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MEMORANDUM

Date: September 13, 2024

To: Scott Neidert, DelDOT HSIP Manager
Lei Xu, DelDOT Statewide Contracts Manager

From: Adam Weiser, WRA

Subject: High Friction Surface Treatment Before/After Analysis

In 2013, the Delaware Department of Transportation (DelDOT) implemented a trial installation of high friction surface treatment (HFST). This treatment is a pavement overlay treatment that utilizes a binder material and high-quality polish-resistant aggregate and is designed to provide improved friction in areas where friction demand is higher or has been lost due to pavement degradation. HFST is primarily used on curves, on interchange ramps, and on approaches to signal-controlled or stop-controlled intersections. The treatment provides for a safety countermeasure that can address wet-surface condition related crashes, typically roadway departure or rear-end crashes. Twenty-two (22) additional HFST locations were implemented in 2015 and 2016, with initial before/after crash analyses identifying the following trends:

- At all but one location, the number of wet-weather roadway departure crashes per year decreased.
- At 19 of 23 locations, zero wet-weather roadway departure crashes were reported during the after period (which ranged from approximately 5 months to 18 months).
- The total number of wet-weather crashes per year decreased at 91% of the locations and by an overall average of 55%.
- The total number of crashes per year decreased at 70% of the locations and by an overall average of 21%.
- The total number of roadway departure crashes per year decreased at 83% of the locations and by an overall average of 56%.

Since the completion of this before/after crash analysis, DelDOT has implemented several new HFST installations, with a total of 44 locations throughout the state receiving HFST. The following provides an updated before/after crash analysis for all 44 locations.

Site Selection

The majority of the locations where HFST has been installed were selected based on a systemic analysis of risk factors that would be improved by the installation of HFST. The Delaware Strategic Highway Safety Plan identifies various emphasis areas to focus safety improvements including addressing roadway departure crashes and intersection-related crashes. Within each emphasis area, several risk factors are identified that can range from road type (functional classification) curve vs. tangent sections of roadway, area type (urban vs. rural) and surface conditions to name a few. In the case of the majority of HFST sites, locations were selected based on a systemic analysis of two-lane rural collector and local roadways that exhibited a higher than average frequency of wet-weather related crashes, including wet-weather roadway departure crashes. Potential sites were ranked according to their wet-weather crash rates and then pavement conditions were assessed to confirm that locations were suitable for installation of HFST. The number of locations chosen were based on the amount of funding available.

Locations can also be selected based on hot-spot crash data analysis through one of DelDOT's active highway safety improvement programs, i.e., the Hazard Elimination Program or High-Risk Rural Roads Program; or locations can be selected based on an individual analysis of crash data resulting from a citizen concern about a particular roadway.

HFST Locations

As noted previously, HFST has been installed at 44 locations statewide since 2013. The first installation of HFST occurred on Pyle Center Road in Sussex County on September 5, 2013. The most recent installation of HFST occurred

on I-95 southbound, between the US 202 interchange and the Brandywine River Bridge with the majority of HFST at that location completed on November 9, 2022 and the remaining portion under the 18th Street overpass completed on July 6, 2023. Table 1 provides the locations of HFST throughout Delaware.

Table 1: HFST Locations (continued on next page)

