Implementing Traffic Calming Measures

Peter F. Kremer, AICP, P.P.

Tom DiBiase, PE, RSP

Brad J. Miller, PE, PP, PTOE, LEED AP

September 14, 2022

Michael Baker INTERNATIONAL | We Make a Difference

What is Traffic Calming?

Michael Baker INTERNATIONAL

SLOW

Traffic Calming Features

The following design techniques can help achieve lower travel speeds and safer motor vehicle traffic. Some of these techniques alter the configuration of the roadway, while others change how people psychologically perceive and respond to a street. These techniques should be considered in appropriate contexts.

Curb Extensions

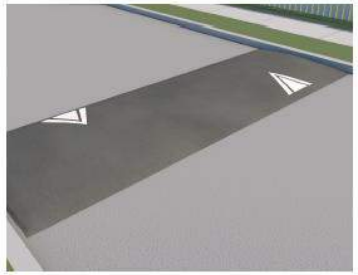
Curb extensions visually and physically narrow the roadway at intersections and mid-block locations. Curb extensions are generally used where there is on-street parking to shorten the pedestrian crossing distance. A curb extension should generally be **1 to 2 feet narrower** than the parking lane, and the length at least the width of the crosswalk (but preferably extended to the advanced stop bar).

Neckdowns

Neckdowns create pinch points by extending the curbline to narrow the roadway, which deters motorists from operating at high speeds on local streets and significantly expands the sidewalk realm for pedestrians.

Chicanes

Chicanes are a series of raised or delineated curb extensions, edge islands, or parking bays that are placed on alternating sides of a street to form an S-shaped bend in the roadway. Chicanes reduce vehicle speeds by requiring drivers to shift laterally through narrow travel lanes.

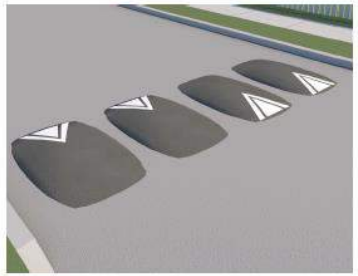


Speed Humps

Speed humps are typically **3 to 4 inches high** and **12 to 14 feet long**, and are designed with an intended vehicle speed of 15 to 20 mph. Humps are often referred to as "bumps" on signage and by the general public.

Center Islands

Center islands create pinch points for traffic by narrowing the width of the travel lanes and reducing pedestrian crossing distances. A center island causes a small amount of deflection without blocking driveway access. Center islands impede high-speed left turns and keep drivers in the correct receiving lane.



Speed Cushions

Speed cushions are speed humps or speed tables that include wheel cutouts that allow larger vehicles to pass unaffected but reduce passenger vehicle speeds. They are often used on key emergency response routes to allow emergency vehicles to pass unimpeded while causing the typical passenger vehicle to slow down. Speed cushions should be used with caution, however, as drivers will often seek out the space in between the humps.

What is Traffic Calming?

Why Traffic Calming?

Michael Baker INTERNATIONAL

FATAL ACCIDENT INVESTIGATION UNIT

YEAR TO DATE - STATEWIDE FATAL CRASH STATISTICS
FOR DECEMBER 31, 2021

FATAL CRASHES			FATALITIES		
2021	-	669	2021	-	699
2020	-	550	2020	-	587
2019	-	524	2019	-	558

FATALITIES FROM 2020 TO 2021	112
PERCENTAGE CHANGE 2020 TO 2021	19.1%
FATALITIES FROM 2019 TO 2020	29
PERCENTAGE CHANGE 2019 TO 2020	5.2%

VICTIM CLASSIFICATION

	2019	2020	2021
DRIVER	289	304	367
PASSENGER	81	86	87
PEDALCYCLIST	12	18	26
PEDESTRIAN	176	179	219
TOTAL	**558**	**587**	**699**

THIS REPORT CONTAINS STATISTICS OF FATAL MOTOR VEHICLE CRASHES THAT HAVE BEEN REPORTED TO THE NEW JERSEY STATE POLICE FATAL ACCIDENT INVESTIGATION UNIT.

THE STATISTICS LISTED FOR PRIOR YEARS CORRESPOND TO THE CURRENT YEAR MONTH AND DAY.

THE STATISTICS CONTAINED IN THIS REPORT ARE PRELIMINARY AND ARE SUBJECT TO CHANGE.

Report Run: 06-SEP-22 10:00 AM

Why Traffic Calming?

Michael Baker INTERNATIONAL

FATAL ACCIDENT INVESTIGATION UNIT

YEAR TO DATE - STATEWIDE FATAL CRASH STATISTICS
FOR DECEMBER 31, 2021

FATAL CRASHES			FATALITIES		
2021	-	669	2021	-	699
2020	-	550	2020	-	587
2019	-	524	2019	-	558

FATALITIES FROM 2020 TO 2021	112
PERCENTAGE CHANGE 2020 TO 2021	19.1%
FATALITIES FROM 2019 TO 2020	29
PERCENTAGE CHANGE 2019 TO 2020	5.2%

VICTIM CLASSIFICATION

	2019	2020	2021
DRIVER	289	304	367
PASSENGER	81	86	87
PEDALCYCLIST	12	18	26
PEDESTRIAN	176	179	219
TOTAL	**558**	**587**	**699**

THIS REPORT CONTAINS STATISTICS OF FATAL MOTOR VEHICLE CRASHES THAT HAVE BEEN REPORTED TO THE NEW JERSEY STATE POLICE FATAL ACCIDENT INVESTIGATION UNIT.

THE STATISTICS LISTED FOR PRIOR YEARS CORRESPOND TO THE CURRENT YEAR MONTH AND DAY.

THE STATISTICS CONTAINED IN THIS REPORT ARE PRELIMINARY AND ARE SUBJECT TO CHANGE.

Report Run: 06-SEP-22 10:00 AM

Why Traffic Calming?

FATAL ACCIDENT INVESTIGATION UNIT

YEAR TO DATE - STATEWIDE FATAL CRASH STATISTICS
FOR DECEMBER 31, 2021

FATAL CRASHES			FATALITIES		
2021	-	669	2021	-	699
2020	-	550	2020	-	587
2019	-	524	2019	-	558

FATALITIES FROM 2020 TO 2021	112
PERCENTAGE CHANGE 2020 TO 2021	19.1%
FATALITIES FROM 2019 TO 2020	29
PERCENTAGE CHANGE 2019 TO 2020	5.2%

VICTIM CLASSIFICATION

	2019	2020	2021
DRIVER	289	304	367
PASSENGER	81	86	87
PEDALCYCLIST	12	18	26
PEDESTRIAN	176	179	219
TOTAL	**558**	**587**	**699**

THIS REPORT CONTAINS STATISTICS OF FATAL MOTOR VEHICLE CRASHES THAT HAVE BEEN REPORTED TO THE NEW JERSEY STATE POLICE FATAL ACCIDENT INVESTIGATION UNIT.

THE STATISTICS LISTED FOR PRIOR YEARS CORRESPOND TO THE CURRENT YEAR MONTH AND DAY.

THE STATISTICS CONTAINED IN THIS REPORT ARE PRELIMINARY AND ARE SUBJECT TO CHANGE.

Report Run: 06-SEP-22 10:00 AM

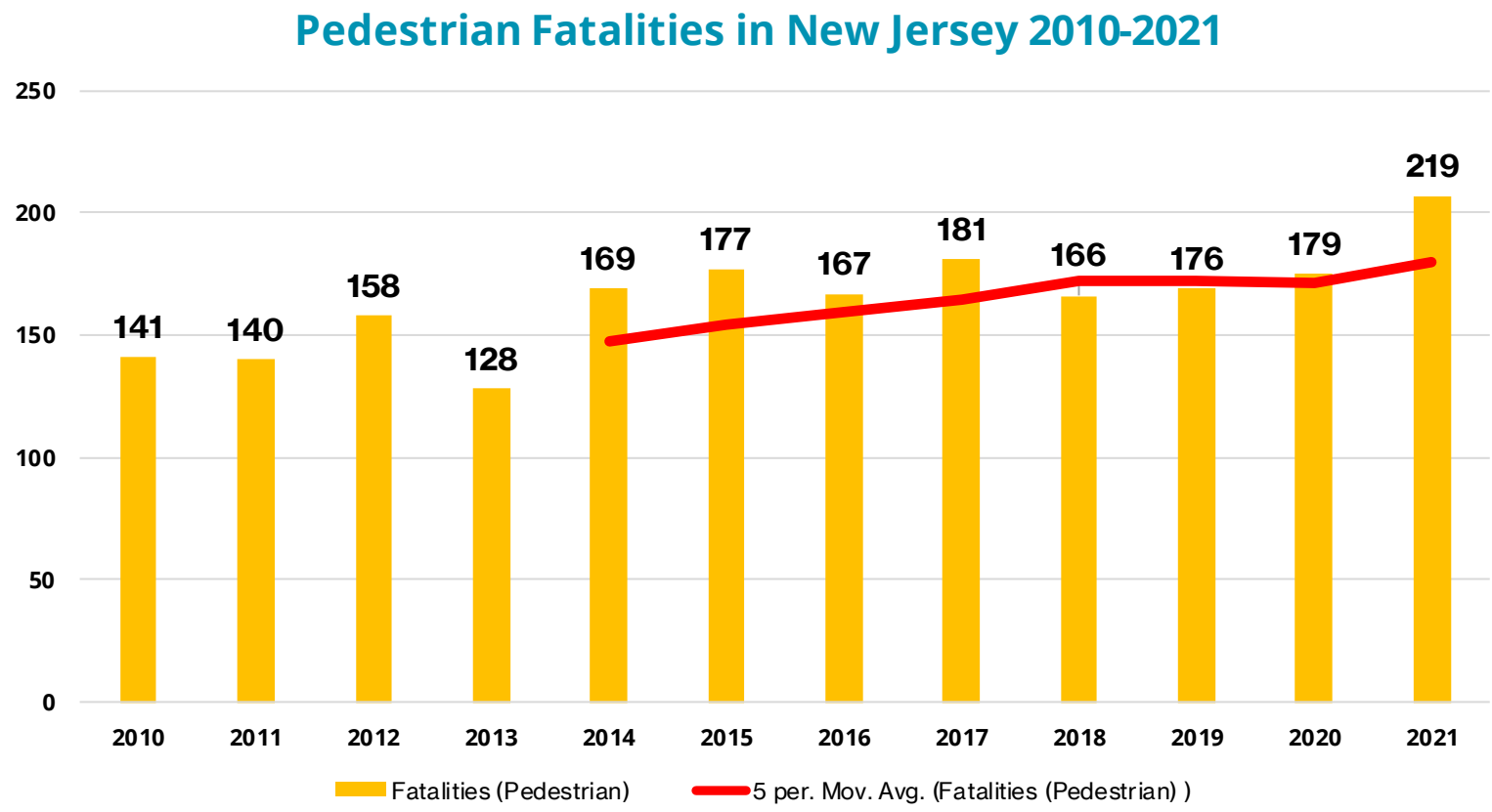
New Jersey Crash Trends

Figure 1.6 Non-Motorized Fatalities and Serious Injuries
Source: NJDOT

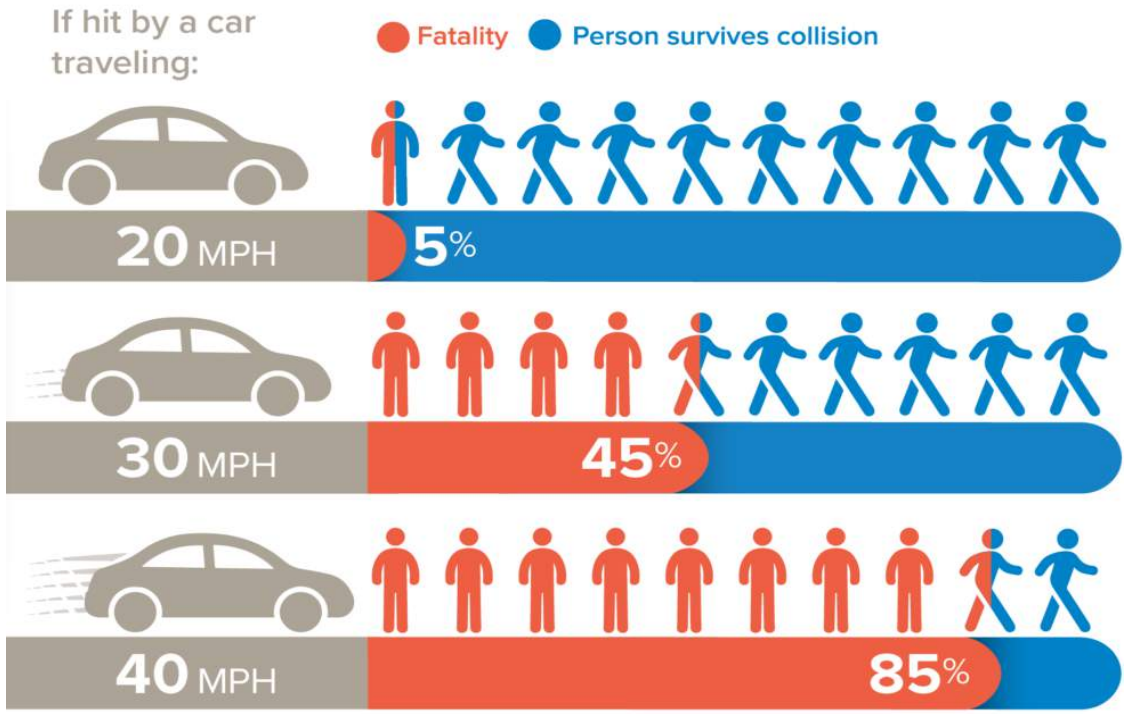
VICTIM CLASSIFICATION – FATAL CRASHES			
	2019	**2020**	**2021**
Driver	289	304	367
Passenger	81	86	87
Pedalcyclist	12	18	26
Pedestrian	176	179	219
NMT total	188	197	245
Total	558	562	663
NMT share	33.7%	33.6%	35.1%
Source: NJ State Police			

