An Impact of Safety Rest Area Closures on Fatigue-Related Highway Crashes in the Pacific Northwest 2021 – 2023

FINAL REPORT

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16. Abstract

Safety rest areas (SRAs) enable highway users to rest during trips. This study examined how SRA facility closures affect highway crashes, particularly those due to driver fatigue. The closures of three SRA facilities in Washington and two SRAs in Idaho were examined. The project team gathered information on SRA closures, mileage points, annual average daily traffic (AADT) of highway sections, and highway crashes from states and media outlets. The Washington State Department of Transportation and Idaho Transportation Department provided crash data, and crash information in these two states was correlated with SRA shutdowns. The numbers of crashes per month and per 10,000 AADT were used to compare crash rates before, during, and after the closures of SRA facilities. The results indicated no significant increase in fatigue-related accidents during the shutdown periods. However, total crash rates and fatigue-related crash rates rose in one location, decreased in another location, and did not change in another location during the closure times. Some extant literature has shown that fatigue-related events increase during SRA facility closures. The study highlighted the importance of SRA facilities in reducing driver fatigue and ensuring safer roads by shedding light on the correlation between SRA closures and highway crashes. The results may help policymakers create strategies for minimizing accidents caused by weariness and formulate regulations for SRA closures.

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EXECUTIVE SUMMARY

Safety rest areas (SRAs) provide a safe place for fatigued drivers to rest along highways. This research project investigated the effects of SRA facility closures on fatigue-related highway crashes in the Pacific Northwest region of the United States. The cases of three SRA facility closures in Washington and Idaho were examined. The primary objectives of this study were to identify the correlation between SRA closure and the number of crashes caused by fatigued driving, and to provide insights to help reduce highway crash rates due to fatigued driving.

The project team gathered information on SRA closures and highway accidents from Washington and Idaho. Data on SRA closures, including the durations and reasons for closure, were acquired from state agencies and news organizations. In addition, data on rest stops in Washington and Idaho were gathered, and a list of roads within a 90-minute driving distance of the closed SRAs was compiled. Crash data, including total and fatigue-related crashes, were gathered from state transportation departments.

Three closed facilities in Washington (Bow Hill SRA, Smokey Point SRA, and Silver Lake SRA) and two closed facilities in Idaho (Snake Riverview SRA and Huetter SRA) were studied. The overall crash rates per month, overall crash rates per month per 10,000 average annual daily traffic (AADT), fatigue-related crash rates per month, and fatigue-related crash rates per month per 10,000 AADT within a 90-minute drive upstream and downstream of the facility shutdowns were calculated and analyzed. These crash rates for the Washington Bow Hill, Smokey Point, and Silver Lake SRA facility shutdowns showed no-change between the shutdown period and before and after the shutdown period.

Similar calculations were performed for the Snake Riverview SRA and Huether SRA closures in Idaho. The crash rates per month and crash rates per month per 10,000 AADT decreased for the Snake Riverview SRA during the closure period in comparison to before and after the shutdown period. In contrast, the closure of the Huetter SRA in Idaho resulted in an increase in overall crashes and fatigue-related crashes during the closure period. These findings suggest that SRA facility closures may be correlated with an increase in fatigue-related incidents because fatigued drivers might continue to drive without resting.

The outcomes of this study indicated that SRA closures may influence highway safety, particularly fatigue-related crashes. The analysis indicated diverse patterns among various

locations, thereby highlighting the need for further research on the underlying variables influencing these outcomes.

The study highlights the importance of SRAs in reducing driver weariness and creating safer highways. The findings may help state transportation agencies develop rules and procedures for future SRA closure decisions. The overall safety of US highways may be enhanced for a broad spectrum of highway users by addressing the issue of fatigued driving and applying effective techniques to prevent crashes caused by fatigue.

Further research is needed to examine the causes of the observed trends and to develop viable methods for minimizing the effects of SRA closures on fatigue-related collisions. Efforts should also be made to strengthen reporting processes to provide reliable statistics on fatigue-related incidents.

Overall, this study contributes to the development of evidence-based policies and initiatives to decrease highway accidents caused by driver weariness, by providing valuable insights into the association between SRA closures and fatigue-related collisions.

CHAPTER 1: INTRODUCTION

1.1 Project Goal

According to the National Highway Traffic Safety Administration, in 2017 approximately 800 deaths and 100,000 police-reported crashes resulted in $12.5 billion in monetary losses due to fatigued driving in the Unites States (NHTSA 2020; NSF 2007). This research project addressed traffic safety by investigating the effects of shutting down safety rest area (SRAs) on fatigue-related highway crashes. This project made an essential step toward documenting the effects of SRA facility closures to better inform policymakers and to justify remedies to prevent highway incidents due to fatigue.

SRAs are state owned and operated off-road facilities where highway travelers can rest and mitigate driving tiredness or fatigue (Caltrans 2020). SRA facilities are considered to be an effective tool to protect highway users and help them arrive safely at their destinations. Yet studies have indicated that 10 to 20 percent of crashes (Banerjee et al. 2010; Feldman 2009; NCHRP 1989) and 12 percent of all near crashes (Feldman 2009) are caused by fatigued drivers in the United States (Sagberg 1999). In fact, driver fatigue can arise from several factors associated with SRA facilities. First, states often close SRAs for various reasons (Shrestha and Powers 2018), such as short-term closures for upgrades and maintenance or long-term closures because of a lack of funding. Prolonged driving as a result of SRA shutdown is a major reason for drivers' fatigue (Crizzle et al. 2020). Second, in some states, SRA facilities are inadequate to meet parking demand. In extreme cases, drivers in some states are unable to find an SRA parking spot 80 percent of the time (Koklanaris 2000) and are forced to continue driving to find another SRA facility. Third, although the recommended spacing between SRA facilities is approximately 50 miles (NCHRP 1989), drivers often must drive as many as 200 miles before reaching an SRA facility to rest.

