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WSP TARGETED ENFORCEMENT ANALYSIS

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for the Washington State Patrol and
Washington Traffic Safety Commission with support
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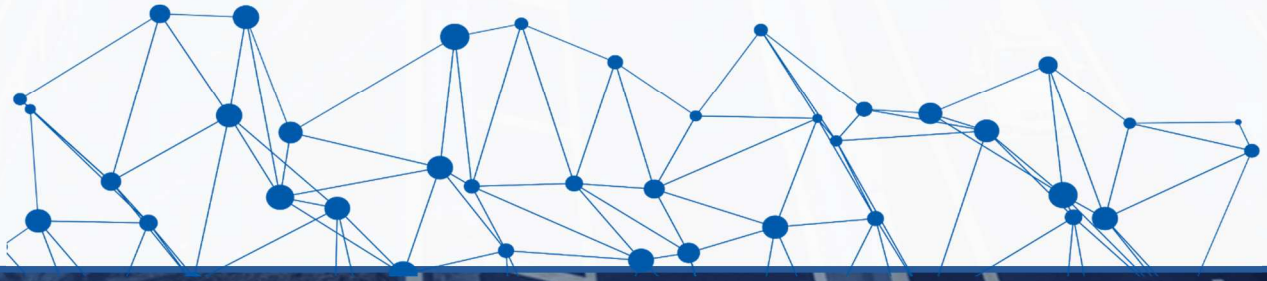

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INTRODUCTION

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Washington State is at a crossroads in terms of traffic safety, with fatality rates reaching levels not seen since the 1980s. Traditional enforcement strategies, primarily based on crash history, are no longer sufficient to proactively address high-risk driving behaviors. The Washington State Patrol (WSP) is responsible for traffic safety enforcement within the state of Washington and needs behavior-based data to better identify and target locations with the greatest potential for serious crashes. The Washington Traffic Safety Commission (WTSC), which serves as the state's designated highway safety office, and WSP aim to reduce fatalities and improve driving behavior across eight districts in Washington state. By integrating historical crash data with driving behavior trends from Michelin Mobility Intelligence, the WTSC and WSP seek to shift from an output-focused approach, such as issuing citations, to an outcome-oriented strategy aimed at decreasing risky driving behaviors that lead to crashes.

The Governor's Highway Safety Association (GHSA) aims to lead states and territories to move toward zero deaths on the nation's roadways through leadership, partnerships and advocacy. In March 2024, GHSA launched a grant program to help state highway safety offices enhance their use of data to improve road safety. The grants included partnerships with Michelin Mobility Intelligence to leverage near real-time traffic data insights in helping public agencies get a clear picture of the complex traffic safety issues on their road network and understand where to act.

Washington was selected as a recipient of the inaugural grant and initiated a pilot safety project in spring 2024. As part of that initial grant, WTSC partnered with MMI to conduct a road safety study focused on South King County and Yakima County. The findings were shared with the WSP, which recognized their potential to enhance traffic safety enforcement across all eight districts. Due to the demonstrated impact of MMI's findings in improving resource deployment, WSP requested expanded mapping and analysis of state routes within the state of Washington. In 2025, WTSC applied for a second grant to build on the progress made with Michelin and was successfully awarded a grant for a second year.

As part of the second grant, WSP and WTSC aimed to better understand the eight districts under WSP jurisdiction. Specifically, WSP wanted to understand the impact that additional law enforcement officers would have when targeting their enforcement within a given corridor. To help achieve this goal and better understand the state routes within the state of Washington, WTSC, WSP, and MMI:

1. Conducted a baseline scan, which is a preliminary analysis of the state routes in Washington to understand the current driving behavior within those routes, across all road segments to identify high-risk segments.
2. Analyzed three separate periods, before/during/after, to evaluate the impact of WSP's targeted enforcement pilot.

This report includes four main components:

- **Executive Summary and Project Overview:** this section synthesizes the principal findings and insights derived from the analysis, designed to enhance understanding and engagement among stakeholders.
- **Detailed Analysis:** this section details an in-depth examination of the baseline scan and the targeted enforcement period analysis. This includes key findings related to each district involved in the initiatives, supplemented by relevant graphs and images that illustrate and reinforce the findings.
- **Methodology:** this section provides detailed insight into the type of telematics data used, the multiple metrics used, and the models and algorithms used throughout the project.
- **Acronyms and Abbreviations:** this section provides definitions for acronyms and abbreviations used throughout the document.

The project did not include recommendations on infrastructure, enforcement or educational actions stemming from the data analysis.

ACRONYMS AND DEFINITIONS

ACRONYMS

GHSA	Governors Highway Safety Association
HVE	High Visibility Enforcement
MMI	Michelin Mobility Intelligence
WSP	Washington State Patrol
WTSC	Washington Traffic Safety Commission

DEFINITIONS

Target corridor: One of the stretches of state road or interstate identified as high risk by MMI and WSP and chosen for the six-week targeted enforcement. Four high risk stretches of road were identified, one in each district, and for each stretch both travel directions were analyzed, giving us eight total corridors.

Comparison corridor: One of the stretches of state road or interstate *not* chosen for target enforcement but selected for its similar size and traffic volume profile to the target corridors. These corridors were used to understand behavior trends in areas not chosen as part of the targeted enforcement. Like the target areas, four stretches of road were selected, each with two directions of travel for a total of eight comparison corridors.

Before period: (May 9 – June 15, 2025): Period prior to additional enforcement, establishing a behavior baseline in target and comparison corridors.

During period: (June 16 – July 31, 2025): Period during targeted enforcement, where additional enforcement resources were deployed to the target corridors. In addition, the public was notified about the emphasis in a statewide press release.

After period: (August 1 – August 30, 2025): Period after the targeted enforcement period was over. The after period was used to evaluate any sustained changes in driving behavior.

Officer-hour: A unit of time indicating how much time officers spend in an area. For example, if the District 1 I-5 north corridor saw ten officer-hours in a day, this means the cumulative amount of time spent by WSP troopers in that corridor was ten hours, whether one officer for ten hours or ten officers for one hour each. This metric comes from the WSP Automatic Vehicle Location data source.

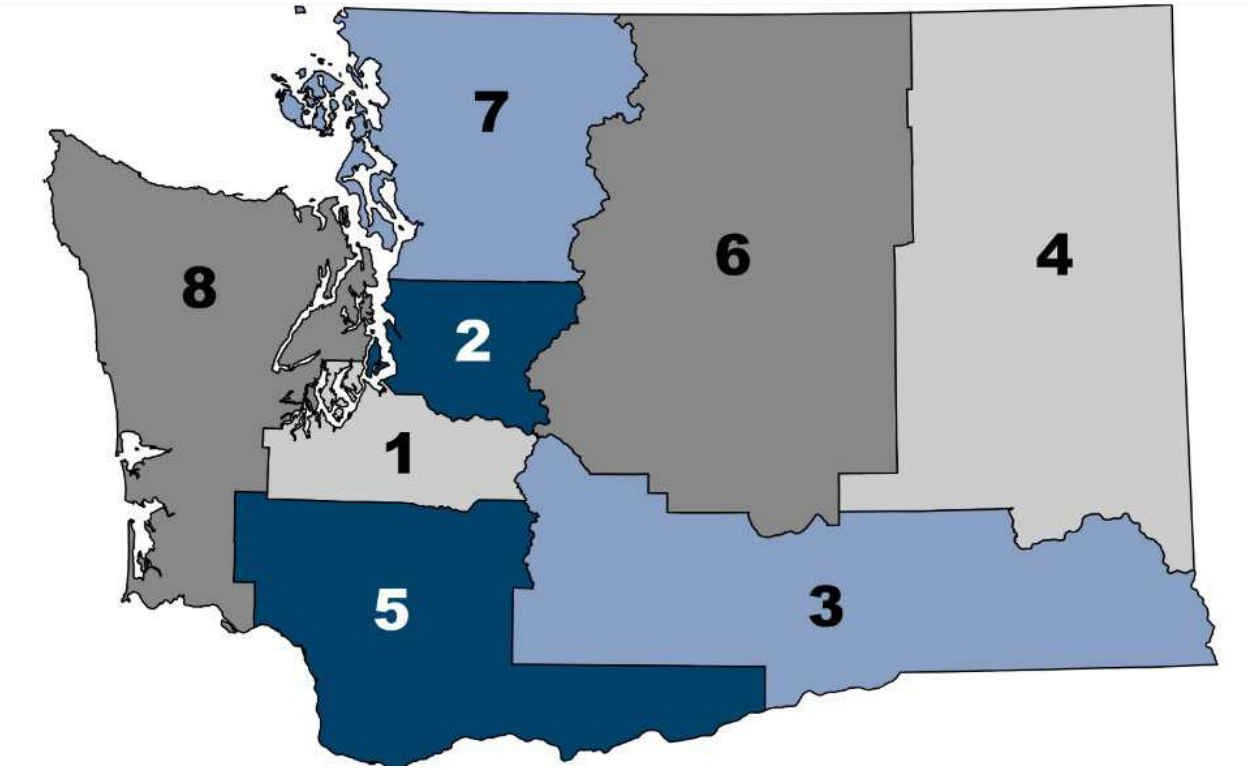
Stationary officer-hours: The amount of time officers spent in an area, while stationary. This metric is used as a proxy for time spent parked measuring speed, or engaging in a traffic stop, etc.