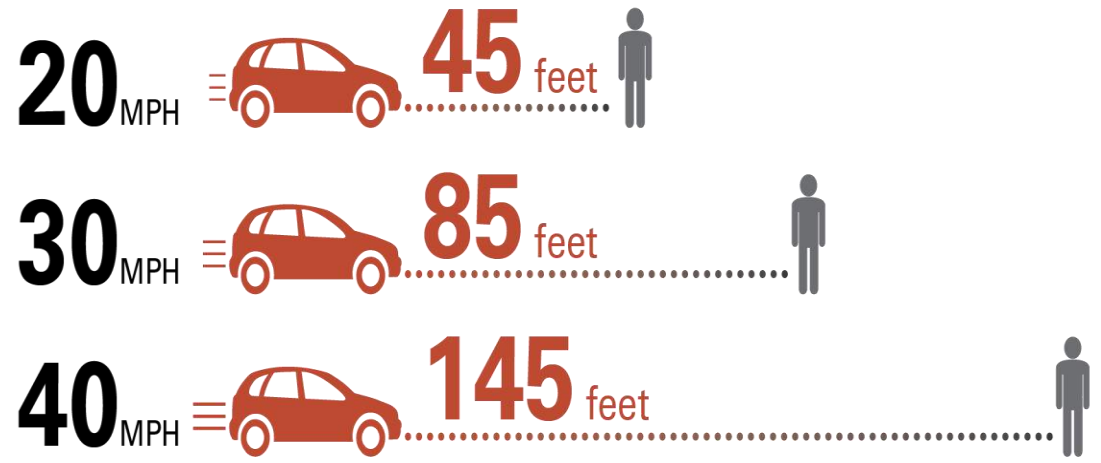
New Jersey Pedestrian Fatalities, 2010-2021

- Recent pedestrian deaths increasing overall and as share of total traffic deaths
- 55% increase in pedestrian fatalities in just 12 years



Driving Speed is the Critical Factor in Crash Severity & Survival





Driving Speed and Visibility

What a driver can see when traveling at …

10–15 MPH

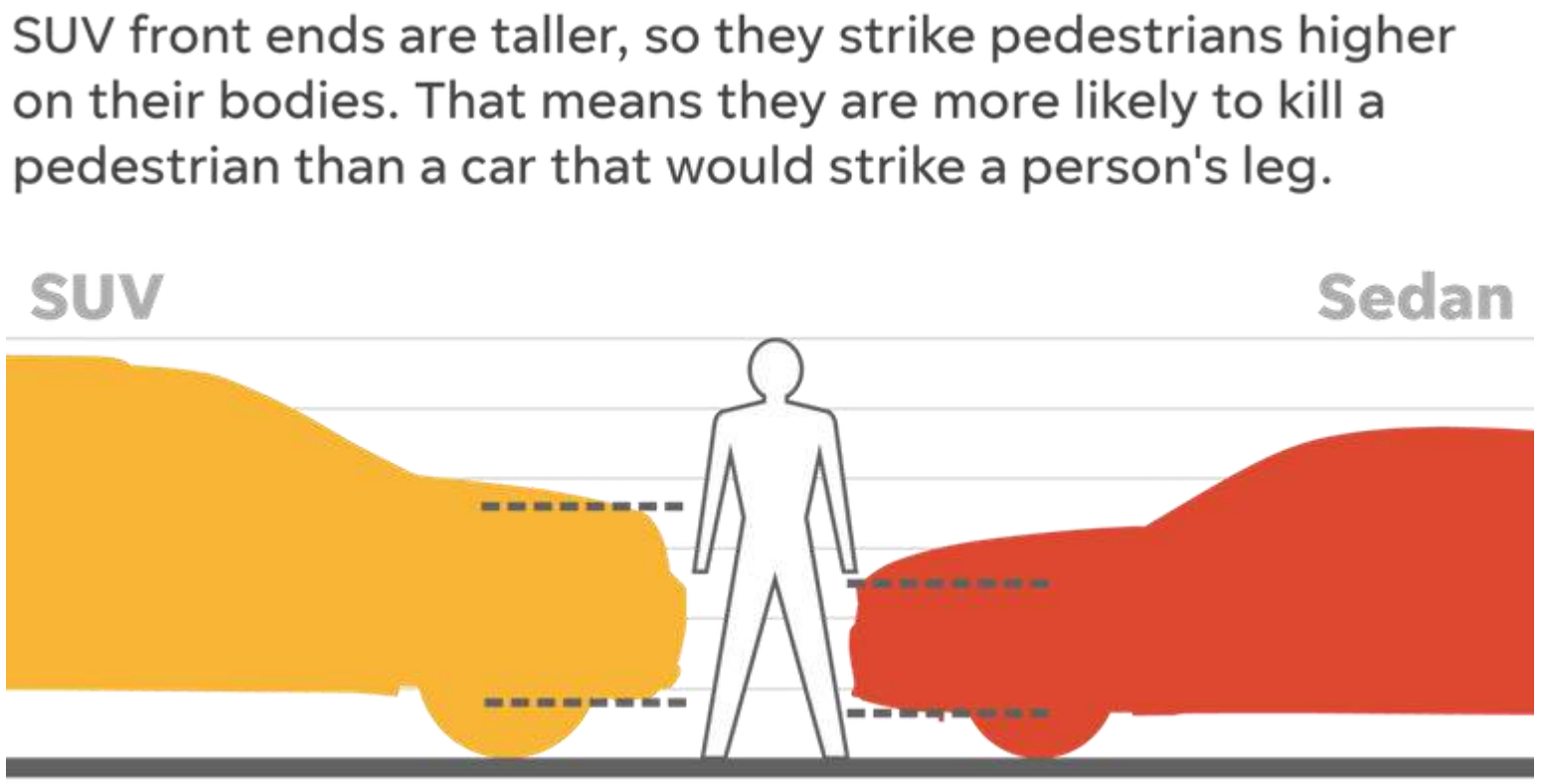
20–30 MPH

30–40 MPH

45+ MPH

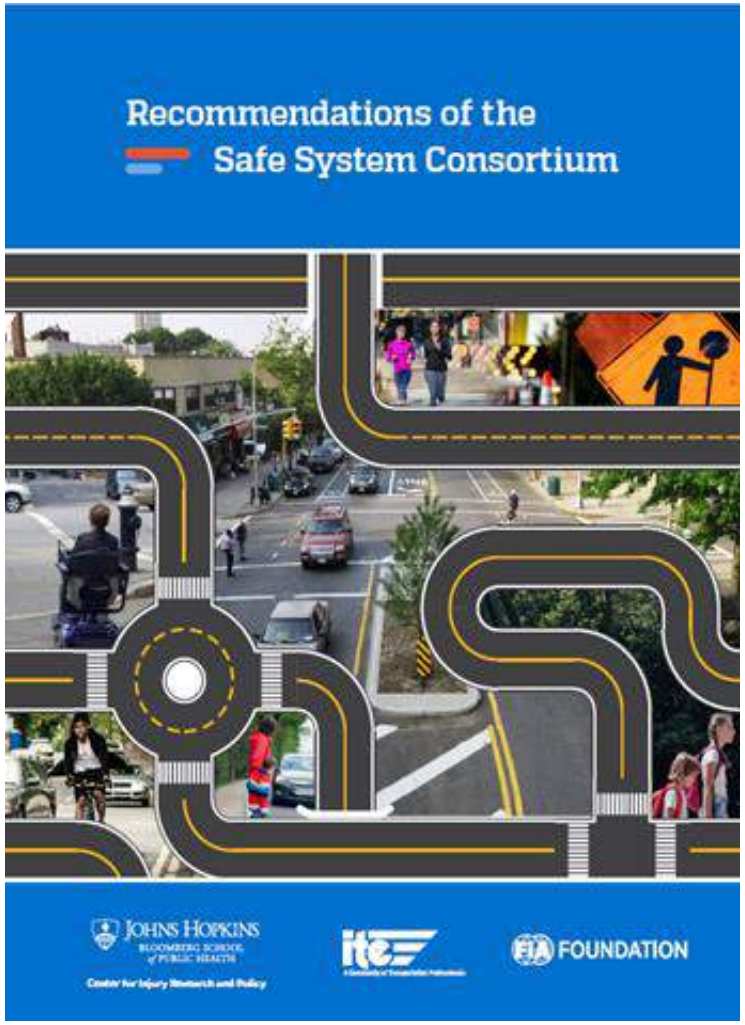
Vehicle Size and Pedestrian Visibility

- Pedestrians are two to three times more likely to die when struck by an SUV or pickup than by a passenger car (NHTSA)

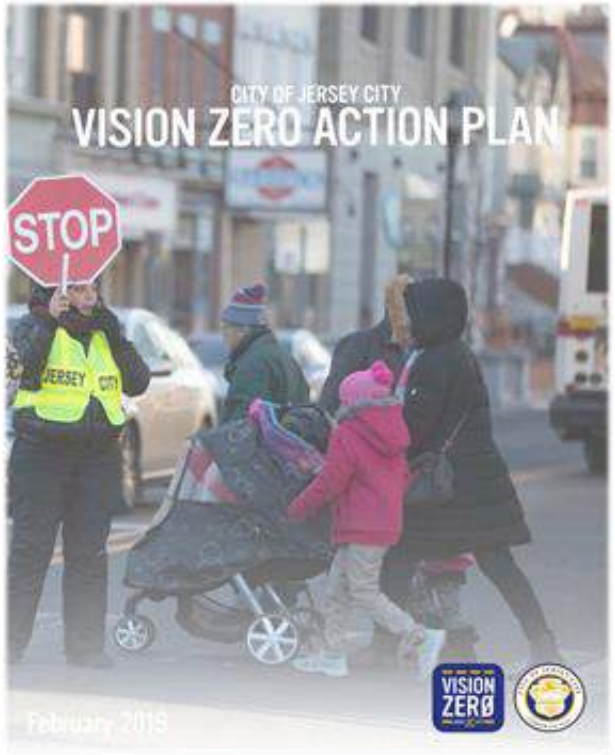


Emerging Trends and Methods

Safe System Approach



Vision Zero & Toward Zero Deaths



Vision Zero is based on a universal value – that no loss of life is acceptable

Road to Zero: A Plan to Eliminate Roadway Deaths

Toward Zero Deaths

Zero deaths is achievable with a shared vision and a cooperative effort of all safety stakeholders, including those that use the roads. Creating a safety culture is an essential element to success – one where good safety behaviors are expected from all road users. An example of a safety culture change is the use of seat belts. Through enforcement and comprehensive, continuous education, there has been a positive and sustained behavior change.

Driving Toward ZERO Deaths

Toward Zero Deaths (TZD) is a national strategy to create a unified traffic safety culture across the country on all public roads. New Jersey has pledged its support of the TZD vision. The NJ 2020 SHSP will serve as a guide for state, county, and municipal safety-related investments. The NJ 2020 SHSP also recognizes the value and incorporates best practices of other zero fatality initiatives, such as Vision Zero and Road to Zero, which share a similar vision. Vision Zero is a city-focused effort to eliminate fatalities and serious injuries while increasing mobility. Jersey City and Hoboken have adopted Vision Zero. Road to Zero is a coalition of nearly 1,000-member organizations that is led by the National Safety Coalition. Road to Zero has three interrelated approaches to achieve zero deaths: Double Down on What Works, Accelerate Advanced Technology, and Prioritize Safety. Toward Zero Deaths and Vision Zero are members of the Road to Zero coalition.

All three of these "zero" deaths initiatives are based on a "Safe Systems" approach. The Safe Systems approach is built on the principles of not accepting the loss of any life, designing a transportation system that accounts for human fallibility, and prioritizing safety over other transportation system goals.

