Final Report

DISTRICT OF COLUMBIA FREIGHT PLAN

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1.0 Introduction

In May of 2013 the District of Columbia Department of Transportation (DDOT) initiated a freight plan to address issues surrounding freight transportation and to have supporting information to become the foundation for integrating freight priority projects in the District's capital programming process.

The issues and supporting information contained in this report consist of strategies and recommendations to support sustainable future economic growth, and balance the needs between communities and various industries in the District.

The Freight Plan includes an inventory and profile of each freight mode, the role freight plays in the District's economy, detail on current and future freight flows into 2040, system capacity and operations by mode, and a strategic plan for the District to support a robust freight transportation and logistics system. The recommendations from the plan support jobs and the economy, provide efficient delivery of goods to residents and businesses, and maximize freight related development in specific corridors of the District.

To arrive at the recommendations in this plan the project team conducted thorough freight flow and economic analyses, using the latest tried and proven tools. Best practices in other studies and current freight plans in other states and cities were consulted for potential inclusion in this report, and several are reflected in the recommendations. The project team partnered with MoveDC and participated in stakeholder conferences in various parts of the District. Special discussions were held with District leadership including discussions with stakeholders such as CSX Rail, United Parcel Service (UPS), and FedEx. Those and other stakeholder interviews and surveys were conducted; the results are included in this report.

The project team also documented and mapped freight movement through the city. This information included modal shares as well as origin, destination, and commodity types at the traffic analysis zone (TAZ) level.

1.1. Background

The District of Columbia (the District or DC) is a dense urban environment with a diverse mixture of land uses that place significant demand on the city's transportation infrastructure. The city's role as an employment center for the region creates a high volume of commuter traffic in peak hours, while the consumer driven economy generates significant demand for freight movement.

The District has experienced a substantial population increase and sustained economic development over the past decade, generating a growing demand for freight activity. While businesses continue to thrive, contributing greatly to the economic needs of the city, population growth caused an increase in demand for housing, employment, and goods and services, all of which create increasing pressure on the city's transportation network.

In 2013, the District had an estimated population of 646,449 and, according to the US Census Bureau, is one of the fastest-growing cities in the United States[1]. In 15 months, between April 2010 and July 2013, the population in DC increased by 7.4 percent or approximately 44,700 people. The city was the 13th fastest growing municipality in the United States between 2012 and 2013, according to the US Bureau of the Census.

The District's burgeoning population has led to an increased demand for consumer goods, which in turn, generates increased freight movement. This puts pressure on an already burdened transportation system.

The Washington, DC metropolitan area is rated as the 10th most congested region in the country in 2014[2], a jump up from 1982 when the area was ranked as the 18th most congested area in the United States. Other congestion metrics such as delay per passenger, percentage of vehicle miles traveled (VMT) in congested conditions, hours of congestion, and delay cost per traveler, have also been worsening over the last twenty years. These trends are expected to continue. Travel forecasts conducted by the Metropolitan Washington Council of Governments (MWCOG) predict regional economic population and job growth, combined with limited opportunities for new transportation services, will produce higher levels of peak congestion than are experienced by trucks and passenger vehicles today.

In addition to the congestion caused by a high volume of private vehicles traveling into the city, the District's transportation infrastructure is shared with other modes such as transit vehicles and bicyclists. Many of the city's residents rely on the extensive bus system and services to conduct their daily business. Surface transit options such as the Washington Metropolitan Transit Authority's (WMATA) Metrobus, DDOT's Circulator, and the development of a streetcar system, initiated on H Street NE, provide an essential service to the estimated 24 percent of District households that do not have access to motor vehicle. In addition to local transit services, the District's transportation network also supports regional transit with over 300 commuter buses entering the city every weekday. As well as the traditional transit options, the District also has a well-established and successful bicycle program. In 2010, DDOT launched the largest bike-sharing program in the country (Capital Bikeshare) and has installed over 50 miles of bike lanes and 64 miles of signed bike routes. All of these modes are important parts of the District's transportation network, but they create competing demands on infrastructure that has few options to expand.

1.2. Key Points

In 2011, the District moved $21.7 billion and 16.8 billion tons in domestic goods to, within, and from the District. By 2040, the District's freight system will move over $61.2 billion worth of goods, weighing 28.9 billion tons. In order to accommodate this projected increase in freight movement, the District Freight Plan will outline freight transportation strategies and recommendations to support sustainable economic growth, and balance the needs between communities and various industries in the District.

[1] http://www.census.gov/newsroom/releases/archives/population/cb14-89.html
[2] http://www.inrix.com/scorecard/default.asp

The freight plan analysis shows the total freight movements to, within, and from the District for 2011 and 2040 by mode. Commodity movements into the District dominate compared to movements within and out of the District, and truck is the dominant mode. Overall, freight traffic in the District is expected to grow by 74 percent from 2011 to 2040 in terms of tons, and 159 percent from 2011 to 2040 in terms of value. The compounded annual growth rate for tons and value is calculated at 1.9 percent and 3.3 percent respectively.

The District is a net consumer rather than producer of goods. By weight and value, more freight comes into the District than leaves the District. However, in terms of the average value per ton, freight leaving the District has a higher value ($2,571/ton) compared to freight coming into the District ($1,269/ton).

Trucks are critical for the District's economy to function. Nearly 99 percent of goods destined for the District arrive by truck. Many businesses in the District rely heavily or solely on truck service to receive and/or ship freight. In doing so, they generate freight-related economic activity as well. While few of these entities/industries are not entirely dependent on the truck mode for shipping freight (as alternative modes are available), it is hard to envision their continued operation levels without such access. In fact, truck access is often instrumental in major business location decisions.

Feasible options for alternative modes are limited. If trucks did not accommodate demand, very few shippers could use other modes (i.e., rail, water, air, or pipeline) to transport freight. Moreover, the use of other modes would likely entail higher transport costs (due to longer transport distances, price, logistics, difficult accessibility, etc.), and could increase overall demand (and resulting handling costs) for all users of other modes. The long-term result could be a migration of businesses that can move away from the District to other locations with better truck accessibility and modal options.

Truck-based freight deliveries create jobs. A total of 129,500 jobs in the District can be traced back to the organizations that ship and/or receive freight via truck in the city. Of these total transport user jobs, a significant majority (97 percent, 125,590 jobs) are attributable to freight terminating in the District of Columbia (inbound movements), and only a small fraction (three percent, 3,910 jobs) are attributable to outbound or intra-district freight originating in DC. If trucks don't accommodate demand, the long-term result could be a migration of businesses that can move away from the District to other locations with better truck accessibility and modal options. This was a theme heard from stakeholders during the plan's development.

1.3. Report Organization

This freight plan report is organized into an Executive Summary, 10 chapters and three appendices.

- **Chapter 1** introduces readers to the plan, and provides some background information about the plan,
- **Chapter 2** includes Modal Profiles and Inventories of Freight Infrastructure in the District, along with a discussion of the users that are the major freight generators in the District,
- **Chapter 3** describes freight flow, in terms of commodity types, value and tonnage, the locations of freight movements and modes of transportation,

- **Chapter 4** analyzes the value of freight transportation to the District's economy,
- **Chapter 5** on Stakeholder Involvement describes the feedback received from the citizenry and business community of DC regarding the analytical findings in this report. The stakeholders were also key to helping the study team organize and validate several recommendations,
- **Chapter 6** describes infrastructure obstacles and impediments, and fits closely with recommendations as well, since freight movement is highly dependent upon supportive infrastructure,
- **Chapter 7** is the Strategic Vision and Tactical Plan for the District. It includes high level goals for freight planning within the District as well as specific elements of what will comprise the future system to best serve the District,
- **Chapter 8** contains the study Recommendations. There are 14 short-term recommendations, six medium term recommendations, and five long term recommendations,
- **Chapter 9** contains assesses funding options to implement the recommendations, and
- **Chapter 10** includes some thoughts on Implementation of the recommendations.

The three appendices (bound under separate cover) include midterm reports that were provided to the District during the process of conducting the freight plan analysis. They include early detail on the literature review, freight flows, economic impacts, stakeholder involvement, and infrastructure obstacles and impediments.

1.4. Data Sources

Key to the analysis contained in this report is gathering pertinent, reliable and trustworthy data to determine freight movement and freight economic impacts. The District decided to use IHS Global Insight's TRANSEARCH data for the purposes of this analysis. TRANSEARCH is a privately maintained comprehensive market research database for intercity freight traffic flows, used nearly exclusively by freight planning jurisdictions throughout the country.

The TRANSEARCH database involves the fusion of various freight traffic data sources into a common framework for planning and analysis. The database provides detailed US and cross-border origin-destination freight shipment data at the state, Business Economic Area (BEA), county, metropolitan area, and zip-code level detail by commodity type (by Standard Transportation Commodity Classification (STCC) code) and major modes of transportation. Chapters 3 and 4 utilize this data and discuss major transport flows and Impact of freight movements on the district economy.

2.0 Modal Profiles and Inventories of Freight Infrastructure

2.1. Highway

The highway section describes the extent and condition of the roadway system that serves trucking in the District. The section includes points of entry, principal corridors, and pavement and bridge condition. The project team drew from freight survey data and DDOT's information management system to develop the highway profile.

