FEHR & PEERS

Memorandum

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To: Matt Mullenax and Michaela McDonough, HEPMPO

From: Tory Gibler and Nicole Waldheim, Fehr & Peers

Subject: HEPMPO Regional Safety Action Plan – High Injury Network Development

DC23-0116

Introduction

Between 2018 and 2022, 154 traffic fatalities occurred in the Hagerstown/Eastern Panhandle Metropolitan Planning Organization (HEPMPO) region on non-interstate roadways, 25 of which involved a person walking, and 25 of which involved a person riding a motorcycle. No bicycle fatalities occurred during the study timeframe. In addition to the people who died in non-interstate traffic crashes, another 567 people sustained incapacitating injuries.

To understand where and why crashes that result in fatalities and serious injuries are most likely to occur and how to reduce the severity and frequency of these crashes, HEPMPO is preparing a Regional Safety Action Plan, rooted in the core elements of the Safe System Approach (SSA). The overall purpose of the Action Plan is to identify projects, programs and strategies that will eliminate fatalities and serious injuries on the roadways within the region and allow the region and local jurisdictions to apply for the next round of funding through the Safe Streets for All (SS4A) grant program and other safety related grant programs.

This memo summarizes the methodology to develop a high-injury network (HIN) for HEPMPO. The HIN is a collection of roadways where a disproportionate number of collisions that result in someone being killed or severely injured (KSI) occur. Together, these collision types are referred to as KSI collisions throughout this memo.

The identification of the HIN will help inform the types of projects and actions to include in the Action Plan.

The following describes the data sources that were used and explains the methodology employed by Fehr & Peers to develop the HIN.

Data Inputs

Roadway Network

The roadway network that served as the basis for this analysis was obtained from Replica, which is a land use and transportation platform built upon Open Streets Map and usable across GIS mapping platforms. Preparation of the initial HIN excluded all non-limited access facilities in the network (e.g., interstates such as I-70, I-81, I-68, and private roads).

Collision Dataset

The analysis was completed based on collision data reflective of 2018 to 2022 for the HEMPOM region, compiled from individual datasets downloaded from the West Virginia Department of Transportation (WVDOT) and the Maryland Department of Transportation (MDOT) crash portals in the Fall of 2023.

All collision data was mapped based on the geolocation associated with each crash record, which revealed some crashes with incomplete or incorrect information, such as crashes that did not actually occur in the region. After removing incorrectly geolocated collisions (i.e., those not actually located within the region), a total of 23,279 collisions, including 152 that resulted in a fatality, 561 that resulted in a severe injury, 5,596 that resulted in some injury, and 16,970 that resulted in no injury are considered in the analysis.

Collision Severity Weighting

The Safe System Approach framework aims to eliminate all serious and fatal injury crashes on roadways within HEPMO. This approach recognizes that while it is not feasible to prevent all crashes, implementation of safe system strategies can reduce the severity of crashes. To prioritize efforts at locations where crashes result in a fatality or severe injury, KSI crashes were assigned a weight factor. As presented in **Table 1**, collision weights are derived from comprehensive crash costs (2021 USD) from the West Virginia Department of Transportation, with the

Highway Safety Manual (HSM) Equivalent Property Damage Only (EPDO) weighting applied.

Comprehensive crash costs include both economic costs and monetized pain and suffering costs. Economic costs are monetary costs associated with emergency services deployment, medical services, productivity loss due to victim injury, insurance, and legal costs, cost associated congestion impacts because of the collision, and property damage costs. Monetized pain and suffering costs are an assumption of the costs associated with lost quality-of-life (or Quality-Adjusted Life Years), accounting for reductions in life expectancy and quality of life changes because of a crash.

Application of the EPDO weighting (dividing the cost of each crash type by the cost of a property damage only crash) approach results in different crash types receiving a different weight factor. As shown in **Table 1**, application of the EPDO weight results in fatal crashes receiving a significantly higher weight which could skew the HIN. In many instances, a crash that results in a severe injury could have been a fatality under slightly different circumstances, such as a victim with underlying health issues. Conversely, a fatal crash involving someone not wearing a seatbelt could have been injury only if the victim was wearing a seatbelt. Consequently, a modified EPDO method was used that groups fatal and serious injury crashes together and groups non-incapacitating injuries together. This approach has been used by peer agencies. The approach to develop the regional HIN also includes all crashes – given the low weight applied to property damage only crashes, only locations where there is high frequency of crashes would affect the HIN.