New Jersey 2020 Strategic Highway Safety Plan (SHSP)

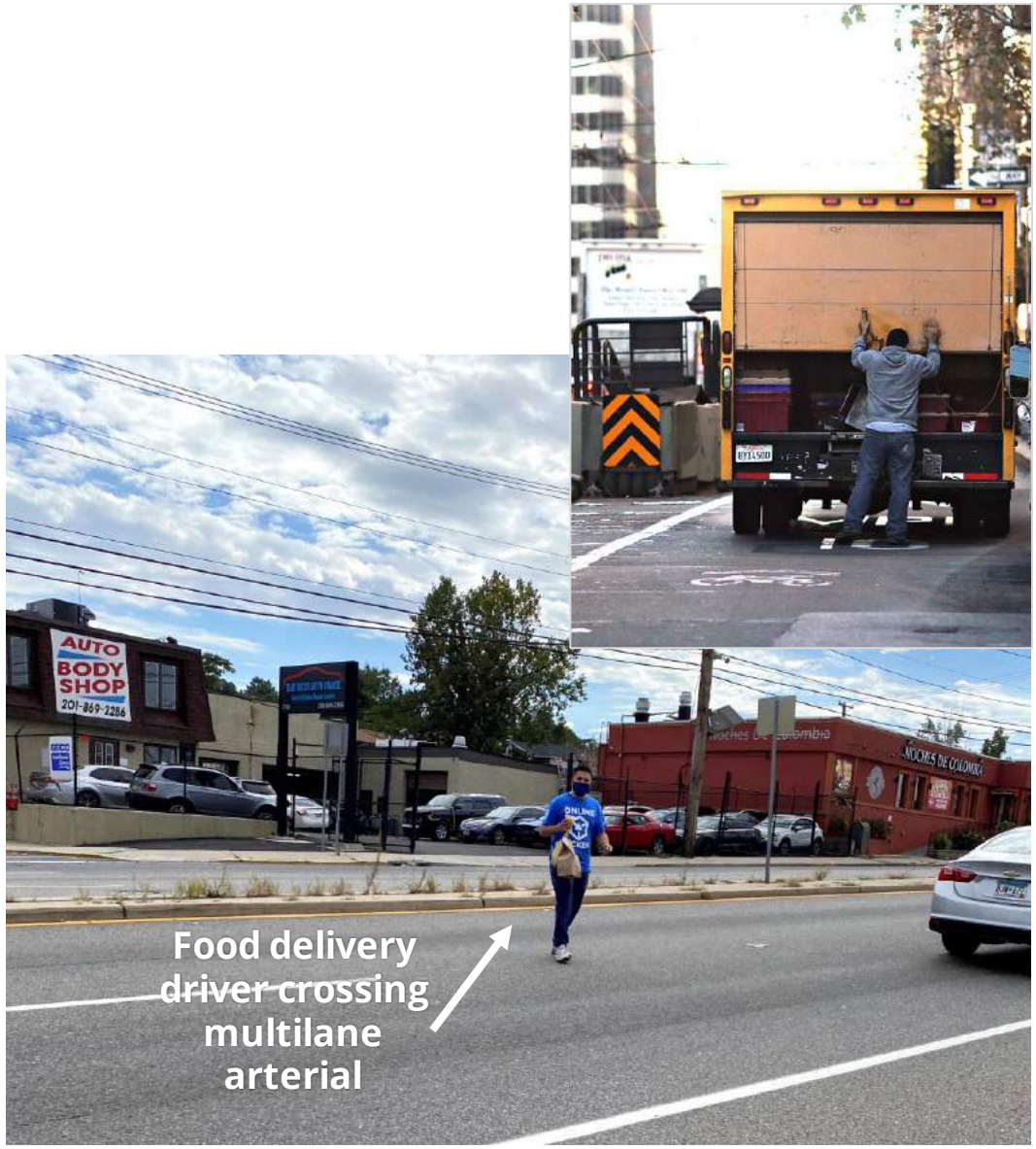
Emphasis on Equity

- Ensure fair and safe access for all
- Disinvested areas typically experience higher safety risks
- State guidance requires enhanced consideration of equity impacts
- Emphasis Area of the 2020 NJ Strategies Highway Safety Plan


Elizabeth, NJ

E-Commerce and Freight

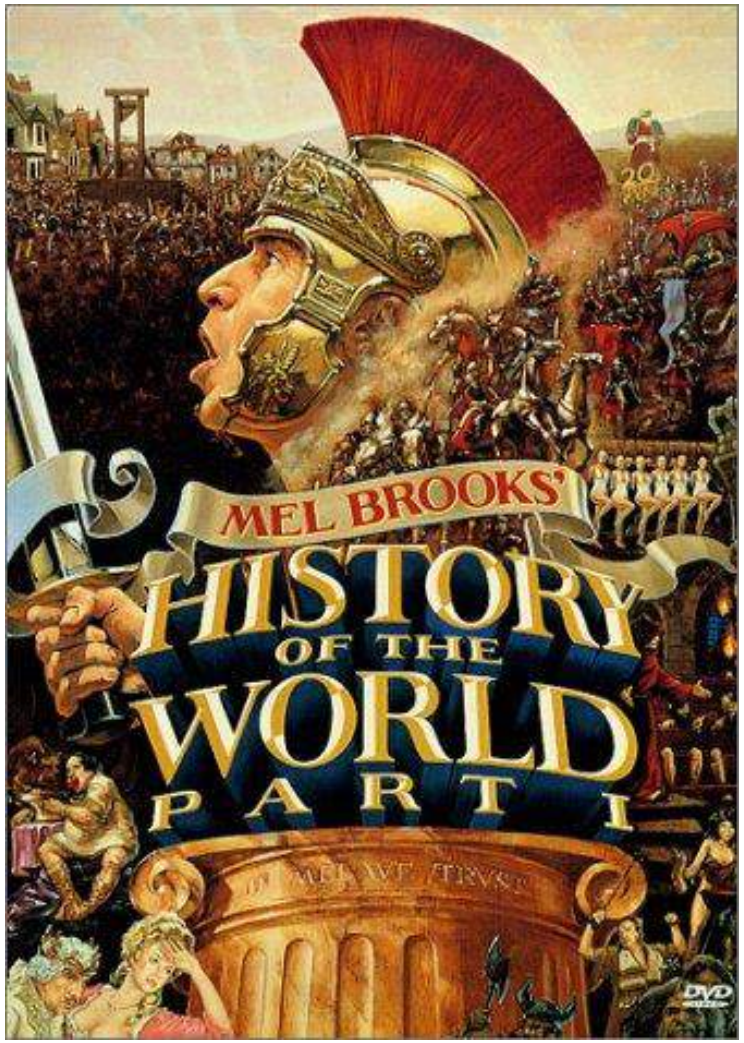
- Significant growth industry in New Jersey
- Lack of pedestrian facilities and access to warehouse locations
- Many pedestrians and transit riders at risk
- Drivers at risk when making deliveries
- Parking in the shoulder or on a curb obstructs cyclists and pedestrians



COMPLETE STREETS DESIGN

Michael Baker INTERNATIONAL | We Make a Difference

History of Design



A New Highway Design Paradigm

Michael Baker INTERNATIONAL

NCHRP RESEARCH REPORT 839

A Performance-Based Highway Geometric Design Process (2016)

2.7 The 2000s to the Present Day—The Need for a New Highway Design Paradigm Is Recognized

The 21st century has seen the continuation of trends earlier established and the emergence of new challenges. The continuation of fuel efficiency placed more severe, permanent limitations on funding for road improvements. Aging infrastructure became the primary problem facing DOTs; the I-35W river bridge collapse was emblematic of the problem, but it was by no means the only example. DOTs also came under considerable pressure to expand their programs to explicitly include pedestrian and bicycle infrastructure.

The severe financial pressures led to innovative approaches, both in project delivery and funding. Regarding the former, the Missouri DOT created the concept of "practical design." The Washington DOT, in response to the needs of funding many major corridor programs and dealing with aging infrastructure on the rural system, fundamentally changed its programming and project design approach with its innovative "design matrices." Other states followed the lead and have experimented with different project design approaches. During this time design-build as an alternative delivery approach emerged. Among the benefits that states have experienced is the innovation in design and construction that enabled projects to be built at lower costs and more quickly.

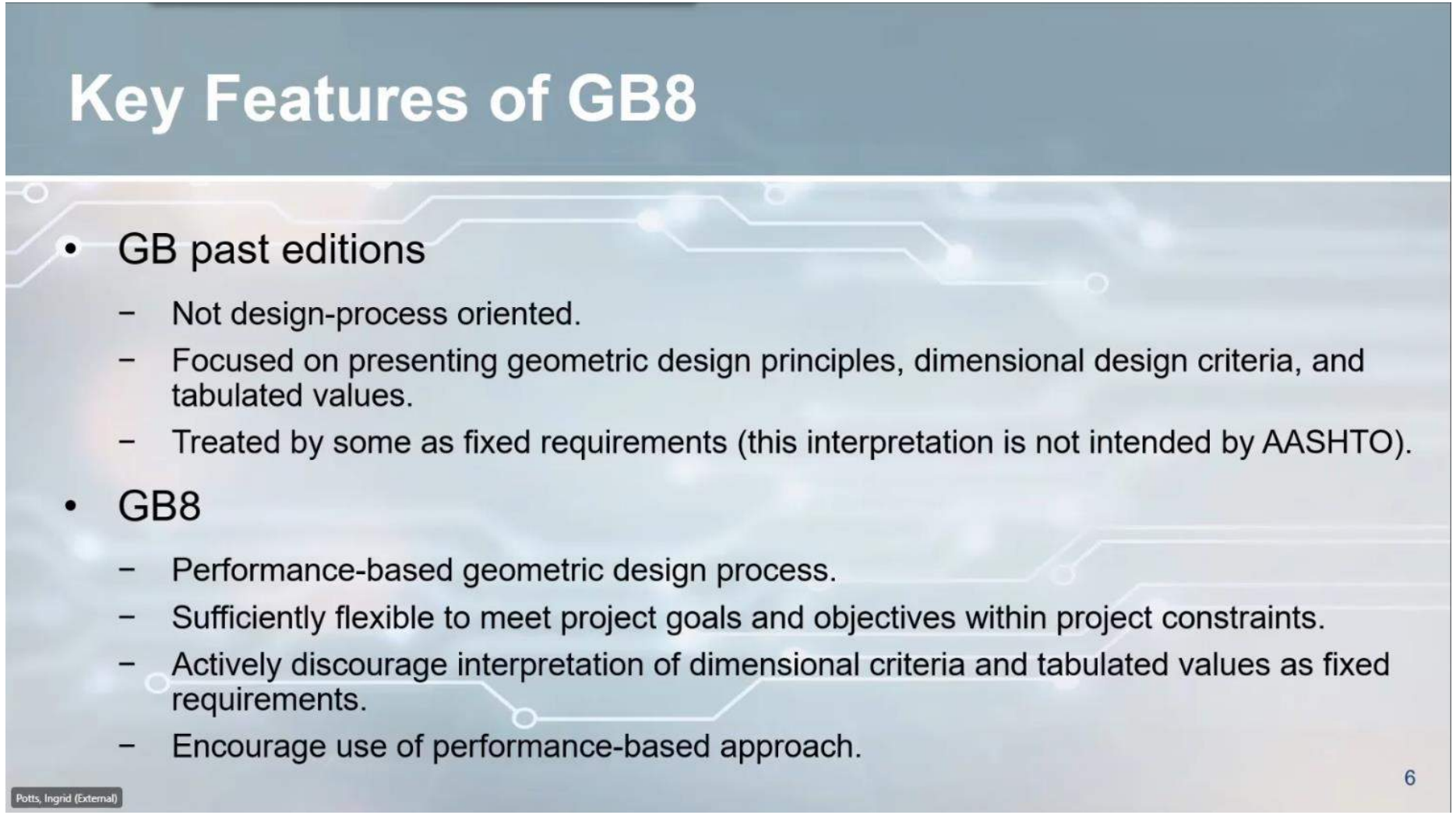
AASHTO Guide for the Design of Highways and Streets:

Green Book 8th Edition Updates

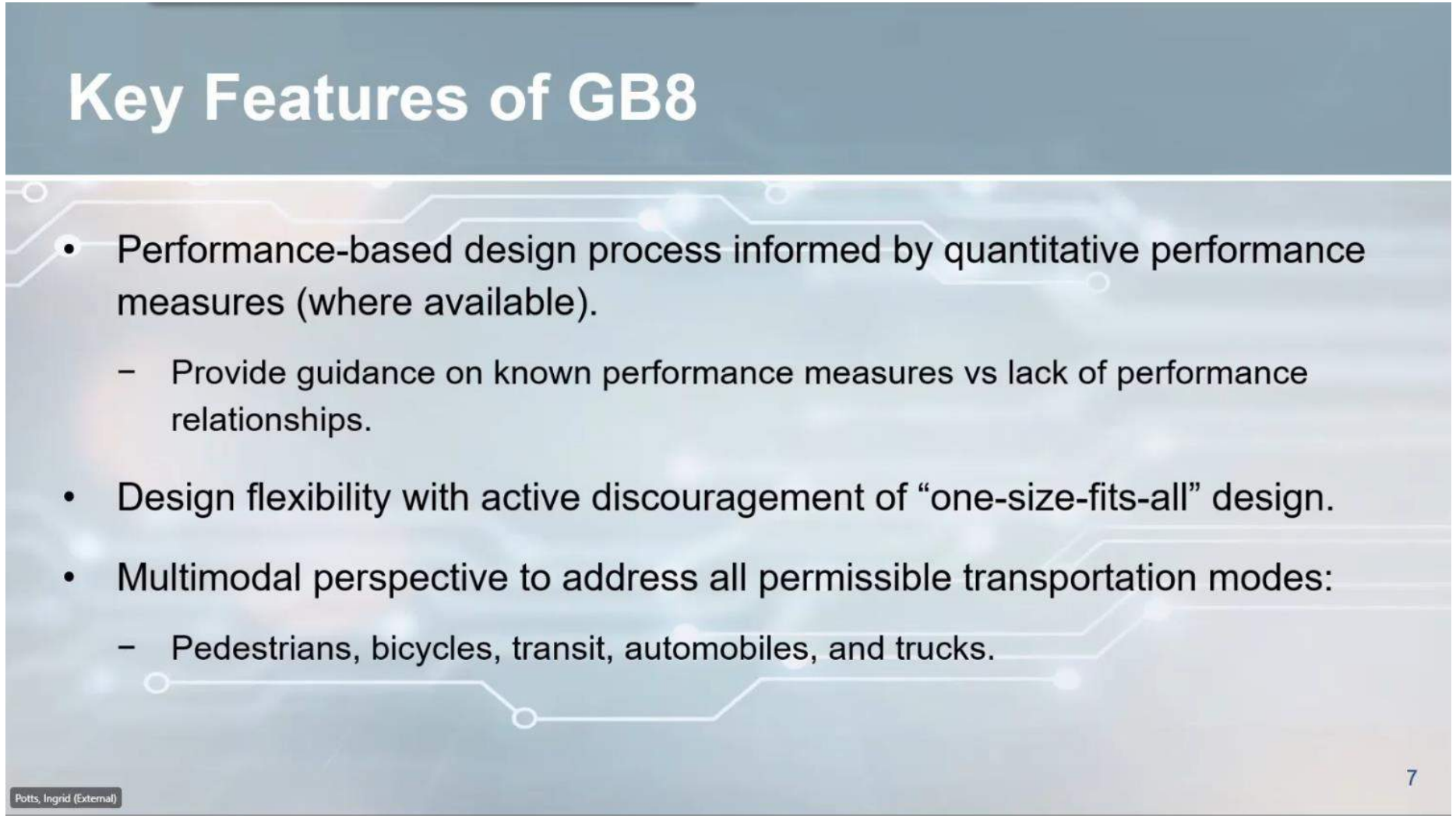
Michael Baker INTERNATIONAL | We Make a Difference

