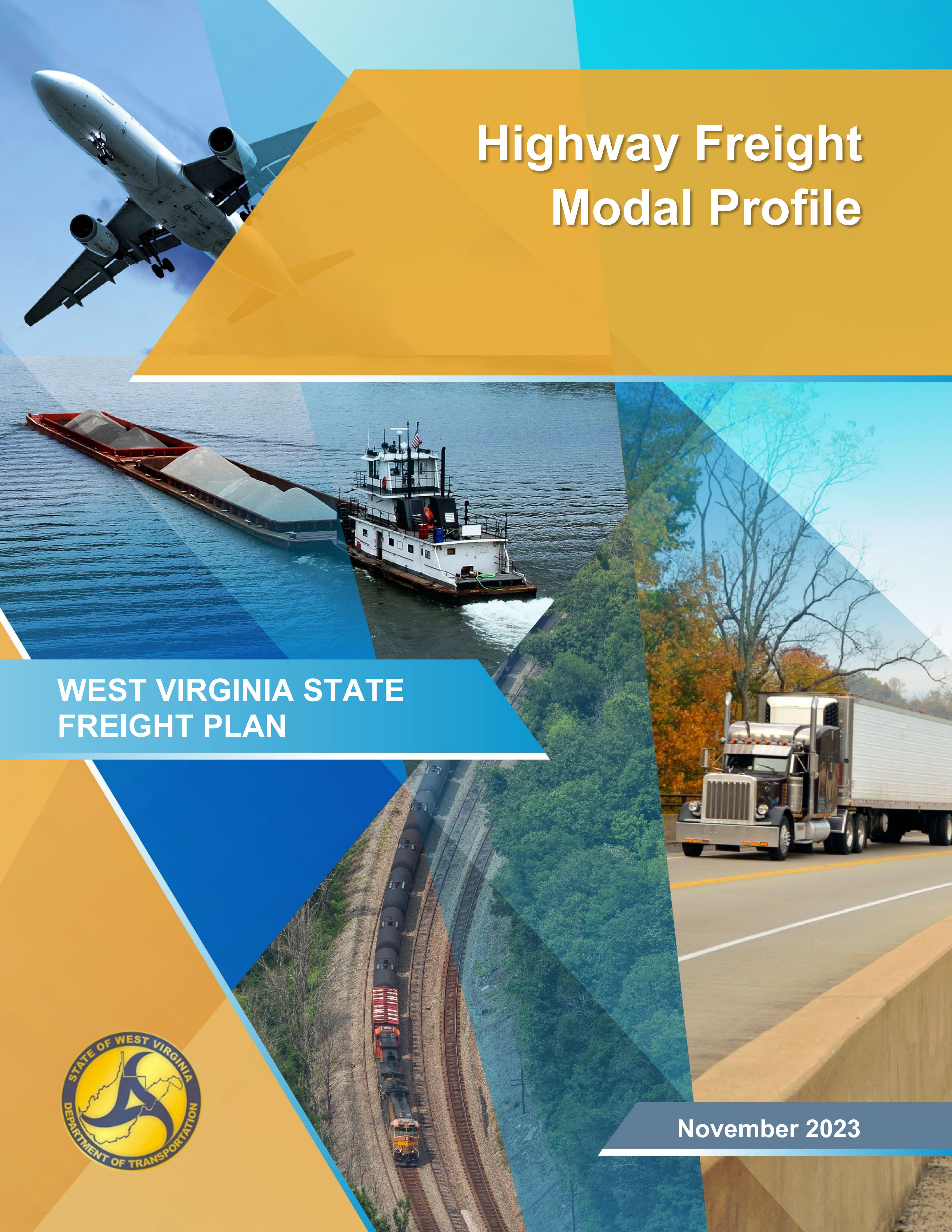

# Highway Freight Modal Profile

## WEST VIRGINIA STATE FREIGHT PLAN

November 2023

STATE OF WEST VIRGINIA DEPARTMENT OF TRANSPORTATION

*Tech Memo*

# West Virginia State Freight Plan

## *Highway Freight Modal Profile*


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*date*

**November 2023**

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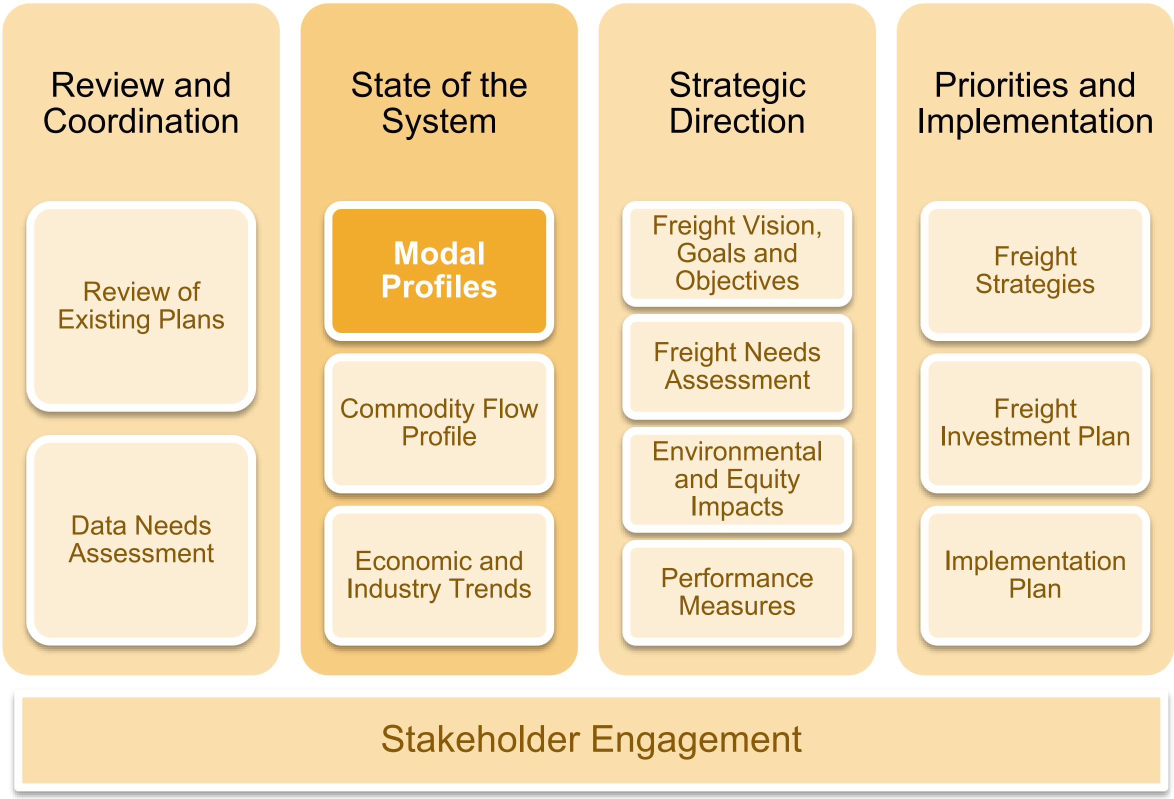
# 1.0 HIGHWAY FREIGHT MODAL PROFILE INTRODUCTION

## 1.1 Overview of the Plan

In 2022, the West Virginia Department of Transportation (WVDOT) began its update of the West Virginia State Freight Plan. This Plan will fulfill federal requirements for state freight planning, identify opportunities for West Virginia to invest in its freight system, and position WVDOT to take full advantage of federal formula and discretionary funding programs for freight transportation investments. Additionally, the Plan will detail freight activity, needs, and priorities, and support WVDOT in meeting the agency's overall goals as well as those of this Plan.

The purpose of this *Highway Freight Modal Profile* is to identify West Virginia's existing highway freight assets and assess their performance and conditions. Documenting existing challenges helps identify strategies and solutions to aid the State going forward. It is one of many complementary technical activities that will be developed as part of this planning process. The overall process is shown in Figure 1.1, and will be developed in conjunction with a robust stakeholder engagement effort that will support the data driven aspects of this Plan.

**Figure 1.1 West Virginia State Freight Plan Technical Activities**



## 1.2 West Virginia Freight Transportation Vision and Goals

The Vision of the West Virginia State Freight Plan is as follows:

**THE WEST VIRGINIA DEPARTMENT OF TRANSPORTATION'S MISSION IS TO RESPONSIBLY PROVIDE A SAFE, EFFICIENT AND RELIABLE TRANSPORTATION SYSTEM THAT SUPPORTS ECONOMIC OPPORTUNITY AND QUALITY OF LIFE.**

WVDOT will achieve this vision through the following goals:

- **System Condition, Efficiency, and Fiscal Sustainability:** Maintain multimodal and intermodal freight transportation infrastructure in a state of good repair and manage lifecycle costs; efficiently deliver projects, programs and services supporting goods movement; and work to maintain existing funding mechanisms while exploring new alternative and sustainable funding mechanisms.
- **Safety and Security for All Users:** Reduce transportation fatalities and serious injuries involving freight vehicles, improve the safety and security of drivers, cargo, and intermodal facilities, and improve the resilience of the freight system particularly to severe weather events and other disruptions.
- **Economic Vitality:** Strengthen the ability of communities and industries to access national and international trade markets, retain and grow existing West Virginia Statewide and Regional economic focus sectors, and support regional economic development that will diversity West Virginia's economy.
- **Multimodal Mobility, Reliability, and Accessibility:** Facilitate freight mobility and connections for on-demand and reliable goods delivery across all West Virginia communities, including critical services such as health care and emergency management.
- **Livable and Healthy Communities:** Create freight transportation systems that operate efficiently and cleanly, protect the natural environment and maintain access for residents and visitors to experience WV's natural and cultural destinations.

## 1.3 Highway Profile Overview and Organization

The remainder of this technical memorandum is organized as follows:

- Section 2.0 – Inventory – Highways are among the most important freight transportation network assets as they represent the most extensive geographic footprint of all freight modes in the State. This section of the report details the unique attributes of the highway system, the existing conditions and demands, and the various freight related needs.
- Section 3.0 – Demand – This section quantifies and characterizes the freight demand on West Virginia's highway network. Demand is measured as the tonnage and value of the various goods transported on the network. Identifying the underlying factors driving freight demand on State's highway and how they may change over time is important for planning for corresponding changes of freight vehicle activity.

- Section 4.0 – Condition and Performance – The purpose of the conditions and performance analysis is to understand the demands on the State's highway freight network and see where the system is meeting (or failing to meet) those demands. This information provides decision-makers with a stronger foundation for identifying and assessing potential highway freight system investments. The analysis is informed by data on average truck travel times, pavement conditions, and bridge conditions, among others.
- Section 5.0 – Safety – This section of the report examines the safety performance of the State's highway network. Transportation safety is extremely important and is one of the highest priorities at all levels of transportation planning and engineering – National, Statewide, Regional and Local.

## 1.4 Key Findings

Presented below are key findings from the analysis conducted in this Highway Profile. This technical memorandum contains additional details on all items listed.

- 3,828 centerline miles of interstate and U.S. route highway system.
- Sixth largest State-maintained highway system in the nation.
- Over 90 percent of public roadway miles are State-owned and maintained.
- West Virginia can designate up to 300 miles of Critical Urban Freight Corridors (CUFC) and 600 miles of Critical Rural Freight Corridors (CRFC) for the National Highway Freight Network (NHFN).
- Top freight by weight is coal and gravel, top freight by value is mixed freight and plastic/rubber.
- Seventy-five percent of lane miles and 86 percent of bridges are in fair or good condition.
- As measured by both truck travel time reliability and truck travel time index, interstates were least reliable in the PM peak period.
- On average, non-interstate National Highway System (NHS) experienced worse truck travel time reliability measures than interstates.
- Commercial Motor Vehicles (CMV) made up just over 11 percent of fatal and serious injury crashes in 2021.
- West Virginia has 1,860 truck parking spaces, 82 percent of which are located along interstates.
- Between 2017 and 2021 there were 78 crashes involving parked trucks, about 4 percent resulted in a fatality, and just over half resulted in property damage only.

# 2.0 HIGHWAY FREIGHT NETWORK INVENTORY

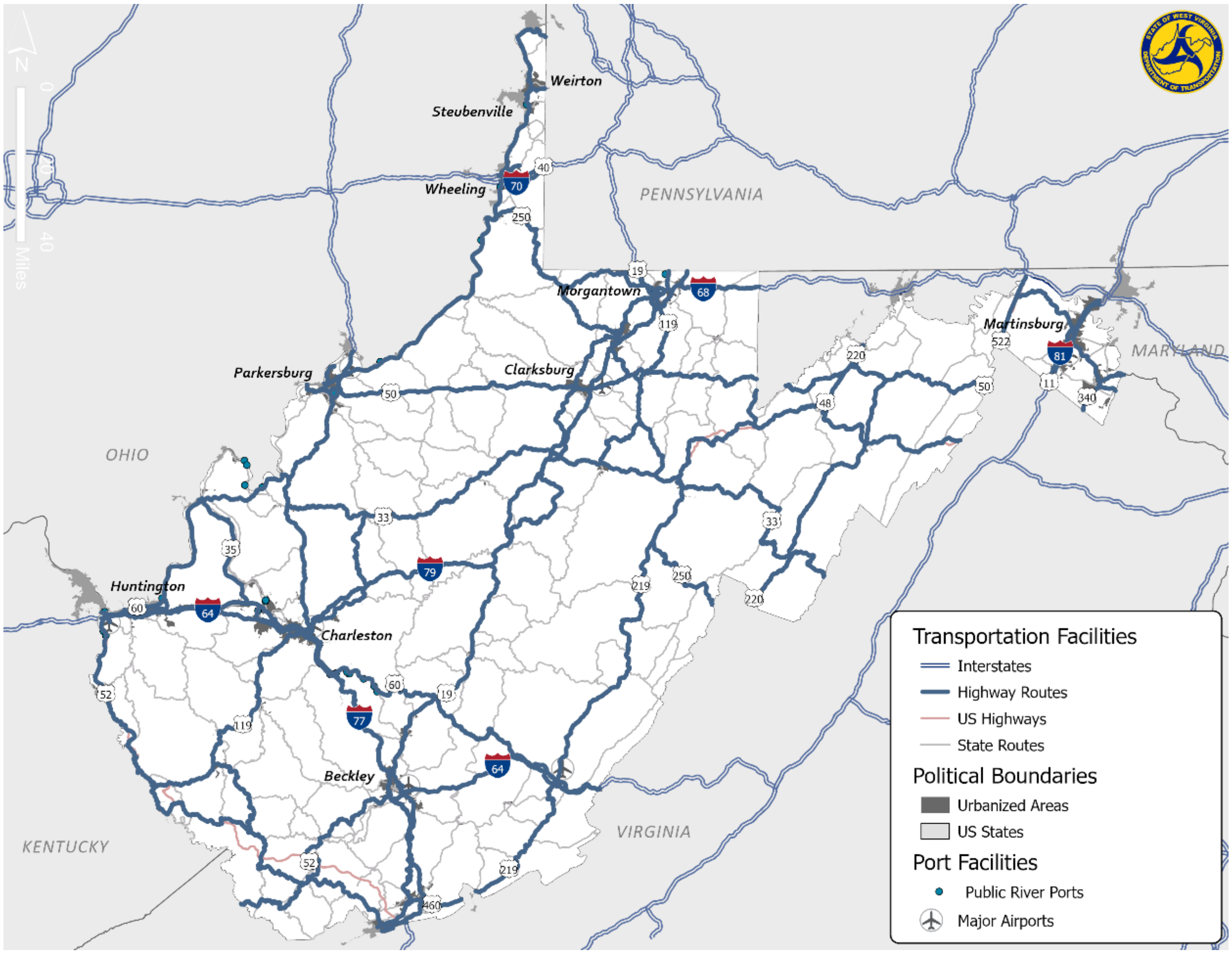
## 2.1 Overview of Highways in West Virginia

In West Virginia, freight moves through a transportation system that encompasses all modes. The State is served by inland waterways and ports, two Class I railroads with multiple rail terminals, and seven commercial service airports which can provides cargo services. The State's highway network connects all these assets to provide truck access from the State's various freight terminals (river ports, rail yards, and airports) to origins or destinations of goods.

Highways are among the most important transportation assets for freight transport in the nation, and particularly in West Virginia. They are typically critical components of first and last mile connections within the supply chain, and represent the most extensive geographic footprint of all freight modes in the State. The freight plan's highway profile details the unique attributes of the highway system in West Virginia, the existing conditions and demands, and the various freight related needs.

West Virginia contains approximately 3,828 centerline miles of interstate and U.S. route highway system, used to transport a variety of materials and products throughout the State. The system is extensive given the topographic challenges associated with The Mountain State but manages to provide relatively direct corridors between cities and supports an efficient movement of freight through and within the State. Figure 2.1 shows the extent of the State's highway system.

### Figure 2.1 West Virginia Highway System

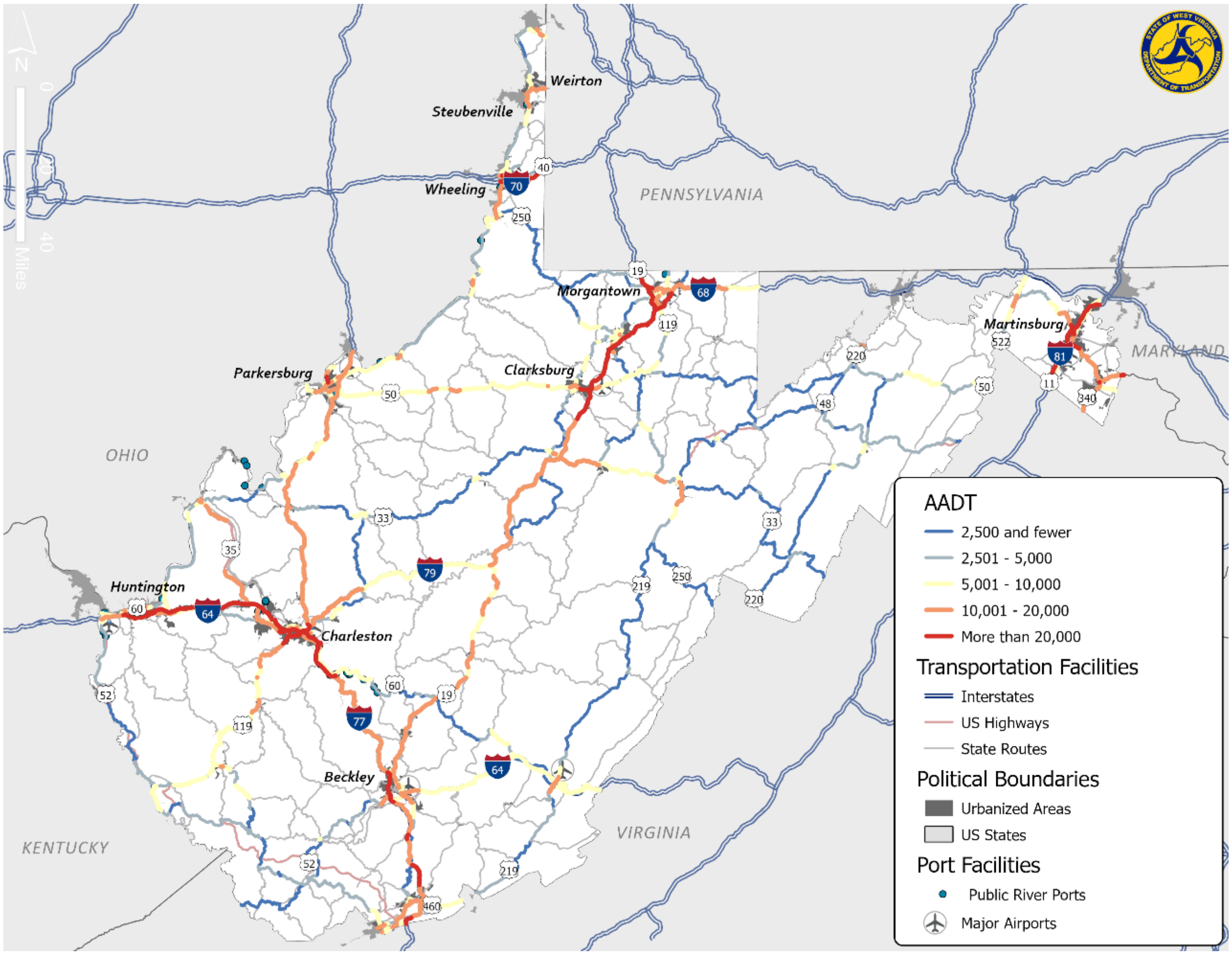



*Source: West Virginia Department of Transportation Dataset, 2020*

The interstate and U.S. route highway system carries on average nearly 21.9 million vehicle miles daily (average daily VMT). Most of the miles are generated in high traffic areas where the total average annual daily traffic (AADT) volume is more than 20,000. These highway segments are in the Charleston, Clarksburg, and Morgantown areas. Figure 2.2 shows the total AADT of these highway segments throughout the State. Notably, only 8 segments, totaling just under 3 miles of highway, exceed 50,000 total AADT. They are located near the Charleston I-77 and I-64 interstate interchange, with 5 segments on I-77 and 3 segments on I-64.

Additionally, West Virginia's interstates 79 and 77 serve as the central corridors for travel within the State. U.S. routes 19 and 60 provide additional centrally located corridors within West Virginia. The State also contains some milage for interstates 64, 70, and 470 west of the eastern panhandle, and interstate 81 in the eastern panhandle. These roadways serve many of the State's major cities including Charleston, Huntington, Morgantown, Parkersburg, and Wheeling to the northwest, among many other cities, towns, and municipalities.

**Figure 2.2 West Virginia Interstate and U.S. Route Highway System by AADT, 2020**




Source: *West Virginia Department of Transportation Dataset, 2020*

## 2.2 West Virginia Roads by Functional Classification

Roadways are divided into multiple classifications based on their design and upon the intended use. The major functional systems, as defined by American Association of State Highway and Transportation Officials (AASHTO) Policy on Geometric Design of Highways and Streets (or Green Book), are Freeway, Arterial, Collectors, and Local Streets. These three classifications have additional sub-classifications within each, providing further definition, e.g., urban versus rural, principle versus minor. Local roadways can be described as smaller roadways not intended for use in long distance travel, except at the origin or destination end of a trip. 1 Collector roadways primarily facilitate intra-county travel and funnel traffic from local roads to the arterial network. Principal arterials provide for travel over multiple counties at relatively high speeds. Interstate highways provide for travel over much longer distances and at higher speeds. Goods movement

[1] Federal Highway Administration, *Highway Functional Classification Concepts, Criteria and Procedures*, 2013 Edition.

relies primarily on the interstate and arterial networks. However, collector and local roadways often represent the first and last miles for freight shipments.

### 2.2.1 HPMS Functional Classification

The Highway Performance Monitoring System (HPMS) is a national-level highway information system that includes data on the extent, condition, performance, use and operating characteristics of the nation's highways. The HPMS contains administrative and extent data of system information on all public roads, while information on other characteristics is represented in HPMS as a mix of universe and sample data for arterial and collector functional systems. Annual submittal of HPMS data is required and includes limited data on all public roadway sections which includes the Federal-aid system, a more detailed data set for designated sections of the Federal-aid system, and area-wide summary information primarily for lower functional system roads.

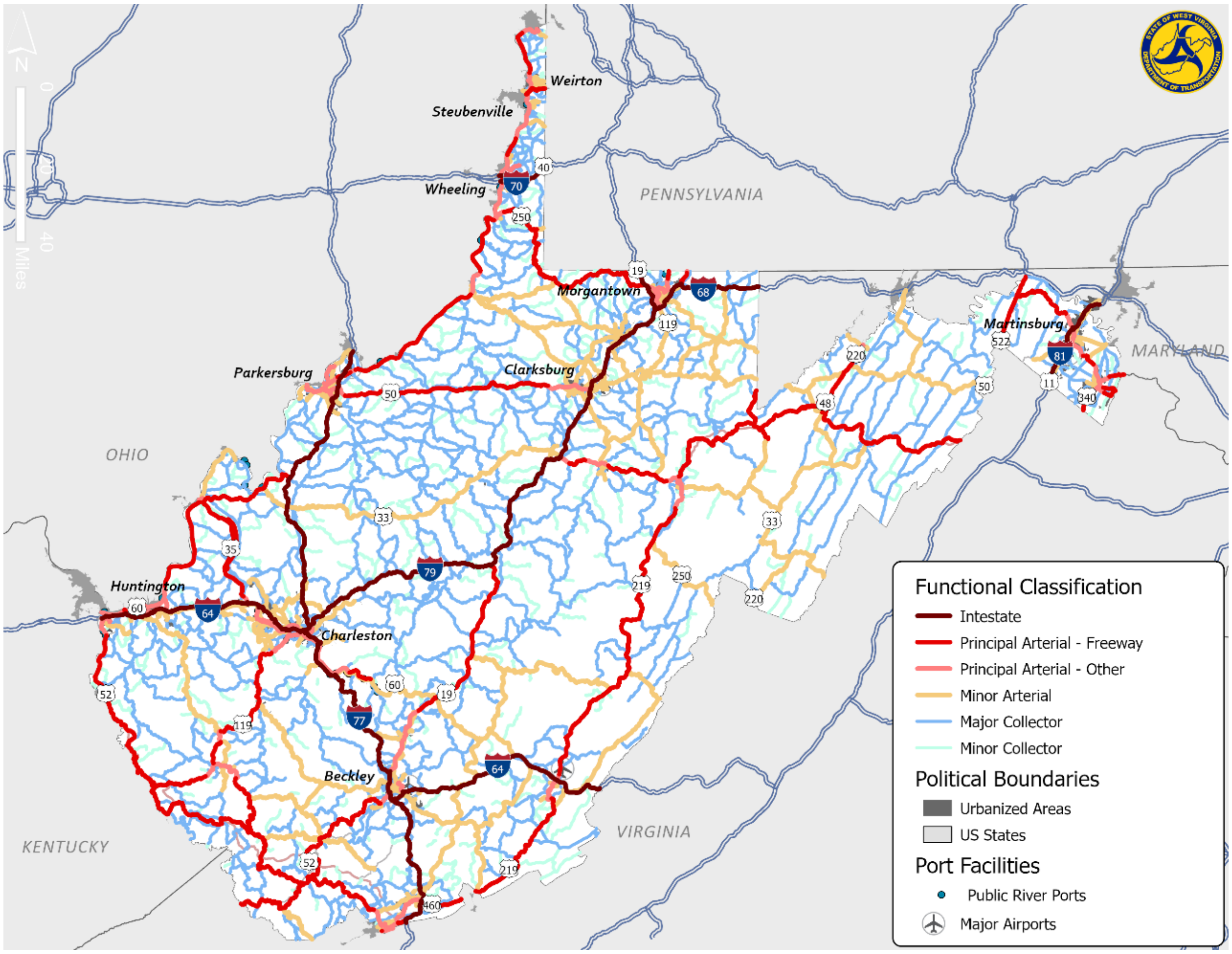
Within the HPMS dataset, the functional classification of the roadways helps to define the use case scenarios, and a segment's purpose within the context of the full roadway network. Roadways within the State are classified from interstates as the high volume and uninterrupted components of the network, to local roads with lower volumes that funnel to the higher classification roadways. Understanding the extent and breadth of higher functional roadways provides context to the ability for freight to move within and through West Virginia. HPMS functional classifications include:

- Classification 1: Interstates, which are part of the Interstate Highway System
- Classifications 2 and 3: Primary arterials, which are the main thoroughfares in the network:
- Classification 2: Freeways and expressways, if they have on- and off- ramp access and egress.
- Classification 3: Other, if there is no on- and off- ramp access and egress.
- Classification 4: Minor arterials, which interconnect and augment primary arterials.
- Classification 5: Major collectors, which funnel local roads into the arterial network.
- Classification 6: Minor collectors, which support major collectors in funneling.
- Classification 7: Local roads, which include all remaining roads.

**6th Largest State-Maintained Highway System in the Nation**

West Virginia has the sixth largest State-maintained highway system in the nation, with 39,145 miles of public road, of which 38,404 miles are State maintained. In total, West Virginia has over 1,300 miles of interstate highway, representing 3.3 percent of miles, connecting freight movement to many of the State's most populous cities and providing a highly accessible freight corridor for inbound, outbound, and internal highway freight movements. Additionally, the State has over 2,500 miles of arterial roadways providing access to the State's extensive resource and industrial industries. Figure 2.3 details the West Virginia roadway network by functional classification for classifications 1 through 6 above.

