FAIRMOUNT LINE STATION-ACCESS ANALYSIS

An Assessment of the Safety and Comfort of Bicycle and Pedestrian Access to Five Fairmount Line Stations

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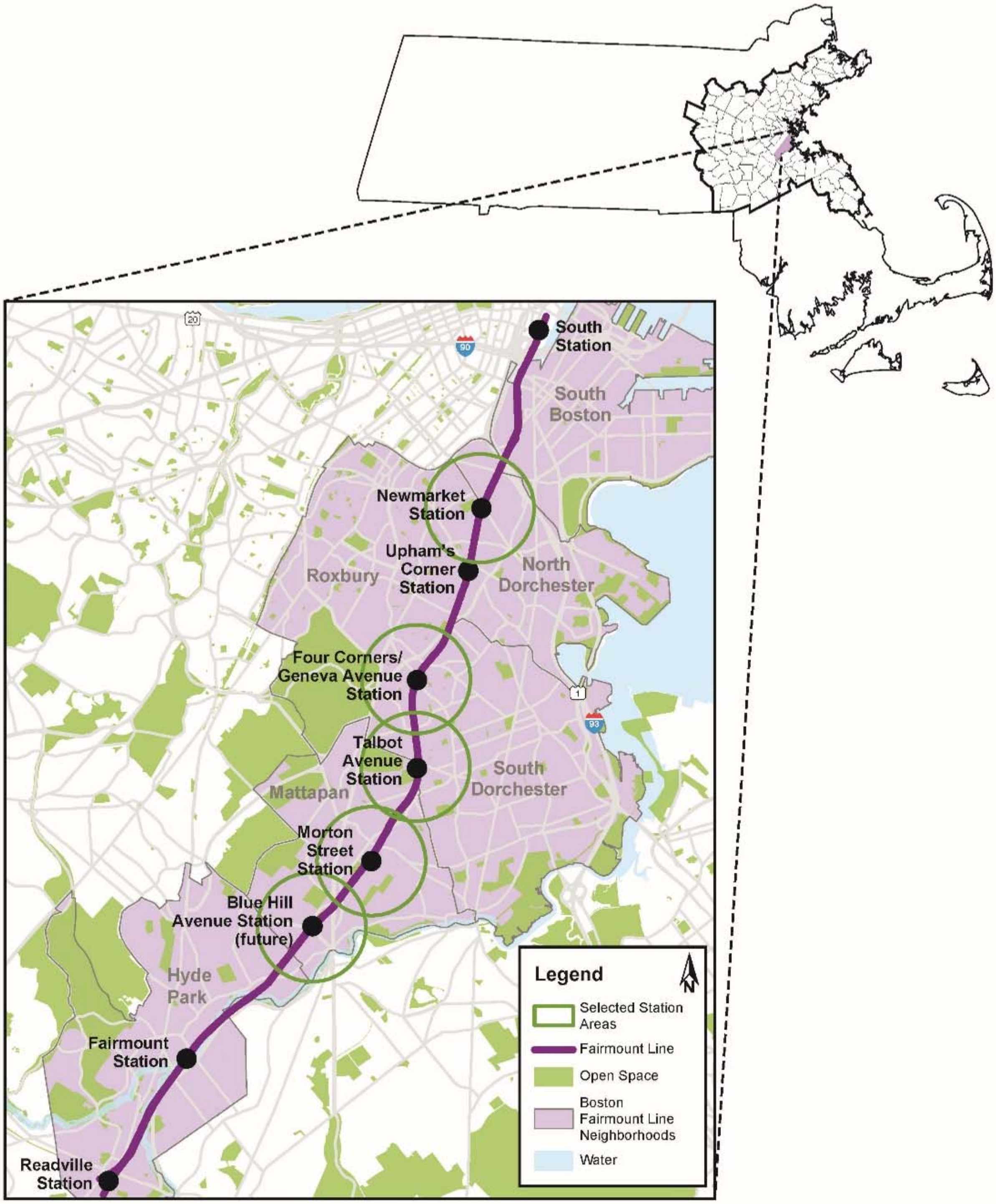

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Abstract

This report documents the existing bicycle and pedestrian travel conditions within a half-mile radius of five stations on the Massachusetts Bay Transportation Authority (MBTA) commuter rail Fairmount Line. The Fairmount Line is the only MBTA commuter rail branch that exclusively serves the City of Boston, traveling through its Downtown, South Boston, Roxbury, Dorchester, Mattapan, and Hyde Park neighborhoods. Apart from South Station, there are currently seven Fairmount Line stations, with plans to add an eighth. Including the planned station (Blue Hill Avenue), the eight stations on the line are Newmarket, Upham's Corner, Four Corners/Geneva Avenue, Talbot Avenue, Morton Street, Fairmount, and Readville. Using the ActiveTrans Priority Tool (APT), five of these stations were selected for analysis: Newmarket, Four Corners/Geneva Avenue, Talbot Avenue, Morton Street, and Blue Hill Avenue. MPO staff traveled by foot and on bike through the five selected station areas along Boston Bike Network roadways and the Fairmount Greenway path, and noted the conditions of the bicycle and pedestrian environment. MPO staff assessed bicycle facilities, bike racks, pedestrian signals, sidewalks, curb ramps, detectable warnings, and pavement markings. This report presents staff's assessments of the five station areas, followed by improvement recommendations, and cost estimates for each station area analyzed.

Four appendices are included at the end of this report:

- Appendix A explains the APT and the station-area selection process.
- Appendix B describes different types of bicycle and pedestrian infrastructure, outlining their associated requirements.
- Appendix C compiles feedback received from the public.
- Appendix D documents differences between the pedestrian signal measurements taken by MPO staff and the City of Boston's records of the same conditions, in order to indicate the locations at which signal timings should be restored to their recorded conditions.

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1.1.2 Study Area

The MBTA offers commuter rail service between Boston's central business district (CBD) to Readville along its 9.2-mile Fairmount Line (see Figure 1-1). The line begins at South Station and passes through the Downtown, South Boston, Roxbury, Dorchester, Mattapan, and Hyde Park neighborhoods. Since 2012, the MBTA has opened three new stations as part of the Fairmount Line improvement program: Talbot Avenue, Newmarket, and Four Corners/Geneva Avenue, all located in Dorchester. These additions, along with the anticipated Blue Hill Avenue Station in Mattapan, are located outside of Boston's CBD, as are the pre-existing stations: Readville (Readville/Hyde Park), Fairmount (Hyde Park), Morton Street (Mattapan), and Upham's Corner (Roxbury). The Fairmount Line is the only MBTA Commuter Rail Branch that exclusively serves the City of Boston.[1]

1.1.3 Study Purpose

The Boston Region Metropolitan Planning Organization (MPO) conducted this study to build upon the Boston Redevelopment Authority (BRA)'s Fairmount Indigo Planning Initiative, a three-year study launched in February 2012.[2] The Fairmount Line is located in some of Boston's most disadvantaged neighborhoods,[3] which for years only received rail service from Fairmount Line trains with high fare structures and infrequent stops.[4] Approximately 132,000 residents live within a half mile of the Fairmount Line,[5] which provides direct access to the center of downtown Boston, but inbound boarding totals for a typical weekday on the Fairmount Line from 2007 to 2013 were the lowest of all MBTA commuter rail lines.[6] Poor access to public rail transportation in the communities

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[1] *Fairmount Line Improvements*; Massachusetts Bay Transportation Authority; <<http://mbta.com/about_the_mbta/t_projects/default.asp?id=14261>>.

[2] *Fairmount Indigo Planning Initiative*; City of Boston Redevelopment Authority; 2016; <<http://www.bostonredevelopmentauthority.org/planning/planning-initiatives/fairmount-indigo-planning-initiative>>.

[3] *Fairmount Indigo Planning Initiative Corridor Plan*; City of Boston Redevelopment Authority; September 2014; page 6.

[4] *Fairmount Indigo Planning Initiative Corridor Plan: Executive Summary*; City of Boston Redevelopment Authority; September 2014; page 4.

[5] *Fairmount Indigo Planning Initiative*; City of Boston Redevelopment Authority; <<http://www.bostonredevelopmentauthority.org/planning/planning-initiatives/fairmount-indigo-planning-initiative>>.

[6] *Ridership and Service Statistics (Fourteenth Edition);* Massachusetts Bay Transportation Authority; July 2014; page 78 (Chapter 4, Page 7).

surrounding the Fairmount Line has a long history; and these circumstances have established considerable barriers to economic opportunity for both residents and businesses.

The goal of the BRA's Fairmount Indigo Planning Initiative was to identify ways in which the City of Boston could address the critical need for economic growth and physical improvement along the Fairmount Line.[7] Through the planning initiative, the BRA considered short- and long-term strategies for encouraging public realm improvements and increase job access and capital investment along the corridor.[8] Over the course of three years, the BRA completed a corridor plan as well as studies of the Upham's Corner, Four Corners/Geneva Avenue, and Blue Hill Avenue station areas.[9] The initiative is discussed in further detail below (Section 1-5).

The purpose of this Boston Region MPO study is to build upon the work of the BRA to improve non-motorized transportation options within the neighborhoods surrounding the Fairmount Line, specifically regarding the safety and comfort of residents walking and bicycling to Fairmount Line stations. To identify impediments to bicycle and pedestrian travel, the study assesses the environment within a half-mile radius of five selected Fairmount Line stations and provides recommendations for improving each station area.

[7] *Fairmount Indigo Planning Initiative Corridor Plan*; City of Boston Redevelopment Authority; September 2014; page 6.

[8] *Fairmount Indigo Planning Initiative*; City of Boston Redevelopment Authority; <<http://www.bostonredevelopmentauthority.org/planning/planning-initiatives/fairmount-indigo-planning-initiative>>.

[9] *Ibid*.

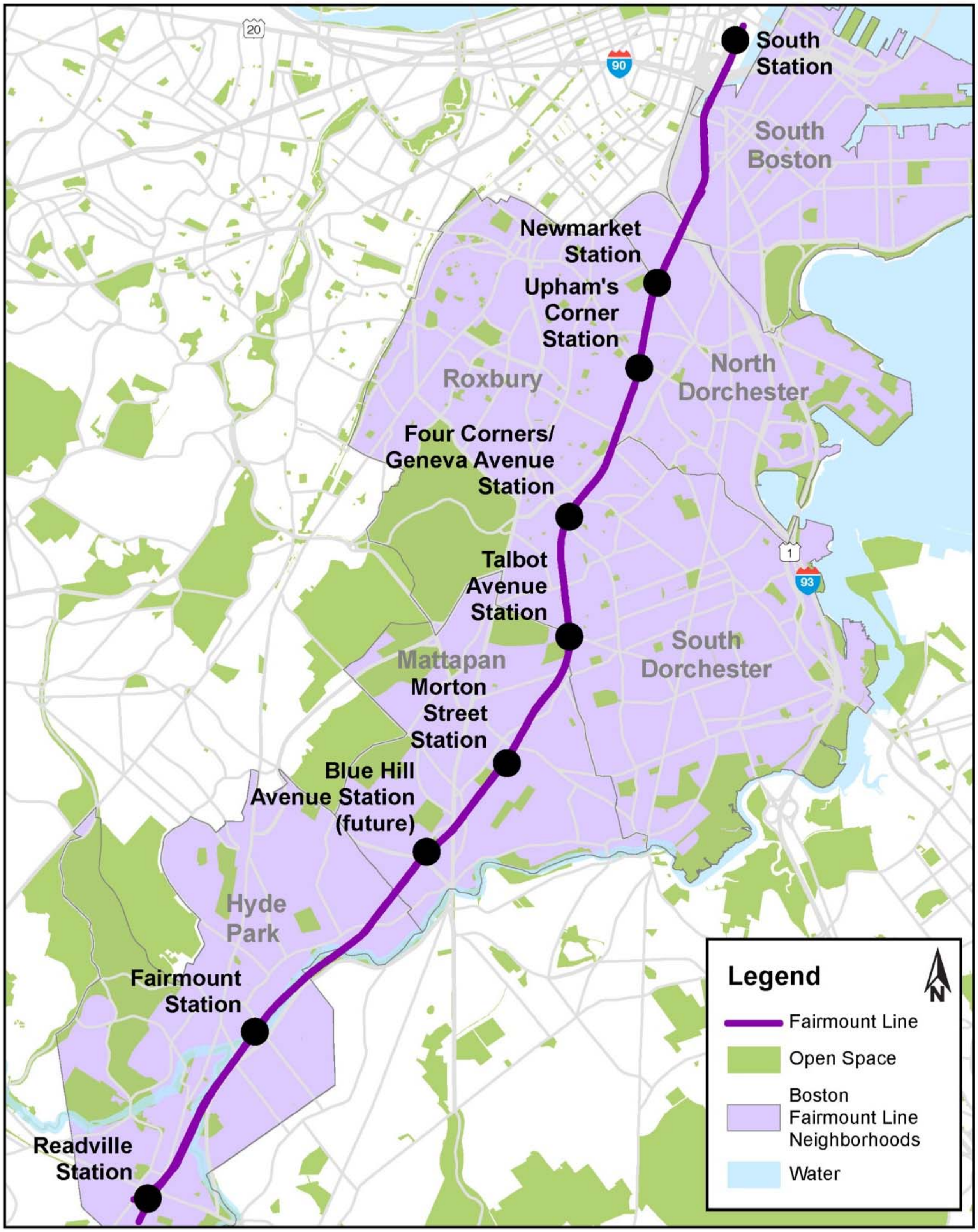

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FIGURE 1-1
MBTA Fairmount Line Stations in City of Boston Neighborhoods

Fairmount Line Station Access Analysis

1.1.4 Fairmount Line History

The Fairmount Line initially opened in January 1855 as part of the Boston and New York Central Railroad "Midland Railroad."[10] The Town of Dorchester filed an injunction within six months of the line's opening that halted the trains until the railroad removed all grade crossings in Dorchester.[11] After service resumed in 1856, passenger service under various corporate entities continued uninterrupted along the line for 88 years.[12] Passenger service was abandoned on the line in 1944 after competition from other transit modes reduced ridership, but freight operations continued to use the line.[13]

In 1979, construction along the Southwest Corridor—that runs from Back Bay Station to Forest Hills Station through the Back Bay, South End, Roxbury, and Jamaica Plain neighborhoods of Boston[14]—led the MBTA to restore passenger service on what is now the Fairmount Line when trains headed to South Station were redirected through Dorchester.[15] In order to accommodate the renewed passenger service, infrastructure along the Dorchester Branch right-of-way was upgraded.[16] The MBTA considered the Dorchester Branch a temporary service, and most passenger service was reassigned to the Southwest Corridor in 1987 upon completion of the Southwest Corridor project[17], which developed recreational facilities and open space by creating the Southwest Corridor Park and provided mass transit by relocating the Orange Line along the Southwest Corridor.[18] However, in spite of the MBTA's intentions, public sentiment pushed for continued Dorchester Branch service.[19] In response, MBTA Railroad Operation designed the "Fairmount Line" as a rail-based shuttle service between Readville

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[10] *Fairmount Line Feasibility Study*; KKO and Associates, L.L.C., and HNTB Companies; Massachusetts Bay Transportation Authority Planning Department; October 16, 2002; page 2.
[11] *Ibid*.
[12] *Ibid*.
[13] *Ibid*.
[14] *Southwest Corridor Park*; Executive Office of Energy and Environmental Affairs of the State of Massachusetts; http://www.mass.gov/eea/agencies/dcr/massparks/region-boston/southwest-corridor-park.html.
[15] *Fairmount Line Feasibility Study*; KKO and Associates, L.L.C., and HNTB Companies; Massachusetts Bay Transportation Authority Planning Department; October 16, 2002; page 2.
[16] *Ibid*.
[17] *Ibid*.
[18] *Southwest Corridor Park*; Executive Office of Energy and Environmental Affairs of the State of Massachusetts; http://www.mass.gov/eea/agencies/dcr/massparks/region-boston/southwest-corridor-park.html.
[19] *Fairmount Line Feasibility Study*; KKO and Associates, L.L.C., and HNTB Companies; Massachusetts Bay Transportation Authority Planning Department; October 16, 2002; page 2.

and South Station to replace the service that had been rerouted to the Southwest Corridor.[20]

1.1.5 Fairmount Line Updates

The Fairmount Line Feasibility Study, published in October 2002, was conducted to determine what upgrades to existing infrastructure were needed to maintain a state-of-good-repair on the Fairmount Line.[21] The feasibility study proposed improvements to the Fairmount Line that could increase ridership and revenues, and simultaneously hope to alleviate overcrowding on buses along the Fairmount Corridor.[22] The study presented six improvement packages—a “state of good repair *plus*” package, followed by packages one through five—that were designed for sequential implementation, with each package building upon earlier packages’ infrastructure and service improvements.[23] After achieving a “state-of-good-repair *plus*” through the (sequentially) first package, package one recommends building four new passenger stations: Newmarket, Four Corners, Talbot, and Blue Hill Avenue.[24] Package two recommends improving off-peak service frequencies, longer hours of service, and providing weekend service.[25] Package three proposes improving peak service frequencies; package four suggests constructing an additional station at Columbia Road, plus implementing fares comparable to those paid for MBTA rapid transit service.[26] The final proposal, package five, adds a free transfer to the Red Line from the Fairmount Line.[27]

In 2010, the MBTA released its Foxborough Commuter Rail Feasibility Study.[28] The study’s purpose was to assess the feasibility of expanding service to the special-event rail station at Gillette Stadium in Foxborough to full-time commuter rail service.[29] Three options for expanding service to Foxborough were proposed,

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[20] *Ibid*.
[21] *Fairmount Line Improvements*; Massachusetts Bay Transportation Authority; http://mbta.com/about_the_mbta/t_projects/default.asp?id=14261.
[22] *Ibid*.
[23] *Fairmount Line Feasibility Study*; KKO and Associates, L.L.C., and HNTB Companies; Massachusetts Bay Transportation Authority Planning Department; October 16, 2002; page 8.
[24] *Ibid.*
[25] *Ibid*.
[26] *Ibid*.
[27] *Ibid*.
[28] *Foxborough Commuter Rail Feasibility Study: Final Report*; Jacobs Engineering Group, Ann S. Gailbraith, and Central Transportation Planning Staff (CTPS); Massachusetts Bay Transportation Authority (MBTA) and Massachusetts Executive Office of Housing and Economic Development; September 1, 2010; page 1.
[29] *Foxborough Commuter Rail Feasibility Study: Final Report*; Jacobs Engineering Group, Ann S. Gailbraith, and CTPS; MBTA and Massachusetts Executive Office of Housing and Economic Development; September 1, 2010; page 3.

two of which would change service on the Fairmount Line.[30] Option B, called "Hybrid Service," would extend some Fairmount trains approximately 13 miles to Foxborough.[31] The report notes that Option B would require no new rolling stock (that is, locomotives, carriages, wagons, or other vehicles used on a railroad) and that it would have minimal impacts on existing service and equipment requirements.[32] Option C, "Full Direct Service," would extend all Fairmount service to Foxborough, with all of the station's full-time commuter rail service operating along the Fairmount Line's Dorchester Branch.[33] Option C would require one new train set comprised of existing coaches and a new locomotive.[34] The study states that Option C would have minor but noticeable impacts on existing service and equipment requirements.[35]

Recent Changes

Talbot Avenue Station service began in November 2012 and service at the Newmarket and Four Corners/Geneva Avenue stations started on July 1, 2013.[36] Though service had begun previously, the three stations officially opened together on July 17, 2013.[37] Simultaneously, the MBTA launched a pilot program that moved Fairmount Station into Zone 1A,[38] changing the price of traveling the Fairmount Line to match the cost to ride MBTA rapid transit service. The only station excluded from this price reduction was Readville Station, which remains in Commuter Rail Zone 2.[39] For the same price as the MBTA's Monthly LinkPass, the Zone 1A Commuter Rail pass not only provides unlimited subway and local bus travel, but also unlimited express bus, Inner Harbor Ferry, and Zone 1A

[30] *Foxborough Commuter Rail Feasibility Study: Final Report*; Jacobs Engineering Group, Ann S. Gailbraith, and CTPS; MBTA and Massachusetts Executive Office of Housing and Economic Development; September 1, 2010; page 6.
[31] *Foxborough Commuter Rail Feasibility Study: Final Report*; Jacobs Engineering Group, Ann S. Gailbraith, and CTPS; MBTA and Massachusetts Executive Office of Housing and Economic Development; September 1, 2010; page 7.
[32] *Foxborough Commuter Rail Feasibility Study: Final Report*; Jacobs Engineering Group, Ann S. Gailbraith, and CTPS; MBTA and Massachusetts Executive Office of Housing and Economic Development; September 1, 2010; page 6.
[33] *Ibid*.
[34] *Ibid*.
[35] *Ibid*.
[36] *Patrick Administration Opens Three New Fairmount Commuter Rail Stations*; Kelly Smith; Massachusetts Bay Transportation Authority; July 17, 2013; http://www.mbta.com/about_the_mbta/news_events/?id=27077andmonth=andyear=.
[37] *Ibid*.
[38] *Ibid*.
[39] *Commuter Rail Fares and Passes*; Massachusetts Bay Transportation Authority; http://www.mbta.com/fares_and_passes/rail/.

service.[40] Lastly, on November 29, 2014, the MBTA began hourly weekend service on the Fairmount Line.[41]

1.1.6 Fairmount Line Planning Efforts

Several studies and projects addressing the Fairmount Line have recently been completed or are currently underway. Each effort intends to improve conditions within the areas surrounding Fairmount Line stations.

Fairmount Indigo Planning Initiative

As briefly discussed above, in February 2012, the BRA began the Fairmount Indigo Planning Initiative (FIPI), a three-year study, in order to identify short- and long-term strategies for improving the public realm, capital investment, and job access along the Fairmount Line.[42] The study—which identified Fairmount Line corridor opportunities for transit access, commercial and residential development, community building initiatives, and public realm enhancements—will act as a foundation on which the City of Boston will build new quality-of-life improvements for the 132,000 residents who live within one-half mile of the Fairmount Line; it is the BRA's largest planning study to date.[43][44] The FIPI included corridor-wide planning for the Fairmount Line and planning for the Upham's Corner, Blue Hill Avenue/Cummins Highway, and Four Corners/Geneva Avenue station areas.[45]

Fairmount Greenway Task Force

The goal of the Fairmount Greenway Task Force (FGTF) is to create a nine-mile walking and biking urban greenway with an on-street-and-sidewalk route that loosely follows the Fairmount Line.[46] The purpose of the greenway is to safely connect residents, visitors, commuters, and shoppers to neighborhood business districts, historic sites, and new and existing open space, including parks, schools,

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[40] *Fares and Passes*; Massachusetts Bay Transportation Authority; http://www.mbta.com/fares_and_passes/passes/.
[41] *Gov. Patrick Announces Fairmount Line Service Upgrades*; Cyndi Roy Gonzalez; Massachusetts Bay Transportation Authority; October 16, 2014; http://www.mbta.com/about_the_mbta/news_events/?id=6442453136.
[42] *Fairmount Indigo Planning Initiative*; Boston Redevelopment Authority; http://www.bostonredevelopmentauthority.org/planning/planning-initiatives/fairmount-indigo-planning-initiative.
[43] *Ibid*.
[44] *Ibid*.
[45] *Ibid*.
[46] *Fairmount Greenway Brochure*; Michelle Moon; Fairmount Greenway Task Force; July 2015; page 2.

and community gardens.[47] The concept behind the Fairmount Greenway emerged in 2008 and the FGTF was formed to implement it,[48] with support from the Fairmount/Indigo Line Community Development Corporation (CDC) Collaborative.[49] The *Fairmount Greenway Concept Plan*, created in March 2011, identified the Fairmount Greenway route, including both on-street and off-street pathway sections, along the Neponset River in Mattapan and Hyde Park.[50]

Vision Zero Boston

Vision Zero Boston, launched in December 2015, is the City of Boston's commitment to make serious and fatal traffic crashes in Boston nonexistent by 2030, using proven techniques.[51] Vision Zero Boston, through a partnership that includes the Boston Police Department, builds upon the belief that one travel-related fatality is too many.[52] In order to achieve its goal, Vision Zero Boston promises to take action to reduce speeds and build safer streets, minimize distracted and impaired driving, engage with Bostonians directly about safety, hold itself accountable for results, and respond rapidly to fatalities.[53] Two pilot projects that aim to address Vision Zero Boston's promises are to be implemented within the Talbot Avenue station area.

Priority Corridor: Codman Square

The first Vision Zero pilot project within the Talbot Avenue station area addresses Codman Square as a priority corridor. The City of Boston used data collected from the Boston Police Department (BPD) and Emergency Medical Services (EMS) to identify Codman Square—including the segments of Talbot Avenue and Norfolk Street directly to the west of the intersection—and Massachusetts Avenue as the two initial Vision Zero Boston priority corridors.[54] Vision Zero work along the Codman Square corridor in 2016 is expected to take the form of rapid

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[47] *Fairmount Greenway Brochure*; Michelle Moon; Fairmount Greenway Task Force; July 2015; page 2.

[48] *Fairmount Greenway (re)Visioning Workshop (PowerPoint Presentation)*; Michelle Moon; Fairmount Greenway Task Force; February 5, 2016; Slide 15.

[49] *Create a Fairmount Greenway*; Fairmount Indigo CDC Collaborative; http://fairmountcollaborative.org/our-work/create-a-fairmount-greenway/.

[50] *Fairmount Greenway Concept Plan*; Crosby, Schlessigner, and Smallridge (CSS) with Bryant Associates; Fairmount Greenway Task Force; March 2011; pages 20-21.

[51] *Overview*; Vision Zero Boston; City of Boston; http://www.visionzeroboston.org/overview.

[52] *Overview*; Vision Zero Boston; City of Boston; http://www.visionzeroboston.org/overview.

[53] *Overview*; Vision Zero Boston; City of Boston; http://www.visionzeroboston.org/overview.

[54] *Focusing on the Issues*; Vision Zero Boston; City of Boston; http://www.visionzeroboston.org/focusing.

implementation projects that will provide short-term improvements to the corridor.[55]

Neighborhood Slow Streets: Talbot-Norfolk Triangle

The second Vision Zero pilot project within the Talbot Avenue station area attempts to slow the streets in the Talbot-Norfolk Triangle. Neighborhood Slow Streets is a joint effort between the BPD and the Public Works Department to provide zone-based traffic calming on local streets.[56] The City of Boston is piloting this program in 2016 in the Talbot-Norfolk Triangle and the Stonybrook neighborhood in Jamaica Plain, and intends to deploy both physical changes and visual cues to reduce driving speeds to 20 miles per hour from the default speed limit of 30 mph.[57] Proposed transportation safety projects include building speed humps, restricting parking at key intersections to improve sight lines, and posting easily recognizable identification- and speed-limit signage at all entry points to the neighborhoods.[58] Additional approaches for calming traffic may be used, such as road deviations (called chicanes), street art, raised crosswalks and intersections, neighborhood traffic circles, and curb extensions. After the pilot phase, City of Boston neighborhoods will be invited to apply to the program and will be selected based on objective criteria.[59]

Talbot-Norfolk Triangle Eco-Innovation District

The Talbot-Norfolk Triangle (TNT), bounded by Talbot Avenue, Norfolk Street, and the Fairmount Corridor, is located in the Codman Square area of Dorchester.[60] The Eco-Innovation District is the first of its kind in Boston. The TNT Eco-Innovation District is creating a model for low-income urban neighborhoods to develop into equitable and environmentally sustainable communities.[61] Subjects of interest to the TNT Eco-Innovation District include green infrastructure, energy retrofitting, local energy generation, and transit-oriented development (a type of development located within a half-mile of quality public transportation, characterized by a walkable neighborhood with a variety of amenities).[62]

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[55] *Focusing on the Issues*; Vision Zero Boston; City of Boston; http://www.visionzeroboston.org/focusing.
[56] Stefanie Seskin; City of Boston Active Transportation Director; Boston Transportation Department; Personal Communication; February 18, 2016.
[57] *Ibid*.
[58] *Ibid*.
[59] *Ibid*.
[60] *Ibid*.
[61] *Talbot-Norfolk Triangle (TNT) Eco-Innovation District Brochure*; David Queeley; page 1.
[62] *Talbot-Norfolk Triangle (TNT) Eco-Innovation District Brochure*; David Queeley; page 1.

The Fairmount Line's Talbot Avenue Station is within the bounds of the TNT Eco-Innovation District.[63] The station provides transportation options for local residents, 40 percent of whom work downtown.[64] Although bus transportation into Boston's CBD from the Talbot Norfolk Triangle can take more than an hour, the Fairmount Line transports passengers from Talbot Avenue Station to South Station in 19 minutes[65] or as little as 12 minutes if stops are not requested at stations where the train is only scheduled to stop upon request.[66] The construction of Talbot Avenue Station has increased TNT residents' access to transportation and employment opportunities.

The Codman Square Neighborhood Development Corporation (NDC), part of the partnership that established the TNT Eco-Innovation District,[67] hopes to create a sustainable, transit-oriented urban village in the TNT. As part of their efforts, the NDC established the Levedo Building, a mixed-use, transit-oriented development immediately adjacent to Talbot Avenue Station.[68] The proximity of the Levedo Building to the Fairmont Line provides viable public transportation to key locations and encourages residents to access the station by foot or on bike. The Codman Square NDC is currently identifying more sustainable real-estate projects to further their efforts.[69]

Eco-Teens Talbot-Norfolk Triangle Walk Audit with WalkBoston

In August 2015, a group associated with the Boston Project Ministries known as the Eco-Teens conducted walk audits of the TNT with WalkBoston.[70] The Eco-Teens assessed 13 streets to offer recommendations for improving cleanliness and safety.[71] While the Eco-Teens found considerable vegetation, friendly neighbors, sidewalks, and parking along both sides of most TNT streets, they also noted areas in which the TNT could improve.[72] They cited the lack of traffic signals, absence of trashcans, presence of speeding traffic, poor quality and/or lack of crosswalks, and no apparent maintenance of vegetation.[73] Traffic speeding

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[63] *Talbot-Norfolk Triangle Eco-Innovation District One-Pager*; David Queeley; page 1.
[64] *Talbot-Norfolk Triangle Eco-Innovation District One-Pager*; David Queeley; page 1.
[65] *Fairmount Line Schedule Information*; Massachusetts Bay Transportation Authority; http://www.mbta.com/schedules_and_maps/rail/lines/?route=FAIRMNT.
[66] *Talbot-Norfolk Triangle Eco-Innovation District One-Pager*; David Queeley; page 1.
[67] *Talbot-Norfolk Triangle (TNT) Eco-Innovation District Brochure*; David Queeley; page 1.
[68] *Talbot-Norfolk Triangle (TNT) Eco-Innovation District Brochure*; David Queeley; page 1.
[69] *Talbot-Norfolk Triangle (TNT) Eco-Innovation District Brochure*; David Queeley; page 1.
[70] *Eco-Teens Talbot Norfolk Triangle Walk Audit Report*; Eco-Teens; WalkBoston; August 2015; page 2.
[71] *Ibid*.
[72] *Ibid*.
[73] *Ibid*.

and the lack of maintenance, crosswalks, and trash cans were the Eco-Teens' greatest concerns for Talbot-Norfolk Triangle streets.[74]

1.2 STATION AREA ASSESSMENTS

MPO staff used the APT to determine which five of the eight Fairmount Line stations outside of Boston's CBD to study for possible bicycle and pedestrian improvements, in terms of both safety and comfort. The original project budget allowed for the assessment of four station areas, but additional funds from the deferment of a previously approved study made it possible to add a fifth station area to the evaluation. MPO staff selected the Newmarket, Four Corners/Geneva Avenue, Talbot Avenue, Morton Street, and Blue Hill Avenue station areas. An overview of the APT and the results it generated may be found in Appendix A.

Staff used the seven factors described below to select which Fairmount Line station areas were most in need of bicycle and pedestrian improvements.

- ***Connectivity —*** Used to quantify whether a gap contained a Boston bicycle network gap. Connectivity was a factor that staff used to assess conditions for the bicycle transportation mode only. Every other factor evaluated station areas for both bicycle and pedestrian travel.

- ***Constraints —*** Used to anticipate challenges that an entity might encounter when addressing bicycle and pedestrian infrastructure concerns within a station area. This factor identifies whether multiple jurisdictions have control of roadways within a station area.

- ***Demand —*** Used to reflect the current and future potential for Fairmount Line ridership in a station area. Staff used transit stop density, number of transit boardings, retail activity density, current and projected employment and population densities, and 2035 Fairmount ridership forecasts as variables to inform Demand factor scores.

- ***Equity —*** Used to assess the need for bicycle and pedestrian accommodations within a station area. Staff considered Environmental Justice Areas, young and elderly residents, and households without vehicle availability when assessing station areas for equity.

[74] *Eco-Teens Talbot Norfolk Triangle Walk Audit Report*; Eco-Teens; WalkBoston; August 2015; page 3.

- ***Existing Conditions* —** Used as a proxy to determine how comfortable it would be to travel as a bicyclist or pedestrian in a station area. The variables that staff used to calculate scores for this factor were all vehicle crash numbers.

- ***Safety* —** Used to assess the safety of bicycle and pedestrian travel. The variables that staff used to calculate scores for this factor were all bicycle and pedestrian crash numbers.

- ***Stakeholder Input* —** Used to quantify the station areas identified as needing bicycle and pedestrian improvements by the greatest number of stakeholders.

Once the five station areas had been selected, MPO staff went into the field to observe existing conditions. Staff conducted station area assessments from August 2015 to December 2015.

1.2.1 Methodology

Within the five selected Fairmount Line station areas, MPO staff biked or walked along each roadway segment that included existing or proposed bicycle facilities, as identified in the Boston Bike Network plan. Staff also traveled along the Fairmount Greenway path through each station area. These routes were chosen because of the current and future likelihood of bicyclist and pedestrian travel. The majority of conditions, measurements and observations were documented in the field, on maps and with photographs, although some information was gathered using existing data. Furthermore, MPO staff used resources such as Google Maps and Bing Maps to collect additional measurements and ensure accuracy. The descriptions of and specific details about the bicycle and pedestrian environment that MPO staff used in their considerations may be found in the Bicycle and Pedestrian Infrastructure Overview in Appendix B.

1.2.2 Infrastructure Considerations

MPO staff evaluated several aspects of the bicycle and pedestrian environment near the five selected Fairmount Line stations, including bicycle facilities, bike racks, pedestrian signals, sidewalks, curb ramps, detectable warnings, and pavement markings. A brief overview of these assessments is provided below.

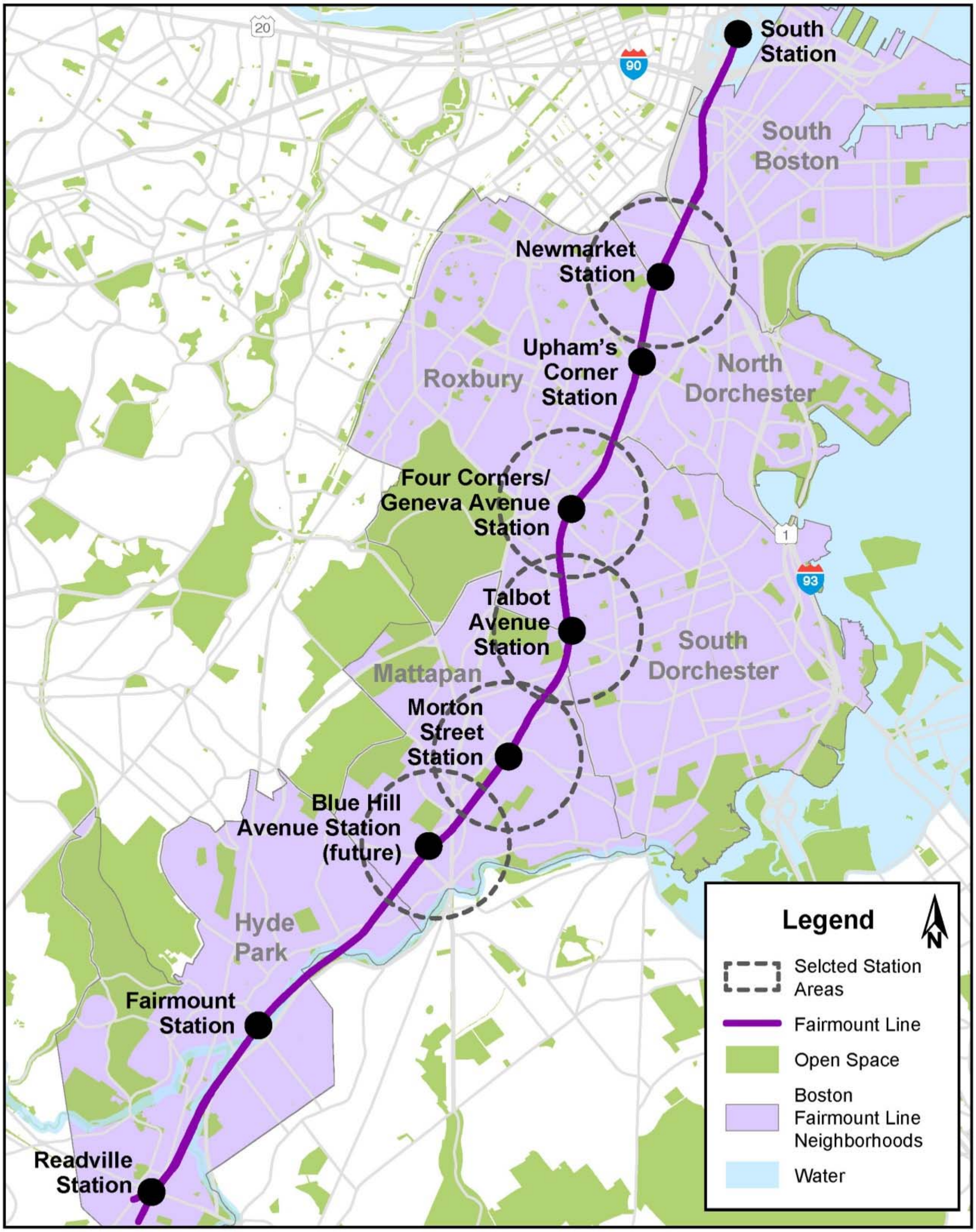

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FIGURE 1-2
Selected Station Areas
MBTA Fairmount Line

Fairmount Line Station Access Analysis

Bicycle Facilities

While staff noted the conditions of bicycle facilities in the field where appropriate, such as where bike lane striping or shared-lane markings (also known as "sharrows") had faded, MPO staff relied on the Boston Bike Network plan's cataloguing of the location, status, and type of bicycle facilities in the city. Staff used Boston Bike Network plan data from October 22, 2015 to document where bicycle facilities are located in the five selected station areas and to identify the type of facility at each location. Staff also used the Boston Bike Network plan's proposed bicycle facility information to document the future distribution of bicycle facility types in the Fairmount Line station areas. The different types of bicycle facilities are described in the Bicycle and Pedestrian Infrastructure Overview in Appendix B.

Bike Racks

MPO staff looked for bike racks while out in the field, and confirmed the location and type of each bike rack using Google Maps. The Association of Pedestrian and Bicycle Professionals (APBP) identifies which bike racks are acceptable for all uses, which bike racks are well suited for high-density locations, and which bike racks should be avoided.[75] MPO staff encountered several Inverted U (also Staple or Loop) and Post & Ring bike racks, both of which APBP has identified as being acceptable for all uses. MPO staff did not notice any of the racks that APBP classified as acceptable for high-density uses, but MPO staff observed a few instances of the unacceptable bike racks within the study areas. Specifically, these types of racks were the Wave (also Undulating or Serpentine), Schoolyard (also Comb or Grid), and Coat Hanger. MPO staff differentiated between acceptable and unacceptable bike racks in their documentation.

Pedestrian Signals

MPO staff noted the presence of pedestrian signals while in the field, and documented their characteristics when found. Staff noted whether the signals included countdown displays, as the Federal Highway Administration (FHWA)'s Manual on Uniform Traffic Control Devices (MUTCD) states that a pedestrian change interval of more than seven seconds should include a pedestrian change interval countdown display.[76] Staff also determined whether the pedestrian crossing phases were concurrent with vehicular traffic or whether there was an exclusive pedestrian phase, and the amount of time the signals provided for pedestrians to cross. They used Google Maps to measure the length of the

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[75] *Essentials of Bike Parking: Selecting and Installing Bicycle Parking That Works*; Association of Pedestrian and Bicycle Professionals (APBP); September 2015; pages 6-8.

[76] *Manual on Uniform Traffic Control Devices, Part 4: Highway Traffic Signals, Chapter 4E: Pedestrian Control Features, Section 4E.07: Countdown Pedestrian Signals*; Federal Highway Administration; December 2009; page 499.

crossings for pedestrians and divided the measurements by the crossing time in order to determine the speed at which pedestrians would need to travel in order to complete the crossing in the time provided, using the 3.5-feet-per-second walking speed that the FHWA recommends for calculating crossing times.[77] Staff also assessed whether the pedestrian intervals of the signals were accompanied by audible indications. The FHWA does not require pedestrian signals to provide information in non-visual formats such as audible tones, speech messages, or vibrating surfaces; however, the MUTCD includes guidance that, where engineering judgement determines it is appropriate, pedestrian signals should provide non-visual information formats.[78]

Sidewalks

While conducting fieldwork MPO staff assessed the quality of sidewalks and noted whether sidewalks met FHWA width standards. According to federal guidelines, sidewalks should include a five-foot-wide pedestrian zone and a six-inch-wide curb zone, plus a two-foot-wide zone for light poles and signs so that they do not obstruct the paths of pedestrians.[79] If trees are planted along a roadway, this zone should be expanded to four feet wide.[80] In addition, if the sidewalk is bordered by a building, storefront, wall, or fence, then two and a half feet should be added to the sidewalk corridor as a frontage zone.[81] The five-foot-wide pedestrian zone provides adequate space for a single wheelchair to turn around or two wheelchair users to pass one another.[82]

Curb Ramps and Detectable Warnings

MPO staff marked the locations of curb ramps while in the field, and indicated their types: perpendicular, diagonal, apex, or median cut-through. Perpendicular curb ramps are aligned with the crossing direction on tight radius corners while diagonal curb ramps are located at the apex of an intersection corner. MPO staff differentiated between diagonal curb ramps and apex curb ramps by identifying

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[77] *Designing Sidewalks and Trail for Access, Part II of II: Best Practices Design Guide, Chapter 8: Pedestrian Crossings, Section 8.6: Crossing Times*; Federal Highway Administration; September 2001; page 8-17.

[78] *Manual on Uniform Traffic Control Devices, Part 4: Highway Traffic Signals, Chapter 4E: Pedestrian Control Features, Section 4E.09: Accessible Pedestrian Signals and Detectors - General*; Federal Highway Administration; December 2009; page 504.

[79] *Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide, Chapter 4: Sidewalk Corridors, Section 4.1: Sidewalk Corridor Width, Section 4.1.2: The Zone System;* Federal Highway Administration (FHWA); September 2001; page 4-4.

[80] *Ibid.*

[81] *Ibid*.

[82] *Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide, Chapter 4: Sidewalk Corridors, Section 4.1: Sidewalk Corridor Width, Section 4.1.4: Improving Access on Narrow Sidewalks;* Federal Highway Administration (FHWA); September 2001; page 4-13.

curb ramps that served one crossing as diagonal and curb ramps that served two crossings as apex. They also noted where curb ramps should have been present but were missing (curb ramps were often identified as “missing” at locations where MPO staff observed crosswalks that led to curbs instead of curb ramps). Finally, they marked whether they observed detectable warnings at curb ramps and other transitions along sidewalks and public streets.

Pavement Markings

MPO staff noted pavement markings such as crosswalks, bike lanes, sharrows, and bike boxes when in the field. They indicated the type of crosswalk striping at crossings, noting whether the markings were transverse lines (standard), ladder, continental, or marked with an unconventional design. Staff also documented locations where markings had faded.

1.3 REPORT STRUCTURE

The next seven chapters of this report document the conditions that MPO staff observed when assessing the five Fairmount Line station areas selected for evaluation. Each chapter addresses a specific aspect of the five station areas, assessing each station area on the topic. The remaining chapters are as follows:

- Chapter 2—Station Area Overviews
- Chapter 3—Bicycle Facilities
- Chapter 4—Bike Racks
- Chapter 5—Pedestrian Signals
- Chapter 6—Sidewalks
- Chapter 7—Curb Ramps and Detectable Warnings
- Chapter 8—Pavement Markings
- Chapter 9—Recommendations
- Chapter 10—Conclusion

Chapter 2—Station Area Overviews

This chapter provides brief descriptions of the five station areas that MPO staff assessed for bicycle and pedestrian travel improvements. In addition to providing basic information about each location, such as the distribution of land use zoning around the stations, these overviews include each area's overall APT prioritization rankings and their individual APT factor rankings that contributed to the final results.

MPO staff used the APT to identify which five Fairmount Line stations were most in need of improvements for bicycle and pedestrian travel. The overall prioritization ranking of each station area is listed in the last column of Table 2-1, with first place signifying the highest priority and eighth signifying the lowest priority. The overall prioritization rankings were calculated by adding together each location's scores for seven different factors: Connectivity, Constraints, Demand, Equity, Existing Conditions, Safety, and Stakeholder Input. Table 2-1 lists the state of each factor in the eight station areas. It would be most beneficial to improve bicycle and pedestrian travel in the locations with the smallest numbers. For more information, please refer to Appendix A.

TABLE 2-1
Fairmount Line Station Area Prioritization Rankings

Station Area	Connectivity	Constraints	Demand	Equity	Existing Conditions	Safety	Stakeholder Input	Priority Ranking
Newmarket	2	1	3	7	2	1	1	1
Morton Street	8	1	5	3	1	2	1	2
Four Corners/ Geneva Ave	2	1	1	2	3	3	4	3
Talbot Avenue	2	1	4	4	7	5	1	4
Upham's Corner	1	5	2	1	4	4	7	5
Blue Hill Ave	2	5	6	5	6	8	5	6
Fairmount	2	7	7	6	5	7	6	7
Readville	2	7	8	8	8	6	7	8

To understand factor prioritization better, consider the equity factor. Locations with the highest prioritization rankings for the equity factor are station areas with the greatest percentages of households without access to a vehicle; the largest percentages of people younger than 18 and/or older than 64; and/or the greatest percentages of environmental justice areas within a half mile of the station. Massachusetts block groups are considered environmental-justice areas if they meet any one of three criteria: 1) 25 percent or more of the block group's population identifies as a race other than white; 2) median household income is less than or equal to 65.49 percent of $65,133, the 2010 Massachusetts state median income: $40,673; 3) 25 percent or more block group households identify as “English-isolated,” without someone older than 14 who only speaks English or who speaks English very well.[83]

2.1 NEWMARKET STATION AREA

Newmarket Station is the northern-most Fairmount Line station outside of Boston’s CBD. The Newmarket Station area is a circle with Newmarket Station at its center with a radius of one half mile, forming an area of almost 22 million square feet. The station area has a population density slightly less than 7,700 people per square mile and an employment density of more than 11,500 jobs per square mile, resulting in an employment density that exceeds population density by almost 50 percent. The MBTA’s Red Line also passes through the area: Andrew Station is located at Andrew Square in the area’s northeast quadrant (see Figure 2-1). Both Andrew and Newmarket connect to South Station, though the Fairmount Line connects directly while the Red Line stops at Broadway Station before reaching South Station. Between Andrew and Newmarket is the South Bay Center, which includes a Stop & Shop supermarket, retail buildings, restaurants, and a bank. Zoning in the area within one half mile of Newmarket Station is listed in Table 2-2 by total square feet and by the percentage of the station area composed of each zoning type.

TABLE 2-2
Zoning in the Newmarket Station Area

Zoning Type	Square Footage	Percentage
Industrial	7,557,917	35
Business	4,706,631	21
Residential	4,557,925	21
Mixed Use	4,375,080	20
Open Space	674,492	3
Commercial/Institutional	19,971	<1
Total	**21,892,016**	**100%**

[83] *MassGIS Data – 2010 U.S. Census – Environmental Justice Populations*; Massachusetts Executive Office for Administration and Finance; December 2012; http://www.mass.gov/anf/research-and-tech/it-serv-and-support/application-serv/office-of-geographic-information-massgis/datalayers/cen2010ej.html.

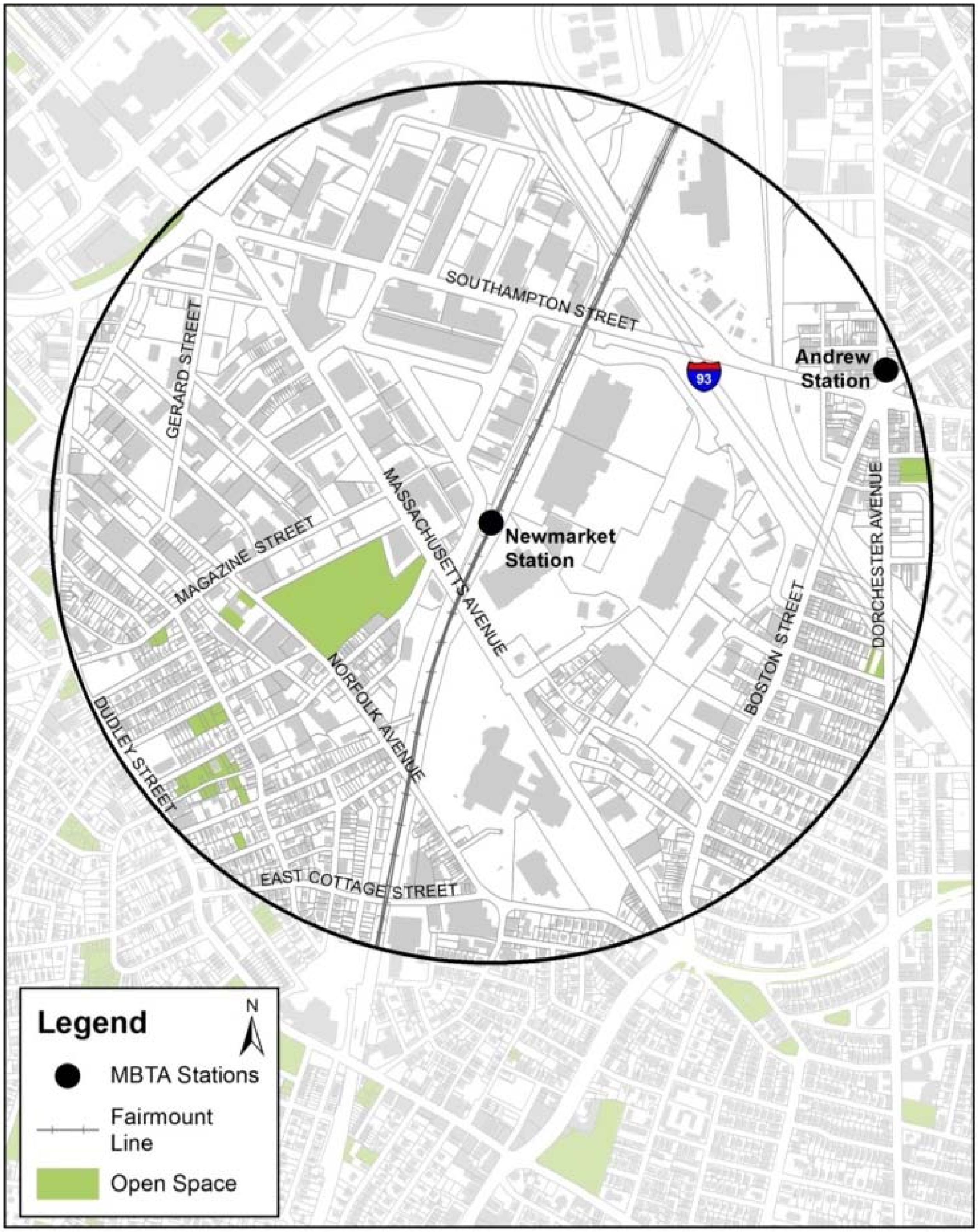

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FIGURE 2-1
MBTA Stations
Newmarket Station Area

Fairmount Line Station Access Analysis

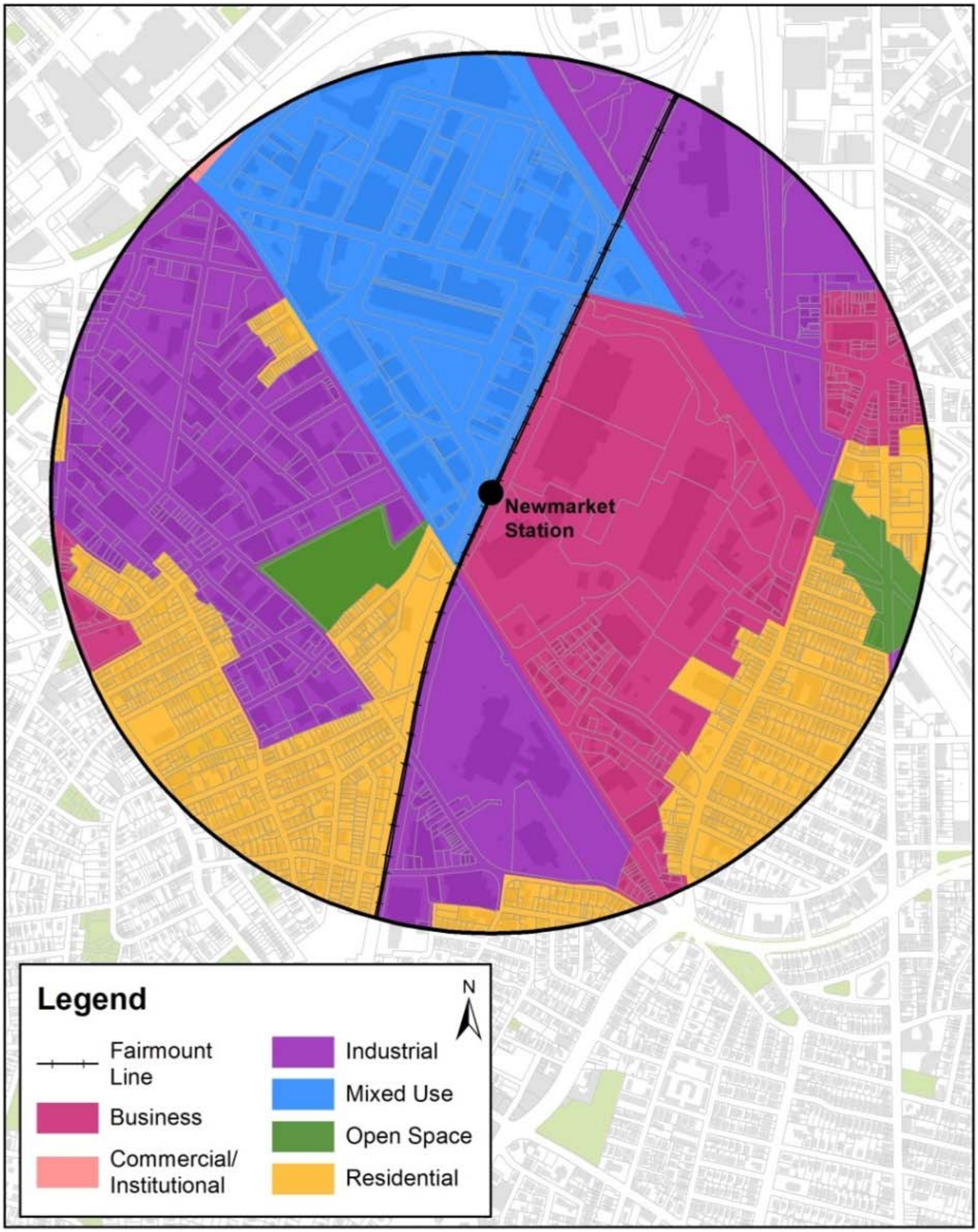

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FIGURE 2-2
Zoning Subdistricts
Newmarket Station Area

Fairmount Line Station Access Analysis

2.1.1 Selection Scores

The APT ranked the Newmarket station area as the highest-priority Fairmount Line station area for bicycle and pedestrian improvements. Newmarket was the only station area with a fatal bike crash and it tied Upham's Corner for the greatest number of non-fatal-injury bike crashes from 2008 to 2012 with a total of seven such crashes. Employment density in the Newmarket Station area exceeded that of the second-most job-dense station area, Upham's Corner, by more than 250 percent. Furthermore, the Newmarket Station area generated more than four times the sales of Upham's Corner, which is the second-most retail active station area. Table 2-3 illustrates that the APT ranked Newmarket Station as the highest priority area for bicycle and pedestrian improvements.

TABLE 2-3
Newmarket Priority Ranking by Factor

Station Area Factor	Priority Ranking
Connectivity	2
Constraints	1
Demand	3
Equity	7
Existing Conditions	2
Safety	1
Stakeholder Input	1
Overall	**1**

2.1.2 Planned Development

The BRA/Economic Development and Industrial Corporation (EDIC) Board approved the proposed plans for the South Bay development on May 12, 2016.[84] The project, which was proposed as a mixed-use, transit-oriented development, will be located to the south of the existing South Bay Center.[85] The development, as envisioned, will be composed of five main buildings, four of which will include approximately 475 apartment units, 115,000 to 125,000 square feet of retail and restaurant space, a 12-screen cinema, and structured parking; the fifth building

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[84] *Minutes of the Economic Development and Industrial Corporation of Boston May 12, 2016 Board of Directors' Meeting Scheduled for 3:30 P.M.*; Economic Development and Industrial Corporation of Boston Board of Directors; May 12, 2016; pages 34-37; http://boston.siretechnologies.com/sirepubbra/cache/2/sjk5kdsldcviycru0eh2srm3/31607292016013900271.pdf.

[85] *Draft Project Impact Report: Volume 1;* Allstate Road (Edens), LLC; Fort Point Associates, Inc.; January 22, 2016; page 1-2.

will serve as a hotel.[86] Newmarket Station is located approximately a quarter mile from the site of the proposed project and Andrew Station is situated approximately half a mile from the site.[87] Estimates suggest that the development will generate high numbers of walking, bicycling, and transit trips (see Table 2-4), reinforcing the importance of improving bicycle and pedestrian access to Newmarket Station.

TABLE 2-4
South Bay Development Trip Estimates

Trip Type	Weekday Morning Peak Hour	Weekday Evening Peak Hour	Saturday Midday Peak Hour
Walking and Bicycling Trips	170	443	503
Transit Trips	147	371	423
Total	**317**	**814**	**926**

Source: Development Plan for Planned Development Area No. 103: South Bay Development; Allstate Road (Edens), LLC; Boston Redevelopment Authority; February 26, 2016; pages 2 and 3.

2.2 FOUR CORNERS/GENEVA AVENUE STATION AREA

The Four Corners/Geneva Avenue station is the third stop on the Fairmount Line as it travels to Readville from South Station. The station area—a circle whose half-mile radius measures approximately 22 million square feet—includes a portion of Franklin Park on its western side. The Four Corners/Geneva Avenue Station area overlaps the Talbot Avenue Station area to the south; there are no signalized intersections within the shared space. Of all eight Fairmount Line station areas, Four Corners/Geneva Avenue contains the most bus stops, with 61 (see Figure 2-3).

2.2.1 Zoning and Selection Scores

Zoning in the area within one-half mile of Four Corners/Geneva Avenue Station is listed in Table 2-5 by total square feet and by the percentage of the station area composed of each zoning type. As shown in Table 2-5 and illustrated in Figure 2-4, 82 percent of the station area is zoned for residential use. It has a population density of more than 22,500 residents per square mile and employs almost 3,000 people per square mile. As a result, Four Corners/Geneva Avenue has approximately 7.5 times more residents than jobs. The large number of residents led the APT to attribute the highest level of demand to the area of all eight Fairmount Line stations, which contributed to the APT ranking Four

[86] *Development Plan for Planned Development Area No. 103: South Bay Development*; Allstate Road (Edens), LLC; Boston Redevelopment Authority; February, 26, 2016; pages 2 and 3.
[87] *Draft Project Impact Report: Volume 1;* Allstate Road (Edens), LLC; Fort Point Associates, Inc.; January 22, 2016; page 4-14.

Corners/Geneva Avenue Station as the third-highest-priority area for bicycle and pedestrian improvements (Table 2-6).

