ROAD SAFETY ASSESSMENTS

Presented by

Kansas Local Technical Assistance Program (KS LTAP)

Sponsored by

Kansas Department of Transportation (KDOT)

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How to Use this Workbook

This workbook contains:

- Key content and resources
- Activity directions and workspace

Use this workbook throughout the training to record responses to questions, take notes during lectures, and capture any other information you find useful or important to have when you return to work.

See the Appendix 1: Definitions

Lesson 1: Introduction

This module introduces the purpose of a Road Safety Assessment (RSA) and how to incorporate it into agency operations to improve the safety of pedestrians and bicyclists. This module also includes definitions used both in the training and in references related to this topic.

Use the information you learn from this course to improve your understanding of the importance of assessing the safety of roadways for both motorists and vulnerable road users.

Introductory Poll

1. What is your role in the organization?
2. What does safety mean to you?
3. Have you ever participated in a road safety assessment before?
4. What is your level of walking, biking, or rolling (no way, no how; interested, but concerned; enthused and confident; or strong and fearless, for example)?
5. What attracted you to this training?

Topics

Lesson 1: Introduction

Lesson 2: Principles of Pedestrian and Bicyclist Safety

Lesson 3: Process: Identify Location

Lesson 4: Process: Collect Data

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Lesson 14: De-Brief of Field Assessment

Lesson 15: Process: Analyze and Report Findings

Lesson 16: Process: Discuss Recommendations

Lesson 17: Process: Write Report

Lesson 18: Advocacy

Learning Outcomes

After completing this module, participants will be able to:

Part 1: Background

1. Describe the purpose of an RSA
2. Define the benefits of an RSA

Part 2: Road Safety Assessment Process

3. Identify potential locations
4. Identify sources of data
5. Identify potential team members
6. Conduct an RSA team meeting
7. Identify key items to review using prompts
8. Describe the contents of a data packet
9. Consider transportation needs
10. Describe meal considerations
11. Identify personal protection needs
12. Identify needed tools

Part 3: Field Visit and Discussions

13. Lead a field review
14. Discuss the field assessment process
15. Analyze findings
16. Consider countermeasures and develop recommendations

Part 4: Next Steps

17. Write a report
18. Understand advocacy related to funding

Part 1: Background

Lesson 2: Principles of Safety

Learning Objective

1. Describe the purpose of an RSA.
    - Why should we perform an RSA?
    - What elements of the road may present a safety concern?
    - What opportunities exist to eliminate or mitigate identified safety concerns?
2. Describe the benefits of an RSA.
    - What is the highest priority?
    - What contributes to higher risk?

Background

There are several types of Road Safety Assessments (RSAs) including an audit of an existing road or road network to check for consistency and unexpected road safety issues, an audit of a road project at various stages of completion (such as design, construction, and post construction) to make sure the project meets the road safety objectives, and a thematic audit focusing on particular aspects of a road (such as work zone traffic control, pedestrians, transit, etc.).

This training on conducting local RSAs is focused on pedestrian and cyclist concerns, exploring safety, accessibility, comfort, and convenience.

Vulnerable road users (VRUs), including pedestrians, cyclists, and others using non-motorized modes of transportation, are killed or seriously injured on Kansas roads every year at a rate faster than other road users. Between 2014 and 2021, there were an estimated 3,172,000,000 VRU trips in Kansas. At that same time, there were 1,034 fatal or suspected serious injury crashes, resulting in 269 VRU deaths and 790 VRU serious injuries. Comprehensive crash costs associated with VRU fatal and suspected serious injury crashes (KA crashes) totaled $4,246,000,000. While VRU KA crashes constitute less than 10% of overall KA crashes in Kansas, VRU KA crashes have increased in recent years at a faster rate than overall KA crashes.

A Suspected Serious Injury is any injury other than fatal which results in one or more of the following:

- Severe laceration resulting in exposure of underlying tissues/muscle/organs or resulting in significant loss of blood
- Broken or distorted extremity (arm or leg)
- Crush injuries

- Suspected skull, chest or abdominal injury other than bruises or minor lacerations
- Significant burns (second and third degree burns over 10% or more of the body)
- Unconsciousness when taken from the crash scene
- Paralysis (loss of the ability to move or feel in part or most of the body)

A fatal injury is any injury that results in death to a person within 30 days after the crash in which the injury occurred.

Rules of Conduct

For this training and when planning and designing roadways:

- Avoid stereotyping based on modes of transportation, e.g. witnessing a pedestrian behaving in a way you thought was wrong or dangerous doesn't mean all pedestrians behave that way and there may be good reasons for the behavior you can't understand, e.g., a woman crosses mid-block to avoid a man she finds threatening
- Keep in mind, drivers behave poorly and make mistakes all of the time but have the potential to kill someone walking or biking
- Recognize and respect different perspectives and life choices, including how we transport ourselves either by necessity or choice
- Acknowledge we are all human and therefore all make mistakes, get distracted, etc.
- If you see someone making a "bad decision", e.g. crossing mid-block without a crossing, consider why they are doing that, e.g. is the next crossing a quarter mile away, is it cold and rainy, is their destination directly across the street, etc.?

Purpose

The purpose of an RSA is to evaluate crash risks along a roadway and recommend improvements.

- There is an increase in both the number and rate of vulnerable road user crashes in Kansas.
- Many elements of the road may present a safety concern such as: lack of pedestrian or bicyclist infrastructure, inconsistencies in infrastructure (gaps, variety of treatments for same conditions, etc.), transitions (ramps).
- An RSA can identify risks and recommend improvements to eliminate or mitigate risks.
- An RSA is not a "standards check" but is an opportunity to identify areas where applied designs may interact with road user behaviors to generate a potential safety issue. This is the difference between nominal safety (based on design standards) and substantive safety (based on roadway safety performance).
- Experience the corridor, intersection, etc., from a variety of perspectives

- Get an idea of how an area “feels” from outside the perspective of an automobile, e.g. does it feel safe, pleasant, inviting?
- Educate participants on proven safety countermeasures in a real-life setting
- Respond to concerns from users or in response to a crash or near-crash
- Experience area from the user perspective prior to applying for funding
- Better demonstrate an understanding of an area, space and physical obstacles (e.g. fences, ditches, retaining walls), risks and potential countermeasures before recommending changes
- For KDOT: determine opportunities prior to survey and design of scheduled road projects, e.g. CCLIP, mill and overlay, heavy preservation, etc.

Principles of Safety

The first priority of any transportation system must be to keep all users safe. Once a baseline of safety is established, other priorities may be addressed such as equity, mobility, health, vibrancy of the community, and others. Other benefits of an RSA include economic development, tourism, and improved livability.

- This training focuses on both cyclists and pedestrians. These vulnerable road users (VRUs) are similar, with similar concerns, but they are different. The biggest difference is that cyclists operate at a higher speed than pedestrians. For this reason, although they may share facilities, the needs of both users must be considered throughout the process.
- Facilities for pedestrians and cyclists are part of the transportation system, but they are often used for recreational purposes too. One key to improving safety for VRUs is to separate them in time and space from motor vehicles.
- There is no typical pedestrian or cyclist. They come in all ages and abilities, and all must be considered when assessing the safety and usability of the infrastructure
- A relatively new approach to roadway safety is called the Safe System Approach. Applying the Safe System approach involves anticipating human mistakes by designing and managing road infrastructure to keep the risk of a mistake low; and when a mistake leads to a crash, the impact on the human body doesn’t result in a fatality or serious injury.

- Six principles form the basis of the Safe System Approach:
  - Deaths and serious injuries are unacceptable
  - Humans make mistakes
  - Humans are vulnerable
  - Responsibility is shared
  - Safety is proactive
  - Redundancy is critical

- Making a commitment to zero traffic deaths means addressing all aspects of safety through the following five Safe System elements that, together, create a holistic approach with layers of protection for road users: Safe Road users, Safe vehicles, Safe speeds, Safe roads, and Post-crash care.

THE FIVE ELEMENTS OF THE SAFE SYSTEM APPROACH

Safe Road Users	Safe Vehicles	Safe Speeds	Safe Roads	Post-Crash Care
The Safe System approach addresses the safety of all road users, including those who walk, bike, drive, ride transit, and travel by other modes.	Vehicles are designed and regulated to minimize the occurrence and severity of collisions using safety measures that incorporate the latest technology.	Humans are unlikely to survive high-speed crashes. Reducing speeds can accommodate human injury tolerances in three ways: reducing impact forces, providing additional time for drivers to stop, and improving visibility.	Designing to accommodate human mistakes and injury tolerances can greatly reduce the severity of crashes that do occur. Examples include physically separating people traveling at different speeds, providing dedicated times for different users to move through a space, and alerting users to hazards and other road users.	When a person is injured in a collision, they rely on emergency first responders to quickly locate them, stabilize their injury, and transport them to medical facilities. Post-crash care also includes forensic analysis at the crash site, traffic incident management, and other activities.
What does this mean for pedestrians and bicyclists?				
The Safe System approach considers the safety of all road users, but particularly those who are most at risk of fatal or serious injury in the event of a crash, such as bicyclists and pedestrians.	Vehicle technology has made crashes more survivable for passengers inside the vehicle. Those same advances have not yet benefited pedestrians and bicyclists to the same degree.	Pedestrians and bicyclists are particularly vulnerable to death or severe injury as vehicular speed increases.	Given their vulnerability to fatal and serious injuries, it is important to separate bicyclists and pedestrians in time and space from vehicles as they have a heavier mass and can travel at greater speeds.	Pedestrians and bicyclists are more likely to be killed or injured in a crash, so post-crash care is even more important to their survival.

You will find the following resources and references in the Appendix:

- FHWA's Proven Safety Countermeasures initiative (PSCi) is a collection of 28 countermeasures and strategies effective in reducing roadway fatalities and serious injuries. Below are examples of proven safety countermeasures for VRUs:
    - Crosswalk Visibility Enhancements (Tech Sheet)
        - Can reduce crashes by 23-48%
    - Pedestrian Hybrid Beacon (Tech Sheet)
        - Can reduce pedestrian crashes by 55%
    - Raised Crosswalk (Tech Sheet)
        - Can reduce pedestrian crashes by 45%
    - Road Diet (Tech Sheet)
        - Can reduce total crashes by 19-47% (19% in urban areas. 47% in suburban areas.)
    - Rectangular Rapid-Flashing Beacon (Tech Sheet)
        - Can reduce pedestrian crashes by 47%

The graphic below illustrates some proven VRU safety countermeasures:

Source: 2020 FHWA.

- STEP Studio (recommendations for pedestrians and cyclists)

Roadway Configuration	Posted Speed Limit and AADT								
	Vehicle AADT <9,000			Vehicle AADT 9,000–15,000			Vehicle AADT >15,000		
	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph	≤30 mph	35 mph	≥40 mph
2 lanes (1 lane in each direction)	❶ 2 4 5 6	❶ 5 6 7 9	① 5 6 ❼ ❾	❶ 4 5 6	❶ 5 6 7 9	① 5 6 ❼ ❾	❶ 4 5 6 7 9	① 5 6 7 9	① 5 6 ❾
3 lanes with raised median (1 lane in each direction)	❶ 2 3 4 5 7 9	❶ ❸ 5 7 9	① ❸ 5 ❼ ❾	① 3 4 5 7 9	① ❸ 5 ❼ ❾	① ❸ 5 ❼ ❾	① ❸ 4 5 7 9	① ❸ 5 ❼ ❾	① ❸ 5 ❾
3 lanes w/o raised median (1 lane in each direction with a two-way left-turn lane)	❶ 2 3 4 5 6 7 9	❶ ❸ 5 6 7 9	① ❸ 5 6 ❾	① 3 4 5 6 7 9	① ❸ 5 6 ❼ ❾	① ❸ 5 6 ❾	① ❸ 4 5 6 7 9	① ❸ 5 6 ❾	① ❸ 5 6 ❾
4+ lanes with raised median (2 or more lanes in each direction)	❶ ❸ 5 7 8 9	❶ ❸ 5 7 8 9	① ❸ 5 8 ❾	① ❸ 5 7 8 9	① ❸ 5 ❼ 8 ❾	① ❸ 5 8 ❾	① ❸ 5 ❼ 8 ❾	① ❸ 5 8 ❾	① ❸ 5 8 ❾
4+ lanes w/o raised median (2 or more lanes in each direction)	❶ ❸ 5 6 7 8 9	① ❸ 5 ❻ 7 8 9	① ❸ 5 ❻ 8 ❾	① ❸ 5 ❻ 7 8 9	① ❸ 5 ❻ ❼ 8 ❾	① ❸ 5 ❻ 8 ❾	① ❸ 5 ❻ ❼ 8 ❾	① ❸ 5 ❻ 8 ❾	① ❸ 5 ❻ 8 ❾

Given the set of conditions in a cell,

\# Signifies that the countermeasure is a candidate treatment at a marked uncontrolled crossing location.

● Signifies that the countermeasure should always be considered, but not mandated or required, based upon engineering judgment at a marked uncontrolled crossing location.

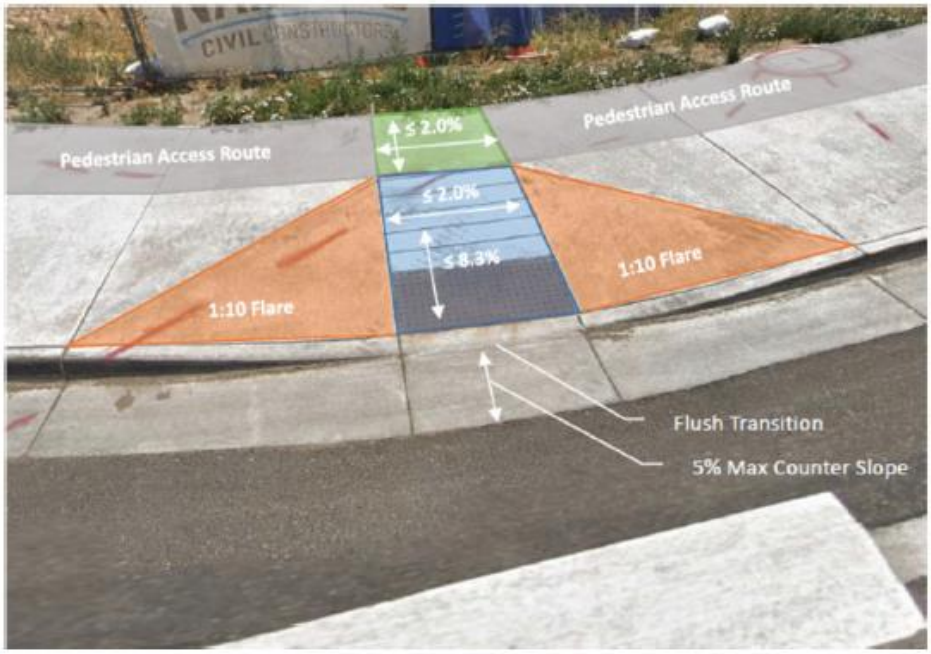
○ Signifies that crosswalk visibility enhancements should always occur in conjunction with other identified countermeasures.*

The absence of a number signifies that the countermeasure is generally not an appropriate treatment, but exceptions may be considered following engineering judgment.

