



**VCU**

**September 2023**

# Pedestrian Safety Study

## Potential Improvements and Recommendations



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## Introduction

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Located in downtown Richmond, Virginia Commonwealth University (VCU) currently enrolls more than 28,000 students across its two main campuses – Monroe Park Campus and Academic Medical Center Campus – and employs more than 24,000 staff between the university and health system. Thousands of students, patients, faculty, staff, and visitors walk VCU’s urban campuses each day – making proactive pedestrian safety a priority for both VCU and the City of Richmond.

Recent incidents resulting in pedestrian injuries and fatalities highlight the urgency of collaboration between VCU and the City to enhance existing infrastructure and enforcement within City owned right-of-way, continue community outreach and education efforts, and create a safer campus community.

The recommendations in this report are based on an evaluation of existing pedestrian conditions on the Monroe Park Campus and Academic Medical Center Campus as well as information from VCU and City public safety administrators.

## Field Observations

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On Wednesday, April 26, 2023, while spring semester classes were in session, the study team walked the Monroe Park and Academic Medical Center Campuses to document existing conditions of pedestrian infrastructure. The study team focused on pedestrian volumes, travel patterns and behaviors, crossing conditions, infrastructure, and general vehicular traffic volumes, types of vehicles (passenger cars, trucks, buses, etc.), speeds, and operations. Over the course of field observations, the study team collected over 150 unique data points and captured accompanying photographs to document concerns related to pedestrian infrastructure and pedestrian and motorist behavior.

**Appendix A** includes the *Existing Conditions Review* memorandum which categorizes the observations into five sections: Visibility and Sight Distance, Pedestrian Crossings and Behavior, Signage and Road Markings, Motorist Behavior, and Additional Infrastructure Concerns. Each section includes a description of the collected data and a selected representative photograph.

The observations described in the *Existing Conditions Review* memorandum account for what the study team observed during a typical weekday on campus and should not be considered a complete account of all pedestrian safety concerns and behavior at VCU.

## University Benchmarking

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The study team conducted virtual interviews with three urban universities to gather lessons learned from pedestrian safety initiatives implemented on their campuses. The University of Louisville (UofL), the University of Minnesota Twin Cities (UMN), and the University of Alabama at Birmingham (UAB) were interviewed as these universities have a similar student enrollment and urban campus characteristics as VCU. The objective of the interviews was to learn about campus initiatives, whether infrastructural or educational, implemented to improve pedestrian, cyclist, and motorist safety.

**Appendix B** includes summaries from the university benchmarking interviews. The following bullet points present pertinent lessons learned from the universities.

- Each university shared that pedestrian safety has been enhanced through reducing vehicular speeds on and near campus through road diets (UofL), reducing posted speed limits to 20 mph (UMN), and implementing strategic signal timing (UAB).
- The universities shared ideas for small-scale, location-specific improvements to enhance pedestrian safety such as speed humps and high-visibility crosswalk markings (UofL) and configurable message signs placed near campus gateways to notify motorists of high pedestrian activity (UMN).
- Each university highlighted the importance of leveraging funds for construction of new campus buildings / facilities to improve adjacent pedestrian and bicycle infrastructure; UofL also shared that leveraging funds to make campus compliant with the Americans with Disabilities Act (ADA) can help improve access and safety for pedestrians of all abilities.
- UMN considers “pedestrians first” in its transportation planning and policy; this principle helps to foster a culture focused on pedestrian safety.
- Each university shared best practices to educate the campus community about pedestrian safety including a pedestrian safety awareness campaign conducted throughout the first month of classes (UAB), transportation orientation sessions for first-year students (UMN), and cycling safety classes (UofL). UofL and UMN noted that their efforts to attain and maintain their recognition as Bicycle Friendly Universities<sup>1</sup> also help enhance safety on campus and provide a framework for making their universities great places for bicycling.
  - Note: The League of American Bicyclists has recognized VCU as a Bicycle Friendly University since 2012. In 2020, VCU earned gold status and has been a gold-status Bicycle Friendly University since then.

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<sup>1</sup> <https://bikeleague.org/bfa/university/>

## Recommendations

The study team identified recommendations based on April 2023 field observations, input from other urban universities, and concerns raised by VCU staff inclusive of the VCU Police Department. The recommendations include treatments aimed to reduce pedestrian conflicts, traffic calming elements to reduce vehicular speeds, and roadway improvements to enhance pedestrian safety and access throughout the VCU campuses. The following sections describe the recommendations categorized as **No Turn on Red Recommendations**, **Pedestrian Crossing Improvements**, **Signal Improvements**, **Roadway Improvements**, and **Maintenance and Operations Recommendations**.

## No Turn on Red Signage

No Turn on Red signage is a relatively low-cost safety treatment that reduces potential conflicts between pedestrians and vehicles turning right (or left) at a red light. The implementation of No Turn on Red signage should be based on sight distance, estimated number of pedestrian conflicts with turn-on-red vehicular maneuvers, estimated turn-on-red crashes, and guidance provided in the Federal Highway Administration's Manual on Uniform Traffic Control Devices (MUTCD). Locations



depicted in **Exhibit 1** are recommended for evaluation for installing No Turn on Red signs.

### **No Turn on Red Signage Implementation Steps**

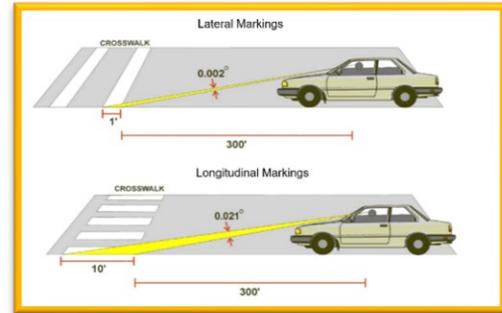
- VCU engaged an engineering consultant to analyze the recommended No Turn on Red approaches to identify locations that meet the City's criteria for implementation.
- The results of the analysis were submitted to the City for review by August 2023.
- For locations that meet the City's criteria, the City will install appropriate signage within 45 days of receiving the analysis. As of August 1, 2023, the City has reviewed, approved, fabricated, and installed 16 signs based upon results of the first 20 intersection analyses. No Turn on Red sign implementation is expected to be complete by September 2023.



## Pedestrian Crossing Improvements

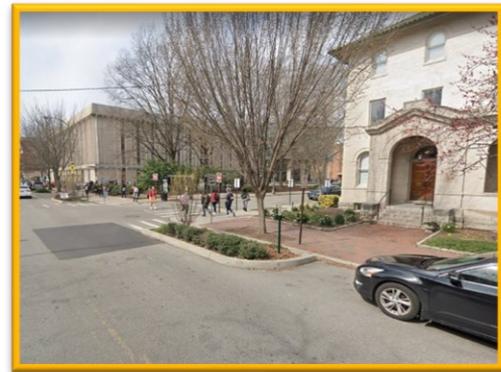
### LONGITUDINAL CROSSWALK MARKINGS

Longitudinal crosswalk markings are white longitudinal lines parallel to traffic flow. When longitudinal lines are used to mark a crosswalk, the lateral crosswalk lines may be omitted. Longitudinal crosswalk markings have higher visibility than lateral crosswalk, improving visibility of the crossing to motorists and pedestrians. Locations where crosswalk marking upgrades are recommended are depicted in **Exhibit 2**.



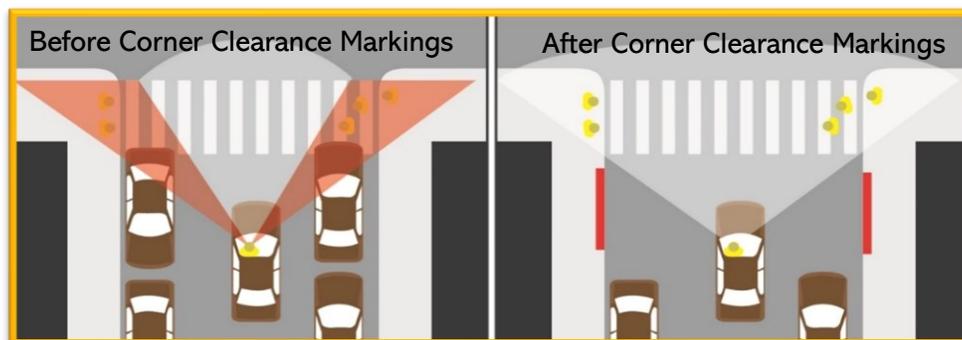
### CURB EXTENSIONS

Curb extensions are used to tighten the physical geometry of an intersection, thereby forcing motorists to drive more deliberate paths through the intersection and reduce their speeds. Curb extensions also shorten the pedestrian crossing distance and time required to cross the street. It is recommended that curb extensions be installed on one or both sides of an intersection approach. Curb extensions can be built with paint, bollards, planters, or concrete. Locations where curb extensions are recommended are depicted in **Exhibit 2**.



