MILWAUKEE PEDESTRIAN PLAN

FINAL DRAFT | April 2019

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(for the rest of us)
STATE LAW

5

Pedestrian Safety Toolbox

This chapter provides information on a series of improvements that make walking safer, more accessible, and more enjoyable. The improvements featured here are not an extensive list of every available option to improve the pedestrian experience, but rather a tailored list of tools that have a demonstrated history of improving pedestrian safety and access. Importantly, nearly all of the tools featured here are already in use in Milwaukee. The tools can be used together, and often greater safety gains can be expected when more than one tool is used. Examples of how the tools can be applied to actual locations in Milwaukee are provided after the toolbox.

The Toolbox provides a brief description of each tool, including its benefits, and information about application of the tool. The majority of the tools target improving pedestrian crossings since crossings are where most crashes occur. The tools can be grouped into the following categories:

Capital Improvements

- Sidewalks
- Curb Extensions
- Pedestrian Islands
- Raised Crosswalks & Intersections
- Right-Turn Redesign

Signs and Markings

- Lane Widths
- Road Diets
- Marked Crosswalks
- Yield to Pedestrian Signs
- Speed Feedback Signs

Signals

- Leading Pedestrian Intervals
- Accessible Pedestrian Signals (APS)
- Protected Left Turns
- Right Turn on Red Restrictions
- Pedestrian Beacons

Crash Reduction Factor (CRF)

A crash reduction factor (CRF) is the percentage crash reduction that might be expected after implementing a given improvement at a specific site. Where applicable, CRFs are included for improvements in the Toolbox.

For more information, see: https://safety.fhwa.dot.gov/tools/.

Proven Safety Countermeasures

Proven Safety Countermeasures are specific treatments highlighted by the Federal Highway Administration for their safety effectiveness and benefits. The Toolbox notes which tools are Proven Safety Countermeasures.

For more information, see: https://safety.fhwa.dot.gov/provencountermeasures/

Guidance and requirements for use of the tools is available from numerous resources, many of which are summarized at the end of this chapter.

Pilot to Permanent Implementation

The typical project development process for pedestrian and street projects can take many years from the initial concept development through construction. During this time, momentum for the project can decrease, as can political will, and community engagement.

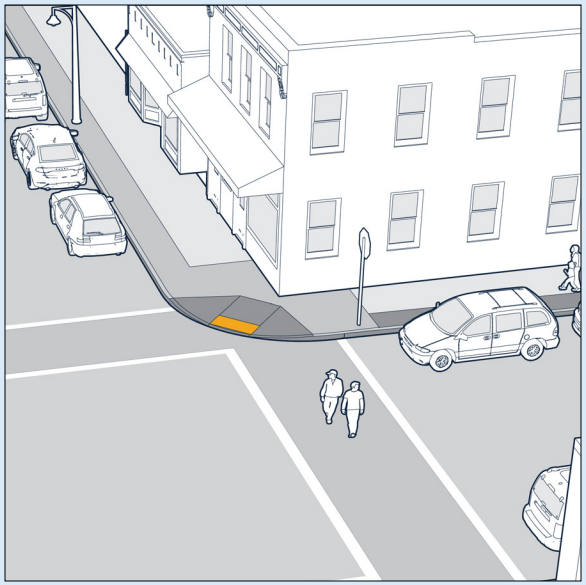
To overcome this and to speed implementation, many of the tools featured in this Toolbox can be implemented rapidly on an interim basis. By constructing pedestrian safety improvements using paint, signs, flexible delineators, and other low-cost materials, projects can be rapidly installed prior to permanent construction. The use of temporary materials is also beneficial as it allows changes to the design based on actual use prior to final construction.

Conventional versus Phased/Interim Project Development

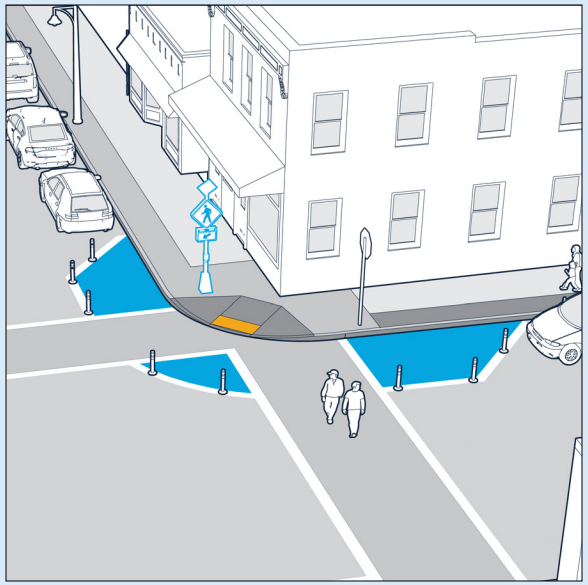
Year	Conventional Project Development	Phased/Interim Design Project Development
Year 1	Concept Plan/Outreach	Concept Plan/Outreach
Year 2		Interim Installation Impacts Analysis
Year 3	Design	Design
Year 4		
Year 5	**Construction**	**Construction**

Adapted from the NACTO Urban Street Design Guide

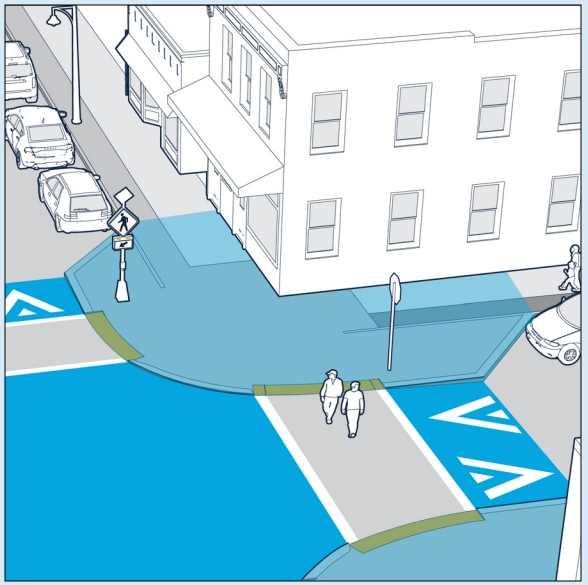
Existing condition



Interim curb extension (paint and flexible delineators)



Permanent curb extension and raised intersection



Sidewalks

DESCRIPTION

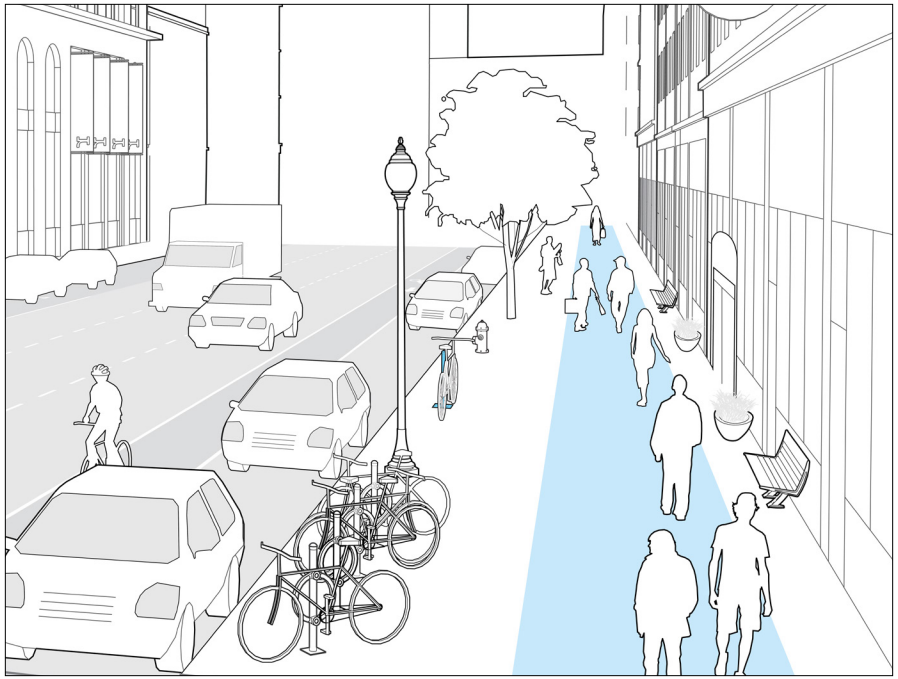
Sidewalks provide space along a street for pedestrian travel. For sidewalks to function, they must be kept clear of any obstacles and be wide enough to comfortably accommodate expected pedestrian volumes (as anticipated by density and adjacent land use), and different types of pedestrians, including those using mobility assistance devices, pushing strollers, or pulling carts.

BENEFITS

- Sidewalks make walking an easy choice between destinations since they create a network for pedestrian travel throughout the city.
- Sidewalks and their buffers provide space for utilities, signs, and amenities such as bus shelters or waiting areas, bicycle parking, public seating, public art, newspaper stands, trash and recycling receptacles, and greenscape elements.
- Sidewalks are not only used for transportation, but for social walking, exercise, lingering, commerce, recreation, and as public social space—all activities that contribute to a vibrant and lively street.
- Sidewalks make access to transit possible since the majority of transit users walk between their destination and transit stops.
- Sidewalks are a Proven Safety Countermeasure with a 65% to 89% reduction in crashes involving pedestrians walking along streets.[19]

TYPICAL APPLICATION

- Sidewalks should be present along all Milwaukee streets.
- The widths of sidewalks will vary based on context and expected pedestrian volumes. Widths may range from 5 feet along residential and industrial streets to 12 feet or wider downtown and in areas of high use.
- Sidewalks must include an accessible pathway that is free of obstructions, such as light poles, traffic signals, trees, utilities, and furniture. ADA guidelines allow a minimum accessible pathway of 4 feet where there are major constraints. The City of Milwaukee uses a minimum width of 5 feet for the accessible pathway.
- Sidewalks that are replaced for maintenance reasons should not be narrower than the sidewalk being replaced (e.g. a 6-foot wide sidewalk should not be replaced with a 5-foot wide sidewalk).



CONSIDERATIONS

- All new sidewalks and curb ramps shall comply with ADA regulations.
- Sidewalks should be clear of any obstructions including utilities, traffic control devices, trees, and furniture.
- The width and design of sidewalks will vary depending on street type, demand, and available right-of-way.
- Sidewalks should, as much as possible, follow the natural path of pedestrian travel parallel to the street. Crosswalks should be aligned with sidewalks to maintain the most direct path of travel.

Curb Extensions

DESCRIPTION

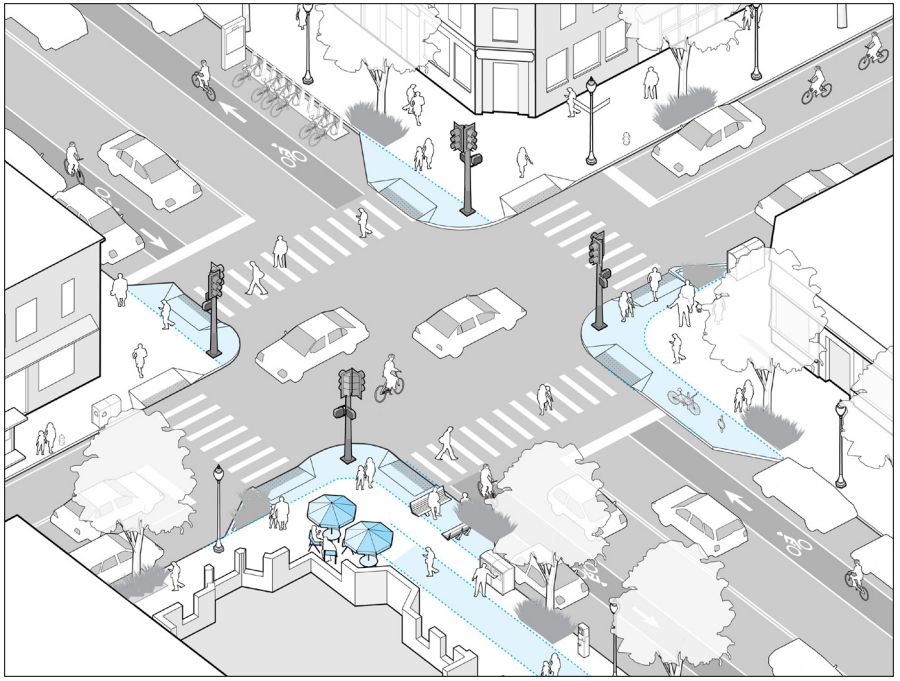
Curb extensions, also known as push-outs, bulb-outs, or bump-outs, are created by reducing the width of the street. This is done by extending the sidewalk at corners or mid-block. Curb extensions are intended to improve visibility, calm traffic, and provide extra space on sidewalks for walking and gathering. In addition to shortening crossing distances, curb extensions create more compact intersections, resulting in smaller corner radii and slower turns by people driving.

BENEFITS

- Provide additional space for pedestrians.
- Slow motorists by reducing the width of streets.
- Reduce the distance required for people to cross the street, resulting in less potential conflict with motorists.
- Slow the speed of motorists making turns at intersections.
- Create additional space for ADA compliant curb ramps.
- Provide opportunity to create accessible parking spaces.
- Improve visibility between pedestrians and other street users.
- Prevent people from parking too close to or on crosswalks.
- Create space for utilities, signs, and amenities such as bus shelters or waiting areas, bicycle parking, public seating, street vendors, and greenscape elements.
- Reduce crashes by up to 30%.[20]

TYPICAL APPLICATION

- Curb extensions should be considered only where parking is present or where other curbside uses like bike share stations and parklets already prevent anyone from using the space as a driving lane.
- Curb extensions are particularly valuable in locations with high volumes of pedestrian traffic, near schools, at unsignalized pedestrian crossings, or where there are demonstrated pedestrian safety issues.
- A typical curb extension extends about 6 feet from the curb, or no further into the street than the parking lane.
- The minimum width of a curb extension should match the existing NO PARKING requirements. The length of a curb extension can vary depending on the intended use (i.e., stormwater management, bus stop waiting areas, restricted parking).



- Bus bulbs are curb extensions that are lengthened to provide space for a transit stop.
- NO PARKING signs or yellow curb should be used to deter parking.
- Temporary curb extensions may be created using paint, flexible delineators, and other temporary materials to speed installation or as a pilot project before permanent construction.

CONSIDERATIONS

- Consider the turning needs of emergency and larger vehicles in curb extension design.
- Maintain direct routes across intersections by aligning pedestrian desire lines on either side of the sidewalk.
- Consider providing a 20-foot long curb extension to restrict parking within 20 feet of an intersection and enhance visibility.
- When curb extensions conflict with turning movements, reducing the width and/or length of the curb extension should be prioritized over elimination.
- Utilities or pedestrian amenities may need to be relocated.

Pedestrian Islands

DESCRIPTION

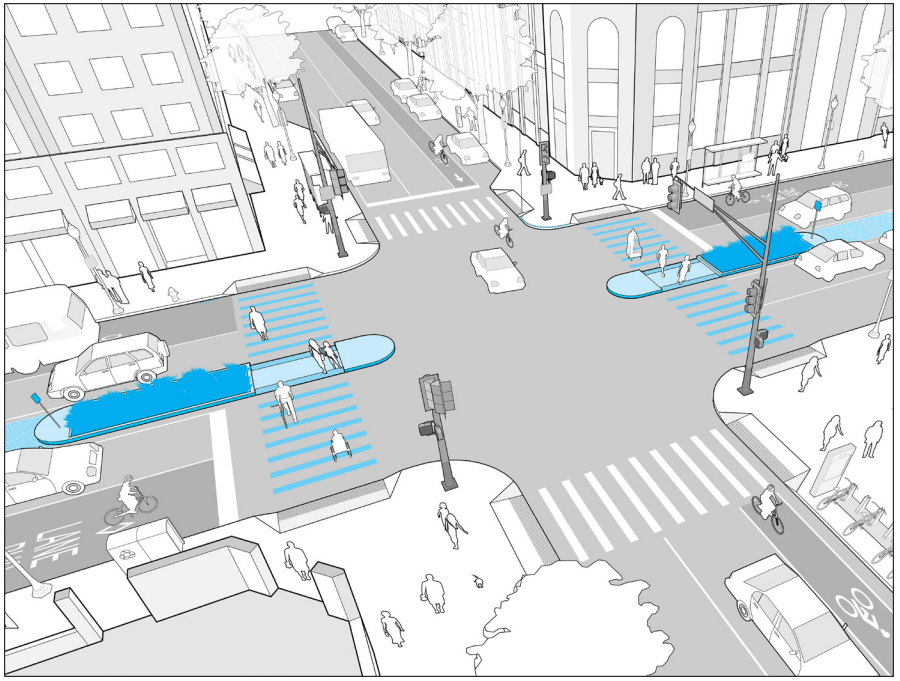
Pedestrian islands are raised medians placed in the middle of a street that provide a protected space for people trying to walk across the street. Pedestrian islands improve safety by reducing conflicts with motorists. They are particularly valuable when used at unsignalized crossings along multilane streets because they make it easier for pedestrians to find gaps in traffic and allow pedestrians to cross one direction of traffic at a time.

BENEFITS

- Allow pedestrians to cross only one direction of traffic at a time by enabling them to stop partway across the street and wait for an adequate gap in traffic before crossing the second half of the street.
- Provide space for trees and other landscaping that can help change the character of a street and reduce motorist speeds.
- Medians have benefits for motorist safety when they replace center turn lanes, as they eliminate mid-block left turning traffic.
- Are effective at reducing crashes at uncontrolled locations on busy multi-lane streets, particularly for slower pedestrians, such as people with disabilities, seniors, and children.
- Pedestrian islands are a Proven Safety Countermeasure with up to 56% pedestrian crash reduction.[21]

TYPICAL APPLICATION

- Pedestrian islands should include at-grade pedestrian cut-throughs as wide as the connecting crosswalks, detectable warnings, and gentle slopes to ensure proper drainage.
- Pedestrian islands should be at least 6 feet wide, and preferably at least 8 feet wide, to provide adequate refuge for pedestrians, especially those using mobility aids or devices, strollers, or bicycles.
- Pedestrian islands should extend beyond both sides of the crosswalk at intersections.
- Signalized intersections with pedestrian islands are generally designed to allow pedestrians to cross the entire street without stopping at the island.
- Temporary pedestrian islands may be created using paint, flexible delineators, and other temporary materials as a pilot project before permanent construction.