Mobile officer-hours: The amount of time officers spent in an area, while actively moving. This metric is used as a proxy for time spent on roving patrols, etc.

Combined officer-hours: The two metrics above, stationary and mobile officer hours, are added together to get combined officer-hours, the total amount of time spent by officers in a specific area.

WSP DISTRICT MAP AND CORRIDOR DESCRIPTIONS

WSP DISTRICT MAP



The eight districts under the jurisdiction of the Washington State Patrol.

CORRIDOR DESCRIPTION

The tables below list the corridors identified for the study, categorized as either target or comparison corridors. These corridors are grouped into four distinct locations based on their district, analyzed by direction of travel, equating to a total of eight target corridors and eight comparison corridors. Each corridor is described by its road name, location, and direction of travel (e.g., I-5 north).

Target Corridors:

CORRIDOR NAME	CORRIDOR BOUNDARIES	CORRIDOR DISTANCE
District 1 Corridor I-5 north through Tacoma	I-5 from Freedom Way to Porter Way	17.1 miles
District 1 Corridor I-5 south through Tacoma		
District 2 Corridor I-5 north near Federal Way	I-5 from Porter Way to S 288th St.	6.4 miles
District 2 Corridor I-5 south near Federal Way		
District 4 Corridor I-90 east through Spokane	I-90 from W Lawton Rd. to N Sullivan Rd.	14 miles
District 4 Corridor I-90 west through Spokane		
District 7 Corridor I-5 north through Everett	I-5 from State Hwy. 527 to 172nd St. NE	16.5 miles
District 7 Corridor I-5 south through Everett		

Table 1: *For each corridor, this table describes the district, road name, location, and direction of travel for target corridors.*

Comparison Corridors

CORRIDOR NAME	CORRIDOR LOCATION	CORRIDOR DISTANCE (TOTAL MILES)
District 1 Comparison Corridor I-5 north around Olympia	I-5 from 113 Ave. SW to Meridian Rd. NE	15.8 miles
District 1 Comparison Corridor I-5 south around Olympia		
District 2 Comparison Corridor I-405 north through Bellevue	I-405 from Benson Rd. S to 228th St. SE	23.1 miles
District 2 Comparison Corridor I-405 south through Bellevue		
District 2 Comparison Corridor I-90 east past Issaquah	I-90 from 150th Ave. SE to 468th Ave. SE	23.1 miles
District 2 Comparison Corridor I-90 west past Issaquah		
District 4 Comparison Corridor I-90 east past Cheney	I-90 from Brown Rd. E to S Salnave Rd.	14.2 miles
District 4 Comparison Corridor I-90 west past Cheney		

Table 2: *For each corridor, this table describes the district, road name, location, and direction of travel for comparison corridors.*

EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

Increased officer presence in corridors is correlated with decreased speed.

- A statistically significant relationship was found between higher officer presence in a corridor on a specific day, and lower average speeds that day.
- In general, across all corridors, for every one-officer-hour increase in each mile of a corridor on a given day, average speed decreases by 5.6 mph. In other words, for a 10-mile-long corridor, an increase of 10 officer-hours per day would be expected to correlate with a 5.6 mph lower average speed that day.
- Different relationships exist within different corridors, with 15 of 16 corridors demonstrating the same relationship where increased presence is correlated with lower speed. Of the target corridors, the District 7 I-5 north corridor showed the most sensitivity to officer presence, where every additional one-officer-hour per mile was associated with a 12.1 mph decrease in speed.

Automatic Vehicle Location data from WSP did not show a major increase in officer presence in most target corridors.

- In the aggregated target corridors, combined daily officer presence (stationary plus roving patrols) decreased 0.4% from the before period to the during period. A closer look shows that *stationary* officer presence in the aggregated target corridors increased by about one officer-hour per day (from 19.0 hours to 20.0 hours), which was offset by a decrease in *mobile* officer presence of about 1.3 officer-hours per day (from 68.2 hours to 66.9 hours) in those corridors. This finding may indicate that these corridors were already known to be high risk, and enforcement saturation had already been reached with existing district resources. Furthermore, an increase in stationary hours and decrease in mobile hours likely indicates more time spent observing driver behaviors and engaging in traffic stops.
- The three target corridors that saw the largest percentage increase in combined officer-hours were the District 2 I-5 south target corridor, with an increase of 39.2% in daily officer hours, and both directions of the District 4 I-90 target corridor, with increases between 4%-9%.
- The change in officer presence in the target corridors slightly outperformed the change in the comparison corridors. Across the aggregated comparison corridors, daily officer presence decreased 8.7% in the during period from the before period, as opposed to the 0.4% decrease in the target corridors mentioned above. This suggests deployment priority was given to the target corridors.

Some target corridors saw significant driver behavior changes.

- Two success stories were the I-5 south target corridors in Districts 2 and 1, where average speeds were significantly lower in the during period than the before period. This partially correlates with the previously mentioned increase in officer hours. Results in other corridors will be discussed in later sections of this report. Not all target corridors saw significant behavior changes.
- One factor that may have limited the ability to increase enforcement in Districts 2, 1, and 7 is that collisions occur at the highest rate in these districts relative to their number of troopers. This likely contributed to officers in these districts having less time at their discretion to focus on patrolling the target corridors. Additionally, as these corridors were previously generally known to be of higher risk, enforcement resource levels may already have been near saturation in these areas even before the during period.

PROJECT OVERVIEW

PROJECT OVERVIEW

Historically, WTSC and WSP relied on crash data to better understand driving behavior. Although this has provided some insight and context, it does not provide a comprehensive understanding of the factors contributing to roadway risk. By incorporating telematics data, WTSC and WSP gained a more layered view of driver behavior across the state.

The availability of MMI telematics data provided law enforcement with a powerful tool for accessing real-time insights into aggregate naturalistic driving behaviors. This can enable a shift from traditional crash-based enforcement strategies to more proactive, targeted interventions. The initial project with MMI demonstrated that while telematics and crash history data each offered valuable perspectives, their combined use, along with additional context from WSP, resulted in a more comprehensive understanding of where serious crashes are most likely to occur.

WSP and WTSC aimed to understand the eight districts under WSP jurisdiction and the impact that additional resources allocated could have within targeted corridors. To support this initiative, MMI conducted a baseline scan of high-risk road segments within the state routes to assess current safety conditions. With that gained perspective, MMI and WSP performed a period analysis to understand the impact of additional law enforcement on driving behavior.

WSP

WSP developed and provided a detailed enforcement plan, including deployment schedules, officer quantity, enforcement type, dates, and locations throughout the study period. During the study, WSP provided input for the development of interactive maps. They also provided instructions and training to the law enforcement officers who were deployed during this project.

WTSC

WTSC acted as a bridge between MMI and WSP to ensure successful completion and progress of the study. WTSC worked closely with WSP to gather feedback to share between the two groups. WTSC also promoted the project partnership through press releases and conferences.

MMI

During the project, MMI provided the data and performed the analysis necessary to conduct the study.

PROJECT OBJECTIVES

At the start of the study, WTSC and WSP identified these main objectives:

1. Conduct and obtain a network screening analysis for the state routes, separated by WSP districts.
2. Conduct a before and after analysis of driver behavior at up to four locations targeted by WSP Traffic Safety Target Zero Teams, motorcycle troopers, and aerial enforcement support.

