C for 9–18 months would require a coordinated traffic management plan to avoid/minimize potential on-Airport traffic disruption.
  - 15–30 overnight and/or off-peak lane and road closures of on-Airport access roads would be expected for a 1- to 2-year period during long-span bridge section erection and other elevated structure work.
  - Airport user inconvenience could potentially occur to certain portions of Airport facilities for 2–4 months during construction of customer transfer connections and circulation. This would require a coordinated traffic management plan to avoid/minimize potential traffic disruption.

5.1.1.3 Permanent/Operational Impacts to Existing Infrastructure

Once completed, this option would have the following permanent/operational impacts on other infrastructure along the route:

- **Brooklyn-Queens Expressway**
  - The off-ramp from the Eastbound BQE Connector northbound roadway to Boody St would be permanently relocated to accommodate the guideway transition to the cut-and-cover tunnel.
  - The completed fixed guideway structure supports could restrict any future NYS DOT roadway improvement plans to widen or adjust the Eastbound BQE Connector between 31st Ave and the GCP.

- **Grand Central Parkway**
  - The on-ramp to the eastbound GCP from Astoria Blvd South and 77th St would be permanently relocated to accommodate the cut-and-cover tunnel.
  - The off-ramp from the eastbound GCP to Ditmars Blvd would be permanently relocated to accommodate the elevated guideway over 94th St.
  - The completed fixed guideway structure could restrict any future NYS DOT roadway improvement plans to widen or adjust the GCP between 77th St and 90th St.

- **Impacts on LGA**
  - The location of the elevated guideway and station in front of Terminal B would result in the construction of structure piers and frames in the area that has currently been identified to be the future permanent Terminal B taxi hold. This could prevent the taxi hold from using this location, requiring an alternate location, which may not be as operationally efficient.

5.1.1.4 Indicative Capital Cost

The Indicative Capital Cost for Option LR-1 is $4.2 billion (in 2022$, excluding future escalation and solely for approximate comparison between study options).

Indicative Capital Costs should be considered to have a range of estimating uncertainty of -10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).

As discussed in more detail in Section 3.2.1.1.1, the preliminary engineering work carried out by the study team has not identified a construction approach that, with confidence, could overcome the significant challenges and complexities presented by the twin constraints of the FAA Airport Design Standards and the existing large-diameter, 90-year-old utility structures along the GCP without more complex, risky, and costly approaches to construction that would require greater engineering exploration beyond the scope of this study. Therefore, to provide a basis of an order-of-magnitude cost on which to compare between options, this option was costed out using the (least cost) baseline solution of an open trench south of Runway 04-22, despite this approach not being compliant with FAA Airport Design Standards. Costs associated with an FAA compliant tunneled solution which could require replacement or relocation of existing sewer structures could result in additional costs of between $1–3 billion.

The following are the notable cost drivers for the option:

- Elevated guideway structure along city streets, BQE, GCP, and on-Airport.
- New elevated light rail stations and passenger connectors at LGA.
- Track-side equipment, systems, and power.
- Provision of a new maintenance and storage facility for passenger vehicles.
- Revenue service light rail passenger vehicles.
- New elevated light rail station and passenger connector at Woodside.
- Cut-and-cover tunnel under Astoria Blvd South and at- and below-grade guideway along GCP (open trench structure south of Runway 04-22).
- Utilities protection and relocation costs.
- Roadway maintenance and traffic protection costs.
- Reconstruction of the 82nd St Bridge (to accommodate open trench structure south of Runway 04-22).
- Modification work to existing subway/LIRR Stations.
- Complexity allowances for working in LIRR and Amtrak ROW.
- Relocation of GCP off-ramp to Ditmars Blvd.
- Long-span crossings of the BQE.

- Long-span crossings on-Airport.
- Relocation of Astoria Blvd South on-ramp to GCP (at 77th St).

5.1.1.5 Indicative Timeline/Schedule

The Indicative Timeline/Schedule (for comparison between study options) for Option LR-1 is approximately 11–12 years from a decision to take the option forward to revenue service. This includes the following notable schedule drivers:

- Planning, approvals, and acquisitions.
- Procurement of design-build contractor(s) for heavy civil construction.
- Procurement of new light rail vehicles.
- Woodside Station tie-in.
- Elevated guideway construction to BQE.
- Cut-and-cover tunnel construction under Astoria Blvd South (longest construction activity).
- 82nd St Bridge reconstruction.
- On-Airport elevated stations and structure.
- Construction of a maintenance and storage facility for passenger vehicles.
- Systems installation and testing.
- 12 months of commissioning.

Figure 5.1-2 illustrates the indicative timeline/schedule for Option LR-1. The key drivers are the major civil construction work, which may trigger longer permitting, approvals, and procurement processes, and the light rail systems commissioning.

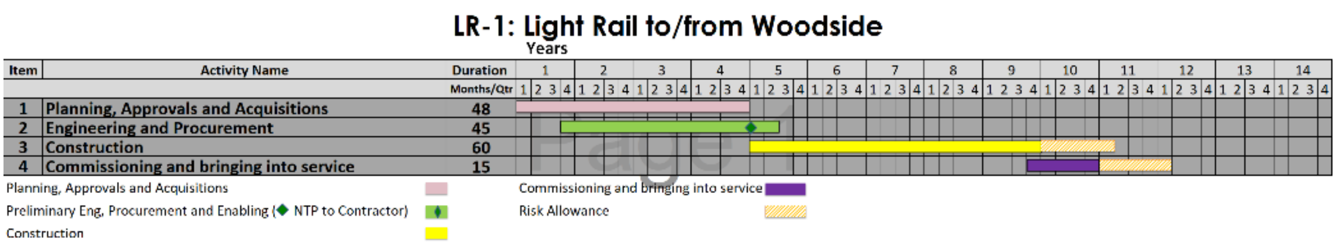


FIGURE 5.1-2: INDICATIVE TIMELINE/SCHEDULE (LR-1)

5.1.2 Transportation Aspects

5.1.2.1 Improved Access to LGA

Three factors have been considered in this category: Standardized Indicative Baseline Off-Peak Travel Time, Reliability, and Transfer Experience.

5.1.2.1.1 Standardized Indicative Baseline Off-Peak Travel Time

- Table 5.1-1, below, provides the Standardized Indicative Baseline Off-Peak Travel Times for the weekday, midday off-peak journeys to be used solely as a baseline for comparison between options. Tables 5.1-2 and 5.1-3 provide a breakdown of the components that make up the total journey, via LIRR and 7-Subway, respectively, the general approach to the estimation of which is described in Section 3.2.2.1.1.
- Passengers making the journeys described would, naturally, experience variations to the baseline timings calculated even where services are running as planned, for reasons as simple as variations in walking speeds or whether a traveler arrives just before a scheduled departure or just misses a departing train.

TABLE 5.1-1: STANDARDIZED INDICATIVE BASELINE OFF-PEAK TRAVEL TIMES, OPTION LR-1

Penn Station or Times Square to LGA (minutes to Terminal B)	LR-1
Via LIRR to Woodside	27
Via Subway (7-Train) to Woodside	35

TABLE 5.1-2: STANDARDIZED INDICATIVE BASELINE OFF-PEAK TRAVEL TIME VIA LIRR BY SEGMENT, OPTION LR-1

Penn Station to La Guardia via LIRR (minutes)	LR-1
START Penn Station (street level)	
walk/wait time	7
LIRR platform (dep)	
LIRR trip time	11
Woodside LIRR platform (arr)	
walk/wait time	5
Woodside light rail platform (dep)	
Light rail trip time	4
1st on-Airport station (arr)	new elevated
END Terminal light rail stop	Terminal B
Total travel time =	27
trip time to next Terminal light rail stop	2
2nd on-Airport station	new elevated
END Terminal light rail stop	Terminal C
Total travel time =	29

TABLE 5.1-3: STANDARDIZED INDICATIVE BASELINE OFF-PEAK TRAVEL TIME VIA 7 SUBWAY BY SEGMENT, OPTION LR-1

Times Square to LaGuardia via 7 Subway (minutes)	LR-1
START Times Square (street level)	
walk/wait time	5
7-Subway platform (dep)	
Subway trip time	20
Woodside 7-Subway platform (arr)	
walk/wait time	6
Woodside light rail platform (dep)	
Light rail trip time	4
1st on-Airport station (arr)	new elevated
END Terminal light rail stop	Terminal B
Total travel time =	35
trip time to next Terminal light rail stop	2
2nd on-Airport station (arr)	new elevated
END Terminal light rail stop	Terminal C
Total travel time =	37

- Passengers for Terminal A would transfer to an existing on-Airport shuttle service running every 10 minutes with an additional trip time of around 7 minutes from Terminal B.

5.1.2.1.2 Reliability

- Option LR-1 would operate exclusively on dedicated infrastructure separate from general roadway conditions.

5.1.2.1.3 Transfer Experience

Riders bound for Terminals B or C would transfer from the Subway or LIRR services to the new light rail service at Woodside Station. Riders bound for Terminal A would have an additional transfer to an existing on-airport shuttle once they reach the airport.

Customer Transfer

- The studied Woodside light rail terminal station would be connected to the north side of the existing station mezzanine near the midpoint of the LIRR platform. The new light rail station would be fully enclosed and located at the same elevation as the existing LIRR station mezzanine, approximately 30-35 ft above street level. Woodside Station is currently accessible so the transfer would be fully ADA-compliant.
- Passengers transferring from the existing Woodside LIRR Station would follow new wayfinding signage and walk approximately 200 ft to the light rail.
- Passengers transferring from the existing 61 St – Woodside 7-Subway station would follow new wayfinding signage and walk approximately 400 ft to the new light rail station platform.

5.1.2.2 Ridership

- Stated preference survey results indicate that 49% of airport passenger respondents are “definitely” or “probably” interested in fixed guideway connections to existing transit services.
- The ridership model projects 7.4 million total riders using Option LR-1, with a corresponding increase in net transit ridership of 5.7 million riders in 2025 (Table 5.1-4).

TABLE 5.1-4: RIDERSHIP MODEL RESULT SUMMARY

Transit Option			Riders on Current Bus Services to LGA (Millions) (No Action)	New Transit Option Impact (Millions)		
Mode Category & Scenario Label		Description		Riders on New LR-1 Light Rail Service	Net Increase in Total Transit Ridership	Total Transit Ridership (LR-1 Light Rail Service + Other Bus Services)
Fixed Guideway with Light Rail	LR-1	Woodside	4.1	7.4	**5.7**	**9.8**

5.1.2.3 Throughput and Capacity

Throughput

- Using the highest hourly single-direction provision of airline seats at LGA in 2019 (4,300 seats on weekday departing flights 9 AM to 10 AM – see Figure 3.2-1, in Section 3.2.2.3), the estimated single-direction peak passenger demand for this option could be approximately 820 passengers per hour.
- It should be noted that these passengers would likely arrive at the transfer station in groups, rather than being evenly distributed throughout the time period.

Capacity of New Transit Option

- Using the AirTrain JFK system as an example, automated light rail systems can be tailored to throughput requirements using an appropriate combination of train length and frequency. Typically, 58-ft cars are able to accommodate more than 75 passengers with luggage, with around one-third of them seated.
- With the proposed arrangement of three-car trains at 4-minute intervals, the potential total capacity of the proposed new light rail link could be:
  - 3,375 pphpd at peak.
- This is sufficient to support the estimated single-direction peak passenger demand from the ridership model, equating to approximately 55 passengers per train at peak with this proposed train-car configuration and frequency.
- Actual train-car configuration and frequency would be adapted in practice to suit demand and other operating requirements.

Impact on Capacity of Existing Downstream Transit Systems

- The stations at Woodside offer transfer access to the 7-Line Subway services and the LIRR Main Line (including the Port Washington Branch).
- Generally, airport passenger loadings are constant through the day both to and from the Airport with the peak passenger loadings occurring outside of the morning Manhattan-bound subway peaks or in the opposite direction (i.e., Airport-bound).
- The existing local and express 7-Subway lines currently operate below their peak capacity during the 8 AM to 9 AM Manhattan-bound commuting peak. While most Manhattan-bound Airport passengers would travel outside this peak, those passengers (including non-Airport passengers) traveling during this peak could experience some crowded conditions.
- This analysis only considers the impact to the 7-Lines; customers transferring at Woodside would have the option to continue their journey to Manhattan on the LIRR, adding to the available capacity of the downstream transit system.

5.1.2.4 Indicative Operating Cost

A preliminary costing exercise, based on previous estimates for the LAIP (Mets-Willets AirTrain, currently on pause) concept, considering the line length and the cost categories relating to it, suggests estimated annual operating and maintenance costs on the order of $40 million per annum. This estimate includes owner’s costs.

5.1.3 Community and Environmental Aspects

5.1.3.1 Local Community Impacts

The route along the LIRR, between 38th Ave, 55th St, 31st Ave, and Boody St, would be located within and near densely developed neighborhoods consisting of a wide variety of properties, ranging from single-family to 6- to 14-story residential buildings, commercial businesses, mixed-use (residential above commercial) buildings, public community buildings, and NYC Parkland. The approximately 3.4-mile route goes through/along the following communities: Woodside, Jackson Heights, and East Elmhurst.

The potential for temporary (during construction) and permanent (once operational) impacts is summarized below for specific areas of the alignment.

5.1.3.1.1 Temporary Impacts during Construction on the Local Neighborhoods Directly Affected

The fixed guideway from Woodside to LGA would require major heavy civil construction activities to build the guideway foundations, elevated structures, and stations along the route. Construction activities are anticipated to occur along the approximately 3.4-mile route for approximately 5 years.

As discussed in more detail in Section 3.2.1.1.1, the preliminary engineering work carried out by the study team has not identified a construction approach that, with confidence, could overcome the significant challenges and complexities presented by the twin constraints of the FAA Airport Design Standards and the existing large-diameter, 90-year-old utility structures along the GCP without more complex, risky, and costly approaches to construction that would require greater engineering exploration beyond the scope of this study. Therefore, to provide a consistent basis on which to evaluate it, this assessment was based on the baseline solution of an open trench south of Runway 04-22, despite this approach not being compliant with FAA Airport Design Standards.

During construction, the following neighborhoods would have the potential for air quality, noise, vibration, or visual impacts. For the frequency and duration of construction activities refer to Section 5.1.1.2 “Infrastructure Impacts during Construction” above:

- **Construction of New Light Rail Station and Structure at Woodside and the Elevated Structure along the LIRR in the Railroad Embankments from 58th St to 61st St**
  - The fixed guideway and light rail station would require major heavy civil construction activities to build the elevated guideway foundations, and structures that would be required, along this approximately 0.25-mile segment of the route.
  - The construction would occur approximately 30–50 ft from 7 short city blocks of residential and commercial properties.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - Planned periodic closure of sidewalks, bike lanes, and parking spaces would be required.
  - Planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.

- **Construction at the Corner of 38th Ave and 55th St along 55th St and Amtrak Rail Corridor**
  - The fixed guideway would require major heavy civil construction activities to build the elevated guideway foundations and structures along this approximately 0.3-mile segment of the route.
  - The construction would occur approximately 30–50 ft from 5 long city blocks of residential and commercial properties.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - Planned periodic closure of sidewalks, bike lanes, and parking spaces would be required.
  - Planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.

- **Construction at the Corner of 58th St and 31st Ave and along 31st Ave**
  - The fixed guideway would require major heavy civil construction activities to build the elevated guideway foundations and structures that would be required along this approximately 0.3-mile segment of the route.
  - The construction would occur approximately 30–50 ft from 4 short city blocks of residential and commercial properties.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - Planned periodic closure of sidewalks, bike lanes, and parking spaces would be required.
  - Planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.

- **Construction at St Michael's Playground**
  - The fixed guideway along this segment of the route would require major heavy civil construction activities to build the guideway foundations and elevated structures that would be required along this segment of the route.
  - The construction would occur within and above the playground for up to two years, and temporary closure of the playground (partial or full) would be required during this period depending on the final detailed design.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - Planned periodic closure of sidewalks, bike lanes, and parking spaces would be required.
  - Planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.

- **Construction Along the Eastbound BQE Connector and Boody St**
  - The fixed guideway would require major heavy civil construction activities to build the elevated guideway foundations, structures, and soundwall that would be required along this approximately 0.4-mile segment of the route.
  - The construction would occur approximately 35–50 ft from 4 short city blocks of residential and commercial properties.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - Planned periodic closure of sidewalks, bike lanes, and parking spaces would be required.
  - Planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.

- **Construction of Cut-and-Cover Tunnel beneath Astoria Blvd South**
  - The proposed guideway along the approximately 0.15-mile segment of the route would transition from running elevated to running at- and below-grade, south of the GCP eastbound roadway.
  - The construction would occur approximately 150–200 ft from 1 city block of commercial properties.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - Planned periodic closure of sidewalks, bike lanes, and parking spaces would be required.
  - Planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.

- **Reconstruction of 82nd St Bridge**
  - Lane closures and contra-flow traffic on 82nd St Bridge would be continuous throughout the construction as bridge sections would be demolished and reconstructed one half at a time.
  - The construction would occur approximately 150–200 ft from 2 short city blocks of residential and commercial properties.
  - Planned periodic lane closures, contra-flow traffic on the bridge, and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - Planned night closures of the GCP could be required for the long-span bridge erection.

- **Constructing over 94th St and the GCP into the Airport**
  - Reconstruction of the GCP eastbound off-ramp onto Ditmars Blvd near 90th St and construction of an elevated guideway (30 ft above 94th St) with long-span (approximately 250–300 ft) bridge structures crossing over 94th St and the GCP into the Airport would be required along the approximately 0.5-mile segment of the route.
  - The construction would occur approximately 100–350 ft from 4 short city blocks of residential and commercial properties.
  - Planned night closures of the GCP would be required for the long-span bridge erection.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - There could be increased construction/haul traffic on local roads because trucks are not allowed on the GCP.

- **Constructing On-Airport Elevated Light Rail Stations**
  - Construction activities associated with the erection of long-span (approximately 350 ft) elevated guideway bridge structures over an approximately 0.5-mile segment of the route over 102nd St and the newly constructed departures roadway at the Airport would be required.
  - The construction would occur over 500 ft from 5 city blocks of residential and commercial properties in the East Elmhurst community located on the other side of 8 lanes of the GCP.
  - Planned night closures of the GCP would be required for the long-span bridge erection.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - There could be increased construction/haul traffic on local roads because trucks are not allowed on the GCP.

- **Construction of the OMSF**
  - The fixed guideway with light rail solution would require a facility of approximately 115,000 sf at the site of the former (now vacant) Courtyard by Marriott hotel on Ditmars Blvd between 90th St and 92nd St. This site on Ditmars was used for this purpose in the analysis; however, due to the hotel's recent change of ownership, it may no longer be available for this purpose. Should this option be advanced, further study would be needed to determine a suitable location for the OMSF.
  - The construction of the facility (track and building(s)) would occur for approximately 1 year and approximately 50–100 ft from 3 city blocks of residential and commercial properties.

5.1.3.1.2 Permanent Operational Impacts on the Local Neighborhoods Directly Affected

Electrically powered light rail vehicles, similar in size and characteristics as the vehicles that currently operate on AirTrain JFK, would operate between LGA and the proposed new light rail station at Woodside at peak headways of 4 minutes. They would operate on a predominantly elevated fixed guideway structure, descending to get past Runway 04-22, ranging approximately 35–500+ ft from residential and commercial properties. During periods of reduced airport demand (e.g., overnight), headways would significantly reduce.

The following local neighborhoods and areas would have the relative potential for permanent noise, vibration, or visual impacts as a result of this option's proposed light rail operations:

- **New Elevated Light Rail Station at Woodside and New Elevated Light Rail along the LIRR in the Railroad Embankments from 58th St to 61st St**

  - From the proposed light rail station at Woodside, light rail vehicles would operate in each direction on an elevated fixed guideway structure following the LIRR rail line to 55th St, approximately 30–50 ft from residential and commercial properties.

- **New Elevated Light Rail at the Corner of 38th Ave and 55th St along 55th St and Amtrak Rail Corridor**
  - From the corner of 38th Ave and 55th St, light rail vehicles would operate in each direction on an elevated fixed guideway structure along the center of 55th St to the Amtrak rail embankment and then to 31st Ave, approximately 30–50 ft from residential and commercial properties.

- **New Elevated Light Rail at the Corner of 58th St and 31st Ave and along 31st Ave**
  - From the corner of 58th St and 31st Ave, light rail vehicles would operate in each direction on an elevated fixed guideway structure along the center of 31st Ave approximately 30–50 ft from residential and commercial properties.

- **New Elevated Light Rail over St Michael's Playground (NYC Parkland)**
  - Light rail vehicles would operate in each direction on an elevated fixed guideway structure above the playground. Depending on the final detailed design, guideway columns could be permanently located within the playground, potentially requiring the (partial or full) closure of the playground.

- **New Elevated Light Rail Along the Eastbound BQE Connector and Boody St**
  - From 31st Ave, light rail vehicles would operate in each direction on an elevated fixed guideway structure along the BQE Eastbound Connector shoulder, approximately 35–50 ft from residential and commercial properties.
  - The Boody St off-ramp would be reconstructed causing a potential permanent impact to the car park access to the Bulova Building and the delivery access to Home Depot. The relocated off-ramp would potentially end up aligning with these access points, requiring their relocation (further north or south).
  - Potential permanent loss of shoulder and parking is expected due to piers along Boody/68th St.

- **New Light Rail Cut-and-Cover Tunnel beneath Astoria Blvd South**
  - North of the Bulova Building, light rail vehicles would operate in each direction within a cut-and-cover tunnel beneath Astoria Blvd South approximately 150–200 ft from commercial properties.

- **New Elevated Light Rail Over 94th St and the GCP into the Airport**
  - Once past the RPZ at the end of Runway 04-22, light rail vehicles would rise to operate in each direction on an elevated fixed guideway structure over the GCP onto the Airport approximately 100–350 ft from residential and commercial properties.

- **New On-Airport Elevated Light Rail Stations**
  - On-Airport, light rail vehicles would operate in each direction on an elevated fixed guideway structure between the two proposed light rail stations over 500 ft from residential and commercial properties in the East Elmhurst community located on the other side of 8 lanes of the GCP.

- **New Light Rail OMSF**
  - The proposed maintenance and storage facility at the site of the former (now vacant) Courtyard by Marriott hotel on Ditmars Blvd between 90th St and 92nd St would experience light rail vehicle movements throughout the day, peaking when vehicles leave and enter the facility at the start and end of peak operations. Maintenance and other activities would occur throughout the day and possibly overnight within covered buildings/vehicle sheds. These activities would occur approximately 50–100 ft from residential and commercial properties. Note that this site on Ditmars was used for this purpose in the analysis; however, due to the hotel's recent change of ownership, it may no longer be available for this purpose. Should this option be advanced, further study would be needed to determine a suitable location for the OMSF.

5.1.3.1.3 Potential Private Property Acquisitions

The new fixed guideway with light rail to/from Woodside may require permanent acquisition of the following:

- Up to 22 private residential, 6 private commercial, 38 industrial, and 7 religious properties.

5.1.3.1.4 Potential Public Property Acquisitions (NYC DOT Plazas and NYC Parks Parkland)

The new fixed guideway with light rail to/from Woodside may result in permanent impacts to the following:

- New support columns for the fixed guideway would be located within Planeview Park and the below-grade structure within Overlook Park.
- No structures would be sited within NYC DOT Plazas.

5.1.3.1.5 Removal/Reconfiguration of Parking Spaces

- A total of approximately 150 on-street public parking spaces would be lost on the following streets:
  - 38th Ave (north of 57th St).
  - 55th St (south of Northern Blvd).
  - 31st Ave.
  - 68th St (north of 31st Ave).
  - Boody St.

  The numbers are approximate and are preliminary estimates based on the alignment.

5.1.3.1.6 Environmental Justice Communities Mapping Analysis

The Environmental Justice communities mapping analysis provides an overview of the minority and low-income communities within 0.25 mile of the transit options being studied.

For Option LR-1, more than half of the block groups within the 0.25-mile buffer of the option alignment are Environmental Justice block groups.

See Figure 5.1-3 below for the analysis map.

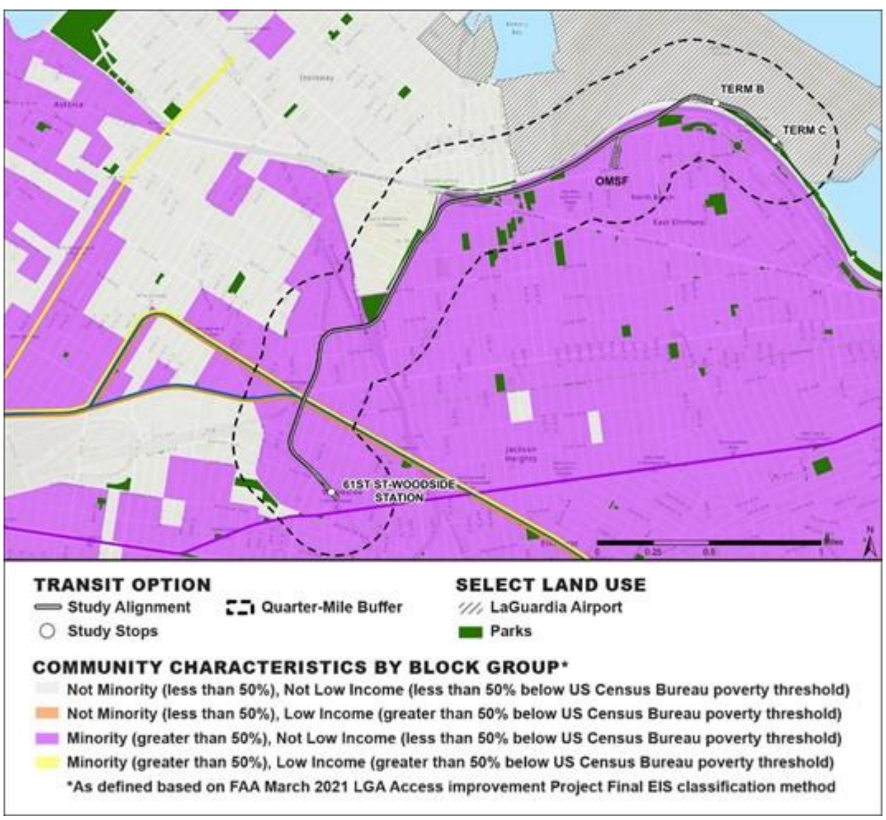


FIGURE 5.1-3: WOODSIDE OPTION – ENVIRONMENTAL JUSTICE COMMUNITIES MAPPING ANALYSIS (AS DEFINED BASED UPON FAA MARCH 2021 LGA ACCESS IMPROVEMENT PROJECT FINAL EIS CLASSIFICATION METHOD)

5.1.3.2 Equity

5.1.3.2.1 Transit Access from LGA

- **Additional Minority and Low-income Populations Reached within 45 Minutes from LGA via Transit (Population Access Analysis)**
  - The results of the Population Access Analysis illustrate how many people, specifically from low-income and minority populations, could travel via transit from LGA to homes within 45 minutes from LGA. Airport passengers or Airport employees living within these areas could potentially benefit from expanded access to these destinations.
  - Option LR-1 is expected to expand transit access from LGA to regional destinations within 45 minutes, as shown in the blue area of "Additional Access Provided by Transit Option" in Figure 5.1-4. Compared to the baseline, the minority population reached within a 45-minute transit trip would increase by 64.5% and the low-income population reached within a 45-minute transit trip would increase by 74.0% as shown in Table 5.1-5.
  - This represents a higher increase in transit access to LGA within 45 minutes for minority and low-income communities.

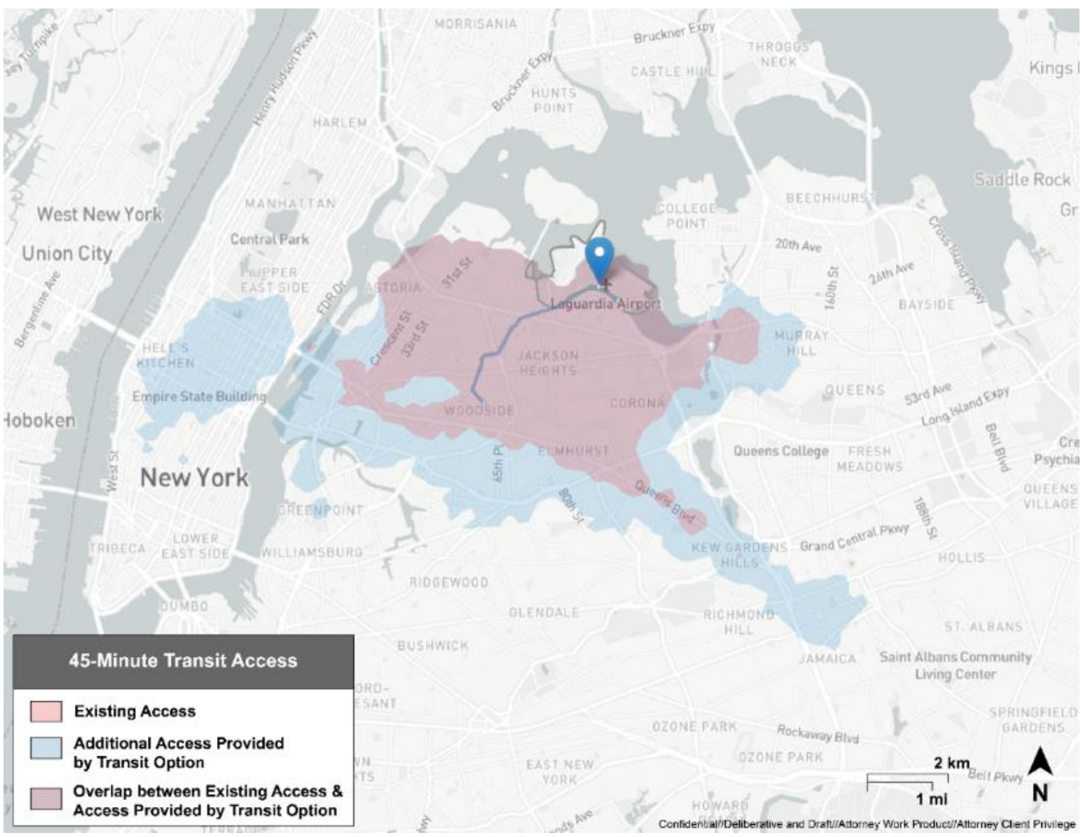


FIGURE 5.1-4: WOODSIDE OPTION LR-1 – POPULATION ACCESS ANALYSIS

TABLE 5.1-5: WOODSIDE OPTION LR-1 – POPULATIONS REACHED WITHIN 45-MINUTE TRANSIT TRIP

		Total Population Reached	Minority Population Reached	Low-Income Population Reached
Baseline	Existing Condition	551,434	422,981	76,750
LR-1	With Option	1,039,299	695,915	133,513
	Net Change	+487,865	+272,934	+56,763
	% Change	88.5%	64.5%	74.0%

- **Additional ADA-Accessible Stations within 45 Minutes from LGA via Transit (ADA Analysis)**
  - The results of the ADA Analysis illustrate how Airport passengers and Airport employees, specifically those requiring ADA-compliant stations, traveling from LGA to other locations could potentially benefit from expanded access to ADA-compliant stations within 45 minutes via transit.
  - More ADA-accessible stations/stops can be reached within a 45-minute transit trip for this option compared to the baseline of existing transit service (Table 5.1-6). This echoes the results from the Population Access Analysis, in which Option LR-1's 45-minute transit travel shed provides an increased amount of access over the baseline transit service. Compared to the baseline, an additional 53 ADA-accessible stations can be reached within a 45-minute transit trip from LGA for Option LR-1.

TABLE 5.1-6: WOODSIDE OPTION LR-1 – ADA ANALYSIS

Subway, Ferry, LIRR, and MNR Stations Reached within 45-Minute Transit Trip from LGA	Baseline	LR-1	Difference between Baseline and LR-1
Total Stations	*43*	*123*	*+80 stations*
ADA-Accessible Stations (Accessible Stations as % of Total)	*20 (47%)*	*73 (59%)*	*+53 stations*

5.1.3.2.2 Transportation Opportunities and Benefits for the Surrounding Community

- **Transportation Opportunities for Neighbors**

  This option does not include intermediate/off-Airport stops. Because there is limited pedestrian access to LGA from adjacent residential areas and walking distance exceeds 0.25 mile, the study team did not consider there to be a significant market for use of the final on-Airport stops by the surrounding community to connect to the broader transit network.

- **Cars Removed from Local Roadways and Emissions Reductions**

  See the "Cars Removed from Local Roadways" section and the "GHG and Other Vehicular Emissions Reductions" section of this evaluation below.

5.1.3.3 Cars Removed from Local Roadways

- Option LR-1 would be expected to remove 2,288,000 Airport passenger vehicles and 268,000 Airport employee vehicles from the road each year.

5.1.3.4 GHG and Other Vehicular Emissions Reductions

- Option LR-1 would be expected to remove 14,250 metric tons of CO_2 equivalent each year.
- Other vehicular emissions reductions are given in Table 5.1-7:

TABLE 5.1-7: OTHER VEHICULAR EMISSIONS REDUCTION (METRIC TONS PER YEAR)

Option	CO	VOC	NOx	SO_2	PM_{10}	$PM_{2.5}$
[LR-1] Woodside	67.2	0.9	4.5	0.2	2.5	0.5

5.1.4 Summary of Evaluation

LR-1: Light Rail to/from Woodside

Option LR-1 would provide a two-seat ride to LGA via a 4-minute light rail ride to/from the existing LIRR Woodside and 61 St-Woodside Subway stations, providing transfer access to both LIRR Main Line (including the Port Washington Branch) and 7-Line Subway services. A new dedicated light rail station would be located adjacent to both existing stations, providing ADA-compliant passenger access between them. The guideway would run above city streets to the BQE and GCP transportation corridors, on to LGA, avoiding city traffic.

This option would require the construction of heavy infrastructure, including elevated concrete guideway structures along predominantly city streets (for approximately 1.5 miles), open-trench concrete structures within the GCP transportation corridor (for approximately 1 mile), and elevated structures on-Airport (for approximately 0.5 miles). This option would have to contend with the construction challenges of constructing within the Amtrak and LIRR rail embankments between Woodside station and 31st Ave, complying with FAA Airport Design Standards while negotiating the 90-year-old utilities under the GCP at the end of Runway 04-22 (a challenge as yet unresolved as discussed in Section 3.2.1.1.1), and constructing a cut-and-cover tunnel at the BQE/GCP intersection. For the purpose of cost comparison, this option was costed out on the basis of a baseline solution of an open trench south of Runway 04-22 despite this approach not being compliant with FAA Airport Design Standards.

Table 5.1-8 summarizes the output from all the factors used to evaluate this option.

TABLE 5.1-8: SUMMARY OF KEY CHARACTERISTICS – LIGHT RAIL TO/FROM WOODSIDE (LR-1)

	Evaluation Factor	Assessment
CONSTRUCTION ASPECTS	Constructability	• **Major unresolved constructability challenge**: Complying with FAA Airport Design Standards while also avoiding disruption to 90-year-old, 15 ft diameter sewer structures at the end of Runway 04-22 (see details in Section 3.2.1.1.1) • Construction of elevated light rail station in dense neighborhood adjacent to existing LIRR and subway stations • Construction adjacent to active rail lines (LIRR and Amtrak) • Constrained construction access adjacent to BQE, Eastbound BQE Connector and GCP • Reconstruction of 82nd St Bridge • Long spans (250-300 ft) over 94th St Bridge and 102nd St bridges on-Airport • Constrained on-Airport sites for new elevated light rail structure and 300 ft stations • Total option route length: approx. 3.4 miles
	Infrastructure Impacts during Construction	• Operational disruption to 7-Line and LIRR service to Woodside • Operational disruption to Amtrak and NEC and CSX freight rail • Lane closures / reductions and speed restrictions on BQE, GCP and Astoria Blvd
	Permanent/Operational Impacts to Existing Infrastructure	• Inhibits future widening of the BQE and GCP • Columns and piers in site of future Terminal B taxi hold
	Indicative Capital Cost (2022$)[59]	$4.2 billion[60] (Does not include any additional costs required for an as yet unresolved solution to get past Runway 04-22 in compliance with FAA Airport Design Standards; potentially up to approx. $1–$3 billion)
	Indicative Timeline/Schedule	11–12 Years
TRANSPORTATION ASPECTS	Standardized Indicative Baseline Off-Peak Travel Time (From Midtown Manhattan)	Via LIRR: 27 mins (4 mins on light rail) (Penn Station to Terminal B, then C; shuttle to Term. A) Via 7-Line: 35 mins (4 mins on light rail) (Times Square to Terminal B, then C; shuttle to Terminal A)
	Transfer Experience	• Transfer from LIRR To light rail station would involve vertical move via stairs, escalator, or elevator up to the mezzanine level and a short walk to the light rail station • Transfer from 7-Line to light rail station would involve vertical move down via stairs, elevator, or escalator to the mezzanine and a slightly longer walk to the light rail station than the LIRR transfer
	Ridership[61]	Total annual projected ridership for option: 7.4 million Net increase in annual projected transit ridership: 5.7 million
	Throughput & Capacity	3,375 pphpd (peak)
	Indicative Operating Cost	$40 million per annum

[59] Indicative Capital Costs should be considered to have a range of estimating uncertainty of –10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).
[60] Costs for heavy infrastructure options approaching LGA from the west/southwest are based on the open-trench construction concept past Runway 04-22 (over the existing 90-year-old utilities), to provide a baseline estimate of the cost of construction. Although this concept does not meet FAA Airport Design Standards, it provides a consistent approach for capital cost comparison purposes. Costs associated with tunnelling and/or relocating utilities would be substantially higher, potentially up to approx. $1–$3 billion.
[61] Experience from AirTrain JFK was that actual ridership turned out to be higher than would have been predicted by the AirTrain JFK forecast and underscores the inherent uncertainty of model predictions. The ridership model supporting this effort could also deviate from eventual ridership demand but was utilized to allow ridership comparisons between the options.

TABLE 5.1-8, CONTINUED.

	Evaluation Factor	Assessment
COMMUNITY AND ENVIRONMENTAL ASPECTS	Local Community Impacts	<u>Construction:</u> • Heavy civil construction of elevated and at-/below-grade structures for approx. 5 years <u>Proximity to communities:</u> • 30–50 ft from 23 city blocks of residential and commercial properties from 61st St to 58th St, along 38th Ave and 55th St, along 31st Ave, the BQE, and Boody St • Above and within St Michael's Playground • Over 500 ft across 8 lanes of the GCP from 9 city blocks of residential and commercial properties opposite the Airport Terminals <u>Permanent impacts:</u> • Acquisition of up to 73 properties (private residential, private commercial, industrial, and religious) • Structures over or adjacent to Planeview Park and Overlook Park[62] • Loss of approx. 150 on-street public parking spaces along 38th Ave, 55th St, 31st Ave, 68th St, and Boody St
	Equity	• Higher increase to low-income and minority populations within 45 minutes of the Airport via transit versus the no-build scenario • +53 additional ADA-compliant stations reachable within a 45-minute transit trip from LGA versus the no-build scenario
	Cars Removed from Local Roadways	2,288,000 airport passenger vehicles and 268,000 airport employee vehicles from the road each year
	GHG and other Vehicular Emissions Reductions	14,250 metric tons of CO2 equivalent each year

[62] Municipal parkland cannot be converted to a non-park use (known as alienation) without State legislative permission. Thus, the acquisition of New York City Parkland for construction of a mass transit option would require legislation authorizing such alienation. Obtaining such legislation is a multi-step process requiring actions by the New York City Council, the Mayor of New York City, the New York State Legislature, and the Governor.

5.2 LR-2: Light Rail to/from Mets-Willets Point

Option LR-2 would connect the Airport via a 4-minute light rail ride to the existing LIRR (Port Washington Branch) station, and the existing NYCT 7-Line subway located in Willets Point. A dedicated airport light rail Airport-transfer station would be located adjacent to both existing stations providing ADA-compliant passenger access between them. The guideway would run along the existing GCP transportation corridor to LGA from the east, avoiding the construction complexities and community impacts associated with options approaching the terminals from the west.

Option Route Description

The route (see Figure 5.2-1) would travel on an elevated guideway from the new light rail station, which would be located above the existing LIRR Mets-Willets Point Station, and then along the GCP and the Malcolm X Promenade to LGA. An OMSF would be located above MTA's Casey Stengel Bus Depot parking lot and the New York Mets parking lot. Once on-Airport, the route would connect to two elevated LRT stations, one serving Terminal C and one serving Terminal B.

This option was the subject of the 2021 Final Environmental Impact Statement (FEIS) for the LAIP (Mets-Willets AirTrain, currently on pause) concept.

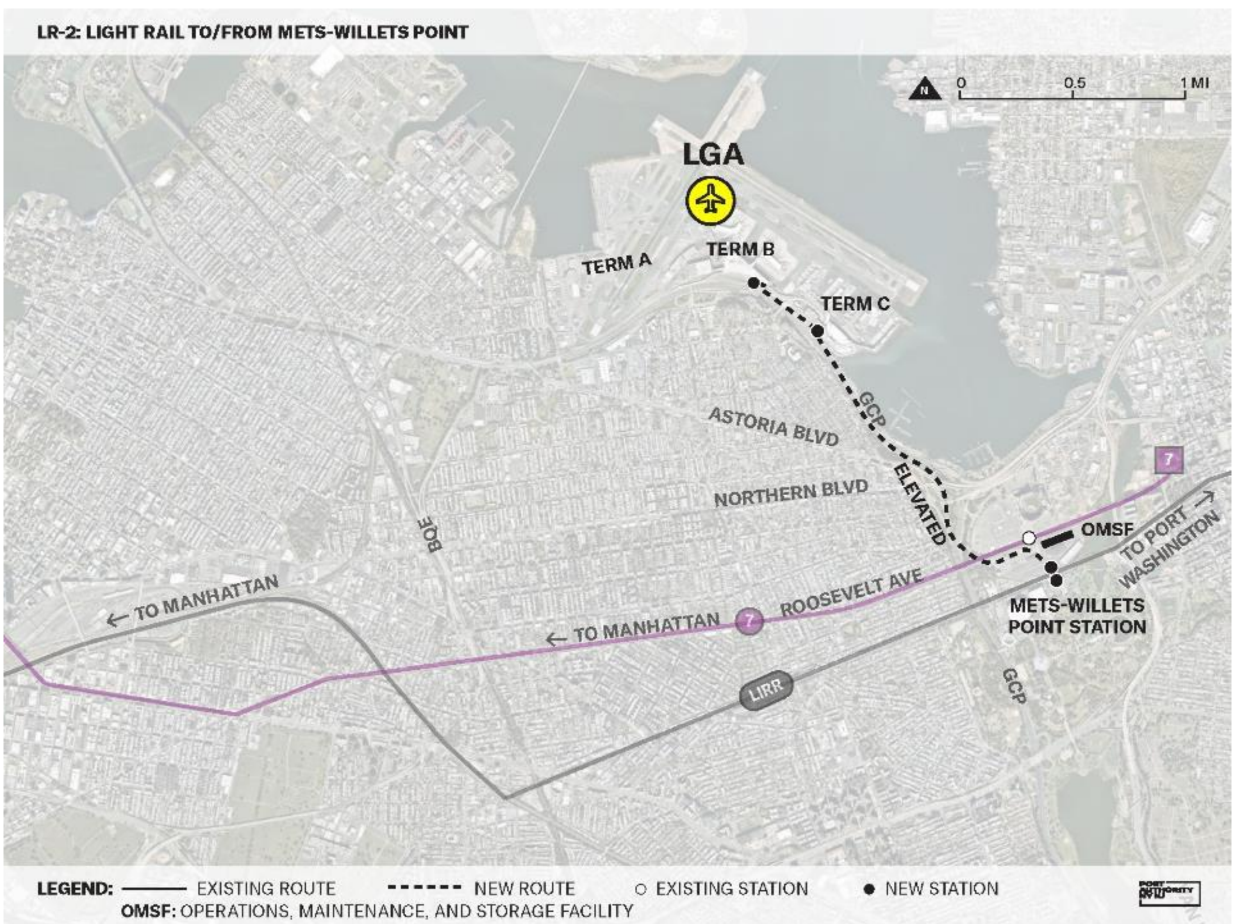


FIGURE 5.2-1: OPTION LR-2

The option includes the enhancement of the MTA LIRR service to Mets-Willets Point, to 4 tph in each direction.

The FAA analyzed the potential environmental impacts associated with this option in the EIS and Record of Decision (ROD). The assessment set forth below was undertaken at a much higher (i.e., conceptual) level than the detailed analyses set forth in the EIS. Although this Report considers the location, intensity, and duration of construction activities to determine the relative potential for local community impacts, the FAA conducted detailed analyses of this option's potential environmental impacts and determined whether or not such impacts would be considered significant. The EIS also considered potential mitigation measures for such impacts. To be consistent with the evaluation of other options, this Report does not discuss the analyses or mitigation measures presented in the EIS.

The length of this route is approximately 2 miles, including the on-Airport portion, the shortest option considered in this Report.

5.2.1 Evaluation of Construction Aspects

5.2.1.1 Constructability

The fixed guideway from Mets-Willets Point to LGA would require heavy civil construction activities to build the elevated guideway foundations, structures, and stations along the route.

The notable challenges and complexities associated with construction of this option are summarized below.

- **Construction of New Fixed Guideway Station over the 'Passerelle Bridge'**
  - The proposed fixed guideway station would be elevated directly above the existing Passerelle pedestrian walkway ('Passerelle Bridge') connecting the Mets-Willets Point LIRR and 7-Line stations. It is understood that replacement of the bridge is part of an NYC Parks future improvements program and NYC Parks funding would be used for the Passerelle bridge replacement; therefore, this cost has not been included in the construction cost estimate for the option.
  - Construction activities would be constrained between the Mets-Willets Point 7-Line Subway station and LIRR Mets-Willets Point Port Washington Branch (PWB) Station and adjacent to the NYCT Corona Yard and Maintenance Facility and NYCT Casey Stengel Bus Depot. This would lead to limiting the use of tall construction equipment to periods during planned rail closures, lead to inefficient working conditions, and require additional mitigations to maintain access and limit the impact to these facilities during construction. These complexities are considered and reflected in the Indicative Timeline/Schedule for this option.
  - Construction activities would be restricted and/or halted during events at the Citi Field stadium and at the U.S. Tennis Association (USTA) Billie Jean King National Tennis Center facilities.
  - Passenger connectivity between the fixed guideway with light rail and other transit services would be provided via one or more environmentally conditioned connectors

with vertical circulation built from the end(s) of the light rail station to the boundary of the existing LIRR Station and the north end of the Passerelle Bridge. These would provide connections to the 7-Line Subway station, OMSF, and Roosevelt Ave. Station improvements required to the LIRR Station to provide additional platforms would be required and are discussed below.

- **Support for Enhanced LIRR Service to Mets-Willets Point**
  - To support this option, a planned enhancement of the LIRR service from 2 to 4 tph in each direction between Mets-Willets Point and Midtown Manhattan would be coordinated with LIRR. This would require two additional tracks and associated platforms at the station. An allowance for a proportion of the cost of this work has been included in the construction cost estimate for this option.
  - This work would require complex coordination with LIRR to phase construction work and track modifications to minimize impacts to the LIRR services. These would likely be conducted over a series of agreed weekend track closures, leading to a protracted construction duration for this work (which has been included in the option Indicative Timeline/Schedule).

- **Construction over the 7-Line Subway and Roosevelt Ave**
  - From the proposed light rail station at Mets-Willets Point, the fixed guideway would pass over the existing NYCT 7-Line and Roosevelt Ave at the western end of the Southfield Parking Lot. This would require long bridge spans of approximately 180-ft length approximately 80 ft above-grade to clear the roadway and tracks. Additional costs have been included in the cost estimate for these non-standard structures.
  - Running parallel to Roosevelt Ave, between the Southfield Parking Lot and the NYCT maintenance shop, is an existing 6-ft water main. The structure foundations would be spaced to avoid fouling the main and avoiding costly relocation of the utilities. Monitoring and protection of the water main during the construction work would be required and an allowance is included for this in the construction cost estimate for the option.
  - The proposed design and construction activities in this area would be coordinated with the MTA and NYC DEP to gain their acceptance of the proposed methodologies.

- **Construction of the Elevated Guideway over the Northern Blvd Interchange with the GCP**
  - The proposed guideway crosses the Northern Blvd intersection with the GCP. The spacing between the intersection’s roadways would result in some long-span bridge structures up to approximately 200 ft through the intersection itself. Crossing the westbound GCP roadway to reach the westbound shoulder would require long-span structures of approximately 200 ft. The increased cost of these structures has been included in the construction cost estimate.

- Lifting these spans in place would require coordination of temporary closures to the GCP and Northern Blvd roadways at various times during the construction so that cranes and other large construction equipment can safely access the area and conduct the work. It would be likely that this would occur during short, overnight periods, which has been reflected in the Indicative Timeline/Schedule for this option.

- **Construction of the Elevated Guideway along the Westbound GCP Roadway**
  - From the Northern Blvd intersection, the elevated guideway is located between the westbound GCP roadway and Malcolm X Promenade, along Flushing Bay for approximately 0.6 mile. Foundations and support piers for the guideway would be located to the north of the GCP, between the roadways and the Promenade, and may require modification to the shoulder to accommodate below-ground elements (e.g., pile caps) and reconstruction of the barrier; these costs are included in the construction cost estimate for the option. The guideway elevation would be designed to be high enough to avoid reconstruction of existing signage gantries and pedestrian footbridges over the GCP to Malcom X Promenade.
  - Construction access to construct the guideway would require temporary lane narrowing to allow sufficient safe clearance for construction to occur within the promenade and GCP shoulder. Additionally, maintaining public access to the gas station, footbridges to Malcolm X Promenade, and the World's Fair Marina would constrain the work activities, introducing construction productivity inefficiencies. These have been captured in the Indicative Timeline/Schedule. Realignment of the acceleration and deceleration lanes for the existing gas station would be required between the proposed guideway piers; this is included in the construction cost estimate for the option.
  - Coordination with NYC Parks would be required to minimize the effects of the impacts to the gas station, footbridges, Marina, and Malcolm X Promenade during this work.

- **Constructing Elevated Stations in Constrained On-Airport Construction Site Conditions**
  - Long-span (approximately 250-ft) bridge structures would be required over 102nd St and the newly constructed departures roadway. This would require structures approximately 70 ft above-grade to clear the multi-level roads while maintaining airport operability, resulting in complex engineering solutions and construction methods. This complexity has been captured in the construction cost for the stations and connecting guideway in the construction estimate.
  - Two elevated light rail stations (each up to 300 ft long) with features such as escalators, elevators, stairs, and signage would be constructed and integrated with the existing Airport terminal buildings. Constructing these within a constrained, operational airport environment would reduce the construction sequence efficiency, introducing construction complexities. This is reflected in the Indicative Timeline/Schedule and cost estimate.

- Construction work in and around the Airport terminals and over Airport roadways would be subject to acceptance by the FAA.

- **Locating the OMSF**
  - The fixed guideway with light rail solution would require a facility of approximately 115,000 sf to store and maintain the fleet of vehicles and conduct system operations. This option includes an OMSF of this size located east of the proposed station at Mets-Willets Point above the existing parking lots. The cost of this facility has been included in the construction estimate for this option.

- **Constructability Risks Not Included in the Cost Estimate Range (–10% to +30%) for this Option**
  - Scale of construction work required to span the 7-Line and Roosevelt Ave: There is a residual risk that, during detailed engineering design and agency coordination with MTA and NYC DEP, additional complexities could arise, which could result in larger or longer span structures being required to cross over the 7-Line and Roosevelt Ave. The study team concluded that this risk is typical for this interface but could still result in a moderate increase in construction costs to mitigate.
  - Accommodating the proposed elevated guideway piers and foundations within the GCP ROW: There is a residual risk that, during detailed design coordination with NYS DOT (and FHWA where applicable), more complex support structures than currently envisaged are required to avoid introducing non-standard roadway elements to the existing highways or to allow existing non-standard elements to be brought up to current standards (in the future by NYS DOT). The study team concluded that, although this risk is typical of work in and around existing major highways, it still has the potential to result in moderate increases in construction cost and schedule prolongation.

5.2.1.2 Infrastructure Impacts during Construction

Construction of this option would result in temporary disruption to other major infrastructure along the route, which would last for 2–3 years. The notable areas of temporary infrastructure disruption are summarized below. The study team evaluated and agreed with the following excerpts of what is set forth in Appendix B of the 2021 Final Environmental Impact Statement for the LAIP (Mets-Willets AirTrain, currently on pause) concept:

- **Operational and Passenger Disruption to LIRR Services at Mets-Willets Point Station**
  - Modifications to the Mets-Willets Point LIRR Station would be staged and phased during off-peak hours and during weekend closures to avoid disrupting LIRR operations during peak travel times.

- **Operational and Passenger Disruption to NYCT 7-Line Services at Mets-Willets Point Station**
  - 10–15 off-peak and/or weekend service suspensions of the 7-Line would be expected, including minimal off-peak weekday suspensions of Subway service between 111th St and Main St-Flushing, and minimal weekend suspensions of Subway service between 11th St and Main St-Flushing.
  - Construction phasing would be coordinated with MTA well in advance of any planned service disruption and would develop plans for alternate commuter connections between stations.
  - Construction phasing, including crane operations in the vicinity of MTA facilities, would be coordinated with MTA to minimize operational impacts.
  - Construction could result in minimal off-peak impacts to the 7-line Train Corona Yard and the NYCT Corona Maintenance Facility.

- **Operational and Access Disruption to MTA NYCT Casey Stengel Bus Depot**
  - Construction of the fixed guideway with light rail OMSF would result in the temporary displacement of the MTA bus parking on the east side of the Bus Depot at the southeast corner of the Roosevelt Ave-126th St intersection.
  - A temporary MTA bus storage/parking facility would be constructed at the MTA/Tully site, located directly across from Roosevelt Ave from the northeast corner of the existing Bus Depot.
  - Construction could also impact off-peak bus operations entering and/or exiting the MTA Bus Washing Facility and Bus Depot via 126th St; alternate entrance/exit measures would be coordinated with MTA.

- **Temporary Roadway Lane Closures and Lane-Shifts during Construction**
  - GCP westbound:
    - North of Northern Blvd: Temporary lane-shift to the north while foundations are constructed.
    - North of Roosevelt Ave: Nighttime closure for two separate 3-night periods during the erection of segmental box girders. Traffic would be detoured.
    - North of Roosevelt Ave: Temporary lane-shift for one month during construction of fixed guideway foundations.
    - Along Flushing Bay Promenade: Temporary left lane roadway and lane-shift to the south.
    - East of the Gulf gas station: Closure of right lane during off-peak as needed.
    - At Marina: Nighttime closure for three separate 3-night periods for the erection of the fixed guideway foundations. Traffic would be detoured with lane closure.

- GCP eastbound:
  - North of Northern Blvd; east of the Gulf gas station: Temporary lane-shift to the south while fixed guideway foundations are constructed.
- GCP/Whitestone Expressway ramp eastbound:
  - Interchange: Nighttime closures for up to 15 nights during the erection of the fixed guideway.
- Astoria Blvd northbound and southbound:
  - At Northern Blvd: Nighttime closure for up to 15 nights during erection of the fixed guideway. Traffic would be detoured.
- Northern Blvd northbound:
  - At Astoria Blvd: Nighttime closure for two separate 3-night periods during erection of fixed guideway. Traffic would be detoured.
  - At GCP: Nighttime closure for two separate 3-night periods during erection of the fixed guideway. Traffic would be detoured.
- Roosevelt Ave eastbound and westbound:
  - At 7-Line: Nighttime closure for 15 nights during erection of the fixed guideway. Traffic would be detoured.
- Shea Rd:
  - North of Roosevelt Ave: Nighttime closure for 3 nights during erection of the fixed guideway. Traffic would be detoured.
- Meridian Rd eastbound and westbound:
  - At Passerelle Bridge: Limited daytime lane closures and nighttime road closures for installation of fixed guideway foundations and superstructure.
- 102nd St:
  - North of LaGuardia Rd: Various nighttime closures during erection of the fixed guideway.
- Airport Access ramps:
  - From LaGuardia Rd to Terminal C: Various nighttime closure during erection of on-Airport station structures and fixed guideway; nighttime closure for 5 nights during erection of the fixed guideway.

5.2.1.3 Permanent/Operational Impacts to Existing Infrastructure

Once completed, this option would have the following permanent/operational impacts on other infrastructure along the route:

- **Grand Central Parkway**
  - The entrance and exit lanes for the existing gas station located on the westbound GCP between Northern Blvd and LGA would be permanently reconfigured to accommodate the proposed elevated guideway piers.

5.2.1.4 Indicative Capital Cost

The Indicative Capital Cost for Option LR-2 is $2.4 billion (in 2022$, excluding future escalation and solely for approximate comparison between study options).

Indicative Capital Costs should be considered to have a range of estimating uncertainty of -10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).

The following are the notable cost drivers for the option:

- Elevated guideway structure along GCP and on-Airport.
- Tall, long-span structure over Subway/Roosevelt Ave.
- Long-span crossing of Northern Blvd/Whitestone Expressway.
- Roadway maintenance and traffic protection costs.
- Utilities protection and relocation costs.
- New elevated light rail station and connector at Mets-Willets Point.
- Modification work to existing LIRR Station.
- New elevated light rail stations and connectors at LGA.
- Track-side equipment, systems, and power.
- Revenue service light rail vehicles.
- Provision of a new maintenance and storage facility.

5.2.1.5 Indicative Timeline/Schedule

The Indicative Timeline/Schedule (for comparison between study options) for Option LR-2 is approximately 6–7 years from a decision to take the option forward to revenue service. This is consistent with the construction duration presented in the LGA Access Improvement Project Final EIS, plus additional, up-front time to undertake contract procurement activities before construction starts. This includes the following notable schedule:

- Property Acquisition.
- Procurement of design-build contractor(s) for heavy civil construction.
- Procurement of new light rail vehicles.
- Mets-Willets Point Station and tie-ins with LIRR and Subway stations (longest construction activity).

- Elevated guideway construction along GCP.
- Construction over Northern Blvd Interchange.
- On-Airport elevated stations and structure.
- Construction of a new OMSF.
- Systems installation and testing.
- 12 months of commissioning.

Figure 5.2-2 illustrates the indicative timeline/schedule for Option LR-2. The key drivers are the major civil construction work in the Mets-Willets Point Station areas, and the light rail systems commissioning. It should be noted that the schedule for this option is based on the project being 'shovel-ready' as the EIS is complete and reference design and construction procurement activities are well advanced.

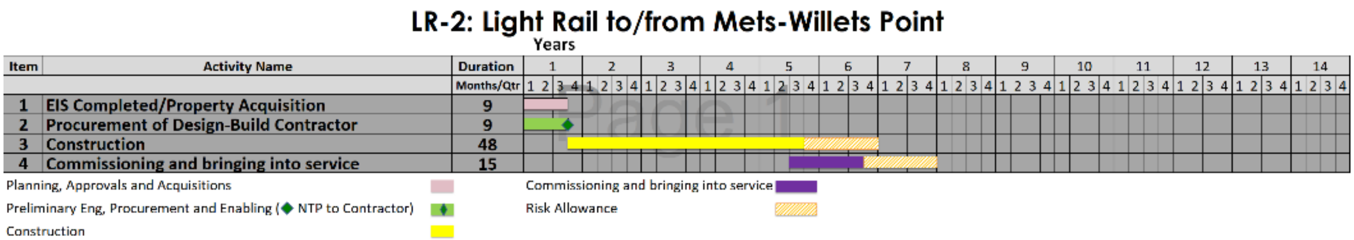


FIGURE 5.2-2: INDICATIVE TIMELINE/SCHEDULE (LR-2)

5.2.2 Transportation Aspects

5.2.2.1 Improved Access to LGA

Three factors have been considered in this category: Standardized Indicative Baseline Off-Peak Travel Time, Reliability, and Transfer Experience.

5.2.2.1.1 Standardized Indicative Baseline Off-Peak Travel Time

- Table 5.2-1, below, provides the Standardized Indicative Baseline Off-Peak Travel Times for the weekday, midday off-peak journeys to be used solely as a baseline for comparison between options. Tables 5.2-2 and 5.2-3 provide a breakdown of the components that make up the total journey, via LIRR and 7-Subway, respectively, the general approach to the estimation of which is described in Section 3.2.2.1.1.
- Passengers making the journeys described would, naturally, experience variations to the baseline timings calculated even where services are running as planned, for reasons as simple as variations in walking speeds or whether a traveler arrives just before a scheduled departure or just misses a departing train.

TABLE 5.2-1: STANDARDIZED INDICATIVE BASELINE OFF-PEAK TRAVEL TIME, OPTION LR-2

Penn Station or Times Square to LGA (minutes to Terminal C)	LR-2
Via LIRR to Mets-Willets Point	31
Via Subway (7-Train) to Mets-Willets Point	50

TABLE 5.2-2: STANDARDIZED INDICATIVE BASELINE OFF-PEAK TRAVEL TIME VIA LIRR BY SEGMENT, OPTION LR-2

Penn Station to LGA via LIRR (minutes)	LR-2
START Penn Station (street level)	
walk/wait time	7
LIRR platform (dep)	
LIRR trip time	16
Mets-Willets LIRR platform (arr)	
walk/wait time	4
Mets-Willets light rail platform (dep)	
Light rail trip time	4
1st on-Airport station (arr)	new elevated
END Terminal light rail stop	Terminal C
Total travel time =	31
trip time to next Terminal light rail stop	2
2nd on-Airport station	new elevated
END Terminal light rail stop	Terminal B
Total travel time =	33

TABLE 5.2-3: STANDARDIZED INDICATIVE BASELINE OFF-PEAK TRAVEL TIME VIA 7 SUBWAY BY SEGMENT, OPTION LR-2

Times Square to LGA via 7 Subway (minutes)	LR-2
START Times Square (street level)	
walk/wait time	5
7-Subway platform (dep)	
Subway trip time	31
Mets-Willets 7-Subway platform (arr)	
walk/wait time	10
Mets-Willets light rail platform (dep)	
Light rail trip time	4
1st on-Airport station (arr)	new elevated
END Terminal light rail stop	Terminal C
Total travel time =	50
Trip time to next Terminal light rail stop	2
2nd on-Airport station (arr)	new elevated
END Terminal light rail stop	Terminal B
Total travel time =	52

- Passengers for Terminal A would transfer to an existing on-Airport shuttle service running every 10 minutes and with an additional trip time of around 7 minutes from Terminal B.

5.2.2.1.2 Reliability

- Option LR-2 would operate exclusively on dedicated infrastructure separate from general roadway conditions.

5.2.2.1.3 Transfer Experience

Riders bound for Terminals B or C would transfer from the Subway or LIRR services to the new light rail service at Mets-Willets Point Station. Riders bound for Terminal A would have an additional transfer to an existing on-airport shuttle once they reach the airport.

Customer Transfer

- The studied Mets-Willets Point light rail terminal station would be fully enclosed and located approximately 60 ft above the LIRR tracks with its southern end over and perpendicular to the mid-point of a new Mets-Willets Point LIRR station, constructed in the same place as the existing one. The new Mets-Willets Point LIRR station would feature additional platforms and tracks to allow for more frequent train service at all times of day to and from Manhattan. Both the LIRR station and new light rail terminus would be fully ADA-compliant, making transfers as seamless as possible.
- Riders arriving at the new Mets-Willets Point LIRR station would follow wayfinding signage and walk approximately 100 ft to the new light rail station platform.
- Riders arriving at the existing Mets-Willets Point 7-Subway station would exit the existing station and walk approximately 1,000 ft through a new covered pedestrian connector ramp and ascend to the light rail station level via elevator, stairway, or escalator. The existing Mets-Willets Point 7-Subway station is not fully ADA-compliant.

5.2.2.2 Ridership

- Stated preference survey results indicate that 49% of airport passenger respondents are "definitely" or "probably" interested in fixed guideway connections to existing transit services.
- The ridership model projects 4.7 million total riders using Option LR-2, with a corresponding increase in net transit ridership of 3.4 million riders in 2025 (Table 5.2-4).

TABLE 5.2-4: RIDERSHIP MODEL RESULT SUMMARY

Transit Option			Riders on Current Bus Services to LGA (Millions) (No Action)	New Transit Option Impact (Millions)		
Mode Category & Scenario Label		Description		Riders on New LR-2 Light Rail Service	Net Increase in Total Transit Ridership	Total Transit Ridership (LR-2 Light Rail Service + Other Bus Services)
Fixed Guideway with Light Rail	LR-2	Mets/Willets Point	4.1	4.7	**3.4**	**7.4**

5.2.2.3 Throughput and Capacity

Throughput

- Using the highest hourly single-direction provision of airline seats at LGA in 2019 (4,300 seats on weekday departing flights 9 AM to 10 AM – see Figure 3.2-1, in Section 3.2.2.3), the estimated single-direction peak passenger demand for this option could be approximately 600 passengers per hour.
- It should be noted that these passengers would likely arrive at the transfer station in groups, rather than being evenly distributed throughout the time period.

Capacity of New Transit Option

- Using the AirTrain JFK system as an example, automated light rail systems can be tailored to throughput requirements using an appropriate combination of train length and frequency. Typically, 58-ft cars are able to accommodate more than 75 passengers with luggage, with around one-third of them seated.
- With the proposed arrangement of three-car trains at 4-minute intervals, the potential total capacity of the proposed new light rail link could be:
  - 3,375 pphpd at peak.
- This is sufficient to support the estimated single-direction peak passenger demand from the ridership model, equating to approximately 40 passengers per train at peak with this proposed train-car configuration and frequency.
- Actual train-car configuration and frequency would be adapted in practice to suit demand and other operating requirements.

Impact on Capacity of Existing Downstream Transit Systems

- The stations at Mets-Willets Point offer transfer access to the 7-Line Subway services and the LIRR (Port Washington Branch).
- Generally, airport passenger loadings are constant through the day both to and from the Airport with the peak passenger loadings occurring outside of the morning Manhattan-bound subway peaks or in the opposite direction (i.e., Airport-bound).
- The existing local and express 7-Subway lines currently operate below their peak capacity during the 8 AM to 9 AM Manhattan-bound commuting peak. While most Manhattan-bound Airport passengers would travel outside this peak, those passengers (including non-Airport passengers) traveling during this peak could experience some crowded conditions.
- This analysis only considers the impact to the 7-Lines; customers transferring at Mets-Willets Point would have the option to continue their journey to Manhattan on the LIRR (including the proposed enhancement to 4 tph), adding to the available capacity of the downstream transit system.

5.2.2.4 Indicative Operating Cost

- Costs of providing additional LIRR services under the East Side Access Program are not included in the estimated operating cost for this option.
- Overall operating and maintenance costs for the new fixed guideway with light rail line were estimated by the Port Authority in 2020 at $34 million per annum. This estimate includes owner's costs.

5.2.3 Community and Environmental Aspects

5.2.3.1 Local Community Impacts

This option would be located mainly along areas with transportation and recreational uses, including at various points along the northern edge of the GCP, Flushing Meadows Corona Park, and Willets Point, which has stadium and sports facilities, parking lots, and subway and bus maintenance and storage facilities in the vicinity. The elevated fixed guideway structure columns would be located along the edge of the Malcolm X Promenade (and adjacent to the World's Fair Marina), which is located on the other side of 8 lanes of GCP from the nearest residential neighborhood of East Elmhurst.

The potential for temporary (during construction) and permanent (once operational) impacts is summarized below for specific areas of the alignment.

5.2.3.1.1 Temporary Impacts during Construction on the Local Neighborhoods Directly Affected

The fixed guideway from Mets-Willets Point to LGA would require major heavy civil construction activities to build the guideway foundations and elevated structures along the route. Construction activities are anticipated to occur along the approximately 2-mile route for approximately 4 years.

During construction, the following neighborhoods would have the potential for air quality, noise, vibration, or visual impacts. For the frequency and duration of construction activities refer to Section 5.2.1.2 "Infrastructure Impacts during Construction" above.

- **Construction of the Elevated Fixed Guideway along the GCP**
  - Planned periodic closures of the GCP (lanes and ramps) would be required for the construction of the elevated structure. The construction would occur approximately 175–275 ft from 4 long city blocks of residential and commercial properties in the East Elmhurst community located on the other side of 8 lanes of the GCP.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.

- There could be increased construction/haul traffic on local roads because trucks are not allowed on the GCP.

- **Construction of the Elevated Fixed Guideway Along Malcolm X Promenade**
  - Due to construction along the Malcolm X Promenade, part of Flushing Meadows-Corona Park (NYC Parklands), along this approximately 0.75-mile segment of the route, it is anticipated that the gas station and adjacent store located along the westbound lanes of the GCP, adjacent to the Flushing Bay Promenade, would need to be closed for approximately 1 month during construction. Additionally, the Marina Restaurant and Banquet Hall may require temporary closures during construction of nearby columns. It is anticipated that any such closure of the Marina Restaurant and Banquet Hall would not extend beyond approximately 3 months, and to the extent practicable, this closure would be scheduled during the off-season.

- **Constructing On-Airport Elevated Light Rail Stations**
  - Construction activities associated with the erection of long-span (approximately 250-ft) elevated guideway bridge structures over an approximately 0.5-mile segment of the route over 102nd St and the newly constructed departures roadway at the Airport would be required.
  - The construction would occur over 500 ft from 5 city blocks of residential and commercial properties in the East Elmhurst community located on the other side of 8 lanes of the GCP.
  - Planned night closures of the GCP would be required for the long-span bridge erection.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - There could be increased construction/haul traffic on local roads because trucks are not allowed on the GCP.

- **Construction of the OMSF**
  - The fixed guideway with light rail solution would require a facility of approximately 115,000 sf to store and maintain the fleet of vehicles and conduct system operations. This option includes an OMSF of this size located east of the proposed station at Mets-Willets Point above the existing parking lots.
  - The construction of the facility (track and building(s)) would occur for approximately 1 year and approximately 100–150 ft from commercial and industrial properties.

5.2.3.1.2 Permanent Operational Impacts on the Community Directly Affected

Electrically powered light rail vehicles, similar in size and characteristics as the vehicles that currently operate on AirTrain JFK, would operate between LGA and the proposed new light rail station at Mets-Willets Point at peak headways of 4 minutes. They would operate on an elevated fixed guideway structure along the full route, ranging approximately 100–500+ ft from commercial, industrial, and residential properties. During periods of reduced airport demand (e.g., overnight), headways would significantly reduce.

The following local neighborhoods and areas would have the relative potential for permanent noise, vibration, or visual impacts because of this option's proposed light rail operations:

- **New Elevated Light Rail Along Malcolm X Promenade (NYC Parkland)**
  - Along the GCP, adjacent to Malcom X Promenade, light rail vehicles would operate in each direction on an elevated fixed guideway structure within the GCP transportation corridor approximately 175–275 ft from residential and commercial properties on the other side of 8 lanes of the GCP.
- **New On-Airport Elevated Light Rail Stations**
  - On-Airport, light rail vehicles would operate in each direction on an elevated fixed guideway structure between the two proposed light rail stations over 500 ft from residential and commercial properties in the East Elmhurst community located on the other side of 8 lanes of the GCP.
- **New Light Rail OMSF**
  - The proposed maintenance and storage facility above the existing parking lots would experience light rail vehicle movements throughout the day, peaking when vehicles leave and enter the facility at the start and end of peak operations. Maintenance and other activities would occur throughout the day and possibly overnight within covered buildings/vehicle sheds. These activities would occur approximately 100–150 ft from commercial and industrial properties.

5.2.3.1.3 Potential Private Property Acquisitions

No private properties are anticipated to be acquired.

5.2.3.1.4 Potential Public Property Acquisitions (NYC DOT Plazas and NYC Parks Parkland)

The new fixed guideway with light rail to/from Mets-Willets Point may result in permanent impacts to the following:

- New support columns for the fixed guideway structure would be located in Flushing Meadows-Corona Park, specifically within Southfield and CitiField parking lots and the southern border of the Malcolm X Promenade, adjacent to the GCP.
- No structures would be sited within NYC DOT Plazas.

5.2.3.1.5 Removal/Reconfiguration of Parking Spaces

This option would have minimal impact to on-street, public parking.

5.2.3.1.6 Environmental Justice Communities Mapping Analysis

The Environmental Justice communities mapping analysis provides an overview of the minority and low-income communities within 0.25 mile of the transit options being studied.

For Option LR-2, more than half of the block groups within the 0.25-mile buffer of the option alignment are Environmental Justice block groups.

See Figure 5.2-3 below for the analysis map.

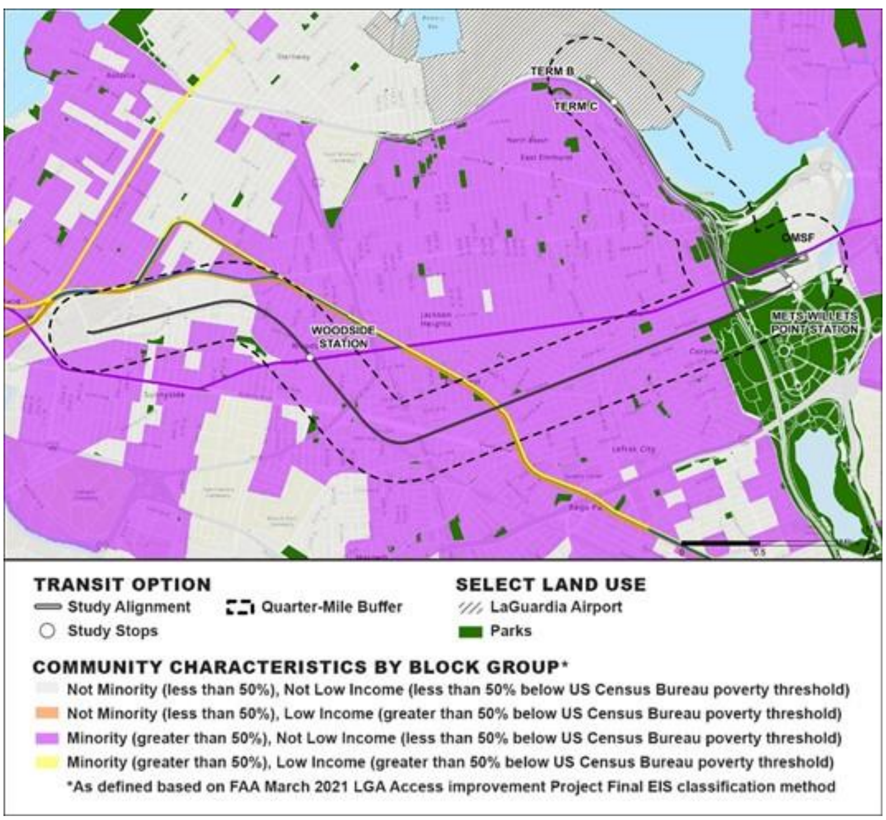


FIGURE 5.2-3: METS-WILLETS OPTION – ENVIRONMENTAL JUSTICE COMMUNITIES MAPPING ANALYSIS (AS DEFINED BASED UPON FAA MARCH 2021 LGA ACCESS IMPROVEMENT PROJECT FINAL EIS CLASSIFICATION METHOD)

5.2.3.2 Equity

5.2.3.2.1 Transit Access from LGA

- **Additional Minority and Low-income Populations Reached within 45 Minutes from LGA via Transit (Population Access Analysis)**
  - The results of the Population Access Analysis illustrate how many people, specifically from low-income and minority populations, could travel via transit from LGA to homes within 45 minutes from LGA. Airport passengers or Airport employees living within these areas could potentially benefit from expanded access to these destinations.
  - Option LR-2 is expected to expand transit access from LGA to regional destinations within 45 minutes, as shown in the blue area of "Additional Access Provided by Transit Option" in Figure 5.2-4.

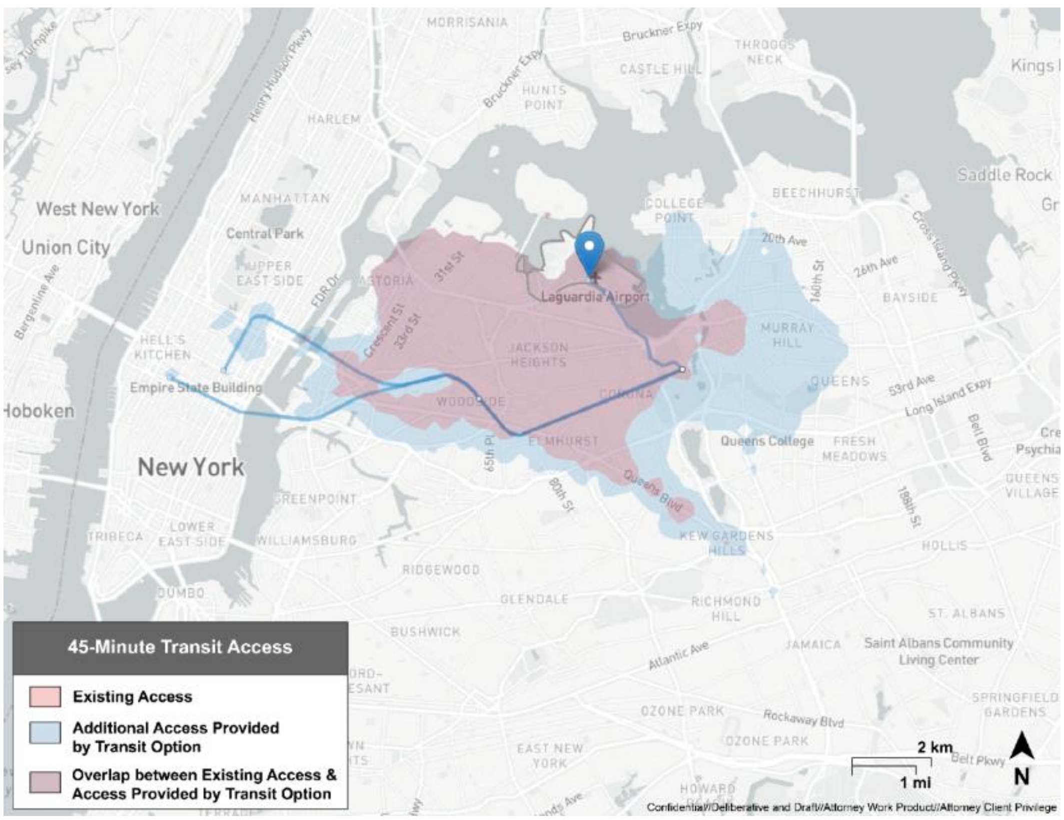


FIGURE 5.2-4: METS-WILLETS POINT OPTION LR-2 – POPULATION ACCESS ANALYSIS

  - This option proposes increasing the number of LIRR trains from Mets-Willets Point to Midtown Manhattan from 2 to 4 tph, resulting in 15-minute service to Midtown. The 4-tph service would allow for a trip length of less than 45 minutes to Midtown Manhattan; however, since the service would be split between two separate destinations (Penn Station and Grand Central Terminal), the results from the model and corresponding map in Figure 5.2-4 show both being inaccessible within a 45-minute trip via transit from LGA.

- Compared to the baseline, the minority population reached within a 45-minute transit trip would increase by 53.5% and the low-income population reached within a 45-minute transit trip would increase by 58.5% as shown in Table 5.2-5.
- This represents a medium increase in transit access to LGA within 45 minutes for minority and low-income communities.

TABLE 5.2-5: METS-WILLETS POINT OPTION LR-2 – POPULATIONS REACHED WITHIN 45-MINUTE TRANSIT TRIP

		Total Population Reached	Minority Population Reached	Low-Income Population Reached
Baseline	Existing Condition	551,434	422,981	76,750
LR-2	With Option	870,285	649,076	121,635
	Net Change	+318,851	+226,095	+44,885
	% Change	57.8%	53.5%	58.5%

- **Additional ADA-Accessible Stations within 45 Minutes from LGA via Transit (ADA Analysis)**
  - The results of the ADA Analysis illustrate how Airport passengers and Airport employees, specifically those requiring ADA-compliant stations, traveling from LGA to other locations could potentially benefit from expanded access to ADA-compliant stations within 45 minutes via transit.
  - More ADA-accessible stations/stops can be reached within a 45-minute transit trip for this option compared to the baseline of existing transit service (Table 5.2-6). This echoes the results from the Population Access Analysis, in which Option LR-2's 45-minute transit travel shed provides an increased amount of access over the baseline transit service. Compared to the baseline, an additional 18 ADA-accessible stations can be reached within a 45-minute transit trip from LGA for Option LR-2.

TABLE 5.2-6: METS-WILLETS POINT OPTION LR-2 – ADA ANALYSIS

Subway, Ferry, LIRR, and MNR Stations Reached within 45-Minute Transit Trip from LGA	Baseline	LR-2	Difference between Baseline and LR-2
Total Stations	*43*	*67*	*+24 stations*
ADA-Accessible Stations (Accessible Stations as % of Total)	*20 (47%)*	*38 (57%)*	*+18 stations*

5.2.3.2.2 Transportation Opportunities and Benefits for the Surrounding Community

- **Transportation Opportunities for Neighbors**

  This option does not include intermediate/off-Airport stops. Because there is limited pedestrian access to LGA from adjacent residential areas and walking distance exceeds 0.25 mile, the study team did not consider there to be a significant market for use of the final on-Airport stops by the surrounding community to connect to the broader transit network.

- **Cars Removed from Local Roadways and Emissions Reductions**

  See the "Cars Removed from Local Roadways" section and the "GHG and Other Vehicular Emissions Reductions" section of this evaluation below.

5.2.3.3 Cars Removed from Local Roadways

- Option LR-2 would be expected to remove 1,491,000 Airport passenger vehicles, and 122,000 Airport employee vehicles, from the road each year.

5.2.3.4 GHG and Other Vehicular Emissions Reduction

- Option LR-2 would be expected to remove 7,780 metric tons of CO_2 equivalent each year.
- Other vehicular emissions reductions are given in Table 5.2-7:

TABLE 5.2-7: OTHER VEHICULAR EMISSIONS REDUCTION (METRIC TONS PER YEAR)

Option	CO	VOC	NOx	SO_2	PM_{10}	$PM_{2.5}$
[LR-2] Mets-Willets Point	36.7	0.5	2.5	0.1	1.4	0.3

5.2.4 Summary of Evaluation

LR-2: Light Rail to/from Mets-Willets Point

Option LR-2 would provide a two-seat ride to LGA via a 4-minute light rail ride to/from the existing LIRR (Port Washington Branch) station, and the existing 7-Line Subway station located in Willets Point. A new dedicated light rail station would be located adjacent to both existing stations, providing ADA-compliant passenger access between them.

The guideway would run along the existing GCP transportation corridor to LGA from the east, avoiding the construction complexities and community impacts associated with options approaching the Airport terminals from the west.

This option would require the construction of heavy infrastructure, including elevated concrete guideway structures completely within the GCP transportation corridor and within the Mets-Willets Point parking lot. This option would have to contend with the construction challenges of crossing over the 7-Line at Roosevelt Ave and constructing along the southern edge of Malcom X Promenade and within the GCP ROW. This option is the shortest evaluated at 2 miles in length.

This option was the subject of the 2021 Final Environmental Impact Statement (FEIS) for the LGA Access Improvement Project (LAIP) (Mets-Willets AirTrain, currently on pause) concept.

Table 5.2-8 summarizes the output from all the factors used to evaluate this option.

TABLE 5.2-8: SUMMARY OF KEY CHARACTERISTICS – LIGHT RAIL TO/FROM METS-WILLETS POINT (LR-2)

	Evaluation Factor	Assessment
CONSTRUCTION ASPECTS	Constructability	• Construction of elevated light rail station over LIRR ROW and Passerelle Bridge • 70ft high structures over Roosevelt Ave/7-Line • Constrained construction access adjacent to GCP • Long spans (200 ft) over Northern Blvd / GCP interchange • Long spans (250 ft) over 102nd St Bridge on-Airport • Constrained on-Airport sites for new elevated light rail structure and 300 ft stations • Total option route length: approx. 2 miles
	Infrastructure Impacts during Construction	• Off-peak outages of LIRR service on Port Washington Branch • Off-peak outages of NYCT 7-Line service over Roosevelt Ave • Temporary disruption to MTA NYCT Casey Stengel Bus Depot • Lane reductions and speed restrictions on GCP • Reduction of pedestrian service on Passerelle Bridge
	Permanent/Operational Impacts to Existing Infrastructure	• Increased (4 tph off-peak) service to LIRR Mets-Willets Point Station • Inhibits future widening of the GCP
	Indicative Capital Cost (2022$)[63]	$2.4 billion
	Indicative Timeline/Schedule	6-7 Years

[63] Indicative Capital Costs should be considered to have a range of estimating uncertainty of –10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).

TABLE 5.2-8, CONTINUED.