Although SRA facilities are perceived as important infrastructure to reduce driver fatigue, several states have closed their SRA facilities because of budgetary shortfalls. Closing SRA facilities enables immediate cost savings but has long-term negative effects (Polansky and Galal 2019; Bergal 2017). A National Cooperative Highway Research Program (NCHRP) study estimated that the annual cost of fatigue-related crashes (due to a lack of parking availability at SRAs) is approximately half the total annual cost (including investments and operations) of SRA facilities (NCHRP 1989). According to studies by Shrestha (2021) and the NCHRP (1989), the

national average annual total cost is approximately $800,000 per SRA. Thus, the approximate economic loss due to closing an SRA is estimated to be $400,000 per year. The loss increases if other losses, such as increased additional travel, discomfort and inconvenience, and environmental pollution (air pollution), are also included. Nonetheless, studies assessing the effects of closing the SRA facilities on highway fatigue-related crashes have been limited. Accordingly, policymakers do not necessarily realize the effects of closures on accidents and fatalities, and therefore, they lack justification for exploring alternatives to short-term and long-term closures.

1.2 Research Background

In the United States, SRA facilities were introduced along highways in the early 1900s (Cardone 1965). They were constructed as part of the Interstate Highway System, whose construction began in 1956. More than 2,700 SRAs are found across the United States (NCHRP 1989). SRAs were envisioned as important facilities to allow highway users, particularly tired and weary drivers, to use restrooms and to rest before continuing their journey safely. A full-size SRA facility may provide several services, such as restrooms, parking, drinking water, picnic tables, free coffee, and tourist information. Studies have recommended that SRAs be spaced approximately 50 miles apart (NCHRP 1989). A study conducted in Minnesota found a decrease in the single-truck crash rate from 0.55 crashes per mile for segments 40 to 50 miles from the previous SRA to 0.45 crashes per mile for Interstate Highway segments 10 to 30 miles from the previous SRA (SRF 2007).

Washington state has 47 SRA facilities, 27 of which are located on the Interstate Highway System (I-5, I-82, I-820, and I-90) and are spaced 30 to 45 miles apart. Another 20 SRA facilities are located on state routes (e.g., US 12, US 82, US 195, SR 7, SR 8, SR 21, and SR 26) (WSDOT 2020). The Washington SRA facilities served more than 24.40 million road users in 2017, a number 4.40 million more than in 2008 (WSDOT 2018; WSDOT 2008).

The number of vehicle miles traveled (VMT) is increasing every year. In Washington state, VMT increased by more than 7 percent in the past decade (PSRC 2018). For the next 15 years, national VMT is forecasted to increase by 1.20 percent annually, and the increase is expected to exceed 6 percent in the coming decade (USDOT 2018). The increase in VMT consequently will potentially result in more tired drivers on highways and an increase in demand

for SRA facilities. Over the past several decades, owing to an increase in VMT, the number of SRA visitors has also increased in most states.

Although SRA facilities are a remedy for fatigue-related highway crashes, many states have closed some or all of their SRAs for various reasons (NBC 2009). A major reason has been budgeting issues (Helber 2009). In the past two decades, state budgetary constraints resulted in the closing of many SRA facilities for long time periods (several months to years). Some states closed two to four facilities, and several states closed between half and all the SRA facilities that they had been operating. For example, Connecticut closed all seven of its SRAs (Bergal 2017; Polansky and Galal 2019). Given the national average cost, the monetary cost of highway crashes due to closing of the seven Connecticut SRA facilities has been estimated to be approximately $2.80 million per year (Shrestha 2021; NCHRP 1989). Recently, Arizona, California, Florida, Georgia, New Mexico, Louisiana, Vermont, and Virginia closed several SRA facilities because of budgetary shortfalls (Shrestha 2021).

States also close their SRA facilities in the short term to conduct routine activities and perform repairs. The routine activities include inspections of electrical, plumbing, water, and wastewater systems and to repair defects, as required. Some routine activities, such as safety inspections of electrical and plumbing systems, require only short-term closures (less than one week). Other activities require longer closures (several months) to complete routine maintenance activities, such as fixing issues of wastewater seepage. For example, Idaho completely shut down its I-84 SRA facility because of a sewage leak in 2019 and reopened it temporarily after more than 10 months (King 2019). In another example, the Washington State DOT completely closed the Horn School SRA facility to fix its wastewater system in the summer of 2020. Figure 1.1 shows the Horn School (and rest area closed information) and Gee Creek SRA facilities in Washington's Eastern and Southwest regions, respectively.

Figure 1.1 Horn and Gee Creek Rest Area Closed for Routine Activities

Closing SRA facilities increases the distance or spacing between SRAs. In most cases, after an SRA facility has been closed, the increased spacing results in a lack of SRA facilities within the recommended spacing of approximately 50 miles (NCHRP 1989). Consequently, weary drivers are forced to continue driving for extended periods until they arrive at another stop facility. Figure 1.2 and Figure 1.3 show SRA facility shutdowns in Idaho and Kentucky, respectively. Several studies have indicated that spacing SRA facilities every 30 miles or less decreases crashes, thus supporting the hypothesis that closing SRA facilities may increase crashes and fatalities. However, this hypothesis has not been proved by evidence, and the extent of any effects of SRA closure is unknown. For instance, a study conducted in Minnesota demonstrated that spacing interstate SRAs by as many as 30 miles or increasing the number of parking spaces decreased truck fatigue-related crashes (SRF 2007). Another study conducted in California observed that the number of highway fatigue-related crashes decreased downstream of SRAs but increased again after approximately 30 miles from SRA facilities (Banerjee et al. 2010). Importantly, the purpose of this project was to identify a relationship between the closure of SRA facilities and the number of crashes due to fatigue, thus providing key information to support state DOT policy and planning managers.