### CORNER CLEARANCE MARKINGS

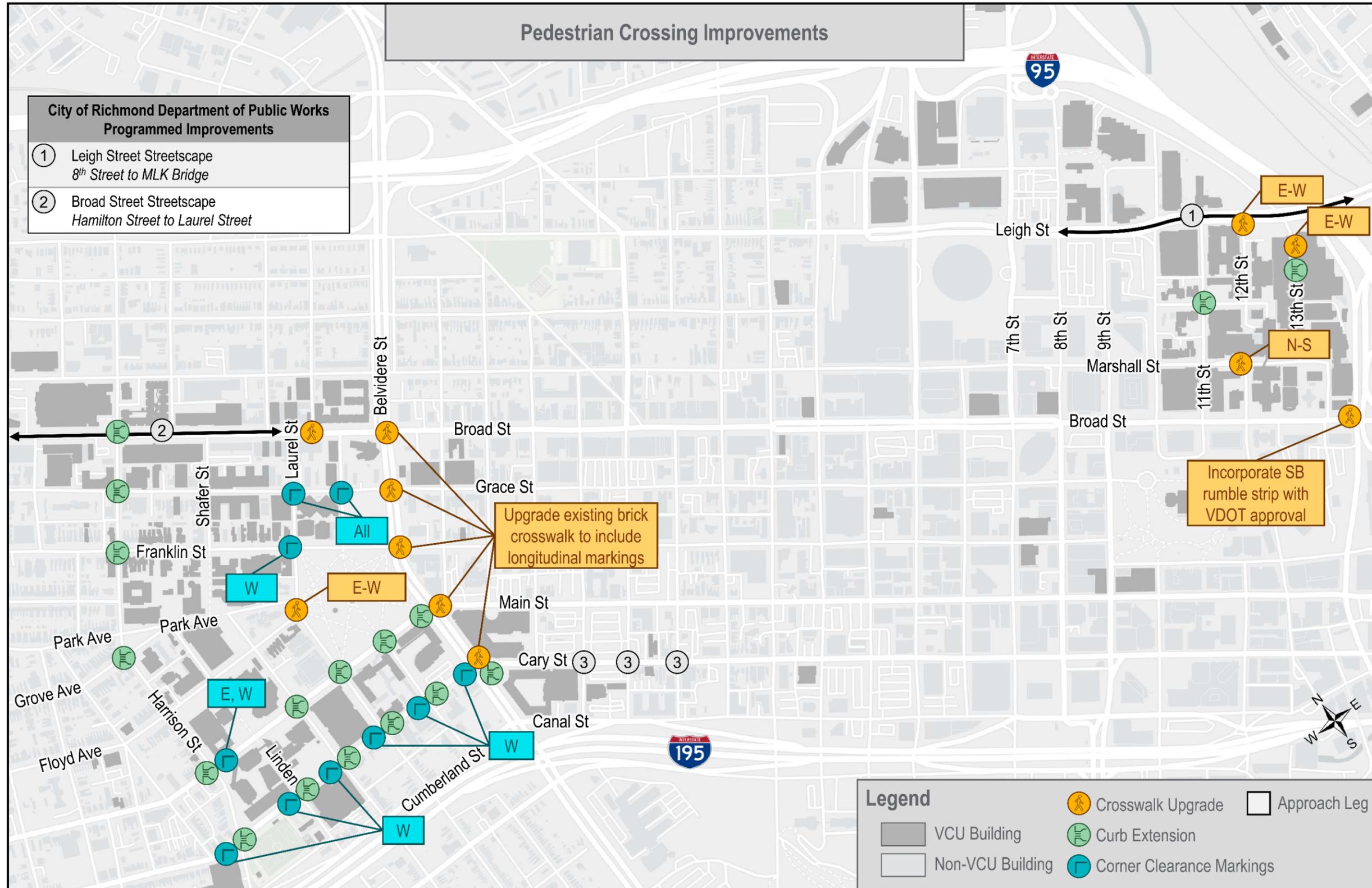
Corner clearance markings are physical markings and/or signed restrictions that eliminate on-street parking and loading spaces within 20 to 25 feet of a pedestrian crossing. Corner clearance markings, also known as daylighting, increase the visibility between pedestrians and vehicles thereby reducing potential conflicts and increasing safety. Locations depicted in **Exhibit 2** are recommended for evaluation for installing corner clearance markings.



### ***Pedestrian Crossing Improvements Implementation Steps***

- The City will replace existing brick crosswalks containing lateral markings along Belvidere Street with high-visibility longitudinal crosswalk markings. Funding is secured for fiscal years 2025 – 2027.
- The City will complete crosswalk upgrades on 12<sup>th</sup> Street as part of a planned repaving project planned for Fall 2023.
- The City will use existing funding to implement the recommended curb extensions at the intersections of Pine Street with Main Street and with Cary Street.
- VCU will engage a consultant to design the other recommended curb extensions.
- VCU will relocate and improve two existing crosswalks and install curb extensions along 13<sup>th</sup> Street near D-Deck.
- The City will complete corner clearance markings in Fall 2023.
- The City is working on the Leigh Street Streetscape and Broad Street Streetscape projects, which include improvements to pedestrian infrastructure and crossings.

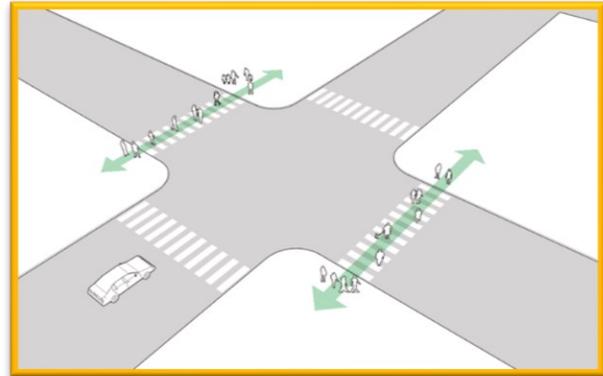
Exhibit 2: Pedestrian Crossing Improvements



## Signal Improvements

### LEADING PEDESTRIAN INTERVALS

A Leading Pedestrian Interval (LPI) typically gives pedestrians a 3- to 7-second head start when entering an intersection before vehicles receive a green light in the same direction of travel. LPIs enhance the visibility of pedestrians within the crosswalk and reinforce that turning motorists must yield the right-of-way to pedestrians in the crosswalk. The City has numerous LPIs deployed at signalized intersections on VCU campuses, with plans to deploy additional LPIs throughout the City. It is recommended that LPIs be implemented at additional locations and incorporated into ongoing City of Richmond retiming efforts. Existing and recommended LPI locations are depicted in **Exhibit 3**.



### RECTANGULAR RAPID FLASHING BEACON

Rectangular Rapid Flashing Beacons (RRFBs) are pedestrian-activated flashing LED lights, typically mounted on existing crosswalk signage, that signal to drivers that a pedestrian is about to enter a crosswalk. RRFBs are placed on both sides of a crosswalk below the pedestrian crossing sign and above the arrow indication pointing at the crosswalk. RRFBs enhance the visibility of crosswalks and encourage motorists to yield to pedestrians crossing the street. Recommended RRFB locations are depicted in **Exhibit 3**.



### PEDESTRIAN HYBRID BEACONS

Pedestrian Hybrid Beacons (PHBs) are pedestrian-activated flashing LED lights that signal to drivers that a pedestrian is about to enter a crosswalk. Unlike RRFBs, PHBs are typically installed on multilane roadways and are mounted on mast arms above the crosswalk, much like a traffic signal. PHBs increase the safety of pedestrians crossing the street by providing them a signalized crossing that requires motorists to stop. A PHB is currently deployed on the Academic Medical Center Campus along Broad Street near 16<sup>th</sup> Street. Recommended PHB locations are depicted in **Exhibit 3**.



### LEFT-TURN HARDENING

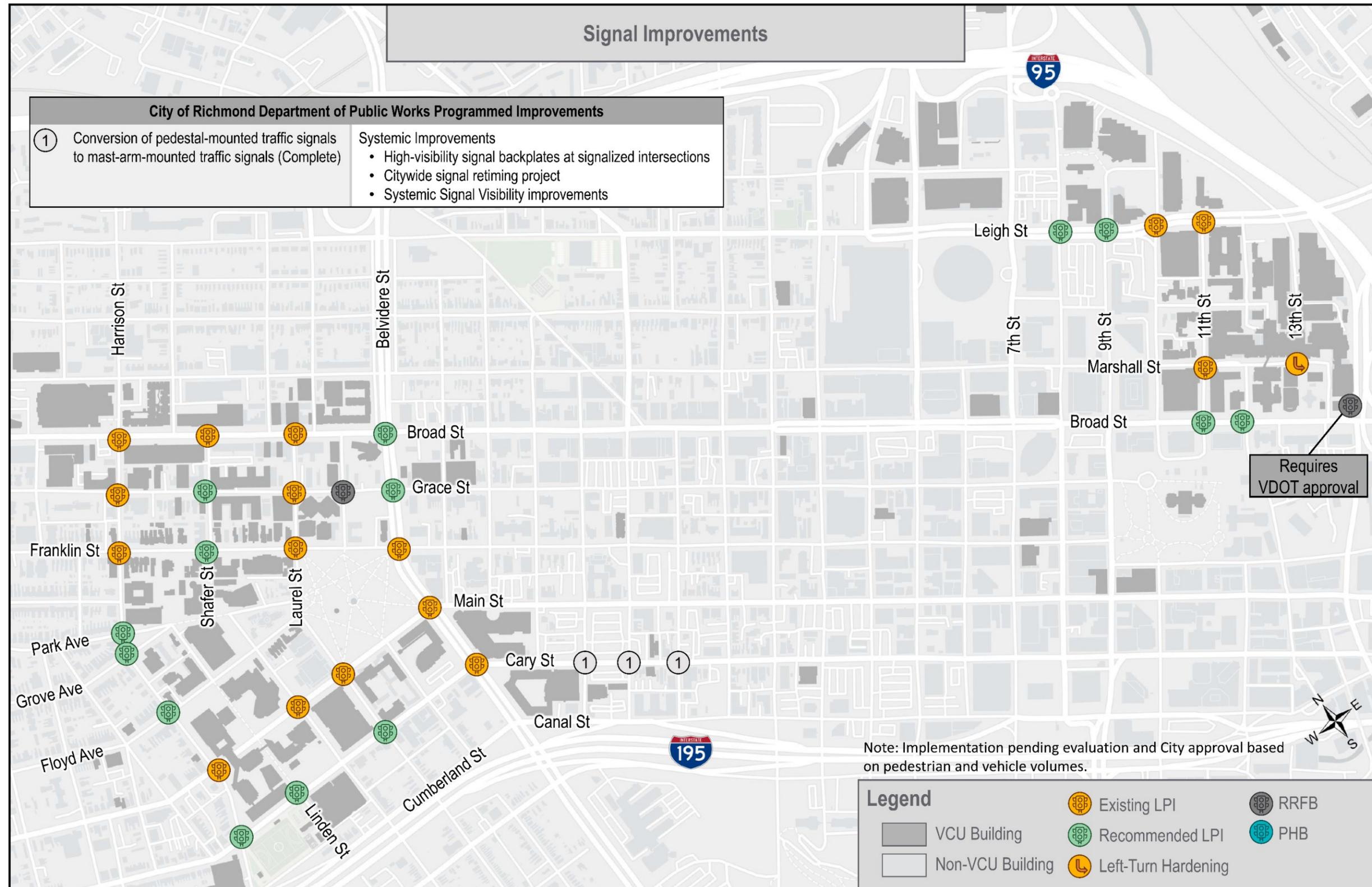
Left-turn hardening refers to the use of modular curbs, vertical delineators, and striping at intersections to reduce left-turning speeds and to prevent “corner cutting.” Left-turn hardening emphasizes the separation between travel directions, guides vehicles into the receiving lane, and reduces turning speeds, reducing the conflict zone between turning vehicles and people biking and walking. Left-turn hardening is recommended at the southbound approach of the intersection of Marshall Street and 13<sup>th</sup> Street, see **Exhibit 3**.



### *Signal Improvements Implementation Steps*

- The City will evaluate, and implement if justified, the recommended LPIs by the end of calendar year 2023.
- The City will consider for approval a future request from VCU to include installation of the RRFB at this Grace Street and Pine Street as part of the scope for the planned VCU residence hall project.
- VCU, with support of the City, will coordinate with VDOT to implement flashing beacons and/or rumble strips at the I-95 off-ramp onto Broad Street.
- The City will implement left-turn hardening for the southbound left-turn at the intersection of Marshall Street and 13th Street as part of its Fall 2023 resurfacing project.
- The City completed the conversion of pedestal-mounted traffic signals to mast-arm-mounted traffic signals at three locations near the Monroe Park Campus.
- The City is in the process of completing a citywide signal retiming project, which will include the traffic signals on VCU campuses.
- The City is in the process of completing the installation of high-visibility signal backplates at signalized intersections as part of a Systemic Signal Visibility improvements project.

