City of Richmond

Bicycle and Pedestrian Network Improvement Study

U.S. Department of Transportation
Federal Highway Administration

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March 2017

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The Richmond, Virginia Pedestrian and Bicycle Network Improvement Study provides a detailed set of infrastructure improvement recommendations to enhance bicycle and pedestrian access to and from seven future Bus Rapid Transit stations along a 7.6-mile corridor in Richmond, Virginia.

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Introduction

A new transit service is launching in Richmond, Virginia. The Pulse is a 7.6-mile Bus Rapid Transit (BRT) corridor running through the heart of the city along Broad and Main Streets linking residential areas and historic communities to 77,000 jobs, numerous cultural and civic buildings (including the State Capitol), retail and dining opportunities, expansive University and medical campuses, the Convention Center and several neighborhoods experiencing redevelopment.

This exciting Greater Richmond Transit Company (GRTC) project dovetails with several ongoing local planning initiatives and brings together numerous local government agencies, private developers, community groups and stakeholders. Critical Federal and State funders, including the Federal Highway Administration (FHWA), Federal Transit Administration (FTA), and Virginia Department of Rail and Public Transportation all have a stake in the success of the new BRT line.

One community, the Greater Fulton neighborhood close to the Eastern terminus of the line, is a focal point as the recipient of a Ladders of Opportunity Transportation Empowerment Pilot (LaddersTEP) technical assistance grant from the U.S. Department of Transportation. The Fulton neighborhood embodies the purpose and spirit of this program: to foster sustainable economic development related to planned transportation projects, and to help build and restore connections, develop workforce capacity, and catalyze neighborhood revitalization.

Against this backdrop, FHWA – which awarded a $24.9 million TIGER grant to support The Pulse – wanted to ensure the most effective use of Federal funding by:

1. Contributing to the planning and technical assistance programs being undertaken as part of The Pulse corridor development
2. Recommending pedestrian and bicycle access improvements to The Pulse to enable the highest possible local ridership, and
3. Learning how more qualitative public and stakeholder outreach can contribute to a successful planning process.

FHWA, in close cooperation with the City of Richmond, initiated The Richmond, Virginia Pedestrian and Bicycle Network Improvement Study – a planning study tightly focused on these three goals. The two primary outcomes of the study are a detailed set of recommended improvements for bicycle and pedestrian access at seven selected stations along the corridor, and a separate technical assistance report "Incorporating Qualitative Data in the Planning Process: Improving Project Delivery and Outcomes".

This report presents a summary of key recommendations designed to increase safety, connectivity and comfort for people accessing seven of the Pulse BRT stops. The recommendations were informed by technical analysis, best practices research, and stakeholder input. The report is organized around three main themes: a review of plans and existing best practices; a summary of findings and recommendations; and a summary of planning level cost estimates for each of the recommended enhancements to the bicycling and pedestrian networks around the seven study areas.

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Plan Review and Best Practices

In preparation for analysis of the seven selected station areas, planning and engineering staff from the Study Team reviewed local planning documents relevant to the station areas as well as related national guidelines and best practice documents.

The local planning documents were reviewed to identify themes. Dominant themes that emerged included improving pedestrian connectivity, bicycle connectivity, as well as increasing wayfinding and creating additional opportunities for place-making.

The national best practice documents were reviewed to identify Key Lessons that the Study Team used to develop the final recommendations for improving access to the proposed stations for people on foot and bicycle. In particular, the Study Team identified lessons that could serve as primary planning principals behind the recommendations to be developed for the seven station areas. These lessons are summarized below For each key lesson, specific references within the documents reviewed are listed (see Table 1).

At the end of each key lesson, the Study Team identified one or more Lessons in Practice, which reflect the convergence of the local planning documents with the national best practices. Full details of the applicable recommendations in the local and national documents can be found in Attachments 1 and 2.

Summary of Documents Reviewed

In reviewing the set of local and national planning documents, the Study Team focused on identifying provisions within established plans that must be respected or adhered to when developing specific recommendations. The Study Team also identified where each of the documents supported one or more of the Key Lesson concepts. The local planning documents reviewed for this study are included in Table 2. The national best practice documents reviewed for this study are listed in Table 3.

Table1: Key Lessons Derived from Local and National Referece Documents

Key Lesson #	Concept
1	Narrow the streets to give pedestrians shorter crossing distances
2	Narrow streets and alleys can be dedicated to pedestrians
3	Make pedestrian routes to stations as direct (and clear) as possible
4	Bike corridor network needs to be direct, comprehensive, and understandable
5	Bike parking opportunities at transit stations are critical
6	Separated bike lanes help cyclists, pedestrians, and transit too
7	Colored pavement boosts bicyclist safety

Themes from Local Planning Documents

There is a significant amount of current and ongoing planning around the BRT and local transit system, bicycling and walking, revitalization of the riverfront, and the opportunities for transit-oriented development in Richmond. There were several recurring themes in the literature that are relevant to improving bicycle and pedestrian access to The Pulse corridor.

Pedestrian Connectivity

The ease, comfort, and safety of routes from surrounding land uses to the transit platform multiply the beneficial effects of the presence of transit, particularly fixed-route service including the Pulse BRT. Best practices in the area of providing pedestrian access to transit in an urban setting focus on the prioritization of pedestrian access, so that the potential transit passenger arriving at the station on foot faces as little friction as possible. In the design of transit stations, pedestrian access routes are given primacy over vehicular access infrastructure such as driveways and parking areas. Similarly, pedestrian infrastructure needs to embody a commitment to pedestrian-friendly access to transit through its state of good repair and level of ADA compliance.

Table 2: Local documents Reviewed

Publication Title	Published by:	Year
Pulse Corridor Plan	City of Richmond; Richmond Regional Planning District (RRPD)	2016
The Gillies Creek Greenway Plan	City of Richmond Pedestrian, Bicycles and Trails Commission	2016
Richmond Bike Master Plan Citizen Survey: Results and Findings	City of Richmond	2016
Richmond Neighborhood Byways Plan	Virginia Commonwealth University	2016
Richmond Region Bicycle Infrastructure Report	Bikewalk RVA; Sportsbackers	2016
Route Modification Recommendations for Richmond East End Communities of Fulton and Church Hill	GRTC	2016
Safe Routes to School Projects in Richmond	VDOT	2016
City of Richmond Bicycle Master Plan	City of Richmond	2015
GRTC Broad Street BRT Route Modifications Report	GRTC	2015
Greater Fulton's Future: Community Vision and Agreement	Local Initiatives Support Coalition; Neighborhood Research Center	2011

Table 3: National Best Practice Documents Reviewed

Publication Title	Published by:	Year	In-text Citation
Guide for the Development of Bicycle Facilities	AASHTO	2012	AASHTO
Boston Complete Streets Guidelines	City of Boston	2013	Boston
Achieving Multimodal Networks: Applying Design Flexibility and Reducing Conflicts	FHWA	2016	FHWA-Multimodal
Delivering Safe, Comfortable, and Connected Pedestrian and Bicycle Networks: A Review of International Practices	FHWA	2015	FHWA – International
Manual of Uniform Traffic Control Devices	FHWA	2009	MUTCD
Separated Bike Lane Planning and Design Guide	FHWA	2015	FHWA- Bike Lane
Transit Street Design Guide	NACTO	2016	NACTO-Transit
Urban Bikeway Design Guide	NACTO	2011	NACTO-Bikeway
Urban Street Design Guide	NACTO	2012	NACTO-Street
Separated Bike Lane Planning and Design Guide	MassDot	2015	MassDot
Estimating Bicycling and Walking for Planning and Project Development (Report 770)	NCHRP	2014	NCHRP 770
Pedestrian and Bicycle Transportation along Existing Roads (Report 803)	NCHRP	2015	NCHRP 803
ThinkBike Charrette Proceedings	N/A	2010-15	ThinkBike

Providing stronger and more comfortable pedestrian connections resonates throughout the local planning documents, including the following examples:

- The Greater Fulton Community Vision Plan highlights the need for improvements in sidewalks, lighting, crosswalks, and general street beautification.
- The Richmond Neighborhood By-Ways Plan aims to achieve beautiful and people-oriented streets that create safe and comfortable communities. More specifically, the Plan calls for individual neighborhoods to adopt an overarching common goal of establishing low-stress residential streets.
- To provide more connections, the Gillies Creek Greenway Plan outlines a network of paths that create safe and connected routes for East End Richmond neighborhoods.
- To connect the BRT line to the surrounding area, the Pulse Corridor Plan outlines specific improvements including where to provide wider sidewalks and streetscaping, and where sidewalk gaps should be filled in.

With the advent of the BRT line, recommendations to provide better pedestrian and bicycle connections to the new BRT stations have been added to local planning documents, including:

- The GRTC Broad Street Route Modifications Report includes recommendations to modify local bus routes and consolidate bus stops to better align with the BRT route in order to facilitate transfers.
- The Pulse Corridor Plan highlights six stations (Cleveland Street, Science Museum/Robinson Street, Allison Street, Arts District/Adams Street, Main Street, and Rocketts Landing/ Orleans Street) that are ripe for improved transit accessibility due to the surrounding market conditions, development readiness, and pedestrian orientation.

Bicycle Connectivity, Bike Share, & Bicycle Parking

Access to transit via bicycle extends the effective reach of a transit system well-beyond the typical ¼ to ½-mile radius used to analyze potential transit ridership. These potential riders can be captured by employing simple principles centered on making routes to transit safe, attractive, and easily navigated, as well as by providing amenities at the point of transfer, where the cyclist becomes a transit passenger, that ease the transition for the cyclist. There is a primary emphasis on plentiful, quality bicycle parking at those points of transfer, as well as smooth, open pathways to the transit station that minimize conflicts with automobiles and pedestrians.

The citizen survey for the Richmond Bike Master Plan shows potential for bicycling becoming prominent in the City. The survey reports that although 96 percent of respondents own or have access to a bicycle, many choose not to bike because of the lack of bike lanes, high traffic volumes and speeds, and inclement weather. Similarly, the Richmond Neighborhood By-Ways Plan notes that individual comfort factors play a strong role into deciding what routes people take on a bicycle, or whether they choose to use non-motorized transportation at all. Providing a network of connections, so that there are multiple ways to reach any given destination, is key to enticing people to bicycle as a transportation mode, as is providing at least some routes attuned to the comfort level of novice cyclists. Specific plans, including

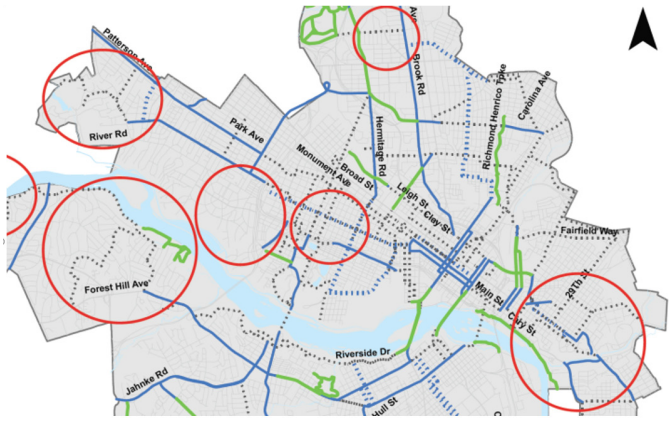


Figure 1: Gaps in Existing & Proposed Bike-Ped Network (Source: from Neighborhoods By-Ways Plan, Figure 20)

the Gillies Creek Greenway Plan and Richmond Regional Bike Report, propose neighborhood bicycle connections to the Virginia Capital Trail; a 52 mile paved trail connecting Richmond and Jamestown. The Pulse Corridor Plan highlights the following recommendations for increase bicycle usage in and around BRT stations:

- improve bicycle infrastructure, specifically protected infrastructure;
- co-locate bike share stations near Pulse stations; and
- sponsor bike share station and/or provide bike parking.

Wayfinding and Placemaking

Strengthening the connectivity and identity of neighborhoods is a recurring theme throughout the local planning documents, and a notable feature of The Greater Fulton Community Vision. For example:

- The Pulse Corridor Plan establishes three goals on which to focus when changing the neighborhoods surrounding the BRT corridor to provide highly walkable corridors and transit oriented development.
  - create compact and mixed used developments,
  - ensure connectivity, and
  - establish thriving and equitable neighborhoods.
- The recommendations in the Richmond Neighborhood By-Ways Plan intertwine with place-making and transit oriented development as it aims to improve the quality and activity level of residential streets.
- The Greater Fulton Community Vision highlights placemaking opportunities and connections between the Greater Fulton Community and Rocketts Landing.

The Fulton neighborhood is also the beneficiary of technical assistance from the Federal Transit Administration as part of the U.S. Department of Transportation's Ladders of Opportunity initiative. The neighborhood is described by former Mayor Dwight Jones as "a once bustling community with industrial, commercial and residential uses" that was negatively affected by urban renewal initiatives in the 1950's and 1960's and badly damaged by floods in the 1970's.

Connecting the community to The Pulse Corridor is essential to the revitalization of this historic neighborhood. In turn, reconnecting the street grid and overcoming the significant barriers in the form of Main Street, Route 5 and the CSX railroad tracks by a combination of improved wayfinding and placemaking projects (e.g. public art), is a core goal of The Pulse Corridor Plan, the Gillies Creek Greenway Plan, and the Greater Fulton Community Vision.

Key Lessons from National Best Practices

Lesson 1: Narrow the streets to give pedestrians shorter crossing distances

Human scale street designs create safe, comfortable places for the community to walk and bike. One of the simplest ways to make a street "people-oriented" is to make it easier to cross. Narrowing down the total street width that pedestrians have to cross increases the comfort level for those on foot, and provides subtle cues to drivers that result in lower automobile speeds and increased overall safety. A variety of techniques exist to either narrow roadways from the outside-in (ex. bulb-outs), or by breaking up the roadway width to be crossed by inserting pedestrian space into the middle of streets (ex. refuge medians). In more urban environments,

Figure 2: Curb extension designed to reduce an existing long turn radius (Source: PBIC Image Library)

a leading pedestrian interval can have the same effect as reducing the crossing distance by giving pedestrians a head start on crossing the street.

Bulb-outs or **curb extensions** are sidewalks that have been expanded into the curb lanes of a street at intersections, or mid-block points where pedestrians can cross. Often they are used to define the curb-side parking space or are incorporated into the design of transit stops, allowing buses or streetcars to pull up to the curb without leaving their travel lane. At intersections, bulb-outs also serve to cut down the turning radius for right turns, encouraging drivers to enter intersections at lower speeds. These features also assist with "daylighting", a term used to describe improving the visibility of the crossings and pedestrians by eliminating visual obstructions such as parked cars and delivery vehicles.

Refuge Medians facilitate ease of pedestrian crossings at wide or high volume intersections by providing a resting area part way through a crossing. AASHTO and FHWA encourage the use of refuge medians due to their positive impact on pedestrian safety at intersections (46-percent reduction in pedestrian crashes per FHWA). Many state DOT guidelines call for using refuge islands where pedestrians cross four or more lanes of traffic. Islands should be a minimum six feet wide to accommodate queuing pedestrians and meet ADA requirements. NACTO guidelines recommend eight to ten feet minimum width.

Adding facilities for transit or bicycles to the center of a roadway provides opportunities to also add refuge medians. For median-running transit lanes, a crosswalk leading to a refuge median is the standard method of providing access to stations.

The **Leading Pedestrian Interval** is a technique in which pedestrian signals at an intersection are timed to give pedestrians a brief WALK indication prior to the green indicator for vehicles. This allows pedestrians to enter the crosswalk without conflict from turning vehicles. This is especially important to counter right-turning drivers who often fail to yield to pedestrians, forcing those on foot to waste a portion of their WALK phase waiting for turning cars to clear.

Figure 3: Bulb-outs on an urban street (Source: Google Maps)

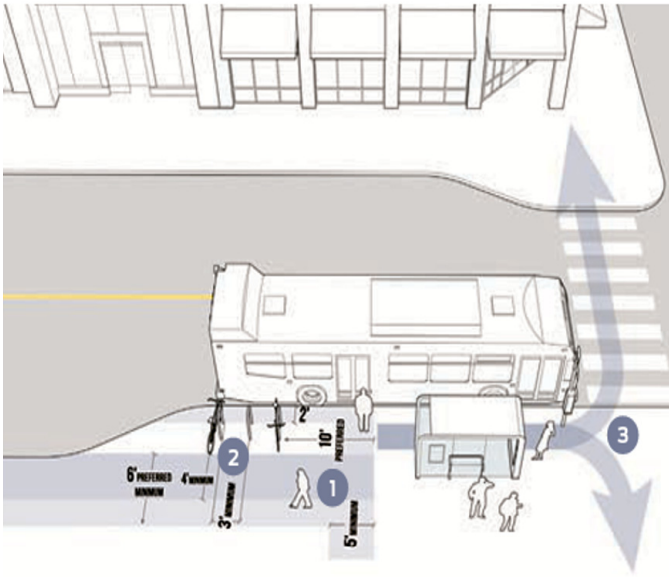


Figure 4: Bulb-out incorporated into a transit stop (Source: NACTO)

Figure 5: Refuge median on an urban street, protected by bollards (Source: Google Maps)

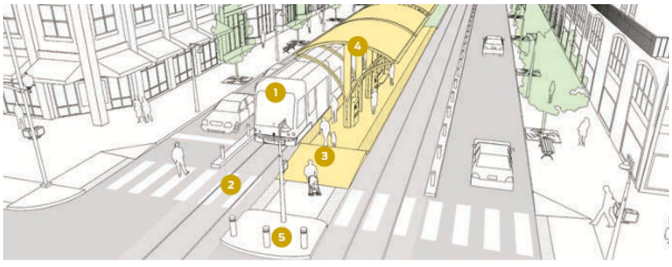


Figure 6: Transit station providing a refuge median as part of its design (Source: NACTO)

Lesson in Practice

This key lesson is reflected in the Richmond Neighborhood By-Ways Plan, which aims to achieve people-oriented, low-stress residential streets. In addition, one of the six improvement types in the Richmond Bike Master Plan is the Bike-Walk Street, which the City describes as limiting vehicular access to increase the comfort level of pedestrians and cyclists. Bike-Walk Streets typically include curb extensions and enhanced intersections to help achieve this goal.

For more information, please see:

- FHWA-Multimodal, Additional Crossing Treatments, p. 35
- NACTO Streets, Design Speed vs. Target Speed section, page 26
- NACTO Transit, Stations & Stops-Median Stop/Left Side Boarding section
- NACTO Streets, Intersection Design Elements - Traffic Signals - Leading Pedestrian Interval section
- AASHTO, Reducing the Number of Travel Lanes, page 4-30
- Richmond Neighborhood By-Ways Plan, Recommendations & Implementation Section
- Richmond Bike Master Plan, Appendix A: Design Guidelines

Lesson 2: Narrow streets and alleys can be dedicated to pedestrians.

The narrowest streets in the urban environment, those around 40 feet or less in total width, can be challenging locations in which in which to accommodate all of the potential users by conventional means. On narrow streets, the prescribed lane widths of a prior era leave little left over to create a quality pedestrian environment. NACTO recommends converting the narrowest urban streets to shared streets, in which the entire street width is considered part of the pedestrian zone. Shared streets are implemented by removing the vertical difference between the street and the sidewalk. In some cases, nominal visual clues remain to show some differentiation between what is in the street and what is out of the street. Safety is maintained by the innate influence of the street

Figure 7: Shared street in Cambridge, MA (Source: NACTO)

design, including strategic placement of street furniture and landscaping islands, which cues drivers to keep their speeds to little more than walking pace.

An even narrower class of streets are alleyways, which are often forbidding places for pedestrians if given over primarily to service vehicles or heavily used as vehicular cut-through routes between streets. The NACTO Urban Street Design Guide highlights programs to create “green alleys”, with improved drainage, repaired paving, and plantings to create a comfort level for pedestrians.

Shared streets and alleys can be temporarily made pedestrian-only for special events, on weekends, or at other times when conditions permit through the use of removable bollards, planters, or fences. (Removable bollards are a particularly useful tool to help emergency responders access a site to which access is already constrained.) As conditions warrant, pedestrian-only streets can be made permanent, if technical analysis shows that their removal from the vehicular network will not significantly affect the functioning of the greater whole.

Lesson in Practice

The Pulse Corridor Plan recommends improving connectivity around station areas – especially around the eastern end of the corridor (Main Street Station to Rocketts Landing) – by improving and introducing pedestrian paths as well as reintroducing a street grid with alleys. The Plan also recommends using alleys to facilitate deliveries, freight access and other services. This can be done concurrently with pedestrian improvements.

For more information, please see:
- NACTO-Street, Very Small Streets section, pages 18-21
- Pulse Corridor Plan, Corridor-Wide Recommendations

Lesson 3: Make pedestrian routes to stations as direct and clear as possible

Transit stations in urban environments are too often designed in a way that does not fully consider pedestrian accessibility, safety and comfort: parking areas and unnecessary fences channelize pedestrians into roundabout routes to the station entrance; substandard pedestrian facilities on nearby streets, and wayfinding signs are often scaled and situated to be most useful for those behind the wheel of a car.

A handful of simple principles can help to ensure comfortable, direct pedestrian access to transit stations:

- **Provide pedestrian and bike pathways through parking lots, not around.** Where parking lots sit between pedestrian trip generators and the transit platform or stop, special consideration should be given to routing pedestrian routes along "desire lines" through rather than around the parking lot. Special paving treatments (ex. pavers, colored asphalt, and embedded decals), landscaping and other visual cues can indicate that pedestrians are welcome to use the most direct route possible to and from the station. Fences typically used to protect vehicles from break-ins should be replaced by more effective means of crime prevention.
- **Dedicated pedestrian paths and entry plazas into stations encourage greater access, even in urban areas with a complete sidewalk network**. Pedestrian routes should lead directly to the station entrance, and should be highlighted by special paving, landscaping treatments, and/or street furniture. The concept of pedestrian-dedicated or shared-space streets is particularly useful in the block nearest to the transit station.
- **Establish highly visible wayfinding at decision points.** Wayfinding signs should be oriented towards sidewalks and trails, should include easy-to-read maps, highlighting the most direct routes to transit stations. Wherever possible, wayfinding should have a heightened element making it visible from a distance amidst eye-level visual clutter.
- **Provide connections to nearby multi-use trails**, which are favored as bicycle and pedestrian commuting routes.
- **Reduced speed limits are increasingly being used by cities to indicate a greater priority for pedestrian safety**. Cities including Boston and Seattle have recently reduced their default speed limit for local roads to 20-mph. Although there are issues around effective compliance rates and enforcement of lower speed limits, this approach is increasingly being used on local streets within neighborhoods and in business districts.

Figure 8: High-quality wayfinding signage in College Park, MD

Lesson in Practice

Within the local documents reviewed, the Richmond Neighborhood Byways Plan includes a recommendation to implement wayfinding with mileage to connect to desired destinations as part of its objective to make neighborhood byways convenient for people who are walking or biking.

For more information, please see:
- FHWA Multimodal, Reduce Conflicts section, page 72
- FHWA Multimodal, Multimodal Access to New Transit Stations, page 76
- AASHTO, Wayfinding for Bicycles section, page 2-20
- Richmond Neighborhood By-Ways Plan, Recommendations & Implementation Section

Lesson 4: Bike network needs to be direct, comprehensive, and understandable

Modern bicycle networks being created in North American cities have generally been superimposed on a street network laid out for automobiles. As a result, urban bicycle networks often reflect only a documentation of what can be done in each roadway (and often on small, disconnected segments), rather than being thought out as a whole. While such pragmatism should be part of the approach, a city's bicycle network should also reflect a desire to provide bicycle access to all areas of the city, with priority placed on connections to the highest concentrations of residents, jobs, and commercial development. Every effort should be made to create the most direct bicycle routes possible to the highest-order destinations. Given the intrinsic tie between bicycle mobility and transit mobility, urban bicycle networks should generally treat transit corridors as higher-order destinations. In addition, bicycle corridors should be laid out parallel to transit corridors, typically in adjacent streets that will not have the high vehicular traffic volumes and higher travel speeds of a corridor chosen for BRT service.

Not every street should necessarily be part of a designated bicycle network, and indeed an urban street grid creates an ideal situation to direct cyclists to those streets most suitable for cycling and/or most easily modified to provide safe and comfortable routes. Establishing a density of cyclists on a particular street helps to provide visibility and "safety in numbers." In urban areas, bike networks should be laid out featuring a hierarchy of treatments (off-street path, protected bike lane, bike lane, bike-friendly street) similar to the functional classification of urban streets. Streets carrying relatively little vehicular traffic can often provide the best opportunity for a high-capacity bicycle route. Small streets can accommodate high-quality bicycle treatments in a variety of ways, including contra-flow bicycle lanes on one-way streets, which also have the added benefit of improving the visibility of cyclists to drivers.

Figure 9: Contra-flow bike-lane on a one-way street provides high-order bicycle accommodation on a low-traffic street

Lesson in Practice

Local documents reinforce this key lesson. Respondents to the Richmond Bike Master Plan Citizen Survey report the lack of bike lanes as one of the primary factors limiting travel by bicycle within the City. Acknowledgement of the need for a hierarchical regional bicycle network are found throughout local documents, including recommendations in the Gillies Creek Greenway Plan and Richmond Regional Bike Report to provide neighborhood bike connections to the Virginia Capital Trail; a 52-mile paved trail connecting Richmond and Jamestown.

For more information, please see:
- FHWA International, page 38
- Richmond Bike Master Plan, Appendix D: Public Outreach
- Gillies Creek Greenway Plan
- Richmond Regional Bike Infrastructure Report, page 14

Lesson 5: Bike parking opportunities at transit stations are critical

A safe, direct, and comfortable bicycle route can be of limited effectiveness if there is not a smooth transition at the transit station or stop from being a cyclist to being a pedestrian/transit rider. Having to dismount while in the path of cars or pedestrians, wrestle a bicycle up or down a set of stairs or on a steep slope, or settling for a lamppost or fence as a parking location, are a significant deterrent to cyclists otherwise eager to transfer to transit.

The most critical feature for cyclists at transit stations is a safe and secure place to park their bicycle. Such locations should be highly visible from the station entrance, easy to find from all approaches to the station, well lit, and located in an area that has good "eyes on the street." Many cyclists have made a significant investment in their bike, sometimes even eliminating an auto from their household; the transit agency or municipality needs to help protect that investment with secure and weather-protected bike parking facilities wherever possible.

NACTO's Transit Street Design Guide recommends two tiers of bicycle parking. Short-term bicycle parking should take the form of racks that are easy and quick to use, and should be located very close to the station entrance, platform, or stop, preferably within 50 feet of the station or platform. Ideally, the quantity of short-term racks should ensure that a few empty slots are always available. Where space is limited at downtown stations, bicycle parking can be provided through repurposing one or more on-street parking spaces into a corral. This represents a trade-off that sets the right tone of prioritizing access for cyclists. Bike corrals can be marked and protected by planters, fencing, or even by flexible bollards, and help to improve sight-lines for both drivers and pedestrians if located in the last spaces before an intersection.

Slightly farther from the station entrance, higher volume long-term parking that is clean, dry, and protected should also be provided at higher ridership stations and transit hubs (e.g. Main Street Station

Figure 10: Interior of covered, attended bike parking facility at Union Station in Washington, DC (source: BikeStation.com)

Figure 11: Three different approaches to demarcating bike corrals

for Amtrak customers). Long-term bicycle parking facilities can take the form of a bike cage, bike station, or bike lockers, and might include services such as air pumps and repair stations.

At all bicycle parking areas, a safe dismount area should be provided. Parking facilities should take new types of bicycles, particularly cargo bikes, into consideration. Where steps are present, a bicycle rail should be provided so that bicycles can be wheeled down the steps.

Lesson in Practice
The Pulse Corridor Plan highlights improved bicycle infrastructure, specifically co-located bike share stations near Pulse stations and/or providing additional, improved bike parking, as a corridor-wide recommendation to increase bicycle usage in and around BRT stations.

For more information, please see:
- AASHTO, Integrating Bicycle Facilities with Transit, page 2-27
- NACTO-Transit, Bike Parking section, page 105
- FHWA-Multimodal, Bridge Design section, page 54
- Association of Pedestrian and Bicycle Professionals, Essentials of Bike Parking: Selecting and Installing Bike Parking that Works, 2015
- Pulse Corridor Plan, Corridor-Wide Recommendations

Lesson 6: Separated bike lanes help cyclists, pedestrians, and transit too

One way to encourage individuals new to on-street cycling is to maximize their level of comfort by physically separating the bicycle lane from vehicular traffic. This can be done with the use of bollards, flex-posts, planters, and curb treatments, among other options. Physically separated bike lanes not only create "lower stress" environments for bicyclists of all comfort levels, but also give greater permanence to the bicycle network than do lanes simply marked with painted lines. Separated bike lanes demonstrate a clear signal to motorists that bicycling is a priority mode of travel in the corridor.

Figure 12: Separated bike lane routed behind a transit stop in Denver, CO (Source: Streetsblog)

Separated bicycle lanes can also break up a wide roadway and shorten crossing distances for pedestrians when a physical refuge is provided between the bicycle lane and vehicle lanes. The physical separation of bicycles and autos also provides a visual cue to pedestrians that bicycles may be present; however, caution must be given to warn pedestrians of on-coming bicycle traffic in the protected bicycle lane. When a bus stop is present, the bicycle lane can "bend" inside towards the curb lane to reduce conflicts with transit vehicles re-entering traffic. This approach can also be used to reduce conflicts with delivery vehicles, valet parking services and other high volume drop-off locations.

Lesson in Practice
A strong desire among cyclists, potential cyclists, and the planning community can be seen in local plans. Respondents to the Richmond Bike Master Plan Citizen Survey report the lack of bike lanes as one of the primary factors limiting travel by

bicycle within the City. Likewise, the Richmond Neighborhood By-Ways Plan cites individual comfort factors as playing play a strong role into deciding whether people will bike, and what routes they will take on bike. The Pulse Corridor Plan highlights improved bicycle infrastructure, specifically protected bike lanes, as a corridor-wide recommendation to increase bicycle usage in and around BRT stations.

For more information, please see:

- MassDot, Chapter 3
- NACTO-Bikeway, Cycle Tracks section, pages 58-104
- Richmond Neighborhood By-Ways Plan, Recommendations & Implementation Section
- Pulse Corridor Plan, Corridor-Wide Recommendations

Figure 13: Urban bike lane demarcated with green-colored pavement

Lesson 7: Colored pavement boosts safety

Early versions of on-street bicycle facilities were commonly delineated by white striped bicycle lanes to establish a dedicated space for travelers on two wheels. The NACTO Bikeway Design Guide and the Boston Complete Streets Guidelines both point out that colored pavement for cyclists improves safety by making cycling facilities more visible and alerting both cyclists and drivers to potential areas of conflict. Research also indicates that green colored pavement also has a tendency to act as a traffic calming measure. With the approval of the latest edition of FHWA's Manual on Uniform Traffic Control Devices (MUTCD), local agencies are increasingly using colored pavements to improve bicycle lane visibility and safety. Green is the only FHWA-approved color for bicycle lanes and when used, is considered a regulatory traffic control device.

When installed to the fullest extent, green-colored bicycle lanes can extend through intersections in a design similar to a cross-walk, and additional features can be implemented to build upon the safety provided by green bike lanes. Some local agencies use intermittent green pavement markings to highlight conflict areas, for example where motor vehicles must merge across a bicycle lane.

Bike Boxes, usually designated by green-colored pavement markings near the stop bar, serve as a queuing area for bicycles at intersections. The NACTO Bikeway Design Guide cites bike boxes as improving safety by increasing the visibility of cyclists to drivers and reducing the likelihood of conflicts with turning automobiles.

Bike Signals facilitate bicyclists crossing of roadways and improve bicyclists' comfort by restricting conflicting movements. Best practices include providing an actuated signal either using pavement detectors or push buttons, together with bicycle stenciled lenses in the signal head. Detection and phasing should be separate from motor vehicles. AASHTO cautions that bicycles may need a longer minimum green time than vehicles to safely cross an intersection and can often operate concurrently with transit signal priority.

Lesson in Practice

Projects already implemented based on the recommendations of the Bicycle Master Plan include buffered bike lanes with green lane markings on the approach to the Manchester Bridge. Greater use of separated bicycling infrastructure in the future will likely be accompanied by colored pavement markings to increase the visibility of people on bikes at intersections and driveway crossings.

For more information, please see:

- Boston, Bicycle Boxes, page 20
- AASHTO, Traffic Signals section, page 4-43
- NACTO-Bikeway, pages 106-121 and pages 254-272.
- Richmond Bike Master Plan, Appendix A: Design Guidelines

Findings and Recommendations

Introduction

Following the review of existing plans and best practices around the U.S., the Study Team focused on assessing existing bicycle and pedestrian infrastructure around seven Pulse Bus Rapid Transit (BRT) stations. The stations selected as part of this project included Orleans Street, East Riverfront, Shockoe Bottom, Arts District, Allison Street, Science Museum, and Cleveland Street. This assessment focused on the existing pedestrian network within a half mile radius and the existing and proposed bicycle network within a three-mile radius around the seven future Pulse BRT Stations. Particular attention was paid to accessibility issues and ADA compliance; pedestrian and bicycle treatments at intersections; and other barriers to pedestrian and bicyclist access.

½ mile =
10-minute walk

3 miles =
15-minute bike ride

The project team used detailed maps and intensive fieldwork to assess existing conditions and identify locations where improvements are needed. Before conducting fieldwork, the Team used GIS data from the City of Richmond to create maps of each station area showing existing sidewalks and bicycle facilities, as well as proposed bicycle facilities from the City of Richmond's 2015 Bicycle Master Plan. The maps included a half-mile buffer around each Pulse station. In several instances, the half-mile buffers overlapped, allowing the fieldwork team to assess conditions for multiple stations simultaneously.

Fieldwork was conducted from Tuesday, November 29 through Friday, December 2, 2016. In the field, the team divvied up the station areas and worked in pairs to assess both sides of each block and all of the intersections within a half mile of each station. Data was recorded using a GPS-enabled smart phone app. The app was pre-programed with a short survey that prompted users to input data related to street width, posted speed limit, presence of sidewalks and curb ramps, type of traffic control device, and select from a list of recommendations that would improve bicyclist and pedestrian access (see survey in Attachment 3). The app was also used to take geotagged photographs of existing conditions. Over the course of three days, six team members collected nearly 1,200 data points and took almost 2,000 photos. The data was downloaded from the app as a GIS shapefile and refined before being used to inform the recommendations on the following pages.

While some recommendations for infrastructure improvements were identified in the field, others were made based on the data collected through stakeholder input, the review of local planning documents, and desktop surveys. In many instances, further study, analysis, and public input are necessary to comprehensively address the issues and recommendations.

All recommendations included in this chapter follow the overall principles put forth in preceding planning initiatives including the Pulse Corridor Plan and the 2015 Richmond Bicycle Master Plan. These principles include increasing and promoting a network of comfortable and accessible bicycle and pedestrian facilities connecting to and from transit. The remainder of this chapter is divided into two sections. The first section focuses on recommendations for citywide policies and programs that will improve accessibility for people walking and biking to and from the Pulse Line and other transit routes. The second section is organized geographically by station, and provides additional detail regarding the existing conditions and proposed recommendations for each of the seven station areas.

Overview

The BRT line is an important addition to the transit system in Richmond, Virginia. Lessons learned from the implementation of this line will be applied to the implementation of future BRT and other transit lines. Furthermore, successful implementation of the Pulse BRT will help increase support for high quality transit service in the region. One critical measure of success for all transit projects is ridership – and one of the best ways to encourage robust ridership is to ensure safe, convenient, and comfortable walking and biking access to the stations and stops. The findings and recommendations presented here identify dozens of relatively minor sidewalk, crosswalk, and roadway design changes, maintenance strategies and operational best practices that will enable and encourage pedestrian and bicycle access to seven of the Pulse stations on Broad and Main Streets.

The recommendations will also help to link a number of neighborhood, citywide, regional and Federal initiatives that are connected to The Pulse. The historic Fulton neighborhood, for example, is in the early stages of economic redevelopment with new industries and housing appearing on either side of Williamsburg Avenue, close to the terminus of The Pulse line in Rocketts Landing. The area is also the subject of ongoing planning and community development involving the Greater Fulton Neighborhood Association, the City of Richmond, CSX, the Greater Richmond Transit Authority and the Federal Highway and Transit Administrations and others. All of these initiatives will benefit from the seamless and safe integration of transportation options which start and finish with the ability of people to walk and ride their bikes to access transit, jobs, services, education, and recreation in both the immediate neighborhood and beyond.

As station areas serving The Pulse develop over the next several years, reinforcing or re-introducing a fine grid of pedestrian-friendly, fully accessible streets, alleys and paths is essential to connect people to BRT and other transit options on Broad and Main Street. These recommendations provide a blueprint for achieving that goal.

Studying the areas around the stations revealed several recurring bicycle and pedestrian infrastructure issues including:

- Curb ramps that are non-compliant with ADA requirements, both in placement and design
- Lack of consistency in type, location and functionality of pedestrian push buttons
- Lack of connectivity to existing regional trails
- Sight lines at intersections obstructed by parked cars
- Sidewalks damaged by tree roots and blocked by permanent obstacles such as utility poles and fire hydrants

Where relevant, the recommendations also dovetail with planning activities extending up to five miles from the station areas, in recognition of the longer distances people might ride a bike to access the BRT corridor.

Citywide Recommendations

This section provides information about recurring issues observed during fieldwork and provides recommendations to increase accessibility to and from the proposed BRT line.

Comprehensive Pedestrian and Accessibility Plan

A Bicycle Master Plan is a critical guide for a city in developing a comprehensive bikeway network over time. The Plan lays out a detailed set of policies, programs and projects to improve the safety, comfort and convenience of bicycling in the city. To address pedestrian safety and encourage higher levels of walking for everyday travel and healthy recreation, a Pedestrian Master Plan is recommended for the City of Richmond. This document will serve as an action plan for improving the accessibility of the city for people with disabilities.

Figure 14: Parking in Shockoe Bottom

Daylight Intersections

During data collection, the study team noted that cars were routinely parked near the intersection – sometimes even in the marked crosswalk. This practice threatens pedestrian safety by obscuring sight distances at the intersection. Cars parked too close to the intersection make it difficult for drivers turning right to notice pedestrians on the sidewalk and for pedestrians to see oncoming cars. Currently, City Code Section 102-222 restricts motor vehicle parking to 20 feet from a crosswalk at an intersection, and penalties have been put in place to help with the compliance of this code.[1]

While the enforcement of the code requires that appropriate signage and education programs be in place, the study team noted that many streets did not have the appropriate signs restricting parking within the required 20 feet from the intersection. It is likely that signs have not been installed due to current funding shortfalls on both new signs and maintenance. In other instances, parking meters or signs have been placed within "no parking" zones but in a number of areas where parking demand is very high, the enforcement has been lax because of citizen complaints and pushback. In such instances, the City has looked at locations on a case-by-case basis to attempt to address potential safety issues.

Recommendations

In order to improve the visibility and safety of pedestrians crossing at intersections, the City should systematically "daylight" intersections. Strategies to achieve this include incrementally installing no-parking signs and marking the existence and length of no-parking zones.

Furthermore, No-parking signs should be installed at least 20 feet (about one parking space) from the crosswalk at the near and far side of the intersection on urban streets with 20–30 mph speed. The City should also, consider installation of bike corrals near intersections, especially at transit stops and in select downtown locations, to prevent motorists from parking too close to the intersection. Furthermore, the City should evaluate the impacts of parking modifications (ex. removing or repurposing parking spaces) by collecting crash data at intersections.

Finally, the City should install curb extensions as a routine design element, especially at intersections

1 http://www.richmondgov.com/Parking/ParkingInformation.aspx

Figure 15: Bike corral near intersection providing ample bicycle parking

near schools, parks, bus stops and other pedestrian activity generators. Curb extensions improve visibility at intersections and serve as speed management mechanisms.

Curb Ramp Orientation

The pedestrian experience is significantly influenced by the design of the built environment. Curb ramps are a critical part of the pedestrian network as they make sidewalks, street crossings, and the other pedestrian routes usable for people with disabilities, pushing strollers, children with bicycles, and others. Intersection design that includes a set of pedestrian crossing facilities and curb ramps positioned for each pedestrian path of travel across the intersection helps increase safety. During field observations, the study team noted that throughout most of the study area, there didn't seem to be a standard installation of curb ramps at intersections. Some intersections included one diagonal curb ramp at each corner, others included two perpendicular curb ramps per corner, while others did not include the appropriate pedestrian accommodations. In conversations with stakeholders, it was noted that the City is currently in the process of developing an updated right-of-way design manual and Complete Streets Guidelines where the installation of curb ramps will be addressed with details. The default installation and upgrade of existing curb ramps should be to include two perpendicular ramps per corner when possible which conforms with the current Virginia Department of Transportation design standards.

Figure 16: Missing curb ramp on the intersection of Main Street and Jefferson Street

Figure 17: Perpendicular curb ramps, high visibility crosswalks make it easier for pedestrians with disabilities to maneuver the intersection

Figure 18: Perpendicular curb ramps, high visibility crosswalks make it easier for pedestrians with disabilities to maneuver the intersection

Recommendations

The City should work to update its design standards to conform to VDOT and national standards. To satisfy best practices for ADA-compliance and accessibility, curb ramps should be installed for each direction a pedestrian would travel to cross the street . The U.S. Access Board's Public Right-of-Way Design Guidelines (PROWAG) include a comprehensive review of standards for curb ramps.[2] While the placement of a diagonal curb ramp is acceptable, best practices for accessibility note that the preferred installation of curb ramps is to include two ramps per corner to orient visually impaired pedestrians in the direction of the sidewalk perpendicular to the adjoining street as shown in Figure 18.[3]

Bicycle Parking

The Study Team observed a wide variety of bicycle parking in the study corridor. Providing visible, easily accessible and secure bicycle parking is essential

2 http://www.ada.gov/pcatoolkit/chap6toolkit.htm

3 Photos are taken from PROWAG standards and ADA compliance Training.

Figure 19: Haphazard bicycle parking in the Science Museum Station study area.

to promoting bike travel. Well done bicycle parking communicates to everyone that bicycling is an expected and viable form of transportation. The appropriate design standards and siting guidelines should be followed to ensure that bicycle parking does not interfere with the pedestrian clear zone.

Recommendations

The City of Richmond currently installs post-and-ring or "staple" style racks that support the frame of a bicycle in two places. However, during field review, the Study Team noted that there seem to be no standards for private businesses or developers to ensure that they install bicycle racks in appropriate design specifications, quantity, and in the right locations. As the City develops these street design guidelines, it should refer to the Association of Pedestrian and Bicycle Professionals' Bicycle Parking Guidelines document, and consider adding bicycle parking requirements to its zoning ordinance, particularly for properties within the Pulse Corridor overlay.

Bus Stop Accessibility and Identification

Bus stops are a key link in the journey of a bus rider. Inaccessible or difficult to identify bus stops can be a significant barrier to increasing transit ridership by inhibiting the use of fixed-route bus service. During field observations, the study team was also asked to review bus stop accessibility. The Study Team checked for a number of elements and ADA requirements including a hard surface landing pad of at least 8 feet by 5 feet[4]; a connecting sidewalk on which users can link to their desired destination; and a barrier-free design that allows users with a wheelchair to rotate and move around within the stop. Additional elements for bus stop accessibility include the provision of lighting (especially at high ridership bus stops), as well as easily identifiable bus stops. While most bus stop locations observed outside the Pulse Line corridor, fulfilled or exceeded ADA requirements for accessibility and include other features like benches, trash receptacles and some wayfinding, the project team noted that many of the existing bus stops within the study area are difficult to find. This is caused by either faded bus stop signs, different colored bus stop poles, bus stop signs sharing street poles with other signs; or because the existing bus stop signs resemble regulatory signs such as no parking signs.

Figure 20: Existing bus stop is placed on top of a regulatory sign. The shape, size and placement makes it difficult to differentiate between the no-parking sign from the back

4 http://www.pedbikeinfo.org/pdf/PlanDesign_Tools_Audits_EasterSealsBusStopAccess2006.pdf. Page 14

Following the field review, the study team met with City staff who noted that GRTC is in the process of replacing their bus stops and developing a new route network focusing on shorter trip times and higher frequency buses along many routes. Staff also shared GRTC's dedicated website on the new bus signs and their installation. The website noted that starting March 2016 GRTC started replacing the bus stop signs along two popular routes as a pilot phase. The new basic bus stop signs would feature a taller, more visible pole in accordance to VDOT Standards, and would include GRTC customer service contact information and the routes serviced by the bus stops. Braille markers would remain on each stop.

Recommendations

The GRTC has continued to work with the City to increase the frequency and reliability of bus service along Broad and Main Streets through The Pulse Line project and other changes. In addition, GRTC has begun upgrading many of its standard bus stop signs, although a number of bus stops for connecting lines to The Pulse still need to be improved. It is recommended that GRTC, working with the City, continue to upgrade its approximately 2,000 signs throughout the system. This will help make bus stops more accessible and visible to all residents and visitors, and could help increase transit ridership throughout the region.

Wayfinding

Wayfinding helps provide information about the transportation user's current location, the location of desired destinations, and how to get to those locations from their current location. Good signs can also encourage people to walk by providing information on the time and distance to major destinations. A comprehensive wayfinding system has the potential to significantly improve the walking and bicycling experience in a community. The Study Team noted that currently there is no comprehensive wayfinding system guiding pedestrians or bicyclists to different destinations, major trails, or transit stops.

Recommendation

To increase the potential for additional transit riders, and to provide information about existing destinations for people walking and biking, it is

Figure 21: By providing clear directional signage to destinations, Washington DC enables pedestrians and bicyclists to make decisions on routing to and more easily get to their destinations

recommended that the City along with GRTC develop and implement a wayfinding plan that identifies existing and potential biking and walking routes. The wayfinding plan should also include a sign protocol, and guidance regarding sign assembly and implementation to guide potential users to and from proposed BRT stations. To this end, the City working with GRTC should focus on developing and implementing a wayfinding system that is simple, consistent and intuitive for all users. More specifically, such a system should:

- Offer navigational assistance identifying the best routes to BRT stations and other destinations, which may be different from driving routes.
- Show desired destinations within walking and or bicycling distance.
- Remind motorists to expect people walking or biking on roadways and sidewalks.