Figure 1.2 SRA Facility Closed on I-84 in Idaho. Credit: King (2019)

Figure 1.3 SRA Facility Closed in Kentucky (I-64). Credit: Hitchcock (2018)

1.3 Research Objectives

The main objective of this study was to determine how SRA facility shutdowns affect the number of fatigue-related highway crashes. The study findings could aid in understanding the relationship between SRA facility shutdowns and the frequency of fatigue-related crashes on highways and, additionally, could assist states in developing policies regarding SRA facility closures or frameworks to decrease highway crashes due to driver fatigue. Ultimately, through

efforts to mitigate driving while drowsy, the US highways will become safer to a wide range of highway users.

CHAPTER 2: RESEARCH METHODOLOGY

After a review of previous work, this study collected SRA facility shutdown data for the states of Washington and Idaho in the past decade. With this information, highway data in the vicinity of SRA shutdowns and crash data from the Washington State Department of Transportation (WSDOT) and the Idaho Transportation Department (ITD) were collected. Figure 2.1 presents an overview of the research approach used in this study. The collected crash data were analyzed, and the crash rates were calculated and compared. Finally, on the basis of the findings, conclusions were drawn.

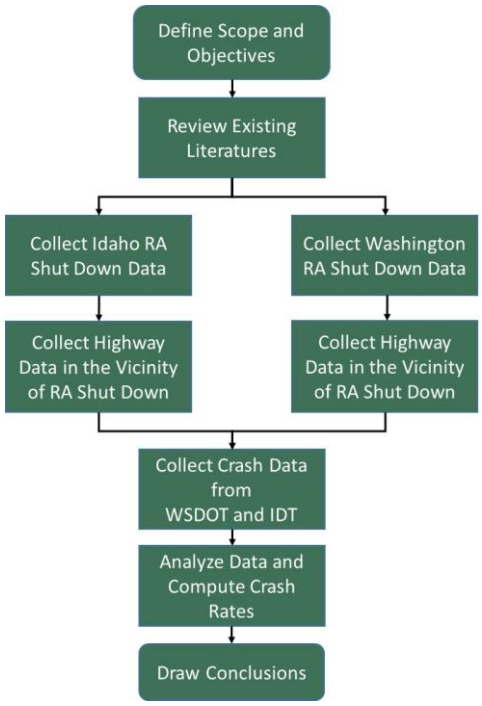

Figure 2.1 Overview of the Research Approach

2.1 SRA Shutdowns

First, SRA shutdown data were collected from states and/or news available online. SRA shutdowns ranging from one week to several months were considered in this project. Some SRA facilities that were shut down for very short periods, such as a few days, were not considered in

the analysis. Three SRA facilities in the state of Washington on I-5 that were recently closed for several months were examined in this project. Similarly, two SRA facilities in two different locations in Idaho that were closed for several months were included in this project. State agencies provided the details of the SRA shutdowns, such as the name of the SRA that was closed, the shutdown period, and the main reason(s) for closing the SRA facilities.

2.2 Highway Data in the Vicinity of SRA Shutdown

After the SRA facility shutdown data were collected, highway data in the vicinity of SRA shutdowns were gathered. The project team examined SRAs within two states in the Pacific Northwest region: Washington and Idaho. The SRAs examined in the state of Idaho were the Snake Riverview and the Huetter SRA facilities. Snake Riverview is on I-84 near Fruitland, Idaho, and Huetter is on I-90 near Post Falls, Idaho. Similarly, three SRAs were examined in the state of Washington: Bow Hill, Smokey Point, and Silver Lake on I-5. The Bow Hill SRA is near Burlington, the Smokey point SRA is near Arlington, and the Silver Lake SRA is near Mill Creek.

Subsequently, a list of highways was compiled, including their mile posts (MPs), up to a 90-minute drive downstream of an SRA shutdown location. Figure 2.2 presents a picture of I-5 (in Washington state) within approximately 90 minutes' driving distance downstream of the SRA shutdown locations.