	Evaluation Factor	Assessment
TRANSPORTATION ASPECTS	Standardized Indicative Baseline Off-Peak Travel Time (From Midtown Manhattan)	Via LIRR: 31 mins (4 mins on light rail) (Penn Station to Terminal C, then B; shuttle to Terminal A) Via 7-Line: 50 mins (4 mins on light rail) (Times Square to Terminal C, then B; shuttle to Terminal A)
	Transfer Experience	• Transfer from LIRR Mets-Willets Point Station to light rail train would involve a vertical move via large elevators and escalators provided direct from LIRR platform to light rail station • 8-min walk from 7-Line Mets-Willets Point Station to light rail in enclosed walkway
	Ridership[64]	Total annual projected ridership for option: 4.7 million Net increase in annual projected transit ridership: 3.4 million
	Throughput & Capacity	3,375 pphpd (peak)
	Indicative Operating Cost	$34 million per annum
COMMUNITY AND ENVIRONMENTAL ASPECTS	Local Community Impacts	<u>Construction:</u> • Heavy civil construction of elevated structures for approx. 4 years <u>Proximity to communities:</u> • Over 500 ft across 8 lanes of the GCP from 9 city blocks of residential and commercial properties along the GCP and opposite the Airport Terminals <u>Permanent impacts:</u> • No permanent private property acquisition • Structures within a portion of Flushing Meadows Corona Park currently used for Mets parking, and along the southern border of Malcolm X Promenade • Minimal, if any permanent loss of public parking spaces
	Equity	• Medium increase to low-income and minority populations within 45 minutes of the Airport via transit versus the no-build scenario • +18 additional ADA-compliant stations reachable within a 45-minute transit trip from LGA versus the no-build scenario
	Cars Removed from Local Roadways	1,491,000 airport passenger vehicles and 122,000 airport employee vehicles from the road each year
	GHG and other Vehicular Emissions Reductions	7,780 metric tons of CO_2 equivalent each year

[64] Experience from AirTrain JFK was that actual ridership turned out to be higher than would have been predicted by the AirTrain JFK forecast and underscores the inherent uncertainty of model predictions. The ridership model supporting this effort could also deviate from eventual ridership demand but was utilized to allow ridership comparisons between the options.

5.3 LR-3: Light Rail to/from Jamaica

Option LR-3 would link LGA to the existing Jamaica transit hub via a 9-minute light rail ride, providing direct access to the LIRR (Main Line, Atlantic Branch, and Montauk Branch) and connections to the E, J, and Z Subway services. By connecting with AirTrain JFK at Jamaica, this option also provides the potential of an integrated AirTrain service to both airports via direct cross-platform transfer between the services and the shared use of the existing Airport-branded station. The guideway would run along the existing VWE and GCP transportation corridors to LGA from the east, avoiding the construction and operational complexities of interacting with the end of Runway 04-22, west of the Airport terminals.

Option Route Description

From Jamaica, the route would cross over the LIRR rail yard next to the existing AirTrain JFK guideway, as well as the LIRR mainline tracks, for one block before turning to travel northwest over the east side of the northbound Van Wyck Expressway ROW for 1.4 miles (Figure 5.3-1). The aerial guideway would be located over the area between the north service road and Northbound VWE, passing over Jamaica Ave, Hillside Ave, the 86th Ave pedestrian bridge, Queens Blvd, Hoover Ave, and 82nd Ave pedestrian bridge before turning further west over the Kew Gardens Interchange. The route would then shift over to the

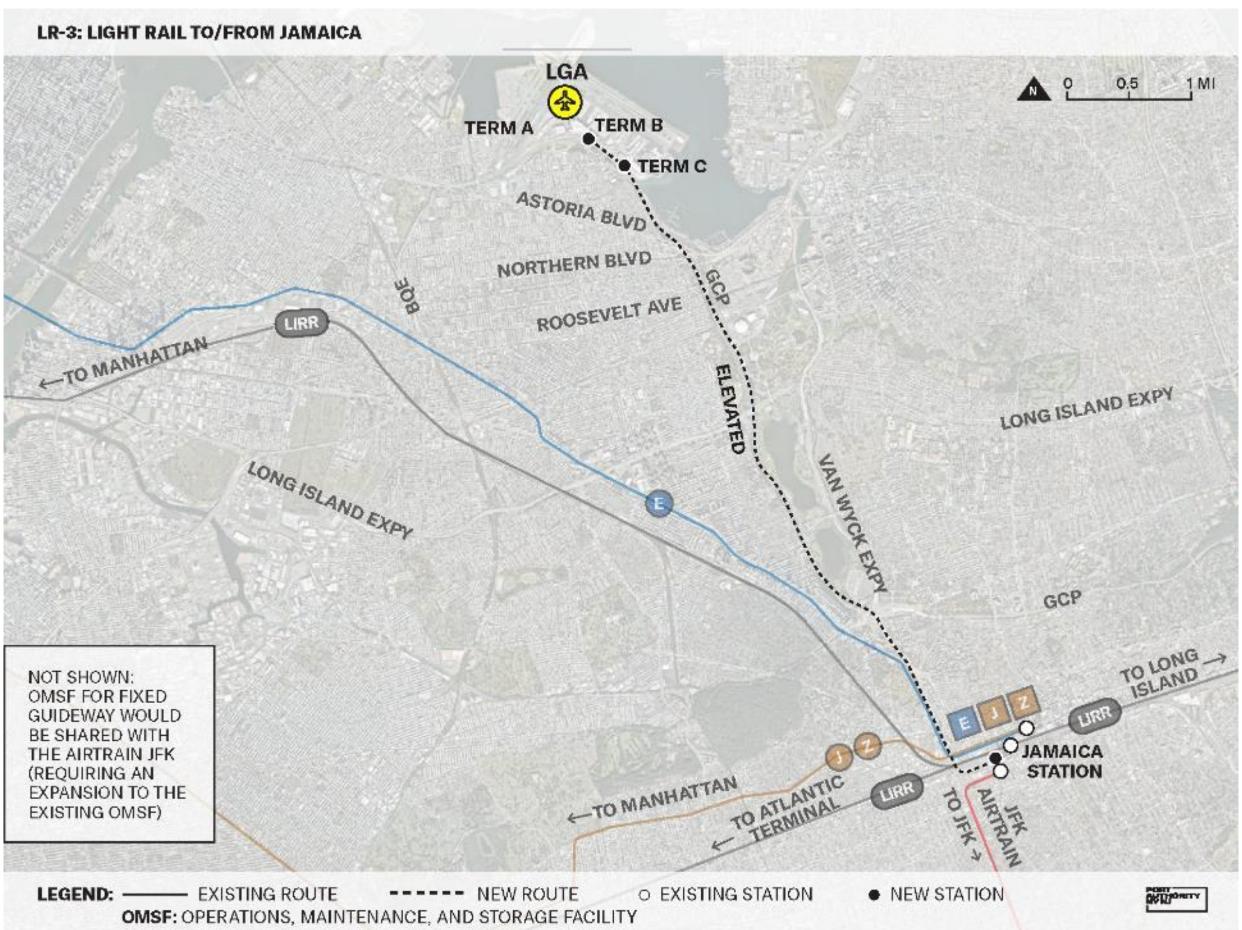


FIGURE 5.3-1: OPTION LR-3

median of the GCP for 3.6 miles, passing over several roadways, pedestrian and Subway bridges, including the triple decker Roosevelt Ave/Subway bridges, and Long Island Expressway Bridge. The route would then cross over the GCP westbound lanes to be above the southern edge of the Malcolm X Promenade adjacent to the GCP for 0.7 mile.

Once on-Airport, the route would connect to two elevated fixed guideway stations, one serving Terminal C and one serving Terminal B. It is anticipated that this option would expand the existing AirTrain JFK OMSF via a 'by-pass' link between the LGA and JFK guideways.

The length of this route is approximately 7 miles, including the on-Airport portion, the longest option (by approximately 2 miles) considered in this Report.

5.3.1 Evaluation of Construction Aspects

5.3.1.1 Constructability

The fixed guideway from Jamaica to LGA would require major heavy civil construction activities to build the elevated guideway foundations, structures, and stations along the route.

The notable challenges and complexities associated with construction of this option are summarized below.

- **Construction of New Fixed Guideway Station Adjacent to the Existing AirTrain JFK Station at Jamaica**
  - The proposed Fixed Guideway station would be located at elevation on the north side of the existing AirTrain JFK Station at Jamaica, above four minor LIRR train storage yard tracks. Passenger connectivity between the fixed guideway with light rail and other transit services would be provided via a 'conditioned space' connector built from the end of the light rail station into the existing AirTrain JFK Building.
  - The design of the support structure would have to span the existing storage access tracks, resulting in a less cost-efficient structural solution. This has been reflected in the construction cost estimate by increases over standard rates. Access to the storage tracks would have to be temporarily suspended to allow safe construction, and this would require coordination with LIRR to agree any operational changes in advance of construction.
  - Crossover tracks and other interface work to link the new and existing structures would have to occur outside of AirTrain JFK operations (e.g., during any planned maintenance outages), resulting in inefficient construction and longer durations; these have been included in the Indicative Timeline/Schedule. There is a risk that coordination with AirTrain JFK would result in wider constraints on the construction program.
- **Construction of the Elevated Guideway above the LIRR Railroad Crossings over the VWE**
  - The proposed elevated guideway would leave Jamaica Station and turn north to follow the VWE, then immediately cross a complex and multi-leveled set of railroads (approximately 12 rail lines on 2 levels) into Jamaica Station. To cross the rail bridges

and avoid supporting columns on them, tall (approximately 80–90 ft), long-span structures (approximately 250–300 ft) would be required. Allowances have been included in the construction cost estimate for these structures.

- Construction of the bridge structures over the LIRR rail would require tall cranes and other equipment to swing the beams in while rail operations on the LIRR are suspended. To minimize impact to the LIRR, this would occur in overnight or weekend outages. This has been reflected in the construction durations for this work.
- All work proposed over the LIRR rails would be subject to approval from LIRR.
- A short, approximately 800-ft length of elevated structure would be required to link the existing AirTrain JFK and the proposed LaGuardia tracks. This would allow trains to directly switch between the LGA and JFK branches (to access the maintenance facility at JFK Airport) without needing to enter Jamaica Station. An allowance for this additional length of track has been included in the cost estimate.

- **Construction of the Elevated Guideway along the Northbound VWE Roadway**
  - From Jamaica Station, the guideway runs at elevation along the northbound roadway of the VWE between the shoulder and the adjacent service road for approximately 1.4 miles. Support columns and piers would be accommodated between the service road and the VWE roadway, but at this stage of development, the need for modifications to shoulder widths and/or lane layouts cannot be ruled out. An allowance for road modification work has been included in the construction cost estimate
  - Work along the VWE will be constrained by the need to maintain VWE roadway widths and traffic flows and safe operations during construction. This would result in inefficiencies in the construction process and the need for major lifting operations to occur outside peak times (i.e., overnight). This has been reflected in the construction durations for this work in the schedule.
  - Along the VWE, the guideway crosses on-/off-ramps from Atlantic Ave, to Jamaica Ave, from Hillside Ave, and to Queens Blvd. These would need to be reconstructed and longer span structures used to provide the necessary sight lines and merge requirements between the guideway support piers. Allowances have been included in the construction cost estimate for this work.
  - The guideway would pass over underground Subway lines for the J/Z-Line (at Archer Ave), the E-Line (between 90th St and 91st Ave), and the F-Line (just north of Hillside Ave). The guideway foundations would be designed to avoid the subway tunnels, but settlement monitoring and possible protection measures would have to be put in place during construction. This is reflected as an increase over standard guideway rates in the construction cost estimate.

- **Construction of the Elevated Guideway over the Queens Blvd Interchange with the VWE**
  - Crossing the Main St/Queens Blvd interchange with the VWE would require long-span structures (approximately 350–400 ft) to avoid placing piers on the Queens Blvd structure or Main St underpass. These structures would be non-standard designs, increasing costs compared to standard rates. An allowance for this has been included in the cost estimate for this option. Erection of these structures would occur in off-peak periods or overnight and require road closures, which has been reflected in the construction duration in the schedule.
  - North of the Queens Blvd interchange, the guideway would pass within the western edge of the Hoover Manton Playground (NYC Parkland). To limit potential impact on the park, construction zones and equipment access would be restricted to the minimum required to build the guideway, constraining construction methodology; this complexity has been reflected in an increase in standard construction costs in the estimate, as well as durations in the schedule.

- **Construction of the Elevated Guideway over the Kew Gardens Interchange**
  - The Kew Gardens Interchange is currently undergoing reconstruction as part of NYS DOT’s operational improvement project for the interchange. The number of intersecting roadways makes this area one of the more complex and constrained areas of the Jamaica route requiring careful partner agency coordination with NYS DOT to optimize the guideway support column locations within the interchange.
  - The Kew Gardens Interchange would have roadways on three or four levels requiring tall (approximately 50–60 ft) structures to span approximately 250–350 ft for the elevated guideway. These structures would be non-standard with complex designs, which is reflected in the cost estimate for this option with increases over the standard cost rates used for the elevated guideway. Erection of these structures would occur in off-peak periods or overnight and require road closures, and this has been reflected in the construction duration in the schedule.
  - Space within the interchange to undertake piling, construct foundations, and build support piers is constrained with limited access for construction equipment and materials. This would make construction working inefficient, increasing the activity durations over what could be expected for similar work in accessible locations. This has been reflected in increased durations in the Indicative Timeline/Schedule.

- **Construction of the Elevated Guideway in the GCP Median**
  - From the Kew Gardens Interchange, the guideway runs at elevation along the median between the east- and westbound roadways of the GCP for approximately 3.6 miles. To maintain compliant widths, the GCP lanes and shoulders would require modification work to accommodate the guideway support piers and their foundations within the median. This could include lane shifting, barrier reconstruction, signage gantry

reconstruction, on-/off-ramp reconfiguration, re-striping, etc. An allowance has been included in the construction cost estimate for this modification work.
- Working within the median of the GCP would result in inefficiencies in the construction process and the need to conduct major lifting operations outside peak times (i.e., overnight). This has been reflected in the construction durations for this work in the schedule.

- **Construction of the Elevated Guideway over the Entry to the NYCT Jamaica Rail Maintenance Yard**
  - North of the Kew Gardens Interchange, the elevated guideway crosses over the rail access point to the NYCT Jamaica maintenance yard facility, requiring bridge spans of approximately 120–150 ft.
  - Lifting these spans would require coordination of temporary closures to the GCP central lanes as well as rail operations through this area so that cranes and other large construction equipment can safely access the area and conduct the work. It would be likely this would occur during overnight periods or weekends; this has been reflected in the Indicative Timeline/Schedule for the option.

- **Construction of the Elevated Guideway over the Long Island Expressway Interchange with the GCP**
  - To avoid setting support columns on the Long Island Expressway bridge structure over the GCP, a structural solution using long-span beams of approximately 300 ft would be required. This increases the costs over the elevated guideway rates used in the estimate and has been reflected in the construction costs for this option.
  - Erecting the beams would occur in off-peak, overnight work with temporary closure of both Long Island Expressway roadways and the middle lanes of the GCP, providing safe construction access for cranes and other lifting equipment. This has been included in the Indicative Timeline/Schedule for this option.

- **Construction of the Elevated Guideway over the LIRR Port Washington Branch and NYCT 7-Line to Mets-Willets Point**
  - Between the Long Island Expressway (LIE) and Northern Blvd interchanges with the GCP, the elevated guideway would cross two railroad bridge structures over the GCP: the LIRR between Woodside and Mets-Willets Point, and the NYCT 7-Line between 111th St and Mets-Willets Point.
  - The LIRR crossing coincides with tall high-tension power lines that cross the GCP in the same location. The 7-Line crossing is a three-tiered crossing, including the grade-separated branch into the Corona Rail Yard and Roosevelt Ave with a signal building located on the bridge top level. Extremely and unusually tall (approximately 100 ft above the GCP roadway) structures would be required to span both the existing high-

tension lines and the 7-Line railroad structures and signal building with suitable clearance. This would result in an elevated guideway at approximately 100 ft above the GCP roadway for approximately 0.25 mile. This has been accounted for in the construction cost estimate with an increase over the standard elevated guideway rates.
- Lifting these spans would require coordination of temporary closures to the GCP central lanes as well as rail operations into Mets-Willets Point so that cranes and other large construction equipment can safely access the area and conduct the work. It would be likely this would occur during limited off-peak and overnight or weekend periods, which has been reflected in the Indicative Timeline/Schedule for this option.

- **Construction of the Elevated Guideway over the Northern Blvd Interchange with the GCP**
  - The proposed guideway crosses the Northern Blvd intersection with the GCP approximately 40–50 ft above-grade. The spacing between the intersection's roadways would result in some long-span bridge structures up to 200 ft through the intersection itself. Crossing the westbound GCP roadway to reach the westbound shoulder would require a long-span structure of approximately 200 ft. The increased cost of these structures has been included in the construction cost estimate.
  - Lifting these spans in place would require coordination of temporary closures to the GCP and Northern Blvd roadways at various times during the construction so that cranes and other large construction equipment can safely access the area and conduct the work. This would be likely to occur during short, overnight periods, which has been reflected in the schedule for this option.

- **Construction of the Elevated Guideway along the Westbound GCP Roadway**
  - From the Northern Blvd intersection, the elevated guideway would be located between the westbound GCP roadway and Malcom X Promenade, along Flushing Bay for approximately 0.6 mile. Foundations and support piers for the guideway would be located to the north of the GCP, between the roadways and the Promenade, and may require modification to the shoulder to accommodate below-ground elements (e.g., pile caps) and reconstruction of the barrier; an allowance is included in the construction cost estimate for this work. The guideway elevation would be designed to be high enough to avoid reconstruction of existing signage gantries and pedestrian footbridges over the GCP to Malcolm X Promenade.
  - Construction access to construct the guideway would require temporary lane narrowing to allow sufficient safe clearance for construction to occur within the promenade and GCP shoulder. Additionally, maintaining public access to the gas station, footbridges to Malcolm X Promenade, and the World's Fair Marina would constrain the work activities, introducing construction productivity inefficiencies. These have been captured in the Indicative Timeline/Schedule. Realignment of the acceleration and deceleration lanes for the existing gas station would be required between the proposed guideway piers. This is included in the construction cost estimate for the option.

- Coordination with NYC Parks would be required to minimize the effects of the impacts to the gas station, footbridges, Marina, and Malcolm X Promenade during this work.

- **Constructing Elevated Stations in Constrained On-Airport Construction Site Conditions**
  - Long-span (approximately 250-ft) bridge structures would be required over 102nd St and the newly constructed departures roadway. This would require structures approximately 70 ft above-grade to clear the multi-level roads while maintaining Airport operability, resulting in complex engineering solutions and construction methods. This complexity has been captured in the construction cost for the stations and connecting guideway in the construction estimate.
  - Two elevated light rail stations (each up to 300 ft long), with features such as escalators, elevators, stairs, and signage, would be constructed and integrated with the existing Airport terminal buildings. Constructing these within a constrained, operational airport environment would reduce the construction sequence efficiency, introducing construction complexities. This is reflected in the Indicative Timeline/Schedule and cost estimate.
  - Construction work in and around the Airport terminals and over Airport roadways would be subject to acceptance by the FAA.

- **Locating the OMSF**
  - The fixed guideway with light rail solution for this option would utilize the existing AirTrain JFK OMSF at JFK Airport. Storage and maintenance space would be required for the additional vehicles (taken to be one-quarter the space required for a full facility) with an increase of approximately 30,000 sf to the existing facility. At this stage of development, it has been determined that the existing facility at JFK can accommodate this increase through expansion into the existing parking lot. This has been captured in the construction cost estimate.
- **Constructability Risks Not Included in the Cost Estimate Range (–10% to +30%) for This Option**
  - Accommodating the proposed elevated guideway piers and foundations within the VWE ROW: The VWE is due to be widened to add managed-use lanes to both roadways as part of a future work plan. There is a residual risk that, during detailed design and partner agency coordination with NYC DOT, NYS DOT, and FHWA, more complex support structures than currently envisaged are required to allow existing non-standard elements to be brought up to current standards as part of this future work plan. The study team concluded that, although this is a risk typical of work in and around existing major highways, it has the potential to result in significant increases in construction cost and schedule prolongation for this option given the extended length of guideway within the VWE ROW.

- Accommodating the proposed elevated guideway piers and foundations within the GCP ROW: There is a residual risk that, during detailed design coordination with NYS DOT (and FHWA where applicable), more complex support structures than currently envisaged are required to avoid introducing non-standard roadway elements to the existing highways or to allow existing non-standard elements to be brought up to current standards (in the future by NYS DOT). The study team concluded that, although this is a risk typical of work in and around existing major highways, it has the potential to result in significant increases in construction cost and schedule prolongation for this option given the extended length of guideway within the GCP ROW.
- Scale of construction work required to cross the Kew Gardens Interchange: The Key Gardens Interchange is a very complex intersection with multiple roadways crossing on several levels. There is a residual risk that, during partner agency coordination with NYC DOT, NYS DOT, and FHWA in the design phases, it is identified that more complex foundation and/or above-ground structural arrangements would be required to support the guideway over the interchange, and/or more constraints placed on construction access than currently accounted for in the evaluation. This risk would be considered typical for this interface given the number of intersecting roads and complexity of the interchange; however, it could still result in large construction cost increases and prolongation to the construction schedule.
- Scale of construction work required to span the LIRR railroad tracks into Jamaica: There is a residual risk that, during engineering design and partner agency coordination with LIRR, more complex or longer span structures and/or more stringent constraints on construction methodology would be required than currently accounted for in the evaluation. This risk would be considered typical for this type of construction interface but could result in construction moderate cost increases and schedule prolongation.
- Scale of construction work required to cross the Main St/Queens Blvd interchange with the VWE: There is a residual risk that, during engineering design and partner agency coordination with NYC DOT, NYS DOT, and FHWA, more complex or longer span structures would be required to support the guideway than currently accounted for in the evaluation. This risk would be considered typical for this type of construction interface but could result in construction moderate cost increases and schedule prolongation.

5.3.1.2 Infrastructure Impacts during Construction

Construction of this option would result in temporary disruption to other major infrastructure along the route, which would last for 2–3 years. The notable areas of temporary infrastructure disruption are summarized below. The durations given below are indicative and based on preliminary assessment.

- **Operational and Passenger Disruption to AirTrain JFK Services at Jamaica Station**
  - 20–30 off-peak and/or overnight closures of one existing platform of the AirTrain JFK station would be required over a period of 12–18 months while the new elevated

guideway structure and tracks are tied into it. This work would be coordinated with AirTrain and timed to occur during planned maintenance outages to minimize impacts to passenger services to JFK Airport.
  - Passengers accessing the AirTrain JFK would possibly experience access inconvenience for 6–9 months while access is re-routed around construction zones.

- **Reduced Rolling Stock Stabling/Storage Capacity for LIRR Trains at Jamaica**
  - Closure of four LIRR train storage tracks located between the Jamaica LIRR Station and AirTrain JFK Station would be required for 1–2 years during construction of foundations, support piers, and elevated structure for the elevated guideway. Maintaining safe access to these storage tracks during construction would not be possible due to the constrained access directly under the proposed light rail station location. Coordination with LIRR would be required to identify suitable alternate storage locations during this time. Access to the train storage area could be reopened once the main structural frame was complete and overhead protection measures were in place.
  - There would be disruption to LIRR rolling stock availability leading to possible service delays during this period as alternate storage may be at a distance.
  - This closure of these tracks would need to be reviewed and accepted by LIRR along with any proposed alternate storage arrangements. The length of the closure would make it one of the priorities during the construction planning phase as the approval could delay the start of the station work.

- **Operational Disruption to LIRR Services Crossing the Van Wyck Expressway at Jamaica**
  - 5–10 overnight or weekend line closures would be needed over a period of 6–12 months to allow the lifting of long-beam structures over the rail lines and deck construction work (concrete pouring, etc.). This would result in MTA-approved reduced services or temporary closures to LIRR services during these periods.
  - These closures would be planned to occur during low/off-peak periods (e.g., overnight, weekends, or during other MTA/LIRR planned line closures for maintenance, etc.). Construction activities would be coordinated to make best use of the available time so as to minimize the number of closures and impact on LIRR operations and services.
  - Coordination would be required with MTA to gain its acceptance of proposed construction methodologies, any planned closures, and proposals for alternate commuter arrangements in advance of the work.

- **Lane Narrowing, Traffic Diversions, and Speed Restrictions on the Van Wyck Expressway**
  - Narrowing of the northbound VWE lanes and traffic speed restrictions between Atlantic Ave and the Kew Gardens Interchange would be necessary for 1–2 years to provide safe construction access to the northbound shoulder during construction of the elevated guideway located between the northbound VWE and VWE service road.

- Closure of the left lane of the northbound VWE service road from Atlantic Ave to Queens Blvd would be needed over a period of 1–2 years to provide safe construction access to the northbound shoulder during construction of the elevated guideway located between the northbound VWE and VWE service road.
- Overnight lane closures would be expected on the northbound VWE roadway to provide access for cranes and other large construction lifting equipment during bridge deck lifting operations. 10–15 off-peak and/or overnight closures would be required over a period of 6–9 months. The northbound VWE would remain open with 1–2 lanes closed, and the activities would be planned to occur in off-peak, overnight periods to minimize disruption and reduce impact on traffic.
- 2–4 off-peak, overnight, and/or weekend closures of each on-/off-ramp to the northbound VWE between Jamaica and the Kew Gardens interchange would be required while long-span beams are lifted in over the on-/off-ramps (6–12 periodic closures in total).
- 2–4 off-peak, overnight, and/or weekend closures of Hillside Ave and Jamaica Ave bridges would be required over a period of 3–6 months while long-span beams are lifted in over these bridges.
- 2–4 off-peak, overnight, and/or weekend closures of the Main St underpass and Queens Blvd Bridge across the VWE would be required over a period of 3–6 months while long-span beams are lifted over the roadways.

o **Roadway Closures and Traffic Diversions at Kew Gardens Interchange**

- Narrowing of the northbound VWE lanes and east- and westbound GCP lanes with traffic speed restrictions through the Kew Gardens Interchange would be needed for up to 3 years to provide safe construction access during construction of the guideway foundations and support piers located between the various roadways in the interchange.
- 10–15 roadway closures on various roadways and access ramps within the Kew Gardens Interchange would be required over a period of 9–15 months to provide safe access for cranes and other large construction lifting equipment while long-span beams are lifted over the roadways.

o **Lane Narrowing and Speed Restrictions on the GCP**

- Narrowing of roadway lanes, removal of the shoulder, and traffic speed restrictions on both the north- and southbound GCP roadways between the Kew Gardens and Northern Blvd interchanges would be needed. Impacts would be for up to 3 years to provide safe construction access to the median during construction of the elevated guideway.
- 15–20 off-peak, overnight, and/or weekend lane closures on both the east- and westbound GCP roadways would be required over a period of 12–18 months while long-span beams are lifted over the roadways.

- 2–4 off-peak, overnight, and/or weekend closures of footbridges and local road bridges would be required over a period of 9–12 months while long-span beams are lifted over the bridges (approximately 7 footbridges and local road bridges in total).

- **Operational Disruption to the NYCT Jamaica Yard Facility**
  - 3–8 overnight line closures into the NYCT's Jamaica storage and maintenance yard would be required over a period of 2–4 months to allow the lifting of long-beam structures over the rail lines and deck construction work (concrete pouring, etc.).
  - These closures would be coordinated with the MTA and planned to occur during off-peak periods (e.g., overnight between last train in and first train out). Construction activities would be coordinated to make best use of the available time to minimize the number of closures and impact on MTA operations.

- **Roadway Closure of the Long Island Expressway over the GCP**
  - 5–10 overnight closures of the LIE crossing of the GCP would be required over a period of 3–6 months to provide safe access for cranes and other large construction lifting equipment during long-span beam lifting operations. The LIE would be temporarily closed in both directions during these periods with traffic diversions in place.

- **Operational Disruption to Subway and LIRR Services from Mets-Willets Point**
  - 5–10 off-peak or weekend single- or double-track closures would be needed over a period of 3–6 months to allow the lifting of long-beam structures over the rail lines and deck construction work (concrete pouring, etc.). This would result in reduced or suspended 7-Line and LIRR Port Washington Branch services on these 5–10 occasions.
  - These closures would be coordinated with NYCT and LIRR for their acceptance of proposed closures and planned to occur during off-peak periods (e.g., overnight, weekends, or during MTA-planned outages). Construction activities would be coordinated to make best use of the available time to minimize the number of closures and impact on MTA and LIRR operations and services. The closures would be alternated so that passengers could transfer to other services (e.g., at Flushing Main St).

- **Temporary Roadway Lane Closures and Lane-Shifts during Construction**

  Due to the shared alignments from the Northern Blvd intersection with the GCP and LGA between this option and LR-2 (Light Rail to/from Mets-Willets Point), the study team evaluated and agreed with the following excerpts of what is set forth in Appendix B of the 2021 Final Environmental Impact Statement for the LAIP (Mets-Willets AirTrain, currently on pause) concept for impacts along this shared section of the alignment:

- GCP westbound:
  - North of Northern Blvd: Temporary lane-shift to the north while foundations are constructed.
  - Along Flushing Bay Promenade: Temporary left lane roadway and lane-shift to the south.
  - East of the Gulf gas station: Closure of right lane during off-peak as needed.
  - At Marina: Nighttime closure for three separate 3-night periods for the erection of the fixed guideway foundations. Traffic would be detoured with lane closure.
- GCP eastbound:
  - North of Northern Blvd; east of the Gulf gas station: Temporary lane-shift to the south while fixed guideway foundations are constructed.
- GCP/Whitestone Expressway ramp eastbound:
  - Interchange: Nighttime closures for up to 15 nights during the erection of the fixed guideway.
- Astoria Blvd northbound and southbound:
  - At Northern Blvd: Nighttime closure for up to 15 nights during erection of the fixed guideway. Traffic would be detoured.
- Northern Blvd northbound:
  - At Astoria Blvd: Nighttime closure for two separate 3-night periods during erection of fixed guideway. Traffic would be detoured.
  - At GCP: Nighttime closure for two separate 3-night periods during erection of the fixed guideway. Traffic would be detoured.
- 102nd St:
  - North of LaGuardia Rd: Various nighttime closures during erection of the fixed guideway.
- Airport Access ramps:
  - From LaGuardia Rd to Terminal C: Various nighttime closures during erection of on-Airport station structures and fixed guideway; nighttime closure for five nights during erection of the fixed guideway.

5.3.1.3 Permanent/Operational Impacts to Existing Infrastructure

Once completed, this option would have the following permanent/operational impacts on other infrastructure along the route:

- **Van Wyck Expressway**
  - The location of the proposed elevated guideway between the VWE northbound roadway and service road would result in permanent realignment of on- and off-ramps to accommodate the support pier/frame arrangements and spacing.
  - The completed guideway could further restrict any future NYS DOT roadway improvement plans to widen or adjust the VWE between Atlantic Ave and Queens Blvd.
- **Grand Central Parkway**
  - The GCP roadway lanes and on-/off-ramps between the Kew Gardens and Northern Blvd interchanges would be redesigned to accommodate the elevated guideway support piers. The completed guideway could restrict any future NYS DOT roadway improvement plans to widen or adjust the GCP in these areas.
  - The entrance and exit lanes for the existing gas station located on the westbound GCP between Northern Blvd and LGA would be permanently reconfigured to accommodate the proposed elevated guideway piers.

5.3.1.4 Indicative Capital Cost

The Indicative Capital Cost for Option LR-3 is $6.2 billion (in 2022%, excluding future escalation and solely for approximate comparison between study options).

Indicative Capital Costs should be considered to have a range of estimating uncertainty of -10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).

The following are the notable cost drivers for the option:

- Elevated guideway structure along VWE, GCP, and on-Airport.
- Revenue service light rail vehicles. (Note: this option is based on procurement of the same vehicles as currently in operation with JFK. If this is not possible, a new fleet of vehicles for both LGA and JFK service would be required along with new systems and controls for a fully integrated service for both airports – this is not considered in the cost of this option.)
- Track-side equipment, systems, and power.
- New elevated light rail stations and connectors at LGA.
- Long-span crossings and complexity allowance for crossing Kew Gardens Interchange.
- Utilities protection and relocation costs.
- Roadway maintenance and traffic protection costs.
- New elevated light rail station and connector at Jamaica.
- Tall, long-span crossings of LIRR (44th Ave) and subway (Roosevelt Ave).
- Long-span crossing of Queens Blvd.

- Tall, long-span structure over existing LIRR signal mast.
- Modification work to existing AirTrain/LIRR stations.
- Expansion of existing OMSF at JFK.
- Long-span crossing of LIE.

5.3.1.5 Indicative Timeline/Schedule

The Indicative Timeline/Schedule (for comparison between study options) for Option LR-3 is approximately 11–12 years from a decision to take the option forward to revenue service. This includes the following notable schedule drivers:

- Planning, approvals, and acquisitions.
- Procurement of design-build contractor(s) for heavy civil construction.
- Procurement of new light rail vehicles.
- Jamaica Station tie-in.
- Elevated guideway construction along VWE.
- Construction over Kew Gardens Interchange.
- Elevated guideway construction along GCP (longest construction activity).
- Elevated structures over LIRR MTA bridges.
- Construction over Northern Blvd Interchange.
- On-Airport elevated stations and structure.
- Expansion of JFK OMSF.
- Systems installation and testing.
- 12 months of commissioning.

Figure 5.3-2 illustrates the indicative timeline/schedule for Option LR-3. The key drivers are the major civil construction work, which may trigger longer permitting, approvals, and procurement processes, and the light rail systems commissioning.

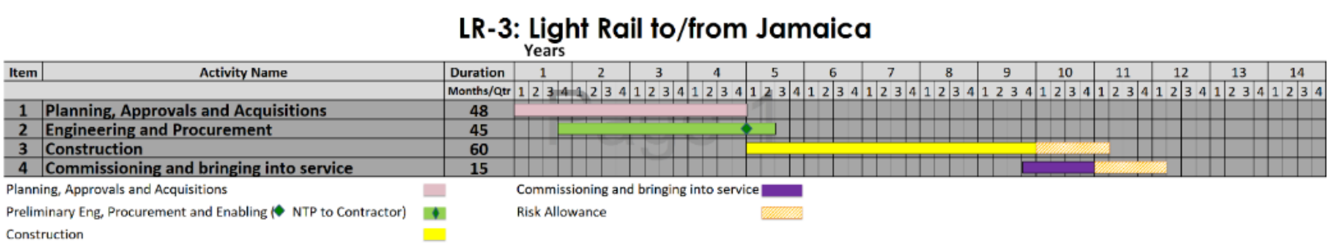


FIGURE 5.3-2: INDICATIVE TIMELINE/SCHEDULE (LR-3)

5.3.2 Transportation Aspects

5.3.2.1 Improved Access to LGA

Three factors have been considered in this category: Standardized Indicative Baseline Off-Peak Travel Time, Reliability, and Transfer Experience.

5.3.2.1.1 Standardized Indicative Baseline Off-Peak Travel Time

- Table 5.3-1, below, provides the Standardized Indicative Baseline Off-Peak Travel Times for the weekday, midday off-peak journeys to be used solely as a baseline for comparison between options. Tables 5.3-2 and 5.3-3 provide a breakdown of the components that make up the total journey, via LIRR and 7-Subway, respectively, the general approach to the estimation of which is described in Section 3.2.2.1.1.
- Passengers making the journeys described would, naturally, experience variations to the baseline timings calculated even where services are running as planned, for reasons as simple as variations in walking speeds or whether a traveler arrives just before a scheduled departure or just misses a departing train.

TABLE 5.3-1: STANDARDIZED INDICATIVE BASELINE OFF-PEAK TRAVEL TIMES, OPTION LR-3

Penn Station to LGA (minutes to Terminal C)	LR-3
Via LIRR to Jamaica	45
Via Subway (E train) to Sutphin Blvd Archer Av JFK Airport	64

TABLE 5.3-2: STANDARDIZED INDICATIVE BASELINE OFF-PEAK TRAVEL TIME VIA LIRR BY SEGMENT, OPTION LR-3

Penn Station to LGA via LIRR (minutes)	LR-3
START Penn Station (street level)	
walk/wait time	7
LIRR platform (dep)	
LIRR trip time	21
Jamaica LIRR platform (arr)	
walk/wait time	8
Jamaica light rail platform (dep)	
Light rail trip time	9
1st on-Airport station (arr)	new elevated
END Terminal light rail stop	Terminal C
Total travel time =	45
trip time to next Terminal light rail stop	2
2nd on-Airport station	new elevated
END Terminal light rail stop	Terminal B
Total travel time =	47

TABLE 5.3-3: STANDARDIZED INDICATIVE BASELINE OFF-PEAK TRAVEL TIME VIA E SUBWAY BY SEGMENT, OPTION LR-3

Penn Station to LGA via E Subway (minutes)	LR-3
START 34th St (8th Ave) Penn Station (street level)	
walk/wait time	6
E-Subway platform (dep)	
Subway trip time	39
Sutphin Blvd E-Subway platform (arr)	
walk/wait time	10
Jamaica light rail platform (dep)	
Light rail trip time	9
1st on-Airport station (arr)	new elevated
END Terminal light rail stop	Terminal C
Total travel time =	64
trip time to next Terminal light rail stop	2
2nd on-Airport station (arr)	new elevated
END Terminal light rail stop	Terminal B
Total travel time =	66

- Passengers for Terminal A would transfer to an existing on-Airport shuttle service running every 10 minutes and with an additional trip time of around 7 minutes from Terminal B.

5.3.2.1.2 Reliability

- Option LR-3 would operate exclusively on dedicated infrastructure separate from general roadway conditions.

5.3.2.1.3 Transfer Experience

Riders bound for Terminals B or C would transfer from the Subway or LIRR services to the new light rail service at Jamaica Station, in the same facility currently utilized by AirTrain JFK. Riders bound for Terminal A would have an additional transfer to an existing on-airport shuttle once they reach the airport.

Customer Transfer

- The studied light rail station at Jamaica would require an expansion of the fully enclosed and climate-controlled facility currently serving AirTrain JFK to accommodate a new light rail service to LGA. Riders bound for LGA would follow new wayfinding signage and walk to the LGA light rail platform adjacent to the existing AirTrain JFK platform.

5.3.2.2 Ridership

- Stated preference survey results indicate that 49% of airport passenger respondents are "definitely" or "probably" interested in fixed guideway connections to existing transit services.
- The ridership model projects 5.9 million total riders using Option LR-3, with a corresponding increase in net transit ridership of 4.3 million riders in 2025 (Table 5.3-4).

TABLE 5.3-4: RIDERSHIP MODEL RESULT SUMMARY

Transit Option			Riders on Current Bus Services to LGA (Millions) (No Action)	New Transit Option Impact (Millions)		
Mode Category & Scenario Label		Description		Riders on New LR-3 Light Rail Service	Net Increase in Total Transit Ridership	Total Transit Ridership (LR-3 Light Rail Service + Other Bus Services)
Fixed Guideway with Light Rail	LR-3	Jamaica	4.1	5.9	**4.3**	**8.3**

5.3.2.3 Throughput and Capacity

Throughput

- Using the highest hourly single-direction provision of airline seats at LGA in 2019 (4,300 seats on weekday departing flights 9 AM to 10 AM – see Figure 3.2-1, in Section 3.2.2.3), the estimated single-direction peak passenger demand for this option could be approximately 730 passengers per hour.
- It should be noted that these passengers would likely arrive at the transfer station in groups, rather than being evenly distributed throughout the time period.

Capacity of New Transit Option

- Using the AirTrain JFK system as an example, automated light rail systems can be tailored to throughput requirements using an appropriate combination of train length and frequency. Typically, 58-ft cars are able to accommodate more than 75 passengers with luggage, with around one-third of them seated.
- With the proposed arrangement of three-car trains at 4-minute intervals, the potential total capacity of the proposed new light rail link could be:
  - 3,375 pphpd at peak.
- This is sufficient to support the estimated single-direction peak passenger demand from the ridership model, equating to approximately 50 passengers per train at peak with this proposed train-car configuration and frequency.
- Actual train-car configuration and frequency would be adapted in practice to suit demand and other operating requirements.

Impact on Capacity of Existing Downstream Transit Systems

- The stations at Jamaica offer transfer access to the E, J, and Z Subway services and the LIRR (Main Line, Atlantic Branch, and Montauk Branch).
- Generally, airport passenger loadings are constant through the day both to and from the Airport with the peak passenger loadings occurring outside of the morning Manhattan-bound subway peaks or in the opposite direction (i.e., Airport-bound).
- The existing E-Subway line currently operates close to its peak capacity during the 8 AM to 9 AM Manhattan-bound commuting peak. While most Manhattan-bound Airport passengers would travel outside this peak, those passengers (including non-Airport passengers) traveling during this peak could experience some crowded conditions.
- This analysis only considers the impact to the E-Line; customers transferring at Jamaica also would have the option to continue their journey to Manhattan on the J and Z Subway lines and multiple LIRR services, adding to the available capacity of the downstream transit system.

5.3.2.4 Indicative Operating Cost

- If any new fixed guideway with light rail serving this route is specified to be technically compatible with the existing AirTrain JFK system, it stands to benefit from sharing resources already in place. These may include use of the existing AirTrain JFK control and maintenance facilities, a pooled fleet, and deployment of supervisory, control, and specialist technical personnel to cover both old and new sections.
- In the absence of definition of technical and operational characteristics, a full operating and maintenance cost estimation exercise is not possible. However, overall operating and maintenance costs for the new line have been estimated on the basis of those previously prepared for the LAIP (Mets-Willets AirTrain, currently on pause) concept, considering the line length and the cost categories relating to it. This preliminary exercise suggests annual operating and maintenance costs on the order of $60 million per annum, additional to current AirTrain JFK costs and not including any economies of scale that may arise.

5.3.3 Community and Environmental Aspects

5.3.3.1 Local Community Impacts

The first 1.25 mile of this option would be in the median between the VWE and the service road and would be located approximately 50 ft from densely developed neighborhoods consisting of a wide range of properties ranging from single-family (row & detached) to 6- to 7-story residential buildings, commercial businesses, public community buildings, and NYC Parkland (Hoover Manton Playground, Malcolm X Promenade, and Flushing Meadows-Corona Park). The approximately 7-mile route goes through/along the following communities: Jamaica, Richmond Hill, Kew Gardens, Forest Hills, Corona, and East Elmhurst.

The potential for temporary (during construction) and permanent (once operational) impacts is summarized below for specific areas of the alignment.

5.3.3.1.1 Temporary Impacts during Construction on the Local Neighborhoods Directly Affected

The fixed guideway from Jamaica to LGA would require major heavy civil construction activities to build the elevated guideway foundations, structures, and stations along the route. Construction activities are anticipated to occur along the approximately 7-mile route for approximately 5 years.

During construction, the following neighborhoods would have the potential for air quality, noise, vibration, or visual impacts. For the frequency and duration of construction activities refer to Section 5.3.1.2 “Infrastructure Impacts during Construction” above:

- **Construction of Elevated Fixed Guideway along the Northbound VWE Service Road**
  - The elevated fixed guideway would run along the northbound roadway of the VWE between the shoulder and the adjacent service road for an approximately 1.4-mile segment of the route. Major heavy civil construction activities would be required to build the elevated guideway foundations and structures.
  - The construction would occur approximately 35–60 ft from 9 long city blocks of residential and commercial properties and approximately 150–200 ft from Archbishop Molloy High School.
  - Planned periodic closures of the VWE (lanes and ramps) would be required for the construction of the elevated structure.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic.
  - Planned periodic closure of sidewalks and parking spaces would be required.
  - Planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.

- **Construction of Elevated Fixed Guideway at Hoover Manton Playground (NYC Parkland)**
  - The fixed guideway along this approximately 0.25-mile segment of the route would require major heavy civil construction activities to build the elevated guideway foundations and structures.
  - Some construction would occur within and above the Hoover Manton Playground for up to two years, and temporary closure of the playground (partial or full) would be required during this period depending on the final detailed design.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - Planned periodic closure of sidewalks and parking spaces would be required.

  - Planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.

- **Construction of Elevated Fixed Guideway Along 134th St**
  - The fixed guideway would require major heavy civil construction activities to build the elevated guideway foundations and structures along the edge of the VWE for the approximately 0.2-mile segment of the route.
  - The construction would occur approximately 40–100 ft from 3 long city blocks of residential and commercial properties and approximately 50–100 ft from Jamaica Hospital Medical Center Dental Clinic and Pediatric Dentistry.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - Planned periodic closure of sidewalks, bike lanes, and parking spaces would be required.
  - Planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.

- **Construction of the Elevated Fixed Guideway along the GCP**
  - Planned periodic closures of the GCP (lanes and ramps) would be required for the construction of the elevated structure, including the tall structure (approximately 100 ft) required over the LIRR and triple-stacked 7-Lines/Roosevelt Ave for the approximately 4.3-mile segment of the route.
  - The construction would occur approximately 150–200 ft from 32 short city blocks of residential properties located on the other side of 4 lanes of the GCP.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - There could be increased construction/haul traffic on local roads because trucks are not allowed on the GCP.

- **Construction of the Elevated Fixed Guideway over the Northern Blvd Interchange with the GCP**
  - Planned periodic closures of the GCP (lanes and ramps) would be required for the construction of the elevated structure. The construction would occur approximately 175–275 ft from 4 long city blocks of residential and commercial properties in the East Elmhurst community located on the other side of 8 lanes of the GCP.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.

- There could be increased construction/haul traffic on local roads because trucks are not allowed on the GCP.

- **Construction of the Elevated Fixed Guideway along Malcolm X Promenade**
  - Due to construction along the Malcolm X Promenade, part of Flushing Meadows-Corona Park (NYC Parklands), along this approximately 0.75-mile segment of the route, it is anticipated that the gas station and adjacent store located along the westbound lanes of the GCP, adjacent to the Flushing Bay Promenade, would need to be closed for approximately 1 month during construction. Additionally, the Marina Restaurant and Banquet Hall may require temporary closures during construction of nearby columns. It is anticipated that any such closure of the Marina Restaurant and Banquet Hall would not extend beyond approximately 3 months, and to the extent practicable, this closure would be scheduled during the off-season.

- **Constructing On-Airport Elevated Light Rail Stations**
  - Construction activities associated with the erection of long-span (approximately 250 ft) elevated guideway bridge structures over an approximately 0.5-mile segment of the route over 102nd St and the newly constructed departures roadway at the Airport would be required.
  - The construction would occur over 500 ft from 5 city blocks of residential and commercial properties in the East Elmhurst community located on the other side of 8 lanes of the GCP.
  - Planned night closures of the GCP would be required for the long-span bridge erection.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - There could be increased construction/haul traffic on local roads because trucks are not allowed on the GCP.

- **Construction of the OMSF**
  - The fixed guideway with light rail solution for this option would utilize the existing AirTrain JFK OMSF at JFK Airport. Storage and maintenance space would be required for the additional vehicles (taken to be one-quarter the space required for a full facility) with an increase of approximately 30,000 sf to the existing facility. The solution is based on a preliminary review that showed that the existing facility at JFK can be accommodated by expanding into the existing parking lot.
  - The expansion of the facility (track and building(s)) would last for approximately 1 year and take place over 500 ft from commercial and industrial properties.

5.3.3.1.2 Permanent Operational Impacts on the Local Neighborhoods Directly Affected

Electrically powered light rail vehicles, similar in size and characteristics to the vehicles that currently operate on AirTrain JFK, would operate between LGA and the proposed new light rail station at Jamaica at peak headways of 4 minutes. They would operate on an elevated fixed guideway structure along the full route, ranging approximately 35–500+ ft from residential, commercial, and industrial properties. During periods of reduced airport demand (e.g., overnight), headways would significantly reduce.

The following local neighborhoods and areas would have the relative potential for permanent noise, vibration, or visual impacts because of this option's proposed light rail operations:

- **New Elevated Light Rail Along the Northbound VWE Service Road**
  - From Jamaica Station, following the northbound VWE, light rail vehicles would operate in each direction on an elevated fixed guideway structure along the eastern edge of the VWE transportation corridor approximately 35–60 ft from residential and commercial properties and approximately 150–200 ft from Archbishop Molloy High School.

- **New Elevated Light Rail at Hoover Manton Playground (NYC Parkland)**
  - Light rail vehicles would operate in each direction on an elevated fixed guideway structure above the Hoover Manton Playground. Depending on the final detailed design, guideway columns could be permanently located within the playground, potentially requiring the (partial or full) closure of parts of the playground.

- **New Elevated Light Rail Along 134th St**
  - From Hoover Manton Playground, light rail vehicles would follow 134th St and operate in each direction on an elevated fixed guideway structure along the eastern edge of the VWE transportation corridor approximately 40–100 ft from residential and commercial properties and approximately 50–100 ft from Jamaica Hospital Medical Center Dental Clinic and Pediatric Dentistry.

- **New Elevated Light Rail Along the GCP**
  - Once over the Kew Gardens Interchange, light rail vehicles would operate in each direction on an elevated structure, including on tall (approximately 100 ft) structures over the LIRR and triple-stacked 7-Lines/Roosevelt Ave, within the GCP median of the transportation corridor approximately 150–200 ft from residential properties located on the other side of 4 lanes of the GCP.

- **New Elevated Light Rail along the Malcolm X Promenade (NYC Parkland)**
  - Once north of the Northern Blvd Interchange, light rail vehicles would operate along the GCP, adjacent to Malcom X Promenade in each direction on an elevated fixed guideway structure within the GCP transportation corridor approximately 175–275 ft from residential and commercial properties on the other side of 8 lanes of the GCP.

- **New On-Airport Elevated Light Rail Stations**
  - On-Airport, light rail vehicles would operate in each direction on an elevated fixed guideway structure between the two proposed light rail stations over 500 ft from residential and commercial properties in the East Elmhurst community located on the other side of 8 lanes of the GCP.

- **New Light Rail OMSF**
  - The fixed guideway with light rail solution for this option would utilize the existing AirTrain JFK OMSF at JFK Airport. This facility already experiences regular vehicle movements, maintenance, and other activities throughout the day, and the proposed expansion would not alter the characteristics of any current impacts.

5.3.3.1.3 Potential Private Property Acquisitions

No private properties are anticipated to be acquired.

5.3.3.1.4 Potential Public Property Acquisitions (NYC DOT Plazas and NYC Parks Parkland)

The new fixed guideway with light rail to/from Jamaica may result in permanent impacts to the following:

- New support columns for the permanent fixed guideway structure would be located within Hoover Manton Playground, and in Flushing Meadows-Corona Park, specifically within the southern border of the Malcolm X Promenade, adjacent to the GCP.
- No structures would be sited within NYC DOT Plazas.

5.3.3.1.5 Removal/Reconfiguration of Parking Spaces

This option would have minimal impact to on-street public parking.

5.3.3.1.6 Environmental Justice Communities Mapping Analysis

The Environmental Justice communities mapping analysis provides an overview of the minority and low-income communities within 0.25 mile of the transit options being studied.

For Option LR-3, more than half of the block groups within the 0.25-mile buffer of the option alignment are Environmental Justice block groups.

See Figure 5.3-3 below for the analysis map.

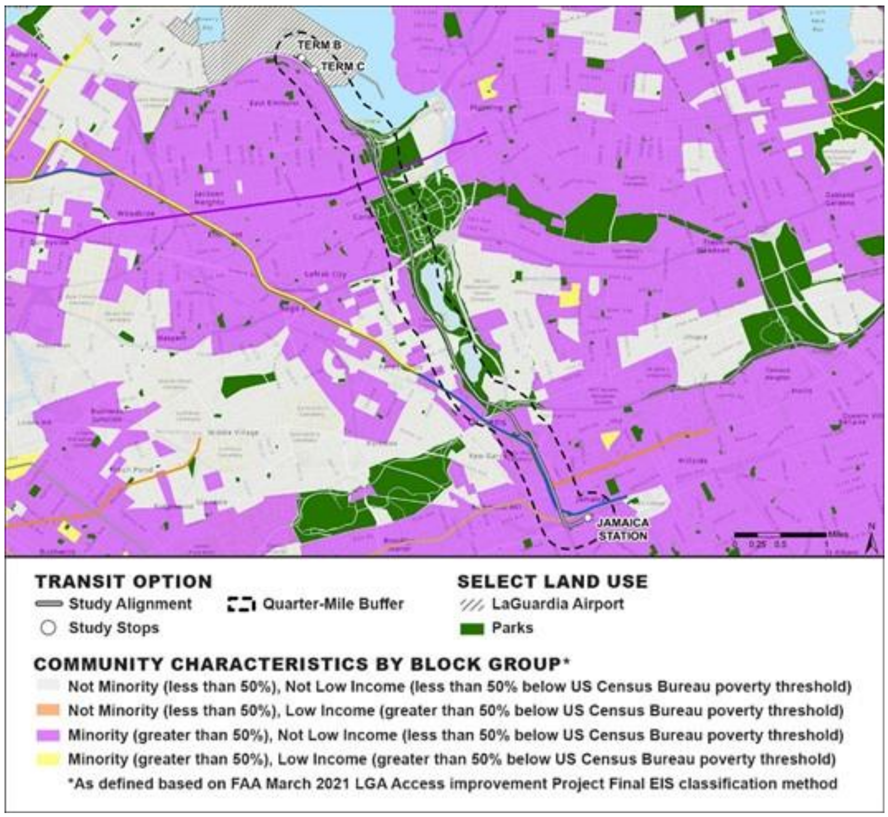


FIGURE 5.3-3: JAMAICA OPTION – ENVIRONMENTAL JUSTICE COMMUNITIES MAPPING ANALYSIS (AS DEFINED BASED UPON FAA MARCH 2021 LGA ACCESS IMPROVEMENT PROJECT FINAL EIS CLASSIFICATION METHOD)

5.3.3.2 Equity

5.3.3.2.1 Transit Access from LGA

- **Additional Minority and Low-income Populations Reached within 45 Minutes from LGA via Transit (Population Access Analysis)**
  - The results of the Population Access Analysis illustrate how many people, specifically from low-income and minority populations, could travel via transit from LGA to homes within 45 minutes from LGA. Airport passengers or Airport employees living within these areas could potentially benefit from expanded access to these destinations.
  - Option LR-3 is expected to expand transit access from LGA to regional destinations within 45 minutes, as shown in the blue area of "Additional Access Provided by Transit Option" in Figure 5.3-4. Compared to the baseline, the minority population reached within a 45-minute transit trip would increase by 87.5% and the low-income population reached within a 45-minute transit trip would increase by 74.1% as shown in Table 5.3-5.
  - This represents a higher increase in transit access to LGA within 45 minutes for minority and low-income communities.

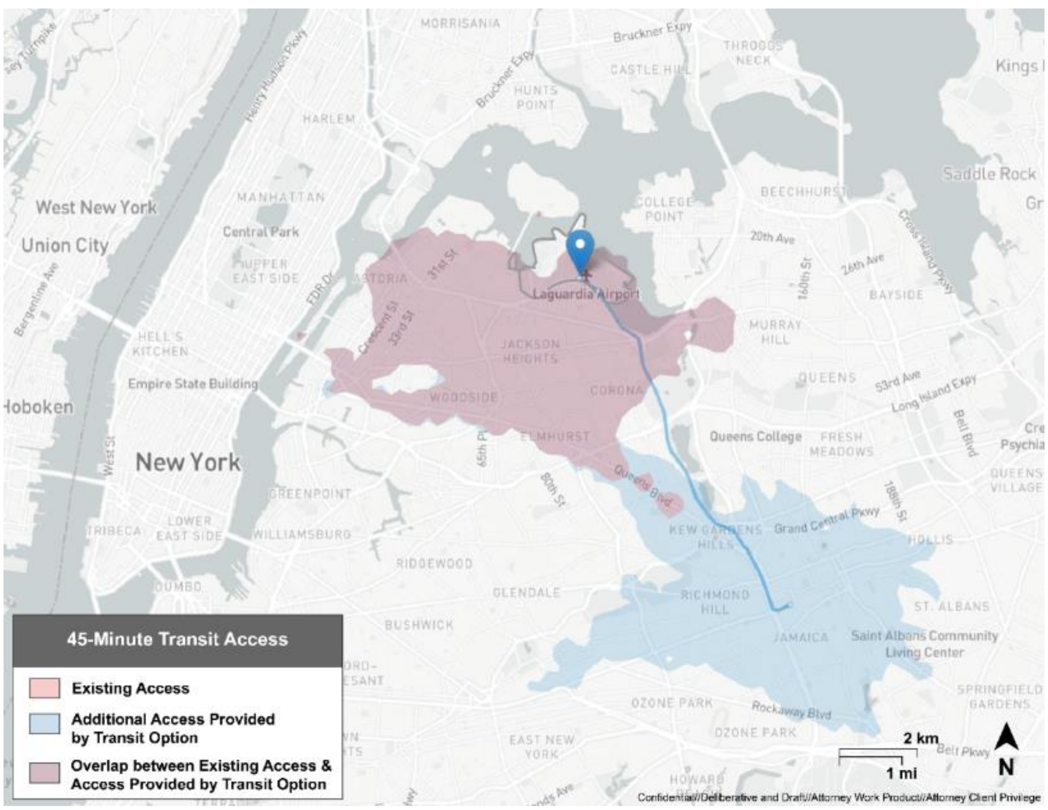


FIGURE 5.3-4: JAMAICA OPTION LR-3 – POPULATION ACCESS ANALYSIS

TABLE 5.3-5: JAMAICA OPTION LR-3 – POPULATIONS REACHED WITHIN 45-MINUTE TRANSIT TRIP

		Total Population Reached	Minority Population Reached	Low-Income Population Reached
Baseline	Existing Condition	551,434	422,981	76,750
LR-3	With Option	992,104	792,981	133,593
	Net Change	+440,670	+370,000	+56,843
	% Change	79.9%	87.5%	74.1%

- **Additional ADA-Accessible Stations within 45 Minutes from LGA via Transit (ADA Analysis)**
  - The results of the ADA Analysis illustrate how Airport passengers and Airport employees, specifically those requiring ADA-compliant stations, traveling from LGA to other locations could potentially benefit from expanded access to ADA-compliant stations within 45 minutes via transit.
  - More ADA-accessible stations/stops can be reached within a 45-minute transit trip for this option compared to the baseline of existing transit service (Table 5.3-6). This echoes the results from the Population Access Analysis, in which Option LR-3's 45-minute transit travel shed provides an increased amount of access over the baseline transit service. Compared to the baseline, an additional 10 ADA-accessible stations can be reached within a 45-minute transit trip from LGA for Option LR-3.

TABLE 5.3-6: JAMAICA OPTION LR-3 – ADA ANALYSIS

Subway, Ferry, LIRR, and MNR Stations Reached within 45-Minute Transit Trip from LGA	Baseline	LR-3	Difference between Baseline and LR-3
Total Stations	*43*	*67*	*+24 stations*
ADA-Accessible Stations (Accessible Stations as % of Total)	*20 (47%)*	*30 (45%)*	*+10 stations*

5.3.3.2.2 Transportation Opportunities and Benefits for the Surrounding Community

- **Transportation Opportunities for Neighbors**

  This option does not include intermediate/off-Airport stops. Because there is limited pedestrian access to LGA from adjacent residential areas and walking distance exceeds 0.25 mile, the study team did not consider there to be a significant market for use of the final on-Airport stops by the surrounding community to connect to the broader transit network.

- **Cars Removed from Local Roadways and Emissions Reductions**

  See the "Cars Removed from Local Roadways" section and the "GHG and Other Vehicular Emissions Reductions" section of this evaluation below.

5.3.3.3 Cars Removed from Local Roadways

- Option LR-3 would be expected to remove 2,005,000 Airport passenger vehicles and 272,000 Airport employee vehicles from the road each year.

5.3.3.4 GHG and Other Vehicular Emissions Reductions

- Option LR-3 would be expected to remove 12,905 metric tons of CO_2 equivalent each year.
- Other vehicular emissions reductions are given in Table 5.3-7:

TABLE 5.3-7: OTHER VEHICULAR EMISSIONS REDUCTION (METRIC TONS PER YEAR)

Option	CO	VOC	NOx	SO_2	PM_{10}	$PM_{2.5}$
[LR-3] Jamaica	60.8	0.9	4.1	0.2	2.3	0.4

5.3.4 Summary of Evaluation

<u>LR-3: Light Rail to/from Jamaica</u>

Option LR-3 would provide a two-seat ride to LGA via a 9-minute light rail ride to/from the existing Jamaica Transit Hub, providing direct access to the LIRR (Main Line, Atlantic Branch, and Montauk Branch), and connections to the E, J, and Z Subway services. By connecting with AirTrain JFK at Jamaica, this option would also provide the potential of an integrated AirTrain service to both airports via direct cross-platform transfer between the services and the shared use of the existing Airport-branded station. The guideway would run along the existing Van Wyck Expressway (VWE) and GCP transportation corridors, to LGA from the east, avoiding the construction and operational complexities of interacting with the end of Runway 04-22, west of the Airport terminals.

This option would require the construction of heavy infrastructure, including elevated concrete guideway structures predominantly within the VWE and GCP transportation corridors. This option would have to contend with the construction challenges of constructing in the VWE and GCP ROW for approximately 6 miles, including crossing over the triple stacked Roosevelt Ave/7-Line bridges over the GCP, crossing the recently reconstructed Kew Gardens Interchange, and crossing over the LIRR rail tracks into Jamaica Station. This option is the longest option evaluated at 7 miles, 2 miles longer than the next longest.

Table 5.3-8 summarizes the output from all the factors used to evaluate this option.

TABLE 5.3-8: SUMMARY OF KEY CHARACTERISTICS – LIGHT RAIL TO/FROM JAMAICA (LR-3)

	Evaluation Factor	Assessment
CONSTRUCTION ASPECTS	Constructability	• Expansion of existing AirTrain JFK Station adjacent to LIRR tracks • Tall (80+ ft) long-span (250–300 ft) structures over LIRR railroad tracks into Jamaica • Tall (100 ft) structures over LIRR Port Washington Branch and Roosevelt Ave/7-Line • Long-span (250–350 ft) structures over Queens Blvd and Kew Gardens Interchanges with VWE • Constrained construction access along VWE and in GCP median • Long span (200-300 ft) structures over LIE and Northern Blvd interchanges with GCP • Long spans (250 ft) over 102nd St Bridge on-Airport • Constrained on-Airport sites for new elevated light rail structure and 300 ft stations • Total option route length: approx. 7 miles
	Infrastructure Impacts during Construction	• Disruption to LIRR storage activities at Jamaica Station • Disruption to AirTrain JFK passengers at Jamaica • Off-peak outages of LIRR main line services crossing over VWE and GCP • Off-peak outages of NYCT 7-Line services bridging over GCP • Lane reductions and speed restrictions on GCP and VWE and at major interchanges
	Permanent/Operational Impacts to Existing Infrastructure	• Inhibits future widening the VWE and GCP • Permanent re-alignment of on- and off-ramps to VWE and GCP
	Indicative Capital Cost (2022$)[65]	$6.2 billion
	Indicative Timeline/Schedule	11–12 Years

[65] Indicative Capital Costs should be considered to have a range of estimating uncertainty of –10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).

TABLE 5.3-8, CONTINUED.

	Evaluation Factor	Assessment
TRANSPORTATION ASPECTS	Standardized Indicative Baseline Off-Peak Travel Time (From Midtown Manhattan)	Via LIRR: 45 mins (9 mins on light rail) (Penn Station to Terminal C, then B; shuttle to Terminal A) Via E-Line: 64 mins (9 mins on light rail) (Penn Station to Terminal C, then B; shuttle to Terminal A)
	Transfer Experience	• Subway or LIRR train to transfer at Jamaica same as existing (possible improvement to subway vertical circulation) • LIRR would involve a single level change via escalator or stairs and a short walk to the light rail fare gates • Subway transfer would involve level change to mezzanine via large high-capacity elevators or escalators and from mezzanine to platform via stairs and/or small elevators, and a greater walking distance to the light rail fare gates than the LIRR
	Ridership[66]	Total annual projected ridership for option: 5.9 million Net increase in annual projected transit ridership: 4.3 million
	Throughput & Capacity	3,375 pphpd (peak)
	Indicative Operating Cost	$60 million per annum
COMMUNITY AND ENVIRONMENTAL ASPECTS	Local Community Impacts	Construction: • Heavy civil construction of elevated structures for approx. 5 years Proximity to communities: • 35–60 ft from 12 city blocks of residential and commercial properties along the VWE, including within the Hoover Manton Playground • 150–200 ft from 32 city blocks of residential and commercial properties along GCP • Over 500 ft across 8 lanes of the GCP from 9 city blocks of residential and commercial properties along the GCP and opposite the Airport Terminals Permanent impacts: • No permanent private property acquisition • Construction and permanent structures over or adjacent to Hoover Manton Playground[67], and along the southern border of Malcolm X Promenade • Minimal, if any permanent loss of on-street public parking spaces
	Equity	• Higher increase to low-income and minority populations within 45 minutes of the Airport via transit versus the no-build scenario • +10 additional ADA-compliant stations reachable within a 45-minute transit trip from LGA versus the no-build scenario
	Cars Removed from Local Roadways	2,005,000 airport passenger vehicles and 272,000 airport employee vehicles from the road each year
	GHG and other Vehicular Emissions Reductions	12,905 metric tons of CO2 equivalent each year

[66] Experience from AirTrain JFK was that actual ridership turned out to be higher than would have been predicted by the AirTrain JFK forecast and underscores the inherent uncertainty of model predictions. The ridership model supporting this effort could also deviate from eventual ridership demand but was utilized to allow ridership comparisons between the options.

[67] Municipal parkland cannot be converted to a non-park use (known as alienation) without State legislative permission. Thus, the acquisition of New York City Parkland for construction of a mass transit option would require legislation authorizing such alienation. Obtaining such legislation is a multi-step process requiring actions by the New York City Council, the Mayor of New York City, the New York State Legislature, and the Governor.

5.4 LR-4: Light Rail to/from Astoria

Option LR-4 would link LGA via a 4-minute light rail ride to the existing Astoria Blvd Subway station, providing transfer access to N and W Subway services. A dedicated light rail Airport-transfer station would be located adjacent to the station above Columbus Sq Park, providing ADA-compliant passenger access between the two. The guideway would run above the GCP transportation corridor, minimizing the direct impact of the fixed guideway with light rail on local communities.

Option Route Description

From the proposed light rail transfer station located above Columbus Sq Park, perpendicular to the existing Astoria Blvd Subway station, the route would follow the ROW of the GCP on an elevated guideway for approximately 2 miles. Along the GCP, the fixed guideway would pass over multiple GCP overpasses, and would have to contend with the construction challenges of crossing the Hell Gate rail trestle and complying with FAA Airport Design Standards at the end of Runway 04-22 while negotiating the 90-year-old utilities under the GCP. As discussed in more detail in Section 3.2.1.1.2, the alignment as evaluated for this option would pass above the Hell Gate rail trestle. As discussed in detail in Section 3.2.1.1.1, the heavier infrastructure options from the west must overcome the significant challenges and complexities presented by the twin constraints of the

FIGURE 5.4-1: OPTION LR-4

FAA Airport Design Standards and the existing large-diameter, 90-year-old utility structures along the GCP. The preliminary engineering work carried out by the study team has not identified a construction approach that, with confidence, could do this without more complex, risky, and costly approaches to construction that would require greater engineering exploration beyond the scope of this study. To provide a consistent basis on which to evaluate the option and to allow cost comparison between the options, Option LR-4 is based on the baseline, simpler construction, concept of an open trench structure located in the embankment to the south of the eastbound GCP roadway, despite this being shown to be not compliant with the FAA Airport Design Standards.

Once east of Runway 04-22, the route would ascend back to an elevated structure to connect to two on-Airport fixed guideway stations, one serving Terminal B and one serving Terminal C (Figure 5.4-1). The OMSF for this option is proposed to use the location of the vacant former Courtyard by Marriott site at 90-10 Ditmars Blvd. This site on Ditmars was used for this purpose in the analysis; however, due to the hotel's recent change of ownership, it may no longer be available for this purpose. Should this option be advanced, further study would be needed to determine a suitable location for the OMSF. This location was determined to be appropriate due to its proximity to the proposed fixed guideway alignment (common to LR-1, LR-4, and LR-5), size, and potential availability.

The route length would be approximately 3 miles, including the on-Airport portion.

5.4.1 Evaluation of Construction Aspects

5.4.1.1 Constructability

The fixed guideway from Astoria to LGA would require major heavy civil construction activities to build the elevated guideway foundations, structures, and stations along the route.

The notable challenges and complexities associated with construction of this option are summarized below.

- **Construction of a New Fixed Guideway Station at Astoria Blvd**
  - The proposed fixed guideway station would be approximately 200 ft long, located adjacent and perpendicular to the existing Astoria Blvd Subway station, and above Astoria Blvd and Columbus Sq Park on an elevated structure. Passenger connectivity between the Subway station and the light rail station would be provided via an environmentally conditioned connector, accessed via new vertical circulation built beneath the end of the fixed guideway station to the existing mezzanine level under the platforms at Astoria Blvd Subway station.
  - Construction of the proposed light rail station and environmentally conditioned connector is in a constrained urban location at the busy intersections of 31st St and 33rd St with Astoria Blvd and Hoyt Ave South and within 50 ft of residences and small businesses. This reduces the efficiency of constructing the work and is reflected in the durations used in the Indicative Timeline/Schedule.

  - Based on initial analysis, the environmentally conditioned connector would be structurally supported from grade, avoiding the need to make complex modifications to the existing Subway structure, although more detailed engineering analysis would be needed to confirm this at a future development stage.

- **Locating Piers in GCP between 31st St and Hell Gate Rail Trestle**
  - From the elevated station at Astoria Blvd, the elevated guideway runs between the GCP eastbound roadway and Astoria Blvd South. The guideway piers would be in the embankment south of the GCP to avoid permanent reduction of roadway widths to either the GCP or Astoria Blvd South.
  - Construction of the guideway would be in a very constrained, narrow area with limited access for construction vehicles and materials, leading to inefficient working practices and design solutions. This is reflected as an increase in the construction cost estimate over standard rates in this area and in the durations used for the schedule activities.

- **Feasibility of Going over the Hell Gate Rail Trestle**
  - As discussed in Section 3.2.1.1.2, the proposed solution for this evaluation would be to go over the trestle structure but with the permanent lowering of the electrical power transmission and messenger wires above the catenary to minimize the overall height of the light rail guideway structure. The resultant gradient of the final alignment would be within generally accepted design limits for light rail vehicles.
  - The structure over the trestle would require complex engineering solutions involving tall (approximately 90–100 ft above the GCP roadway – highest in the MTA Subway system), long-span (approximately 150–200 ft) structures and re-routing of the overhead electrical power lines and messenger wires. An additional cost allowance has been included in the construction cost estimate for this option to account for the increased complexity.
  - The required modifications to the electrical power transmission and messenger wires would require periodic closure of the NEC rail operations. Scheduling these ‘outages’ and agreeing them with Amtrak would be very challenging due to the 24-hour operation of the passenger and freight services using the lines. Outages would need to occur during off-peak, overnight, or weekend line closures, or during planned Amtrak maintenance periods, resulting in an extended construction period for this work. This is included in the Indicative Timeline/Schedule for this option.

- **Locating Piers between GCP and Astoria Blvd South to the North of St Michael’s Cemetery**
  - The elevated fixed guideway structure would remain south of the GCP and continues east until reaching St Michael’s Cemetery where it would run above-ground adjacent to the cemetery. At this point, the available ROW is not sufficient to locate the structure piers and foundations without permanently impacting either the GCP or Astoria Blvd

South roadways. Therefore, the study team located the piers in the northernmost lane of Astoria Blvd South, thus avoiding any reduction in the GCP lanes and shoulder widths. However, this would remove the use of one traffic lane along this stretch of Astoria Blvd South. Traffic impacts would need to be carefully studied.

- Locating piers along the north side of Astoria Blvd South would require reconstruction of the Astoria Blvd South roadways, shoulder, and retaining wall along the south side of the eastbound GCP; a cost allowance for this work is included in the construction cost estimate for the option. The available space to safely conduct construction activities within Astoria Blvd South and adjacent to the GCP is very constrained, restricting efficient working conditions and prolonging construction durations. This is included in the schedule duration for this construction activity.

- **Major constructability challenge of compliance with FAA Airport Design Standards while also avoiding disruption to 90-year-old NYC DEP underground sewer structures (See also Section 3.2.1.1.1)**
  - This option's alignment crosses an area south of Runway 04-22 that is subject to FAA regulations regarding the safe operation of the Airport. This presents a major constructability challenge (described in greater detail in Section 3.2.1.1.1) to negotiate the twin constraints of the FAA Airport Design Standards (governing the construction of new infrastructure in this area) and the existing large-diameter utilities located along and beneath the GCP.
  - The preliminary engineering work carried out by the study team has not identified a construction approach that it could conclude with confidence would practicably overcome these challenges.
  - For the purposes of providing a basis on which to compare options that must pass the end of Runway 04-22, this option was evaluated using the baseline construction concept of an open trench structure located in the embankment to the south of the eastbound GCP roadway, despite this concept being shown to be not compliant with the FAA Airport Design Standards. To provide the Indicative Capital Cost and Timeline/Schedule, the following construction elements for this construction concept:
    - A transition structure taking the subway alignment from an elevated structure into the open trench between the Eastbound BQE Connector/GCP intersection and Astoria Blvd North overpass. The transition structure would be constrained between Astoria Blvd South, the GCP, and the Eastbound BQE Connector northbound roadway.
    - Reconstruction of the GCP on-ramp from Astoria Blvd South at 77th St over the guideway to re-provide traffic access to the GCP around the new transition structure.
    - Reconstruction of the 82nd St Bridge. The open trench structure would have to pass through the existing south abutment of the 82nd St Bridge over the GCP, requiring the bridge's demolition and reconstruction to accommodate the structure.

        - Construction of a below-grade, open-trench structure south of Runway 04-22, staying above the existing major utilities along the GCP.
        - Strengthening of the existing utilities and/or construction of concrete protection slabs above them.
        - Relocation of the existing runway lights (located between the GCP and Ditmars Blvd).

- **Constructing over 94th St and the GCP into the Airport**
    - Once past Runway 04-22, the alignment would ascend back to an elevated guideway structure to pass over the GCP onto the Airport.
    - The GCP eastbound off-ramp onto Ditmars Blvd near 90th St would require reconstruction to accommodate the elevated guideway in this area. An allowance has been included in the construction cost estimate for this work.
    - The guideway crossing over 94th St and both roadways of the GCP into the Airport would require long-span bridge structures of approximately 250–300 ft. These would require complex engineering solutions and construction methods to span the roads, while maintaining traffic mobility on the GCP and into the Airport on 94th St. This introduces increased construction costs over standard rates, which are reflected in the construction estimate.

- **On-Airport Elevated Stations Option: Constrained Construction Site Conditions**
    - Long-span (approximately 350-ft) bridge structures would be required over 102nd St and the newly constructed departures roadway. This would require structures to elevate the guideway to approximately 70 ft above-grade to clear the multi-level roads while maintaining Airport operability, resulting in complex engineering solutions and construction methods. This introduces increased construction costs over standard rates, which are reflected in the construction estimate.
    - Two elevated light rail stations (each up to 300 ft long), with features such as escalators, elevators, stairs, and signage, would be constructed and integrated with the existing Airport terminal buildings. Constructing these within a constrained, operational airport environment would reduce the construction sequence efficiency, introducing construction complexities. This is reflected in the Indicative Timeline/Schedule and cost estimate.

- **Locating the OMSF**
    - The fixed guideway with light rail solution would require a facility of approximately 115,000 sf adjacent to the ROW to store and maintain the fleet of vehicles and conduct system operations. The site of the formerly vacant Courtyard by Marriott hotel on Ditmars was used for this purpose in the analysis; however, due to the hotel’s recent change of ownership, it may no longer be available for this purpose. Should this option be advanced, further study would be needed to determine a suitable location for the OMSF.

- **Constructability Risks Not Included in the Cost Estimate Range (–10% to +30%) for This Option**
  - Scale of construction work required to cross the Hell Gate rail trestle: While the proposed relocation of the electrical lines has been determined to be a technically feasible solution, it would require an iterative detailed design process with Amtrak, CSX, and other involved partner agencies, with an uncertain likelihood of success in finding an acceptable solution. There is a residual risk that such coordination could lead to a requirement for the alignment to pass higher over the trestle (to avoid the power transmission and messenger wires). This would force the alignment to go higher over the trestle than in the current evaluation, requiring substantially taller support structures and deeper foundations and necessitate using larger cranes and other construction equipment to build. Although this could still be technically feasible, it would require more complex construction methodologies or the need for longer construction outages. This could result in significantly greater construction costs and longer construction schedule than currently accounted for in the evaluation, possibly resulting in the inability to pursue this option.
  - Reaching an agreement with Amtrak on timing and length of outages for work on the Hell Gate rail trestle: There is a residual risk that service outages on the Hell Gate rail trestle take longer to acquire or are shorter or less frequent than requested. This could lead to delay in the lowering of the overhead cables, delaying the construction of the elevated sections over the trestle structure. This could delay completion of construction for the elevated guideway, leading to prolongation cost increases.
  - Permanently reducing the travel lanes in Astoria Blvd South from three to two along St Michael’s Cemetery (between 49th St and the Eastbound BQE Connector overpass): Discussions with NYC DOT during this study indicated they would accept the permanent lane reduction to accommodate the structure piers along this stretch of Astoria Blvd South subject to full review and approval during more detailed design development. There remains a residual risk that, during the detailed review, the proposal to permanently reduce the travel lanes is not accepted. Alternative solutions to support an elevated structure along this constrained stretch of the Astoria Blvd/GCP corridor could require much more complex structures straddling over the roadways and/or permanent shifting of the roadways themselves. Although the study team consider this risk to have a lower probability of occurring, the potential construction cost and schedule implications could be significant.
  - Accommodating the proposed guideway structures, piers, and foundations within the GCP ROW: There is a residual risk that, during detailed design coordination with NYS DOT (and FHWA where applicable), more complex support structures than currently envisaged are required to avoid introducing non-standard roadway elements to the existing highways or to allow existing non-standard elements to be brought up to current standards (in the future by NYS DOT). The study team concluded that is a risk typical of work in and around existing major highways but one that still has the potential to result in large increases in construction cost and schedule prolongation.
  - Scale of on-Airport structures or modifications to on-Airport roads required to accommodate new light rail stations and elevated track: The study has evaluated an

alignment that, at this stage of development, can be accommodated within the existing Airport buildings and roadway structures. There remains a residual risk that, once more detailed surveys of the existing structures and their foundations are conducted, more complex or longer span structures are required than currently evaluated and/or structural modifications could be required to the existing on-Airport roadways and support structures. This risk is typical for infrastructure of this type in such constrained and highly built-up areas; however, considering the light rail station's more modest size requirements, it could still result in moderate increases in construction costs over those accounted for in this evaluation.

- Scale of utility strengthening and/or replacement work needed along the GCP: There is a residual risk that, once condition surveys of the existing large-diameter utilities under the GCP can be undertaken, the results identify the utilities to be in a poorer condition than currently evaluated. This could result in more intrusive strengthening or even replacement of the existing utilities before construction work can commence. This is a risk typical for major infrastructure work in close proximity to large legacy utilities; however, it could result in large increases in construction costs and delay to the start of construction, prolonging the overall schedule.

5.4.1.2 Infrastructure Impacts during Construction

Construction of this option would result in temporary disruption to other major infrastructure along the route, which would last over 2–3 years. The notable areas of temporary infrastructure disruption are summarized below. The durations given below are indicative and based on preliminary assessment.

- **Operational and Passenger Disruption to N-/W-Line Subway and MTA M60-SBS Bus Services at Astoria Blvd Station**
  - Temporary periods of disruption to passenger access to Astoria Blvd Subway station would be likely for 2–3 years during construction work around the station entrances for the proposed light rail station and environmentally conditioned connector construction work. Passengers would still be able to access and use the station throughout this period, although their journey would be inconvenienced or re-routed by the presence of construction activity. Further development of engineering solutions, including detailed analysis of passenger flows, would be needed to identify the extent of station disruption and any potential mitigations, like temporary exit stairs.
  - 5–10 off-peak, overnight, or weekend station closures would be necessary over a period of 3–6 months while tie-in work are completed to link the proposed environmentally conditioned connector to the existing Subway station mezzanine. N-/W-Line services would run through the station during this time, but the station would be closed to passengers; a bus replacement service would be required.
  - Minor disruption to the MTA M60-SBS bus service to LGA, which stops outside the Subway station on either side of Columbus Sq Park, would be expected over a period of 1–2 years during construction of the proposed light rail station structure. This would

result in temporary suspension of the stops in Columbus Sq Park requiring alternate bus stops nearby, creating passenger inconvenience and potential increased bus journey times. Coordination with MTA would be required to agree the proposed arrangements for bus passengers and access to Astoria Blvd Station during this time.

- **Lane Narrowing, Traffic Diversions, and Speed Restrictions on GCP and Astoria Blvd South**
  - Narrowing of the eastbound GCP lanes, traffic speed restrictions, and temporary closure of the shoulder between 31st St and the Hell Gate rail trestle would be expected for 9–18 months to provide safe construction access for adjacent piling, foundation, and pier work in the embankment south of the GCP eastbound roadway.
  - 10–20 overnight lane closures and speed restrictions would be anticipated on the eastbound GCP over a period of 6–12 months during erection of overhead bridge structures and deck.
  - Up to 5 overnight or weekend closures of the GCP on-ramp from Astoria Blvd South at 33rd St would be required over a period of 3–6 months during erection of overhead bridge structures and deck.

- **Temporary Periods of Operational Disruption to Rail Services on the Hell Gate Rail Trestle**
  - The below (11–22) partial or full track closures would result in suspended Amtrak, Northeast Corridor passenger, and CSX freight services requiring alternate travel and freight arrangements, generating disruption and inconvenience during these times. This would require careful coordination with both Amtrak and CSX (and any other users of the Northeast Corridor tracks) to agree the timing and length of proposed closures in advance of the work.
  - 5–10 off-peak overnight or weekend full track closures of the Amtrak and CSX rail lines would be expected over a period of 6–9 months during work to tie-in new overhead power and messenger wires and remove the redundant cabling.
  - 4–8 off-peak overnight or weekend partial track closures of the Amtrak and CSX rail lines would be expected over a period of 4–6 months while cranes and other tall equipment are used to construct the guideway piers adjacent to the trestle.
  - 2–4 off-peak overnight or weekend full track closures of the Amtrak and CSX rail lines would be expected over a period of 2–4 months during erection of overhead guideway bridge structures and deck.

- **Off-Peak Closures of the Westbound BQE Connector with the GCP**
  - 5–10 off-peak, overnight, or weekend alternating closures of the north and southbound Westbound BQE Connectors would be expected over a period of 2–6 months during erection of overhead bridge structures and deck.

- **Lane Narrowing, Traffic Diversions, and Speed Restrictions on GCP and Astoria Blvd South**
  - Narrowing of the eastbound GCP lanes, traffic speed restrictions, and temporary closure of the shoulder between 49th St and the Eastbound BQE Connector intersection would be required for 9–18 months to provide safe construction access for adjacent piling, foundation, and pier work in Astoria Blvd South.
  - 10–20 overnight lane closures and temporary speed restrictions on the eastbound GCP would be required over a period of 6–12 months during erection of overhead bridge structures and deck.

- **Lane Narrowing, Traffic Diversions, and Speed Restrictions at the Eastbound BQE Connector/GCP Intersection**
  - Up to 5 overnight or weekend closures of the Eastbound BQE Connector northbound roadway to the GCP would be required over a 2- to 4-month period during erection of overhead bridge structures. Traffic would be diverted via the off-ramp to Boody St, Astoria Blvd South, and the on-ramp to the GCP at 77th St.
  - Closure of the GCP on-ramp from Astoria Blvd South and 77th St for 1–2 months would be necessary while transitioning to the new, relocated on-ramp. Traffic diversions would be required via 23rd Ave and Ditmars Blvd.

- **Lane Narrowing, Traffic Diversions, and Speed Restrictions on GCP**
  - Narrowing of the eastbound GCP lanes and traffic speed restrictions between the Astoria Blvd North overpass and 94th St would be required for 9–18 months to provide safe construction access to the eastbound shoulder during construction of the at- and below-grade guideway located between the GCP and 23rd Ave.
  - Full closure of the Ditmars Blvd GCP off-ramp for 1–2 months would be required while transitioning to a new, relocated off-ramp. Traffic diversions would be required via the Astoria Blvd South off-ramp.
  - 2–4 overnight road closures and traffic diversions would be required over a period of 1—2 weeks to erect long-span bridge sections over the GCP into the Airport.
  - 10–15 off-peak, overnight, and/or weekend road closures on the GCP and traffic diversions would be needed over a period of 12–18 months to demolish the 82nd St Bridge deck and erect new deck structure.
  - Lane closures over a period of 12–18 months on the 82nd St crossing of the GCP would be conducted one roadway at a time so that two-way traffic could still cross the bridge, albeit on a reduced number of traffic lanes.

- **Disruption to Intra-Airport Services and Facilities**
  - Increased construction traffic around Terminals B and C for 9–18 months would require a coordinated traffic management plan to avoid/minimize potential on-Airport traffic disruption.

- 15–30 overnight and/or off-peak lane and road closures of on-Airport access roads would be expected for a 1- to 2-year period during long-span bridge section erection and other elevated structure work.
- Airport user inconvenience could potentially occur to certain portions of Airport facilities for 2–4 months during construction of customer transfer connections and circulation. This would require a coordinated traffic management plan to avoid/minimize potential traffic disruption.

