MAKE YOUR MARK

July 2019

Highway Safety Improvement Program
Local Safety Peer Exchanges

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Local Safety Peer Exchange Background

In 2015, New Jersey updated New Jersey's Strategic Highway Safety Plan, SHSP. This plan included the adoption of the National Strategy on Highway Safety's "Toward Zero Deaths" vision and incorporated a fiscal investment strategy that included a commitment to focus approximately 40 percent of the annual Highway Safety Improvement Program (HSIP) funding on state highways and evaluation and 60 percent on county and municipal network. This was in line with distributions of fatal and serious injury crashes on New Jersey's public roads. HSIP is a federal-aid program that seeks significant reductions in fatalities and serious injuries on all public roads. Consistent with this goal, NJDOT focuses, not only on state highways, but also on providing continuous support and technical assistance to local agencies to improve roadway safety.

FHWA provides peer exchanges throughout the nation on innovative technologies used by various states to provide a forum for others to learn more about these initiatives and their benefits. Through a series of Local Safety Peer Exchange events, NJDOT seeks to apply the same knowledge sharing approach for its counties and municipalities to promote the use of innovative techniques initiated by select counties and share best practices toward reducing fatalities and serious injuries.

To support the delivery of Local Safety Peer Exchanges, NJDOT sought State Transportation Incentive (STIC) funding from the Federal Highway Administration with the approval of the NJ State Transportation Innovation Council (NJ STIC). The Local Safety Peer Exchange events are well-aligned with the FHWA Technology Innovation Deployment Program (TIDP) goal: "Develop and deploy new tools and techniques and practices to accelerate the adoption of innovation in all aspects of highway transportation."

The focus of the Local Safety Peer Exchange is also consistent with two of the FHWA Every Day Counts (EDC- 4) Innovative Initiatives: *Safe Transportation for Every Person (STEP)* which supports the use of cost-effective countermeasures with known safety benefits to address locations of fatal pedestrian crashes; and *Data-Driven Safety Analysis (DDSA)* that uses crash and roadway data to reliably determine the safety performance of projects.

Three peer exchanges were held to share best practices in addressing traffic safety (See Table 1). These full-day events brought together representatives of NJDOT, FHWA, counties, municipalities, and Metropolitan Planning Organizations (MPOs) to discuss project prioritization, substantive safety, implementation of FHWA safety countermeasures, and use of a systemic safety approach.

Table 1: Local Safety Peer Exchange Events by Region

Date	Region	Counties	Location
December 6, 2017	Central	Hunterdon, Somerset, Union, Middlesex, Monmouth, Mercer, Ocean	NJDOT
June 13, 2018	South	Burlington, Camden, Gloucester, Atlantic, Salem, Cumberland, Cape May	Cumberland County Community College
March 26, 2019	North	Sussex, Passaic, Bergen, Essex, Hudson, Warren, Morris	NJTPA

Introduction

The Local Safety Peer Exchange events included a day-long program that was hosted by one of the state's Metropolitan Planning Organizations (MPOs), or held at NJDOT Headquarters. Participants were given a folder that included the agenda, break-out session discussion questions for morning and afternoon, an Action Plan form, and Feedback Survey form, as well as two reference documents – a table describing the FHWA Safety Countermeasures, and a listing of useful weblinks.

Examples of these documents can be found in **Appendix A**. A list of presenters for the three local safety peer exchanges can be found in Table 2. Flash drives with the day's presentations were made available to the participants; the presentations can be found in **Appendix B**. The presentations were also made publicly available on the NJDOT Technology Transfer website.

Welcoming Remarks. Welcoming remarks were given at each of the events:

- In the Central region, Michael Russo, NJDOT Assistant Commissioner for Planning, Multimodal & Grant Administration, emphasized that NJDOT supports the use of federal funds on projects that go beyond milling and paving to focus on maximizing safety on local roads. He expressed his interest in seeing funding programs grow with support to counties and municipalities.

- In the South region, Jennifer Marandino, Executive Director of South Jersey Transportation Planning Organization (SJTPO), provided examples of work being done in the SJTPO region that reflects the use of data driven safety analysis and implementation of FHWA safety countermeasures. SJTPO uses crash data and the TR-1 police crash report forms to create crash diagrams for local agencies within their region. She noted that every SJTPO county was invited to propose up to three locations for roundabouts, and each county has identified potential locations. She also noted that these locations do not have to be on the network screening list and criteria other than recorded crashes may be considered for these improvements. She described awkward intersections that had no crashes but could benefit from implementation of roundabouts. She also noted that Burlington County, in the DVRPC region, currently has four roundabouts built, and has applied for two more.

  She reported that SJTPO is working on four road diets, one for each county in the region (Atlantic, Cape May, Cumberland, and Salem). The agency is also reviewing crash data for the Cumberland County Bicycle Pedestrian Safety Action Plan and anticipates that the process will result in ten projects that are eligible for HSIP funding. The agency had undertaken the identification of hazardous curves, and developed one project addressing multiple curves to receive HSIP funding.

- In the North Region, Mary D. Ameen, Executive Director of North Jersey Transportation Planning Authority (NJTPA), reported that NJTPA's work is guided by the agency's *2045 Plan: Connecting North Jersey*, an update of the Regional Transportation Plan that was approved in November 2017. The goal of the MPO's work is to make all forms of transportation safer. The plan includes projects throughout the region totaling $48 million. The agency is studying regional crash data and promoting pedestrian safety.

Table 2: Local Safety Peer Exchange Presenters

Presenter	Topic	Region	Appendix Page
NJDOT Asst. Commissioner Michael Russo, Planning, Multimodal & Grant Administration	Welcoming Remarks	Central	N/A
Jennifer Marandino, SJTPO, Executive Director	Welcoming Remarks	South	N/A
Mary D. Ameen, NJTPA, Executive Director	Welcoming Remarks	North	N/A
Caroline Trueman, FHWA NJ Division	NJ's Safety Performance Targets: Why It Matters	Central South	21 63
Sophia Azam, NJDOT, Transportation Data & Safety	NJ's Safety Performance Targets: Why It Matters	Central	21
Daniel LiSanti, NJDOT Safety Bicycle and Pedestrian Programs	NJ's Safety Performance Targets: Why It Matters	South North	63 107
Keith Skilton, FHWA NJ Division	NJ's Safety Performance Targets: Why They Matter	North	107
Chris Zajac, NJDOT, Traffic and Technology	Safety Voyager Overview	Central South North	26 67 112
Vincent Cardone, Monmouth County, Principal Engineer II, Traffic	Monmouth County Demonstration of the Use of Safety Voyager	Central South North	29 69 114
John McFadden, FHWA, Safety & Design	Understanding Substantive vs. Nominal Approaches to Design	Central South North	35 76 121
Deanna Stockton, Princeton Township, Municipal Engineer	Princeton's Approach to Traffic Calming	Central South North	54 98 131
Patricia Bates Smith, Somerset County, Principal Engineer	Somerset County's Approach to Systemic Safety Improvements - High Friction Surface Treatment on roadways based on crash data	Central North	51 128
Douglas W. Whitaker, Cumberland County, Assistant County Engineer	Cumberland County's Approach to Systemic Safety Improvements - "hot-spot" and systemic projects and the implementation of countermeasures	South	95
Karen Scurry, FHWA Office of Safety, New Jersey Division	FHWA's 2017 Update of the Proven Safety Countermeasures	Central South North	57 101 134

NJ's Safety Performance Targets: Why It Matters. Following the welcoming remarks, NJDOT's Bureau of Safety Bicycle and Pedestrian Programs program managers and representatives of FHWA's New Jersey Division Highway Safety Improvement Program presented on the state's Toward Zero Deaths traffic safety vision and safety performance targets. Some key points were made at each of the events:

- FHWA has identified New Jersey as an Intersection and Pedestrian Focus State.
- Generally, 45 percent of fatal and serious injury crashes in New Jersey are lane departure, 30 percent are intersection crashes, and 25 percent involve pedestrians or bicyclists. New Jersey's local road system represents approximately 91 percent of the total road miles in the state, and approximately 57 percent of the fatal and serious injuries.
- New Jersey's Strategic Highway Safety Plan guides the allocation of Highway Safety Improvement Program funds and resources to reduce highway fatalities and serious injuries on the state's roadways. HSIP apportionments account for approximately six percent of the total annual apportioned federal funds that NJDOT can receive from the FHWA.
- NJDOT is required to report Safety Performance Targets for the Highway Safety Improvement Program (HSIP) that are included in New Jersey's Annual Safety Report. Safety targets are set for the following safety performance measures: the number of fatalities; the rate of fatalities per 100 million VMT; the number of serious injuries; the rate of serious injuries per 100 million VMT; and the number of non-motorized fatalities and serious injuries. The targets are established after careful consideration of previous trends, recently built projects and the current socioeconomic environment. The targets are based on five year rolling average values and are reported to satisfy federal requirements with the understanding that New Jersey's safety vision is to achieve zero deaths on all public roads. This long-term safety vision requires time to change attitudes and behaviors and to construct infrastructure improvements to reduce the frequency and severity of crashes.
- To aid in the implementation of the HSIP, New Jersey uses Data Driven Safety Analysis (DDSA) tools, such as AASHTO's Highway Safety Manual (HSM), and Safety Management System (SMS) network screening lists. These lists are developed for the state and local roadway system and are based on methodologies which include parameters such as type of crash, crash severity, and crash frequency.
- Local governments apply for HSIP funding for road safety projects through their MPOs. Agencies will work with their network screening lists and Safety Voyager to identify locations, review hot spot and systemic approaches to address crash locations, and identify proven safety countermeasures to address the issues. Many countermeasures were implemented at the local level and have been successful.
- A Local public agency (LPA) representative asked a question about funding projects. The FHWA representative noted that local agencies should not worry about funding; the LPAs should identify projects, and the MPO, NJDOT and FHWA are responsible for determining funding and eligibility. A representative of DVRPC noted that local agencies may not have design capabilities or funds for design, but the MPOs and NJDOT can assist.

Figure 1 Attendees at the December 6, 2017 Peer Exchange.

Morning Session

Morning Presentations

Safety Voyager Overview. Chris Zajak from NJDOT provided an overview of *Safety Voyager*, an online portal to be used for analysis of statewide road safety related data such as crashes and annual average daily traffic data. In the third peer exchange, Mr. Zajak noted changes for the most recent version of *Safety Voyager* expected to be released at the end of April 2019. These changes include the addition of a module on pedestrian and bicycle crashes, heat maps, and changes to Query Builder and reporting. As users change parameters in the Query Engine, the map will be updated in real time to reflect these changes. The pdfs of redacted TR-1 reports will be made available for 2016, 2017, and 2018.

NJDOT is uploading crash data every two weeks, as it becomes available from municipalities. However, he noted that some locations cannot be identified because they are not geocoded, or there is no milepost or latitude and longitude included in the crash report. There may be lags in reporting among some of NJ's municipalities; however, as more municipalities turn to online reporting systems, more crash reports will be available with fewer delays. This tool can be useful to address inquiries from the public or media concerning specific locations. *Safety Voyager* remains password protected and users should contact Mr. Zajak to gain access.

Monmouth County Demonstration of the Use of Safety Voyager. Vincent Cardone described Monmouth County's demonstration project on the use of *Safety Voyager* for project screening for the High Risk Rural Roads Program. The County frequently receives requests related to road safety. Beginning with a network screening list, the agency used *Safety Voyager* to map crashes along a corridor, and selected potential countermeasures based on crash type, and the use of crash modification factors to compare and select highway safety improvements. He noted that effective presentation of data will help decision makers understand the requests for funding for specific projects. When inquiries come in from the public or municipal or county officials regarding specific locations, they follow the same process and begin with data available in *Safety Voyager*. Mr. Cardone noted that attention to the details of crashes is needed in order to determine if a crash was due to road conditions or unrelated factors, and to assist in selecting appropriate countermeasures to address road safety. *Safety Voyager* allows users to view information for all crashes at a location and to filter for details.

Understanding Substantive vs. Nominal Approaches to Design. John McFadden, FHWA presented on substantive vs. nominal approaches to design and the integration of safety performance into all highway investment decisions. Highway engineers are used to thinking about safety in terms of adherence to design criteria, referred to as "nominal safety." The performance of a highway (either existing or expected) as determined by crash frequency and severity, is referred to as "substantive" or quantitative safety. We can think of a road as "nominally safe" if it meets the minimum standard of care and is current with respect to published standards and guidelines. He emphasized the value of going beyond mere compliance with design standards and guidelines to consider actual or expected performance of a roadway in terms of crash frequency and severity.

Mr. McFadden discussed AASHTO's *Highway Safety Manual* that can help agencies quantify the safety impacts of transportation decisions by providing estimates of a roadway's expected safety performance. Many decisions or actions that professionals make involve marginal or incremental differences among alternatives. The HSM functions as a tool that applies an evidence-based technical approach to safety analysis.

Morning Breakout Session

In the December 6, 2017 and June 13, 2018 peer exchanges, these presentations were followed by a breakout session that provided an opportunity for representatives of MPOs, municipalities and counties to share processes and procedures for prioritizing projects and diagnosing safety issues at specific locations. In the first peer exchange, attendees were divided into three groups with multiple representatives of an agency split among the groups to share experiences. In the second peer exchange, representatives of agencies remained in the same group. Due to time constraints, there was no morning breakout session held in the March 26, 2019 peer exchange. In the third event, more questions were asked of the presenters during and after the presentations than in the prior two peer exchanges. Two of the three morning breakout session questions were addressed in the afternoon breakout session.

Morning Breakout Session Questions

The following discussion questions were provided to guide the morning breakout session:

1.) When your MPO solicits Local Safety Projects in your region, how do you prioritize projects?
    A.) Do you sometimes use the list 'opportunistically' to address locations that have infrastructure issues/needs?
    B.) To what extent do politics affect project selections and advancement?
        i. Are there times when you use the politics to positively influence project selections and decisions?
        ii. Can you use data in that process? If yes, how?
2.) Once a project location is identified, how do you diagnose the safety issues and potential countermeasures for that location?
3.) Do you have examples in your community where you've applied substantive safety effectively? If not, do you have ideas of how you can apply substantive safety in your region?

In general, counties use their network screening lists to prioritize projects. However, in some counties, other locations may be identified through familiarity with local conditions and the county will conduct its own crash analysis of these locations. One county has used data from the local police department. One participant expressed that they examine crash frequency/types/severity, but it is difficult to make these decisions without reference to the context of the crash event (e.g. roadway conditions, weather, time of day, etc.). It was noted that some statistical models use data to measure the effect of licensing laws, and level and quality of enforcement.

A participant offered that project prioritization can be difficult. A project may be elevated in priority if an advocate, or someone who is passionate about a particular program, promotes it. Projects are often elevated if funding seems easier to handle based on the scope of work. One county is prioritizing projects on a first-come, first-serve basis rather than based on data. The question was asked: how can a county have a location accepted if it is not on the network screening list? Another agency noted that they presented a potential modern roundabout project at a location not on the screening list.

Participants voiced that every project is affected by county and local politics, not only in selection and advancement, but also in design details. It was noted that mayors try to influence which projects are developed, reflecting the reality that municipalities have to commit resources to completing funding applications and they have to face feedback from residents who can sometimes stall projects. While data driven safety analysis (DDSA) can provide a basis for decision-making and setting priorities, at times the technical method can clash with the political nature of local decisions. It was observed that politicians have used DDSA when data supports projects that they are interested in, but can dismiss data when it does not support their priorities. Data can be used to make the case for projects, but it will take time for decision makers to become familiar and comfortable using the information.

Substantive safety, more often than not, is used as a large part, but not the only part in developing design guidance for roads. One participant noted their use of the interactive highway safety design model as a resource to support substantive safety analysis. In the past, participants have used programs like Rutgers' Plan4Safety and found that the tool worked well for designating high risk areas. However, there is some confusion about what tool to use now. A participant noted that the NJDOT tool, *Safety Voyager*, looks promising but seems not very easy to use. There was interest expressed about the revisions to the highway safety manual (HSM) in providing more analytical methods and tools. When discussing substantive safety, breakout group participants gave examples of their local adoption of countermeasures. These comments can be found in Table 3 below.

Participants discussed two useful resources: Road Safety Audits, and the *NJDOT Complete Streets Design Guide*. When there is a crash or congestion, people call NJDOT. In reviewing these incidents, NJDOT considers the need for a roadway safety audit to look for potential improvements to that location. Road safety audits are being offered; counties and municipalities should speak with their MPOs about availability. Participants have found the *New Jersey Complete Streets Design Guide* to be a useful resource.

Some challenges and opportunities were raised in the morning discussions:

- Participants voiced the idea that congestion and safety are not complementary and cannot be improved at the same time.
- Coordination with utility companies on the timing of utility improvements with road improvements is often difficult. The county will repave a road and a year later the water company will take it up to do work.
- Construction of new driveways may present some municipalities with the opportunity to incorporate safety improvements into these projects. Identifying permits that have been issued for new driveways could assist in identifying potential project locations.
- Participants suggested that the funding application process should be made easier for counties.

General discussion focused on a couple of safety countermeasures. It was noted that, nationally, there is a move away from using the "85 percent rule" for speed. The question was raised whether the 85th percentile is appropriate for a small municipality. It was noted that use of the FHWA USLIMITS2 countermeasure can aid in determining speed limits for specific road segments.

Roundabouts were a particular topic of discussion. NJDOT stated that the Bureau of Safety Bicycle and Pedestrian Programs (BSBPP), who administrates the HSIP, has an unwritten policy to consider roundabouts at all proposed intersection projects. Participants raised several concerns regarding pedestrians at roundabouts. Pedestrians, including crossing guards, may have more difficulty finding the gaps in traffic. Sight impaired pedestrians have particular difficulty at roundabouts. It was suggested that a HAWK signal could be placed at the approach to the roundabout. Similarly, island placement at each approach might address these issues. It was agreed that there is a need for more studies of pedestrians at roundabouts. It was noted that driver visibility going into the roundabout is usually sufficient, but exiting the roundabout can be difficult. Authorities may be unsure about enforcement at these locations. Specific actions undertaken at the local level can be found in Table 3.

Table 3: Morning Breakout Section Comments

Local Agency	Comments
Asbury Park	Looking at implementing new and updated signage and signals.
	The City is just starting to get into safety at specific locations; they have had a traffic engineer for only one year. The City is seeing a lot of growth and there will be many opportunities to work on pedestrian safety. Their issues are very tied to seasonal population fluctuations.
Atlantic County	For their own projects, they look at crash data, and design in-house. They are focusing on pedestrian safety at 29 intersections on the barrier islands, a CMAQ project. Tweaking the timing of signals, creating bike lanes.
Camden County	There is a lot of political will to expand Crosskeys Road. The project was first proposed about 20 years ago, and is now moving forward because the freeholders support the project, despite some public opposition.
	DVRPC is helping do crash diagrams. With one project, they looked at crashes involving left turns and right turns, and the design changed from a signal project to a roundabout to a two lane roundabout.
Cape May County	They talk to local officials – professionals do the concept design. They are focusing on incorporating more safety into all projects.
Cumberland County	Starting with the screening list, they take a systemic approach, looking at similar issues faced by numerous local agencies. They consult with SJTPO to determine what projects are likely to receive funding. When exploring intersection improvements, they look to see what can be done to improve safety, not just milling and paving.
Mercer County	The process of project identification is data-driven and engineering based. The process may be cyclical based on who is in office, and is also a function of funding levels.
	They are very involved with data to identify the circumstances in regard to safety. They take the DVRPC chart and do their own analysis. Right now, they are working on the top 20 most dangerous intersections based on collisions, etc. They pull out data in GIS and look at the locations that do not involve right of way or wetlands and then go into the concept development phase. They complete a system-wide analysis and optimize for maximum safety benefits.
Middlesex County	The County does not typically apply directly for local safety projects. Instead, they allow the municipalities to propose projects and then the County filters these requests. They follow this process believing that if the project does not have local support, it will not succeed. For example, public opposition to plans to widen Oak Tree Road from two lanes to four lanes divided resulted from a lack of public information. Ninety people showed up to a freeholder meeting and the project died. Since then, the County has involved municipalities in the project design and engaged the public. For the local safety program, the County is ultimately the sponsor but the municipality completes the application.
	They do not have a list of the most dangerous intersections other than what can be found on the NJ Transportation Planning Authority (NJTPA) website.
	They fund everything that comes in that really needs funding and if it is a good project. Some funding programs come up and they cannot find a problem that fits the criteria.

Table 3: Morning Breakout Section Comments (cont.)

Local Agency	Comments
Princeton	Fatalities had been declining, but jumped in the past two years. Princeton is difficult due to small constrained spaces and many historic areas. It is a very walkable city so there are many conflicts between bike/ped and vehicles. They are working on traffic calming based on statistics. Their new methodology involves safety voyager crash data much earlier in the process, completing a road safety audit, and gaining approval of the traffic safety committee before a pilot roadway change is made. They involve stakeholders from the very beginning and incorporate Complete Streets ideas. Neighborhood meetings are held for design and preconstruction.
	Alexander Road, Princeton roundabout is popular.
	They are looking at: o Using a HAWK signal for a school crossing on a 45 mph road o Piloting speed cushions – installation is time intensive o Temporary bike lanes o Removing brick crosswalks due to trip and fall injuries o Traffic calming elements put in place in the 1990s, some are being removed with repaving because they are no longer up to standards o Colored crosswalks and MUTCD o Pop-up roundabouts o Sidewalk improvements are funded by the municipality – used to be 50/50 with the homeowner. Results in less funding for highway projects.
Red Bank	Curb extensions, raised intersection.
Somerset County	They start at the top of their network screening list and work down.
	If there are municipal roads on the network screening list, the County asks if the municipality is doing anything at the local level. Township roads are working their way up in the rankings. The County acts as the project manager on these projects in some cases. With local Safe Routes To School (SRTS) projects, the County steps in to help with project administration if the municipality cannot handle it.
	New Center Road; Somerset road diets; Promenade Boulevard road diet. Because of complaints from locals, the county may be reluctant to do another road diet – or will need more outreach and support before pursuing one. Somerset towns are not supportive of change.
Warren County	The County is often responding to complaints from residents or municipal or county officials rather than to crash reports. They review the crash history of the location and crash data to determine if there is a need for interventions.
West Windsor	They implement road diets while road resurfacing. The municipality has also installed flashing beacons at intersections.

Afternoon Session

Afternoon Presentations

Princeton's Approach to Traffic Calming. Deanna Stockton, Princeton's town engineer, presented on Princeton's approach to traffic calming. Princeton experiences large pedestrian traffic volumes along and across a state highway and adjacent roadways. An engaged citizenry is looking for more pedestrian-friendly solutions to traffic issues. In relation to the four E's, enforcement is limited by the number of police officers available. The municipality has partnered with the local Transportation Management Association on education initiatives. In general, engineering is the principal means for addressing safety concerns.

Designing for road safety begins with a review of crash reports on *Safety Voyager*, speed data, and Annual Average Daily Traffic numbers to identify locations for focus. Ms. Stockton notes that the graphical representations available in *Safety Voyager* are useful for communicating with municipal officials. The engineer works closely with the police on traffic safety and discusses the initial data with them. The planning process includes review of FHWA countermeasures, use of the Complete Streets checklist, and referral to the town's Master Plan. Findings are discussed with the town's Traffic Safety Committee and committee input contributes to a conceptual plan. Neighborhood meetings provide another perspective which is integrated into the design. The town's Complete Streets Committee reviews the final plan. Often, traffic calming measures are piloted before a substantial investment is made in permanent installation. Ms. Stockton looks for community champions to advocate for improvements. She noted that they have established criteria and a map of potential traffic calming locations. She also noted several roadblocks to change, and was looking for experiences in other communities on Complete Streets improvements on state highways, traffic calming, and success stories for safety improvements. Princeton has found a decline in crashes which they attribute to three years of twice a year Street Smart campaigns. Ms. Stockton noted that evaluation of safety improvement implementation is a priority. Collaboration with the police and the use of speed radar signs make evaluation easier.

Somerset County's Approach to Systemic Safety Improvements – High Friction Surface Treatment on Roadways Based on Crash Data. At the December 7, 2017 and the March 26, 2019 peer exchanges, Patricia Bates Smith, Engineer for Somerset County, described the county's exploration of surface treatments on horizontal curves with high numbers of crashes, primarily on High Risk Rural Roadways. Based on crash data, locations were evaluated and sites chosen for friction pavement courses at horizontal curves. They tried micro-milling first, but the surface did not last and was not well received by the public. High Friction Surface Treatment (HFST) is now applied to curves with recent severe crashes and locations noted by municipalities or residents. She shared the county's evaluation method for identified locations which helps to determine the extent of application on horizontal curves. At the March 26th peer exchange, Ms. Bates Smith noted that the current year's activities include restoring micromilled areas and repairing HFST areas. They will be identifying high crash locations for future signage or HFST treatments using in-house GIS crash mapping, and the NJ Regional Curve Inventory and Safety Assessment for the NJTPA Region. She also referred to the guidance documents and other resources available on FHWA's webpage on HFST.

Cumberland County's Approach to Systemic Safety Improvements – "Hot Spots" and Systemic Projects and the Implementation of Countermeasures. Cumberland County has also employed High Friction Surface Treatment on county roads as reported by Douglas Whitaker at the June 13, 2018 peer exchange. The County uses the network screening list to determine pedestrian intersection hot spots, pedestrian corridor hot spots, intersection hot spots, and High Risk Rural Roads hot spots. The County's systemic approach includes the use of centerline rumble strips and High Friction Surface Treatment on horizontal curves. Installation of rumble strips was based on NJDOT criteria, as well as County criteria. The HFST treatment was applied to High Risk Rural Roads, chosen on the basis of the network screening list with additions of locations known to the engineering department, as well as a review of the current pavement conditions. As part of these projects, the County reviewed signage at these locations for retroreflectivity, size, location, and spacing. Mr. Whitaker noted the pros and cons of the techniques, and offered some "Lessons Learned" regarding the long project delivery timeline and the centralized project review process.

FHWA's 2017 Update of the Proven Safety Countermeasures. Karen Scurry from FHWA reviewed the Proven Safety Countermeasures and their associated safety benefits. The Proven Safety Countermeasures (PSC) initiative has been around for 10 years and have grown from 9 countermeasures in 2008 to 20 countermeasures today. The PSCs are organized around FHWA's focus areas: Intersections, Roadway Departure, and Pedestrians, and also includes several crosscutting strategies that include Road Safety Audits, Local Road Safety Plans, and US2Limits. Safety benefits are described in terms of the expected percentage reduction in roadway crashes of various types. Countermeasures applied through a systemic approach will have the most impact. Ideally, countermeasures would be incorporated into other projects, such as repaving, to achieve safety goals. Ms. Scurry noted the Crash Modification Factor (CMF) Clearinghouse that lists over 800 countermeasures. This resource can help evaluate what countermeasure is appropriate for specific locations. Ms. Scurry emphasized the need to check geographic context in particular, cautioning that what worked in Montana might not work in Newark.

Afternoon Breakout Session

In the December 6, 2017 peer exchange, participants regrouped with their colleagues for the afternoon breakout session. At the June 13, 2018, participants were grouped as they were in the morning session. Discussion questions focused on countermeasures in use and other systemic improvements. At the March 26, 2019 event, participants were grouped naturally around tables.

Afternoon Breakout Session Questions

The following questions framed the discussion in the afternoon breakout session.

1.) Have you used Proven Countermeasures in your area, please share?
2.) Have you advanced any projects under the Systemic Safety approach?
3.) How do you handle push back when implementing new countermeasures/ facing challenges?
    A.) Do you have a champion or a safety advocacy team that helps promote these activities?
    B.) If yes, how did those partnerships form? Was there a particular issue/safety concern that raised the awareness in your community?
4.) For your general resurfacing program or other infrastructure improvement programs, do you consider adding safety improvements like bike lanes or other systemic improvements involving less extensive impacts?

Afternoon Breakout Session Questions
In the March 26, 2019 peer exchange, the following questions were addressed in the afternoon breakout session:

1.) When your MPO solicits Local Safety Projects in your region, how do you prioritize projects?
   - A.) Do you sometimes use the list 'opportunistically' to address locations that have infrastructure issues/needs?
   - B.) To what extent do politics affect project selections and advancement?
     - i. Are there times when you use the politics to positively influence project selections and decisions?
     - ii. Can you use data in that process? If yes, how?

2.) Do you have examples in your community where you've applied substantive safety effectively? If not, do you have ideas of how you can apply substantive safety in your region?

3.) How do you handle push back when implementing new countermeasures/ facing challenges?
   - A.) Do you have a champion or a safety advocacy team that helps promote these activities?
   - B.) If yes, how did those partnerships form? Was there a particular issue/safety concern that raised the awareness in your community?

4.) For your general resurfacing program or other infrastructure improvement programs, do you consider adding safety improvements like bike lanes or other systemic improvements involving less extensive impacts?

The discussion indicated that many Proven Safety Countermeasures (PSC) that are easy to implement are already in use. Several participants expressed a desire to better identify the right countermeasures for specific local contexts:

- Longitudinal rumble strips and roundabouts are often considered whenever new projects are instituted.
- Road diets are often considered for any new project that has safety issues. A participant noted that some safety issues persist despite the implementation of road diets.
- Road Safety Audits (RSAs), as one participant reported, are being performed with varying results. They engaged stakeholders from NJDOT and FHWA on some RSAs and some countermeasures have been adopted.
- It was noted that some of the most effective PSCs can be costly. Participants are trying to find ways to fund various projects including the more expensive PSCs.
- A participant asked if HSIP funds could be used to evaluate signals for adaptation to Leading Pedestrian Intervals. These projects would be particularly relevant in shore towns.
- NJDOT is developing a systemic project to install backplates with retroreflective borders on traffic signals on state roads.

- In July 2015, NJDOT introduced its Systemic Pilot Program for Roundabouts to the counties. While roundabouts are typically not a low-cost systemic countermeasure, NJDOT launched the pilot program to provide counties with a special opportunity to implement a modern roundabout on a local roadway. NJDOT would support the funding of one roundabout project for each county with Federal Highway Safety Improvement Program funds as part of this pilot program with the goal of implementing selected roundabouts in a relatively short period of time.

- A Monmouth County representative noted that they encountered difficulties with retroreflective borders adhering to the backplate surfaces.

One participant noted that their agency had experienced issues with use of the *FHWA Manual on Uniform Traffic Control Devices (MUTCD)*. At one location there was too much signage, and flashing signs in the distance caused motorists to miss signs close to them. Although everything was developed according to MUTCD specifications, conditions worsened.

Participants find Corridor Access Management to be confusing, with various regulations and guidance coming from different levels of New Jersey government. The opinion was expressed that the State needs to overhaul access management code; otherwise, decisions seem to be made on a case by case basis. Some access management strategies have been instituted (e.g. dedicated turning lanes) as part of road diets. There have been difficulties working with property owners who see driveway turning lane restrictions as harmful to their businesses. It was noted that instituting this countermeasure requires improved communication between NJDOT, local agencies, and business owners, and all stakeholders needed to be involved early in the project.

A participant related that they had not heard of some of the newer countermeasures, and that they are still unsure of what these countermeasures are, and how they would be applied. Some of these concepts have been around for a decade and have been implemented slowly.

Training helps in spreading the word, and people seem more passionate about countermeasures after attending training or information sessions on them. Generally, whether or not a PSC is used depends on whether or not the right person is aware of the countermeasure and pushes for its use. Some representatives of townships have attended courses in road diets/roundabouts, including EDC Exchanges hosted by FHWA.

Education and public outreach are also needed for transportation projects. LPAs find it useful to inform the community on the costs and the statistics associated with every countermeasure. Some are “easy sells” such as Safety Edge and HSFT. Other policy wide changes can be harder to adopt and implement.

MPOs are looking for safety champions who are committed in leading the safety improvement projects. LPAs report that many projects do not have a champion. Most LPAs find that politics affects project selection and that projects have been, at times, used as campaign issues. However, public engagement in certain projects can influence political decision making. Issues between police and politicians have also affected project selection.

Initiatives undertaken at the local level were discussed in the breakout session. Comments from the breakout groups are recorded in Table 4.

Figure 2 Attendees in an afternoon breakout session at the June 13, 2018 Peer Exchange

Make Your Mark

A Local Safety Peer Exchange

FHWA SAFETY COUNTERMEASURES

Countermeasure	Description	Web Address
Longitudinal Rumble Strips and Stripes	With roadway departure crashes accounting for more than half of the fatal roadway crashes annually in the United States, rumble strips and stripes are designed to address these crashes caused by distracted, drowsy, or otherwise inattentive drivers who drift from their lane.	https://safety.fhwa.dot.gov/provencountermeasures/long_rumble_strip/
Median Barriers	Median barriers are longitudinal barriers that separate opposing traffic on a divided highway and are designed to redirect vehicles striking either side of the barrier. Median barriers significantly reduce the severity of cross-median crashes, which are attributed to the relatively high speeds that are typical on divided highways.	https://safety.fhwa.dot.gov/provencountermeasures/median_barrier/
SafetyEdgeSM	SafetyEdgeSM technology shapes the edge of the pavement at approximately 30 degrees from the pavement cross slope during the paving process. This systemic safety treatment eliminates the vertical drop-off at the pavement edge, allowing drifting vehicles to return to the pavement safely.	https://safety.fhwa.dot.gov/provencountermeasures/safety_edge/
Backplates with Retroreflective Borders	Backplates added to a traffic signal indication improve the visibility of the illuminated face of the signal by introducing a controlled-contrast background. The improved visibility of a signal head with a backplate is made even more conspicuous by framing it with a retroreflective border.	https://safety.fhwa.dot.gov/provencountermeasures/blackplate/

Figure 3 Participants received handouts and discussed their experiences with implementation of FHWA's Proven Safety Countermeasures.

Table 4: Afternoon Breakout Session

Local Agency	Projects
Bergen County	Incorporates safety improvements in resurfacing projects, including upgrades to ramps, camera installation, and audible pedestrian countdowns. They have installed ladder crosswalks at new intersections with high traffic volumes
Cumberland County	Installed 150 miles of rumble strip centerline.
	Has used High Friction Surface Treatment on horizontal curves on High Risk Rural Roads.
	With two high speed roads that have few stops, they are working on all-way stops instead of two-way stops. They are using crash data to identify locations.
Hudson County	They consider safety improvements including rumble strips and signs, in conjunction with resurfacing projects. The county has hesitated to install bike lanes on the boulevards, and historically has pushed bike lanes to lower volume roads, but that is changing. They implement standard safety improvements, including ADA compliance, through all repaving projects. HFST has been used on curves on projects that are not local safety funded. They have installed rumble strips on center lines, and high visibility crosswalks. Thermal plastic rumble strips were installed in school zones. The strips can cause increased noise for local residents; however, people become used to the sound. The County installed Leading Pedestrians Intervals along JFK Boulevard. There was little pushback. Congestion had been a concern with installation of a road diet, but they are unaware of any safety issues resulting from the implementation of the road diet and traffic is more orderly. They hold public meetings as part of the federal process, and have found that reaching out to local community groups (like bicycling groups) is effective.
Mercer County	When the public complains about any change, the County responds with data. The corridor outside NJDOT is a high-crash location near a school. There were complaints with the Parkway Avenue road diet but people seem happy with it now. The County has added bikeable shoulders with the intent of expanding these to bike lanes. It is helpful to know that bike lanes reduce crashes for motorists. For the top 10 locations, they conduct spatial analysis within 100 feet of the intersection.

Table 4: Afternoon Breakout Session (cont.)

Local Agency	Projects
Monmouth County	In 2007, a proposed roundabout at Brookdale Community College raised concern that young and inexperienced drivers would not understand how to drive through a roundabout. The County published a brochure which was distributed through the college, a champion of the roundabout. The public is now very supportive. Pedestrian crossings at a roundabout are difficult. Splitter islands assist if available. Monmouth puts ADA compliant ramps in at roundabouts but does not add sidewalks if there are none prior to the improvement. Reference was made to FHWA's Roundabouts: An Informational Guide. The County uses backplates on all appropriate projects, ladder striping at all intersections, and RRFBs. A road safety audit led to implementation of a road diet.
Newark	The Newark Pedestrian and Bicycle Safety Action Plan can be used as a guidebook to address a priority list. Requests for road safety audits at certain locations are based on identified high crash corridors or locations. Many calls for projects come from the City Council based on citizen complaints for specific locations. The Plan was a way for the city to use a data-driven process with data tools and public outreach to identify locations in need. When community concerns bubbled up, engineers could show an intervention would be better at another location. The Plan is available on the NJTPA website. The City is implementing several pedestrian safety projects. The County is implementing curb extensions. High visibility crosswalks, sign upgrades, and ADA compliance are built into any project. Larger buses hit curbs at turns where there are bumpouts. Newark has a speedbump installation policy. People want them installed, but when they are, people want them out. The multiple jurisdictions throughout Newark make it challenging to make improvements.
Ocean County	Ocean County had a 33-mile project of identified linked hotspots that became a system project.
Pennington	An exclusive pedestrian phase at a signalized intersection near a high school is operating. This phasing creates more congestion but is safer.

Table 4: Afternoon Breakout Session (cont.)

Local Agency	Projects
Princeton	Princeton's population is aging and there are large volumes of pedestrians walking along and across a state highway. The township engineer works closely with the police department on traffic safety issues. Princeton has piloted rubber curbs at intersections to reduce turning radii and make crossings safer, and piloted a bike lane on a minor collector road with parking spaces removed.
	If there are crashes at a location, they first double up the stop signs, add reflector strips, pavement markings, and "stop ahead" signs.
	They tried leading pedestrian intervals at a location where there had been a pedestrian fatality. There was some discussion on the idea of area presence detection for pedestrians to cue signals.
Somerset County	The County used micro-milling of roads as a low-cost solution, using a local contractor. The life expectancy of the road is 5-6 years. Motorcyclists and bicyclists were not happy. They then tried a high friction surface treatment using bauxite aggregate. This surface has a longer life, higher cost, and requires specialized installation. It has been used in specific areas, generally on horizontal curves.
Trenton	A link between the Heritage Trail and the Delaware & Raritan Canal is being created.
Warren County	The county is very rural. They tried an experimental treatment of pavement marking, but it is not proven yet. They have not used any proven safety countermeasures, but have considered high friction surface treatments. However, there was some skepticism, as well as concerns about liability, within the agency. Questions that arose include: what happens when it starts wearing off? Do they have to touch up the surface? What is required maintenance and is it expensive? If they don't maintain the roadway are they liable?
	They were looking at HPTO as a paving alternative. They found the spec on it is very narrow and difficult to achieve so they shied away from it. Warren uses chevron signs, which work well. In-line rubber strips in one area worked well but the person who implemented them just retired so the effort has stopped for now. They developed a study for a modern roundabout at an intersection with blinking lights, but received substantial pushback from freeholders and residents and did not implement the idea. Now there is a plan for a traffic light but there is doubt that it will ever get implemented. Warren has advanced intersection signs everywhere – they oversize them. There is skepticism about anything electric or solar-powered in Warren County. The County does not have a safety committee, a champion, or safety advocacy team; they talk to police and residents directly.
	When Warren resurfaces a road, they replace all the signs as a matter of policy. The new signs will last longer. They will be updating all of the curbs and chevrons. They have to bring the signalized intersections up to standard as well. They installed ADA ramps, etc. They are hesitant to put in bike lanes because of liability.

Summary – Action Plan

Representatives of municipalities, counties, and MPOs discussed their Action Plans in their breakout groups in the December 6, 2017 and June 13, 2018 peer exchanges. Attendees noted briefly what countermeasures and strategies they were using and what practices they anticipated using in the future. Attendees then presented the plans to the larger group. These comments can be found in Table 5. Due to time constraints, Action Plans were not discussed in the March 26, 2019 peer exchange.

Table 5: Summary Action Plan

Local Agency	Projects
Asbury Park	They took a systemic approach with low-cost actions. At unsignalized intersections, they gathered 3-5 years of pedestrian crash data, placed a sign at each intersection, and repainted crosswalks. Anecdotally, traffic has slowed. They are planning to use Leading Pedestrian Intervals and Pedestrian Hybrid Beacons.
Atlantic County	They are interested in CMF methodology. They are more thorough when applying standards beyond design exception reports, to back up decisions.
City of Vineland	They are interested in looking at Systemic Low Cost Countermeasures, having Road Safety Audits baked into all their projects, and Bike Plans. There were some challenges to implementation of road diets in the past. They would consider proposing them again with some changes, and pointing to the successes in other communities and counties.
DVRPC	The agency would like to conduct a regional analysis of intersections to create a hierarchy of need for Leading Pedestrian Intervals. They also want to help the counties beyond network screening overlays.
Mercer County	They are coming up with a Bike Plan and Greater Mercer Transportation Management Association is creating a trail plan.
Monmouth County	Has roundabouts, centerline rumble strips, SafetyEdge, Road Diets and one to come, Systematic Approach in the shore towns.
	Plans to explore USLimits2 to determine if they can use other criteria than the 85 percent. They are assembling a Traffic Safety Committee, a multidisciplinary committee including members of parks, facilities, among others. They are pursuing funding for Pedestrian Hybrid Beacons.
	Noted that they have trouble with Leading Pedestrian Intervals because there is so much violation of the law on the part of drivers. They have used pedestrian decoy programs.
NJTPA	They will educate county freeholders by featuring successful projects and recommend holding public information sessions in the preliminary stages of project development and creating a project specific website. They are looking at use of centerline rumble strips systemically.
Princeton	They are planning for a road diet on a municipal road (5 yrs.), a Master Plan for Witherspoon Street, and a Pedestrian Beacon on a county roadway near a school – the location is the centerpiece of the trail system.

Table 5: Summary Action Plan (cont.)

Local Agency	Projects
SJTPO	Planning on incorporating low-cost countermeasures into all of their projects, and working with NJDOT to find the best places to use them. There is a systemic Backplates with Retroreflective Borders project and Systematic Application of Multiple Low-Cost Countermeasures at Stop-Controlled Intersections. They want to expand rumble strip application and work on Safety Action Plans.
Somerset County	They are looking to quantify the risk on their projects, evaluate roundabout actions with signals, use Safety Voyager, and pedestrian leading interval. They want to incorporate SafetyEdge into resurfacing of rural roads. They have not used centerline rumble strips on some roads over concern of the effect on bicyclists.
Warren County	Considering high friction surface, oversize intersection signs, rumble strips, a modern roundabout, SafetyEdge, and Rectangular Rapid Flash Beacons (RRFB). The MPO will help with applications; Warren has not sought funding for several years.
West Windsor	They have a road diet and a roundabout. They anticipate doing a traffic model for the township. Will be using Safety Voyager.

Feedback Survey

All attendees were asked to complete a Feedback Survey at the end of the session; not all participants completed the survey. Survey results for each session, and compiled results for all three sessions, are available in **Appendix C**. In general, attendees reported that they found the peer exchange content useful, the format appropriate for learning about the topics, and time adequate to cover the topics sufficiently. Most attendees agreed or strongly agreed that the information presented was transferable to their work. Participants had suggestions for topics, issues or best practices they would like to see discussed at future safety peer exchanges (See Table 6). They suggested topics that could be added to these local safety peer exchanges (See Table 7).

Table 6: Future Safety Peer Exchange Session Topics

General Topic	Specific Comments
Safety Countermeasures	More on new proven safety countermeasures
	More safety countermeasures, advances, and new trends
	Inventory "best practices" or proven safety countermeasures that have been installed, by agency, so that conversations can happen between those that have done it with those who want to do it.
	Incorporating safety improvements in all projects; Pedestrian Hybrid Beacons
	More experiences on different Proven Safety Countermeasures, including USLIMITS, HAWK signs, LPI, and low cost at stop intersections
	USLIMITS2
	Road diets; High Surface Friction Course in other colors, i.e. red (Endurablend)
	More examples of countermeasure used at LPA level - along with data that proves how effective it was
	Speed limit determination
Project Delivery	Streamlining the project delivery process for safety projects
	How does a project get funded and what is the project delivery process for state, local, and county roads
Bicycle/Pedestrian	Bicycle safety topics/planning
	More bike/ped focus
	Mid-block crossings
Intersections	Mini roundabouts
Education and Outreach	Success stories regarding education campaigns
	Overcoming opposition to developing and implementing Complete Streets policies.
FHWA Oversight	Findings of a CAP review. Example-show issues and encounters
Complete Streets	Complete Streets implementation- real world solutions to design and implementation of bike lanes and treatment at intersections where bump outs are used to reduce length of pedestrian crossing, but interrupts the available bike lane.
Safety Voyager	Post-construction crash analysis. Demonstration of a sample project going through Safety Voyager to obtain crash data downloading to Excel.
Local Agencies	Local Safety Plans

Table 7: Topics to Add to the Workshop

General Topic	Specific Comments
Safety Countermeasures	Safety Countermeasures
	US2Limits
	More on designing for each countermeasure
Funding & Application	List of safety funding programs and what agencies can apply
	How to make a successful application for federal funding
	How to capture safety related improvements that use local and State funds
	Navigating through the state NJDOT's grant funding, project delivery, project prioritization process.
Implementation	Highway Safety Manual implementation
	More Highway Safety Manual information
	More low-cost, quick cheap solutions and how to get them implemented
	Incorporating safety low cost improvements
Case Studies/Examples	Even more practical project examples
	Case studies
	Show NJDOT Annual Safety Report Results (project sample) and what goes to Congress
	More demonstration project case studies for local (county/municipal) applications to provide verification of effectiveness.
	Examples from each county showing completed projects. Proven safety countermeasures-where have they been completed? How many?
	Various experiences on RSAs, etc.
Bicycle/Pedestrian	Implementing bike improvements/bike lanes
	Road diets, pedestrian safety corridor/system approach
	Discuss bike/ped improvements a little more in depth w/in proven safety countermeasures and items/actions that aren't one of the 20 but will be eventually (projected to be a proven countermeasure).
	Safety Intersection Improvements to address pedestrians and vehicles in urban areas
	Issues of county/state/municipal responsibility for installation and maintenance of sidewalks; The reluctance of some jurisdictions to embrace Complete Streets and bike/ped safety
	Bike lanes and signal optimization
	Handicap ramps, guiderail.
Education and Outreach	Solutions to dealing with pushback, how to sell a tough idea like a roundabout to the average citizen
	Local opposition to safety improvements and how to deal with it
Safety Voyager	Safety Voyager overview
	Use of Autocad, Safety Voyager

Conclusion and Looking Forward

Participant suggestions for topics to add to the local safety peer exchange agenda, as well as topics for future peer exchanges, reflect the value of peer exchange events. Representatives of local agencies welcomed an opportunity to learn about examples of successful implementation of safety countermeasures in other communities. Use of case studies and practical project examples can lend weight to the use of crash-related data in the local decision making process, as well as further guide the implementation process. Participants gained from hearing of the challenges and the lessons learned associated with implementation.

The participating local public agencies (LPAs) were generally interested in making greater use of data sources and analysis to provide a basis for project identification. However, the participants often were wary of the political nature of the local project selection process and how it could affect the identification of locations for safety improvements. There was a recognition among the participants of the importance of making continuing efforts to further educate the public and local decisionmakers on the need for roadway safety improvements and the basis for selection of particular safety countermeasures.

Through discussions and feedback, there were a strong interest among LPA participants for further sharing of lessons learned regarding implementation of proven safety countermeasures, education campaigns, pedestrian and bicycle issues, Complete Streets policies, and data analysis, among other topics. This expressed interest speaks to the need among LPAs for more opportunities for knowledge sharing such as the peer exchange series provided. Participants want to know what is new and what is in the works, and to hear from NJDOT and FHWA regarding the grant funding process.

These peer exchanges suggest some next steps. One of these is already in the planning stages. Dan Lisanti, NJDOT and Keith Skilton, FHWA will be conducting regional half-day workshops on proven safety countermeasures later in 2019. Other initiatives might include development of an inventory of successful implementation of proven safety countermeasures (PSCMs) by local agencies, MPOs, and the state. This repository would serve as a resource for local agencies, enabling counties and municipalities toreach out to peer organizations for information on particular PSCMs. Presentations in the form of webinars on particular proven safety countermeasures, such as USLIMITS2, would be valuable resources for local public agencies. A hands-on workshop or a webinar on the use of Safety Voyager, would support expanded use of this tool for data driven safety analysis among local agencies. These steps, among others, would support NJDOT's and FHWA's continuing efforts to promote the use of innovative techniques and knowledge sharing with the goal of reducing fatalities and serious injuries on the state's roadways.

APPENDIX

HSIP Local Safety Peer Exchange

APPENDIX A

HSIP Local Safety Peer Exchange Meeting Materials

- Agendas
- Break Out Discussion Questions
- Evaluation Form
- Action Plan Form
- Countermeasures
- Useful Weblinks

Make Your Mark

A Local Safety Peer Exchange

December 6, 2017

AGENDA

8:00-8:15AM	Registration
8:15-9:00AM	Introductions
9:00-9:10AM	Mike Russo Welcome
9:10-9:40AM	NJ's Safety Performance Targets: Why It Matters
9:40-10:40AM	Safety Voyager Overview and Monmouth County Demonstration
10:40-10:55AM	***Break***
10:55-11:25AM	Understanding Substantive vs. Nominal Approaches to Design
10:25-11:45AM	Breakout Sessions
11:45AM-12:30PM	***Lunch***
12:30-1:00PM	Somerset County's Approach to Systemic Safety Improvements
1:00-1:30 PM	Princeton's Approach to Traffic Calming
1:30-2:00 PM	FHWA's 2017 Update of the Proven Safety Countermeasures
2:00-2:15PM	***Break***
2:15-3:00 PM	Breakout Sessions and Next Steps Planning
3:00-3:45PM	Attendee Report Outs Review of Breakout Discussion Questions

Cumberland County Community College
Banquet Room (1/3), Luciano Conference Center
3322 College Drive
Vineland, NJ 08360

Toward Zero Deaths
National Strategy on Highway Safety

Make Your Mark

A Local Safety Peer Exchange

June 13, 2018

AGENDA

8:00-8:15AM	Registration
8:15-9:00AM	Introductions
9:00-9:10AM	Welcome, Jennifer Marandino, SJTPO
9:10-9:40AM	NJ's Safety Performance Targets: Why It Matters, Caroline Trueman and Daniel LiSanti
9:40-10:40AM	Safety Voyager Overview and Monmouth County Demonstration, Chris Zajac and Vince Cardone
10:40-10:55AM	***Break***
10:55-11:25AM	Understanding Substantive vs. Nominal Approaches to Design, John McFadden
11:25-11:45AM	Breakout Sessions
11:45AM-12:30PM	***Lunch***
12:30-1:00PM	Cumberland County's Approach to Systemic Safety Improvements, Douglas W. Whitaker
1:00-1:30 PM	Princeton's Approach to Traffic Calming, Deanna Stockton
1:30-2:00 PM	FHWA's 2017 Update of the Proven Safety Countermeasures, Karen Scurry
2:00-2:15PM	***Break***
2:15-3:00 PM	Breakout Sessions and Next Steps Planning
3:00-3:45PM	Attendee Report Outs Review of Breakout Discussion Questions

New Jersey Department of Transportation
Training Room A, 2nd Floor E&O building
1035 Parkway Avenue
Ewing Township, NJ

Toward Zero Deaths
National Strategy on Highway Safety

Make Your Mark

A Local Safety Peer Exchange

March 26, 2019

AGENDA

8:00-8:15AM	Registration
8:15-9:00AM	Introductions
9:00-9:10AM	Welcoming Remarks Mary D. Ameen, NJTPA Executive Director
9:10-9:40AM	NJ's Safety Performance Targets: Why It Matters Daniel LiSanti and Keith Skilton
9:40-10:40AM	Safety Voyager Overview and Monmouth County Demonstration Chris Zajac and Vince Cardone
10:40-10:55AM	***Break***
10:55-11:25AM	Understanding Substantive vs. Nominal Approaches to Design John McFadden
10:25-11:45AM	Breakout Sessions
11:45AM-12:30PM	***Lunch***
12:30-1:00PM	Somerset County's Approach to Systemic Safety Improvements Tricia Bates Smith
1:00-1:30 PM	Princeton's Approach to Traffic Calming Deanna Stockton
1:30-2:00 PM	FHWA's 2017 Update of the Proven Safety Countermeasures Karen Scurry
2:00-2:15PM	***Break***
2:15-3:00 PM	Breakout Sessions and Next Steps Planning
3:00-3:45PM	Attendee Report Outs Review of Breakout Discussion Questions

New Jersey Transportation Planning Authority
1 Newark Center, 17th Floor, Board Room
Newark, NJ 07102

Make Your Mark

A Local Safety Peer Exchange

BREAKOUT SESSION QUESTIONS

Discussion Questions: (AM portion)

1.) When your MPO solicits Local Safety Projects in your region, how do you prioritize projects?
 A.) Do you sometimes use the list 'opportunistically' to address locations that have infrastructure issues/needs?
 B.) To what extent do politics affect project selections and advancement?
 i. Are there times when you use the politics to positively influence project selections and decisions?
 ii. Can you use data in that process? If yes, how?

2.) Once a project location is identified, how do you diagnose the safety issues and potential countermeasures for that location?