2.1.1. Introduction

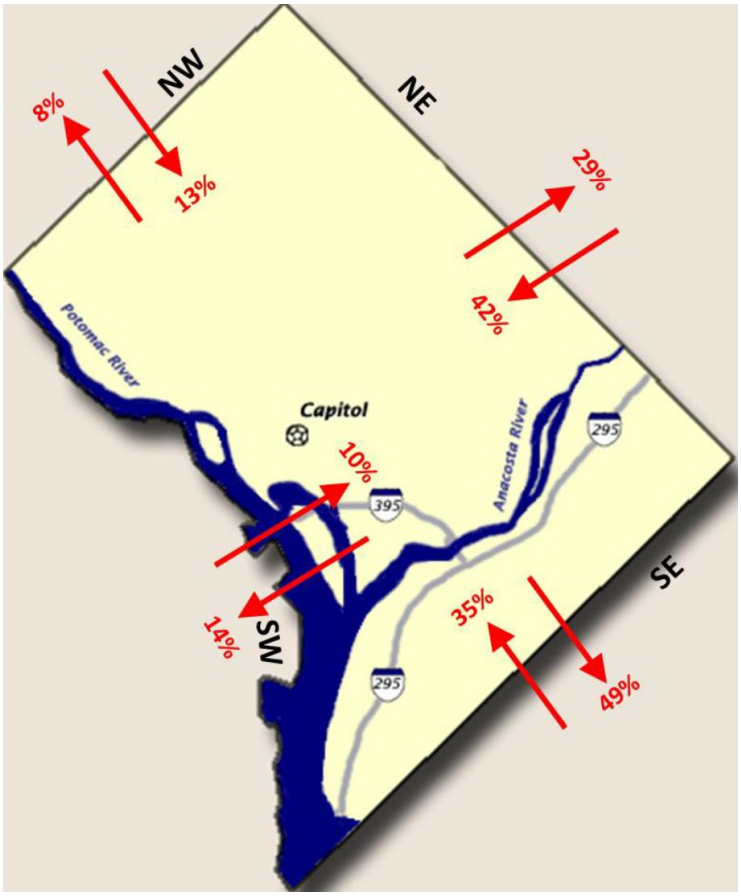
The highway system serves several important functions in the District's freight transportation system, including mobility for trucked freight, connectivity between freight generating facilities to, from, or within the District, and connectivity between airports, waterways, railroads, and businesses within the District of Columbia.

Trucking accounts for almost all of the inbound and outbound freight shipments in the District. In terms of tonnage, 99.3 percent and 98.9 percent of inbound traffic moves by truck, while in terms of value the shares are nearly identical at 99.5 percent and 99.9 percent, respectively.

Almost all trucks operating in the District have either an origin or a destination within the city. In other words, there is very little truck through-traffic within the city. Additionally, more trucks enter the District from Maryland than from Virginia. Further, inbound and outbound truck traffic is heavily concentrated to the east and south of the District. The percent of truck traffic entering and exiting the District is shown in **Figure 1.**

More than 40 percent of inbound trucks enter the District from the northeast on routes such as US 1, and US 50. The eastern part of the District, and the areas of MD east of the District, are home to many warehouses and transfer points, particularly along New York Avenue and in the Landover and Lanham, Maryland, areas. Additionally, truck traffic from Baltimore and other locations on the Eastern Shore enters the District from the east. There is also substantial truck traffic, 35 percent, from Maryland travel to southeast Washington. Similarly, for outbound traffic, over 75 percent of trucks leave via the District's eastern and southern borders with Maryland.

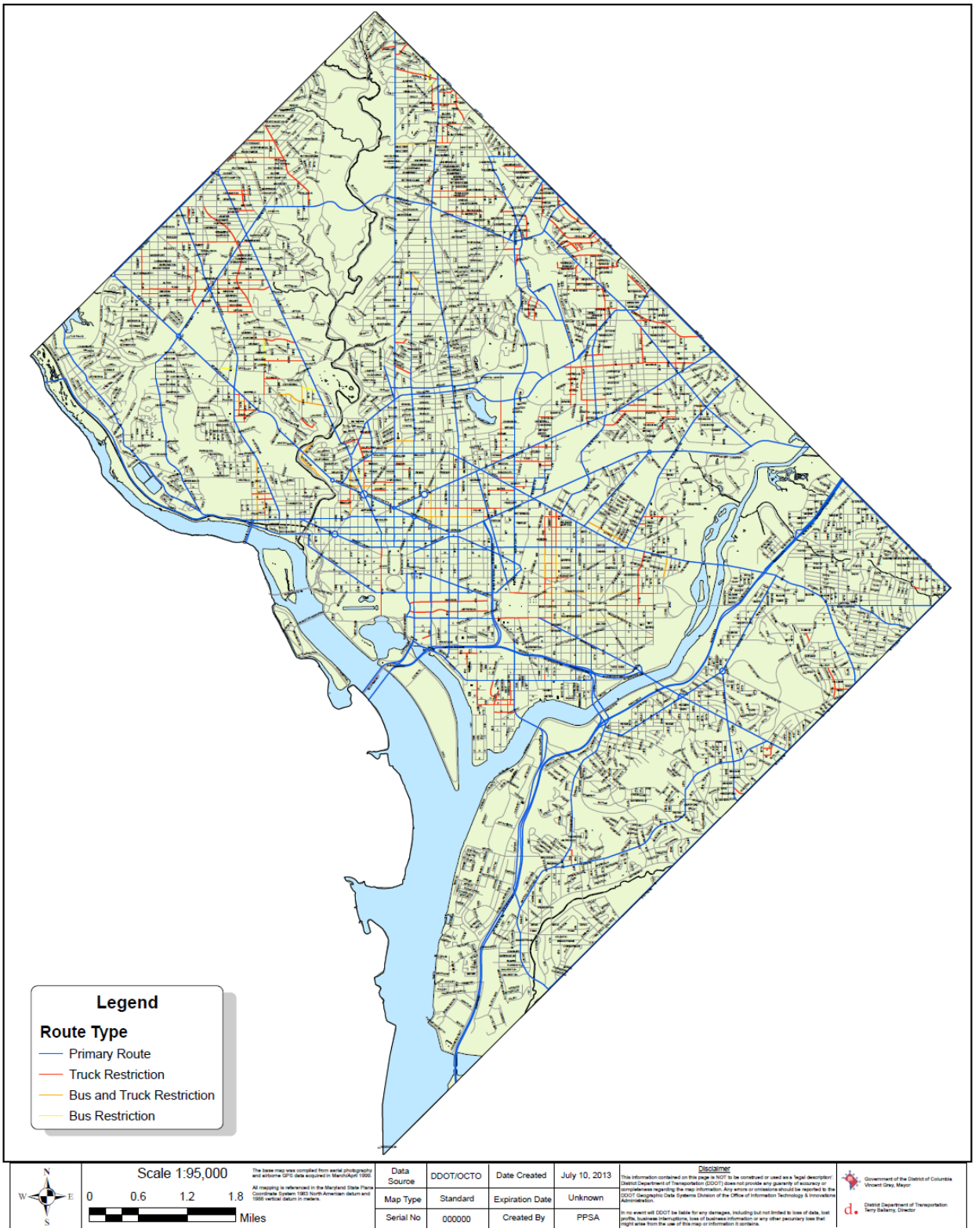
Figure 1: Inbound and Outbound Truck Traffic



In 2010, the Motor Carrier Division of the Policy, Planning and Sustainability Administration (PPSA) at DDOT developed a city-wide truck and bus route system to improve the management and monitoring of truck and bus traffic in the city under a single, comprehensive regulatory system. Specific routes were designated as part of the truck and bus route system based on a variety of factors, which included engineering characteristics, roadway classifications, planner review, industry and community feedback, and field observations. Routes included in the truck and bus route system were and designated as primary or restricted.

A “primary route” designation indicates the road meets technical standards, can handle high truck traffic volumes, or serves major truck and/or bus destinations. A “restricted route” designation indicates a road that may not be used by trucks or buses for any purpose due to security reasons, inadequate capacity, or the residential quality of the area. Roads in the District that have neither a “primary route” or “restricted route” designation may have trucks and/or buses travel on them, but only for an official business need. All trucks or buses which must travel on a non-designated road must take the most direct access road to their destination, conduct their business (i.e. deliver a package) and take the most direct road back to a ‘primary route’ for travel through the rest of the city. The District’s latest truck and bus route and restrictions map is shown in **Figure 2**.

Figure 2: Truck Routes in Washington, DC



2.1.2. Pavement Type and Condition

Pavement conditions on the District's roadways are surveyed regularly to measure rutting, cracking, and roughness. This information is summarized into a pavement condition index (PCI) that ranges from zero to 100; where 80-100 represent good condition, 65-79 average, and <64 poor. Similarly pavement roughness, defined as an expression of irregularities in the pavement surface that adversely affect the ride quality of a vehicle (and thus the user), is measured as poor to very good. In general, trucks, due to their greater per-axle loads, cause more roadway damage than automobiles. It is important to note that proper distribution of weight across axles helps to minimize the impact of additional weight on pavement and is a greater factor in determining the extent of damage than the absolute weight of a load (i.e., the lower the weight per axle the lesser the road damage caused by that vehicle).

In the District, asphalt overlay on concrete accounts for 100 percent of the primary route lane-miles. Almost 82 percent of the truck route roadways (or 49 out of 60) had a good PCI rating (80-100). Eighteen percent of the truck route roadways (11 out of 60) had an average PCI rating (65-79). There were no roadways on the truck (primary) route with poor PCI rating (<64). Pavement roughness was fair for 72 percent of truck route roadways, good for 18 percent, and poor for 10 percent of the roadways.