5.4.1.3 Permanent/Operational Impacts to Existing Infrastructure

Once completed, this option would have the following permanent/operational impacts on other infrastructure along the route:

- **Grand Central Parkway**
  - The permanent location of guideway structure piers in the embankment south of the GCP between 33rd St and 49th St, and in Astoria Blvd South to the north of St Michael's Cemetery, would restrict any future NYS DOT roadway improvement plans to widen or adjust the GCP in these areas.
  - The on-ramp to the eastbound GCP from Astoria Blvd South and 77th St would be permanently relocated to accommodate the guideway transition structure.
  - The off-ramp from the eastbound GCP to Ditmars Blvd would be permanently relocated to accommodate the elevated guideway over 94th St.
  - The completed fixed guideway structure could restrict any future NYS DOT roadway improvement plans to widen or adjust the GCP between 77th St and 90th St.

- **Astoria Blvd South**
  - The fixed guideway structure piers in Astoria Blvd South to the north of St Michael's Cemetery would require the permanent reduction of Astoria Blvd South from three to two traffic lanes between 49th St and the GCP off-ramp. Discussions with NYC DOT indicate this could be possible but would require NYC DOT review and approval during future detailed development should this option be selected for further study.

- **Impacts on LGA**
  - The location of the elevated guideway and station in front of Terminal B would result in the construction of structure piers and frames in the area that has currently been identified to be the future permanent Terminal B taxi hold. This could prevent the taxi hold from using this location, requiring an alternate location, which may not be as operationally efficient.

5.4.1.4 Indicative Capital Cost

The Indicative Capital Cost for Option LR-4 is $3.7 billion (in 2022$, excluding future escalation and solely for approximate comparison between study options).

Indicative Capital Costs should be considered to have a range of estimating uncertainty of -10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).

As discussed in more detail in Section 3.2.1.1.1, the preliminary engineering work carried out by the study team has not identified a construction approach that, with confidence, could overcome the significant challenges and complexities presented by the twin constraints of the FAA Airport Design Standards and the existing large-diameter, 90-year-old utility structures along the GCP without more complex, risky, and costly approaches to construction that would require greater engineering exploration beyond the scope of this study. Therefore, to provide a basis of an order-of-magnitude cost on which to compare between options, this option was costed out using the (least cost) baseline solution of an open trench south of Runway 04-22, despite this approach not being compliant with FAA Airport Design Standards. Costs associated with an FAA compliant tunneled solution which could require replacement or relocation of existing sewer structures could result in additional costs of between $1–3 billion.

The following are the notable cost drivers for the option:

- Elevated guideway structure along GCP and on-Airport.
- New elevated light rail stations and connectors at LGA.
- Track-side equipment, systems, and power.
- Provision of a new OMSF.
- Revenue service light rail vehicles.
- New elevated light rail station and connector at Astoria Blvd.
- Transition structure and at- and below-grade guideway along GCP (open trench structure south of Runway 04-22).
- Utilities protection and relocation costs.
- Roadway maintenance and traffic protection costs.
- Replacement of the 82nd St Bridge (to accommodate open trench structure south of Runway 04-22).
- Tall, long-span structure over Hell Gate rail trestle.
- Relocation of GCP off-ramp to Ditmars Blvd.
- Long-span crossings on-Airport.
- Relocation of Astoria Blvd South on-ramp to GCP (at 77th St).

5.4.1.5 Indicative Timeline/Schedule

The Indicative Timeline/Schedule (for comparison between study options) for Option LR-4 is approximately 11–12 years from a decision to take the option forward to revenue service. This includes the following notable schedule:

- Planning, approvals, and acquisitions.
- Procurement of design-build contractor(s) for heavy civil construction.
- Procurement of new light rail vehicles.
- Astoria Blvd Station tie-in.
- Elevated guideway construction along GCP.
- Construction over Hell Gate rail trestle.
- Transition and 82nd St Bridge reconstruction (longest construction activity).
- On-Airport elevated stations and structure.
- Construction of a new OMSF.
- Systems installation and testing.
- 12 months of commissioning.

Figure 5.4-2 illustrates the indicative timeline/schedule for Option LR-4. The key drivers are the major civil construction work, which may trigger longer permitting, approvals, and procurement processes, and the light rail systems commissioning.

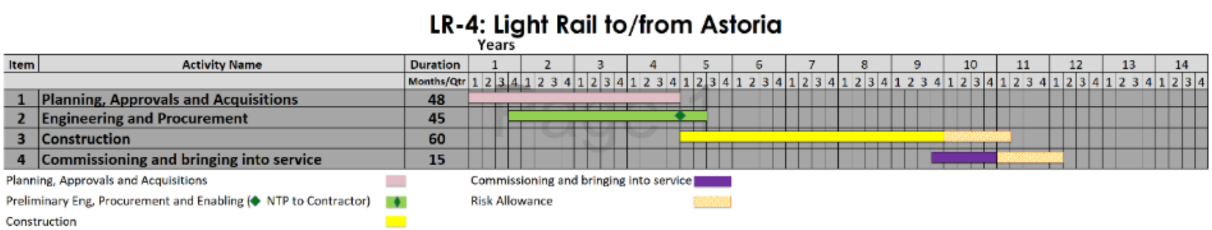


FIGURE 5.4-2: INDICATIVE TIMELINE/SCHEDULE (LR-4)

5.4.2 Transportation Aspects

5.4.2.1 Improved Access to LGA

Three factors have been considered in this category: Standardized Indicative Baseline Off-Peak Travel Time, Reliability, and Transfer Experience.

5.4.2.1.1 Standardized Indicative Baseline Off-Peak Travel Time

- Table 5.4-1, below, provides the Standardized Indicative Baseline Off-Peak Travel Times for the weekday, midday off-peak journeys to be used solely as a baseline for comparison between options. Table 5.4-2 provides a breakdown of the components that make up the total journey, the general approach to the estimation of which is described in Section 3.2.2.1.1.
- Passengers making the journeys described would, naturally, experience variations to the baseline timings calculated even where services are running as planned, for reasons as simple as variations in walking speeds or whether a traveler arrives just before a scheduled departure or just misses a departing train.

TABLE 5.4-1: STANDARDIZED INDICATIVE BASELINE OFF-PEAK TRAVEL TIME, OPTION LR-4

Times Square to LGA (minutes to Terminal B)	LR-4
Via Subway (N or W train) to Astoria Blvd	36

TABLE 5.4-2: STANDARDIZED INDICATIVE BASELINE OFF-PEAK TRAVEL TIME BY SEGMENT, OPTION LR-4

Times Square to LGA via N/W Subway (minutes)	LR-4
START Times Square (street level)	
walk/wait time	5
N/W Subway platform (dep)	
Subway trip time	21
Astoria Blvd N/W Subway platform (arr)	
walk/wait time	6
Astoria Blvd light rail platform (dep)	
Light rail trip time	4
1st on-Airport station (arr)	new elevated
END Terminal light rail stop	Terminal B
Total travel time =	36
trip time to next Terminal light rail stop	2
2nd on-Airport station	new elevated
END Terminal light rail stop	Terminal C
Total travel time =	38

- Passengers for Terminal A would transfer to an existing on-Airport shuttle service running every 10 minutes and with an additional trip time of around 7 minutes from Terminal B.

5.4.2.1.2 Reliability

- Option LR-4 would operate exclusively on dedicated infrastructure separate from general roadway conditions.

5.4.2.1.3 Transfer Experience

Riders bound for Terminals B or C would transfer from the N/W Subway service to the new light rail service at Astoria Blvd Station. Riders bound for Terminal A would have an additional transfer to an existing on-airport shuttle once they reach the airport.

Customer Transfer

- The studied light rail terminal station at Astoria would be located perpendicular to the mid-point of the existing station platform. The fully enclosed station would be at an elevation of approximately 30-35 ft above street level, the same height as the existing Subway platforms.

The existing Astoria Blvd Station is accessible so all transfers would use the existing station infrastructure to achieve ADA-compliance.

- Riders transferring from the existing Astoria Blvd Subway Station would follow the new wayfinding signage and connect to the new light rail station through a new extension of the existing mezzanine, a walk of approximately 300 ft.

5.4.2.2 Ridership

- Stated preference survey results indicate that 49% of airport passenger respondents are "definitely" or "probably" interested in fixed guideway connections to existing transit services.
- The ridership model projects 4.9 million total riders using Option LR-4, with a corresponding increase in net transit ridership of 3.1 million riders in 2025 (Table 5.4-3).

TABLE 5.4-3: RIDERSHIP MODEL RESULT SUMMARY

Transit Option			Riders on Current Bus Services to LGA (Millions) (No Action)	New Transit Option Impact (Millions)		
Mode Category & Scenario Label		Description		Riders on New LR-4 Light Rail Service	Net Increase in Total Transit Ridership	Total Transit Ridership (LR-4 Light Rail Service + Other Bus Services)
Fixed Guideway with Light Rail	LR-4	Astoria	4.1	4.9	**3.1**	**7.1**

5.4.2.3 Throughput and Capacity

Throughput

- Using the highest hourly single-direction provision of airline seats at LGA in 2019 (4,300 seats on weekday departing flights 9 AM to 10 AM – see Figure 3.2-1, in Section 3.2.2.3), the estimated single-direction peak passenger demand for this option could be approximately 600 passengers per hour.
- It should be noted that these passengers would likely arrive at the transfer station in groups, rather than being evenly distributed throughout the time period.

Capacity of New Transit Option

- Using the AirTrain JFK system as an example, automated light rail systems can be tailored to throughput requirements using an appropriate combination of train length and frequency. Typically, 58-ft cars are able to accommodate more than 75 passengers with luggage, with around one-third of them seated.
- With the proposed arrangement of three-car trains at 4-minute intervals, the potential total capacity of the proposed new light rail link could be:
  - 3,375 pphpd at peak.

- This is sufficient to support the estimated single-direction peak passenger demand from the ridership model, equating to approximately 40 passengers per train at peak with this proposed train-car configuration and frequency.
- Actual train-car configuration and frequency would be adapted in practice to suit demand and other operating requirements.

Impact on Capacity of Existing Downstream Transit Systems

- The station at Astoria Blvd offers transfer access to the N/W Subway services.
- Generally, airport passenger loadings are constant through the day both to and from the Airport with the peak passenger loadings occurring outside of the morning Manhattan-bound subway peaks or in the opposite direction (i.e., Airport-bound).
- The existing N- and W-Subway lines currently operate close to their peak capacity during the 8 AM to 9 AM Manhattan-bound commuting peak. Most Manhattan-bound Airport passengers would travel outside this peak. While most Manhattan-bound Airport passengers would travel outside this peak, those passengers (including non-Airport passengers) traveling during this peak could experience some crowded conditions.
- The study team noted that Astoria Blvd Station is an elevated station with two island platforms and a mezzanine located between the platform level and the street. The mezzanine is connected to each platform via two sets of stairs, one at either end of the mezzanine, and one elevator. The station spans Astoria Blvd North, the Grand Central Parkway, and Hoyt Ave South. Connections to Astoria Blvd North and Hoyt Ave South are provided from the street via stairs and an elevator at each location. The layout and location of the station is highly constrained making adding additional elevators or escalators difficult, if not impossible. The MTA expressed concerns that new Airport passengers utilizing this station may subject the limited number of elevators to overcrowding due to increased numbers of passengers with luggage.

5.4.2.4 Indicative Operating Cost

A preliminary costing exercise, based on previous estimates for the LAIP (Mets-Willets AirTrain, currently on pause) concept, considering the line length and the cost categories relating to it, suggests estimated annual operating and maintenance costs on the order of $40 million per annum. This estimate includes owner’s costs.

5.4.3 Community and Environmental Aspects

5.4.3.1 Local Community Impact

This option would be located within and adjacent to densely developed neighborhoods along Astoria Blvd and consisting of a wide range of properties ranging from single-family (row & detached) to 3- to 6-story residential buildings, commercial businesses, mixed-use (residential above commercial) buildings, public community buildings, and NYC Parkland (Columbus Park, Planeview Park, and Overlook Park). The approximately 3-mile route goes through/along the following communities: Astoria, Ditmars Steinway, Woodside, Jackson Heights, and East Elmhurst.

The potential for temporary (during construction) and permanent (once operational) impacts is summarized below for specific areas of the alignment.

5.4.3.1.1 Temporary Impacts during Construction on the Local Neighborhoods Directly Affected

The fixed guideway from Astoria Blvd Station to LGA would require major heavy civil construction activities to build the elevated guideway foundations, structures, and stations along the route. Construction activities are anticipated to occur along the approximately 3-mile route for approximately 5 years.

As discussed in more detail in Section 3.2.1.1.1, the preliminary engineering work carried out by the study team has not identified a construction approach that, with confidence, could overcome the significant challenges and complexities presented by the twin constraints of the FAA Airport Design Standards and the existing large-diameter, 90-year-old utility structures along the GCP without more complex, risky, and costly approaches to construction that would require greater engineering exploration beyond the scope of this study. Therefore, to provide a consistent basis on which to evaluate it, this assessment was based on the baseline solution of an open trench south of Runway 04-22, despite this approach not being compliant with FAA Airport Design Standards.

During construction, the following neighborhoods would have the potential for air quality, noise, vibration, or visual impacts. For the frequency and duration of construction activities refer to Section 5.4.1.2 “Infrastructure Impacts during Construction” above:

- **Construction of the Fixed Guideway Transfer Station with Astoria Blvd Station**
  - The fixed guideway and light rail station would require major heavy civil construction activities to build the guideway foundations, elevated structures, and stations on Astoria Blvd South, 31st St, 32nd St, and 33rd St.
  - The construction would occur approximately 35–80 ft from 1 short city block of residential and commercial properties.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - Planned periodic closure of sidewalks, bike lanes, and parking spaces would be required.
  - Planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.
  - Planned periodic closure of Columbus Sq Park (NYC Parkland) would potentially be required depending on the final detailed design.

- **Construction Along Astoria Blvd and the GCP Between 31st St and Hell Gate Rail Trestle**
  - The fixed guideway would require major heavy civil construction activities to build the elevated guideway foundations and structures between the GCP eastbound shoulder and Astoria Blvd South along this approximately 0.5-mile segment of the route.
  - The construction would occur approximately 40–70 ft from 10 short city blocks of residential and commercial properties.
  - Planned periodic lane closures and diversions on Astoria Blvd South would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - Planned periodic closure of sidewalks, bike lanes, and parking spaces would be required along Astoria Blvd for the construction of the piling and retaining wall.
  - Planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.

- **Construction over the Hell Gate Rail Trestle**
  - The guideway over the trestle would require tall (approximately 90–100 ft above the GCP roadway), long-span (approximately 150–200 ft) structures, and re-routing of the overhead electrical power lines and messenger wires. To erect the guideway piers, bridge structure, and deck would involve tall cranes and other equipment adjacent to and over the Amtrak rail lines along this 0.25-mile segment of the route.
  - The construction would occur approximately 50–75 ft from 2 short city blocks of residential and commercial properties.

- **Construction to the North of St Michael's Cemetery**
  - The construction (piling, piers, and bridge structure) of the elevated fixed guideway that runs to the south of the GCP eastbound roadway, which is to the north of St Michael's Cemetery, would be required over an approximately 0.5-mile segment of the route. Construction would occur approximately 35–50 ft from the cemetery's northern boundary.
  - Planned periodic lane closures and diversions on Astoria Blvd South would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.

- **Construction at the Eastbound BQE Connector to GCP Intersection**
  - The construction (piling, piers, and bridge structure) of the elevated fixed guideway would occur over an approximately 0.25-mile segment of the route.
  - The construction would occur approximately 180–200 ft from 1 city block of commercial properties.

  - Planned overnight or weekend closures of Astoria Blvd South, the GCP, and the Eastbound BQE Connector northbound roadway would be required. This could lead to traffic increases on local roads, including potential impacts to local bus routes during road closures.
  - Planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.

- **Reconstruction of 82nd St Bridge**
  - Lane closures and contra-flow traffic on 82nd St Bridge would be continuous throughout the construction as bridge sections would be demolished and reconstructed one half at a time.
  - The construction would occur approximately 150–200 ft from 2 short city blocks of residential and commercial properties.
  - Planned periodic lane closures, contra-flow traffic on the bridge, and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - Planned night closures of the GCP could be required for the long-span bridge erection.

- **Constructing over 94th St and the GCP into the Airport**
  - Reconstruction of the GCP eastbound off-ramp onto Ditmars Blvd near 90th St and construction of an elevated guideway (30 ft above 94th Street) with long-span (approximately 250–300 ft) bridge structures crossing over 94th St and the GCP into the Airport would be required along the approximately 0.5-mile segment of the route.
  - The construction would occur approximately 100–350 ft from 4 short city blocks of residential and commercial properties.
  - Planned night closures of the GCP would be required for the long-span bridge erection.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - There could be increased construction/haul traffic on local roads because trucks are not allowed on the GCP.

- **Constructing On-Airport Elevated Light Rail Stations**
  - Construction activities associated with the erection of long-span (approximately 350 ft) elevated guideway bridge structures over an approximately 0.5-mile segment of the route over 102nd St and the newly constructed departures roadway at the Airport would be required.
  - The construction would occur over 500 ft from 5 city blocks of residential and commercial properties in the East Elmhurst community located on the other side of 8 lanes of the GCP.

- Planned night closures of the GCP would be required for the long-span bridge erection.
- Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
- There could be increased construction/haul traffic on local roads because trucks are not allowed on the GCP.

- **Construction of the OMSF**
  - The fixed guideway with light rail solution would require an approximately 115,000-sf facility at the site of the former (now vacant) Courtyard by Marriott hotel on Ditmars Blvd between 90th St and 92nd St. This site on Ditmars was used for this purpose in the analysis; however, due to the hotel's recent change of ownership, it may no longer be available for this purpose. Should this option be advanced, further study would be needed to determine a suitable location for the OMSF.
  - The construction of the facility (track and building(s)) would occur for approximately 1 year and approximately 50–100 ft from 3 city blocks of residential and commercial properties.

5.4.3.1.2 Permanent Operational Impacts on the Local Neighborhoods Directly Affected

Electrically powered light rail vehicles, similar in size and characteristics to the vehicles that currently operate on AirTrain JFK, would operate between LGA and the proposed new light rail station at Astoria Blvd at peak headways of 4 minutes. They would operate along a predominantly elevated fixed guideway, descending to get past Runway 04-22, ranging approximately 35–500+ ft from residential and commercial properties. During periods of reduced airport demand (e.g., overnight), headways would significantly reduce.

The following local neighborhoods and areas would have the relative potential for permanent noise, vibration, or visual impacts as a result of this option's proposed light rail operations:

- **New Elevated Light Rail Transfer Station with Astoria Blvd Station**
  - At the proposed light rail station at Astoria Blvd, light rail vehicles would operate in each direction on an elevated fixed guideway and station structure above Columbus Sq Park approximately 35–80 ft from residential and commercial properties.
- **New Elevated Light Rail Along Astoria Blvd and the GCP between 31st St and Hell Gate Rail Trestle**
  - From the light rail station, light rail vehicles would operate in each direction on an elevated fixed guideway structure between Astoria Blvd South and the GCP transportation corridor approximately 40–70 ft from residential and commercial properties.

- **New Elevated Light Rail Over the Hell Gate Rail Trestle**
  - At the Hell Gate rail trestle, the fixed guideway would need to rise over the trestle (approximately 90–100 ft above the GCP roadway, the highest in the MTA subway system) on long-span (approximately 150–200 ft) structures. Light rail vehicles would operate in each direction on an elevated guideway structure between Astoria Blvd South and the GCP transportation corridor approximately 50–75 ft from residential and commercial properties.
- **New Elevated Light Rail to the North of St Michael's Cemetery**
  - The elevated fixed guideway structure would run to the south of the GCP eastbound roadway to the north of St Michael's Cemetery. Light rail vehicles would operate in each direction on an elevated guideway structure within the GCP transportation corridor approximately 35–50 ft from the cemetery boundary.
- **New Elevated Light Rail at Eastbound BQE Connector to GCP Intersection**
  - East of St Michael's Cemetery, light rail vehicles would transition from an elevated fixed guideway to an at- and below-grade structure, operating in each direction within the GCP transportation corridor approximately 180–200 ft from commercial properties.
- **New Elevated Light Rail Over 94th St and the GCP into the Airport**
  - Once past the RPZ and the end of Runway 04-22, light rail vehicles would rise to operate in each direction on an elevated fixed guideway structure over the GCP onto the Airport approximately 100–350 ft from residential and commercial properties.
- **New On-Airport Elevated Light Rail Stations**
  - On-Airport, light rail vehicles would operate in each direction on an elevated fixed guideway structure between the two proposed light rail stations over 500 ft from residential and commercial properties in the East Elmhurst community located on the other side of 8 lanes of the GCP.
- **New Light Rail OMSF**
  - The proposed maintenance and storage facility at the site of the former (now vacant) Courtyard by Marriott hotel on Ditmars Blvd between 90th St and 92nd St would experience light rail vehicle movements throughout the day, peaking when vehicles leave and enter the facility at the start and end of peak operations. Maintenance and other activities would occur throughout the day and possibly overnight within covered buildings/vehicle sheds. These activities would occur approximately 50–100 ft from residential and commercial properties. Note that this site on Ditmars was used for this purpose in the analysis; however, due to the hotel's recent change of ownership, it may no longer be available for this purpose. Should this option be advanced, further study would be needed to determine a suitable location for the OMSF.

5.4.3.1.3 Potential Private Property Acquisitions

The new fixed guideway with light rail to/from Astoria may require permanent acquisition of the following:

- Up to 4 private commercial properties.

5.4.3.1.4 Potential Public Property Acquisitions (NYC DOT Plazas and NYC Parks Parkland)

The new fixed guideway with light rail to/from Astoria may result in permanent impacts due to the following:

- New support columns for the permanent fixed guideway structure would be located within Columbus Sq Park and Planeview Park, and the below-grade structure within Overlook Park.
- No structures would be sited within NYC DOT Plazas.

5.4.3.1.5 Removal/Reconfiguration of Parking Spaces

This option would have minimal impact to on-street public parking.

5.4.3.1.6 Environmental Justice Communities Mapping Analysis

The Environmental Justice communities mapping analysis provides an overview of the minority and low-income communities within 0.25 mile of the transit options being evaluated.

For Option LR-4, less than half of the block groups within the 0.25-mile buffer of the option alignment are Environmental Justice block groups.

See Figure 5.4-3 below for the analysis map.

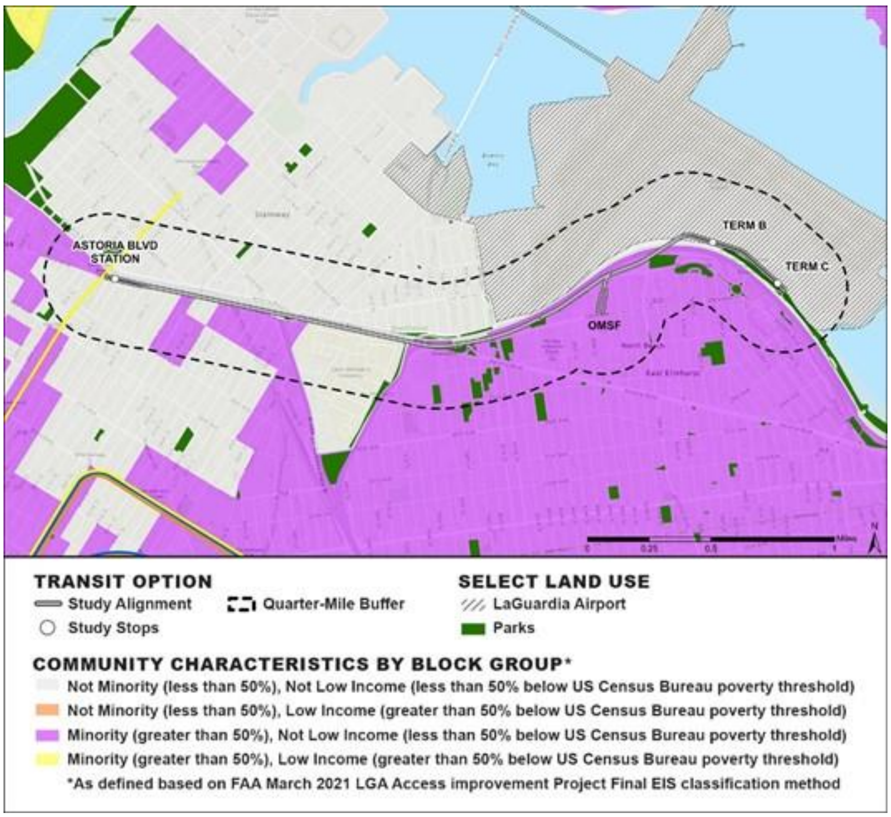


FIGURE 5.4-3: ASTORIA OPTION – ENVIRONMENTAL JUSTICE COMMUNITIES MAPPING ANALYSIS (AS DEFINED BASED UPON FAA MARCH 2021 LGA ACCESS IMPROVEMENT PROJECT FINAL EIS CLASSIFICATION METHOD)

5.4.3.2 Equity

5.4.3.2.1 Transit Access from LGA

- **Additional Minority and Low-income Populations Reached within 45 Minutes from LGA via Transit (Population Access Analysis)**
  - The results of the Population Access Analysis illustrate how many people, specifically from low-income and minority populations, could travel via transit from LGA to homes within 45 minutes from LGA. Potential Airline passengers or Airport employees living within these areas could potentially benefit from expanded access to these destinations.
  - Option LR-4 is expected to expand transit access from LGA to regional destinations within 45 minutes, as shown in the blue area of "Additional Access Provided by Transit Option" in Figure 5.4-4. Compared to the baseline, the minority population reached within a 45-minute transit trip would increase by 62.7% and the low-income population reached within a 45-minute transit trip would increase by 94.2% as shown in Table 5.4-4.
  - This represents a higher increase in transit access to LGA within 45 minutes for minority and low-income communities.

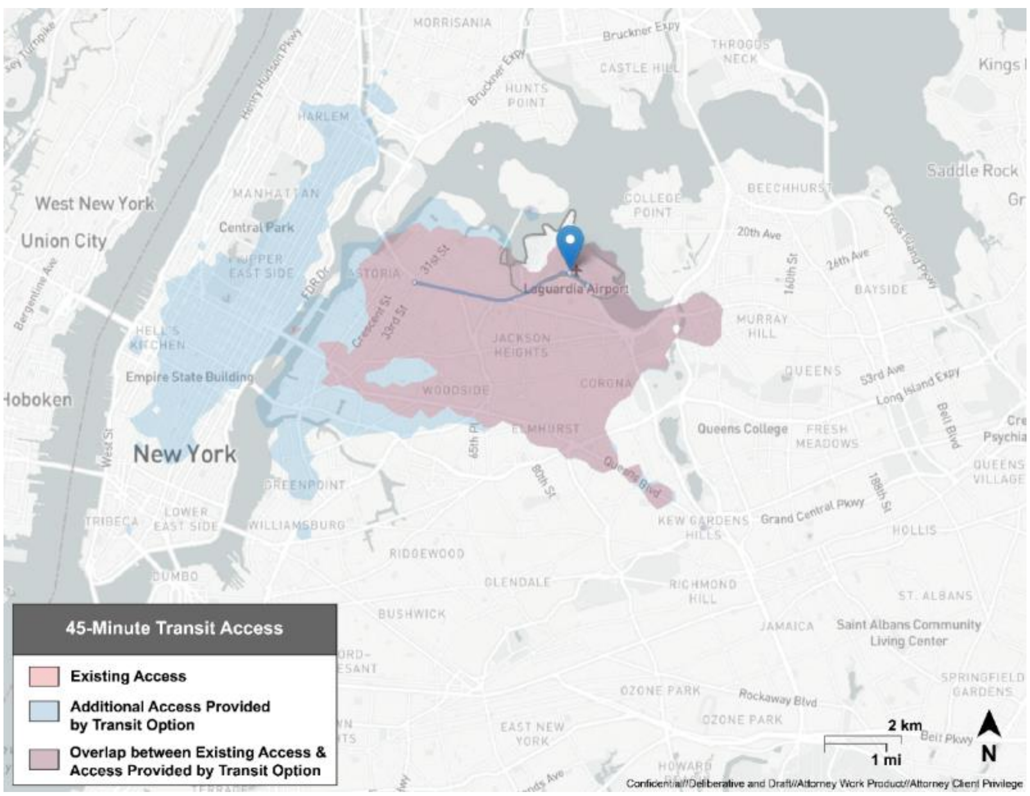


FIGURE 5.4-4: ASTORIA OPTION LR-4 – POPULATION ACCESS ANALYSIS

TABLE 5.4-4: ASTORIA OPTION LR-4 – POPULATIONS REACHED WITHIN 45-MINUTE TRANSIT TRIP

		Total Population Reached	Minority Population Reached	Low-Income Population Reached
Baseline	Existing Condition	551,434	422,981	76,750
LR-4	With Option	1,167,151	688,010	149,020
	Net Change	+615,717	+265,029	+72,270
	% Change	111.7%	62.7%	94.2%

- **Additional ADA-Accessible Stations within 45 Minutes from LGA via Transit (ADA Analysis)**
  - The results of the ADA Analysis illustrate how Airport passengers and Airport employees, specifically those requiring ADA-compliant stations, traveling from LGA to other locations could potentially benefit from expanded access to ADA-compliant stations within 45 minutes via transit.
  - More ADA-accessible stations/stops can be reached within a 45-minute transit trip for this option compared to the baseline of existing transit service (Table 5.4-5). This echoes the results from the Population Access Analysis, in which Option LR-4's 45-minute transit travel shed provides an increased amount of access over the baseline transit service. Compared to the baseline, an additional 65 ADA-accessible stations can be reached within a 45-minute transit trip from LGA for Option LR-4.

TABLE 5.4-5: ASTORIA OPTION LR-4 – ADA ANALYSIS

Subway, Ferry, LIRR, and MNR Stations Reached within 45-Minute Transit Trip from LGA	Baseline	LR-4	Difference between Baseline and LR-4
Total Stations	*43*	*145*	*+102 stations*
ADA-Accessible Stations (Accessible Stations as % of Total)	*20 (47%)*	*85 (59%)*	*+65 stations*

5.4.3.2.2 Transportation Opportunities and Benefits for the Surrounding Community

- **Transportation Opportunities for Neighbors**

  This option does not include intermediate/off-Airport stops. Because there is limited pedestrian access to LGA from adjacent residential areas and walking distance exceeds 0.25 mile, the study team did not consider there to be a significant market for use of the final on-Airport stops by the surrounding community to connect to the broader transit network.

- **Cars Removed from Local Roadways and Emissions Reductions**

  See the “Cars Removed from Local Roadways” section and the “GHG and Other Vehicular Emissions Reductions” section of this evaluation below.

5.4.3.3 Cars Removed from Local Roadways

- Option LR-4 would be expected to remove 1,292,000 Airport passenger vehicles, and 48,000 Airport employee vehicles, from the road each year.

5.4.3.4 GHG and Other Vehicular Emissions Reductions

- Option LR-4 would be expected to remove 5,735 metric tons of CO_2 equivalent each year.
- Other vehicular emissions reductions are given in Table 5.4-6:

TABLE 5.4-6: OTHER VEHICULAR EMISSIONS REDUCTION (METRIC TONS PER YEAR)

Option	CO	VOC	NOx	SO_2	PM_{10}	$PM_{2.5}$
[LR-4] Astoria	27.0	0.4	1.8	0.1	1.0	0.2

5.4.4 Summary of Evaluation

<u>LR-4: Light Rail to/from Astoria</u>

Option LR-4 would provide a two-seat ride to LGA via a 4-minute light rail ride to/from the existing Astoria Blvd Subway station, providing transfer access to N and W Subway services. A new dedicated light rail station would be located adjacent to the station above Columbus Sq, providing ADA-compliant passenger access between the two. The guideway would run above the GCP transportation corridor, minimizing the direct impact of the light rail on local communities.

This option would require the construction of heavy infrastructure, including elevated and open-trench concrete guideway structures predominantly along the GCP transportation corridor. This option would have to contend with the construction challenges of crossing the Hell Gate rail trestle (90–100 ft above the ground), complying with FAA Airport Design Standards 04-22 while negotiating the 90-year-old utilities under the GCP at the end of Runway (a challenge as yet unresolved as discussed in Section 3.2.1.1.1), and traversing the constrained area north of St Michael’s Cemetery. For the purpose of cost comparison, this option was costed out on the basis of a baseline solution of an open trench south of Runway 04-22 despite this approach not being compliant with FAA Airport Design Standards.

Table 5.4-7 summarizes the output from all the factors used to evaluate this option.

TABLE 5.4-7: SUMMARY OF KEY CHARACTERISTICS – LIGHT RAIL TO/FROM ASTORIA (LR-4)

	Evaluation Factor	Assessment
CONSTRUCTION ASPECTS	Constructability	• **Major unresolved constructability challenge**: Complying with FAA Airport Design Standards while also avoiding disruption to 90-year-old, 15 ft diameter sewer structures at the end of Runway 04-22 (see details in Section 3.2.1.1.1) • Tall (90+ ft) long-span (150–200 ft) structures spanning the Hell Gate rail trestle • Construction of elevated light rail station in dense neighborhood adjacent to existing Astoria Blvd Station and above Columbus Sq Park • Constrained construction access adjacent to GCP • Reconstruction of 82nd St Bridge • Long spans (250-300 ft) over 94th St Bridge and 102nd St Bridges on-Airport • Constrained on-Airport sites for new elevated structure and 300 ft light rail stations • Total option route length: approx. 3 miles
	Infrastructure Impacts during Construction	• Operational impacts to N/W services • Lane narrowing, traffic diversions, speed restrictions on BQE, GCP and Astoria Blvd • Disruption to services (Amtrak, Metro-North) on Hell Gate rail trestle
	Permanent/Operational Impacts to Existing Infrastructure	• Permanent loss of travel lane on Astoria Blvd South along St. Michael's Cemetery • Inhibits future widening of the GCP • Columns and piers in site of future Terminal B taxi hold
	Indicative Capital Cost (2022$)[68]	$3.7 billion[69] (Does not include any additional costs required for an as yet unresolved solution to get past Runway 04-22 in compliance with FAA Airport Design Standards; potentially up to approx. $1–$3 billion)
	Indicative Timeline/Schedule	11–12 Years
TRANSPORTATION ASPECTS	Standardized Indicative Baseline Off-Peak Travel Time (From Midtown Manhattan)	Via N/W-Lines: 36 mins (4 mins on light rail) (Times Square to Terminal B, then C; shuttle to Terminal A)
	Transfer Experience	• Transfer from N/W-Line to light rail station would involve a vertical move down via stairs, elevator, or escalator to station mezzanine and then a second vertical move up to the light rail platform level via stairs, elevator, or escalator
	Ridership[70]	Total annual projected ridership for option: 4.9 million Net increase in annual projected transit ridership: 3.1 million
	Throughput & Capacity	3,375 pphpd (peak)
	Indicative Operating Cost	$40 million per annum

[68] Indicative Capital Costs should be considered to have a range of estimating uncertainty of –10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).
[69] Costs for heavy infrastructure options approaching LGA from the west/southwest are based on the open-trench construction concept past Runway 04-22 (over the existing 90-year-old utilities), to provide a baseline estimate of the cost of construction. Although this concept does not meet FAA Airport Design Standards, it provides a consistent approach for capital cost comparison purposes. Costs associated with tunnelling and/or relocating utilities would be substantially higher, potentially up to approx. $1–$3 billion.
[70] Experience from AirTrain JFK was that actual ridership turned out to be higher than would have been predicted by the AirTrain JFK forecast and underscores the inherent uncertainty of model predictions. The ridership model supporting this effort could also deviate from eventual ridership demand but was utilized to allow ridership comparisons between the options.

TABLE 5.4-7, CONTINUED.

	Evaluation Factor	Assessment
COMMUNITY AND ENVIRONMENTAL ASPECTS	Local Community Impacts	Construction: • Heavy civil construction of elevated and at-/below-grade structures for approx. 5 years Proximity to communities: • 35–80 ft from one city block of residential and commercial properties on 31st St • 40–75 ft from 12 city blocks of residential and commercial properties along the GCP • 35–50 ft from the north end of St Michael's Cemetery along Astoria Blvd South • Over 500 ft across 8 lanes of the GCP from 9 city blocks of residential and commercial properties opposite the Airport Terminals Permanent impacts: • Acquisition of up to 4 properties (private commercial) • Structures over or adjacent to Columbus Sq Park, Planeview Park, Overlook Park, and to the north of St. Michael's Cemetery[71] • Minimal, if any permanent loss of on-street public parking spaces
	Equity	• Higher increase to low-income and minority populations within 45 minutes of the Airport via transit versus the no-build scenario • +65 additional ADA-compliant stations reachable within a 45-minute transit trip from LGA versus the no-build scenario
	Cars Removed from Local Roadways	1,292,000 airport passenger vehicles and 48,000 airport employee vehicles from the road each year
	GHG and other Vehicular Emissions Reductions	5,735 metric tons of $CO2$ equivalent each year

[71] Municipal parkland cannot be converted to a non-park use (known as alienation) without State legislative permission. Thus, the acquisition of New York City Parkland for construction of a mass transit option would require legislation authorizing such alienation. Obtaining such legislation is a multi-step process requiring actions by the New York City Council, the Mayor of New York City, the New York State Legislature, and the Governor.

5.5 LR-5: Light Rail to/from Jackson Heights

Option LR-5 would link LGA via a 5-minute light rail ride to the existing Jackson Hts-Roosevelt Av/74 St-Broadway Subway stations, providing multiple transfer access to the E, F, M, R, and 7 Line subway services and the busy community hub around the station. A dedicated light rail Airport-transfer station would be located above Broadway adjacent to the 7-Line station providing ADA-compliant passenger access. The guideway would run above city streets to the BQE and GCP transportation corridors, on to LGA, avoiding city traffic.

This option could connect to the future planned Interborough Express (IBX), an MTA-led rapid transit program currently in the planning stage. The IBX would connect Bay Ridge, Brooklyn to Jackson Heights, Queens, with a terminus close to the existing Jackson Heights Station. It would connect with up to 17 different subway lines, as well as the LIRR, with end-to-end travel times anticipated at around 40 minutes.

Option Route Description

From the transfer-station at Jackson Heights, the route (Figure 5.5-1) would travel on an elevated guideway above Broadway, through a commercial area, for 0.2 mile. The route would turn right to be

FIGURE 5.5-1: OPTION LR-5

above 69th St, immediately adjacent to the BQE on the west side and residential/commercial property on the east side for 0.4 mile. After crossing 34th Ave heading north, the route would curve over the BQE off-ramp until reaching Northern Blvd. After crossing Northern Blvd heading north, the route would be above 68th St with residences or other commercial properties located on both sides of 68th St for 0.25 mile. North of 30th Ave, 68th St becomes Boody St with residences or commercial properties located at the intersections with 70th St and 71st St on the east side and the BQE on the west side for 0.5 mile. The route would turn east to navigate the ramps of the BQE and GCP interchange, in a cut-and-cover tunnel beneath Astoria Blvd South.

The route would then run at-grade inside the southern edge of the GCP ROW before needing to descend below-grade for 0.3 mile to contend with the construction challenges of complying with FAA Airport Design Standards at the end of Runway 04-22 while negotiating the 90-year-old utilities under the GCP. As discussed in detail in Section 3.2.1.1.1, the heavier infrastructure options from the west must overcome the significant challenges and complexities presented by the twin constraints of the FAA Airport Design Standards and the existing large-diameter, 90-year-old utility structures along the GCP. The preliminary engineering work carried out by the study team has not identified a construction approach that, with confidence, could do this without more complex, risky, and costly approaches to construction that would require greater engineering exploration beyond the scope of this study. To provide a consistent basis on which to evaluate the option and to allow cost comparison between the options, Option LR-5 is based on the baseline, simpler construction, concept of an open trench structure located in the embankment to the south of the eastbound GCP roadway, despite this being shown to be not compliant with the FAA Airport Design Standards.

Once east of Runway 04-22, the route would ascend and cross over the GCP and ramps associated with the 94th St interchange to connect to two fixed guideway stations, one serving Terminal B and one serving Terminal C. The OMSF for this option is proposed to use the location of the vacant former Courtyard by Marriott site at 90-10 Ditmars Blvd. This site on Ditmars was used for this purpose in the analysis; however, due to the hotel’s recent change of ownership, it may no longer be available for this purpose. Should this option be advanced, further study would be needed to determine a suitable location for the OMSF. This location was determined to be appropriate due to its proximity to the proposed fixed guideway alignment (common to LR-1, LR-4, and LR-5), size, and potential availability.

The length of this route is approximately 3.2 miles, including the on-Airport portion.

5.5.1 Evaluation of Construction Aspects

5.5.1.1 Constructability

The fixed guideway from Jackson Heights to LGA would require major heavy civil construction activities to build the elevated guideway foundations, structures, and stations along the route.

The notable challenges and complexities associated with construction of this option are summarized below.

- **Construction of a New Fixed Guideway Station over Broadway at Jackson Heights and Connectivity Interface with MTA Station Infrastructure**

- The proposed fixed guideway station would be elevated over Broadway on the north side of the existing Jackson Hts-Roosevelt Av/74 St-Broadway Subway station. Passenger connectivity between the Subway station and the light rail station is provided via an environmentally conditioned connector down to Diversity Plaza on 37th Road and underground to the existing Jackson Hts-Roosevelt Av/74 St-Broadway Subway mezzanine.
- Construction of the proposed light rail station and environmentally conditioned connector in a highly constrained urban location reduces the efficiency of construction work. This has been reflected in the durations used in the Indicative Timeline/Schedule and the costs in the estimate.
- Structural modification of the existing steelwork of the Subway stations would be required to accommodate the proposed mezzanine connection. An allowance has been included in the cost estimate for the station work.

- **Construction of the Elevated Guideway over the Broadway and 37th St Intersection over the BQE**
  - Medium-span structures of approximately 150–200 ft would be required to span the intersection of 37th St and Broadway, resulting in increased costs over standard elevated guideway rates (which have been included in the cost estimate).
  - Maintaining traffic access across the intersection, including the on- and off-ramps to the BQE, would require careful construction planning to avoid congestion and would introduce construction inefficiencies, impacting the construction schedule. This would include overnight working for bridge section lifts, and this has been reflected in the Indicative Timeline/Schedule for this area.

- **Construction of the Elevated Guideway from Broadway to the BQE Split**
  - From Broadway, the guideway would run at elevation along the center of 69th St and 68th St adjacent to the CSX railroad and BQE until Boody St, requiring medium-span structures (up to 100 ft) over the intersections with 37th Ave, 35th Ave, 34th Ave, Northern Blvd, 32nd Ave, and 31st Ave.
  - Between 34th Ave and Northern Blvd the guideway runs above the BQE northbound off-ramp to Northern Blvd. The off-ramp would require modification (potentially shifting eastwards) so that column piers for the guideway deck support frames could be located between the BQE roadway and the off-ramp. An allowance has been included in the cost estimate for this work.
  - This part of the route follows local residential streets that would constrain the use of large construction equipment and cranes except for short periods. This has been included as increased durations for construction activities in this area.

- **Construction of the Elevated Guideway between Eastbound BQE Connector and Boody St**
  - Guideway piers would be located in the 68th St and Boody St roadways, running adjacent to the Eastbound BQE Connector northbound roadway for approximately 0.5 mile. This avoids impacting the Eastbound BQE Connector roadway support structure and Eastbound BQE Connector traffic lanes.
  - Construction of the guideway piers along 68th St and Boody St would require modification and reconstruction of the existing soundwall along the Eastbound BQE Connector. An allowance has been included in the cost estimate for this work.
  - The elevated guideway structure would require reconstruction of one overhead signage gantry along the Eastbound BQE Connector. An allowance has been included in the cost estimate for this work.
  - Construction work and access along 68th St and Boody St and adjacent to the Eastbound BQE Connector would be constrained for large equipment and vehicles, resulting in inefficient sequencing and methodologies. This complexity is reflected in an increase over standard construction costs in the estimate, and extended durations in the schedule for work in this area.

- **Major constructability challenge of compliance with FAA Airport Design Standards while also avoiding disruption to 90-year-old NYC DEP underground sewer structures (See also Section 3.2.1.1.1)**
  - This option's alignment crosses an area south of Runway 04-22 that is subject to FAA regulations regarding the safe operation of the Airport. This presents a major constructability challenge (described in greater detail in Section 3.2.1.1.1) to negotiate the twin constraints of the FAA Airport Design Standards (governing the construction of new infrastructure in this area) and the existing large-diameter utilities located along and beneath the GCP.
  - The preliminary engineering work carried out by the study team has not identified a construction approach that it could conclude with confidence would practicably overcome these challenges.
  - For the purposes of providing a basis on which to compare options that must pass the end of Runway 04-22, this option was evaluated using the baseline construction concept of an open trench structure located in the embankment to the south of the eastbound GCP roadway, despite this concept being shown to be not compliant with the FAA Airport Design Standards. To provide the Indicative Capital Cost and Timeline/Schedule, the following construction elements for this construction concept:
    - Construction of a cut-and-cover tunnel beneath Astoria Blvd South for the guideway transition from parallel to the Eastbound BQE Connector northbound roadway to south of the GCP eastbound roadway.
    - Reconstruction of the Eastbound BQE Connector northbound off-ramp to Astoria Blvd South and Boody St approximately 300–400 ft south of its current location.

  - Reconstruction of the GCP on-ramp from Astoria Blvd South at 77th St over the guideway to re-provide traffic access to the GCP around the new transition structure.
  - Reconstruction of the 82nd St Bridge. The open trench structure would have to pass through the existing south abutment of the 82nd St Bridge over the GCP, requiring the bridge's demolition and reconstruction to accommodate the structure.
  - Construction of a below-grade, open-trench structure south of Runway 04-22, staying above the existing major utilities along the GCP.
  - Strengthening of the existing utilities and/or construction of concrete protection slabs above them.
  - Relocation of the existing runway lights, located between the GCP and Ditmars Blvd.

- **Constructing over 94th St and the GCP into the Airport**
  - Once past Runway 04-22, the alignment would ascend back to an elevated guideway structure to pass over the GCP onto the Airport.
  - The GCP eastbound off-ramp onto Ditmars Blvd near 90th St would require reconstruction to accommodate the elevated guideway in this area. An allowance has been included in the construction cost estimate for this work.
  - The guideway crossing over 94th St and both roadways of the GCP into the Airport would require long-span (approximately 250–300 ft) bridge structures. These would require complex engineering solutions and construction methods to span the roads, while maintaining traffic mobility on the GCP and into the Airport on 94th St. This introduces increased construction costs over standard rates, which are reflected in the construction estimate.

- **On-Airport Elevated Stations, Constrained Construction Site Conditions**
  - Long-span (approximately 350-ft) bridge structures would be required over 102nd St and the newly constructed departures roadway. This would require structures to elevate the guideway to approximately 70 ft above-grade to clear the multi-level roads while maintaining airport operability, resulting in complex engineering solutions and construction methods. This introduces increased construction costs over standard rates, reflected in the construction estimate.
  - Two elevated light rail stations (each up to 300 ft), with features such as escalators, elevators, stairs, and signage, would be constructed and integrated with the existing Airport terminal buildings. Constructing these within a constrained, operational airport environment would reduce the construction sequence efficiency, introducing construction complexities. This is reflected in the Indicative Timeline/Schedule and cost estimate.
  - Construction work in and around the Airport terminals and over Airport roadways would be subject to acceptance by the FAA.

- **Locating the OMSF**
  - The fixed guideway with light rail solution would require a facility of approximately 115,000 sf adjacent to the ROW to store and maintain the fleet of vehicles and conduct system operations. The site of the formerly vacant Courtyard by Marriott hotel on Ditmars was used for this purpose in the analysis; however, due to the hotel's recent change of ownership, it may no longer be available for this purpose. Should this option be advanced, further study would be needed to determine a suitable location for the OMSF.

- **Constructability Risks Not Included in the Cost Estimate Range (–10% to +30%) for This Option**
  - Scale of construction work required to transition the alignment at the BQE/GCP intersection from elevated to cut-and-cover tunnel under Astoria Blvd South: This complex interface would require careful partner agency coordination with NYC DOT, NYS DOT, and FHWA during the design stage. There is a residual risk that gaining the necessary approvals, keeping all roads open to traffic, and maintaining access to adjacent businesses during construction would require more complex temporary access arrangements or greater working constraints on construction sequencing than currently evaluated. This risk is typical for such a complex transition where multiple highways and other roads converge; however, should the process to gain approval prove more complex, it could result in prolongation to the current construction schedule and high increases in construction cost.
  - Accommodating the proposed guideway structures, piers, and foundations within the GCP ROW: There is a residual risk that, during detailed design coordination with NYS DOT (and FHWA where applicable), more complex support structures than currently envisaged are required to avoid introducing non-standard roadway elements to the existing highways or to allow existing non-standard elements to be brought up to current standards (in the future by NYS DOT). The study team concluded this risk is typical of work in and around existing major highways but one that still has the potential to result in large increases in construction cost and schedule prolongation.
  - Scale of construction work required to tie-into the existing Jackson Hts-Roosevelt Av/74 St-Broadway Subway station: There is a residual risk that, due to the Jackson Heights Station existing mezzanine tie-in point being underground, construction of the tie-in becomes more complex than accounted for in the evaluation should ground surveys identify constraints in the proposed tie-in route. The study team concluded that this is a risk that would be considered typical of interfacing with an existing facility in this way but could still have the potential to result in large increases in construction costs and prolong the project schedule.
  - Scale of on-Airport structures or modifications to on-Airport roads required to accommodate new light rail stations and elevated track: The study has evaluated an alignment that, at this stage of development, can be accommodated within the existing Airport buildings and roadway structures. There remains a residual risk that, once more

detailed surveys of the existing structures and their foundations are conducted, more complex or longer span structures are required than currently evaluated and/or structural modifications could be required to the existing on-Airport roadways and support structures. This risk is typical for infrastructure of this type in such constrained and highly built-up areas; however, considering the light rail station's more modest size requirements, it could still result in moderate increases in construction costs over those accounted for in this evaluation.

- Construction methodology for working in and over existing Amtrak, LIRR, and/or CSX rail ROWs: There is a residual risk that partner agency coordination, during detailed design with Amtrak, LIRR, and/or CSX, results in more stringent constraints being imposed on construction methodologies than currently evaluated. This could include fewer line blockades, shorter working windows, or smaller construction zones. This risk is typical for construction work adjacent to operating railroads; it could result in prolongation of the construction schedule with associated cost increases.
- Scale of utility strengthening and/or replacement work needed along the GCP: There is a residual risk that, once condition surveys of the existing large-diameter utilities under the GCP can be undertaken, the results identify the utilities to be in a poorer condition than currently evaluated. This could result in more intrusive strengthening or even replacement of the existing utilities before construction work can commence. This is a risk typical for major infrastructure work in close proximity to large legacy utilities; however, it could result in large increases in construction costs and delay to the start of construction, prolonging the overall schedule.

5.5.1.2 Infrastructure Impacts during Construction

Construction of this option would result in temporary disruption to other major infrastructure along the route, which would last for 2–3 years. The notable areas of temporary infrastructure disruption are summarized below. The durations given below are indicative and based on preliminary assessment.

- **Operational and Passenger Disruption to Subway and MTA Bus Services Using Jackson Hts-Roosevelt Av/74 St-Broadway Station**
  - 5–10 overnight station closures are likely, restricting passenger access over a period of 4–8 months, while the more intrusive construction work would occur to the existing below-ground subway mezzanine for the Subway/light rail passenger connection. Subway services on E, F, M, R, and 7 Lines would continue during the work. Passenger access to the station would be restricted during this work; however, coordination with MTA during detailed development could allow limited passenger access (e.g., to the 7-Line or to transfer between lines) if the work is conducted behind safety hoardings, reducing the impact. Jackson Hts-Roosevelt Av/74 St-Broadway Station is a busy transfer station, and this work would be timed and coordinated with the MTA to minimize impacts to passenger services.

  - Disruption to passengers accessing Jackson Hts-Roosevelt Av/74 St-Broadway Station is expected for 1–2 years while pedestrians along Broadway are safely routed around construction zones for the proposed light rail station and connector. Periodic inconvenience and reduced passenger circulation access are likely at the mezzanine interface points for 1–2 months during construction of the mezzanine connections. Passengers would still be able to access and use the station throughout this period, although their journey would be inconvenienced or re-routed by the presence of construction activity. Further development of engineering solutions, including detailed analysis of passenger flows, would be needed to identify the extent of station disruption and any potential mitigations, like temporary exit stairs.
  - Disruption to the various MTA bus services (including the Q70-SBS and Q47 Airport routes) that have bus stops located along Broadway and Roosevelt Ave is expected for 1–2 years during construction work for the proposed light rail station and passenger connector.

- **Operational Disruption to Rail Services Using the CSX Freight Railroad**
  - 2–4 overnight and/or weekend closures to the CSX freight line between Broadway and 35th Ave would be required over a 4- to 8-week period during adjacent guideway foundation construction using piling rigs and other tall equipment. Closures would need to be planned in advance and accepted by CSX (and other freight line users); they would be timed to occur during non-freight use periods to minimize impact to railroad users.
  - 1–2 overnight closures to the CSX freight line between Broadway and 58th St would be required over a 2- to 4-week period during adjacent erection of elevated guideway bridge sections. Closures would need to be planned in advance and accepted by CSX (and other freight line users); they would be timed to occur during non-freight use periods to minimize impact to railroad users.

- **Lane Closures on BQE Northbound Off-Ramp to Northern Blvd**
  - Reduction of the northbound BQE off-ramp to Northern Blvd exit lanes from two to one would be necessary for a period 6–12 months to allow shifting the off-ramp structure prior to guideway pier column construction.
  - Temporary speed restrictions and lane width reductions on the northbound BQE off-ramp to Northern Blvd are expected for 1–2 years (following off-ramp shifting) to provide safe construction access for guideway foundations, column piers, and bridge deck. Two lanes would be maintained during this period, but shoulder widths would be reduced.
  - 2–4 overnight closures would be required to the northbound BQE off-ramp to Northern Blvd over a 2- to 4-month period during erection of elevated guideway bridge sections.

- **Lane Closures and Speed Restrictions on Eastbound BQE Connector**
  - Temporary removal of the Eastbound BQE Connector right-hand shoulder and traffic speed restrictions between 31st Ave and 25th Ave would be expected for 9–18 months to provide safe construction access to the northbound shoulder for adjacent piling, foundation, and pier work on 68th St.
  - 15–30 overnight lane closures and speed restrictions on the northbound roadway would be likely over a period of 9–18 months during elevated bridge deck erection.
  - There would be overnight full road closures and traffic diversions for up to a week to replace four overhead signage gantries. These would be coordinated with lane closures for bridge deck beam erection.

- **Lane Narrowing, Traffic Diversions, and Speed Restrictions at the Eastbound BQE Connector/GCP Intersection**
  - There would be a closure of the Boody St Eastbound BQE Connector off-ramp for 1–2 months while transitioning to a new, relocated off-ramp. Traffic diversions would be required and could be provided via a temporary access roadway further south onto Boody St.
  - Speed restrictions on the Eastbound BQE Connector northbound lanes for 9–18 months would be likely to provide safe construction access to the adjacent cut-and-cover tunnel construction under Boody St.
  - A realignment of Boody St would likely be required at the intersection with Astoria Blvd South for 9–18 months during construction of the cut-and-cover tunnel. The temporary diverted road could be provided through the parking area north of the Bulova Building.
  - There would be temporary lane closures and traffic detours expected on Astoria Blvd South between the intersections of Boody St and 77th St for 9–18 months during construction of the cut-and-cover tunnel. Astoria Blvd South would be reduced from two lanes to one lane to avoid a full road closure during this time.
  - Closure of the GCP on-ramp from Astoria Blvd South and 77th St for 1–2 months would be necessary while transitioning to the new, relocated on-ramp. Traffic diversions would be required via 23rd Ave and Ditmars Blvd.

- **Lane Narrowing, Traffic Diversions, and Speed Restrictions on GCP**
  - Narrowing of the eastbound GCP lanes and traffic speed restrictions between the Astoria Blvd North overpass and 94th St would be required for 9–18 months to provide safe construction access to the eastbound shoulder during construction of the at- and below-grade guideway located between the GCP and 23rd Ave.
  - Full closure of the Ditmars Blvd GCP off-ramp for 1–2 months would be required while transitioning to a new, relocated off-ramp. Traffic diversions would be required via the Astoria Blvd South off-ramp.
  - 2–4 overnight road closures and traffic diversions would be required over a period of 1–2 weeks to erect long-span bridge sections over the GCP into the Airport.

- 10–15 off-peak, overnight, and/or weekend road closures on the GCP and traffic diversions would be needed over a period of 12–18 months to demolish the 82nd St Bridge deck and erect new deck structure.
- Lane closures would be required over a period of 12–18 months on the 82nd St crossing of the GCP; these would be conducted one roadway at a time so that two-way traffic could still cross the bridge, albeit on a reduced number of traffic lanes.

- **Disruption to Intra-Airport Services and Facilities**
  - Increased construction traffic around Terminals B and C for 9–18 months would require a coordinated traffic management plan to avoid/minimize potential on-Airport traffic disruption.
  - 15–30 overnight and/or off-peak lane and road closures of on-Airport access roads would be expected for a 1- to 2-year period during long-span bridge section erection and other elevated structure work.
  - Airport user inconvenience could potentially occur to certain portions of Airport facilities for 2–4 months during construction of customer transfer connections and circulation. This would require a coordinated traffic management plan to avoid/minimize potential traffic disruption.

5.5.1.3 Permanent/Operational Impacts to Existing Infrastructure

Once completed, this option would have the following permanent/operational impacts on other infrastructure along the route:

- **Brooklyn-Queens Expressway**
  - The off-ramp from the northbound BQE roadway to Northern Blvd would be permanently realigned to accommodate guideway support piers.
  - The off-ramp from the Eastbound BQE Connector northbound roadway to Boody St would be permanently relocated to accommodate the guideway transition to the cut-and-cover tunnel.
  - The completed fixed guideway structure supports could restrict any future NYS DOT roadway improvement plans to widen or adjust the Eastbound BQE Connector between 31st Ave and the GCP.

- **Grand Central Parkway**
  - The on-ramp to the eastbound GCP from Astoria Blvd South and 77th St would be permanently relocated to accommodate the cut-and-cover tunnel.
  - The off-ramp from the eastbound GCP to Ditmars Blvd would be permanently relocated to accommodate the elevated guideway over 94th St.
  - The completed fixed guideway structure could restrict any future NYS DOT roadway improvement plans to widen or adjust the GCP between 77th St and 90th St.

- **Impacts on LGA**
  - The location of the elevated guideway and station in front of Terminal B would result in the construction of structure piers and frames in the area that has currently been identified to be the future permanent Terminal B taxi hold. This could prevent the taxi hold from using this location, requiring an alternate location, which may not be as operationally efficient.

5.5.1.4 Indicative Capital Cost

The Indicative Capital Cost for Option LR-5 is $4.0 billion (in 2022$, excluding future escalation and solely for approximate comparison between study options).

Indicative Capital Costs should be considered to have a range of estimating uncertainty of -10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).

As discussed in more detail in Section 3.2.1.1.1, the preliminary engineering work carried out by the study team has not identified a construction approach that, with confidence, could overcome the significant challenges and complexities presented by the twin constraints of the FAA Airport Design Standards and the existing large-diameter, 90-year-old utility structures along the GCP without more complex, risky, and costly approaches to construction that would require greater engineering exploration beyond the scope of this study. Therefore, to provide a basis of an order-of-magnitude cost on which to compare between options, this option was costed out using the (least cost) baseline solution of an open trench south of Runway 04-22, despite this approach not being compliant with FAA Airport Design Standards. Costs associated with an FAA compliant tunneled solution which could require replacement or relocation of existing sewer structures could result in additional costs of between $1–3 billion.

The following are the notable cost drivers for the option:

- Elevated guideway structure along city streets, BQE, GCP, and on-Airport.
- New elevated light rail stations and connectors at LGA.
- Track-side equipment, systems, and power.
- Cut-and-cover tunnel under Astoria Blvd South and at- and below-grade guideway along GCP (open trench structure south of Runway 04-22).
- Provision of a new OMSF.
- Revenue service light rail vehicles.
- New elevated light rail station and connector at Jackson Heights.
- Utilities protection and relocation costs.
- Roadway maintenance and traffic protection costs.
- Replacement of the 82nd St Bridge (to accommodate open trench structure south of Runway 04-22).
- Modification work to existing Subway station.
- Reconstruction of BQE off-ramp to Northern Blvd.
- Relocation of Astoria Blvd South on-ramp to GCP (at 77th St).
- Long-span crossings on-Airport.
- Relocation of GCP off-ramp to Ditmars Blvd.

5.5.1.5 Indicative Timeline/Schedule

The Indicative Timeline/Schedule (for comparison between study options) for Option LR-5 is approximately 11–12 years from a decision to take the option forward to revenue service. This includes the following notable schedule drivers:

- Planning, approvals, and acquisitions.
- Procurement of design-build contractor(s) for heavy civil construction.
- Procurement of new light rail vehicles.
- Jackson Heights Station tie-in.
- Elevated guideway construction to BQE.
- Cut-and-cover tunnel construction under Astoria Blvd South (longest construction activity).
- 82nd St Bridge reconstruction.
- On-Airport elevated stations and structure.
- Construction of an OMSF.
- Systems installation and testing.
- 12 months of commissioning.

Figure 5.5-2 illustrates the indicative timeline/schedule for Option LR-5. The key drivers are the major civil construction work, which may trigger longer permitting, approvals, and procurement processes, and the light rail systems commissioning.

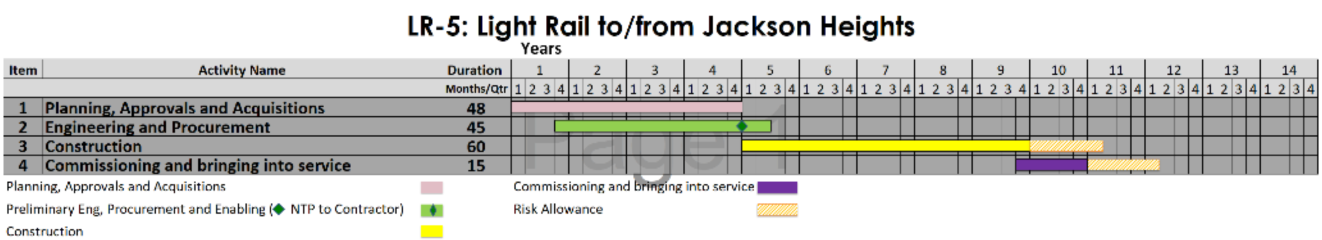


FIGURE 5.5-2: INDICATIVE TIMELINE/SCHEDULE (LR-5)

5.5.2 Transportation Aspects

5.5.2.1 Improved Access to LGA

Three factors have been considered in this category: Standardized Indicative Baseline Off-Peak Travel Time, Reliability, and Transfer Experience.

5.5.2.1.1 Standardized Indicative Baseline Off-Peak Travel Time

- Table 5.5-1, below, provides the Standardized Indicative Baseline Off-Peak Travel Times for the weekday, midday off-peak journeys to be used solely as a baseline for comparison between options. Table 5.5-2 provides a breakdown of the components that make up the total journey, the general approach to the estimation of which is described in Section 3.2.2.1.1.

- Passengers making the journeys described would, naturally, experience variations to the baseline timings calculated even where services are running as planned, for reasons as simple as variations in walking speeds or whether a traveler arrives just before a scheduled departure or just misses a departing train.

TABLE 5.5-1: STANDARDIZED INDICATIVE BASELINE OFF-PEAK TRAVEL TIME, OPTION LR-5

Penn Station to LGA (minutes to Terminal B)	LR-5
Via Subway (E train) to Jackson Heights	37

TABLE 5.5-2: STANDARDIZED INDICATIVE BASELINE OFF-PEAK TRAVEL TIME BY SEGMENT, OPTION LR-5

Penn Station to LGA via E Subway (minutes)	LR-5
START 34th St (8th Av) Penn Station (street level)	
walk/wait time	6
E-Subway platform (dep)	
Subway trip time	18
Jackson Heights E-Subway platform (arr)	
walk/wait time	8
Jackson Heights light rail platform (dep)	
Light rail trip time	5
1st on-Airport station (arr)	new elevated
END Terminal light rail stop	Terminal B
Total travel time =	37
trip time to next Terminal light rail stop	2
2nd on-Airport station	new elevated
END Terminal light rail stop	Terminal C
Total travel time =	39

- Passengers for Terminal A would transfer to an existing on-Airport shuttle service running every 10 minutes and with an additional trip time of around 7 minutes from Terminal B.

5.5.2.1.2 Reliability

- Option LR-5 would operate exclusively on dedicated infrastructure separate from general roadway conditions.

5.5.2.1.3 Transfer Experience

Riders bound for Terminals B or C would transfer from the Subway services to the new light rail service at Jackson Heights-Roosevelt Av/74 St Station, colloquially known as Jackson Heights Station. Riders bound for Terminal A would have an additional transfer to an existing on-airport shuttle once they reach the airport.

Customer Transfer

- The studied light rail terminal at Jackson Heights Station would connect to the existing elevated Jackson Heights station, at the same level as the 7-Line platform, roughly 30-35 feet above Broadway. Since the existing Jackson Heights Station is accessible, all transfers would be ADA-compliant.
- Riders arriving at Jackson Heights Station from the underground subway lines, the E, M, F, or R would follow new wayfinding from the underground platform level to the elevated light rail station, and approximately 250 ft walk. Riders arriving via the 7-Line would have a direct connection from the platform level to the fully enclosed light rail station with a less than 200 ft walk with minimal changes in elevation.

5.5.2.2 Ridership

- Stated preference survey results indicate that 49% of airport passenger respondents are “definitely” or “probably” interested in fixed guideway connections to existing transit services.
- The ridership model projects 7.3 million total riders using Option LR-5, with a corresponding increase in net transit ridership of 5.5 million riders in 2025 (Table 5.5-3).

TABLE 5.5-3: RIDERSHIP MODEL RESULT SUMMARY

Transit Option			Riders on Current Bus Services to LGA (Millions) (No Action)	New Transit Option Impact (Millions)		
Mode Category & Scenario Label		Description		Riders on New LR-5 Light Rail Service	Net Increase in Total Transit Ridership	Total Transit Ridership (LR-5 Light Rail Service + Other Bus Services)
Fixed Guideway with Light Rail	LR-5	Jackson Heights	4.1	7.3	**5.5**	**9.5**

5.5.2.3 Throughput and Capacity

Throughput

- Using the highest hourly single-direction provision of airline seats at LGA in 2019 (4,300 seats on weekday departing flights 9 AM to 10 AM – see Figure 3.2-1, in Section 3.2.2.3), the estimated single-direction peak passenger demand for this option could be approximately 860 passengers per hour.
- It should be noted that these passengers would likely arrive at the transfer station in groups, rather than being evenly distributed throughout the time period.

Capacity of New Transit Option

- Using the AirTrain JFK system as an example, automated light rail systems can be tailored to throughput requirements using an appropriate combination of train length and frequency. Typically, 58-ft cars are able to accommodate more than 75 passengers with luggage, with around one-third of them seated.

- With the proposed arrangement of three-car trains at 4-minute intervals, the potential total capacity of the proposed new light rail link could be:
  - 3,375 pphpd at peak.
- This is sufficient to support the estimated single-direction peak passenger demand from the ridership model, equating to approximately 60 passengers per train at peak with this proposed train-car configuration and frequency.
- Actual train-car configuration and frequency would be adapted in practice to suit demand and other operating requirements.

Impact on Capacity of Existing Downstream Transit Systems

- Jackson Hts-Roosevelt Av/74 St-Broadway stations offer transfer access to the E, F, M, R, and 7-Subway lines.
- Generally, airport passenger loadings are constant through the day both to and from the Airport with the peak passenger loadings occurring outside of the morning Manhattan-bound subway peaks or in the opposite direction (i.e., Airport-bound).
- The existing E- and F-Subway lines currently operate close to their peak capacity during the 8 AM to 9 AM Manhattan-bound commuting peak. While most Manhattan-bound Airport passengers would travel outside this peak, those passengers (including non-Airport passengers) traveling during this peak could experience some crowded conditions.
- The MTA noted that crowding could occur when groups of passengers arrive and depart at the same time.
- The study team noted that this station has five levels (underground platform, underground mezzanine, street, elevated mezzanine, and elevated platform), each accessible only by a single elevator. The underground mezzanine is also connected to the elevated mezzanine by an escalator that bypasses the street. As such, the additional passenger load for this option could overload the currently provided elevators and escalators. The physical layout of the station would make adding elevators and/or escalators difficult, if not impossible, without significant station reconfiguration.

5.5.2.4 Indicative Operating Cost

A preliminary costing exercise, based on previous estimates for the LAIP (Mets-Willets AirTrain, currently on pause) concept, considering the line length and the cost categories relating to it, suggests estimated annual operating and maintenance costs on the order of $40 million per annum. This estimate includes owner’s costs.

5.5.3 Community and Environmental Aspects

5.5.3.1 Local Community Impacts

The option has a proposed fixed guideway station that would be located at elevation over Broadway on the north side of the existing Jackson Hts-Roosevelt Av/74 St-Broadway Subway station. Passenger connectivity between the Subway station and the light rail station would be provided via an environmentally conditioned connector down to Diversity Plaza (NYC Plaza) on 37th Road and underground to the existing Jackson Hts-Roosevelt Av/74 St-Broadway Subway mezzanine.

The first 1.25 miles along Broadway, 69th St, 68th St, and Boody St would be located within densely developed neighborhoods (properties on both sides of the structure) consisting of a wide range of properties ranging from single-family (row & detached) to 6- to 14-story residential buildings, commercial businesses, mixed-use (residential above commercial) buildings, public community buildings, NYC Parkland (Planeview Park and Overlook Park), and NYC Plaza (Diversity Plaza). The approximately 3.2-mile route goes through/along the following neighborhoods: Woodside, Jackson Heights, and East Elmhurst.

The potential for temporary (during construction) and permanent (once operational) impacts is summarized below for specific areas of the alignment.

5.5.3.1.1 Temporary Impacts during Construction on the Local Neighborhoods Directly Affected

The fixed guideway from Jackson Hts-Roosevelt Av/74 St-Broadway Station to LGA would require major heavy civil construction activities to build the elevated guideway foundations, structures, and stations along the route. Construction activities are anticipated to occur along the approximately 3.2-mile route for approximately 5 years.

As discussed in more detail in Section 3.2.1.1.1, the preliminary engineering work carried out by the study team has not identified a construction approach that, with confidence, could overcome the significant challenges and complexities presented by the twin constraints of the FAA Airport Design Standards and the existing large-diameter, 90-year-old utility structures along the GCP without more complex, risky, and costly approaches to construction that would require greater engineering exploration beyond the scope of this study. Therefore, to provide a consistent basis on which to evaluate it, this assessment was based on the baseline solution of an open trench south of Runway 04-22, despite this approach not being compliant with FAA Airport Design Standards.

During construction, the following neighborhoods would have the potential for air quality, noise, vibration, or visual impacts. For the frequency and duration of construction activities refer to Section 5.5.1.2 “Infrastructure Impacts during Construction” above:

- **Construction of a New Light Rail Station and Structure at Jackson Heights and the Elevated Structure along Broadway, 69th St, and 68th St**
  - The fixed guideway and light rail station would require major heavy civil construction activities to build the elevated guideway foundations, and structures that would be required along this approximately 0.65-mile segment of the route.
  - The construction would occur within 35–50 ft of 2 short and 6 long city blocks of residences and commercial properties, including Diversity Plaza (NYC Plaza, open to pedestrians at the outdoor market off Broadway).
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - Planned periodic closure of sidewalks, bike lanes, and parking spaces would be required.
  - Planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.

- **Construction Along the Eastbound BQE Connector and Boody St**
  - The fixed guideway would require major heavy civil construction activities to build the elevated guideway foundations and structures along this approximately 0.3-mile segment of the route.
  - The construction would occur approximately 35–50 ft from 4 short city blocks of residential and commercial properties.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - Planned periodic closure of sidewalks, bike lanes, and parking spaces would be required.
  - Planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.

- **Construction of Cut-and-Cover Tunnel beneath Astoria Blvd South**
  - The proposed guideway along the approximately 0.15-mile segment of the route would transition from running elevated to running at- and below-grade, south of the GCP eastbound roadway.
  - The construction would occur approximately 150–200 ft from 1 city block of commercial properties.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - Planned periodic closure of sidewalks, bike lanes, and parking spaces would be required.
  - Planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.

- **Reconstruction of 82nd St Bridge**
  - Lane closures and contra-flow traffic on 82nd St Bridge would be continuous throughout the construction as bridge sections would be demolished and reconstructed one half at a time.
  - The construction would occur approximately 150–200 ft from 2 short city blocks of residential and commercial properties.
  - Planned periodic lane closures, contra-flow traffic on the bridge, and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - Planned night closures of the GCP could be required for the long-span bridge erection.
- **Constructing over 94th St and the GCP into the Airport**
  - Reconstruction of the GCP eastbound off-ramp onto Ditmars Blvd near 90th St and construction of an elevated guideway (30 ft above 94th Street) with long-span (approximately 250–300 ft) bridge structures crossing over 94th St and the GCP into the Airport would be required along the approximately 0.5-mile segment of the route.
  - The construction would occur approximately 100–350 ft from 4 short city blocks of residential and commercial properties.
  - Planned night closures of the GCP would be required for the long-span bridge erection.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - There could be increased construction/haul traffic on local roads because trucks are not allowed on the GCP.
- **Constructing On-Airport Elevated Light Rail Stations**
  - Construction activities associated with the erection of long-span (approximately 350-ft) elevated guideway bridge structures over an approximately 0.5-mile segment of the route over 102nd St and the newly constructed departures roadway at the Airport would be required.
  - The construction would occur over 500 ft from 5 city blocks of residential and commercial properties in the East Elmhurst community located on the other side of 8 lanes of the GCP.
  - Planned night closures of the GCP would be required for the long-span bridge erection.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - There could be increased construction/haul traffic on local roads because trucks are not allowed on the GCP.

- **Construction of the OMSF**
  - The fixed guideway with light rail solution would require a facility of approximately 115,000 sf at the site of the former (now vacant) Courtyard by Marriott hotel on Ditmars Blvd between 90th St and 92nd St. This site on Ditmars was used for this purpose in the analysis; however, due to the hotel's recent change of ownership, it may no longer be available for this purpose. Should this option be advanced, further study would be needed to determine a suitable location for the OMSF.
  - The construction of the facility (track and building(s)) would occur for approximately 1 year and approximately 50–100 ft from 3 city blocks of residential and commercial properties.

5.5.3.1.2 Permanent Operational Impacts on the Local Neighborhoods Directly Affected

Electrically powered light rail vehicles, similar in size and characteristics to the vehicles that currently operate on AirTrain JFK, would operate between LGA and the proposed new light rail station at Jackson Heights at peak headways of 4 minutes. They would operate on a predominantly elevated fixed guideway structure, descending to get past Runway 04-22, ranging approximately 35–500+ ft from residential and commercial properties. During periods of reduced airport demand (e.g., overnight), headways would significantly reduce.

The following local neighborhoods and areas would have the relative potential for permanent noise, vibration, or visual impacts as a result of this option's proposed light rail operations:

- **New Elevated Light Rail Station at Jackson Heights and the Elevated Structure along Broadway, 69th St, and 68th St**
  - From the proposed light rail station at Jackson Heights, light rail vehicles would operate in each direction on an elevated fixed guideway structure along the center of Broadway, 69th St, and 68th St, approximately 35–50 ft from residential and commercial properties.

- **New Elevated Light Rail Along the Eastbound BQE Connector and Boody St**
  - Once the guideway reaches the Eastbound BQE Connector, light rail vehicles would operate in each direction on an elevated fixed guideway structure along the BQE Eastbound Connector shoulder, approximately 35–50 ft from residential and commercial properties.
  - The Boody St off-ramp would be reconstructed causing a potential permanent impact to the car park access to the Bulova Building and the delivery access to Home Depot. The relocated off-ramp would potentially end up aligning with these access points, requiring their relocation (further north or south).
  - Potential permanent loss of shoulder and parking would be likely due to piers along Boody St and 68th St.

- **New Light Rail Cut-and-Cover Tunnel beneath Astoria Blvd South**
  - North of the Bulova Building, light rail vehicles would operate in each direction within a cut-and-cover tunnel beneath Astoria Blvd South approximately 150–200 ft from commercial properties.

- **New Elevated Light Rail over 94th St and the GCP into the Airport**
  - Once past the RPZ and the end of Runway 04-22, light rail vehicles would rise to operate in each direction on an elevated fixed guideway structure over the GCP onto the Airport approximately 100–350 ft from residential and commercial properties.

- **New On-Airport Elevated Light Rail Stations**
  - On-Airport, light rail vehicles would operate in each direction on an elevated fixed guideway structure between the two proposed light rail stations over 500 ft from residential and commercial properties in the East Elmhurst community located on the other side of 8 lanes of the GCP.

- **New Light Rail OMSF**
  - The proposed maintenance and storage facility at the site of the former (now vacant) Courtyard by Marriott hotel on Ditmars Blvd between 90th St and 92nd St would experience light rail vehicle movements throughout the day, peaking when vehicles leave and enter the facility at the start and end of peak operations. Maintenance and other activities would occur throughout the day and possibly overnight within covered buildings/vehicle sheds. These activities would occur approximately 50–100 ft from residential and commercial properties. Note that this site on Ditmars was used for this purpose in the analysis; however, due to the hotel's recent change of ownership, it may no longer be available for this purpose. Should this option be advanced, further study would be needed to determine a suitable location for the OMSF.

5.5.3.1.3 Potential Private Property Acquisitions

The new fixed guideway with light rail to/from Jackson Heights may require permanent acquisition of the following:

- Up to 44 private residential and 10 private commercial.

5.5.3.1.4 Potential Public Property Acquisitions (NYC DOT Plazas and NYC Parks Parkland)

The new fixed guideway with light rail to/from Jackson Heights would result in permanent impacts to the following:

- New support columns for the permanent fixed guideway structure would be located within Planeview Park and the below-grade structure within Overlook Park.
- Passenger connectivity between the Subway station and the light rail station is provided via a ‘conditioned space’ connector down to and within Diversity Plaza (NYC DOT Plaza open to pedestrians at the outdoor market off Broadway) on 37th Rd.

5.5.3.1.5 Removal/Reconfiguration of Parking Spaces

- A total of approximately 200 public parking spaces would be lost on the following streets:
  - Broadway.
  - 68th St.
  - 69th St.
  - Boody St.

The numbers are approximate and are preliminary estimates based on the alignment.

5.5.3.1.6 Environmental Justice Communities Mapping Analysis

The Environmental Justice communities mapping analysis provides an overview of the minority and low-income communities within 0.25 mile of the transit options being evaluated.

For Option LR-5, more than half of the block groups within the 0.25-mile buffer of the option alignment are Environmental Justice block groups.

See Figure 5.5-3 below for the analysis map.

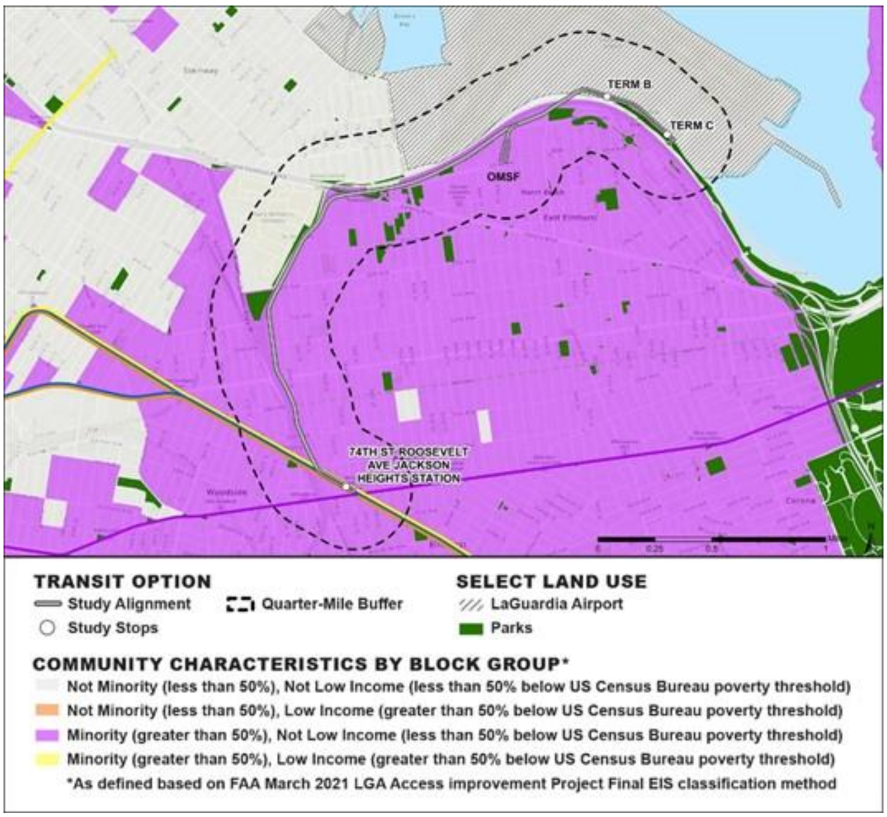


FIGURE 5.5-3: JACKSON HEIGHTS OPTION – ENVIRONMENTAL JUSTICE COMMUNITIES MAPPING ANALYSIS (AS DEFINED BASED UPON FAA MARCH 2021 LGA ACCESS IMPROVEMENT PROJECT FINAL EIS CLASSIFICATION METHOD)

5.5.3.2 Equity

5.5.3.2.1 Transit Access from LGA

- **Additional Minority and Low-income Populations Reached within 45 Minutes from LGA via Transit (Population Access Analysis)**
  - The results of the Population Access Analysis illustrate how many people, specifically from low-income and minority populations, could travel via transit from LGA to homes within 45 minutes from LGA. Airport passengers or Airport employees living within these areas could potentially benefit from expanded access to these destinations.
  - Option LR-5 is expected to expand transit access from LGA to regional destinations within 45 minutes, as shown in the blue area of “Additional Access Provided by Transit Option” in Figure 5.5-4. Compared to the baseline, the minority population reached within a 45-minute transit trip would increase by 129.2% and the low-income population reached within a 45-minute transit trip would increase by 155.4% as shown in Table 5.5-4.
  - This represents a higher increase in transit access to LGA within 45 minutes for minority and low-income communities.

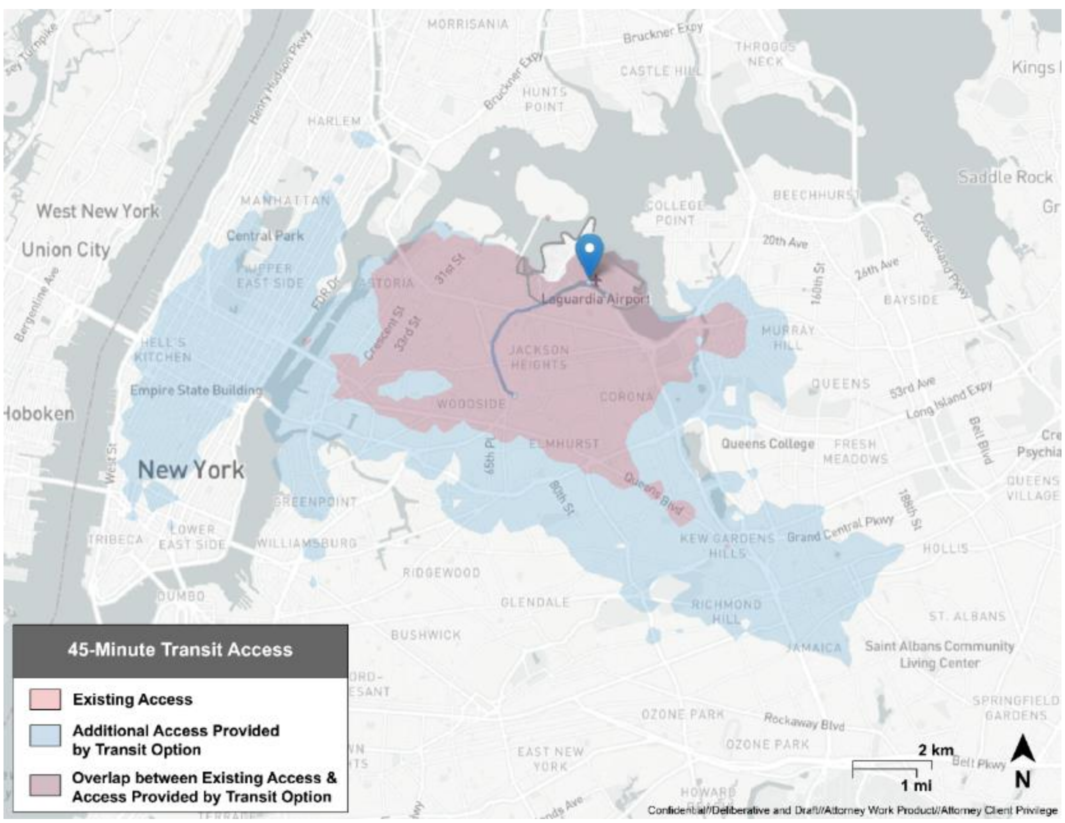


FIGURE 5.5-4: JACKSON HEIGHTS OPTION LR-5 – POPULATION ACCESS ANALYSIS

TABLE 5.5-4: JACKSON HEIGHTS OPTION LR-5 – POPULATIONS REACHED WITHIN 45-MINUTE TRANSIT TRIP

		Total Population Reached	Minority Population Reached	Low-Income Population Reached
Baseline	Existing Condition	551,434	422,981	76,750
LR-5	With Option	1,647,988	969,414	196,013
	Net Change	+1,096,554	+546,433	+119,263
	% Change	198.9%	129.2%	155.4%

- **Additional ADA-Accessible Stations within 45 Minutes from LGA via Transit (ADA Analysis)**
  - The results of the ADA Analysis illustrate how Airport passengers and Airport employees, specifically those requiring ADA-compliant stations, traveling from LGA to other locations could potentially benefit from expanded access to ADA-compliant stations within 45 minutes via transit.
  - More ADA-accessible stations/stops can be reached within a 45-minute transit trip for this option compared to the baseline of existing transit service (Table 5.5-5). This echoes the results from the Population Access Analysis, in which Option LR-5's 45-minute transit travel shed provides an increased amount of access over the baseline transit service. Compared to the baseline, an additional 77 ADA-accessible stations can be reached within a 45-minute transit trip from LGA for Option LR-5.