3.) Do you have examples in your community where you've applied substantive safety effectively? If not, do you have ideas of how you can apply substantive safety in your region?

Discussion Questions (PM portion)

1.) Have you used Proven Countermeasures in your area, please share?

2.) Have you advanced any projects under the Systemic Safety approach?

3.) How do you handle push back when implementing new countermeasures/ facing challenges?

 A.) Do you have a champion or a safety advocacy team that helps promote these activities?
 B.) If yes, how did those partnerships form? Was there a particular issue/safety concern that raised the awareness in your community?

4.) For your general resurfacing program or other infrastructure improvement programs, do you consider adding safety improvements like bike lanes or other systemic improvements involving less extensive impacts?

5.) Please fill out the table for your end of day report out session.

Make Your Mark

A Local Safety Peer Exchange

FEEDBACK SURVEY FOR PARTICIPANTS

Please complete both sides of this evaluation sheet.

---

1. Did you find the Local Safety Peer Exchange content useful? *(circle one)* YES NO
2. Was the format appropriate for learning about the topics covered? *(circle one)* YES NO
3. Was there adequate time for learning about the topics covered? *(circle one)* YES NO

4. The sessions provided information that is transferrable to your work:

   For each session below, please indicate how strongly you agree or disagree that the presented information is transferrable to your work.

Session		Strongly Disagree	Disagree	Agree	Strongly Agree
A.	NJ's Safety Performance Targets: Why It Matters	○	○	○	○
B.	Safety Voyager Overview and Demonstration	○	○	○	○
C.	Understanding Substantive vs. Nominal Approaches to Design	○	○	○	○
D.	Morning Breakout Sessions	○	○	○	○
E.	Systemic Safety Improvements	○	○	○	○
F.	Traffic Calming	○	○	○	○
G.	FHWA's 2017 Update of the Proven Safety Countermeasures	○	○	○	○
H.	Afternoon Breakout Sessions and Next Steps Planning	○	○	○	○

5. What topics, issues or best practices do you think should be added to this workshop?

6. What topics, issues or best practices would you like to see discussed at future Safety Peer Exchange sessions?

7. Do you have any other comments?

Make Your Mark

A Local Safety Peer Exchange

December 6, 2017

ACTION PLAN

Agency:

The following best practices could be used by my agency:

Best practices and/or policies to adapt or replicate within my agency	Responsible Agency and Partners	Time Frame	Details
A.			
B.			
C.			
D.			
E.			
F.			
G.			
H.			

Toward Zero Deaths
National Strategy on Highway Safety

FHWA SAFETY COUNTERMEASURES

In 2008, FHWA began promoting certain infrastructure-oriented safety treatments and strategies, chosen based on proven effectiveness and benefits, to encourage widespread implementation by State, tribal, and local transportation agencies to reduce serious injuries and fatalities on American highways. This became known as the Proven Safety Countermeasures initiative. The list was updated in 2012 and again in 2017. https://safety.fhwa.dot.gov/provencountermeasures/

Countermeasure		Description	Web Address
	Roadside Design Improvements at Curves	Roadside design improvement at curves is a strategy encompassing several treatments that target the high-risk roadside environment along the outside of horizontal curves. These treatments prevent roadway departure fatalities by giving vehicles the opportunity to recover safely and by reducing crash severity.	https://safety.fhwa.dot.gov/provencountermeasures/roadside_design/
	Reduced Left-Turn Conflict Intersections	Reduced left-turn conflict intersections are geometric designs that alter how left-turn movements occur in order to simplify decisions and minimize the potential for related crashes. Two highly effective designs that rely on U-turns to complete certain left-turn movements are known as the restricted crossing U-turn (RCUT) and the median U-turn (MUT).	https://safety.fhwa.dot.gov/provencountermeasures/reduced_left/
	Systemic Application of Multiple Low-Cost Countermeasures at Stop-Controlled Intersections	This systemic approach to intersection safety involves deploying a group of multiple low-cost countermeasures, such as enhanced signing and pavement markings, at a large number of stop controlled intersections within a jurisdiction. It is designed to increase driver awareness and recognition of the intersections and potential conflicts.	https://safety.fhwa.dot.gov/provencountermeasures/syst_stop_control/

FHWA SAFETY COUNTERMEASURES

Countermeasure	Description	Web Address
 Leading Pedestrian Intervals	A leading pedestrian interval (LPI) gives pedestrians the opportunity to enter an intersection 3-7 seconds before vehicles are given a green indication. With this head start, pedestrians can better establish their presence in the crosswalk before vehicles have priority to turn left.	https://safety.fhwa.dot.gov/provencountermeasures/lead_ped_int/
 Local Road Safety Plans	A local road safety plan (LRSP) provides a framework for identifying, analyzing, and prioritizing roadway safety improvements on local roads. The LRSP development process and content are tailored to local issues and needs. The process results in a prioritized list of issues, risks, actions, and improvements that can be used to reduce fatalities and serious injuries on the local road network.	https://safety.fhwa.dot.gov/provencountermeasures/local_road/
 USLIMITS2	USLIMITS2 is a free, web-based tool designed to help practitioners assess and establish safe, reasonable, and consistent speed limits for specific segments of roadway. It is applicable to all types of facilities, from rural and local roads and residential streets to urban freeways.	https://safety.fhwa.dot.gov/provencountermeasures/uslimits2/
 Enhanced Delineation and Friction for Horizontal Curves	This proven safety countermeasure for reducing crashes at curves includes a variety of potential strategies that can be implemented in combination or individually. These strategies fall into two categories: enhanced delineation and increased pavement friction.	https://safety.fhwa.dot.gov/provencountermeasures/enhanced_delineation/

FHWA SAFETY COUNTERMEASURES

Countermeasure	Description	Web Address
Longitudinal Rumble Strips and Stripes	With roadway departure crashes accounting for more than half of the fatal roadway crashes annually in the United States, rumble strips and stripes are designed to address these crashes caused by distracted, drowsy, or otherwise inattentive drivers who drift from their lane.	https://safety.fhwa.dot.gov/provencountermeasures/long_rumble_strip/
Median Barriers	Median barriers are longitudinal barriers that separate opposing traffic on a divided highway and are designed to redirect vehicles striking either side of the barrier. Median barriers significantly reduce the severity of cross-median crashes, which are attributed to the relatively high speeds that are typical on divided highways.	https://safety.fhwa.dot.gov/provencountermeasures/median_barrier/
SafetyEdgeSM	SafetyEdgeSM technology shapes the edge of the pavement at approximately 30 degrees from the pavement cross slope during the paving process. This systemic safety treatment eliminates the vertical drop-off at the pavement edge, allowing drifting vehicles to return to the pavement safely.	https://safety.fhwa.dot.gov/provencountermeasures/safety_edge/
Backplates with Retroreflective Borders	Backplates added to a traffic signal indication improve the visibility of the illuminated face of the signal by introducing a controlled-contrast background. The improved visibility of a signal head with a backplate is made even more conspicuous by framing it with a retroreflective border.	https://safety.fhwa.dot.gov/provencountermeasures/blackplate/

FHWA SAFETY COUNTERMEASURES

Countermeasure		Description	Web Address
	Corridor Access Management	Access management refers to the design, application, and control of entry and exit points along a roadway. This includes intersections with other roads and driveways that serve adjacent properties. Thoughtful access management along a corridor can simultaneously enhance safety for all modes, facilitate walking and biking, and reduce trip delay and congestion.	https://safety.fhwa.dot.gov/provencountermeasures/corridor_access_mgmt/
	Left and Right Turn Lanes at Two-Way Stop-Controlled Intersections	Auxiliary turn lanes—either for left turns or right turns—provide physical separation between turning traffic that is slowing or stopped and adjacent through traffic at approaches to intersections. Turn lanes can be designed to provide for deceleration prior to a turn, as well as for storage of vehicles that are stopped and waiting for the opportunity to complete a turn.	https://safety.fhwa.dot.gov/provencountermeasures/left_right_turn_lanes/
	Roundabouts	The modern roundabout is a type of circular intersection configuration that safely and efficiently moves traffic through an intersection. Roundabouts feature channelized approaches and a center island that results in lower speeds and fewer conflict points.	https://safety.fhwa.dot.gov/provencountermeasures/roundabouts/

FHWA SAFETY COUNTERMEASURES

Countermeasure	Description	Web Address
Yellow Change Intervals	At a signalized intersection, the yellow change interval is the length of time that the yellow signal indication is displayed following a green signal indication. The yellow signal confirms to motorists that the green has ended and that a red will soon follow. Since red-light running is a leading cause of severe crashes at signalized intersections, it is imperative that the yellow change interval be appropriately timed.	https://safety.fhwa.dot.gov/provencountermeasures/yellow_xhg_intervals/
Medians and Pedestrian Crossing Islands in Urban and Suburban Areas	For pedestrians to safely cross a roadway, they must estimate vehicle speeds, adjust their walking speed, determine gaps in traffic, and predict vehicle paths. Installing raised medians or pedestrian crossing islands can help improve safety by simplifying these tasks and allowing pedestrians to cross one direction of traffic at a time.	https://safety.fhwa.dot.gov/provencountermeasures/ped_medians/
Pedestrian Hybrid Beacons	The pedestrian hybrid beacon (PHB) is a traffic control device designed to help pedestrians safely cross busy or higher-speed roadways at midblock crossings and uncontrolled intersections. As a safety strategy to address this pedestrian crash risk, the PHB is an intermediate option between a flashing beacon and a full pedestrian signal because it assigns right of way and provides positive stop control. It also allows motorists to proceed once the pedestrian has cleared their side of the travel lane, reducing vehicle delay.	https://safety.fhwa.dot.gov/provencountermeasures/ped_hybrid_beacon/

FHWA SAFETY COUNTERMEASURES

Countermeasure	Description	Web Address
 Road Diets	A Road Diet typically involves converting an existing four-lane undivided roadway to a three-lane roadway consisting of two through lanes and a center two-way left-turn lane (TWLTL).	https://safety.fhwa.dot.gov/provencountermeasures/road_diets/
 Walkways	A walkway is any type of defined space or pathway for use by a person traveling by foot or using a wheelchair. These may be pedestrian walkways, shared use paths, sidewalks, or roadway shoulders. Well-designed pedestrian walkways, shared use paths, and sidewalks improve the safety and mobility of pedestrians.	https://safety.fhwa.dot.gov/provencountermeasures/walkways/
 Road Safety Audits	Road Safety Audits are performed by a multidisciplinary team independent of the transportation project. RSAs consider all road users, account for human factors and road user capabilities, are documented in a formal report, and require a formal response from the road owner.	https://safety.fhwa.dot.gov/provencountermeasures/road_safety_audit/

USEFUL WEBLINKS

Resource	Description	Web Address
Federal Highway Administration (FHWA) Office of Safety	The mission of the FHWA's Office of Safety is exercising leadership throughout the highway community to make the nation's roadways safer by: developing, evaluating and employing lifesaving countermeasures; advancing the use of scientific methods and data-driven decisions; fostering a safety culture; and promoting an integrated, multidisciplinary (4Es) approach to safety.	https://safety.fhwa.dot.gov/
FHWA Proven Safety Countermeasures	In 2008, FHWA began promoting certain infrastructure-oriented safety treatments and strategies, chosen based on proven effectiveness and benefits, to encourage widespread implementation by State, tribal, and local transportation agencies to reduce serious injuries and fatalities on American highways. This became known as the Proven Safety Countermeasures initiative. The list was updated in 2012 and again in 2017.	https://safety.fhwa.dot.gov/provencountermeasures/
National Highway Traffic Safety Administration	NHTSA's mission is to save lives, prevent injuries, and reduce economic costs due to road traffic, crashes, through education, research, safety standards, and enforcement.	https://www.nhtsa.gov/

USEFUL WEBLINKS

Resource	Description	Web Address
NJDOT Highway Safety	NJDOT has joined other states in the Toward Zero Deaths initiative, a national vision for zero deaths on our nation's highways. NJDOT has implemented safety programs to help achieve that vision. NJDOT, along with its many partners, has developed a Strategic Highway Safety Plan to focus programs on activities that will be most effective in reducing fatalities and serious injuries.	http://www.state.nj.us/transportation/about/safety/
New Jersey Strategic Highway Safety Plan (SHSP) 2015	The NJ SHSP is a statewide, coordinated safety plan that provides a comprehensive framework for reducing highway fatalities and serious injuries on all public roads under state, county or local jurisdiction. The SHSP is mandated by the U.S. Department of Transportation to guide the allocation of safety funding.	http://www.state.nj.us/transportation/about/safety/pdf/2015strategichighwaysafetyplan.pdf
New Jersey Highway Safety Improvement Program (HSIP)	The FHWA established the HSIP to achieve a significant reduction in traffic fatalities and serious injuries on all public roads. The NJ HSIP emphasizes a data-driven, strategic approach to improving highway safety that focuses on results.	http://www.state.nj.us/transportation/about/safety/hsip.shtm
New Jersey Highway Safety Improvement Program Manual 2016	The NJ HSIP requires a statewide strategic highway safety plan to set goals and prioritize safety investments.	http://www.state.nj.us/transportation/about/safety/pdf/2016hsipmanual.pdf

USEFUL WEBLINKS

Resource	Description	Web Address
Crash Modification Factors Clearinghouse	A crash modification factor (CMF) is used to compute the expected number of crashes after implementing a countermeasure on a road or intersection. The Clearinghouse provides a searchable online database of CMFs along with guidance and resources on using CMFs in road safety practice, and guidance to researchers on best practices for developing high quality CMFs.	http://www.cmfclearinghouse.org/
NJDOT Safety Voyager	Safety Voyager is a software application designed to provide a quick and easy visual perspective of crash data. By providing 2D and 3D graphical displays, Safety Voyager can quickly show a comparative view of crashes with a defined area, municipality or county as determined by the user. Various filters are available to create detailed user defined queries.	http://www.state.nj.us/transportation/refdata/accident/crashdatasearch.shtm
New Jersey Bicycle & Pedestrian Master Plan 2016	The Master Plan presents the vision, goals, and implementation strategies to successfully advance bicycling and walking throughout the State.	http://www.state.nj.us/transportation/commuter/bike/pdf/bikepedmasterplan2016.pdf
NJDOT Local Aid and Economic Development	The NJDOT Division of Local Aid and Economic Development works with county and municipal government officials to improve the efficiency and effectiveness of the State's transportation system. The website provides information on funding, applications, engineering requirements, and the procurement process.	http://www.state.nj.us/transportation/business/localaid/

Make Your Mark

A Local Safety Peer Exchange

USEFUL WEBLINKS

Resource	Description	Web Address
New Jersey Division of Highway Traffic Safety	The mission of the NJ Division of Highway Traffic Safety is the safe passage of all roadway users in New Jersey as the State moves toward zero fatalities. To achieve this mission, the Division promotes statewide traffic safety programs through education, engineering and enforcement activities.	http://www.nj.gov/oag/hts/index.html
North Jersey Transportation Planning Authority (NJTPA)	The federally-designated Metropolitan Planning Organization for the northern New Jersey region that includes Bergen, Essex, Hudson, Hunterdon, Middlesex, Monmouth, Morris, Ocean, Passaic, Somerset, Sussex, Union and Warren Counties.	http://www.njtpa.org/home
Delaware Valley Regional Planning Commission (DVRPC)	The federally-designated Metropolitan Planning Organization for a region that spans two states and includes Bucks, Chester, Delaware, Montgomery, and Philadelphia counties in Pennsylvania; and Burlington, Camden, Gloucester, and Mercer Counties in New Jersey.	https://www.dvrpc.org/
South Jersey Transportation Planning Organization (SJTPO)	The federally-designated Metropolitan Planning Organization covering Atlantic, Cape May, Cumberland, and Salem Counties in southern New Jersey.	http://www.sjtpo.org/

APPENDIX B

HSIP Local Safety Peer Exchange Presentations

- 12.6.17
- 6.13.18
- 3.26.19

Make Your Mark

A Local Safety Peer Exchange

December 6, 2017

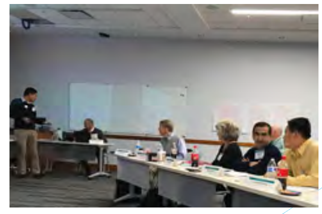
Sophia Azam, Executive Manager NJDOT Bureau of Transportation Data & Safety

Caroline Trueman, FHWA NJ Division Highway Safety Improvement Program

Welcome

Event Overview

- Agenda
- Housekeeping
- Expectations



Ground Rules

Introductions

- Name
- Organization
- Position
- Role with Respect to Local Safety Program

Welcome

Assistant Commissioner Capital Investment Planning & Grant Administration,

Michael Russo

Today's Take-Aways…..

- NJ's Vision Zero & Safety Performance Targets
- Pedestrian & Intersection Focus State
- NJ Design Manual Compliance ≠ Maximum Safety Benefit
- Partnering WE CAN MAKE A POSITIVE DIFFERENCE FOR SAFETY!

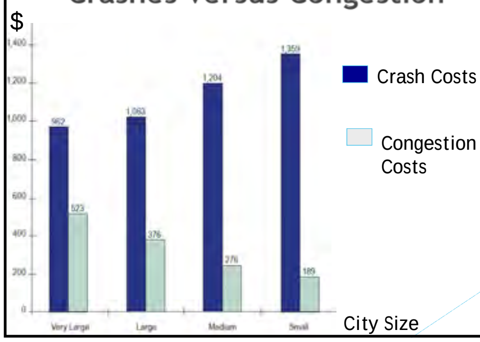
Safety Target Setting

	Five Performance Measures
✓	Number of Fatalities
✓	Rate of Fatalities per 100 Million VMT
✓	Number of Serious Injuries
✓	Rate of Serious Injuries per 100 Million VMT
✓	Number of Non-motorized Fatalities and Non-motorized Serious Injuries

Intersection & Pedestrian Focus State

2X National Average % Pedestrian Fatalities

Crashes versus Congestion



Substantive Vs. Nominal Safety

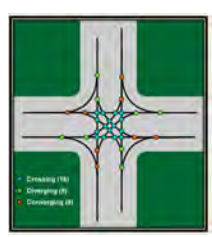
Standards Approach yields updated traffic signal Versus…

Intersection List

Maximizing Safety Benefits with Infrastructure Investments

ROUNDABOUTS VS. TRAFFIC SIGNAL 71% REDUCTION INJURY CRASHES

The difference between conflicts



HSIP Components & Purpose

- Rail Highway Grade Crossing Program set-aside
- Highway Safety Improvement Program

Achieve significant reduction in fatalities & serious injuries on ALL PUBLIC ROADS.

Highway Safety Improvement Program

- Strategic Highway Safety Plan
- Data Driven All Public Roads
- Safety Target Setting Performance Measures
- Annual Safety Reporting

Achieve significant reduction in fatalities & serious injuries on ALL PUBLIC ROADS.

NJ HSIP Manual
NJ LSP Assessment Findings Observations

Plan Process Evaluation

NJ's SHSP - PLAN

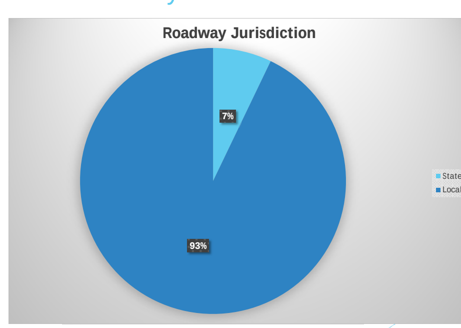
- Updating every 5 years
- Statewide Plan – all 4 E's
- Signed by Governor or Governor's Representative
- Overall Goal for NJ
- HSIP project eligibility dependent upon identified element in SHSP

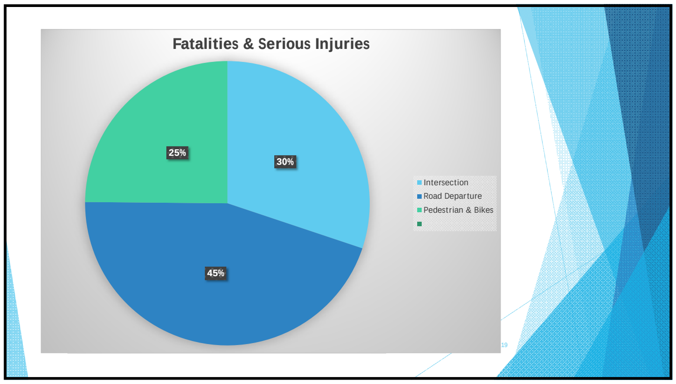
"Vision without action is a dream, Action without vision is a nightmare."

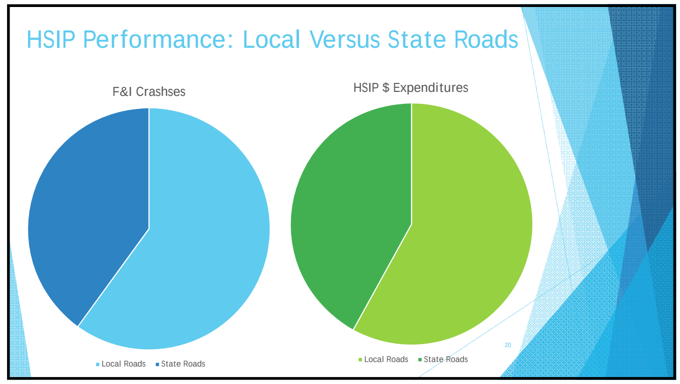
Data Driven

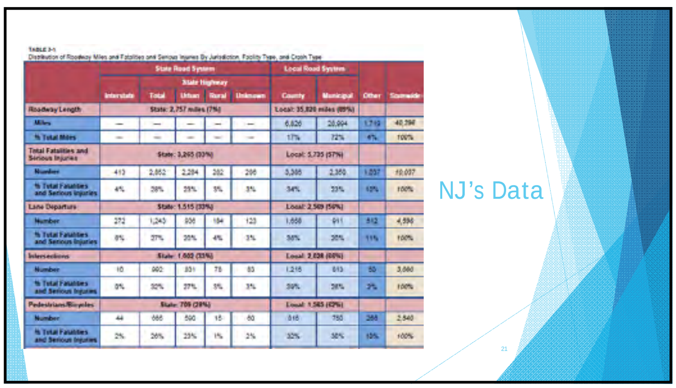
- Network Screening
  - Severity
  - Types of Crashes
- Safety Data Voyager
- Project Approaches
  - Hot Spot
  - Systemic

F&I Crashes By Jurisdiction

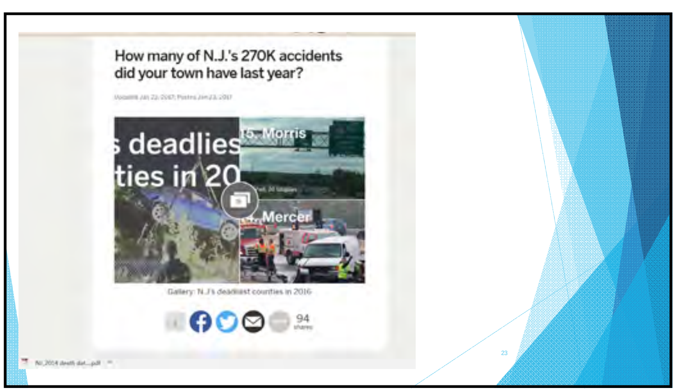


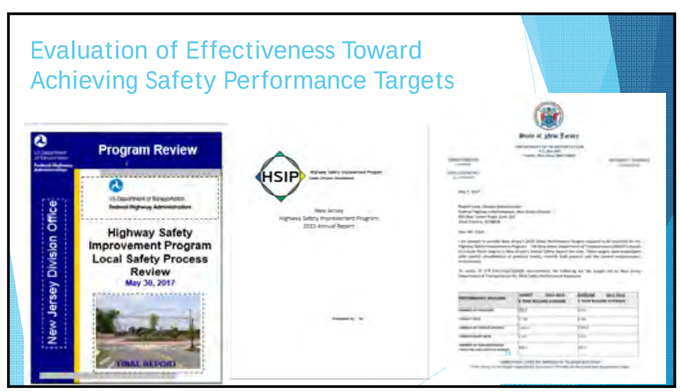

Fatalities & Serious Injuries
30%
45%
25%
Intersection
Road Departure
Pedestrian & Bikes


HSIP Performance: Local Versus State Roads
F&I Crashses
HSIP $ Expenditures
Local Roads
State Roads
Local Roads
State Roads


NJ's Data


LSP Process
HSIP Funding on Local Roads
Pilot Program FY 2004 2 Projects per MPO $1 M per MPO
FY 2009 Introduced the HRRRP $1 M per MPO
FY 2011 Authorizations All MPOs: 12 projects $4.9 M
FY 2014 Authorizations NJTPA: 13 Projects $16.2 M
FY 2015 Authorizations NJTPA: 24 Projects $18.3 M
DVRPC: 4 Projects $5.7 M
SJTPO: 4 Project $2.1 M


How many of N.J.'s 270K accidents did your town have last year?
s deadlies
ties in 20
Mercer
Gallery: N.J.'s deadliest counties in 2016
94


Evaluation of Effectiveness Toward
Achieving Safety Performance Targets
Program Review
Highway Safety Improvement Program Local Safety Process Review
May 30, 2017
New Jersey Division Office
FINAL REPORT
HSIP

Questions


Evaluation
HSIP
Program
Crash
Data
Safety
Effectiveness
Spreadsheet
Countermeasure
Target
Guidelines
Analysis
Performance
Tracking
Condition
Sites
Crashes
Reports
Tableau

Safety Voyager

December 6, 2017

U.S. Department of Transportation
Federal Highway Administration

GPI

Safety Voyager

What is Safety Voyager?

Safety Voyager is a online portal for statewide analysis of roadway safety related data including crashes, AADT data and ball bank data.

Safety Voyager

The road so far…

Project Initiation
April 2016

Version 1
December 2016

Update 1
August 2017

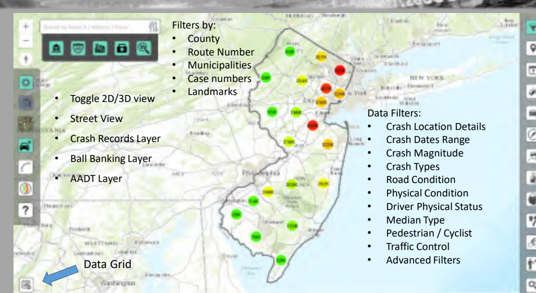
- 90% data geocoded
- Export to CSV

Update 2
November 2017

- October 2017 Data Set Published
- 93% data has been geocoded
- Match SLD Network to correspond with Crash Records based on the year (2011-2016)
- Increased records export up to 50,000

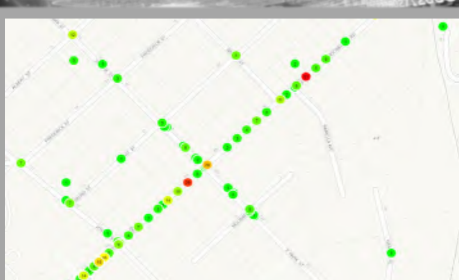
Safety Voyager

User Interface



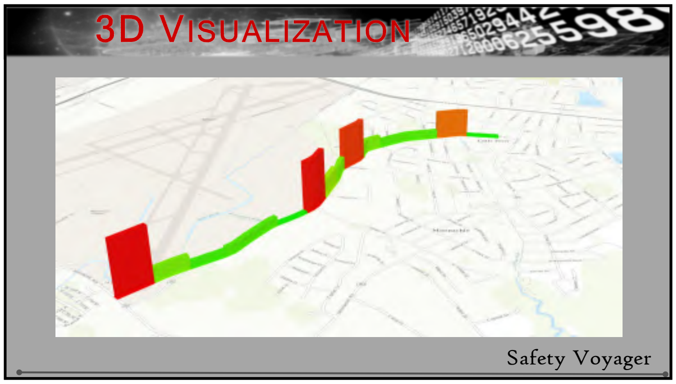
Safety Voyager

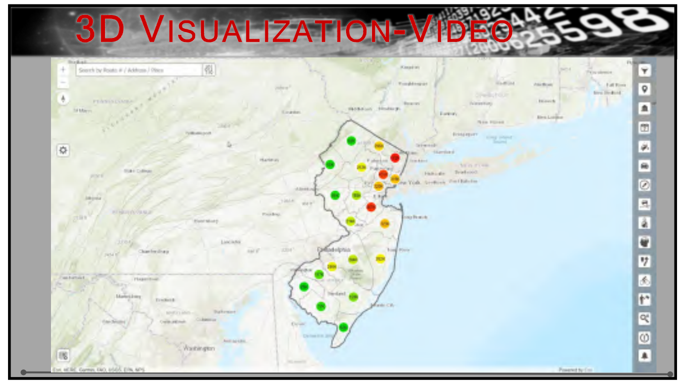
2D Visualization

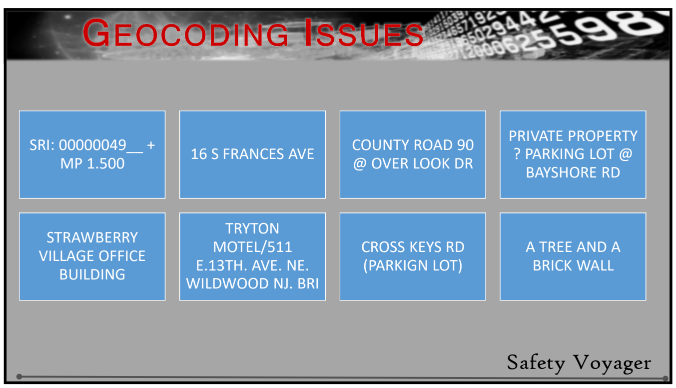


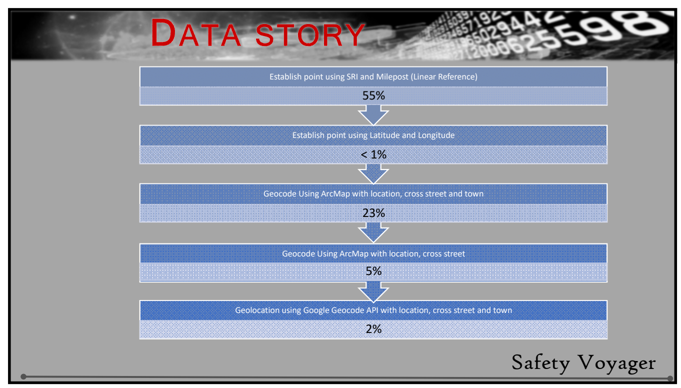
Safety Voyager

2D Visualization Video

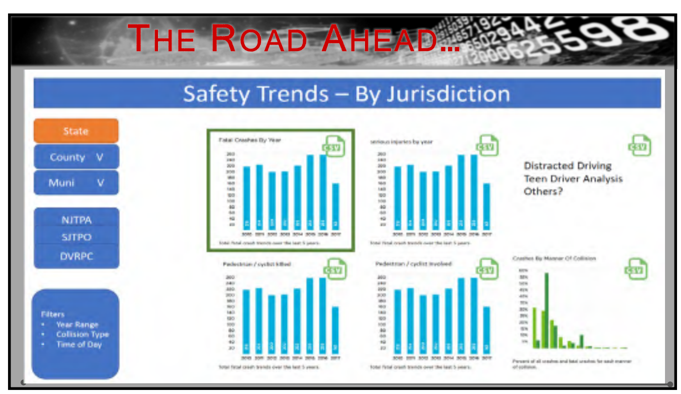

3D Visualization
Safety Voyager


3D Visualization-Video

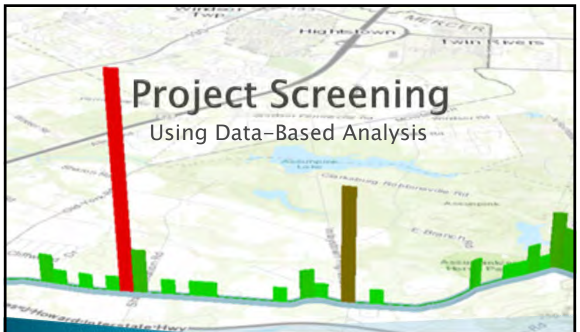

Geocoding Issues
SRI: 00000049__ + MP 1.500
16 S FRANCES AVE
COUNTY ROAD 90 @ OVER LOOK DR
PRIVATE PROPERTY ? PARKING LOT @ BAYSHORE RD
STRAWBERRY VILLAGE OFFICE BUILDING
TRYTON MOTEL/511 E.13TH. AVE. NE. WILDWOOD NJ. BRI
CROSS KEYS RD (PARKIGN LOT)
A TREE AND A BRICK WALL
Safety Voyager


Data Story
Establish point using SRI and Milepost (Linear Reference)
55%
Establish point using Latitude and Longitude
< 1%
Geocode Using ArcMap with location, cross street and town
23%
Geocode Using ArcMap with location, cross street
5%
Geolocation using Google Geocode API with location, cross street and town
2%
Safety Voyager


The Road Ahead…
Safety – Calendar
County
Muni
Drowsy & Distracted
Aggressive Driving
Ped/Bike
Impaired Driving
Older Drivers
Unbelted
Young Drivers
Work Zone
Intersection
Liquor Stores Bars
Schools
Buffer size slider 200ft to 2miles
Time of Day


The Road Ahead…
Safety Trends – By Jurisdiction
State
County
Muni
NJTPA
SJTPO
DVRPC
Filters
Year Range
Collision Type
Time of Day
Distracted Driving
Teen Driver Analysis
Others?


QUESTIONS
Thank you for your attention
Contact info:
Chris Zajac 609-530-4548
chris.zajac@dot.nj.gov
Safety Voyager



Project Screening

Using Data-Based Analysis

Vincent Cardone
Principal Engineer II, Traffic
Monmouth County

High Risk Rural Roads Program

- Competitive program administered by MPO
- Uses funds from the Federal Highway Administration's Highway Safety Improvements Program (HSIP).
- Only NJTPA member subregions are eligible to submit applications to the NJTPA for these programs. Municipalities located within the subregions may recommend a project to their respective county

High Risk Rural Roads Program

- For projects to be advanced in FY 2018 all environmental approvals, local approval, and right-of-way acquisition must be completed and a full set of PS&E documents submitted to the Local Aid office by a set deadline.

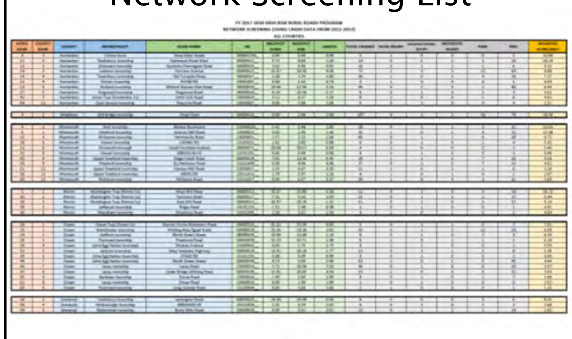
High Risk Rural Roads Program

- Project sponsors must give consideration to modern roundabouts for all new intersection and intersection upgrade projects.
- The National Environmental Policy Act (NEPA) regulations must be followed. As such, projects must have minimal or no environmental and cultural resource impacts.
- Projects must be completed within 24 months of receiving federal authorization.

High Risk Rural Roads Program

- The following types of projects are NOT eligible:
  - improvements involving State, U.S. and Interstate highways including any improvements at intersections with such facilities;
  - routine maintenance/ replacement projects (including general resurfacing projects)
  - congestion management/ roadway capacity enhancements (road widening)
  - Aesthetic improvements along the rights-of-way.

NJTPA High Risk Rural Roads Network Screening List

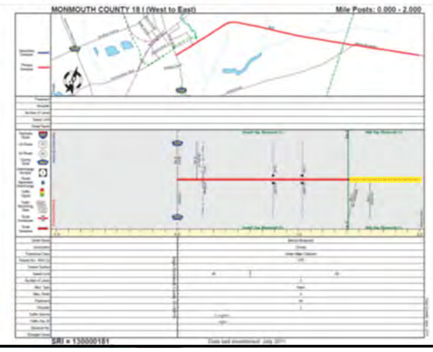


Monmouth County List

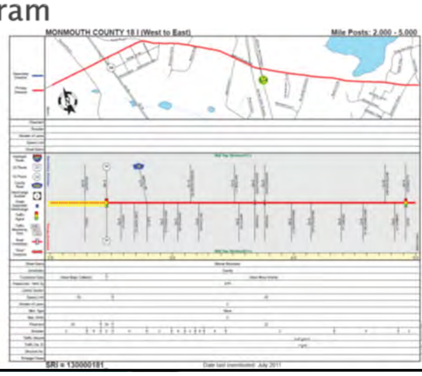
NJTPA RANK	COUNTY RANK	COUNTY	MUNICIPALITY	ROAD NAME	SRI	MILEPOST START	MILEPOST END	LENGTH
4	1	Monmouth	Wall township	Belmar Boulevard	130000181_	1.41	2.46	1.05
6	1	Monmouth	Freehold township	Jackson Mill Road	13000023__	0.00	1.45	1.45
15	4	Monmouth	Millstone township	Perrineville Road	13000001__	1.57	3.23	1.66
26	8	Monmouth	Howell township	CASINO RD	13191012__	2.62	3.60	0.98
31	8	Monmouth	Roosevelt borough	South Rochdale Avenue	00000571__	29.68	30.57	0.89
31	8	Monmouth	Howell township	ARNOLD BLVD	13191101__	0.00	0.89	0.89
42	9	Monmouth	Upper Freehold township	Stage Coach Road	00000524__	7.91	13.36	5.45
43	9	Monmouth	Freehold township	Ely Harmony Road	13321049__	0.00	4.46	4.46
51	12	Monmouth	Upper Freehold township	Holmes Mill Road	13000027__	1.37	4.67	3.30
56	12	Monmouth	Upper Freehold township	MEIRS RD	13511013__	1.79	3.97	2.18
60	12	Monmouth	Millstone township	Millstone Road	13321017__	0.00	5.57	5.57

ROAD NAME	SRI	TOTAL CRASHES	FATAL INJURY	INCAPACITATING INJURY	MODERATE INJURY	PAIN	PDO	Weighted Score/mile
Belmar Boulevard	130000181_	28	0	2	1	3	22	13.61
Jackson Mill Road	13000023__	35	1	0	3	9	22	12.98
Perrineville Road	13000001__	40	0	1	1	8	30	8.72
CASINO RD	13191012__	6	0	1	0	1	4	5.93
South Rochdale Avenue	00000571__	4	1	0	0	0	3	5.40
ARNOLD BLVD	13191101__	4	0	1	0	0	3	5.40
Stage Coach Road	00000524__	29	1	1	5	7	15	4.58
Ely Harmony Road	13321049__	37	0	1	5	7	24	4.52
Holmes Mill Road	13000027__	13	1	0	3	1	8	3.28
MEIRS RD	13511013__	4	1	0	1	0	2	2.97
Millstone Road	13321017__	39	1	0	4	3	31	2.60

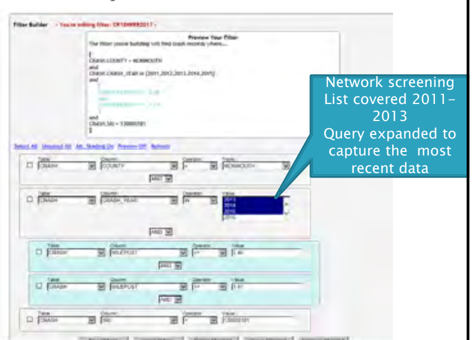
Identify location on straight line diagram



Identify location on straight line diagram

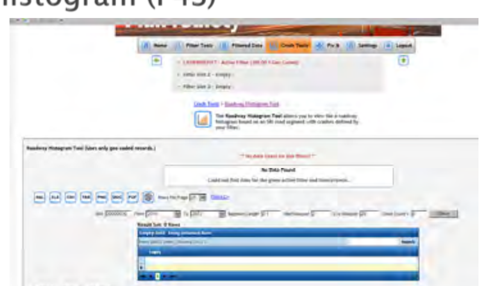


Plan4Safety Filter

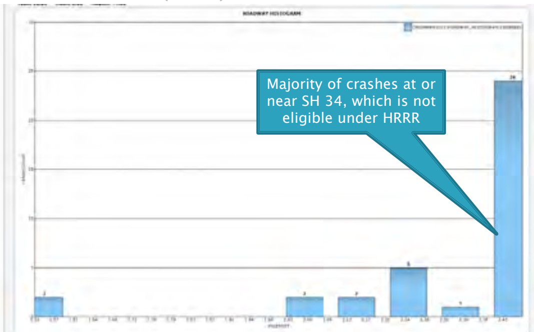


Plan4Safety GIS Point View

Use crash tools to create a road histogram (P4S)



Road Histogram reveals crash locations (P4S)



Safety Voyager

- Process using Safety Voyager is similar, but results are obtained faster

Crash SRI and Milepost

Filters are easy to find

Review remainder of screening list

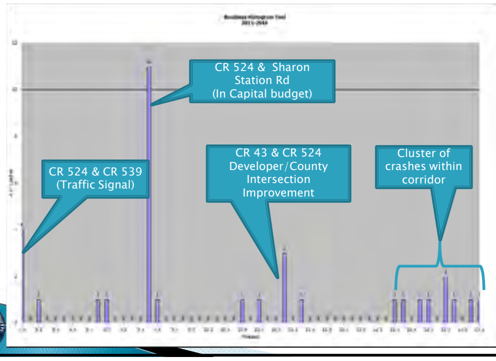
- Iterative process
- Need to diagnose the problem before coming up with a solution

Review remainder of screening list

4	1	Monmouth	Wall township	Belmar Boulevard	130000181_	1.41	2.46	1.05
6	1	Monmouth	Freehold township	Jackson Mill Road	130000023_	0.00	1.45	1.45
15	4	Monmouth	Millstone township	Perrineville Road	13000001_	1.57	3.23	1.66
26	8	Monmouth	Howell township	CASINO RD	13191012_	2.62	3.60	0.98
31	8	Monmouth	Roosevelt borough	South Rochdale Avenue	00000571_	29.68	30.57	0.89
31	8	Monmouth	Howell township	ARNOLD BLVD	13291101_	0.00	0.89	0.89
42	9	Monmouth	Upper Freehold township	Stage Coach Road	00000524_	7.91	13.36	5.45
40	9	Monmouth	Freehold township	Ely Harmony Road	13321049_	0.00	4.48	4.48
51	12	Monmouth	Upper Freehold township	Holmes Mill Road	13000027_	1.37	4.67	3.30
56	12	Monmouth	Upper Freehold township	MEIRS RD	13511013_	1.79	3.97	2.18
60	12	Monmouth	Millstone township	Millstone Road	13321017_	0.00	5.57	5.57

- Jackson Mills Rd corridor included several Developer-lead projects that were yet to be constructed
- Perrineville Rd-reviewed intersection of CR 1 & Millstone Rd for possible roundabout-Green Acres implications and ROW impacts would not qualify under HRRR
- Casino Rd, South Rochdale Ave, & Arnold Blvd had 3 to 4 crashes per corridor-Cost/Benefit would be low
- CR 524 (Stage Coach Rd)-Several “hot spots”
  - CR 524 & CR 539-Traffic Signal installed by Developer
  - CR 524 & Sharon Station Rd-Discussions with Upper Freehold for large-scale project outside funding limits of HRRR
  - Several fixed object crashes in the corridor, especially along easterly portion (connects to segment previously approved by HRRR)

CR 524 Histogram (P4S)



CR 524 Histogram–SafetyVoyager

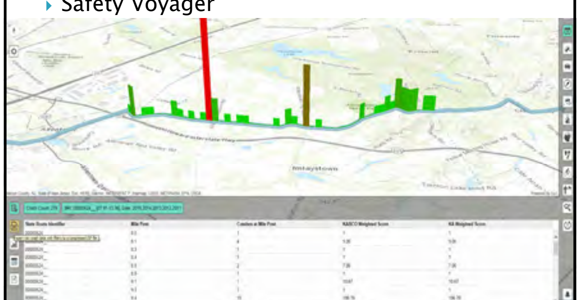
Detailed Crash Data

Detailed Crash Data

- Plan4Safety

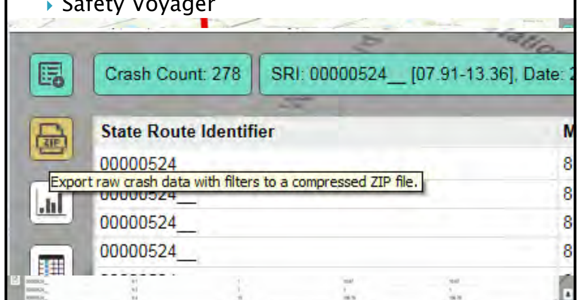
Detailed Crash Data

- Safety Voyager



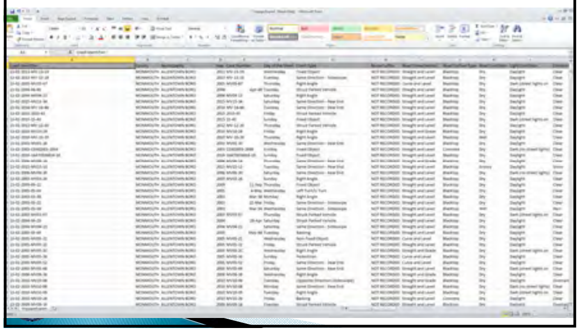
Detailed Crash Data

- Safety Voyager



Detailed Crash Data

- Safety Voyager



Crash Diagram/Crash table

Crash Diagram/Crash table

Crash Diagram/Crash Table

Crash Diagram/Crash Table

DATE:	26-Jul-15	BY:	VC
ANALYSIS PERIOD:	Jan 2011 to Dec 2013		

	12	1	2	3	4	5	6	7	8	9	10	11
AM	1	1					1	2	1	1		
PM	1	1	2		1	2	1		1	1		

Crash Year	No. of Crashes
2011	4
2012	1
2013	1
2014	7
2015	3
2016	1

Light condition	No. of Crashes
Daylight	11
Dark (No Street Lights)	3
Dark (Street Lights On/ spot)	1
Dark (Street Lights Off)	1

Surface	No. of Crashes
Dry	9
Wet	4
Snowy	2
Icy	2

Type of Crash	No. of Crashes	% of Total
Backing	0	0%
Fixed object	13	76%
Left turn/U turn	0	0%
Opp. direction	0	0%
Headon/Angular	0	0%
Petalcyclist	0	0%
Pedestrian	0	0%
Right Angle	0	0%
Rear end	1	6%
Side swipe	0	0%
Animal	3	18%

Severity	No. of Crashes
PDO	9
Pain	4
Moderate Injury	4
Incapacitating Injury	0
Fatal Injury	0

Countermeasures selected based on crash type

- High friction surface treatment (FHWA proven Safety Countermeasure)
- Centerline rumble strips (FHWA proven Safety Countermeasure)
- Safety Edge pavement edge treatment (FHWA proven Safety Countermeasure)
- 8" edge line marking
- Raised pavement markers on center line
- Additional signage for advanced guidance on roadway
- Sign upgrades based on advisory speed limits determined by ball banking
- Improve sign visibility by installation of retroreflective post covers
- Chevrons and/or other traffic control devices to provide further guidance through curves
- Brush clearing to improve line of sight
- Installation of breakaway roadside fixtures within clear zone

Crash Modification Factors

http://www.cmfclearinghouse.org/

Crash Modification factors

Treatment	Crash modifcation factor			
	Total		Fatal/Injury	
	CMF #	CMF	CMF #	CMF
High Friction Surface Treatment	7900	0.759	N/A	1
Safety Edge	4303	0.923	4323	0.835
Centerline Rumble Strip	3364	0.83	3368	0.63
Combined CMF		0.581		0.526
Predicted Crash Rate-Existing Conditions		2.343		0.846
Predicted Crash Rate-Post-construction		**1.362**		**0.445**

Cost/Benefit Analysis can be performed by comparing KABCO costs with and without modification factors vs estimated project cost (over the service life of the improvement)

KABCO Costs

	Injury Severity		Estimated Cost	
			2001*	2016/17
	Fatal	(K)	$4,008,900	$5,447,373.00
	Fatal and/or Injury	(K/A/B/C)	$158,200	$214,965.30
	Injury	(A/B/C)	$82,600	$112,238.52
"Incapacitating"------ >	Disability Injury	(A)	$216,000	$293,505.09
"Moderate"---------- >	Evident Injury	(B)	$79,000	$107,346.77
"Complaint of Pain"--- >	Possible Injury	(C)	$44,900	$61,011.01
	Property Damage Only	(O)	$7,400	$10,055.27

* *Societal Crash Costs by Severity, FHWA-HRT-05-051, October 2005*

Concept Plan

Summary

- Follow the guidelines for the funding solicitations
- Develop a process for selecting potential projects
  - Start with "high level" data (i.e. network screening lists)
  - Narrow down to a specific corridor or location
  - Identify crash patterns & develop a problem statement
  - Identify potential countermeasures
  - Evaluate the potential effect of countermeasures (i.e. use CMF)
- Effective understanding and presentation of data will help the people that make the decisions.

Thank You

vince.cardone@co.monmouth.nj.us

Vincent Cardone
Principal Engineer II, Traffic
Monmouth County

Data-Driven Safety Analysis – Nominal vs. Substantive Safety.

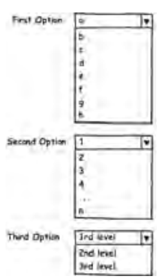
Analysis

Integrating Safety Performance into ALL Highway Investment Decisions

U.S. Department of Transportation
Federal Highway Administration

Quantifying the impacts of potential projects…

We need to know how a roadway will perform in terms of safety



"Safety"

- A core value for all transportation agencies
- Our customers have been assured that maintaining and improving safety is a top priority
- Much of an agency's investments are intended to produce a "safe" highway or system
- "Safety" has traditionally been incorporated in highway programs and projects within a standards-based framework

---

Approaches for Considering Safety

Nominal Safety

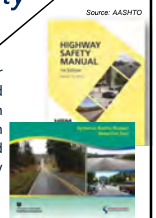
Substantive Safety

Source: AASHTO

Examined in reference to compliance with standards, warrants, guidelines and sanctioned design procedures

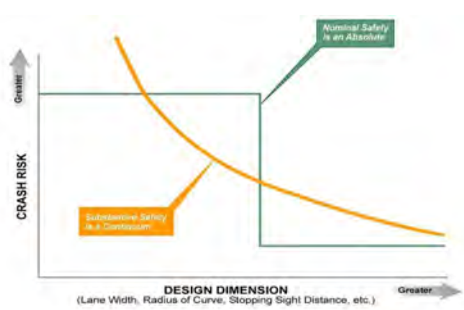
The actual or expected performance in terms of crash frequency and severity

Source: AASHTO



*Adapted from Ezra Hauer, ITE Traffic Safety Toolbox Introduction, 1999

Nominal vs Substantive Safety



Hwy Design Standards in the U.S.

Initially, AASHO's Committee on Standards confined itself to disseminating information on design to its members, but in 1928 it proposed that the Association adopt "standards of practice" to guide the member States in technical matters in which some uniformity from State to State was urgently needed. As a result, on March 1, 1928, AASHO approved its first four standards which read as follows:

- That wherever practicable shoulders along the edges of pavements shall have a standard width of not less than 8 feet.
- That on pavements 10 feet shall be considered as the standard width for each traffic lane.
- That the crown of a two-lane concrete pavement shall be 1 inch.
- That no part of a concrete pavement shall have a thickness of less than 6 inches, and that all unsupported edges shall be strengthened. *(6)*

B-7

Hwy Design Standards in the U.S.

TABLE 1-1
Evolution of AASHTO (AASHO) Design Policies in the United States[1]

A Policy on Highway Classification, September 16, 1938
A Policy on Highway Types (Geometric), February 13, 1940
A Policy on Sight Distance for Highways, February 17, 1940
A Policy on Criteria for Marking and Signing No-Passing Zones for Two and Three-Lane Roads, February 17, 1940
A Policy on Intersections at Grade, October 7, 1940
A Policy on Rotary Intersections, September 26, 1941
A Policy on Grade Separations for Intersecting Highways, June 19, 1944
A Policy on Design Standards-Interstate, Primary and Secondary Systems, 1945
Policies on Geometric Highway Design, 1950
A Policy on Geometric Design of Rural Highways, 1954
A Policy on Arterial Highways in Urban Areas, 1957
A Policy on Geometric Design of Rural Highways, 1965
A Policy on Design of Urban Highways and Arterial Streets, 1973
A Policy on Geometric Design of Highways and Streets, 1984
A Policy on Geometric Design of Highways and Streets, 1990
A Policy on Geometric Design of Highways and Streets, 1994
A Policy on Geometric Design of Highways and Streets, 2001

B-8

Hwy Design Standards in the U.S.

TITLE 23 - HIGHWAYS
CHAPTER 1 - FEDERAL-AID HIGHWAYS

§ 109. Standards

(a) **In General.**— The Secretary shall ensure that the plans and specifications for each proposed highway project under this chapter provide for a facility that will—

(1) adequately serve the existing and planned future traffic of the highway in a manner that is conducive to safety, durability, and economy of maintenance; and

(2) be designed and constructed in accordance with criteria best suited to accomplish the objectives described in paragraph (1) and to conform to the particular needs of each locality.