PROJECT STRUCTURE

The project consisted of two phases:

MMI conducted a baseline scan of driving behavior across Washington state using telematics data from May 1st, 2024, to October 31st, 2024. This analysis focused on the eight WSP districts and resulted in the creation of eight interactive maps, one for each district. MMI used a tool that allows for the visualization and interaction of the various metrics used for the state of Washington. The maps included layers such as speed data, hard braking hotspots, acceleration zones, and high-risk corridor identification. With this tool, WSP gained a deeper understanding of driving behavior patterns within each district.

As part of phase one, eight corridors (two corridors each from Districts 1, 2, 4, and 7) were identified as higher risk and became the focus of the analysis in phase two.

Phase two aimed to evaluate the impact of additional law enforcement on driving behavior within the target corridors with the study periods broken into before, during, and after as defined earlier in this document.

By combining insights from both phases, WSP gained a comprehensive understanding of driving behavior across all eight districts and evidence of the effectiveness of targeted enforcement strategies. The interactive maps and telematics data provide actionable intelligence for future enforcement planning, while the corridor analysis demonstrates how strategic deployment can influence driver behavior and potentially reduce crash risk.

DETAILED ANALYSIS

DETAILED ANALYSIS

PHASE ONE:

BASELINE SCAN HIGH-LEVEL SUMMARY

To support data-driven enforcement strategies and improve traffic safety outcomes, MMI developed district-level insights into driving behavior in collaboration with WTSC and WSP. Recognizing the need for tools that help law enforcement allocate resources more effectively, MMI conducted a comprehensive baseline scan using telematics data collected between May and October 2024. This scan served as both the foundation for creating interactive maps tailored to each of WSP's eight districts and helped gain a general understanding of those eight districts. By analyzing key metrics related to speeding, crash risk, and driving behavior severity, the maps provided a dynamic view of traffic safety conditions, enabling targeted interventions and informed decision-making.

To ensure the interactive maps would effectively support law enforcement in managing resources and understanding district-level driving behavior MMI utilized the following key metrics:

- **Speeding Severity Groups**: Classifies each road segment into one of four categories based on the prevalence of speeding-related risky driving behavior.
- **Representative Speed**: Captures typical speed behavior on road segments, offering insights into speed patterns across different times and days.
- **Vehicle-to-Vehicle Crash Risk**: Estimates systematic crash risk for each segment, focusing on predictable patterns involving multiple metrics.
- **Driving Behavior Severity Ranking**: ranks road segments based on the frequency, intensity, and speed of risky driving events, including braking and acceleration.
- **Focus Corridor Identification**: Flags high-risk corridors using a model that incorporates driving behavior, crash history, and crash risk analysis.

Based on this baseline scan, MMI created eight interactive maps, one for each WSP district. Each interactive map included layers representing MMI's models and algorithms, enabling users to explore district-level driving behavior and safety conditions. The maps served two primary goals:

1. To provide each WSP district with a tool for understanding driving behavior and optimizing enforcement resource deployment.

2. To identify high-risk stretches within four districts (referred to in this report as target corridors, two corridors each from Districts 1, 2, 4, and 7) for targeted enforcement during a six-week period in phase two.

The method used to select the target corridors was a collaborative effort utilizing both MMI's insights as well as WSP's on-the-ground knowledge of where the best places to set up enforcement emphasis. MMI's crash risk models and high-speed risk hotspot detection algorithms, combined with analysis of severe crash history, identified over a dozen high-risk stretches across the four districts. After evaluating potential high-risk segments, WSP selected four suitable locations for targeted enforcement. Each location was assessed in a single direction of travel, with each direction defined as a separate corridor. This approach resulted in a total of eight target corridors (two single-direction corridors per location). This way, not only did MMI's insights inform district-level enforcement planning but also guided the selection of areas for targeted intervention and impact analysis in the second phase of the project.

PHASE TWO:

ASSESSING THE EFFECTIVENESS OF TARGETED ENFORCEMENT

The core objective of MMI's engagement with this project was to measure the effectiveness of WSP's targeted enforcement program using MMI's telematics data. As referenced earlier, MMI's data and risk projection maps were used to select high-risk corridors in four districts for the enforcement emphasis. These corridors also met other criteria such as being on roads with characteristics that were conducive to ground and aerial enforcement emphasis. The primary method of evaluating program effectiveness was to compare metrics such as average speed, frequency of high-speed events, etc. across the periods before, during, and after the targeted enforcement. As the analysis progressed, an additional focus on the localized day-specific, corridor-specific enforcement-behavior relationship was added.

The first method of evaluating program effectiveness, looking at behavior metrics in aggregate, was carried out via a statistical process called hypothesis testing. In addition to hypothesis testing, a number of other factors were explored to better explain and understand the behavioral dynamics occurring in each corridor throughout the three periods of time. The most important of these factors was an analysis of AVL (Automatic Vehicle Location) data provided by WSP, which was used to measure the presence of state troopers in each corridor as well as whether they were stationary or mobile, and to determine how much state trooper presence changed throughout the three periods. Data regarding aerial support in the target corridors was not available for this study.

Another important set of data points came from a set of comparison corridors, which were a separate set of corridors not included in WSP's targeted enforcement plan, but with similar characteristics and traffic volumes (in District 1, one stretch of I-5, in District 2, a stretch of I-90 and I-405, and in District 4, another stretch of I-90). These provided a useful comparison to understand driver behavior in corridors not subject to targeted enforcement. Lastly, data from these targeted and comparison corridors in 2024 was studied to establish an understanding of baseline trends related to seasonality and other driving conditions.

The second method of evaluating the impact of enforcement took a different approach, looking at the impact of higher levels of enforcement in a specific corridor on a specific day. This approach used a different statistical method, known as a hierarchical linear model, to measure how much speed would be expected to decrease in a corridor for each additional officer-hour present in that corridor in a day. Certain filters were applied to the data in this process, to remove the bias of certain outlier days where traffic speeds

appeared to be influenced by non-enforcement factors, such as traffic queues related to severe crashes or major entertainment events.

Findings comparing behavior in before and during periods via hypothesis testing

Overall, during the hypothesis testing phase of the analysis where aggregate metrics such as speeds of driving events and rates of high-intensity hard braking were included, significant improvement in driver behavior was not seen in most target corridors. Some specific improvements were seen, which are detailed below, but in general, no pattern of behavioral improvement from the before period to the during period was observed.

However, a critical finding to help explain these results came from analysis of the WSP-provided AVL data. Analysis of this data indicates that there was no major increase in officer presence in most target corridors, whether stationary or in roving patrols. Despite the initial plan for the targeted enforcement , a number of factors likely contributed to enforcement levels not increasing significantly, including the fact that WSP troopers in Districts 1, 2, and 7 are required to respond to higher numbers of crashes and incidents than troopers in other districts, which limits the discretionary amount of time they have to spend patrolling specific corridors. In addition, the selected target corridors were generally already known to be higher-risk and may have already reached resource-dependent enforcement saturation prior to the during period.

More specifically, when comparing the AVL data in the targeted enforcement corridors as well as the comparison corridors, a 0.4% overall decrease in total officer hours was seen in the target corridors, versus an 8.7% overall decrease in total officer-hours seen in the comparison corridors. When looking only at stationary time spent in corridors, the target corridors did see an increase of 5.5% daily stationary officer-hours, which is noteworthy but likely was a smaller increase than was initially planned, although it did outperform the 6.6% decrease in daily stationary officer-hours in the comparison corridors . Overall, these results may reflect deficits in trooper resources across the state, but it appears that priority was placed on the target corridors (staffing was kept steady, as opposed to the lower staffing seen in the comparison corridors). Three out of eight target corridors stand out as seeing increased enforcement in the during period – the District 2 I-5 south corridor saw a 39.2% increase in total officer-hours, while the District 4 I-90 corridors (east and west) saw an increase of between 4%-9% depending on travel direction.