2.1.3. Bridge Characteristics and Condition

The primary truck route network has 160 bridges. Analysis of bridge characteristics (material, age, and condition) are beyond the scope of this task and hence are not presented. However, the location of the bridges on the truck routes is shown in **Figure 2.** Inventory rating and operating rating is shown for all bridges. Inventory rating is the capacity rating for the vehicle type used in the rating that will result in a load level which can safely utilize an existing structure for an indefinite period of time. Inventory load level approximates the design load level for normal service conditions. Operating rating is the absolute maximum permissible load level to which the structure may be subjected for the vehicle type used in the rating. This rating determines the capacity of the bridge for occasional use. Allowing heavy vehicles to use the bridge to its maximum capacity will reduce bridge life. This value is typically used when evaluating overweight permit vehicle moves.

2.1.4. Loading Zones

The District's 50,000 odd businesses generate yearly revenue of $60.1 billion. Approximately $16.3 billion (27 percent) of District's revenues are generated within 200 feet of existing loading zones with $3.2 billion of this amount generated by freight-intensive businesses (any business that requires a large amount of truck and/or freight deliveries and/or shipments). As the data demonstrates, the loading zones are crucial in serving businesses, especially those that deal in consumer goods and perishables.

In 2012, DDOT conducted a city-wide loading zone inventory. The data collected included location, loading days and hours, signage information, and the commercial composition of block.

2.1.5. Highway Summary

The highway system serves several important functions in the District's freight transportation system, including mobility for trucked freight, connectivity between freight generating facilities to, from, or

within the District, and connectivity between airports, waterways, railroads, and businesses within the District.

- Trucking accounts for almost all of the inbound and outbound freight shipments in the District, nearly 99 percent.
- More trucks enter the District from Maryland than from Virginia. Further, inbound and outbound truck traffic is heavily concentrated to the east and south of the District.
- Asphalt overlay on concrete is the only pavement type in the District, accounting for 100 percent of the primary route lane-miles. The pavement condition index (PCI) had a rating of either average or good for all pavements in the District.
- Bridges in the District allow trucks to operate at normal frequency, or at an inventory rating, which means the trucks are not overloading existing bridges and can safely utilize them for an indefinite period of time.

2.2. Rail

The rail profile describes the use, extent and condition of the freight rail system that serves the District. The section describes the operators and levels of service, and it points to current and future initiatives for improvements. The project team drew from discussions with representatives of the rail industry, freight survey data, and DDOT sources to develop the rail profile.

2.2.1. Introduction

The rail profile describes the use, extent, and condition of the freight rail system that serves the District. Freight railroads in the US are generally categorized as Class I railroads, Class II or regional railroads, and Class III or short-line railroads. Some short-line railroads are further classified as terminal railroads.

Approximately 44 million tons of cargo is shipped by rail that travels through, to or from the District. The District of Columbia is currently served by two Class I railroads; there is also one Class III switching or terminal railroad used for passenger trains at Union Station. **Table 1** summarizes the mileage data for the two freight railroads operating within the District of Columbia, CSX Transportation (CSXT) and Norfolk Southern Railway (NS). NS does not own railroad lines but has leased the trackage rights from CSX Transportation. CSX currently services 3 customers in the District.

Table 1: Freight Rail Owners and Operators in Washington, DC

Railroad	Reporting Marks	Washington, DC Rail Route Miles		
		Miles Operated	Miles Owned	Miles Operated Via Trackage Rights
Class I Railroads — CSX Transportation	CSXT	20	18	2
Class I Railroads — Norfolk Southern Railway	NS	13	-	13

Source: CSXT and NS 2012 R-1 Annual Reports; AAR State Facts

The total number of trains also can aid with depicting an accurate portrayal of rail volumes. On average, 11 Intermodal, 14 Merchandise, 4 Automotive trains and 2 Bulk/Grain/Coal travel through the District.

In addition to the 20 miles of active track, there are 6.2 miles of inactive rail tracks located parallel to and just west of I-295 near Bolling Air Force base. The city is looking into alternative transportation uses for this right-of-way.

The District's rail network is expected to play a prominent role in the country's growing international and domestic rail intermodal movements. DC is located on one of CSXT's major intermodal routes. As such CSXT has undertaken a massive rail infrastructure improvement program to remove existing restrictions to the movement of double-stack container trains in the DC area. Currently, 30 freight-carrying trains enter the District of Columbia daily; this number is expected to increase to 34 daily trains by 2040.

This initiative as well as other rail freight-related initiatives that are ongoing or planned are described in the sections below.

2.2.1.1. CSXT National Gateway

The National Gateway project is intended to remove tunnel and other overhead clearance restrictions to accommodate double-stack train movements between Mid Atlantic ports and key Midwest distribution points. The National Gateway corridors generally parallel the following interstate highway routes:

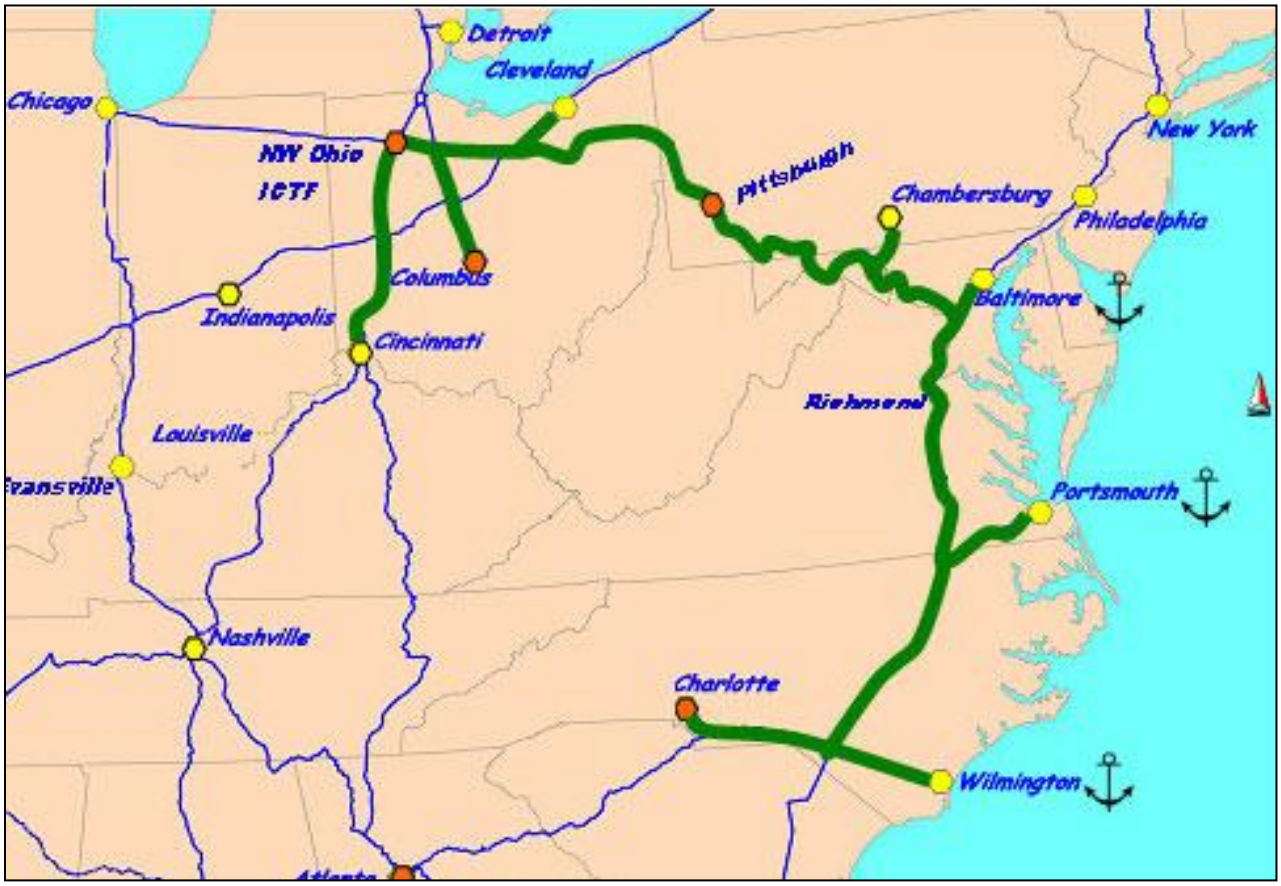
- The I-95/I-81 Corridor between North Carolina and Baltimore, MD via Washington, DC,
- The I-70/I-76 Corridor between Washington, DC and northwest Ohio via Pittsburgh, PA, and
- The I-40/Carolina Corridor between Wilmington, NC and Charlotte, NC.

The CSX National Gateway corridors are shown in **Figure 3**.

Within the District's boundaries, a number of projects will address clearance and capacity issues:

- **Virginia Bridge Tunnel Project**: CSX's Virginia Street Tunnel is located in southeast Washington, DC beneath the eastbound lanes side of Virginia Avenue. The tunnel's west and east portals are located near 2nd Street SE and 11th Street SE, respectively. The tunnel is approximately 4,000 feet long and contains a single railroad track. The proposed project will replace the tunnel roof allowing vertical clearances that will accommodate double-stack trains and re-establish a second set of tracks. This project will eliminate the chokepoint that currently delays all trains travelling through the Washington, DC region.