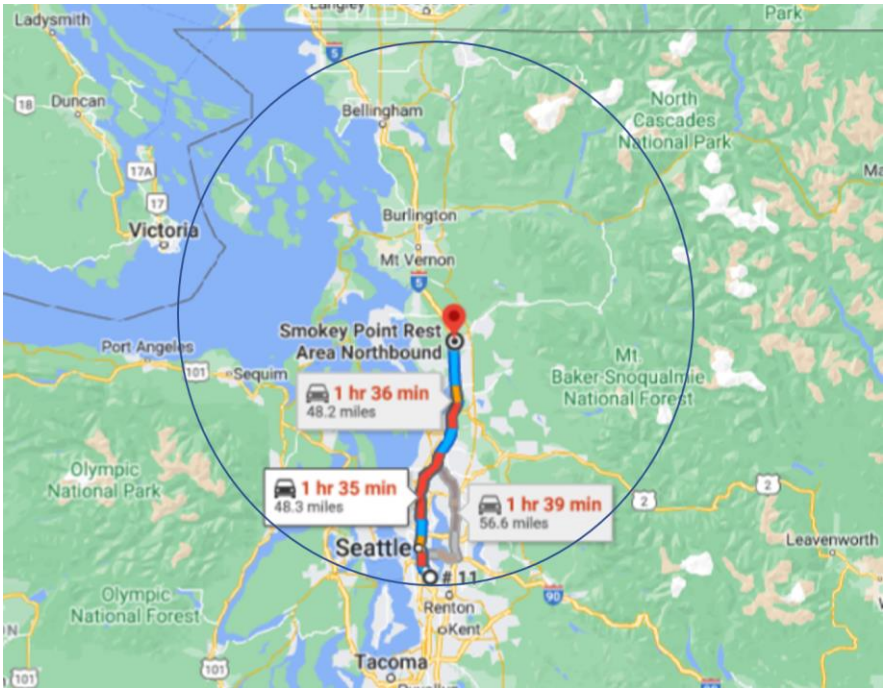

Figure 2.2 Area Within a 90-Minute Drive of the SRA Facility Shutdowns

To identify the MPs of the Washington highways, the WSDOT GeoPortal (WSDOT 2023a), WSDOT MP maps (WSDOT 2023b), and Google Maps were used. For Idaho highways, the project team used IDT mile logs as well as Google Maps to track MPs. Table 2.1 presents the names of the highways and their MP information for both Washington and Idaho.

Table 2.1 Highways with MP Information Considered Near SRA Shutdowns

S.N.	Washington		S.N.	Idaho	
	Name of Highway	**Section (MP-MP)**		**Name of Highway**	**Section (MP-MP)**
1.	I-5		1.	I-84	0-62
2.	I-90	2-53	2.	US-95	0-120
3.	I-405	0-30	3.	US-30	21-31
4.	US-2	0-49	4.	US-20	9-53
5.	WA 532	0-10	5.	SH-78	0-60
6.	WA-9	0-96	6.	SH-69	1-9
7.	WA-11	0-20	7.	SH-55	0-17
8.	WA-20	54-109	8.	SH-55	45-65
9.	WA-530	17-67	9.	SH-52	0-54
10.	WA-534	0-5	10.	SH-45	10-28
11.	WA-538	0-3	11.	SH-44	0-22
12.	WA-542	0-10	12.	SH-21	0-40
13.	WA-536	0-5	13.	SH-19	0-20
14.	WA-546	0-8	14.	SH-16	98-114
15.	WA-544	0-9	15.	I-90	0-74
16.	WA-539	0-12	16.	US-95	371-490
17.	WA-504	0-27	17.	SH-200	30-60
18.	WA-167	0-26	18.	SH-97	61-96
19.	WA-169	0-25	19.	SH-41	0-39
20.	WA-164	0-14	20.	SH-4	0-7
21.	WA-99	0-55	21.	SH-3	80-118
22.	WA-18	0-27.9			
23.	WA-202	0-30			
24.	WA-203	0-24			
25.	WA-520	0-12			
26.	WA-522	0-24			

2.3 Crash Data Collection

The project team collected crash data from the WSDOT Head Office in Olympia, Washington, through the Public Disclosure Request Center (WSDOT 2023c). For the segments of highways listed in Table 2.1, the project team requested overall crash data, including fatigue-related crashes and crash data from a few months before and after the SRA facility shutdown. A total of 47 SRA facilities are in operation in six regions of Washington state: eight in the Northwest, six in the North Central area, four in Olympia, eight in the Southwest, twelve in the

South Central area, and nine in the Eastern region. Figure 2.3 presents these six regions of Washington state. Three of the 47 SRAs—Bow Hill, Smokey Point, and Silver Lake—were shut down for several months.

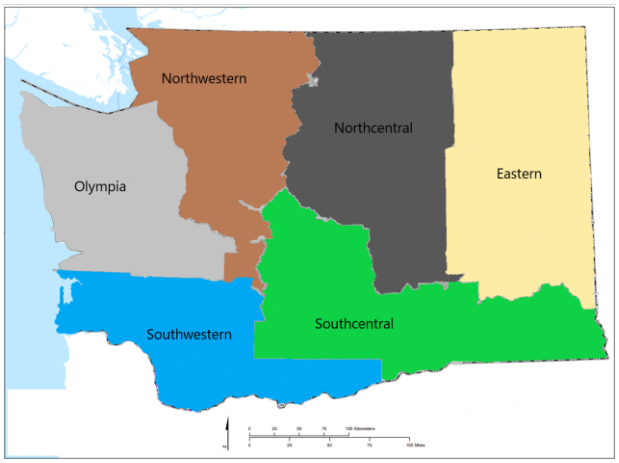

Figure 2.3 Six Regions in Washington State.

Idaho contains seven regions: the Panhandle, Clearwater, Southwest, Salmon, Magic Valley, Upper Snake, and Southeast. Figure 2.4 represents the seven regions. In Idaho, 22 SRAs are operated. In this project, the project team considered two SRA facilities that were closed for several weeks, Snake Riverview on I-84 and Huetter on I-90. The Snake Riverview SRA closed from August 2019 to June 2020, and the Huetter SRA facility closed from August 2021 to October 2021.

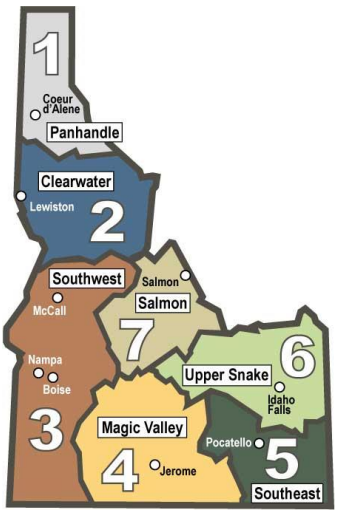

Figure 2.4 Seven Regions in Idaho State.