Exhibit 3: Signal Improvements



## Roadway Improvements

### SPEED TABLES

Speed tables are elongated speed humps with a flat top. Speed tables are typically long enough for an entire wheelbase of a passenger car to rest on top. Speed tables physically encourage drivers to slow down. The City of Richmond installed 13 new speed tables within the VCU Monroe Park Campus in May 2023. Locations depicted in **Exhibit 4** include existing speed tables and locations where speed tables are recommended for evaluation; locations for speed tables are subject to the review and approval of various City emergency service units.



### RAISED INTERSECTIONS

Raised intersections are raised plateaus that extend through the length and width of an intersection. Inclines are provided on intersection approaches to ramp up onto the raised portion of the intersection. Pedestrian crosswalks are also elevated as part of this treatment. Raised intersections physically encourage motorists to reduce their speeds approaching the intersection and enhance the visibility the crosswalks. Raised intersections are currently deployed on the Monroe Park Campus at the intersections of Floyd Avenue at Linden Street and Grove Avenue at Linden Street. An additional raised intersection is recommended for evaluation at the intersection of Clay Street and 10<sup>th</sup> Street as part of future development (see **Exhibit 4**).



### ROAD CLOSURE

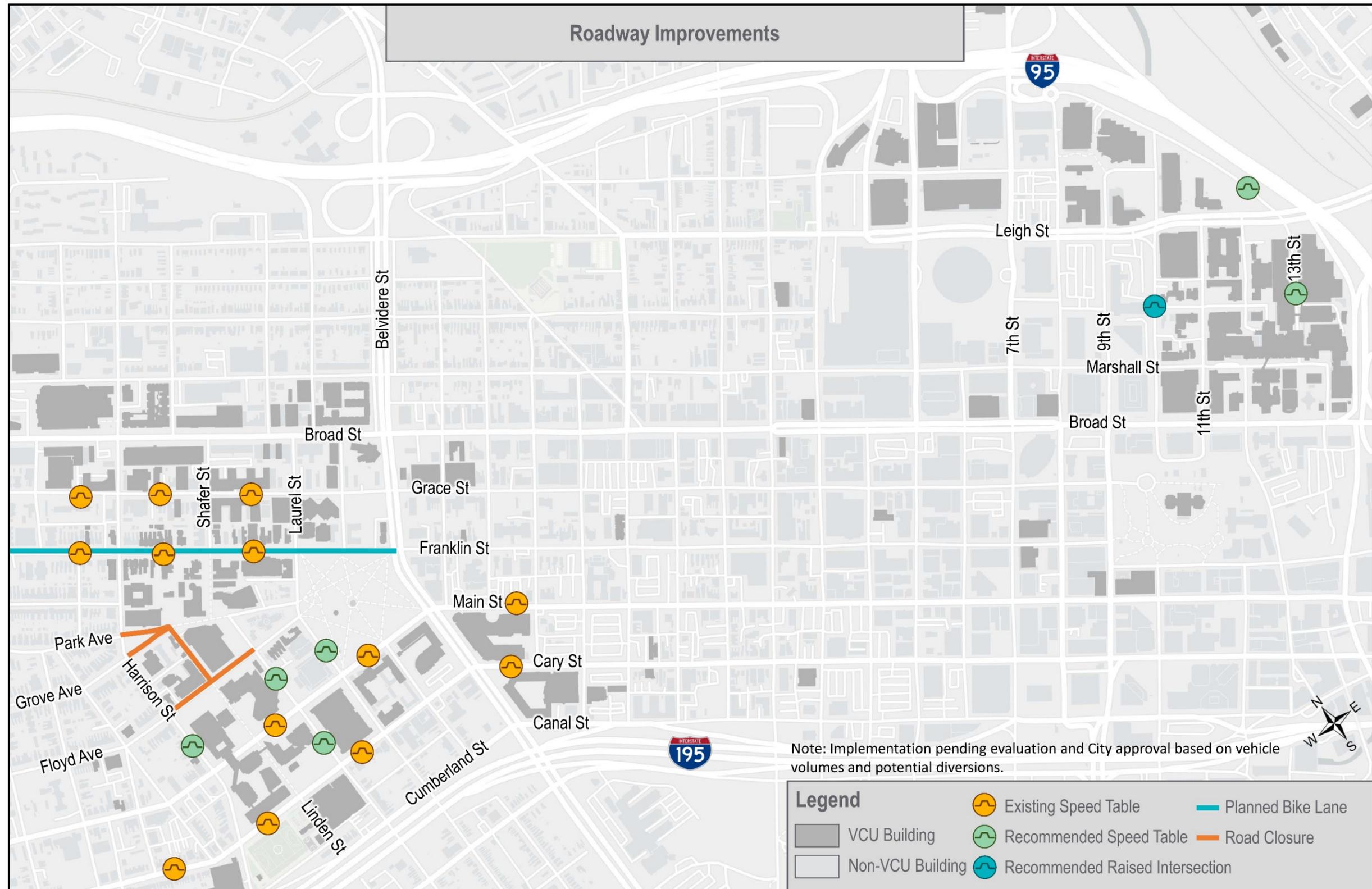
Road closures are accomplished by installing a physical barrier that blocks a street to motor vehicle traffic. Road closures should allow for the free movement of all pedestrians and cyclists. Road closures are currently deployed on the VCU Monroe Park Campus along Linden Street between Floyd Avenue and Cary Street, along Shafer Street between Franklin Street and Park Avenue, and along Park Avenue between Linden Street and Cathedral Place. The cost of implementing road closures varies and is dependent on the complexity of streetscape elements and physical barriers installed. It is suggested that the roads marked in orange in **Exhibit 4** be evaluated for potential road closures. This will require additional study and engagement with impacted property owners and emergency services agencies. This study should evaluate the impact of the closure of the roads marked in orange to motor vehicle traffic, bicyclists, and pedestrians within and around the Monroe Park Campus.



### *Roadway Improvements Implementation Steps*

- The City is moving forward with a proposed bicycle lane project along Franklin Street. Public engagement expected in Fall 2023 and implementation in 2024-25.
- VCU requests that the City work with the City Fire Marshall to locate additional speed tables as shown on **Exhibit 4**. This will require approval of various City emergency services units.
- The City will evaluate the recommendation for the raised intersection at Clay Street and 10<sup>th</sup> Street as part of future development.
- VCU will install speed tables along 13<sup>th</sup> Street near D-Deck pending City Fire Marshall approval.

Exhibit 4: Roadway Improvements



## Maintenance and Operations Recommendations

Based on the conducted field observations, several maintenance and operations recommendations were identified. The recommendations include vegetation trimming, sign upgrades, pavement marking and stop bar restoration, minor signal modifications, and a recommendation to review and improve valet operations. The maintenance and operations recommendations are depicted in **Exhibit 5**.

### SIGNAL LOUVERS

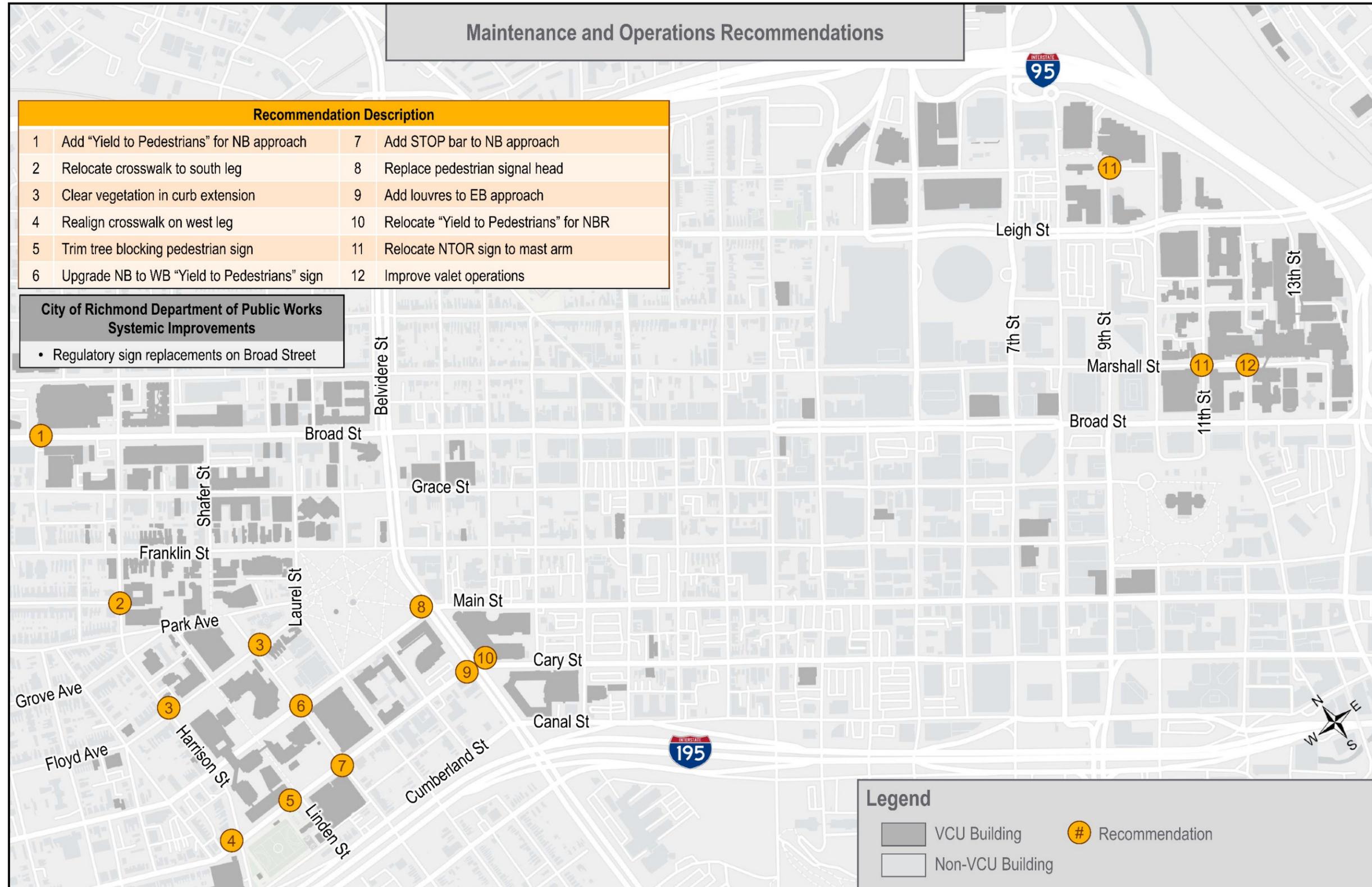
Signal louvers are devices mounted inside of a traffic signal to limit the distance from the intersection where signal indications are visible. Signal louvers are recommended on the eastbound approach of Cary Street at Belvidere Street to limit the distance that the green traffic signal ball is visible until after drivers pass the existing crosswalk at Pine Street. The louvers are intended to keep drivers focused on looking for pedestrians in the crosswalk at Pine Street before turning their attention to the signal at Belvidere Street.