Figure 3: CSX National Gateway Corridors



- **New Jersey Avenue Project**: The track passing beneath New Jersey Avenue will be lowered in conjunction with the Virginia Avenue project to provide additional vertical clearance.
- **10th Street SW Project**: The track passing beneath 10th Street SW will be lowered in conjunction with the 12th Street and I-395 Ramp projects to provide additional vertical clearance.
- **12th Street SW Project**: The track passing beneath 12th Street SW will be lowered in conjunction with the 10th Street SW and I-395 Ramp projects to provide additional vertical clearance.
- **I-395 Ramp Project**: The track passing beneath the I-395 ramp will be lowered in conjunction with the 12th Street SW and 10th Street SW projects to provide additional vertical clearance.
- **Potomac River Swing (Long)Bridge**: This project will modify or replace the existing diagonal and internal bridge bracing members with systems that provide both the required bracing and needed rail car clearance.

These projects, once completed, will increase capacity and efficiency, providing opportunities to attract new businesses and reducing freight shipping costs in the region.

2.2.1.2. Long Bridge Study

Long Bridge is a two-track railroad bridge owned by CSXT that was constructed in the late 19th and early 20th century. It serves CSXT, Amtrak, and Virginia Railway Express (VRE), is the only rail bridge that connects the District of Columbia and the Commonwealth of Virginia, and is a major choke point for both freight and passenger rail movements.

In 2010, The District Department of Transportation was awarded $2.9 million in American Recovery and Reinvestment Act (ARRA) funds toward the replaceing Long Bridge over the Potomac River. The purpose of the project is to complete a comprehensive study of Long Bridge to include identification of short-term structural remediation requirements and long-term capacity improvements, identify and analyze alternatives that meet the short-term and long-term multi-modal needs, determine the appropriate NEPA action, and identify, collect, and evaluate data in support of the recommended improvements. Public meetings have been held to review alternative concepts developed from preliminary engineering work completed. The study's final report is scheduled to be completed by winter 2014.

2.2.1.3. Maryland Avenue Southwest Plan

The Maryland Avenue Southwest Plan was initiated to study the feasibility of decking the existing rail corridor, bounded by 6th and 12th Streets SW along Maryland Avenue, and reconstructing a major missing link in the L'Enfant street grid. The rail corridor is currently utilized by CSXT, VRE, and Amtrak.

The study found that a four-track system along Maryland Avenue would be optimal for passenger and freight rail as well as connectivity issues that users have to face while using Amtrak, MARC, VRE, and WMATA metro. An in depth transportation study is needed for this project followed by the required NEPA documentation for the corridor, as well as the resolution of right-of-way and funding issues.

2.2.1.4. Washington, DC Freight Bypass Study

The National Capital Planning Commission, due to concerns over the transportation of hazardous materials by rail through the core of the city, conducted a study to develop alternatives that would mitigate security concerns, eliminate impediments to the publics' access to the Anacostia River, accommodate state-of-the-art railroad infrastructure, and enable expansion of freight and passenger rail capacity in the Washington, DC region.

The primary focus of the alternative routes studied was the rerouting of trains around the District. The study identified three routes for further study. These routes include diverting the CSXT Capital Subdivision at Hyattsville, MD and following the existing Alexandria Extension through Southeast Washington, crossing the Potomac River in a new tunnel and joining the CSXT in Alexandria, and the establishment of new routes through Maryland that would cross the Potomac River south of Washington, DC.

2.2.2. Summary

Although the DC freight rail network is small in terms of rail infrastructure mileage and the amount of freight currently originating and terminating in the District, it plays a key role in the regional freight network and with regard to local and regional rail passenger operations, with over 90 intercity or commuter passenger rail trains operating over the CSXT network daily.

Ongoing improvements to the rail freight network will further enhance the importance of the District's network by providing a key to the double-stack intermodal container freight route from the East Coast to Midwest markets. Although these improvements will not likely result in the District becoming an intermodal hub, it will enhance the operational capabilities of both rail freight and passenger operations by removing existing bottlenecks and clearance restrictions, and possibly expand rail service to District markets by reducing rail transportation costs. These actions would not only benefit existing or potential rail users, but also result in a reduction of the number of trucks traveling through the region producing safety and environmental benefits for the area.

2.3. Air

This section provides a summary review of the airport facilities that serve cargo activity to determine the level of activity, each airports role in the region's air cargo network, and the type of cargo being serviced by each facility. Airport data is provided for Washington-Reagan (DCA), and airports in neighboring jurisdictions serving the District including Washington Dulles (IAD) and Baltimore-Washington International (BWI). The primary sources of this data came from the District, State DOT's, the Federal Aviation Administration (FAA), commercial sources of air cargo data, and the airlines themselves.

Air cargo accounts for a miniscule share of the region's total inbound (less than 0.001 percent) and outbound freight (0.02 percent) and a slightly larger share in terms of value (0.09 percent and 2.32 percent for inbound and outbound traffic, respectively). All three of the region's airports support air cargo operations and among them, IAD ships the largest volume of freight by far, with 49.3 million tons in 2012, as compared to 20.9 million tons at BWI and 1.0 million at DCA.

2.3.1. Introduction

The DC region is currently served by three airports, Baltimore Washington International (BWI), Washington Dulles International Airport (IAD), and Ronald Reagan Washington National Airport (DCA). Each of these airports is vital to the movement of air cargo to the East Coast. Both passenger airlines and dedicated cargo carriers transport high-value, time-sensitive goods through these hubs.

Ronald Reagan Washington National Airport (DCA) is located three miles south from downtown Washington, DC along the Potomac River in Arlington County, VA. The airport is situated with direct access to George Washington Memorial Parkway and is two miles from I-395, which provides access to downtown Baltimore from I-95 (20 miles from DCA). I-95 via I-395 also provides direct access to the Port of Baltimore (43 miles from DCA).

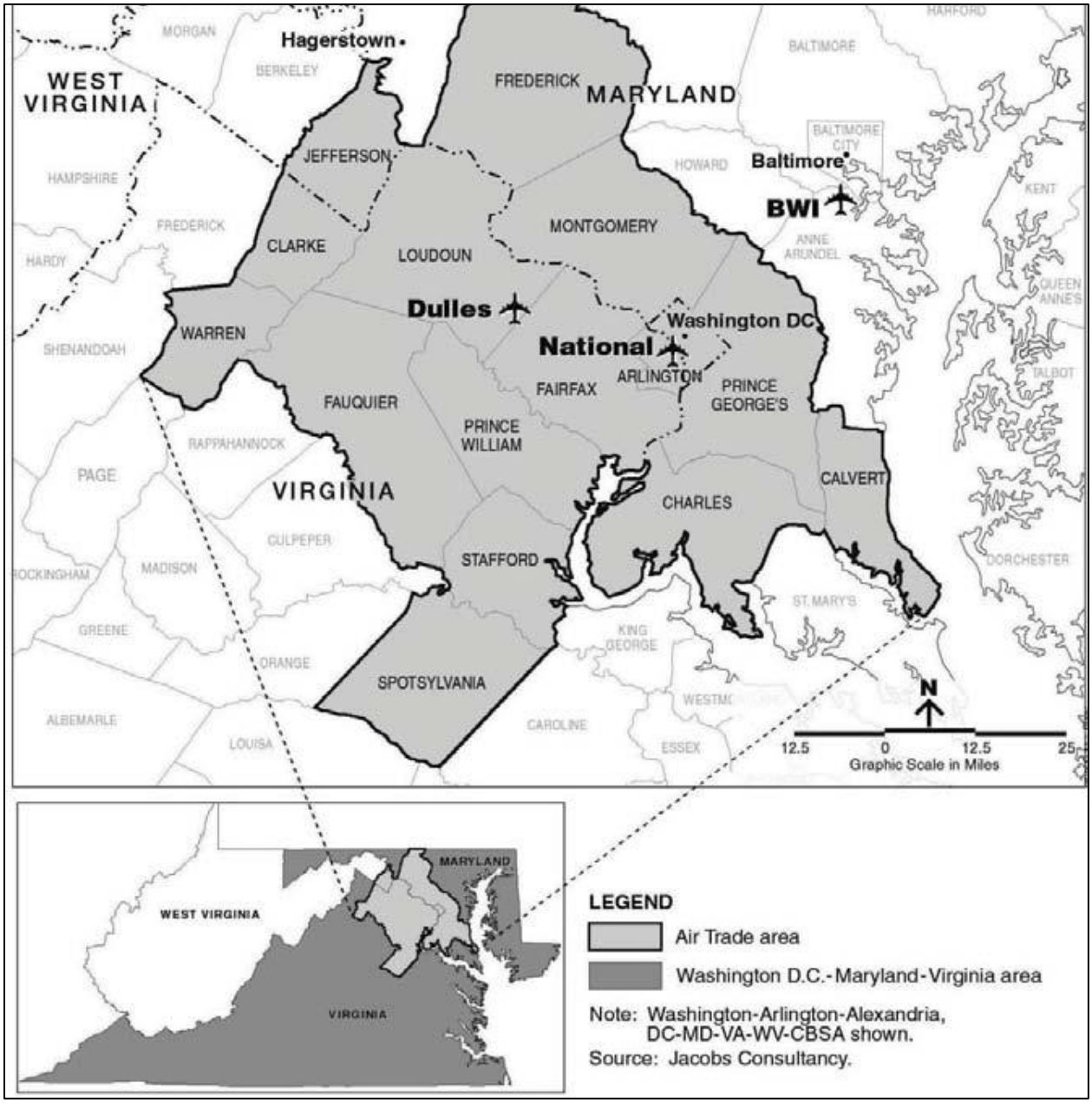
Washington Dulles International Airport (IAD) is located 26 miles west from downtown Washington, DC, located in Fairfax and Loudoun Counties, VA. IAD is situated with direct access to Dulles Greenway Toll Road, and is 14 miles from I-495 (Capital Beltway) which connects to multiple metropolitan areas. Connectors through I-495 include: I-270, I-95, MD 201, and MD 4. The interstate also provides direct access to Andrews AFB (45 miles from IAD).