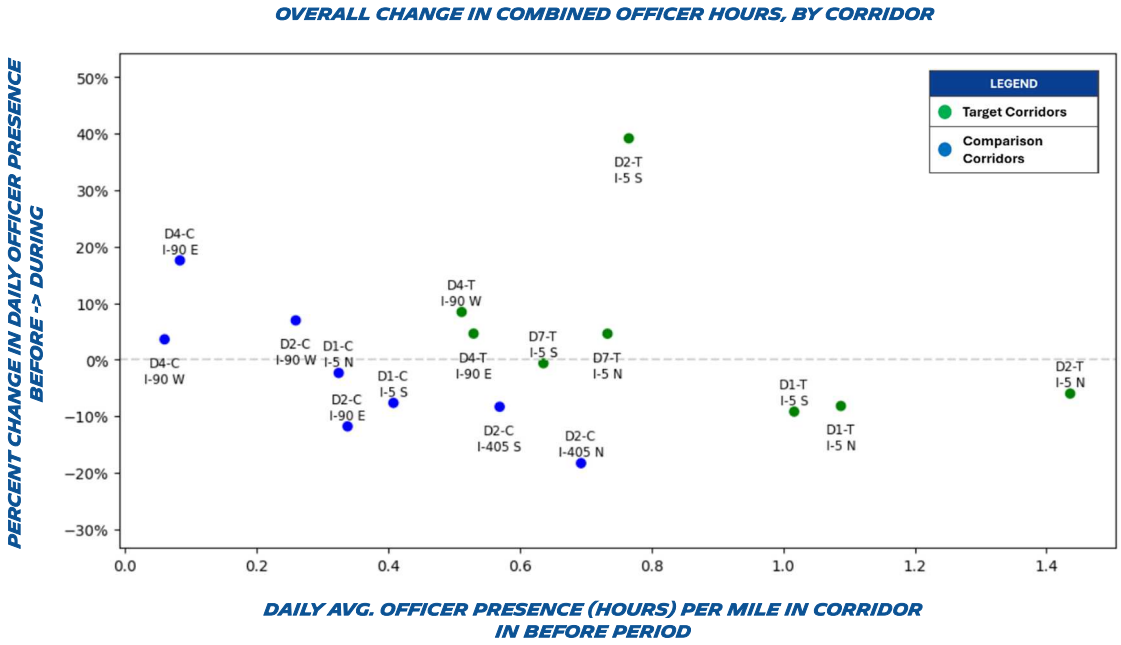


Figure 1: *Comparison of each corridor in terms of daily officer hours in the before period vs the during period. The further to the right on the plot, the more officer-hours a corridor saw in the before period, to give a sense for the baseline amount of enforcement occurring. The further up on the plot, the higher the percent change in daily officer hours from before to during, with all points above the dotted gray horizontal line indicating there was an increase in daily officer hours, and all points below the line indicating a decrease. In summary, four of eight target corridors increased officer hours, one had nearly no change, and three decreased in total officer hours. In the comparison corridors, three had increased officer hours, one had nearly no change, and four decreased.*

Regarding the findings of the behavioral difference hypothesis testing, the strongest evidence for behavioral improvement came in the District 2 I-5 south target corridor and District 1 I-5 south target corridor. These target corridors both showed statistically significant improvement in average speed during hard braking and acceleration events, both in daily aggregate as well as in specific time frames. Speeds improved most significantly in the District 1 I-5 south target corridor during the non-rush-hour daylight hours, and in the District 2 I-5 south target corridor during both the non-rush-hour daylight hours as well as the nighttime hours. Looking further north in the target corridors, District 7 I-5 north showed significant improvement in overall driving event speeds, specifically during the higher-traffic daytime hours. The table below summarizes which metrics showed a statistically significant improvement in driver behavior on the corridors.

For each corridor, five speed-related metrics and nine occurrence of hard braking or acceleration metrics were evaluated.

Speed metrics	Mean speed hard braking, mean speed hard acceleration, mean speed hard braking broken out during three different parts of the day (nighttime, daytime-low traffic hours, daytime-high traffic hours)
Occurrence of hard braking/acceleration metrics	Rate of most severe hard braking and acceleration, rate of hard braking and acceleration 0-10mph above speed limit, rate of hard braking and acceleration 10+ mph above speed limit (all broken out during the three different parts of the day, listed above)

Overall results of statistical hypothesis testing

Corridor	Significant Driver Speed Improvement Observed, Across Different Metrics	Significant Risky Event Improvement Observed, Across Different Metrics
Target Corridors		
D2 I-5 North near Federal Way	0/5 metrics (0%)	0/9 (0%)
D2 I-5 South near Federal Way	4/5 (80%)	0/9 (0%)
D1 I-5 North near Tacoma	0/5 (0%)	0/9 (0%)
D1 I-5 South near Tacoma	3/5 (60%)	0/9 (0%)
D7 I-5 North near Everett	2/5 (40%)	0/9 (0%)
D7 I-5 South near Everett	0/5 (0%)	0/9 (0%)
D4 I-90 West near Spokane	0/5 (0%)	0/9 (0%)
D4 I-90 East near Spokane	0/5 (0%)	0/9 (0%)
Comparison Corridors		
D2 I-405 North near Bellevue	3/5 (60%)	1/9 (11%)
D2 I-405 South near Bellevue	3/5 (60%)	1/9 (11%)
D2 I-90 West near Issaquah	2/5 (40%)	0/9 (0%)
D2 I-90 East near Issaquah	2/5 (40%)	0/9 (0%)
D1 I-5 North near Olympia	2/5 (40%)	0/9 (0%)
D1 I-5 South near Olympia	4/5 (80%)	2/9 (22%)
D4 I-90 West near Cheney	0/5 (0%)	3/9 (33%)
D4 I-90 East near Cheney	0/5 (0%)	1/9 (11%)

Table 3: *Table summarizing how many of the tracked metrics (5 speed metrics, 9 near-miss metrics) showed statistically significant improvement from the before period to the during period.*

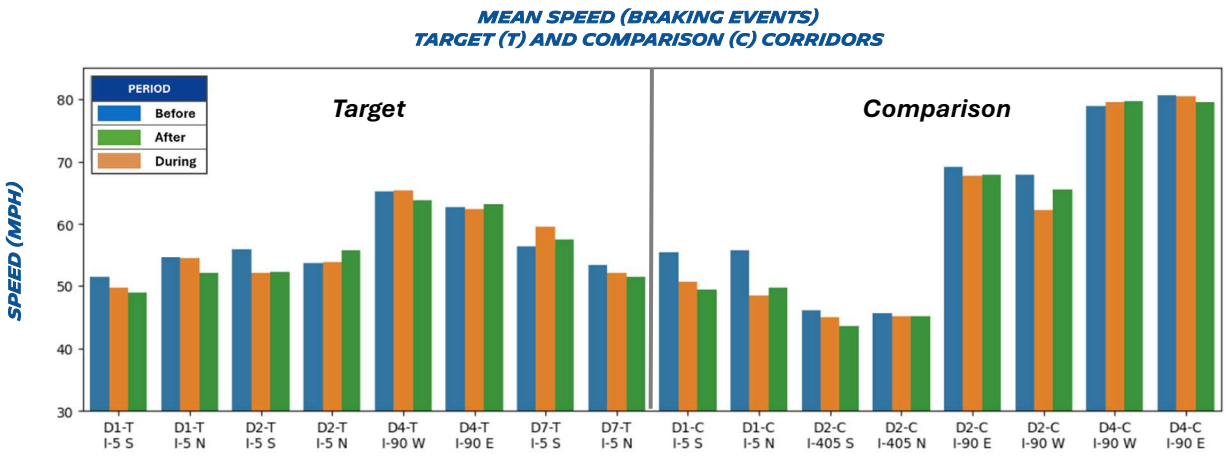


Figure 2: *Comparison of mean hard braking event speeds in each corridor in the before, during, and after periods. The target corridors (labeled with "T") are shown to the left of the plot, and the comparison corridors (labeled with "C") are shown on the right.*

The relationship between enforcement and driver speed in each corridor, evaluated day by day

In a separate analysis from the aggregate comparison of behavior across different periods, driver speed was studied each day in each corridor to quantify its relationship with officer presence in the same corridor that same day. A statistical model was used that determined specific relationships in each corridor. This approach faces certain limitations, such as avoiding any focus on other factors that could influence speed, but it also has certain strengths, such as being able to avoid any dependence on a large-scale ramp-up in officer presence over the course of a long period of time.

It's important to note that while this model only examines the relationship between speed and enforcement presence, to the exclusion of all other variables, efforts were made to eliminate outliers and less-relevant days from the analysis dataset. For example, specific days were identified in many corridors where traffic patterns indicated large sections of the corridor being affected by major congestion, possibly due to a severe crash or a major sporting event in the area. These days (approximately 18% of all day-corridor pairs) were removed from the dataset, which creates a more confident estimate of officer impact that is more relevant to days with normal traffic flow and traffic patterns.