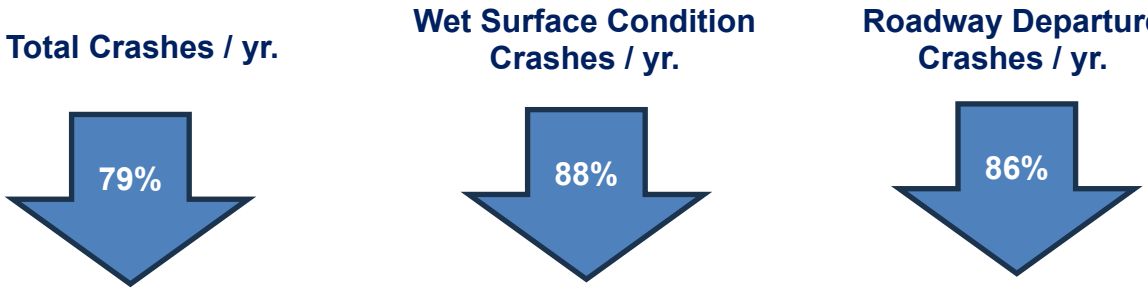
Location No.	Road Name	County	Maint. Road No.	Installation Type	Installation Date
1	Pyle Center Road	Sussex	382	Curve	9/5/2013
2	Ramp from SR 273 EB to I-95 NB	New Castle	6047/6042	Curve	9/26/2015
3	Staytonville Road	Sussex	224	Curve	10/5/2015
4	Oak Road	Sussex	594	Curve	10/7/2015
5	Oak Road	Sussex	594	Curve	10/7/2015
6	Mt. Friendship Road	Kent	91	Curve	10/9/2015
7	Griffith Lake Drive	Sussex	633	Curve	10/10/2015
8	Tharp Road	Sussex	534	Curve	10/12/2015
9	Pyle Center Road	Sussex	382	Curve	10/13/2015
10	Double Bridges Road	Sussex	363	Curve	10/15/2015
11	Morris Mill Road	Sussex	297	Curve	10/15/2015
12	River Road	Sussex	312	Curve	10/17/2015
13	Montchanin Road	New Castle	232	Curve	10/20/2015
14	New London Road	New Castle	262	Curve	10/21/2015
15	Kirkwood St. George's Road	New Castle	409	Curve	10/22/2015
16	Pleasant Hill Road	New Castle	301	Curve	10/22/2015
17	Conley's Chapel Road	Sussex	280B	Curve	7/13/2016
18	Bayard Road	Sussex	84	Curve	7/14/2016
19	Roxana Road	Sussex	52	Curve	7/15/2016
20	Hollyville Road (SR 24A)	Sussex	48	Curve	7/16/2016
21	Patriots Way/Bethesda Road	Sussex	326	Curve	7/17/2016
22	Morris Mill Road	Sussex	297	Stop-controlled Approach	7/17/2016
23	Cedar Creek Road	Sussex	212	Curve	7/18/2016
24	DE Route 9 (River Road, N378)	New Castle	378	Curve	7/19/2016
25	Patriots Way	Sussex	318	Curve	6/12/2017
26	Mount Joy Road	Sussex	297	Curve	6/13/2017
27	Old Wilmington Road	New Castle	275	Curve	6/14/2017
28	Hopkins Road	New Castle	302	Curve	6/15/2017
29	Brackenville Road	New Castle	288/274	Signalized Intersection Approach	8/21/2019
30	Pleasant Hill Road	New Castle	301	Curve	8/23/2019

Location No.	Road Name	County	Maint. Road No.	Installation Type	Installation Date
31	Stoney Batter Road	New Castle	283	Curve	8/27/2019
32	Thompson Station Road	New Castle	53	Stop-controlled Approach/Curves	8/28/2019
33	SR 1 southbound, Tybouts Corner	New Castle	67/82	Curve	11/21/2020
34	Asbury Road	Sussex	446	Curve	8/2/2021
35	Gum Road	Sussex	392	Curve	8/3/2021
36	Gravel Hill Road	Sussex	248	Curve	8/4/2021
37	Phillips Branch Road	Sussex	302	Curve	4/20/2022
38	Cannon Road	Sussex	307	Curve	4/21/2022
39	Concord Pond Road	Sussex	524/516	Curve	4/25/2022
40	Interstate 495 Northbound	New Castle	60	Curve	5/11/2022
41	Newton Road	Sussex	582	Curve	5/11/2022
42	Thompsonville Road (Betts Pond Road)	Sussex	326	Curve	5/17/2022
43	Old Furnace Road	Sussex	46	Curve	5/19/2022
44	Interstate 95 Southbound	New Castle	59	Curve	7/6/2023

Before/After Crash Analysis

For each HFST location, crash data covering five years before installation of HFST were evaluated for the "before" period. The "after" period for each location covered the day after HFST installation through July 31, 2023. The before/after crash data was normalized for each site and the analysis is based on annual crash frequencies (crashes/year). The average number of years before HFST installation is 5.0 years and the average years after HFST installation is 5.5 years.