Federal Highway Administration, DOT

in the geometric and structural design of highways.

§625.2 Policy.

(a) Plans and specifications for proposed National Highway System (NHS) projects shall provide for a facility that will—

(1) Adequately serve the existing and planned future traffic of the highway in a manner that is conducive to safety, durability, and economy of maintenance; and

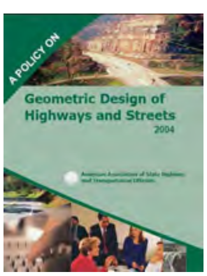
(2) Be designed and constructed in accordance with criteria best suited to accomplish the objectives described in paragraph (a)(1) of this section and to conform to the particular needs of each locality.

B-9

FHWA Adopts AASHTO for NHS

B-10

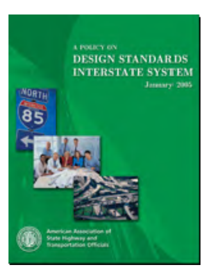
FHWA's Design Standards



- FHWA's standard for projects on the NHS (regardless of funding)
- For New construction or Reconstruction
- For any "3R" type of work on a freeway

B-11

FHWA's Design Standards



- Interstate System demands a higher benchmark for design
- Green Book criteria still apply where not superceded by the Interstate Policy

B-12

FHWA's Design Standards

- 3R projects "shall be constructed in accordance with standards which preserve and extend the service life of highways and enhance highway safety" [23 CFR 625.2]
- For non-freeway projects, States may have separate 3R criteria approved by FHWA in lieu of using the Green Book criteria.
- 40 States have opted to do so

B-13

FHWA's Guides & References

- Viewed as "best practices" but don't rise to the same level of importance
- Formerly itemized in 23 CFR 625
- Now listed in FAPG
- Notable examples include
  - AASHTO Roadside Design Guide
  - TRB Highway Capacity Manual

B-14

FHWA Standards Only for NHS

(o) Compliance With State Laws for Non-NHS Projects.— Projects (other than highway projects on the National Highway System) shall be designed, constructed, operated, and maintained in accordance with State laws, regulations, directives, safety standards, design standards, and construction standards.

B-15

States Designate Standards Off NHS

B-16

A Predictive Illustration…

All three of these meet design standards…

Source: CH2MHILL

but predictive analysis tells us they would perform very differently from a safety perspective.

17

The EDC Data-Driven Safety Analysis Initiative…

- Goal: Integrate **safety performance** into **ALL** highway investment decisions

18

What is the HSM?

- A tool that applies an **evidence-based** technical approach to safety
- Provides reliable **estimates** of an existing or proposed roadway's **expected safety performance**.
- Helps agencies **quantify** the **safety impacts** of transportation decisions, similar to the way agencies quantify:
  - traffic growth
  - environmental impacts
  - traffic operations
  - pavement life
  - construction costs

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The Vision for the HSM

A Document Akin To the HCM…

1. Definitive; represents quantitative 'state-of-the-art' information
2. Widely accepted within professional practice of transportation engineering
3. Science-based; updated regularly to reflect research

20

AASHTO Highway Safety Manual, First Edition

2010 Release:

- Rural Two-Lane Roads
- Multilane Rural Highways
- Urban/Suburban Arterials

2014 Supplement:

- Freeway Segments
- Ramps
- Ramp Terminals

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Highway Safety Manual Organization

Part A	Introduction, Human Factors & Fundamentals
Part B	Safety Management Process
Part C	Predictive Methods
Part D	Crash Modification Factors

22

HSM Companion Software

HSM Part	Supporting Tool
PART B: Roadway Safety Management Process	AASHTOWare SafetyAnalyst Agile Assets Safety Analyst CARE Numetric usRAP Vision Zero Suite Other commercial… State-Developed
PART C: Predictive Methods	HSM & ISATe Spreadsheets IHSDM
PART D: CMFs	FHWA CMF Clearinghouse

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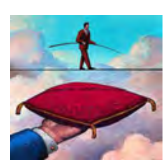
Design Practice Involves Risk

- Two fundamental types of risk:
  - Risk of tort lawsuits arising from crashes alleged to be associated with a design ("Tort Risk")
  - Risk of the solution not performing as expected in terms of safety and operations ("Engineering Risk")



B-24

Tort Risk

- Adherence to criteria does not automatically prove *reasonable care*
- Deviation from criteria does not automatically prove *negligence*

B-25

Tort Risk

- In most jurisdictions, the Court does not have authority to rule that the design decision wa the "correct" choice
- The Court can only render judgment on whether the process was complete and whether the outcome was reasonable given the process

B-26

Meeting Design Criteria Important

- "Transportation agencies limit greatly the risk of a successful tort suit by focusing on design solutions that are proven, i.e., that are within current design guidelines and criteria".
- "Providing a nominally safe design is the first and major step toward minimizing tort risk".

B-27

Engineering Risk

- How good (or poor) is the existing substantive safety performance?
- What should the long term safety performance of the roadway be?
- What is the difference in expected substantive safety if the exception is implemented?

B-28

Engineering Risk

- What is the degree to which a standard is being reduced?
- Will the exception affect other geometric elements?
- What additional features will be introduced, (e.g., signing or delineation) that would mitigate the potential adverse effects of the exception?

B-29

CSS Approach Helps Minimize Risk

- It is an unavoidable fact that DOTs face public and legal scrutiny for virtually all their actions.
- However, if a design team works closely with stakeholders, is creative within the bounds of good engineering practice, and fully documents all decisions, they will have gone a long way toward minimizing the risk associated with a future tort action should that occur

B-30

Would you expect these alternatives to perform the same over a 30-yr project life?

Shouldn't we know how alternatives will perform from a safety perspective before investing millions of taxpayer dollars?

Source: CH2MHILL

31

Incorporating Safety Performance into Investment Decisions

"Road safety management is in transition. The transition is from action based on experience, intuition, judgment, and tradition, to action based on empirical evidence, science, and technology…"

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Resources

C M F
CRASH MODIFICATION FACTORS CLEARINGHOUSE

- HSM Implementation Guide for Managers (FHWA)
- Integrating the HSM into the PDP (FHWA)
- HSM Users Guide (NCHRP 17-50)
- Integration of Safety in the PDP and Beyond (ITE)
- Scale and Scope of the HSM in the PDP (TPF-5(255))
- HSM Policy and Procedures Informational Guide (FHWA)

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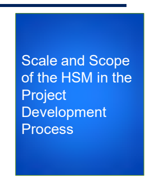
New Resource (soon!):



- **Scale and Scope of the HSM in Project Development Process**
  - Informational Guide funded by the TPF-5(255) HSM Pooled Fund
  - Helps identify appropriate HSM safety assessment methods by for various project applications
  - Chapter on each PD Phase, with examples
  - Includes a continuous case study example (planning through design)
  - Anticipated completion date: October 2016

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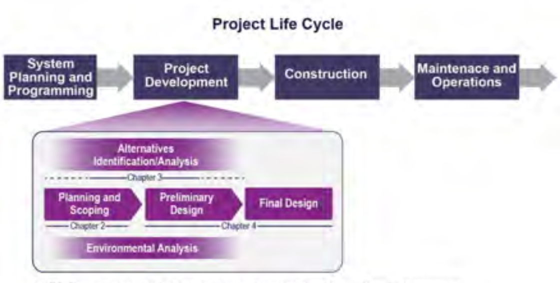
The Project Development Process



Source: Leidos

35

Safety Analysis Methodologies

- Safety Assessment Methods
  - Basic
  - Intermediate
  - Advanced
- Levels of Reliability:
  - Observed Crashes (Basic)
  - Predicted Crashes (Intermediate)
  - Expected Crashes (Advanced)
- Appropriate method f(project phase, task, type, available resources)

36

Project Type Descriptions for Assessment Id

Table 3. Example Project Type Descriptions for Safety Assessment Method Identification

Project Type	Example Description
1R	The 1R project type designation is often associated with routine maintenance activities. This type of project could include a pavement overlay, roadside maintenance, or a minor upgrade to existing roadside hardware. For 1R projects, there are very few, if any, new improvements.
2R	The 2R project type designation is generally associated with resurfacing existing facilities or restoring road characteristics that are in need of an upgrade. As part of the 2R project, a limited number of new design or operational changes may be incorporated. These enhancements are minor and do not change the overall character of the facility.
3R	The 3R project type is often associated with major rehabilitation of an existing facility. This could include pavement improvements for the existing road, minor roadway widening, roadside shoulder improvement projects, and construction of select low-cost safety improvements at the site or system-wide level.
4R	The 4R project type includes major retrofit construction efforts including modification of the design to meet geometric criteria standards. This type of project generally includes substantial changes to the character of the road (significant widening, realignment, major operational modifications).
NL	The NL project type indicates a highway on new location. This type of project has all new construction for the majority of the alignment.

Source: Leidos

Assessment Methods vs. Project Phase/Task

Project Phase	Related Task	Project Type[1]	Safety Assessment Method to Consider: Basic	Intermediate	Advanced
Planning and Scoping (Chapter 2)	Preliminary Planning and Needs Assessment	1R, 2R, 3R, 4R, NL	✓		
	Establish Project Purpose and Need	2R	✓		
		3R, 4R	✓	✓	✓
		NL	✓	✓	
	Establish Project Scope	2R	✓		
		3R	✓	✓	
		4R	✓	✓	✓
		NL	✓	✓	
Alternatives Identification and Evaluation (Chapter 3)	Alternative Selection	2R	✓		
		3R, 4R		✓	✓
		NL		✓	
	Interchange Justification Request	3R, 4R		✓	✓
		NL		✓	
Preliminary and Final Design (Chapter 4)	Selecting specific design elements and their dimensions	2R	✓		
		3R, 4R		✓	✓
		NL		✓	
	Design Exception	3R, 4R		✓	✓
		NL		✓	
	Value Engineering	4R		✓	✓
		NL		✓	
	Establishing the Work Zone Transportation Management Plan	2R	✓		
		3R, 4R		✓	
		NL		✓	

Source: Leidos

Safety Analysis Methodologies

- Safety Assessment Methods
  - Basic
  - Intermediate
  - Advanced
- Levels of Reliability:
  - Observed Crashes (Basic)
  - Predicted Crashes (Intermediate)
  - Expected Crashes (Advanced)
- Appropriate method f(project phase, task, type, available resources)

Observed, Predicted and Expected Crashes

- Adding observed crash data and weighting this information with the predicted crash values (calculated using the CMF and SPF combination) can improve the quality and statistical reliability of the crash prediction for a specific location (resulting in a calculated *expected* number of crashes).
- Consequently, the three key levels of reliability presented in the HSM are represented as:
  1) Observed crashes
  2) Predicted average number of crashes
  3) Expected average number of crashes

Building Blocks for Safety Assessment Methods

- Three basic "building blocks" that vary depending on the proposed project analysis include:
  - Observed Crashes,
  - Crash Modification Factors/Functions, and
  - Safety Performance Functions

Basic, Intermediate and Advanced Methods

- The **basic methods** evaluate observed crashes and/or CMF applications related to the observed crashes. The basic methods introduced in this Guide include:
  - *Site Evaluation or Audit*
  - *Historical Crash Data Evaluation*
  - *CMF Applied to Observed Crashes*
  - *CMF Relative Comparison*
- **Intermediate safety assessment methods** include the use of SPFs and result in the more statistically reliable predicted average number of crashes. The intermediate methods introduced in this Guide include:
  - *AADT-Only SPF*
  - *SPF with CMF Adjustment*
- **Advanced safety assessment methods** include all three key building blocks and result in the most statistically reliable expected average number of crashes. The advanced safety assessment method introduced in this Guide include:
  - *SPF with CMF Weighted with Observed Crashes*

Source: Leidos

Data Needs by Safety Assessment Methods

Table 4. Data Needs for Safety Assessment Methods

Safety Assessment Method	Data Needs: Road Type[1]	Road Characteristics[2]	Traffic Volume[3]	Observed Crash Data[4]
Site Evaluation or Audit	✓	✓		✗
Historical Crash Data Evaluation	✗	✗		✓
CMF Applied to Observed Crashes	✓	✓		✓
CMF Relative Comparison	✓	✓		
AADT-Only SPF	✓		✓	
SPF with CMF Adjustment	✓	✓	✓	
SPF with CMF Weighted with Observed Crashes	✓	✓	✓	✓

Key:
✓ = Required Data
✗ = Recommended Data

[1] Road Type refers to rural two-lane highway, rural multi-lane highway, urban freeway, etc.
[2] Road Characteristics includes physical features such as lane widths, access density, etc.
[3] Traffic Volume is the average daily traffic (ADT) or annual average daily traffic (AADT) in vehicles per day
[4] Observed Crash Data represents the historic crash data at the study site

Source: Leidos

Safety Analysis Methodologies

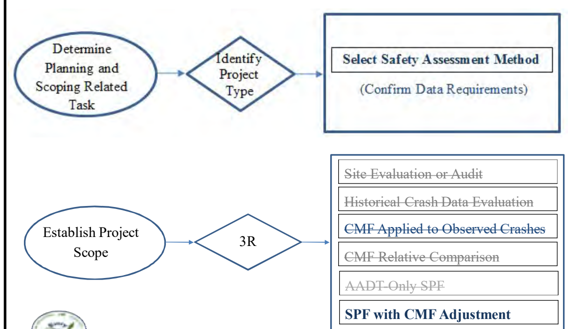
- Safety Assessment Methods
  - Basic
  - Intermediate
  - Advanced
- Levels of Reliability:
  - Observed Crashes (Basic)
  - Predicted Crashes (Intermediate)
  - Expected Crashes (Advanced)
- Appropriate method f(project phase, task, type, available resources)

Table 1. Primary Analysis Application for Safety Assessment Methods

Application	Basic: Site Evaluation or Audit (Observed Crashes)	Historical Crash Data Evaluation (Observed Crashes)	CMF Applied to Observed Crashes (Observed Crashes)	CMF Relative Comparison	Intermediate: AADT-Only SPF (Predicted Crashes)	SPF with CMF Adjustment (Predicted Crashes)	Advanced: SPF with CMF Weighted with Observed Crashes (Expected Crashes)
Existing Performance	1	2					
Future Performance of an Existing Road			2 & 3	3	4	3 & 4	2, 3, & 4
Future Impact of Minor Geometric Changes to Existing Road			2 & 3	3		3 & 4	2, 3, & 4
Future Impact of Major Geometric Changes to Existing Road						3 & 4	
Future Performance for a New Facility					4	3 & 4	

Basis for Analysis: 1 = Site Characteristics 2 = Crash History 3 = CMF Values 4 = AADT

Safety Assessment Method Selection Process



Example of example problems…

PROBLEM OVERVIEW

Safety Assessment Method: **SPF with CMF Adjustment**

Project Phase: **Planning & Scoping**
Related Task: **Establish Project Purpose and Need**
Project Type: **3R**
Calculation Method: ☐ Hand Calculated ☒ Tool Based

Comments:
This example problem will evaluate the effect lane widening can have on reducing fatal and injury crashes for a two-lane undivided rural highway at a site where crash data is not available.

LEVEL OF ANALYSIS

Basic Intermediate Advanced

What to do when no 1:1 fit?

- How to address scenario where analysis site does not match HSM existing conditions?
- Review HSM model parameter attributes;
- Identify site specific parameters
- Evaluate differences/tradeoffs w.r.to differences;
- Adjust site values to comply with HSM parameter constraints and document
- Consistently apply this assumption for alternatives analysis

Safety Analysis Applications in Design Phase

- Selecting design elements/features
- Design Exceptions
- Performance-Based Practical Design

Safety Analysis to justify Design Exceptions

Proposed **10 Controlling Criteria:**

- Design speed
- **Lane width**
- **Shoulder width**
- **Horizontal curve radius**
- **Superelevation**
- **Maximum Grade**
- Stopping sight distance
- Cross slope
- Vertical clearance
- Design Loading Structural capacity

23 CFR 625

Design Exceptions

- Required for projects on the NHS
- FHWA documentation expectations:
  – Specific design criteria that will not be met
  – Existing roadway characteristics
  – Alternatives considered
  – **Comparison of the safety and operational performance of the roadway** and other impacts such as right-of-way, community, environmental, cost, and usability by all modes of transportation
  – Proposed mitigation measures
  – Compatibility with adjacent sections of roadway

Performance-based Practical Design

- An approach to decision-making that encourages *engineered solutions* rather than reliance on maximum values or limits found in design specifications
- Characteristics
  – grounded in performance management
  – exercises engineering judgment to address purpose and need
  – **uses appropriate performance-analysis tools**
  – considers both short- and long-term project and system goals

Design Decisions Assessment Method Options

Table 9. Preliminary and Final Design Safety Assessment Method Options

Related Task	Objective	Project Type	Basic: Site Evaluation or Audit (Observed Crashes)	Basic: Historical Crash Data Evaluation (Observed Crashes)	Basic: CMF Applied to Observed Crashes (Observed Crashes)	Basic: CMF Relative Comparison	Intermediate: AADT-Only SPF (Predicted Crashes)	Intermediate: SPF with CMF Adjustment (Predicted Crashes)	Advanced: SPF with CMF Weighted with Observed Crashes (Expected Crashes)
Safety Assessments:	Increasing Level of Reliability →								
Selecting specific design elements and their dimensions	To compare safety impacts of alternative dimensions	2R	✓	✓	✓	✓			
		3R, 4R	✓	✓	✓	✓	✓	✓	✓
		NL				✓	✓	✓*	
Design Exception	To quantify design exceptions and mitigation strategies	3R, 4R			✓	✓	✓	✓[7]	✓
		NL					✓	✓	
Value Engineering	To quantify phases of value engineering process	4R			✓	✓	✓[8]	✓	✓
		NL					✓	✓	
Establishing the Work Zone Transportation Management Plan	To compare safety impacts of traffic control strategies	2R	✓			✓	✓	✓	
		3R, 4R					✓	✓	
		NL					✓	✓	

Design Decisions Assessment Method Options

Table 9. Preliminary and Final Design Safety Assessment Method Options

Related Task	Objective	Project Type	Basic: Site Evaluation or Audit (Observed Crashes)	Basic: Historical Crash Data Evaluation (Observed Crashes)	Basic: CMF Applied to Observed Crashes (Observed Crashes)	Basic: CMF Relative Comparison	Intermediate: AADT-Only SPF (Predicted Crashes)	Intermediate: SPF with CMF Adjustment (Predicted Crashes)	Advanced: SPF with CMF Weighted with Observed Crashes (Expected Crashes)
Safety Assessments:	Increasing Level of Reliability →								
Selecting specific design elements and their dimensions	To compare safety impacts of alternative dimensions	2R	✓	✓	✓	✓			
		3R, 4R	✓	✓	✓	✓	✓	✓	✓
		NL				✓	✓	✓*	
Design Exception	To quantify design exceptions and mitigation strategies	3R, 4R			✓	✓	✓	✓[7]	✓
		NL					✓	✓	
Value Engineering	To quantify phases of value engineering process	4R			✓	✓	✓[8]	✓	✓
		NL					✓	✓	
Establishing the Work Zone Transportation Management Plan	To compare safety impacts of traffic control strategies	2R	✓			✓	✓	✓	
		3R, 4R					✓	✓	
		NL					✓	✓	

Case Study – Arizona DOT

Use Predictive Method for Alternatives

PROJECT LOCATION

SR 264 (MP 441 to 466)

- Rural Minor Arterial
- Navajo County, Arizona
- Undivided Two-Lane, Two-Way Road
- 12-foot travel lanes
- 0-1-foot shoulders
- Intermittent right and left turn lanes
- Intermittent passing lanes

Source: Arizona DOT

Alternative Improvements Included:

- Widening to 5 ft shoulders
- Widening to 8 ft shoulders
- Improve superelevation
- CL & Shoulder rumble strips
- Flattening side slopes
- Install guardrail

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Case Study – Arizona DOT

Parameters for Existing & Proposed Conditions:

- Used IHSDM to perform safety analysis

ROADWAY ELEMENT	HSM Base Condition	Existing SR 264 (1-Foot Shoulders)	Alternative A (5-Foot Shoulders)	Alternative B (8-Foot Shoulders)
Lane width	12-Foot	12-Foot	12-Foot	12-Foot
Shoulder width	6-Foot	1-Foot	5-Foot	8-Foot
Shoulder type	Paved	Paved	Paved	Paved
Roadside hazard rating	3	Varies (6 or 7 most frequent)	Varies (1 or 2 most frequent)	Varies (1 or 2 most frequent)
Driveway density	≤ 5 per mile	Per survey & Holbrook District turnout database	Per survey & Holbrook District turnout database	Per survey & Holbrook District turnout database
Horizontal curves: length, radius, and presence or absence of spiral transitions	None	Per best fit alignment	Per best fit alignment (match existing)	Per best fit alignment (match existing)
Horizontal curves: Superelevation	None	Per as-builts & survey	Per as-builts & survey (match existing)	Per as-builts & survey (match existing)
Grades	< 3%	Per as-builts & survey	Per as-builts & survey (match existing)	Per as-builts & survey (match existing)
Centerline rumble strips	None	None	Present	Present
Passing lanes	None	Per survey	Per survey (match existing)	Per survey (match existing)
Two-way left-turn lanes	None	Per survey	Per survey (match existing)	Per survey (match existing)
Lighting	None	Present @ US 191 intersection	Present @ US 191 intersection (match existing)	Present @ US 191 intersection (match existing)
Automated speed enforcement	None	None	None	None

Source: Arizona DOT

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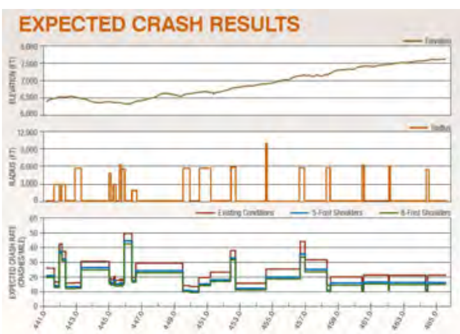
Case Study – Arizona DOT

Plot of Geometric Features and Expected Crashes



Source: Arizona DOT

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Case Study – Arizona DOT

Crash Prediction Results

Expected Crash Frequency by Severity: 2016–2036

Source: Arizona Department of Transportation, Traffic Safety Evaluation Report

Alternative	Total Crashes	Fatal and Injury Crashes	Property Damage Only Crashes	Reduction in Total Crashes over Existing Conditions	Percent Reduction
No Build	636.4	283.4	353.0	—	—
Alternative A	531.6	230.5	301.1	104.8	16.5
Alternative B	504.2	216.8	287.4	132.2	20.8
Only Superelevation Improvements	635.3	282.7	352.6	1.1	0.2

- **IHSDM Safety Analysis:**
  - Model was un-calibrated as used (not necessary for comparative alternatives analysis)
  - **Alternative B** (8-ft shoulders) **would reduce crashes by 4 percent more** than Alternative A (5-ft shoulders)

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Case Study – Arizona DOT

Benefit to Cost Ratio: Design Alternatives

Alternative	Annual Benefit	Annual Cost	Benefit/Cost Ratio
Alternative A	$3,873,681	$1,680,561	2.30
Alternative B	$5,084,207	$2,678,713	1.90
Superelevation Improvements	$41,807	$135,464	0.31

Source: Arizona Department of Transportation, Traffic Safety Evaluation Report

- **Economic analysis:**
  - Although Alternative B (8-ft shoulders) could provide the greater benefit in reduction in fatal and injury crashes, **Alternative A** (5-ft shoulders) would provide the **greater return on investment** and was selected as the preferred alternative.

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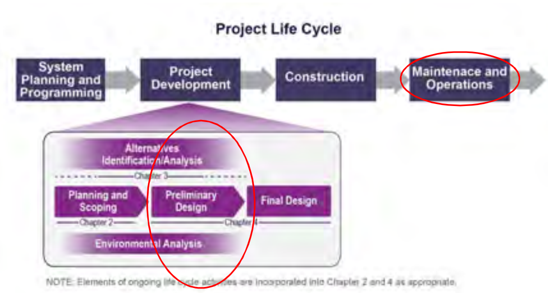
Safety Analysis from a Traffic Operations Perspective



Source: Leidos

60

Safety Analysis in Traffic Operations

- Interchange Access Requests
  - Policy Point #3 Requires Safety and Operational Analysis
- Traffic Impact Studies
- Intersection Control Evaluation (ICE)
- Work Zones
- Part-Time Shoulder Use

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Policy Point #3

Policy Point 3: An operational and safety analysis has concluded that the proposed change in access does not have a significant adverse impact on the safety and operation of the Interstate facility (which includes mainline lanes, existing, new, or modified ramps, ramp intersections with crossroad) or on the local street network based on both the current and the planned future traffic projections. The analysis shall, particularly in urbanized areas, include at least the first adjacent existing or proposed interchange on either side of the proposed change in access (23 CFR 625.2(a), 655.603(d) and 771.111(f)). The crossroads and the local street network, to at least the first major intersection on either side of the proposed change in access, shall be included in this analysis to the extent necessary to fully evaluate the safety and operational impacts that the proposed change in access and other transportation improvements may have on the local street network (23 CFR 625.2(a) and 655.603(d)). Requests for a proposed change in access must include a description and assessment of the impacts and ability of the proposed changes to safely and efficiently collect, distribute and accommodate traffic on the Interstate facility, ramps, intersection of ramps with crossroad, and local street network (23 CFR 625.2(a) and 655.603(d)). Each request must also include a conceptual plan of the type and location of the signs proposed to support each design alternative (23 U.S.C. 109(d) and 23 CFR 655.603(d)).

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Case Study: I-270/US 33 Interchange, Dublin OH

- Three of eight interchange alternatives were developed and analyzed based on a list of criteria:
  - Traffic Operations
  - Design & Construction
  - Environmental Impacts
  - Right-of-Way Needs
  - Capital Costs
  - **Safety Performance**

63 **ISATe**

Case Study: I-270/US 33 Interchange, Dublin OH

- ISATe used for safety analysis:
  - Model was un-calibrated as used
  - Results used for comparisons are relative
  - Focused on KAB type crashes from 2015-2035

Predicted Crashes and Societal Costs: 2015–2035

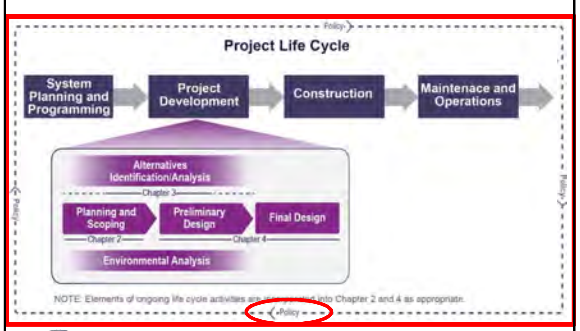
	KAB Crashes	Societal Costs
No Build	308	$97 million
Alternative 4	325	$91 million
Alternative 7	409	$109 million
Alternative 8	320	$89 million

Source: CH2M HILL

- Alternative 8 predicted to have lowest KAB crash frequency and lowest expected societal cost
- City of Dublin and ODOT selected Alternative 8 as the preferred alternative based on all of the criteria.

64 **ISATe**

Implementing Safety Analysis in Project Development



Source: Leidos

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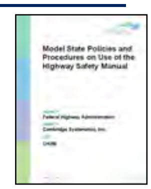
New Resource (soon!):



- **Model State Policies & Procedures on of the Highway Safety Manual**
  - Informational Guide funded by TPF-5(255) HSM Pooled Fund
  - Identifies existing HSM language in State policy/procedural manuals
  - In areas with limited or no HSM language, provides model language that a State could start with
  - Language on each PD Phase
  - Anticipated completion date: September 2016

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Model State Policy example

Engineering and Design – Preliminary Engineering
2.3.1.3. Design Manuals

- Design manuals provide an excellent opportunity to integrate the Highway Safety Manual into the project development process. Through the research for this project, the Georgia Department of Transportation, Pennsylvania Department of Transportation, and Washington State Department of Transportation were identified as noteworthy design manual examples and provide the basis for the model policy statement and guidance language.

Noteworthy examples

Should:

- Pennsylvania Department of Transportation - A safety assessment, including the potential safety benefits shall be discussed if the proposed improvements will contribute to a reduced number and/or severity of crashes. Consider using AASHTO's Highway Safety Manual (HSM) to calculate crash frequencies to quantify the substantive safety performance of the alternatives.
  - Source: Pennsylvania Department of Transportation. 2014. District Highway Safety Guidance Manual. Publication PUB 638 (12-14). December.

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Conclusions

- Safety assessment categories linked to crashes parameter
  - Basic (Observed)
  - Intermediate (Predicted)
  - Advanced (Expected)
- HSM (and other) predictive methods not always a 1:1 fit with our sites- what to do?
  - Apply engineering judgement to a new tool?
    - Best fit possible
    - Fully DOCUMENT ALL ASSUMPTIONS.

68

What is "Risk"?

Risk *n.* 1. The possibility of suffering harm or loss; danger. 2. A factor, element, or course involving uncertain danger; hazard. 3. The danger or probability of loss to an insurer. *tr. v* 1. To expose to a chance of loss or damage.

Are you a "Risk Taker"?

What is Risk Management?

International Organization for Standardization

The International Standards Organization (ISO) characterizes Risk Management as:

- Explicitly addresses uncertainty
- Based on the best available information
- Part of the decision making process
- Systematic, structured, and an integral part of organizational processes
- Dynamic, iterative, responsive to change, and capable of continual improvement and enhancement
- Accounts for human factors
- Transparent and inclusive

A-70

Applicability to Transportation

Risk comes in many forms and is inherent in the delivery and operation of transportation projects. Examples of where risk is incurred:

- Project cost (cost escalation, changes to project scope)
- Level of engineering analysis (greater investigation generally means fewer unknowns)
- Serviceability (when projects fail to satisfy performance demands)
- Legal claims and tort liability
- Safety (geometric design, structure design, geotechnical design)

A-71

Adapted from: FHWA Federal Lands Highway Division *Project Development and Design Manual*. March 2008

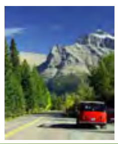
Highway-related Principles

- "It is *not feasible or intended for highway projects to be entirely risk-free*, as there are potential rewards to the project when risk is taken."
- "To understand the risks associated with decisions involving the selection and application of design standards and criteria, it is essential to *have knowledge of the basis and assumptions underlying the standards, as well as knowing the conditions (physical, traffic and safety) for the project.*"

A-72

Risk Basis for Improving Design

- "In many cases, the *risks associated with decisions can be mitigated with inclusion or enhancement of other features*, which may offset the risk."
- "The *evaluation of risk is an interdisciplinary* process requiring involvement of project team members and stakeholders based on the specific issues and an evaluation of risk tolerability."



A-73

Assessing the Risks

- Risk assessment is the process of assessing the probability and severity of adverse consequences associated with activities, recommendations or designs.
- For most transportation projects the risk assessment is not a complicated quantitative assessment, but rather a practical assessment based on experience, engineering judgment and historical standard of practice.
- To the extent possible, risks should be quantified, both on the basis of their potential probability and for their potential consequences.

A-74

Risk and Geometric Design

Risk management in geometric design involves:

- Applying engineering knowledge and judgment
- Incorporating performance prediction tools
- Using latest best practices and new technologies
- Balancing competing project interests, including but not limited to, cost, operational efficiency, environmental issues, social concerns, and safety performance

Risk Management = Trade-Off Considerations

A-75

Challenge of Highway Design

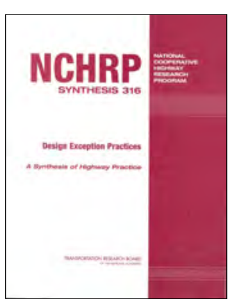
Effectively dealing with the "**TRADE-OFFS**"

- Adding lanes vs. minimizing property takes
- Clear zones vs. preserving mature trees
- Property access vs. high mobility
- Designing for vehicle traffic vs. accommodating other user groups

A-76

Going Beyond the FHWA Criteria

- 24 States have some design criteria that are higher than AASHTO's
- 15 States have "supplemental" criteria
- For example, Caltrans has established "mandatory" and "advisory" criteria

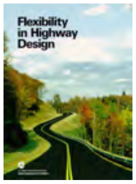


B-77

Local Practice?

B-78

"Introducing" Flexibility in Design

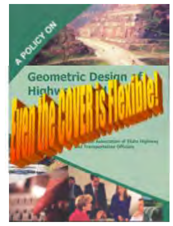


- Joint effort of
  - FHWA
  - AASHTO
  - Non-traditional partners
- Central theme of Thinking Beyond the Pavement Conference in 1998

This guide does not attempt to create new standards. Rather, the guide builds on the flexibility in current laws and regulations to explore opportunities to use flexible design as a tool to help sustain important community interests without compromising safety. To do so, this guide stresses the need to identify and discuss those flexibilities and to continue breaking down barriers that sometimes make it difficult for highway designers to be aware of local concerns of interested organizations and citizens.

B-79

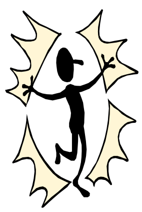
Where's the Design Flexibility?



- As highway designers, highway engineers strive to provide for the needs of highway users while maintaining the integrity of the environment. Unique combinations of design requirements that are often conflicting result in unique solutions to the design problems.
- Sufficient flexibility is permitted to encourage independent designs tailored to particular situations

B-80

Where's the Design Flexibility?



- Design speed
- Design vehicle
- Design user
- Level of performance
- Alignment
- Cross-Section
- Others

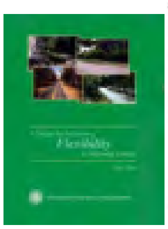
Designers have choices!

B-81

Where's the Design Flexibility?

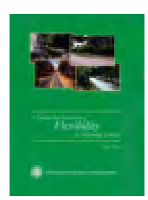
B-82

Where's the Design Flexibility?



B-83

Where's the Design Flexibility?



3.6.1.2 Flexibility in AASHTO Policy

The AASHTO Green Book recognizes the need for flexibility and provides that flexibility, citing how lane width can be tailored, to a degree, to fit the particular environment in which the roadway functions (e.g., low volume rural roads or residential areas versus higher volume rural or urban facilities). The formulation of policy values demonstrates considerable flexibility.

For low speed, lower volume rural roads and highways with little or no truck traffic, lane widths as low as 9 feet (2.7 meters) may be acceptable; lane widths substantially less than 12 feet (3.6 meters) are considered adequate for a wide range of volume, speed, and other conditions.

For the reconstruction of rural two-lane highways, the AASHTO Green Book notes that less than 12-foot or 3.6-meter lane widths may be retained "where alignment and safety record are satisfactory." In other words, widening a narrow existing highway is not mandated if its safety performance is acceptable. Flexibility is also evident for lower-class roads and streets, with recommended narrower lane widths consistent with lower design speeds on such roads.

The discussion of lane width in the AASHTO Green Book for urban areas also reflects a high degree of flexibility. It is noted that lane widths "may vary from 10 to 12 ft (3.0 to 3.6 m) for arterials." For lower classification facilities, similar flexible language encourages the tailoring of an urban street cross section to site-specific conditions.

B-84

Standard Design Not Always Best

- "Unfortunate that the word "standards" should have been chosen. Strictly interpreted, the meaning would indicate that the standard design was the best design.
- Standards are merely recommended designs which are to be adhered to unless conditions indicate that a variation in the design would meet them better.
- To neglect the detailed study of local conditions often results not only in an unwarranted increase in cost, but may result in a type of construction which fits poorly the location where used".

B-85

Meeting Design Criteria Important

- Safety or traffic operational problems are less likely to develop if design criteria are met.
- Designers should strive to meet criteria and look first at using the flexibility inherent in the adopted criteria to achieve a balanced, safe, and context sensitive design.
- In some situations, design exceptions will be necessary and the goal is to achieve a high level of substantive safety and efficient traffic operations.

B-86

Design Exceptions

"The process and resulting documentation associated with a geometric feature created or perpetuated by a highway construction project that does not conform to the minimum criteria set forth in the standards and policies".

B-87

Design Exceptions Valid Process

- Not admission of failure
- Not flawed design
- A legitimate exercise of professional judgement

B-88

Standards Not Devalued

- When evaluating the need for a design exception the design standards are not devalued;
- Rather, in-depth understanding of the standards including the underlying theories and basis is used to add value to a unique situation by applying flexibility.

B-89

Skilled Designers Minimize Risk

- The ability to develop a context-sensitive solution by working within and sometimes outside design criteria, while maintaining the safety and operational integrity of the highway, requires a broad and deep understanding of the operational effects of highway geometry.
- For this reason, knowledgeable, experienced, professional highway engineers are essential for a successful context-sensitive project.

B-90

Questions & Answers

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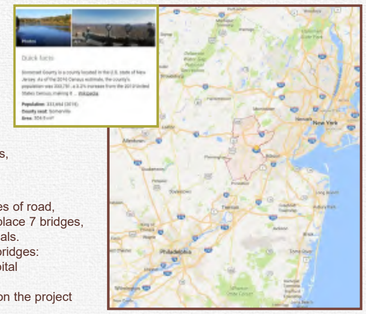
PAVEMENT FRICTION SURFACE TREATMENTS

Work being done on County Routes
Somerset County Engineering
Presented by Patricia Bates Smith
Principal Engineer, Highway

Somerset – who are we?

Engineering office with:
- Staff of 36 people
- In 10 different disciplines
- Managing infrastructure including:
  - 250 miles of County Roads
  - 193 traffic signals
  - 762 bridges
  - As well as county sites, facilities and parks.



Annually, we resurface 15 miles of road, reconstruct 1.5 miles road, replace 7 bridges, install or upgrade 3 traffic signals.
Annual budgets for road and bridges:
$9 - $18 million, County Capital
$4 million, State Aid
$ vary, Federal Aid - based on the project

Somerset County – Local Safety Projects

Program	Project	Town	Description	Grant Amount	Length (miles)	Project Status
2010 LSP	Hamilton St (CR 514) & Franklin Blvd (CR 617)	Franklin	Traffic signal modifications and upgrade, left turn lanes, resurfacing, ADA ramps.	$190,000.00	N/A	completed
2011 LSP	Overheight vehicle detectors	Manville, South Bound Brook	Installation of 2 height detection at approaches to low railroad overpasses, 533 in Manville, 527 in South Bound Brook	$170,000.00	N/A	completed
2012 LSP	North Bridge St & Cliff St intersection	Somerville	Installation of a new traffic signal	$150,000.00	N/A	completed
2012 LSP	Easton Ave (CR 527) & Foxwood Dr.	Franklin	Traffic signal modifications and upgrade: dedicated left turn lanes, pedestrian signals	$220,000.00	N/A	completed
2012 HRRR	New Centre Rd (CR 627)	Hillsborough	Rural road safety measures including, pavement repair, resurfacing, micro-mill friction course, wet weather high visibility traffic stripes	$490,000.00	1	completed
2013 HRRR	River Rd (CR 627)	Hillsborough	Rural road safety measures including, pavement repair, resurfacing, micro-mill friction course, wet weather high visibility traffic stripes	$380,000.00	0.8	completed
2014 LSP	Promenade Blvd (CR 685)	Bridgewater	Safety measures on 4 lane urban drive: Road diet, medians, cross walks, curb ramps, sidewalk extension.	$750,000.00	0.65	completed
2014 HRRR	Bedminster Safety Improvements including Pottersville Rd (CR 512), Lamington Rd (CR 523) and Burnt Mills Rd (CR 620)	Bedminster	Rural road safety measures including pavement repair, resurfacing, High Friction Surface Course on horizontal curves, wet weather high visibility striping, pavement safety edge, driveway aprons, new signage and delineators.	$4,125,000.00	10	completed
2014 LSP	Chimney Rock Rd (CR 525)	Bridgewater	Rural road safety measures including pavement repair, resurfacing, High Friction Surface Course on horizontal curves, wet weather high visibility striping, pavement safety edge, new signage and delineators.	$400,000.00	1	completed
2015 LSP	Mountain Ave (CR 642)	North Plainfield	Local Safety suburban street including: 2 traffic signal modifications and upgrades, ADA ramp compliance, striping.	$960,000.00	1.3	Final docs
2015 LSP	Washington Ave (CR 529) & Greenbrook Rd (CR 634)	Green Brook	Local Safety suburban street including: traffic signal replacement, Road Diet, RCP culvert replacement, ADA curb ramp compliance.	$780,000.00	0.4	completed
2016 LSP	Main St (CR 533)	Manville	Local Safety suburban street including: 5 traffic signal modifications, 1 traffic signal replacement, Road Diet, ADA ramp compliance, resurfacing, striping.	$3,000,000.00	1.1	prelim design
2017 LSP	Easton Ave (CR 527) & Demott Lane	Franklin	Safety measures on 4 lane arterial roadway including: traffic signal modifications, barrier upgrades, ADA ramp compliance, rehabilitation of existing HMA bikepath including ADA compliance.	$1,440,000.00	0.8	await grant award
				$13,055,000.00		
	Projects that applied a pavement surface treatment					

HFST – How did we get started?

… there was a need.

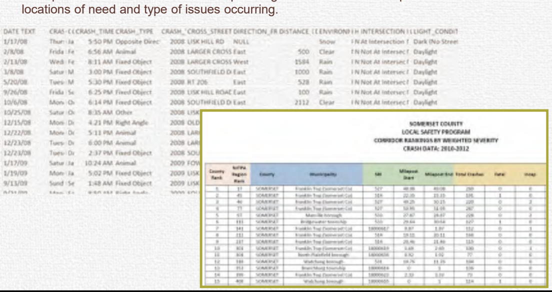
- 2006 police concern for crashes on Warrenville Hill:
- 14% grade at steepest;
- Substandard S-bend horizontal alignment;
- Driveways and side streets;
- Route 22 approach at near 10% gradient.

'Warrenville Hill', CR 651 north of Route 22.

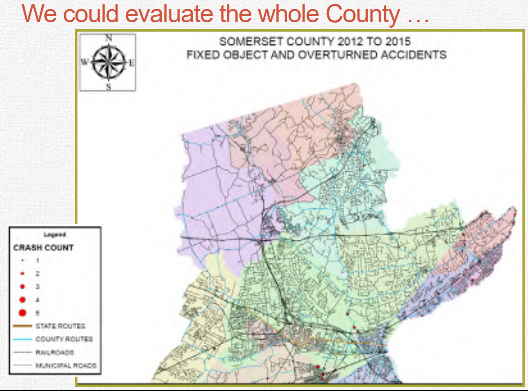
Safety became measurable.

The availability of crash data from the Plan4Safety crash database allowed our office, as well as our MPO, to look at crash trends around the region.

This provided us the data to start planning for infrastructure improvements based on locations of need and type of issues occurring.



We could evaluate the whole County …



How, what, where, and when of friction courses …

Because of County wide crash analysis we could now see which areas needed further investigation for possible safety improvements including friction courses at horizontal curves.

- What was the correct method?
- When is it warranted?
- How to determine the limits of need on a curve?

VARIOUS LOCATIONS - KENTUCKY
Kentucky Transportation Cabinet . Automated High Friction Surfacing Treatment

BROCHURE www.dbiservices.com

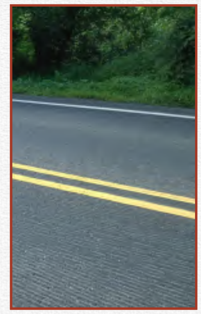
Micro milling – our early solution

Pros:

- Provided high friction surface which reduced 'run off road' crashes
- Low cost of installation
- Installation by local pavement contractors

Cons:

- Short life expectancy with surface due to moisture penetration, oxidation, and friction loss.
- Complaints from motorcyclists and bicyclists
- Poor image portrayed to the public of milling off new pavement surface.



High Friction Surface Treatment

PROS:

- Promoted by FHWA as proven safety measure (NCHRP Document 108)
- Safe for all vehicle types
- Longer life expectancy than micro-milling (due to microtexture of aggregate used).

CONS:

- High cost
- Specialize trade needing sub-contracting work added to paving contracts.

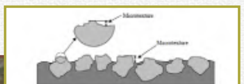


Figure 3: The relationship between different textures in pavement aggregate (25)

Texas Transportation Institute, July 2012, Using High Friction Surface Treatments to Improve Safety at Horizontal Curves.

NCHRP
Web-Only Document 108
Guide for Pavement Friction

When is HFST warranted?

Assessing Curve Severity and Design Consistency Using Energy- and Friction-Based Measures

Michael P. Pratt and James A. Bonneson

Friction-Based Curve Risk Components

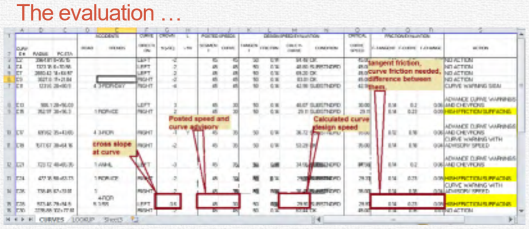
Given the importance of side friction demand in drivers' curve speed choice and perception of risk, and the fact that skidding or truck rollover will occur at excessive side friction demands, it can be rationalized that curve risk can be quantified in regard to side friction comfort levels and the friction demands experienced at curve speed.

TABLE 2 Candidate Guidance for Curve Signing

Side Friction Demand, g	Suggested Signing Treatments	Side Friction Differential, g
0.19 or less	None	0.00
0.20–0.23	Curve warning sign	0.01–0.04
0.24–0.27	Curve warning sign, advisory speed plaque	0.05–0.08
0.27–0.30	Redundant curve warning signs and advisory speed plaques	0.08–0.11
0.30–0.34	Redundant curve warning signs and advisory speed plaques, chevrons	0.11–0.15
0.35 or more	Other measures to reduce speed limit, rebuild curve, etc.	0.16 or more

My take away … it is about the difference in the side friction experienced by driver, calculated from the speeds along the tangent segment of roadway and the horizontal curve.

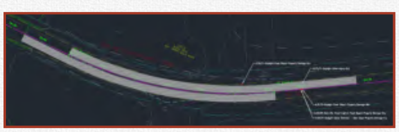
The evaluation …



AASHTO "A Policy on Geometric Design of Highways and Streets 2011" Chapter 3, p3-31, equation 3.8 for minimum radius.

Data needed:

- Centerline alignment geometry
- Roadway cross slope
- Road profile slope
- Posted speed limit
- Posted curve advisory plate speed



The Details

U.S. Customary

$$R_{min} = \frac{V^2}{15(0.01e_{max} + f_{max})} \quad (3\text{-}8)$$

Result of evaluation – action to take

Side Friction Differential	Action
0 - .009	No action
.01 - .019	Curve warning sign
.02 - .044	Curve warning with advisory speed
.045 - .074	Advance curve warnings and chevrons
.075 and above	High friction surface treatment

HFST limits: approach length + length of curve (PC to PT)

Table 5: Recommended Distance Upstream of the PC to Begin HFST Application

Approach Speed (mph)	Curve Speed (mph)						
	30	35	40	45	50	55	60
35	35	-	-	-	-	-	-
40	76	41	-	-	-	-	-
45	122	86	46	-	-	-	-
50	173	138	97	51	-	-	-
55	230	184	154	108	57	-	-
60	282	257	216	170	119	62	-
65	359	324	284	238	188	130	68

Texas Transportation Institute, July 2012, Using High Friction Surface Treatments to Improve Safety at Horizontal Curves.

HIGH FRICTION SURFACE TREATMENT

1. DESCRIPTION

Work for placing high friction surface treatment (HFST) on HMA pavement. The HFST consists of a resin binder with a aggregate topping.

2. MATERIALS

2.1 Epoxy Resin Binder

A two-part exothermic epoxy resin binder which holds the aggregate topping firmly in place, and meets the requirements shown in the following table:

Epoxy Resin Binder Requirements

Property	Requirement	Test Method
Ultimate Tensile Strength	2650 psi min	ASTM D638
Elongation at break point	30% min	ASTM D638
Compressive Strength	1600 psi min	ASTM D695
Water Absorption	1.0% max	ASTM D570
Shore D Hardness, min 77°F	65-75	ASTM D2240
Gel Time, minutes	15-45 min	ASTM C881
Flexural Yield Strength, min psi	2000	ASTM D790
Cure Rate	3 hrs. max	ASTM D1640, 0.2" thickness
Mixing Ratio	As recommended by the manufacturer	N/A

Two part epoxy materials that are not exothermic in curing will not be allowed. Material to arrive on-site in clearly marked pails for hand applications and in larger plastic containers for mechanical application-operations. The volumes of the pails or containers must be labeled in US gallons to assist in proper mixing dosage and application rates.

2.2 Aggregate Topping

Furnish a blend of calcined bauxite aggregate consisting of a 1-3mm gradation. Ensure the aggregate is delivered to the construction site in clearly labeled 55 lb bags or 2200 lb super sacks. The aggregate topping is to be clean, dry, and free from deleterious matter. The aggregate topping must meet the requirements shown in the following table:

Aggregate Topping Requirements

Property	Test Method	Requirement
Aggregate Grading	AASHTO T27	No. 6 Percentage Passing 95% min No.16 Percentage Passing 5% max
Aggregate Abrasion Value.	AASHTO T96	20% max.
Aggregate Acid Insolubility	ASTM D3042	Greater than 90%
Aggregate Magnesium Soundness	ASTM C88	30% max

2.3 Material Certifications

Provide an independent laboratory report showing that the epoxy binder meets the requirements of this section.

Submit certification from the manufacturer of the aggregate that it meets the requirements of this section.

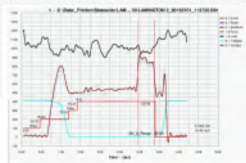
Submit documentation of the in-place friction characteristics (minimum 55 FN40R in accordance with ASTM E274) of aggregate bonded to a vehicular bearing surface using the modified epoxy binder.

Submit a list of project with the installer's contact information on which a minimum of 3000 SY of high friction aggregate and epoxy binder was placed within the past three years.

HFST – first installation 2015

Federal Aid project Bedminster Safety
Performing test strip for friction number evaluation before installation.

ICC performed 16 tests on the road around the Test Patch of Safe-T-Grip on Lamington Rd, Bedminster NJ. The average FN40R value for the asphalt road was 55. The Test Patch numbers jumped up to a FN40R value of 86. The graphs provided show what the jump in friction looks like. It is our professional opinion that the material we tested on the Test Patch is extremely safe for roadway surface application and has a significantly higher friction value then the road it was placed on.



Statewide Striping Test Patch, Lamington Rd Bedminster Township, NJ Friction Report
7/17/2015 International Cybernetics, Largo, FL

Some results …

An in-office evaluation of crashes in the years prior to applying friction treatment and the year following. The data utilized was distributed along the entire project corridors so the reductions shown are not solely attributed to the horizontal curve crash reductions.

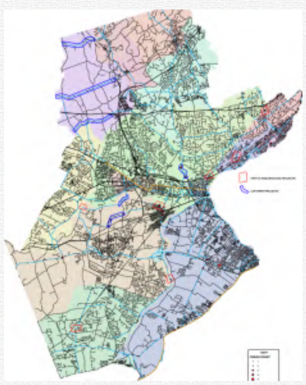
County Roads	Road Segments	Year applied	Corridor - Annual avg crashes before	Corridor - crashes year after	Reduction	Treatment type
New Center Road (CR 627)	From Auten Road to Roycefield Road	2013	19	10	47%	Micro surfacing along full segment
River Road (CR 625)	From Lyman Street Bridge to Roycefield Road	2014	25	5	80%	Micro surfacing along full segment
Chimney Rock Road (CR 525)	From Thompson Avenue to Gilbride Road	2015	73	12	84%	HFST applied to 5 curves on 1 mile road segment (steep vertical)
Burnt Mills Road (CR 620)	From Rattlesnake Bridge Road to Country Club Road	2015	20	9	55%	HFST applied to 5 curves on 3 mile road segment
Pottersville Road (CR 512)	From Hacklebarney Road to Route 206	2015	8	7	13%	HFST applied to 4 curves on 2.4 mile road segment
Lamington Road (CR 523)	From County Line to Route 206	2015	23	17	26%	HFST applied to 2 curves on 5 mile road segment

And now …
a systematic approach

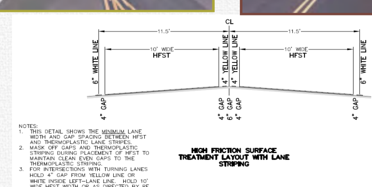
As part of our annual resurfacing program we are including HFST treatments to locations in need. Locations to evaluate are determined from:

- County wide crash mapping
- Concerns expressed by Municipalities or residents
- Recent severe crashes

HFST is bid as square yard (SY) pay item. Bids have come in between $35 -$65/ SY (bid within large resurfacing contracts).



Photos



Questions?

Thank You!