**Figure 2.3 West Virginia Roadways by Functional Classification**

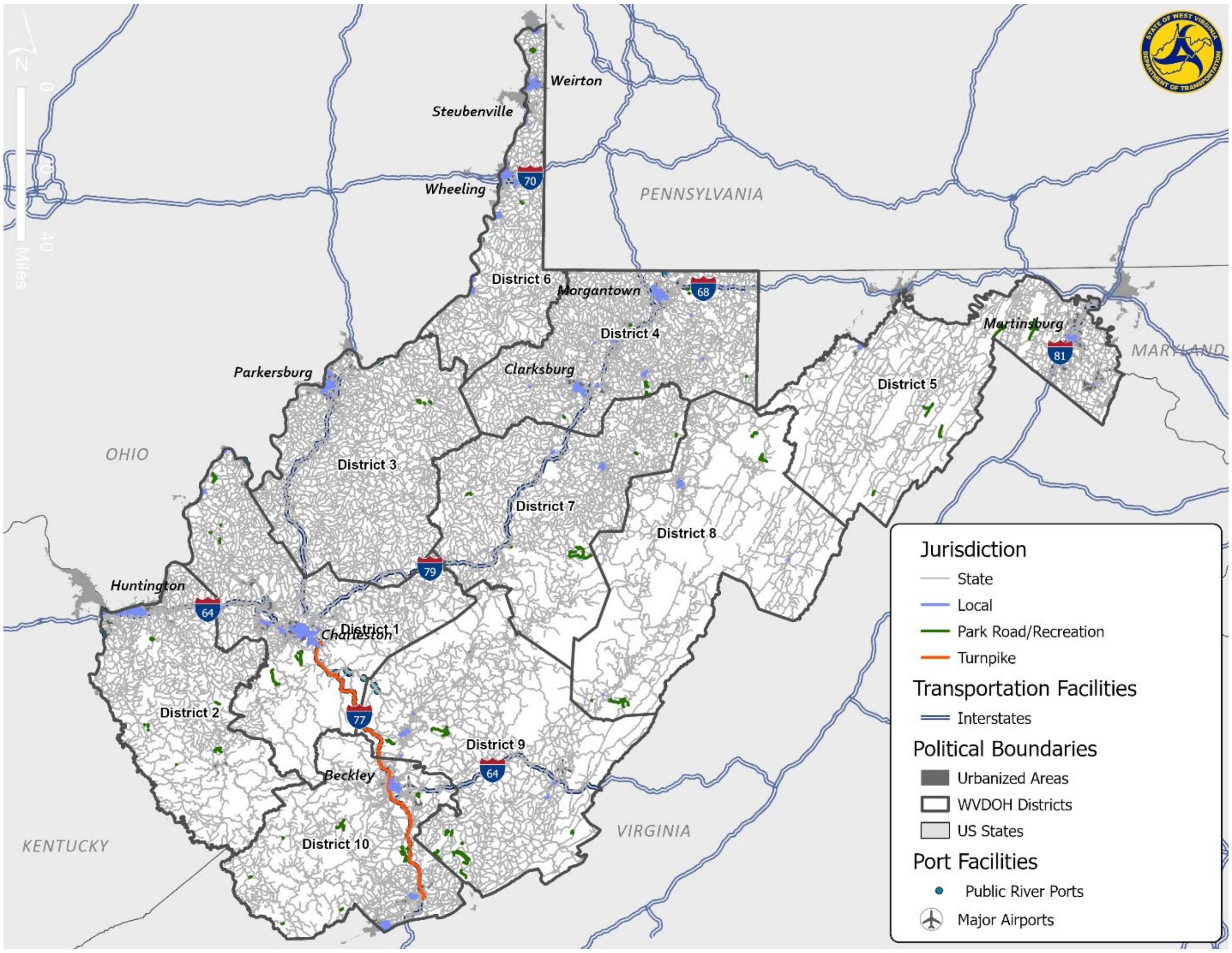



Source: *West Virginia Department of Transportation Dataset, Federal Highway Administration Functional Classification 2021*

## 2.2.2 Roads by Jurisdiction

West Virginia is unique among most states because while ranking among the smaller half of states in population and land area, it ranks among the top 10 for State-maintained centerline mileage. Well over 90 percent of public roadway miles are State-owned and maintained, or 38,404 of the 39,146 public road miles. The State's Division of Highways (DOH) manages these miles, and shares the network with 173 miles of turnpike, 198 Park/Recreation roads, and 279 miles of local roads. Figure 2.4 shows West Virginia roadways by jurisdiction, and the district boundaries.

### Figure 2.4 West Virginia Roadways by Jurisdiction




*Source: West Virginia Department of Transportation Roadway Ownership Dataset, 2021*

West Virginia DOH is divided into 10 districts. District 4 supports approximately 13.5 percent of all public centerline miles. The district, located in the north-central region of the State, contains a large share of the State's urban areas including cities along the I-79 corridor of Morgantown, Fairmont, and Clarksburg. District 3 is the next largest representation of public road centerline miles, followed by Districts 1, 9 and 7 respectively. These are some of the largest districts by area but are also largely in the north/western or southern parts of the State, showing how the Appalachian Mountains represent a distinct topographic challenge to infrastructure development. These districts also represent many of the major metropolitan areas in the State, including the State Capital, Charleston, located in District 1. Table 2.1 shows the distribution of public road miles in the State. Notably, the districts are aggregations of counties, but most of the seven Metropolitan Planning Organizations (MPOs) in the State cross district boundaries into other states or other West Virginia Districts. The exceptions being Morgantown-Monongalia County MPO and the Regional Intergovernmental Council, which are entirely located in Districts 4 and 1, respectively.

**Table 2.1 Roadway Miles by District**

| WVDOH District Number | Number of Centerline Miles | Percent of Centerline Miles |
|---|---|---|
| District 1 | 4,441 | 11.1% |
| District 2 | 3,625 | 9.0% |
| District 3 | 5,014 | 12.5% |
| District 4 | 5,406 | 13.5% |
| District 5 | 3,890 | 9.7% |
| District 6 | 2,602 | 6.5% |
| District 7 | 4,304 | 10.7% |
| District 8 | 2,931 | 7.3% |
| District 9 | 4,362 | 10.9% |
| District 10 | 3,583 | 8.9% |

*Note: Due to segment overlap between districts, the values are slightly higher across all districts.*

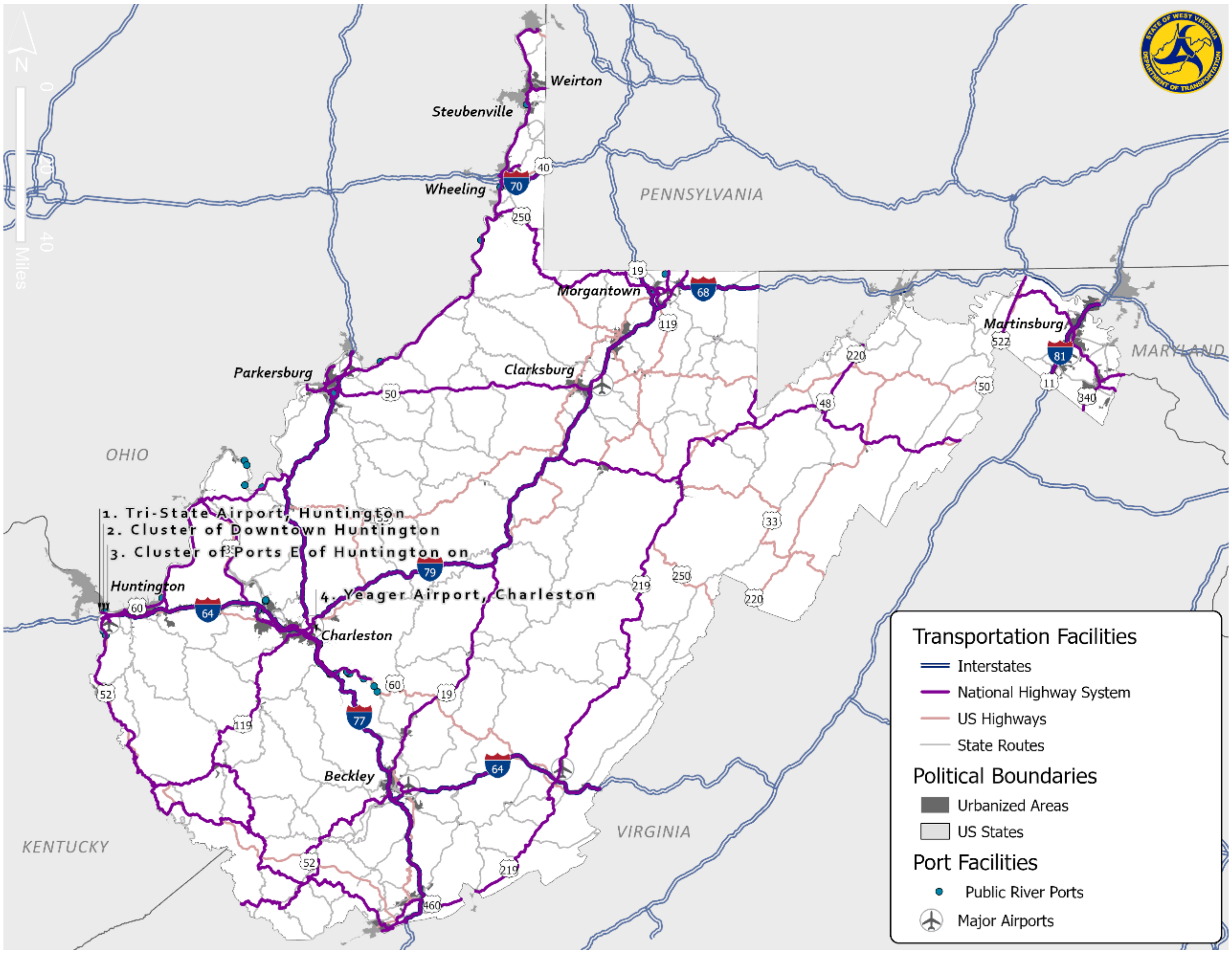
*Source: West Virginia Department of Transportation Roadway Ownership Dataset, 2021*

## 2.3 National Highway System

The National Highway System (NHS) is a federal designation for roadways that are important to the national economy, defense, and general mobility. The designation includes the Eisenhower Interstate System, the Strategic Highway Network (STRAHNET), major strategic highway network connectors, intermodal connectors and other principal arterials characterized by providing access between an arterial and an intermodal transportation facility. Nationally, the network consists of more than 223 thousand miles of roadway and nearly 1,800 intermodal connectors representing nearly 3,000 miles of the NHS.

The NHS plays just as important a role in West Virginia's mobility and economy as it does at the national level. The State has 3,731 miles of NHS roadway, with 9 intermodal connectors representing just over 23 miles of that total. Among the intermodal connectors are roadways that connect passenger rail, river ports, bus terminals, airports, and multipurpose passenger facilities. While these connectors are not exclusively apart of the freight system, the NHS is important for identifying freight critical corridors in the context of the national economy and interstate mobility. Freight movement extends well beyond the bounds of West Virginia, whether the shipments originate, end or are simply passing through the State. Understanding how the national network connects to, and is supported by, the West Virginia portions of the NHS provides the appropriate context for interpreting demand analyses. Figure 2.5 shows the extent of the NHS in West Virginia.

### Figure 2.5 West Virginia National Highway System and Freight Intermodal Connectors




*Source: Federal Highway Administration, NHS System, 2023*

In the context of freight movement on West Virginia roadways, there are two maritime port connectors and two airport connectors on the State's NHS totaling 18.4 miles, or nearly 80 percent of the intermodal connector miles in the State.[2] Three of the four connectors are in the Huntington area and include two connectors to ports located along the Ohio River and the Huntington Tri-State Airport. The last connector is the Yeager International Airport in Charleston. The two port-based connectors are important for inland waterborne freight as the Ohio River flows into the Mississippi River, thereby connecting West Virginia to the most expansive inland marine highway in the country. Both Cincinnati and Louisville are immediately downstream of the ports, in addition to longer haul connections with Memphis, Baton Rouge, and ultimate the Port of New Orleans, one of the largest deepwater ports in the nation in total tons handled.

The two airport-based connectors are a mix of passenger and cargo. Both the Yeager International Airport in Charleston and the Tri-State Airport in Huntington serve passenger traffic and air cargo. Additionally, both airports host military installments that include exchange stores, recruiting offices, response units and, in the

[2] West Virginia - Intermodal Connectors - National Highway System - Planning - FHWA (dot.gov)

case of Yeager International Airport, a joint forces headquarters. Though not necessarily freight focused, both sites play an important role in the movement of cargo into their corresponding urban populations.

Given the context of the four freight related connectors in the State, Table 2.2 shows the criteria used to determine which NHS roadways are considered intermodal connectors for airport and port facilities.

**Table 2.2 NHS Intermodal Connector Criteria**

| Connector Type | Primary Criteria | Secondary Criteria |
|---|---|---|
| **Airport** | • Passenger – scheduled commercial service with more than 250,000 annual enplanements.<br>• Cargo - 100 trucks per day in each direction on the principal connecting route, or 100,000 tons per year arriving or departing by highway transport vehicles. | • Intermodal terminals that handle more than 20 percent of passengers or freight volumes by mode within the State.<br>• Intermodal terminals identified in either the Intermodal Management System or the State/metropolitan transportation plans as a major facility.<br>• Significant investment in, or expansion of, an intermodal terminal.<br>• Connecting routes targeted for investment by the State, MPO or others to address an existing or anticipated deficiency as a result of increased traffic. |
| **Port Terminal** | • Terminals that handle more than 50,000 Twenty-Foot Equivalent Units (TEUs) per year, or other units measured that would convert to more than 100 trucks per day in each direction.<br>• Bulk commodity terminals that handle more than 500,000 tons per year by highway transport vehicles, or 100 trucks per day in each direction on the principal connecting route.<br>• Passenger – terminals that handle more than 250,000 passenger per year or 1,000 passengers per day for at least 90 days during the year/ | |

*Source: Federal Highway Administration, NHS Criteria, 2023*

## 2.4 Freight System Designations

West Virginia has several different freight system designations to identify routes and corridors where freight demand exists and is directed. This section describes these designations, which include the National Highway Freight Network (NHFN), the Federal Strategic Highway Network (STRAHNET), the Coal Resource Transportation System (CRTS), The Appalachian Highway System and the State Designated Truck Routes.

### *2.4.1 Federal – National Highway Freight Network*

The National Highway Freight Network (NHFN), established by the Federal Highway Administration (FHWA), defines the portions of the NHS and the State's highway system that are eligible for federal funding through the National Highway Freight program. The Fixing America's Surface Transportation (FAST) Act repealed both the Primary Freight Network and National Freight Network from Moving Ahead for Progress in the 21st Century Act (MAP-21) and directed the FHWA Administrator to establish the NHFN to strategically direct Federal resources and policies toward improved performance of highway portions of the U.S. freight transportation system. The NHFN includes the following subsystems of roadways:

- **Primary Highway Freight System (PHFS):** This is a network of highways identified as the most critical highway portions of the U.S. freight transportation system determined by measurable and objective national data. The network consists of 41,518 centerlines miles, including 37,436 centerline miles of Interstate and 4,082 centerline miles of non-Interstate roads.

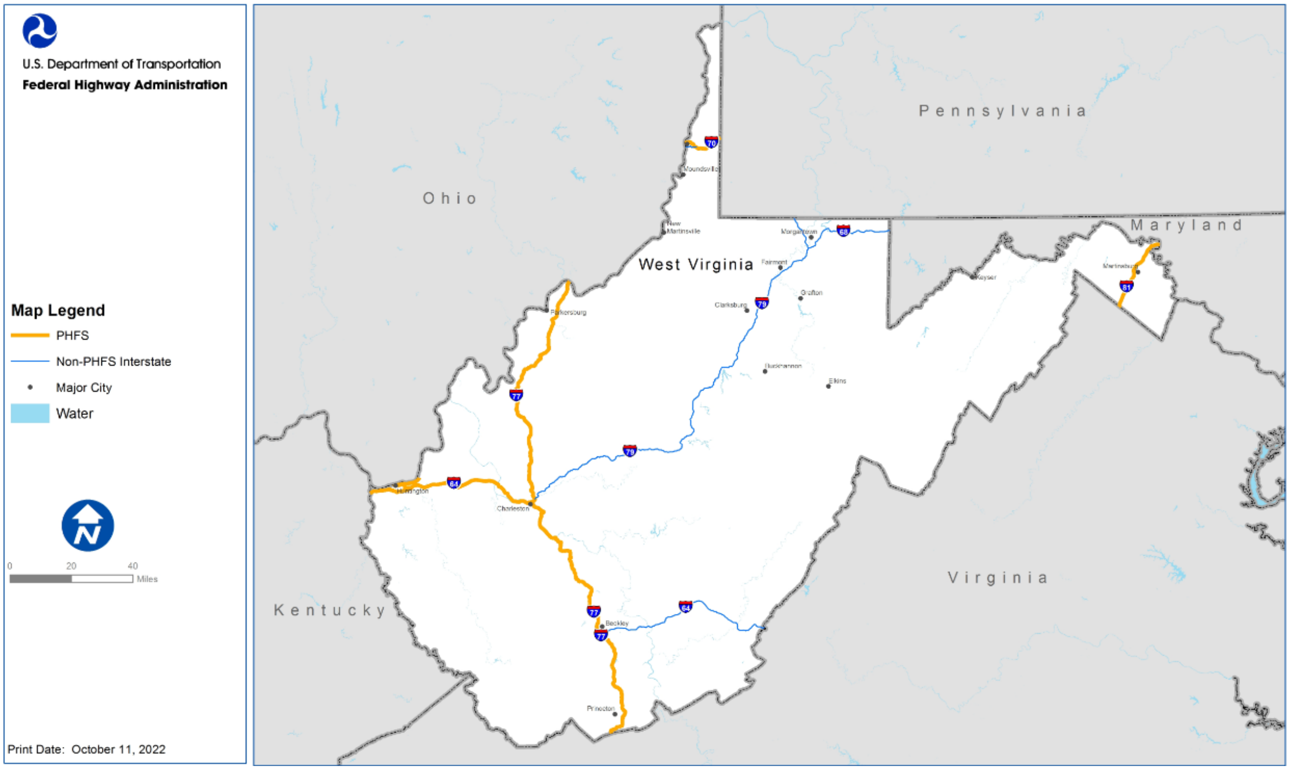
- **Other Interstate portions not on the PHFS:** These highways consist of the remaining portion of Interstate roads not included in the PHFS. These routes provide important continuity and access to freight transportation facilities. These portions amount to an estimated 9,511 centerline miles of Interstate, nationwide, and will fluctuate with additions and deletions to the Interstate Highway System.

- **Critical Rural Freight Corridors (CRFCs):** These are public roads not in an urbanized area which provide access and connection to the PHFS and the Interstate with other important ports, public transportation facilities, or other intermodal freight facilities.

- **Critical Urban Freight Corridors (CUFCs):** These are public roads in urbanized areas which provide access and connection to the PHFS and the Interstate with other ports, public transportation facilities, or other intermodal transportation facilities.

Prior to designation of CRFCs and CUFCs, the Interim NHFN consists of the PHFS and other Interstate portions not on the PHFS, for an estimated total of 51,029 centerline miles. West Virginia supports 561 miles of NHFN, with 301 miles of PHFS roadway and 260 miles of non-PHFS interstate[3]. Figure 2.6 shows the extent of the State's PHFS and the non-PHFS interstate alignment.

### Figure 2.6 West Virginia PHFS and non-PHFS Interstate




*Source: Federal Highway Administration, 2019*

[3] National Highway Freight Network Map and Tables for West Virginia - FHWA Freight Management and Operations (dot.gov)

## Critical Rural and Urban Freight Corridors

CRFCs and CUFCs are important freight corridors that provide critical connectivity to the NHFN. By designating these important corridors, States can strategically direct resources toward improved system performance and efficient movement of freight on the NHFN. The designation of CRFCs and CUFCs will increase the State's NHFN, allowing expanded use of National Highway Freight Program (NHFP) formula funds and INFRA Grant Program funds for eligible projects that support national goals identified in 23 U.S.C. 167(b) and 23 U.S.C. 117(a)(2).

States and in certain cases, MPOs are responsible for designating public roads for the CRFCs and CUFCs in accordance with section 1116 of the FAST Act and section 11114 of the Infrastructure Investment and Jobs Act (IIJA), 2022. State designation of the CRFCs is limited to a maximum of 300 miles of highway or 25 percent of the PHFS mileage in the State, whichever is greater. The IIJA also added that a State with a population per square mile of area that is less than the national average, based on the 2010 census, may designate as critical rural freight corridors a maximum of 600 miles of highway or 25 percent of the primary highway freight system mileage in the State, whichever is greater. Given this addendum, West Virginia with a population per square mile of 77.1 as compared to 87.4 for the national average[4], is permitted a maximum of 600 miles of designated CRFCs. State and MPO designation of the CUFC is limited to a maximum of 150 miles of highway or 30 percent of the PHFS mileage in the State, whichever is greater. This means West Virginia is permitted 150 miles of CUFCs.

### Critical Rural Freight Corridors

23 U.S.C. 167(e) identifies the requirements for designating CRFCs. A State may designate a public road within the borders of the State as a CRFC if the public road is not in an urbanized area and meets one or more of the following seven elements:

1. Is a rural principal arterial and has a minimum of 25 percent of the annual average daily traffic of the road measured in passenger vehicle equivalent units from trucks;[5]
2. Provides access or service to energy exploration, development, installation, or production areas;
3. Provides access or service to-
    a. A grain elevator;
    b. An agricultural facility;
    c. Mining facility;
    d. A forestry facility; or
    e. An intermodal facility;

[4] Population per square mile, Census 2010. U.S. Census Bureau QuickFacts: United States

[5] Federal Highway Administration vehicle class 8 to 13, https://www.fhwa.dot.gov/policyinformation/tmguide/tmg_2013/vehicle-types.cfm.

4. Connects to an international port of entry;
5. Provides access to a significant air, rail, water, or other freight facility in the State; or
6. Has been determined by the State to be vital to improving the efficient movement of freight of importance to the economy of the State.

First and last mile connectivity is essential to an efficiently functioning freight system. These public roads provide immediate links between such freight generators as manufacturers, distribution points, rail intermodal and port facilities and a distribution pathway. FHWA encourages States, when making CRFC designations, to consider first or last mile connector routes from high-volume freight corridors to key rural freight facilities, including manufacturing centers, agricultural processing centers, farms, intermodal, and military facilities. Currently, West Virginia is developing a list of recommended CRFCs.

### Critical Urban Freight Corridors

23 U.S.C. 167(f) identifies the requirements for designating CUFCs. In an urbanized area with a population of 500,000 or more individuals, the MPO, in consultation with the State, may designate a CUFC. In an urbanized area with a population of less than 500,000 individuals, the State, in consultation with the MPO, may designate a CUFC.

A public road designated as a CUFC must be in an urbanized area, regardless of whether the population is above or below 500,000 individuals, and meet one or more of the following four elements:

1. Connects an intermodal facility to:
    a. The PHFS;
    b. The Interstate System; or
    c. An intermodal freight facility;
2. Is located within a corridor of a route on the PHFS and provides an alternative highway option important to goods movement;
3. Serves a major freight generator, logistic center, or manufacturing and warehouse industrial land; or
4. Is important to the movement of freight within the region, as determined by the MPO or the State.

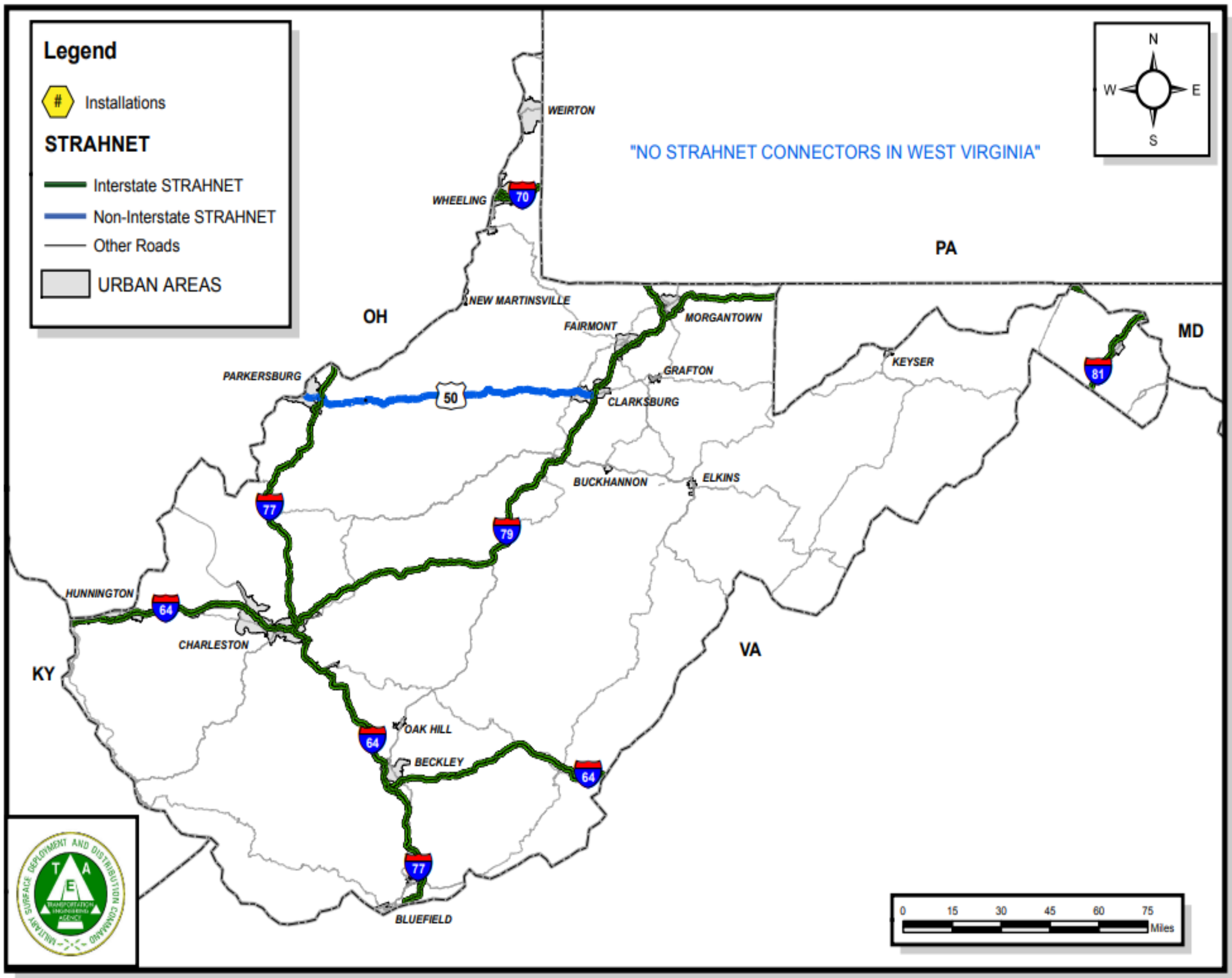
FHWA encourages States, when making CUFC designations, to consider first or last mile connector routes from high-volume freight corridors to freight-intensive land and key urban freight facilities, including ports, rail terminals, and other industrial-zoned land.

The State, in consultation with the State's MPOs is in the process of updating the CUFC designation.

### 2.4.2 Federal – Strategic Highway Network (STRAHNET)

The STRAHNET is a designation given to roads that provide defense access, continuity, and emergency capabilities for movements of personnel and equipment in both peace and war.[6] It includes Routes (for long-distance travel) and Connectors (to connect individual installations to the Routes). The STRAHNET includes over 61,000 miles of Interstate and other important highways. An additional 1,700 miles of STRAHNET connectors link over 200 military installations and ports to the STRAHNET. In West Virginia, there are no STRAHNET installations, so there are no connectors included in the designation; however, all interstate miles in the State, and the 77 miles of US-50 from I-79 in Clarksburg to the State border with Ohio are included in the STRAHNET. All interstate miles are automatically included in the STRAHNET, but the inclusion of the western portion of US-50 indicates it is an important freight corridor for the movement of national military assets to and across the Ohio River, and likewise for non-military freight. Figure 2.7 shows the STRAHNET designated roadways in West Virginia.

**Figure 2.7 West Virginia STRAHNET Roadways and Installations**




*Source: U.S. Department of Transportation Federal Highway Administration, 2020*

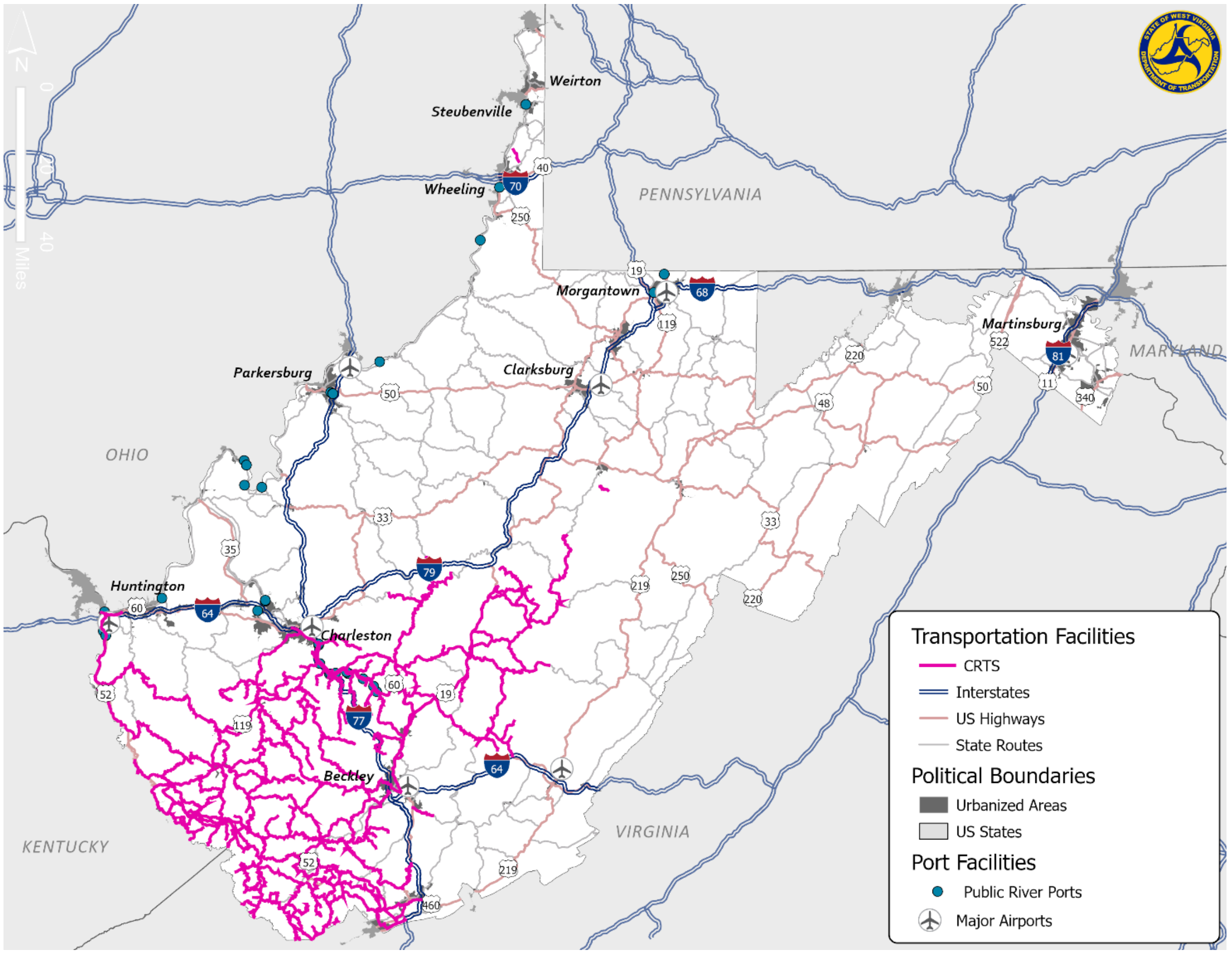
6 Highways for National Defense - STRAHNET Summary.pdf (army.mil)

### 2.4.3 State – Additional Designation for Truck Routes

In addition to federal designations, West Virginia provides State recognized routes for truck traffic specific to the needs of the freight related industries that operate in the State. Using federal designations in conjunction with local expertise, West Virginia has developed the Coal Resource Transportation System (CRTS) and the State Designated Truck Routes, in addition to being incorporated into the Appalachian Development Highway System (ADHS).