Transportation Research Board on the AASHTO Green Book 8th Ed. Updates

Michael Baker INTERNATIONAL



Transportation Research Board on the AASHTO Green Book 8th Ed. Updates



Transportation Research Board on the AASHTO Green Book 8th Ed. Updates

Michael Baker INTERNATIONAL

Performance Issues to be Addressed in GB8:

- **Operational and trip efficiency and comfort/ease of use for all transport modes:**
  - Pedestrian
  - Bicycle **(Use level of traffic stress)**
  - Auto
  - Transit
  - Truck
- **Existing and expected future crash frequency and severity**
- Construction Cost, and future maintenance cost
- Accessibility (Disability)
- Available ROW, and impacts on existing and potential future development
- Operational flexibility (incident mgmt and maintenance)
- Community impacts and quality of life
- Impacts on historical structures
- Impacts on Environment
  - Air quality
  - Noise
  - Wetlands
  - Wildlife
  - Water quality/stormwater mgmt
  - Habitat
  - Trees/canopy
- Archeological preservation

Today – AASHTO Green Book 7

Michael Baker INTERNATIONAL

1 | New Framework for Geometric Design

Please read – 35 pages!

- "New" research, eliminating CSDEs =/= improving safety, performance
  - For more, see: 2014 NCHRP 783: Evaluation of the 13 Controlling Criteria for Geometric Design
  - 2016 FHWA Revisions to Controlling Criteria for Design & Documentation of Design Exceptions
  - 2016 NCHRP A Performance-Based Highway Geometric Design Process
  - Dive deeper – 2022 NCHRP Visualization of Highway Performance Measures
- Overdesigning, overspending, under-performing
- New project types: New construction, reconstruction, existing roads
- Project Purpose & Need is paramount
  - Focus on a specific performance issue: e.g. modal mobility; crashes (safety); poor infrastructure conditions. "Good PM should focus on performance issues that need improvement"
- 2016 AASHTO Resolution – make geometric design flexible and performance-based, multi-modal, cognizant of funding & ROW constraints
- Consistent with FAST ACT, (and now IIJA)
- 7th Ed. makes first step to new framework. Next ed. will incorporate performance-based approach for all modes

2022 Complete Streets Report to Congress

Michael Baker INTERNATIONAL | We Make a Difference

2022 Complete Streets Report to Congress

- https://highways.dot.gov/complete-streets
- Overviews USDOT and FHWA's *mandate* for Complete Streets Design
- And the Safe Systems Approach to design
  - Succinct (51 pgs)
  - Filled with Resources / Links
  - **BIL "clarified that local jurisdictions may use design guides that are different from State standards on roads they own not on NHS, without approval from the State"**
- FHWA Five (5) strategies:
  - **Improve data collection and analysis**
  - **Support rigorous safety assessment**
  - **Accelerate adoption of standards and guidance**
  - **Reinforce primacy of safety for *all users***
  - **Make Complete Streets FHWA's default approach (tie to funding)**

Traffic Calming should address Safety Risks

- Travel speeds
- High pedestrian demand
- Long crossing distances
- Vulnerable users and at-risk age groups
- Crash hotspots and crash severity
- Lane departure crashes

FHWA Proven Safety Countermeasures

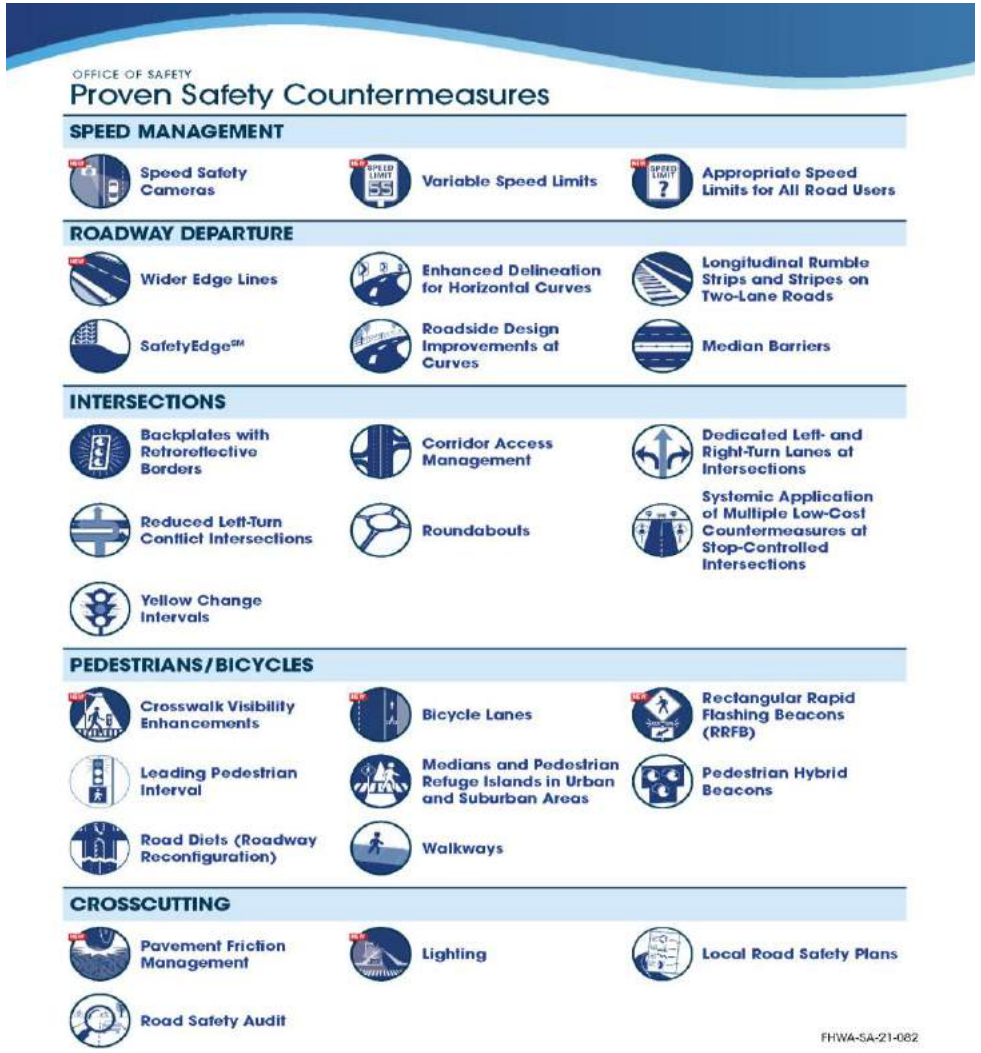
The FHWA has identified and is promoting widespread use of a set of 28 Proven Safety Countermeasures that can offer significant, measurable impacts as part of any agency's data-driven, systemic approach to improving safety. These strategies are designed to enhance safety on all kinds of roads—from rural to urban, from high-volume freeways to less traveled two-lane State and county roads, from signalized crossings to horizontal curves, and everything in between. Each countermeasure addresses **speed management, intersections, roadway departures,** or **pedestrians/ bicyclists**—along with crosscutting strategies that address all four safety focus areas.

Which Proven Safety Countermeasures Will You Use?

For more information on this and other FHWA Proven Safety Countermeasures, please visit https://safety.fhwa.dot.gov/provencountermeasures.

U.S. Department of Transportation
Federal Highway Administration

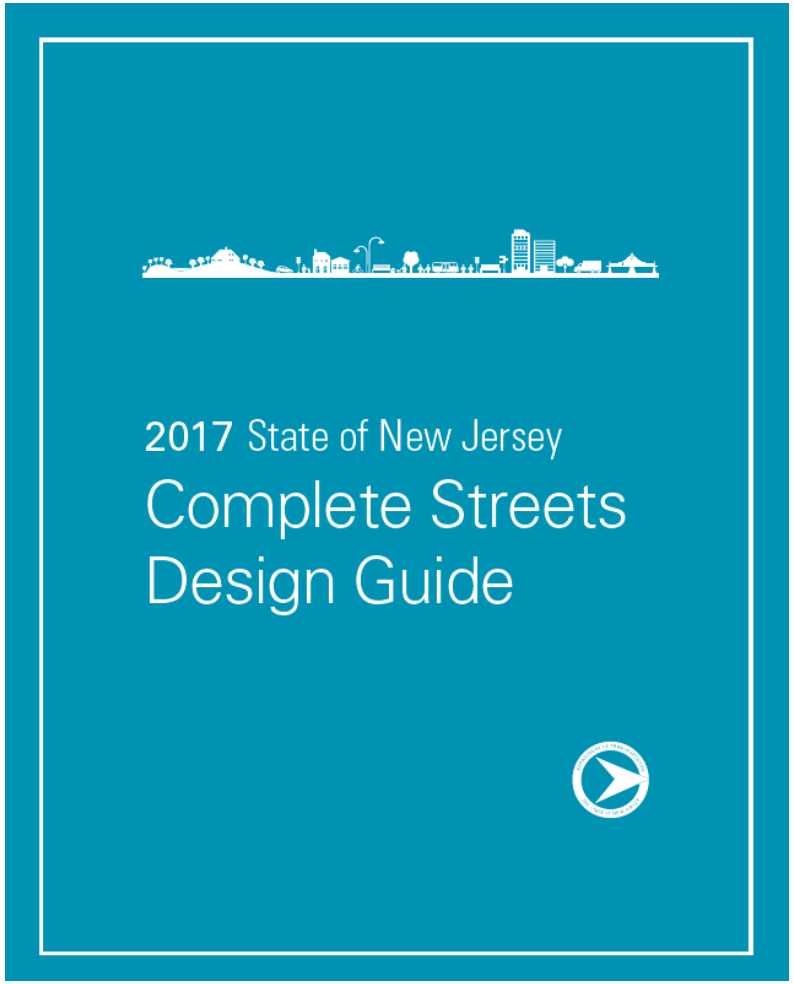
ZERO IS OUR GOAL
A SAFE SYSTEM IS HOW WE GET THERE
https://safety.fhwa.dot.gov/



Guidance Documents

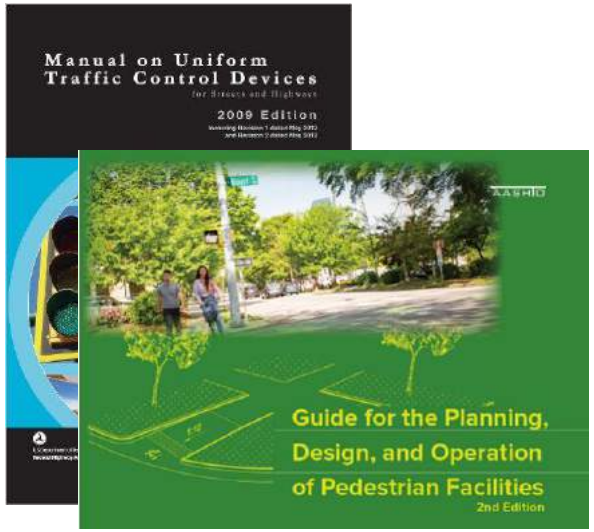
Michael Baker INTERNATIONAL | We Make a Difference

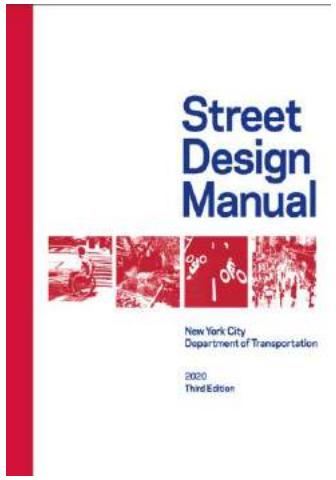
NJ Complete Streets Design Guide

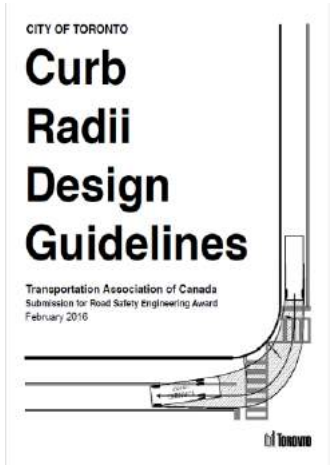


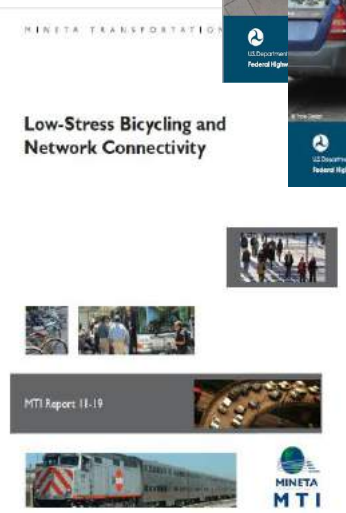
Best practices,
how-to **guidance** for
plans and **projects**,
to improve **mobility** and **safety.**

