Speed Management Action Plan

Pennsylvania Department of Transportation

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Chapter 1: Introduction

Motor vehicle crashes are responsible for more fatalities between the ages of 5 and 24 than any other cause of death and remains one of the leading killers among all age groups in the United States.[1] From 2010 to 2014, Pennsylvania averaged 1,265 highway fatalities and 3,340 serious injuries annually.

Pennsylvania has over 43,000 miles on the State-maintained roadway system and 77,000 miles of locally-owned roadways. Due to its intermediary location between major metropolitan areas on the east coast and the Midwest, Pennsylvania's roadways carry a large amount of commercial truck traffic, ranging between 30 to 50 percent on certain interstate highways. Pennsylvania also has a significant amount of rural roadways, which exhibit fatality rates that are twice those on urban roadways.

Problem Identification

Aggressive driving caused 12 percent of all fatalities and 8 percent of all serious injuries in Pennsylvania between 2010 to 2014, and of all those fatal and serious injury (FSI) crashes, 34 percent are directly due to speeding-related factors. In Pennsylvania, a crash can be attributed to aggressive driving when one vehicle involved has committed one of the following actions:

- Making an illegal U-Turn
- Sudden slowing or stopping
- Making improper or careless turns
- Turning from the wrong lane
- Careless passing or lane change
- Proceeding without clearance after stop
- Passing in no passing zone
- Running a stop sign
- Running a red light
- Failure to respond to TCD
- Tailgating
- Making improper entrance to highway
- Speeding
- Driving too fast for conditions
- Making improper exit from highway
- Driver fleeing police (police chase)

According to the National Highway Transportation Safety Board's (NHTSA) 2014 fatality data, Pennsylvania has the third highest percentage of speeding-related traffic fatalities in the nation at 43 percent, significantly higher than the national average of 28 percent. In addition, the State ranked third

[1] Pennsylvania Strategic Highway Safety Plan, 2012.

in the Nation that same year for having the highest speeding-related fatalities in 2014 with 509 deaths.[2] These statistics reveal the severity of speeding issues in Pennsylvania.

In Pennsylvania's 2012 Strategic Highway Safety Plan (SHSP), the State identified reducing speeding and aggressive driving as one of the "Vital Seven" safety focus areas with a long-term focus area goal of reaching 50 percent fatality reduction by 2030 and developed strategies to address the issue. Many of the strategies incorporate engineering, enforcement, and education to meet the State's goal of reducing speeding-related crashes.

Between 2010 and 2014, speeding-related crashes have steadily decreased from 702 (2006-2010 average) and reached 589 (2010-2014 average). Figure 1 displays Pennsylvania's trend of reduction in speeding-related crashes for the same period of time. Pennsylvania experienced 1,195 overall fatalities in 2014 which is the lowest ever in Pennsylvania motor vehicle crashes since 1928. With significant overall fatality reductions since the finalization of SHSP, the State should maintain its focus on speeding-related crashes for accomplishing the SHSP long-term goal by 2030.

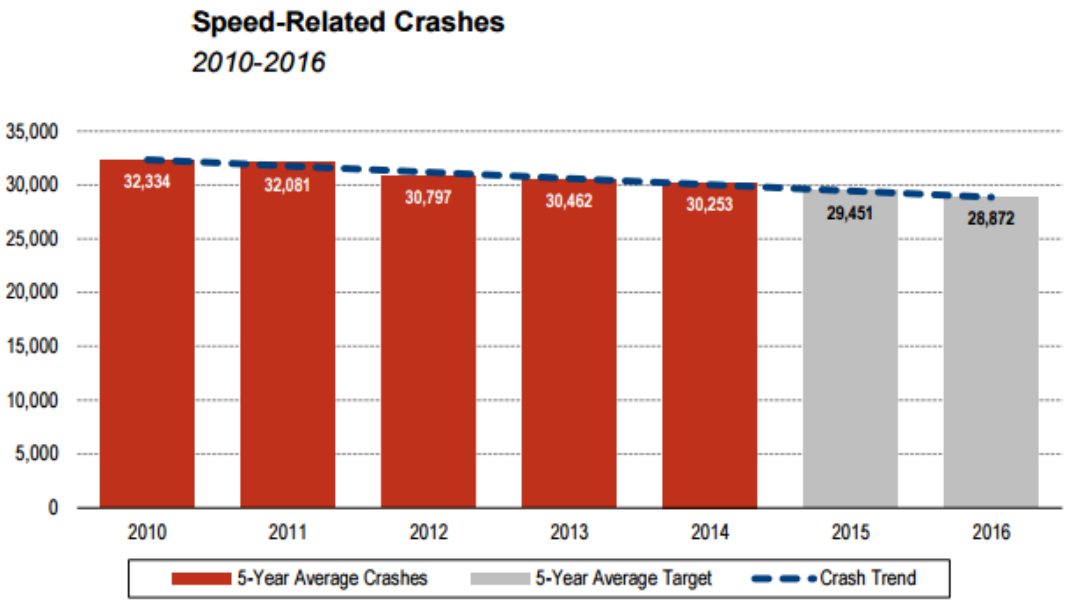


Figure 1 PennDOT speeding-related actual crashes and reduction goals (Source: FFY 2016 Pennsylvania Highway Safety Plan)

FHWA has identified roadway departure (RwD), intersection, and pedestrian/bicycle crashes as the three safety focus areas with the greatest potential for reducing fatalities. Speeding-related crashes occur in all three of these focus areas, and many of the countermeasures applicable to crashes within these focus areas also apply to speeding-related crashes. With speeding as a crosscutting issue, FHWA

[2] Traffic Safety Facts, NHTSA, 2013. Available at: https://crashstats.nhtsa.dot.gov/Api/Public/ViewPublication/812162

encourages agencies to take a broad look at speeding-related policies, safety plans, and programs and identify opportunities for integrating speed management throughout.

This concept of integrating speed management within the three focus areas of roadway departure, intersection, and pedestrian and bicyclist, as well as within agency's existing policies, plans and programs is the foundation for Pennsylvania's Speed Management Action Plan. Below is the general outline of this plan:

Chapter 2 describes the approach to develop the plan, identifies key data analysis and literature review findings, and describes the SHSP Steering Committee Meeting where speed management strategies were discussed.

Chapter 3 presents speed management strategies and countermeasures that could be integrated into Pennsylvania's roadway departure, intersection, and pedestrian, and bicyclist plans.

Chapter 4 lists broader themes relating to speed management in Pennsylvania and potential strategies to address them.

Chapter 5 highlights the next steps, including considerations for future research needs relating to speed management and potential partners for success.

Reducing fatalities and severe injuries on the transportation system is directly impacted by an agency's efforts to manage roadway speeds and to implement effective speed management strategies. This speed management plan will assist Pennsylvania in reaching its safety goals.

Chapter 2: Approach

This plan was developed based on a three-pronged approach that included 1) a review of relevant Pennsylvania transportation literature, 2) data analysis to identify factors and trends that contribute to speeding-related crashes, and 3) results from a SHSP Steering Committee meeting where Pennsylvania's safety stakeholders gathered to discuss speed management, roadway departure, intersection and pedestrian/bicycle strategies.

Literature Review

A literature review of PennDOT's current state of practice, speeding-related policies and guidance, other safety plans, and countermeasure the DOT would consider using indicated how Pennsylvania is integrating speed management currently. Areas of improvement identified while reviewing these documents helped shape the recommendations and strategies presented in this plan.

The review covers the following resources:

- *Federal Fiscal Year 2016 Pennsylvania Highway Safety Plan* (NHTSA, 2016)
- *Pennsylvania Crash Facts and* Statistics (PennDOT, 2014)
- *PennDOT Bicycle and Pedestrian Plan* (PennDOT, 2007)
- *Pennsylvania Strategic Highway Safety Plan* (PennDOT, 2012)
- *Pennsylvania Intersection Safety Implementation Plan* (FHWA Office of Safety, 2010)
- *Pennsylvania Roadway Departure Safety Implementation Plan* (FHWA Office of Safety, 2010)
- *Pennsylvania Traffic Calming Handbook* (PennDOT, July 2012)
- *PennDOT Traffic Engineering Manual* (Pub. 46, March 2014)
- *Official Traffic Control Devices* - PennDOT's supplement to FHWA's MUTCD (Pub 212, 3-06)
- *Drive Safe PA* Brochure– Pennsylvania's Guide to Safe Driving (Pub 670, 3-09)
- The Pennsylvania Code on Speed Limits – 67 Pa. Code § 212.108, 75 Pa. Code § 3361&3368 (46 Pa.B. 2944, June 4, 2016)

PennDOT completed a Speed Management Countermeasures List by indicating the likelihood of using specific countermeasures to address speed-related focus area crashes. These countermeasures were used to help determine the strategies within this plan. The completed list is found in Appendix A.

Data Analysis

An analysis of Pennsylvania State crash data revealed the characteristics of speeding-related crashes within roadway departure, intersection, and pedestrian and bicyclist safety focus areas. Pennsylvania DOT provided five years (2010-2014) of crash data from their State database for analysis. This set of data included information about all crashes on all roads.

A road traffic crash may occur as a result of several factors combined. In order to determine the most effective countermeasures to avoid speeding related crashes, it is necessary to identify as many contributing circumstances as possible.

Examination of fatal and serious injury (level A on the KABCO scale[3]) crash trends and causes consisted of three categories:

- Roadway departure crashes involving speeding ,
- Intersections crashes involving speeding, and
- Pedestrian/bicycle crashes involving speeding.

Speeding-related crash findings in each category were compared to overall (both speeding and non-speeding) crashes within that category in order to identify potential anomalies in speeding-related crash trends and factors that may contribute to speeding-related crashes. This section describes how the definition and queries for each of these categories within the Pennsylvania state crash database. The data analysis summary is included in Appendix B.

Defining Speeding-Related Crashes

The FLAG table of Pennsylvania Crash Database provided the speeding-related crashes as those which has the value "1" (1=YES, 0=NO) in the "SPEEDING_RELATED" field.

Defining Roadway Departure Crashes

The definition of roadway departure crashes covered the crashes in the database that meet the following criteria:

- All single vehicle non-pedestrian, non-bicycle crashes.
    - Does not include intersection crashes.
    - Does not include any other pedestrian or pedcycle-related crashes.

- Head-On crashes and Sideswipe crashes where one vehicle was traveling E and one W or one vehicle was traveling N and one S.
    - Does not include intersection crashes.
    - Does not include any other pedestrian or pedcycle-related crashes.

- All other crashes in where Crash Event 1-3 was a fixed object.
    - Does not include intersection crashes.
    - Does not include any other pedestrian or pedcycle-related crashes.

These query criteria was combined with that described under *Defining Speeding-Related Crashes* to generate all roadway departure crashes involving speeding.

Defining Intersection Crashes

The FLAG table of Pennsylvania Crash Database provided the intersection crashes as those which have the value "True" in the "Intersection" field.

[3] The KABCO scale is a five point indexing system that consists of: fatal injury (K), incapacitating injury (A), non-incapacitating injury (B), possible injury (C), and no injury/property damage only (O).

This query criteria was combined with that described under *Defining Speeding-Related Crashes* to generate all intersection crashes involving speeding.

Defining Pedestrian and Bicycle crashes

The FLAG table of Pennsylvania Crash Database provided the pedestrian and bicycle crashes as those which have the value "TRUE" in the "PEDESTRIAN" or "BICYCLE" fields.

This query criteria was combined with that described under *Defining Speeding-Related Crashes* to generate all pedestrian and bicycle crashes involving speeding.

SHSP Steering Committee Meeting

FHWA's team and Pennsylvania SHSP safety stakeholders participated in a Steering Committee Meeting conducted on July 7, 2016, at the Pennsylvania Department of Transportation in Harrisburg. Participants specializing in a variety of disciplines attended from PennDOT.