TABLE 5.5-5: JACKSON HEIGHTS OPTION LR-5 – ADA ANALYSIS

Subway, Ferry, LIRR, and MNR Stations Reached within 45-Minute Transit Trip from LGA	Baseline	LR-5	Difference between Baseline and LR-5
Total Stations	*43*	*168*	*+125 stations*
ADA-Accessible Stations (Accessible Stations as % of Total)	*20 (47%)*	*97 (58%)*	*+77 stations*

5.5.3.2.2 Transportation Opportunities and Benefits for the Surrounding Community

- **Transportation Opportunities for Neighbors**

  This option does not include intermediate/off-Airport stops. Because there is limited pedestrian access to LGA from adjacent residential areas and walking distance exceeds 0.25 mile, the study team did not consider there to be a significant market for use of the final on-Airport stops by the surrounding community to connect to the broader transit network.

- **Cars Removed from Local Roadways and Emissions Reductions**

  See the "Cars Removed from Local Roadways" section and the "GHG and Other Vehicular Emissions Reductions" section of this evaluation below.

5.5.3.3 Cars Removed from Local Roadways

- Option LR-5 would be expected to remove 2,336,000 Airport passenger vehicles, and 174,000 Airport employee vehicles, from the road each year.

5.5.3.4 GHG and Other Vehicular Emissions Reductions

- Option LR-5 would be expected to remove 10,942 metric tons of CO_2 equivalent each year.
- Other vehicular emissions reductions are given in Table 5.5-6:

TABLE 5.5-6: OTHER VEHICULAR EMISSIONS REDUCTION (METRIC TONS PER YEAR)

Option	CO	VOC	NOx	SO_2	PM_{10}	$PM_{2.5}$
[LR-5] Jackson Heights	51.6	0.7	3.5	0.2	2.0	0.4

5.5.4 Summary of Evaluation

LR-5: Light Rail to/from Jackson Heights

Option LR-5 would provide a two-seat ride to LGA via a 5-minute light rail ride to/from the existing Jackson Hts-Roosevelt Av/74 St-Broadway stations, providing multiple transfer access to the E, F, M, R, and 7-Line services and the busy community hub around the station. A new dedicated light rail station would be located above Broadway adjacent to the 7-Line station, providing ADA-compliant passenger access. LR-5 could also link to the proposed Interborough Express (IBX) project's Jackson Heights terminus. The guideway would run above city streets to the BQE and GCP transportation corridors, on to LGA, avoiding city traffic.

This option would require the construction of heavy infrastructure, including elevated concrete guideway structures along predominantly city streets (for approximately 1.3 miles), open-trench concrete structures within the GCP transportation corridor (for approximately 1 mile), and elevated structures on-Airport (for approximately 0.5 miles). This option would have to contend with the construction challenges of complying with FAA Airport Design Standards while negotiating the 90-year-old utilities under the GCP at the end of Runway 04-22 (a challenge as yet unresolved as discussed in Section 3.2.1.1.1), constructing a cut-and-cover tunnel at the BQE/GCP intersection, and constructing the transfer station and guideway above city streets. For the purpose of cost comparison, this option was costed out on the basis of a baseline solution of an open trench south of Runway 04-22 despite this approach not being compliant with FAA Airport Design Standards.

Table 5.5-7 summarizes the output from all the factors used to evaluate this option.

TABLE 5.5-7: SUMMARY OF KEY CHARACTERISTICS – LIGHT RAIL TO/FROM JACKSON HEIGHTS (LR-5)

	Evaluation Factor	Assessment
CONSTRUCTION ASPECTS	Constructability	• **Major unresolved constructability challenge**: Complying with FAA Airport Design Standards while also avoiding disruption to 90-year-old, 15 ft diameter sewer structures at the end of Runway 04-22 (see details in Section 3.2.1.1.1) • Construction of elevated light rail station in dense neighborhood and urban hub adjacent to existing subway station • Constrained construction access adjacent to BQE, Eastbound BQE Connector and GCP • Reconstruction of 82nd St Bridge • Long spans (250-300 ft) over 94th St Bridge and 102nd St bridges on-Airport • Constrained on-Airport sites for new elevated light rail structure and 300 ft stations • Total option route length: approx. 3.2 miles
	Infrastructure Impacts during Construction	• Operational disruption to E, F, M, R lines and MTA bus services at Jackson Heights Station • Operational disruption to CSX line • Lane closures / reductions and speed restrictions on BQE, GCP and Astoria Blvd
	Permanent/Operational Impacts to Existing Infrastructure	• Inhibits future widening of the BQE and GCP • Columns and piers in site of future Terminal B taxi hold
	Indicative Capital Cost (2022$)[72]	$4.0 billion[73] (Does not include any additional costs required for an as yet unresolved solution to get past Runway 04-22 in compliance with FAA Airport Design Standards; potentially up to approx. $1–$3 billion)
	Indicative Timeline/Schedule	11–12 Years
TRANSPORTATION ASPECTS	Standardized Indicative Baseline Off-Peak Travel Time (From Midtown Manhattan)	Via E-Line: 37 mins (5 mins on light rail) (Penn Station to Terminal B, then C; shuttle to Terminal A)
	Transfer Experience	• Transfer from 7-Line to light rail station would involve vertical move down to mezzanine via stair or escalator and then a second vertical move back up to the light rail platform level via elevator or escalator • Transfer from E, F, M, and R-Lines to light rail station would involve a vertical move up to the subway mezzanine level, followed by a short walk to a second vertical move up via escalator or elevator to the light rail platform level
	Ridership[74]	Total annual projected ridership for option: 7.3 million Net increase in annual projected transit ridership: 5.5 million
	Throughput & Capacity	3,375 pphpd (peak)
	Indicative Operating Cost	$40 million per annum

[72] Indicative Capital Costs should be considered to have a range of estimating uncertainty of –10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).

[73] Costs for heavy infrastructure options approaching LGA from the west/southwest are based on the open-trench construction concept past Runway 04-22 (over the existing 90-year-old utilities), to provide a baseline estimate of the cost of construction. Although this concept does not meet FAA Airport Design Standards, it provides a consistent approach for capital cost comparison purposes. Costs associated with tunnelling and/or relocating utilities would be substantially higher, potentially up to approx. $1–$3 billion.

[74] Experience from AirTrain JFK was that actual ridership turned out to be higher than would have been predicted by the AirTrain JFK forecast and underscores the inherent uncertainty of model predictions. The ridership model supporting this effort could also deviate from eventual ridership demand but was utilized to allow ridership comparisons between the options.

TABLE 5.5-7, CONTINUED.

	Evaluation Factor	Assessment
COMMUNITY AND ENVIRONMENTAL ASPECTS	Local Community Impacts	Construction: • Heavy civil construction of elevated and at-/below-grade structures for approx. 5 years Proximity to communities: • 35–50 ft from 15 city blocks of residential and commercial properties along Broadway, 69th St, 68th St, the BQE, and Boody St • Over 500 ft across 8 lanes of the GCP from 9 city blocks of residential and commercial properties opposite the Airport Terminals Permanent impacts: • Acquisition up to 54 properties (private residential, private commercial, and industrial) • Structures over or adjacent to Planeview Park, Overlook Park[75], and adjacent to Diversity Plaza • Loss of approx. 200 on-street public parking spaces along Broadway, 68th St, 69th St, and Boody St
	Equity	• Higher increase to low-income and minority populations within 45 minutes of the Airport via transit versus the no-build scenario • +77 additional ADA-compliant stations reachable within a 45-minute transit trip from LGA versus the no-build scenario
	Cars Removed from Local Roadways	2,336,000 airport passenger vehicles and 174,000 airport employee vehicles from the road each year
	GHG and other Vehicular Emissions Reductions	10,942 metric tons of CO2 equivalent each year

[75] Municipal parkland cannot be converted to a non-park use (known as alienation) without State legislative permission. Thus, the acquisition of New York City Parkland for construction of a mass transit option would require legislation authorizing such alienation. Obtaining such legislation is a multi-step process requiring actions by the New York City Council, the Mayor of New York City, the New York State Legislature, and the Governor.

6.0 BUS – TRANSIT IMPROVEMENTS ALONG EXISTING ROUTES

Bus improvement options would provide solutions to improving existing services accessing LGA; the Study evaluated improvements to the current LaGuardia Link Q70 Select Bus Service (Q70-SBS) and M60 Select Bus Service (M60-SBS) MTA-operated bus services. The improvements to these services would be intended to reduce current travel times, improve the reliability of the bus service, and increase passenger convenience compared to current operations.

Each of the options in this section was developed in consultation with the MTA to capitalize on its experience running bus services in New York City. As these options propose improvements to existing services rather than entirely new services, the evaluation was based on maintaining the existing service frequency and bus fleet and focused on infrastructure improvements, such as:

- Spot improvements.
- Transit priority signaling.
- Bypass lanes.
- Queue jumps.
- Transit lanes.

The bus options also considered the availability of customer convenience factors at bus stops (i.e., weather protection, seating and space for luggage, additional transit information, etc.) both at the Airport and at the transfer points. The timetable and service frequency of services would be adjusted to suit demand.

The evaluation considered the following existing bus route improvements as described below:

- B-1: LaGuardia Link Q70-SBS Route Improvements:
  - B-1A: Q70-SBS with spot improvements.
  - B-1B: Q70-SBS with heavier infrastructure improvements.
  - B-1C: Q70-SBS with lighter infrastructure improvement.
- B-2: M60-SBS Route with spot improvements.

The study team evaluated three levels of intervention for the Q70-SBS, Option B-1: B-1A, with spot improvements to the Q70-SBS; B-1B, with new, heavy construction bus-only infrastructure to avoid peak-time congestion on the GCP; and B-1C, a middle, cost-efficient option to improve bus services but with less community impact.

Plan and profile alignment drawings for each of the bus improvement alignments can be found in Appendix Section 2.3; they show the proposed layouts of the options as evaluated.

6.1 B-1: LaGuardia Link Q70-SBS Route Improvements

Option B-1 would offer improvements to the existing Q70-SBS bus route operated by the MTA. The Q70-SBS currently links LGA, via the BQE and GCP transportation corridors, with the existing Jackson Hts-Roosevelt Av/74 St-Broadway stations (at Jackson Heights), and the existing LIRR Woodside and 61 St-Woodside Subway stations (at Woodside). These provide transfer access to the E, F, M, R, and 7-Line Subway services at Jackson Heights, and the LIRR Main Line (including the Port Washington Branch) and 7-Line Subway services at Woodside, as well as connections to other MTA bus services. Jackson Heights is also the locale for a proposed terminal station for the planned MTA-led Interborough Express (IBX) project.

Currently, with the exception of the HOV lane in front of Terminal B in LGA, the Q70-SBS operates in mixed-flow traffic conditions for the entire route. Congestion and slow traffic conditions along portions of the route make the Q70-SBS slower and more variable at certain times of the day, which impacts its reliability. Some of the problem areas are:

- Near the intersection of 74th St/Roosevelt Ave/Broadway (congestion throughout the day).
- Broadway between 75th St and the BQE (slow traffic speeds).
- Along the northbound BQE (slow traffic speeds in the afternoon).
- Along the eastbound GCP (slow traffic speeds in the afternoon).
- Along the westbound GCP (periodic traffic congestion).
- Arrivals Rd near Terminal C (congestion in front of the terminal).
- Approaching westbound LaGuardia Rd/94th St (congestion at the intersection).

As part of the evaluation, three sub-options were considered, referred to herein as B-1A, B-1B, and B-1C; the key physical differences between the sub-options are summarized below:

- B-1A (Figure 6.1-1) would offer simple improvements to the existing Q-70 SBS service to improve customer experience and bus travel times. These improvements would include improved wayfinding and signage at existing stops, the introduction of a new 'queue jump' at the BQE off-ramp to Broadway, and traffic signals revised to prioritize the buses.
- B-1B (Figure 6.1-2) would offer bus travel time improvements over the existing Q70-SBS service through the introduction of new bus-only heavy infrastructure. In addition to the queue jump and transit signal improvements of B-1A, Sub-Option B-1B would convert the northbound BQE shoulder to a bus-only lane and construct a new dedicated busway structure from the BQE to new elevated bus stops on the Airport, allowing buses to completely bypass traffic on the GCP.
- B-1C (Figure 6.1-3) would offer bus travel time improvements over the existing Q70-SBS service through the introduction of new bus-only light infrastructure. In addition to the queue jump and transit signal improvements of B-1A, Sub-Option B-1C would convert the northbound BQE shoulder to a bus-only lane and construct a new bus-only loop-road and at-grade bus stop at Terminal C, bypassing traffic at the current Terminal C stop.

Like the existing Q70-SBS, all B-1 options would originate from the 61 St-Woodside Subway and LIRR Station and follow Roosevelt Ave to a stop at the Jackson Hts-Roosevelt Av/74 St-Broadway Subway and

Bus Station before traveling to LGA via Broadway, the BQE, and GCP. Once on-Airport, the B-1 options would stop at Terminal C and Terminal B.

Sub-Option Route Descriptions

More detailed descriptions of each of the sub-options' routes are provided below.

Sub-Option B-1A – Q70-SBS with Spot Improvements

B-1A evaluated possible transit priority and spot improvements to the existing Q70-SBS service to reduce travel times without the need for heavy construction, including transit signal priorities and queue jumps at the BQE southbound off-ramp to Broadway. This sub-option serves Terminal C on the existing 'Arrivals Road North' and Terminal B on the existing HOV level in front of the Terminal B headhouse, as well as LaGuardia Rd/94 St bus stop near the East Garage (frequently used by Airport employees and a stop on the existing Q70-SBS service). B-1A improvements could be operational in the shortest time period of the three sub-options.

The length of this route is approximately 4 miles, including the on-Airport portion.

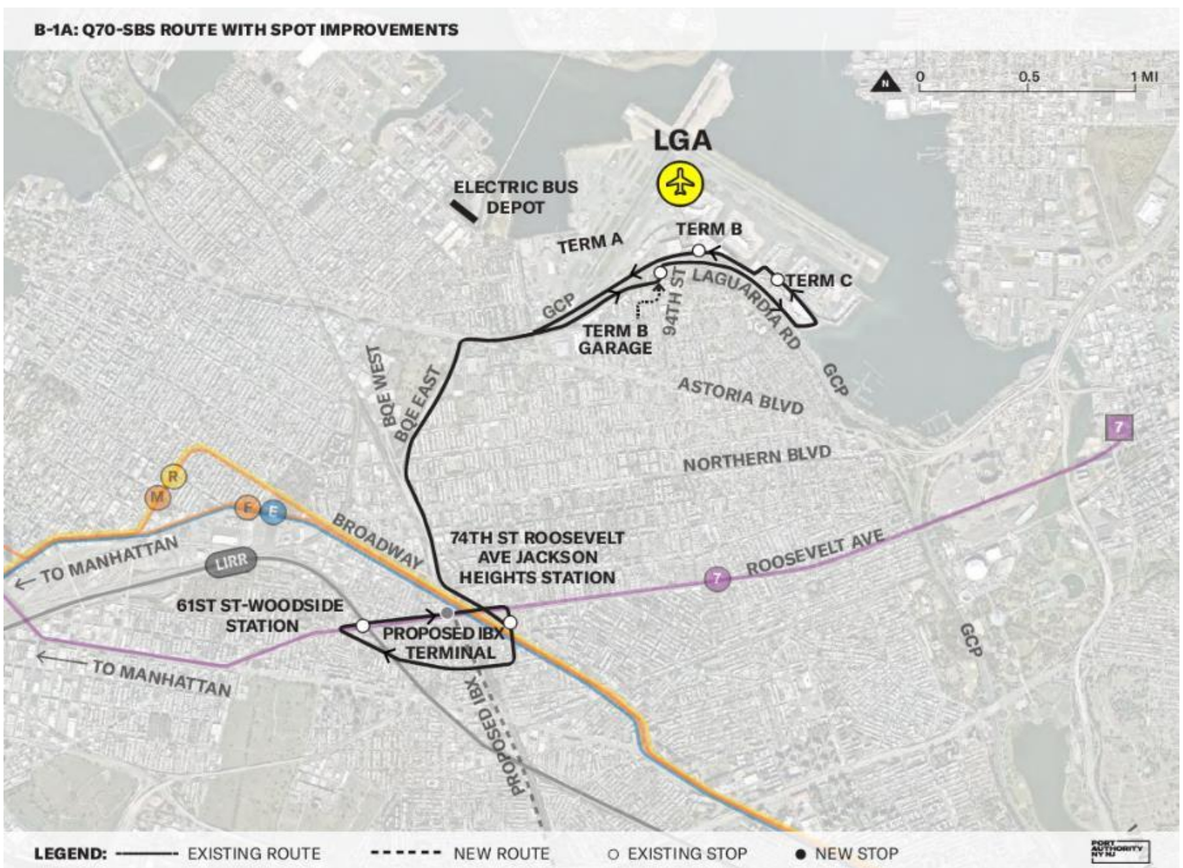


FIGURE 6.1-1: SUB-OPTION B-1A

Sub-Option B-1B – Q70-SBS with Heavier Infrastructure Improvements

This sub-option would connect LGA to the NYCT 7-Local and Express Subway and LIRR services at 61 St-Woodside Station, and NYCT 7-Local and E, F, M, and R Subway lines at Jackson Hts-Roosevelt Av/74 St-Broadway Subway station using a mix of new bus-only lanes and a newly constructed dedicated heavy infrastructure busway with portions at-grade and portions running on an elevated guideway structure into the Airport.

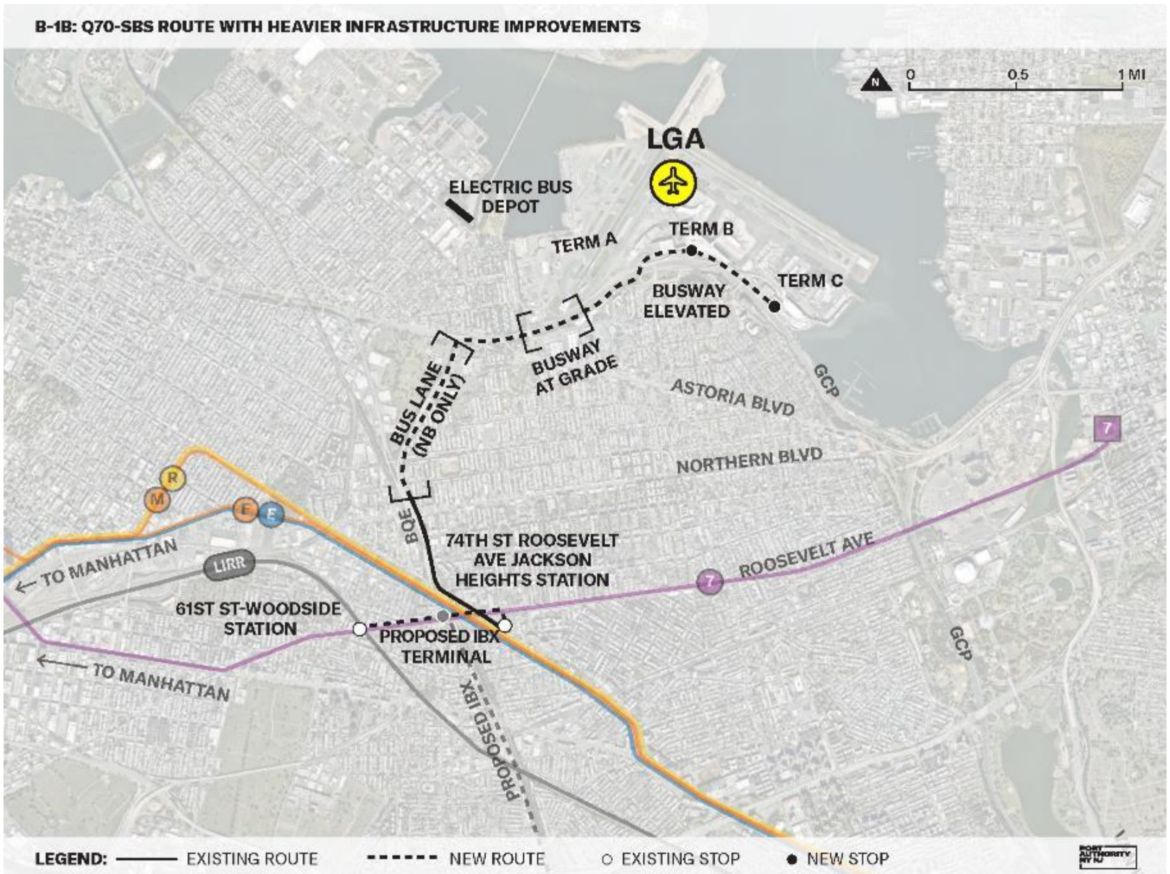


FIGURE 6.1-2: SUB-OPTION B-1B

Travelers would transfer between the 7 Local, 7 Express, and LIRR service to the Q70-SBS bus service on Roosevelt Ave below the 61 St-Woodside Station complex at street level. Q70-SBS buses would operate from 61 St-Woodside to Jackson Hts-Roosevelt Av/74 St-Broadway on Roosevelt Ave in general-purpose lanes. Following the current Q70-SBS travel path, the Q70-SBS buses would use the existing bus bay at 75th St/Broadway inside the Jackson Hts-Roosevelt Av/74 St-Broadway Station complex. Proposed improvements made on Broadway from 73rd St to the BQE on-ramps would improve vehicle flow while Q70-SBS buses operate in general-purpose lanes. The service would enter the BQE in shared lanes until passing over Northern Blvd, where an existing shoulder would be converted to a (full-time or part-time) bus-only lane for the LGA-bound service. This lane would continue to the Astoria Blvd exit where Q70-SBS buses would exit the BQE to avoid congestion between the BQE and GCP. North of 31st Ave, this sub-option would require widening the BQE onto Boody St to provide additional space to accommodate the bus-only lane. This reconfiguration would require approximately 1,000 ft of soundwall, retaining wall, and roadside barrier relocation, and re-channelization of the northbound BQE and Boody St. Q70-SBS buses would exit the BQE and use a bypass lane at the off-ramp and intersection of Astoria Blvd to enter a dedicated bi-directional newly constructed busway located south of the GCP in the embankment.

As discussed in detail in Section 3.2.1.1.1, the heavier infrastructure options from the west (including this option, B-1B) must overcome the significant challenges and complexities presented by the twin constraints of the FAA Airport Design Standards and the existing large-diameter, 90-year-old utility structures along the GCP. The preliminary engineering work carried out by the study team has not identified a construction approach that, with confidence, could do this without more complex, risky, and costly approaches to construction that would require greater engineering exploration beyond the scope of this study. To provide a consistent basis on which to evaluate the option and to allow cost comparison between the options, Sub-Option B-1B is based on the baseline, simpler construction, concept of an at-grade busway structure in the embankment south of the GCP, despite this being shown to be not compliant with the FAA Airport Design Standards.

Once east of Runway 04-22 the busway would transition to an elevated structure starting around 90th St. The busway would pass over the existing loop ramp from southbound 94th St to the eastbound GCP, over 94th St, and then cross the GCP onto LGA property. Two elevated bus stops would directly serve Terminal B and Terminal C, with a walk (approximately 0.5 minute and 4 minutes to Terminals B and C, respectively) and connecting to the respective bus stop and ticketing hall. The existing Q70-SBS stop near the East Parking garage would not be retained in this sub-option.

Q70-SBS buses headed from LGA to the Jackson Hts-Roosevelt Av/74 St-Broadway and 61 St-Woodside stations would travel on the proposed newly constructed elevated busway westbound toward 82nd St, then onto Astoria Blvd North over the GCP and access the BQE by utilizing an existing on-ramp at 78th St. A bus-only signal phase would be added on Astoria Blvd North prior to the entrance to the BQE connector on-ramp to allow for the safe approach of buses onto the on-ramp (the on-ramp currently has a stop sign at the end of the ramp). Travel on the BQE would be within existing general-purpose lanes until reaching the Broadway exit where buses would utilize a bypass lane and reconfigured intersection signaling to jump ahead of general-purpose traffic.

B-1B offers the potential for the greatest improvements in travel time and reliability of the three Q70-SBS B-1 sub-options through the use of the dedicated bus-only busway at the expense of greater impacts related to the heavier infrastructure required and longer time to bring into operation. The dedicated busway past Runway 04-22 itself has significant, as yet unresolved, challenges and complexities.

The length of this route is approximately 4 miles, including the on-Airport portion.

Sub-Option B-1C – Q70-SBS with Lighter Infrastructure Improvements

This sub-option follows the same route alignment as the B-1B sub-option from 61 St-Woodside and Jackson Hts-Roosevelt Av/74 St-Broadway until reaching Astoria Blvd around 77th Street, including the repurposing of an existing shoulder BQE to a (full-time or part-time) bus-only lane for the LGA-bound service.

From 77th St, instead of the heavy infrastructure of the dedicated busway used in B-1B, buses would benefit from signal prioritization and utilize existing on-ramps to enter the general-purpose travel lanes on the GCP with the service proceeding along the eastbound GCP until reaching the Exit 7 LGA flyover. Service would travel along the various LGA access roads until reaching a limited-access ramp serving transit and taxis, where service would exit around a 180-degree bus-only loop and serve a new at-grade bus stop at Terminal C. Service would continue on limited-access roadways to the existing Terminal B at-grade bus stop. The existing Q70-SBS

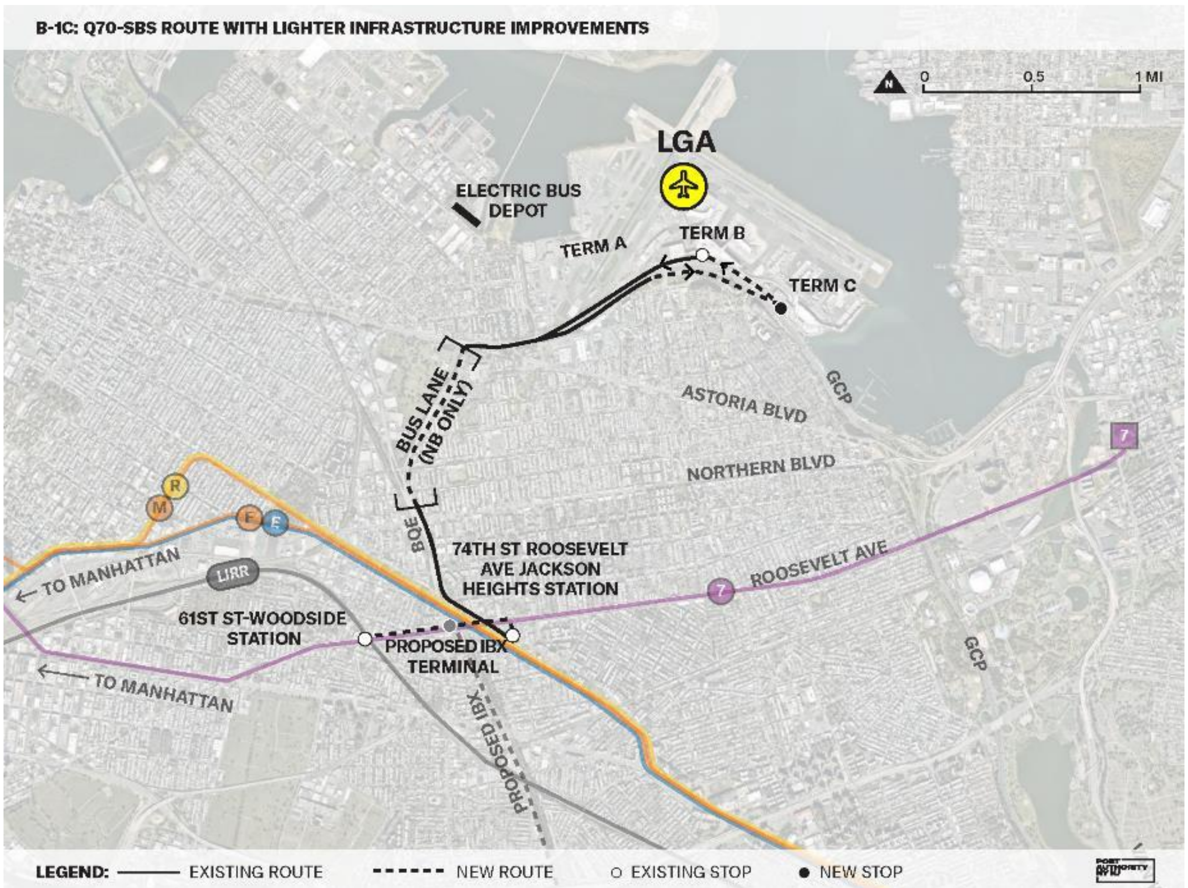


FIGURE 6.1-3: SUB-OPTION B-1C

stop near the East Parking garage would not be retained in this sub-option.

Q70-SBS buses traveling back toward the Jackson Hts-Roosevelt Av/74 St-Broadway and 61 St-Woodside stations would utilize existing access roads and ramps to enter the GCP and then the BQE, traveling in existing general-purpose travel lanes.

Sub-Option B-1C offers the potential for increased travel time benefits over B-1A and shorter time to enter operation than B-1B through the adoption of B-1B’s lighter infrastructure improvements and avoiding the constructability challenge posed by heavy construction at the end of Runway 04-22.

The length of this route is approximately 4 miles, including the on-Airport portion.

6.1.1 Evaluation of Construction Aspects

6.1.1.1 Constructability

The proposed improvements to the existing Q70-SBS bus route have three sub-options reviewed as part of the evaluation:

Sub-Option B-1A would require minor roadway work only (i.e., very little to no construction work), whereas Sub-Option B-1B would require reconstruction of the sound barrier, retaining wall, and roadside barrier between eastbound BQE and Boody St, and heavier construction for the at-grade and elevated fixed busway structures on the south side of the GCP and into the Airport. Sub-Option B-1C would require construction work on the BQE sound barrier, retaining wall, and roadside barrier, and the taxi access road to provide the bus-loop. Due to low clearance under the 102nd St Bridge, lowering of the taxi access road may be required.

<u>Sub-Option B-1A</u>

There are no notable constructability challenges for Sub-Option B-1A, although all proposed improvement work would require NYC DOT approval/coordination.

<u>Sub-Options B-1B and B-1C</u>

The notable challenges and complexities associated with construction common to both Sub-Options B-1B and B-1C are summarized below.

- **Proposed Bus Lane in Eastbound BQE Connector Right-Hand Shoulder**
  - Sub-Options B-1B and B-1C would create an Airport-bound dedicated bus lane on the Eastbound BQE Connector. This would be achieved through repurposing the existing northbound shoulder from the BQE split and taking space from Boody St up to the off-ramp to Astoria Blvd South.
  - Repurposing the existing eastbound BQE right-hand shoulder to support a dedicated bus lane would require widening a portion of the existing shoulder near 70th St, which would expand the highway into the adjacent Boody St shoulder. This would require reconstruction of approximately 0.5 mile of road barrier and approximately 600 ft of soundwall and retaining wall between the eastbound BQE roadway and Boody St along with construction and striping of the new shoulder-running bus lane.
  - Widening of the Eastbound BQE Connector from 70th St to the off-ramp to Astoria Blvd South would require replacement of four overhead signage gantries.
  - Construction work alongside the Eastbound BQE Connector would result in constrained access for large equipment and inefficient construction, which is reflected in the Indicative Timeline/Schedule for these sub-options.

- **Constructability Risks Not Included in the Cost Estimate Range (–10% to +30%) Common to Both Sub-Options B-1B and B-1C**
  - Repurposing of the BQE northbound shoulder as a bus-only lane: During the study, NYS DOT has advised that repurposing of the shoulder to allow vehicular travel would require federal, state, and local approval. The re-purposing of shoulders or lanes on highways for bus-only purposes is not without precedent and the travel time benefits associated with re-purposed shoulder warrant continued discussion with NY State.

<u>Sub-Option B-1B Only</u>

The notable challenges and complexities associated with construction specific to Sub-Option B-1B are summarized as:

- **Major constructability challenge of compliance with FAA Airport Design Standards while also avoiding disruption to 90-year-old NYC DEP underground sewer structures (See also Section 3.2.1.1.1)**
  - This option's alignment crosses an area south of Runway 04-22 that is subject to FAA regulations regarding the safe operation of the Airport. This presents a major constructability challenge (described in greater detail in Section 3.2.1.1.1) to negotiate the twin constraints of the FAA Airport Design Standards (governing the construction of new infrastructure in this area) and the existing large-diameter utilities located along and beneath the GCP.
  - The preliminary engineering work carried out by the study team has not identified a construction approach that it could conclude with confidence would practicably overcome these challenges.
  - For the purposes of providing a basis on which to compare options that must pass the end of Runway 04-22, this option was evaluated using the baseline construction concept of an at-grade busway structure located in the embankment to the south of the eastbound GCP roadway, despite this concept being shown to be not compliant with the FAA Airport Design Standards. To provide the Indicative Capital Cost and Timeline/Schedule, the following construction elements for this construction concept:
    - Construction of a transition roadway from Astoria Blvd North and South to the dedicated bus-only busway in the embankment south of the eastbound GCP roadway.
    - Reconstruction of the 82nd St Bridge. The busway structure would have to pass through the existing south abutment of the 82nd St Bridge over the GCP, requiring the bridge's demolition and reconstruction to accommodate the structure.
    - Construction of an at-grade, busway structure south of Runway 04-22, staying above the existing major utilities along the GCP.
    - Strengthening of the existing utilities and/or construction of concrete protection slabs above them.
    - Relocation of the existing runway lights, located between the GCP and Ditmars Blvd.

- **Constructing over 94th St and the GCP into the Airport**
  - Once past Runway 04-22, the alignment would ascend back to an elevated busway structure to pass over the GCP onto the Airport.
  - The GCP eastbound off-ramp onto Ditmars Blvd near 90th St would require reconstruction to accommodate the elevated busway in this area. An allowance has been included in the construction cost estimate for this work.
  - The elevated busway crossing over 94th St and both roadways of the GCP into the Airport would require long-span bridge structures of approximately 250–300 ft. These would require complex engineering solutions and construction methods to span the roads, while maintaining traffic mobility on the GCP and into the Airport on 94th St. This introduces increased construction costs over standard rates, which are reflected in the construction estimate.

- **On-Airport Elevated Bus Stops: Constrained Construction Site Conditions**
  - Long-span (approximately 350-ft) bridge structures would be required over 102nd St and the newly constructed departures roadway. This would require complex engineering solutions and construction methods to span these roads, while maintaining Airport operability. This introduces increased construction costs over standard rates, reflected in the construction estimate.
  - At this stage of development, the study determined that the support piers for the elevated bus turnaround loop structure between Terminal C, the parking structure, and over the Airport access roads could be located without modification to the existing Airport roadways or structures.
  - Constructing within a constrained, operational airport environment would reduce the construction sequence efficiency, introducing construction complexities. This is reflected in the Indicative Timeline/Schedule for this work.
  - Construction work in and around the Airport terminals and over Airport roadways would be subject to acceptance by the FAA.

- **Constructability Risks Not Included in the Cost Estimate Range (–10% to +30%) Specific to Sub-Option B-1B Only**
  - Accommodating the proposed elevated busway/guideway piers and foundations within the GCP ROW: There is a residual risk that, during detailed design coordination with NYS DOT (and FHWA where applicable), more complex support structures than currently envisaged are required to avoid introducing non-standard roadway elements to the existing highways or to allow existing non-standard elements to be brought up to current standards (in the future by NYS DOT). The study team concluded this risk is typical of work in and around existing major highways but one that still has the potential to result in large increases in construction cost and schedule prolongation.

Sub-Option B-1C Only

The notable challenges and complexities associated with construction specific to Sub-Option B-1C are summarized as:

- **Construction of Bus Loop around Constrained Airport Roads at Terminal C**
  - The on-Airport route proposes a new bus-only loop road in front of the Terminal C parking structure and taxi access road. The study team concluded that the taxi access road between Terminal B and Terminal C under the 102nd St Bridge structures has sufficient headroom for standard MTA buses or future electric buses to navigate under the bridge without the need to lower the roadway under the bridge.
  - The proposed Terminal C bus loop would pass under multiple on-Airport roadways and support structures. The study team concluded that the loop can be constructed to avoid the need to modify any of the existing road structure columns or supports.
  - Constructing within a constrained, operational airport environment would reduce the construction sequence efficiency, introducing construction complexities. This is reflected in the Indicative Timeline/Schedule for this sub-option.
  - Construction work in and around the Airport terminals and over Airport roadways would be subject to acceptance by the FAA.

6.1.1.2 Infrastructure Impacts during Construction

Sub-Option B-1A

Construction of Sub-Option B-1A would result in disruptions of short duration. The durations given below are indicative and based on preliminary assessment.

- **Disruption to Existing MTA Bus Route Operations while Improvements Take Place**
  - New pavement markings, and signal work, would result in periodic lane reductions, detours, or other impacts to general-purpose traffic and would most likely create temporary, periodic impacts to existing Q70-SBS services. Disruption would be over a period of 3–6 months and be periodic, localized, and short (1–2 days) with the lane being painted closed over short lengths to minimize impact.

Sub-Option B-1B

Construction of Sub-Option B-1B would result in temporary disruption to other major infrastructure along the route, which could last for 2–3 years. The notable areas of temporary infrastructure disruption are summarized below. The durations shown are indicative and based on preliminary assessment.

- **Disruption to Existing MTA Bus Route Operations while Improvements Take Place**
  - Construction and lane repurposing work would result in periodic lane reductions, detours, or other impacts to general-purpose traffic, and would also impact existing Q70-SBS service. Disruption would be over a period of 6–9 months and be periodic, localized, and short (1–2 days) with the lane being painted closed over short lengths to minimize impact.

- **Lane Narrowing, Traffic Diversions, and Speed Restrictions on Eastbound BQE Connector**
  - Overnight lane closures and speed restrictions would be required over a period of 1–2 weeks to repaint the northbound shoulder and designate it as a bus lane.
  - Narrowing of the Eastbound BQE Connector northbound lanes and traffic speed restrictions from the BQE split and Astoria Blvd South off-ramp would be required for 6–12 months to provide safe construction access to the eastbound right-hand shoulder during barrier reconstruction work and bus lane construction.
  - There would be overnight full road closures and traffic diversions for up to a week to replace four overhead signage gantries.

- **Lane Narrowing, Traffic Diversions, and Speed Restrictions on GCP**
  - Narrowing of the eastbound GCP lanes and traffic speed restrictions between the Astoria Blvd North overpass and 94th St would be required for 9–18 months to provide safe construction access to the eastbound shoulder during construction of the at-grade busway located between the GCP and 23rd Ave.
  - Full closure of the Ditmars Blvd GCP off-ramp for 1–2 months would be required while transitioning to a new, relocated off-ramp. Traffic diversions would be required via the Astoria Blvd South off-ramp.
  - 2–4 overnight road closures and traffic diversions would be required over a period of 1–2 weeks to erect long-span bridge sections over the GCP into the Airport.
  - 10–15 off-peak, overnight, and/or weekend road closures on the GCP and traffic diversions would be needed over a period of 12–18 months to demolish the 82nd St Bridge deck and erect a new deck structure.
  - Lane closures over a period of 12–18 months on the 82nd St crossing of the GCP would be conducted one roadway at a time so that two-way traffic could still cross the bridge, albeit on a reduced number of traffic lanes.

- **Disruption to Intra-Airport Services and Facilities**
  - Increased construction traffic would require a coordinated traffic management plan to avoid/minimize potential on-Airport traffic disruption.
  - 15–30 overnight and/or off-peak lane and road closures of on-Airport access roads would be expected for a 1- to 2-year period during long-span bridge section erection and other elevated structure work.

   - Airport user inconvenience could potentially occur to certain portions of Airport Facilities for 2–4 months during construction of bus customer transfer connections and circulation.

Sub-Option B-1C

Construction of Sub-Option B-1C would result in some disruption to other major infrastructure, which could last up to a year. The notable areas of temporary infrastructure disruption are summarized below. The durations shown are indicative and based on preliminary assessment.

- **Disruption to Existing MTA Bus Route Operations while Improvements Take Place**
   - Construction and lane repurposing work would result in periodic lane reductions, detours, or other impacts to general-purpose traffic, and would also impact existing Q70-SBS service. Disruption would be over a period of 6–9 months and be periodic, localized, and short (1–2 days) with the lane being painted closed over short lengths to minimize impact.

- **Lane Narrowing, Traffic Diversions, and Speed Restrictions on Eastbound BQE Connector**
   - Overnight lane closures and speed restrictions would be required over a period of 1–2 weeks to re-paint the northbound shoulder and designate it as a bus lane.
   - Narrowing of the Eastbound BQE Connector northbound lanes and traffic speed restrictions from the BQE split and Astoria Blvd South off-ramp would be required for 6–12 months to provide safe construction access to the eastbound right-hand shoulder during barrier reconstruction work and bus lane construction.
   - There would be overnight full road closures and traffic diversions for up to a week to replace four overhead signage gantries.

- **Disruption to Intra-Airport Services and Facilities**
   - Overnight and/or off-peak lane closures would be expected while roadway lanes around Terminals B and C are re-painted for 2–4 weeks.
   - 5–10 overnight and/or off-peak lane and taxi-road closures would be expected around Terminal C for construction of the Terminal C bus loop for 2–4 months.

6.1.1.3 Permanent/Operational Impacts to Existing Infrastructure

Sub-Option B-1A

Once completed, Sub-Option B-1A would have no notable permanent or operational impacts on other infrastructure along the route.

Sub-Option B-1B

Once completed, Sub-Option B-1B would have the following permanent/operational impacts on other infrastructure along the route:

- **Permanent Conversion of Eastbound BQE Connector Right-Hand Shoulder**
  - A dedicated bus lane on the Eastbound BQE Connector northbound roadway would permanently convert the shoulder to a (full-time or part-time) bus-only travel way for approximately 1 mile until the off-ramp to Astoria Blvd South.
  - This would not impact regular traffic flow and the bus lane would remain accessible for emergency use or in the event of a broken-down vehicle. A broken-down vehicle in the bus lane would limit transit operations but not necessarily general traffic.
  - Repurposing of the existing shoulder to a bus-only lane would require federal, state, and local approval.

- **Grand Central Parkway**
  - The off-ramp from the eastbound GCP to Ditmars Blvd would be permanently relocated to accommodate the elevated busway over 94th St.
  - The completed at-grade busway, elevated structure could restrict any future NYS DOT roadway improvement plans to widen or adjust the GCP between 49th St and 90th St.

- **Impacts on LGA**
  - The location of the elevated busway and bus transfer stops in front of Terminal B would result in the construction of structure piers and frames in the area that has currently been identified to serve as the future permanent Terminal B taxi hold. This could prevent the taxi hold from using this location, requiring an alternate location, which may not be as operationally efficient.

Sub-Option B-1C

Once completed, Sub-Option B-1C would have the following permanent/operational impacts on other infrastructure along the route:

- **Permanent Conversion of Eastbound BQE Connector Right-Hand Shoulder**
  - A dedicated bus lane on the Eastbound BQE Connector northbound roadway would permanently convert the shoulder to a (full-time or part-time) bus-only travel way for approximately 1 mile until the off-ramp to Astoria Blvd South.
  - This would not impact regular traffic flow and the bus lane would remain accessible for emergency use or in the event of a broken-down vehicle. A broken-down vehicle in the bus lane would limit transit operations but not necessarily general traffic.

– Repurposing of the existing shoulder to a bus-only lane would require federal, state, and local approval.

6.1.1.4 Indicative Capital Cost

Sub-Option B-1A

The Indicative Capital Cost for Sub-Option B-1A is $20 million (in 2022$, excluding future escalation and solely for approximate comparison between study options).

Indicative Capital Costs should be considered to have a range of estimating uncertainty of -10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).

The following are the notable cost drivers for the option:

- Transit signal priority upgrades.
- Upgrades to existing and new (replacement) bus stops.
- Upgraded wayfinding at subway-bus transfer stops.

Sub-Option B-1B

The Indicative Capital Cost for Sub-Option B-1B is $1.2 billion (in 2022$, excluding future escalation and solely for approximate comparison between study options).

Indicative Capital Costs should be considered to have a range of estimating uncertainty of -10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).

As discussed in more detail in Section 3.2.1.1.1, the preliminary engineering work carried out by the study team has not identified a construction approach that, with confidence, could overcome the significant challenges and complexities presented by the twin constraints of the FAA Airport Design Standards and the existing large-diameter, 90-year-old utility structures along the GCP without more complex, risky, and costly approaches to construction that would require greater engineering exploration beyond the scope of this study. Therefore, to provide a basis of an order-of-magnitude cost on which to compare between options, this option was costed out using the (least cost) baseline solution of an at-grade busway south of Runway 04-22, despite this approach not being compliant with FAA Airport Design Standards. Costs associated with an FAA compliant tunneled solution which could require replacement or relocation of existing sewer structures could result in additional costs of between $1–3 billion.

The following are the notable cost drivers for the option:

- Elevated busway structure along GCP and on-Airport.
- New elevated bus stops, passenger amenities, and vertical circulation at LGA.
- Replacement of the 82nd St Bridge (to accommodate at-grade busway structure south of Runway 04-22).
- Utilities protection and relocation costs.
- Roadway maintenance and traffic protection costs during construction.
- Relocation of GCP off-ramp to Ditmars Blvd.

- Connector ramp and at-grade busway along GCP.
- Long-span crossings on-Airport.
- Long-span crossings of the GCP.
- Transit signal priority upgrades.
- BQE retaining wall and sound barrier for new bus lane.
- Repurposing the shoulder for approximately 1 mile with minor widening of the BQE for repurposing to a bus lane.
- Upgraded wayfinding at subway-bus transfer stops.

Sub-Option B-1C

The Indicative Capital Cost for Sub-Option B-1C is $100 million (in 2022$, excluding future escalation and solely for approximate comparison between study options).

Indicative Capital Costs should be considered to have a range of estimating uncertainty of -10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).

The following are the notable cost drivers for the option:

- New at-grade bus stops at LGA.
- Transit signal priority upgrades.
- BQE retaining wall and sound barrier for new bus lane.
- New on-Airport Terminal C bus loop-road.
- Repurposing the shoulder for approximately 1 mile with minor widening of the BQE for repurposing to a bus lane.
- Upgrades to existing bus stops at Woodside and Jackson Heights.
- Upgraded wayfinding at subway-bus transfer stops.

6.1.1.5 Indicative Timeline/Schedule

Sub-Option B-1A

The Indicative Timeline/Schedule (for comparison between study options) for Sub-Option B-1A is approximately 1-2 years from a decision to take the option forward to revenue service. This includes the following notable schedule drivers:

- Planning, approvals, and acquisitions.
- Preliminary engineering.

Figure 6.1-4 illustrates the indicative timeline/schedule for Sub-Option B-1A. The key driver is the up-front planning and approvals and preliminary engineering required to finalize the project.

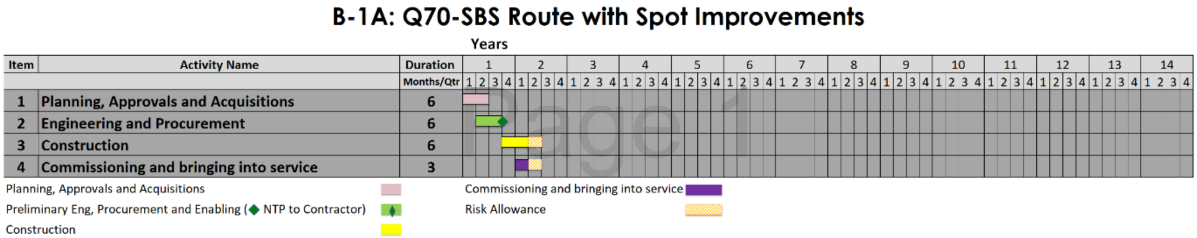


FIGURE 6.1-4: INDICATIVE TIMELINE/SCHEDULE (B-1A)

Sub-Option B-1B

The Indicative Timeline/Schedule (for comparison between study options) for Sub-Option B-1B is approximately 9–10 years from a decision to take the option forward to revenue service. This includes the following notable schedule drivers:

- Planning, approvals, and acquisitions.
- Procurement of design-build contractor(s) for heavy civil construction.
- 82nd St Bridge reconstruction (longest construction activity).
- Elevated busway to Airport.
- New on-Airport elevated bus stops and connectors.
- Traffic signaling and systems.
- 6 months of commissioning.

Figure 6.1-5 illustrates the indicative timeline/schedule for Sub-Option B-1B. The key drivers are the major civil construction work, which may trigger longer permitting, approvals, and procurement processes.

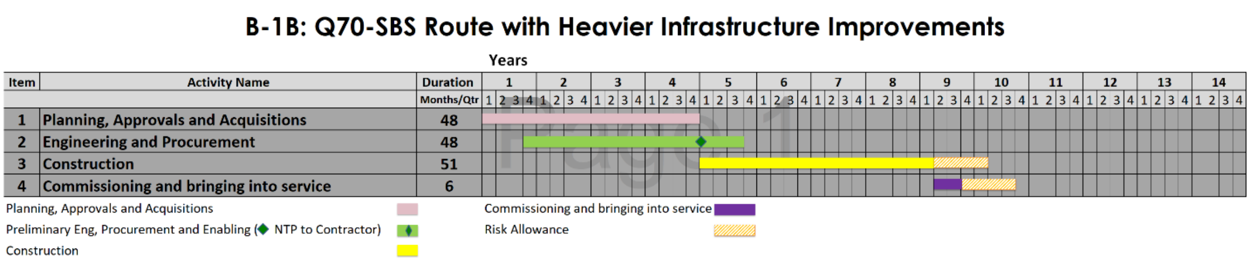


FIGURE 6.1-5: INDICATIVE TIMELINE/SCHEDULE (B-1B)

Sub-Option B-1C

The Indicative Timeline/Schedule (for comparison between study options) for Sub-Option B-1C is approximately 2–3 years from a decision to take the option forward to revenue service. This includes the following notable schedule drivers:

- Planning, approvals, and acquisitions.
- Procurement of construction contractor(s).
- BQE bus lane reconfiguration
- On-Airport roadway reconfigurations.
- Traffic signaling systems.
- 3 months of commissioning.

Figure 6.1-6 illustrates the indicative timeline/schedule for Sub-Option B-1C. The key drivers are the planning and minor civil work. Implementation of the improvements are independent of each other and could be introduced individually into use as quickly as possible.

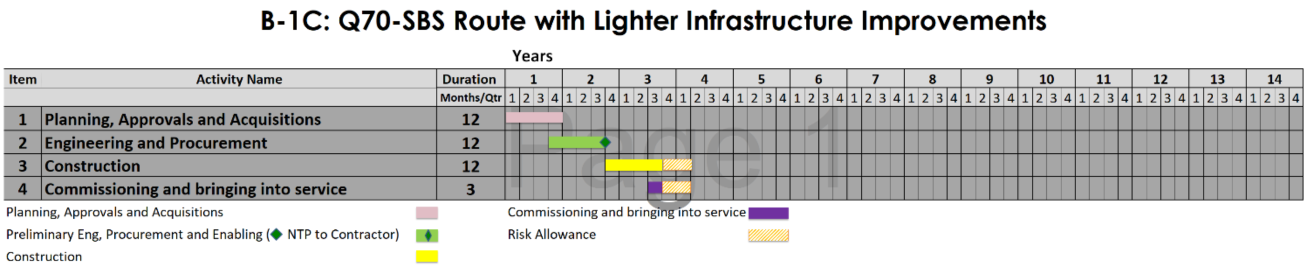


FIGURE 6.1-6: INDICATIVE TIMELINE/SCHEDULE (B-1C)

6.1.2 Transportation Aspects

6.1.2.1 Improved Access to LGA

Three factors have been considered in this category: Standardized Indicative Baseline Off-Peak Travel Time, Reliability, and Transfer Experience.

6.1.2.1.1 Standardized Indicative Baseline Off-Peak Travel Time

<u>Sub-Options B-1A, B-1B, and B-1C</u>

- Table 6.1-1, below, provides the Standardized Indicative Baseline Off-Peak Travel Times for the weekday, midday off-peak journeys to be used solely as a baseline for comparison between options. Tables 6.1-2 and 6.1-2 provide a breakdown of the components that make up the total journey, via LIRR and E-Subway, respectively, the general approach to the estimation of which is described in Section 3.2.2.1.1.
- Passengers making the journeys described would, naturally, experience variations to the baseline timings calculated even where services are running as planned, for reasons as simple as variations in walking speeds or whether a traveler arrives just before a scheduled departure or just misses a departing train.

TABLE 6.1-1: STANDARDIZED INDICATIVE BASELINE OFF-PEAK TRAVEL TIMES, OPTION B-1

Penn Station to LGA (minutes to first terminal served, B or C)	Current Q70	B-1A	B-1B	B-1C
Via LIRR to Woodside	46	42	35	39
Via Subway (E train) to Jackson Heights	48	45	39	42

TABLE 6.1-2: STANDARDIZED INDICATIVE BASELINE OFF-PEAK TRAVEL TIMES VIA LIRR BY SEGMENT, OPTION B-1

Penn Station to LGA via LIRR (minutes)	Current Q70-SBS	B-1A	B-1B	B-1C
START Penn Station (street level)				
walk/wait time	7	7	7	7
LIRR platform (dep)				
LIRR trip time	11	11	11	11
Woodside LIRR platform (arr)				
walk/wait time	9	6	6	6
Woodside bus stop (dep)				
Bus trip time	19	18	11	15
1st on-Airport bus stop (arr)	existing	existing	new elevated	new at-grade
END Terminal bus stop	Terminal C	Terminal C	Terminal B	Terminal C
Total travel time =	46	42	35	39
trip time to next Terminal bus stop	4	4	2	3
2nd on-Airport bus stop (arr)	existing	existing	New elevated	existing
END Terminal bus stop	Terminal B	Terminal B	Terminal C	Terminal B
Total travel time =	50	46	37	42

TABLE 6.1-3: STANDARDIZED INDICATIVE BASELINE OFF-PEAK TRAVEL TIMES VIA E SUBWAY BY SEGMENT, OPTION B-1

Penn Station to LGA via Subway (minutes)	Current Q70-SBS	B-1A	B-1B	B-1C
START Penn Station (street level)				
walk/wait time	6	6	6	6
E-Subway platform (dep)				
Subway trip time	18	18	18	18
Jackson Heights E-Subway platform (arr)				
walk/wait time	9	7	7	7
Jackson Heights bus stop (dep)				
Bus trip time	15	14	8	11
1st on-Airport bus stop (arr)	existing	existing	new elevated	new at-grade
END Terminal bus stop	Terminal C	Terminal C	Terminal B	Terminal C
Total travel time =	48	45	39	42
trip time to next Terminal bus stop	4	4	2	3
2nd on-Airport bus stop (arr)	existing	existing	new elevated	existing
END Terminal bus stop	Terminal B	Terminal B	Terminal C	Terminal B
Total travel time =	52	49	41	45

- The above standardized indicative baseline off-peak travel times are a baseline for weekday, midday off-peak journeys. Bus running times in mixed-use traffic would be subject to traffic congestion during peak times. Estimates of the potential increase to the Standardized Indictive Travel Time for peak-time traffic have been calculated solely for comparative purposes as:

  - Sub-Option B-1A: around 9 minutes from Woodside and around 8 minutes from Jackson Heights to Terminal B.
  - Sub-Option B-1B: around 3 minutes from Woodside and around 1 minute from Jackson Heights to Terminal C.
  - Sub-Option B-1C: around 5 minutes from Woodside and Jackson Heights to Terminal B.
- Allowances of this order for predictable congestion would be reflected in the MTA schedules; less predictable variations in travel time are discussed in the “Reliability” section.
- Passengers for Terminal A would transfer to an existing on-Airport shuttle service running every 10 minutes and with an additional trip time of around 7 minutes from Terminal B.

6.1.2.1.2 Reliability

Sub-Option B-1A

- Measures to help increase reliability for Sub-Option B-1A are:

- Transit signal priority, which would allow buses to move through intersections without having to stop and wait for traffic.
- The queue jump lane at the BQE off-ramp to Broadway would help ensure the buses never have to wait more than one light cycle as they exit the BQE onto Broadway.

Sub-Option B-1B

- Measures to help increase reliability for Sub-Option B-1B are:
  - Transit signal priority, which would allow buses to move through intersections without having to stop and wait for traffic.
  - The queue jump lane at the BQE off-ramp to Broadway would help ensure the buses never have to wait more than one light cycle as they exit the BQE onto Broadway.
  - A mile-long exclusive (full-time or part-time) bus lane on the right shoulder of the northbound BQE Connector from Northern Blvd to Astoria Blvd would help bypass general traffic congestion.
  - A new grade-separated heavy infrastructure bus roadway south of the GCP and onto the Airport allowing the buses to bypass traffic on the GCP as well as general congestion on the Airport frontage.

Sub-Option B-1C

- Measures to help increase reliability for Sub-Option B-1C are:
  - Transit signal priority, which would allow buses to move through intersections without having to stop and wait for traffic.
  - The queue jump lane at the BQE off-ramp to Broadway would help ensure the buses never have to wait more than one light cycle as they exit the BQE onto Broadway.
  - A mile-long exclusive (full-time or part-time) bus lane on the right shoulder of the northbound BQE Connector from Northern Blvd to Astoria Blvd would help bypass general traffic congestion.
  - Utilization of a new specially-designated bus pick-up and drop-off area near Terminal C with direct, exclusive road access to avoid congestion on the Airport frontage.

6.1.2.1.3 Transfer Experience

Sub-Options B-1A, B-1B, and B-1C

The Q70-SBS route provides riders bound for Terminals B or C with a two-seat ride via LIRR to Woodside Station or the 7-line, E, F, M, or R Subway service to Jackson Heights-Roosevelt Av/74 St Station, colloquially known as Jackson Heights Station. Riders bound for Terminal A have an additional transfer to an existing on-airport shuttle once they reach the airport.

Customer Transfer

- The existing bus stop at Woodside is located beneath the LIRR overpass on Roosevelt Ave. Riders arriving at Woodside via the Subway or LIRR would follow new lighting and wayfinding to the existing covered stop, a walk of approximately 400 ft. Since Woodside is an accessible station, the transfer would be ADA-compliant using the existing station amenities.
- The existing bus stop at Jackson Heights Station is located at the southeast corner of the station, near the intersection of 75th St and Broadway. Riders arriving at Jackson Heights on the Subway would be guided from the platform to the bus stop by new lighting and wayfinding throughout the station, a walk of approximately 300-450 ft depending on Subway line. Since Jackson Heights is an accessible station, all transfers would be ADA-compliant using the existing station amenities.

6.1.2.2 Ridership

- Stated preference survey results indicate that 33% of airport passenger respondents are “definitely” or “probably” interested in BRT connections to existing transit services.
- B-1B and B-1C are projected increase ridership on the Q70-SBS by 1.6 and 1.9 million riders, respectively, in 2025, compared to a projected 0.7 million increase in transit ridership under Option B-1A (Table 6.1-4). Based on the 2019 Q70-SBS ridership of approximately 1.9 million, this would increase the total projected Q70-SBS ridership to 2.6 million for B-1A, 3.8 million for B-1B, and 3.5 million for B-1C.

TABLE 6.1-4: RIDERSHIP MODEL RESULT SUMMARY

Transit Option				Riders on Current Bus Services to LGA (Millions) (No Action)	New Transit Option Impact (Millions)	
Mode Category & Scenario Label			Description		Net Increase in Q70-SBS Ridership	Total Bus Ridership (Q70-SBS Improvements + Other Bus Routes)
Bus - Transit Improvements Along Existing Routes	Bus	B-1A	Q70-SBS – Spot Improvements	4.1	**0.7**	**4.7**
	BRT*	B-1B	Q70-SBS – Heavier Infrastructure*	4.1	**1.9**	**6.0**
		B-1C	Q70-SBS – Lighter Infrastructure*	4.1	**1.6**	**5.7**
*Due to the more extensive infrastructure enhancements, Sub-Options B-1B and B-1C were treated as BRT for the purposes of this ridership analysis.						

6.1.2.3 Throughput and Capacity

Throughput

Sub-Options B-1A, B-1B, and B-1C

- Using the highest hourly single-direction provision of airline seats at LGA in 2019 (4,300 seats on weekday departing flights 9 AM to 10 AM – see Figure 3.2-1, in Section 3.2.2.3), the estimated single-direction peak passenger throughput for each sub-option could be:
  - Sub-Option B-1A: approx. 345 passengers per hour.
  - Sub-Option B-1B: approx. 390 passengers per hour.
  - Sub-Option B-1C: approx. 345 passengers per hour.
- It should be noted that these passengers would likely arrive at the transfer station in groups, rather than being evenly distributed throughout the time period.

Capacity of New Transit Option

<u>Sub-Options B-1A, B-1B, and B-1C</u>

- Actual vehicle frequency would be adapted in practice to suit demand and other operating requirements.

Impact on Capacity of Existing Downstream Transit Systems

<u>Sub-Options B-1A, B-1B, and B-1C</u>

- All B-1 sub-options provide passenger connection to Jackson Hts-Roosevelt Av/74 St-Broadway stations, offering transfer access to the E, F, M, R, and 7-Subway lines.
- Generally, airport passenger loadings are constant through the day both to and from the Airport with the peak passenger loadings occurring outside of the morning Manhattan-bound subway peaks or in the opposite direction (i.e., Airport-bound).
- The existing E- and F-Subway lines currently operate close to their peak capacity during the 8 AM to 9 AM Manhattan-bound commuting peak. While most Manhattan-bound Airport passengers would travel outside this peak, those passengers (including non-Airport passengers) traveling during this peak would likely experience crowded conditions.
- The MTA noted that crowding could occur when groups of passengers arrive and depart at the same time.
- The study team noted that the Jackson Heights Station has five levels (underground platform, underground mezzanine, street, elevated mezzanine, and elevated platform), each accessible only by a single elevator. The underground mezzanine is also connected to the elevated mezzanine by an escalator that bypasses the street. As such, the additional passenger load for this option could overload the currently provided elevators and escalators, due to increased demand from passengers with luggage. The physical layout of the station would make adding elevators and/or escalators difficult, if not impossible, with significant station reconfiguration.

6.1.2.4 Indicative Operating Cost

<u>Sub-Options B-1A, B-1B, and B-1C</u>

Any increase in operating cost would depend on any changes in operating protocols.

6.1.3 Community and Environmental Aspects

6.1.3.1 Local Community Impacts

The three sub-options generally follow the route of the existing Q70-SBS service with the following variances:

- B-1A follows the entire existing Q70-SBS route with roadway modifications (parking and lane restriping, curb replacement, transit signal prioritization changes, bypass lanes, etc.) and reduced headways. Buses would travel in mixed-flow traffic throughout its route and use the existing on-Airport roadways.
- B-1B follows the existing Q70-SBS route until 94th St (with repurposing of a 1-mile section of the BQE shoulder to a (full-time or part-time) bus-only lane from Northern Blvd to the Astoria Blvd exit). It then transitions to a dedicated system to the Airport. Buses would travel in a combination of mixed-flow traffic, dedicated bus lanes, and a dedicated busway/guideway (at-grade and elevated busway structure) into the Airport.
- B-1C follows the existing Q70-SBS route until Astoria Blvd at 77th St (with proposed repurposing of a 1-mile section of the BQE shoulder to a (part-time or full-time) dedicated bus lane). It then enters the general-purpose lanes of the GCP to the Airport. Buses would travel in a combination of mixed-flow traffic, dedicated bus lanes, and general-purpose travel lanes on the GCP into the Airport.

Each of the approximately 4-mile routes runs through and/or adjacent to the Woodside, Jackson Heights, and East Elmhurst neighborhoods. Each of these neighborhoods includes a wide range of properties ranging from single-family (row & detached) to 6- to 14-story residential buildings, commercial businesses, mixed-use (residential above commercial) buildings, public community buildings, NYC Parkland (Planeview Park and Overlook Park), and an NYC Plaza (Diversity Plaza).

The potential for temporary (during construction) and permanent (once operational) impacts is summarized below for specific areas of the alignment.

6.1.3.1.1 Temporary Impacts during Construction on the Local Neighborhoods Directly Affected

<u>Sub-Option B-1A</u>

Roadway modification activities (parking and lane restriping, curb replacement, bypass lanes, etc.) would occur along the approximately 4-mile route for approximately 0.5 year for Sub-Option B-1A.

During construction, the following neighborhoods would have the potential for air quality, noise, vibration, or visual impacts. For the frequency and duration of construction activities refer to Section 6.1.1.2 “Infrastructure Impacts during Construction” above.

- **Roadway Modification**

- Light roadway modification activities (parking and lane restriping, curb replacement, transit signal prioritization changes, bypass lanes, etc.) would occur along the approximately 4-mile route would have periodic impacts on traffic flow during a 6-month period.
- Planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.

Sub-Option B-1B

Roadway construction (for the bus lanes and restriping) and heavy civil construction (for the elevated busway foundations, structures, and bus stops onto the Airport) activities are anticipated to occur along the approximately 4-mile route for approximately 4.25 years for Sub-Option B-1B.

As discussed in more detail in Section 3.2.1.1.1, the preliminary engineering work carried out by the study team has not identified a construction approach that, with confidence, could overcome the significant challenges and complexities presented by the twin constraints of the FAA Airport Design Standards and the existing large-diameter, 90-year-old utility structures along the GCP without more complex, risky, and costly approaches to construction that would require greater engineering exploration beyond the scope of this study. Therefore, to provide a consistent basis on which to evaluate the option, this assessment was based on the baseline solution of an at-grade busway south of Runway 04-22, despite this approach not being compliant with FAA Airport Design Standards.

During construction, the following neighborhoods would have the potential for air quality, noise, vibration, or visual impacts. For the frequency and duration of construction activities refer to Section 6.1.1.2 “Infrastructure Impacts during Construction” above:

- **Construction from Existing Jackson Hts-Roosevelt Av/74th St-Broadway Subway Station to Astoria Blvd/82nd St**
  - Roadway modification activities (restriping and curb resetting) would occur for an approximately 2-mile segment of the route from Jackson Heights Station to Astoria Blvd, including a portion approximately 50–75 ft from Diversity Plaza (NYC Plaza open to pedestrians at the outdoor market off Broadway) and the shoulder repurposing along the 1-mile section of the Eastbound BQE Connector.
  - Planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.

- **Reconstruction of 82nd St Bridge**
  - Lane closures and contra-flow traffic on 82nd St Bridge would be continuous throughout the construction as bridge sections would be demolished and reconstructed one half at a time.
  - The construction would occur approximately 150–200 ft from 2 short city blocks of residential and commercial properties.

- Planned periodic lane closures, contra-flow traffic on the bridge, and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
- Planned night closures of the GCP would be required for the long-span bridge erection.

- **Constructing over 94th St and the GCP into the Airport**
  - Reconstruction of the GCP eastbound off-ramp onto Ditmars Blvd near 90th St and construction of an elevated busway (30 ft above 94th Street) with long-span (approximately 250–300 ft) bridge structures crossing over 94th St and the GCP into the Airport would be required along the approximately 0.5-mile segment of the route.
  - The construction would occur approximately 100–350 ft from 4 short city blocks of residential and commercial properties.
  - Planned night closures of the GCP would be required for the long-span bridge erection.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - There could be increased construction/haul traffic on local roads because trucks are not allowed on the GCP.

- **Constructing On-Airport Elevated Bus Stops**
  - Construction activities associated with the erection of long-span (approximately 350-ft) elevated busway bridge structures over an approximately 0.5-mile segment of the route over 102nd St and the newly constructed departures roadway at the Airport would be required.
  - The construction would occur over 500 ft from 5 city blocks of residential and commercial properties in the East Elmhurst community located on the other side of 8 lanes of the GCP.
  - Planned night closures of the GCP would be required for the long-span bridge erection.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - There could be increased construction/haul traffic on local roads because trucks are not allowed on the GCP.

Sub-Option B-1C

Roadway construction activities are anticipated to occur along the approximately 4-mile route for approximately 1 year for Sub-Option B-1C.

During construction, the following neighborhoods would have the potential for air quality, noise, vibration, or visual impacts. For the frequency and duration of construction activities refer to

Section 6.1.1.2 “Infrastructure Impacts during Construction” above:

- **Construction from Existing Jackson Hts-Roosevelt Av/74 St-Broadway Subway Station to Astoria Blvd/82nd St**
  - Roadway modification activities (restriping and curb resetting) would occur for an approximately 2-mile segment of the route from Jackson Heights Station to Astoria Blvd, including a portion approximately 50–75 ft from Diversity Plaza (NYC Plaza open to pedestrians at the outdoor market off Broadway) and the shoulder repurposing along the 1-mile section of the Eastbound BQE Connector.
  - Planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.

- **Constructing On-Airport At-Grade Bus Stops**
  - Roadway modification activities (roadway reconfiguration, restriping, curb resetting, paving, signage, and drainage) would be required along an approximately 0.5-mile segment of the route to construct the proposed Terminal C bus loop, which would pass under multiple on-Airport roadways and support structures. The loop road would be constructed to avoid the need to modify any of the existing columns or supports.
  - The construction would occur over 500 ft from 5 city blocks of residential and commercial properties in the East Elmhurst community located on the other side of 8 lanes of the GCP.
  - Planned periodic lane closures and diversions could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - There could be increased construction/haul traffic on local roads because trucks are not allowed on the GCP.

6.1.3.1.2 Permanent Operational Impacts on the Local Neighborhoods Directly Affected

<u>Sub-Option B-1A</u>

Existing buses would operate in mixed-flow traffic throughout the route, ranging approximately 35–50 ft from residential and commercial properties while on city streets.

As this sub-option would retain the existing bus frequency and bus type, the relative potential for permanent noise, vibration, or visual impacts is expected to remain unchanged.

<u>Sub-Option B-1B</u>

Existing buses would operate in a mixture of at-grade, mixed-flow traffic, dedicated bus lanes, and a dedicated elevated busway structure, ranging approximately 35–500+ ft from residential and commercial properties.

The following neighborhoods and areas would have the relative potential for new permanent noise, vibration, or visual impacts as a result of this sub-option's proposed bus operations on the following new infrastructure:

- **New Elevated Busway over 94th St and the GCP into the Airport**
  - To enter the airport from the GCP, buses would rise to operate in each direction on an elevated busway over the GCP onto the Airport approximately 100–350 ft from residential and commercial properties.

- **New On-Airport Elevated Bus Stops**
  - On-Airport, buses would operate in each direction on an elevated busway between the two proposed bus stops over 500 ft from residential and commercial properties in the East Elmhurst community located on the other side of 8 lanes of the GCP.

Sub-Option B-1C

Existing buses would operate predominantly in at-grade, mixed-flow traffic with some dedicated bus lanes, ranging approximately 35–50 ft from residential and commercial properties while on city streets.

As this sub-option would not add any significant new infrastructure, the relative potential for permanent noise, vibration, or visual impacts is expected to remain unchanged.

6.1.3.1.3 Potential Private Property Acquisitions

Sub-Option B-1A

No private properties are anticipated to be acquired.

Sub-Option B-1B

No private properties are anticipated to be acquired.

Sub-Option B-1C

No private properties are anticipated to be acquired.

6.1.3.1.4 Potential Public Property Acquisitions (NYC DOT Plazas and NYC Parks Parkland)

The B-1 Sub-Options would result in permanent impacts to the following:

Sub-Option B-1A

- No structures would be sited within NYC Parks Parkland.

Sub-Option B-1B

- New support columns for the permanent elevated Busway structure would be located within Planeview Park and the at-grade Busway within Overlook Park.

Sub-Option B-1C

- No structures would be sited within NYC Parks Parkland.

6.1.3.1.5 Removal/Reconfiguration of Parking Spaces

The B-1 sub-options would require the removal of following parking spaces.

Sub-Option B-1A

This option would have minimal impact to on-street public parking.

Sub-Option B-1B

- A total of approximately 30 on-street public parking spaces would be lost on the following streets:
  - 56th St (between Woodside Ave and Skillman Ave).
  - Broadway.
  - Boody St.

  The numbers are approximate and are preliminary estimates based on the alignment.

Sub-Option B-1C

- A total of approximately 20 on-street public parking spaces would be lost on the following streets:
  - Broadway.
  - Boody St.

  The numbers are approximate and are preliminary estimates based on the alignment.

6.1.3.1.6 Environmental Justice Communities Mapping Analysis

The Environmental Justice communities mapping analysis provides an overview of the minority and low-income communities within 0.25 mile of the transit options being evaluated.

Sub-Option B-1A

For Sub-Option B-1A, more than half of the block groups within the 0.25-mile buffer of the option alignment are Environmental Justice block groups.

See Figure 6.1-7 below for the analysis map for Q70-SBS Sub-Option B-1A.

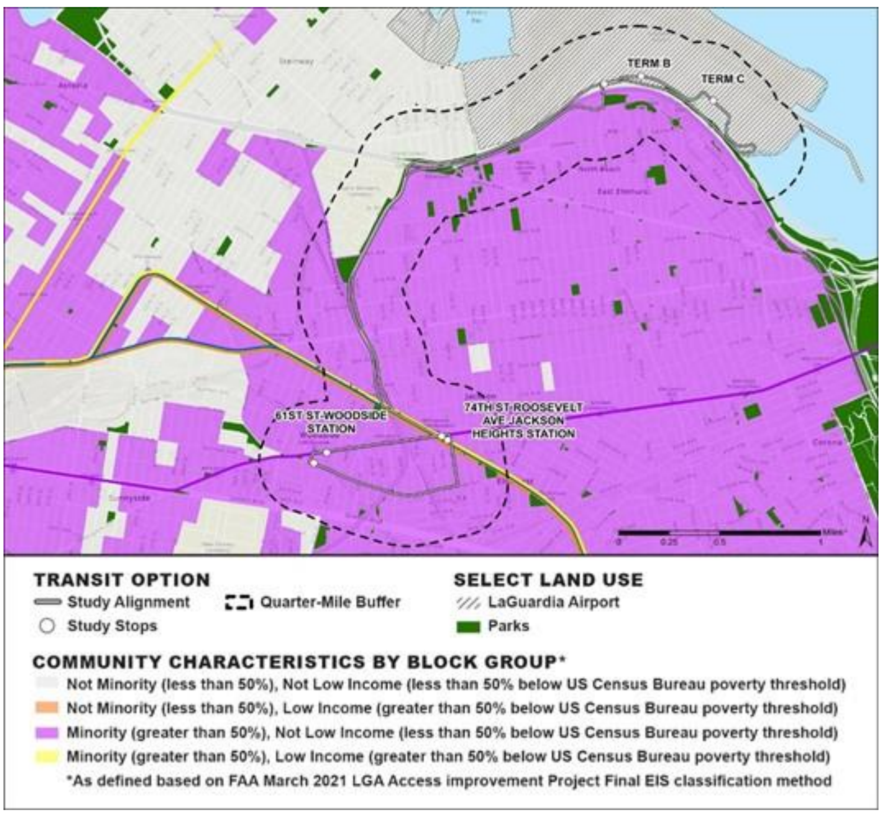


FIGURE 6.1-7: SUB-OPTION B-1A – ENVIRONMENTAL JUSTICE COMMUNITIES MAPPING ANALYSIS (AS DEFINED BASED UPON FAA MARCH 2021 LGA ACCESS IMPROVEMENT PROJECT FINAL EIS CLASSIFICATION METHOD)

Sub-Option B-1B

For Sub-Option B-1B, more than half of the block groups within the 0.25-mile buffer of the option alignment are Environmental Justice block groups.

See Figure 6.1-8 below for the analysis map for Q70-SBS Sub-Option B-1B.

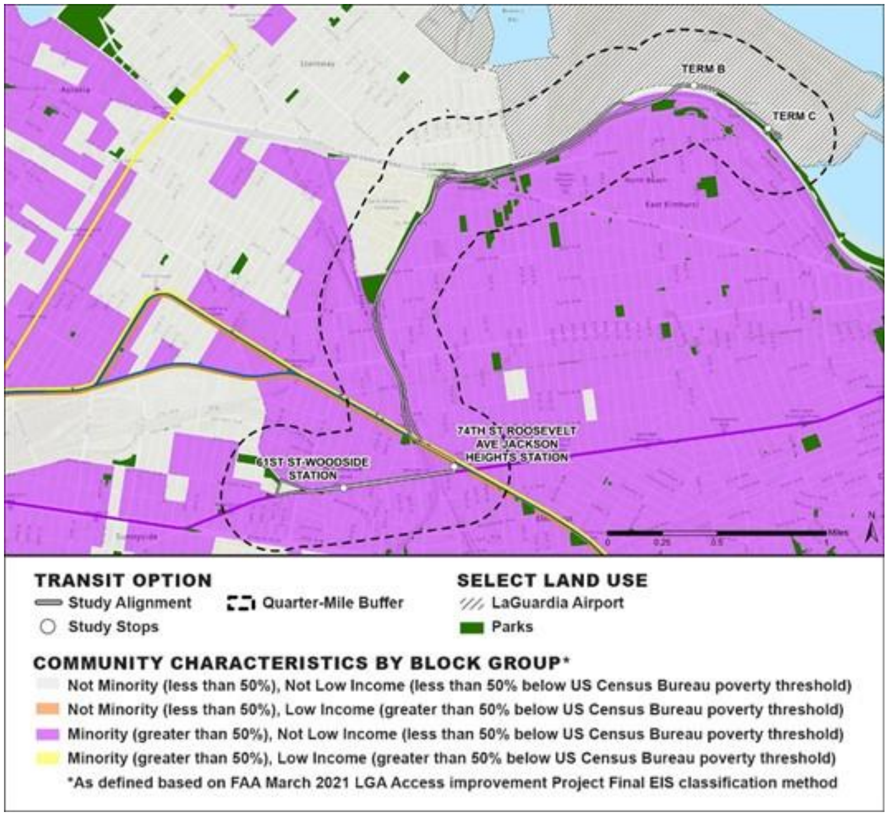


FIGURE 6.1-8: SUB-OPTION B-1B – ENVIRONMENTAL JUSTICE COMMUNITIES MAPPING ANALYSIS (AS DEFINED BASED UPON FAA MARCH 2021 LGA ACCESS IMPROVEMENT PROJECT FINAL EIS CLASSIFICATION METHOD)

Sub-Option B-1C

For Sub-Option B-1C, more than half of the block groups within the 0.25-mile buffer of the option alignment are Environmental Justice block groups.

See Figure 6.1-9 below for the analysis map for Q70-SBS Sub-Option B-1C.

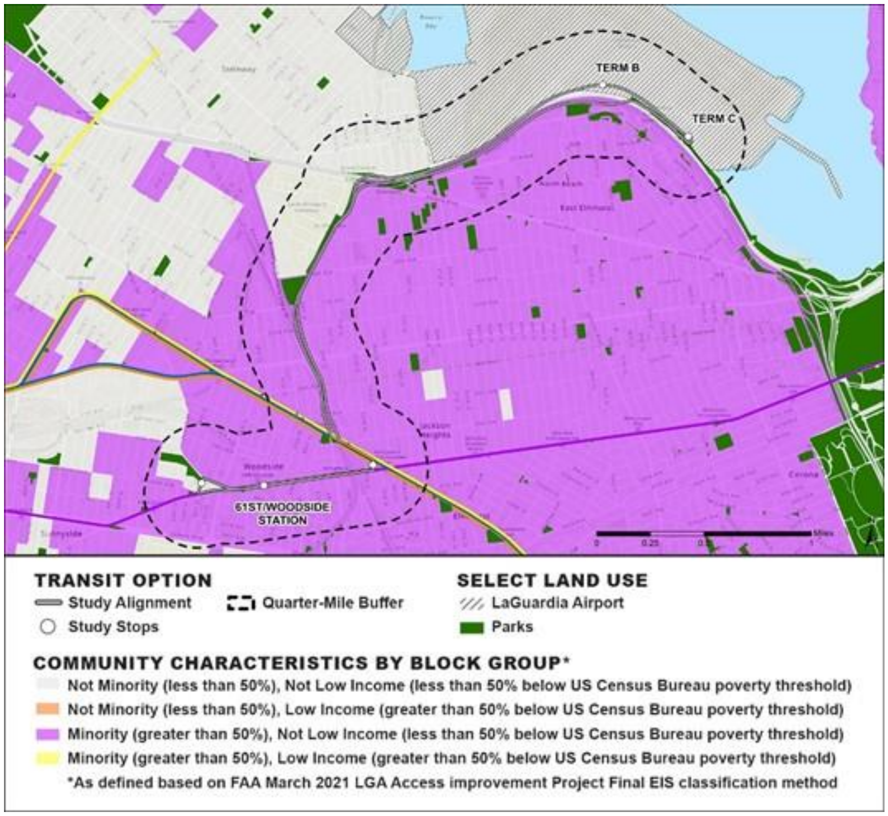


FIGURE 6.1-9: SUB-OPTION B-1C – ENVIRONMENTAL JUSTICE COMMUNITIES MAPPING ANALYSIS (AS DEFINED BASED UPON FAA MARCH 2021 LGA ACCESS IMPROVEMENT PROJECT FINAL EIS CLASSIFICATION METHOD)

6.1.3.2 Equity

6.1.3.2.1 Transit Access from LGA

<u>Sub-Option B-1A</u>

- **Additional Minority and Low-income Populations Reached within 45 Minutes from LGA via Transit (Population Access Analysis)**
  - The results of the Population Access Analysis illustrate how many people, specifically from low-income and minority populations, could travel via transit from LGA to homes within 45 minutes from LGA. Airport passengers or Airport employees living within these areas could potentially benefit from expanded access to these destinations.
  - Sub-Option B-1A is expected to expand transit access from LGA to regional destinations within 45 minutes, as shown in the blue area of "Additional Access Provided by Transit Option" in Figure 6.1-10. Compared to the baseline, the minority population reached within a 45-minute transit trip would increase by 54.5% and the low-income population reached within a 45-minute transit trip would increase by 60.6% as shown in Table 6.1-5.
  - This represents a medium increase in transit access to LGA within 45 minutes for minority and low-income communities.

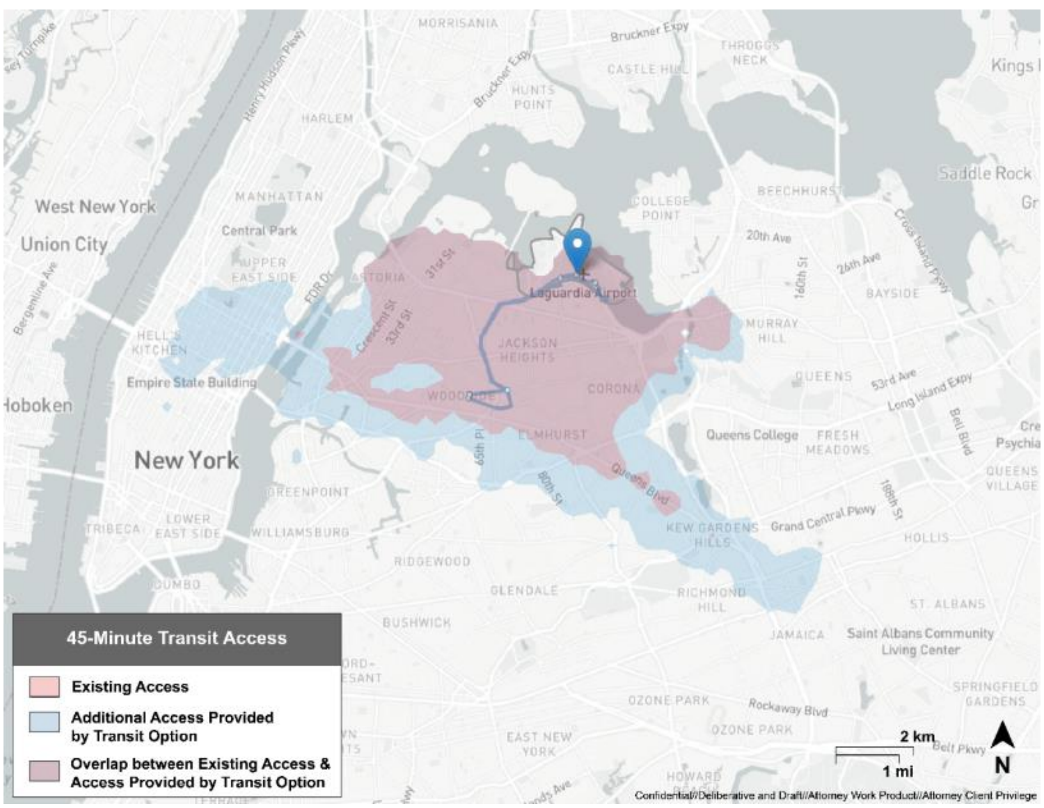


FIGURE 6.1-10: SUB-OPTION B-1A – POPULATION ACCESS ANALYSIS

TABLE 6.1-5: SUB-OPTION B-1A – POPULATIONS REACHED WITHIN 45-MINUTE TRANSIT TRIP

		Total Population Reached	Minority Population Reached	Low-Income Population Reached
Baseline	Existing Condition	551,434	422,981	76,750
B-1A	With Option	962,452	653,683	123,231
	Net Change	+411,018	+230,702	+46,481
	% Change	74.5%	54.5%	60.6%

- **Additional ADA-Accessible Stations within 45 Minutes from LGA via Transit (ADA Analysis)**
  - The results of the ADA Analysis illustrate how Airport passengers and Airport employees, specifically those requiring ADA-compliant stations, traveling from LGA to other locations could potentially benefit from expanded access to ADA-compliant stations within 45 minutes via transit.
  - More ADA-accessible stations/stops can be reached within a 45-minute transit trip for this option compared to the baseline of existing transit service (Table 6.1-6). This echoes the results from the Population Access Analysis, in which Sub-Option B-1A's 45-minute transit travel shed provides an increased amount of access over the baseline transit service. Compared to the baseline, an additional 37 ADA-accessible stations can be reached within a 45-minute transit trip from LGA for Sub-Option B-1A.