1 High-visibility crosswalk markings, parking restrictions on crosswalk approach, adequate nighttime lighting levels, and crossing warning signs
2 Raised crosswalk
3 Advance Yield Here To (Stop Here For) Pedestrians sign and yield (stop) line
4 In-Street Pedestrian Crossing sign
5 Curb extension
6 Pedestrian refuge island
7 Rectangular Rapid-Flashing Beacon (RRFB)*
8 Road Diet
9 Pedestrian Hybrid Beacon (PHB)*

- Countermeasures That Work (NHTSA – behavioral recommendations)
  - Alcohol- and Drug-Impaired Driving
  - Seatbelts and Child Restraints
  - Speeding and Speed Management
  - Distracted Driving
  - Motorcycle Safety
  - Young Drivers
  - Older Drivers
  - Pedestrian Safety
  - Bicycle Safety
  - Drowsy Driving

- The U.S. Access Board has issued the Public Rights of Way Accessibility Guidelines (PROWAG) under the Americans with Disabilities Act (ADA) and the Architectural Barriers Act (ABA). These guidelines address access to sidewalks and streets, crosswalks, curb ramps, pedestrian signals, on-street parking, and other components of public right-of-way. These guidelines also review shared use paths, designed mainly for cyclists and pedestrians for transportation and recreation. When the guidelines are adopted, with or without additions and modifications, compliance with the accessibility standards is mandatory.
    - Perpendicular Curb Ramp



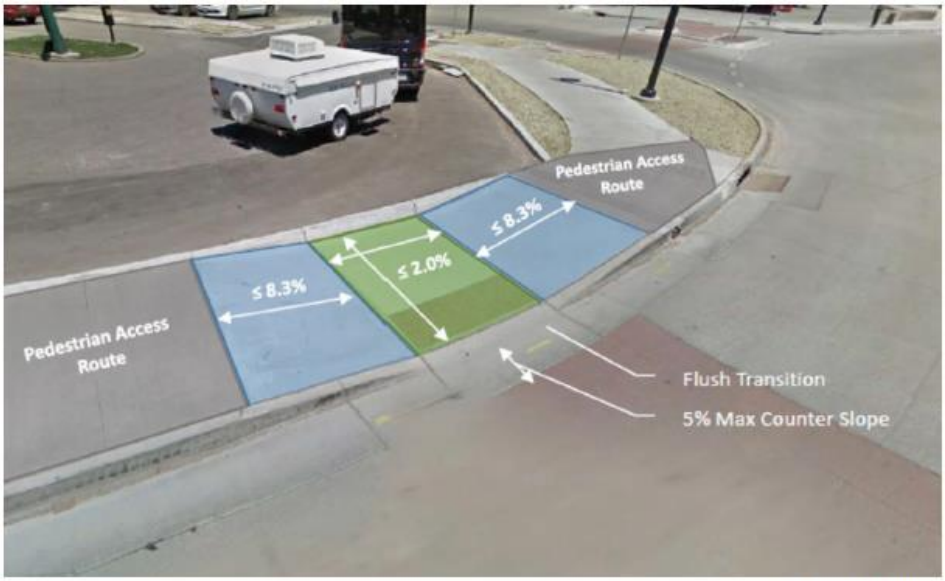
Colorado DOT

        - Perpendicular Curb Ramp Measurements
            - Landing Running Slope – max 2.1%
            - Landing Cross Slope – max 2.1%
            - Landing Length – match curb ramp width
            - Landing Width – match sidewalk width
            - Ramp Running Slope – max 8.33%
            - Flare slope – 10% or less, measured parallel to curb
            - DWS – 2-foot length for full width of ramp
            - Sidewalk Cross Slope – 2.1% or less
            - Counter Gutter Slope – 5.00% or less

- Ramp Cross Slope

  - Stop/Yield Control – 2.1% max
  - Signalized or Uncontrolled – 5% max
  - Midblock Crossing – can match street grade

- Parallel Curb Ramp



Colorado DOT

        - Parallel Curb Ramp Measurements
            - Landing Running Slope – max 2.1%
            - Landing Width and Length – 4 feet
            - Ramp Cross Slope – 2.1% max
            - DWS – 2-foot length for full width of ramp
            - Sidewalk Cross Slope – 2.1% or less
            - Counter Gutter Slope – 5% or less
            - Vertical curb behind landing (if necessary)
- Kansas Active Transportation Resources
    - Additional Design Guidance, Mapping and Network Planning, Engagement and Equity, Project Delivery, Data Tools and Performance Measures, Funding, Active Tourism, Bicycle and Pedestrian Safety and Education, and more, can be found on the KDOT webpage (https://www.ksdot.gov/bureaus/burRail/bike/KAT_Planning_Resources.asp)
    - Visit the Kansas Active Transportation Plan webpage (https://www.ksdot.gov/KansasATP.asp) to view the recently published plan, toolkits, recordings of virtual series, KDOT Crosswalk guide (https://www.ksdot.gov/Assets/wwwksdotorg/KansasATP/documents/KDOTCrosswalkGuide_FINAL.pdf), and more
    - See the Kansas Active Transportation Plan and Policy Registry Map (https://storymaps.arcgis.com/stories/b3cf2ba132ea447fa57d49a96d26bfeb) to view published active transportation plans across the state
- The intent of an RSA should not be to get to a predetermined solution, but to consider a variety of alternatives to meet the needs of the traveling public. Don't begin with a particular end in mind – be open to all perspectives
- Risks:
    - Traffic volume (higher = more risk)
    - Number of lanes/width of crossings (more lanes, wider crossing = more risk)
    - Availability of ped/cycle facilities (availability = less risk)
    - Lighting (availability = less risk)
    - Controlled crossings (controlled crossings are less risky than uncontrolled)
    - Speeds (higher speeds = higher risk)

- Items to consider – GORE:
    - Geometrics
    - Operations
    - Roadway Users
    - Environment

- **Could you explain to others why an RSA should be performed?**
- I**ncreased Risks of Vulnerable Road User Crashes**

There are a variety of factors that contribute to vulnerable road user crashes. Three factors are _____, availability of facilities, and _____ _____.

- **What are the elements of a Safe System?**

Safe road users, safe vehicles, safe speeds, safe roads, and post-crash care.

Part 1 Wrap Up

Learning Outcomes:

1. Describe the purpose of an RSA
2. Define the benefits of an RSA

Discussion Question: Can you think of a time in the past when you had difficulties getting from place to place as a pedestrian or cyclist?

Part 2: Road Safety Assessment Process

Lesson 3: Identify Location

Learning Objective:

3. Identify potential locations.

Discussion question: What types of locations in your community are a priority to you?

Location Identification

There are a variety of approaches to choose the location of an RSA. Here are some, along with their benefits and drawbacks:

- High Injury Network – starting with locations that have a history of crashes may result in "quick wins" and be easier to get support; however, unless there is a clear concentration of crashes at one location, a history of crashes does not necessarily relate to increased odds of future crashes
- High Risk (systemic) – determining risk takes a little longer than identifying where crashes have occurred, but risk has a higher correlation to future crashes
- School Route – choosing one or more routes that children may take to school, especially if any of those children are also disabled can reduce the risk of poor decisions made by inexperienced users; however, there may be other routes in the community that could affect more users
- Future Route – reviewing a new facility before it is constructed can identify potential issues that may not have been considered; in general, new facilities will be designed to meet baseline standards, so there are likely many other routes that will be a higher priority
- Distance: less than two miles
- Determined in advance, pre-scouted, relevant data collected
- Crash history, citizen-voiced concerns, high injury or risk network, school route, a route identified in a local transportation plan, a future route, etc.

- RSA can be for the entire route or for site-specific issues – generally it's better to consider the entire route, but this there is a known issue with certain site-specific issues, addressing all locations with the same concern can be more efficient
- Determine areas where the team can safely stop to discuss the area or sections of the route

Lesson 4: Collect Data

Learning Objective:

4. Identify sources of data.

The Need

Minimum data needs include both crash data and traffic (vehicular and ped/cycle, if available). It can be beneficial to have a team meeting before gathering data to make sure all data interests are covered; this can be just the local members or via a short virtual meeting. Data sources and considerations include:

- The local law enforcement agency is often the best source of crash data for pedestrian and cyclist crashes since not all crash reports are required to be sent to KDOT (such as minor injury crashes). The narratives can provide valuable information regarding the circumstances of the crash.
- The Kansas Department of Transportation has a Crash Data Dashboard (https://storymaps.arcgis.com/stories/01b8e784d1634e94b84ea0df67b8aea4). It can be helpful for general crash history, but it is not intended for detailed analysis.
- For specific location-based crash information, an Open Records request should be submitted to KDOT (KDOT@TST.CrashDataInfo@ks.gov) with as much location information as possible (for example, include all names of a roadway and the limits of the route). The initial request should be for general crash information along the route; once specific crashes are identified that appear relevant, again, reviewing the narratives can be extremely beneficial.
- Hospital records and even "near misses" are other sources of relevant information.
- For vehicular traffic counts, the local municipality may have counts available. For state highways and major streets and roads, KDOT will have traffic counts. https://www.ksdot.gov/maps.asp
- If traffic counts are not currently available, traffic counters can be borrowed for free from the Kansas Local Technical Assistance Program's (LTAP) Equipment Loan Program.
- Crowd-sourced data (such as Strava) can be used for pedestrian and cyclist data but is dependent on the participation rate in the local area.

- Other types of data that can be useful include:
    - Google Earth or Streetview for an overall view of the area and for preliminary measurements
    - Comprehensive plans
    - Functional Classification

Functional Classification	Distance Served (and Length of Route)	Access Points	Speed Limit	Distance between Routes	Usage (AADT and DVMT)	Significance	Number of Travel Lanes
Arterial	Longest	Few	Highest	Longest	Highest	Statewide	More
Collector	Medium	Medium	Medium	Medium	Medium	Medium	Medium
Local	Shortest	Many	Lowest	Shortest	Lowest	Local	Fewer

    - Land use or zoning maps
- It is also helpful to consider how adjacent, parallel, and connecting roadways affect the route

Data-Driven

Although anecdotal evidence can be helpful, data should be the basis for all analysis. Many funding sources (such as the Highway Safety Improvement Program) are required to be data-driven.

Think about it:

- Why is data even necessary?

Lesson 5: Select Team

Learning Objective:

5. Identify potential team members.

This training will give you the skills to organize and lead a team if you choose to do so. Who else should be included on the team and how large should the team be? Here are some guidelines for success.

Optimal Team Size

The best practice is to put together the smallest team that can bring all the necessary knowledge and experience to the process. Generally, that would mean five to twelve members. With smaller teams, ensuring that all interests are represented is essential. Teams with over a dozen members can have difficulties with logistics as well as coming to a consensus on recommendations. If a large team is necessary to represent all interests, consideration should be given to splitting into several smaller teams or having teams focused on different areas or interests.

Potential Team Members

Consider specific facility users when selecting your team, such as users associated with:

- Areas on Aging
- Independent Living
- Disability Rights
- Underserved communities

There are specific reasons to include participants from:

- Law enforcement – source of data and future support
- Schools and/or bus drivers – familiarity with location and for future educational efforts
- Neighborhood – familiarity with location and for future advocacy
- Businesses – familiarity with location and financial support or promotion
- Nearby community – regional perspective and extension of knowledge of the process
- KDOT (if highway) – include recommendations in future projects or funding
- Maintenance staff – understand importance and their role
- Local government – responsibilities and funding
- Community groups or public health groups – promotion or advocacy

- Public transit – connectivity issues

Here are some sources of technical assistance through the process that may or may not be included as team members:

- Federal Highway Administration (FHWA)
- KDOT – Bureau of Multimodal Transportation
- Kansas LTAP

Roles and Responsibilities

All team members should commit to the time necessary to prepare for the RSA, such as reviewing material ahead of time. They should also be expected to contribute their thoughts and perspectives. Some specific roles that could be assigned:

- Team Leader – organize and select team
- Note Keeper(s) – to capture team members' input
- Report Writer – can be combined with other roles, but good to identify early in the process

Lesson 6: Meet

Learning Objective:

6. Conduct an RSA team meeting.

Before meeting, data gathered should be distributed to all team members for review, ideally at least a week prior to the team meeting and field review. Items to cover during the meeting itself:

- Introduction of team members with their area of expertise
- Clarify the scope (other issues can be addressed later or at a separate meeting) – stay focused
- Constraints such as design requirements (MUTCD, PROWAG, etc.), laws (yield to pedestrians), ordinances (parking, right turn on red, etc.)
- Crash patterns or other insights from the data

Lesson 7: Prompts

Learning Objective:

7. Identify key items to review using prompts.

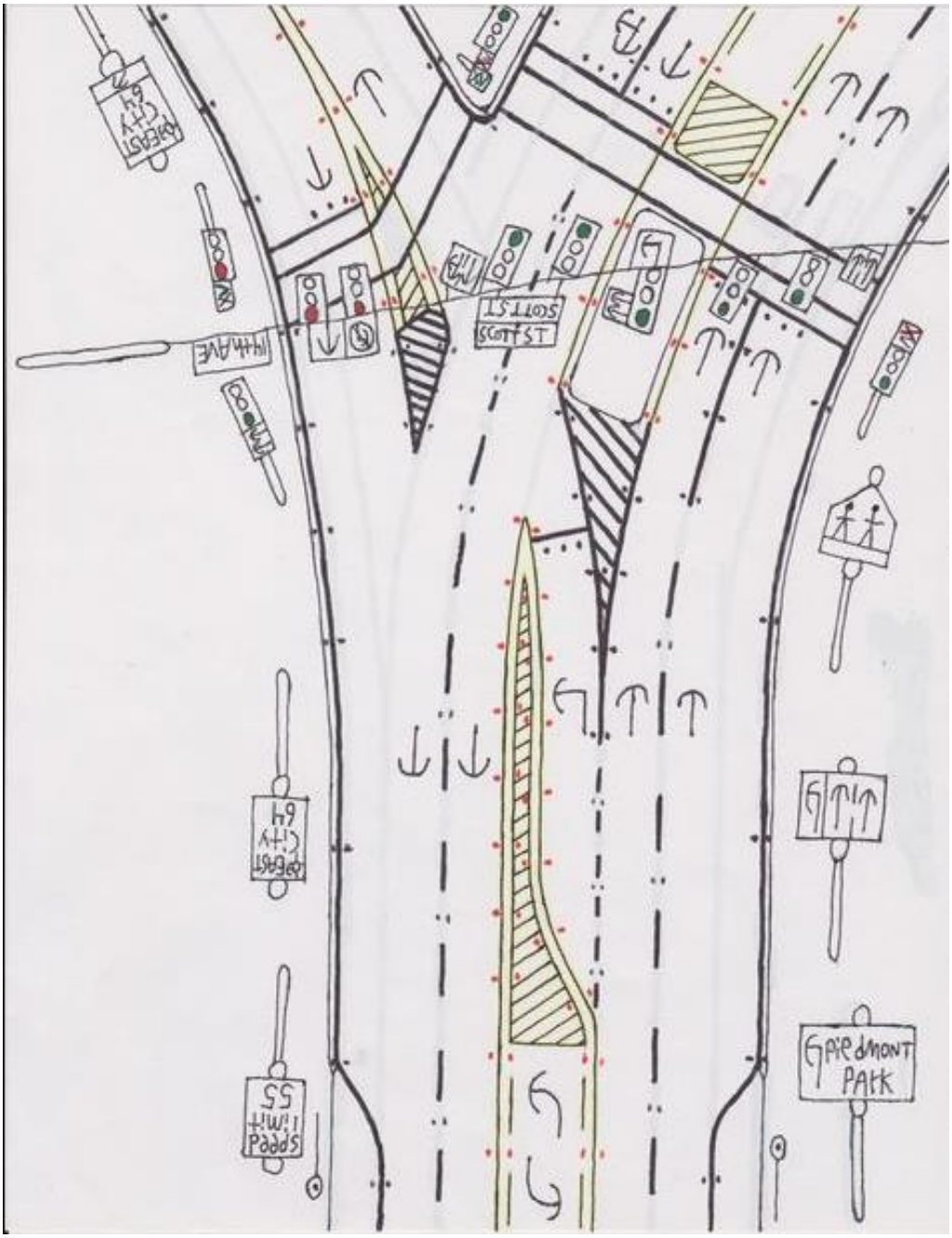
Traverse the route as a group, discussing impressions and concerns. If the focus is a pedestrian or cyclist perspective, walking, biking, or rolling would be appropriate. If the length makes these modes difficult, it is still beneficial to get out of whatever vehicle is used to observe details that would be difficult to experience from a vehicle. See Appendix 2 and Appendix 3 for examples of proven safety countermeasures to consider and example prompt list that can aide in the review.