The workshop agenda included discussions around the following topics:

- Linking SHSP with PA Speed Management Action Plan
- Improving Intersection Safety
- Reducing Run-Off Road Crashes/ Hit Fixed Object Crashes
- Reducing Head-On and Cross-Median Crashes
- Improving Pedestrian/Bicycle Safety
- Enhancing Safety on Local Roads

The attendee list and workshop agenda can be found in Appendix C.

During the workshop, attendees discussed advantages and disadvantages to countermeasures and strategies associated with reducing roadway departure, intersection, and pedestrian/bicycle crashes, including those with a speed-management component. These strategies and associated discussion were captured and were integral to shaping this speed management plan.

Chapter 3: Integrating Speed Management within Focus Areas

According to FHWA, "In addressing speeding-related issues, the roles and responsibilities of all participants (i.e. engineers, law enforcement, policy-makers, public) should be defined clearly and shared among all. Any strategy selected should be based upon a general approach to behavior modification through a program involving public education, attitude change, special visible enforcement, and targeted promotion. This approach should be accompanied by continued development of appropriate engineering and legislative actions. The strategy must be consistent, using proven highway safety methods and technology.

The major components of the [speed management] plan should include: 1) long-term framework and goals to address and modify public behavior against speeding and aggressive driving while encouraging positive change, 2) medium-term reviews to continuously monitor and measure performance of the process, procedures, and practices, such as setting appropriate speed limits, and 3) short-term initiatives-that will provide effective results to urgent issues, such as targeted enforcement, education, and outreach activities. Monitoring and evaluation of program effects is imperative."[4]

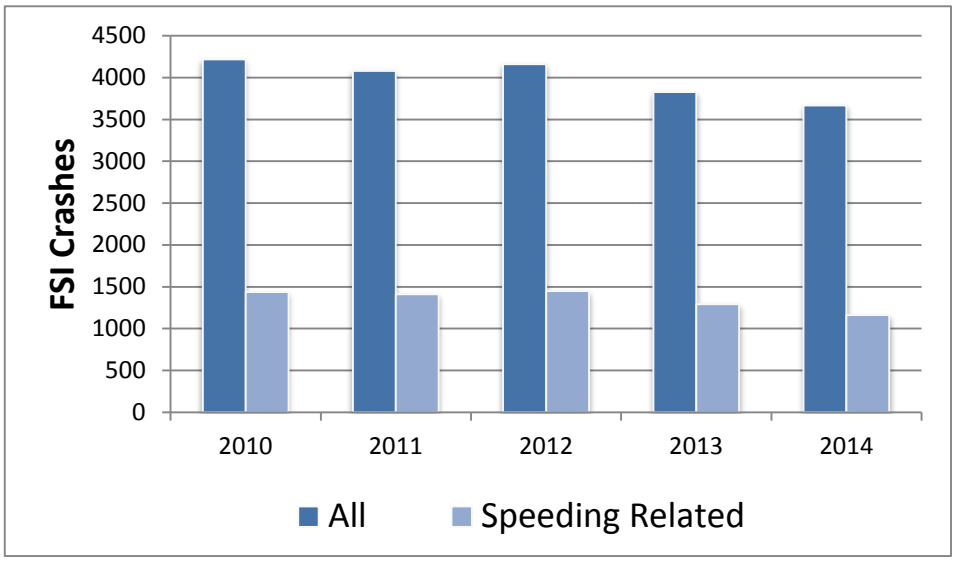


Figure 2 Pennsylvania's Total and Speeding-related FSI crashes (2010 to 2014)

With roadway departure, intersections, and pedestrian and bicycle crashes accounting for approximately 90 percent of the traffic fatalities in the United States, these key focus areas are a vital link in managing speeding and targeting speeding-related crashes. Each of these areas contributes significantly to Pennsylvania's total speeding-related fatality and serious injury (FSI) levels. As shown in Figure 3, roadway departure speeding-related crashes overwhelmingly account for the majority of fatal and serious injury speed-related crashes, similar to nationwide trend. Intersection and pedestrian and bicycle speeding-related crashes are also significant contributors to the overall crash rate.

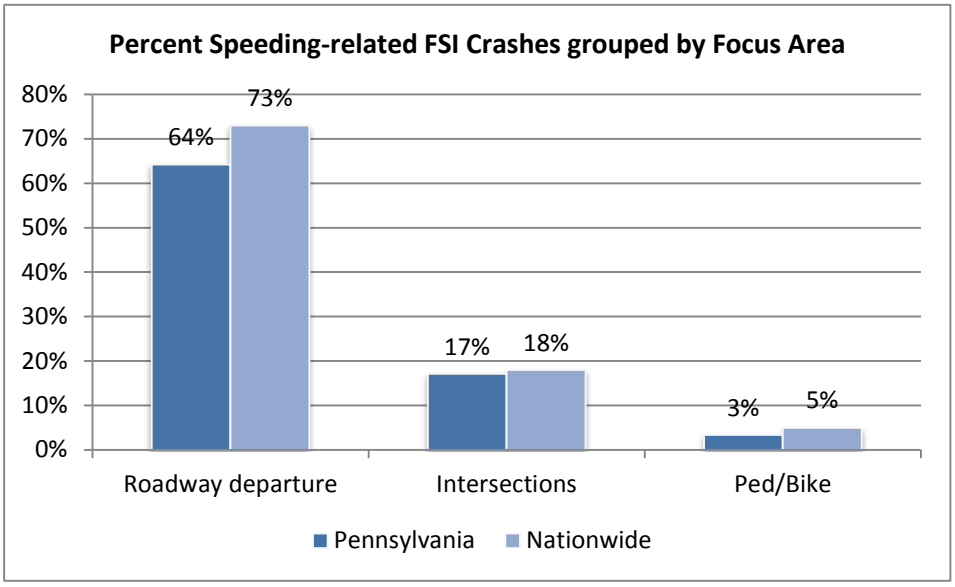


Figure 3 Pennsylvania's speeding-related FSI crashes by focus area

[4] FHWA Study Tour for Speed Management and Enforcement Technology, 1995.

Note: A single crash may be attributed to multiple focus areas (e.g., an intersection crash may also be a pedestrian/bicycle crash).

Existing Overall Speed Management Strategies

Pennsylvania's top strategies stated in 2012 SHSP to combat speeding and other aggressive driving behaviors incorporate enforcement, education, and the use of technology. The strategies are shown below:

1. Targeting law enforcement in areas with a high rate of aggressive driving crashes (PA Aggressive Driving Education and Enforcement Project). Targeted traffic enforcement is very effective in changing driver behavior to drive more safely.
   a. Problem Specific Policing / Selective Traffic Enforcement Programs
   b. Continue public awareness program through earned and paid media
2. Continuing funding aggressive driving enforcement trainings for law enforcement officers and the public, providing online training when applicable.
3. Placing speed timing devices and red light running cameras in the appropriate locations. Utilizing any other effective engineering practices. [5]
4. Educating prosecutors and judges to ensure speed violations are treated seriously and fairly. Ensuring that sanctions are upheld against repeat offenders.
5. Continuing to develop comprehensive traffic safety public information and education problems that are designed to motivate change in unsafe behaviors. Continuing to provide school programs focused on safe driving practices.

One of the most effective ways to ensure implementation of speed management practices is to identify opportunities to integrate speed management into existing plans. This leverages existing resources rather than attempting to identify new resources – human and fiscal – to focus specifically on speed management. The following subsections identify some key data analysis findings and present speed management countermeasures that could be integrated into Pennsylvania's roadway departure, intersection, and pedestrian and bicyclist plans.

While not all strategies reduce overall speeds, all strategies help reduce crashes, both speeding and non-speeding related. Speed reductions listed within each strategy's description are sourced from FHWA's *A Desktop Reference of Potential Effectiveness in Reducing Speed* [6], unless otherwise noted.

Speeding-related Roadway Departure Crashes

Data analysis showed that 45 percent of all fatal and serious injury RwD crashes in Pennsylvania are speeding-related. This percentage is higher than the nationwide percentage of 40. While 72 percent of FSI RwD crashes occur in rural areas, this number is 74 percent for speeding-related FSI RwD crashes. Again, both of these percentages are around 10 percent higher than nationwide averages, indicating a

[5] Denotes legislative strategies recommended by highway safety partners and does not constitute endorsement by agency leadership.
[6] Resource can be found at: http://safety.fhwa.dot.gov/speedmgt/ref_mats/eng_count/2014/reducing_speed.cfm

speed management focus needed on rural roads in Pennsylvania. Another over-representation relates to the non-turnpike (State) system: 67 percent of the speeding related RwD crashes occurring on these roads, which accounts for only 30 percent of all the miles of the entire system.

As roadway departure crashes have been an important issue in Pennsylvania, a Roadway Departure Safety Implementation Plan (RDIP) was developed in 2012 to identify a set of low cost countermeasures, deployment levels, and funds needed to achieve a substantial and cost effective annual reduction in roadway departure fatalities. Some of the speeding-related strategies from this plan are as follows:

- The traditional approach of relying primarily on implementing major improvements at high-crash roadway departure locations must be complemented with a systematic approach that involves deploying large numbers of relatively low-cost, cost-effective countermeasures at many targeted roadway departure sites with moderate crash levels, and a comprehensive approach that coordinates an engineering, education, and enforcement (3-E) initiative on corridors with large numbers of severe roadway departure crashes where speeding and aggressive driving are major crash concern.
- The safety program needs to be expanded to incorporate low-cost, cost-effective countermeasures on other types of projects – such as resurfacing and surface transportation projects – when a crash history exists within the project area and the appropriate countermeasures can reduce future crash potential. Planning, Design, Safety, and Maintenance Offices should coordinate to review these efforts, identify opportunities, and make long-term adjustments through processes or policies to ensure opportunities are not overlooked.
- Additional countermeasures rarely or never used in Pennsylvania need to be carefully and judiciously deployed on highway sections that have specific crash problems that these countermeasures can address. These countermeasures include the following: florescent yellow warning signs in advance of curves; lateral transverse grooves on poorly drained concrete pavements; and traffic calming to achieve substantive high-end speed reductions in advance of populated areas and sharp curves.
- A substantial education and highly visible enforcement program should be initiated and coordinated with the Safety Program to improve safe driver behavior on selected corridors that have significant numbers of severe speeding-related roadway departure crashes.

The RDIP plan led PennDOT to achieve tangible innovations. In 2016, the agency published a report that includes Pennsylvania-specific regionalized safety performance functions (SPFs) that can be used to quantitatively assess the safety performance of planned or existing highways.[7]

In addition to deploying engineering countermeasures, PennDOT has launched "Education and Enforcement Corridor Initiatives" that combine education and enforcement actions on corridors stretching five miles in length that have high concentrations of total and roadway departure crashes involving either alcohol, speeding, or unbelted drivers.

[7] Regionalized Safety Performance Functions, PennDOT, 2016. Available at: http://www.dot7.state.pa.us/BPR_PDF_FILES/Documents/Research/Complete%20Projects/Operations/Regionalized_Safety_Performance.pdf

Pennsylvania developed a Traffic Calming Handbook[8] in 2012. Traffic calming measures are mainly used to address speeding and high cut-through traffic volumes on neighborhood streets, but rural traffic calming countermeasures are also important. FHWA Report HRT-08-067, *Traffic Calming on Main Roads Through Rural Communities,* and Iowa Highway Research Board Project TR-630, *Evaluation of Low Cost Traffic Calming for Rural Communities – Phase II* includes types of traffic calming countermeasures and the studies showing their effectiveness. In addition, the use of peripheral transverse pavement markings (which are placed only on the edges of the travel lane) on a continuous section rather than for a point-specific location can be considered to reduce excessive speeds throughout a section of roadway.[9]

In Pennsylvania, 41 percent of FSI RwD speeding-related crashes involved alcohol, and 81 percent of FSI RwD speed related crashes involved male drivers. Such statistics help agencies in determining targets for education and enforcements efforts. The characteristics of alcohol-involved crash locations can be used to select where to focus enforcement efforts. Education and public awareness campaigns can be placed in marketing avenues that capture and address male drivers.

