

2022 REPORT

AUTOMATED WORK ZONE SPEED ENFORCEMENT



pennsylvania
DEPARTMENT OF TRANSPORTATION



ACKNOWLEDGEMENTS

75 P.A. C.S. § 3369 authorized the development of the Automated Speed Enforcement in Active Work Zones program, commonly referred to as Automated Work Zone Speed Enforcement, or AWZSE. This program is a joint safety program supported by the Pennsylvania Department of Transportation (PennDOT), the Pennsylvania Turnpike Commission (PTC), and the Pennsylvania State Police (PSP). 75 P.A. C.S. § 3369(h)(4) requires the following report of the program to the Senate and House Transportation Committee Chairs by no later than April 1, annually.

Throughout 2021, PennDOT, PTC, and PSP continued their close collaboration to administer and refine the pilot program. Executive staff from all three agencies actively participated in the program's Executive Committee, helping to steer the pilot program. Additionally, PennDOT's Bureau of Maintenance and Operations, PTC's Traffic Engineering and Operations division, and PSP's Bureau of Patrol lead daily activities for the pilot program. These groups were supported by a number of others at each agency during 2021, including PennDOT's Engineering Districts, Press Office, and Fiscal Services; PTC's Engineering, Construction, and Maintenance Divisions, Legal Department, Accounting/Finance, and Communications; and PSP's Fiscal Services. The efforts of these parties, along with the Program Administrator and System Administrator, have contributed to the success of the AWZSE pilot program in 2021.



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GLOSSARY

AWZSE Automated Work Zone
Speed Enforcement

PENNDOT Pennsylvania Department
of Transportation

PSP Pennsylvania State Police

PTC Pennsylvania Turnpike
Commission

EXECUTIVE SUMMARY

In 2021, Pennsylvania's Automated Work Zone Speed Enforcement program completed its first full calendar year of operation. This program is geared towards improving safety by reducing speeding in work zones on select PennDOT-operated and all Commission-operated highways. The program uses portable automated speed enforcement systems to provide enforcement of excessive speeding (11+ MPH) in active work zones.

In 2021, the program continued to fulfill the stated goals of the program:

- **Reduce speeds in work zones.** During 2021's primary construction months (April–November), speeding in AWZSE enforced work zones has been reduced to 20% of all traffic, and excessive speeding (11+ MPH over the posted speed limit) has been reduced to 3%.
- **Promote work zone safety.** A reduction of over 100 crashes annually has occurred in 2020 in work zones on Pennsylvania interstates, freeways, and expressways.
- **Improve driver behavior.** Measured, sustained speed reductions have been observed in AWZSE-enforced work zones, with smaller (but measurable) reductions at times when AWZSE is not in effect in those zones.
- **Save worker and traveler lives.** Fatal crashes in Pennsylvania Work Zones continue their reduction from pre-AWZSE levels (roughly 25% reduction).
- **Complement existing speed enforcement by the Pennsylvania State Police.** In 2021, Pennsylvania State Police supported 101 projects for \$5.5 million. This support was for work activities where PSP presence remains the most effective tool to enhance safety.



Deployment/Violation History

Since the start of enforcement in March 2020 through the end of 2021, the program has completed over 5,000 deployments and issued over 640,000 notices of violation. Table 1 shows a breakdown of program statistics through the end of 2021.

	2020 TOTALS	2021 TOTALS	PROGRAM TOTALS
Deployments	2,084	3,302	5,386
Violations per Deployment	105	129	120
Violations Issued *	219,231	424,778	644,009
% With only First Violation	87.40%	84.70%	85.60%
% With 2 Violations	8.80%	10.80%	10.10%
% With 3+ Violations	3.80%	4.50%	4.30%

* Excludes violations issued and subsequently rescinded. See the "Program Controls" section for additional information.

TABLE 1. PROGRAM STATISTICS BY YEAR

The maturation of the AWZSE pilot program has provided benefits to the crews in work zones around the Commonwealth, as well as for those traveling through these work zones. The data has shown that AWZSE is an effective tool in improving work zone safety across the Commonwealth, counter to national trends of increasing work zone crashes.



Work Zone Safety

The onset of AWZSE enforcement in 2020 has coincided with reductions in work zone crashes across the Commonwealth. In the three years prior to AWZSE enforcement (2017-2019), the number of crashes in work zones was consistent, approximately 1,800 annually. In 2020, the first year of AWZSE program operation, the number of work zone crashes significantly decreased, to just over 1,400. Undoubtedly, this reduction can be somewhat attributed to the start of the COVID-19 pandemic and associated stay-at-home orders. However, there was a more significant decrease in work zone crashes than the decrease in traffic volume due to the COVID pandemic. Notably, this reduction in work zone crashes has run counter to the alarming national trends of increasing traffic and highway speeds during the COVID-19 pandemic.

Work Zone Travel Speeds

Since the onset of AWZSE enforcement, travel speeds in work zones across the Commonwealth have reduced. During 2021's primary construction months (April – November), speeding in AWZSE-enforced work zones has been reduced to 20% of all traffic, and excessive speeding (11+ MPH over the posted speed limit) has been reduced to 3% of all traffic. These trends are most acute when active enforcement is occurring. There is evidence, though, that travel speeds have slowed in AWZSE projects even when active enforcement is not occurring. For example, on I-78 in Berks County (Section 12M), work zone speeds have consistently been reduced between 6-9 MPH despite not having enforcement at all times. Observational data has also shown that adjacent to the enforcement area, travel speeds are further reduced by as much as 5 MPH beyond this base level of travel speed reduction.

One significant trend that has been observed with the AWZSE program is that the work zones that have been most challenging to gain speed limit compliance are those work zones where the work area is protected by a barrier. Throughout the program, travel speeds adjacent to barrier protected work zones have been higher than travel speeds adjacent to work zones protected only by channelizers (devices such as barrels, cones, or vertical panels). Table 2 shows the percentage of vehicles traveling over the posted work zone speed limit and the percentage of vehicles excessively speeding (11 MPH or more over the posted speed limit) in each type of work zone.

	Deployments	% Over Speed Limit	% Excessively Speeding (11+ MPH)
Channelizer	68%	18.66%	3.20%
Barrier	32%	40.40%	7.33%

TABLE 2. PROGRAM SPEEDING SUMMARY, THROUGH 2021

Throughout the life of the program, the percentage of vehicles over the speed limit and the percentage of vehicles excessively speeding have been more than double in barrier protected work zones than in unprotected work zones.

A National Success Story

Pennsylvania's program continues to be a national model for the development of sound, effective use of AWZSE as a tool to improve work zone safety. Numerous states across the country have used Pennsylvania's example to establish their own work zone pilot programs. In particular, in the northeast and mid-Atlantic states, New York and Connecticut are advancing similar statewide pilot programs, and Delaware and Virginia are piloting AWZSE at individual locations. Pennsylvania's program fits in well with national transportation priorities. The United States Department of Transportation (USDOT) has developed a new National Roadway Safety Strategy, and automated speed enforcement is one key Departmental action for USDOT to enable safe speeds as part of this strategy.

To date, the AWZSE program team has discussed Pennsylvania's pilot program with 25 other states. Of note, the Indiana Department of Transportation enlisted Purdue University to study data from Pennsylvania's program to determine the effectiveness of AWZSE enforcement. The study team from Purdue is in the process of publishing a study on their findings, which indicate that AWZSE enforcement is effective in Pennsylvania work zones.

PROGRAM OVERVIEW

INTRODUCTION

Act 86 (2018) authorized the development of the Automated Speed Enforcement in Active Work Zones program, commonly referred to as Automated Work Zone Speed Enforcement, or AWZSE. This program is a joint safety program supported by the Pennsylvania Department of Transportation, the Pennsylvania Turnpike Commission, and the Pennsylvania State Police. 75 P.A. C.S. § 3369(h)(4) requires the following report of the program to the Senate and House Transportation Committee Chairs by no later than April 1 annually. This report provides a summary of the status of the program.

The statewide AWZSE program began operation in March 2020. After a brief pause due to the pandemic, the program has been operating continuously since April 2020. 2021 was the first full calendar year of operation and 58% more enforcements were completed than in 2020. The program has had the intended effect of improving work zone safety for all roadways users. Speeding has reduced, including an additional 8% reduction in speeding from 2020 to 2021. Work zone crashes across the Commonwealth have also reduced since the onset of the program.