For the highway networks presented in Table 2.1, raw crash data were requested from the WSDOT and ITD. The project team collected grouped the data into periods before SRA closure, during SRA closure, and after SRA closure. From the crash data, the total numbers of crashes and fatigue-related crashes before, during, and after the shutdowns were calculated and compared. The findings are presented in Chapter 3.

CHAPTER 3: FINDINGS AND DISCUSSION

To investigate the effects of SRA facility closure on highway accidents, the project team collected crash report data from Washington and Idaho. This project analyzed and compared crash rates to determine whether any evidence indicated that closing SRA facilities affected the crash rates on highways. For the data analysis, data regarding SRA facility shutdown, shutdown period, network of highways with MP information, annual average daily traffic (AADT) information, and crashes were collected. The results of the analysis of the datasets are presented and discussed in the following sub-sections. Table 3.1 presents the names of the SRA facilities, their locations, and shutdown and crash data collection periods.

Table 3.1 SRA Facilities—Shutdown and Data Collection Periods

SRA Facility	**Location**	**Shutdown Periods**	**Crash Data Collection Period**
Bow Hill, Smokey Point, Silver Lake SRAs	I-5, Washington	10/15/2021 – 6/30/2022	10/01/2020 - 4/30/2023
Snake Riverview Welcome Center	I-84, Idaho	8/21/2019 – 7/1/2020	7/01/ 2018 – 7/01/2021
Huetter SRA	I-90, Idaho	8/20/ 2021 – 10/02/2021	7/01/ 2020 – 06/24/2022

3.1 Washington State

As explained in the research methodology section, the project team first compiled a list of highways within a driving distance of approximately 90 minutes from the SRA shutdown locations. Table 3.2 presents the list of highways with their MP information and AADT for the three SRA facility closures in Washington state. The crash rate per month within a 90-minute drive upstream and downstream of the closed SRA facilities on I-5 during the SRA shutdown period of October 15, 2021, to June 30, 2022, was 818.59; the crash rates were 731.28 before and 615.50 after the facility shutdown. In addition, because the number of crashes might have been affected by highway AADT, the number of crashes per month per 10,000 AADT was calculated. The numbers of total crashes per month per 10,000 AADT were 308.95 before, 345.84 during, and 253.15 after the SRA shutdown. These findings indicated that the SRA closures were associated with an approximately 12 percent increase in the overall crash rate per month per 10,000 AADT.

Similar calculations were performed to analyze the numbers of fatigue-related crashes for the same highway sections. The numbers of fatigue-related crash rates per month were 24.96 before, 24.24 during, and 11.90 after the SRA facility shutdown periods, and the fatigue-related crash rates per month per 10,000 AADT were 10.55 before, 10.24 during, and 4.89 after. These findings demonstrated that whereas overall crash rates increased, fatigue-related crashes did not increase during the SRA facility shutdown period. This may have been because of incorrect reporting or a lack of reporting by some fatigued drivers. Previous studies have shown that fatigue-related accidents increase when SRA facilities are shut down.

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Table 3.2 Crash Analysis for Bow Hill, Smokey Point, and Silver Lake SRA Shutdowns on I-5, Washington

Highway	Section (MP-MP)	AADT	Duration	No. of Incidents (All Types)			No. of Incidents (Fatigue-Related)		
				Total No.	Per Month	Per 10k AADT	Total No.	Per Month	Per 10k AADT
I-5		107,882	Before SD	-	-	-	132	22.10	2.05
		107,882	During SD	-	-	-	102	12.10	1.11
		112,353	After SD	-	-	-	-	-	-
I-90	2-53	55,100	Before SD	718	57.44	10.42	24	1.92	0.35
		55,100	During SD	608	71.53	12.98	6	0.71	0.13
		55,400	After SD	528	52.80	9.53	8	0.80	0.14
I-405	0-30	111,857	Before SD	1701	136.08	12.17	24	1.92	0.17
		111,857	During SD	1366	160.71	14.37	18	2.12	0.19
		115,429	After SD	1319	131.90	11.43	18	1.80	0.16
US-2	0-49	12,700	Before SD	418	33.44	26.33	12	0.96	0.76
		12,700	During SD	302	35.53	27.98	3	0.35	0.28
		12,067	After SD	263	26.30	21.80	5	0.50	0.41
WA 532	0-10	17,500	Before SD	91	7.28	4.16	4	0.32	0.18
		17,500	During SD	79	9.29	5.31	3	0.35	0.20
		18,000	After SD	60	6.00	3.33	5	0.50	0.28
WA-9	0-96	10,067	Before SD	528	42.24	41.96	17	1.36	1.35
		10,067	During SD	404	47.53	47.21	8	0.94	0.93
		10,017	After SD	326	32.60	32.55	8	0.80	0.80
WA-11	0-20	5,620	Before SD	57	4.56	8.11	2	0.16	0.28
		5,620	During SD	36	4.24	7.54	1	0.12	0.21
		5,800	After SD	24	2.40	4.14	0	0.00	0.00
WA-20	54-109	10,633	Before SD	292	23.36	21.97	7	0.56	0.53
		10,633	During SD	222	26.12	24.56	8	0.94	0.89