Examples of things to consider:

- Context Sensitive – is route on a business district, near grocery store, schools, neighborhoods, transit stops, etc.? Are speeds and crossing appropriate for the context?
- Inviting – how does the street feel, do you want to walk on it?
- Connected – where does the path lead, if anywhere?
- Accessible – can someone who is blind, using a walking support device, or pushing a stroller navigate the area?
- Functional inclusions, e.g. benches, landscaping, shade, etc. – what seasonal challenges might be present, e.g. no shade in the heat of summer or excessive amounts of concrete?
- Maintenance – what started out good may not be good today
- Maintenance – dirt, debris, and trash can be significant impairments to navigating even good infrastructure
- Connectivity – gaps in route continuity may lead walkers or cyclists to take risks
- Consistency in devices – avoid user confusion
- Visibility of crossings
- Is there a need to provide infrastructure on both sides of a roadway or is one side adequate?
- Surface inconsistencies – PROWAG has guidelines
- Drainage – if drainage is affected, it can affect the integrity of the pavement
- Lighting, or lack thereof – crash rates are significantly higher in times of darkness
- Traffic control devices (signs, traffic signals, pavement markings) – all should be appropriate and in good condition; see the MUTCD
- Roadway width as well as the width of the right of way

- Vertical and horizontal clearance for pedestrian and cyclist facilities – signs, trees, and street furniture can be limiting
- Overall comfort and the feel of safety
- Consider a nighttime review or reviews during peak and non-peak traffic times
- Taking pictures or video can be a good reference for later and for inclusion in the final report; sketches of important features can also be helpful.

Sketch Example



Discussion Question: Are there items you would add to the prompt lists?

Lesson 8: Data Packets

Learning Objective:

8. Describe the contents of a data packet.

Items to Include

- Agenda/Schedule
- Map
- Crash data; actual reports are optional
- Traffic data
- Prompt lists in format most appropriate for team members (including those with disabilities); consider paper vs. electronic versions
- Space for notes

Lesson 9: Transportation

Learning Objective:

9. Consider transportation needs.

Traversing the route from the perspective of focus users (pedestrians, cyclists, those in wheelchairs, motorists) should be a priority. If the route is too long to walk, for example, in the time allowed, consider splitting the team to walk sections separately.

If the team is traveling in a large vehicle, consider enlisting a driver so that all team members can focus on the review itself.

Lesson 10: Meals

Learning Objective:

10. Describe meal considerations.

Timing

If a team meeting or field review occurs during a mealtime, consider whether observing users is important and make necessary accommodations. For example, in many locations, the lunch hour is one of the busiest times of the day. Staggering lunches may be a good option.

Lesson 11: Personal Protection

Learning Objective:

11. Identify personal protection needs.

Items to consider:

- Safety vests for everyone
- Hats
- Sunscreen
- Umbrellas
- Water
- Bicycle helmets

Lesson 12: Tools

Learning Objective:

12. Identify needed tools.

Tools to consider:

- Cameras
- Writing utensils
- Clipboards
- Measuring equipment (wheel, tape measure, scope meter)
- Level
- Speed gun
- Traffic paint

Part 2 Wrap Up

Learning Outcomes:

3. Identify potential locations.
4. Identify sources of data.
5. Identify potential team members.
6. Conduct an RSA team meeting.
7. Identify key items to review using prompts
8. Describe the contents of a data packet.
9. Consider transportation needs.
10. Describe meal considerations.
11. Identify personal protection needs.
12. Identify needed tools.

Part 3: Field Visit and Discussions

Lesson 13: Lead a Field Review

Learning Objective:

13. Identify key items to review using prompts.

Discussion question: What user perspective will you use as you review the location?

See Appendix 2 and Appendix 3 for examples of pedestrian and bicyclist proven safety countermeasures to consider and example prompt list for ideas of items to look for in the field.

Lesson 14: De-Brief of Field Assessment

Learning Objective:

14. Discuss the field assessment process.

Discussion questions:

- Did anything surprise you during the field review?
- Was the length of the route selected too long or too short for the time allowed?

When selecting a date for the field review, consider timing. For example, for a field review near a school, the review may be most beneficial during the half hour to hour either before or after school or both (traffic is much different before and after school). For other locations, shift changes, lunch times, early evening, or game times may be critical

Discussion Question: Any other items you wish you would have had for the field review?

Lesson 15: Analyze and Report Findings

Learning Objective:

15. Analyze findings.

After the field review, come together as a group to compare observations and make sure all are captured for the report.

- Discuss overall impressions, then specifics (one direction at a time, for example).
- Consider user needs both for today and into the future.
    - Transit connection
    - Push button accessibility
- Note positives as well as negatives.
- Would reallocating the available width improve operations or safety?
- How would any changes recommended affect the larger community?
- Would changes improve consistency or start a trend of improvements?

Lesson 16: Discuss Recommendations

Learning Objective:

16. Consider countermeasures and develop recommendations.

For each issue identified in the findings, discuss possible countermeasures, and make a recommendation. These can be short-term, mid-term, or long-term improvements. Another option is a pilot project at one location that could be expanded based on a successful result and available funding.

Recommendations should be context sensitive. What may be appropriate in a downtown area may not be effective in other areas. Recommendations need not be limited to infrastructure; behavioral improvements could include training or speed management, for example.

Discussion Question: Which part of the process seems most difficult or intimidating?

Part 3 Wrap Up

Learning Outcomes:

13. Lead a field review.
14. Discuss the field assessment process
15. Analyze findings.
16. Consider countermeasures and develop recommendations.

Part 4: Next Steps

Lesson 17: Write Report

Learning Objective:

17. Write a report.

See Appendix 4 for an example RSA Report Outline and Appendix 5 for an example RSA report.

Remember, the report is your communication with those who will read it – local government, citizens, or those providing funding. It will be more engaging with pictures; one or two per issue or recommendation can be beneficial.

The report should be constructive, cooperative, and diplomatic. It should summarize the scope, opportunities, and constraints involved. Other items to include:

- Team members
- Documents used or reviewed
- Date of all meetings and field reviews
- Safety concerns and recommendations

Lesson 18: Advocacy and Funding

Learning Objective:

18. Understand advocacy related to funding.
    - Sharing information
    - Applying for funding

Discussion question: Which groups need to hear the results of an RSA?

What commitment can you make to do something—big or small—to implement some of the tips you learned in this class?

Advocacy

Once the RSA report is written and includes recommendations, the goal is to implement those recommendations. For some recommendations, the team members involved in the RSA may have the authority to initiate the implementation. For other recommendations, approval from others may be needed before implementation. Any team member should be adequately informed to present the recommendations.

One way to present the information could be to pass the written report to local officials. In other cases, a summary could be given orally, with or without a PowerPoint-type presentation. Suggested items include; pictures along the route, descriptions of concerns, sketches of recommendations, and projected costs, if available.

A good practice would be to request a formal response with a time frame and an implementation plan, no matter which presentation format is used.

Funding

Often additional funding is necessary to implement medium to higher cost recommendations. Some locals may be able to add this funding by adjusting their budgets. Others may need funding from outside sources. Most outside sources will require an application along with providing justification (such as the RSA written report).

Some possible sources of funding include:

- Transportation Alternatives Program
    - Safe Routes to Schools
- Highway Safety Improvement Program – Intersections
- Safe Streets and Roads for All (and KDOT's Match Program)
- Cost Share
- Congestion Mitigation
- City Connecting Link Improvement Program
- Innovative Technology Program

The Kansas Infrastructure Hub (www.kshub.org) is a good resource for obtaining guidance regarding funding opportunities at both the state and federal level; limited grant writing assistance is also available.

Part 4 Wrap Up

Learning Outcomes:

17. Write a report.

18. Understand advocacy related to funding.

Discussion Question: What commitment can you make to do something—big or small—to implement some of the tips you learned in this class?

My Notes from Q&A

REMEMBER TO CAPTURE TIPS SHARED BY YOUR CLASSMATES.
YOU MIGHT BE ABLE TO USE THEM IN YOUR JOB, TOO!

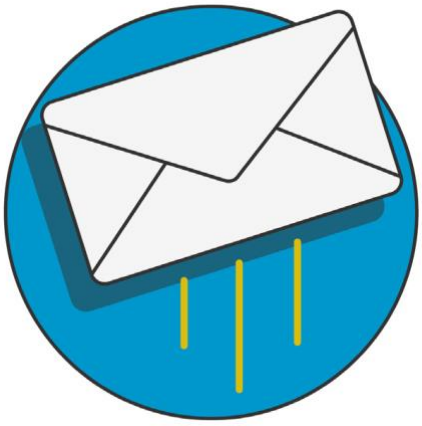
Need More Information?

The Kansas Local Technical Assistance Program (LTAP) provides a comprehensive range of transportation-related training in:

- Safety
- Pavements
- Asset Management
- Bridges
- Budgeting
- Communications
- Roadside maintenance and drainage
- Leadership and supervision
- Weather-related operations

Visit our website to learn more about training and resources. www.ksltap.org

To find out more about what we can do for you, contact one of the Kansas LTAP staff directly.



Lindsay Francis, LTAP Director,
lfrancis@ku.edu

Nelda Buckley, LTAP Local Field Liaison,
nelda.buckley@ku.edu

Appendix

Appendix 1: Definitions

Source: 2020 FHWA.

- Accessible – able to be reached or used by people of all levels of abilities; often used to describe a facility that is, at a minimum, compliant with the Americans with Disabilities Act (ADA)
- Accessible Pedestrian Signal (APS) – a device that communicates information about pedestrian signal timing in a nonvisual format including audible tones, verbal messages, and/or vibrotactile information
- Active Transportation – an umbrella term for all the ways people can get around in an active manner, such as walking, biking, using mobility assistance devices (such as wheelchairs and scooters), in-line skating, skateboarding, and more
- Americans with Disabilities Act of 1990 (ADA) - the Americans with Disabilities Act (ADA) is a comprehensive federal statute that prohibits discrimination against people with disabilities and requires equal opportunity in the areas of employment, transportation, state and local services, programs and activities, public accommodations and communications; federal standards provide guidance on accessible routes, curb ramps,

transit shelters, and other elements of the built environment; for more info, visit www.ada.gov/index.html

- Americans with Disabilities Act Accessibility Guidelines (ADAAG) – provides scoping and technical specifications for new construction and alterations undertaken by entities covered by the ADA
- Annual Average Daily Traffic (AADT) – the total volume of traffic passing a point or segment of a highway facility in both directions for one year divided by the number of days in the year
- Approach – section of the accessible route that flanks the landing of a curb ramp; may be slightly graded if the landing level is below the elevation of the adjoining sidewalk
- Arterial – streets that serve primarily through traffic and provide access to abutting properties as a secondary function; see Principal Arterial and Minor Arterial
- Average Daily Traffic (ADT) – the average 24-hour volume of traffic passing a point or segment of a highway in both directions
- Barrier –some kind of obstacle that prevents movement or access via active transportation; natural barriers could be lakes, rivers, or mountains, while unnatural barriers could be highways, walls, or fences
- Bicycle – a pedal-powered vehicle upon which the human operator sits; includes three- and four-wheeled human-powered vehicles, but not tricycles for children
- Bicycle Boulevard – a street segment, or series of contiguous street segments, that has been modified to accommodate through cycle traffic and minimize through motor traffic
- Bicycle (Bike) Box – a defined and/or colored area at a signalized intersection provided for cyclists to pull in front of waiting traffic; intended to reduce car-cycle conflicts, particularly involving right-turning movements across the path of a bicyclist, and to increase cyclist visibility
- Bicycle Facilities – a general term denoting improvements and provisions to accommodate or encourage cycling, including parking and storage facilities, and shared roadways not specifically defined for bicycle use
- Bicycle Lane or Cycle Lane – a portion of roadway that has been designated for preferential or exclusive use by bicyclists by pavement markings and, if used, signs; intended for one-way travel, usually in the same direction as the adjacent traffic lane, unless designed as a contra-flow lane
- Bicycle Level of Service (BLOS) – a model used to estimate cyclists' average perception of the quality of service of a section of roadway between two intersections
- Bicycle Locker or Cycle Locker – a secure, lockable container used for individual cycle storage

- Bicycle Network - a system of bikeways designated by the jurisdiction having authority; may include cycle lanes, cycle routes, shared use paths, and other identifiable bicycle facilities
- Bicycle (Bike) Path – a facility that is intended for the exclusive use by bicyclists, where a separate, parallel path is provided for pedestrians and other wheeled users; most pathways are shared between cyclists and other uses (see Shared Use Path)
- Bicycle Rack or Bike Rack – a stationary fixture to which a cycle can be securely attached
- Bicycle Route or Bike Route – a roadway or bikeway designated by the jurisdiction having authority, either with a unique route designation or with Bike Route signs, along which cycle guide signs may provide directional and distance information; signs that provide directional, distance, and destination information for cyclists do not necessarily establish a cycle route
- Bicycle Wheel Channel – a channel installed along the side of a stairway to facilitate walking a cycle up or down the stairs
- Bikeway – any type of cycle facility, including paths in separate rights-of-way and on-street bikeways; includes cycle lanes, paved shoulders, signed bike routes, and side paths; regardless of whether such facilities are designated for the exclusive use of bicycles or are to be shared with other transportation modes
- Bikeshare – a service made available by public or private entities where individuals may access shared bicycles on a short-term basis for a price or for free
- Buffered Cycle Lane – cycle lanes with a painted buffer to increase lateral separation between cyclists and motor vehicles
- Bus/Bikeway – a marked lane for exclusive use by buses and cyclists; may also be referred to as a bus/cycle lane
- Capital Improvement Program (CIP) – a short-range plan that identifies and plans for capital projects and related financing options
- Collector – surface street providing land access and traffic circulation within residential, commercial, and industrial areas; gathers traffic from Local Roads and funnels them to the Arterial network
- Commercial Facility – a facility that is intended for nonresidential use by private entities and whose operation brings about commerce
- Complete Streets - roadways that are designed to provide safe and convenient travel along and across streets for all users, including pedestrians, cyclists, riders and drivers of public transportation, as well as drivers of other motor-vehicles, and people of all ages and abilities, including children, older adults, and individuals with disabilities
- Contraflow Bicycle Lane – a cycle lane that allows cyclists to travel the opposite direction of motor vehicle traffic on a one-way street

- Controlled Pedestrian Crossing – a pedestrian crossing where motorists are required to stop by either a STOP sign, traffic signal, or other traffic control device
- Crash Modification Factor (CMF) – a multiplicative factor used to compute the expected number of crashes after implementing a given countermeasure; if available, calibrated or locally developed State estimates may provide a better estimate of effects for the State
- Crash Reduction Factor (CRF) – the percentage crash reduction that might be expected after implementing a given countermeasure at a specific site
- Cross Slope – the slope measured perpendicular to the direction of travel
- Crossing Island – pedestrian refuge within the right-of-way and traffic lanes of a highway or street
- Crosswalk – that part of a roadway at an intersection that is included within the extensions of the lateral lines of the sidewalks on opposite sides of the roadway, measured from the curb line, or in the absence of curbs from the edges of the roadway, or in the absence of a sidewalk on one side of the roadway, the part of the roadway included within the extension of the lateral lines of the sidewalk at right angles to the centerline; also, any portion of a roadway at an intersection or elsewhere that is distinctly indicated for pedestrian crossing by lines or other markings on the surface
- Curb Extension – a roadway edge treatment where the curb line and sidewalk protrude out toward the middle of the roadway to narrow the width of the street in order to create safer and shorter crossing distances for pedestrians while increasing the available space for street furniture, benches, plantings, and trees; sometimes called “bulb outs” or “neckdowns”
- Curb Ramp – a combined ramp and landing to accomplish a change in level at a curb; provides street and sidewalk access to pedestrians using wheelchairs
- Cyclist (Bicyclist, Rider or Cycle Rider) – a person who is riding a bicycle or other cycle type
- Detectable Warning – standardized surface feature built in, or applied to, walking surfaces or other elements to warn pedestrians with vision impairments of hazards on a sidewalk and or loading platform, such as the curb line or drop-off
- Diagonal Curb Ramp – curb ramp positioned at the apex of the curb radius at an intersection, bisecting the corner angle
- Drainage Inlet – site where water runoff from the street or sidewalk enters the storm drain system; the openings to drainage inlets are typically covered by a grate or other perforated surface to protect pedestrians
- Driveway Crossing – extension of sidewalk across a driveway that meets the requirements of ADAAG
- Fatal injury - any injury that results in death to a person within 30 days after the crash in which the injury occurred.