PROGRAM GOALS

The passage of Act 86 (2018) recognized that Pennsylvania's highway work zones continue to provide safety hazards for Pennsylvania workers and traveling public. The AWZSE program is geared towards improving safety in our highway work zones statewide. Specific program goals include:

- Reduce speeds in work zones
- Promote work zone safety
- Improve driver behavior
- Save worker and traveler lives
- Complement existing speed enforcement by the Pennsylvania State Police

PROGRAM STATUS

The program began enforcement on March 9, 2020. Enforcement activities were placed on hold March 16, 2020, due to the COVID-19 pandemic halting all construction activities statewide. Enforcement resumed at limited critical and emergency projects on April 20, 2020 and has been in continuous operation since then. Some highlights of enforcement from 2021 include:

- Over 3,000 deployments were completed in support of both construction and maintenance activities, a 58% increase from 2020.
- Issuance of over 420,000 notices of violation to registered owners.
- An 8% decrease in the percentage of traffic speeding in work zones.

Field Deployment Approach

Since the start of enforcement in March 2020, the approach to field deployments includes:

- The program has 17 enforcement units available statewide. Generally, ten units are available for eligible PennDOT roadways and seven are available for Commission roadways.
- Units are available for two shifts daily: daylight and overnight shifts.
- Program supports both construction and maintenance activities.
- Program supports both long-term and short-term work zones.

AGENCY ROLES AND RESPONSIBILITIES

As noted above, the AWZSE program is a joint program between PennDOT, the Pennsylvania Turnpike Commission, and Pennsylvania State Police. These agencies have jointly developed a program specific Interagency Agreement. Additionally, there are two contracted entities for the program, a Program Administrator and System Administrator. The Program Administrator assists the agencies with program development and execution. The System Administrator is responsible the technical aspects of the program. For additional information, see the “Agency Roles and Responsibilities” section of the [AWZSE 2021 Annual Report](#).

PROGRAM ELEMENT	LEGISLATIVE REQUIREMENT
Roadway Eligibility §3369(b)	PennDOT: All federal-aid highways with an active work zone Turnpike: All Turnpike highways with an active work zone
Police Validation §3369(d)(1)	Pennsylvania State Police (PSP) Automated Enforcement Unit within the Bureau of Patrol reviews all fine carrying violations
Sign Requirements §3369(b)	<ul style="list-style-type: none">• Two “Active Speed Limit Photo Enforced” signs shall be placed prior to the enforcement location (AWZSE Vendor Responsibility)• One “Active Enforcement Vehicle” sign on Vehicle (AWZSE Vendor Responsibility)• One “End Road Work” or “End Active Work Zone” sign (Construction or Maintenance Responsibility)• Any regulatory speed limit reduction signs need to be placed in conformance with the approved Traffic Control Plan
Violation §3369(c)	11 mph or more over the work zone regulatory speed limit
Active Work Zone Requirement §3369(a)	Workers must be present while AWZSE is active. AWZSE enforcement will occur in the activity area of the work zone. (AWZSE Vendor will be Responsible for documenting this requirement through daily logs and certification that the deployment meets the Legislative requirements)

TABLE 3. SUMMARY OF PROGRAM REQUIREMENTS

PROGRAM ELEMENT	LEGISLATIVE REQUIREMENT
AWZSE Locations §3369(b)	The agencies will identify potential AWZSE locations on its website (workzonecameras.penndot.gov/locations).
Issuing of Violations §3369(d)	<ul style="list-style-type: none"> Once the Registered Vehicle Owner is identified through state Driver Vehicle Records, the program has 30 days from identification to mail the violation to the Registered Vehicle Owner. <p>Violations must be mailed within 90 days from the date the violation occurred.</p>
Defenses §3369(g)	<ul style="list-style-type: none"> The vehicle was reported stolen at the time the violation occurred. The person receiving the Notice of Violation was not the Registered Vehicle Owner when the violation occurred. Device being used for enforcement was not operating correctly at the time the violation.
Contest Process §3369(j)	<ul style="list-style-type: none"> Registered Vehicle Owner has 30 days from the mail date to request a hearing. 1st Level Appeals are heard through an Informal Hearing Officer which is a Law Clerk in PennDOT's Office of Chief Counsel. If the Registered Vehicle Owner wants to contest the finding of liability ruling of the Informal Hearing Officer, the appeal then goes to a 2nd Level Appeal through the District Court System. 2nd Level Appeals are heard by the District Justice where the violation occurred, and their finding of liability ruling is considered final.
Penalty Structure §3369(e)	<ul style="list-style-type: none"> 1st Violation – No Monetary Fine 2nd Violation – \$75 fine 3rd and subsequent Violations – \$150 fine per occurrence Fines identified are flat fees except for \$3.75 credit card convenience fees and/or late payment fees. Court costs are applied if a violation is appealed to the District Court system.
Annual Reporting §3369(h)(4)	Annual report to the PA Legislature Transportation Committees by April 1st each year.

TABLE 3, CONT. SUMMARY OF PROGRAM REQUIREMENTS

75 P.A. C.S. § 3369(H)(4) MANDATED REPORTING

75 P.A. C.S. § 3369(h)(4) requires this Annual Report contain specific information regarding the program during the previous calendar year. This section contains that information for calendar year 2021.

Work Zone Crash Information

In 2020, there were 1,416 total crashes in work zones on all Pennsylvania roadways. On PennDOT and Commission roadways, 45.9 percent of the crashes contained fatalities or injuries. There were 816 injured persons resulting from work zone crashes and 15 persons fatally injured, with one of the fatalities being a worker within the work zone. The crash data from 2020 indicates that work zone crashes reduced by a greater percentage (19.2%) than traffic volume reduced from the pandemic (13.4%). Figure 1 shows the number of work zone crashes by year between 2017-2020.

Crash data from 2021 is not available as part of this report. An addendum to this report will be published when 2021 crash data has been formalized and published.

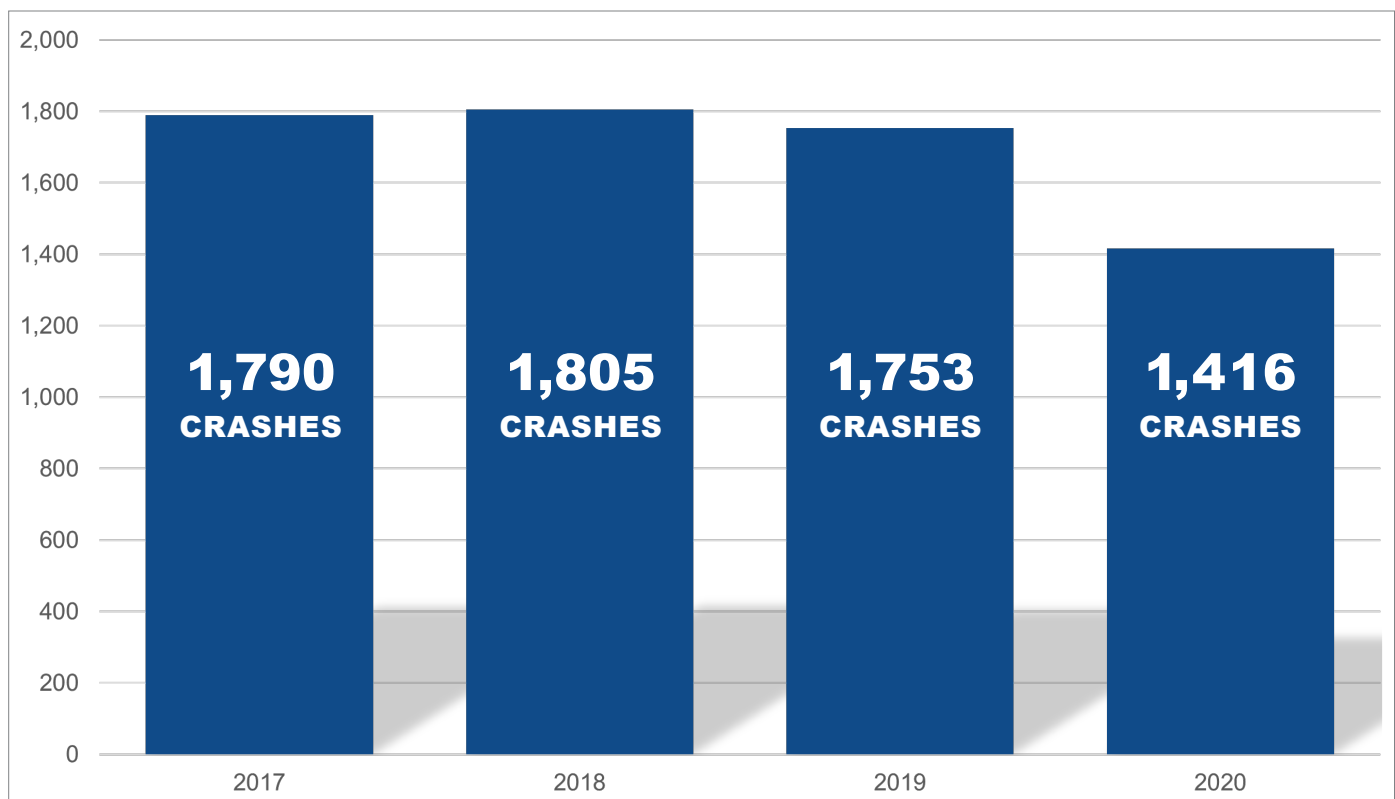


FIGURE 1. WORK ZONE CRASHES BY YEAR, 2017-2020



A closer look at where these work zone crashes occurred shows that the program is having a measurable effect on reducing crashes where AWZSE enforcement has been targeted. Since the onset of the program, work zone crashes on interstates and other freeways/expressways have dropped by an average of over 100 crashes annually, a substantial reduction from the years prior.