Highway	Section (MP-MP)	AADT	Duration	No. of Incidents (All Types)			No. of Incidents (Fatigue-Related)		
				Total No.	Per Month	Per 10k AADT	Total No.	Per Month	Per 10k AADT
		10,617	After SD	172	17.20	16.20	8	0.80	0.75
WA-530	17-67	2,650	Before SD	97	7.76	29.28	7	0.56	2.11
		2,650	During SD	74	8.71	32.85	1	0.12	0.44
		2,600	After SD	81	8.10	31.15	4	0.40	1.54
WA-534	0-5	3,450	Before SD	13	1.04	3.01	2	0.16	0.46
		3,450	During SD	7	0.82	2.39	0	0.00	0.00
		3,425	After SD	1	0.10	0.29	0	0.00	0.00
WA-538	0-3	14,925	Before SD	110	8.8	5.90	0	0.00	0.00
		14,925	During SD	64	7.53	5.04	0	0.00	0.00
		15,450	After SD	58	5.80	3.75	1	0.10	0.06
WA-542	0-10	13,717	Before SD	90	7.2	5.25	4	0.32	0.23
		13,717	During SD	54	6.35	4.63	2	0.24	0.17
		13,700	After SD	51	5.10	3.72	1	0.10	0.07
WA-536	0-5	8,500	Before SD	42	3.36	3.95	0	0.00	0.00
		8,500	During SD	21	2.47	2.91	0	0.00	0.00
		8,520	After SD	24	2.40	2.82	1	0.10	0.12
WA-546	0-8	7,125	Before SD	26	2.08	2.92	0	0.00	0.00
		7,125	During SD	14	1.65	2.31	1	0.12	0.17
		7,100	After SD	17	1.70	2.39	0	0.00	0.00
WA-544	0-9	7,733	Before SD	34	2.72	3.52	0	0.00	0.00
		7,733	During SD	34	4.00	5.17	1	0.12	0.15
		7,633	After SD	33	3.30	4.32	1	0.10	0.13
WA-539	0-12	20,740	Before SD	188	15.04	7.25	3	0.24	0.12
		20,740	During SD	126	14.82	7.15	0	0.00	0.00
		20,540	After SD	144	14.40	7.01	0	0.00	0.00
WA-504	0-27	3,047	Before SD	40	3.2	10.50	0	0.00	0.00
		3,047	During SD	25	2.94	9.65	2	0.24	0.77
		3,032	After SD	44	4.40	14.51	3	0.30	0.99
WA-167	0-26	80,667	Before SD	934	74.72	9.26	26	2.08	0.26
		80,667	During SD	687	80.82	10.02	13	1.53	0.19
		82,333	After SD	539	53.90	6.55	18	1.80	0.22
WA-169	0-25	19,667	Before SD	210	16.8	8.54	5	0.40	0.20
		19,667	During SD	150	17.65	8.97	3	0.35	0.18
		19,683	After SD	131	13.10	6.66	3	0.30	0.15
WA-164	0-14	14,940	Before SD	183	14.64	9.80	4	0.32	0.21
		14,940	During SD	156	18.35	12.28	4	0.47	0.31
		15,240	After SD	133	13.30	8.73	3	0.30	0.20

Highway	Section (MP-MP)	AADT	Duration	No. of Incidents (All Types)			No. of Incidents (Fatigue-Related)		
				Total No.	Per Month	Per 10k AADT	Total No.	Per Month	Per 10k AADT
WA-99	0-55	25,833	Before SD	2021	161.68	62.59	19	1.52	0.59
		25,833	During SD	1516	178.35	69.04	14	1.65	0.64
		26,000	After SD	1359	135.90	52.27	12	1.20	0.46
WA-18	0-27.9	37,167	Before SD	351	28.08	7.56	9	0.72	0.19
		37,167	During SD	292	34.35	9.24	6	0.71	0.19
		37,333	After SD	255	25.50	6.83	3	0.30	0.08
WA-202	0-30.5	17,733	Before SD	221	17.68	9.97	2	0.16	0.09
		17,733	During SD	166	19.53	11.01	1	0.12	0.07
		18,083	After SD	173	17.30	9.57	4	0.40	0.22
WA-203	0-24	11,133	Before SD	79	6.32	5.68	1	0.08	0.07
		11,133	During SD	78	9.18	8.24	4	0.47	0.42
		11,283	After SD	55	5.50	4.87	2	0.20	0.18
WA-520	0-12	53,400	Before SD	376	30.08	5.63	0	0.00	0.00
		53,400	During SD	197	23.18	4.34	0	0.00	0.00
		61,400	After SD	135	13.50	2.20	3	0.30	0.05
WA-522	0-24	25,833	Before SD	321	25.68	9.94	8	0.64	0.25
		25,833	During SD	280	32.94	12.75	5	0.59	0.23
		27,167	After SD	230	23.00	8.47	8	0.80	0.29
Average; Total		**23,669**	**Before SD**	**9,141**	**731.28**	**308.95**	**312**	**24.96**	**10.55**
Average; Total		**23,669**	**During SD**	**6,958**	**818.59**	**345.84**	**206**	**24.24**	**10.24**
Average; Total		**24,314**	**After SD**	**6,155**	**615.50**	**253.15**	**119**	**11.90**	**4.89**

3.2 Idaho State

Following the same procedures used for the Washington data, the overall crash rate per month and crash rate per month per 10,000 AADT were calculated for all types of crashes and for fatigue-related crashes for Idaho highway sections. Table 3.3 presents the list of highways with their MP and AADT information for the Snake Riverview Welcome Center SRA shutdown.

The overall crash rates per month within a 90-minute drive downstream of the closed SRA were 205.38 before, 171.56 during, and 219.25 after the SRA facility shutdown. Similarly, the numbers of crashes per month per 10,000 AADT were 143.64 before, 121.06 during, and 146.85 after the SRA shutdown.

To analyze the number of fatigue-related accidents for the same highway sections, the project team performed similar computations. Fatigue-related accident rates per month were 6.84

before, 4.89 during, and 7.33 after the SRA shutdown period, and fatigue-related accident rates per 10,000 AADT were 4.78 before, 3.45 during, and 4.91 after. These results indicated that accidents due to weariness did not increase during the SRA shutdown, possibly as a result of incorrect or incomplete reporting, given that other research has indicated that the closure of SRA facilities increases the number of fatigue-related incidents.