Conclusion

This report contains more than 300 specific recommendations for action. Most recommendations have been given a planning-level cost estimate for completion, except where further analysis is needed. Many of these action items are relatively inexpensive (e.g. replacing a curb ramp, fixing a damaged sidewalk, re-striping an intersection or bike lane marking); some are more expensive (e.g. installing a separated bike lane or protected intersection); and a few are identified as being most suitable for completion as part of a larger transportation project (e.g. replacing a major bridge with high quality bike and pedestrian access) or redevelopment (e.g. reintroducing a grid of neighborhood streets in a Transit Oriented Development project).

Where feasible, this report identifies groups of projects – linked by proximity or similarity – that can be completed in increments of approximately $300,000, which was noted as a common median cost for city transportation projects.

The report does not prioritize projects. However, there are tools such as the **ActiveTrans Prioritization Tool (APT)** that can be used to prioritize projects based on criteria that are ranked by the community and/or City staff.

Station Area Recommendations

The following maps and summaries include specific issues and recommendations for each Pulse station. Station area recommendations serve as a complement to the recommendations contained in the Pulse Corridor Plan and 2015 City of Richmond Bicycle Master Plan.

A number of issue area themes emerged after the field evaluation was completed. The table below notes each station area by the specific theme that emerged.

Travel-Shed for Station Areas

Recommendations for changes to the station areas were developed with three travel-sheds in mind.

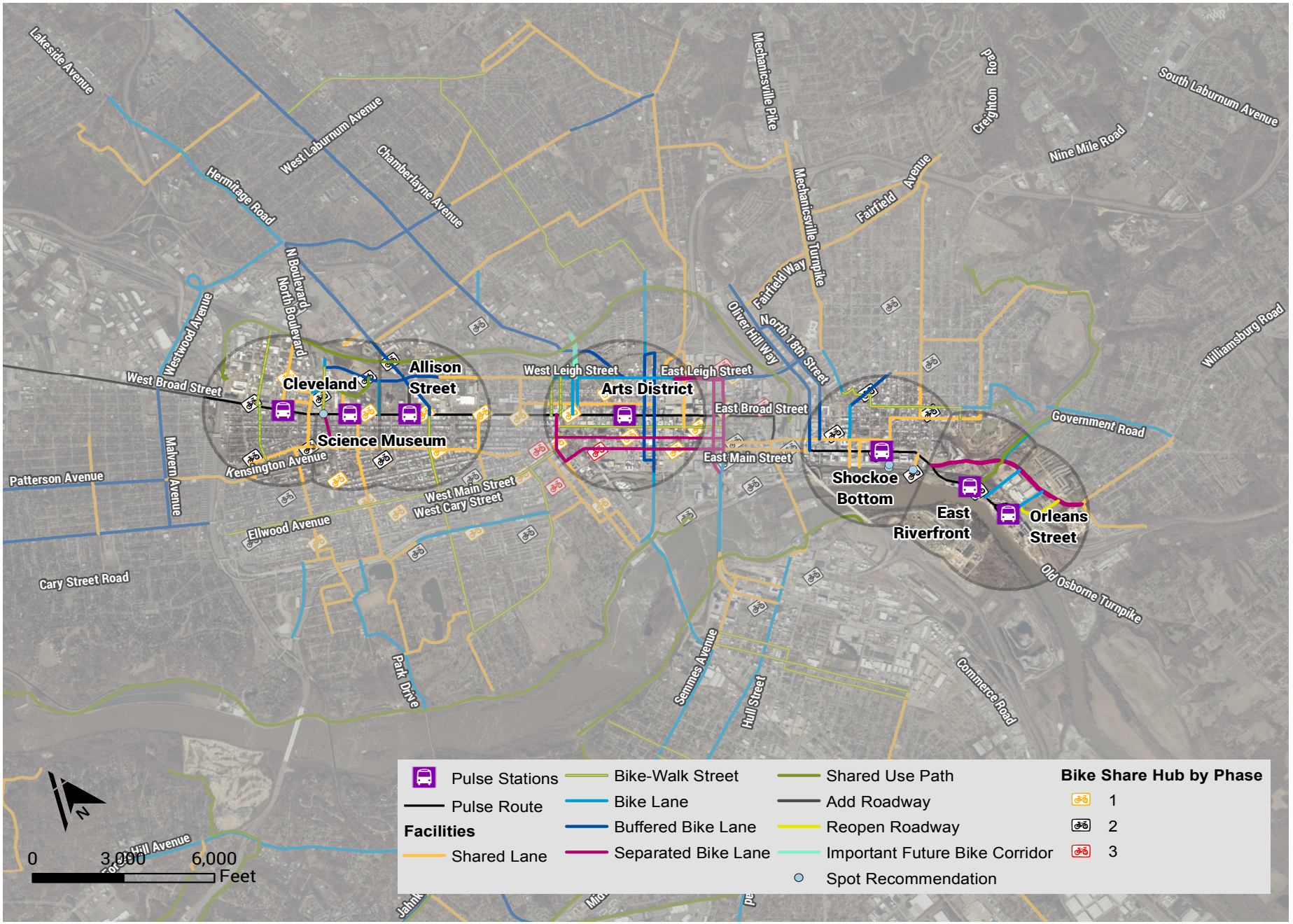
1. Half-mile radius from each station. The fieldwork for this study was completed within a half-mile radius of each station area. This corresponds to the distance generally considered to be realistic for people to walk – a 10 to 15-minute walk – to a bus or BRT service. All the detailed pedestrian recommendations and some specific bicycle network recommendations are contained within this half-mile radius. (see Figure 8 below)
2. Half-mile to three-mile radius. Longer walking trips and the majority of bicycling trips to access The Pulse are assumed to be contained within a radius of up to three miles (a 15 to 20-minute bike ride). In particular, the desktop review of potential bicycling and walking infrastructure recommendations within this radius focused on the potential to overcome significant barriers to travel such as I-95, I-195, The James River, and major rail lines. Enabling people to cross these barriers safely and comfortably by foot and by bike can increase the catchment area, and potential ridership, of the BRT line.
3. Three to five-mile radius. The extended three and five mile acess to The Pulse corridor is a valuable opportunity to more effectively link the City of Richmond's planned bicycle network (2015 City of Richmond Bicycle Master Plan) to the transit system so they can more effectively be used in tandem and to complement each other. This reflects FTA's definition of bicycling and walking catchment areas for the purposes of transit planning. Therefore, additional desktop review and stakeholder input was gathered to identify projects that would connect and expand the bike network within this broader radius of each station.

All the pedestrian issues and recommendations are unique to each station and are listed only once in relation to the closest station which they are most likely to affect. Where stations are close together and the half-mile radius overlaps, the shape of the half-mile buffer area is adjusted to avoid duplicating recommendations.

Table 4 Overarching Themes by Station Area

	Cleveland Street	Science Museum	Allison Street	Arts District	Shockoe Bottom	East Riverfront	Orleans Street
Limited ADA accessibility	●	●	●	●	●	●	●
Limited bicycle connectivity	●	●	●		●	●	●
Limited pedestrian connectivity						●	●
Highway/major arterial or rail crossings	●	●			●	●	
Topography				●	●	●	

Figure 22: Citywide Bicycle Recommendations



Orleans Street/Rocketts Landing

Overview

The Orleans Street/Rocketts Landing station is the terminus of the Pulse line, located in the far southeastern section of the study area at the E Main Street and Orleans Street intersection. The half mile area surrounding the Orleans Street/ Rocketts Landing station contains sparse industrial development, a dense, newly constructed mixed use development (Rocketts Landing), Gillies Creek Park, and residential neighborhoods. The road network is limited; railroad tracks and industrial parcels separate the station from the newer single family residential developments to the east.

Issues

The Orleans Street/Rocketts Landing station is currently better suited to pedestrian and bicycle

ORLEANS STREET STATION IN CONTEXT

The East Riverfront and Orleans Stations are considered "Emerging Stations." This combined station area scores well in terms of household and employment growth, has relatively low property values and rent prices, and has an abundance of vacant and underutilized property that could be ripe for redevelopment. Overall, the area is not currently zoned for high-density development, and portions are characterized by "superblocks" which do not foster an urban environment. Walkability and the availability of attractions and businesses are currently poor, as evidenced by this station area's Walkscore® of only 35 out of 100.

-The Pulse Corridor Plan, December 2016

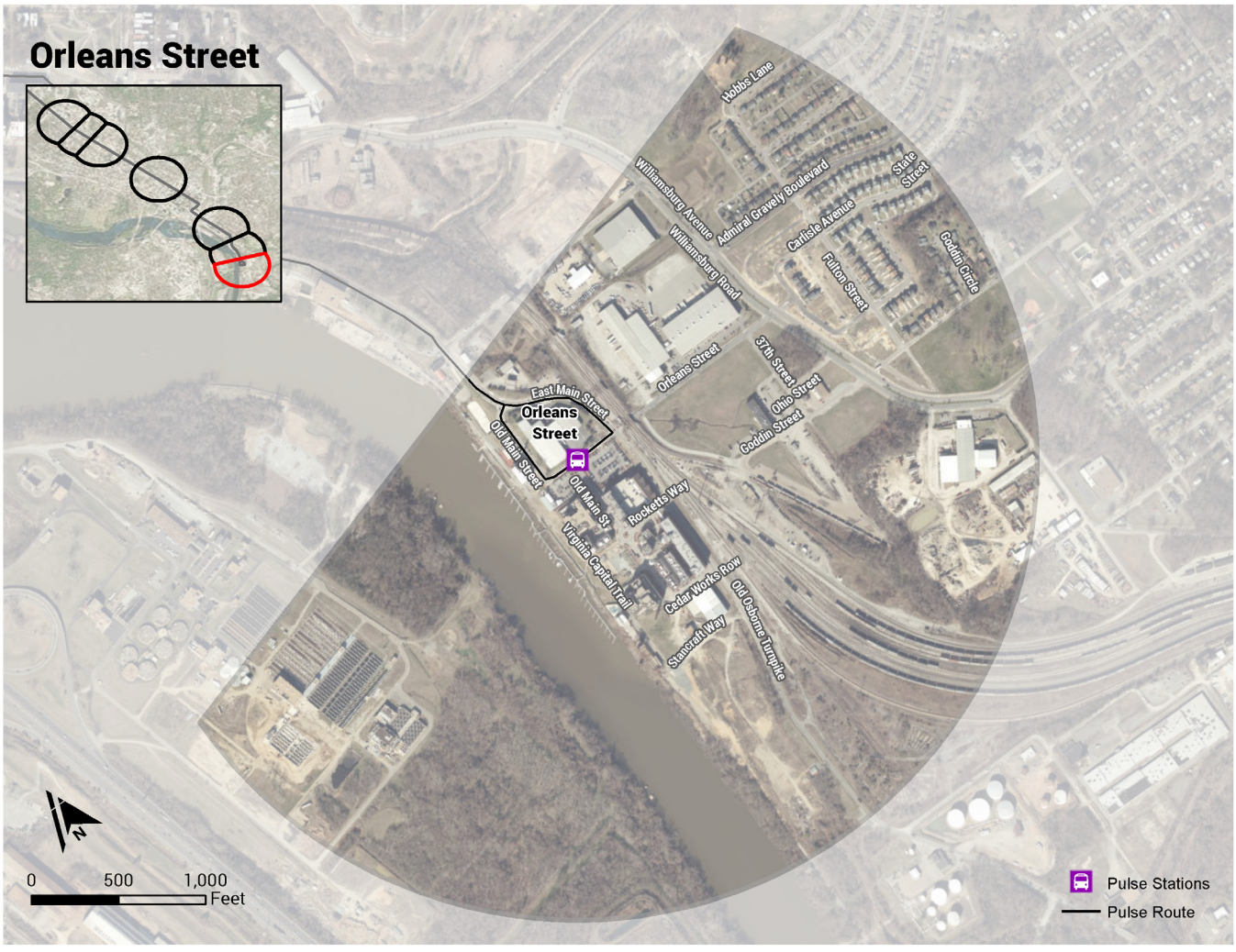


Figure 23: Orleans Street Station Study Area

Figure 24: Concerns about pedestrian accessibility in the neighborhood include cracked curb ramps and narrow sidewalks such as the ones displayed above.

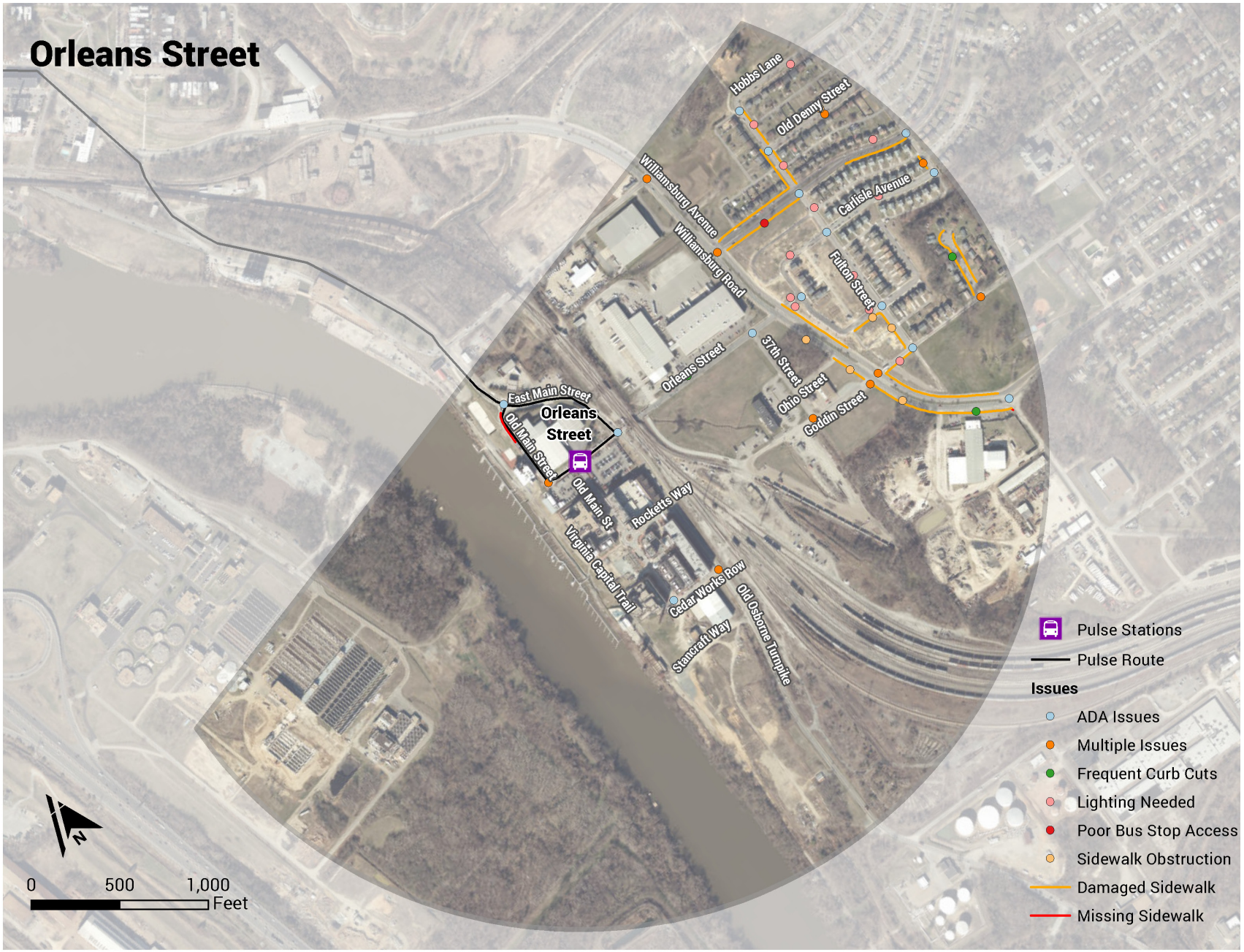
traffic than the East Riverfront station due to its location adjacent to the existing Rocketts Landing mixed use development. Rocketts Landing is compact, and has a connected sidewalk network with pedestrian scale lighting and other streetscape elements. Beyond the development, the pedestrian and bicycle environment is very similar to the area around the East Riverfront station. E Main Street and Williamsburg Avenue continue to be the main arteries through the station area, and pose the same challenges for pedestrians and bicyclists as listed above.

There are three distinct sets of issues affecting the accessibility of the Orleans Street station to the historic Fulton neighborhood. Each set of issues is dependent on the most direct and critical connection from the station to the residential neighborhoods east of Williamsburg Avenue. There is no sidewalk or marked crosswalk to connect to Orleans Street from Rocketts Landing, and the sidewalk on Orleans Street is narrow and has overgrown vegetation. The underpass is uninviting for people on foot or bicycle. Sidewalks within the development flanking Admiral Gravely Boulevard are narrow and disconnected. Particularly along the streets south of Admiral Gravely Boulevard, curb ramps are damaged or missing and accessibility is limited.

The first set of issues relates to the area between Main Street and Williamsburg Avenue/Road. Currently, these roads and the streets that connect them are inhospitable to walking – Main Street has no sidewalks; Orleans Street has poor sidewalks and at the far end of Orleans Street, there are no curb ramps or marked crosswalks across the four lanes of traffic on Williamsburg Avenue. Goddin Street is closed to pedestrian and bicycle traffic and is not a through street. Very little pedestrian activity was observed as the area is largely undeveloped. However, in the future this area is planned to be a vibrant mixed-use, transit oriented neighborhood and it is essential that development build in a fine grained network of streets and pedestrian access. This new TOD should also connect seamlessly across Williamsburg Avenue.

The second set of issues relates to bicycle access. Today, because of the distances involved, bicycle access to the Orleans Street station is more feasible than walking from existing neighborhoods, even as far away as the Ashley Oaks Apartments to the Northeast of Government Road (which is about a ten-minute bike ride away). Bicycle access to and from Orleans Street is a good option along the flatter areas of the greater Fulton neighborhoods and for those adjacent to Gillie Creek.

Figure 25: Orleans Street Station Issues Map



Third, further into the Fulton neighborhood, and up the hill from the Williamsburg Ave area, transit access to the Orleans Street station is the most feasible option. Any changes to the GRTC route map should provide frequent service to The Pulse station, enabling its role as a way to access jobs and services in the City of Richmond.

Recommendations

- Replace or install curb ramps to meet ADA standards.
- Repair and widen sidewalks to meet ADA standards.
- Clear vegetation from sidewalks on Williamsburg Avenue.
- Add separated bike lanes on Williamsburg Avenue.
- Add sidewalks and marked crosswalks on E Main Street.
- As redevelopment occurs between the CSX tracks and Williamsburg Avenue, add new streets to create a grid.
- Consider re-opening Goddin Street for bicycle and pedestrian traffic. This will require coordination and negotiation with CSX.
- Consider adding traffic signals at Williamsburg Avenue/Orleans Street and Orleans Street/E Main Street.
- Improve pedestrian access to the waterfront at the end of Orleans Street through signs and improved pedestrian facilities.
- Add striped bike lanes on Orleans Street between Williamsburg Avenue and E Main Street as interim treatment. Longer term, consider greater separation between bicyclists and motor vehicle traffic as part of CSX underpass improvements.
- Improve signs from Williamsburg Avenue to Orleans Street Station, Rocketts Landing, and Virginia Capital Trail.

Figure 26: E Main Street adjacent to Rocketts Landing development.

Figure 27: A No Trespassing sign on Goddin Street currently prohibits bicycle and pedestrian access.

Figure 28: Orleans Street Station Pedestrian Recommendations Map

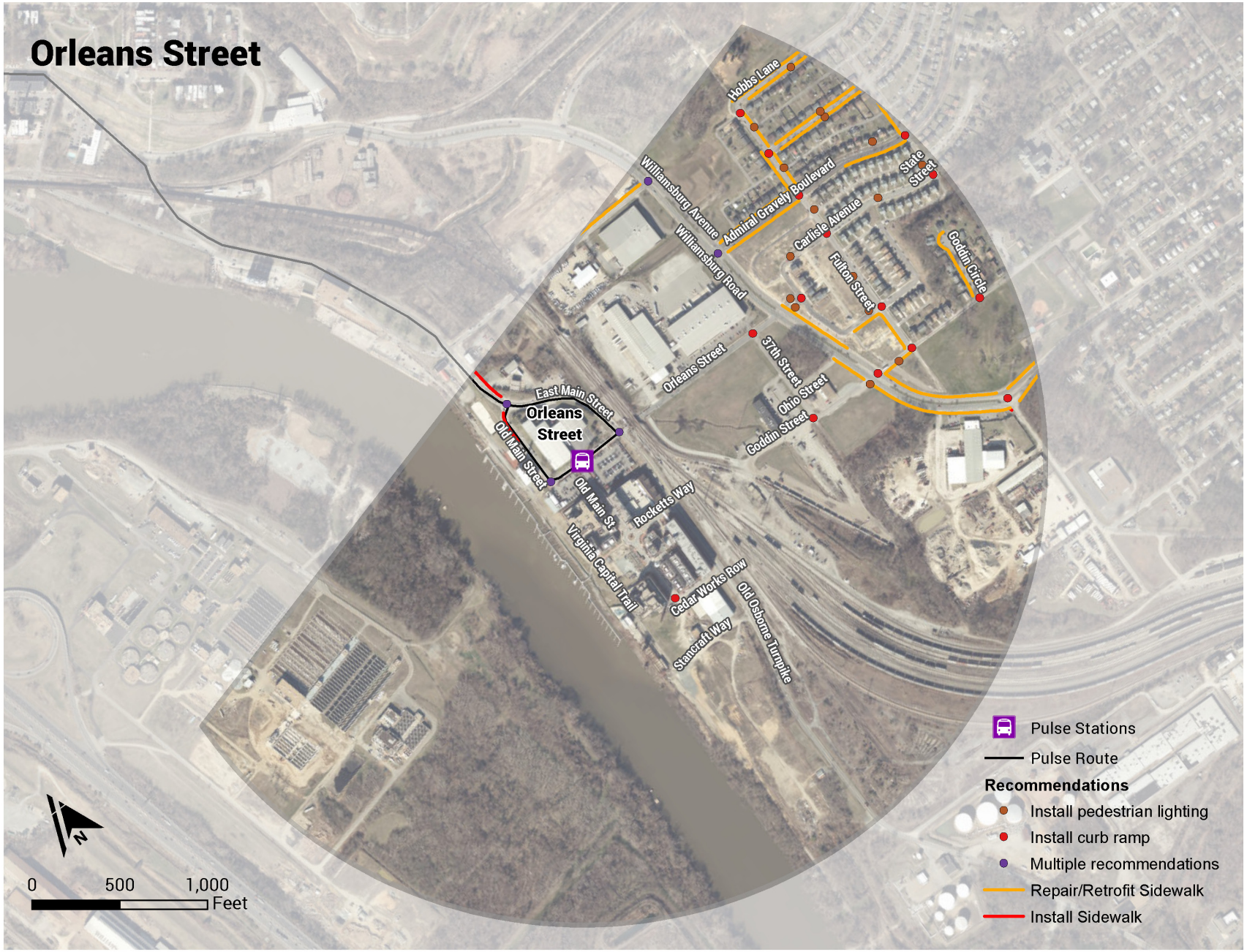
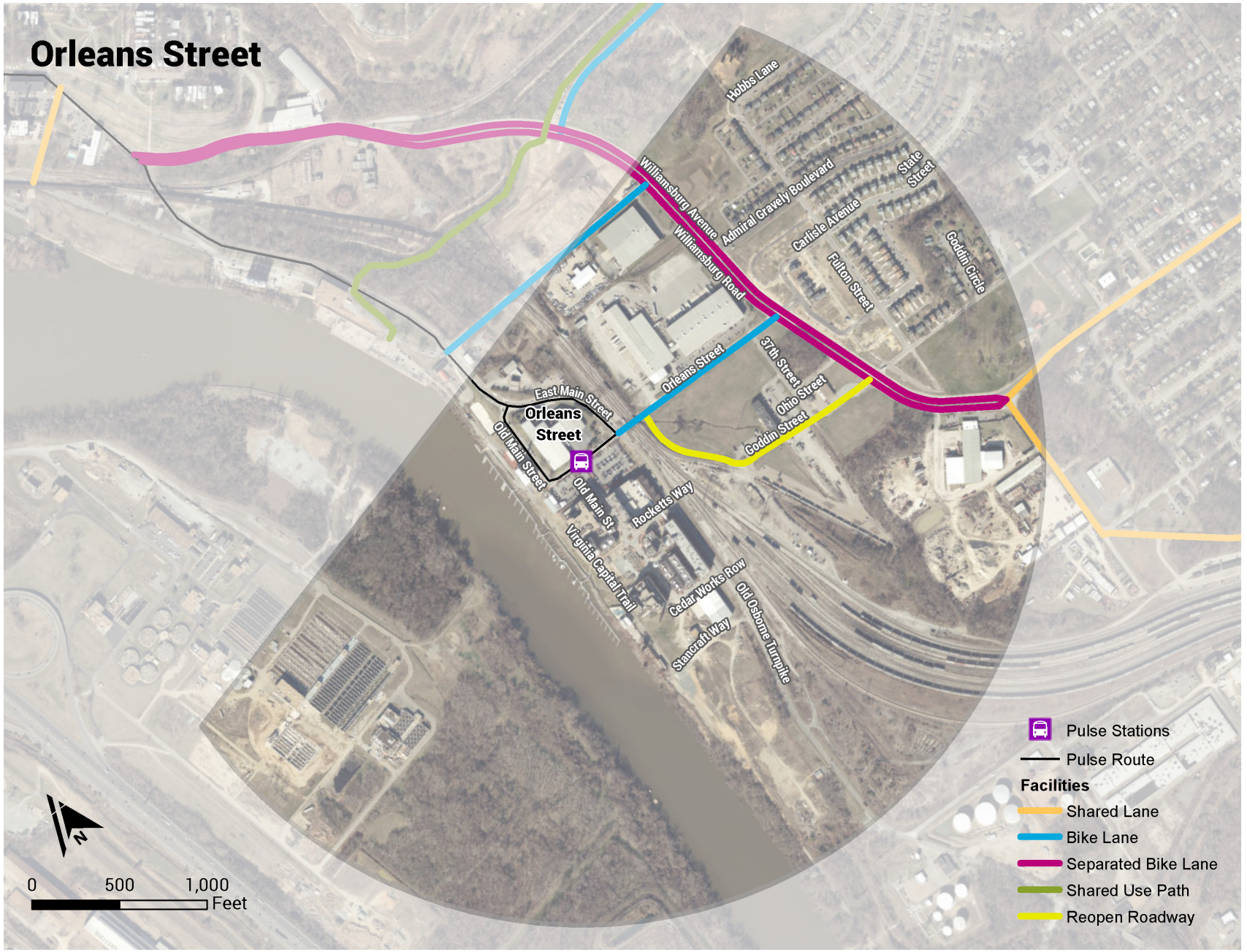


Figure 29: Orleans Street Station Bicycle Recommendations Map



East Riverfront

Overview

The East Riverfront station is located in the southeastern section of the study area on E Main Street north of the intersection with Wharf and Nicholson Streets. The half mile area surrounding the East Riverfront/Route 5 station is characterized by sparse, mostly industrial development. The road network is limited, and railroad tracks and steep topography separate the station from the Church Hill neighborhood to the northeast.

Issues

The East Riverfront/Route 5 station area differs substantially from the areas around the other stations to the west. The dense urban street grid found in Shockoe Bottom gives way to sparse industrial development connected by only a few

EAST RIVERFRONT STATION IN CONTEXT

The East Riverfront and Orleans Stations are considered "Emerging Stations." This combined station area scores well in terms of household and employment growth, has relatively low property values and rent prices, and has an abundance of vacant and underutilized property that could be ripe for redevelopment. Overall, the area is not currently zoned for high-density development, and portions are characterized by "superblocks" which do not foster an urban environment. Walkability and the availability of attractions and businesses are currently poor, as evidenced by this station area's Walkscore® of only 35 out of 100.

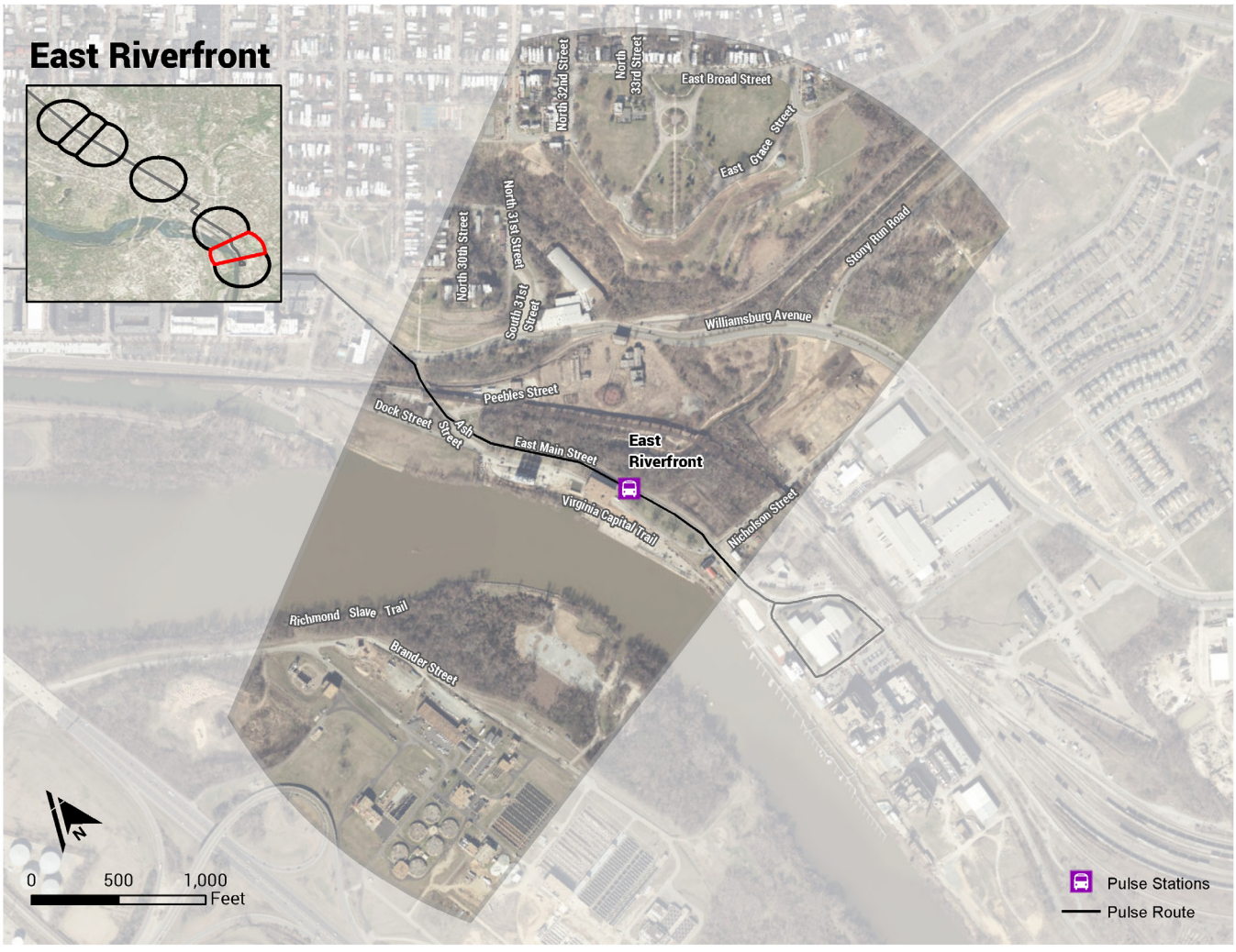


Figure 30: East Riverfront Station Study Area

through routes. E Main Street and Williamsburg Avenue are the main north-south corridors, and both streets present challenges for pedestrians and bicyclists.

E Main Street is posted at 30 mph and has two, wide motor vehicle travel lanes. There are no continuous sidewalks or bicycle facilities along E Main Street. While E Main Street parallels the alignment of the Virginia Capital Trail, grade changes and infrequent trail access points make connecting to the trail difficult. A review of projects being implemented as part of the bicycle master plan showed that t Main Street between Nicholson Street and Williamsburg Avenue has been completely redesigned to include sidewalks, bike lanes, narrower lanes, on-street parking, pedestrian lighting, reconfigured intersections, and street trees. These changes are scheduled for construction in 2017.

Williamsburg Avenue is posted at 35 mph, and has two motor vehicle travel lanes in either direction and a center median. There are continuous sidewalks along both sides of Williamsburg Avenue, but they are directly adjacent to the roadway and have become overgrown with vegetation in many places. There are no existing bicycle facilities on Williamsburg Avenue.

Both roads are difficult for pedestrians to cross, with few marked crosswalks, fewer signalized intersections, and there are concerns about speeding. Neither artery is a pleasant place to walk, and pedestrians have to walk a significant distance along both roads to reach their destinations. Pedestrians wishing to travel east from the station have to walk through the railroad underpass on Nicholson Street, which is narrow, dark, and uninviting. The development in the area is mostly industrial, set back from the main roads, and fails to provide “eyes on the street.”

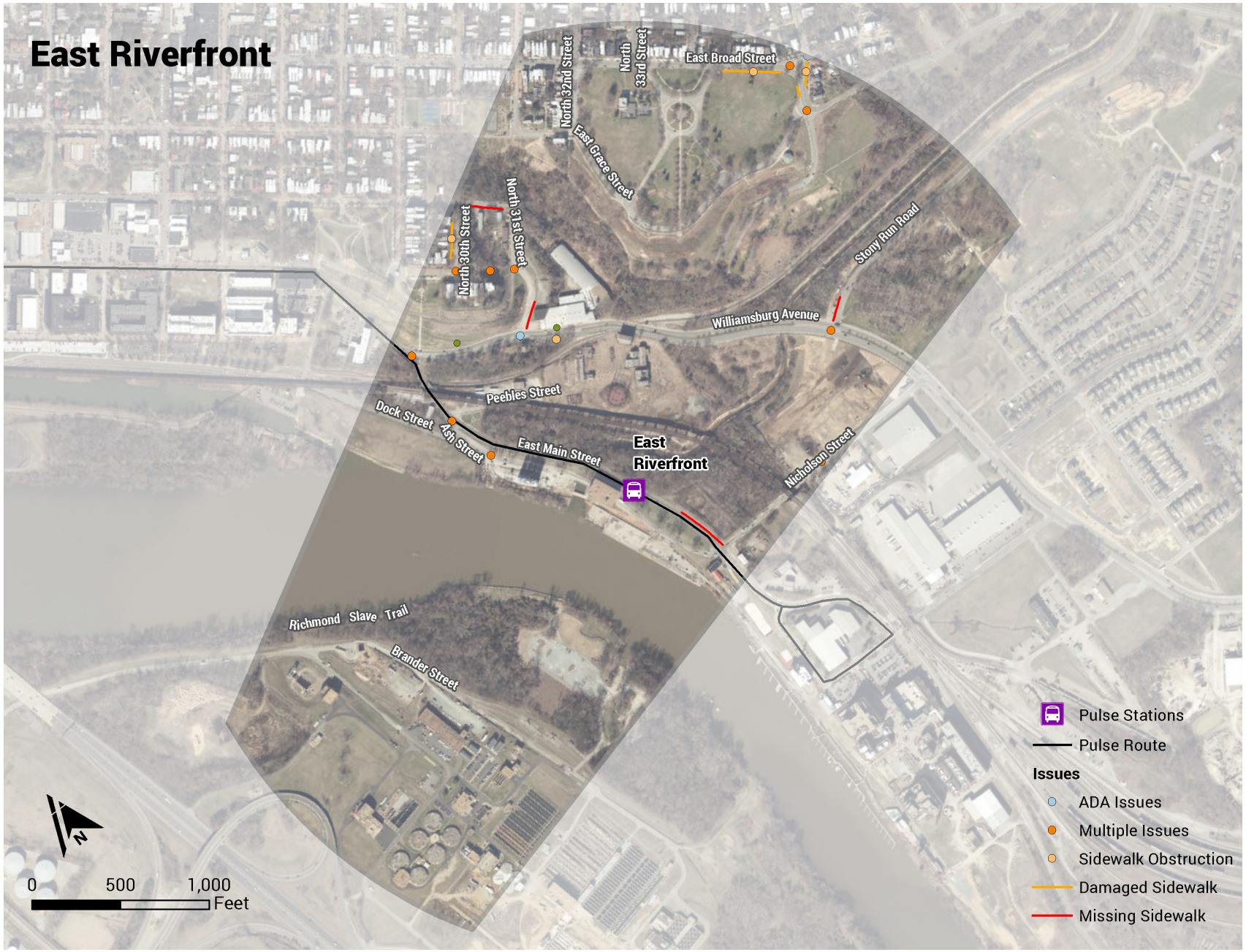
There are multiple pedestrian routes through Libby Hill Park at the far northern edge of the study area. Feedback received from local stakeholders noted that the local community has expressed interest in providing connections to the to the Riverfront that address the steep slopes and grade differential.

Figure 31: Uninviting pedestrian environment along Williamsburg Avenue

Recommendations

- Replace or install curb ramps to meet ADA standards.
- Clear vegetation from sidewalks on Williamsburg Avenue.
- Change proposed bike lanes to separated bike lanes on Williamsburg Avenue.
- Widen sidewalk on Williamsburg Avenue at the base of Libby Hill Park.
- Widen sidewalk on Nicholson Street.
- Add striped bike lanes on Nicholson Street between E Main Street and Williamsburg Avenue.
- Add sidewalks and high visibility marked crosswalks on E Main Street to connect the East Riverfront Station to Libby Hill Park to the north and Nicholson Street, Virginia Capital Trail, and Rocketts Landing development to the south.
- Tighten curb radii and add marked crosswalks at Stony Run Road and Williamsburg Avenue intersection.
- Complete construction of the Gillie Creek Greenway as an essential connection from the Ashley Oaks Apartments and Montrose Heights

Figure 32: East Riverfront Statoin Pedestrian Issues Map



neighborhood.

- Investigate the need for a traffic signal at Stony Run Road and Williamsburg Avenue to help facilitate future greenway crossings.
- Investigate installation of grade separated crossing of the Norfolk-Southern at-grade rail line and Gillie Creek that connects Fulton Road to the bottom of Chimborazo Park.
- Study the implementation of a bicycle and pedestrian connection between Libby Hill Park and the Riverfront.

Figure 33: The intersection of Stony Run Road and Williamsburg Avenue is wide and lacks marked crosswalks and ADA compliant curb ramps

Figure 34: One of several steep pedestrian paths in Libby Hill Park

Figure 35: East Riverfront Station Pedestrian Recommendations Map

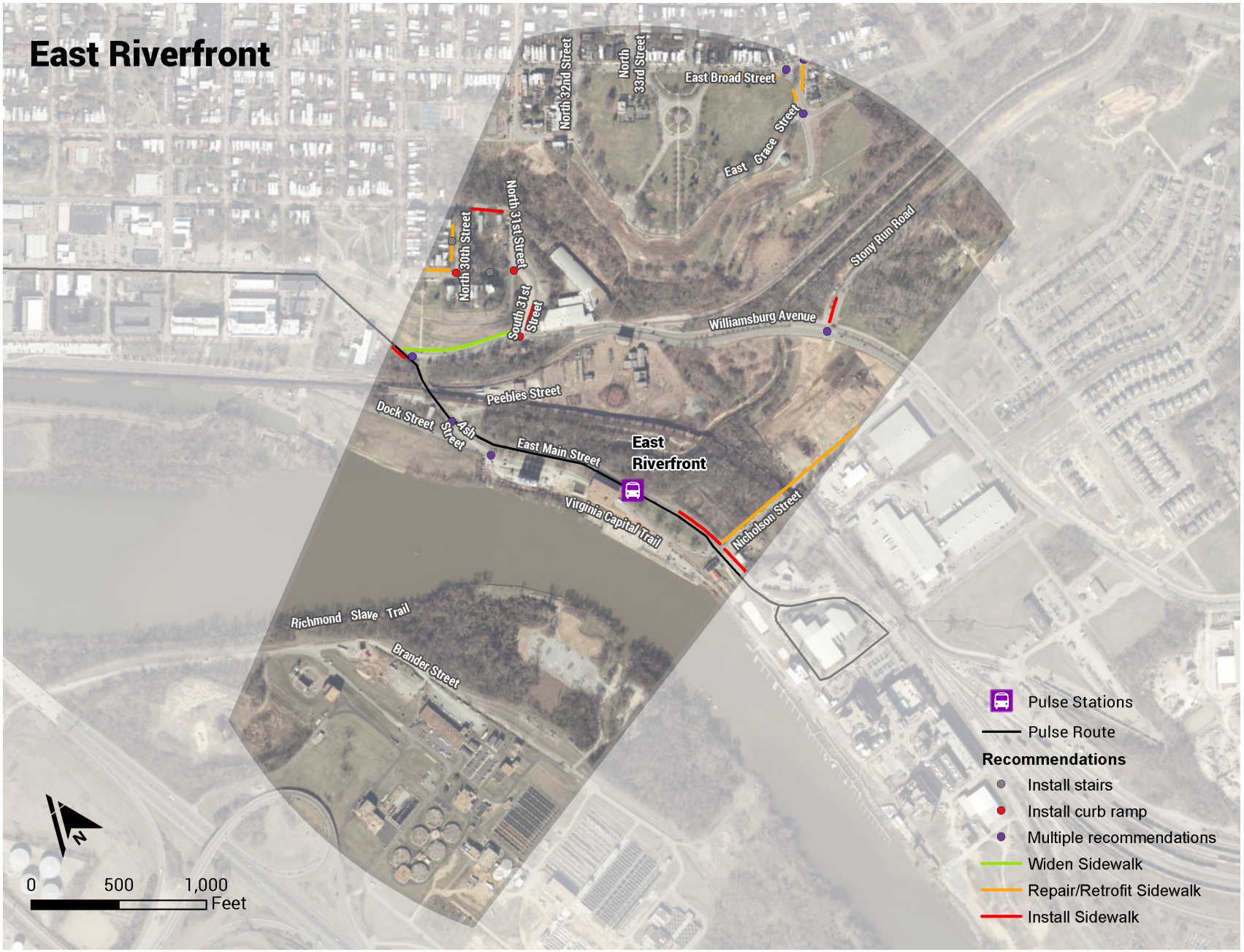
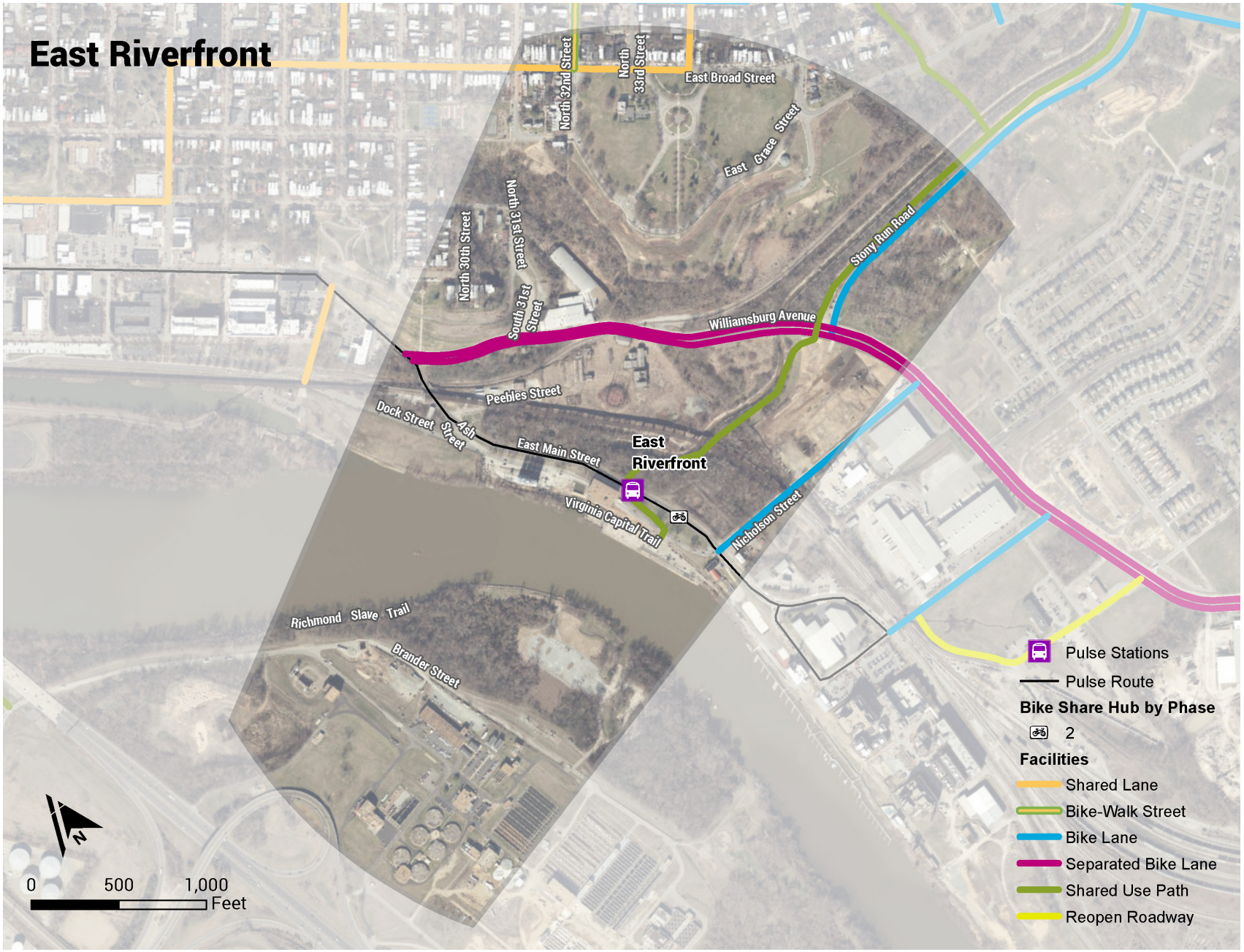


Figure 36: East Riverfront Station Bicycle Recommendations Map



Shockoe Bottom

Overview

The Shockoe Bottom Station is located in the southeastern section of the study area at the intersection of E Main Street and S 24th Street. The half-mile area surrounding the Shockoe Bottom/24th Street station encompasses the central portion of the Shockoe Bottom neighborhood and southern edge of the Church Hill neighborhood. The Shockoe Bottom/24th Street station is only a few blocks from the Virginia Capital Trail along the James River.