AWZSE enforcement can also be completed safely and effectively, and often can enforce in portions of the active work zone area where traditional enforcement can be limited due to site constraints. The program also has a successful safety record, as there have not been any crashes within a work zone with the AWZSE unit present that have been caused by the presence of the enforcement unit. There have been less than five crashes in a work zone while AWZSE has been active, and each of these crashes has occurred at least a mile away from the unit.



Speed Data

Speed data presented in this report represents data collected from January 1, 2021, through December 31, 2021. A full discussion on speed data is presented in the Speed Data section of this report. Highlights of the speed data include:

- During the peak construction seasons, the total percentage of speeding vehicles in AWZSE enforced work zones has been reduced to 18-20% on average, reduced from 30-35% at the start of the program in 2020. Similarly, excessive speeding in AWZSE enforced work zones during the peak construction season has been reduced to 3%, down from 5-8% at the start of the program.
- June 2021 experienced the lowest percentage of traffic over the posted speed limit in the program history, at 17.8%. June 2021 also had the second lowest percentage of traffic excessively speeding (11 MPH or more over the posted speed limit) in program history, at 2.3%, just slightly higher than the record low set in November 2020 which was 2.2%.
- Speeds have been higher in barrier protected work zones than in unprotected (channelizer – barrels, cones, panels) work zones. This is due to drivers having a false sense of security in these work zones, giving the impression that speeds can be higher in these work zones despite the presence of changed roadway characteristics.



Number of Violations

In 2021, the program issued 424,778 violations. Of the issued notices, 15.3% were repeat violators, incurring fines for 2nd and subsequent violations of the statute.

Program Fines

In 2021, the Transportation Agencies collected \$4,834,730.34 in fine remittance. The program has a payment rate of slightly over 73%.

Program Contracts

For calendar year 2021, the amounts paid for contracts related to the program are as follows:

- Program Administrator (Responsible for Program Execution) – \$1,223,348.20
- System Administrator (Responsible for Technical Aspects of the Program) – \$3,971,803.84
- TOTAL – \$5,195,152.04

Program Administrator costs are based on time spent supporting the Transportation Agencies and System Administrator costs are based on a flat fee per deployment. Additionally, PSP costs incurred by the program total \$540k for calendar year 2021, bringing total expenditures for the program to \$5.7 Million for calendar year 2021. Comparing the program expenditures against the fine remittance received by the program, the cost to the Transportation Agencies for program operation in calendar year 2021 was \$900k.

To cover initial program startup costs, the AWZSE program applied for and received grant money from the Roosevelt Boulevard Automated Speed Enforcement program (Title 75 Section 3370) to cover the System Administrator's fixed costs, approximately \$2.1 Million over a 12-month period. This grant allows the agencies to reduce the need to transfer funds from construction budgets in the future, permitting necessary projects to move forward while allowing the work zones in support of those projects to be safer with AWZSE deployments.



Table 4 provides a consolidated financial overview of the program. To date, the program has expended nearly \$1 million more than fine revenue has generated. This difference illustrates the investment that the Department of Transportation and the Turnpike Commission have made to use this program as a tool to enhance work zone safety.

Year	INCOME	EXPENDITURES			TOTAL
	Fine Remittance	PSP Costs	Program Administrator	System Administrator	Yearly Total
2019	-	-	\$346,938.24	-	(-\$346,938.24)
2020	\$1,666,403.00	\$463,572.88	\$1,503,763.78	\$1,471,024.42	(-\$1,771,958.08)
2021	\$4,834,730.34	\$543,176.46	\$1,223,348.20	\$3,971,803.84	(-\$903,598.16)
SUBTOTAL	\$6,508,580.84	\$1,006,749.34	\$3,074,050.22	\$4,047,894.33	(-\$3,022,494.48)
	INCOME	EXPENDITURES			TOTAL
2021 Grant	\$2,100,000.00	-	-	-	\$2,100,000.00
PROGRAM TOTAL TO DATE					(-\$922,494.48)

TABLE 4. FINE REMITTANCE, INCOME, AND EXPENDITURE, OVERALL PROGRAM, 2019-2021

Prior to October 16, 2019—the effective date of the Interagency Agreement—all costs for the program were divided evenly between the Department and the Commission. After the Interagency Agreement effective date each agency is responsible for program costs that can be directly assigned to each agency, for example each agency pays the direct cost for each individual deployment. Shared program costs are currently split to be reflective of the relative utilization of the program by each agency.



Number of hours provided by Pennsylvania State Police for increased work zone presence

Since the program has not generated excess revenue, additional PSP hours for work zone presence were not provided during calendar year 2021.

Use of remaining funds under Section 3369 (h) 3. iv.

Since the program has not generated excess revenue, no remaining funds were available to be used during calendar year 2021.

2021 AWZSE PROGRAM ACHIEVEMENTS

During calendar year 2021, the program completed the first full calendar year of operation. The program completed 3,302 deployments in 10 of the 11 PennDOT Districts and across the Turnpike system, including the east-west mainline Turnpike (I-76 and I-276) and the Northeast Extension (I-476). Deployments occurred in support of both construction and maintenance activities on both agencies' roadways. The number of deployments completed in 2021 represents a 58% increase in deployments from 2020. With the program completing its first full year of active enforcement, the program has shifted from a developmental approach to a program that is more mature and focusing on continual improvement.

Work Zone Crashes

- A total of 1,416 crashes occurred in Pennsylvania work zones in 2020, the first year of program operation. This represented a 19% decrease from 2019. Additionally, fatalities have reduced by 6% from 2019 to 2020. Work zone crashes reduced at a greater rate than traffic volume had decreased. This trend shown in Pennsylvania is the opposite of national trends where work zone crashes have increased despite reduced volumes resulting from the pandemic.
- When 2021 data is finalized, an addendum to this report will be issued.
- A reduction of over 100 crashes annually has occurred in 2020 on Pennsylvania interstates, freeways, and expressways. These highways are typically the highest speed roadways in the Commonwealth; reducing crashes on these roadways has had an impact on reducing fatalities in Pennsylvania work zones.

Program Feedback

- Feedback received from construction and maintenance personnel has been overwhelmingly positive.
- Field personnel, including the most vulnerable workers in unprotected work zones, have indicated that they perceive that drivers more consistently comply with the work zone speed limit when the AWZSE enforcement unit is present and enforcing. This perception has been supported by research of Pennsylvania work zones conducted by Purdue University (found in the Speed Data section of this document.)
- The use of AWZSE has become a mainstream activity for many agency and field staff. Construction and maintenance personnel at both agencies see the value of AWZSE as a safety enhancement tool, and now proactively request AWZSE enforcement at new project locations.

SPEED DATA

Two primary metrics are used to measure the performance of the AWZSE program's impacts: Percent over the Speed Limit and Percent Excessively Speeding. Percent over the Speed Limit measures the percentage of detected vehicles exceeding the posted work zone speed limit by any amount. Percent Excessively Speeding measures the percentage of detected vehicles going 11 mph or more over the posted work zone speed limit. These metrics are tracked for each deployment completed, which allows for program staff to monitor speeding trends across all projects. This leads to identification of work zones with consistent speeding issues that may benefit from increased enforcement to better manage speeds through those work zones.

Figure 2 provides a summary of speed data captured in 2021.

Speeds have generally been higher in long-term barrier protected work zones than in short-term unprotected work zones. As the enforcement units have been deployed to the long-term barrier protected work zones, a reduction in speeds has been seen in these work zones. Some of the more vulnerable long-term work zones still have crashes in these barrier-protected long-term work zones; these crashes occur when workers are not present and automated enforcement is not activated. This shows that the enforcement units are not only increasing safety for the workers active in the zone, but also for the motorists traveling through these work zones.