- Feasible – capable of being accomplished with a reasonable amount of effort, cost, or other hardship; regarding ADA compliance, feasibility is determined case–by–case.
- FHWA – Federal Highway Administration
- Flare – sloped surface that flanks a curb ramp and provides a graded transition between the ramp and the sidewalk; flares bridge differences in elevation and are intended to prevent ambulatory pedestrians from tripping; not considered part of the accessible route
- Freeways and Expressways – look very similar to Interstates; have directional travel lanes usually separated by some type of physical barrier; access and egress points are limited to on- and off-ramp locations or a very limited number of at-grade intersections; designed and constructed to maximize their mobility function; abutting land uses are not directly served; principal arterial
- Gap – either (1) a break in continuity of infrastructure (such as a section of sidewalk that is missing between two other segments of sidewalks) or (2) a break in the flow of vehicular traffic, sufficiently long enough for a pedestrian to cross to the other side of the street or to a place of refuge
- Grade – the slope parallel to the direction of travel that is calculated by dividing the vertical change in elevation by the horizontal distance covered, measured in percent
- Grate – a framework of latticed or parallel bars that prevents large objects from falling through a drainage inlet but permits water and some sediment to fall through the slots; wheelchair casters and tires of road cycles can get caught in poorly placed grate openings
- Grade-Separated Crossing – a facility such as overpass, underpass, skywalk, or tunnel that allows pedestrians and motor vehicles to cross each other at different levels
- Guide strip – some type of raised material with grooves that pedestrians with vision impairments use for cane directional cues; for example, guide strips may be used by pedestrians with vision impairments to navigate a crosswalk, track to an emergency exit, or access the door of a light rail system
- Gutter – trough or dip used for drainage purposes that runs along the edge of the street and curb or curb ramp
- Hearing Impairment – condition of partial or total deafness
- High Visibility Crosswalk – a pedestrian crossing location marked by patterns such as wide longitudinal lines parallel to the flow of traffic as described by the Manual on Uniform Traffic Control Devices (MUTCD)
- Highway – a general term denoting a public way for purposes of vehicular travel, including the entire area within the right-of-way
- Highway Safety Improvement Program (HSIP) – a Federal-aid program with the purpose to achieve a significant reduction in traffic fatalities and serious injuries on all public roads, including non-State-owned roads and roads on tribal land; requires a data-driven,

strategic approach to improving highway safety on all public roads with a focus on performance

- Independent Right-of-Way – a general term denoting right-of-way outside the boundaries of a conventional highway
- Infrastructure – any type of physical treatment or facility designed to be used by active transportation modes (biking, walking, skateboarding, using a wheelchair, riding a scooter); examples could be linear, such as sidewalks, trails, or on-street bikeways, or they could be at specific locations, such as curb extensions, pedestrian crossing islands, or marked crosswalks
- Intermodalism – a transportation policy that promotes full development of multiple alternative modes of travel, and encourages the optimization of mode or combination of modes for travel mobility, efficiency, sustainability, economy, and environmental health; the availability, effectiveness, and safety of pedestrian facilities contribute to the achievement of intermodalism
- Intersection – area where two or more pathways or roadways meet
- Interstate – the highest classification of arterials; designed and constructed with mobility and long-distance travel in mind; officially designated by the US Secretary of Transportation and are considered principal arterials
- Kinesthetic – sensory experience derived from the movement of the body or limbs
- Landing – level area of sidewalk at the top or bottom of a ramp
- Local Road – road that serves individual residences or businesses, and/or distributes traffic within a given urban or rural area; not intended for use in long distance travel, except at the origin or destination of the trip; often designed to discourage through traffic
- Locator Tone – a repeating sound informs approaching pedestrians that they are required to push a button to actuate the pedestrian signal; this tone enables pedestrians with vision impairments to locate the pushbutton
- Loop Detector - an inductive (wire) loop embedded in the pavement that detects the presence of a vehicle at a signalized intersection to activate a signal change. Diagonal quadruple loops typically provide the best cycle detection
- Nominal Safety – safety standard based on adherence to design standards
- Marked Crosswalk – a pedestrian crossing that is delineated by crosswalk pavement markings in accordance with the MUTCD
- Median Island – an island in the center of a road that physically separates the directional flow of traffic and can provide pedestrians with a place of refuge and reduce the crossing distance between safety points
- Micromobility – transportation over short distances provided by lightweight, usually single-person vehicles (such as cycles and scooters)

- Mid-Block Crossing – designated crosswalks away from an established intersection provided to facilitate crossings at places where there is a significant pedestrian desire line such as bus stops, parks, and building entrances
- Minimum Clearance Width – the narrowest point on a sidewalk or trail; created when obstacles, such as utility poles or tree roots, protrude into the sidewalk and reduce the design width
- Minor Arterial – provides service for trips of moderate length; serves geographic areas that are smaller than Principal Arterials; offers connectivity to Principal Arterials; provides intra-community continuity
- Mobility – the potential for movement and the ability to get from one place to another using one or more modes of transport to meet daily needs. As such, it differs from accessibility, which refers to the ability to access or reach a desired service or activity
- Mode Split – the percentage of travelers using a particular type of transportation (e.g., driving, biking, walking, transit)
- Multimodal - transportation and land use planning that considers diverse transportation options, typically including walking, cycling, public transit and automobile, and accounts for land use factors that affect accessibility
- National Bike Routes – a national network of cycle routes that may span multiple States or have national or regional significance
- Network –the system of active transportation infrastructure that are connected to enable access to a wide variety of destinations
- New Construction – project where an entirely new facility will be built from the ground up
- Nominal Safety – whether a design or design element meets minimum design criteria based on nation or state standards and guidance documents
- Obstacle – an object that limits the horizontal or vertical passage space, by protruding into the circulation route and reducing the clearance width of a sidewalk
- Off-Road Accommodation - a facility that is separate from the roadway used by motor vehicles; may parallel a roadway or may be separate from a road on an independent alignment; can be separated from pedestrian traffic (bicycle path) or shared with pedestrian traffic (shared use path)
- On-Road Accommodation - a facility that is part of the roadway or traveled way that is typically used by cyclists and/or motor vehicles such as a wide curb lane, bicycle lane, or bikeable shoulder
- Other Principal Arterial – serve major centers of metropolitan areas, provide a high degree of mobility, and can also provide mobility through rural areas; abutting land uses can be served directly
- Parallel Curb Ramp – curb ramp design where the sidewalk slopes down on either side of a landing; require users to turn before entering the street

- Parking Restriction – parking restrictions can include the removal of parking space markings, or the installation of new signs and/or markings that prohibit parking in specific areas
- Passing Space – section of path or sidewalk wide enough to allow two wheelchair users to pass one another or travel abreast
- Path or Pathway – track or route along which pedestrians are intended to travel
- Paved Shoulder - the portion of the roadway contiguous with the traveled way for accommodation of stopped vehicles, for emergency use, and for lateral support of sub-base, base, and surface courses; use by cyclists may be allowed or prohibited based upon specific State and local laws
- Pavement Markings – markings used to convey messages to roadway (or shared use path) users; they indicate which part of the road to use, provide information about conditions ahead, and indicate where passing is allowed
- Pedestrian – any person afoot or using a wheelchair (manual or motorized) or means of conveyance (other than a bicycle) propelled by human power, such as skates or a skateboard
- Pedestrian-Access Route – a continuous, unobstructed path connecting all accessible elements of a pedestrian system that meets the requirements of ADAAG
- Pedestrian-Actuated Traffic Control – pushbutton or other control operated by pedestrians designed to interrupt the prevailing signal cycle to permit pedestrians to cross a signalized intersection or midblock crossing
- Pedestrian Hybrid Beacon (PHB) – a traffic control device with a face that consists of two red lenses above a single yellow lens; unlike a traffic signal, the PHB rests in the dark until a pedestrian activates it via a pushbutton or other form of detection; PHBs are also known as “HAWK” beacons, which is an acronym for High-intensity Activated crossWalK beacons.
- Performance Measure – a metric used to determine progress or setbacks toward achieving a specific goal and objective; usually tracked regularly (e.g., annually) to understand trends
- Perpendicular Curb Ramp – curb ramp design where the ramp path is perpendicular to the edge of the curb
- Placemaking - creating places with a focus on transforming public spaces to strengthen the connections between people and these places; a process centered on people and their needs, aspirations, desires, and visions, which relies strongly on community participation
- Principal Arterial – Interstate, Freeways and Expressways, and Other Principal Arterials
- Protected Intersection – modeled after Dutch intersection design, a protected intersection brings physical protection as cyclists ride through the crossing; has four main elements:

(1) a corner refuge island, (2) a forward stop bar for cyclists, (3) a setback cycle and pedestrian crossing, and (4) a bicycle-friendly signal phasing

- Public Right of Way Accessibility Guidelines (PROWAG) – guidelines from the U.S. Access Board to inform federal, state, and local government agencies on how to make their pedestrian facilities, such as sidewalk, crosswalk, shared use paths, and on-street parking, accessible to people with disabilities
- Rail-Trail – a shared use path, either paved or unpaved, built within the right-of-way of a former railroad
- Rail-with-Trail – a shared use path, either paved or unpaved, built within the right-of-way of an active railroad
- Raised Crosswalk – traffic calming treatment at a pedestrian crossing or crosswalk that raises the entire wheelbase of a vehicle to the level of the sidewalk and spans the entire width of the roadway to encourage motorists to reduce speed; often placed at midblock crossing locations to reinforce pedestrian priority to drivers
- Ramp – sloped transition between two elevation levels
- Rectangular Rapid-Flashing Beacon (RRFB) – RRFBs are pedestrian-actuated conspicuity enhancements used in combination with a pedestrian, school, or trail crossing warning sign to improve safety at uncontrolled, marked crosswalks; the device includes two rectangular-shaped yellow indications, each with an LED-array-based light source, that flash with high frequency when activated; RRFBs are placed on both ends of a crosswalk; if the crosswalk contains a pedestrian refuge island or other type of median, an RRFB should be placed to the right of the crosswalk and on the median (instead of the left side of the crosswalk); the flashing pattern is pedestrian-activated by pushbuttons or automated detection and is unlit when not activated
- Recumbent Bicycle - a bicycle with pedals at roughly the same level as the seat where the operator is seated in a reclined position with their back supported
- Refuge Island – space within a curbed median or channelizing island where pedestrians can wait to continue crossing a roadway; sometimes referred to as a crossing island or pedestrian island
- Right-of-Way – real property rights (whether by fee-simple ownership, by easement, or by other agreement) acquired across land for a public purpose
- Right of Way (Assignment) – the right of one driver or pedestrian to proceed in a lawful manner in preference to another driver or pedestrian
- Road Diet – a roadway reconfiguration that can result in a reduction in the number or width of travel lanes; the space gained is typically put to other uses and travel modes
- Road Safety Assessment/Audit (RSA) – the formal safety performance examination of an existing or future road or intersection by an independent, multidisciplinary team; it qualitatively estimates and reports on potential road safety issues and identifies opportunities for improvements in safety for all road users

- Roadway – the portion of the highway, including shoulders, intended for vehicular use
- Roundabout – a type of circular intersection that provides yield control to all entering vehicles and features channelized approaches and geometry to encourage reduced travel speeds through the circular roadway
- Rumble Strips – a textured or grooved pavement treatment designed to create noise and vibration to alert motorists of a need to change their path or speed; longitudinal rumble strips are sometimes used on or along shoulders or center lines of highways to alert motorists who stray from the appropriate traveled way; transverse rumble strips are placed on the roadway surface in the travel lane, perpendicular to the direction of travel
- Rural – areas outside the boundaries of urban areas
- Separated Bicycle (Bike) Lane – one- or two-way bikeway that combines the user experience of a side path with the on-street infrastructure of a conventional cycle lane; physically separated from both motor vehicle and pedestrian traffic with a vertical element (curbs, flex posts, or on-street parking)
- Suspected Serious Injury - any injury other than fatal which results in one or more of the following: severe laceration resulting in exposure of underlying tissues/muscle/organs or resulting in significant loss of blood; Broken or distorted extremity (arm or leg); crush injuries; suspected skull, chest or abdominal injury other than bruises or minor lacerations; significant burns (second and third degree burns over 10% or more of the body); unconsciousness when taken from the crash scene; paralysis (loss of the ability to move or feel in part or most of the body)
- Shared Lane – a lane of a traveled way that is open to both cycle and motor vehicle travel; a narrow travel lane (less than 14 feet) does not allow cyclists and motorists to travel side-by-side; a wide curb lane (at least 14 feet) allows cyclists to travel side-by-side within the same traffic lane
- Shared Lane Marking (or “sharrows”) – pavement marking symbols that assist cyclists with lateral positioning in lanes and that denote shared cycle and motor vehicle travel lanes
- Shared Roadway – a roadway that is open to both cycle and motor vehicle travel; any existing street where cycles are not prohibited
- Shared Use Path (also commonly referred to as trails, greenways, or multi-use paths) – paths designed for and generally used by cyclists, pedestrians, and other non-motorized users; physically separated from motor vehicle traffic by an open space or barrier and either within the highway right-of-way or within an independent right-of-way; most shared use paths are designed for two-way travel
- Shoulder – the portion of the roadway contiguous with the traveled way that accommodates stopped vehicles, emergency use, and lateral support of subbase, base, and surface courses; paved shoulders are often used by cyclists
- Shy Distance – area along sidewalk closest to buildings, retaining walls, curbs, and fences generally avoided by pedestrians