Supporting Guidance









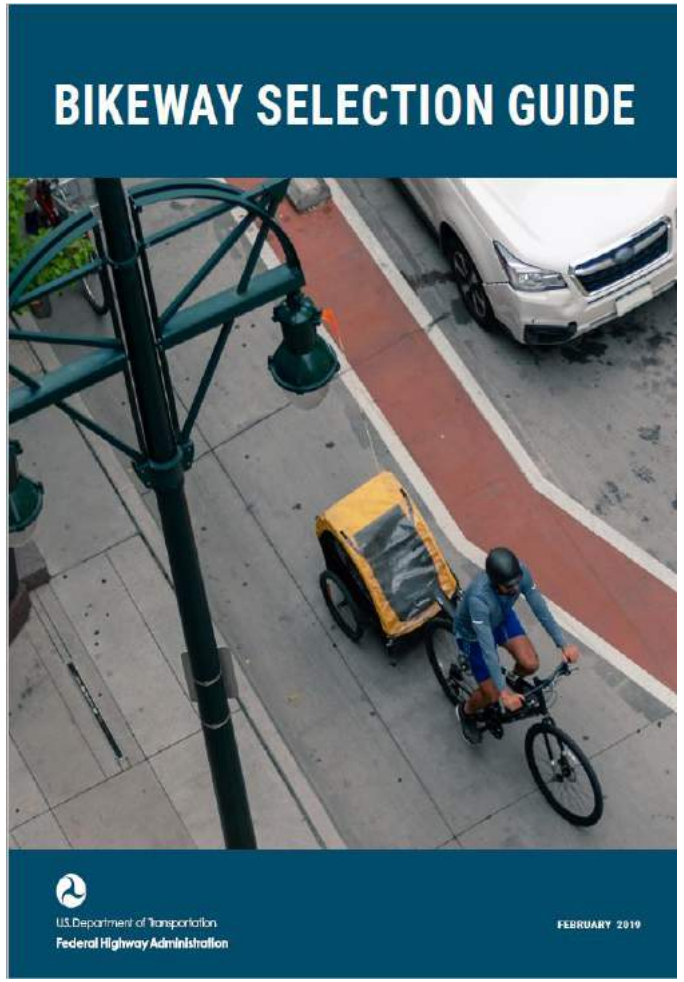
Complete Street Guidance

- Building Networks: 2018 USDOT/FHWA Measuring Multimodal Network Connectivity: https://www.fhwa.dot.gov/environment/bicycle_pedestrian/publications/multimodal_connectivity/fhwahep18032.pdf
  - Other Performance-Measurement resources are available in CS Report to Congress, pg 21
- Ped Design: 2021 AASHTO Guide for the Planning, Design, and Operation of Pedestrian Facilities, 2nd Edition (Purchase): https://store.transportation.org/Item/CollectionDetail?ID=224
- **Bikes at Intersections: 2019 NACTO Don't Give Up at the Intersection (Bicycle Crossings):** https://nacto.org/wp-content/uploads/2019/05/NACTO_Dont-Give-Up-at-the-Intersection.pdf
- **VRUs at Intersections: 2020 Alta Planning – Corner Design for All Users:** https://altago.com/wp-content/uploads/Corner-Design-for-All-Users_Alta_Sept-2020.pdf
- **Curb radius reduction: 2016 City of Toronto Curb Radius Design Guidelines, Transpo Assoc of Canada (Winner of 2016 Road Safety Engineering Award**
  https://www.tac-atc.ca/en/about-tac/awards/road-safety-achievement
  https://www.tac-atc.ca/en/conference/papers/city-toronto-curb-radii-design-guidelines
- 2020 NYCDOT Street Design Manual 3rd Ed.: https://www.nycstreetdesign.info/sites/default/files/2020-03/FULL-MANUAL_SDM_v3_2020.pdf
- 2020 City of Los Angeles Supplemental Street Design Guide: https://eng2.lacity.org/techdocs/streetd/Supplemental_Design_Guide-040220-FINAL.pdf

Bicycle Guidance

- **2019 USDOT/FHWA Bikeway Selection Guide:**
  https://safety.fhwa.dot.gov/ped_bike/tools_solve/docs/fhwasa18077.pdf
  - 2021 USDOT/FHWA Traffic Analysis and Intersection Considerations to Inform Bikeway Selection:
    https://safety.fhwa.dot.gov/ped_bike/tools_solve/docs/FHWA-SA-21-010_Traffic_Analysis_Intersection_Considerations.pdf
  - 2021 USDOT/FHWA In-Street Motor Vehicle Parking and the Bikeway Selection Process:
    https://safety.fhwa.dot.gov/ped_bike/tools_solve/docs/FHWA-SA-21-009_On_Street_Motor_Vehicle_Parking.pdf
- 202X AASHTO Guide for the Development of Bicycle Facilities, 5th Edition (Pending)
- **2019 NACTO Don't Give Up at the Intersection (Bicycle Crossings):**
  https://nacto.org/wp-content/uploads/2019/05/NACTO_Dont-Give-Up-at-the-Intersection.pdf
- 2015 USDOT/FHWA Separated Bike Lane Planning and Design Guide
  https://nacto.org/wp-content/uploads/2016/05/2-4_FHWA-Separated-Bike-Lane-Guide-ch-5_2014.pdf
- 2012 Bike Level-of-Traffic-Stress (LTS): 2012 - USDOT Mineta Transportation Institute at San Jose State Uni - Low-Stress Bike & Network Connect (Original Bike LTS Document):
  https://transweb.sjsu.edu/research/Low-Stress-Bicycling-and-Network-Connectivity

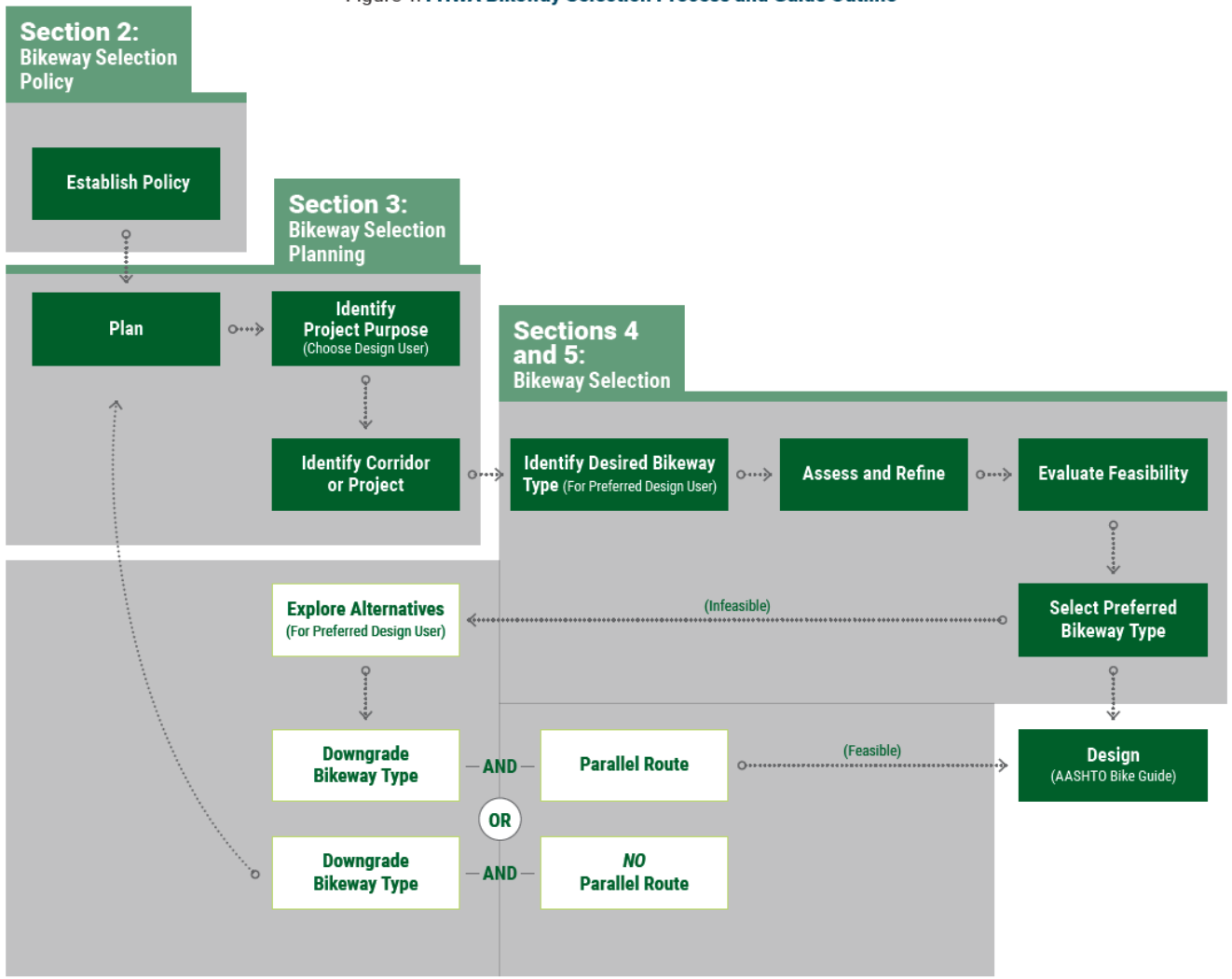
2019 USDOT/FHWA Bikeway Selection Guide



2019 USDOT/FHWA Bikeway Selection Guide:
https://safety.fhwa.dot.gov/ped_bike/tools_solve/docs/fhwasa18077.pdf

FHWA Bikeway Selection Guide (2019)

Figure 1: **FHWA Bikeway Selection Process and Guide Outline**



FHWA Bikeway Selection Guide (2019)

Table 2: Intersection Performance Characteristics by Bikeway Type

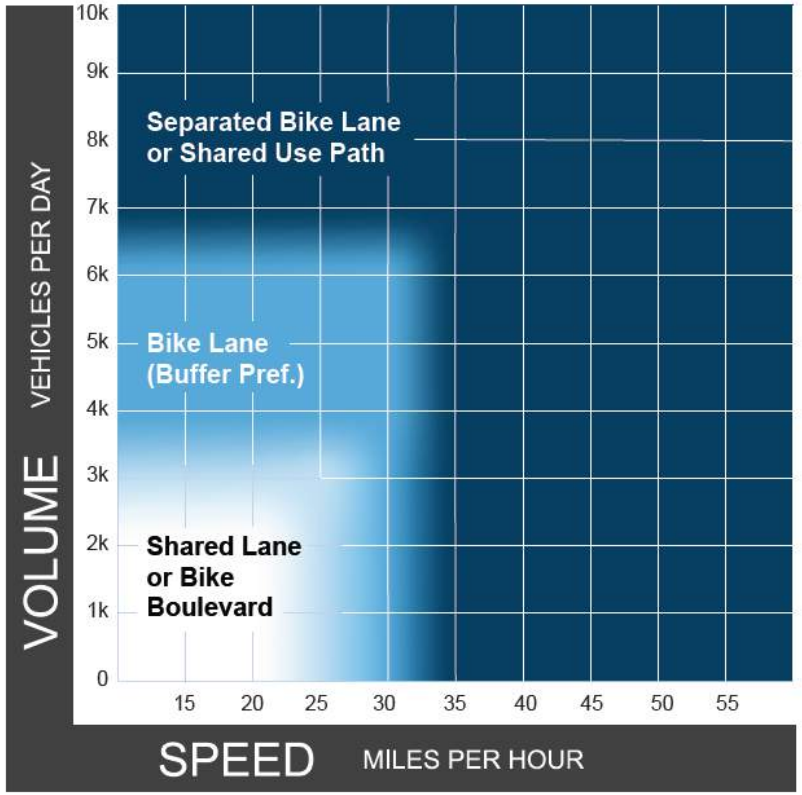
	Shared Lanes	Boulevards	Shoulders	Bike Lanes	One-Way Separated Bike Lanes with Mixing Zones	Separated Bike Lanes and Sidepaths with Protected Intersections
Functionality (Comfort) - Roads can be categorized by their function						
Lowest at higher vehicle speeds and volumes	✓	✓	✓	✓		
Highest at lower vehicle speeds and volumes	✓	✓	✓	✓		
Moderate to High due to separation from traffic and constrained entry point					✓	
High due to separation from traffic and constrained conflict point						✓
Homogeneity - Roads with vehicles of balanced speeds, directions, and masses are the safest						
Intersection approach exposure to potential motorist conflict is high	✓	✓	✓			
Turning conflict exposure correlates with vehicle speeds and volumes	✓		✓	✓	✓	✓
Turning conflict exposure generally lower due to lower vehicle speeds and volumes		✓				
Constrained entry point reduces approach exposure if visibility is good					✓	
Constrained conflict point eliminates approach exposure, and constrains conflicts to a single point						✓
Predictability (Right-of-Way) - Roads should be intuitive						
No ability to imply right-of-way priority to bicyclists	✓		✓			
Right-of-way priority can be clarified by providing a bikeway on the approach or restricting through-vehicle access		✓				
Right-of-way priority is clarified to require motorists to yield				✓	✓	✓
Conflicts may occur anywhere within the facility	✓	✓	✓	✓		
Conflict point is constrained to one location increasing predictability					✓	✓