Issues

The Shockoe Bottom Station area includes a dense street grid that provides many routing options. Throughout most streets in the neighborhoods of Church Hill and Shockoe Bottom, vehicular speeds are slow and mature tree canopies provide shade

SHOCKOE BOTTOM STATION IN CONTEXT

The Shockoe Bottom Station area is an "Emerging Station" as it performs well in all three categories of analysis. The area is growing in population and employment, has low land costs, and high commercial permit activity. Overall, the area is not zoned for high-density development, though some portions of the walkshed do allow this form by-right. The area has a large amount of vacant land, but only a few vacant parcels offer large-scale redevelopment opportunities. This area is one of the least dense in jobs and population but access to a variety of businesses, a strong street grid, and proximity to city parks boosts this station's Walkscore® to a 92 out of 100.

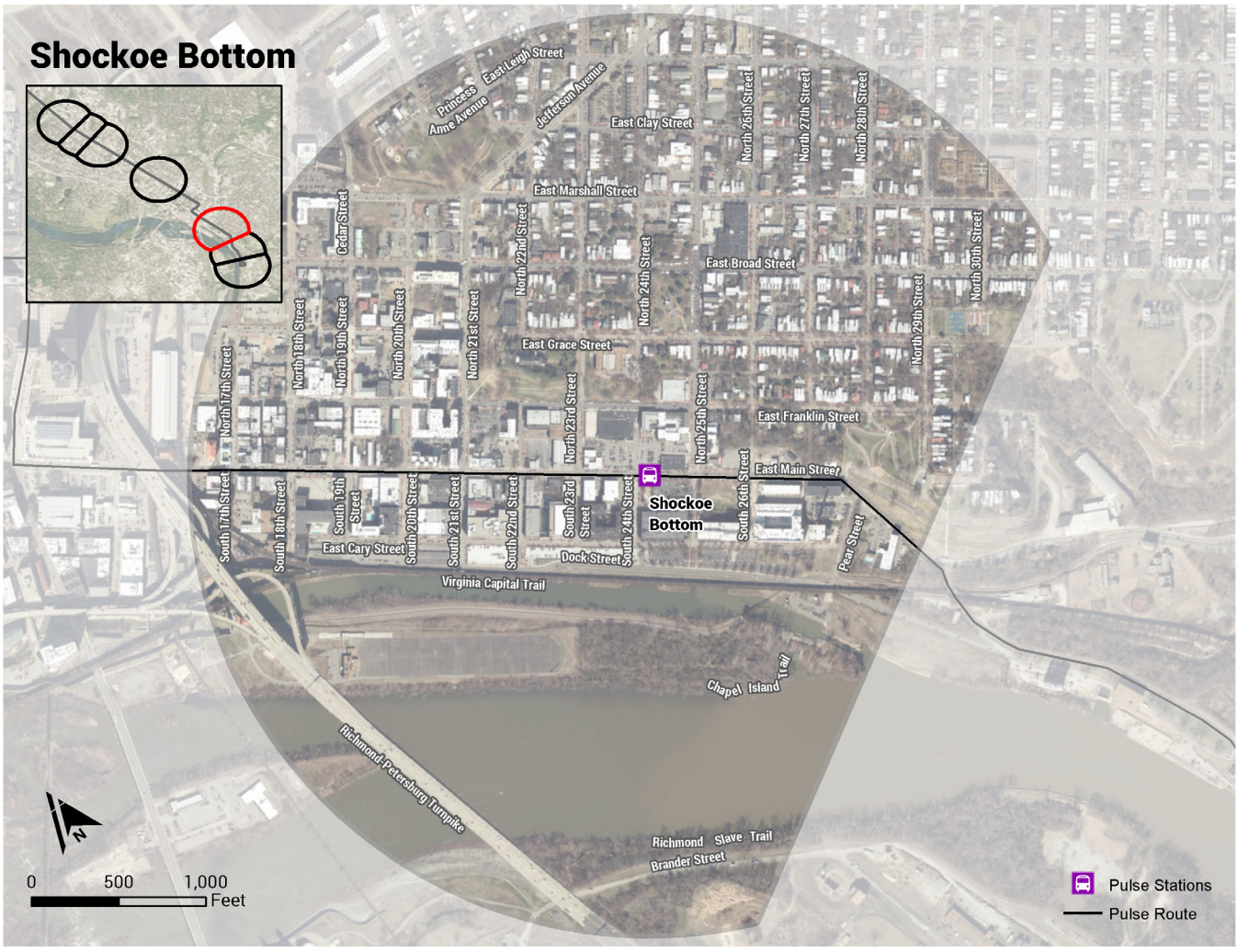


Figure 37: Shockoe Bottom Station Study Area

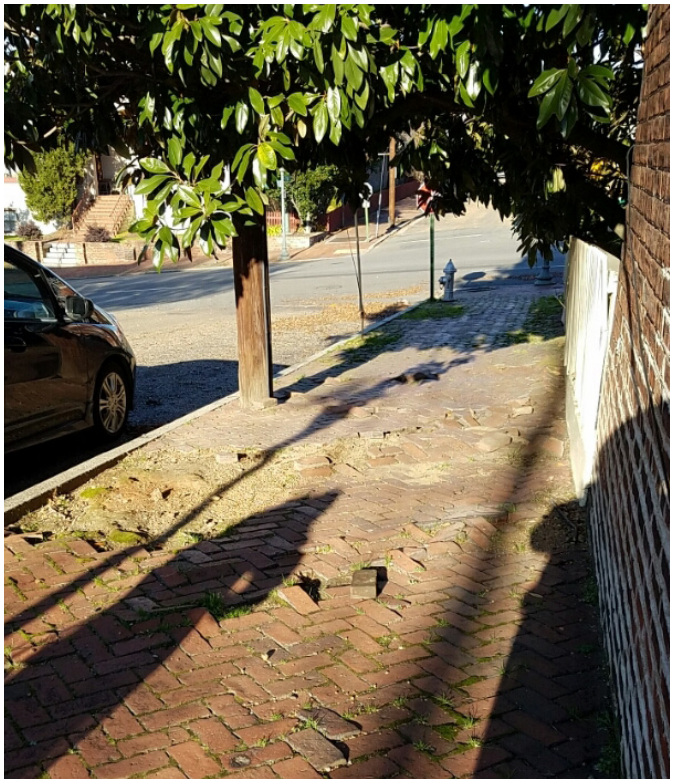


Figure 38: Sidewalk conditions in the Church Hill neighborhood

Figure 39: Existing staircase in disrepair which could provide an additional connection between the neighborhood of Church Hill and the BRT corridor

from the elements making walking throughout the area easy. However, due to the community's age, most of the sidewalks are brick and overtime have been damaged by tree roots and the elements. Such damage includes the shifting of bricks to the point where pedestrians of all abilities have difficulty traversing some sidewalks in the area. Additionally, while there are some intersections with ADA-compliant curb ramps, a number of them have either no curb ramps or substandard ones making it difficult for persons with disabilities to connect to the number of destinations on the northeastern part of the study area.

The fine-grained street network serves the heavily-populated area of lofts and apartments in the old tobacco warehouses south of Main Street. The existing network of alleys could be used to provide an even-denser, high-quality pedestrian network either side of Main Street between 23rd and 25th Streets.

The area includes a number of historic stairs that may provide the most direct connections for residents to the BRT line. The staircases are a unique feature of this neighborhood and could become a celebrated feature with creative marketing, signing and wayfinding (e.g. promoting the number of calories burned by climbing the stairs). The existence of the stairs may not be widely known, and/or those who do know of them don't realize just how close they are to the BRT Station at 24th and Main. However, one staircase (27th Street) is permanently closed and others are in need of repair to make them a true focal point for walkability and transit access.

While the area includes a compact grid, short blocks and slow traffic patterns, it is marked by difficult topography making street slopes challenging north and east of Main Street for people bicycling. Further, streets with cobblestones and lack of wayfinding also have a negative effect for residents and visitors opting to bike throughout the area. However, the close proximity to the Virginia Capital Trail, a regional destination which connects Richmond to Jamestown makes it imperative to provide comfortable connections to and from it.

Figure 40: Shockoe Bottom Station Issues Map

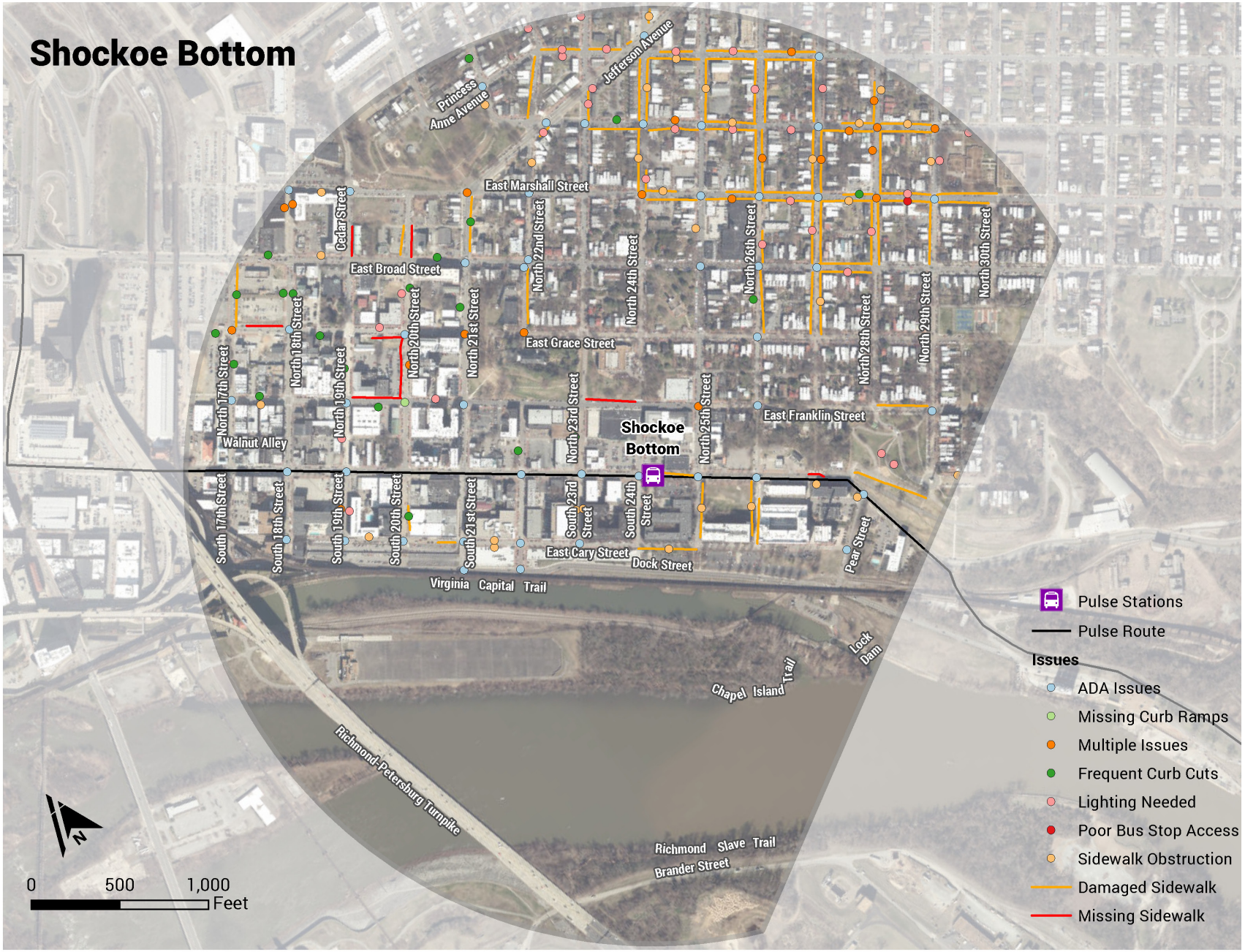


Figure 41: Unmarked crossing make it difficult to access the Virginia Capital Trail

As currently configured, Main Street and Dock Street act as barriers for both bicyclists and pedestrians. Main Street for example, includes ADA compliant sidewalks and buffers. However, the perceived speed and lack of marked crossings, make it difficult for people to connect the areas north of the corridor with destinations on the south. Similarly, while Dock Street includes wide striped shoulders on both sides of the street, excessive speeds and lack of marked crossings, have a negative effect on the number of people walking and biking along the corridor.

Recommendations

While the majority of recommendations for improving accessibility to the Shockoe Bottom BRT station focus on improving pedestrian access, there a number of possible improvements for also improving bicycle connectivity. The recommended improvements include:

- Implement high visibility pedestrian activated signal-controlled crossings on Dock Street and 25th Street to improve connectivity along Dock Street for pedestrians and cyclists going to and coming from the Capital Trail/ Low Line.
- Work with private landowners to add bike ramp to stairs at the southern end of 25th Street.
- Improve crossings at 23rd and 25th Streets on Main Street by installing high visibility crossings and signs.
- Reconstruct sidewalks on northern part of study area.
- Construct new sidewalks on Franklin Street, 20th Street, Grace Street and Cedar Street
- Reconfigure existing crossing on Pear Street and Dock Street to improve access to trailhead. Include advance warning signs on Dock Street, traffic calming to slow traffic in advance and high visibility crosswalks. Consider the implementation of a HAWK signal.
- Improve wayfinding to and from the trail as well as other local and regional destinations.
- Implement buffered bike lanes along 18th Street, 17th Street and Jefferson Avenue.
- Consider rebuilding and reopening stars on 27th Street.

Figure 42: Shockoe Bottom Station Pedestrian Recommendations Map

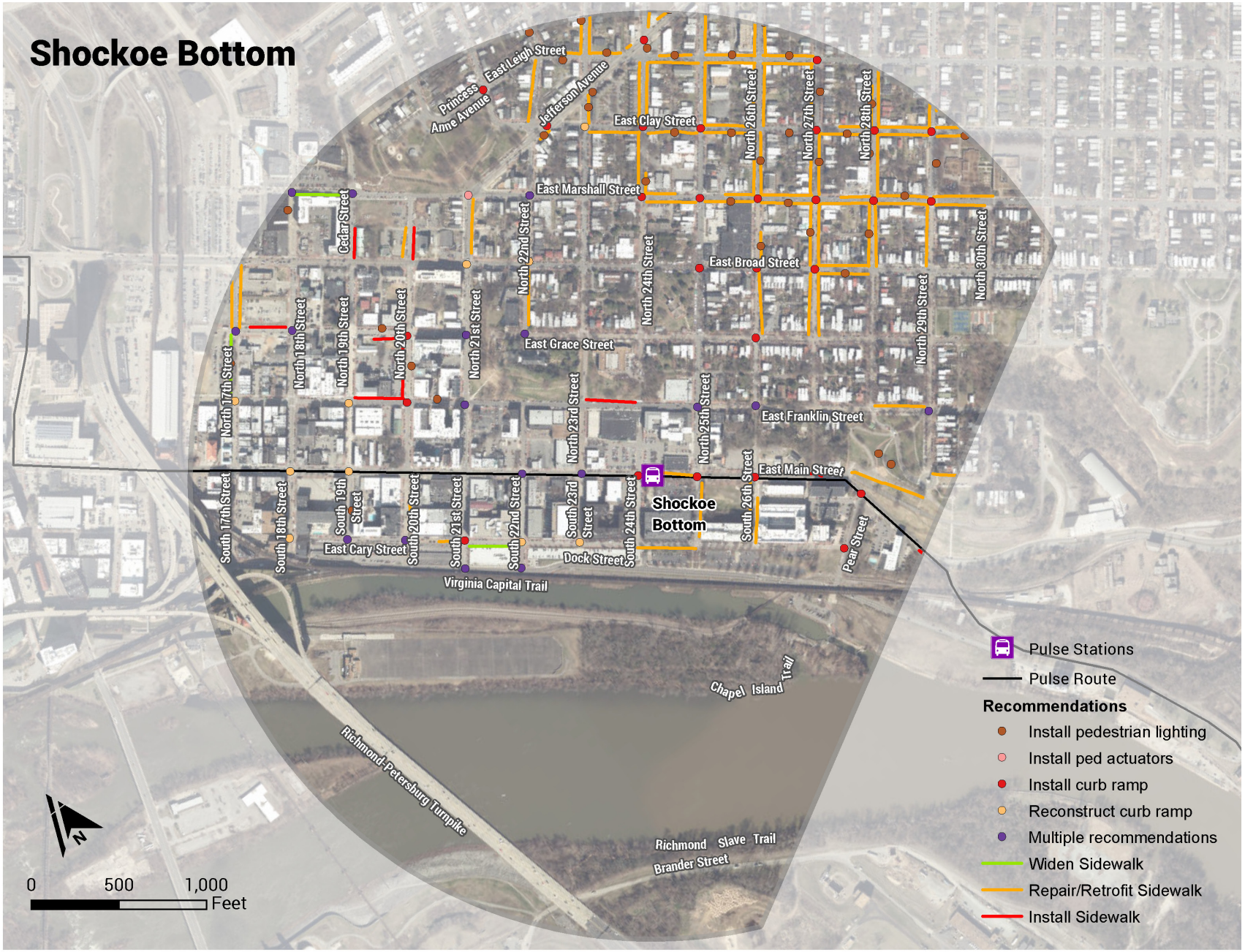
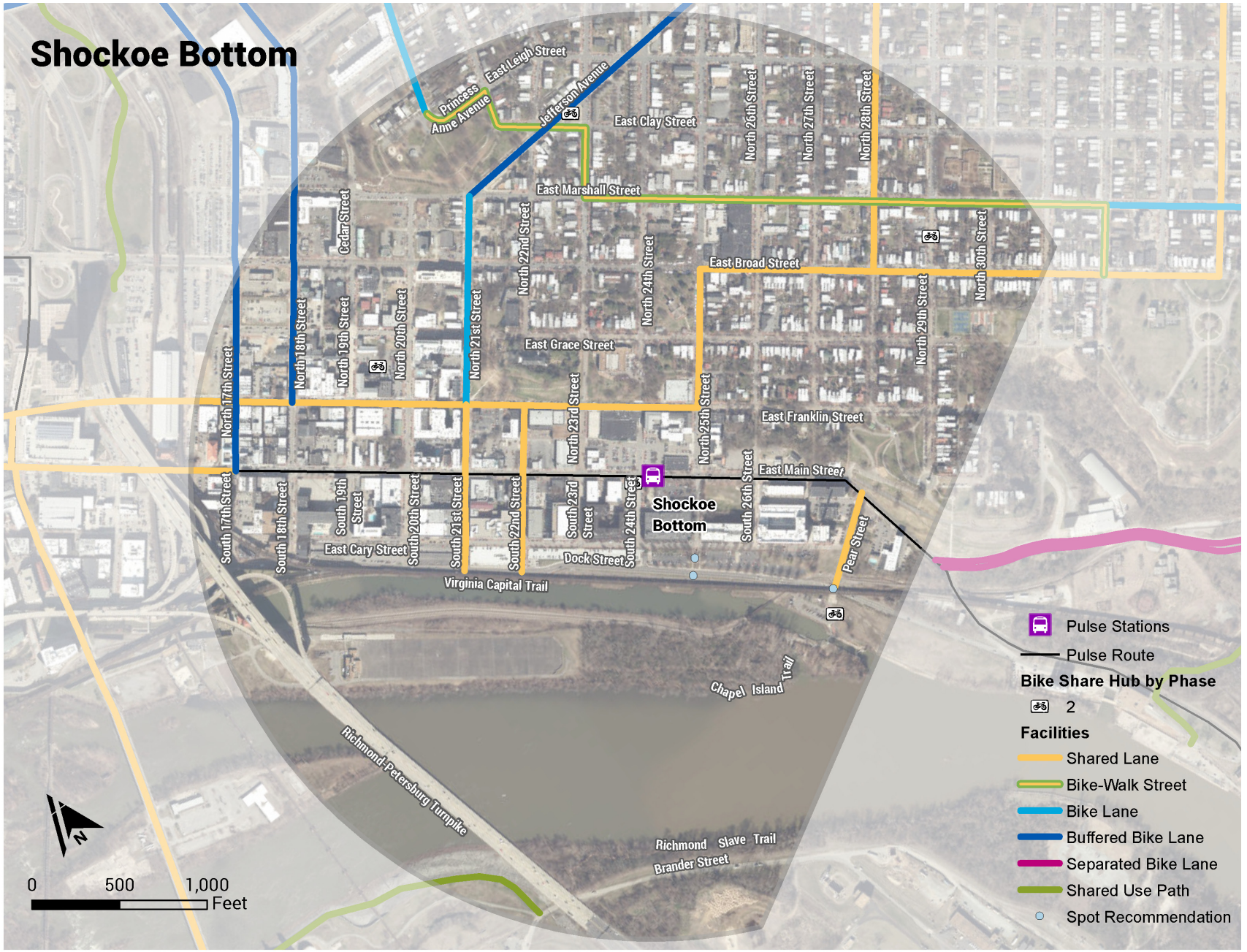


Figure 43: Shocloe Bottom Station Bicycle Recommendations Map



Arts District/Adams Street

Overview

The Arts District/Adams Street station is located in the center of the study area at the intersection of N Broad Street and N Adams Street. The half mile area surrounding the Arts District/Adams Street station is the most urban of the station areas and encompasses portions of the Jackson Ward, Monroe Ward and City Center neighborhoods.

Issues

The area includes a dense street grid with good north-south and east-west pedestrian connectivity. Sidewalks are generally ADA-compliant and accessible while major intersections have pedestrian signal heads with countdown indicators. Wide, one-way streets provide an opportunity for improved multimodal routing options and new dedicated bicycle facilities.

ARTS DISTRICT STATION IN CONTEXT

The Arts District Station area is an "Emerging Station." This station area has the highest population density in the Corridor. Though jobs are growing, the area still has a small employment density relative to other stations. Land costs are more affordable than other portions of the Corridor. Rents are higher in this station area, but the area is seeing a growth in commercial development. Much of the area allows high-density development by-right and is attracting larger developments. The many nearby amenities and the strong street grid translate to a Walk Score® of 95 out of 100.

-The Pulse Corridor Plan, December 2016

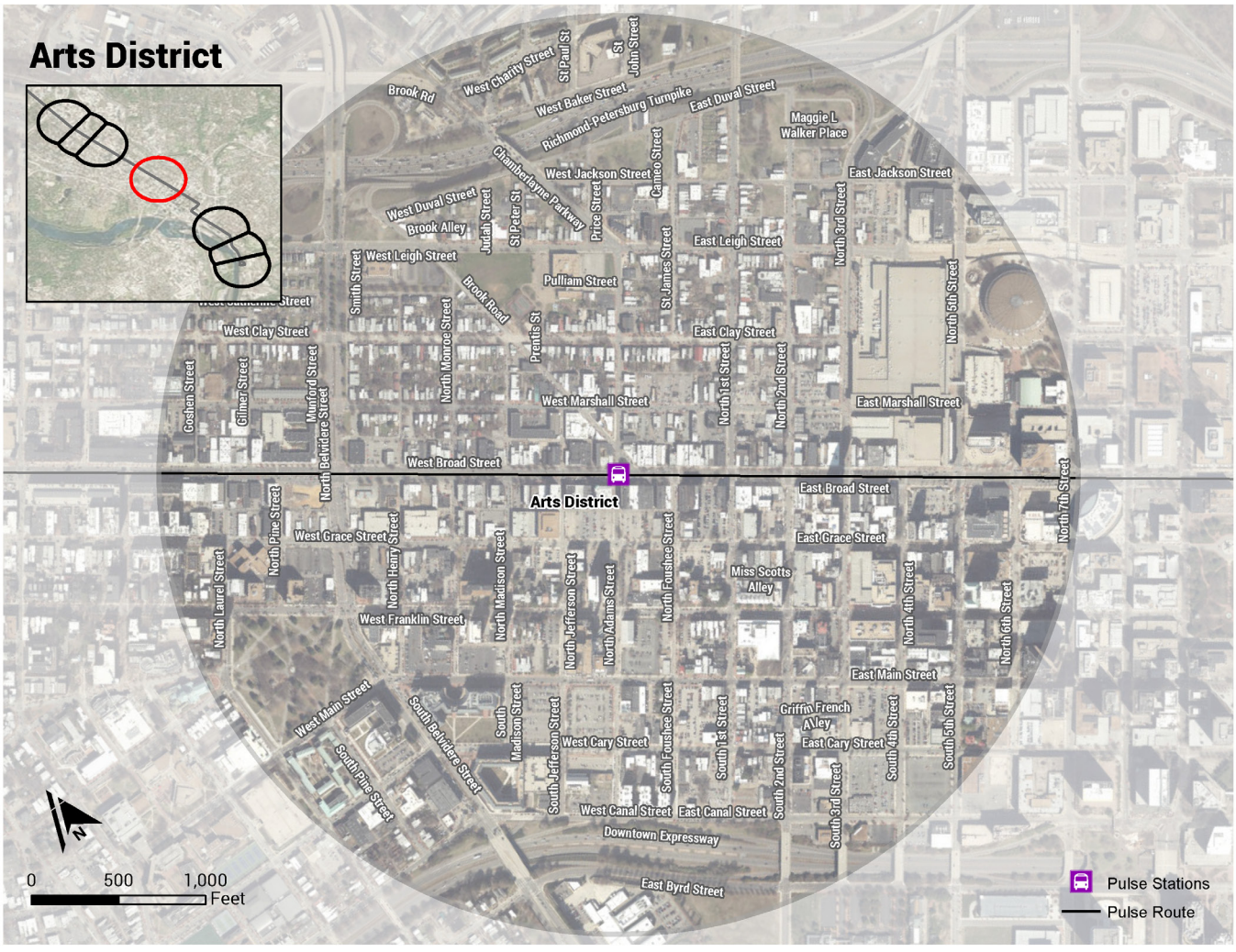


Figure 44: Arts District Station Study Area

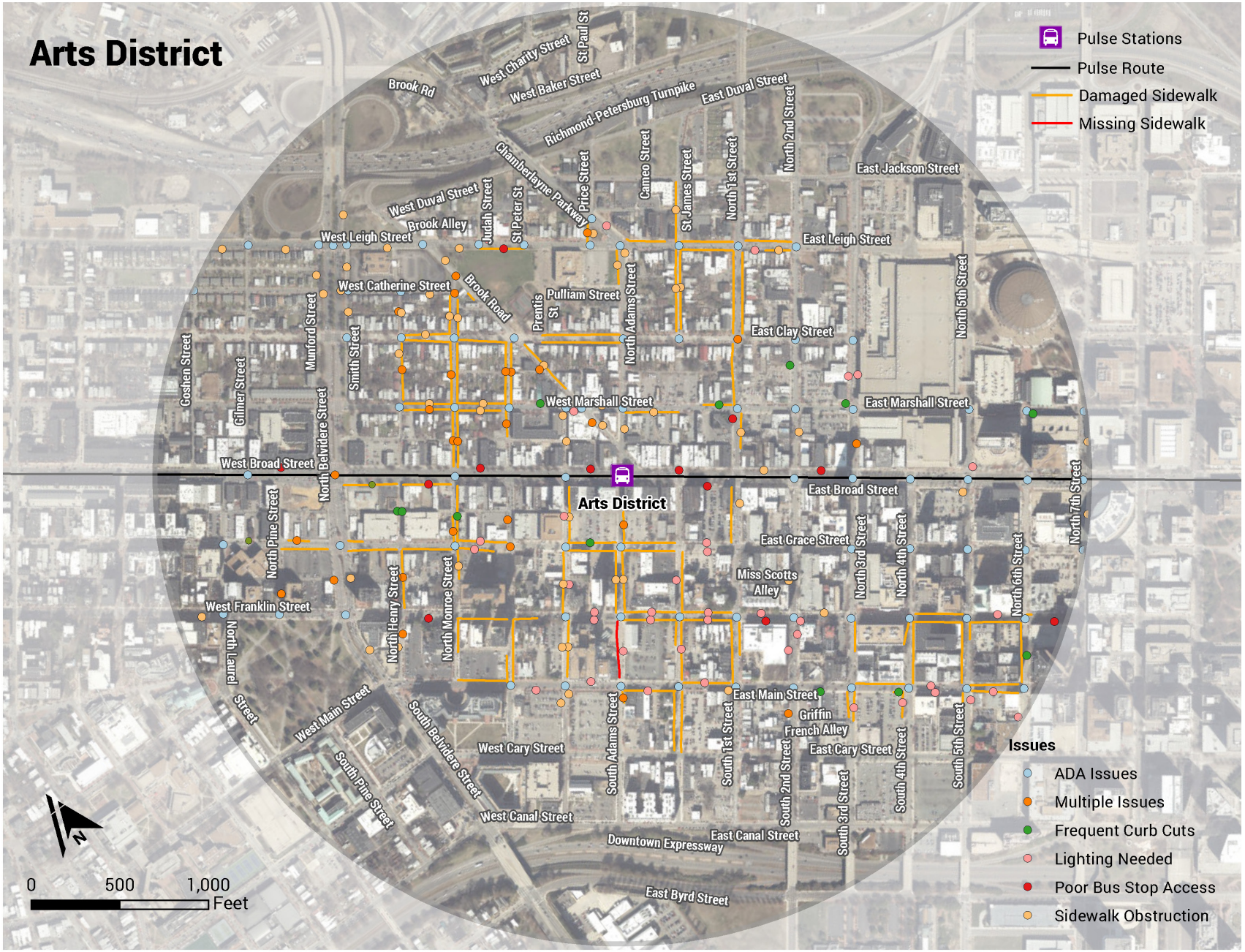
Figure 45: Missing curb ramp at the intersection of Broad Street and Adams Street makes it difficult for pedestrians with disabilities to cross the street

A number of student housing units for Virginia Commonwealth University and Virginia Union University are located within the study area, and pedestrian activity is high along many of its streets. Because of the close proximity of both universities, on-street parking is in high demand.

To the north of the Arts District station, there are block faces that lack sidewalks. Additionally, some existing sidewalks are inaccessible because they are too narrow. Leigh Street, north of the station, is difficult to safely cross due to infrequent marked crosswalks and signalized intersections. Leigh Street's width and vehicle speed also make crossing it challenging. Belvidere Street, a major north-south arterial running through the Arts District station area, includes signalized intersections and comfortable pedestrian accommodations including median refuge islands. However, there is not sufficient time at the traffic signal given to safely cross the street. As a multi-lane intersection, the intersection of Belvidere Street and Broad Street acts as a major barrier for east-west and north-south pedestrian and bicycle connectivity.

Figure 46: Deteriorating crosswalk on St. James Street and Clay Street

Figure 47: Arts District Station Issues Map



Interstate 64/95 to the north of the area, also acts as a barrier for bicycling and walking.

Recommendations

- Construct protected bike lanes on 1st and 2nd Streets.
- Repair/retrofit a number of sidewalks along local streets (see map).
- Install new curb ramps on a number of intersections, especially south of the proposed BRT line.
- Replace crosswalks at Clay Street and St. James Street and 1st Street.
- Make accessibility improvements at the intersection of Broad Street and Monroe Street, as well as Jefferson Street and Broad Street.
- Provide continuous high quality bicycle facility (i.e., bike lane) and traffic calming infrastructure along Leigh Street.
- Evaluate possibility of a one to two-way conversion on Clay Street, Marshall Street and Grace Street.
- Implement Bike/Walk Street on Gilmer Street and Goshen Street.
- Extend proposed separated bike lane on Laurel from Broad Street to Franklin Street
- Consider bike lanes on Mumford Street and Smith Street from Broad to Leigh Street.
- Identify Belvidere Bridge as critical long term bike corridor/crossing.

Figure 48: Arts District Station Pedestrian Recommendations Map

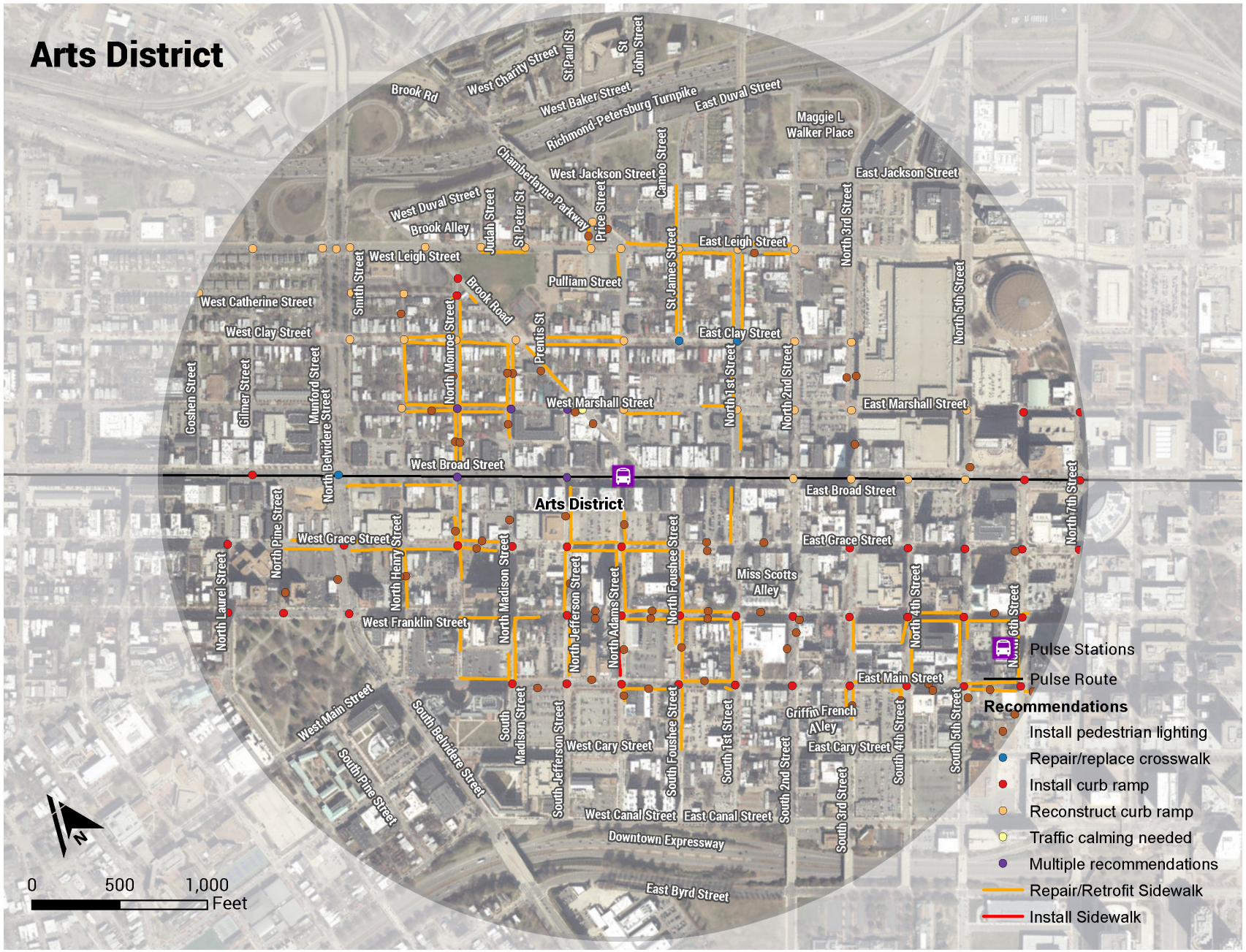
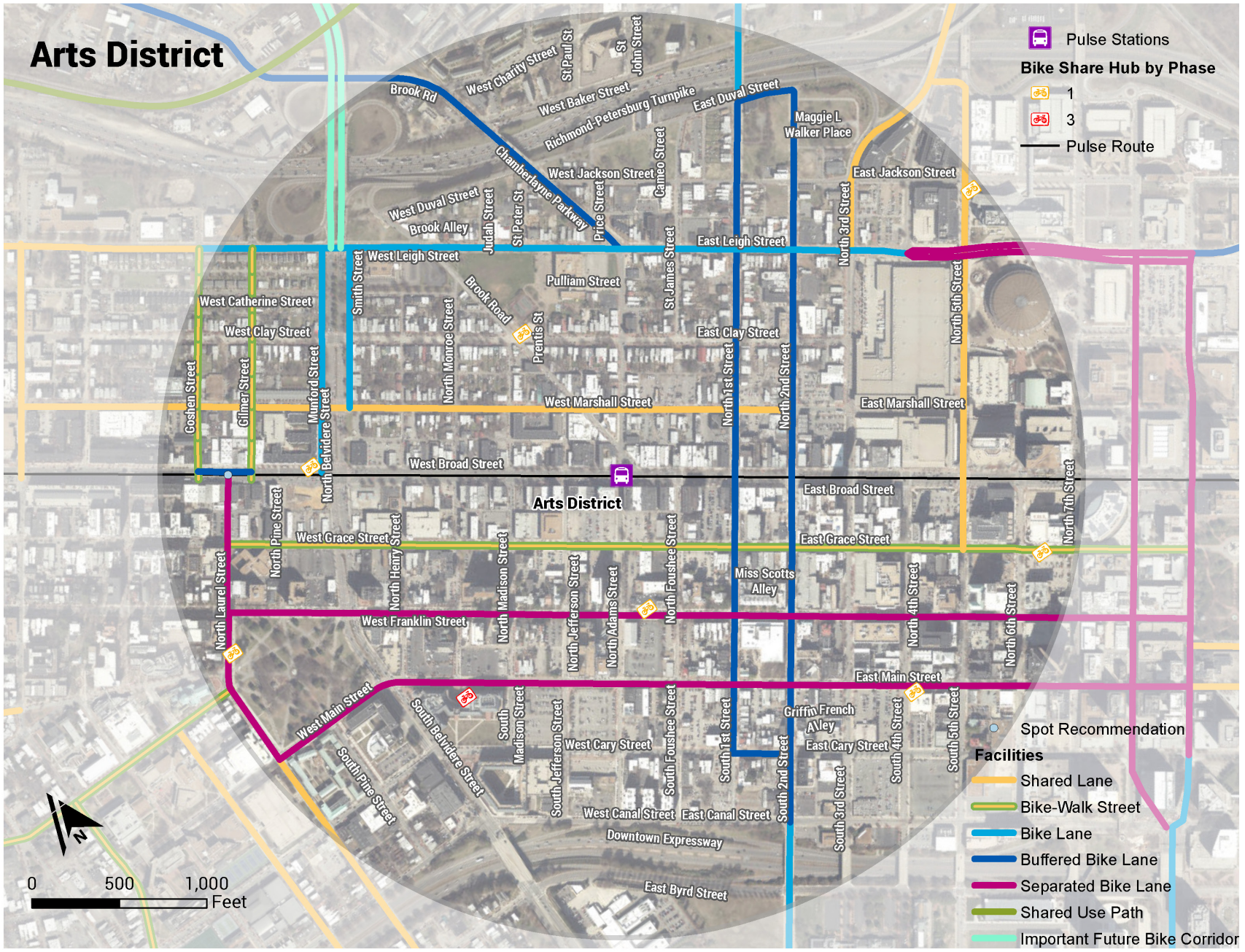


Figure 49: Arts District Station Bicycle Recommendations Map



Allison Street

Overview

The Allison Street Station is located in the northern portion of the study area at the intersection of N Broad Street and N Allison Street. The half mile area surrounding the Allison Street station encompasses a variety of land uses, portions of the Fan District neighborhood, and contains a segment of Monument Avenue. The commercial, civic and industrial area north of the station differs substantially from the mostly residential area south of the station.

Issues

The area shares some of the same characteristics, barriers, and issues related to walking and biking as the proposed Science Museum station. The Fan District Neighborhood is located directly south of Broad Street and is comprised of single family

ALLISON STREET STATION IN CONTEXT

The Sciences Museum of Virginia and Allison Street Station Areas are "Emerging Stations." The area has seen a small increase in population, features low land costs, and low office rents. However, most of the area is not zoned to enable by-right high-intensity development. The area north of W. Broad Street is a collection of superblocks, which create inhospitable pedestrian environments today, but could be significantly redeveloped with a walkable higher-density development pattern over time.

-The Pulse Corridor Plan, December 2016

Figure 50: Allison Street Station Study Area

and row homes with short blocks. Most roads in the neighborhood include five-foot sidewalks and a variable buffer which offers some separation between motorists and people walking. Most streets only include roadway oriented lighiting. Local streets with 25 mph speed limits are generally comfortable for most bicyclists accustomed to riding in traffic. This southern area includes a number of issues including lack of ADA compliant and/or marked crossings (ex. no existing curb ramps), damaged sidewalks, lack of pedestrian-oriented lighting, and poor accessibility to/from bus stops. The neighborhood is divided by Monument Avenue which acts as a barrier due to its wide travel lanes (12feet), lack of protected medians, fast traffic, and lack of marked crossings that prevent pedestrians from crossing the street.

The northern part of the study area exhibits more industrial land uses and characteristics including longer block lengths, roadway oriented lighting, and lack of pedestrian facilities on some roadways. In particular Marshall Street, Clay Street, Allen Avenue and parts of Leigh Street have an incomplete or damaged sidewalk network making it difficult for pedestrians to traverse the neighborhood. Furthermore, speeds appear to be high on Hermitage

Figure 51: Sidewalk in disrepair along Leigh Street

Figure 52: Lack of crosswalks on Monument Avenue make it difficult for pedestrians to cross the street to connect to the Broad Street Corridor

Figure 53: Allison Street Station Issues Map

Road, however the observed traffic volume was low. A number of existing intersections represent barriers for people walking and biking including those on Leigh Street and Hermitage Road, Leigh Street and Lombardy Street, Leigh Street and Allen Avenue and Broad Street and Allen Avenue.

Recommendations

Specific recommendations are listed below and conform to the recommendations contained in the 2015 City of Richmond Bicycle Master Plan, Draft Pulse Corridor Plan and others:

- Construct buffered bike lanes on Hermitage Road and Leigh Street.
- Study the construction of a rail-trail greenway along the railway corridor directly north of Leigh Street providing east-west connections.
- Determine crossing improvements and/or a better crossing of Broad via the Allen St proposed bike boulevard As redevelopment occurs, introduce a more connected street grid north of Broad Street using complete streets guidelines.
- As redevelopment occurs, ensure extension of North Allison to Hermitage Road secured for bike access/trail connection.
- Explore the creation of an east-west bike route between Belvidere and Boulevard Avenue.
- Improve intersections at Leigh Street and Hermitage Road, Leigh Street and Lombardy Street, Leigh Street and Allen Avenue, Monument Avenue and Meadow Street; and, Broad Street and Allen Avenue.
- Construct new or repair existing sidewalks on Clay Street, Marshall Street, Allen Avenue, Grace Street, Hermitage Road and Leigh Street.
- Construct protected bicycle infrastructure at the Meadow, Hermitage, and Broad Street intersection to provide a key north-south link in the bicycle network
- Improve intersection at Stuart Circle to better accommodate cyclists.

Figure 54: Existing bicycling and pedestrian facilities along Hermitage Road

Figure 55: Allison Street Station Pedestrian Recommendations Map

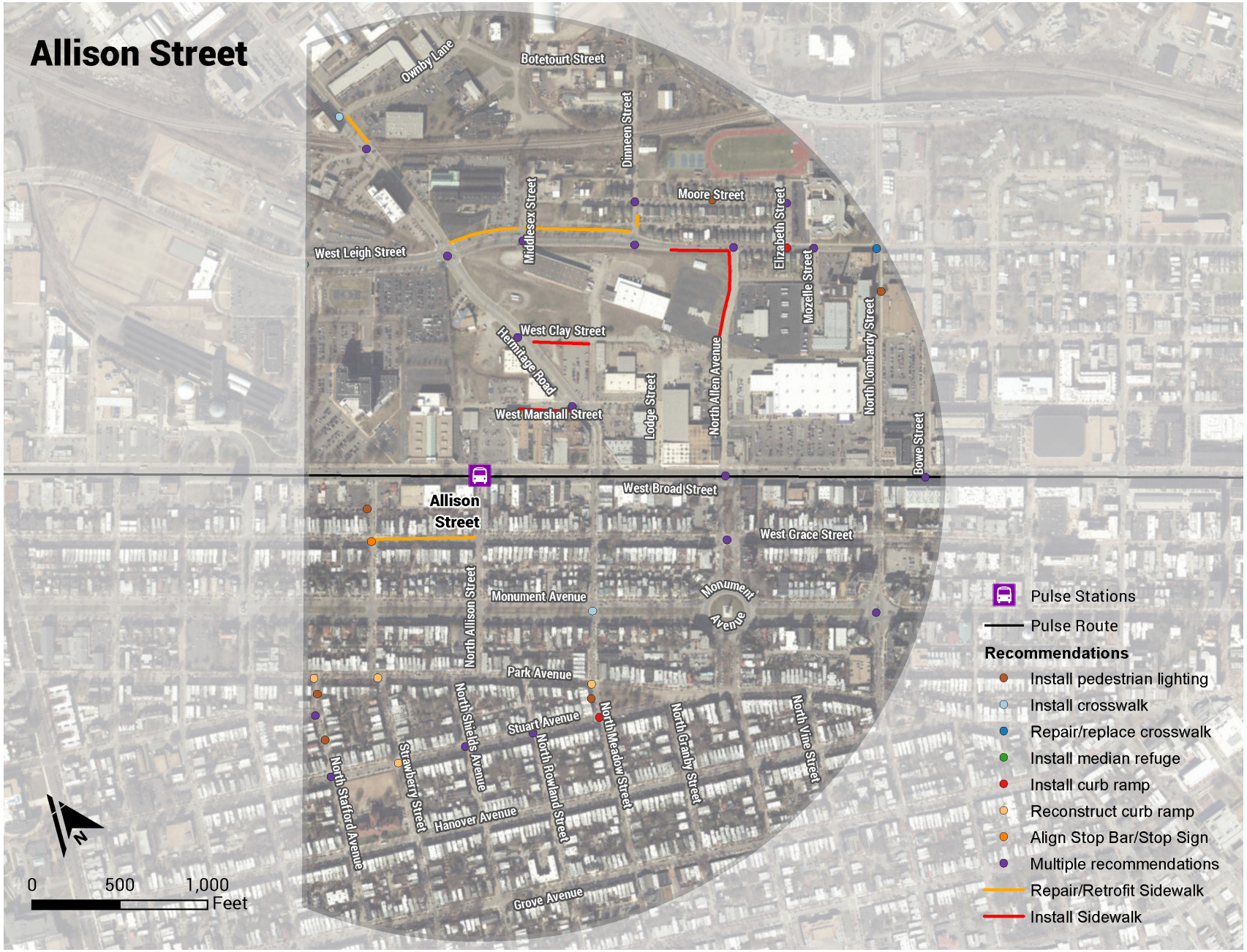


Figure 56: Allison Street Station Bicycle Recommendations Map

Science Museum

Overview

The Science Museum/Robinson Street station is located in the northern portion of the study area at the intersection of N Broad Street and N Robinson Street. The half mile area surrounding the Science Museum/Robinson Street station encompasses a variety of land uses, portions of the Museum District and Fan District neighborhoods, and contains segments of major roads including N Boulevard Avenue and Monument Avenue. The civic and industrial area north of the station differs substantially from the mostly residential area south of the station.