TABLE 6.1-6: SUB-OPTION B-1A – ADA ANALYSIS

Subway, Ferry, LIRR, and MNR Stations Reached within 45-Minute Transit Trip from LGA	Baseline	B-1A	Difference between Baseline and B-1A
Total Stations	*43*	*98*	*+55 stations*
ADA-Accessible Stations (Accessible Stations as % of Total)	*20 (47%)*	*57 (58%)*	*+37 stations*

Sub-Option B-1B

- **Additional Minority and Low-income Populations Reached within 45 Minutes from LGA via Transit (Population Access Analysis)**
  - The results of the ADA Analysis illustrate how Airport passengers and Airport employees, specifically those requiring ADA-compliant stations, traveling from LGA to other locations could potentially benefit from expanded access to ADA-compliant stations within 45 minutes via transit.
  - Sub-Option B-1B is expected to expand transit access from LGA to regional destinations within 45 minutes, as shown in the blue area of “Additional Access Provided by Transit Option” in Figure 6.1-11. Compared to the baseline, the minority population reached within a 45-minute transit trip would increase by 78.2% and the low-income population reached within a 45-minute transit trip would increase by 87.7% as shown in Table 6.1-7.
  - This represents a higher increase in transit access to LGA within 45 minutes for minority and low-income communities.

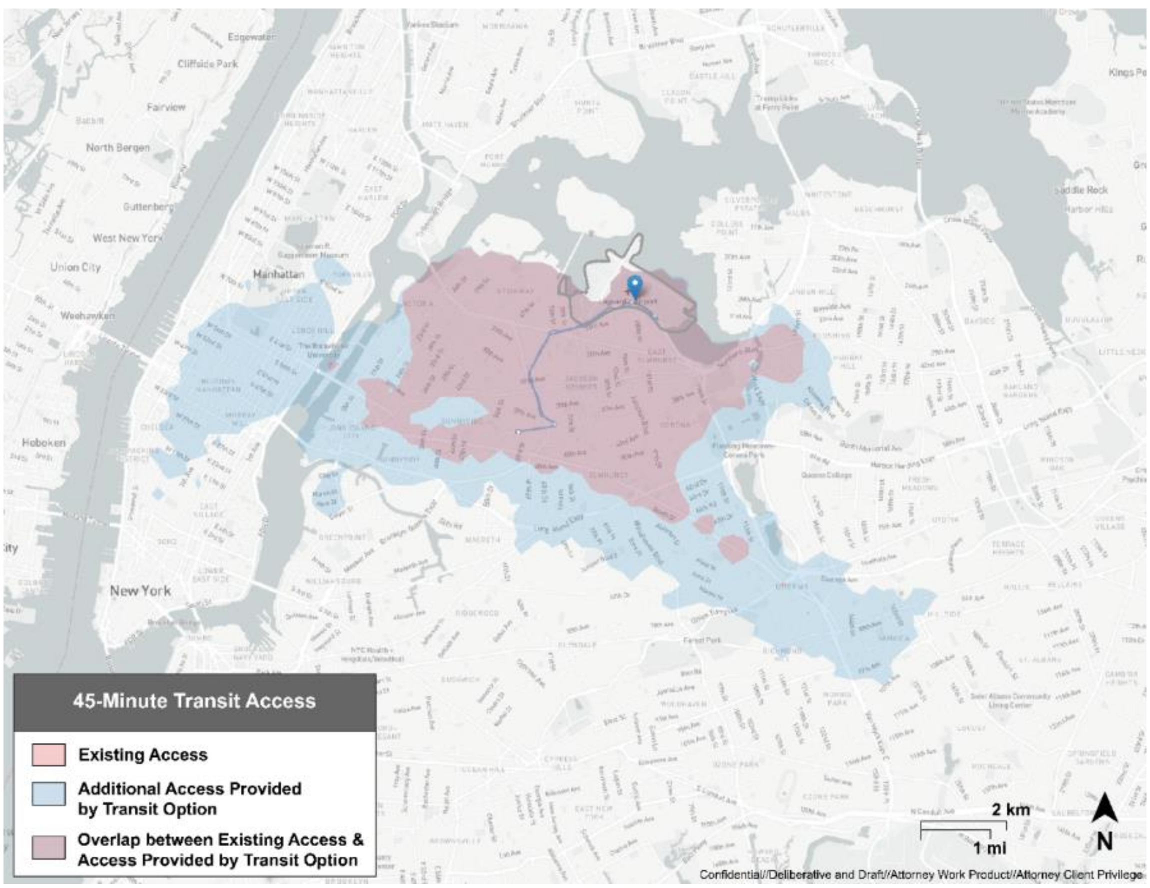


FIGURE 6.1-11: SUB-OPTION B-1B – POPULATION ACCESS ANALYSIS

TABLE 6.1-7: SUB-OPTION B-1B – POPULATIONS REACHED WITHIN 45-MINUTE TRANSIT TRIP

		Total Population Reached	Minority Population Reached	Low-Income Population Reached
Baseline	Existing Condition	551,434	422,981	76,750
B-1B	With Option	1,178,579	753,918	144,079
	Net Change	+627,145	+330,937	+67,329
	% Change	113.7%	78.2%	87.7%

- **Additional ADA-Accessible Stations within 45 Minutes from LGA via Transit (ADA Analysis)**
  - The results of the ADA Analysis illustrate how Airport passengers and Airport employees, specifically those requiring ADA-compliant stations, traveling from LGA to other locations could potentially benefit from expanded access to ADA-compliant stations within 45 minutes via transit.
  - More ADA-accessible stations/stops can be reached within a 45-minute transit trip for this option compared to the baseline of existing transit service (Table 6.1-8). This echoes the results from the Population Access Analysis, in which Sub-Option B-1B's 45-minute transit travel shed provides an increased amount of access over the baseline transit service. Compared to the baseline, an additional 54 ADA-accessible stations can be reached within a 45-minute transit trip from LGA for Sub-Option B-1B.

TABLE 6.1-8: SUB-OPTION B-1B – ADA ANALYSIS

Subway, Ferry, LIRR, and MNR Stations Reached within 45-Minute Transit Trip from LGA	Baseline	B-1B	Difference between Baseline and B-1B
Total Stations	*43*	*126*	*+83 stations*
ADA-Accessible Stations (Accessible Stations as % of Total)	*20 (47%)*	*74 (59%)*	*+54 stations*

Sub-Option B-1C

- **Additional Minority and Low-income Populations Reached within 45 Minutes from LGA via Transit (Population Access Analysis)**
  - The results of the Population Access Analysis illustrate how many people, specifically from low-income and minority populations, could travel via transit from LGA to homes within 45 minutes from LGA. Airport passengers or Airport employees living within these areas could potentially benefit from expanded access to these destinations.
  - Sub-Option B-1C (Without Terminal A) is expected to expand transit access from LGA to regional destinations within 45 minutes, as shown in the blue area of "Additional Access Provided by Transit Option" in Figure 6.1-12. Compared to the baseline, the minority population reached within a 45-minute transit trip would increase by 52.8% and the low-income population reached within a 45-minute transit trip would increase by 58.7% as shown in Table 6.1-9.
  - This represents a medium increase in transit access to LGA within 45 minutes for minority and low-income communities.

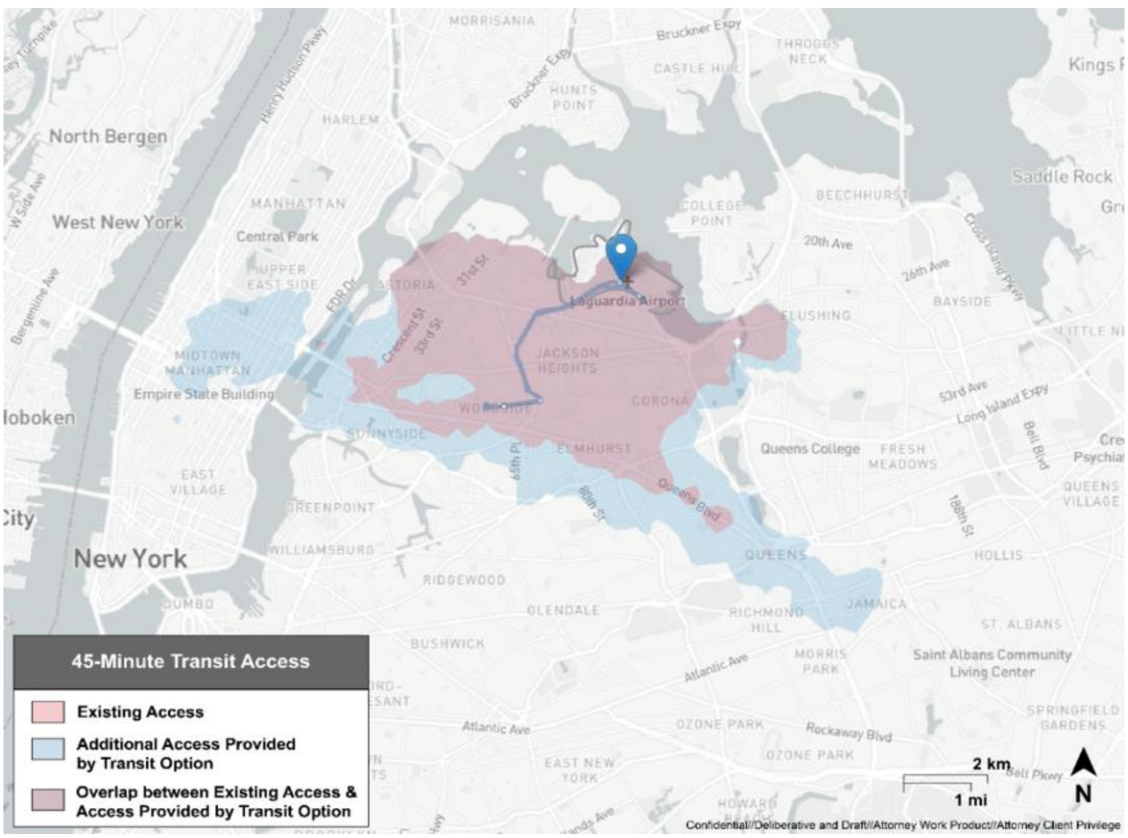


FIGURE 6.1-12: SUB-OPTION B-1C – POPULATION ACCESS ANALYSIS

TABLE 6.1-9: SUB-OPTION B-1C – POPULATIONS REACHED WITHIN 45-MINUTE TRANSIT TRIP

		Total Population Reached	Minority Population Reached	Low-Income Population Reached
Baseline	Existing Condition	551,434	422,981	76,750
B-1C (Without Terminal A)	With Option	945,654	646,248	121,800
	Net Change	+394,220	+223,267	+45,050
	% Change	71.5%	52.8%	58.7%

- **Additional ADA-Accessible Stations within 45 Minutes from LGA via Transit (ADA Analysis)**
  - The results of the ADA Analysis illustrate how Airport passengers and Airport employees, specifically those requiring ADA-compliant stations, traveling from LGA to other locations could potentially benefit from expanded access to ADA-compliant stations within 45 minutes via transit.
  - More ADA-accessible stations/stops can be reached within a 45-minute transit trip for this option compared to the baseline of existing transit service (Table 6.1-10). This echoes the results from the Population Access Analysis, in which Sub-Option B-1C's 45-minute transit travel shed provides an increased amount of access over the baseline transit service. Compared to the baseline, an additional 37 ADA-accessible stations can be reached within a 45-minute transit trip from LGA for Sub-Option B-1C.

TABLE 6.1-10: SUB-OPTION B-1C – ADA ANALYSIS

Subway, Ferry, LIRR, and MNR Stations Reached within 45-Minute Transit Trip from LGA	Baseline	B-1C (Without Terminal A)	Difference between Baseline and B-1C (Without Terminal A)
Total Stations	*43*	*97*	*+54 stations*
ADA-Accessible Stations (Accessible Stations as % of Total)	*20 (47%)*	*57 (59%)*	*+37 stations*

6.1.3.2.2 Transportation Opportunities and Benefits for the Surrounding Community

<u>Sub-Option B-1A</u>

- **Transportation Opportunities for Neighbors**

  This option does not include new intermediate/off-Airport stops. Because there is limited pedestrian access to LGA from adjacent residential areas and walking distance exceeds 0.25 mile, the study team did not consider there to be a significant market for use of the final on-Airport stops by the surrounding community to connect to the broader transit network.

- **Cars Removed from Local Roadways and Emissions Reductions**

  See the “Cars Removed from Local Roadways” section and the “GHG and Other Vehicular Emissions Reductions” section of this evaluation below.

<u>Sub-Option B-1B</u>

- **Transportation Opportunities for Neighbors**

  This option does not include new intermediate/off-Airport stops. Because there is limited pedestrian access to LGA from adjacent residential areas and walking distance exceeds 0.25 mile, the study team did not consider there to be a significant market for use of the final on-Airport stops by the surrounding community to connect to the broader transit network.

- **Cars Removed from Local Roadways and Emissions Reductions**

  See the “Cars Removed from Local Roadways” section and the “GHG and Other Vehicular Emissions Reductions” section of this evaluation below.

<u>Sub-Option B-1C</u>

- **Transportation Opportunities for Neighbors**

  This option does not include new intermediate/off-Airport stops. Because there is limited pedestrian access to LGA from adjacent residential areas and walking distance exceeds 0.25 mile, the study team did not consider there to be a significant market for use of the final on-Airport stops by the surrounding community to connect to the broader transit network.

- **Cars Removed from Local Roadways and Emissions Reductions**

  See the “Cars Removed from Local Roadways” section and the “GHG and Other Vehicular Emissions Reductions” section of this evaluation below.

6.1.3.3 Cars Removed from Local Roadways

<u>Sub-Option B-1A</u>

- Sub-Option B-1A would be expected to remove 277,000 Airport passenger vehicles, and 264,000 Airport employee vehicles, from the road each year.

<u>Sub-Option B-1B</u>

- Sub-Option B-1B would be expected to remove 837,000 Airport passenger vehicles, and 201,000 Airport employee vehicles, from the road each year.

<u>Sub-Option B-1C</u>

- Sub-Option B-1C would be expected to remove 703,000 Airport passenger vehicles, and 150,000 Airport employee vehicles, from the road each year.

6.1.3.4 GHG and Other Vehicular Emissions Reductions

Sub-Option B-1A

- Sub-Option B-1A would be expected to remove 1,841 metric tons of CO_2 equivalent each year.

Sub-Option B-1B

- Sub-Option B-1B would be expected to remove 5,835 metric tons of CO_2 equivalent each year.

Sub-Option B-1C

- Sub-Option B-1C would be expected to remove 4,944 metric tons of CO_2 equivalent each year.

Other vehicular emissions reductions are given in Table 6.1-11:

TABLE 6.1-11: OTHER VEHICULAR EMISSIONS REDUCTION (METRIC TONS PER YEAR)

Option	CO	VOC	NOx	SO_2	PM_{10}	$PM_{2.5}$
Sub-Option B-1A	8.7	0.1	0.6	0.03	0.3	0.1
Sub-Option B-1B	27.5	0.4	1.8	0.1	1.0	0.2
Sub-Option B-1C	23.3	0.3	1.6	0.1	0.9	0.2

6.1.4 Summary of Evaluation

Option B-1 would offer improvements to the existing Q70-SBS bus route operated by the MTA. The Q70-SBS currently provides a two-seat ride link to LGA, via the BQE and GCP transportation corridors, with the existing Jackson Hts-Roosevelt Av/74 St-Broadway stations (at Jackson Heights), and the existing LIRR Woodside and NYCT 61 St-Woodside stations (at Woodside). These provide transfer access to the E, F, M, R, and 7-Line Subway services at Jackson Heights and the LIRR Main Line (including the Port Washington Branch) and 7-Line Subway services at Woodside, as well as connections to other MTA bus services. Jackson Heights is also the locale for a proposed terminal station for the planned MTA-led IBX project.

Three levels of intervention were evaluated for the Q-70 SBS service:

- B-1A, with spot improvements to the Q70-SBS;
- B-1B, with new, heavy construction bus-only infrastructure to avoid peak-time congestion on the GCP, and;
- B-1C, a middle, more cost-efficient option (than B-1B) to improve bus services but with less community impact.

<u>B-1A: Q70-SBS Route with Spot Improvements</u>

Sub-Option B-1A would offer improvements to the existing Q-70 SBS service to improve customer experience and bus travel times. These would include improved wayfinding and signage at existing stops and the introduction of a new 'queue jump' at the BQE off-ramp to Broadway and transit signals revised to prioritize the buses. The service would continue to be operated by the MTA using the current bus fleet and timetable which MTA can adjust to suit increased demand levels.

This sub-option would require light roadway work (line painting, re-curbing, etc.) for the bus queue jump and stop improvements.

Table 6.1-12 summarizes the output from all the factors used to evaluate this option.

TABLE 6.1-12: SUMMARY OF KEY CHARACTERISTICS – Q70-SBS ROUTE WITH SPOT IMPROVEMENTS (B-1A)

	Evaluation Factor	Assessment
CONSTRN ASPECTS	Constructability	• Total option route length: approx. 4 miles
	Infrastructure Impacts during Construction	• Minor disruption to existing MTA bus routes (inc. Q70-SBS) during roadway work
	Permanent/Operational Impacts to Existing Infrastructure	None
	Indicative Capital Cost (2022$)[76]	$20 million
	Indicative Timeline/Schedule	1-2 Years

[76] Indicative Capital Costs should be considered to have a range of estimating uncertainty of –10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).

TABLE 6.1-12, CONTINUED.

	Evaluation Factor	Assessment
TRANSPORTATION ASPECTS	Standardized Indicative Baseline Off-Peak Travel Time (From Midtown Manhattan)	LIRR via Woodside: 42–51 mins (18–27 mins on bus, up to 5% quicker than current Q70-SBS[77]) (Penn Station to Terminal C then B; shuttle to Terminal A) Subway E-Line via Jackson Heights: 45–53 mins (14–22 mins on bus, up to 7% quicker than current Q70-SBS[77]) (Penn Station to Terminal C then B; shuttle to Terminal A)
	Transfer Experience	• Transfer from Woodside LIRR station to the bus stop would involve vertical moves via existing stairs and elevators (first to mezzanine and then to grade) and a short walk, in open air, to the covered bus stop • Transfer from Jackson Heights E, F, M, and R-Lines to the bus stop would involve vertical moves up to the subway mezzanine level via existing stairs and elevators (3 elevator rides to reach grade), followed by a short walk, in open air, to the covered bus stop • Transfer from Jackson Hts 7-Line to the bus stop would involve vertical moves via existing stairs/elevators from platform to grade, and a short walk, in open air, to covered bus stops • Jackson Heights is a complicated station with 5 Subway lines; improved wayfinding would be provided as part of the option
	Ridership[78]	Based on 2019 Q70-SBS Ridership, total projected ridership: 2.6 million Net increase in annual projected Q70-SBS ridership: 0.7 million
	Throughput & Capacity	Would be adapted to suit demand
	Indicative Operating Cost	Would depend on any future changes in operating protocols
COMMUNITY AND ENVIRONMENTAL ASPECTS	Local Community Impacts	Construction: • Light roadway work (e.g., restriping, curb replacements, bypass lanes) for approx. 0.5 year Proximity to communities: • No change from existing Q70-SBS service Permanent impacts: • No permanent private property acquisitions • No impacts to NYC parklands or plazas • Minimal, if any permanent loss of on-street public parking spaces
	Equity	• Medium increase to low-income and minority populations within 45 minutes of the Airport via transit versus the no-build scenario • +37 additional ADA-compliant stations reachable within a 45-minute transit trip from LGA versus the no-build scenario
	Cars Removed from Local Roadways	277,000 airport passenger vehicles and 264,000 airport employee vehicles from the road each year
	GHG and other Vehicular Emissions Reductions	1,841 metric tons of CO2 equivalent each year

[77] Based on MTA data for actual bus run times.
[78] Experience from AirTrain JFK was that actual ridership turned out to be higher than would have been predicted by the AirTrain JFK forecast and underscores the inherent uncertainty of model predictions. The ridership model supporting this effort could also deviate from eventual ridership demand but was utilized to allow ridership comparisons between the options.

B-1B: Q70-SBS Route with Heavier Infrastructure Improvements

Sub-Option B-1B would offer bus travel time improvements over the existing Q70-SBS service through the introduction of new bus-only heavy infrastructure. In addition to the queue jump and transit signal improvements of B-1A, Sub-Option B-1B would convert the northbound BQE shoulder to a bus-only lane and construct a new dedicated busway structure from the BQE to new elevated bus stops on the Airport, allowing buses to completely bypass traffic on the GCP.

This sub-option would require a mix of light roadway work (line painting, re-curbing, etc.) and heavy infrastructure, including an at-grade busway structure along the GCP rising to elevated structures on-Airport. This sub-option would have to contend with the construction challenges of complying with FAA Airport Design Standards while negotiating the 90-year-old utilities under the GCP at the end of Runway 04-22 (a challenge as yet unresolved as discussed in Section 3.2.1.1.1) and would require federal, state and local approvals to convert the BQE shoulder to a bus-only lane (which has been done on other projects involving expedited bus services). For the purpose of cost comparison, this option was costed out on the basis of a baseline solution of a new at-grade roadway south of Runway 04-22 despite this approach not being compliant with FAA Airport Design Standards.

Table 6.1-13 summarizes the output from all the factors used to evaluate this option.

TABLE 6.1-13: SUMMARY OF KEY CHARACTERISTICS – Q70-SBS ROUTE WITH HEAVIER INFRASTRUCTURE IMPROVEMENTS (B-1B)

	Evaluation Factor	Assessment
CONSTRUCTION ASPECTS	Constructability	• **Major unresolved constructability challenge**: Complying with FAA Airport Design Standards while also avoiding disruption to 90-year-old, 15 ft diameter sewer structures at the end of Runway 04-22 (see details on pages ES-31 to ES-36) • Repurpose eastbound BQE connector right shoulder to bus-only lane • Constrained construction access adjacent to GCP • Reconstruction of 82nd St Bridge • Long spans (250-300 ft) over 94th St Bridge and 102nd St bridges on-Airport • Constrained on-Airport sites for new elevated busway structure and bus stops • Total option route length: approx. 4 miles
	Infrastructure Impacts during Construction	• Disruption to existing MTA bus operations (inc. Q70-SBS) • Lane closures / reductions and speed restrictions on BQE, GCP and Astoria Blvd
	Permanent/Operational Impacts to Existing Infrastructure	• Permanent conversion of right shoulder on Eastbound BQE Connector to bus-only lane • Inhibits future widening of the BQE and GCP • Columns and piers in site of future Terminal B taxi hold
	Indicative Capital Cost (2022$)[79]	$1.2 billion[80] (Does not include any additional costs required for an as yet unresolved solution to get past Runway 04-22 in compliance with FAA Airport Design Standards; potentially up to approx. $1–$3 billion)
	Indicative Timeline/Schedule	9–10 Years

[79] Indicative Capital Costs should be considered to have a range of estimating uncertainty of –10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).

[80] Costs for heavy infrastructure options approaching LGA from the west/southwest are based on the open-trench construction concept past Runway 04-22 (over the existing 90-year-old utilities), to provide a baseline estimate of the cost of construction. Although this concept does not meet FAA Airport Design Standards, it provides a consistent approach for capital cost comparison purposes. Costs associated with tunnelling and/or relocating utilities would be substantially higher, potentially up to approx. $1–$3 billion.

TABLE 6.1-13, CONTINUED.

	Evaluation Factor	Assessment
TRANSPORTATION ASPECTS	Standardized Indicative Baseline Off-Peak Travel Time (From Midtown Manhattan)	LIRR via Woodside: 35–38 mins (11–14 mins on bus, up to 42% quicker than current Q70-SBS[81]) (Penn Station to Terminal B then C; shuttle to Terminal A) Subway E-Line via Jackson Heights: 39–40 mins (8–9 mins on bus, up to 47% quicker than current Q70-SBS[81]) (Penn Station to Terminal B then C; shuttle to Terminal A)
	Transfer Experience	• Transfer from Woodside LIRR station to the bus stop would involve vertical moves via existing stairs and elevators (first to mezzanine and then to grade) and a short walk, in open air, to the covered bus stop • Transfer from Jackson Heights E, F, M, and R-Lines to the bus stop would involve vertical moves up to the subway mezzanine level via existing stairs and elevators (3 elevator rides to reach grade), followed by a short walk, in open air, to the covered bus stop • Transfer from Jackson Hts 7-Line to the bus stop would involve vertical moves via existing stairs/elevators from platform to grade, and a short walk, in open air, to covered bus stops • Jackson Heights is a complicated station with 5 Subway lines; improved wayfinding would be provided as part of the option
	Ridership[82]	Based on 2019 Q70-SBS Ridership, total projected ridership: 3.8 million Net increase in annual projected Q70-SBS ridership: 1.9 million
	Throughput & Capacity	Would be adapted to suit demand
	Indicative Operating Cost	Would depend on any future changes in operating protocols
COMMUNITY AND ENVIRONMENTAL ASPECTS	Local Community Impacts	Construction: • Mix of heavy civil construction and light roadway work for approx. 4.25 years Proximity to communities: • Over 500 ft across 8 lanes of the GCP from 9 city blocks of residential and commercial properties opposite the Airport Terminals Permanent impacts: • No permanent private property acquisition • Structures over or adjacent to Planeview Park and Overlook Park[83] • Loss of approx. 30 public on-street parking spaces on 56th St, Broadway, and Boody St
	Equity	• Higher increase to low-income and minority populations within 45 minutes of the Airport via transit versus the no-build scenario • +54 additional ADA-compliant stations reachable within a 45-minute transit trip from LGA versus the no-build scenario
	Cars Removed from Local Roadways	837,000 airport passenger vehicles and 201,000 airport employee vehicles from the road each year
	GHG and other Vehicular Emissions Reductions	5,835 metric tons of CO2 equivalent each year

[81] Based on MTA data for actual bus run times.
[82] Experience from AirTrain JFK was that actual ridership turned out to be higher than would have been predicted by the AirTrain JFK forecast and underscores the inherent uncertainty of model predictions. The ridership model supporting this effort could also deviate from eventual ridership demand but was utilized to allow ridership comparisons between the options.
[83] Municipal parkland cannot be converted to a non-park use (known as alienation) without State legislative permission. Thus, the acquisition of New York City Parkland for construction of a mass transit option would require legislation authorizing such alienation. Obtaining such legislation is a multi-step process requiring actions by the New York City Council, the Mayor of New York City, the New York State Legislature, and the Governor.

B-1C: Q70-SBS Route with Lighter Infrastructure Improvements

Sub-Option B-1C would offer bus travel time improvements over the existing Q70-SBS service through the introduction of new bus-only light infrastructure. In addition to the queue jump and transit signal improvements of B-1A, Sub-Option B-1C would convert the northbound BQE shoulder to a bus-only lane and construct a new bus-only loop-road and at-grade bus stop at Terminal C, bypassing traffic at the current Terminal C stop. The service would continue to be operated by the MTA using the current bus fleet and timetable which MTA can adjust to suit future demand levels.

This sub-option would require light roadway work (line painting, re-curbing, etc.) and new roadway construction on-Airport around Terminal C. It would avoid the constructability challenge posed by heavy construction at the end of Runway 04-22. This sub-option would require federal, state and local approvals to convert the BQE shoulder to a bus-only lane (which has been done on other projects involving expedited bus services).

Table 6.1-14 summarizes the output from all the factors used to evaluate this option.

TABLE 6.1-14: SUMMARY OF KEY CHARACTERISTICS – Q70-SBS ROUTE WITH LIGHTER INFRASTRUCTURE IMPROVEMENTS (B-1C)

	Evaluation Factor	Assessment
CONSTRUCTION ASPECTS	Constructability	• Repurpose eastbound BQE connector right shoulder to bus-only lane • Constrained on-Airport sites for at-grade bus stops and bus turnaround • Total option route length: approx. 4 miles
	Infrastructure Impacts during Construction	• Minor disruption to existing MTA bus routes (inc. Q70-SBS) during roadway work • Lane closures / reductions and speed restrictions on BQE
	Permanent/Operational Impacts to Existing Infrastructure	• Permanent conversion of right shoulder on Eastbound BQE Connector to bus-only lane
	Indicative Capital Cost (2022$)[84]	$100 million[85]
	Indicative Timeline/Schedule	2-3 Years

[84] Indicative Capital Costs should be considered to have a range of estimating uncertainty of –10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).
[85] Cost includes potential early enabling work, including road circulation improvements around Terminal C by relocating bus drop-off and pick-up closer to the Terminal C garage.

TABLE 6.1-14, CONTINUED.

	Evaluation Factor	Assessment
TRANSPORTATION ASPECTS	Standardized Indicative Baseline Off-Peak Travel Time (From Midtown Manhattan)	LIRR via Woodside: 39–44 mins (15–20 mins on bus, up to 21% quicker than current Q70-SBS[86]) (Penn Station to Terminal C then B; shuttle to Terminal A) Subway E-Line via Jackson Heights: 42–47 mins (11–16 mins on bus, up to 27% quicker than current Q70-SBS[86]) (Penn Station to Terminal C then B; shuttle to Terminal A)
	Transfer Experience	• Transfer from Woodside LIRR station to the bus stop would involve vertical moves via existing stairs and elevators (first to mezzanine and then to grade) and a short walk, in open air, to the covered bus stop • Transfer from Jackson Heights E, F, M, and R-Lines to the bus stop would involve vertical moves up to the subway mezzanine level via existing stairs and elevators (3 elevator rides to reach grade), followed by a short walk, in open air, to the covered bus stop • Transfer from Jackson Hts 7-Line to the bus stop would involve vertical moves via existing stairs/elevators from platform to grade, and a short walk, in open air, to covered bus stops • Jackson Heights is a complicated station with 5 Subway lines; improved wayfinding would be provided as part of the option
	Ridership[87]	Based on 2019 Q70-SBS Ridership, total projected ridership: 3.5 million Net increase in annual projected Q70-SBS ridership: 1.6 million
	Throughput & Capacity	Would be adapted to suit demand
	Indicative Operating Cost	Would depend on any future changes in operating protocols
COMMUNITY AND ENVIRONMENTAL ASPECTS	Local Community Impacts	<u>Construction:</u> • Light roadway (e.g., restriping, curb replacements, bypass lanes) for approx. 1 year <u>Proximity to communities:</u> • No change from existing Q70-SBS service <u>Permanent impacts:</u> • No permanent private property acquisitions • No impacts to NYC parklands or plazas • Permanent loss of approx. 20 on-street public parking spaces along Broadway and Boody St
	Equity	• Medium increase to low-income and minority populations within 45 minutes of the Airport via transit versus the no-build scenario • +37 additional ADA-compliant stations reachable within a 45-minute transit trip from LGA versus the no-build scenario
	Cars Removed from Local Roadways	703,000 airport passenger vehicles and 150,000 airport employee vehicles from the road each year
	GHG and other Vehicular Emissions Reductions	4,944 metric tons of CO2 equivalent each year

[86] Based on MTA data for actual bus run times.
[87] Experience from AirTrain JFK was that actual ridership turned out to be higher than would have been predicted by the AirTrain JFK forecast and underscores the inherent uncertainty of model predictions. The ridership model supporting this effort could also deviate from eventual ridership demand but was utilized to allow ridership comparisons between the options.

6.2 B-2: M60-SBS Route with Spot Improvements

Option B-2 would offer improvements to the existing M60-SBS bus route operated by MTA, which originates from Manhattan (providing access to Metro North services to locations in New York and Connecticut), and links LGA with the existing Astoria Blvd Subway station in Queens, providing two-seat ride access to the N and W Subway services. The current M60-SBS uses the GCP/Astoria Blvd transportation corridor to access all three LGA terminals. Potential improvements to travel time, service reliability, and service frequency from the Astoria Blvd Station to LGA have been assessed in this option (Figure 6.2-1).

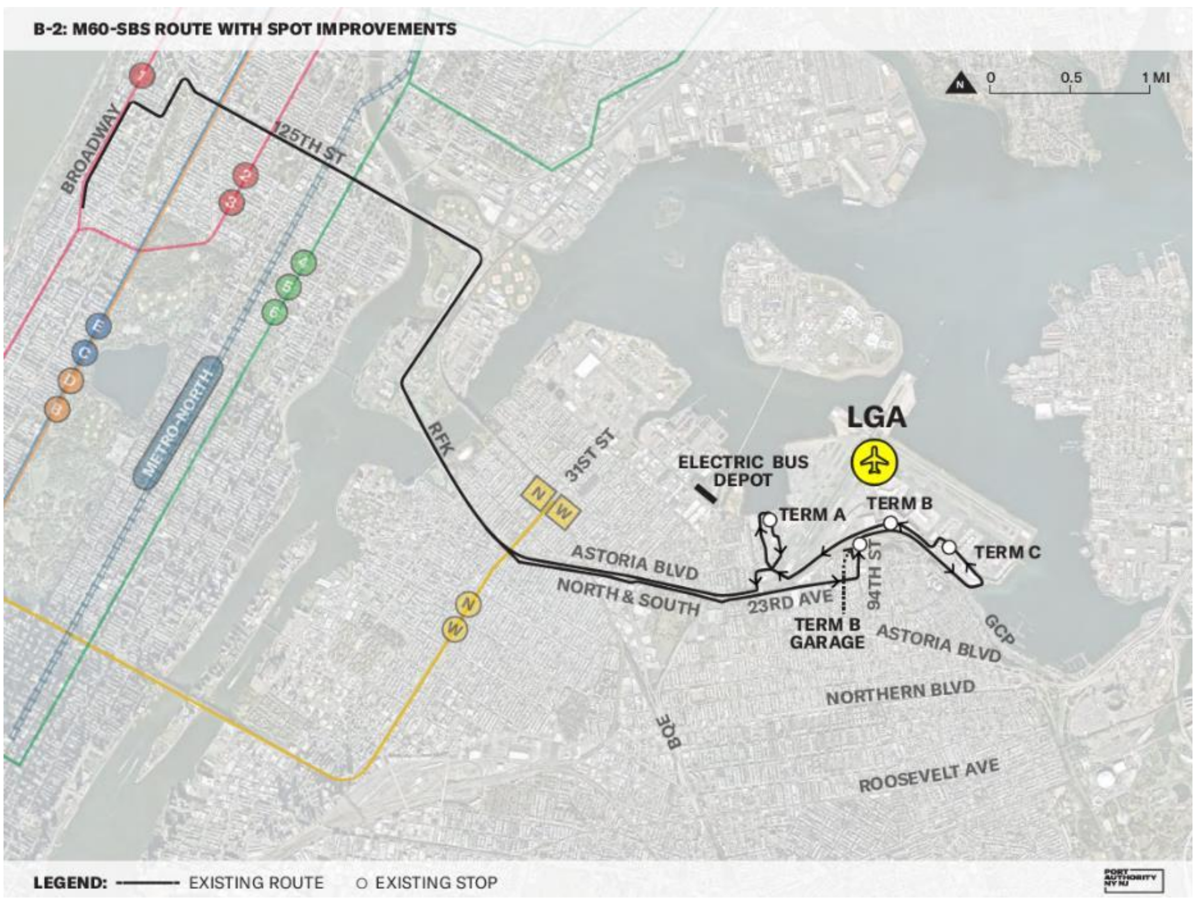


FIGURE 6.2-1: OPTION B-2

Currently, the M60-SBS operates in mixed-flow traffic conditions for the majority of its route, except for the HOV lane in front of Terminal B in LGA, and along 125th St between St Nicholas Ave and 2nd Ave in Manhattan (where it operates on bus lanes in both directions). The length of the M60-SBS (nearly 10 miles in one direction), plus congestion and slow traffic conditions along portions of the route, make the M60-SBS slower at certain times of the day, impacting its reliability. Some of the current areas of congestion are:

- Along 125th St in Manhattan, including segments with bus lanes (slow traffic speeds and general congestion).
- On the Robert F. Kennedy Bridge (slow traffic speeds in both directions).
- Astoria Blvd (slow traffic speeds in the afternoon both directions).
- Astoria Blvd approaching Boody St (slow eastbound traffic).
- GCP service road approaching 78th St (slow westbound traffic).
- Arrivals Rd near Terminal C (congestion in front of the terminal).
- Approaching westbound LaGuardia Rd/94th St (congestion at the intersection).

Option Route Description

For the purposes of this evaluation, the Queens portion of the route from Astoria Blvd Subway station to LGA is considered. As the M60-SBS has already benefited from transit signal improvements, the proposed improvements would be limited to improved wayfinding and signage at existing stops. Other improvements considered in this option that require little to no modifications to existing roadways are:

- Stop improvements to better passenger experience and to reduce dwell times.
- Bypass lanes and/or queue jump lanes at periodic locations where space permits to improve journey times (note: the exact locations of these elements would be determined during more detailed development).

The service would continue to be operated by the MTA using the current bus fleet and timetable which MTA can adjust to suit future demand levels.

The length of this route is approximately 9.5 miles, including the Manhattan, Queens, and on-Airport portions, approximately 4.2 miles considering only the Queens and on-Airport portions.

6.2.1 Evaluation of Construction Aspects

6.2.1.1 Constructability

The proposed improvements to the M60-SBS route include transit queue jumps (with resulting signal modifications) and bus stop improvements. The evaluation identified that the existing M60-SBS route currently utilizes TSP, and no new roadway infrastructure is required. The route would continue to operate in mixed-flow lanes on- and off-Airport. It would utilize existing at-grade bus stops that serve Terminal A, Terminal C on ‘Arrivals Road North,’ and Terminal B on the existing HOV level in front of the Terminal B headhouse as well as the LaGuardia Rd/94 St bus stop near the East Garage (frequently used by Airport employees and a stop on the existing M60-SBS service).

This option would require minor roadway work only (i.e., very little to no construction work) to implement; subsequently, there are no notable constructability challenges for the option although all proposed improvement work would require NYC DOT approval/coordination.

6.2.1.2 Infrastructure Impacts during Construction

Construction of this option would result in some temporary disruption to other major infrastructure along the route; any disruptions would be of short duration. The durations given below are indicative and based on preliminary assessment.

- **Disruption to Existing MTA Bus Route Operations while Improvements Take Place**
  - Disruption to general-purpose traffic due to new pavement marking and signal work would be localized and short (1–2 days) with the lane being painted closed over short lengths to minimize impact. The resulting detours, or other impacts to general-purpose traffic, most likely would also impact existing M60-SBS services for the duration of this work.

6.2.1.3 Permanent/Operational Impacts to Existing Infrastructure

Once completed, this option would have no permanent or operational impacts on other infrastructure along the route.

6.2.1.4 Indicative Capital Cost

The Indicative Capital Cost for Option B-2 is $5 million (in 2022$, excluding future escalation and solely for approximate comparison between study options).

Indicative Capital Costs should be considered to have a range of estimating uncertainty of -10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).

Due to the limited opportunity to further improve the existing M60-SBS service, the notable cost driver for the option is limited to:

- An allowance for customer experience and wayfinding enhancements at Astoria Blvd subway-bus transfer stop.

6.2.1.5 Indicative Timeline/Schedule

The Indicative Timeline/Schedule (for comparison between study options) for Option B-2 is approximately 1-2 years from a decision to take the option forward to revenue service. This includes the following notable schedule drivers:

- Planning, approvals, and acquisitions.
- Preliminary engineering.

Figure 6.2-2 illustrates the indicative timeline/schedule for Option B-2. The key driver is any up-front planning and approvals and preliminary engineering required to finalize the project.

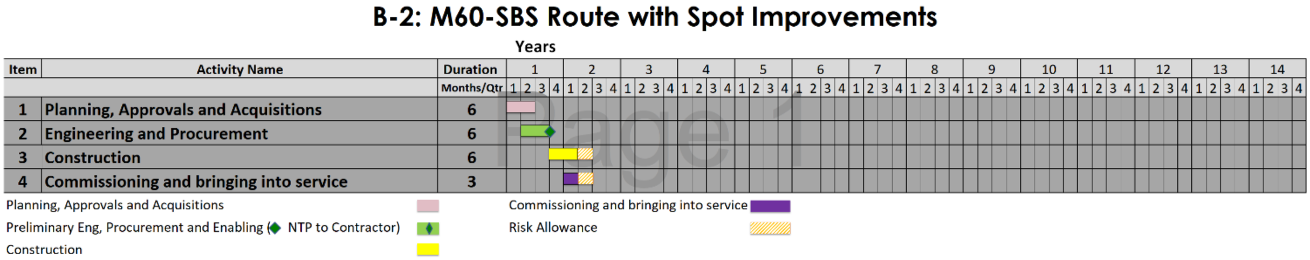


FIGURE 6.2-2: INDICATIVE TIMELINE/SCHEDULE (B-2)

6.2.2 Transportation Aspects

6.2.2.1 Improved Transit Access to LGA

Three factors have been considered in this category: Standardized Indicative Baseline Off-Peak Travel Time, Reliability, and Transfer Experience.

6.2.2.1.1 Standardized Indicative Baseline Off-Peak Travel Time

- Table 6.2-1, below, provides the Standardized Indicative Baseline Off-Peak Travel Times for the weekday, midday off-peak journeys to be used solely as a baseline for comparison between options. Table 6.2-2 provides a breakdown of the components that make up the total journey, the general approach to the estimation of which is described in Section 3.2.2.1.1.
- Passengers making the journeys described would, naturally, experience variations to the baseline timings calculated even where services are running as planned, for reasons as simple as variations in walking speeds or whether a traveler arrives just before a scheduled departure or just misses a departing train.

TABLE 6.2-1: STANDARDIZED INDICATIVE BASELINE OFF-PEAK TRAVEL TIMES, OPTION B-2

Times Square to LGA (minutes to Terminal C)	Current M60-SBS	B-2
Via Subway (N/W train) to Astoria Blvd	52	48

TABLE 6.2-2: STANDARDIZED INDICATIVE BASELINE OFF-PEAK TRAVEL TIMES BY SEGMENT, OPTION B-2

Times Square to LGA via N/W Subway (minutes)	Current M60-SBS	B-2
START Times Square (street level)		
walk/wait time	5	5
N/W Subway platform (dep)		
Subway trip time	21	21
Astoria Blvd N/W Subway platform (arr)		
walk/wait time	9	6
Astoria Blvd bus stop (dep)		
Bus trip time	17	16
1st on-Airport bus stop (arr)	existing	existing
END Terminal bus stop	Terminal C	Terminal C
Total travel time =	52	48
trip time to next Terminal bus stop	2	3
2nd on-Airport bus stop (arr)	existing	existing
END Terminal bus stop	Terminal B	Terminal B
Total travel time =	54	51
trip time to next Terminal bus stop	7	7
3rd on-Airport bus stop (arr)	existing	existing
END Terminal bus stop	Terminal A	Terminal A
Total travel time =	61	58

- The above standardized indicative baseline off-peak travel times are a baseline for weekday, midday off-peak journeys. Bus running times in mixed-use traffic would be subject to traffic congestion during peak times. Estimates of the potential increase to the Standardized Indictive Travel Time for peak-time traffic have been calculated solely for comparative purposes as around 9 minutes from Astoria Blvd to Terminal C.

6.2.2.1.2 Reliability

- The M60-SBS already has Transit Signal Priority implemented where possible. A measure that would increase reliability of this option would be:
  - Utilization of a new direct, exclusive road access to avoid congestion on the Airport frontage.

6.2.2.1.3 Transfer Experience

The M60-SBS route provides riders bound for Terminals A, B, or C with a two-seat ride via any of Subway lines served by the M60-SBS.

Customer Transfer

- The studied transfer at Astoria Blvd Station for passengers going to the airport would utilize the existing bus stop at its present location adjacent to Columbus Sq Park located at the southern end of the Astoria Blvd Station. Riders would follow new wayfinding to walk approximately 250 ft from the subway platform to the bus stop. Riders coming from the airport would use the existing bus stop at the corner of Hoyt Ave North and 31st St and follow new wayfinding to the platform, an approximately 430 ft walk. Astoria Blvd is an accessible station, so all transfers would be ADA-compliant using existing station amenities.

6.2.2.2 Ridership

- The ridership model projects an increase in net transit ridership of 0.4 million riders in 2025 (Table 6.2-3).

TABLE 6.2-3: RIDERSHIP MODEL RESULT SUMMARY

Transit Option				Riders on Current Bus Services to LGA (Millions) (No Action)	New Transit Option Impact (Millions)	
Mode Category & Scenario Label			Description		Net Increase in M60-SBS Ridership	Total Bus Ridership (M60-SBS Improvements + Other Bus Routes)
Bus - Transit Improvements Along Existing Routes	Bus	B-2	M60-SBS – Spot Improvements	4.1	**0.4**	**4.4**

6.2.2.3 Throughput and Capacity

Throughput

- Using the highest hourly single-direction provision of airline seats at LGA in 2019 (4,300 seats on weekday departing flights 9 AM to 10 AM – see Figure 3.2-1, in Section 3.2.2.3), the estimated single-direction peak passenger demand for this option could be approximately 300 passengers per hour.
- It should be noted that these passengers would likely arrive at the transfer station in groups, rather than being evenly distributed throughout the time period.

Capacity of New Transit Option

- Articulated buses can provide a loading capacity of up to 90 passengers per vehicle. For the purposes of comparison between options, using the existing morning service frequency of 10-minute headways up to a potential maximum of 5-minute headways proposed for these services, the potential total capacity of the B-2 bus service could be:
  - 540–1,080 pphpd.
- This is sufficient to support the estimated single-direction peak passenger demand from the ridership model, equating to approximately 25 passengers per bus at peak.
- Actual vehicle frequency would be adapted in practice to suit demand and other operating requirements.

Impact on Capacity of Existing Downstream Transit Systems

- Option B-2 provides passenger connection to Astoria Blvd Subway station, offering transfer access to the N/W Subway lines.
- Generally, airport passenger loadings are constant through the day both to and from the Airport with the peak passenger loadings occurring outside of the morning Manhattan-bound subway peaks or in the opposite direction (i.e., Airport-bound).
- The existing N- and W-Subway lines currently operate close to their peak capacity during the 8 AM to 9 AM Manhattan-bound commuting peak. While most Manhattan-bound Airport passengers would travel outside this peak, those passengers (including non-Airport passengers) traveling during this peak could experience some crowded conditions.
- Customers using Option B-2 also have the option to remain on the service as it continues toward Manhattan.
- The study team noted that Astoria Blvd Station is an elevated station with two island platforms and a mezzanine located between the platform level and the street. The mezzanine is connected to each platform via two sets of stairs, one at either end of the mezzanine, and one elevator. The station spans Astoria Blvd North, the Grand Central Parkway, and Astoria Blvd South. Connections to Astoria Blvd North and South are provided from the street via stairs and an elevator at each location. The layout and location of the station is highly constrained making adding additional elevators or escalators difficult, if not impossible. The MTA expressed concerns that new Airport passengers utilizing this station may subject the limited number of elevators and stairwells to overcrowding.

6.2.2.4 Indicative Operating Cost

Any increase in operating cost would depend on any changes in operating protocols.

6.2.3 Community and Environmental Aspects

6.2.3.1 Local Community Impacts

This option follows the existing M60-SBS route along Astoria Blvd South, 23rd St, and 94th St to LGA. It would include roadway modification activities (parking and lane restriping, curb replacement, bypass lanes, etc.) and reduced headways. For the purposes of this evaluation, the Queens portion of the route from Astoria Blvd Subway station to LGA is considered.

The route would pass by a wide range of properties, including single-family and 6- to 7-story residential buildings, commercial businesses, and public community buildings. The route goes through/along the communities of Astoria, Ditmars Steinway, and East Elmhurst.

The potential for impacts is summarized below for specific areas of the alignment (for the frequency and duration of construction activities refer to the “Infrastructure Impacts during Construction” section above).

6.2.3.1.1 Temporary Impacts during Construction on the Local Neighborhoods Directly Affected

Roadway modification activities (parking and lane restriping, curb replacement, bypass lanes, etc.) would occur along the approximately 4-mile route for approximately 0.5 years.

During construction, the following neighborhoods would have the potential for air quality, noise, vibration, or visual impacts. For the frequency and duration of construction activities refer to Section 6.2.1.2 "Infrastructure Impacts during Construction" above:

- **Roadway Modification**
  - Light roadway modification activities (parking and lane restriping, curb replacement, etc.) would occur along the approximately 3-mile route would have periodic impacts on traffic flow during a 6-month period.
  - Planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.

6.2.3.1.2 Permanent Operational Impacts on the Local Neighborhoods Directly Affected

- Existing buses would continue to operate in mixed-flow traffic throughout the route, ranging approximately 35–50 ft from residential and commercial properties while on city streets.
- As this option would not add any significant new infrastructure, the relative potential for permanent noise, vibration, or visual impacts is expected to remain unchanged.

6.2.3.1.3 Potential Private Property Acquisitions

No private properties are anticipated to be acquired.

6.2.3.1.4 Potential Public Property Acquisitions (NYC DOT Plazas and NYC Parks Parkland)

No structures would be sited within NYC Parks Parkland or NYC DOT Plazas.

6.2.3.1.5 Removal/Reconfiguration of Parking Spaces

This option would have minimal impact to on-street public parking.

6.2.3.1.6 Environmental Justice Communities Mapping Analysis

The Environmental Justice communities mapping analysis provides an overview of the minority and low-income communities within 0.25 mile of the transit options being studied.

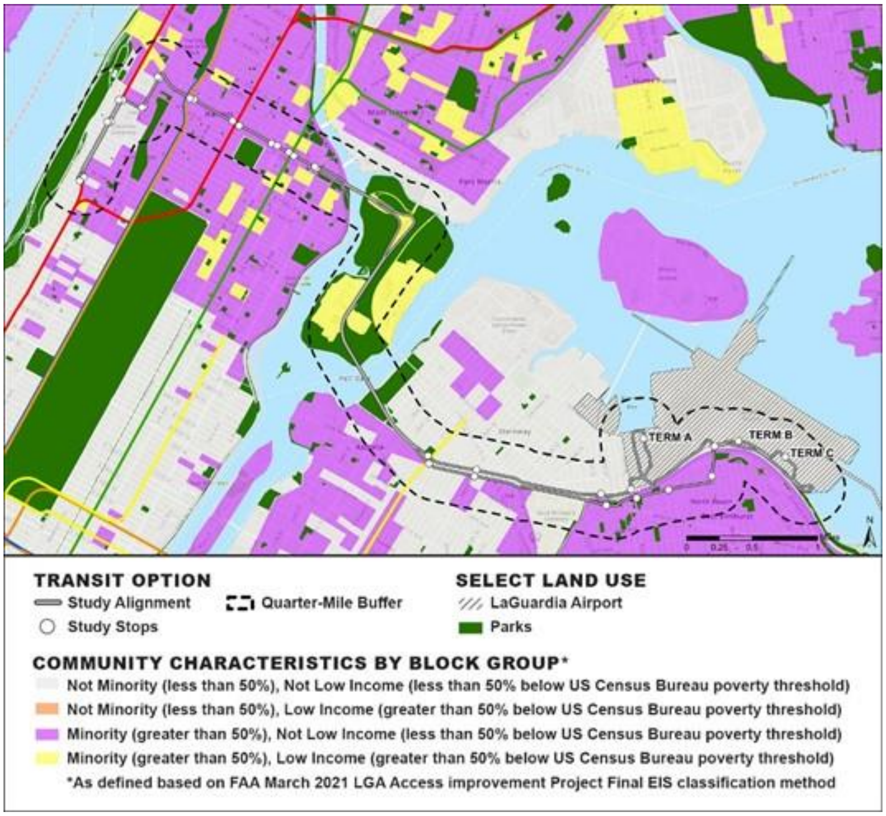


FIGURE 6.2-3: M60-SBS – ENVIRONMENTAL JUSTICE COMMUNITIES MAPPING ANALYSIS (AS DEFINED BASED UPON FAA MARCH 2021 LGA ACCESS IMPROVEMENT PROJECT FINAL EIS CLASSIFICATION METHOD)

For Option B-2, more than half of the block groups within the 0.25-mile buffer of the option alignment are Environmental Justice block groups.

See Figure 6.2-3 above for the analysis map for this option.

6.2.3.2 Equity

6.2.3.2.1 Transit Access from LGA

- **Additional Minority and Low-income Populations Reached within 45 Minutes from LGA via Transit (Population Access Analysis)**
  - The results of the Population Access Analysis illustrate how many people, specifically from low-income and minority populations, could travel via transit from LGA to homes within 45 minutes from LGA. Airport passengers or Airport employees living within these areas could potentially benefit from expanded access to these destinations.
  - Option B-2 is expected to expand transit access from LGA to regional destinations within 45 minutes, as shown in the blue area of “Additional Access Provided by Transit Option” in Figure 6.2-4. Compared to the baseline, the minority population reached within a 45-minute transit trip would increase by 9.2% and the low-income population reached within a 45-minute transit trip would increase by 17.4% as shown in Table 6.2-4.
  - This represents a lower increase in transit access to LGA within 45 minutes for minority and low-income communities.

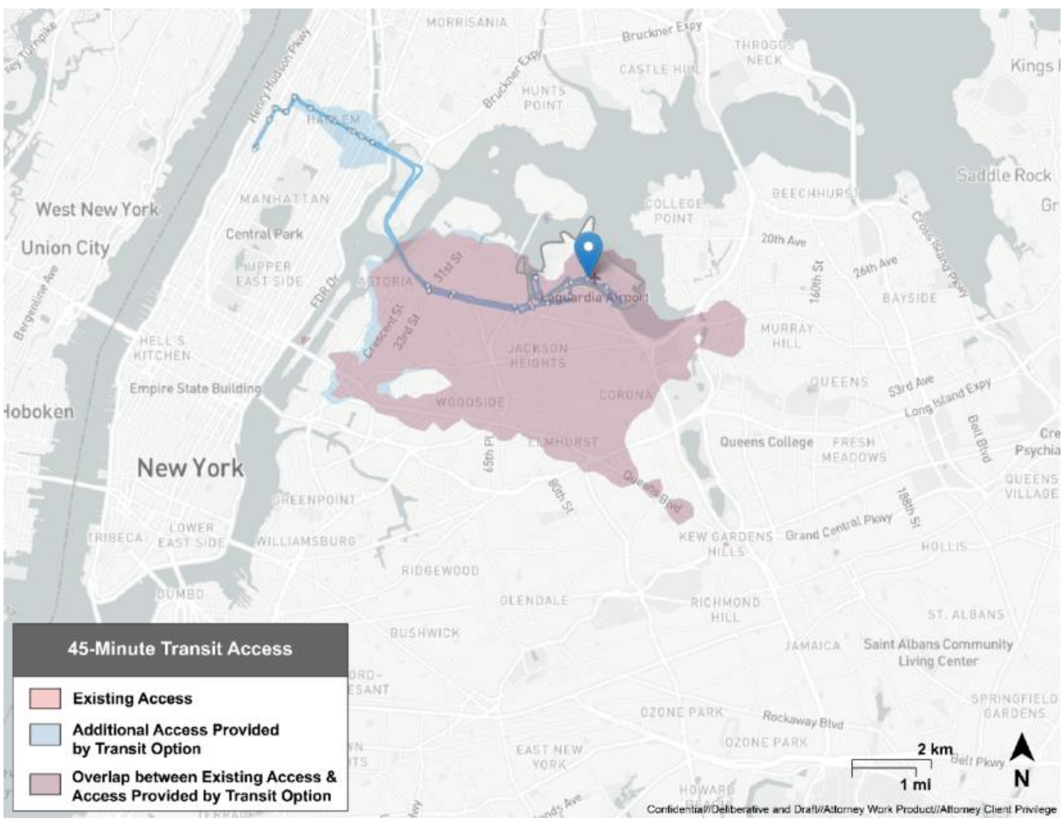


FIGURE 6.2-4: M60-SBS OPTION B-2 – POPULATION ACCESS ANALYSIS

TABLE 6.2-4: OPTION B-2 – POPULATIONS REACHED WITHIN 45-MINUTE TRANSIT TRIP

		Total Population Reached	Minority Population Reached	Low-Income Population Reached
Baseline	Existing Condition	551,434	422,981	76,750
B-2	With Option	599,349	462,040	90,106
	Net Change	+47,915	+39,059	+13,356
	% Change	8.7%	9.2%	17.4%

- **Additional ADA-Accessible Stations within 45 Minutes from LGA via Transit (ADA Analysis)**
  - The results of the ADA Analysis illustrate how Airport passengers and Airport employees, specifically those requiring ADA-compliant stations, traveling from LGA to other locations could potentially benefit from expanded access to ADA-compliant stations within 45 minutes via transit.
  - More ADA-accessible stations/stops can be reached within a 45-minute transit trip for this option compared to the baseline of existing transit service (Table 6.2-5). This echoes the results from the Population Access Analysis, in which Option B-2's 45-minute transit travel shed provides an increased amount of access over the baseline transit service. Compared to the baseline, an additional 4 ADA-accessible stations can be reached within a 45-minute transit trip from LGA for Option B-2.

TABLE 6.2-5: OPTION B-2 – ADA ANALYSIS

Subway, Ferry, LIRR, and MNR Stations Reached within 45-Minute Transit Trip from LGA	Baseline	B-2	Difference between Baseline and B-2
Total Stations	*43*	*49*	*+6 stations*
ADA-Accessible Stations (Accessible Stations as % of Total)	*20 (47%)*	*24 (49%)*	*+4 stations*

6.2.3.2.2 Transportation Opportunities and Benefits for the Surrounding Community

- **Transportation Opportunities for Neighbors**

  This option does not include any new intermediate/off-Airport stops compared to the current M60-SBS. Because there is limited pedestrian access to LGA from adjacent residential areas and walking distance exceeds 0.25 mile, the study team did not consider there to be a significant market for use of the final on-Airport stops by the surrounding community to connect to the broader transit network.

- **Cars Removed from Local Roadways and Emissions Reductions**

  See the "Cars Removed from Local Roadways" section and the "GHG and Other Vehicular Emissions Reductions" section of this evaluation below.

6.2.3.3 Cars Removed from Local Roadways

- Option B-2 would be expected to remove 136,000 Airport passenger vehicles, and 153,000 Airport employee vehicles, from the road each year.

6.2.3.4 GHG and Other Vehicular Emissions Reductions

- Option B-2 would be expected to remove 963 metric tons of CO_2 equivalent each year.
- Other vehicular emissions reductions are given in Table 6.2-6:

TABLE 6.2-6: OTHER VEHICULAR EMISSIONS REDUCTION (METRIC TONS PER YEAR)

Option	CO	VOC	NOx	SO_2	PM_{10}	$PM_{2.5}$
[B-2] M60 Enhanced	4.5	0.1	0.3	0.01	0.2	0.03

6.2.4 Summary of Evaluation

B-2: M60-SBS Route with Spot Improvements

Option B-2 would offer improvements to the existing M60-SBS bus route operated by MTA, which originates from Manhattan (providing access to Metro North services to locations in New York and Connecticut), and links LGA with the existing Astoria Blvd Subway station in Queens, providing two-seat ride access to the N and W Subway services. The current M60-SBS uses the GCP/Astoria Blvd transportation corridor to access all three LGA terminals. As the M60-SBS has already benefited from transit signal improvements, the proposed improvements would be limited to improved wayfinding and signage at existing stops. The service would continue to be operated by the MTA using the current bus fleet and timetable which MTA can adjust to suit future demand levels.

This option would require light roadway work (line painting, re-curbing, etc.) for the stop improvements.

Table 6.2-7 summarizes the output from all the factors used to evaluate this option.

TABLE 6.2-7: SUMMARY OF FINDINGS – M60-SBS ROUTE WITH SPOT IMPROVEMENTS (B-2)

	Evaluation Factor	Assessment
CONSTRN ASPECTS	Constructability	• Total option route length: approx. 4.2 miles (considering only the Queens to LGA portion)
	Infrastructure Impacts during Construction	• Minor disruption to existing MTA bus routes (inc. M60-SBS) during roadway work
	Permanent/Operational Impacts to Existing Infrastructure	None
	Indicative Capital Cost (2022$)[88]	$5 million
	Indicative Timeline/Schedule	1-2 Years

[88] Indicative Capital Costs should be considered to have a range of estimating uncertainty of –10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).

TABLE 6.2-7, CONTINUED.

	Evaluation Factor	Assessment
TRANSPORTATION ASPECTS	Standardized Indicative Baseline Off-Peak Travel Time (From Midtown Manhattan)	Via N/W-Lines: 48–57 mins (16–25 mins on bus, up to 6% quicker than current M60-SBS[89]) (Times Square to Terminal C; serves Terminals C, B, then A)
	Transfer Experience	• Transfer to the bus stop at Astoria Blvd Subway station would involve two vertical moves via existing stairs or existing elevator from platform to grade, and a short walk, in open air, to the covered bus stop • Circulation space at the mezzanine level of Astoria Blvd Station is constrained
	Ridership[90]	Net increase in annual projected M60-SBS ridership: 0.4 million
	Throughput & Capacity	Would be adapted to suit demand
	Indicative Operating Cost	Would depend on any future changes in operating protocols
COMMUNITY AND ENVIRONMENTAL ASPECTS	Local Community Impacts	<u>Construction:</u> • Light roadway (e.g., restriping, curb replacements, bypass lanes) for approx. 0.5 year <u>Proximity to communities:</u> • No change from existing M60-SBS service <u>Permanent impacts:</u> • No permanent private property acquisitions • No impacts to NYC parklands or plazas • Minimal, if any permanent loss of on-street public parking spaces
	Equity	• Lower increase to low-income and minority populations within 45 minutes of the Airport via transit versus the no-build scenario • +4 additional ADA-compliant stations reachable within a 45-minute transit trip from LGA versus the no-build scenario
	Cars Removed from Local Roadways	136,000 airport passenger vehicles and 153,000 airport employee vehicles from the road each year
	GHG and other Vehicular Emissions Reductions	963 metric tons of CO_2 equivalent each year

[89] Based on MTA data for actual bus run times.

[90] Experience from AirTrain JFK was that actual ridership turned out to be higher than would have been predicted by the AirTrain JFK forecast and underscores the inherent uncertainty of model predictions. The ridership model supporting this effort could also deviate from eventual ridership demand but was utilized to allow ridership comparisons between the options.

7.0 BUS – NEW DEDICATED BUS RAPID TRANSIT (BRT) ROUTES

The Bus Rapid Transit (BRT) options would provide new dedicated, non-stop bus shuttle services to LGA from existing transit hubs within Queens. BRT options would use Transit Signal Prioritization (TSP), convert existing traffic lanes to BRT-only bus lanes, and/or build new separated busway structures to avoid traffic congestion, and would introduce a new electric bus fleet. BRT options would offer travel time, reliability, and customer experience benefits over existing bus services.

These options could offer flexibility in the operating frequency of the shuttle service to the Airport, tailoring the timetable to suit demand during Airport operating hours. For the purposes of comparison between options, example 5-minute maximum headways are used in the evaluation to determine capital and operating costs and potential capacity, but actual frequency would be adapted to suit demand. Creating new dedicated bus lanes on existing roadways would typically require repurposing of existing travel or parking lanes or widening of existing roadways which could involve significant construction. Transit signal priority for the new bus services would be provided to the maximum extent feasible.

The evaluation included bus stops having customer convenience features (i.e., weather protection, seating and space for luggage, additional transit information, etc.) plus some enhanced customer features (i.e., level platform boarding, upgraded wayfinding, and dynamic signage).

Each of the options in this section was developed in consultation with the MTA and, for the purposes of developing cost assessments, MTA’s most recently available information was used. The proposed bus fleet to serve the Airport would use zero emission, electric buses, to minimize noise- and emission-related impacts to the non-traveling public and would be equipped with passenger convenience amenities such as trip progress displays, automatic announcements, air conditioning, and luggage racks.

To support the new buses, all options include the provision of a dedicated bus storage, maintenance, and charging facility (depot). For the purposes of the evaluation, this depot would be located on Airport property known as ‘Ingraham’s Mountain,’ located west of the main Airport area near the intersection of 19th Ave and 45th St in Queens. Should any of these options be considered for future development, the location of the depot would need to be reviewed and may be subject to change.

The new dedicated BRT options (and sub-options) evaluated as part of this study are described below:

- BRT-1: BRT shuttle to/from Astoria Blvd Station via Astoria Blvd/GCP:
    - BRT-1A: Astoria Blvd shuttle with bus lanes on Astoria Blvd and newly constructed busway/guideway adjacent to the GCP.
    - BRT-1B: Astoria Blvd shuttle with full busway on Astoria Blvd and adjacent to the GCP.
    - BRT-1C: Astoria Blvd shuttle with bus lanes on Astoria Blvd only.
- BRT-2: BRT shuttle to/from Astoria-Ditmars Blvd Station via 31st St/19th Ave.
- BRT-3: BRT shuttle to/from Northern Blvd Station via Northern Blvd/94th St.

The study team initially evaluated two sub-options of Option BRT-1. BRT-1A considered the (lighter construction) conversion of travel lanes to bus lanes along Astoria Blvd plus a dedicated (heavier construction) busway to elevated on-Airport bus stops. BRT-1B adopted a (heavier construction) full busway along Astoria Blvd and the GCP, also to elevated on-Airport bus stops. A third sub-option, BRT-1C, is intermediate between the previous two, adopting the (lighter construction) bus lanes along Astoria Blvd of BRT-1A, and avoiding the (heavier construction) elevated busway in both BRT-1A and BRT-1B by having buses travel on the GCP in mixed-flow traffic to at-grade on-Airport bus stops.

Plan and profile alignment drawings for each of the BRT alignments can be found in Appendix Section 2.4; they show the proposed layouts of the options as evaluated.

7.1 BRT-1: BRT Shuttle to/from Astoria Blvd Station via Astoria Blvd/GCP

Option BRT-1 would create a new electric bus shuttle service to LGA from the existing Astoria Blvd Subway station, providing transfer access to N and W-Line Subway services. BRT bus stops would be located adjacent to the station on either side of Columbus Sq Park and buses would use the Astoria Blvd/GCP transportation corridor to reach the Airport.

The study team evaluated three sub-options of BRT-1. BRT-1A would use a combination of bus lanes on Astoria Blvd and a dedicated elevated busway onto the Airport to avoid possible congestion and traffic delays, improving travel time and reliability. BRT-1B would further improve these with a separated busway for the full route from Astoria Blvd Station to LGA. BRT-1C offers cost-efficient options, converting bus lanes on Astoria Blvd only, realizing much of the travel time benefits while avoiding both the cost and community impacts of the heavy infrastructure required of the separated busway.

In all sub-options, passengers would transfer between the N- and W-Lines and the BRT from the Astoria Blvd Subway station to the improved bus stops on the north and south side of Columbus Square Park using the existing ADA-compliant vertical transportation elements within the station. BRT bus stops would be located on the north and south sides of the square, respectively.

The key physical differences in how each sub-option gets to LGA are as follows:

- BRT-1A (Figure 7.1-1) would utilize dedicated BRT-only bus lanes, repurposing existing traffic lanes on Astoria Blvd North (westbound) and Astoria Blvd South (eastbound), and transition to an elevated BRT-only busway east of the Astoria Blvd North overpass (to bypass traveling in mixed traffic in the GCP) to travel to two elevated on-Airport bus stops. BRT-1A would require a mix of lighter (lane re-purposing) and heavier (elevated busway structure) construction.
- BRT-1B (Figure 7.1-2) would utilize a dedicated bi-directional (east and westbound) BRT-only busway formed by repurposing one existing traffic lane and constructing an additional lane on Astoria Blvd South, and transition to an elevated BRT-only busway structure east of 44th St (to bypass traveling in mixed-flow traffic in the GCP) to travel to two elevated on-Airport bus stops. BRT-1B would require heavier construction throughout.
- BRT-1C (Figure 7.1-3) would utilize dedicated BRT-only bus lanes, repurposing existing traffic lanes on Astoria Blvd North (westbound) and Astoria Blvd South (eastbound) (like BRT-1A), and transition to running in mixed-flow traffic on the GCP into the Airport to travel to two at-grade bus stops. The route would serve Terminal C, via a new dedicated BRT-only loop that would tie into the existing taxi access road, and Terminals A and B, via existing on-Airport roads. BRT-1C would require lighter construction throughout.

Sub-Option Route Descriptions

More detailed descriptions of each of the sub-options' routes are provided below.

Sub-Option BRT-1A: Astoria Blvd shuttle with bus lanes on Astoria Blvd and heavy

infrastructure busway adjacent to the GCP

Heading east toward LGA, Sub-Option BRT-1A (see Figure 7.1-1) would split eastbound and westbound BRT lanes either side of the GCP onto Astoria Blvd South and North, respectively, between 32nd St and 82nd St, for a length of 1.2 miles. Where these bus lanes intersect several streets at-grade, they would use TSP to optimize travel time. Ramps between the GCP and Astoria Blvd in the BQE interchange vicinity would be modified to provide additional transit priority and reduce conflicts between modes. An at-grade transition between 78th St and 80th St would require rebuilding of several roads and adding new transit priority lanes for the BRT. At the Astoria Blvd North overpass of the GCP, the eastbound bus lane would enter a two-way dedicated BRT-only busway running along the south side of the GCP separated from the GCP traffic, to pass under 82nd St (requiring the bridge's reconstruction). At the same location, the westbound bus lane would exit the two-way dedicated BRT-only busway and cross the GCP to continue westbound on Astoria Blvd North.

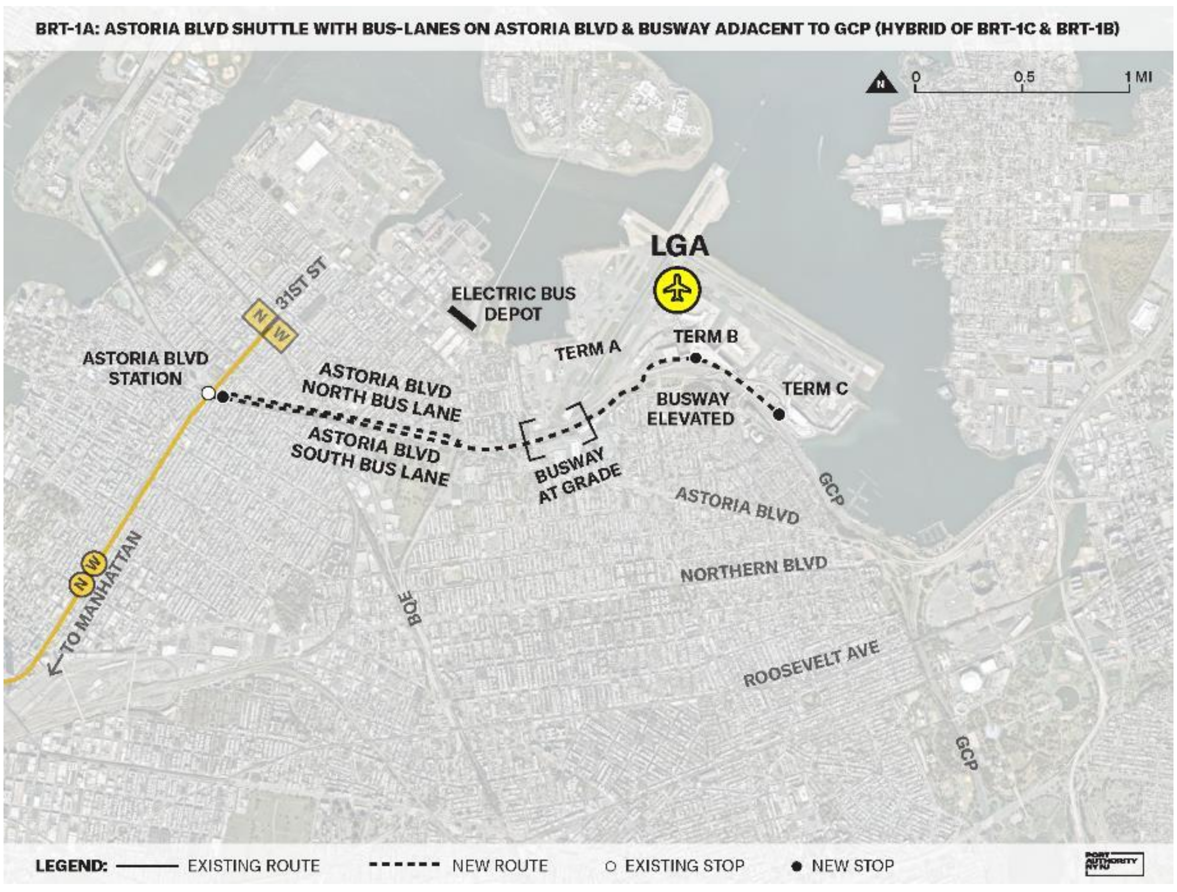


FIGURE 7.1-1: SUB-OPTION BRT-1A

As discussed in detail in Section 3.2.1.1.1, the heavier infrastructure options from the west (including this option, BRT-1A) must overcome the significant challenges and complexities presented by the twin constraints of the FAA Airport Design Standards and the existing large-diameter, 90-year-old utility structures along the GCP. The preliminary engineering work carried out by the study team has not identified a construction approach that, with confidence, could do this without more complex, risky, and costly approaches to construction that would require greater engineering exploration beyond the scope of this study. To provide a consistent basis on which to evaluate the option and to allow cost comparison between the options, Sub-Option BRT-1A is based on the baseline, simpler construction, concept of an at-grade busway structure in the embankment south of the GCP, despite this being shown to be not compliant with the FAA Airport Design Standards.

Once east of Runway 04-22 the busway would transition to an elevated structure starting around 90th St. The busway would pass over a rebuilt GCP off-ramp at 94th St, then cross the GCP onto LGA property. Two elevated bus stops would directly serve Terminal B and Terminal C, with a short walk connecting the respective stop to the ticketing hall.

Sub-Option BRT-1B: Astoria Blvd shuttle with full heavy infrastructure busway on Astoria Blvd and adjacent to the GCP

Sub-Option BRT-1B (Figure 7.1-2) would provide a bi-directional BRT-only busway from Astoria Blvd Subway station all the way to LGA. From Columbus Sq Park, the busway would begin at-grade on the south side of GCP on Astoria Blvd between 32nd St and 44th St with a physical

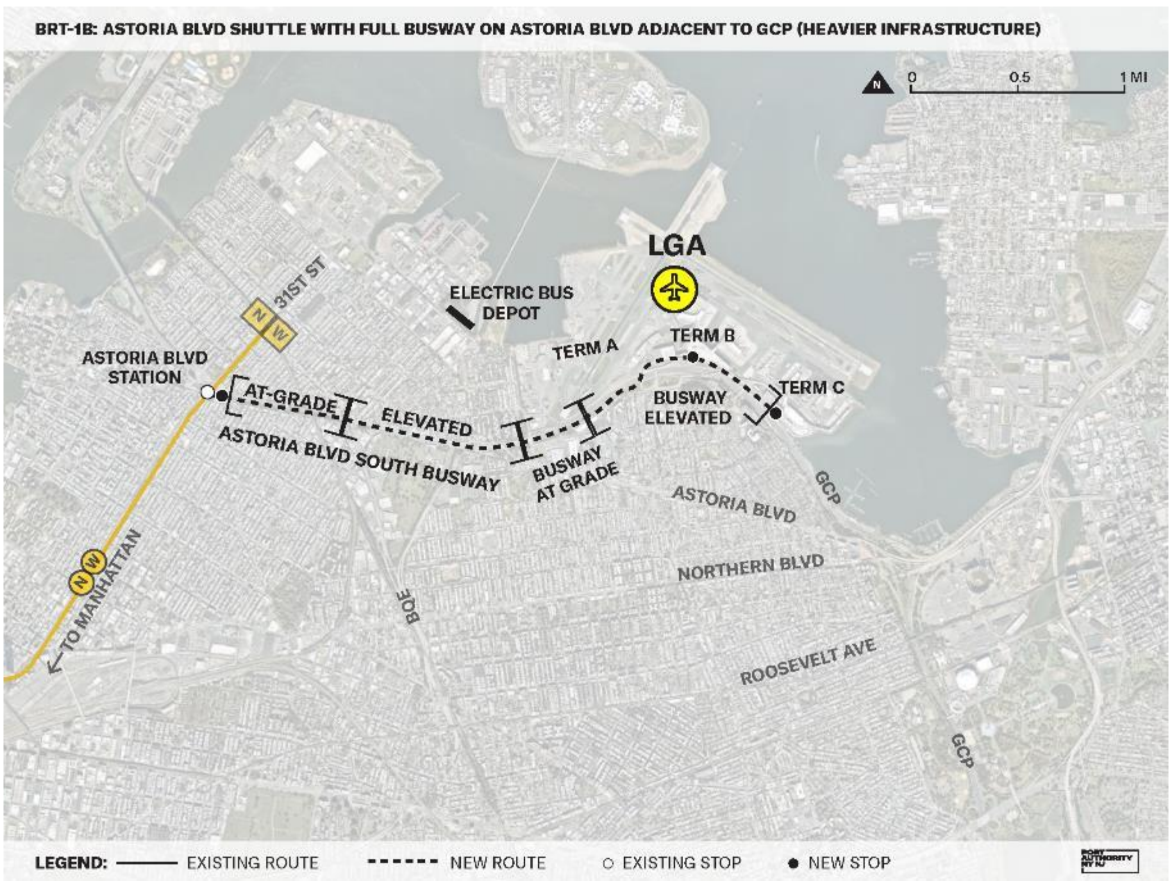


FIGURE 7.1-2: SUB-OPTION BRT-1B

separation from the general-purpose lanes on Astoria Blvd South. Where this busway would intersect several streets at-grade and pass under the Hell Gate rail trestle, it would use coordinated transit signals and physical barriers to maintain priority, then would enter an elevated structure running in the space between eastbound Astoria Blvd and the GCP east of 44th St. This elevated structure would run between the GCP and eastbound Astoria Blvd where it would pass over the westbound BQE to westbound GCP interchange, run parallel to St Michael's Cemetery, pass the BQE East interchange, and then continue in a dedicated at-grade busway, south of the GCP and separated from the GCP traffic, to pass under 82nd St (requiring the bridge's reconstruction).

As discussed in detail in Section 3.2.1.1.1, the heavier infrastructure options from the west (including this option, BRT-1B) must overcome the significant challenges and complexities presented by the twin constraints of the FAA Airport Design Standards and the existing large-diameter, 90-year-old utility structures along the GCP. The preliminary engineering work carried out by the study team has not identified a construction approach that, with confidence, could do this without more complex, risky, and costly approaches to construction that would require greater engineering exploration beyond the scope of this study. To provide a consistent basis on which to evaluate the option and to allow cost comparison between the options, Sub-Option BRT-1B is based on the baseline, simpler construction, concept of an at-grade busway structure in the embankment south of the GCP, despite this being shown to be not compliant with the FAA Airport Design Standards.

Once east of Runway 04-22 the busway would transition to an elevated structure starting around 90th St. The busway would pass over a rebuilt GCP off-ramp at 94th St, then cross the GCP onto LGA property. Two new elevated bus stops would serve Terminal B and Terminal C, via a short walk connecting the respective bus stop to the ticketing hall.

Sub-Option BRT-1C: Astoria Blvd shuttle with bus lanes on Astoria Blvd only (Lighter Infrastructure)

The BRT-1C route (Figure 7.1-3) would follow that of BRT-1A from Astoria Blvd Station until reaching Astoria Blvd around 77th St. From here, BRT buses would utilize existing on-ramps to enter the general-purpose travel lanes on the GCP, avoiding the need for further compliance with the FAA Airport Design Standards past Runway 04-22 as compliance of the existing GCP roadways and the traffic using them are already 'grandfathered'. Service would proceed along the eastbound GCP until reaching the Exit 7 LGA flyover. Service would travel along the various LGA access roads until reaching a limited-access ramp serving BRT, transit, and taxis, where service would exit around a 180-degree loop-road and serve a new at-grade bus stop at Terminal C. Service would continue on limited-access roadways to the Terminal B at-grade bus stop. Service would then continue to the existing Terminal A bus stop location using the existing on-Airport roadway network.

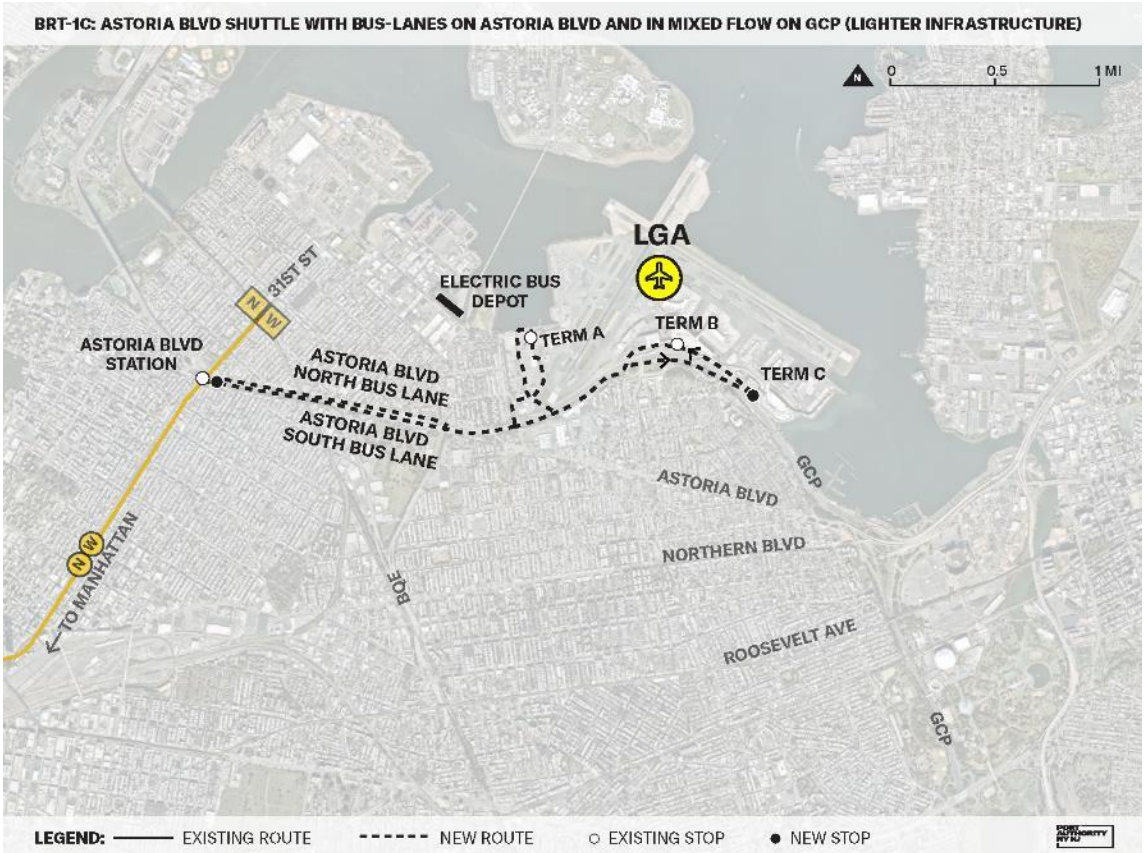


FIGURE 7.1-3: SUB-OPTION BRT-1C

All sub-options of the BRT-1 route would operate in addition to the existing M60-SBS bus route, which would continue to provide local stops and services into Manhattan. The length of all variations of this route are approximately 3 miles, including the on-Airport portion.

7.1.1 Evaluation of Construction Aspects

7.1.1.1 Constructability

The proposed BRT bus shuttle service from Astoria Blvd Station option has three sub-options within the GCP transportation corridor:

- BRT-1A would utilize bus lanes on Astoria Blvd North and South and an at-grade and elevated busway along the south side of the GCP from the Astoria Blvd North bridge to two elevated bus stops in LGA.
- BRT-1B would utilize a busway all the way to LGA, varying between at-grade and elevated along Astoria Blvd South and the GCP to two elevated bus stops in LGA.

- BRT-1C would utilize the bus lanes of BRT-1A to the Astoria Blvd North bridge, before traveling in mixed-flow traffic on the GCP to two at-grade bus stops in LGA, requiring a new westbound off-ramp to Astoria Blvd North.