Table 2 (continued): Intersection Performance Characteristics by Bikeway Type

	Shared Lanes	Boulevards	Shoulders	Bike Lanes	One-Way Separated Bike Lanes with Mixing Zones	Separated Bike Lanes and Sidepaths with Protected Intersections
Forgiveness (Safety) - Infrastructure can be designed to accommodate human error						
Relies upon perfect user (driver and bicyclist) behavior to avoid crashes	✓	✓	✓	✓		
Minimal: bicyclists operating in shared space with vehicles	✓					
Moderate: application of traffic calming treatments and lower operating speeds can improve safety		✓				
Moderate: bicyclists operate in separated space from vehicles, however vehicles can encroach into the facility at any location			✓	✓		
Moderate: bicyclists operate in separated space from vehicles except for defined entry point, followed by shared operating space					✓	
High: bicyclists operate in separated space from vehicles except for defined conflict point which can be designed to reduce motorist speed, but contraflow movement from two-way operation can increase risk						✓
Awareness (Visibility) - Awareness improves safety for all users						
Visibility may be restricted by parking necessitating parking restrictions					✓	✓
Visibility is typically unrestricted	✓	✓	✓	✓		
Requires high level of motorists scanning to identify bicyclists approaching from behind or operating beside them	✓	✓	✓	✓		
Requires moderate level of motorists scanning to identify bicyclists approaching or within the conflict point					✓	✓
Key Crash Types Associated with Bikeway Type						
Right and left hooks	✓	✓	✓	✓	✓	✓
Sideswipes	✓	✓	✓	✓		
Overtaking	✓	✓	✓	✓		
Hit from behind	✓	✓	✓	✓		
Merging	✓	✓	✓	✓	✓	
Failure to yield at conflict point	✓	✓	✓	✓	✓	✓

FHWA Bikeway Selection Guide (2019)

Figure 9: Preferred Bikeway Type for Urban, Urban Core, Suburban and Rural Town Contexts



Notes

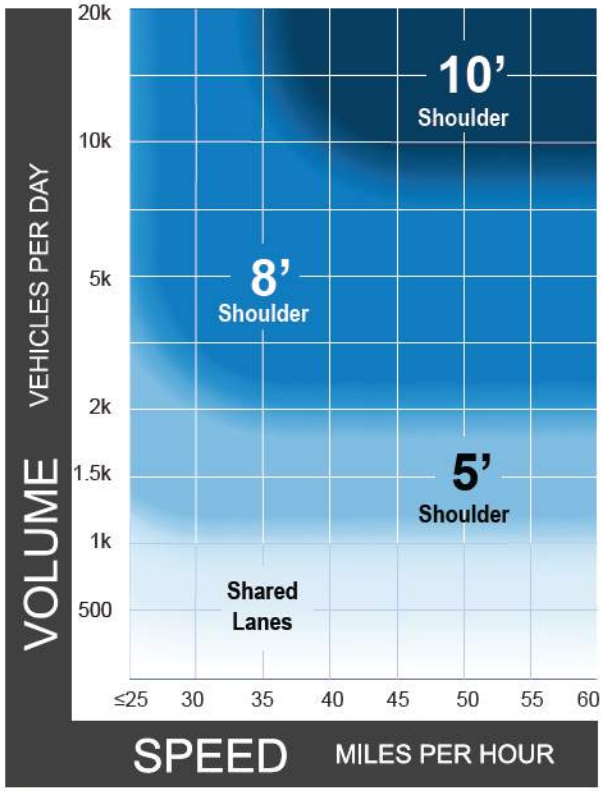
1 Chart assumes operating speeds are similar to posted speeds. If they differ, use operating speed rather than posted speed.

2 Advisory bike lanes may be an option where traffic volume is <3K ADT.

3 See page 32 for a discussion of alternatives if the preferred bikeway type is not feasible.

BIKEWAY SELECTION GUIDE | 4. BIKEWAY SELECTION

Figure 10: Preferred Shoulder Widths for Rural Roadways



Notes

1 This chart assumes the project involves reconstruction or retrofit in constrained conditions. For new construction, follow recommended shoulder widths in the AASHTO Green Book.

2 A separated shared use pathway is a suitable alternative to providing paved shoulders.

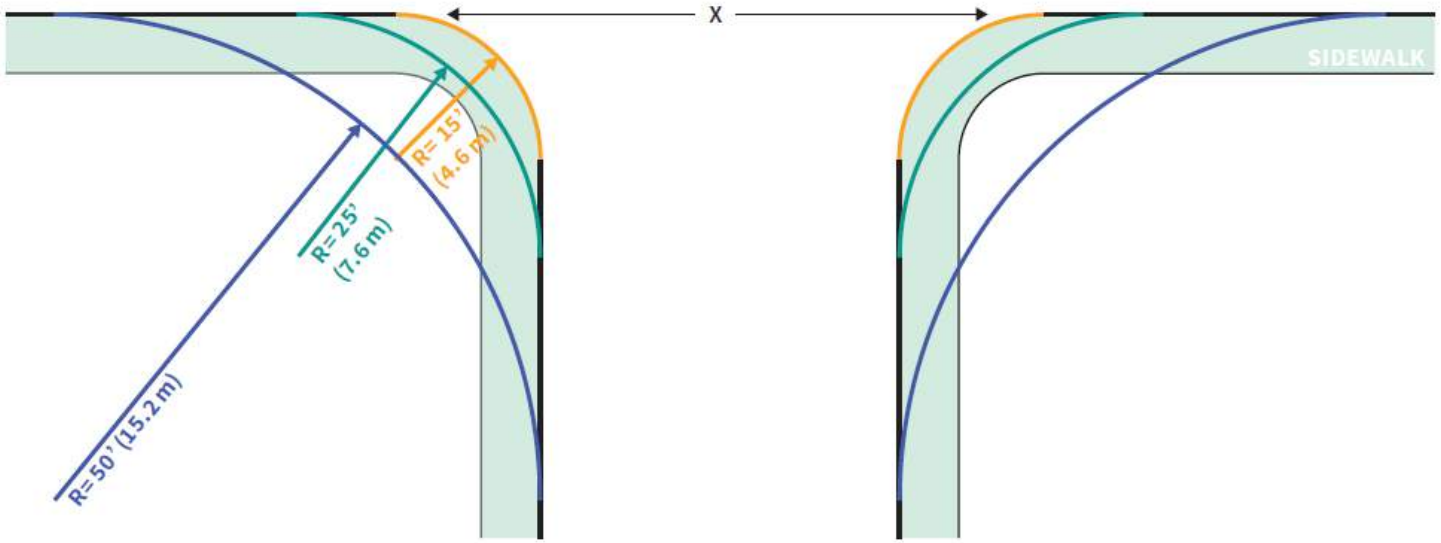
3 Chart assumes operating speeds are similar to posted speeds. If they differ, use operating speed rather than posted speed.

4 If the percentage of heavy vehicles is greater than 5%, consider providing a wider shoulder or a separated pathway.

Intersection Design – Curb Radius

VRUs at Intersections: 2020 Alta Planning – Corner Design for All Users: https://altago.com/wp-content/uploads/Corner-Design-for-All-Users_Alta_Sept-2020.pdf

Curb Radius Design



Curb Radius (R_1)	Crossing Distance (X)	Crossing Time*	Effective Turning Radius (R_2)**	Vehicle Turning Speed***
15 ft (4.6 m)	37 ft (11.3 m)	10.6 seconds	41 ft (12.5 m)	14 mph (22.5 kph)
25 ft (7.6 m)	50 ft (15.2 m)	14.3 seconds	52 ft (15.8 m)	16 mph (25.7 kph)
50 ft (15.2 m)	89 ft (27.1 m)	25.4 seconds	74 ft (22.6 m)	18 mph (29.0 kph)

*Assumes an average crossing speed of 3.5 fps (3.8 kph)

** Assumes the following widths: 6 ft (1.8 m) bike lane, 10 ft (3.0 m) travel lane, 7 ft (2.1 m) vehicle, 2 ft (0.6 m) clear from corner. $R_2 = v^2/[15(F)]$, where F = 0.32, 0.31, and 0.29, respectively.

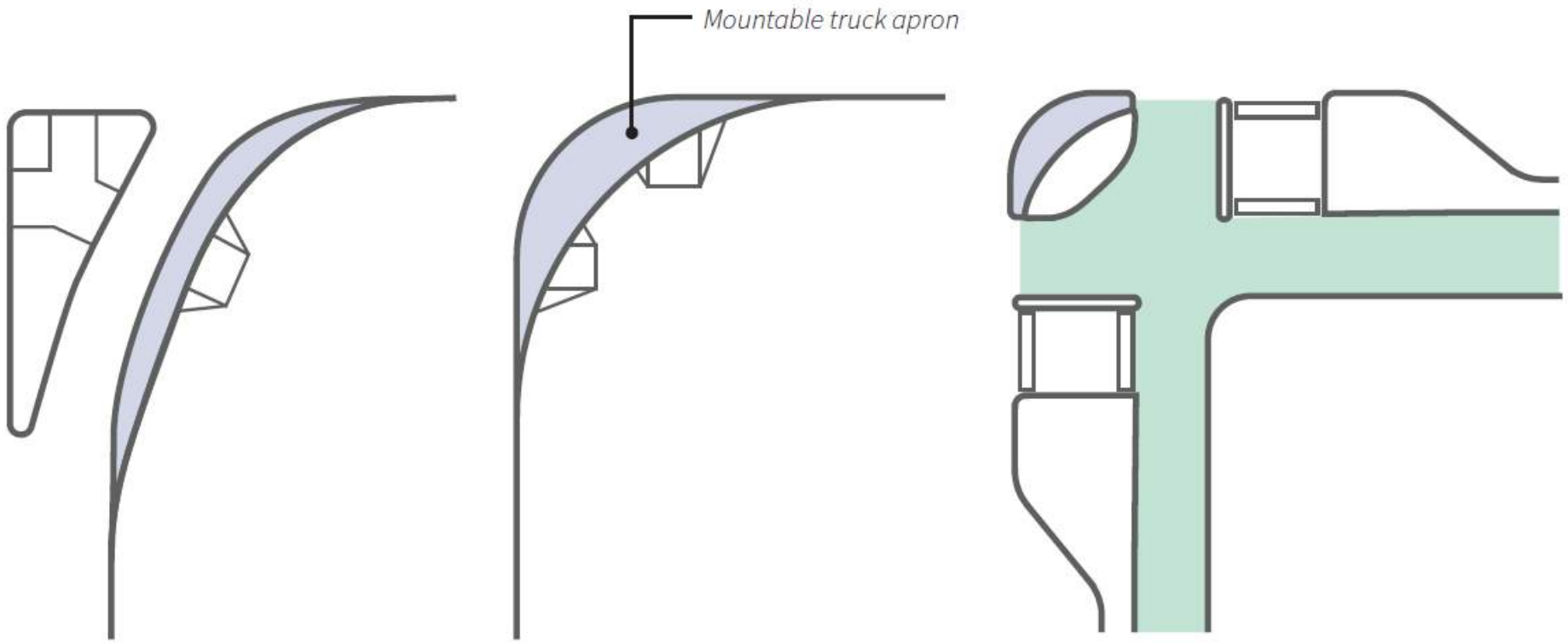
*** Average speed in middle of turn

Figure 8: Pedestrian Exposure vs Corner Radii

Curb Radius Design

Crosswalk does not continue across mountable apron (Bend, OR) But it should!

Curb Radius Design



Channelized Right Turn

Conventional Intersection Corner

Protected Intersection Corner

Curb Radius Design

Design Objectives

For a truck apron to be effective, it must:

- Deter smaller vehicles from turning across it
- Clearly convey to drivers of larger control vehicles that it is a traversable surface
- Be traversable by large vehicles without threatening stability
- Deter pedestrians and bicyclists from stopping or queuing on it

Curb Radius Design

Flush with roadway (Ottawa, ON)

Curb Radius Design – Case Studies

Agencies Consulted

City of Mississauga, Ontario, Canada

City of Austin, Texas, USA

New York City Department of Transportation, New York, New York, USA

Upper Westside Improvement District, Atlanta, GA, USA

Atlanta Downtown, Atlanta, Georgia, USA

Portland Bureau of Transportation, Portland, Oregon, USA

City of San Jose, San Jose, California, USA

Oregon Department of Transportation, Region 4, Oregon, USA

Minnesota Department of Transportation, Minnesota, USA

SUPPLEMENTAL DESIGN GUIDANCE
CORNER RADIUS
CITY OF TORONTO

Michael Baker INTERNATIONAL | We Make a Difference

Curb Radius Design

Curb radius reduction: 2016 City of Toronto Curb Radius Design Guidelines, Transpo Assoc of Canada (Winner of 2016 Road Safety Engineering Award

https://www.tac-atc.ca/en/about-tac/awards/road-safety-achievement):

https://www.tac-atc.ca/en/conference/papers/city-toronto-curb-radii-design-guidelines