TABLE 2-5
Zoning in the Four Corners/Geneva Avenue Station Area

Zoning Type	Square Footage	Percentage
Residential	17,859,415	82
Business	1,565,410	7
Open Space	1,260,538	6
Industrial	1,206,680	6
Total	**21,892,042**	**100%**

TABLE 2-6
Four Corners/Geneva Avenue Priority Ranking by Factor

Station Area Factor	Priority Ranking
Connectivity	2
Constraints	1
Demand	1
Equity	2
Existing Conditions	3
Safety	3
Stakeholder Input	4
Calculated Overall Ranking	**3**

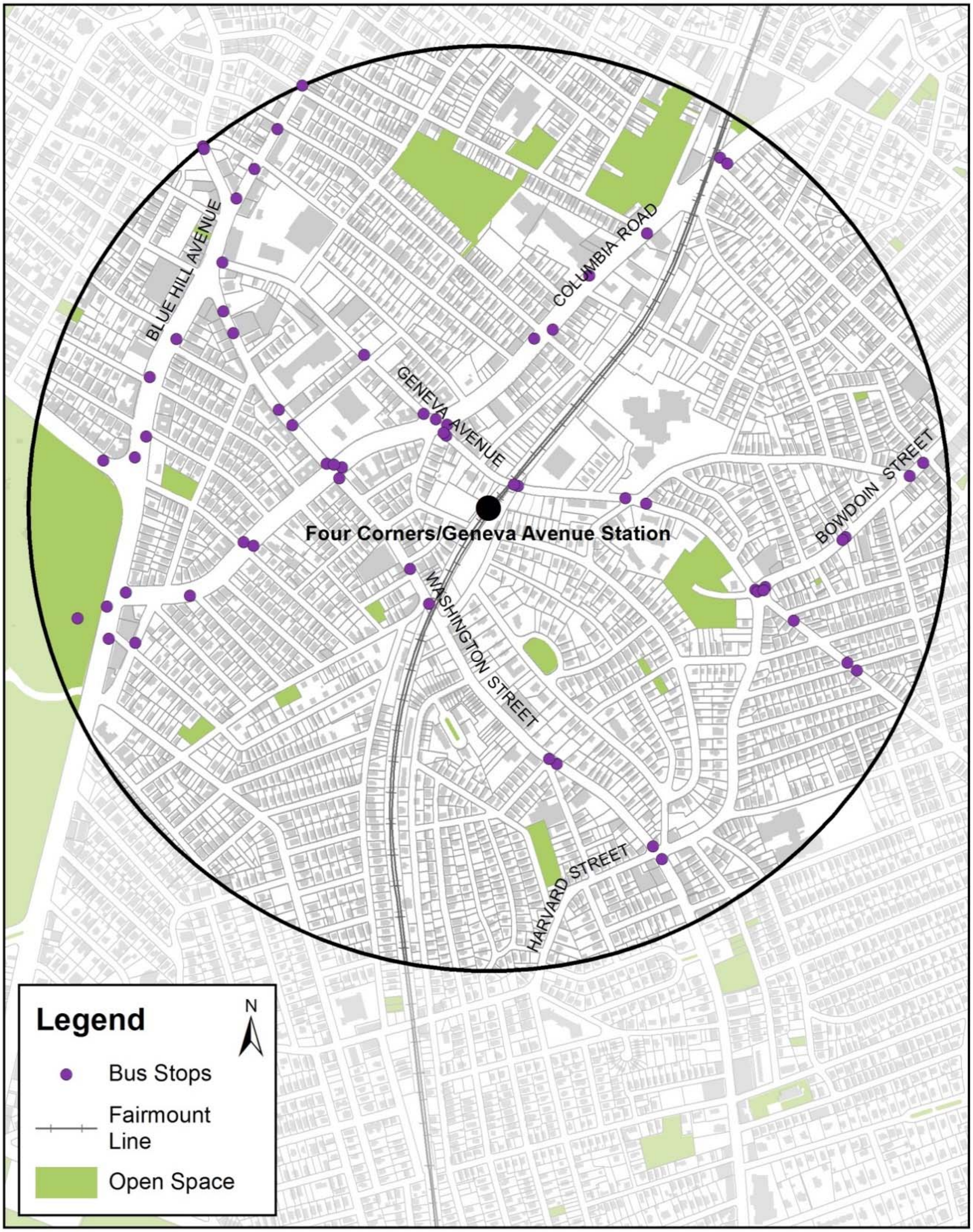

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FIGURE 2-3
Bus Stops
Four Corners/Geneva Avenue Station Area

Fairmount Line Station Access Analysis

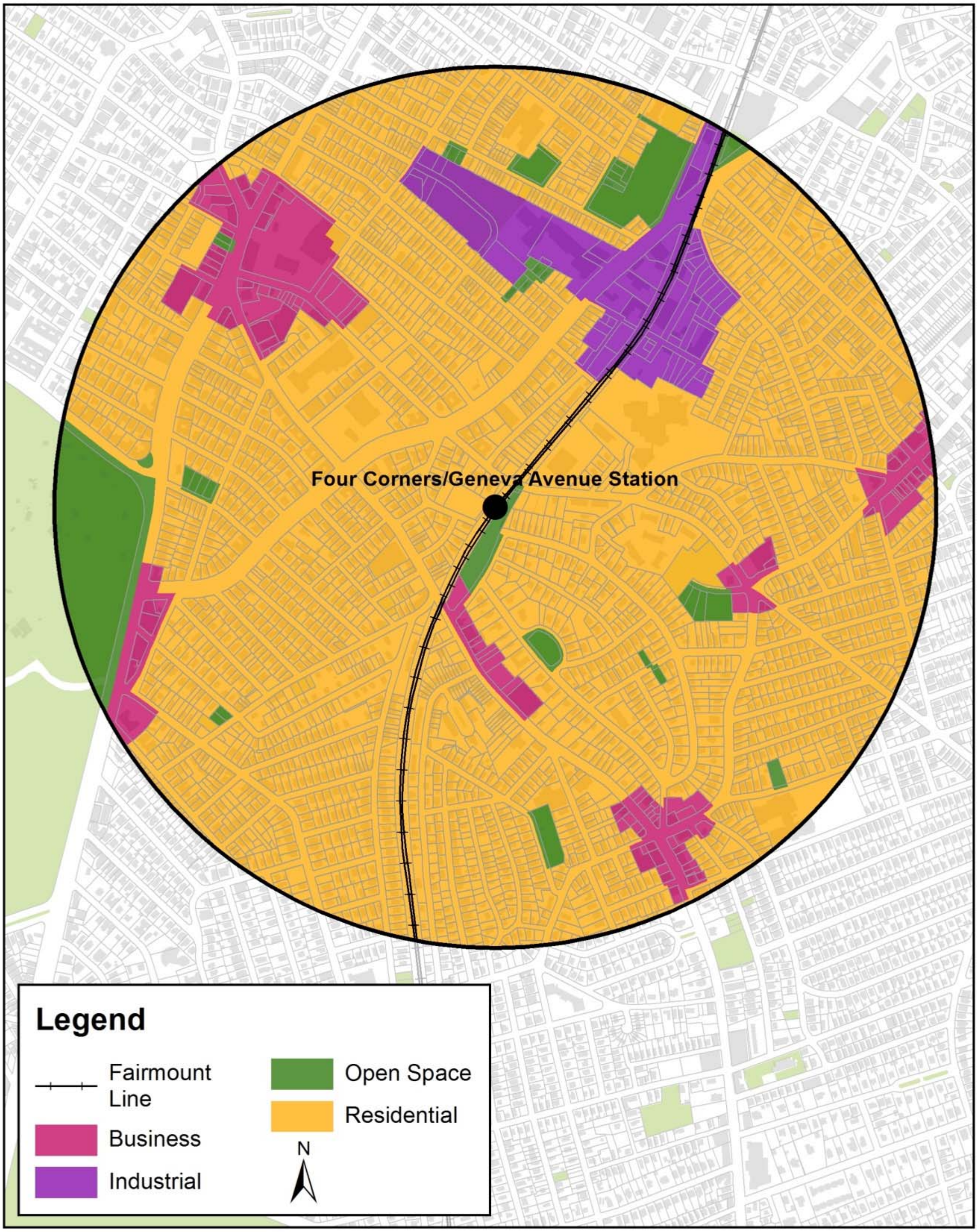

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FIGURE 2-4
Zoning Subdistricts
Four Corners/Geneva Avenue Station Area

Fairmount Line Station Access Analysis

2.2.2 Planned Development

The population of the Four Corners/Geneva Avenue Station area is expected to grow approximately 12 percent by 2040, which is greater than that of the Upham's Corner, Fairmount, and Readville station areas. Employment growth in the area is forecasted to exceed employment growth in the Blue Hill Avenue and Fairmount station areas, increasing 24 percent by 2040. The Four Corners/Geneva Avenue population grew more slowly than that of the Newmarket, Morton Street, and Blue Hill Avenue station areas and its employment grew more slowly than employment in the Newmarket, Upham's Corner, Talbot Avenue, Morton Street, and Readville station areas. According to estimates based on expected development, Four Corners/Geneva Avenue Station is expected to draw the fifth-largest ridership demand for the Fairmount Line in 2035.[88]

2.3 TALBOT AVENUE STATION AREA

The Talbot Avenue Station is the fourth stop on the Fairmount Line as it travels to Readville from South Station. The station includes the TNT within its bounds, in the southeastern quadrant of the station area near Codman Square.

The station area has a population density of almost 17,800 people per square mile and an employment density of almost 2,700 people per square mile, resulting in an employment density that is 15 percent as dense as that of the station area's population. The entire study location is considered an environmental-justice area. In addition to the TNT southeast of Talbot Avenue Station, the study area includes the Joseph Lee Elementary School, Harambee Park, the Berkshire Partners Blue Hill Boys and Girls Club of Boston, and the Sportsmen's Tennis and Enrichment Center, all northwest of Talbot Avenue Station. Zoning in the area within one-half mile of Talbot Avenue Station is listed in Table 2-7 by total square feet and by the percentage of the station area composed of each zoning type.

TABLE 2-7
Zoning in the Talbot Avenue Station Area

Zoning Type	Square Footage	Percentage
Residential	16,982,109	78
Open Space	2,935,907	13
Business	1,566,893	7
Industrial	407,133	2
Total	**21,892,042**	**100%**

[88] *Review and Update of Fairmount Line Ridership Forecasts*; Scott Peterson; Central Transportation Planning Staff to the Boston Region MPO; November 15, 2011; page 2.

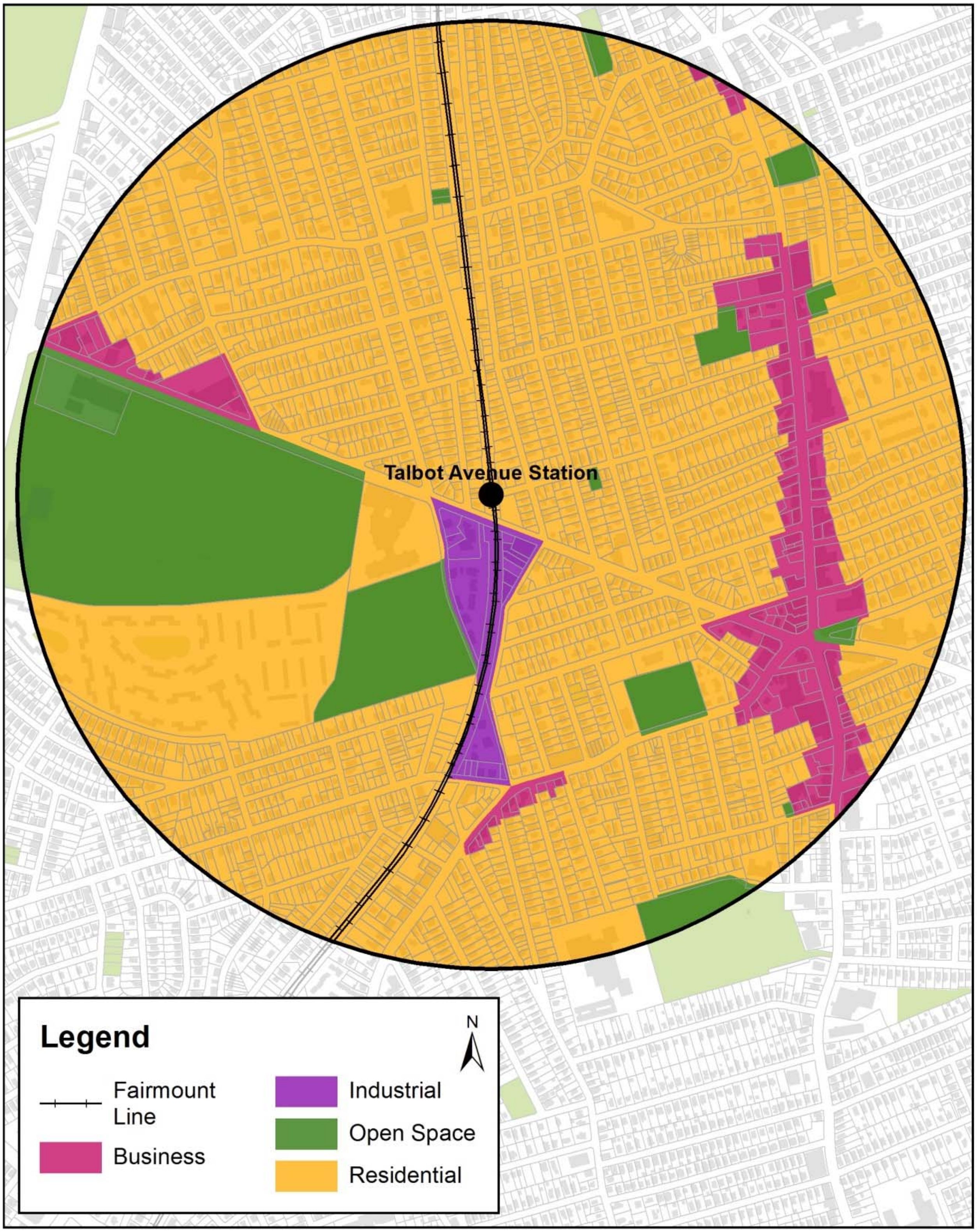

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FIGURE 2-5
Zoning Subdistricts
Talbot Avenue Station Area

Fairmount Line Station Access Analysis

2.3.1 Selection Scores

Every stakeholder entity that MPO staff polled, from advocacy groups to municipal government departments, identified Talbot Avenue as a Fairmount Line station area in great need of bicycle and pedestrian improvements. Portions of three Boston Region Bike Network gaps are located within the Talbot Avenue station area, which led the APT to rank it second in priority for connectivity. The Newmarket, Four Corners/Geneva Avenue, Blue Hill Avenue, Fairmount, and Readville station areas all contain the same number of gaps, so they all ranked second in connectivity.

In the bicycle and pedestrian safety category, APT ranked Talbot Avenue as fifth out of the eight Fairmount Line station areas, in spite of the area experiencing the fourth-largest number of bicycle crashes and the fourth-largest number of pedestrian crashes between 2008 and 2012. MPO staff averaged the pedestrian and bicycle safety scores to determine each station area's overall safety score for APT calculations. Although Upham's Corner had a lower prioritization score for pedestrian safety, the station area's prioritization score for bicycles was more than double that of Talbot Avenue. Finally, the low number of vehicular crashes in the station area between 2008 and 2012 contributed to Talbot Avenue's seventh-place priority ranking for the existing conditions factor.

TABLE 2-8
Talbot Avenue Priority Ranking by Factor

Station Area Factor	Priority Ranking
Connectivity	2
Constraints	1
Demand	4
Equity	4
Existing Conditions	7
Safety	5
Stakeholder Input	1
Calculated Overall Ranking	**4**

2.3.2 Planned Development

The population of the Talbot Avenue station area is expected to grow 12 percent by 2040, while the number of jobs is expected to grow 29 percent by the same year. Calculations based on development plans for the station area in the year

2035 indicate daily ridership totals of 180 boardings and alightings at Talbot Avenue Station by that time.[89]

2.4 MORTON STREET STATION AREA

Morton Street Station is the fifth stop on the Fairmount Line as it travels toward Readville from South Station. Approximately 13,200 people live in the Morton Street station area—a population density of more than 16,800 people per square mile. Employment is about 8.5 percent the size of the population. With about 1,400 jobs per square mile or an estimated 1,100 total jobs, this area has the lowest job-to-resident ratio of all eight Fairmount Line station areas. Despite this, it generates the third-largest amount of retail activity of the Fairmount Line station areas: almost $110,500,000 in annual sales.

The Morton Street area ranks third among the Fairmount Line stations for transit boardings. Of the eight Fairmount Line station areas, the largest amount of fatal and severe vehicle crashes have occurred there, as have the second-largest number of total vehicle crashes. Morton Street is similar to Talbot Avenue in that it is the only other Fairmount Line station whose surrounding area is entirely comprised of environmental justice areas.

Zoning in the area within one half mile of Morton Street Station is listed in Table 2-9 by total square feet and by the percentage of the station area composed of each zoning type.

TABLE 2-9
Zoning in Morton Street Station Area

Zoning Type	Square Footage	Percentage
Residential	17,972,516	82
Open Space	796,654	4
Business	1,957,230	9
Commercial/Institutional	978,615	4
Industrial	187,027	1
Total	**21,892,042**	**100%**

[89] *Review and Update of Fairmount Line Ridership Forecasts*; Scott Peterson; Central Transportation Planning Staff to the Boston Region MPO; November 15, 2011; page 2.

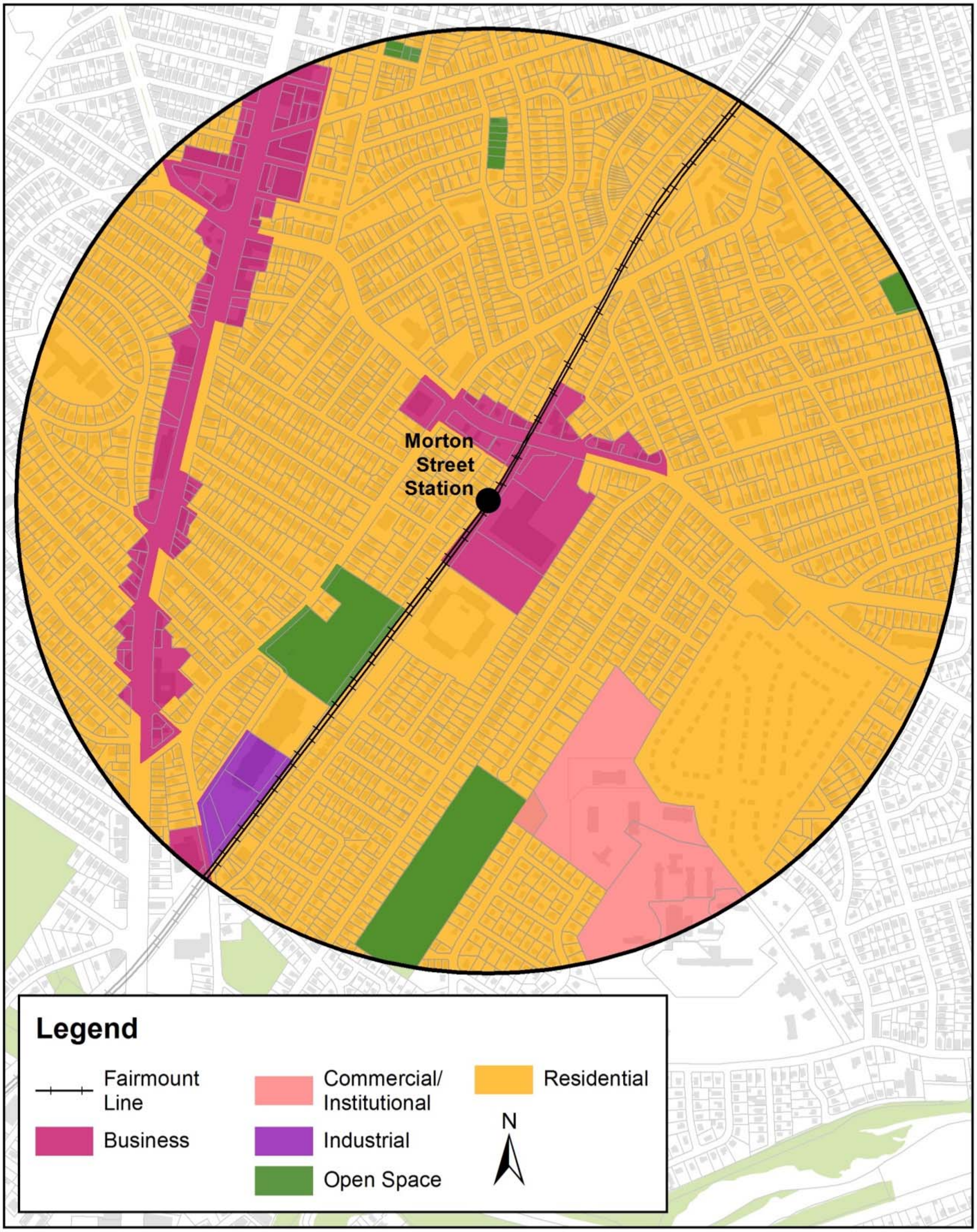

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FIGURE 2-6
Zoning Subdistricts
Morton Street Station Area

Fairmount Line Station Access Analysis

2.4.1 Selection Scores

APT ranked Morton Street as the second-highest priority station area for bicycle and pedestrian improvements overall. This is partly because of the large number of vehicle crashes in the station area, which contributed to Morton Street's existing conditions being ranked as the highest priority for improvement. Every stakeholder entity that MPO staff polled, from advocacy groups to municipal government departments, identified Morton Street as a Fairmount Line station area in great need of bicycle and pedestrian improvements. APT ranked Morton Street as the second-highest priority station area for bicycle and pedestrian safety because from 2008 through 2012 bicycle and pedestrian crashes numbered the third and second greatest of all eight Fairmount Line station areas, respectively. Finally, in spite of the fact that all of Morton Street is considered an environmental justice area, APT identified Morton Street as the third-highest priority location for equity considerations because the percentage of households in this area with no vehicle access was the fifth highest of all eight Fairmount Line stations.

TABLE 2-10
Morton Street Priority Ranking by Factor

Station Area Factor	Priority Ranking
Connectivity	8
Constraints	1
Demand	5
Equity	3
Existing Conditions	1
Safety	2
Stakeholder Input	1
Calculated Overall Ranking	**2**

2.4.2 Planned Development

Population within the Morton Street station area is expected to grow 15 percent by 2040, while employment is predicted to increase by 33 percent within the same period. In spite of this growth, 2035 ridership forecasts indicate that the station will have 10 fewer total boardings and alightings by that year; this makes it the only station of the five selected Fairmount Line stops at which ridership in 2035 is expected to decline from current levels.[90]

[90] *Review and Update of Fairmount Line Ridership Forecasts*; Scott Peterson; Central Transportation Planning Staff to the Boston Region MPO; November 15, 2011; page 2.

2.5 BLUE HILL AVENUE STATION AREA

Blue Hill Avenue Station has not yet been constructed, although it is anticipated to become the sixth stop on the Fairmount Line as it travels toward Readville from South Station. The majority of the station area will be within the bounds of the City of Boston, although almost 10 percent of the station area is within the town of Milton, as illustrated in Figure 2-7. The station area's population is estimated to be nearly 8,500, with approximately 1,600 jobs or more within the station area itself. This means that there will be jobs for roughly 19 percent of the Blue Hill Avenue station area population, making it the fourth largest, in terms of employment percentage, of the eight Fairmount Line station areas.

Zoning in the area within one-half mile of Blue Hill Avenue Station is listed in Table 2-11 by total square feet and by the percentage of the station area composed of each zoning type. Figure 2-7 illustrates the zoning in the Blue Hill Avenue station area.

TABLE 2-11
Zoning in Blue Hill Avenue Station Area

Zoning Type	Square Footage	Percentage
Residential	17,517,891	80
Business	2,342,284	11
Open Space	1,757,346	8
Industrial	187,027	1
Neponset River	87,494	<1
Total	**21,892,042**	**100%**

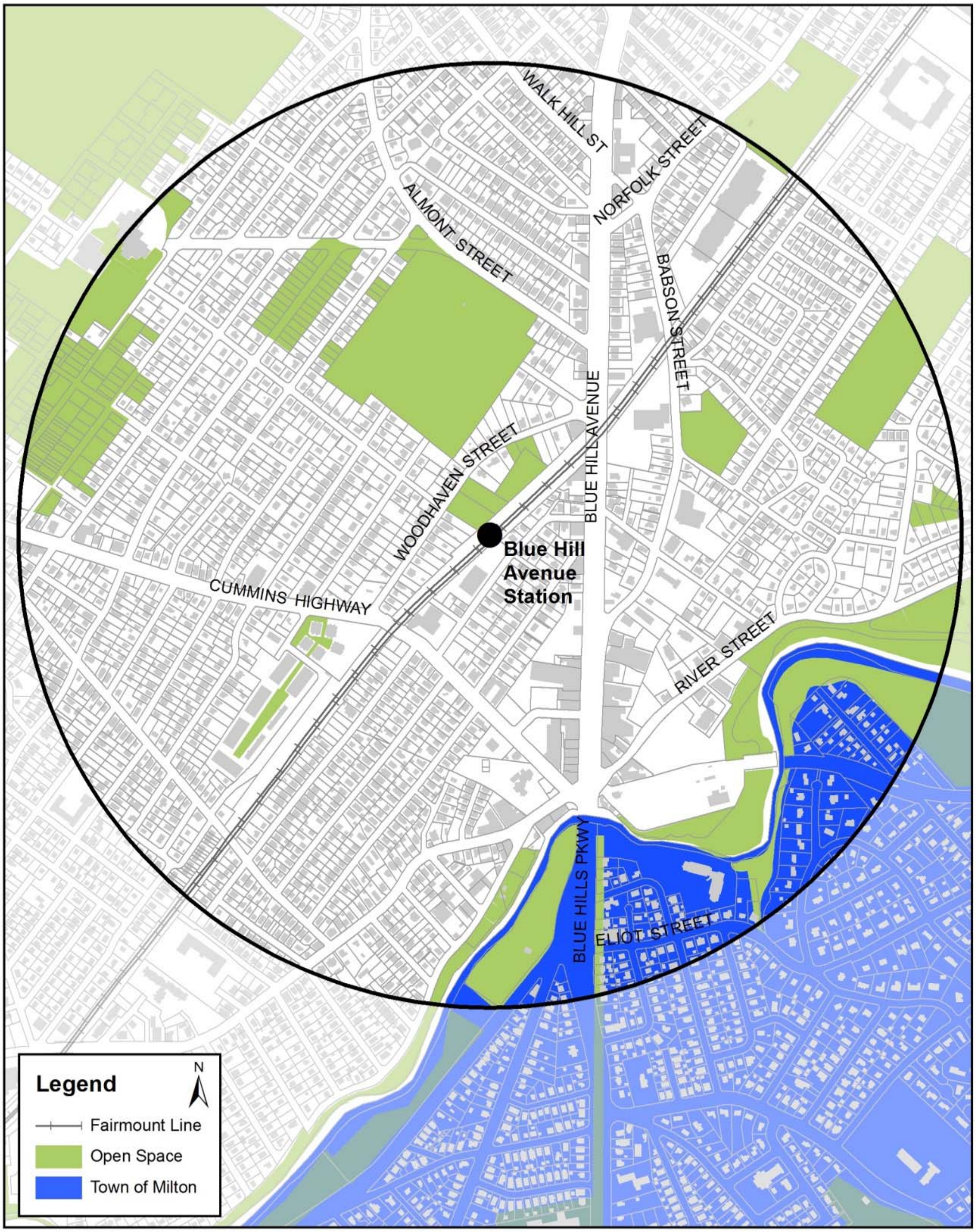

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FIGURE 2-7
Town of Milton
Blue Hill Avenue Station Area

Fairmount Line Station Access Analysis

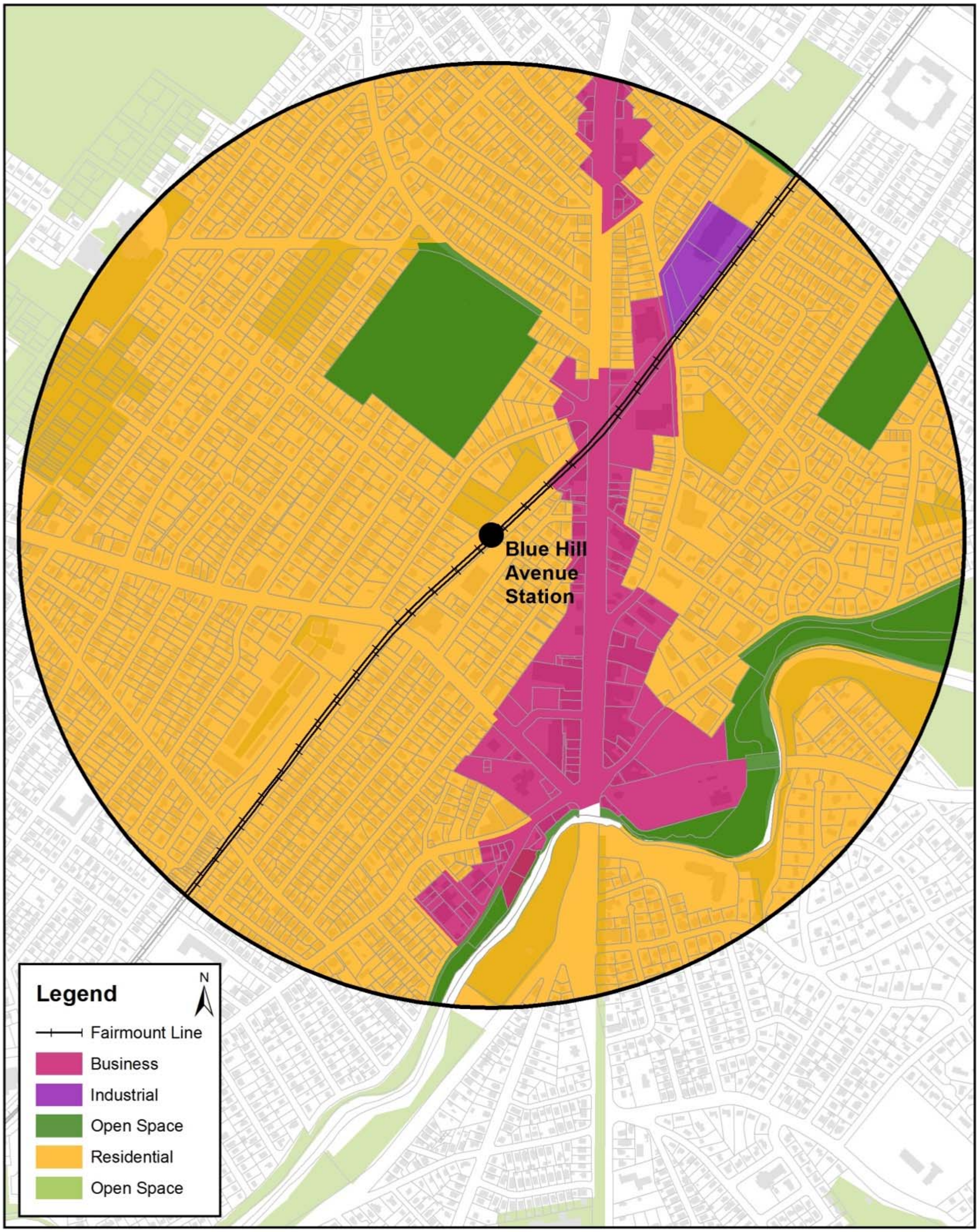

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FIGURE 2-8
Zoning Subdistricts
Blue Hill Avenue Station Area

Fairmount Line Station Access Analysis

2.5.1 Selection Scores

The BRA was the only entity polled by MPO staff that identified the Blue Hill Avenue station area as one of the locations most in need of improvements to the bicycle and pedestrian environment. This may be because the station has yet to be constructed, and the stakeholders (listed in Appendix A) that MPO staff polled could have been less familiar with the area than they are with the other station locations on the Fairmount Line. Aside from the BRA, the stakeholders that MPO staff polled did not identify Blue Hill Avenue as a high priority for bicycle and pedestrian improvements. In addition, the fact that it does not lie entirely within the City of Boston introduces the possibility of multi-jurisdictional conflict when attempts are made to address station area concerns. These constraints acted against Blue Hill Avenue's overall prioritization for improvement.

TABLE 2-12
Blue Hill Avenue Priority Ranking by Factor

Station Area Factor	Priority Ranking
Connectivity	2
Constraints	5
Demand	6
Equity	5
Existing Conditions	6
Safety	8
Stakeholder Input	5
Calculated Overall Ranking	**6**

2.5.2 Planned Development

The APT ranked Blue Hill Avenue as the sixth-highest priority station area of the eight Fairmount Line stations for the demand factor. In spite of this low-priority ranking, population in the Blue Hill Avenue station area is expected to grow 20 percent by 2040—five percent greater than expected in any other Fairmount Line station area. Employment is estimated to grow 12 percent, which is the slowest rate of all Fairmount Line station areas. However, based on current development plans, calculations indicate that there will be 300 boardings and alightings at the Blue Hill Avenue station daily by 2035—30 percent more than the expected number of 2035 daily boardings and alightings at Fairmount Station, the Fairmount Line stop with the second-greatest expected ridership in 2035.[91]

[91] *Review and Update of Fairmount Line Ridership Forecasts*; Scott Peterson; Central Transportation Planning Staff to the Boston Region MPO; November 15, 2011; page 2.

Chapter 3—Bicycle Facilities

This chapter assesses the bicycle facilities in five Fairmount Line station areas. Each section focuses on the infrastructure surrounding one of the stations and illustrates where the Boston Bike Network Plan identifies existing and future bicycle facilities. Each section also outlines the route of the Fairmount Greenway in the station area. The Boston Bike Network Plan anticipates that 75 miles of future bicycle infrastructure will occur within approximately five years, while other improvements are longer-term goals that the City of Boston hopes to implement over the next 30 years, ultimately achieving a network of 356 miles.[92] The plan differentiates between primary and secondary facility recommendations, describing the secondary recommendations as retrofit or short-term solutions where a primary recommendation is temporarily not possible. Appendix B includes descriptions of the Boston Bike Network Plan bicycle facilities.

The five sections of this chapter include a map of the existing facilities in a station area, a map of the Boston Bike Network Plan's primary bicycle facility recommendations, a map of the Boston Bike Network Plan's secondary recommendations, and a map the Fairmount Greenway's path within each study location. The Boston Bike Network Plan's suggested local routes, marked in grey on the maps of the existing and recommended infrastructure, do not have associated facility recommendations, but are included in the map because they are popular local routes. When conducting fieldwork, MPO staff traveled along each of the routes identified on the four maps—routes chosen for their current and future potential to attract bicyclists and pedestrians because of enhanced accommodations.

3.1 NEWMARKET

The existing bicycle facilities in the Newmarket Station area include shared lane markings and bike lanes; a small segment of the South Bay Harbor Trail accounts for the shared-use path where Massachusetts Avenue crosses Melnea Cass Boulevard in the northwestern portion of the station area (see Figure 3-1). The Boston Bike Network identified portions of the Fairmount Greenway in the Newmarket area as suggested local routes, and recommended that segments of the Greenway near Newmarket become neighborways (see Figures 3-2, 3-3, 3-4).

[92] *Boston Bike Network Plan*; Boston Bikes; City of Boston Department of Transportation; 2013; page 2.

3.2 FOUR CORNERS/GENEVA AVENUE

The proximity of Four Corners/Geneva Avenue Station to Franklin Park and its zoo adds some high-quality infrastructure to this station area. On Franklin Park Road, a bike lane in the roadway is located adjacent to a shared-use path on the north side of the street that is lined with benches and trees (see Figure 3-1). The Boston Bike Network Plan indicates that the current bicycle facilities in the Four Corners/Geneva Avenue station area include shared-lane markings, bike lanes, and a small stretch of buffered bike lane on Columbia Road traveling northeast under the rail bridge that serves the Fairmount Line (see Figure 3-2). Not included in the plan (and therefore missing from the figure) are the bike lanes that MPO staff observed on both sides of Seaver Street, to the west of its intersection with Blue Hill Avenue. The Boston Bike Network has identified portions of the Fairmount Greenway in the Four Corners/Geneva Avenue area as suggested local routes and has recommended that segments of the Greenway in the station area become neighborways. Primary bicycle facility recommendations are included in Figure 3-3, secondary recommendations are illustrated in Figure 3-4, and the route of the Fairmount Greenway is cited in Figure 3-5.

FIGURE 3-1
Shared-Use Path and Bike Lane on Franklin Park Road

Source: Central Transportation Planning Staff.

3.3 TALBOT AVENUE

The bicycle facilities currently present in the station area are shared-lane markings and bike lanes (see Figure 3-1). Portions of the Fairmount Greenway in the Talbot Avenue station area are identified in the Boston Bicycle Network Plan as recommended locations for neighborways, shared roads, and suggested local routes (for recommendations, see Figure 3-2 and Figure 3-3). The path of the

Fairmount Greenway in the Talbot Avenue station area is documented in Figure 3-4.

3.4 MORTON STREET

The bicycle facilities currently present in the Morton Street station area are shared-lane markings and bike lanes (see Figure 3-4). Portions of the Fairmount Greenway in the Morton Street station area are identified in the Boston Bike Network Plan as having shared-lane markings and are recommended for bike lanes or marked as suggested local routes (see Figure 3-2 and Figure 3-3). The path of the Fairmount Greenway in the Morton Street station area is documented in Figure 3-4.

3.5 BLUE HILL AVENUE

The bicycle facilities currently present in the Blue Hill Avenue station area include shared-lane markings, bike lanes, and a shared-use path in the southern portion of the station area where the Neponset River Trail is located (see Figure 3-1). One portion of the Fairmount Greenway in the Blue Hill Avenue station area is identified in the Boston Bike Network Plan as having shared-lane markings but recommendations for the route include a two-way cycle track on one side of Blue Hill Avenue, a shared-use path, buffered bike lanes, bike lanes, and shared-lane markings (see Figure 3-2 and Figure 3-3). The path of the Fairmount Greenway in the Blue Hill Avenue station area is documented in Figure 3-4.

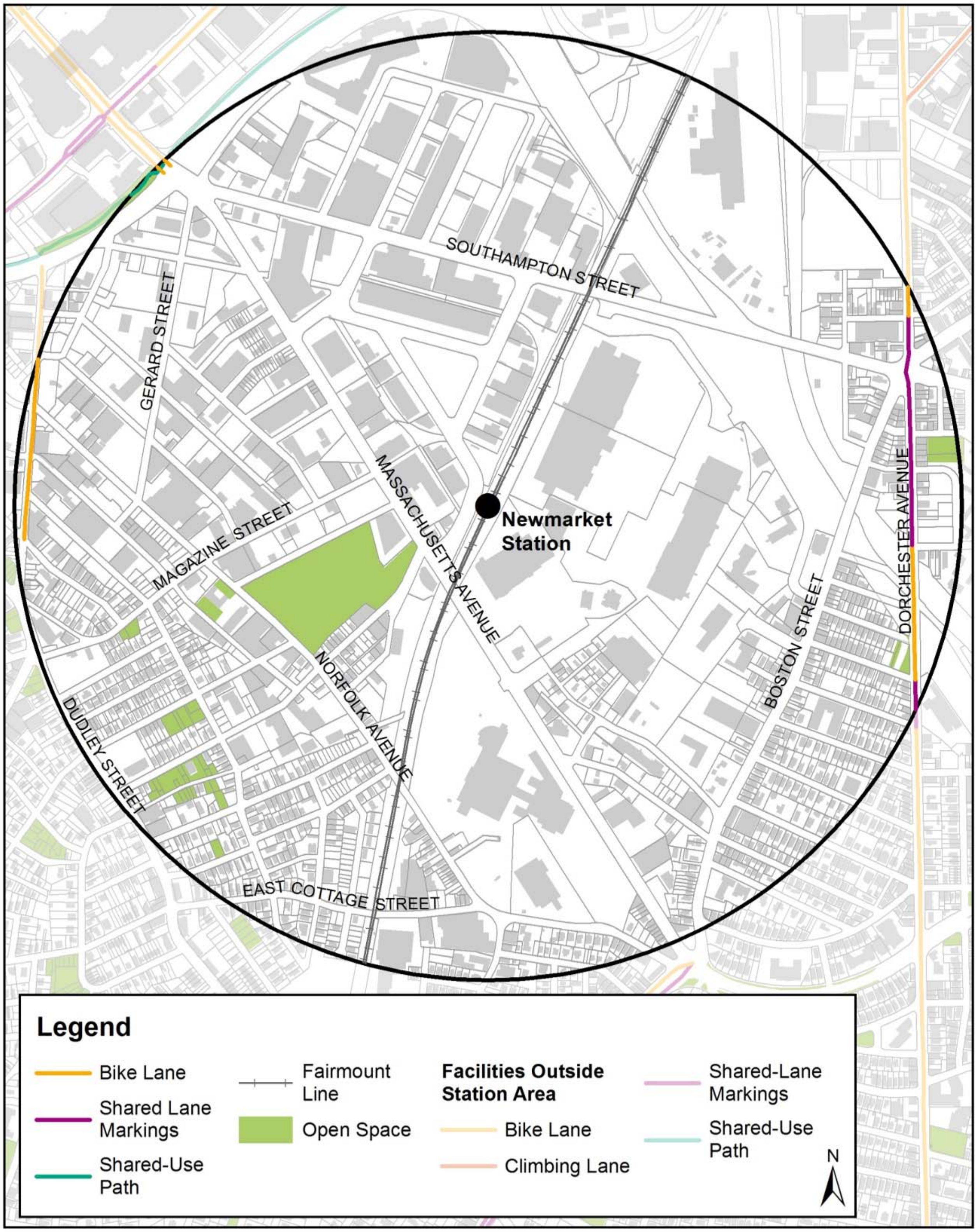

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FIGURE 3-2
Existing Bicycle Facilities
Newmarket Station Area

Fairmount Line Station Access Analysis

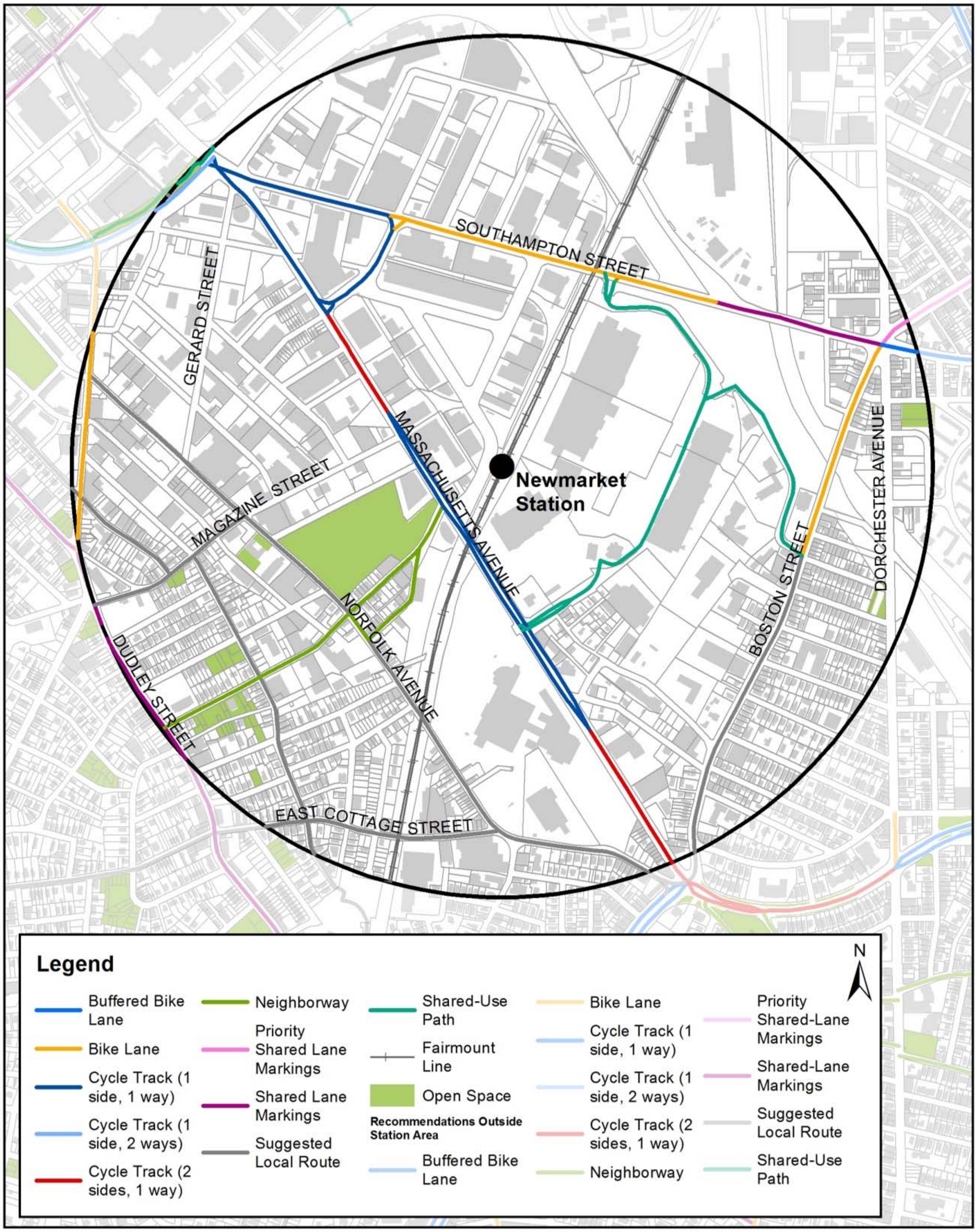

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FIGURE 3-3
Primary Facility Recommendations
Newmarket Station Area

Fairmount Line Station Access Analysis

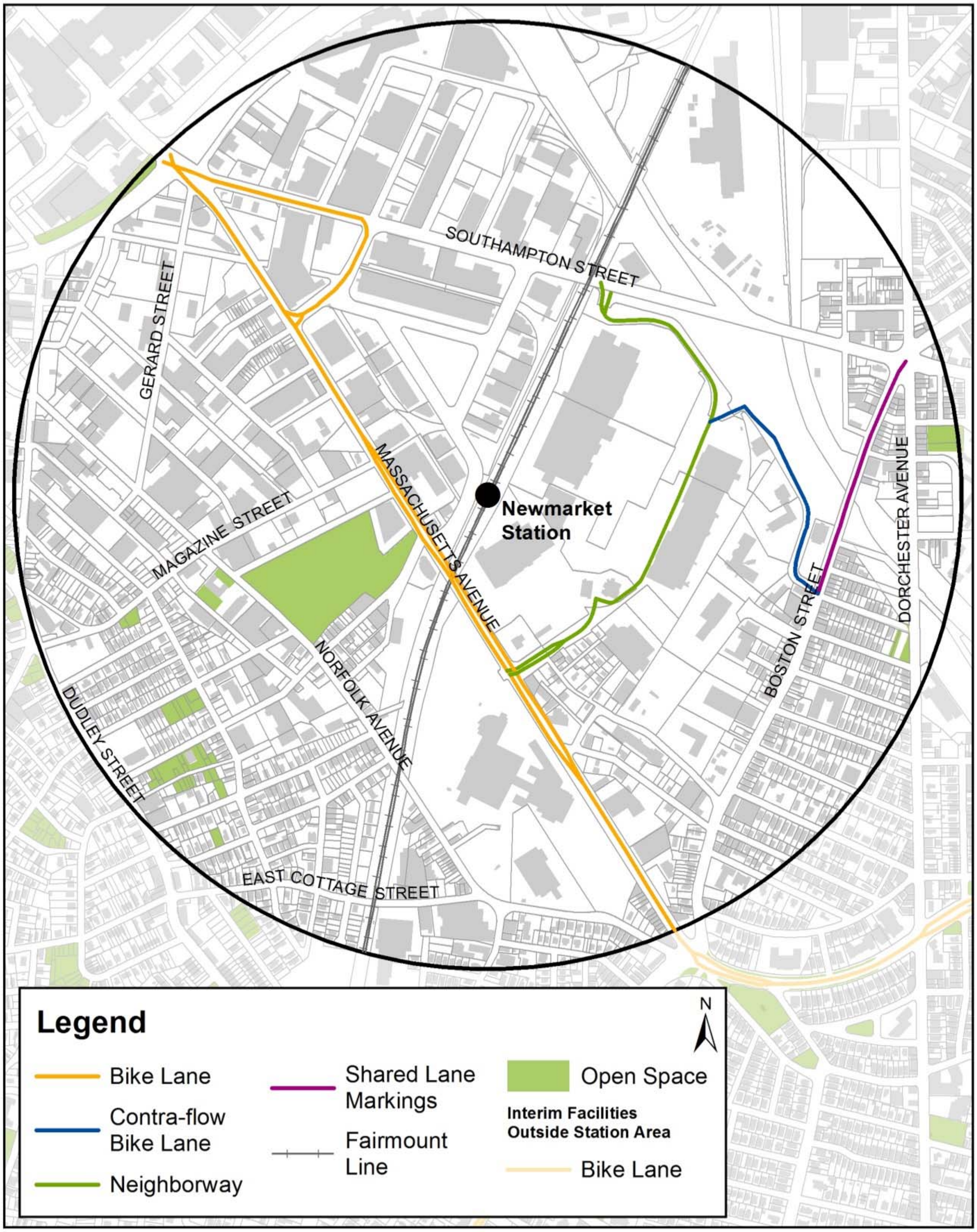

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FIGURE 3-4
Secondary Facility Recommendations
Newmarket Station Area

Fairmount Line Station Access Analysis

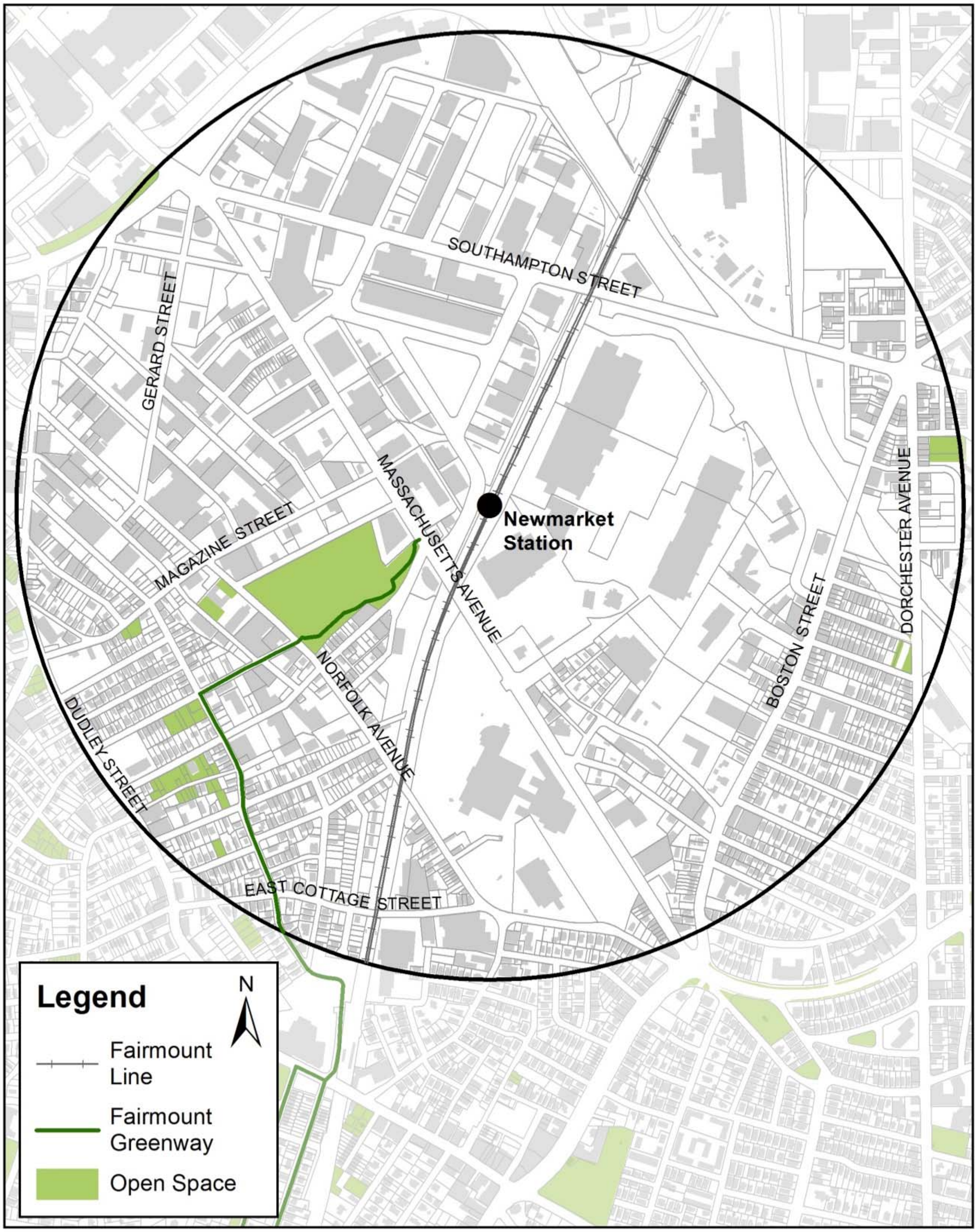

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FIGURE 3-5
Fairmount Greenway
Newmarket Station Area

Fairmount Line Station Access Analysis

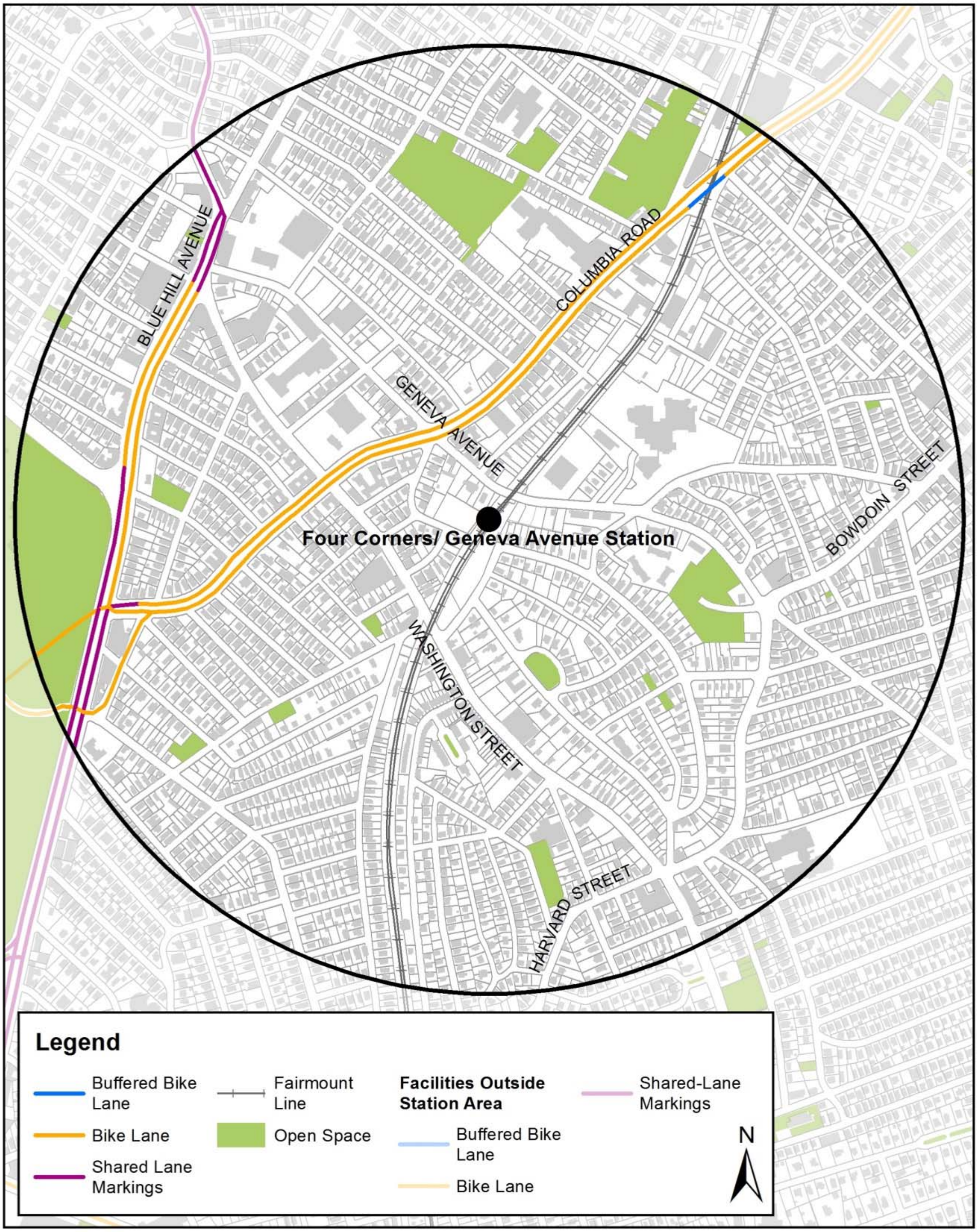

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FIGURE 3-6
Existing Bicycle Facilities
Four Corners/Geneva Avenue Station Area

Fairmount Line Station Access Analysis

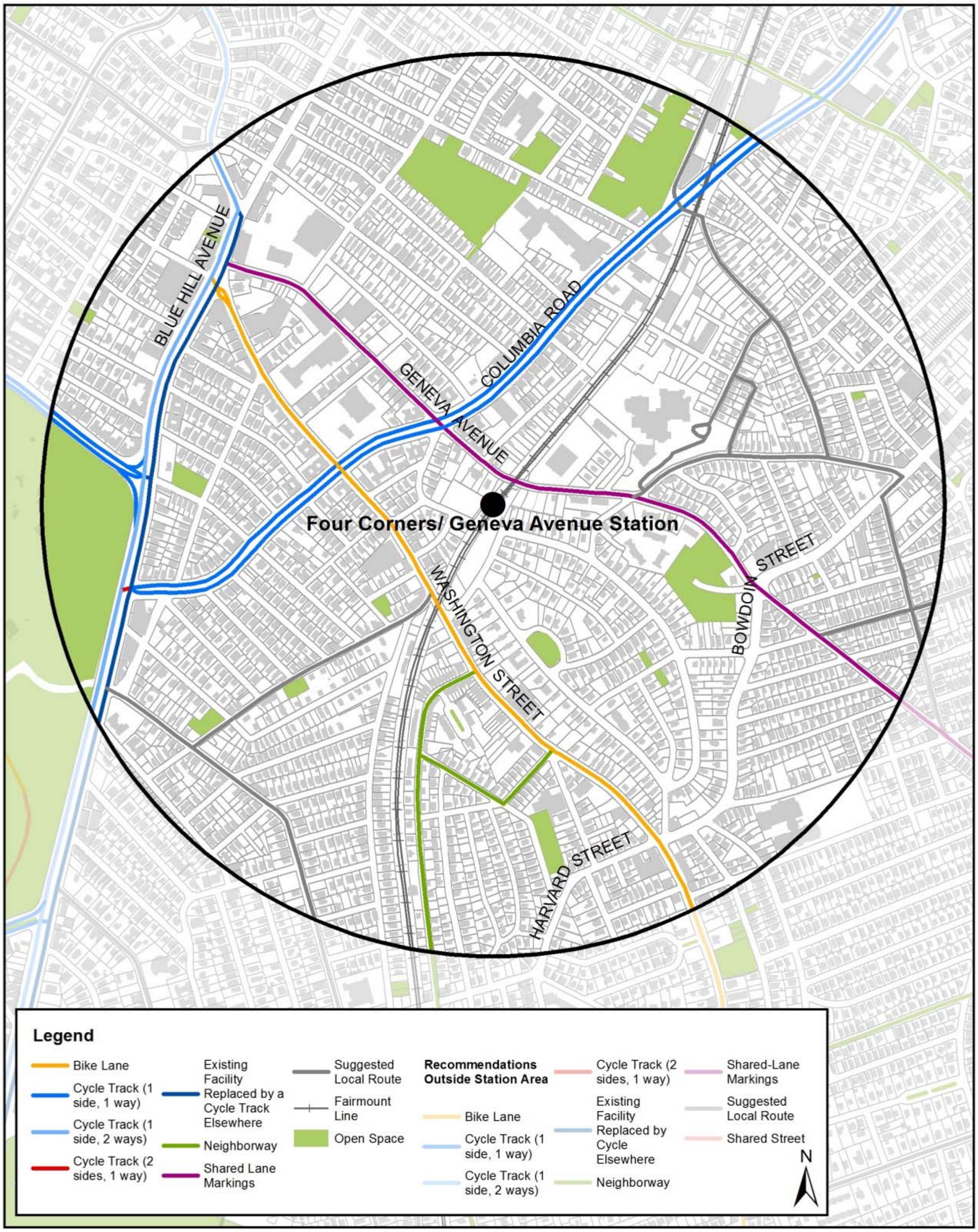

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FIGURE 3-7
Primary Facility Recommendations
Four Corners/Geneva Avenue Station Area