The CRTS was created in 2003 out of a need to determine which roadways best supported coal hauler permits for gross vehicle weights (GVW) up to 120,000 pounds.[7] The CRTS includes 15 southern West Virginia counties, with CRTS status determined through the Coal Resource Transportation Designation Committee (CRTDC). The CRTDC was commissioned in 2005, two years after the creation of the CRTS. There are ten counties excluded from the CRTDC jurisdiction, thereby remaining under the jurisdiction of the WVDOH, including Boone, Fayette, Lincoln, Logan, McDowell, Mercer, Mingo, Raleigh, Wayne, and Wyoming counties. Figure 2.8 shows the CRTS across southern and central West Virginia.

**Figure 2.8 West Virginia's Coal Resource Transportation System**




*Source: West Virginia Department of Transportation Division of Highways, 2019*

[7] CRTS (wv.gov)

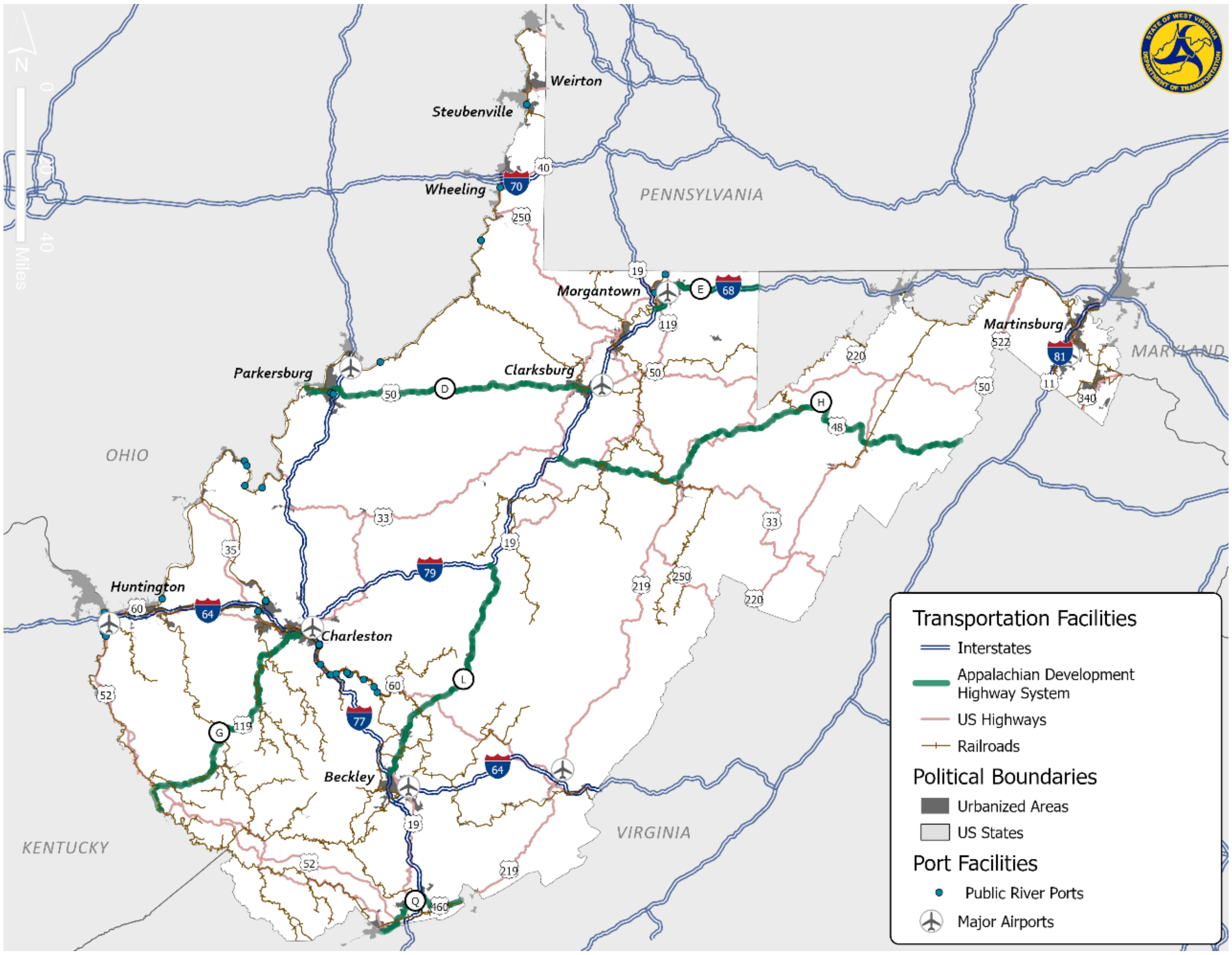
The ADHS was launched in 1965, with specifically dedicated annual funding for its construction from the U.S. Congress.[8] However, in 2012, MAP-21 and its successor, the FAST Act, no longer provided dedicated ADHS funds to States' Departments of Transportation. States were then allowed to build and complete ADHS corridors at their own discretion per a larger more general federal allocation. In 2020, specifically dedicated funding of $100 million was allocated for the purposes of constructing the ADHS. The funds were then distributed to the states based on their relative proportional share of remaining work.[9] As of Fiscal Year 2022, 2,814.8 miles, or 91.1 percent, of the ADHS is under construction or open to traffic. Part of what has not been fully completed is Corridor H in West Virginia. The Appalachian Regional Commission (ARC), the economic development partnership agency responsible for the coalition between the various jurisdictions within the Appalachian region, has stated that by 2040, 100 percent of eligible miles will be complete and open to traffic or, at least, partially complete.

The ADHS is comprised of six distinct segments, each represented by a letter of the alphabet. From southernmost to northernmost the segments are Q, G, L, H, D, and E. Figure 2.9 details the extent of the ADHS in West Virginia. Understanding where funds are likely to be programed for this project can support prioritization of funding for other freight projects. Notably, Corridor H is among the 8.9 percent that remains incomplete, so future completion should be an expectation for infrastructure improvement. Additionally, existing ADHS infrastructure represents a federal commitment to growth and connectivity within and through West Virginia.

[8] Appalachian Development Highway System - Appalachian Regional Commission (arc.gov)

[9] https://www.arc.gov/wp-content/uploads/2020/07/ADHSCompletionPlanReport-9-2013.pdf

### Figure 2.9 West Virginia Appalachian Development Highway System

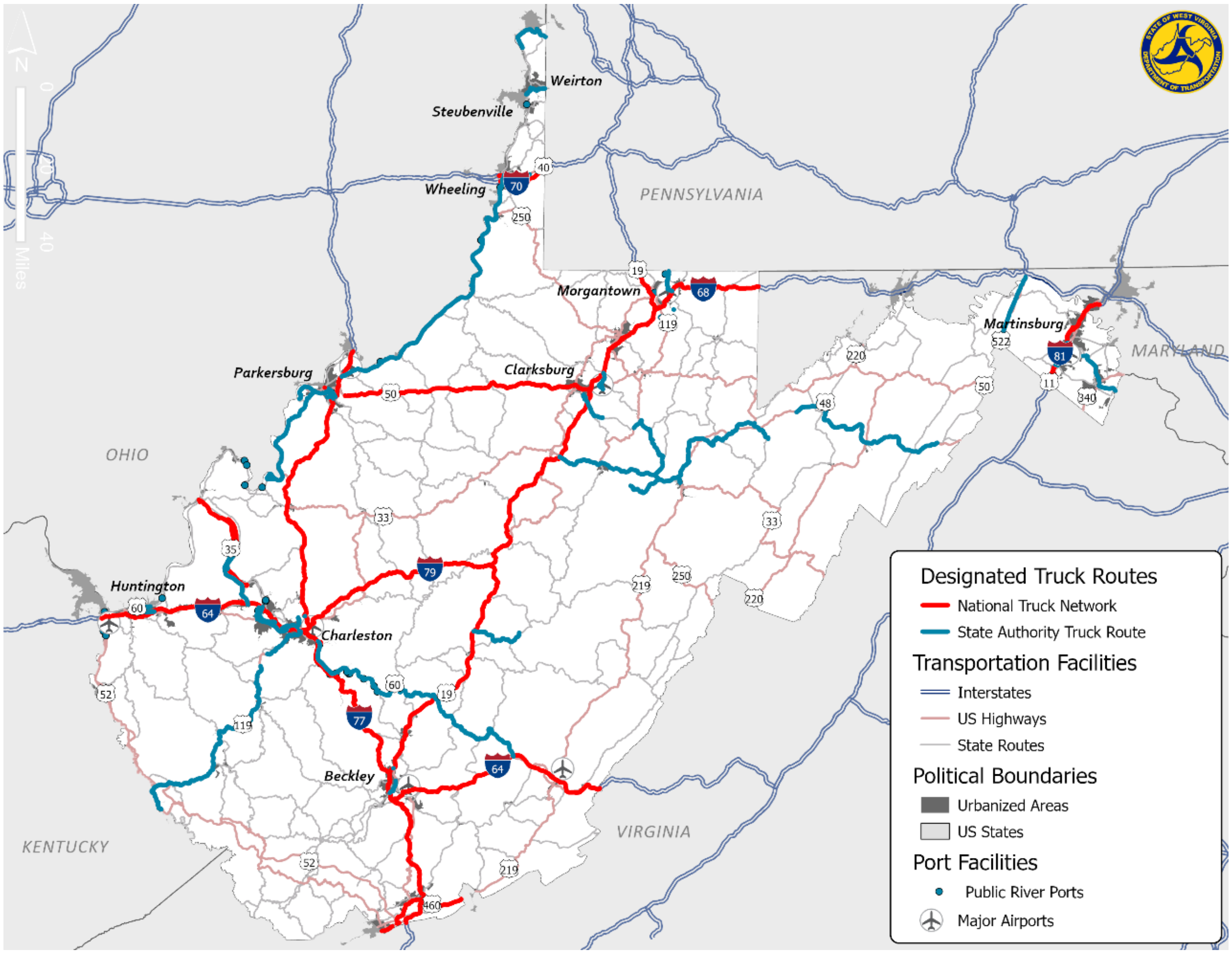



*Source: West Virginia Department of Transportation, 2022*

The State designated truck route map identifies routes that are part of the National Truck Network, as defined in the Code of Federal Regulations Section 658, and routes that are designated under the State authority as truck routes. The State designated truck routes expand on the National Truck Network to include important routes that provide access to and from terminals, facilities for food, fuel, repairs and rest and points of loading and unloading for household goods carriers from such highways and further. These routes are designated by the West Virginia Commissioner of Highways as defined in West Virginia Code article 17 chapter 4.[10] Figure 2.10 shows the State designated truck routes in West Virginia.

[10] West Virginia Code (wvlegislature.gov)

**Figure 2.10 West Virginia Designated Truck Routes**




Source: *West Virginia Department of Transportation, 2022*

## 2.5 Intelligent Transportation Systems

This section of the report inventories the current intelligent transportation system (ITS) and technology programs in the State. Specifically, it summarizes the devices, systems, and data available within WVDOT's existing ITS program. This is important for freight as most of the State's goods travel on the highway system. In this regard, the State's ITS is critical for facilitating the efficient movement of goods and for mitigating disruptions on the system due to crashes and other forms of non-recurring congestion.

The various elements of the State's ITS are managed by Traffic Management Centers (TMC). TMCs serve as operational centers with one or more human operators that provide access to all data collection, processing, and dissemination equipment available. In this sense, they serve as a hub for data movement in traffic management systems. Typically, TMCs correspond to larger metropolitan areas that experience higher traffic volumes. WVDOT operates two TMCs – the WVDOT Central Headquarters TMC and the Marshall University Rahall Transportation Institute Back-Up TMC and Training Center.[11]

Table 2.4 identifies the ITS field devices that are available in the State's Advanced Traffic Management System (ATMS) platform. Notably, WVDOT's devices are completely managed wirelessly as there is no fiber optic cable in the State's system.

### Table 2.3 ITS Device Types

| Device | Statewide Count | Description |
|---|---|---|
| Closed-Circuit Television (CCTV) Camera | 80+ | CCTV cameras provide coverage on high-traffic corridors. They feed back to the traffic management centers, allowing for quick response times to incidents on the road network. |
| Dynamic Message Signs (DMS) | 100+ | Dynamic message signs display important messages to drivers on key corridors. |
| Weigh-in-motion Stations (WIM) | 30 | WIM stations capture and record truck axle weights and GVW as they drive over a sensor. They can also be used to provide vehicle counts. |
| Classification Count Stations (CCS) | 50+ | Classification count stations provide information on both the volume of vehicles traversing a section of roadway and their classification according to the FHWA 13-vehicle classification system. |
| Road Weather Information Systems (RWIS) | 50+ | A Road Weather Information System (RWIS) is comprised of Environmental Sensor Stations (ESS) in the field, a communication system for data transfer, and central systems to collect field data from numerous ESS. These stations measure atmospheric, pavement and/or water level conditions. |

*Source: Federal Highway Administration, 2022*

Dynamic message signs (DMS) are electronic signs that have the capability of changing part or all of a sign's message. Most DMS are the large electronic signs that appear over highways, but smaller versions can be found on other routes. DMS can be used for many applications regarding traffic management, public safety, and evacuation. Together with CCTV cameras, DMS are important for mitigating disruptions on the system due to incidents and other unpredictable events as they allow WVDOT to convey timely information on travel conditions to the traveling public. There are 80+ DMS and 100+ CCTV cameras deployed throughout the State.[12]

Road weather information systems (RWIS) collect data on atmospheric conditions, pavement conditions, water level data using environmental sensor stations (ESS). ESS are fixed roadway locations with one or more sensors for measuring these data. RWIS process observations from ESS to develop detailed descriptions of current weather conditions or near-term forecasts, and display or disseminate road weather information to DOT and emergency management agencies to support decision making. There are 50+ ESS deployed throughout the State in support of the RWIS.[13]

WVDOT owns dedicated Weigh-In-Motion (WIM) and continuous count stations (CCS) around the State that are used to collect data for planning purposes. While CCS are both owned and operated by WVDOT, WIM stations are owned by WVDOT but jointly operated with the West Virginia State Police. WIM is a technology

[11] https://www.q-free.com/reference/wvdoh-tmc-statewide-atms-west-virginia/

[12] https://transportation.wv.gov/highways/programplanning/LRTP/Documents/Highways_FactSheet_Final.pdf

[13] Ibid.

that estimates vehicle weights of at-speed trucks to (1) inventory the percentage of overweight vehicles at a given location, (2) collect and classify traffic data for planning activities, and (3) provide notification of a likely overweight vehicle for law enforcement to investigate. Continuous count stations collect average annual daily traffic information and other data, typically through loop detectors. There are 30 WIM stations and CCS deployed throughout the State.

In addition to these field devices, WVDOT incorporates 511 into its ITS program and operates a truck parking availability system (TPAS). The 511 program was established by the Federal Communications Commission (FCC) in 2000 with the goal of providing a single national phone number as the source for all things related to traveler information. Several states, including West Virginia, incorporate 511 into its ITS program as a traveler information dissemination method. WVDOT operates a TPAS along I-81 which monitors real-time usage of truck parking and disseminates that information to motor carriers via dynamic message signs, 511, and mobile applications.

## 2.6 OS/OW Network and Weigh Stations

The issuance of Oversized Overweight (OS/OW) permits, and the enforcement of size and weight restrictions are among the more critical freight related functions of the WVDOH. West Virginia publicizes OS/OW restrictions on the Legal Size and Weight Limits site, and sources permit applications through their partner site GotPermits,com. This section details the restrictions within the West Virginia roadway network, the methods of permit issuance, and the infrastructure used to monitor OS/OW vehicles,

### *2.6.1 Size and Weight Restrictions*

In West Virginia, the legal size and weight limits are defined in West Virginia Code Chapter 17C, Articles 17-1 through 18-1[14]. The weight limitations are largely standardized for interstate highways, where gross vehicle weight (GVW) is not to exceed 80,000 pounds and follows the Federal Bridge Formula, including additional restrictions for single unit vehicles due to the nature of reduced load dispersion. West Virginia applies similar restrictions to U.S. and State routes, wherein GVW is not to exceed 80,000 pounds, but implements a generalized weight limitation scheme dependent on truck type and axel count. Finally, local routes cap GVW at 65,000, but follow the same single unit restrictions as interstate. Notably, U.S., State and local routes all integrate a 10 percent tolerance, while interstates do not and follow the federal guidelines[15].

The size limits are largely more standardized by roadway type, with some specifications dependent on the vehicle type. All vehicles are required to have a height of no more than 13 feet 6 inches, unless otherwise identified low clearance, and vehicle width is to not exceed 8 feet on local service routes where lane width is less than 10 feet, or 8 feet 6 inches for any route where lane width is 10 feet or more. Front overhang cannot exceed 3 feet, and rear overhang cannot exceed 6 feet. The overall allowable length is where vehicle type dependencies apply, a full list of which are available on the Legal Size and Weight Limits page of the West Virginia Department of Transportation website, but general requirements include 55 and 70 foot limitations on county roads and U.S./State routes, respectively, and no length limitations on interstates and National Network Highways.

[14] West Virginia Code | §17C-17 (wvlegislature.gov)

[15] Legal Size and Weight Limits (wv.gov)

### 2.6.2 OS/OW Vehicles

Oversize and overweight vehicles are a common occurrence in West Virginia. Many of the freight generating industries in the State, including resource acquisition and machinery, can require permit to move cargo. For this reason, there are three types of OS/OW permits in West Virginia designed to support freight movement within and through the State: single trip, blanket – regular, and blanket – seagoing.

Single trip permits are important for infrequent or need based freight movement. Permits of this type are largely designed for unique instances, such as mobile home relocation or one time transport of uniquely shaped and sized items like machinery or pre-molded infrastructure. For single trip permits, there is additional size restrictions for mobile home trips, including a width limitation of 16 feet, height limitation of 15 feet 6 inches, and a length of 80 feet (110 feet combined).

Blanket permits are yearlong permits that are subdivided into regular and seagoing permits. The regular permit is either oversized only, or both oversized and overweight. The permit requires that the load be non-divisible, which would suggest a focus on industries with uniquely shaped products or cargo. The seagoing permits are specific to overweight containerized cargo. The target market for seagoing permits would largely focus on freight trips associated with the Ohio River, international east-coast ports, or inbound/outbound containers moving processed food, household and office supplies, or medical cargo.

West Virginia largely standardizes their OS/OW by roadway classification, but there are additional route, weight, size, and date/day of week restrictions[16]. The State now grants weekend travel when requested for anything under 14 feet wide, but limits travel on many of the major federal holidays, like Christmas Day and Independence Day. The State also details approved routes and weight and clearance restricted routes for annual blanket permits so permit purchasers can establish routes that can support their regular traffic. This includes specifically detailing routes that are capable of supporting vehicles carrying timber products[17]. Additionally, special requirements are made for vehicles approved for low-impact bridge crossings, including speed and State monitored requirements to ensure safe passage and infrastructure longevity. While each load will require individual research to determine the need and extent of permitting, the State provides ample resources to ensure compliance is easy and efficient.

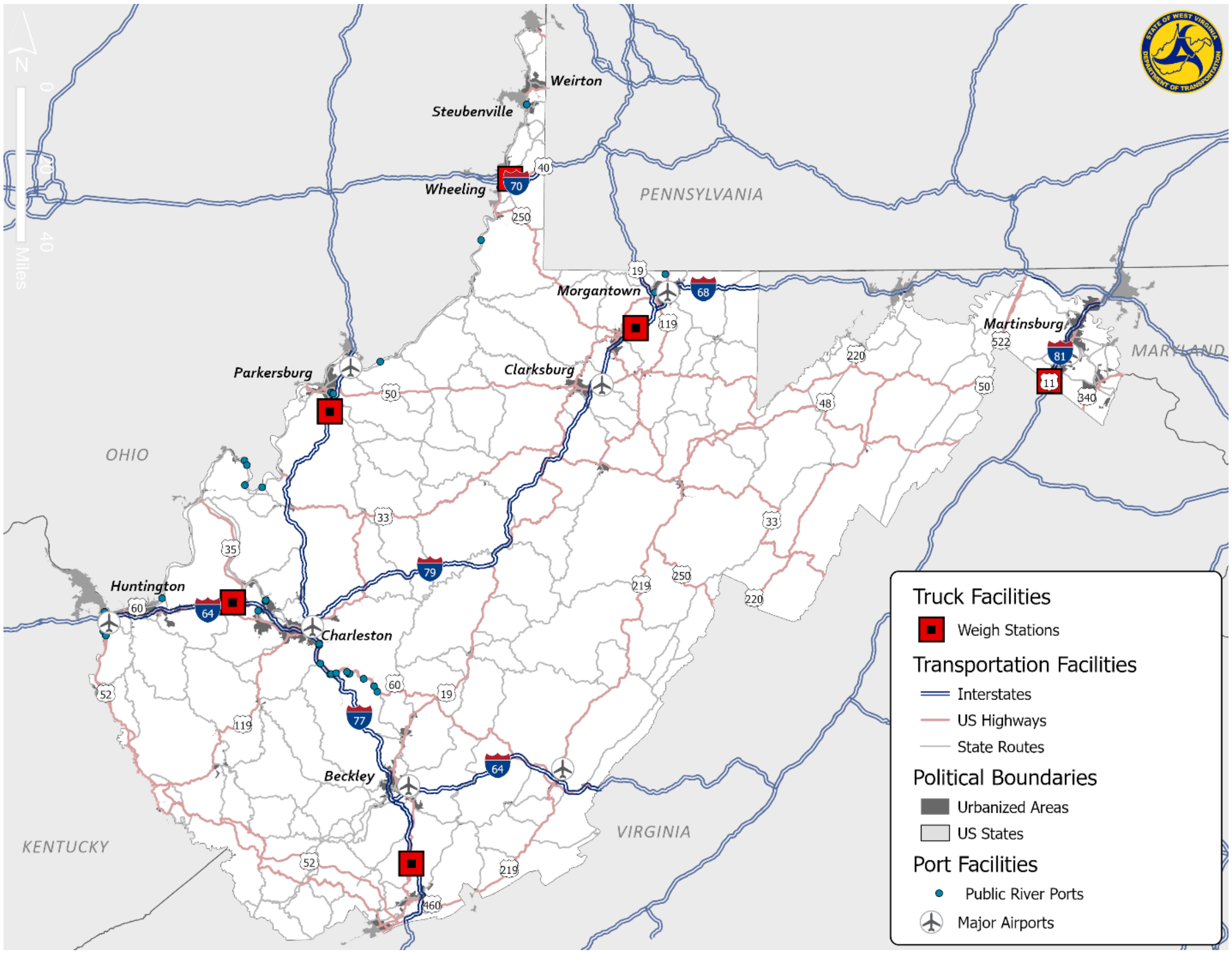
### 2.6.3 Weigh Stations

Weigh stations serve to monitor freight vehicles to ensure that they are not over their size limitations, which can have a larger impact on roadway conditions and safety. Additionally, weigh stations may also be used for truck parking, especially in emergency situations such as inclement weather or highway closures. There are six weigh stations in West Virginia. As shown in Figure 2.11, the weigh stations exist across the State near most of the interstate border crossings, including I-70, I-79, I-81, I-64, and two locations on I-77. In addition to traditional weigh stations, West Virginia deploys weigh-in-motion (WIM) stations which enhance the flow of freight movement by eliminating delays caused by having to exit the main lanes of the highway.

[16] Oversize/Overweight Hauling Permits (wv.gov)

[17] Microsoft Word - Selected Routes for Timber Permit (wv.gov)

**Figure 2.11. West Virginia Weigh Stations**




*Source: West Virginia Department of Transportation.*

## 2.7 Truck Parking Inventory

Truck parking facilities are essential for truck movements across West Virginia's highways. Truck drivers require places to take mandatory breaks during the day and overnight, refuel their vehicles, and coordinate delivery windows with their final destination. Inadequate truck parking supplies forces these drivers to make difficult choices that compromise their and other roadway users' safety- such as driving outside of their scheduled hours, possibly in an overtired state, or parking in undesignated areas that could be unsafe for the driver or create roadway hazards.

### *2.7.1 Methodology*

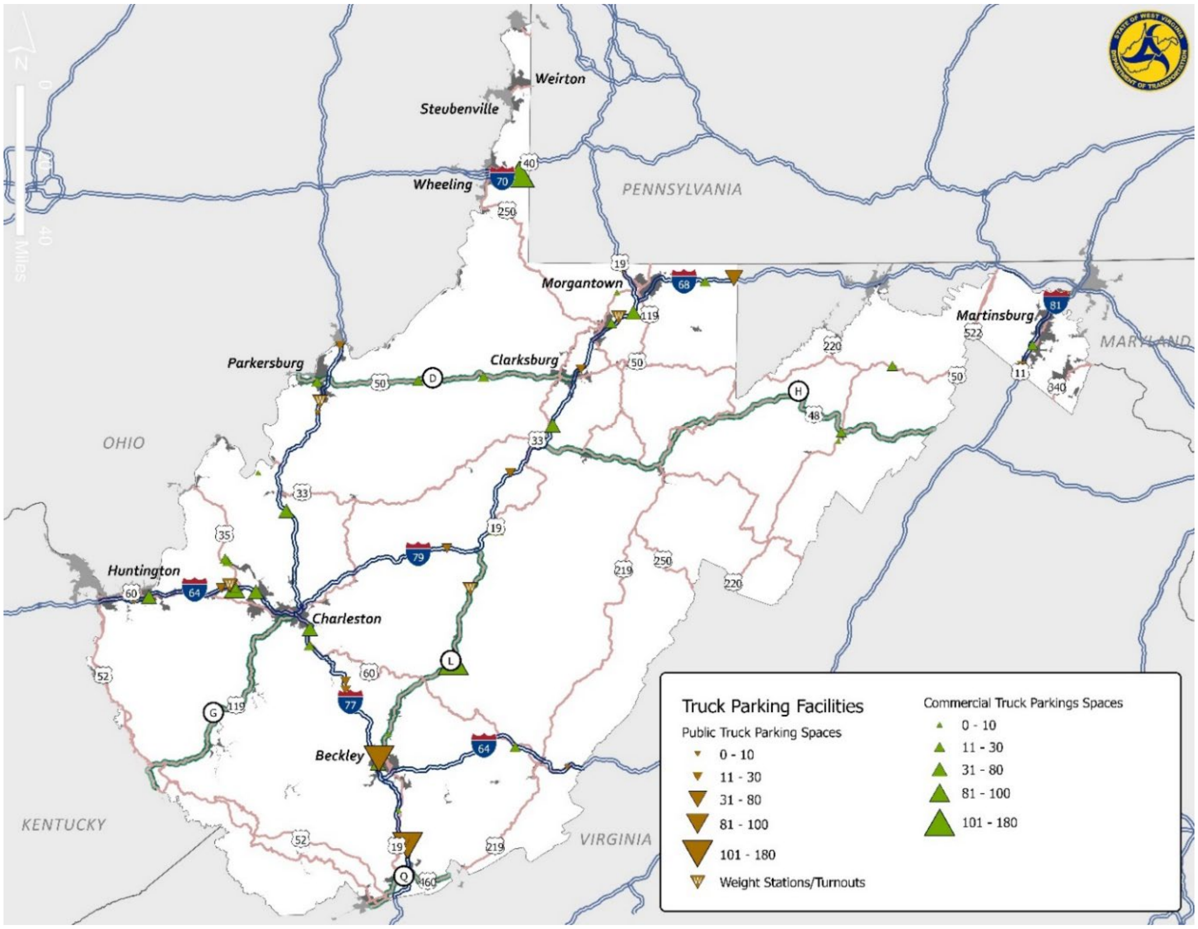
Data on the location and capacity of truck parking facilities was gathered from previous WVDOT inventory initiatives, the Jason Law surveys of the State, third-party websites (e.g., TruckStopGuide.com, Trucker Path), company websites (e.g., Pilot, Flying J, etc.), and from examining current aerial maps. The inventory of truck parking facilities covers both public and commercial facilities. Public facilities include rest areas and welcome centers which are owned by WVDOT, are located adjacent to State highways and federal interstates, and provide parking and access to restrooms, vending machines, and other basic services. Most commercial vehicle weigh stations in West Virginia have parking spaces for trucks, although they are dedicated for conducting inspections and other weigh station business, and not intended for general truck parking needs. Importantly, in cases where public facilities were co-located, but separated by a median barrier (e.g., an eastbound facility and a separate westbound facility directly across the highway), each facility was counted separately as part of the analysis. Commercial truck parking facilities are private businesses that typically provide fuel, and often offer food, showers, and other services for truck drivers.

Information on the capacity (i.e., number of spaces) of truck parking facilities reported from the various data sources was not always consistent. Sources from official reporting such as company websites or public data were used when available. In cases where firsthand data was unavailable, information on capacity from third party sources such as mobile applications were collected and compared to aerial imagery to estimate the number of spaces available.  Using this methodology, every public facility –regardless of capacity- and any private facility with at least 10 parking spaces were included as part of the State's truck parking inventory.

## 2.7.2 Inventory

In total, there are 60 truck parking facilities – public and commercial - included in the inventory analysis. These facilities provide approximately 1,860 truck parking spaces in West Virginia. Figure 2.12: Truck Parking Inventory in West Virginia displays truck parking locations across the State.

**Figure 2.12 Truck Parking Inventory in West Virginia**




*Source: West Virginia Department of Transportation, 2022*

Table 2.5 groups truck parking facilities by seven typologies which describe the level of amenities usually present at the facility for truck drivers. Public facilities are based on West Virginia DOT's naming conventions. Rest areas and welcome centers both provide parking, restrooms, and potentially vending machines. Travel plazas provide amenities typical of a gas station by partnering with commercial entities who provide food and fuel for drivers.