### *Maintenance and Operations Implementation Steps*

- The City has completed the identified sign maintenance recommendations identified in this report.
- The City and VCU will revisit improvements to the valet area on Marshall Street.
- The City has installed signal louvers on the eastbound approach of the intersection of Cary Street and Belvidere Street.
- The City is in the process of replacing regulatory signs on Broad Street.

**Exhibit 5: Maintenance and Operations Recommendations**



## Other Improvements

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Along with the location-specific improvements discussed in the previous section, the following programmatic improvements are recommended.

### **GATEWAY FEATURES**

Like the existing gateway feature located at the intersection of Main Street and Linden Street, it is recommended that additional gateway features be installed to help define campus boundaries. Defining the campus boundaries will alert drivers that they have entered the VCU campuses where heavier pedestrian volumes are present and additional awareness is needed.

### **MOBILE SPEED FEEDBACK SIGNS**

Speed feedback signs are designed to encourage drivers to slow down by alerting them of their speed. It is recommended that the VCU Police Department purchase and deploy speed feedback signs at locations where speeding is observed. An additional benefit of speed feedback signs is their ability to record vehicle speeds which will assist VCU Police with building a database of speed hotspots where additional traffic calming or speed enforcement should be prioritized.

### **SPEED MANAGEMENT VIA SIGNAL TIMING**

Speed management via signal timing aims to improve pedestrian safety by altering driver behavior and vehicle speeds on a corridor. Coordinated signal timings can be optimized for slower speeds, thereby reducing the timesaving benefit of driving above the posted speed limit. Built-in stops can also be created to force traffic to slow in speeding hotspots. It is recommended that the City continue to complete such optimization along Harrison Street, Main Street, and Cary Street.

### **SPEED STUDY**

With the recent installation of 13 speed tables by the City of Richmond throughout the VCU Monroe Park Campus, it is recommended that the City and VCU work collaboratively to evaluate the effectiveness of speed tables on VCU campuses to inform future traffic calming decisions, assist in identifying candidate speed table locations, and support additional speed enforcement. If new speed tables are proposed, then a speed study will be required.

### **SPEED ENFORCEMENT**

The failure of motorists to obey speed limits creates an unsafe environment for other road users including pedestrians and bicyclists. Although this study recommends several engineering and educational countermeasures to create a safer environment for pedestrians, it is recommended that the City of Richmond and VCU Police develop a collaborative speed enforcement plan to reduce speeding through campus. Given traffic passing through campus is not confined to University-related activities, coordinated speed enforcement amongst City and VCU Police units will be most effective to reduce speeding and improve pedestrian safety on campus.

### **CURB REVEAL ADJUSTMENTS**

Curb reveal is the height of the vertical curb that is visible (revealed) above the roadway surface and serves as a protective measure for vehicles accidentally mounting the curb or sidewalk. As roadways are resurfaced and new pavement is laid on top of existing surfaces, the reveal height may become reduced thereby diminishing the effectiveness of the curb in protecting pedestrians from vehicles running off the road. Curb reveal adjustments are recommended when implementing roadway resurfacing projects.

### **PEDESTRIAN SIGNING AND PAVEMENT MARKINGS**

VCU will seek approval for "Look Left" and "Look Right" pavement markings at crosswalks that traverse one-way streets. In addition to "Look Left" and "Look Right" pavement markings, sidewalk signage and markings are recommended to educate pedestrians about crossing safety, specifically at crosswalks that traverse one-way streets. VCU will implement and maintain these markings.

### **POSTED SPEED LIMIT REDUCTION**

In an effort to improve VCU and the City's pedestrian safety culture, it is critical to achieve slower vehicle speeds. While the previously discussed improvements typically result in a reduction in travel speeds, VCU and the City will monitor speed data to inform future discussions regarding speed limit reduction.

### **OUTREACH AND EDUCATION**

It is recommended that VCU continue outreach and education initiatives for the entire VCU community as they relate to pedestrian safety. Additionally, as the VCU campuses include major commuter routes used daily by non-VCU commuters, it is recommended that the City of Richmond develop a Citywide outreach and education program to raise awareness and help to develop a safer driving, walking, and biking culture.

### ***Other Improvement Implementation Steps***

- VCU will continue to implement gateway features at key locations throughout VCU campuses. Upcoming implementations include gateway features at the intersections of Broad Street and Belvidere Street, Cary Street and Belvidere Street, Leigh Street and 12<sup>th</sup> Street, Broad Street and College Street, and Broad Street and 10<sup>th</sup> Street.
- VCU will implement mobile speed feedback signs on campus.
- The City is in the process of completing a citywide signal retiming project, which will include the traffic signals on VCU campuses.
- VCU will work collaboratively with the City to evaluate the effectiveness of speed tables on VCU campuses to inform future traffic calming decisions, assist in identifying candidate speed table locations, and support additional speed enforcement.
- VCU and the City will work together on a joint speed enforcement plan.
- VCU will pursue a "school zone" status for VCU campuses, allowing for additional speed enforcement including the use of automated speed enforcement cameras.
- VCU will work with the City to determine locations for red-light running cameras on campus.

### ***Other Improvement Implementation Steps (Continued)***

- VCU and the City will work together to request the state to modify the reckless driving code to include 10 MPH over posted speed.
- The City will adjust the curb reveal when implementing roadway resurfacing projects.
- VCU will seek City approval for pedestrian signage, pavement markings, and sidewalk graphics as needed.
- VCU and the City will monitor speed data to inform future discussions regarding speed limit reduction.
- VCU will continue outreach and education initiatives as they relate to pedestrian safety and requests the City conduct a citywide outreach and education program to raise awareness and help to develop a safer driving, walking, and biking culture.

## Summary

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In response to pedestrian safety concerns identified through field observations and discussions with VCU staff and the VCU Police Department, improvements are recommended at various locations throughout the VCU campuses. The improvements focus on safety measures emphasizing pedestrians as primary users on the VCU campuses. Traffic calming measures influencing travel speeds through redesigning geometric elements of streets and the built environment are offered. The development of this improvement plan was an iterative process and involved coordination with VCU and City of Richmond staff.

# Appendix A: Existing Conditions Review Memorandum



**VCU**

**June 2023**

# Pedestrian Safety Study

## Existing Conditions Review



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# Existing Conditions Review

## Introduction

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Located in downtown Richmond, Virginia Commonwealth University (VCU) currently enrolls more than 28,000 students across its two main campuses – Monroe Park Campus and Academic Medical Center Campus – and employs more than 24,000 staff between the university and health system. Thousands of students, patients, faculty, staff, and visitors walk VCU's urban campuses each day – making proactive pedestrian safety a priority for both VCU and the City of Richmond.

Recent incidents resulting in pedestrian injuries and fatalities highlight the urgency of collaboration between VCU and the City to enhance existing infrastructure and enforcement within City owned right-of-way, continue community outreach and education efforts, and create a safer campus community.

The recommendations in this report are based on an evaluation of existing pedestrian conditions on the Monroe Park Campus and Academic Medical Center Campus as well as information from VCU and City public safety administrators.

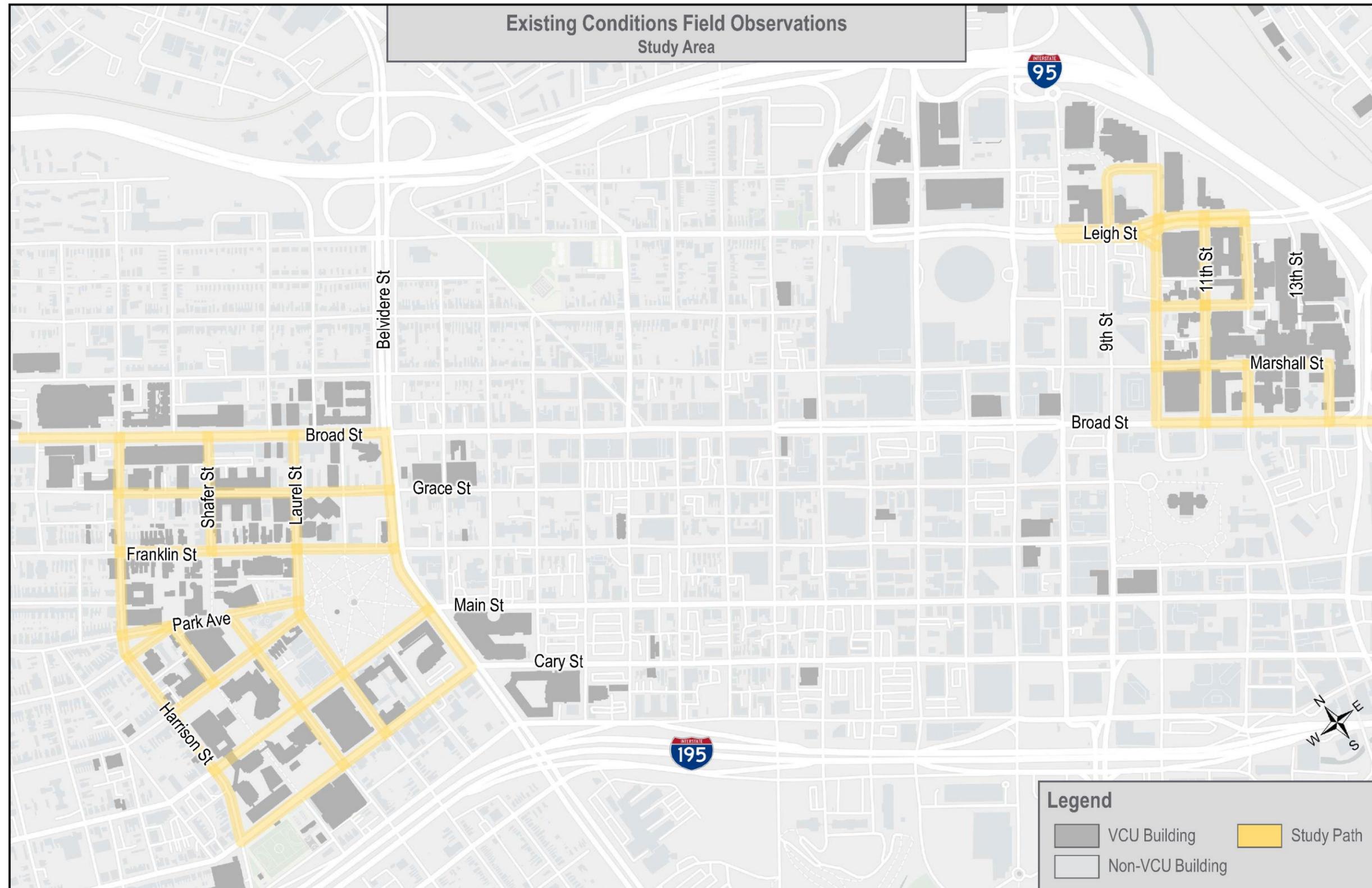
## Field Observations

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On Wednesday, April 26, 2023, while spring semester classes were in session, the study team walked the Monroe Park and Academic Medical Center Campuses to document existing conditions of pedestrian infrastructure. The study team focused on pedestrian volumes, travel patterns and behaviors, crossing conditions, infrastructure, and general vehicular traffic volumes, types of vehicles (passenger cars, trucks, buses, etc.), speeds, and operations. Over the course of field observations, the study team collected over 150 unique data points and captured accompanying photographs to document concerns related to pedestrian infrastructure and pedestrian and motorist behavior.