- Side path – a shared use path located immediately adjacent and parallel to a roadway; physically separated from the travel lanes using elements such as a curb, flex post, or on-street parking; designed to support and encourage pedestrian use where an on-road cycle facility, like a separated bicycle lane, exists
- Sidewalk – a paved pathway paralleling a street or highway right-of-way, beyond the curb or edge of roadway pavement, which is intended for use by pedestrians
- Sight Distance – the length of roadway visible to a driver or pedestrian; the distance a person can see along an unobstructed line of sight
- Signed Shared Roadway (Signed Bike Route) – a shared roadway that has been designated by signing as a preferred route for bicycle use
- Sloping Curb – a curb with a sloping face, usually on the order of 30-to-45 degrees from vertical, that can be traversed in emergency situations
- Speed Management - a set of measures to limit the negative effects of excessive and inappropriate speeds
- Substantive Safety – actual or expected roadway safety performance; may be quantified in terms of crash frequency, crash rate, crash type, and/or crash severity
- Suburban – built up area surrounding a core urban area
- Tactile Warning – change in surface condition providing a tactile cue to alert pedestrians with vision impairments of a potentially hazardous situation
- Touch Technique – environmental scanning method in which a blind person arcs a cane from side to side and touches points outside both shoulders; used primarily in unfamiliar or changing environments, such as on sidewalks and streets
- Toward Zero Deaths (TZD) – a traffic safety framework that seeks to eliminate highway fatalities by engaging diverse safety partners and technology to address traffic safety culture
- Traffic Calming – a strategy to slow the speed of motor vehicle traffic to a “desired speed” by incorporating physical features, such as chicanes, mini traffic circles, speed humps, and curb extensions.
- Transportation Agency - Federal, state, or local government entity responsible for planning and designing transportation systems and facilities for a particular jurisdiction
- Transportation Demand Management (TDM) – a set of strategies aimed at maximizing traveler choices; providing travelers, regardless of whether they drive alone, with travel choices, such as work location, route, time of travel, and mode to improve travel reliability
- Traveled Way – the portion of the roadway intended for the movement of vehicles, exclusive of shoulders, bike lanes, and sidewalks immediately inside of the shoulder
- Truncated Domes – small domes with flattened tops used as tactile warning at transit platforms and at other locations where a tactile warning is needed

- Two-Stage Turn Queue Boxes – designated areas in an intersection that provide a safe way to make left turns at from a right-side cycle lane, or right turns from a left side bike lane
- Uncontrolled Pedestrian Crossing – an established pedestrian crossing that does not include a traffic signal, pedestrian hybrid beacon, or STOP sign to require that motor vehicles stop before entering the crosswalk
- Unpaved Path – a path not surfaced with a hard, durable surface such as asphalt or Portland cement concrete
- Urban – places within boundaries set by state and local officials, having a population of 5,000 or more; often densely populated and containing a high density of built structures
- U.S. Access Board (United States Architectural and Transportation Barriers Compliance Board) – independent Federal agency responsible for developing Federal accessibility guidelines under the ADA and other laws
- Vehicle Queue – a line of stopped vehicles in a single travel lane, commonly caused by traffic control at an intersection
- Vertical Clearance – minimum unobstructed vertical passage space required along a sidewalk or trail; often limited by obstacles such as building overhangs, tree branches, signs, and awnings
- Vertical Curb – a steep-faced curb, designed with the intention of discouraging vehicles from leaving the roadway
- Vibrotactile Pedestrian Device – device that communicates information about pedestrian timing through a vibrating surface by touch
- Vision Impairment – loss or partial loss of vision
- Vision Zero – similar to TZD, a vision to eliminate traffic fatalities and serious injuries within the transportation system; employs comprehensive strategies to address roadway design, traffic behavior, and law enforcement
- Visual Warning – use of contrasts in surface to indicate a change in environment, as at a curb ramp where the sidewalk changes to the street
- Vulnerable Road User (VRU) – anyone walking, biking, or rolling by non-motorized forms of transportation on public roads
- Walk Interval – traffic signal phase in which the WALKING PERSON (symbolizing WALK) signal indication is displayed
- Walkable – an area or a route that is suitable or safe for walking
- Walking – an inclusive term that includes both ambulatory and non-ambulatory modes; encompasses all forms of mobility devices, including using a wheelchair, cane, walker, or other mobility device that allows the user to travel at human speed

- Wayfinding – a system of directional signs or audible or tactile elements along streets or paths that assist people in finding major destinations; can be designed specifically for drivers, cyclists, or pedestrians
- Width, Sidewalk – total width of a sidewalk including obstructions and beginning at the edge of a roadway to the side of a building; *clear width* is the portion of sidewalk that excludes obstructions and any attached curb; *effective width* is the portion of clear width that excludes any shy distances
- Woonerf – a common space to be shared by pedestrians, cyclists, and low-speed motor vehicles; usually narrow streets without curbs and sidewalks; plantings, street furniture, and other obstacles are placed so as to discourage and inhibit through traffic movements

Appendix 2: Proven Safety Countermeasures for VRU's

A. Crosswalk Visibility Enhancements (Tech Sheet)
B. Pedestrian Hybrid Beacon (Tech Sheet)
C. Raised Crosswalk (Tech Sheet)
D. Road Diet (Tech Sheet)
E. Rectangular Rapid-Flashing Beacon (Tech Sheet)

Crosswalk Visibility Enhancements

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COUNTERMEASURE TECH SHEET

This example combines curb extensions, high-visibility markings, overhead lighting, and in-street signs on a two-lane roadway.

This group of countermeasures includes improved lighting, advance or in-street warning signage, pavement markings, and geometric design elements. Such features may be used in combination to indicate optimal or preferred locations for people to cross and to help reinforce the driver requirement to yield the right-of-way to pedestrians at crossing locations.

For multi-lane roadway crossings where vehicle AADTs are in excess of 10,000, a marked crosswalk alone is typically not sufficient (Zegeer, 2005). Under such conditions, more substantial crossing improvements are also needed to prevent an increase in pedestrian crash potential. Examples of more substantial treatments include the refuge island, PHB, and RRFB.

Poor lighting conditions, obstructions such as parked cars, and horizontal or vertical roadway curvature can reduce visibility at crosswalks, contributing to higher crash rates.

Crosswalk visibility enhancements help make crosswalks and/or pedestrians more visible and can help pedestrians decide where to cross.

Crosswalk visibility enhancements can reduce crashes by

23–48%

FEATURES:

- High visibility marking improves visibility of the crosswalk compared to the standard parallel lines.
- Parking restriction on the crosswalk approach improves the sightlines for motorists and pedestrians.
- Advance STOP or YIELD markings & signs reduce the risk of a multiple threat crash.
- Curb extension improves sight distance between drivers and pedestrians and narrows crossing distance.
- In street STOP or YIELD signs may improve driver yielding rates.

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Crosswalk Visibility Enhancements

EDC-4 STEP: https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/step.cfm

High-visibility crosswalk marking. High-visibility crosswalks are preferred over parallel line crosswalks and should be provided at all established midblock pedestrian crossings. They should also be considered at uncontrolled intersections.

Parking restriction on the crosswalk approach. Parking restriction can include the removal of parking space markings, installation of new "parking prohibition" pavement markings or curb paint, and signs. The minimum setback is 20 feet in advance of the crosswalk where speeds are 25 mph or less, and 30 feet where speeds are between 26 and 35 mph.

Advance YIELD or STOP markings and signs.[1] The stop bar or "sharks teeth" yield markings are placed 20 to 50 feet in advance of a marked crosswalk to indicate where vehicles are required to stop or yield in compliance with the accompanying "STOP Here for Pedestrians" or "YIELD Here to Pedestrians" sign.

Curb extension. This treatment, also referred to as bulb-outs, extends the sidewalk or curb line out into the parking lane, which reduces the effective street width. Curb extensions must not extend into travel lanes and should not extend across bicycle lanes.

Improved nighttime lighting. Consideration should be given to placing lights in advance of midblock and intersection crosswalks on both approaches to illuminate the front of the pedestrian and avoid creating a silhouette.

In-street STOP or YIELD to pedestrian sign.[2] These signs serve to remind road users of laws regarding right-of-way, and they may be appropriate on 2-lane or 3-lane roads where speeds limits are 30 mph or less. The sign can be placed in between travel lanes or in a median.

COST

Countermeasure	Range	Average
High visibility crosswalk marking	$600-5,700 each	$2,540 each
Lighting	*Varies based on fixture type and utility service agreement*	
Parking restriction	*Varies based on the required signs and pavement markings*	
Curb extension	$2,000-20,000	$13,000 each
Advance STOP/YIELD sign	N/A	$300 each
Advance STOP/YIELD line	N/A	$320 each
In-street STOP/YIELD sign	N/A	$240 each

[1]MUTCD section 2B.12 In-Street and Overhead Pedestrian Crossing Signs (R1-6, R1-6a, R1-9, and R1-9a)

[2]MUTCD reference:Section 2B.11 Yield Here To Pedestrians Signs and Stop Here For Pedestrians Signs (R1-5 Series)

References

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Zegeer, C., R. Srinivasan, B. Lan, D. Carter, S. Smith, C. Sundstrom, N.J. Thirsk, J. Zegeer, C. Lyon, E. Ferguson, and R. Van Houten. (2017). NCHRP Report 841: Development of Crash Modification Factors for Uncontrolled Pedestrian Crossing Treatments. Transportation Research Board, Washington, D.C.

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- Marked Crosswalks and Enhancements: http://www.pedbikesafe.org/PEDSAFE/countermeasures_detail.cfm?CM_NUM=4
- Lighting and Illumination: http://www.pedbikesafe.org/PEDSAFE/countermeasures_detail.cfm?CM_NUM=8
- Parking Restrictions: http://www.pedbikesafe.org/PEDSAFE/countermeasures_detail.cfm?CM_NUM=9
- Curb Extensions: http://www.pedbikesafe.org/PEDSAFE/countermeasures_detail.cfm?CM_NUM=5
- Advance Stop/Yield Lines: http://www.pedbikesafe.org/PEDSAFE/countermeasures_detail.cfm?CM_NUM=13

Pedestrian Hybrid Beacon (PHB)

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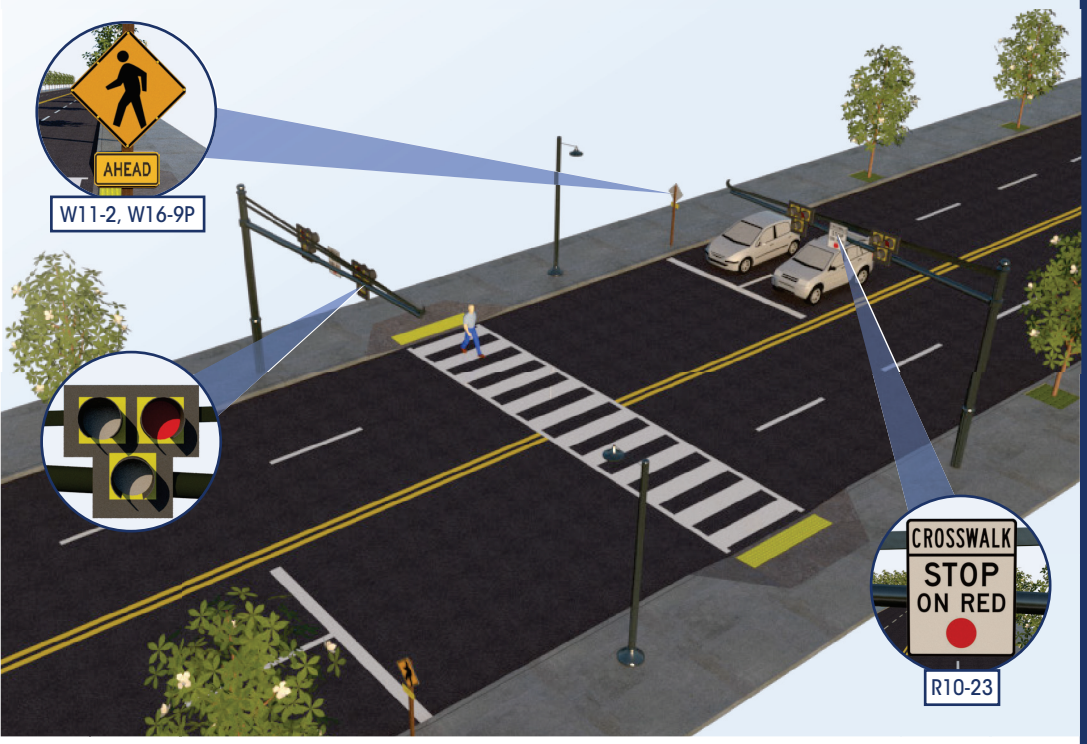
COUNTERMEASURE TECH SHEET



A Pedestrian Hybrid Beacon head consists of two red lenses above a single yellow lens. Unlike a traffic signal, the PHB rests in dark until a pedestrian activates it via pushbutton or other form of detection. When activated, the beacon displays a sequence of flashing and solid lights that indicate the pedestrian walk interval and when it is safe for drivers to proceed (see figure on back page).

The PHB is often considered for installation at locations where pedestrians need to cross and vehicle speeds or volumes are high, but traffic signal warrants are not met. These devices have been successfully used at school crossings, parks, senior centers, and other pedestrian crossings on multilane streets. PHBs are typically installed at the side of the road or on mast arms over midblock pedestrian crossings.

High speeds and multiple lanes of traffic create challenges for pedestrians crossing at unsignalized locations.

PHBs can warn and control traffic at unsignalized locations and assist pedestrians in crossing a street or highway at a marked crosswalk.

PHBs can reduce pedestrian crashes by **55%**

FEATURES:

- Beacons stop all lanes of traffic, which can reduce pedestrian crashes.

OFTEN USED WITH:

- High-visibility crosswalk markings
- Raised islands
- Advance STOP or YIELD signs and markings

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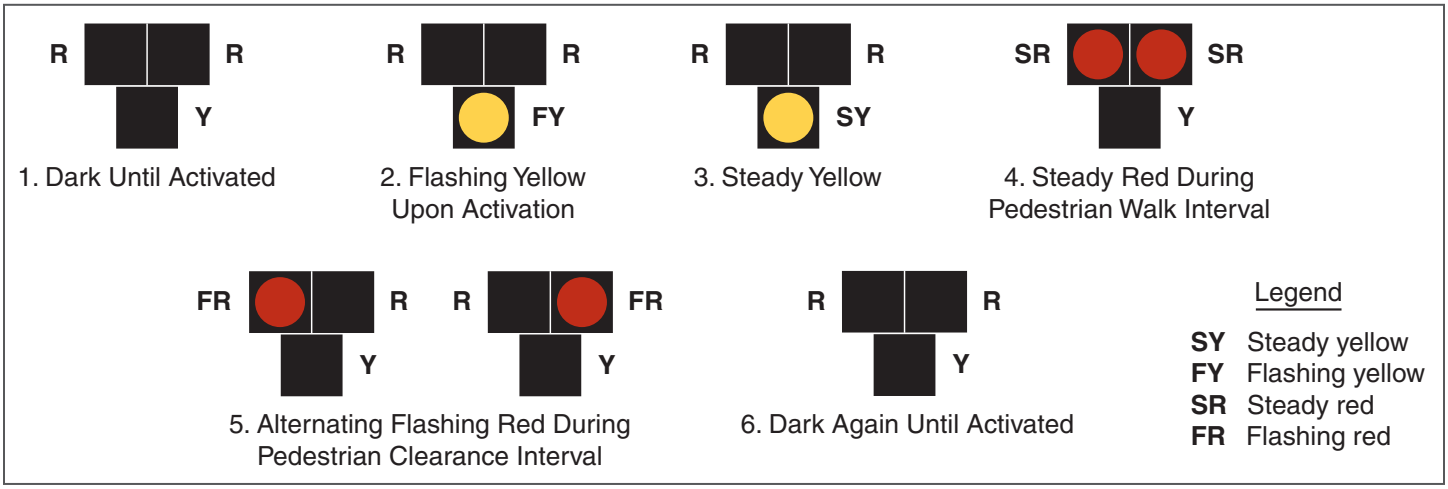
Pedestrian Hybrid Beacon (PHB)

EDC-4 STEP: https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/step.cfm

Figure 4F-3. Sequence for a Pedestrian Hybrid Beacon from FHWA's *Manual on Uniform Traffic Control Devices*, 2009 Edition, p. 511



When a pedestrian activates a PHB, a flashing yellow light is followed by a solid yellow light, alerting drivers to slow. A solid red light requires drivers to stop while pedestrians have the right-of-way to cross the street. When the pedestrian signals display a flashing DON'T WALK indication, the overhead beacon flashes red, and drivers may proceed if the crosswalk is clear.