### Table 2.4 Truck Parking Typologies

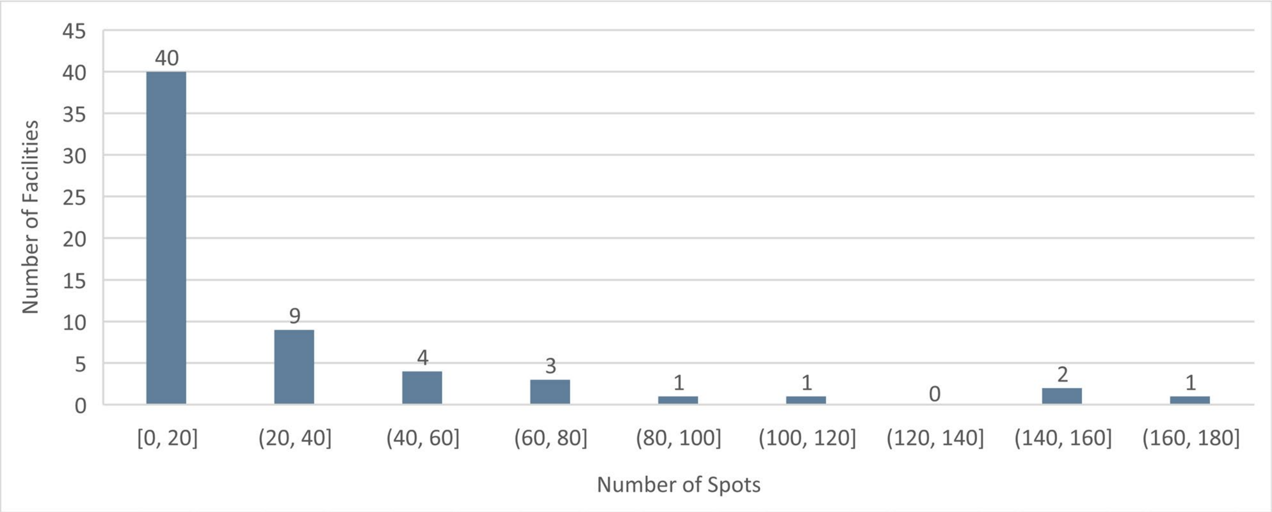
| | Type of Facilities | Number of Facilities | Parking Capacity |
|---|---|---|---|
| Public | Travel Plaza | 2 (3%) | 137 (7%) |
| | Welcome Center | 9 (15%) | 283 (15%) |
| | Rest Area | 13 (22%) | 216 (12%) |
| Commercial | Truck Stop | 9 (15%) | 755 (41%) |
| | Gas Station | 22 (37%) | 414 (22%) |
| | Other Commercial Facilities | 5 (8%) | 55 (3%) |
| | ***Total*** | ***60*** | ***1860*** |

*Source: West Virginia Department of Transportation, 2022*

Commercial facilities include truck stops which provide full service amenities such as specialized fueling stations, maintenance facilities, showers, food, etc. Gas stations typically provide fuel, food, and restrooms, but not the other amenities offered at full service truck stops. Other commercial facilities are any facility that does not provide fuel but allow drivers to park overnight. These include restaurants, retail establishments, and commercial parking lots.

Commercial facilities make up 66 percent of the total truck parking capacity in West Virginia. The nine full-amenity truck stops in the State account for 755 spots or 41 percent of the State's capacity. However, the typical truck parking facility in West Virginia provides 10 – 20 spots. As shown in Figure 2.13, 40 facilities (or 67 percent of all facilities in the State) have 20 or less spots.

### Figure 2.13 Distribution of Truck Parking Capacity




*Source: West Virginia Department of Transportation, 2022*

Table 2.6 shows the total number of private and commercial parking spaces by type of roadway. When analyzing parking facilities at the intersection of two major roadways the higher classification roadway was given precedent (e.g., interstates > U.S. Highways > State Routes). 16 facilities were located at intersections accounting for 523 parking spots in West Virginia. 82 percent of West Virginia trucking capacity (or 1,524 spots) are along interstate corridors or interchanges of interstates and other major facilities. About 35 percent of the State's truck parking capacity is publicly provided via travel plazas, rest areas, and welcome centers. All of the State's public facilities are located adjacent to interstates or interchanges between interstates and other major facilities. The majority of commercially provided truck parking capacity is also proximate to interstates. About 72 percent (873 spaces in total) of commercial truck parking spaces are along interstates.

### Table 2.5 Truck Parking Capacity by Roadway Type

| Roadway Type | Public | Commercial | Total |
|---|---|---|---|
| **Interstate** | 651 | 873 | 1,524 |
| **U.S. Highway** | 0 | 303 | 303 |
| **State Route** | 0 | 33 | 33 |
| ***Total*** | **651** | **1,209** | **1,860** |

*Source: West Virginia Department of Transportation, 2022*

Table 2.7 provides details on truck parking capacity at the corridor level. For example, the I-77 corridor contains the largest share of both public and commercial truck parking capacity. Nearly 56 percent of public spaces and nearly 21 percent of commercial spaces are located along I-77. It is followed by I-79 and I-64 in terms of total capacity. These three corridors alone account for 64 percent of the State's total truck parking capacity.

### Table 2.6 Total Truck Parking Facilities by Corridor

| Corridor | Number of Public Parking Spaces | Percent of Total Public Parking Spaces | Number of Commercial Parking Spaces | Percent of Commercial Parking Spaces | Total Parking Spaces | Percent of Total Parking Spaces |
|---|---|---|---|---|---|---|
| **I-77** | 367 | 56% | 253 | 21% | 620 | 33% |
| **I-79** | 126 | 19% | 252 | 21% | 378 | 20% |
| **I-64** | 60 | 9% | 150 | 12% | 210 | 11% |
| **US-19** | 0 | 0% | 195 | 16% | 195 | 10% |
| **I-70** | 0 | 0% | 170 | 14% | 170 | 9% |
| **I-81** | 54 | 8% | 28 | 2% | 82 | 4% |
| **US-50** | 0 | 0% | 76 | 6% | 76 | 4% |
| **I-68** | 44 | 7% | 20 | 2% | 64 | 3% |
| **Rt-817** | 0 | 0% | 33 | 3% | 33 | 2% |
| **US-220** | 0 | 0% | 22 | 2% | 22 | 1% |
| **US-340** | 0 | 0% | 10 | 1% | 10 | 1% |
| ***Total*** | **651** | **100%** | **1,209** | **100%** | **1,860** | **100%** |

*Source: West Virginia Department of Transportation, 2022*

Table 2.8 shows the number of parking facilities and truck parking spaces by WVDOT district. The State is divided into 10 transportation districts, which are each comprised of multiple counties. The results in Table 2.8 indicate that districts generally have a comparable number of public facilities - between 10 to 20 percent – but with a few outliers. Districts 1 and 10 have the largest truck parking supply. Together, they account for about 36 percent of all truck parking spaces. Four of the State's 6 interstates traverse District 1, which likely contributes to the prevalence of commercial facilities. District 10 is traversed by two interstates – I-77 and I-64. Notably, I-77 provides access to the Charlotte, NC metropolitan area which likely contributes to the prevalence of truck parking capacity along this corridor. Districts 2 and 8 have notably small shares of the State's overall truck parking capacity. District 8 has no capacity, while District 2 has only 3 percent. Both Districts 2 and 8 are heavily forested and mountainous and contain multiple wildlife management areas, state parks, national forests, and other environmentally sensitive areas. This limits the suitability of much of these districts for truck parking facilities.

### Table 2.7 Total Number of Truck Parking Facilities and Spaces

| District | Number of Public Parking Spaces | Percent of Total Public Parking Spaces | Number of Commercial Parking Spaces | Percent of Commercial Parking Spaces | Total Parking Spaces | Percent of Total Parking Spaces |
|---|---|---|---|---|---|---|
| 1 | 80 | 12% | 268 | 22% | 348 | 19% |
| 2 | 20 | 3% | 37 | 3% | 57 | 3% |
| 3 | 43 | 7% | 136 | 11% | 179 | 10% |
| 4 | 98 | 15% | 135 | 11% | 233 | 13% |
| 5 | 54 | 8% | 78 | 6% | 132 | 7% |
| 6 | 0 | 0% | 170 | 14% | 170 | 9% |
| 7 | 72 | 11% | 146 | 12% | 218 | 12% |
| 8 | 0 | 0% | 0 | 0% | 0 | 0% |
| 9 | 8 | 1% | 197 | 16% | 205 | 11% |
| 10 | 276 | 42% | 42 | 3% | 318 | 17% |
| **Total** | **651** | **100%** | **1,209** | **0.98** | **1,860** | **100%** |

*Source: West Virginia Department of Transportation, 2022*

# 3.0 HIGHWAY FREIGHT TRANSPORTATION DEMAND

This section discusses West Virginia's Highway Freight Transportation Demand, measured as the extent to which carriers and shippers use the State's roadway network. The metrics for demand include average volume of freight vehicles, types and quantity of commodities moved, the value of the commodities moved, and the utilization of truck parking infrastructure. The State supports a wide range of industries, moving cargo including coal and gravel sourced directly from the State, manufactured goods like rubber and plastics, machinery, and machine parts such as those for vehicles, and dozens of other freight commodities. As one of a few gateways through the Appalachian Mountains, the State's through corridors provide a critical link between the Midwest and the Northeast.

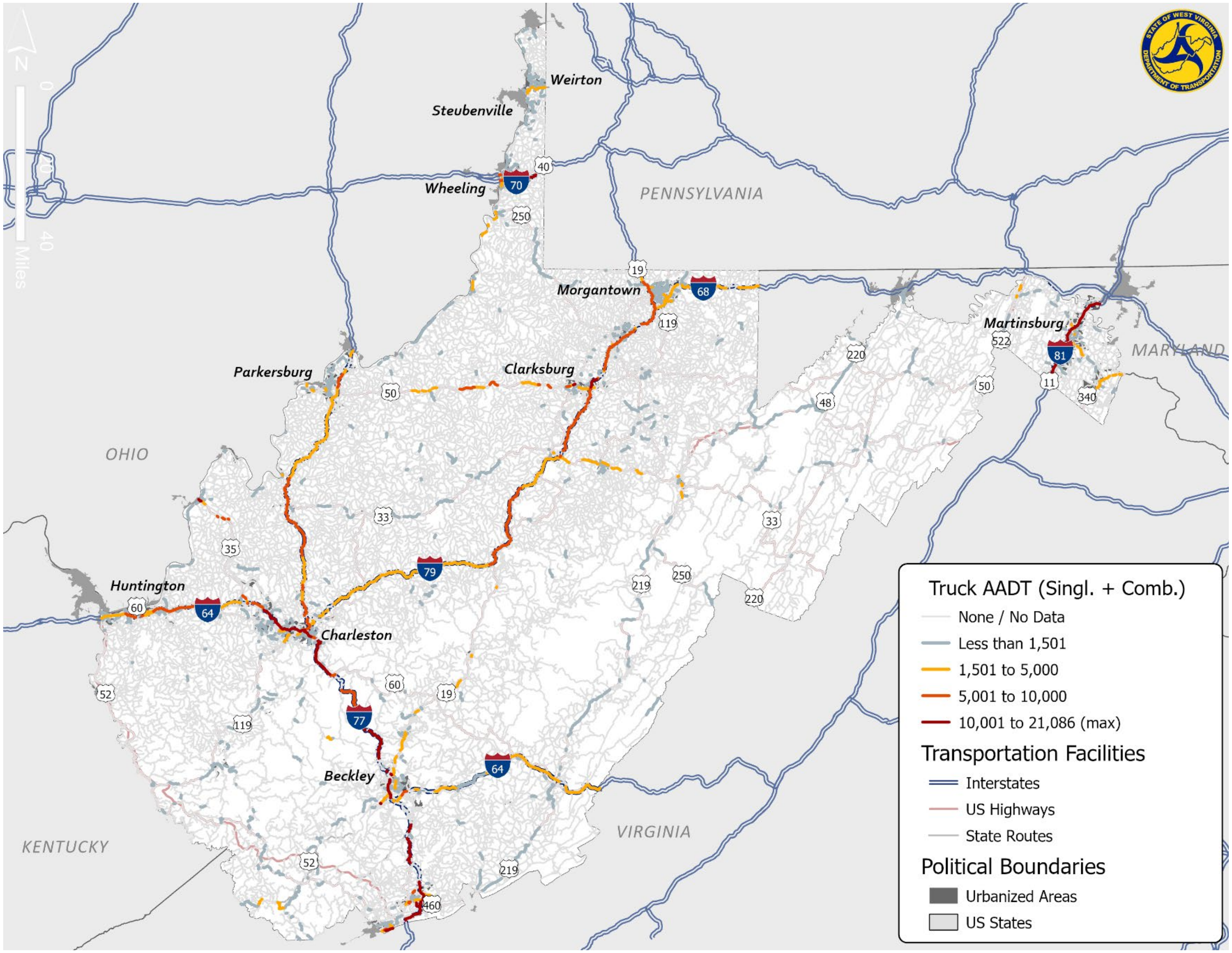
Much of the State's roadway freight volumes run along the interstates, which include I-64, I-77, and I-79 as the major bisecting routes, along with I-81 in the northeast panhandle and I-70 in the northwest. Additionally, much of the State's highway freight by tonnage is coal, gravel, fuels, timber, and other raw and processed materials. These bulk materials can require more trucks, with higher capacity, which can drive freight trips and therefore truck volumes and parking utilization. It is important to understand the dynamics of the core freight industries to program appropriate freight projects.

## 3.1 Truck Volumes and Users – Interstate & Non-Interstate

There are approximately 1,300 interstate miles in West Virginia, with an additional 37,850 non-interstate miles. Despite making up the smallest share of roadway miles in the State, interstates constitute the highest share of truck AADT. There also exists lower volumes of trucks on many of the U.S. routes throughout the State, and some of the State or local roadways. The truck volumes largely follow the roadway classification inventory, where higher order roadways carry the majority of the traffic. This implies a roadway network that is well suited to support existing industries and freight commodities.

The location and intensity of truck volumes, as presented in Figure 3.1, suggest there are widely distributed rural freight corridors providing niche service to freight related industries. This is notable in the southern portion of the State and the north central region just west of the Appalachian range. Additionally, there are modestly trafficked alternative fright corridors providing a more direct route to in-state destinations. These include routes such as the US-219/250 providing a north-south alternative on the eastern border of the State, and US-50 and US-48 connecting central West Virginia with I-79 and the Ohio River. The highest measured truck AADT on non-interstate roadway is 13,629 on a roadway in the south of the State that serves as a connector from I-77 to the City of Princeton.

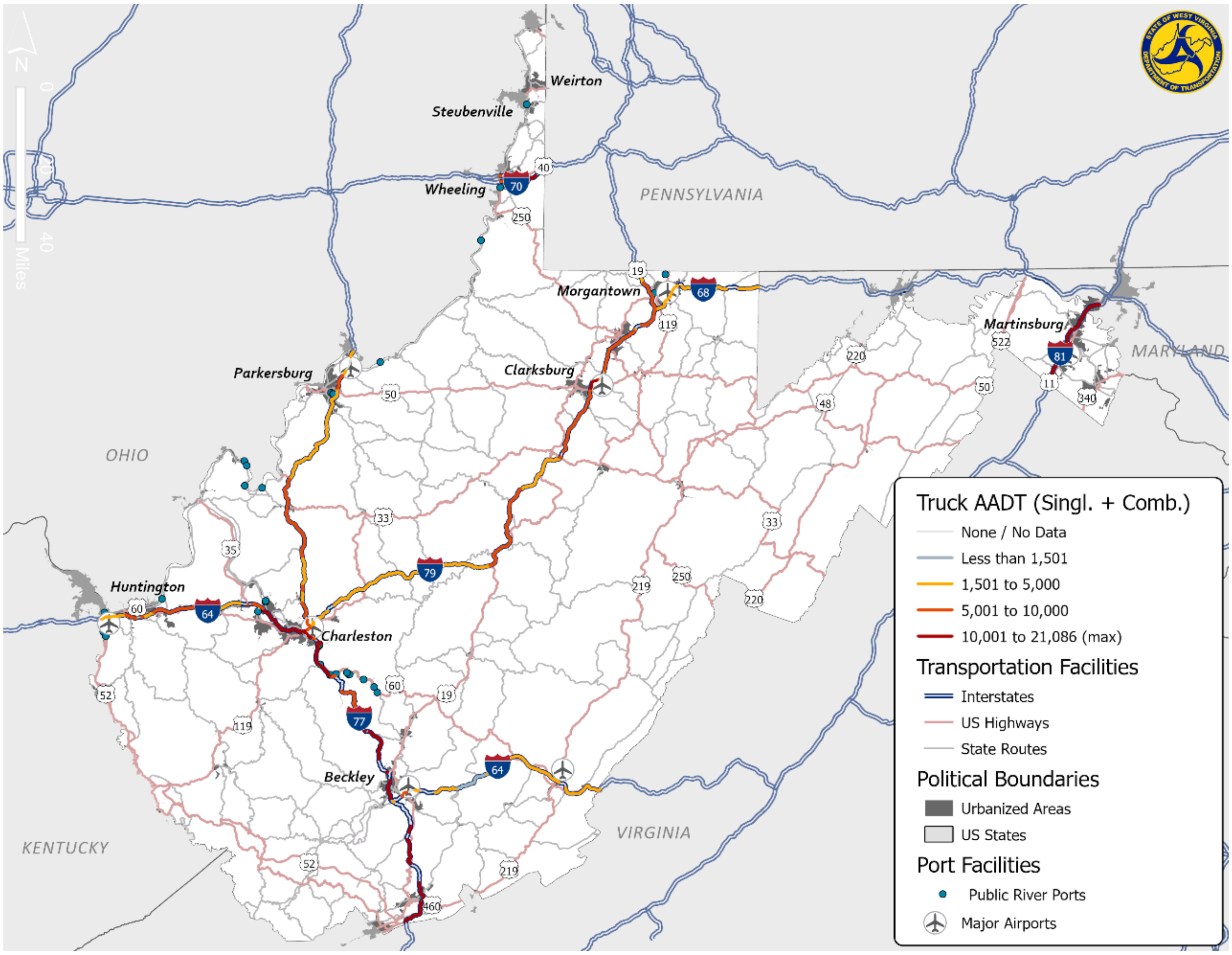
**Figure 3.1 West Virginia Truck AADT – Single and Combination Trucks, 2020**




*Source: West Virginia Department of Transportation Dataset, 2020*

Interstates around the Charleston area support some of the highest truck volumes in the State, with segments regularly exceeding 15,000 truck per day on average in 2020. While not the highest truck volumes in the State, the I-81 corridor in the eastern panhandle through Martinsburg also supports over 15,000 trucks per day on portions of the interstate. While both corridors support the highest volumes of trucks in the State, they do not do so for the same reason. From Figure 3.2, the Charleston area appears to be a freight generator while also serving as a facilitator for truck movements between the converging interstate routes. The segment of I-81 that crosses through the State appears to be positioned for through movements for travel along the eastern side of the Appalachians. Notably, portions of the West Virginia Turnpike are carrying large volumes of trucks, indicating a substantial among of traffic entering and departing the interstate in this area, likely in part from the various coal and raw materials industries.

**Figure 3.2 West Virginia Interstate Only Truck AADT – Single and Combination Trucks, 2020**




*Source: West Virginia Department of Transportation Dataset, 2020*

Roadways in West Virginia with truck AADT in excess of 15,000 are exclusively interstates, namely I-77 and I-81. Table 3.1 shows the directional segments of interstate that exceed 15,000 truck AADT, which are also the top 10 highest truck AADT segments. All ten segments are in the northbound direction, further suggesting there is induced demand from processing and manufacturing in the Charleston area that drives a substantial amount of truck traffic, and that the I-81 West Virginia section is primarily a through route for access to the major northeast U.S. metro areas. The northbound flow along I-77 also suggests the population centers in the State correspond with the truck routes.

**Table 3.1 West Virginia Roadways with 15,000 Directional Truck AADT**

| Roadway | Location Description | Truck AADT |
|---|---|---|
| I-77 NB | I-77 NB at the US-19 interchange (Mountaineer Expressway) near Beckley and Raleigh. | 21,086 |
| I-77 NB | I-77 NB north of the Harper Rd. interchange (SR-3) between Harper and Beckley | 19,800 |
| I-81 NB | I-81 NB north of Apple Harvest Dr. interchange (SR-45) in Martinsburg | 19,796 |
| I-77 NB | I-77 NB south of the Harper Rd. interchange (SR-3) between Harper and Beckley | 16,701 |
| I-77 NB | I-77 NB south of the Lens Creed Rd. interchange (SR-94) in Chesapeake | 16,697 |
| I-81 NB | I-81 NB south of Hedgesville Rd. interchange (SR-9) to Dry Run Road interchange (SR-14) in Martinsburg | 16,284 |
| I-81 NB | I-81 NB south of Dry Run Road interchange (SR-14) in Martinsburg | 16,091 |
| I-77 NB | I-77 NB at the I-77/US-119 NB interchange in Charleston | 16,041 |
| I-77 NB | I-77 NB at the Coal Heritage Trail / Robert C Byrd Dr. interchange (SR-16) in MacArthur | 15,548 |
| I-77 NB | I-77 NB north of the Coal Heritage Trail / Robert C Byrd Dr. interchange (SR-16) in MacArthur | 15,117 |

*Source: West Virginia Department of Transportation, 2022*

## 3.2 Commodity Flow Analysis

This section presents West Virginia Highway Commodity Flow Analysis. The analysis utilizes the Freight Analysis Framework – Version 5 (FAF5) data to determine freight flows across the nation. The FAF is produced through a partnership between BTS and FHWA, and integrates data from various sources to create a comprehensive picture of freight movement among states and major metropolitan areas by all modes of transportation. The current version provides estimates for tonnage, value, and ton-miles by origin-destination pair of FAF regions, commodity type, and mode. Additionally, the current base year is 2020 with a future year of 2050.The following section details the existing highway freight flows, and future estimated flow, in West Virginia.

### *3.2.1 Truck Directional Freight*

In In 2019, more than 122 million tons of goods, valued at $83 billion were transported by truck with an average value of approximately $776 per ton.

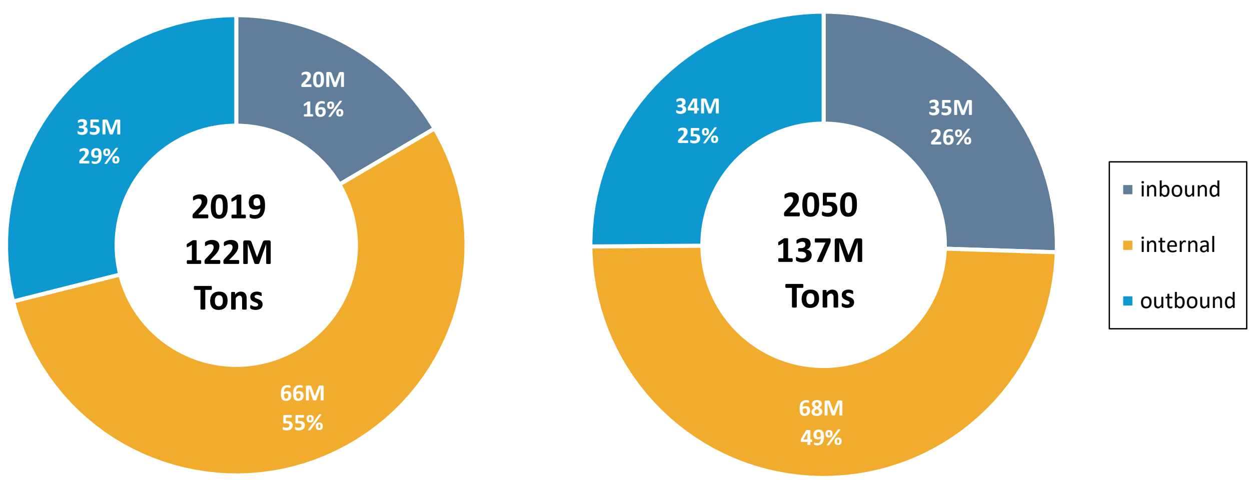
Internal traffic made up the largest share of highway movement. In 2019, more than 66 million tons of goods, valued at $21 billion. The average tonnage value for internal truck flow was $318.

Outbound flow transported 35 million tons of commodity in 2019, consisting of 29 percent of the total truck tonnage, valued at $31 billion (37 percent of total truck flow value). The average tonnage value for outbound truck flow was approximately $886.

Inbound truck flow made up the lowest total truck flow tonnage ratio (20 million tons, 16 percent) and the highest total truck flow value ($32 billion, 38 percent) among all truck flow directions in 2019. The average tonnage value for inbound truck flow was approximately $1,600.

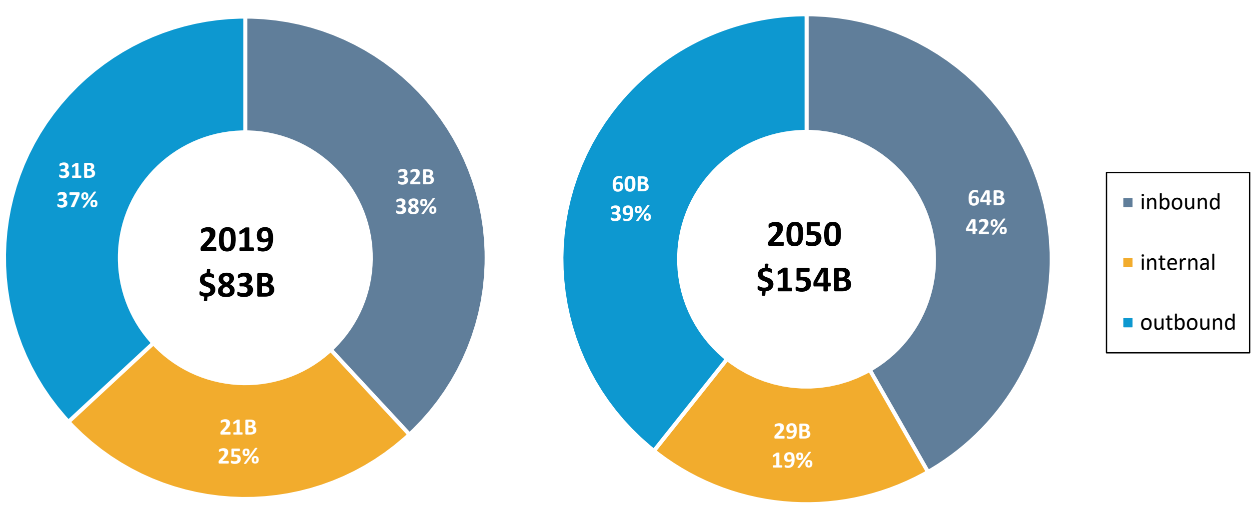
In 2050, the projected total truck movement will reach 137 million tons (12 percent increase compared with 2019 tonnage), valued at $154 billion (85 percent increase based on 2019 value). Figure 3.3 and Figure 3.4show the balance of inbound, internal, and outbound truck flow tonnage and value in 2019 and 2050.