Speeding related FSI RwD crashes occurring on curves account for 56 percent of the total. PennDOT's *Traffic Engineering Manual* covers additional signing and delineation at curves and turns by listing conditions that should be considered for additional treatments; however, speeding crashes is not one of them. On the other hand, Pennsylvania is a pioneer in using advance marking for curves.

In Pennsylvania, 74 percent of speeding-related FSI RwD crashes occur in rural areas, while this percentage is as low as 62 in nationwide. Based on the data analysis results, a focus on speeding-related crashes on rural State roads is the most effective way to reduce speeding-related RwD fatalities.

Data analysis showed that 87 percent of speeding-related FSI roadway departure (RwD) crashes in Pennsylvania from 2010 to 2014 were non-vehicle collisions. Of that number, 20 percent were tree-collisions. When looking at *all* FSI tree collision crashes, 55 percent were speeding related. Removing frequently hit trees and other objects in hazardous roadside locations and high-crash corridors is a 2012 SHSP strategy that Pennsylvania has mixed success with so far.

Over 80 percent of speeding-related tree FSI crashes occur in rural areas and 73 percent of such crashes occur where the speed limit is 45 mph or below. Therefore a focus on rural areas is crucial when applying these strategies. The road sections with speed limits below 45 mph may be a priority. Just over 11 percent of speeding-related FSI RwD crashes are collisions with utility poles/traffic signs and13 percent of speeding-related FSI RwD crashes are collisions with guardrail, end treatment, and barriers.

Head-on and cross-median crashes are 18 percent of all speeding-related FSI RwD crashes in Pennsylvania. Of these, 30 percent are opposing direction crashes where 67 percent of such crashes occur in rural areas and 74 percent on roadways with posted speed limit less than 50 mph. A focus on rural roads with speed limits less than 50 mph may accelerate the fatality reduction.

[8] Pennsylvania's Traffic Calming Handbook, PennDOT, 2012. Available at: http://www.dot.state.pa.us/public/pubsforms/Publications/PUB%20383.pdf

[9] Pavement Markings for Speed Reduction, Bryan Katz, SAIC 2004.

Countermeasures for Reducing Speeding-related Roadway Departure Crashes

During the 2016 SHSP Steering Committee Meeting, attendees discussed potential countermeasure implementations that can supplement Pennsylvania's existing and under-consideration strategies to address speeding-related RwD crashes. Overall, discussions suggested the implementation of the countermeasures listed in this section.

Deploying the following countermeasures can help PennDOT address speeding at curves:

Enhance curve signing and delineation. Install oversized signs, florescent sheeting, full post delineation, center and edge line striping, raised pavement markers and wet-reflective markings at curves with high speeding-related roadway departure crashes. Ensure consistency in deployments. Consider rumble strip applications (edge line or shoulder) in conjunction with paved shoulders four feet wide or greater. Widen shoulders to accommodate additional locations to install rumble strips. Clarify pavement conditions for installing/retrofitting rumble strips. Include shoulder widening in resurfacing process.

Remove or delineate fixed objects within curves. Remove trees, brush, and other obstacles within designated distance from the edge of travel way along the outside of curves as appropriate. Delineate any fixed objects that cannot feasibly be removed along the outside of curves; all fixed objects including trees, utility poles, culverts/bridge abutments, mailboxes, and guide rail should be considered.

Improve roadway design and geometric enhancements. Widen lanes and/or shoulders on curves and rural highways. Improvements like widening could be done only on the curve. Deploy self-enforcing roadway countermeasures in advance of curve when curve is the limiting speed factor, such as advanced signing, marking, etc.

Use reflective and innovative signs. Similar to intersection advance warnings, consider reflective strips on curve warning signs, dynamic or lighted signs, or other opportunities for emerging technologies.

If enhanced curve signing and delineation has been previously installed and the area is still experiencing high speeding-related crashes, **consider sequential dynamic curve warning system**, a series of blinking chevron signs installed throughout a curve that flashes sequentially through the curve to warn speeding drivers. Also consider dynamic speed feedback signs in corridors or in advance of locations with lower advisory or posted speeds.

Transverse or optical speed bars. Use optical speed bars where studies show they can be effective, such as approaches to low-speed zones.[10] [11] [12] This pavement measure creates a visual effect that encourages motorists to slow down. Bar placement can be designed to minimize wear from wheel tracking. While some studies show optical speed bars are not effective, some have shown that they decrease speeding, especially those travelling more than 10 mph over the speed limit. If a potential location considered for

[10] Evaluation of Best Practices in Traffic Operations and Safety: Phase 1: Flashing LED Stop Sign and Optical Speed Bars, E.D. Arnold, K.E. Lantz, Virginia Transportation Research Council, 2007.
[11] Effectiveness of Optical Speed Bars in Reducing Approach Speeds to Rural Communities, A. Balde, S. Dissanayake, Journal of Transportation Safety & Security 5(3), 2013.
[12] Evaluation of Low Cost Traffic Calming for Rural Communities – Phase II, S. Hallmark, S. Knickerbocker, N. Hawkins, CTRE, April 2013, found at: http://publications.iowa.gov/14769/1/rural_traffic_calming_w_cvr.pdf.

improvement matches up very similarly with a successful example, then transverse or optical speed bars may be applicable. Studies have shown reductions in 85th percentile speeds up to 5 mph. It is often used when there is a need for sudden decrease in speed (e.g., at sharp curves or short ramps).

Curve inventory. Build inventory of curves, geometry, signing, etc. to allow data-driven approach for evaluating horizontal curve safety.

The following engineering countermeasures can address the speeding-related RwD crashes on any State highway road segments:

Apply skid-resistant pavement/ high friction surfacing treatments and drainage improvements. For High friction surface treatments (HFST) place a thin layer of specially engineered, durable high friction aggregates as a topping on resins or polymers – usually urethane, silicon, or epoxy – with a binder. These aggregate systems have long lasting skid resistance, while also making the overlay much more resistant to wear and polishing. The increased friction enables shorter stopping distances and allows speeding drivers to recover more quickly from their mistakes.

Improve recovery area/clear zone. Eliminate shoulder drop-offs, starting with high severity (> 6 inch) drop-offs. Update or install guiderail where warranted. Speed coupled with high traffic volume contributes to the problem.

- Eliminate all substandard/unserviceable guiderail.
- Design safer slopes and swales to prevent rollovers.
- Remove/relocate/delineate roadside objects in hazardous locations.

Rural ITS solutions. Install speed feedback signs, speed activated warning or speed limit reminder signs, or other signs/beacons that notify the side street or major street vehicle of an approaching vehicle. Research shows these types of signs have been effective at reducing speeds by 5 mph.
Systemic & Systematic Implementation. Implement FHWA Roadway Departure Plan and update as needed. Ensure compliance with MUTCD Standards. Potentially include a "before and after" comparison of speed distribution surveys in the areas where new strategies are applied, in order to determine if high-end speeding is being reduced.

Retroreflectivity. Improve sign retroreflectivity through maintenance of existing signs.

Reducing the Severity and Frequency of Hit Fixed Object Crashes

Removing frequently hit trees and other objects in hazardous roadside locations and high-crash corridors is a 2012 SHSP strategy that Pennsylvania has mixed success with so far. In addition to tree removal, the State can pursue following specific strategies to address the speeding-related tree collisions:

Additional shielding. Install additional guiderail, as appropriate. Modify roadside clear zone in the vicinity of hazardous fixed objects. Shield bridge end walls (examples include bridge transition guiderail). Also, evaluate short, ineffective runs of guardrail and if they can be removed.

Control wildlife. Develop, revise, and implement planting guidelines to prevent placing trees in hazardous locations.

Remove/relocate frequently hit utility poles. Relocate aboveground utilities underground where possible. Relocate poles in high-crash locations farther from the roadway and/or to less vulnerable locations, or remove when possible.

Delineation. Delineate trees and utility poles that cannot be removed in hazardous locations.
Use breakaway devices. Pursue the use of break-away devices for utility poles and sign supports. Evaluate the available breakaway devices and use the option that is most appropriate for the conditions.
Planning ahead and systematic implementation. Develop, revise, and implement policies to prevent placing or replacing poles within the recovery area where right-of-way limits allow.

Reducing Head-On & Cross-Median Crashes

Installing center line rumble strips is a strategy stated in the State's 2012 SHSP to address head-on and cross-median crashes. The following engineering, education, and enforcement countermeasures can address speeding-related head-on and cross-median crashes:

Rumble strips. Continue to install center line rumble strips for two-lane roads in non-residential areas. Install center line rumble strips in targeted locations, such as curves. Install left shoulder rumble strips on divided highways with no median barriers

Install median barriers. Install cable barriers for open medians at high crossover locations and other traffic barriers on four lane undivided roads. Improve design and application of barrier and attenuation systems.

Improve road design. Consider road diets, pavement marking medians, lane reconfigurations, etc. Reallocation of total two-lane width (lane and shoulder) to include a narrow "buffer median" or to provide wider medians will improve median design for vehicle recovery. Widen lanes and/or shoulders on curves. Install center 2-way left turn lanes on two-lane and four-lane roads. Install wide cross sections and/or alternating passing lanes or four-lane sections at key locations on two-lane highways.

Delineation. Provide enhanced pavement markings and median delineation.

Implement low-cost improvements at curves. Examples include advanced curve warning markings, edge line delineation, chevrons, etc.

Evaluate passing zones. Evaluate passing zones on two-lane highways according to new AASHTO "Green Book" standards and using Highway Safety Manual evaluation techniques.

Improve data collection. Enhance agency crash data systems for head-on/crossover crashes. Review crashes in passing zones to help determine if those zones are in place according to standards. Incorporate a cross median crash flag to Pennsylvania Police Crash Report for a more efficient way to identify crossover crashes. Update cross median crash report each year until a cross median crash flag is added to the police report.

Speeding-related Intersection Crashes

Data analysis showed that currently 20 percent of all fatal and serious injury intersection crashes in Pennsylvania are speeding-related, similar to the nationwide percentage of 21 percent. The rural/urban

split for speeding-related intersection crashes in Pennsylvania is relatively equal, while nationwide, urban crashes account for 62 percent and rural crashes for 38 percent.

Over 75 percent of speeding-related intersection crashes occur on non-turnpike State highways in Pennsylvania, which is slightly higher than the nationwide average of 73 percent. Additionally, 27 percent of all FSI speeding-related intersection crashes occur at signalized intersections, similar to 28 percent of speeding-related fatal crashes nationally. On the other hand, stop sign controlled intersections in Pennsylvania account for 26 percent of these FSI crashes, which is 11 percent higher than nationwide data that indicates only fatal crashes.

PennDOT developed the Intersection Safety Implementation Plan[13] in 2010 to address the safety issues at priority intersections, realizing the traditional approach of relying primarily on pursuing major improvements at high-crash intersections must be complemented with a systemic approach that involves deploying large numbers of relatively low-cost, cost-effective countermeasures at many targeted high-crash, stop-controlled and signalized intersections; and a comprehensive approach that coordinates engineering, education, and enforcement (3E) initiatives on corridors and in urban areas with large numbers of severe intersection crashes. The list of actions recommended included: providing assistance to local governments, encouraging district safety involvements, improving funding possibilities, deploying new and innovative countermeasures, spreading the implementation of roundabouts, and adopting new performance measures.

Intersection approaches where drivers commonly enter the intersection at excessive speeds can potentially increase the severity of crashes. In addition, higher approach speeds may make it more difficult for some stopped drivers at stop-controlled intersections to identify safe gaps to enter the intersection. Another concern is intersections with high speeds on the through approaches and limited sight distance on the stop approach. Speed reduction, particularly at intersections that have multiple crashes in which the crash report has identified speeding as a causative factor should consider immediate improvements to reduce high-end intersection approach speeds. The predominant speed reduction enhancements are lane narrowing, dynamic warning signs, transverse pavement markings, slow/speed limit pavement markings, friction/skid resistance surface treatments, etc.

In Pennsylvania, 32 percent of all intersection FSI crashes are speeding-related at roads with posted speed limits between 40 to 45mph. Focusing on road sections with this speed limit range may lead to more effective fatality reductions.