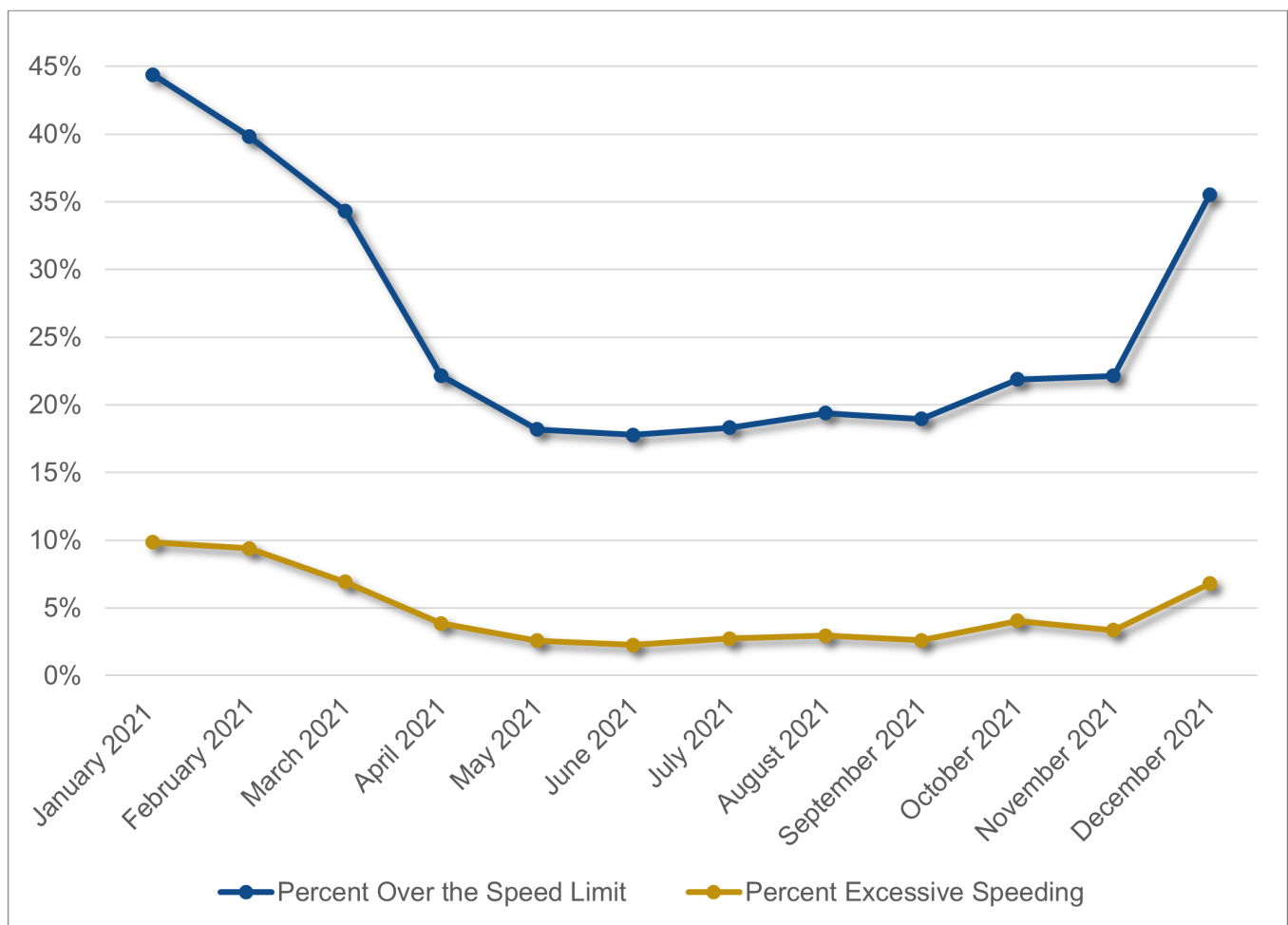


FIGURE 2 . PERCENT OVER SPEED LIMIT AND PERCENT EXCESSIVELY SPEEDING, BY MONTH, 2021

The higher percentages of over speed limit and excessively speeding in January-March and again in December occur because the majority of the deployments in those months are to barrier protected projects where speeds are higher. When there is a better balance between barrier and channelizer projects (April-September), speeds are lower.

A closer look at a few long-term projects indicates that long-term, sustained speed reductions have occurred in work zones after several targeted enforcement shifts. A major example of that is the I-78 reconstruction and widening project in Greenwich and Maxatawny Townships (Section 12M), Berks County. This 8.7-mile-long project includes long-term barrier protection in both directions of travel for nearly the entirety of the work area, with a work zone speed limit of 50 MPH. In September of 2019, prior to the onset of AWZSE deployments, average travel speeds ranged from 58 MPH westbound to nearly 62 MPH eastbound. Since this program started, the travel speeds have ranged from 54-56 MPH in both directions, even though AWZSE enforcement has typically only been in one direction on any given day.

As part of an effort to introduce a similar program in the state of Indiana, the Purdue University, on behalf of the Indiana Department of Transportation, coordinated with the project team to collect, analyze, and report on data regarding the effectiveness of AWZSE deployments in Pennsylvania work zones. Purdue prepared and published a report titled Using Connected Vehicle Trajectory Data to Evaluate the Impact of Automated Work Zone Speed Enforcement by Jijo Mathew. This report yielded several findings, however, the most instructive to Pennsylvania's program include:

- In the AWZSE-enforced work zones studied, speed limit compliance is higher in Pennsylvania than in Indiana. Perhaps more notably, the percentage of vehicles excessively speeding in Pennsylvania is significantly lower than in Indiana.
- There is a noticeable effect on vehicle speeds when enforcement is present (3-5 MPH reduction) compared to the same location within the work zone when enforcement is not present.
- Work Zone length also affects speed limit compliance – with shorter work zones having better compliance.



2021 AWZSE PROGRAM OPERATION

In 2021, the program shifted from a developmental approach to a program that is more mature and focusing on continual improvement. Throughout the year, several enhancements were made to this program, improving the overall effectiveness in the program meeting its stated goals.

DEPLOYMENT INFORMATION

One of the program goals is to improve driver behavior in Pennsylvania work zones. To achieve this goal, program deployment locations and frequency must strike a balance between statewide coverage and focusing deployments at work zones where speeding has been identified as a major issue. With that in mind, AWZSE deployments were completed in 10 of 11 PennDOT Engineering Districts and to Turnpike roadways across the state. Over 3,300 individual deployments across 87 different projects were completed in 2021.

As shown, the AWZSE program actively enforced year-round throughout 2021, with no significant interruptions to program operation. During the winter months (December – March), the number of deployments are typically significantly reduced due to a lower number of available, active work zones. Additionally, significant winter weather events across the state can impact multiple days of deployments to the already lower number of construction activities that are available for deployment in winter. These winter weather impacts can be seen in Figure 3, particularly in February 2021.