Figure 3.3 West Virginia Truck Tonnage by Direction, 2019 and 2050




*Source: FAF5*

**Figure 3.4 West Virginia Truck Value by Direction, 2019 and 2050**

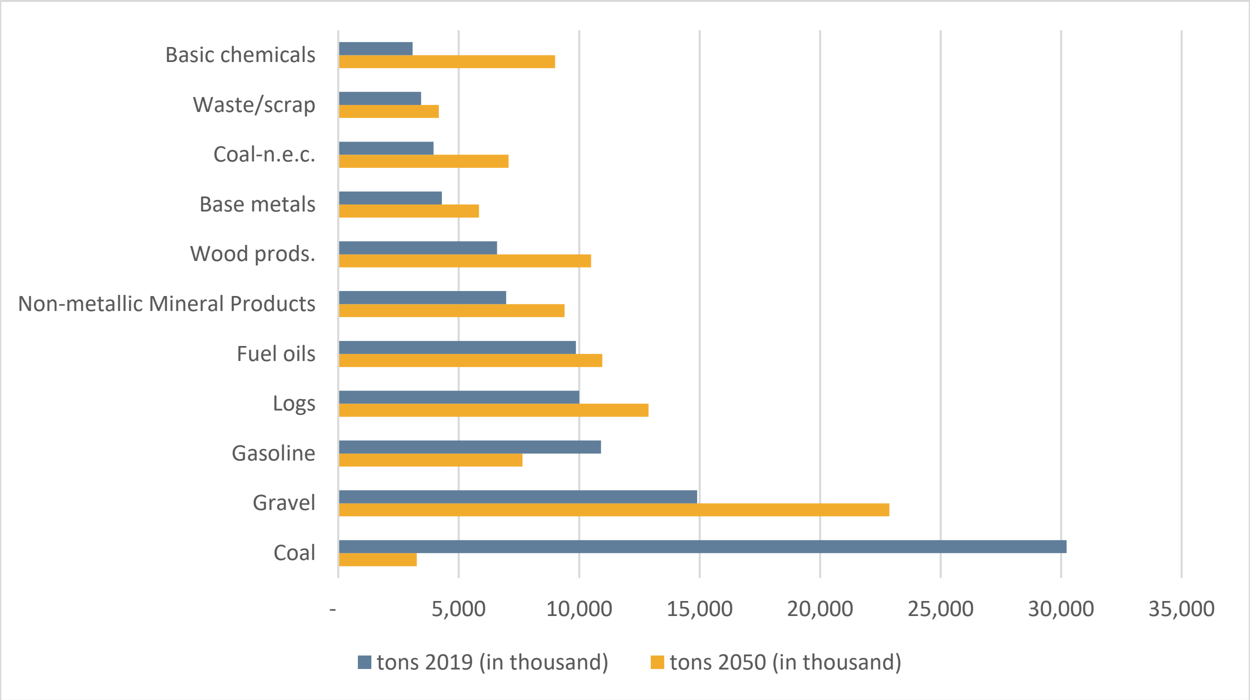



*Source: FAF5*

### 3.2.2 Top Truck Commodities

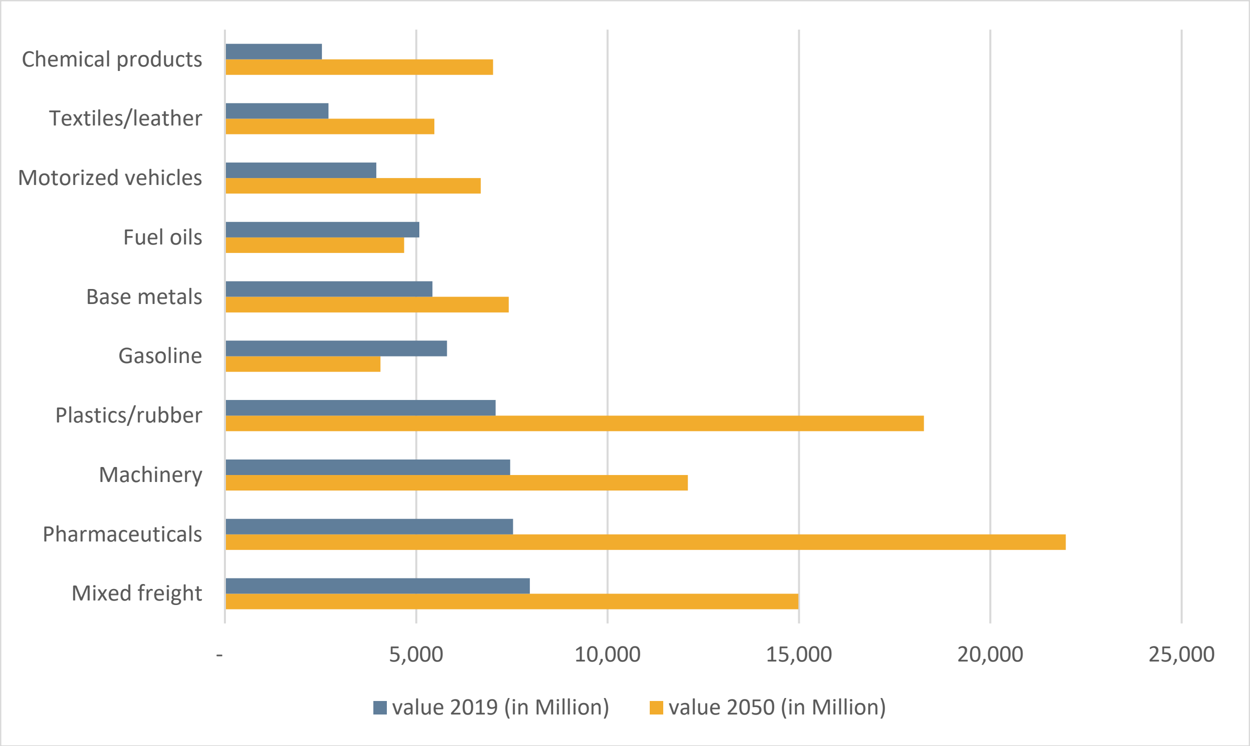
The coal industry is the leading industry in West Virginia. In 2021, West Virginia was ranked the second-largest coal producer in the U.S. Figure 3.5 and Figure 3.6 show the 2019 top 10 truck commodity by tonnage and value, respectively. As figures show, trucks transported approximately 30 million tons of coal in 2019, accounting for 25 percent of the total truck flow. However, with the continuing decline in the coal industry, the tonnage of coal transport by truck is projected to shrink drastically in 2050, truck will transport 3 million tons of coal, accounting for 2 percent of 2050 total truck flow. The second leading truck commodity by tonnage is gravel. In 2019, nearly 15 million tons of gravel were transported by truck, accounting for 12 percent of the total truck flow, and the number is projected to increase to 23 million tons, accounting for 17 percent of the 2050 total truck flow. Gasoline is the third leading truck commodity by tonnage. In 2019, approximately 11 million tons of gasoline were transported by truck, accounting for 9 percent of the total truck flow. The projected gasoline tonnage is estimated to decline to 8 million tons in 2050, accounting for 6 percent of total 2050 truck freight tonnage. Combined, the top 10 commodity in 2019 made up 83 percent of total truck tonnage. In 2050, these commodities account for 76 percent of total truck tonnage. Gravel is estimated to be the leading commodity by truck tonnage, followed by logs (13 million tons, 9 percent of the total truck tonnage). Fuel oils will remain the third major truck commodity by tonnage in 2050.

**Figure 3.5 West Virginia Top 10 Truck Commodities by Tonnage, 2019 and 2050**




*Source: FAF5*

**Figure 3.6 West Virginia Top 10 Truck Commodities by Value, 2019 and 2050**



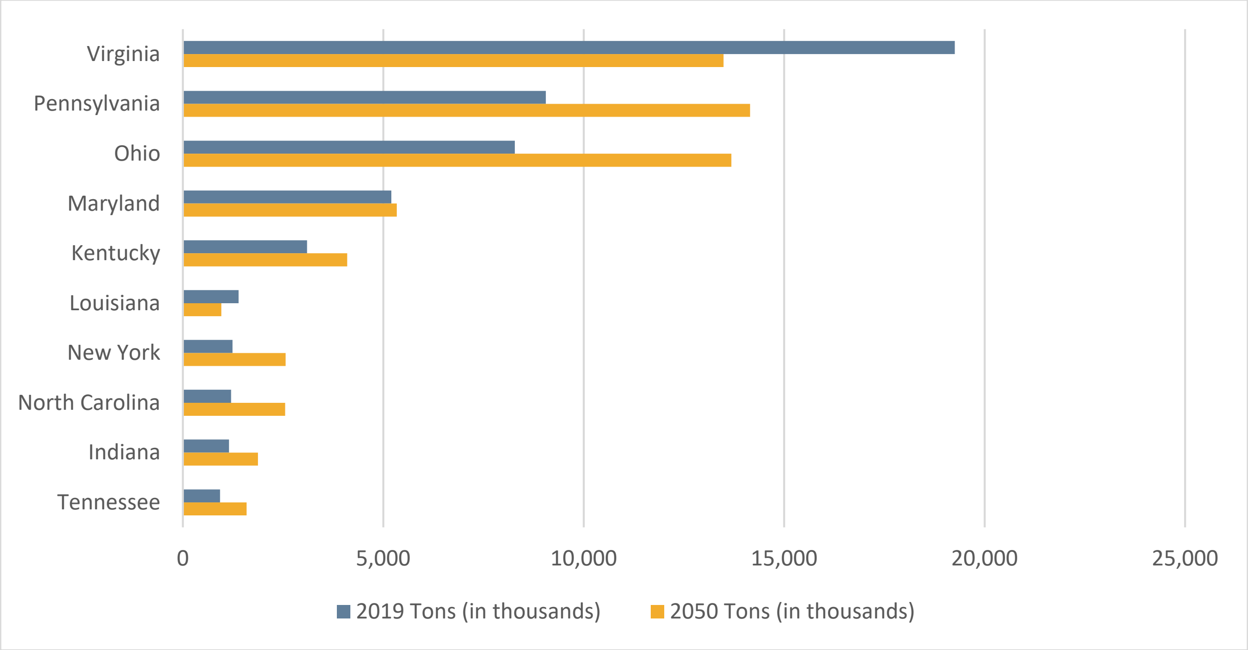

*Source: FAF5*

From the value perspective, the top truck commodities in 2019 include Mixed freight ($8 billion, 10 percent of total truck value), Pharmaceuticals ($7.5 billion, 9 percent), Machinery ($7.4 billion, 9 percent), and Plastics/rubber ($7 billion, 8 percent). The top 10 commodities generated more than 67 percent of total truck value in 2019, and by 2050 these commodities are projected to account for nearly 67 percent of total truck value. Gasoline and fuel oils values however, are projected to decline 30 percent and 8 percent respectively.

### *3.2.3 Domestic Trading Partners*

Figure 3.7 shows the top truck trading partner states by tonnage. In terms of tonnage, Virginia, Pennsylvania, Ohio, Maryland, and Kentucky were the top five domestic trading partner states in 2019 and will make up four of the top five trading partner states in 2050. Virginia tonnage is expected to drop enough to make Pennsylvania the number one domestic trade partner by tonnage, but Virginia will only drop to the second spot. The other four of the top five states are expected to increase trade in tonnage from 2019 to 2050. In 2019, the top 10 states accounted for more than 91 percent of total tonnage moving by truck. By 2050, the top 10 are projected to make up 87 percent of total truck tonnage.

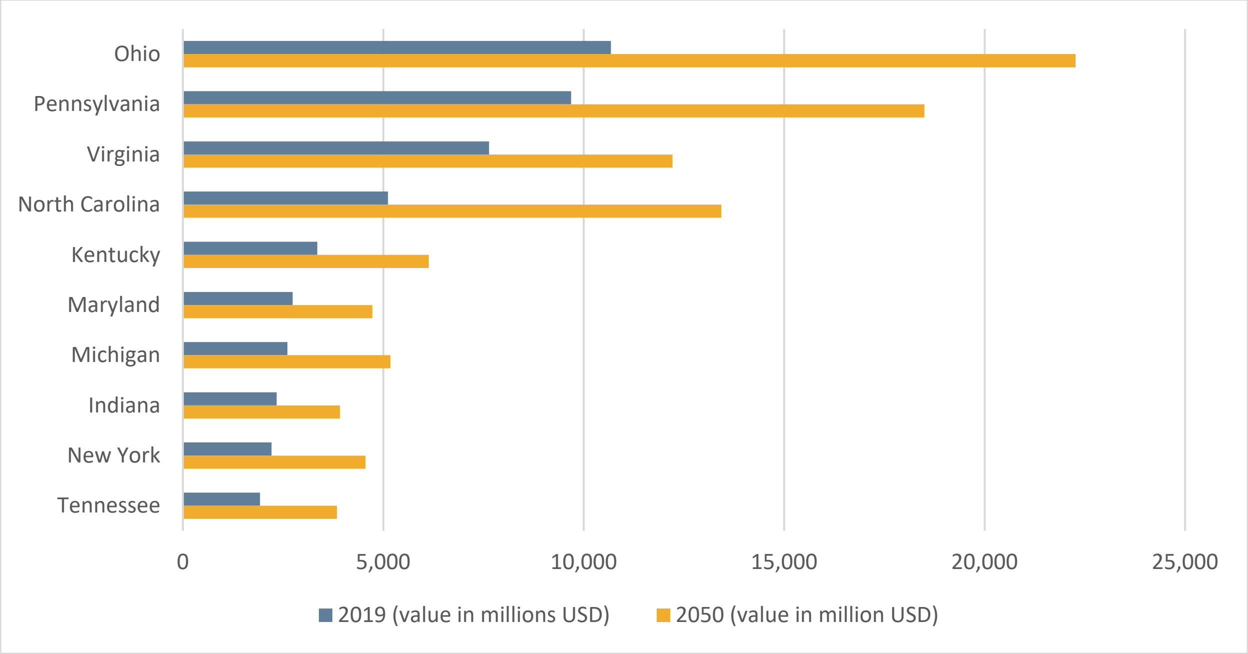
### Figure 3.7 West Virginia Top Interstate Trading Partners by Tonnage, 2019 and 2050




*Source: Freight Analysis Framework 5.4.1, disaggregated by Cambridge Systematics Inc. 2023.*

Figure 3.8 shows the top domestic trading partners by value for West Virginia. Measured by 2019 value, Ohio, Pennsylvania, Virginia, North Carolina, and Kentucky were the top five domestic trading partner states for goods moving in and out of West Virginia by truck. In 2019, the top 10 states made up over 77 percent of the total truck value, and in 2050, the top 10 trading partners are estimated to make up more than 76 percent of the total truck value.

### Figure 3.8 West Virginia Top Interstate Trading Partners by Value, 2019 and 2050




*Source: Freight Analysis Framework 5.4.1, disaggregated by Cambridge Systematics Inc. 2023.*

# 4.0 HIGHWAY NETWORK CONDITION AND PERFORMANCE

The purpose of the conditions and performance analysis is to understand the demands on the State's highway freight network and see where the system is meeting (or failing to meet) those demands. This information provides decision-makers with a stronger foundation for identifying and assessing potential highway freight system investments. The analysis is informed by data on average truck travel times, pavement conditions, and bridge conditions, among others.

## 4.1 Condition

This section of the report characterizes the condition of roadways in West Virginia. Specifically, it focuses on pavement and bridge conditions. These are important for freight mobility as poor pavement conditions can negatively impact the efficiency and safety of freight travel. Bridges that cannot handle typical truck sizes and weights can also negatively impact the efficiency of freight movements, resulting in higher costs that are ultimately passed along to shippers and consumers. Understanding where highway freight asset condition challenges exist is the first step to identifying solutions for addressing those needs.

### *4.1.1 Pavement*

Roadway pavement condition can impact the cost and safety of travel for passengers and freight. Cracked and rutting roadway surfaces can cause additional wear and tear on freight vehicles as well as damage the goods they are transporting. Poor pavement conditions can also impact travel time-based performance measures if vehicles must decrease their speeds to avoid potholes or other condition-related hazards. Pavement conditions may also impact safety performance.

The U.S. Department of Transportation under MAP-21 and the FAST Act requires states to submit pavement performance measure data in a variety of areas to FHWA. These last two laws have introduced reforms into the Federal-Aid Highway Program by establishing new requirements for pavement performance management to foster efficient investment of federal transportation funds. Pavement condition performance measures based on the FHWA rulemaking are shown in Table 4.1.

### Table 4.1 FHWA Pavement Performance Rating and Thresholds

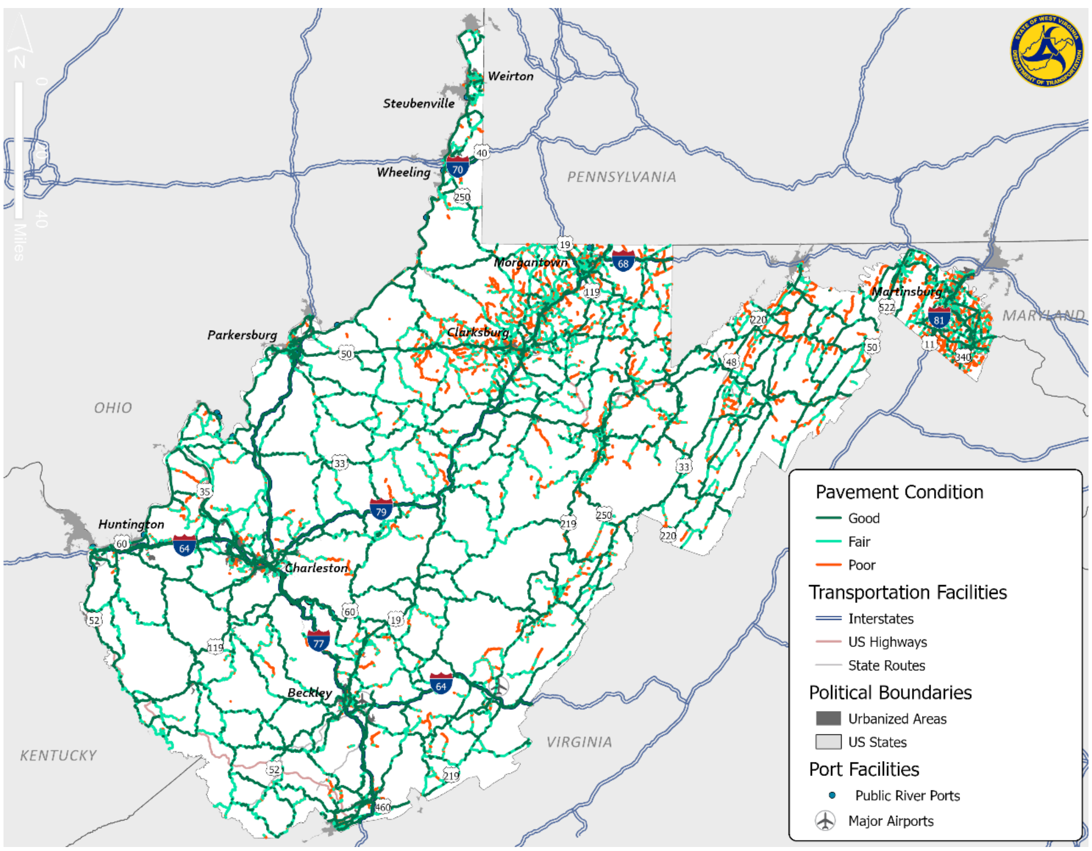
| Metric | Good | Fair | Poor |
|---|---|---|---|
| IRI (inches/mile) | < 95 | 95–170 | > 170 |
| PSR (0.0–5.0 value) | ≥ 4.0 | 2.0–4.0 | ≤ 2.0 |
| Cracking Percent (%) | < 5 | CRCP: 5–10<br>Jointed Concrete: 5–15<br>Asphalt: 5–20 | > 10<br>> 15<br>> 20 |
| Rutting (inches) | < 0.20 | 0.20–0.40 | > 0.40 |
| Faulting (inches) | < 0.10 | 0.10–0.15 | > 0.15 |

Source: *FHWA Rulemaking for pavement.*

Notes: *IRI stands for International Roughness Index; PSR stands for Present Serviceability Index and may be used only on routes with posted speed limit <40 mph; CRCP stands for Continuously Reinforced Concrete Pavement.*

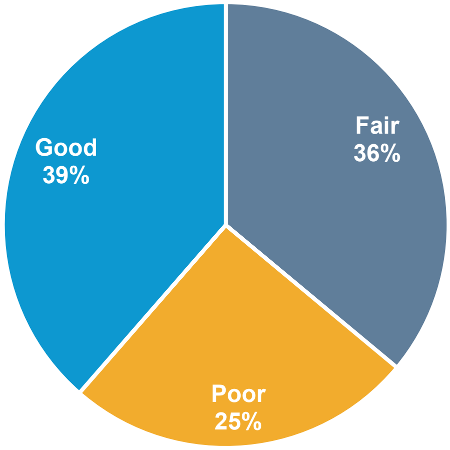
Figure 4.2 shows the percentage of lane-miles by condition category for roadways that report pavement condition. It indicates that the majority of the State's lane-miles, about 75 percent, are in good to fair condition based on IRI values. About one quarter of West Virginia's roadways exhibit poor pavement conditions indicating that they are in need of rehabilitation in the near or immediate future. Pavement conditions throughout West Virginia are depicted in Figure 4.1

### Figure 4.1 Pavement Conditions Statewide




Source: *Federal Highway Administration, Highway Performance Monitoring System, 2020; Cambridge Systematics, Inc. analysis.*

**Figure 4.2 Percent of Lane-Miles by Condition Category**

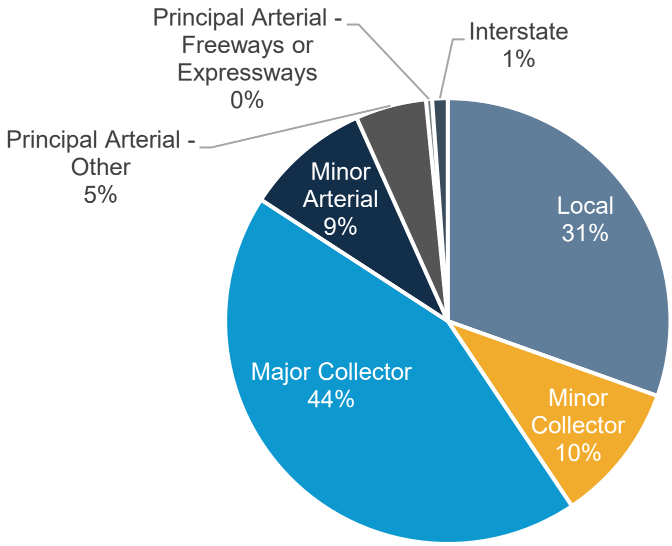



*Source: Federal Highway Administration, Highway Performance Monitoring System, 2020; Cambridge Systematics, Inc. analysis.*

Figure 4.3 and Table 4.2 show pavement conditions in the region by functional classification. Generally, poorer pavements are concentrated on lower functional class roadways – namely local roads and minor collectors – as shown in Figure 4.3. Approximately 85 percent of poor pavements Statewide as measured by lane-miles are located on local, minor collector, and major collector roadways. Furthermore, as shown in Table 4.2 about 74 percent of local, nearly 67 percent of minor collector, and about 34 percent of major collector lane-miles have pavements that are in poor condition. Often, lower functional class roadways receive a lower priority for maintenance relative to higher functional class roadways due to lower traffic volumes. However, for freight these corridors can also comprise important first/last-mile connections to freight assets and freight-generating land uses.

Though West Virginia's higher functional class roadways generally exhibit fair to good pavement conditions, a substantial share of lane-miles of principal arterials (freeways and expressways) have pavements that are in poor condition. About 30 percent of lane-miles on these corridors were rated as poor. However, principal arterials (freeways and expressways) comprise only about 97 (less than 1 percent) of the State's nearly 83,000 lane-miles.

**Figure 4.3 Percent of Lane-Miles in Poor Condition by Functional Class**




*Source: Federal Highway Administration, Highway Performance Monitoring System, 2020; Cambridge Systematics, Inc. analysis.*

**Table 4.2 Percent of Lane-Miles by Functional Class and Condition Category**

| Roadway Type | Local | Minor Collector | Major Collector | Minor Arterial | Principal Arterial - Other | Principal Arterial – Freeways & Expressways | Interstate | Total |
|---|---|---|---|---|---|---|---|---|
| Good | 3.4% | 3.9% | 17.8% | 33.8% | 59.8% | 19.2% | 84.6% | 38.6% |
| Fair | 22.4% | 29.3% | 48.1% | 50.5% | 33.8% | 50.5% | 13.8% | 36.1% |
| Poor | 74.2% | 66.8% | 34.1% | 15.7% | 6.4% | 30.3% | 1.6% | 25.4% |
| **Total** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** | **100.0%** |

*Source: Federal Highway Administration, Highway Performance Monitoring System, 2020; Cambridge Systematics, Inc. analysis.*

### *4.1.2 Bridges*

Bridges are a critical component of highway infrastructure, providing access over the many creeks, rivers, and ravines throughout West Virginia. It is important to identify brides that are unable to handle typical truck sizes or weights to mitigate congestion and avoid re-routing as trucks must find alternative detours. If a truck cannot pass over a bridge, and does not have a close alternative route, a detour can prove costly in both time and money. Condition rating is one method for determining if a bridge can be a barrier for certain trucks. The National Bridge Inventory rates bridges on a 0-10 scale (10 being best condition and 0 being worst) based on numerous factors including their:

- Deck condition;
- Superstructure condition;
- Substructure condition; and

- Culvert condition.

If the minimum rating from these four factors is below or equal to 4, the bridge is considered in "poor or structurally deficient" condition. A rating between 5 and 6 indicates "fair" condition and a rating of 7 or higher indicates "good" condition.

Per federal inspection standards, bridges are assigned a rating that represents the general condition of the structure. In accordance with the bridge performance measures final rulemaking, published in January of 2017[18], bridge condition is determined by the lowest rating of National Bridge Inventory (NBI) condition ratings for Item 58 (Deck), Item 59 (Superstructure), Item 60 (Substructure), or Item 62 (Box Culvert). If the lowest rating is greater than or equal to 7, the bridge is classified as Good; if it is less than or equal to 4, the classification is Poor; if the lowest rating is 5 or 6 the classification is Fair.

Table 4.3 shows the condition rating for bridges in West Virginia by maintenance ownership. There are a total of 7,317 bridges in the State where 23 percent are in good condition, 57 percent are in fair condition, and 20 percent are in poor condition. Bridges in poor condition are the vast minority of bridges, and as shown in Figure 4.4 they are distributed evenly across the State. The condition of box culverts is shown in Table 4.4. It shows that most of the State's 550 box culverts are in good to fair condition – 29 percent and 62 percent, respectively. Only about 9 percent of box culverts are in poor condition.

### Table 4.3 Condition Rating of West Virginia Bridges by Maintenance Ownership, 2021

| Owner | Poor | % Poor | Fair | % Fair | Good | % Good | Total |
|---|---|---|---|---|---|---|---|
| State | 1,409 | 20% | 3,948 | 56% | 1,662 | 24% | 7,019 |
| County | 0 | 0% | 0 | 0% | 2 | 100% | 2 |
| City | 33 | 33% | 54 | 53% | 14 | 14% | 101 |
| Other[1] | 19 | 10% | 143 | 73% | 33 | 17% | 195 |
| **Total** | **1,461** | **20%** | **4,145** | **57%** | **1,711** | **23%** | **7,317** |

*Source: Federal Highway Administration, National Bridge Inventory, 2021; Cambridge Systematics, Inc. analysis.*
*[1] Other owners include state park, forest, or reservation agencies, private entities, railroads, toll authority, and Corps of Engineers.*

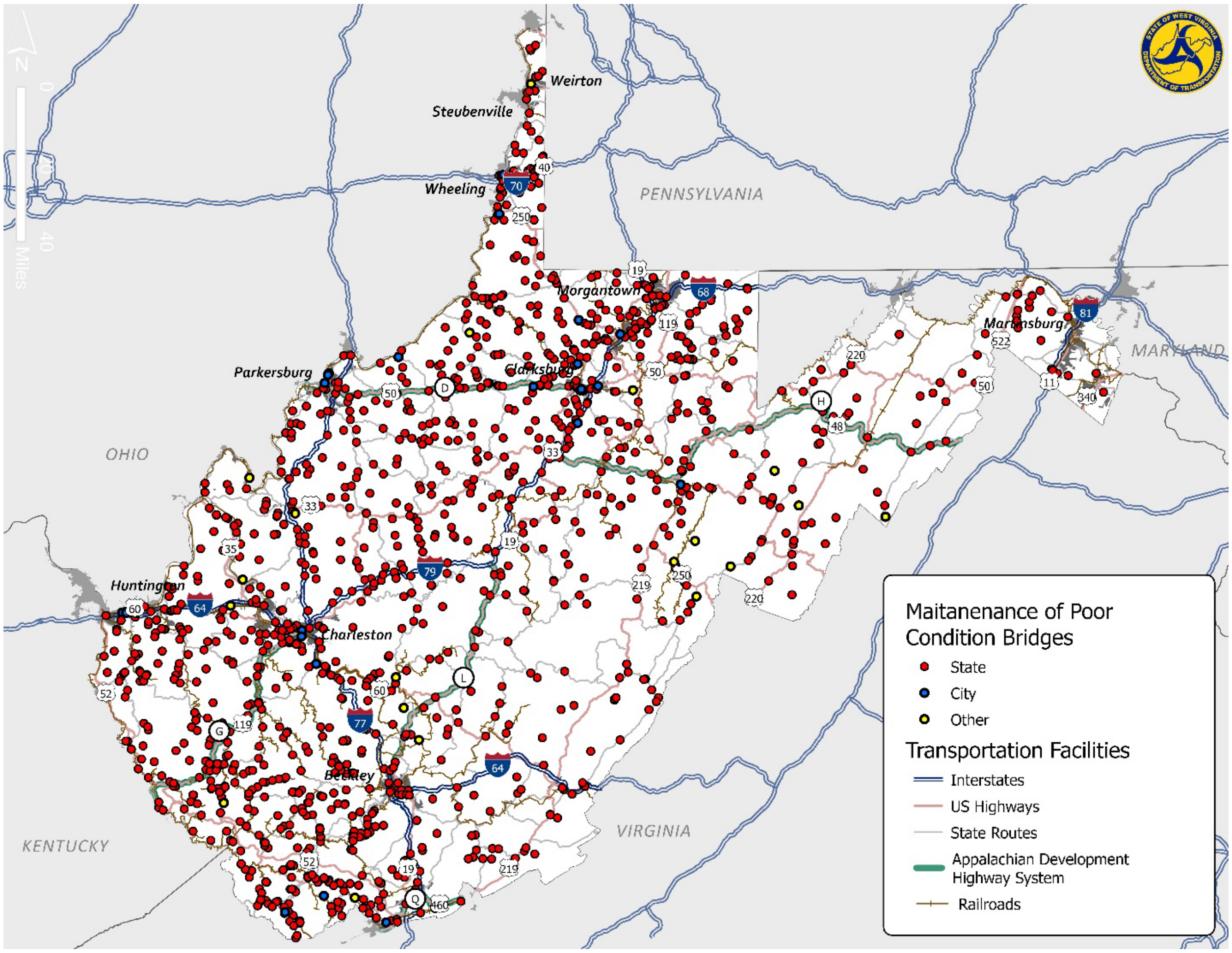
### Table 4.4 Condition Rating of West Virginia Box Culverts by Maintenance Ownership, 2021

| Owner | Poor | % Poor | Fair | % Fair | Good | % Good | Total |
|---|---|---|---|---|---|---|---|
| State | 46 | 9% | 331 | 62% | 155 | 29% | 532 |
| City | 0 | 0% | 3 | 100% | 0 | 0% | 3 |
| Other[1] | 4 | 27% | 6 | 40% | 5 | 33% | 15 |
| **Total** | **50** | **9%** | **340** | **62%** | **160** | **29%** | **550** |

*Source: Federal Highway Administration, National Bridge Inventory, 2021; Cambridge Systematics, Inc. analysis.*
*[1] Other owners include state park, forest, or reservation agencies, private entities, railroads, toll authority, and Corps of Engineers.*

[18] U.S. Department of Transportation. Federal Highway Administration. Bridge Performance Measures. Final Rulemaking. Available at: https://www.fhwa.dot.gov/tpm/pubs/PM2BridgeFactSheet.pdf.

### Figure 4.4 Location of West Virginia Bridges in Poor Condition




*Source: Federal Highway Administration, National Bridge Inventory, 2021; Cambridge Systematics, Inc. analysis.*

Of West Virginia's over 7,300 bridges, 844 of them carry routes that are part of the National Highway Freight Network (NHFN). As discussed in section 2.4.1, NHFN routes are those that are considered most essential to national goods movement. Of the 844, 121 bridges (about 14 percent) were rated as being in poor condition. About 86 percent of NHFN bridges are in fair or good condition as shown in Table 4.5.

### Table 4.5 Condition of West Virginia Bridges on the National Highway Freight Network, 2021

| Owner | Poor | % Poor | Fair | % Fair | Good | % Good | Total |
|---|---|---|---|---|---|---|---|
| State | 121 | 14% | 507 | 60% | 119 | 14% | 747 |
| WV Turnpike | - | 0% | 93 | 11% | 4 | 0.4% | 97 |
| **Total** | **121** | **14%** | **600** | **71%** | **123** | **15%** | **844** |

*Source: Federal Highway Administration, National Bridge Inventory, 2021; Cambridge Systematics, Inc. analysis.*

The distribution of bridges and box culverts in poor condition by functional classification for rural and urban areas are shown in Table 4.6. It shows that these structures are broadly distributed across roadway types for both rural and urban areas. As shown in Table 4.7 the structures in good and fair conditions carry 96 percent of the traffic across the State's structures.