Almost 30 percent of the police crash reports in Pennsylvania do not define whether the intersection is signalized or stop controlled, although other data sources show what traffic control is at the intersection, like signal permits and SAP sign inventories. Strengthening the collaboration between agencies and law enforcement, training law enforcement officers to ensure consistent data collection, and looking for ways to bridge data sources would allow PennDOT to have more trustworthy, complete intersection crash data.

[13] Pennsylvania's Intersection Safety Implementation Plan, 2010. Page 4

Nearly 35 percent of speeding-related FSI intersections crashes in Pennsylvania are angle crashes, while 33 percent are non-vehicle collisions. Only 12 percent of these crashes are front-to-rear (rear end) crashes.

Countermeasures for Speeding-related Intersection Crashes

During the 2016 SHSP Steering Committee Meeting, attendees discussed potential countermeasure implementations that can supplement Pennsylvania's existing and under-consideration strategies to address speeding-related intersection crashes. Overall, discussions suggested the implementation of the countermeasures listed in this section.

Improving access management and intersection geometry could reduce fatalities by preventing angle and non-vehicle (mostly pedestrian) crashes. The following countermeasures can be considered to address these crash types:

Roundabouts. Roundabouts eliminate crossing conflicts and can have significant traffic calming effects. Studies have shown roundabouts can lower speeds by as much as 15 to 20 mph and reduce severe crashes by nearly 80 percent.

Revise geometry of complex intersections. Provide or improve left & right turn channelization. Utilize indirect left-turn treatments. Install J-turns. Add offset and/or longer turn lanes. Convert intersections to roundabouts where possible. Restrict Access to Properties Using Driveway Closures or Turn Restrictions

Reduction of lane width markings. For intersections located on high-speed roadways, narrow the lanes leading up to the intersection using pavement markings, rumble strips and pavement markings, or median, to create visual cues to drivers the roadway is changing and there is a need to slow down. Realign intersection approaches to reduce or eliminate intersection skew

Improve geometry of pedestrian and bicycle facilities. Pedestrian refuge islands allow pedestrians to cross in two stages, simplifying the crossing task. Refuge islands or median islands also provide visual friction to reduce motorists' speeds. Curb extensions also provide safety benefit to pedestrians by reducing their crossing path and improve the visibility of pedestrians by aligning them with the parking lane. Restrict or eliminate parking on intersection approaches.

Congestion management. Improve availability of gaps in traffic and assist drivers in judging gap sizes at unsignalized intersections

Provide skid resistance in intersection and on approaches. The increased friction enables shorter stopping distances and allows speeding drivers to recover more quickly from their mistakes.

Improve signing and delineation. Post appropriate speed limits with warning signs on intersection approaches. Install larger signs and provide lighting. Use LED bulbs, backplates, turning lanes, and signal heads. Also consider dynamic speed feedback signs.

Targeted enforcement, outreach, and education. Determine specific arterial corridors with a high speeding-related intersection crash history and conduct high visibility enforcement and education efforts. Data shows males are more likely to be involved in speeding-related intersection crashes. Motorcyclists are also a group that is at high risk of involvement in this type of crash. Use the data

regarding crash time and alcohol-related crashes to select specific corridors and shifts for enhanced enforcement and to develop collaboration, outreach, and education efforts.

Complete Streets to safely accommodate all road users. The use of Smart Transportation Principles and Complete Streets concepts are encouraged by PennDOT to consider all modes of transportation not just in addressing issues on existing streets but the design of new or reconstructed streets.

Signalized Intersections

Routine and innovative solutions at signalized intersections can address speeding-related crashes. The following signalized intersection countermeasures should be considered:

Pedestrian improvements. Employ improvements to reduce the risk of pedestrian-vehicle interaction, such as pedestrian countdown timers, crosswalks, etc.

Signal timing. Consider reviewing existing signal timing and improve coordination of signals.

Enhanced ITS solutions. Employ emergency vehicle preemption and adaptive control software (ACS).

Install dilemma zone protection measures. On high-speed roads with signals, install advance detection sensor equipment that adjusts the start time of the yellow-signal either earlier or later based on observed vehicle locations and speeds.

Review flashing operations. PennDOT currently allows flashing operation on their signals during periods of low traffic volumes, unless an engineering or traffic study indicates otherwise. PennDOT permits a flashing operation if the total volume of vehicles entering the intersection drops below 325 vehicles per hour in urban areas or 225 vehicles per hour in rural areas for a period of four or more consecutive hours. The crash data at flashing operation time and locations should be collected and analyzed in order to correctly capture the safety effect of this application at the exact locations.

Stop-Controlled Intersections

Systemically implementing low-cost improvements, as listed below, can achieve significant reductions in fatalities due to speeding-related stop-controlled intersection crashes:

Appropriate traffic control. Ensure stop controlled intersections have appropriate signing and traffic control.

Enhanced advance warnings. Employ pavement markings such as intersection ahead and turn path markings. Implement flashing beacons at stop-controlled approaches at high crash locations. Also consider dynamic speed feedback signs, as appropriate.

Improve sight distance. Ensure clear sight triangles on stop or yield-controlled approaches to intersections. Control vegetation, utility poles, traffic signs, and any other objects that may obstruct driver's view on approaching intersection roads.

Speeding-related Pedestrians/Bicyclists Crashes

Data analysis showed that 8 percent of all fatal and serious injury crashes involving a bicyclist or a pedestrian in Pennsylvania between 2012 and 2014 were speeding-related. Considering the lack of

physical protection that bicyclists and pedestrian have, speeding-related crashes are very likely to result in fatalities. Approximately 65 percent of these crashes occur in urban areas; 63 percent of FSI pedestrian/bike speed related crashes occurred on state highways, while 30 percent occur on local roads. In the State, 75 percent of FSI pedestrian/bicycle crashes occurred at non-intersection locations.

PennDOT's most current Bicycle and Pedestrian Plan, developed in 2007, does not address speeding. A new plan is expected to be completed in 2016 to more fully integrate bicycle/pedestrian transportation into PennDOT's routine project development processes and to include the partners in the process at the appropriate levels of responsibility.

Over 30 percent of FSI pedestrian/bicycle speed related crashes occur on roadways posted 30-35 mph, while 29 percent of FSI pedestrian/bicycle crashes occur on roadways with speed limit 25 mph or less. With 75 percent of FSI pedestrian/bicycle speeding-related crashes in Pennsylvania occurring at non-intersection locations, the State can benefit from countermeasures and strategies that prevent the pedestrian/bicyclist and motor vehicle interaction from occurring, supplemented with education, outreach, and enforcement efforts.

Countermeasures for Speeding-related Pedestrian and Bicycle Crashes

During the 2016 SHSP Steering Committee Meeting, attendees discussed potential countermeasure implementations that can supplement Pennsylvania's existing and under-consideration strategies to address speeding-related pedestrian and bicycle crashes. Overall, discussions suggested the implementation of the countermeasures listed in this section.

With majority of speeding related pedestrian/bicycle crashes occurring in urban settings, PennDOT could consider the countermeasures below to address the issue:

Reduce pedestrian/bicycle exposure to vehicular traffic. Install mid-block crossing facilities such as medians and pedestrian crossing islands in urban and suburban areas when warranted. Install overpasses/underpasses. Provide sidewalks, walkways, curb ramps and crosswalk enhancements. Improve conspicuity of pedestrians and the sight distance between vehicles and pedestrians. Implement lighting/crosswalk illumination measures. Conduct outreach to local authorities to encourage use of Pennsylvania Infrastructure Bank (PIB) for crosswalk painting.

Improve signal hardware for pedestrians. Review pedestrian signal timing and pedestrian accessibility and associated features such as pedestrian pushbuttons. Determine criteria on when to install accessible pedestrian signals (APS). Promote use of pedestrian signals such as pedestrian countdown signals. Determine other benefits & criteria for such as turn restrictions, leading pedestrian, Interval, etc. Continue to deploy yield-to-pedestrian channelizing devices to communities across the commonwealth and measure their effectiveness.

Revise and improve shoulders for bicycle traffic. Provide safe roadway facilities for parallel travel by upgrading shoulder pavement.

Revise and improve intersections for bicycle traffic. Restrict right turn on red (RTOR) movements as warranted. Provide bicycle-related signals.

Accommodate bicycle use on roads. Increase bicycle related-signage. Promote existing design manual and standard criteria such as bicycle safe grates, scuppers, and rumble strips on all projects. Illuminate intersections to improve bicyclists' visibility

Increase public awareness on pedestrian safety. Provide education, outreach, and training to motivate a change in specific behaviors that can lead to fewer pedestrian injuries. Analyze pedestrian crash/fatality rates, use data regarding crash time and alcohol-related crashes, and provide statistics to District Bicycle and Pedestrian Coordinators to target focus areas for outreach training. Conduct Walkable Community Programs. Increase the number of pedestrian-related questions on the written Driver's Exam. Educate PennDOT staff and consultants on safe pedestrian practices as a means to improve awareness as end users of the pedestrian mode. Develop targeted pedestrian safety programs to include taverns/bars/pubs. Improve pedestrian safety in Transportation Enhancements (TE) and Federal Safe Routes to Schools (SRTS) programs.

Increase public awareness on bicycle traffic. Develop expanded public education and marketing campaigns. Identify Police departments that have officers on bikes. Support and fund communities with local bicyclist public information and education (PI&E) programs. Expand school and community programs that teach bicycle safety to children and adult bicyclists. Expand PennDOT educational campaign to include updating the State's bicycle driver's manual and reaching out to various other Governmental Departments. Include safe bicycling and sharing the road concepts in drivers' education programs. Promote the share-the-road program through School Districts teaching the concepts.

Internal bicyclist education. Educate community professionals on effective ways to promote safe bicycling. Educate PennDOT staff and consultants on safe bicycling practices as a means to improve awareness as end users of the bicycling mode and clarify the need to understand shoulder usage vs. lane usage.

Promote bicycle helmet use. Support and fund helmet initiatives for children under age 12. Promote Pub 636 (Bicycle is not a Toy Pamphlet).

Enforce pedestrian laws. Improve enforcement of pedestrian laws and discourage unsafe pedestrian behavior. Enforce yield to pedestrian law at marked crosswalks (if changing the sign in order to stop the pedestrian is not feasible). Target areas of unsafe pedestrian behavior, including drugs and alcohol. Use the data regarding crash time and alcohol-related crashes to select specific corridors and shifts for enhanced enforcement

Improve legislation on pedestrian/bicycle safety. Promote legislation to establish a Universal Pedestrian Access component to all projects. Determine other States' laws, quantify the relationship between land use and pedestrian safety, and enact law within context of Pennsylvania Vehicle code.[14]

Enforce bicycle safety laws. Strictly enforce bicycle laws including bicycle helmet use and 4-foot passing law, which took effect in April 2012. Promote existing five video series of law enforcement videos.

[14] Denotes legislative strategies recommended by highway safety partners and does not constitute endorsement by agency leadership.

Dedicate funding for pedestrian/bicycle solutions. Identify and fund effective programs in reducing motor vehicle-bicycle crashes, including visibility of bicyclists. Support and fund additional bicycle safety law enforcement.

Further data collection and analysis. Examine the root causes of location specific speeding-related pedestrian crashes in order to develop and implement effective countermeasures.

Chapter 4: Key Themes and Strategies

This section presents key themes, associated challenges, and strategies to overcome these challenges, all of which were synthesized from information and feedback gained through the literature review and data analysis. Each theme begins with a discussion of the associated challenges. Then, the plan presents several strategies to help PennDOT agencies overcome these challenges.

Enhancing Speeding-related Data Collection

There is a lack of consensus on what constitutes a safe speed for particular conditions and the lack of a rigorous definition of a speeding-related crash. A speeding-related crash is usually defined as one that involves exceeding the speed limit or traveling too fast for conditions. Currently, identification of speeding-related crashes is based on the judgment of the investigating officer and, as such, the percentage of crashes that are classified as speeding-related can be highly variable across jurisdictions.