CONSIDERATIONS

- Pedestrian islands should be considered at locations on busy 2-lane streets and on any street with more than two lanes.
- If there is enough width, pedestrian islands and curb extensions can be used together to create a highly visible pedestrian crossing and calm traffic.
- Where possible, stormwater management techniques should be utilized on pedestrian islands with adequate space, as long as a clear path for pedestrians is maintained. Plantings should be short to maximize visibility, and ideally involve minimal maintenance.

Raised Crosswalks & Intersections

DESCRIPTION

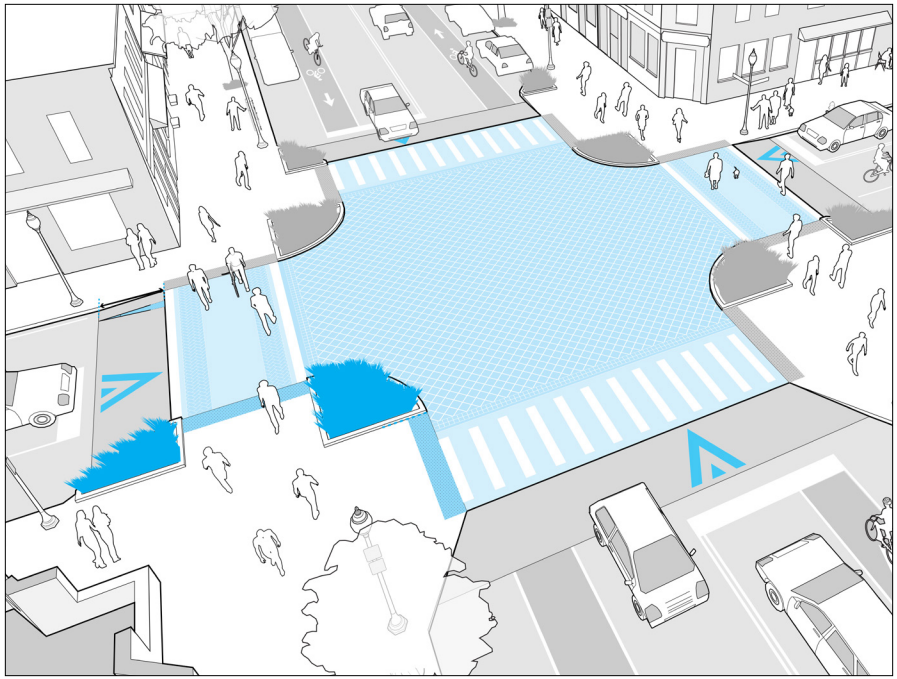
Raised crosswalks and intersections are created by raising the street to the same level as the sidewalk. These treatments provide many benefits, especially for people with mobility impairments, because there are no vertical transitions to navigate.

BENEFITS

- Encourage motorists to travel through crosswalks at safe speeds.
- Improve motorists' awareness by prioritizing pedestrian crossings and helping define locations where pedestrians are expected.
- Reduce turning speeds of motorists at intersections and driveways.
- Increase visibility between drivers and pedestrians by raising pedestrians in the motorists' field of view and giving pedestrians an elevated vantage point from which to look for oncoming traffic.
- Create pedestrian crossings which are more comfortable, convenient, and accessible since transitioning between the sidewalk and roadway does not require negotiating a curb ramp.
- Raised crosswalks may reduce fatal and injury crashes by up to 36%.[22]

TYPICAL APPLICATION

- Raised crosswalks and intersections are appropriate in areas with high pedestrian activity. They should also be considered at locations where poor pedestrian visibility and low motorist yielding have been identified.
- Raised crosswalks can be provided along side streets of major thoroughfares to slow traffic exiting the main street and make crossings more visible to drivers.
- Raised crosswalks should include pavement markings for motorists and appropriate signage at crosswalks, per the MUTCD.
- High-visibility or textured paving materials can be used to enhance the contrast between the raised crossing or intersection and the surrounding street.
- Raised crosswalks and intersections require detectable warnings at the curb line for people who are blind or have low vision.
- Raised crosswalks and intersections can be useful in placemaking where slow traffic speeds and decorative treatments are desirable.



CONSIDERATIONS

- Care should be taken to maintain direct routes across intersections where pedestrians are most likely to walk.
- Raised crosswalks are particularly valuable at unsignalized mid-block locations, where drivers are less likely to expect or yield to pedestrians.
- Design speeds and emergency vehicle routes must be considered when designing raised crosswalks and intersections; these treatments may not be appropriate for high-speed streets.
- Installation of raised crosswalks and intersections may affect snow removal operations. Snow plow operators should be adequately warned and trained.
- Raised intersections and crosswalks can be used as gateway treatments to signal to drivers when there are transitions to a slower speed, pedestrian-oriented environment.
- Designs should ensure proper drainage.

Right-Turn Lane Redesigns

DESCRIPTION

The design of right-turn lanes at intersections must consider the needs of pedestrians. Exclusive right-turn lanes might be desirable at busy intersections, but the design and control of these can have a significant impact on safety for pedestrians. Intersections with right-turns slip lanes (see illustration) are almost always candidates for redesign in urban areas.

Opportunities for the redesign of right turns include modifying traffic controls, reducing the turning radius of corners, and eliminating right turn slip lanes. When slip lanes are eliminated, they reduce the overall crossing distance for pedestrians and slow the speeds of turning traffic which in turn improve pedestrian safety.

BENEFITS

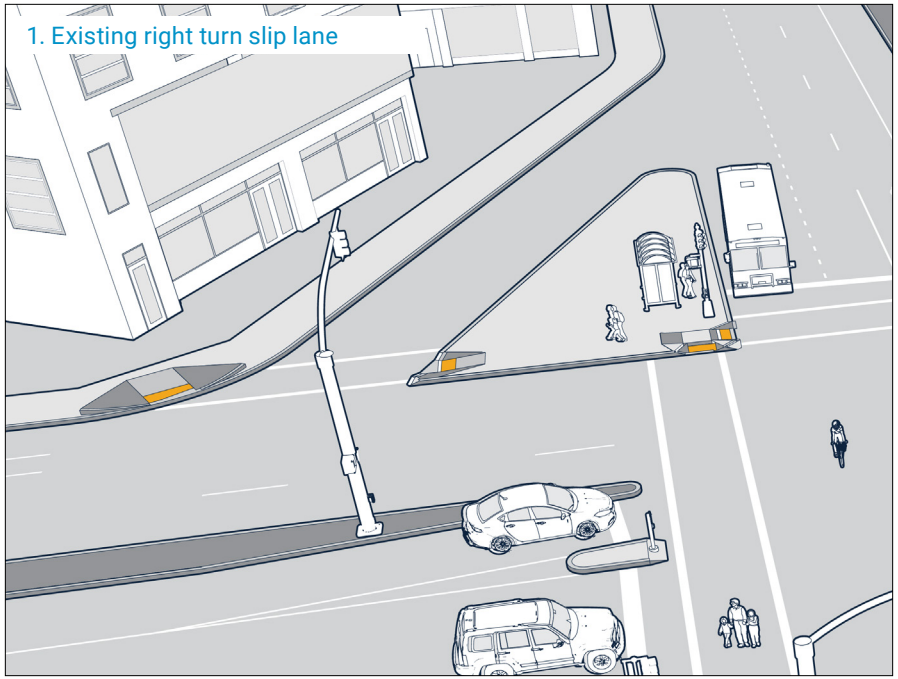
- Slower motorist turning speeds.
- Improved visibility of pedestrians and clearer sight lines for motorists.
- Reduced crossing distance and pedestrian exposure to motorists.
- Opportunity to incorporate streetscape elements.

TYPICAL APPLICATION

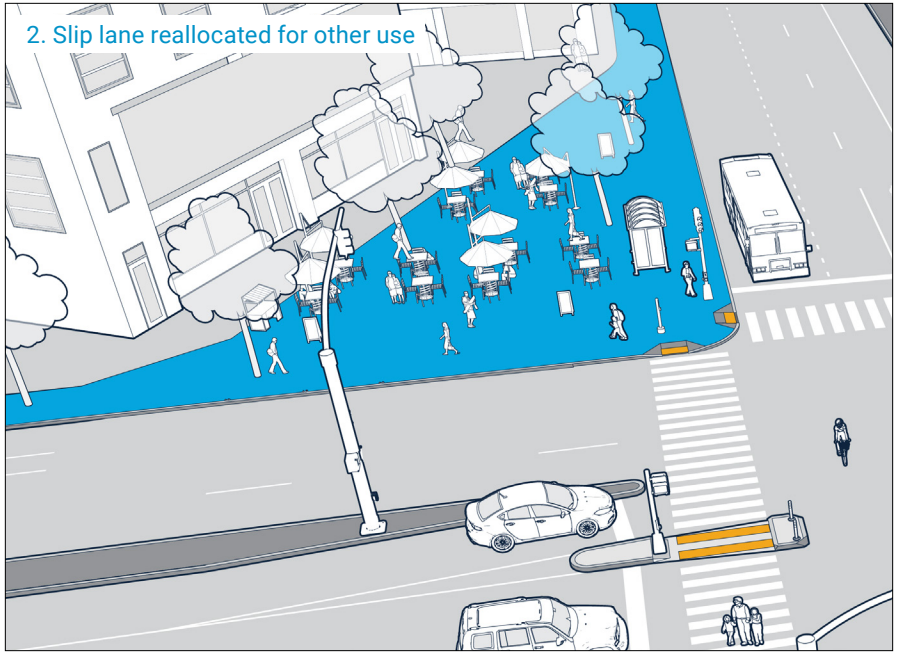
- Redesign should be considered at all locations with right-turn slip lanes and other locations with a high number of crashes involving turning motorists.
- Slip lanes may be redesigned using rapid implementation treatments that allow evaluation of the redesign in a low-cost, temporary manner.
- Where slip lanes cannot be removed, crosswalks should be relocated for maximum visibility to a spot where the driver is looking ahead, at least one car length back from the intersecting street. Crosswalks should also be oriented at a 90 degree angle to the right turn lane to improve sight lines and reduce crossing distance. Raised crosswalks may be used to improve yield compliance at the pedestrian crossing where slip lanes are used.

CONSIDERATIONS

- Elimination of right-turn slip lanes should result in a corner radius of less than 40 feet.
- To accommodate large vehicle turning movements, painted buffers or truck aprons may be used.



1. Existing right turn slip lane



2. Slip lane reallocated for other use

Lane Widths

DESCRIPTION

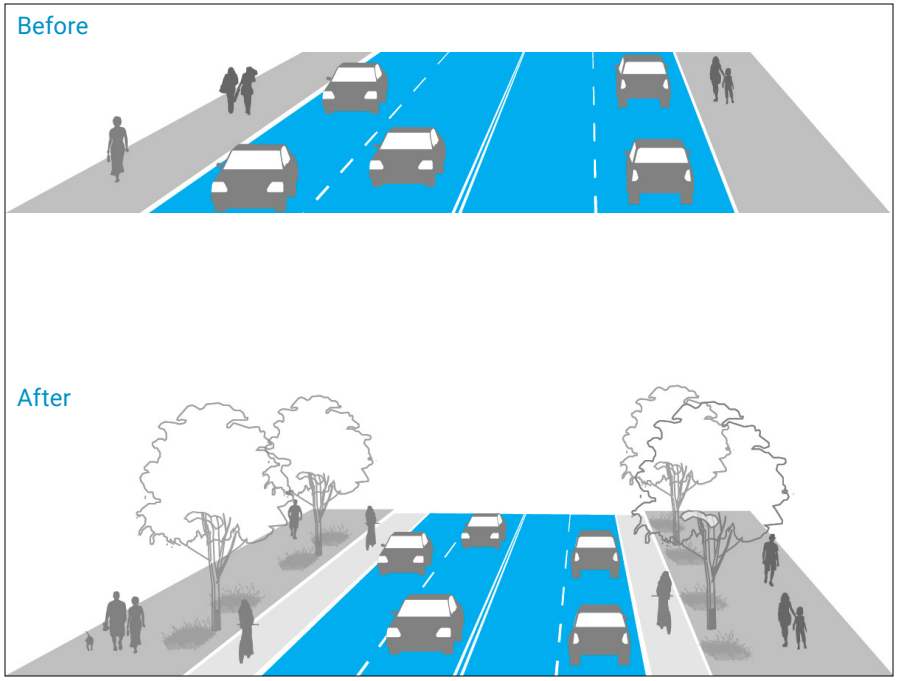
Narrowing lanes slows traffic and creates space that can be reallocated to other modes, in the form of wider sidewalks, bike lanes, and improved transit accommodations.

BENEFITS

- Provide space for features such as curb extensions and pedestrian islands that shorten crossing distances and improve pedestrian safety.
- Reduce speeding.
- Shorten the distance that a pedestrian needs to cross lanes of active traffic.
- Create opportunities to reallocate underused street space for other uses such as pedestrian islands, turn lanes, bike lanes, etc.
- Provide a positive impact on the safety of a street without impacting traffic operations.
- Narrowing motor vehicle lanes does not increase crash frequencies under most urban and suburban conditions.[23]

TYPICAL APPLICATION

- Lane narrowing candidates include streets with travel lanes that are more than 10 feet wide, streets with parking lanes that are more than 7 feet wide, and streets with wide center turn lanes.
- Lane widths of 10 feet are appropriate on most Milwaukee streets; for designated truck or transit routes, one travel lane of 11 feet may be used in each direction.
- Lane narrowing can be implemented when a street is being resurfaced or reconstructed, or as a standalone marking and signing project.



CONSIDERATIONS

- Excess space on a street should be allocated to bike lanes, bike lane buffers, or parking lanes before travel lanes.
- On streets with on-street parking and bicycle lanes, it is advantageous to provide a buffer between the parking lane and the bike lane, particularly in areas with high parking turnover, to reduce the likelihood that a person opening their car door will strike a person riding their bike.

Road Diets

DESCRIPTION

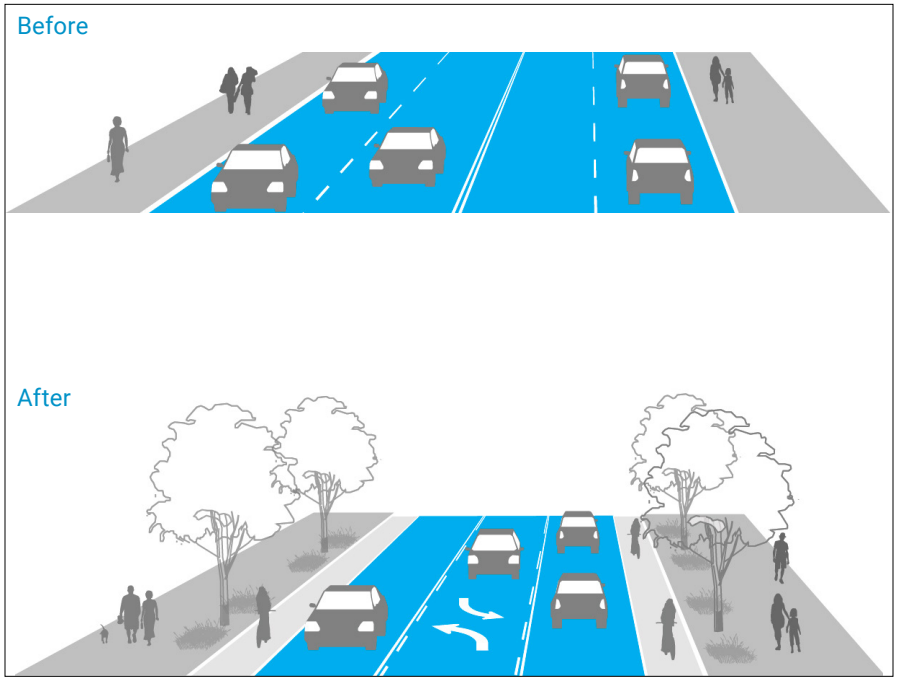
Road diets, also known as lane reconfiguration or right-sizing streets, repurpose travel lanes to provide more space for people walking, biking, and using transit. Road diets are typically done on streets where traffic volumes do not support the need for additional motor vehicle lanes.

BENEFITS

- Provide space for features such as curb extensions and pedestrian islands that shorten crossing distances and improve pedestrian safety.
- Better organize movements and operations along and across the street.
- Eliminate or reduce the risk of multiple threat crashes where a motorist in one lane stops while the motorist in the adjacent lane continues to move and hits another street user.
- Provide turn lanes to reduce conflicts between street users.
- Reduce the severity and frequency of rear-end and right-angle crashes between motorists.
- Reduce speeding.
- Make it easier for pedestrians to cross the street by shortening crossing distances and reducing exposure to motorists.
- Create opportunities to reallocate underused street space for other uses such as pedestrian islands, turn lanes, bike lanes, etc.
- Road diets are a Proven Safety Countermeasure with an overall crash reduction factor of 19% to 47% for all modes.[24]

TYPICAL APPLICATION

- Road diet candidates include four-lane undivided roadways, which can be converted to a three-lane cross section (one lane in each direction with a center turn lane or center median), and multi-lane streets with extra capacity where one or more lanes can be removed.
- Road diets can be implemented when a street is being resurfaced or reconstructed, or as a standalone marking and signing project.