BRT-1B would require the extension of the Astoria Blvd South roadway lane into the embankment south of the eastbound GCP roadway, likely using an earth-filled concrete retaining wall. East of 44th St, a separate elevated structure would be required for the busway to achieve the necessary headroom over the Westbound BQE Connectors and minimize permanent travel lane reduction in Astoria Blvd South to the north of St Michael's Cemetery.

East of the Astoria Blvd North overpass, both BRT-1A and BRT-1B would require construction of dedicated BRT-only busway lanes and elevated fixed busway structures on the south side of the GCP and into the Airport, requiring the reconstruction of the 82nd St Bridge over the GCP.

Sub-Options BRT-1A and BRT-1B

The notable construction challenges and complexities common to both Sub-Options BRT-1A and BRT-1B are summarized below.

- **Construction of Bus Stops and Bus Turnaround/Layover around Columbus Sq Park**
  - Transfer bus stops for Astoria Blvd Subway station are proposed to be on either side of Columbus Sq Park. Access to the Astoria Blvd Subway station would be from Columbus Sq Park via the existing subway access structures and elevators. Costs are included in the cost estimate for passenger shelters and other small structures.
  - To provide the appropriate 'customer transfer experience' from the elevated Subway station to the at-grade BRT stops, additional new vertical circulation, wayfinding, amenities, and architectural treatment would be required. An allowance is provided in the cost estimate for the construction of these elements.

- **Major constructability challenge of compliance with FAA Airport Design Standards while also avoiding disruption to 90-year-old NYC DEP underground sewer structures (See also Section 3.2.1.1.1)**
  - This option's alignment crosses an area south of Runway 04-22 that is subject to FAA regulations regarding the safe operation of the Airport. This presents a major constructability challenge (described in greater detail in Section 3.2.1.1.1) to negotiate the twin constraints of the FAA Airport Design Standards (governing the construction of new infrastructure in this area) and the existing large-diameter utilities located along and beneath the GCP.
  - The preliminary engineering work carried out by the study team has not identified a construction approach that it could conclude with confidence would practicably overcome these challenges.
  - For the purposes of providing a basis on which to compare options that must pass the end of Runway 04-22, this option was evaluated using the baseline construction concept

of an at-grade busway structure located in the embankment to the south of the eastbound GCP roadway, despite this concept being shown to be not compliant with the FAA Airport Design Standards. To provide the Indicative Capital Cost and Timeline/Schedule, the following construction elements for this construction concept:

- Construction of a transition structure/roadway from Astoria Blvd North and South to the dedicated bus-only busway in the embankment south of the eastbound GCP roadway.
- Reconstruction of the 82nd St Bridge. The busway structure would have to pass through the existing south abutment of the 82nd St Bridge over the GCP, requiring the bridge's demolition and reconstruction to accommodate the structure.
- Construction of an at-grade, busway structure south of Runway 04-22, staying above the existing major utilities along the GCP.
- Strengthening of the existing utilities and/or construction of concrete protection slabs above them.
- Relocation of the existing runway lights, located between the GCP and Ditmars Blvd.

- **Constructing over 94th St and the GCP into the Airport**
  - Once past Runway 04-22, the alignment would ascend back to an elevated busway structure to pass over the GCP onto the Airport.
  - The GCP eastbound off-ramp onto Ditmars Blvd near 90th St would require reconstruction to accommodate the elevated busway in this area. An allowance has been included in the construction cost estimate for this work.
  - The elevated busway crossing over 94th St and both roadways of the GCP into the Airport would require long-span bridge structures of approximately 250–300 ft. These would require complex engineering solutions and construction methods to span the roads, while maintaining traffic mobility on the GCP and into the Airport on 94th St. This introduces increased construction costs over standard rates, which is reflected in the construction estimate.

- **On-Airport Elevated Bus Stops: Constrained Construction Site Conditions**
  - Long-span (approximately 350-ft) bridge structures would be required over 102nd St and the newly constructed departures roadway. This would require complex engineering solutions and construction methods to span these roads, while maintaining Airport operability. This introduces increased construction costs over standard rates, reflected in the construction estimate.
  - At this stage of development, the study determined that the support piers for the elevated bus turnaround loop structure between Terminal C, the parking structure, and over the Airport access roads could be located without modification to the existing Airport roadways or structures.

- Constructing within a constrained, operational airport environment would reduce the construction sequence efficiency, introducing construction complexities. This is reflected in the Indicative Timeline/Schedule for this sub-option.
- Construction work in and around the Airport terminals and over Airport roadways would be subject to acceptance by the FAA.

- **Constructability Risks Not Included in the Cost Estimate Range (–10% to +30%) Common to Both Sub-Options BRT-1A and BRT-1B**
  - Accommodating the proposed elevated busway/guideway piers and foundations within the GCP ROW: There is a residual risk that, during detailed design coordination with NYS DOT (and FHWA where applicable), more complex support structures than currently envisaged are required to avoid introducing non-standard roadway elements to the existing highways or to allow existing non-standard elements to be brought up to current standards (in the future by NYS DOT). The study team concluded that is a risk typical of work in and around existing major highways but one that still has the potential to result in large increases in construction cost and schedule prolongation.

Sub-Option BRT-1B

The notable construction challenges and complexities specific to Sub-Option BRT-1B are summarized below.

- **Construction of Lane Extension in GCP Embankment**
  - Sub-Option BRT-1B would extend the Astoria Blvd South roadway northward into the embankment south of the eastbound GCP roadway from 33rd St to 44th St, creating the additional lane required for the proposed bi-directional BRT-only busway. At this stage of development, it has been determined that the retaining wall support structure for the BRT-only lane extension could be constructed entirely within the GCP embankment between 35th St and 43rd St, avoiding permanently modifying lanes on the GCP, and pass under the Hell Gate rail trestle without need to modify the structure.
  - The Astoria Blvd South on-ramp to the GCP at 33rd St would require reconstruction to accommodate the new additional lane for the busway. An allowance is included in the construction cost estimate for this work.
  - Modification would be required to the existing parapets of bridges over the GCP at 35th St, 37th St, Steinway St, and 43rd St to accommodate the new at-grade busway. An allowance for these costs is included in the construction cost estimate for this sub-option. The evaluation at this stage of development has determined that no major structural modification or reconstruction would be required to these bridges when modifying the parapets.
  - Construction of the busway retaining structure would be in a very constrained, narrow area with limited access for construction vehicles and materials, leading to inefficient

working practices and design solutions. This is reflected in the Indicative Timeline/Schedule for this sub-option.
- Constructing the busway beneath the Hell Gate rail trestle is considered to have a low interface with Amtrak; therefore, no additional construction costs or schedule durations have been added for this issue.

- **Locating Piers between GCP and Astoria Blvd South to the North of St Michael's Cemetery**
  - The elevated busway structure of Sub-Option BRT-1B structure would remain south of the GCP continuing east until reaching St Michael's Cemetery where it would run above-ground adjacent to the cemetery. At this point, the available ROW is not sufficient to locate the structure piers and foundations without permanently impacting either the GCP or Astoria Blvd South roadways. Therefore, the study team located the piers in the northernmost lane of Astoria Blvd South, thus avoiding any reduction in the GCP lanes and shoulder widths. However, this would remove the use of one traffic lane along this stretch of Astoria Blvd South. Traffic impacts would need to be carefully studied.
  - Locating piers along the north side of Astoria Blvd South would require reconstruction of the Astoria Blvd South roadways, shoulder, and retaining wall along the south side of the eastbound GCP; a cost allowance for this work is included in the construction cost estimate for the option. The available space to safely conduct construction activities within Astoria Blvd South and adjacent to the GCP is very constrained, restricting efficient working conditions and prolonging construction durations. This is included in the schedule duration for this construction activity.

- **Constructability Risks Not Included in the Cost Estimate Range (–10% to +30%) Specific to Sub-Option BRT-1B Only**
  - Permanently reducing the travel lanes in Astoria Blvd South down from three to two along St Michael's Cemetery (between 49th St and the Eastbound BQE Connector overpass): Discussions with NYC DOT during this study indicated they would accept the permanent lane reduction to accommodate the structure piers along this stretch of Astoria Blvd South subject to full review and approval during more detailed design development. There remains a residual risk that, during the detailed review, the proposal to permanently reduce the travel lanes is not accepted. Alternative solutions to support an elevated structure along this constrained stretch of the Astoria Blvd/GCP corridor could require much more complex structures straddling over the roadways and/or permanent shifting of the roadways themselves. Although the study team considers this risk to have a lower probability of occurring, the potential construction cost and schedule implications could be significant.
  - Scale of bridge modification work between 33rd St and 44th St to accommodate proposed lane extension into GCP embankment: There is a residual risk that future detailed structural surveys identify the need for wider structural intervention (e.g.,

reconstruction of abutments, bridge decks, etc.) to the bridges over the GCP that interface with the proposed busway extension than currently accounted for in the evaluation. This risk would be considered typical for this kind of interface but could result in moderate increases in construction costs and construction schedule prolongation.

- Accommodating the proposed retained busway in the GCP embankment between 33rd St and 44th St: There is a residual risk that, during partner agency coordination with NYS DOT and FHWA as part of detailed design, the current retained extension of Astoria Blvd South into the GCP embankment restricts any future GCP roadway widening plans NYS DOT may have and requires modification to gain approval. The study team concluded that this risk would have a high probability of being mitigated as part of the design process but could still result in moderate increases in construction costs and delay to the start of construction while this occurs.

Sub-Option BRT-1C

The notable construction challenges and complexities specific to Sub-Option BRT-1C are summarized below.

- **Construction of Bus Stops and Bus Turnaround/Layover around Columbus Square Park**
  - Transfer bus stops for Astoria Blvd Subway station are proposed to be on either side of Columbus Sq Park. Access to the Astoria Blvd Subway station would be from Columbus Sq Park via the existing subway access structures and elevators. Costs are included in the cost estimate for passenger shelters and other small structures.
  - To provide the appropriate 'customer transfer experience' from the elevated Subway station to the at-grade BRT stops, additional new vertical circulation, wayfinding, amenities, and architectural treatment would be required. An allowance is provided in the cost estimate for the construction of these elements.

- **Construction of Bus Loop around Constrained Airport Roads at Terminal C**
  - The on-Airport route proposes a new BRT bus-only loop road in front of the Terminal C parking structure and taxi access road. The study team concluded that the taxi access road between Terminal B and Terminal C under the 102nd St Bridge structures has sufficient headroom for standard MTA buses or future electric buses to navigate under the bridge without the need to lower the roadway under the bridge.
  - The proposed Terminal C bus loop would pass under multiple on-Airport roadways and support structures. The study team concluded that the loop can be constructed to avoid the need to modify any of the existing road structure columns or supports.

- Constructing within a constrained, operational airport environment would reduce the construction sequence efficiency, introducing construction complexities. This is reflected in the Indicative Timeline/Schedule for this sub-option.
- Construction work in and around the Airport terminals and over Airport roadways would be subject to acceptance by the FAA.

7.1.1.2 Infrastructure Impacts during Construction

Sub-Options BRT-1A and BRT-1B

Construction of Sub-Options BRT-1A and BRT-1B would result in the following temporary disruption to other major infrastructure along the route, which could last for 2–3 years; by virtue of its greater length of construction work along the GCP, BRT-1B's impacts would be more widespread than BRT-1A.

The notable areas of temporary infrastructure disruption common to both Sub-Options BRT-1A and BRT-1B are summarized below. The durations given below are indicative and based on preliminary assessment.

- **Disruption to Existing MTA Bus Services around Columbus Square Park and Access to Subway Station**
  - Construction and lane repurposing work around the busy intersection of Hoyt Ave South, Astoria Blvd, and 31st St would require temporary lane reductions and detours to general-purpose traffic that would also impact existing MTA bus operations in the area. This could result in a potential temporary increase in travel times, reduced reliability, relocation of bus stops, or rerouting of service for up to a year.
  - Construction work around Columbus Sq Park would result in inconvenience to passengers accessing the Astoria Blvd Subway station for up to a year due to re-routed pedestrian access around construction zones.

- **Lane Narrowing, Traffic Diversions, and Speed Restrictions on GCP**
  - Narrowing of the eastbound GCP lanes and traffic speed restrictions between the Astoria Blvd North overpass and 94th St would be required for 9–18 months to provide safe construction access to the eastbound shoulder during construction of the at-grade busway located between the GCP and 23rd Ave.
  - Full closure of the Ditmars Blvd GCP off-ramp for 1–2 months would be required while transitioning to the new, relocated off-ramp. Traffic diversions would be required via the Astoria Blvd South off-ramp.
  - 2–4 overnight road closures and traffic diversions would be required over a period of 1–2 weeks to erect long-span bridge sections over the GCP into the Airport.

- 10–15 off-peak, overnight, and/or weekend road closures on the GCP and traffic diversions would be needed over a period of 12–18 months to demolish the 82nd St Bridge deck and erect new deck structure.
- Lane closures over a period of 12–18 months on the 82nd St crossing of the GCP; these would be conducted one roadway at a time so that two-way traffic could still cross the bridge, albeit on a reduced number of traffic lanes.

- **Disruption to Intra-Airport Services and Facilities**
  - Increased construction traffic around Terminals B and C for 9–18 months would require a coordinated traffic management plan to avoid/minimize potential on-Airport traffic disruption.
  - 15–30 overnight and/or off-peak lane and road closures of on-Airport access roads would be expected for a 1- to 2-year period during long-span bridge section erection and other elevated structure work.
  - Airport user inconvenience could potentially occur to certain portions of Airport facilities, for 2–4 months during construction of bus customer transfer connections and circulation.

Sub-Option BRT-1B

The notable areas of temporary infrastructure disruption specific to Sub-Option BRT-1B are summarized below. The durations given below are indicative and based on preliminary assessment.

- **Lane Narrowing, Traffic Diversions, and Speed Restrictions on GCP**
  - Narrowing of the eastbound GCP lanes, traffic speed restrictions, and temporary closure of the shoulder between 31st St and 43rd St would be expected for 9–18 months to provide safe construction access for adjacent retaining structure work in the embankment south of the GCP roadway.
  - Restricted access and reduced lane widths to eastbound GCP via on-ramp from 33rd St would be expected for 6–12 months while the on-ramp is reconstructed to accommodate proposed lane extension.

- **Off-Peak Closures of the Westbound BQE Connector with the GCP**
  - 5–10 off-peak, overnight, or weekend alternating closures of the north- and southbound Westbound BQE Connectors would be expected over a period of 2–6 months during erection of overhead bridge structures and deck.

- **Lane Narrowing, Traffic Diversions, and Speed Restrictions on GCP and Astoria Blvd South**
  - Narrowing of the eastbound GCP lanes, traffic speed restrictions, and temporary closure of the shoulder between 49th St and the Eastbound BQE Connector intersection would be required for 9–18 months to provide safe construction access for adjacent piling, foundation, and pier work in Astoria Blvd South.
  - 10–20 overnight lane closures and temporary speed restrictions on the eastbound GCP would be required over a period of 6–12 months during erection of overhead bridge structures and deck.

- **Lane Narrowing, Traffic Diversions, and Speed Restrictions at the Eastbound BQE Connector/GCP Intersection**
  - Up to 5 overnight or weekend closures of the Eastbound BQE Connector northbound roadway to the GCP would be required over a 2- to 4-month period during erection of overhead bridge structures. Traffic would be diverted via the off-ramp to Boody St, Astoria Blvd South, and the on-ramp to the GCP at 77th St.
  - Closure of the GCP on-ramp from Astoria Blvd South and 77th St for 1–2 months would be necessary while transitioning to the new, relocated on-ramp. Traffic diversions would be required via 23rd Ave and Ditmars Blvd.

Sub-Option BRT-1C

Construction of Sub-Option BRT-1C, which could last for up to a year, would result in less disruption to other major infrastructure along the route as compared to BRT-1A and BRT-1B.

The notable areas of temporary infrastructure disruption specific to Sub-Option BRT-1C are summarized below. The durations given below are indicative and based on preliminary assessment.

- **Disruption to Existing MTA Bus Services around Columbus Square Park and Access to Subway Station**
  - Construction and lane repurposing work around the busy intersection of Hoyt Ave South, Astoria Blvd, and 31st St would require temporary lane reductions and detours to general-purpose traffic that would also impact existing MTA bus operations in the area. This would result in a potential temporary increase in travel times, reduced reliability, relocation of bus stops, or rerouting of service for up to a year.
  - Construction work around Columbus Sq Park would result in inconvenience to passengers accessing the Astoria Blvd Subway station for up to a year due to re-routed pedestrian access around construction zones.

- **Disruption to Intra-Airport Services and Facilities**
  - Overnight and/or off-peak lane closures for 2–4 weeks would be needed while roadway lanes around Terminals B and C are re-painted.
  - 5–10 overnight and/or off-peak lane and taxi-road closures would be expected around Terminal C for construction of the Terminal C bus loop for 2–4 months.

7.1.1.3 Permanent/Operational Impacts to Existing Infrastructure

<u>Sub-Options BRT-1A, BRT-1B, and BRT-1C</u>

Once completed, Sub-Options BRT-1A, BRT-1B, and BRT-1C would have the following common permanent/operational impacts on other infrastructure along the route:

- **Existing MTA Bus Services along Astoria Blvd North and South**
  - Converting a general-purpose traffic lane to BRT bus-only lanes on Astoria Blvd North (Sub-Options BRT-1A and BRT-1C) and South (Sub-Options BRT-1A, BRT-1B, and BRT-1C) would permanently reduce the number of available lanes for general traffic along Astoria Blvd, potentially increasing traffic congestion. Existing MTA bus services along Astoria Blvd North and South would still use the general-purpose lanes (to allow these services to make their more frequent stops). The increased congestion could potentially lead to increased journey times and reduce reliability for the existing MTA bus services, particularly at peak times.

<u>Sub-Options BRT-1A and BRT-1B</u>

Once completed, Sub-Options BRT-1A and BRT-1B would have the following common permanent/operational impacts on other infrastructure along the route:

- **Grand Central Parkway**
  - The off-ramp from the eastbound GCP to Ditmars Blvd would be permanently relocated to accommodate the elevated busway over 94th St.
  - The completed at-grade busway, elevated structure could restrict any future NYS DOT roadway improvement plans to widen or adjust the GCP between 80th St and 90th St.

- **Impacts on LGA**
  - The location of the elevated busway and bus transfer stops in front of Terminal B would result in the construction of structure piers and frames in the area that has currently been identified to be the future permanent Terminal B taxi hold. This could prevent the taxi hold from using this location, requiring an alternate location, which may not be as operationally efficient.

Sub-Option BRT-1B

Once completed, Sub-Option BRT-1B would have the following specific permanent/operational impacts on other infrastructure along the route:

- **Access to FDNY Fire Station on Astoria Blvd South**
  - Permanent access to the FDNY fire station located on Astoria Blvd South between 42nd St and 43rd St would be retained (and possibly improved) by curtailing the busway separation barrier in front of the building. The increased roadway width provided by the extension into the GCP embankment could actually increase the available turning space for firetrucks entering and exiting the building.

- **Grand Central Parkway**
  - The completed extension of Astoria Blvd South into the embankment south of the GCP between 33rd St and 49th St, and busway structure piers in Astoria Blvd South to the north of St Michael's Cemetery, could restrict any future NYS DOT roadway improvement plans to widen or adjust the GCP in these areas.
  - The on-ramp to the eastbound GCP from Astoria Blvd South and 77th St would be permanently relocated to accommodate the busway transition structure.

- **Astoria Blvd South**
  - The busway structure piers in Astoria Blvd South to the north of St Michael's Cemetery would require the permanent reduction of Astoria Blvd South from three to two traffic lanes between 49th St and the GCP off-ramp. Discussions with NYC DOT indicate this could be possible but would require NYC DOT review and approval during future detailed development should this option be selected for further study.

7.1.1.4 Indicative Capital Cost

Sub-Option BRT-1A

The Indicative Capital Cost for Sub-Option BRT-1A is $1.3 billion (in 2022$, excluding future escalation and solely for approximate comparison between study options).

Indicative Capital Costs should be considered to have a range of estimating uncertainty of -10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).

As discussed in more detail in Section 3.2.1.1.1, the preliminary engineering work carried out by the study team has not identified a construction approach that, with confidence, could overcome the significant challenges and complexities presented by the twin constraints of the FAA Airport Design Standards and the existing large-diameter, 90-year-old utility structures along the GCP without more complex, risky, and costly approaches to construction that would require greater engineering exploration beyond the scope of this study. Therefore, to provide a basis of an order-of-magnitude cost on which to compare between options, this option was costed out using the (least cost) baseline solution of an at-grade busway south of Runway 04-22, despite this approach not being compliant with FAA Airport Design Standards. Costs associated with an FAA compliant tunneled solution which could require replacement or relocation of existing sewer structures could result in additional costs of between $1–3 billion.

The following are the notable cost drivers for the option:

- Elevated busway structure along GCP and on-Airport.
- New elevated bus stops, passenger amenities, and vertical circulation at LGA.
- Reconstruction of the 82nd St Bridge (to accommodate at-grade busway structure south of Runway 04-22).
- Utilities protection and relocation costs.
- Provision of a new bus depot.
- Roadway maintenance and traffic protection costs.
- Relocation of GCP off-ramp to Ditmars Blvd.
- Connector ramp and at-grade busway along GCP.
- Long-span crossings on-Airport.
- New electric, zero-emission buses and charging stations (up to 11 buses).
- Long-span crossings of the GCP.
- New passenger amenities at Astoria Blvd subway-bus transfer stop.
- New at-grade bus stops at Columbus Sq Park.

Sub-Option BRT-1B

The Indicative Capital Cost for Sub-Option BRT-1B is $1.9 billion (in 2022$, excluding future escalation and solely for approximate comparison between study options).

Indicative Capital Costs should be considered to have a range of estimating uncertainty of -10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).

As discussed in more detail in Section 3.2.1.1.1, the preliminary engineering work carried out by the study team has not identified a construction approach that, with confidence, could overcome the significant challenges and complexities presented by the twin constraints of the FAA Airport Design Standards and the existing large-diameter, 90-year-old utility structures along the GCP without more complex, risky, and costly approaches to construction that would require greater engineering exploration beyond the scope of this study. Therefore, to provide a basis of an order-of-magnitude cost on which to compare between options, this option was costed out using the (least cost) baseline solution of an at-grade busway south of Runway 04-22, despite this approach not being compliant with FAA Airport Design Standards. Costs associated with an FAA compliant tunneled solution which could require replacement or relocation of existing sewer structures could result in additional costs of between $1–3 billion.

The following are the notable cost drivers for the option:

- Elevated busway structure along GCP and on-Airport.
- New elevated bus stops, passenger amenities, and vertical circulation at LGA.
- Elevated busway structure along St Michael's Cemetery.
- Utilities protection and relocation costs.
- Reconstruction of the 82nd St Bridge (to accommodate at-grade busway structure south of Runway 04-22).
- Roadway maintenance and traffic protection costs.
- Provision of a new bus depot.
- Relocation of GCP off-ramp to Ditmars Blvd.
- Relocation of Astoria Blvd on-ramp to GCP (at 33rd St).
- Relocation of Astoria Blvd South on-ramp to GCP (at 77th St).
- Retaining wall and bridge modifications along Astoria Blvd South.
- Connector ramp and at-grade busway along GCP.
- Long-span crossings on-Airport.
- Long-span crossings of the GCP.
- New electric, zero-emission buses and charging stations (up to 11 buses).
- New passenger amenities at Astoria Blvd subway-bus transfer stop.
- New at-grade bus stops at Columbus Sq Park.

<u>Sub-Option BRT-1C</u>

The Indicative Capital Cost for Sub-Option BRT-1C is $220 million (in 2022$, excluding future escalation and solely for approximate comparison between study options).

Indicative Capital Costs should be considered to have a range of estimating uncertainty of -10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).

The following are the notable cost drivers for the option:

- Provision of a new bus depot.
- New electric, zero-emission buses and charging stations (up to 15 buses).
- New at-grade bus stops at LGA.
- Transit signal priority upgrades.
- Utilities protection and relocation costs.
- New passenger amenities at Astoria Blvd subway-bus transfer stop.
- New at-grade bus stops at Columbus Sq Park.

7.1.1.5 Indicative Timeline/Schedule

<u>Sub-Option BRT-1A</u>

The Indicative Timeline/Schedule (for comparison between study options) for Sub-Option BRT-1A is approximately 9–10 years from a decision to take the option forward to revenue service. This includes the following notable schedule drivers:

- Planning, approvals, and acquisitions.
- Procurement of design-build contractor(s) for heavy civil construction.
- Procurement of new electric, zero-emission vehicles.
- Astoria transfer station.
- Astoria Blvd roadway reconfiguration.
- 82nd St Bridge reconstruction (longest construction activity).
- Elevated busway to Airport.
- On-Airport elevated bus stops and connectors.
- Construction of a new bus depot.
- Traffic signaling and systems.
- 6 months of commissioning.

Figure 7.1-4 illustrates the high-level indicative program for the Astoria Blvd Station shuttle service (Sub-Option BRT-1A). The key drivers are the major civil construction work, which may trigger longer permitting, approvals, and procurement processes.

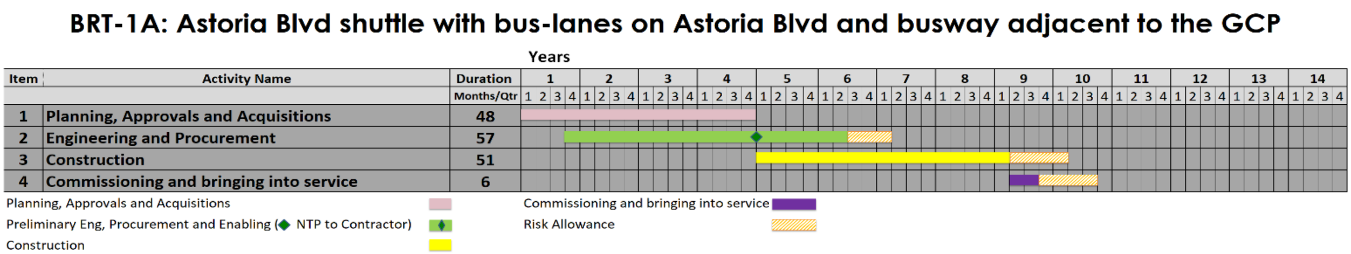


FIGURE 7.1-4: INDICATIVE TIMELINE/SCHEDULE (BRT-1A)

Sub-Option BRT-1B

The Indicative Timeline/Schedule (for comparison between study options) for Sub-Option BRT-1B is approximately 9–10 years from a decision to take the option forward to revenue service. This includes the following notable schedule drivers:

- Planning, approvals, and acquisitions.
- Procurement of design-build contractor(s) for heavy civil construction.
- Procurement of new electric, zero-emission vehicles.
- Astoria transfer station.
- Astoria Blvd South lane extension.
- Elevated busway along St Michael's Cemetery.
- Astoria Blvd roadway reconfiguration.
- 82nd St Bridge reconstruction (longest construction activity).
- Elevated busway to airport.
- On-Airport elevated bus stops and connectors.
- Construction of a new bus depot.

- ○ Traffic signaling and systems.
- ○ 9 months of commissioning.

Figure 7.1-5 illustrates the indicative timeline/schedule for Sub-Option BRT-1B. The key drivers are the major civil construction work, which may trigger longer permitting, approvals, and procurement processes.

BRT-1B: Astoria Blvd Shuttle with Full Busway on Astoria Blvd Adjacent to GCP

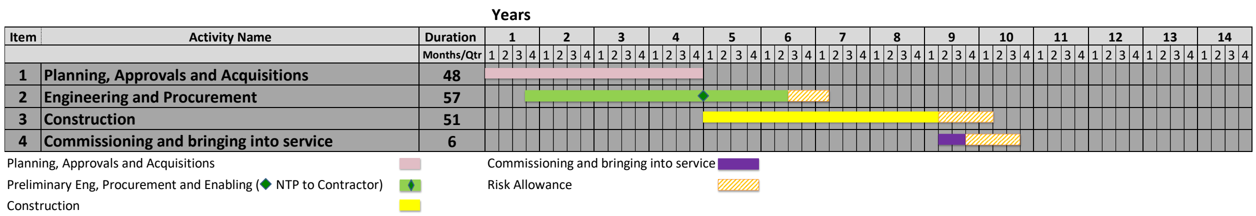


FIGURE 7.1-5: INDICATIVE TIMELINE/SCHEDULE (BRT-1B)

Sub-Option BRT-1C

The Indicative Timeline/Schedule (for comparison between study options) for Sub-Option BRT-1C is approximately 4–5 years from a decision to take the option forward to revenue service. This includes the following notable schedule drivers:

- ○ Planning, approvals, and acquisitions.
- ○ Procurement of construction contractor(s).
- ○ Procurement of new electric, zero-emission vehicles.
- ○ Astoria Blvd transfer station (longest construction activity).
- ○ On-Airport roadway reconfigurations.
- ○ Construction of a new bus depot.
- ○ Traffic signaling and systems.
- ○ 6 months of commissioning.

Figure 7.1-6 illustrates the indicative program for Sub-Option BRT-1C. The key drivers are the electric, zero-emission bus procurement and civil work.

BRT-1C: Astoria Blvd Shuttle with Bus-Lanes on Astoria Blvd and in Mixed Flow on GCP

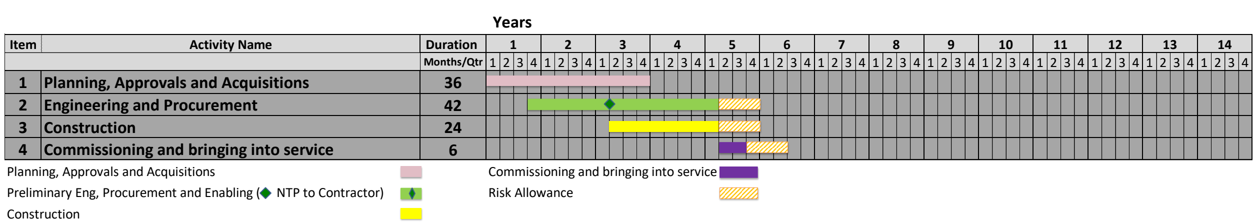


FIGURE 7.1-6: INDICATIVE TIMELINE/SCHEDULE (BRT-1C)

7.1.2 Transportation Aspects

7.1.2.1 Improved Access to LGA

Three factors have been considered in this category: Standardized Indicative Baseline Off-Peak Travel Time, Reliability, and Transfer Experience.

7.1.2.1.1 Standardized Indicative Baseline Off-Peak Travel Time

Sub-Options BRT-1A, BRT-1B, and BRT-1C

- Table 7.1-1, below, provides the Standardized Indicative Baseline Off-Peak Travel Times for the weekday, midday off-peak journeys to be used solely as a baseline for comparison between options. Table 7.1-2 provides a breakdown of the components that make up the total journey, the general approach to the estimation of which is described in Section 3.2.2.1.1.
- Passengers making the journeys described would, naturally, experience variations to the baseline timings calculated even where services are running as planned, for reasons as simple as variations in walking speeds or whether a traveler arrives just before a scheduled departure or just misses a departing train.

TABLE 7.1-1: STANDARDIZED INDICATIVE BASELINE OFF-PEAK TRAVEL TIMES, OPTION BRT-1

Times Square to LGA (minutes to first terminal served, B or C)	BRT-1A	BRT-1B	BRT-1C
Via Subway (N/W train) to Astoria Blvd	38	37	41

TABLE 7.1-2: STANDARDIZED INDICATIVE BASELINE OFF-PEAK TRAVEL TIMES BY SEGMENT, OPTION BRT-1

Times Square to LGA via N/W Subway (minutes)	BRT-1A	BRT-1B	BRT-1C
START Times Square (street level)			
walk/wait time	5	5	5
N/W Subway platform (dep)			
Subway trip time	21	21	21
Astoria Blvd N/W Subway platform (arr)			
walk/wait time	6	6	6
Astoria Blvd bus stop (dep)			
Bus trip time	6	5	9
1st on-Airport bus stop (arr)	new elevated	new elevated	new at-grade
END Terminal bus stop	Terminal B	Terminal B	Terminal C
Total travel time =	38	37	41
trip time to next Terminal bus stop	2	2	3
2nd on-Airport bus stop (arr)	new elevated	new elevated	existing
END Terminal bus stop	Terminal C	Terminal C	Terminal B
Total travel time =	40	39	44
trip time to next Terminal bus stop	-	-	7
3rd on-Airport bus stop (arr)			existing
END Terminal bus stop			Terminal A
Total travel time =	-	-	51

- The above standardized indicative baseline off-peak travel times are a baseline for weekday, midday off-peak journeys. Bus running times in mixed-use traffic would be subject to traffic congestion during peak times. Estimates of the potential increase to the Standardized Indictive Travel Time for peak-time traffic have been calculated solely for comparative purposes as:
  - Sub-Option B-1A: around 1 minute from Astoria Blvd to Terminal B.
  - Sub-Option B-1B: around 1 minute from Astoria Blvd to Terminal B.
  - Sub-Option B-1C: around 5 minutes from Astoria Blvd to Terminal C.
- Allowances of this order for predictable congestion would be reflected in the MTA schedules; less predictable variations in travel time are discussed in the “Reliability” Section.
- In Sub-Options BRT-1A and BRT-1B passengers for Terminal A would transfer to an existing on-Airport shuttle service running every 10 minutes and with an additional trip time of around 7 minutes from Terminal B.

7.1.2.1.2 Reliability

Sub-Option BRT-1A

- Measures to increase reliability of Sub-Option BRT-1A include:
  - Dedicated bus lanes on Astoria Blvd North and South, minimizing congestion due to general traffic.
  - Transit signal priority, which would allow buses to move through intersections without having to stop and wait for traffic.
  - A new grade-separated heavy infrastructure bus roadway south of the GCP and onto the Airport allowing the buses to bypass traffic on the GCP as well as general congestion on the Airport frontage.

Sub-Option BRT-1B

- Measures to increase reliability of Sub-Option BRT-1B include:
  - Dedicated bus lanes on Astoria Blvd South, minimizing congestion due to general traffic.
  - Transit signal priority, which would allow buses to move through intersections without having to stop and wait for traffic.
  - A new grade-separated heavy infrastructure bus roadway south of the GCP and onto the Airport allowing the buses to bypass traffic on the GCP as well as general congestion on the Airport frontage.

Sub-Option BRT-1C

- Measures to increase reliability of Sub-Option BRT-1C include:
  - Dedicated bus lanes on Astoria Blvd North and South, minimizing congestion due to general traffic.
  - Transit signal priority, which would allow buses to move through intersections without having to stop and wait for traffic.
  - Utilization of a new specially-designated bus pick-up and drop-off area near Terminal C with direct, exclusive road access to avoid congestion on the Airport frontage.

7.1.2.1.3 Transfer Experience

Sub-Options BRT-1A, BRT-1B, and BRT-1C

Riders bound for Terminals B or C would transfer from the N/W Subway service to the Airport shuttle service at Astoria Blvd Station. Riders bound for Terminal A would either have an additional transfer to an existing on-airport shuttle once they reach the airport (BRT-1A and BRT-1B) or have a direct connection via the new non-stop service (BRT-1C).

Customer Transfer

- Riders would arrive and depart from new bus stops on the north and south side of Columbus Sq Park, adjacent to Astoria Blvd Station. Riders transferring from the Subway would follow the new wayfinding signage and walk approximately 250 ft to the bus stop at street level utilizing the existing station stairs and elevators. Since Astoria Blvd is an accessible station, all transfers would be ADA-compliant. It should be noted that this station’s mezzanine and elevators are undersized with respect to the needs of a typical airport passenger with luggage.

7.1.2.2 Ridership

Sub-Options BRT-1A, BRT-1B, and BRT-1C

- Stated preference survey results indicate that 33% of airport passenger respondents are “definitely” or “probably” interested in BRT connections to existing transit services.
- The ridership model projects 3.7 million total riders using Option BRT-1A, 3.8 million riders using Option BRT-1B, and 3.4 million riders utilizing Option BRT-1C. The three options increase net ridership by approximately 2 million riders in 2025 (Table 7.1-3).

TABLE 7.1-3: RIDERSHIP MODEL RESULT SUMMARY

Transit Option				Riders on Current Bus Services to LGA (Millions) (No Action)	New Transit Option Impact (Millions)		
Mode Category & Scenario Label			Description		Riders on BRT-1 Shuttle Service	Net Increase in Total Bus Ridership	Total Bus Ridership (BRT-1 Shuttle + Other Bus Routes)
Bus - New Dedicated Bus Rapid Transit (BRT) Routes	BRT	BRT-1A	Astoria Blvd (Hybrid)	4.1	3.7	**2.1**	**6.1**
		BRT-1B	Astoria Blvd Heavier Infrastructure	4.1	3.8	**2.2**	**6.2**
		BRT-1C	Astoria Blvd Lighter Infrastructure	4.1	3.4	**1.9**	**5.9**

7.1.2.3 Throughput and Capacity

Throughput

Sub-Options BRT-1A, BRT-1B, and BRT-1C

- Using the highest hourly single-direction provision of airline seats at LGA in 2019 (4,300 seats on weekday departing flights 9 AM to 10 AM – see Figure 3.2-1, in Section 3.2.2.3), the estimated single-direction peak passenger demand for each sub-option could be:
  - Sub-Option BRT-1A: approx. 390 passengers per hour.

- Sub-Option BRT-1B: approx. 430 passengers per hour.
- Sub-Option BRT-1C: approx. 390 passengers per hour.

- It should be noted that these passengers would likely arrive at the transfer station in groups, rather than being evenly distributed throughout the time period.

Capacity of New Transit Option

Sub-Options BRT-1A, BRT-1B, and BRT-1C

- Actual vehicle frequency would be adapted in practice to suit demand and other operating requirements.

Impact on Capacity of Existing Downstream Transit Systems

Sub-Options BRT-1A, BRT-1B and BRT-1C

- All BRT-1 sub-options provide passenger connection to Astoria Blvd Subway Station, offering transfer access to the N/W Subway lines.
- Generally, airport passenger loadings are constant through the day both to and from the Airport with the peak passenger loadings occurring outside of the morning Manhattan-bound subway peaks or in the opposite direction (i.e., Airport-bound).
- The existing N- and W-Subway lines currently operate close to their peak capacity during the 8 AM to 9 AM Manhattan-bound commuting peak. While most Manhattan-bound Airport passengers would travel outside this peak, those passengers (including non-Airport passengers) traveling during this peak could experience some crowded conditions.
- The study team noted that Astoria Blvd Station is an elevated station with two island platforms and a mezzanine located between the platform level and the street. The mezzanine is connected to each platform via two sets of stairs, one at either end of the mezzanine, and one elevator. The station spans Astoria Blvd North, the Grand Central Parkway, and Hoyt Ave South. Connections to Astoria Blvd North and Hoyt Ave South are provided from the street via stairs and an elevator at each location. The layout and location of the station are highly constrained making adding additional elevators or escalators difficult. The MTA expressed concerns that new Airport passengers utilizing this station may subject the limited number of elevators and stairwells to overcrowding.

7.1.2.4 Indicative Operating Cost

Sub-Options BRT-1A and BRT-1B

Annual operating and maintenance costs for Sub-Options BRT-1A and BRT-1B are estimated at up to $8 million.

Sub-Option BRT-1C

Annual operating and maintenance costs for Sub-Option BRT-1C are estimated at up to $11.9 million, with the increased cycle time requiring more vehicles and crew.

7.1.3 Community and Environmental Aspects

7.1.3.1 Local Community Impacts

The three sub-options would be located within and near densely developed neighborhoods on either side of the GCP corridor that consist of a wide range of properties, including single-family (row & detached) and 3- to 6-story residential buildings, commercial businesses, mixed-use (residential above commercial) buildings, public community buildings, and NYC Parkland (Columbus Park, Planeview Park, and Overlook Park). The approximately 3-mile route goes through/along the following communities: Astoria, Ditmars Steinway, Woodside, Jackson Heights, and East Elmhurst.

The potential for temporary (during construction) and permanent (once operational) impacts is summarized below for specific areas of the alignment.

7.1.3.1.1 Temporary Impacts during Construction on the Local Neighborhoods Directly Affected

<u>Sub-Option BRT-1A</u>

Roadway construction (for the bus lanes and restriping) and heavy civil construction (for the elevated busway foundations, structures, and bus stops onto the Airport) activities are anticipated to occur along the approximately 3-mile route for approximately 4.25 years for Sub-Option BRT-1A.

As discussed in more detail in Section 3.2.1.1.1, the preliminary engineering work carried out by the study team has not identified a construction approach that, with confidence, could overcome the significant challenges and complexities presented by the twin constraints of the FAA Airport Design Standards and the existing large-diameter, 90-year-old utility structures along the GCP without more complex, risky, and costly approaches to construction that would require greater engineering exploration beyond the scope of this study. Therefore, to provide a consistent basis on which to evaluate them, this assessment was based on the baseline solution of an at-grade busway south of Runway 04-22, despite this approach not being compliant with FAA Airport Design Standards.

During construction, the following neighborhoods would have the potential for air quality, noise, vibration, or visual impacts. For the frequency and duration of construction activities refer to Section 7.1.1.2 “Infrastructure Impacts during Construction” above:

- **Construction of Bus Stops and Bus Turnaround/Layover around Columbus Sq Park and along Astoria Blvd**
  - Roadway construction activities (restriping, signing, and curb resetting) on Astoria Blvd, 31st St, and Hoyt Ave South to provide a clockwise BRT-only bus turnaround route around the square would be required at this segment of the route.

- The construction would occur approximately 35–80 ft from one short city block of residential and commercial properties.
- Planned periodic lane closures and diversions on Astoria Blvd South and 31st St, 32nd St, and 33rd St would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
- Planned periodic closure of sidewalks, bike lanes, and parking spaces would be required along Astoria Blvd.
- Planned periodic closure of Columbus Sq Park (NYC Parkland) would be required depending on the final detailed design of the bus stops and turnaround.
- Planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.

- **Construction of the BRT Lanes along Astoria Blvd North and South**
  - Roadway modification activities (restriping, signing, and curb resetting) would be required on Astoria Blvd North and Astoria Blvd South over an approximately 1.5-mile segment of the route.
  - The roadway modifications would occur approximately 35–50 ft from 25 short city blocks of residential and commercial properties.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - Planned periodic closure of sidewalks, bike lanes, and parking spaces would be required.
  - Planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.
  - Planned periodic suspension of truck deliveries for loading/unloading at commercial businesses would be required.
- **Reconstruction of 82nd St Bridge**
  - Lane closures and contra-flow traffic on 82nd St Bridge would be continuous throughout the construction as bridge sections would be demolished and reconstructed one half at a time.
  - The construction would occur approximately 150–200 ft from 2 short city blocks of residential and commercial properties.
  - Planned periodic lane closures, contra-flow traffic on the bridge, and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - Planned night closures of the GCP would be required for the long-span bridge erection.
- **Constructing over 94th St and the GCP into the Airport**
  - Reconstruction of the GCP eastbound off-ramp onto Ditmars Blvd near 90th St and construction of an elevated busway (30 ft above 94th Street) with long-span

(approximately 250–300 ft) bridge structures crossing over 94th St and the GCP into the Airport would be required along the approximately 0.5-mile segment of the route.
- The construction would occur approximately 100–350 ft from 4 short city blocks of residential and commercial properties.
- Planned night closures of the GCP would be required for the long-span bridge erection.
- Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
- There could be increased construction/haul traffic on local roads because trucks are not allowed on the GCP.

- **Constructing On-Airport Elevated Bus Stops**
  - Construction activities associated with the erection of long-span (approximately 350-ft) elevated busway bridge structures over an approximately 0.5-mile segment of the route over 102nd St and the newly constructed departures roadway at the Airport would be required.
  - The construction would occur over 500 ft from 5 city blocks of residential and commercial properties in the East Elmhurst community located on the other side of 8 lanes of the GCP.
  - Planned night closures of the GCP would be required for the long-span bridge erection.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - There could be increased construction/haul traffic on local roads because trucks are not allowed on the GCP.

- **Constructing the Bus Depot at Ingraham's Mountain off 19th Ave**
  - Construction of the proposed facility (roadway and building(s)) on an elevated portion (approximately 50,000 sf) of the existing LGA property known as 'Ingraham's Mountain' would occur for approximately 1 year approximately 200–300 ft from 4 short city blocks of commercial properties.

Sub-Option BRT-1B

Roadway construction (for the bus lanes and restriping) and heavy civil construction (for the elevated busway foundations, structures, and bus stops onto the Airport) activities are anticipated to occur along the approximately 3-mile route for approximately 4.25 years for Sub-Option BRT-1B.

As discussed in more detail in Section 3.2.1.1.1, the preliminary engineering work carried out by the study team has not identified a construction approach that, with confidence, could overcome the significant challenges and complexities presented by the twin constraints of the FAA Airport Design Standards and the existing large-diameter, 90-year-old utility structures along the GCP without more complex, risky, and costly approaches to construction that would require greater engineering exploration beyond the scope of this study. Therefore, to provide a consistent basis on which to evaluate them, this assessment was based on the baseline solution of an at-grade busway south of Runway 04-22, despite this approach not being compliant with FAA Airport Design Standards.

During construction, the following neighborhoods would have the potential for air quality, noise, vibration, or visual impacts. For the frequency and duration of construction activities refer to Section 7.1.1.2 “Infrastructure Impacts during Construction” above:

- **Construction of Bus Stops and Bus Turnaround/Layover around Columbus Sq Park and along Astoria Blvd**
  - Roadway construction activities (restriping, signing, and curb resetting) on Astoria Blvd, 31st St, and Hoyt Ave South to provide a clockwise BRT-only bus turnaround route around the square would be required at this segment of the route.
  - The construction would occur approximately 35–80 ft from one short city block of residential and commercial properties.
  - Planned periodic lane closures and diversions on Astoria Blvd South and 31st St, 32nd St, and 33rd St would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - Planned periodic closure of sidewalks, bike lanes, and parking spaces along Astoria Blvd would be required.
  - Planned periodic closure of Columbus Sq Park (NYC Parkland) would be required depending on the final detailed design of the bus stops and turnaround.
  - Planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.

- **Construction of Astoria Blvd Lane Extension in GCP Embankment**
  - Construction of the retaining wall (including piling) would be required from 33rd St to 44th St, an approximately 0.5-mile segment of the route, creating the additional lane required for the proposed bi-directional BRT-only busway.
  - The construction would occur approximately 35–50 ft from 13 short city blocks of residential and commercial properties.
  - Planned periodic lane closures and diversions on Astoria Blvd South would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - Planned periodic closure of sidewalks, bike lanes, and parking spaces would be required along Astoria Blvd for the construction of the piling and retaining wall.

- Planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.

- **Construction to the North of St Michaels Cemetery**
  - The construction of the elevated busway structure (piling, piers, and bridge structure) that runs to the south of the GCP eastbound roadway to the north of St Michael's Cemetery would be required over an approximately 0.5-mile segment of the route. Construction would occur approximately 35–50 ft from the cemetery's northern boundary.
  - Planned periodic lane closures and diversions on Astoria Blvd South would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.

- **Construction of the Transition from Elevated Busway to At-Grade at the Eastbound BQE Connector/GCP Intersection**
  - Roadway construction activities (paving, striping, signing, and curb setting) for the busway transition from being elevated to at-grade (at the level of the existing GCP roadway) would be required between the Eastbound BQE Connector/GCP intersection and Astoria Blvd North overpass for an approximately 0.25-mile segment of the route.
  - The construction would occur approximately 180–200 ft from 1 city block of commercial properties.
  - Planned overnight or weekend closures of Astoria Blvd South, the GCP, and the Eastbound BQE Connector northbound roadway would be required. This could lead to traffic increases on local roads, including potential impacts to local bus routes during road closures.
  - Planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.

- **Reconstruction of 82nd St Bridge**
  - Lane closures and contra-flow traffic on 82nd St Bridge will be continuous throughout the construction as bridge sections are demolished and reconstructed one half at a time.
  - The construction would occur approximately 150–200 ft from 2 short city blocks of residential and commercial properties
  - Planned periodic lane closures, contra-flow traffic on the bridge, and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - Planned night closures of the GCP would be required for the long-span bridge erection.

- **Constructing over 94th St and the GCP into the Airport**
  - Reconstruction of the GCP eastbound off-ramp onto Ditmars Blvd near 90th St and construction of an elevated busway (30 ft above 94th Street) with long-span (approximately 250–300 ft) bridge structures crossing over 94th St and the GCP into the Airport would be required along the approximately 0.5-mile segment of the route.
  - The construction would occur approximately 100–350 ft from 4 short city blocks of residential and commercial properties.
  - Planned night closures of the GCP would be required for the long-span bridge erection.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - There could be increased construction/haul traffic on local roads because trucks are not allowed on the GCP.

- **Constructing On-Airport Elevated Bus Stops**
  - Construction activities associated with the erection of long-span (approximately 350-ft) elevated busway bridge structures over an approximately 0.5-mile segment of the route over 102nd St and the newly constructed departures roadway at the Airport would be required.
  - The construction would occur over 500 ft from 5 city blocks of residential and commercial properties in the East Elmhurst community located on the other side of 8 lanes of the GCP.
  - Planned night closures of the GCP would be required for the long-span bridge erection.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - There could be increased construction/haul traffic on local roads because trucks are not allowed on the GCP.

- **Constructing the Bus Depot at Ingraham's Mountain off 19th Ave**
  - Construction of the proposed facility (roadway and building(s)) on an elevated portion (approximately 50,000 sf) of the existing LGA property known as 'Ingraham's Mountain' would occur for approximately 1 year approximately 200–300 ft from 4 short city blocks of commercial properties.

Sub-Option BRT-1C

Roadway construction activities are anticipated to occur along the approximately 4-mile route for approximately 2 years for Sub-Option BRT-1C.

During construction, the following neighborhoods would have the potential for air quality, noise, vibration, or visual impacts. For the frequency and duration of construction activities refer to Section 7.1.1.2 “Infrastructure Impacts during Construction” above:

- **Construction of Bus Stops and Bus Turnaround/Layover around Columbus Sq Park and along Astoria Blvd**
  - Roadway construction activities (restriping, signing, and curb resetting) on Astoria Blvd, 31st St, and Hoyt Ave South to provide a clockwise BRT-only bus turnaround route around the square would be required at this segment of the route.
  - The construction would occur approximately 35–80 ft from 1 short city block of residential and commercial properties.
  - Planned periodic lane closures and diversions on Astoria Blvd South and 31st St, 32nd St, and 33rd St would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - Planned periodic closure of sidewalks, bike lanes, and parking spaces would be required along Astoria Blvd.
  - Planned periodic closure of Columbus Sq Park (NYC Parkland) would be required depending on the final detailed design of the bus stops and turnaround.
  - Planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.

- **Construction of the BRT Lanes along Astoria Blvd North and South**
  - Roadway modification activities (restriping, signing, and curb resetting) on Astoria Blvd North and Astoria Blvd South over an approximately 1.5-mile segment of the route would be required.
  - The modification would occur approximately 35–50 ft from 25 short city blocks of residential and commercial properties.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - Planned periodic closure of sidewalks, bike lanes, and parking spaces would be required.
  - Planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.
  - Planned periodic suspension of truck deliveries for loading/unloading at commercial businesses would be required.

- **Constructing On-Airport At-Grade Bus Stops**
  - Roadway construction activities (roadway reconfiguration, restriping, curb resetting, paving, signage, and drainage) would be required along an approximately 0.5-mile segment of the route to construct the proposed Terminal C bus loop, which would pass

under multiple on-Airport roadways and support structures. The loop road would be constructed to avoid the need to modify any of the existing columns or supports.

- The construction would occur over 500 ft from 5 city blocks of residential and commercial properties in the East Elmhurst community located on the other side of 8 lanes of the GCP.
- Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
- There could be increased construction/haul traffic on local roads because trucks are not allowed on the GCP.

- **Constructing the Bus Depot at Ingraham's Mountain off 19th Ave**
  - Construction of the proposed facility (roadway and building(s)) on an elevated portion (approximately 50,000 sf) of the existing LGA property known as 'Ingraham's Mountain' would occur for approximately 1 year approximately 200–300 ft from 4 short city blocks of commercial properties.

7.1.3.1.2 Permanent Operational Impacts on the Local Neighborhoods Directly Affected

<u>Sub-Option BRT-1A</u>

Electric, zero-emission buses could operate between LGA and the proposed bus transfer stop at Astoria Blvd. They would operate in a mixture of at-grade dedicated bus lanes and a dedicated elevated busway structure onto the airport, ranging approximately 35–50 ft from residential and commercial properties when on city streets.

The following neighborhoods and areas would have the relative potential for permanent noise, vibration, or visual impacts as a result of this sub-option's proposed bus operations:

- **New Bus Stops and Bus Turnaround/Layover around Columbus Square Park and along Astoria Blvd**
  - In the area around Columbus Sq Park, buses would operate in at-grade dedicated bus lanes alongside other city traffic approximately 35–50 ft from residential and commercial properties.

- **New BRT Lanes along Astoria Blvd North and South**
  - From the bus transfer stop at Astoria Blvd to 79th St, buses would operate in at-grade dedicated bus lanes running alongside other city traffic on Astoria Blvd North and South approximately 35–50 ft from residential and commercial properties.

- Astoria Blvd North is a mix of commercial and residential properties with on-street parking along the right-hand curbside. This sub-option would use a combination of a reduction in parking and the permanent repurposing of a general-purpose travel lane to provide the BRT-only lane.
- Astoria Blvd South is a mix of commercial and residential properties with on-street parking along the right-hand curbside. This sub-option would permanently repurpose a general-purpose travel lane to provide the BRT-only lane.

- **New Elevated Busway over 94th St and the GCP into the Airport**
  - To enter the airport from the GCP, buses would rise to operate in each direction on an elevated busway over the GCP onto the Airport approximately 100–350 ft from residential and commercial properties.

- **New On-Airport Elevated Bus Stops**
  - On-Airport, buses would operate in each direction on an elevated busway between the two proposed bus stops over 500 ft from residential and commercial properties in the East Elmhurst community located on the other side of 8 lanes of the GCP.

- **New Bus Depot at Ingraham's Mountain off 19th Ave**
  - The new bus depot at Ingraham's Mountain would lead to increased electric, zero-emission bus traffic entering/exiting the facility along 19th Ave, a mainly residential and commercial corridor.

Sub-Option BRT-1B

Electric, zero-emission buses could operate between LGA and the proposed bus transfer stop at Astoria Blvd in a mixture of at-grade and elevated dedicated busway structures, ranging approximately 35–500+ ft from residential and commercial properties.

The following neighborhoods and areas would have the potential for permanent noise, vibration, or visual impacts as a result of this sub-option's proposed bus operations:

- **New Bus Stops and Bus Turnaround/Layover around Columbus Square Park and along Astoria Blvd**
  - In the area around Columbus Sq Park, buses would operate in at-grade dedicated bus lanes alongside other city traffic approximately 35–50 ft from residential and commercial properties.

- **New BRT Lanes along Astoria Blvd South**
  - From the bus transfer stop at Astoria Blvd to 46th St, buses would operate in an at-grade dedicated busway running alongside other city traffic on Astoria Blvd South approximately 35–50 ft from residential and commercial properties.
  - Astoria Blvd South is a mix of commercial and residential properties with on-street parking along the right-hand curbside. This sub-option would permanently repurpose a general-purpose travel lane to provide part of the busway.

- **New Elevated Busway to the North of St Michael's Cemetery**
  - Between 46th St and 77th St, buses would rise to operate in each direction on an elevated busway to the north of St Michael's Cemetery, within the GCP transportation corridor approximately 35–50 ft from the cemetery boundary.

- **New Elevated Busway at Eastbound BQE Connector to GCP Intersection**
  - East of St Michael's Cemetery, buses would transition from an elevated busway to run alongside city traffic in a busway south of the GCP, operating in each direction within the GCP transportation corridor approximately 180–200 ft from commercial properties.

- **New Elevated Busway over 94th St and the GCP into the Airport**
  - To enter the Airport from the GCP, buses would rise to operate in each direction on an elevated busway over the GCP onto the Airport approximately 100–350 ft from residential and commercial properties.

- **New On-Airport Elevated Bus Stops**
  - On-Airport, buses would operate in each direction on an elevated busway between the two proposed bus stops over 500 ft from residential and commercial properties in the East Elmhurst community located on the other side of 8 lanes of the GCP.

- **New Bus Depot at Ingraham's Mountain off 19th Ave**
  - The new bus depot at Ingraham's Mountain would lead to increased electric, zero-emission bus traffic entering/exiting the facility along 19th Ave, a mainly residential and commercial corridor.

Sub-Option BRT-1C

Electric, zero-emission buses would operate between LGA and the proposed bus transfer stop at Astoria Blvd in a mixture of at-grade dedicated bus lanes and in mixed-flow traffic along the GCP, ranging approximately 35–50 ft from residential and commercial properties while on city streets.

The following neighborhoods and areas would have the potential for permanent noise, vibration, or visual impacts as a result of this sub-option's proposed bus operations:

- **New Bus Stops and Bus Turnaround/Layover around Columbus Square Park and along Astoria Blvd**
  - In the area around Columbus Sq Park, buses would operate in at-grade dedicated bus lanes alongside other city traffic approximately 35–50 ft from residential and commercial properties.

- **New BRT Lanes along Astoria Blvd North and South**
  - From the bus transfer stop at Astoria Blvd to 79th St, buses would operate in at-grade dedicated bus lanes running alongside other city traffic on Astoria Blvd North and South approximately 35–50 ft from residential and commercial properties.
  - Astoria Blvd North is a mix of commercial and residential properties with on-street parking along the right-hand curbside. This sub-option would use a combination of a reduction in parking and the permanent repurposing of a general-purpose travel lane to provide the BRT-only lane.
  - Astoria Blvd South is a mix of commercial and residential properties with on-street parking along the right-hand curbside. This sub-option would permanently repurpose a general-purpose travel lane to provide the BRT-only lane.

- **New Bus Depot at Ingraham's Mountain off 19th Ave**
  - The new bus depot at Ingraham's Mountain would lead to increased electric, zero-emission bus traffic entering/exiting the facility along 19th Ave, a mainly residential and commercial corridor.

7.1.3.1.3 Potential Private Property Acquisitions

The new dedicated BRT-1 options (and sub-options) may require acquisition of the following:

Sub-Option BRT-1A

No private properties are anticipated to be acquired.

Sub-Option BRT-1B

No private properties are anticipated to be acquired.

Sub-Option BRT-1C

No private properties are anticipated to be acquired.

7.1.3.1.4 Potential Public Property Acquisitions (NYC DOT Plazas and NYC Parks Parkland)

The new dedicated BRT-1 options (and sub-options) would result in permanent impacts to the following:

Sub-Options BRT-1A and BRT-1B

- Transfer bus stops for Astoria Blvd Subway station would be located on either side of Columbus Sq Park.
- Access to the Subway station would be from within Columbus Sq Park via the existing subway access structures and elevators.
- New support columns for the permanent elevated busway structure would be located within Planeview Park and the at-grade busway within Overlook Park.
- No structures would be sited within NYC DOT Plazas.

Sub-Option BRT-1C

- Transfer bus stops for Astoria Blvd Subway station would be located on either side of Columbus Sq Park.
- Access to the Subway station would be from within Columbus Sq Park via the existing subway access structures and elevators.
- No structures would be sited within NYC DOT Plazas.

7.1.3.1.5 Removal/Reconfiguration of Parking Spaces

The new dedicated BRT options (and sub-options) would require removal of the following parking spaces.

<u>Sub-Option BRT-1A</u>

- A total of approximately 110 on-street public parking spaces would be lost on the following streets:
  - Near the Astoria Blvd bus stop (west of 34th St).
  - Astoria Blvd North (between 45th St and 79th St).

The number is approximate and is a preliminary estimate based on the alignment.

<u>Sub-Option BRT-1B</u>

- A total of approximately 40 on-street public parking spaces would be lost on the following streets:
  - Near the Astoria Blvd bus stop (west of 34th St).
  - Ditmars Blvd (between 86th St and 90th St).

The number is approximate and is a preliminary estimate based on the alignment.

<u>Sub-Option BRT-1C</u>

- A total of approximately 110 on-street public parking spaces would be lost on the following streets:
  - Near the Astoria Blvd bus stop (west of 34th St).
  - Astoria Blvd North (between 45th St and 79th St).

The number is approximate and is a preliminary estimate based on the alignment.

7.1.3.1.6 Environmental Justice Communities Mapping Analysis

The Environmental Justice communities mapping analysis provides an overview of the minority and low-income communities within 0.25 mile of the transit options being studied.

<u>Sub-Option BRT-1A</u>

For Sub-Option BRT-1A, less than half of the block groups within the 0.25-mile buffer of the option alignment are Environmental Justice block groups.

See Figure 7.1-7 below for the analysis map for Sub-Option BRT-1A.

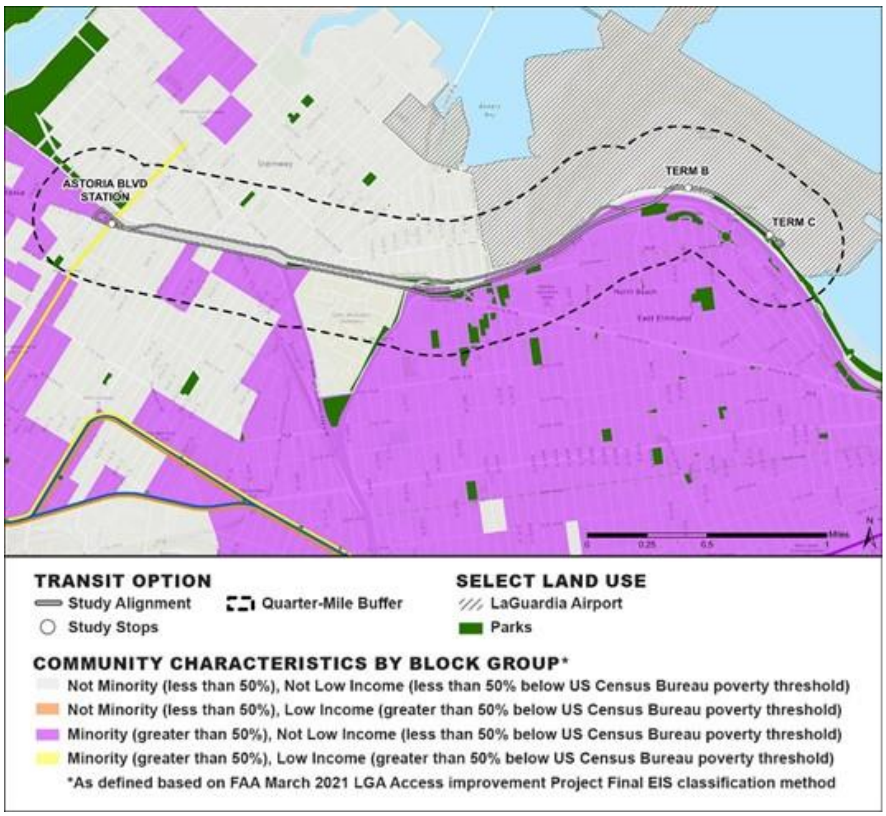


FIGURE 7.1-7: ASTORIA BLVD STATION BRT-1A - ENVIRONMENTAL JUSTICE COMMUNITIES MAPPING ANALYSIS (AS DEFINED BASED UPON FAA MARCH 2021 LGA ACCESS IMPROVEMENT PROJECT FINAL EIS CLASSIFICATION METHOD)

Sub-Option BRT-1B

For Sub-Option BRT-1B, less than half of the block groups within the 0.25-mile buffer of the option alignment are Environmental Justice block groups.

See Figure 7.1-8 below for the analysis map for Sub-Option BRT-1B.

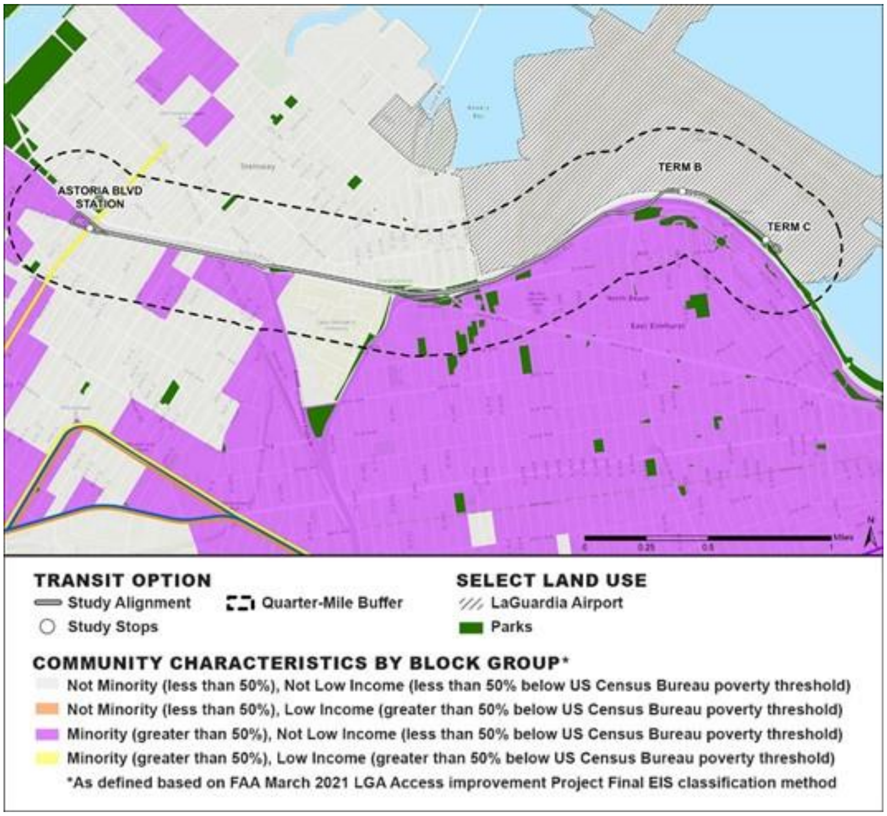


FIGURE 7.1-8: ASTORIA BLVD STATION BRT-1B - ENVIRONMENTAL JUSTICE COMMUNITIES MAPPING ANALYSIS (AS DEFINED BASED UPON FAA MARCH 2021 LGA ACCESS IMPROVEMENT PROJECT FINAL EIS CLASSIFICATION METHOD)

Sub-Option BRT-1C

For Sub-Option BRT-1C, less than half of the block groups within the 0.25-mile buffer of the option alignment are Environmental Justice block groups.

See Figure 7.1-9 below for the analysis map for Sub-Option BRT-1C.

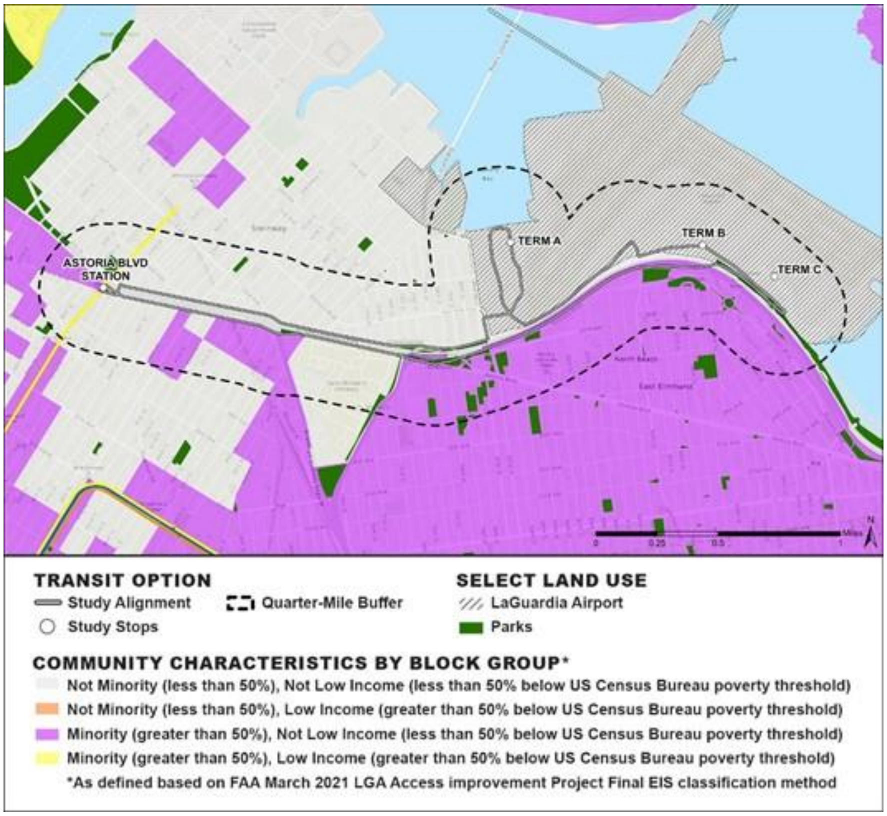


FIGURE 7.1-9: ASTORIA BLVD STATION BRT-1C – ENVIRONMENTAL JUSTICE COMMUNITIES MAPPING ANALYSIS (AS DEFINED BASED UPON FAA MARCH 2021 LGA ACCESS IMPROVEMENT PROJECT FINAL EIS CLASSIFICATION METHOD)

7.1.3.2 Equity

7.1.3.2.1 Transit Access from LGA

<u>Sub-Option BRT-1A</u>

- **Additional Minority and Low-income Populations Reached within 45 Minutes from LGA via Transit (Population Access Analysis)**
  - The results of the Population Access Analysis illustrate how many people, specifically from low-income and minority populations, could travel via transit from LGA to homes within 45 minutes from LGA. Airport passengers or Airport employees living within these areas could potentially benefit from expanded access to these destinations.
  - Option BRT-1A is expected to expand transit access from LGA to regional destinations within 45 minutes, as shown in the blue area of "Additional Access Provided by Transit Option" in Figure 7.1-10. Compared to the baseline, the minority population reached within a 45-minute transit trip would increase by 37.5% and the low-income population reached within a 45-minute transit trip would increase by 53% as shown in Table 7.1-4.
  - This represents a medium increase in transit access to LGA within 45 minutes for minority and low-income communities.

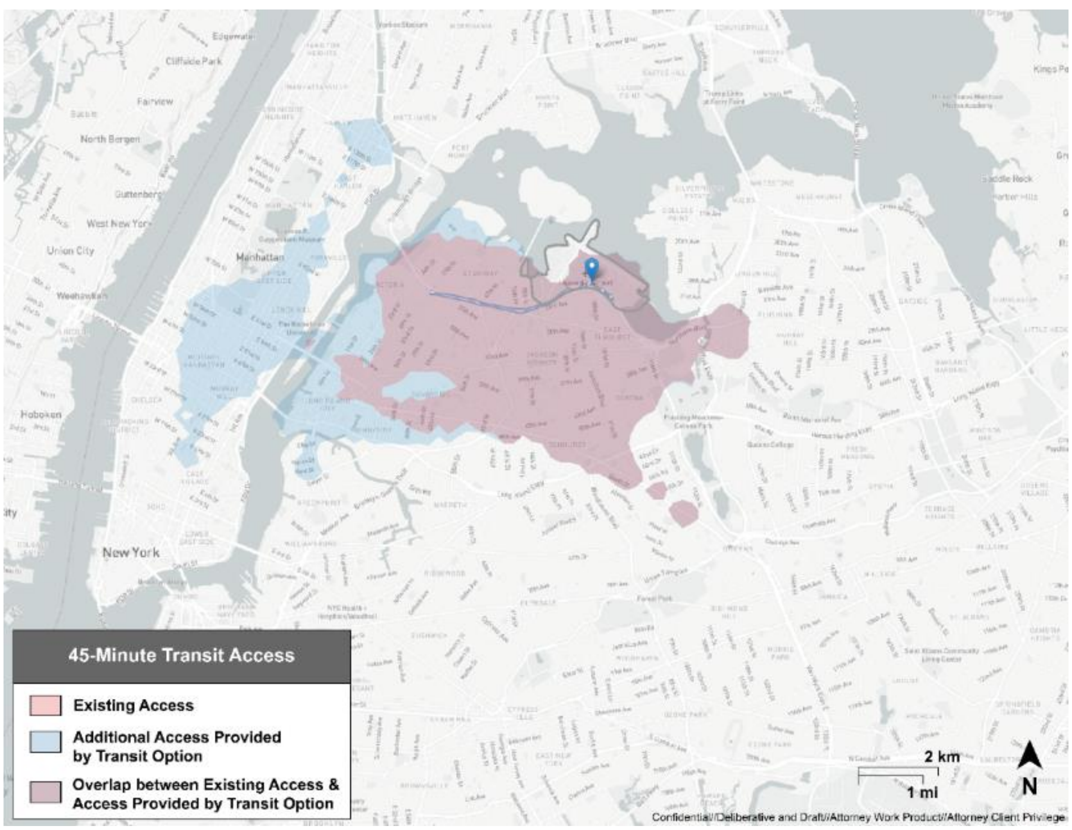


FIGURE 7.1-10: ASTORIA BLVD STATION BRT-1A – POPULATION ACCESS ANALYSIS

TABLE 7.1-4: ASTORIA BLVD STATION BRT-1A – POPULATIONS REACHED WITHIN 45-MINUTE TRANSIT TRIP

		Total Population Reached	Minority Population Reached	Low-Income Population Reached
Baseline	Existing Condition	551,434	422,981	76,750
BRT-1A	With Option	949,874	581,442	117,439
	Net Change	+398,440	+158,461	+40,689
	% Change	72.3%	37.5%	53.0%

- **Additional ADA-Accessible Stations within 45 Minutes from LGA via Transit (ADA Analysis)**
  - The results of the ADA Analysis illustrate how Airport passengers and Airport employees, specifically those requiring ADA-compliant stations, traveling from LGA to other locations could potentially benefit from expanded access to ADA-compliant stations within 45 minutes via transit.
  - More ADA-accessible stations/stops can be reached within a 45-minute transit trip for this sub-option compared to the baseline of existing transit service (Table 7.1-5). This echoes the results from the Population Access Analysis, in which BRT-1A's 45-minute transit travel shed provides an increased amount of access over the baseline transit service. Compared to the baseline, an additional 48 ADA-accessible stations can be reached within a 45-minute transit trip from LGA for Sub-Option BRT-1A.

TABLE 7.1-5: ASTORIA BLVD STATION BRT-1A – ADA ANALYSIS

Subway, Ferry, LIRR, and MNR Stations Reached within 45-Minute Transit Trip from LGA	Baseline	BRT-1A	Difference between Baseline and BRT-1A
Total Stations	*43*	*117*	*+74 stations*
ADA-Accessible Stations (Accessible Stations as % of Total)	*20 (47%)*	*68 (58%)*	*+48 stations*

Sub-Option BRT-1B

- **Additional Minority and Low-income Populations Reached within 45 Minutes from LGA via Transit (Population Access Analysis)**
  - The results of the Population Access Analysis illustrate how many people, specifically from low-income and minority populations, could travel via transit from LGA to homes within 45 minutes from LGA. Airport passengers or Airport employees living within these areas could potentially benefit from expanded access to these destinations.
  - Sub-Option BRT-1B is expected to expand transit access from LGA to regional destinations within 45 minutes, as shown in the blue area of "Additional Access Provided by Transit Option" in Figure 7.1-11. Compared to the baseline, the minority population reached within a 45-minute transit trip would increase by 49.8% and the low-income population reached within a 45-minute transit trip would increase by 72.9% as shown in Table 7.1-6.
  - This represents a medium increase in transit access to LGA within 45 minutes for minority and low-income communities.

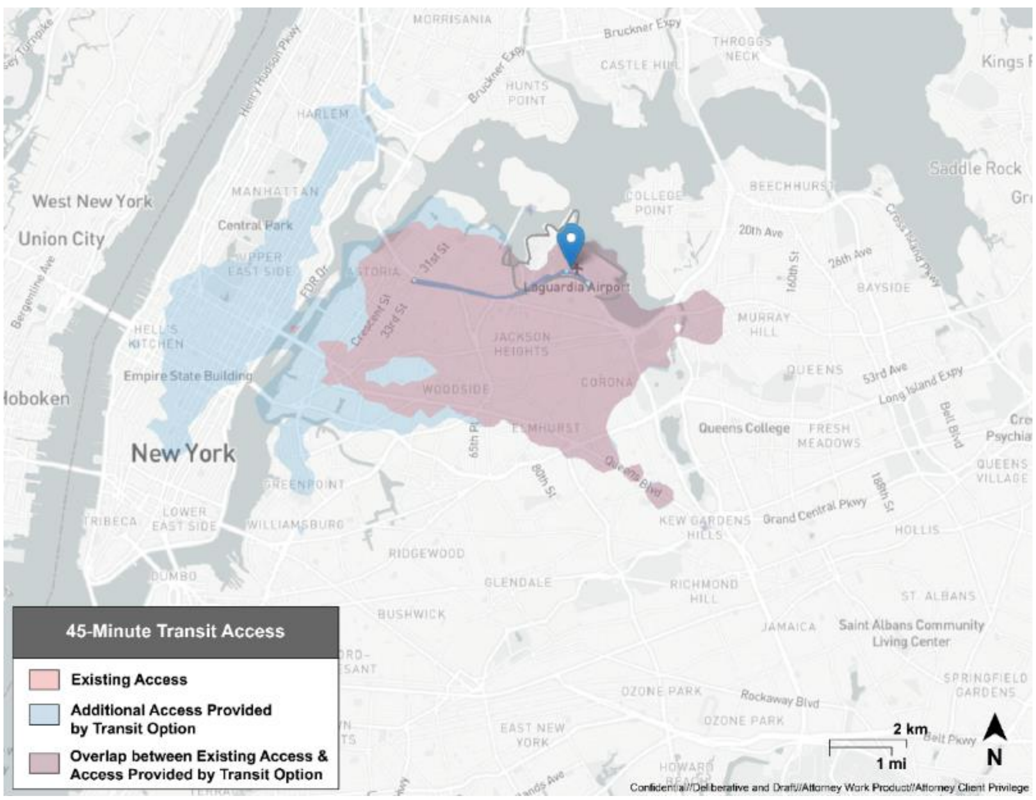


FIGURE 7.1-11: ASTORIA BLVD STATION BRT-1B – POPULATION ACCESS ANALYSIS

TABLE 7.1-6: ASTORIA BLVD STATION BRT-1B – POPULATIONS REACHED WITHIN 45-MINUTE TRANSIT TRIP

		Total Population Reached	Minority Population Reached	Low-Income Population Reached
Baseline	Existing Condition	551,434	422,981	76,750
BRT-1B	With Option	1,060,985	633,500	132,707
	Net Change	+509,551	+210,519	+55,957
	% Change	92.4%	49.8%	72.9%

- **Additional ADA-Accessible Stations within 45 Minutes from LGA via Transit (ADA Analysis)**
  - The results of the ADA Analysis illustrate how Airport passengers and Airport employees, specifically those requiring ADA-compliant stations, traveling from LGA to other locations could potentially benefit from expanded access to ADA-compliant stations within 45 minutes via transit.
  - More ADA-accessible stations/stops can be reached within a 45-minute transit trip for this option compared to the baseline of existing transit service (Table 7.1-7). This echoes the results from the Population Access Analysis, in which BRT-1B's 45-minute transit travel shed provides an increased amount of access over the baseline transit service. Compared to the baseline, an additional 58 ADA-accessible stations can be reached within a 45-minute transit trip from LGA for Sub-Option BRT-1B.

TABLE 7.1-7: ASTORIA BLVD STATION BRT-1B – ADA ANALYSIS

Subway, Ferry, LIRR, and MNR Stations Reached within 45-Minute Transit Trip from LGA	Baseline	BRT-1B	Difference between Baseline and BRT-1B
Total Stations	*43*	*132*	*+89 stations*
ADA-Accessible Stations (Accessible Stations as % of Total)	*20 (47%)*	*78 (59%)*	*+58 stations*

Sub-Option BRT-1C

- **Additional Minority and Low-income Populations Reached within 45 Minutes from LGA via Transit (Population Access Analysis)**
  - The results of the Population Access Analysis illustrate how many people, specifically from low-income and minority populations, could travel via transit from LGA to homes within 45 minutes from LGA. Airport passengers or Airport employees living within these areas could potentially benefit from expanded access to these destinations.
  - Sub-Option BRT-1C is expected to expand transit access from LGA to regional destinations within 45 minutes, as shown in the blue area of "Additional Access Provided by Transit Option" in Figure 7.1-12. Compared to the baseline, the minority population reached within a 45-minute transit trip would increase by 22.9% and the low-income population reached within a 45-minute transit trip would increase by 31.6% as shown in Table 7.1-8.
  - This represents a lower increase in transit access to LGA within 45 minutes for minority and low-income communities.

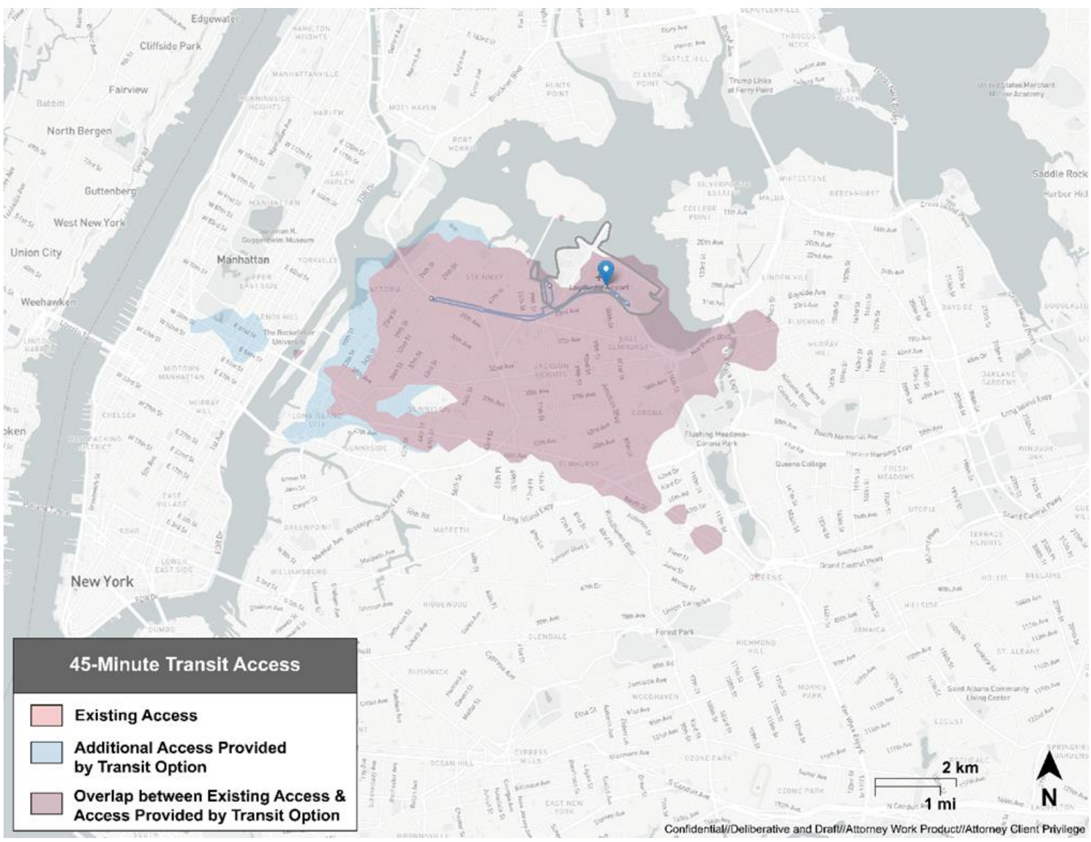


FIGURE 7.1-12: ASTORIA BLVD STATION BRT-1C – POPULATION ACCESS ANALYSIS

TABLE 7.1-8: ASTORIA BLVD STATION BRT-1C – POPULATIONS REACHED WITHIN 45-MINUTE TRANSIT TRIP

		Total Population Reached	Minority Population Reached	Low-Income Population Reached
Baseline	Existing Condition	551,434	422,981	76,750
BRT-1C (With Terminal A)	With Option	612,313	454,292	84,643
	Net Change	+59,760	+30,298	+7,891
	% Change	10.8%	7.1%	10.3%

- **Additional ADA-Accessible Stations within 45 Minutes from LGA via Transit (ADA Analysis)**
  - The results of the ADA Analysis illustrate how Airport passengers and Airport employees, specifically those requiring ADA-compliant stations, traveling from LGA to other locations could potentially benefit from expanded access to ADA-compliant stations within 45 minutes via transit.
  - More ADA-accessible stations/stops can be reached within a 45-minute transit trip for this option compared to the baseline of existing transit service (Table 7.1-9). This echoes the results from the Population Access Analysis, in which BRT-1C's (without Terminal A) 45-minute transit travel shed provides an increased amount of access over the baseline transit service. Compared to the baseline, an additional 41 ADA-accessible stations can be reached within a 45-minute transit trip from LGA for Sub-Option BRT-1C (without Terminal A).

TABLE 7.1-9: ASTORIA BLVD STATION BRT-1C – ADA ANALYSIS

Subway, Ferry, LIRR, and MNR Stations Reached within 45-Minute Transit Trip from LGA	Baseline	BRT-1C (With Terminal A)	Difference between Baseline and BRT-1C (With Terminal A)
Total Stations	*43*	*62*	*+19 stations*
ADA-Accessible Stations (Accessible Stations as % of Total)	*20 (47%)*	*30 (48%)*	*+10 stations*

7.1.3.2.2 Transportation Opportunities and Benefits for the Surrounding Community

Sub-Option BRT-1A

- **Transportation Opportunities for Neighbors**

  This option does not include intermediate/off-Airport stops. Because there is limited pedestrian access to LGA from adjacent residential areas and walking distance exceeds 0.25 mile, the study team did not consider there to be a significant market for use of the final on-Airport stops by the surrounding community to connect to the broader transit network.