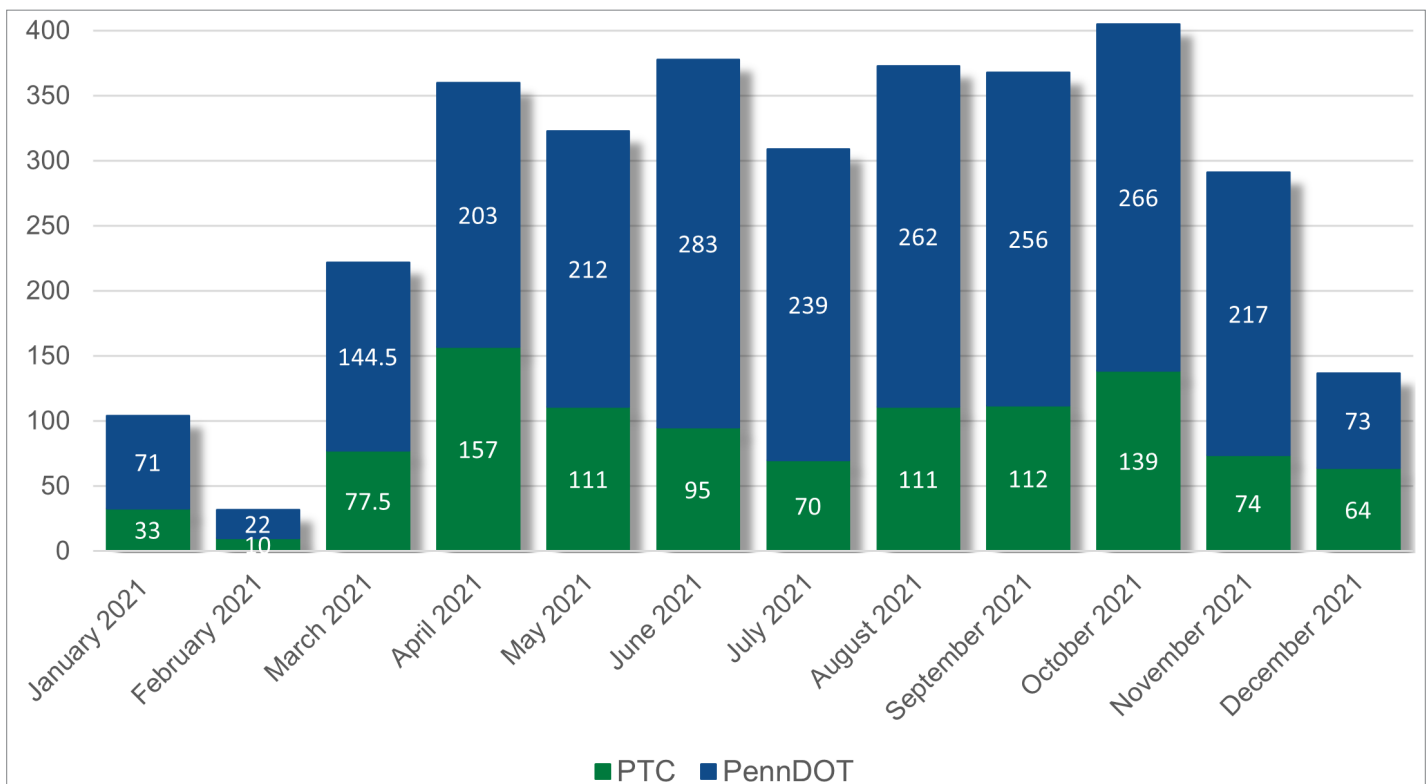


FIGURE 3. DEPLOYMENTS BY AGENCY BY MONTH, 2021

DEPLOYMENT APPROACH

Work zones selected for AWZSE enforcement continue to be selected and prioritized using a data-driven process to maximize the effectiveness of the systems. To that end, during 2021, PennDOT and the Turnpike Commission deployed to a wide variety of projects under differing conditions. These include (but are not limited to):

- Construction or Maintenance activities
- Barrier-Protected or Channelizer (Unprotected work zones)
- Work zones where speed limits were reduced, vs. work zones where speed limits were maintained.

Construction vs. Maintenance Activities

A primary difference in Pennsylvania's program from other peer state programs is the emphasis to pilot on all work zones on the applicable roadways. This includes enforcement on maintenance activities, which are locations where often workers are most vulnerable.

- In 2020, the program completed 97 deployments to maintenance activities, representing under 5% of all deployments completed in 2020. In 2021, the program completed 384 deployments to maintenance activities, representing nearly 12% of all deployments completed in 2021.
 - The program completed 58% more deployments in 2021 than in 2020, but deployments to maintenance work zones increased by nearly 300%.
- During the periods of the year when maintenance activities are most active on the Turnpike (March-May and September), one enforcement unit is dedicated to support maintenance activities within each of the five maintenance districts.

During 2021, maintenance activities were increased to 12% of all deployments, with a heavier emphasis in March, April, May, and September. Generally, the performance of AWZSE in maintenance work zones has been consistent with the performance in short-term, channelized construction zones. For both project types, there have been program operations lessons learned. Enforcements in support of maintenance activities tend to have shorter enforcement durations than enforcements

supporting long-term construction projects. This is due to the short-term nature of work zones established for maintenance activities. Enforcements in support of Turnpike maintenance activities rarely exceeded four hours in duration, whereas enforcements supporting construction projects were generally longer than six hours, with many fulfilling the eight-hour enforcement shift window. Similarly, AWZSE deployments supporting short-term overnight construction projects are generally shorter due to restricted time windows permitted for contractors to take travel lanes to perform work activities.



Barrier-Protected vs. Channelizer (Unprotected work zones)

The data-driven process to select work zones for AWZSE deployments considers the work zone configuration as an influencing factor. In particular, the number of travelers speeding and excessively speeding has been much higher in long-term barrier protected work zones than in short-term unprotected work zones. Additionally, barrier-protected long-term work zones continue to be plagued with crashes when workers are not present and automated enforcement is not occurring. On the other hand, those work zones without barrier protection often pose a higher risk for those working in those zones and reducing speeds adjacent to them is an important factor in improving their safety. Optimizing the balance between barrier and channelizer protected work zones to provide the greatest safety benefits is an on-going evaluation. Roughly 32% of all deployments were to barrier protected work zones, and 68% were to work zones without barrier protection.

Speed Limit Reductions

Speed limits in work zones are carefully established as they affect the safety of motorists and workers. PennDOT and the Turnpike Commission have slightly different approaches to establishing work zone speed limits, though both are rooted in optimizing safety in work zones. For most Turnpike Commission work zones, the work zone speed limit is reduced from 70 MPH to 55 MPH. The establishment of most work zones along Turnpike roadways introduces hazards that necessitate the reduction of the speed limit for safe travel adjacent to the work areas. Additionally, since most of the Turnpike roadways are homogenous in nature, a consistent work zone speed limit is generally applied systemwide.

PennDOT's highway network is much more varied, requiring that the evaluation of speed limit reductions be conducted on a case-by-case basis. Most work zones on PennDOT highways are located where the normal speed limit is less than 70 MPH; many work zone configurations on PennDOT roadways also may not warrant a reduction.

The presence of a reduced work zone speed limit is not a selection factor for AWZSE deployments. When a project is selected in a work zone that has a reduced speed limit, the AWZSE unit will enforce at 11 MPH over the reduced work zone speed limit. Similarly, when a project is selected and the speed limit is not reduced, the AWZSE unit will enforce at 11 MPH over the normal posted speed limit.

In 2021, 36 of the 87 projects selected for enforcement did not have a reduced work zone speed limit. More specifically, 18 of the 54 unique PennDOT projects (33%) had a reduced speed limit; 36 of the PennDOT projects did not have a reduced speed limit.

Data Tracking and Reporting

The program has established a set process and format for receiving deployment information from the System Administrator. This information is ingested into a management console that is used for scheduling, providing a single point of information for the program. Through the same management console, the program has instituted a tracking application to show current, paused, and completed deployments on an interactive state map that is pushed to the public facing website. This replaces a previous manually intensive process to update the project list and map on the public website on a weekly basis in accordance with the enabling legislation.

VIOLATION DATA

For calendar year 2021, the program issued 424,778 violations, which is a 76.3% issuance rate from 556,695 captured events. When an event is captured, a detailed verification and review process occurs to ensure that the event captured can progress forward through the issuance process. Violations are issued to all types and classes of vehicles, with very few exceptions (i.e. active emergency responder). During this multi-step process, events may be rejected for a variety of reasons, but will fall into two main categories: Controllable Rejects and Uncontrollable Rejects.

Controllable Rejects are issues that are within the System Administrator's control that prevent the captured event from being issuable. Uncontrollable rejects are issues with a captured event outside of the System Administrator's control that prevent it from being issuable. Some examples of each type of reject category are:

- Controllable Rejects
 - Image Clarity – Plate is illegible and cannot be read
 - Image Framing – Cameras are not aligned properly to capture plate images
- Uncontrollable Rejects
 - Canadian/Diplomat/Foreign Plate
 - No DMV Hit – After three attempts, no registered owner information is available for violation issuance.
 - No Plate – Vehicle is fully in view, but no plate is visible in any of the collected images.
 - Obstruction – Obstruction of license plate to prohibit plate read (trailer hitch, bike rack, etc.)

The program team is continually reviewing processes to increase the issuance rate by reducing the nearly 24% rejection rate. Actions that have been taken to improve the issuance rate include:

- Reviewing and refining deployment locations to make sure as many obstructions resulting from the roadway or work zone configuration are avoided.
- Establishing direct connections with neighboring state DMVs to minimize the number of Out-of-State No DMV hits, reducing the reliance on third party vehicle record lookup services currently resulting in increased "No DMV Hit" rejections. Currently, the accuracy of vehicle records from state DMVs with direct connections are roughly 20% higher than those states relying on third party services.

Additionally, the System Administrator contract includes liquidated damages designed to limit the allowable percentage of controllable rejects. For all violations processed in 2021, the System Administrator has met the contract goals for controllable reject percentage.

Table 5 provides a summary of violations captured by the program in 2021. Table 6 provides a breakdown of how many of each tier of violations were issued by the program in 2021.

Potential Violations	Controllable Rejects	Uncontrollable Rejects	Other Rejects	In Process	Issued *
556,695	33,605	98,079	199	34	424,778 (76%)

* Excludes violations issued and subsequently rescinded. See the "Program Controls" section for additional information.

TABLE 5. OVERALL PROGRAM VIOLATION SUMMARY, 2021

	First Violation (\$0)	Second Violation (\$75)	Third/Subsequent Violation (\$150)	Issued *	Total Repeat Rate
PennDOT	179,300	23,800	10,600	213,700	16.1%
PTC	180,400	22,150	8,550	211,100	14.6%
TOTAL	359,700	46,000	19,100	424,800	15.3%

* Excludes violations issued and subsequently rescinded. See the "Program Controls" section for additional information.

TABLE 6. ISSUED NOTICE DISTRIBUTION BY AGENCY, 2021

Violations captured throughout 2021 resulted in a repeat rate of 15.3%, meaning those violations were fine-carrying 2nd or subsequent violations. The remainder of the violations issued in 2021, or 84.7%, were zero-fine first violations.