Table 1: Crash Costs[1] and EPDO Weight Factors

Severity	Crash Cost	EPDO Weight	Modified EPDO Weight[2]
Fatal (K)	$9,646,300	1,414	**249**
Incapacitating Injury (A)	$552,200	115	
Non-Incapacitating Injury (B)	$177,300	23	**13**
Possibly Injury (C)	$104,800	14	
No Injury (0)	$10,000	1	**1**

1. Source: West Virginia Department of Transportation KABCO Crash Costs

2. Based on an average weighted KA crash cost developed for the HEPMPO Region (Berkeley, Jefferson, and Washington Counties of $2,494,926 for 2018 – 2022 and an average weighted BC crash cost in Berkely, Jefferson, and Washington Counties of $130,713).

Collision Mode Weighting

In addition to applying a weight factor based on the severity of a crash, a weight factor was developed and applied based on the travel mode of crash victims. Review of the data indicates that people walking, bicycling, and riding motorcycles are disproportionately represented in crashes that result in a KSI. Regionally, people outside of vehicles are involved in about 3.7 % of all reported crashes but are involved in 33.1% of all fatal crashes, 30.5% of all KSI crashes and 8.3% of all injury crashes. For the region, the resulting weight factor, based on the proportion of overall crashes involving someone outside a vehicle to crashes that resulted in an injury, is 3. The factor is in-line with weight factors used by other jurisdictions in the development of their HINs.

US DOT Transportation Disadvantage

To understand the impact of the HIN on transportation disadvantaged populations, the US Department of Transportation (DOT) Equitable Transportation Community (ETC) online explorer tool and data was used to understand locations in the region that experience transportation disadvantage. The tool and metric were developed by USDOT to identify communities that experience transportation insecurity through transportation disadvantage. Transportation disadvantage occurs when people are unable to access the needs of their daily life regularly, reliably, and safely. There are five main components of transportation disadvantage with the indicators used to identity communities summarized below:

1. **Transportation Insecurity** occurs when people are unable to get to where they need to go to meet the needs of their daily life regularly, reliably, and safely. Nationally, there are well-established policies and programs that aim to address food insecurity and housing insecurity, but not transportation insecurity. A growing body of research indicates that transportation insecurity is a significant factor in persistent poverty. This indicator uses measures related to transportation cost burden, access, and safety.

2. **The Environmental Burden** component of the index includes variables measuring factors such as pollution, hazardous facility exposure, water pollution and the built environment. These environmental burdens can have far-reaching

consequences such as health disparities, negative educational outcomes, and economic hardship.

3. **Social Vulnerability** is a measure of socioeconomic indicators that have a direct impact on quality of life. This set of indicators measure lack of employment, educational attainment, poverty, housing tenure, access to broadband, and housing cost burden as well as identifying household characteristics such as age, disability status and English proficiency.

4. The **Health Vulnerability** category assesses the increased frequency of health conditions that may result from exposure to air, noise, and water pollution, as well as lifestyle factors such as poor walkability, car dependency, and long commute times.

5. **Climate and Disaster Risk Burden** reflects sea level rise, changes in precipitation, extreme weather, and heat which pose risks to the transportation system. These hazards may affect system performance, safety, and reliability. As a result, people may have trouble getting to their homes, schools, stores, and medical appointments.

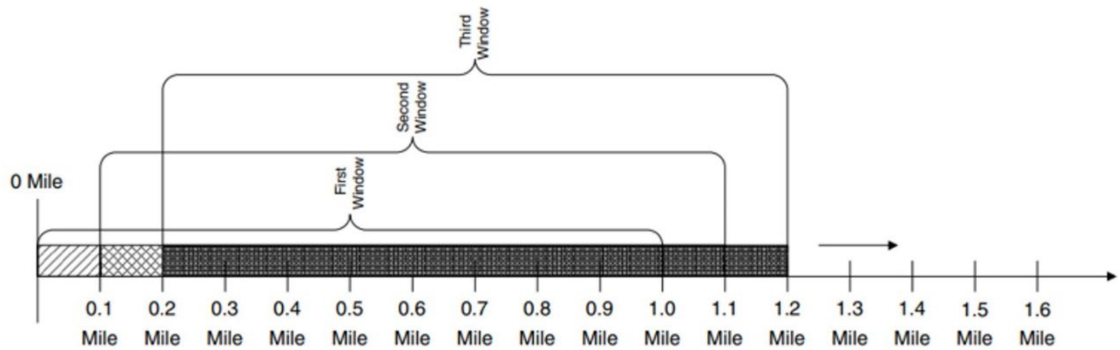
Each indicator is comprised of multiple factors. Additional information can be found on the US DOT website: https://www.transportation.gov/priorities/equity/justice40/etc-explorer.