The results of the statistical model were highly supportive of the theory that increasing officer presence in a corridor leads to safer driving behavior.

IN AGGREGATE ACROSS ALL CORRIDORS, THE STATISTICAL MODEL ESTIMATES THAT A 1-OFFICER-HOUR INCREASE IN EACH MILE OF A CORRIDOR IN A GIVEN DAY LEADS TO A 5.6 MPH DECREASE IN SPEED IN THE CORRIDOR THAT DAY. IN OTHER WORDS, FOR A 10-MILE-LONG CORRIDOR, AN INCREASE OF 10 OFFICER-HOURS IN A GIVEN DAY WOULD BE EXPECTED TO REDUCE AVERAGE SPEED BY 5.6 MPH IN THE CORRIDOR

Breaking this down even further into officer-hours when the officer is stationary and officer-hours when the officer is actively moving, a 1-stationary-officer-hour increase per mile correlated with a 3.2mph decrease in average speed, while a 1-moving-officer-hour increase per mile correlated with a 7.0mph decrease in average speed. When an additional model was trained looking at each specific corridor, fifteen out of sixteen corridors showed negative relationships between officer presence and driver speed, meaning an overwhelming majority demonstrated the desired impact from officer presence.

A deeper dive into the results of this corridor-specific model provides interesting insights into the different effects of officer presence. Of the 16 corridors (eight target and eight comparison corridors)), five of them demonstrated relationships where a 1-officer-hour-increase per mile correlated with a greater than 10 mph drop in average speed. The two most responsive corridors were the I-405 north and south corridors near Bellevue, followed by three I-5 corridors.

OF THE TARGET CORRIDORS, I-5 NORTH IN DISTRICT 7 SHOWED THE MOST SENSITIVITY TO OFFICER PRESENCE, WHERE EVERY ADDITIONAL ONE-OFFICER-HOUR PER MILE WAS ASSOCIATED WITH A 12.1 MPH DECREASE IN AVERAGE SPEED.

Conversely, four of the five least responsive corridors were stretches of I-90 – both travel directions on the stretch east of Issaquah in District 2, and both travel directions southwest of Spokane in District 4. All of these corridors were among the lowest-traffic volume corridors, as well as being among the highest-speed corridors in general.

Although these relationships cannot definitively be stated to be causal, the strength and consistency of the relationships support the premise that increasing enforcement in an area does improve driving behavior. An extremely interesting pattern was observed in the corridors that were most responsive to each additional hour of officer presence - they were also the corridors that tended to see higher officer presence in general. This may imply that the impact of extra enforcement grows exponentially as the amount of enforcement grows, suggesting that targeted enforcement in specific areas is likely to make a bigger difference on overall behavior across a road network than trying to spread resources thinly to cover more area. This hypothesis merits further investigation, although outside the scope of the current study.

TARGETED ENFORCEMENT IN SPECIFIC AREAS IS LIKELY TO MAKE A BIGGER DIFFERENCE ON OVERALL BEHAVIOR THAN TRYING TO SPREAD RESOURCES THINLY TO COVER MORE AREA.

District-specific Findings (Officer hours patterns and driver behavior outcomes)

The below tables summarize some of the key metrics and takeaways for the corridors in each district, including some general information, some metrics around daily officer hours per mile, how additional officer presence may influence driver speed, and an overview of any significant driver behavior changes observed from the before to the during period.

Interpretation:

- "Expected Speed with 0 Officer Hours" is a parameter of the statistical model used to map the relationship between officer hours and average speed in a day. This value describes an expected average speed over a full day, including high-traffic times as well as lower-traffic times where higher speeds are common. There were very few days in the dataset where officer hours were exactly zero, so this number is a statistical estimate rather than a reported metric.
- "Speed Change with +1 Officer-Hour per Mile" is another parameter of the statistical model, showing the estimate of how much average speed in a day would drop if officer hours per mile changed from 0 to 1. For some corridors with high officer presence on a regular basis, this may reflect a typical day, and for others like the District 4 comparison corridors, this may be an abnormally high number of officer hours. A more negative value here may indicate that enforcement strategies in the corridor in question were especially effective.
- "Officer-Hrs Per Mile (Before/During)" are columns showing the average officer hours per mile per day in each corridor, in each period. This column allows the reader to have a sense for generally how saturated each corridor is with trooper presence, and how much that presence changed from the before to during period.

District 2

CORRIDOR	LENGTH	TRAFFIC VOLUME	OFFICER-HRS PER MILE (BEFORE)	OFFICER-HRS PER MILE (DURING)	PERCENT CHANGE
I-5, Federal Way - South (Target)	6.4 mi	High	0.77	1.07	+39%
I-5, Federal Way - North (Target)	6.4 mi	High	1.44	1.35	-6%
I-405, Bellevue - South (Control)	23.0 mi	High	0.57	0.52	-8%
I-405, Bellevue - North (Control)	23.0 mi	High	0.69	0.57	-18%
I-90, Issaquah - West (Control)	23.0 mi	Low	0.26	0.28	+7%
I-90, Issaquah - East (Control)	23.0 mi	Low	0.34	0.30	-12%

CORRIDOR (CONTINUED)	EXPECTED SPEED WITH 0 OFFICER HOURS	SPEED CHANGE WITH +1 OFFICER-HR PER MILE	SIGNIFICANT CHANGES IN DRIVER BEHAVIOR FROM BEFORE TO DURING PERIOD
I-5, Federal Way - South (Target)	64 mph	-1.1 mph	Avg. Speed decreased across the board, across multiple metrics, times of day, and statistical tests.
I-5, Federal Way - North (Target)	63.8 mph	-3.6 mph	No significant driver behavior change observed.
I-405, Bellevue - South (Control)	60.5 mph	-22.0 mph*	Avg. Speed decreased in general, and specifically during daytime lower-traffic hours.
I-405, Bellevue - North (Control)	57.4 mph	-14.1 mph*	Avg. Speed decreased in general, and specifically during daytime lower-traffic hours.
I-90, Issaquah - West (Control)	68.2 mph	-0.2 mph	Avg. Speed decreased in general, and specifically at nighttime.
I-90, Issaquah- East (Control)	69.4 mph	-2.6 mph	Avg. Speed decreased in general.

Table 4: *The metrics in this table refer to the target and comparison corridors within District 2.*

Notes:

- The I-5 south target corridor in District 2 (past Federal Way) was one of the major success stories of the targeted enforcement. Not only was enforcement successfully ramped up in the during period in the southbound direction, but the hoped-for corresponding impact on driver behavior was also seen, with significant reductions in driving speed both in general as well as especially strongly in the daytime non-rush-hour parts of the day.
- The I-405 corridors past Bellevue in both directions were more sensitive than any other corridors studied in terms of how much an additional officer-hour correlated with a decrease in driver speed (Speed change with +1 officer-hour per mile). This indicates that enforcement in these corridors may have been especially effective, even though they were not part of the targeted enforcement program.

*The findings in the I-405 corridors may seem extreme at first glance, but a few additional details are necessary for context. First, the typical officer-hours-per-mile that these two

corridors saw in a day was around 0.6, so a value of 1.0 officer hour per mile would be almost double the normal police presence, which would intuitively have a significant impact on speed. Secondly, although the "expected average speed with zero officer hours" is 60.5 mph, which is near the speed limit, this includes time periods where these corridors are highly congested and speed is much lower. The strong relationship between officer presence and decreased speed likely would more specifically relate to speed during free-flow times, where average speed is much higher than 60.5 mph and with many high-speed drivers going even faster than the average at those times. Lastly, the nature of the statistical model used (a linear model) means that some of the more extreme data points are often not perfectly estimated, so while the values of –14.1 and –22.0 confidently tell us that there's a large change in average speed when more officers are present, these specific values may not remain quite so extreme if a larger analysis was done across a longer time period.