The program has an approximately 73% payment rate. The only statutory recourse against non-paying violators is to send those violations to a collections agency. Violations can be transferred to collections once all reminder notices have been sent and no payment has been received after 120 days, which at the end of 2021 was approximately 11%. Transfer of eligible notices to collections will begin in 2022.

Currently, unpaid E-ZPass violations must be paid prior to renewing vehicle registration, which ensures a high payment rate for the Turnpike's tolling system. The AWZSE program does not have this same level of enforcement, as transferring unpaid violations to collections remains the only recourse.

A breakdown of the payment status of all violations is shown in Figure 4. The "other" category includes violations that were currently in process at the end of 2021.

Over the life of the program, 76% of events captured were of vehicles registered in Pennsylvania or states adjacent to Pennsylvania (i.e. Maryland, Ohio, New York, New Jersey, etc.). An additional 13% were other out-of-state registrations, and the final 11% were foreign plates or unidentified plate origin which are unable to be issued. For vehicles captured that are registered in or adjacent to Pennsylvania, this indicates the motorists whose behavior is most important to change through this program. The program is working towards establishing direct lookup agreements with states that represent the highest share of out-of-state violators to ensure greater accuracy and timeliness with Registered Owner information. The breakdown of captured vehicle registrations is shown in Figure 5.

“Drive like you work here.”

National Work Zone Awareness Week

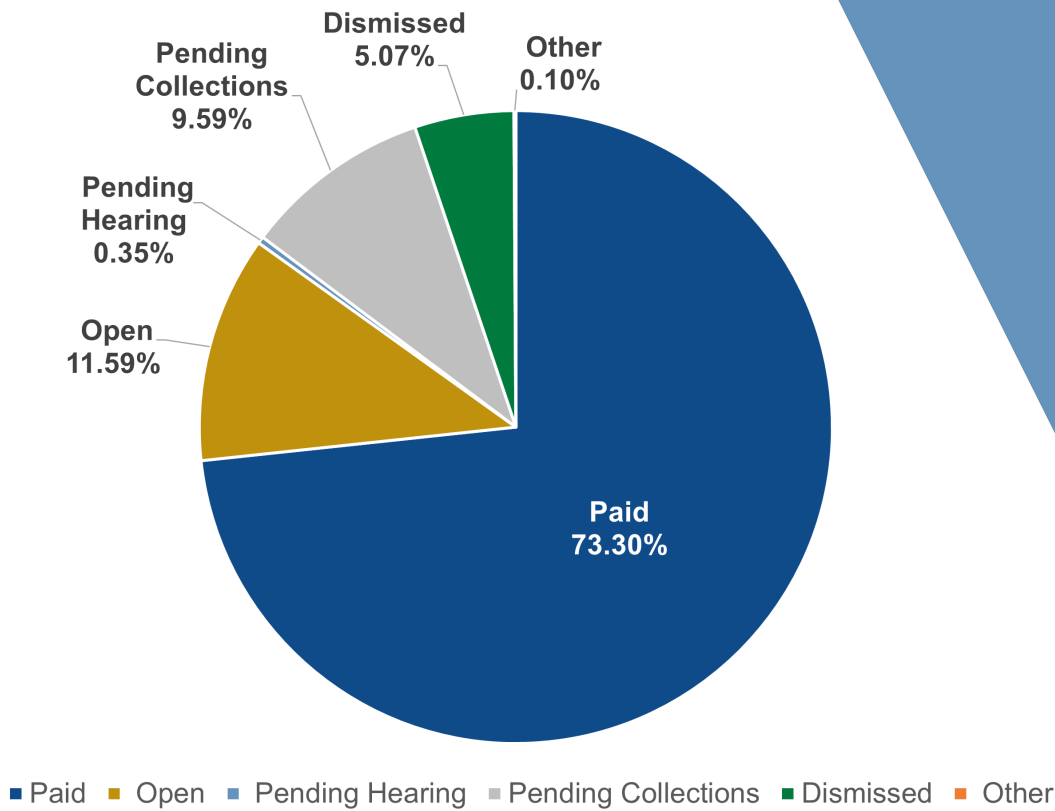


FIGURE 4. BREAKDOWN OF PAYMENT STATUS, PROGRAM LIFE (2020-2021)

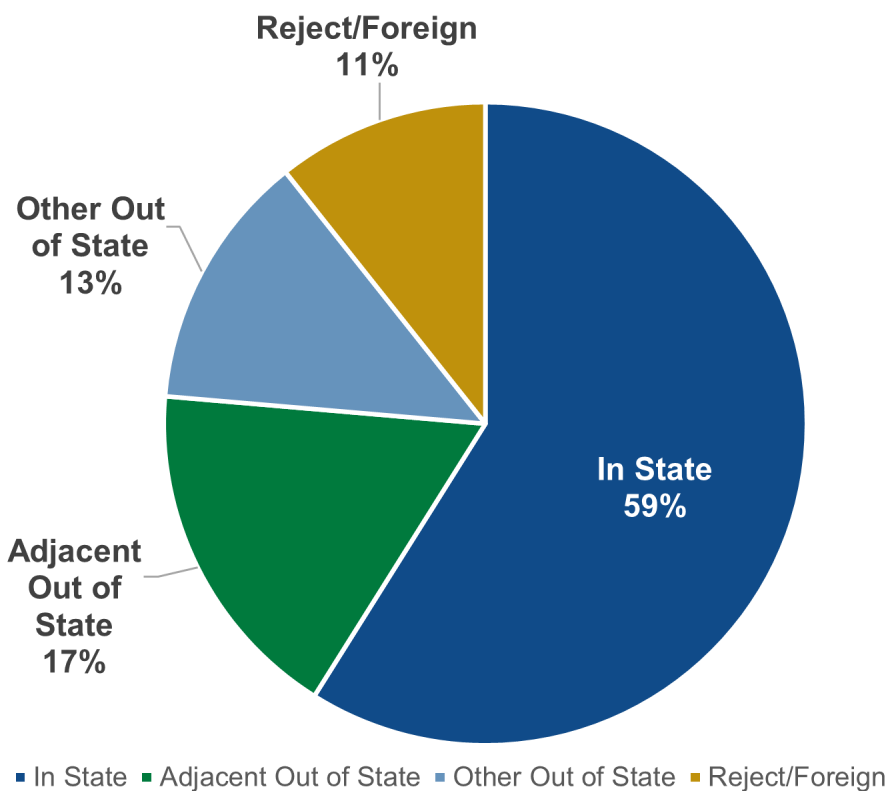


FIGURE 5. BREAKDOWN OF VEHICLE REGISTRATIONS FOR EVENTS CAPTURED, PROGRAM LIFE (2020-2021)

CONTESTED VIOLATIONS

From the start of the program in March 2020 through the end of 2021, the program received approximately 4,100 informal hearing requests, less than 1% of all violations, from registered owners contesting liability. PennDOT filled two full time AWZSE hearing officer positions to preside over the informal hearings, which began in March 2021. At the current time, all hearings are being conducted virtually.

Numerous hearing requests have been made where the registered owner attempts to void the violation based on a technicality rather than questioning the accuracy of the violation or the applicability of the location of the work zone deployment. Hearings held to date have generally resulted in the registered owner being found liable. “Not liable” findings have typically been associated with one of the three defenses in §3369(g) – a stolen vehicle reported to a police department, evidence that the registered owner was not the owner at the time of the offense, or an error in the speed timing device accuracy. At the time of this report, there have been zero “not liable” findings attributed to the last defense.

Table 7 and Figure 6 provide data about informal hearings over the life of the program (March 2020 – December 31, 2021).