Accurate law enforcement collection of speeding-related crash data is needed in order for engineers to determine locations and corridors with speeding issues. Law enforcement and engineers must agree on a universal definition of a speeding-related crash in order to perform accurate data analysis. Additionally, coupling this data with accurate time, location, and circumstances information is crucial to benefit from the data as much as possible and to effectively identify and address the issues.

A comprehensive look across all agencies within Pennsylvania will help to assess the consistency of the definition of a speeding-related crash. Workshops will provide a good opportunity to ensure that there is consistency across all parties' speeding-related crash definition. This knowledge will indicate the quality of the speeding-related crash data. This common definition of speeding should be integrated at both agency and law enforcement units via trainings to avoid any differences of interpretation and to clarify its use.

Setting Appropriate Speed Limits

All speed limits on existing Pennsylvania highways shall be established by criteria in related sections of Pennsylvania Consolidated Statutes (Title 75 Sections 3161 to 3368 and Section 6109(a)(5)(10)), Pennsylvania State Code (Title 67 Chapter 212.108) and PennDOT Traffic Engineering Manual (Pub. 46). The manual dictates that all speed limit studies shall be completed using the standard TE-101 "Speed Restrictions Engineering and Traffic Study" form.[15] The PennDOT Traffic Engineering Manual also provides guidelines on determining advisory and work zone speed limits.

Inconsistent procedures and policies in setting speed limits is a challenge for many agencies. Additionally, many speed limits are set based on the design speed or political pressure and may not be appropriate to actual road user needs over an extended road section. This has led to speed limits being posted 8-12 mph below the operating speed of traffic, in some cases, resulting in motorists who are traveling at reasonable speeds becoming violators, and law enforcement misallocating resources to cite

[15] Form available at: http://www.dot.state.pa.us/Portal%20Information/Traffic%20Signal%20Portal/TE.html

them for these violations. Another related challenge appears when analyzing and using the speeding related data to implement strategies; as inadequately set speed limits will mislead the analysis results with wrongly identified "violators".

It is essential that PennDOT works within the agency, districts, political officials, and law enforcement on the state of the practice regarding techniques for evaluating, setting, and monitoring speeds and appropriate speed limits and associated benefits.

Recommended Strategies

Set Appropriate Speed Limits. Setting appropriate speed limits is important for the safety and mobility of all users. Practitioners consider many factors to determine speed limits for a roadway. The process for setting speed limits and many speed concepts are not easily understood, especially with technical engineering terminology that is not familiar to many people. Develop outreach and education materials tailored towards lawmakers or officials to help them make informed decisions on statutory speed limits.[16] Since they are responsible for ultimately making laws for setting statutory speed limits, it is important they understand the concepts, processes, and importance of setting appropriate speed limits.

Develop Outreach. Develop an outreach plan for local agencies to educate them on application of statutory speed limits to various functional roadway classifications. This could include a fact sheet explaining the information or possible participation in a local agency meeting with a short presentation on the importance of understanding functional classification and the corresponding speed limits, along with how to identify and incorporate speed management/traffic calming countermeasures.

Conduct Education. It can often be challenging for designers and planners to determine appropriate speed limits and design speed for planning a roadway or in consideration of new developments along a roadway. Conduct a training workshop for internal planning, design, and traffic staff (and others as appropriate) devoted to speeding and speed management, including functional classification, choosing design speed, measuring operating speeds, setting speed limits, and choosing speed management countermeasures. Also, consider complementing this type of course with a context sensitive solutions training workshop. FHWA is a possible resource for identifying appropriate training courses that may already be available.

Use USLIMITS2. The USLIMITS2 expert speed zoning tool can assist practitioners as a reference in setting objective, consistent, and enforceable speed limits. Used as a complement to the comprehensive engineering speed study, it provides a fair and unbiased result that supports the credibility of an agency's speed studies. USLIMITS2 cannot be the sole method to determine a speed limit; however this tool may be beneficial when providing supplemental information to lawmakers on making informed decisions on statutory speed limits.

[16] FHWA Office of Safety – Speed Management is developing outreach materials for non-technical audiences and it should be available soon.

Systemic Approach To Proactively Addressing Speeding Related Crashes

Agencies perceive that speed management is difficult to implement. In many cases implementation is driven by a centralized position but action is taken at the district or regional level. Institutionalizing innovative engineering countermeasures is a key strategy for Pennsylvania's success in addressing speeding issues.

Data analysis revealed that speeding-related crashes occur more frequently on low volume rural roads than urban areas. Pennsylvania looks at the ratio of urban versus rural fatalities to figure out where to focus. Fatalities in both settings should be declining at the same rate.[17] A systemic and proactive approach is crucial in low volume rural roads, as a spot-location approach would mean to wait until an FSI speeding crash to happen, which is too late to save a life and does not align with the Towards Zero Deaths goal.

The systemic approach to speeding allows widely implementing safety countermeasures based on high-risk roadway features correlated with FSI speeding crash types. The approach provides a more comprehensive method for safety planning and implementation that supplements and complements traditional site analysis. The approach also helps agencies broaden their speed management efforts and consider risk as well as crash history when identifying where to make low-cost safety improvements.

Programmatic Strategies to Prevent the Opportunity of Speeding to Occur

Even though speeding is traditionally considered directly related to driver behavior, it is possible to address the initial reasons that led the driver to speeding. Geometric design improvements and consistency among all roads (in terms of speed limits, signage, geometry, enforcement, and road condition) can dramatically reduce speeding in Pennsylvania in the long-term.

Recommended Strategies

Geometric Consistency. Avoid having highly-designed road segments with a single curve or location that is under-designed.

Utilize HSM To Evaluate Geometric Improvements. Perform HSM Network Screenings according to the methods that Highway Safety Manual (HSM) provides for evaluating road geometry.

Realistic Speed Limits. Use speed limits that reflect conditions and driver expectations, rather than artificially lowered. Better assessment of speed limit establishment process.

Local Road Improvements. Communicate and coordinate improvements and needs to the locals. LTAP to develop a Curve Safety Class and is a priority, possibly this fall. Create safety checklist for local road projects.

Enforcement of Speed on Local or Rural Roads. There is not much enforcement on low-traffic roads in Pennsylvania. Use launch pads in more locations. Support police with crash data, provide for data-driven enforcement approaches.

[17] Systemic Safety Implementation Peer Exchange Summary Report, Columbus, OH, November 2014, page 9.

Take Advantage of 511PA Applications. These website and mobile phone applications are underutilized. Similarly, consider expanded use of Waze for curve warnings.

Expand Safety Consideration on All Roadway Projects. Perform safety analyses or consider upgrades on resurfacing projects. Do not limit to simple engineering solutions on projects – examine them at a higher perspective to ensure the proper product is being installed.

Identify Funding For Future Maintenance. It is crucial to maintain the safety countermeasures that are currently funded by HSIP. Ensure funding to keep these countermeasures in place through future maintenance cycles.

Targeted enforcement, outreach, and education. Determine specific corridors with a high speeding-related crash history and conduct high visibility enforcement and education efforts. Consider integrating speed management efforts into other focused enforcement and education programs such as distracted driving, motorcyclists, youth, etc. Data shows males are more likely to be involved in speeding-related crashes. Motorcyclists are also a group that is at high risk.

Performance Measurement

Measuring the performance of speed management efforts can be difficult for several reasons.

- Speed management efforts are often cross-cutting so isolating the effectiveness of the speeding-management component may be difficult. This is especially true when relying on fatality information since there are relatively few fatalities and many other potential factors.
- Data beyond fatality information may be difficult to collect, access, or analyze with the regularity necessary for meaningful performance measures.
- Speed management efforts are likely to rely heavily on engagement of local agencies as well as State agencies. Establishing speed management performance measures that can be applied across the board may be challenging.

Despite these potential challenges, it is critical that performance measures be established, targets set, and progress monitored regularly. This is especially true as federal programs are increasingly associated with an expectation for performance management.

Recommended Strategies:

Identify meaningful performance measures. Rather than relying solely on measures that have been chosen because the data is readily available, identify what would actually be helpful for decision-makers and program managers. It may mean that performance measures have to be implemented with a phased in approach – first measure with available data while working toward acquisition and access to the desired measures.

Consider all potential data sources. While crashes, injuries, and citations issued are datasets most commonly associated with measuring the performance of speed management efforts, there are a suite of other data that may be useful. For example, adjudication data may provide and understanding of the

outcome of speed citations and a public survey about attitudes toward speed management efforts may provide critical insight into public perception.

Engage partner agencies. Although one agency may be ultimately responsible for managing a statewide speed management program, it will rely heavily on participation by local and regional agencies as well. It is helpful to understand what they consider "success" in the performance measure setting process. They may also have access to data that is not available at the State level.

Assign responsibility and accountability and set a schedule. It is important to assign responsibility for collecting and reporting performance measures. It is equally important to assign accountability for the measures at the appropriate level. In addition, a schedule for performance reporting should be established. Annual performance measures are common but in some cases, a more frequent measure may help a program adjust direction if early indicators show a need for change from the original plan. Having a responsible party and an expected schedule prevents performance measurement from being set aside or forgotten as part of the speed management process. Accountability ensures that the efforts to improve are continuous.

Cumulative Strategies and Countermeasures

Table 1 presents a list of all strategies mentioned in this plan, their related speed-management focus impact area, and its relative implementation time, cost, and impact. Table 2 details speed management countermeasures; associated impact area; relative cost, and crash modification factors.

These tables serve as a resource for Pennsylvania DOT and stakeholders to prioritize their next steps to improve their overall speed management program and reduce speeding related crashes, as they consider budget and staffing resources.

Table 1. Speed Management Strategies; Associated Impact Area; and Relative Implementation Time, Cost, and Impact.

Strategy	Impact Area			Relative Implementation Time			Relative Cost			Relative Impact		
	RwD	Intersections	Ped/Bike	Immediate	Short Term	Long Term	Low	Midrange	High	High	Midrange	Project Specific
Road Geometry												
Widen lanes and/or shoulders on curves and rural highways	X					X			X		X	
Utilize HSM to Evaluate Geometric Improvements												
Consider roundabouts to help transition from higher speed to lower speed roadways.		X	X			X		X				X
Review existing 4-lane undivided roadways to determine candidate roads for reconfiguring the lanes.			X		X		X					X
Revise intersection geometrics, use left/right turn channelization, j-turns, offset/longer turn lanes, lane widths. Consider on-street parking, street trees, sidewalks, bicycle facilities, planter strips, and other street elements to create visual friction without introducing new crash types (such as fixed objects).		X	X		X			X				X
Improve sight distance at intersections and availability of gaps in traffic and assist drivers in judging gap sizes at unsignalized intersections		X			X			X		X		
Assess existing pedestrian and bicycle facilities to identify areas where these users may be more vulnerable to speed-related crashes.			X			X		X			X	
Speed Setting Criteria												
Develop an alternative process to identify higher risk roads and conduct a screening process for reviewing existing speed limits on those roads.	X	X	X		X		X			X		
Determine an appropriate number of reviews on existing speed limits per year.	X	X	X		X		X			X		
Consider using performance measures to track screening progress, as well as identifying the number of roadways with speed limits that have inappropriate speed limits.	X	X	X			X	X			X		

Strategy	Impact Area			Relative Implementation Time			Relative Cost			Relative Impact		
	RwD	Intersections	Ped/Bike	Immediate	Short Term	Long Term	Low	Midrange	High	High	Midrange	Project Specific
Examine ways to include implications on bicyclists and pedestrians for different locations and facilities within setting of speeds. Balance multimodal interests within the context of the facility, considering the different users and uses.			X		X			X				X
Review locations that transition from higher speeds to lower speeds to evaluate the speed limits and the location of the speed limit signs.	X	X	X			X	X			X		
Traffic Signals												
Develop a plan to systematically review all signal timings to ensure yellow and all-red clearance intervals are appropriate for the speed limit and the intersection geometry.		X		X				X			X	
Review flashing traffic light operations		X		X			X				X	
Improve signal hardware for pedestrians, bicyclists, and people with disabilities.												
Coordinate signals on arterials to promote progression and uniform speed.		X				X		X		X		
Targeted Enforcement												
Determine specific corridors with a high speeding-related roadway departure or intersections crash history and conduct high visibility enforcement and education efforts.	X	X				X			X	X		
Enforce speed limits along high speeding-related crash locations where data indicates is increased risk of pedestrian or bicyclist involvement, such as schools, busy urban areas, etc.			X			X			X	X		
Internal Training												
Conduct a training workshop for internal planning, design, and traffic staff (and others as appropriate) devoted to speed and speed management, including functional classification, choosing design speed, measuring operating speeds, setting speed limits, choosing speed management countermeasures, designing safe roadsides, and transitioning between high/low speed areas.	X	X	X		X		X				X	