Table 3.3 Crash Analysis for Snake Riverview Welcome Center SRA Shutdown on I-84, Idaho

Highway	Section (MP-MP)	AADT	Duration	Number of Incidents (All Types)			Number of Incidents (Fatigue-Related)		
				Total No.	Per Month	Per 10k AADT	Total No.	Per Month	Per 10k AADT
I-84E	0-62	49,464	Before SD	413	30.04	6.07	14	1.02	0.21
		47,857	During SD	297	26.40	5.52	8	0.71	0.15
		49,036	After SD	414	34.50	7.04	7	0.58	0.12
I-84W	0-62	49,464	Before SD	502	36.51	7.38	19	1.38	0.28
		47,857	During SD	308	27.38	5.72	6	0.53	0.11
		49,036	After SD	511	42.58	8.68	18	1.50	0.31
US-95	0-120	3,729	Before SD	226	16.44	44.08	9	0.65	1.76
		3,800	During SD	141	12.53	32.98	14	1.24	3.27
		4,107	After SD	233	19.42	47.28	21	1.75	4.26
US-30	21-31	3,490	Before SD	16	1.16	3.33	3	0.22	0.63
		3,750	During SD	11	0.98	2.61	1	0.09	0.24
		4,040	After SD	15	1.25	3.09	0	0.00	0.00
US-20	9-53	16,400	Before SD	762	55.42	33.79	12	0.87	0.53
		15,800	During SD	494	43.91	27.79	9	0.80	0.51
		16,300	After SD	489	40.75	25.00	14	1.17	0.72
SH-78	0-60	1,199	Before SD	22	1.60	13.34	1	0.07	0.61
		1183	During SD	23	2.04	17.28	1	0.09	0.75
		1,218	After SD	31	2.58	21.21	2	0.17	1.37
SH-69	1-9	22,250	Before SD	138	10.04	4.51	4	0.29	0.13
		23,650	During SD	85	7.56	3.19	1	0.09	0.04
		24,950	After SD	120	10.00	4.01	2	0.17	0.07
SH-55	0-17	8,900	Before SD	149	10.84	12.18	6	0.44	0.49
		8,779	During SD	113	10.04	11.44	3	0.27	0.30
		9,850	After SD	192	16.00	16.24	1	0.08	0.08
SH-55	45-65	8,900	Before SD	34	2.47	2.78	2	0.15	0.16
		8,779	During SD	29	2.58	2.94	1	0.09	0.10
		9,850	After SD	51	4.25	4.31	3	0.25	0.25
SH-52	0-54	2,592	Before SD	95	6.91	26.66	8	0.58	2.24
		2,608	During SD	48	4.27	16.36	0	0.00	0.00
		2,958	After SD	73	6.08	20.56	2	0.17	0.56
SH-45	10-28	6,138	Before SD	111	8.07	13.15	0	0.00	0.00
		6,188	During SD	84	7.47	12.07	3	0.27	0.43
		6,550	After SD	121	10.08	15.39	4	0.33	0.51
SH-44	0-22	18,650	Before SD	222	16.15	8.66	3	0.22	0.12
		18,110	During SD	140	12.44	6.87	2	0.18	0.10
		19,710	After SD	207	17.25	8.75	4	0.33	0.17
SH-21	0-40	4,436	Before SD	50	3.64	8.20	1	0.07	0.16
		5,555	During SD	39	3.47	6.24	2	0.18	0.32
		6,552	After SD	62	5.17	7.89	4	0.33	0.51
SH-19	0-20	7,551	Before SD	1	0.07	0.10	4	0.29	0.39
		7,399	During SD	67	5.96	8.05	2	0.18	0.24
		7,852	After SD	45	3.75	4.78	4	0.33	0.42

Highway	Section (MP-MP)	AADT	Duration	Number of Incidents (All Types)			Number of Incidents (Fatigue-Related)		
				Total No.	Per Month	Per 10k AADT	Total No.	Per Month	Per 10k AADT
SH-16	98-114	11,313	Before SD	83	6.04	5.34	8	0.58	0.51
		11,250	During SD	51	4.53	4.03	2	0.18	0.16
		11,938	After SD	67	5.58	4.68	2	0.17	0.14
Average; Total		**14,298**	**Before SD**	**2824**	**205.38**	**143.64**	**94**	**6.84**	**4.78**
Average; Total		**14,171**	**During SD**	**1930**	**171.56**	**121.06**	**55**	**4.89**	**3.45**
Average; Total		**14,930**	**After SD**	**2631**	**219.25**	**146.85**	**88**	**7.33**	**4.91**

Through a method similar method to that described in the earlier analysis, the crash rates per month and crash rates per month per 10,000 AADT were computed for overall and fatigue-related crashes. The list of highways, with their MP and AADT data, for the Huetter SRA facility shutdown on I-90 in Idaho is shown in Table 3.4.

The overall crash rates within a 90-minute drive downstream of the closed SRA were 97.45 before, 104.26 during, and 105.49 after the SRA shutdown. Similar results were obtained when the numbers of monthly crash rates per 10,000 AADT were computed. Overall crash rates per month per 10,000 AADT were 133.79 before, 135.62 during, and 134.85 after the SRA facility shutdown.

The fatigue-related accident rates per month for the same highway sections were 2.47 before, 6.38 during, and 2.74 after the SRA facility shutdown period, and the fatigue-related accident rates per 10,000 AADT were 3.39 before, 8.30 during, and 3.51 after, respectively. These findings strongly indicated that, both the overall crash rates and crash rates due to fatigue increased during the SRA facility shutdown, possibly because fatigued drivers might not have been able to rest and instead continued to drive without stopping. Previous studies have revealed that when SRA facilities are closed, the number of incidents associated with fatigue increases on highways.