### Table 4.6. Condition of West Virginia Bridges and Box Culverts by Functional Classification and Urban/Rural Location, 2021

| Roadway Type | Bridges | | Box Culverts | |
|---|---|---|---|---|
| | Poor | % Poor | Poor | % Poor |
| | | ***Rural*** | | |
| Interstate | 47 | 4% | 2% | 2% |
| Principal Arterial - Other | 63 | 5% | 18% | 18% |
| Minor Arterial | 84 | 7% | 16% | 16% |
| Major Collector | 332 | 27% | 33% | 33% |
| Minor Collector | 90 | 7% | 2% | 2% |
| Local | 621 | 50% | 29% | 29% |
| ***Rural Total*** | ***1,237*** | ***100%*** | ***100%*** | ***100%*** |
| | | ***Urban*** | | |
| Interstate | 44 | 20% | 0 | 0% |
| Principal Arterial - Other Freeways/Expressways | 14 | 6% | 0 | 0% |
| Principal Arterial - Other | 27 | 12% | 0 | 0% |
| Minor Arterial | 49 | 22% | 5 | 100% |
| Collector | 25 | 11% | 0 | 0% |
| Local | 65 | 29% | 0 | 0% |
| ***Urban Total*** | ***224*** | ***100%*** | ***5*** | ***100%*** |
| **Total** | **1,461** | **93%** | **50** | **7%** |

Source: *Federal Highway Administration, National Bridge Inventory, 2021; Cambridge Systematics, Inc. analysis.*

### Table 4.7 Average Daily Traffic (ADT) on West Virginia Bridges and Box Culverts, 2021

| Condition | ADT on Bridges | % ADT on Bridges | ADT on Box Culverts | % ADT on Box Culverts | Total ADT | % of Total ADT |
|---|---|---|---|---|---|---|
| Good | 3,965,045 | 16% | 800,903 | 26% | 4,765,948 | 17% |
| Fair | 17,324,564 | 68% | 2,172,696 | 70% | 19,497,260 | 68% |
| Poor | 4,116,344 | 16% | 125,803 | 4% | 4,242,147 | 15% |
| **Total** | **25,405,953** | **100%** | **3,099,402** | **100%** | **28,505,355** | **100%** |

Source: *Federal Highway Administration, National Bridge Inventory, 2021; Cambridge Systematics, Inc. analysis.*

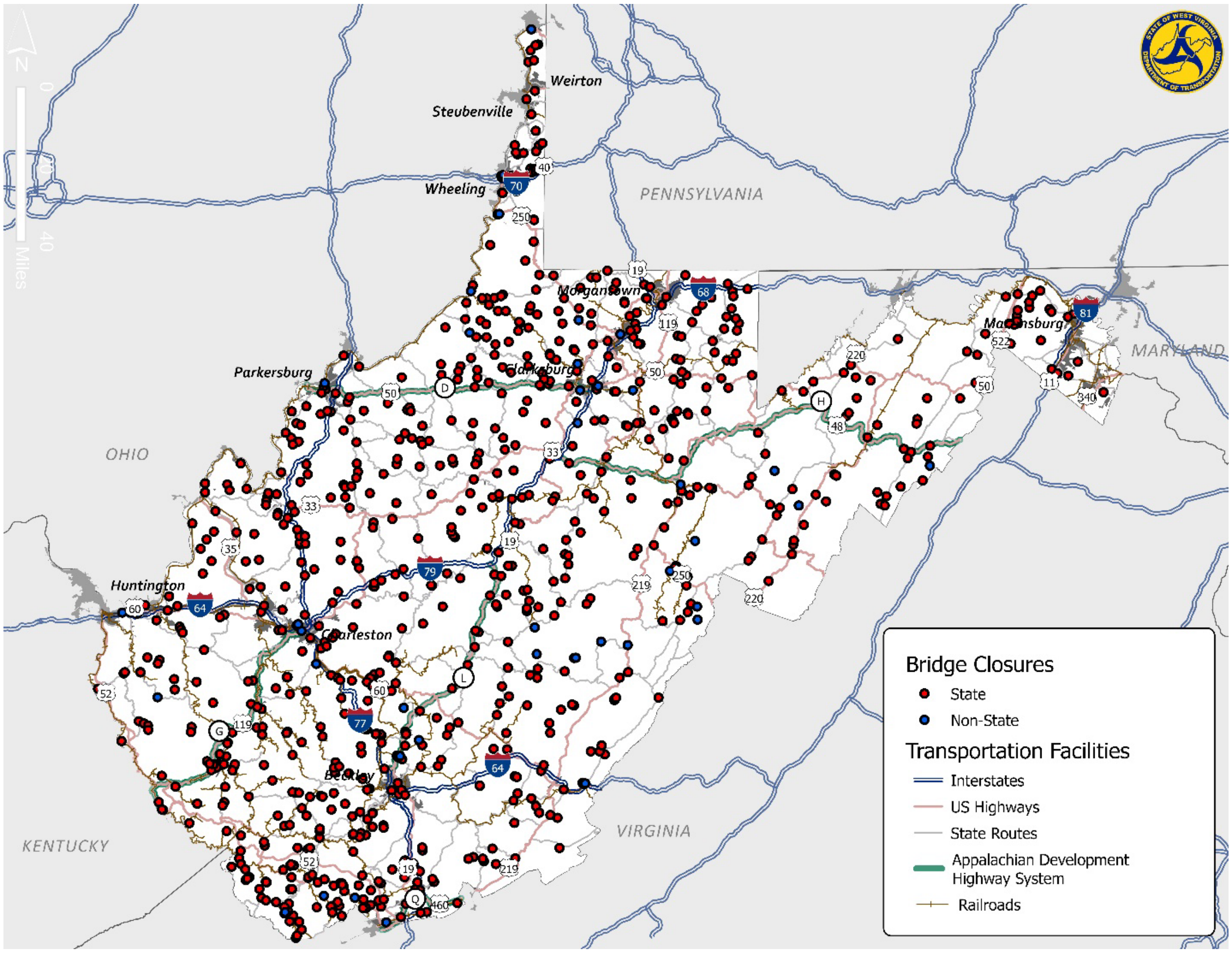
Posted and closed bridges are another challenge to efficient freight movement. A posted bridge is one that has a weight limit below the standard truck axle distribution weight, which means heavier trucks may not be able to use the bridge. The heavier truck must either detour around the bridge or reduce its payload, which would lead to more trucks on the road for the same haul. Bridges that have been closed require that trucks choose an alternative route that may not be as efficient. In total, there are 882 posted and 12 closed bridges in West Virginia as shown in Table 4.8 and Figure 4.5. Nearly 11 percent of posted bridges are maintained by the State.

### Table 4.8 Posted and Closed Bridges by Functional Classification, 2021

| Roadway Type | Posted Bridges | | Closed Bridges | |
|---|---|---|---|---|
| | No. of Bridges | % of Statewide Total | No. of Bridges | % of Statewide Total |
| | ***State Maintained*** | | | |
| Interstate | 0 | 0.0% | 1 | 8.3% |
| Principal Arterial - Other | 33 | 3.7% | - | 0% |
| Minor Arterial | 78 | 8.8% | - | 0% |
| Major Collector | 217 | 24.6% | 2 | 16.7% |
| Minor Collector | 42 | 4.8% | - | 0% |
| Local | 462 | 52.4% | 8 | 66.7% |
| ***State Maintained Total*** | ***832*** | ***94.3%*** | ***11*** | ***91.7%*** |
| | ***Non-State Maintained*** | | | |
| Interstate | - | 0% | - | 0% |
| Principal Arterial - Other Freeways/Expressways | - | 0% | - | 0% |
| Principal Arterial - Other | - | 0% | - | 0% |
| Minor Arterial | 3 | 0.3% | 1 | 8.3% |
| Collector | 4 | 0.5% | - | 0% |
| Local | 43 | 4.9% | - | 0% |
| ***Non-State Maintained Total*** | ***50*** | ***5.7%*** | ***1*** | ***8.3%*** |
| **Total** | **882** | **100.0%** | **12** | **100.0%** |

*Source: Federal Highway Administration, National Bridge Inventory, 2021; Cambridge Systematics, Inc. analysis.*

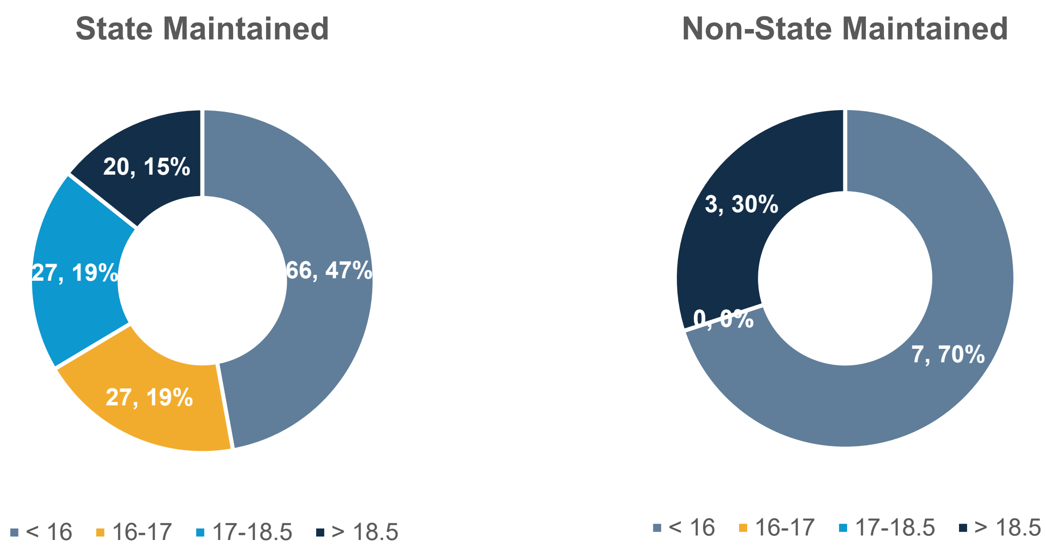
### Figure 4.5 Posted and Closed Bridges, 2021




*Source: Federal Highway Administration, National Bridge Inventory, 2021; Cambridge Systematics, Inc. analysis.*

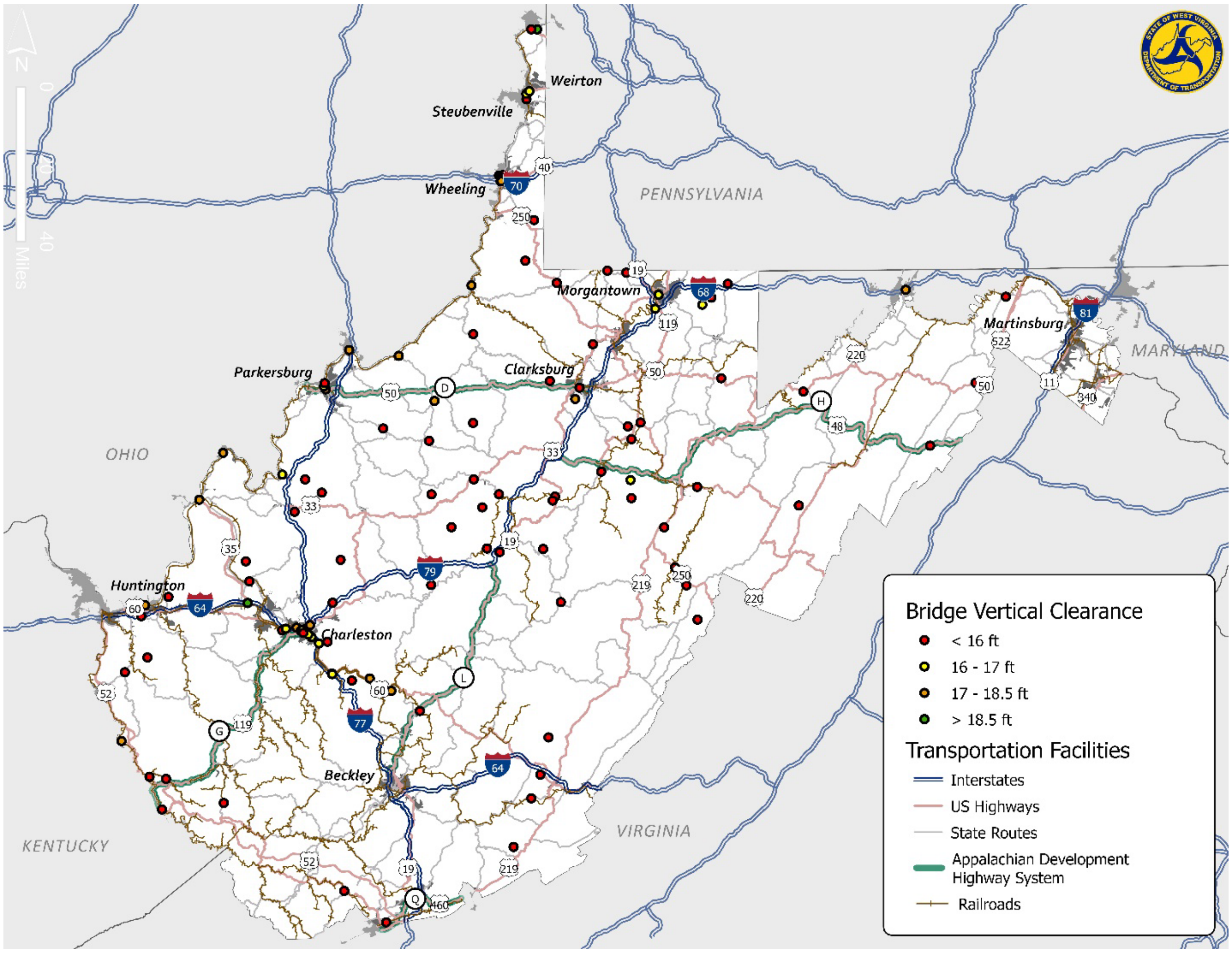
Vertical clearance is another issue that can impact freight mobility as trucks are forced to divert to less efficient routes if a facility does not have sufficient vertical clearance. In general, bridges with less than 16.5 feet of vertical clearance can impose significant challenges to the movement of goods. Figure 4.6 shows the distribution of vertical under clearance for bridges in West Virginia while Figure 4.7 depicts their locations.

Figure 4.6 Distribution of Vertical Clearance on Roadway Bridges, 2021




*Source: Federal Highway Administration, National Bridge Inventory, 2021; Cambridge Systematics, Inc. analysis.*

**Figure 4.7 Vertical Clearance on Roadway Bridges, 2021**




*Source: Federal Highway Administration, National Bridge Inventory, 2021; Cambridge Systematics, Inc. analysis.*

## 4.2 Performance

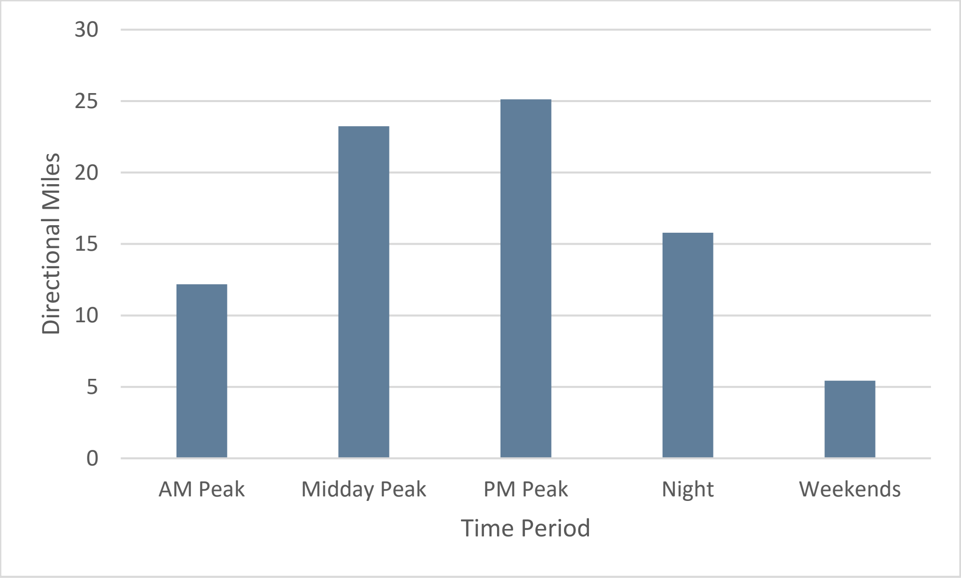
This section of the report focuses on the performance of roadways in the State. It draws upon the freight bottlenecks analysis previously conducted as part of West Virginia's annual performance reporting. The information from the highway freight bottlenecks analysis is supplemented with additional analysis of truck travel time data from the National Performance Management Research Data Set (NPMRDS). The NPMRDS contains average travel times in 15-minute bins over roadway segments that comprise the National Highway System (NHS). Truck travel times are derived from in-vehicle monitoring systems, navigation systems, and other on-board devices that generate global positioning system (GPS) data. Thus, the data set is a real-world source of information on congestion and mobility.

### *4.2.1 Truck TTTR*

Truck travel time reliability on West Virginia's Interstate highway system is captured by calculating the Truck Travel Time Reliability (TTTR) metric. The TTTR is the freight performance metric adopted by FHWA that must be reported for Interstate highways.[19] It is calculated as the ratio of the 95th percentile travel time to the 50th percentile travel time: TTTR = 95th Percentile Truck Travel Time/50th Percentile Truck Travel Time. High TTTR values indicate unreliable truck travel times while low TTTR values indicate more reliable travel times. For example, a TTTR value equal to two indicates that truck travel times may be twice as long as average travel times for a given time period. Per 23 CFR 490.611, the TTTR metric is calculated over the following time periods: 6 a.m.–10 a.m. Monday–Friday, 10 a.m.–4 p.m. Monday–Friday, 4 p.m.–8 p.m. Monday–Friday, 8 p.m.–6 a.m. Monday–Friday, and 6 a.m.–8 p.m. Saturday–Sunday.

Figure 4.8 shows the amount of interstate highway directional miles that are unreliable for truck travel, meaning a TTTR value greater than or equal to 1.5, by time of day. There are over 1,142 directional miles on West Virginia's interstate highway system. The results shown in Figure 4.8 indicate that only a small fraction of those miles exhibit poor reliability for truck travel. The PM peak period is the most challenged time of day with about 25 directional miles of interstate highway experiencing a TTTR greater than 1.5. However, this represents only about 2 percent of directional miles.

**Figure 4.8 Directional Miles of Unreliable Interstate by Time of Day, 2021**

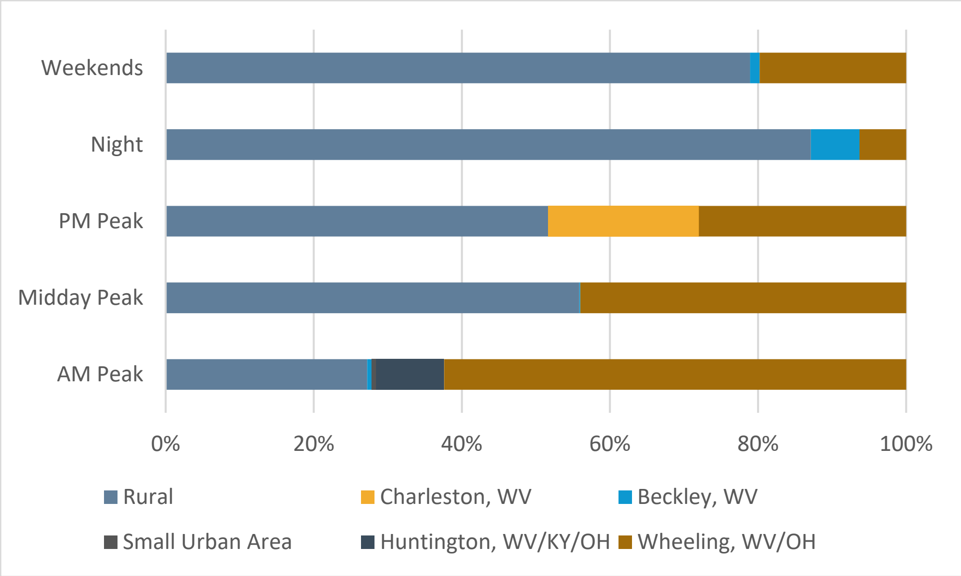



*Source: National Performance Management Research Data Set; WVDOT; Cambridge Systematics, Inc. analysis.*

Figure 4.9 shows the areas of the State in which the unreliable interstate mileage is concentrated by time of day. During the AM peak period, truck travel time challenges are primarily concentrated in the Wheeling urbanized area. About 62 percent of unreliable interstate directional miles are in that area. Approximately 9 percent of unreliable mileage in the AM peak period is in the Huntington area while about 27 percent is in rural areas. Except for the AM peak period, the majority of unreliable interstate directional miles are in rural areas.

[19] National Performance Management Measures: Assessing Performance of the National Highway System, Freight Movement on the Interstate System, and Congestion Mitigation and Air Quality Improvement Program, *Federal Register*, Volume 82, Number 11, January 18, 2017, https://www.federalregister.gov/documents/2017/01/18/2017-00681/national-performance-management-measures-assessing-performance-of-the-national-highway-system.

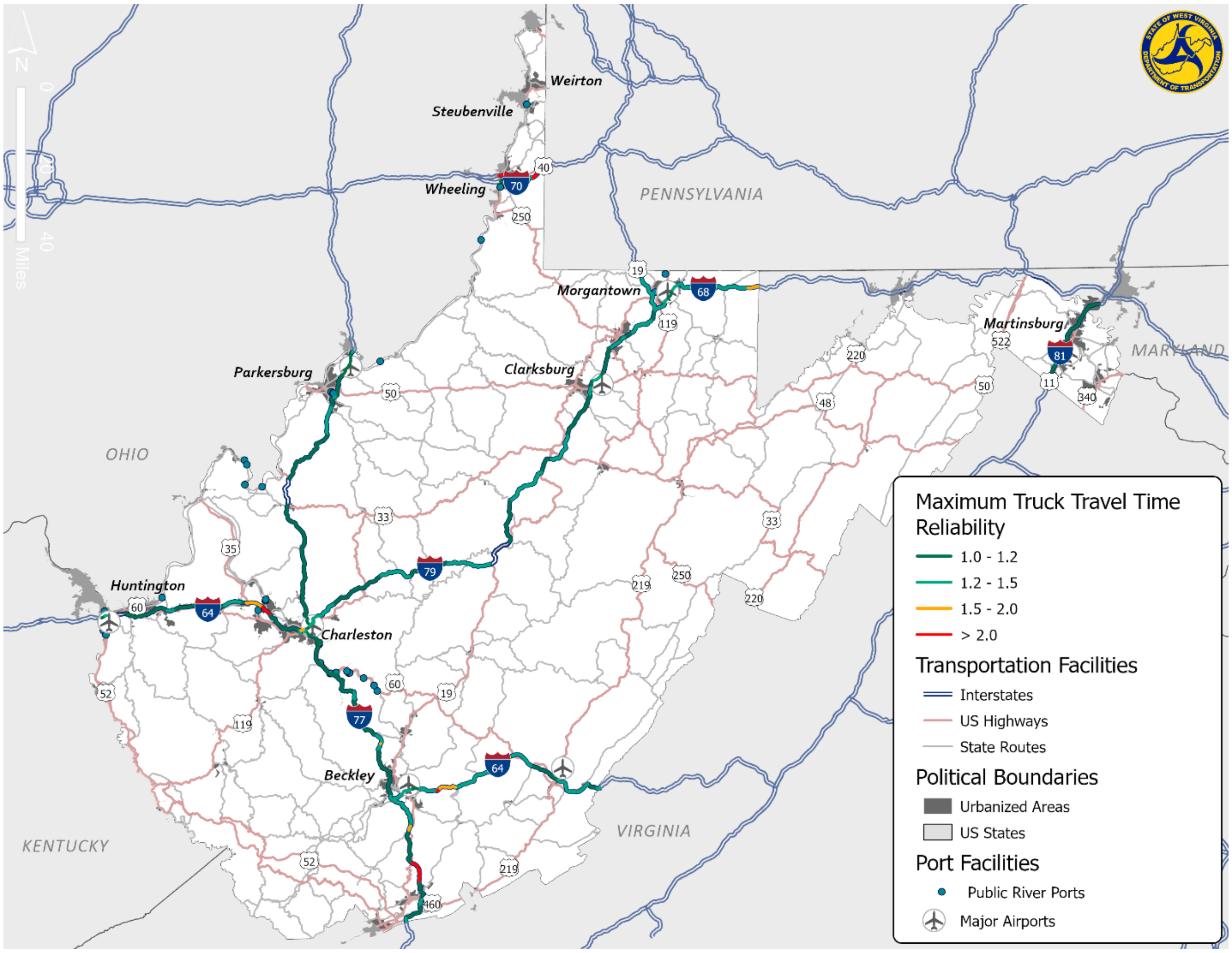
**Figure 4.9 Directional Miles of Unreliable Interstate by Location, 2021**




*Source: National Performance Management Research Data Set; WVDOT; Cambridge Systematics, Inc. analysis.*

Figure 4.10 depicts West Virginia's interstate highway network and the maximum TTTR values based on 2021 data. It shows that much of the State's system provides for reliable truck travel. Only a small portion of the system exhibits TTTR values that meet or exceed the 1.5 threshold.

### Figure 4.10 Maximum Truck Travel Time Reliability (TTR), 2021




Source: National Performance Management Research Data Set; WVDOT; Cambridge Systematics, Inc. analysis.

### 4.2.2 Truck Buffer Time Index

This analysis measures reliability via the buffer time index (BTI). The BTI is the ratio of the difference between the 95th percentile truck travel time and average travel time to the average travel time: [(95th Percentile Travel Time – Average Travel Time) / Average Travel Time] x 100 percent. Thus, buffer time index is expressed as a percentage. For example, if BTI and average travel time are 20 percent and 10 minutes, then the buffer time would be 2 minutes. Since it is calculated by 95th percentile travel time, it represents almost all worst-case delay scenarios and assures travelers to be on-time 95 percent of all trips. A lower BTI indicates that worst-case delays are generally comparable to average travel times. A higher BTI indicates the opposite, that extra travel time is needed to traverse a corridor because worst-case travel times deviate significantly from the average.

The results of the truck BTI analysis by time of day for interstate and non-interstate NHS corridors are shown in Table 4.9. For interstate highways, the results indicate that BTI are generally low which implies a high level of consistency in truck travel times. By time of day, the highest calculated BTI was less than 15 and was observed during the overnight time period. In part, the low BTI values on West Virginia's interstate highways reflect the ability of limited-access roadways to provide more consistent travel times.

**Table 4.9 Statewide Weighted Average Truck Buffer Time Index**

| Time Period | Interstate | Non-Interstate NHS |
|---|---|---|
| AM Peak | 11.3 | 46.0 |
| Midday | 10.1 | 45.6 |
| PM Peak | 11.1 | 45.0 |
| Overnight | 14.7 | 41.0 |
| Weekend | 11.7 | 45.1 |

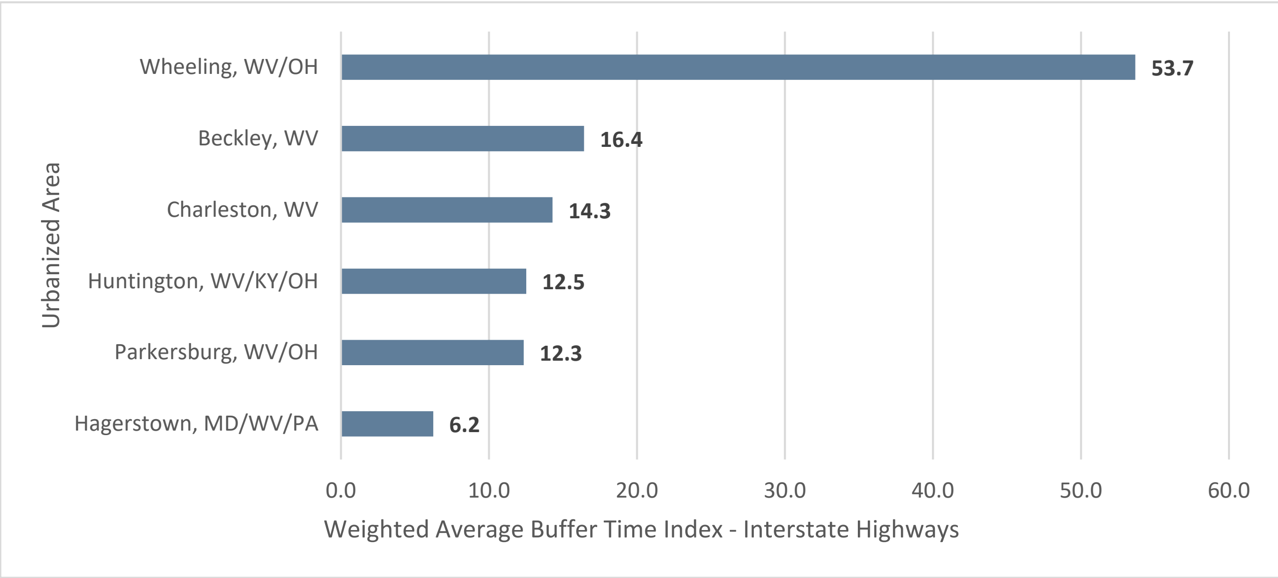
*Source: National Performance Management Research Data Set; WVDOT; Cambridge Systematics, Inc. analysis.*

Truck BTI values on West Virginia's non-interstate NHS roadways are substantially higher than those observed on interstate highways, but still relatively low. Across time periods, truck BTI values range from about 41 to 46. This indicates that $95^{th}$ percentile truck travel times are generally 41 to 46 percent higher than average travel times during those same time periods. For an average travel time of 10 minutes for a corridor, this would indicate that the worst-case travel time is about 14 minutes. The higher BTI values observed on West Virginia's non-interstate NHS roadways reflect, in part, the impact of driveways, intersection control devices, and other factors that can result is less consistent travel times.

Figure 4.11 and Figure 4.12 show how truck BTI varies across West Virginia's urbanized areas for interstate highways and non-interstate NHS roadways, respectively. Compared to the Statewide results presented in Table 4.9, the BTI values for urbanized areas are generally higher. For interstate highways, the highest average truck BTI value was observed in the Wheeling urbanized area. This area's truck BTI value of 53.7 far exceeded values observed in the State's other urbanized areas.