CONSIDERATIONS

- Outreach should be conducted to determine if a candidate street is meeting the needs of the community.
- A traffic study may be necessary to determine if high-traffic streets are candidates for removing one or more parking or travel lanes.
- Retaining or adding turn lanes at intersections and adjusting signal timing can reduce delays for people driving.
- Excess space on a street should be allocated to bike lanes, bike lane buffers, or parking lanes before travel lanes.
- On streets with on-street parking and bicycle lanes, it is advantageous to provide a buffer between the parking lane and the bike lane, particularly in areas with high parking turnover, to reduce the likelihood that a person opening their car door will strike a person riding their bike.

Marked Crosswalks

DESCRIPTION

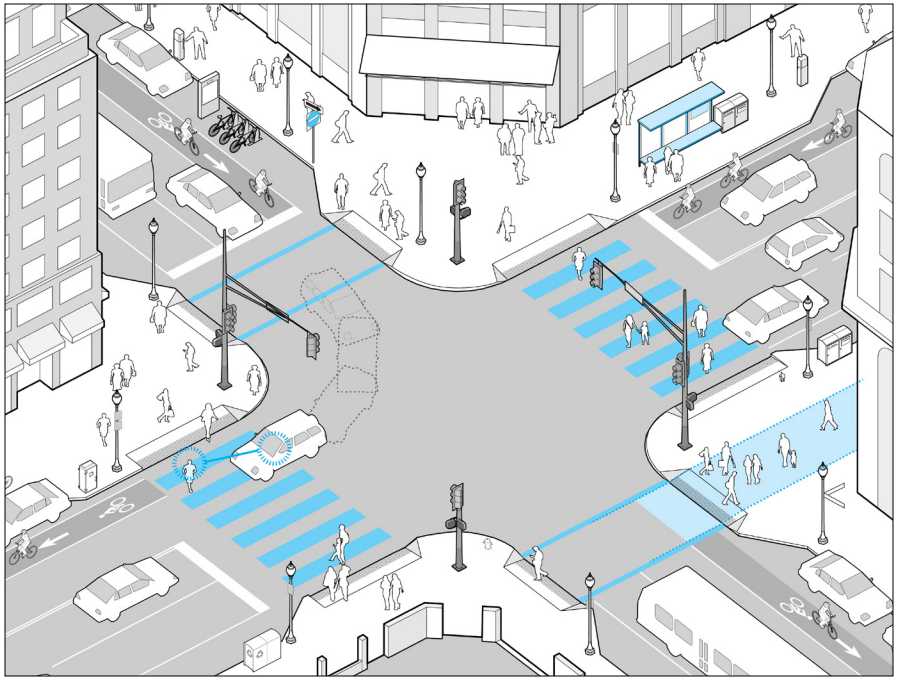
Legal crosswalks exist at all locations where sidewalks meet the street, regardless of whether a crosswalk is marked or not. Drivers are legally required to yield to pedestrians at intersections with crosswalks, even where there is no marked crosswalk. Providing marked crosswalks communicates to drivers that pedestrians may be present and helps guide pedestrians to locations where it is best to cross the street.

BENEFITS

- Enhance the visibility of crossing locations.
- Encourage people to use most comfortable and visible crossing locations.
- Guide the path of pedestrian travel.
- High visibility crosswalks may provide up to 48% reduction in pedestrian crashes.[25]

TYPICAL APPLICATION

- Marked crosswalks should be at least 8 feet wide or the width of the approaching sidewalk, whichever is greater. In areas of heavy pedestrian volumes, crosswalks can be up to 25 feet wide.
- Crosswalks should provide a slip-resistant, level, and accessible surface, and should not include stamped pavements or pavers. If a decorative treatment is desired, stamped pavements or pavers may be used in the intersection itself.
- Crosswalks should directly connect the approaching sidewalks and should be located to maximize the visibility of pedestrians.
- Perpendicular crosswalks minimize crossing distances and therefore limit pedestrian exposure to motorists.
- Continental crosswalk bars should be installed parallel to the direction of traffic.
- ADA-compliant curb ramps should align directly with the crosswalk. The bottom of the ramp should lie within the crosswalk.
- Stop lines at stop-controlled and signalized intersections should be located at least 8 feet in advance of crosswalks.
- New marked crosswalks on streets with multiple lanes in each direction, higher speeds, or higher volumes should include additional treatments such as raised crossings, Rectangular Rapid Flashing Beacons, or Pedestrian Hybrid Beacons to create an enhanced crossing.



CONSIDERATIONS

Continental crosswalks (wide bars parallel to the direction of travel, as shown for the left and right crosswalks in illustration) are more visible to drivers than standard crosswalks. Continental crosswalks should be used at:

- Midblock crossings;
- Unsignalized intersections adjacent to schools and parks;
- Unsignalized crossings of arterial and collector streets near major pedestrian generators;
- Signalized intersections near a major pedestrian generator; and
- Signalized intersections with a history of pedestrian crashes.

In all other controlled locations, transverse style crosswalks may be considered.

Crosswalk markings should consist of non-skid, retroreflective material. On new pavement, markings should be embedded into the pavement when possible so that the surface of the marking is flush with the pavement to reduce maintenance needs and provide a smooth, accessible surface.

Yield to Pedestrian Signs

DESCRIPTION

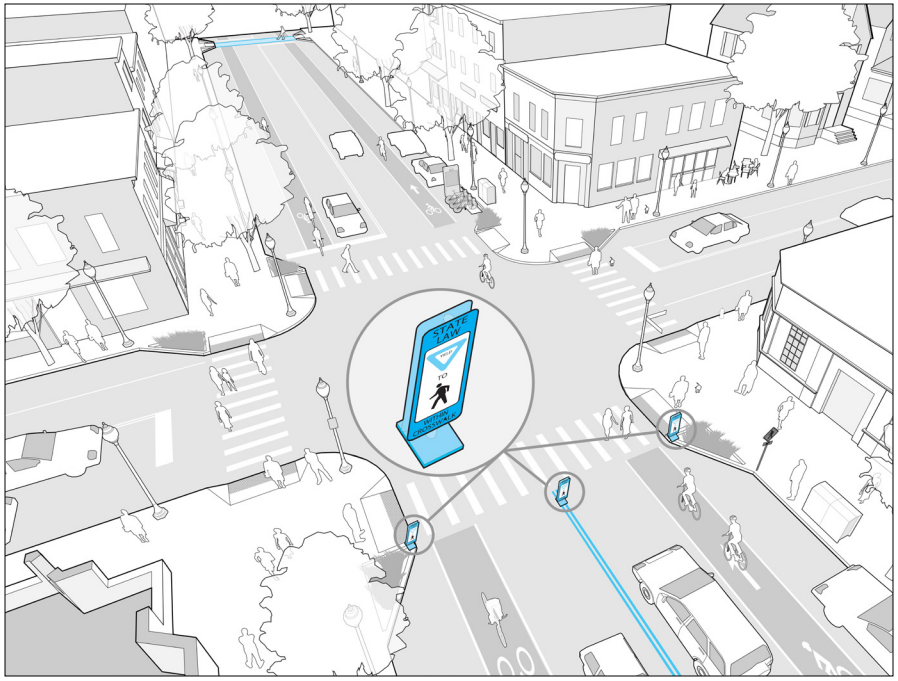
In-street **YIELD TO PEDESTRIAN** signs (MUTCD R1-6) are placed in the street at crosswalks to remind motorists to comply with the state law requiring they yield to pedestrians in crosswalks. They also increase awareness and visibility of pedestrian crossings. They are often used in commercial districts; school crossings; locations with children, seniors, or persons with disabilities; or where high pedestrian volumes occur. In-street signs can be used in conjunction with advanced warning signs and pedestrian crossing signs at crosswalks.

BENEFITS

- Can improve yielding behavior of motorists to pedestrians.
- Improve visibility of pedestrian crosswalks.
- May reduce motorist speeds.
- Increase motorist compliance with pedestrian laws.
- **YIELD TO PEDESTRIAN** signs deployed in a gateway configuration have been shown to increase motorist yielding to pedestrians from less than 10 percent to over 90 percent, and to decrease traffic speeds between 4 and 10 miles per hour.[26]

TYPICAL APPLICATION

- In-street **YIELD TO PEDESTRIAN** signs shall only be used at uncontrolled intersections or midblock locations.
- In-street **YIELD TO PEDESTRIAN** signs should be placed at the crosswalk on the center line or on a median island, but they should not obstruct the crosswalk. In-street signs should also be placed outside the path of turning motorists, and should be installed on a flexible delineator to ensure they bounce back if struck.
- In-street **YIELD TO PEDESTRIAN** signs work best on two lane streets with speed limits of 35 miles per hour or less.
- **YIELD TO PEDESTRIAN** signs are most effective when deployed in a "gateway" configuration with signs installed at both ends of the crosswalk and between travel lanes (see illustration).
- **YIELD TO PEDESTRIAN** signs may also be placed above the street; this position avoids the risk of signs being struck by motorists.
- **YIELD TO PEDESTRIAN** signs should be installed 1.5 to 50 feet in advance of the crosswalk; no portion of the sign should be in the crosswalk.[27]



CONSIDERATIONS

In-street signs:

- May be permanent or temporary. It may be preferable to remove them during winter for snow removal operations.
- Require regular monitoring and should be replaced when damaged.
- Are typically not used at yield-controlled intersections.
- May be used in combination with pedestrian warning signs placed on the right side of the street, on the sidewalk, or mounted on a mast arm above the crosswalk.

Speed Feedback Signs

DESCRIPTION

Speed feedback signs provide a dynamic message to drivers exceeding a specified speed threshold. The signs alert motorists of their current speed or display a message to slow down to encourage speed limit compliance. Speed feedback signs should be used in areas with high volumes of pedestrians and areas where the speed limit is reduced. Speed feedback signs can be mounted to an existing pole or portable (mounted on a trailer).

BENEFITS

- Display targeted messages to drivers who are speeding.
- Moderately reduce motorist speeds including speeds that far exceed the posted speeds.
- Reduce crashes in select applications.
- Studies demonstrate speeds are reduced 1.5 to 5 miles per hour on average, with a greater effectiveness in reducing very high speeds.[28]

TYPICAL APPLICATION

Speed feedback signs are best deployed:

- At speed zone transitions, to reaffirm the change in posted speeds;
- In advance of key pedestrian crossings or where high motorist speeds make it difficult for pedestrians to cross the street;
- In school zones; and
- In work zones.

Signs should be installed in conjunction with a **SPEED LIMIT** sign.

When signs are deployed on a portable trailer, care should be taken to ensure that the signs do not interfere with people walking, biking, or driving.

Signs may display **SLOW DOWN** instead of the actual measured speed for motorists traveling more than 15 miles per hour over the posted speed limit (to discourage reckless motorists from seeing how high a speed they can record).

CONSIDERATIONS

- Studies have indicated that speed feedback signs may be most effective in reducing high speeds.
- Deploy portable speed signs in conjunction with high-visibility enforcement events conducted by the police department.
- May not have a continuous speed-reducing impact once motorists have passed the sign.

Leading Pedestrian Intervals

DESCRIPTION

Leading Pedestrian Intervals (LPI) initiate the pedestrian WALK signal three to seven seconds before motorists traveling in the same direction are given the green indication. This allows pedestrians to enter the intersection prior to turning motorists, increasing visibility between all modes. LPIs give pedestrians a head start to establish themselves in the intersection before the green phase. LPIs especially benefit slower pedestrians, including people with disabilities, seniors, and children.

BENEFITS

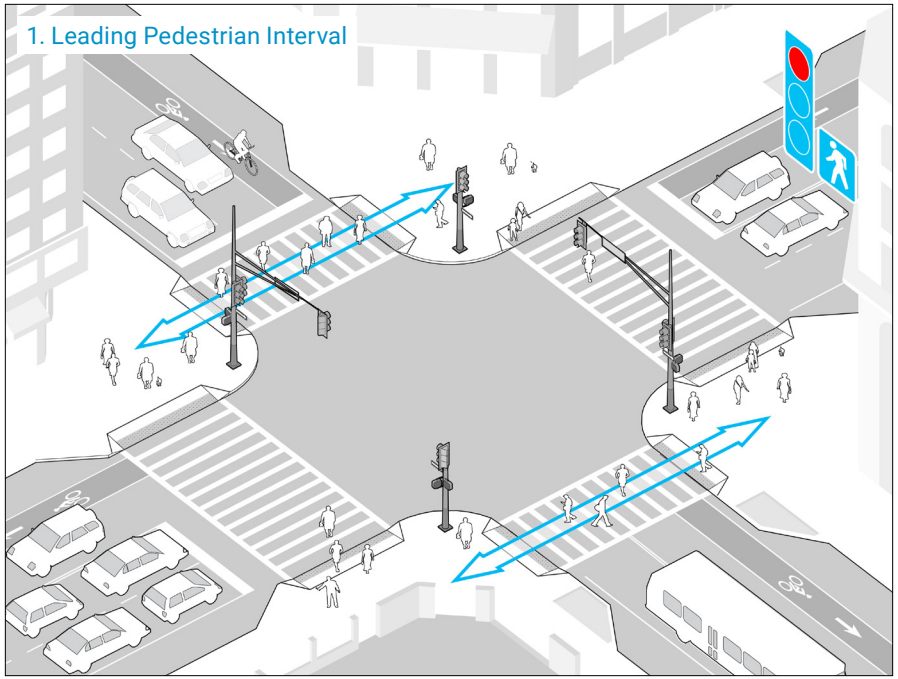
- Prioritize pedestrian safety and convenience at intersections.
- Increase visibility of crossing pedestrians.
- Reduce conflicts between pedestrians and motorists.
- Increase compliance of motorists yielding to pedestrians.
- Enhance safety for pedestrians who need more time to cross the intersection
- Leading Pedestrian Intervals are a Proven Safety Countermeasure with up to 60% pedestrian crash reduction.[29]

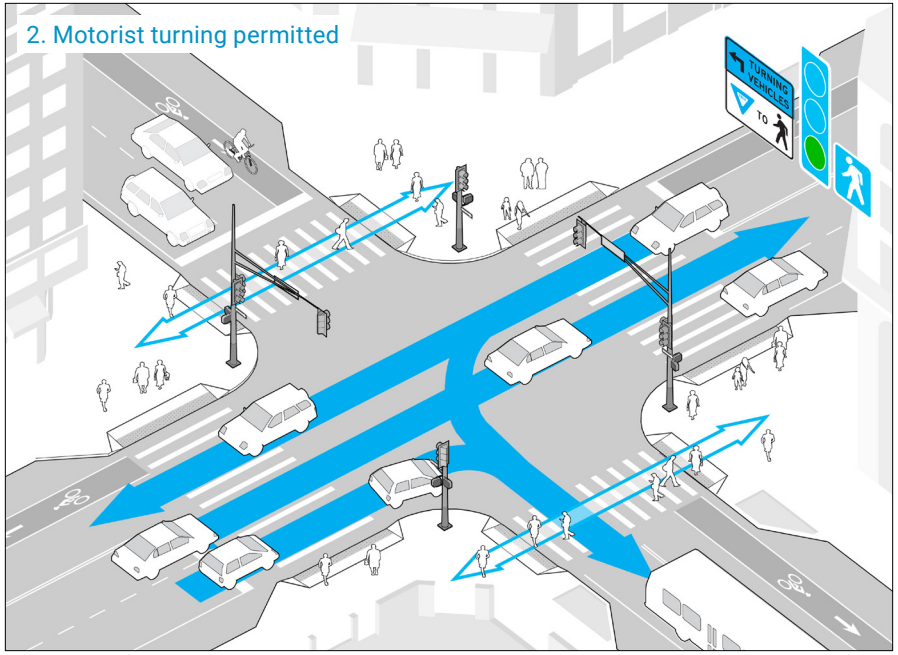
TYPICAL APPLICATION

- Used at intersections with high volumes of pedestrians and conflicting motorist turning movements.
- Locations with seniors or school children who tend to walk slower.
- When needed, a left turn arrow shall be provided after the through green signal at locations with a LPI.

CONSIDERATIONS

- **NO TURN ON RED** signs should be considered with LPIs.
- Concurrent pedestrian phasing should appropriately match the motorist signal phasing.





Accessible Pedestrian Signals

DESCRIPTION

Accessible pedestrian signals (APS) and accessible detectors are devices that communicate information in non-visual formats about the pedestrian crossing to people with visual and/or hearing disabilities. APS and detectors may include features such as audible tones, speech messages, detectable arrow indications, and/or vibrating surfaces.

BENEFITS

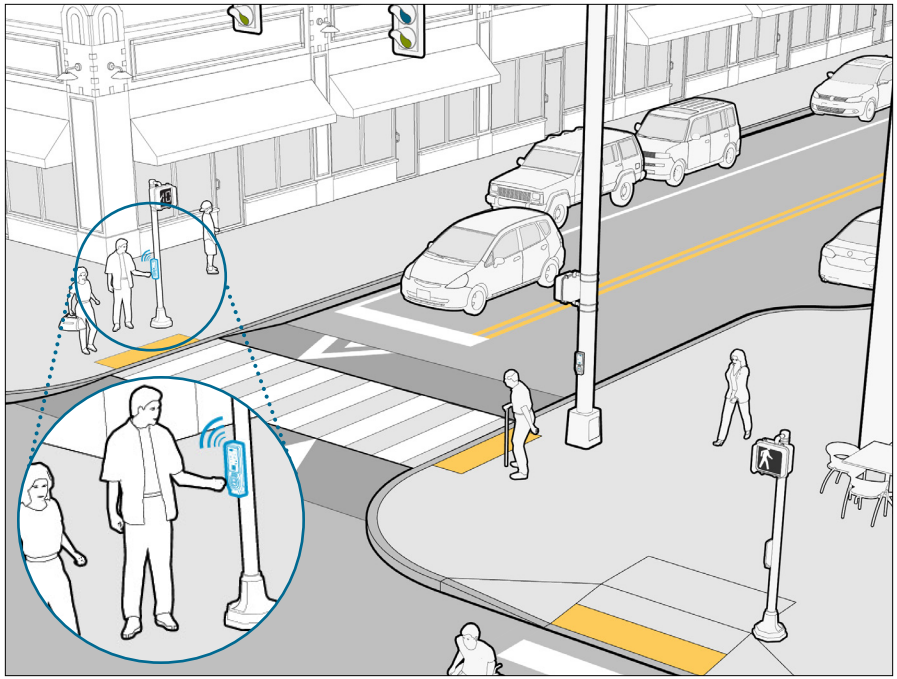
Provide people with vision and/or hearing disabilities information about:

- Location of pushbuttons, if used;
- Beginning of WALK interval;
- Direction of crosswalk;
- Location of destination sidewalk;
- Intersection street name in Braille or raised print;
- Intersection signalization with speech messages; and
- Intersection geometry through detectable maps or diagrams, or through speech messages.