Fairmount Line Station Access Analysis

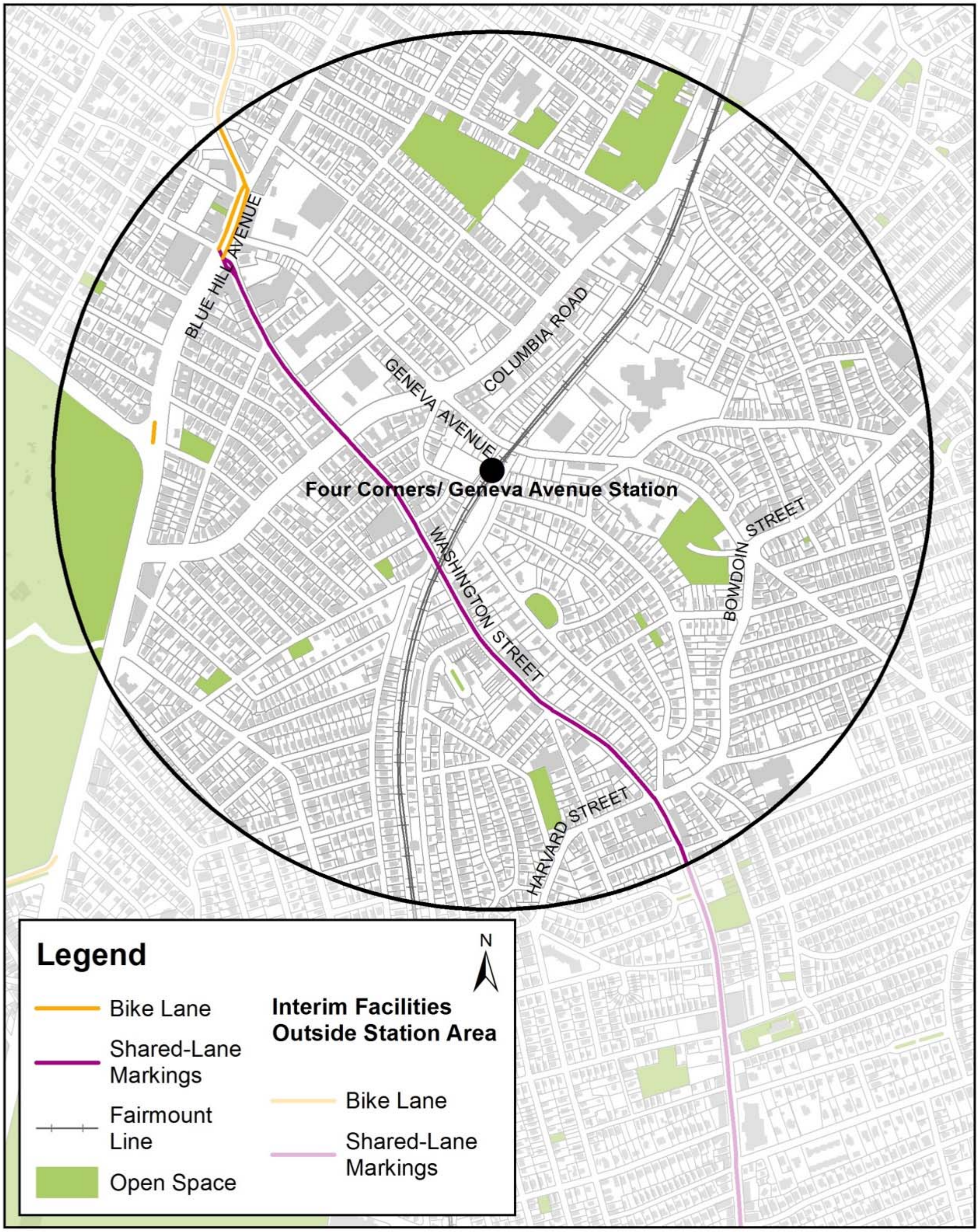

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FIGURE 3-8
Secondary Facility Recommendations
Four Corners/Geneva Avenue Station Area

Fairmount Line Station Access Analysis

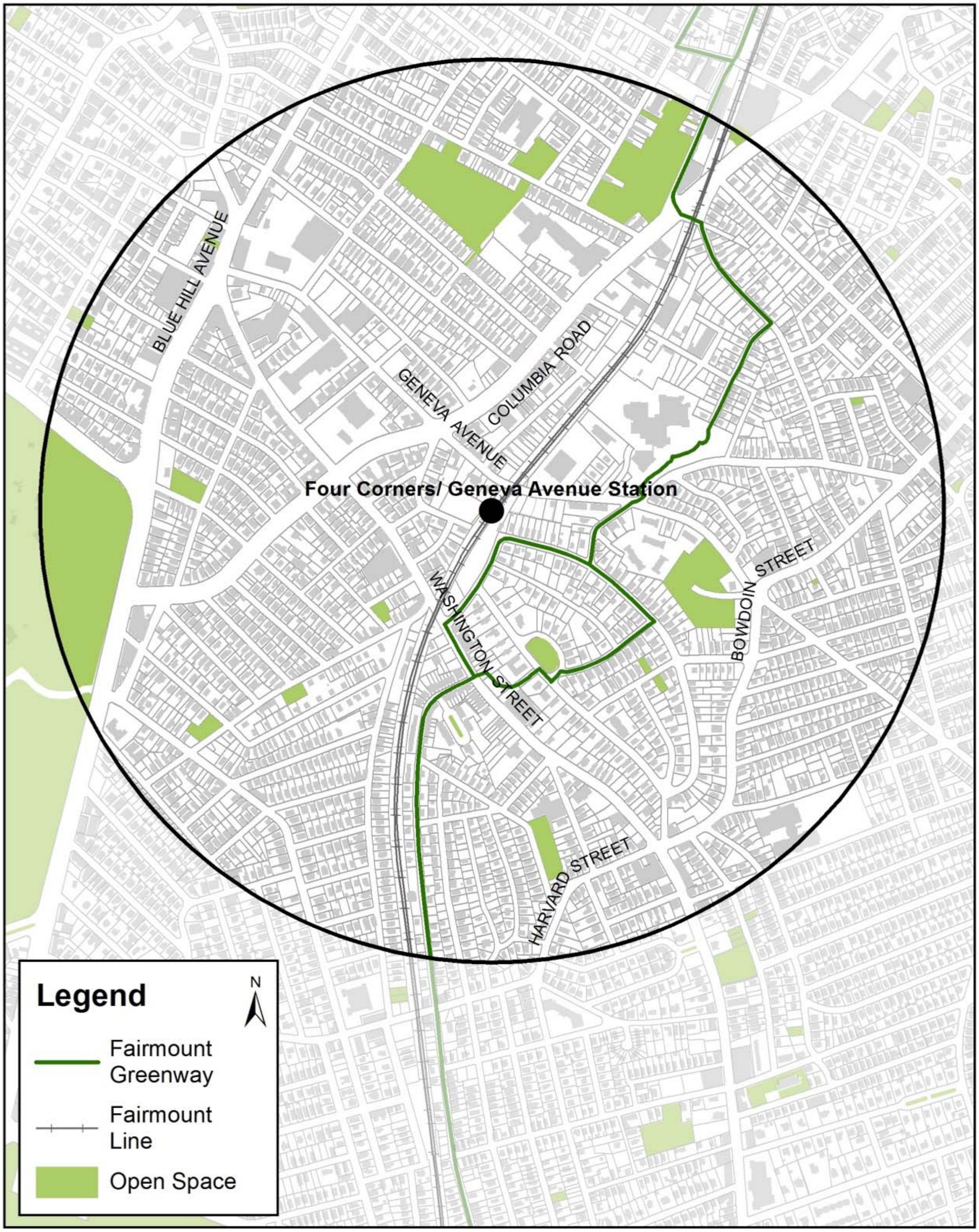

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FIGURE 3-9
Fairmount Greenway Route
Four Corners/Geneva Avenue Station Area

Fairmount Line Station Access Analysis

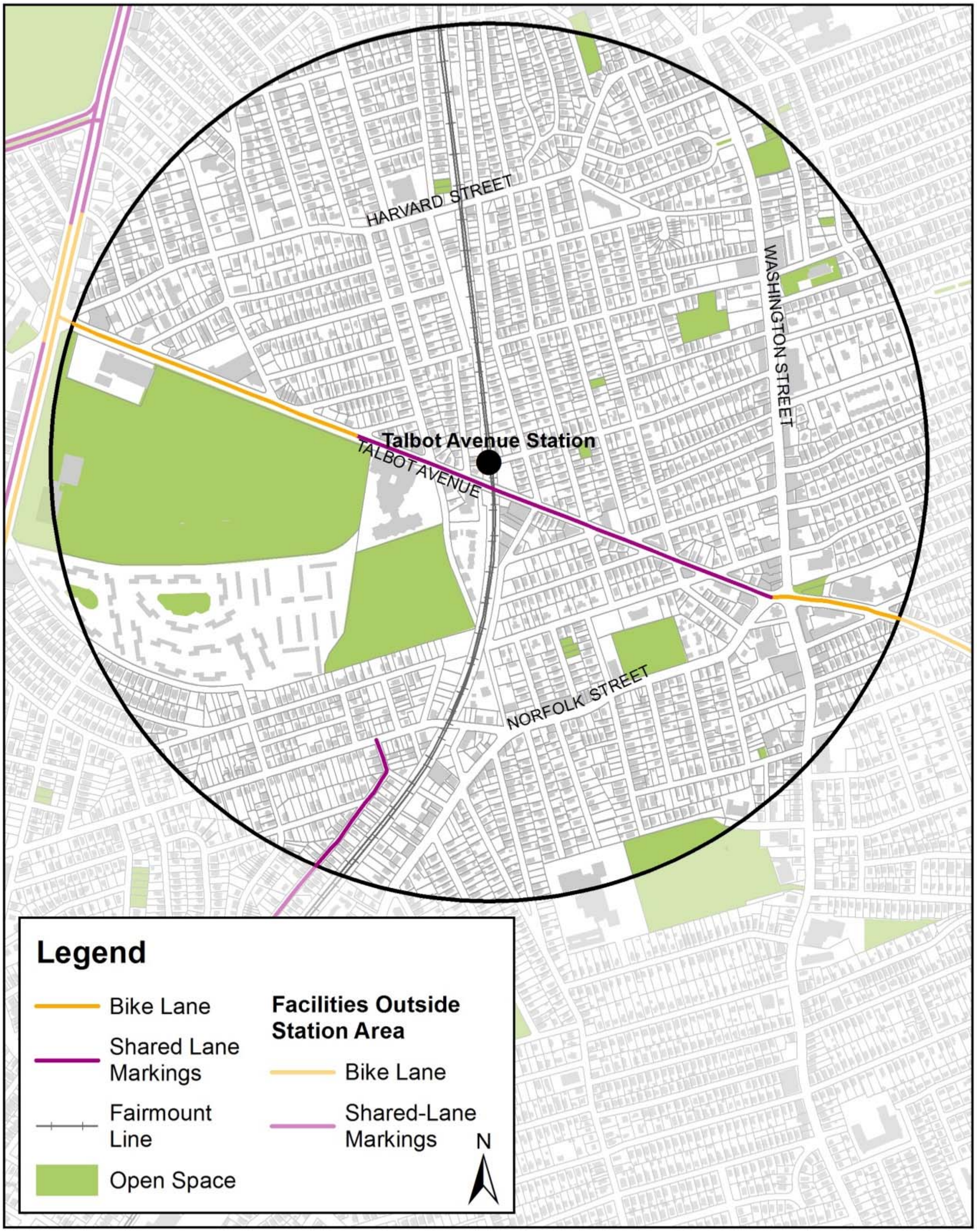

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FIGURE 3-10
Existing Bicycle Facilities
Talbot Avenue Station Area

Fairmount Line Station Access Analysis

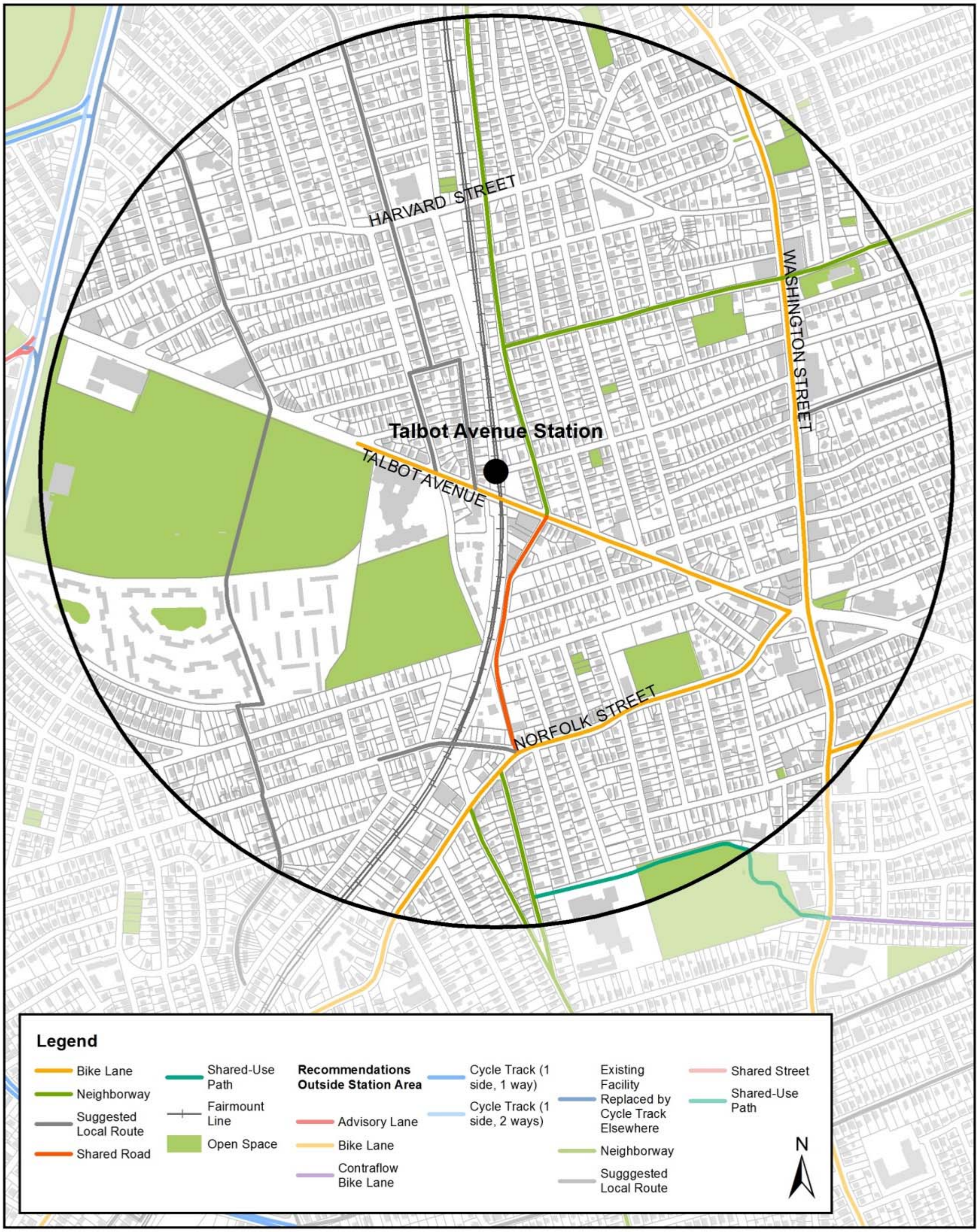

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FIGURE 3-11
Primary Facility Recommendations
Talbot Avenue Station Area

Fairmount Line Station Access Analysis

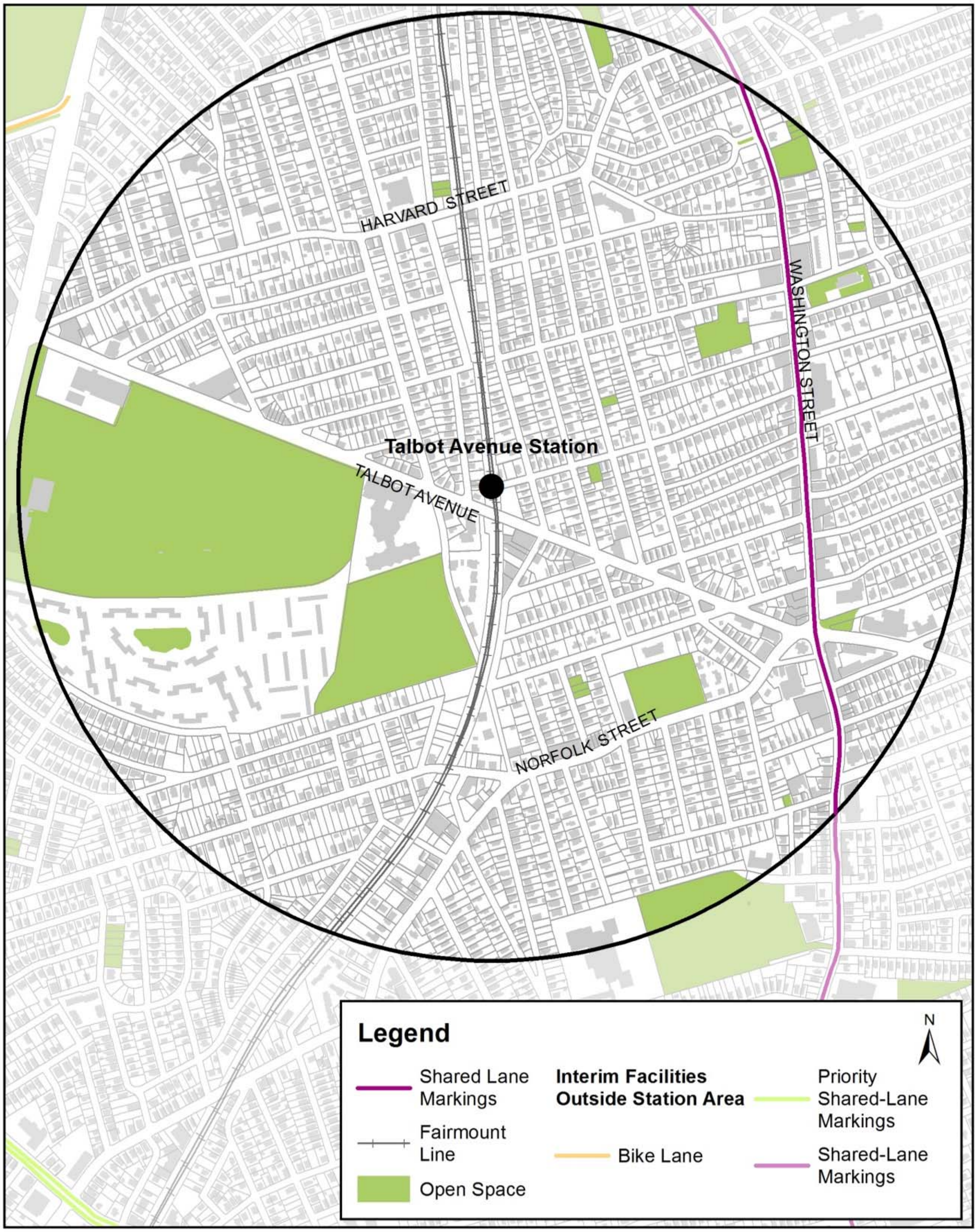

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FIGURE 3-12
Secondary Facility Recommendations
Talbot Avenue Station Area

Fairmount Line Station Access Analysis

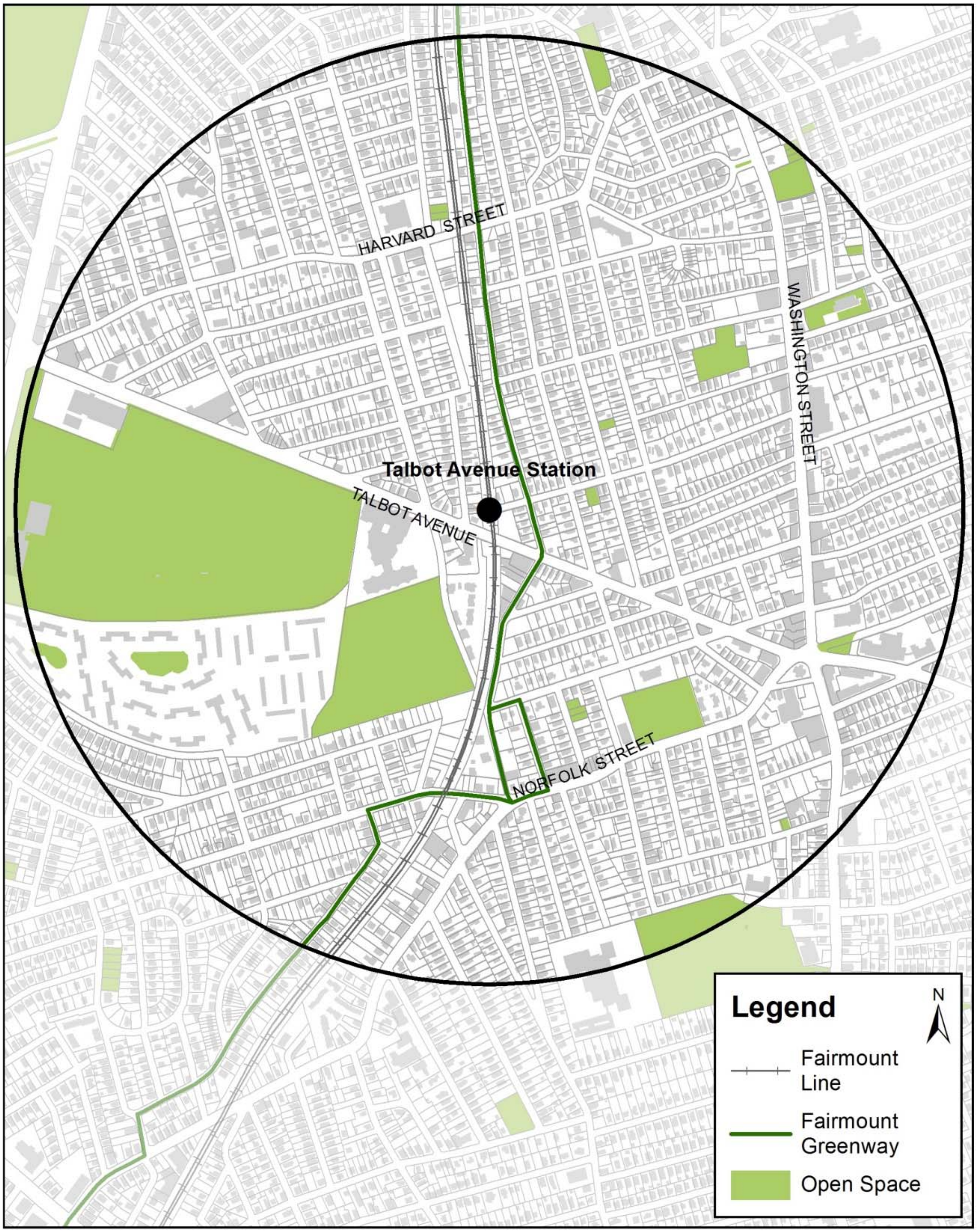

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FIGURE 3-13
Fairmount Greenway
Talbot Avenue Station Area

Fairmount Line Station Access Analysis

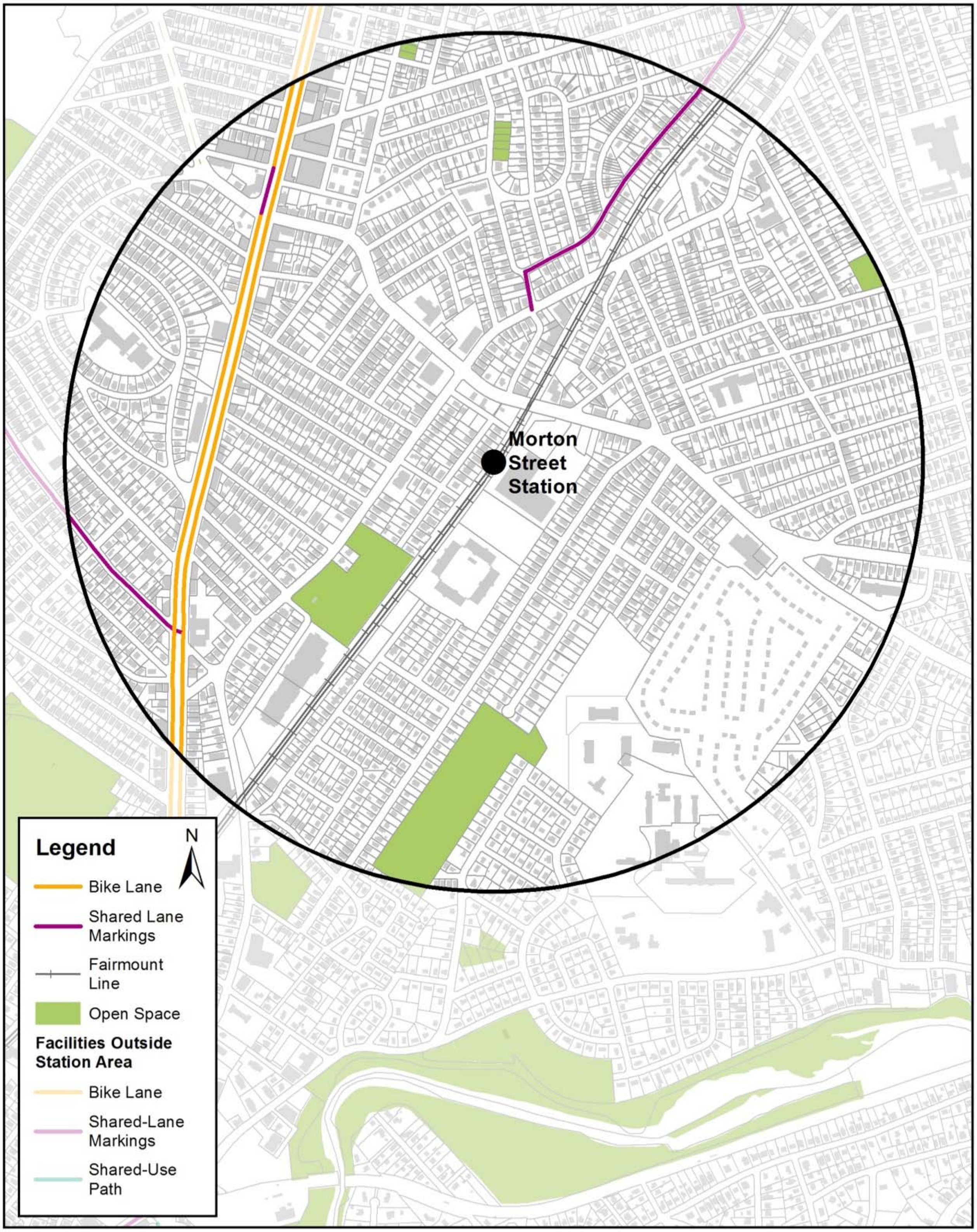

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FIGURE 3-14
Existing Bicycle Facilities
Morton Street Station Area

Fairmount Line Station Access Analysis

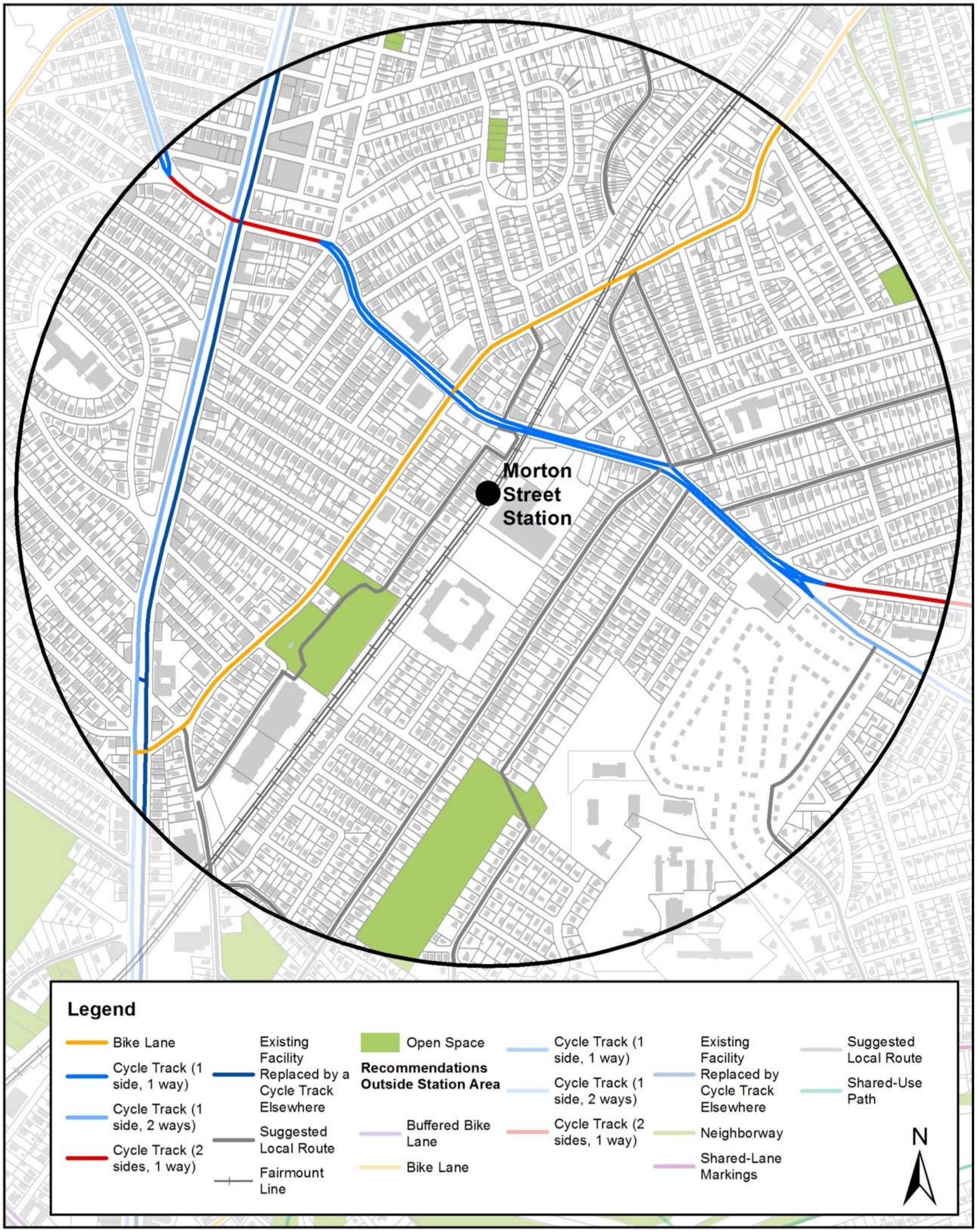

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FIGURE 3-15
Primary Facility Recommendations
Morton Street Station Area

Fairmount Line Station Access Analysis

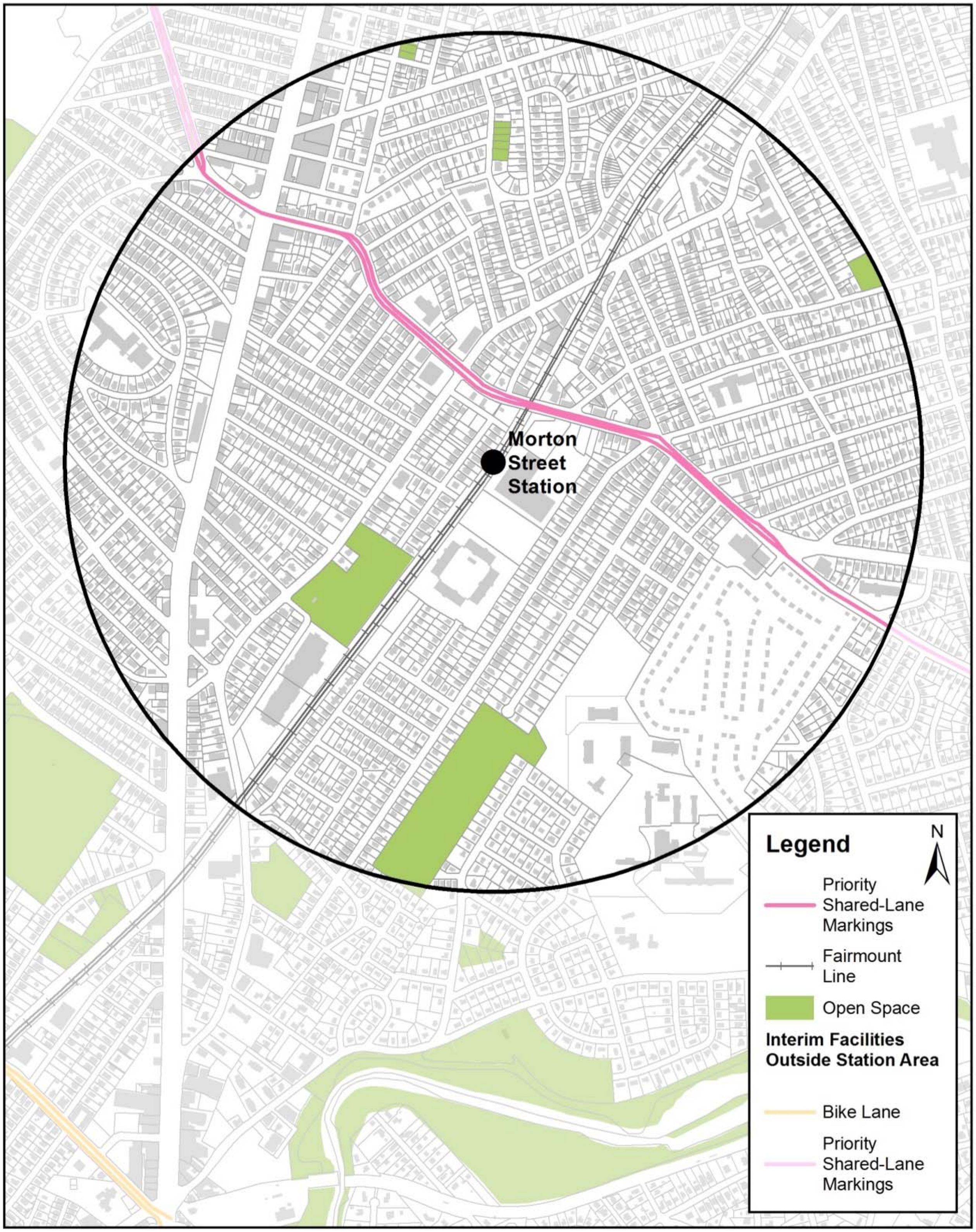

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FIGURE 3-16
Secondary Facility Recommendations
Morton Street Station Area

Fairmount Line Station Access Analysis

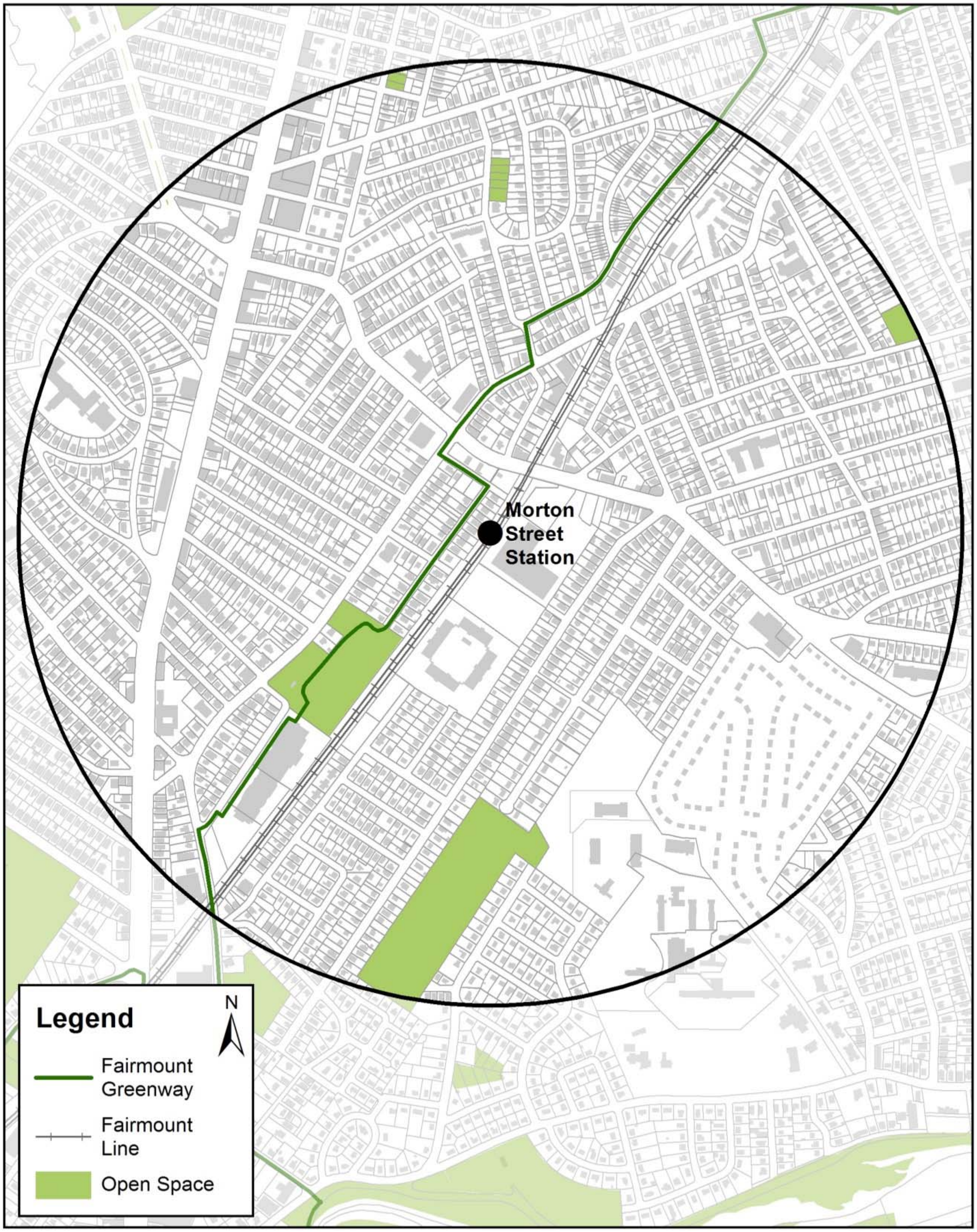

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FIGURE 3-17
Fairmount Greenway
Morton Street Station Area

Fairmount
Line Station
Access Analysis

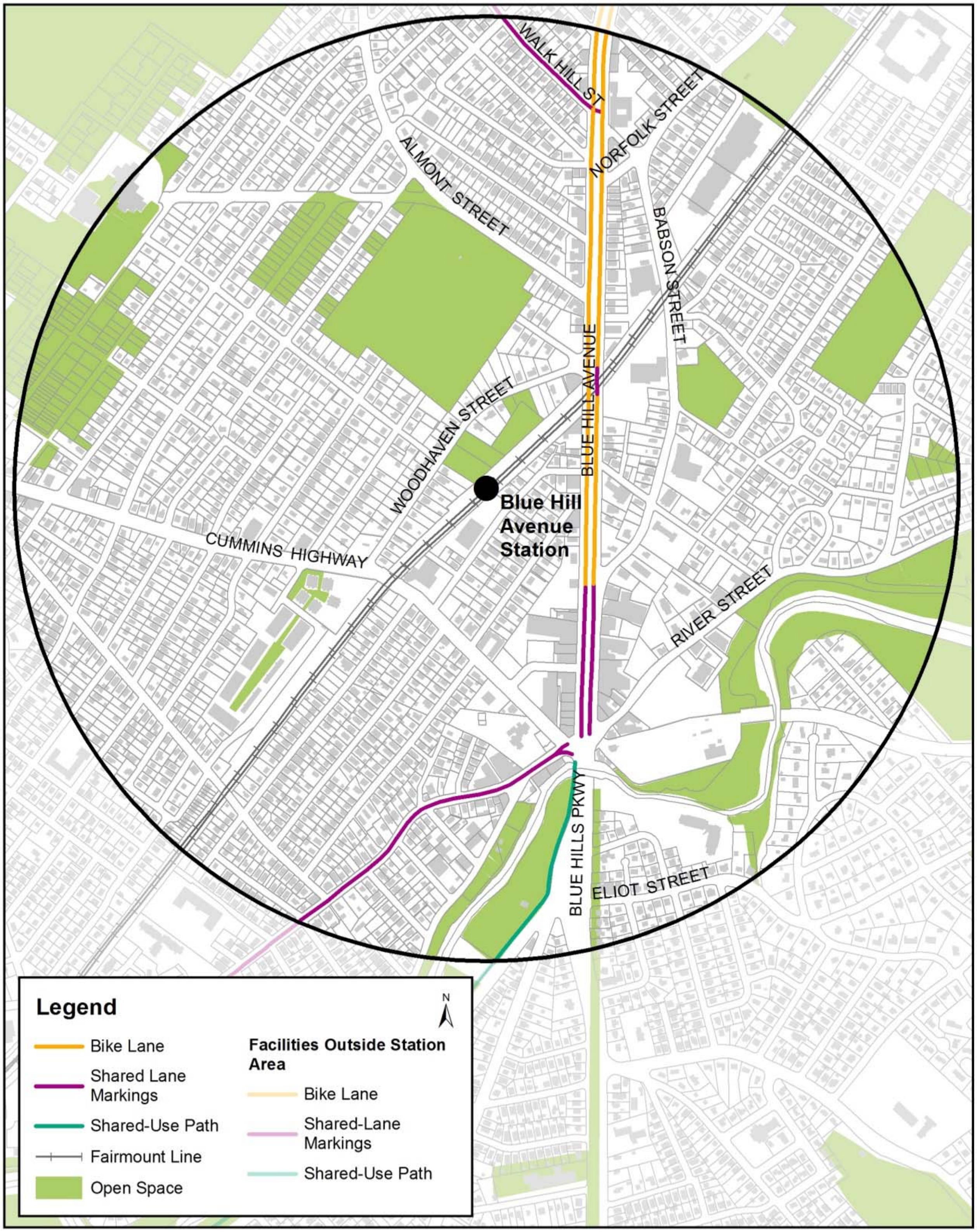

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FIGURE 3-18
Existing Bicycle Facilities
Blue Hill Avenue Station Area

Fairmount Line Station Access Analysis

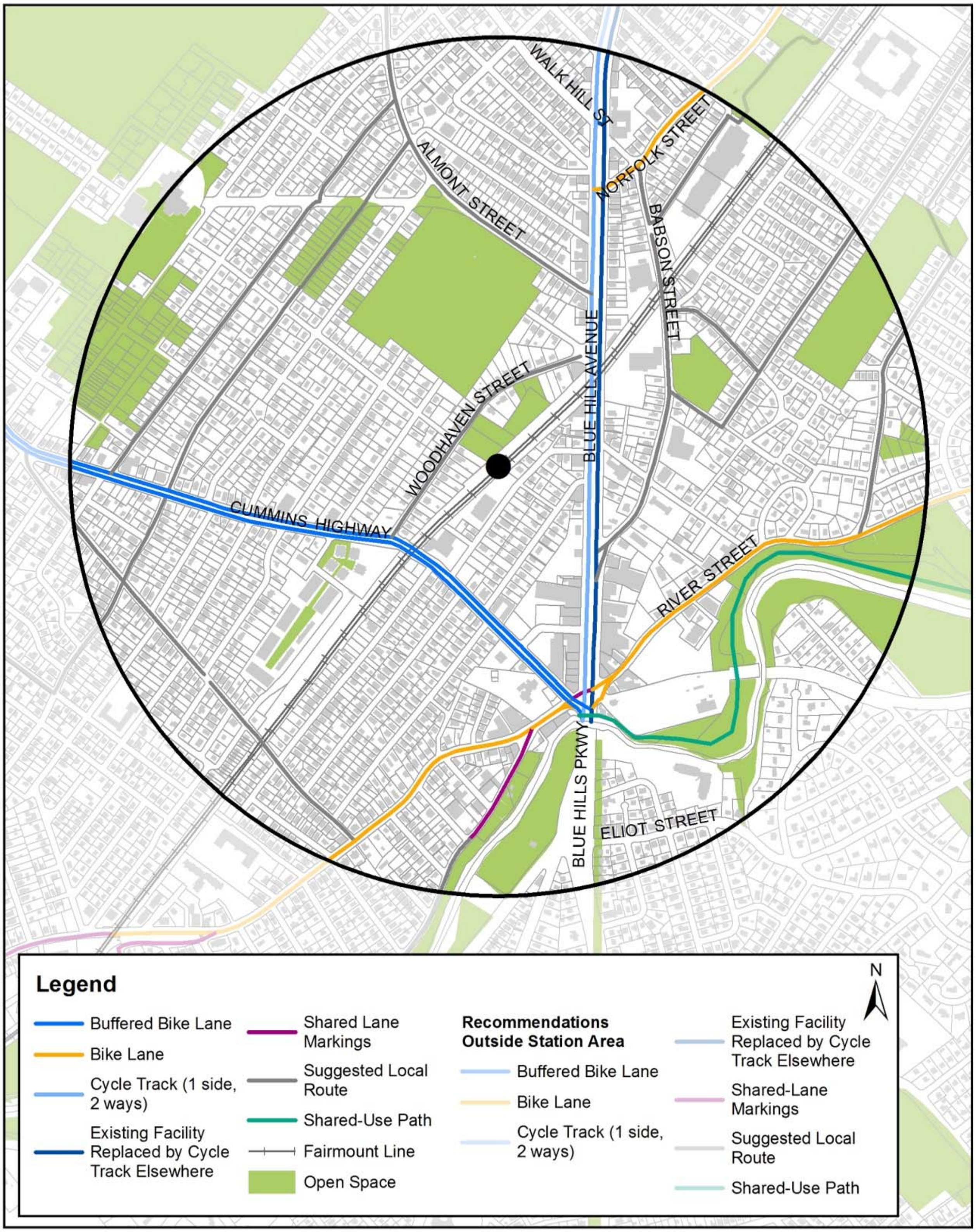

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FIGURE 3-19
Primary Facility Recommendations
Blue Hill Avenue Station Area

Fairmount Line Station Access Analysis

CTPS	**FIGURE 3-20** **Secondary Facility Recommendations** **Blue Hill Avenue Station Area**	*Fairmount Line Station Access Analysis*

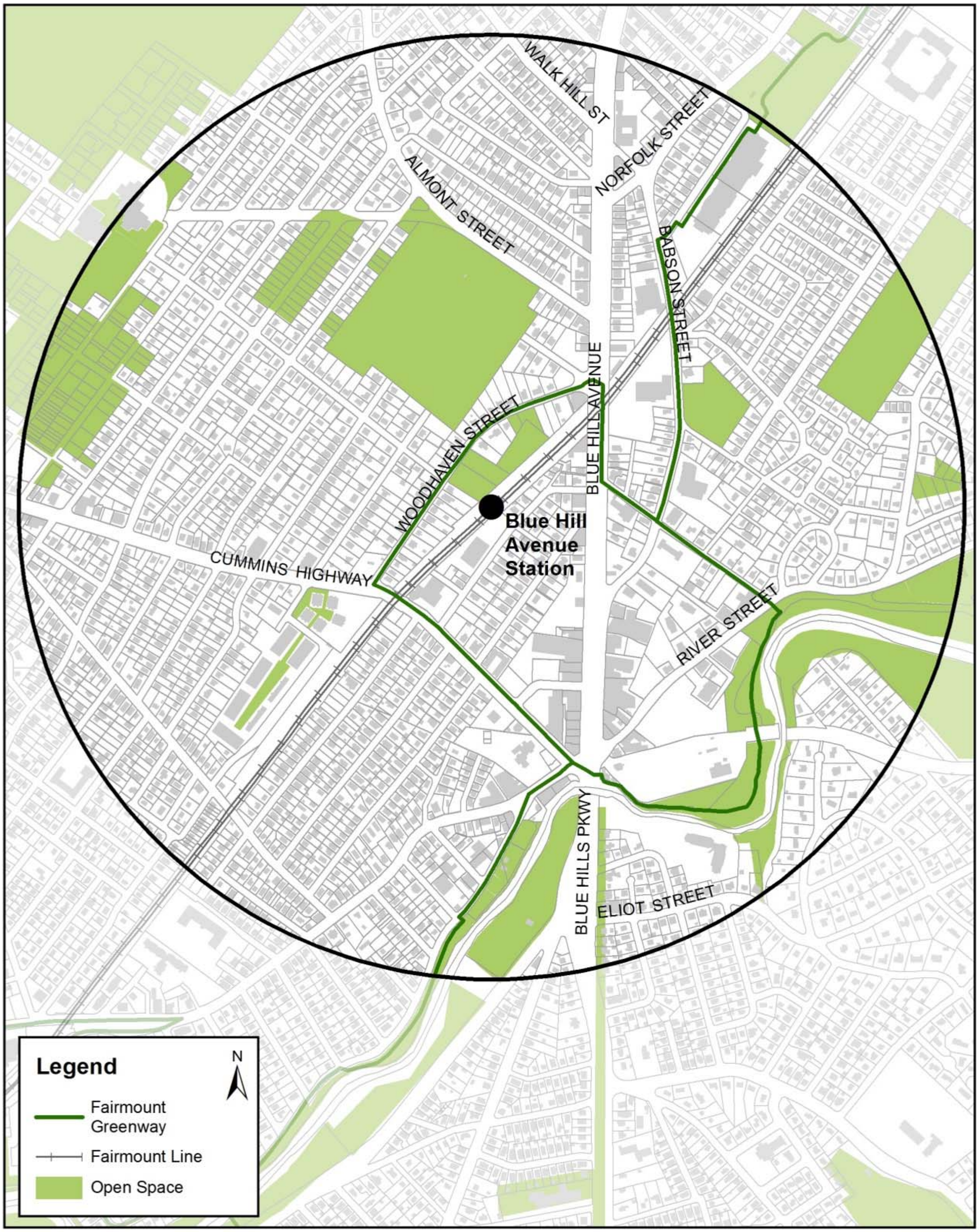

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FIGURE 3-21
Fairmount Greenway
Blue Hill Avenue Station Area

Fairmount Line Station Access Analysis

Chapter 4—Bike Racks

This chapter documents the locations where MPO staff found bike racks in the five selected Fairmount Line station areas. In addition to documenting bike rack installations, this chapter identifies each bike rack as either acceptable or unacceptable. The distinctions are based on guidance published in the Association of Pedestrian and Bicycle Professionals' (APBP) *The Essentials of Bike Parking*, which classifies several bike racks as acceptable for all uses or acceptable for high-density locations.[93] APBP's third bike rack category identifies bike racks that should be avoided because of performance concerns.[94]

MPO staff found several Inverted U (also Staple or Loop) and Post and Ring bike racks, both of which APBP has identified as being acceptable for all uses. MPO staff did not notice any of the racks that APBP classified as acceptable for high-density uses, but within the study areas there were a few bike racks that should be avoided. These bike racks were the Wave (also Undulating or Serpentine), Schoolyard (also Comb or Grid), and Coat Hanger. Refer to Appendix B for bike rack information. The staff documentation differentiates between acceptable bike racks and those that should be avoided. MPO staff recommend the replacement of any of the bike racks that should be avoided. A sufficient number of acceptable bike racks should be installed to replace the existing amount of bicycle parking at a given location.

This chapter also documents the locations where the City of Boston has installed Post and Ring bicycle racks, using City of Boston data. This highlights any differences between the bike racks observed by MPO staff and those that the City of Boston indicates it has installed. MPO staff recommend verifying the presence of City of Boston bike racks where MPO staff did not observe them, even though City of Boston documentation indicates otherwise.

4.1 NEWMARKET

MPO staff observed a total of 11 bike racks in the Newmarket Station area. Ten bike racks were Post and Ring, four of which were found on Norfolk Avenue. The remaining six bike racks were seen near Andrew Square. MPO staff found the Newmarket area's only APBP-discouraged bike rack, which was a Schoolyard

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[93] *Essentials of Bike Parking: Selecting and Installing Bicycle Parking That Works*; Association of Pedestrian and Bicycle Professionals (APBP); September 2015; pages 6-8.

[94] *Essentials of Bike Parking: Selecting and Installing Bicycle Parking That Works*; Association of Pedestrian and Bicycle Professionals (APBP); September 2015; pages 6-8.

rack, outside the Stop & Shop just east of Newmarket Station. The location of each bike rack, whether acceptable or discouraged, is illustrated in Figure 4-1.

4.2 FOUR CORNERS/GENEVA AVENUE

MPO staff observed 11 bike racks in the Four Corners/Geneva Avenue Station area. Of those, eight were in the Inverted U style; all were located on Norwell Street, south of its intersection with Washington Street; three of the eight racks on Norwell Street are documented in Figure 4-2.

FIGURE 4-2
Inverted U Bike Racks on Norwell Street—Four Corners/Geneva Avenue

Source: Central Transportation Planning Staff.

APBP advises against the bike rack types of the remaining three installations that MPO staff observed in this area. Two Wave bike racks are installed in front of the Dorchester Arts Collaborative on Washington Street, shown in Figure 4-3. MPO staff found the final bike rack, a Coat Hanger-style rack, outside the northern Geneva Avenue entrance to the Four Corners/Geneva Avenue Station inbound platform (documented in Figure 4-4). The locations of both the acceptable and the discouraged bike racks in the area are illustrated in Figure 4-5.

FIGURE 4-3
Wave Bike Racks outside the Dorchester Arts Collaborative

Source: Central Transportation Planning Staff.

FIGURE 4-4
Coat Hanger Bike Rack Outside the Geneva Avenue Inbound Platform

Source: Central Transportation Planning Staff.

4.3 TALBOT AVENUE

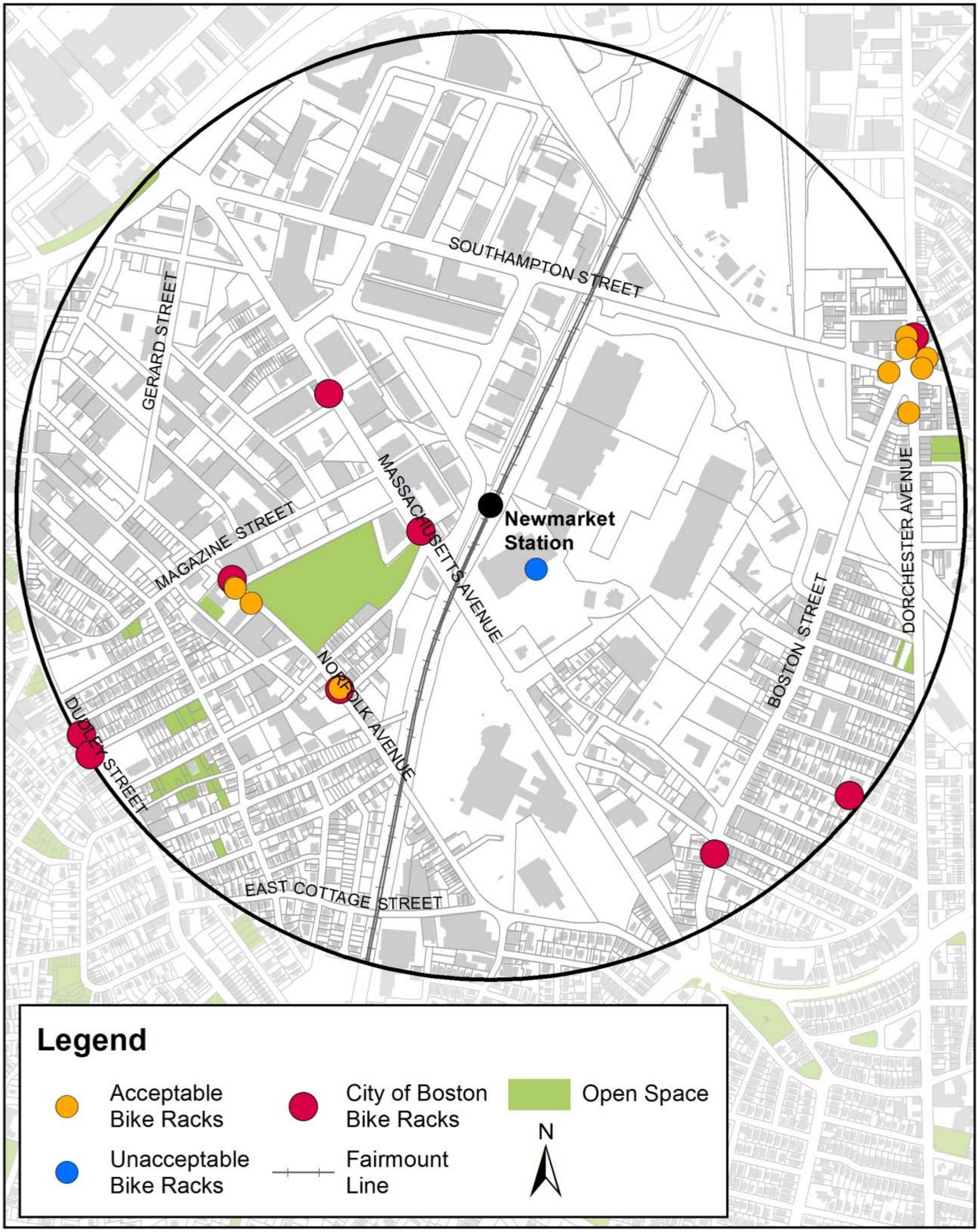
MPO staff observed three bike racks in Talbot Avenue station area, two of which were in the Inverted U-style and located beside each other in front of the Dorchester District Court on Washington Street. At the entrance to the inbound Fairmount Line platform located to the northeast of the station entrances on Talbot Avenue, MPO staff found a Coat Hanger-style bike rack, which the APBP discourages. The locations of these bike racks are illustrated in Figure 4-6.

4.4 MORTON STREET

MPO staff did not observe any bike racks along the selected roadways within the station area, but documentation indicates that the city installed bike racks there (see Figure 4-7).

4.5 BLUE HILL AVENUE

MPO staff did not observe any bike racks in the Blue Hill Avenue station area but City of Boston documentation indicates that it did install bike racks in the area (see Figure 4-8).