Strategy	Impact Area			Relative Implementation Time			Relative Cost			Relative Impact		
	RwD	Intersections	Ped/Bike	Immediate	Short Term	Long Term	Low	Midrange	High	High	Midrange	Project Specific
Assign responsibility and accountability and set a schedule for reporting performance measures.	X	X	X			X	X			X		
Collaboration with External Partners												
Provide supporting information and data on the risks of speeding, corridors with a high amount of speeding related crashes, etc. to law enforcement, advocacy groups, and legislature.	X	X	X		X		X				X	
Review the crash coding manual and work with law enforcement to learn if there is a need or ways to better define whether a crash is speed-related.	X	X	X			X		X			X	
Collaborate with the courts/judicial system to gain information on adjudication data.	X	X	X			X		X			X	
To improve data on the amount of pedestrians and bicyclists in a particular area, injuries, and excessive speeding violations, work together with law enforcement, emergency responders, and special interest groups, including the freight industry, and incorporate new technology to collect information on volumes of pedestrians and bicyclists.			X			X				X		
Continue to foster relationships with local agencies and reach out to those that may need more engineering support on speed-related issues.	X	X	X	X			X			X		
Policy and Guidance												
Review existing guidance in PennDOT's design manual to determine if there needs to be additional information included on addressing, planning, and designing high to low speed transition areas and regarding design aspects of roundabouts and road diets to ensure freight movements are considered.	X	X	X			X	X			X		
Ensure that the design manual promotes context sensitive design principles to consider all stakeholders and road users during project development.			X	X			X				X	
Data												
Review data pertaining to adjudication and traffic safety diversion program, and use to complement speeding-related crash data.	X	X	X			X		X			X	

Strategy	Impact Area			Relative Implementation Time			Relative Cost			Relative Impact		
	RwD	Intersections	Ped/Bike	Immediate	Short Term	Long Term	Low	Midrange	High	High	Midrange	Project Specific
Consider adding intersection identifiers to the crash databases, developing a database that links roadways IDs to speed limits, and creating a horizontal curve inventory to further identify speed-related crash locations.	X	X	X			X	X			X		
Rather than relying solely on measures that have been chosen because the data is readily available, identify what would actually be helpful for decision-makers and program managers.	X	X	X			X	X			X		
Include a "before and after" comparison of speed distribution surveys in the areas where new strategies are applied, in order to determine if high-end speeding is being reduced.	X	X	X	X			X			X		
Consider all potential data sources.	X	X	X			X	X			X		
Education and Outreach												
Support public reporting of speeding and aggressive driving. Develop a campaign to support this option, with messages such as, "safety is everyone's responsibility" or "we should watch out for each other" or similar messages.	X	X	X		X			X			X	
Incorporate speed management into education programs that combat impaired driving and into safety initiatives targeted at youths, motorcyclists, and commercial vehicle operators.	X	X	X			X	X				X	
Combine education and outreach with enforcement efforts. Consider combination of focuses, such as speeding and alcohol involvement or speeding and distraction.	X	X	X			X	X				X	
Conduct education and outreach on pedestrian and bicyclist safety, from all viewpoints, i.e., teaching the pedestrian, bicyclist, and driver important safety tips and rules.			X			X	X				X	
Develop outreach and education materials tailored towards lawmakers or officials to help them make informed decisions on statutory speed limits.	X	X	X		X		X				X	

Strategy	Impact Area			Relative Implementation Time			Relative Cost			Relative Impact		
	RwD	Intersections	Ped/Bike	Immediate	Short Term	Long Term	Low	Midrange	High	High	Midrange	Project Specific
Develop an outreach plan for local agencies to educate them on application of statutory speed limits to various functional roadway classifications. This could include a fact sheet explaining the information or possible participation in a local agency meeting with a short presentation on the importance of understanding functional classification and the corresponding speed limits, along with how to identify and incorporate speed management/traffic calming countermeasures.	X	X	X			X		X			X	
Continue education on the benefits of road diets and roundabouts and how they can often be designed to accommodate freights' needs.	X	X	X		X		X				X	

Table 2. Speed Management Countermeasures; Associated Impact Area; Relative Cost, and Crash Modification Factor (CMF)

Countermeasure	Impact Area			Relative Cost			CMF
	RwD	Intersections	Ped/Bike	Low	Mid	High	
Enhanced curve signing and delineation	X			X			0.671 – 0.741
Sequential dynamic curve warning system	X				X		0.438 – 0.627
Signing or dynamic signing addressing speed	X	X	X		X		0.87 – 0.95
Transverse or optical speed bars.	X			X			0.68
Median barriers	X		X		X		0.57 – 1.24
Remove or delineate fixed objects within curves	X			X			0.5 - 0.9
Center line or edge line rumble strips	X		X	X			0.6 – 0.85
High friction surface treatments (HFST)	X				X		0.522 – 0.607
Improve visibility or conspicuity of intersections		X		X			Unknown
Dilemma zone protection measures		X			X		0.6 - 0.8
Reduce lane widths		X		X			Unknown
Transverse rumble strips		X		X			0.36 – 1.4
Roundabouts		X	X			X	Varies by crash type
Lane reconfiguration (Road Diet)			X	X			0.59 – 1.0
Pedestrian refuge islands and curb extensions			X		X		0.54 – 1.94
Rectangular rapid flash beacons (RRFB)		X	X		X		Unknown

Chapter 5: Conclusion and Next Steps

Summary

From 2010 to 2014, speeding-related crashes dropped six percent and FSI speeding-related crashes fell over 10 percent in Pennsylvania. While this trend indicates a slight reduction in both crash severity types, additional focus on speed management is needed to continue the trend. Since roadway departure, intersection, and pedestrian/bicycle crashes have been identified by the Federal Highway Administration (FHWA) as the three areas with great potential to reduce fatalities, this plan encourages Pennsylvania to integrate speed management into these three safety focus areas by providing strategies and countermeasures for improving safety in each of these focus areas.

Pennsylvania's State and local agencies are also encouraged to take a broad look at their existing policies and programs to identify opportunities for fully integrating speed management throughout the organization. This document recommends strategies for incorporating speed management into these broader plans as well as within design guidance and manuals. Lastly, this plan recommended strategies for tackling some of Pennsylvania's main speed management related challenges.

Future Research Needs

While this report proposed numerous strategies for tackling speed management challenges encountered by Pennsylvania's transportation agencies, there are always opportunities to improve speed management solutions. PennDOT, either independently or through an associated university, should conduct additional speed management related research and investigation related to:

- Impact of Rumble Strips on Bicyclists
- Evaluation of Passing Zones
- Effectiveness of Optical Speed Bars
- Reduction in Speeding by enabling Law Enforcement to Use Radar[18]

Partners for Success

This plan's success depends not only on efforts put forth by Penn DOT, but also local jurisdictions throughout Pennsylvania and other safety partners:

- AAA Foundation for Traffic Safety
- Associated General Contractors
- Bicycle and pedestrian advocacy groups
- County Commissioners Association of Pennsylvania
- Construction industry
- Emergency services

[18] Denotes legislative strategies recommended by highway safety partners and does not constitute endorsement by agency leadership.

- Pennsylvania Association Chiefs of Police
- Pennsylvania Department of Education
- Pennsylvania Department of Health
- Pennsylvania Department of Motor Vehicles
- Pennsylvania Highway Information Association
- Pennsylvania Metropolitan Planning Organization (MPO) Consortium
- Pennsylvania Motor Truck Association
- Pennsylvania Motorcycle Safety Program
- Pennsylvania Patient Safety Authority
- Pennsylvania Public Transportation Association
- Pennsylvania Sheriffs' Association
- Pennsylvania State Police and local enforcement agencies
- Pennsylvania State Police Motor Carrier Division
- Universities, research institutes, and schools
- Work Zone Safety Industry/Groups

Appendix A – Speed Management Countermeasures List

Countermeasure	Description	Safety Focus	Urban/Rural Applicability	Roadway Environment	Priority to Implement (scale of 1-5) 1 - low; 5 - high
STATIC SIGNING					
One direction large arrow sign (W1-6)		RwD	Rural	Curves	5
Add flashers to existing curve warning signs		RwD	Rural	Curves	4
Add orange diamonds to existing curve warning signs		RwD	Rural	Curves	4
Curve Treatment Level 1: Basic Curve Signing (advanced warning, chevrons, speed plates)	Installing basic curve signing to meet MUTCD minimum	RwD	Rural	Curves	5
Curve Treatment Level 2: Enhanced signing/delineation	Installing enhanced signing/delineation (oversized signs, florescent sheeting, full post delineation, etc)	RwD	Rural	Curves	4
INTERACTIVE SIGNING					
Sequential Dynamic Curve Warning System	series of blinking chevron signs installed throughout a curve, flashes sequentially through the curve to warn speeding drivers	RwD	Urban, Rural	Curves	4
Speed feedback signs	sign that dynamically displays speed of passing vehicles with the message, "YOUR SPEED XX"	RwD	Rural, Urban	Any roads; school zones, advance of signalized intersection; work zones	5
Speed activated warning sign	sign that displays warning messages to speeding drivers	RwD	Rural, Urban	Any roads; work zones; curves	5
Speed activated speed limit reminder sign	displays speed limit to speeding drivers	RwD	Rural, Urban	Any roads	5
Variable speed limit sign	Signs that allow speed limit to change	RwD	Urban	Principal arterial,	5

Countermeasure	Description	Safety Focus	Urban/Rural Applicability	Roadway Environment	Priority to Implement (scale of 1-5) 1 - low; 5 - high
	according to conditions			interstate	
Speed Limit Sign with LED	Speed limit sign enhanced with LED lights	Pedestrian	Rural	Community entrance	4

Countermeasure	Description	Safety Focus	Urban/Rural Applicability	Roadway Environment	Priority to Implement (scale of 1-5) 1 - low; 5 - high
SURFACE TREATMENTS AND MARKINGS					
Transverse rumble strips	raised or grooved patterns installed on the roadway travel lane or shoulder pavements, perpendicular to the direction of travel	RwD	Urban, Suburban, Rural	Local; stop-controlled approaches, major	4
Converging chevron marking pattern	type of transverse pavement markings forming chevron shape to create the illusion of travelling faster as well as the impression of narrower lanes	RwD	Rural, Urban	Local street, collector, arterial; exit ramps; curves on directional interchange ramps	3
Transverse markings	a series of white lines placed across the center of the lane and spaced progressively closer to create the illusion of travelling faster	RwD	Rural	Horizontal curves; Work zone	3
Optical Speed Bars	a series of white rectangular markings typically 1 foot wide placed just inside both edges of the lane and spaced progressively closer to create the illusion of travelling faster as well as the impression of narrower lane.	RwD/intersection	Rural	Local street, collector, arterial; curves	3