Improve safety for pedestrians with vision and/or hearing disabilities.

TYPICAL APPLICATION

- When used, two pedestrian pushbuttons should be provided on each corner per the MUTCD. Pushbuttons should be separated by 10 feet and located between 1.5 and 6 feet from the edge of curb.
- Audible tones can be set as high as 100 decibels, although most installations do not need to be set this high. Audible tone volumes should be set based on ambient noise levels at each location.
- At locations where the pedestrian WALK signal automatically displays during every signal cycle, accessible push buttons are only used to initiate the accessible features, not the WALK signal.



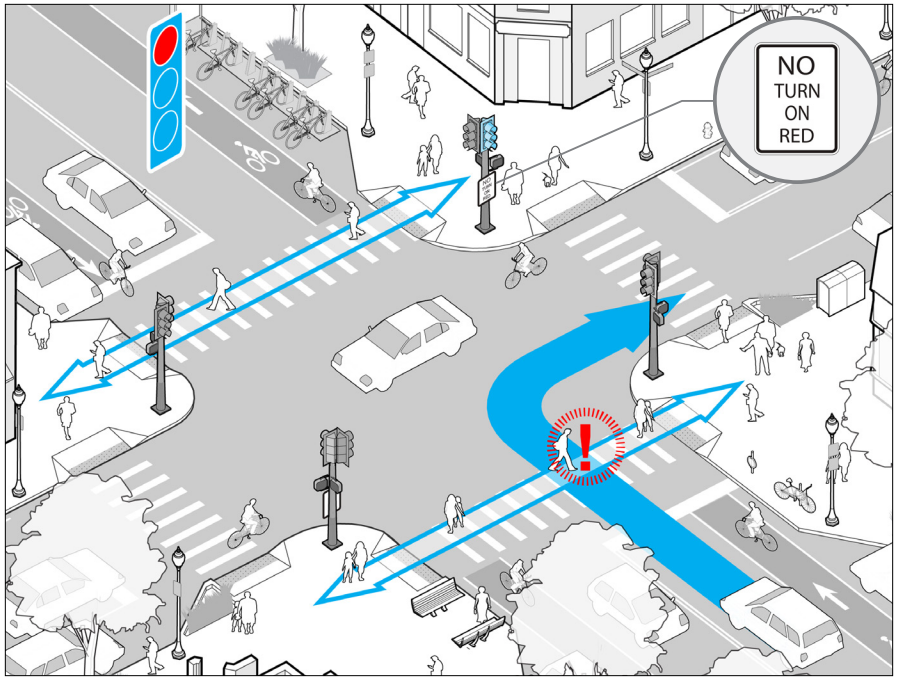
CONSIDERATIONS

- Audible walk indications should have the same duration as the pedestrian walk indication or should be provided in the first 7 seconds of the walk interval, whichever is shorter.
- For detailed information on accessible signals and pushbuttons, please refer to the United States Access Board's website.

Right Turn on Red Restrictions

DESCRIPTION

Right turn on red restrictions prevent motorists from turning right (or left on intersecting one-way streets) while the traffic signal is red. Restricting this movement eliminates conflicts with pedestrians crossing in front of turning motorists.



BENEFITS

- Reduce conflicts between motorists and pedestrians.
- Prioritize pedestrian safety and convenience at intersections.
- Right turn on red restrictions can significantly increase the portion of motorists who stop at marked stop lines and decrease the number of motorists who turn right on red without stopping.[30]

TYPICAL APPLICATION

Right turn on red restrictions should be considered when one or more of the following conditions apply:

- An exclusive pedestrian phase;
- An LPI;
- High volumes of pedestrians
- Where bicycle two-stage turn queue boxes are installed;
- Poor sight distances and visibility;
- Locations where poor intersection geometry causes unexpected conflicts; or
- Locations with a reported crash history.

CONSIDERATIONS

- Should be implemented all hours of the day, but can be considered by time of day in some circumstances.
- Can be used in conjunction with LPIs or bicycle signals that allow through movements when turning vehicular traffic is stopped.

Protected Left Turns

DESCRIPTION

A protected left turn provides a green arrow for left turning motorists while stopping both on-coming traffic and pedestrians to eliminate conflicts. A lagging left turn is a protected left turn in which the left-turn arrow displays at the end of a green phase after motorists traveling straight have passed through the intersection. Lagging left turns allow pedestrians to cross the intersection at the beginning of a signal cycle, reducing conflicts between pedestrians and motorists.

BENEFITS

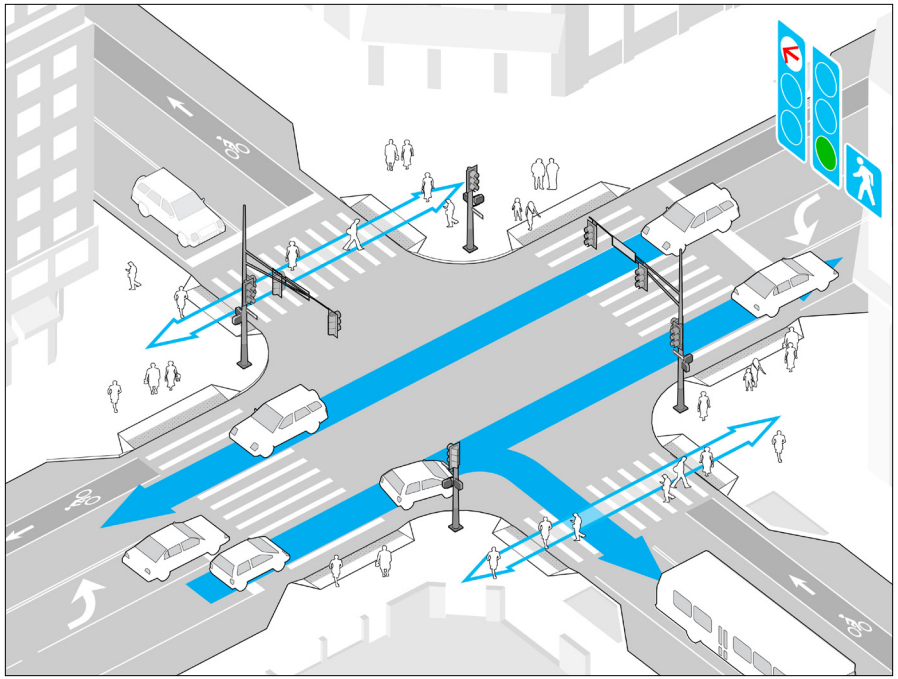
- Reduce conflicts between pedestrians and turning motorists by allowing pedestrians to cross the street separately from left-turning motorists.
- Reduce motorist-motorist collisions.
- Reduce all left-turn crashes up to 99%.[31]

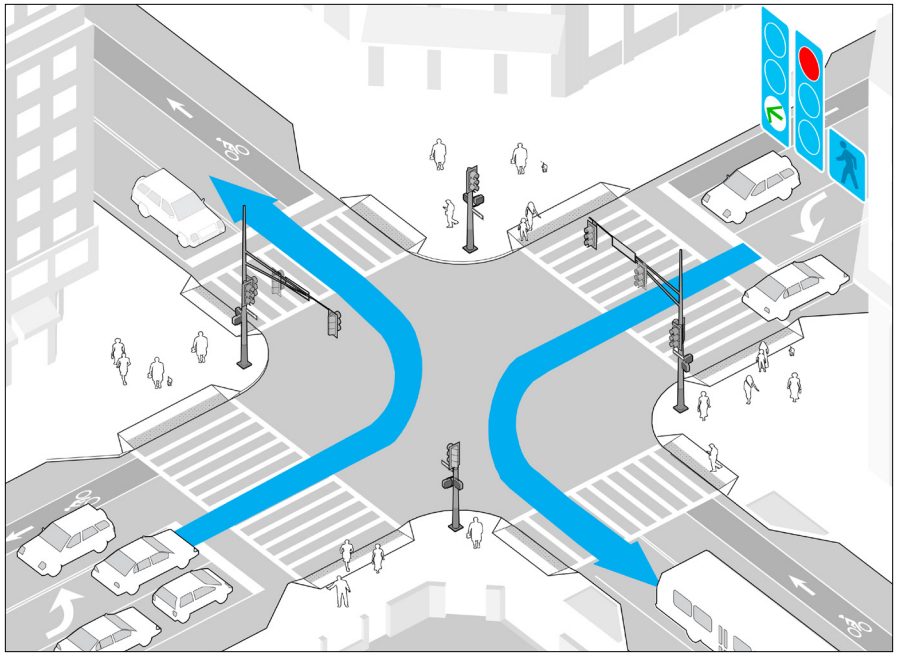
TYPICAL APPLICATION

- Protected left turns should be used where there are conflicts between left turning motorists, opposing traffic, and people walking.
- Use should be considered at intersections with visibility concerns.

CONSIDERATIONS

- Dedicated left turn lanes shall be installed in conjunction with protected left turn arrows.





Pedestrian Beacons

DESCRIPTION

At some unsignalized crossings, particularly those with four or more lanes, it can be very challenging for pedestrians to cross the street. At these locations pedestrian-activated beacons may assist pedestrians crossing the street.

Rectangular Rapid Flash Beacons (RRFBs) are LEDs that supplement pedestrian warning signs at unsignalized intersections or mid-block crosswalks. They are activated by pedestrians manually by a push button or passively by a pedestrian detection system. RRFBs use an irregular flash pattern that is similar to emergency flashers on police vehicles. RRFBs may be installed on either two-lane or multi-lane streets.

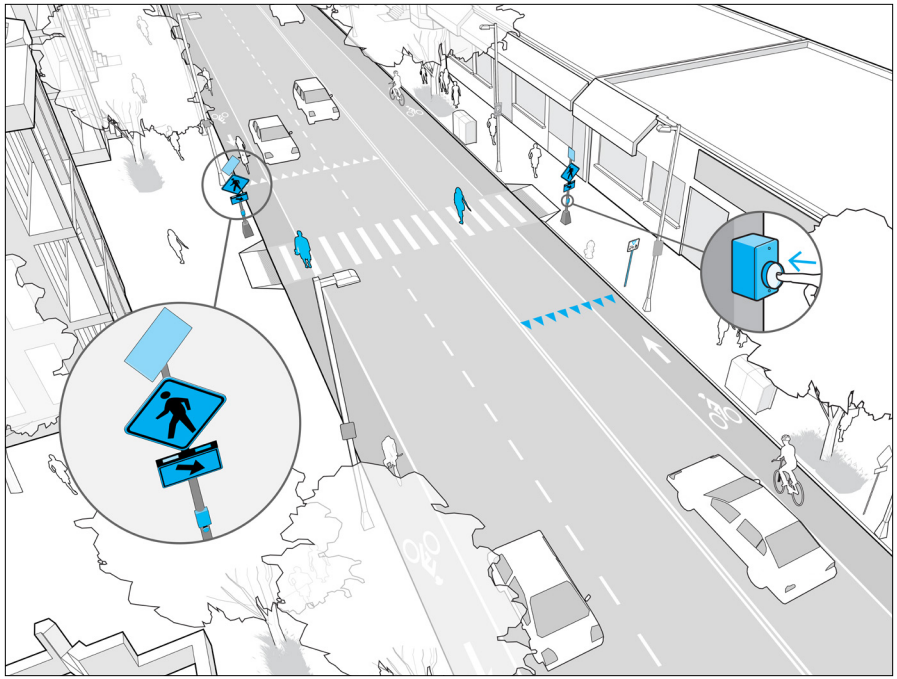
Pedestrian hybrid beacons (PHB) help pedestrians safely cross busy or higher-speed streets at midblock crossings and uncontrolled intersections. The beacon head consists of two red lights above a single yellow light. The lights remain "dark" until a pedestrian wanting to cross the street pushes the call button to activate the beacon. The signal then initiates a yellow to red lighting sequence consisting of steady and flashing lights that directs motorists to slow and come to a stop. The pedestrian signal then flashes a WALK display to the pedestrian. Once the pedestrian has safely crossed, the hybrid beacon again goes dark after going through an alternating flashing sequence.

BENEFITS

- Increased yielding behavior by motorists at pedestrian crossings.
- Requirements to install PHBs are less than for full traffic signals.
- RRFBs may reduce pedestrian crashes up to 47 percent.[32]
- Pedestrian hybrid beacons are a Proven Safety Countermeasure with up to 69% pedestrian crash reduction.[33]

TYPICAL APPLICATION

- RRFBs can be used when a signal is not warranted at an unsignalized crossing.
- RRFBs are installed on both sides of the street at the edge of the crosswalk. If there is a pedestrian refuge or other type of median, an additional beacon should be installed in the median.
- PHBs are an interim option between a flashing beacon and a full signal.
- RRFBs and PHBs are not appropriate at intersections with signals or STOP signs.



CONSIDERATIONS

- RRFBs are considerably less expensive to install than mast-arm mounted signals. They can also be installed with solar-power panels to eliminate the need for a power source.
- RRFBs should be limited to locations with safety concerns, and should not be installed in locations with sight distance constraints that limit the driver's ability to view pedestrians on the approach to the crosswalk.
- RRFBs should be used in conjunction with advance yield pavement marking and signs.
- PHBs are not widely implemented, so agencies should consider an education and outreach effort when implementing a PHB within a community.

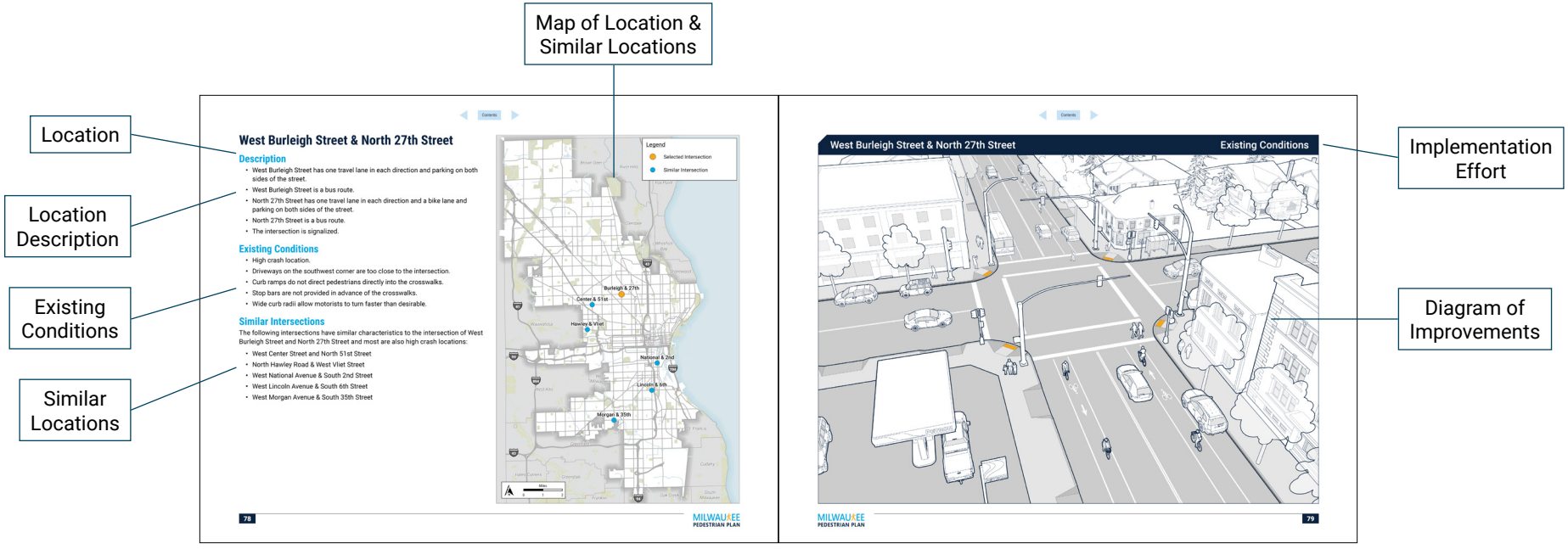
Using the Tools

The following pages apply many of the treatments detailed in this toolbox to actual locations in Milwaukee. The example locations were selected because they are high crash locations and represent common intersection types seen throughout Milwaukee. Each example location includes an illustration of the existing conditions and illustrations of potential short- and long-term improvements. The illustrations are not necessarily recommendations for that specific location. Each location also includes a map displaying similar locations throughout Milwaukee, although not all similar intersections are included.

Implementation

Low-Effort: Actions can be carried out at relatively low cost and with minimal infrastructure work; actions typically are limited to markings and signs.

High-Effort: Actions involve infrastructure work that is most efficiently implemented as part of a street resurfacing or reconstruction.



West Burleigh Street & North 27th Street

Description

- West Burleigh Street has one travel lane in each direction and parking on both sides of the street.
- West Burleigh Street is a bus route.
- North 27th Street has one travel lane in each direction and a bike lane and parking on both sides of the street.
- North 27th Street is a bus route.
- The intersection is signalized.