CTPS	**FIGURE 4-1** **Bike Racks** **Newmarket Station Area**	*Fairmount Line Station Access Analysis*

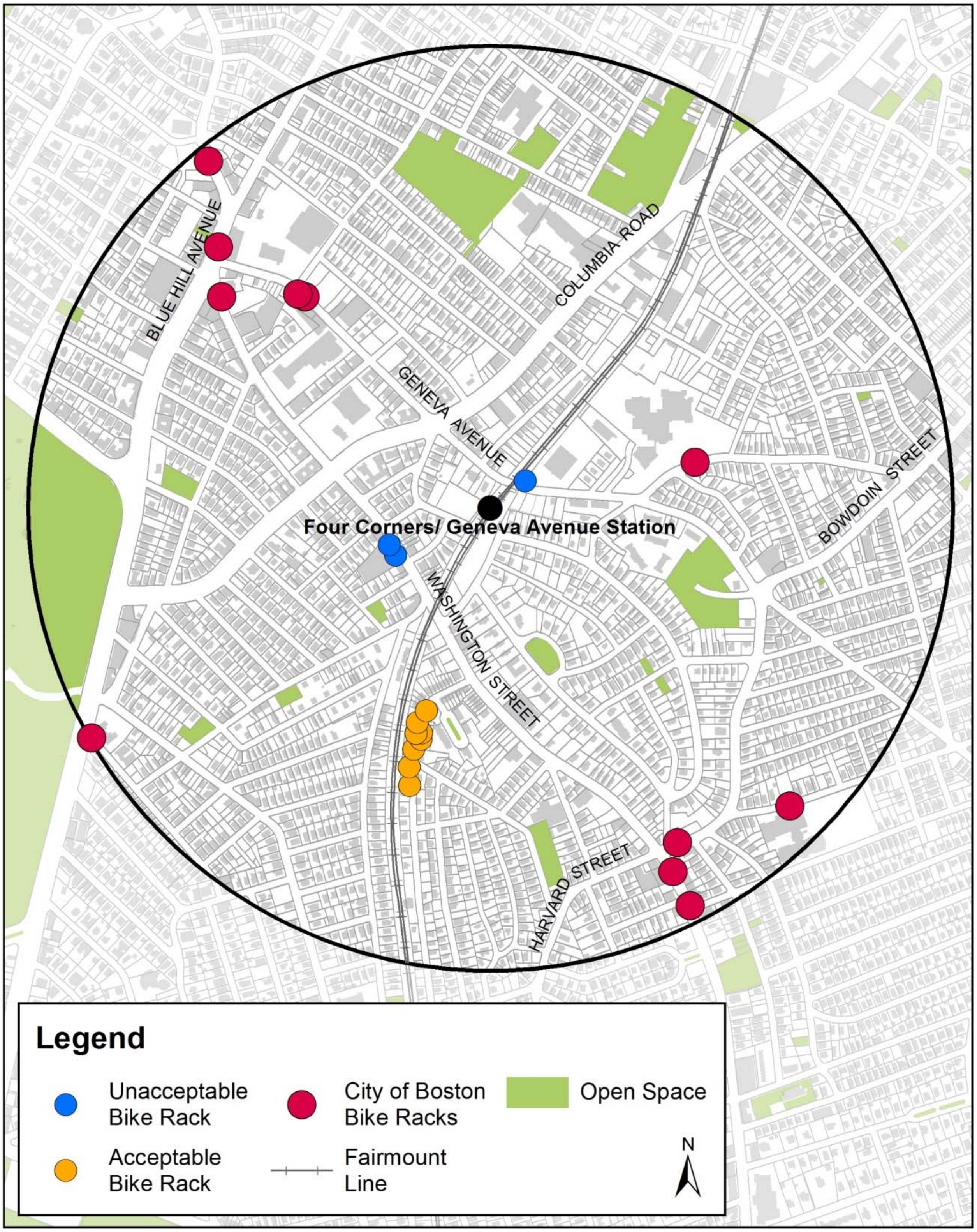


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FIGURE 4-5
Bike Racks
Four Corners/Geneva Avenue Station Area

Fairmount Line Station Access Analysis

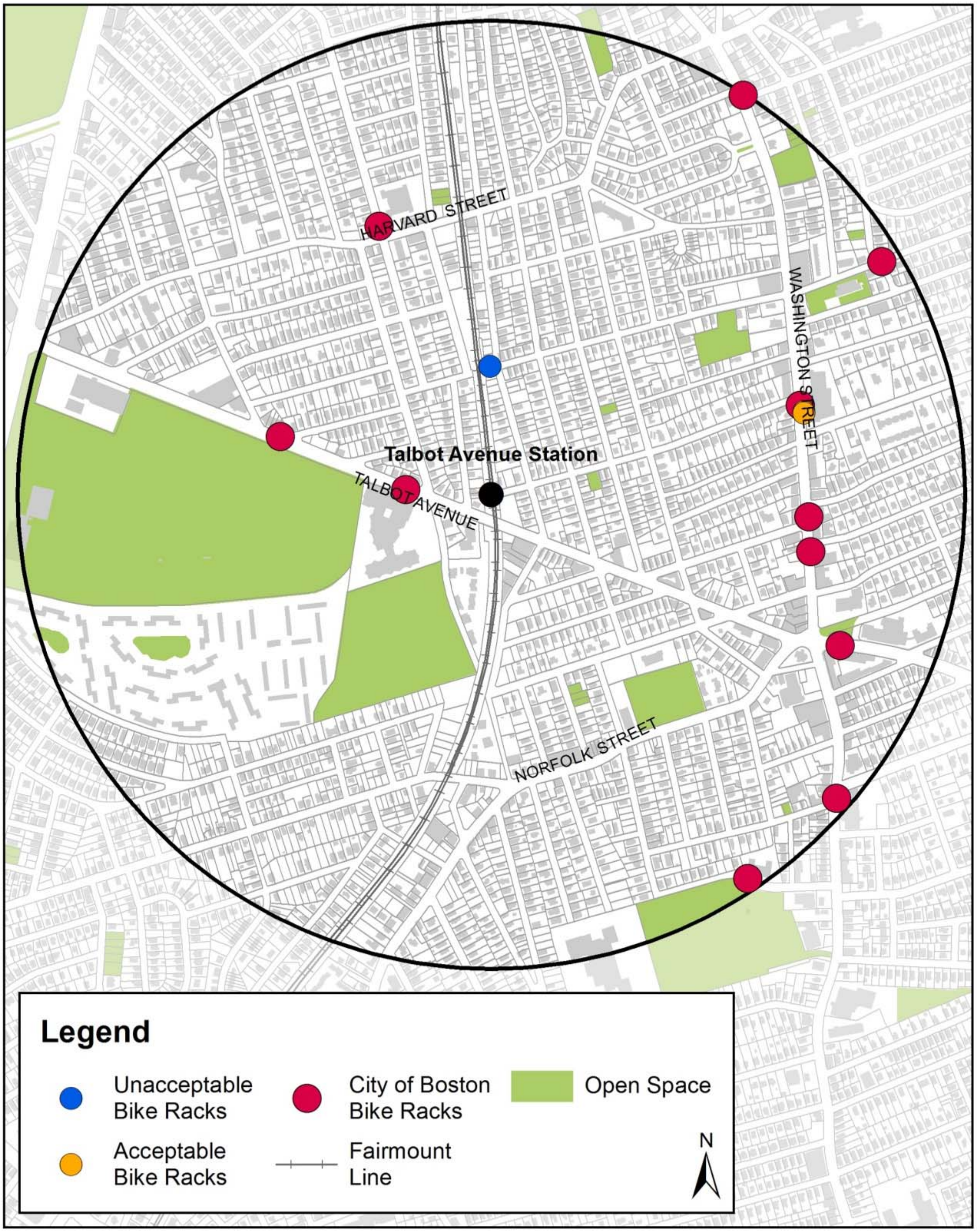

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FIGURE 4-6
Bike Racks
Talbot Avenue Station Area

Fairmount Line Station Access Analysis

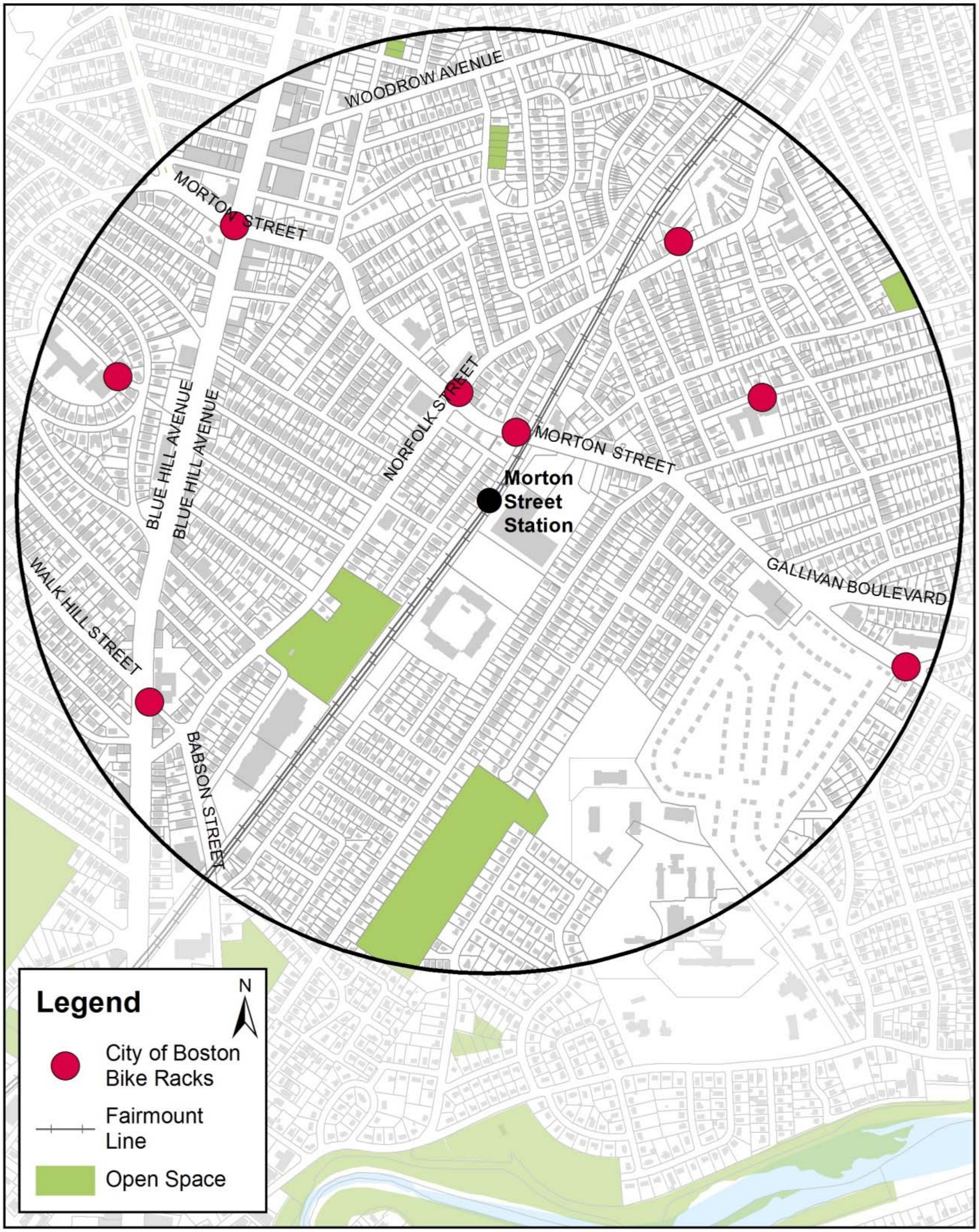

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FIGURE 4-7
Bike Racks
Morton Street Station Area

Fairmount Line Station Access Analysis

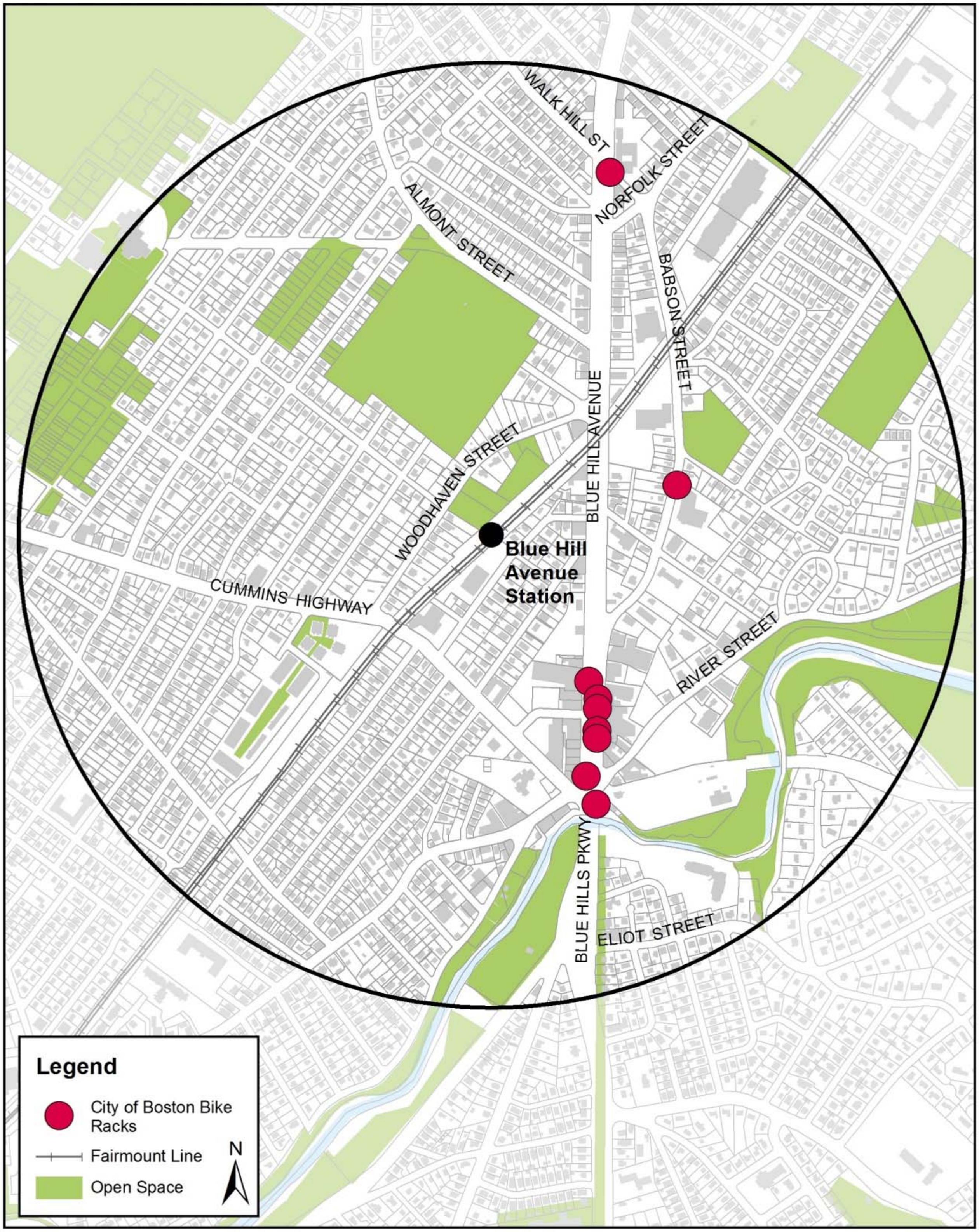

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FIGURE 4-8
Bike Racks
Blue Hill Avenue Station Area

Fairmount Line Station Access Analysis

Chapter 5—Pedestrian Signals

This chapter documents the presence of pedestrian signals throughout the five Fairmount Line station areas. Several signal attributes are listed in tables for each location. The first table in each section provides general information about the station area's pedestrian signals: Whether the pedestrian phases are exclusive or concurrent with vehicular traffic, whether the phases are accompanied by audible indications, and whether the signals featured countdown displays. The FHWA's MUTCD states that a pedestrian change interval of more than seven seconds should include a pedestrian change interval countdown display;[95] for those with change intervals of seven seconds or less, a countdown display is optional.[96] Regarding audible indications, the FHWA does not require pedestrian signals to provide information in non-visual formats such as audible tones, speech messages, or vibrating surfaces; however, the MUTCD includes guidance that, where engineering judgement determines it is appropriate, pedestrian signals should provide non-visual information formats.[97]

The second table in each section addresses duration of the pedestrian phases—the walk interval (walking person symbol), pedestrian change interval (flashing upraised hand symbol), and red clearance/buffer interval (solid upraised hand symbol while all vehicular signals are red)—and the longest length that pedestrians might cross during the crossing time provided, which is defined as the combined duration of the pedestrian change and buffer intervals. MPO staff used Google Maps to identify and measure the longest crossing length and divided the measurement by its crossing time in order to determine the speed at which pedestrians would need to travel in order to complete the crossing.

The FHWA recommends that crossing time calculations should use a 3.5-feet-per-second walking speed.[98] MUTCD guidelines state that pedestrian clearance time

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[95] *Manual on Uniform Traffic Control Devices, Part 4: Highway Traffic Signals, Chapter 4E: Pedestrian Control Features, Section 4E.07: Countdown Pedestrian Signals*; Federal Highway Administration; December 2009; page 499.

[96] Manual on Uniform Traffic Control Devices, Part 4: Highway Traffic Signals, Chapter 4E: Pedestrian Control Features, Section 4E.06: Pedestrian Intervals and Signal Phases; Federal Highway Administration; December 2009; page 497.

[97] *Manual on Uniform Traffic Control Devices, Part 4: Highway Traffic Signals, Chapter 4E: Pedestrian Control Features, Section 4E.09: Accessible Pedestrian Signals and Detectors - General*; Federal Highway Administration; December 2009; page 504.

[98] *Designing Sidewalks and Trail for Access, Part II of II: Best Practices Design Guide, Chapter 8: Pedestrian Crossings, Section 8.6: Crossing Times*; Federal Highway Administration; September 2001; page 8-17.

should allow an individual walking at a speed of 3.5 feet per second, or slower, to leave the curb and reach either 1) the other side of the street or 2) a median that is wide enough for pedestrians to wait.[99] MPO staff calculated crossing speeds at each intersection by measuring the longest crossing at each intersection. The longest crossings were measured from the ramp of one pedestrian-friendly area to another, and therefore did not include accessible medians, which are medians 1) with ramps or cut-throughs, 2) located within the path of a crosswalk, and 3) at least six feet wide. Accessible medians safely accommodate multiple pedestrians and provide sufficient space for a stroller, wheelchair, or bicycle.

In order to verify the information collected in the field, MPO staff requested data from the City of Boston Transportation Department (BTD) for every signalized intersection within the Fairmount Line station areas. MassDOT provided information for a few intersections in the Morton Street station area. Each station area's pedestrian signal attribute information and timing data recorded in the tables of this chapter come from BTD and MassDOT. Appendix D highlights the differences between the pedestrian signal data collected by MPO staff and the information provided by BTD and MassDOT. The disparities should be assessed by city and state employees because they could represent differences between BTD and MassDOT documentation and the actual conditions at a given location. In some cases, this might mean that pedestrian signals do not provide sufficient time or information for pedestrians to cross roadways safely in spite of satisfactory planning efforts.

5.1 NEWMARKET

MPO staff documented 15 signalized intersections in the station area: 13 intersections were made up exclusively of pedestrian signals with countdowns; while two intersections did not have any countdown pedestrian signals (see Figure 5-1). Table 5-1 cites information about the pedestrian signals at each of the 15 intersections assessed by MPO staff. Two intersections feature both exclusive pedestrian phases and pedestrian phase signals that illuminate concurrently with vehicular traffic.

[99] *Manual on Uniform Traffic Control Devices, Part 4: Highway Traffic Signals, Chapter 4E: Pedestrian Control Features, Section 4E.06: Pedestrian Intervals and Signal Phases*; Federal Highway Administration; December 2009; page 497.

TABLE 5-1
Pedestrian Signals in the Newmarket Station Area

Intersection or Crossing	Exclusive or Concurrent	Audible	Count-down
112 Southampton Street	Exclusive	No	Yes
Allstate Road and Massachusetts (Mass.) Avenue	Exclusive	No	Yes
Blue Hill Ave, Dudley St, Magazine St, Mount Pleasant Ave	Exclusive	No	Yes
Boston Street and Harvest Street	Exclusive	No	Yes
Boston Street, Washburn Street, and Frontage Road	Both	Yes	Yes
Dorchester Avenue, Father Songin Way, O'Connor Way	Exclusive	No	Yes
Dudley Street, Dunmore Street, and Hampden Street	Exclusive	No	Yes
Hampden Street, Keegan Street, and Norfolk Avenue	Concurrent	No	Yes
Magazine Street and Massachusetts Avenue	Exclusive	No	Yes
Magazine Street and Norfolk Avenue	Both	No	No
Massachusetts Avenue and Chesterton Street	Concurrent	No	Yes
Mass. Ave, Melnea Cass Blvd, JFK Ramp, Southampton St	Concurrent	No	Yes
Massachusetts Ave, Newmarket Square, and Shirley Street	Concurrent	No	Yes
Southampton Street, Massachusetts Ave, and Bradston St	Exclusive	No	Yes
Southampton Street and South Bay Drive	Exclusive	No	No

The duration of the walk interval, pedestrian change interval, and red clearance interval of each Newmarket station area intersection is listed in Table 5-2, below. The table also includes the length of the longest pedestrian crossing associated with the interval durations and the calculated crossing speed at which a pedestrian would need to walk in order to cross the roadway before signals turn green for vehicular traffic. The boxed rows indicate intersections with multiple pedestrian signal timings that are specific to different roadway crossings. Staff found that seven crossing locations’ signal timings allowed pedestrians walking at a speed of 3.5 feet per second or slower to leave the curb and reach the other side of the street or a median that is wide enough for pedestrians to wait. At 16 crossing locations, the interval durations did not provide sufficient time for pedestrians to cross.

TABLE 5-2
Durations, Lengths, and Speeds of Pedestrian Crossings near Newmarket

Intersection or Crossing	Walk Interval (seconds)	Pedestrian Change Interval (seconds)	Red Clearance Interval (seconds)	Longest Crossing Length (feet)	Expected Crossing Speed (feet/sec)[a]
112 Southampton Street**	7	9	1	49	4.88
Allstate Road, Massachusetts Avenue**	7	13	4	99	5.81
Blue Hill Ave, Dudley St, Magazine St, Mount Pleasant Ave	7	14	4	62	3.46
Boston Street and Harvest Street	8	4	4	40	4.97
Boston Street, Washburn St, Frontage Road	7	7	4	39	3.53
Boston Street, Washburn St, Frontage Road	7	10	4	41	2.90
Dorchester Ave, Father Songin Way, O'Connor Way**	7	10	4	52	3.68
Dudley Street, Dunmore Street, and Hampden Street	7	13	4	71	4.18
Hampden Street, Keegan Street, and Norfolk Avenue*	7	7	2	34	3.73
Hampden Street, Keegan St, Norfolk Avenue	7	7	2	31	3.49
Magazine Street, Massachusetts Avenue**	7	10	4	49	3.53
Magazine Street and Norfolk Avenue	4	11	1	43	3.62
Magazine Street and Norfolk Avenue**	7	6	4	45	4.45
Massachusetts Avenue, Chesterton Street	35	8	1	28	3.14
Massachusetts Avenue, Chesterton Street	8	8	1	48	5.36
Mass Ave, Melnea Cass Blvd, JFK Ramp, Southampton St	7	20	2	85	3.87
Mass Ave, Melnea Cass Blvd, JFK Ramp, Southampton St	7	20	2	51	2.31
Mass Ave, Melnea Cass Blvd, JFK Ramp, Southampton St	7	22	2	38	1.57
Mass Ave, Melnea Cass Blvd, JFK Ramp, Southampton St	7	20	2	91	4.12
Massachusetts Ave, Newmarket Square, Shirley St**	7	9	2	64	5.78
Massachusetts Ave, Newmarket Square, Shirley St*	15	14	3	86	5.07
Southampton St, Massachusetts Ave, Bradston St	8	9	4	23	1.80
Southampton Street and South Bay Drive	7	11	4	59	3.94

[a] Longest Crossing Length /(Pedestrian Change Interval + Red Clearance Interval).
Note: Walk interval durations followed by an asterisk indicate that the pedestrian signal rests in the walk phase. Walk interval durations followed by two asterisks indicate that the pedestrian phase is only called after pushbutton actuation.

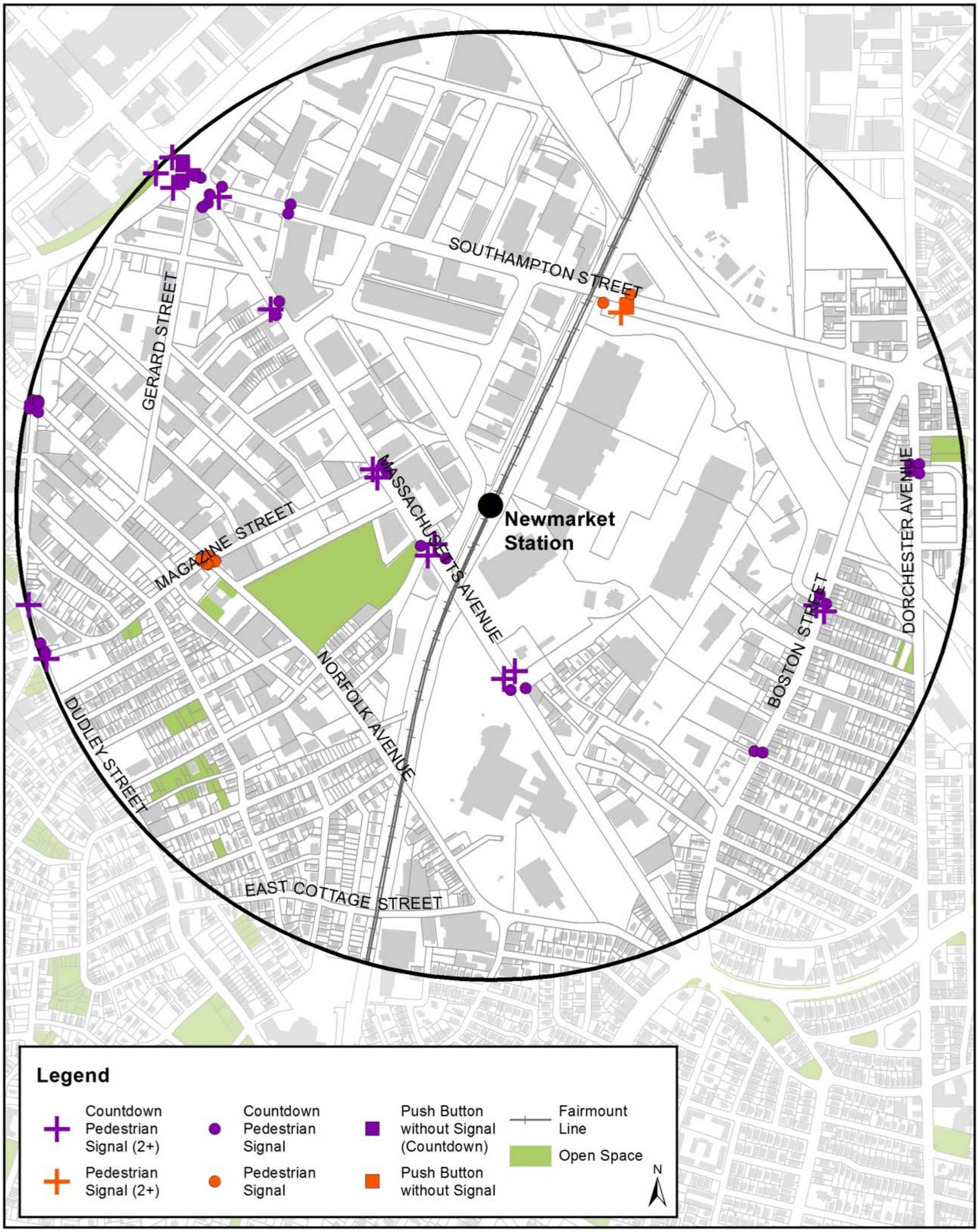

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FIGURE 5-1
Pedestrian Signals
Newmarket Station Area

Fairmount Line Station Access Analysis

5.2 FOUR CORNERS/GENEVA AVENUE

MPO staff documented 15 signalized intersections along the selected roadways in the station area. They found that 11 intersections had pedestrian countdown signals exclusively while two intersections did not have any countdown pedestrian signals at all. The remaining two intersections in the station area are composed of a combination of different types of pedestrian signals, some of which include countdown displays and some of which do not. This information is represented in Figure 5-2-1. Listed in Table 5-2-1 is information about the pedestrian signals at each of the 15 intersections observed by MPO staff. One intersection features both exclusive pedestrian phases and pedestrian phases that illuminate concurrently with vehicular traffic.

TABLE 5-3
Pedestrian Signals in the Four Corners/Geneva Avenue Station Area

Intersection or Crossing	Exclusive or Concurrent	Audible	Count-down
Blue Hill Avenue and Columbia Road	Exclusive	No	Yes
Blue Hill Avenue and Seaver Street	Both	Yes	13 of 14
Blue Hill Avenue, Cheney Street, Washington Street	Exclusive	No	Yes
Blue Hill Avenue, Warren Street, and Georgia Street	Concurrent	No	Yes
Columbia Road and Devon Street	Exclusive	No	Yes
Columbia Road and Geneva Avenue	Concurrent	No	Yes
Columbia Road and Seaver Street	Concurrent	No	Yes
Columbia Road and Washington Street	Concurrent	No	Yes
Columbia Road and Wyola Place	Exclusive	No	No
Columbia Road, Ceylon Street, and Richfield Street	Exclusive	No	Yes
Geneva Avenue and Bowdoin Street	Exclusive	No	Yes
Glen Lane, Blue Hill Avenue, and Glenway Street	Exclusive	No	No
Harvard Street, Washington St, Bowdoin St, Bowdoin Ave	Concurrent	No	Yes
Washington Street and Erie Street	Concurrent	Yes	3 of 4
Washington Street and Vassar Street	Exclusive	No	Yes

The pedestrian signals at two intersections in the station area do not feature countdown displays: the six signals where Columbia Road and Wyola Place intersect; and the eight signals at the intersection of Glen Lane, Blue Hill Avenue, and Glenway Street. MPO staff found the pedestrian change interval for the six pedestrian signals at Columbia Road and Wyola Place to be 18 seconds long, although documentation from the Boston Public Works Department indicates that the interval lasts 21 seconds. The pedestrian change interval at the intersection of Glen Lane, Blue Hill Avenue, and Glenway Street is 24 seconds long.

The duration of the walk interval, pedestrian change interval, and red clearance interval of each Four Corners/ Geneva Avenue station area intersection is listed in Table 5-2-2, below. The table also includes the length of the longest pedestrian crossing associated with the interval durations and the calculated crossing speed at which a pedestrian would need to walk in order to cross the roadway before signals turn green for vehicular traffic. The boxed rows indicate intersections with multiple pedestrian signal timings that are specific to different roadway crossings. Staff found that nine crossing locations' signal timings allowed pedestrians walking at a speed of 3.5 feet per second or slower to leave the curb and reach the other side of the street or a median that is wide enough for pedestrians to wait. At 18 crossing locations, the interval durations did not provide sufficient time for pedestrians to cross.

TABLE 5-4
Durations, Lengths, and Speeds of Pedestrian Crossings near Four Corners/ Geneva Avenue

Intersection or Crossing	Walk Interval (seconds)	Pedestrian Change Interval (seconds)	Red Clearance Interval (seconds)	Longest Crossing Length (feet)	Expected Crossing Speed (feet/sec)[a]
Blue Hill Avenue and Columbia Road**	7	27	4	107	3.45
Blue Hill Avenue and Seaver Street**	7	9	3	26	2.13
Blue Hill Avenue and Seaver Street**	7	6	6	30	2.49
Blue Hill Avenue and Seaver Street**	7	19	3	84	3.82
Blue Hill Avenue and Seaver Street**	7	6	3	18	2.00
Blue Hill Avenue, Cheney St, Washington Street	7	25	4	88	3.02
Blue Hill Avenue, Warren Street, Georgia Street	7	10	6	67	4.17
Blue Hill Avenue, Warren Street, Georgia Street	7	14	4	71	3.93
Blue Hill Avenue, Warren Street, Georgia Street	7	8	4	52	4.30
Columbia Road and Devon Street	7	22	4	93	3.59
Columbia Road and Geneva Avenue*	8	12	4	63	3.94
Columbia Road and Geneva Avenue	7	24	4	118	4.22
Columbia Road and Geneva Avenue*	8	12	3	67	4.47
Columbia Road and Seaver Street*	8	8	3	32	2.93
Columbia Road and Seaver Street	7	20	3	95	4.11
Columbia Road and Washington Street*	8	7	3	45	4.52
Columbia Road and Washington Street**	7	21	3	94	3.91
Columbia Road and Washington Street*	8	7	3	46	4.56
Columbia Road and Wyola Place**	7	21	4	54	2.15
Columbia Road, Ceylon Street, Richfield Street	7	25	4	103	3.54
Geneva Avenue and Bowdoin Street	7	13	4	81	4.75
Glen Lane, Blue Hill Avenue, Glenway Street	7	24	4	94	3.37
Harvard St, Washington St, Bowdoin St, Bowdoin Ave	10	10	1	70	6.38

Intersection or Crossing	Walk Interval (seconds)	Pedestrian Change Interval (seconds)	Red Clearance Interval (seconds)	Longest Crossing Length (feet)	Expected Crossing Speed (feet/sec)[a]
Harvard St, Washington St, Bowdoin St, Bowdoin Ave	10	10	1	58	5.24
Washington Street and Erie Street*	8	7	2	38	4.21
Washington Street and Erie Street**	8	8	1	48	5.39
Washington Street and Vassar Street**	7	9	4	45	3.48
Washington Street and Vassar Street	13	12	1	38	2.92

[a] Longest Crossing Length / (Pedestrian Change Interval + Red Clearance Interval).

Note: Walk interval durations followed by an asterisk indicate that the pedestrian signal rests in the walk phase. Walk interval durations followed by two asterisks indicate that the pedestrian phase is only called after pushbutton actuation.

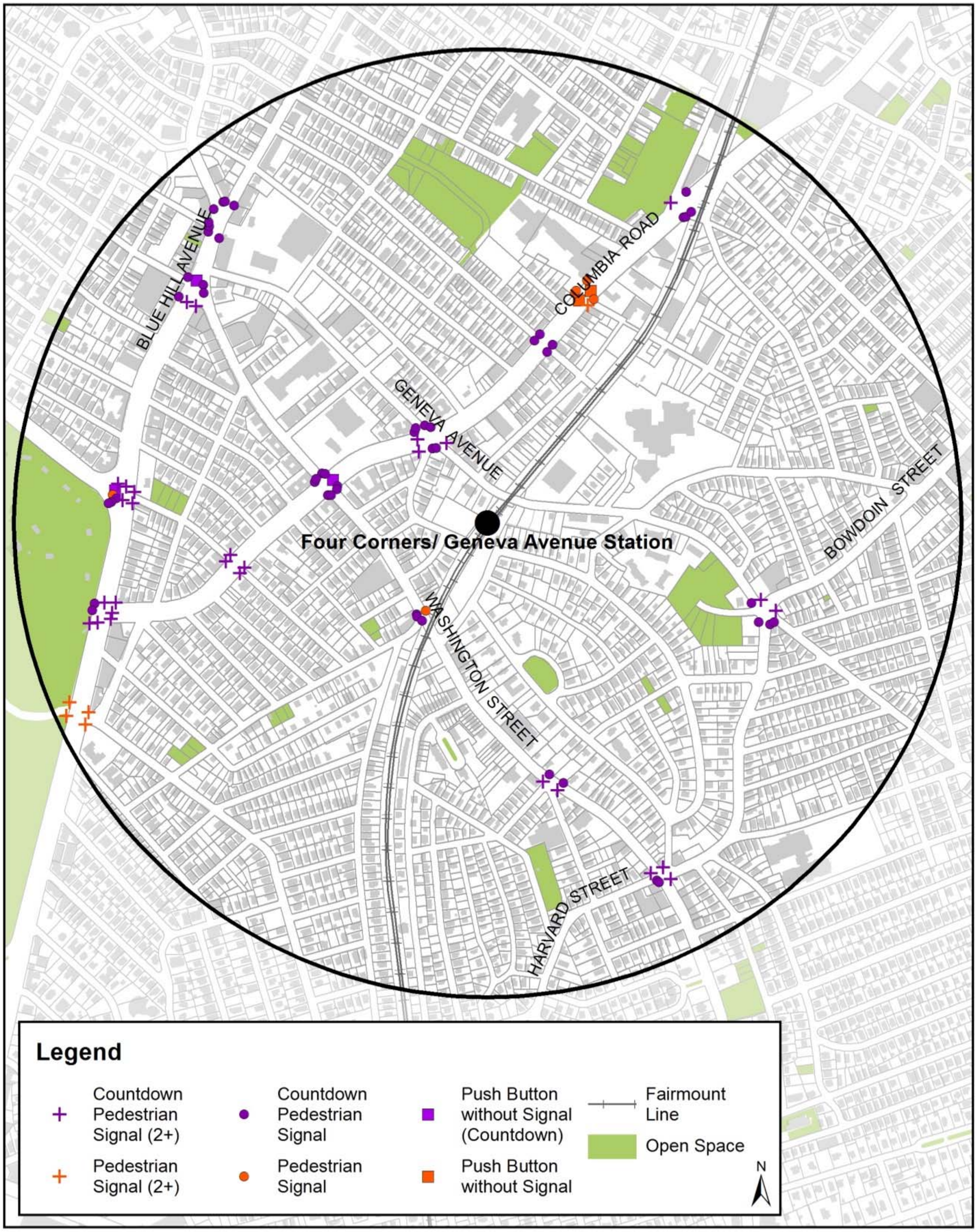

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FIGURE 5-2
Pedestrian Signals
Four Corners/Geneva Avenue Station Area

Fairmount Line Station Access Analysis

5.3 TALBOT AVENUE

MPO staff documented nine signalized intersections along the selected roadways in the Talbot Avenue station area: seven intersections were exclusively made up of pedestrian signals with countdowns while two intersections did not have any countdown pedestrian signals (see Figure 5-3). Of note is that MPO staff did not find pedestrian signal countdown displays at the intersection of Talbot Avenue, Colonial Avenue, Aspinwall Road, and Spencer Street while documentation from the BTD states that there are pedestrian signal countdown displays at the intersection (see Appendix D). Listed in Table 5-5 is information about the pedestrian signals at each of the nine intersections MPO staff observed in the station area. Table 5-5 shows that every intersection within the Talbot Avenue station area features an exclusive pedestrian phase.

TABLE 5-5
Pedestrian Signals in the Talbot Avenue Station Area

Intersection or Crossing	Exclusive or Concurrent	Audible	Count-down
Harvard Street, Glenway Street, and Warner Street	Exclusive	No	Yes
Norfolk Street and Stanton Street	Exclusive	No	Yes
Norfolk St, New England Avenue, Woodrow Ave	Exclusive	No	Yes
Talbot Avenue and Bernard Street	Exclusive	No	No
Talbot Ave, Colonial Ave, Aspinwall Rd, Spencer St	Exclusive	No	Yes
Talbot Avenue, Norwell Street, New England Ave	Exclusive	Yes	Yes
Talbot Avenue, Washington Street, Norfolk Street	Exclusive	No	Yes
Washington Street and Melville Avenue	Exclusive	No	Yes
Washington Street and Park Street	Exclusive	No	Yes

The nine pedestrian signals at the intersection of Talbot Avenue and Bernard Street do not feature countdown displays. MPO staff found that the pedestrian change interval for these pedestrian signals last 16 seconds, although documentation from the Boston Public Works Department indicates the interval lasts 12 seconds and is followed by a four-second long red clearance interval.

The duration of the walk interval, pedestrian change interval, and red clearance interval of each Talbot Avenue station area intersection are listed in Table 5-6. The table also includes the length of the longest pedestrian crossing associated with the interval durations and the calculated crossing speed at which a pedestrian would need to walk in order to cross the roadway before signals turn green for vehicular traffic. Staff found that four crossing locations' signal timings allowed pedestrians walking at a speed of 3.5 feet per second or slower to leave the curb and reach the other side of the street or a median that is wide enough for pedestrians to wait. At five crossing locations, the interval durations did not provide sufficient time for pedestrians to cross.

TABLE 5-6
Durations, Lengths, and Speeds of Talbot Avenue Pedestrian Crossings

Intersection or Crossing	Walk Interval (seconds)	Pedestrian Change Interval (seconds)	Red Clearance Interval (seconds)	Longest Crossing Length (feet)	Expected Crossing Speed (feet/sec)[a]
Harvard St, Glenway St, Warner St**	8	7	4	33	2.98
Norfolk Street and Stanton Street	7	7	4	52	4.75
Norfolk St, New England Ave, Woodrow Ave	7	11	4	58	3.89
Talbot Avenue and Bernard Street	7	12	4	74	4.63
Talbot Ave, Colonial Ave, Aspinwall Rd, Spencer St	7	7	4	64	5.79
Talbot Ave, Norwell S, New England Ave**	7	7	4	49	4.43
Talbot Avenue, Washington Street, Norfolk St	7	20	4	84	3.48
Washington Street and Melville Avenue**	7	9	4	45	3.45
Washington Street and Park Street	7	13	4	48	2.84

[a] Longest Crossing Length/(Pedestrian Change Interval + Red Clearance Interval).
Note: Walk interval durations followed by two asterisks indicate that the pedestrian phase is only called after pushbutton actuation.

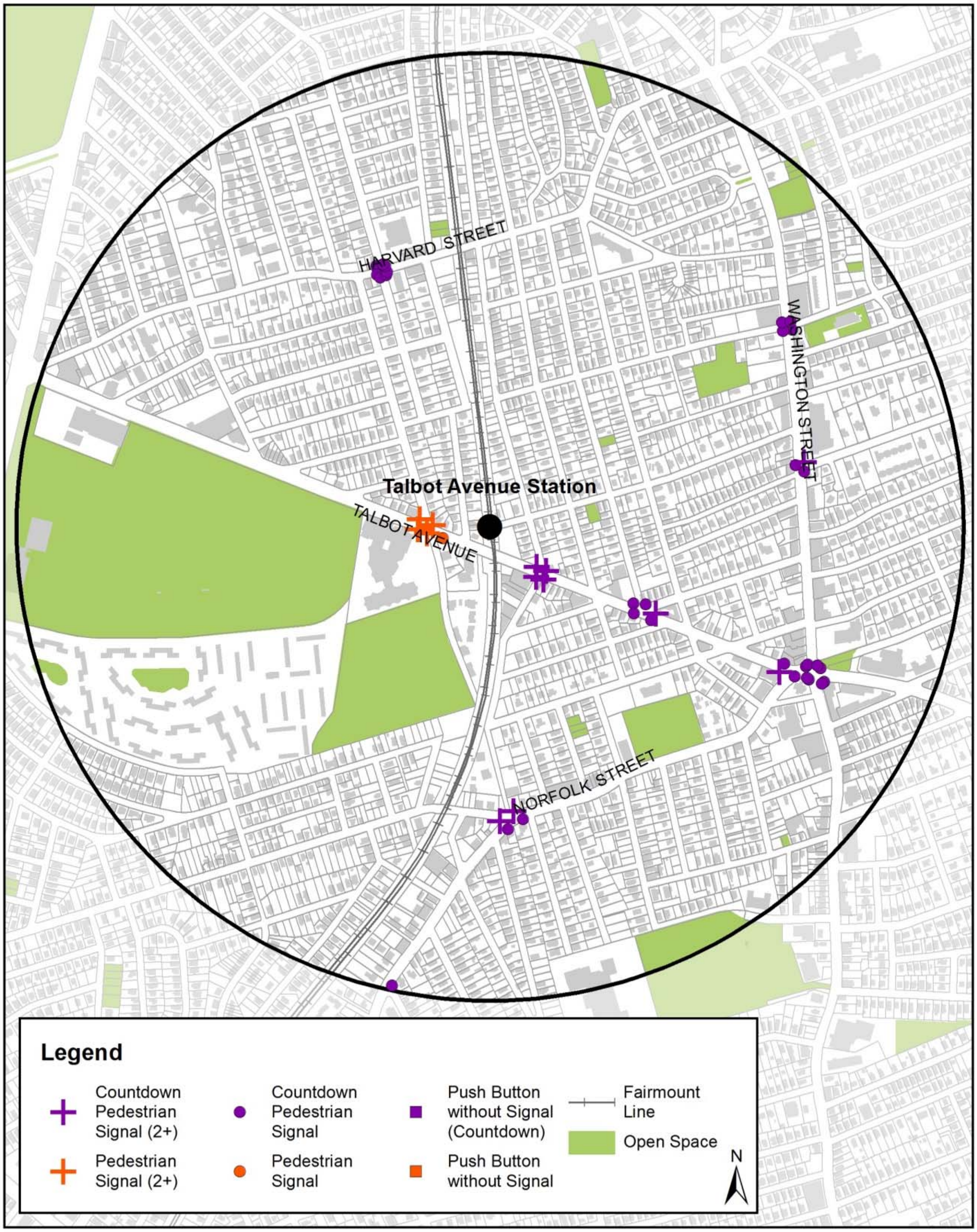

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FIGURE 5-3
Pedestrian Signals
Talbot Avenue Station Area

Fairmount Line Station Access Analysis

5.4 MORTON STREET

MPO staff documented 16 signalized intersections or crossings along the selected roadways in the Morton Street station area: eight intersections were exclusively made up of pedestrian signals with countdowns while eight intersections and crossings did not have any countdown pedestrian signals (see Figure 5-4). Listed in Table 5-7 is information about the pedestrian signals at each of the 16 intersections and crossings that MPO staff assessed in the station area. The table shows that every intersection and crossing within the Morton Street station area features an exclusive pedestrian phase, although one also includes concurrent pedestrian phases.

One difference between the BTD data and the information collected by MPO staff at the eight BTD-managed Morton Street Station area intersections is that MPO staff did not find pedestrian signal countdown displays at the intersection of Norfolk Street, Fessenden Street, and Mildred Avenue, while documentation from the BTD states that there are pedestrian countdown displays at the intersection. The BTD information, which indicates that the eight Morton Street station area intersections and crossings managed by the BTD include pedestrian countdown displays, is represented in Figure 5-4.

TABLE 5-7
Pedestrian Signals in the Morton Street Station Area

Intersection or Crossing	Exclusive or Concurrent	Audible	Count-down
Blue Hill Avenue and Clarkwood Street	Exclusive	Yes	Yes
Blue Hill Avenue and Morton Street	Exclusive	No	No
Blue Hill Avenue and Norfolk Street	Exclusive	No	Yes
Blue Hill Avenue, Baird Street, and Woodrow Ave	Exclusive	No	Yes
Blue Hill Avenue, Walk Hill Street, and Babson St	Exclusive	No	Yes
Blue Hill Avenue, Wellington Hill St, Fessenden St	Exclusive	No	Yes
Gallivan Boulevard (east of split from Morton St)	Exclusive	No	No
Morton Street and Evans Street	Exclusive	No	No
Morton Street and Norfolk Street	Exclusive	No	No
Morton St (between Theodore and Wildwood Streets)	Exclusive	No	No
Morton Street (east of Gallivan Boulevard split)	Exclusive	No	No
Morton Street (west of Gallivan Boulevard split)	Exclusive	No	No
Morton St, Selden St, West Selden St, Corbet Street	Exclusive	No	Yes
Norfolk Street and Babson Street	Both	No	Yes
Norfolk Street and Stanton Street	Exclusive	No	Yes
Norfolk Street, Fessenden Street, Mildred Avenue	Exclusive	No	Yes

Only one location in the Morton Street station area features a pedestrian change interval of seven seconds or less—the intersection of Norfolk Street and Stanton Street—but it features countdown displays in spite of its short pedestrian change interval. In spite of MUTCD standards, which dictate that a pedestrian change interval of more than seven seconds should include a pedestrian change interval countdown display,[100] the eight pedestrian signals without countdown displays in the Morton Street Station area all have pedestrian change intervals longer than seven seconds (see Table 5-8).

The duration of the walk interval, pedestrian change interval, and red clearance interval of each Morton Street station area intersection is listed in Table 5-8, below. The table also includes the length of the longest pedestrian crossing associated with the interval durations and the calculated crossing speed at which a pedestrian would need to walk in order to cross the roadway before signals turn green for vehicular traffic. The boxed rows indicate intersections with multiple pedestrian signal timings that are specific to different roadway crossings. Staff found that eight crossing locations' signal timings allowed pedestrians walking at a speed of 3.5 feet per second or slower to leave the curb and reach the other side of the street or a median that is wide enough for pedestrians to wait. Of the eight crossings, three are one of two crossings at the same intersection. These second crossings are among the 12 locations where the interval durations did not provide sufficient time for pedestrians to cross.

Two of the crossings that provide inadequate crossing times occur at the same intersection. To calculate the speed at which pedestrians would need to travel to safely traverse the longest crossing at each of the eight intersections and crossings for which MPO staff did not have BTD information, MPO staff assumed that the duration of the red clearance interval was three seconds long, per MUTCD minimum buffer interval requirements.[101]

[100] *Manual on Uniform Traffic Control Devices, Part 4: Highway Traffic Signals, Chapter 4E: Pedestrian Control Features, Section 4E.07: Countdown Pedestrian Signals*; Federal Highway Administration; December 2009; page 499.

[101] *Manual on Uniform Traffic Control Devices, Part 4: Highway Traffic Signals, Chapter 4E: Pedestrian Control Features, Section 4E.06: Pedestrian Intervals and Signal Phases*; Federal Highway Administration; December 2009; page 497.

TABLE 5-8
Durations, Lengths, and Speeds of Morton Street Pedestrian Crossings

Intersection or Crossing	Walk Interval (seconds)	Pedestrian Change Interval (seconds)	Red Clearance Interval (seconds)	Longest Crossing Length (feet)	Expected Crossing Speed (feet/ sec)[a]
Blue Hill Avenue and Clarkwood Street	7**	22	4	92	3.55
Blue Hill Avenue and Clarkwood Street	7*	10	4	33	2.36
Blue Hill Avenue and Morton Street	7	15	1	107	6.69
Blue Hill Avenue and Norfolk Street	8**	21	4	79	3.14
Blue Hill Avenue, Baird Street, Woodrow Ave	7**	14	3	91	5.38
Blue Hill Avenue, Walk Hill Street, Babson St	7**	16	4	34	1.69
Blue Hill Avenue, Walk Hill Street, Babson St	7*	16	4	72	3.58
Blue Hill Avenue, Wellington Hill St, Fessenden St	7	24	4	131	4.70
Gallivan Boulevard (east of split from Morton St)	7.2	10.2	1.2	39	3.39
Morton Street and Evans Street	6	14	1	63	4.21
Morton Street and Norfolk Street	6	14	1	63	4.18
Morton St (between Theodore and Wildwood Sts)	12	10	2	63	5.28
Morton Street (east of Gallivan Boulevard split)	7.2	12	1.2	60	4.51
Morton Street (west of Gallivan Boulevard split)	7	17.5	1.4	40	2.12
Morton St, Selden St, West Selden St, Corbet St	6	14	1	62	4.13
Norfolk Street and Babson Street	7	9	1	39	3.90
Norfolk Street and Babson Street	7	11	4	62	4.14
Norfolk Street and Stanton Street	7	7	4	52	4.75
Norfolk Street, Fessenden Street, Mildred Ave	7**	10	4	61	4.33
Norfolk Street, Fessenden Street, Mildred Ave	7	10	4	33	2.36

[a] Longest Crossing Length/(Pedestrian Change Interval + Red Clearance Interval).
Note: Walk interval durations followed by an asterisk indicate that the pedestrian signal rests in the walk phase. Walk interval durations followed by two asterisks indicate that the pedestrian phase is only called after pushbutton actuation.

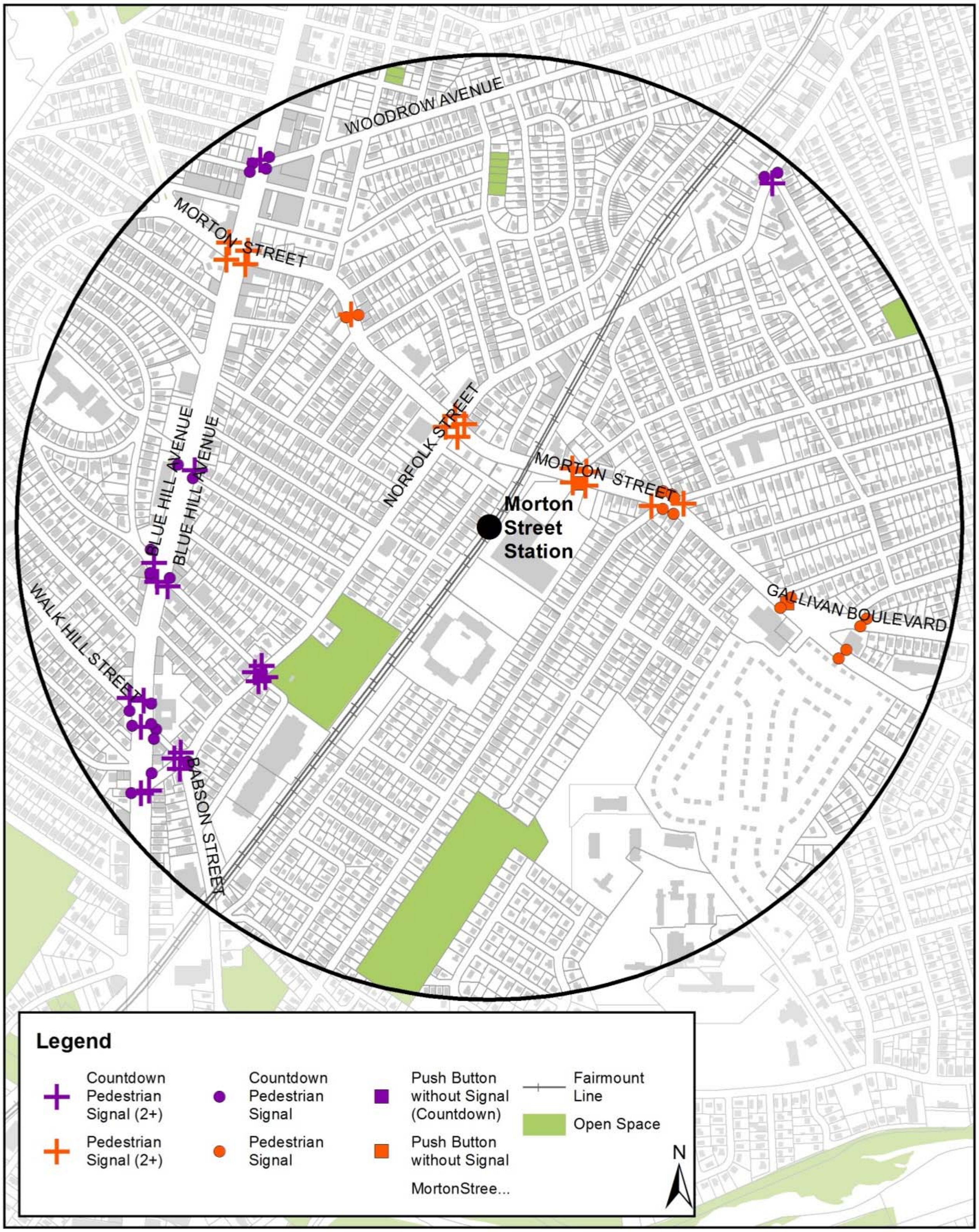

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FIGURE 5-4
Pedestrian Signals
Morton Street Station Area

Fairmount Line Station Access Analysis

5.5 BLUE HILL AVENUE

MPO staff documented 15 intersections with pedestrian signals in the station area, 14 of which were located in the City of Boston. The one intersection found by MPO staff in the Milton portion of the station area did not include countdown displays, but completed improvements to the intersection are expected in spring 2017 and will include countdown displays as well as audible and vibro-tactile pedestrian pushbuttons for every pedestrian signal. Vibro-tactile pedestrian pushbuttons communicate pedestrian signal intervals using the perception of vibration through touch. The expected conditions are included in Table 5-9.

Of the 14 City of Boston intersections, MPO staff found that two do not feature countdown displays on their pedestrian signals (see Table 5-9). BTD data indicates countdown displays are present at the two intersections where MPO staff did not observe countdown displays. BTD documentation also indicates that there are not countdown displays at one intersection where MPO staff to noted countdown displays. Table 5-9 lists information about the pedestrian signals at each of the 14 intersections that MPO staff observed in the Boston portion of the Blue Hill Avenue station area. One intersection features both exclusive pedestrian phases and pedestrian phases that illuminate concurrently with vehicular traffic.

TABLE 5-9
Pedestrian Signals in the Blue Hill Avenue Station Area

Intersection or Crossing	Exclusive or Concurrent	Audible	Count-down
Babson Street and Fremont Street	Exclusive	No	Yes
Babson Street and Norfolk Street	Both	No	Yes
Blue Hill Avenue and Babson Street	Exclusive	No	Yes
Blue Hill Avenue and Fairway Street	Exclusive	No	Yes
Blue Hill Avenue and Norfolk Street	Exclusive	No	Yes
Blue Hill Avenue and Woodhaven Street	Exclusive	No	Yes
Blue Hill Avenue, Regis Road, and Fremont Street	Exclusive	No	Yes
Blue Hill Avenue, River Street, and Cummins Highway	Concurrent	No	Yes
Blue Hill Avenue, Walk Hill Street, and Babson Street	Exclusive	No	Yes
Cummins Highway and Itasca Street	Concurrent	No	No
Cummins Highway and Woodhaven Street	Exclusive	No	Yes
Cummins Highway, Rexford Street, and Rockdale St	Exclusive	No	Yes
Norfolk Street, Fessenden Street, and Mildred Avenue	Exclusive	No	Yes
Rector Road and River Street	Exclusive	No	Yes
Blue Hills Parkway, Brush Hill Road, and Eliot Street	--	Yes	Yes

According to BTD documentation, there is one intersection in the Blue Hill Avenue station area with pedestrian signals that do not feature countdown displays: the intersection of Cummins Highway and Itasca Street. This intersection also features a pedestrian change interval longer than seven seconds across Cummins Highway. MUTCD standards dictate that the pedestrian signals at the crossing should include countdown displays.

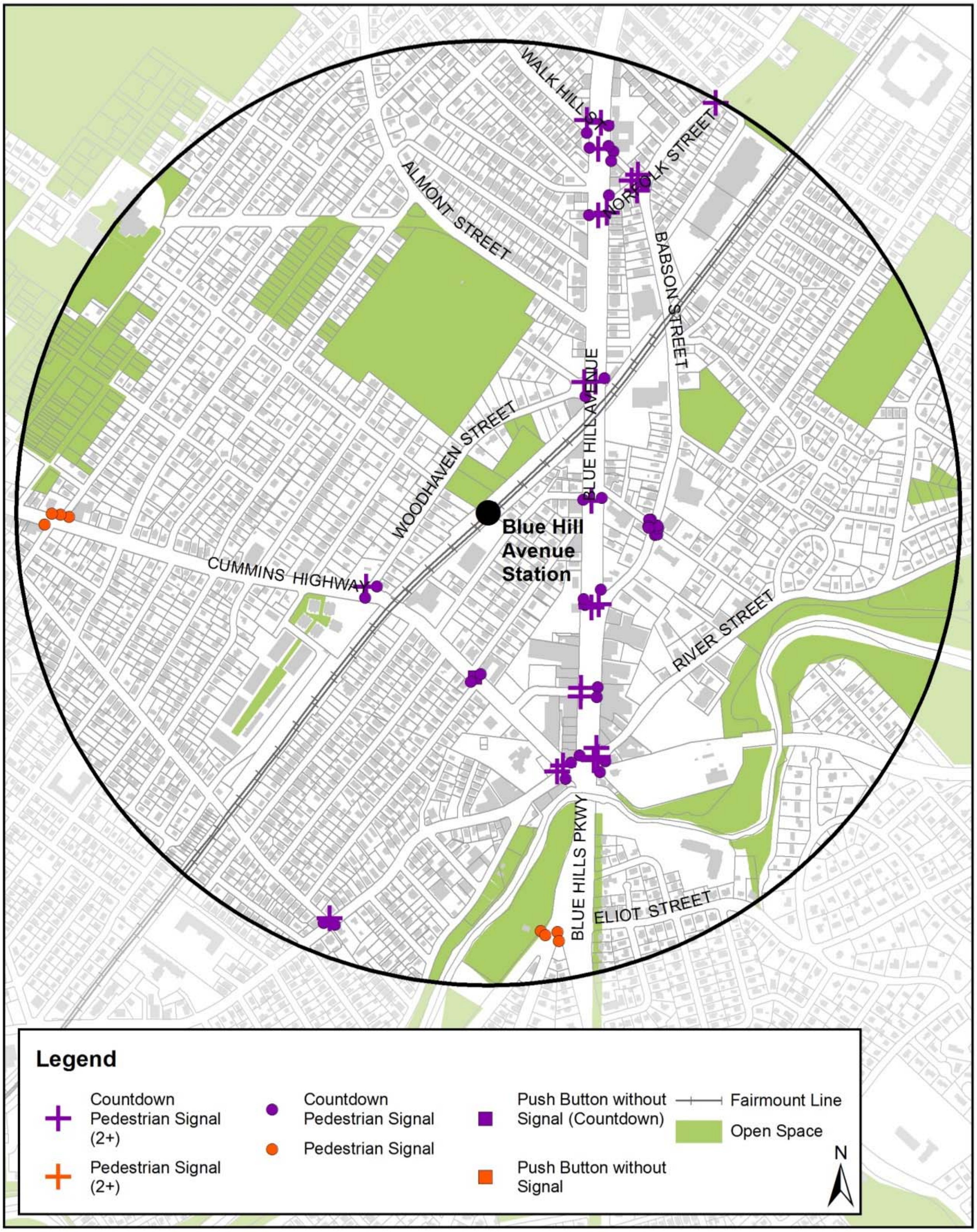
Table 5-10 lists the duration of the walk interval, pedestrian change interval, and red clearance interval of each Blue Hill Avenue station area intersection. The table also includes the length of the longest pedestrian crossing associated with the interval durations and the calculated crossing speed at which a pedestrian would need to walk in order to cross the roadway before signals turn green for vehicular traffic. The boxed rows indicate intersections with multiple pedestrian signal timings that are specific to different roadway crossings. Staff found that six crossing locations' signal timings allowed pedestrians walking at a speed of 3.5 feet per second or slower to leave the curb and reach the other side of the street or a median that is wide enough for pedestrians to wait. At 15 crossing locations, the interval durations did not provide sufficient time for pedestrians to cross.