Guidance: City of Toronto

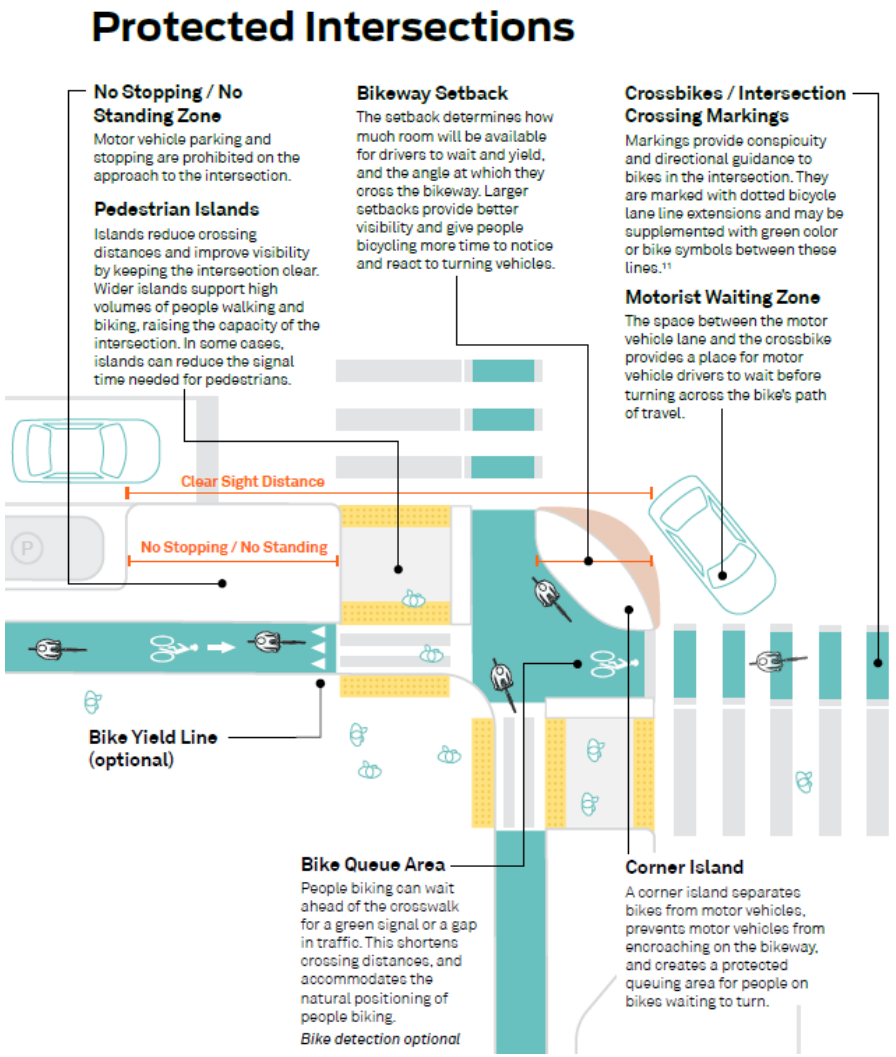
- New Road Engineering Design Guidelines Section: Curb Radii Guideline
  - **Defines what constitutes frequent truck turns**
  - **Defines design and control vehicles for intersection contexts**
  - **Defines optimal turning vehicle speeds for vehicle types**
  - **Notes large control vehicles are allowed to cross the centerline and use the full width of the receiving roadway in some intersection contexts.**

2019 NACTO Bicycle Crossings (Don't Give Up at the Intersection)

2019 NACTO Don't Give Up at the Intersection (Bicycle Crossings):
https://nacto.org/wp-content/uploads/2019/05/NACTO_Dont-Give-Up-at-the-Intersection.pdf

2019 NACTO Bicycle Crossings (Don't Give Up at the Intersection)

Michael Baker INTERNATIONAL



2019 NACTO Bicycle Crossings (Don't Give Up at the Intersection)

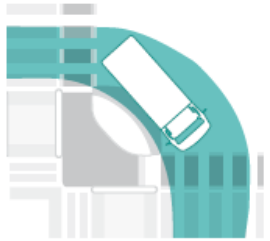
Michael Baker INTERNATIONAL

Protected Intersections

Design, Control, & Managed Vehicles

The selection of the Design, Control, and Managed vehicles informs the design of the corner radius at a protected intersection, as well as the need for any vertical features.

Design Vehicle

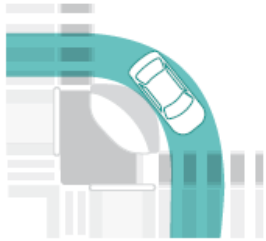


The **Design Vehicle** is the largest typical vehicle that will frequently use the street. For major streets and downtown settings, a DL-23 delivery truck is a typical design vehicle. In protected intersections, it is acceptable for the design vehicle to use all of the first lane, and part of the second lane of the receiving street. In a neighborhood setting, a 15' car/light truck is a typical design vehicle, allowing for a tighter turn radius. In locations where truck turn volumes are high, a single-unit 30'-40' truck is a typical design vehicle. A city bus should be used as a design vehicle only if a scheduled/planned bus route makes that turn. In most cases, this affects only one corner. Turn speeds of 3-5 mph should be used for modeling the design vehicle.

Control Vehicle

The **Control Vehicle** or accommodated vehicle is the largest vehicle that will infrequently use the street. For major streets and downtown settings, a WB-50 truck is a typical control vehicle. In protected intersection designs, this vehicle can make the turn at a very low or 'crawl' speed. It is expected to turn over mountable elements, and may enter the lane adjacent to its lane of origin. In a neighborhood setting, sanitation or fire emergency vehicles are control vehicles. Turn speeds should be set 1-5 mph for the control vehicle. For turn speeds under 5 mph, field testing or observation is recommended as software may be inaccurate at low speeds.

Managed Vehicle



The **Managed Vehicle** is the most common vehicle to use the street. It is typically smaller than the design vehicle which means it is capable of higher, more dangerous speeds. In most urban streets, the managed vehicle is a personal vehicle or taxi. In protected intersections, the goal for a managed vehicle is to keep turn speeds below 10 mph. In some cases, this requires that the design vehicle turns over a mountable element.

NJ Speed Hump Law

Michael Baker INTERNATIONAL | We Make a Difference

Raised Crossings

NJ Speed Hump Law - C.39:4-8.9

- https://www.state.nj.us/transportation/eng/documents/speedhumps/
  - Law originally based on ITE Guidelines for the Design and Application of Speed Humps (1993; possibly updated in 2007, per NJDOT website)
  - Requires NJDOT Commissioner approval for speed hump installation on County or Municipal roads where speed > 30 MPH and ADT > 3,000 VPD

Times have changed

- ITE issued Updated Speed Hump Guidance: May 2018 Update: "[Speed humps] Not appropriate for roads with 85th-percentile speeds of **45 mph** or more" (Same speed noted for speed table/ raised crosswalks)
- https://www.ite.org/pub/?id=2c815e39%2Dbb70%2D72a3%2D4e31%2D0356ae6af6b0
- https://safety.fhwa.dot.gov/speedmgt/traffic_calm.cfm also dated guidance, always seek the latest available

Coordination, Collaboration, & Implementation

Michael Baker INTERNATIONAL | We Make a Difference

Implementing Traffic Calming Measures

Coordination and Buy-In from:

- Local Public Officials
  - Elected: Mayor/Council
  - Staff: Engineers/Planners
- Stakeholders
  - EMS, Fire, Police
  - Transit/Schools
  - Local Businesses/Chamber of Commerce
  - Residents
  - Community Organizations
    - Complete Streets, Bike/Ped, etc.
  - Religious Organizations
- Regional/State/Federal – *Who's Paying?*

Implementing Traffic Calming Measures

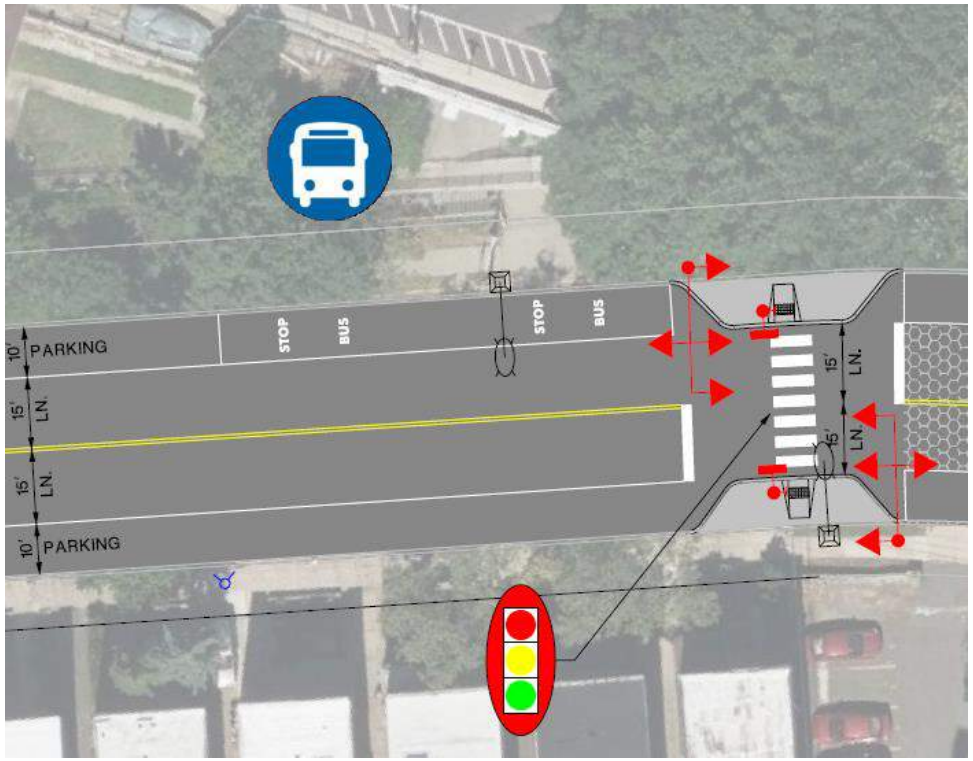
Coordination and Buy-In

- Solicit input from local officials/professionals, the public, and community organizations – ***Listen to the Users!***
  - Use context sensitive design – *Not One Size Fits All*
  - Incorporate input to extent practicable
  - Educate where possible
  - Acknowledge you can't please everyone & "Compromise" isn't a Bad Word

Implementing Traffic Calming Measures

Local Public Officials

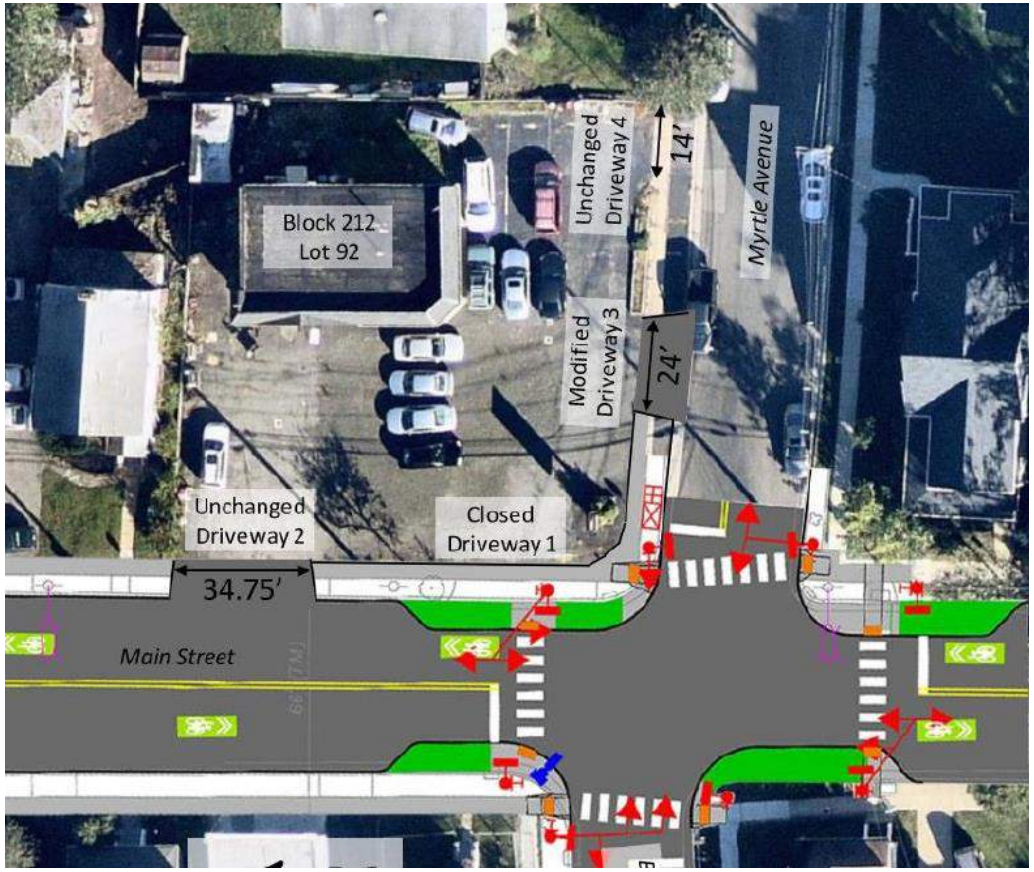
- Potential Concerns
  - On-Street parking impacts to residents and businesses
    - Title 39 (Section 4-138), no parking within 25’ of corners
    - NJ Transit Bus Stops (105’)
- Solutions
  - Perform parking utilization study
  - On-street parking analysis
  - Curb extensions reduce “no parking” to 10’