CONSIDERATIONS

PHBs are a candidate treatment for roads with three or more lanes that generally have annual average daily traffic (AADT) above 9,000. PHBs should be strongly considered for all midblock and intersection crossings where the roadway speed limits are equal to or greater than 40 miles per hour (mph). The PHB should meet the application guidelines provided in the Manual on Uniform Traffic Control Devices for existing or projected pedestrian volumes.

PHBs are intended for installation at midblock locations, but can be installed at intersections. They should only be installed in conjunction with marked crosswalks and pedestrian countdown signals.

When PHBs are not in common use in a community, consider conducting an outreach effort to educate the public and law enforcement officers on the PHBs' purpose and use.

COST

The PHB is often less expensive than a full traffic signal installation. The costs range from $21,000 to $128,000, with an average per unit cost of $57,680.

References

Zegeer, C., R. Srinivasan, B. Lan, D. Carter, S. Smith, C. Sundstrom, N.J. Thirsk, J. Zegeer, C. Lyon, E. Ferguson, and R. Van Houten. (2017). NCHRP Report 841: Development of Crash Modification Factors for Uncontrolled Pedestrian Crossing Treatments. Transportation Research Board, Washington, D.C.

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Raised Crosswalk

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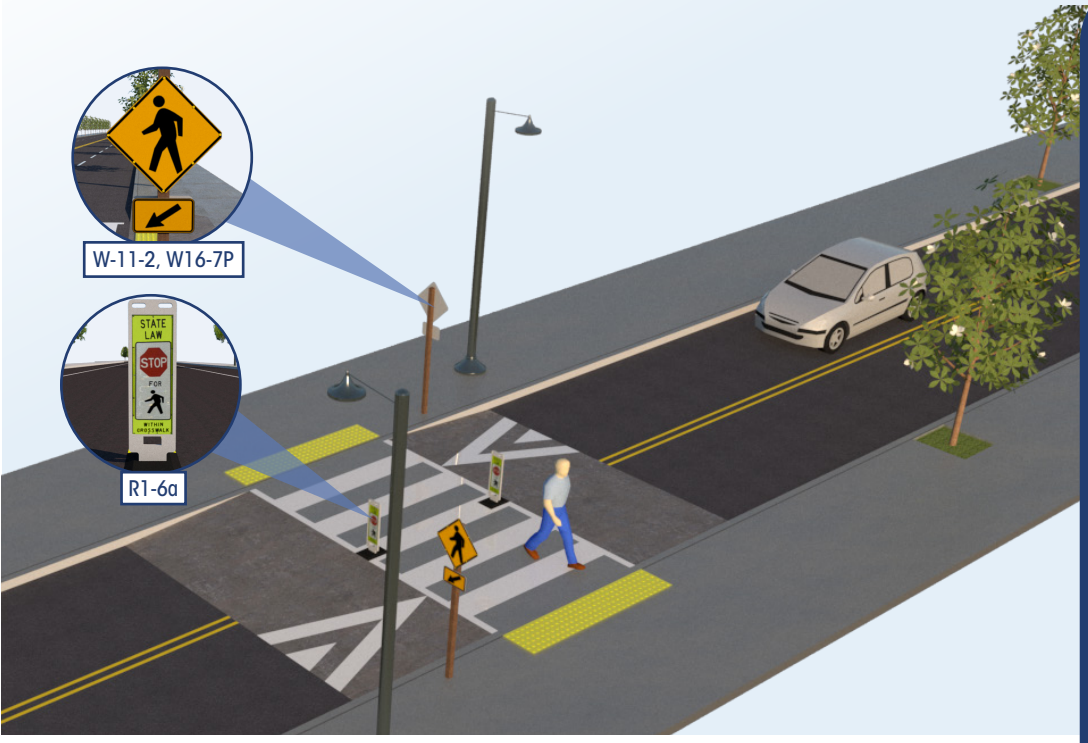
COUNTERMEASURE TECH SHEET



Raised crosswalks are ramped speed tables spanning the entire width of the roadway, often placed at midblock crossing locations. The crosswalk is demarcated with paint and/or special paving materials. These crosswalks act as traffic-calming measures that allow the pedestrian to cross at grade with the sidewalk.

In addition to their use on local and collector streets, raised crosswalks can be installed in campus settings, shopping centers, and pick-up/drop-off zones (e.g., airports, schools, transit centers).

Raised crosswalks are flush with the height of the sidewalk. The crosswalk table is typically at least 10 feet wide and designed to allow the front and rear wheels of a passenger vehicle to be on top of the table at the same time. Detectable warnings (truncated domes) and curb ramps are installed at the street edge for pedestrians with impaired vision.

Local and collector roads with high speeds pose a significant challenge for pedestrians crossing the roadway.

A raised crosswalk can reduce vehicle speeds and enhance the pedestrian crossing environment.

Raised crosswalks can reduce pedestrian crashes by

45%

FEATURES:

- Elevated crossing makes the pedestrian more prominent in the driver's field of vision, and allows pedestrians to cross at grade with the sidewalk
- Approach ramps may reduce vehicle speeds and improve motorist yielding

OFTEN USED WITH:

- Crosswalk visibility enhancements

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Raised Crosswalk

EDC-4 STEP: https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/step.cfm

Boston, MA. Photo: Peter Furth / nacto.org

CONSIDERATIONS

Raised crosswalks are typically installed on 2-lane or 3-lane roads with speed limits of 30 mph or less and annual average daily traffic (AADT) below about 9,000. Raised crossings should generally be avoided on truck routes, emergency routes, and arterial streets.

Drainage can be an issue. Raised crosswalks may be installed with curb extensions where parking exists. They may also be used at intersections, particularly at the entrance of the minor street.

Since this countermeasure can cause discomfort and noise (especially with larger vehicles), it may be appropriate to get public buy-in. Raised crosswalks may not be appropriate for bus transit routes or primary emergency vehicle routes. For States that experience regular snowfall, snowplowing can be a concern.

COST

The cost associated with a raised crosswalk ranges from $7,110 to $30,880 each, with the average cost estimated at $8,170.

References

Federal Highway Administration. (2013). "Raised Pedestrian Crossings" in PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System. Available: http://www.pedbikesafe.org/PEDSAFE/countermeasures_detail.cfm?CM_NUM=7

Thomas, L., Thirsk, N. J., & Zegeer, C. (2016). NCHRP Synthesis 498: Application of Pedestrian Crossing Treatments for Streets and Highways. Transportation Research Board, Washington D.C.

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Road Diet

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COUNTERMEASURE TECH SHEET

Multilane roads can take longer to cross and vehicle speeds may be high.

Road Diets can decrease the lane crossing distance and reduce vehicle speeds.

Road Diets can reduce total crashes by

19–47%*

*19% in urban areas, 47% in suburban areas.

FEATURES:

- Reduced crossing distance and exposure.
- Reduced vehicle speeds.
- Promote Complete Streets.
- Provide space for installing curb extensions and widening sidewalks.
- Create space for bicycle, transit, and/or parking lanes.

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Road Diet

EDC-4 STEP: https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/step.cfm

A typical Road Diet converts an existing four-lane, undivided roadway to two through lanes and a center, two-way left turn lane. This design allows left-turning drivers to exit the traffic stream while waiting for a gap to complete their turn and frees up space that can be reallocated to other uses, including:

- Pedestrian refuge island
- Crosswalk visibility enhancements, such as curb extensions
- On-street parking, with parking restrictions on crosswalk approaches
- Widened sidewalks and landscaped buffers
- Bicycle lane and/or transit lanes

A Road Diet can be a relatively low-cost safety solution, particularly where only pavement marking modifications are required to implement the reconfigured roadway design. When planning in conjunction with reconstruction or overlay projects, the change in cross section may be completed without any additional cost.

CONSIDERATIONS

While Road Diets are effective countermeasures for midblock collisions, they are not recommended for all multilane roadways. Typically, a suitable roadway has a current and future average daily traffic (ADT) equal to or less than about 20,000. In some instances, Road Diets have been successfully used on roads with ADTs as high as 25,000.

FHWA's Road Diet Informational Guide provides a closer look at the safety and operational benefits of Road Diets to help agencies determine if this countermeasure may suit their needs. Communities will need to consider a range of factors, including:

- Vehicle speed
- Level of Service (LOS)
- Quality of Service
- Vehicle volume (ADT)
- The operation and volume of pedestrians, bicyclists, transit, and freight
- Peak hour and peak direction traffic flow
- Vehicle turning volumes and patterns
- Frequency of stopping and slow moving vehicles
- Presence of parallel roadways

Since Road Diets may be new or uncommon in a community, consider conducting an outreach effort to educate the public on the purpose and potential benefits.

COST

The cost associated with a Road Diet can vary widely. Restriping costs for the three lanes plus bicycle lanes are estimated at $25,000 to $40,000 per mile, depending on the amount of lane lines that need to be repainted. When a Road Diet involves geometric features like extended sidewalks, curb extensions, a raised median or refuge island, the costs can increase to $100,000 or more per mile.

References

Pawlovich, M.D., W. Li, A. Carriquiry, and T. Welch. "Iowa's Experience with Road Diet Measures—Use of Bayesian Approach to Assess Impacts on Crash Frequencies and Crash Rates." Transportation Research Record: Journal of the Transportation Research Board, No. 1953, Transportation Research Board, Washington, D.C., 2006.

Persaud, B., B. Lan, C. Lyon, and R. Bhim. "Comparison of empirical Bayes and full Bayes approaches for before–after road safety evaluations." Accident Analysis & Prevention, Volume 42, Issue 1, 2010, pp. 38-43.

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Federal Highway Administration. (2013). "Lane Reduction (Road Diet)" in PEDSAFE: Pedestrian Safety Guide and Countermeasure Selection System. Available: http://www.pedbikesafe.org/PEDSAFE/countermeasures_detail.cfm?CM_NUM=19

Rectangular Rapid-Flashing Beacon (RRFB)

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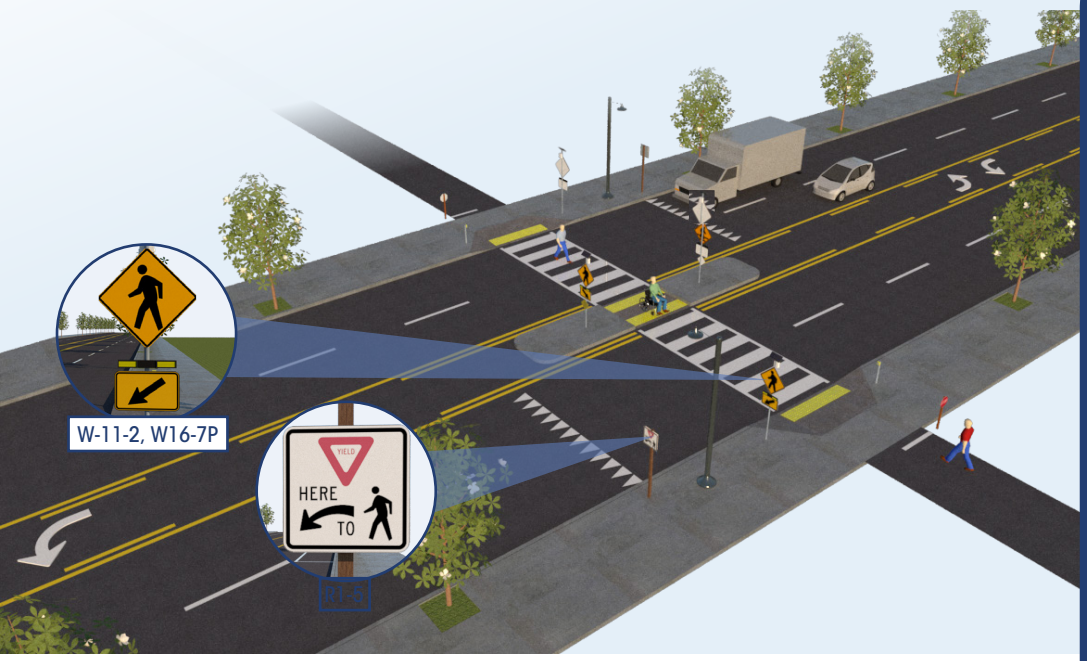
COUNTERMEASURE TECH SHEET



RRFBs are pedestrian-actuated conspicuity enhancements used in combination with a pedestrian, school, or trail crossing warning sign to improve safety at uncontrolled, marked crosswalks. The device includes two rectangular-shaped yellow indications, each with an LED-array-based light source, that flash with high frequency when activated.

The RRFB is a treatment option at many types of established pedestrian crossings. Research indicates RRFBs can result in motorist yielding rates as high as 98 percent at marked crosswalks. However, yielding rates as low as 19 percent have also been noted. Compliance rates varied most per the city location, posted speed limit, crossing distance, and whether the road was one- or two-way. RRFBs are particularly effective at multilane crossings with speed limits less than 40 mph. Consider the Pedestrian Hybrid Beacon (PHB) instead for roadways with higher speeds. FHWA's *Guide for Improving Pedestrian Safety at Uncontrolled Crossing Locations* (HSA-17-072) provides specific conditions where practitioners should strongly consider the PHB instead of the RRFB.

Multiple lanes of traffic create challenges for pedestrians crossing at unsignalized locations.

RRFBs can make crosswalks and/or pedestrians more visible at a marked crosswalk.

RRFBs can reduce pedestrian crashes by **47%**

FEATURES:

- Enhanced warning improves motorist yielding

OFTEN USED WITH:

- Crosswalk visibility enhancements
- Pedestrian refuge island
- Advance STOP or YIELD markings and signs

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Rectangular Rapid-Flashing Beacon (RRFB)

EDC-4 STEP: https://www.fhwa.dot.gov/innovation/everydaycounts/edc_4/step.cfm

Princeton, NJ. Photo: VHB

CONSIDERATIONS

FHWA has issued interim approval for the use of the RRFB (IA-21). State and local agencies must request and receive permission to use this interim approval before they can use the RRFB. IA-21 does not provide guidance or criteria based on number of lanes, speed, or traffic volumes.

RRFBs are placed on both ends of a crosswalk. If the crosswalk contains a pedestrian refuge island or other type of median, an RRFB should be placed to the right of the crosswalk and on the median (instead of the left side of the crosswalk).

RRFBs typically draw power from standalone solar panel units, but may also be wired to a traditional power source. IA-21 provides conditions for the use of accessible pedestrian features with the RRFB assembly. When RRFBs are not in common use in a community, consider conducting an outreach effort to educate the public and law enforcement officers on their purpose and use.

COST

The cost associated with RRFB installation ranges from $4,500 to $52,000 each, with the average cost estimated at $22,250. These costs include the complete system installation with labor and materials.

References

MUTCD section 2B.12 In-Street and Overhead Pedestrian Crossing Signs (R1-6, R1-6a, R1-9, and R1-9a).

Fitzpatrick, K., M. Brewer, R. Avelar, and T. Lindheimer. "Will You Stop for Me? Roadway Design and Traffic Control Device Influences on Drivers Yielding to Pedestrians in a Crosswalk with a Rectangular Rapid-Flashing Beacon." Report No. TTI-CTS-0010. Texas A&M Transportation Institute, College Station, Texas. June 2016. https://static.tti.tamu.edu/tti.tamu.edu/documents/TTI-CTS-0010.pdf

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Appendix 3: Prompt Lists

A. NHTSA Walkability Checklist

B. AARP Sidewalks, Streets and Crossings Walking Audit

C. AARP Public Transit Access

Appendix 3A

Take a walk and use this checklist to rate your neighborhood's walkability.

How walkable is your community?