TABLE 5-10
Durations, Lengths, and Speeds of Blue Hill Avenue Pedestrian Crossings

Intersection or Crossing	Walk Interval (seconds)	Pedestrian Change Interval (seconds)	Red Clearance Interval (seconds)	Longest Crosswalk Length (feet)	Expected Crossing Speed (feet/ sec)[a]
Babson Street and Fremont Street	8	8	4	56	4.66
Babson Street and Norfolk Street	7	9	1	39	3.86
Babson Street and Norfolk Street	7	11	4	63	4.21
Blue Hill Avenue and Babson Street**	7	16	4	34	1.69
Blue Hill Avenue and Babson Street*	7	16	4	71	3.56
Blue Hill Avenue and Fairway Street	7	15	4	73	3.87
Blue Hill Avenue and Norfolk Street**	8	21	4	79	3.14
Blue Hill Avenue and Woodhaven Street**	7	21	4	41	1.63
Blue Hill Avenue, Regis Road, Fremont Street	7	15	4	43	2.24
Blue Hill Avenue, River St, Cummins Highway**	6	9	2	40	3.61
Blue Hill Avenue, River St, Cummins Highway**	6	9	5	92	6.54
Blue Hill Avenue, River St, Cummins Highway**	6	9	2	60	5.44
Blue Hill Avenue, Walk Hill Street, Babson St	7	10	4	80	5.75
Cummins Highway and Itasca Street*	7	5	3	44	5.53
Cummins Highway and Itasca Street**	7	11	2	64	4.90
Cummins Highway and Woodhaven Street	7	10	4	62	4.40
Cummins Highway, Rexford St, Rockdale St	7	10	4	67	4.76

Intersection or Crossing	Walk Interval (seconds)	Pedestrian Change Interval (seconds)	Red Clearance Interval (seconds)	Longest Crosswalk Length (feet)	Expected Crossing Speed (feet/ sec)[a]
Norfolk Street, Fessenden St, Mildred Avenue**	7	10	4	61	4.39
Norfolk Street, Fessenden Street, Mildred Ave	7	10	4	34	2.40
Rector Road and River Street	7	13	4	33	1.92
Rector Road and River Street*	8	7	4	42	3.82
Blue Hills Parkway, Brush Hill Road, Eliot Street	--	--	--	--	--

[a]Longest Crossing Length/(Pedestrian Change Interval + Red Clearance Interval).
Note: Intersection names followed by an asterisk indicate that the pedestrian signal rests in the walk phase. Intersection names followed by two asterisks indicate that the pedestrian phase is only called after pushbutton actuation.



CTPS	**FIGURE 5-5** **Pedestrian Signals** **Blue Hill Avenue Station Area**	*Fairmount Line Station Access Analysis*

Chapter 6—Sidewalks

This chapter documents sidewalk widths in each station area, especially at locations where sidewalks are narrower than five feet. Each section consists of a table that lists the measurements and provides information about obstructions at the specific locations. MPO staff identified each sidewalk measurement with the name of the street on which it was taken and included a general description of the area.

6.1 NEWMARKET

Table 6-1 below cites sidewalk widths in the Newmarket area.

TABLE 6-1
Sidewalks in the Newmarket Station Area

Street	Location	Side of Street	Sidewalk Width	Sidewalk Obstruction	Width to Obstruction
Southampton Street	Between Newmarket Square and Allstate Road (in front of Costas Provisions, Good Guys Provision, and South Bay Motors)	South	--	Pole	4'9"
Southampton Street	East of where Allstate Road intersects the south side of Southampton Street	North	--	Pole	3'1"
Southampton Street	West median on Southampton Street at the entrance to I-93 Frontage Road	North	3'8" (median cut-through width)	--	--
Southampton Street	Right before the intersection with the I-93 Frontage Road (just to the east of the Frontage Road entrance)	North	--	Pole	3'8"
Southampton Street	Where Southampton Street crosses the railroad tracks (west of Andrew Square)	North	4'11"	Pole	3'0" (pavement to pole) 2'5" (pavement)
Boston Street	South of Ellery Street, where Father Songin Way intersects Boston Street from the east	West	10'	Pole (in middle)	4'9" (either side)
Boston Street	Where Ellery Street intersects Boston Street from the west	East	10'	Tree Pit	3'9"
Boston Street	North of Power Street	West	--	Hydrant	3'4"
Boston Street	West of Power Street	West	--	Pole	3'6"
Boston Street	Just north of Rawson Street	West	--	Pole	2'9"
Boston Street	Between West Bellflower Street, Enterprise Street	West	--	Street Trees	5'
Massachusetts Avenue	Northwest of Edward Everett Square	East	8'6"	Pole	5'10"
Massachusetts Avenue	Northwest of Edward Everett Square	West	8'0"	Pole	5'6"

Street	Location	Side of Street	Sidewalk Width	Sidewalk Obstruction	Width to Obstruction
Massachusetts Avenue	Northwest of Allstate Road	West	7'11"	--	--
Massachusetts Avenue	North of Allstate Road	East	10'3"	--	--
Massachusetts Avenue	1010 Massachusetts Avenue	East	11'10"	Tree Planter	5'7"
Massachusetts Avenue	North of 1010 Massachusetts Avenue	East	4'4"	--	--
Massachusetts Avenue	South of Theodore Glynn Way	East	12'1"	Bus Shelter	5'8"
Hampden Street	Between Howard Street and George Street	East	6'6"	Pole	3'0"
Hampden Street	Between Howard Street and George Street	East	6'6"	Hydrant	4'0"
Dudley Street	Southeast corner of Dudley/ Langdon Intersection	East	10'1"	Pole	5'8"
Langdon Street	North of Dudley Street Neighborhood Charter School, per GoogleMaps (or Emerson School, according to sign)	South	10'1"	Bus Shelter	4'6"
East Cottage Street	West of the East Cottage Street, Norfolk Avenue, and Humphreys Street intersection	North	6'11"	Hydrant to Vegetation	2'3"
East Cottage Street	West of the East Cottage Street, Norfolk Avenue, and Humphreys Street intersection	North	6'11"	Hydrant to Fence	4'11"
East Cottage Street	Curve where East Cottage Street becomes Norfolk Avenue	Northeast	6'8"	Pole	3'2"
East Cottage Street	East of the Fairmount Line rail bridge	South	6'7"	Fence in sidewalk	5'11"
East Cottage Street	Driveway that is just east of the Fairmount Line rail bridge	South	-	Fence across driveway entrance	3'10"
East Cottage Street	East of East Cottage Street intersection with Humphreys Street and Norfolk Avenue	South	7'	Tree Box to Fence	4'5"
East Cottage Street	East of East Cottage Street intersection with Humphreys Street and Norfolk Avenue	South	7'	Tree Box to Fence	3'6"
East Cottage Street	East of East Cottage Street intersection with Humphreys Street and Norfolk Avenue	South	7'	Tree Box to Fence	3'7"
East Cottage Street	East of East Cottage Street intersection with Humphreys Street and Norfolk Avenue	North	6'11"	Hydrant	4'10"
Norfolk Avenue	Between Magazine Street, Gerard Street	East	7'6"	Vegetation	2'3"
Norfolk Avenue	Between Gerard Street and Hampden Street	West	6'0"	Driveway Curb Ramp to Fence	4'4"
Norfolk Avenue	Between Gerard Street and Hampden Street	East	6'11"	Pole	3'7"
Magazine Street	Between Norfolk Avenue and Cedric Street	South	6'7"	Pole	3'4"

Street	Location	Side of Street	Sidewalk Width	Sidewalk Obstruction	Width to Obstruction
Magazine Street	Between Cedric Street and George Street	South	6'0"	--	--
Magazine Street	Between Eustis Street and Dunmore Street	North	7'6"	Pole	5'0"
Magazine Street	Between Dunmore Street and Dudley St	South	7'2"	Pole	4'5"
Shirley Street	Between Roswell Street and George Street	South	7'4"	--	--
Clifton Street	At intersection with Longmeadow Street	West	7'0"	Tree	3'5"

6.2 FOUR CORNERS/GENEVA AVENUE

Table 6-2 contains MPO staff sidewalk observations in the Four Corners/Geneva Avenue station area.

TABLE 6-2
Sidewalks in the Four Corners/Geneva Avenue Station Area

Street	Location	Side of Street	Sidewalk Width	Sidewalk Obstruction	Width to Obstruction
Puritan Avenue	Near intersection with Richfield Street	Southeast	5'	Debris	3'
Geneva Avenue	Beside Geneva Cliffs, between Everton/ Bowdoin Sts	Southwest	6'5"	Pole	4'6"
Richfield Street	Near Pilgrim Place, between Westwood Street/ Puritan Ave	Southwest	6'8"	Tree	3'
Richfield Street	Near Pilgrim Place, between Westwood Street/ Puritan Ave	Southwest	6'8"	Tree Grate	1'8"
Richfield Street	Near Pilgrim Place, between Westwood Street/ Puritan Ave	Southwest	6'8"	Pole	4'6"
Richfield Street	Near Pilgrim Place, between Westwood Street/ Puritan Ave	Southwest	6'8"	Pole Area	4'
Richfield Street	Between Davidson Ave and Olney St	West	6'11"	Pole	4'2"
Geneva Avenue	Between Bishop Joel Smith Way/ Normandy St	Northeast	7'	Overgrown Vegetation	4'2"
Geneva Avenue	Between Bishop Joel Smith Way/ Normandy St	Northeast	7'	Pole	3'9"
Homes Avenue	Between Topliff St/ Geneva Ave	North	7'1"	Tree	2'10'
Holland School Path	UP Holland Academy	--	6'	--	--
Geneva Avenue	Between Fairmount Line and Olney St	South	6'2"	--	---
Geneva Avenue	Between Vaughan Ave and the Fairmount Line	South	7'2"	--	--
Washington Street	Between Norwell and Vassar Streets	Northeast	9'8"	--	--

FIGURE 6-1
Debris on Puritan Avenue near Richfield Street

Source: Central Transportation Planning Staff.

FIGURE 6-2
Narrow Sidewalk on Richfield Street

Source: Central Transportation Planning Staff.

FIGURE 6-3
Overgrown Vegetation on Geneva Avenue

Source: Central Transportation Planning Staff.

6.3 TALBOT AVENUE

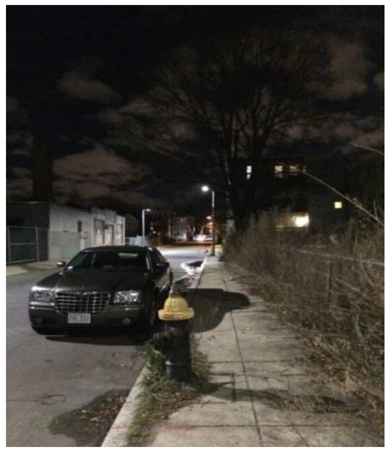
Table 6-3 below cites sidewalk conditions in the Talbot Avenue station area that were observed and documented by staff.

TABLE 6-3
Sidewalks in the Talbot Avenue Station Area

Street	Location	Side of Street	Sidewalk Width	Sidewalk Obstruction	Width to Obstruction
Dunbar Avenue/ Wentworth Terrace	Roberts Playground	South	7'	--	--
Edson Street	Between Norfolk Street and path to Roberts Playground	West	6'4"	Fire Hydrant	4'4"
Edson Street	Between Norfolk Street and path to Roberts Playground	West	6'4"	Pole	2'9"
Edson Street	Between Norfolk Street and path to Roberts Playground	East	6'10"	--	--
Ferndale Street	Between Southern Avenue/ Norfolk Street	East	6'8"	Tree	2'9"
Ferndale Street	Between Southern Avenue/ Norfolk Street	West	6'6"	Fire Hydrant	4'2"
New England Ave	Between Norfolk Street/ Southern Avenue	West	4'3"	Pole	1'7"
Norfolk Street	Intersection with Withington Street	North	7'10"	Pole	5'5"
Paved Path	Harambee Park	Center	10'	--	--
Talbot Avenue	Between Helen Street and Bernard Street	North	8'8"	--	--
Talbot Avenue	Between Blue Hill Ave/ Harvard St/ Nightingale St	North	10'1.5"	--	--
Talbot Avenue	Between Nightingale Street and Wales Street	South	12'	-	--

Street	Location	Side of Street	Sidewalk Width	Sidewalk Obstruction	Width to Obstruction
Talbot Avenue	Between Westcott Street/ Fairmount Rail Line	South	10'	--	--
Talbot Avenue	Under Fairmount Line Rail Bridge	North	9'8"	--	--
Wollaston Terrace	Between Woodrow Avenue Jones Avenue	East	4'	Fire Hydrant	2'
Woodrow Avenue	Between New England Ave/ Fairmount Rail Line	North	7'11"	Tree	4'5"

FIGURE 6-4
Overgrown Vegetation between Browning Avenue and Kingsdale Street



Source: Central Transportation Planning Staff.

FIGURE 6-5
South View of New England Avenue from Southern Avenue Intersection

Source: Central Transportation Planning Staff.

FIGURE 6-6
New England Avenue Sidewalk between Southern Avenue and Norfolk Street

Source: Central Transportation Planning Staff.

6.4 MORTON STREET

MPO staff's assessment of sidewalks in the Morton Street station area is presented in Table 6-4.

TABLE 6-4
Sidewalks in the Morton Street Station Area

Street	Location	Side of Street	Sidewalk Width	Sidewalk Obstruction	Width to Obstruction
Morton Street	Just northwest of Lorna Road	West	11'9"	--	--
West Selden Street	Southwest of Morton Street	Southeast	7' 9.5"	Pole	4'6"
West Selden Street	Between Wooddale Ave and Rich St	Northwest	7'10"	Leaves	5'3"
Morton Street	Between Fuller St and Selden St	East	8'10"	--	-
Fuller Street	Between Capen St and Morton St	North	6'6"	Pole	4' 1.5"
Selden Street	Between Capen St and Milton Ave	North	7'0"	Pole	5'0"
Gallivan Boulevard	Between Pine Ridge Rd/ Wilmington Ave	North	7'2"	Hydrant	6'
Standard Street	Curve in Standard St located south of intersection of Woodgate St/ Woodbole Ave	East	6'10"	Tree Cut Out	3'3"
Woodgate Street	Between Woodbole Ave/ Standard St	West	6' 10.5"	Tree Cut Out	3' 3.5"
Morton Street	Between Woodgate St/ Gallivan Blvd	South	9'10"	Pole	6' 5"
Pine Ridge Road	Northeast corner of where Pine Ridge Road meets Morton Street	Southeast	6'2"	Pole	4'
West Selden Street	Between Lena Terrace/ Wooddale Ave	Southeast	8'	Tree Cut Out	2'10"
West Selden Street	Between Lena Terrace/ Wooddale Ave	Southeast	8'	Debris	2'
West Selden Street	Between Halborn Street and Rich Street	West	7'6"	--	--
Gladeside Avenue	Between Cragmere Terrace/ Arborcrest Terr	West	4'	Tree	2'8"
Gladeside Avenue	Between Cragmere Terrace/ Arborcrest Terr	West	4'	Debris	2'10"
Astoria Street	Between Elizabeth and Flint Sts	East	7'1"	Hydrant	4'9"

Street	Location	Side of Street	Sidewalk Width	Sidewalk Obstruction	Width to Obstruction
George H. Walker Playground Path	Walker Playground	North	5'5"	--	--
George H. Walker Playground Path	Walker Playground	South	5'8"	--	--
Walk Hill Street	Northwest of Fottler Road	Southwest	6'11"	Pole	4'
Blue Hill Avenue	Across from Tennis Road entrance	East	14'6"	Tree	8'7"
Babson Street	Between where Babson Street crosses the Fairmount rail line/ Mildred Ave	East	4'4"	Extra narrow point	3' 11.5"
Babson Street	Wider Alternate Sidewalk: Between where Babson Street crosses the Fairmount rail line and Mildred Avenue	East	6'6"	Narrowest point	5'6"
Blue Hill Avenue	Between Morton St/ Landor Road	East	10'1"	Tree	4'11"

6.5 BLUE HILL AVENUE

Table 6-5 presents MPO staff's observations of sidewalks in the Blue Hill Avenue station area.

TABLE 6-5
Sidewalks in the Blue Hill Avenue Station Area

Location	Side of Street	Sidewalk Width	Sidewalk Obstruction	Width to Obstruction
Between location just east of Gladeside Ave and location slightly west of Fremont Street	South	6'8"	Slope	4'
Between Fremont Street and Blue Hill Ave, River St, Cummins Highway intersection	South	8'4"	Tree Cut Out	2'10"
West of Blue Hills Parkway, south of Blue Hill Ave, River St, Cummins Highway intersection	--	6'1"	--	--
West of Blue Hills Parkway, south of Blue Hill Ave, River St, Cummins Highway intersection	--	8'0"	--	--
Between Messinger St and Newcastle St	West	--	Narrow Point	2'10"

Chapter 7—Curb Ramps and Detectable Warnings

This chapter provides information about the curb ramps and detectable warnings in the five Fairmount Line station areas. When MPO staff found curb ramps and detectable warnings in the field, they marked their locations and indicated their types. Appendix B provides information and illustrations that specify curb ramp types. Perpendicular curb ramps are aligned with the crossing direction on tight radius corners while diagonal curb ramps are located at the apex of an intersection corner. MPO staff differentiated between diagonal curb ramps and apex curb ramps by identifying curb ramps that served one crossing as diagonal and curb ramps that served two crossings as apex. They also noted where curb ramps should have been present but were missing. Curb ramps were often identified as missing at locations where MPO staff observed crosswalks that led to curbs instead of curb ramps.

In addition to documenting the presence of curb ramps, MPO staff also marked whether they observed detectable warnings at curb ramps and other transitions along sidewalks and public streets. Detectable warnings alert users to their presence through their texture of truncated domes, contrast in color from the surrounding surface, and material change from the surrounding surface. The Americans with Disabilities Act Accessibility Guidelines (ADAAG) state that detectable warnings—distinctive dome-shaped surface patterns that, when detected underfoot or by cane, alert pedestrians to the boundary between street and sidewalk—should accompany every curb ramp and median cut-through.

7.1 NEWMARKET

MPO staff observed 257 curb ramps within the Newmarket Station area. The numbers of each type of ramp are summarized in Table 7-1; and the curb ramp and median cut-through distribution in the Newmarket station area is illustrated in Figure 7-1. MPO staff noted 140 detectable warnings in the Newmarket Station area (see Figure 7-1; however, there should have been 271 detectable warnings to accommodate every transition that MPO staff observed in the area.

TABLE 7-1
Newmarket Station Area Curb Ramps

Curb Ramp Type	Number of Ramps
Diagonal	113
Perpendicular	111
Apex	33
Median Cut-Through	7
Missing Curb Ramp	43

7.2 FOUR CORNERS/GENEVA AVENUE

MPO staff observed 294 curb ramps within the station area. One of these provides three directions for leaving a pedestrian island at the intersection of Seaver Street and Blue Hill Avenue. The numbers of each curb ramp type in the station area are summarized in Table 7-2 and the curb ramp and median cut-through distribution within the Four Corners/Geneva Avenue station area is illustrated in Figure 7-2.

TABLE 7-2
Four Corners/Geneva Avenue Station Area Curb Ramps

Curb Ramp Type	Number of Ramps
Diagonal	125
Perpendicular	116
Apex	53
Median Cut-Throughs	10
Missing Curb Ramp	8

While gathering data in the Four Corners/Geneva Avenue station area, MPO staff observed 184 detectable warnings. Their distribution throughout the station area is documented in Figure 7-2. One of the 10 median cut-throughs provides three directions for leaving a pedestrian island. This median cut-through, located at the intersection of Seaver Street and Blue Hill Avenue, should include three detectable warnings instead of the typical two. A total of 315 detectable warnings would be required to accompany every curb ramp and median cut-through transition that MPO staff observed in the station area.

7.3 TALBOT AVENUE

MPO staff observed 300 curb ramps within the Talbot Avenue station area. The numbers of each curb ramp type in the station area are summarized in Table 7-3 and the curb ramp and median cut-through distribution within the Talbot Avenue station area is illustrated in Figure 7-3. MPO staff observed 145 detectable warnings in the station area, and 300 are needed for the station area to be in accordance with the ADAAG. The distribution of the existing warnings is documented in Figure 7-3.

TABLE 7-3
Talbot Avenue Station Area Curb Ramps

Curb Ramp Type	Number of Ramps
Diagonal	135
Perpendicular	114
Apex	51
Median Cut-Throughs	0
Missing Curb Ramp	39

7.4 MORTON STREET

MPO staff observed 264 curb ramps within the Morton Street station area, which are summarized in Table 7-4; curb ramp and median cut-through distribution within the Morton Street station area is illustrated in Figure 7-4. In order to comply with ADAAG, 284 detectable warnings would be required to accompany each curb ramp and median cut-through in the Morton Street Station area. However, only 98 detectable warnings are currently in place (see Figure 7-4).

TABLE 7-4
Morton Street Station Area Curb Ramps

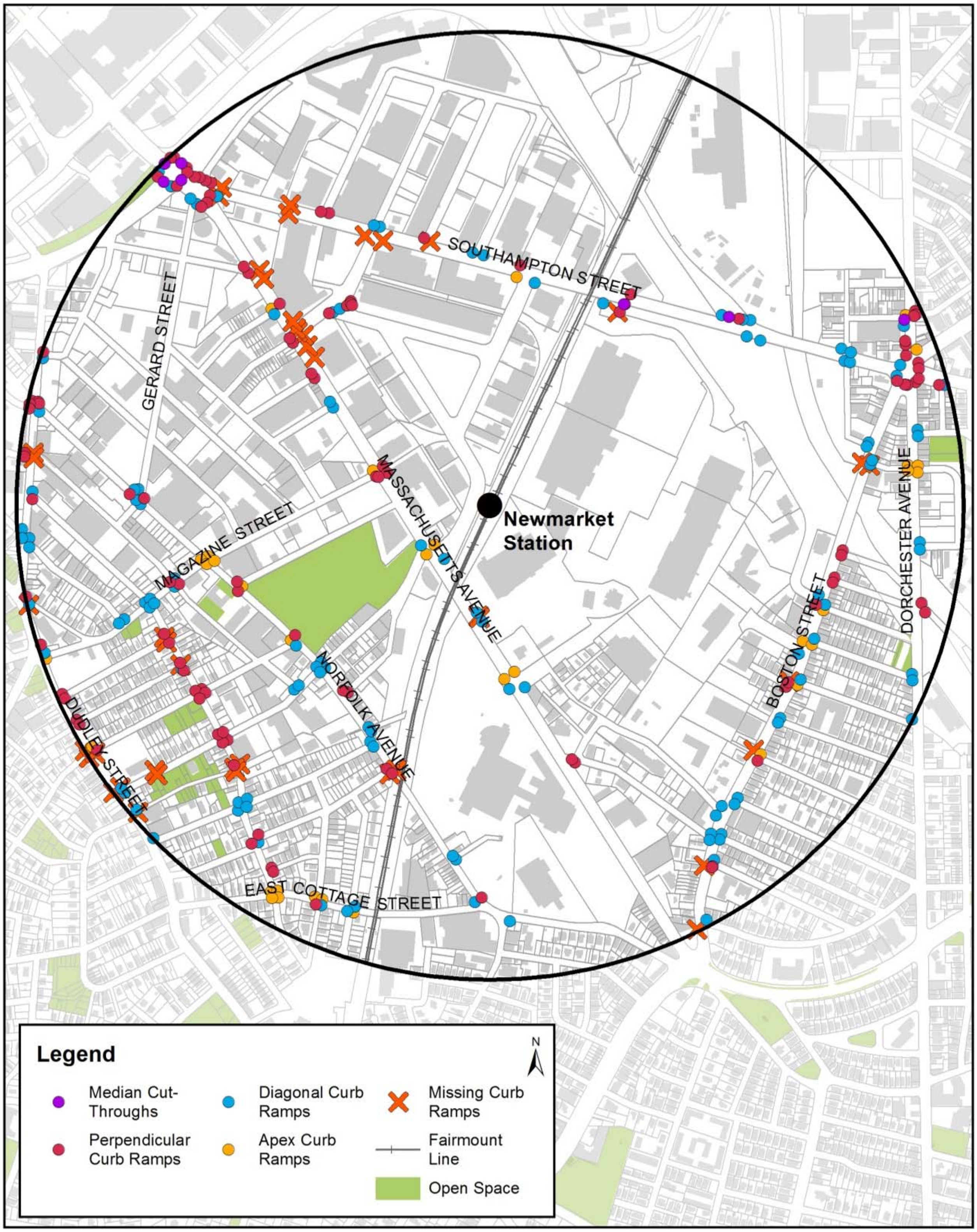
Curb Ramp Type	Number of Ramps
Diagonal	131
Perpendicular	106
Apex	27
Median Cut-Throughs	10
Missing Curb Ramp	39

7.5 BLUE HILL AVENUE

MPO staff observed 261 curb ramps within the Blue Hill Avenue station area, which are summarized in Table 7-5; the curb ramp and median cut-through distribution within the Blue Hill Avenue station area is illustrated in Figure 7-5. In order to comply with ADAAG, 271 detectable warnings would be required to accompany each curb ramp and median cut-through in the Blue Hill Avenue station area; MPO staff observed only 163 existing detectable warnings (see Figure 7-5).

TABLE 7-5
Blue Hill Avenue Station Area Curb Ramps

Curb Ramp Type	Number of Curb Ramps
Diagonal	133
Perpendicular	99
Apex	29
Median Cut-Through	5
Missing Curb Ramp	25



CTPS	**FIGURE 7-1** **Curb Ramps** **Newmarket Station Area**	*Fairmount Line Station Access Analysis*

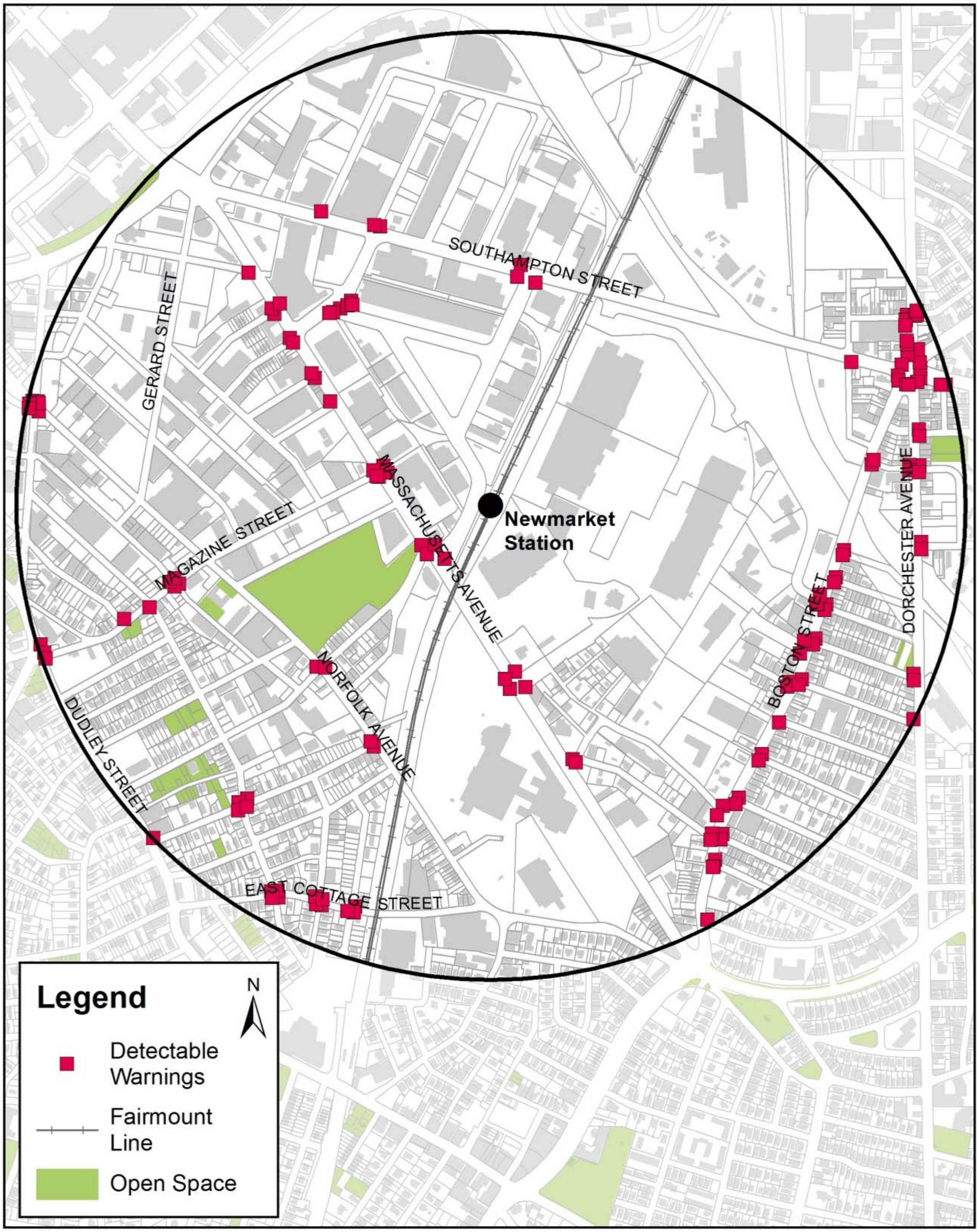


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FIGURE 7-2
Detectable Warnings
Newmarket Station Area

Fairmount Line Station Access Analysis

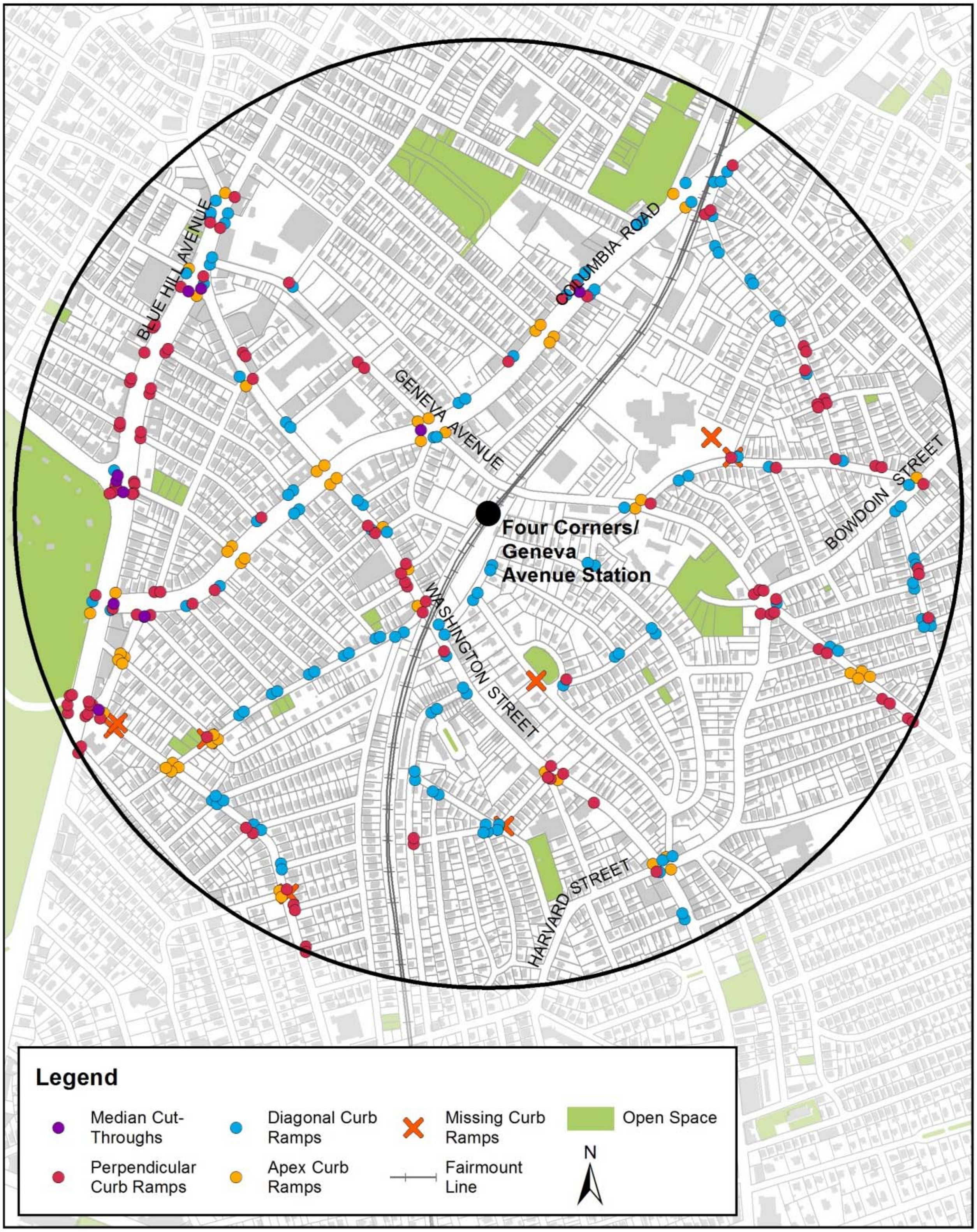

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FIGURE 7-3
Curb Ramps
Four Corners/Geneva Avenue Station Area

Fairmount Line Station Access Analysis

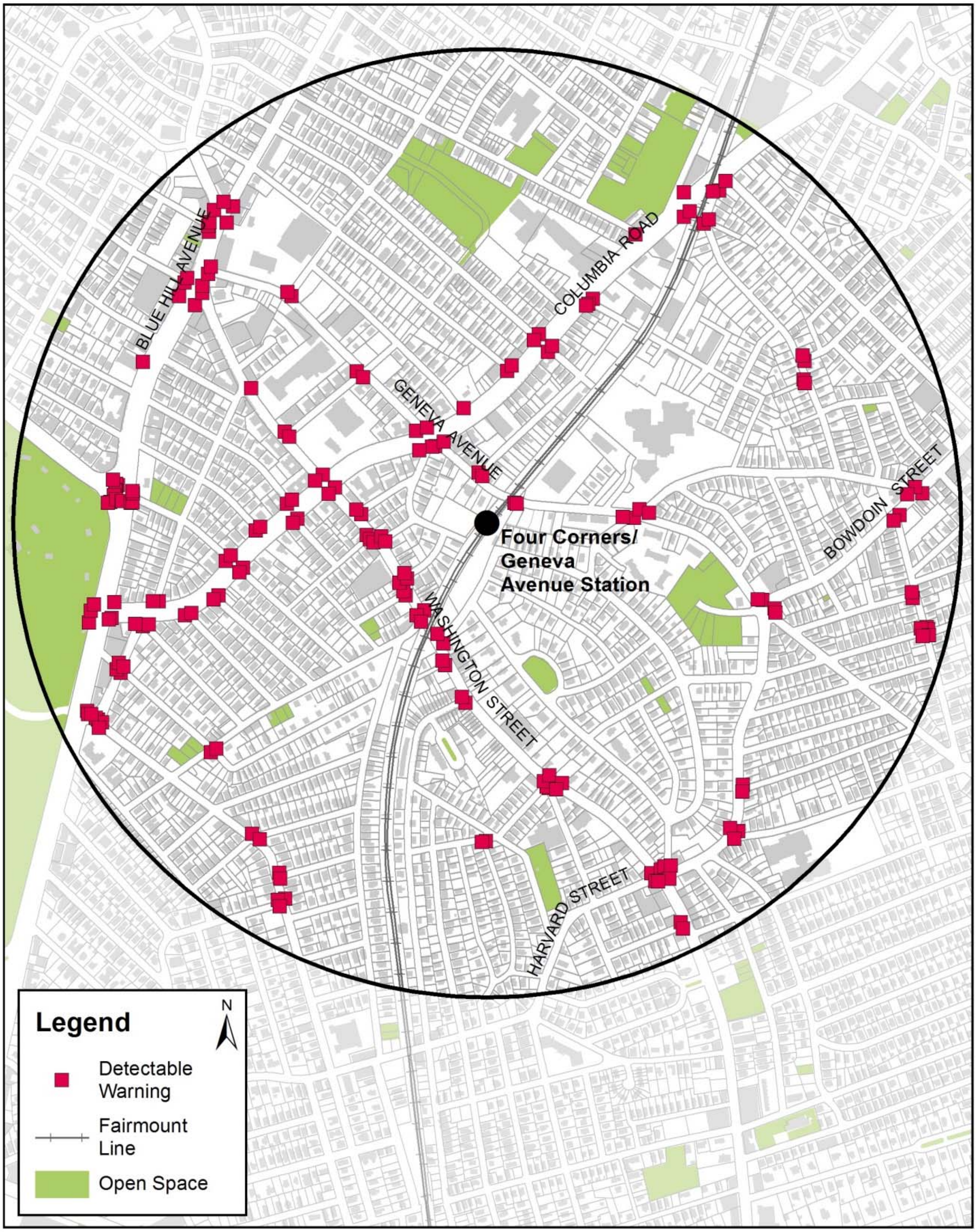

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FIGURE 7-4
Detectable Warnings
Four Corners/Geneva Avenue Station Area

Fairmount Line Station Access Analysis

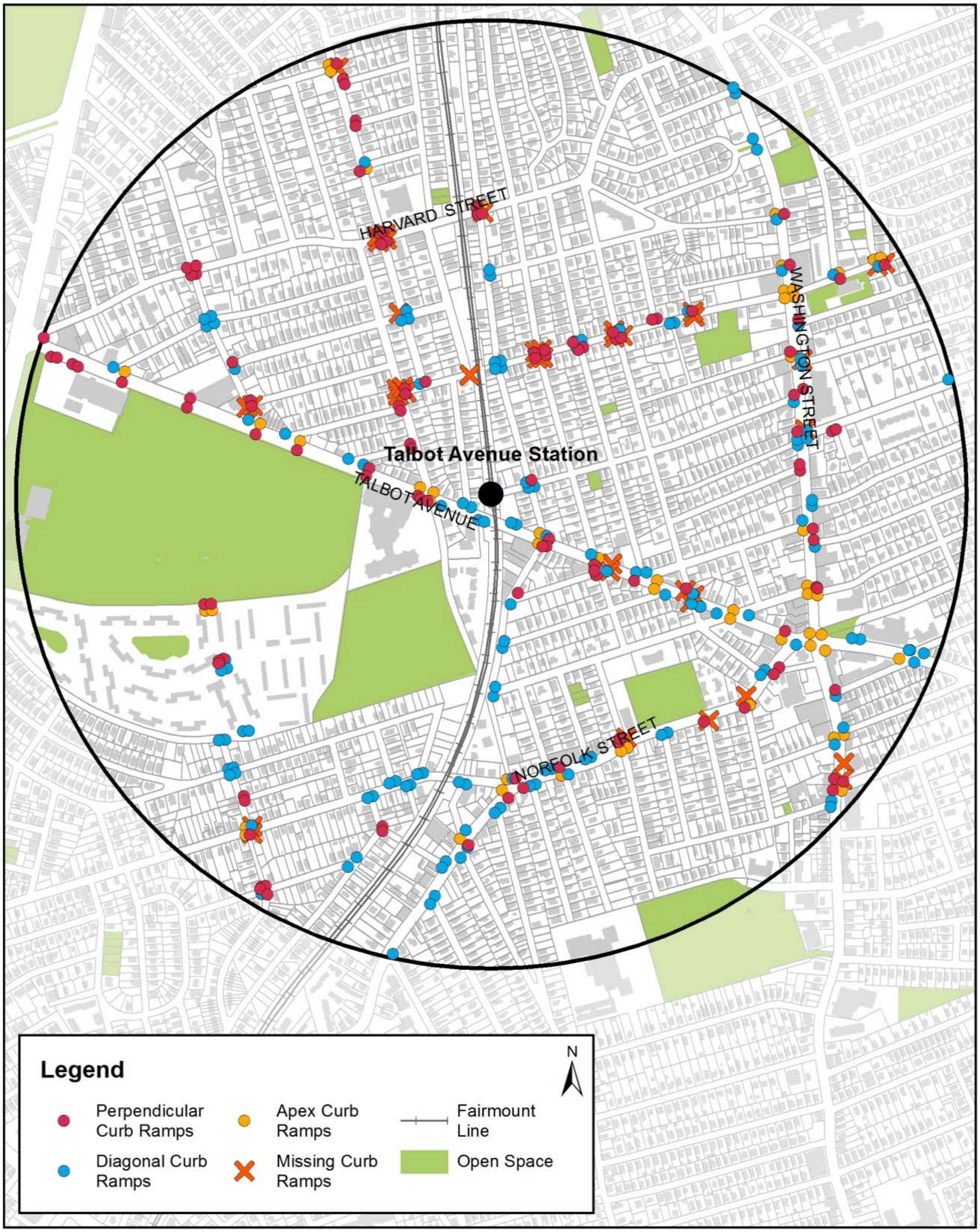

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FIGURE 7-5
Curb Ramps
Talbot Avenue Station Area

Fairmount Line Station Access Analysis

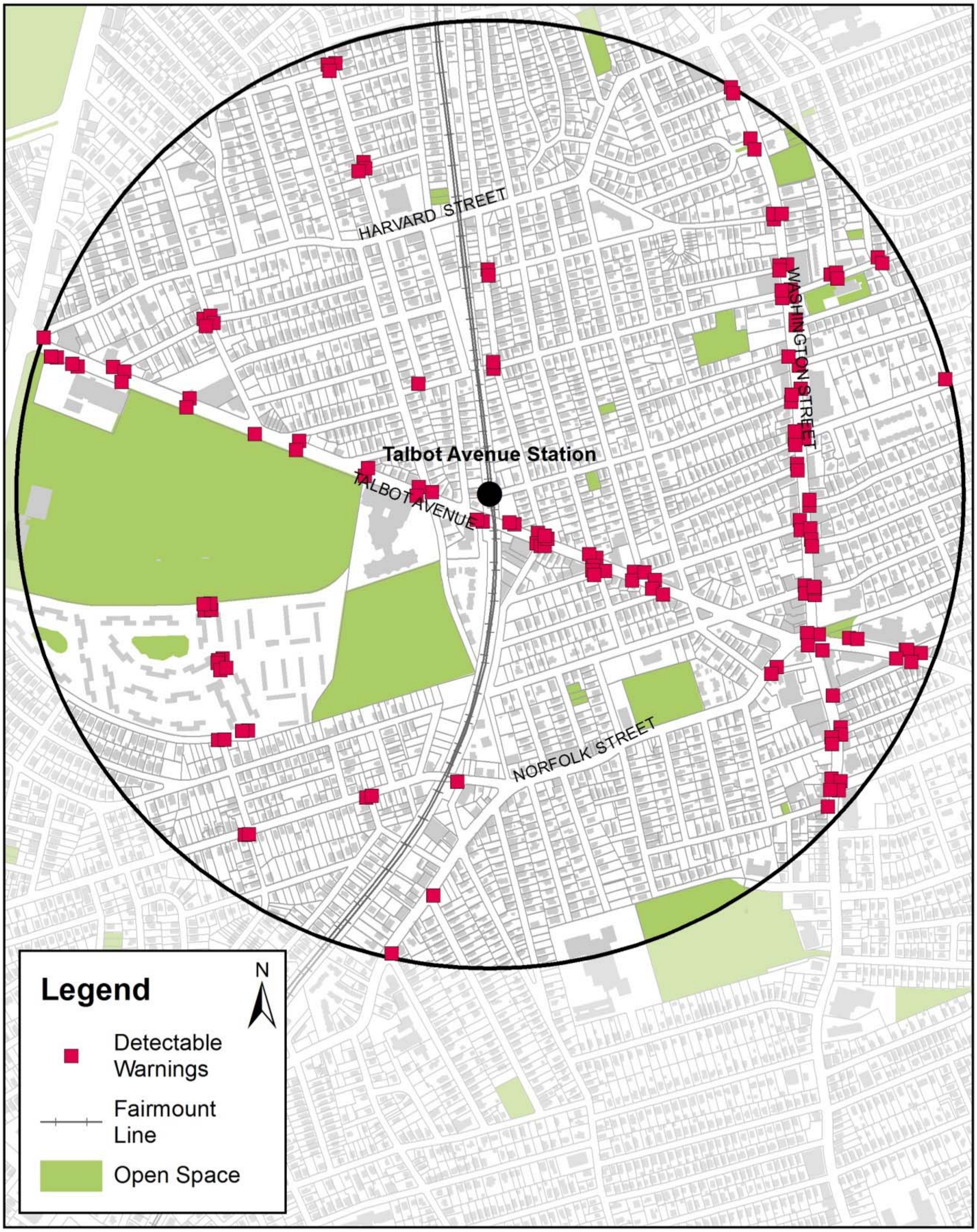

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FIGURE 7-6
Detectable Warnings
Talbot Avenue Station Area

Fairmount Line Station Access Analysis

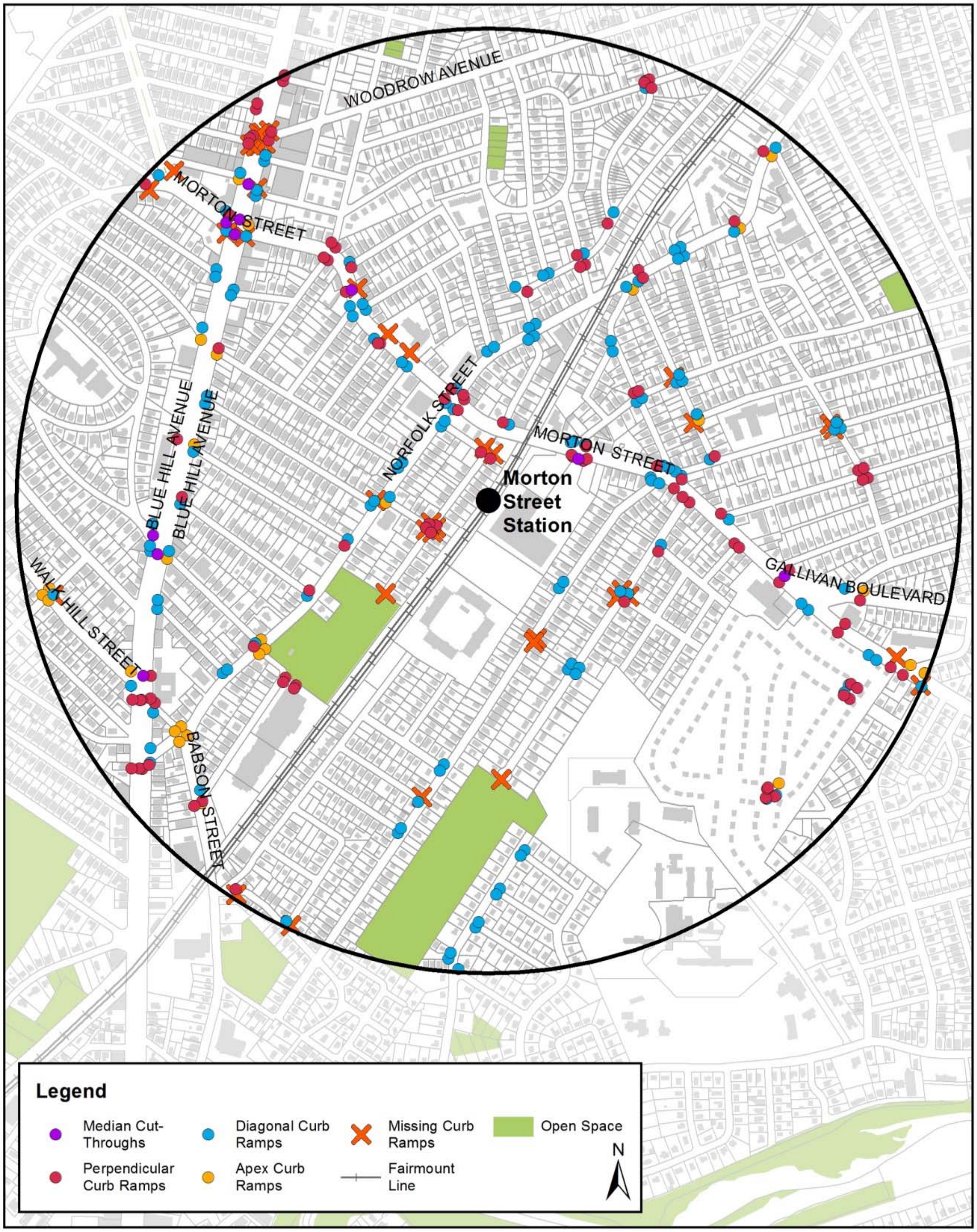

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FIGURE 7-7
Curb Ramps
Morton Street Station Area

Fairmount Line Station Access Analysis

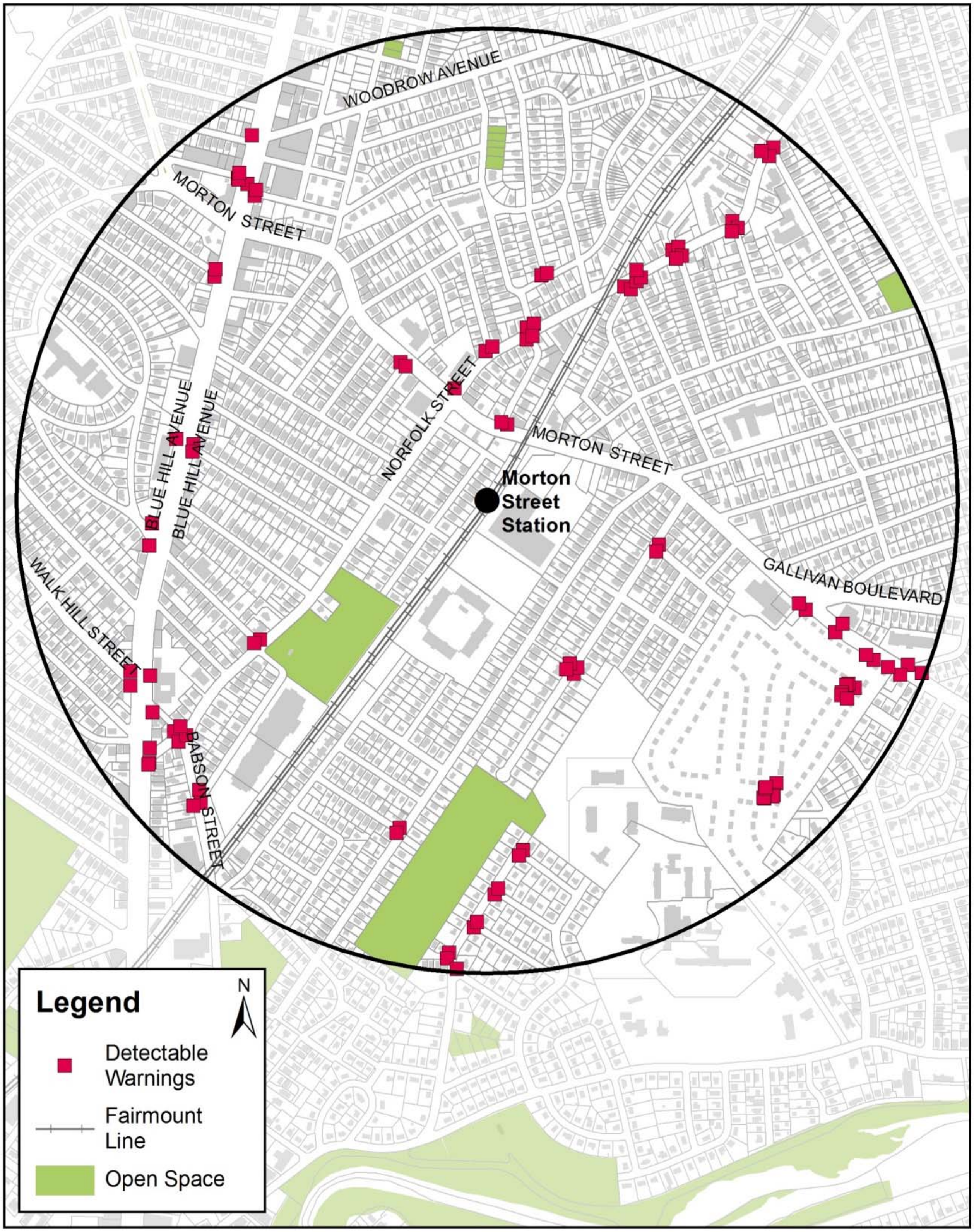

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FIGURE 7-8
Detectable Warnings
Morton Street Station Area

Fairmount Line Station Access Analysis

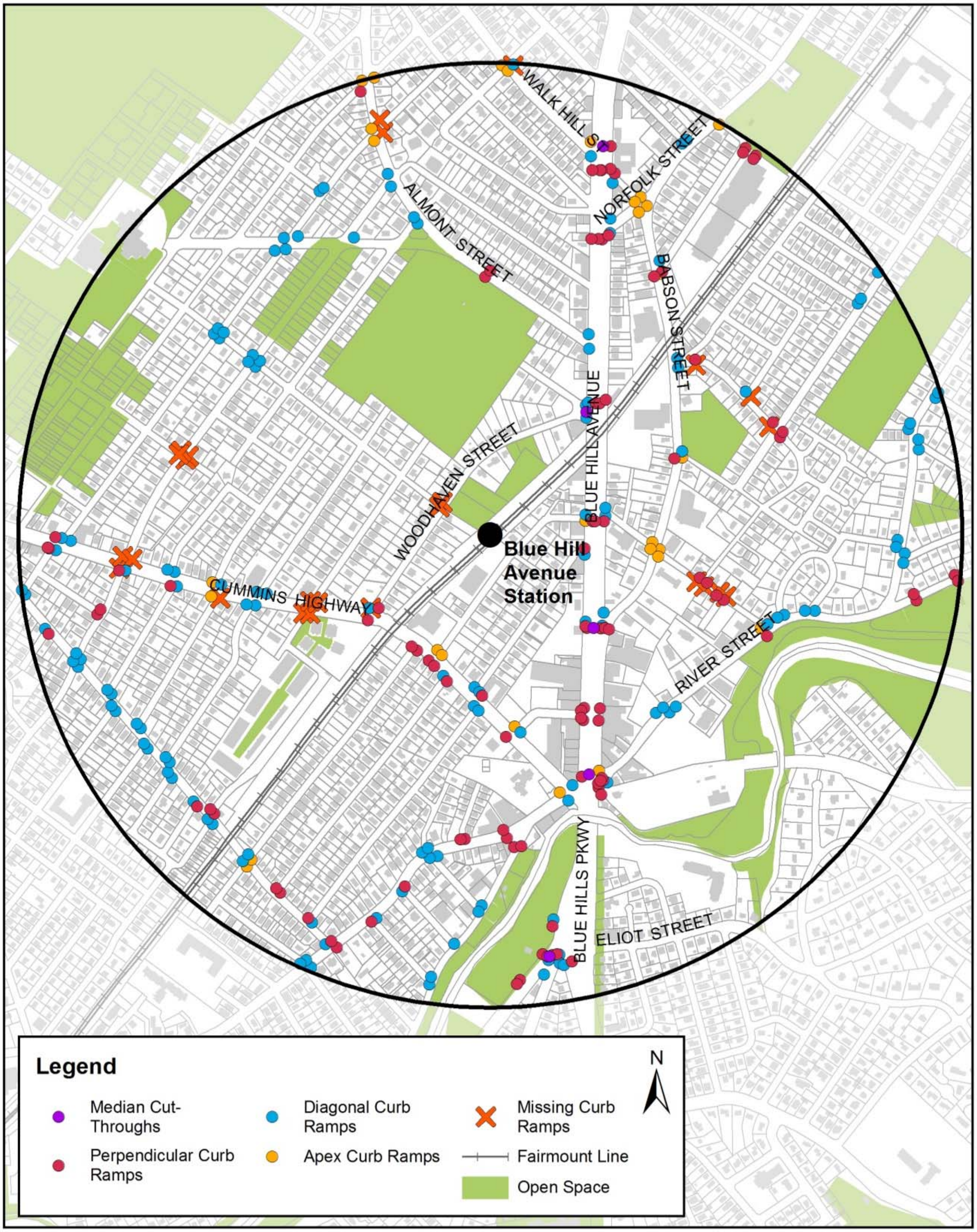

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FIGURE 7-9
Curb Ramps
Blue Hill Avenue Station Area

Fairmount Line Station Access Analysis

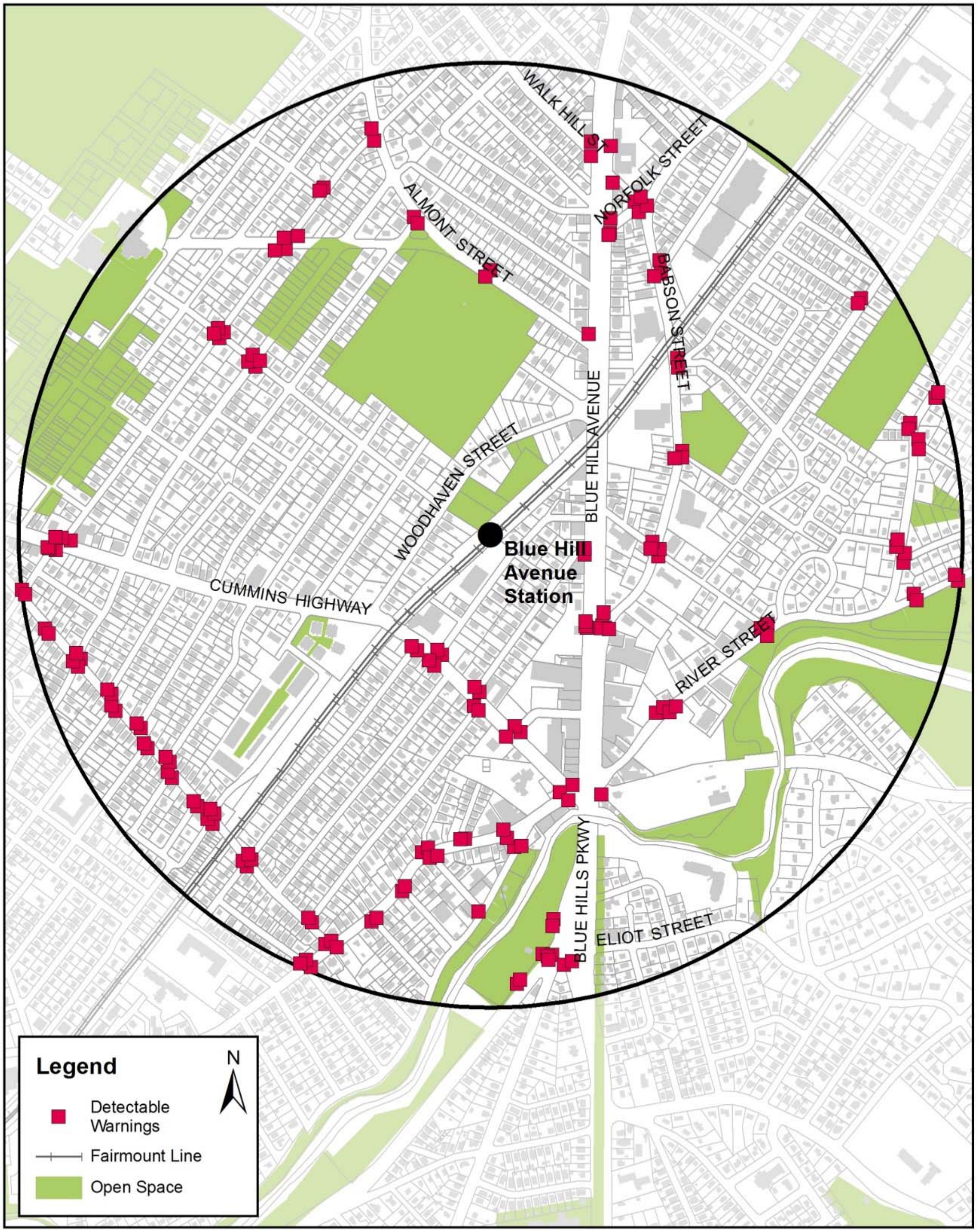

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FIGURE 7-10
Detectable Warnings
Blue Hill Avenue Station Area

Fairmount Line Station Access Analysis

Chapter 8—Pavement Markings

8.1 NEWMARKET

As illustrated in Figure 8-1, MPO staff observed 99 crosswalks in the Newmarket Station area, 19 of which contained faded crosswalk markings. Figure 8-1 shows three pavement markings in the form of bicycle boxes in the Newmarket Station area—the only pavement markings of this type in all five Fairmount Line station areas.