SCIENCE MUSEUM STATION IN CONTEXT

The Science Museum of Virginia and Allison Street Station Areas are "Emerging Stations." The area has seen a small increase in population, features low land costs, and low office rents. However, most of the area is not zoned to enable by-right high-intensity development. The area north of W. Broad Street is a collection of superblocks, which create inhospitable pedestrian environments today, but could be significantly redeveloped with a walkable higher-density development pattern over time.

-The Pulse Corridor Plan, December 2016

Issues

As noted, the area directly south of Broad Street is comprised of single family row homes in compact

Figure 57: Science Museum Station Study Area

blocks of 500 to 600 feet in length making it very easy for a pedestrian to walk. Most local streets parallel to the Broad Street corridor include one through lane and one parking lane in each direction. This configuration and the 25 mph speed make bicycling comfortable.

This area does have some deficiencies mainly related to roadway crossings and poor sight distances. Crossings along roadways can be challenging because of the lack of ADA compliant curb ramps and crosswalks. Additionally, a good number of existing alleys and driveways act as conflict points for people walking and biking especially along streets with high demand for on street parking. Throughout the southern area, drivers were observed parking up to the intersection, limiting the sight distances for pedestrians, bicyclists and turning vehicles. A review of sidewalk conditions also noted a number of sidewalks in disrepair.

The area directly north of the Science Museum, exhibits more industrial land uses with longer block lengths and lack of street connectivity. Streets like Myers Street do not include sidewalks, making pedestrians in the area opt to walk in the middle of the street to be visible. Furthermore, street lighting is either limited or non-existent. Finally, while North Boulevard includes commercial land uses, there are many driveways in and out of off street parking lots which create many potential conflict points. These deficiencies were more evident and served as obstacles for residents with limited mobility or disabilities as well as those biking. Additionally, perceived speed along these two corridors was higher than the posted speed limits (35 mph) leading to uncomfortable biking and walking conditions.

Recommendations

Recommendations for the expected service area range from the creation of an east-west bike route between Belvidere and Boulevard, to the improvement of a number of intersections. Specific recommendations are listed below and conform to the recommendations contained in the 2015 City of Richmond Bicycle Master Plan, Draft Pulse Corridor Plan and others:

- Increase pedestrian oriented lighting throughout Broad Street, North Boulevard and Monument Street.
- Explore the creation of an east-west bike route

Figure 58: Sidewalk conditions along Broad Street

Figure 59: Science Museum Station Issues Map

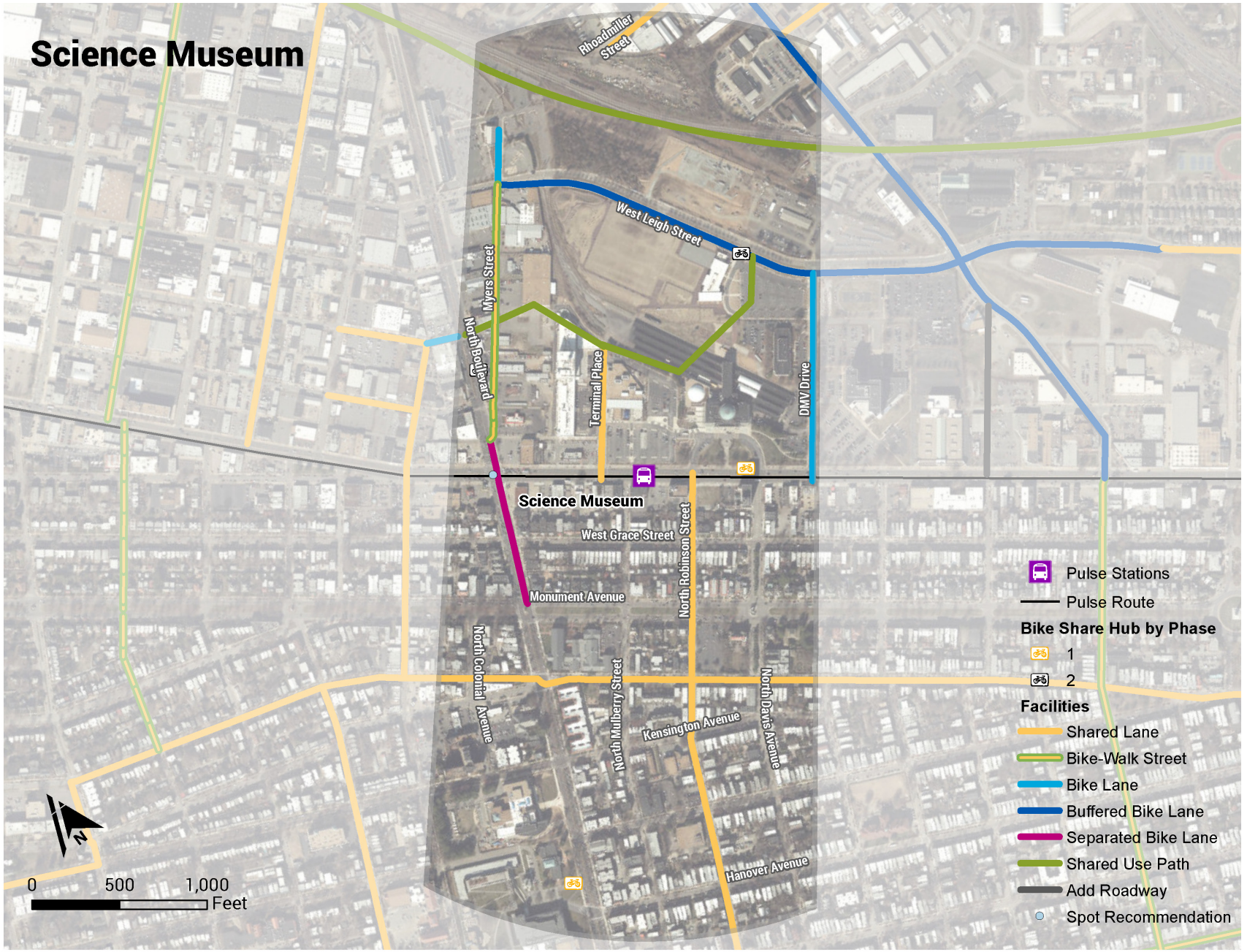
Figure 60: Existing bicycle facilities along North Boulevard

between Belvidere Street and Boulevard.

- Improve direct access to proposed BRT station by improving crosswalks at North Davis Avenue and Broad Street, North Robinson Street and Broad Street and Terminal Place and Broad Street.
- Provide more frequent high visibility marked crossings on Monument Avenue, Broad Street, and North Boulevard to decrease the distance a pedestrian has to travel to cross the street and prevent jay-walking.
- As redevelopment occurs, introduce a more connected street grid north of Broad Street using complete streets guidelines.
- Consider the implementation of bike lanes on DMV drive from Broad Street to Leigh Street by reconfiguring existing on-street parking.
- Increase wayfinding on Terminal Place from Broad Street to Railroad Tracks/Redskins Center and identify corridor as major bicycling connector as redevelopment occurs.
- Connect Terminal Place at Railroad tracks to Myers Street through redevelopment of retail/commercial sites.
- Consider implementation of separate path/trail to provide east-west connection from Terminal place to North Boulevard opposite to Clay Street.
- Consider implementation of trail around Bon Secours Redskins Training Ground to connect with existing facilities on Leigh Street.
- Long term, consider the reconfiguration of Myers Street as Bike/Walk street or bike priority corridor with two-way separated bike lane from intersection of Myers and Boulevard across Broad Street/Boulevard Intersection to Monument.

Figure 61: Science Museum Station Pedestrian Recommendations Map

Figure 62: Science Museum Station Bicycle Recommendations Map



Cleveland Street

Overview

The Cleveland Street Station is located at the northwestern edge of the study area at the intersection of N Broad Street and N Cleveland Street. The half mile area surrounding the Cleveland Street Station encompasses a variety of land uses, portions of the Scott's Addition, Museum District and Fan District neighborhoods, and contains several major roads including Interstate 195 and N Boulevard Avenue.

Issues

The area around the Cleveland Street Station is crisscrossed by several major roads which can make walking challenging and uninviting. While there are fairly wide sidewalks along Broad Street, N Boulevard and Monument Avenue, for the most part

CLEVELAND STREET STATION IN CONTEXT

The Cleveland Station area is an "Emerging Station" because the area is experiencing population and employment growth, features lower property values, offers low office rents per square foot, and has seen a large amount of permit activity over the past five years. The area is part of one of the densest population clusters in the City of Richmond and enjoys a strong street grid and high connectivity, though it is in need of a complete sidewalk network and overall complete streets network.

-The Pulse Corridor Plan, December 2016

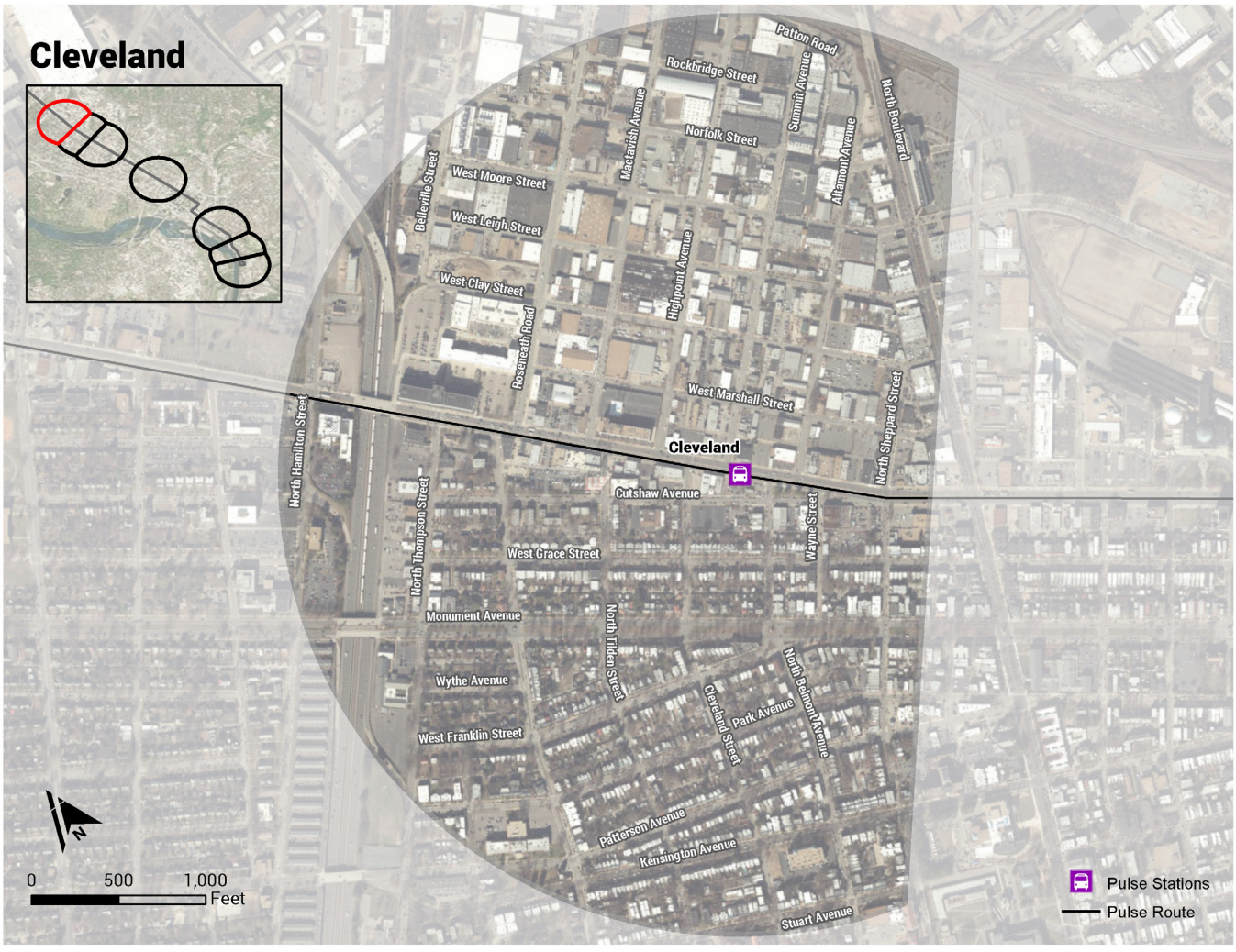


Figure 63: Cleveland Street Station Study Area

they lack pedestrian scale lighting, street furniture, shade and other streetscape elements that support pedestrian activity. Crossing these streets poses a challenge: pedestrian push buttons are located out of reach for pedestrians with mobility limitations, curb ramps do not align with marked crosswalks, and the allotted crossing time is often insufficient. Along the I-195 corridor, another challenge is the on and off ramps. The ramp design does little to slow the speeds of drivers entering or leaving the interstate, nor are drivers expecting to encounter pedestrians at the top of the ramps.

North of Broad Street and east of I-195, the multi-family residential and small scale office and commercial developments being built in the Scott's Addition neighborhood are more conducive to walking and bicycling than the mostly light industrial uses that previously existed. The street network in the neighborhood is a regular grid, which is generally good for walking and bicycling. The issue in Scott's Addition is that most of the streets are effectively four lanes wide (two parking and two travel lanes) making them challenging to cross; and several are one-way, which requires bicyclists to travel additional distance to reach their destinations.

One-way street systems also tend to increase motor vehicle speeds and the need for turning movements – both of which can adversely affect the safety of pedestrians and bicyclists.

South of Broad Street, the neighborhood is primarily residential, with narrower streets and a dense block network. Here the issues for pedestrians are mostly related to older curb ramps and sidewalks in need of repair, and poor sight lines at intersections due to cars parked too close to the corner. The narrower, residential streets have lower speeds and traffic volumes, which makes them good candidates for neighborhood bike routes.

Figure 64: The sidewalk along Broad Street has plenty of width but lacks basic pedestrian features

Recommendations

- Add sidewalks in Scott's Addition where missing.
- Install pedestrian scale streetlights throughout Scott's Addition where missing.
- Complete the multi-use path along the northern part of Scott's Addition. Connect this path across the entire top of the neighborhood as well as under Boulevard.
- Rebuild Patton Avenue and connect it to north/south streets in Scott's Addition to complete the street grid.
- As an interim feature, add counter flow bike lane on Clay between N Sheppard and Boulevard.
- Connect Park Avenue and proposed Greenway with a Bike/Walk Street and traffic calming along MacTavish Avenue and Tilden Street.
- Evaluate the conversion of one-way streets in Scott's Addition (Norfolk, Moore, Clay, and Marshall Streets) to two-way streets.
- Based on the observed traffic volumes, many if not all of the streets in Scott's Addition are prime candidates for road diets that would create dedicated space for bicyclists, and reduce the number of potential conflicts at intersections.

Figure 65: Cleveland Street Station Issues Map

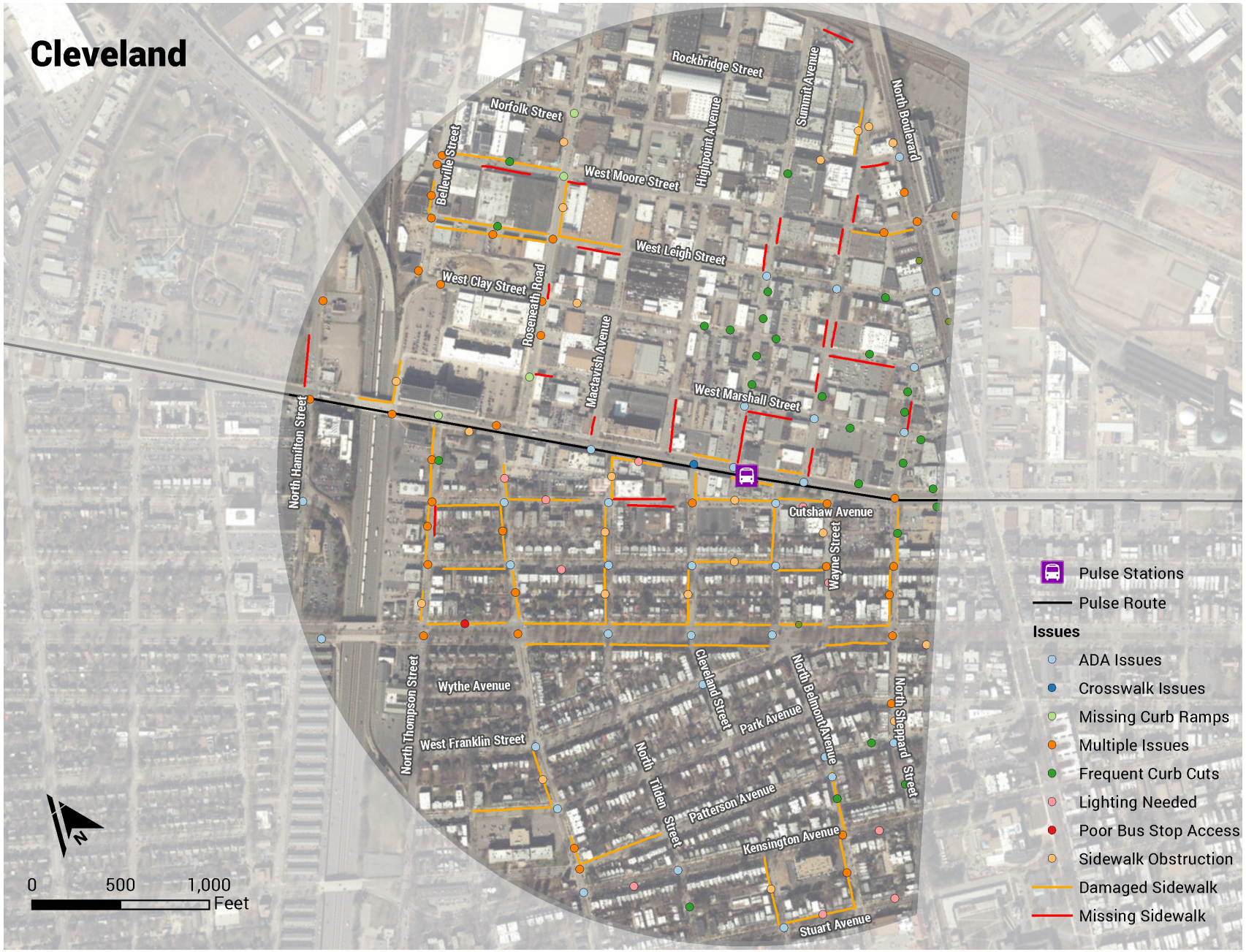


Figure 66: Wide driveways in Scott's Addition interrupt the sidewalk

- Extend medians at major intersections along Monument Boulevard to create pedestrian refuge islands.
- Repair sidewalks and reconstruct curb ramps to meet ADA standards.

Figure 67: Cleveland Street Station Pedestrian Recommendations Map

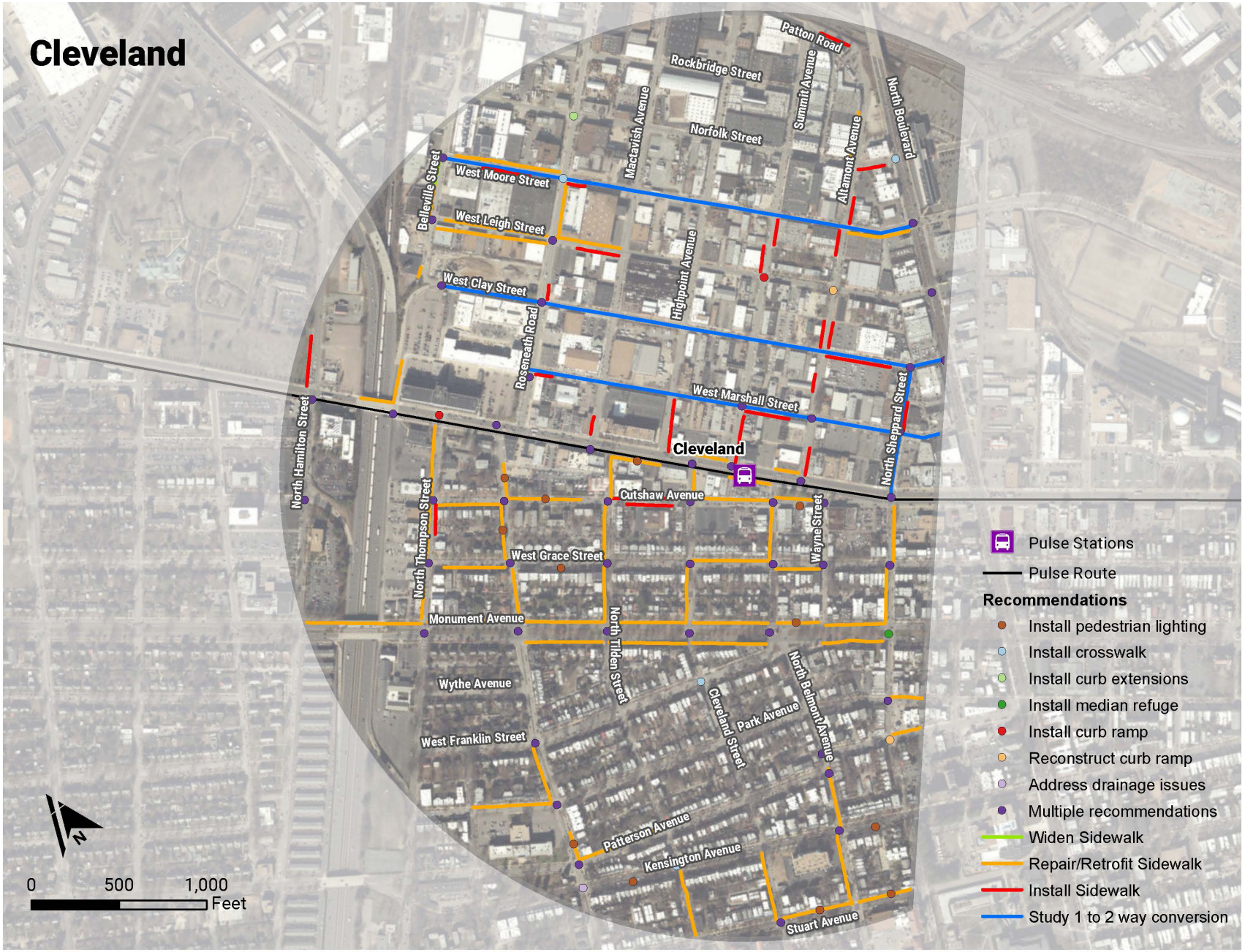
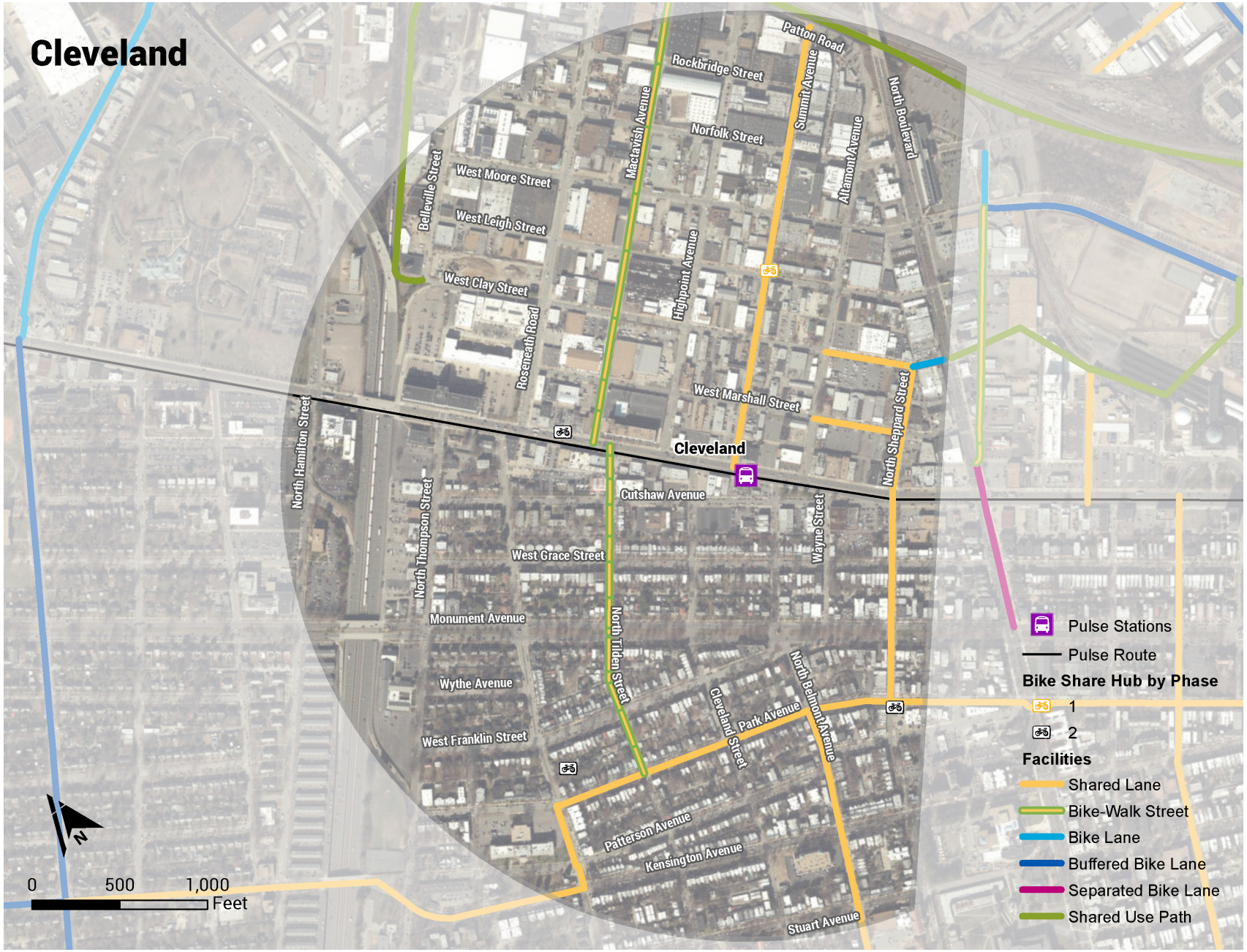


Figure 68: Cleveland Street Station Bicycle Recommendations Map



Cost Estimates

Following the development of recommendations related to infrastructure improvements around each of the seven study areas, a series of planning level cost estimates were developed. At the request of the City of Richmond and FHWA, cost estimates and related projects were grouped into $300,000 clusters where appropriate, to help the implementation of the proposed improvements. This section describes the methodology and assumptions used for the pedestrian and bicycle-related estimates.

Pedestrian Cost Estimates

Planning level cost estimates were developed for individual recommendations to the existing pedestrian network. The following methodology was used:

- Site assessment was based on street-level review of each location through fieldwork check.
- Cost estimates for linear improvements were developed by establishing a cost per linear foot or cost per square foot for the recommended facility type and applying it to the length or area of the improvement.
- Cost estimates for individual spot improvements were developed by identifying anticipated quantities for significant construction items (e.g. asphalt, sidewalk, concrete curb, pavement markings, etc.).
- All cost estimates assume that 20 percent contingency, 10 percent design, 15 percent utilities and 5 percent survey, are applied to the base cost.

Unit prices for construction items were established based on regional historical bid pricing available through the Virginia Department of Transportation Website[5], the FHWA Costs for Pedestrian and Bicycle Infrastructure Improvements[6], and the Study Team's experience and judgment. All units have been presented in Linear Feet (LF), as single units (EA) and Per Intersection (PI). The table below presents all assumptions related to unit costs to develop the project estimates.

Although quantities and unit prices were developed for each estimate, a fluctuation in quantities and bid prices can be expected as the level of design progresses. Final construction costs for a bid package can only be determined after a final or near-final design has been completed. The costs provided in this document are only intended for budgeting purposes and should be further informed by City engineers.

Individual station recommendations and cost estimates can be found below.

5 http://www.virginiadot.org/business/resources/const/DistrictAverages.pdf

6 http://www.pedbikeinfo.org/cms/downloads/Countermeasure%20Costs_Report_Nov2013.pdf

Table 4: Pedestrian network recommendations costs and assumptions

Item Description	Unit	2016 Average Cost	Total Unit Cost with Contingency, Design Fee, Utilities, and Survey*	Assumptions
SIDEWALKS				
Install NEW Concrete Sidewalk	LF	$ 33	$ 49	Assumes 5' sidewalk. Unit cost from FHWA Costs for Ped. And Bic. Infrastructure Improvements (2012)**. All unknown sidewalk types are considered "brick" to err on the conservative side, since brick sidewalk costs more per linear foot. Unit cost includes excavation, grading, and materials
Install NEW Brick Sidewalk	LF	$ 62	$ 93	
Replace/Repair/Widen Concrete Sidewalk	LF	$ 33	$ 49	
Replace/Repair/Widen Brick Sidewalk	LF	$ 62	$ 93	
CROSSWALKS				
Install NEW High-Visibility Crosswalk	EA	$ 2,994	$ 4,491	Assumes an average 60' High-Visibility Crosswalk with 24" wide ladder strips, each 10' long; average standard crosswalk is considered two 6" standard strips, spanning 30' each. Replacing or repairing crosswalks includes prices of new crosswalk plus eradication of average standard crosswalk. Unit cost calculated based on Richmond average unit prices.
Install NEW Standard Crosswalk	EA	$ 733	$ 1,099	
Replace/Repair Standard with High-Vis Crosswalk	EA	$ 3,026	$ 4,539	
Replace/Repair Standard Crosswalk	EA	$ 765	$ 1,147	
LIGHTING				
Install Streetlight	EA	$ 5,022	$ 7,532	Average cost from FHWA Costs for Ped. And Bic. Infrastructure Improvements (2012) **. Where streetlights are recommended on a sidewalk segment, three (3) streetlights were included. Crosswalk lighting cost estimate includes lighting across all legs of intersection.
Install Crosswalk Lighting	PI	$ 18,131	$ 27,196	
PEDESTRIAN SIGNALS				
Pedestrian Push Button	EA	$ 360	$ 540	Unit cost from FHWA Costs for Ped. And Bic. Infrastructure Improvements (2012)**. This cost is for each individual push button or rapid flashing beacon. At a standard intersection, eight (8) push buttons would be added to cost estimate. Unit price does not include costs associated with powering the system.
Install Rapid Flashing Beacon	EA	$ 22,895	$ 34,343	
Install Pedestrian Signal	EA	$ 766	$ 1,149	From Virginia DOT District Averages - RCHMD average unit cost. Assume cost per signal head; each pedestrian signal would be affixed to existing pole.
CURB WORK				
Install Curb Extensions	PI	$ 13,377	$ 20,066	Unit costs from FHWA Costs for Ped. And Bic. Infrastructure Improvements (2012)**. Curb ramp costs are assumed to be per curb ramp, not corner. Cost to reduce turn radii was assumed to be approximately the same as installing curb extensions. All four corners of the intersection would be replaced with curb extensions to effectively reduce the curb radii.
Install/Reconstruct Curb Ramp	EA	$ 833	$ 1,250	
Install Median Refuge	EA	$ 13,520	$ 20,280	
Reduce Turn Radii	PI	$ 13,377	$ 20,066	

Contingency (20%); Design (10%); Utilities (15%); Survey (5%)

****All 2012 Average Costs were increased to accommodate a linear inflation of 2.9%.***

Orleans Street

The following map and table provide a list and pedestrian related cost estimates for the recommended improvements within the Orleans Street study area. The estimates correspond to the half mile radius around the proposed Orleans Street station. The total recommended pedestrian improvements amount to around $1.15 M and include the installation of new sidewalks, installation or upgrade of curb ramps, and installation of pedestrian oriented lighting.

Figure 69: Cleveland Street Station Proposed Pedestrian Improvements and Projects

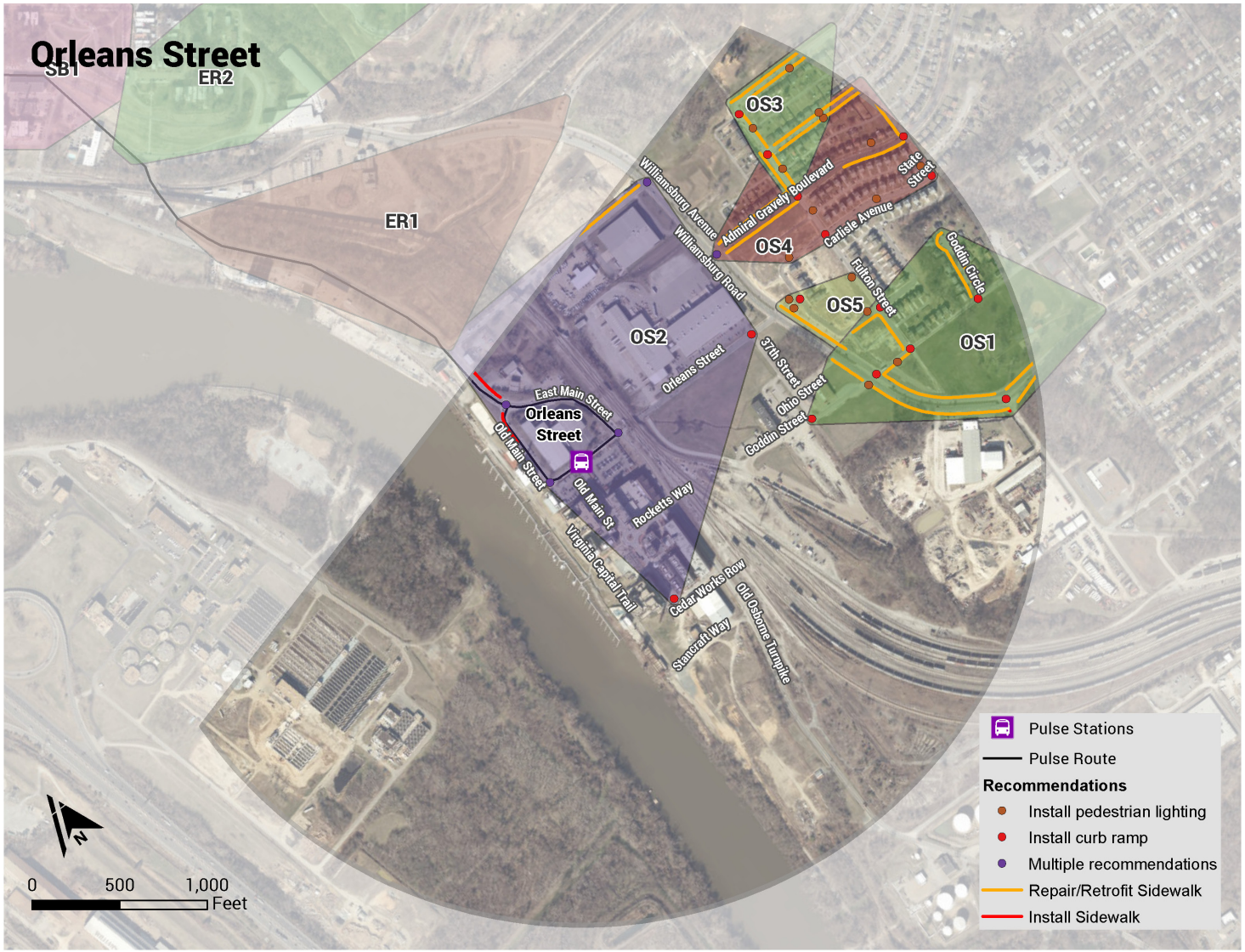


Table 5: Cost Estimates for Pedestrian Related improvements around the Proposed Orleans Street Pulse Station

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Install New Sidewalk	$750	Hatcher St	Williamsburg Ave	Partway to Nelson St	SB	OS1
Repair/Retrofit Sidewalk	$1,050	Goddin St	Williamsburg Ave	Partway to S 37th St	EB	OS1
Repair/Retrofit Sidewalk	$9,600	Goddin St	Williamsburg Ave	Fulton St	EB	OS1
Repair/Retrofit Sidewalk	$10,350	Williamsburg Ave	Ohio St	Goddin St	SB	OS1
Repair/Retrofit Sidewalk	$15,000	Goddin Dr.	Goddin St	Dead-end	NB	OS1
Repair/Retrofit Sidewalk	$15,900	Williamsburg Rd	Hatcher St	Northampton St	EB	OS1
Repair/Retrofit Sidewalk	$20,400	Williamsburg Ave	Goddin St	Partway to Hatcher St	SB	OS1
Repair/Retrofit Sidewalk	$21,150	Williamsburg Ave	Partway to Goddin St	Hatcher St	SB	OS1
Repair/Retrofit Sidewalk	$21,750	Goddin Dr.	Goddin St	Dead-end	SB	OS1
Repair/Retrofit Sidewalk	$33,000	Williamsburg Ave	Hatcher St	Goddin St	NB	OS1
Repair/Retrofit Sidewalk	$34,950	Williamsburg Rd	Hatcher St	Northampton St	WB	OS1
Install pedestrian lighting	$22,600	Goddin St	Williamsburg Ave	Fulton St	EB	OS1
Install pedestrian lighting	$22,600	Goddin St	Goddin Ct	Northampton St	WB	OS1
Install pedestrian lighting	$22,600	Goddin St	Williamsburg Ave	Partway to S 37th St	EB	OS1
Install curb ramp	$5,000	Williamsburg Ave at Hatcher St				OS1
Install curb ramp	$7,500	Goddin St at Fulton St				OS1
Install curb ramp	$10,000	Goddin St at Williamsburg Ave				OS1
Install curb ramp	$2,500	Goddin St at Goddin Ct				OS1
Install curb ramp	$7,500	Goddin St at S 37th St				OS1
Project Cost	**$284,200**					**OS1**
Install curb ramp	$3,700	Old Main St at Alley				OS2
Install crosswalk	$4,500	E Main St at Orleans St				OS2
Install curb ramp	$8,700	E Main St at Orleans St				OS2
Traffic calming needed	Further Study Needed	E Main St at Orleans St				OS2

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Install crosswalk	$1,100	Old Main St at Orleans St				OS2
Install curb ramp	$2,500	Old Main St at Orleans St				OS2
Install crosswalk	$4,500	Old Main St at E Main St				OS2
Install curb ramp	$2,500	Old Main St at E Main St				OS2
Install median refuge	$20,300	Nicholson St at Williamsburg Ave				OS2
Install pedestrian actuators	$4,200	Nicholson St at Williamsburg Ave				OS2
Install pedestrian signal	$9,200	Nicholson St at Williamsburg Ave				OS2
Install curb ramp	$5,000	Orleans St at S 37th St				OS2
Install New Sidewalk	$9,450	Old Main St	E Main St	Orleans St	SB	OS2
Install New Sidewalk	$18,750	E Main St	Nicholson St	Partway to Old Main St	NB	OS2
Repair/Retrofit Sidewalk	$69,300	Nicholson St	E Main St	Williamsburg Ave	WB	OS2
Project Cost	$163,700					OS2
Repair/Retrofit Sidewalk	$11,250	Fulton St	Old Denny St	Admiral Gravely Blvd	NB	OS3
Repair/Retrofit Sidewalk	$12,300	Fulton St	Old Nicholson St	Old Denny St	NB	OS3
Repair/Retrofit Sidewalk	$13,200	Fulton St	Old Denny St	Admiral Gravely Blvd	SB	OS3
Repair/Retrofit Sidewalk	$28,650	Old Nicholson Rd	Gilliam St	Fulton St	EB	OS3
Repair/Retrofit Sidewalk	$35,250	Old Nicholson Rd	Gilliam St	Fulton St	WB	OS3
Install pedestrian lighting	$22,600	Fulton St	Old Denny St	Admiral Gravely Blvd	NB	OS3
Install pedestrian lighting	$22,600	Fulton St	Old Nicholson St	Old Denny St	NB	OS3
Install pedestrian lighting	$22,600	Old Denny St	Gilliam St	Fulton St	EB	OS3
Install pedestrian lighting	$22,600	Old Denny St	Gilliam St	Fulton St	WB	OS3
Install pedestrian lighting	$22,600	Old Nicholson Rd	Gilliam St	Fulton St	EB	OS3
Install curb ramp	$5,000	Fulton St at Old Denny St				OS3
Install curb ramp	$2,500	Fulton St at Old Nicholson St				OS3
Project Cost	**$221,150**					**OS3**

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Install curb ramp	$8,700	Louisiana St at Fulton St				OS4
Install curb ramp	$2,500	Louisiana St at Gilliam St				OS4
Install curb ramp	$7,500	Admiral Gravely Blvd at Gilliam St				OS4
Install curb ramp	$5,000	Admiral Gravely Blvd at Fulton St				OS4
Install crosswalk	$4,500	Williamsburg Ave at Admiral Gravely Blvd				OS4
Install curb ramp	$7,500	Williamsburg Ave at Admiral Gravely Blvd				OS4
Install median refuge	$20,300	Williamsburg Ave at Admiral Gravely Blvd				OS4
Install pedestrian lighting	$22,600	Fulton St	Admiral Gravely Blvd	Louisiana St	NB	OS4
Install pedestrian lighting	$22,600	Louisiana St	Erin Crescent St	Gilliam St	WB	OS4
Install pedestrian lighting	$22,600	Gilliam St	State St	Partway to Louisiana St	SB	OS4
Install pedestrian lighting	$22,600	Admiral Gravely Blvd	Gilliam St	Partway to Fulton St	WB	OS4
Install pedestrian lighting	$22,600	Louisiana St	Louisiana St	Fulton St	WB	OS4
Repair/Retrofit Sidewalk	$4,200	Gilliam St	State St	Partway to Louisiana St	SB	OS4
Repair/Retrofit Sidewalk	$16,350	Gilliam St	Old Denny St	Admiral Gravely Blvd	SB	OS4
Repair/Retrofit Sidewalk	$18,300	Admiral Gravely Blvd	Gilliam St	Partway to Fulton St	EB	OS4
Repair/Retrofit Sidewalk	$24,600	Admiral Gravely Blvd	Fulton St	Williamsburg Ave	EB	OS4
Repair/Retrofit Sidewalk	$24,600	Admiral Gravely Blvd	Fulton St	Williamsburg Ave	WB	OS4
Repair/Retrofit Sidewalk	$29,700	Old Denny St	Gilliam St	Fulton St	EB	OS4
Repair/Retrofit Sidewalk	$30,150	Old Denny St	Gilliam St	Fulton St	WB	OS4
Project Cost	**$316,900**					**OS4**
Repair/Retrofit Sidewalk	$16,500	Louisiana St	Louisiana St	Fulton St	EB	OS5
Repair/Retrofit Sidewalk	$22,800	Fulton St	Louisiana St	Goddin St	NB	OS5
Repair/Retrofit Sidewalk	$22,050	Williamsburg Ave	Orleans St	Ohio St	NB	OS5
Install pedestrian lighting	$22,600	Orleans St	Williamsburg Ave	Louisiana St	WB	OS5
Install pedestrian lighting	$22,600	Orleans St	Williamsburg Ave	Louisiana St	EB	OS5
Install pedestrian lighting	$22,600	Louisiana St	Louisiana St	Fulton St	WB	OS5

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Install pedestrian lighting	$22,600	Fulton St	Louisiana St	Alley	SB	OS5
Install curb ramp	$7,500	Fulton St at Louisiana St				OS5
Install curb ramp	$3,700	Orleans St at Louisiana St				OS5
Project Cost	**$162,950**					**OS5**

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East Riverfront

The following table and map provide a list and pedestrian related cost estimates for the recommended improvements within the East Riverfront study area. The estimates correspond to the half mile radius around the proposed East Riverfront Pulse station. The total recommended pedestrian improvements amount to over $350,000 and include the installation of new crosswalks, pedestrian signals, curb ramps, and traffic calming.