Baltimore Washington International (BWI) is situated with direct access to I-195, six miles from I-95 which connects to multiple metropolitan centers along the East Coast. Connectors through I-95 include

I-495, MD 100, I-195, I-695, I-895, MD 295, and I-395. The interstate also provides direct access to Andrews AFB (37 miles from BWI) and the Port of Baltimore seaport (10 miles from BWI).

The location of the three airports are depicted in **Figure 4**.

Figure 4: Airport Proximity Map

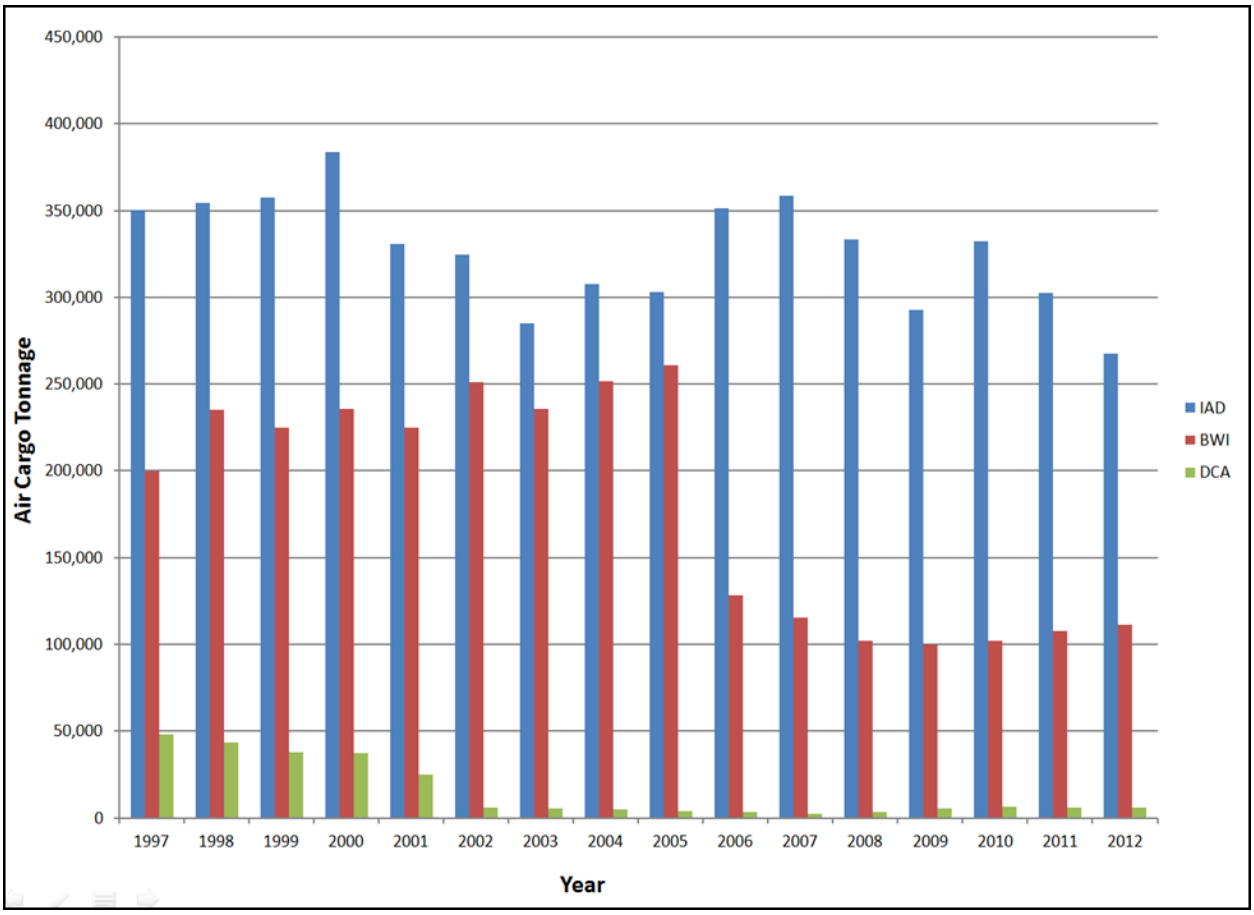


2.3.1.1. Traffic

Figure 5 illustrates air cargo tonnage traffic for the three airports supporting cargo activity in the DC region. Cargo traffic at DCA dropped off in 2001 as a result of the United States Postal Service (USPS) dropping a number of airmail contracts with passenger carriers and switching to FedEx for airmail as

well as increased use of trucks. From 2005 into 2006, BWI experienced a significant drop in ACI Air Cargo Tonnage. While multiple factors can cause this result, Maryland DOT states that with increased competition for long-haul domestic and international flights, BWI experienced reduced wide-body airline service capable of accommodating unit load devices and other significant cargo shipments. Price wars by long-haul airlines at other regional East Coast airports encouraged additional leakage of air cargo from Maryland shippers away from BWI to John F. Kennedy International Airport in New York City and to IAD in Northern Virginia.[3] Thus, explaining the increase in air cargo tonnage at IAD from 2005 to 2006. DCA continues to see an overall decrease in ACI Air Cargo Tonnage from 1997 to present.

Figure 5: ACI Air Cargo Tonnage



2.3.1.2. Routes

Air cargo transport is a vital component to domestic and international logistics networks. Providing highly reliable and successful routes and hubs insures the sustainability of the industry and success at airports like BWI, DCA, and IAD in the future. The top air cargo carrier hubs providing goods to the District are FedEx, United Parcel Service (UPS), and DHL. Often collectively referred to as the "Big

[3] *Maryland Department of Transportation; Freight Planning*

Three", these integrated air cargo express companies together make up a total of almost 20 percent of the worldwide air freight business[4].

Washington Dulles (IAD) continues to have a stronghold on the market with more than 49.3 million pounds of cargo handled at the facility. A majority of this cargo can be attributed to IAD regular international passenger flights which hold carrier cargo in the belly compartments of aircraft.

Much of the opportunity for cargo growth at IAD is focused on perishable goods. According to Metropolitan Washington Airports Authority (MWAA) airport planners, the airport foresees the future perishable goods (pharmaceutical, flowers, fish, etc.) business at the airport growing 16 percent per year. Without dedicated facilities to store perishable goods, the current capacity to accommodate this demand is very limited. MWAA is conducting a study to determine the feasibility of IAD expanding into the perishable goods business and what facilities would be needed to do so. The options for perishable goods facility development include the conversion of existing cargo space, expanding cargo Building #6 or next to it to include a new refrigerated section or new facility development along the airport's western boundary where large-scale cargo expansion is foreseen.

Similar to other US airports, IAD has experienced a dramatic drop in annual cargo volumes – down more than 21 percent since 2000. While domestic cargo has dropped precipitously, IAD's international cargo has risen but is not sufficient to neutralize domestic losses. IAD continues to host United Airlines with a hub operation providing a robust level of cargo activity. Many additional national and low-fare carriers continue to add passenger flights which have belly space for cargo. Foreign carriers continue to add flights to IAD as well, making room for cargo to additional destinations.

The cargo operation at IAD has been described as one with great potential. With limited perishable storage and no all-cargo carriers, IAD has limited physical and operational capabilities today. Significant plans for the future, however, intend to change that perspective. The airport has more developable land than most airports in the country and a rapidly growing industrial development and import/export market in DC and Northern Virginia. The airport's relatively high cargo space occupancy rate and increasing interest in surrounding warehouse development supports a forecast of eventual cargo expansion at IAD.

The description of the market share data from 2008 and 2012 at BWI, IAD, DCA airports is described below.

Baltimore Washington International Airport (BWI)

In 2012, Southwest Airlines carried 59 percent of the cargo transported in the belly holds of passenger aircraft, an increase from 55 percent. AirTran followed second with 13 percent and Delta with 10 percent. Other airlines comprised the remaining 18 percent. Previously, AirTran had the second highest market share followed by US Airways.

Washington Dulles International Airport (IAD)

FedEx had the largest market share in 2012 for air cargo transport at IAD. With a 63 percent share, FedEx dominates the market and is trailed by United Airlines which posts 24 percent share while UPS

[4] The Supply Chain and Logistics Institute- Air Freight Industry

reports just 12 percent share in air cargo transported. FedEx' share is increased from its 2008 activity which reported 56 percent share. United Airlines' share has dropped from 27 percent to 24 percent while UPS has doubled its share. Federal Express Airlines has maintained market share at IAD steadily since 2008.