8.2 FOUR CORNERS/GENEVA AVENUE

MPO staff observed 127 crosswalks in the station area (see Figure 8-2). Staff found 17 faded crosswalk segments, whose locations are documented in the figure.

8.3 TALBOT AVENUE

MPO staff observed 125 crosswalks in the Talbot Avenue station area, eight of which were faded. The locations of the faded crosswalks are documented in Figure 8-3.

8.4 MORTON STREET

MPO staff observed 116 crosswalks in the station area. Along the crosswalks, MPO staff found 14 faded segments. The locations of all crosswalks (including the faded instances) are displayed in Figure 8-4.

8.5 BLUE HILL AVENUE

MPO staff documented 100 crosswalks in the station area (illustrated in Figure 8-5), nine of which had faded crosswalk segments.

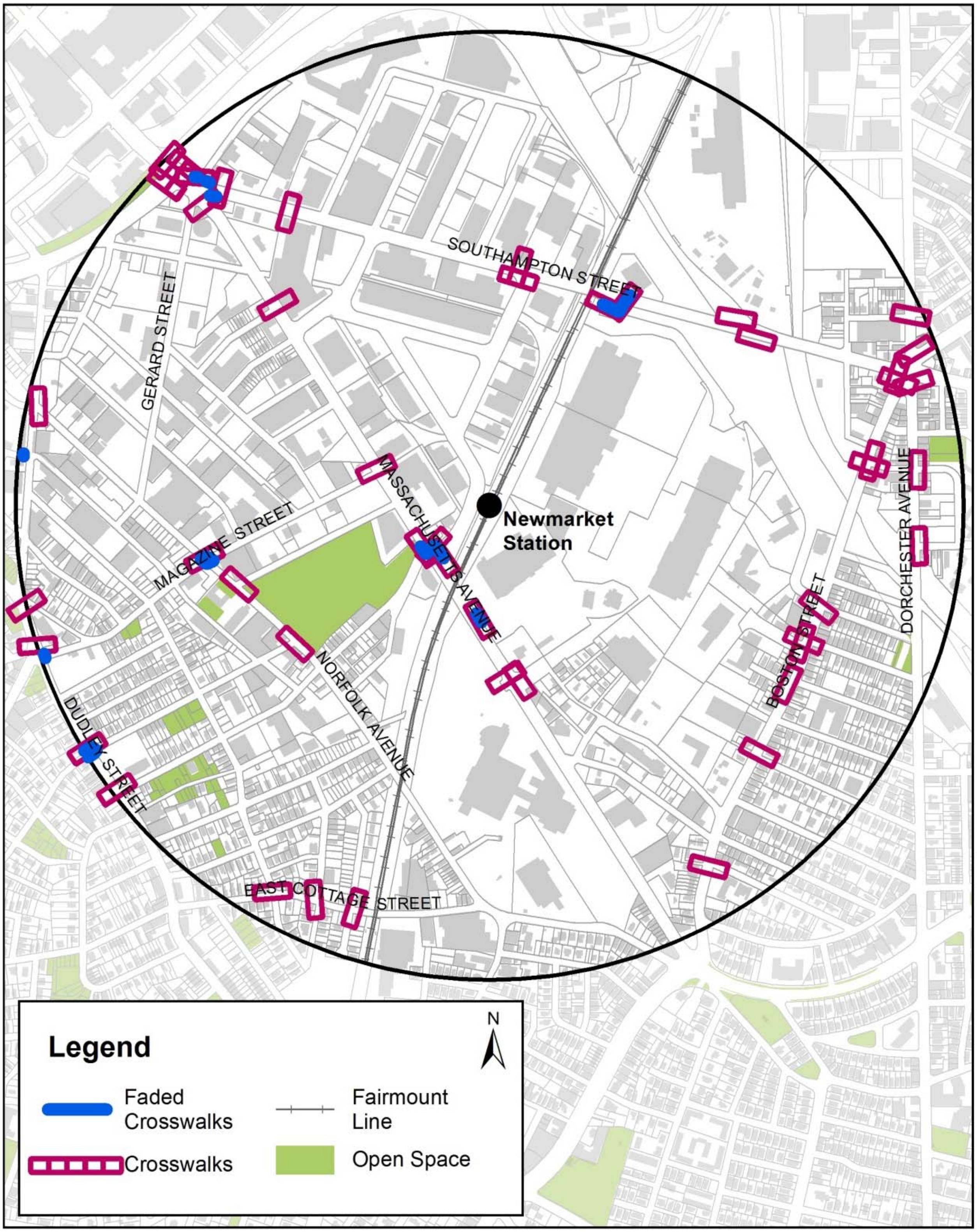

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FIGURE 8-1
Faded Crosswalk Locations
Newmarket Station Area

Fairmount Line Station Access Analysis

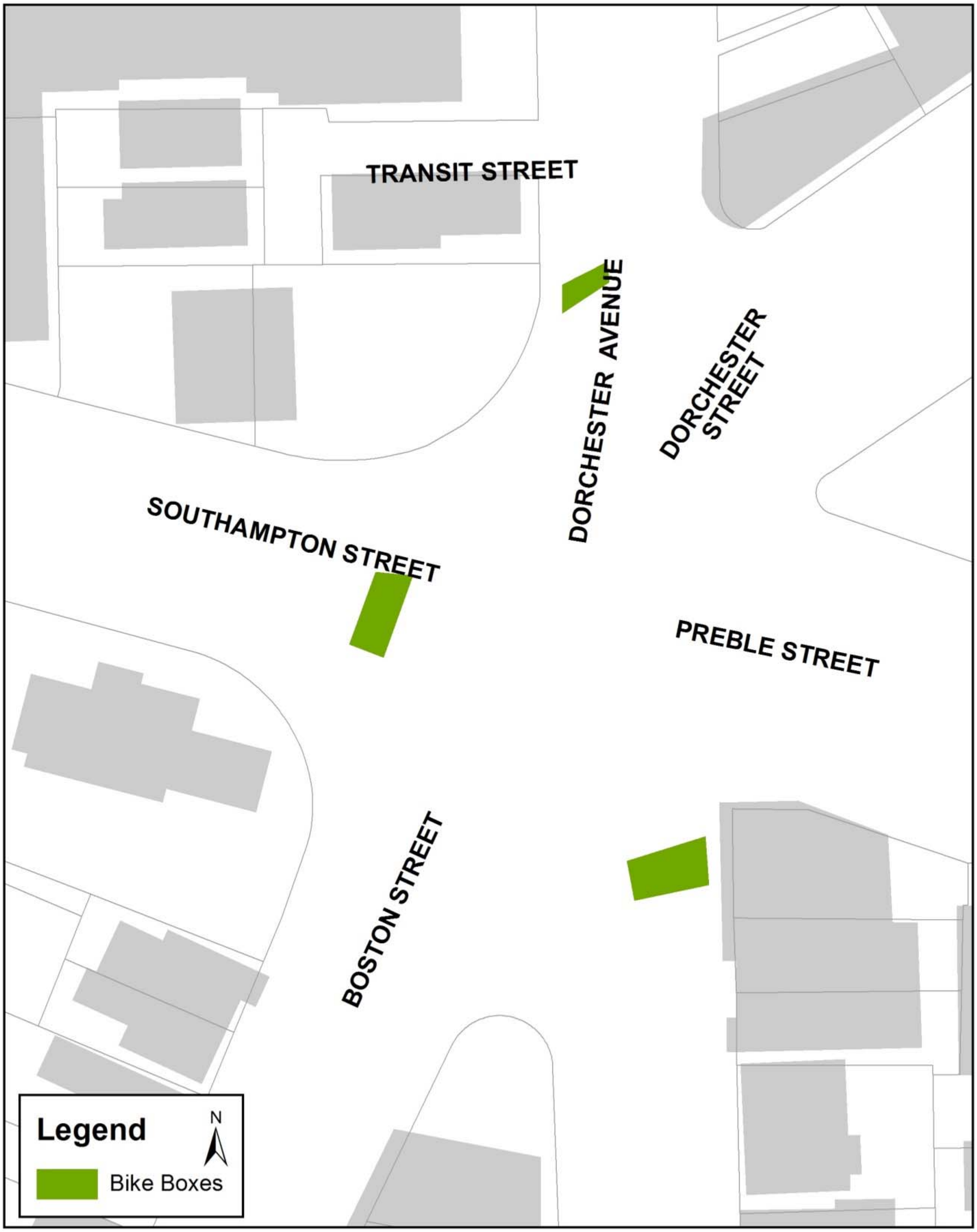

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FIGURE 8-2
Bike Boxes
Newmarket Station Area

Fairmount Line Station Access Analysis

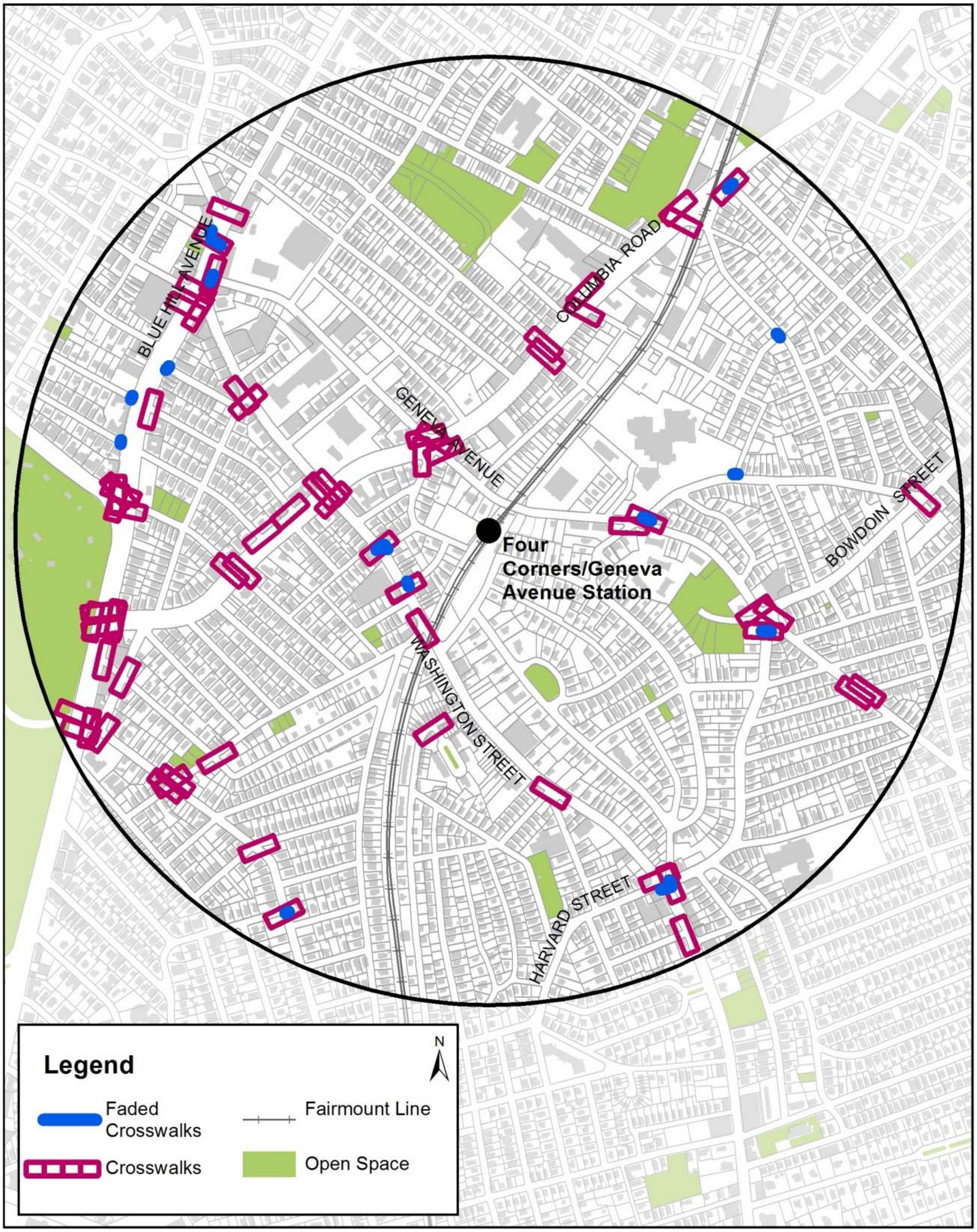

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FIGURE 8-3
Faded Crosswalk Locations
Four Corners/Geneva Avenue Station Area

Fairmount Line Station Access Analysis

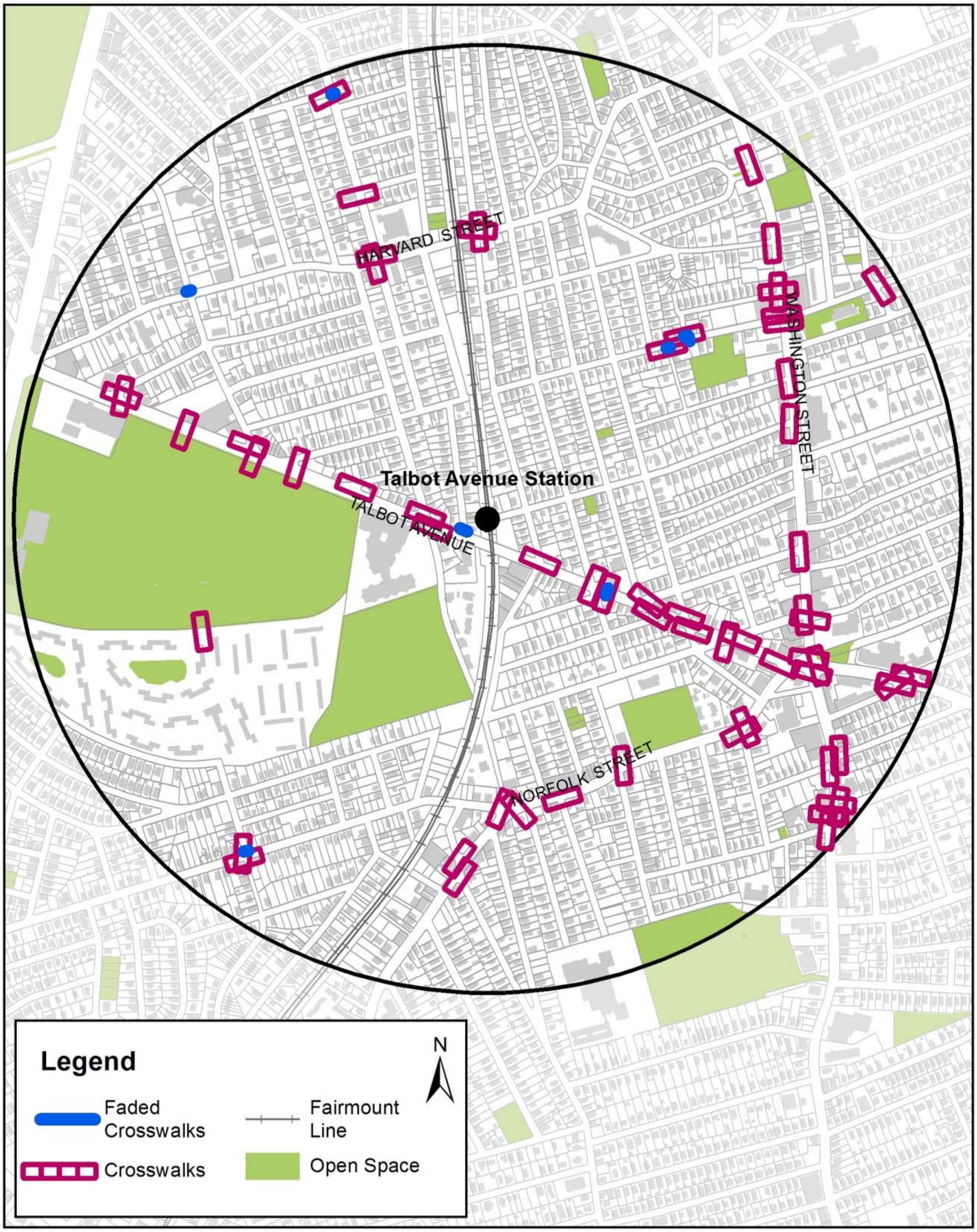

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FIGURE 8-4
Faded Crosswalk Locations
Talbot Avenue Station Area

Fairmount Line Station Access Analysis

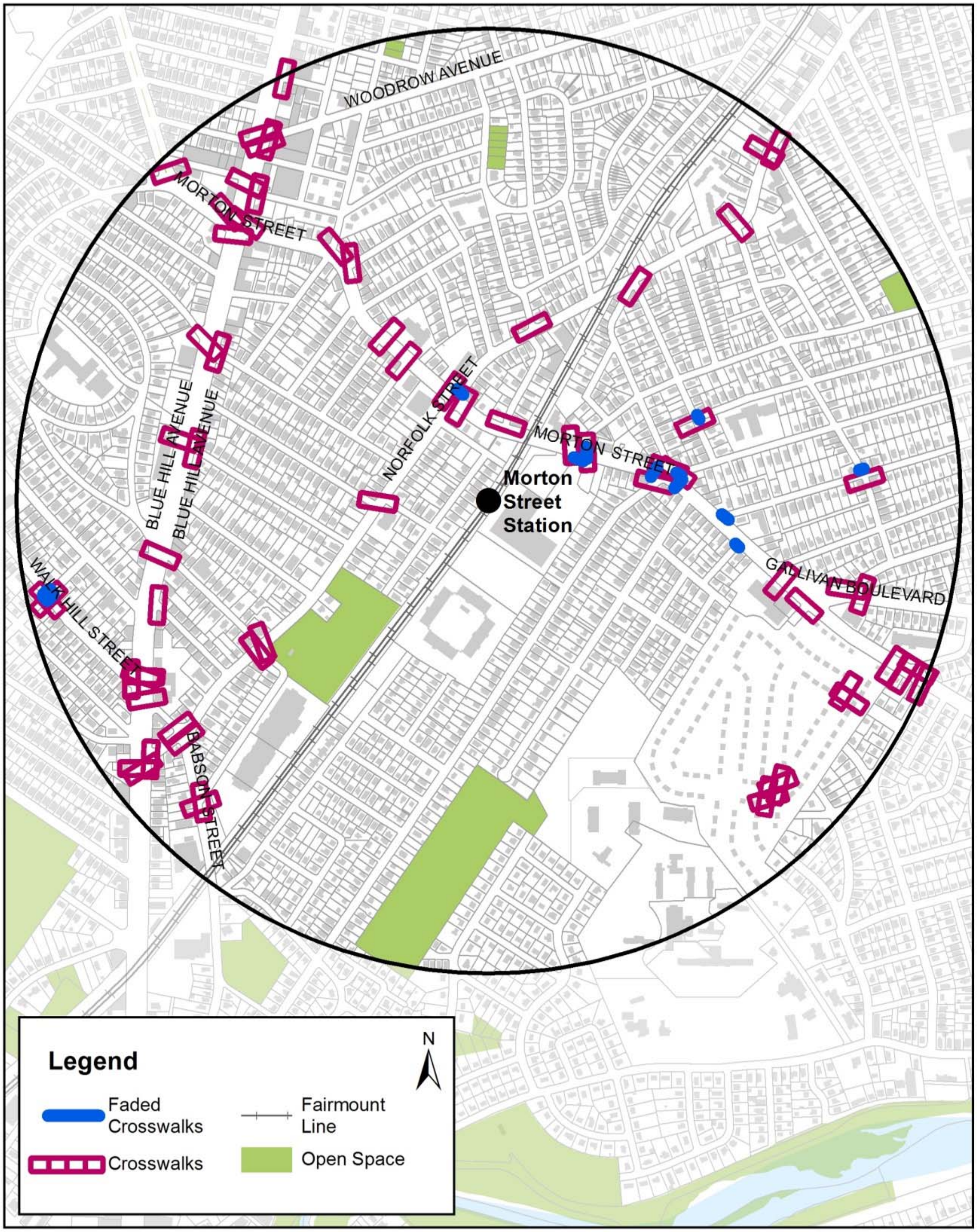

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FIGURE 8-5
Faded Crosswalk Locations
Morton Street Station Area

Fairmount Line Station Access Analysis

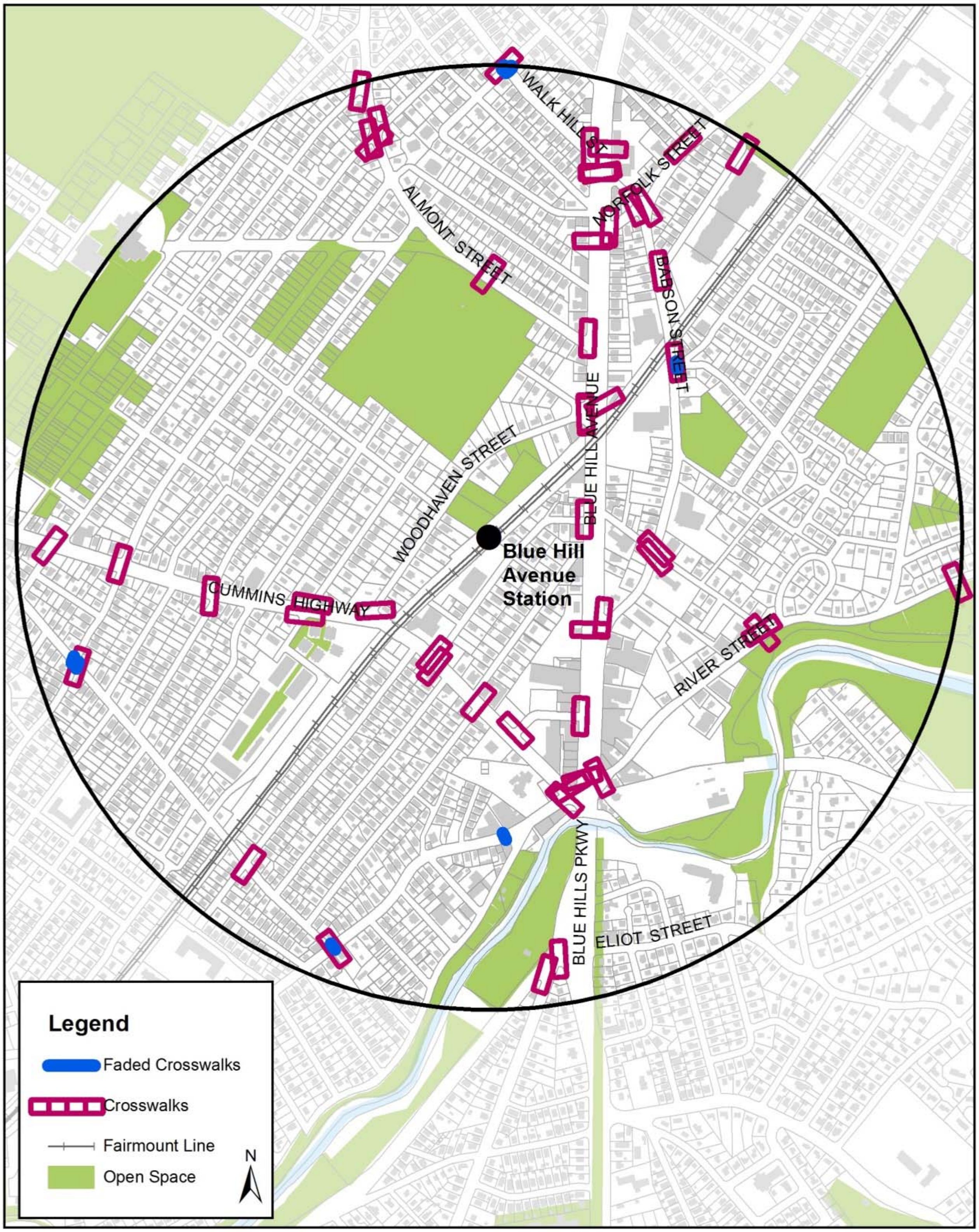

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FIGURE 8-6
Faded Crosswalk Locations
Blue Hill Avenue Station Area

Fairmount Line Station Access Analysis

Chapter 9—Recommendations

9.1 BICYCLE FACILITIES

Bicycle facilities such as bike lanes and shared-use paths already exist in all five of the assessed Fairmount Line station areas, and more facilities—such as buffered bike lanes and cycle tracks—are recommended for future installation in the Boston Bike Network plan. In order to make bicycle travel safer and more comfortable, bicycle facilities should be included at every available opportunity and markings for existing facilities should be repainted when they begin to fade. The minimum width for vehicular traffic lanes in the City of Boston is 10 feet, and it is important to consider accommodating busses when allocating roadway width for bicycle travel.[102] With these considerations in mind, vehicle lane striping should be narrowed to accommodate bicycle facilities where possible. Bike lanes should be at least five feet wide (or a minimum of eight feet wide for bi-directional travel) and, when possible, separated from motor vehicles with a two- to three-foot wide striped buffer zone adjacent to vehicle travel and parking lanes.[103]

To separate cyclists from motorists further, bollards should be installed within buffer zones. Bollards are short, vertical posts that often are used to control or direct road traffic (see Appendix B for more information). Shared-use paths should be constructed as an alternative to on-street bicycle accommodations, where road conditions, cyclist demand, and off-road space indicate a shared-use path is needed and feasible. Shared-lane markings should be installed along routes often used by cyclists where conditions do not allow for a bike lane or shared-use path.

Table 9-1 lists cost estimates for the improvements cited above. These improvements would be best incorporated into roadway reconstruction projects to coincide with repaving the surface. Bicycle pavement markings, such as bike lane and shared-lane markings, cost $180 on average.[104] The calculations in Table 9-1 assume that 30 bicycle pavement markings are installed per mile. The cost of striping a standard four-to- six-inch wide lane line using paint or thermoplastic

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[102] *Boston Complete Streets Guidelines, Minimum Widths for Roadway Lanes*; City of Boston; 2013; page 103.

[103] *Separated Bike Lane Planning and Design Guide*; Massachusetts Department of Transportation; November 2015; page 34.

[104] *Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public*; Max A. Bushell, Bryan W. Poole, Charles V. Zegeer, and Daniel A. Rodriguez; UNC Highway Safety Research Center; October 2013; page 30.

striping in Massachusetts averages between $0.50 and $0.60 per linear foot.[105] The bike lane, buffered bike lane, and vehicular lane calculations represented in Table 9-1 all assume striping costs of $0.60 per linear foot. Bike lanes are one linear foot of striping for each linear foot of facility, while buffered bike lanes are 2.2 feet of linear striping for each linear foot of facility. This is because MPO staff assumed that buffered bike lanes would include two linear feet of striping connected by one four-foot long diagonal stripe every 20 feet. Vehicular striping for one lane going in one direction is one linear foot of yellow striping, while two lanes going in one direction is one linear foot of yellow striping, with an additional one-half linear foot of striping for the white dashed center line. The FHWA states that bollards typically are spaced between 10 and 40 feet apart, so the calculations in Table 9-1 assume that bollards, which cost an average of $730 each,[106] are installed once every 35 feet.[107]

TABLE 9-1
Bicycle Facility Cost Estimates

Bicycle Facility	Estimated Cost for One Direction (per linear foot)	Estimated Cost for Two Directions (per linear foot)	Estimated Cost for One Direction (per linear mile)	Estimated Cost for Two Directions (per linear mile)
Bike Lane /Shared-Lane Markings	$1.00	$2.00	$5,400	$10,800
Bike Lane	$0.60	$1.20	$3,168	$6,336
Bike Lane and Markings	$1.60	$3.20	$8,568	$17,136
Buffered Bike Lane	$1.30	$2.60	$6,970	$13,939
Buffered Bike Lane, Markings	$2.30	$4.70	$12,370	$24,739
Bollards	$20.90	$41.70	$110,126	$220,251
Buffered Bike Lane and Bollards	$22.20	$44.40	$117,095	$234,191
Buffered Bike Lane, Markings, Bollards	$23.20	$46.40	$122,495	$244,991
Re-striping One Vehicular Lane	$0.60	$1.20	$3,168	$6,336
Re-striping Two Vehicular Lanes	$0.90	$1.80	$4,752	$9,504
Paved Shared-Use Path	$91.10	--	$481,140	--

[105] *Pedestrian Infrastructure: Strategies for Improving Pedestrian Safety through Low-Cost Traffic Calming*; WalkBoston; August 2015; page 23.

[106] *Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public*; Max A. Bushell, Bryan W. Poole, Charles V. Zegeer, and Daniel A. Rodriguez; UNC Highway Safety Research Center; October 2013; page 18.

[107] *Separated Bike Lane Planning and Design Guide – Step 2: Forms of Separation*; Federal Highway Administration (FHWA); May 2015; page 84.

9.2 BIKE RACKS

MPO staff recommend that the City of Boston replace all bike racks not supported by the APBP and install acceptable bike rack styles instead. One inverted U bike rack, which can serve two bicycles at one time, costs approximately $245.[108] The costs of such improvements are summarized in Table 9-2. The City of Boston has installed Ring and Post bike racks throughout the five Fairmount Line station areas, as documented in Figure 9-1. APBP deems the Ring and Post bike rack style acceptable. Table 9-2 does not include cost calculations for the Morton Street and Blue Hill Avenue station areas because MPO staff did not find bike racks at either location.

Bike parking serves an important role in supporting bicycle transportation: the absence of bike racks reduces the convenience and practicality of bicycle travel. To encourage bicycling as a mode of transportation, MPO staff recommend that, in addition to replacing the unacceptable bike racks, more APBP acceptable bike racks also be installed throughout each of the five Fairmount Line station areas. New bike rack installations should follow APBP's placement guidelines, as illustrated in Figure 9-2. The spacing requirements that APBP provides apply to Inverted-U and Post and Ring bike racks, both of which allow one bicycle to be roughly centered on each side of the rack.[109] The average bicycle footprint is six feet by two feet, although bikes with trailers or cargo bikes can extend ten feet or longer.[110] These are important measurements that should be factored into bike rack installations.

TABLE 9-2
Bicycle Rack Replacement Costs for the Five Fairmount Line Station Areas

Station Area	Total Bike Racks	Total Bike Parking Spaces	Unacceptable Bike Racks	Unacceptable Bike Parking Spaces	Acceptable Bike Racks Needed	Estimated Cost
Newmarket	21	56	1	16	8	$1,960
Four Corners/Geneva Avenue	28	71	3	21	11	$2,695
Talbot Avenue	28	63	1	9	5	$1,225
Morton Street	13	26	--	--	--	--
Blue Hill Avenue	10	20	--	--	--	--

108 *Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public*; Max A. Bushell, Bryan W. Poole, Charles V. Zegeer, and Daniel A. Rodriguez; UNC Highway Safety Research Center; October 2013; Database of Costs (Excel spreadsheet).

109 *Essentials of Bike Parking: Selecting and Installing Bicycle Parking That Works*; Association of Pedestrian and Bicycle Professionals (APBP); September 2015; page 10.

110 *Essentials of Bike Parking: Selecting and Installing Bicycle Parking That Works*; Association of Pedestrian and Bicycle Professionals (APBP); September 2015; page 10.

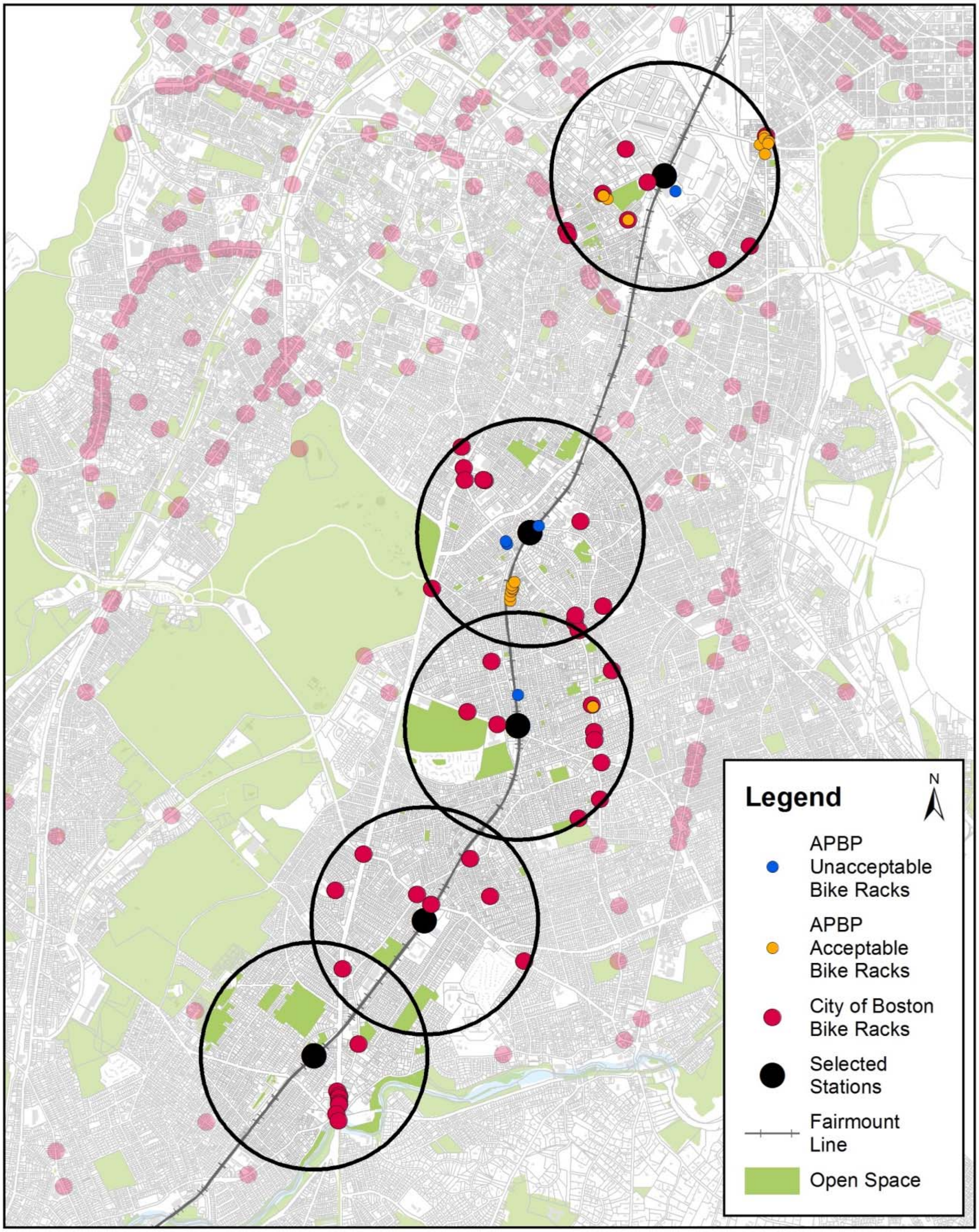

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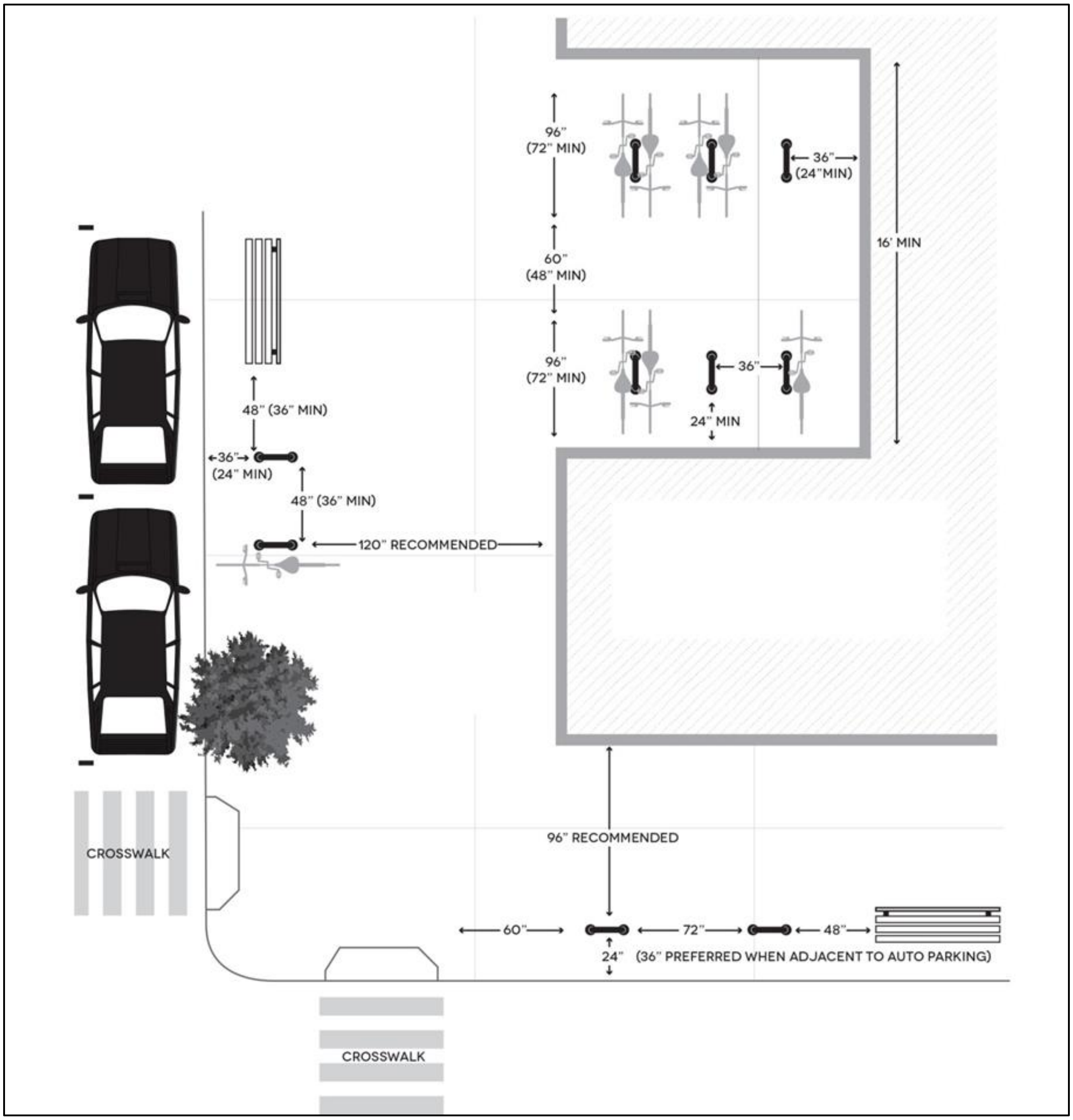
FIGURE 9-1
Bike Racks
Fairmount Line Station Areas

Fairmount Line Station Access Analysis

FIGURE 9-2
APBP Bike Rack Placement Recommendations



Essentials of Bike Parking: Selecting and Installing Bicycle Parking That Works; Association of Pedestrian and Bicycle Professionals (APBP); September 2015; page 10.

9.3 PEDESTRIAN SIGNALS

MUTCD standards require all pedestrian signals with a pedestrian change interval lasting longer than seven seconds to include a countdown display.[111] Table 9-3 lists the number of pedestrian signals without countdown displays in each station area and indicates how many of those signals have pedestrian change intervals that last longer than seven seconds. This provides the information necessary to calculate the number of countdown displays that should be added to each station area. Pedestrian signal countdown timer modules cost $740 on average.[112] New pedestrian signal heads, which cost $550 each on average,[113] are not factored into the cost estimates listed in Table 9-3 because the need for their installation will vary on a case-by-case basis.

TABLE 9-3
Pedestrian Signals in Need of Countdown Displays

Station Area	Signals without Countdown Display	Non-Countdown Signals with Pedestrian Change Intervals More than 7 Seconds	Estimated Cost of Countdown Displays
Newmarket	12	8	$5,920
Four Corners/Geneva Avenue	14	14	$10,360
Talbot Avenue	9	9	$6,660
Morton Street	44	44	$32,560
Blue Hill Avenue	4	2	$1,480
Total	**83**	**77**	**$56,980**

Table 9-4 documents the number of crossings in the five station areas that do not provide sufficient time for pedestrians to cross at a speed of 3.5 feet per second or slower.

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[111] *Manual on Uniform Traffic Control Devices, Part 4: Highway Traffic Signals, Chapter 4E: Pedestrian Control Features, Section 4E.07: Countdown Pedestrian Signals*; Federal Highway Administration; December 2009; page 499.

[112] *Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public*; Max A. Bushell, Bryan W. Poole, Charles V. Zegeer, and Daniel A. Rodriguez; UNC Highway Safety Research Center; October 2013; page 27.

[113] *Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public*; Max A. Bushell, Bryan W. Poole, Charles V. Zegeer, and Daniel A. Rodriguez; UNC Highway Safety Research Center; October 2013; page 28.

TABLE 9-4
Crossings Too Long for Provided Crossing Time

Station Area	Crossings with Travel Speeds Faster than 3.5 Feet per Second
Newmarket	16
Four Corners/Geneva Avenue	18
Talbot Avenue	5
Morton Street	12
Blue Hill Avenue	15
Total	**66**

The least expensive solution for amending the inadequate time of the combined pedestrian change and red clearance intervals at crossings throughout the Fairmount Line station areas would be to increase the length of the pedestrian change and red clearance intervals. Table 9-5 lists the total combined duration of the two intervals that would be necessary to meet the MUTCD standard of 3.5 feet per second. Table 9-5 also lists the total combined duration of the two intervals that would be necessary to meet the even-more accessible speed of 2.8 feet per second, which is used by the City of San Francisco to better serve elderly and mobility-impaired populations.[114]

An alternative to adjusting the pedestrian signals at each crossing listed in the table below is to shorten the distance that pedestrians must cross during the pedestrian change and red clearance intervals. This can be done by creating accessible median islands or extending sidewalks into the roadway where lane widths allow. The minimum width for vehicular traffic lanes in the City of Boston is 10 feet.[115] Median islands and curb extensions can be created with low-cost, interim materials such as planters, pavement markings, temporary curbs, and bollards.[116] When funding becomes available, permanent median islands and curb extensions—which cost $13,520 and $13,000 on average, respectively—should be constructed.[117]

[114] *Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide, Chapter 8: Pedestrian Crossings, Section 8.6: Crossing Times;* Federal Highway Administration (FHWA); September 2001; page 8-17.
[115] *Boston Complete Streets Guidelines, Minimum Widths for Roadway Lanes*; City of Boston; 2013; page 103.
[116] *Urban Street Design Guide, Street Design Elements, Lane Widths*; National Association of City Transportation Officials; Island Press; October 2012; http://nacto.org/publication/urban-street-design-guide/street-design-elements/lane-width/.
[117] *Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public*; Max A. Bushell, Bryan W. Poole, Charles V.

TABLE 9-5
New Crossing Durations for Acceptable Speeds at Problematic Crossings

Intersection/ Crossing	Current Expected Crossing Speed (feet/ sec)	Current Crossing Duration (seconds)	Crossing Length (feet)	Crossing Duration (3.5 feet/ second)	Crossing Duration (2.8 feet/ second)
Newmarket Station Area:					
112 Southampton Street	4.88	10	49	14	18
Allstate Road and Massachusetts Avenue	5.81	17	99	29	36
Boston Street and Harvest Street	4.97	8	40	12	15
Boston Street, Washburn Street, and Frontage Rd	3.53	11	39	12	14
Dorchester Ave, Father Songin Way, O'Connor Way	3.68	14	52	15	19
Dudley Street, Dunmore Street, and Hampden Street	4.18	17	71	21	26
Hampden Street, Keegan Street, and Norfolk Avenue	3.73	9	34	10	12
Magazine Street and Massachusetts Avenue	3.53	14	49	15	18
Magazine Street and Norfolk Avenue	3.62	12	43	13	16
Magazine Street and Norfolk Avenue	4.45	10	45	13	16
Massachusetts Avenue and Chesterton Street	5.36	9	48	14	18
Mass Ave, Melnea Cass Blvd, JFK Ramp, Southampton St	3.87	22	85	25	31
Mass Ave, Melnea Cass Blvd, JFK Ramp, Southampton St	4.12	22	91	26	33
Massachusetts Ave, Newmarket Square, Shirley St	5.78	11	64	19	23
Massachusetts Ave, Newmarket Square, Shirley St	5.07	17	86	25	31
Southampton Street and South Bay Drive	3.94	15	59	17	22
Four Corners/ Geneva Avenue Station Area:					
Blue Hill Avenue and Seaver Street	3.82	22	84	25	31
Blue Hill Avenue, Warren Street, and Georgia Street	4.17	16	67	20	24
Blue Hill Avenue, Warren Street, and Georgia Street	3.93	18	71	21	26
Blue Hill Avenue, Warren Street, and Georgia Street	4.30	12	52	15	19
Columbia Road and Devon Street	3.59	26	93	27	34
Columbia Road and Geneva Avenue	3.94	16	63	18	23
Columbia Road and Geneva Avenue	4.22	28	118	34	43
Columbia Road and Geneva Avenue	4.47	15	67	20	24
Columbia Road and Seaver Street	4.11	23	95	28	34
Columbia Road and Washington Street	4.52	10	45	13	17
Columbia Road and Washington Street	3.91	24	94	27	34
Columbia Road and Washington Street	4.56	10	46	14	17
Columbia Road, Ceylon Street, and Richfield Street	3.54	29	103	30	37
Geneva Avenue and Bowdoin Street	4.75	17	81	24	29
Harvard St, Washington St, Bowdoin St, Bowdoin Ave	6.38	11	70	21	26
Harvard St, Washington St, Bowdoin St, Bowdoin Ave	5.24	11	58	17	21
Washington Street and Erie Street	4.21	9	38	11	14
Washington Street and Erie Street	5.39	9	48	14	18

Zegeer, and Daniel A. Rodriguez; UNC Highway Safety Research Center; October 2013; pages 14-15.

Intersection/ Crossing	Current Expected Crossing Speed (feet/ sec)	Current Crossing Duration (seconds)	Crossing Length (feet)	Crossing Duration (3.5 feet/ second)	Crossing Duration (2.8 feet/ second)
Talbot Avenue Station Area:					
Norfolk Street and Stanton Street	4.75	11	52	15	19
Norfolk Street, New England Avenue, Woodrow Ave	3.89	15	58	17	21
Talbot Avenue and Bernard Street	4.63	16	74	22	27
Talbot Ave, Colonial Ave, Aspinwall Road, Spencer St	5.79	11	64	19	23
Talbot Avenue, Norwell Street, New England Avenue	4.43	11	49	14	18
Morton Street Station Area:					
Blue Hill Avenue and Clarkwood Street	3.55	26	92	27	33
Blue Hill Avenue and Morton Street	4.28	25	107	31	39
Blue Hill Avenue, Baird Street, and Woodrow Avenue	5.38	17	91	27	33
Blue Hill Avenue, Walk Hill Street, and Babson Street	3.58	20	72	21	26
Blue Hill Avenue, Wellington Hill St, Fessenden Street	4.70	28	131	38	47
Morton Street (between Theodore/ Wildwood Sts)	4.87	13	63	19	23
Morton Street (east of Gallivan Boulevard split)	3.97	15	60	18	22
Morton Street, Selden St, West Selden St, Corbet St	3.64	17	62	18	23
Norfolk Street and Babson Street	3.90	10	39	12	14
Norfolk Street and Babson Street	4.14	15	62	18	23
Norfolk Street and Stanton Street	4.75	11	52	15	19
Norfolk Street, Fessenden Street, Mildred Avenue	4.33	14	61	18	22
Blue Hill Avenue Station Area:					
Babson Street and Fremont Street	4.66	12	56	16	20
Babson Street and Norfolk Street	3.86	10	39	12	14
Babson Street and Norfolk Street	4.21	15	63	19	23
Blue Hill Avenue and Babson Street	3.56	20	71	21	26
Blue Hill Avenue and Fairway Street	3.87	19	73	21	27
Blue Hill Avenue, River Street, and Cummins Highway	3.61	11	40	12	15
Blue Hill Avenue, River Street, and Cummins Highway	6.54	14	92	27	33
Blue Hill Avenue, River Street, and Cummins Highway	5.44	11	60	18	22
Blue Hill Avenue, Walk Hill Street, and Babson Street	5.75	14	80	23	29
Cummins Highway and Itasca Street	5.53	8	44	13	16
Cummins Highway and Itasca Street	4.90	13	64	19	23
Cummins Highway and Woodhaven Street	4.40	14	62	18	22
Cummins Highway, Rexford Street, Rockdale Street	4.76	14	67	20	24
Norfolk Street, Fessenden Street, Mildred Avenue	4.39	14	61	18	22
Rector Road and River Street	3.82	11	42	12	15

9.4 SIDEWALKS

MPO staff recommend removing debris and overgrown vegetation at locations where such obstructions impede access and ease of travel along the pedestrian zone of a sidewalk. Staff also suggest widening the pedestrian zone to a minimum of five feet in places where poles and trees narrow the sidewalk. FHWA guidance states that obstructions such as poles and trees should be moved outside the pedestrian zone to a furniture zone, which is at least two feet wide, or a planter zone, which is at least four feet wide. Please refer to Appendix B for more information.

The average cost of a concrete sidewalk is $32 per linear foot.[118] A concrete sidewalk accompanied by a curb costs an average of $150 per linear foot.[119] It is only possible to widen the sidewalk corridor where there is sufficient right of way. By narrowing traffic lanes to the City of Boston's minimum 10-foot width, additional space may be carved from the public right-of-way for the sidewalk corridor.[120] At locations where such reallocation is not possible, especially in areas where the pedestrian zone is less than three feet wide, protruding objects and permanent obstacles should be removed from the pedestrian zone.[121]

9.5 CURB RAMPS

Throughout the Fairmount Line station areas, MPO staff noted locations where curb ramps were needed but not present. Typically, this occurred where a crosswalk led to a curb instead of a curb ramp. Curb ramps cost an average of $810 each.[122] Table 7-6 lists the number of missing curb ramps that staff found in each station area, and the estimated cost of constructing them. MPO staff recommend installing curb ramps at every location where a crosswalk meets a curb and where a pedestrian corridor intersects a roadway.

[118] *Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public*; Max A. Bushell, Bryan W. Poole, Charles V. Zegeer, and Daniel A. Rodriguez; UNC Highway Safety Research Center; October 2013; page 25.

[119] *Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public*; Max A. Bushell, Bryan W. Poole, Charles V. Zegeer, and Daniel A. Rodriguez; UNC Highway Safety Research Center; October 2013; page 25.

[120] *Boston Complete Streets Guidelines, Minimum Widths for Roadway Lanes*; City of Boston; 2013; page 103.

[121] *Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide, Chapter 4: Sidewalk Corridors, Section 4.1: Sidewalk Corridor Width, Section 4.1.4: Improving Access on Narrow Sidewalks;* Federal Highway Administration (FHWA); September 2001; page 4-12.

[122] *Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public*; Max A. Bushell, Bryan W. Poole, Charles V. Zegeer, and Daniel A. Rodriguez; UNC Highway Safety Research Center; October 2013; page 19.

TABLE 9-6
Missing Curb Ramps in Fairmount Line Station Areas

Station Area	Missing Curb Ramps	Estimated Cost
Newmarket	43	$34,830
Four Corners/ Geneva Ave	8	$6,480
Talbot Avenue	39	$31,590
Morton Street	39	$31,590
Blue Hill Avenue	25	$20,250
Total	**154**	**$124,740**

9.6 DETECTABLE WARNINGS

Table 9-7 shows the number of locations in each station area where detectable warnings have not been installed to inform pedestrians of the transition from pedestrian zone to vehicle travel lane. The table also presents cost estimates for adding a six-square-foot detectable warning at each location. The average cost of a detectable warning is $42 per square foot.[123] Table 9-8 shows cost estimates for adding six-square-foot detectable warnings to each curb ramp installation that MPO staff recommend.

TABLE 9-7
Missing Detectable Warnings and Estimated Costs

Station Area	Existing Curb Ramps	Median Cut-Through Entrances	Existing Detectable Warnings	Missing Detectable Warnings	Estimated Cost
Newmarket	257	14	140	131	$33,012
Four Corners/ Geneva Ave	294	21	184	131	$33,012
Talbot Avenue	300	0	145	155	$39,060
Morton Street	264	20	98	186	$46,872
Blue Hill Avenue	261	10	163	108	$27,216
Total	**1,376**	**65**	**730**	**711**	**$179,172**

[123] *Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public*; Max A. Bushell, Bryan W. Poole, Charles V. Zegeer, and Daniel A. Rodriguez; UNC Highway Safety Research Center; October 2013; page 19.

TABLE 9-8
Cost of Detectable Warnings at Missing Curb Ramp Locations

Station Area	Missing Curb Ramps	Estimated Cost
Newmarket	43	$10,836
Four Corners/ Geneva Avenue	8	$2,016
Talbot Avenue	39	$9,828
Morton Street	39	$9,828
Blue Hill Avenue	25	$6,300
Total	**154**	**$38,808**

9.7 PAVEMENT MARKINGS

MPO staff observed faded crosswalk striping at locations throughout the five Fairmount Line station areas. To ensure the visibility of crosswalks to all roadway users, it is important to maintain solid crosswalk striping. A striped crosswalk costs an average of $8.51 per linear foot.[124] Table 9-9 cites the estimated cost of restriping existing faded crosswalk segments.

TABLE 9-9
Estimated Cost of Restriping Faded Crosswalks

Station Area	Linear Feet of Faded Crosswalk	Cost to Restripe Faded Crosswalk
Newmarket	805	$6,847
Four Corners/ Geneva Avenue	603	$5,127
Talbot Avenue	223	$1,898
Morton Street	604	$5,140
Blue Hill Avenue	306	$2,600
Total	**2,540**	**$21,612**

[124] *Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public*; Max A. Bushell, Bryan W. Poole, Charles V. Zegeer, and Daniel A. Rodriguez; UNC Highway Safety Research Center; October 2013; page 24.

Chapter 10—Conclusion

MPO staff identified five station areas along the MBTA's Fairmount Line—Newmarket, Four Corners/Geneva Avenue, Talbot Avenue, Morton Street, and Blue Hill Avenue—that need improvements to make bicycle and pedestrian travel safer and more comfortable. After selecting the station areas, MPO staff assessed each location for impediments to bicycle and pedestrian travel and noted changes that could increase the appeal of walking and bicycling in each area. MPO staff paid particular attention to:

- Bicycle facilities
- Bike racks
- Pedestrian signals
- Sidewalks
- Curb ramps
- Detectable warnings
- Pavement markings.

MPO staff documented the presence of each type of infrastructure observed in the station areas and considered their suitability for bicyclists' and pedestrians' needs. For example, staff identified fading crosswalks and bike racks in shapes that do not allow for proper bicycle locking because of old, broken, or outdated parts. MPO staff mapped the locations of each amenity, indicating characteristics of important features, such as the type of bicycle facility or the orientation of curb ramps. By mapping locations of the existing facilities surrounding the five stations, MPO staff then could offer insight into the types of changes to the physical environment that would benefit bicyclists and pedestrians in each station area. The City of Boston can use this information to guide its efforts to improve bicycle and pedestrian access to the Fairmount Line.

While gathering data for the maps, a high priority for staff was to identify areas where improvements to the physical environment would help bicyclists and pedestrians feel safer and more comfortable. By improving infrastructure for people walking and bicycling in the five Fairmount Line station areas, traveling on foot and by bicycle could become an increasingly appealing mode of travel and might encourage more people to access the Fairmount Line by such means. This would allow residents who live near Fairmount Line stations to become less dependent on motor vehicles and would provide them with direct access to the MBTA's light rail rapid transit through South Station.

Among staff's suggestions is to add buffered or separated bicycle facilities to roadways in Fairmount Line station areas wherever feasible, which would encourage potential bicyclists of all levels to choose to travel by bicycle. In addition, staff suggest that more inverted U and post and ring bike racks be installed to improve the practicality of bicycling as a transportation mode. Aside from locations where high-density racks or long-term bicycle parking are installed, staff recommend that inverted U and post and ring racks replace all existing bicycle parking. While wheelwell-secure bike racks are acceptable by APBP standards, this style is not common; to avoid user confusion, MPO staff do not recommend installing them.

To improve the pedestrian experience around Fairmount Line stations, MPO staff suggest giving pedestrians wider walkways wherever possible. Wider sidewalks and paved routes with separate zones that house poles and other utilities outside the path of pedestrians are improvements that make walking safer and more comfortable. Incorporating green space, especially as a buffer between pedestrians and vehicle traffic, provides more protection and creates a pleasing atmosphere that encourages travel along the corridor. While these improvements would have a significant impact on the pedestrian experience, the importance of ADA accessibility for pedestrian safety and comfort cannot be overstated. The width of sidewalks and paths should be able to accommodate two wheelchairs passing or riding side-by-side; curb ramps with detectable warnings should provide smooth transitions to and from pedestrian zones; and sidewalks should be in good physical condition to accommodate wheelchairs. Adequate lighting, visible crosswalk markings, and pedestrian signals with countdown displays that provide sufficient time for pedestrians to cross all are improvements that staff recommend incorporating into Fairmount Line station areas to enhance pedestrians' experience, and encourage current and potential Fairmount Line riders to walk to their nearest station.

By suggesting improvements to bicycle and pedestrian facilities, this study seeks to increase the transportation options available to those who live within walking and bicycling distance of Fairmount Line stations. In turn, this may lead to greater employment opportunities and better access to amenities for people within the vicinity of the five Fairmount Line stations assessed in this study.

Appendix A—ActiveTrans Priority Tool and Fairmount Line Station Area Selection

STATION AREA SELECTION

MPO staff used the ActiveTrans Priority Tool (APT) to determine which of the eight Fairmount Line stations outside of Boston's CBD were most in need of bicycle and pedestrian improvements. The original project budget allowed for assessment of four station areas, but additional funds made it possible to add a fifth station area to the assessment.

ActiveTrans Priority Tool

The (APT) is a National Cooperative Highway Research Program (NCHRP) Report guidebook, and programmed spreadsheet, that was released in 2015 by the Transportation Research Board. APT provides a transparent, systematic methodology for evaluating and prioritizing pedestrian and bicycle improvements, and its flexible approach can be customized to support different types of projects. The tool is unique in that it is built for separate and specific consideration of bicyclists and pedestrians' needs. APT calculates a score for each project under consideration—in this case, the eight Fairmount Line station areas—and assigns priority rankings that correspond to each project's score, with the highest scoring project receiving the highest ranking. MPO staff populated two APT programmed spreadsheets, one with pedestrian-specific data and the other with bicyclist-specific data. The scores calculated in each spreadsheet then were averaged to determine which station areas were the highest priorities for both bicyclists and pedestrians. The process MPO staff followed when using the APT to prioritize the Fairmount Line station areas is summarized below.

Define Factors

The first step when using APT is to define which factors to consider. APT factors are categories that reflect the values and priorities of the selection process.

The factors that staff used to select which Fairmount Line station areas were most in need of bicycle and pedestrian improvements are listed below:

- Connectivity
- Constraints
- Demand
- Equity
- Existing Conditions
- Safety
- Stakeholder Input

Importantly, the factor of "connectivity" could be quantified for bicyclists, but not pedestrians, because the MPO has network gap data for bicycle facilities only. Thus, the connectivity factor was omitted from the pedestrian priority rankings.

The stakeholders that MPO staff polled for the "stakeholder input" factor were as follows:

- Boston Redevelopment Authority (BRA)
- WalkBoston
- Fairmount Greenway Task Force of the Fairmount/Indigo Line CDC Collaborative
- Fairmount/Indigo Transit Equity Coalition of the Fairmount/Indigo Line CDC Collaborative
- Executive Directors of the Fairmount/Indigo Line CDC Collaborative

Select Variables

In order to illustrate the condition of each factor within a given station area in a quantifiable way, MPO staff selected variables. This process involved determining what data was available, calculating the variable values for each station area, and inputting the information into the APT spreadsheet. The variables for each factor are listed below.

- Connectivity
  - Number of Boston region bicycle network gaps within each station area (2014 Central Transportation Planning Staff, to the Boston Region MPO) Bicycle Network Evaluation study)
- Constraints
  - Whether or not there are multiple jurisdictions with control of roadways within a station area
- Demand
  - Employment Density (jobs per square mile)
  - Retail Activity Density (dollars of sales per square mile)
  - Population Density (population per square mile)
  - Transit Stop Density (number of bus stops per square mile)
  - Transit Boardings (number of boardings at transit stops each week)
  - 2040 Population (change in population by 2040)
  - 2040 Employment (change in employment by 2040)
  - 2035 Ridership Forecast (expected ridership in 2035[125])

[125] *Review and Update of Fairmount Line Ridership Forecasts*; Scott Peterson; Central Transportation Planning Staff to the Boston Region MPO; November 15, 2011; page 2.