The following memorandum categorizes these observations into five sections: **Visibility and Sight Distance**, **Pedestrian Crossings and Behavior**, **Signage and Road Markings**, **Motorist Behavior**, and **Additional Infrastructure Concerns**. Each section includes a description of the collected data and a selected representative photograph. **Exhibit A-1** depicts the locations of the observed concerns grouped by observation category.

The observations described in this memorandum account for what the study team observed during a typical weekday on campus and should not be considered a complete account of all pedestrian safety concerns and behavior at VCU.

**Exhibit A-1: Study Area**

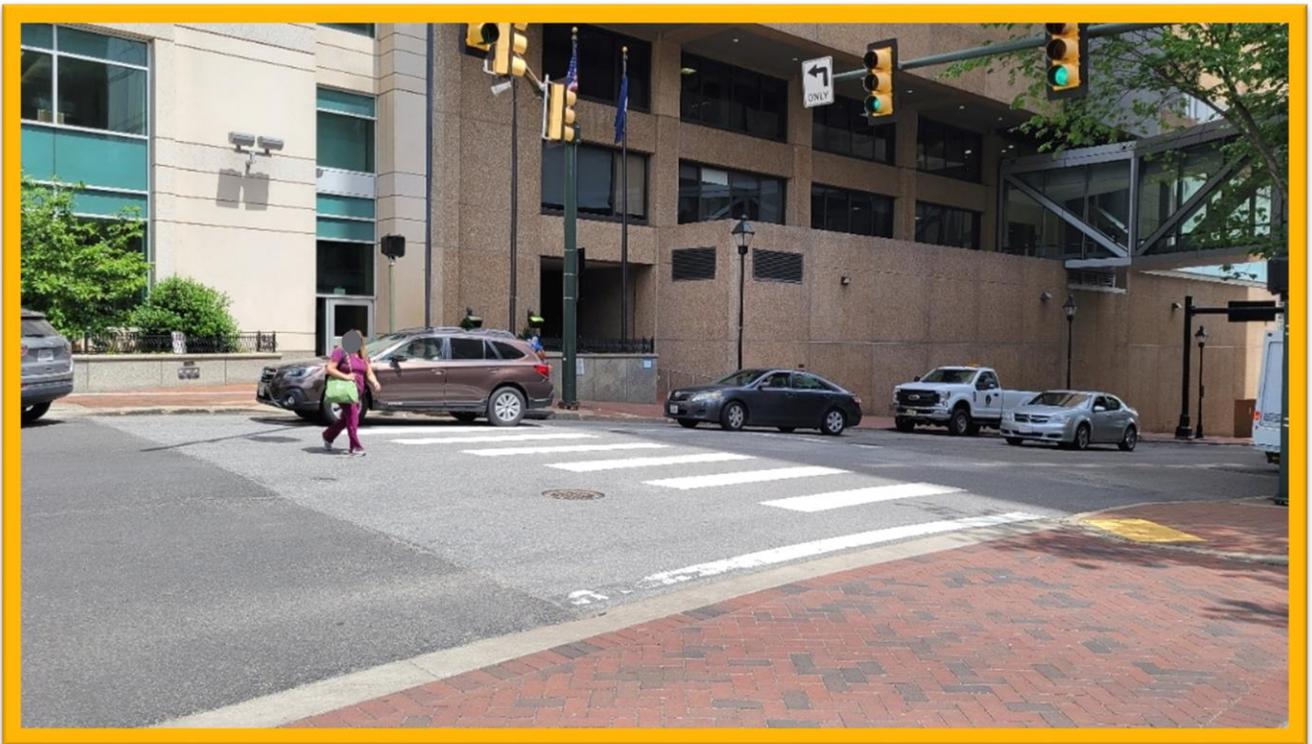
### VISIBILITY AND SIGHT DISTANCE

It is crucial that all road users (including pedestrians, cyclists, and motorists) can fully see their surroundings and anticipate potential conflict at locations where pedestrians, cyclists, and vehicles interact. The study team identified 24 locations on the VCU Monroe Park and Academic Medical Center Campuses where vegetation, parked vehicles, or traffic signal infrastructure impaired visibility, as shown in **Exhibit A-2**.

The three green icons show locations where the study team observed vegetation in landscaped bump-outs or a nearby tree impairing pedestrian or cyclist / motorist visibility.

The 16 yellow icons show locations where the study team observed a vehicle parked in a way that impedes the view of oncoming traffic or blocks a crosswalk. At these locations, relocating or removing on-street parking, loading areas, or bus stops may improve sight distance and overall safety for pedestrians. **Figure A-1** shows a unique situation the study team observed on the Academic Medical Center Campus where vehicles waiting for valet parking were stopped in the crosswalk. The pedestrian was also crossing against an opposing green light.

The five grey icons show where other objects impair visibility, such as the traffic signal cabinet at Cary Street and Cherry Street, as shown in **Figure A-2**, and the traffic signal poles at Cary Street and Harrison Street.

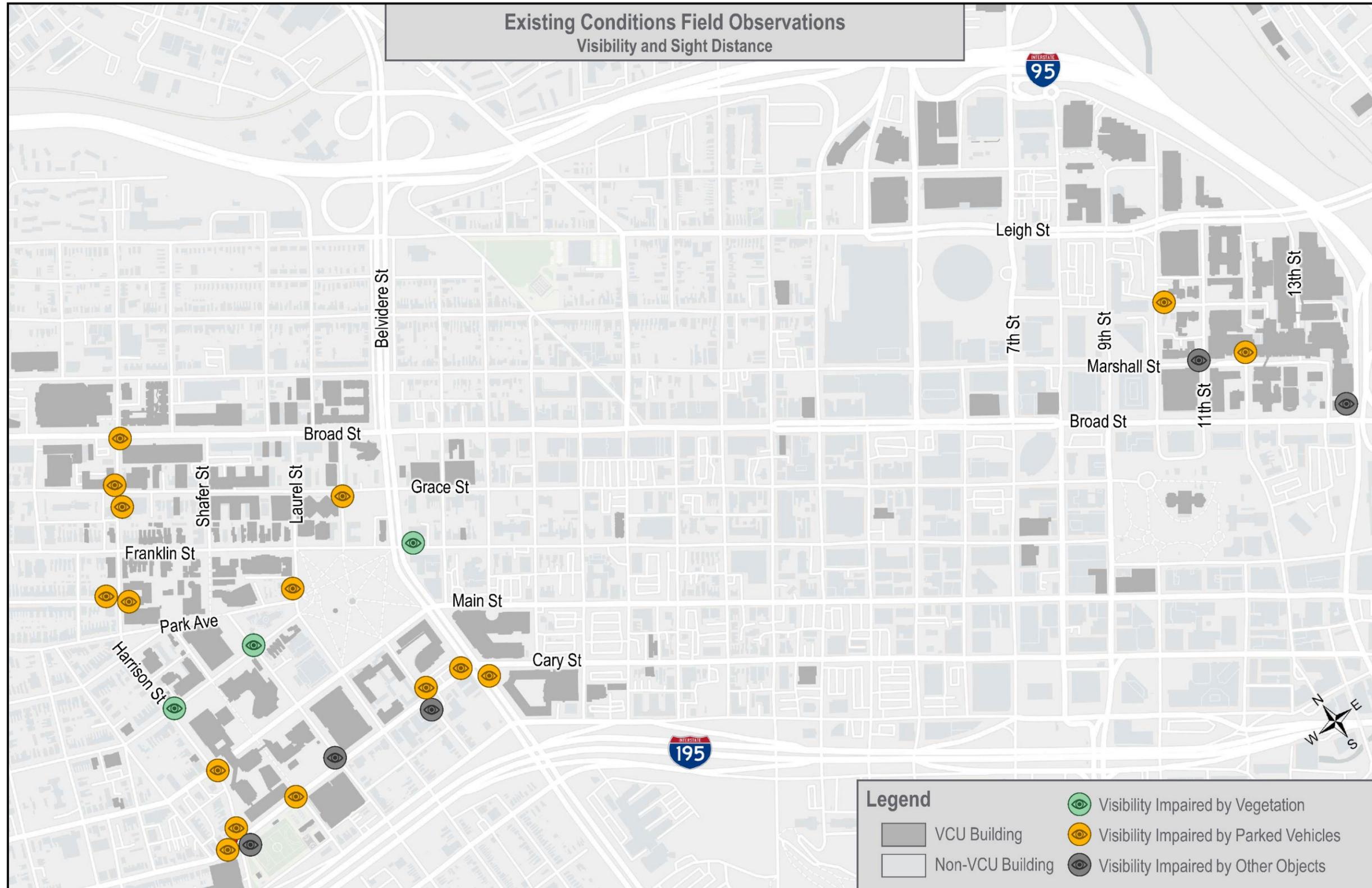


**Figure A-1: Valet Queues Blocking Crosswalk and Pedestrian Crossing at Marshall Street and 12<sup>th</sup> Street**



Figure A-2: Impaired Pedestrian Sight Distance at Cary Street and Cherry Street

Exhibit A-2: Visibility and Sight Distance Observations



## PEDESTRIAN CROSSINGS AND BEHAVIOR

Crossing a heavily trafficked street is a necessary but potentially dangerous activity for pedestrians. It is essential that crossings are designed with pedestrians in mind and are marked clearly, have signal timings favoring pedestrians, and offer full visibility for motorists and pedestrians. Crossings should be designed with an understanding that humans make mistakes and unsafe decisions—as both motorists and pedestrians. **Exhibit A-3** presents 31 locations within the Monroe Park and Academic Medical Center Campuses where crossing infrastructure can improve. The Exhibit also present locations where the study team observed pedestrian demonstrating potentially unsafe crossing behavior.