References:
- http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w108.pdf NCRHP Web Only Document 108, "Guide for Pavement Friction", Transportation Research Board
- http://trb.metapress.com/content/7717239k62781311/ Pratt, Michael P. and James A. Bonneson "Assessing Curve Severity and Design Consistency Using Energy and Friction Based Measures", Transportation Research Record No. 2075, 2008, pp 8-15.
- AASHTO "A Policy on Geometric Design of Highways and Streets 2011" Chapter 3, p3-25, Figure 3.6 Side Friction Factors Assumed for Design, and p3-31, equation 3.8 for minimum radius.
- http://d2dtl5nnlpfr0r.cloudfront.net/tti.tamu.edu/documents/TTI-2012-8.pdf Brimley, Brad & Paul Carlson, "Using High Friction Surface Treatments to Improve Safety at Horizontal Curves", Texas Transportation Institute, July 2012, p 13.

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Local Safety Peer Exchange

A Municipal Perspective

General Statistics

- State DOT has jurisdiction on just 7% of roads in New Jersey / 66% volume
- Counties and municipalities maintain 35,000+ miles of roadways
  - In Mercer County, the County maintains 180 miles & Municipalities maintain 1,200+ miles
  - Princeton maintains 120 miles
    - 105 miles of sidewalks and pathways
  - West Windsor maintains 120+ miles

Princeton Statistics

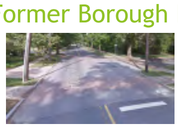
- Prior to 2013, Princeton was two communities: Borough of Princeton and Township of Princeton

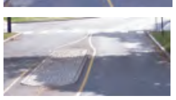
	Borough	Township
Road miles	20	100
Speed limits	25 and less	25 - 45
Population	12,000+	16,000+
Size	1.8 sq. mi.	16.5 sq. mi.
Density	6,679 / sq. mi.	1,010 / sq. mi.

Former Borough Traffic Calming Program

- Began in 1994
- Goals: Create safer roads, reduce speeds, don't shift traffic to other roadways
  - Neighborhood desires: Save trees, keep on-street parking

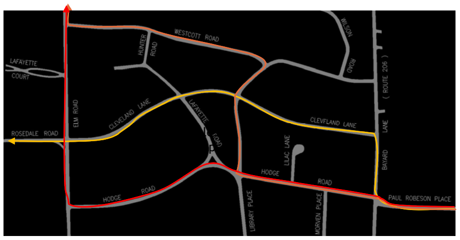
Former Borough Examples





Hodge Road AADT and Speed (Avg / 85th Percentile)

Western Section Traffic Calming



Speed tables
Speed humps
Mini circles

Realigned geometry
Splitter islands
Bumpouts – mid-block and intersections

Former Township Policy on Traffic Calming

- Township Policy created in 2002 prohibiting speed humps (vertical deflections)

Sgt. Michael Henderson, Traffic Safety Officer, said that a significant number of people would die due to delayed response of emergency vehicles from the humps in the roadways. Sgt. Henderson also said that the police would be opposed to planting trees in the center of roads.

Greg Paulson, Princeton First Aid and Rescue Squad, said that the humps cause great concern about impediments to response time. He also said that going over the humps was a hazard to both the patients and passengers in the emergency vehicles.

As a result, the Traffic Safety Committee recognizes that there are (and will continue to be) some circumstances in which some kinds of traffic calming devices and policies will be, on balance, of benefit to the community at large. At the same time, the Traffic Safety Committee believes that the risk to emergency service workers, emergency vehicles, and the general public relating to the installation of speed humps, speed bumps, and raised traffic islands outweighs any benefits derived. The Township therefore prohibits the installation of these types of devices on municipal streets within Princeton Township.

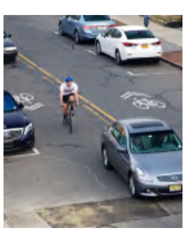
Consolidated Princeton Traffic Calming – A Work in Progress

- Prohibition of vertical traffic calming sustained in 2013 after consolidation
  - Main issues and conflicts:
    - Overall citizen safety – bike / ped and emergency response
    - Environmental – increased emissions
    - Risk of lawsuits and municipal civil liability
- Reconsideration of the prohibition in 2017
  - Speeding is not going away
  - Volume is not going away
  - Curbing, striping, tree plantings and radar speed signs are not solving the problem
  - Bumpouts are not desired by bicyclists or Public Works

Princeton's Engineering Design Process

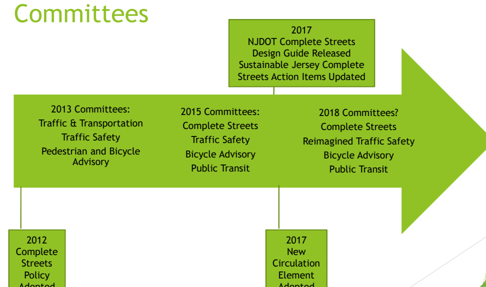
- Notify residents of upcoming project and request utility information
- Request sewer review and tree review by Public Works staff
- Complete the Complete Streets checklist
  - Gather police reports and identify if there are engineering solutions
- Prepare a conceptual plan
  - Review bicycle mobility plan, sidewalk master plan, and other reference documents
- Conduct a design neighborhood meeting
- Finalize design and award contract
- Conduct a preconstruction neighborhood meeting
- Big Question: How should the various transportation committees be incorporated into the design process?

Roadblocks



- Historic
- Loss of parking
- Constricted space
- Perceived loss of property value
- Tree removals
- Road maintenance issues
- Priorities
- Conflicts between ped needs and bicyclist needs
- The Squeaky Wheel

Reformulation of Transportation Committees



The Road Forward

- Institute Complete Streets
  1. Build Your Complete Streets Team
  2. Establish Internal Review Procedures
  3. Training
  4. Inventory and review of planning and design documents
  5. Implement a Complete Streets Project

- Use Complete Streets Checklist and Road Safety Audits
- Use Safety Voyager to supplement police crash reports
- Reference FHWA Proven Safety Countermeasures

- Ordinance design guidance documents
- Reformulate the Traffic Safety Committee to be a Staff-level Complete Streets Committee including Health and Human Services professionals
- Neighborhood Outreach in Concept and Preconstruction Phases
- Establish Criteria and Map of Potential Traffic Calming Locations

Traffic Calming Criteria

	Points				
	1	2	3	4	5
Percent of speeding (5MPH above)	10%	20%	30%	40%	50%
Density of Housing (lot size)	40,000sf	30,000sf	20,000sf	10,000sf	>10,000sf
Are there Sidewalks	2 sides		1 side		no sidewalks
Volume of traffic	500 VPD	750 VPD	1,000 VPD	2,000 VPD	3,000 VPD
Other Criteria:	Proximity to Pedestrian destination				

- Pilot fixes before they are built
- Participate in regional dialogues
- Find community champions to advocate for improvements
- Continue to evaluate modifications

DVPRC Region

Princeton's Design Process - Updated

- Notify residents of upcoming project and request utility information
- Request sewer review and tree review by Public Works Staff
- Complete checklist
  - Use Safety Voyager for crash data, then gather police reports and identify if there are engineering solutions
- Complete a road safety audit
- Prepare a conceptual plan
  - Review bicycle mobility plan, sidewalk master plan, and other reference documents
- Conduct a design neighborhood meeting
- Gain approval of the Traffic Safety Committee
- Pilot potential roadway changes
- Finalize design and award contract
- Conduct a preconstruction neighborhood meeting
- …

QUESTIONS?

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Municipality of Princeton
400 Witherspoon Street, Princeton, NJ 08540
609-921-7077 x 1138 609-731-2625

Princeton Police Traffic Safety Bureau
Lt. Geoff Maurer
Sgt. Thomas R. Murray III
Ptl. Michael Schubert
Ptl. Michael Strobel
609-921-2100

FHWA's 2017 Update of the Proven Safety Countermeasures

Make Your Mark
A Local Safety Peer Exchange
December 6, 2017

U.S. Department of Transportation Federal Highway Administration

Safe Roads for a Safer Future
http://safety.fhwa.dot.gov

Life Cycle of a Safety Countermeasure

- Experimental
- Tried
- Proven

Pilot → High Crash Location → Systemic → Policy

2

FHWA's Proven Safety Countermeasures

Intersection	Roadway Departure	Pedestrian	Crosscutting Strategies
• Left- and Right-Turn Lanes at Two-Stop Controlled Intersections • Backplates with Retroreflective Borders • Corridor Access Management • Yellow Change Interval • Roundabouts • Systemic Application of Multiple Low Cost Countermeasures at Stop-Controlled Intersections* • Reduced Left-Turn Conflict Intersections*	• Longitudinal Rumble Strips and Stripes along Two-Lane Highways • Median Barrier • SafetyEdge℠ • Enhanced Delineation and Friction for Horizontal Curves • Roadside Design Improvements at Curves*	• Medians and Pedestrian Crossing Islands in Urban and Suburban Areas • Pedestrian Hybrid Beacon • Road Diet • Walkways • Leading Pedestrian Intervals*	• Road Safety Audits • Local Road Safety Plans* • US Limits*

3

PSC*i* – Intersections

- Left- and Right-Turn Lanes at Two-Way Stop-Controlled Intersections
- Backplates with Retroreflective Borders
- Corridor Access Management
- Yellow Change Interval
- Roundabouts
- Systemic Application of Multiple Low-Cost Countermeasures at Stop-Controlled Intersections
- Reduced Left-Turn Conflict Intersections

4

Left and Right Turn Lanes at Two-Way Stop-Controlled Intersections

SAFETY BENEFITS:

LEFT-TURN LANES
28-48%
Reduction in total crashes

RIGHT-TURN LANES
14-26%
Reduction in total crashes

Source: Highway Safety Manual

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Backplates with Retroreflective Borders

Example of a signal backplate framed with a retroreflective border.

Safety Benefit:

15%
Reductions in total crashes

Source: CMF Clearinghouse, CMF ID 1410.

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Corridor Access Management

SAFETY BENEFITS:

5-23%
Reduction in total crashes along 2-lane rural roads

25-31%
Reduction in injury and fatal crashes along urban/suburban arterials

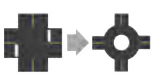
Source: Highway Safety Manual

Yellow Change Interval

Safety Benefits of Well-Timed Yellow Change Intervals:
36-50%
Reduction in red light running
8-14%
Reduction in total crashes
12%
Reduction in injury crashes
Source: NCHRP Report 731, *Guidelines for Timing Yellow and All-Red Intervals at Signalized Intersections.*

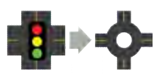
Roundabouts

Two-Way Stop-Controlled Intersection to a Roundabout



82%
Reduction in severe crashes

Signalized Intersection to a Roundabout



78%
Reduction in severe crashes

Source: *Highway Safety Manual*

Systemic Application of Multiple Low Cost Countermeasures at Stop-Controlled Intersections

- Mostly signing & pavement marking enhancements.
- Strategy relies on cost economy and treatment saturation.
- Best suited for intersections with under 20,000 AADT Total Entering.

Systemic Approach for Stop Intersections

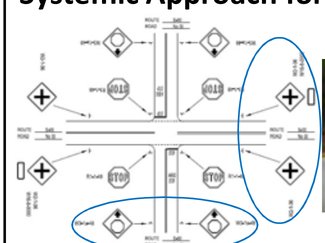
Evaluation Results from LCSI-PFS Study:

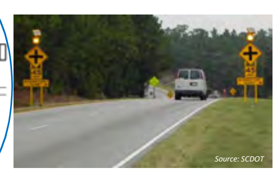
- Sample consisted of 434 treated sites and 568 reference sites across South Carolina.
- Included 2X2 (3-leg, 4-leg) and 4X2 (3-leg, 4-leg) sites.
- Range of 3-5 years before and after data.

Recommended CMFs from FHWA-HRT-17-086

	Total	Fatal & Injury	Rear End	Right Angle	Nighttime
CMF	0.917	0.899	0.933	0.941	0.853

Systemic Approach for Stop Intersections

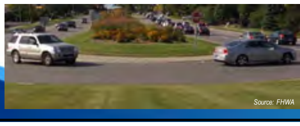


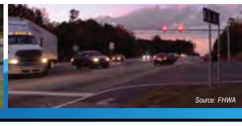

Source: SCDOT


Source: SCDOT

Reduced Left-Turn Conflict Intersections (MUT and RCUT)

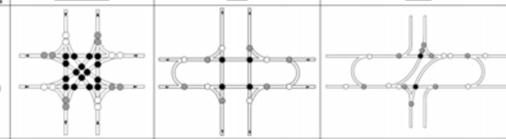
- Geometric designs that alter how left-turn movements occur.
- Simplify and reduce or modify conflicts related to turning.
- Proven safety and operational benefits.


Source: FHWA


Source: FHWA

13

Reduced Left-Turn Conflict Intersections

Vehicle-Vehicle Conflict Points	Conventional	MUT	RCUT
● Crossing ◐ Merging ○ Diverging			
Crossing	16	4	2
Merging	8	6	6
Diverging	8	6	6
Total	32	16	14

Sources: FHWA-SA-14-069, FHWA-SA-14-070

MUT Safety Performance

- 30% decrease F&I Crashes.
- 16% decrease All Crashes.

RCUT Safety Performance

- 54% decrease F&I Crashes.
- 35% decrease All Crashes.

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PSC*i* – Roadway Departure

- Longitudinal Rumble Strips and Stripes along Two-Lane Highways
- Median Barrier
- SafetyEdge[SM]
- Enhanced Delineation and Friction for Horizontal Curves
- Roadside Design Improvements at Curves

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Longitudinal Rumble Strips and Stripes


Shoulder rumble strips and center line rumble stripes are installed on this roadway.


Example of an edge line rumble stripe.

SAFETY BENEFITS:

Center Line Rumble Strips
44-64%
Head-on, opposite-direction, and sideswipe fatal and injury crashes

Shoulder Rumble Strips
13-51%
Single vehicle, run-off-road fatal and injury crashes

Source: NCHRP Report 641, *Guidance for the Design and Application of Shoulder and Centerline Rumble Strips*

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Median Barrier


Median cable barrier prevents a potential head-on crash.

SAFETY BENEFITS:
Median Barriers Installed on Rural Four-Lane Freeways
97%
Reduction in cross-median crashes

Soruce: NCHRP Report 794, *Median Cross-Section Design for Rural Divided Highways*

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SafetyEdge$_{SM}$


Example of SafetyEdge$_{SM}$ after backfill material settles or erodes.

SAFETY BENEFIT:

11%
Reduction in fatal and injury crashes

Source: *Safety Effects of the SafetyEdge$_{SM}$* FHWA-SA-17-044

SafetyEdge[SM] CMFs	
Drop-Off	0.655
ROR	0.790
Head-on	0.813
F+I	0.892
Total	0.989

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Enhanced Delineation and Friction for Curves


Chevron signs installed along a curve.

SAFETY BENEFITS:
Chevron Signs
25%
Reduction in nighttime crashes
16%
Reduction in non-intersection fatal and injury crashes
Source: CMF Clearinghouse, CMF IDs 2438 and 2439

SAFETY BENEFITS:
High Friction Surface Treatment
52%
Reduction in wet road crashes
24%
Reduction in curve crashes
Source: CMF Clearinghouse, CMF IDs 7900 and 7901

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Roadside Design Improvements at Curves

- Increase clear zone at curves.
  - Recommended by AASHTO RDG.
  - Proven to reduce crashes.
- Improve traversability.
  - Adding or widening shoulders in curves.
  - flatter slopes at curves than in tangent sections.
- Reconsider when to install barrier
  - Reduce severity.

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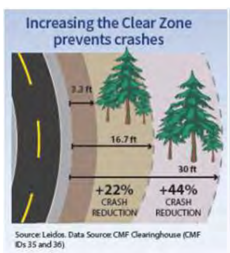
Roadside Design Improvements at Curves

Increase Clear Zone on the Outside of Curves



Source: Leidos. Data Source: CMF Clearinghouse (CMF IDs 35 and 36)

27%
of all fatal crashes occur at curves
80%
of all fatal crashes at curves are roadway departure crashes

21

PSC*i* – Pedestrians & Bicycles

- Medians and Pedestrian Crossing Islands in Urban and Suburban Areas
- Pedestrian Hybrid Beacon
- Road Diet
- Walkways
- Leading Pedestrian Intervals

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Medians and Pedestrian Crossing Islands


Median and pedestrian crossing islands near a roundabout.


Example of a road with a median and pedestrian crossing islands.


Example of a pedestrian crossing island.

SAFETY BENEFITS:

Raised Median
46%
Reduction in pedestrian crashes

Pedestrian Crossing Island
56%
Reduction in pedestrian crashes

Source: Desktop Reference for Crash Reduction Factors, FHWA-SA-08-011, September 2008, Table 11

23

Pedestrian Hybrid Beacons


Pedestrians cross the roadway at a PHB location.

Example of PHBs mounted on a mast arm.

Safety Benefits:

69%
Reduction in pedestrian crashes

29%
Reduction in total crashes

15%
Reduction in serious injury and fatal crashes

Source: CMF Clearinghouse, CMF IDs: 2911, 2917, 2922

24

Road Diets

Before and after photos of a Road Diet project.


Road Diet project in Honolulu, Hawaii.

SAFETY BENEFIT:

4-Lane → 3-Lane
Road Diet Conversions
19-47%
Reduction in total crashes

Source: *Evaluation of Lane Reduction "Road Diet" Measures on Crashes*, FHWA-HRT-10-053.

Walkways


Example of a shared use path.


Example of a sidewalk in a residential area.


Paved shoulder used as a walkway.

SAFETY BENEFITS:

Sidewalks 65-89%
Reduction in crashes involving pedestrians walking along roadways

Paved Shoulders 71%
Reduction in crashes involving pedestrians walking along roadways

Source: *Desktop Reference for Crash Reduction Factors*, FHWA-SA-08-011, Table 11

Leading Pedestrian Interval

- Pedestrians get "WALK" signal before vehicles get green light.
- Provides pedestrians a 3-7 second head start before vehicles are given a green indication.
- Allows pedestrians to establish presence in crosswalk before vehicles have priority to turn left.

Leading Pedestrian Interval

Benefits:

- 60% reduction in pedestrian-vehicle crashes at intersections.
- Increased visibility of crossing pedestrians.
- Reduced conflicts between pedestrians and vehicles.
- Increased likelihood of motorists yielding.

PSC*i* – Crosscutting Strategies

- Road Safety Audits
- Local Road Safety Plans
- USLIMITS2

Road Safety Audits

A road safety audit is a proactive formal safety performance examination of an existing or future road or intersection by an independent and multi-disciplinary team.


Multi-disciplinary team performs field review

SAFETY BENEFIT:

10-60%

Reduction in total crashes

Source: *Road Safety Audits: An Evaluation of RSA Programs and Projects*, FHWA-SA-12-037; and *FHWA Road Safety Audit Guidelines*, FHWA-SA-06-06.

Local Road Safety Plans

- Developing an LRSP is an effective strategy to improve local road safety.
- Local roads experience 3X the fatality rate of the Interstate Highway System.

USLIMITS2

- Free Web-based Tool
- Designed to help practictioners assess and establish safe, reasonable and consistent speed limits
- Supports customary engineering studies
- Produces unbiased and objective suggested speed limit value based on:
  – 50th and 85th percentile speeds
  – Traffic volumes
  – Roadway characteristics
  – Crash data

PSC*i* – Available Resources

http://safety.fhwa.dot.gov/provencountermeasures

- 1-pager marketing flyers.
- Slides from webinar and link to recorded session.
- Links to additional FHWA resources for each item.

Contacts for Further Information

Intersection Countermeasures:

Jeffrey Shaw jeffrey.shaw@dot.gov (708) 283-3524

Roadway Departure Countermeasures:

Menna Yassin menna.yassin@dot.gov (202) 366-2833
Cathy Satterfield cathy.satterfield@dot.gov (708) 283-3552

Pedestrian/Bicycle Countermeasures:

Tamara Redmon tamara.redmon@dot.gov (202) 366-4077

Crosscutting:

LRSP – Rosemarie Anderson rosemarie.anderson@dot.gov (202) 366-5007
RSA – Becky Crowe rebecca.crowe@dot.gov (804) 775-3381
USLIMITS2 – Guan Xu guan.xu@dot.gov (202) 366-5892

Additional Resources

- Crash Modification Factors Clearinghouse
  – http://www.cmfclearinghouse.org
- Systemic Safety Project Selection Tool
  – http://safety.fhwa.dot.gov/systemic
- US Roadway Assessment Program
  – http://www.usrap.org/
- Pedestrian and Bicycle Crash Analysis Tool
  – http://www.pedbikeinfo.org/pbcat_us/

Time to Share!!!

- Which of these countermeasures have you tried in your jurisdiction?
  – Successes?
  – Challenges?
- Have adopted any of these countermeasures into agency policies or design standards?
- What other proven safety countermeasures have you tried in your jurisdiction?

Make Your Mark

A Local Safety Peer Exchange

Daniel LiSanti, Program Manager NJDOT Bureau of Transportation Data & Safety
Caroline Trueman, FHWA NJ Division Highway Safety Improvement Program

Welcome

Event Overview

- Agenda
- Housekeeping
- Expectations

Ground Rules

Introductions

- Name
- Organization
- Position
- Role with Respect to Local Safety Program

Welcome

Jennifer Marandino
Executive Director
SJTPO

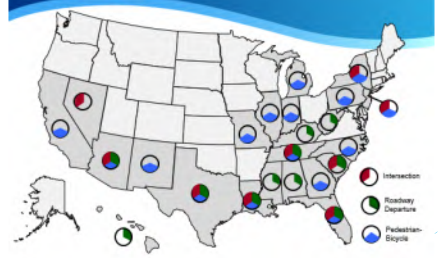
Today's Take-Aways…..

- NJ's Vision Zero & Safety Performance Targets
- Pedestrian & Intersection Focus State
- NJ Design Manual Compliance ≠ Maximum Safety Benefit
- Partnering WE CAN MAKE A POSITIVE DIFFERENCE FOR SAFETY!

Safety Target Setting

	Five Performance Measures
✓	Number of Fatalities
✓	Rate of Fatalities per 100 Million VMT
✓	Number of Serious Injuries
✓	Rate of Serious Injuries per 100 Million VMT
✓	Number of Non-motorized Fatalities and Non-motorized Serious Injuries

Intersection & Pedestrian Focus State

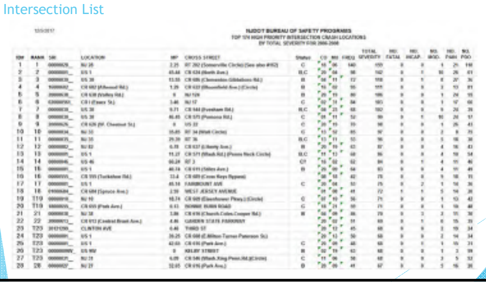


2X National Average % Pedestrian Fatalities

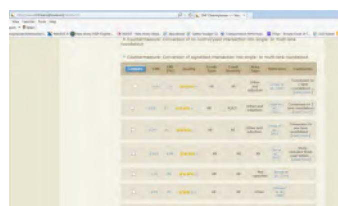
Substantive Vs. Nominal Safety

Standards Approach yields updated traffic signal Versus…

Intersection List



Maximizing Safety Benefits with Infrastructure Investments

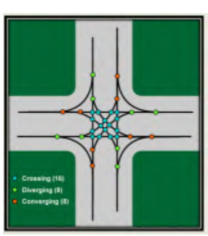


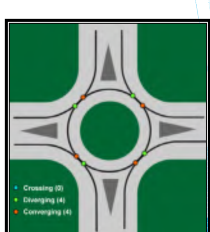
ROUNDABOUTS VS. TRAFFIC SIGNAL

71%

REDUCTION INJURY CRASHES

The difference between conflicts





HSIP Components & Purpose

- Rail Highway Grade Crossing Program set-aside
- Highway Safety Improvement Program

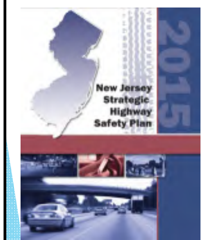
Achieve significant reduction in fatalities & serious injuries on ALL PUBLIC ROADS.

Highway Safety Improvement Program

- Strategic Highway Safety Plan
- Data Driven All Public Roads
- Safety Target Setting
  Performance Measures
- Annual Safety Reporting

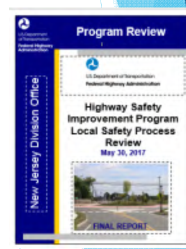
Achieve significant reduction in fatalities & serious injuries on ALL PUBLIC ROADS.

NJ HSIP Manual
NJ LSP Assessment Findings Observations



Plan

Process



Evaluation

NJ's SHSP - PLAN

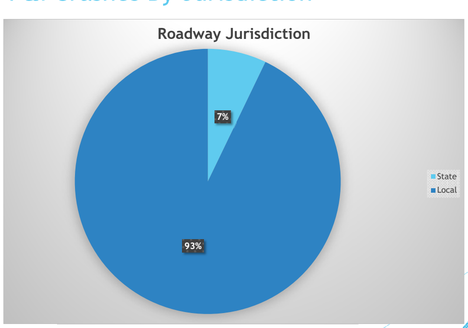
- Updating every 5 years
- Statewide Plan – all 4 E's
- Signed by Governor or Governor's Representative
- Overall Goal for NJ
- HSIP project eligibility dependent upon identified element in SHSP

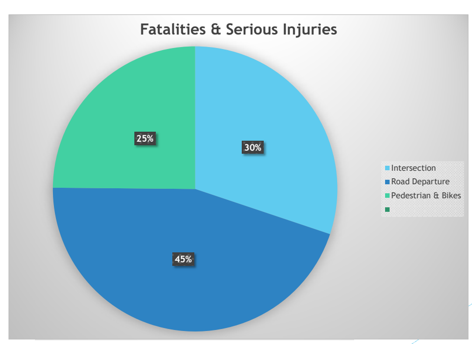
"Vision without action is a dream,
Action without vision is a nightmare."

Data Driven

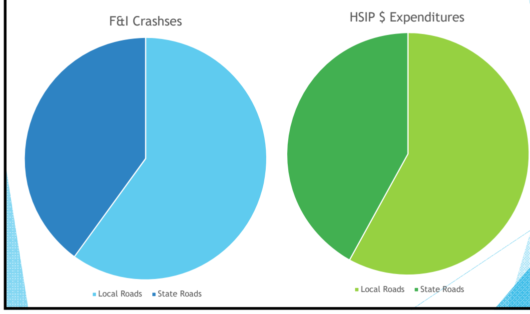
- Network Screening
  - Severity
  - Types of Crashes
- Safety Data Voyager
- Project Approaches
  - Hot Spot
  - Systemic

F&I Crashes By Jurisdiction





HSIP Performance: Local Versus State Roads

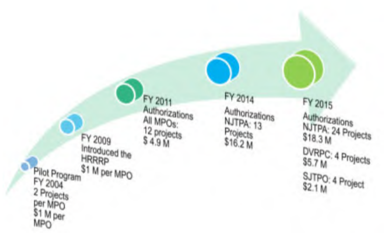


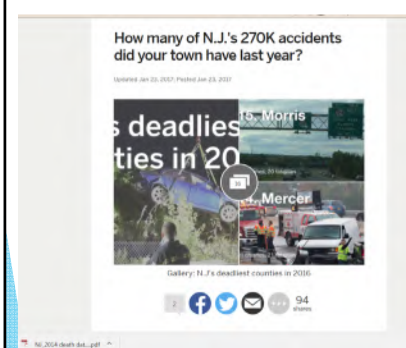
NJ's Data

TABLE 3-1
Distribution of Roadway Miles and Fatalities and Serious Injuries By Jurisdiction, Facility Type, and Crash Type

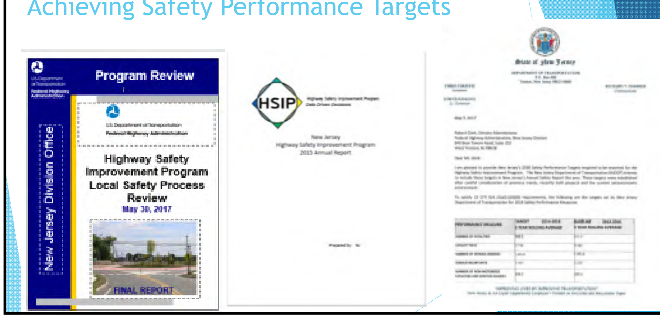
	State Road System					Local Road System		Other	Statewide
		State Highway							
	Interstate	Total	Urban	Rural	Unknown	County	Municipal		
Roadway Length	State: 2,757 miles (7%)					Local: 35,820 miles (89%)			
Miles	—	—	—	—	—	6,826	28,994	1,719	40,296
% Total Miles	—	—	—	—	—	17%	72%	4%	100%
Total Fatalities and Serious Injuries	State: 3,265 (33%)					Local: 5,735 (57%)			
Number	413	2,852	2,284	282	286	3,385	2,350	1,037	10,037
% Total Fatalities and Serious Injuries	4%	28%	23%	3%	3%	34%	23%	10%	100%
Lane Departure	State: 1,515 (33%)					Local: 2,569 (56%)			
Number	272	1,243	936	184	123	1,658	911	512	4,596
% Total Fatalities and Serious Injuries	6%	27%	20%	4%	3%	36%	20%	11%	100%
Intersections	State: 1,002 (33%)					Local: 2,028 (66%)			
Number	10	992	831	78	83	1,215	813	50	3,080
% Total Fatalities and Serious Injuries	0%	32%	27%	3%	3%	39%	26%	2%	100%
Pedestrians/Bicycles	State: 709 (28%)					Local: 1,565 (62%)			
Number	44	665	590	15	60	815	750	298	2,340
% Total Fatalities and Serious Injuries	2%	28%	23%	1%	2%	32%	30%	10%	100%

LSP Process
HSIP Funding on Local Roads



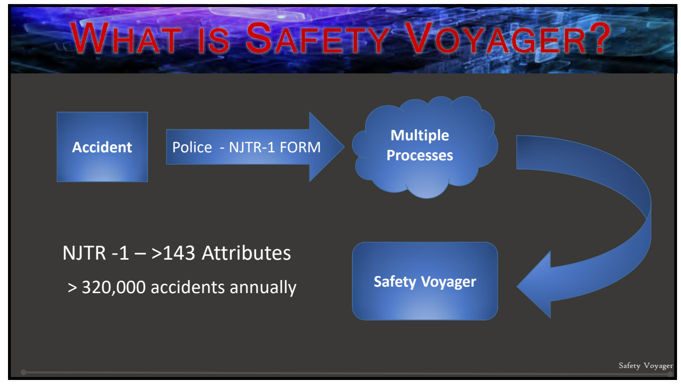


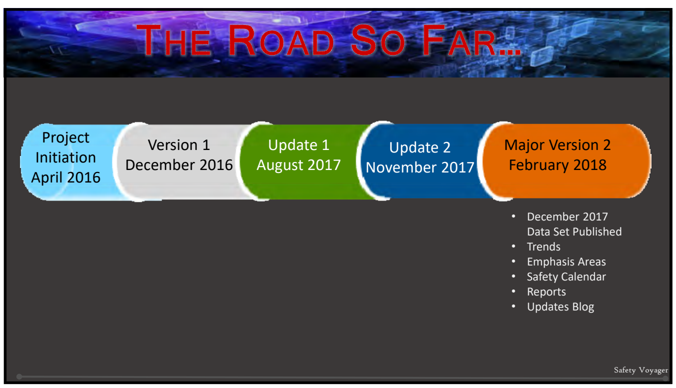
Evaluation of Effectiveness Toward Achieving Safety Performance Targets

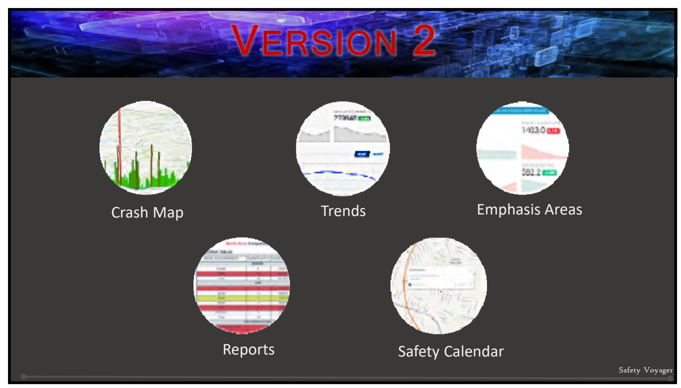


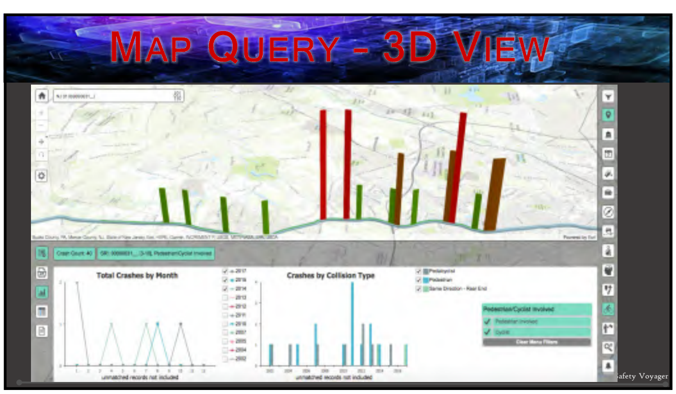
Questions


NJ Department of Transportation
GPI
Safety Voyager
SAFETY VOYAGER
U.S. Department of Transportation
Federal Highway Administration


WHAT IS SAFETY VOYAGER?
Accident
Police - NJTR-1 FORM
Multiple Processes
NJTR -1 – >143 Attributes
> 320,000 accidents annually
Safety Voyager
Safety Voyager

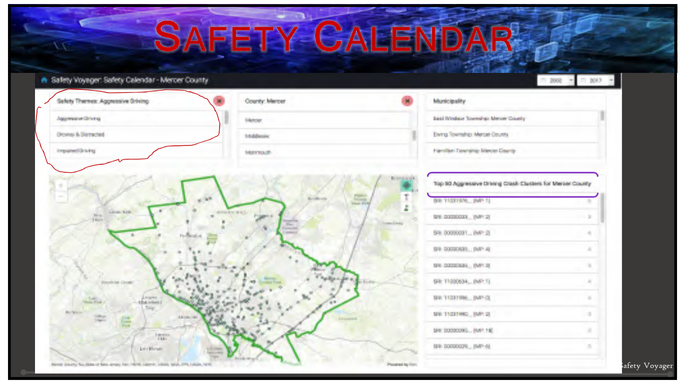

THE ROAD SO FAR…
Project Initiation April 2016
Version 1 December 2016
Update 1 August 2017
Update 2 November 2017
Major Version 2 February 2018
• December 2017 Data Set Published
• Trends
• Emphasis Areas
• Safety Calendar
• Reports
• Updates Blog
Safety Voyager

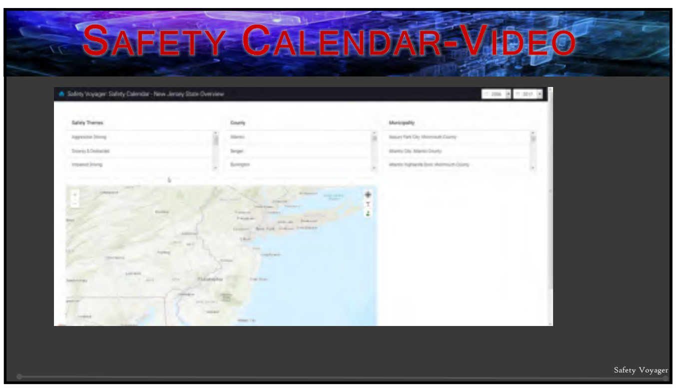

VERSION 2
Crash Map
Trends
Emphasis Areas
Reports
Safety Calendar
Safety Voyager

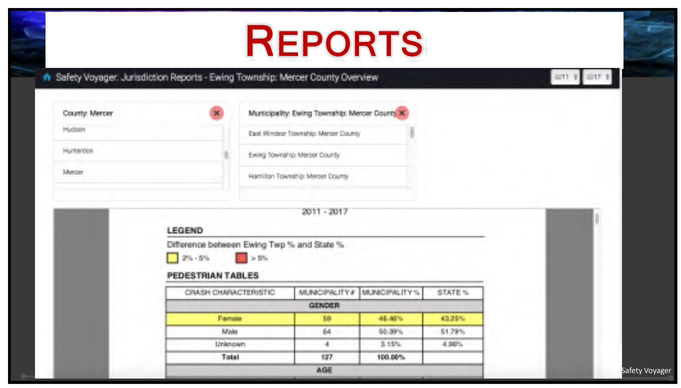

MAP QUERY – 3D VIEW
Total Crashes by Month
Crashes by Collision Type

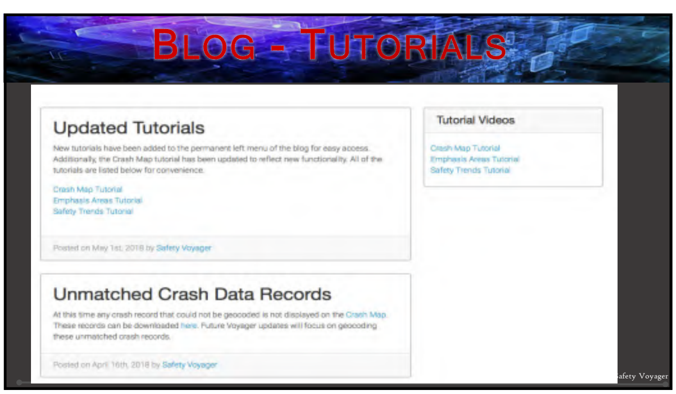

TRENDS
Safety Voyager: Safety Trends - New Jersey State Overview
Safety Voyager


Emphasis Areas
Safety Voyager: Emphasis Areas - New Jersey State Overview
Safety Voyager

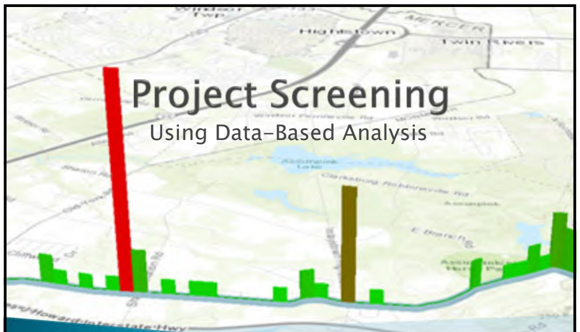

Safety Calendar
Safety Voyager: Safety Calendar - Mercer County
Safety Voyager


Safety Calendar-Video
Safety Voyager


Reports
Safety Voyager: Jurisdiction Reports - Ewing Township: Mercer County Overview
County: Mercer
Hudson
Hunterdon
Mercer
Municipality: Ewing Township: Mercer County
East Windsor Township: Mercer County
Ewing Township: Mercer County
Hamilton Township: Mercer County
2011 - 2017
LEGEND
Difference between Ewing Twp % and State %
2% - 5%
> 5%
PEDESTRIAN TABLES
CRASH CHARACTERISTIC
MUNICIPALITY #
MUNICIPALITY %
STATE %
GENDER
Female 59 46.46% 43.25%
Male 64 50.39% 51.79%
Unknown 4 3.15% 4.96%
Total 127 100.00%
AGE
Safety Voyager


Blog - Tutorials
Updated Tutorials
New tutorials have been added to the permanent left menu of the blog for easy access. Additionally, the Crash Map tutorial has been updated to reflect new functionality. All of the tutorials are listed below for convenience.
Crash Map Tutorial
Emphasis Areas Tutorial
Safety Trends Tutorial
Posted on May 1st, 2018 by Safety Voyager
Unmatched Crash Data Records
At this time any crash record that could not be geocoded is not displayed on the Crash Map. These records can be downloaded here. Future Voyager updates will focus on geocoding these unmatched crash records.
Posted on April 16th, 2018 by Safety Voyager
Tutorial Videos
Crash Map Tutorial
Emphasis Areas Tutorial
Safety Trends Tutorial


Questions
Thank you for your attention
Contact info:
Chris Zajac 609-530-4548
chris.zajac@dot.nj.gov
Safety Voyager



Project Screening

Using Data-Based Analysis

Vincent Cardone
Principal Engineer II, Traffic
Monmouth County

High Risk Rural Roads Program

- Competitive program administered by MPO
- Uses funds from the Federal Highway Administration's Highway Safety Improvements Program (HSIP).
- Only NJTPA member subregions are eligible to submit applications to the NJTPA for these programs. Municipalities located within the subregions may recommend a project to their respective county

High Risk Rural Roads Program

- For projects to be advanced in FY 2018 all environmental approvals, local approval, and right-of-way acquisition must be completed and a full set of PS&E documents submitted to the Local Aid office by a set deadline.

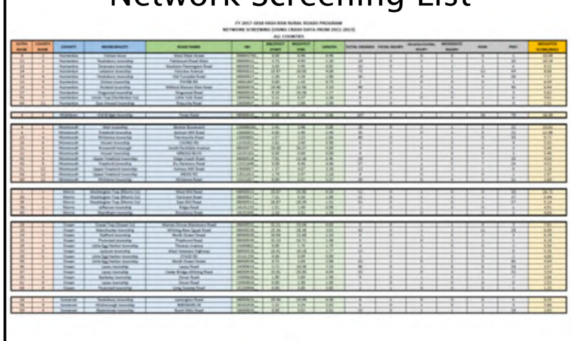
High Risk Rural Roads Program

- Project sponsors must give consideration to modern roundabouts for all new intersection and intersection upgrade projects.
- The National Environmental Policy Act (NEPA) regulations must be followed. As such, projects must have minimal or no environmental and cultural resource impacts.
- Projects must be completed within 24 months of receiving federal authorization.

High Risk Rural Roads Program

- The following types of projects are NOT eligible:
  - improvements involving State, U.S. and Interstate highways including any improvements at intersections with such facilities;
  - routine maintenance/ replacement projects (including general resurfacing projects)
  - congestion management/ roadway capacity enhancements (road widening)
  - Aesthetic improvements along the rights-of-way.

NJTPA High Risk Rural Roads Network Screening List



Monmouth County List

NJTPA RANK	COUNTY RANK	COUNTY	MUNICIPALITY	ROAD NAME	SRI	MILEPOST START	MILEPOST END	LENGTH
4	1	Monmouth	Wall township	Belmar Boulevard	130000181_	1.41	2.46	1.05
6	1	Monmouth	Freehold township	Jackson Mill Road	13000023__	0.00	1.45	1.45
15	4	Monmouth	Millstone township	Perrineville Road	13000001__	1.57	3.23	1.66
26	8	Monmouth	Howell township	CASINO RD	13191012__	2.62	3.60	0.98
31	8	Monmouth	Roosevelt borough	South Rochdale Avenue	00000571__	29.68	30.57	0.89
31	8	Monmouth	Howell township	ARNOLD BLVD	13191101__	0.00	0.89	0.89
42	9	Monmouth	Upper Freehold township	Stage Coach Road	00000524__	7.91	13.36	5.45
43	9	Monmouth	Freehold township	Ely Harmony Road	13321049__	0.00	4.46	4.46
51	12	Monmouth	Upper Freehold township	Holmes Mill Road	13000027__	1.37	4.67	3.30
56	12	Monmouth	Upper Freehold township	MEIRS RD	13511013__	1.79	3.97	2.18
60	12	Monmouth	Millstone township	Millstone Road	13321017__	0.00	5.57	5.57

ROAD NAME	SRI	TOTAL CRASHES	FATAL INJURY	INCAPACITATING INJURY	MODERATE INJURY	PAIN	PDO	Weighted Score/mile
Belmar Boulevard	130000181_	28	0	2	1	3	22	13.61
Jackson Mill Road	13000023__	35	1	0	3	9	22	12.98
Perrineville Road	13000001__	40	0	1	1	8	30	8.72
CASINO RD	13191012__	6	0	1	0	1	4	5.93
South Rochdale Avenue	00000571__	4	1	0	0	0	3	5.40
ARNOLD BLVD	13191101__	4	0	1	0	0	3	5.40
Stage Coach Road	00000524__	29	1	1	5	7	15	4.58
Ely Harmony Road	13321049__	37	0	1	5	7	24	4.52
Holmes Mill Road	13000027__	13	1	0	3	1	8	3.28
MEIRS RD	13511013__	4	1	0	1	0	2	2.97
Millstone Road	13321017__	39	1	0	4	3	31	2.60

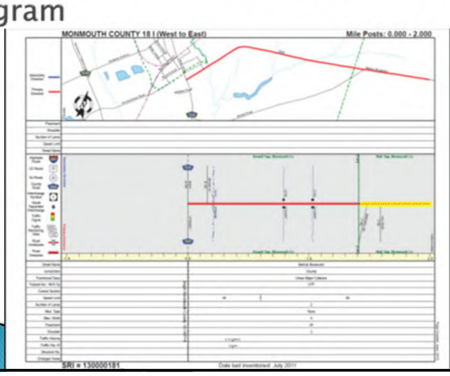
Monmouth County List

Lists are ranked assuming the weight of a fatal crash is the same as an incapacitating injury crash and using the value of a Complaint of Pain injury as the base value (K=A, no Property Damage only (PDO)).

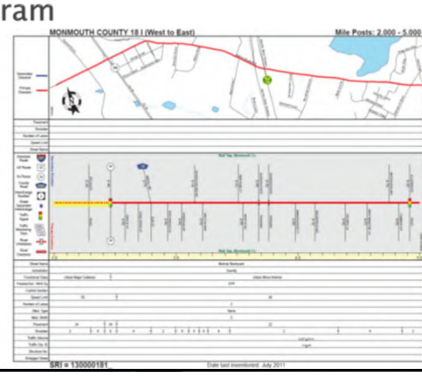
NJTPA / RUTGERS		HSM (FHWA-HRT-05-051) Link Published 2005		Weighting Factors		
		2001 dollars	2012 dollars (KABCO)	KABCO Weight	K=A Weight	K=A No PDO Weight
K	Fatal	$ 4,008,900	$ 5,197,200	89.30	4.81	2.73
ABC	ALL INJURY	$ 82,600	$ 107,100			
A	Incapacitating	$ 216,000	$ 280,000	4.81	4.81	2.73
B	Moderate	$ 79,000	$ 102,400	1.76	1.76	1.00
C	Complaint of Pain	$ 44,900	$ 58,200	1.00	1.00	0.57
O	PDO	$ 7,400	$ 9,600	0.16	0.16	0.00

ROAD NAME	SRI	TOTAL CRASHES	FATAL INJURY	INCAPACITATING INJURY	MODERATE INJURY	PAIN	PDO	Weighted Score/mile
Belmar Boulevard	130000181_	28	0	2	1	3	22	13.61
Jackson Mill Road	13000023__	35	1	0	3	9	22	12.98
Perrineville Road	13000001__	40	0	1	1	8	30	8.72
CASINO RD	13191012__	6	0	1	0	1	4	5.93
South Rochdale Avenue	00000571__	4	1	0	0	0	3	5.40
ARNOLD BLVD	13191101__	4	0	1	0	0	3	5.40
Stage Coach Road	00000524__	29	1	1	5	7	15	4.58
Ely Harmony Road	13321049__	37	0	1	5	7	24	4.52
Holmes Mill Road	13000027__	13	1	0	3	1	8	3.28
MEIRS RD	13511013__	4	1	0	1	0	2	2.97
Millstone Road	13321017__	39	1	0	4	3	31	2.60

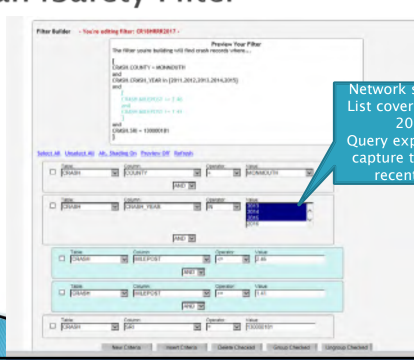
Identify location on straight line diagram



Identify location on straight line diagram



Plan4Safety Filter

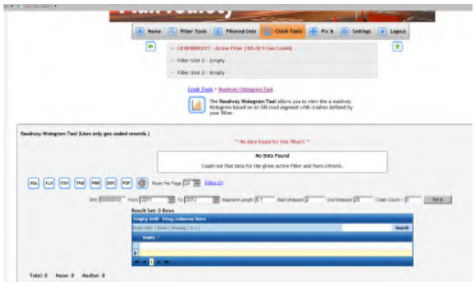


Network screening List covered 2011-2013
Query expanded to capture the most recent data

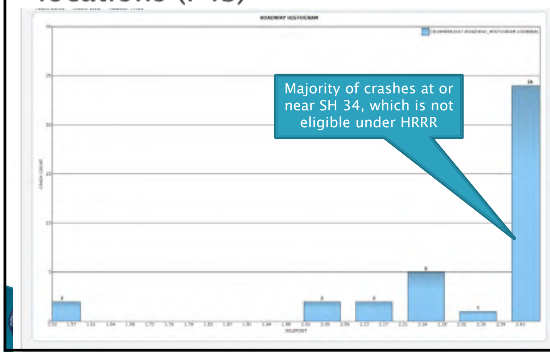
Plan4Safety GIS Point View

60% of 2012-2015 Data was geocoded in Plan4Safety

Use crash tools to create a road histogram (P4S)



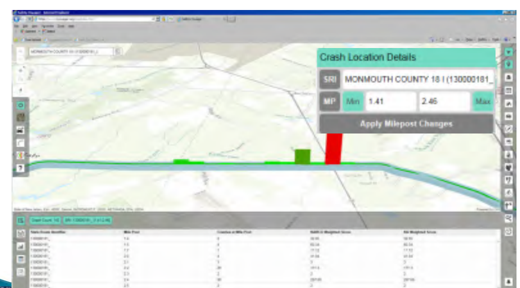
Road Histogram reveals crash locations (P4S)



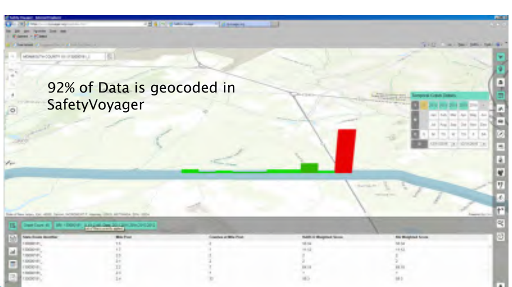
Safety Voyager

- Process using Safety Voyager is similar, but results are obtained faster

Crash SRI and Milepost



Filters are easy to find



Review remainder of screening list

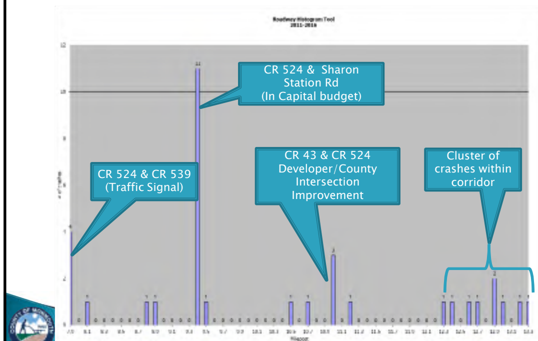
- Iterative process
- Need to diagnose the problem before coming up with a solution

Review remainder of screening list

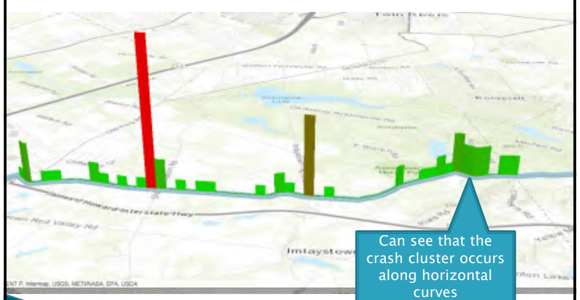
4	1	Monmouth	Wall township	Belmar Boulevard	13000181_	1.41	2.46	1.05
6	1	Monmouth	Freehold township	Jackson Mill Road	13000023_	0.00	1.45	1.45
15	4	Monmouth	Millstone township	Perrineville Road	13000001_	1.57	3.23	1.66
26	8	Monmouth	Howell township	CASINO RD	13191012_	2.62	3.60	0.98
31	8	Monmouth	Roosevelt borough	South Rochdale Avenue	00000571_	29.68	30.57	0.89
31	8	Monmouth	Howell township	ARNOLD BLVD	13191101_	0.00	0.89	0.89
42	9	Monmouth	Upper Freehold township	Stage Coach Road	00000524_	7.91	13.36	5.45
43	9	Monmouth	Freehold township	Ely Harmony Road	13321049_	0.00	4.46	4.46
51	12	Monmouth	Upper Freehold township	Holmes Mill Road	13000027_	1.57	4.87	3.30
56	12	Monmouth	Upper Freehold township	MEIRS RD	13511013_	1.79	3.97	2.18
60	12	Monmouth	Millstone township	Millstone Road	13321017_	0.00	5.57	5.57

- Jackson Mills Rd corridor included several Developer-lead projects that were yet to be constructed
- Perrineville Rd-reviewed intersection of CR 1 & Millstone Rd for possible roundabout-Green Acres implications and ROW impacts would not qualify under HRRR
- Casino Rd, South Rochdale Ave, & Arnold Blvd had 3 to 4 crashes per corridor-Cost/Benefit would be low
- CR 524 (Stage Coach Rd)-Several "hot spots"
  - CR 524 & CR 539-Traffic Signal installed by Developer
  - CR 524 & Sharon Station Rd-Discussions with Upper Freehold for large-scale project outside funding limits of HRRR
  - Several fixed object crashes in the corridor, especially along easterly portion (connects to segment previously approved by HRRR)

CR 524 Histogram (P4S)



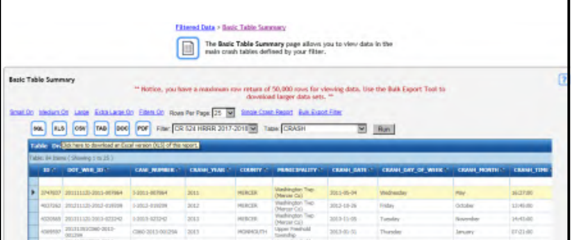
CR 524 Histogram-SafetyVoyager



Detailed Crash Data

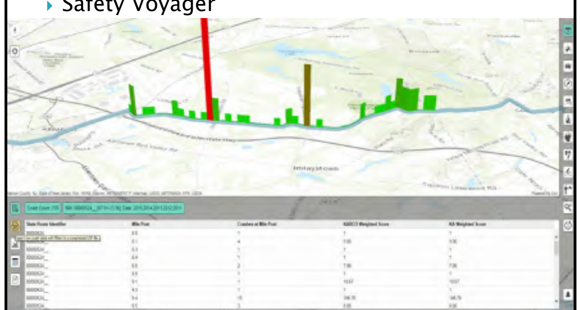
Detailed Crash Data

- Plan4Safety



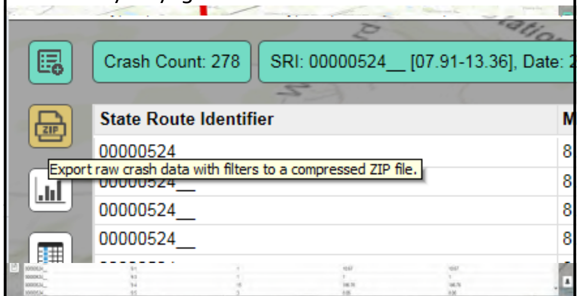
Detailed Crash Data

- Safety Voyager



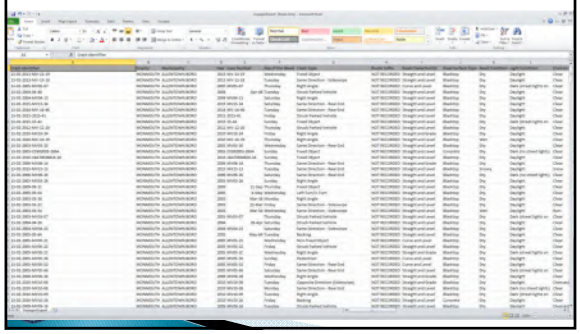
Detailed Crash Data

- Safety Voyager



Detailed Crash Data

- Safety Voyager



Crash Diagram/Crash table

Crash Diagram/Crash table

Crash Diagram/Crash Table

Crash Diagram/Crash Table

DATE:	26-Jul-15	BY:	VC
ANALYSIS PERIOD:	Jan 2011 to Dec 2013		

	12	1	2	3	4	5	6	7	8	9	10	11
AM	1	1					1	2	1	1		
PM	1	1	2		1	2	1		1	1		

Crash Year	No. of Crashes
2011	4
2012	1
2013	1
2014	7
2015	3
2016	1

Light condition	No. of Crashes
Daylight	11
Dark (No Street Lights)	3
Dark (Street Lights On/ spot)	1
Dark (Street Lights Off)	1

Surface	No. of Crashes
Dry	9
Wet	4
Snowy	2
Icy	2

Type of Crash	No. of Crashes	% of Total
Backing	0	0%
Fixed object	13	76%
Left turn/U turn	0	0%
Opp. direction	0	0%
Headon/Angular	0	0%
Petalcyclist	0	0%
Pedestrian	0	0%
Right Angle	0	0%
Rear end	1	6%
Side swipe	0	0%
Animal	3	18%

Severity	No. of Crashes
PDO	9
Pain	4
Moderate Injury	4
Incapacitating Injury	0
Fatal Injury	0

Countermeasures selected based on crash type

- High friction surface treatment (FHWA proven Safety Countermeasure)
- Centerline rumble strips (FHWA proven Safety Countermeasure)
- Safety Edge pavement edge treatment (FHWA proven Safety Countermeasure)
- 8" edge line marking
- Raised pavement markers on center line
- Additional signage for advanced guidance on roadway
- Sign upgrades based on advisory speed limits determined by ball banking
- Improve sign visibility by installation of retroreflective post covers
- Chevrons and/or other traffic control devices to provide further guidance through curves
- Brush clearing to improve line of sight
- Installation of breakaway roadside fixtures within clear zone

Crash Modification Factors

http://www.cmfclearinghouse.org/

Crash Modification factors

Treatment	Crash modifcation factor			
	Total		Fatal/Injury	
	CMF #	CMF	CMF #	CMF
High Friction Surface Treatment	7900	0.759	N/A	1
Safety Edge	4303	0.923	4323	0.835
Centerline Rumble Strip	3364	0.83	3368	0.63
Combined CMF		0.581		0.526
Predicted Crash Rate-Existing Conditions		2.343		0.846
Predicted Crash Rate-Post-construction		**1.362**		**0.445**

Cost/Benefit Analysis can be performed by comparing KABCO costs with and without modification factors vs estimated project cost (over the service life of the improvement)

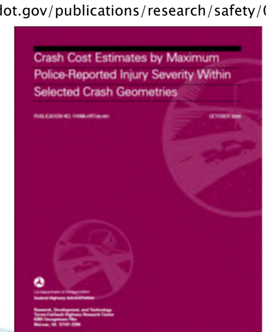
KABCO Costs

	Injury Severity		Estimated Cost	
			2001*	**2016/17**
	Fatal	(K)	$4,008,900	$5,447,373.00
	Fatal and/or Injury	(K/A/B/C)	$158,200	$214,965.30
	Injury	(A/B/C)	$82,600	$112,238.52
"Incapacitating"------ >	Disability Injury	(A)	$216,000	$293,505.09
"Moderate"---------- >	Evident Injury	(B)	$79,000	$107,346.77
"Complaint of Pain"--- >	Possible Injury	(C)	$44,900	$61,011.01
	Property Damage Only	(O)	$7,400	$10,055.27

* *Societal Crash Costs by Severity, FHWA-HRT-05-051, October 2005*

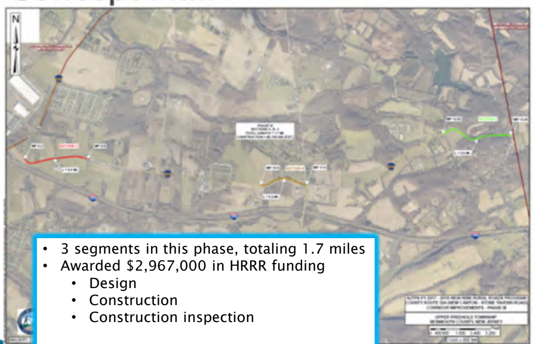
KABCO Costs

https://www.fhwa.dot.gov/publications/research/safety/05051/05051.pdf



Concept Plan

Concept Plan



- 3 segments in this phase, totaling 1.7 miles
- Awarded $2,967,000 in HRRR funding
  - Design
  - Construction
  - Construction inspection

Summary

- Follow the guidelines for the funding solicitations
- Develop a process for selecting potential projects
  - Start with "high level" data (i.e. network screening lists)
  - Narrow down to a specific corridor or location
  - Identify crash patterns & develop a problem statement
  - Identify potential countermeasures
  - Evaluate the potential effect of countermeasures (i.e. use CMF)
- Effective understanding and presentation of data will help the people that make the decisions.