Figure 70: East Riverfront Station Proposed Pedestrian Improvements and Projects

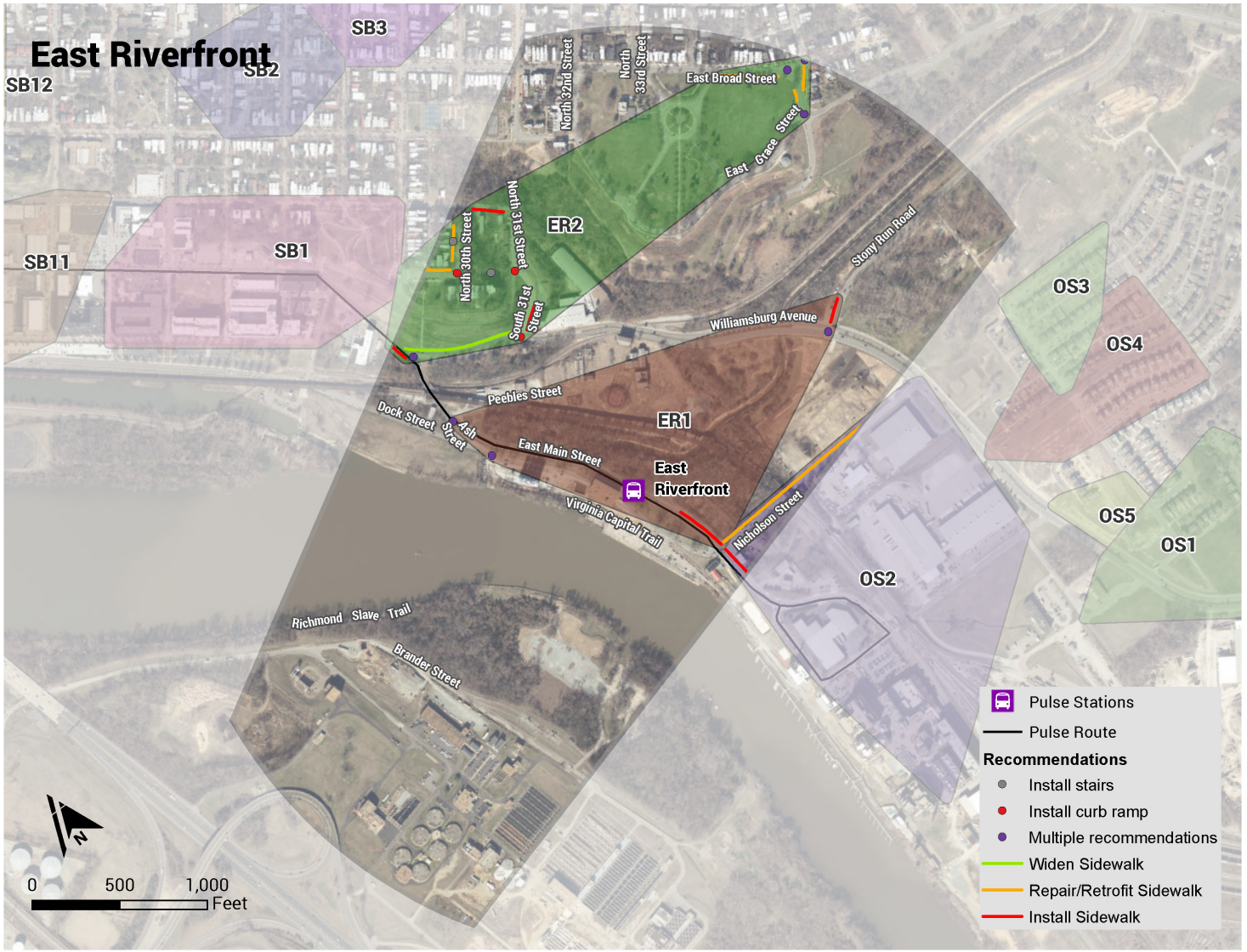

Table 6: Cost Estimates for Pedestrian Related improvements around the Proposed East Riverfront Pulse Station

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Install New Sidewalk	$6,900	Stony Run Rd	Williamsburg Ave	Partway east	WB	ER1
Install New Sidewalk	$14,550	E Main St	Nicholson St	Partway north	NB	ER1
Install crosswalk	$4,500	Williamsburg Ave at Stoney Run Rd				ER1
Install curb ramp	$7,500	Williamsburg Ave at Stoney Run Rd				ER1
Install crosswalk	$4,500	Ash St at Water St				ER1
Install curb ramp	$2,500	Ash St at Water St				ER1
Install pedestrian signal	$9,200	Ash St at Water St				ER1
Traffic calming needed	Further Study Needed	Ash St at Water St				ER1
Install crosswalk	$4,500	Ash St at E Main St				ER1
Install curb ramp	$5,000	Ash St at E Main St				ER1
Project Cost	$59,150					ER1
Install crosswalk	$4,500	E Broad St at N 36th St				ER2
Reconstruct curb ramp (demolish/rebuild)	$3,700	E Broad St at N 36th St				ER2
Install crosswalk	$1,100	E Grace St at Government Rd				ER2
Install curb ramp	$2,500	E Grace St at Government Rd				ER2
Install crosswalk	$4,500	E Broad St at N 36th St				ER2
Install curb ramp	$2,500	E Broad St at N 36th St				ER2
Install median refuge	$20,300	E Broad St at N 36th St				ER2
Reduce turning radii	$20,100	E Broad St at N 36th St				ER2
Install crosswalk	**$4,500**	E Main St at Williamsburg Ave				ER2
Install curb ramp	$7,500	E Main St at Williamsburg Ave				ER2

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Install median refuge	$20,300	E Main St at Williamsburg Ave				ER2
Install pedestrian actuators	$4,200	E Main St at Williamsburg Ave			ER2	
Reduce turning radii	$20,100	E Main St at Williamsburg Ave			ER2	
Install curb ramp	$7,500	Williamsburg Ave at S 31st St			ER2	
Install curb ramp	$7,500	N 31st St at S 31st St			ER2	
Install curb ramp	$7,500	Libby Terrace at N 30th St		ER2		
Repair/Retrofit Sidewalk	$3,150	Government Rd	E Grace St	Partway to E Broad St	SB	ER2
Install New Sidewalk	$10,650	E Main St	Partway to Peach St	Williamsburg Ave	EB	ER2
Repair/Retrofit Sidewalk	$6,750	N 36th St	Government Rd	E Broad St	SB	ER2
Install New Sidewalk	$7,800	S 31st St	Williamsburg Ave	Partway to N 31st St	NB	ER2
Install New Sidewalk	$8,700	E Franklin St	N 31st St	N 20th St	EB	ER2
Repair/Retrofit Sidewalk	$18,600	N 30th St	Libby Terrace	Dead end	SB	ER2
Repair/Retrofit Sidewalk	$24,750	Libby Terrace	N 30th St	N 29th St	EB	ER2
Repair/Retrofit Sidewalk	$16,050	E Broad St	N 34th St	Government Rd	EB	ER2
Widen Existing Sidewalk	$59,250	Williamsburg Ave	E Main St	S 31st St	WB	ER2
Consider installation of stairs	Further study needed	N 30th St	Libby Terrace	Dead end	SB	ER2
Stairs to 31st St	Further study needed	Path	Libby Terrace	N 31st St	N/A	ER2
Project Cost	$294,000					ER2

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Shockoe Bottom

The following table and map provide a list and pedestrian related cost estimates for the recommended improvements within the Shockoe Bottom study area. The estimates correspond to the half mile radius around the proposed Pulse station. The total recommended pedestrian improvements amount to over $3.9 M and include the installation of new crosswalks, pedestrian signals, curb ramps, and traffic calming, as well as the installation of new sidewalks.

Figure 71: Shockoe Bottom Station Proposed Pedestrian Improvements and Projects

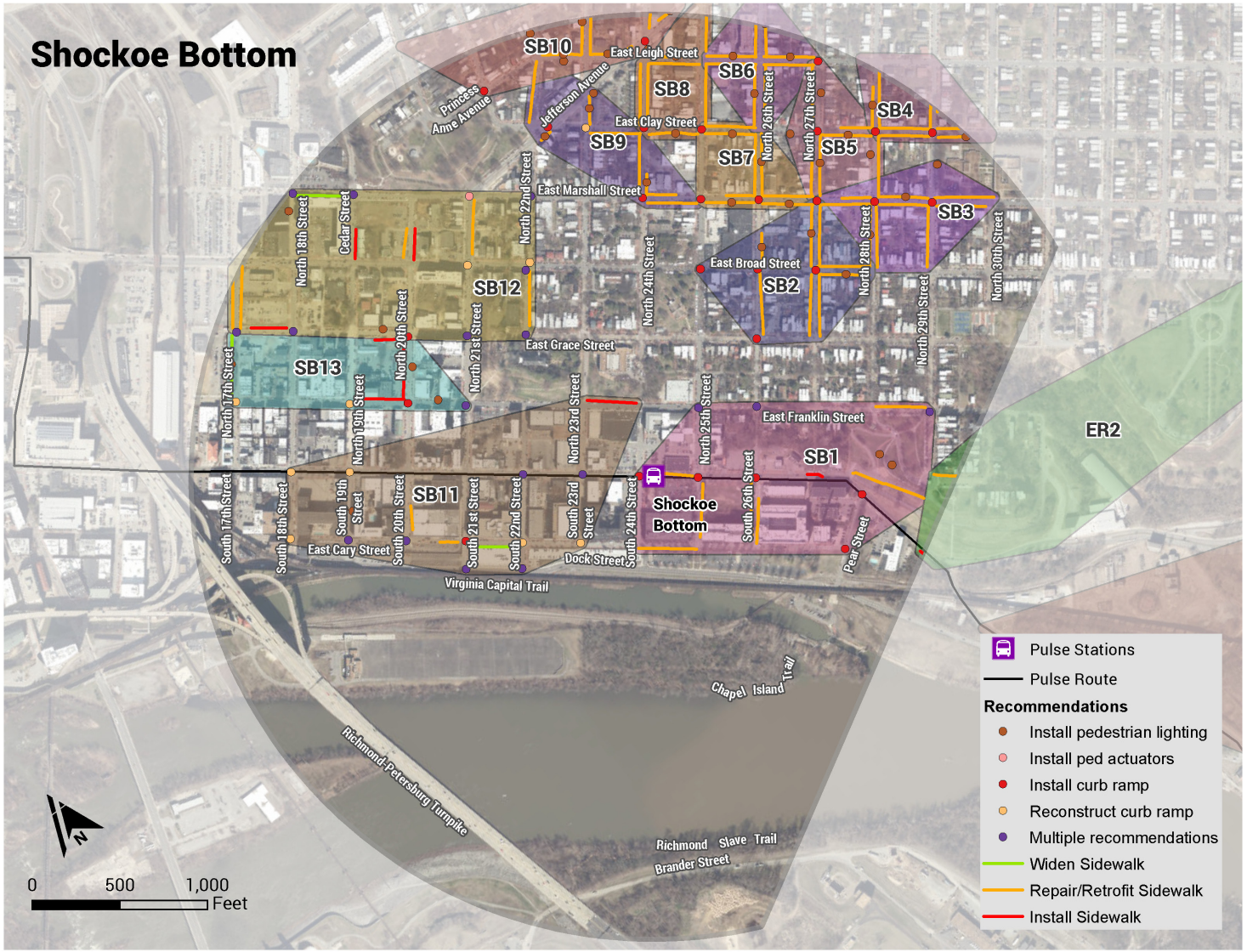

Table 7: Cost Estimates for Pedestrian Related improvements around the Proposed Shockoe Bottom Station

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Install New Sidewalk	$4,500	E Main St	Partway to N 26th St	Partway to Pear St	WB	SB1
Repair/Retrofit Sidewalk	$23,850	S 26th St	E Cary St	E Main St	NB	SB1
Repair/Retrofit Sidewalk	$25,950	E Main St	S 24th St	S 25th St	WB	SB1
Repair/Retrofit Sidewalk	$26,400	E Franklin St	N 28th St	N 29th St	WB	SB1
Repair/Retrofit Sidewalk	$28,350	S 25th St	E Main St	E Cary St	NB	SB1
Repair/Retrofit Sidewalk	$28,350	S 26th St	E Cary St	E Main St	SB	SB1
Repair/Retrofit Sidewalk	$30,750	E Cary St	S 24th St	S 25th St	EB	SB1
Repair/Retrofit Sidewalk	$40,200	Libby Hill Park				SB1
Install pedestrian lighting	$22,600	Path	Libby Terrace	E Franklin St	N/A	SB1
Install pedestrian lighting	$22,600	Path	Libby Terrace	E Franklin St	N/A	SB1
Install curb extensions	$20,100	E Franklin St at N 29th St				SB1
Traffic calming needed	Further Study Needed	E Franklin St at N 29th St				SB1
Install curb ramp	$1,200	E Cary St at Pear St				SB1
Install curb ramp	$5,000	E Main St at S 24th St				SB1
Install curb ramp	$5,000	E Main St at S 25th St				SB1
Install curb ramp	$7,500	E Main St at S 26th St				SB1
Install curb ramp	$2,500	E Main St at Pear St				SB1
Install crosswalk	$1,100	E Franklin St at N 25th St				SB1
Reconstruct curb ramp (demolish/rebuild)	$1,200	E Franklin St at N 25th St				SB1
Install crosswalk	$1,100	E Franklin St at N 26th St				SB1
Reconstruct curb ramp (demolish/rebuild)	$2,500	E Franklin St at N 26th St				SB1
Project Cost	$300,750					SB1
Repair/Retrofit Sidewalk	$16,650	N 26th St	E Broad St	Partway to E Marshall St	NB	SB2
Repair/Retrofit Sidewalk	$14,100	E Broad St	N 27th St	N 28th St	EB	SB2
Repair/Retrofit Sidewalk	$14,700	E Broad St	N 27th St	N 28th St	WB	SB2
Repair/Retrofit Sidewalk	$32,100	N 27th St	E Grace St	E Broad St	SB	SB2
Repair/Retrofit Sidewalk	$32,400	N 27th St	E Broad St	E Marshall St	NB	SB2
Repair/Retrofit Sidewalk	$32,400	N 27th St	E Grace St	E Broad St	NB	SB2
Repair/Retrofit Sidewalk	$32,550	N 27th St	E Broad St	E Marshall St	SB	SB2

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Repair/Retrofit Sidewalk	$32,700	N 26th St	E Grace St	E Broad St	NB	SB2
Install pedestrian lighting	$22,600	N 26th St	E Broad St	Partway to E Marshall St	NB	SB2
Install pedestrian lighting	$22,600	N 27th St	E Broad St	E Marshall St	SB	SB2
Install pedestrian lighting	$22,600	E Broad St	N 27th St	N 28th St	EB	SB2
Install curb ramp	$5,000	E Broad St at N 27th St				SB2
Install curb ramp	$10,000	E Grace St at N 26th St				SB2
Install curb ramp	$5,000	E Broad St at N 26th St				SB2
Install curb ramp	$5,000	E Broad St at N 25th St				SB2
Project Cost	$300,400					SB2
Install curb ramp	$8,700	E Marshall St at N 29th St				SB3
Install curb ramp	$10,000	E Marshall St at N 28th St				SB3
Install curb ramp	$3,700	E Marshall St at N 27th St				SB3
Install pedestrian lighting	$22,600	E Marshall St	N 28th St	N 29th St	WB	SB3
Install pedestrian lighting	$22,600	N 29th St	E Marshall St	E Clay St	NB	SB3
Install pedestrian lighting	$22,600	N 28th St	E Broad St	E Marshall St	SB	SB3
Repair/Retrofit Sidewalk	$8,100	E Marshall St	N 27th St	N 28th St	WB	SB3
Repair/Retrofit Sidewalk	$25,350	E Marshall St	N 28th St	N 29th St	EB	SB3
Repair/Retrofit Sidewalk	$25,650	E Marshall St	N 28th St	N 29th St	WB	SB3
Repair/Retrofit Sidewalk	$26,100	E Marshall St	N 29th St	N 30th St	EB	SB3
Repair/Retrofit Sidewalk	$26,400	E Marshall St	N 27th St	N 28th St	EB	SB3
Repair/Retrofit Sidewalk	$16,800	E Marshall St	N 29th St	N 30th St	WB	SB3
Repair/Retrofit Sidewalk	$31,800	N 29th St	E Broad St	E Marshall St	SB	SB3
Repair/Retrofit Sidewalk	$32,250	N 28th St	E Broad St	E Marshall St	NB	SB3
Repair/Retrofit Sidewalk	$32,700	N 28th St	E Broad St	E Marshall St	SB	SB3
Project Cost	$315,350					SB3
Install New Sidewalk	$6,000	E Leigh St	Alley	N 28th St	WB	SB4
Repair/Retrofit Sidewalk	$11,400	N 28th St	E Clay St	E Leigh St	SB	SB4
Repair/Retrofit Sidewalk	$23,700	N 29th St	Partway to E Clay St	E Leigh St	NB	SB4
Repair/Retrofit Sidewalk	$26,400	E Clay St	N 28th St	N 29th St	WB	SB4
Repair/Retrofit Sidewalk	$14,100	E Clay St	N 29th St	N 30th St	WB	SB4
Repair/Retrofit Sidewalk	$14,250	E Leigh St	N 28th St	N 29th St	WB	SB4
Repair/Retrofit Sidewalk	$26,700	E Clay St	N 28th St	N 29th St	EB	SB4
Repair/Retrofit Sidewalk	$14,700	E Clay St	N 29th St	N 30th St	EB	SB4
Repair/Retrofit Sidewalk	$31,800	N 28th St	E Clay St	E Leigh St	NB	SB4

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Repair/Retrofit Sidewalk	$32,550	N 29th St	E Clay St	E Leigh St	SB	SB4
Install pedestrian lighting	$22,600	E Clay St	N 29th St	N 30th St	EB	SB4
Install pedestrian lighting	$22,600	N 29th St	Partway to E Clay St	E Leigh St	NB	SB4
Install pedestrian lighting	$22,600	N 28th St	E Clay St	E Leigh St	SB	SB4
Install curb ramp	$10,000	E Clay St at N 29th St				SB4
Install curb ramp	$7,500	E Clay St at N 30th St				SB4
Install curb ramp	$5,000	E Leigh St at N 28th St				SB4
Project Cost	$291,900					SB4
Install curb ramp	$8,700	E Clay St at N 27th St				SB5
Install curb ramp	$10,000	E Clay St at N 28th St				SB5
Install curb ramp	$5,000	E Leigh St at N 27th St				SB5
Install pedestrian lighting	$22,600	E Clay St	Alley	N 27th St	EB	SB5
Install pedestrian lighting	$22,600	E Clay St	N 27th St	N 28th St	EB	SB5
Install pedestrian lighting	$22,600	N 27th St	E Marshall St	E Clay St	NB	SB5
Install pedestrian lighting	$22,600	N 27th St	E Clay St	E Leigh St	NB	SB5
Install pedestrian lighting	$22,600	N 28th St	E Clay St	Alley	SB	SB5
Repair/Retrofit Sidewalk	$16,650	E Clay St	N 27th St	N 28th St	WB	SB5
Repair/Retrofit Sidewalk	$26,400	E Clay St	N 27th St	N 28th St	EB	SB5
Repair/Retrofit Sidewalk	$31,950	N 27th St	E Marshall St	E Clay St	NB	SB5
Repair/Retrofit Sidewalk	$32,250	N 27th St	E Clay St	E Leigh St	SB	SB5
Repair/Retrofit Sidewalk	$32,400	N 28th St	E Marshall St	E Clay St	NB	SB5
Repair/Retrofit Sidewalk	$32,550	N 27th St	E Marshall St	E Clay St	SB	SB5
Project Cost	$308,900					SB5
Repair/Retrofit Sidewalk	$25,650	E Leigh St	N 25th St	N 26th St	EB	SB6
Repair/Retrofit Sidewalk	$26,100	E Leigh St	N 25th St	N 26th St	WB	SB6
Repair/Retrofit Sidewalk	$26,250	E Leigh St	N 26th St	N 27th St	EB	SB6
Repair/Retrofit Sidewalk	$26,550	E Leigh St	N 26th St	N 27th St	WB	SB6
Repair/Retrofit Sidewalk	$32,700	N 26th St	E Clay St	E Leigh St	NB	SB6
Repair/Retrofit Sidewalk	$32,850	N 26th St	E Leigh St	M St	NB	SB6
Repair/Retrofit Sidewalk	$17,550	N 26th St	E Leigh St	M St	SB	SB6
Repair/Retrofit Sidewalk	$33,150	N 26th St	E Clay St	E Leigh St	SB	SB6
Install pedestrian lighting	$22,600	N 26th St	E Clay St	E Leigh St	SB	SB6
Install pedestrian lighting	$22,600	N 26th St	E Leigh St	M St	NB	SB6
Install pedestrian lighting	$22,600	E Leigh St	N 25th St	N 26th St	WB	SB6
Install pedestrian lighting	$22,600	E Leigh St	N 26th St	N 27th St	WB	SB6
Project Cost	$311,200					SB6

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Install pedestrian lighting	$22,600	N 26th St	E Marshall St	E Clay St	NB	SB7
Install pedestrian lighting	$22,600	E Clay St	N 25th St	N 26th St	EB	SB7
Install pedestrian lighting	$22,600	E Marshall St	N 25th St	N 26th St	EB	SB7
Install pedestrian lighting	$22,600	E Marshall St	N 26th St	N 27th St	EB	SB7
Repair/Retrofit Sidewalk	$15,300	E Marshall St	N 25th St	N 26th St	WB	SB7
Repair/Retrofit Sidewalk	$25,350	E Marshall St	N 25th St	N 26th St	EB	SB7
Repair/Retrofit Sidewalk	$26,550	E Clay St	N 25th St	N 26th St	EB	SB7
Repair/Retrofit Sidewalk	$26,550	E Clay St	N 25th St	N 26th St	WB	SB7
Repair/Retrofit Sidewalk	$26,700	E Marshall St	N 26th St	N 27th St	WB	SB7
Repair/Retrofit Sidewalk	$26,850	E Marshall St	N 26th St	N 27th St	EB	SB7
Repair/Retrofit Sidewalk	$31,950	N 26th St	E Marshall St	E Clay St	SB	SB7
Repair/Retrofit Sidewalk	$32,250	N 26th St	E Marshall St	E Clay St	NB	SB7
Install curb ramp	$8,700	E Marshall St at N 26th St				SB7
Install curb ramp	$5,000	E Marshall St at N 25th St				SB7
Install curb ramp	$5,000	E Clay St at N 25th St				SB7
Project Cost	$320,600					SB7
Install curb ramp	$8,700	E Clay St at N 24th St				SB8
Repair/Retrofit Sidewalk	$16,800	E Leigh St	N 24th St	N 25th St	WB	SB8
Repair/Retrofit Sidewalk	$25,950	E Clay St	N 24th St	N 25th St	EB	SB8
Repair/Retrofit Sidewalk	$26,400	E Leigh St	N 24th St	N 25th St	EB	SB8
Repair/Retrofit Sidewalk	$29,400	N 25th St	M St	E Leigh St	NB	SB8
Repair/Retrofit Sidewalk	$32,250	N 24th St	E Clay St	E Leigh St	SB	SB8
Repair/Retrofit Sidewalk	$32,400	N 24th St	E Clay St	E Leigh St	NB	SB8
Repair/Retrofit Sidewalk	$33,000	N 25th St	E Clay St	E Leigh St	NB	SB8
Install pedestrian lighting	$22,600	E Clay St	N 24th St	N 25th St	EB	SB8
Install pedestrian lighting	$22,600	E Clay St	N 24th St	N 25th St	WB	SB8
Install pedestrian lighting	$22,600	E Leigh St	N 24th St	N 25th St	WB	SB8
Project Cost	$272,700					SB8
Install pedestrian lighting	$22,600	N 23rd St	E Clay St	Jefferson Ave	NB	SB9
Install pedestrian lighting	$22,600	N 24th St	E Marshall St	Partway to E Clay St	NB	SB9
Install pedestrian lighting	$22,600	Jefferson Ave	N 22nd St	E Clay St	EB	SB9
Install pedestrian lighting	$22,600	Jefferson Ave	N 23rd St	Partway to E Leigh St	EB	SB9
Repair/Retrofit Sidewalk	$6,600	Jefferson Ave	N 22nd St	E Clay St	EB	SB9
Repair/Retrofit Sidewalk	$6,000	N 24th St	E Marshall St	Partway to E Clay St	NB	SB9
Repair/Retrofit Sidewalk	$15,000	N 23rd St	E Clay St	Jefferson Ave	NB	SB9
Repair/Retrofit Sidewalk	$15,450	E Marshall St	N 24th St	Alley	WB	SB9

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Repair/Retrofit Sidewalk	$26,250	E Marshall St	N 24th St	N 25th St	EB	SB9
Repair/Retrofit Sidewalk	$26,550	E Clay St	N 23rd St	N 24th St	EB	SB9
Repair/Retrofit Sidewalk	$32,400	N 22nd St	E Clay St	E Leigh St	SB	SB9
Repair/Retrofit Sidewalk	$32,700	N 24th St	E Clay St	E Marshall St	SB	SB9
Install curb ramp	$10,000	E Marshall St at N 24th St				SB9
Install curb ramp	$2,500	Jefferson Ave at N 22nd St				SB9
Reconstruct curb ramp (demolish/rebuild)	$3,700	E Clay St at N 23rd St				SB9
Project Cost	$267,550					SB9
Repair/Retrofit Sidewalk	$2,550	Jefferson St	E Leigh St	N 24th St	WB	SB10
Repair/Retrofit Sidewalk	$3,900	N 24th St	M St	E Leigh St	NB	SB10
Repair/Retrofit Sidewalk	$14,400	Jefferson Ave	N 24th St	M St	WB	SB10
Repair/Retrofit Sidewalk	$16,500	E Leigh St	N 23rd St	Jefferson St	WB	SB10
Repair/Retrofit Sidewalk	$20,400	E Leigh St	N 22nd St	N 23rd St	WB	SB10
Repair/Retrofit Sidewalk	$32,400	N 23rd St	E Leigh St	M St	SB	SB10
Repair/Retrofit Sidewalk	$32,550	N 23rd St	E Leigh St	M St	NB	SB10
Install pedestrian lighting	$22,600	N 23rd St	E Leigh St	M St	SB	SB10
Install pedestrian lighting	$22,600	N 22nd St	E Leigh St	M St	SB	SB10
Install pedestrian lighting	$22,600	N 24th St	Jefferson Ave	E Leigh St	NB	SB10
Install pedestrian lighting	$22,600	N 24th St	M St	Jefferson St	SB	SB10
Install pedestrian lighting	$22,600	E Leigh St	N 22nd St	N 23rd St	EB	SB10
Install pedestrian lighting	$22,600	E Leigh St	N 22nd St	N 23rd St	WB	SB10
Install pedestrian lighting	$22,600	E Leigh St	N 23rd St	Jefferson St	WB	SB10
Install pedestrian lighting	$22,600	Jefferson Ave	N 24th St	M St	WB	SB10
Install curb extensions	$20,100	Cedar St at Mosby St				SB10
Install curb ramp	$2,500	Cedar St at Mosby St				SB10
Install curb ramp	$3,700	Jefferson Ave at N 24th St				SB10
Install curb ramp	$2,500	Princess Anne Ave at N 21st St				SB10
Project Cost	$332,300					SB10
Install crosswalk	$4,500	E Cary St at S 20th St				SB11
Install curb ramp	$6,200	E Cary St at S 20th St				SB11
Install curb ramp	$2,500	E Cary St at S 21st St				SB11
Consider lane diet	Further Study Needed	Dock St at S 22nd St				SB11

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Traffic calming needed	Further Study Needed	Dock St at S 22nd St				SB11
Install curb ramp	$2,500	Dock St at S 21st St				SB11
Install median refuge	$20,300	Dock St at S 21st St				SB11
Install pedestrian signal	$9,200	Dock St at S 21st St				SB11
Install street/pedestrian scale light	$27,200	Dock St at S 21st St				SB11
Traffic calming needed	Further Study Needed	Dock St at S 21st St				SB11
Reconstruct curb ramp (demolish/rebuild)	$5,000	E Cary St at S 22nd St				SB11
Reconstruct curb ramp (demolish/rebuild)	$5,000	E Cary St at S 23rd St				SB11
Reconstruct curb ramp (demolish/rebuild)	$6,200	E Main St at S 18th St				SB11
Reconstruct curb ramp (demolish/rebuild)	$5,000	E Cary St at S 18th St				SB11
Install crosswalk	$4,500	E Cary St at S 19th St				SB11
Install curb ramp	$8,700	E Cary St at S 19th St				SB11
Reconstruct curb ramp (demolish/rebuild)	$5,000	E Main St at S 19th St				SB11
Install crosswalk	$4,500	E Main St at S 23rd St				SB11
Reconstruct curb ramp (demolish/rebuild)	$2,500	E Main St at S 23rd St				SB11
Consider RRFB Installation	$34,300	E Main St at S 22nd St				SB11
Restrict Parking next to Bus Stop or crossing	Further Study Needed	E Main St at S 22nd St				SB11
Install pedestrian lighting	$22,600	S 19th St	E Main St	E Cary St	NB	SB11
Install pedestrian lighting	$22,600	S 19th St	Partway from E Cary St	Partway from E Main St	SB	SB11
Repair/Retrofit Sidewalk	$9,450	E Cary St	S 21st St	Partway to S 20th St	EB	SB11
Repair/Retrofit Sidewalk	$10,500	N 24th St	M St	E Leigh St	NB	SB11
Repair/Retrofit Sidewalk	$12,600	S 20th St	E Cary St	Partway to E Main St	NB	SB11
Widen Existing Sidewalk	$25,650	E Cary St	S 21st St	S 22nd St	EB	SB11

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Install New Sidewalk	$26,100	E Franklin St	N 23rd St	N 24th St	EB	SB11
Project Cost	$282,600					SB11
Repair/Retrofit Sidewalk	$15,450	N 20th St	Alley	E Broad St	SB	SB12
Install New Sidewalk	$15,600	N 19th St	E Broad St	E Marshall St	NB	SB12
Install New Sidewalk	$16,500	N 20th St	Alley	E Broad St	NB	SB12
Widen Existing Sidewalk	$28,200	E Marshall St	N 18th St	Cedar St	EB	SB12
Repair/Retrofit Sidewalk	$28,650	N 21st St	E Marshall St	E Broad St	NB	SB12
Repair/Retrofit Sidewalk	$28,800	N 22nd St	E Grace St	E Broad St	NB	SB12
Repair/Retrofit Sidewalk	$31,500	N 17th St	E Grace St	E Broad St	SB	SB12
Repair/Retrofit Sidewalk	$33,000	N 17th St	E Grace St	E Broad St	NB	SB12
Install pedestrian lighting	$22,600	N 20th St	E Broad St	E Grace St	SB	SB12
Install pedestrian lighting	$22,600	N 18th St	E Marshall St	E Broad St	SB	SB12
Install crosswalk	$1,100	E Marshall St at N 19th St				SB12
Install curb ramp	$2,500	E Marshall St at N 19th St				SB12
Install curb extensions	$20,100	E Marshall St at N 18th St				SB12
Install curb ramp	$1,200	E Marshall St at N 18th St				SB12
Install pedestrian actuators	$4,200	E Marshall St at N 21st St				SB12
Install crosswalk	$4,500	E Grace St at N 21st St				SB12
Install curb extensions	$20,100	E Grace St at N 21st St				SB12
Install curb ramp	$2,500	E Grace St at N 21st St				SB12
Reconstruct curb ramp (demolish/rebuild)	$5,000	E Broad St at N 21st St				SB12
Install crosswalk	$1,100	E Marshall St at N 22nd St				SB12
Install curb ramp	$10,000	E Marshall St at N 22nd St				SB12
Reconstruct curb ramp (demolish/rebuild)	$2,500	E Broad St at N 22nd St				SB12
Install crosswalk	$4,500	E Broad St at N 22nd St				SB12
Reconstruct curb ramp (demolish/rebuild)	$2,500	E Broad St at N 22nd St				SB12
Install crosswalk	$1,100	E Grace St at N 22nd St				SB12
Install curb ramp	$2,500	E Grace St at N 22nd St				SB12
Project Cost	$328,300					SB12

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Install curb ramp	$7,500	E Grace St at N 20th St				SB13
Install curb ramp	$6,200	E Franklin St at N 20th St				SB13
Install curb extensions	$20,100	E Grace St at N 18th St				SB13
Install curb ramp	$2,500	E Grace St at N 18th St				SB13
Install curb extensions	$20,100	E Grace St at N 17th St				SB13
Install curb ramp	$10,000	E Grace St at N 17th St				SB13
Reconstruct curb ramp (demolish/rebuild)	$2,500	E Franklin St at N 17th St				SB13
Reconstruct curb ramp (demolish/rebuild)	$5,000	E Franklin St at N 19th St				SB13
Install curb extensions	$20,100	E Franklin St at N 21st St				SB13
Reconstruct curb ramp (demolish/rebuild)	$5,000	E Franklin St at N 21st St				SB13
Install pedestrian lighting	$22,600	N 20th St	E Franklin St	E Grace St	NB	SB13
Install pedestrian lighting	$22,600	E Franklin St	N 20th St	N 21st St	WB	SB13
Install pedestrian lighting	$22,600	N 17th St	E Franklin St	E Grace St	SB	SB13
Install pedestrian lighting	$22,600	E Grace St	N 19th St	N 20th St	WB	SB13
Install New Sidewalk	$16,650	E Grace St	N 20th St	Alley	EB	SB13
Install New Sidewalk	$10,050	E Grace St	N 17th St	N 18th St	EB	SB13
Install New Sidewalk	$13,650	E Franklin St	N 19th St	N 20th St	WB	SB13
Install New Sidewalk	$31,800	N 20th St	E Franklin St	E Grace St	SB	SB13
Widen Existing Sidewalk	$32,850	N 17th St	E Franklin St	E Grace St	SB	SB13
Project Cost	$294,400					SB13

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Arts District

The following table and map provide a list and pedestrian related cost estimates for the recommended improvements within the Arts District study area. The estimates correspond to the half mile radius around the proposed Pulse station. The total recommended pedestrian improvements amount to over $3.8 M and include the installation of new crosswalks, sidewalks, curb ramps, pedestrian lighting as well as retrofitting some sidewalks and curb ramps to make them ADA accessible.

Figure 73: Arts District Station Proposed Pedestrian Improvements and Projects

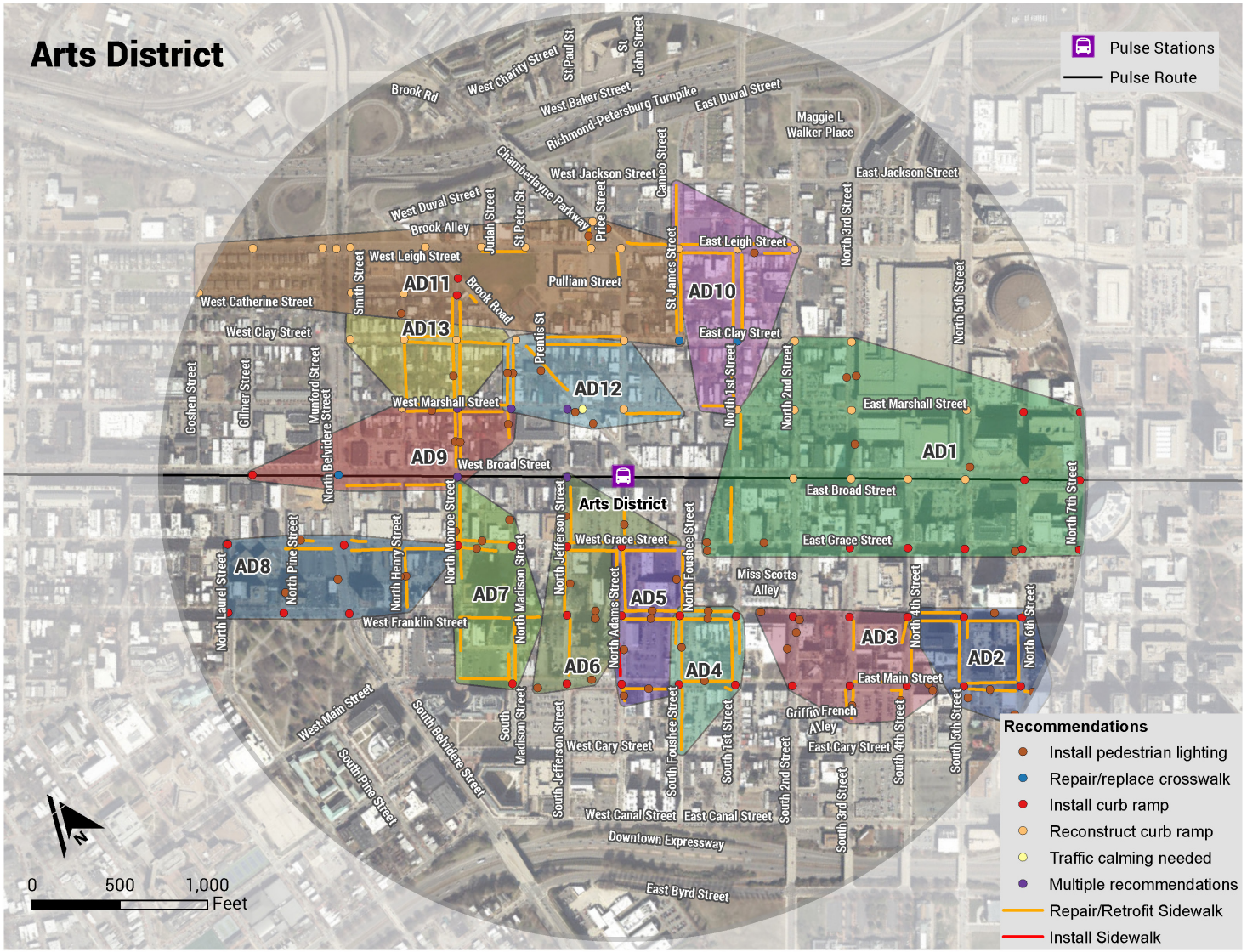

Table 8: Cost Estimates for Pedestrian Related improvements around the Proposed Arts District Station

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Repair/Retrofit Sidewalk	$9,750	N 1st St	E Marshall St	E Broad St	NB	AD1
Repair/Retrofit Sidewalk	$15,450	N 1st St	E Grace St	E Broad St	SB	AD1
Install pedestrian lighting	$22,600	N 3rd St	E Marshall St	E Clay St	SB	AD1
Install pedestrian lighting	$22,600	N 3rd St	E Marshall St	E Clay St	NB	AD1
Install pedestrian lighting	$22,600	N 3rd St	E Broad St	E Marshall St	NB	AD1
Install pedestrian lighting	$22,600	E Grace St	N 6th St	Partway to N 5th St	EB	AD1
Install pedestrian lighting	$22,600	E Grace St	N 1st St	N Foushee St	WB	AD1
Install pedestrian lighting	$22,600	E Grace St	N Foushee St	N 1st St	EB	AD1
Install pedestrian lighting	$22,600	E Grace St	N 1st St	N 2nd St	WB	AD1
Install pedestrian lighting	$22,600	N 5th St	E Broad St	Partway to E Marshall St	NB	AD1
Reconstruct curb ramp (demolish/rebuild)	$5,000	E Marshall St at N 2nd St				AD1
Reconstruct curb ramp (demolish/rebuild)	$5,000	E Marshall St at N 3rd St				AD1
Reconstruct curb ramp (demolish/rebuild)	$5,000	E Clay St at N 3rd St				AD1
Reconstruct curb ramp (demolish/rebuild)	$5,000	E Clay St at N 2nd St				AD1
Reconstruct curb ramp (demolish/rebuild)	$5,000	E Broad St at N 2nd St				AD1
Reconstruct curb ramp (demolish/rebuild)	$5,000	E Broad St at N 3rd St				AD1
Reconstruct curb ramp (demolish/rebuild)	$5,000	E Marshall St at N 5th St				AD1
Reconstruct curb ramp (demolish/rebuild)	$5,000	E Broad St at N 5th St				AD1
Reconstruct curb ramp (demolish/rebuild)	$5,000	E Broad St at N 4th St				AD1
Install curb ramp	$2,500	E Marshall St at N 6th St				AD1
Install curb ramp	$3,700	E Marshall St at N 7th St				AD1
Install curb ramp	$5,000	E Broad St at N 7th St				AD1
Install curb ramp	$5,000	E Broad St at N 6th St				AD1
Install curb ramp	$5,000	E Grace St at N 6th St				AD1
Install curb ramp	$5,000	E Grace St at N 7th St				AD1
Install curb ramp	$5,000	E Grace St at N 5th St				AD1

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Install curb ramp	$5,000	E Grace St at N 4th St				AD1
Install curb ramp	$5,000	E Grace St at N 3rd St				AD1
Project Cost	$292,200					AD1
Repair/Retrofit Sidewalk	$2,550	E Franklin St	N 6th St	Partway to N 7th St	WB	AD2
Repair/Retrofit Sidewalk	$5,100	S 5th St	E Main St	Partway to E Cary St	SB	AD2
Repair/Retrofit Sidewalk	$4,650	S 5th St	Alley	E Franklin St	NB	AD2
Repair/Retrofit Sidewalk	$5,550	E Main St	S 6th St	Partway to S 7th St	EB	AD2
Repair/Retrofit Sidewalk	$13,050	E Main St	S 5th St	S 6th St	EB	AD2
Repair/Retrofit Sidewalk	$13,350	E Franklin St	N 4th St	N 5th St	WB	AD2
Repair/Retrofit Sidewalk	$13,350	E Main St	S 5th St	S 6th St	WB	AD2
Repair/Retrofit Sidewalk	$13,650	E Franklin St	N 4th St	N 5th St	EB	AD2
Repair/Retrofit Sidewalk	$13,800	E Franklin St	S 5th St	S 6th St	EB	AD2
Repair/Retrofit Sidewalk	$16,350	N 6th St	E Franklin St	E Main St	SB	AD2
Repair/Retrofit Sidewalk	$16,650	N 5th St	E Franklin St	E Main St	SB	AD2
Install pedestrian lighting	$22,600	E Main St	S 6th St	Partway to S 7th St	EB	AD2
Install pedestrian lighting	$22,600	E Main St	S 6th St	S 7th St	WB	AD2
Install pedestrian lighting	$22,600	E Main St	S 5th St	S 6th St	EB	AD2
Install pedestrian lighting	$22,600	S 6th St	E Main St	E Cary St	SB	AD2
Install pedestrian lighting	$22,600	S 6th St	E Cary St	E Main St	NB	AD2
Install pedestrian lighting	$22,600	E Franklin St	S 5th St	S 6th St	WB	AD2
Install pedestrian lighting	$22,600	S 5th St	E Main Street	Partway to E Cary St	NB	AD2
Install curb ramp	$5,000	E Franklin St at N 5th St				AD2
Install curb ramp	$3,700	E Franklin St at N 6th St				AD2
Install curb ramp	$5,000	E Main St at S 6th St				AD2
Install curb ramp	$5,000	E Main St at S 5th St				AD2
Project Cost	$294,950					AD2
Install curb ramp	$5,000	E Franklin St at N 2nd St				AD3
Install curb ramp	$3,700	E Franklin St at N 3rd St				AD3
Install curb ramp	$5,000	E Franklin St at N 4th St				AD3
Install curb ramp	$2,500	E Main St at S 4th St				AD3

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Install curb ramp	$5,000	E Main St at S 3rd St				AD3
Install curb ramp	$2,500	E Main St at S 2nd St				AD3
Install pedestrian lighting	$22,600	E Main St	N 4th St	N 5th St	WB	AD3
Install pedestrian lighting	$22,600	E Main St	N 4th St	N 5th St	EB	AD3
Install pedestrian lighting	$22,600	N 2nd St	E Franklin St	Partway to E Main St	NB	AD3
Install pedestrian lighting	$22,600	N 2nd St	E Main St	E Franklin St	SB	AD3
Install pedestrian lighting	$22,600	S 4th St	E Main St	Partway to E Cary St	SB	AD3
Install pedestrian lighting	$22,600	S 3rd St	E Main St	Griffin French Alley	NB	AD3
Install pedestrian lighting	$22,600	E Franklin St	N 2nd St	N 1st St	WB	AD3
Install pedestrian lighting	$22,600	E Franklin St	N 2nd St	Partway to N 3rd St	EB	AD3
Repair/Retrofit Sidewalk	$5,100	E Main St	S 4th St	Partway to N 3rd St	EB	AD3
Repair/Retrofit Sidewalk	$12,000	N 4th St	Alley	E Franklin St	SB	AD3
Repair/Retrofit Sidewalk	$13,350	S 4th St	E Main St	Partway to E Cary St	SB	AD3
Repair/Retrofit Sidewalk	$13,350	S 3rd St	E Main St	Griffin French Alley	SB	AD3
Repair/Retrofit Sidewalk	$15,150	S 3rd St	E Main St	Griffin French Alley	NB	AD3
Repair/Retrofit Sidewalk	$15,300	N 3rd St	E Franklin St	Partway to E Main St	NB	AD3
Repair/Retrofit Sidewalk	$13,500	E Main St	N 3rd St	N 4th St	WB	AD3
Repair/Retrofit Sidewalk	$16,950	N 4th St	E Franklin St	E Main St	NB	AD3
Project Cost	$309,200					AD3
Repair/Retrofit Sidewalk	$3,150	E Main St	S 1st St	Partway to S Foushee St	EB	AD4
Repair/Retrofit Sidewalk	$12,000	N Foushee St	Alley	W Franklin St	SB	AD4
Repair/Retrofit Sidewalk	$9,150	N 1st St	E Franklin St	Alley	NB	AD4
Repair/Retrofit Sidewalk	$24,300	E Main St	S Foushee St	S 1st St	WB	AD4
Repair/Retrofit Sidewalk	$13,800	E Franklin St	N 1st St	N Foushee St	WB	AD4
Repair/Retrofit Sidewalk	$25,950	E Franklin St	N 1st St	N Foushee St	EB	AD4
Repair/Retrofit Sidewalk	$30,450	N Foushee St	W Main St	W Franklin St	NB	AD4
Repair/Retrofit Sidewalk	$30,750	S Foushee St	W Cary St	W Main St	SB	AD4
Repair/Retrofit Sidewalk	$31,800	N 1st St	E Main St	E Franklin St	SB	AD4
Repair/Retrofit Sidewalk	$31,950	S Foushee St	W Cary St	W Main St	NB	AD4
Install pedestrian lighting	$22,600	E Main St	S Foushee St	S 1st St	WB	AD4
Install pedestrian lighting	$22,600	N Foushee St	W Main St	W Franklin St	NB	AD4
Install pedestrian lighting	$22,600	E Franklin St	N 1st St	N Foushee St	WB	AD4