- **Cars Removed from Local Roadways and Emissions Reductions**

  See the "Cars Removed from Local Roadways" section and the "GHG and Other Vehicular Emissions Reductions" section of this evaluation below.

Sub-Option BRT-1B

- **Transportation Opportunities for Neighbors**

  This sub-option does not include intermediate/off-Airport stops. Because there is limited pedestrian access to LGA from adjacent residential areas and walking distance exceeds 0.25 mile, the study team did not consider there to be a significant market for use of the final on-Airport stops by the surrounding community to connect to the broader transit network.

- **Cars Removed from Local Roadways and Emissions Reductions**

  See the "Cars Removed from Local Roadways" section and the "GHG and Other Vehicular Emissions Reductions" section of this evaluation below.

Sub-Option BRT-1C

- **Transportation Opportunities for Neighbors**

  This sub-option does not include intermediate/off-Airport stops. Because there is limited pedestrian access to LGA from adjacent residential areas and walking distance exceeds 0.25 mile, the study team did not consider there to be a significant market for use of the final on-Airport stops by the surrounding community to connect to the broader transit network.

- **Cars Removed from Local Roadways and Emissions Reductions**

  See the "Cars Removed from Local Roadways" section and the "GHG and Other Vehicular Emissions Reductions" section of this evaluation below.

7.1.3.3 Cars Removed from Local Roadways

Sub-Option BRT-1A

- Sub-Option BRT-1A would be expected to remove 667,000 Airport passenger vehicles, and 42,000 Airport employee vehicles, from the road each year.

Sub-Option BRT-1B

- Sub-Option BRT-1B would be expected to remove 692,000 Airport passenger vehicles, and 48,000 Airport employee vehicles, from the road each year.

Sub-Option BRT-1C

- Sub-Option BRT-1C would be expected to remove 585,000 Airport passenger vehicles, and 29,000 Airport employee vehicles, from the road each year.

7.1.3.4 GHG and Other Vehicular Emissions Reductions

Sub-Option BRT-1A

- Sub-Option BRT-1A would be expected to remove 3,270 metric tons of CO_2 equivalent each year.

Sub-Option BRT-1B

- Sub-Option BRT-1B would be expected to remove 3,401 metric tons of CO_2 equivalent each year.

Sub-Option BRT-1C

- Sub-Option BRT-1C would be expected to remove 2,903 metric tons of CO_2 equivalent each year.

Other vehicular emissions reductions are given in Table 7.1-10:

TABLE 7.1-10: OTHER VEHICULAR EMISSIONS REDUCTION (METRIC TONS PER YEAR)

Option	CO	VOC	NOx	SO_2	PM_{10}	$PM_{2.5}$
[BRT-1A] Astoria Blvd 'Hybrid'	15.4	0.2	1.0	0.05	0.6	0.1
[BRT-1B] Astoria Blvd 'Heavier Infrastructure'	16.0	0.2	1.1	0.05	0.6	0.1
[BRT-1C] Astoria Blvd 'Lighter Infrastructure'	13.7	0.2	0.9	0.04	0.5	0.1

7.1.4 Summary of Evaluation

Option BRT-1 would create a new electric bus shuttle service to LGA via a two-seat ride from the existing Astoria Blvd Subway station, providing transfer access to N and W-Line Subway services. BRT bus stops would be located adjacent to the station on either side of Columbus Sq, and buses would use the Astoria Blvd/GCP transportation corridor to reach the Airport. All sub-options would require the construction of a new bus depot on Airport property at Ingraham's Mountain.

The study team evaluated three sub-options of BRT-1:

- BRT-1A would use a combination of bus lanes on Astoria Blvd and a dedicated elevated busway onto the Airport to avoid possible congestion and traffic delays, improving travel time and reliability.
- BRT-1B would further improve these with a separated busway for the full route from Astoria Blvd Station to LGA.
- BRT-1C offers a more cost-efficient option to BRT-1A or BRT-1B, converting bus lanes on Astoria Blvd but avoiding heavy construction, realizing many of the travel time benefits while avoiding both the cost and community impacts of the heavy infrastructure required by the separated busway.

<u>BRT-1A: Astoria Blvd Shuttle with Bus Lanes on Astoria Blvd and Heavy Infrastructure Busway Adjacent to the GCP</u>

Sub-Option BRT-1A would offer bus travel time and reliability benefits through the conversion of travel lanes on Astoria Blvd North and South to bus-only lanes with traffic signals revised to prioritize the buses, and a new dedicated busway structure to new elevated bus stops on-Airport, allowing buses direct access to the Airport, bypassing other Airport traffic. This sub-option would offer improvements including signage, wayfinding, and weather-protected bus stops to the passenger transfer connection at Astoria Blvd Subway station. However, MTA has advised that any new access improvements to platform level would be limited by the space available within the existing constrained station infrastructure.

This sub-option would require a mix of heavy infrastructure, including an at-grade busway structure along the GCP rising to elevated structure on-Airport along with light roadway work at other points (line painting, re-curbing, etc.) for the new bus lanes. The heavy infrastructure sections of this sub-option would have to contend with the construction challenges of complying with FAA Airport Design Standards while negotiating the 90-year-old utilities under the GCP at the end of Runway 04-22 (a challenge as yet unresolved as discussed in Section 3.2.1.1.1). For the purpose of cost comparison, this option was costed out on the basis of a baseline solution of an at-grade roadway south of Runway 04-22, despite this approach not being compliant with FAA Airport Design Standards.

Table 7.1-11 summarizes the output from all the factors used to evaluate this option.

TABLE 7.1-11: SUMMARY OF KEY CHARACTERISTICS – ASTORIA BLVD SHUTTLE WITH BUS LANES ON ASTORIA BLVD AND BUSWAY ADJACENT TO THE GCP (BRT-1A)

	Evaluation Factor	Assessment
CONSTRUCTION ASPECTS	Constructability	• **Major unresolved constructability challenge**: Complying with FAA Airport Design Standards while also avoiding disruption to 90-year-old, 15 ft diameter sewer structures at the end of Runway 04-22 (see details in Section 3.2.1.1.1) • Construction of bus turnaround /layover adjacent to existing Astoria Blvd Station and Columbus Sq Park • Constrained construction access adjacent to GCP • Reconstruction of 82nd St Bridge • Long spans (250-300 ft) over 94th St Bridge and 102nd St bridges on-Airport • Constrained on-Airport sites for new elevated busway structure and bus stops • Total option route length: approx. 3 miles
	Infrastructure Impacts during Construction	• Disruption to existing bus service and access to Astoria Blvd Station at Columbus Sq Park • Lane narrowing, traffic diversions, and speed restrictions on GCP and Astoria Blvd
	Permanent/Operational Impacts to Existing Infrastructure	• Permanent reduction of travel lanes on Astoria Blvd North and South, disrupting MTA services using these routes • Inhibits future widening of the GCP • Columns and piers in site of future Terminal B taxi hold
	Indicative Capital Cost (2022$)[91]	$1.3 billion[92] (Does not include any additional costs required for an as yet unresolved solution to get past Runway 04-22 in compliance with FAA Airport Design Standards; potentially up to approx. $1–$3 billion)
	Indicative Timeline/Schedule	9–10 Years
TRANSPORTATION ASPECTS	Standardized Indicative Baseline Off-Peak Travel Time (From Midtown Manhattan)	Via N/W-Lines: 38–39 mins (6–7 mins on bus) (Times Square to Terminal B, then C; shuttle to Terminal A)
	Transfer Experience	• Transfer to the bus stop at Astoria Blvd Subway station would involve two vertical moves via existing stairs or existing elevator from platform to grade, and a short walk, in open air, to the covered bus stop • Circulation space at the mezzanine level of Astoria Blvd Station is constrained • Serves Terminals B and C only, shuttle to Terminal A
	Ridership[93]	Total annual projected ridership for option: 3.7 million Net increase in annual projected transit ridership: 2.1 million
	Throughput & Capacity	Would be adapted to suit demand
	Indicative Operating Cost	Up to $8 million per annum

[91] Indicative Capital Costs should be considered to have a range of estimating uncertainty of –10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).

[92] Costs for heavy infrastructure options approaching LGA from the west/southwest are based on the open-trench construction concept past Runway 04-22 (over the existing 90-year-old utilities), to provide a baseline estimate of the cost of construction. Although this concept does not meet FAA Airport Design Standards, it provides a consistent approach for capital cost comparison purposes. Costs associated with tunnelling and/or relocating utilities would be substantially higher, potentially up to approx. $1–$3 billion.

[93] Experience from AirTrain JFK was that actual ridership turned out to be higher than would have been predicted by the AirTrain JFK forecast and underscores the inherent uncertainty of model predictions. The ridership model supporting this effort could also deviate from eventual ridership demand but was utilized to allow ridership comparisons between the options.

TABLE 7.1-11, CONTINUED.

	Evaluation Factor	Assessment
COMMUNITY AND ENVIRONMENTAL ASPECTS	Local Community Impacts	Construction: • Mix of heavy civil construction and light roadway work for approx. 4.25 years Proximity to communities: • Heavy civil construction over 500 ft across 8 lanes of the GCP from 9 city blocks of residential and commercial properties opposite the Airport Terminals • Bus Depot construction 200–300 ft from 4 city blocks of commercial properties near Ingraham's Mountain • Light roadway modification within 35–50 ft of 26 city blocks of residential and commercial properties along Astoria Blvd North and South Permanent impacts: • No permanent private property acquisition • Structures over or adjacent to Planeview Park and Overlook Park[94] • Loss of approx. 110 on-street public parking spaces near Astoria Blvd bus stop and along Astoria Blvd North Operations: • Operated with a quiet, zero-emissions all-electric bus fleet • Bus depot on airport property, 200–300 ft from commercial areas
	Equity	• Medium increase to low-income and minority populations within 45 minutes of the Airport via transit versus the no-build scenario • +48 additional ADA-compliant stations reachable within a 45-minute transit trip from LGA versus the no-build scenario
	Cars Removed from Local Roadways	667,000 airport passenger vehicles and 42,000 airport employee vehicles from the road per each year
	GHG and other Vehicular Emissions Reductions	3,270 metric tons of CO2 equivalent each year

[94] Municipal parkland cannot be converted to a non-park use (known as alienation) without State legislative permission. Thus, the acquisition of New York City Parkland for construction of a mass transit option would require legislation authorizing such alienation. Obtaining such legislation is a multi-step process requiring actions by the New York City Council, the Mayor of New York City, the New York State Legislature, and the Governor.

BRT-1B: Astoria Blvd Shuttle with Full Heavy Infrastructure Busway on Astoria Blvd and Adjacent to the GCP

Sub-Option BRT-1B would offer bus travel time and reliability benefits through the construction of a new dedicated busway structure from the Subway station all the way to the Airport. This would consist of the conversion of one lane and construction of an additional lane along Astoria Blvd South with traffic signals revised to prioritize the buses, and a new dedicated busway structure to new elevated bus stops on-Airport, allowing buses direct access to the Airport, bypassing other airport traffic. This sub-option would offer improvements including signage, wayfinding, and weather-protected bus stops to the passenger transfer connection at Astoria Blvd Subway station. However, MTA has advised that any new access improvements to platform level would be limited by the space available within the existing constrained station infrastructure.

This sub-option would require the construction of heavy infrastructure, including at-grade and elevated concrete busway structures predominantly along the GCP transportation corridor. This sub-option would have to contend with the construction challenges of complying with FAA Airport Design Standards while negotiating the 90-year-old utilities under the GCP at the end of Runway 04-22 (a challenge as yet unresolved as discussed in Section 3.2.1.1.1), extending Astoria Blvd South into the GCP embankment, and traversing the constrained area north of St Michael's Cemetery. For the purpose of cost comparison, this option was costed out on the basis of a baseline solution of an at-grade roadway south of Runway 04-22, despite this approach not being compliant with FAA Airport Design Standards.

Table 7.1-12 summarizes the output from all the factors used to evaluate this option.

TABLE 7.1-12: SUMMARY OF KEY CHARACTERISTICS – ASTORIA BLVD SHUTTLE WITH FULL BUSWAY ON ASTORIA BLVD AND ADJACENT TO THE GCP (BRT-1B)

	Evaluation Factor	Assessment
CONSTRUCTION ASPECTS	Constructability	• **Major unresolved constructability challenge**: Complying with FAA Airport Design Standards while also avoiding disruption to 90-year-old, 15 ft diameter sewer structures at the end of Runway 04-22 (see details in Section 3.2.1.1.1) • Construction of lane extension in GCP embankment and under Hell Gate rail trestle • Construction of bus turnaround /layover adjacent to existing Astoria Blvd Station and Columbus Sq Park • Constrained construction access adjacent to GCP • Reconstruction of 82nd St Bridge • Long spans (250-300 ft) over 94th St Bridge and 102nd St bridges on-Airport • Constrained on-Airport sites for new elevated busway structure and bus stops • Total option route length: approx. 3 miles
	Infrastructure Impacts during Construction	• Disruption to existing bus service and access to Astoria Blvd Station at Columbus Sq Park • Lane narrowing, traffic diversions, speed restrictions on BQE, GCP and Astoria Blvd
	Permanent/Operational Impacts to Existing Infrastructure	• Permanent reduction of travel lane on Astoria Blvd South, disrupting MTA services using these routes • Permanent loss of travel lane on Astoria Blvd South along St. Michael's Cemetery • Inhibits future widening of the GCP • Columns and piers in site of future Terminal B taxi hold
	Indicative Capital Cost (2022$)[95]	$1.9 billion[96] (Does not include any additional costs required for an as yet unresolved solution to get past Runway 04-22 in compliance with FAA Airport Design Standards; potentially up to approx. $1–$3 billion)
	Indicative Timeline/Schedule	9–10 Years
TRANSPORTATION ASPECTS	Standardized Indicative Baseline Off-Peak Travel Time (From Midtown Manhattan)	Via N/W-Lines: 37–38 mins (5–6 mins on bus) (Times Square to Terminal B, then C; shuttle to Terminal A)
	Transfer Experience	• Transfer to the bus stop at Astoria Blvd Subway station would involve two vertical moves via existing stairs or existing elevator from platform to grade, and a short walk, in open air, to the covered bus stop • Circulation space at the mezzanine level of Astoria Blvd Station is constrained • Serves Terminals B and C only, shuttle to Terminal A
	Ridership[97]	Total annual projected ridership for option: 3.8 million Net increase in annual projected transit ridership: 2.2 million
	Throughput & Capacity	Would be adapted to suit demand
	Indicative Operating Cost	Up to $8 million per annum

[95] Indicative Capital Costs should be considered to have a range of estimating uncertainty of –10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).
[96] Costs for heavy infrastructure options approaching LGA from the west/southwest are based on the open-trench construction concept past Runway 04-22 (over the existing 90-year-old utilities), to provide a baseline estimate of the cost of construction. Although this concept does not meet FAA Airport Design Standards, it provides a consistent approach for capital cost comparison purposes. Costs associated with tunnelling and/or relocating utilities would be substantially higher, potentially up to approx. $1–$3 billion.
[97] Experience from AirTrain JFK was that actual ridership turned out to be higher than would have been predicted by the AirTrain JFK forecast and underscores the inherent uncertainty of model predictions. The ridership model supporting this effort could also deviate from eventual ridership demand but was utilized to allow ridership comparisons between the options.

TABLE 7.1-12, CONTINUED.

	Evaluation Factor	Assessment
COMMUNITY AND ENVIRONMENTAL ASPECTS	Local Community Impacts	<u>Construction:</u> • Heavy civil construction of elevated and at-grade structures for approx. 4.25 years <u>Proximity to communities:</u> • 35–50 ft from 14 city blocks of residential and commercial properties along Astoria Blvd South • 35–50 ft from the north end of St Michael's Cemetery along Astoria Blvd South • 200–300 ft from 4 city blocks of commercial properties near Ingraham's Mountain • Over 500 ft across 8 lanes of the GCP from 9 city blocks of residential and commercial properties opposite the Airport Terminals <u>Permanent impacts:</u> • No permanent private property acquisition • Construction and permanent structures over or adjacent to Planeview Park and Overlook Park[98] • Permanent loss of approx. 40 on-street public parking spaces near Astoria Blvd bus stop and along Ditmars Blvd <u>Operations:</u> • Operated with a quiet, zero-emissions all-electric bus fleet • Bus depot on airport property, 200–300 ft from commercial areas
	Equity	• Medium increase to low-income and minority populations within 45 minutes of the Airport via transit versus the no-build scenario • +58 additional ADA-compliant stations reachable within a 45-minute transit trip from LGA versus the no-build scenario
	Cars Removed from Local Roadways	692,000 airport passenger vehicles and 48,000 airport employee vehicles from the road each year
	GHG and other Vehicular Emissions Reductions	3,401 metric tons of CO_2 equivalent each year

[98] Municipal parkland cannot be converted to a non-park use (known as alienation) without State legislative permission. Thus, the acquisition of New York City Parkland for construction of a mass transit option would require legislation authorizing such alienation. Obtaining such legislation is a multi-step process requiring actions by the New York City Council, the Mayor of New York City, the New York State Legislature, and the Governor.

BRT-1C: Astoria Blvd Shuttle with Bus Lanes on Astoria Blvd Only (Lighter Infrastructure)

Sub-Option BRT-1C would offer bus travel time benefits through the adoption of cost-efficient light infrastructure construction through the conversion of travel lanes on Astoria Blvd North and South to bus-only lanes with traffic signals revised to prioritize the buses, and utilization of a new bus-only loop-road and at-grade bus stop at Terminal C, bypassing traffic at the current Terminal C stop. This sub-option would offer improvements including signage, wayfinding, and weather-protected bus stops to the passenger transfer connection at Astoria Blvd Subway station. However, MTA has advised that any new access improvements to platform level would be limited by the space available within the existing constrained station infrastructure.

This sub-option would require light roadway work (line painting, re-curbing, etc.) for the new bus lanes and new roadway construction on-Airport around Terminal C.

Table 7.1-13 summarizes the output from all the factors used to evaluate this option.

TABLE 7.1-13: SUMMARY OF ASSESSMENT – ASTORIA BLVD SHUTTLE WITH BUS LANES ON ASTORIA BLVD ONLY (BRT-1C)

	Evaluation Factor	Assessment
CONSTRUCTION ASPECTS	Constructability	• Construction of bus turnaround /layover adjacent to existing Astoria Blvd Station and Columbus Sq Park • Constrained on-Airport sites for at-grade bus stops and bus turnaround • Total option route length: approx. 3 miles
	Infrastructure Impacts during Construction	• Disruption to existing bus service and access to Astoria Blvd Station at Columbus Sq Park
	Permanent/Operational Impacts to Existing Infrastructure	• Permanent reduction of travel lanes on Astoria Blvd North and South, disrupting MTA services using these routes
	Indicative Capital Cost (2022$)[99]	$220 million[100]
	Indicative Timeline/Schedule	4-5 Years

[99] Indicative Capital Costs should be considered to have a range of estimating uncertainty of –10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).
[100] Cost would exclude circulation improvements around Terminal C if the Q-70 Light Improvement Option proceeds, as then such improvements would be implemented regardless of whether this option was selected to proceed.

TABLE 7.1-13, CONTINUED.

	Evaluation Factor	Assessment
TRANSPORTATION ASPECTS	Standardized Indicative Baseline Off-Peak Travel Time (From Midtown Manhattan)	Via N/W-Lines: 41–46 mins (9–14 mins on bus) (Times Square to Terminal C; serves Terminals C, B, then A)
	Transfer Experience	• Transfer to the bus stop at Astoria Blvd Subway station would involve two vertical moves via existing stairs or existing elevator from platform to grade, and a short walk, in open air, to the covered bus stop • Circulation space at the mezzanine level of Astoria Blvd Station is constrained • Serves Terminals A, B and C
	Ridership[101]	Total annual projected ridership for option: 3.4 million Net increase in annual projected transit ridership: 1.9 million
	Throughput & Capacity	Would be adapted to suit demand
	Indicative Operating Cost	Up to $11.9 million per annum
COMMUNITY AND ENVIRONMENTAL ASPECTS	Local Community Impacts	<u>Construction:</u> • Light roadway (e.g., restriping, curb replacements, bypass lanes) for approx. 2 years <u>Proximity to communities:</u> • 35–50 ft from 26 city blocks of residential and commercial properties along Astoria Blvd North and South • 200–300 ft from 4 city blocks of commercial properties near Ingraham's Mountain <u>Permanent impacts:</u> • No permanent private property acquisitions • No impacts to NYC parklands or plazas • Permanent loss of approx. 110 on-street public parking spaces near Astoria Blvd bus stop and along Astoria Blvd North <u>Operations:</u> • Operated with a quiet, zero-emissions all-electric bus fleet • Bus depot on airport property, 200–300 ft from commercial areas
	Equity	• Lower increase to low-income and minority populations within 45 minutes of the Airport via transit versus the no-build scenario • +10 additional ADA-compliant stations reachable within a 45-minute transit trip from LGA versus the no-build scenario
	Cars Removed from Local Roadways	585,000 airport passenger vehicles and 29,000 airport employee vehicles from the road each year
	GHG and other Vehicular Emissions Reductions	2,903 metric tons of CO2 equivalent each year

[101] Experience from AirTrain JFK was that actual ridership turned out to be higher than would have been predicted by the AirTrain JFK forecast and underscores the inherent uncertainty of model predictions. The ridership model supporting this effort could also deviate from eventual ridership demand but was utilized to allow ridership comparisons between the options.

7.2 BRT-2: BRT Shuttle to/from Astoria-Ditmars Blvd Station via 31st St/19th Ave

Option BRT-2 would create a new electric bus shuttle service direct to LGA from the existing Astoria-Ditmars Blvd Subway station, providing transfer access to N- and W-Line Subway services to Manhattan at their terminus in Astoria. BRT-2 utilize TSP for buses and exclusive peak-time bus-only lanes by converting from existing travel/parking lanes on 31st St and 19th Ave. In addition, a new, bus-only roadway through ConEd property would create a direct link between 31st St and 19th Ave and construction of a new bus-only loop-road and at-grade bus stop at Terminal C would allow buses to bypass traffic at the current Terminal C stop.

BRT-2 would provide an ADA-compliant connection to street level and the BRT bus stops on 31st St, providing direct access to the N/W-Line Subway terminus. Accessing LGA from the western end via 19th Ave would also allow BRT-2 to serve Airport Terminal A on its way to Terminals B and C.

Option Route Description

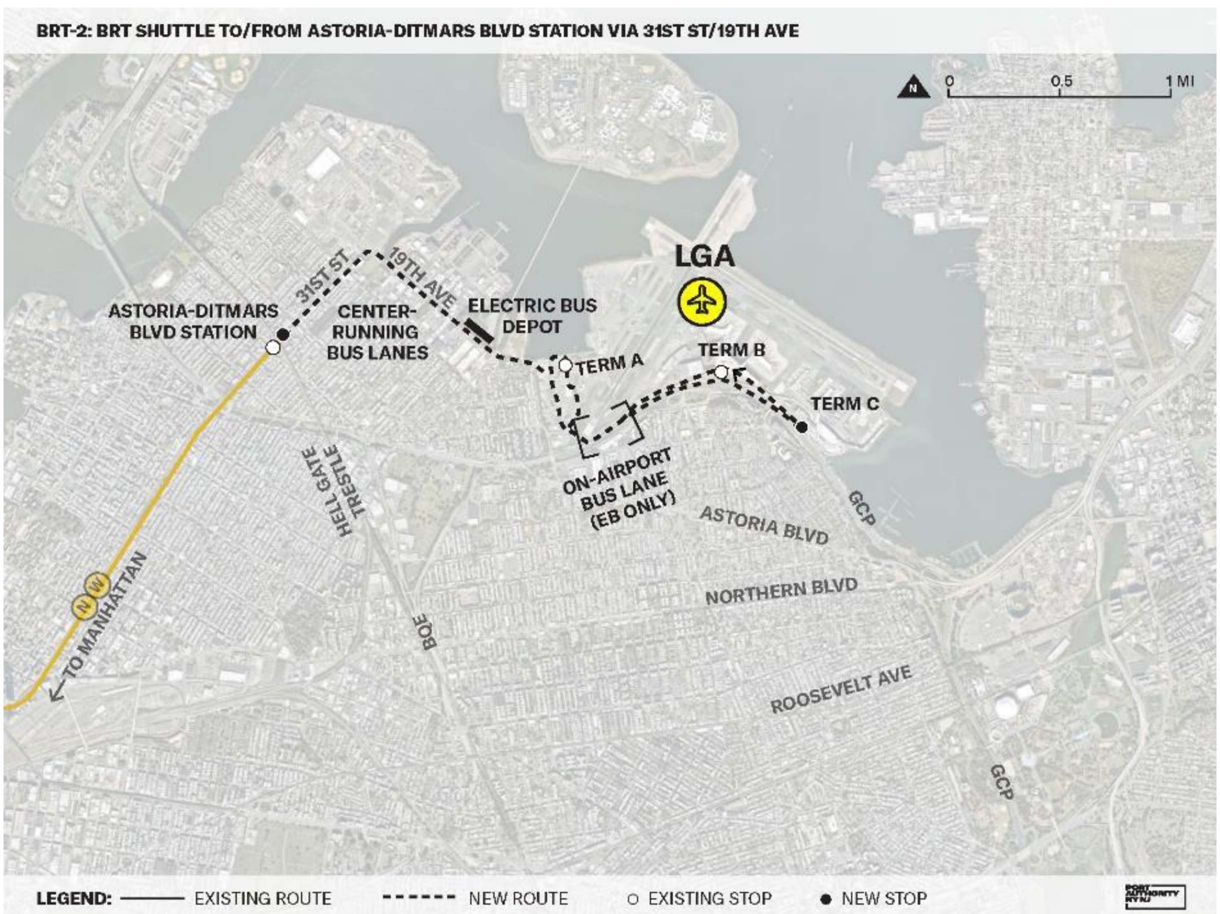


FIGURE 7.2-1: OPTION BRT-2

From the Airport-transfer stop at Astoria-Ditmars Subway station (Figure 7.2-1) heading towards LGA, BRT buses would enter peak-time dedicated bus lanes north of Ditmars Blvd and proceed north, entering a restricted access property owned by ConEd and subject to several easements, to a new intersection and new street extension of 19th Ave onto ConEd's property intersecting with 31st St—a length of 0.5-mile. Where these bus lanes would intersect two streets at-grade, TSP would be adopted to optimize travel time. A bus-only roadway on property owned by ConEd would link 19th Ave with 31st St from the current street end at Luyster Creek. After turning east onto this new segment of 19th Ave, buses would travel eastbound entering a 0.8-mile dedicated bus lane, ending at the intersection of 19th Ave, 81st St, and an unnamed LGA access road. This bus lane would intersect 17 streets at-grade and would use TSP to optimize the travel time.

Buses would enter LGA property to travel on Airport roads: Bowery Bay Blvd, Marine Terminal Road, and Runway Drive. All these roadways are 'grandfathered' in respect of the FAA Airport Design Standards compliance past Runway 04-22. Existing roadway lanes on Bowery Bay Blvd and a single roadway lane on Runway Dr would be repurposed to provide bus-only lanes (potentially during peak periods only). The dedicated bus lane on Runway Dr would end at 94th St where buses would utilize existing airport access roads to reach BRT bus stops at Terminals A, B, and C. Buses would utilize a new 180-degree loop-road to serve a new at-grade bus stop at Terminal C.

Bus turnaround facilities would be provided via a loop along 23rd Ave, 33rd St, and through the Ditmars #2 Municipal Parking Lot to link back to 31st St south of the proposed bus/subway transfer stops.

The length of this route is approximately 3 miles, including the on-Airport portion.

7.2.1 Evaluation of Construction Aspects

7.2.1.1 Constructability

Provision for dedicated BRT bus-only lanes along 31st St and 19th Ave would require limited construction activities and minor roadway work to repurpose the existing traffic and parking lanes (curbing, line painting, and signage) and upgrade traffic signaling to change the prioritization, requiring NYC DOT approval/coordination. This option has some constructability challenges and complexities, summarized as follows:

- **Provision of ADA-Compliant Access from Astoria-Ditmars Blvd Station**
  - The BRT transfer bus stops for the Subway at Astoria-Ditmars Blvd Station are proposed to be at the north end of the existing subway elevated structure on 31st St before the intersection with Ditmars Blvd. The Astoria-Ditmars Blvd Subway station does not currently have ADA access. The cost to provide elevator access and other accessibility features from the BRT bus stops at street level to the platform and suitable fare control facilities at the northern end of the existing Subway station is included in the construction cost estimate for the option.
  - Working within a live operational rail environment to install the new elevators and fare array at the end of the existing Subway platforms would constrain the construction work

to off-peak or weekend closure periods. Constrained access to construct at 31st St and Ditmars Blvd, adjacent to residences and small businesses, would impose restrictions on the types of construction equipment and activities that could occur. These complexities would introduce inefficiencies, extending the construction period; this is included in the Indicative Timeline/Schedule for this option.

- **New BRT Bus-Only Road Construction from 31st St to 19th Ave Past Luyster Creek**
  - The BRT route is proposed to continue along 31st St through private, commercial land within the ConEd property to meet 19th Ave where it currently ends adjacent to Luyster Creek. This would require the construction of approximately 900 ft of new, full-depth bus-only roadways, in both directions, separated from other vehicles entering the property from 31st St around Luyster Creek. Costs to construct the new roadway are included in the construction estimate for this option.
  - The ConEd property is not accessible to the public; only authorized users may enter through a secure access road, protected by a security booth. Alterations, including but not limited to relocation of the existing security booth, island, and median it sits on, would be required to maintain the secure access to the property. ConEd and all parties to the associated easement would need to provide concurrence on the proposed solution.
  - The ConEd and Luyster Creek properties likely have hazardous soils that would need to be handled and disposed of properly. An allowance has been provided for this in the construction cost estimate for the option.

- **New BRT Bus-Only Road Construction within the West Side of LGA**
  - Once the BRT route enters the Airport at 19th Ave, it would continue in mixed-flow traffic until Runway Drive, where one lane toward Terminals B and C would be repurposed to a BRT bus-only lane. Only lighter construction activities are expected, to re-paint roadway markings and install bus stops, which would occur overnight or in off-peak times to minimize the impact to Airport traffic. This is reflected in the Indicative Timeline/Schedule for this option.

- **Construction of Bus Loop around Constrained Airport Roads at Terminal C**
  - The on-Airport route proposes a new BRT bus-only loop road in front of the Terminal C parking structure and taxi access road. The study team concluded that the taxi access road between Terminal B and Terminal C under the 102nd St Bridge structures has sufficient headroom for standard MTA buses or future electric buses to navigate under the bridge without the need to lower the roadway under the bridge.

- The proposed Terminal C bus loop would pass under multiple on-Airport roadways and support structures. The study team concluded that the loop can be constructed to avoid the need to modify any of the existing road structure columns or supports.
- Constructing within a constrained, operational airport environment would reduce the construction sequence efficiency, introducing construction complexities. This is reflected in the Indicative Timeline/Schedule for this option.
- Construction work in and around the Airport terminals and over Airport roadways would be subject to acceptance by the FAA.

- **Constructability Risks Not Included in the Cost Estimate Range (–10% to +30%) for This Option**
  - Proposed route through ConEd and Luyster Creek properties: There is a residual risk that detailed development further uncovers or identifies issues that prevent the option linking 31st St and 19th Ave with a roadway through the ConEd and Luyster Creek properties. Should this not be possible, an alternate route avoiding the properties would need to be developed using existing public streets parallel to the properties.

7.2.1.2 Infrastructure Impacts during Construction

Construction of this option would result in some temporary disruption to other major infrastructure along the route, which would last up to 2 years. The notable areas of temporary infrastructure disruption are summarized below. The durations shown are indicative and based on preliminary assessment.

- **Passenger Access Disruption to Astoria-Ditmars Blvd Station**
  - Up to 5–10 overnight or weekend station closures, restricting train operations, may be necessary over a period of 6–9 months while the existing Subway platforms are modified to accommodate the new ADA elevators and fare array. NYCT runs a continuous service throughout the day, requiring this work to be conducted during planned outages coordinated with the MTA in advance.
  - Construction work around Astoria-Ditmars Blvd station would result in inconvenience to passengers accessing the Subway station due to re-routed pedestrian access around construction zones for up to a year.

- **Disruption to ConEd Property Access Roads**
  - The primary entrance to the site at 20th Ave would be closed for up to a year during construction to accommodate the building of a new security access area and lanes. During this time, temporary access means (and associated costs) would be coordinated with ConEd and other stakeholders to maintain site access rights.

- **Disruption to Intra-Airport Services and Facilities**
  - Overnight and/or off-peak lane closures would be expected while roadway lanes in Bowery Bay Blvd, Runway Drive, and around Terminal B and C are re-painted.
  - 5–10 overnight and/or off-peak lane and taxi road closures would be expected around Terminal C for construction of the Terminal C bus loop for 2–4 months.

7.2.1.3 Permanent/Operational Impacts to Existing Infrastructure

Once completed, this option would have the following permanent/operational impacts on other infrastructure along the route:

- **Reduced General-Purpose Lane Access to and within LGA**
  - Lanes on Bowery Bay Blvd and Runway Drive on-Airport roads would be repurposed to provide dedicated bus-only lanes (potentially limited to peak periods only), reducing the capacity for other intra-airport traffic (Bowery Bay Blvd reduced from 4 to 2 lanes and Runway Drive from 3 to 2 lanes). Once east of 94th St, this option would not utilize any dedicated bus-only lanes on-Airport. Discussions with LGA Facilities during the study have determined that a single unidirectional bus lane on Runway Drive can be accommodated.

7.2.1.4 Indicative Capital Cost

The Indicative Capital Cost for Option BRT-2 is $340 million (in 2022$, excluding future escalation and solely for approximate comparison between study options).

Indicative Capital Costs should be considered to have a range of estimating uncertainty of -10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).

The following are the notable cost drivers for the option:

- Provision of a new bus depot.
- New electric, zero-emission buses and charging stations (up to 17 buses).
- New ADA-compliant vertical circulation and subway-bus connection at Astoria-Ditmars Subway station.
- New at-grade bus stops at LGA.
- New roadway through ConEd property connecting 31st St and 19th Ave.
- New at-grade bus stops at Astoria-Ditmars Blvd.

7.2.1.5 Indicative Timeline/Schedule

The Indicative Timeline/Schedule (for comparison between study options) for Option BRT-2 is approximately 4–5 years from a decision to take the option forward to revenue service. This includes the following notable schedule drivers:

- Planning, approvals, and acquisitions.
- Procurement of new electric, zero-emission vehicles.
- New ADA compliant vertical circulation at Astoria-Ditmars Blvd station.
- 31st St and 19th Ave roadway reconfiguration through ConEd property.
- On-Airport roadway reconfigurations.
- Construction of a new bus depot.
- Traffic signaling and systems.
- 6 months of commissioning.

Figure 7.2-2 illustrates the indicative timeline/schedule for Option BRT-2. The key drivers are the electric, zero-emission bus procurement and civil work.

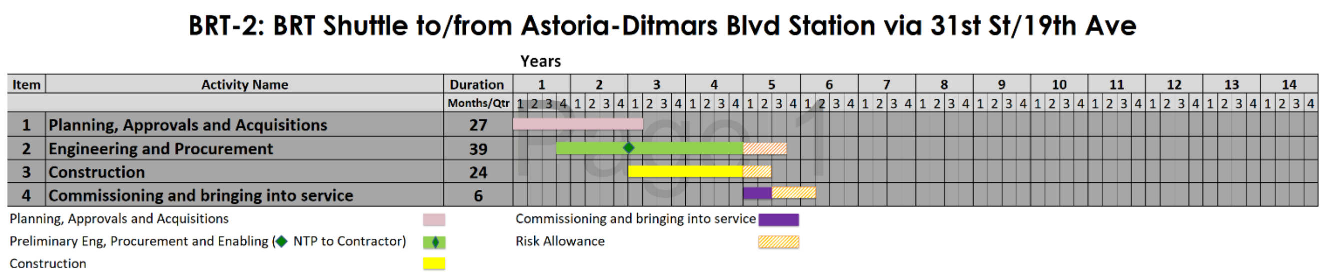


FIGURE 7.2-2: INDICATIVE TIMELINE/SCHEDULE (BRT-2)

7.2.2 Transportation Aspects

7.2.2.1 Improved Access to LGA

Three factors have been considered in this category: Standardized Indicative Baseline Off-Peak Travel Time, Reliability, and Transfer Experience.

7.2.2.1.1 Standardized Indicative Baseline Off-Peak Travel Time

- Table 7.2-1, below, provides the Standardized Indicative Baseline Off-Peak Travel Times for the weekday, midday off-peak journeys to be used solely as a baseline for comparison between options. Table 7.2-2 provides a breakdown of the components that make up the total journey, the general approach to the estimation of which is described in Section 3.2.2.1.1.
- Passengers making the journeys described would, naturally, experience variations to the baseline timings calculated even where services are running as planned, for reasons as

simple as variations in walking speeds or whether a traveler arrives just before a scheduled departure or just misses a departing train.

TABLE 7.2-1: STANDARDIZED INDICATIVE BASELINE OFF-PEAK TRAVEL TIME, OPTION BRT-2

Times Square to LGA (minutes to Terminal C)	BRT-2
Via Subway (N/W train) to Astoria-Ditmars Blvd	49

TABLE 7.2-2: STANDARDIZED INDICATIVE BASELINE OFF-PEAK TRAVEL TIME BY SEGMENT, OPTION BRT-2

Times Square to LGA via N/W Subway (minutes)	BRT-2
START Times Square (street level)	
walk/wait time	5
N/W Subway platform (dep)	
Subway trip time	23
Astoria-Ditmars Blvd N/W Subway platform (arr)	
walk/wait time	6
Astoria-Ditmars Blvd bus stop (dep)	
Bus trip time	7
1st on-Airport bus stop (arr)	existing
END Terminal bus stop	Terminal A
Total travel time =	41
trip time to next Terminal bus stop	8
2nd on-Airport bus stop (arr)	new at-grade
END Terminal bus stop	Terminal C
Total travel time =	49
trip time to next Terminal bus stop	3
3rd on-Airport bus stop (arr)	existing
END Terminal bus stop	Terminal B
Total travel time =	52

- The above standardized indicative baseline off-peak travel times are a baseline for weekday, midday off-peak journeys. Bus running times in mixed-use traffic would be subject to traffic congestion during peak times. Estimates of the potential increase to the Standardized Indictive Travel Time for peak-time traffic have been calculated solely for comparative purposes as around 3 minutes from Astoria-Ditmars Blvd to Terminal C.

7.2.2.1.2 Reliability

- Option BRT-2 would operate during peak times mostly within bus lanes on 31st St and 19th Ave. Measures to increase reliability of this option include:
  - Dedicated peak-time bus lanes on 31st St and 19th Ave, minimizing congestion due to general traffic.

- Transit signal priority, which would allow buses to move through intersections without having to stop and wait for traffic.
- Utilization of a new specially-designated bus pick-up and drop-off area near Terminal C with direct, exclusive road access to avoid congestion on the Airport frontage.
- A new eastbound dedicated bus lane on Runway Dr, to allow buses to bypass congestion on the west side of the Airport.

7.2.2.1.3 Transfer Experience

Riders bound for Terminals A, B, or C would transfer from the N/W Subway service to the Airport shuttle service at Astoria-Ditmars Blvd Station, the last stop on the N/W Line. Since Astoria-Ditmars Station is the last stop on the line, passengers bound for the airport would have ample time to gather their belongings and disembark while riders arriving from the Airport would have a climate-controlled Manhattan-bound train waiting for them in the station.

Customer Transfer

- As the current Astoria-Ditmars Blvd Station is not accessible, the station would need to be brought into ADA compliance to support this option. New bus stops serving the Airport would be located near the intersection of 31st St and Ditmars Blvd. To facilitate the transfer, new elevators and stairs would provide direct access to street level. Riders would follow new wayfinding to the north end of the platform and walk a short distance to the new bus stop.

7.2.2.2 Ridership

- Stated preference survey results indicate that 33% of airport passenger respondents are “definitely” or “probably” interested in BRT connections to existing transit services.
- The ridership model projects 3.0 million total riders using Option BRT-2, with a corresponding increase in net transit ridership of 1.6 million riders in 2025 (7.2-3).

TABLE 7.2-3: RIDERSHIP MODEL RESULT SUMMARY

<table>
<tr><th colspan="4">Transit Option</th><th rowspan="2">Riders on Current Bus Services to LGA (Millions) (No Action)</th><th colspan="3">New Transit Option Impact (Millions)</th></tr>
<tr><th colspan="3">Mode Category & Scenario Label</th><th>Description</th><th>Riders on BRT-2 Shuttle Service</th><th>Net Increase in Total Bus Ridership</th><th>Total Bus Ridership (BRT-2 Shuttle + Other Bus Routes)</th></tr>
<tr><td>Bus - New Dedicated Bus Rapid Transit (BRT) Routes</td><td>BRT</td><td>BRT-2</td><td>Astoria-Ditmars Blvd</td><td>4.1</td><td>3.0</td><td>1.6</td><td>5.7</td></tr>
</table>

7.2.2.3 Throughput and Capacity

Throughput

- Using the highest hourly single-direction provision of airline seats at LGA in 2019 (4,300 seats on weekday departing flights 9 AM to 10 AM – see Figure 3.2-1, in Section 3.2.2.3), the estimated single-direction peak passenger demand for this option could be approximately 345 passengers per hour.
- It should be noted that these passengers would likely arrive at the transfer station in groups, rather than being evenly distributed throughout the time period.

Capacity of New Transit Option

- Actual vehicle frequency would be adapted in practice to suit demand and other operating requirements.

Impact on Capacity of Existing Downstream Transit Systems

- Option BRT-2 provides passenger connection to Astoria Blvd Subway station, offering transfer access to the N/W Subway lines.
- Generally, airport passenger loadings are constant through the day both to and from the Airport with the peak passenger loadings occurring outside of the morning Manhattan-bound subway peaks or in the opposite direction (i.e., Airport-bound).
- The existing N- and W-Subway lines currently operate close to their peak capacity during the 8 AM to 9 AM Manhattan-bound commuting peak. While most Manhattan-bound Airport passengers would travel outside this peak, those passengers (including non-Airport passengers) traveling during this peak could experience some crowded conditions.
- The study team noted that Astoria-Ditmars Blvd Station currently has a narrow platform and two stairwells from the station platform to the mezzanine and an additional four stairwells from the mezzanine to the street. There is an additional stairwell through an indoor mall that does not have 24/7 access. This option would construct a new station area to the north of the existing station platform, to address concerns about potential overcrowding at the existing stairwells and addressing the lack of ADA-accessibility at this station.

7.2.2.4 Indicative Operating Cost

Indicative operating costs have been estimated at up to $13.6 million per year.

7.2.3 Community and Environmental Aspects

7.2.3.1 Local Community Impacts

This option would be located within and near densely developed neighborhoods along 31st St and 19th Ave. 31st St is mainly commercial from the Astoria-Ditmars Blvd Subway station to Ditmars Blvd and then transitions to mainly residential, consisting of a variety of single-family and 3- to 6-story residential buildings, and mixed-use (residential above commercial) buildings. 19th Ave is mainly commercial businesses with three blocks of residential properties at its eastern end. The approximately 3-mile route goes through/along the following communities: Astoria, Ditmars Steinway, Astoria Heights, and East Elmhurst.

The potential for temporary (during construction) and permanent (once operational) impacts is summarized below for specific areas of the alignment.

7.2.3.1.1 Temporary Impacts during Construction on the Local Neighborhoods Directly Affected

Roadway construction activities are anticipated to occur at two sections (Astoria-Ditmars Subway station and on the ConEd property) and lane restriping along the rest of the approximately 3-mile route for approximately 1.5 years.

During construction, the following neighborhoods would have the potential for air quality, noise, vibration, or visual impacts. For the frequency and duration of construction activities refer to Section 7.2.1.2 “Infrastructure Impacts during Construction” above:

- **Construction of the Bus Turnaround and Layover along 31st St and Ditmars Blvd**
  - Roadway modification activities (parking and lane restriping, curb replacement, etc.) would be required on 31st St, 23rd Ave, and through the Ditmars #2 Municipal parking lot to provide a counterclockwise bus turnaround route at this segment of the route.
  - The roadway modification would occur approximately 35–50 ft around 1 city block of residential and commercial properties.
  - Limited number of planned periodic lane closures and diversions on 31st St would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during lane closures.
  - Limited number of planned periodic closure of sidewalks, bike lanes, and parking spaces would be required.
  - Limited number of planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.

- **Construction of the BRT Lanes along 31st St**
  - Roadway modification activities (restriping, signing, and curb resetting) would be required on 31st St over an approximately 0.5-mile segment of the route.
  - The roadway modification would occur approximately 35–50 ft from 3 long city blocks of residential and commercial properties.
  - Limited number of planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during lane closures.
  - Limited number of planned periodic closure of sidewalks, bike lanes, and parking spaces would be required.
  - Limited number of planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.
  - Limited number of planned periodic suspension of truck deliveries for loading/unloading at commercial businesses would be necessary.

- **Construction of the BRT Lanes along 19th Ave**
  - Roadway modification activities (restriping, signing, and curb resetting) would be required on 19th Ave over an approximately 1-mile segment of the route.
  - The roadway modification would occur approximately 35–50 ft from 11 short city blocks of commercial properties.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during lane closures.
  - Limited number of planned periodic closure of sidewalks and parking spaces would be required.
  - Limited number of planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.
  - Limited number of planned periodic suspension of truck deliveries for loading/unloading at commercial businesses would be required.

- **Construction of the BRT Lanes Adjacent to the Elmjack Baseball Fields**
  - Roadway modification activities (restriping, signing, and curb resetting) on 19th Ave over this segment of the route would be required.
  - The roadway modification would occur approximately 50–75 ft from the boundary of land with community baseball fields.

- Limited number of planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during lane closures.
- Limited number of planned periodic closure of sidewalks and parking spaces would be required.

- **Constructing On-Airport At-Grade Bus Stops**
  - On-Airport roadway construction activities (roadway reconfiguration, restriping, curb resetting, paving, signage, and drainage) would be required along an approximately 0.5-mile segment of the route to construct the proposed Terminal C bus loop, which would pass under multiple on-Airport roadways and support structures. The loop road would be constructed to avoid the need to modify any of the existing columns or supports.
  - The construction would occur over 500 ft from 5 city blocks of residential and commercial properties in the East Elmhurst community located on the other side of 8 lanes of the GCP.

- **Constructing the Bus Depot at Ingraham's Mountain off 19th Ave**
  - Construction of the proposed facility (roadway and building(s)) on an elevated portion (approximately 50,000 sf) of the existing LGA property known as 'Ingraham's Mountain' would occur for approximately 1 year approximately 200–300 ft from commercial properties.

7.2.3.1.2 Permanent Operational Impacts on the Local Neighborhoods Directly Affected

Electric, zero-emission buses would operate on 31st St and 19th Ave between LGA and the proposed bus transfer stop at Astoria-Ditmars Blvd. They would operate in a combination of at-grade peak-time dedicated bus lanes and in mixed-flow traffic, ranging approximately 35–50 ft from residential and commercial properties while on city streets.

The following neighborhoods and areas would have the relative potential for permanent noise, vibration, or visual impacts as a result of this option's proposed bus operations:

- **New Bus Turnaround and Layover along 31st St and Ditmars Blvd.**
  - Buses would operate in at-grade peak-time dedicated bus lanes on 31st St, 23rd Ave alongside other city traffic, and through the Ditmars #2 Municipal parking lot to provide a counterclockwise bus turnaround route approximately 35–50 ft from residential and commercial properties.

- **New BRT Lanes along 31st Street**
  - From the bus transfer stop at Astoria-Ditmars Blvd, buses would operate in each direction in at-grade peak-time dedicated bus lanes alongside other city traffic along the center of 31st St, approximately 35–50 ft from residential and commercial properties.
  - 31st St is predominantly residential with on-street parking along both curbsides. This option would reduce the parking at peak times to provide the BRT-only lanes.

- **New BRT Lanes along 19th Ave**
  - East of the ConEd property, buses would operate in each direction in at-grade peak-time dedicated bus lanes alongside other city traffic along the center of 19th Ave, approximately 35–50 ft from residential and commercial properties.
  - 19th Ave is a mix of commercial and residential with on-street parking along both curbsides. This option would reduce the parking at peak times to provide the BRT-only lanes.

- **New BRT Lanes Adjacent to the Elmjack Baseball Fields**
  - Buses would operate in each direction in at-grade peak-time dedicated bus lanes alongside other city traffic approximately 50–75 ft from the boundary of land with community baseball fields. This option would reduce the parking at peak times to provide the BRT-only lanes.

- **New Bus Depot at Ingraham's Mountain off 19th Ave**
  - The new bus depot at Ingraham's Mountain would lead to increased electric, zero-emission bus traffic entering/exiting the facility along 19th Ave, a mainly residential and commercial corridor.

7.2.3.1.3 Potential Private Property Acquisitions

The Astoria-Ditmars Blvd Station Shuttle Service may require acquisition of the following:

- Up to 2 private commercial and 4 industrial properties.

7.2.3.1.4 Potential Public Property Acquisitions (NYC DOT Plazas and NYC Parks Parkland)

- No structures would be sited within NYC Parks Parkland or NYC DOT Plazas.

7.2.3.1.5 Removal/Reconfiguration of Parking Spaces

- A total of approximately 200 on-street public parking spaces would be lost on the following streets:
  - 31st St.
  - 19th Ave.

The number is approximate and is a preliminary estimate based on the alignment.

7.2.3.1.6 Environmental Justice Communities Mapping Analysis

The Environmental Justice communities mapping analysis provides an overview of the minority and low-income communities within 0.25 mile of the transit options being studied.

For Option BRT-2, less than half of the block groups within the 0.25-mile buffer of the option alignment are Environmental Justice block groups.

See Figure 7.2-3 below for the analysis map for this option.

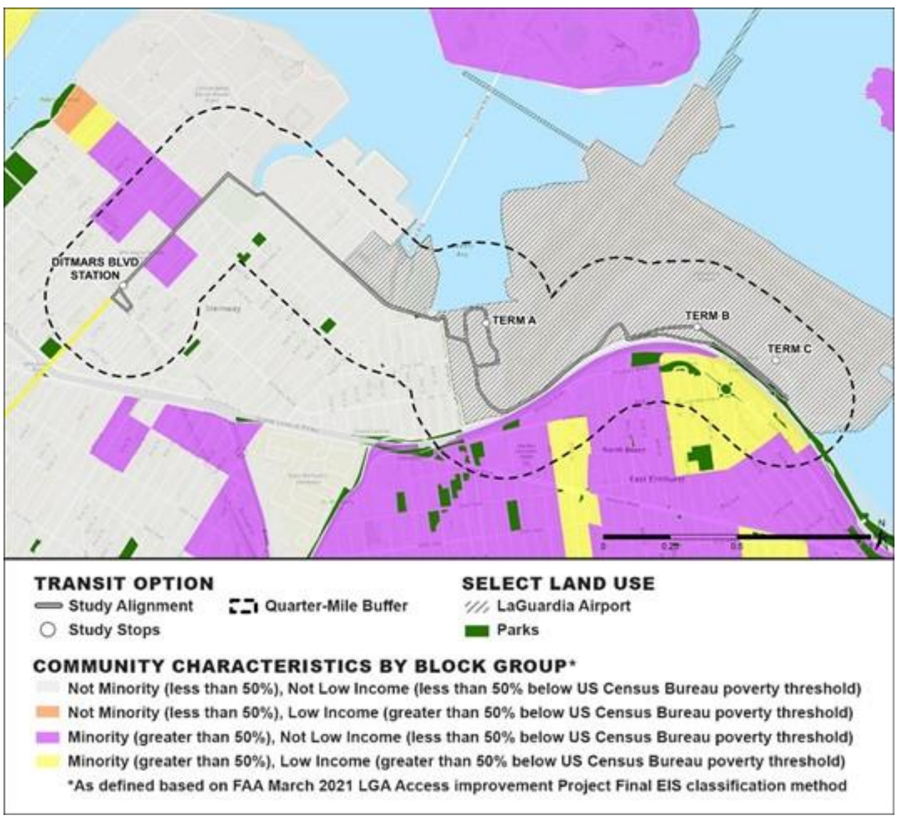


FIGURE 7.2-3: ASTORIA-DITMARS BLVD STATION SHUTTLE SERVICE – ENVIRONMENTAL JUSTICE COMMUNITIES MAPPING ANALYSIS (AS DEFINED BASED UPON FAA MARCH 2021 LGA ACCESS IMPROVEMENT PROJECT FINAL EIS CLASSIFICATION METHOD)

7.2.3.2 Equity

7.2.3.2.1 Transit Access from LGA

- **Additional Minority and Low-income Populations Reached within 45 Minutes from LGA via Transit (Population Access Analysis)**
  - The results of the Population Access Analysis illustrate how many people, specifically from low-income and minority populations, could travel via transit from LGA to homes within 45 minutes from LGA. Airport passengers or Airport employees living within these areas could potentially benefit from expanded access to these destinations.
  - Option BRT-2 is expected to expand transit access from LGA to regional destinations within 45 minutes, as shown in the blue area of "Additional Access Provided by Transit Option" in Figure 7.2-4. Compared to the baseline, the minority population reached within a 45-minute transit trip would increase by 4.9% and the low-income population reached within a 45-minute transit trip would increase by 6.8% as shown in Table 7.2-4.
  - This represents a lower increase in transit access to LGA within 45 minutes for minority and low-income communities.

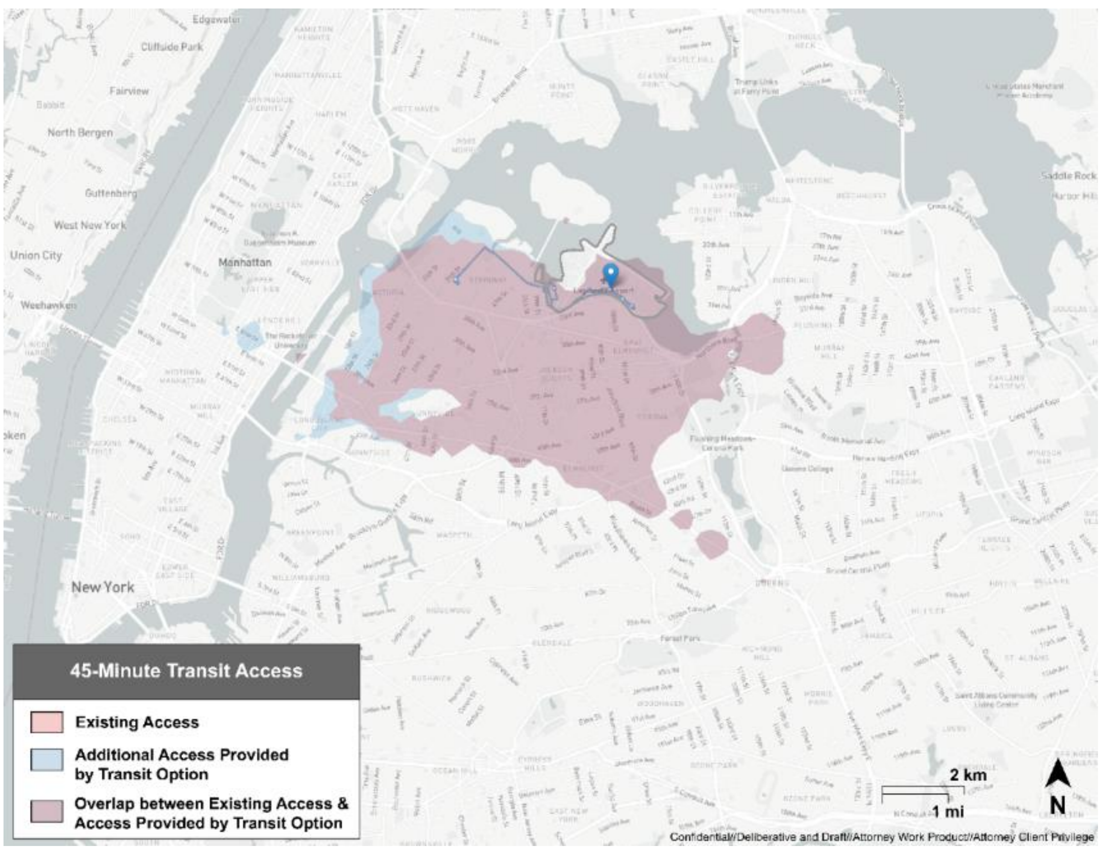


FIGURE 7.2-4: ASTORIA-DITMARS BLVD BRT-2 – POPULATION ACCESS ANALYSIS

TABLE 7.2-4: ASTORIA-DITMARS BLVD BRT-2 – POPULATIONS REACHED WITHIN 45-MINUTE TRANSIT TRIP.

		Total Population Reached	Minority Population Reached	Low-Income Population Reached
Baseline	Existing Condition	551,434	422,981	76,750
BRT-2	With Option	591,612	444,955	81,938
	Net Change	39,059	20,961	5,186
	% Change	7.1%	4.9%	6.8%

- **Additional ADA-Accessible Stations within 45 Minutes from LGA via Transit (ADA Analysis)**
  - The results of the ADA Analysis illustrate how Airport passengers and Airport employees, specifically those requiring ADA-compliant stations, traveling from LGA to other locations could potentially benefit from expanded access to ADA-compliant stations within 45 minutes via transit.
  - More ADA-accessible stations/stops can be reached within a 45-minute transit trip for this option compared to the baseline of existing transit service (Table 7.2-5). This echoes the results from the Population Access Analysis, in which Option BRT-2's 45-minute transit travel shed provides an increased amount of access over the baseline transit service. Compared to the baseline, an additional 9 ADA-accessible stations can be reached within a 45-minute transit trip from LGA for Option BRT-2 (with Terminal A and ConEd).

TABLE 7.2-5: ASTORIA BLVD STATION BRT-2 – ADA ANALYSIS

Subway, Ferry, LIRR, and MNR Stations Reached within 45-Minute Transit Trip from LGA	Baseline	BRT-2 (With Terminal A and ConEd)	Difference between Baseline and BRT-2 (With Terminal A and ConEd)
Total Stations	*43*	*56*	*+13 stations*
ADA-Accessible Stations (Accessible Stations as % of Total)	*20 (47%)*	*29 (52%)*	*+9 stations*

7.2.3.2.2 Transportation Opportunities and Benefits for the Surrounding Community

- **Transportation Opportunities for Neighbors**

  This option does not include intermediate/off-Airport stops. Because there is limited pedestrian access to LGA from adjacent residential areas and walking distance exceeds 0.25 mile, the study team did not consider there to be a significant market for use of the final on-

Airport stops by the surrounding community to connect to the broader transit network.

- **Cars Removed from Local Roadways and Emissions Reductions**

  See the "Cars Removed from Local Roadways" section and the "GHG and Other Vehicular Emissions Reductions" section of this evaluation below.

7.2.3.3 Cars Removed from Local Roadways

- Option BRT-2 would be expected to remove 509,000 Airport passenger vehicles, and 22,000 Airport employee vehicles, from the road each year.

7.2.3.4 GHG and Other Vehicular Emissions Reductions

- Option BRT-2 would be expected to remove 2,328 metric tons of CO_2 equivalent each year.
- Other vehicular emissions reductions are given in Table 7.2-6:

TABLE 7.2-6: OTHER VEHICULAR EMISSIONS REDUCTION (METRIC TONS PER YEAR)

Option	CO	VOC	NOx	SO_2	PM_{10}	$PM_{2.5}$
[BRT-2] Astoria-Ditmars Blvd	11.0	0.2	0.7	0.03	0.4	0.1

7.2.4 Summary of Evaluation

BRT-2: BRT Shuttle to/from Astoria-Ditmars Blvd Station via 31st St/19th Ave

Option BRT-2 would create a new electric bus shuttle service direct to LGA from the existing Astoria-Ditmars Blvd Subway station, providing a two-seat ride transfer access to N and W-Line Subway services to Manhattan at their terminus in Astoria.

BRT-2 would offer peak-time bus travel time benefits through the conversion of existing travel/parking lanes on 31st St and 19th Ave to peak-time bus-only lanes and with traffic signals revised to prioritize the buses. In addition, a new, bus-only roadway through ConEd property would create a direct link between 31st St and 19th Ave and utilization of a new bus-only loop-road and at-grade bus stop at Terminal C would allow buses to bypass traffic at the current Terminal C stop. BRT-2 would construct new vertical circulation from the end of the subway platform direct to street level and the BRT bus stops on 31st St, providing direct access to the N/W-Line subway terminus. Accessing LGA from via 19th Ave would allow BRT-2 to serve Airport Terminal A on its way to Terminals B/C.

This option would require light roadway work (line painting, re-curbing, etc.) for the new bus lanes, new roadway construction to link 31st St and 19th Ave around the ConEd property, new roadway construction on-Airport around Terminal C, and the construction of a new bus depot on Airport property at Ingraham's Mountain.

Table 7.2-7 summarizes the output from all the factors used to evaluate this option.

TABLE 7.2-7: SUMMARY OF KEY CHARACTERISTICS – BRT SHUTTLE TO/FROM ASTORIA-DITMARS BLVD STATION VIA 31ST ST/19TH AVE (BRT-2)

	Evaluation Factor	Assessment
CONSTRUCTION ASPECTS	Constructability	• Construction of ADA compliant passenger access at Astoria-Ditmars Blvd Station • Construction of a bus-only road from 31st St to 19th Ave via ConEd property • Constrained on-Airport sites for at-grade bus stops and bus turnaround • Total option route length: approx. 3 miles
	Infrastructure Impacts during Construction	• Passenger access disruption at Astoria-Ditmars Blvd Station • Disruption to ConEd facility access roads • Disruption to LGA facilities and access roads
	Permanent/Operational Impacts to Existing Infrastructure	• Permanent reduction of travel lanes on LGA roads: Runway Dr and Bowery Bay Blvd
	Indicative Capital Cost (2022$)[102]	$340 million[103]
	Indicative Timeline/Schedule	4-5 Years

[102] Indicative Capital Costs should be considered to have a range of estimating uncertainty of –10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).
[103] Cost would exclude circulation improvements around Terminal C if the Q-70 Light Improvement Option proceeds, as then such improvements would be implemented regardless of whether this option was selected to proceed.

TABLE 7.2-7, CONTINUED.

	Evaluation Factor	Assessment
TRANSPORTATION ASPECTS	Standardized Indicative Baseline Off-Peak Travel Time (From Midtown Manhattan)	Via N/W-Lines: 41–44 mins (7–10 mins on bus) (Times Square to Terminal A) Via N/W-Lines: 49–52 mins (15–18 mins on bus) (Times Square to Terminal C, then B)
	Transfer Experience	• End of line Subway stop: boarding/alighting easier for passengers (usually a train waiting) • Transfer to the bus stop would involve one vertical move from platform to grade and a short walk to the covered bus stop • Serves Terminals A, B, and C
	Ridership[104]	Total annual projected ridership for option: 3.0 million Net increase in annual projected transit ridership: 1.6 million
	Throughput & Capacity	Would be adapted to suit demand
	Indicative Operating Cost	Up to $13.6 million per annum
COMMUNITY AND ENVIRONMENTAL ASPECTS	Local Community Impacts	<u>Construction:</u> • Light roadway (e.g., restriping, curb replacements, bypass lanes) for approx. 1.5 years <u>Proximity to communities:</u> • 35–50 ft from 15 city blocks of residential and commercial properties along 31st St and 19th Ave • 200–300 ft from 4 city blocks of commercial properties near Ingraham's Mountain <u>Permanent impacts:</u> • Permanent acquisition up to 6 properties (private commercial and industrial) – Access agreements may be possible rather than acquisition • No impacts to NYC parklands or plazas • Permanent loss of approx. 200 public on-street parking spaces along 31st St and 19th Ave (potentially only during peak-hours) • Increased bus traffic on 31st St and 19th Ave (albeit electric vehicles) <u>Operations:</u> • Operated with a quiet, zero-emissions all-electric bus fleet • Bus depot on airport property, 200–300 ft from commercial areas
	Equity	• Lower increase to low-income and minority populations within 45 minutes of the Airport via transit versus the no-build scenario • +9 additional ADA-compliant stations reachable within a 45-minute transit trip from LGA versus the no-build scenario
	Cars Removed from Local Roadways	509,000 airport passenger vehicles and 22,000 airport employee vehicles from the road each year
	GHG and other Vehicular Emissions Reductions	2,328 metric tons of CO2 equivalent each year

[104] Experience from AirTrain JFK was that actual ridership turned out to be higher than would have been predicted by the AirTrain JFK forecast and underscores the inherent uncertainty of model predictions. The ridership model supporting this effort could also deviate from eventual ridership demand but was utilized to allow ridership comparisons between the options.

7.3 BRT-3: BRT Shuttle to/from Northern Blvd Station via Northern Blvd/94th St

Option BRT-3 would create a new electric shuttle bus service direct to LGA from the existing Northern Blvd Subway station, providing transfer access to the E, M, and R-Lines.[105] BRT bus stops would be provided near the station entrances on Northern Blvd. BRT-3 would provide bus travel time benefits through the conversion of existing travel lanes on Northern Blvd and 94th St to bus-only lanes with TSP to avoid possible congestion and traffic delays along these roads, and construction of a new bus-only loop-road and at-grade bus stop at Terminal C would allow buses to bypass traffic at the current Terminal C stop.

<u>Option Route Description</u>

Passengers would transfer between the Subway and the BRT using new elevators and stairs at Northern Blvd Subway station. Passengers would be required to cross surface streets to reach the proposed BRT-3 bus stops between 55th St and 56th St, approximately 500 ft from Northern Blvd's station entrance/exit. Riders going from LGA to the Subway service would be required to cross Northern Blvd to access the Northern Blvd Subway station, because the shallow Subway station lacks a connecting mezzanine level or underpass, allowing access to only one train direction per side of street.

Heading east toward LGA on Northern Blvd (Figure 7.3-1), BRT service would enter dedicated center-running bus lanes starting at 57th St. The BRT service would remain in these lanes until reaching 94th St, where service would turn north and continue toward LGA on 94th St.

Northern Blvd is a dense commercial corridor with high sidewalk activity levels between 80th St and 94th St; it would require re-channelization and reconstruction of center medians and curb extensions at crosswalks to provide uninterrupted bus lane lengths. Side streets intersecting Northern Blvd would be converted into T-type intersections, allowing for right-in/right-out access, as left turns would be restricted to major intersections. The proposed median would sever direct north-south traffic along 58th St, 60th St, 61st St, 70th St, 71st St, 73rd St, 76th St, 77th St, 78th St, 81st St, 82nd St, 85th St, 86th St, 87th St, 88th St, 91st St, 92nd St, 93rd St, and 94th St, between Northern Blvd and Ditmars Blvd. To implement this option, therefore, would require careful coordination with NYC DOT and MTA.

The BRT-3 route has been optimized for travel time and reliability to LGA. However, would not be compatible with NYC DOT's near-term plans to improve road safety and bus services along Northern Blvd,[106] and BRT-3 would adversely impact current bus routes along Northern Blvd (particularly the Q66) and north-south bus routes crossing Northern Blvd.

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[105] The M-Train runs to Northern Blvd weekdays only (between 6 AM and 9 PM). The R-Train runs 7 days a week, all times except overnights. The E-Train stops at Northern Blvd overnights 7 days a week.
[106] Northern Blvd Bus Improvements: https://www1.nyc.gov/html/dot/downloads/pdf/northern-blvd-broadway-114-st-transit-jun2022.pdf

FIGURE 7.3-1: OPTION BRT-3

BRT service on 94th St would enter dedicated bus lanes (along the roadway edges) with right turns at intersections for general-purpose vehicles. Parking restrictions on 94th St would be required to provide bus priority along this segment. This segment of the route is approximately 1 mile in length. At Ditmars Blvd, BRT service would cross over the GCP on an existing overpass and enter LGA property. Service would travel along the various LGA access roads until reaching a limited-access ramp serving BRT, transit, and taxis, where service would exit around a 180-degree loop and serve a new at-grade bus stop at Terminal C. Service would continue on limited-access roadways to the Terminal B at-grade bus stop.

The length of this route is approximately 3.5 miles, including the on-Airport portion.

7.3.1 Evaluation of Construction Aspects

7.3.1.1 Constructability

Provision for dedicated BRT bus-only lanes along Northern Blvd and 94th St would require limited construction activities and minor roadway work to repurpose the existing traffic and parking lanes (raised median, curbing, bus stops, line painting, and signage) and upgrade traffic signaling to change the prioritization, requiring NYC DOT approval/coordination. This option does, however, have some construction challenges and complexities, summarized as follows:

- **Provision of New Bus Stops and Turnaround/Layover Area for Northern Blvd Station**
  - The BRT bus stops for access to the Northern Blvd Subway station would be located at an existing car dealership lot between Broadway, Northern Blvd, 55th St, and 56th St. Minor roadwork, passenger shelter, and other small structures would be required at the bus stop location; 55th St would be repurposed to provide entrance to the turnaround. An allowance is included in the construction cost estimate for this work.

- **Provision of ADA-Compliant Access to Northern Blvd Station**
  - Currently, Northern Blvd Station access is not ADA-compliant. In discussions, MTA confirmed that the station has been added to their program of future work to provide ADA vertical transportation access. The evaluation of this options adopts the proposed future vertical circulation for access to the station and includes a cost allowance for additional circulation to account for the increased passenger demand and customer experience for the BRT. During any future development of this option, coordination would be required with MTA to integrate the future ADA access point with the proposed passenger routes from the bus stop/turnaround.
  - To provide the appropriate 'customer transfer experience' from the underground Subway station to the at-grade BRT stops, additional vertical circulation, wayfinding, amenities, and architectural treatment would be required. An allowance is provided in the cost estimate for the construction of this work.

- **Construction of Bus Loop around Constrained Airport Roads at Terminal C**
  - The on-Airport route would include a new BRT bus-only loop road in front of the Terminal C parking structure and taxi access road. The study team concluded that the taxi access road between Terminal B and Terminal C under the 102nd St Bridge structures has sufficient headroom for standard MTA buses or future electric buses to navigate under the bridge without the need to lower the roadway under the bridge.
  - The proposed Terminal C bus loop would pass under multiple on-Airport roadways and support structures. The study team concluded that the loop can be constructed to avoid the need to modify any of the existing road structure columns or supports.
  - Construction within a constrained, operational airport environment would reduce the construction sequence efficiency, introducing construction complexities. This is reflected in the Indicative Timeline/Schedule for this option.
  - Construction work in and around the Airport terminals and over Airport roadways would be subject to acceptance by the FAA.

- **Constructability Risks Not Included in the Cost Estimate Range (–10% to +30%) for this Option**
  - Scale of ADA-compliant access work required to link to the existing Northern Blvd Subway station: As the planned MTA ADA access improvements to the Northern Blvd Subway station are not yet fully developed, there remains a risk that additional access points and/or vertical circulation could be required to satisfy BRT passenger accessibility than currently accounted for in the evaluation. This risk could result in large increases in construction cost and delays to the construction schedule due to the complexity of tying into an underground station environment.
  - Challenge in constructing a customer transfer facility between the proposed BRT bus stops and the Northern Blvd Subway station: The proposed BRT bus stops between 55th St and 56th St are approximately 500 ft from the Northern Blvd Station entrance/exit and would require crossing city streets. Providing a suitable ‘customer transfer experience’ between subway and bus could require more complex solutions (e.g., underground walkways) than currently accounted for in the evaluation. This risk could introduce large increases in construction costs and prolong the construction schedule.

7.3.1.2 Infrastructure Impacts during Construction

Construction of this option would result in some temporary disruption to other major infrastructure along the route, which would last up to 2 years. The notable areas of temporary infrastructure disruption are summarized below. The durations shown are indicative and based on preliminary assessment.

- **Disruption to Existing MTA Bus Route Operations while Roadway Work Takes Place**
  - Construction and lane repurposing work that would result in temporary lane reductions, detours, or other impacts to general-purpose traffic would most likely also impact existing MTA bus operations using Northern Blvd and 94th St. This would result in a potential increase in travel times, reduced reliability, relocation of bus stops, or rerouting of service for the duration of this work.

- **Disruption to Intra-Airport Services and Facilities**
  - Overnight and/or off-peak lane closures would be needed while roadway lanes around Terminals B and C are re-painted
  - 5–10 overnight and/or off-peak lane and taxi-road closures would be expected around Terminal C for construction of the Terminal C bus loop for 2–4 months.

7.3.1.3 Permanent/Operational Impacts to Existing Infrastructure

Once completed, this option would have the following permanent/operational impacts on other infrastructure along the route:

- **Existing MTA Bus Services along Northern Blvd**
  - Permanently converting the two center lanes to BRT bus-only lanes along Northern Blvd between Broadway and 94th St would reduce the number of general-purpose (GP) traffic lanes along this part of Northern Blvd, potentially increasing traffic congestion. Existing MTA bus services (including the Q66) along Northern Blvd would still use the GP lanes (to allow these services to make their more frequent stops). The increased congestion could potentially lead to increased journey times and reduce reliability for the existing MTA bus services, particularly at peak times.
  - Permanent closure of intersections on Northern Blvd to north-south traffic would impact the current routes of the MTA's Q47, Q33, Q49, and Q72 bus services, which cross Northern Blvd. This could require the potential permanent re-routing of these services.

- **Compatibility with Existing NYC DOT Corridor Plan**
  - This option may have compatibility issues with current NYC DOT plans for the Northern Blvd corridor. These plans, which are currently being implemented, would improve pedestrian safety and permanently reduce the roadway to two GP travel lanes per direction. Any modifications to the route to accommodate the presently planned roadway improvements would need to be coordinated with NYC DOT.

- **Reduced General-Purpose Lane Access to LGA**
  - BRT bus traffic entering the Airport would benefit from a BRT bus-only lane over 94th St. This would permanently reduce the available GP lanes from two to one approaching the 94th St Bridge over the GCP. This could lead to potential congestion of traffic entering the Airport from Ditmars Blvd and 94th St.

7.3.1.4 Indicative Capital Cost

The Indicative Capital Cost for Option BRT-3 is $200 million (in 2022$, excluding future escalation and solely for approximate comparison between study options).

Indicative Capital Costs should be considered to have a range of estimating uncertainty of -10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).

The following are the notable cost drivers for the option:

- Provision of a new bus depot.
- New electric, zero-emission buses and charging stations (up to 17 buses).
- TSP upgrades.
- New ADA-compliant vertical circulation and subway-bus connection at Northern Blvd Subway station.
- New at-grade bus stops at LGA.
- New at-grade bus stops and turnaround at Northern Blvd.

7.3.1.5 Indicative Timeline/Schedule

The Indicative Timeline/Schedule (for comparison between study options) for Option BRT-3 is approximately 4–5 years from a decision to take the option forward to revenue service. This includes the following notable schedule drivers:

- Planning, approvals, and acquisitions.
- Procurement of new electric, zero-emission vehicles.
- Northern Blvd transfer station.
- Northern Blvd and 94th St roadway reconfiguration.
- On-Airport roadway reconfigurations and lowering of taxi access road.
- Construction of a new bus depot.
- Traffic signaling and systems.
- 6 months of commissioning.

Figure 7.3-2 illustrates the indicative timeline/schedule for Option BRT-3. The key drivers are the electric, zero-emission bus procurement and civil work.

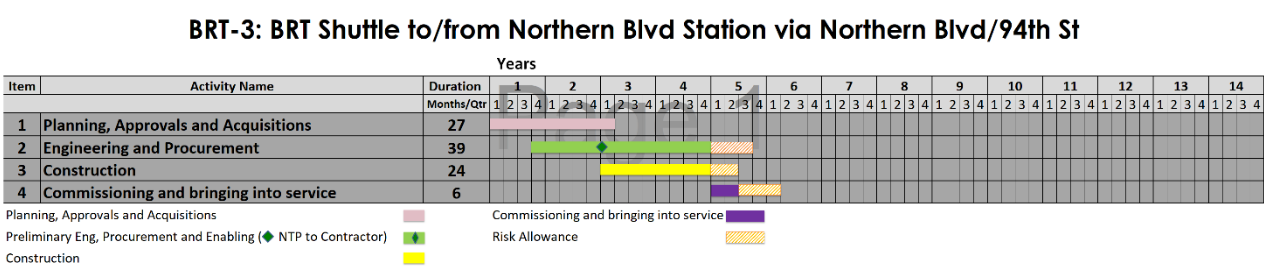

FIGURE 7.3-2: INDICATIVE TIMELINE/SCHEDULE (BRT-3)

7.3.2 Transportation Aspects

7.3.2.1 Improved Access to LGA

Three factors have been considered in this category: Standardized Indicative Baseline Off-Peak Travel Time, Reliability, and Transfer Experience.

7.3.2.1.1 Standardized Indicative Baseline Off-Peak Travel Time

- Table 7.3-1, below, provides the Standardized Indicative Baseline Off-Peak Travel Times for the weekday, midday off-peak journeys to be used solely as a baseline for comparison between options. Table 7.3-2 provides a breakdown of the components that make up the total journey, the general approach to the estimation of which is described in Section 3.2.2.1.1.
- Passengers making the journeys described would, naturally, experience variations to the baseline timings calculated even where services are running as planned, for reasons as simple as variations in walking speeds or whether a traveler arrives just before a scheduled departure or just misses a departing train.

TABLE 7.3-1: STANDARDIZED INDICATIVE BASELINE OFF-PEAK TRAVEL TIME, OPTION BRT-3

Herald Square to LGA (minutes to Terminal C)	BRT-3
Via Subway (M train) to Northern Blvd	49

TABLE 7.3-2: STANDARDIZED INDICATIVE BASELINE OFF-PEAK TRAVEL TIME BY SEGMENT, OPTION BRT-3

Herald Square to LGA via M Subway (minutes)	BRT-3
START Herald Square (street level)	
walk/wait time	7
M-Subway platform (dep)	
Subway trip time	19
Northern Blvd M-Subway platform (arr)	
walk/wait time	9
Northern Blvd bus stop (dep)	
Bus trip time	14
1st on-Airport bus stop (arr)	new at-grade
END Terminal bus stop	Terminal C
Total travel time =	49
trip time to next Terminal bus stop	3
2nd on-Airport bus stop (arr)	existing
END Terminal bus stop	Terminal B
Total travel time =	52

- The above standardized indicative baseline off-peak travel times are a baseline for weekday, midday off-peak journeys. Bus running times in mixed-use traffic would be subject to traffic congestion during peak times. Estimates of the potential increase to the Standardized Indictive Travel Time for peak-time traffic have been calculated solely for comparative purposes as around 3 minutes from Northern Blvd to Terminal C.

- Passengers for Terminal A would transfer to an existing on-Airport shuttle service running every 10 minutes and with an additional trip time of around 7 minutes from Terminal B.

7.3.2.1.2 Reliability

- Measures to increase reliability of Option BRT-3 include:
  - Dedicated bus lanes on Northern Blvd and 94th St, minimizing congestion due to general traffic.
  - Transit signal priority, which would allow buses to move through intersections without having to stop and wait for traffic.
  - Utilization of a new specially-designated bus pick-up and drop-off area near Terminal C with direct, exclusive road access to avoid congestion on the Airport frontage.

7.3.2.1.3 Transfer Experience

Riders bound for Terminals B, or C would transfer from the M/R Subway service to the Airport shuttle service at Northern Blvd Station. Riders bound for Terminal A would have an additional transfer to an existing on-airport shuttle once they reach the airport.

Customer Transfer

- Riders arriving at Northern Blvd Station would follow the new wayfinding signage and ascend to street level from the platforms via one of the existing sets of stairs. The new bus stop would be an approximately 750 ft walk from the station, with multiple crossings of busy streets. The station is not currently accessible, and the study team noted that the constrained site would make adding ADA-compliance to this station quite difficult.

7.3.2.2 Ridership

- Stated preference survey results indicate that 33% of airport passenger respondents are “definitely” or “probably” interested in BRT connections to existing transit services.
- The ridership model projects 2.0 million total riders using Option BRT-3, with a corresponding increase in net transit ridership of 1.1 million riders in 2025 (Table 7.3-3).

TABLE 7.3-3: RIDERSHIP MODEL RESULT SUMMARY

Transit Option				Riders on Current Bus Services to LGA (Millions) (No Action)	New Transit Option Impact (Millions)		
Mode Category & Scenario Label			Description		Riders on BRT-3 Shuttle Service	Net Increase in Total Bus Ridership	Total Bus Ridership (BRT-3 Shuttle + Other Bus Routes)
Bus - New Dedicated Bus Rapid Transit (BRT) Routes	BRT	BRT-3	Northern Blvd No Stop	4.1	2.0	**1.1**	**5.2**

7.3.2.3 Throughput and Capacity

Throughput

- Using the highest hourly single-direction provision of airline seats at LGA in 2019 (4,300 seats on weekday departing flights 9 AM to 10 AM – see Figure 3.2-1, in Section 3.2.2.3), the estimated single-direction peak passenger demand for this option could be approximately 170 passengers per hour.
- It should be noted that these passengers would likely arrive at the transfer station in groups, rather than being evenly distributed throughout the time period.

Capacity of New Transit Option

- Actual vehicle frequency would be adapted in practice to suit demand and other operating requirements.

Impact on Capacity of Existing Downstream Transit Systems

- Option BRT-3 provides passenger connection to Northern Blvd Subway Station, offering transfer access to the E, M, and R-Subway lines.
- Generally, airport passenger loadings are constant through the day both to and from the Airport with the peak passenger loadings occurring outside of the morning Manhattan-bound subway peaks or in the opposite direction (i.e., Airport-bound).
- The existing E, M and R-Subway lines currently operate below their peak capacity during the 8 AM to 9 AM Manhattan-bound commuting peak. While most Manhattan-bound Airport passengers would travel outside this peak, those passengers (including non-Airport passengers) traveling during this peak could experience some crowded conditions.
- The study team noted that the Northern Blvd Station is a shallow underground station consisting of two side platforms serving the local trains with no mezzanine or underpass. Access to the station is via a single stairwell from each station platform to the street and no elevators or escalators. Thus, without significant work to improve circulation from the platforms to the street level, there would be concerns about potential overcrowding at the existing stairwells due to the slower movement of passengers with luggage traveling up and down.

7.3.2.4 Indicative Operating Cost

Operating and maintenance costs for the proposed bus service have been estimated at up to $13.2 million per annum.

7.3.3 Community and Environmental Aspects

7.3.3.1 Local Community Impacts

This option would be located within and near densely developed neighborhoods along Northern Blvd (NY 25A) and 94th St. Northern Blvd consists mainly of commercial businesses (within 50 ft of the bus route), some mixed-use (residential above commercial) buildings, and the 78th St Plaza (NYC Plaza) from the Northern Blvd Subway station to 79th St. The route would then run along mainly mixed-use buildings with retail and restaurants, and residential (within 50 ft of the bus route) consisting of a variety of single-family and 3- to 6-story residential buildings until 94th St. This option would include roadway modification activities (parking and lane restriping, curb replacement, transit signal prioritization changes, bypass lanes, etc.) and 5-minute headways. Property usage along 94th St is mainly residential (within 50 ft of the bus route) consisting of a variety of single-family residential (row & detached) buildings, 3- to 6-story apartment buildings, and mixed-use buildings. The approximately 2.5-mile route goes through/along the following communities: Woodside, Jackson Heights, and East Elmhurst.

The potential for temporary (during construction) and permanent (once operational) impacts is summarized below for specific areas of the alignment.

7.3.3.1.1 Temporary Impacts during Construction on the Local Neighborhoods Directly Affected

Roadway construction activities are anticipated to occur along the approximately 2.5-mile route for 1.5 years.

During construction, the following neighborhoods would have the potential for air quality, noise, vibration, or visual impacts. For the frequency and duration of construction activities refer to Section 7.3.1.2 “Infrastructure Impacts during Construction” above:

- **Construction of Bus Turnaround and Layover Area at Northern Blvd Station**
  - Roadway modification activities (restriping, signing, curb resetting, passenger shelter, and restriping) for the BRT bus stops and turnaround at the Northern Blvd Subway station would be required at an existing car dealership lot between Broadway, Northern Blvd, 55th St, and 56th St at this segment of the route.
  - The roadway modification and transfer stop construction would occur approximately 35–50 ft from 3 short city blocks of residential and commercial properties.

  - Planned periodic lane closures and diversions on Broadway, Northern Blvd, 55th St, and 56th St would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - Planned periodic closure of sidewalks, bike lanes, and parking spaces along Astoria Blvd would be required.
  - Planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.

- **Construction of the BRT Lanes along Northern Blvd (NY 25A)**
  - Roadway modification activities (restriping, signing, and curb resetting) would be required for the bus lane and median modifications over an approximately 1.7-mile segment of the route along Northern Blvd.
  - The roadway modification would occur approximately 35–50 ft from 32 short city blocks of commercial and residential over commercial properties, and approximately 200–250 ft from 78th St Plaza (NYC Plaza open to pedestrians at the outdoor market off Northern Blvd).
  - Planned periodic lane closures and diversions on Northern Blvd would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - Planned periodic closure of sidewalks, bike lanes, and parking spaces along Northern Blvd would be required.
  - Planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.
  - Planned periodic suspension of truck deliveries would be needed for loading/unloading at commercial businesses.