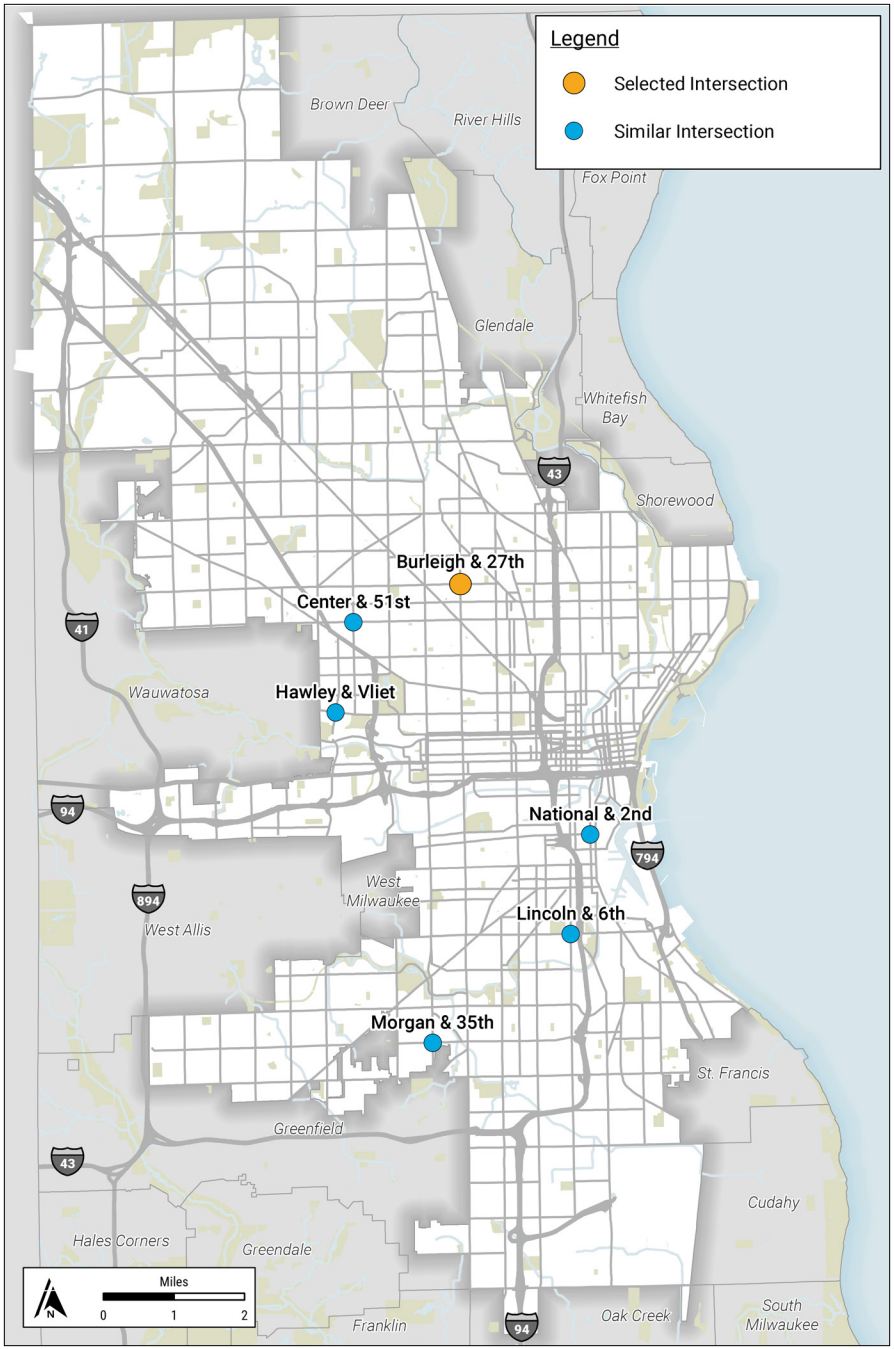
Existing Conditions

- High crash location.
- Driveways on the southwest corner are too close to the intersection.
- Curb ramps do not direct pedestrians directly into the crosswalks.
- Stop bars are not provided in advance of the crosswalks.
- Wide curb radii allow motorists to turn faster than desirable.

Similar Intersections

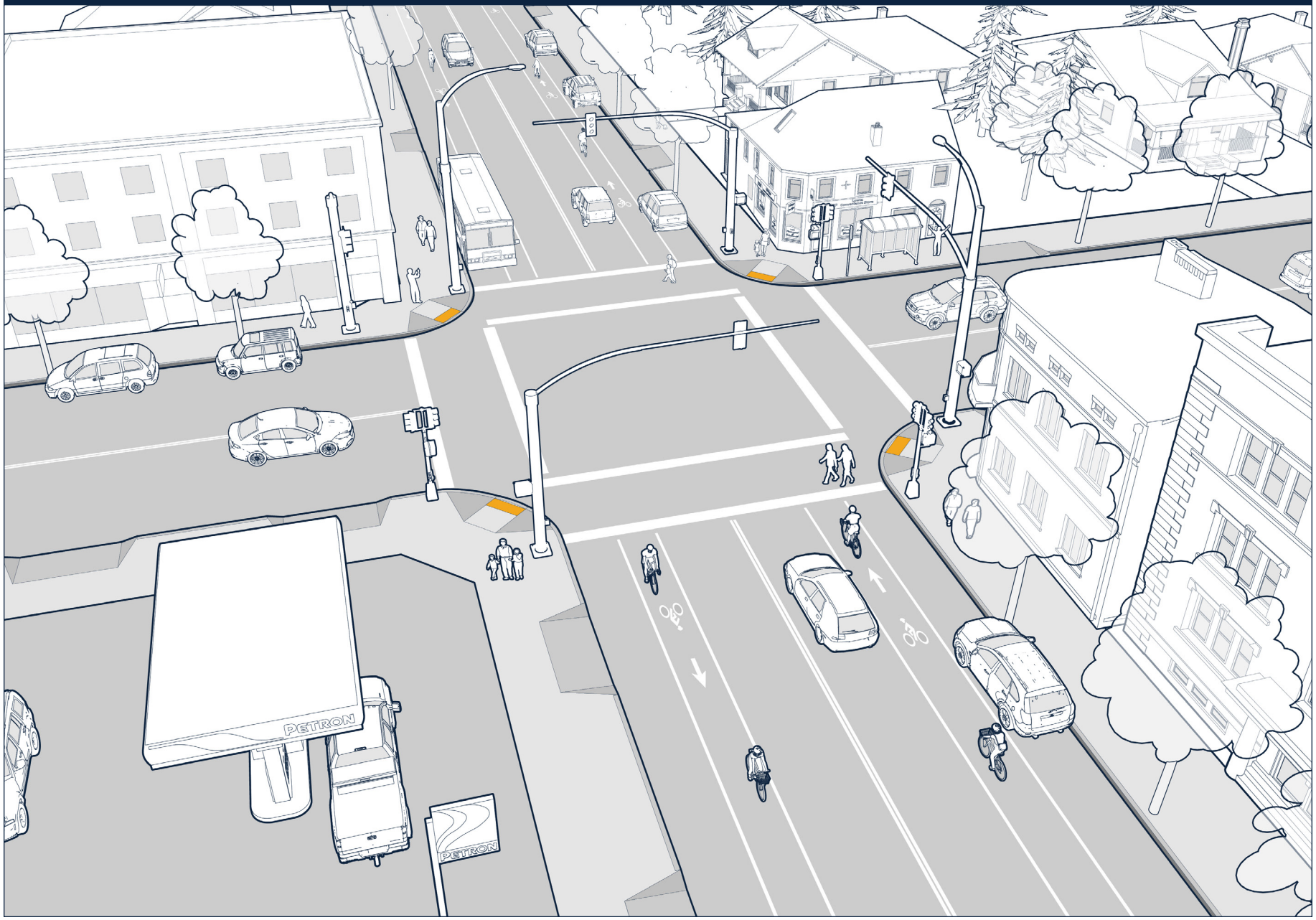
The following intersections have similar characteristics to the intersection of West Burleigh Street and North 27th Street and most are also high crash locations:

- West Center Street and North 51st Street
- North Hawley Road & West Vliet Street
- West National Avenue & South 2nd Street
- West Lincoln Avenue & South 6th Street
- West Morgan Avenue & South 35th Street

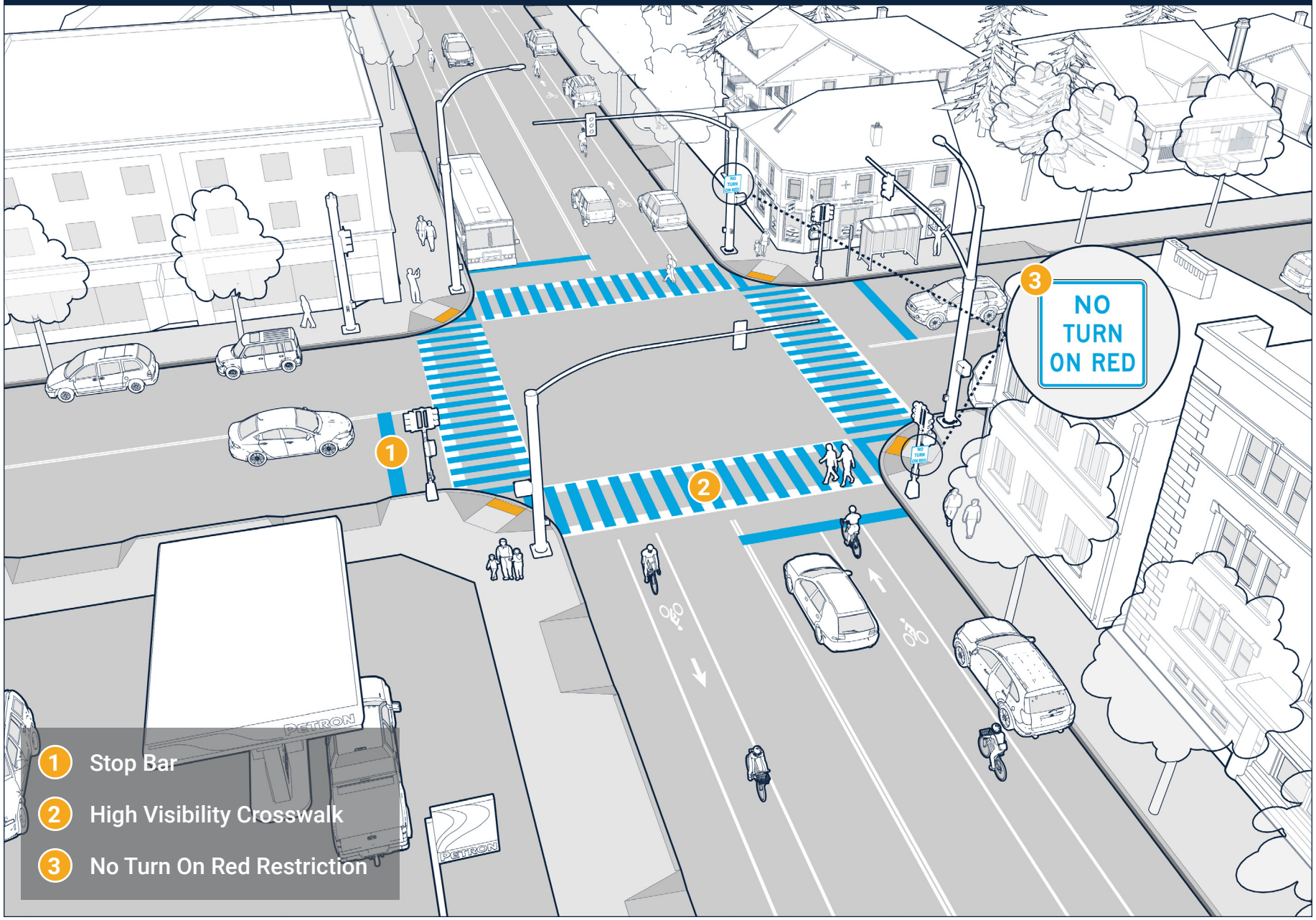


West Burleigh Street & North 27th Street

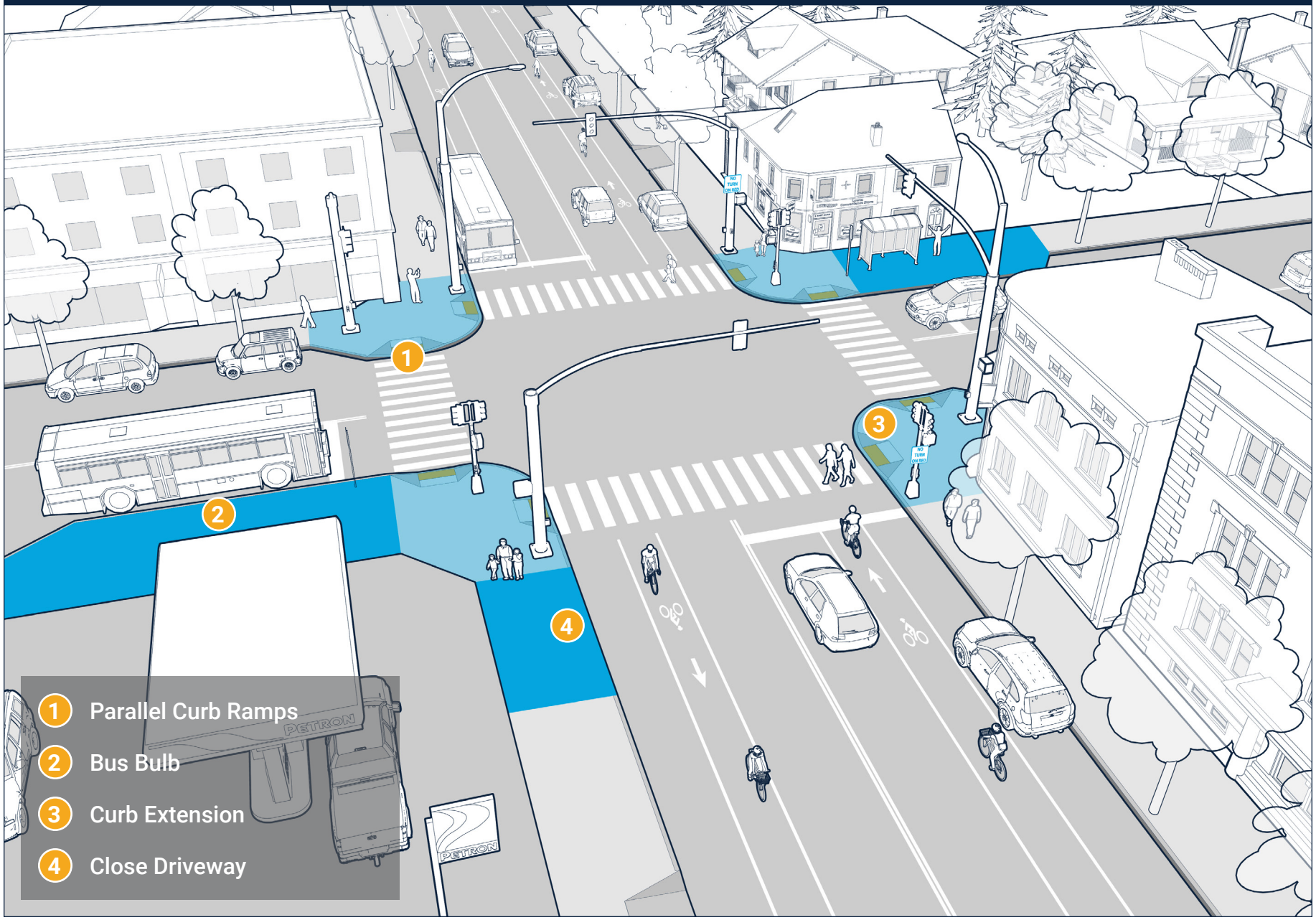
Existing Conditions



West Burleigh Street & North 27th Street — Low-Effort Improvements



West Burleigh Street & North 27th Street — High-Effort Improvements



West Capitol Drive & North 76th Street

Description

- West Capitol Drive is median-divided state highway; the street has two travel lanes and a parking lane in each direction; the parking lane is designated as a third travel lane during peak periods.
- West Capitol Drive is a bus route.
- North 76th Street is median-divided and has two travel lanes in each direction and a bike lane and parking on both sides of the street.
- North 76th Street is a bus route.
- The intersection is signalized.