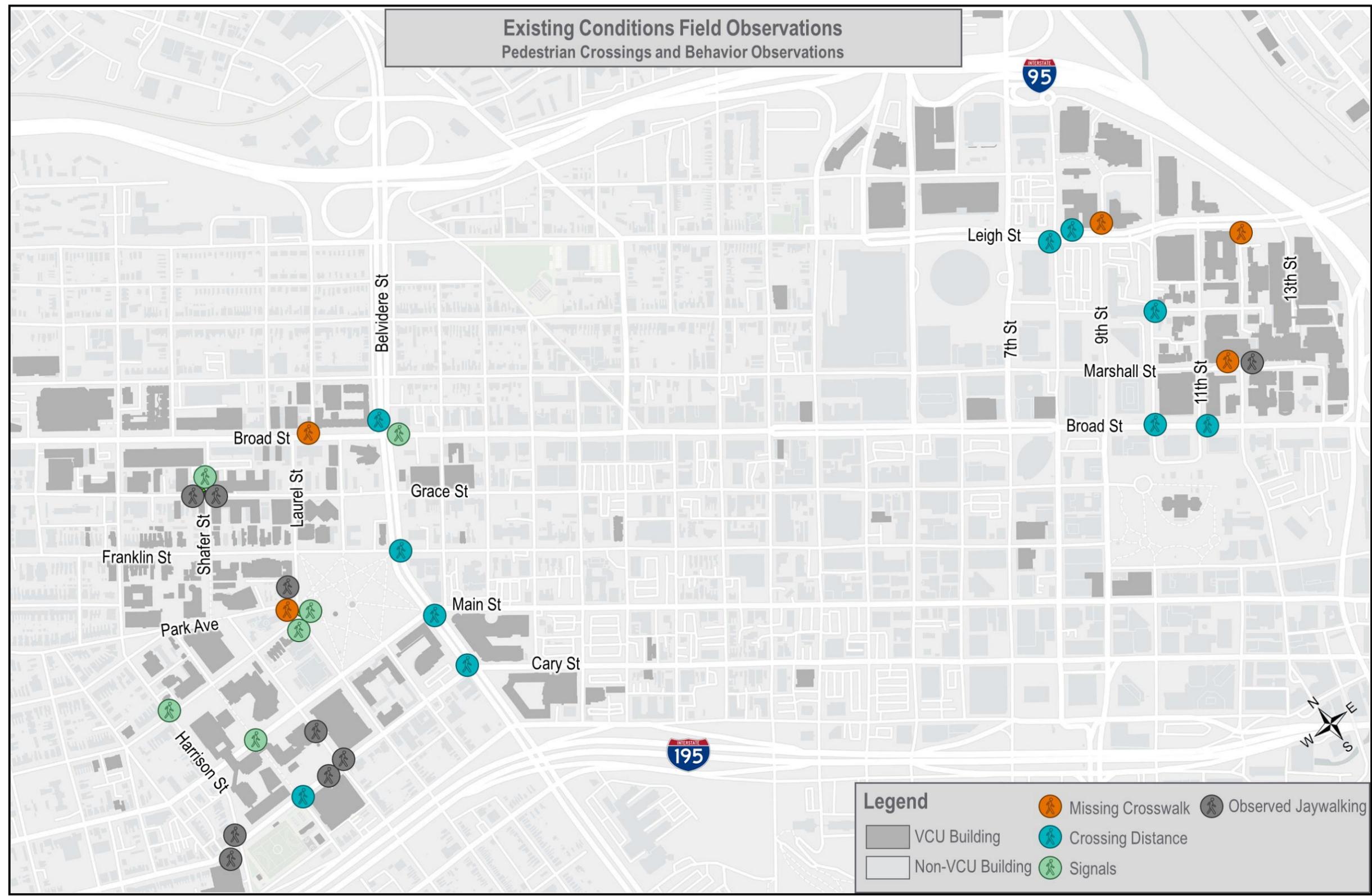
The four locations shown in orange may benefit from the addition of a crosswalk as there was observed pedestrian activity but no crosswalk.

Ten locations shown in blue have particularly long pedestrian crossing distances (at some points spanning six lanes of traffic) that prolong pedestrian exposure to vehicular conflicts.

The eight locations shown in green denote locations where the study team observed traffic signals that lack pedestrian signal infrastructure or could have signal timings improved to better serve pedestrian volumes.

The nine locations shown in grey depict locations where the study team observed pedestrians crossing at a potentially unsafe location or during the Do Not Walk signal phase. The study team observed some pedestrians acting like they were in a herd—following other pedestrians and crossing against a Do Not Walk signal without checking for oncoming vehicles—at several locations. The study team will further investigate these locations to identify improvements to better direct pedestrians and vehicles at intersections and provide safe and convenient crossing opportunities.

Exhibit A-3: Pedestrian Crossings and Behavior Observations



### SIGNAGE AND ROAD MARKINGS

Proper signage and pavement markings direct traffic and depicts rules of the road and road configurations to promote safety for all road users. **Exhibit A-4** includes 20 opportunities to enhance existing signs and markings.

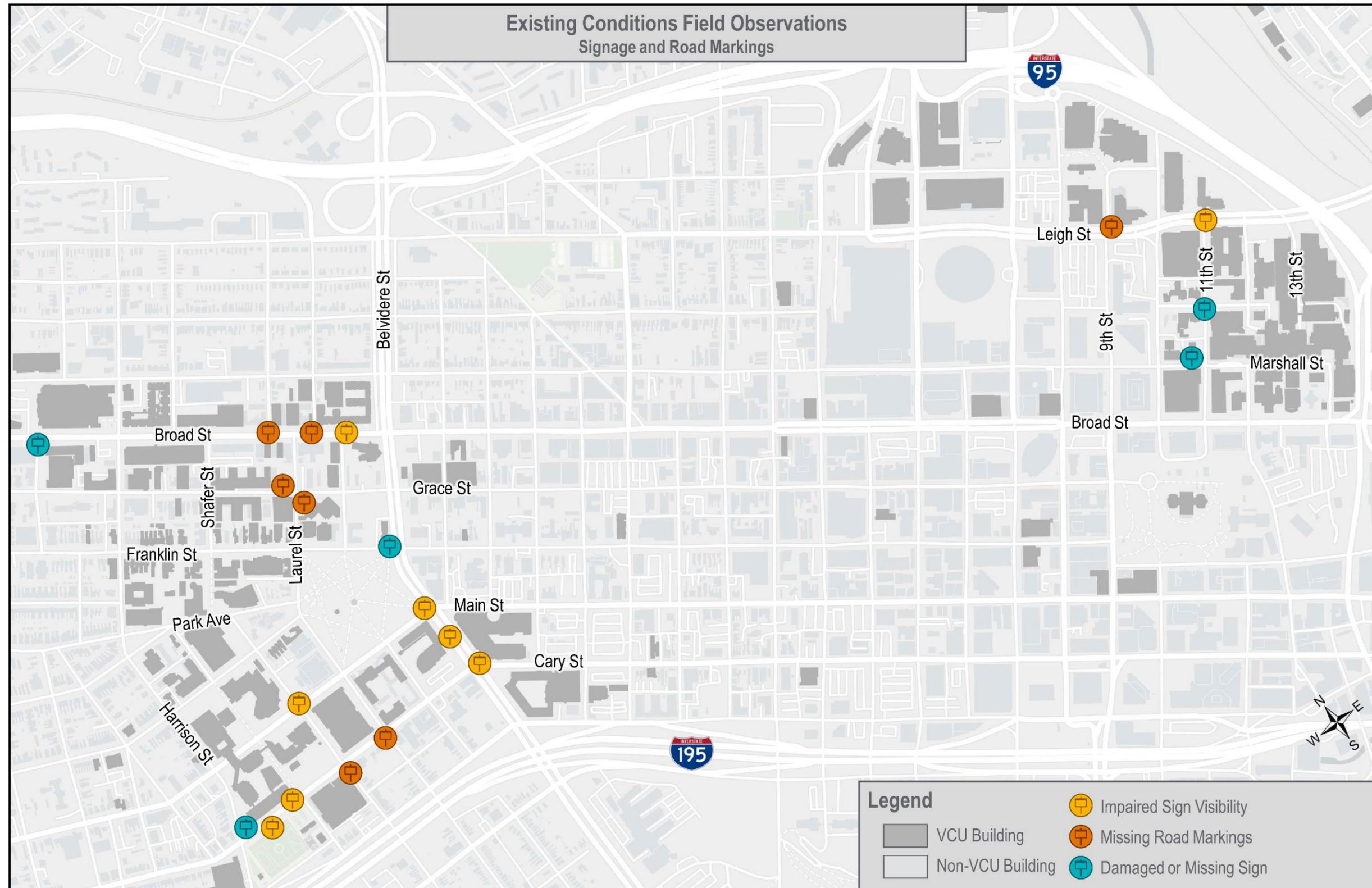
The eight yellow locations shown represent pedestrian focused warning signs that are difficult to see due to placement, vegetation cover, or other infrastructure blocking the line of sight to the sign.

The seven orange locations represent locations with inadequate road markings. Road marking concerns range from missing stop bars to confusing road markings. Confusing road markings include locations where the study team observed motorists using a bus lane or parking lane as a right-turn lane. Signage and pavement markings that offer conflicting information can be dangerous for pedestrians and motorists. **Figure A-3** shows an intersection where there are no stop bar or crosswalk markings.

The five blue locations represent signs that require maintenance or are installed in an improper location. These locations include graffitied signs, inconsistent sign placement, and unmarked locations with high pedestrian activity. One such location is the intersection of Clay Street and 11<sup>th</sup> Street, where high pedestrian volumes conflict with free-flowing traffic.