- **Construction of the BRT Lanes along 94th Street**
  - Roadway modification activities (restriping, signing, and curb resetting) would be required for the bus lane and median modifications over an approximately 1.0-mile segment of the route along 94th St.
  - The roadway modification would occur approximately 35–50 ft from 8 long city blocks of residential and commercial properties.
  - Planned periodic lane closures and diversions on 94th St would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - Planned periodic closure of sidewalks, bike lanes, and parking spaces along 94th St would be required.
  - Planned periodic suspension for less than a day each of services (water, sanitary, electric, gas, communications, etc.) to residences and businesses would be required.

- Planned periodic suspension of access to residences would be needed for deliveries for loading/unloading.

- **Constructing On-Airport At-Grade Bus Stops**
  - Roadway construction activities (roadway reconfiguration, restriping, curb resetting, paving, signage, and drainage) would be required along an approximately 0.75-mile segment of the route to construct the proposed Terminal C bus loop, which would pass under multiple on-Airport roadways and support structures. The loop road would be constructed to avoid the need to modify any of the existing columns or supports.
  - The construction would occur over 500 ft from 5 city blocks of residential and commercial properties in the East Elmhurst community located on the other side of 8 lanes of the GCP.
  - Planned periodic lane closures and diversions would be required and could lead to increases in local road traffic, including potential impacts to local bus routes during road closures.
  - There could be increased construction/haul traffic on local roads because trucks are not allowed on the GCP.

- **Constructing the Bus Depot at Ingraham's Mountain off 19th Ave**
  - Construction of the proposed facility (roadway and building(s)) on an elevated portion (approximately 50,000 sf) of the existing LGA property known as 'Ingraham's Mountain' would occur for approximately 1 year approximately 200–300 ft from 4 short city blocks of commercial properties.

7.3.3.1.2 Permanent Operational Impacts on the Local Neighborhoods Directly Affected

Electric, zero-emission buses would operate between LGA and the proposed bus transfer stop at Northern Blvd. They would operate predominantly in at-grade dedicated bus lanes with some running in mixed-flow traffic on-Airport, ranging approximately 35–50 ft from residential and commercial properties while on city streets.

The following neighborhoods and areas would have the relative potential for permanent noise, vibration, or visual impacts as a result of this option's proposed bus operations:

- **New BRT Lanes along Northern Blvd (NY 25A)**
  - From the bus transfer stop between 55th St and 56th St, buses would operate in each direction in at-grade dedicated bus lanes alongside other city traffic in the center of Northern Blvd, approximately 35–50 ft from commercial properties and residential over commercial properties.

- Northern Blvd is predominantly commercial with on-street parking along both curbsides. This option would replace one general-purpose travel lane in each direction with dedicated BRT-only lanes, blocking north-south traffic at several intersections. Permanent lane restrictions would potentially lead to an increase in local road traffic on adjacent neighborhood streets.
- The loss of parking could potentially be reduced by eliminating a travel lane during off-peak travel times.

- **New BRT Lanes along 94th Street**
  - Buses would operate in each direction in at-grade dedicated bus lanes alongside other city traffic along the shoulders of 94th St, approximately 35–50 ft from residential properties.
  - 94th St is predominantly residential with 1–2 family homes with on-street parking along both curbsides. This option would reduce the parking to provide space for the BRT-only lanes.

- **New Bus Depot at Ingraham's Mountain off 19th Ave**
  - The new bus depot at Ingraham's Mountain would lead to increased electric, zero-emission bus traffic entering/exiting the facility along 19th Ave, a mainly residential and commercial corridor.

7.3.3.1.3 Potential Private Property Acquisitions

The Northern Blvd Station Shuttle Service may require permanent acquisition of the following:

- Up to 3 private commercial properties.

7.3.3.1.4 Potential Public Property Acquisitions (NYC DOT Plazas and NYC Parks Parkland)

The option would result in permanent impacts to the following:

- No structures would be sited within NYC Parks Parkland.
- Electric, zero-emission bus operations along Northern Blvd would occur approximately 200–250 ft from the 78th St Plaza (a NYC DOT Plaza open to pedestrians at the outdoor market off Northern Blvd).

7.3.3.1.5 Removal/Reconfiguration of Parking Spaces

- A total of approximately 280 on-street public parking spaces would be lost on the following streets:

- Northern Blvd.
- 94th St.

The number is approximate and is a preliminary estimate based on the alignment.

7.3.3.1.6 Environmental Justice Communities Mapping Analysis

The Environmental Justice communities mapping analysis provides an overview of the minority and low-income communities within 0.25 mile of the transit options being studied.

For Option BRT-3, more than half of the block groups within the 0.25-mile buffer of the option alignment are Environmental Justice block groups.

See Figure 7.3-3 below for the analysis map for this option.

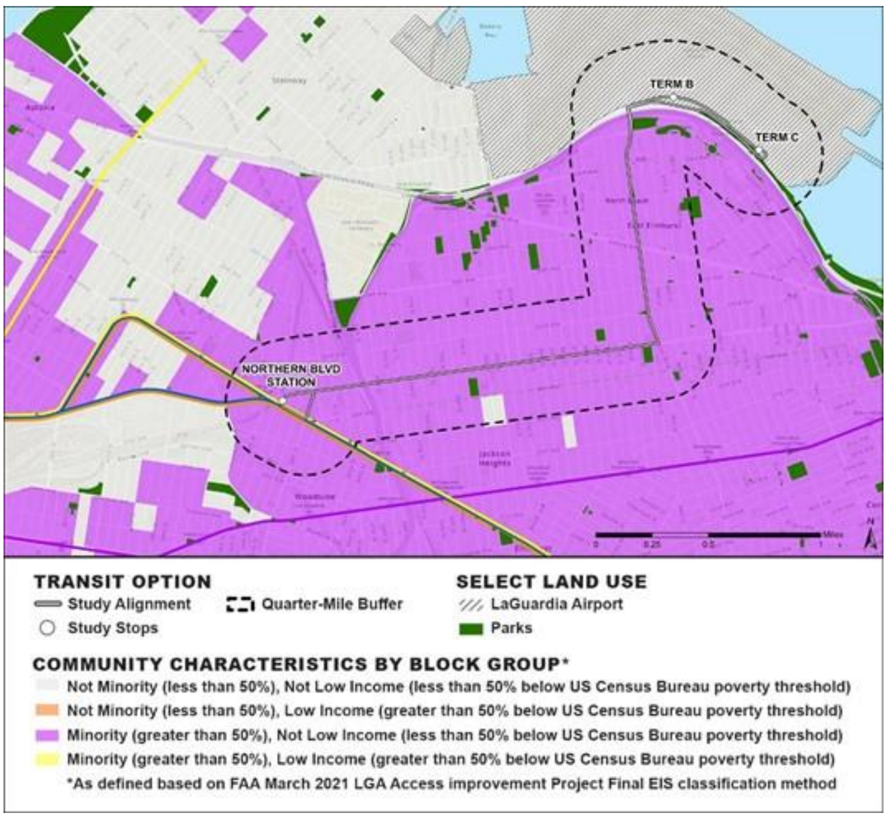

FIGURE 7.3-3: NORTHERN BLVD STATION – ENVIRONMENTAL JUSTICE COMMUNITIES MAPPING ANALYSIS (AS DEFINED BASED UPON FAA MARCH 2021 LGA ACCESS IMPROVEMENT PROJECT FINAL EIS CLASSIFICATION METHOD)

7.3.3.2 Equity

7.3.3.2.1 Transit Access from LGA

- **Additional Minority and Low-income Populations Reached within 45 Minutes from LGA via Transit (Population Access Analysis)**
  - The results of the Population Access Analysis illustrate how many people, specifically from low-income and minority populations, could travel via transit from LGA to homes within 45 minutes from LGA. Airport passengers or Airport employees living within these areas could potentially benefit from expanded access to these destinations.
  - Option BRT-3 is expected to expand transit access from LGA to regional destinations within 45 minutes, as shown in the blue area of "Additional Access Provided by Transit Option" in Figure 7.3-4. Compared to the baseline, the minority population reached within a 45-minute transit trip would increase by 19.4% and the low-income population reached within a 45-minute transit trip would increase by 19.3% (see Table 7.3-4).
  - This represents a medium increase in transit access to LGA within 45 minutes for minority and low-income communities.

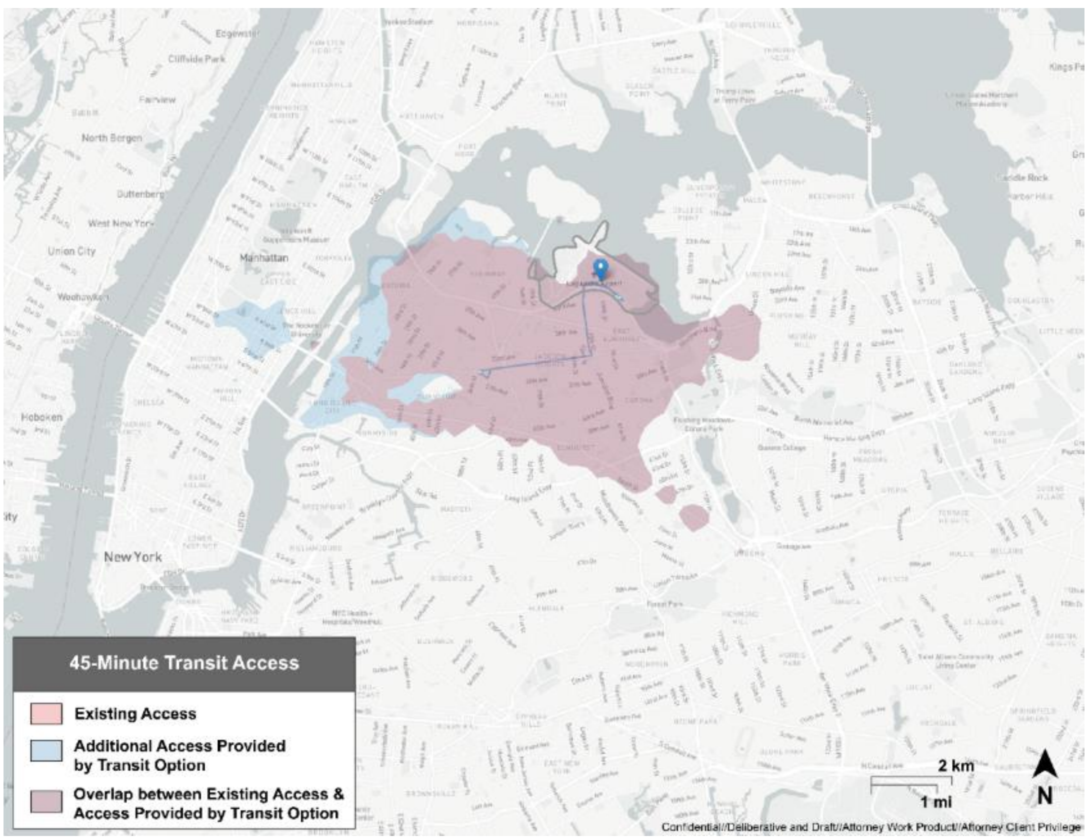

FIGURE 7.3-4: NORTHERN BLVD STATION BRT-3 – POPULATION ACCESS ANALYSIS

TABLE 7.3-4: NORTHERN BLVD STATION OPTION BRT-3 – POPULATIONS REACHED WITHIN 45-MINUTE TRANSIT TRIP

		Total Population Reached	Minority Population Reached	Low-Income Population Reached
Baseline	Existing Condition	551,434	422,981	76,750
BRT-3	With Option	713,585	504,883	91,565
	Net Change	+162,151	+81,902	+14,815
	% Change	29.4%	19.4%	19.3%

- **Additional ADA-Accessible Stations within 45 Minutes from LGA via Transit (ADA Analysis)**
  - The results of the ADA Analysis illustrate how Airport passengers and Airport employees, specifically those requiring ADA-compliant stations, traveling from LGA to other locations could potentially benefit from expanded access to ADA-compliant stations within 45 minutes via transit.
  - More ADA-accessible stations/stops can be reached within a 45-minute transit trip for this option compared to the baseline of existing transit service (Table 7.3-5). This echoes the results from the Population Access Analysis, in which Option BRT-3's 45-minute transit travel shed provides an increased amount of access over the baseline transit service. Compared to the baseline, an additional 15 ADA-accessible stations can be reached within a 45-minute transit trip from LGA for Option BRT-3.

TABLE 7.3-5: NORTHERN BLVD STATION BRT-3 – ADA ANALYSIS

Subway, Ferry, LIRR, and MNR Stations Reached within 45-Minute Transit Trip from LGA	Baseline	BRT-3	Difference between Baseline and BRT-3
Total Stations	*43*	*67*	*+24 stations*
ADA-Accessible Stations (Accessible Stations as % of Total)	*20 (47%)*	*35 (52%)*	*+15 stations*

7.3.3.2.2 Transportation Opportunities and Benefits for the Surrounding Community

- **Transportation Opportunities for Neighbors**

  This option does not include intermediate/off-Airport stops. Because there is limited pedestrian access to LGA from adjacent residential areas and walking distance exceeds 0.25 mile, the study team did not consider there to be a significant market for use of the final on-Airport stops by the surrounding community to connect to the broader transit network.

- **Cars Removed from Local Roadways and Emissions Reductions**

  See the “Cars Removed from Local Roadways” section and the “GHG and Other Vehicular Emissions Reductions” section of this evaluation below.

7.3.3.3 Cars Removed from Local Roadways

- Option BRT-3 would be expected to remove 371,000 Airport passenger vehicles, and 158,000 Airport employee vehicles, from the road each year.

7.3.3.4 GHG and Other Vehicular Emissions Reductions

- Option BRT-3 would be expected to remove 2,392 metric tons of CO_2 equivalent each year.
- Other vehicular emissions reductions are given in Table 7.3-6:

TABLE 7.3-6: OTHER VEHICULAR EMISSIONS REDUCTION (METRIC TONS PER YEAR)

Option	CO	VOC	NOx	SO_2	PM_{10}	$PM_{2.5}$
[BRT-3] Northern Blvd	11.3	0.2	0.8	0.03	0.4	0.1

7.3.4 Summary of Evaluation

BRT-3: BRT Shuttle to/from Northern Blvd Station via Northern Blvd/94th St

Option BRT-3 would create a new electric bus shuttle service direct to LGA from the existing Northern Blvd Subway station, providing two-seat ride transfer access to M and R-Line Subway services (E-Line services are overnight only). BRT bus stops would be provided near to the station entrances on Northern Blvd. BRT-3 would provide bus travel time benefits through the conversion of existing travel lanes on Northern Blvd and 94th St to bus-only lanes with traffic signals revised to prioritize the buses to avoid possible congestion and traffic delays along these roads, and utilization of a new bus-only loop-road and at-grade bus stop at Terminal C would allow buses to bypass traffic at the current Terminal C stop.

This option would require light roadway work (line painting, re-curbing, etc.) for the new bus lanes, new roadway construction on-Airport around Terminal C, and construction of the bus depot on Airport property at Ingraham's Mountain.

Table 7.3-7 summarizes the output from all the factors used to evaluate this option.

TABLE 7.3-7: SUMMARY OF KEY CHARACTERISTICS – BRT SHUTTLE TO/FROM NORTHERN BLVD STATION VIA NORTHERN BLVD/94TH ST (BRT-3)

	Evaluation Factor	Assessment
CONSTRUCTION ASPECTS	Constructability	• Construction of ADA compliant access to Northern Blvd Station • Construction of new bus stops and turnarounds at Northern Blvd and 55th St • Constrained on-Airport sites for at-grade bus stops and bus turnaround • Total option route length: approx. 3.5 miles
	Infrastructure Impacts during Construction	• Disruption to existing MTA bus services using Northern Blvd
	Permanent/Operational Impacts to Existing Infrastructure	• Permanent closure of north-south intersections across Northern Blvd, requiring re-routing of some existing MTA bus services • Permanent reduction of Northern Blvd general-purpose travel lanes each way • Reduction of 102nd St bridge to 1 general-purpose travel lane into LGA • Precludes planned City DOT roadway reconfiguration
	Indicative Capital Cost (2022$)[107]	$200 million[108]
	Indicative Timeline/Schedule	4-5 Years

[107] Indicative Capital Costs should be considered to have a range of estimating uncertainty of –10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).
[108] Cost would exclude circulation improvements around Terminal C if the Q-70 Light Improvement Option proceeds, as then such improvements would be implemented regardless of whether this option was selected to proceed.

TABLE 7.3-7, CONTINUED.

	Evaluation Factor	Assessment
TRANSPORTATION ASPECTS	Standardized Indicative Baseline Off-Peak Travel Time (From Midtown Manhattan)	Via M-Line: 49–52 mins (14–17 mins on bus) (Herald Square to Terminal C, then B; shuttle to Terminal A)
	Transfer Experience	• Transfer to the bus stop from the Subway station would involve vertical moves via existing stairs to grade, new ADA-compliant elevators would be of the smaller type • The walk to the covered bus stop would be approx. 500 ft and involve crossing of streets • Serves Terminals B and C only
	Ridership[109]	Total annual projected ridership for option: 2.0 million Net increase in annual projected transit ridership: 1.1 million
	Throughput & Capacity	Would be adapted to suit demand
	Indicative Operating Cost	Up to $13.2 million per annum
COMMUNITY AND ENVIRONMENTAL ASPECTS	Local Community Impacts	<u>Construction:</u> • Light roadway (e.g., restriping, curb replacements, bypass lanes) for approx. 1.5 years <u>Proximity to communities:</u> • 35–50 ft from 40 city blocks of residential and commercial properties along Northern Blvd & 94th St • 200–300 ft from 4 city blocks of commercial properties near Ingraham's Mountain <u>Permanent impacts:</u> • Acquisition up to 3 properties (private commercial) • Operations 200–250 ft from 78th St Plaza • No impacts to NYC parklands or plazas • Loss of approx. 280 on-street public parking spaces along Northern Blvd and 94th St <u>Operations:</u> • Operated with a quiet, zero-emissions all-electric bus fleet • Bus depot on airport property, 200–300 ft from commercial areas
	Equity	• Medium increase to low-income and minority populations within 45 minutes of the Airport via transit versus the no-build scenario • +15 additional ADA-compliant stations reachable within a 45-minute transit trip from LGA versus the no-build scenario
	Cars Removed from Local Roadways	371,000 airport passenger vehicles and 158,000 airport employee vehicles from the road each year
	GHG and other Vehicular Emissions Reductions	2,392 metric tons of CO2 equivalent each year

[109] Experience from AirTrain JFK was that actual ridership turned out to be higher than would have been predicted by the AirTrain JFK forecast and underscores the inherent uncertainty of model predictions. The ridership model supporting this effort could also deviate from eventual ridership demand but was utilized to allow ridership comparisons between the options.

8.0 FERRY SERVICE + SHUTTLE BUS

The Ferry options would provide direct access to LGA from waterfront areas of Manhattan by taking advantage of the existing New York waterway network. Once on the ferry, passengers would avoid possible traffic congestion and travel delays and experience improved reliability compared to other, road-based transit options. Additionally, the ferry options received considerable interest from various interested stakeholders.

Potential stops at existing piers could include the following:

- Pier 11 in Lower Manhattan.
- East 34th St Pier in Midtown Manhattan.
- East 90th St Pier in Upper Manhattan.

There are two potential locations for ferry landings at the Airport. The first option is in Bowery Bay on the far west side of the Airport near Terminal A. The other is in Flushing Bay on the far east side of the Airport near Terminal C. Ferry service to LGA could stop at either or both landing locations.

The evaluation considered the following ferry service options (and sub-options) as described below:

- F-1: Ferry service + shuttle bus to/from Manhattan:
    - F-1A: Ferry service + shuttle bus to Bowery Bay.
    - F-1B: Ferry service + shuttle bus to Flushing Bay.

Ferries, if matching the standards offered by existing New York ferry operations, would offer a comfortable seated ride, on-board refreshments, and restrooms. In almost all cases, customers would be dependent on a bus or other surface transportation to reach the off-Airport piers. All ferry options require shuttle bus connections from ferry landings at the Airport to the primary passenger terminals (B and C). The Flushing Bay landing sub-option requires a shuttle bus connection to Terminal A as well.

8.1 F-1: Ferry Service + Shuttle Bus to/from Manhattan

Since LGA is located on the Northern Queens waterfront, it can be reached via direct ferry service from Manhattan. A ferry from Manhattan would provide access from three piers, Pier 11 (Wall Street), Pier 34 (Midtown), and Pier 90 (Upper East Side). As the ferries are not directly accessible to the subway network without walking, riders would need to either walk or take a bus, taxi, or private vehicle to access the pier. From there, the ferry would traverse the East River before dropping passengers off at either Bowery Bay (Sub-Option F-1A) or Flushing Bay (Sub-Option F-1B). For the Bowery Bay option, passengers bound for Terminal A would walk from the ferry landing to the terminal or board a shuttle bus to access Terminals B and C. The Flushing Bay landing would require an on-Airport shuttle to access all three terminals. All ferry services would be provided by diesel-powered or hybrid electric vessels.

Sub-Option F-1A: Ferry Service + Shuttle Bus to Bowery Bay

Figure 8.1-1 shows Sub-Option F-1A, Bowery Bay, on the far west side of the airport near Terminal A.

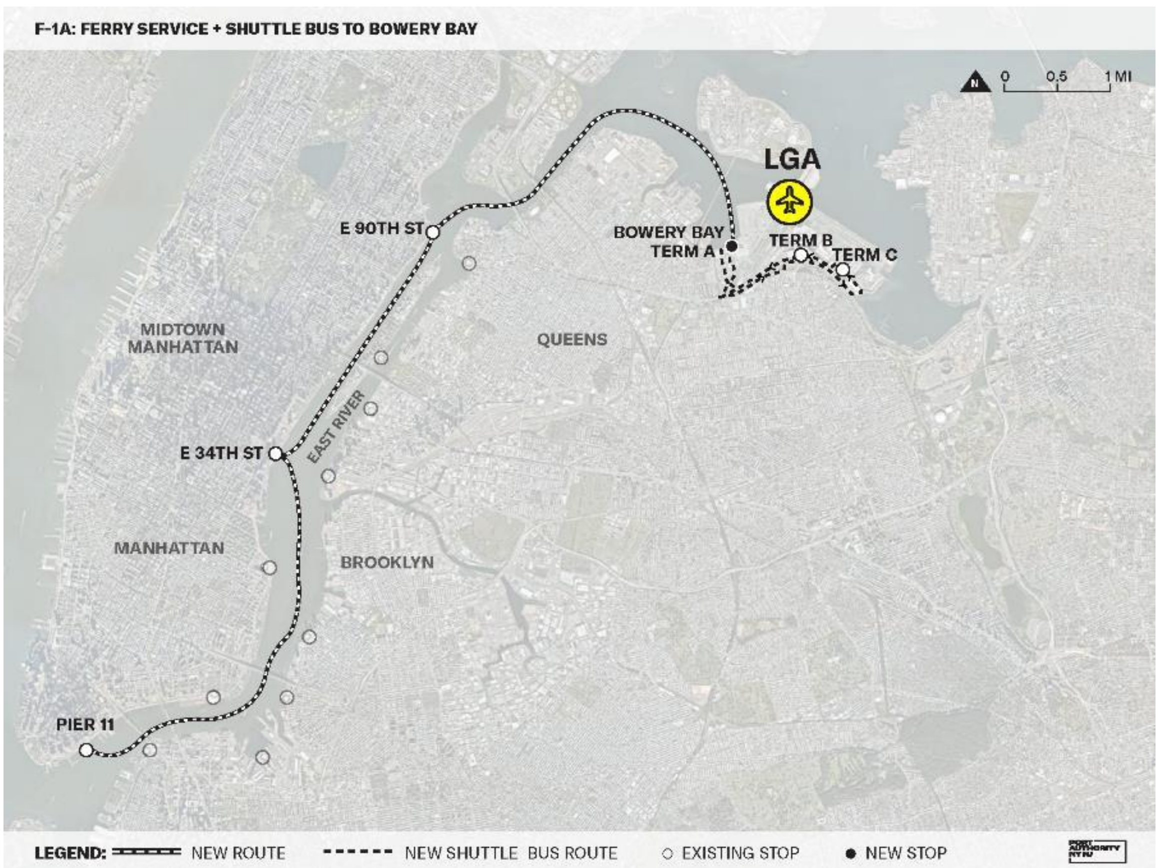

FIGURE 8.1-1: SUB-OPTION F-1A – FERRY SERVICE + SHUTTLE BUS: BOWERY BAY FERRY STOP

Sub-Option F-1B: Ferry Service + Shuttle Bus to Flushing Bay

Figure 8.1-2 shows Sub-Option F-1B, Flushing Bay, on the far east side of the airport near Terminal C.

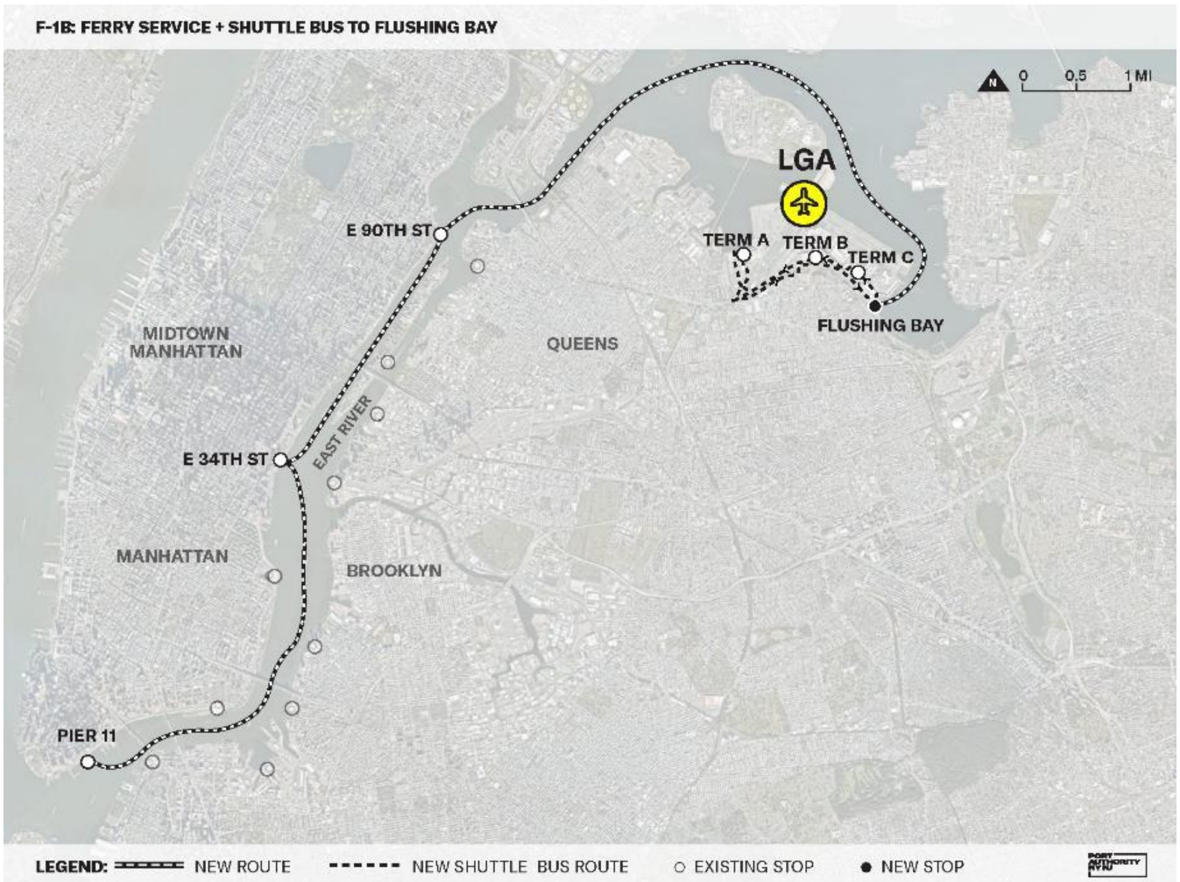

FIGURE 8.1-2: SUB-OPTION F-1B – FERRY SERVICE + SHUTTLE BUS: FLUSHING BAY FERRY STOP

The ferry service route lengths are approximately 7 miles to Bowery Bay and 10 miles to Flushing Bay from East 34th St Pier in Midtown Manhattan.

8.1.1 Evaluation of Construction Aspects

8.1.1.1 Constructability

Sub-Option F-1A (Bowery Bay)

- Construction of the Bowery Bay ferry landing would be similar to other existing ferry landings along the East River and would need to follow the processes necessary to acquire approved permits. In addition, a bus stop/access to the landing would be built.
- All other proposed ferry loading sites along the route at Pier 11, East 34th St Pier, and East 90th St Pier already exist with adequate weather protection for passengers and no new construction is anticipated. Securing landing rights should be possible at each of these locations but would be subject to future negotiations.
- Passengers using the ferry to Bowery Bay would be able to walk about 100 ft to/from Terminal A using a covered walkway.
- For accessing Terminals B and C, a bus loading area would be constructed providing transport by buses timed to the arrivals/departures of the ferries.
- A new storage/maintenance facility would likely be required for the proposed ferry fleet. The location of this facility has not been determined as part of this assessment, but a provisional cost sum is included in the construction cost estimate.

Sub-Option F-1B (Flushing Bay)

- Construction of the Flushing Bay ferry landing and bus stop/access is more complicated than Bowery Bay due to the following reasons:
  - A channel would need to be dredged in the shallow water of Flushing Bay and a vessel docking area would need to be constructed to provide depth of about –10 ft at mean low tide (as required by NYC EDC for its ferry operations). To minimize the amount of dredging, the ferry landing would be located about 1,200 feet offshore and a long, covered walkway would be constructed leading to the shoreline.
  - The Airport's new Terminal C and perimeter fence are now located directly along the Flushing Bay shoreline. As a result, it would be necessary to construct a bus access road and pick-up point on landfill/reclamation along the edge of the Bay, requiring modification to the existing seawall (extension into the Bay). The landfill/reclamation would extend along the shoreline for about 300 ft to provide space for the bus loading area and bus access road.
  - The buses would access the terminal arrivals road network located in proximity to the loading area.
  - The dredging, reclamation, and road construction would require environmental approvals.
  - A new storage/maintenance facility would likely be required for the proposed ferry fleet. The location of this facility would be determined as part of future detailed

assessment, but a provisional cost sum has been included in the construction cost estimate.

- All other proposed ferry loading sites along the route at Pier 11, East 34th St Pier, and East 90th St Pier already exist with adequate weather protection for passengers and no new construction is anticipated. Securing landing rights should be possible at each of these locations but would be subject to future negotiations.

8.1.1.2 Infrastructure Impacts during Construction

<u>Sub-Option F-1A (Bowery Bay)</u>

- The temporary impacts would include construction vehicle traffic on- and off-Airport; pile driving in the Bay; on-Airport construction laydown areas required to build a ferry landing near the west side of LGA; and provision of bus access linking LGA terminals to the landing location.

<u>Sub-Option F-1B (Flushing Bay)</u>

- This sub-option would include dredging an access channel for the ferry in the bay from the existing navigable channel; construction of a ferry dock/landing; and construction of a 1,200-ft-long, pile-supported covered walkway to the shoreline.
- To connect the Airport road network to a new onshore bus loading area landfill/reclamation at the edge of the Bay for approximately 300 ft and modification to the existing seawall (extension into the Bay) would be required to accommodate the new bus access road and passenger loading area. Construction of this work would increase on-Airport construction vehicle traffic and contribute to congestion in and around Terminal C.
- Environmental approvals for the dredging, bay disturbance, impact to the shoreline, and impact to the existing seawall would be required prior to beginning construction.

8.1.1.3 Permanent/Operational Impacts to Existing Infrastructure

Once completed, this option would have the following permanent/operational impacts on other infrastructure along the route:

<u>Sub-Option F-1A (Bowery Bay)</u>

- Based on discussion with the NYC EDC, Pier 11, East 34th St Pier, and East 90th St Pier are currently at or near capacity during peak months and further discussion would need to be held to determine how a new service could be accommodated.
- Some additional shuttle bus traffic would occur on Bowery Bay Road to/from the bus loading area.

Sub-Option F-1B (Flushing Bay)

- Based on discussion with the NYC EDC, Pier 11, East 34th St Pier, and East 90th St Pier are currently at or near capacity during peak months and further discussion would need to be held to determine how a service could be accommodated.
- Some additional on-Airport shuttle bus traffic would occur on the terminal road network with this option, particularly in and around Terminal C.

8.1.1.4 Indicative Capital Cost

Sub-Option F-1A (Bowery Bay)

The Indicative Capital Cost for Sub-Option F-1A is $130 million (in 2022$, excluding future escalation and solely for approximate comparison between study options).

Indicative Capital Costs should be considered to have a range of estimating uncertainty of -10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).

The following are the notable cost drivers for the option:

- Construction of the ferry landing in Bowery Bay.
- An allowance of $10 million for a new storage/maintenance facility.
- An allowance for 5 new vessels at $6 million each.

Sub-Option F-1B (Flushing Bay)

The Indicative Capital Cost for Sub-Option F-1B is $240 million (in 2022$, excluding future escalation and solely for approximate comparison between study options).

Indicative Capital Costs should be considered to have a range of estimating uncertainty of -10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).

The following are the notable cost drivers for the option:

- Construction of the ferry landing in Flushing Bay.
- Dredging of Flushing Bay.
- Extension of seawall and land reclamation for bus access.
- An allowance of $10 million for a new storage/maintenance facility.
- An allowance for 5 new vessels at $6 million each.

8.1.1.5 Indicative Timeline/Schedule

Sub-Option F-1A (Bowery Bay)

The Estimated Total Option Duration (for comparison between study options) for Sub-Option F-1A is approximately 3–4 years from a decision to take the option forward to revenue service.

This includes the following notable schedule drivers and conventions:

- Planning, approvals, and acquisitions.
- Procurement of new ferries.
- Constructing a ferry landing near the west side of LGA (including pile driving in water).
- Constructing a new storage/maintenance facility.
- 3 months of commissioning.

Figure 8.1-3 illustrates the indicative timeline/schedule for Option F-1A. The key drivers are ferry procurement and construction of the ferry landing in Bowery Bay. Procurement of the ferries are a risk to this timeline if suitable vessels cannot be readily acquired.

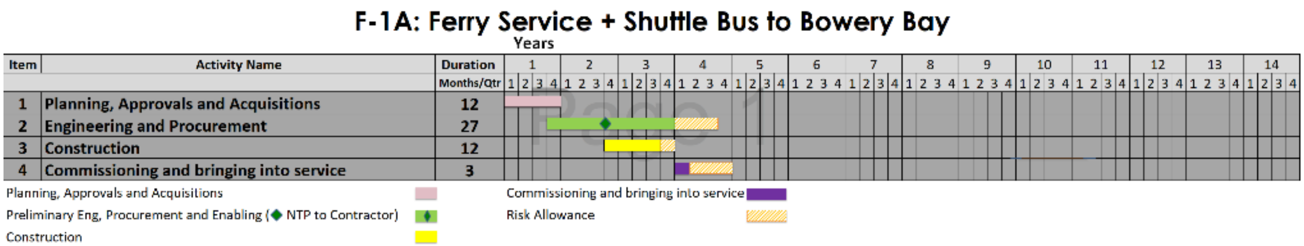

FIGURE 8.1-3: INDICATIVE TIMELINE/SCHEDULE (F-1A)

Sub-Option F-1B (Flushing Bay)

The Estimated Total Option Duration (for comparison between study options) for Sub-Option F-1B is approximately 4–5 years from a decision to take the option forward to revenue service. This includes the following notable schedule drivers and conventions:

- Planning, approvals, and acquisitions.
- Procurement of new ferries.
- Dredging an access channel for the ferry in the bay from the existing navigable channel.
- Constructing a ferry dock/landing and a 1,200-ft-long covered walkway supported on piles to the shoreline.
- Constructing a new storage/maintenance facility.
- Additional impacts include connecting the Airport road network to an onshore bus loading area. To complete this work, landfill/reclamation at the edge of the bay for about 300 ft and a seawall would be required.
- 3 months of commissioning.

Figure 8.1-4 illustrates the indicative timeline/schedule for Sub-Option F-1B. The key drivers are ferry procurement and more extensive construction in Flushing Bay (due to dredging and reclamation). Ferry procurement delay poses less of a risk to this option as the construction activities are longer.

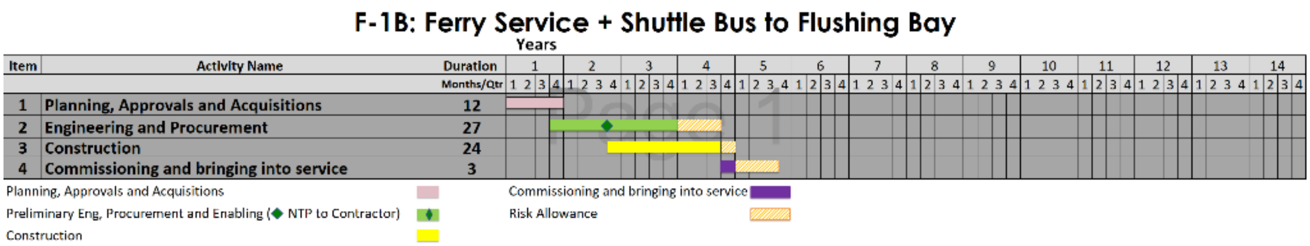

FIGURE 8.1-4: INDICATIVE TIMELINE/SCHEDULE (F-1B)

8.1.2 Transportation Aspects

8.1.2.1 Improved Access to LGA

Three factors have been considered in this category: Standardized Indicative Baseline Off-Peak Travel Time, Reliability, and Transfer Experience.

8.1.2.1.1 Standardized Indicative Baseline Off-Peak Travel Time

Sub-Options F-1A and F-1B

- Table 8.1-1, below, provides the Standardized Indicative Baseline Off-Peak Travel Times for the weekday, midday off-peak journeys to be used solely as a baseline for comparison between options. Table 8.1-2 provides a breakdown of the components that make up the total journey, the general approach to the estimation of which is described in Section 3.2.2.1.1.
- Passengers making the journeys described would, naturally, experience variations to the baseline timings calculated even where services are running as planned, for reasons as simple as variations in walking speeds or whether a traveler arrives just before a scheduled departure or just misses a departing train.

TABLE 8.1-1: STANDARDIZED INDICATIVE BASELINE OFF-PEAK TRAVEL TIMES, OPTION F-1

Penn Station to LGA (minutes to Terminal C)	F-1A	F-1B
Via Ferry	80	82

TABLE 8.1-2: STANDARDIZED INDICATIVE BASELINE OFF-PEAK TRAVEL TIMES BY SEGMENT, OPTION F-1

Penn Station to LGA via ferry (minutes)	F-1A	F-1B
START Penn Station (street level)		
walk/wait time	5	5
M34-SBS Penn Station bus stop (dep)		
Bus trip time	12	12
East 34th St Ferry Terminal bus stop (arr)		
walk/wait time	13	13
East 34th St Pier (dep)		
Ferry trip time	29	37
Bowery Bay LGA pier (arr)		-
Flushing Bay LGA pier (arr)	-	
END Terminal ferry stop	Terminal A	-
Total travel time =	59	-
walk/(wait) time	5	11
Airport shuttle bus stop (dep)		
Shuttle bus trip time to next Terminal bus stop	16	4
1st on-Airport bus stop (arr)	existing	existing
END Terminal bus stop/ferry stop	Terminal C	Terminal C
Total travel time =	80	82
trip time to next Terminal bus stop	4	4
2nd on-Airport station	existing	existing
END Terminal bus stop	Terminal B	Terminal B
Total travel time =	84	86
trip time to next stop	-	7
3rd on-Airport station	-	existing
END Terminal bus stop	-	Terminal A
Total travel time =	-	93

8.1.2.1.2 Reliability

Sub-Options F-1A and F-1B

- Because ferries operate exclusively in the water, they would not be subject to any variability in travel times associated with road traffic conditions.

8.1.2.1.3 Transfer Experience

Riders bound for Terminals B and C would have a minimum two-seat ride via ferry service from Pier 34 in Midtown Manhattan. Most customers would need to take a bus or taxi from Midtown to the Pier, transfer to the ferry using the existing facilities, and then transfer from the ferry to an on-airport shuttle once they reach the new pier at the Airport. Riders bound for Terminal A would either have a short walk from the ferry or need to transfer to the on-airport shuttle, depending on the chosen landing location.

Customer Transfer

Sub-Option F-1A

- The studied transfer at Bowery Bay would connect the new fully enclosed ferry landing to a new on-Airport shuttle bus stop. Walking distance to the new shuttle bus stop would be approximately 100 ft; however, Airport passengers connecting to Terminal A would need to walk across Bowery Bay Blvd to Terminal A, a total distance of approximately 300 ft.

Sub-Option F-1B

- The studied transfer at Flushing Bay would connect the new fully enclosed ferry landing to a new on-Airport shuttle bus stop. Walking distance to the new shuttle bus stop would be approximately 1,200 ft. Customers would wait at the bus stop to board the on-airport shuttle service to Terminal C, then Terminal B, then Terminal A:

8.1.2.2 Ridership

Sub-Options F-1A and F-1B

- Stated preference survey results indicate that 14% of airport passenger respondents are “definitely” or “probably” interested in ferry services.
- The ridership model projects 0.7 million total riders using either Option F-1A or F-1B, with a corresponding increase in net transit ridership of 0.4 million riders in 2025 (Table 8.1-3).

TABLE 8.1-3: RIDERSHIP MODEL RESULT SUMMARY

Transit Option			Riders on Current Bus Services to LGA (Millions) (No Action)	New Transit Option Impact (Millions)		
Mode Category & Scenario Label		Description		Riders on F-1 Ferry Service	Net Increase in Total Transit Ridership	Total Transit Ridership (F-1 Ferry Service + Other Bus Services)
Ferry	F-1A	Bowery Bay	4.1	0.7	**0.4**	**4.5**
	F-1B	Flushing Bay	4.1	0.7	**0.4**	**4.5**

8.1.2.3 Throughput and Capacity

Sub-Options F-1A and F-1B

Throughput

- Using the highest hourly single-direction provision of airline seats at LGA in 2019 (4,300 seats on weekday departing flights 9 AM to 10 AM – see Figure 3.2-1, in Section 3.2.2.2), the estimated single-direction peak passenger demand for this option could be approximately 90 passengers per hour.

Capacity of New Transit Option

- The ferries used would have a passenger capacity of between 100 and 150 passengers per vehicle. Using the 0.5-hourly proposed service, the potential total capacity of F-1A and F-1B ferry services could be:
  - 300 pphpd at peak.
- This is sufficient to support the estimated single-direction peak passenger demand from the ridership model, equating to around 45 passengers per ferry at peak.

Impact on Capacity of Existing Downstream Transit Systems

- The ferry sub-options do not provide direct passenger connection to existing Subway lines; therefore, no assessment has been made on potential impacts to downstream transit systems for these sub-options.
- NYC EDC has indicated that accommodating the proposed level of ferry landings at Pier 11, East 34th St Pier, and East 90th St Pier (0.5-hourly service in each direction) would need to be assessed in more detail should this option be selected for further study.

8.1.2.4 Indicative Operating Cost

Sub-Options F-1A and F-1B

- Operating costs from the 2013 Citywide Ferry Study were prepared for a four-ferry 0.5-hourly service similar to that proposed in this study.
- The 2013 Citywide Ferry Study indicated that the daily operating cost for a four-ferry service was estimated at $25,299/day with 12-hour/day operations, or $527/hour/vessel. A 20% escalation brings this to $30,358, or $632/hour/vessel in current 2022 dollars.
- For purposes of this study, this number falls within current estimates provided by the NYC EDC for its ferry operations of $600 to $1,500/hour.
- On an annual basis, the estimated operating cost would be approximately $9.2 million/year for a 12-hour daily operation and $11 million/year for a 16-hour daily operation.

8.1.3 Community and Environmental Aspects

8.1.3.1 Local Community Impacts

8.1.3.1.1 Temporary Impacts during Construction on the Local Neighborhoods Directly Affected

Construction activities are anticipated to occur along the route for 1 year for F-1A and 2 years for F-1B.

<u>Sub-Option F-1A (Bowery Bay)</u>

- The proposed construction work, such as piling, would be in Bowery Bay in proximity to, but not within, the existing communities of Ditmars Steinway, Astoria, and Rikers Island. There could be increased traffic on some neighborhood roads near LGA due to construction vehicle traffic transiting to/from the Airport.

<u>Sub-Option F-1B (Flushing Bay)</u>

- The proposed construction work, such as piling and dredging, would be in Flushing Bay in proximity to, but not within, the existing communities of East Elmhurst, North Corona, Flushing, and College Point, including the World’s Fair Marina and the Malcolm X Promenade. There could be increased traffic on some neighborhood roads near LGA due to construction vehicle traffic transiting to/from the Airport.

8.1.3.1.2 Permanent Operational Impacts on the Local Neighborhoods Directly Affected

<u>Sub-Option F-1A (Bowery Bay)</u>

- Ferries would likely use diesel or hybrid engines. The communities of Ditmars Steinway, Astoria, and Rikers Island would be more than 300 feet from permanent ferry operations.

<u>Sub-Option F-1B (Flushing Bay)</u>

- Ferries would likely use diesel or hybrid engines. The communities of East Elmhurst, North Corona, Flushing, and College Point, including the World’s Fair Marina and the Malcolm X Promenade, would be more than 500 feet from permanent ferry operations.

8.1.3.1.3 Potential Private Property Acquisitions

No private properties are anticipated to be acquired with either of these sub-options.

8.1.3.1.4 Potential Public Property Acquisitions (NYC DOT Plazas and NYC Parks Parkland)

No impacts are expected for either of these sub-options.

8.1.3.1.5 Removal/Reconfiguration of Parking Spaces

No permanent loss of on-street parking spaces is expected with either of these sub-options.

8.1.3.1.6 Environmental Justice Communities Mapping Analysis

The Environmental Justice communities mapping analysis provides an overview of the minority and low-income communities within 0.25 mile of the transit options being evaluated.

Sub-Option F-1A (Bowery Bay)

For Sub-Option F-1A, less than half of the block groups within the 0.25-mile buffer of the option alignment are Environmental Justice block groups.

See Figure 8.1-5 below for the analysis map for F-1A.

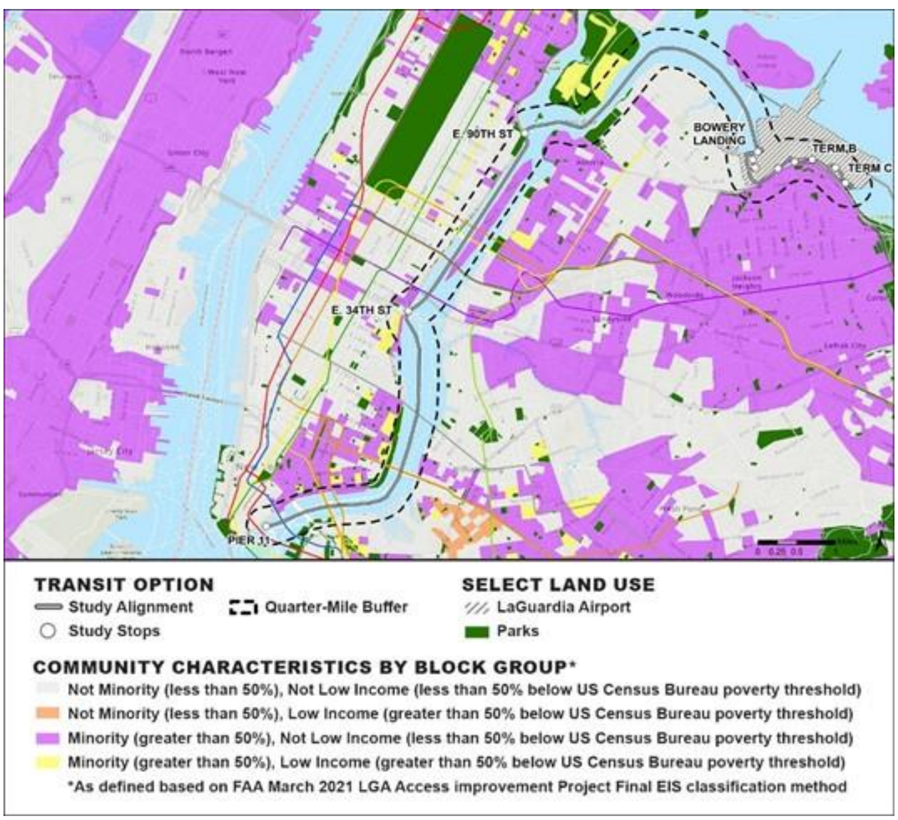

FIGURE 8.1-5: SUB-OPTION F-1A BOWERY BAY – ENVIRONMENTAL JUSTICE COMMUNITIES MAPPING ANALYSIS (AS DEFINED BASED UPON FAA MARCH 2021 LGA ACCESS IMPROVEMENT PROJECT FINAL EIS CLASSIFICATION METHOD)

Sub-Option F-1B (Flushing Bay)

For Sub-Option F-1B, less than half of the block groups within the 0.25-mile buffer of the option alignment are Environmental Justice block groups.

See Figure 8.1-6 below for the analysis map for F-1B.

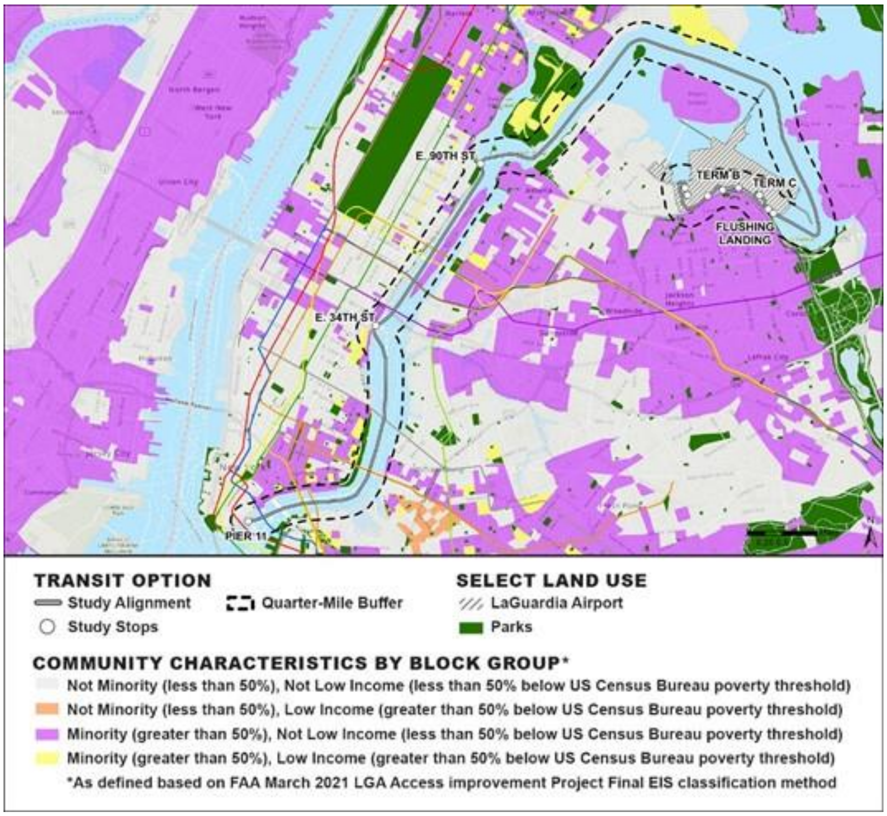

FIGURE 8.1-6: SUB-OPTION F-1B FLUSHING BAY – ENVIRONMENTAL JUSTICE COMMUNITIES MAPPING ANALYSIS (AS DEFINED BASED UPON FAA MARCH 2021 LGA ACCESS IMPROVEMENT PROJECT FINAL EIS CLASSIFICATION METHOD)

8.1.3.2 Equity

8.1.3.2.1 Transit Access from LGA

<u>Sub-Option F-1A (Bowery Bay)</u>

- **Additional Minority and Low-income Population Reached within 45 Minutes from LGA via Transit (Population Access Analysis)**
  - The results of the Population Access Analysis illustrate how many people, specifically from low-income and minority populations, could travel via transit from LGA to homes within 45 minutes from LGA. Airport passengers or Airport employees living within these areas could potentially benefit from expanded access to these destinations.
  - Option F-1A is not expected to expand transit access from LGA to regional destinations within 45 minutes (see Figure 8.1-7 below). Although there is a small area of additional access provided by the transit option (indicated in blue on the map), it is entirely on LGA property and therefore does not increase access to where people live. As a result, no additional minority or low-income population is reached within a 45-minute transit trip from LGA compared to the baseline as shown in Table 8.1-4.
  - This represents a lower increase in transit access to LGA within 45 minutes for minority and low-income communities.

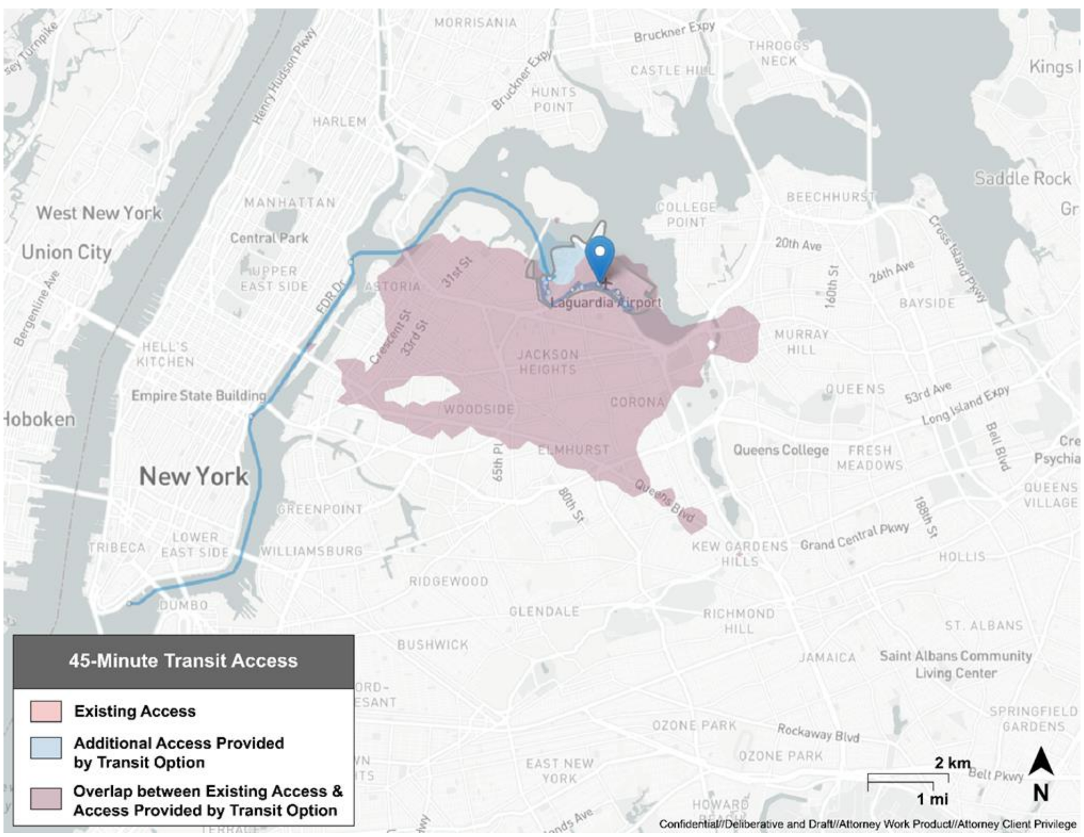

FIGURE 8.1-7: FERRY SERVICE + SHUTTLE BUS F-1A – POPULATION ACCESS ANALYSIS

TABLE 8.1-4: FERRY SERVICE + SHUTTLE BUS F-1A – POPULATIONS REACHED WITHIN 45-MINUTE TRANSIT TRIP

		Total Population Reached	Minority Population Reached	Low-Income Population Reached
Baseline	Existing Condition	551,434	422,981	76,750
F-1A	With Option	551,434	422,981	76,750
	Net Change	0	0	0
	% Change	0.0%	0.0%	0.0%

- **Additional ADA-Accessible Stations within 45 Minutes from LGA via Transit (ADA Analysis)**
  - The results of the ADA Analysis illustrate how Airport passengers and Airport employees, specifically those requiring ADA-compliant stations, traveling from LGA to other locations could potentially benefit from expanded access to ADA-compliant stations within 45 minutes via transit.
  - For Sub-Option F-1A, there is only one additional ADA-accessible station reached within the 45-minute transit trip from LGA compared to the baseline: the new ferry station for this sub-option (Table 8.1-5). No stations besides this are reached in addition to the new ferry station, because the sub-option does not expand the reach of how far one could travel via transit from LGA within 45 minutes.

TABLE 8.1-5: FERRY SERVICE + SHUTTLE BUS F-1A – ADA ANALYSIS

Subway, Ferry, LIRR, and MNR Stations Reached within 45-Minute Transit Trip from LGA	Baseline	F-1A	Difference between Baseline and F-1A
Total Stations	*43*	*44*	*+1 station*
ADA-Accessible Stations (Accessible Stations as % of Total)	*20 (47%)*	*21 (49%)*	*+1 station*

<u>Sub-Option F-1B (Flushing Bay)</u>

- **Additional Minority and Low-income Population Reached within 45 Minutes from LGA via Transit (Population Access Analysis)**
  - The results of the Population Access Analysis illustrate how many people, specifically from low-income and minority populations, could travel via transit from LGA to homes within 45 minutes from LGA. Airport passengers or Airport employees living within these areas could potentially benefit from expanded access to these destinations.
  - Sub-Option F-1B is not expected to expand transit access from LGA to regional destinations within 45 minutes, as shown in Figure 8.1-8. As a result, no additional minority population or low-income population is reached within a 45-minute transit trip from LGA compared to the baseline as shown in Table 8.1-6.

– This represents a lower increase in transit access to LGA within 45 minutes for minority and low-income communities.

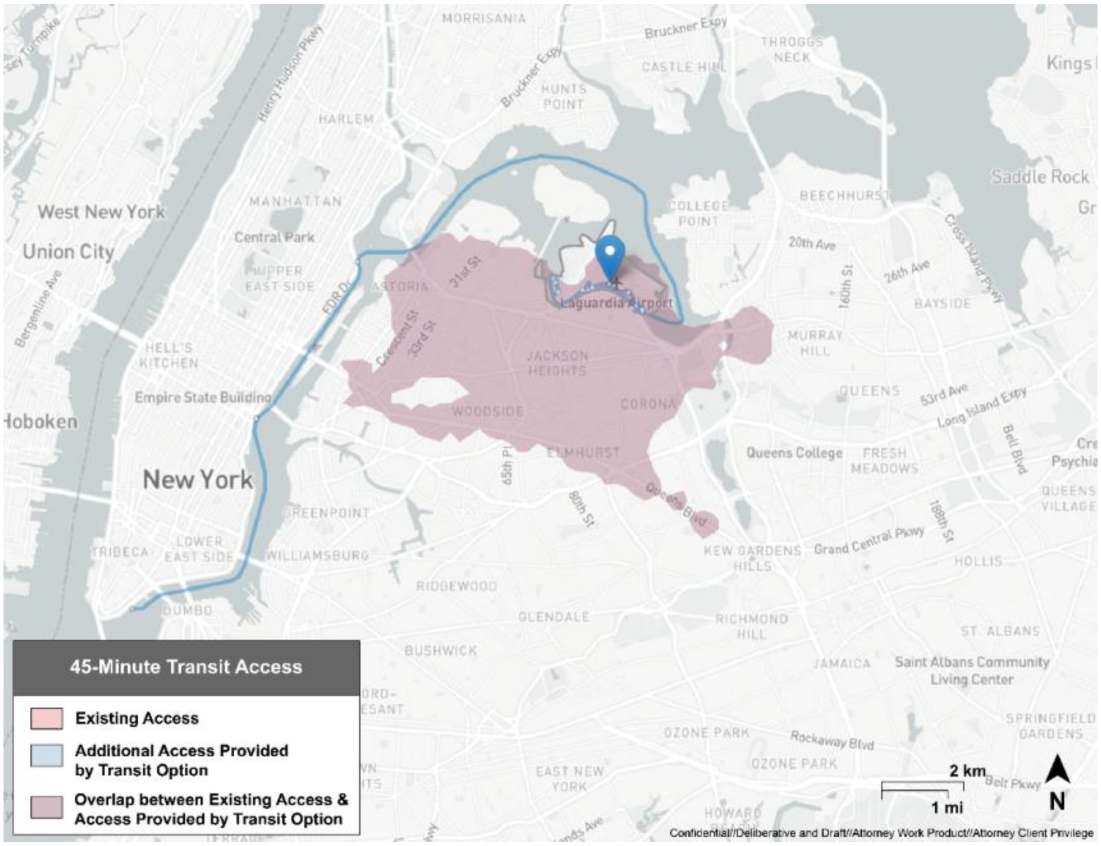

FIGURE 8.1-8: FERRY SERVICE + SHUTTLE BUS F-1B – POPULATION ACCESS ANALYSIS

TABLE 8.1-6: FERRY SERVICE + SHUTTLE BUS F-1B – POPULATIONS REACHED WITHIN 45-MINUTE TRANSIT TRIP

		Total Population Reached	Minority Population Reached	Low-Income Population Reached
Baseline	Existing Condition	551,434	422,981	76,750
F-1B	With Option	551,434	422,981	76,750
	Net Change	0	0	0
	% Change	0.0%	0.0%	0.0%

- **Additional ADA-Accessible Stations within 45 Minutes from LGA via Transit (ADA Analysis)**
  - The results of the ADA Analysis illustrate how Airport passengers and Airport employees, specifically those requiring ADA-compliant stations, traveling from LGA to other locations could potentially benefit from expanded access to ADA-compliant stations within 45 minutes via transit.
  - For Sub-Option F-1B, there is only one additional ADA-accessible station reached within the 45-minute transit trip from LGA compared to the baseline: the new ferry station for this sub-option (Table 8.1-7). No stations besides this are reached in addition to the new ferry station, because the option does not expand the reach of how far one could travel via transit from LGA within 45 minutes.

TABLE 8.1-7: FERRY SERVICE + SHUTTLE BUS F-1B – ADA ANALYSIS

Subway, Ferry, LIRR, and MNR Stations Reached within 45-Minute Transit Trip from LGA	Baseline	F-1B	Difference between Baseline and F-1B
Total Stations	*43*	*44*	*+1 station*
ADA-Accessible Stations (Accessible Stations as % of Total)	*20 (47%)*	*21 (49%)*	*+1 station*

8.1.3.2.2 Transportation Opportunities and Benefits for the Surrounding Community

<u>Sub-Option F-1A (Bowery Bay)</u>

- **Transportation Opportunities for Neighbors**

  This option does not include new intermediate/off-Airport stops. Because there is limited pedestrian access to LGA from adjacent residential areas and walking distance exceeds 0.25 mile, the study team did not consider there to be a significant market for use of ferry options by the surrounding community to connect to the broader transit network.

- **Cars Removed from Local Roadways and Emissions Reductions**

  See the "Cars Removed from Local Roadways" section and the "GHG and Other Vehicular Emissions Reductions" section of this evaluation below.

<u>Sub-Option F-1B (Flushing Bay)</u>

- **Transportation Opportunities for Neighbors**

  This option does not include new intermediate/off-airport stops. Because there is limited pedestrian access to LGA from adjacent residential areas and walking distance exceeds 0.25 mile, the study team did not consider there to be a significant market for use of the final on-Airport stops by the surrounding community to connect to the broader transit network.

- **Cars Removed from Local Roadways and Emissions Reductions**

  See the "Cars Removed from Local Roadways" section and the "GHG and Other Vehicular Emissions Reductions" section of this evaluation below.

8.1.3.3 Cars Removed from Local Roadways

Sub-Option F-1A (Bowery Bay)

- Sub-Option F-1A would be expected to remove 190,000 Airport passenger vehicles, and 3,000 Airport employee vehicles, from the road each year.

Sub-Option F-1B (Flushing Bay)

- Sub-Option F-1B would be expected to remove 198,000 Airport passenger vehicles, and 4,000 Airport employee vehicles, from the road each year.

8.1.3.4 GHG and Other Vehicular Emissions Reduction

Sub-Option F-1A (Bowery Bay)

- Sub-Option F-1A would be expected to remove 656 metric tons of CO_2 equivalent each year.
- Other vehicular emissions are given in Table 8.1-9.

Sub-Option F-1B (Flushing Bay)

- Sub-Option F-1B would be expected to remove 780 metric tons of CO_2 equivalent each year.
- Other vehicular emissions are given in Table 8.1-8:

TABLE 8.1-8: OTHER VEHICULAR EMISSIONS REDUCTION (METRIC TONS PER YEAR)

Option	CO	VOC	NOx	SO_2	PM_{10}	$PM_{2.5}$
[F-1A] Bowery Bay	3.1	0.04	0.2	0.01	0.1	0.02
[F-1B] Flushing Bay	3.7	0.1	0.2	0.01	0.1	0.03

8.1.4 Summary of Evaluation

Since LGA is located on the northern Queens waterfront, it can be reached via direct ferry service from Manhattan. A ferry from Manhattan would provide access from three piers, Pier 11 (Wall Street), Pier 34 (Midtown), and Pier 90 (Upper East Side). To reach one of the piers, riders would need to either walk or take a bus, taxi, or private vehicle to access the ferry. Once on the ferry, passengers would avoid possible traffic congestion and traffic delays but would face reduced appeal as a result of bad weather. Upon arriving at the Airport at the Bowery Bay landing, the approximately 90% of airport passengers utilizing Terminals B and C would need to board a shuttle bus to access those terminals. The Flushing Bay landing would require an on-Airport shuttle to access all three terminals.

The journey time to complete travel has been estimated at 81–83 minutes (including approximately 19 minutes to reach the ferry terminals at the East River from Midtown Manhattan and 29–37 minutes on the ferry from West 34th St), the longest of all the options considered. As a result, the ridership for the ferry options has been projected to be low generating an increase of travelers using public transit of about 0.4 additional (0.7 million total) passengers per year (the lowest of all the options evaluated).

Although the ferries are an attractive option because they would generate few impacts on neighborhoods, the low ridership is a serious limitation on their suitability as a mass transit solution for LGA. In comparison, upgrading the existing Q70-SBS bus (B-1C) route is projected to provide about 1.6 million additional (2.7 million total) transit riders at about half the cost ($100 million for the improved Q70-SBS versus $140–240 million for the ferry options). In addition, the ferry options face severe potential impacts from storms and inclement weather that could potentially disrupt ferry operations and affect the reliability of the service.

The EDC has recently sent out a Request for Proposals (RFP) to broaden City ferry services, including the option of providing such branded service to LGA, if the operator chooses to do so.

F-1A: Express Ferry Service + Shuttle Bus to Bowery Bay

This sub-option would require the construction of a new bus loading area and ferry landing on-Airport and piling and marine dredging in Bowery Bay.

Table 8.1-9 summarizes the output from all the factors used to evaluate this option.

TABLE 8.1-9: SUMMARY OF KEY CHARACTERISTICS – FERRY SERVICE + SHUTTLE BUS TO BOWERY BAY (F-1A)

	Evaluation Factor	Assessment
CONSTRN ASPECTS	Constructability	• Construction of new bus loading area and ferry landing on-Airport • Provision and siting of new ferry storage/maintenance facility • Total option route length: approx. 7 miles (from Pier 34 in Midtown Manhattan)
	Infrastructure Impacts during Construction	• Provision of on-Airport construction laydown • Vehicle traffic on- and off-Airport
	Permanent/Operational Impacts to Existing Infrastructure	• Increased on-Airport shuttle bus traffic on terminal road network
	Indicative Capital Cost (2022$)[110]	$130 million
	Indicative Timeline/Schedule	3–4 Years
TRANSPORTATION ASPECTS	Standardized Indicative Baseline Off-Peak Travel Time (From Midtown Manhattan)	Via M34 bus: 80 mins (19 mins on M34 bus to East River ferry stop, 29 mins on ferry, 16 mins on Airport shuttle bus) (Penn Station to Terminal C) Via M34 bus: 59 mins (19 mins on M34 bus to East River ferry stop, 29 mins on ferry) (Penn Station to Terminal A)
	Transfer Experience	• Transfer: 3 mode changes and 2 transfers from Midtown Manhattan • Need to walk or take bus from Midtown to get to the pier/ferry landing • Bus stops on Marginal Street are around 150 ft from the East 34th St pier and 300–400 feet from the embarkation gangways • Short walk to Terminal A and on-Airport bus pick-up • Passengers for Terminals B and C would need to board a shuttle bus to those terminals
	Ridership[111]	Total annual projected ridership for option: 0.7 million Net increase in annual projected transit ridership: 0.4 million
	Throughput & Capacity	300 pphpd (peak)
	Indicative Operating Cost	$11 million per annum

[110] Indicative Capital Costs should be considered to have a range of estimating uncertainty of –10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).
[111] Experience from AirTrain JFK was that actual ridership turned out to be higher than would have been predicted by the AirTrain JFK forecast and underscores the inherent uncertainty of model predictions. The ridership model supporting this effort could also deviate from eventual ridership demand but was utilized to allow ridership comparisons between the options.

TABLE 8.1-9, CONTINUED.

	Evaluation Factor	Assessment
COMMUNITY AND ENVIRONMENTAL ASPECTS	Local Community Impacts	Construction: • Marine and on-Airport construction work for approx. 1 year Proximity to communities: • Communities over 300 ft from piling and marine dredging in Bowery Bay • Communities over 300 ft from ferry terminal structures near LGA Terminal A Permanent impacts: • No permanent private property acquisition • No impacts to NYC parklands or plazas • No permanent loss of on-street public parking spaces
	Equity	• Lower increase to low-income and minority populations within 45 minutes of the Airport via transit versus the no-build scenario • +1 additional ADA-compliant stations reachable within a 45-minute transit trip from LGA versus the no-build scenario
	Cars Removed from Local Roadways	190,000 airport passenger vehicles and 3,000 airport employee vehicles from the road each year
	GHG and other Vehicular Emissions Reductions	656 metric tons of CO_2 equivalent each year

F-1B: Express Ferry Service + Shuttle Bus to Flushing Bay

This sub-option would require the construction of a new bus loading area and ferry landing on-Airport, piling and marine dredging in Flushing Bay, and land reclamation and seawall reconstruction around the new Terminal C facility.

Table 8.1-10 summarizes the output from all the factors used to evaluate this option.

TABLE 8.1-10: SUMMARY OF KEY CHARACTERISTICS – FERRY SERVICE + SHUTTLE BUS TO FLUSHING BAY (F-1B)

	Evaluation Factor	Assessment
CONSTRUCTION ASPECTS	Constructability	• Dredging in Flushing Bay required • Land reclamation and existing seawall reconstruction around Terminal C required for access to Airport roadways • Provision and siting of new ferry storage/maintenance facility • Total option route length: approx. 10 miles (from Pier 34 in Midtown Manhattan)
	Infrastructure Impacts during Construction	• Provision of on-Airport construction laydown • Vehicle traffic on- and off-Airport
	Permanent/Operational Impacts	• Increased on-Airport shuttle bus traffic on terminal road network
	Indicative Capital Cost (2022$)[112]	$240 million
	Indicative Timeline/Schedule	4–5 Years
TRANSPORTATION ASPECTS	Standardized Indicative Baseline Off-Peak Travel Time (From Midtown Manhattan)	Via M34 bus: 82 mins (19 mins of M34 bus to East River ferry stop, 37 mins on ferry) (Penn Station to Terminal C)
	Transfer Experience	• Transfer: 3 mode changes and 2 transfers from Midtown Manhattan • Need to walk or take bus from midtown to get to the pier/ferry landing • Bus stops on Marginal Street are around 150 ft from the East 34th St pier and 300–400 feet from the embarkation gangways • Longer walk to Airport bus pick-up (approx. 1,200 ft walk from ferry landing) • Passengers for all LGA terminals would need to board a shuttle bus to those terminals
	Ridership[113]	Total annual projected ridership for option: 0.7 million Net increase in annual projected transit ridership: 0.4 million
	Throughput & Capacity	300 pphpd (peak)
	Indicative Operating Cost	$11 million per annum

[112] Indicative Capital Costs should be considered to have a range of estimating uncertainty of –10% to +30% as a result of the preliminary nature of engineering undertaken (less than 1%).

[113] Experience from AirTrain JFK was that actual ridership turned out to be higher than would have been predicted by the AirTrain JFK forecast and underscores the inherent uncertainty of model predictions. The ridership model supporting this effort could also deviate from eventual ridership demand but was utilized to allow ridership comparisons between the options.

TABLE 8.1-10, CONTINUED.

	Evaluation Factor	Assessment
COMMUNITY AND ENVIRONMENTAL ASPECTS	Local Community Impacts	Construction: • Marine and on-Airport construction work for approx. 2 years Proximity to communities: • Communities over 500 ft across 8 lanes of the GCP from piling, marine dredging, land reclamation work in Flushing Bay, and ferry terminal structures near Terminal C Permanent impacts: • No permanent private property acquisition • No impacts to NYC parklands or plazas • No permanent loss of on-street public parking spaces
	Equity	• Lower increase to low-income and minority populations within 45 minutes of the Airport via transit versus the no-build scenario • +1 additional ADA-compliant stations reachable within a 45-minute transit trip from LGA versus the no-build scenario
	Cars Removed from Local Roadways	198,000 airport passenger vehicles and 4,000 airport employee vehicles from the road each year
	Greenhouse Gas and other Vehicular Emissions Reductions	780 metric tons of CO_2 equivalent each year

9.0 EMERGING TECHNOLOGIES

The study team employed two independent consultants to analyze the current state of emerging technologies in both foreign and domestic markets. These technologies include:

- Heavy infrastructure solutions such as hyperloop, electric vehicles in narrow tunnels, and personal and group rapid transit systems;
- Light infrastructure solutions such as electric scooters and flying drones/taxis;
- Variants of existing technologies such as connected autonomous vehicles, aerial trams, electric ferries, and gondolas.

The study team considered examples from the US and around the world to determine their applicability to LGA and their capability to deliver the high-volume transit solutions needed to significantly increase transit access to the Airport. After a thorough review the study team found that each of the emerging technologies suffer from one or more of the following flaws:

- By their design, they lack the operating capacity, speed, and/or performance needed to effectively deliver mass transit to the airport.
- Working prototypes exist but the technology is still years away from being mature enough for implementation.
- Working prototypes that could serve as the basis for proper evaluation are still under development.

Despite these current drawbacks, the study team concluded that some of these technologies are likely to mature into more viable mass transit solutions in the future. Given the rapid development in the autonomous vehicle market, it is likely that mass transit autonomous vehicles will one day be able to successfully navigate in pedestrian-heavy mixed-flow traffic environments, which would make them suitable for service to a busy airport terminal frontage. Likewise, other technologies explored may also be considered in the future as they become more mature.

9.1 Preliminary Observations

9.1.1 Heavy Infrastructure Observations

New heavy infrastructure options such as electric vehicles in narrow tunnels, hyperloop, or other pod-like transportation that in tunnels could potentially provide a one-seat ride from Midtown Manhattan to LGA; however, the existing market solutions are not sufficiently mature to allow the same level of analysis as other options. To be considered for future evaluation, the vendor would need to demonstrate to the Port Authority that such a technology could be successfully deployed, either through demonstrations or working installations, and could achieve the stated performance metrics. There is only one operational example of the electric vehicles in narrow tunnels concept, the Las Vegas Convention Center (LVCC) Loop, and currently no operational prototypes of a hyperloop system, which would involve a high-speed rail vehicle in a de-pressurized tube. Options of this type were therefore not advanced for further study for the following reasons:

- New, proprietary tunnel boring technology has never been deployed to construct a tunnel of the length required to go from Midtown Manhattan to LGA. The only currently operational example of this technology is the LVCC Loop, which is less than 2 miles long, whereas a connection to LGA would be at least 6 miles and traverse a variety of soil and rock conditions, including a crossing under the East River. In addition to the geographic complexities of New York City, there is also a vast network of underground infrastructure, including subways, utility lines, and piled foundations, that would need to be avoided by any tunneled alignment.
- Although a tunneled alignment has the general advantage of avoiding surface obstacles and roadway traffic, there still are numerous challenges to consider.
    - Ventilation: A system of this length would need to have adequate ventilation to meet code requirements. These vents would likely have impacts to properties on the surface.
    - Emergency Egress: In such a lengthy system, emergency exits would need to be provided, which could result in additional property takings at the surface.
    - Property: Although the rolling stock would have the maneuverability of a private vehicle, the tunnel boring machine itself would likely have a much wider turning radius, perhaps near 1,000 ft. This presents a challenge in finding an alignment that minimizes the acquisition of private property, or the obtaining of subterranean easements.
    - Maintenance and Control Facility (MCF): A location would need to be determined for this facility, which ideally would be located very close, if not attached, to the tunnel. If this MCF is not directly attached to the loop system, additional traffic impacts to the community would be expected. This MCF location would need adequate space to service and charge all of the vehicles. It is unclear whether an MCF would need to be positioned at a terminus of a hyperloop system.
    - LVCC Loop Rolling Stock: The only operational system of electric vehicles in narrow tunnels, the LVCC Loop, utilizes Tesla passenger vehicles that require human drivers and can only fit a maximum of 4 passengers along with the vehicle operator. Without higher-capacity autonomous vehicles, which may be possible but are not currently in use, the operation and

maintenance cost of this system could be potentially much higher than other options, and storage of the vehicles required to provide the service could prove challenging. To date, the LVCC has only achieved its designed capacity of 2,200 passengers per hour per direction in controlled tests.

- Adoption of rolling stock that more closely aligns with an autonomous group rapid transit (GRT) system would significantly reduce the risks associated with this solution, since it could:
    - Provide a platform-level boarding experience with luggage being placed on racks or on the floor inside the vehicle versus having to load and unload luggage from a trunk. This would be more time-efficient and contribute to lower operating costs.
    - Accommodate wheelchair-using passengers who, otherwise, would either need to call a specialized vehicle equipped with a wheelchair lift or need to be assisted into the vehicle by a customer service representative.
    - Enable higher system throughput. Although the tunnel technology does not preclude use of a larger GRT-type vehicle, it is unclear whether such a platform is currently under development.
    - Hyperloop rolling stock: there are currently no operational prototypes of a Hyperloop system capable of carrying passengers that would allow for a proper evaluation.

9.1.2 Light Infrastructure Observations

New light infrastructure options such as electric scooters and aerial taxis / flying drones were deemed to not have enough operating capacity to provide a true mass-transit solution to the airport.

Drones and aerial taxis have the advantage of not requiring a lot of space to move passengers over long distances. With a pad of concrete, an aerial taxi carrying a family can comfortably take off and land in a variety of locations. Presently, an aerial taxi service, Blade, does serve the Port Authority airports from Manhattan; however, the prices are prohibitively high for most customers. If a new technology, such as an unmanned electric done, were to allow the price to be more competitive with other modes, it is possible that this could be considered a more viable solution in the future. Presently, however, the technology necessary to make this a viable solution is not mature. Therefore, the study team did not consider this to be a viable solution to increasing mass transit access to LaGuardia.

Light, individual modes such as electric bikes and scooters, though gaining popularity for shorter personal trips, were also seen as an unlikely mode choice for travelers with luggage, possibly also traveling as part of a group. Although the airport is seeking to become more amenable to these types of mode choices, the study team did not consider increasing access to LaGuardia via electric bike, scooter, or other light individual mode as a viable mass transit solution.

9.1.3 Variants of Existing Technologies

The study team also considered other variants on existing technologies such as high-speed electric ferries, connected autonomous vehicles, and aerial trams and gondolas. Electric ferries and aerial trams both suffered from a lack of throughout and capacity.

- Aerial trams generally operate between two points with two vehicles moving at the same time in opposite directions. Depending on the length of the journey, this can create long wait times at either terminus, with generally an extended dwell period to pick up passengers before moving again. This mode is particularly susceptible to high winds. Therefore, aerial trams were not seen as a viable solution to increase mass transit to LaGuardia Airport.
- Ferries generally are unable to operate at high frequencies because of the length of their journey. Even if an electric, high speed ferry was able to significantly reduce the travel time between Manhattan and the airport, it would still be susceptible to the same weather restrictions as its traditional counterpart. There are currently no commercially available examples of a high speed ferry that would make this a viable option.
- Gondolas have been deployed in other places with challenging geography to increase access at a relatively inexpensive price. The study team found that these systems, while service-proven, are unlikely to be able to provide the level of service necessary to be the primary mode of access to a major airport. Furthermore, the length of alignments that would need to be considered, along with the restrictions on above-grade solutions, create serious design challenges for a gondola. For these reasons, the study team did not consider a gondola to be a viable solution to increase mass transit access to LaGuardia Airport.
- Connected Autonomous Vehicles, whether a fleet of buses or taxis, would have the ability to run at-speed in mixed-flow traffic in the variety of conditions experienced in and around LaGuardia Airport including highways, local arterial roadways, and airport frontages. Unfortunately, none of the technologies currently available are able to legally operate in all of these environments.

10.0 ADDITIONAL PROPOSALS RECEIVED

Additional proposals received are included in Section 1.5 of the Appendix.

11.0 GLOSSARY OF TERMS

Term	Definition
Articulated Bus	A bus with two rigid sections joined by a flexible central pivot allowing for greater length and capacity than a traditional bus.
Back-of-house space	Space associated with a station or other transit building that is not accessible to the public. The size and layout of the back-of-house space is generally dictated by the operational and functional requirements of the building, transit system and operator and would include space for plant, operations and amenities for staff and employees.
Bus Rapid Transit	A form of mass transit that uses buses or similar specialized vehicles on separated roadways (Busways, see below) or dedicated lanes (Bus Lanes, see below). Bus Rapid Transit (BRT) quickly and efficiently transport passengers to their destinations, while offering the flexibility to meet a variety of local conditions.
Bus Lane	An existing or new roadway lane (or lanes) dedicated to the use of bus or Bus Rapid Transit vehicles. Bus lanes may have varying levels of exclusivity and separation from general traffic. A bus lane may be separated from other roadway lanes with physical barriers or with paint to designate its purpose. Some bus lanes may allow non-bus traffic under certain conditions, while dedicated bus lanes are exclusively for the use of bus or Bus Rapid Transit vehicles. Implementation may require light levels of intervention and impacts, including repurposing general-purpose lanes for bus-only circulation.
Busway	A two-direction roadway for exclusive use of bus transit vehicles, physically separated from other general-purpose vehicles. The roadway can be at-grade, elevated, or tunneled. Physical separation could be in the form of a barrier, landscaping, or other similar treatments. Implementation may require high-level of intervention and impacts, including heavier construction and-or full street closures for general through traffic.
Fixed Guideway	A right-of-way completely grade-separated from general-purpose traffic, capable of handling a variety of vehicles from personal rapid transit pods to light rail.
Fuel Farm	Area designated for the installation of bulk fuel storage tanks and related equipment necessary to store and dispense aviation fuel.
Headway	The time interval between vehicles moving in the same direction on a particular route. For example, if there is a route that departs Cherry St every 30 minutes, it has half-hour headways.
Midday off-peak	The period on weekdays between the end of the morning peak travel period and the beginning of the evening peak travel period.
Mixed-Flow Traffic	Standard general-purpose travel lanes where bus transit vehicles operate in a mixed environment with all vehicle types.
NYC Parkland	Land under the jurisdiction of the New York City Department of Parks and Recreation (NYC Parks). The New York City Department of Parks and Recreation

Term	Definition
	is the steward of more than 30,000 acres of land — 14% of New York City — including more than 5,000 individual properties.
NYC Plaza Program	A program administered by the New York City Department of Transportation (NYC DOT) that transforms underutilized public roadways into social public spaces. The NYC Plaza Program is a key part of the City's effort to ensure that all New Yorkers live within a 10-minute walk of a quality open space.
Re-channelization	The redesign or re-construction of traffic lanes and islands/medians in a way that provides definite paths for vehicles to follow through an intersection. Effective re-channelization reduces points of conflicting traffic movements and helps to separate traffic flow.
Runway Protection Zone	As explained by FAA, “runway protection zones are a trapezoidal area ‘off the end of the runway that serves to enhance the protection of people and property on the ground’ in the event an aircraft lands or crashes beyond the runway end. Runway Protection Zones underlie a portion of the approach closest to the airport.” At LGA, the runway protection zone for Runway 04-22 crosses the GCP and adjacent roadways.
Transit Signal Priority	Transit Signal Priority tools modify traffic signal timing or phasing when transit vehicles are approaching a signalized intersection to reduce time transit vehicles spend at red lights. Transit Signal Priority (TSP) is typically in the form of extending a green phase for transit, beginning a green phase early for transit, or a dedicated transit signal phase.
Travel Shed	A geographic catchment area for transit within which residents and employees may be likely to use the relevant transit option.
Peak Hours	For the purposes of this Report, Peak Hours are Peak commuting hours within NYC. They are defined by the MTA as 6 AM-10 AM in the Manhattan-bound direction and 4 PM-8 PM in the outbound direction. Highways and local roadways experience their maximum traffic congestion during these times.
Wait Time	The time spent by passengers while waiting for a transit vehicle.

12.0 STUDY APPENDIX

[Under separate cover]