Countermeasure	Description	Safety Focus	Urban/Rural Applicability	Roadway Environment	Priority to Implement (scale of 1-5) 1 - low; 5 - high
Add shoulder markings to narrow lane			Rural, Urban	2 lane road through small town; exit ramp	4
Speed Limit XX Pavement Legend	speed limit painted on roadway	Pedestrian	Rural, Urban	Any roads	4
"Slow" pavement legend	Slow painted on roadway	Pedestrian, RwD	Rural, Urban	Local roads, collector, arterial; curves	5
"XX MPH" + Curve Symbol (ACWM)	painted on roadway prior to curve	RwD			4
In-Roadway Warning Lights	flashing lights installed in the roadway to warn users that they are approaching a condition on or adjacent to the roadway that might not be apparent and require the driver to slow down	Intersection /Pedestrian	Rural, Urban	Any roads; pedestrian crossing; school zones, curves	2
Internally illuminated raised pavement markers	Steadily illuminated lights installed in the roadway surface	Pedestrian/ RwD	Rural, Urban	Any roads; pedestrian crossing; school zones, curves	1
Alignment delineation			Urban, Rural	Any roads	4
High friction surface treatment		RwD/intersection	Rural/Urban	Curves and intersection approaches	5
INTERSECTION TREATMENTS					
Roundabout		Intersection	Urban, Rural	Local street, collector, arterial; ramp terminals	5
VERTICAL CHANGES WITHIN THE ROADWAY					
Speed Hump	rounded raised area across the road, typically 12-14 feet in length and 3-4 inches high	Pedestrian	Urban, Suburban	Local street	2

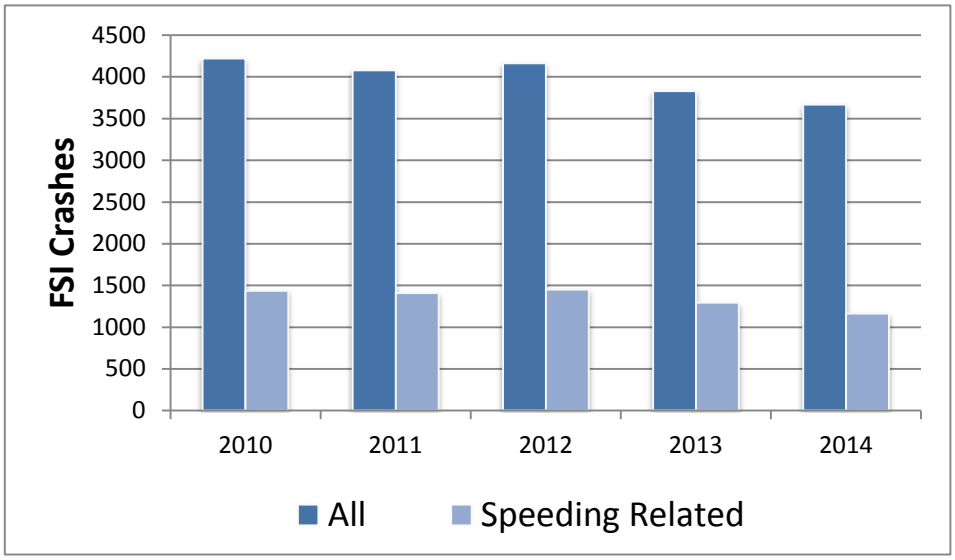
Countermeasure	Description	Safety Focus	Urban/Rural Applicability	Roadway Environment	Priority to Implement (scale of 1-5) 1 - low; 5 - high
Speed Cushion	speed hump typically 6-7 feet wide that allows most emergency vehicles to straddle the hump	Pedestrian	Urban	Local street	2
Speed Table	long speed hump typically 22 feet in length with a flat section in the middle and ramps on the ends	Pedestrian	Urban	Local street	4
Raised Intersection	raised plateau, with ramps on all approaches, where roads intersect	Pedestrian	Urban	Local street	4
HORIZONTAL CHANGES WITHIN THE ROADWAY					
Road diet	restripe road to reduce the number of lanes from 2 lanes in each direction to 1 lane in each direction with a center turn lane	Pedestrian	Urban	Arterial road	3
Choker/Bulb Outs	mid-block curb extensions that narrow a road by extending the sidewalk or widening the planting strip	Pedestrian	Urban	Local street	4
Neckdown/Bulb Outs	intersection curb extensions that narrow a road by extending the width of a sidewalk	Pedestrian	Urban	Local street	4
Chicane	curb extensions that alternate from one side of the street to the other, forming S-shaped curves	Pedestrian	Urban	Local street	4
Lateral Shift	curb extensions that shifts travel lanes to one side of road for extended distance and then back to the other side		Urban	Local street	4
Center Island/Refuge Island	raised island along the centerline of a street that narrows the travel lanes	Pedestrian	Urban		5
Longitudinal rumble strips	raised or grooved patterns installed on	RwD	Rural		3

Countermeasure	Description	Safety Focus	Urban/Rural Applicability	Roadway Environment	Priority to Implement (scale of 1-5) 1 - low; 5 - high
	both inside edges of normal travel lane to narrow effective width				
Tubular channelizers	tubes used to create island in center of roadway	Pedestrian	Rural, Urban	Local, collector, arterial	3
VERTICAL DELINEATION					
Delineator Post		RwD	Rural, Urban	Any roads; curves	5
Landscaping	Roadside plantings used to create vertical friction	RwD	Urban	Collector	1
(See also the sections on STATIC SIGNING and DYNAMIC SIGNING for potential options related to vertical delineation)					
GATEWAY ENTRANCE TREATMENTS					
Gateway Treatment	placed at community entrance to remind drivers of changing roadway character	Pedestrian	Rural	Community entrance	3
ENFORCEMENT AND/OR EDUCATION RELATED					
Corridor Enforcement and Education			Urban, rural	Any road	5
Corridor 3-E Initiative (engineering, education, enforcement)			Urban, Rural	Any road	5
Automated Enforcement	Use of cameras to enforce speed limits		Urban, Rural	Any road	2
Red signal enforcement lights (tattletale lights)	Auxillary lights connected to a traffic signal to help law enforcement officers more efficiently and safely issue citations for drivers who violate the red phase of the signal.	Intersection	Urban		3
OTHER COUNTERMEASURES THAT MAY HAVE AN EFFECT ON SPEEDS					
Centerline rumble strips	Traditional milled-in rumble strips	RwD	Rural		5

Countermeasure	Description	Safety Focus	Urban/Rural Applicability	Roadway Environment	Priority to Implement (scale of 1-5) 1 - low; 5 - high
Raised thermoplastic centerline rumble strips		RwD	Urban?, Rural		1
Edge line or shoulder rumble strips	Traditional milled-in rumble strips	RwD			5
Raised thermoplastic edge line/shoulder rumble strips		RwD	Urban?, Rural		1
Sinusoidal/mumble strips	Type of rumble strip that has a sine wave pattern milled into the pavement; has a lower level of exterior noise while still providing an interior noise/vibration. Can be used on centerline or edgeline.	RwD	Urban, Rural	Any roads, where noise is a concern	4
Wider centerline pavement markings		RwD	Urban, Rural		3
Wider edge lines		RwD	Urban, Rural		2
Add center and edge pavement markings		RwD	Rural, Urban	Any roads	5
OTHERS YOU WOULD LIKE TO CONSIDER/LOOK INTO?					
Add conspicuity device to existing curve warning signs					5

Appendix B – Data Analysis Summary

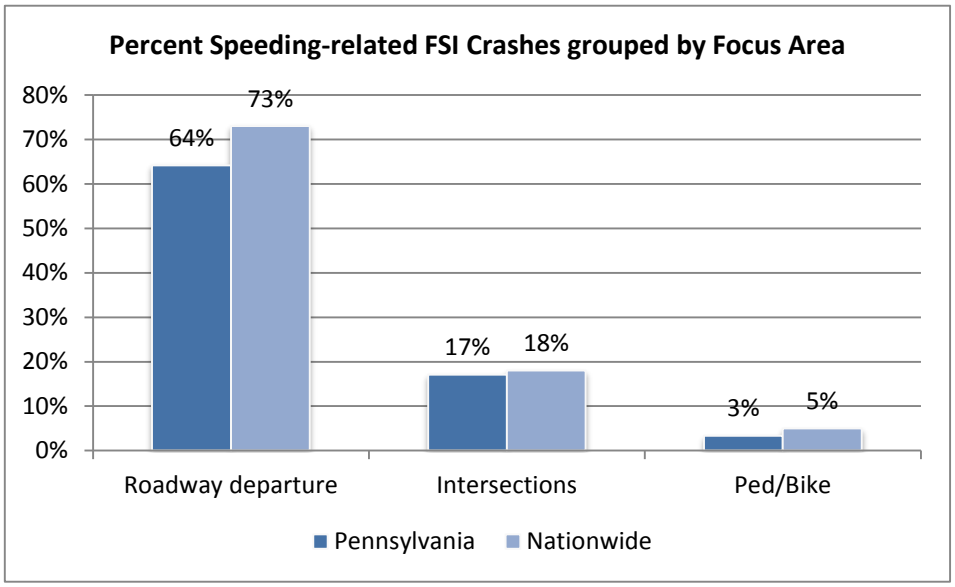
Overall



Fatal and serious injury speeding-related crashes are on a slight decline in Pennsylvania, as are all fatal and serious injury crashes.

Speeding-related FSI crashes account for *34 percent* of all FSI crashes in Pennsylvania (using 5 years of data).

- Nationwide, 5 year average is *31 percent*.



Overwhelmingly, roadway departure speeding-related crashes account for the majority of fatal and serious injury speeding-related crashes, similar to nationwide trend. Roadway Departure

Category	Pennsylvania (FSI)	Nationwide (fatal)	Additional Info/Remarks
Speeding-related RwD	• 45 percent of all FSI roadway departure crashes are speeding-related	• 40 percent of fatal roadway departure crashes are speeding-related	
Rural/Urban	• 72 percent of FSI RwD crashes occur in rural areas • 74 percent of speeding-related FSI RwD crashes occur in rural areas	• 65 percent of fatal RwD crashes occur in rural areas • 62 percent of speeding-related fatal RwD crashes occur in rural areas	
Roadway Type	Speeding-related FSI RwD: • State highway (non-turnpike) – 67 percent • Local road/street – 25 percent	• Principle arterial – 16 percent • Minor arterial – 16 percent • Local – 27 percent • Collector – 25 percent • Interstate/freeway – 13 percent.	PA Rural Roads (percent of miles of system) Principal arterial – 2.16 percent Minor arterial – 6.12 percent Local – 70.12 percent Collector – 19.63 percent Interstate/Freeway – 1.51 percent PA Urban Roads (percent of miles of system) Principal arterial – 6.11 percent Minor arterial – 8.62 percent Local – 70.92 percent Collector – 11.61 percent Interstate/Freeway – 1.60 percent PA Urban+Rural Roads Principal arterial – 3.68 percent Minor arterial – 7.08 percent Local – 70.43 percent Collector – 16.55 percent Interstate/Freeway – 1.55 percent

Category	Pennsylvania (FSI)	Nationwide (fatal)	Additional Info/Remarks
Speed Limit	• 40-45 mph - 33 percent • 50-55 mph - 27 percent • 30-35 mph – 23 percent	• 50-55 mph – 35 percent • 40-45 mph – 21 percent	• Pennsylvania data departed slightly from national data, with FSI speeding-related crashes occurring on lower-speed roads.
Horizontal Alignment	• 56 percent of FSI speeding-related occur on curves	• 38 percent	• Pennsylvania is significantly over the national average.
Driver Characteristics	• 81 percent of FSI RwD speed related crashes are male • 55 percent of males aged 15-20 involved in FSI RwD crashes were coded as speeding-related • Females aged 21-24 came closest to bridging the gap with males in being involved in FSI RwD speeding-related crashes compared to other age groups (46 percent of females and 51 percent of males) • 23 percent of females 75 years and older involved in FSI RwD crashes were coded as speeding-related (compared to males at 18 percent)	• 79 percent male • 53 percent of males aged 15-20 fatal RwD crashes were coded as speeding-related • 14 percent of females 75 years and older involved in fatal RwD crashes were coded as speeding-related (compared to males at 17 percent)	
Alcohol related	• 41 percent of FSI RwD speeding-related crashes involved alcohol	• 45 percent of fatal RwD speeding-related crashes involved alcohol	