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Install pedestrian lighting	$22,600	E Franklin St	N 1st St	N Foushee St	EB	AD4
Install curb ramp	$5,000	W Franklin St at N Foushee St				AD4
Install curb ramp	$5,000	E Franklin St at N 1st St				AD4
Install curb ramp	$3,700	E Main St at S 1st St				AD4
Install curb ramp	$5,000	W Main St at S Foushee St				AD4
Project Cost	$322,400					AD4
Install curb ramp	$5,000	N Adams St at W Franklin St				AD5
Install curb ramp	$5,000	W Main St at N Adams St				AD5
Install pedestrian lighting	$22,600	W Main St	S Adams St	S Foushee St	EB	AD5
Install pedestrian lighting	$22,600	S Adams St	W Main St	Partway to W Cary St	NB	AD5
Install pedestrian lighting	$22,600	N Adams St	W Main St	W Franklin St	NB	AD5
Install pedestrian lighting	$22,600	N Foushee St	W Grace St	W Franklin St	SB	AD5
Install pedestrian lighting	$22,600	W Franklin St	N Adams St	N Foushee St	WB	AD5
Install pedestrian lighting	$22,600	W Franklin St	N Adams St	N Foushee St	EB	AD5
Repair/Retrofit Sidewalk	$5,850	S Adams St	W Main St	Partway to W Cary St	NB	AD5
Repair/Retrofit Sidewalk	$26,550	W Main St	S Adams St	S Foushee St	EB	AD5
Repair/Retrofit Sidewalk	$14,400	W Franklin St	N Adams St	N Foushee St	WB	AD5
Repair/Retrofit Sidewalk	$14,700	W Franklin St	N Adams St	N Foushee St	EB	AD5
Install New Sidewalk	$29,550	N Adams St	W Main St	W Franklin St	SB	AD5
Repair/Retrofit Sidewalk	$16,800	N Adams St	W Grace St	W Franklin St	NB	AD5
Repair/Retrofit Sidewalk	$31,650	N Foushee St	W Grace St	W Franklin St	NB	AD5
Repair/Retrofit Sidewalk	$17,250	N Adams St	W Grace St	W Franklin St	SB	AD5
Project Cost	$302,350					AD5
Repair/Retrofit Sidewalk	$8,400	N Adams St	W Grace St	Alley	NB	AD6
Repair/Retrofit Sidewalk	$13,350	W Grace St	N Jefferson St	N Adams St	EB	AD6
Repair/Retrofit Sidewalk	$13,500	W Grace St	N Jefferson St	N Adams St	WB	AD6
Repair/Retrofit Sidewalk	$14,400	W Grace St	N Adams St	N Foushee St	EB	AD6
Repair/Retrofit Sidewalk	$14,550	W Grace St	N Adams St	N Foushee St	WB	AD6
Repair/Retrofit Sidewalk	$15,750	N Jefferson St	W Main St	W Franklin St	NB	AD6
Repair/Retrofit Sidewalk	$15,750	N Jefferson St	W Broad St	W Grace St	NB	AD6
Repair/Retrofit Sidewalk	$16,800	N Jefferson St	W Franklin St	W Grace St	SB	AD6
Install pedestrian lighting	$22,600	W Main St	N Jefferson St	N Adams St	WB	AD6
Install pedestrian lighting	$22,600	W Main St	S Madison St	S Jefferson St	EB	AD6
Install pedestrian lighting	$22,600	N Jefferson St	W Franklin St	W Grace St	NB	AD6

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Install pedestrian lighting	$22,600	N Jefferson St	Alley	Partway to W Grace St	SB	AD6
Install pedestrian lighting	$22,600	N Adams St	W Grace St	Alley	NB	AD6
Install pedestrian lighting	$22,600	W Franklin St	N Jefferson St	N Adams St	EB	AD6
Install pedestrian lighting	$22,600	W Franklin St	N Adams St	N Jefferson St	WB	AD6
Install crosswalk	$4,500	W Broad St at N Jefferson St				AD6
Reconstruct curb ramp (demolish/rebuild)	$5,000	W Broad St at N Jefferson St				AD6
Install curb ramp	$5,000	W Grace St at N Adams St				AD6
Install curb ramp	$10,000	W Grace St at N Jefferson St				AD6
Install curb ramp	$8,700	W Franklin St at N Jefferson St				AD6
Install curb ramp	$2,500	W Main St at S Jefferson St				AD6
Project Cost	$306,400					AD6
Install curb ramp	$10,000	N Madison St at W Grace St				AD7
Install curb ramp	$3,700	W Main St at S Madison St				AD7
Install curb ramp	$8,700	W Grace St at N Monroe St				AD7
Install pedestrian lighting	$22,600	N Monroe St	W Grace St	Alley	SB	AD7
Install pedestrian lighting	$22,600	N Madison St	Alley	W Grace St	SB	AD7
Install pedestrian lighting	$22,600	W Grace St	N Monroe St	N Madison St	WB	AD7
Install pedestrian lighting	$22,600	W Grace St	N Monroe St	N Madison St	EB	AD7
Repair/Retrofit Sidewalk	$6,750	W Franklin St	N Madison St	Partway to N Jefferson St	EB	AD7
Repair/Retrofit Sidewalk	$13,800	N Monroe St	W Grace St	Alley	SB	AD7
Repair/Retrofit Sidewalk	$7,500	N Madison St	W Main St	Alley	SB	AD7
Repair/Retrofit Sidewalk	$14,850	N Monroe St	Alley	W Grace St	NB	AD7
Repair/Retrofit Sidewalk	$16,950	N Monroe St	Alley	W Franklin St	NB	AD7
Repair/Retrofit Sidewalk	$18,150	W Grace St	N Monroe St	N Madison St	EB	AD7
Repair/Retrofit Sidewalk	$13,650	W Grace St	N Monroe St	N Madison St	WB	AD7
Repair/Retrofit Sidewalk	$13,950	W Main St	N Monroe St	N Madison St	WB	AD7
Repair/Retrofit Sidewalk	$13,950	W Franklin St	N Monroe St	N Madison St	EB	AD7
Repair/Retrofit Sidewalk	$30,450	N Monroe St	W Grace St	W Broad St	NB	AD7
Repair/Retrofit Sidewalk	$32,850	N Madison St	W Franklin St	W Main St	NB	AD7
Project Cost	$295,650					AD7
Repair/Retrofit Sidewalk	$4,200	W Grace St	N Belvidere St	Partway to N Henry St	WB	AD8
Repair/Retrofit Sidewalk	$11,100	W Grace St	N Pine St	Alley	WB	AD8

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Repair/Retrofit Sidewalk	$13,050	W Grace St	N Pine St	N Belvidere St	EB	AD8
Repair/Retrofit Sidewalk	$13,650	W Grace St	N Henry St	N Monroe St	EB	AD8
Repair/Retrofit Sidewalk	$13,650	W Grace St	N Belvidere St	N Henry St	EB	AD8
Repair/Retrofit Sidewalk	$30,150	N Henry St	W Grace St	W Franklin St	NB	AD8
Install pedestrian lighting	$22,600	N Pine St	W Franklin St	Alley	NB	AD8
Install pedestrian lighting	$22,600	N Henry St	W Grace St	W Franklin St	NB	AD8
Install pedestrian lighting	$22,600	N Henry St	W Grace St	W Franklin St	SB	AD8
Install pedestrian lighting	$22,600	W Grace St	N Pine St	Alley	WB	AD8
Install pedestrian lighting	$22,600	N Belvedere St	W Grace St	W Franklin St	SB	AD8
Install curb ramp	$3,700	W Franklin St at N Belvidere St				AD8
Install curb ramp	$3,700	W Franklin St at N Pine St				AD8
Install curb ramp	$10,000	W Franklin St at N Laurel St				AD8
Install curb ramp	$2,500	W Grace St at N Laurel St				AD8
Install curb ramp	$15,000	W Grace St at N Belvidere St				AD8
Project Cost	$233,700					AD8
Install crosswalk	$4,500	N Monroe St at W Broad St				AD9
Reconstruct curb ramp (demolish/rebuild)	$5,000	N Monroe St at W Broad St				AD9
Install crosswalk	$1,100	W Marshall St at N Monroe St				AD9
Reconstruct curb ramp (demolish/rebuild)	$5,000	W Marshall St at N Monroe St				AD9
Install crosswalk	$1,100	W Marshall St at N Madison St				AD9
Reconstruct curb ramp (demolish/rebuild)	$6,200	W Marshall St at N Madison St				AD9
Reconstruct curb ramp (demolish/rebuild)	$5,000	W Marshall St at N Henry St				AD9
Repair/replace crosswalk	$4,500	W Broad St at N Belvidere St				AD9
Install curb ramp	$2,500	Gilmer St at W Broad St				AD9
Install pedestrian lighting	$22,600	W Marshall St	N Henry St	N Monroe St	EB	AD9
Install pedestrian lighting	$22,600	N Monroe St	W Marshall St	W Broad St	SB	AD9
Install pedestrian lighting	$22,600	N Monroe St	W Marshall St	W Broad St	NB	AD9
Install pedestrian lighting	$22,600	N Madison St	W Marshall St	Alley	SB	AD9
Repair/Retrofit Sidewalk	$13,350	N Madison St	W Marshall St	Alley	SB	AD9
Repair/Retrofit Sidewalk	$22,950	W Marshall St	N Monroe St	N Madison St	EB	AD9

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Repair/Retrofit Sidewalk	$24,150	W Marshall St	N Henry St	N Monroe St	EB	AD9
Repair/Retrofit Sidewalk	$24,300	W Marshall St	N Henry St	N Monroe St	WB	AD9
Repair/Retrofit Sidewalk	$13,350	W Broad St	N Henry St	N Monroe St	EB	AD9
Repair/Retrofit Sidewalk	$25,950	W Marshall St	N Monroe St	N Madison St	WB	AD9
Repair/Retrofit Sidewalk	$15,000	W Broad St	N Belvidere St	N Henry St	EB	AD9
Repair/Retrofit Sidewalk	$28,650	N Monroe St	W Marshall St	W Broad St	SB	AD9
Repair/Retrofit Sidewalk	$28,800	N Monroe St	W Marshall St	W Broad St	NB	AD9
Project Cost	$321,800					AD9
Repair/Retrofit Sidewalk	$6,900	E Leigh St	N 2nd St	Partway to N 1st St	EB	AD10
Repair/Retrofit Sidewalk	$14,700	E Marshall St	N 1st St	Partway to N Adams St	WB	AD10
Repair/Retrofit Sidewalk	$24,000	W Leigh St	N 1st St	N 2nd St	WB	AD10
Repair/Retrofit Sidewalk	$27,150	W Leigh St	St. James St	N 1st St	WB	AD10
Repair/Retrofit Sidewalk	$14,550	W Leigh St	St. James St	N 1st St	EB	AD10
Repair/Retrofit Sidewalk	$31,650	St, James St	W Leigh St	W Jackson St	SB	AD10
Repair/Retrofit Sidewalk	$17,250	N 1st St	E Marshall St	E Clay St	SB	AD10
Repair/Retrofit Sidewalk	$42,750	N 1st St	W Leigh St	E Clay St	NB	AD10
Repair/Retrofit Sidewalk	$42,900	N 1st St	W Leigh St	E Clay St	SB	AD10
Install pedestrian lighting	$22,600	E Leigh St	N 1st St	Partway to N 2nd St	EB	AD10
Reconstruct curb ramp (demolish/rebuild)	$5,000	E Marshall St at N 1st St				AD10
Repair/replace crosswalk	$1,100	E Clay St at N 1st St				AD10
Reconstruct curb ramp (demolish/rebuild)	$5,000	W Leigh St at St, James St			AD10	AD10
Reconstruct curb ramp (demolish/rebuild)	$5,000	N 1st St at E Leigh St			AD10	AD10
Reconstruct curb ramp (demolish/rebuild)	$5,000	E Leigh St at N 2nd St			AD10	AD10
Project Cost	$265,550					AD10
Repair/replace crosswalk	$1,100	St. James St at E Clay St				AD11
Reconstruct curb ramp (demolish/rebuild)	$2,500	W Leigh St at Smith St				AD11
Reconstruct curb ramp (demolish/rebuild)	$12,500	W Leigh St at N Belvidere St				AD11
Reconstruct curb ramp (demolish/rebuild)	$2,500	W Leigh St at Munford St				AD11
Reconstruct curb ramp (demolish/rebuild)	$5,000	W Leigh St at I-95/I-64 Exit Ramp				AD11
Install curb ramp	$5,000	W Leigh St at Goshen St				AD11

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Reconstruct curb ramp (demolish/rebuild)	$5,000	Goshen St at Catherine St				AD11
Reconstruct curb ramp (demolish/rebuild)	$5,000	W Leigh St at Brook Rd				AD11
Reconstruct curb ramp (demolish/rebuild)	$2,500	Judah St at W Leigh St				AD11
Reconstruct curb ramp (demolish/rebuild)	$2,500	W Leigh St at St. Peter St				AD11
Reconstruct curb ramp (demolish/rebuild)	$2,500	W Leigh St at Price St				AD11
Reconstruct curb ramp (demolish/rebuild)	$2,500	Chamberlayne Pkwy at Price St				AD11
Reconstruct curb ramp (demolish/rebuild)	$5,000	W Leigh St at Chamberlayne Pkwy				AD11
Repair/Retrofit Sidewalk	$2,100	W Leigh St	Chamberlayne Pkwy	St. James St	WB	AD11
Repair/Retrofit Sidewalk	$9,450	Price St	W Leigh St	Chamberlayne Pkwy	SB	AD11
Repair/Retrofit Sidewalk	$17,550	N Adams St	Pulliam St	W Leigh St	SB	AD11
Repair/Retrofit Sidewalk	$9,750	W Leigh St	Chamberlayne Pkwy	St. James St	WB	AD11
Repair/Retrofit Sidewalk	$12,300	W Leigh St	Judah St	St. Peter St	EB	AD11
Repair/Retrofit Sidewalk	$41,100	St. James St	E Clay St	E Leigh St	NB	AD11
Repair/Retrofit Sidewalk	$42,450	St. James St	E Clay St	E Leigh St	SB	AD11
Install pedestrian lighting	$22,600	Chamberlayne Pkwy	W Leigh St	Price St	NB	AD11
Install pedestrian lighting	$22,600	W Leigh St	Judah St	St. Peter St	WB	AD11
Install pedestrian lighting	$22,600	Price St	W Leigh St	Chamberlayne Pkwy	SB	AD11
Project Cost	$256,100					AD11
Install pedestrian lighting	$22,600	W Marshall St	N Jefferson St	Brook Rd	EB	AD12
Install pedestrian lighting	$22,600	N Madison St	W Clay St	W Marshall St	NB	AD12
Install pedestrian lighting	$22,600	N Madison St	W Clay St	W Marshall St	SB	AD12
Install pedestrian lighting	$22,600	Brook Rd	Alley	W Marshall St	SB	AD12
Install pedestrian lighting	$22,600	Brook Rd	W Clay St	W Marshall St	SB	AD12
Repair/Retrofit Sidewalk	$28,050	E Marshall St	N Adams St	Partway to N 1st St	EB	AD12
Repair/Retrofit Sidewalk	$31,800	Brook Rd	W Clay St	Partway to W Marshall St	NB	AD12
Repair/Retrofit Sidewalk	$31,950	N Madison St	W Clay St	W Marshall St	NB	AD12
Repair/Retrofit Sidewalk	$32,400	N Madison St	W Clay St	W Marshall St	SB	AD12
Repair/Retrofit Sidewalk	$40,650	W Clay St	Prentis St	N Adams St	WB	AD12
Repair/Retrofit Sidewalk	$40,800	W Clay St	Prentis St	N Adams St	EB	AD12

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Install crosswalk	$1,100	N Jefferson St at W Marshall St				AD12
Reconstruct curb ramp (demolish/rebuild)	$2,500	N Jefferson St at W Marshall St				AD12
Traffic calming needed	Further Study Needed	W Marshall St at Brook Rd				AD12
Reconstruct curb ramp (demolish/rebuild)	$3,700	W Marshall St at N Adams St				AD12
Reconstruct curb ramp (demolish/rebuild)	$5,000	E Clay St at N Adams St				AD12
Reconstruct curb ramp (demolish/rebuild)	$7,500	W Clay St at Brook Rd				AD12
Project Cost	$338,450					AD12
Reconstruct curb ramp (demolish/rebuild)	$5,000	W Clay St at N Henry St				AD13
Reconstruct curb ramp (demolish/rebuild)	$5,000	W Clay St at N Monroe St				AD13
Install curb ramp	$7,500	N Monroe St at Brook Rd				AD13
Install curb ramp	$6,200	Catherine St at N Monroe St				AD13
Reconstruct curb ramp (demolish/rebuild)	$2,500	Catherine St at N Henry St				AD13
Reconstruct curb ramp (demolish/rebuild)	$7,500	Smith St at W Clay St				AD13
Reconstruct curb ramp (demolish/rebuild)	$1,200	Catherine St at Smith St				AD13
Repair/Retrofit Sidewalk	$2,550	Brook Rd	Partway to N Monroe St	Partway to W Clay St	SB	AD13
Repair/Retrofit Sidewalk	$19,050	N Monroe St	Catherine St	W Clay St	NB	AD13
Repair/Retrofit Sidewalk	$19,650	N Monroe St	Catherine St	W Clay St	SB	AD13
Repair/Retrofit Sidewalk	$23,400	W Clay St	N Henry St	N Monroe St	WB	AD13
Repair/Retrofit Sidewalk	$23,850	W Clay St	N Henry St	N Monroe St	EB	AD13
Repair/Retrofit Sidewalk	$25,350	W Clay St	N Monroe St	N Madison St	EB	AD13
Repair/Retrofit Sidewalk	$29,850	N Henry St	W Clay St	W Marshall St	NB	AD13
Repair/Retrofit Sidewalk	$31,500	N Monroe St	W Clay St	W Marshall St	NB	AD13
Install pedestrian lighting	$22,600	N Henry St	W Clay St	Catherine St	SB	AD13
Install pedestrian lighting	$22,600	N Monroe St	W Clay St	W Marshall St	SB	AD13
Repair/Retrofit Sidewalk	$31,800	N Monroe St	W Clay St	W Marshall St	SB	AD13
Project Cost	$287,100					AD13

Allison Street

The following table and map provide a list and pedestrian related cost estimates for the recommended improvements within the Allison Street study area. The estimates correspond to the half mile radius around the proposed Pulse station. The total recommended pedestrian improvements amount to around $937,000 and include the retrofit and repair of existing sidewalks, installation of new crosswalks and the retrofit of existing curb ramps to make them fully ADA accessible.

Figure 74: Allison Street Station Proposed Pedestrian Improvements and Projects

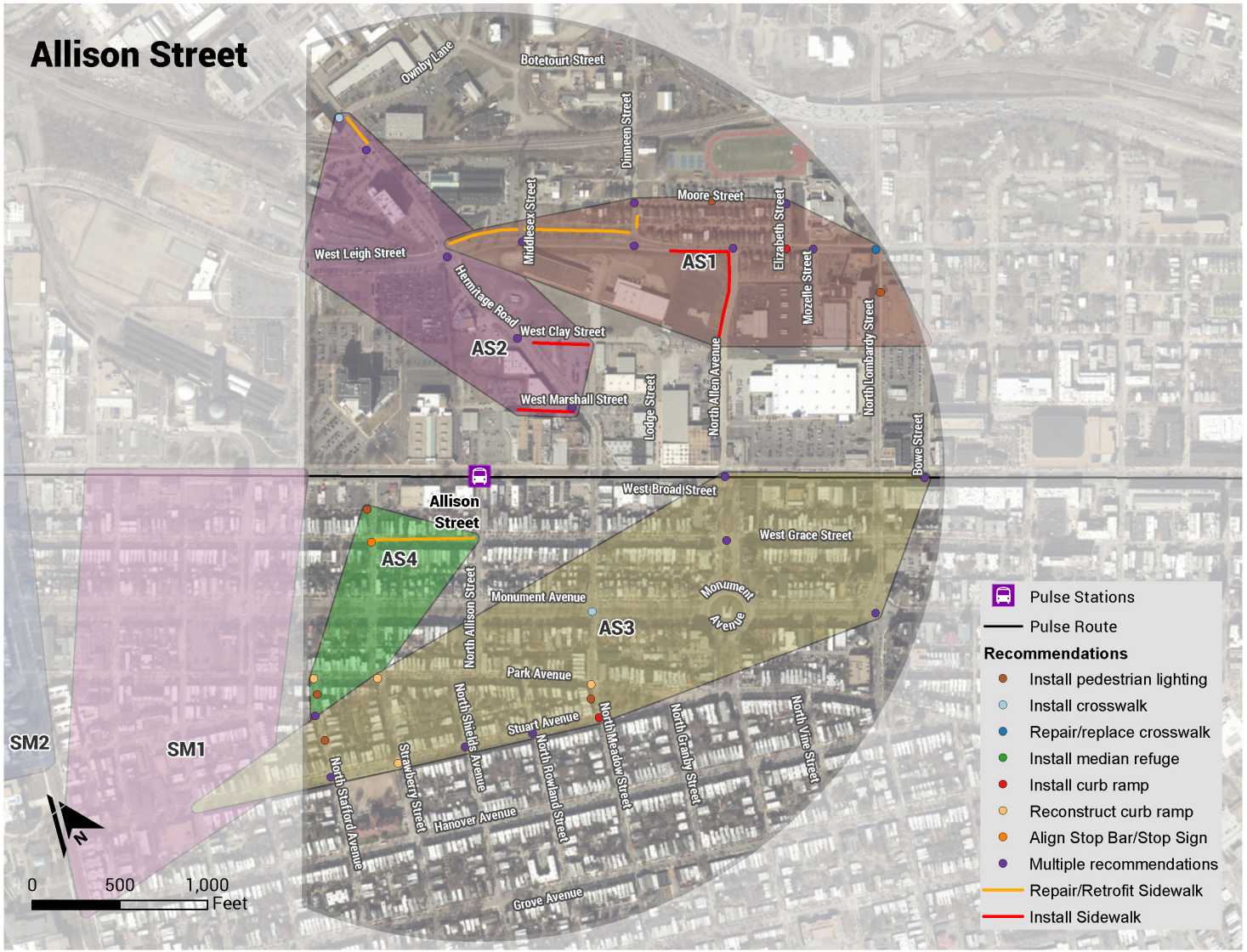

Table 9: Cost Estimates for Pedestrian Related improvements around the Proposed Allison Street Station

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Repair/Retrofit Sidewalk	$3,150	Dinneen St	Alley	Partway to Moore St	NB	AS1
Install New Sidewalk	$30,150	W Leigh St	N Allen Ave	Partway to Dinneen St	EB	AS1
Repair/Retrofit Sidewalk	$19,500	W Leigh St	Hermitage Rd	Middlesex St	WB	AS1
Install New Sidewalk	$47,550	N Allen St	W Leigh St	Partway to W Broad St	SB	AS1
Repair/Retrofit Sidewalk	$29,550	W Leigh St	Middlesex St	Dinneen St	WB	AS1
Install pedestrian lighting	$22,600	Moore St	Dinneen St	Elizabeth St	WB	AS1
Install pedestrian lighting	$22,600	N Lombardy St	W Leigh St	W Broad St	NB	AS1
Install crosswalk	$4,500	W Leigh St at N Allen Ave				AS1
Install curb ramp	$5,000	W Leigh St at N Allen Ave				AS1
Install curb ramp	$2,500	W Leigh St at Elizabeth St				AS1
Install crosswalk	$1,100	Elizabeth St at Moore St				AS1
Install curb ramp	$5,000	Elizabeth St at Moore St				AS1
Install street/pedestrian scale light	$27,200	Elizabeth St at Moore St				AS1
Install crosswalk	$1,100	Dinneen St at Moore St				AS1
Install curb ramp	$10,000	Dinneen St at Moore St				AS1
Install crosswalk	$4,500	W Leigh St at Dinneen St				AS1
Reconstruct curb ramp (demolish/rebuild)	$2,500	W Leigh St at Dinneen St				AS1
Reduce turning radii	$20,100	W Leigh St at Dinneen St				AS1
Install crosswalk	$4,500	W Leigh St at Mozelle St				AS1
Install curb ramp	$3,700	W Leigh St at Mozelle St				AS1
Repair/replace crosswalk	$4,500	N Lombardy St at W Leigh St				AS1
Install crosswalk	$1,100	W Clay St at Bowe St				AS1
Reconstruct curb ramp (demolish/rebuild)	$2,500	W Clay St at Bowe St				AS1
Install crosswalk	$4,500	W Leigh St at Middlesex St				AS1

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Reconstruct curb ramp (demolish/rebuild)	$2,500	W Leigh St at Middlesex St				AS1
Reduce turning radii	$20,100	W Leigh St at Middlesex St				AS1
Project Cost	$302,000					AS1
Install median refuge	$20,300	W Marshall St at Hermitage Rd				AS2
Install median refuge	$20,300	W Marshall St at Hermitage Rd				AS2
Reconstruct curb ramp (demolish/rebuild)	$5,000	W Marshall St at Hermitage Rd				AS2
Reduce turning radii	$20,100	W Marshall St at Hermitage Rd				AS2
Install crosswalk	$4,500	W Clay St at Hermitage Rd				AS2
Reconstruct curb ramp (demolish/rebuild)	$2,500	W Clay St at Hermitage Rd				AS2
Reduce turning radii	$20,100	W Clay St at Hermitage Rd				AS2
Reconstruct curb ramp (demolish/rebuild)	$5,000	W Leigh St at Hermitage Rd				AS2
Reduce turning radii	$20,100	W Leigh St at Hermitage Rd				AS2
Repair/replace crosswalk	$4,500	W Leigh St at Hermitage Rd				AS2
Install median refuge	$20,300	W Leigh St at DMV Dr.				AS2
Install crosswalk	$4,500	Hermitage Rd at Railroad Tracks				AS2
Install median refuge	$20,300	Hermitage Rd at Railroad Tracks				AS2
Install pedestrian signal	$9,200	Hermitage Rd at Railroad Tracks				AS2
Reduce turning radii	$20,100	Hermitage Rd at Railroad Tracks				AS2
Traffic calming needed	Further Study Needed	Hermitage Rd at Railroad Tracks				AS2
Install crosswalk	$4,500	Hermitage Rd at Ownby Lane				AS2
Repair/Retrofit Sidewalk	$9,000	Hermitage Rd	Ownby Ln	Partway to W Leigh St	NB	AS2
Install New Sidewalk	$15,450	W Marshall St	N Meadow St	Dead end	EB	AS2
Install New Sidewalk	$29,100	W Clay St	Hermitage Road	N Meadow St	EB	AS2
Project Cost	$254,850					AS2
Install pedestrian lighting	$22,600	Stuart Ave	N Rowland St	N Meadow St	WB	AS3

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Install pedestrian lighting	$22,600	N Meadow St	Park Ave	Stuart Ave	SB	AS3
Install median refuge	$20,300	W Franklin St at N Lombardy St				AS3
Install median refuge	$20,300	W Franklin St at N Lombardy St				AS3
Install median refuge	$20,300	W Franklin St at N Lombardy St				AS3
Install pedestrian actuators	$4,200	W Franklin St at N Lombardy St				AS3
Install median refuge	$20,300	N Allen Ave at W Grace St				AS3
Install median refuge	$20,300	N Allen Ave at W Grace St				AS3
Reconstruct curb ramp (demolish/rebuild)	$5,000	N Meadow St at Park Ave				AS3
Reconstruct curb ramp (demolish/rebuild)	$7,500	Park Ave at Strawberry St				AS3
Install curb ramp	$5,000	Stuart Ave at N Meadow St				AS3
Install crosswalk	$1,100	Stuart Ave at N Rowland St				AS3
Install curb ramp	$10,000	Stuart Ave at N Rowland St				AS3
Install crosswalk	$1,100	N Shields Ave at Stuart Ave				AS3
Reconstruct curb ramp (demolish/rebuild)	$5,000	N Shields Ave at Stuart Ave				AS3
Reconstruct curb ramp (demolish/rebuild)	$5,000	Stuart Ave at Strawberry St				AS3
Install curb extensions	$20,100	N Stafford Ave at Stuart Ave				AS3
Install curb ramp	$10,000	N Stafford Ave at Stuart Ave				AS3
Reconstruct curb ramp (demolish/rebuild)	$5,000	N Robinson St at Stuart Ave				AS3
Install curb ramp	$5,000	W Broad St at Bowe St				AS3
Install median refuge	$20,300	W Broad St at Bowe St				AS3
Install curb ramp	$5,000	W Broad St at N Allen Ave				AS3
Install median refuge	$20,300	W Broad St at N Allen Ave				AS3
Install crosswalk	$1,100	N Meadow St at Monument Ave				AS3
Project Cost	$277,400					AS3

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Relocate stop sign to align w stop bar	Further Study Needed	W Grace St at Strawberry St				AS4
Reconstruct curb ramp (demolish/rebuild)	$2,500	N Stafford Ave at Park Ave				AS4
Install crosswalk	$1,100	Kensington Ave at N Stafford Ave				AS4
Install curb ramp	$3,700	Kensington Ave at N Stafford Ave				AS4
Install pedestrian lighting	$22,600	N Stafford Ave	Stuart Ave	Kensington Ave	NB	AS4
Install pedestrian lighting	$22,600	N Stafford Ave	Kensington Ave	Park Ave	NB	AS4
Install pedestrian lighting	$22,600	Strawberry St	W Grace St	W Broad St	SB	AS4
Repair/Retrofit Sidewalk	$28,350	W Grace Street	Strawberry St	Allison St	WB	AS4
Project Cost	$103,450					AS4

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Science Museum

The following table and map provide a list and pedestrian related cost estimates for the recommended improvements within the Science Museum study area. The estimates correspond to the half mile radius around the proposed Pulse station. The total recommended pedestrian improvements amount to over $620,000 and include the retrofit and repair of existing sidewalks, installation of new crosswalks and the retrofit of existing curb ramps to make them fully ADA accessible.\

Figure 75: Science Museum Station Proposed Pedestrian Improvements and Projects

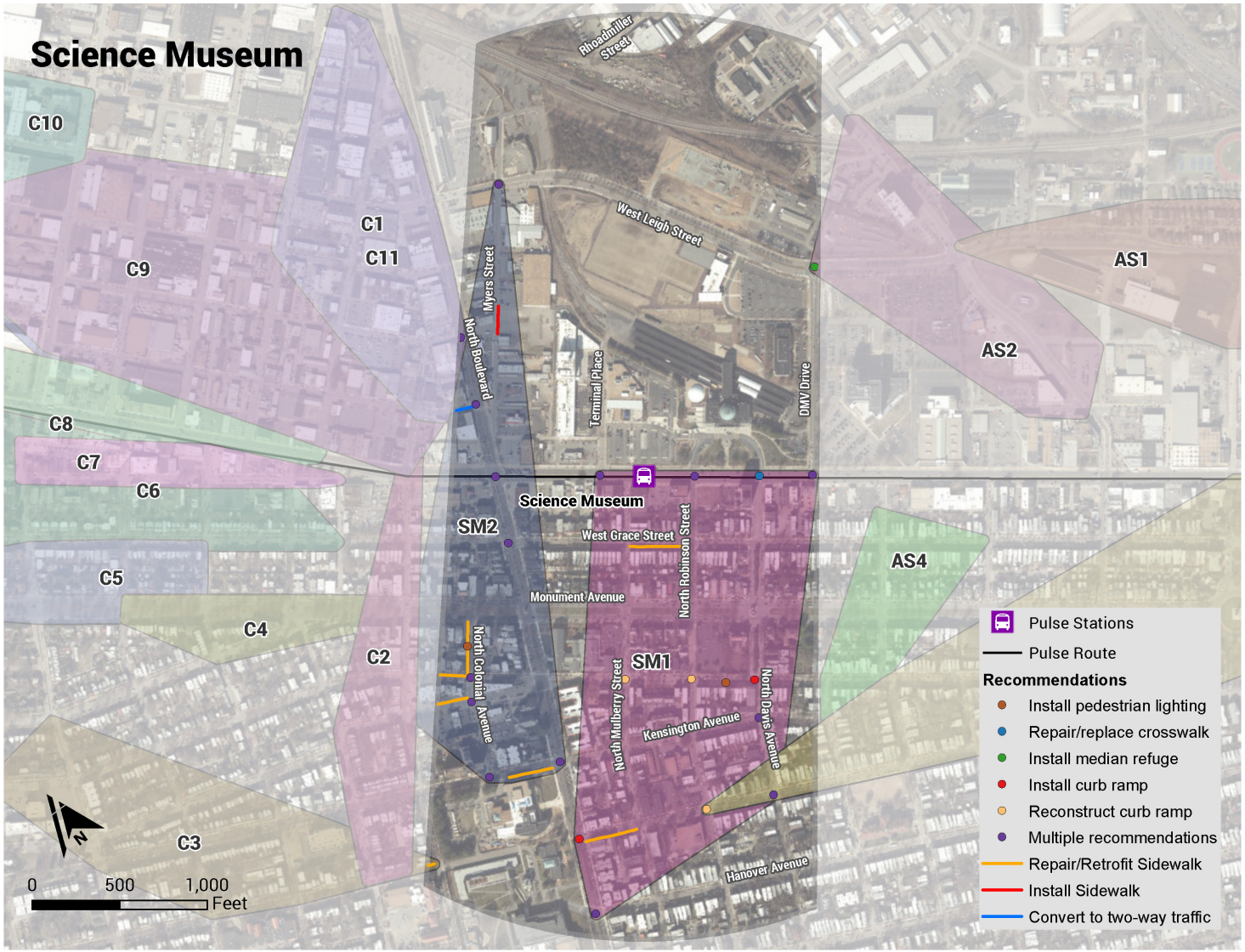

Table 10: Cost Estimates for Pedestrian Related improvements around the Proposed Science Museum Station

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Repair/Retrofit Sidewalk	$14,850	Stuart Ave	N Boulevard	N Mulberry St	EB	SM1
Repair/Retrofit Sidewalk	$16,200	W Grace St	N Mulberry St	N Robinson St	EB	SM1
Install pedestrian lighting	$33,900	Park Ave	N Robinson St	N Davis Ave	EB	SM1
Install median refuge	$20,300	W Broad St at DMV Dr.				SM1
Reconstruct curb ramp (demolish/rebuild)	$2,500	W Broad St at DMV Dr.				SM1
Repair/replace crosswalk	$4,500	N Davis Ave at W Broad St				SM1
Reconstruct curb ramp (demolish/rebuild)	$5,000	Park Ave at N Mulberry St				SM1
Reconstruct curb ramp (demolish/rebuild)	$5,000	N Robinson St at Park Ave				SM1
Install curb ramp	$6,200	Park Ave at N Davis Ave				SM1
Install crosswalk	$1,100	Kensington Ave at N Davis Ave				SM1
Reconstruct curb ramp (demolish/rebuild)	$5,000	Kensington Ave at N Davis Ave				SM1
Install crosswalk	$1,100	N Davis Ave at Stuart Ave				SM1
Install curb extensions	$20,100	N Davis Ave at Stuart Ave				SM1
Install curb ramp	$3,700	N Davis Ave at Stuart Ave				SM1
Install median refuge	$20,300	N Boulevard at Hanover Ave				SM1
Reduce turning radii	$20,100	N Boulevard at Hanover Ave				SM1
Install curb ramp	$2,500	N Boulevard at Stuart Ave				SM1
Install curb extensions	$20,100	W Broad St at Terminal Pl				SM1
Install median refuge	$20,300	W Broad St at Terminal Pl				SM1
Install street/pedestrian scale light	$27,200	W Broad St at Terminal Pl				SM1
Reconstruct curb ramp (demolish/rebuild)	$2,500	W Broad St at Terminal Pl				SM1
Repair/replace crosswalk	$4,500	W Broad St at Terminal Pl				SM1
Repair/replace pedestrian actuators	$4,200	W Broad St at Terminal Pl				SM1
Install curb extensions	$20,100	N Robinson St at W Broad St				SM1

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Reconstruct curb ramp (demolish/rebuild)	$5,000	N Robinson St at W Broad St				SM1
Repair/replace pedestrian actuators	$4,200	N Robinson St at W Broad St				SM1
Project Cost	$290,450					SM1
Install crosswalk	$1,100	Park Ave at N Colonial Ave				SM2
Install curb ramp	$5,000	Park Ave at N Colonial Ave				SM2
Install street/pedestrian scale light	$27,200	N Boulevard at Kensington Ave				SM2
Repair/replace crosswalk	$4,500	N Boulevard at Kensington Ave				SM2
Repair/replace pedestrian actuators	$4,200	N Boulevard at Kensington Ave				SM2
Install crosswalk	$1,100	N Colonial Ave at Kensington Ave				SM2
Install curb extensions	$20,100	N Colonial Ave at Kensington Ave				SM2
Install curb ramp	$7,500	N Colonial Ave at Kensington Ave				SM2
Install crosswalk	$1,100	Patterson Ave at N Colonial Ave				SM2
Install curb extensions	$20,100	Patterson Ave at N Colonial Ave				SM2
Reconstruct curb ramp (demolish/rebuild)	$5,000	Patterson Ave at N Colonial Ave				SM2
Install crosswalk	$4,500	W Leigh St at Myers St				SM2
Reconstruct curb ramp (demolish/rebuild)	$5,000	W Leigh St at Myers St				SM2
Install curb extensions	$20,100	W Marshall St at N Boulevard				SM2
Install median refuge	$20,300	W Marshall St at N Boulevard				SM2
Reconstruct curb ramp (demolish/rebuild)	$3,700	W Marshall St at N Boulevard				SM2
Install curb extensions	$20,100	N Boulevard at W Broad St				SM2
Reconstruct curb ramp (demolish/rebuild)	$7,500	N Boulevard at W Broad St				SM2
Install curb extensions	$20,100	N Boulevard at W Grace St				SM2
Install median refuge	$20,300	N Boulevard at W Grace St				SM2
Reconstruct curb ramp (demolish/rebuild)	$5,000	N Boulevard at W Grace St				SM2

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Install pedestrian lighting	$33,900	N Colonial St	Monument Ave	Park Ave	SB	SM2
Install New Sidewalk	$14,700	Myers St	Partway to N Boulevard	W Leigh St	NB	SM2
Repair/Retrofit Sidewalk	$12,450	Kensington Ave	Alley	N Boulevard	EB	SM2
Repair/Retrofit Sidewalk	$15,000	N Colonial St	Monument Ave	Park Ave	SB	SM2
Repair/Retrofit Sidewalk	$16,200	Park Ave	N Sheppard St	N Colonial Ave	WB	SM2
Repair/Retrofit Sidewalk	$17,100	Patterson Ave	N Sheppard St	N Colonial Ave	WB	SM2
Project Cost	$332,850					SM2

Cleveland Street

The following table and map provide a list and pedestrian related cost estimates for the recommended improvements within the Cleveland Street study area. The estimates correspond to the half mile radius around the proposed Pulse station. The total recommended pedestrian improvements amount to just over $3.0 M and include the retrofit and installation of sidewalks, curb ramps and crosswalks, installation of curb extensions, and one-to two-way street conversions.

Figure 75: Cleveland STreet Station Proposed Pedestrian Improvements and Projects

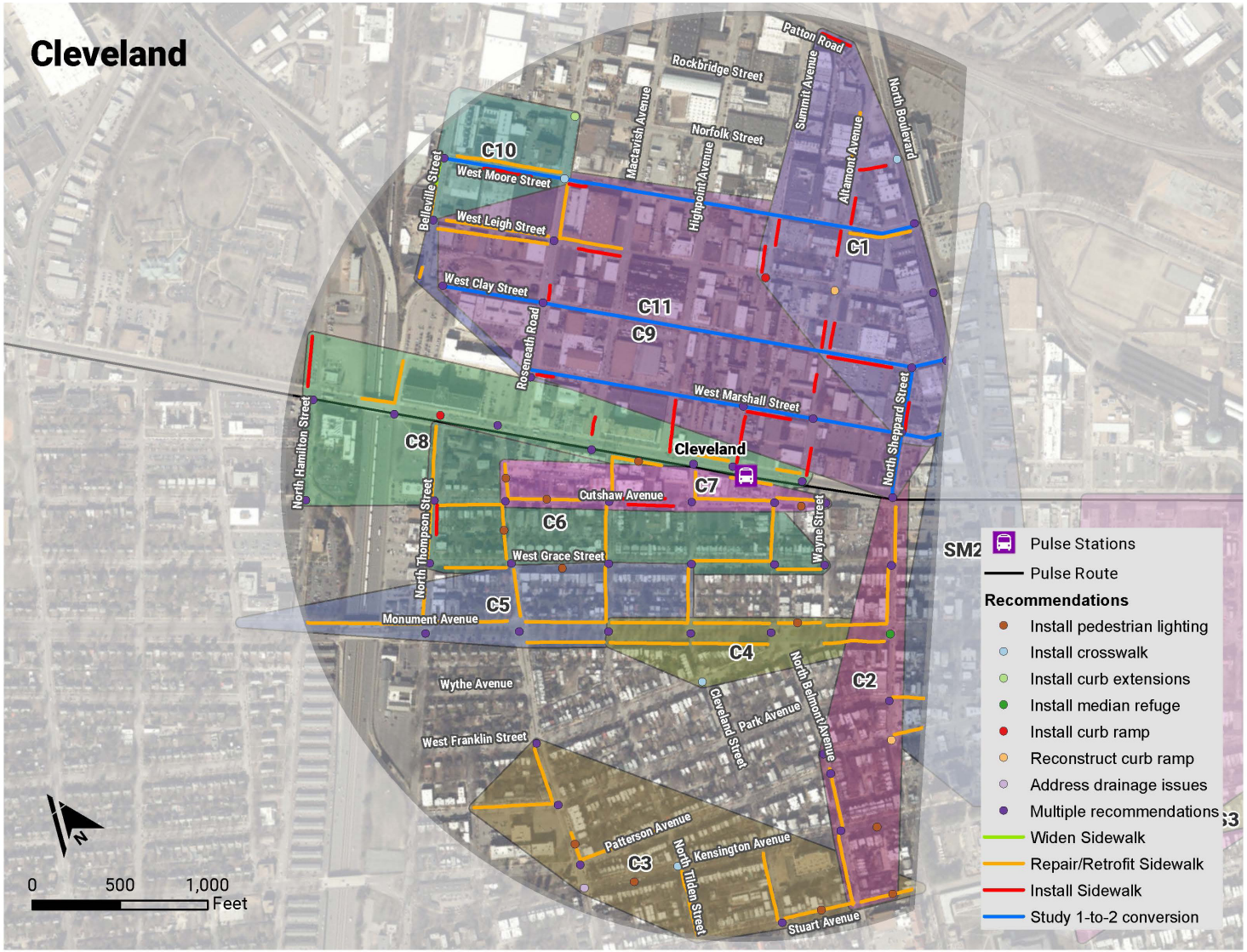

Table 11: Cost Estimates for Pedestrian Related improvements around the Proposed Cleveland Street Station

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Install New Sidewalk	$6,900	Altamont Ave	Moore St	Alley	SB	C1
Install New Sidewalk	$7,050	Altamont Ave	W Clay St	Alley	NB	C1
Install New Sidewalk	$7,050	Summit Ave	Moore St	Alley	NB	C1
Install New Sidewalk	$7,200	Summit Ave	Alley	W Leigh St	SB	C1
Install New Sidewalk	$13,800	Altamont Ave	W Clay St	Alley	SB	C1
Install New Sidewalk	$13,950	Altamont Ave	Moore St	Alley	NB	C1
Install New Sidewalk	$7,500	Norfolk St	Altamont Ave	N Boulevard	EB	C1
Install New Sidewalk	$8,250	N Sheppard St	W Marshall St	Alley	NB	C1
Install New Sidewalk	$16,200	Altamont Ave	Alley	East of Summit Ave	EB	C1
Repair/Retrofit Sidewalk	$13,050	Altamont Ave	Partway north	Norfolk St	SB	C1
Repair/Retrofit Sidewalk	$17,250	Moore St	Altamont Ave	N Boulevard	EB	C1
Install New Sidewalk	$34,200	W Clay St	Altamont Ave	Alley	EB	C1
Install crosswalk	$4,500	Norfolk St at N Boulevard				C1
Install curb ramp	$5,000	Moore St at N Boulevard				C1
Install median refuge	$20,300	Moore St at N Boulevard				C1
Repair/replace pedestrian actuators	$4,200	Moore St at N Boulevard				C1
Reconstruct curb ramp (demolish/rebuild)	$5,000	W Leigh St at Altamont Ave				C1
Install curb ramp	$5,000	Summit Ave at W Leigh St				C1
Install curb extensions	$20,100	W Leigh St at N Boulevard				C1
Install median refuge	$20,300	W Leigh St at N Boulevard				C1
Reconstruct curb ramp (demolish/rebuild)	$3,700	W Leigh St at N Boulevard				C1
Install curb extensions	$20,100	W Clay St at N Boulevard				C1
Install median refuge	$20,300	W Clay St at N Boulevard				C1
Reconstruct curb ramp (demolish/rebuild)	$3,700	W Clay St at N Boulevard				C1
Install crosswalk	$1,100	W Clay St at N Sheppard St				C1
Install curb extensions	$20,100	W Clay St at N Sheppard St				C1
Project Cost	$305,800					C1
Repair/Retrofit Sidewalk	$14,850	N Sheppard St	Monument Ave	W Grace St	SB	C2