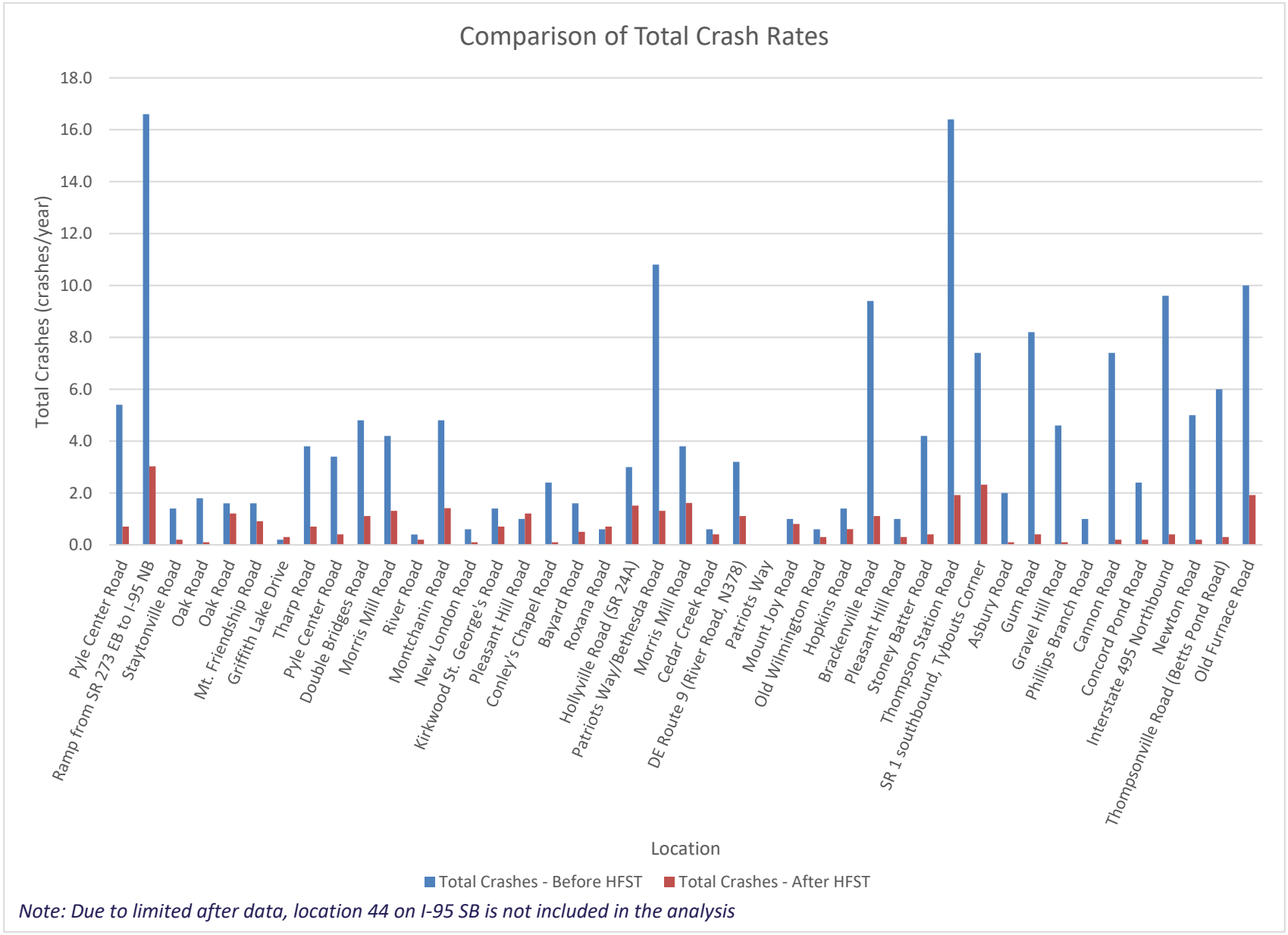
The before/after crash analysis evaluated the annual total crashes at each site as well as the annual roadway departure and wet-surface condition crashes at each site. For HFST, the primary indicator of success is a reduction in these three crash types (total, roadway departure, and wet-surface condition crashes). The following results were obtained from the before/after crash analysis:



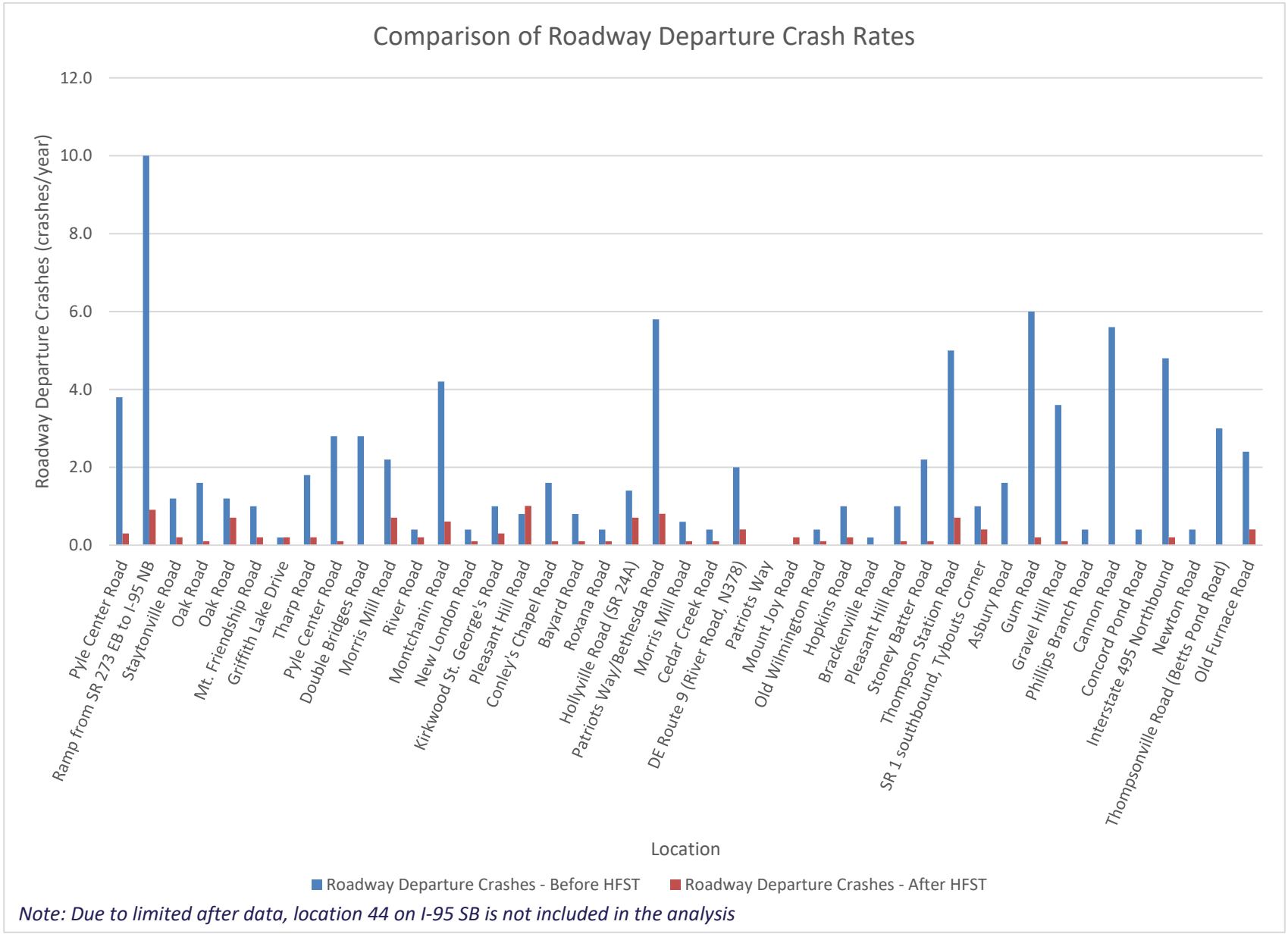
- At four sites (Griffith Lake Drive, location 7; Pleasant Hill Road, location 16; Roxana Road, location 19; and Phillips Branch Road, location 37), the total number of crashes per year increased, however at three of the four locations, roadway departure crashes and wet-surface condition crashes either decreased or remained the same.
- At 15 of the locations, there were no wet-surface crashes during the after period.

- At 9 of the locations, there were no roadway departure crashes during the after period.