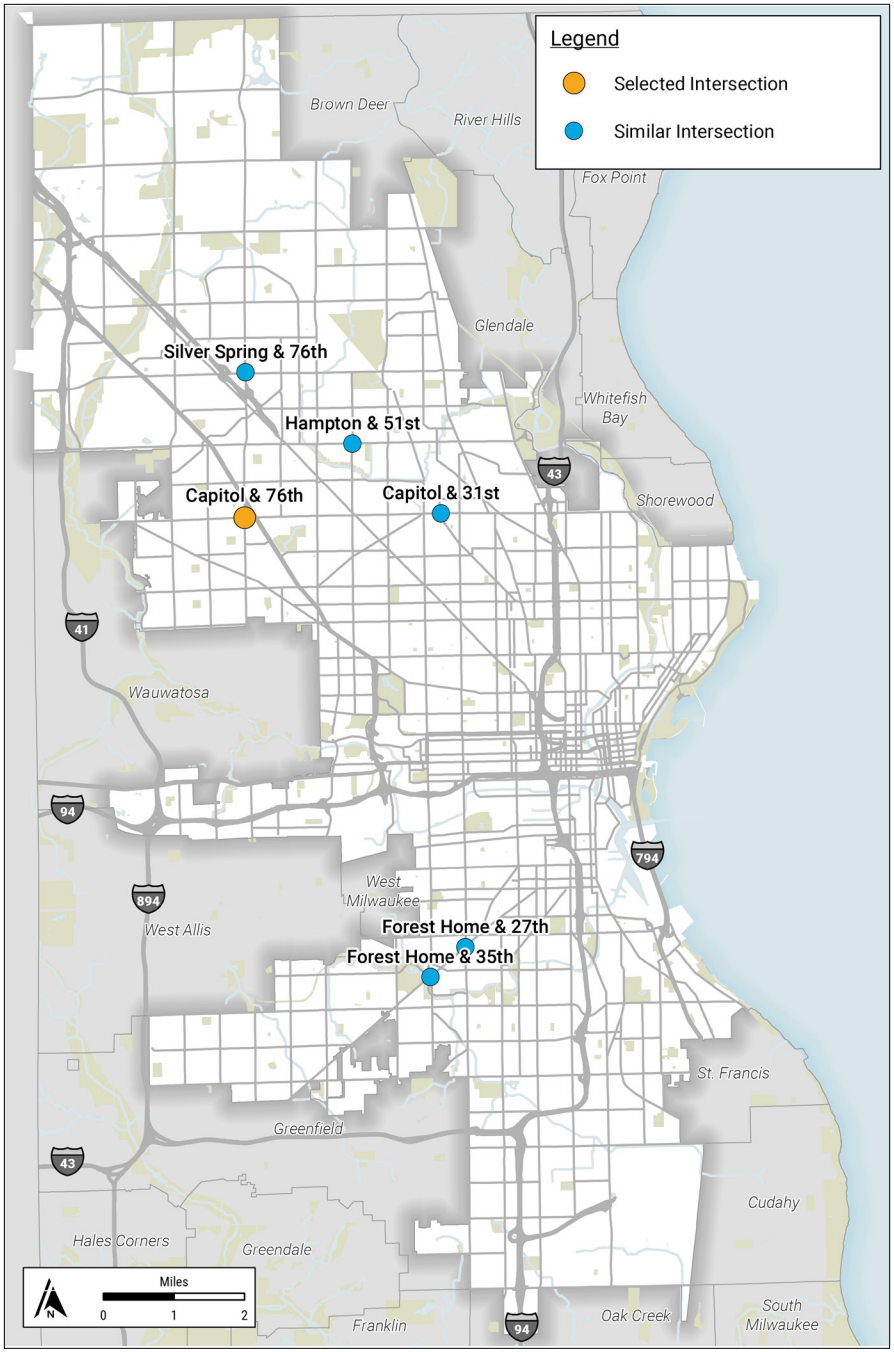
Existing Conditions

- High crash location.
- Driveways on the northwest, southwest, and southeast corner are too close to the intersection.
- Curb ramps do not direct pedestrians directly into the crosswalks.
- Median islands do not extend through the crosswalks.
- Right turn slip lanes and wide curb radii allow motorists to turn at high speeds.
- Pedestrian crossing distances are long.

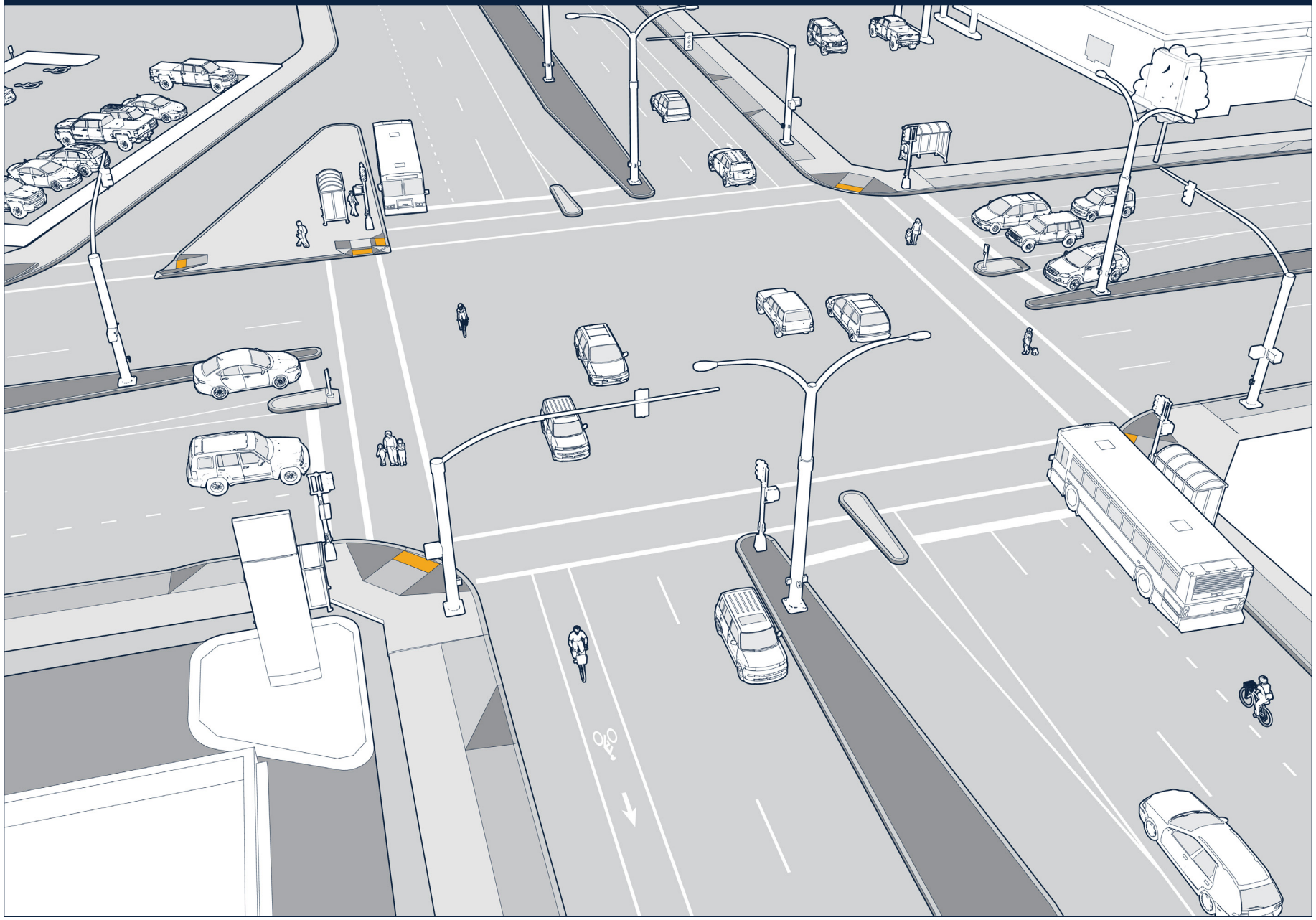
Similar Intersections

The following intersections have similar characteristics to the intersection of West Capitol Drive and North 76th Street and most are also high crash locations:

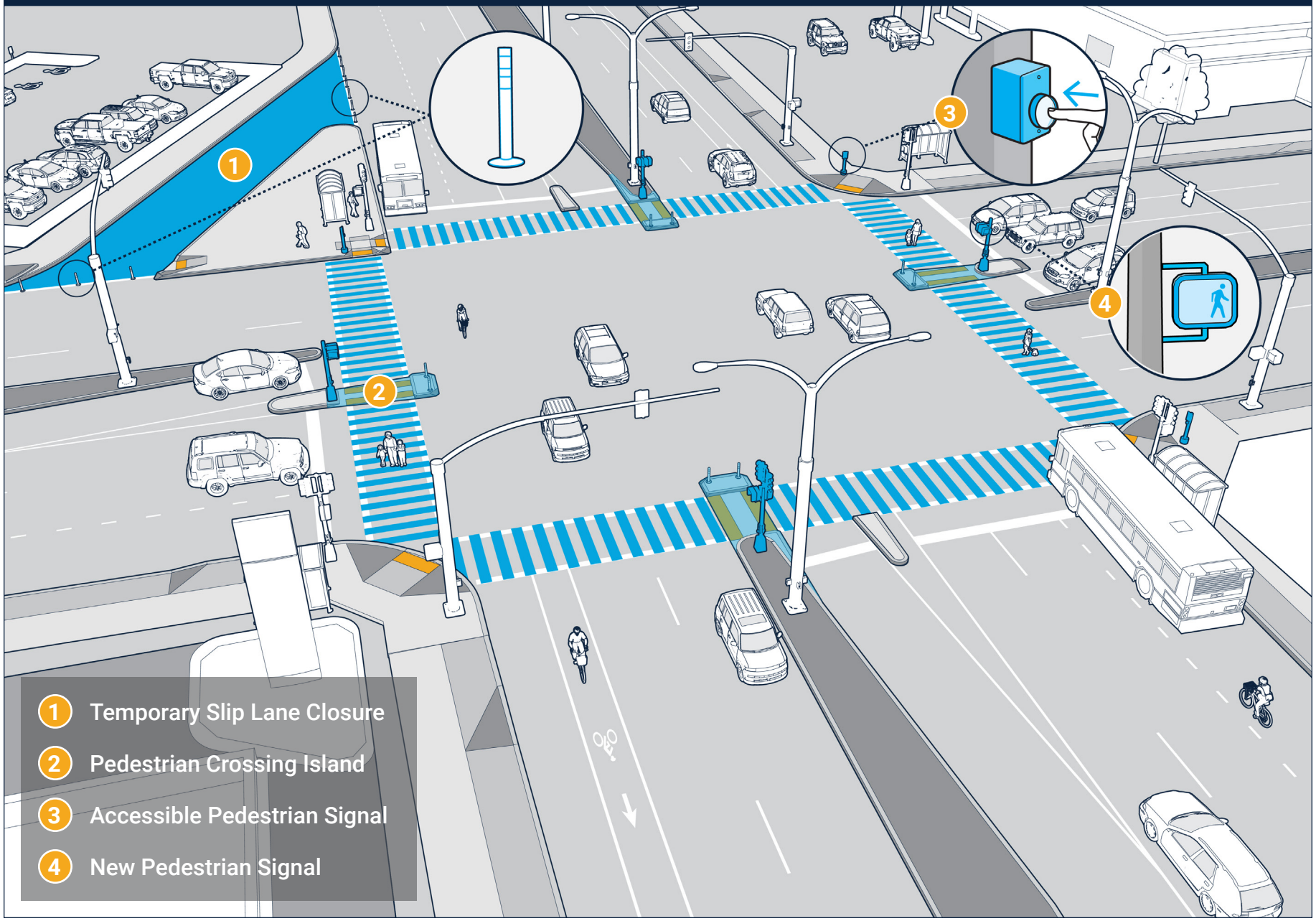
- West Silver Spring Drive & North 76th Street
- West Hampton Avenue & North 51st Street
- West Capitol Drive & North 31st Street
- West Forest Home Avenue & South 27th Street
- West Forest Home Avenue & South 35th Street



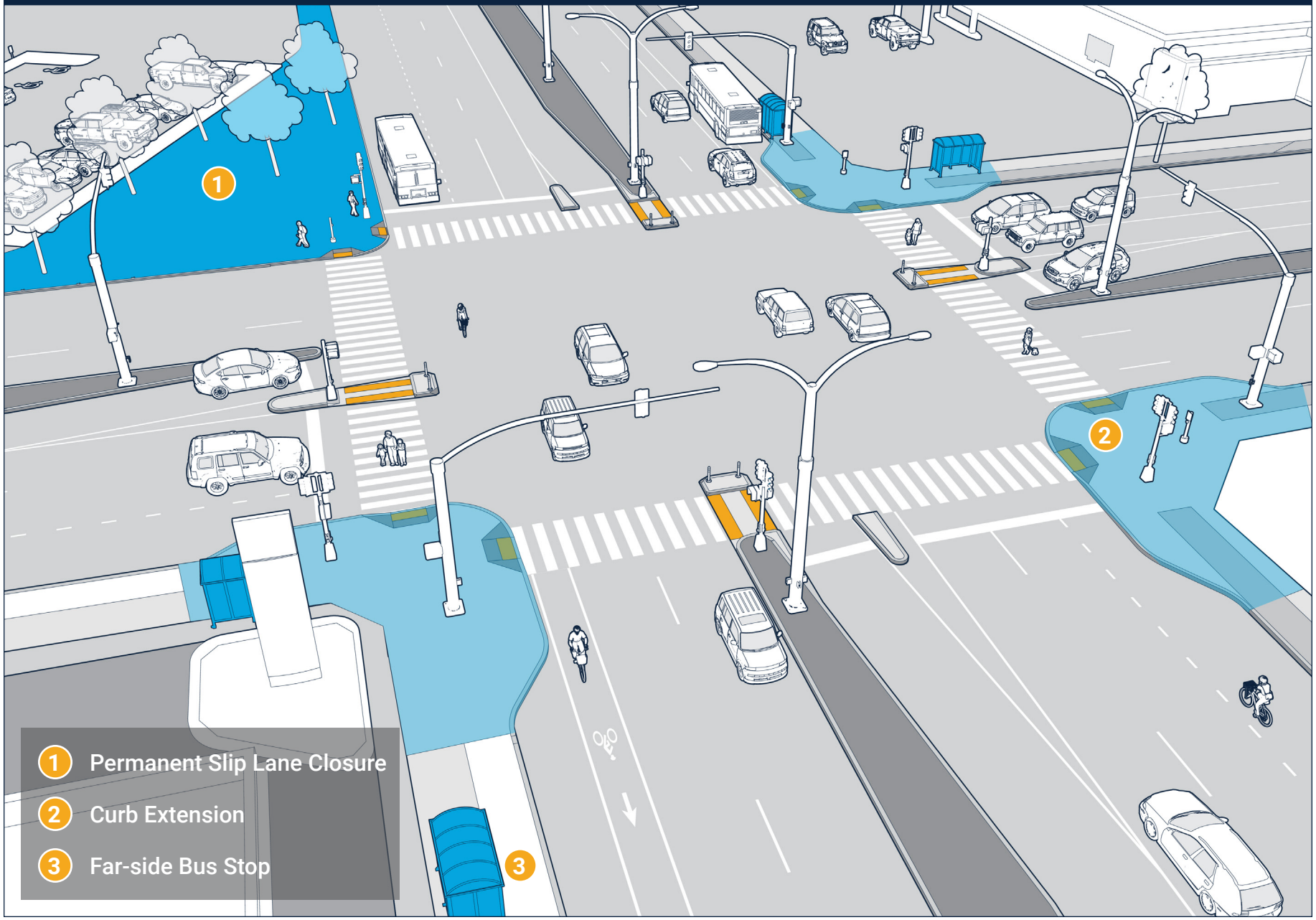
West Capitol Drive & North 76th Street — Existing Conditions



West Capitol Drive & North 76th Street — Low-Effort Improvements



West Capitol Drive & North 76th Street — High-Effort Improvements



West Walker Street & South Cesar Chavez Drive

Description

- West Walker Street is a local street with one travel lane and a parking lane in each direction.
- South Cesar Chavez Drive has one travel lane and a parking lane in each direction; during peak hours the parking lane is designated as a travel lane.
- South Cesar Chavez Drive is a bus route.
- West Walker Street has a stop sign at South Cesar Chavez Drive, which is uncontrolled at the intersection.

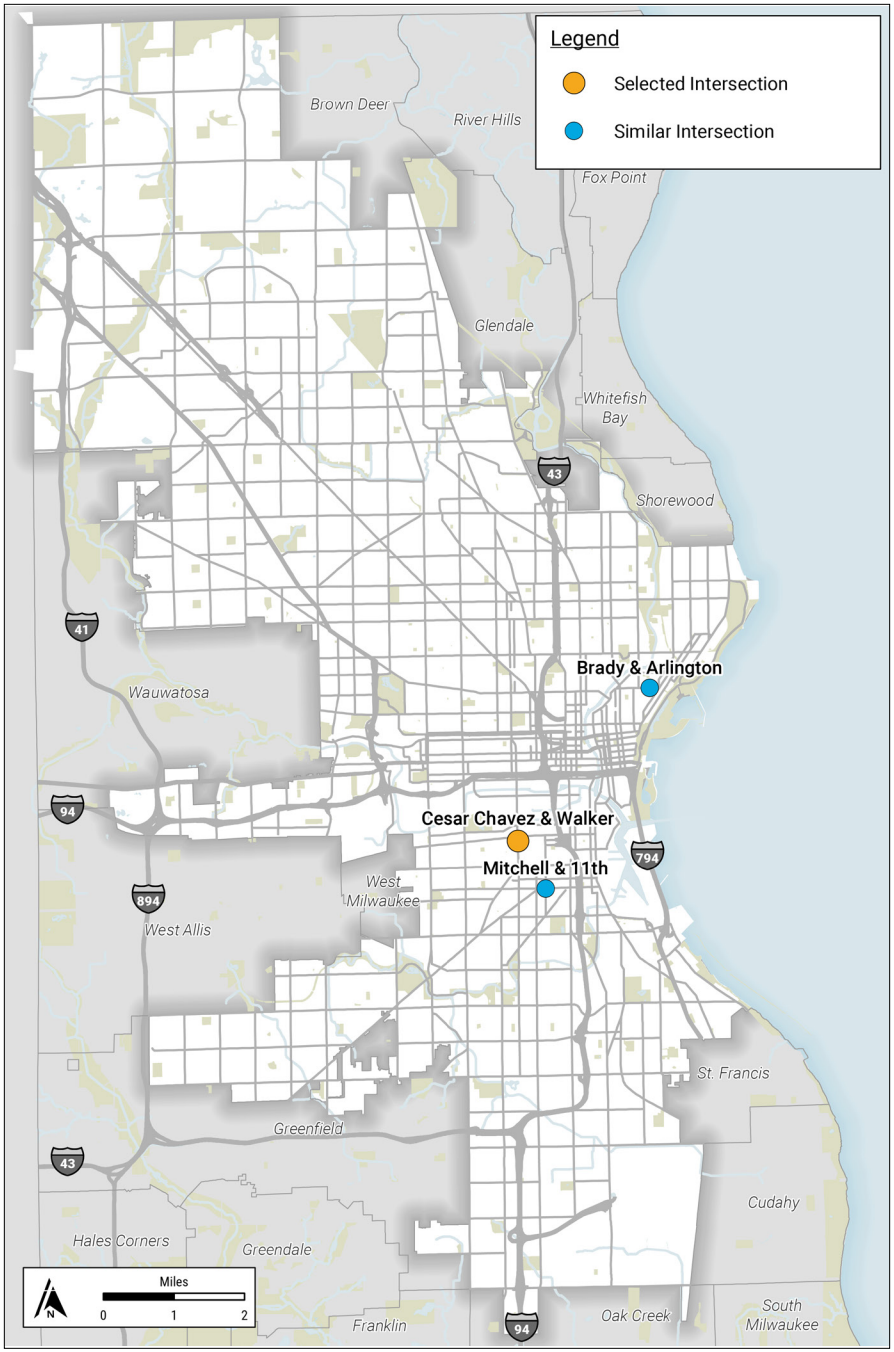
Existing Conditions

- High crash location.
- Curb ramps do not direct pedestrians directly into the crosswalks.
- During peak hours, there is a multiple threat crash risk on South Cesar Chavez Drive where a motorist in one lane stops for a person crossing the street, but a motorist in the next lane does not stop.
- Parking is restricted to provide a northbound travel lane during the morning peak hour.