- Equity
    - Percent Environment Justice Area (low-income and ethnicity)
    - Percent of Population Younger than Age 18 or Older than 64
    - Percent of Households without Vehicle Availability
- Existing Conditions
    - Number of Vehicular Crashes (2008–2012)
    - Number of Fatal Vehicular Crashes (2008–2012)
    - Number of Non-Fatal Injury Vehicular Crashes (2008–2012)
    - Number of HSIP-Eligible Vehicular Crash Clusters (2010–2012)
    - Number of Top 200 Vehicular High−Crash Locations (2010−2012)

- Safety
    - Number of Bicycle Crashes (2008−2012)
    - Number of Pedestrian Crashes (2008−2012)
    - Number of Fatal Bicycle Crashes (2008−2012)
    - Number of Fatal Pedestrian Crashes (2008−2012)
    - Number of Non-Fatal Injury Bicycle Crashes (2008−2012)
    - Number of Non-Fatal Injury Pedestrian Crashes (2008−2012)
    - Number of Bicycle Crash Clusters (2002−2012)
    - Number of Pedestrian Crash Clusters (2002−2012)
- Stakeholder Input
    - Number of Stakeholder Recommendations
    - BRA Recommendation

A few of the variables listed above, such as the jurisdiction variable under the constraints factor, are qualitative instead of quantitative. The first step in addressing this issue is to assign numeric values to qualitative variables. In the case of the jurisdiction variable, station areas that did not include multiple jurisdictions were given a value of 1, while station areas with multiple jurisdictions were assigned a value of 0.

Scale Variables

The variables used to quantify factor conditions in the Fairmount Line station areas have different units and are therefore not comparable. Evaluating raw numbers of pedestrian crashes against dollars of sales per square mile, for example, would lead to an assessment that disproportionately values retail activity density because sales numbers are large, while crash incident totals are much smaller by nature. In order to assess the variables equitably, they must all be adjusted to a common scale. MPO staff selected 0 to 10.

Depending on the variable being scaled, MPO staff chose either proportionate scaling or quantile scaling from the APT spreadsheet drop-down menus. Proportionate scaling was used when the range of values did not include outliers.[126] This scaling process assigns the highest value in the common scale to the greatest raw value and the lowest common scale value to the lowest raw value.[127] When there were outliers in the range of values, however, MPO staff scaled the numbers based on quantiles.[128] In each case, four quantiles for the common scale were used, with the raw data values assigned to the 0, 3.3, 6.7, or 10 quantile. The lowest raw values belonged to the 0 quantile while the highest raw values composed the 10 quantile.

Establish and Apply Factor Weights

The importance of each factor in the decision-making process was taken into consideration by weighting. The weights assigned to the factors indicate their importance in the decision-making process based on the values and purpose of the study. Each scaled variable value was multiplied by the weight assigned to its factor when compiling the station area scores. MPO staff weighted safety and stakeholder input as the most important factors when calculating the pedestrian and bicycle priority scores, assigning each 10 weights. Existing conditions, equity, and demand were each given 3 weights. In the pedestrian priority calculations, constraints were given 2 weights. The bicycle priority calculations, however, gave 1 weight to both the constraints and connectivity factors in order to account for the fact that the bicycle priority calculations included an additional factor. The weighting is illustrated as percentages below.

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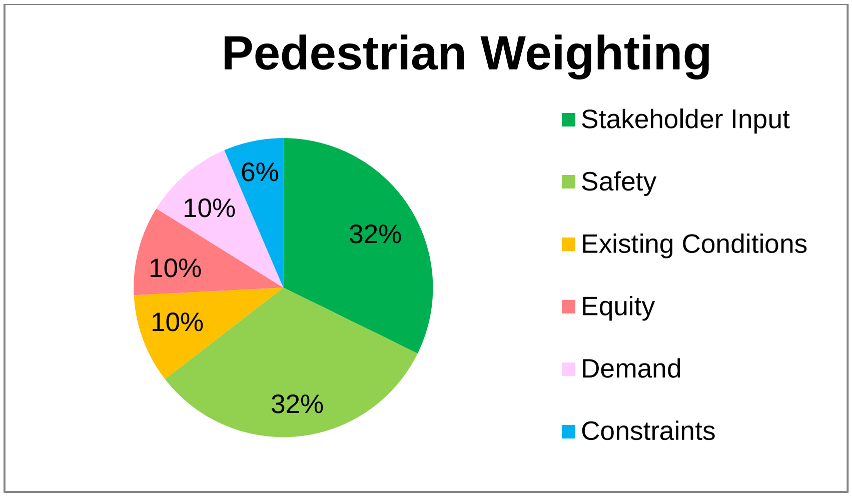
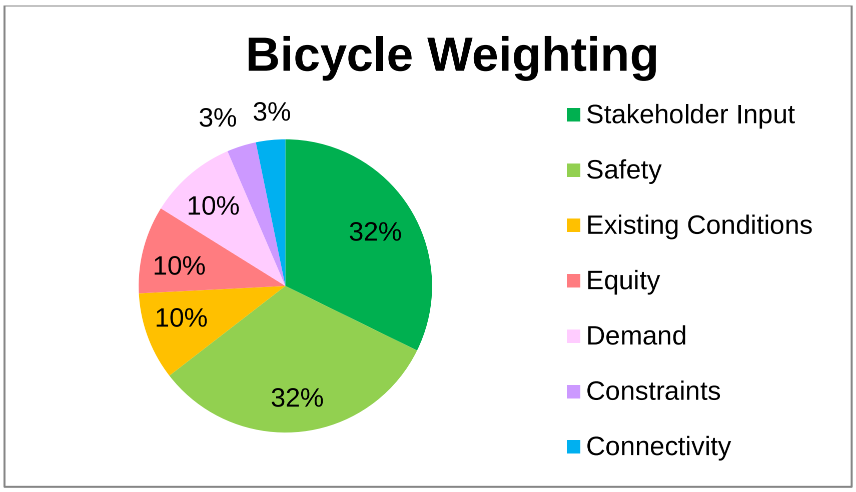
[126] *NCHRP Report 803: Pedestrian and Bicycle Transportation Along Existing Roads – ActiveTrans Priority Tool Guidebook*; Peter A. Lagerwey, Michael J. Hintze, James B. Elliott, Jennifer L. Toole (Toole Design Group), Robert J. Schneider (University of Wisconsin-Milwaukee), Kittelson & Associates, Inc.; Transportation Research Board; 2015; page 43.

[127] *NCHRP Report 803: Pedestrian and Bicycle Transportation Along Existing Roads – ActiveTrans Priority Tool Guidebook*; Peter A. Lagerwey, Michael J. Hintze, James B. Elliott, Jennifer L. Toole (Toole Design Group), Robert J. Schneider (University of Wisconsin-Milwaukee), Kittelson & Associates, Inc.; Transportation Research Board; 2015; page 43.

[128] *NCHRP Report 803: Pedestrian and Bicycle Transportation Along Existing Roads – ActiveTrans Priority Tool Guidebook*; Peter A. Lagerwey, Michael J. Hintze, James B. Elliott, Jennifer L. Toole (Toole Design Group), Robert J. Schneider (University of Wisconsin-Milwaukee), Kittelson & Associates, Inc.; Transportation Research Board; 2015; page 44.





Selected Station Areas

The APT helped MPO staff identify which five station areas were most in need of bicycle and pedestrian safety and comfort improvements. The prioritization ranks for the combined bicycle and pedestrian calculations were as follows:

1. Newmarket
2. Morton Street
3. Four Corners/Geneva Avenue
4. Talbot Avenue
5. Upham's Corner
6. Blue Hill Avenue
7. Fairmount
8. Readville

Location	Connectivity	Constraints	Demand	Equity	Existing Conditions	Safety	Stakeholder Input	Priority Score	Priority Rank
Newmarket	3	15	18	13	22	83	100	255	1
Morton Street	0	15	16	26	30	60	100	247	2
Four Corners/ Geneva Ave	3	15	22	27	15	53	63	199	3
Talbot Avenue	3	15	16	20	4	39	100	197	4
Upham's Corner	5	8	21	27	13	49	0	123	5
Blue Hill Avenue	3	8	14	18	6	10	50	109	6
Fairmount	3	0	12	17	9	19	38	97	7
Readville	3	0	7	0	2	22	0	34	8

The four station areas with the highest priority rankings were immediately selected for assessment. Even when the factors were not weighted, the same four station areas were identified as being of the highest priority for bicycle and pedestrian improvements on the Fairmount Line. The selection of the fifth station took additional factors into consideration. The Boston Redevelopment Authority, which had created Station Area Plans for Upham's Corner and Blue Hill Avenue, specifically requested that MPO staff assess the Blue Hill Avenue station area. There were not stakeholder requests for an assessment of Upham's Corner but WalkBoston and the BRA both had expressed the opinion that the Blue Hill Avenue station area is need of improvement.

These circumstances were compounded by the fact that Blue Hill Avenue Station is anticipated to have the most boardings of all the Fairmount Line stations in 2035,[129] and that it is forecasted to experience the largest percentage of population growth by 2040. As a result, MPO staff selected Blue Hill Avenue as the fifth and final station area for assessment in the Fairmount Line Station-Access Analysis.

[129] *Review and Update of Fairmount Line Ridership Forecasts*; Scott Peterson; Central Transportation Planning Staff to the Boston Region MPO; November 15, 2011; page 2.

Appendix B—Bicycle and Pedestrian Infrastructure Overview

INFRASTRUCTURE CONSIDERATIONS

MPO staff noted several characteristics of the bicyclist and pedestrian environment in order to assess the five selected Fairmount Line station areas. Although staff documented the majority of conditions in the field, some information was gathered using existing data. Staff also used resources such as Google Maps and Bing Maps when documenting field notes in the office to collect additional measurements and ensure accuracy. Appendix B explains how MPO staff acquired the data used in the *Fairmount Line Station-Access Analysis* report and provides definitions for various elements that contribute to the quality of the bicycle and pedestrian environment. The topics covered below include bicycle facilities, bike racks, pedestrian signals, sidewalks, curb ramps, detectable warnings, pavement markings, traffic calming infrastructure, and interim improvements.

Bicycle Facilities

The Boston Bike Network Plan documents bicycle facilities in the City of Boston from 2007 to the present and lays out plans for future bicycle infrastructure, indicating where new facilities will be installed and identifying locations where existing conditions will be improved. MPO staff received Boston Bicycle Network shapefiles (current as of October 22, 2015) from the City of Boston in order to map the current and future bike network in the five selected Fairmount Line station areas. Staff separated the network into existing and proposed facilities in order to illustrate the locations of current bicycle facilities and the areas where new bicycle facilities are anticipated. The bicycle facilities included in the Boston Bike Network are explained below, based on descriptions produced for the City of Boston by Toole Design Group.[130]

Advisory Lane

On low-volume, narrow roads that measure less than 30 feet without parking and less than 44 feet with parking, a dashed bicycle lane with a minimum width of five feet, known as an advisory lane, is provided on both sides of the road. Motor vehicles may enter the bicycle lane to give way to oncoming vehicles.

[130] *Boston Bike Network Bike Facility Descriptions*; Peter Robie; Toole Design Group; City of Boston; August 2015.

Advisory Lane

Source: http://streets.mn/2014/09/30/writers-round-up-advisory-bike-lanes/.

Buffered Bike Lane

A buffered bike lane is an exclusive lane for bicycle travel that measures a minimum width of five feet and is accompanied by a two- to three-foot striped buffer zone adjacent to a vehicle travel lane to provide separation from motor vehicles. The MassDOT Separated Bike Lane Planning & Design Guide states that, regardless of the type of street buffer, a six-foot buffer width is recommended.[131] In constrained conditions, a minimum street buffer width of two feet is allowed, although a minimum one-foot width is permitted alongside a raised bike lane.[132]

131 *Separated Bike Lane Planning & Design Guide*; Massachusetts Department of Transportation; November 2015; page 34.

132 *Separated Bike Lane Planning & Design Guide*; Massachusetts Department of Transportation; November 2015; page 34.

Buffered Bike Lane

Source: https://www.reddit.com/r/bicycling/comments/1m8zlh/boston_did_this bike lane_right_extrawide/.

Bike Lane

A bike lane is an exclusive lane for bicycle travel that is a minimum of five feet wide.

Bike Lane

Source: http://streetsmarts.bostonbiker.org/.

Buffered Climbing Lane

Buffered climbing lanes are provided on roads with steep grades where bicycle lanes cannot be provided on both sides of the road. In these cases, an exclusive bicycle lane measuring a minimum of five feet wide and accompanied by a two- to three-foot striped buffer zone is provided in the uphill direction and a marked shared-lane is provided in the downhill direction. Streets with buffered climbing lanes may also be described as streets with a buffered bike lane on one side.

Buffered Climbing Lane

Source: http://edmontonbikes.ca/2013-on-street-bike-routes/.

Bus Bike Lane

A bus bike lane is a lane for shared bus and bicycle travel that measures a minimum width of 11 feet. Motor vehicles are prohibited in bus bike lanes except where signs indicate otherwise.

Bus Bike Lane

Source: http://thetysonscorner.com/transportation-officials-want-to-widen-rt-123-again/.

Climbing Lane

Climbing lanes are found on roads with steep grades where bicycle lanes cannot be provided on both sides of the road. An exclusive bicycle lane measuring a minimum of five feet is provided in the uphill direction and a marked shared-lane is provided in the downhill direction.

Climbing Lane

Source: http://la.streetsblog.org/2012/03/06/santa-monica-debuts-two-new-bikeway-designs/.

Contraflow Bike Lane

On one-way streets, bicyclists may operate in two directions via a contraflow bike lane that measures a minimum of five feet and exclusively serves bicycle travel in the opposite direction of motor vehicle travel. Bicycles traveling in the same direction as motorists should have a bicycle lane or, if necessary, share the lane of travel with automobile drivers.

Contraflow Bike Lane

Source: http://www.bmorebikes.com/fawn-st-contraflow-bike-lane/.

Cycle Track

A cycle track is a physically separated bicycle facility protected from motor vehicle traffic via bollards, flexposts, medians, on-street parking, or planters. MassDOT recommends that flexible delineator posts and rigid bollards be installed within the center of a street buffer and placed between 10 and 80 feet apart from one another along a roadway.[133] If parking stops are used to provide physical separation, MassDOT recommends their installation be consistently spaced along a roadway between parking stops, with a 9- to 12-foot separation between each stop.[134] Ideally, cycle tracks are constructed at or near sidewalk level. MassDOT refers to cycle tracks as separated bike lanes, explaining that they are spaces along roadways that serve bicyclists exclusively.[135] The MassDOT definition mentions that horizontal and vertical elements physically divide separated bike lanes from pedestrian and motor vehicle spaces.[136]

[133] *Separated Bike Lane Planning & Design Guide*; Massachusetts Department of Transportation; November 2015; pages 36-37.
[134] *Separated Bike Lane Planning & Design Guide*; Massachusetts Department of Transportation; November 2015; page 36.
[135] *Separated Bike Lane Planning & Design Guide*; Massachusetts Department of Transportation; November 2015; page 2.
[136] *Separated Bike Lane Planning & Design Guide*; Massachusetts Department of Transportation; November 2015; page 2.

Cycle Track

Source: http://www.cambridgema.gov/CDD/Transportation/design/bicycling/cycletracks.aspx.

Cycle Track/Bike Lane

A cycle track/bike lane street is a street with a cycle track on one side and a bike lane on the other.

Cycle Track/Bike Lane

Source: http://www.peopleforbikes.org/blog/entry/at-last-feds-move-toward-a-green-light-for-protected-bike-lanes.

Existing Facility Replaced by Cycle Track Elsewhere

This designation specifically addresses a circumstance on Blue Hill Avenue where there is an existing bike lane and the proposed facility is a bidirectional cycle track on one side of Blue Hill Avenue. MassDOT recommends a width of 10 feet for two-way bike lanes with less than 150 cyclists per peak hour.[137] However, where conditions are constrained, MassDOT states that a two-way bike lane may measure a minimum of eight feet wide.[138]

Existing Facility Replaced by Cycle Track Elsewhere

Source: https://spokesdunedin.wordpress.com/2012/11/10/protected-bike-lanes/.

Neighborway

Neighborways, also known as bicycle boulevards, are quiet, low-volume streets that are designed for slower speeds and give priority to bicyclists and pedestrians. These streets are designated by neighborway or bicycle boulevard pavement markings and signed as bicycle routes. Traffic-calming devices may be installed along the corridor to reduce vehicular speeds and increase driver awareness of pedestrians and bicycles.

[137] *Separated Bike Lane Planning & Design Guide*; Massachusetts Department of Transportation; November 2015; page 31.

[138] *Separated Bike Lane Planning & Design Guide*; Massachusetts Department of Transportation; November 2015; page 31.

Neighborway

Source: http://www.bikewalklincolnpark.com/2011/10/quick-and-easy-primer-on-bicycle.html.

Parking Buffered Bike Lane

A parking buffered bike lane is an exclusive lane for bicycle travel that measures a minimum of five feet wide and is accompanied by a two- to three-foot striped buffer zone adjacent to on-street parking to provide separation from motor vehicles.

Parking Buffered Bike Lane

Sources (left to right): http://cyclingchristchurch.co.nz/2015/02/02/last-stop-boston-and-reflections-on-us-cycling/; http://chi.streetsblog.org/2013/09/10/eyes-on-the-street-new-buffered-bike-lanes-on-madison-avenue/; http://spacing.ca/edmonton/2014/07/02/four-wild-cheap-ideas-edmonton-can-introduce-right-now-protect-cyclists/.

Priority Shared-Lane Markings

Priority shared-lane markings are found on multi-lane streets with two or more travel lanes in a single direction where shared-lane markings are centered in the outside travel lane. Priority shared-lane markings can be supplemented with dashed longitudinal lines and/or colored pavement to denote bicycle prioritization, encouraging motor vehicles to pass using the inside travel lane.

Priority Shared-Lane Markings

Sources (left-to-right): https://www.bostonglobe.com/metro/2013/11/24/new-sharrows-steroids-debut-allston-brighton-avenue/ZfqrBJVsbhPVF0Ux4j5PFI/story.html. http://www.caeconomy.org/reporting/entry/oakland-introduces-color-to-bike-lanes-to-increase-safety.

Shared-Lane Markings

Where exclusive bike lanes are not feasible and speeds are less than 35 miles per hour, shared-lane pavement markings, also known as “sharrows,” designate that bicycles and motor vehicles must share a travel lane. Importantly, research using Chicago census block group data indicates that areas where sharrows were installed experienced a significantly smaller drop in the number of injury crashes per year per 100 bicyclists (6.7 fewer injuries) than streets where bike lanes were added (27.5 fewer injuries) and even than streets where bicycle infrastructure was not added (13.5 fewer injuries).[139]

Shared-Lane Markings

Source: http://sdotblog.seattle.gov/2009/09/24/sharing-the-road-with-sharrows/.

[139] *The Relative (In)Effectiveness of Bicycle Sharrows on Ridership and Safety Outcomes*; Nicholas N. Ferenchak and Wesley E. Marshall; University of Colorado Denver; Transportation Research Board 2016 Annual Meeting; August 2015; page 2.

Shared Street

Shared streets are streets designed for slow speeds with a single grade or surface shared by all users: motorists, transit users, bicyclists, and pedestrians. Traffic-calming devices are typically installed on shared streets to maintain slow speeds.

Shared Streets in Grenoble, France

Sources (left-to-right): http://ca.france.fr/en/discover/grenoble. https://lesoeuvresdeben.wordpress.com/category/travel-blog/.

Shared Street in Boston's Downtown Crossing Area

Source: http://www.panoramio.com/photo/39944914.

Shared-Use Path

A shared-use path is an off-road pathway that is physically separated from motorized travel for shared-use by bicyclists and pedestrians.

Shared-Use Path

Sources (left-to-right): http://www.thevoiceofdowntownboston.com/bike-riding-through-downtown-boston-where-to-go/. https://rootsrated.com/stories/6-reasons-why-boston-is-an-awesome-city-for-outdoor-lovers.

Suggested Local Route

Suggested local routes were offered as popular routes during the Boston Bike Network planning process but ultimately did not receive a facility recommendation.

Bike Racks

When in the field, MPO staff marked the locations of bicycle racks they encountered. Bike parking serves an important role in supporting bicycle transportation because a lack of bike racks reduces the convenience and practicality of bicycle travel. The City of Boston maintains a shapefile of bike rack locations but the file only contains those racks that have been installed on public property and at MBTA stations with Pedal and Park facilities.[140] MPO staff documented bike rack location and type in order to supplement the data provided by the City of Boston. The APBP has created a guidebook that facilitates the successful selection and installation of useful bicycle parking.[141] MPO staff assessed bicycle parking in the Fairmount Line station areas using APBP criteria and recommendations.

While the guide addresses both short- and long-term bicycle parking, this study discusses short-term bicycle parking facilities because they were the only type observed by staff. APBP suggests that users likely would value the shelter and convenience of long-term bicycle parking more than the ease and convenience of

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[140] *Bike Parking*; City of Boston; http://www.cityofboston.gov/bikes/parking.asp.

[141] *Essentials of Bike Parking: Selecting and Installing Bicycle Parking That Works*; Association of Pedestrian and Bicycle Professionals (APBP); September 2015; http://c.ymcdn.com/sites/www.apbp.org/resource/resmgr/Bicycle_Parking/EssentialsofBikeParking_FINA.pdf.

short-term facilities when parking for two hours or longer.[142] Therefore, MPO staff recommend installing long-term bicycle parking at locations where bicyclists are expected to park for two or more hours.

Bike Rack Performance Criteria

APBP identifies five characteristics of good bicycle parking. The first is that a bike rack should support a bike upright without putting stress on its wheels.[143] This is done by providing two points of contact with the bike, at least six inches apart, horizontally on a bike's frame.[144] It also may be accomplished with one point cradling the bicycle's wheel and at least one other point supporting the bike's frame securely.[145] APBP specifies that the high point of the rack should measure at least 32 inches tall.[146]

The second criterion for good bicycle parking is that it should accommodate a diverse array of bicycles and attachments.[147] This means that, if installed with proper clearances, a bike rack should serve nearly all common bike styles and attachments instead of restricting the width, height, or length of bicycles, wheels, or attachments.[148]

In addition, effective bicycle parking should allow users to lock a bike's frame and at least one wheel with a U-lock.[149] APBP explains that rack tubes with a two-inch cross section or larger can complicate the use of smaller U-locks.[150] A single U-

[142] *Essentials of Bike Parking: Selecting and Installing Bicycle Parking That Works*; Association of Pedestrian and Bicycle Professionals (APBP); September 2015; page 1.
[143] *Essentials of Bike Parking: Selecting and Installing Bicycle Parking That Works*; Association of Pedestrian and Bicycle Professionals (APBP); September 2015; page 5.
[144] *Essentials of Bike Parking: Selecting and Installing Bicycle Parking That Works*; Association of Pedestrian and Bicycle Professionals (APBP); September 2015; page 5.
[145] *Essentials of Bike Parking: Selecting and Installing Bicycle Parking That Works*; Association of Pedestrian and Bicycle Professionals (APBP); September 2015; page 5.
[146] *Essentials of Bike Parking: Selecting and Installing Bicycle Parking That Works*; Association of Pedestrian and Bicycle Professionals (APBP); September 2015; page 5.
[147] *Essentials of Bike Parking: Selecting and Installing Bicycle Parking That Works*; Association of Pedestrian and Bicycle Professionals (APBP); September 2015; page 5.
[148] *Essentials of Bike Parking: Selecting and Installing Bicycle Parking That Works*; Association of Pedestrian and Bicycle Professionals (APBP); September 2015; page 5.
[149] *Essentials of Bike Parking: Selecting and Installing Bicycle Parking That Works*; Association of Pedestrian and Bicycle Professionals (APBP); September 2015; page 5.
[150] *Essentials of Bike Parking: Selecting and Installing Bicycle Parking That Works*; Association of Pedestrian and Bicycle Professionals (APBP); September 2015; page 5.

lock should be able to capture one wheel and part of the closed loop of a bike frame.[151]

Another important quality of a good bike rack is that it provides security and longevity suitable to its intended location.[152] This relates most directly to choosing rack materials and coatings that are appropriate for their situations, and selecting tamper-resistant mounting hardware for vulnerable locations.[153] For the majority of general-use bike racks, the most appropriate, and common, materials are steel and stainless steel.[154]

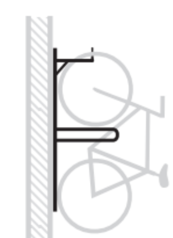
Finally, APBP addresses the fact that bike racks should be intuitive.[155] Users encountering the rack for the first time should be able to discern that it is bicycle parking, and they should not need written instructions in order to use the rack as intended.[156]

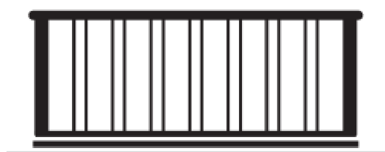
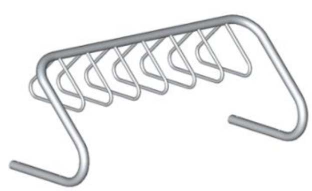
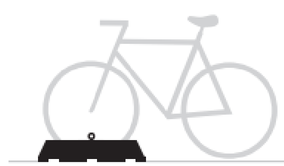
Acceptable and Unacceptable Bike Rack Styles

According to the Association of Pedestrian and Bicycle Professionals, there are three styles of bicycle racks that, when properly designed and correctly installed, meet all of the performance criteria listed above. Some bike racks, classified as high-density, may be appropriate for certain constrained circumstances, even though they do not meet all performance criteria. APBP cites seven racks that should be avoided based on performance concerns (see figure below).

[151] *Essentials of Bike Parking: Selecting and Installing Bicycle Parking That Works*; Association of Pedestrian and Bicycle Professionals (APBP); September 2015; page 5.
[152] *Essentials of Bike Parking: Selecting and Installing Bicycle Parking That Works*; Association of Pedestrian and Bicycle Professionals (APBP); September 2015; page 5.
[153] *Essentials of Bike Parking: Selecting and Installing Bicycle Parking That Works*; Association of Pedestrian and Bicycle Professionals (APBP); September 2015; page 5.
[154] *Essentials of Bike Parking: Selecting and Installing Bicycle Parking That Works*; Association of Pedestrian and Bicycle Professionals (APBP); September 2015; page 5.
[155] *Essentials of Bike Parking: Selecting and Installing Bicycle Parking That Works*; Association of Pedestrian and Bicycle Professionals (APBP); September 2015; page 5.
[156] *Essentials of Bike Parking: Selecting and Installing Bicycle Parking That Works*; Association of Pedestrian and Bicycle Professionals (APBP); September 2015; page 5.

Styles of Bike Racks

Style	Image	Description
1) Acceptable:		
Inverted U (Staple, Loop)		• Common style • Appropriate for many uses • Two points of ground contact • Can be installed in series on rails • Available in many variations
Post and Ring		• Common style • Appropriate for many uses • One point of ground contact • Less prone to unintended perpendicular parking than Inverted U • Can convert parking meter posts
Wheelwell-Secure		• Includes element that cradles one wheel • Design and performance vary by manufacturer • Typically contains bikes well: desirable for long-term parking/ large-scale installations (e.g., campus) • Accommodates fewer bicycle types and attachments than Inverted U and Post and Ring styles
2) Appropriate for Some, but Not All, Circumstances/Users/Bicycles (High Density):		
Staggered Wheelwell-/ Secure		• Variation of wheelwell-secure rack designed to stagger handlebars vertically or horizontally to increase parking density • Reduces usability • Limits types of bikes accommodated • Contains bikes well • Helps fit more parking into constrained spaces
Vertical		• Typically used for high-density indoor parking • Not accessible to all users or all bikes • Can be used in combination with on-ground parking to increase density of overall parking • Creates safety concerns not inherent in on-ground parking
Two-Tier		• Typically used for high-density indoor parking • Performance varies widely

Style	Image	Description
		• Models for public use include lift assist for upper-tier parking • Recommend testing before purchasing • Creates safety concerns not inherent in on-ground parking • Requires maintenance for moving parts
3) Unacceptable:		
Wave (Undulating, Serpentine)		• Not intuitive or user-friendly • Real-world use of this style often falls short of expectations • Supports bike frame at only one location when used as intended
Schoolyard (Comb, Grid)		• Does not allow locking of frame • Can lead to wheel damage • Inappropriate for most public uses • Useful for temporary attended bike storage at events and in locations with no theft concerns • Sometimes preferred by recreational riders who may travel without locks and tend to monitor their bikes while parked
Coathanger		• This style has a top bar that limits the types of bikes it can accommodate
Wheelwell		• Racks that cradle bicycles with only a wheelwell: - Do not provide suitable security - Pose a tripping hazard - Can lead to wheel damage
Bollard		• Typically, does not appropriately support a bike's frame at two separate locations

Style	Image	Description
Spiral		• Possible aesthetic appeal • Functional downsides related to access, real-world use, and the need to lift a wheel to park
Swing Arm Secured		• Intended to capture a bike's frame and both wheels with a pivoting arm • In practice, accommodates limited types of bikes • Have moving parts that create unnecessary complications

Sources: 1) *Essentials of Bike Parking: Selecting and Installing Bicycle Parking That Works*; Association of Pedestrian and Bicycle Professionals (APBP); September 2015; 2) http://www.chinabikerack.com/products/.

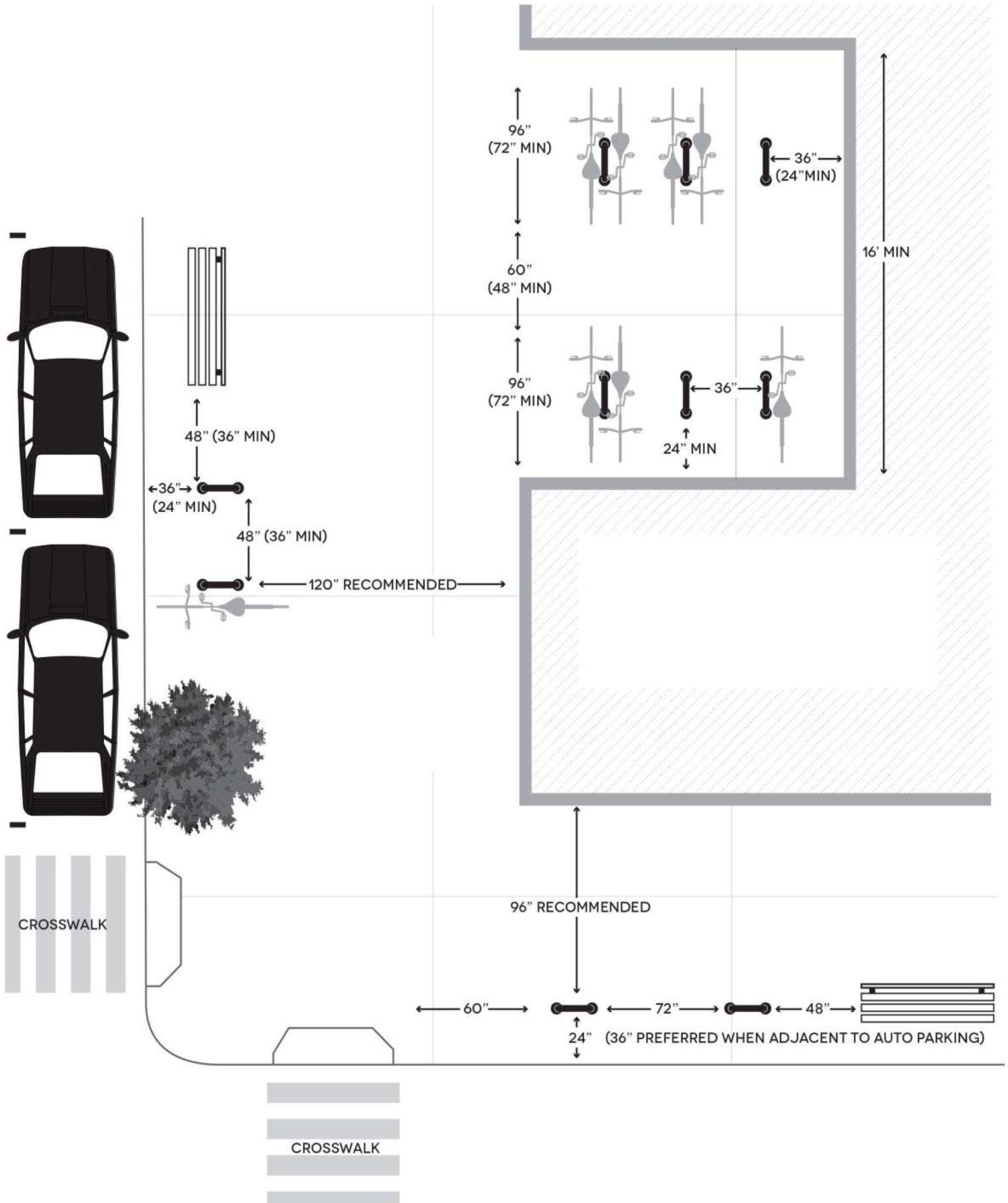
Placement

A typical bicycle footprint measures approximately six-feet long and two-feet wide, although cargo bikes and bikes with trailers can reach 10 feet or longer.[157] This is important to take into consideration when deciding where to install bike racks, as not all arrangements will accommodate all bicycles. In especially tight spots, APBP recommends considering wheelwell-secure bike racks as they may be located next to walls and they constrain the bicycle footprint more reliably than post-and-ring and inverted-U racks.[158] Another consideration when installing bike racks is the importance of maintaining the pedestrian through zone when adding racks to sidewalks.[159] This is done by aligning racks with existing sidewalk obstructions to provide all sidewalk users with a clear line of travel.[160] Finally, to avoid conflicts with opening car doors when sidewalk racks are adjacent to automobile street parking, the racks should be placed between parking stalls.[161] Below is the APBP diagram that illustrates minimum spacing requirements for inverted-U or post-and-ring racks that park one bicycle on each side of the rack.[162]

[157] *Essentials of Bike Parking: Selecting and Installing Bicycle Parking That Works*; Association of Pedestrian and Bicycle Professionals (APBP); September 2015; page 10.
[158] *Essentials of Bike Parking: Selecting and Installing Bicycle Parking That Works*; Association of Pedestrian and Bicycle Professionals (APBP); September 2015; page 10.
[159] *Essentials of Bike Parking: Selecting and Installing Bicycle Parking That Works*; Association of Pedestrian and Bicycle Professionals (APBP); September 2015; page 10.
[160] *Essentials of Bike Parking: Selecting and Installing Bicycle Parking That Works*; Association of Pedestrian and Bicycle Professionals (APBP); September 2015; page 10.
[161] *Essentials of Bike Parking: Selecting and Installing Bicycle Parking That Works*; Association of Pedestrian and Bicycle Professionals (APBP); September 2015; page 10.
[162] *Essentials of Bike Parking: Selecting and Installing Bicycle Parking That Works*; Association of Pedestrian and Bicycle Professionals (APBP); September 2015; page 10.

Recommended clearances are listed first and, where appropriate, they are followed by minimum clearances in parentheses.

Bike Rack Placement



Essentials of Bike Parking: Selecting and Installing Bicycle Parking That Works; Association of Pedestrian and Bicycle Professionals (APBP); September 2015; page 10.

Pedestrian Signals

Pedestrian signals facilitate those crossing roadways on foot by informing them when it is safe to cross the street. These signals display two symbols to communicate to pedestrians when it is safe to cross a roadway: a walking person and an upraised hand.[163] The steady walking person signal, symbolizing Walk, informs pedestrians that it is their turn to begin crossing in the direction of the signal;[164] this is known as the walk interval.[165] The flashing upraised hand signal, symbolizing Don't Walk, means that pedestrians should not start to cross the roadway, but that those who already have begun to cross should proceed to the far side of the street;[166] this is known as the pedestrian change interval.[167] Pedestrians should not cross to the far side of the street if a traffic control device indicates that pedestrians only have time to proceed to the median of a divided highway or other island or pedestrian refuge area.[168] The steady upraised hand signal, symbolizing Don't Walk, tells pedestrians not to enter the roadway.[169] MUTCD standards dictate that the first three or more seconds of the steady upraised hand signal following the pedestrian change interval should serve as a buffer interval, during which traffic from conflicting vehicles should continue to wait for a green light.[170] MPO staff noted the following pedestrian signal conditions when conducting fieldwork.

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[163] *Manual on Uniform Traffic Control Devices, Part 4: Highway Traffic Signals, Chapter 4E: Pedestrian Control Features, Section 4E.01: Pedestrian Signal Heads*; Federal Highway Administration; December 2009; page 495.

[164] *Manual on Uniform Traffic Control Devices, Part 4: Highway Traffic Signals, Chapter 4E: Pedestrian Control Features, Section 4E.02: Meaning of Pedestrian Signal Head Indications*; Federal Highway Administration; December 2009; page 495.

[165] *Manual on Uniform Traffic Control Devices, Part 4: Highway Traffic Signals, Chapter 4E: Pedestrian Control Features, Section 4E.06: Pedestrian Intervals and Signal Phases*; Federal Highway Administration; December 2009; page 498.

[166] *Manual on Uniform Traffic Control Devices, Part 4: Highway Traffic Signals, Chapter 4E: Pedestrian Control Features, Section 4E.02: Meaning of Pedestrian Signal Head Indications*; Federal Highway Administration; December 2009; page 495.

[167] *Manual on Uniform Traffic Control Devices, Part 4: Highway Traffic Signals, Chapter 4E: Pedestrian Control Features, Section 4E.02: Meaning of Pedestrian Signal Head Indications*; Federal Highway Administration; December 2009; page 495.

[168] *Manual on Uniform Traffic Control Devices, Part 4: Highway Traffic Signals, Chapter 4E: Pedestrian Control Features, Section 4E.02: Meaning of Pedestrian Signal Head Indications*; Federal Highway Administration; December 2009; page 495.

[169] *Manual on Uniform Traffic Control Devices, Part 4: Highway Traffic Signals, Chapter 4E: Pedestrian Control Features, Section 4E.02: Meaning of Pedestrian Signal Head Indications*; Federal Highway Administration; December 2009; page 495.

[170] *Manual on Uniform Traffic Control Devices, Part 4: Highway Traffic Signals, Chapter 4E: Pedestrian Control Features, Section 4E.06: Pedestrian Intervals and Signal Phases*; Federal Highway Administration; December 2009; page 497.

Characteristics

MPO staff noted whether a signal's pedestrian crossing phase was accompanied by an audible indication of the pedestrian signal intervals to provide crossing information to pedestrians in a non-visual format. The MUTCD does not require installation of accessible pedestrian signals that provide information through audible tones, vibrating surfaces, and/or speech messages in order to communicate in a non-visual format. However, the MUTCD does include guidance that says accessible pedestrian signals should be provided where engineering judgement determines such signals would be appropriate.[171] MPO staff also identified which pedestrian signals provide a countdown to inform those crossing of the amount of time that remains in the pedestrian change interval in order to traverse a roadway safely. The MUTCD states that a pedestrian change interval of more than seven seconds should include a pedestrian change interval countdown display for this purpose.[172] Finally, at each intersection, MPO staff noted whether pedestrian signal phases were concurrent with vehicular traffic or whether they stopped vehicular traffic altogether to allow for an exclusive pedestrian crossing phase.

Timing

MPO staff used a stopwatch to measure the length of time pedestrians are given to cross at each pedestrian signal. Staff recorded the seconds when the steady walking person is visible, indicating that pedestrians are free to begin to cross the roadway, and the number of seconds the upraised hand flashes to warn pedestrians that there may not be enough time remaining in the pedestrian signal phase for an individual to cross the street safely. As pedestrians, MPO staff could not consistently observe the vehicular traffic lights. This, combined with the varied reaction times of automobile drivers to the illumination of a green light, prevented accurate measurement of the pedestrian signal buffer intervals. Staff calculated two crossing speeds: one divides crossing lengths using only the measured pedestrian change interval durations; the other assumes that each pedestrian signal conforms with MUTCD standards by adding the requisite three-second buffer interval to the recorded pedestrian change interval durations.[173] The

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[171] *Manual on Uniform Traffic Control Devices, Part 4: Highway Traffic Signals, Chapter 4E: Pedestrian Control Features, Section 4D.03: Provisions for Pedestrians*; Federal Highway Administration; December 2009; page 450.

[172] *Manual on Uniform Traffic Control Devices, Part 4: Highway Traffic Signals, Chapter 4E: Pedestrian Control Features, Section 4E.07: Countdown Pedestrian Signals*; Federal Highway Administration; December 2009; page 499.

[173] *Manual on Uniform Traffic Control Devices, Part 4: Highway Traffic Signals, Chapter 4E: Pedestrian Control Features, Section 4E.06: Pedestrian Intervals and Signal Phases*; Federal Highway Administration; December 2009; page 497.

combined duration of the pedestrian change interval and the buffer interval must not be shorter than the calculated pedestrian clearance time.[174]

MUTCD guidance states that pedestrian clearance time should allow an individual traveling at a walking speed of three-and-a-half feet per second to leave the curb at the end of the Walk interval and reach either the far side of the traveled way or a median of sufficient width to allow pedestrians to wait.[175] The FHWA states that crossing times at all intersections should be adjusted to suit the speeds of older adults and people with disabilities, as every intersection will be used by a variety of pedestrians.[176] Specifically, the FHWA recommends that walking speeds of no more than three-and-a-half feet (1.065 meters) per second be used to calculate crossing times, as research shows that the majority of pedestrians walk at speeds slower than four feet (1.22 meters) per second, and 15 percent of pedestrians walk more slowly than three-and-a-half feet per second.[177]

Crossing Length

Using the GoogleMaps measurement tool and aerial satellite imagery, MPO staff measured pedestrian crossing lengths to determine whether the clearance time provided by the combined duration of the pedestrian change interval and the buffer interval would allow an individual to cross the entire segment at a speed of three-and-a-half feet per second. Understanding the rate at which pedestrians are expected to cross a roadway serves as an indication of the accessibility of a pedestrian crossing. Elderly individuals and those with disabilities may not feel comfortable crossing a street if they are not able to do so in the time the signal provides, which may discourage such individuals from walking at all in certain locations.

In order to improve a sense of safety and encourage walking within the Fairmount Line station areas, it is important to identify which crossings require longer pedestrian crossing phases. At intersections where the pedestrian signal phase is

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[174] *Manual on Uniform Traffic Control Devices, Part 4: Highway Traffic Signals, Chapter 4E: Pedestrian Control Features, Section 4E.06: Pedestrian Intervals and Signal Phases*; Federal Highway Administration; December 2009; page 497.

[175] *Manual on Uniform Traffic Control Devices, Part 4: Highway Traffic Signals, Chapter 4E: Pedestrian Control Features, Section 4E.06: Pedestrian Intervals and Signal Phases*; Federal Highway Administration; December 2009; page 497.

[176] *Designing Sidewalks and Trail for Access, Part II of II: Best Practices Design Guide, Chapter 8: Pedestrian Crossings, Section 8.6: Crossing Times*; Federal Highway Administration; September 2001; page 8-17.

[177] *Designing Sidewalks and Trail for Access, Part II of II: Best Practices Design Guide, Chapter 8: Pedestrian Crossings, Section 8.6: Crossing Times*; Federal Highway Administration; September 2001; page 8-17.

exclusive, staff recorded only the longest uninterrupted crossing lengths because such intersections are only as accessible as the timing provided for crossing the widest segment. Interruptions took the form of medians, islands, and other pedestrian refuge areas. These were considered as interruptions only if they measured at least six feet wide, thereby providing sufficient room for a pedestrian with a bicycle, or a stroller, to wait for the next pedestrian phase;[178] or if they included cut-throughs or curb ramps to ensure that the interruptions were fully accessible.[179]

Sidewalks

One way the transportation system supports pedestrian travel is by providing sidewalks. Sidewalk characteristics can promote pedestrian access in numerous ways: minimal obstacles; wide pathways; minimal protruding objects; minimal changes in level; moderate grades and cross slopes; rest areas outside of the pedestrian zone; good lighting; firm, stable, and slip-resistant surfaces; and clearly defined pedestrian, furniture, and frontage zones.[180] As MPO staff traveled through the five station areas by bike and on foot, they documented sidewalk conditions. Although staff did record each of the characteristics cited above, they paid the greatest attention to sidewalk width.

The FHWA explains that, within the sidewalk corridor, there should be four pedestrian zones to accommodate the needs of pedestrians.[181] The zones and their minimum widths are listed in the “Minimum Widths for Sidewalk Zones” table below.[182] A sidewalk width of five feet is necessary to allow a single wheelchair

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[178] *Urban Street Design Guide, Intersection Design Elements, Crosswalks and Crossings, Pedestrian Safety Islands*; National Association of City Transportation Officials; Island Press; October 2012; http://nacto.org/publication/urban-street-design-guide/intersection-design-elements/crosswalks-and-crossings/pedestrian-safety-islands/.

[179] *NCHRP Report 500: Guidance for Implementation of the AASHTO Strategic Highway Safety Plan, Volume 10: A Guide for Reducing Collisions Involving Pedestrians, Section V: Strategies for Addressing the Problem, Strategy 9.1 A3: Construct Pedestrian Refuge Islands and Raised Medians*; Charles V. Zegeer, Jane Stutts, Herman Huang, Michael J. Cynecki, Ron Van Houten, Barbara Alberson, Ronald Pfefer, Timothy R. Neuman, Kevin L. Slack; Kelly K. Hardy; Transportation Research Board; 2004; page V-21.

[180] *Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide, Chapter 4: Sidewalk Corridors;* Federal Highway Administration (FHWA); September 2001; page 4-1.

[181] *Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide, Chapter 4: Sidewalk Corridors, Section 4.1: Sidewalk Corridor Width, Section 4.1.2: The Zone System;* Federal Highway Administration (FHWA); September 2001; page 4-3.

[182] *Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide, Chapter 4: Sidewalk Corridors, Section 4.1: Sidewalk Corridor Width, Section 4.1.2: The Zone System;* Federal Highway Administration (FHWA); September 2001; page 4-4.

user to turn around or two wheelchair users to pass one another.[183] No frontage zone is needed if at least two- and a-half feet of open space are available between the property line and the sidewalk corridor.[184] In such cases, the minimum width recommended for the sidewalk corridor is seven- and a-half feet instead of the minimum eight- and-a-half feet of right-of-way that the FHWA generally recommends. [185] In some locations, it may be possible to increase the widths of sidewalk corridors by reducing traffic lane widths to the City of Boston's 10-foot-wide minimum travel lane.[186] The National Association of City Transportation Officials (NACTO) Urban Street Design Guide explains that such widths would have a positive impact on the safety of streets without affecting traffic operations; and, they are appropriate in urban areas.[187] Where it is not possible to widen the sidewalk, especially in areas where the pedestrian zone is less than three feet wide, protruding objects and permanent obstacles should be removed from the pedestrian zone.[188]

Minimum Widths for Sidewalk Zones

Zone	Minimum Width
Curb Zone	6 inches
Planter/Furniture Zone	24 inches (2 feet)
If Planting Street Trees	***48 inches (4 feet)***
Pedestrian Zone	60 inches (5 feet)
Frontage Zone	30 inches (2.5 feet)
Total Sidewalk Corridor	10 feet

[183] *Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide, Chapter 4: Sidewalk Corridors, Section 4.1: Sidewalk Corridor Width, Section 4.1.4: Improving Access on Narrow Sidewalks;* Federal Highway Administration (FHWA); September 2001; page 4-13.

[184] *Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide, Chapter 4: Sidewalk Corridors, Section 4.1: Sidewalk Corridor Width, Section 4.1.2: The Zone System;* Federal Highway Administration (FHWA); September 2001; page 4-4.

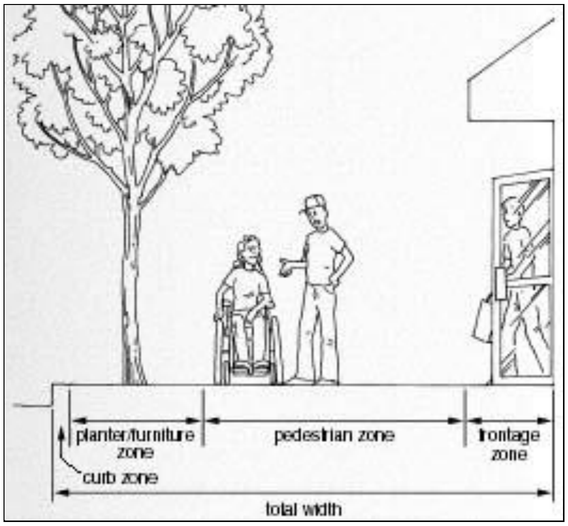
[185] *Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide, Chapter 4: Sidewalk Corridors, Section 4.1: Sidewalk Corridor Width, Section 4.1.2: The Zone System;* Federal Highway Administration (FHWA); September 2001; pages 4-3 & 4-4.

[186] *Boston Complete Streets Guidelines, Minimum Widths for Roadway Lanes*; City of Boston; 2013; page 103.

[187] *Urban Street Design Guide, Street Design Elements, Lane Widths*; National Association of City Transportation Officials; Island Press; October 2012; http://nacto.org/publication/urban-street-design-guide/street-design-elements/lane-width/.

[188] *Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide, Chapter 4: Sidewalk Corridors, Section 4.1: Sidewalk Corridor Width, Section 4.1.4: Improving Access on Narrow Sidewalks;* Federal Highway Administration (FHWA); September 2001; page 4-12.

Sidewalk Zones



Source: http://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/sidewalk2/sidewalks204.cfm#the.

MPO staff measured sidewalks using a surveyor's wheel, a measuring tape, or the GoogleMaps measurement tool and satellite imagery. Staff took measurements primarily at locations where it appeared as though the pedestrian zone was narrower than five feet. There should not be any obstructions within the pedestrian zone, as this is the area of the sidewalk corridor that is designated for pedestrian travel.[189] Utilities and pedestrian amenities should be located in the planter/ furniture zone in order to ensure that light poles, fire hydrants, street trees, and other amenities do not act as obstacles to safe and comfortable pedestrian travel.[190] A planter/ furniture zone also provides a buffer between traffic and pedestrians.[191] Staff measured the width of the pedestrian zone where it appeared as though utilities or pedestrian amenities had been located within the five-foot corridor that should be reserved exclusively for pedestrian travel.

[189] *Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide, Chapter 4: Sidewalk Corridors, Section 4.1: Sidewalk Corridor Width, Subsection 4.1.2: The Zone System, Sub-Subsection 4.1.2.3: Pedestrian Zone;* Federal Highway Administration (FHWA); September 2001; page 4-6.

[190] *Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide, Chapter 4: Sidewalk Corridors, Section 4.1: Sidewalk Corridor Width, Section 4.1.2: The Zone System;* Federal Highway Administration (FHWA); September 2001; page 4-4.

[191] *Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide, Chapter 4: Sidewalk Corridors, Section 4.1: Sidewalk Corridor Width, Section 4.1.2: The Zone System;* Federal Highway Administration (FHWA); September 2001; page 4-6.

Curb Ramps

Curb ramps offer pedestrians an accessible path and are required at all altered or newly constructed streets, roads, highways, and street-level pedestrian walkways at any intersection with curbs or other barriers to access.[192] Curb ramps may either cut through curbs or be built up to them.[193] The entirety of a curb ramp, aside from side flares, must be contained within its crosswalk.[194] Whether or not they are marked, it is understood that crosswalks are located at every intersection.[195] When traveling through the five Fairmount Line station areas, MPO staff marked the locations of curb ramps and indicated the curb ramp's structural design type relative to the sidewalk. These types are described below.

Perpendicular Curb Ramps

Although a variety of designs may be considered, a perpendicular curb ramp that is oriented at a 90-degree angle to the curb is recommended for access from the pedestrian zone to the street.[196] Perpendicular curb ramps are not always possible because they take up additional right-of-way by requiring a wide sidewalk corridor or a curb extension to accommodate the ramp and the required level landing.[197] The severe cross slopes and rapid changes in cross slopes over short distances that characterize perpendicular curb ramps without level landings can be unsafe for wheelchair users to maneuver.[198] The MassDOT Highway Division prefers when curb ramps are paired with a reciprocal curb ramp.[199]

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[192] *ADA Standards for Accessible Design, 28 CFR 35.151 New Construction and Alterations, Section (i): Curb Ramps*; Department of Justice; September 15, 2010; page 13.

[193] *Guide to the ADA Standards, Chapter 4: Accessible Routes, Ramps and Curb Ramps, Section 406: Curb Ramps*; United States Access Board; July 23, 2004; page 122.

[194] *Guide to the ADA Standards, Chapter 4: Accessible Routes, Ramps and Curb Ramps, Section 406: Curb Ramps*; United States Access Board; July 23, 2004; page 126.

[195] *Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide, Chapter 8: Pedestrian Crossings, Section 8.5: Crosswalks;* Federal Highway Administration (FHWA); September 2001; page 8-10.

[196] *Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide, Chapter 4: Sidewalk Corridors, Section 4.1: Sidewalk Corridor Width, Section 4.1.2: The Zone System;* Federal Highway Administration (FHWA); September 2001; page 4-4.

[197] *Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide, Chapter 7: Curb Ramps, Section 7.2: Curb Ramp Types, Section 7.2.1: Perpendicular Curb Ramps;* Federal Highway Administration (FHWA); September 2001; page 7-8.

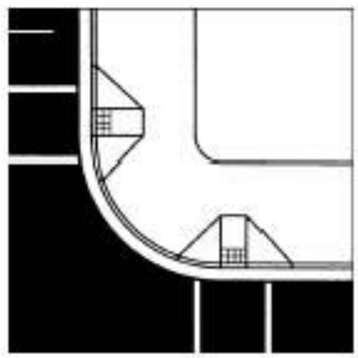
[198] *Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide, Chapter 7: Curb Ramps, Section 7.2: Curb Ramp Types, Section 7.2.1: Perpendicular Curb Ramps;* Federal Highway Administration (FHWA); September 2001; page 7-6.

[199] *Notes on Walks and Wheelchair Ramps for Designers and Construction Engineers*; Massachusetts Department of Transportation (MassDOT) Highway Division; March 2012; page 4.

Perpendicular curb ramps are aligned with the crossing direction on tight radius corners, resulting in a straight path of travel and causing them to be positioned within the crosswalk.[200] Perpendicular curb ramps also are stationed at the expected crossing location for all pedestrians and are aligned perpendicular to vehicular traffic.[201] In spite of the benefits of this structural design type, perpendicular curb ramps do not provide a straight path of travel on large radius corners and are more expensive than a single diagonal curb ramp.[202]

The image below reflects one type of acceptable design for curb ramps perpendicular to crosswalks.

Design for Curb Ramp Perpendicular to Crosswalk



Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide, Chapter 7: Curb Ramps, Section 7.2: Curb Ramp Specifications; Federal Highway Administration (FHWA); September 2001; page 7-19.

Diagonal Curb Ramps

The alternative is to provide a diagonal curb ramp that is located at the apex of an intersection corner, leading users diagonally into the center of the intersection if

[200] *Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide, Chapter 7: Curb Ramps, Section 7.2: Curb Ramp Types, Section 7.2.1: Perpendicular Curb Ramps;* Federal Highway Administration (FHWA); September 2001; page 7-8.

[201] *Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide, Chapter 7: Curb Ramps, Section 7.2: Curb Ramp Types, Section 7.2.1: Perpendicular Curb Ramps;* Federal Highway Administration (FHWA); September 2001; page 7-8.

[202] *Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide, Chapter 7: Curb Ramps, Section 7.2: Curb Ramp Types, Section 7.2.1: Perpendicular Curb Ramps;* Federal Highway Administration (FHWA); September 2001; page 7-8.

they are moving down the ramp in a straight path.[203] The MassDOT Highway Division states that, where intersection geometry precludes use of paired ramps, apex ramps serving two directions may be used.[204] When apex curb ramps are used, the ramp must be fully contained by both crosswalks that the apex curb ramp is serving.[205] For people with visual impairments who use the curb to identify the transition from the sidewalk to the street, diagonal curb ramps can enhance their ability to detect the intersection by allowing a pedestrian's normal path of travel to intersect a curb instead of a curb ramp.[206]

While diagonal curb ramps require less space and are less expensive than the perpendicular option because there is only one curb ramp per corner, diagonal curb ramps introduce areas of potential conflict between pedestrians and motorists who are traveling straight and turning.[207] Additional disadvantages of diagonal curb ramps include the difficulties they introduce for most people with disabilities, as the ramps do not align with the proper crossing direction.[208] Furthermore, wheelchair users must turn at both the top and bottom of diagonal curb ramps and it is difficult to create the level area at the bottom of a diagonal curb ramp that wheelchair users need for maneuvering purposes.[209] Finally, diagonal curb ramps may cause a visually impaired individual to mistake the ramp for a perpendicular curb ramp, which could cause the individual to travel into the

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[203] *Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide, Chapter 7: Curb Ramps, Section 7.2: Curb Ramp Types, Section 7.2.2: Diagonal Curb Ramps;* Federal Highway Administration (FHWA); September 2001; page 7-8.

[204] *Notes on Walks and Wheelchair Ramps for Designers and Construction Engineers*; Massachusetts Department of Transportation (MassDOT) Highway Division; March 2012; page 4.

[205] *Notes on Walks and Wheelchair Ramps for Designers and Construction Engineers*; Massachusetts Department of Transportation (MassDOT) Highway Division; March 2012; page 4.

[206] *Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide, Chapter 7: Curb Ramps, Section 7.2: Curb Ramp Types, Section 7.2.2: Diagonal Curb Ramps;* Federal Highway Administration (FHWA); September 2001; page 7-10.

[207] *Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide, Chapter 7: Curb Ramps, Section 7.2: Curb Ramp Types, Section 7.2.2: Diagonal Curb Ramps;* Federal Highway Administration (FHWA); September 2001; pages 7-10 & 7-11.

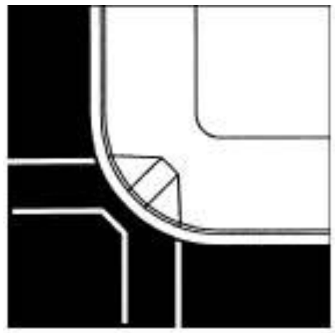
[208] *Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide, Chapter 7: Curb Ramps, Section 7.2: Curb Ramp Types, Section 7.2.2: Diagonal Curb Ramps;* Federal Highway Administration (FHWA); September 2001; page 7-11.

[209] *Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide, Chapter 7: Curb Ramps, Section 7.2: Curb Ramp Types, Section 7.2.2: Diagonal Curb Ramps;* Federal Highway Administration (FHWA); September 2001; page 7-11.

middle of the intersection unintentionally, if audible traffic cues are ambiguous or lacking.[210]

The image below reflects one type of acceptable design for curb ramps diagonal to crosswalks.

Design for Curb Ramp Diagonal to Crosswalk



Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide, Chapter 7: Curb Ramps, Section 7.2: Curb Ramp Specifications; Federal Highway Administration (FHWA); September 2001; page 7-20.

Diagonal Curb Ramps

Source: Central Transportation Planning Staff.

[210] *Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide, Chapter 7: Curb Ramps, Section 7.2: Curb Ramp Types, Section 7.2.2: Diagonal Curb Ramps;* Federal Highway Administration (FHWA); September 2001; page 7-11.

Documentation

MPO staff identified each curb ramp as being either perpendicular, diagonal, or apex. MPO staff differentiated between diagonal and apex curb ramps by marking curb ramps that served only one crossing as diagonal and curb ramps that served two crossings as apex. Staff also noted locations where curb ramps should have been provided, but where they were not present. One of the greatest barriers to movement for pedestrians at pedestrian crossings is a curb without a curb ramp.[211] Staff noted locations where crosswalks led to curbs without ramps, as well as locations where installing curb ramps would improve pedestrian access.

Detectable Warnings

Detectable warnings at locations such as curb ramps and other transitions along sidewalks and public streets, where there are increased hazards for people with vision impairments, serve to alert such individuals that they are approaching a vehicular area or a drop-off along a rail station platform.[212] Detectable warnings are required by the ADA and must be included when altering or constructing curb ramps.[213] Detectable warnings convey information in multiple formats in order to communicate environmental conditions best. The texture of the truncated domes, contrast in color from the surrounding surface, and changes in material resiliency between surfaces all serve to inform pedestrians that they have reached a boundary between the sidewalk and the street.[214] The color contrast between a detectable warning and the surrounding surface can make it easier for pedestrians to identify the location of the curb on the opposite corner of a crossing, especially for wheelchair users, people of short stature, and children.[215]

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[211] *Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide, Chapter 8: Pedestrian Crossings, Section 8.1: Barriers to Pedestrian Access, Section 8.1.1: Movement Barriers;* Federal Highway Administration (FHWA); September 2001; pages 8-2 & 8-3.