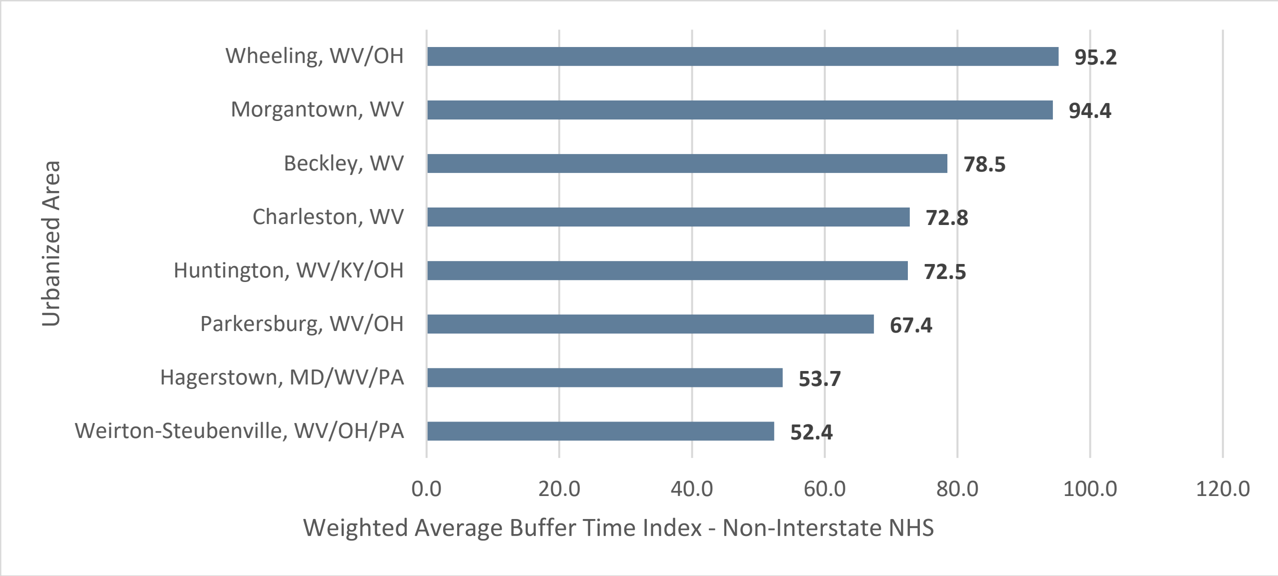
Average truck BTI values for non-interstate NHS roadways in West Virginia's urbanized are generally 1.5X to 2X higher than the Statewide average. This demonstrates that the State's truck travel time reliability challenges are largely concentrated in these areas. The Wheeling and Morgantown urbanized areas exhibited the highest truck BTI values for non-interstate NHS roadways. Both areas averaged BTI values that exceed 94 and 95, respectively.

### Figure 4.11 Truck Buffer Time Index by Urbanized Area – Interstate Highways, 2021




*Source: National Performance Management Research Data Set; WVDOT; Cambridge Systematics, Inc. analysis.*

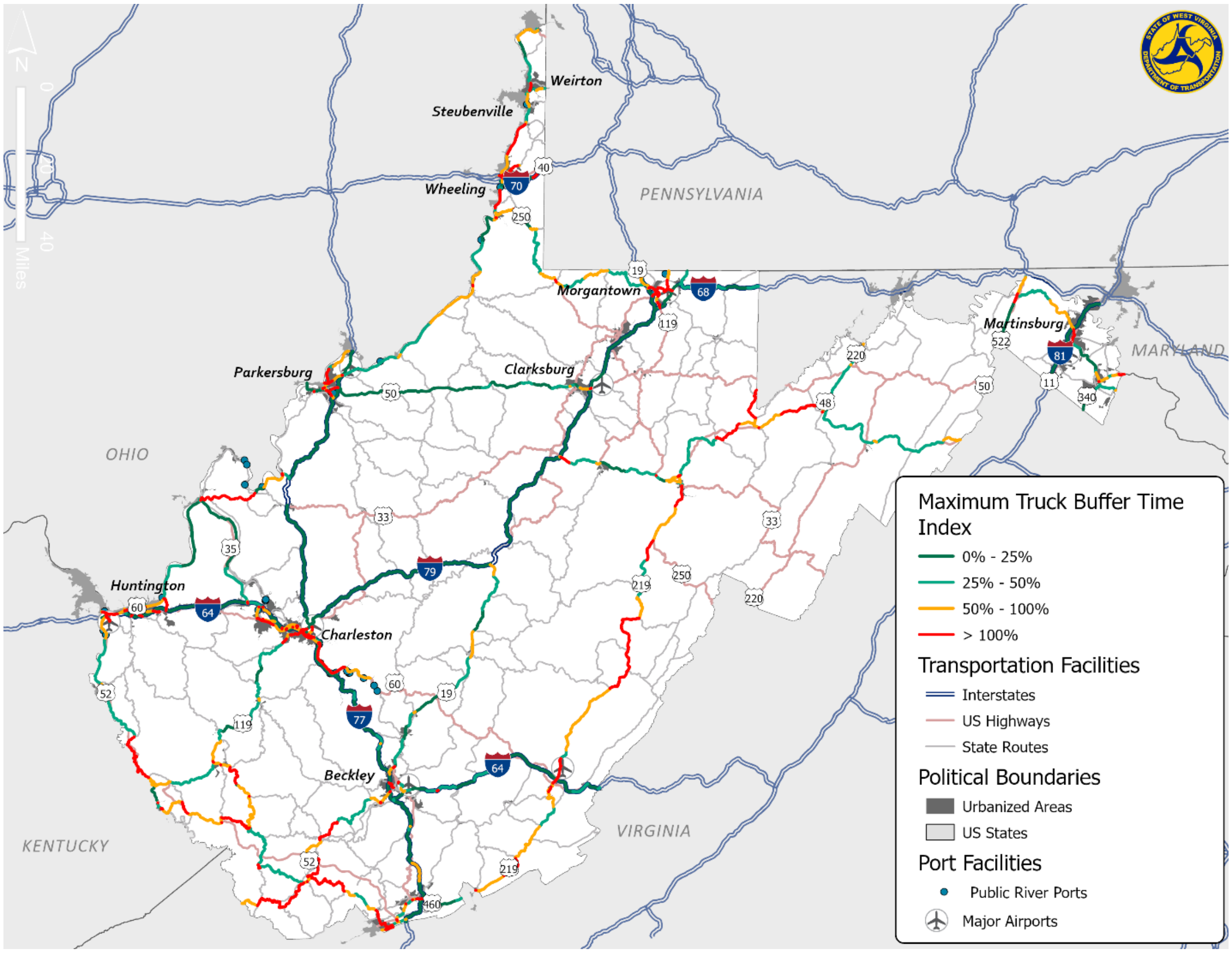
### Figure 4.12 Truck Buffer Time Index by Urbanized Area – Non-Interstate NHS, 2021




*Source: National Performance Management Research Data Set; WVDOT; Cambridge Systematics, Inc. analysis.*

Figure 4.13 depicts West Virginia's highway network and the maximum truck BTI values based on 2021 data.

**Figure 4.13 Maximum Truck Buffer Time Index, 2021**




*Source: National Performance Management Research Data Set; WVDOT; Cambridge Systematics, Inc. analysis.*

## *4.2.3 Truck Travel Time Index*

Truck-related congestion on West Virginia's network is also captured by calculating the Truck Travel Time Index (TTI). TTI is a commonly used measure of congestion intensity on a roadway network. It is calculated as the ratio of the average truck travel time to the reference travel time: TTI = Mean Truck Travel Time / Reference Travel Time. Thus, TTI reflects the degree to which speeds decline during peak periods. A low truck TTI indicates that that the peak and off-peak travel periods have generally the same level of intensity. Conversely, a high TTI indicates that peak period performance is much worse relative to its off-peak performance. For instance, a TTI equal to 1.6 indicates that travel times during peak periods are 60 percent longer than during free flow conditions.

The results of the truck TTI analysis by time of day for interstate and non-interstate NHS corridors are shown in Table 4.10. For interstate highways, the results indicate that truck TTI are generally low which implies that truck-related congestion is not severe. By time of day, the highest calculated TTI was 1.14 and was observed during the overnight and PM peak time periods.

### Table 4.10 Statewide Weighted Average Truck Travel Time Index

| Time Period | Interstate | Non-Interstate NHS |
|---|---|---|
| AM Peak | 1.12 | 1.41 |
| Midday | 1.12 | 1.44 |
| PM Peak | 1.14 | 1.62 |
| Overnight | 1.14 | 1.36 |
| Weekend | 1.13 | 1.38 |

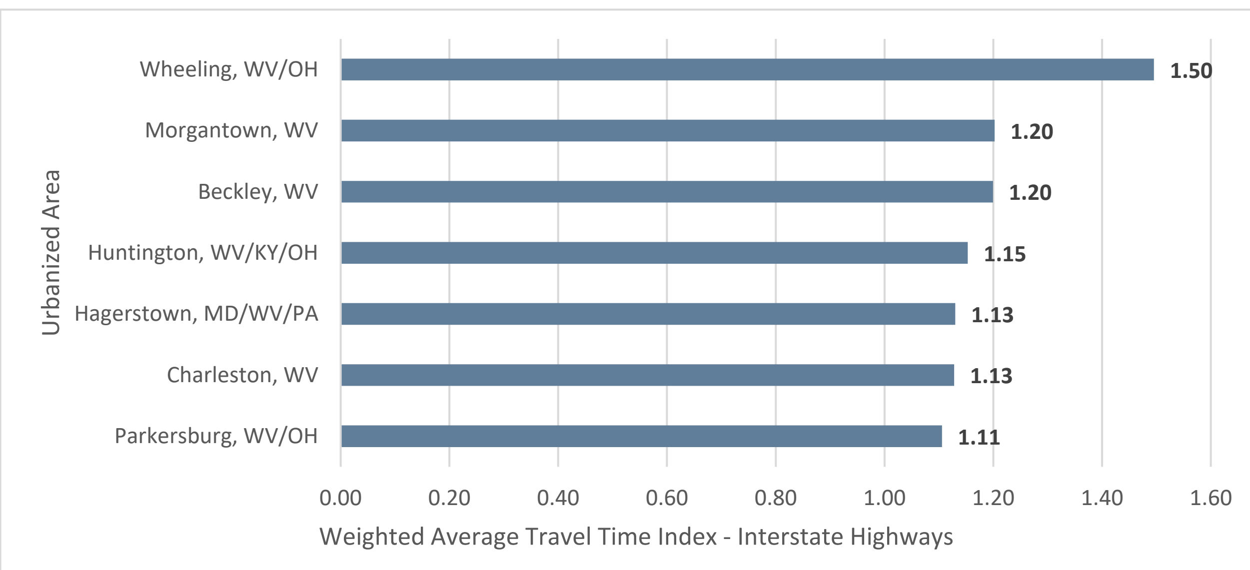
*Source: National Performance Management Research Data Set; WVDOT; Cambridge Systematics, Inc. analysis.*

Truck TTI values on West Virginia's non-interstate NHS roadways are higher than those observed on interstate highways, but still relatively low. Across time periods, truck BTI values range from about 1.36 to 1.62. This indicates that average truck travel times are generally 1.36X to 1.62X higher than the reference travel time.

Figure 4.14 and Figure 4.15 show how truck TTI varies across West Virginia's urbanized areas for interstate highways and non-interstate NHS roadways, respectively. The results for the Wheeling, Morgantown, and Beckley urbanized areas are generally higher than the Statewide though not substantially. For other urbanized areas the results are comparable to Statewide averages.

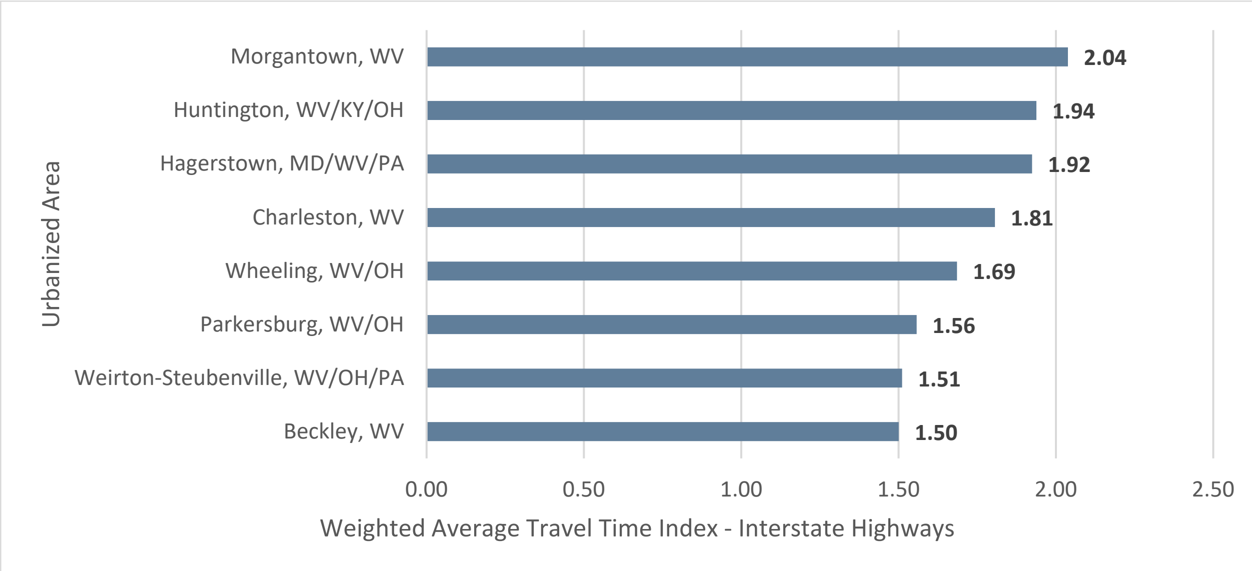
Average truck TTI values for non-interstate NHS roadways in West Virginia's urbanized are much higher than the Statewide average. As shown in Figure 4.15, these values range from about 1.5 to 2. The Morgantown urbanized area was the only one with an average truck TTI value that exceeds 2.0. However, the Huntington and Hagerstown urbanized areas were close to this threshold. The results in Figure 4.14 and Figure 4.15 combined with the Statewide results in Table 4.10 indicate that truck delay challenges are most pronounced on roadways that serve as first-/last-mile connectors for trucks within the State's urban regions.

### Figure 4.14 Truck Travel Time Index by Urbanized Area – Interstate Highways, 2021




*Source: National Performance Management Research Data Set; WVDOT; Cambridge Systematics, Inc. analysis.*

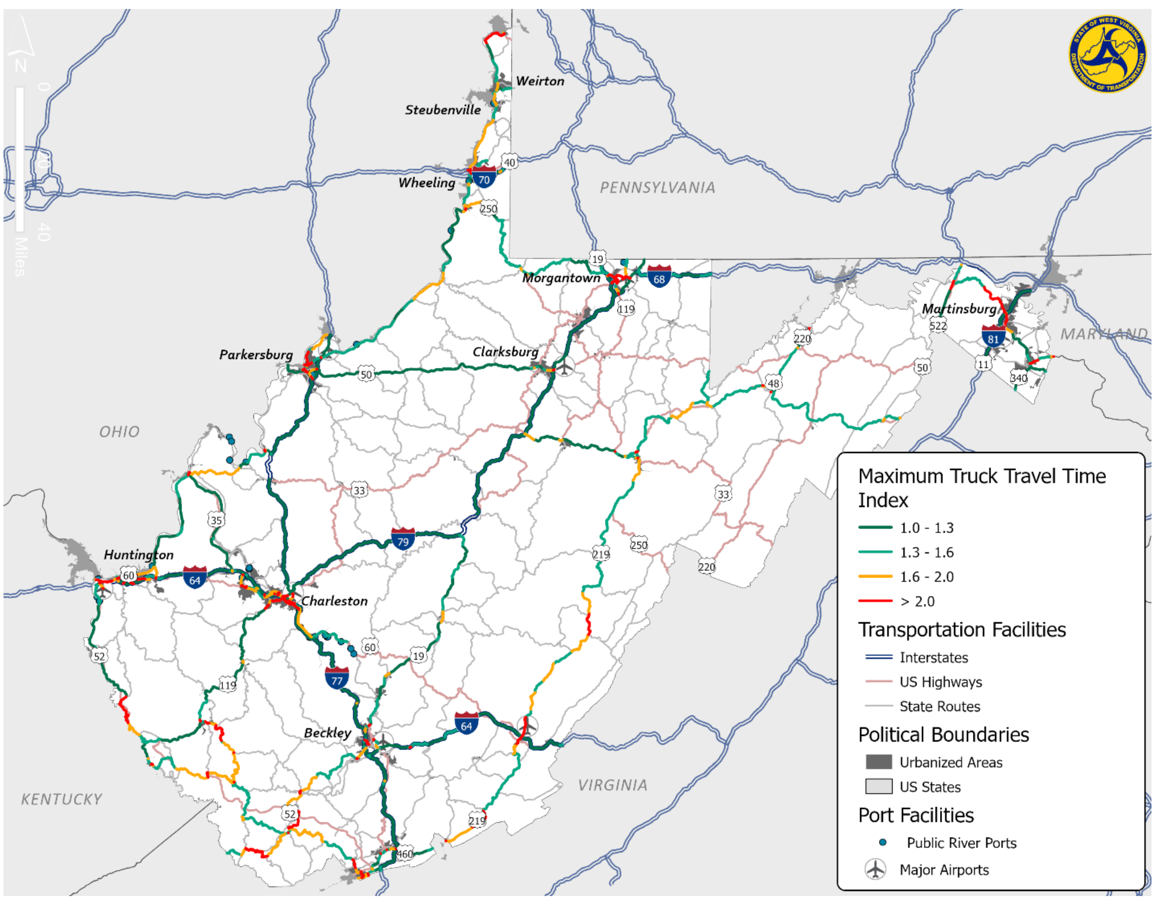
### Figure 4.15 Truck Travel Time Index by Urbanized Area – Non-Interstate NHS, 2021




*Source: National Performance Management Research Data Set; WVDOT; Cambridge Systematics, Inc. analysis.*

Figure 4.16 depicts West Virginia's highway network and the maximum truck TTI values based on 2021 data.

### Figure 4.16 Maximum Truck Travel Time Index, 2021




*Source: National Performance Management Research Dataset; WVDOT; Cambridge Systematics, Inc. analysis.*

### 4.2.4 Bottlenecks

When considering mobility and reliability, truck bottlenecks are a top concern for freight travel. Truck bottlenecks occur when trucks are delayed by slow speeds due to recurring traffic congestion, truck travel times are inconsistent due to planned or unplanned events (including incidents or work zones), or where restrictions limit truck travel (such as posted bridges).[20] West Virginia previously identified its freight bottlenecks as part of the October 2022 Baseline Performance Period Report and tracks their performance on an ongoing basis as part of FHWA required performance reporting.[21] The bottlenecks identified in Table 4.11. were determined through overlaying three critical sets of data—truck tonnage data, travel time reliability data, and needs identified by stakeholders through the prior Freight Plan (and complemented by outcomes of the 2050 LRTP and the State Rail Plan). As determined by the WVDOT October 2022 Baseline Performance Period Report, these bottlenecks met the following criteria:

- Greater than 20,000 annual truck tonnage consistent with 2012 FAF data.
- Planning time index and/or truck travel time reliability at 7 or above.
- Identified as a need by stakeholders during the Freight Plan outreach.

**Table 4.11. West Virginia Highway Truck Freight Bottlenecks**

| Bottleneck Location |
|---|
| I-81 from Exit 12 to Maryland State Line |
| I-70 from Ohio State Line to Pennsylvania State Line |
| I-64 from Exit 28 to Exit 59 |
| I-77 from Exit 40 to Exit 48 (U.S. 19) |
| U.S. 35 from Buffalo Bridge to existing 4-lane section in Mason County (approximately 14 miles) |
| I-79 from Exit 115 to Exit 121 |
| I-77 from Exit 89 to Exit 96 |
| I-77 from Exit 9 to Virginia State Line (East River Mountain Tunnel) |
| I-79 from Exit 152 (U.S. 19) to Pennsylvania State Line |
| Appalachian Highway Development System—Corridor H: U.S. 23/U.S. 48 from Weston WV to Strasburg VA. |

As part of its October 2022 Full Performance Period Report, WVDOT conducted a review of 2019 and 2021 NPMRDS data for each bottleneck. Table 4.12 presents the results of this assessment. Summary statistics are noted below:

- Five of these ten bottlenecks in 2019 experienced TTTR indices over 1.50, while the remainder showed TTTR below 1.40.
- In 2021, only two of the eight Interstate bottlenecks experienced TTTR indices over 1.50, while the remainder showed average TTTRs at 1.20 or below (overall representing reliable truck travel). The two non-Interstate bottlenecks, while not included in calculations for the required performance measure, have

[20] FHWA, Truck Freight Bottleneck Reporting Guidebook, FHWA-HOP-18-070, July 2018, https://www.fhwa.dot.gov/tpm/guidance/hop18070.pdf.

[21] 23 U.S.C. 150.

also showed improvements as a result of project completions (however in both cases, US-35 and Corridor H, construction is occurring in new locations and planned for future segments later this decade).

- The most significant improvements, in all cases resulting from concluded projects, include I-81 in Martinsburg, I-77/I-64 in Beckley, and I-77 from the Virginia state line to Princeton.

Based on the results, there were no new or emerging bottlenecks identified on the Interstate System.

### Table 4.12 West Virginia Highway Truck Freight Bottlenecks – 2019 and 2021 TTTR

| Bottleneck Location | 2019 TTTR | 2021 TTTR |
|---|---|---|
| I-81 from Exit 12 to Maryland State Line | I-81 southbound between Exit 12 and Exit 8 measures a TTTR of 1.89. I-81 northbound from Exit 5 to Exit 8 measures a TTTR of 1.49. Generally, the remainder of the corridor measures a TTTR less than 1.40. | In 2021, the entire I-81 corridor operated at an average TTTR of 1.1, representing reliable truck travel. Near the I-81 Northbound West Virginia welcome center is the highest TTTR in the corridor at 1.25 occurring during overnight hours, primarily attributed to truck parking. |
| I-70 from OH State Line to PA State Line | Extensive work zones were initiated in this corridor in 2019 associated with bridge reconstruction projects. As a result of the work zones, which are planned to continue through 2022, combined with truck volumes and interchange spacing issues, TTTR values routinely exceeded 1.50 in both the eastbound and westbound direction. In some segments, including Exit 5 to the Pennsylvania state line, TTTR exceeds 5.00 | The entire I-70 corridor, from the Pennsylvania state line to the Ohio state line operated at an average TTTR of 2.58 in 2021. As a result of the work zones, including lane closures and detours during 2021, TTTR values routinely exceeded 2.5 across nearly 5 miles of this corridor in both the eastbound and westbound direction. This is generally consistent with performance in 2019, with some shifts in the most severe reliability issues as work zones shift during construction. |
| I-64 from Exit 28 to Exit 59 | Most of this corridor from Exit 28 (Milton) to Exit 59 (I-77 split in Charleston) experiences TTTR at 1.40 or less. TTTR over 1.50 appears in three key locations – at Exit 34, from Exit 40 (US-35 interchange) to Exit 47, and from Exit 54 to Exit 59 in Charleston. High TTTR at these locations is tied to interchange spacing and design limitations and ongoing maintenance and construction activities. | In 2021, TTTR from US-35 in Teays Valley (exit 40) to exit 59 (the I-77 spilt in Charleston) averages 1.30, which reflects some unreliable segments in this corridor. Multiple segments between Exit 47 and 44 (Cross Lanes to Nitro) and from Exit 59 to 58A (US-119) operate at TTTR's above 1.8, and in some cases as high as 2.5 at Exit 45. High TTTR at these locations is tied to interchange spacing and design limitations and ongoing maintenance and construction activities. |
| I-77/I-64 from (Exit 40) to (Exit 48) US-19 | An ongoing widening project on I-77 in this segment is anticipated to impact TTTR during this performance period. In 2019, TTTR has remained below 1.40. | In 2021, I-77 within the Beckley region operated at an average TTTR of 1.13, representing reliable truck travel. No segment in the corridor between US-19 N and I-64 operated above 1.20. Note, WV 16, the primary truck corridor towards southwest West Virginia, operates at a TTTR of 1.90 from Exit 42 to the Coalfields Expressway. |
| US-35 from Buffalo Bridge to existing 4-lane section in Mason County (app. 14 mi.) | Capacity projects are planned within this corridor during this performance period. In 2019, prior to the start of construction activity, TTTR has remained below 1.40 for the entire corridor. | In 2021, generally US-35 operates reliably for trucks (average TTTR of less than 1.20) throughout Mason County, however, US-35 continues to see high TTTR (over 2.0) near the interchange with I-64. |

| Bottleneck Location | 2019 TTTR | 2021 TTTR |
|---|---|---|
| I-79 from Exit 115 to Exit 121 | This segment of I-79 in Clarksburg/Bridgeport facilitates truck movement across four closely spaced interchanges, including US-50. In 2019, TTTR has remained below 1.40 for the entire corridor. | In 2021, I-79 in the Clarksburg/Bridgeport area operated at an average TTTR of 1.21, representing reliable truck travel. The segment between Exit 121 and 124, which also includes a rest area and truck parking, operates at 1.32. Note, Exit 124 provides access to WV 279, which is the primary truck route bypass east of Bridgeport, providing access to US-50 and manufacturing and warehouse facilities adjacent to North Central West Virginia Airport. |
| I-77/I-64 from Exit 89 to Exit 96 | This segment of I-77/I-64 facilitates truck access/egress to freight dependent industries. In 2019, TTTR has remained below 1.40 for the entire corridor. | In 2021, I-77/I-64 from the I-64 interchange in Charleston to the Chelyan toll plaza operated at an average TTTR of 1.22, representing reliable truck travel. Note, US-60 from the I-77/I-64 interchange (exit 92) to the Chelyan Bridge provides access to the freight dependent industries in this area and operates at unreliable TTTR's above 1.80 in 2021. |
| I-77 from Exit 9 to Virginia State Line (East River Mountain Tunnel) | TTTR in this corridor has been high in recent years due to pavement rehabilitation work combined with curves and steep grades. TTTR in the I-77 southbound direction averaged above 2.00 for this entire corridor in 2019. | In 2021, I-77 from the Virginia state line to US-460 (Exit 9) operated at an average TTTR of 1.19, representing reliable truck travel. I-77 between the tunnel and Exit 1 (US-52) operated at an average TTTR of 1.3 (both directions) during the overnight hours generally due to lower speeds in this area adjacent to the tunnel and the interchange. |
| I-79 from Exit 152 (US-19) to Pennsylvania State Line | I-79 through the Morgantown region facilitates truck access/egress to freight dependent industries while also serving the primary corridor connecting West Virginia to southwest PA and Pittsburgh. In 2019, TTTR has remained below 1.40 for the entire corridor. | In 2021, I-79 through the Morgantown region (Pennsylvania state line to I-68 interchange operated at an average TTTR of 1.22, representing reliable truck travel. The highest TTTR in the corridor is in the northbound direction from Exit 152 and Exit 155, due to interchanges and merges. Note, NHS roadways and interchanges with I-79, including US-19 at exits 155 and 152 operate at TTTRs over 2.0. |
| Appalachian Highway Development System (AHDS) - Corridor H | This corridor, from Elkins, WV to the Viginia state line, is continuing buildout to a four-lane divided facility. Bottlenecks occur in the under-construction 2-lane sections as truck volumes increase across the remainder of the corridor. Most sections of this corridor in 2019 measured TTTR of 1.4 or above, with a number of sections including Davis to Mt. Storm and Baker to Wardensville seeing TTTR indexes over 1.70. | In 2021, Corridor H from Davis to Wardensville is complete and open to traffic. While the corridor does experience TTTR over 1.50 in specific segments, these are primarily due to lower truck speeds within steep grades along the corridor, not construction activities or incidents. The segment from Kerens to Parsons is currently under construction, resulting in higher TTTR in this area (averaging 1.8 to 2.0). |

Across the entire Interstate system in West Virginia, the TTTR index was 1.21 in 2021, while the 2021 target was 1.40. Note, during 2020, at the height of the travel and economic impacts of the COVID-19 pandemic, the TTTR in West Virginia declined to 1.19. As total traffic volumes returned to near 2019 levels in 2021 and truck traffic surpassed 2019 levels, TTTR increased, however it remained below the 2019 performance (1.27) and the 2017 baseline (1.22).

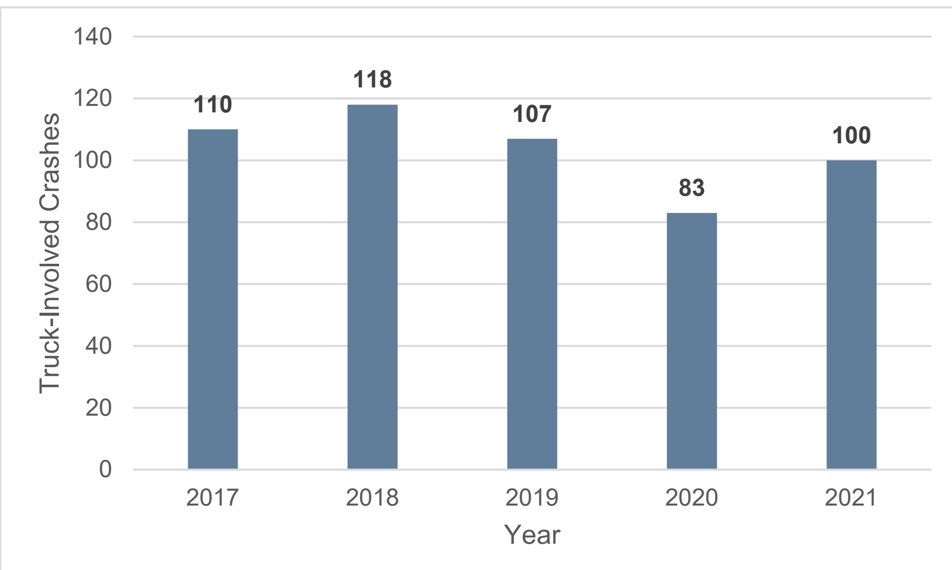
# 5.0 SAFETY

This section of the report examines the safety performance of the State's highway network. Transportation safety is extremely important and is one of the highest priorities at all levels of transportation planning and engineering – national, Statewide, regional, and local. The safety analysis was conducted using data from WVDOT's crash database for the 2017 to 2021 time period. This analysis provides an overview of truck-involved crashes on the state's highway network.