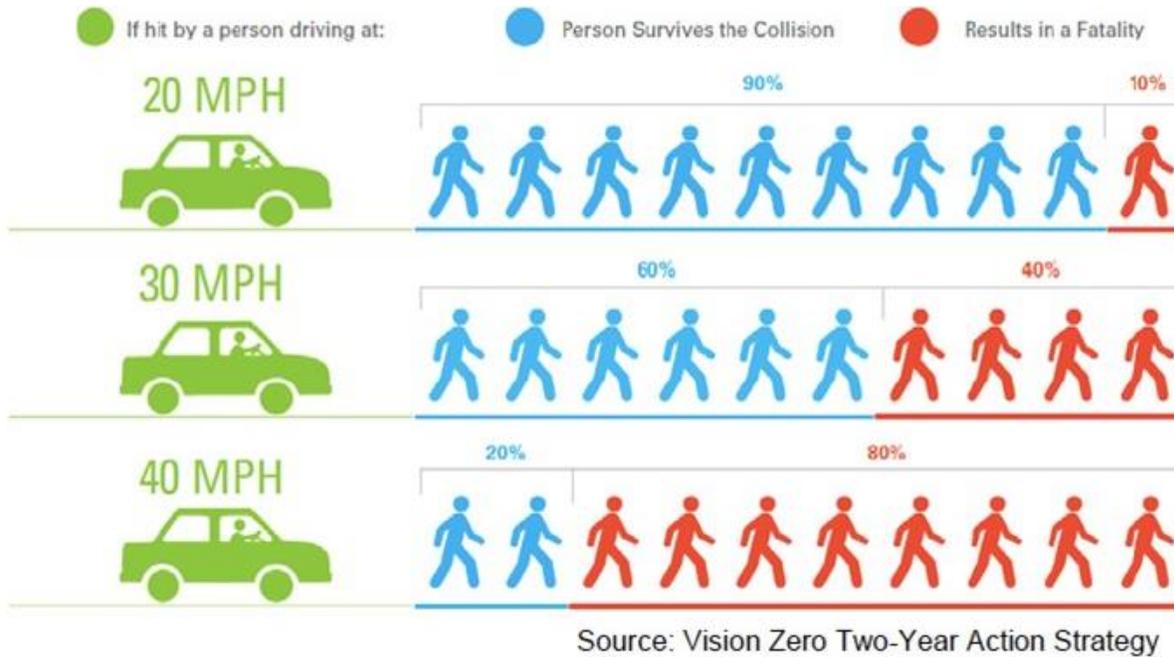


**Figure A-3: Missing Stop Bar and Crosswalk at Broad Street and Gilmer Street**

**Exhibit A-4: Signage and Road Marking Observations**


### MOTORIST BEHAVIOR

While motorists are responsible for their own behavior and following traffic laws such as yielding to pedestrians and maintaining safe speeds, there are infrastructure elements that can encourage better situational awareness and traffic calming. Speeding vehicles create significant danger for pedestrians and increase severity of any conflict. **Figure A-4** demonstrates how increased vehicular speeds dramatically increase the likelihood of pedestrian fatality in the event of a collision. **Exhibit A-5** presents 37 locations where the study team observed unsafe motorist behavior.



**Figure A-4: Pedestrian Fatality Probability based on Vehicle Speed**

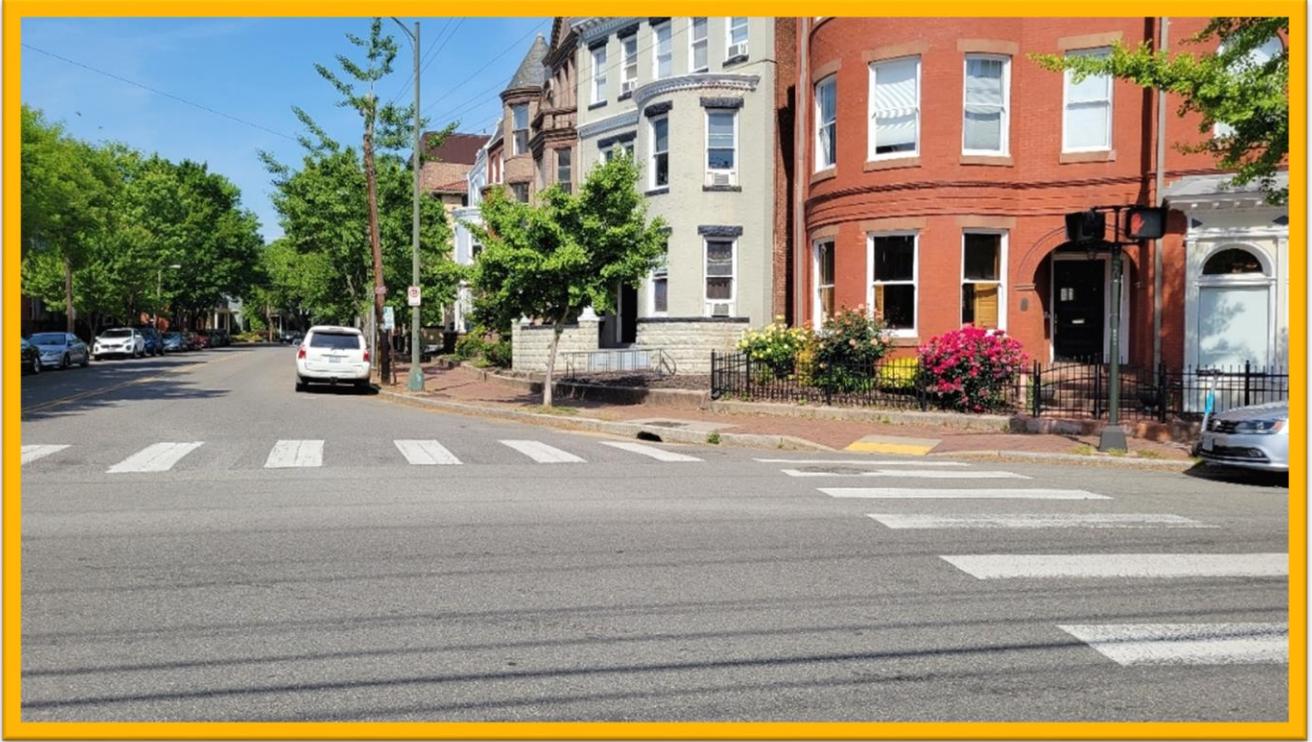
The seven yellow icons depict locations where the study team observed motorists turning at high speeds. Taking a turn with too sharp an angle or at too high a speed increases the likelihood and potential severity of a vehicle-pedestrian collision. Motorists taking a turn too quickly can lose control of the vehicle, drive over the curb, not notice a pedestrian, or not have enough time to brake. This category of observations also includes intersections with a large turning radius as the radius enables motorists to turn quickly through the intersection and increases the crossing distance for pedestrians. **Figure A-5** presents an example of a corner with a large radius that enables motorists to take right turns at a higher speed.

The thirteen red icons depict locations where the study team observed vehicles exceeding the posted speed limit.

The thirteen blue icons depict locations where the study team observed motorists failing to yield to pedestrians. In some cases, this failure to yield occurred because motorists advanced into the crosswalk to make a right turn at a red light, which blocked crossing pedestrians. In other instances, when turning motorists had a green light and pedestrians had a walk signal simultaneously, motorists ignored the pedestrian right-of-way and turned before pedestrians had

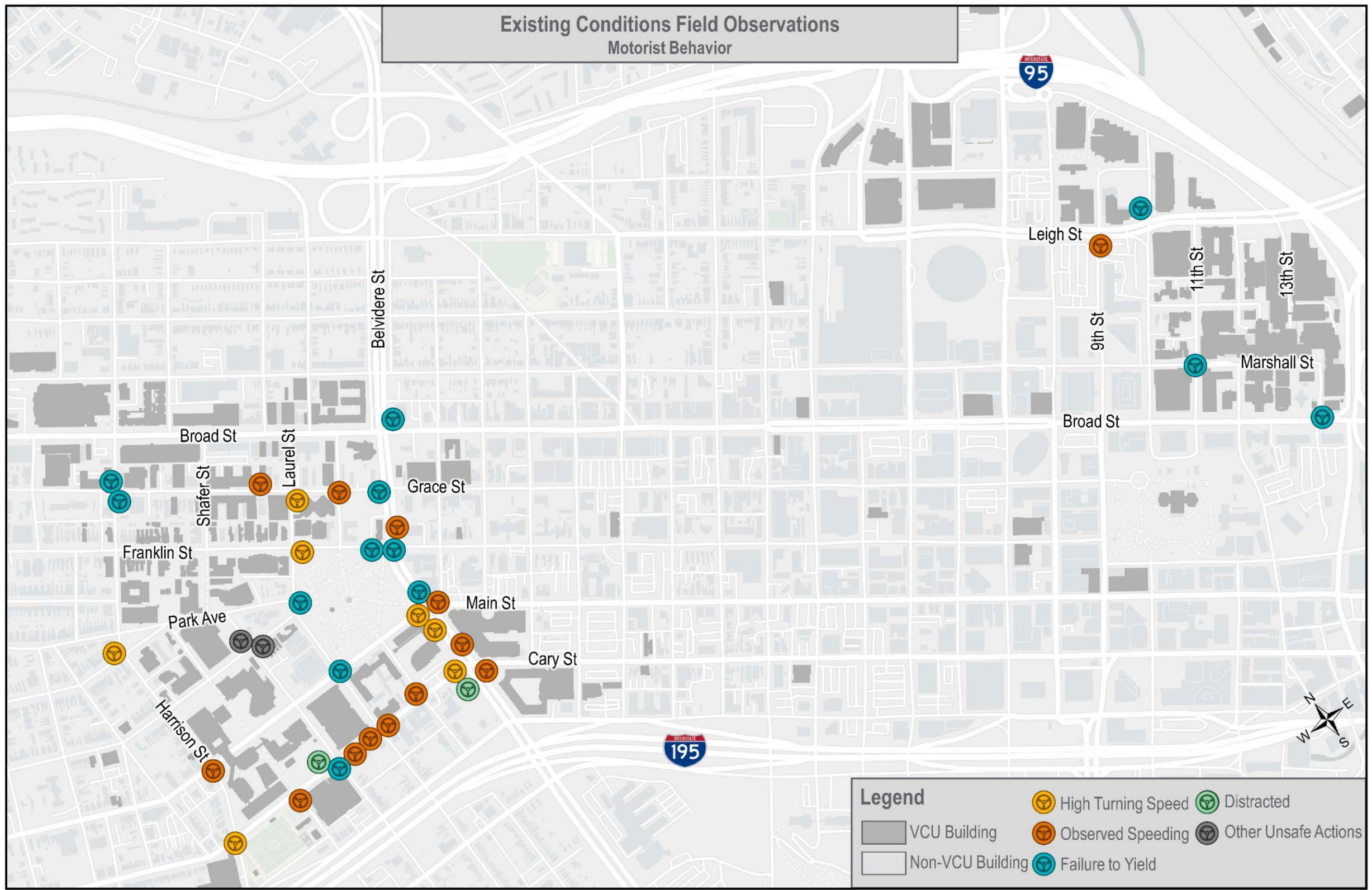
a chance to start crossing. At the two locations in green, the study team observed distracted motorists.

The two locations in grey depict where the study team noticed motorists making other kinds of unsafe maneuvers, such as unsafe U-turns.