Thank You

vince.cardone@co.monmouth.nj.us

Vincent Cardone
Principal Engineer II, Traffic
Monmouth County

Data-Driven Safety Analysis – Nominal vs. Substantive Safety.

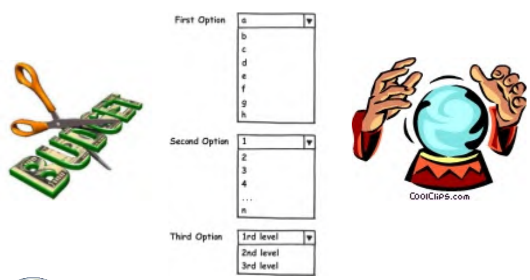
Integrating Safety Performance into ALL Highway Investment Decisions

U.S. Department of Transportation
Federal Highway Administration

Quantifying the impacts of potential projects…

2

We need to know how a roadway will perform in terms of safety



3

"Safety"

- A core value for all transportation agencies
- Our customers have been assured that maintaining and improving safety is a top priority
- Much of an agency's investments are intended to produce a "safe" highway or system
- "Safety" has traditionally been incorporated in highway programs and projects within a standards-based framework

4

Approaches for Considering Safety

Nominal Safety

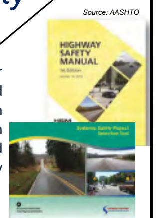
Substantive Safety

Source: AASHTO

Examined in reference to compliance with standards, warrants, guidelines and sanctioned design procedures

The actual or expected performance in terms of crash frequency and severity

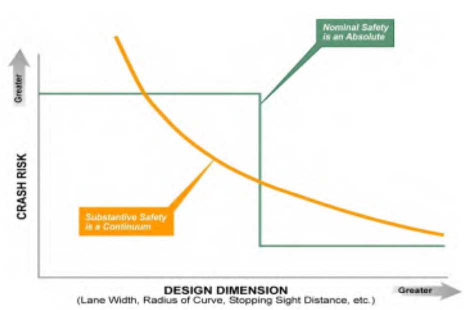
Source: AASHTO



*Adapted from Ezra Hauer, ITE Traffic Safety Toolbox Introduction, 1999

5

Nominal vs Substantive Safety



6

Hwy Design Standards in the U.S.

Initially, AASHO's Committee on Standards confined itself to disseminating information on design to its members, but in 1928 it proposed that the Association adopt "standards of practice" to guide the member States in technical matters in which some uniformity from State to State was urgently needed. As a result, on March 1, 1928, AASHO approved its first four standards which read as follows:

- That wherever practicable shoulders along the edges of pavements shall have a standard width of not less than 8 feet.
- That on pavements 10 feet shall be considered as the standard width for each traffic lane.
- That the crown of a two-lane concrete pavement shall be 1 inch.
- That no part of a concrete pavement shall have a thickness of less than 6 inches, and that all unsupported edges shall be strengthened. *(6)*

B-7

Hwy Design Standards in the U.S.

TABLE 1-1
Evolution of AASHTO (AASHO) Design Policies in the United States[1]

A Policy on Highway Classification, September 16, 1938
A Policy on Highway Types (Geometric), February 13, 1940
A Policy on Sight Distance for Highways, February 17, 1940
A Policy on Criteria for Marking and Signing No-Passing Zones for Two and Three-Lane Roads, February 17, 1940
A Policy on Intersections at Grade, October 7, 1940
A Policy on Rotary Intersections, September 26, 1941
A Policy on Grade Separations for Intersecting Highways, June 19, 1944
A Policy on Design Standards-Interstate, Primary and Secondary Systems, 1945
Policies on Geometric Highway Design, 1950
A Policy on Geometric Design of Rural Highways, 1954
A Policy on Arterial Highways in Urban Areas, 1957
A Policy on Geometric Design of Rural Highways, 1965
A Policy on Design of Urban Highways and Arterial Streets, 1973
A Policy on Geometric Design of Highways and Streets, 1984
A Policy on Geometric Design of Highways and Streets, 1990
A Policy on Geometric Design of Highways and Streets, 1994
A Policy on Geometric Design of Highways and Streets, 2001

B-8

Hwy Design Standards in the U.S.

TITLE 23 - HIGHWAYS
CHAPTER 1 - FEDERAL-AID HIGHWAYS

§ 109. Standards

(a) **In General.**— The Secretary shall ensure that the plans and specifications for each proposed highway project under this chapter provide for a facility that will—

(1) adequately serve the existing and planned future traffic of the highway in a manner that is conducive to safety, durability, and economy of maintenance; and

(2) be designed and constructed in accordance with criteria best suited to accomplish the objectives described in paragraph (1) and to conform to the particular needs of each locality.

Federal Highway Administration, DOT

in the geometric and structural design of highways.

§ 625.2 Policy.

(a) Plans and specifications for proposed National Highway System (NHS) projects shall provide for a facility that will—

(1) Adequately serve the existing and planned future traffic of the highway in a manner that is conducive to safety, durability, and economy of maintenance; and

(2) Be designed and constructed in accordance with criteria best suited to accomplish the objectives described in paragraph (a)(1) of this section and to conform to the particular needs of each locality.

B-9

FHWA Adopts AASHTO for NHS

§ 625.4 Standards, policies, and standard specifications.

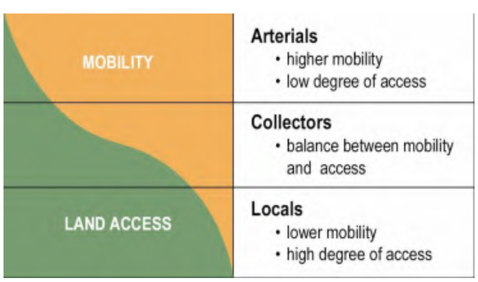
The documents listed in this section are incorporated by reference with the approval of the Director of the Federal Register in accordance with 5 U.S.C. 552(a) and 1 CFR part 51 and are on file at the Office of the Federal Register in Washington, DC. They are available as noted in paragraph (d) of this section. The other CFR references listed in this section are included for cross-reference purposes only.

(a) *Roadway and appurtenances.* (1) A Policy on Geometric Design of Highways and Streets, AASHTO 2001. [See § 625.4(d)(1)]

(2) A Policy on Design Standards Interstate System, AASHTO, January 2005. [See § 625.4(d)(1)]

B-10

Defining the Function



Functional Classification

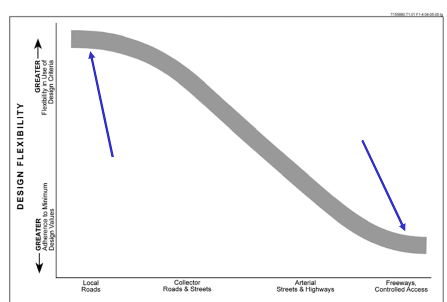
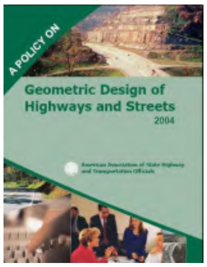


Figure 1-4
Functional Classification Versus Flexibility in Design

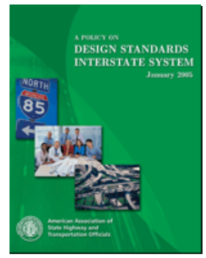
FHWA's Design Standards



- FHWA's standard for projects on the NHS (regardless of funding)
- For New construction or Reconstruction
- For any "3R" type of work on a freeway

B-13

FHWA's Design Standards

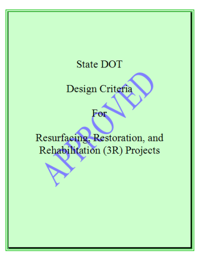


- Interstate System demands a higher benchmark for design
- Green Book criteria still apply where not superceded by the Interstate Policy

B-14

FHWA's Design Standards

- 3R projects "shall be constructed in accordance with standards which preserve and extend the service life of highways and enhance highway safety" [23 CFR 625.2]
- For non-freeway projects, States may have separate 3R criteria approved by FHWA in lieu of using the Green Book criteria.
- 40 States have opted to do so



B-15

FHWA's Guides & References

- Viewed as "best practices" but don't rise to the same level of importance
- Formerly itemized in 23 CFR 625
- Now listed in FAPG
- Notable examples include
  - AASHTO Roadside Design Guide
  - TRB Highway Capacity Manual

B-16

FHWA Standards Only for NHS

(o) Compliance With State Laws for Non-NHS Projects.— Projects (other than highway projects on the National Highway System) shall be designed, constructed, operated, and maintained in accordance with State laws, regulations, directives, safety standards, design standards, and construction standards.

B-17

States Designate Standards Off NHS

B-18

A Predictive Illustration…

All three of these meet design standards…

Source: CH2MHILL

but predictive analysis tells us they would perform very differently from a safety perspective.

19

The EDC Data-Driven Safety Analysis Initiative…

- Goal: Integrate **safety performance** into **ALL** highway investment decisions

20

What is the HSM?

- A tool that applies an **evidence-based** technical approach to safety
- Provides reliable **estimates** of an existing or proposed roadway's **expected safety performance**.
- Helps agencies **quantify** the **safety impacts** of transportation decisions, similar to the way agencies quantify:
  - traffic growth
  - environmental impacts
  - traffic operations
  - pavement life
  - construction costs

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The Vision for the HSM

A Document Akin To the HCM…

1. Definitive; represents quantitative 'state-of-the-art' information
2. Widely accepted within professional practice of transportation engineering
3. Science-based; updated regularly to reflect research

22

AASHTO Highway Safety Manual, First Edition

2010 Release:

- Rural Two-Lane Roads
- Multilane Rural Highways
- Urban/Suburban Arterials

2014 Supplement:

- Freeway Segments
- Ramps
- Ramp Terminals

23

Highway Safety Manual Organization

Part A	Introduction, Human Factors & Fundamentals
Part B	Safety Management Process
Part C	Predictive Methods
Part D	Crash Modification Factors

24

HSM Companion Software

HSM Part	Supporting Tool
PART B: Roadway Safety Management Process	AASHTOWare SafetyAnalyst Agile Assets Safety Analyst CARE Numetric usRAP Vision Zero Suite Other commercial… State-Developed
PART C: Predictive Methods	HSM & ISATe Spreadsheets IHSDM
PART D: CMFs	FHWA CMF Clearinghouse

25

Design Practice Involves Risk

- Two fundamental types of risk:
  - Risk of tort lawsuits arising from crashes alleged to be associated with a design ("Tort Risk")
  - Risk of the solution not performing as expected in terms of safety and operations ("Engineering Risk")

B-26

Tort Risk

- Adherence to criteria does not automatically prove *reasonable care*
- Deviation from criteria does not automatically prove *negligence*

B-27

Tort Risk

- In most jurisdictions, the Court does not have authority to rule that the design decision was the "correct" choice
- The Court can only render judgment on whether the *process* was complete and whether the outcome was reasonable given the *process*

B-28

Meeting Design Criteria Important

- "Transportation agencies limit greatly the risk of a successful tort suit by focusing on design solutions that are proven, i.e., that are within current design guidelines and criteria".
- "Providing a nominally safe design is the first and major step toward minimizing tort risk".

B-29

Engineering Risk

- How good (or poor) is the existing substantive safety performance?
- What should the long term safety performance of the roadway be?
- What is the difference in expected substantive safety if the exception is implemented?

B-30

Engineering Risk

- What is the degree to which a standard is being reduced?
- Will the exception affect other geometric elements?
- What additional features will be introduced, (e.g., signing or delineation) that would mitigate the potential adverse effects of the exception?

B-31

CSS Approach Helps Minimize Risk

- It is an unavoidable fact that DOTs face public and legal scrutiny for virtually all their actions.
- However, if a design team works closely with stakeholders, is creative within the bounds of good engineering practice, and fully documents all decisions, they will have gone a long way toward minimizing the risk associated with a future tort action should that occur

B-32

Would you expect these alternatives to perform the same over a 30-yr project life?

Shouldn't we know how alternatives will perform from a safety perspective before investing millions of taxpayer dollars?

Source: CH2MHILL

33

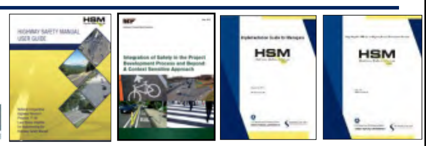
Incorporating Safety Performance into Investment Decisions

"Road safety management is in transition. The transition is from action based on experience, intuition, judgment, and tradition, to action based on empirical evidence, science, and technology…"

34

Resources

CMF CRASH MODIFICATION FACTORS CLEARINGHOUSE



- HSM Implementation Guide for Managers (FHWA)
- Integrating the HSM into the PDP (FHWA)
- HSM Users Guide (NCHRP 17-50)
- Integration of Safety in the PDP and Beyond (ITE)
- Scale and Scope of the HSM in the PDP (TPF-5(255))
- HSM Policy and Procedures Informational Guide (FHWA)

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New Resource (soon!):

Scale and Scope of the HSM in the Project Development Process

- **Scale and Scope of the HSM in Project Development Process**
  - Informational Guide funded by the TPF-5(255) HSM Pooled Fund
  - Helps identify appropriate HSM safety assessment methods by for various project applications
  - Chapter on each PD Phase, with examples
  - Includes a continuous case study example (planning through design)
  - Anticipated completion date: October 2016

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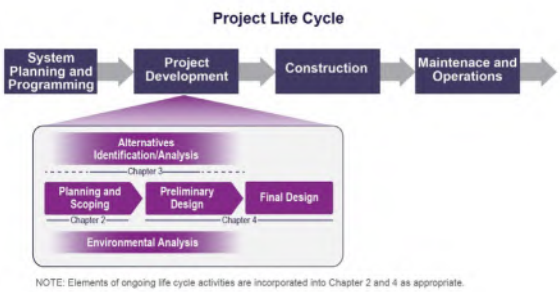
The Project Development Process



Source: Leidos

Safety Analysis Methodologies

- Safety Assessment Methods
  - Basic
  - Intermediate
  - Advanced
- Levels of Reliability:
  - Observed Crashes (Basic)
  - Predicted Crashes (Intermediate)
  - Expected Crashes (Advanced)
- Appropriate method f(project phase, task, type, available resources)

Project Type Descriptions for Assessment Id

Table 3. Example Project Type Descriptions for Safety Assessment Method Identification

Project Type	Example Description
1R	The 1R project type designation is often associated with routine maintenance activities. This type of project could include a pavement overlay, roadside maintenance, or a minor upgrade to existing roadside hardware. For 1R projects, there are very few, if any, new improvements.
2R	The 2R project type designation is generally associated with resurfacing existing facilities or restoring road characteristics that are in need of an upgrade. As part of the 2R project, a limited number of new design or operational changes may be incorporated. These enhancements are minor and do not change the overall character of the facility.
3R	The 3R project type is often associated with major rehabilitation of an existing facility. This could include pavement improvements for the existing road, minor roadway widening, roadside shoulder improvement projects, and construction of select low-cost safety improvements at the site or system-wide level.
4R	The 4R project type includes major retrofit construction efforts including modification of the design to meet geometric criteria standards. This type of project generally includes substantial changes to the character of the road (significant widening, realignment, major operational modifications).
NL	The NL project type indicates a highway on new location. This type of project has all new construction for the majority of the alignment.

Source: Leidos

Assessment Methods vs. Project Phase/Task

Project Phase	Related Task	Project Type[1]	Safety Assessment Method to Consider		
			Basic	Intermediate	Advanced
Planning and Scoping (Chapter 2)	Preliminary Planning and Needs Assessment	1R, 2R, 3R, 4R, NL	✓		
	Establish Project Purpose and Need	2R	✓		
		3R, 4R	✓	✓	✓
		NL	✓	✓	
	Establish Project Scope	2R	✓		
		3R	✓	✓	
		4R	✓	✓	✓
		NL	✓	✓	
Alternatives Identification and Evaluation (Chapter 3)	Alternative Selection	2R	✓		
		3R, 4R		✓	✓
		NL		✓	
	Interchange Justification Request	3R, 4R		✓	✓
		NL		✓	
Preliminary and Final Design (Chapter 4)	Selecting specific design elements and their dimensions	2R	✓		
		3R, 4R		✓	✓
		NL		✓	
	Design Exception	3R, 4R		✓	✓
		NL		✓	
	Value Engineering	4R		✓	✓
		NL		✓	
	Establishing the Work Zone Transportation Management Plan	2R	✓		
		3R, 4R		✓	
		NL		✓	

Source: Leidos

Safety Analysis Methodologies

- Safety Assessment Methods
  - Basic
  - Intermediate
  - Advanced
- Levels of Reliability:
  - Observed Crashes (Basic)
  - Predicted Crashes (Intermediate)
  - Expected Crashes (Advanced)
- Appropriate method f(project phase, task, type, available resources)

Observed, Predicted and Expected Crashes

- Adding observed crash data and weighting this information with the predicted crash values (calculated using the CMF and SPF combination) can improve the quality and statistical reliability of the crash prediction for a specific location (resulting in a calculated *expected* number of crashes).
- Consequently, the three key levels of reliability presented in the HSM are represented as:
  1) Observed crashes
  2) Predicted average number of crashes
  3) Expected average number of crashes

Building Blocks for Safety Assessment Methods

- Three basic "building blocks" that vary depending on the proposed project analysis include:
  - Observed Crashes,
  - Crash Modification Factors/Functions, and
  - Safety Performance Functions

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Basic, Intermediate and Advanced Methods

- The **basic methods** evaluate observed crashes and/or CMF applications related to the observed crashes. The basic methods introduced in this Guide include:
  - *Site Evaluation or Audit*
  - *Historical Crash Data Evaluation*
  - *CMF Applied to Observed Crashes*
  - *CMF Relative Comparison*
- **Intermediate safety assessment methods** include the use of SPFs and result in the more statistically reliable predicted average number of crashes. The intermediate methods introduced in this Guide include:
  - *AADT-Only SPF*
  - *SPF with CMF Adjustment*
- **Advanced safety assessment methods** include all three key building blocks and result in the most statistically reliable expected average number of crashes. The advanced safety assessment method introduced in this Guide include:
  - *SPF with CMF Weighted with Observed Crashes*

Source: Leidos

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Data Needs by Safety Assessment Methods

Table 4. Data Needs for Safety Assessment Methods

Safety Assessment Method	Data Needs			
	Road Type[1]	Road Characteristics[2]	Traffic Volume[3]	Observed Crash Data[4]
Site Evaluation or Audit	✓	✓		✗
Historical Crash Data Evaluation	✗	✗		✓
CMF Applied to Observed Crashes	✓	✓		✓
CMF Relative Comparison	✓	✓		
AADT-Only SPF	✓		✓	
SPF with CMF Adjustment	✓	✓	✓	
SPF with CMF Weighted with Observed Crashes	✓	✓	✓	✓

Key:
✓ = Required Data
✗ = Recommended Data

[1] Road Type refers to rural two-lane highway, rural multi-lane highway, urban freeway, etc.
[2] Road Characteristics includes physical features such as lane widths, access density, etc.
[3] Traffic Volume is the average daily traffic (ADT) or annual average daily traffic (AADT) in vehicles per day
[4] Observed Crash Data represents the historic crash data at the study site

Source: Leidos

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Safety Analysis Methodologies

- Safety Assessment Methods
  - Basic
  - Intermediate
  - Advanced
- Levels of Reliability:
  - Observed Crashes (Basic)
  - Predicted Crashes (Intermediate)
  - Expected Crashes (Advanced)
- Appropriate method f(project phase, task, type, available resources)

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Table 1. Primary Analysis Application for Safety Assessment Methods

Application	Basic				Intermediate		Advanced
	Site Evaluation or Audit	Historical Crash Data Evaluation	CMF Applied to Observed Crashes	CMF Relative Comparison	AADT-Only SPF	SPF with CMF Adjustment	SPF with CMF Weighted with Observed Crashes
	Observed Crashes				*Predicted Crashes*		*Expected Crashes*
Existing Performance	1	2					
Future Performance of an Existing Road			2 & 3	3	4	3 & 4	2, 3, & 4
Future Impact of Minor Geometric Changes to Existing Road			2 & 3	3		3 & 4	2, 3, & 4
Future Impact of Major Geometric Changes to Existing Road						3 & 4	
Future Performance for a New Facility					4	3 & 4	

Basis for Analysis: 1 = Site Characteristics 2 = Crash History 3 = CMF Values 4 = AADT

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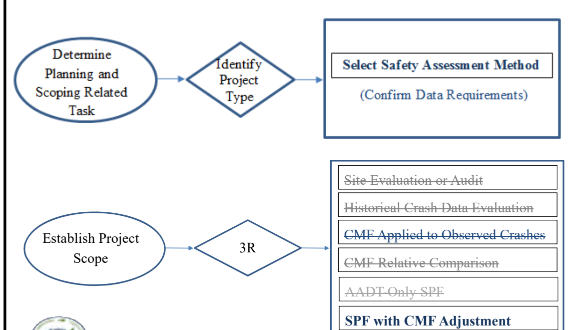
Safety Assessment Method Selection Process



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Example of example problems…

PROBLEM OVERVIEW				
Safety Assessment Method:	SPF with CMF Adjustment			
Project Phase:	**Planning & Scoping**	Calculation Method:	☐ Hand Calculated	☒ Tool Based
Related Task:	**Establish Project Purpose and Need**			
Project Type:	**3R**			
Comments: This example problem will evaluate the effect lane widening can have on reducing fatal and injury crashes for a two-lane undivided rural highway at a site where crash data is not available.				
LEVEL OF ANALYSIS				
Basic		Intermediate		Advanced

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What to do when no 1:1 fit?

- How to address scenario where analysis site does not match HSM existing conditions?
- Review HSM model parameter attributes;
- Identify site specific parameters
- Evaluate differences/tradeoffs w.r.to differences;
- Adjust site values to comply with HSM parameter constraints and document
- Consistently apply this assumption for alternatives analysis

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Safety Analysis Applications in Design Phase

- Selecting design elements/features
- Design Exceptions
- Performance-Based Practical Design

51

Safety Analysis to justify Design Exceptions

Proposed **10 Controlling Criteria:**

- Design speed
- **Lane width**
- **Shoulder width**
- **Horizontal curve radius**
- **Superelevation**
- **Maximum Grade**
- Stopping sight distance
- Cross slope
- Vertical clearance
- Design Loading Structural capacity

23 CFR 625

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Design Exceptions

- Required for projects on the NHS
- FHWA documentation expectations:
  - Specific design criteria that will not be met
  - Existing roadway characteristics
  - Alternatives considered
  - **Comparison of the safety and operational performance of the roadway** and other impacts such as right-of-way, community, environmental, cost, and usability by all modes of transportation
  - Proposed mitigation measures
  - Compatibility with adjacent sections of roadway

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Performance-based Practical Design

- An approach to decision-making that encourages *engineered solutions* rather than reliance on maximum values or limits found in design specifications
- Characteristics
  - grounded in performance management
  - exercises engineering judgment to address purpose and need
  - **uses appropriate performance-analysis tools**
  - considers both short- and long-term project and system goals

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Design Decisions Assessment Method Options

Table 9. Preliminary and Final Design Safety Assessment Method Options

Related Task	Objective	Project Type	Basic: Site Evaluation or Audit	Basic: Historical Crash Data Evaluation	Basic: CMF Applied to Observed Crashes	Basic: CMF Relative Comparison	Intermediate: AADT-Only SPF	Intermediate: SPF with CMF Adjustment	Advanced: SPF with CMF Weighted with Observed Crashes
			Observed Crashes				Predicted Crashes		Expected Crashes
Safety Assessments:	Increasing Level of Reliability →								
Selecting specific design elements and their dimensions	To compare safety impacts of alternative dimensions	2R	✓	✓	✓	✓			
		3R, 4R	✓	✓	✓	✓	✓	✓	✓
		NL				✓	✓	✓ 4	
Design Exception	To quantify design exceptions and mitigation strategies	3R, 4R			✓	✓	✓	✓ 7	✓
		NL					✓	✓	
Value Engineering	To quantify phases of value engineering process	4R			✓	✓	✓ 6	✓	✓
		NL					✓	✓	
Establishing the Work Zone Transportation Management Plan	To compare safety impacts of traffic control strategies	2R	✓			✓	✓	✓	
		3R, 4R					✓	✓	
		NL					✓	✓	

Design Decisions Assessment Method Options

Table 9. Preliminary and Final Design Safety Assessment Method Options

Related Task	Objective	Project Type	Basic: Site Evaluation or Audit	Basic: Historical Crash Data Evaluation	Basic: CMF Applied to Observed Crashes	Basic: CMF Relative Comparison	Intermediate: AADT-Only SPF	Intermediate: SPF with CMF Adjustment	Advanced: SPF with CMF Weighted with Observed Crashes
			Observed Crashes				Predicted Crashes		Expected Crashes
Safety Assessments:	Increasing Level of Reliability →								
Selecting specific design elements and their dimensions	To compare safety impacts of alternative dimensions	2R	✓	✓	✓	✓			
		3R, 4R	✓	✓	✓	✓	✓	✓	✓
		NL				✓	✓	✓ 4	
Design Exception	To quantify design exceptions and mitigation strategies	3R, 4R			✓	✓	✓	✓ 7	✓
		NL					✓	✓	
Value Engineering	To quantify phases of value engineering process	4R			✓	✓	✓ 6	✓	✓
		NL					✓	✓	
Establishing the Work Zone Transportation Management Plan	To compare safety impacts of traffic control strategies	2R	✓			✓	✓	✓	
		3R, 4R					✓	✓	
		NL					✓	✓	

Case Study – Arizona DOT

Use Predictive Method for Alternatives

PROJECT LOCATION

SR 264 (MP 441 to 466)

- Rural Minor Arterial
- Navajo County, Arizona
- Undivided Two-Lane, Two-Way Road
- 12-foot travel lanes
- 0-1-foot shoulders
- Intermittent right and left turn lanes
- Intermittent passing lanes

Source: Arizona DOT

Alternative Improvements Included:

- Widening to 5 ft shoulders
- Widening to 8 ft shoulders
- Improve superelevation
- CL & Shoulder rumble strips
- Flattening side slopes
- Install guardrail

Case Study – Arizona DOT

Parameters for Existing & Proposed Conditions:

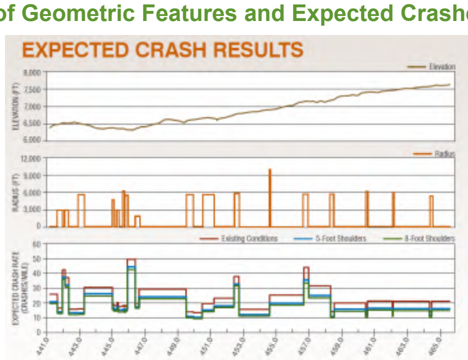
- Used IHSDM to perform safety analysis

ROADWAY ELEMENT	HSM Base Condition	Existing SR 264 (1-Foot Shoulders)	Alternative A (5-Foot Shoulders)	Alternative B (8-Foot Shoulders)
Lane width	12-Foot	12-Foot	12-Foot	12-Foot
Shoulder width	6-Foot	1-Foot	5-Foot	8-Foot
Shoulder type	Paved	Paved	Paved	Paved
Roadside hazard rating	3	Varies (6 or 7 most frequent)	Varies (1 or 2 most frequent)	Varies (1 or 2 most frequent)
Driveway density	≤ 5 per mile	Per survey & Holbrook District turnout database	Per survey & Holbrook District turnout database	Per survey & Holbrook District turnout database
Horizontal curves: length, radius, and presence or absence of spiral transitions	None	Per best fit alignment	Per best fit alignment (match existing)	Per best fit alignment (match existing)
Horizontal curves: Superelevation	None	Per as-builts & survey	Per as-builts & survey (match existing)	Per as-builts & survey (match existing)
Grades	≤ 3%	Per as-builts & survey	Per as-builts & survey (match existing)	Per as-builts & survey (match existing)
Centerline rumble strips	None	None	Present	Present
Passing lanes	None	Per survey	Per survey (match existing)	Per survey (match existing)
Two-way left-turn lanes	None	Per survey	Per survey (match existing)	Per survey (match existing)
Lighting	None	Present @ US 191 Intersection	Present @ US 191 Intersection (match existing)	Present @ US 191 Intersection (match existing)
Automated speed enforcement	None	None	None	None

Source: Arizona DOT

Case Study – Arizona DOT

Plot of Geometric Features and Expected Crashes



Source: Arizona DOT

Case Study – Arizona DOT

Crash Prediction Results

Expected Crash Frequency by Severity: 2016–2036

Source: Arizona Department of Transportation, Traffic Safety Evaluation Report

Alternative	Total Crashes	Fatal and Injury Crashes	Property Damage Only Crashes	Reduction in Total Crashes over Existing Conditions	Percent Reduction
No Build	636.4	283.4	353.0	—	—
Alternative A	531.6	230.5	301.1	104.8	16.5
Alternative B	504.2	216.8	287.4	132.2	20.8
Only Superelevation Improvements	635.3	282.7	352.6	1.1	0.2

- **IHSDM Safety Analysis:**
  - Model was un-calibrated as used (not necessary for comparative alternatives analysis)
  - **Alternative B** (8-ft shoulders) **would reduce crashes by 4 percent more** than Alternative A (5-ft shoulders)

Case Study – Arizona DOT

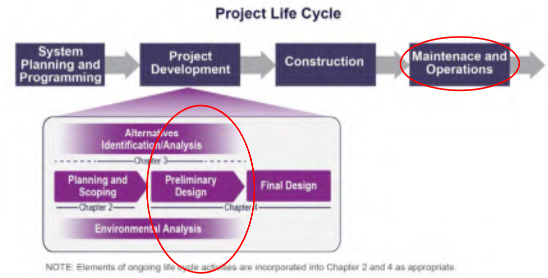
Benefit to Cost Ratio: Design Alternatives

Alternative	Annual Benefit	Annual Cost	Benefit/Cost Ratio
Alternative A	$3,873,681	$1,680,561	2.30
Alternative B	$5,084,207	$2,678,713	1.90
Superelevation Improvements	$41,807	$135,464	0.31

Source: Arizona Department of Transportation, Traffic Safety Evaluation Report

- **Economic analysis:**
  - Although Alternative B (8-ft shoulders) could provide the greater benefit in reduction in fatal and injury crashes, **Alternative A** (5-ft shoulders) would provide the **greater return on investment** and was selected as the preferred alternative.

Safety Analysis from a Traffic Operations Perspective



Source: Leidos

Safety Analysis in Traffic Operations

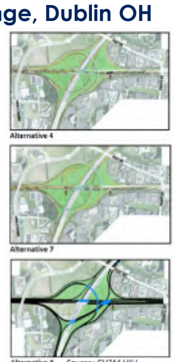
- Interchange Access Requests
  - Policy Point #3 Requires Safety and Operational Analysis
- Traffic Impact Studies
- Intersection Control Evaluation (ICE)
- Work Zones
- Part-Time Shoulder Use

Policy Point #3

Policy Point 3: An operational and safety analysis has concluded that the proposed change in access does not have a significant adverse impact on the safety and operation of the Interstate facility (which includes mainline lanes, existing, new, or modified ramps, ramp intersections with crossroad) or on the local street network based on both the current and the planned future traffic projections. The analysis shall, particularly in urbanized areas, include at least the first adjacent existing or proposed interchange on either side of the proposed change in access (23 CFR 625.2(a), 655.603(d) and 771.111(f)). The crossroads and the local street network, to at least the first major intersection on either side of the proposed change in access, shall be included in this analysis to the extent necessary to fully evaluate the safety and operational impacts that the proposed change in access and other transportation improvements may have on the local street network (23 CFR 625.2(a) and 655.603(d)). Requests for a proposed change in access must include a description and assessment of the impacts and ability of the proposed changes to safely and efficiently collect, distribute and accommodate traffic on the Interstate facility, ramps, intersection of ramps with crossroad, and local street network (23 CFR 625.2(a) and 655.603(d)). Each request must also include a conceptual plan of the type and location of the signs proposed to support each design alternative (23 U.S.C. 109(d) and 23 CFR 655.603(d)).

Case Study: I-270/US 33 Interchange, Dublin OH

- Three of eight interchange alternatives were developed and analyzed based on a list of criteria:
  - Traffic Operations
  - Design & Construction
  - Environmental Impacts
  - Right-of-Way Needs
  - Capital Costs
  - **Safety Performance**



Source: CH2M HILL

Case Study: I-270/US 33 Interchange, Dublin OH

- ISATe used for safety analysis:
  - Model was un-calibrated as used
  - Results used for comparisons are relative
  - Focused on KAB type crashes from 2015-2035

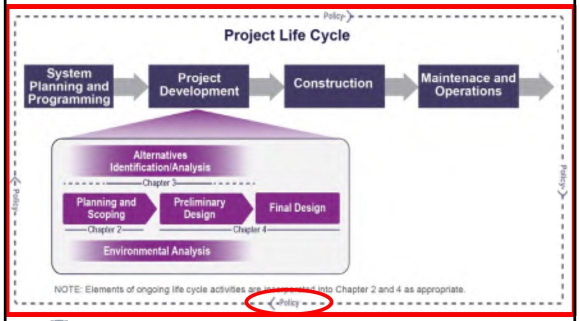
Predicted Crashes and Societal Costs: 2015–2035

	KAB Crashes	Societal Costs
No Build	308	$97 million
Alternative 4	325	$91 million
Alternative 7	409	$109 million
Alternative 8	320	$89 million

Source: CH2M HILL

- Alternative 8 predicted to have lowest KAB crash frequency and lowest expected societal cost
- City of Dublin and ODOT selected Alternative 8 as the preferred alternative based on all of the criteria.

Implementing Safety Analysis in Project Development



Source: Leidos

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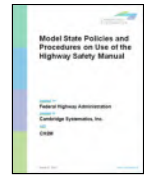
New Resource (soon!):



- **Model State Policies & Procedures on of the Highway Safety Manual**
  - Informational Guide funded by TPF-5(255) HSM Pooled Fund
  - Identifies existing HSM language in State policy/procedural manuals
  - In areas with limited or no HSM language, provides model language that a State could start with
  - Language on each PD Phase
  - Anticipated completion date: September 2016

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Model State Policy example

Engineering and Design – Preliminary Engineering
2.3.1.3. Design Manuals

- Design manuals provide an excellent opportunity to integrate the Highway Safety Manual into the project development process. Through the research for this project, the Georgia Department of Transportation, Pennsylvania Department of Transportation, and Washington State Department of Transportation were identified as noteworthy design manual examples and provide the basis for the model policy statement and guidance language.

Noteworthy examples

Should:

- Pennsylvania Department of Transportation - A safety assessment, including the potential safety benefits shall be discussed if the proposed improvements will contribute to a reduced number and/or severity of crashes. Consider using AASHTO's Highway Safety Manual (HSM) to calculate crash frequencies to quantify the substantive safety performance of the alternatives.
  - Source: Pennsylvania Department of Transportation. 2014. District Highway Safety Guidance Manual. Publication PUB 638 (12-14). December.

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Conclusions

- Safety assessment categories linked to crashes parameter
  - Basic (Observed)
  - Intermediate (Predicted)
  - Advanced (Expected)
- HSM (and other) predictive methods not always a 1:1 fit with our sites- what to do?
  - Apply engineering judgement to a new tool?
    - Best fit possible
    - Fully DOCUMENT ALL ASSUMPTIONS.

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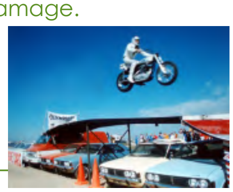
What is "Risk"?

Risk *n.* 1. The possibility of suffering harm or loss; danger. 2. A factor, element, or course involving uncertain danger; hazard. 3. The danger or probability of loss to an insurer. *tr. v* 1. To expose to a chance of loss or damage.

Are you a "Risk Taker"?



What is Risk Management?

International Organization for Standardization

The International Standards Organization (ISO) characterizes Risk Management as:

- Explicitly addresses uncertainty
- Based on the best available information
- Part of the decision making process
- Systematic, structured, and an integral part of organizational processes
- Dynamic, iterative, responsive to change, and capable of continual improvement and enhancement
- Accounts for human factors
- Transparent and inclusive

A-72

Applicability to Transportation

Risk comes in many forms and is inherent in the delivery and operation of transportation projects. Examples of where risk is incurred:

- Project cost (cost escalation, changes to project scope)
- Level of engineering analysis (greater investigation generally means fewer unknowns)
- Serviceability (when projects fail to satisfy performance demands)
- Legal claims and tort liability
- Safety (geometric design, structure design, geotechnical design)

A-73

Adapted from: FHWA Federal Lands Highway Division *Project Development and Design Manual*. March 2008

Highway-related Principles

- "It is *not feasible or intended for highway projects to be entirely risk-free*, as there are potential rewards to the project when risk is taken."
- "To understand the risks associated with decisions involving the selection and application of design standards and criteria, it is essential to *have knowledge of the basis and assumptions underlying the standards, as well as knowing the conditions (physical, traffic and safety) for the project*."

A-74

Risk Basis for Improving Design

- "In many cases, the *risks associated with decisions can be mitigated with inclusion or enhancement of other features*, which may offset the risk."
- "The *evaluation of risk is an interdisciplinary process* requiring involvement of project team members and stakeholders based on the specific issues and an evaluation of risk tolerability."

A-75

Assessing the Risks

- Risk assessment is the process of assessing the probability and severity of adverse consequences associated with activities, recommendations or designs.
- For most transportation projects the risk assessment is not a complicated quantitative assessment, but rather a practical assessment based on experience, engineering judgment and historical standard of practice.
- To the extent possible, risks should be quantified, both on the basis of their potential probability and for their potential consequences.

A-76

Risk and Geometric Design

Risk management in geometric design involves:

- Applying engineering knowledge and judgment
- Incorporating performance prediction tools
- Using latest best practices and new technologies
- Balancing competing project interests, including but not limited to, cost, operational efficiency, environmental issues, social concerns, and safety performance

Risk Management = Trade-Off Considerations

A-77

Challenge of Highway Design

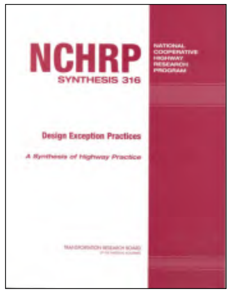
Effectively dealing with the "**TRADE-OFFS**"

- Adding lanes vs. minimizing property takes
- Clear zones vs. preserving mature trees
- Property access vs. high mobility
- Designing for vehicle traffic vs. accommodating other user groups

A-78

Going Beyond the FHWA Criteria

- 24 States have some design criteria that are higher than AASHTO's
- 15 States have "supplemental" criteria
- For example, Caltrans has established "mandatory" and "advisory" criteria

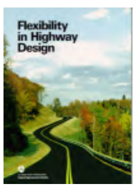


B-79

Local Practice?

B-80

"Introducing" Flexibility in Design

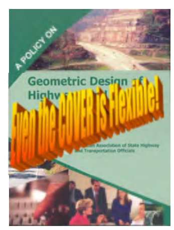


- Joint effort of
  - FHWA
  - AASHTO
  - Non-traditional partners
- Central theme of Thinking Beyond the Pavement Conference in 1998

This guide does not attempt to create new standards. Rather, the guide builds on the flexibility in current laws and regulations to explore opportunities to use flexible design as a tool to help sustain important community interests without compromising safety. To do so, this guide stresses the need to identify and discuss those flexibilities and to continue breaking down barriers that sometimes make it difficult for highway designers to be aware of local concerns of interested organizations and citizens.

B-81

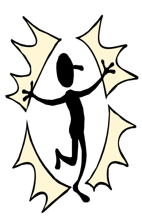
Where's the Design Flexibility?



- As highway designers, highway engineers strive to provide for the needs of highway users while maintaining the integrity of the environment. Unique combinations of design requirements that are often conflicting result in unique solutions to the design problems.
- Sufficient flexibility is permitted to encourage independent designs tailored to particular situations

B-82

Where's the Design Flexibility?



- Design speed
- Design vehicle
- Design user
- Level of performance
- Alignment
- Cross-Section
- Others

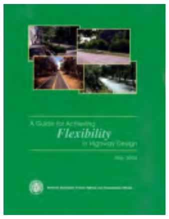
Designers have choices!

B-83

Where's the Design Flexibility?

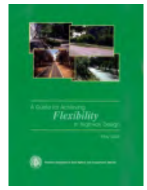
B-84

Where's the Design Flexibility?



B-85

Where's the Design Flexibility?



3.6.1.2 Flexibility in AASHTO Policy

The AASHTO Green Book recognizes the need for flexibility and provides that flexibility, citing how lane width can be tailored, to a degree, to fit the particular environment in which the roadway functions (e.g., low volume rural roads or residential areas versus higher volume rural or urban facilities). The formulation of policy values demonstrates considerable flexibility.

For low speed, lower volume rural roads and highways with little or no truck traffic, lane widths as low as 9 feet (2.7 meters) may be acceptable; lane widths substantially less than 12 feet (3.6 meters) are considered adequate for a wide range of volume, speed, and other conditions.

For the reconstruction of rural two-lane highways, the AASHTO Green Book notes that less than 12-foot or 3.6-meter lane widths may be retained "where alignment and safety record are satisfactory." In other words, widening a narrow existing highway is not mandated if its safety performance is acceptable. Flexibility is also evident for lower-class roads and streets, with recommended narrower lane widths consistent with lower design speeds on such roads.

The discussion of lane width in the AASHTO Green Book for urban areas also reflects a high degree of flexibility. It is noted that lane widths "may vary from 10 to 12 ft (3.0 to 3.6 m) for arterials." For lower classification facilities, similar flexible language encourages the tailoring of an urban street cross section to site-specific conditions.

B-86

Standard Design Not Always Best

- "Unfortunate that the word "standards" should have been chosen. Strictly interpreted, the meaning would indicate that the standard design was the best design.
- Standards are merely recommended designs which are to be adhered to unless conditions indicate that a variation in the design would meet them better.
- To neglect the detailed study of local conditions often results not only in an unwarranted increase in cost, but may result in a type of construction which fits poorly the location where used".

B-87

Meeting Design Criteria Important

- Safety or traffic operational problems are less likely to develop if design criteria are met.
- Designers should strive to meet criteria and look first at using the flexibility inherent in the adopted criteria to achieve a balanced, safe, and context sensitive design.
- In some situations, design exceptions will be necessary and the goal is to achieve a high level of substantive safety and efficient traffic operations.

B-88

Design Exceptions

"The process and resulting documentation associated with a geometric feature created or perpetuated by a highway construction project that does not conform to the minimum criteria set forth in the standards and policies".

B-89

Design Exceptions Valid Process

- Not admission of failure
- Not flawed design
- A legitimate exercise of professional judgement

B-90

Standards Not Devalued

- When evaluating the need for a design exception the design standards are not devalued;
- Rather, in-depth understanding of the standards including the underlying theories and basis is used to add value to a unique situation by applying flexibility.

Skilled Designers Minimize Risk

- The ability to develop a context-sensitive solution by working within and sometimes outside design criteria, while maintaining the safety and operational integrity of the highway, requires a broad and deep understanding of the operational effects of highway geometry.
- For this reason, knowledgeable, experienced, professional highway engineers are essential for a successful context-sensitive project.

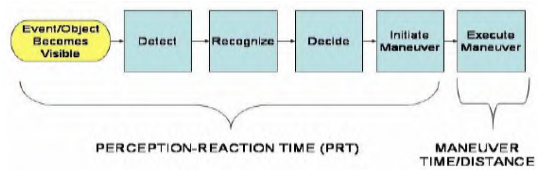
Example – Stopping Sight Distance (SSD)

Distance required to perceive an object in roadway and bring vehicle to a stop

"… the sight distance at every point along a roadway should be at least that needed for a below-average driver or vehicle to stop."

AASHTO Green Book Chapter 3

SSD Conceptual Model



SSD = perception reaction distance + braking distance

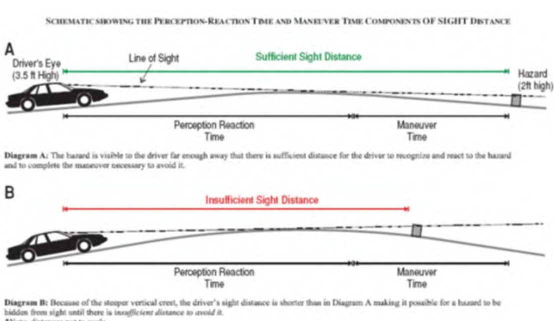
$SSD = 1.47\ V\ t + (1.075\ V^2 / a)$

V = design speed in mph

t = percept reaction time (2.5 sec)

a = deceleration rate (11.2 ft/sec^2)

SSD Conceptual Model



SSD Design Values

Design speed (mph)	Stopping sight distance: Calculated (ft)	Stopping sight distance: Design (ft)
15	76.7	80
20	111.9	115
25	151.9	155
30	196.7	200
35	246.2	250
40	300.6	305
45	359.8	360
50	423.8	425
55	492.4	495
60	566.0	570
65	644.4	645
70	727.6	730
75	815.5	820
80	908.3	910

From Exhibit 3-1, AASHTO Green Book

Level Terrain

US Customary						
Design speed (mph)	Stopping sight distance (ft)					
	Downgrades			Upgrades		
	3 %	6 %	9 %	3 %	6 %	9 %
15	80	82	85	75	74	73
20	116	120	126	109	107	104
25	158	165	173	147	143	140
30	205	215	227	200	184	179
35	257	271	287	237	229	222
40	315	333	354	289	278	269
45	378	400	427	344	331	320
50	446	474	507	405	388	375
55	520	553	593	469	450	433
60	598	638	686	538	515	495
65	682	728	785	612	584	561
70	771	825	891	690	658	631
75	866	927	1003	772	736	704
80	965	1035	1121	859	817	782

From Exhibit 3-2, AASHTO Green Book

SSD on Grades

SSD Design Values

Design speed (mph)	Stopping sight distance: Calculated (ft)	Stopping sight distance: Design (ft)
15	76.7	80
20	111.9	115
25	151.9	155
30	196.7	200
35	246.2	250
40	300.6	305
45	359.8	360
50	423.8	425
55	492.4	495
60	566.0	570
65	644.4	645
70	727.6	730
75	815.5	820
80	908.3	910

From Exhibit 3-1, AASHTO Green Book
Level Terrain

US Customary						
Design speed (mph)	Stopping sight distance (ft)					
	Downgrades			Upgrades		
	3 %	6 %	9 %	3 %	6 %	9 %
15	80	82	85	75	74	73
20	116	120	126	109	107	104
25	158	165	173	147	143	140
30	205	215	227	200	184	179
35	257	271	287	237	229	222
40	315	333	354	289	278	269
45	378	400	427	344	331	320
50	446	474	507	405	388	375
55	520	553	593	469	450	433
60	598	638	686	538	515	495
65	682	728	785	612	584	561
70	771	825	891	690	658	631
75	866	927	1003	772	736	704
80	965	1035	1121	859	817	782

From Exhibit 3-2, AASHTO Green Book
SSD on Grades

SSD Design Recommendations

"Stopping sight distances exceeding those shown in Exhibit 3-1 should be used as the basis for design wherever practical. Use of longer stopping sight distances increases the margin of safety for all drivers …"

"The recommended stopping sight distances are based on passenger car operations and do not explicitly consider design for truck operation."