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Repair/Retrofit Sidewalk	$15,450	N Sheppard St	W Broad St	W Grace St	NB	C2
Repair/Retrofit Sidewalk	$16,350	N Belmont St	Patterson Ave	Kensington Ave	NB	C2
Repair/Retrofit Sidewalk	$19,650	N Belmont Ave	Kensington Ave	Stuart Ave	SB	C2
Install pedestrian lighting	$22,600	Stuart Ave	N Belmont Ave	N Sheppard St	WB	C2
Install pedestrian lighting	$22,600	Kensington Ave	N Belmont Ave	N Sheppard St	EB	C2
Install crosswalk	$1,100	N Sheppard St at W Grace St				C2
Reconstruct curb ramp (demolish/rebuild)	$5,000	N Sheppard St at W Grace St				C2
Install median refuge	$20,300	N Sheppard St at Monument Ave				C2
Install crosswalk	$1,100	Park Ave at N Sheppard St				C2
Install curb extensions	$20,100	Park Ave at N Sheppard St				C2
Install curb ramp	$10,000	Park Ave at N Sheppard St				C2
Reconstruct curb ramp (demolish/rebuild)	$5,000	Patterson Ave at N Sheppard St				C2
Install crosswalk	$1,100	N Belmont Ave at Patterson Ave				C2
Install curb extensions	$20,100	N Belmont Ave at Patterson Ave				C2
Reconstruct curb ramp (demolish/rebuild)	$1,200	N Belmont Ave at Patterson Ave				C2
Install crosswalk	$1,100	Patterson Ave at N Belmont Ave				C2
Install curb extensions	$20,100	Patterson Ave at N Belmont Ave				C2
Reconstruct curb ramp (demolish/rebuild)	$2,500	Patterson Ave at N Belmont Ave				C2
Install crosswalk	$1,100	Kensington Ave at N Belmont Ave				C2
Repair/replace crosswalk	$1,100	Kensington Ave at N Belmont Ave				C2
Repair/replace pedestrian actuators	$4,200	Kensington Ave at N Belmont Ave				C2
Install crosswalk	$1,100	W Marshall St at N Sheppard St				C2
Install curb extensions	$20,100	W Marshall St at N Sheppard St				C2
Install median refuge	$20,300	W Marshall St at N Sheppard St				C2
Reconstruct curb ramp (demolish/rebuild)	$3,700	W Marshall St at N Sheppard St				C2

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Install crosswalk	$4,500	W Broad St at N Sheppard St				C2
Install curb extensions	$20,100	W Broad St at N Sheppard St				C2
Reconstruct curb ramp (demolish/rebuild)	$3,700	W Broad St at N Sheppard St				C2
Project Cost	$300,100					C2
Install median refuge	$20,300	Patterson Ave at Roseneath Rd				C3
Reconstruct curb ramp (demolish/rebuild)	$5,000	Patterson Ave at Roseneath Rd				C3
Repair/replace pedestrian actuators	$4,200	Patterson Ave at Roseneath Rd				C3
Install curb extensions	$20,100	Cleveland St at Stuart Ave				C3
Reconstruct curb ramp (demolish/rebuild)	$5,000	Cleveland St at Stuart Ave				C3
Install crosswalk	$1,100	Kensington Ave at Tilden St				C3
Address drainage issues	Further Study Needed	Roseneath Rd at Kensington Ave				C3
Install curb extensions	$20,100	Roseneath Rd at Park Ave				C3
Install median refuge	$20,300	Roseneath Rd at Park Ave				C3
Reconstruct curb ramp (demolish/rebuild)	$5,000	Roseneath Rd at Park Ave				C3
Install curb extensions	$20,100	W Franklin St at Roseneath Rd				C3
Install median refuge	$20,300	W Franklin St at Roseneath Rd				C3
Reconstruct curb ramp (demolish/rebuild)	$5,000	W Franklin St at Roseneath Rd				C3
Install pedestrian lighting	$22,600	Stuart Ave	Cleveland St	N Belmont Ave	WB	C3
Install pedestrian lighting	$22,600	Roseneath Rd	Alley	Patterson Ave	NB	C3
Install pedestrian lighting	$22,600	Kensington Ave	Roseneath Rd	Tilden St	EB	C3
Repair/Retrofit Sidewalk	$7,950	Roseneath Rd	Alley	Patterson Ave	NB	C3
Repair/Retrofit Sidewalk	$15,450	Roseneath Rd	W Franklin St	Park Ave	SB	C3
Repair/Retrofit Sidewalk	$17,250	Stuart Ave	N Belmont Ave	N Sheppard St	WB	C3
Repair/Retrofit Sidewalk	$19,200	Tilden St	Kensington Ave	Stuart Ave	NB	C3
Repair/Retrofit Sidewalk	$19,350	Cleveland St	Kensington Ave	Stuart Ave	SB	C3
Repair/Retrofit Sidewalk	$19,800	Stuart Ave	Cleveland St	N Belmont Ave	WB	C3
Repair/Retrofit Sidewalk	$21,900	Park Ave	N Nansemond St	Roseneath Rd	WB	C3
Repair/Retrofit Sidewalk	$23,850	Patterson Ave	Roseneath Rd	Tilden St	WB	C3

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Project Cost	$359,050					C3
Repair/Retrofit Sidewalk	$11,850	Monument Ave	N Belmont Ave	Wayne St	WB	C4
Repair/Retrofit Sidewalk	$16,800	Monument Ave	Wayne St	N Sheppard St	WB	C4
Repair/Retrofit Sidewalk	$17,100	Monument Ave	W Franklin St	N Sheppard St	EB	C4
Repair/Retrofit Sidewalk	$21,000	Monument Ave	Cleveland St	N Belmont Ave	EB	C4
Repair/Retrofit Sidewalk	$21,150	Monument Ave	Cleveland St	N Belmont Ave	WB	C4
Repair/Retrofit Sidewalk	$21,300	Monument Ave	Tilden St	Cleveland St	EB	C4
Repair/Retrofit Sidewalk	$21,750	Monument Ave	Tilden St	Cleveland St	WB	C4
Install pedestrian lighting	$22,600	Monument Ave	N Belmont Ave	Wayne St	WB	C4
Install crosswalk	$4,500	N Belmont Ave at Monument Ave				C4
Install curb extensions	$20,100	N Belmont Ave at Monument Ave				C4
Install street/pedestrian scale light	$27,200	N Belmont Ave at Monument Ave				C4
Reconstruct curb ramp (demolish/rebuild)	$8,700	N Belmont Ave at Monument Ave				C4
Install crosswalk	$4,500	Cleveland St at Monument Ave				C4
Install curb extensions	$20,100	Cleveland St at Monument Ave				C4
Install median refuge	$20,300	Cleveland St at Monument Ave				C4
Install street/pedestrian scale light	$27,200	Cleveland St at Monument Ave				C4
Reconstruct curb ramp (demolish/rebuild)	$5,000	Cleveland St at Monument Ave				C4
Install crosswalk	$1,100	W Franklin St at Cleveland St				C4
Project Cost	$292,250					C4
Install crosswalk	$4,500	Monument Ave at N Hamilton St				C5
Install curb ramp	$5,000	Monument Ave at N Hamilton St				C5
Install median refuge	$20,300	Monument Ave at N Hamilton St				C5
Repair/replace crosswalk	$4,500	Monument Ave at N Hamilton St				C5
Repair/replace pedestrian actuators	$4,200	Monument Ave at N Hamilton St				C5
Install crosswalk	$4,500	Tilden St at Monument Ave				C5
Reconstruct curb ramp (demolish/rebuild)	$5,000	Tilden St at Monument Ave				C5

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Install median refuge	$20,300	Monument Ave at Roseneath Rd				C5
Install street/pedestrian scale light	$27,200	Monument Ave at Roseneath Rd				C5
Reconstruct curb ramp (demolish/rebuild)	$5,000	Monument Ave at Roseneath Rd				C5
Repair/replace pedestrian actuators	$4,200	Monument Ave at Roseneath Rd				C5
Install curb ramp	$5,000	Monument Ave at Thompson St				C5
Install median refuge	$20,300	Monument Ave at Thompson St				C5
Install pedestrian actuators	$4,200	Monument Ave at Thompson St				C5
Repair/replace crosswalk	$4,500	Monument Ave at Thompson St				C5
Repair/Retrofit Sidewalk	$8,400	N Thompson St	Monument Ave	Alley	SB	C5
Repair/Retrofit Sidewalk	$13,050	Roseneath Rd	Monument Ave	W Grace St	NB	C5
Repair/Retrofit Sidewalk	$14,700	Cleveland St	W Grace St	Monument Ave	SB	C5
Repair/Retrofit Sidewalk	$15,150	Monument Ave	Kent Rd	N Hamilton St	WB	C5
Repair/Retrofit Sidewalk	$15,300	Tilden St	W Grace St	Monument Ave	SB	C5
Repair/Retrofit Sidewalk	$21,750	Monument Ave	Roseneath Rd	Tilden St	EB	C5
Repair/Retrofit Sidewalk	$22,050	Monument Ave	N Thompson St	Roseneath Rd	WB	C5
Repair/Retrofit Sidewalk	$22,500	Monument Ave	Roseneath Rd	Tilden St	WB	C5
Repair/Retrofit Sidewalk	$34,200	Monument Ave	N Hamilton St	N Thompson St	WB	C5
Project Cost	$305,800					C5
Install New Sidewalk	$15,450	N Thompson St	Alley	Cutshaw Ave	NB	C6
Repair/Retrofit Sidewalk	$12,150	W Grace St	N Belmont Ave	Wayne St	EB	C6
Repair/Retrofit Sidewalk	$14,550	N Belmont Ave	W Grace St	Cutshaw Ave	SB	C6
Repair/Retrofit Sidewalk	$14,850	Tilden St	Cutshaw Ave	W Grace St	SB	C6
Repair/Retrofit Sidewalk	$15,000	Roseneath Rd	W Grace St	Cutshaw Ave	SB	C6
Repair/Retrofit Sidewalk	$17,100	W Grace St	N Thompson St	Roseneath Rd	EB	C6
Repair/Retrofit Sidewalk	$17,700	N Thompson St	W Grace St	Cutshaw Ave	SB	C6
Repair/Retrofit Sidewalk	$18,000	Cutshaw Ave	N Thompson St	Roseneath Rd	EB	C6
Repair/Retrofit Sidewalk	$19,650	N Thompson St	Cutshaw Ave	W Broad St	SB	C6
Repair/Retrofit Sidewalk	$21,450	W Grace St	Cleveland St	N Belmont Ave	WB	C6
Install pedestrian lighting	$22,600	W Grace St	Roseneath Rd	Tilden St	EB	C6
Install pedestrian lighting	$22,600	Roseneath Rd	W Grace St	Cutshaw Ave	SB	C6
Install crosswalk	$1,100	Cutshaw Ave at N Thompson St				C6
Install curb extensions	$20,100	Cutshaw Ave at N Thompson St				C6
Install curb ramp	$7,500	Cutshaw Ave at N Thompson St				C6

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Install crosswalk	$1,100	N Thompson St at W Grace St				C6
Install curb ramp	$7,500	N Thompson St at W Grace St				C6
Install crosswalk	$1,100	W Grace St at Roseneath Rd				C6
Reconstruct curb ramp (demolish/rebuild)	$5,000	W Grace St at Roseneath Rd				C6
Install crosswalk	$1,100	W Grace St at Tilden St				C6
Install curb ramp	$10,000	W Grace St at Tilden St				C6
Install crosswalk	$1,100	W Grace St at Cleveland St				C6
Reconstruct curb ramp (demolish/rebuild)	$2,500	W Grace St at Cleveland St				C6
Install crosswalk	$1,100	W Grace St at N Belmont Ave				C6
Reconstruct curb ramp (demolish/rebuild)	$5,000	W Grace St at N Belmont Ave				C6
Install crosswalk	$1,100	Wayne St at W Grace St				C6
Reconstruct curb ramp (demolish/rebuild)	$1,200	Wayne St at W Grace St				C6
Project Cost	$277,600					C6
Install crosswalk	$1,100	Cutshaw Ave at Wayne St				C7
Install curb ramp	$10,000	Cutshaw Ave at Wayne St				C7
Install crosswalk	$1,100	Cutshaw Ave at N Belmont Ave				C7
Reconstruct curb ramp (demolish/rebuild)	$5,000	Cutshaw Ave at N Belmont Ave				C7
Install crosswalk	$1,100	Cutshaw Ave at Cleveland St				C7
Install median refuge	$20,300	Cutshaw Ave at Cleveland St				C7
Install curb ramp	$10,000	Cutshaw Ave at Cleveland St				C7
Install crosswalk	$1,100	Cutshaw Ave at Tilden St				C7
Install curb extensions	$20,100	Cutshaw Ave at Tilden St				C7
Install curb ramp	$7,500	Cutshaw Ave at Tilden St				C7

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Install street/pedestrian scale light	$27,200	Cutshaw Ave at Tilden St				C7
Install crosswalk	$1,100	Cutshaw Ave at Roseneath Rd				C7
Install curb extensions	$20,100	Cutshaw Ave at Roseneath Rd				C7
Install curb ramp	$10,000	Cutshaw Ave at Roseneath Rd				C7
Install pedestrian lighting	$22,600	Cutshaw Ave	N Belmont Ave	Wayne St	EB	C7
Install pedestrian lighting	$22,600	Cutshaw Ave	Roseneath Rd	Tilden St	WB	C7
Install pedestrian lighting	$22,600	Roseneath Rd	Cutshaw Ave	Alley	NB	C7
Repair/Retrofit Sidewalk	$7,050	Cleveland St	Cutshaw Ave	W Broad St	NB	C7
Repair/Retrofit Sidewalk	$8,850	Roseneath Rd	Cutshaw Ave	Alley	NB	C7
Repair/Retrofit Sidewalk	$12,600	Cutshaw Ave	N Belmont Ave	Wayne St	WB	C7
Install New Sidewalk	$12,750	Cutshaw Ave	Tilden St	Cleveland St	EB	C7
Install New Sidewalk	$14,850	Cutshaw Ave	Tilden St	Cleveland St	WB	C7
Repair/Retrofit Sidewalk	$20,550	Cutshaw Ave	Roseneath Rd	Tilden St	WB	C7
Repair/Retrofit Sidewalk	$21,300	Cutshaw Ave	Cleveland St	N Belmont Ave	WB	C7
Project Cost	$301,450					C7
Repair/Retrofit Sidewalk	$6,600	W Broad St	N Belmont Ave	Altamont Ave	WB	C8
Install New Sidewalk	$7,800	Altamont Ave	Alley	W Broad St	NB	C8
Repair/Retrofit Sidewalk	$9,300	W Broad St	I-195	I-195	WB	C8
Repair/Retrofit Sidewalk	$10,050	W Broad St	Cleveland St	Summit Ave	WB	C8
Repair/Retrofit Sidewalk	$11,100	Tilden St	Cutshaw Ave	W Broad St	NB	C8
Repair/Retrofit Sidewalk	$11,550	W Broad St	Summit Ave	N Belmont Ave	EB	C8
Repair/Retrofit Sidewalk	$22,800	W Clay St	W Broad St	Partway to Belleville St	NB	C8
Repair/Retrofit Sidewalk	$14,100	W Broad St	Tilden St	Highpoint Ave	EB	C8
Install New Sidewalk	$14,250	N Hamilton St	Mestin Ln	W Broad St	SB	C8
Install pedestrian lighting	$22,600	W Broad St	Tilden St	Highpoint Ave	EB	C8
Install curb ramp	$5,000	W Broad St at N Hamilton St				C8
Reconstruct curb ramp (demolish/rebuild)	$5,000	W Broad St at N Hamilton St				C8
Repair/replace crosswalk	$4,500	W Broad St at N Hamilton St				C8
Install RRFB	$34,300	W Broad St at N Hamilton St				C8
Install crosswalk	$1,100	Cutshaw Ave at N Hamilton St				C8
Install curb ramp	$7,500	Cutshaw Ave at N Hamilton St				C8
Install street/pedestrian scale light	$27,200	Cutshaw Ave at N Hamilton St				C8

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Reduce turning radii	$20,100	Cutshaw Ave at N Hamilton St				C8
Install crosswalk	$4,500	W Broad St at Alley				C8
Install curb ramp	$2,500	W Broad St at Alley				C8
Install curb ramp	$2,500	W Broad St at N Thompson St				C8
Install curb ramp	$2,500	W Broad St at Roseneath Rd				C8
Repair/replace crosswalk	$4,500	W Broad St at Roseneath Rd				C8
Install crosswalk	$4,500	Mactavish Ave at W Broad St				C8
Reconstruct curb ramp (demolish/rebuild)	$5,000	Mactavish Ave at W Broad St				C8
Install crosswalk	$4,500	Cleveland St at W Broad St				C8
Install curb ramp	$2,500	Cleveland St at W Broad St				C8
Repair/replace pedestrian actuators	$4,200	Cleveland St at W Broad St				C8
Install crosswalk	$4,500	W Broad St at Summit Ave				C8
Reconstruct curb ramp (demolish/rebuild)	$2,500	W Broad St at Summit Ave				C8
Install curb extensions	$20,100	W Broad St at Summit Ave				C8
Reconstruct curb ramp (demolish/rebuild)	$2,500	W Broad St at Summit Ave				C8
Project Cost	$301,650					C8
Install crosswalk	$1,100	Belleville St at W Leigh St				C9
Install curb ramp	$7,500	Belleville St at W Leigh St				C9
Install crosswalk	$1,100	W Clay St at I-195				C9
Install curb ramp	$2,500	W Clay St at I-195				C9
Install crosswalk	$1,100	W Marshall St at Roseneath Rd				C9
Install curb ramp	$5,000	W Marshall St at Roseneath Rd				C9
Reconstruct curb ramp (demolish/rebuild)	$2,500	W Marshall St at Roseneath Rd				C9
Consider lane diet	Further Study Needed	W Leigh St at Roseneath Rd				C9
Install crosswalk	$1,100	W Leigh St at Roseneath Rd				C9

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Install curb extensions	$20,100	W Leigh St at Roseneath Rd				C9
Install curb extensions	$20,100	W Leigh St at Roseneath Rd				C9
Narrow on-street parking aisle	Further Study Needed	W Leigh St at Roseneath Rd				C9
Install curb extensions	$20,100	Roseneath Rd at W Clay St				C9
Install pedestrian signal	$9,200	Roseneath Rd at W Clay St				C9
Reconstruct curb ramp (demolish/rebuild)	$5,000	Roseneath Rd at W Clay St				C9
Install crosswalk	$1,100	W Marshall St at Summit Ave				C9
Install curb ramp	$1,200	W Marshall St at Summit Ave				C9
Install curb extensions	$20,100	W Marshall St at Altamont Ave				C9
Reconstruct curb ramp (demolish/rebuild)	$5,000	W Marshall St at Altamont Ave				C9
Install New Sidewalk	$2,250	Altamont Ave	Partway to W Clay St	Alley	SB	C9
Install New Sidewalk	$5,100	Altamont Ave	Partway to W Marshall St	Alley	SB	C9
Repair/Retrofit Sidewalk	$5,550	Belleville St	Partway to W Clay St	Partway to W Leigh St	SB	C9
Install New Sidewalk	$4,050	Roseneath Rd	W Clay St	Partway to W Leigh St	NB	C9
Install New Sidewalk	$4,650	W Marshall St	Roseneath Rd	Partway to Mactavish Ave	EB	C9
Install New Sidewalk	$4,800	Moore St	Roseneath Rd	Partway to Mactavish Ave	EB	C9
Install New Sidewalk	$4,950	Mactavish Ave	W Broad St	Partway to Alley	SB	C9
Install New Sidewalk	$11,850	W Leigh St	Roseneath Rd	Mactavish Ave	EB	C9
Install New Sidewalk	$23,100	W Marshall St	Summit Ave	Altamont Ave	EB	C9
Install New Sidewalk	$13,200	Summit Ave	W Broad St	W Marshall St	NB	C9
Install New Sidewalk	$14,550	Highpoint Ave	W Broad St	W Marshall St	NB	C9
Repair/Retrofit Sidewalk	$15,150	Roseneath Rd	W Leigh St	Moore St	NB	C9
Repair/Retrofit Sidewalk	$17,400	W Leigh St	Roseneath Rd	Mactavish Ave	EB	C9
Repair/Retrofit Sidewalk	$29,100	W Leigh St	Belleville St	Roseneath Rd	WB	C9
Repair/Retrofit Sidewalk	$31,200	W Leigh St	Belleville St	Roseneath Rd	EB	C9
Project Cost	$310,700					C9
Repair/Retrofit Sidewalk	$3,450	Norfolk St	Belleville St	Partway to Roseneath Rd	WB	C10

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
Widen Existing Sidewalk	$16,500	Belleville St	Partway to Moore St	Moore St	SB	C10
Repair/Retrofit Sidewalk	$9,000	Belleville St	W Leigh St	Partway to Moore St	SB	C10
Install New Sidewalk	$13,500	Moore St	Belleville St	Roseneath Rd	EB	C10
Repair/Retrofit Sidewalk	$29,550	Moore St	Belleville St	Roseneath Rd	WB	C10
Install crosswalk	$1,100	Belleville St at Norfolk St			C10	
Install curb ramp	$1,200	Belleville St at Norfolk St			C10	
Install crosswalk	$1,100	Belleville St at Moore St			C10	
Install curb ramp	$5,000	Belleville St at Moore St			C10	
Relocate obstruction	Further Study Needed	Belleville St at Moore St			C10	
Install crosswalk	$1,100	Roseneath Rd at Moore St			C10	
Install curb extensions	$20,100	Roseneath Rd at Norfolk St			C10	
Project Cost	$101,600					C10
1-way to 2-way conversion	$9,200	W Marshall St	N Boulevard	Roseneath Rd		C11
1-way to 2-way conversion	$9,400	W Marshall St	N Boulevard	Roseneath Rd		C11
1-way to 2-way conversion	$11,500	W Marshall St	N Boulevard	Roseneath Rd		C11
1-way to 2-way conversion	$9,200	W Marshall St	N Boulevard	Roseneath Rd		C11
1-way to 2-way conversion	$9,200	W Marshall St	N Boulevard	Roseneath Rd		C11
1-way to 2-way conversion	$3,800	W Marshall St	N Boulevard	Roseneath Rd		C11
1-way to 2-way conversion	$3,900	W Marshall St	N Boulevard	Roseneath Rd		C11
1-way to 2-way conversion	$4,100	W Clay St	Belleville St	N Boulevard		C11
1-way to 2-way conversion	$9,400	W Clay St	Belleville St	N Boulevard		C11
1-way to 2-way conversion	$9,200	W Clay St	Belleville St	N Boulevard		C11
1-way to 2-way conversion	$9,200	W Clay St	Belleville St	N Boulevard		C11
1-way to 2-way conversion	$9,200	W Clay St	Belleville St	N Boulevard		C11
1-way to 2-way conversion	$2,600	W Clay St	Belleville St	N Boulevard		C11
1-way to 2-way conversion	$8,900	W Clay St	Belleville St	N Boulevard		C11
1-way to 2-way conversion	$13,100	W Clay St	Belleville St	N Boulevard		C11
1-way to 2-way conversion	$4,100	N Sheppard St	W Broad St	W Clay St		C11
1-way to 2-way conversion	$4,300	N Sheppard St	W Broad St	W Clay St		C11
1-way to 2-way conversion	$4,500	N Sheppard St	W Broad St	W Clay St		C11
1-way to 2-way conversion	$3,800	N Sheppard St	W Broad St	W Clay St		C11
1-way to 2-way conversion	$15,800	Moore St	Belleville St	N Boulevard		C11
1-way to 2-way conversion	$9,300	Moore St	Belleville St	N Boulevard		C11

Recommendation	Cost Estimate	Location	From	To	Street face	Project Id
1-way to 2-way conversion	$9,200	Moore St	Belleville St	N Boulevard		C11
1-way to 2-way conversion	$9,100	Moore St	Belleville St	N Boulevard		C11
1-way to 2-way conversion	$9,200	Moore St	Belleville St	N Boulevard		C11
1-way to 2-way conversion	$3,800	Moore St	Belleville St	N Boulevard		C11
1-way to 2-way conversion	$1,800	Moore St	Belleville St	N Boulevard		C11
1-way to 2-way conversion	$3,100	Moore St	Belleville St	N Boulevard		C11
Project Cost	$199,900					C11

Bicycle Improvement Estimates

The recommended projects are meant to complement the proposed improvements put forth by the 2015 Richmond Bicycle Master Plan. The planning level cost estimates were developed for individual recommendations contained in this report. Cost estimates related to the recommendations contained in the 2015 Richmond Bicycle Master Plan are not included in the tables below. The following methodology was used:

- Site assessment was based on street-level review of each location through fieldwork check.
- Cost estimates for linear improvements were developed by establishing a cost per linear foot for the recommended facility type and applying it to the length of the improvement. In general, any cost estimates that could be calculated and stated as linear improvements were calculated that way, since the improvement geometries were recorded as linear data in the geodatabase. The linear cost figures contained in the Richmond Bicycle Master Plan (pp. 3-14 to 3-15) were used as a general basis for all cost estimates since they represent a researched, local set of unit costs based on the City's experience, and supplemented as needed.
- Cost estimates for individual spot improvements were developed by identifying anticipated quantities for significant construction items (e.g. asphalt, sidewalk, concrete curb, pavement markings, etc.).
- All cost estimates assume that 20 percent contingency, 10 percent design, 15 percent utilities and 5 percent survey, are applied to the base cost unless otherwise noted.

Unit prices for construction items were established based on regional historical bid pricing available through the planning level cost estimates in the Richmond Bicycle Master Plan and the Study Team's experience and judgment. All units have been presented in Linear Feet (LF) with the exception of High-Intensity Activated Walk (HAWK) signal systems, which are presented as single units (EA).

The table below presents all assumptions related to unit costs to develop the project estimates. Although quantities and unit prices were developed for each estimate, a fluctuation in quantities and bid prices can be expected as the level of design progresses. Final construction costs for a bid package can only be determined after a final or near-final design has been completed. The costs provided in this document are only intended for budgeting purposes and should be further informed by City engineers.

Individual station recommendations and cost estimates can be found below. All cost estimates shown in the maps and tables below include a unique Project ID which identifies each particular project and can be used to reference each proposed improvement.

Table 12: Bicycle network recommendations costs and assumptions

Item Description	Unit	2016 Average Cost	Total Unit Cost with Contingency, Design Fee, Utilities, and Survey*	Assumptions
BIKE LANES				
Improve Bike Lane Signs	LF	$ 0.24	$ 0.38	All estimates are for ONE side of a street, double for installations on both sides of a street or bi-directional bike lanes. Based on linear unit costs in Richmond Master Bike Plan. Assumes 25% design and 25% contingency for all categories. Separated bike lanes estimate assumes a 4'-wide median strip providing a physical barrier between bike lanes and traffic, and includes 5% landscaping, 10% utility adjustments, and 10% drainage in addition to design and contingency.
Install NEW Standard Bike Lanes	LF	$ 8	$ 12	
Install NEW Buffered Bike Lanes	LF	$ 18	$ 27	
Install NEW Separated Bike Lanes	LF	$ 86	$ 160	
BIKE BOULEVARDS				
Install NEW Shared Lane Markings (Sharrows)	LF	$ 1.24	$ 2	All estimates are for both sides of a street Based on linear unit costs in Richmond Master Bike Plan. Assumes 25% design and 25% contingency for shared lane markings (sharrows). Bike boulevard treatment estimate includes traffic calming treatments and intersection treatments, and includes 5% landscaping, 10% utility adjustments, and 10% drainage in addition to design and contingency.
Install NEW Bike Boulevard Treatments	LF	$ 29	$ 54	
BIKE TRAILS				
Install NEW off-street bike trails	LF	$ 61	$ 106	Assumes 10'-wide paved path separated into two 5' lanes, with minimal signage. Includes 25% design, 5% landscaping, 10% drainage, and 25% contingency.
SIGNALS				
Install High-Intensity Activated Walk (HAWK) signal systems	EA	$ 80,000	$ 135,000	Unit cost from relevant local examples including the 2015 Bicycle Master Plan. This cost is for a standard installation on a two-way roadway, including signal arms and push buttons on either side of the street. Unit price does not include associated curb cuts or crosswalks, or costs associated with powering the system.
OTHER IMPROVEMENTS				
Repave cobblestone alleys	LF	$ 81	$ 152	Unit costs from relevant local examples. Assumes 15'-wide alleys. Includes 25% design, 5% landscaping, 10% utility adjustments, 10% drainage, and 25% contingency.
Convert one-way streets to two-way	LF	$ 12	$ 24	Unit costs for one-way to two-way conversion are assumed to be similar to two-way installation of standard bike lanes (similar quantities of lane markings and signage). Assumes 25% design and 25% contingency. Does not account for signal costs at signalized intersections.

Contingency (20%); Design (10%); Utilities (15%); Survey (5%)

****** All 2012 Average Costs were increased to accommodate a linear inflation of 2.9%.***

Orleans Street

The following table and map provide a list and bicycle related cost estimates for the recommended improvements within the Orleans Street study area. The estimates correspond to the half mile radius around the proposed Pulse station. The total recommended bicycle improvements amount to over $1.5 M and include the construction of bike lanes, separated bike lanes, and increasing signs around the area.

Figure 76: Orleans Street Station Bicycle Recommendations Map

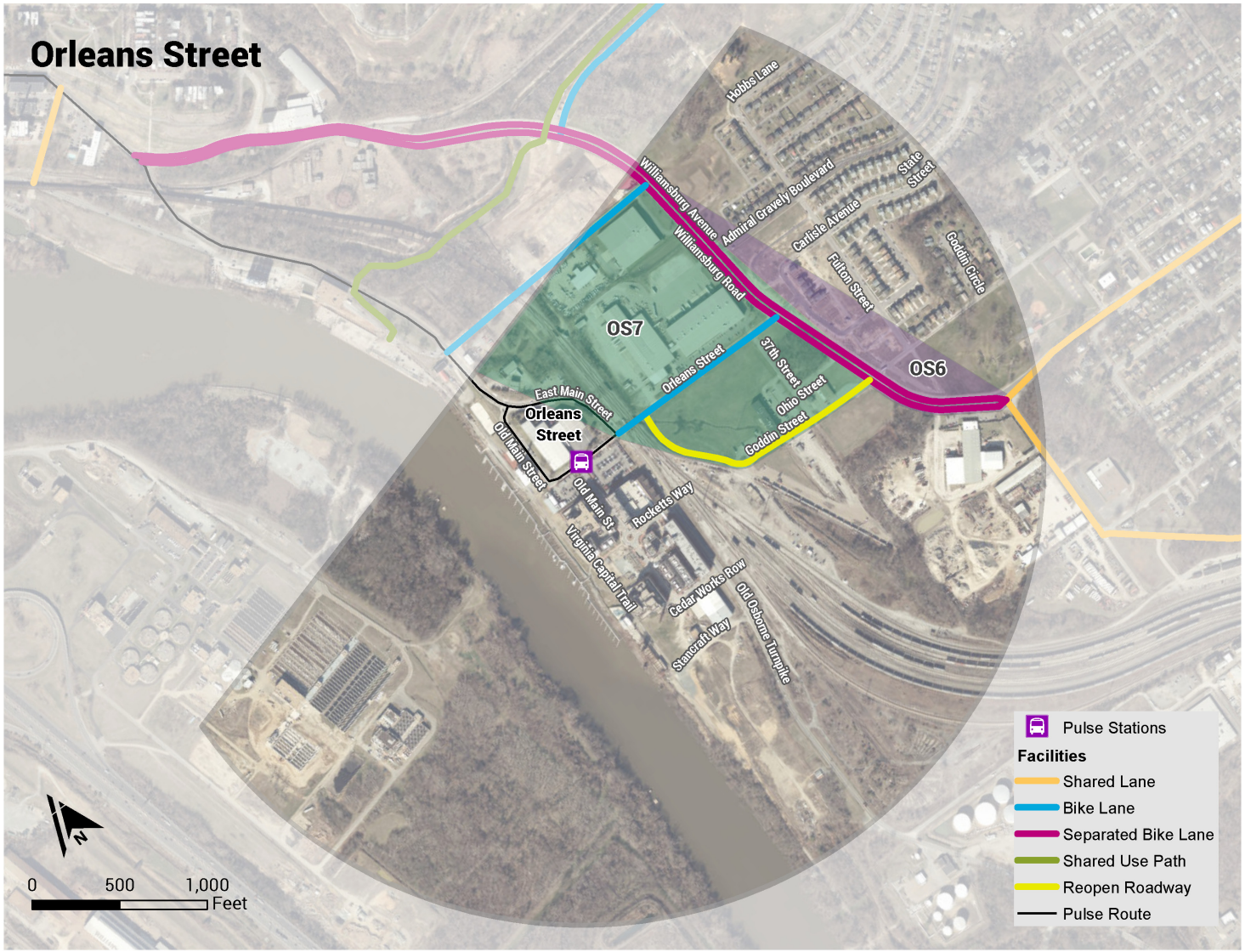

Table 13: Cost Estimates for bicycle related improvements around the proposed Orleans Street Pulse Station

Recommendation	Cost Estimate	Location	From	To	Project ID
Separated Bike Lane	$1,505,450	Williamsburg Ave	Hatcher St	E Main St	OS6
Project Cost	$1,505,450				OS6
Bike Lane	$25,300	Orleans St	E Main St	Williamsburg Ave	OS7
Increase signage from Williamsburg to Rocketts Landing	$500	Orleans St	E Main St	Williamsburg Ave	OS7
Bike Lane	$33,500	Nicholson St	E Main St	Williamsburg Ave	OS7
Consider reopening Goddin Street for bike/pedestrian traffic	Further Study Needed	Goddin St	Williamsburg Ave	Orleans St	OS7
Project Cost	$59,300				OS7

East Riverfront

The following table and map provide a list and bicycle related cost estimates for the recommended improvements within the East Riverfront study area. The estimates correspond to the half mile radius around the proposed Pulse station. The total recommended bicycle improvements amount to over $1.8 M and include the construction of separated bike lanes.

Figure 76: East Riverfront Station Bicycle Recommendations Map

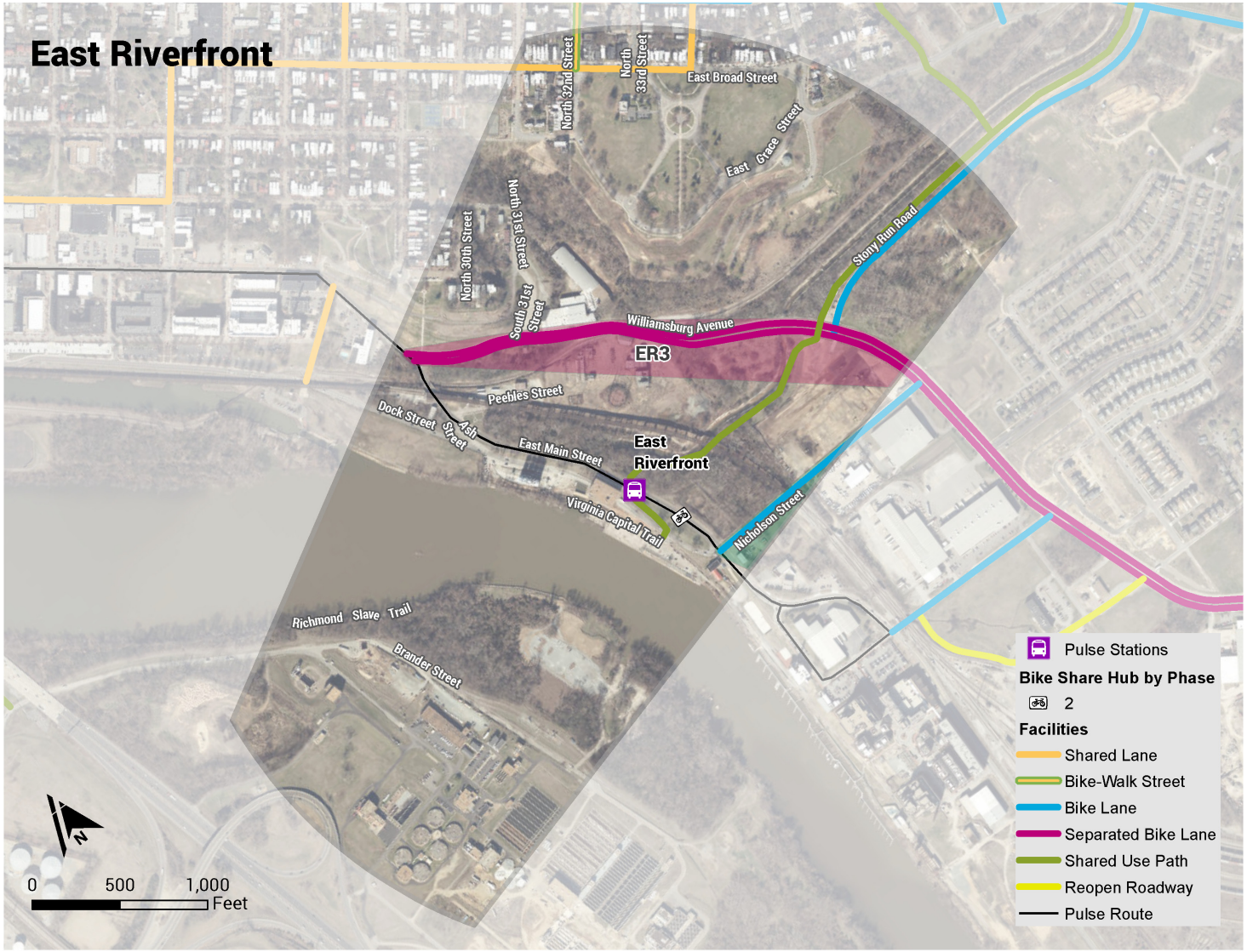

Table 13: Cost Estimates for bicycle related improvements around the proposed East Riverfront Pulse Station

Recommendation	Cost Estimate	Location	From	To	Project ID
Separated Bike Lane	$1,825,000	Williamsburg Ave	Hatcher St	E Main St	ER3
Project Cost	$1,825,500				ER3

Shockoe Bottom

The following table and map provide a list and bicycle related cost estimates for the recommended improvements within the Shockoe Bottom study area. The estimates correspond to the half mile radius around the proposed Pulse station. The total recommended bicycle improvements amount to over $350,000 and include the construction of additional bike-walk streets and bike lanes.

Figure 77: Shockoe Bottom Station Bicycle Recommendations Map

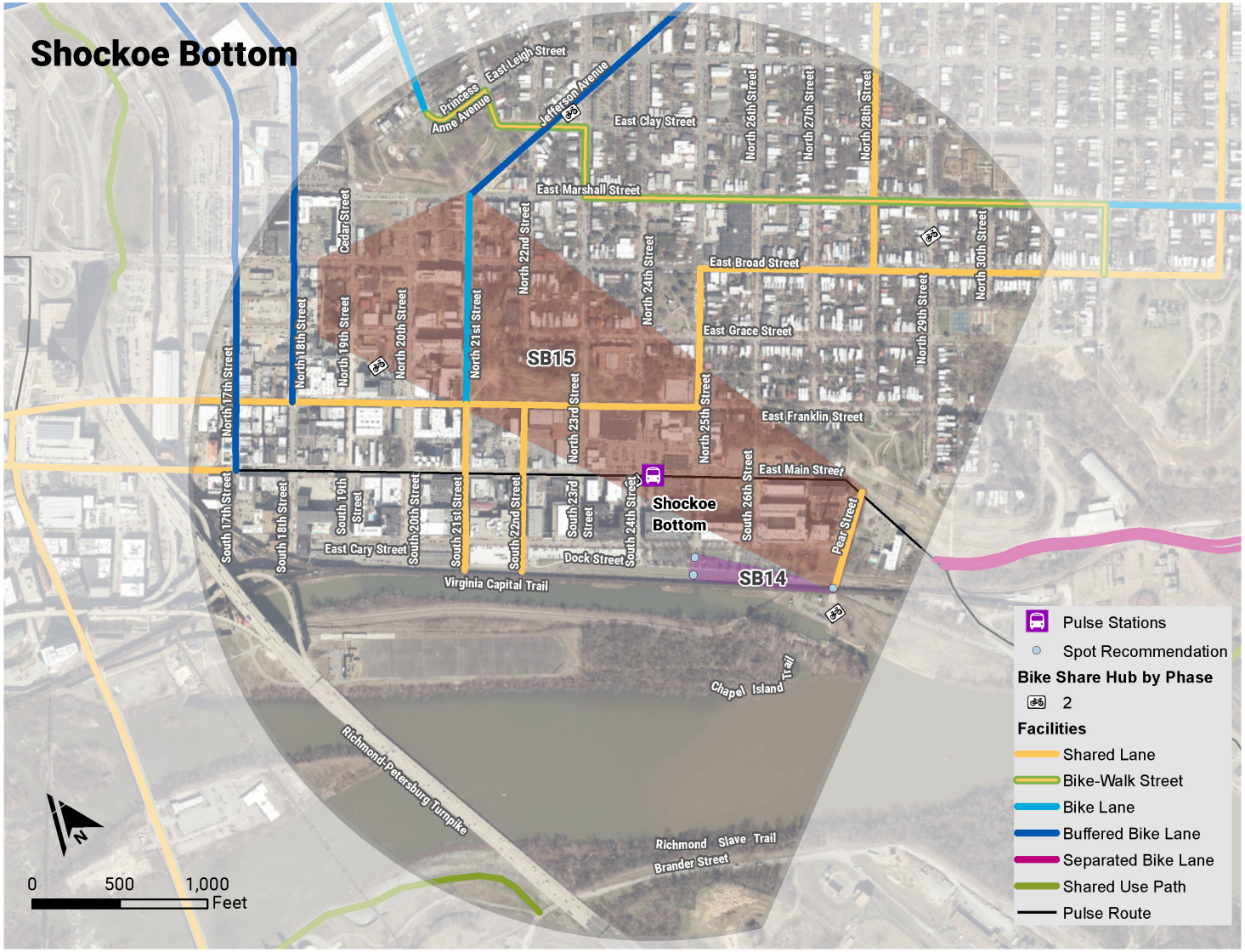

Table 14: Cost Estimates for bicycle related improvements around the proposed Shockoe Bottom Pulse Station

Recommendation	Cost Estimate	Location	From	To	Project ID
Change Pear St crossing to include advance warning signs on Dock and traffic calming. Hi-viz crosswalk with HAWK signal.	$135,000	Pear St at E Dock St			SB14
Change Dock St crossing to hi-viz ped-activated signal-controlled crossing	$135,000	Dock St at S 25th St			SB14
Add bike ramp to stairs at end of 25th Street	Further Study Needed	Dock St at S 25th St			SB14
Project Cost	$270,000				SB14
Sharrows	$2,600	Pear St	Dock St	E Main St	SB15
Climbing Lane	$26,900	N 21st St	E Franklin St	E Marshall St	SB15
Convert cobblestone at alley to concrete or asphalt	$60,600	Alley between N 18th St and N 19th St	E Broad St	E Grace St	SB15
Project Cost	$90,100				SB15

Arts District

The following table and map provide a list and bicycle related cost estimates for the recommended improvements within the Arts District study area. The estimates correspond to the half mile radius around the proposed Pulse station. The total recommended bicycle improvements amount to $2.6 M and include the implementation of bike-walk streets as well as planning for future connections on the N. Belvidere Street bridge.

Figure 78: Arts District Station Bicycle Recommendations Map

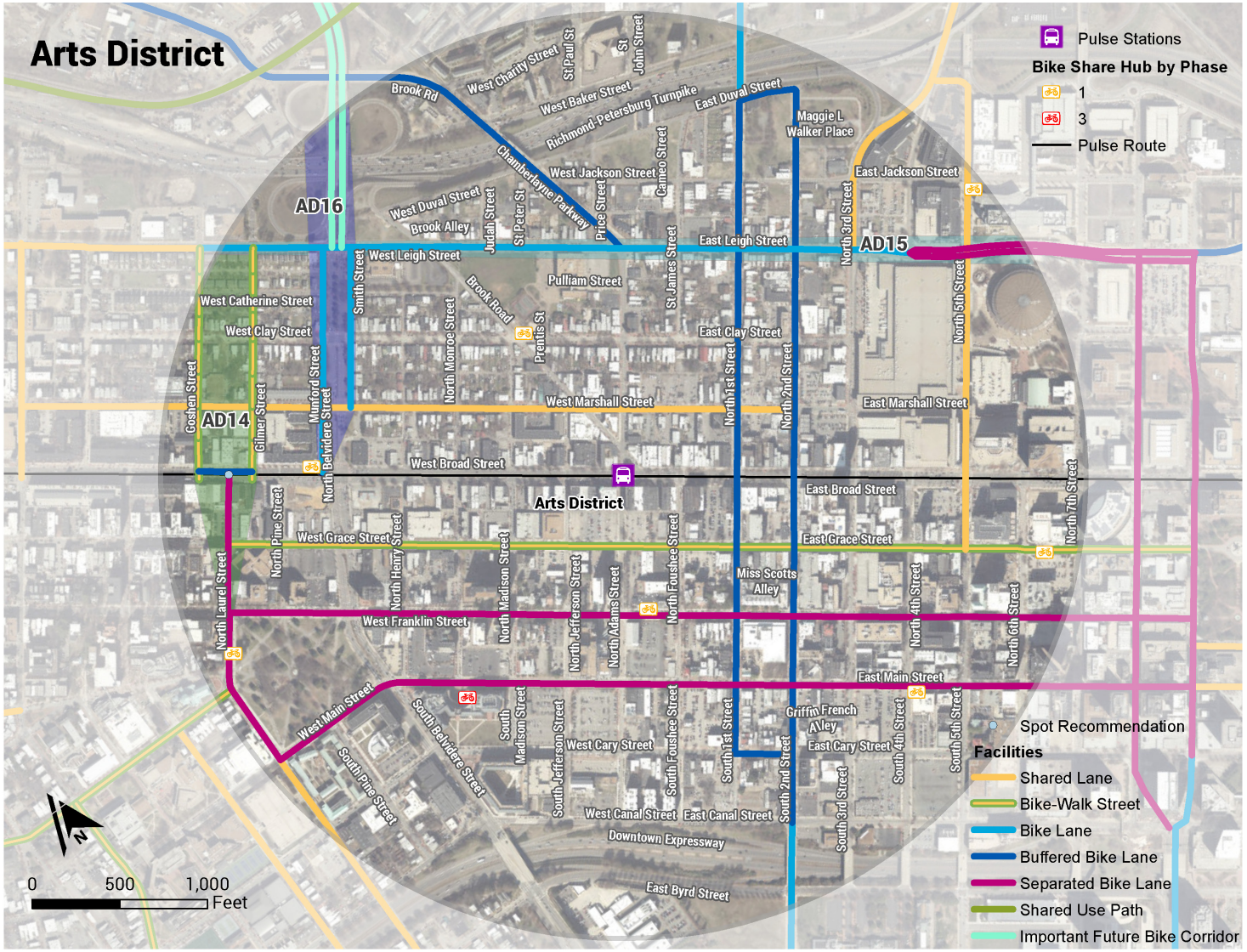

Table 15: Cost Estimates for bicycle related improvements around the proposed Arts District Pulse Station

Recommendation	Cost Estimate	Location	From	To	Project ID
Buffered Bike Lane	$7,500	W Broad St	Glimer St	Goshen St	AD14
Extend planned Laurel separated bike lanes	$241,900	N Laurel St	W Broad St	W Franklin St	AD14
Bike Boulevard. Pave Goshen.	$471,200	Goshen St	W Leigh St	W Broad St	AD14
Bike Boulevard	$71,100	Gilmer St	W Broad St	W Leigh St	AD14
Install HAWK signal	$135,000	W Broad St at Laurel St			AD14
Project Cost	$926,700				AD14
Bike Lane	$62,00	W Leigh St	St. James St	Goshen St	AD15
Sharrows and traffic calming to reinforce 25mph speed limit	$12,700	W Leigh St	Goshen St	Dineen St	AD15
Bike Lane	$29,900	E Leigh St	St. James St	N 4th St	AD15
Separated Bike Lane	$1,525,600	E Leigh St	N 4th St	N 12th St	AD15
Project Cost	$1,630,200				AD15
Bike Lane	$20,800	Smith St	W Leigh St	W Marshall St	AD16
Long Term: critical bike corridor/crossing	Further Study Needed	N Belvidere St	Mitchell St	W Leigh St	AD16
Bike Lane	$29,000	Munford St	W Broad St	W Leigh St	AD16
Project Cost	$49,800				AD16

Allison Street

The following table and map provide a list and bicycle related cost estimates for the recommended improvements within the Allison Street study area. The estimates correspond to the half mile radius around the proposed Pulse station. The total recommended bicycle improvements amount to $1.2 M and include the construction of new roadway connections, buffered bike lanes, and shared lane markings.