Due to the limited amount of after data, location 44 on I-95 SB approaching the Brandywine River Bridge is not included in this before/after analysis. Due to the number of before period crashes (53 total crashes per year and 39 wet-surface condition crashes per year), it is recommended to update the before/after analysis for that site annually over the next three years, Overall, HFST treatment is a successful safety countermeasure based on the results of the before/after analysis. As additional locations receive the treatment, those sites should be monitored for crash reduction benefits to ensure that the HFST treatment is continuing to provide a safety benefit.



Note: Due to limited after data, location 44 on I-95 SB is not included in the analysis



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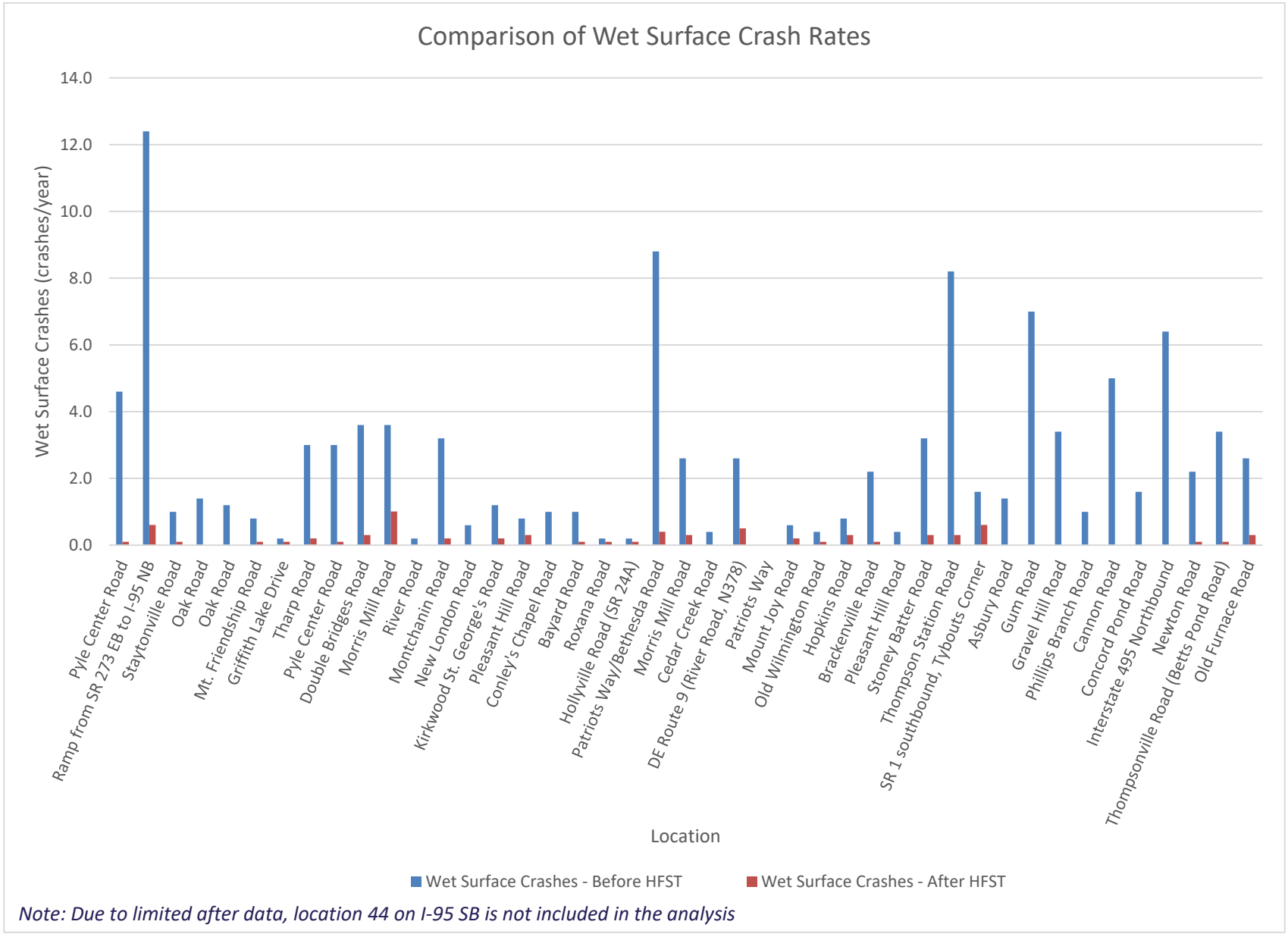

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