Hearings Requested	Found Liable	Found Not Liable	In Process	Other (Cancelled or Rescheduled)	Appealed to Courts
4,838	3,805	327	473	233	131

TABLE 7 . CONTESTED VIOLATION DATA OVER LIFE OF PROGRAM, MARCH 2020 – DECEMBER 2021

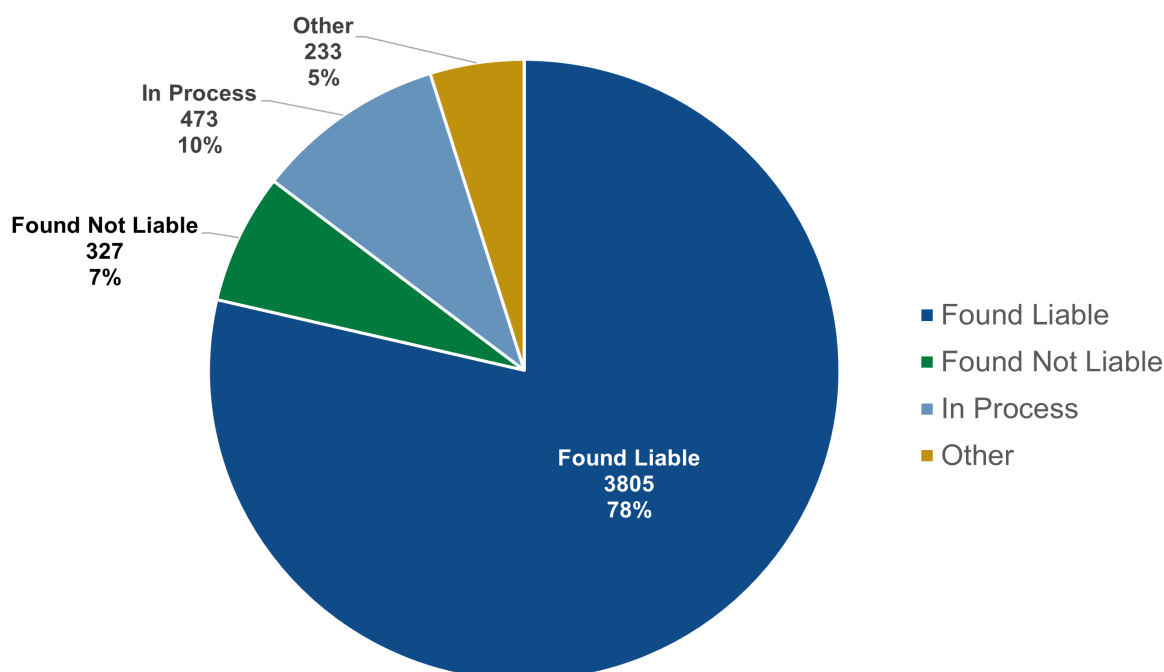


FIGURE 6. HEARING DATA OVER LIFE OF PROGRAM, MARCH 2020 – DECEMBER 2021



As Table 8 shows, zero-fine first violations have been a majority of the violations contested, though the proportion of first violations contested is significantly less than the proportion of all first violations. While there are no financial implications to the violators, they have expressed several reasons why they contested. First, several violators were concerned about violations impacting their driving record for insurance purposes. While they would often admit their guilt, they would also request leniency in merit points. For these hearings, the program hearing officers explained the program, relayed that the violations are civil in nature and did not impact their driving record, and described the facts in each case. In many of these cases violators were appreciative and indicated that they would change their behavior. This was a common refrain for first violation hearings.

Contested First Violations	Contested Fine Carrying Violations
2,711 (56%)	2,127 (44%)

TABLE 8. CONTESTED VIOLATION BREAKDOWN BY TYPE, MARCH 2020 – DECEMBER 2021

Another reason for first violation contests was a procedural element. When a violator receives their first violation, no action is required by the motorist unless they are contesting the violation. Early in the program, numerous motorists that received zero fine first violations assumed that some response was necessary and remitted the coupon to contest their violations. Revisions to language on the notice and the Frequently Asked Questions on the program website have improved motorist understanding that no response is required on zero fine first violations.

PUBLIC OUTREACH

Public outreach is a key element of the program – as it is the cornerstone of the education component of the program principles. Outreach goals have included:

- Overall program awareness
- Program goals
- Enforcement location and approach
- Consequences of violating this law

Program Website

A dedicated program website has been developed and is hosted by PennDOT at workzonecameras.penndot.gov. This website includes program information, locations where AWZSE deployments are active or completed, Frequently Asked Questions (FAQ) about the program, and a contact form for program questions or concerns. In 2021, the website had nearly 209,000 unique page views.



Social Media and Media Relations

Social media has been a key tool to disseminate information about the program and remind motorists of the consequences of speeding in Pennsylvania work zones. In 2021, PennDOT made a total of ten social media posts across four platforms amassing nearly 95,000 impressions.

Throughout the lifespan of the program, media requests have been consistently fielded by the Department and the Commission. In 2021, PennDOT fielded nine formal media inquiries on the AWZSE program.

Information Sessions with Other States

The success experienced by the Pennsylvania program has spurred interest in other states and shows that Pennsylvania's program is a model that other states are attempting to emulate. The Transportation Agencies and the Program Administrator have presented to numerous other states about Pennsylvania's program and provide information on how the program was developed from initial concept through to operation. Figure 7 shows which states the Pennsylvania AWZSE program has provided information to or held information sessions with.

On behalf of Indiana, Purdue University reached out to the program to gather data and information to assist in the development of a study to support the implementation of a similar AWZSE program in Indiana. Using connected vehicle data, the Purdue team was able to track speed profiles of vehicles through Pennsylvania work zones when AWZSE was present or not present. The study concluded that AWZSE enforcements are effective at controlling driver speeds through work zones.

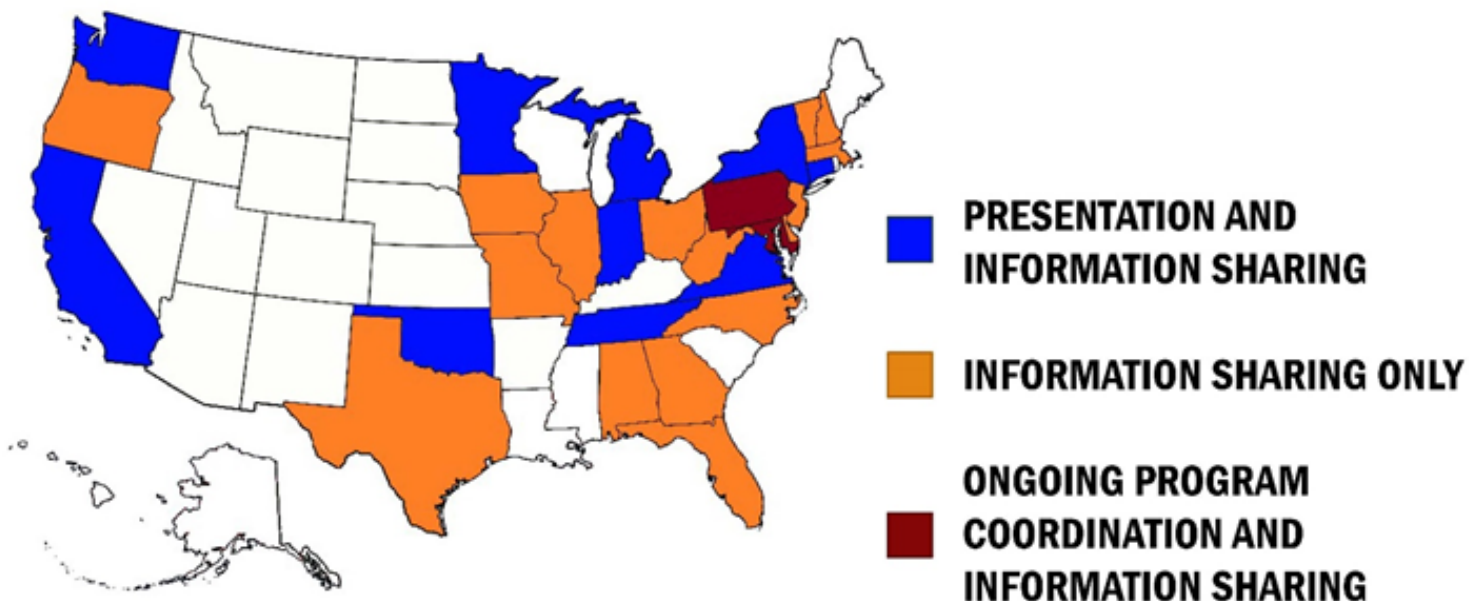


FIGURE 7. MAP OF INFORMATION SHARING WITH OTHER STATES

PROGRAM CONTROLS

Historically throughout the program, the Program Administrator has performed field QC and backoffice QC activities, and PSP has performed field QC activities. A summary of QC activities traditionally completed by each group include:

- Program Administrator field quality control reviews include:
 - Confirming that both advance warning signs are present and conspicuous.
 - Confirming that the notice is located on the vehicle.
 - Confirming that the end road work sign is present and conspicuous.
 - Confirming that speed limit signs are present and conspicuous.
 - Confirming that the enforcement unit is placed appropriately in relation to the work activity.
- Program Administrator backoffice quality control reviews include:
 - Random sampling of deployment records to ensure that completed deployments meet statutory requirements.
 - Random sampling of rejected events to confirm appropriate reject categorization.
 - Random sampling of prepared notices of violation to confirm accurate details.
- PSP field quality control checks include:
 - Confirmation that speed detection equipment has current certification.
 - Enforcement signing is set up according to the legislation.
 - PSP performed quality control at 149 unique enforcement setups since the start of the program (March 2020) and has found no improper setups per the statute.

Between the Program Administrator and PSP, a total of 4.2% of all deployments that occurred covering 52% of all deployment locations were field quality control checked over the life of the program.