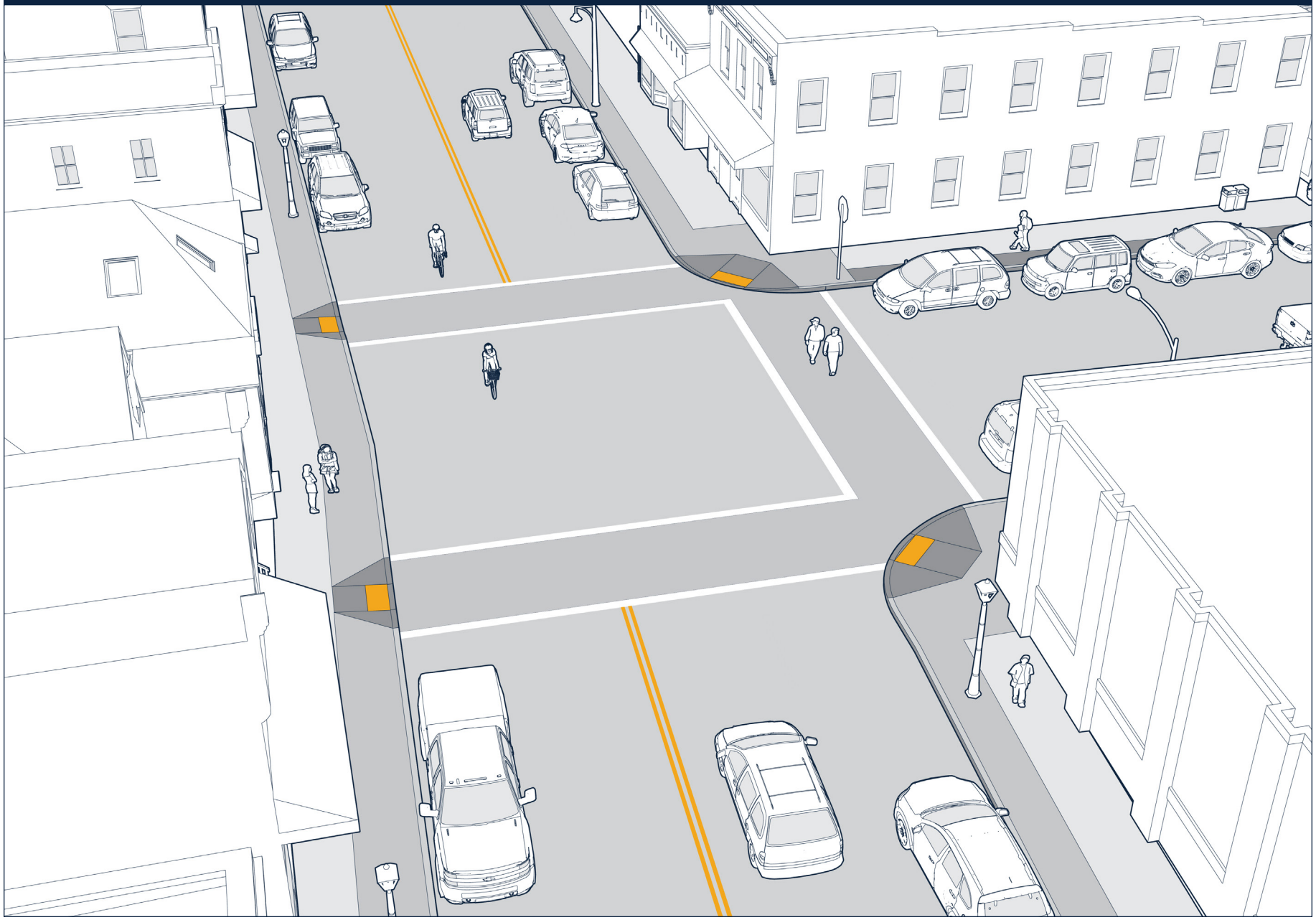
Similar Intersections

The following intersections have similar characteristics to the intersection of West Walker Street and South Cesar Chavez Drive and most are also high crash locations:

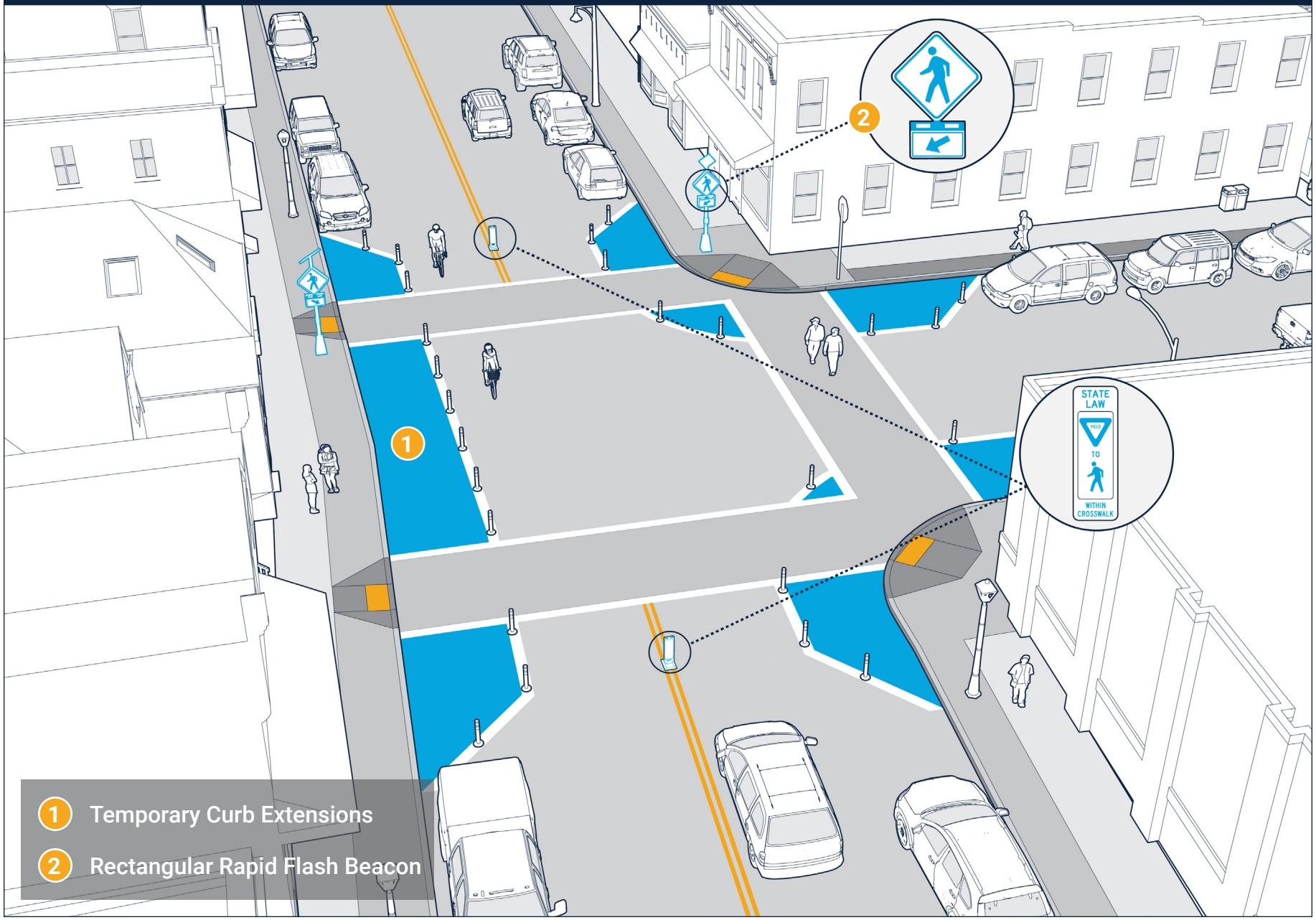
- East Brady Street & North Arlington Place
- West Mitchell Street & South 11th Street



West Walker Street & South Cesar Chavez Drive — Existing Conditions

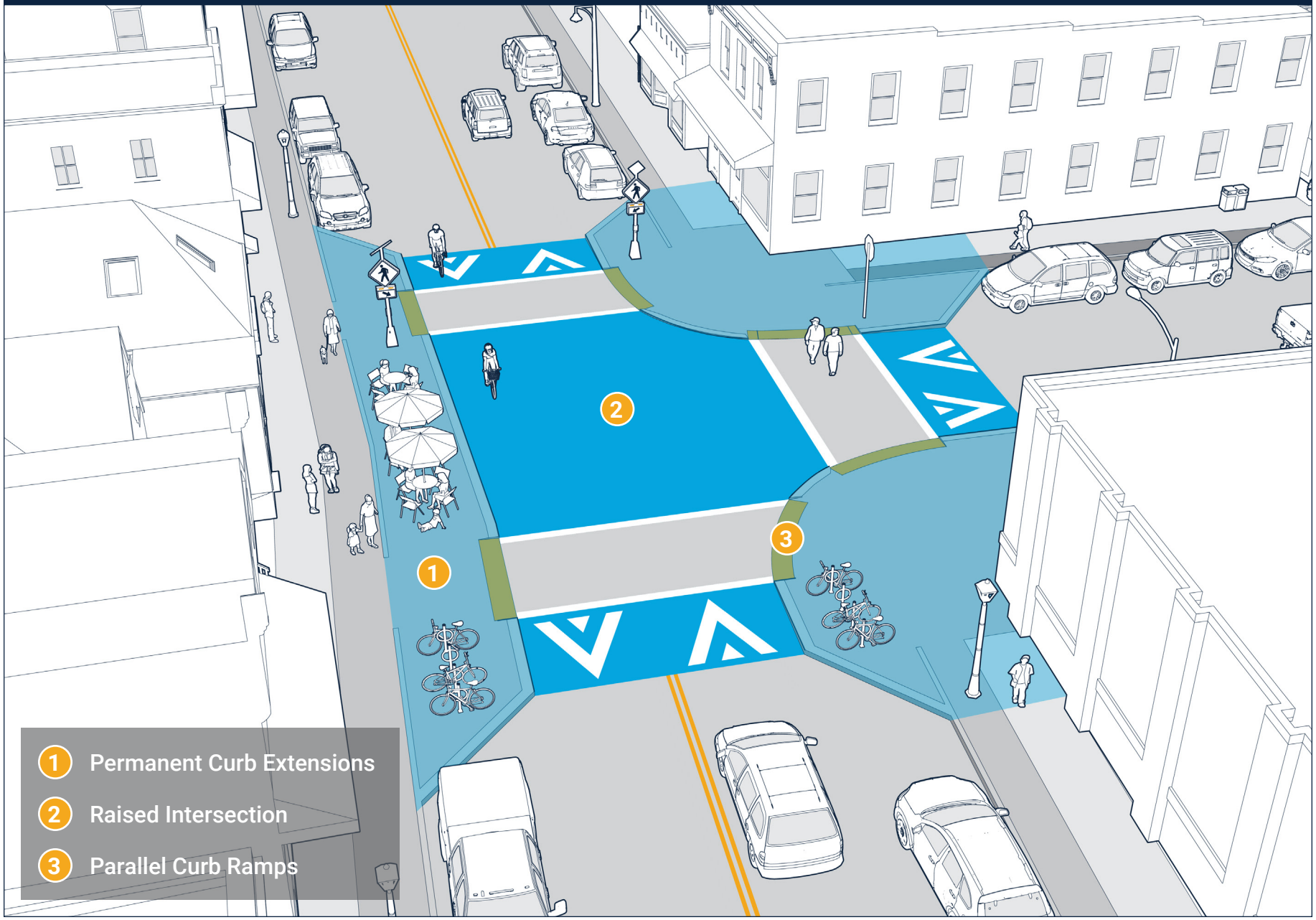


West Walker Street & South Cesar Chavez Drive — Low-Effort Improvements



1. Temporary Curb Extensions
2. Rectangular Rapid Flash Beacon

West Walker Street & South Cesar Chavez Drive — High-Effort Improvements



East Highland Avenue & North Water Street

Description

- East Highland Avenue is a local street with one travel lane and a parking lane in each direction; west of North Water Street, East Highland Avenue has diagonal parking on one side of the street.
- North Water Street is median-divided and has two travel lanes, a bike lane, and a parking lane in each direction; there are left turn lanes at the intersection; the street is a bus route.
- East Highland Avenue has a stop sign at North Water Street, which is uncontrolled at the intersection.

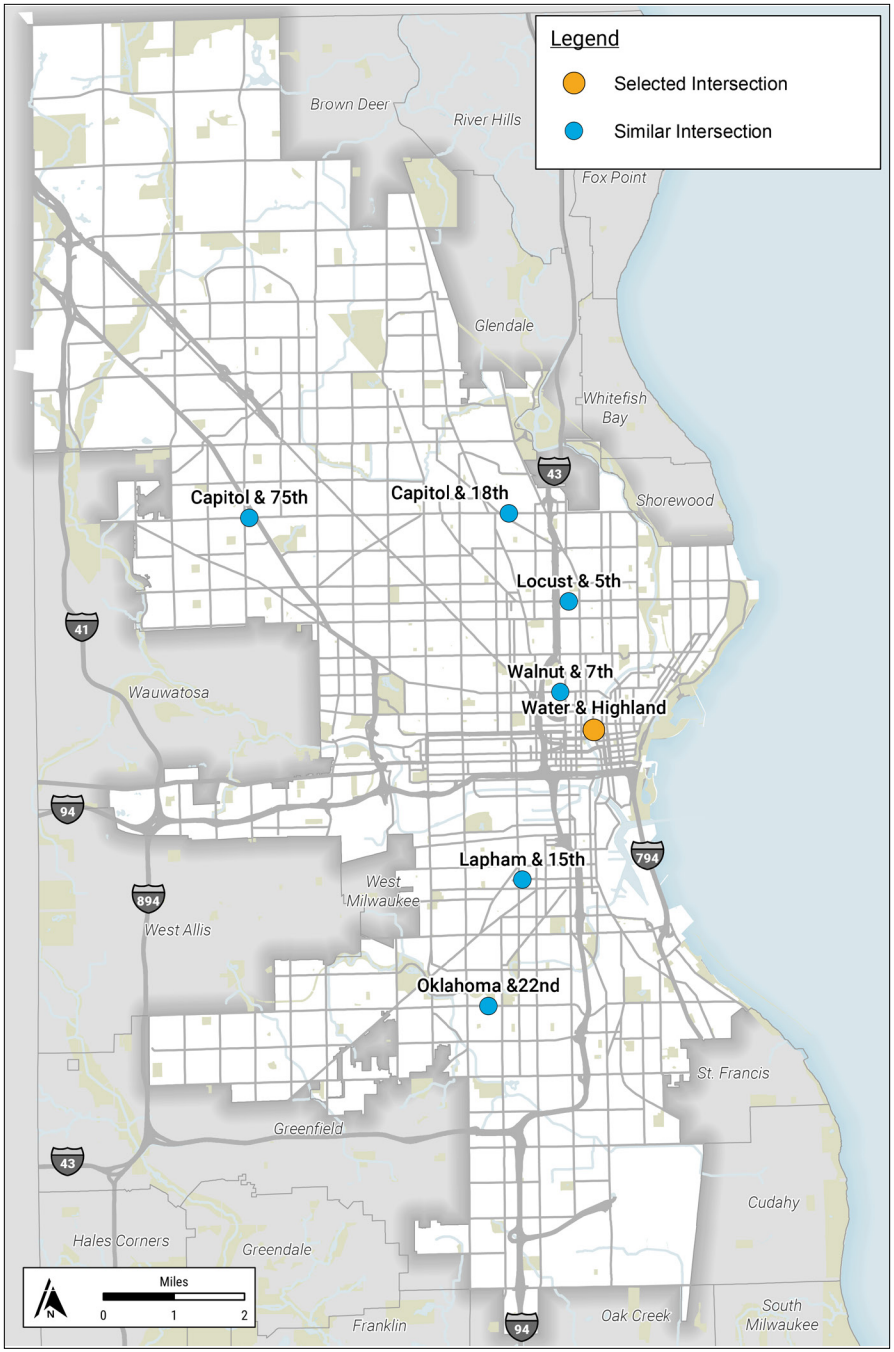
Existing Conditions

- High crash location.
- Crosswalks are not marked on East Highland Avenue.
- Some curb ramps do not direct pedestrians directly into the crosswalks.
- Median islands do not protect the crosswalks.
- There is a multiple threat crash risk on North Water Street.