District 1

CORRIDOR	LENGTH	TRAFFIC VOLUME	OFFICER-HRS PER MILE (BEFORE)	OFFICER-HRS PER MILE (DURING)	PERCENT CHANGE
I-5, Tacoma - North (Target)	17.1 mi	High	1.09	1.00	-8%
I-5, Tacoma - South (Target)	17.1 mi	High	1.02	0.92	-9%
I-5, Olympia - North (Control)	15.7 mi	Low-Medium	0.33	0.32	-2%
I-5, Olympia - South (Control)	15.7 mi	Low-Medium	0.41	0.38	-8%

CORRIDOR (CONTINUED)	EXPECTED SPEED WITH 0 OFFICER HOURS	SPEED CHANGE WITH +1 OFFICER-HR PER MILE	SIGNIFICANT CHANGES IN DRIVER BEHAVIOR FROM BEFORE TO DURING PERIOD
I-5, Tacoma - North (Target)	62.6 mph	-6.3 mph	No significant driver behavior change observed.
I-5, Tacoma - South (Target)	64.9 mph	-11.0 mph	Avg. Speed decreased in general, and specifically during daytime lower-traffic hours.
I-5, Olympia - North (Control)	65.6 mph	-6.6 mph	Avg. Speed decreased in general.
I-5, Olympia - South (Control)	62.4 mph	-11.8 mph	Avg. Speed decreased in general as well as specifically in the daytime hours. The rate of especially risky near-misses decreased at night.

Table 5: *The metrics in this table refer to the target and comparison corridors within District 1.*

Notes:

- The I-5 south corridors in District 1 (both the target corridor near Tacoma as well as the comparison corridor near Olympia) both saw improved driver behavior in the during period. Although these corridors did not themselves see higher officer hours,

it's possible that the trickle-down effect of targeted enforcement in the District 2 target corridor on I-5 south had a partial impact.

- District 1 in general saw improved driver behavior in the during period, with three of four corridors (target and comparison) seeing statistically significant behavior improvements.

District 7

CORRIDOR	LENGTH	TRAFFIC VOLUME	OFFICER-HRS PER MILE (BEFORE)	OFFICER-HRS PER MILE (DURING)	PERCENT CHANGE
I-5, Everett - North (Target)	16.7 mi	Medium-High	0.73	0.77	+5%
I-5, Everett - South (Target)	16.3 mi	Medium-High	0.64	0.63	-1%

CORRIDOR (CONTINUED)	EXPECTED SPEED WITH 0 OFFICER HOURS	SPEED CHANGE WITH +1 OFFICER-HR PER MILE	SIGNIFICANT CHANGES IN DRIVER BEHAVIOR FROM BEFORE TO DURING PERIOD
I-5, Everett - North (Target)	67.2 mph	-12.1 mph	Avg. Speed decreased in general.
I-5, Everett - South (Target)	67.9 mph	-5.2 mph	Avg. Speed increased in general.

Table 6: *The metrics in this table refer to the target corridors within District 7.*

Notes:

- The target corridor on I-5 north near Everett was another success of the targeted enforcement, as it saw speed improvements in the during period. This behavior improvement correlated with a 5% increase in daily officer-hours, indicating at least a small-scale ramp-up during the targeted enforcement.

- Both directions on the I-5 corridor showed significant responsiveness to increased police presence, indicating that enforcement in this corridor may have been especially effective.

District 4

CORRIDOR	LENGTH	TRAFFIC VOLUME	OFFICER-HRS PER MILE (BEFORE)	OFFICER-HRS PER MILE (DURING)	PERCENT CHANGE
I-90, Spokane - West (Target)	14.0 mi	Medium	0.51	0.55	+8%
I-90, Spokane - East (Target)	14.0 mi	Medium	0.53	0.55	+5%
I-90, Cheney - West (Control)	14.2 mi	Very Low	0.06	0.062	+4%
I-90, Cheney - East (Control)	14.2 mi	Very Low	0.08	0.10	+18%

CORRIDOR (CONTINUED)	EXPECTED SPEED WITH 0 OFFICER HOURS	SPEED CHANGE WITH +1 OFFICER-HR PER MILE	SIGNIFICANT CHANGES IN DRIVER BEHAVIOR FROM BEFORE TO DURING PERIOD
I-90, Spokane - West (Target)	68.4 mph	-5.4 mph	No significant driver behavior change observed.
I-90, Spokane - East (Target)	67.9 mph	-7.0 mph	No significant driver behavior change observed.
I-90, Cheney - West (Control)	79.0 mph	-0.9 mph	The rate of especially risky hard braking and acceleration decreased during the daytime hours.
I-90, Cheney - East (Control)	80.1 mph	+1.51 mph	The rate of especially risky hard braking and acceleration decreased during daytime lower-traffic hours.

Table 7: *The metrics in this table refer to the target and comparison corridors within District 4.*

Notes:

- The I-90 target corridors in D4 saw a modest increase in officer presence in both directions during the targeted enforcement program, and on specific days when enforcement was higher this correlated with noticeably lower speeds. This did not translate to statistically significant decreases in speed in the during period but is still an encouraging indicator of targeted enforcement effectiveness.
- The comparison corridors on I-90 in both directions southwest of Spokane near Cheney saw significantly lower officer presence than any other corridor studied, which also correlated with a much lower general traffic volume. Interestingly, in this corridor, increased officer hours showed an inconclusive relationship with driver speed. This lends support to the theme observed across the rest of the study, which is that increasing enforcement in an area over time has an exponential effect on speed improvements, but with such low traffic and officer volume in this area, the critical mass of officers needed to see this speed improvement was not reached.
- However, the comparison corridors did see a significant improvement in the frequency of severe hard braking and acceleration in the during period. This is encouraging, especially when accounting for the moderate increase in officer hours in the area over the same period.

Some sustained change in driver behavior was seen after the targeted enforcement period ended

Another question that the study worked to answer was to determine how long any residual effects of targeted enforcement periods would last – or more specifically, after an extended period of targeted enforcement in an area, would improved driver behavior continue to be observed even after the targeted enforcement ended, and if so, for how long? Being able to answer this question was dependent on two requirements: significant increases in daily officer hours occurring in the target corridors, and then a significant reduction (or reversion back to baseline level) of daily officer hours immediately following the during period. As referenced earlier in this report, in most corridors one or both prerequisites were not met. However, in a few corridors, the behavior in the transition period from during to after targeted enforcement is worth highlighting.

Three of the eight target corridors saw a significant improvement in speed in the during period. Of these, two saw a marked increase in speed after the targeted enforcement period ended – one of which saw a 4.4mph increase in average speed in the first two weeks after the targeted enforcement period ended. The other corridor, which did not see an increase in speed after enforcement ended, was the District 7 I-5 north corridor near Everett, which could indicate a residual effect of the enforcement program.

Corridor	Significant speed Improvement (Before -> During)	Average speed difference (last week of During, compared to first two weeks of After)	Out of the first 14 days of After, how many are faster than last-week-of-During average?
Target Corridors			
D2 I-5 North near Federal Way	No	1.1mph faster after	6/14
D2 I-5 South near Federal Way	Yes	4.4mph faster after	7/14
D1 I-5 North near Tacoma	No	0.6mph slower after	5/14
D1 I-5 South near Tacoma	Yes	1.6mph faster after	8/14
D7 I-5 North near Everett	Yes	0.4mph slower after	5/14
D7 I-5 South near Everett	No	1.8mph faster after	9/14
D4 I-90 West near Spokane	No	0.6mph slower after	5/14
D4 I-90 East near Spokane	No	1.3mph faster after	8/14
Comparison Corridors			
D2 I-405 North near Bellevue	Yes	1.2mph faster after	4/14
D2 I-405 South near Bellevue	Yes	2.1mph slower after	3/14
D2 I-90 West near Issaquah	Yes	1.8mph faster after	10/14
D2 I-90 East near Issaquah	Yes	1.3mph faster after	7/14
D1 I-5 North near Olympia	Yes	3.8mph faster after	9/14
D1 I-5 South near Olympia	Yes	1.0mph faster after	9/14
D4 I-90 West near Cheney	No	1.2mph slower after	4/14
D4 I-90 East near Cheney	No	1.6mph slower after	2/14

Table 8: *For each corridor, this table shows whether or not the corridor saw behavior improvement during the enforcement period, how much faster or slower driver speeds were in the first two weeks following the enforcement period relative to the last week of the enforcement period, and how many days in the first two weeks after the enforcement period had higher average speeds than the average speed in the last week of the enforcement period.*

CONCLUSION

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Individually, targeted enforcement programs and telematics insights around driving behavior can be both valuable and impactful. When combined, the potential impact can grow exponentially. However, there are significant challenges and obstacles that need to be addressed to ensure that these programs are designed and the pieces integrated with one another optimally and are executed while accounting for these challenges. Additionally, the right systems for measurement need to be in place to confirm that the right approach is being taken, or if not, to ensure early course correction.