AASHTO Green Book

Conceptual Safety Relationship?

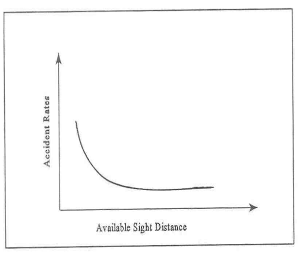


Figure 4. Conceptual Relationship Between Available Sight Distance and Safety at Crest Vertical Curves

Past studies that examined the relationship between SSD and safety have been inconsistent and inconclusive

NCHRP 400

Conceptual Safety Relationship?

Parameters	1940 A Policy on Sight Distance for Highways	1954 A Policy on Geometric Design - Rural Highways	1965 A Policy on Geometric Design - Rural Highways	1971 A Policy on Geometric Design of Highways and Streets	1984 and 1990 A Policy on Geometric Design Highways and Streets
Design Speed	Design Speed	85 to 95 percent of design speed.	80 to 93 percent of design speed.	Min. - 80 to 93 percent of design speed. Des. - design speed.	Min. - 80 to 93 percent of design speed. Des. - design speed.
Perception - Reaction Time	Variable: 3.0 sec at 30 mph 2.0 sec at 70 mph	2.5 sec	2.5 sec	2.5 sec	2.5 sec
Design Pavement/ Stop	Dry Pavement Locked-wheel Stop	Wet Pavement Locked-wheel Stop	Wet Pavement Locked-wheel Stop	Wet Pavement Locked-wheel Stop	Wet Pavement Locked-wheel Stop
Friction Factors	Ranges from 0.50 at 30 mph to 0.40 at 70 mph	Ranges from 0.36 to 30 mph to 0.29 to 70 mph	Ranges from 0.36 to 30 mph to 0.27 at 70 mph	Ranges from 0.35 at 0.30 mph to 0.27 at 70 mph	Slightly higher at higher speeds than 1970 values
Eye Height	4.5 ft	4.5 ft	3.75 ft	3.75 ft	3.5 ft
Object Height	4.0 in	4.0 in	6.0 in	6.0 in	6.0 in

Conceptual Safety Relationship?

There are a number of factors or conditions associated with driver responses to a hazardous event or object that are not reflected in the basic sight distance model, but nonetheless can have a profound effect on driver behavior and overall roadway safety:

- Conditions or events that occur prior to a hazardous event/object becoming visible to the driver
- How and when the driver processes relevant information
- Driving as an "episodic" activity versus driving as a "smooth and continuous" activity
- The nature of the hazardous object or event
- The nature of the driver's response
- Individual differences across drivers
- The quality and applicability of the empirical research used to develop the driver models

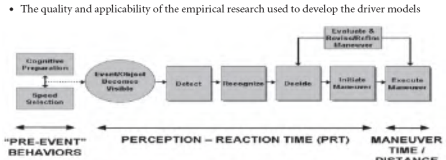


Figure 22-2. Added elements to basic sight distance behavioral model.

Risk Assessment Guidelines

- Assess the risk of a location with SSD below current criteria. Risk is related to traffic volume (exposure) and other features within the sight restriction (intersections, narrow bridges, high-volume driveways, sharp curvature)
- "Where no high-risk features exist wit[h] the sight restriction, nominal deficiencies as great as 5-10 mph may not create an undue risk of increased crashes."

Page 59

Guide for Achieving Flexibility in Highway Design AASHTO

Questions & Answers

John McFadden, P.E.
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Evaluation of the 13 Controlling Criteria for Geometric Design

DETAILS

94 pages | 8.5 x 11 | PAPERBACK
ISBN 978-0-309-30796-3 | DOI 10.17226/22291

AUTHORS

Harwood, Douglas W.; Hutton, Jessica M.; Fees, Chris; Bauer, Karin M.; Glen, Alan; Ouren, Heidi; Quincy Engineering; HQE, Inc.

SYSTEMIC SAFETY IMPROVEMENTS

Projects being done along County Routes in Cumberland County

Douglas W. Whitaker, P.E.
Assistant County Engineer

Cumberland County Engineering Department

Engineering office with:
- Staff of 7
  (5 full-time; 2 part-time)
- Managing infrastructure including:
  - 540 miles of County Roads
  - 50 traffic signals and 19 flashers
  - 54 bridges and 169 minor bridges
  - Provide assistance to remaining Public Works divisions (Roads, Mosquito Control, Traffic Safety) on an as-needed basis

The department's annual construction budget has averaged $8 million per year, but with the reauthorization of the Transportation Trust Fund, it has increased to $12.5 million annually:
about $9.3 million, State Aid
about $2.2 million, Federal Aid
about $1 million, County bonds

In addition, the county receives additional funding (HSIP, CMAQ, LAIF) on an individual project basis.

Highway Safety Improvement Program (HSIP)

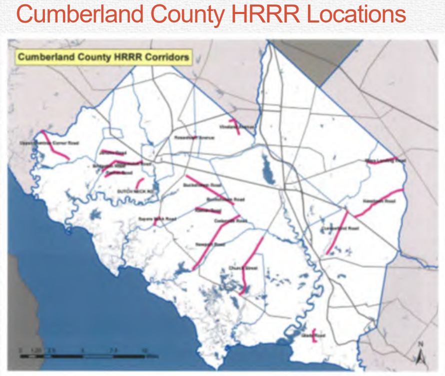
- HSIP is a core Federal-Aid program with the purpose to achieve a significant reduction in highway fatalities and serious injuries on all public roads and requires a data-driven, strategic approach to improving highway safety with a focus on performance.
- Cumberland County's approach to HSIP is to focus on both "hot-spot" and systemic projects:
  - The "hot-spot" projects require more in-depth data collection and analysis to determine appropriate site specific improvements related to the crash history.
  - The systemic projects apply a given improvement type over a large number of applicable locations to counteract more "random" crash events.

The Systemic Approach
Starting from Scratch – Network Screening Lists

- The network screening lists shown below were provided to Cumberland County – these took crash information for a given timeframe and determined weighted "scores" for each location based on a number and severity of crashes:
  - Pedestrian intersection hot spots.
  - Pedestrian corridor hot spots.
  - Intersections hot spots.
  - High Risk Rural Roads (HRRR) hot spots.

  - Roadways Eligible for Centerline Rumble Strips

Cumberland County HRRR Locations



FHWA Proven Safety Countermeasures

- Roundabouts
- Corridor Access Management
- Backplates with Retroreflective Borders
- Road Diet
- Medians and Pedestrian Crossing Islands in Urban & Suburban Areas
- Pedestrian Hybrid Beacon
- Longitudinal Rumble Strips and Stripes on Two-Lane Roads
- Safety Edge SM
- Enhanced Delineation and Friction for Horizontal Curves

Centerline Rumble Strips

- NJDOT criteria
  - Twenty (20) foot minimum pavement width.
  - Speed Limit of 35 miles per hour or greater.
  - Two-lane Urban or Rural Roadways.
- Cumberland County criteria
  - "New" asphalt roadways (10 years old or less).
  - Limit installation areas due to residential density.

❑ Approximately 150 miles selected across eleven municipalities.

Actual Construction and After

- Night time construction
  - Less Traffic to impact
  - Safer for construction workers & inspectors
  - Short duration – several miles constructed nightly
- Lessons Learned
  - Age of existing asphalt
  - Seal Coating
  - Complaints / Questions:
    - ✓ Residential - Noise
    - ✓ Roadway Users
    - ✓ Centerline versus white line
    - ✓ Why?

High Friction Surface Treatment (HFST)

- Pros:
  - Proven Safety Measure
  - Safe for all Vehicle Types
  - Durability
- Cons:
  - High Unit Cost
  - Specialized Trade
    - ❑ Currently no contractors located within the region installing
    - ❑ Improper installation limits usefulness and life expectancy

Current Application – HFST at Curves

- Installation of High Friction Aggregate on Existing Asphalt Surface with Epoxy Binder:
  - Greatly increases the Friction between Roadway Surface and Vehicle Tires.
  - Durable – life expectancy equal to or exceeding the asphalt pavement itself.
- As part of the project, update and upgrade existing safety features:
  - Review signage at each site and update as needed:
    - ❑ Retroreflectivity
    - ❑ Size
    - ❑ Location
    - ❑ Spacing

Selecting the Locations

- HRRR Screening List
- Other Locations "Known" to Engineering Department
  - Crash History
  - Municipalities
  - Residents
  - Geometry
- Existing or Proposed Pavement Condition
  - Only as durable as the asphalt it is placed on.
  - Similar to rumble strips, only "recent" pavement locations selected.
- Original 28 locations has been expanded to 39 locations in final application (18 HRRR; 21 non-HRRR)

Ongoing Topics for Discussion

- Network Screening Lists
  - Aging of Data (current list: 2011 through 2013)
  - Completed project locations still on Current List
- Project Delivery
  - Timeline from application to construction substantial:
    - ✓ Rumble Strips – 22 months from application submission to construction Notice to Proceed.
    - ✓ HFST – 16 months so far…
    - ✓ This extended period limits flexibility to update the construction to latest information (seal coating).
  - Centralized review process eliminates interactions with the Local Public Agency – the entity not only selecting the project locations, but having the most detailed knowledge of them.
- Separate HRRR & non-HRR projects

Discussion / Questions?

Thanks:

- Cumberland County Board of Chosen Freeholders
- Federal Highway Administration
- New Jersey Department of Transportation
- South Jersey Transportation Planning Organization

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Local Safety Peer Exchange

A Municipal Perspective

Deanna Stockton, P.E., C.M.E., Municipal Engineer

General Statistics

COUNTY	JURISDICTION						TOTAL
	NJDOT	Authority	County	Municipal	Park (State,Local)	Federal Agency FWS, NPS, Military	
Atlantic	145	57	371	1,395	9	8	1,986
Bergen	106	40	440	2,412	0	0	2,998
Burlington	156	38	501	1,930	219	61	2,904
Camden	102	28	389	1,535	7	0	2,062
Cape May	74	31	201	731	26	0	1,063
Cumberland	89	0	540	679	0	0	1,308
Essex	61	19	213	1,375	10	0	1,679
Gloucester	154	20	400	1,143	0	0	1,717
Hudson	35	21	53	515	2	0	626
Hunterdon	115	1	237	1,078	15	0	1,446
Mercer	119	14	173	1,213	10	1	1,530
Middlesex	139	40	295	2,094	9	1	2,578
Monmouth	205	27	365	2,770	26	131	3,523
Morris	162	0	296	2,107	19	10	2,594
Ocean	141	39	608	2,174	110	37	3,108
Passaic	55	5	235	1,029	10	0	1,333
Salem	86	9	353	430	5	1	884
Somerset	106	0	230	1,398	0	0	1,735
Sussex	111	0	314	907	87	13	1,433
Union	68	20	176	1,160	6	0	1,430
Warren	103	5	256	697	31	44	1,136
TOTAL	2,331	413	6647	28,772	599	308	39,071
			STATEWIDE TOTAL				39,071

- NJDOT has jurisdiction on just 7% of roads in New Jersey / 66% volume
- In Mercer: 11% County, 79% Municipal, 7% NJDOT
- In Cumberland: 41% County, 52% Municipal, 7% NJDOT

Princeton Statistics

- Prior to 2013, Princeton was two communities: Borough of Princeton and Township of Princeton
- Borough was more urban
- Township was more suburban / rural

	Borough	Township
Road miles	20	100
Speed limits	25 and less	25 - 45
Population	12,000+	16,000+
Size	1.8 sq. mi.	16.5 sq. mi.
Density	6,679 / sq. mi.	1,010 / sq. mi.

Former Borough Traffic Calming Examples

Hodge Road AADT and Speed (Avg / 85th Percentile)

Former Township Policy on Traffic Calming

- Township Policy created in 2002 prohibiting speed humps (vertical deflections)

Sgt. Michael Henderson, Traffic Safety Officer, said that a significant number of people would die due to delayed response of emergency vehicles from the humps in the roadways. Sgt. Henderson also said that the police would be opposed to planting trees in the center of roads.

Greg Paulson, Princeton First Aid and Rescue Squad, said that the humps cause great concern about impediments to response time. He also said that going over the humps was a hazard to both the patients and passengers in the emergency vehicles.

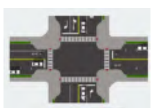
Municipal Traffic Safety Concerns

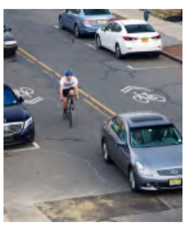
- Vehicle speeds
- Volume
- Public rights of way are valuable and have many competing needs in a livable community
- Road users don't always follow the rules
- Distracted driving is increasing
- Curbing, striping, tree plantings, radar speed signs, and police enforcement are not enough
- A walkable and bikeable town is often less friendly to drivers, especially for parking
- Bumpouts are undesirable to bicyclists and Public Works – but they have advantages for pedestrians

Princeton's Safety Design Process

- Review crash reports, speed data, and meet with police
- Gather road AADT data
- Complete the Complete Streets checklist
- Review the Master Plan for bicycle mobility, pedestrian, and other prescribed improvements
- Conduct a site visit
- Discuss findings with Traffic Safety Committee (staff-led committee with Engineering, Police, and Public Works representatives)
- Prepare a conceptual plan
- Conduct a design neighborhood meeting and gain neighborhood perspective
- Adapt conceptual plan
- Review conceptual plan with Complete Streets Committee (Council-appointed committee including bike, transit and other advocates)

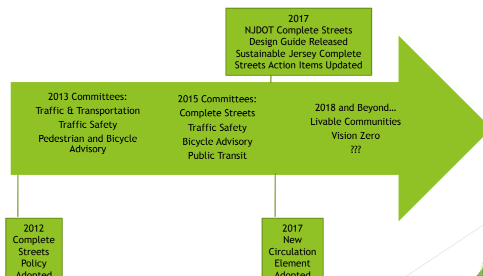
Roadblocks





- Historic
- Loss of parking
- Constricted space
- Perceived loss of property value
- Tree removals
- Road maintenance issues
- Priorities
- Conflicts between ped needs and bicyclist needs
- The Squeaky Wheel

Progression in Safety Design



The Future of Safety

SUSTAINABLE JERSEY • CERTIFIED • A Better Tomorrow, One Community at a Time

2017 State of New Jersey
Complete Streets
Design Guide

VISION ZERO

Forgiving Design	Forgiveness of Slow Speeds
Increases safety at high speeds	Fosters the safety of slow speeds
Wide travel lanes	Narrow travel lanes
Broad, smooth curves	Short, tight curves
Clear zone free of fixed objects	Variety of fixed objects (light poles, trees, mail boxes, planter boxes, etc) directly adjacent to the travel way
Wide shoulders	Shoulders are used for parking, bike lanes, and loading zones
Feels comfortable to drive fast	Feels dangerous to drive fast

- Use Complete Streets Checklist and Road Safety Audits
- Use Safety Voyager to supplement police crash reports
- Compare USLimits2 versus 85th percentile for speed limit establishment
- Reference FHWA Proven Safety Countermeasures

- Establish Criteria and Map of Potential Traffic Calming Locations

Traffic Calming Criteria					
	Points				
	1	2	3	4	5
Percent of speeding (5MPH above)	10%	20%	30%	40%	50%
Density of Housing (lot size)	40,000sf	30,000sf	20,000sf	10,000sf	>10,000sf
Are there Sidewalks	2 sides		1 side		no sidewalks
Volume of traffic	500 VPD	750 VPD	1,000 VPD	2,000 VPD	3,000 VPD
Other Criteria:	Proximity to Pedestrian destination				

- Pilot fixes before they are built
- Participate in county and regional dialogues
- Find community champions to advocate for improvements
- Continue to evaluate modifications

DVRPC Region

QUESTIONS?

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609-921-7077 x 1138 609-731-2625

Princeton Police Traffic Safety Bureau
Lt. Geoff Maurer
Sgt. Thomas R. Murray III
609-921-2100

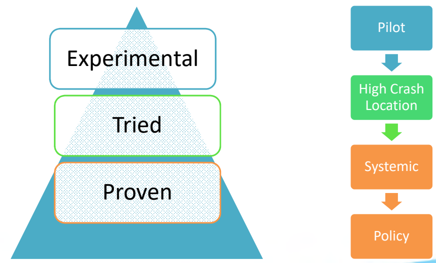
FHWA's 2017 Update of the Proven Safety Countermeasures

Make Your Mark
A Local Safety Peer Exchange
June 13, 2018

U.S. Department of Transportation
Federal Highway Administration

http://safety.fhwa.dot.gov

Life Cycle of a Safety Countermeasure



FHWA's Proven Safety Countermeasures

Intersection	Roadway Departure	Pedestrian	Crosscutting Strategies
• Left- and Right-Turn Lanes at Two-Stop Controlled Intersections • Backplates with Retroreflective Borders • Corridor Access Management • Yellow Change Interval • Roundabouts • Systemic Application of Multiple Low Cost Countermeasures at Stop-Controlled Intersections* • Reduced Left-Turn Conflict Intersections*	• Longitudinal Rumble Strips and Stripes along Two-Lane Highways • Median Barrier • SafetyEdge[SM] • Enhanced Delineation and Friction for Horizontal Curves • Roadside Design Improvements at Curves*	• Medians and Pedestrian Crossing Islands in Urban and Suburban Areas • Pedestrian Hybrid Beacon • Road Diet • Walkways • Leading Pedestrian Intervals*	• Road Safety Audits • Local Road Safety Plans* • US Limits*

PSC*i* – Intersections

- Left- and Right-Turn Lanes at Two-Way Stop-Controlled Intersections
- Backplates with Retroreflective Borders
- Corridor Access Management
- Yellow Change Interval
- Roundabouts
- Systemic Application of Multiple Low-Cost Countermeasures at Stop-Controlled Intersections
- Reduced Left-Turn Conflict Intersections

Left and Right Turn Lanes at Two-Way Stop-Controlled Intersections


Example of left-turn lanes.


Example of a right-turn lane.

SAFETY BENEFITS:

LEFT-TURN LANES
28-48%
Reduction in total crashes

RIGHT-TURN LANES
14-26%
Reduction in total crashes

Source: Highway Safety Manual

Backplates with Retroreflective Borders

Example of a signal backplate framed with a retroreflective border.

Safety Benefit:

15%
Reductions in total crashes

Source: CMF Clearinghouse, CMF ID 1410.

Corridor Access Management

This intersection design restricts left-turn movements to improve safety.

A raised median reduces conflict points along this roadway.

Use of roundabouts, raised median, and right-in/right-out driveways can be an effective access management plan.

SAFETY BENEFITS:

5-23%
Reduction in total crashes along 2-lane rural roads

25-31%
Reduction in injury and fatal crashes along urban/suburban arterials

Source: Highway Safety Manual

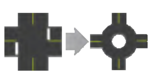
Yellow Change Interval

Safety Benefits of Well-Timed Yellow Change Intervals:
36-50%
Reduction in red light running
8-14%
Reduction in total crashes
12%
Reduction in injury crashes

Source: NCHRP Report 731, *Guidelines for Timing Yellow and All-Red Intervals at Signalized Intersections.*

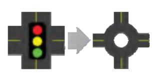
Roundabouts

Two-Way Stop-Controlled Intersection to a Roundabout



82%
Reduction in severe crashes

Signalized Intersection to a Roundabout



78%
Reduction in severe crashes

Source: *Highway Safety Manual*

Systemic Application of Multiple Low Cost Countermeasures at Stop-Controlled Intersections

- Mostly signing & pavement marking enhancements.
- Strategy relies on cost economy and treatment saturation.
- Best suited for intersections with under 20,000 AADT Total Entering.

Average Benefit/Cost Ratio
12:1

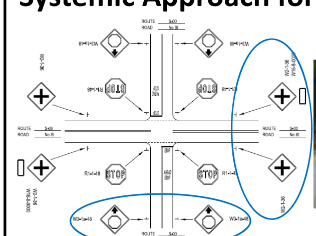
Systemic Approach for Stop Intersections

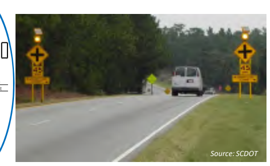
Evaluation Results from LCSI-PFS Study:

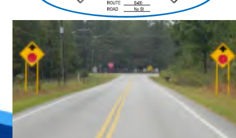
- Sample consisted of 434 treated sites and 568 reference sites across South Carolina.
- Included 2X2 (3-leg, 4-leg) and 4X2 (3-leg, 4-leg) sites.
- Range of 3-5 years before and after data.

Recommended CMFs from FHWA-HRT-17-086					
	Total	Fatal & Injury	Rear End	Right Angle	Nighttime
CMF	0.917	0.899	0.933	0.941	0.853

Systemic Approach for Stop Intersections

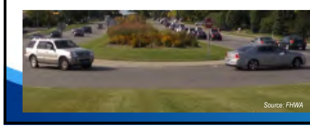


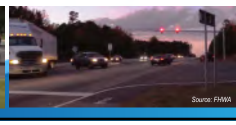

Source: SCDOT


Source: SCDOT

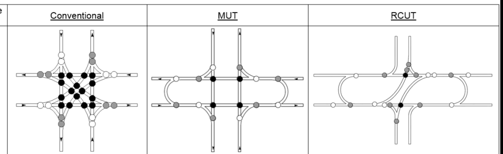
Reduced Left-Turn Conflict Intersections (MUT and RCUT)

- Geometric designs that alter how left-turn movements occur.
- Simplify and reduce or modify conflicts related to turning.
- Proven safety and operational benefits.





Reduced Left-Turn Conflict Intersections

Vehicle-Vehicle Conflict Points	Conventional	MUT	RCUT
● Crossing ◉ Merging ○ Diverging			
Crossing	16	4	2
Merging	8	6	6
Diverging	8	6	6
Total	32	16	14

Sources: FHWA-SA-14-069, FHWA-SA-14-070

MUT Safety Performance

- 30% decrease F&I Crashes.
- 16% decrease All Crashes.

RCUT Safety Performance

- 54% decrease F&I Crashes.
- 35% decrease All Crashes.

PSC*i* – Roadway Departure

- Longitudinal Rumble Strips and Stripes along Two-Lane Highways
- Median Barrier
- SafetyEdge[SM]
- Enhanced Delineation and Friction for Horizontal Curves
- Roadside Design Improvements at Curves

Longitudinal Rumble Strips and Stripes


Shoulder rumble strips and center line rumble stripes are installed on this roadway.


Example of an edge line rumble stripe.

SAFETY BENEFITS:

Center Line Rumble Strips
44-64%
Head-on, opposite-direction, and sideswipe fatal and injury crashes

Shoulder Rumble Strips
13-51%
Single vehicle, run-off-road fatal and injury crashes

Source: NCHRP Report 641, *Guidance for the Design and Application of Shoulder and Centerline Rumble Strips*

Median Barrier


Median cable barrier prevents a potential head-on crash.

SAFETY BENEFITS:
Median Barriers Installed on Rural Four-Lane Freeways
97%
Reduction in cross-median crashes

Soruce: NCHRP Report 794, *Median Cross-Section Design for Rural Divided Highways*

SafetyEdge$_{SM}$


Example of SafetyEdge$_{SM}$ after backfill material settles or erodes.

SAFETY BENEFIT:

11%
Reduction in fatal and injury crashes

Source: *Safety Effects of the SafetyEdge$_{SM}$*, FHWA-SA-17-044

SafetyEdge[SM] CMFs	
Drop-Off	0.655
ROR	0.790
Head-on	0.813
F+I	0.892
Total	0.989

Enhanced Delineation and Friction for Curves


Chevron signs installed along a curve.

SAFETY BENEFITS:
High Friction Surface Treatment
52%
Reduction in wet road crashes
24%
Reduction in curve crashes
Source: CMF Clearinghouse, CMF IDs 7900 and 7901

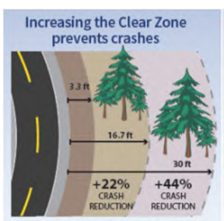
SAFETY BENEFITS:
Chevron Signs
25%
Reduction in nighttime crashes
16%
Reduction in non-intersection fatal and injury crashes
Source: CMF Clearinghouse, CMF IDs 2438 and 2439

Roadside Design Improvements at Curves

- Increase clear zone at curves.
  - Recommended by AASHTO RDG.
  - Proven to reduce crashes.
- Improve traversability.
  - Adding or widening shoulders in curves.
  - flatter slopes at curves than in tangent sections.
- Reconsider when to install barrier
  - Reduce severity.

Roadside Design Improvements at Curves

Increase Clear Zone on the Outside of Curves



Source: Leidos. Data Source: CMF Clearinghouse (CMF IDs 35 and 36)

27%
of all fatal crashes occur at cuves
80%
of all fatal crashes at curves are roadway departure crashes

PSC*i* – Pedestrians & Bicycles

- Medians and Pedestrian Crossing Islands in Urban and Suburban Areas
- Pedestrian Hybrid Beacon
- Road Diet
- Walkways
- Leading Pedestrian Intervals

Medians and Pedestrian Crossing Islands


Median and pedestrian crossing islands near a roundabout.


Example of a road with a median and pedestrian crossing islands.


Example of a pedestrian crossing island.

SAFETY BENEFITS:

Raised Median
46%
Reduction in pedestrian crashes

Pedestrian Crossing Island
56%
Reduction in pedestrian crashes

Source: Desktop Reference for Crash Reduction Factors, FHWA-SA-08-011, September 2008, Table 11

Pedestrian Hybrid Beacons


Pedestrians cross the roadway at a PHB location.

Example of PHBs mounted on a mast arm.

Safety Benefits:

69%
Reduction in pedestrian crashes

29%
Reduction in total crashes

15%
Reduction in serious injury and fatal crashes

Source: CMF Clearinghouse, CMF IDs: 2911, 2917, 2922

Road Diets

Before and after photos of a Road Diet project.


Road Diet project in Honolulu, Hawaii.

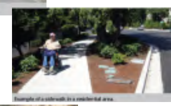
SAFETY BENEFIT:

4-Lane → 3-Lane
Road Diet Conversions
19-47%
Reduction in total crashes

Source: *Evaluation of Lane Reduction "Road Diet" Measures on Crashes*, FHWA-HRT-10-053.

Walkways


Example of a shared use path.


Example of a sidewalk in a residential area.


Paved shoulder used as a walkway

SAFETY BENEFITS:

Sidewalks 65-89%
Reduction in crashes involving pedestrians walking along roadways

Paved Shoulders 71%
Reduction in crashes involving pedestrians walking along roadways

Source: *Desktop Reference for Crash Reduction Factors*, FHWA-SA-08-011, Table 11

Leading Pedestrian Interval

NEW

- Pedestrians get "WALK" signal before vehicles get green light.
- Provides pedestrians a 3-7 second head start before vehicles are given a green indication.
- Allows pedestrians to establish presence in crosswalk before vehicles have priority to turn left.

Leading Pedestrian Interval

Benefits:

- 60% reduction in pedestrian-vehicle crashes at intersections.
- Increased visibility of crossing pedestrians.
- Reduced conflicts between pedestrians and vehicles.
- Increased likelihood of motorists yielding.

PSC*i* – Crosscutting Strategies

- Road Safety Audits
- Local Road Safety Plans
- USLIMITS2

Road Safety Audits

A road safety audit is a proactive formal safety performance examination of an existing or future road or intersection by an independent and multi-disciplinary team.


Multi-disciplinary team performs field review

SAFETY BENEFIT:

10-60%
Reduction in total crashes

Source: *Road Safety Audits: An Evaluation of RSA Programs and Projects*, FHWA-SA-12-037; and *FHWA Road Safety Audit Guidelines*, FHWA-SA-06-06.

Local Road Safety Plans

- Developing an LRSP is an effective strategy to improve local road safety.
- Local roads experience 3X the fatality rate of the Interstate Highway System.

USLIMITS2

- Free Web-based Tool
- Designed to help practictioners assess and establish safe, reasonable and consistent speed limits
- Supports customary engineering studies
- Produces unbiased and objective suggested speed limit value based on:
  - 50th and 85th percentile speeds
  - Traffic volumes
  - Roadway characteristics
  - Crash data

PSC*i* – Available Resources

http://safety.fhwa.dot.gov/provencountermeasures

- 1-pager marketing flyers.
- Slides from webinar and link to recorded session.
- Links to additional FHWA resources for each item.

Contacts for Further Information

Intersection Countermeasures:

Jeffrey Shaw jeffrey.shaw@dot.gov (708) 283-3524

Roadway Departure Countermeasures:

Menna Yassin menna.yassin@dot.gov (202) 366-2833

Cathy Satterfield cathy.satterfield@dot.gov (708) 283-3552

Pedestrian/Bicycle Countermeasures:

Tamara Redmon tamara.redmon@dot.gov (202) 366-4077

Crosscutting:

LRSP – Rosemarie Anderson rosemarie.anderson@dot.gov (202) 366-5007

RSA – Becky Crowe rebecca.crowe@dot.gov (804) 775-3381

USLIMITS2 – Guan Xu guan.xu@dot.gov (202) 366-5892

Additional Resources

- Crash Modification Factors Clearinghouse
  - http://www.cmfclearinghouse.org
- Systemic Safety Project Selection Tool
  - http://safety.fhwa.dot.gov/systemic
- US Roadway Assessment Program
  - http://www.usrap.org/
- Pedestrian and Bicycle Crash Analysis Tool
  - http://www.pedbikeinfo.org/pbcat_us/

Time to Share!!!

- Which of these countermeasures have you tried in your jurisdiction?
  - Successes?
  - Challenges?
- Have adopted any of these countermeasures into agency policies or design standards?
- What other proven safety countermeasures have you tried in your jurisdiction?

Make Your Mark

A Local Safety Peer Exchange

Daniel LiSanti, Manager NJDOT Bureau of Safety, Bicycle and Pedestrian Programs
Keith Skilton, FHWA NJ Division Highway Safety Improvement Program

Welcome

Event Overview

- Agenda
- Housekeeping
- Expectations

AGENDA

8:00-8:15AM	Registration
8:15-9:00AM	Introductions
9:00-9:10AM	Welcoming Remarks Mary D. Ameen, NJTPA Executive Director
9:10-9:40AM	NJ's Safety Performance Targets: Why It Matters Daniel LiSanti and Keith Skilton
9:40-10:40AM	Safety Voyager Overview and Monmouth County Demonstration Chris Zajac and Vince Cardone
10:40-10:55AM	*Break*
10:55-11:25AM	Understanding Substantive vs. Nominal Approaches to Design John McFadden
10:25-11:45AM	Breakout Sessions
11:45AM-12:30PM	*Lunch*
12:30-1:00PM	Somerset County's Approach to Systemic Safety Improvements Tricia Bates Smith
1:00-1:30 PM	Princeton's Approach to Traffic Calming Deanna Stockton
1:30-2:00 PM	FHWA's 2017 Update of the Proven Safety Countermeasures Karen Scurry
2:00-2:15PM	*Break*
2:15-3:00 PM	Breakout Sessions and Next Steps Planning
3:00-3:45PM	Attendee Report Outs Review of Breakout Discussion Questions

Ground Rules

Introductions

- Name
- Organization
- Position
- Role with Respect to Local Safety Program

Welcome

Mary D. Ameen
Executive Director
NJTPA

Today's Take-Aways…..

- NJ's Zero Death Vision & Safety Performance Targets
- Pedestrian & Intersection Focus State
- NJ Design Manual Compliance = Maximum Safety Benefit
- Partnering WE CAN MAKE A POSITIVE DIFFERENCE FOR SAFETY!

Safety Target Setting

	Five Performance Measures
✓	Number of Fatalities
✓	Rate of Fatalities per 100 Million VMT
✓	Number of Serious Injuries
✓	Rate of Serious Injuries per 100 Million VMT
✓	Number of Non-motorized Fatalities and Non-motorized Serious Injuries

Intersection & Pedestrian Focus State

HSIP Purpose & Components

- Rail Highway Grade Crossing Program set-aside
- Highway Safety Improvement Program

Achieve significant reduction in fatalities & serious injuries on ALL PUBLIC ROADS.

Highway Safety Improvement Program

- Strategic Highway Safety Plan
- Data Driven All Public Roads
- Safety Target Setting Performance Measures
- Annual Safety Reporting

Achieve significant reduction in fatalities & serious injuries on ALL PUBLIC ROADS.

NJ's SHSP - PLAN

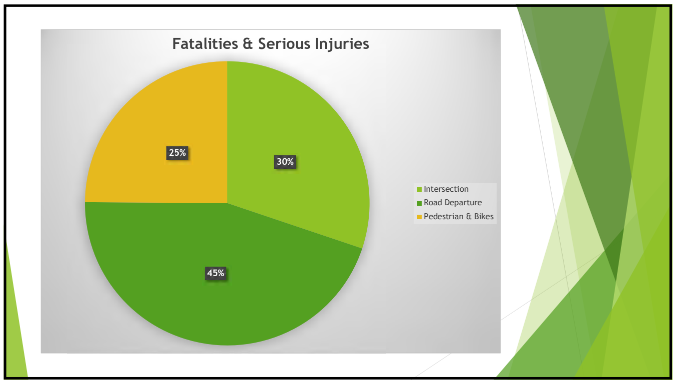
- Updating every 5 years
- Statewide Plan – all 4 E's
- Signed by Governor or Governor's Representative
- Overall Goal for NJ
- HSIP project eligibility dependent upon identified element in SHSP

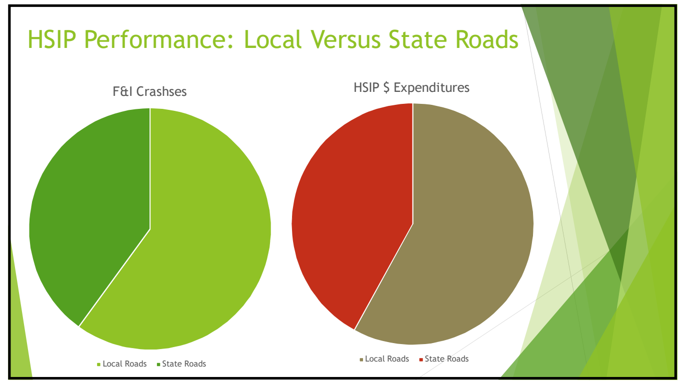
"Vision without action is a dream, Action without vision is a nightmare."

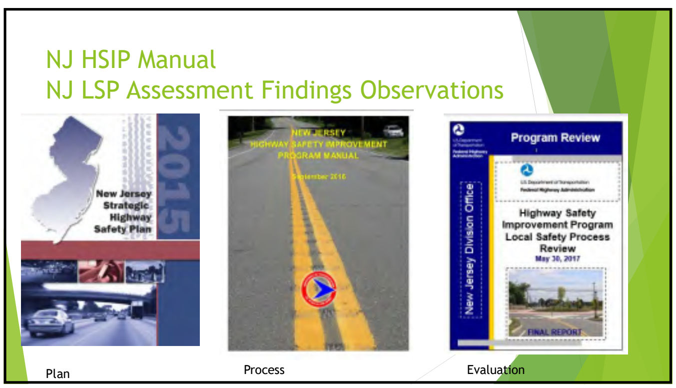
TABLE 3-1
Distribution of Roadway Miles and Fatalities and Serious Injuries By Jurisdiction, Facility Type, and Crash Type

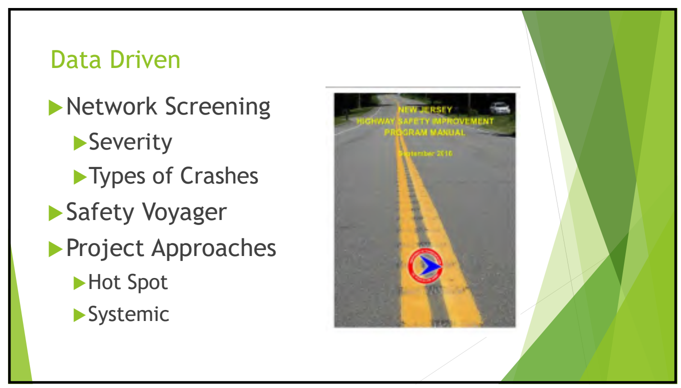
	State Road System					Local Road System			
		State Highway							
	Interstate	Total	Urban	Rural	Unknown	County	Municipal	Other	Statewide
Roadway Length	State: 2,757 miles (7%)					Local: 35,820 miles (89%)			
Miles	—	—	—	—	—	6,826	28,994	1,718	40,296
% Total Miles	—	—	—	—	—	17%	72%	4%	100%
Total Fatalities and Serious Injuries	State: 3,265 (33%)					Local: 5,735 (57%)			
Number	413	2,852	2,284	282	286	3,385	2,350	1,037	10,037
% Total Fatalities and Serious Injuries	4%	28%	23%	3%	3%	34%	23%	10%	100%
Lane Departure	State: 1,515 (33%)					Local: 2,569 (56%)			
Number	272	1,243	936	184	123	1,658	911	512	4,596
% Total Fatalities and Serious Injuries	6%	27%	20%	4%	3%	36%	20%	11%	100%
Intersections	State: 1,002 (33%)					Local: 2,028 (66%)			
Number	10	992	831	78	83	1,215	813	50	3,080
% Total Fatalities and Serious Injuries	0%	32%	27%	3%	3%	39%	26%	2%	100%
Pedestrians/Bicycles	State: 709 (28%)					Local: 1,565 (62%)			
Number	44	665	590	15	60	815	750	266	2,340
% Total Fatalities and Serious Injuries	2%	28%	23%	1%	2%	32%	30%	10%	100%

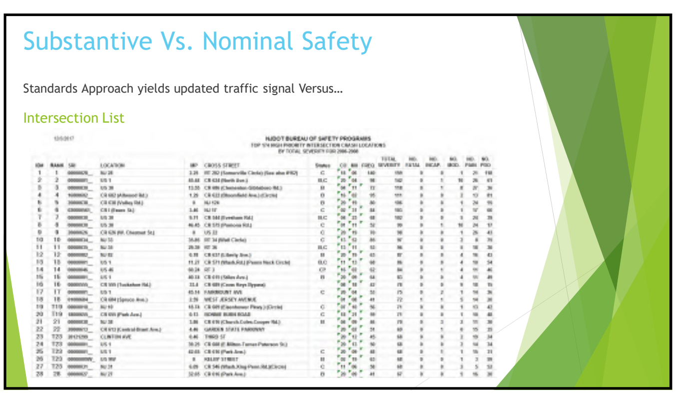
NJ's Data

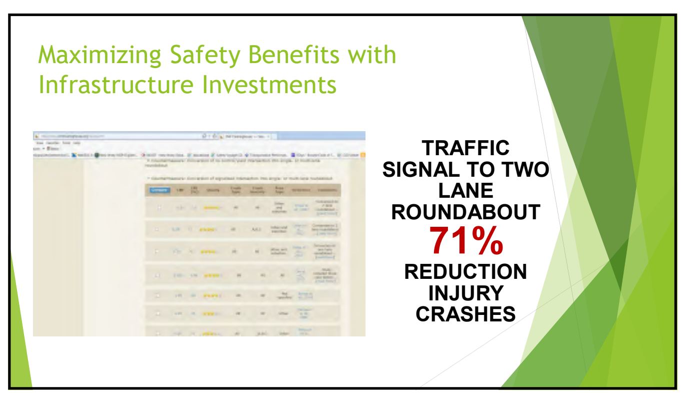

Fatalities & Serious Injuries
25%
30%
45%
Intersection
Road Departure
Pedestrian & Bikes


HSIP Performance: Local Versus State Roads
F&I Crashses
HSIP $ Expenditures
Local Roads
State Roads
Local Roads
State Roads

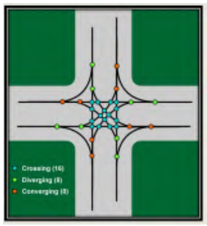

NJ HSIP Manual
NJ LSP Assessment Findings Observations
2015
New Jersey Strategic Highway Safety Plan
NEW JERSEY HIGHWAY SAFETY IMPROVEMENT PROGRAM MANUAL
September 2016
Program Review
New Jersey Division Office
Highway Safety Improvement Program Local Safety Process Review
May 30, 2017
FINAL REPORT
Plan
Process
Evaluation

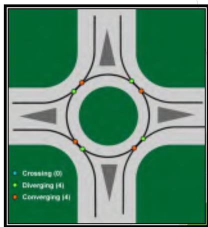

Data Driven
Network Screening
Severity
Types of Crashes
Safety Voyager
Project Approaches
Hot Spot
Systemic
NEW JERSEY HIGHWAY SAFETY IMPROVEMENT PROGRAM MANUAL
September 2016


Substantive Vs. Nominal Safety
Standards Approach yields updated traffic signal Versus…
Intersection List

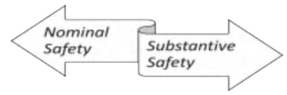

Maximizing Safety Benefits with Infrastructure Investments
TRAFFIC SIGNAL TO TWO LANE ROUNDABOUT
71%
REDUCTION INJURY CRASHES

The difference between conflicts





Nominal Versus Substantive



Compliance with standards, warrants, guidelines

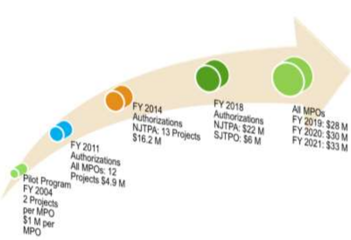
Predicted crashes frequency & severity

Balancing Project Needs

Continuing Evolution of Safety Programs

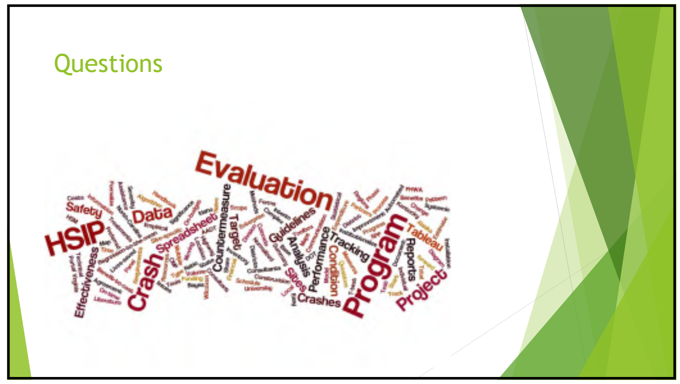
- Changes in Methodologies and Procedures
  - 2016 HSIP Program Manual
  - Using the HSM as a tool (predictive methods)
- Modifications to Program/Project Development
  - Full scope projects can now be developed enabling substantive assessments in lieu of low cost countermeasures within confines of existing ROW and without modifying existing geometry
  - Systemic Programs/Projects

LSP Process
HSIP Funding on Local Roads

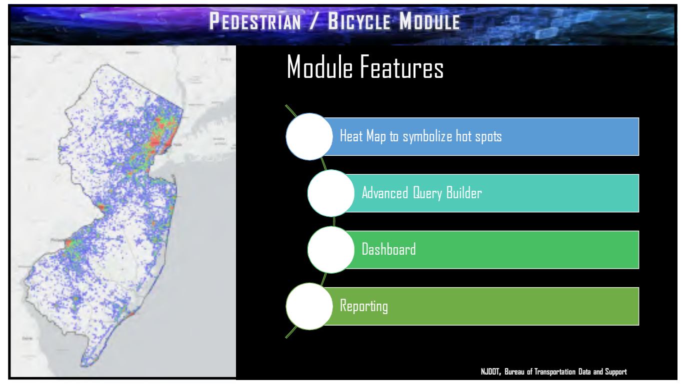


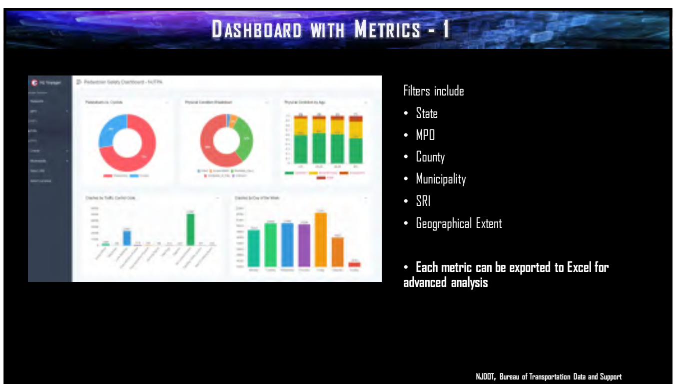
Evaluation of Effectiveness Toward Achieving Safety Performance Targets

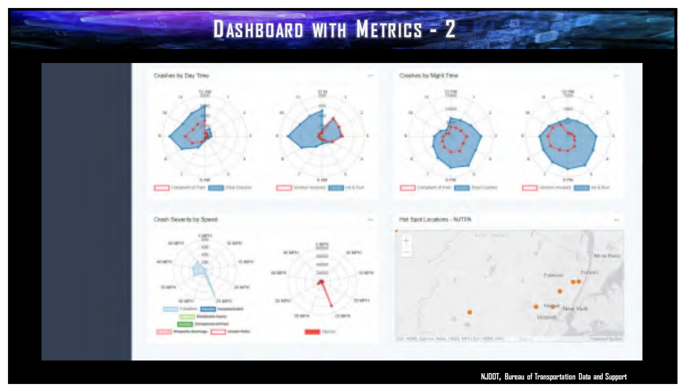

How many of N.J.'s 270K accidents did your town have last year?
s deadlies
ties in 20
Morris
Mercer
Gallery: N.J.'s deadliest counties in 2016
94

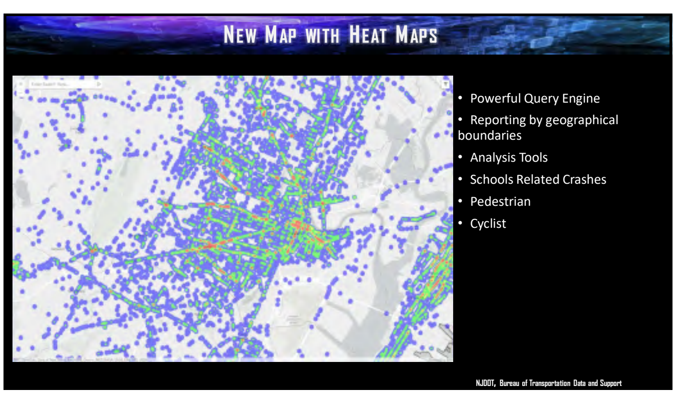

Questions
Evaluation
HSIP
Crash
Data
Program
Project
Safety
Effectiveness
Countermeasure
Spreadsheet
Guidelines
Analysis
Tracking
Tableau
Reports
Crashes
Performance

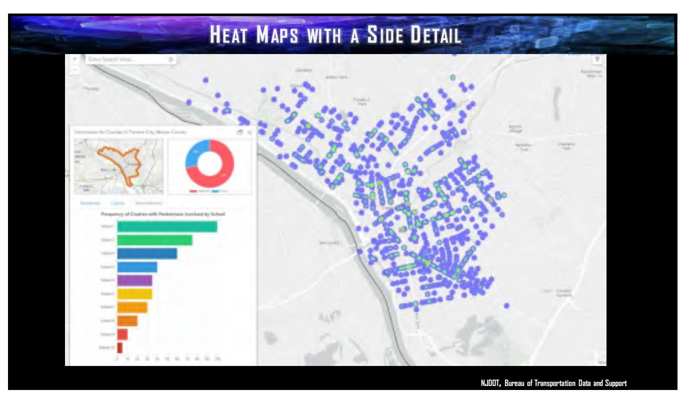

NJ Department of Transportation
GPI
Safety Voyager
Email address
Password
Sign In
Reset Password
SAFETY VOYAGER
U.S. Department of Transportation
Federal Highway Administration


PEDESTRIAN / BICYCLE MODULE
Module Features
Heat Map to symbolize hot spots
Advanced Query Builder
Dashboard
Reporting
NJDOT, Bureau of Transportation Data and Support

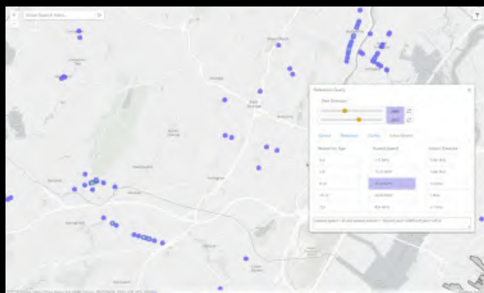

DASHBOARD WITH METRICS - 1
Filters include
• State
• MPO
• County
• Municipality
• SRI
• Geographical Extent
• Each metric can be exported to Excel for advanced analysis
NJDOT, Bureau of Transportation Data and Support


DASHBOARD WITH METRICS - 2
NJDOT, Bureau of Transportation Data and Support

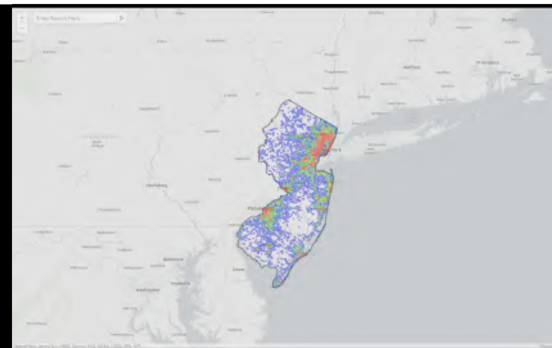

NEW MAP WITH HEAT MAPS
• Powerful Query Engine
• Reporting by geographical boundaries
• Analysis Tools
• Schools Related Crashes
• Pedestrian
• Cyclist
NJDOT, Bureau of Transportation Data and Support


HEAT MAPS WITH A SIDE DETAIL
NJDOT, Bureau of Transportation Data and Support

New Query Engine



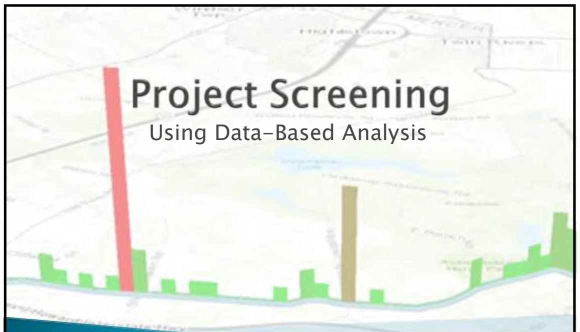
Sample: Query for 20-25 mph zones and year 2008-2012



Thank You For Your Attention

Questions ?

Contact Info:
Chris Zajac
609-963-1893
chris.zajac@dot.nj.gov



Project Screening

Using Data-Based Analysis

Vincent Cardone
Principal Engineer II, Traffic
Monmouth County

High Risk Rural Roads Program

- Competitive program administered by MPO
- Uses funds from the Federal Highway Administration's Highway Safety Improvements Program (HSIP).
- Only NJTPA member subregions are eligible to submit applications to the NJTPA for these programs. Municipalities located within the subregions may recommend a project to their respective county

High Risk Rural Roads Program

- For projects to be advanced in FY 2018 all environmental approvals, local approval, and right-of-way acquisition must be completed and a full set of PS&E documents submitted to the Local Aid office by a set deadline.

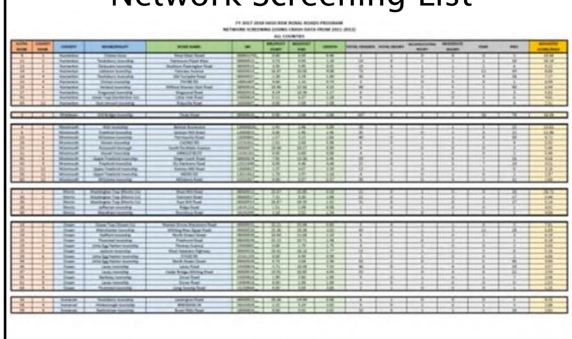
High Risk Rural Roads Program

- Project sponsors must give consideration to modern roundabouts for all new intersection and intersection upgrade projects.
- The National Environmental Policy Act (NEPA) regulations must be followed. As such, projects must have minimal or no environmental and cultural resource impacts.
- Projects must be completed within 24 months of receiving federal authorization.