## 5.1 Trucks Involved in Crashes

There were 518 fatal and serious injury crashes involving trucks in West Virginia based on 2017-2021 data as shown in Figure 5.1. This represents about 10.45 percent of all fatal and serious injury crashes in the State. The number of fatal and serious injury crashes remained nearly constant from 2017 to 2021 with an average of about 104 truck-involved crashes per year. Over the analysis period, the annual number of fatal and serious injury truck-involved crashes in the state ranged from a low of 83 crashes in 2020 to a high of 118 in 2018.

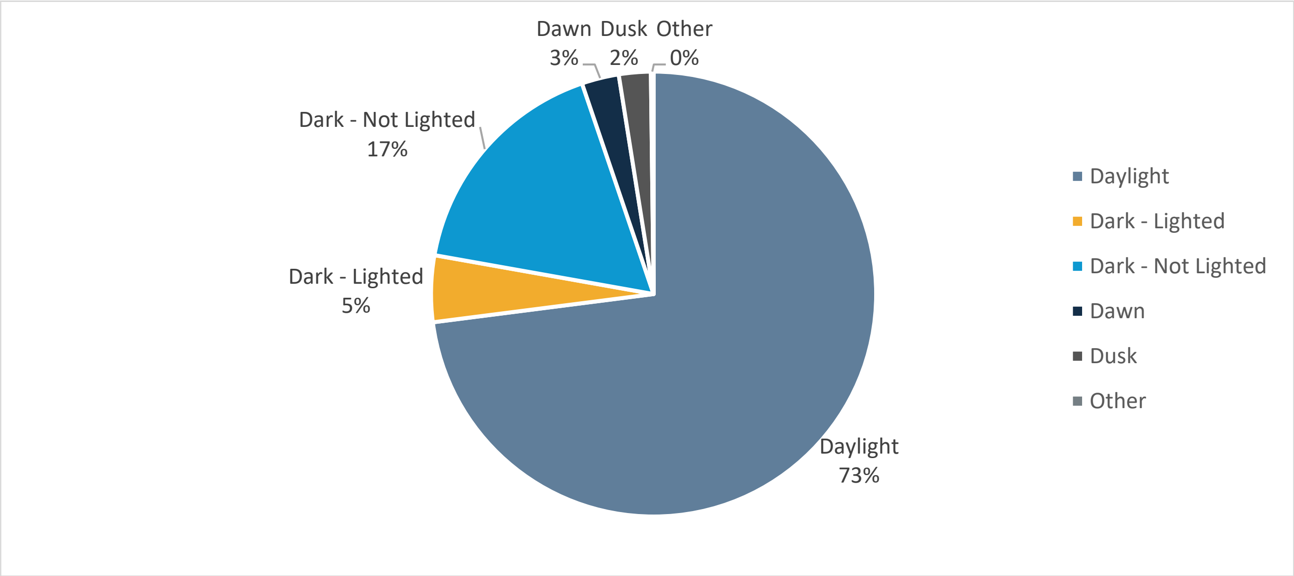
**Figure 5.1 Statewide Fatal and Serious Injury Truck-Involved Crashes by Year, 2017-2021**




*Source: WVDOT; Cambridge Systematics, Inc. analysis.*

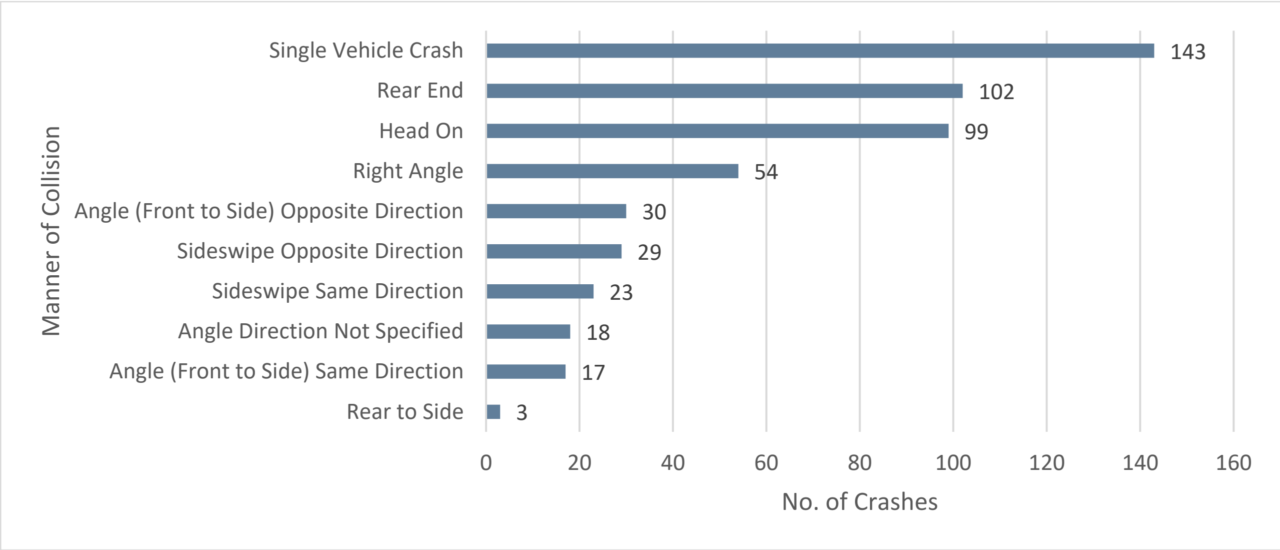
As shown in Figure 5.2, nearly three-quarters of truck-involved crashes occurred during daylight hours. This would imply that dark lighting is not a contributing factor to these crashes. For crashes involving trucks, single vehicle crash, rear end, head on, and right angle were the most prevalent as shown in Figure 5.3. These accounted for nearly 77 percent of truck-involved crashes observed during the analysis period. Head - on and angle collisions (right, front to side same direction, front to side opposite direction, and direction not specified) are the most severe crash types, accounting for approximately 19.1 percent and 23 percent of truck-involved crashes, respectively. The prevalence of single vehicle crashes may be related to factor such as roadway alignment and excessive speed. Angle crashes may be due to many factors, including excessive speed, drivers not obeying traffic signals, and poor visibility of traffic signals due to the prevalence of large trucks.[22] Lane width and worn or inadequate pavement markings are typical contributing factors for sideswipe crashes.[23] For rear end crashes, congestion and inappropriate approach speeds are contributing factors.[24]

### Figure 5.2 Lighting Conditions of Fatal and Serious Injury Truck-Involved Crashes Statewide, 2017-2021




*Source: WVDOT; Cambridge Systematics, Inc. analysis.*

### Figure 5.3 Statewide Fatal and Serious Injury Truck-Involved Crashes by Manner of Collision, 2017-2021




[22] American Association of State Highway and Transportation Officials (2009). *Highway Safety Manual*. Exhibit 6-4 and Exhibit 6-5, pgs. 6-6 to 6-7, 1st edition.

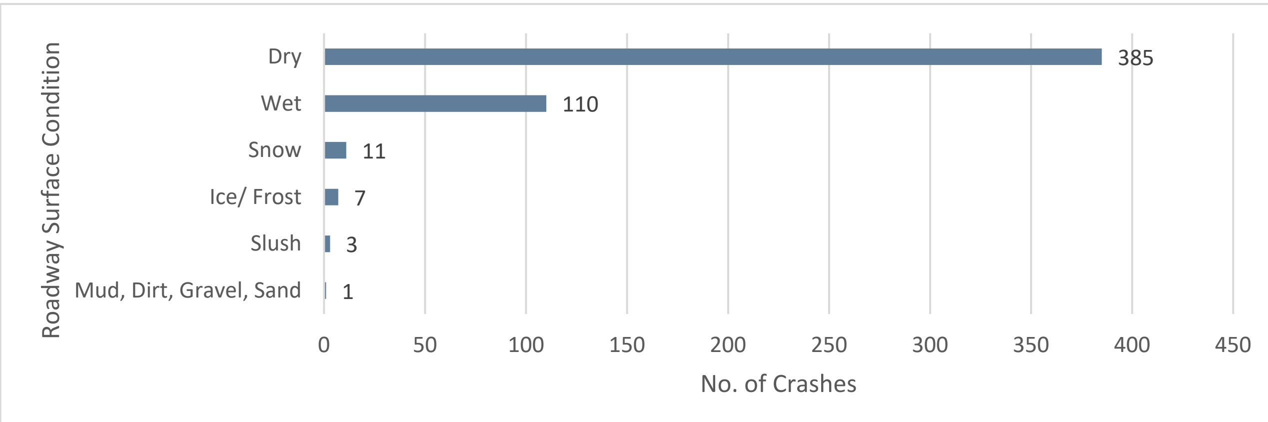
[23] Ibid.

[24] Ibid.

*Source: WVDOT; Cambridge Systematics, Inc. analysis.*

Figure 5.4 shows the roadway surface conditions that were present at the time of the fatal and serious injury truck-involved crashes. Nearly 75 percent of these crashes occurred when roadway conditions were dry and about 21 percent happened when roadway conditions were wet. Only about 4 percent of fatal and serious injury truck-involved crashes occurred during snow, ice/ frost, or slush conditions. To some extent, the low share of truck-involved crashes during those conditions may be reflective of limited truck activity due to adverse weather.

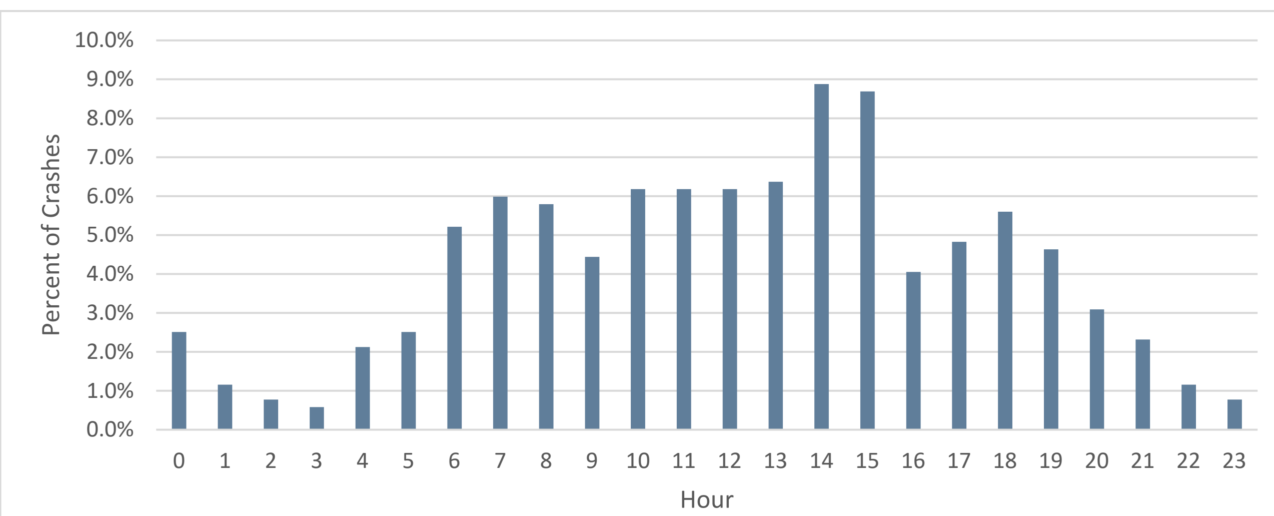
**Figure 5.4 Roadway Surface Conditions of Fatal and Serious Injury Truck-Involved Crashes Statewide, 2017-2021**




*Source: WVDOT; Cambridge Systematics, Inc. analysis.*

Fatal and serious injury truck-involved crashes by time of day are shown in Figure 5.5. The majority of crashes occurred during typical business hours when trucking activity would be highest, 6 a.m. to 7 p.m. Over 78 percent of fatal and serious injury truck-involved crashes took place during this time frame. The 2 p.m. – 3 p.m. and 3 p.m. – 4 p.m. hours exhibited the highest share of these crashes. Just under 9 percent of fatal and serious injury truck-involved crashes occurred during each of these hours.

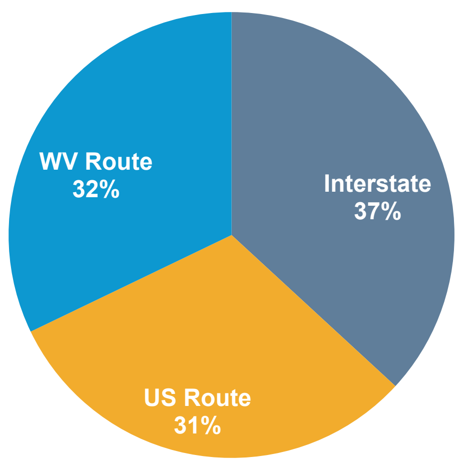
**Figure 5.5 Statewide Fatal and Serious Injury Truck-Involved Crashes by Time of Day, 2017-2021**



*Source: WVDOT; Cambridge Systematics, Inc. analysis.*

Of the State's 518 fatal or serious injury truck crashes, 445 (about 86 percent) occurred on interstate highways, U.S. routes, or State routes. As shown in Figure 5.6, approximately 37 percent of these crashes happened on interstate highways. Interstate highways typically carry a larger share of vehicle-miles which results in these highways having a greater exposure to the potential for a crash. For example, in 2020 interstate highways accounted for nearly 4.8 billion of West Virginia's over 16 billion vehicle-miles. This is about 30 percent of total vehicle miles despite interstate highways comprising only about 2.9 percent of total lane-miles in the State.[25] About 32 percent occurred on State routes while 31 percent happened on U.S. routes.

### Figure 5.6 Fatal and Serious Injury Truck-Involved Crashes on Interstates, U.S. Routes, and State Routes, 2017-2021




*Source: WVDOT; Cambridge Systematics, Inc. analysis.*

Generally, fatal, and serious injury truck-involved crashes primarily occurred in West Virginia's most populous counties. As shown in Table 5.1, ten of West Virginia's 55 counties accounted for about 49 percent of these crashes. Kanawha County experienced the largest share of fatal or serious injury truck-involved crashes with about 11 percent. This is also the State's most populous county and is where three of West Virginia's six interstate highways meet.

### Table 5.1 Fatal and Serious Injury Truck-Involved Crashes on Interstates, U.S. Routes, and State Routes by County, 2017-2021

| County | Number of Crashes | Percent of Total |
|---|---|---|
| Kanawha | 49 | 11.0% |
| Berkeley | 29 | 6.5% |
| Raleigh | 23 | 5.2% |

[25] Federal Highway Administration, "Table VM-2: Vehicle-miles of travel by functional system" and "Table HM-60: Estimate lane-miles by functional system," *Highway Statistics*, 2020.

| County | Number of Crashes | Percent of Total |
|---|---|---|
| Putnam | 19 | 4.3% |
| Mercer | 18 | 4.0% |
| Monongalia | 17 | 3.8% |
| Harrison | 16 | 3.6% |
| Jackson | 16 | 3.6% |
| Wood | 16 | 3.6% |
| Ohio | 15 | 3.4% |
| ***Subtotal*** | ***218*** | ***49.0%*** |
| Remaining Counties | 227 | 51.0% |
| **Total** | **445** | **100.0%** |

*Source: WVDOT; Cambridge Systematics, Inc. analysis.*

## 5.2 Truck Parking

Concern surrounding adequate and safe truck parking has grown nationally since the passing of Jason's Law as part of MAP-21. Jason's Law established a "national priority on addressing the shortage of long-term parking for commercial motor vehicles on the NHS to improve the safety of motorized and non-motorized users and for commercial motor vehicle operators." The law also required FHWA and state DOTs to evaluate and develop metrics to measure the capability to provide adequate parking and rest facilities for trucks.

Drivers unable to find safe spaces to rest may continue driving past the hours of service (HOS) limits, increasing the possibility for a drowsy-driving incident. Due to the increased level of tracking through ELDs, drivers may also park wherever they are when their HOS expire regardless of their location (e.g., a highway entry/exit ramp, a local roadway bordering an authorized parking location that is full, a highway shoulder). Trucks parking on the highway shoulder, on entrance/exit ramps, or other unauthorized locations is generally considered as "unsafe" for drivers and other roadway users.

A FMCSA study found driver fatigue to be an associated risk factor in 13 percent of large truck involved crashes between April 2001 and December 2003.[26] Subsequent studies determined that the risk for crashes or safety critical events (i.e., hard stops, evasive maneuvers, etc.) increases with driving-time[27] and/or a combination of driving time and work hours,[28] suggesting that fatigue is a factor. A 2009 study found that rest areas are a countermeasure to crashes (both fatigue- and non-fatigue-related) as crash rates were observed to decrease immediately downstream of a rest area while increasing further downstream with greater

[26] Federal Motor Carrier Safety Administration. Large Truck Crash Causation Study – Analysis Brief. July 2007. Online at: https://www.fmcsa.dot.gov/safety/research-and-analysis/large-truck-crash-causation-study-analysis-brief

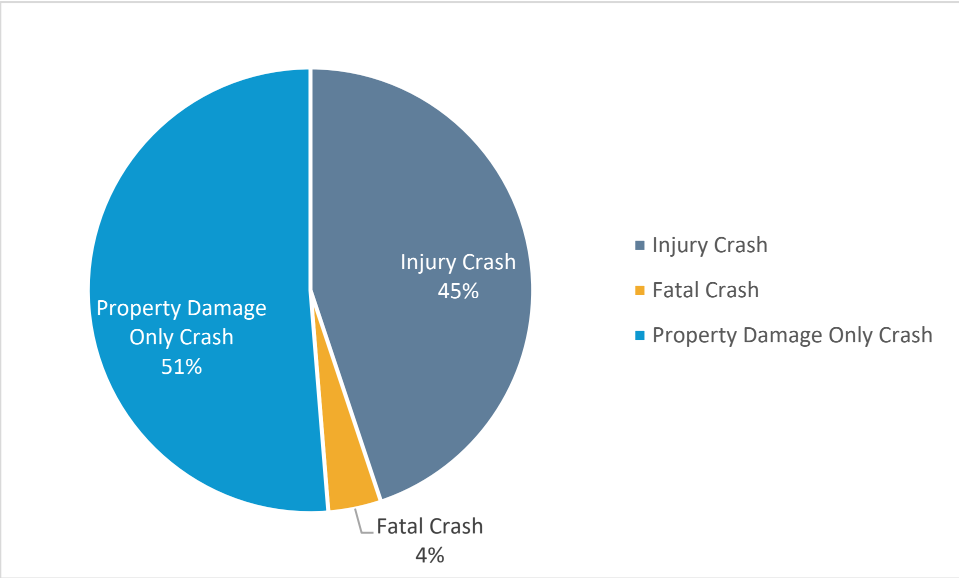
[27] Jovanis, P. et al. "Hours of Service and Driver Fatigue: Driver Characteristics Research." (2011) https://rosap.ntl.bts.gov/view/dot/70

[28] Blanco, M. et al. "The Impact of Driving, Non-driving Work, and Rest Breaks on Driving Performance in Commercial Vehicle Operations" (2011), https://vtechworks.lib.vt.edu/handle/10919/55114.

distance from the rest area.[29] With the increase in truck traffic nationwide and the continued lack of truck parking capacity, this issue is still likely a serious concern.

The remainder of this section of the report investigates crashes involving unauthorized parked trucks on West Virginia roadways. For this analysis, trucks are considered to be parked in an unauthorized location if they are on the roadway shoulder, entrance/exit ramp, median, or other roadside location. In total, there were 78 crashes involving parked trucks between 2017-2021. The results in Figure 5.7 show that about 4 percent of these crashes resulted in a fatality, and about half resulted in some type of injury.

### Figure 5.7 Parked Truck-Involved Crashes by Severity, 2017-2021

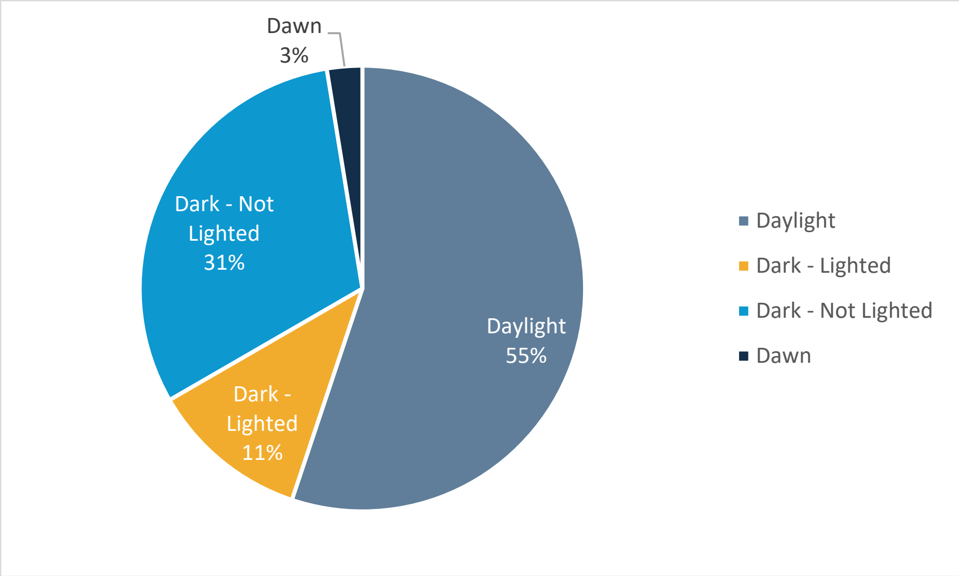



*Source: WVDOT; Cambridge Systematics, Inc. analysis.*

As shown in Figure 5.8, over half of parked truck-involved crashes occurred during daylight hours. This would imply that dark lighting is not a contributing factor to these crashes. Figure 5.9 summarizes the manner of collision for parked truck-involved crashes. About one-third of crashes were reported as single vehicle crashes. Rear end and sideswipe same direction were the next most prevalent collision types accounting for 20 and 16 total crashes, respectively.

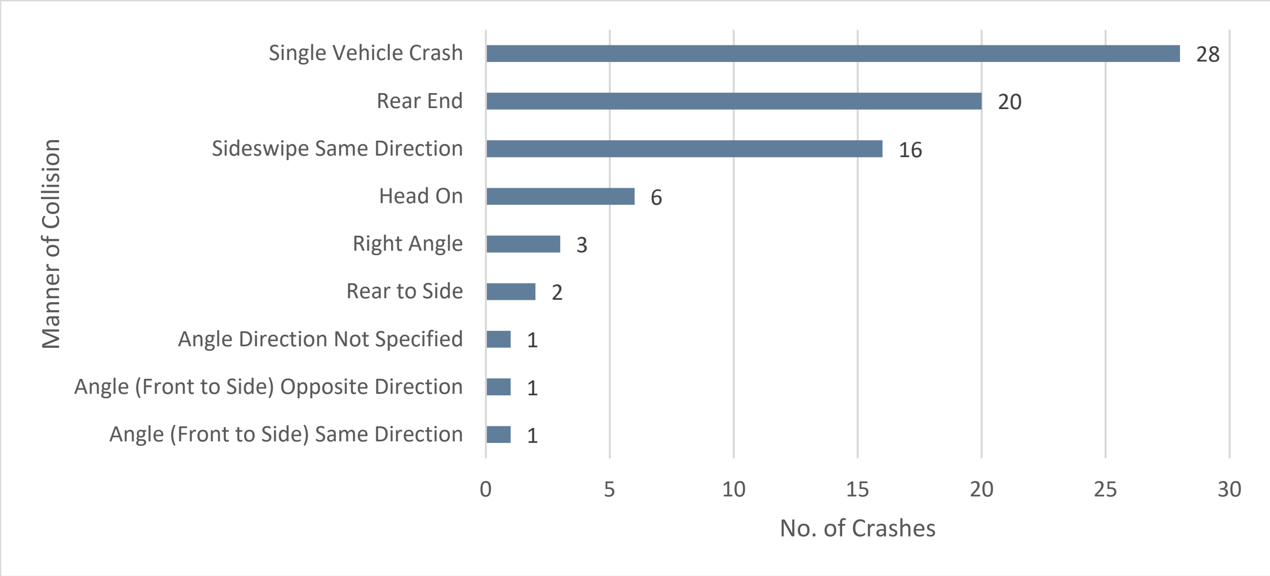
[29] Banerjee, I., et al. “Rest Areas—Reducing Accidents Involving Driver Fatigue” University of California Berkeley Traffic Safety Center and California Department of Transportation, May 2009. https://dot.ca.gov/-/media/dot-media/programs/research-innovation-system-information/documents/final-reports/ca09-1092-finalreport-a11y.pdf.

**Figure 5.8 Parked Truck-Involved Crashes by Lighting Conditions, 2017-2021**




*Source: WVDOT; Cambridge Systematics, Inc. analysis.*

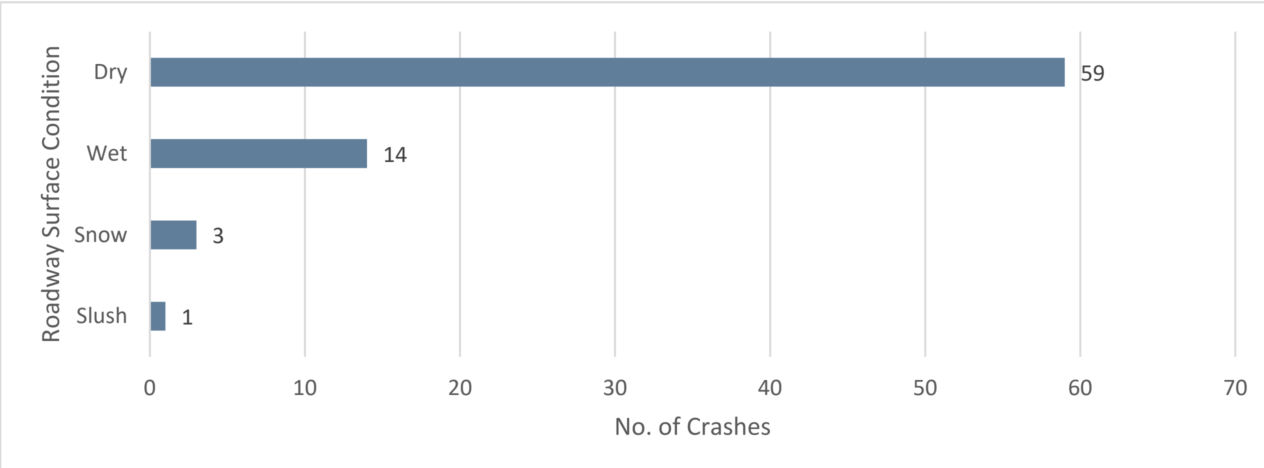
**Figure 5.9 Parked Truck-Involved Crashes by Manner of Collision, 2017-2021**




*Source: WVDOT; Cambridge Systematics, Inc. analysis.*

Figure 5.10 summarizes roadway surface conditions at the time of the crashes. It shows that 59 of the 78 total crashes (over 75 percent) occurred when roadway surface conditions were dry. This implies that roadway surface condition was generally not a contributing factor to parked truck-involved crashes.

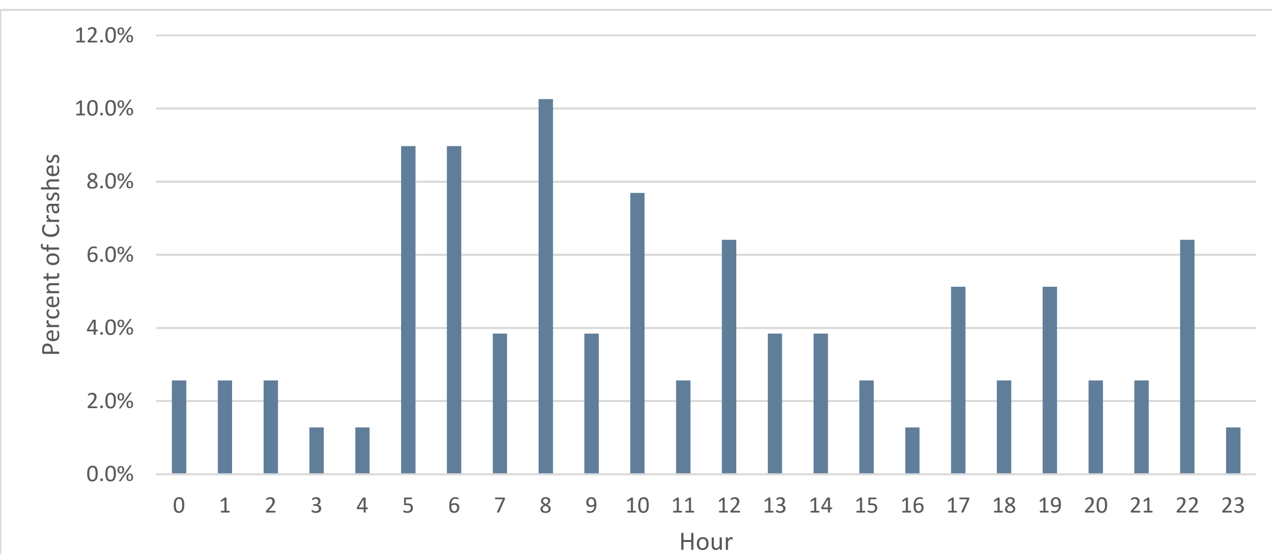
**Figure 5.10 Parked Truck-Involved Crashes by Roadway Surface Conditions, 2017-2021**




*Source: WVDOT; Cambridge Systematics, Inc. analysis.*

As shown in Figure 5.11, crashes involving parked generally occurred during typical business hours when trucking activity would be highest, 6 a.m. to 7 p.m. About 68 percent of parked truck-involved crashes took place during this time frame. Interestingly, there are spikes in crashes during the 5 a.m. and 10 p.m. hours. The sharp increase in parked truck-involved crashes during the 5 a.m. hour may be a result of commuters just beginning to enter the roadway network. It is unclear why the spike in crashes during the 10 p.m. hour occurs. This may correspond to a time of day where drivers begin to settle for unauthorized parking locations if authorized locations are unavailable.

**Figure 5.11 Parked Truck-Involved Crashes by Time of Day, 2017-2021**




*Source: WVDOT; Cambridge Systematics, Inc. analysis.*