Washington Reagan National (DCA) Airport

American Airlines has the largest market share for air cargo transport at DCA in 2012. FedEx has the second largest market share in 2012 for air cargo transport at the airport with 21 percent. Interestingly US Airways has lost significant market share between 2008 to 2012 dropping from 38 to 19 percent share, and Frontier Airlines has stepped into the market at DCA with a share of 18 percent in 2012 (1 percent in 2008).

2.3.1.3. Air Cargo Trucked to Distant Airports

While all three airports in the Washington, DC market area support a wide variety of cargo users there are a number airports outside of the area that attract cargo originating in or destined for the District. Many air cargo shippers, receivers, and air forwarders truck air cargo to and from major international passenger and cargo gateways located within a 24-hour drive from the DC metro area such as John F. Kennedy International (JFK) in New York City, Newark Liberty International, Philadelphia International, and Chicago O'Hare International. While air eligible commodities are generally time sensitive due to the perishable nature of the goods, physically or economically, these major cargo gateways exert a "gravitational" pull largely due to the immense cargo lift capacity provided on international bound wide-body passenger flights. The additional long truck haul required to transport the cargo to and/or from these cargo gateway airports is commonly accepted by shippers as part of the cost of doing business as long as they can make their customer's schedules.

While cargo may be exported and imported to and/or from distant airport markets outside of DC area airports there is a strong likelihood that air cargo tonnage trucked to and from distant markets to Dulles will increase as the amount of international wide-body lift capacity increases. Air cargo trucked in and out of the DC market will likely remain on interstate and other limited access highway systems as much as possible, due to the congestion and access issues on the District's arterial road system.

2.3.2. Summary

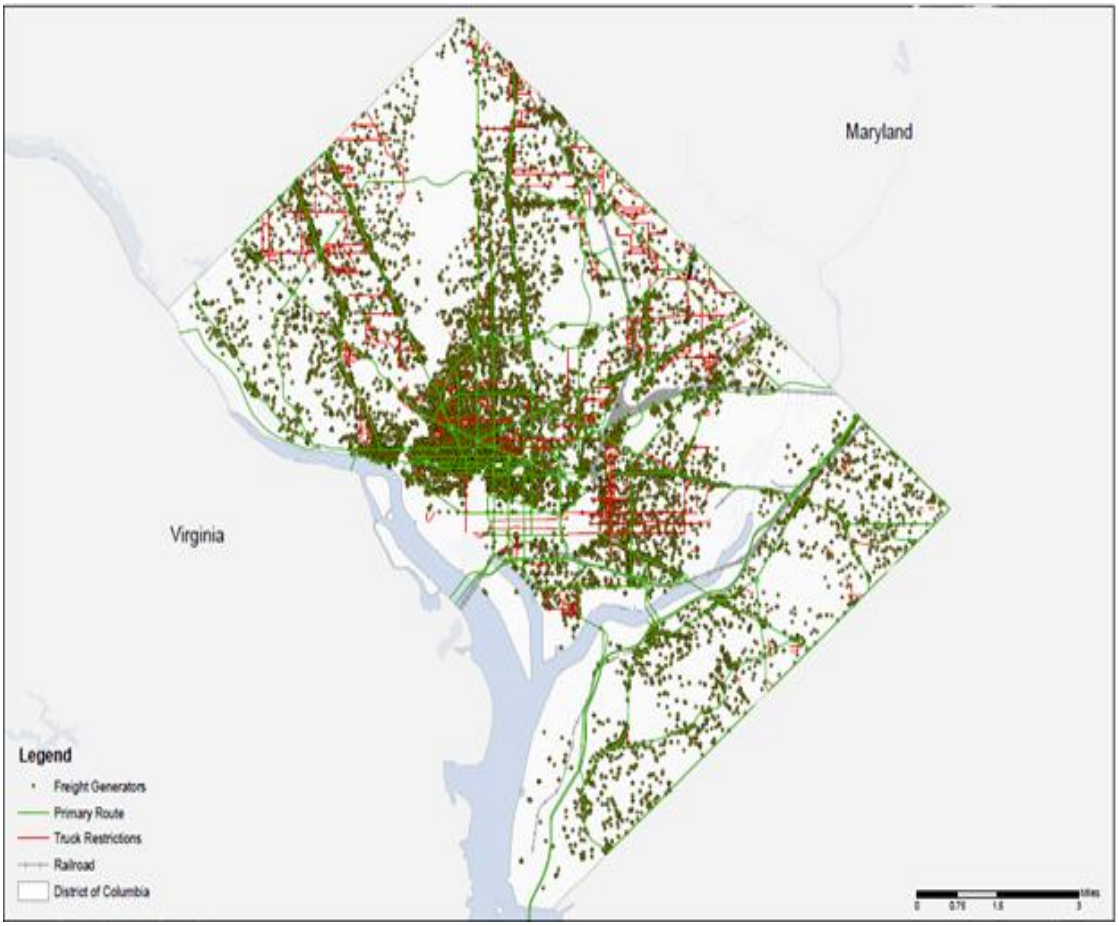
The international lift at IAD dominates the air cargo market in the region making the airport an International Gateway. BWI's strengths are within the domestic air cargo market. The biggest takeaway related to truck movements is that the integrated express carriers move the most time sensitive cargo and that they measure performance down to the minute. Movement of UPS and FedEx vehicles is a science as well as an art and drivers are trained to maneuver the city through well planned routes and limited left turns.

2.4. Freight Generators

A freight generator is any establishment that produces something of commercial value and is of interest to the plan because of the traffic and logistics implications. Despite the absence of traditionally recognized freight generators, e.g., heavy industry and large scale warehousing, there are significant

freight movements within the District. Apart from the more recognizable movement of small packages and letters associated with the many governmental agencies and associated departments and allied industries, freight movement within the District is aligned with the needs of resident and workforce consumers. Over 60,000 locations in the District have the potential to generate inbound and/or outbound deliveries. These locations are depicted in **Figure 6**, along with the truck routes, and were provided to the project team by the DDOT.

Figure 6: Freight-Generating Locations in Washington, DC



Source: IHS Global Insight Freight Locator Database

The project team created a catalogue of freight generators to summarize the 60,000 freight-generating businesses and non-profit agencies in the District into eight industry categories. The categories are:

- Agriculture/Forest/Fish
- Mining
- Construction
- Manufacturing
- Transportation/Utilities
- Wholesale Trade
- Retail Trade
- Finance/Insurance/Real Estate

- Services/Public Administration

The industries with greater than 100 employees as a percentage of total District employment are presented in **Table 2**.

Table 2: Percentage of Organizations with Greater than 100 Employees (Categorized by Industry)

Industry	Percentage of Total
Agriculture/Forest/Fish	0.6%
Manufacturing	11.9%
Transportation/Utilities	2.3%
Wholesale Trade	4.5%
Retail Trade	37.9%
Services	42.9%

2.4.1. Agriculture/Forest/Fish

There are very few locations within the District that generate activities related to agriculture, forestry, or fishing. However, the locations that do exist typically reside in or are encircled by residential areas. Planning efforts should focus on mitigating potential conflict between the commercial vehicles servicing these businesses and the needs of local communities.

Key Trends:

- Location within low-medium density residential areas and potentially smaller commercial venues serving localized resident populations
- May lack adequately sized loading/unloading facilities to accommodate commercial vehicles
- Truck configuration varies with commodity, small courier to tractor-trailer
  - Predominantly inbound freight movements with little or no outbound
  - Large vehicle configuration supporting inbound movements to reduce shipment transportation costs
  - Freight movement origins typically outside the District
  - Long-haul vehicle operators may not be familiar with the area

2.4.2. Manufacturing

Many of the District's manufacturing-related businesses are located in areas not identified as heavy industrial or manufacturing centers. Due to limited space available for manufacturing and shipping, the manufacturing businesses are small, limited to production in small quantities producing unique manufacturing outputs, e.g., specialty or promotional items. Though largely publishers and printers, this category includes a "craft" breweries and a perfume-toiletries manufacturer.

Key Trends:

- Located within the District center, near governmental and commercial areas

  - Smaller vehicles to support local office needs
  - Potential distribution capabilities

- Located in outer regions of District
  - Facilities with warehouse characteristics, e.g., loading/unloading docks
  - Expected to receive materials in bulk in larger configured vehicles
  - Distribution to points within the District utilizing single unit vehicles

2.4.3. Transportation/Utilities

A limited number of organizations position fleets of trucks on properties within the District. For the most part, motor carrier operators choose to service the District from facilities in neighboring cities such as Winchester and Fairfax, Virginia. Cost, capacity, and accessibility are concerns when identifying locations in the area. Commercial real estate costs are significantly higher in the District than in outlying areas. A lack of "truck-friendly" roadway design limits the efficiency of accessing an available parcel. Space for parking trucks is limited and trucks are banned from or unwelcome in many residential or mixed-use designated areas. Utilities position fleets outside of the District for similar purposes. The US Post Office operates off Brentwood Parkway and maintains a fleet of local delivery vehicles. A consideration for freight planning with USPS locations is the additional presence and utilization of larger commercial (tractor-trailer) vehicles transporting mail between the larger distribution center and the local Post Office. In addition, the city's trash transfer site in Ward 5 attracts city and private trash haulers that service sight sites.

A local household goods transport company is identified within this group. This carrier type does not maintain equipment locally, as trucks generally move directly from pick-up to delivery. The impact on local movement, for this and similar businesses, is the need of tractor-trailers and other smaller commercial vehicles to access warehouses for temporary warehousing. This may occur when a delay at delivery has arisen, long-term storage is contracted, or the delivery location requires a special vehicle which predicates "cross dock activities" or unloading and reloading goods between the over-the-road truck and the special vehicle.