High Risk Rural Roads Program

- The following types of projects are NOT eligible:
  - improvements involving State, U.S. and Interstate highways including any improvements at intersections with such facilities;
  - routine maintenance/ replacement projects (including general resurfacing projects)
  - congestion management/ roadway capacity enhancements (road widening)
  - Aesthetic improvements along the rights-of-way.

NJTPA High Risk Rural Roads Network Screening List



Monmouth County List

NJTPA RANK	COUNTY RANK	COUNTY	MUNICIPALITY	ROAD NAME	SRI	MILEPOST START	MILEPOST END	LENGTH
4	1	Monmouth	Wall township	Belmar Boulevard	130000181_	1.41	2.46	1.05
6	1	Monmouth	Freehold township	Jackson Mill Road	13000023__	0.00	1.45	1.45
15	4	Monmouth	Millstone township	Perrineville Road	13000001__	1.57	3.23	1.66
26	8	Monmouth	Howell township	CASINO RD	13191012__	2.62	3.60	0.98
31	8	Monmouth	Roosevelt borough	South Rochdale Avenue	00000571__	29.68	30.57	0.89
31	8	Monmouth	Howell township	ARNOLD BLVD	13191101__	0.00	0.89	0.89
42	9	Monmouth	Upper Freehold township	Stage Coach Road	00000524__	7.91	13.36	5.45
43	9	Monmouth	Freehold township	Ely Harmony Road	13321049__	0.00	4.46	4.46
51	12	Monmouth	Upper Freehold township	Holmes Mill Road	13000027__	1.37	4.67	3.30
56	12	Monmouth	Upper Freehold township	MEIRS RD	13511013__	1.79	3.97	2.18
60	12	Monmouth	Millstone township	Millstone Road	13321017__	0.00	5.57	5.57

ROAD NAME	SRI	TOTAL CRASHES	FATAL INJURY	INCAPACITATING INJURY	MODERATE INJURY	PAIN	PDO	Weighted Score/mile
Belmar Boulevard	130000181_	28	0	2	1	3	22	13.61
Jackson Mill Road	13000023__	35	1	0	3	9	22	12.98
Perrineville Road	13000001__	40	0	1	1	8	30	8.72
CASINO RD	13191012__	6	0	1	0	1	4	5.93
South Rochdale Avenue	00000571__	4	1	0	0	0	3	5.40
ARNOLD BLVD	13191101__	4	0	1	0	0	3	5.40
Stage Coach Road	00000524__	29	1	1	5	7	15	4.58
Ely Harmony Road	13321049__	37	0	1	5	7	24	4.52
Holmes Mill Road	13000027__	13	1	0	3	1	8	3.28
MEIRS RD	13511013__	4	1	0	1	0	2	2.97
Millstone Road	13321017__	39	1	0	4	3	31	2.60

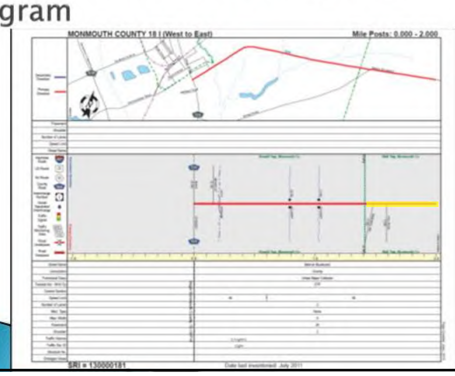
Monmouth County List

Lists are ranked assuming the weight of a fatal crash is the same as an incapacitating injury crash and using the value of a Complaint of Pain injury as the base value (K=A, no Property Damage only (PDO)).

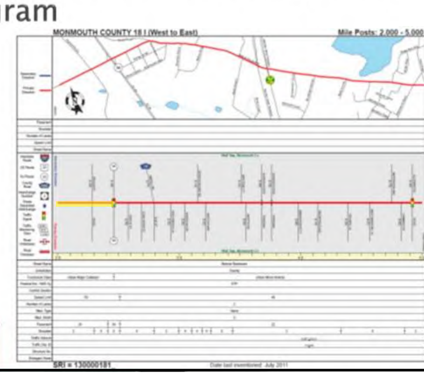
		HSM (FHWA-HRT-05-051) Link	Published 2005	Weighting Factors		
		2001 dollars	2012 dollars (KABCO)	KABCO Weight	KnA Weight	KnA No PDO Weight
K	Fatal	$ 4,008,900	$ 5,197,200	89.30	4.81	2.73
ABC	ALL INJURY	$ 82,600	$ 107,100			
A	Incapacitating	$ 216,000	$ 280,000	4.81	4.81	2.73
B	Moderate	$ 79,000	$ 102,400	1.76	1.76	1.00
C	Complaint of Pain	$ 44,900	$ 58,200	1.00	1.00	0.57
O	PDO	$ 7,400	$ 9,600	0.16	0.16	0.00

ROAD NAME	SRI	TOTAL CRASHES	FATAL INJURY	INCAPACITATING INJURY	MODERATE INJURY	PAIN	PDO	Weighted Score/mile
Belmar Boulevard	130000181_	28	0	2	1	3	22	13.61
Jackson Mill Road	13000023__	35	1	0	3	9	22	12.98
Perrineville Road	13000001__	40	0	1	1	8	30	8.72
CASINO RD	13191012__	6	0	1	0	1	4	5.93
South Rochdale Avenue	00000571__	4	1	0	0	0	3	5.40
ARNOLD BLVD	13191101__	4	0	1	0	0	3	5.40
Stage Coach Road	00000524__	29	1	1	5	7	15	4.58
Ely Harmony Road	13321049__	37	0	1	5	7	24	4.52
Holmes Mill Road	13000027__	13	1	0	3	1	8	3.28
MEIRS RD	13511013__	4	1	0	1	0	2	2.97
Millstone Road	13321017__	39	1	0	4	3	31	2.60

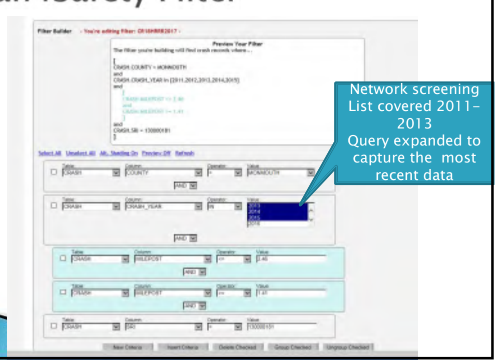
Identify location on straight line diagram



Identify location on straight line diagram

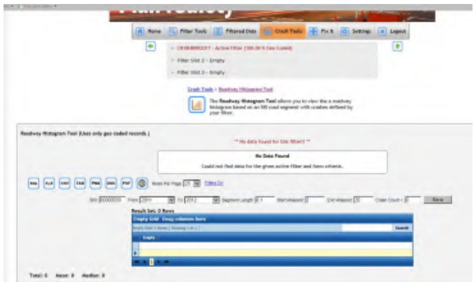


Plan4Safety Filter

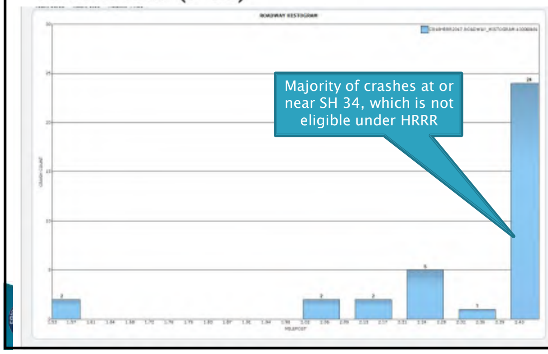


Plan4Safety GIS Point View

Use crash tools to create a road histogram (P4S)



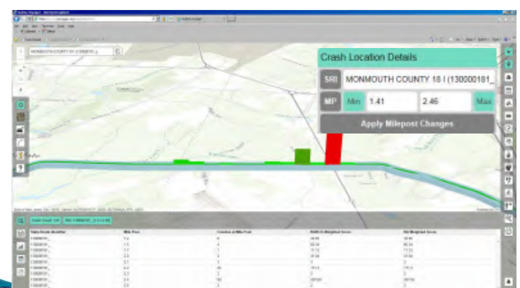
Road Histogram reveals crash locations (P4S)



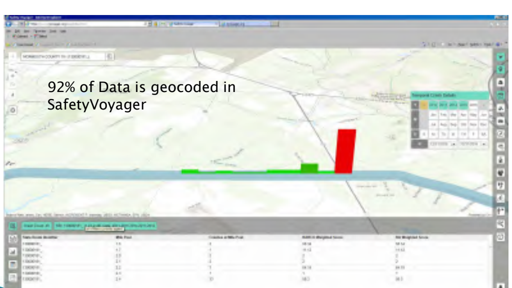
Safety Voyager

- Process using Safety Voyager is similar, but results are obtained faster

Crash SRI and Milepost



Filters are easy to find



Review remainder of screening list

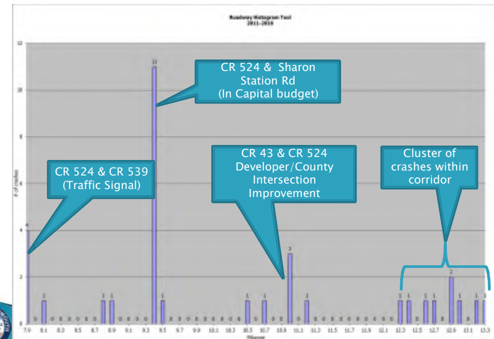
- Iterative process
- Need to diagnose the problem before coming up with a solution

Review remainder of screening list

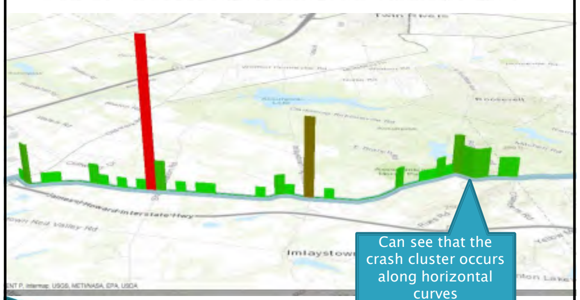
4	1	Monmouth	Wall township	Belmar Boulevard	130000131_	1.41	2.46	1.05
6	1	Monmouth	Freehold township	Jackson Mill Road	13000023_	0.00	1.45	1.45
15	4	Monmouth	Millstone township	Perrineville Road	13000001_	1.57	3.23	1.66
26	8	Monmouth	Howell township	CASINO RD	13191012_	2.62	3.60	0.98
31	8	Monmouth	Roosevelt borough	South Rochdale Avenue	00000571_	29.68	30.57	0.89
31	8	Monmouth	Howell township	ARNOLD BLVD	13191101_	0.00	0.89	0.89
42	9	Monmouth	Upper Freehold township	Stage Coach Road	00000524_	7.91	13.36	5.45
43	9	Monmouth	Freehold township	Ely Harmony Road	13321049_	0.00	4.46	4.46
51	12	Monmouth	Upper Freehold township	Holmes Mill Road	13000027_	1.37	4.67	3.30
56	12	Monmouth	Upper Freehold township	MEIRS RD	13511013_	1.79	3.97	2.18
60	12	Monmouth	Millstone township	Millstone Road	13321017_	0.00	5.57	5.57

- Jackson Mills Rd corridor included several Developer-lead projects that were yet to be constructed
- Perrineville Rd-reviewed intersection of CR 1 & Millstone Rd for possible roundabout-Green Acres implications and ROW impacts would not qualify under HRRR
- Casino Rd, South Rochdale Ave, & Arnold Blvd had 3 to 4 crashes per corridor-Cost/Benefit would be low
- CR 524 (Stage Coach Rd)-Several "hot spots"
  - CR 524 & CR 539-Traffic Signal installed by Developer
  - CR 524 & Sharon Station Rd-Discussions with Upper Freehold for large-scale project outside funding limits of HRRR
  - Several fixed object crashes in the corridor, especially along easterly portion (connects to segment previously approved by HRRR)

CR 524 Histogram (P4S)



CR 524 Histogram-SafetyVoyager



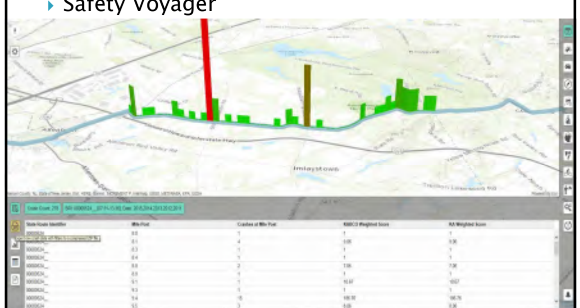
Detailed Crash Data

Detailed Crash Data

- Plan4Safety

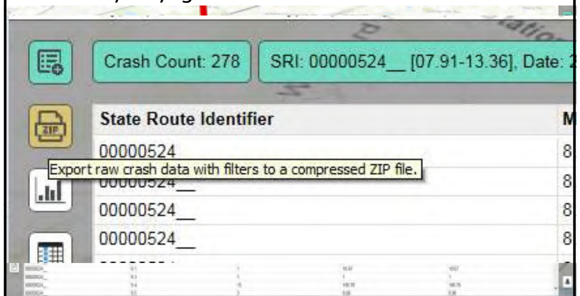
Detailed Crash Data

- Safety Voyager



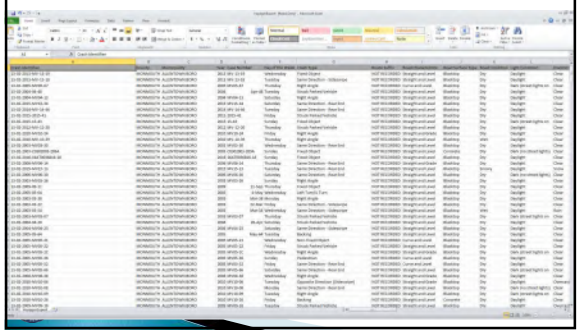
Detailed Crash Data

- Safety Voyager



Detailed Crash Data

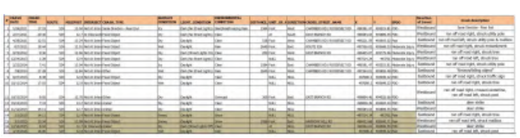
- Safety Voyager



Crash Diagram/Crash table

Crash Diagram/Crash table

Crash Diagram/Crash Table



Crash Diagram/Crash Table

DATE:	26-Jul-15	BY:	VC
ANALYSIS PERIOD:	Jan 2011 to Dec 2013		

	12	1	2	3	4	5	6	7	8	9	10	11
AM	1	1					1	2	1	1		
PM	1	1	2		1	2	1		1	1		

Crash Year	No. of Crashes
2011	4
2012	1
2013	1
2014	7
2015	3
2016	1

Light condition	No. of Crashes
Daylight	11
Dark (No Street Lights)	3
Dark (Street Lights On/ spot)	1
Dark (Street Lights Off)	1

Surface	No. of Crashes
Dry	9
Wet	4
Snowy	2
Icy	2

Type of Crash	No. of Crashes	% of Total
Backing	0	0%
Fixed object	13	76%
Left turn/U turn	0	0%
Opp. direction	0	0%
Headon/Angular	0	0%
Petalcyclist	0	0%
Pedestrian	0	0%
Right Angle	0	0%
Rear end	1	6%
Side swipe	0	0%
Animal	3	18%

Severity	No. of Crashes
PDO	9
Pain	4
Moderate Injury	4
Incapacitating Injury	0
Fatal Injury	0

Countermeasures selected based on crash type

- High friction surface treatment (FHWA proven Safety Countermeasure)
- Centerline rumble strips (FHWA proven Safety Countermeasure)
- Safety Edge pavement edge treatment (FHWA proven Safety Countermeasure)
- 8" edge line marking
- Raised pavement markers on center line
- Additional signage for advanced guidance on roadway
- Sign upgrades based on advisory speed limits determined by ball banking
- Improve sign visibility by installation of retroreflective post covers
- Chevrons and/or other traffic control devices to provide further guidance through curves
- Brush clearing to improve line of sight
- Installation of breakaway roadside fixtures within clear zone

Crash Modification Factors

http://www.cmfclearinghouse.org/

Crash Modification factors

Treatment	Crash modifcation factor			
	Total		Fatal/Injury	
	CMF #	CMF	CMF #	CMF
High Friction Surface Treatment	7900	0.759	N/A	1
Safety Edge	4303	0.923	4323	0.835
Centerline Rumble Strip	3364	0.83	3368	0.63
Combined CMF		0.581		0.526
Predicted Crash Rate-Existing Conditions		2.343		0.846
Predicted Crash Rate-Post-construction		**1.362**		**0.445**

Cost/Benefit Analysis can be performed by comparing KABCO costs with and without modification factors vs estimated project cost (over the service life of the improvement)

KABCO Costs

	Injury Severity		Estimated Cost	
			2001*	**2016/17**
	Fatal	(K)	$4,008,900	$5,447,373.00
	Fatal and/or Injury	(K/A/B/C)	$158,200	$214,965.30
	Injury	(A/B/C)	$82,600	$112,238.52
"Incapacitating"------ >	Disability Injury	(A)	$216,000	$293,505.09
"Moderate"---------- >	Evident Injury	(B)	$79,000	$107,346.77
"Complaint of Pain"--- >	Possible Injury	(C)	$44,900	$61,011.01
	Property Damage Only	(O)	$7,400	$10,055.27

* *Societal Crash Costs by Severity, FHWA-HRT-05-051, October 2005*

KABCO Costs

https://www.fhwa.dot.gov/publications/research/safety/05051/05051.pdf

Concept Plan

Concept Plan

- 3 segments in this phase, totaling 1.7 miles
- Awarded $2,967,000 in HRRR funding
  - Design
  - Construction
  - Construction inspection

Summary

- Follow the guidelines for the funding solicitations
- Develop a process for selecting potential projects
  - Start with “high level” data (i.e. network screening lists)
  - Narrow down to a specific corridor or location
  - Identify crash patterns & develop a problem statement
  - Identify potential countermeasures
  - Evaluate the potential effect of countermeasures (i.e. use CMF)
- Effective understanding and presentation of data will help the people that make the decisions.

Thank You

vince.cardone@co.monmouth.nj.us

Vincent Cardone
Principal Engineer II, Traffic
Monmouth County

Data-Driven Safety Analysis – Nominal vs. Substantive Safety.

Integrating Safety Performance into ALL Highway Investment Decisions

U.S. Department of Transportation
Federal Highway Administration

"Safety"

- A core value for all transportation agencies
- Our customers have been assured that maintaining and improving safety is a top priority
- Much of an agency's investments are intended to produce a "safe" highway or system
- "Safety" has traditionally been incorporated in highway programs and projects within a standards-based framework

2

Approaches for Considering Safety

Nominal Safety

Substantive Safety

Source: AASHTO

Examined in reference to compliance with standards, warrants, guidelines and sanctioned design procedures

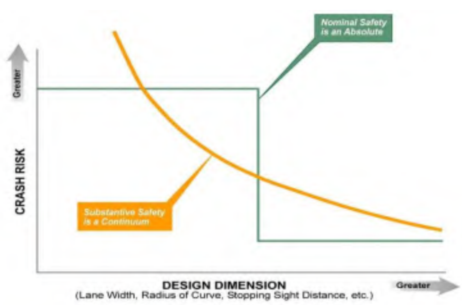
The actual or expected performance in terms of crash frequency and severity

Source: AASHTO

Adapted from Ezra Hauer, ITE Traffic Safety Toolbox Introduction, 1999

3

Nominal vs Substantive Safety



4

Hwy Design Standards in the U.S.

Initially, AASHO's Committee on Standards confined itself to disseminating information on design to its members, but in 1928 it proposed that the Association adopt "standards of practice" to guide the member States in technical matters in which some uniformity from State to State was urgently needed. As a result, on March 1, 1928, AASHO approved its first four standards which read as follows:

- That wherever practicable shoulders along the edges of pavements shall have a standard width of not less than 8 feet.
- That on pavements 10 feet shall be considered as the standard width for each traffic lane.
- That the crown of a two-lane concrete pavement shall be 1 inch.
- That no part of a concrete pavement shall have a thickness of less than 6 inches, and that all unsupported edges shall be strengthened. *(6)*

B-5

Hwy Design Standards in the U.S.

TABLE 1-1
Evolution of AASHTO (AASHO) Design Policies in the United States[1]

A Policy on Highway Classification, September 16, 1938
A Policy on Highway Types (Geometric), February 13, 1940
A Policy on Sight Distance for Highways, February 17, 1940
A Policy on Criteria for Marking and Signing No-Passing Zones for Two and Three-Lane Roads, February 17, 1940
A Policy on Intersections at Grade, October 7, 1940
A Policy on Rotary Intersections, September 26, 1941
A Policy on Grade Separations for Intersecting Highways, June 19, 1944
A Policy on Design Standards-Interstate, Primary and Secondary Systems, 1945
Policies on Geometric Highway Design, 1950
A Policy on Geometric Design of Rural Highways, 1954
A Policy on Arterial Highways in Urban Areas, 1957
A Policy on Geometric Design of Rural Highways, 1965
A Policy on Design of Urban Highways and Arterial Streets, 1973
A Policy on Geometric Design of Highways and Streets, 1984
A Policy on Geometric Design of Highways and Streets, 1990
A Policy on Geometric Design of Highways and Streets, 1994
A Policy on Geometric Design of Highways and Streets, 2001

B-6

Hwy Design Standards in the U.S.

TITLE 23 - HIGHWAYS
CHAPTER 1 - FEDERAL-AID HIGHWAYS

§ 109. Standards

(a) **In General.**— The Secretary shall ensure that the plans and specifications for each proposed highway project under this chapter provide for a facility that will—

(1) adequately serve the existing and planned future traffic of the highway in a manner that is conducive to safety, durability, and economy of maintenance; and

(2) be designed and constructed in accordance with criteria best suited to accomplish the objectives described in paragraph (1) and to conform to the particular needs of each locality.

Federal Highway Administration, DOT

in the geometric and structural design of highways.

§ 625.2 **Policy.**

(a) Plans and specifications for proposed National Highway System (NHS) projects shall provide for a facility that will—

(1) Adequately serve the existing and planned future traffic of the highway in a manner that is conducive to safety, durability, and economy of maintenance; and

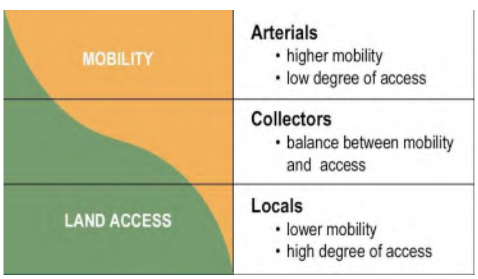
(2) Be designed and constructed in accordance with criteria best suited to accomplish the objectives described in paragraph (a)(1) of this section and to conform to the particular needs of each locality.

B-7

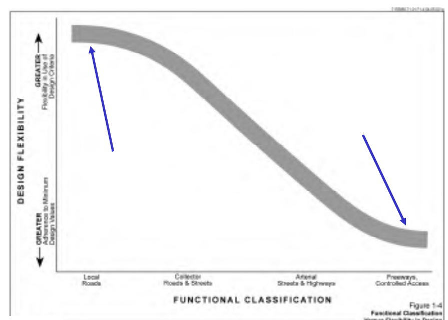
FHWA Adopts AASHTO for NHS

B-8

Defining the Function



Functional Classification



FHWA Standards Only for NHS

(o) **Compliance With State Laws for Non-NHS Projects.—** Projects (other than highway projects on the National Highway System) shall be designed, constructed, operated, and maintained in accordance with State laws, regulations, directives, safety standards, design standards, and construction standards.

B-11

States Designate Standards Off NHS

B-12

A Predictive Illustration…

All three of these meet design standards…

Source: CH2MHILL

but predictive analysis tells us they would perform very differently from a safety perspective.

13

The EDC Data-Driven Safety Analysis Initiative…

- Goal: Integrate **safety performance** into **ALL** highway investment decisions

14

What is the HSM?

- A tool that applies an **evidence-based** technical approach to safety
- Provides reliable **estimates** of an existing or proposed roadway's **expected safety performance**.
- Helps agencies **quantify** the **safety impacts** of transportation decisions, similar to the way agencies quantify:
  - traffic growth
  - environmental impacts
  - traffic operations
  - pavement life
  - construction costs

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The Vision for the HSM

A Document Akin To the HCM…

1. Definitive; represents quantitative 'state-of-the-art' information
2. Widely accepted within professional practice of transportation engineering
3. Science-based; updated regularly to reflect research

16

AASHTO Highway Safety Manual, First Edition

2010 Release:

- Rural Two-Lane Roads
- Multilane Rural Highways
- Urban/Suburban Arterials

2014 Supplement:

- Freeway Segments
- Ramps
- Ramp Terminals

17

Highway Safety Manual Organization

Part A	Introduction, Human Factors & Fundamentals
Part B	Safety Management Process
Part C	Predictive Methods
Part D	Crash Modification Factors

18

HSM Companion Software

HSM Part	Supporting Tool
PART B: Roadway Safety Management Process	AASHTOWare SafetyAnalyst Agile Assets Safety Analyst CARE Numetric usRAP Vision Zero Suite Other commercial… State-Developed
PART C: Predictive Methods	HSM & ISATe Spreadsheets IHSDM
PART D: CMFs	FHWA CMF Clearinghouse

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Design Practice Involves Risk

- Two fundamental types of risk:
  - Risk of tort lawsuits arising from crashes alleged to be associated with a design ("Tort Risk")
  - Risk of the solution not performing as expected in terms of safety and operations ("Engineering Risk")

B-20

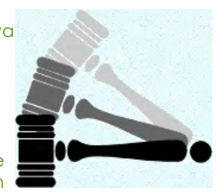
Tort Risk

- Adherence to criteria does not automatically prove *reasonable care*
- Deviation from criteria does not automatically prove *negligence*

B-21

Tort Risk

- In most jurisdictions, the Court does not have authority to rule that the design decision wa the "correct" choice
- The Court can only render judgment on whether the process was complete and whether the outcome was reasonable given the process



B-22

Meeting Design Criteria Important

- "Transportation agencies limit greatly the risk of a successful tort suit by focusing on design solutions that are proven, i.e., that are within current design guidelines and criteria".
- "Providing a nominally safe design is the first and major step toward minimizing tort risk".

B-23

Engineering Risk

- How good (or poor) is the existing substantive safety performance?
- What should the long term safety performance of the roadway be?
- What is the difference in expected substantive safety if the exception is implemented?

B-24

Engineering Risk

- What is the degree to which a standard is being reduced?
- Will the exception affect other geometric elements?
- What additional features will be introduced, (e.g., signing or delineation) that would mitigate the potential adverse effects of the exception?

B-25

CSS Approach Helps Minimize Risk

- It is an unavoidable fact that DOTs face public and legal scrutiny for virtually all their actions.
- However, if a design team works closely with stakeholders, is creative within the bounds of good engineering practice, and fully documents all decisions, they will have gone a long way toward minimizing the risk associated with a future tort action should that occur

B-26

Case Study – Arizona DOT

Parameters for Existing & Proposed Conditions:

- Used IHSDM to perform safety analysis

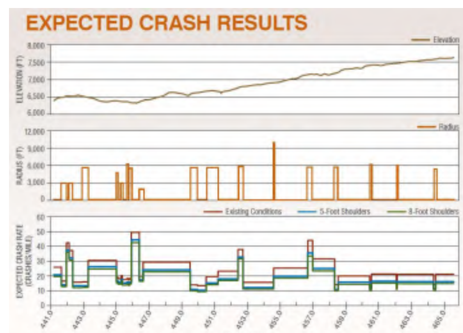
ROADWAY ELEMENT	HSM Base Condition	Existing SR 264 (1-Foot Shoulders)	Alternative A (5-Foot Shoulders)	Alternative B (8-Foot Shoulders)
Lane width	12-Foot	12-Foot	12-Foot	12-Foot
Shoulder width	6-Foot	1-Foot	5-Foot	8-Foot
Shoulder type	Paved	Paved	Paved	Paved
Roadside hazard rating	3	Varies (6 or 7 most frequent)	Varies (1 or 2 most frequent)	Varies (1 or 2 most frequent)
Driveway density	≤ 5 per mile	Per survey & Holbrook District turnout database	Per survey & Holbrook District turnout database	Per survey & Holbrook District turnout database
Horizontal curves: length, radius, and presence or absence of spiral transitions	None	Per best fit alignment	Per best fit alignment (match existing)	Per best fit alignment (match existing)
Horizontal curves: Superelevation	None	Per as-builts & survey	Per as-builts & survey (match existing)	Per as-builts & survey (match existing)
Grades	≤ 3%	Per as-builts & survey	Per as-builts & survey (match existing)	Per as-builts & survey (match existing)
Centerline rumble strips	None	None	Present	Present
Passing lanes	None	Per survey	Per survey (match existing)	Per survey (match existing)
Two-way left-turn lanes	None	Per survey	Per survey (match existing)	Per survey (match existing)
Lighting	None	Present @ US 191 Intersection	Present @ US 191 Intersection (match existing)	Present @ US 191 Intersection (match existing)
Automated speed enforcement	None	None	None	None

Source: Arizona DOT

B-27 27

Case Study – Arizona DOT

Plot of Geometric Features and Expected Crashes



Source: Arizona DOT

28

Case Study – Arizona DOT

Crash Prediction Results

Expected Crash Frequency by Severity: 2016–2036
Source: Arizona Department of Transportation, Traffic Safety Evaluation Report

Alternative	Total Crashes	Fatal and Injury Crashes	Property Damage Only Crashes	Reduction in Total Crashes over Existing Conditions	Percent Reduction
No Build	636.4	283.4	353.0	–	–
Alternative A	531.6	230.5	301.1	104.8	16.5
Alternative B	504.2	216.8	287.4	132.2	20.8
Only Superelevation Improvements	635.3	282.7	352.6	1.1	0.2

- **IHSDM Safety Analysis:**
  - Model was un-calibrated as used (not necessary for comparative alternatives analysis)
  - **Alternative B** (8-ft shoulders) **would reduce crashes by 4 percent more** than Alternative A (5-ft shoulders)

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Case Study – Arizona DOT

Benefit to Cost Ratio: Design Alternatives

Alternative	Annual Benefit	Annual Cost	Benefit/Cost Ratio
Alternative A	$3,873,681	$1,680,561	2.30
Alternative B	$5,084,207	$2,678,713	1.90
Superelevation Improvements	$41,807	$135,464	0.31

Source: Arizona Department of Transportation, Traffic Safety Evaluation Report

- **Economic analysis:**
  - Although Alternative B (8-ft shoulders) could provide the greater benefit in reduction in fatal and injury crashes, **Alternative A** (5-ft shoulders) would provide the **greater return on investment** and was selected as the preferred alternative.

30

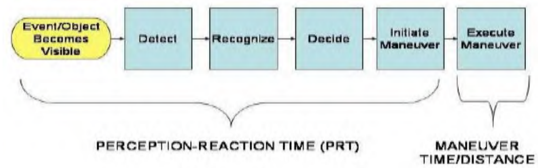
Example – Stopping Sight Distance (SSD)

Distance required to perceive an object in roadway and bring vehicle to a stop

"… the sight distance at every point along a roadway should be at least that needed for a below-average driver or vehicle to stop."

AASHTO Green Book Chapter 3

SSD Conceptual Model

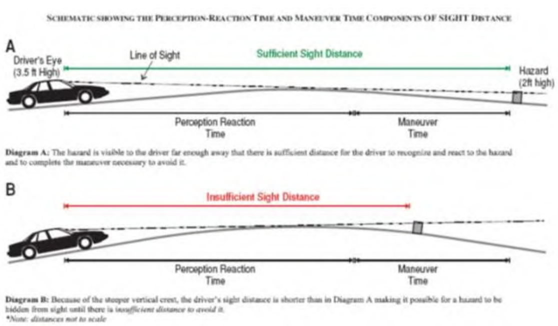


SSD = perception reaction distance + braking distance

$SSD = 1.47\ V\ t + (1.075\ V^2 / a)$

- V = design speed in mph
- t = percept reaction time (2.5 sec)
- a = deceleration rate (11.2 ft/sec^2)

SSD Conceptual Model



SSD Design Values

Design speed (mph)	Stopping sight distance: Calculated (ft)	Stopping sight distance: Design (ft)
15	76.7	80
20	111.9	115
25	151.9	155
30	196.7	200
35	246.2	250
40	300.6	305
45	359.8	360
50	423.8	425
55	492.4	495
60	566.0	570
65	644.4	645
70	727.6	730
75	815.5	820
80	908.3	910

From Exhibit 3-1, AASHTO Green Book

Level Terrain

US Customary						
Design speed (mph)	Stopping sight distance (ft)					
	Downgrades			Upgrades		
	3 %	6 %	9 %	3 %	6 %	9 %
15	80	82	85	75	74	73
20	116	120	126	109	107	104
25	158	165	173	147	143	140
30	205	215	227	200	184	179
35	257	271	287	237	229	222
40	315	333	354	289	278	269
45	378	400	427	344	331	320
50	446	474	507	405	388	375
55	520	553	593	469	450	433
60	598	638	686	538	515	495
65	682	728	785	612	584	561
70	771	825	891	690	658	631
75	866	927	1003	772	736	704
80	965	1035	1121	859	817	782

From Exhibit 3-2, AASHTO Green Book

SSD on Grades

SSD Design Values

Design speed (mph)	Stopping sight distance: Calculated (ft)	Stopping sight distance: Design (ft)
15	76.7	80
20	111.9	115
25	151.9	155
30	196.7	200
35	246.2	250
40	300.6	305
45	359.8	360
50	423.8	425
55	492.4	495
60	566.0	570
65	644.4	645
70	727.6	730
75	815.5	820
80	908.3	910

From Exhibit 3-1, AASHTO Green Book

Level Terrain

US Customary						
Design speed (mph)	Stopping sight distance (ft)					
	Downgrades			Upgrades		
	3 %	6 %	9 %	3 %	6 %	9 %
15	80	82	85	75	74	73
20	116	120	126	109	107	104
25	158	165	173	147	143	140
30	205	215	227	200	184	179
35	257	271	287	237	229	222
40	315	333	354	289	278	269
45	378	400	427	344	331	320
50	446	474	507	405	388	375
55	520	553	593	469	450	433
60	598	638	686	538	515	495
65	682	728	785	612	584	561
70	771	825	891	690	658	631
75	866	927	1003	772	736	704
80	965	1035	1121	859	817	782

From Exhibit 3-2, AASHTO Green Book

SSD on Grades

SSD Design Recommendations

"Stopping sight distances exceeding those shown in Exhibit 3-1 should be used as the basis for design wherever practical. Use of longer stopping sight distances increases the margin of safety for all drivers …"

"The recommended stopping sight distances are based on passenger car operations and do not explicitly consider design for truck operation."

AASHTO Green Book

Conceptual Safety Relationship?

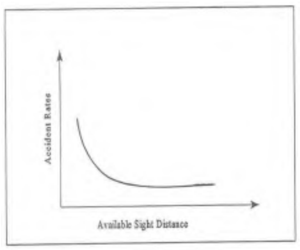


Figure 4. Conceptual Relationship Between Available Sight Distance and Safety at Crest Vertical Curves

Past studies that examined the relationship between SSD and safety have been inconsistent and inconclusive

NCHRP 400

F-37/24

Conceptual Safety Relationship?

Parameters	1940 A Policy on Sight Distance for Highways	1954 A Policy on Geometric Design - Rural Highways	1965 A Policy on Geometric Design - Rural Highways	1971 A Policy on Geometric Design of Highways and Streets	1984 and 1990 A Policy on Geometric Design Highways and Streets
Design Speed	Design Speed	85 to 95 percent of design speed.	80 to 93 percent of design speed.	Min. - 80 to 93 percent of design speed. Des. - design speed.	Min. - 80 to 93 percent of design speed. Des. - design speed.
Perception - Reaction Time	Variable: 3.0 sec at 30 mph 2.0 sec at 70 mph	2.5 sec	2.5 sec	2.5 sec	2.5 sec
Design Pavement/ Stop	Dry Pavement Locked-wheel Stop	Wet Pavement Locked-wheel Stop	Wet Pavement Locked-wheel Stop	Wet Pavement Locked-wheel Stop	Wet Pavement Locked-wheel Stop
Friction Factors	Ranges from 0.50 at 30 mph to 0.40 at 70 mph	Ranges from 0.36 to 30 mph to 0.29 to 70 mph	Ranges from 0.36 to 30 mph to 0.27 at 70 mph	Ranges from 0.35 at 0.30 mph to 0.27 at 70 mph	Slightly higher at higher speeds than 1970 values
Eye Height	4.5 ft	4.5 ft	3.75 ft	3.75 ft	3.5 ft
Object Height	4.0 in	4.0 in	6.0 in	6.0 in	6.0 in

F-38/24

Conceptual Safety Relationship?

There are a number of factors or conditions associated with driver responses to a hazardous event or object that are not reflected in the basic sight distance model, but nonetheless can have a profound effect on driver behavior and overall roadway safety:

- Conditions or events that occur prior to a hazardous event/object becoming visible to the driver
- How and when the driver processes relevant information
- Driving as an "episodic" activity versus driving as a "smooth and continuous" activity
- The nature of the hazardous object or event
- The nature of the driver's response
- Individual differences across drivers
- The quality and applicability of the empirical research used to develop the driver models

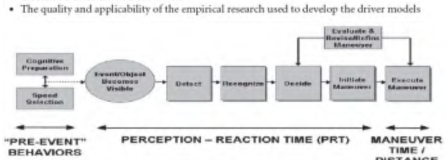


Figure 22-2. Added elements to basic sight distance behavioral model.

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Risk Assessment Guidelines

- Assess the risk of a location with SSD below current criteria. Risk is related to traffic volume (exposure) and other features within the sight restriction (intersections, narrow bridges, high-volume driveways, sharp curvature)
- "Where no high-risk features exist within the sight restriction, nominal deficiencies as great as 5-10 mph may not create an undue risk of increased crashes."

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Guide for Achieving Flexibility in Highway Design AASHTO

F-40/24

Questions & Answers

John McFadden, P.E.
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PAVEMENT FRICTION SURFACE TREATMENTS

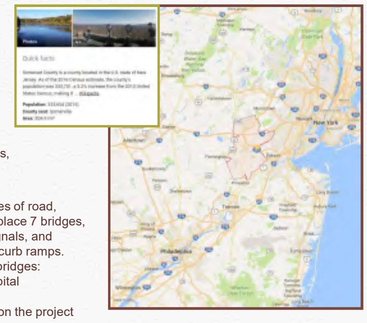
A SYSTEMIC SAFETY APPROACH FOR HORIZONTAL CURVES ON SOMERSET COUNTY ROUTES

Somerset County Engineering
Presented by Patricia Bates Smith
Principal Engineer, Highway

Somerset – who are we?

Engineering office with:
- Staff of 36 people
- In 10 different disciplines
- Managing infrastructure including:
  - 250 miles of County Roads
  - 193 traffic signals
  - 762 bridges
  - As well as county sites, facilities and parks.

Annually, we resurface 15 miles of road, reconstruct 1.5 miles road, replace 7 bridges, install or upgrade 10 traffic signals, and replaced more than 150 ADA curb ramps.
Annual budgets for road and bridges:
$9 - $18 million, County Capital
$6 million, State Aid
$ vary, Federal Aid - based on the project



Somerset County – Local Safety Projects

Program	Project	Town	Description	Grant Amount	Length (miles)	Project Status
2010 LSP	Hamilton St (CR 514) & Franklin Blvd (CR 617)	Franklin	Traffic signal modifications and upgrade, left turn lanes, resurfacing, ADA ramps.	$190,000.00	N/A	completed
2011 LSP	Overheight vehicle detectors	Manville, South Bound Brook	Installation of 2 height detection at approaches to low railroad overpasses, 533 in Manville, 527 in South Bound Brook	$170,000.00	N/A	completed
2012 LSP	North Bridge St & Cliff St intersection	Somerville	Installation of a new traffic signal	$150,000.00	N/A	completed
2012 LSP	Easton Ave (CR 527) & Foxwood Dr.	Franklin	Traffic signal modifications and upgrade: dedicated left turn lanes, pedestrian signals	$220,000.00	N/A	completed
2012 HRRR	New Centre Rd (CR 627)	Hillsborough	Rural road safety measures including, pavement repair, resurfacing, micro-mill friction course, wet weather high visibility traffic stripes	$490,000.00	1	completed
2013 HRRR	River Rd (CR 627)	Hillsborough	Rural road safety measures including, pavement repair, resurfacing, micro-mill friction course, wet weather high visibility traffic stripes	$380,000.00	0.8	completed
2014 LSP	Promenade Blvd (CR 685)	Bridgewater	Safety measures on 4 lane urban drive: Road diet, medians, cross walks, curb ramps, sidewalk extension.	$750,000.00	0.65	completed
2014 HRRR	Bedminster Safety Improvements including Pottersville Rd (CR 512), Lamington Rd (CR 523) and Burnt Mills Rd (CR 620)	Bedminster	Rural road safety measures including pavement repair, resurfacing, High Friction Surface Course on horizontal curves, wet weather high visibility striping, pavement safety edge, driveway aprons, new signage and delineators.	$4,125,000.00	10	completed
2014 LSP	Chimney Rock Rd (CR 525)	Bridgewater	Rural road safety measures including pavement repair, resurfacing, High Friction Surface Course on horizontal curves, wet weather high visibility striping, pavement safety edge, new signage and delineators.	$400,000.00	1	completed
2015 LSP	Mountain Ave (CR 642)	North Plainfield	Local Safety suburban street including: 2 traffic signal modifications and upgrades, ADA ramp compliance, striping.	$960,000.00	1.3	completed
2015 LSP	Washington Ave (CR 529) & Greenbrook Rd (CR 634)	Green Brook	Local Safety suburban street including: traffic signal replacement, Road Diet, RCP culvert replacement, ADA curb ramp compliance.	$780,000.00	0.4	completed
2016 LSP	Main St (CR 533)	Manville	Local Safety suburban street including: 5 traffic signal modifications, 1 traffic signal replacement, Road Diet, ADA ramp compliance, resurfacing, striping.	$3,000,000.00	1.1	prelim design
2017 LSP	Easton Ave (CR 527) & Demott Lane	Franklin	Safety measures on 4 lane arterial roadway including: traffic signal modifications, barrier upgrades, ADA ramp compliance, rehabilitation of existing HMA bikepath including ADA compliance.	$1,440,000.00	0.8	consultant award
2017 round-about	Allen Road (CR 652) and Somerville Road Roundabout	Bernards	Installation of a modern roundabout at an existing 4-way stop controlled intersection that is seeing high crash rates.	-	0.2	consultant award
				$13,055,000.00		

Projects that applied a pavement surface treatment

Surface Friction Treatments – How did we get started?

… there was a need.

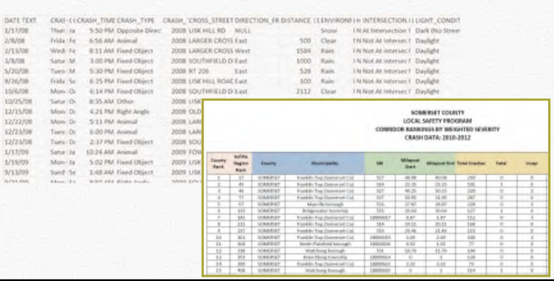
- 2006 police concern for crashes on Warrenville Hill:
- 14% grade at steepest;
- Substandard S-bend horizontal alignment;
- Driveways and side streets;
- Route 22 approach at near 10% gradient.

'Warrenville Hill', CR 651 north of Route 22.

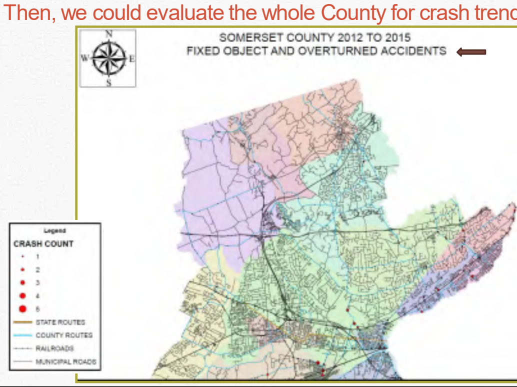
Suddenly, safety became measurable.

The availability of crash data from the Plan4Safety crash database allowed our office, as well as our MPO, to look at crash trends around the region.

This provided us the data to start planning for infrastructure improvements based on locations of need and type of issues occurring.



Then, we could evaluate the whole County for crash trends



What now to do with this information? Friction treatments!

Because of County wide crash analysis we could now see which areas needed further investigation for possible safety improvements

- friction courses gave us a tool to use at horizontal curves. But, we still had questions:

- What was the correct friction treatment method?
- When is it warranted?
- How to determine the length of need on a horizontal curve?

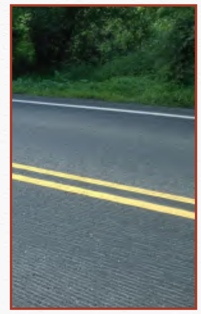
Micro milling – our initial solution.

Pros:

- Provided high friction surface which reduced 'run-off-road' type crashes
- Low cost of installation
- Installation by local pavement contractors

Cons:

- Short life expectancy with surface due to moisture penetration, oxidation, and friction loss.
- Complaints from motorcyclists and bicyclists
- Poor image portrayed to the public of milling off new pavement surface.



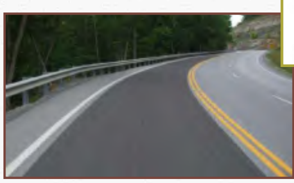
Next came … High Friction Surface Treatment!

PROS:

- Promoted by FHWA as proven safety measure (NCHRP Document 108)
- Safe for all vehicle types
- Longer life expectancy than micro-milling (due to microtexture of aggregate used).

CONS:

- High cost
- Specialize trade needing sub-contracting work added to paving contracts.



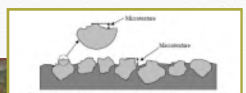
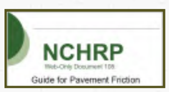
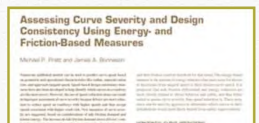


Figure 3: The relationship between different textures in pavement aggregate (15)

Texas Transportation Institute, July 2012, Using High Friction Surface Treatments to Improve Safety at Horizontal Curves.



When is a friction treatment warranted?



Friction-Based Curve Risk Components

Given the importance of side friction demand in drivers' curve speed choice and perception of risk, and the fact that skidding or truck rollover will occur at excessive side friction demands, it can be rationalized that curve risk can be quantified in regard to side friction comfort levels and the friction demands experienced at curve speed.

TABLE 2 Candidate Guidance for Curve Signing

Side Friction Demand, g	Suggested Signing Treatments	Side Friction Differential, g
0.19 or less	None	0.00
0.20–0.23	Curve warning sign	0.01–0.04
0.24–0.27	Curve warning sign, advisory speed plaque	0.05–0.08
0.27–0.30	Redundant curve warning signs and advisory speed plaques	0.08–0.11
0.30–0.34	Redundant curve warning signs and advisory speed plaques, chevrons	0.11–0.15
0.35 or more	Other measures to reduce speed limit, rebuild curve, etc.	0.16 or more

After much research … our take away is:
- it is about the difference in the side friction experienced by driver. This is calculated by finding the difference in the travel speeds along the tangent segment of roadway and the horizontal curve.

Our evaluation method.

Data needed:

- Centerline alignment geometry
- Roadway cross slope
- Road profile slope
- Posted speed limit
- Posted curve advisory plate speed

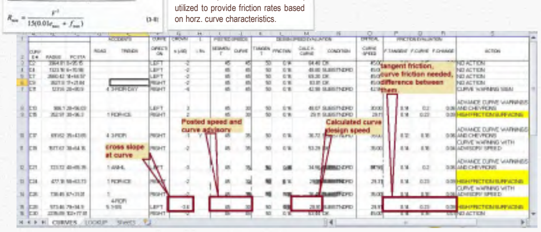
From the result of the evaluation, friction ranges developed giving guidance for the action to take.

Side Friction Differential	Action
0 - .009	No action
.01 - .019	Curve warning sign
.02 - .044	Curve warning with advisory speed
.045 - .074	Advance curve warnings and chevrons
.075 and above	High friction surface treatment

U.S. Customary

$$R_{min} = \frac{V^2}{15(0.01e_{max} + f_{max})} \quad (3\text{-}8)$$

Formula 3.8, AASHTO 'Green Book', utilized to provide friction rates based on horz. curve characteristics.



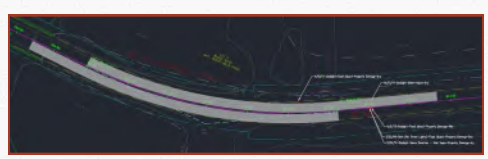
What is the Length of Need?

Friction treatment length of need determination: approach length + length of curve (PC to PT)

Table 5: Recommended Distance Upstream of the PC to Begin HFST Application

Approach Speed (mph)	Curve Speed (mph)						
	30	35	40	45	50	55	60
35	35	-	-	-	-	-	-
40	76	41	-	-	-	-	-
45	122	86	46	-	-	-	-
50	173	138	97	51	-	-	-
55	230	194	154	108	57	-	-
60	282	257	216	170	119	62	-
65	359	324	284	238	188	130	68

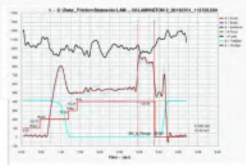
Texas Transportation Institute, July 2012, Using High Friction Surface Treatments to Improve Safety at Horizontal Curves.



HFST – first installation 2015

Federal Aid project Bedminster Safety Performing test strip for friction number evaluation before installation.

ICC performed 16 tests on the road around the Test Patch of Safe-T-Grip on Lamington Rd. Bedminster NJ. The average FN40R value for the asphalt road was 55. The Test Patch numbers jumped up to a FN40R value of 86. The graphs provided show what the jump in friction looks like. It is our professional opinion that the material we tested on the Test Patch is extremely safe for roadway surface application and has a significantly higher friction value then the road it was placed on.



Statewide Striping Test Patch, Lamington Rd Bedminster Township, NJ Friction Report
7/17/2015 International Cybernetics, Largo, FL

Some results …

An in-office evaluation of crashes in the years prior to applying friction treatment and the year following.

The data utilized was distributed along the entire project corridors so the reductions shown are not solely attributed to the horizontal curve crash reductions.

County Roads	Road Segments	Year applied	Corridor - Annual avg crashes before	Corridor - crashes year after	Reduction	Treatment type
New Center Road (CR 627)	From Auten Road to Roycefield Road	2013	19	10	47%	Micro surfacing full project length
River Road (CR 625)	From Lyman Street Bridge to Roycefield Road	2014	25	5	80%	Micro surfacing full project length
Chimney Rock Road (CR 525)	From Thompson Avenue to Gilbride Road	2015	73	12	84%	HFST applied to 5 curves on 1 mile road segment (steep vertical)
Burnt Mills Road (CR 620)	From Rattlesnake Bridge Road to Country Club Road	2015	20	9	55%	HFST applied to 5 curves on 3 mile road segment
Pottersville Road (CR 512)	From Hacklebarney Road to Route 206	2015	8	7	13%	HFST applied to 4 curves on 2.4 mile road segment
Lamington Road (CR 523)	From County Line to Route 206	2015	23	17	26%	HFST applied to 2 curves on 5 mile road segment
Dukes Parkway East (CR 618)	From 6th Ave to 7th Ave, Manville	2016	4.4	1	77%	HFST applied to both travel lanes at one horz. curve

Where are we now?

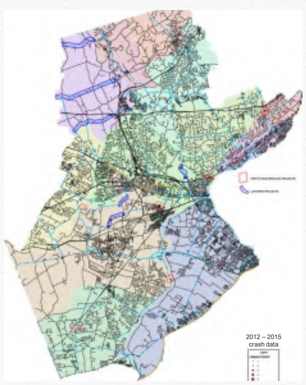
2016 and 2017, as part of our annual resurfacing program, we installed HFST treatments to locations in need. Locations to evaluate were determined from:

- Concerns expressed by Municipalities or residents
- Recent severe crashes

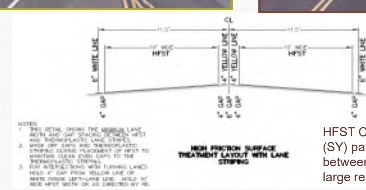
2019 performing restoration to micro-milled areas and repairs to HFST areas.

Future: prioritize high crash locations for evaluation to implement additional signage or friction surface treatments. Data sources to prioritize coming from:

- In-house GIS crash mapping
- NJ Regional Curve Inventory and Safety Assessment for the North Jersey Transportation Planning Authority (NJTPA) Region



Our HFST Installations



HFST COST: bid as square yard (SY) pay item. Bids have come in between $35 -$65/ SY (bid within large resurfacing contracts).