**Figure A-5: Large Curb Radius at Intersection of Harrison Street and Grove Avenue**

Exhibit A-5: Motorist Behavior Observations



### ADDITIONAL INFRASTRUCTURE CONCERNS

Providing safe and accessible infrastructure for all pedestrians, including pedestrians that use mobility devices, is essential to improving campus pedestrian safety.

**Exhibit A-6** presents 31 locations that require improvements to make pedestrian infrastructure more accessible. Properly designed curb ramps are important to ensure that pedestrians with visual impairments and those using wheelchairs, strollers, walkers, crutches, bikes, and other mobility devices can safely access the sidewalk. Curb ramps should have a level landing, tactile warning surface, and directly face the crossing that they serve. This design directs users into the crosswalk and towards the opposing curb ramp rather than directing them towards the center of the intersection, potentially into oncoming traffic.

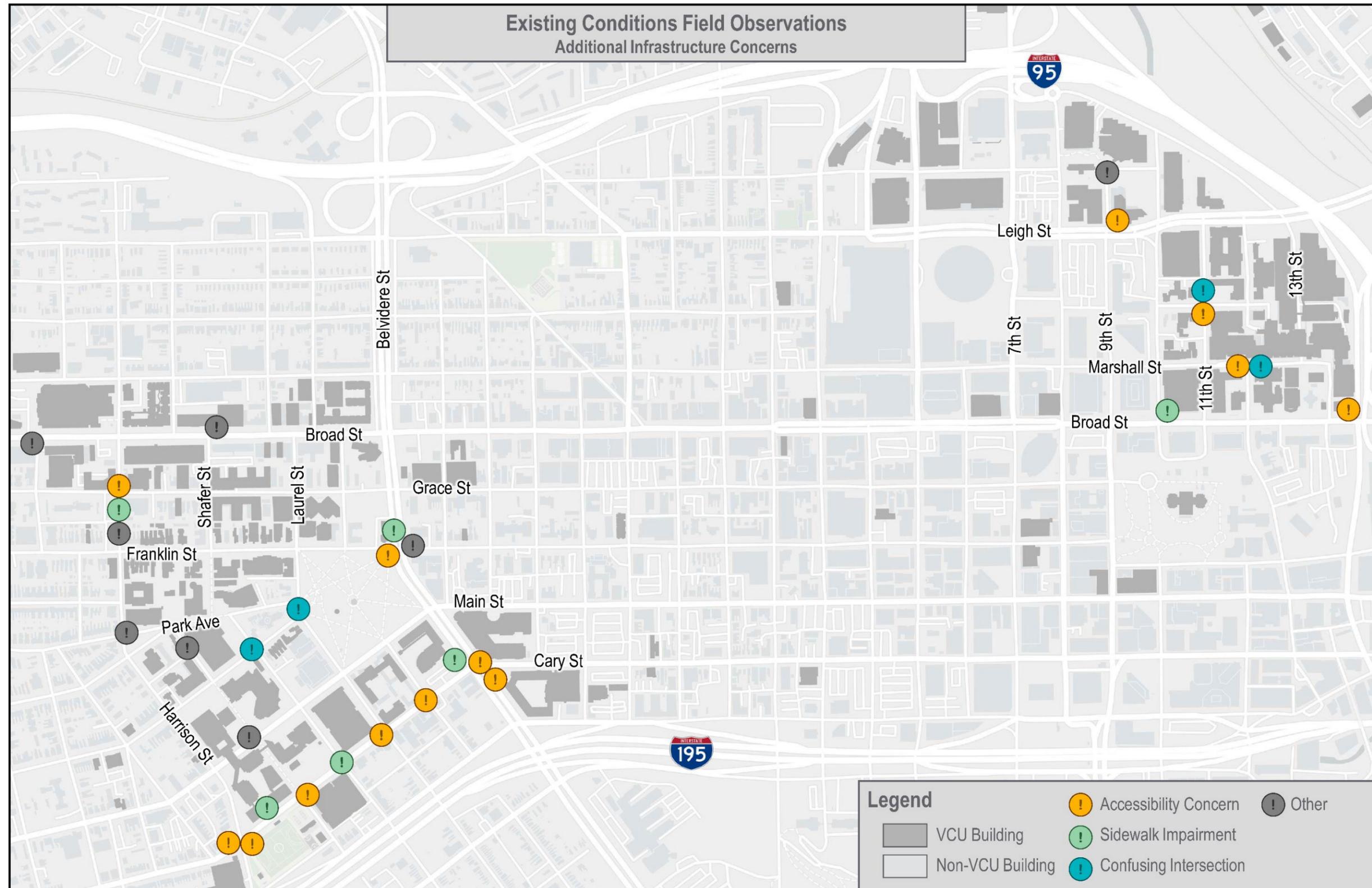
The thirteen yellow icons identify accessibility concerns including inadequate curb ramps or warped pavement within crosswalks that make the pedestrian path less accessible.

The six green icons represent areas with inadequate sidewalks. An obstructed or too-narrow sidewalk may force pedestrians into the road leading to a higher chance of a pedestrian-vehicle conflict.

The four blue icons show where the study team observed confusing configuration and infrastructure. One example the study team noted is traffic signals facing the wrong way on a one-way street at the intersection of Marshall Street and 12<sup>th</sup> Street.

The eight gray icons represent a collection of other unique infrastructure concerns that the study team noted. The study team observed vehicles parking, loading, or otherwise impeding sidewalks and bike lanes. For example, several alleyway entrances along Harrison Street introduce additional conflict points between vehicles and pedestrians. The study team also observed several motorists dropping off students along Main Street near the VCU Student Commons, which created congestion and impaired visibility for motorists and pedestrian at this high pedestrian activity intersection.

Exhibit A-6: Additional Infrastructure Concerns



## Conclusion and Next Steps

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The observations noted in this portion of the study will be used to develop targeted recommendations to improve pedestrian safety on the VCU Monroe Park and Academic Medical Center Campuses. Categorizing observations and concerns will assist the study team in identifying appropriate countermeasures to mitigate the range of pedestrian safety concerns identified. Improvements may include traffic signal retiming to encourage slower speeds, leading pedestrian intervals (LPIs), traffic calming treatments, curb extensions, corner clearance markings, right-turn on red restrictions, on-street parking restrictions and removals, vegetation trimming, and signage and pavement markings.

# Appendix B: University Benchmarking Interview Summaries

## University of Louisville

The University of Louisville (UofL) currently enrolls 23,000 students at its Belknap Campus and Health Sciences Campus (HSC) in Louisville, Kentucky. Similar to VCU, UofL has separate academic and medical campuses both set in an urban context. Furthermore, several one-way streets traverse both UofL campuses. UofL is a silver-status Bicycle Friendly University.

UofL noted that pedestrian accommodations on campus changed notably with the Eastern Parkway road diet. This project involved reducing the number of vehicular travel lanes, installing curb bump outs and transit pull outs, and standardizing pedestrian crossings throughout the corridor. Since then, the University has partnered with the state or City on several more road diet projects. One such road diet project on 1<sup>st</sup> Street and Brook Street included converting a pair of one-way streets to two-way streets.

UofL shared insights into systemic improvements that their institution prefers to implement throughout campus. These improvements include installing high-visibility crosswalk striping, curb bump outs, speed humps, and raised crosswalks. UofL has leveraged capital projects funding to improve pedestrian infrastructure, such as the crosswalk improvements along Preston Street on the HSC. Moving forward, UofL would like to leverage Americans with Disabilities Act (ADA) funding to make their campus ADA compliant, which can result in improved pedestrian access and safety for people of all abilities.



The discussion on education and outreach at UofL focused on bike safety classes and a voucher program created to encourage more students and staff to commute to campus by bike. UofL leveraged a 2012 grant from the Kentucky Bicycle and Bikeway Commission to fund the bike safety classes.

## University of Minnesota Twin Cities

The University of Minnesota Twin Cities (UMN) currently enrolls nearly 55,000 students at its academic and medical campuses straddling the Mississippi River in Minneapolis, Minnesota. Like VCU, UMN has an urban campus with some of the highest pedestrian volumes in its city. UMN is a platinum-status Bicycle Friendly University.

UMN has followed the principle of “pedestrians first” in campus and transportation planning since the adoption of the 1996 campus master plan. This principle has guided the implementation of a campus-wide speed limit of 20 mph and other systemic improvements. UMN shared their preference to install big and bold signage in line with the Federal Highway Administration Manual for Uniform Traffic Control Devices (MUTCD) standards to bring awareness to pedestrian crossings. UMN also installs speed feedback and changeable message signs at key campus gateway locations. These gateway features encourage motorists

to drive the speed limit and remind motorists of increased pedestrian and bicycle traffic when students are on campus.

In addition to providing targeted outreach to motorists, UMN conducts education and outreach to students. UMN holds a transportation orientation session catered to first-year students and focuses their outreach efforts at the beginning of each school year.

UMN partners with the City of Minneapolis and Hennepin County to incorporate pedestrian and bicycle infrastructure improvements on City- and County-administered transportation projects. UMN is strategic with their efforts to include pedestrian and bicycle infrastructure improvements as part of ongoing pavement management initiatives conducted by the City and County.

## University of Alabama at Birmingham

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The University of Alabama at Birmingham (UAB) currently enrolls 22,000 students on its campus spanning over 100 city blocks in downtown Birmingham, Alabama. Like VCU, UAB has an urban setting and several major thoroughfares adjacent to and traversing through campus. UAB is a bronze-status Bicycle Friendly University.

The best practices interview with UAB focused on pedestrian safety outreach and education initiatives conducted by the UAB Police and Public Safety Department.

UAB shared their experience in conducting an annual pedestrian safety campaign, where UAB Police and Public Safety officers partner with student groups to hand out over 5,000 pedestrian safety information pamphlets to staff and students at heavily-trafficked intersections on campus. UAB focuses their efforts at intersections with a history of traffic safety issues and crashes involving pedestrians. UAB Public Safety officers also speak during orientation to share information about pedestrian safety to new students and their parents.

Systemically, UAB focuses on reducing vehicular speeds on campus to provide a safer environment for pedestrians. UAB deploys speed feedback signs at select locations on campus to encourage speed reduction. UAB noted that traffic signals on thoroughfares through and adjacent to campus are timed to encourage motorists to drive slower to arrive at the downstream traffic signals on green.

Recently, researchers and students at UAB developed StreetBit, a smartphone-based application that uses Bluetooth technology to alert pedestrians when they are approaching an intersection (if the intersection is equipped with Bluetooth beacons). The UAB team has conducted a pilot study and noted that the application has the potential to enhance pedestrian safety, especially in mitigating pedestrian safety concerns regarding distracted pedestrians.