HIN Development

Sliding Window Approach

The HIN analysis was conducted using a sliding window approach, which uses overlapping windows to account for errors in collision location reporting. For a specific window length, performance measures are calculated for that window along a corridor (e.g., the number of fatal or serious injury collisions multiplied by the mode). The window is shifted along the corridor for a given offset distance and the analysis is repeated for the shifted window. Using this approach, a single location would be evaluated in several different windows, which would account for any inaccuracies inherent within collision location reporting. Windows with the highest values for the segment or facility are identified as candidate HIN locations. An example of the sliding window approach is shown on Error! Reference source not found..

Figure 1: Sliding Window Approach Visualization



Sliding Window Parameters

A 0.5-mile window length with a 0.125-mile offset distance was chosen for the HIN analysis. Any segment less than 0.5-mile in length was treated as a single segment without any offset shifting.

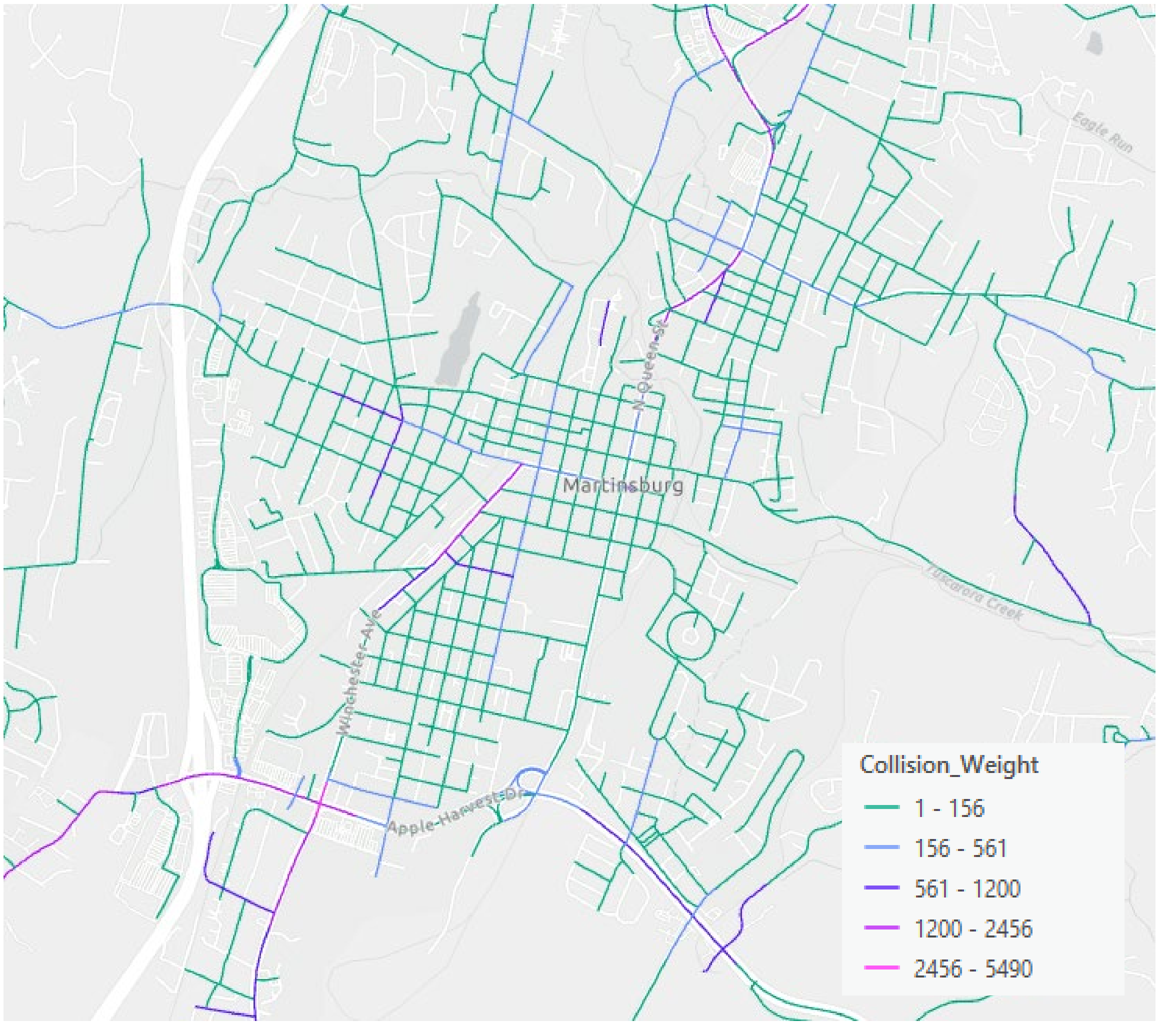
Collision Summary for Each Window

Collisions were summarized for each window using a 120-ft search radius. This radius was chosen by inspecting collision locations relative to the centerline network at various locations throughout the network, including along divided roadways such as Dual Highway. The collision summary for each window consisted of summing all weighted collision values within the search radius. For example, a window with 15 property-damage only, 10 minor injury collisions and 5 KSI collisions within 100 feet would receive a weighted score of 1,390 (15*1+10*13+ 5*249), presuming no pedestrians, bicyclists or motorcyclists were involved. For that same window, if a pedestrian, bicyclist, or motorcyclist was involved in 1 of the 15 property-damage only crashes, 3 of the 10 minor injury collisions and 3 of the 5 KSI collisions, that window would receive a weighted score of 2,964 (14*1+1*3*1+7*17+ 3*3*17+2*317+3*3*317).

HIN Development

After summarizing all collision windows throughout the network, the HIN draft was built using the weighted score of each window. By visualizing the weighted score throughout the network, potential HIN corridors could be identified, as shown on **Figure 2**.