Category	Pennsylvania (FSI)	Nationwide (fatal)	Additional Info/Remarks
Time of Day	• 44 percent occurred in daytime • 40 percent occurred during nighttime with no lighting	• 38 percent occurred in daytime • 35 percent occurred during nighttime with no lighting	
Hour of Day	• 28 percent of FSI RwD speeding-related crashes occurred from 6 pm to midnight • 26 percent of FSI RwD speeding-related crashes occurred from 10 am – 4 pm	• 31 percent of fatal RwD speeding-related crashes occurred from 6 pm to midnight • 29 percent of fatal RwD speeding-related crashes occurred from midnight to 5 am	
Vehicle Type	• 50 percent of FSI RwD speeding-related crashes involve automobiles. • 15 percent of FSI RwD speeding-related crashes involve SUVs. • 14 percent of FSI RwD speeding-related crashes involve motorcycles. • 13 percent of FSI RwD speeding-related crashes involve small trucks.	• 45 percent of fatal RwD speeding-related crashes involve passenger vehicles • 37 percent involve light trucks • 13 percent involve motorcycles	

Category	Pennsylvania (FSI)	Nationwide (fatal)	Additional Info/Remarks

Crash Type	• 87 percent of fatal RwD speeding-related crashes are non-vehicle collisions
	  • 20 percent – tree collision
	  • 14 percent – embankment
	  • 13 percent – guardrail, end treatment, barrier
	  • 11 percent – utility pole/traffic sign
	  • 5 percent - rollover/overturn
		• 93 percent of fatal RwD speeding-related crashes are non-vehicle collisions
		  • 18 percent – tree collision
		  • 18 percent – embankment
		  • 16 percent - rollover/overturn	

Rollover/Overturn Crashes			
General	• 4 percent of all FSI RwD crashes; 52 percent of those are speeding-related	• 14 percent of all fatal RwD crashes; 16 percent of those are speeding-related	
Speed Limit	• 79 percent on roadways posted less than 50 mph.	• 41 percent on roadways posted less than 50 mph.	• Nearly double the national average.
Vehicle Type	• 34 percent – SUVs • 26 percent – passenger vehicles • 19 percent – light truck • 13 percent – ATVs	• 51 percent – light truck • 43 percent – passenger vehicles	
Opposing Direction Crashes			
General	• 18 percent of all FSI RwD crashes • 30 percent of opposing direction crashes are speeding-related	• 15 percent are speeding-related	• Pennsylvania has double the percentage of speeding-related opposing direction crashes compared to nationwide.
Rural/Urban	• 67 percent in rural areas	• 67 percent in rural areas	

Category	Pennsylvania (FSI)	Nationwide (fatal)	Additional Info/Remarks
Speed Limit	• 74 percent on roadways posted less than 50 mph.	• 40 percent on roadways posted less than 50 mph.	• Nearly double the national average. Discuss roadway types and characteristics that are posted at less than 50 mph.
Vehicle Type	• 52 percent – automobile • 15 percent – SUVs • 13 percent – light truck • 13 percent – motorcycles	• 81 percent – light truck • 14 percent – passenger vehicles • 3 percent - motorcycles	• Speeding related FSI opposing direction crashes involving motorcycles is higher than national.
Tree Crashes			
General	• 55 percent of tree FSI crashes are speeding-related	• 18 percent	
Rural/Urban	• 81 percent of tree FSI speeding-related crashes occur in rural areas.	• 68 percent rural • 31 percent urban • 1 percent unknown	
Speed Limit	• 73 percent – 45 mph or below • 25 percent – 50 mph or greater	• 54 percent - 45 mph or below • 43 percent - 50 mph or greater • 3 percent - unknown	• 81 percent of crashes happen in rural areas and 73 percent on roads under 45 mph.

Intersections

Category	Pennsylvania	Nationwide	Additional Info/Remarks
Speeding-related intersections	• 20 percent of all FSI intersection crashes are speeding-related	• 21 percent	
Rural/Urban	• The rural/urban split for speeding-related intersection FSI in Pennsylvania is relatively equal	• Urban – 62 percent • Rural – 38 percent	• Focus on intersections in both urban and rural areas.
Traffic control	• Signalized – 27 percent • Stop-control– 26 percent • N/A – 44 percent (is this no control?)	• Traffic signal – 28 percent • Stop sign – 15 percent • No control – 51 percent	• Focus on both signalized and stop-controlled intersections • From the 2010 Intersection safety implementation plan, highest fatality rates for speeding were at State Rural Stop Controlled and State Rural Unknown TCD.

Category	Pennsylvania	Nationwide	Additional Info/Remarks
Roadway Type and Ownership	• State highway (non-turnpike) – 77 percent • Local road/street – 19 percent • Percent of intersection FSI crashes that are speeding related for both State highways and local road/streets is 20 percent.	• Principle arterial – 30 percent • Minor arterial – 23 percent • Local – 27 percent • Collector – 16 percent • Interstate/freeway – 3 percent.	• Focus on intersections on State highways PA Rural Roads (percent of miles of system) Principal arterial – 2.16 percent Minor arterial – 6.12 percent Local – 70.12 percent Collector – 19.63 percent Interstate/Freeway – 1.51 percent PA Urban Roads (percent of miles of system) Principal arterial – 6.11 percent Minor arterial – 8.62 percent Local – 70.92 percent Collector – 11.61 percent Interstate/Freeway – 1.60 percent PA Urban+Rural Roads Principal arterial – 3.68 percent Minor arterial – 7.08 percent Local – 70.43 percent Collector – 16.55 percent Interstate/Freeway – 1.55 percent

Category	Pennsylvania	Nationwide	Additional Info/Remarks
Speed Limit	• 40-45 mph - 32 percent • 30-35 mph - 28 percent • On roads signed at 60 mph or greater, 30 percent of all FSI intersection crashes were speeding-related. • On roads signed at 25 mph or less, only 18 percent of FSI intersection crashes were speeding-related.	• 40-45 mph - 30 percent • 30-35 mph - 28 percent • 17 percent of intersection crashes occurring on roads signed at 60 mph or greater were speeding-related. • 29 percent of intersection crashes occurring on roads signed at 25 mph or less were speeding-related	• The overall breakdown of the speeding-related intersection crashes by speed limit is similar between PA and nationwide. • In PA, it is more likely that intersection crashes are speeding related as the speed limit increases. This is opposite of the nationwide trend.
Driver Characteristics	• Males 76 percent	• Males 77 percent	• Males • Age 21-24 for both males and females • Same as nationwide trends
Alcohol related	• 26 percent of FSI intersection speed related crashes had alcohol involvement.	• 35 percent of fatal intersection speed related crashes had alcohol involvement.	• Alcohol-related FSI intersection crashes were more likely to be speeding-related than those that were not alcohol-related • Same as nationwide trends
Time of Day	• 51 percent – day • 28 percent – dark with lighting	• 49 percent – day • 32 percent – dark with lighting	• Highest occurrence during day • Same as nationwide trends
Hour of Day	• 28 percent – between 6 pm through midnight • 26 percent – between 1 0am through 4 pm	• 31 percent – between 6 pm through midnight • 23 percent – between 10 am through 4pm	• Highest occurrence at 6 pm to midnight • Same as nationwide trends

Category	Pennsylvania	Nationwide	Additional Info/Remarks
Vehicle Type	• 47 percent – automobiles • 21 percent – motorcycles • 12 percent – SUVs • 9 percent – small truck	• 42 percent – passenger vehicles • 32 percent – light trucks • 17 percent – motorcycles	

Crash Type	• 34 percent – angle
	• 33 percent – non-vehicle collision
	• 12 percent – front-to-rear (rear end)
		• 41 percent – angle collision
		• 39 percent – non-vehicle collision
		  • 11 percent – curb, ditch, or embankment
		  • 5 percent – pedestrian or cyclists
		  • 3 percent – tree
		• 13 percent – front-to-rear	

Angle Crashes			
Speed Limit	• 83 percent - lower than 50 mph	• 72 percent – lower than 50 mph	
Non-Vehicle Collision (Fixed Object)			
Speed Limit	• 66 percent – lower than 50 mph		
Front-to-Rear Crashes			
Speed Limit	• 74 percent – lower than 50 mph	• 55 percent – lower than 50 mph	

Pedestrians/Bicyclists

Category	Pennsylvania	Nationwide	Additional Info/Remarks
Speeding related pedestrian/bicyclist	• 8 percent of all FSI involving a bicyclist or pedestrian were speeding related	• 8 percent	
Rural/Urban	• 65 percent of FSI ped/bike speeding related crashes were urban.	• 72 percent urban	• Identify some of the major urbanized areas in Pennsylvania –develop some safety initiatives
Location	• 75 percent of FSI ped/bike speed related crashes occurred at non-intersection locations.	• 54 percent of fatal ped/bike speed related crashes occurred at mid-block locations. • 14 percent occurred on a shoulder, roadside, or parking lane.	

Category	Pennsylvania	Nationwide	Additional Info/Remarks
Roadway Type and Ownership	• 63 percent of FSI ped/bike speed related crashes occurred on state highways. • 30 percent occur on local roads.	• 24 percent of fatal ped/bike speed related crashes occur on principal arterials • 23 percent occur on local roads • 20 percent occur on minor arterials	PA Rural Roads (percent of miles of system) Principal arterial – 2.16 percent Minor arterial – 6.12 percent Local – 70.12 percent Collector – 19.63 percent Interstate/Freeway – 1.51 percent PA Urban Roads (percent of miles of system) Principal arterial – 6.11 percent Minor arterial – 8.62 percent Local – 70.92 percent Collector – 11.61 percent Interstate/Freeway – 1.60 percent PA Urban+Rural Roads Principal arterial – 3.68 percent Minor arterial – 7.08 percent Local – 70.43 percent Collector – 16.55 percent Interstate/Freeway – 1.55 percent

Category	Pennsylvania	Nationwide	Additional Info/Remarks
Speed Limit	• 31 percent of FSI ped/bike speed related crashes occur on roadways posted 30-35 mph. • 29 percent occur on roadways posted 25 mph or less. • 24 percent occur on roadways posted 40-45 mph.	• 31 percent of fatal ped/bike speed related crashes occur on roadways posted 30-35 mph. • 20 percent occur on roadways posted 40-45 mph. • 19 percent occur on roadways posted 60 mph or more.	
Driver Characteristics	• 71 percent of drivers in FSI bike/ped speed related crashes are male. • Male drivers aged 25-34 accounted for the highest number of FSI bike/ped crashes (14 percent) closely followed by males aged 45-54 (13 percent).	• 72 percent of drivers in fatal bike/ped speed related crashes are male. • Male drivers aged 35-44 accounted for the highest number of fatal bike/ped crashes (13 percent) closely followed by males aged 25-34 (12 percent).	

Category	Pennsylvania	Nationwide	Additional Info/Remarks
Time of Day	• 40 percent of FSI bike/ped speed related crashes occurred in the daytime. • 37 percent occurred in dark conditions with lighting present.	• 35 percent of fatal bike/ped speed related crashes occurred in the daytime. • 38 percent occurred in dark conditions with lighting present.	
Hour of Day	• 35 percent of FSI bike/ped speed related crashes occurred from 6 pm to midnight • 28 percent occurred from midnight to 5 am	• 40 percent of FSI bike/ped speed related crashes occurred from 6 pm to midnight • 20 percent occurred from midnight to 5 am	

Appendix C – SHSP Steering Committee Meeting Agenda and Attendee List

Strategic Highway Safety Plan (SHSP)

Steering Committee Meeting

Thursday, July 7, 2016

8:30 AM Welcome & Introductions
8:40 AM Linking SHSP with PA Speed Management Action Plan

9:00 AM Improving Intersection Safety

10:00 AM Reducing Run-Off Road Crashes/ Hit Fixed Object Crashes

11:00 AM Reducing Head-On and Cross-Median Crashes

12:00 PM Break for Lunch

1:00 PM Improving Pedestrian/Bicycle Safety

2:30 PM Enhancing Safety on Local Roads

3:30 PM Adjourn Steering Committee Meeting

Name	Title/Organization	Email
To be provided by PennDOT		