ANALYSIS OF TELEMATICS DRIVING BEHAVIOR DATA INDICATES THAT AT A LOCALIZED LEVEL, INCREASED OR TARGETED LAW ENFORCEMENT CORRELATES STRONGLY WITH SAFER DRIVING BEHAVIOR.

Fifteen of the sixteen target and control corridors analyzed demonstrated statistically significant relationships where average driver speeds were lower when officers spent more time in those corridors. However, only three of the eight target corridors saw significantly lower speeds in the during period than in the before period. Despite the apparent contradiction, the conflicting results can likely be explained by the fact that most corridors did not see a major surge in daily officer hours during the targeted enforcement period, but at localized times and places, increased enforcement did lead to better driving behavior.

Although it was not the focus of this study to determine how to most effectively implement targeted enforcement programs, learnings along the way may be used to help inform future program design and execution. Constraints on discretionary trooper time in high-crash-frequency districts may limit the amount of extra enforcement attention that can be given to specific areas and thus need to be managed. Consistent monitoring of program execution and key performance indicators related to officer presence while the program is active can allow for real-time resource reallocations to be made. If officer resource constraints are significant, telematics data can be used to identify historic patterns of dangerous driving behavior specific to time of day and day of the week in target corridors and thus identify some of the highest potential impact times for additional enforcement to be present.

FUTURE CONSIDERATIONS AND OPPORTUNITIES

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Telematics data played a key role throughout this project and study. From identifying high-risk areas, to providing behavior and risk maps across the entire state for use by the rest of the WSP FOB, to measuring and quantifying the results of the program, the insights derived from telematics data helped proactively guide the actions taken and retroactively measure the impacts of those actions.

Having established the usefulness of this innovative approach, consideration should be given to the lessons learned in this study as well as how to incorporate this approach into WSP & WSTC's ongoing and future safety efforts. Whether by identifying high-risk corridors, optimizing officer deployment and planning, creating interactive maps to bring insights, or measuring the impact of safety campaigns, telematics data can deliver immediate and measurable value, including in many ways that have not yet been explored in Washington.

One possible avenue to realizing some of this transformative potential is by identifying high-risk focus corridors on a quarterly basis and evaluating the impact of enforcement actions on the previous quarter's target areas – a regular refresh not only allows for the most up-to-date understanding of risk patterns across the state, but also builds familiarity, confidence, and buy-in from the officers utilizing this data.

Another avenue is through utilizing telematics insights during the design stage of future enforcement programs. In this most recent program, telematics insights were used to select the location of high-risk corridors, but future programs can be even more impactful if telematics insights are used to inform trooper assignments around specific high-risk days and times in addition to locations. Additionally, learnings from this study around where additional officer presence makes the most difference on driver behavior can be used to optimize deployment of WSP resources, maximizing trooper effectiveness in a budget-constrained environment.

Considering these and other uses, the value of incorporating telematics data and insights into safety and enforcement applications on an on-going basis is apparent. Regardless of the specific implementation plan or program design, continuing to take a data-driven approach will be key to unlocking significant safety improvements. By integrating telematics data with enforcement planning, we can empower smarter and faster decision-making that will directly lead to improved safety on Washington's roadways.

APPENDIX

APPENDIX

Figures related to officer hours across the target and comparison corridors

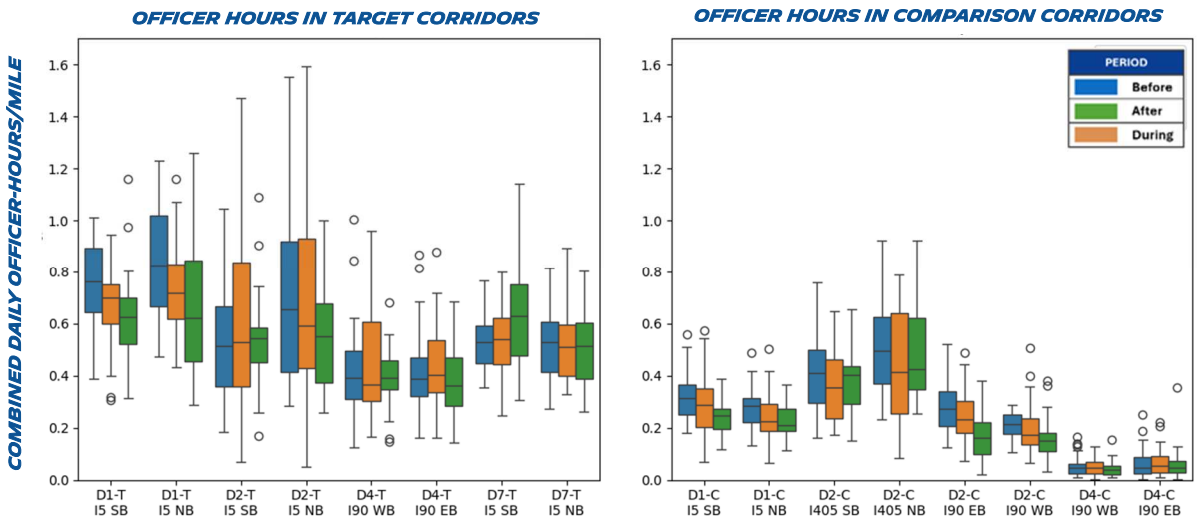

Figure 3: Range of daily officer-hours during each period in each corridor. Each box-and-whisker represents the distribution of officer hours in each corridor, showing the minimum, 25th percentile, median, 75th percentile, and maximum, along with any outliers.

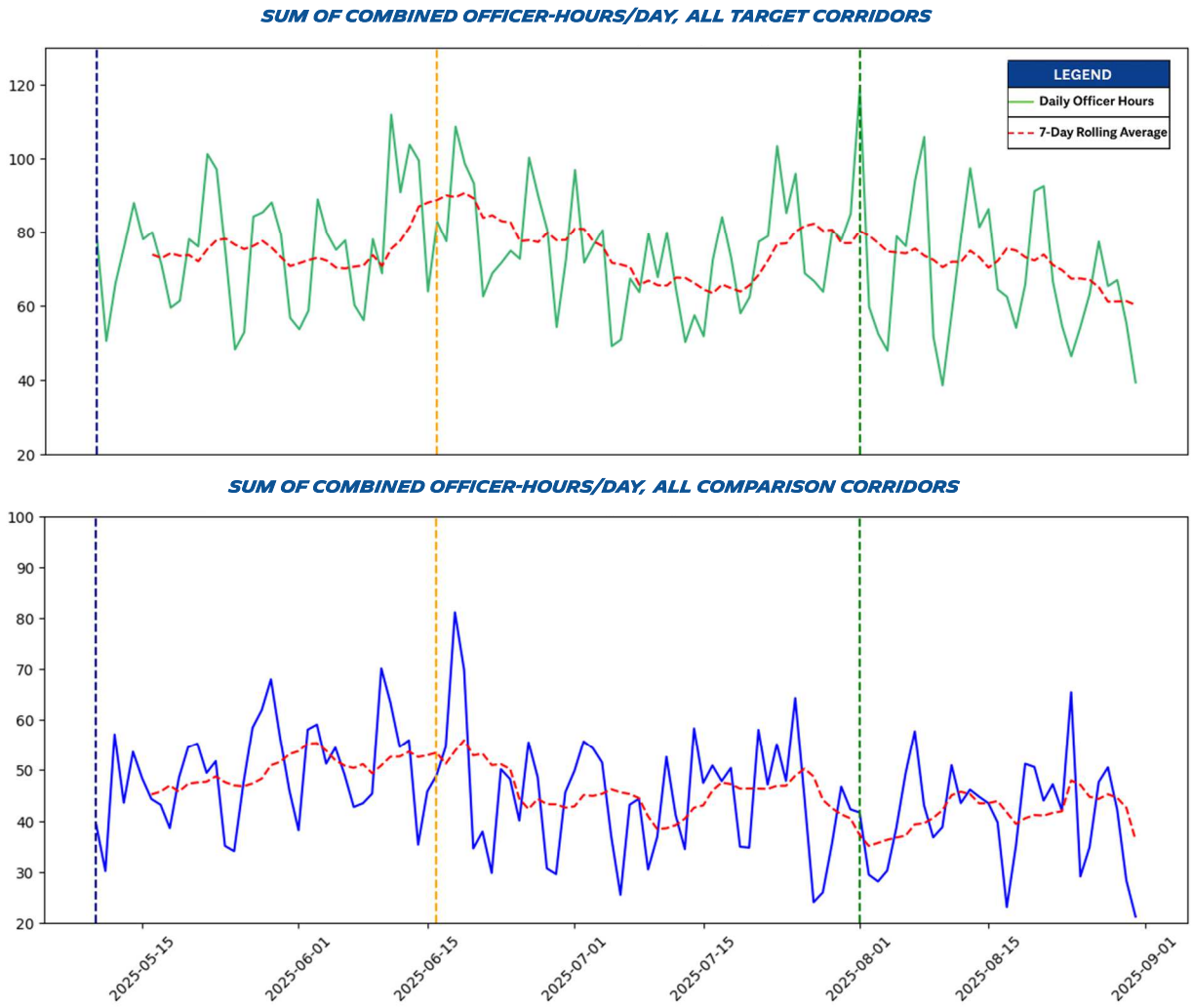

Figure 4 and Figure 5: *Trends over time in officer presence, added up across all target corridors in the first plot and across all comparison corridors in the second plot. Although there are certain periods of ramped-up presence in the target corridors, the overall trend in the target corridors looks fairly similar to the comparison corridors.*