New HFST Resources

Federal Highway Administration webpage has a page of FAQs, Links, and Other Resources, General Pavement Friction Resources which includes documents of:

- May 2016 HFST Curve Selection and Installation Guide
- Guidance documents
- Fact Sheet
- Aggregate Studies
- Technical specifications
- Videos
- Other resources

Questions?

Thank You!

References:

- http://onlinepubs.trb.org/onlinepubs/nchrp/nchrp_w108.pdf NCRHP Web Only Document 108, "Guide for Pavement Friction", Transportation Research Board
- http://trb.metapress.com/content/7717239k62781311/ Pratt, Michael P. and James A. Bonneson "Assessing Curve Severity and Design Consistency Using Energy and Friction Based Measures", Transportation Research Record No. 2075, 2008, pp 8-15.
- AASHTO "A Policy on Geometric Design of Highways and Streets 2011" Chapter 3, p3-25, Figure 3.6 Side Friction Factors Assumed for Design, and p3-31, equation 3.8 for minimum radius.
- http://d2dtl5nnlpfr0r.cloudfront.net/tti.tamu.edu/documents/TTI-2012-8.pdf Brimley, Brad & Paul Carlson, "Using High Friction Surface Treatments to Improve Safety at Horizontal Curves", Texas Transportation Institute, July 2012, p 13.
- https://safety.fhwa.dot.gov/roadway_dept/pavement_friction/faqs_links_other/ Federal Highway HFST FAQ webpage

For more information contact:

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Local Safety Peer Exchange

A Municipal Perspective

Deanna Stockton, P.E., C.M.E.
Municipal Engineer
Princeton, Mercer County

General Statistics

COUNTY	JURISDICTION						TOTAL
	NJDOT	Authority	County	Municipal	Park (State,Local)	Federal Agency FWS, NPS, Military	
Atlantic	145	57	371	1,395	9	8	1,986
Bergen	106	40	440	2,412	0	0	2,998
Burlington	156	38	501	1,930	219	61	2,904
Camden	102	28	389	1,535	7	0	2,062
Cape May	74	31	201	731	26	0	1,063
Cumberland	89	0	540	679	0	0	1,308
Essex	61	19	213	1,375	10	0	1,679
Gloucester	154	20	400	1,143	0	0	1,717
Hudson	35	21	53	515	2	0	626
Hunterdon	115	1	237	1,078	15	0	1,446
Mercer	119	14	173	1,213	10	1	1,530
Middlesex	139	40	295	2,094	9	1	2,578
Monmouth	205	27	365	2,770	26	131	3,523
Morris	162	0	296	2,107	19	10	2,594
Ocean	141	39	608	2,174	110	37	3,108
Passaic	55	5	235	1,029	10	0	1,333
Salem	86	9	353	430	5	1	884
Somerset	106	0	230	1,398	0	0	1,735
Sussex	111	0	314	907	87	13	1,433
Union	68	20	176	1,160	6	0	1,430
Warren	103	5	256	697	31	44	1,136
TOTAL	2,331	413	6647	28,772	599	308	39,071
			STATEWIDE TOTAL				39,071

- NJDOT has jurisdiction on just 7% of roads in New Jersey / 66% volume
- In Mercer: 11% County, 79% Municipal, 7% NJDOT
- In Somerset: 14% County, 80% Municipal, 6% NJDOT

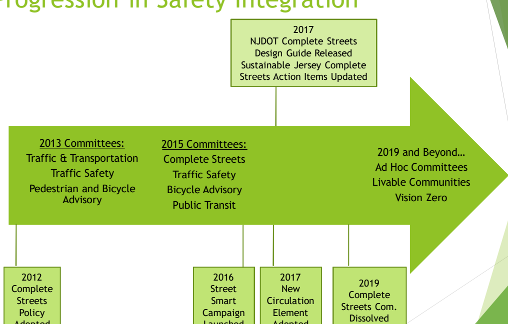
Princeton Statistics

- Consolidated in 2013
- Borough form of government
- 18.1 square miles with 120 miles of municipal roadways plus 9 miles of State Highways (including 3 miles of the King's Highway historic district)
- Mercer County is 12th densest in state (1669 / km^2)
  - Bergen is most dense (4069 / km^2)
  - Middlesex is 2nd most dense
- Complete Streets policies have been adopted by all municipalities and County in Mercer

Municipal Traffic Safety Concerns

- Vehicle speeds
- Volume – Waze, Apple Maps, etc.
- Public rights of way are valuable and have many competing needs in a livable community
- Road users don't always follow the rules
- Distracted driving is increasing
- Curbing, striping, tree plantings, radar speed signs, and police enforcement are not enough
- A walkable and bikeable town is often less friendly to drivers, especially for parking
- Bumpouts are undesirable to bicyclists and Public Works – but they have advantages for pedestrians
- Equity

Progression in Safety Integration



2019 Transportation Ad Hoc Committees

- Traffic Calming
- Crosswalks, Lighting and Pedestrian Safety Group
- Transportation Communications

VISION ZERO

SUSTAINABLE JERSEY • CERTIFIED • A Better Tomorrow, One Community at a Time

Forgiving Design	Forgiveness of Slow Speeds
Increases safety at high speeds	Fosters the safety of slow speeds
Wide travel lanes	Narrow travel lanes
Broad, smooth curves	Short, tight curves
Clear zone free of fixed objects	Variety of fixed objects (light poles, trees, mail boxes, planter boxes, etc) directly adjacent to the travel way
Wide shoulders	Shoulders are used for parking, bike lanes, and loading zones
Feels comfortable to drive fast	Feels dangerous to drive fast

Princeton's Road Safety Design Process

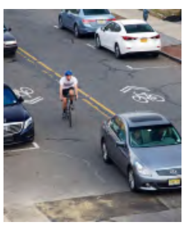
- Review Safety Voyager, crash reports
- Gather road AADT and speed data from DVRPC and / or speed radar signs
- Complete the Complete Streets checklist
- Review the Master Plan for bicycle mobility, pedestrian, and other prescribed improvements
- Conduct a site visit
- Identify potential FHWA proven safety countermeasures for use
- Discuss findings with Traffic Safety Committee (staff-led committee with Engineering, Police, and Public Works representatives)
- Prepare a conceptual plan
- Conduct a design neighborhood meeting and gain neighborhood perspective
- Adapt conceptual plan

Successful Pilots

- Speed cushions near a park

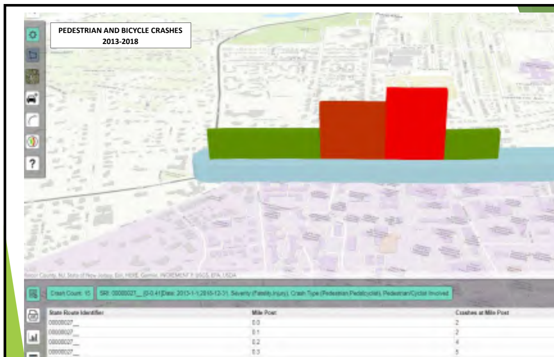
- Bike lane pilot on a minor collector road; parking removed for 2 weeks

Roadblocks



- Historic
- Level of Service
- Loss of parking
- Constricted space
- Perceived loss of property value
- Tree removals
- Road maintenance issues
- Priorities
- Conflicts between ped needs and bicyclist needs
- The Squeaky Wheel

Case Study – NJ 27 Nassau Street (MP 0.0 -0.4)



The Bureau of Traffic Engineering (BTE) has reviewed the request and prepared Synchro simulation models to compare the current level of service (LOS) with the LOS of the proposed operation. The models with the pedestrian only phase is forcing the traffic signals to run over capacity, increases the overall intersection delays, increased queue lengths and decrease the operation LOS. This will inevitably lead to additional requests to improve the operation LOS to decrease the delays. There is no functional way to maintain the current LOS with a pedestrian only phase at this time. Since all three intersection currently have pedestrian amenities and pedestrian phasing in the current timing directives, BTE is not recommending the installation of the pedestrian only phase at the three intersections.

Pedestrian killed at Washington and Nassau Street intersection

QUESTIONS?

- What strategies do municipalities have for getting NJDOT to make Complete Streets improvements to a state highway located in a downtown?
- Have any NJ municipalities pursued a traffic calming master plan?
- Are there NJ codes / policies regarding street lighting?
- Do you use USLimits2 in addition to 85th percentile for speed limit establishment?
- What are your success stories for safety improvements?

Thank you!

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Princeton Police Traffic Safety Bureau
Lt. Geoff Maurer
Sgt. Thomas R. Murray III
609-921-2100

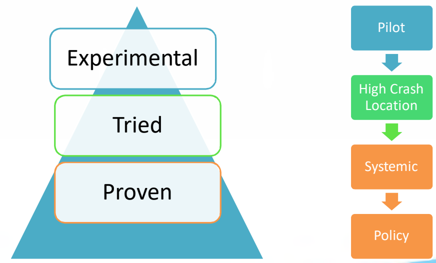
FHWA's 2017 Update of the Proven Safety Countermeasures

Make Your Mark
A Local Safety Peer Exchange
March 26, 2019

U.S. Department of Transportation
Federal Highway Administration

Safe Roads for a Safer Future
http://safety.fhwa.dot.gov

Life Cycle of a Safety Countermeasure



FHWA's Proven Safety Countermeasures

Intersection	Roadway Departure	Pedestrian	Crosscutting Strategies
• Left- and Right-Turn Lanes at Two-Stop Controlled Intersections • Backplates with Retroreflective Borders • Corridor Access Management • Yellow Change Interval • Roundabouts • Systemic Application of Multiple Low Cost Countermeasures at Stop-Controlled Intersections* • Reduced Left-Turn Conflict Intersections*	• Longitudinal Rumble Strips and Stripes along Two-Lane Highways • Median Barrier • SafetyEdge^{SM} • Enhanced Delineation and Friction for Horizontal Curves • Roadside Design Improvements at Curves*	• Medians and Pedestrian Crossing Islands in Urban and Suburban Areas • Pedestrian Hybrid Beacon • Road Diet • Walkways • Leading Pedestrian Intervals*	• Road Safety Audits • Local Road Safety Plans* • US Limits*

3

PSC*i* – Intersections

- Left- and Right-Turn Lanes at Two-Way Stop-Controlled Intersections
- Backplates with Retroreflective Borders
- Corridor Access Management
- Yellow Change Interval
- Roundabouts
- Systemic Application of Multiple Low-Cost Countermeasures at Stop-Controlled Intersections
- Reduced Left-Turn Conflict Intersections

4

Left and Right Turn Lanes at Two-Way Stop-Controlled Intersections


Example of left-turn lanes.


Example of a right-turn lane.

SAFETY BENEFITS:

LEFT-TURN LANES
28-48%
Reduction in total crashes

RIGHT-TURN LANES
14-26%
Reduction in total crashes

Source: Highway Safety Manual

5

Backplates with Retroreflective Borders

Example of a signal backplate framed with a retroreflective border.

Safety Benefit:

15%
Reductions in total crashes

Source: CMF Clearinghouse, CMF ID 1410.

6

Corridor Access Management

SAFETY BENEFITS:

5-23%
Reduction in total crashes along 2-lane rural roads

25-31%
Reduction in injury and fatal crashes along urban/suburban arterials

Source: Highway Safety Manual

7

Yellow Change Interval

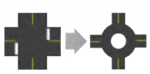
Safety Benefits of Well-Timed Yellow Change Intervals:
36-50%
Reduction in red light running
8-14%
Reduction in total crashes
12%
Reduction in injury crashes

Source: NCHRP Report 731, *Guidelines for Timing Yellow and All-Red Intervals at Signalized Intersections.*

8

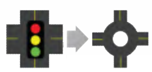
Roundabouts

Two-Way Stop-Controlled Intersection to a Roundabout



82%
Reduction in severe crashes

Signalized Intersection to a Roundabout



78%
Reduction in severe crashes

Source: *Highway Safety Manual*

9

Systemic Application of Multiple Low Cost Countermeasures at Stop-Controlled Intersections

- Mostly signing & pavement marking enhancements.
- Strategy relies on cost economy and treatment saturation.
- Best suited for intersections with under 20,000 AADT Total Entering.

10

Systemic Approach for Stop Intersections

Evaluation Results from LCSI-PFS Study:

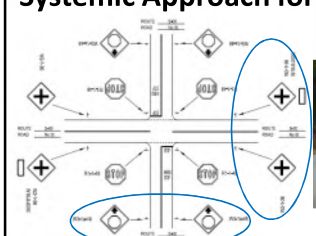
- Sample consisted of 434 treated sites and 568 reference sites across South Carolina.
- Included 2X2 (3-leg, 4-leg) and 4X2 (3-leg, 4-leg) sites.
- Range of 3-5 years before and after data.

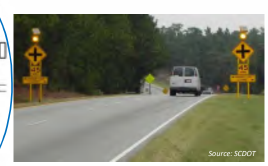
Recommended CMFs from FHWA-HRT-17-086

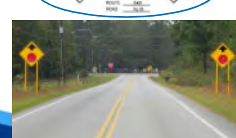
	Total	Fatal & Injury	Rear End	Right Angle	Nighttime
CMF	0.917	0.899	0.933	0.941	0.853

11

Systemic Approach for Stop Intersections



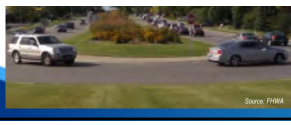


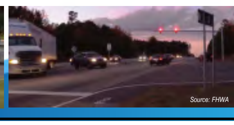


12

Reduced Left-Turn Conflict Intersections (MUT and RCUT)

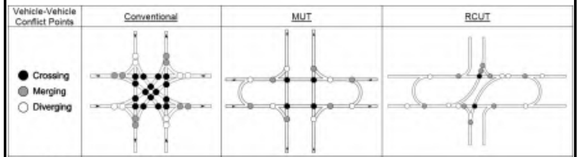
- Geometric designs that alter how left-turn movements occur.
- Simplify and reduce or modify conflicts related to turning.
- Proven safety and operational benefits.





13

Reduced Left-Turn Conflict Intersections



Vehicle-Vehicle Conflict Points	Conventional	MUT	RCUT
Crossing	16	4	2
Merging	8	6	6
Diverging	8	6	6
Total	32	16	14

Sources: FHWA-SA-14-069, FHWA-SA-14-070

MUT Safety Performance

- 30% decrease F&I Crashes.
- 16% decrease All Crashes.

RCUT Safety Performance

- 54% decrease F&I Crashes.
- 35% decrease All Crashes.

14

PSC*i* – Roadway Departure

- Longitudinal Rumble Strips and Stripes along Two-Lane Highways
- Median Barrier
- SafetyEdge[SM]
- Enhanced Delineation and Friction for Horizontal Curves
- Roadside Design Improvements at Curves

15

Longitudinal Rumble Strips and Stripes

Shoulder rumble strips and center line rumble stripes are installed on this roadway.

Example of an edge line rumble stripe.

SAFETY BENEFITS:

Center Line Rumble Strips
44-64%
Head-on, opposite-direction, and sideswipe fatal and injury crashes

Shoulder Rumble Strips
13-51%
Single vehicle, run-off-road fatal and injury crashes

Source: NCHRP Report 641, *Guidance for the Design and Application of Shoulder and Centerline Rumble Strips*

16

Median Barrier

Median cable barrier prevents a potential head-on crash.

SAFETY BENEFITS:
Median Barriers Installed on Rural Four-Lane Freeways
97%
Reduction in cross-median crashes

Source: NCHRP Report 794, *Median Cross-Section Design for Rural Divided Highways*

17

SafetyEdge$_{SM}$

Example of SafetyEdge$_{SM}$ after backfill material settles or erodes.

SAFETY BENEFIT:

11%
Reduction in fatal and injury crashes

Source: *Safety Effects of the SafetyEdge$_{SM}$*, FHWA-SA-17-044

SafetyEdge[SM] CMFs	
Drop-Off	0.655
ROR	0.790
Head-on	0.813
F+I	0.892
Total	0.989

18

Enhanced Delineation and Friction for Curves


Chevron signs installed along a curve.

SAFETY BENEFITS:
High Friction Surface Treatment
52%
Reduction in wet road crashes
24%
Reduction in curve crashes
Source: CMF Clearinghouse, CMF IDs 7900 and 7901

SAFETY BENEFITS:
Chevron Signs
25%
Reduction in nighttime crashes
16%
Reduction in non-intersection fatal and injury crashes
Source: CMF Clearinghouse, CMF IDs 2438 and 2439

19

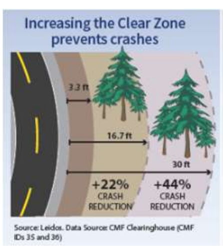
Roadside Design Improvements at Curves

- Increase clear zone at curves.
  - Recommended by AASHTO RDG.
  - Proven to reduce crashes.
- Improve traversability.
  - Adding or widening shoulders in curves.
  - flatter slopes at curves than in tangent sections.
- Reconsider when to install barrier
  - Reduce severity.

20

Roadside Design Improvements at Curves

Increase Clear Zone on the Outside of Curves



27%
of all fatal crashes occur at cuves
80%
of all fatal crashes at curves are roadway departure crashes

21

PSC*i* – Pedestrians & Bicycles

- Medians and Pedestrian Crossing Islands in Urban and Suburban Areas
- Pedestrian Hybrid Beacon
- Road Diet
- Walkways
- Leading Pedestrian Intervals

22

Medians and Pedestrian Crossing Islands


Median and pedestrian crossing islands near a roundabout.


Example of a road with a median and pedestrian crossing islands.


Example of a pedestrian crossing island.

SAFETY BENEFITS:

Raised Median
46%
Reduction in pedestrian crashes

Pedestrian Crossing Island
56%
Reduction in pedestrian crashes

Source: Desktop Reference for Crash Reduction Factors, FHWA-SA-08-011, September 2008, Table 11

23

Pedestrian Hybrid Beacons


Pedestrians cross the roadway at a PHB location.

Example of PHBs mounted on a mast arm.

Safety Benefits:

69%
Reduction in pedestrian crashes

29%
Reduction in total crashes

15%
Reduction in serious injury and fatal crashes

Source: CMF Clearinghouse, CMF IDs: 2911, 2917, 2922

24

Road Diets

Before and after photos of a Road Diet project.


Road Diet project in Honolulu, Hawaii.

SAFETY BENEFIT:

4-Lane → 3-Lane
Road Diet Conversions
19-47%
Reduction in total crashes

Source: *Evaluation of Lane Reduction "Road Diet" Measures on Crashes*, FHWA-HRT-10-053.

25

Walkways


Example of a shared use path.


Example of a sidewalk in a residential area.


Paved shoulder used as a walkway.

SAFETY BENEFITS:

Sidewalks 65-89%
Reduction in crashes involving pedestrians walking along roadways

Paved Shoulders 71%
Reduction in crashes involving pedestrians walking along roadways

Source: *Desktop Reference for Crash Reduction Factors*, FHWA-SA-08-011, Table 11

26

Leading Pedestrian Interval

NEW

- Pedestrians get "WALK" signal before vehicles get green light.
- Provides pedestrians a 3-7 second head start before vehicles are given a green indication.
- Allows pedestrians to establish presence in crosswalk before vehicles have priority to turn left.

27

Leading Pedestrian Interval

Benefits:

- 60% reduction in pedestrian-vehicle crashes at intersections.
- Increased visibility of crossing pedestrians.
- Reduced conflicts between pedestrians and vehicles.
- Increased likelihood of motorists yielding.

28

PSC*i* – Crosscutting Strategies

- Road Safety Audits
- Local Road Safety Plans
- USLIMITS2

29

Road Safety Audits

A road safety audit is a <u>proactive</u> formal safety performance examination of an existing or future road or intersection by an <u>independent</u> and <u>multi-disciplinary</u> team.


Multi-disciplinary team performs field review

SAFETY BENEFIT:

10-60%

Reduction in total crashes

Source: *Road Safety Audits: An Evaluation of RSA Programs and Projects*, FHWA-SA-12-037; and *FHWA Road Safety Audit Guidelines*, FHWA-SA-06-06.

30

Local Road Safety Plans

- Developing an LRSP is an effective strategy to improve local road safety.
- Local roads experience 3X the fatality rate of the Interstate Highway System.

USLIMITS2

- Free Web-based Tool
- Designed to help practictioners assess and establish safe, reasonable and consistent speed limits
- Supports customary engineering studies
- Produces unbiased and objective suggested speed limit value based on:
  - 50th and 85th percentile speeds
  - Traffic volumes
  - Roadway characteristics
  - Crash data

PSC*i* – Available Resources

http://safety.fhwa.dot.gov/provencountermeasures

- 1-pager marketing flyers.
- Slides from webinar and link to recorded session.
- Links to additional FHWA resources for each item.

Contacts for Further Information

Intersection Countermeasures:

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Roadway Departure Countermeasures:

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Cathy Satterfield cathy.satterfield@dot.gov (708) 283-3552

Pedestrian/Bicycle Countermeasures:

Tamara Redmon tamara.redmon@dot.gov (202) 366-4077

Crosscutting:

LRSP – Rosemarie Anderson rosemarie.anderson@dot.gov (202) 366-5007

RSA – Becky Crowe rebecca.crowe@dot.gov (804) 775-3381

USLIMITS2 – Guan Xu guan.xu@dot.gov (202) 366-5892

Additional Resources

- Crash Modification Factors Clearinghouse
  - http://www.cmfclearinghouse.org
- Systemic Safety Project Selection Tool
  - http://safety.fhwa.dot.gov/systemic
- US Roadway Assessment Program
  - http://www.usrap.org/
- Pedestrian and Bicycle Crash Analysis Tool
  - http://www.pedbikeinfo.org/pbcat_us/

Time to Share!!!

- Which of these countermeasures have you tried in your jurisdiction?
  - Successes?
  - Challenges?
- Have adopted any of these countermeasures into agency policies or design standards?
- What other proven safety countermeasures have you tried in your jurisdiction?

APPENDIX C
HSIP Local Safety Peer Exchange Participant Feedback Reports

- Summary Feedback Report
- 12.6.17
- 6.13.18
- 3.26.19

Summary Feedback Report

Q1 - Did you find the Local Safety Peer Exchange content useful?

#	Answer	%	Count
1	Yes	100.00%	50
2	No	0.00%	0
	Total	100%	50

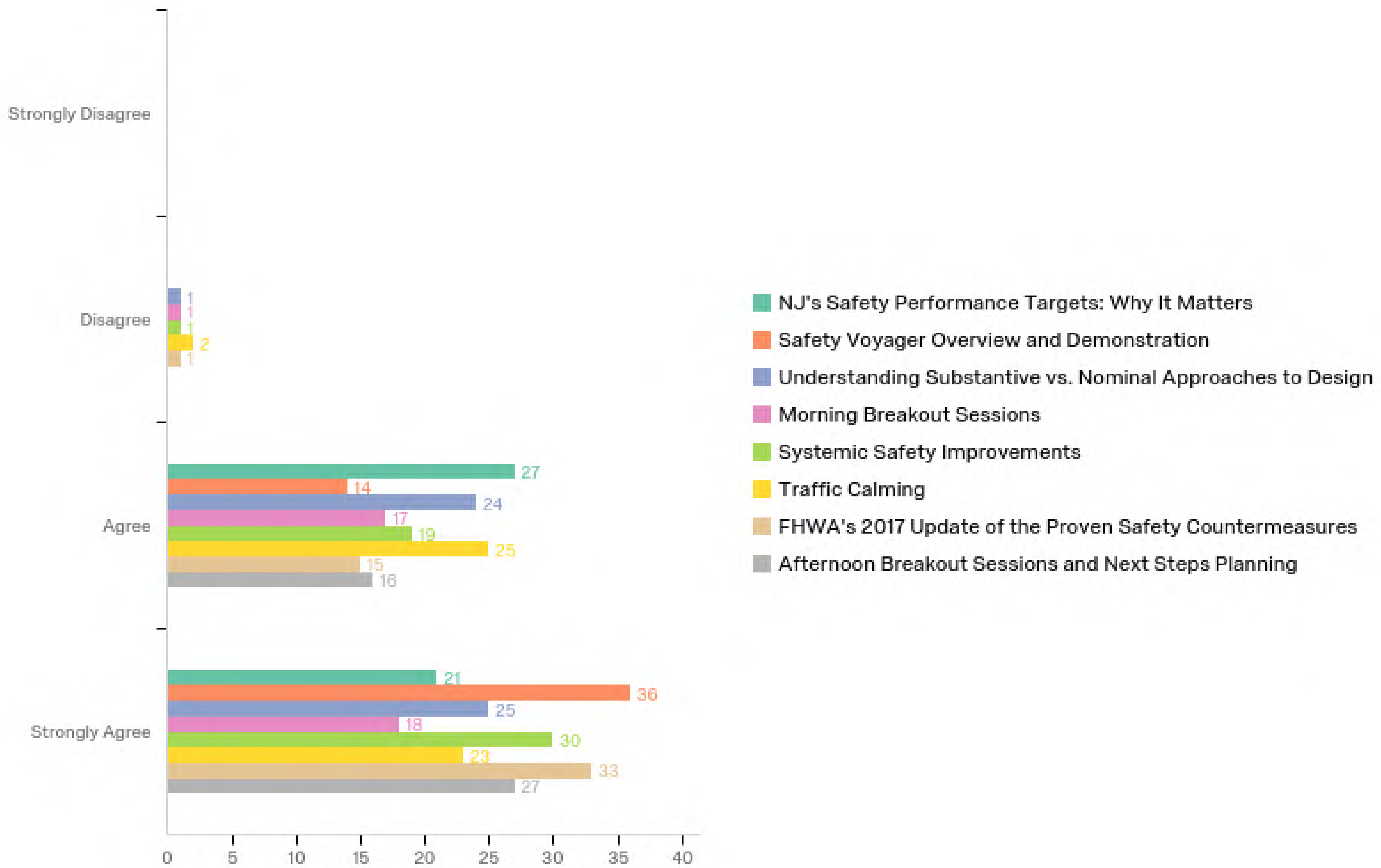
Q2 - Was the format appropriate for learning about the topics covered?

#	Answer	%	Count
1	Yes	100.00%	50
2	No	0.00%	0
	Total	100%	50

Q3 - Was there adequate time for learning about the topics covered?

#	Answer	%	Count
1	Yes	96.00%	48
2	No	4.00%	2
	Total	100%	50

Q4 - The sessions provided information that is transferable to your work: For each session below, please indicate how strongly you agree or disagree that the presented information is transferable to your work.



Q4 Continued- The sessions provided information that is transferable to your work: For each session below, please indicate how strongly you agree or disagree that the presented information is transferable to your work.

#	Question	Strongly Disagree		Disagree		Agree		Strongly Agree		Total
1	NJ's Safety Performance Targets: Why It Matters	0.00%	0	0.00%	0	56.25%	27	43.75%	21	48
2	Safety Voyager Overview and Demonstration	0.00%	0	0.00%	0	28.00%	14	72.00%	36	50
3	Understanding Substantive vs. Nominal Approaches to Design	0.00%	0	2.00%	1	48.00%	24	50.00%	25	50
4	Morning Breakout Sessions	0.00%	0	2.78%	1	47.22%	17	50.00%	18	36
5	Systemic Safety Improvements	0.00%	0	2.00%	1	38.00%	19	60.00%	30	50
6	Traffic Calming	0.00%	0	4.00%	2	50.00%	25	46.00%	23	50
7	FHWA's 2017 Update of the Proven Safety Countermeasures	0.00%	0	2.04%	1	30.61%	15	67.35%	33	49
8	Afternoon Breakout Sessions and Next Steps Planning	0.00%	0	0.00%	0	37.21%	16	62.79%	27	43

Q5 - What topics, issues or best practices do you think should be added to this workshop?

What topics, issues or best practices do you think should be added to this workshop?
Issues of county/state/municipal responsibility for installation and maintenance of sidewalks; The reluctance of some jurisdictions to embrace Complete Streets and bike/ped safety
More demonstartion project case strudies for local (county/municipal) applications to provide verification of effectiveness.
Solutions to dealing with pushback, How to sell a tough idea like a roundabout to the average citizen
More HSM info.
Various experiences on RSAs, etc.
Road diets, pedestrian safety corridor/system approach
List of safety funding programs and what agencies can apply
Discuss bike/ped improvements a little more in depth w/in proven safety countermeasures and items/actions that aren't one of the 20 but will be eventually (projected to be a proven countermeasure).
Bit more designing of each measure.
Bike lanes and signal optimization.
Can't see anything at this time.
Examples from each county showing completed projects. Proven safety countermeasures-where have they been completed? How many?
Implementing bike improvements/bike lanes Safety Intersection Improvements to address pedestrians and vehicles in urban areas Show Annual Safety Report Results (project sample) and what goes to Congress
How to make a successful application for federal funding
Highway safety manual implementation

Q5 Continued - What topics, issues or best practices do you think should be added to this workshop?

What topics, issues or best practices do you think should be added to this workshop?
Case studies
Tools- Autocad, Safety Voyager
Safety Countermeasures
Navigating through the state NJDOT's grant funding, project delivery, project prioritization.
incorporating safety low cost improvements
Handicap ramps, guiderail.
More low-cost, quick cheap solutions and how to get them implemented
How to capture safety related improvements that use local and State funds
Even more practical project examples
US limits
Local opposition to safety improvements and how to deal with it.
Safety voyager overview

Q7 - What topics, issues or best practices would you like to see discussed at future Safety Peer Exchange sessions?

What topics, issues or best practices would you like to see discussed at future Safety Peer Exchange sessions?
More bike/ped focus
USLIMITS 2
Complete Streets implementation- real world solutions to design and implentation of bike lanes and treatment at intersections where bump outs are used to reduce length of pedestrian crossing, but interrupts the available bike lane.
More in-depth on new proven safety countermeasures.
More experiences on different Proven Safety Countermeasures, including USLIMITS, HAWK signs, LPI, and low cost at stop intersections.
Success stories regarding education campaigns
More examples of countermeasure used at LPA bod - along with data that proves how effective it was.
Inventory of what "best practices" or proven safety countermeasures that have been installed, by agency, so that conversations can happen between those that have done it with those that want to do it.
Streamlining the project delivery process for safety projects
Post construction crash analysis. Demonstration of a sample project going through Safety Voyager to obtain crash data downloading to Excel.
Findings of a CAP review. Sample-show issues and encounters
Speed limit determination, mini roundabouts
More safety counter measures, advances, and new trends
How does a project get funded and what is the project delivery process for state, local, and county roads.
incorporating safety improvements in all projects, Ped Hybrid Beacons
Road diets, High surface friction in other colors i.e. red (Endurablend)
Bicycle safety topics/planning
Mid block crossings
Overcoming opposition to developing and implementing Complete Streets policies.
Safety countermeasures
Local Safety Plans.

Q8 - Do you have any other comments?

Do you have any other comments?
Excellent format for exchange of experiences (positive or negative_ across all levels of agencies (state, county, municipal) and learn latest innovations in technologies, strategies, and performance measures.
9 AM start. Re: adequate time for learning about the topics covered, John acFadden should have had more time.
Roundabout pedestrian crossings are not safe.
None at this time
No
Great presenters
Good peer exchange
Could you please consider having representatives from DVRPC? Other examples of counties implementing safety measures
Very informative
Well worth the time spent away from the office. There was adequate time for learning about the topics covered, but additional time is always good
Trainings for Safety Voyager, and how Autocad data can be integrated.
Training is always good. Subjects: US Limits, local road safety plans.
Interested in USLIMITS 2 information- intro webinar as suggested today.
Great session! I like the peer exchange format.
Facility was good, peer idea exchange by group was helpful
Nice job!
Very informative and helpful sessions.
It is an excellent program

Make Your Mark Peer Exchange

Feedback Survey Report

December 6, 2017 Session

Q1 - Did you find the Local Safety Peer Exchange content useful?

#	Answer	%	Count
1	Yes	100.00%	15
2	No	0.00%	0
	Total	100%	15

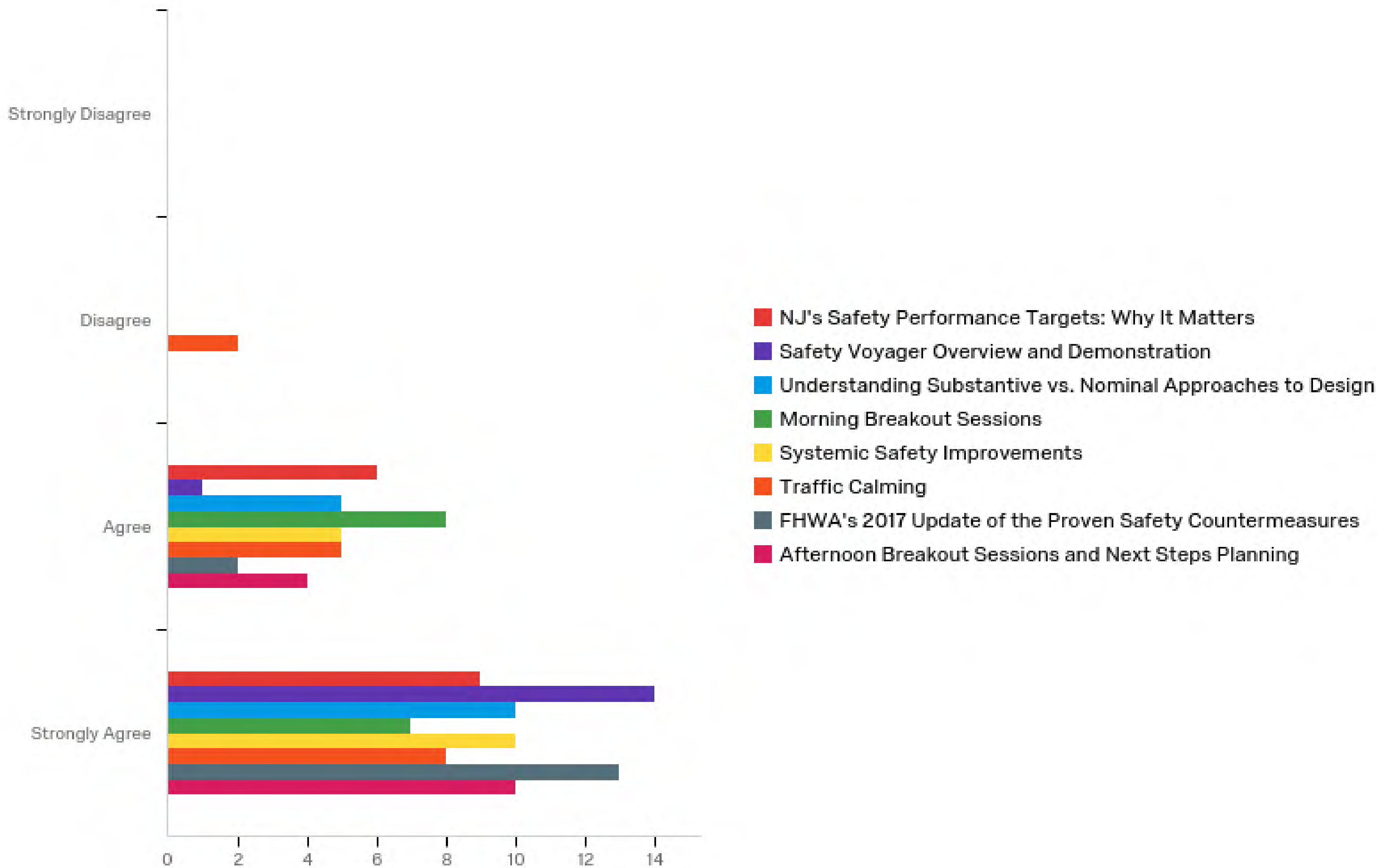
Q2 - Was the format appropriate for learning about the topics covered?

#	Answer	%	Count
1	Yes	100.00%	15
2	No	0.00%	0
	Total	100%	15

Q3 - Was there adequate time for learning about the topics covered?

#	Answer	%	Count
1	Yes	100.00%	15
2	No	0.00%	0
	Total	100%	15

Q4 - For each session below, please indicate how strongly you agree or disagree that the presented information is transferable to your work.



Q4 Continued - For each session below, please indicate how strongly you agree or disagree that the presented information is transferable to your work.

#	Question	Strongly Disagree		Disagree		Agree		Strongly Agree		Total
1	NJ's Safety Performance Targets: Why It Matters	0.00%	0	0.00%	0	40.00%	6	60.00%	9	15
2	Safety Voyager Overview and Demonstration	0.00%	0	0.00%	0	6.67%	1	93.33%	14	15
3	Understanding Substantive vs. Nominal Approaches to Design	0.00%	0	0.00%	0	33.33%	5	66.67%	10	15
4	Morning Breakout Sessions	0.00%	0	0.00%	0	53.33%	8	46.67%	7	15
5	Systemic Safety Improvements	0.00%	0	0.00%	0	33.33%	5	66.67%	10	15
6	Traffic Calming	0.00%	0	13.33%	2	33.33%	5	53.33%	8	15
7	FHWA's 2017 Update of the Proven Safety Countermeasures	0.00%	0	0.00%	0	13.33%	2	86.67%	13	15
8	Afternoon Breakout Sessions and Next Steps Planning	0.00%	0	0.00%	0	28.57%	4	71.43%	10	14

Q5 - What topics, issues or best practices do you think should be added to this workshop?

What topics, issues or best practices do you think should be added to this workshop?
Safety voyager overview
Highway safety manual implementation
More low-cost, quick cheap solutions and how to get them implemented
Road diets, pedestrian safety corridor/system approach
Can't see anything at this time.
How to capture safety related improvements that use local and State funds
Discuss bike/ped improvements a little more in depth w/in proven safety countermeasures and items/actions that aren't one of the 20 but will be eventually (projected to be a proven countermeasure).
List of safety funding programs and what agencies can apply
How to make a successful application for federal funding
Implementing bike improvements/bike lanes Safety Intersection Improvements to address pedestrians and vehicles in urban areas Show Annual Safety Report Results (project sample) and what goes to Congress

Q7 - What topics, issues or best practices would you like to see discussed at future Safety Peer Exchange sessions?

What topics, issues or best practices would you like to see discussed at future Safety Peer Exchange sessions?
Safety countermeasures
Speed limit determination mini roundabouts
Streamlining the project delivery process for safety projects
Bicycle safety topics/planning
Inventory of what "best practices" or proven safety countermeasures that have been installed, by agency, so that conversations can happen between those that have done it with those that want to do it.
Success stories regarding education campaigns
Findings of a CAP review. Sample-show issues and encounters

Q8 - Do you have any other comments?

Do you have any other comments?
It is an excellent program
Could you please consider having representatives from DVRPC? Other examples of counties implementing safety measures
No
Well worth the time spent away from the office. There was adequate time for learning about the topics covered, but additional time is always good
Great session! I like the peer exchange format.
None at this time
Good peer exchange

Make Your Mark Peer Exchange

Feedback Survey Report

June 13, 2018 Session

Q1 - Did you find the Local Safety Peer Exchange content useful?

#	Answer	%	Count
1	Yes	100.00%	16
2	No	0.00%	0
	Total	100%	16

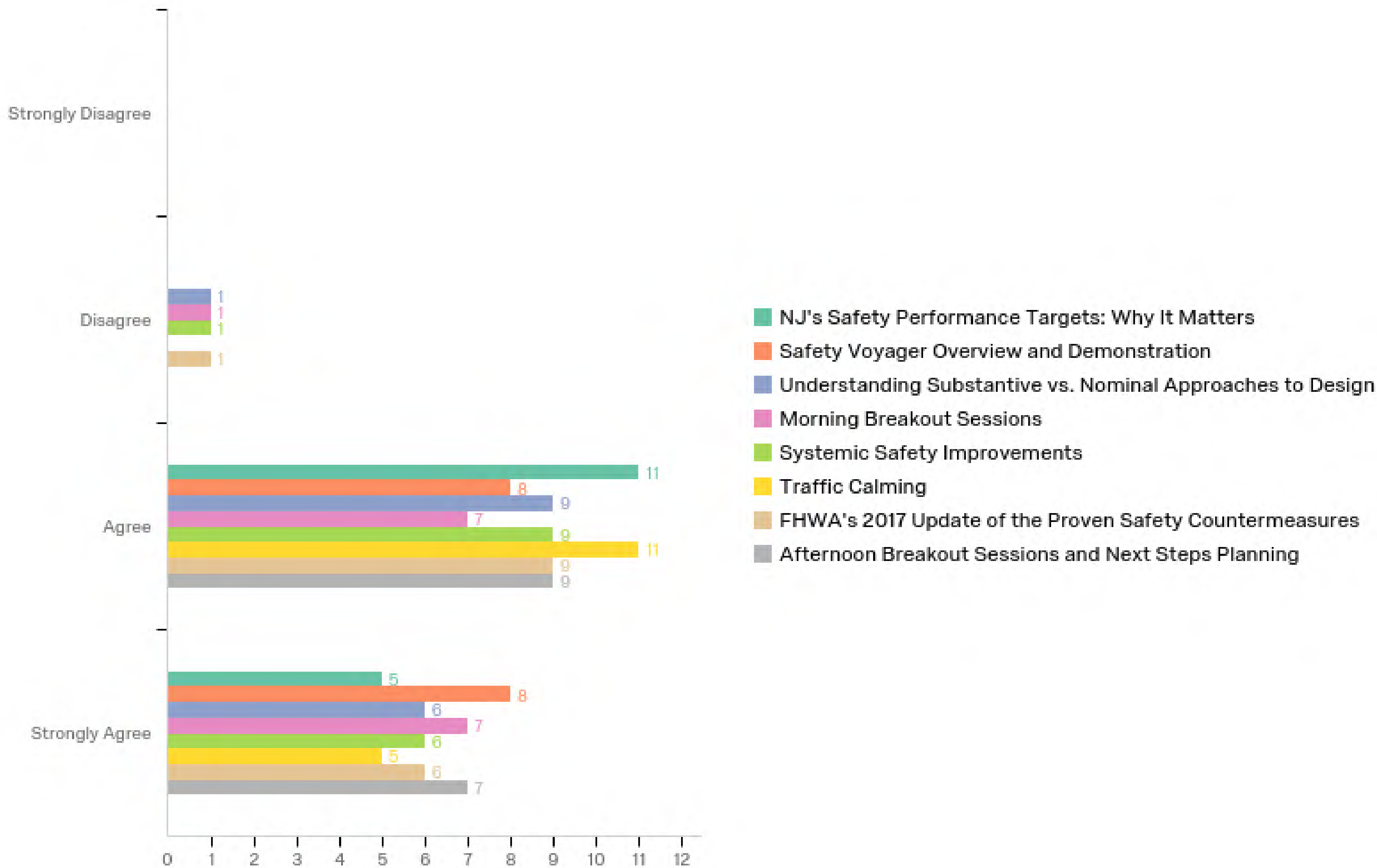
Q2 - Was the format appropriate for learning about the topics covered?

#	Answer	%	Count
1	Yes	100.00%	16
2	No	0.00%	0
	Total	100%	16

Q3 - Was there adequate time for learning about the topics covered?

#	Answer	%	Count
1	Yes	93.75%	15
2	No	6.25%	1
	Total	100%	16

Q4 - For each session below, please indicate how strongly you agree or disagree that the presented information is transferable to your work.



Q4 Continued - For each session below, please indicate how strongly you agree or disagree that the presented information is transferable to your work.

#	Question	Strongly Disagree		Disagree		Agree		Strongly Agree		Total
1	NJ's Safety Performance Targets: Why It Matters	0.00%	0	0.00%	0	68.75%	11	31.25%	5	16
2	Safety Voyager Overview and Demonstration	0.00%	0	0.00%	0	50.00%	8	50.00%	8	16
3	Understanding Substantive vs. Nominal Approaches to Design	0.00%	0	6.25%	1	56.25%	9	37.50%	6	16
4	Morning Breakout Sessions	0.00%	0	6.67%	1	46.67%	7	46.67%	7	15
5	Systemic Safety Improvements	0.00%	0	6.25%	1	56.25%	9	37.50%	6	16
6	Traffic Calming	0.00%	0	0.00%	0	68.75%	11	31.25%	5	16
7	FHWA's 2017 Update of the Proven Safety Countermeasures	0.00%	0	6.25%	1	56.25%	9	37.50%	6	16
8	Afternoon Breakout Sessions and Next Steps Planning	0.00%	0	0.00%	0	56.25%	9	43.75%	7	16

Q5 - What topics, issues or best practices do you think should be added to this workshop?

What topics, issues or best practices do you think should be added to this workshop?
US limits
Even more practical project examples
Incorporating safety low cost improvements
Case studies
Issues of county/state/municipal responsibility for installation and maintenance of sidewalks; The reluctance of some jurisdictions to embrace Complete Streets and bike/ped safety

Q7 - What topics, issues or best practices would you like to see discussed at future Safety Peer Exchange sessions?

What topics, issues or best practices would you like to see discussed at future Safety Peer Exchange sessions?
Mid-block crossings
Incorporating safety improvements in all projects, Ped Hybrid Beacons
More safety counter measures, advances, and new trends
More bike/ped focus

Q8 - Do you have any other comments?

Do you have any other comments?
Nice job!
Very informative
Facility was good, peer idea exchange by group was helpful

Make Your Mark Peer Exchange

Feedback Survey Report

March 28, 2019 Session

Q1 - Did you find the Local Safety Peer Exchange content useful?

#	Answer	%	Count
1	Yes	100.00%	19
2	No	0.00%	0
	Total	100%	19

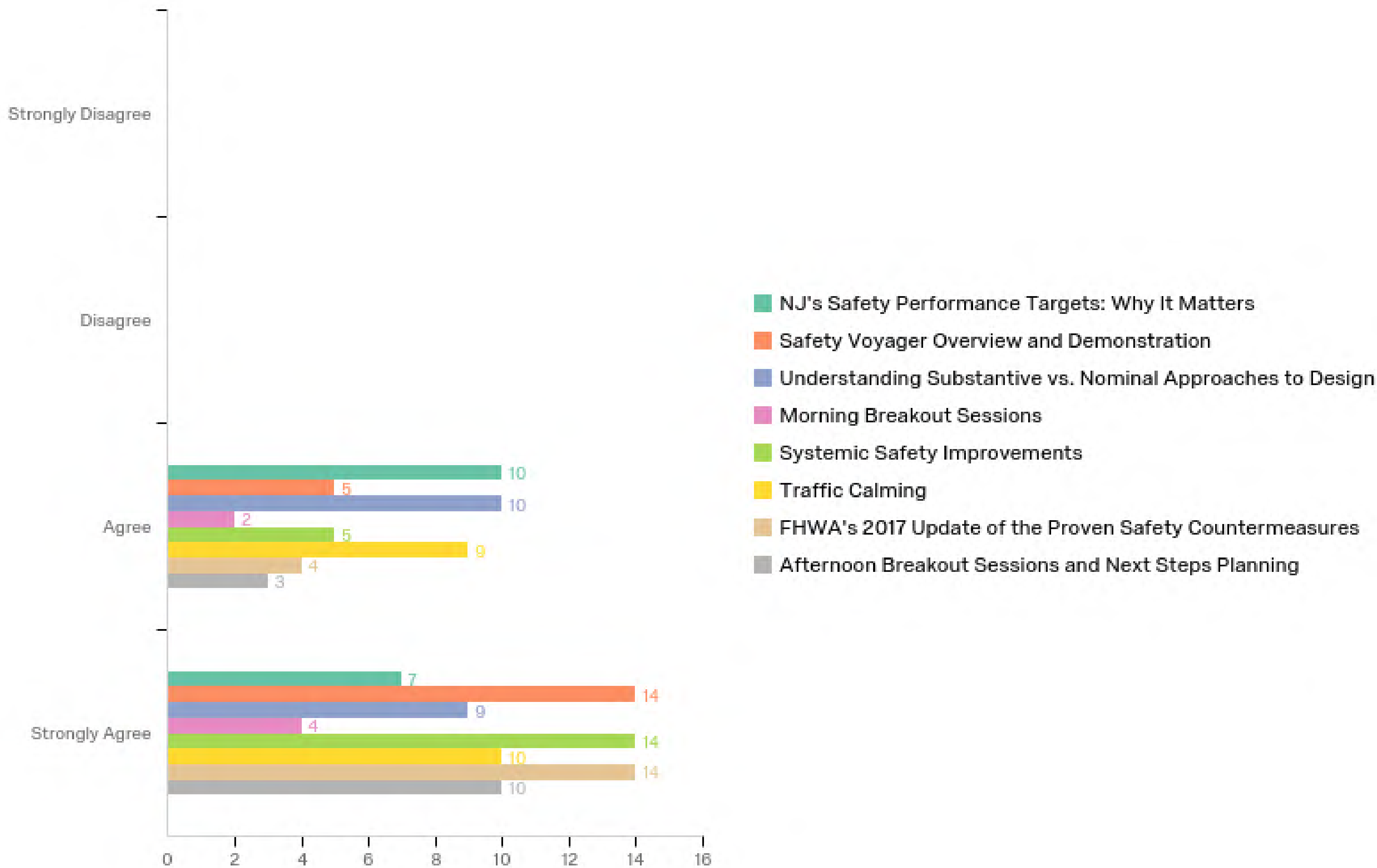
Q2 - Was the format appropriate for learning about the topics covered?

#	Answer	%	Count
1	Yes	100.00%	19
2	No	0.00%	0
	Total	100%	19

Q3 - Was there adequate time for learning about the topics covered?

#	Answer	%	Count
1	Yes	94.74%	18
2	No	5.26%	1
	Total	100%	19

Q4 - The sessions provided information that is transferable to your work: For each session below, please indicate how strongly you agree or disagree that the presented information is transferable to your work.



Q4 Continued- The sessions provided information that is transferable to your work: For each session below, please indicate how strongly you agree or disagree that the presented information is transferable to your work.

#	Question	Strongly Disagree		Disagree		Agree		Strongly Agree		Total
1	NJ's Safety Performance Targets: Why It Matters	0.00%	0	0.00%	0	58.82%	10	41.18%	7	17
2	Safety Voyager Overview and Demonstration	0.00%	0	0.00%	0	26.32%	5	73.68%	14	19
3	Understanding Substantive vs. Nominal Approaches to Design	0.00%	0	0.00%	0	52.63%	10	47.37%	9	19
4	Morning Breakout Sessions	0.00%	0	0.00%	0	33.33%	2	66.67%	4	6
5	Systemic Safety Improvements	0.00%	0	0.00%	0	26.32%	5	73.68%	14	19
6	Traffic Calming	0.00%	0	0.00%	0	47.37%	9	52.63%	10	19
7	FHWA's 2017 Update of the Proven Safety Countermeasures	0.00%	0	0.00%	0	22.22%	4	77.78%	14	18
8	Afternoon Breakout Sessions and Next Steps Planning	0.00%	0	0.00%	0	23.08%	3	76.92%	10	13

Q5 - What topics, issues or best practices do you think should be added to this workshop?

What topics, issues or best practices do you think should be added to this workshop?
Navigating through the state NJDOT's grant funding, project delivery, project prioritization.
More demonstartion project case strudies for local (county/municipal) applications to provide verification of effectiveness.
Bike lanes and signal optimization.
Safety Countermeasures
Tools- Autocad, Safety Voyager
Bit more designing of each measure.
Local opposition to safety improvements and how to deal with it.
More HSM info.
Handicap ramps, guiderail.
Various experiences on RSAs, etc.
Solutions to dealing with pushback, How to sell a tough idea like a roundabout to the average citizen
Examples from each county showing completed projects. Proven safety countermeasures-where have they been completed? How many?

Q7 - What topics, issues or best practices would you like to see discussed at future Safety Peer Exchange sessions?

What topics, issues or best practices would you like to see discussed at future Safety Peer Exchange sessions?
How does a project get funded and what is the project delivery process for state, local, and county roads.
Complete Streets implementation- real world solutions to design and implentation of bike lanes and treatment at intersections where bump outs are used to reduce length of pedestrian crossing, but interrupts the available bike lane.
More examples of countermeasure used at LPA bod - along with data that proves how effective it was.
Overcoming opposition to developing and implementing Complete Streets policies.
Road diets, High surface friction in other colors i.e. red (Endurablend)
More experiences on different Proven Safety Countermeasures, including USLIMITS, HAWK signs, LPI, and low cost at stop intersections.
More in-depth on new proven safety countermeasures.
Local Safety Plans.
USLIMITS 2
Post construction crash analysis. Demonstration of a sample project going through Safety Voyager to obtain crash data downloading to Excel.

Q8 - Do you have any other comments?

Do you have any other comments?
Excellent format for exchange of experiences (positive or negative_ across all levels of agencies (state, county, municipal) and learn latest innovations in technologies, strategies, and performance measures.
Roundabout pedestrian crossings are not safe.
Trainings for Safety Voyager, and how Autocad data can be integrated.
Very informative and helpful sessions.
9 AM start. Re: adequate time for learning about the topics covered, John acFadden should have had more time.
Interested in USLIMITS 2 information- intro webinar as suggested today.
Great presenters
Training is always good. Subjects: US Limits, local road safety plans.