An area of consideration for these types of access needs is the non-local nature of the vehicle operator. The driver may only be passing through the District, seeking access for delivery or pick-up of goods. Drivers without access to wayfinding information may find themselves on roads not intended for their commercial vehicle.

Key Trends:

- Located in mixed use and light commercial areas
- Fleet configuration typically smaller delivery trucks
- Storage and warehouse may attract large tractor-trailer, class eight vehicles. Limitations on vehicle configuration size:
  - Elevates operating costs through requirement of specialty vehicles

- Emissions increases due to increased trip volumes relaying goods from less restrictive transfer locations to storage within the District.

2.4.4. Wholesale Trade

There is not a large amount of wholesale activity in the District. The few wholesale locations that exist utilize medium and larger commercial vehicles to service the final mile delivery of goods. Representing a variety of commodities (e.g. electrical supplies, beverages) these activities generate trips on a daily basis to end user, or retail sites.

Key Trends:

- Located in areas parallel to US 50 towards the border with Maryland
- Inbound and outbound trips expected with more trips out to local consumption points
  - Inbound expected to be on larger tractor-trailer combinations
  - Outbound to end user expected to be on smaller vehicles

2.4.5. Retail Trade, SIC 52-59

Tourism and government-centric travel produce a significant volume of freight trips to support retail activities in the District. Just-in-time inventory strategies and high consumption at the end user location contributes to the high frequency of trips associated with these businesses. Restaurants, bars, and caterers consume perishable goods daily and often require numerous replenishment trips throughout a single day's operation. This variety of trip types may include all types of commercial vehicles. Groceries and other retail establishments also require daily restocking of existing inventory. The larger the volume of goods sold through a retail and/or grocery business the larger the vehicles used to reduce trip costs.

Key Trends:

- Retail activity located throughout District
- Predominantly inbound to location with little to no outbound
- Movements subject to inventory strategies and seasonal influences
  - Holiday or specialty, e.g., Christmas, back-to-school
  - Tourism seasonality

2.4.6. Services

Service industries (lodgings and health services) include business sectors with unique supply chain needs. Hotels, motels, and other temporary lodgings require a diverse set of supply chains. These include commodities, ranging from cleaning chemicals to paper products, through food products, both perishable and non-perishable. The health services sector requires the delivery of highly specialized, perishable materials and requires source to end user delivery on an immediate and reliable basis.

Key Trends:

- Locations require a variety of vehicle configurations and sizes to access
- Predominately inbound movements with little to no outbound traffic generation
- Activity in health services subject to:
  - 24 hours a day, seven days a week, 365 days a year access
  - Reliabile access

2.4.7. Summary

With the diverse presence of freight generation across the District, resulting from the local or cottage nature of businesses, the District's primary routes satisfy goods movement needs where those businesses are located on or within close proximity of a major commercial or freight corridor.

Where concentrations are not on these corridors, the District's restricted routes present potential challenges to commercial vehicle movement. Placement of roadways on this system restricts the use of the roadway as a cross area access route. The restricted route, as with all routes, affords access on an "as necessary" basis to facilitate a delivery or pick-up. The lack of roadways with primary route designation to penetrate off corridor areas, coupled with the posting of restricted route roadways, may position vehicles onto roadways and into conflict with community needs. This may occur more frequently when the driver is not regularly operating in the District, as is often seen in the manufacturing and wholesale industries.

The District's continuing review and interaction with the community and private sector organizations involved in goods movements will present opportunities to educate on the benefits of goods movement. An understanding of the need to efficiently provide for freight mobility may promote a harmonious plan where economic sustainability, through goods movement, and the community acceptance of commercial vehicles can guide commercial vehicle routing.

2.5. Maritime-River

Although the District's boundary encompasses two major rivers, neither is a significant source of freight movements, due to the District's service-based economy, the rivers' lack of accessibility, and lack of shipping infrastructure. The region's major rivers – the Potomac, Anacostia, and Occoquan – are part of a Federal initiative, known as the Marine Highway Program, to provide financial incentives for investment that increases waterborne freight and reduces highway demands. In the years ahead, these incentives may prove beneficial as shippers look for more cost-effective means of transporting commodities from and to the District.

According to US Army Corps of Engineers Waterborne Commerce Statistics (USACE), shipments totaled 110,000 short tons of one inbound commodity in 2011: gasoline. Earlier years (2000-2006) show 600,000-700,000 short tons total, due to shipments of aggregate, probably for construction purposes. Some other tonnage shipments are suppressed in the USACE data due to confidentiality.

Shipping the gasoline by truck instead of by pipeline would add 10 truck trips per day, assuming 300 tons of gasoline per day and roughly 30 tons of gasoline per tank truck. As a share of total truck traffic, this number is not significant in the regional context.

There is also a small US government maritime operation, by the US Army Corps of Engineers along the Anacostia River at the edge of a property that used to be a Washington Gas gas manufacturing plant (closed in 1983, demolished in 1988). The US government owns a 0.35-acre portion of the old gas plant property and it is managed by the US Army Corps of Engineers. The Army Corps uses this small section as a station for debris collection boats that patrol the Anacostia and Potomac Rivers.

3.0 Major Freight Transport Flows

3.1. Introduction

Understanding the movement of goods in the District is critical for the development of a comprehensive freight plan that is responsive to current and future infrastructure needs and helps improve economic and social conditions in the District.

3.1.1. IHS Global Insight TRANSEARCH Data Overview

The District decided to use IHS Global Insight's TRANSEARCH data for the purposes of this analysis. TRANSEARCH is a privately maintained comprehensive market research database for intercity freight traffic flows compiled by IHS Global Insight. The development of the TRANSEARCH database involves the fusion of various freight traffic data sources into a common framework for planning and analysis. The database provides detailed US and cross-border origin-destination freight shipment data at the state, Business Economic Area (BEA), county, metropolitan area, and zip-code level detail by commodity type (by Standard Transportation Commodity Classification (STCC) code) and major modes of transportation. Forecasts of commodity flows up to 30 years are available for the following four modes – air, truck, water, and rail. The data is compiled from the following sources:

- Commodity Flow Survey (CFS)
- Carload Waybill Sample
- USACE Waterborne Commerce Statistics
- Federal Aviation Authority (FAA) Airport Activity Statistics
- Bureau of Census Foreign Trade Devision (FTD)
- American Association of Railroads (AAR) Freight Commodity Statistics
- Inter-industry trade patterns

TRANSEARCH has some limitations to how this data should be used and interpreted:

- **Mode Limitations**: The Rail Waybill data used in TRANSEARCH is based on data collected by Class I railroads. The waybill data contains some information for regional and short-line railroads, but only in regards to interline service associated with a Class I railroad. The rail tonnage movements provided by the TRANSEARCH database, therefore, are conservative estimates.

- **Use of Multiple Data Sources**: TRANSEARCH consists of a national database built from company-specific data and other available databases. To customize the dataset for a given region and project, local and regional data sources are often incorporated. This incorporation requires the development of assumptions that sometimes compromise the accuracy of the resulting database.

- **Data Collection and Reporting**: The level of detail provided from some specific companies when reporting their freight shipment activities limits the accuracy of TRANSEARCH. If a shipper moves a shipment intermodally, for example, one mode must be identified as the primary method of movement. Suppose three companies make shipments from the Midwest US to Europe using rail to New York then water to Europe. One company may report the shipment as simply a rail move from the Midwest to New York; another may report it as a water move from New York to Europe; the third may report the shipment as an intermodal move from the Midwest to Europe with rail as the primary mode. The various ways in which companies report their freight shipments can limit the accuracy of TRANSEARCH.

- **Limitations of International Movements**: TRANSEARCH does not report international air shipments through the regional gateways. Additionally, specific origin and destination information is not available for overseas waterborne traffic through marine ports. Overseas ports are not identified and TRANSEARCH estimates the domestic distribution of maritime imports and exports. TRANSEARCH data also does not completely report international petroleum and oil imports through marine ports.

TRANSEARCH's county-to-county market detail is developed through the use of Global Insights' Motor Carrier Data Exchange inputs and the Global Insights' Freight Locator database of shipping establishments. Freight Locator provides information about the specific location of manufacturing facilities, along with measures of facility size (both in terms of employment and annual sales) and a description of the products produced. This information is aggregated to the county level and used in allocating production among counties.

Much of the Motor Carrier Data Exchange inputs from the trucking industry are provided by zip code. The zip code information is translated to counties and used to further refine production patterns. A compilation of county-to-county flows and a summary of terminating freight activity are used to develop destination assignments.

3.1.2. Freight Overview

Table 3 presents the total freight movements within, into, and out of the District for 2011 and 2040 by mode. Key highlights include:

- The District imports far more goods than it exports. Inbound freight movements by weight are 25 times greater than outbound movements.

- The major inbound commodities by weight are broken stone and retail goods (Warehouse and Distribution Center). Together, these two commodity groups account for 58 percent of all inbound commodities. In terms of value, retail goods and miscellaneous electrical and industrial equipment, which includes office electronics, predominate.