Figure 79: Allison Street Station Bicycle Recommendations Map

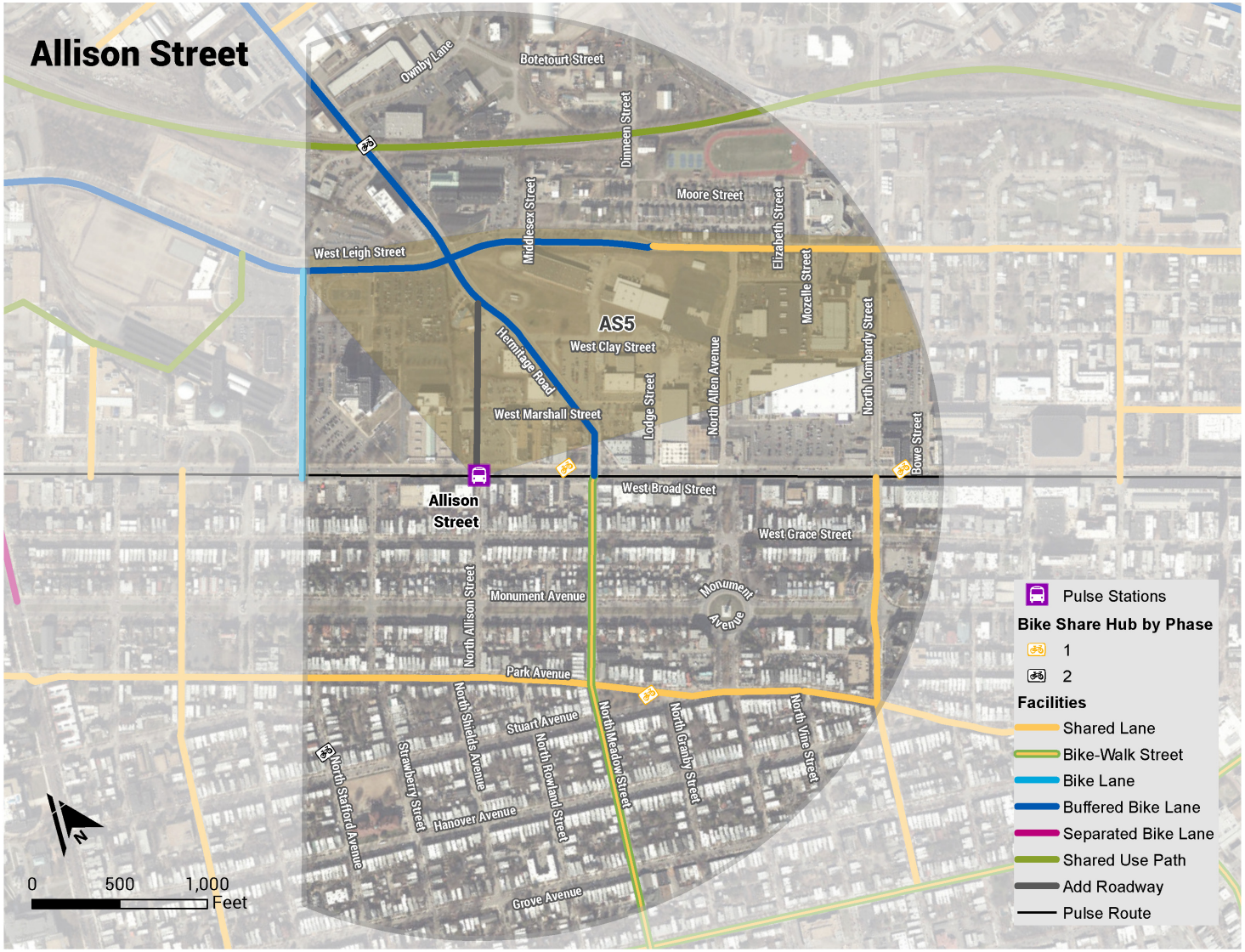

Table 16: Cost Estimates for bicycle related improvements around the proposed Allison Street Pulse Station

Recommendation	Cost Estimate	Location	From	To	Project ID
Sharrows and traffic calming to reinforce 25mph speed limit	$122,750	W Leigh St	Goshen St	Dineen St	AS5
Upgrade existing buffered bike lane to separated bike lane	$1,152,900	W Leigh St	Dineen St	Myers St	AS5
As redevelopment occurs, ensure extension of North Allison to Hermitage Rd to secure bike access/trail connection	Further Study Needed	N Allison St	W Broad St	Hermitage Rd	AS5
Project Cost	$1,275,650				AS5

Science Museum

The following table and map provide a list and bicycle related cost estimates for the recommended improvements within the Science Museum study area. The estimates correspond to the half mile radius around the proposed Pulse station. The total recommended bicycle improvements amount to over $1.7M and include the provision of new trail connections, separated bike lanes, and bike lanes.

Figure 80: Science Museum Bicycle Recommendations Map

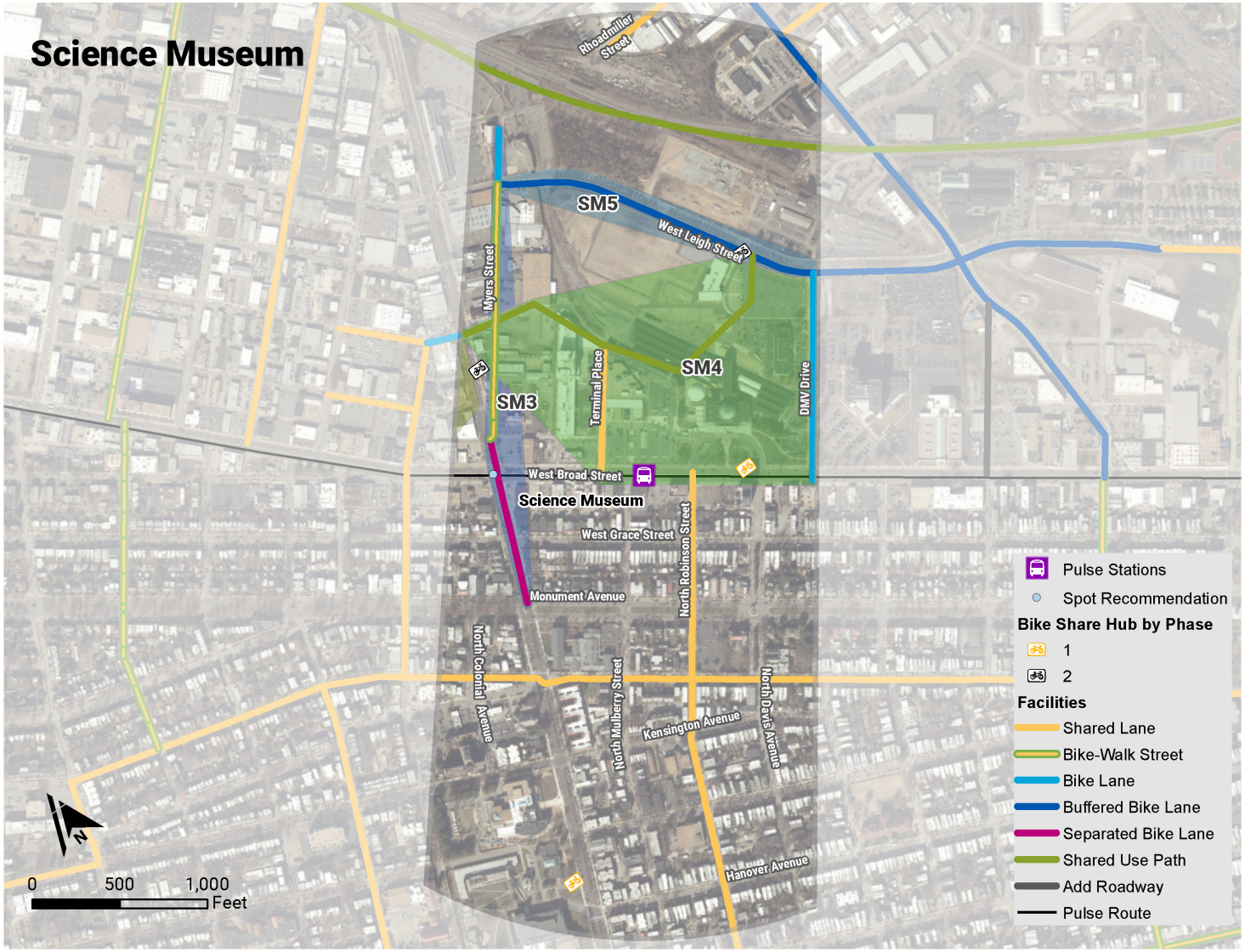

Table 17: Cost Estimates for bicycle related improvements around the proposed Science Museum Pulse Station

Recommendation	Cost Estimate	Location	From	To	Project ID
Two-way Separated Bike Lane	$235,340	N Boulevard	Myers St	W Broad St	SM3
Bike Lane	$7,100	Myers St	W Leigh St	Dead-end	SM3
Bike-walk street	$78,100	Myers St	N Boulevard	W Leigh St	SM3
Protected Bike Intersection	Further Study Needed	N Boulevard at W Broad St			SM3
Project Cost	$326,240				SM3
Build trail around Bon Secours Redskins Training Ground	$122,500	Trail	Terminal Pl	W Leigh St	SM4
Signed route. Identify for major bike corridor with redevelopment	$2,900	Terminal Pl	W Broad St	Proposed sidepath	SM4
Connect Terminal Plate to Myers Street through redevelopment. Separate path/trail from Terminal only Boulevard opposite Clay Street	$84,500	Sidepath	N Boulevard	Terminal Pl	SM4
Bike Lane	$27,900	Dmv Dr	W Broad St	W Leigh St	SM4
Project Cost	$237,800				SM4
Upgrade existing buffered bike lane to separated bike lane	$1,136,100	W Leigh St	Dineen St	Myers St	SM5
Project Cost	$1,136,100				SM5

Cleveland Street

The following table and map provide a list and bicycle related cost estimates for the recommended improvements within the Cleveland Street study area. The estimates correspond to the half mile radius around the proposed Pulse station. The total recommended bicycle improvements amount to over $260,000 and include the conversion of existing right of way to bike-walk streets, implementation of shared lane markings, and the provision of bike lanes.

Figure 81: Cleveland Street Station Bicycle Recommendations Map

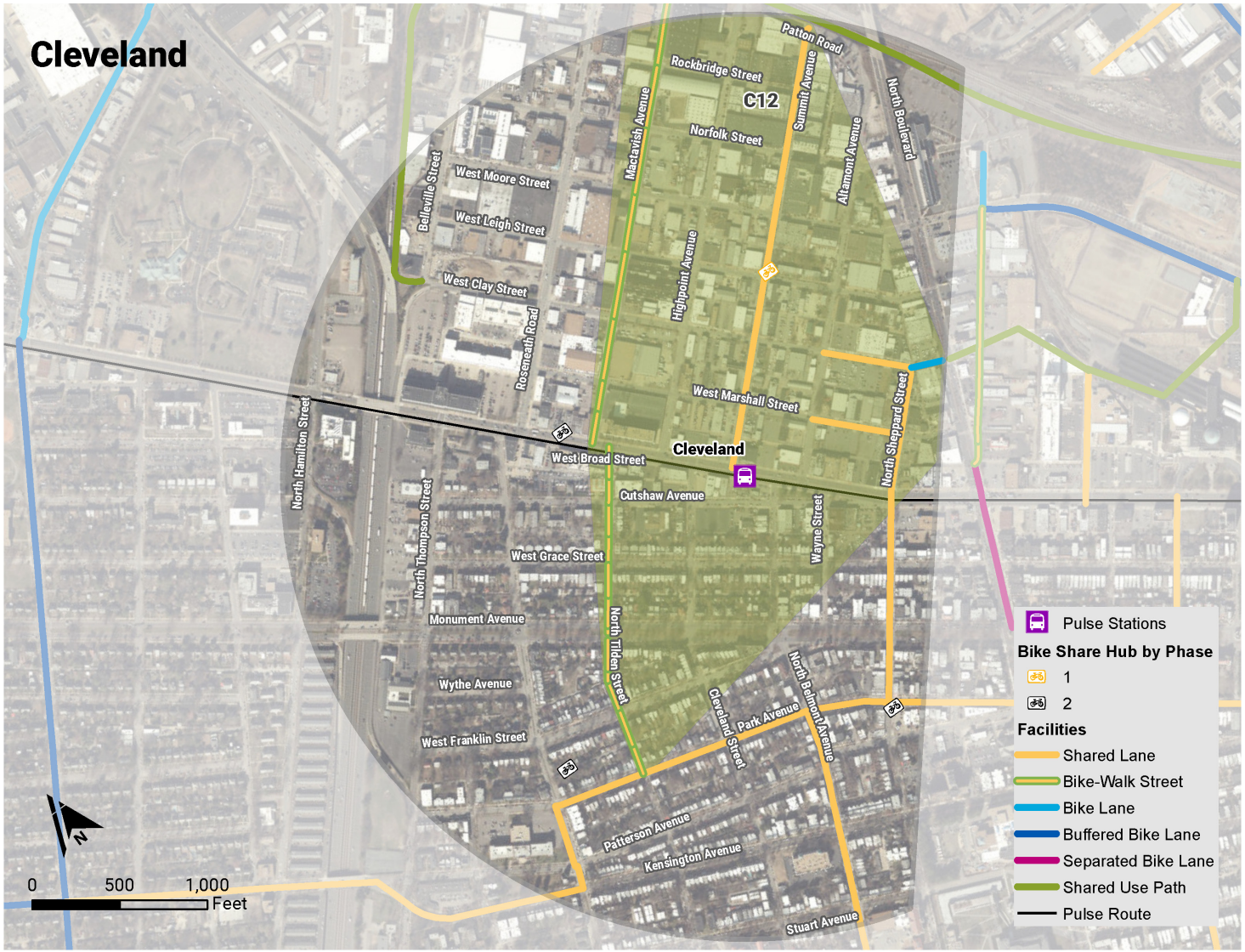

Table 18: Cost Estimates for bicycle related improvements around the proposed Cleveland Street Pulse Station

Recommendation	Cost Estimate	Location	From	To	Project ID
Until 1 to 2-way conversion, install contraflow bike lane	$2,100	W Clay St	N Boulevard	N Sheppard St	C12
Bike-walk streets	$99,600	Tilden St	W Broad St	Park Ave	C12
Sharrows	$10,100	Summit Ave	W Broad St	Dead-end	C12
Bike-walk streets	$157,500	Mactavish Ave	W Broad St	Proposed trail	C12
Project Cost	$269,300				C12

ATTACHMENTS

Attachment 1 - Matrix of Best Practice Documents Reviewed

National Guidelines and Best Practices

Document	Year Published	Description	RELEVANT PROVISIONS or FINDINGS by SUBJECT:				
			Access and Infrastructure			Wayfinding	Placemaking / TOD
			Pedestrians	Bicycles, Bike Share, Parking	Transit		
FHWA Separated Bike Lane Planning and Design Guide	**2015**	It outlines planning considerations for separated bike lanes (aka cycle tracks or protected bike lanes) and provides design options for one and two-way scenarios. It provides midblock and intersection design info and case studies. Table 1 highlights design resources. (FHWA, NACTO, ITE, AASHTO) Report offers a list of types of dividers (Page 8).	Separated bike lanes provide shorter crossing distances for pedestrians, they may provide pedestrian refuge area and reduce bikes on sidewalks.	Separated bike lanes contribute to increased bicycling. Are part of a bike network, which may include on/off-street biking. Can be part of a "low-stress" network. Beware of loading zones and how to mark them. Provides information on bike signals, bike boxes, signs, pavement markings, transitions to on-street facility.	Separated bike lanes decrease"leapfrogging" with buses. Consider placing bike corridors on parallel streets to transit corridors. Page 9 has design options for bikes at transit stops.	Plan for separated bike lanes along corridors that naturally draw cyclists to expand opportunities. Fill unmet needs on busy streets that discourage cycling due to high-traffic volumes.	Discussion on equity. Bike lanes can provide low-cost travel, last-mile connections, greater mobility. Can lead to increased job opportunities. Choose corridors where residential or business communities have bought in to the idea of encouraging cycling through strategic infrastructure investment. Consider connections to schools, parks, transit stops, commercial areas, residential areas, etc. will better serve the community.
NACTO Urban Bikeway Design Guide	**April 2011**	Provides state-of-the-practice solutions to help create complete streets, safe and enjoyable for bikes. Sections includes bike lanes, cycle tracks, intersections, bike signals, and bike signing and marking.	Installing buffered bike lanes reduces the travel lanes for pedestrians to cross Pedestrian malls act as refuges and provide additional connections Sidewalk curbs and furnishings should be used to prevent pedestrian use of cycle zone or change in pavement or landscaping	Left-side bike lanes improve visibility to motorists; minimizes door crashes; fewer bus and loading zone conflicts; no need to change location on streets with rush hour restrictions Rectangular Rapid Flashing Beacons (RRFBs) can be used for bike routes at unsignalized intersections; pedestrian hybrid beacons (**H**igh Intensity **A**ctivated Cross**W**al**K**s: HAWKs) can be used for crossing major streets. Green-colored pavement frequently used for bikes, especially high-conflict points. Portland has used blue.	Special consideration should be given to manage bike and pedestrian interaction at stops. Bike boxes group cyclists together and minimize impeding transit or other traffic; reduce vehicle encroachment into crosswalk	Section 1, Page 238 (Page 240 of 304 in PDF) -Comprehensive signing and/or pavement markings to guide bicyclists to destinations along preferred bicycle route Signs typically placed at decision points (types: confirmation, turn, decision)	
NACTO Transit Street Design Guide		How cities can use transit to create active and efficient streets. Provides prioritization guide. Design guidance for development of transit.	Center transit lines eliminate conflicts with drop-offs, deliveries, illegal parking, bicyclists, some turning movements while improving pedestrian experience.	Bike parking can supplement transit ridership and replace time/space-consuming on-bus bike racks. Adequate parking deters locking bikes to other things (trees, signs, etc.) Locate parking with clear zone, avoid pedestrian/vehicle traffic, provide uncluttered space, well-lit area. Short-term parking within 50 feet of stop/ entrance/ destination. Long-term can use lockers or cages.	Transit curb designs are detailed on page 102 of the report. Transit Lane designs are detailed in Chapter 5. A crucial complement to the transit network is a suite of flexible, convenient, and affordable mobility choices— walking, bicycling, shared mobility, and on-demand rides—that, together with fixed-route transit, allow residents to avoid the costs of car ownership and make proactive decisions about each trip they take.	Wayfinding information should be included at transit stops. Critical info includes stop name, route number, stop number, directions/ destination, & system logo. Stop name should be large enough for riders to see while inside transit vehicle. Real-time displays with multiple routes and arrival times increase rider satisfaction. Lighting and driver-rider visibility are important. Audible announcements preferred to Braille. DC has pushbutton-activated audible bus arrival announcements.	Making it possible to quickly and reliably go anywhere by transit is a way for cities to significantly improve quality of life.

National Guidelines and Best Practices

Document	Year Published	Description	RELEVANT PROVISIONS or FINDINGS by SUBJECT:				
			Access and Infrastructure			Wayfinding	Placemaking / TOD
			Pedestrians	Bicycles, Bike Share, Parking	Transit		
NACTO Urban Street Design Guide - OVERVIEW	**October 2012**	Analyzes urban streets to provide design guides for differently-sized streets, transit streets speed, safety, parklets, etc.	Design for pedestrians. Slow speeds. Provide pedestrian refuges when crossing streets. Sidewalk used for walking and outdoor spaces. Can make really small streets (<40 feet wide) be pedestrian-only or shared space. Curb extensions narrow space.	Bike parking can use existing street space. Bike lanes can be part of a road diet.	Transit streets prioritize transit over general traffic, provide safe places for people to walk and access the stops, and form the backbone of a larger local network. BRT prioritizes bus through dedicated running ways, pre-emption, off-board fare collection. Select Bus Service in NYC features branded vehicles, red bus lanes, signal priority, pre-payment of fares, bus bulbs, offset lanes for parking & loading, on-bus camera enforcement	none	Streets are public spaces: should be designed with public spaces as well as for movement. Act Now! Implement project quickly with temporary materials as a test prior to permanent materials. Advantages: neighborhood aesthetics, health & safety, low-cost, changeable.
Delivering Safe, Comfortable, and Connected Pedestrian and Bicycle Networks: A Review of International Practices (FHWA)	**May 2015**	Identifies international designs and practices that may improve safety and increase walking and biking in the US. It covers (1) network infrastructure, (2) limited auto traffic areas, (3) signalization, traffic control, and intelligent transport systems, (4) policy change, (5) criteria or methods for prioritizing improvements, and (6) goals and network performance measures.	The standard approach in countless European cities is to simply limit car use in historic cores of cities. However, there are increasing variations to these relatively staid approaches and more cities are experimenting. Some cities are expanding the area of their car-free zones; others are adjusting dimensions of it (e.g., allowing bicycles, motorbikes, or transit; adjusting day or times of day; allowing only residents; allowing car traffic but only at very slow speeds). Page 20 offers 3 more examples of pedestrian-only spaces.	Groningen, The Netherlands: implemented green waves and two green phases for cyclists during one cycle. Implemented optical rain sensors to further reduce bicyclist waiting times during rain events. The sensors have the ability to detect snow and four levels of rain from drizzle to heavy rain. As a result of committing extra traffic signal green time to cyclists, other road users experience additional delay at a time when more demand is placed on driving and public transit. --Allow contraflow cycling on one-way streets. --Convert streets to one-way to create room for bicycles. --Provide footrests at intersections. --Provide more air pumps. Develop new types of bicycle parking (e.g., for cargo bikes — “one-fourth of all cargo bike owners say that their cargo bike is a direct replacement for a car”).	Denmark supports direct connections to transit stops with occasional infrastructure (footrests at traffic signals and air pumps) on the route.	Queensland, AU: guidelines show importance of signing by destination to inform of potentially more-direct, lower-traffic routes to destination and to inform community of destinations that can be reached by bicycle. Route numbers or names can be incorporated into wayfinding signage but will not have meaning to those unfamiliar with the network. Signage should be conspicuous, legible, coherent, and functional. Guidance is provided on planning the overall wayfinding program, designing specific signage elements, and installing and maintaining signage.	Lane lighting at night for bike/pedestrian paths increases safety. May need to update policies that could prevent nighttime light usage.

National Guidelines and Best Practices

Document	Year Published	Description	RELEVANT PROVISIONS or FINDINGS by SUBJECT:				
			Access and Infrastructure			Wayfinding	Placemaking / TOD
			Pedestrians	Bicycles, Bike Share, Parking	Transit		
AASHTO Guide for the Development of Bicycle Facilities	**2012**	Provides info on how to accommodate bike travel and operations in most riding environments. Provides info on physical infrastructure recommendations. Integrating bicycle facilities with transit begins in section 2-7.	Appropriate lighting needed Bike improvements can increase crossing distance for pedestrians; can make streets more comfortable; can improve sight distance and add a buffer	-Consider recreational vs utilitarian trips; skill level -Short- and long-term bike parking needed at stores, transit stations, schools, and workplaces; short-term parking needed at recreational sites, parks, trailheads, etc. -Provide proper pavement markings or adjust design to minimize leap-frogging with buses (educate riders / drivers) -Enough well-lit, secure bike parking at transit stations and stops; high-capacity bike parking at transit stations and full-service staffed bike parking -Bike parking should be easy to find and use; located where there is vehicle parking and where there isn't (downtowns)	Bike facilities expand the range of transit use Evaluate availability of bike racks on buses; policies regarding bikes on transit vehicles; location of facilities Ease of access to transit often determines use of transit - public education programs about linking biking and transit promote both modes. Four components of bike-transit integration: -facilitating bike access on transit vehicles; -offering bike parking at transit locations; -improving bikeways to transit; -promoting usage of bicycle and transit programs Emerging ways of accommodating bicycles on transit, such as high-capacity, on-bus bicycle racks, bicycle-on-vanpool services, and new methods for storing bicycles on rail cars.	Better access for bicyclists within transit stations and wayfinding signs for navigation to and from transit stations. Adjusting routes to maximize bicycle usage.	A good bike plan may include safety education, building code and parking facility design, land-use policy, school bus policy, social marketing, etc. Serve utilitarian & nondiscretionary trips New methods of bicycle and transit education, such as on-bus bicycle rack demonstrations for bicyclists and share-the-road training for bus drivers.
NCHRP Report 803, Pedestrian and Bicycle Transportation along Existing Roads		Presents the “ActiveTrans Priority Tool (APT),” a step-by-step methodology to prioritize improvements to pedestrian and bike facilities, separately or as “complete streets” approach. The tool does not provide design solutions.			Good accessibility includes waiting space for transit		Tool designed to be responsive to community and agency values - flexible and transparent

National Guidelines and Best Practices

Document	Year Published	Description	RELEVANT PROVISIONS or FINDINGS by SUBJECT:				
			Access and Infrastructure			Wayfinding	Placemaking / TOD
			Pedestrians	Bicycles, Bike Share, Parking	Transit		
FHWA Achieving Multimodal Networks: Applying Design Flexibility and Reducing Conflicts	2016	A resource for practitioners seeking to build multimodal transportation networks. Highlights ways that planners and designers can apply the design flexibility found in current national design guidance to address common roadway design challenges and barriers. It focuses on reducing multimodal conflicts and achieving connected networks so that walking and bicycling are safe, comfortable, and attractive options for people of all ages and abilities.	-Addresses multi-modal conflicts at transit stations (page 71) -Provide crosswalks for all legs of intersections near transit station. Provide midblock crossings as necessary. -Use curb extensions and islands to reduce crossing distance. -Tighten curb radii or provide slip lanes to accommodate bus turning movements. -Enhance pedestrian crossings that will slow vehicles (raised crosswalks). -Install sidewalk on goat paths. -Reduce conflicts with private vehicles & buses. When unavoidable, use traffic calming measures. -Address barriers to shortest-distance paths.	-Provide bike channels on stairways - minimizes conflicts with pedestrian ramps. -Separate bikes from bus-only roads with adjacent route. -Minimize dismount zones. -Provide direct bike access to station via separated paths not served by streets. -Offer a variety of bike parking options. -Locate parking near route and station entrance while avoiding pedestrian conflicts. Distribute parking to serve all routes. -Offer bike-share. -Plan elevators, etc. to accommodate bikes and ADA accommodations.	Provide designated crossings at bus loading/pick-up/drop-off	Provide bike/pedestrian wayfinding across surface parking lots at stations. Ensure walkways are as direct as possible. Ensure nearby paths/trails are linked to station and have wayfinding.	Provide maintenance - snow, conditions, etc. Ensure TOD is configured for convenient pedestrian/bike access.
NCHRP Report 770: Estimating Bicycling and Walking for Planning and Project Development	2014	Contains methods to estimate biking and walking demand; include old and new methods; uses GIS			Destination areas served by transit are more likely to draw ridership if the areas are pedestrian or bicycle friendly.		

National Guidelines and Best Practices

Document	Year Published	Description	RELEVANT PROVISIONS or FINDINGS by SUBJECT:				
			Access and Infrastructure			Wayfinding	Placemaking / TOD
			Pedestrians	Bicycles, Bike Share, Parking	Transit		
Boston Complete Streets Guidelines	2013	Aims to improve the quality of life by creating streets to live and sustain transportation networks. Address pedestrians, bikes, & transit on equal footing with motor vehicle users.	Lively sidewalks become venues for people to participate in face-to-face activities, support businesses, and to use new innovations in digital technology to interact with the public realm. They should be accessible to all (wheelchairs, strollers, age, etc.), all-weather(snow storage, stormwater, shade), and human-scaled (transparent windows, benches, awnings, etc.). Incorporate smart-infrastructure networks (fiber optic cables, "smart" tags (RFID or QR) to create opportunities to access local info. Real-time info, monitor air quality and noise, trash/recycling collection info, street light info, solar-powered trash compactors, LED lights, etc. (page 19)	Add bike parking to the greenscape / furnishing zone between sidewalk and curb Consider colored pavement at conflict points. Aim for continuous facilities without out-of-the-way routing. Use reverse-angled parking for angled parking adjacent to on-street bike facilities. Discussion on left side bike lanes, contra flow lanes, climbing lanes, priority shared lanes (on multi-lane streets, can use sharrows with colored pavement sections to indicate vehicles preferred to use inside lane with bikes in outside lane - in FHWA experimental phase)	Transit is within walking distance of virtually every place in the city. Bike racks required on non-residential street reconstructions. On-street bike parking should be considered when there are space constraints on the sidewalk. Transit stop info: bus stops, shelters, lights, far-side generally preferred Min. 750 feet between bus stops	Wayfinding signage at intersections	Transit stop amenities improve the value of transit to the community. Personalizing transit stops gives community a sense of ownership and pride. Page 151: Intersections are spaces for the community to gather and enjoy as well as pass through. Sense of place is created through physical elements (facades, trees, walls, fences) that enclose the space; public facilities (libraries, PO); local amenities (stores, restaurants, grocery); transit/bike share station; & art. Major intersections serve as a gateway. Street name signs and multimodal wayfinding signs are important for safety and convenience of all users. Should be strategically placed to maximize visibility. Pedestrian-scale signs should include Braille and be multilingual, as necessary. Bike signs should be post-mounted and include direction, distance, and/or time info to destinations, transit, and bike routes. Incorporate Green Walls (page 33), plazas, sidewalk cafes, building entrances and driveways. Section on street furniture.
MassDot Separated Bike Lane Planning and Design Guide	2015	Guide for planners and designers to use when considering, evaluating, and designing separated bike lanes as part of a complete streets approach.	Sidewalk buffer can discourage pedestrians from walking in bike lane and cyclists from using sidewalk. Ped crossings before and after the bus (specifically floating bus stop locations)	Bike lane should allow side by side riding if possible. Edges free from handlebar hazards. Wide enough to accommodate demand. Smooth and minimal changes in elevation and horizontal alignment. Bus stops are natural locations for bike parking. Provide longer-range and faster fist- and last-mile connections compared to walking.	Buffer zones on each side provide separation for bike lane. Maintain offsets in transit zones. Where feasible, separated bike lanes should be routed behind bus stops to eliminate conflicts between buses and bicyclists. This recommended configuration— referred to as “a floating bus stop”— repurposes the street buffer into a dedicated passenger platform between the motor vehicle lane and the bike lane.	Follow MUTCD standards for signage and markings.	Landscaping improves community aesthetics and provides traffic calming. Buffer designs should incorporate when possible.

National Guidelines and Best Practices

Document	Year Published	Description	RELEVANT PROVISIONS or FINDINGS by SUBJECT:				
			Access and Infrastructure			Wayfinding	Placemaking / TOD
			Pedestrians	Bicycles, Bike Share, Parking	Transit		
2016 ThinkBike Charrette Proceedings and Products **Cycling in the Netherlands section**	**2016**	A creative work session with the Dutch bicycle planning professionals and local experts in various cities. The Dutch bike planning regime is based on the following five principles: 1. Safety - The cyclist needs a safe traffic environment. 2. Directness - The route needs to be as short as possible and easy to ride. 3. Coherent - The network needs to be coherent; without missing links. 4. Attractive - The routes need to be attractive: low air pollution, social safety (the paths should be well lit and well maintained), nice surroundings etc. 5. Comfortable - The pavement needs to be smooth and even.	In general we can observe that over the past four decades, the Netherlands has seen a reallocation of urban road space in favor of cyclists and pedestrians. Whenever appropriate space for motorized traffic is allowed, traffic calming measures are being applied.	-Cycle paths are recognizable by a colored (reddish) asphalt; -At intersections cycling facilities are continuous, and whenever feasible cyclists get right of way; -Bicycle boxes can be applied at some types of intersections so as to make sure that cyclists won't be cut off by right turning cars; -In case of car parking along the road: positioning of the cycling facility on the right hand side of the parking lane instead of on the left hand side to minimize the number of potential conflicts ('dooring'). Bike parking should offer some protection against theft, orderly, use of space, attractive, and should be ubiquitous.	About 40% of all train passengers use bicycles to get to the railway station while about 12% is (also) using a bicycle to get from the end station to their final destination. > A sufficient number of adequate guarded and unguarded bicycles parking facilities; > Travel time information at all transit stops; > Bicycle repair shops at major transit stops; > Bicycle sharing system with an integrated ticketing service with transit-operators.		Perceived safety is as important as factual safety. Segregated bicycling facilities are emphasized along busy streets. Dutch highway authorities make sure school routes and traffic calmed school zones are well designed to enable children a safe trip between home and school. At elementary schools in the Netherlands 'traffic education' is part of the curriculum.

Attachment 2 - Matrix of Local Documents Reviewed

Applicable Local Planning Documents

Document	Year Published	Description	RELEVANT PROVISIONS or FINDINGS by SUBJECT:				
			Access and Infrastructure			Wayfinding	Placemaking / TOD
			Pedestrians	Bicycles, Bike Share, Parking	Transit		
City of Richmond 2015 Bicycle Master Plan	**2015**	Appendix E contains a map, cross-section, and photo of 17 corridors identified as key connections needing bike infrastructure improvements.		Plan contains six improvement types: Bike-Walk Street, Bike Lane, Buffered Bike Lane, Cycle Track, Shared Use Path, and Shared Lane. Details existing condition of bike corridors in Appendix E.			
Pulse Corridor Plan Draft Recommendations	**November 2016**	Presentation presented at public meetings. The plan outline steps to reach the Corridor goals: 28 Corridor-Wide Recommendations; 14 Station Area Visions, and 63 Station Area Recommendations	Average walkscore within Corridor is 74, 'Very Walkable'; Corridor-wide connected recommendations include: provide wider sidewalks and streetscape in high-density redevelopment through road diets or set backs; construct sidewalks where missing in the neighborhoods; improve pedestrian scale lighting	Corridor-wide connected improvements include: improve bicycle infrastructure, specifically protected infrastructure; co-located bike share stations near Pulse stations; establish car sharing programs; encourage reduced automobile parking in exchange for dedicated car-share spots, sponsoring bike share station and/or providing bike parking	Priority stations based on their market conditions, development readiness, and pedestrian-orientation are 1) Cleveland, 2) Science Museum, 3) Allison, 4) Downtown Arts, 5) Main Street, and 6) Orleans; Corridor-wide connected recommendations include: align local GRTC routes with Pulse to allow for easy transfers		The recommendations meet three defined goals for creating a highly walkable corridor for TOD: 1) Compact & Mixed use, 2) Connected, and 3) Thriving & Equitable; Includes proposed future land uses around each station and potential TOD overlay elements
Greater Fulton's Future: Community Vision and Agreement	**June 2011**	Greater Fulton is made up of the East End neighborhoods of Fulton, Fulton Hill, and Montrose Heights. The Community Vision is designed to be a working document that is reviewed and revised as community leaders from Greater Fulton begin work on initiatives, programs, and activities outlined in this document. As more residents are engaged in the implementation of this Community Vision, and progress is made on specific elements of the document, it is anticipated that new ideas and opportunities will be identified for future action.	Safety; connections; better sidewalks; better lighting; street beautification; new crosswalks	Bike lanes and sidewalks to Chimborazo Park; path to Capital Trail	Bus punctuality; better (bus) transportation services	The Greater Fulton area is near the two easternmost BRT stops. Explore the redesign of the intersection of Williamsburg Road, Darbytown Road and Salem Street to improve safety and reinforce the proposed “Main Street” corridor.	Contains maps on land use, zoning, landmarks, buildings, city-owned properties, greenspace, public transportation, and topography. Rocketts Landing is directly east of Greater Fulton. Greater Fulton should explore future opportunities with the Rocketts Landing landowners.
GRTC Broad Street BRT Route Modifications Report	**2015**	Provides recommendations for modifications to local bus stops/routes to ensure ridership connections and efficiency to future BRT.			-Recommendations to improve ridership activity / transfer activity & to maintain safe and efficient transit operations for the proposed BRT. Contains bus and ridership volumes. KEY RECOMMENDATIONS INCLUDE -Traffic and Transit Operations -Phased bus scheduling -Bus Stop Consolidations – to provide conjoined local bus and BRT stops along the corridor to enhance connectivity (transfers) between the BRT and local buses and to provide pedestrian safety for customers using transit. -Bus Bay Modifications -Bus Route Modifications – Adjust routes 3-4, route 37, route 74, routes 72 and 73, routes 7 and 43-44, & Routes 64, 66, 81, and 82	BRT and local bus runningway configurations; includes map of routes	

Applicable Local Planning Documents

Document	Year Published	Description	RELEVANT PROVISIONS or FINDINGS by SUBJECT:				
			Access and Infrastructure			Wayfinding	Placemaking / TOD
			Pedestrians	Bicycles, Bike Share, Parking	Transit		
Route Modification Recommendations for Richmond East End Communities of Fulton and Church Hill	**July 2016**	Defines and recommends services to improve mobility, reduce travel times, and create more direct connections to the proposed BRT in these communities. Church Hill is the eastern terminus of Broad Street. This district encompasses the original land plat of the city of Richmond. It is immediately east of Shockoe Bottom and west of Chimborazo. Church Hill North is to the north. Fulton is located south of Gillies Creek.	Implement safe access to multiple points of the BRT; improved accessibility to bus stops	Implement safe access to multiple points of the BRT	Enhance connections between BRT and local routes; high transfers; improve operations; reduce bus volumes downtown Modifications to existing routes -7, 43, 44, and 52- to connect to the BRT and improve directness of travel reducing travel time to and from downtown. -- Introduction of community shuttles to provide direct service to the BRT. -- Introduction of community circulators to broaden mobility in and between Church Hill, Church Hill North, and Fulton neighborhoods.		
Richmond Bike Master Plan Citizen Survey: Results and Findings	**April, 2016**	Survey for Richmond Bike Master Plan 96% of respondents own or have access to a bicycle. 55% are "enthused and confident" while 29% are "interested but concerned" and 14% are "fearless" riders 2/3 ride more than once a week Most discouraging reasons not to bike are lack of bike lanes, high traffic volumes/speeds, and rain 82% state more bike parking increases chance of visiting a business. Top responses for locations to bike to: 1.park 2.Carytown **3.VCU 4.Downtown 5.The Fan 6.MCV 7.Church Hill** 8.Pony Pasture **9.Willow Lawn 10.Shockoe Bottom 11.Museum District** 12.Forest Hill.		Destinations needing improved bike access: **1.Downtown** 2.Carytown **3.The Fan 4.VCU** 5.parks **6.Shockoe Bottom 7.Church Hill** 8.The River 9.South Side/Forest Hill 10.Forest Hill **11.Willow Lawn** 12.Belle Isle/River List of 22 roads/corridors for desired bike infrastructure: 1.Cary St **2.Broad St 3.Main St 4.Boulevard 5.Monument Ave** 6.Forest Hill Ave **7.Belvidere St** 8.Patterson Ave 9.Grove Ave 10.Floyd Ave 11.River Rd 12.Franklin Rd **13.Hull St/14th St 14.Leigh St** 15.Chamberlayne Ave/Rd/Pkwy **16.Grace St 17.Hermitage Rd** 18.Semmes Ave 19.Huguenot Rd 20.Three Chopt Rd 21.Midlothian Turnpike **22.Meadow St**			
Safe Routes to School Projects in Richmond	**2016-2017**	Greater Richmond Fit 4 Kids (Richmond Public Schools) has had two grants awarded for $45k for SRTS programs at six schools during the '16-'17 school year	2014 Grant: **Fox Elementary School (Fan District)** and Munford Elementary School (west of I-195) Raised crosswalks, traffic circles, pedestrian and bicycle signage	Dumbarton Elementary (Laurel): Walk to School Events & Active Living Challenges			
The Gillies Creek Greenway Plan	**2015**	Gillies Creek Greenway will be a network of separated, paved, multi-use paths through the East End of Richmond along Gillies Creek. This area is comprised of the Richmond neighborhoods of Fulton, Montrose Heights, Oakwood, and Chimborazo Park.	Alternative, safe, and connected routes are necessary for these communities. The Greenway will serve as a safe connector for the East End.		Will connect to the VA Capital Trail, the Riverfront area (including Richmond Canal Walk and Potterfield Memorial Bridge)		Connection to the future Stone Brewery and Beer Garden & Church Hill North redevelopment

Applicable Local Planning Documents

Document	Year Published	Description	RELEVANT PROVISIONS or FINDINGS by SUBJECT:				
			Access and Infrastructure			Wayfinding	Placemaking / TOD
			Pedestrians	Bicycles, Bike Share, Parking	Transit		
Richmond Neighborhood Byways Plan Encouraging Safer Streets for People Who Walk and Bike	**May 2016**	This plan recommends the designation of low-stress residential streets, either by request of residents or by the adoption of this plan, into neighborhood byways to encourage and support people of all ages and abilities to live actively.	People-oriented street designs create safe and more comfortable places for the community to bike, walk, play and travel.	An individual's comfort can be a factor that decides what routes people use and if they walk or bike at all. Improving connectivity is desirable.	To have broad support from the community and other organizations, routes avoid streets that were primary Greater Richmond Transit Company (GRTC) routes or designated as Emergency Routes used by fire departments.	Implement wayfinding with mileage to connect to desired destinations.	Traffic calming measures and infrastructure can be used to improve the quality of a residential street and move it towards becoming a neighborhood byway.
Richmond Region Bicycle Infrastructure Report	**February 2016**	The purpose of this report is to document our region's progress in building bicycle infrastructure since 2013 and offer some commentary on our journey toward becoming a comfortable and connected region for people of all ages and abilities to ride.		Completed the Richmond portion of the Virginia Capital Trail. Constructing a pedestrian/bike-only bridge.			

Attachment 3 - Survey Questions for Data Collection

ISSUES	CHOICES				
ROW CHARACTERISTICS					
Posted Speed	25	30	35	40+	
Street width (curb to curb)					
Number of travel lanes					
Number of parking lanes					
Bicycle Facilities	None	Bike lane	Sharrow/signed route	Trail	Separated bike lane
ROW Photos					
SIDEWALKS					
Sidewalk Segment Number					
Sidewalk Present	Yes	No			
Effective Sidewalk Width					
Sidewalk Photo					
Sidewalk Meets ADA (4' min)	Yes	No			
Sidewalk buffer present	Yes	No			
Sidewalk buffer width					
Obstruction on sidewalks	Yes	No			
Damaged/ defective sidewalks	Yes	No			
Lighting type	pedestrian scale	roadway oriented	none		
Conflict points (driveways)	0	1 to 2	3 to 5	6 to 10	11 or more
Shade (percent of sidewalk with shade)	0%	25%	50%	75%	100%
BUS STOPS					
Bus stop visible					
Existence of landing pad (8x5 min)					
Landing pad connection					
Existence of bus shelter					
INTERSECTION CHARACTERISTICS					
Intersection number					
Intersection photo					
Total potential curb ramps					
Existing type of curb ramps					
number of existing curb ramps					
ADA compliance	None	Truncated dome surface (4'x2')	Slope less than 2% (rough assessment)	Landing Area	
Number of wide curb radii					
Existence of slip lane					
Existing traffic control device					
Marked crosswalks					
Total potential crosswalks					
Crosswalk type					
Pedestrian Countdown indicators					
Pedestrian refuge island (>6 ft)	Yes	No			
Crosswalk lighting type	pedestrian scale	roadway oriented	none		
MITIGATIONS (Examples)					
SIDEWALK - Install sidewalk					
SIDEWALK - Repair sidewalk					
SIDEWALK - Demolish/replace sidewalk					
SIDEWALK - Widen sidewalk					

SIDEWALK - Relocate obstruction					
CURB RAMPS - Reconstruct curb ramp (demolish/rebuild)					
CURB RAMPS - Install curb ramp					
Reduce turning radii					
SIGNALS - Install pedestrian signal					
SIGNALS - Modify pedestrian signal					
SIGNALS - Install ped actuators					
SIGNALS - Repair/replace ped actuators					
CROSSWALK - Install/replace stop sign					
CROSSWALK -Install crosswalk					
CROSSWALK -Repair/replace crosswalk					
REFUGES - Install refuge					
REFUGES - Install median with refuge					
REFUGES - Install pedestrian island with refuge					
LIGHTING - Install street/pedestrian scale light					
LIGHTING - Repair street/pedestrian scale light					
Consider road diet					
Consider lane diet					
Install curb extensions					
Eliminate on-street parking					
Narrow on-street parking isle					
Traffic calming needed					

U.S. Department of Transportation
Federal Highway Administration