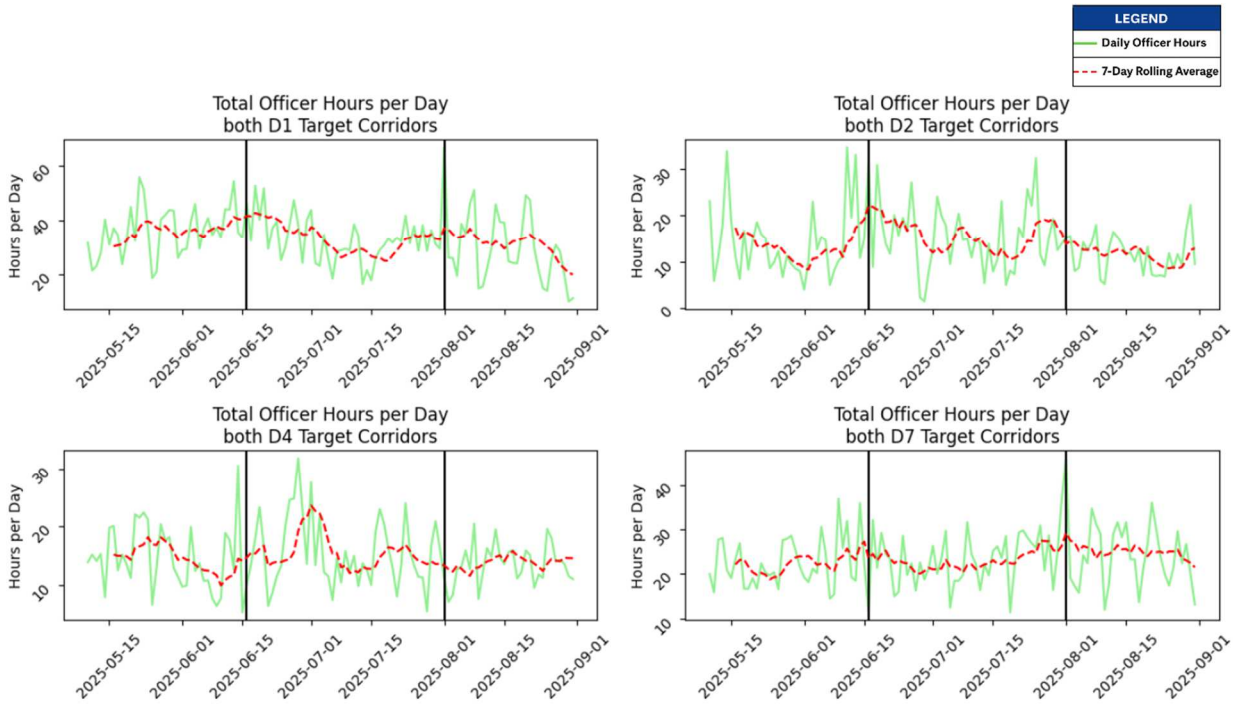

Figure 6: *Daily combined officer-hours over time by district, target corridors.*

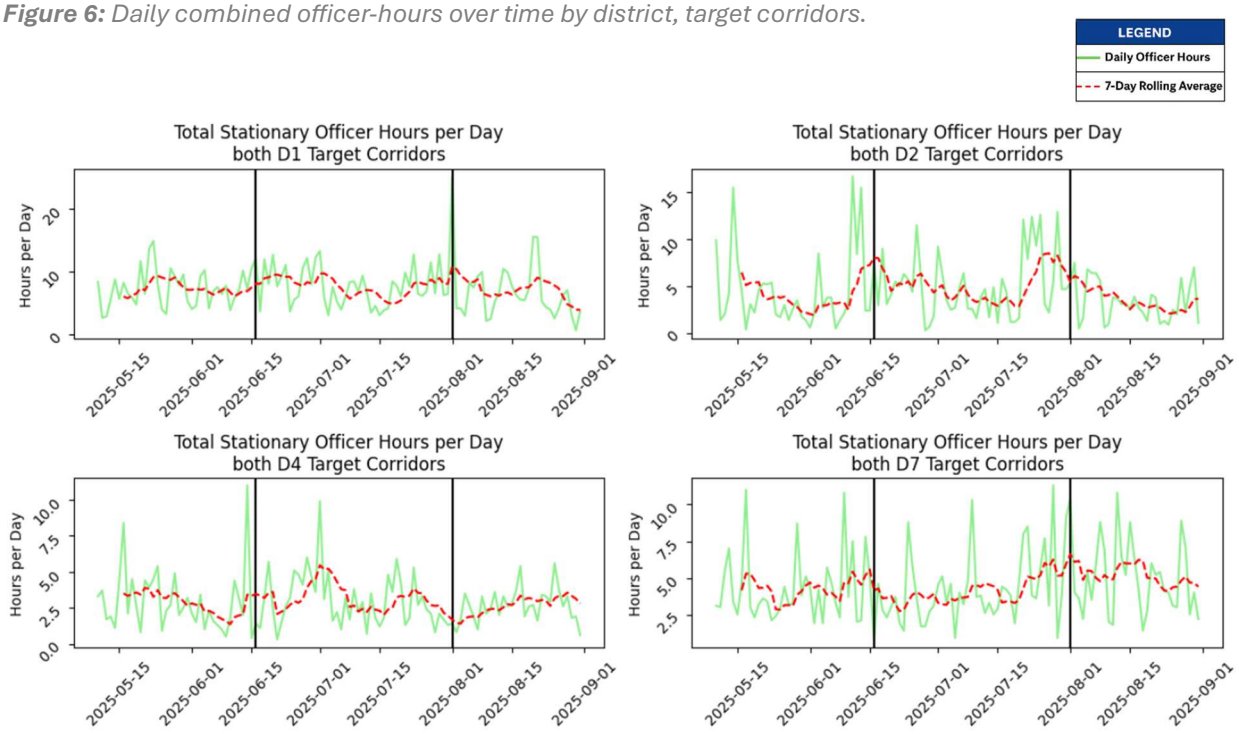

Figure 7: *Daily stationary officer-hours over time by district, target corridors.*

Conceptual overview of the hierarchical linear mixed model

The statistical model used in this analysis identifies relationships between multiple data points. The data points in this analysis take the form of a date, a corridor, an average speed, and a number of officer-hours per corridor-mile. Officer presence was normalized by mile, to account for the differing corridor lengths.

Each day for each corridor is one record in the dataset – so for 104 days in the before, during, and after period, and for 16 total corridors, the analysis dataset contains approximately 104 * 16, or 1664 day-corridor pairs.

A hierarchical model groups non-independent data points (in this case, by corridor) and identifies a specific relationship between data points within each group. This approach was chosen due to the different dynamics present in each corridor (namely, different speed limits, different lane counts in some areas, different traffic volumes and officer resources). The results of the hierarchical linear mixed model are helpful for understanding the magnitude of the effect of officer presence and how this relationship differs across corridors. Although this model is helpful to understanding which corridors saw the most responsiveness to officer presence, it is still a relatively simple model (only using one predictor, officer presence). A future analysis could incorporate other elements, such as traffic volume, to further explore other relationships that affect how effective targeted enforcement is on driver behavior.