Table 3.4 Crash Analysis for Huetter SRA Shutdown on I-90, Idaho

Highway	Section (MP-MP)	AADT	Duration	No. of Incidents (All Types)			No. of Incidents (Fatigue-Related)		
				Total No.	Per Month	Per 10k AADT	Total No.	Per Month	Per 10k AADT
I-90	0-73.8	22,850	Before SD	441	32.07	14.04	15	1.09	0.48
		24,000	During SD	49	34.75	14.48	3	2.13	0.89
		24,600	After SD	346	39.54	16.07	8	0.91	0.37
US-95	371 - 490	11,000	Before SD	507	36.87	33.52	13	0.95	0.86
		11,567	During SD	63	44.68	38.63	4	2.84	2.45

		11,783	After SD	375	42.86	36.37	9	1.03	0.87
SH-200	30 – 60	3,730	Before SD	68	4.95	13.26	2	0.15	0.39
		3,980	During SD	9	6.38	16.04	0	0.00	0.00
		3,900	After SD	45	5.14	13.19	3	0.34	0.88
SH-97	61 – 96	1,196	Before SD	39	2.84	23.72	1	0.07	0.61
		1,438	During SD	5	3.55	24.66	0	0.00	0.00
		1,710	After SD	17	1.94	11.36	1	0.11	0.67
SH-41	0-39	9,630	Before SD	219	15.93	16.54	2	0.15	0.15
		10,180	During SD	19	13.48	13.24	2	1.42	1.39
		10,260	After SD	98	11.20	10.92	1	0.11	0.11
SH-4	0-7	502	Before SD	1	0.07	1.45	0	0.00	0.00
		508	During SD	0	0.00	0.00	0	0.00	0.00
		504	After SD	2	0.23	4.54	0	0.00	0.00
SH-3	80-118	2,080	Before SD	65	4.73	22.73	1	0.07	0.35
		2,140	During SD	2	1.42	6.63	0	0.00	0.00
		2,000	After SD	40	4.57	22.86	2	0.23	1.14
Average; Total		**7,284**	**Before SD**	**1340**	**97.45**	**133.79**	**34**	**2.47**	**3.39**
Average; Total		**7,688**	**During SD**	**147**	**104.26**	**135.62**	**9**	**6.38**	**8.30**
Average; Total		**7,822**	**After SD**	**923**	**105.49**	**134.85**	**24**	**2.74**	**3.51**

CHAPTER 4: CONCLUSIONS

This study investigated how SRA closures affected the numbers of highway crashes due to driver fatigue. Understanding the correlation between SRA facility shutdowns and the prevalence of fatigue-related collisions was the goal of this project, to guide policy development and decrease fatigue-related accidents.

The project team gathered data on SRA closures and highway crashes from the states of Idaho and Washington and compared the numbers of total monthly crashes and crashes due to fatigue before, during, and after the closure of SRA facilities. In addition, the numbers of crashes per 10,000 AADT were calculated by considering the AADT on the highway sections.

Three SRA facilities in Washington state were closed between October 15, 2021, and June 30, 2022,: Bow Hill, Smokey Point, and Silver Lake. Data analysis indicated that the overall crash rates per month were higher during the closure period than before and after. However, the numbers of fatigue-related crash rates did not increase during the shutdown time, possibly because of underreporting by tired drivers or insufficient data gathering. Previous research has indicated that closing SRA facilities increases the number of fatigue-related accidents.

Analysis of the Snake Riverview Welcome Center SRA closure on I-84 in Idaho yielded results similar to those in Washington. During the closure period, August 2019 to June 2020, the overall crash rates per month, crash rates per month per 10,000 AADT, and fatigue-related crash rates per month and per month per 10,000 AADT did not increase. Again, this finding may have been due to reporting errors or insufficient data collection. According to other studies, the closure of SRA facilities correlates with an increase in fatigue-related incidents.

In contrast, the project results showed that the overall and fatigue-related crash rates per month and crash rates per month per 10,000 AADT increased significantly during the August 2021 to October 2021shutdown of the Huetter SRA facility on I-90 in Idaho. Vehicles may have continued to travel without stopping when SRA facilities were shut down. Previous research has suggested that the closure of SRA facilities increases the number of fatigue-related highway crashes.

Overall, the study findings provide valuable information on the influence of SRA closures on crash rates induced by driver weariness. The results additionally highlight the importance of SRA facilities in reducing driving fatigue and enhancing road safety. The study's

findings may help state DOTs draft regulations for SRA closures and formulate strategies to decrease fatigue-related crashes in the future.

Policymakers and transportation agencies may improve highway safety by analyzing the correlation between SRA facility closures and crash rates. This study emphasized the need to prioritize steps to reduce driver fatigue and ensure the availability of suitable rest spaces (or provide alternative facilities) for the traveling public. Finally, American highways will become safer for a wide range of highway users if drowsy driving is reduced.

To advance the field, future studies should investigate additional factors that affect fatigue-related collisions, such as driver demographics, time of day, and specific highway conditions. Comprehensive research investigating the effectiveness of SRA sites, design, and amenities at minimizing fatigue-related accidents would also provide valuable insights for transportation planning and infrastructure development.

Finally, the findings of this study add to the expanding body of evidence indicating an association between SRA closures and highway crashes due to driver fatigue. Highway rest facilities are extremely important for reducing fatigue-related accidents. The transportation sector may endeavor to create safer highways and reduce the hazards connected with fatigued driving through further research and informed policymaking.

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