Implementing Traffic Calming Measures

Local Public Officials

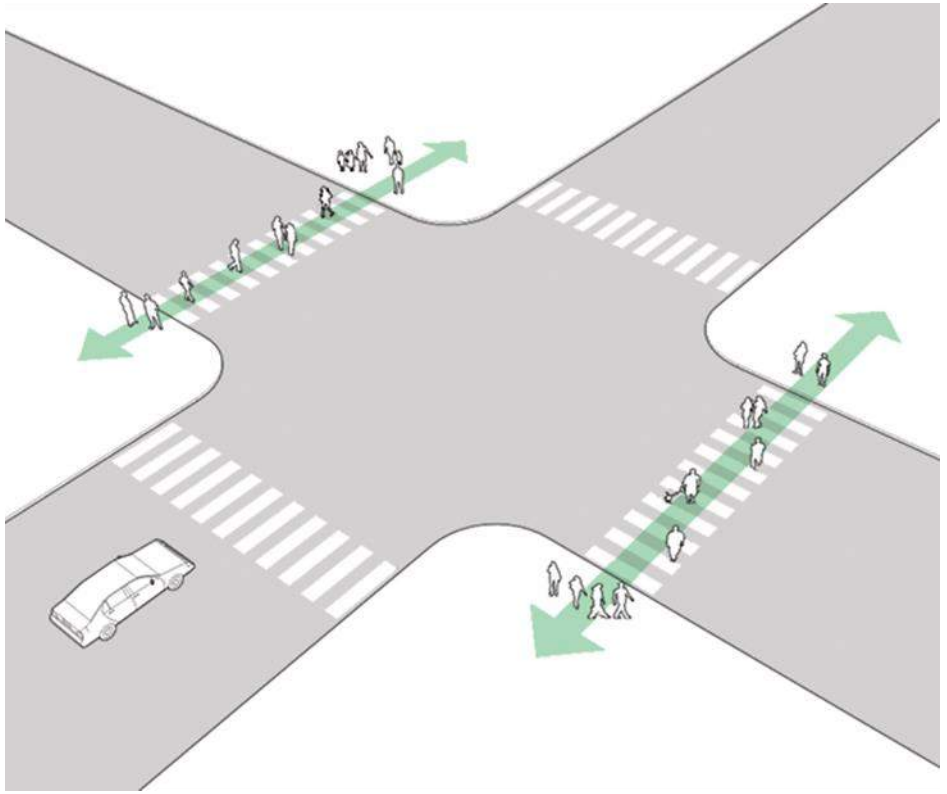
- Potential Concerns
  - Reducing access to residences and businesses
- Solutions
  - Perform AutoTurn maneuver analysis
  - Review local zoning requirements
  - Coordinate with impacted property owners early in design



Implementing Traffic Calming Measures

Local Public Officials

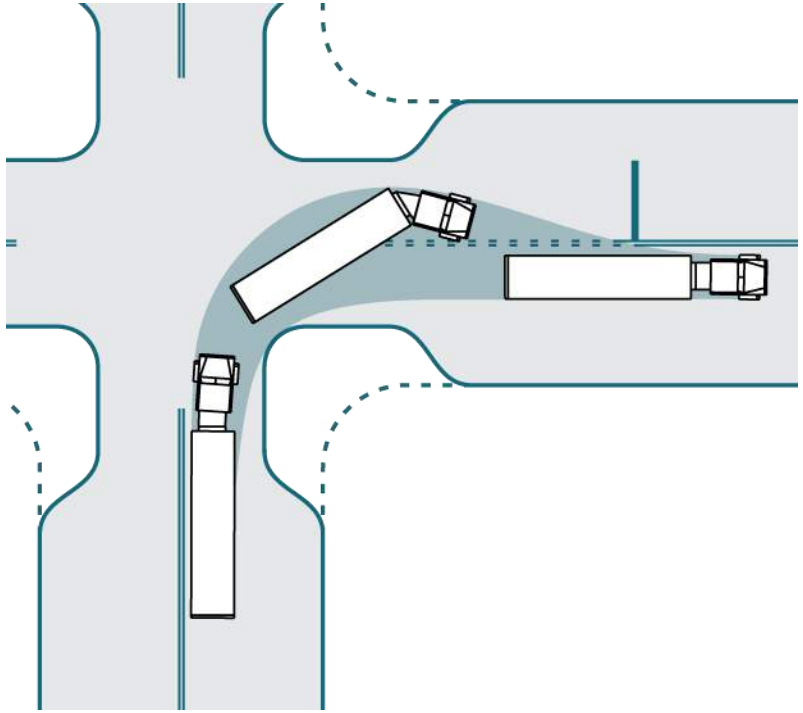
- Potential Concerns
  - Reduction to vehicle LOS due to LPIs, All-Ped Phases, curb extensions
- Solutions
  - Synchro/SimTraffic Analysis
  - Safety Benefit Cost analysis
  - Point to regional examples



Implementing Traffic Calming Measures

Stakeholders

- Potential Concerns
  - Emergency vehicle turning maneuvers
- Solutions
  - AutoTurn
  - E/V pre-emption



Allowing infrequent vehicles to use the whole intersection (moving left slightly before the turn and using the lane adjacent to the right lane on the receiving side) allows the entire intersection to become more compact, reducing turning speeds of regular vehicles to 12–15 mph. A recessed stop bar prevents conflicts with opposing traffic. **– NACTO Urban Street Design Guide**

Implementing Traffic Calming Measures

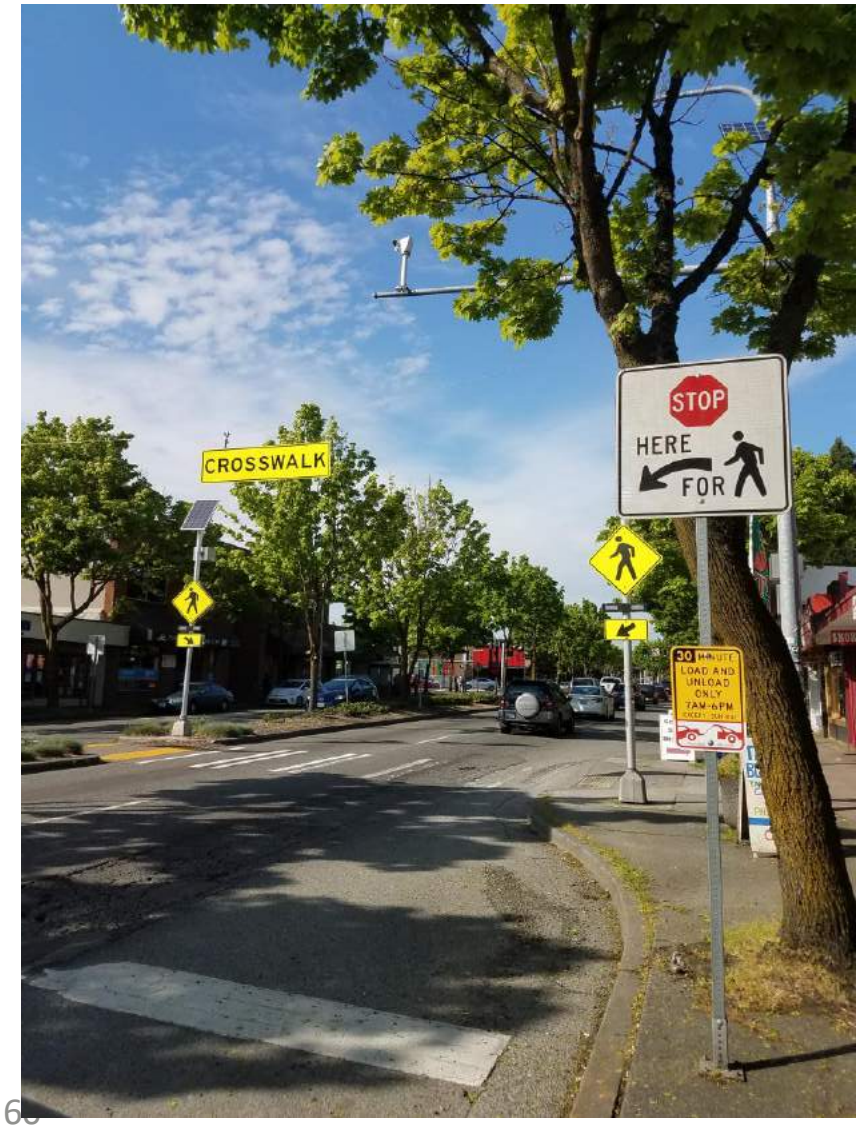
Stakeholders

- Potential Concerns
  - Balancing competing needs for Complete Streets, LOS, and on-street parking
- Solutions
  - Incorporate public input/comments
  - Iterative design
  - Acknowledge “compromise” isn’t a bad word

Implementing Traffic Calming Measures

Religious Organizations

- Potential Concerns
  - Parking during religious service
  - Pedestrian actuation
- Solutions
  - Flex zones
  - Time of day-based recall



Implementing Traffic Calming Measures

Coordination and Buy-In

Lessons Learned:

- Coordinate & collaborate with impacted stakeholders early in the process
- Listen to the multi-modal road users
- Virtual and hybrid public meetings lead to more input & know the audience
  - Use laymen terms
  - May need to be multi-lingual
- Enforcement (police) vs Design (physical obstructions)
  - Double parking in bike lanes
  - Parking in bus stops
  - Parking less than 25’ from corners
  - Speeding

Michael Baker INTERNATIONAL | We Make a Difference

QUESTIONS/COMMENTS

Peter F. Kremer, AICP, P.P.
peter.kremer@mbakerintl.com

Tom DiBiase, PE, RSP
thomas.dibiase@mbakerintl.com

Brad J. Miller, PE, PP, PTOE, LEED AP
brad.miller@mbakerintl.com

Liability and Complete Streets

Michael Baker INTERNATIONAL | We Make a Difference

Liability and Complete Streets

- Concerns about liability can be a barrier to Complete Streets
- New Jersey's Tort Claims Act provides immunity for planning, design, and improvements
- This immunity is perpetual and mode-neutral

Protection from Liability

- Tort Claims Act provides perpetual immunity for planning, design, and improvements
- Perpetual immunity attaches when a plan, design or improvement is:
  - Approved by an official body
  - Approved by a public employee exercising discretion
  - In conformity with standards previously approved by authorized entity or person
- Approved plan must sufficiently address the condition to demonstrate official discretionary approval
- Project MUST be constructed in conformance with previously approved plan/design
- Routine maintenance critical to “perpetual“ immunity

Liability

- Accommodating transit, bicycles and pedestrians safely is NOT liability-inducing
- The choice of ***doing nothing*** can lead to liability

“Dangerous Condition” Liability

- Public entities liable for injury caused by its property in dangerous condition
  - Where condition created a reasonably foreseeable risk of the kind of injury incurred
  - And where either:
    - A negligent or wrongful act or omission of an employee of public entity created the dangerous condition, or
    - Public entity had actual or constructive notice of the dangerous condition and sufficient time to have taken measures to protect against the dangerous conditions
- Action or inaction of public entity must be **palpably unreasonable** – “no prudent person would approve of the public entity’s course of action.”
- Underscores the importance of a regular maintenance program – doing nothing can lead to liability

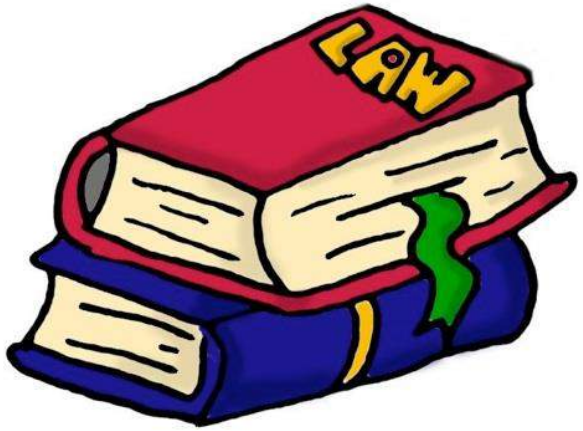
Statutory Citations
New Jersey Title 59 - Claims Against Public Entities

Tort Claims Act:

- N.J.S.A. 59:2-1a

Plan or Design Immunity

- N.J.S.A. 59:4-6



Today – AASHTO Green Book 7

- 1.3 Overview of the New Framework for Geometric Design
  - 1.4 Functional Classification
  - 1.5 Context Classification

Functional Class	Context Class				
	Rural	Rural Town	Suburban	Urban	Urban Core
Local Road or Street					
Collector Road or Street					
Arterial Road or Street					
Freeway					

Note: This framework together with an assessment of multimodal needs and performance measures should guide the flexible approach to the design of projects. The shaded cell, representing a freeway in a rural town context, is unlikely to occur often.

Figure 1-1. Framework for Roadway Design Based on Functional Classification and Roadway Context

Today – AASHTO Green Book 7

- 1.6 Multimodal Considerations
  - “Essential” in design given road context and community needs
  - Design for current and anticipated users
  - Rely on planning documents – Bicycle/pedestrian network or corridor plans (Master Plans)
- 1.7 Design Process to Address Specific Project Types
  - Flexibility
    - New Construction
    - Reconstruction (change roadway type)
    - Construction on existing roads (maintain roadway type)
- 1.8 Design Flexibility
  - Critical to project Purpose & Need, context, constraints, community
  - Design criteria not fixed; are guidelines (starting point) for design
  - Performance-Based Design is key to flexibility

Today – AASHTO Green Book 7

- 1.9 Performance-Based Design
  - Projects should address Purpose & Need, and be flexible
  - Quantitative and Qualitative measures *can be developed / relevant* to performance
  - Measure performance wrt Purpose & Need
    - No not optimize performance measures, but *balance them* (site-specific)
  - Performance-Based Analysis
    - 1. Establish quantitative targets for improvement for specific measures (measure no-build vs. future)
    - 2. OR specify performance measures that will be improved vs. no-build (without necessarily specifying how much); and other performance measures that remain relatively unchanged
  - Possible models: Crash prediction, systemic safety models, traffic sim models, air quality or noise models

Curb Radius Design

Traversable Curb (Mississauga, ON)

Curb Radius Design

Traversable Curb (St. Louis Park, MN)

Curb Radius Design

Examples of a dual path corner design include:

Curb extension (Ottawa, ON)