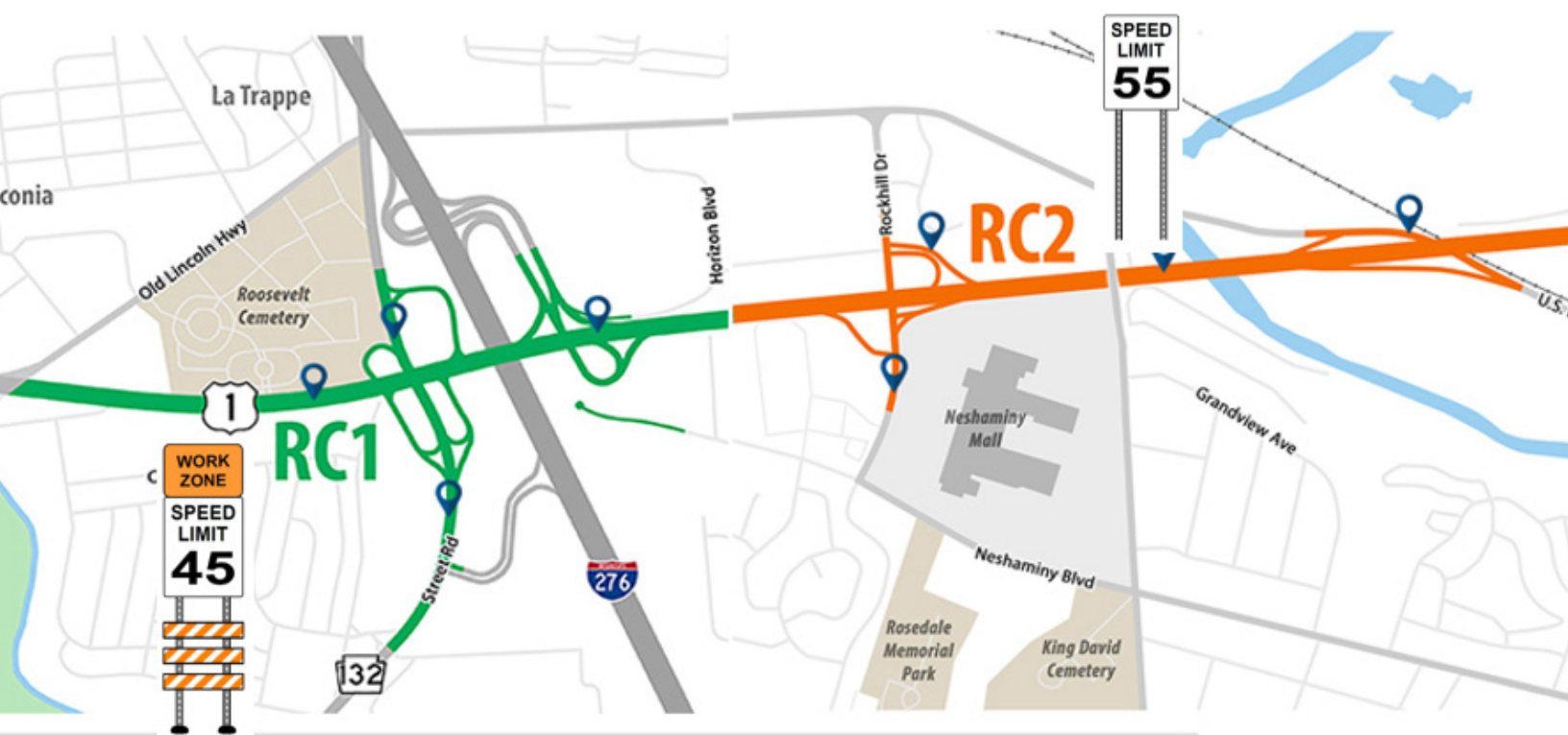


FIGURE 8 – RC2 PROJECT LOCATION MAP

US 1 RC2 Work Zone

Despite these quality control efforts, an issue occurred at a deployment location in Bucks County in late 2021. From September 2021 through December 2021, the US 1 RC2 project was a construction project where AWZSE was deployed to reduce speeds within this work zone. Following several complaints, PennDOT reviewed the AWZSE deployment and discovered the work zone speed limit was incorrectly identified as 45 MPH. The speed limit in an adjacent work zone was lowered to 45mph, but the RC2 work zone remained at 55 MPH. As a result, all 62,640 violations associated with AWZSE deployments on US-1 were rescinded, including zero-fine first violations, and fine carrying violations.

This project is one of two concurrent construction projects along US 1, as shown in Figure 8. The speed limit in an adjacent work zone (RC1) was lowered to 45mph, but the RC2 work zone remained at 55 MPH. Work zone speed limit signing was not required for the RC2 work zone as the normal speed limit of 55 MPH was maintained during the project. Due to the proximity of the two work zones and lack of work zone speed limit signs in RC2, the speed limit was incorrectly identified as 45 MPH.

With the speed limit incorrectly identified, in the interest of program transparency and fairness to motorists, all violations from these deployments were rescinded. These included the 21% of violations issued that would have been valid had the enforcement units been set to the correct speed limit. The elements of AWZSE deployments that are most often questioned by contesting motorists, specifically the presence of advance warning signage and the calibration and certification of the enforcement units, were in place and met statutory requirements for these deployments.

LEGISLATIVE MODIFICATIONS AND INFORMATION

The effective date of the Act 86 of 2018 was February 16, 2019. The effective date of expiry for Act 86 is February 16, 2024. The agencies continue to monitor the effectiveness of the program; however, the results seen in 2021 appear to demonstrate the value that AWZSE, when deployed effectively, has had promoting work zone safety, reducing speeds and crashes in work zones. Legislative action will soon be needed to extend the program beyond its current date of expiry.

The current application of AWZSE as a five-year pilot program has provided some lessons learned, including potential modifications that may need to be included into any legislative action. These potential modifications include:

- Simplification of the program fine structure, including consideration of a flat fee per violation instead of a tiered fine structure.
- Addition of the ability for vehicle registration to be withheld for significant unpaid violations.
- Add requirement for every work zone to have a speed limit sign present regardless of a speed limit reduction.
- Permit hearings to occur virtually over the life of the program, providing more flexibility and opportunity for violations to be contested, especially for out-of-state and commercial entities.
- Consideration of AWZSE applicability, including potential for non-active work zones where noted safety concerns exist that can be mitigated through AWZSE.
- Consideration to move the annual report due date to June 1 of the following year, as annual crash data is typically finalized in April of the following year. This would allow the annual report to include the most recent year's crash data instead of having to reference the previous year's data.



2021 LESSONS LEARNED

In 2021, the program continued to meet its overall program goals:

- **Reduce speeds in work zones.** Generally speaking, work zone speeds have trended downward throughout AWZSE enforced work zones, with a year over year reduction in the percentage of traffic traveling over the speed limit. During 2021's primary construction months (April – November), speeding in AWZSE enforced work zones has been reduced to 20% of all traffic, and excessive speeding (11+ MPH over the posted speed limit) has been reduced to 3%.
- **Promote work zone safety.** Throughout 2021, the Transportation Agencies (PennDOT and the Turnpike Commission) have promoted the use of AWZSE as a tool to enhance work zone safety. From 2019 to 2020, the first year the program was in operation, there was a 19% reduction in crashes in work zones. A reduction of over 100 crashes annually has occurred in 2020 and 2021 in work zones on Pennsylvania interstates, freeways, and expressways. The agencies have incorporated this messaging into their overall work zone safety messaging programs. Several press articles and efforts have highlighted the effectiveness of the program and have focused on the safety benefits of the program.
- **Improve driver behavior.** Measured, sustained speed reductions have been observed in AWZSE-enforced work zones, with smaller (but measurable) reductions at times when AWZSE is not in effect in those zones.
- **Save worker and traveler lives.** Overall fatality numbers from work zone crashes decreased slightly from 2019 to 2020, and based on preliminary data, decreased again from 2020 to 2021.
- **Complement existing speed enforcement by the Pennsylvania State Police.** In 2021, Pennsylvania State Police supported 101 projects for \$5.5 million. This support was for work activities where PSP support remains the most effective tool to enhance safety. PSP also remains a committed program partner and serves a vital role in the program. The combination of existing and automated enforcement continues to be applied in a complementary manner and is yielding benefits in our work zones.

The program will continue operation into 2022:

- Continued and enhanced project screening, deployment scheduling, and data tracking.
- Implementation of enhanced quality control procedures.
- Continued mainstreaming of the program, increasing the pool of projects and activities to which AWZSE can be deployed to on an annual basis.

The AWZSE program is focused on continuing to meet these program goals and is taking steps in 2022 to better meet the program goals and further make Commonwealth work zones safer. All three agencies are committed to increasing the use of this tool in 2022, building upon the program successes in 2020 and 2021. Applying the lessons learned since the start of the program in March 2020 will be critical to achieving the desired safety improvements and continues to be an emphasis point for all involved in the AWZSE program.