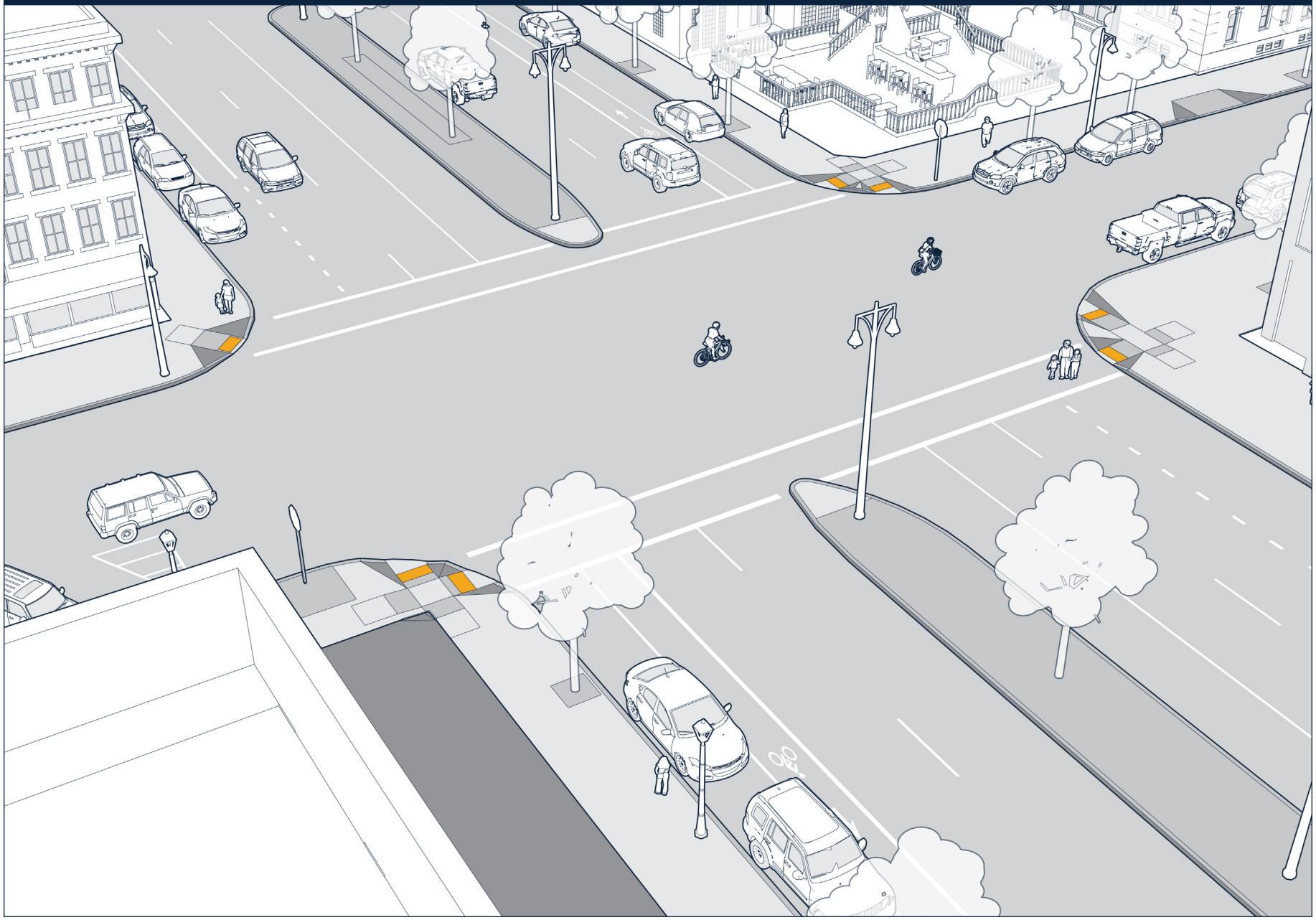
Similar Intersections

The following intersections have similar characteristics to the intersection of East Highland Avenue and North Water Street and most are also high crash locations:

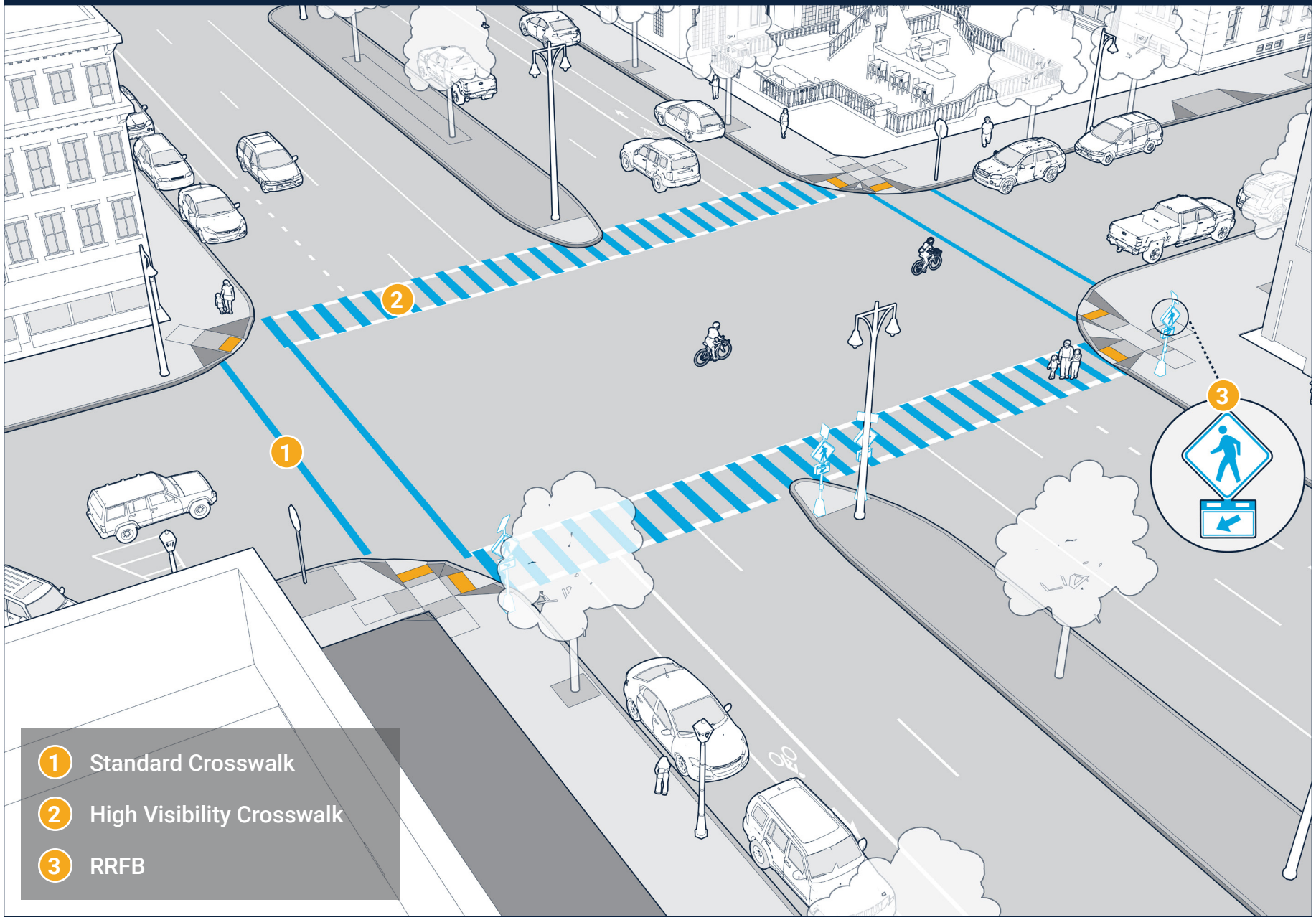
- West Capitol Drive & North 75th Street
- West Capitol Drive & North 18th Street
- West Locust Street & North 5th Street
- West Walnut Street & North 7th Street
- West Lapham Boulevard & South 15th Street
- West Oklahoma Avenue & South 22nd Street



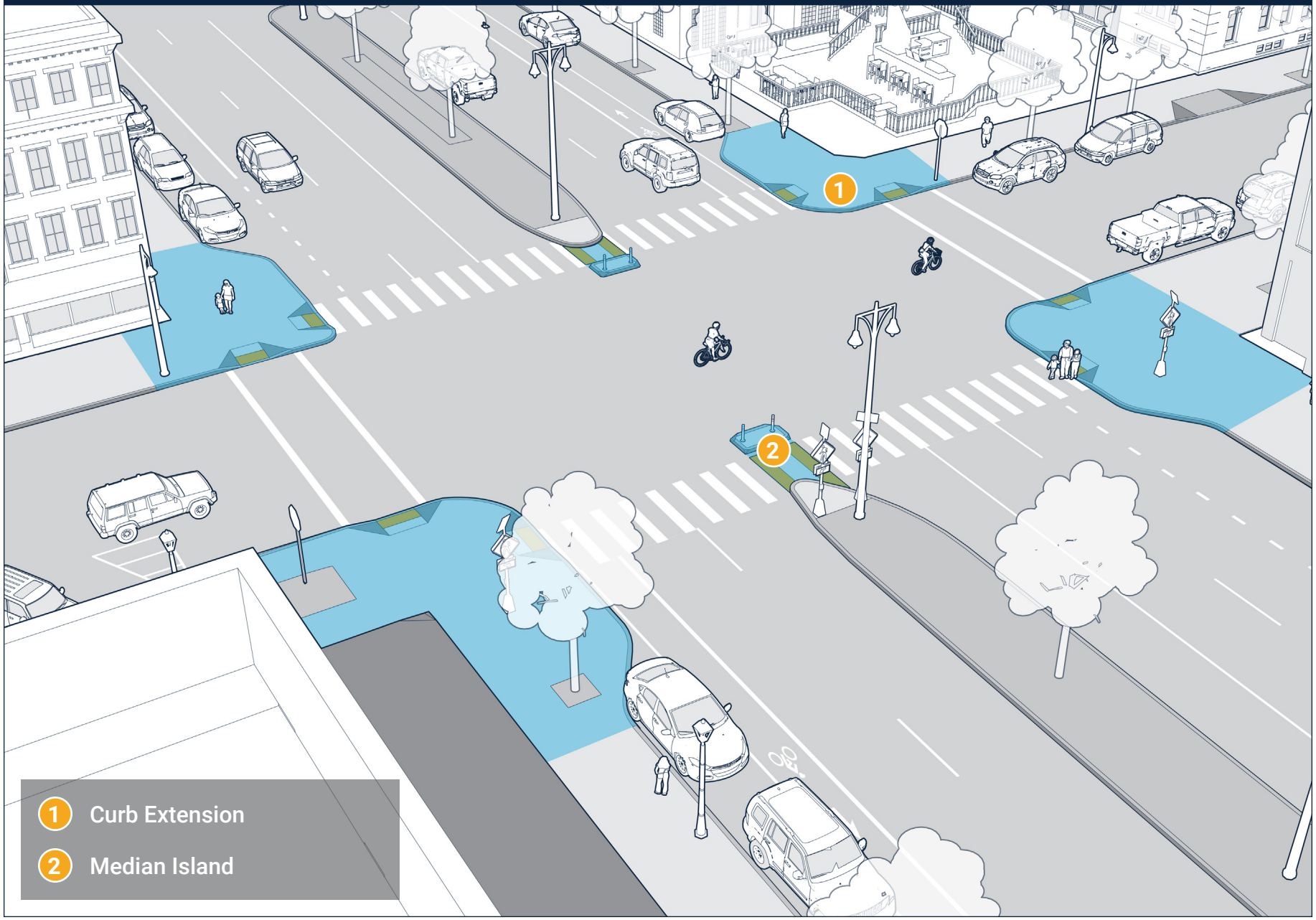
East Highland Avenue & North Water Street — Existing Conditions



East Highland Avenue & North Water Street — Low-Effort Improvements



East Highland Avenue & North Water Street — High-Effort Improvements

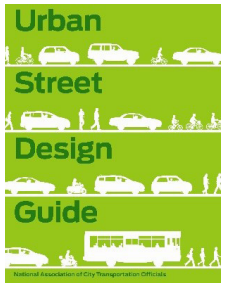


Standards and Guidelines

Guidelines—such as the NACTO suite of design guides—are intended to help implement innovative designs. The most relevant standards and guidelines are described below. Guidelines focused on bicycle and transit design are included because street designs for people bicycling and using transit often also benefit people walking.

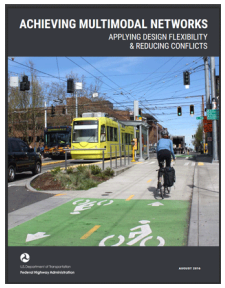
Pedestrian Guidelines

NACTO Urban Street Design Guide – 2013



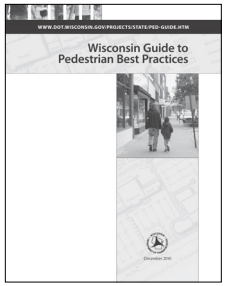
The purpose of the NACTO Urban Street Design Guide is to provide cities with state-of-the-practice solutions that can help to design complete streets in urban settings. The NACTO Urban Street Design Guide recognizes the direct relationship between street design and economic development and emphasizes safety for all traffic modes. The NACTO Urban Street Design Guide is not intended to be a comprehensive guide for the geometric design of the street, rather it covers design principles to meet the complex needs of cities. The NACTO Urban Street Design Guide references the MUTCD.

FHWA Achieving Multimodal Networks – 2016



Achieving Multimodal Networks is a resource for practitioners seeking to build multimodal transportation networks. The publication highlights ways to apply the design flexibility found in current national design guidance to address common street 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.

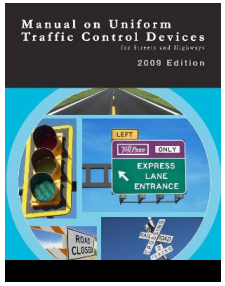
Wisconsin Guide to Pedestrian Best Practices – 2010



Chapter 5 of the Wisconsin DOT's Guide to Pedestrian Best Practices features the most complete guidance in Wisconsin on designing pedestrian facilities. It includes guidance on pedestrian facility design as well as how streets can be designed to positively impact pedestrian accommodations. It reinforces the guidance from the 2004 Guide for the Planning, Design, and Operation of Pedestrian Facilities with additional depth and detail on nearly all topics in that guide.

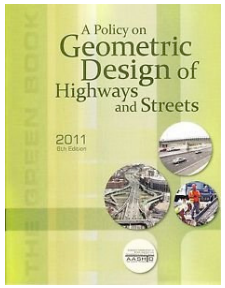
Other Guides

Manual on Uniform Traffic Control Devices (MUTCD) – 2009



The MUTCD is issued by the Federal Highway Administration of the U.S. Department of Transportation to specify the standards by which traffic signs, road surface markings, and signals are designed, installed, and used. These specifications include the shapes, colors, fonts, sizes, etc., used in pavement markings and signs. All traffic control devices must generally conform to these standards. The manual is used to ensure traffic control devices conform to the national standard.

AASHTO Green Book – 2011



The American Association of State Highway and Transportation Officials' (AASHTO) Policy on Geometric Design of Highways and Streets, 6th Edition, 2011, commonly referred to as the "Green Book," contains current design research and best practices for highway and street geometric design. The document provides guidance for arterials, collectors, and local streets in both urban and rural locations.

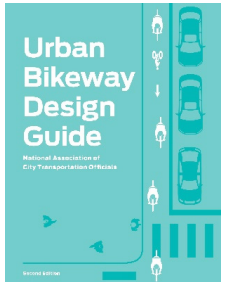
Wisconsin Facilities Development Manual (FDM) – 2018

The Wisconsin FDM provides policy, procedural requirements, and guidance encompassing the facilities development process within the Wisconsin Department of Transportation, Division of Transportation Systems Development (DTSD). It is applicable to all types of improvements on the state trunk highway system and other street/highway systems where federal or state funds may be used for improvements. Adherence to the FDM's requirements provides for the uniform development of transportation systems and plans that reflect sound engineering practice and sensitive environmental concern. Chapter 11, Section 46 of the FDM details design requirements for bicycle and pedestrian accommodation.

NACTO Transit Street Design Guide – 2016

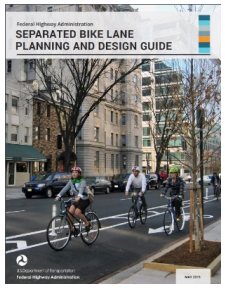
The NACTO Transit Street Design Guide provides guidelines on developing transit facilities and designing city streets to prioritize transit, improve transit service quality, and support other goals related to transit. The guide also includes recommendations on integrating transit with other modes and the design of specialized transit street elements.

NACTO Urban Bikeway Design Guide – 2012



The NACTO Urban Bikeway Design Guide provides cities with state-of-the-practice solutions to create complete streets that are safe and enjoyable for people riding bikes. The NACTO Urban Bikeway Design Guide is not intended to be a comprehensive guide for the geometric design of bikeways. The guide covers certain types of on-street bikeway designs, specifically bike lanes and several new and innovative types of on-street bikeway design treatments, but does not cover shared use paths, signal design, and other relevant topics. In most cases, the NACTO Urban Bikeway Design Guide should be used in tandem with the AASHTO Bike Guide.

FHWA Separated Bike Lane Planning & Design Guide – 2015



The Separated Bike Lane Planning and Design Guide is issued by the Federal Highway Administration (FHWA) and provides guidelines for one- and two-way separated bike lanes. The guide provides case studies to aid in implementation. The guide also identifies data to collect before and after separated bike lane projects and potential future research to refine and improve the practice.

Endnotes

1 National Realtors Association 2013 Community Preference Survey.

2 U.S. Census American Community Survey, 2016.

3 U.S. Census American Community Survey, 2016.

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