Location of walk _____

_____

Rating Scale:

1. Did you have room to walk?

☐ Yes ☐ Some problems:

- ☐ Sidewalks or paths started and stopped
- ☐ Sidewalks were broken or cracked
- ☐ Sidewalks were blocked with poles, signs, shrubbery, dumpsters, etc.
- ☐ No sidewalks, paths, or shoulders
- ☐ Too much traffic
- ☐ Something else _____

Locations of problems: _____

Rating: (circle one)
1 2 3 4 5 6

_____

_____

2. Was it easy to cross streets?

☐ Yes ☐ Some problems:

- ☐ Road was too wide
- ☐ Traffic signals made us wait too long or did not give us enough time to cross
- ☐ Needed striped crosswalks or traffic signals
- ☐ Parked cars blocked our view of traffic
- ☐ Trees or plants blocked our view of traffic
- ☐ Needed curb ramps or ramps needed repair
- ☐ Something else _____

Locations of problems: _____

Rating: (circle one)
1 2 3 4 5 6

_____

_____

3. Did drivers behave well?

☐ Yes ☐ Some problems: Drivers...

- ☐ Backed out of driveways without looking
- ☐ Did not yield to people crossing the street
- ☐ Turned into people crossing the street
- ☐ Drove too fast
- ☐ Sped up to make it through traffic lights or drove through traffic lights?
- ☐ Something else _____

Locations of problems: _____

Rating: (circle one)
1 2 3 4 5 6

_____

_____

4. Was it easy to follow safety rules? Could you and your child...

☐ Yes	☐ No	Cross at crosswalks or where you could see and be seen by drivers?
☐ Yes	☐ No	Stop and look left, right and then left again before crossing streets?
☐ Yes	☐ No	Walk on sidewalks or shoulders facing traffic where there were no sidewalks?
☐ Yes	☐ No	Cross with the light?

Locations of problems: _____

Rating: (circle one)
1 2 3 4 5 6

_____

_____

5. Was your walk pleasant?

☐ Yes ☐ Some unpleasant things:

- ☐ Needed more grass, flowers, or trees
- ☐ Scary dogs
- ☐ Scary people
- ☐ Not well lighted
- ☐ Dirty, lots of litter or trash
- ☐ Dirty air due to automobile exhaust
- ☐ Something else _____

Locations of problems: _____

Rating: (circle one)
1 2 3 4 5 6

_____

_____

How does your neighborhood stack up? Add up your ratings and decide.

1. _____
2. _____
3. _____
4. _____
5. _____

Total _____

26–30	Celebrate! You have a great neighborhood for walking.
21–25	Celebrate a little. Your neighborhood is pretty good.
16–20	Okay, but it needs work.
11–15	It needs lots of work. You deserve better than that.
5–10	It's a disaster for walking!

Now that you've identified the problems, go to the next page to find out how to fix them.

Appendix 3B

AARP Walk Audit Tool Kit Worksheet

Sidewalks, Streets and Crossings

SINGLE-LOCATION AUDIT

Community Name: _____

Location/Street Name(s): _____

Audit date: _____ **Start time:** _____ AM | PM **End time:** _____ AM | PM

Posted speed limit(s): _____ **Do the motorists appear to be obeying the speed limit(s)?** _____

Total number of vehicle lanes: _____ **The street is:** ☐ one-way | ☐ two-way

If more than one lane: Does the roadway have ☐ a median and/or ☐ a pedestrian island?

The street has:

☐ no sidewalk
☐ no sidewalk but needs one
☐ no sidewalk but needs two
☐ partial sidewalks
☐ a sidewalk on one side of the street
☐ sidewalks on both sides of the street

YES | NO | OTHER Skip any statements that don't apply

THE SIDEWALK:

☐ ☐ ☐ 1. Is separated from the street by a barrier or buffer (a curb, grass, landscaping)
☐ ☐ ☐ 2. Is surfaced with a material that is smooth and consistent (e.g., or asphalt rather than bricks)
☐ ☐ ☐ 3. Is in good condition, without cracks or raised sections
☐ ☐ ☐ 4. Is free of obstacles (hydrants, utility poles, overgrown landscaping, trash receptacles)
☐ ☐ ☐ 5. Is free of interruptions from driveways (such as to/from homes, parking lots, etc.)
☐ ☐ ☐ 6. Is continuous (no segments are missing) and complete (it doesn't randomly end)
☐ ☐ ☐ 7. Is wide enough (at least 5 feet) for two people to walk side by side or pass one another
☐ ☐ ☐ 8. Has tactile ground surface indicators so pedestrians with vision impairment will know when the path is ending
☐ ☐ ☐ 9. Has a curb cut ramp (for use by wheelchairs, baby strollers, etc.) wherever it is interrupted by a street

THE STREET:

☐ ☐ ☐ 1. Has traffic lights and/or stop signs at intersections and crossings
☐ ☐ ☐ 2. The traffic lights and/or stop signs are clearly visible to drivers and pedestrians
☐ ☐ ☐ 3. Has crosswalks
☐ ☐ ☐ 4. The crosswalks are well marked and clearly visible to drivers and pedestrians
☐ ☐ ☐ 5. Has signage alerting drivers to the presence of pedestrians
☐ ☐ ☐ 6. Has a designated bicycle lane
☐ ☐ ☐ 7. Has a pedestrian crossing signal, also called a beacon (if yes, complete the next section)

THE PEDESTRIAN CROSSING SIGNALS:

☐ ☐ ☐ 1. Are working
☐ ☐ ☐ 2. Have a "push-to-walk" mechanism, meaning pedestrians can stop vehicle traffic
☐ ☐ ☐ 3. Have audible prompts for people with vision impairment
☐ ☐ ☐ 4. Are placed in appropriate locations (if not, make note of where more are needed)
☐ ☐ ☐ 5. Provide enough time to cross (indicate the amount of time: _____ minutes _____ seconds)
☐ ☐ ☐ 6. Provide suitable opportunities to cross (indicate the amount of time pedestrians must wait for a traffic light change in order to cross: _____ minutes _____ seconds)

Consider using the "Build a Better Block" worksheet as well.

Walkability of the area, based on the findings above: ☐ **Great** ☐ **Acceptable** ☐ **Mixed** ☐ **Poor**

Visit *AARP.org/WalkAudit* to download, print, copy and/or share additional worksheets.

Appendix 3C

AARP Walk Audit Tool Kit Worksheet

Public Transit Access

Community Name: _____

Location/Street Name(s): _____

Audit date: _____ **Start time:** _____ **AM | PM** **End time:** _____ **AM | PM**

YES | NO | OTHER **Skip any statements that don't apply**

IMPRESSIONS:

☐ ☐ ☐ 1. Pedestrians can safely access and depart from the transit stop or station

☐ ☐ ☐ 2. The transit stop or station is in a useful location

☐ ☐ ☐ 3. The transit stop or station protects waiting passengers from moving vehicles

☐ ☐ ☐ 4. The transit stop or station has suitable seating for waiting passengers

☐ ☐ ☐ 5. The transit stop or station features shelter from (check all that apply) ☐ rain ☐ sun ☐ heat ☐ cold ☐ wind

☐ ☐ ☐ 6. The transit stop or station is clean and well-maintained

☐ ☐ ☐ 7. The transit stop or station is well lighted

☐ ☐ ☐ 8. The transit stop or station has useful amenities (if yes, describe what they are)

☐ ☐ ☐ 9. The transit stop or station feels safe from crime

☐ ☐ ☐ 10. I would feel safe and comfortable waiting in this location

NOTES OR OTHER OBSERVATIONS:

Walkability of the area, based on the findings above: ☐ **Great** ☐ **Acceptable** ☐ **Mixed** ☐ **Poor**

Visit *AARP.org/WalkAudit* to download, print, copy and/or share additional worksheets.

Appendix 4: Example RSA Report Outline

1. Introduction
    a. Background on study area
    b. Objective of RSA
    c. Relationship to other efforts (Pedestrian and Bicycle Safety Action Plans, etc.)
2. RSA site locations
3. Geometric conditions and multimodal volume summary
    a. Vehicle traffic
    b. Pedestrian and bicyclist traffic
    c. Transit
4. Crash history
    a. Pedestrian and bicyclist crash history
    b. Vehicle crash summary
5. RSA Team members and roles/areas of expertise
6. Assessment findings
    a. Positive existing features
    b. Identified safety issues and suggestions for improvements (include pictures)
7. Improvements suggested for consideration and implementation timeframe (near- to long-term)
    a. Signalized intersection A
    b. Intersection B
    c. Mid-block C
    d. Potential crosswalk D
    e. Signalized intersection E
    f. Mid-block F
8. Conclusions

Appendix 5: RSA Report Example

Appendix 5: RSA Report Example

U.S. Department of Transportation

Federal Highway Administration

National Highway Traffic Safety Administration

Federal Motor Carrier Safety Administration

Federal Transit Administration

Kansas Department of Transportation

Lawrence-Douglas County Metropolitan Planning Organization

City of Lawrence

Lawrence Transit

University of Kansas Center for Sustainability

University of Kansas Transportation Center

Assessment Report

Pedestrian, Bicycle, and Transit

City Of Lawrence, Kansas
19th Street
from Iowa to Barker

March 26, 2015

Practical Road Safety Assessment

Appendix 5: RSA Report Example

U.S. Department of Transportation
Federal Highway Administration

Summary

The U.S. Department of Transportation (DOT) launched an initiative to reduce the growing number of pedestrian and bicyclist injuries and fatalities through a comprehensive approach that addresses infrastructure safety, education, vehicle safety, and data collection. As part of this initiative, road safety assessments (RSA) focused on pedestrian and bicycle safety are being conducted by DOT field offices in every state. The ultimate goal of these RSAs is to help communities build streets that are safer for people walking, bicycling, and taking public transportation through an experiential understanding of the problem. The Federal Highway Administration (FHWA) is the lead DOT agency in Kansas with the Federal Transit Administration (FTA), the National Highway Traffic Safety Administration (NHTSA), and the Federal Motor Carrier Safety Administration (FMCSA) providing expertise in their respective fields.

This initiative is aimed at reversing the recent rise in deaths and injuries among the growing number of Americans who bicycle and walk to their daily activities. In many cases public transportation is used for part of these trips. An initial step in addressing non-motorized transportation safety is to conduct an RSA of a particular location by bringing together interested federal, state and local stakeholders to experience the system from the perspective of those who use the transportation system by foot or on a bike. The immediate goal of this RSA is to focus on a location that has non-motorized safety challenges. It is intended to provide a practical real world environment to open the dialogue, share knowledge, identify patterns that lead to gaps, and build relationships leading to safer pedestrian and bicycle networks over time. It is hoped that this RSA will serve as a model for future efforts in Kansas of this nature.

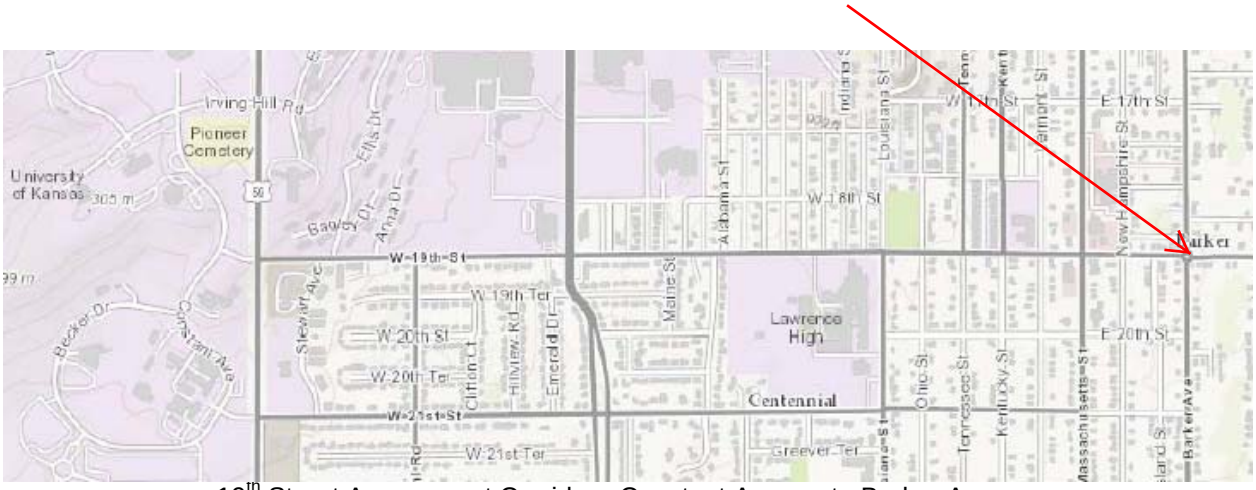
RSAs have proven to be an effective method of observing safety issues in real time and identifying potential physical and operational improvements through an experiential understanding of the problems. The Kansas Division Office of FHWA is promoting the Practical RSA (PRSA) approach for this assessment generally following KDOT Local Project guidelines developed for safety projects. A PRSA follows a simplified process and does not attempt to gather extensive data other than what is readily available with a simplified report format to document findings.

A PRSA looks at how a corridor is operating in terms of safety. The primary intent is to identify measures depending on available resources, to reduce the potential for fatal or severe injury crashes in the corridor. It is not necessarily intended to lead to the development of a project but to identify low cost solutions which may be implemented by maintenance forces; however, moderate and higher cost solutions may and should be identified so they may be considered by an agency in its planning and project development process. The measures outlined in this report are considered suggestions and are not considered mandates that changes be made. The goal of this effort is to identify a variety of measures that could be taken as resources permit to make improvements to enhance the safety of the corridor.

Based on discussions with key partners in the Kansas Department of Transportation (KDOT) and the City of Lawrence (City), the 19th St. corridor from just west of Iowa St. (U.S. 59) at Constant Ave. east to the roundabout at Barker Ave. would be an ideal location for this effort. 19th St. is a two-lane minor arterial that provides an important east-west connection near the University of Kansas (KU) campus. See assessment area map below.

Appendix 5: RSA Report Example

U.S. Department of Transportation
Federal Highway Administration



19th Street Assessment Corridor - Constant Avenue to Barker Avenue

The City and Lawrence-Douglas County MPO had very good readily available data for the 19th St. corridor including bike/pedestrian crash data for the 5 year period including 2009 through 2013. They proved GIS based maps of bike/pedestrian crashes, peak traffic, bike plan, sidewalk defects, sidewalk ramps, bike signs and intersection controls, bus routes/stops, planned Safe Routes to School (SRTS) routes, and street classification. Documentation from the Multimodal Planning Studies covering the 19th St. Corridor was provided to the RSA Team. In addition, the University of Kansas provided documentation of future redevelopment related to the 19th St. corridor.

Information provided shows that the entire corridor is on a bike route. East of Naismith has segments with bike lanes or planned to have bike lanes. East from Maine to Massachusetts St. and at the Barker Roundabout includes proposed SRTS segments. There are six transit routes touching the corridor with numerous bus stops on or adjacent to 19th St. A new transit center is proposed at 21st St. and Iowa St. The City has inventoried its sidewalk and sidewalk ramps noting condition and accessibility. It is clear that the corridor serves a significant number of bicyclists and pedestrians. The peak traffic counts shows that the major (signalized) intersections within the corridor approach or exceed 2000 entering vehicles during peak hours. For the 5-year period noted, there were 8 bicycle injury crashes documented; 2 occurred on the moderate grade approaching Iowa St. between Stewart Ave. and Ousdahl Rd.,1 near Illinois St., 4 occurred between Louisiana St. and Massachusetts where there are intermittent extra lanes to accommodate higher turning volumes, and 1 occurred at the Barker Roundabout. Likewise, there were 10 pedestrian injury crashes with 7 (70% of the total) occurring in a two block (3-intersection) segment from Tennessee St. to Vermont St. This is in the area of intermittent extra lanes noted above in addition to being right at the location of the Cordley Elementary School which was closed this school year for renovation.