Figure *2*: Initial Visualization of Collision Weight Summaries for High Injury Network (Zoomed into Martinsburg)



The HIN draft was built by using the following iterative process, with the goal of achieving a network that accounted for approximately 40-60 percent of the KSI collisions in the region:

1. Select/flag window segments throughout the network with collision weight values above a certain total weight threshold (e.g., 775 as shown on **Figure 2**).
2. Adjacent high-scoring windows (flagged in the previous step) are aggregated into longer corridor segments (greater than 0.5 mile in length) when appropriate.
3. Cleaning/reasonableness check:

a. Some high scoring windows on local roads which intersect with major ones were removed from consideration if it was discovered that the collision score was being skewed by the number of collisions on the major leg of the intersection.
b. Any small gaps (<1/2 mile) in between the aggregated corridor segments in step 2 were added to the draft HIN for continuity.

HIN Refinement

The initial HIN identified about 113 centerline roadway miles within the region and accounted for 43% of the KSI collisions. The initial HIN was further refined based on project team feedback with the goal of a more concentrated network. The HIN was refined with the following data layers:

- Equity areas as designated by the USDOT Transportation Disadvantaged Community data tool.
- Vulnerable Road Users corridors as identified by Maryland and West Viriginia's Vulnerable Road User Assessments.
- Pedestrian Safety Action Plan (PSAP) priority corridors in Maryland.
- Community feedback regarding safety concerns and nears misses as received through the Safety Action Plan's online survey.

Segments and corridors that overlapped with the above data layers were included. A final set of segments were added to fill gaps between HIN segments as needed.

HIN and HIN Statistics

The resulting high-injury network can be viewed on the HEPMPO SAP Data Map, under the "Draft High Injury Network" tab. HEPMPO contains about 3,438 centerline miles. Crashes that occur on the HIN segments account for 30 percent of all KSI crashes in the region. 53 percent of pedestrian KSI, 36 percent of bicyclist KSI, and 32 percent of motorcyclist KSI crashes also occur on these roadways, as summarized in **Table 2**.