[212] *Guide to the ADA Standards, Chapter 4: Accessible Routes, Ramps and Curb Ramps, Section 406: Curb Ramps*; United States Access Board; July 23, 2004; page 129.

[213] *Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide, Chapter 6: Providing Information to Pedestrians, Section 6.3: Detectable Warnings;* Federal Highway Administration (FHWA); June 26, 2009; https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/sidewalk2/pdf/07chapter6.pdf.

[214] *Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide, Chapter 6: Providing Information to Pedestrians, Section 6.3: Detectable Warnings;* Federal Highway Administration (FHWA); September 2001; page 6-6.

[215] *Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide, Chapter 6: Providing Information to Pedestrians, Section 6.3: Detectable Warnings;* Federal Highway Administration (FHWA); September 2001; page 6-6.

At a minimum, detectable warnings must occupy the space within 24 inches of the back of the curb,[216] and they must span the width of the curb ramp run, which must measure a minimum of 36 inches.[217] Calculations in this report therefore assume that detectable warnings have an area of 864 inches, or six square feet. Staff marked the locations of the detectable warnings that they encountered when assessing the five selected Fairmount Line station areas.

Detectable Warning

Source: http://www.adatile.com/replaceable_wet_set.php.

Pavement Markings

While conducting fieldwork, Staff noted pavement markings such as crosswalks, bike lanes, sharrows, and bike boxes, and indicated on field maps locations where markings had faded and needed re-painting. Staff also noted what types of crosswalk markings were used; and identified locations where quick, inexpensive pavement markings could be added to station areas to provide immediate, if temporary, improvements.

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[216] *Guide to the ADA Standards, Chapter 4: Accessible Routes, Ramps and Curb Ramps, Section 406: Curb Ramps*; United States Access Board; July 23, 2004; page 129.
[217] *Guide to the ADA Standards, Chapter 4: Accessible Routes, Ramps and Curb Ramps, Section 406: Curb Ramps*; United States Access Board; July 23, 2004; page 122.

Crosswalks

MUTCD standards state that, before a marked crosswalk is installed at a location not controlled by a Stop sign, Yield sign, or traffic control signal, an engineering study should be performed.[218] It is recommended that crosswalks be marked using the continental crosswalk design, as research indicates that drivers find it to be the most visible crosswalk marking option.[219]

Other crosswalk markings also are acceptable according to MUTCD standards, which state that crosswalk lines shall consist of solid white lines not less than six inches or greater than 24 inches wide.[220] Although parallel, or standard, crosswalk markings are permissible; they are less visible to motorists than continental crosswalk markings.[221] MPO staff mainly observed crosswalks marked with the ladder pattern in the Fairmount Line station areas studied. When documenting the locations of crosswalks, MPO staff indicated in field notes when crosswalks marked with designs different from the continental and standard patterns were noticed. This was done in order to understand which crosswalks might be less visible than others might. MPO staff also considered the trajectory of existing crosswalks where the configuration appeared counter-intuitive or dangerous. Finally, staff identified locations where there appeared to be strong pedestrian desire lines for street crossings.

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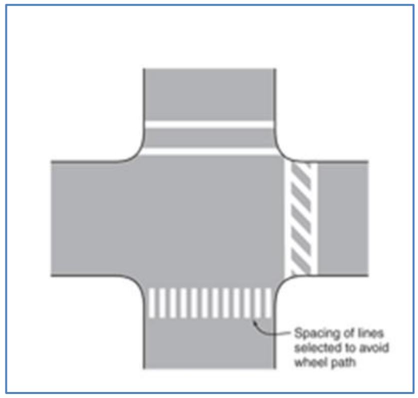
[218] *Manual on Uniform Traffic Control Devices, Part 3: Markings, Chapter 3B: Pavement and Curb Markings, Section 3B.18: Crosswalk Markings*; Federal Highway Administration; December 2009; page 384.

[219] *Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide, Chapter 8: Pedestrian Crossings, Section 8.5: Crosswalks, Section 8.5.1: Crosswalk Markings;* Federal Highway Administration (FHWA); September 2001; pages 8-11.

[220] *Manual on Uniform Traffic Control Devices, Part 3: Markings, Chapter 3B: Pavement and Curb Markings, Section 3B.18: Crosswalk Markings*; Federal Highway Administration; December 2009; page 383.

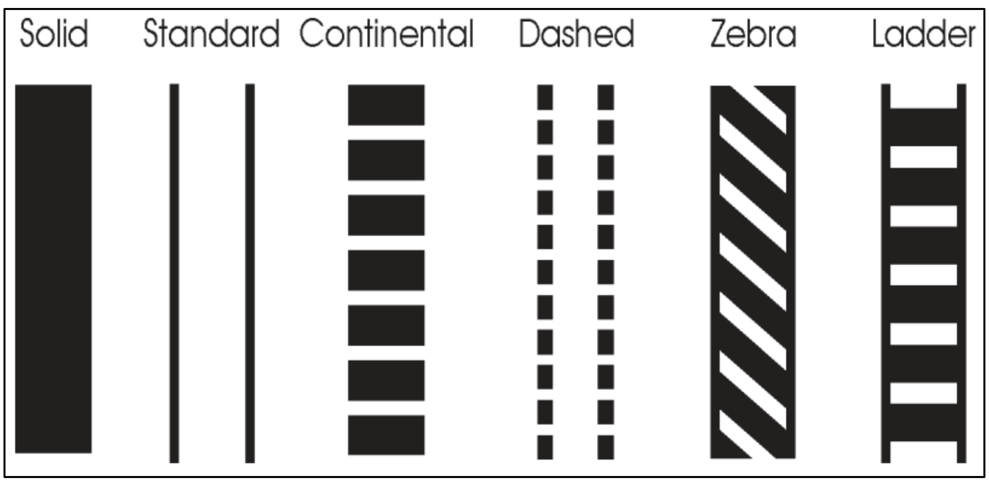
[221] *Designing Sidewalks and Trails for Access, Part II of II: Best Practices Design Guide, Chapter 8: Pedestrian Crossings, Section 8.5: Crosswalks, Section 8.5.1: Crosswalk Markings;* Federal Highway Administration (FHWA); September 2001; pages 8-11.

Basic Crosswalk Markings



Source: Manual on Uniform Traffic Control Devices, Part 3: Markings, Chapter 3B: Pavement and Curb Markings, Section 3B.18: Crosswalk Markings; Federal Highway Administration; December 2009; page 384.

Types of Crosswalk Markings



Source: Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public; Max A. Bushell, Bryan W. Poole, Charles V. Zegeer, and Daniel A. Rodriguez; UNC Highway Safety Research Center; October 2013; page 23.

Bike Boxes

Bike boxes, typically demarcated in green, are included at intersections to provide cyclists with a safe, visible location where they can wait ahead of queuing vehicular traffic during the red signal phase.[222] When bike boxes extend across the entire travel lane, the pavement markings allow cyclists to position themselves for left turns while the signal is red.[223] An additional benefit is that bike boxes prevent conflicts between cyclists and right-turning vehicles when the signal turns green because cyclists are located ahead of vehicular traffic.[224] Bike boxes also group cyclists together, thereby allowing them to clear an intersection quickly; in turn, this reduces the duration of potential conflict with vehicular traffic.[225] Finally, bike boxes provide a buffer between crosswalks and motorists, helping to minimize vehicles encroaching into the pedestrian space.[226]

Bike Box on Speedway in Austin, Texas

Source: http://nacto.org/publication/urban-bikeway-design-guide/intersection-treatments/bike-boxes/.

[222] http://nacto.org/publication/urban-bikeway-design-guide/intersection-treatments/bike-boxes/
[223] *Ibid*.
[224] *Ibid*.
[225] *Ibid*.
[226] *Ibid*.

Traffic-Calming Infrastructure

While they were in the field, staff occasionally noticed speeding vehicles. There were instances when Fairmount Line residents informed MPO staff of locations where vehicles often travel fast enough to cause safety concerns. A study by the AAA Foundation for Traffic Safety identified pedestrians' risk of severe injury or death during a collision relative to impact speed (illustrated in the table below). As impact speed increases, the likelihood of a collision resulting in severe injury or death to a pedestrian grows. Speeding traffic reduces the safety and comfort of an environment for bicyclists and pedestrians and can discourage individuals' decisions to bike or walk in a location.

	Risk of Severe Injury					Risk of Death				
	10%	**25%**	**50%**	**75%**	**90%**	**10%**	**25%**	**50%**	**75%**	**90%**
Impact Speed (mph)	16	23	31	39	46	23	32	42	50	58

Source: Impact Speed and a Pedestrian's Risk of Severe Injury or Death; AAA Foundation for Traffic Safety; September 2011; page 11.

A number of techniques may be deployed in order to slow vehicular traffic and make roads safer for all modes of transportation. They range from simple striping solutions—such as narrowing traffic lanes, using back-in angle parking spaces instead of parallel parking, or changing one-way streets to allow bi-directional travel[227]—to horizontal shifts—like traffic circles and chicanes, narrowing roadways with medians and curb extensions, and vertical deflections in the form of speed tables, speed humps, and raised crossings.[228] In addition, vegetation may be used to reduce the "optical width" of a street to discourage speeding, especially when in the form of vertical elements like trees.[229] A description of each of these traffic-calming measures is provided below.

Narrowing Traffic Lanes

Lane width is one roadway factor that influences driver behavior. While there is not a consensus on the relationship between speed and lane width, studies have found that as the width of a traffic lane increases, so do the speeds at which vehicles travel. One study found that for every one-foot increase in lane width, 85^{th-}percentile vehicular traffic speeds increased by 2.9 miles per hour.[230] The

[227] *Traffic Calming Toolbox*; Project for Public Spaces; http://www.pps.org/reference/livememtraffic/.
[228] *Traffic Calming Measures*; Institute of Transportation Engineers; 2016; http://www.ite.org/traffic/tcdevices.asp.
[229] *Traffic Calming Toolbox*; Project for Public Spaces; http://www.pps.org/reference/livememtraffic/.
[230] *Relationship Between Lane Width and Speed: Review of Relevant Literature*; Parsons Transportation Group; September 2003; page 6.

reduction in driving speed associated with narrower traffic lanes may be attributed to drivers staying in their lanes and steering more accurately as a lane's width decreases.[231] Narrowing lane width discourages speeding by using a psycho-perceptive sense of enclosure.[232] The NACTO Urban Street Design Guide explains that such narrowed widths have a positive impact on streets' safety without affecting traffic operations, and are appropriate in urban areas.[233] In the City of Boston, travel lanes may measure a minimum of 10-feet wide.[234]

Back-In Angle Parking Spaces

Striping parking spaces at a diagonal instead of creating parking spaces parallel to the curb narrows street widths, thereby shortening the "peering distance" for people crossing the street.[235] This type of parking also removes the danger of a motorist opening a car door into the path of a bicyclist.[236] In addition, back-in diagonal parking eliminates the difficulty of backing into moving traffic that motorists encounter when leaving conventionally angled parking spaces.[237] In these ways, back-in angle parking benefits many road users. Another benefit is that it gives motorists clear sight lines when leaving a parking space, minimizing the likelihood of collisions with pedestrians, bicycles, or other vehicles. Back-in diagonal parking also prevents children from running into the street when the doors of a vehicle parked in such a spot are opened;[238] instead, children are directed to the curb.

[231] *Relationship Between Lane Width and Speed: Review of Relevant Literature*; Parsons Transportation Group; September 2003; page 5.

[232] *Traffic Calming: State of the Practice, Chapter 3: Traffic Calming Measures*; Reid Ewing; Institute of Transportation Engineers; August 1999; page 31.

[233] *Urban Street Design Guide, Street Design Elements, Lane Widths*; National Association of City Transportation Officials; Island Press; October 2012; http://nacto.org/publication/urban-street-design-guide/street-design-elements/lane-width/.

[234] *Boston Complete Streets Guidelines, Minimum Widths for Roadway Lanes*; City of Boston; 2013; page 103.

[235] *Traffic Calming Toolbox*; Project for Public Spaces; http://www.pps.org/reference/livememtraffic/.

[236] *Back-In Angle Parking: What Is It, and When and Where Is It Most Effective?*; Pedestrian and Bicycle Information Center; http://www.pedbikeinfo.org/data/faq_details.cfm?id=3974.

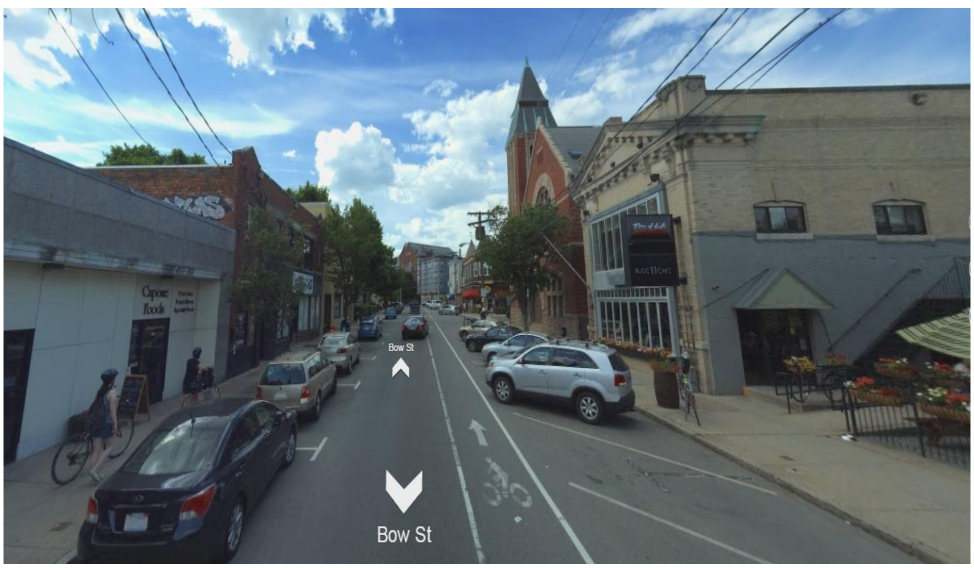
[237] *Back-In Angle Parking: What Is It, and When and Where Is It Most Effective?*; Pedestrian and Bicycle Information Center; http://www.pedbikeinfo.org/data/faq_details.cfm?id=3974.

[238] *What Are The Advantages and Disadvantages of Using Back-In, Head-Out Angled Parking at an Elementary School?;* National Center for Safe Routes to School;

Back-In Angle Parking on South Congress Avenue in Austin, Texas

Source: http://www.clearskyimages.com/blog/location-photography-south-congress-st-austin.

Back-In Angle Parking on Bow Street at Union Square in Somerville



Source: Google Street View, Bow Street, Union Square, Somerville, Massachusetts.

Replacing One-Way Roads with Two-Way Streets

Speeds tend to be higher on one-way streets than on two-way streets because the way that signals are timed on one-way streets causes fewer stops for vehicles.[239] In addition, many claim that a lack of concern for oncoming traffic encourages drivers to speed on one-way streets. Perhaps the most evident difference between traffic flows on one- versus two-way streets, however, is the fact that there are not conflicting left-turn maneuvers at intersections on one-way roads. Left turns at intersections reduce maximum vehicle flows, which limits the speeds at which motorists travel down two-way streets.[240] Therefore, converting a one-way street to two-way travel is one approach for calming traffic speeds.

Additional benefits of two- versus one-way streets include: two-way streets allow drivers to navigate more directly to their destinations;[241] bus stops for both directions of travel are located on the same street, and therefore are easier to find on two-way streets;[242] and bidirectional travel puts all businesses within motorists' sight of by allowing storefront exposure on both sides of the street at intersections.[243] Moreover, the danger of multiple-threat pedestrian crashes—which occur when a driver on a multilane road stops to allow a pedestrian to cross and an on-coming vehicle traveling in the same direction in an adjacent lane strikes the crossing pedestrian[244]—would be less on a two-way street than it would on the same street if traffic traveled in only one direction.

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[239] *Two-Way Street Networks: More Efficient than Previously Thought?*; Vikash V. Gayah; Access: Transportation Research at the University of California; Number 41; Fall 2012; page 11.

[240] *Two-Way Street Networks: More Efficient than Previously Thought?*; Vikash V. Gayah; Access: Transportation Research at the University of California; Number 41; Fall 2012; page 12.

[241] *Two-Way Street Networks: More Efficient than Previously Thought?*; Vikash V. Gayah; Access: Transportation Research at the University of California; Number 41; Fall 2012; page 11.

[242] *The Case Against One-Way Streets*; Eric Jaffe; CityLab; January 31, 2013; http://www.citylab.com/commute/2013/01/case-against-one-way-streets/4549/.

[243] *Advantages and Disadvantages of One-Way Streets*; Glatting, Jackson, Kercher, Anglin; October 20, 2007; page 4.

[244] *Safety Effects of Marked Versus Unmarked Crosswalks at Uncontrolled Locations: Final Report and Recommended Guidelines (FHWA Publication Number HRT-04-100)*; United Stated Department of Transportation Federal Highway Administration; September 2005; page 39.

Traffic Circles/Roundabouts

Traffic circles and roundabouts calm traffic by disrupting straight routes that allow vehicles to gather speed. They are installed for this purpose, and for their ability to help reduce angle collisions; they help traffic flow more efficiently because they eliminate left turns at intersections.[245] In addition, traffic circles and roundabouts have the potential to provide cost savings when installed in place of signalized intersections, although this is dependent upon landscaping costs and maintenance.[246] Finally, traffic circles and roundabouts may act as entrances to special districts or areas by serving as gateway treatments.[247]

Landscaped Traffic Circle

Source: http://www.greenbuildingadvisor.com/sites/default/files/MiniCircle_007_Burden.jpg.

[245] *Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public*; Max A. Bushell, Bryan W. Poole, Charles V. Zegeer, and Daniel A. Rodriguez; UNC Highway Safety Research Center; October 2013; page 17.

[246] *Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public*; Max A. Bushell, Bryan W. Poole, Charles V. Zegeer, and Daniel A. Rodriguez; UNC Highway Safety Research Center; October 2013; page 17.

[247] *Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public*; Max A. Bushell, Bryan W. Poole, Charles V. Zegeer, and Daniel A. Rodriguez; UNC Highway Safety Research Center; October 2013; page 17.

Chicanes

Chicanes are concrete islands that divert vehicles horizontally, and reduce speed by offsetting the path of travel. When landscaped, chicanes provide the extra benefit of adding vegetation to the environment. Chicanes may be accompanied by a median island that enforces the roadway markings.

Landscaped Chicanes with Median Island

Source: http://www.pedbikesafe.org/PEDSAFE/cm_images/Chicane4.jpg.

Medians

Medians calm traffic by separating different streams of travel and limiting turning movements along a roadway.[248] Generally, medians are separated from lanes of traffic by a curb; they are located in the center of a road, and they are narrower than islands.[249] Medians provide space for lighting and landscaping, they make pedestrians more visible to motorists and facilitate pedestrian crossings, and they slow the speed of traffic.[250]

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[248] *Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public*; Max A. Bushell, Bryan W. Poole, Charles V. Zegeer, and Daniel A. Rodriguez; UNC Highway Safety Research Center; October 2013; page 15.

[249] *Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public*; Max A. Bushell, Bryan W. Poole, Charles V. Zegeer, and Daniel A. Rodriguez; UNC Highway Safety Research Center; October 2013; page 15.

[250] *Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public*; Max A. Bushell, Bryan W. Poole, Charles V.

Median with Lighting and Trees

Source:
http://envisionmainstreetalpharetta.files.wordpress.com/2013/04/main-street-with-4-lanes-and-parallel-parking.jpg.

Curb Extensions

Curb extensions are traffic-calming measures that extend curb lines into the parking lane of a roadway.[251] These treatments, also called bulb-outs or chokers, typically extend the sidewalk or provide a location for street-side landscaping. By bringing one or both curbs into the street, curb extensions reduce the effective street width and create a pinch point along a roadway.[252] At intersections, curb extensions can create a gateway effect and reduce the crossing distance for pedestrians while increasing the overall visibility of pedestrians by aligning them with the parking lane.[253]

Zegeer, and Daniel A. Rodriguez; UNC Highway Safety Research Center; October 2013; page 15.

[251] *Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public*; Max A. Bushell, Bryan W. Poole, Charles V. Zegeer, and Daniel A. Rodriguez; UNC Highway Safety Research Center; October 2013; page 14.

[252] *Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public*; Max A. Bushell, Bryan W. Poole, Charles V. Zegeer, and Daniel A. Rodriguez; UNC Highway Safety Research Center; October 2013; page 14.

[253] *Urban Street Design Guide, Street Design Elements, Curb Extensions, Gateway*; National Association of City Transportation Officials (NACTO); Island Press; October 2012; http://nacto.org/publication/urban-street-design-guide/street-design-elements/curb-extensions/gateway/.

Landscaped Curb Extensions

Source: https://portlandfrogs.files.wordpress.com/2008/04/siskiyou1.jpg.

Speed Humps/Speed Bumps/Speed Tables

Speed humps, speed bumps, and speed tables are vertical traffic-control measures that are approximately three- to-four inches high at their center.[254] All three of these elements generally are comprised of paved asphalt.[255] Speed humps extend the full width of the street, allowing for unimpeded bicycle travel by tapering in height near the drain gutter.[256] Speed bumps tend to be smaller and rise at a steeper grade than speed humps, causing motorists to reduce speeds more significantly, but also making speed bumps more difficult for bicyclists to navigate.[257] Speed tables are flat-topped speed humps, or speed humps that are very long and broad.[258] Occasionally, a pedestrian crossing is included in the flat

[254] *Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public*; Max A. Bushell, Bryan W. Poole, Charles V. Zegeer, and Daniel A. Rodriguez; UNC Highway Safety Research Center; October 2013; page 17.

[255] *Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public*; Max A. Bushell, Bryan W. Poole, Charles V. Zegeer, and Daniel A. Rodriguez; UNC Highway Safety Research Center; October 2013; page 17.

[256] *Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public*; Max A. Bushell, Bryan W. Poole, Charles V. Zegeer, and Daniel A. Rodriguez; UNC Highway Safety Research Center; October 2013; page 17.

[257] *Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public*; Max A. Bushell, Bryan W. Poole, Charles V. Zegeer, and Daniel A. Rodriguez; UNC Highway Safety Research Center; October 2013; page 17.

[258] *Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public*; Max A. Bushell, Bryan W. Poole, Charles V. Zegeer, and Daniel A. Rodriguez; UNC Highway Safety Research Center; October 2013; page 17.

portion of a speed table.[259] Each type of these traffic-calming treatments usually is installed in multiples, often as sets of three.[260]

Speed Hump

Source: http://old.mcallen.net/landingpages/lp_traffic/speed_hump.aspx.

Raised Crossings

Raised crossings elevate the pedestrian crossing area to the height of the sidewalk, creating a speed table for an entire intersection.[261] Ramps are included on either side of the crossing for approaching vehicles.[262] The difference between a raised crossing and a raised intersection is that raised crossings are limited to the width of the crosswalk.[263] Raised crosswalks increase motorists' visibility of pedestrians, which encourages motorists to yield at crossings, while simultaneously causing them to slow down for the speed table.[264]

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[259] *Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public*; Max A. Bushell, Bryan W. Poole, Charles V. Zegeer, and Daniel A. Rodriguez; UNC Highway Safety Research Center; October 2013; page 17.

[260] *Ibid.*

[261] *Costs for Pedestrian and Bicyclist Infrastructure Improvements: A Resource for Researchers, Engineers, Planners, and the General Public*; Max A. Bushell, Bryan W. Poole, Charles V. Zegeer, and Daniel A. Rodriguez; UNC Highway Safety Research Center; October 2013; page 16.

[262] *Ibid.*

[263] *Ibid.*

[264] *Ibid*.

Raised Crossing

Source: https://marrickvillegreens.wordpress.com/vision/people-friendly-streets/.

Street Trees

Street trees provide many benefits to a roadway. In addition to contributing to the aesthetic of a location, street trees may provide shade, filter and absorb stormwater, and improve pedestrian safety when located between the sidewalk and the roadway by providing a buffer between pedestrians and vehicles. Street trees also may improve the safety of a roadway by reducing the travel speeds of motorists because, as vertical elements, street trees help reduce the "optical width" of a roadway.[265] By making a street appear narrower, trees can discourage speeding.

Street Trees on Boston Street in Dorchester

Source: Boston Street, Dorchester, Boston, Katrina Crocker, MPO Staff.

[265] *Traffic Calming 101*. Project for Public Spaces; http://www.pps.org/reference/livememtraffic/.

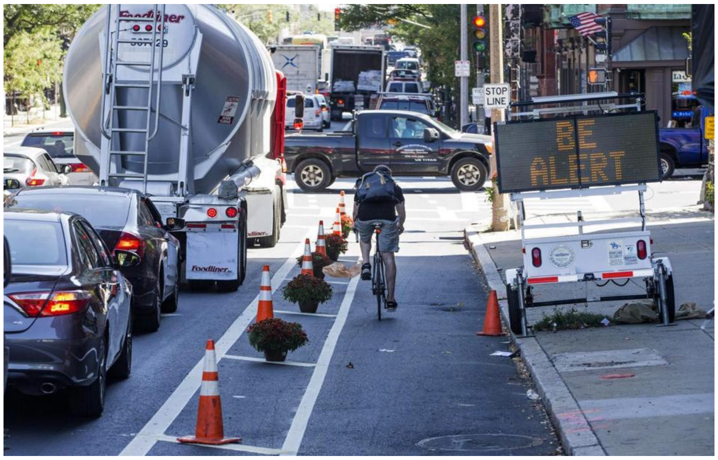
Street Trees on Boston Street in Dorchester

Source: Boston Street, Dorchester, Boston, Katrina Crocker, MPO Staff.

Interim Improvements

Interim improvements make it possible to change a street quickly and inexpensively, making it safer and more comfortable for bicyclists and pedestrians. These techniques use materials like paint, flexible bollards, and planters to create inexpensive trials of many types of traffic-calming infrastructure. Interim improvements can provide increased safety at dangerous locations rapidly and they allow traffic improvements to be tested before they are officially constructed. This can save money and help communities determine whether a specific improvement is the right solution for a particular problem area. When successful, interim improvements also can build support for proposed projects.

Separated Bicycle Lane Made of Interim Materials on Mass Ave



Source: https://www.bostonglobe.com/metro/2015/09/09/cyclist-places-potted-plants-mass-ave-create-temporary-bike-lane-plans-install-more/rhH0HV94d1mpImKPy8vfJO/story.html.

Curb Extensions Made of Interim Materials in Austin, Texas

Source: http://www.citylab.com/design/2016/01/polka-dots-help-pedestrian-reclaim-space-in-austin/433749/.

Temporary Protected Intersection in Minneapolis, Minnesota

Source: http://bikeportland.org/2014/06/19/portlanders-protected-intersection-concept-gets-first-street-demo-minneapolis-107534.

Appendix C—Feedback from the Public

TALBOT AVENUE STATION

- The bike lanes along Talbot Avenue change to sharrows from the Lee School to Codman Square, which causes bicyclists to join vehicular traffic. Those familiar with the area consider the length of Talbot Avenue where there is not a bike lane to be the most heavily crossed and dangerous segment of the road.
- The accident with a motor vehicle that killed a teenaged cyclist on Talbot Avenue in 2015 occurred within a block of the Fairmount Line's Talbot Avenue Station, where New England Avenue meets Talbot Avenue. This cyclist was traveling home from work, using a bicycle as his mode of transportation.
- One member of the public thinks that parking should be removed from one side of Talbot Avenue to create space for a two-way cycle track on one side of the road; the remaining row of parked vehicles would act as a buffer between cyclists and moving traffic.
- A cyclist who rides daily year round refuses to travel west on Talbot Avenue where the bike lanes disappear, choosing a longer route instead to avoid the segment.
- Illegal double parking, with vehicles blocking bike lanes, is a recurring issue in the area surrounding Talbot Avenue Station.

BLUE HILL AVENUE STATION

- One member of the public believes that an underpass is needed in Mattapan Square. Two greenways cross at this location and the square presents a large physical and mental barrier to bicycling in and through Mattapan.
- A member of the public expressed the need for secure Pedal and Park bike cages at Blue Hill Avenue Station to protect bicycles from the weather and theft while commuters are at work during the day.

FAIRMOUNT STATION

- One member of the public explained that the lack of adequate signage surrounding Fairmount Station causes confusion and discourages Fairmount Line ridership by not clearly indicating the station's: 1) presence; 2) entrances; and 3) inbound and outbound sides.
- A member of the public expressed discomfort when traveling along the Fairmount Station handicapped ramps because of their length, which caused this person to experience a sense of claustrophobia. This individual

also reported that the ramps are not adequately lit, which could make the station feel unwelcoming and unsafe.

- A person reported that there is not a crosswalk directly in front of the station to link both sides of Fairmount Avenue.
- An individual expressed the need for secure Pedal and Park bike cages at Fairmount Station to protect bicycles from the weather and theft while commuters are at work during the day.

FAIRMOUNT LINE OVERALL

- The public expressed the need for Pedal and Park bike cages at Fairmount Line stations to protect bicycles from the weather and theft while commuters are at work during the day.
- The public asserted that sustainable stormwater infrastructure in the form of vegetation should be incorporated along the length of the Fairmount Greenway to make the route inviting and to increase the safety of walking and bicycling.
- The public also mentioned that more street trees and other vegetation along the Fairmount Greenway would make the Fairmount route more attractive for residents and commuters.
- The public cited the need for “slow streets”—a new approach to traffic calming requests in Boston that focuses on street designs that self-enforce slower speeds and safer behaviors[266]—in the Codman Square Eco-Innovation District.

[266] *Neighborhood Slow Streets*; Vision Zero; City of Boston; http://www.visionzeroboston.org/nss.

Appendix D—Differences between Officially Documented Pedestrian Signal Conditions and MPO Staff Field Observations

NEWMARKET STATION

Observations versus Official Documentation of Pedestrian Signal Qualities

	MPO Observations			BTD Documentation		
Intersection or Crossing	**Exclusive or Concurrent**	**Audible**	**Countdown**	**Exclusive or Concurrent**	**Audible**	**Countdown**
112 Southampton Street	Exclusive	--	--	Exclusive	No	Yes
Allstate Road and Massachusetts Avenue	Exclusive	No	Yes	Exclusive	No	Yes
Blue Hill Avenue, Dudley Street, Magazine Street, and Mount Pleasant Ave	Exclusive	No	Yes	Exclusive	No	Yes
Boston Street and Harvest Street	--	--	--	Exclusive	No	Yes
Boston Street, Washburn St, and Frontage Road	Concurrent	--	Yes	Both	Yes	Yes
Boston Street, Washburn St, and Frontage Road	Exclusive	--	Yes	--	--	--
Dorchester Avenue, Father Songin Way, and O'Connor Way	--	--	--	Exclusive	No	Yes
Dudley Street, Dunmore Street, and Hampden St	--	No	Yes	Exclusive	No	Yes
Hampden Street, Keegan Street, and Norfolk Avenue	--	--	--	Concurrent	No	Yes
Magazine Street and Massachusetts Avenue	Exclusive	--	Yes	Exclusive	No	Yes
Magazine Street and Norfolk Avenue	Exclusive	No	No	Both	No	No
Massachusetts Avenue and Chesterton Street	--	--	--	Concurrent	No	Yes
Massachusetts Avenue, Melnea Cass Blvd, JFK Ramp, and Southampton Street	Concurrent	No	Yes	Concurrent	No	Yes
Massachusetts Avenue, Melnea Cass Blvd, JFK Ramp, and Southampton Street	Concurrent	No	Yes	--	--	--
Massachusetts Avenue, Melnea Cass Blvd, JFK Ramp, and Southampton Street	Concurrent	No	Yes	--	--	--
Massachusetts Avenue, Melnea Cass Blvd, JFK Ramp, and Southampton Street	Concurrent	No	Yes	--	--	--
Massachusetts Avenue, Newmarket Square, and Shirley Street	Concurrent	No	Yes	Concurrent	No	Yes
Massachusetts Avenue, Newmarket Square, and Shirley Street	Concurrent	No	Yes	--	--	--
Massachusetts Avenue, Newmarket Square, and Shirley Street	Concurrent	No	Yes	--	--	--
Southampton Street, Massachusetts Avenue, and Bradston Street	--	--	--	Exclusive	No	Yes
Southampton Street, Massachusetts Avenue, and Bradston Street	--	--	--	--	--	--
Southampton Street, Massachusetts Avenue, and Bradston Street	--	--	--	--	--	--
Southampton Street and South Bay Drive	Exclusive	No	No	Exclusive	No	No
Southampton Street and South Bay Drive	Exclusive	No	No	--	--	--

NEWMARKET STATION (CONT'D.)

Observations versus Official Documentation of Pedestrian Signal Timings

	MPO Observations					BTD Documentation				
Intersection or Crossing	Walk Interval (seconds)	Pedestrian Change Interval (seconds)	Red Clearance Interval (seconds)	Longest Crossing Overall (feet)	Expected Crossing Speed (feet/sec)[a]	Walk Interval (seconds)	Pedestrian Change Interval (seconds)	Red Clearance Interval (seconds)	Longest Crossing Length (feet)	Expected Crossing Speed (feet/sec)[a]
112 Southampton Street	7	**8**	-	49	**6.10**	7	**9**	**1**	49	**4.88**
Allstate Road and Massachusetts Avenue	7	13	-	99	**7.60**	7	13	**4**	99	**5.81**
Blue Hill Avenue, Dudley Street, Magazine Street, and Mount Pleasant Avenue	7	**13**	-	62	**4.79**	7	**14**	**4**	62	**3.46**
Boston Street and Harvest Street	-	-	-	40	-	**8**	**4**	**4**	40	**4.97**
Boston Street, Washburn Street, and Frontage Road	7	7	-	39	**5.55**	7	7	**4**	39	**3.53**
Boston Street, Washburn Street, and Frontage Road	7	10	-	41	**4.06**	7	10	**4**	41	**2.90**
Dorchester Ave, Father Songin Way, and O'Connor Way	-	-	-	52	-	7	10	**4**	52	**3.68**
Dudley Street, Dunmore Street, and Hampden Street	7	**12**	-	71	**5.92**	7	**13**	**4**	71	**4.18**
Hampden Street, Keegan Street, and Norfolk Avenue	-	-	-	34	-	**7**	**7**	**2**	34	**3.73**
Hampden Street, Keegan Street, and Norfolk Avenue	-	-	-	-	-	**7**	**7**	**2**	**31**	**3.49**
Magazine Street and Massachusetts Avenue	7	10	-	49	**4.94**	7	10	**4**	49	**3.53**
Magazine Street and Norfolk Avenue	7	**10**	-	45	4.45	7	**6**	**4**	45	4.45
Magazine Street and Norfolk Avenue	-	-	-	-	-	**4**	**11**	**1**	**43**	**3.62**
Massachusetts Avenue and Chesterton Street	-	-	-	48	-	**8**	**8**	**1**	48	**5.36**
Massachusetts Avenue and Chesterton Street	-	-	-	-	-	**35**	**8**	**1**	**28**	**3.14**
Massachusetts Avenue, Melnea Cass Blvd, JFK Ramp, and Southampton Street	-	-	-	**147**	-	**7**	**20**	**2**	**85**	**3.87**
Massachusetts Avenue, Melnea Cass Blvd, JFK Ramp, and Southampton Street	-	-	-	91	-	**7**	**20**	**2**	91	**4.12**
Massachusetts Avenue, Melnea Cass Blvd, JFK Ramp, Southampton Street	-	-	-	**82**	-	**7**	**22**	**2**	**38**	**1.57**
Massachusetts Avenue, Melnea Cass Blvd, JFK Ramp, and Southampton Street	-	-	-	**94**	-	**7**	**20**	**2**	**51**	**2.31**
Massachusetts Ave, Newmarket Square, and Shirley St	7	9	-	64	**7.06**	7	9	**2**	64	**5.78**
Massachusetts Ave, Newmarket Square, and Shirley St	**22**	**14**	-	**50**	**3.60**	-	-	-	-	-
Massachusetts Ave, Newmarket Square, and Shirley St	**22**	14	-	86	**6.16**	**15**	14	**3**	86	**5.07**
Southampton St, Massachusetts Avenue, and Bradston St	-	-	-	**36**	-	**8**	**9**	**4**	**23**	**1.80**
Southampton St, Massachusetts Avenue, and Bradston St	-	-	-	**38**	-	-	-	-	-	-
Southampton St, Massachusetts Avenue, and Bradston St	-	-	-	**52**	-	-	-	-	-	-
Southampton Street and South Bay Drive	7	**14**	-	**112**	**8.01**	7	**11**	**4**	**59**	**3.94**
Southampton Street and South Bay Drive	**7**	**21**	-	**107**	**5.10**	-	-	-	-	-

[a]Longest Crossing Length/(Pedestrian Change Interval + Red Clearance Interval).

Note: Highlighted cells with bold text signify a variation between MPO staff observations and City of Boston Transportation Department (BTD) documentation of the conditions.

FOUR CORNERS/GENEVA AVENUE STATION

Observations versus Official Documentation of Pedestrian Signal Qualities

	MPO Observations			BTD Documentation		
Intersection or Crossing	Exclusive or Concurrent	Audible	Countdown	Exclusive or Concurrent	Audible	Countdown
Blue Hill Avenue and Columbia Road	Exclusive	No	Yes	Exclusive	No	Yes
Blue Hill Avenue and Seaver Street	Exclusive	Yes	Yes	Both	Yes	Yes
Blue Hill Avenue and Seaver Street	Concurrent	Yes	**3 of 4 Countdown**	-	-	-
Blue Hill Avenue and Seaver Street	Concurrent	Yes	Yes	-	-	-
Blue Hill Avenue, Cheney Street, and Washington Street	Exclusive	No	Yes	Exclusive	No	Yes
Blue Hill Avenue, Warren Street, and Georgia Street	Concurrent	No	Yes	Concurrent	No	Yes
Blue Hill Avenue, Warren Street, and Georgia Street	**Concurrent**	**No**	**Yes**	-	-	-
Columbia Road and Devon Street	Exclusive	No	Yes	Exclusive	No	Yes
Columbia Road and Geneva Avenue	Concurrent	No	Yes	Concurrent	No	Yes
Columbia Road and Geneva Avenue	**Concurrent**	**No**	**Yes**	-	-	-
Columbia Road and Seaver Street	Concurrent	No	Yes	Concurrent	No	Yes
Columbia Road and Seaver Street	**Concurrent**	**No**	**Yes**	-	-	-
Columbia Road and Washington Street	Concurrent	No	Yes	Concurrent	No	Yes
Columbia Road and Washington Street	**Concurrent**	**No**	**Yes**	-	-	-
Columbia Road and Wyola Place	Exclusive	No	No	Exclusive	No	No
Columbia Road, Ceylon Street, and Richfield Street	Exclusive	No	Yes	Exclusive	No	Yes
Geneva Avenue and Bowdoin Street	Exclusive	No	Yes	Exclusive	No	Yes
Glen Lane, Blue Hill Avenue, and Glenway Street	Exclusive	No	No	Exclusive	No	No
Harvard Street, Washington Street, Bowdoin Street, and Bowdoin Avenue	Concurrent	No	Yes	Concurrent	No	Yes
Harvard Street, Washington Street, Bowdoin Street, and Bowdoin Avenue	**Concurrent**	**No**	**Yes**	-	-	-
Washington Street and Erie Street	Concurrent	Yes	Yes	Concurrent	Yes	Yes
Washington Street and Erie Street	Concurrent	Yes	**1 of 2 Countdown**	-	-	-
Washington Street and Vassar Street	Exclusive	No	Yes	Exclusive	No	Yes

Note: Highlighted cells with bold text signify a variation between MPO staff observations and City of Boston Transportation Department (BTD) documentation of the conditions.

FOUR CORNERS/GENEVA AVENUE STATION (CONT'D.)

Observations versus Official Documentation of Pedestrian Signal Timings

	MPO Observations					BTD Documentation				
Intersection or Crossing	**Walk Interval (seconds)**	**Pedestrian Change Interval (seconds)**	**Red Clearance Interval (seconds)**	**Longest Crossing Overall (feet)**	**Expected Crossing Speed (feet/sec)[a]**	**Walk Interval (seconds)**	**Pedestrian Change Interval (seconds)**	**Red Clearance Interval (seconds)**	**Longest Crossing Length (feet)**	**Expected Crossing Speed (feet/sec)[a]**
Blue Hill Avenue and Columbia Road	7	27	-	107	**3.96**	7	27	**4**	107	**3.45**
Blue Hill Avenue and Seaver Street	7	**5**	-	**18**	**3.58**	7*	**9**	**3**	**26**	**2.13**
Blue Hill Avenue and Seaver Street	7	**9**	-	**90**	**9.99**	7*	**6**	**6**	**30**	**2.49**
Blue Hill Avenue and Seaver Street	7	**5**	-	**126**	**25.23**	7	**19**	**3**	**84**	**3.82**
Blue Hill Avenue, Cheney Street, and Washington Street	7	**10**	-	**99**	**9.91**	7	**25**	**4**	**88**	**3.02**
Blue Hill Avenue, Warren Street, and Georgia Street	7	**9**	-	67	**7.42**	7	**10**	**6**	67	**4.17**
Blue Hill Avenue, Warren Street, and Georgia Street	**6**	**8**	-	70	**8.81**	**7**	**14**	**4**	71	**3.93**
Blue Hill Avenue, Warren Street, and Georgia Street	-	-	-	-	-	**7**	**8**	**4**	**52**	**4.30**
Columbia Road and Devon Street	7	**16**	-	93	**5.84**	7	**22**	**4**	93	**3.59**
Columbia Road and Geneva Avenue	-	-	-	-	-	**8***	**12**	**4**	**63**	**3.94**
Columbia Road and Geneva Avenue	7	24	-	118	**4.92**	7	24	**4**	118	**4.22**
Columbia Road and Geneva Avenue	**7**	12	-	67	**5.59**	**8***	12	**3**	67	**4.47**
Columbia Road and Seaver Street	**42**	**5**	-	32	**6.45**	**8***	**8**	**3**	32	**2.93**
Columbia Road and Seaver Street	7	**22**	-	**92**	**4.17**	7	**20**	**3**	**95**	**4.11**
Columbia Road and Washington Street	**37**	**10**	-	45	**4.52**	**8***	**7**	**3**	45	**4.52**
Columbia Road and Washington Street	7	21	-	94	**4.47**	7	21	**3**	94	**3.91**
Columbia Road and Washington Street	-	-	-	-	-	**8***	**7**	**3**	**46**	**4.56**
Columbia Road and Wyola Place	7	**18**	-	54	**2.99**	7	**21**	**4**	54	**2.15**
Columbia Road, Ceylon Street, and Richfield Street	7	25	-	103	**4.11**	7	25	**4**	103	**3.54**
Geneva Avenue and Bowdoin Street	7	**17**	-	81	**4.75**	7	**13**	**4**	81	**4.75**
Glen Lane, Blue Hill Avenue, and Glenway Street	7	24	-	94	**3.93**	7	24	**4**	94	**3.37**
Harvard Street, Washington Street, Bowdoin Street, and Bowdoin Avenue	10	10	-	**67**	**6.73**	10	10	**1**	**70**	**6.38**
Harvard Street, Washington Street, Bowdoin Street, and Bowdoin Avenue	10	10	-	**56**	**5.62**	10	10	**1**	**58**	**5.24**
Washington Street and Erie Street	**7**	7	-	38	**5.42**	**8***	7	**2**	38	**4.21**
Washington Street and Erie Street	**7**	8	-	48	**6.06**	**8**	8	**1**	48	**5.39**
Washington Street and Vassar Street	7	9	-	**79**	**8.83**	7	9	**4**	**45**	**3.48**
Washington Street and Vassar Street	-	-	-	-	-	**13**	**12**	**1**	**38**	**2.92**

[a]Longest Crossing Length/(Pedestrian Change Interval + Red Clearance Interval).

Notes: 1) Intersection names followed by an asterisk indicate that the pedestrian signal rests in the walk phase. 2) Highlighted cells with bold text signify a variation between MPO staff observations and City of Boston Transportation Department (BTD) documentation of the conditions.

TALBOT AVENUE STATION

Observations versus Official Documentation of Pedestrian Signal Qualities

Intersection or Crossing	MPO Observations: Exclusive or Concurrent	MPO Observations: Audible	MPO Observations: Countdown	BTD Documentation: Exclusive or Concurrent	BTD Documentation: Audible	BTD Documentation: Countdown
Harvard Street, Glenway Street, and Warner Street	Exclusive	No	Yes	Exclusive	No	Yes
Norfolk Street and Stanton Street	Exclusive	No	Yes	Exclusive	No	Yes
Norfolk Street, New England Avenue, and Woodrow Avenue	Exclusive	No	Yes	Exclusive	No	Yes
Talbot Avenue and Bernard Street	Exclusive	No	No	Exclusive	No	No
Talbot Avenue, Colonial Avenue, Aspinwall Road, and Spencer Street	Exclusive	**Yes**	**No**	Exclusive	**No**	**Yes**
Talbot Avenue, Norwell Street, and New England Avenue	Exclusive	Yes	Yes	Exclusive	Yes	Yes
Talbot Avenue, Washington Street, and Norfolk Street	Exclusive	No	Yes	Exclusive	No	Yes
Washington Street and Melville Avenue	Exclusive	No	Yes	Exclusive	No	Yes
Washington Street and Park Street	Exclusive	No	Yes	Exclusive	No	Yes

Note: Highlighted cells with bold text signify a variation between MPO staff observations and City of Boston Transportation Department (BTD) documentation of the conditions.

Observations versus Official Documentation of Pedestrian Signal Timings

Intersection or Crossing	MPO Observations: Walk Interval (seconds)	MPO Observations: Pedestrian Change Interval (seconds)	MPO Observations: Red Clearance Interval (seconds)	MPO Observations: Longest Crossing Overall (feet)	MPO Observations: Expected Crossing Speed (feet/sec)[a]	BTD Documentation: Walk Interval (seconds)	BTD Documentation: Pedestrian Change Interval (seconds)	BTD Documentation: Red Clearance Interval (seconds)	BTD Documentation: Longest Crossing Length (feet)	BTD Documentation: Expected Crossing Speed (feet/sec)[a]
Harvard Street, Glenway Street, and Warner Street	**7**	**10**	-	33	**3.28**	**8****	**7**	**4**	33	**2.98**
Norfolk Street and Stanton Street	7	7	-	52	**7.46**	7	7	**4**	52	**4.75**
Norfolk Street, New England Avenue, and Woodrow Ave	7	**14**	-	58	**4.17**	7	**11**	**4**	58	**3.89**
Talbot Avenue and Bernard Street	7	**16**	-	74	**4.63**	7	**12**	**4**	74	**4.63**
Talbot Ave, Colonial Ave, Aspinwall Road, and Spencer St	7	**10**	-	64	**6.37**	7	**7**	**4**	64	**5.79**
Talbot Avenue, Norwell Street, and New England Avenue	7	7	-	49	**6.96**	7**	7	**4**	49	**4.43**
Talbot Avenue, Washington Street, and Norfolk Street	7	**21**	-	84	**3.98**	7	**20**	**4**	84	**3.48**
Washington Street and Melville Avenue	7	**8**	-	45	**5.61**	7**	**9**	**4**	45	**3.45**
Washington Street and Park Street	7	13	-	48	**3.72**	7	13	**4**	48	**2.84**

[a] Longest Crossing Length/(Pedestrian Change Interval + Red Clearance Interval).

Notes: 1) Intersection names followed by two asterisks indicate that the pedestrian phase is only called after pushbutton actuation. 2) Highlighted cells with bold text signify a variation between MPO staff observations and City of Boston Transportation Department (BTD) documentation of the conditions.

MORTON STREET STATION

Observations versus Official Documentation of Pedestrian Signal Qualities

	MPO Observations			BTD Documentation			MassDOT Documentation		
Intersection or Crossing	**Exclusive or Concurrent**	**Audible**	**Countdown**	**Exclusive or Concurrent**	**Audible**	**Countdown**	**Exclusive or Concurrent**	**Audible**	**Countdown**
Blue Hill Avenue and Clarkwood Street	Exclusive	Yes	Yes	Exclusive	Yes	Yes	-	-	-
Blue Hill Avenue and Clarkwood Street	-	-	-	**Exclusive**	**Yes**	**Yes**	-	-	-
Blue Hill Avenue and Morton Street	Exclusive	No	No	-	-	-	Exclusive	No	No
Blue Hill Avenue and Norfolk Street	Exclusive	-	Yes	Exclusive	**No**	Yes	-	-	-
Blue Hill Avenue, Baird Street, and Woodrow Avenue	Exclusive	No	Yes	Exclusive	No	Yes	-	-	-
Blue Hill Avenue, Walk Hill Street, and Babson Street	Exclusive	No	Yes	Exclusive	No	Yes	-	-	-
Blue Hill Avenue, Walk Hill Street, and Babson Street	-	-	-	**Exclusive**	**No**	**Yes**	-	-	-
Blue Hill Avenue, Wellington Hill Street, and Fessenden St	Exclusive	No	Yes	Exclusive	No	Yes	-	-	-
Gallivan Boulevard (east of split from Morton Street)	Exclusive	No	No	-	-	-	Exclusive	No	No
Morton Street and Evans Street	Exclusive	**Yes**	No	-	-	-	Exclusive	**No**	No
Morton Street and Norfolk Street	Exclusive	No	No	-	-	-	Exclusive	No	No
Morton Street (between Theodore and Wildwood Streets)	Exclusive	No	No	-	-	-	Exclusive	No	No
Morton Street (east of Gallivan Boulevard split)	Exclusive	No	No	-	-	-	Exclusive	No	No
Morton Street (west of Gallivan Boulevard split)	Exclusive	No	No	-	-	-	Exclusive	No	No
Morton Street, Selden St, West Selden St, Corbet Street	Exclusive	No	**No**	-	-	-	Exclusive	No	**Yes**
Norfolk Street and Babson Street	**Exclusive**	No	**Yes**	**Concurrent**	No	Yes	-	-	-
Norfolk Street and Babson Street	-	-	-	**Exclusive**	**No**	**Yes**	-	-	-
Norfolk Street and Stanton Street	Exclusive	No	**Yes**	Exclusive	No	Yes	-	-	-
Norfolk Street, Fessenden Street, and Mildred Avenue	Exclusive	No	**No**	Exclusive	No	**Yes**	-	-	-
Norfolk Street, Fessenden Street, and Mildred Avenue	-	-	-	**Exclusive**	**No**	**Yes**	-	-	-

Note: Highlighted cells with bold text signify a variation between MPO staff observations, the City of Boston Transportation Department (BTD), and MassDOT's documentation of the conditions.

MORTON STREET STATION (CONT'D.)

Observations versus Official Documentation of Pedestrian Signal Timings

	MPO Observations					BTD Documentation					MassDOT Documentation				
	Walk Interval (seconds)	Pedestrian Change Interval (seconds)	Red Clearance Interval (seconds)	Longest Crossing Overall (feet)	Expected Crossing Speed (feet/sec)	Walk Interval (seconds)	Pedestrian Change Interval (seconds	Red Clearance Interval (seconds)	Longest Crossing Overall (feet)	Expected Crossing Speed (feet/sec)	Walk Interval (seconds)	Pedestrian Change Interval (seconds)	Red Clearance Interval (seconds)	Longest Crossing Overall (feet)	Expected Crossing Speed (feet/sec)
Blue Hill Avenue and Clarkwood St	7	22	-	92	4.19	7**	22	4	92	3.54	-	-	-	-	-
Blue Hill Avenue and Clarkwood St	-	-	-	-	-	7*	10	4	33	2.36	-	-	-	-	-
Blue Hill Avenue and Morton Street	5	25	-	107	4.28	-	-	-	-	-	7	15	1	107	6.69
Blue Hill Avenue and Norfolk Street	8	21	-	79	3.74	8**	21	4	79	3.16	-	-	-	-	-
Blue Hill Ave, Baird St, Woodrow Ave	7	14	-	91	6.53	7**	14	3	91	5.35	-	-	-	-	-
Blue Hill Ave, Walk Hill St, Babson St	-	-	-	-	-	7**	16	4	34	1.70	-	-	-	-	-
Blue Hill Ave, Walk Hill St, Babson St	7	10	-	80	8.05	7*	16	4	72	3.60	-	-	-	-	-
Blue Hill Avenue, Wellington Hill St, and Fessenden Street	7	24	-	131	5.48	7	24	4	131	4.68	-	-	-	-	-
Gallivan Boulevard (east of split from Morton Street)	7	11	-	39	3.51	-	-	-	-	-	7	10	1	39	3.39
Morton Street and Evans Street	7	18	-	63	3.51	-	-	-	-	-	6	14	1	63	4.21
Morton Street and Norfolk Street	7	18	-	63	3.48	-	-	-	-	-	6	14	1	63	4.18
Morton Street (between Theodore Street and Wildwood Street)	10	10	-	63	6.34	-	-	-	-	-	12	10	2	63	5.28
Morton Street (east of Gallivan Boulevard split)	7	12	-	60	4.96	-	-	-	-	-	7	12	1	60	4.51
Morton Street (west of Gallivan Boulevard split)	7	19	-	40	2.11	-	-	-	-	-	7	18	1	40	2.12
Morton Street, Selden Street, West Selden Street, and Corbet Street	6	14	-	62	4.42	-	-	-	-	-	6	14	1	62	4.13
Norfolk Street and Babson Street	-	-	-	-	-	7	9	1	39	3.90	-	-	-	-	-
Norfolk Street and Babson Street	7	14	-	55	3.94	7	11	4	62	4.13	-	-	-	-	-
Norfolk Street and Stanton Street	7	7	-	52	7.46	7	7	4	52	4.73	-	-	-	-	-
Norfolk Street, Fessenden Street, and Mildred Avenue	7	10	-	53	5.27	7**	10	4	61	4.36	-	-	-	-	-
Norfolk Street, Fessenden Street, and Mildred Avenue	-	-	-	-	-	7	10	4	33	2.36	-	-	-	-	-

[a]Longest Crossing Length/(Pedestrian Change Interval + Red Clearance Interval).

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BLUE HILL AVENUE STATION

Observations versus Official Documentation of Pedestrian Signal Qualities

Intersection or Crossing	MPO Observations: Exclusive or Concurrent	MPO Observations: Audible	MPO Observations: Countdown	BTD Documentation: Exclusive or Concurrent	BTD Documentation: Audible	BTD Documentation: Countdown
Babson Street and Fremont Street	Exclusive	No	Yes	Exclusive	No	Yes
Babson Street and Norfolk Street	**Exclusive**	No	Yes	**Both**	No	Yes
Blue Hill Avenue and Babson Street	Exclusive	No	Yes	Exclusive	No	Yes
Blue Hill Avenue and Fairway Street	Exclusive	No	Yes	Exclusive	No	Yes
Blue Hill Avenue and Norfolk Street	Exclusive	-	Yes	Exclusive	**No**	Yes
Blue Hill Avenue and Woodhaven Street	Exclusive	No	Yes	Exclusive	No	Yes
Blue Hill Avenue, Regis Road, and Fremont Street	Exclusive	No	Yes	Exclusive	No	Yes
Blue Hill Avenue, River Street, and Cummins Highway	Concurrent	No	**No**	Concurrent	No	**Yes**
Blue Hill Avenue, Walk Hill Street, and Babson Street	Exclusive	No	Yes	Exclusive	No	Yes
Cummins Highway and Itasca Street	Concurrent	**Yes**	**Yes**	Concurrent	**No**	**No**
Cummins Highway and Woodhaven Street	Exclusive	No	Yes	Exclusive	No	Yes
Cummins Highway, Rexford Street, and Rockdale Street	Exclusive	No	Yes	Exclusive	No	Yes
Norfolk Street, Fessenden Street, and Mildred Avenue	Exclusive	No	**No**	Exclusive	No	**Yes**
Rector Road and River Street	Exclusive	No	Yes	Exclusive	No	Yes
Blue Hills Parkway, Brush Hill Road, and Eliot Street (Milton, MA)	-	**Yes**	**Yes**	-	**Yes**	**Yes**

Note: Highlighted cells with bold text signify a variation between MPO staff observations and City of Boston Transportation Department (BTD) documentation of the conditions.

BLUE HILL AVENUE STATION (CONT'D.)

Observations vs. Official Documentation of Pedestrian Signal Timings

	MPO Observations					BTD Documentation				
Intersection or Crossing	Walk Interval (seconds)	Pedestrian Change Interval (seconds)	Red Clearance Interval (seconds)	Longest Crossing Overall (feet)	Expected Crossing Speed (feet/sec)[a]	Walk Interval (seconds)	Pedestrian Change Interval (seconds)	Red Clearance Interval (seconds)	Longest Crossing Length (feet)	Expected Crossing Speed (feet/sec)[a]
Babson Street and Fremont Street	8	8	**4**	55.87	**4.66**	8	8	-	55.87	**6.98**
Babson Street and Norfolk Street	7	**9**	**1**	**38.60**	**3.86**	7	**14**	-	**55.21**	**3.94**
Babson Street and Norfolk Street	**7**	**11**	**4**	**63.15**	**4.21**	-	-	-	-	-
Blue Hill Avenue and Babson Street	7*	**16**	**4**	71.19	**3.56**	7	**17**	-	71.19	**4.19**
Blue Hill Avenue and Babson Street	**7****	**16**	**4**	**33.70**	**1.69**	-	-	-	-	-
Blue Hill Avenue and Fairway Street	7	15	**4**	73.45	**3.87**	7	15	-	73.45	**4.90**
Blue Hill Avenue and Norfolk Street	8**	21	**4**	78.60	**3.14**	8	21	-	78.60	**3.74**
Blue Hill Avenue and Woodhaven Street	**7****	21	**4**	40.76	**1.63**	**8**	21	-	40.76	**1.94**
Blue Hill Avenue, Regis Road, and Fremont Street	7	15	**4**	42.62	**2.24**	7	15	-	42.62	**2.84**
Blue Hill Avenue, River Street, and Cummins Highway	-	-	-	-	-	**5**	**10**	-	15.58	**1.56**
Blue Hill Avenue, River Street, and Cummins Highway	**6****	**9**	**5**	91.60	**6.54**	**5**	**10**	-	91.60	**9.16**
Blue Hill Avenue, River Street, and Cummins Highway	-	-	-	-	-	**6**	**12**	-	36.02	**3.00**
Blue Hill Avenue, River Street, and Cummins Highway	**6****	**9**	**2**	59.82	**5.44**	**5**	**10**	-	59.82	**5.98**
Blue Hill Avenue, River Street, and Cummins Highway	-	-	-	-	-	**5**	**10**	-	33.41	**3.34**
Blue Hill Avenue, River Street, and Cummins Highway	**6****	**9**	**2**	39.72	**3.61**	**8**	**12**	-	39.72	**3.31**
Blue Hill Avenue, Walk Hill Street, and Babson Street	7	10	**4**	80.45	**5.75**	7	10	-	80.45	**8.05**
Cummins Highway and Itasca Street	7**	11	**2**	63.69	**4.90**	7	11	-	63.69	**5.79**
Cummins Highway and Itasca Street	7*	5	**3**	44.21	**5.53**	7	5	-	44.21	**8.84**
Cummins Highway and Woodhaven Street	7	**10**	**4**	61.54	**4.40**	7	**14**	-	61.54	**4.40**
Cummins Highway, Rexford Street, and Rockdale Street	7	**10**	**4**	66.63	**4.76**	7	**14**	-	66.63	**4.76**
Norfolk Street, Fessenden Street, and Mildred Avenue	7**	10	**4**	61.49	**4.39**	7	10	-	52.69	**5.27**
Norfolk Street, Fessenden Street, and Mildred Avenue	7	10	**4**	33.53	**2.40**	-	-	-	-	-
Rector Street and River Street	8*	7	**4**	42.00	**3.82**	8	8	-	42.16	**5.27**
Rector Street and River Street	7	13	**4**	32.56	**1.92**	-	-	-	-	-
Blue Hill Avenue, Brush Hill Road, Eliot Street, and Blue Hills Parkway (Milton, MA)	-	-	-	-	-	-	-	-	-	-

[a]Longest Crossing Length/(Pedestrian Change Interval + Red Clearance Interval).

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