This PRSA report includes route-wide issues and site-specific issues as they relate to bicycle, pedestrian and transit. It identifies the location and type of issue being considered; a discussion and photo examples of the issue; and lower, medium, and higher cost suggestions of measures for consideration. The Manual on Uniform Traffic Control Devices (MUTCD) is the national standard for all public roadways and is a source document for many of the suggestions provided.

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The Team

Dave Cronin, City of Lawrence Public Works
David Woosley, City of Lawrence Traffic Engineering
Zach Baker, City of Lawrence
Carol Fittell, City of Lawrence
Bob Nugent, City of Lawrence Transit
Jessica Mortinger, Lawrence –Douglas County MPO
Jeff Severin, KU Center for Sustainability
Pat Weaver, KU Transportation Center
Ron Seitz, Bureau of Local Projects, KDOT
Tod Salfrank, Bureau of Local Projects, KDOT
Ed Thornton, Bureau of Local Projects, KDOT
Nelda Buckley, Bureau of Local Projects, KDOT
Bill Legge, Bureau of Local Projects, KDOT
Gary Herman, Traffic Safety, KDOT
Kathleen Deitering, Traffic Engineering, KDOT
Mokhtee Ahmad, Regional Administrator, Region 7, FTA
Mark Bechtel, Community Planner, Region 7, FTA
Daniel Nguyen, Community Planner, Region 7, FTA
Susan DeCourcy, Regional Administrator, Region 7, NHTSA
Randy Bolin, Program Manager, Region 7, NHTSA
Max Strathman, Division Administrator, Kansas Division, FMCSA
John Knowles, Program Development Team Leader, Kansas Division, FHWA
David LaRoche, Safety Engineer, Kansas Division, FHWA

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Route Wide Issues

Bicycle: Except where there are bike lanes, bicyclists must share the road with high traffic volumes including commercial vehicles. Vehicles were observed not giving the required 3' passing clearance.

Discussion: This is generally a two lane street with a center turn lane from about Alabama St. to Kentucky St. and at other major intersections in the corridor. Two segments have bicycle lanes, between Naismith and Alabama and east of Massachusetts St. Only experienced riders should use 19th St., particularly from west of Tennessee to east of Kentucky where there is less than desirable pavement condition and an auxiliary lane which may cause confusion.

Shared lanes generally work well with low vehicle volumes. A curb lane greater than 14' allows a motorist to pass a bicyclist with an adequate comfort clearance of greater than 3'. Bicycle lanes are used to designate a preferential use of the roadway for bicyclists. The existing roadway does not have adequate width for either wider curb lanes or additional bike lanes in its current configuration.

Suggestions:
Lower Cost: Consider a parallel alternate route on 21st St. for a bicycle boulevard. This much lower volume residential street would be safer and favorable to less experienced riders.

Initiate an education campaign to bring public attention to the 3' passing law. Suggest it correspond with the start of school in September.

Provide "Shared-Lane Marking" to fill gaps between segments with bike lanes particularly where lanes are too narrow for a bicyclist and a motorist to travel side-by-side and to eliminate any confusion as to where a bicyclist should be when extra lanes are present.

Provide timely street cleaning for bike lanes and along curb where a bicyclist will normal ride to remove sand and other debris.

Higher Cost: Reconstruct to 3-lanes with bike lanes (planned between Iowa and Naismith; but bike lanes are not shown on planning map).

Bike lane between Naismith and Alabama.

Pedestrian: Much of the sidewalk in the corridor is less than 4' wide, aging and in poor condition. Pedestrian walk intervals at signalized crossings provided less than 7 seconds to initiate a crossing for both minor and major roadways.

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SW Corner of 19th & Kentucky

Discussion: Cracking, faulting, and general deterioration of sidewalks are prevalent. Many curb ramps exhibit these conditions in addition to having running slopes and/or cross slopes greater than desirable with no turning space. Many sidewalk sections have no buffer space.

The MUTCD recommends a pedestrian walk interval of at least 7 seconds along with countdown pedestrian signals to inform pedestrians of the time remaining in the pedestrian change interval. Many of the pedestrian push buttons were not located in accessible locations. Only crosswalks at Louisiana St. had pedestrian countdown signals and accessible pedestrian signals (APS). APS provides information in non-visual format to users with visual disabilities.

Crosswalk Pavement markings were worn at a number of locations. The City uses a continental (longitudinal) crosswalk pavement marking which has greater visibility than the standard marking but this effect diminishes as the markings fade.

Sidewalk from about Illinois St. to Louisiana St. and from about Iowa St. to Constant Ave is 5' wide, fairly new, and in good condition. The poor condition of the remaining sidewalk and narrow right-of-way does not lend itself to low-cost fixes. While a 4' sidewalk is acceptable, a 5' sidewalk with a buffer strip is more pedestrian friendly.

Recommend that sidewalks within the public right-of-way follow the "Proposed Accessibility Guidelines for Pedestrian Facilities in the Public Right-of-Way" (PROWAG). In general, vertical discontinuities greater than ¼" are undesirable. A 1:1 bevel can be used for those under ½". Those greater than ½" are treated with a 1:12 slope. Cross slopes should not exceed 2% and running slope should not exceed 5% (unless following road grade). Curb ramps are subject to the same cross slope but may have running slope up to 8.33%. Perpendicular curb ramps are generally preferred as they provide a more direct route without requiring maneuvering by those using mobility devices. Parallel curb ramps should be considered where right-of-way is limited. Landings are necessary at the top of parallel and bottom of perpendicular ramps.

Suggestions:
Lower Cost: Update crosswalk markings as necessary to maintain visibility.

Provide recommended pedestrian walk interval of 7 seconds at signalized crossings. Consider longer intervals on minor street crossings.

Moderate Cost: Upgrade to pedestrian countdown signals.

Upgrade to APS.

Higher Cost: Reconstruct with appropriate pedestrian accommodations (planned between Iowa and Naismith, should include pedestrian facilities on both sides of 19th St.

Looking west from the SE corner at Kentucky.

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Looking east from the SW corner at Ousdahl.

South side of 19th east of high school.

Transit: There is a lack of improved bus stop waiting areas along the corridor. Patrons tended to stand on the curb close to traffic.

Discussion: Concrete pads at bus stops provide patrons room to be a safer distance from the street. A sheltered seating area provides a dedicated space for waiting with greater visibility to a motorist. In addition, greater accessibility to transit services can be achieved with a concrete pad.

Transit stop at Anna Drive.

Transit stop at KU dorm near Naismith (Right).

Suggestions:
Add concrete pads at transit stops. Consider benches, shelters, bike racks, and trash receptacles.

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Site Specific Issues

Constant Avenue

Transit: No bike racks at Constant Avenue transit stop

Discussion: Transit provides bicycle racks on buses but no bike rack accommodation at stop. Space was allocated for racks in bus stop design but not installed at time of construction.

Suggestions:
Lower Cost: Install bike rack.

Constant Transit Stop.

Iowa Street

Bicycle: Poor connectivity across Iowa St.

Discussion: There is an existing multi-use path along the west side of Iowa St. KU is proposing a multi-use path (Jayhawk Trail) which will generally run diagonally on campus from the NE across the intersection to the SE. Crossing Iowa St. with its high volume is a concern.

Suggestions:
Lower Cost: In conjunction with the planned transit center and bicycle boulevard concept discussed under corridor wide issues, create a signalized crossing at 21st St. that connects the transit center and the bicycle boulevard on the east side of Iowa St. with the multi-use paths on west side of Iowa St.

Coordinate KU improvements (Jayhawk Trail) with planned City of Lawrence improvements on 19th St. to address bicyclists crossing Iowa St.

Enhanced pavement markings and signing to support bicycle movements through the intersection. Consider bicycle detection in conjunction with a bike box concept.

Medium Cost: Consider the optional use of a bicycle signal face to control bicycle movements consistent with the MUTCD Interim Approval.

Looking north across 19th at Iowa.

Pedestrian: This is not a pedestrian friendly intersection.

Discussion: Large intersections can be difficult for pedestrians to manage with long exposure times. Large corner radii promote high speed turns. An injury pedestrian crash occurred in a crosswalk at this intersection. An additional challenge of negotiating steep curb ramp grades with lack of level landings in conjunction with the street crossing increases the difficulty.

This intersection provides the connection between the sidewalk along the east, multi-use path along west side of Iowa St., sidewalk on the south side of 19th St., and the proposed Jayhawk Trail. The proposed transit center at 21st St. at Iowa St. could add to pedestrian traffic.

Curb ramps were discussed under “Route Wide Issues,” but the sidewalk at this intersection is generally newer and this is a critical intersection in the pedestrian network. Diagonal (corner)

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ramps are provided on all quadrants, these are generally undesirable in terms of accessibility as they direct pedestrians into the intersection potentially exposing them to parallel crossing traffic. This is particularly problematic for wheelchair users who then must turn in the roadway. Necessary landings were lacking on all quadrants. Landings provide a staging area and turning space. The elevation difference between the roadway and sidewalk on the NW, NE and SW corners have led to excessive grade on these curb ramps.

There are no cross walk markings across 19th on the east side of Iowa. An offset pavement marked median area is currently provided on Iowa St. for turning traffic on Iowa St.

Suggestions:
Lower Cost: Add crosswalk marking on the east crossing of 19th St.

Provide minimum 7 seconds walk interval and consider more time for 19th St. crossing.

Medium Cost: Consider a pedestrian refuge median for the Iowa St. crossing. See http://safety.fhwa.dot.gov/provencountermeasures/fhwa_sa_12_011.cfm. Provide countdown pedestrian signals.

Re-grade and add landings for curb ramps. Curb ramps should not exceed 15' but a combination ramp should be considered. This is where perpendicular ramp runs are brought to an intermediate landing. Then the ramp is continued in the direction of the sidewalk (parallel). Provide APS.

Looking east across Iowa at 19th.

Looking north across 19th at Iowa.

Iowa to Naismith

Bicycle: Moderate grade approaching Iowa St. heading west.

Discussion: Grade can slow down even the best bicyclists and can be challenging to less experienced riders to maintain a straight path.

Suggestions:
Lower Cost: Add a west-bound bike climbing lane approaching Iowa St. using striping.

Looking west back to Iowa St.

Pedestrian: No sidewalk on the north side of 19th St.

Discussion: This is an area of higher pedestrian volumes. There is no crosswalk to support access to the Anna Drive transit stop. An injury pedestrian crash occurred near the Anna Drive intersection.

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Note pedestrian crossing road.

Suggestions:
Lower Cost: Add crosswalk markings at Anna Drive transit stop.

Moderate Cost: Add sidewalk.

Pedestrian was accessing transit stop.

Naismith Drive

Bicycle: No space allocated for a bicyclist queued or moving through this intersection.

Discussion: Naismith Dr. is a major bike route to KU. There are some older style shared lane markings along the curb on Naismith Dr. but a bicyclist is not allocated any dedicated space at intersection.

Suggestions:
Lower Cost: Reallocate space in the cross-section to better accommodate a bicyclist and keep a motorist aware of the mixed use.

At Naismith Dr. looking north

Pedestrian: Crosswalks are not marked across 19th Street.

Discussion: Marked crosswalks give clear direction, increase visibility and inform the driver to be aware of pedestrians.

Suggestions:
Lower Cost: Add crosswalk markings.

Naismith to Louisiana

Pedestrian: No sidewalk on north side of 19th St. between Louisiana and Alabama. No crosswalk to match pedestrian (student) desire to cross 19th St. at high school to the west of Louisiana St.

Discussion: There is a sizable student population attending the high school living in the vicinity. High school students cross 19th St. at locations of opportunity and expediency.

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Sidewalks along this area are relatively new and in good shape. The roadway is designed as a 3-lane facility with a center turn lane.

Suggestions:
Lower Cost: Consider a marked & signed mid-block crossing at a suitable location to match student desire lines. If speed is a concern, a raised crosswalk may be helpful.

Implement an education/enforcement campaign in conjunction with the marked crosswalk.

Moderate Cost: Provide pedestrian actuated signals. This could be a rectangular rapid flashing beacon or pedestrian hybrid beacon. Would suggest the hybrid beacon since Lawrence has installed these at a number of locations and should be understood. They also provided additional comfort of a dedicated walk phase.

Consider pedestrian refuge medians in conjunction with marked crosswalk. See http://safety.fhwa.dot.gov/provencountermeasures/fhwa_sa_12_011.cfm.

Add missing sidewalk.

Louisiana to Massachusetts

Bicycle: A majority of the injury bike crashes in the corridor occurred in this segment.

Discussion: There are intermittent added lanes to accommodate high vehicle turning movements. The injury crashes involving bicyclists are indicative of the need to better address a bicyclist needs. Tennessee and Kentucky are paired one-way major collector routes north of 19th but are local two-way streets south of 19th. Overwhelmingly, traffic using Tennessee and Kentucky involves turns to/from 19th St. There is very little desire for east bound right turns from 19th St. yet there is an auxiliary lane with a starting taper near Ohio St. heading eastbound with an ending taper starting at Kentucky terminating west of Vermont St. This encourages weaving and can lead to unsafe vehicle maneuvers. -

Auxiliary lane termination east of Kentucky

Suggestions:
Lower Cost: Consider a roadway reconfiguration which eliminates the eastbound auxiliary right lane and add bike lanes

Pedestrian: A majority of the injury pedestrian crashes in the corridor occurred in this segment.

Discussion: The 7 injury crashes involving pedestrians in the two block stretch including Tennessee, Kentucky and Vermont is a concern. As noted, Tennessee and Kentucky are one way routes to/from the downtown area. Additional weaving due to the auxiliary lane and high vehicle turning movements creates a poor pedestrian environment. Cordley Elementary School is located between Kentucky and Vermont. While it does not appear any of the pedestrian crashes involved elementary school children, consideration should be given to children walking to school. Data provided shows 19th St. is a proposed route for SRTS planning.

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School x-walk sign looking East from Mass. St.

Suggestions:
Lower cost: Implement a SRTS program at Cordley. Consider a walking school element in the SRTS program.

A lane reassignment as discussed above under bicycle considerations for this segment.

Trim trees to keep desirable sight lines to signs.

Massachusetts Street

Pedestrian: Crosswalks are not marked across 19th Street.

Discussion: A marked crosswalk gives clear direction, increases visibility and informs the driver to be aware of pedestrians.

Suggestions:
Lower Cost: Add crosswalk markings.

Barker Avenue

Bicycle: While there are bike lanes approaching this roundabout, a bicyclist must share the lane through the roundabout.

Discussion: Barker Avenue is a relatively low volume residential street. 19th St. is also located in a residential area east of the Massachusetts corridor. However, there are higher traffic volumes than one would expect for the residential area including what appears to be disproportionate high level of commercial vehicles.

Suggestions:
Lower Cost: Provide bike guidance approaching roundabout and "Shared-Lane Marking" in the roundabout. This includes improving the overall pavement markings at this location.

Restrict through commercial traffic east of Massachusetts St.

Looking east to Barker Roundabout.

Pedestrian: There are no marked crosswalks at this roundabout.

Discussion: The crosswalks are generally defined by bricks and with signing. Colored pavements treatment such as brick do not provide the desired contrast provided by crosswalk lines.

Suggestions:
Lower Cost: Provide transverse crosswalk lines.

Appendix 5: RSA Report Example

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Report prepared by:

David LaRoche
Safety Engineer
Federal Highway Administration
Kansas Division Office
6111 SW 29th, Ste 100
Topeka, KS 66614
Phone: 785-273-2647

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