Table 2: HEPMPO HIN Statistics

	All Roadways*	Draft All Roadways HIN	HIN % All Roadways	% In Transportation Disadvantage Communities
Centerline miles	3,438	84	1%	62%
All collisions**	23,279	6,545	27%	50%
KSI (All modes)	713	208	30%	46%
Ped KSI	86	46	53%	56%
Bike KSI	11	4	36%	81%
Motorcycle KSI	127	41	32%	49%

Source: Maryland Crash Data, West Virginia Crash Data, Replica, Fehr & Peers.
Notes: * All roads in Replica dataset excluding limited access (interstate, privates roads, tolls, etc)
**Collisions within 120' of network

A total of 126 road segments exist on the draft HEPMPO HIN. Each segment was scored and ranked based on safety score within each segment (e.g. the sum of each collision severity multiplied by the crash mode). Connecting segments were developed into corridors. The top segments and corridors are included in Table 3 and Table 4 below.

Table 3: Top HEPMPO HIN Segments

Road Name	Extents	Safety Score Per Mile[1]	Transportation Disadvantage Community[2]
1. E Washington St	Flowing Springs Wy to Jefferson Ter (0.4 Miles)	9,693	N
2. Dual Highway	Cleveland Ave to Manor Dr (0.3 Miles)	9,259	Y
3. Dual Highway	Edgewood Dr to Day View Dr (0.3 Miles)	8,957	Y
4. Dual Highway	Cannon Ave to Cleveland Ave (0.4 Miles)	8,898	Y
5. Virginia Ave	Snyder Ave to Howard St (0.4 Miles)	7,344	Y
6. Apple Harvest Dr	I-81 ramps to Winchester Ave (0.3 Miles)	7,258	Y
7. W Washington St	Burhans Blvd to Potomac St (0.4 Miles)	7,115	N
8. Brown Rd	Williamsport Pk to Willingham Wy (0.4 Miles)	6,301	Y
9. Edwin Miller Blvd	McMillan Ct to Meridian Pkwy (0.6 Miles)	4,715	N
10. Dual Highway	Mount Aetna to Edgewood Dr (0.7 Miles)	4,576	Y

Source: Maryland Crash Data, West Virginia Crash Data, Replica, Fehr & Peers.
1. The Safety Score is calculated based on the total number of crashes, the highest level of injury sustained in each crash, and the travel mode of victims.
2. Transportation disadvantage occurs when people are unable to access the needs of their daily life regularly, reliably, and safely. Additional information can be found on the US DOT website: https://www.transportation.gov/priorities/equity/justice40/etc-explorer.

Table 4: Top HEPMPO HIN Corridors

Road Name	Extents	Safety Score Per Mile[1]	Transportation Disadvantage Community[2]
1. Brown Rd	Williamsport Pk to Willingham Wy (0.4 Miles)	4,715	N
2. Burnhans Blvd	Cushwas Aly to Pennsylvania Ave (1.4 Miles)	4,415	Y
3. Dual Highway	Cannon Ave to Beaver Creek Rd (4 Miles)	4,361	Y
4. Edgewood Dr	Baltimore St to Dual Hwy (0.9 Miles)	3,837	Y
5. Washington St	Railroad Crossing to Jefferson Ter (2.2 Miles)	3,806	Y
6. Edwin Miller Blvd	McMillan Ct to Cloud St (1.5 Miles)	3,540	Y
7. Church St	Burhans Blvd to Potomac St (0.4 Miles)	3,443	Y
8. Flowing Springs Rd	Pacesetter Wy to E Washington St (0.4 Miles)	3,381	Y
9. Warm Springs Ave	Edwin Miller Blvd to Williamsport Pk (0.9 Miles)	2,781	Y
10. Winchester Ave	King St to Paynes Ford Rd (3 Miles)	2,682	Y

Source: Maryland Crash Data, West Virginia Crash Data, Replica, Fehr & Peers.
1. The Safety Score is calculated based on the total number of crashes, the highest level of injury sustained in each crash, and the travel mode of victims.
2. Transportation disadvantage occurs when people are unable to access the needs of their daily life regularly, reliably, and safely. Additional information can be found on the US DOT website: https://www.transportation.gov/priorities/equity/justice40/etc-explorer.

Next Steps

After the HIN is finalized, the network and priority locations will be included in the Regional Safety Action Plan. A handful of priority locations will have Safety Corridor Profiles drafted as part of project selection. Each Safety Corridor Profile will included specific countermeasures and recommendations to address fatal and severe collisions history, vulnerable road users and other as-risk features.