Table 3: Washington, DC Total Freight Traffic (2011 and 2040)

Mode*	2011 (tons)				2040 (tons)			
	Inbound	Within	Outbound	Through	Inbound	Within	Outbound	Through
Air	0	0	0	0	0	0	0	0
Other	0	0	0	30	0	0	0	261
Truck	15,752,928	320,572	606,701	10,444,145	26,776,501	502,136	1,436,489	18,697,371
Water	96,015	0	0	0	122,113	0	0	0
Total	15,857,822	320,572	613,281	10,445,802	26,905,836	502,136	1,451,056	18,701,661
Mode	**2011 (value in millions)**				**2040 (value in millions)**			
	Inbound	Within	Outbound	Through	Inbound	Within	Outbound	Through
Air	$0	$0	$0	$0	$0	$0	$0	$0
Other	$0	$0	$0	$1	$0	$0	$0	$12
Truck	$20,035	$40	$1,575	$13,311	$57,356	$79	$3,600	$29,785
Water	$88	$0	$0	$0	$112	$0	$0	$0
Total	$20,125.80	$40.17	$1,576.51	$13,314.72	$57,475.44	$79.27	$3,604.25	$29,801.57
Mode	**2011-2040 Change (% change in tons)**				**2011-2040 Change (% change in value)**			
	Inbound	Within	Outbound	Through	Inbound	Within	Outbound	Through
Air	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Other	N/A	N/A	N/A	770.0%	N/A	N/A	N/A	1100%
Truck	70.0%	56.6%	136.8%	79.0%	186%	98%	129%	124%
Water	27.2%	N/A	N/A	N/A	27%	N/A	N/A	N/A
Total	69.7%	56.6%	136.6%	79.0%	186%	97%	129%	124%

Source: prepared by CDM Smith, based on Transearch data for 2011 and 2040.
Note: All 2040 values are in 2011 dollars and not inflated to 2040. Rail waybill data is limited for commodities traveling by rail for the District. Rail data is reflected using data from the 2013 rail fact book(see table18)

- The major outbound commodities by weight are retail goods, bakery products and processed non-metal minerals (such as cement). These three commodities account for 55 percent of all outbound movements. In terms of value, retail goods, pharmaceuticals, printed matter, and bakery products account for half of all outbound shipments.
- Trucks move virtually all of the Districts goods, and this fact is expected to continue into the future.
- Through movements are significant, totaling 10.4 million tons in 2011, as compared to 15.7 million tons of inbound shipments.
- Overall, freight shipments are expected to grow by 75 percent from 2011 to 2040 in terms of tons, and 159 percent from 2011 in terms of value.

3.2. Current Freight Flows

Table 4 shows truck movements by direction in the District. As expected more freight comes into the District than leaves the District, by weight and value. However, in terms of the average value per ton,

freight leaving the District has a higher value per ton ($2,596/ton) on average compared to freight coming into the District ($1,272/ton).

Table 4: Washington, DC Truck Freight Traffic (2011)

Direction	Tons		Value (Millions)		Average Value/Ton
	Amount	Percent	Amount	Percent	
Inbound	15,752,928	58.1%	$20,035	57.3%	$1,272
Within	320,572	1.2%	$40	0.1%	$125
Outbound	606,701	2.2%	$1,575	4.5%	$2,596
Through	10,444,145	38.5%	$13,311	38.1%	$1,275
Total	27,124,347	100.0%	$34,961	100.0%	$1,289

Source: prepared by CDM Smith, based on TRANSEARCH data for 2011.

Directional movements are categorized as outbound (originating within the District, terminating beyond), inbound (originating beyond the District, terminating within), intra (originating and terminating within the District), and through (originating and terminating beyond the District). Inbound District movements are the largest economically-relevant movement accounting for 15.8 million tons (58.4 percent), valued at $20 billion. However, the second largest volume, through movements (i.e., originating and terminating beyond the District, and only passing through), measuring 10.4 million tons, or 38.7 percent of total, are of no direct economic consequence to *trade users* in the District.[5]

3.2.1. Inbound Truck Freight

From a traffic impact perspective, the weight of freight coming into the District has the most significant bearing on freight movements in the District. **Table 5** shows the top ten commodities, by weight, coming into the District. As shown in the table, most of the commodities coming into the District are either related to the construction or retail industries.

From an economic development perspective, the value of freight coming into the District has the most significant bearing on freight movements in the District. **Table 6** shows the top ten commodities, by value, coming into the District. In terms of value, the top commodities in the District are retail focused and reflect headquarters affects where the value of freight such as missile parts is shown as coming into the District when in reality these commodities are destined for manufacturing facilities around the country but are procured within the District[6].

[5] Albeit, transport service provision impacts may be marginally affected by through movements via any District-based truckers.

[6] Headquarters effects refers to the misattribution of a manufacturing or industrial activity at a different corporate location, such as a headquarters.

Table 5: Commodities by Weight Coming Into Washington, DC (2011)

Commodity	Tons	
	Amount	Percent
Broken Stone or Riprap	5,250,178	33%
Warehouse & Distribution Center	3,932,235	25%
Gravel or Sand	889,015	6%
Petroleum Refining Products	706,356	4%
Concrete Products	423,015	3%
Asphalt Paving Blocks or Mix	366,293	2%
Misc. Electrical Industrial Equipment	317,874	2%
Paper Waste or Scrap	187,260	1%
Misc. Nonmetallic Minerals, N.E.C	154,173	1%
Misc. Waste or Scrap	138,864	1%
All Other Commodities	3,387,665	22%
Total	15,752,928	100%

Source: prepared by CDM Smith, based on Transearch data for 2011.

Table 6: Commodities by Value Coming Into Washington, DC (2011)

Commodity	Value	
	Amount	Percent
Warehouse & Distribution Center	$4,402	22%
Misc. Electrical Industrial Equipment	$2,345	12%
Missile or Space Vehicle Parts	$1,409	7%
Ships or Boats	$975	5%
Petroleum Refining Products	$645	3%
Misc. Printed Matter	$419	2%
Radio or TV Transmitting Equipment	$368	2%
Electric Measuring Instruments	$332	2%
Pharmaceuticals	$311	2%
Mail and Express Traffic	$257	1%
All Other Commodities	$8,572	43%

Source: prepared by CDM Smith, based on Transearch data for 2011.

3.2.2. Outbound Truck Freight

Similar to the inbound movements, the outbound movements are sorted by weight and value to reflect their importance on the infrastructure and economy respectively. **Table 7** and **Table 8** show the top commodities moving out the District by weight and value, respectively. Similar to the inbound movements, the outbound movements are construction and retail industry-oriented along with pharmaceuticals.

Table 7: Commodities by Weight Leaving Washington, DC (2011)

Commodity	Tons	
	Amount	Percent
Warehouse & Distribution Center	238,603	39%
Bread or Other Bakery Prod	55,265	9%
Nonmetal Minerals, Processed	45,162	7%
Paper Waste or Scrap	41,994	7%
Textile Scrap or Sweepings	40,892	7%
Misc. Printed Matter	29,647	5%
Periodicals	20,850	3%
Newspapers	16,526	3%
Motor Vehicle Parts or Accessories	12,529	2%
Pharmaceuticals	12,421	2%
All Other Commodities	92,812	15%
Total	**606,701**	**100%**

Source: prepared by CDM Smith, based on TRANSEARCH data for 2011.

Table 8: Commodities by Value Leaving Washington, DC (2011)

Commodity	Value (Millions)	
	Amount	Percent
Warehouse & Distribution Center	$267	17%
Pharmaceuticals	$227	14%
Misc. Printed Matter	$151	10%
Bread or Other Bakery Prod	$135	9%
Motor Vehicle Parts or Accessories	$108	7%
Radio or TV Transmitting Equipment	$102	6%
Women's or Children' s Clothing	$64	4%
Periodicals	$60	4%
Wooden Kitchen Cabinets	$48	3%
Industrial Pumps	$47	3%
All Other Commodities	$366	23%
Total	**$1,575**	**100%**

Source: prepared by CDM Smith, based on TRANSEARCH data for 2011.

3.2.3. Internal Truck Freight

Understanding freight traffic within the District is critical for drawing meaningful conclusions regarding the nature of freight impacts on the network and associated economic value offered by freight. As in the other directional movements, the construction and retail industries generate the greatest volume of internal truck freight. **Table 9** and **Table 10** show the top commodities moving within the District by weight and value respectively.

Table 9: Top Commodities by Weight within Washington, DC (2011)

Commodity	Tons	
	Amount	Percent
Ready-mix Concrete, Wet	302,870	94%
Warehouse & Distribution Center	9,565	3%
Newspapers	3,957	1%
Paper Waste or Scrap	3,464	1%
Misc. Waste or Scrap	413	0%
Misc. Glassware, blown or Pressed	91	0%
Kitchen Cabinets, wood	66	0%
Mail and Express Traffic	51	0%
Textile Scrap or Sweepings	49	0%
Cut Stone or Stone Products	17	0%
All Other Commodities	28	0%
Total	**320,572**	**100%**

Source: prepared by CDM Smith, based on Transearch data for 2011.

Table 10: Top Commodities by Value within Washington, DC (2011)

Commodity	Value (Millions)	
	Amount	Percent
Ready-mix Concrete, Wet	$20.9	52.0%
Warehouse & Distribution Center	$10.7	26.7%
Newspapers	$6.9	17.3%
Paper Waste or Scrap	$0.7	1.8%
Misc. Glassware, blown or Pressed	$0.3	0.8%
Kitchen Cabinets, wood	$0.3	0.7%
Mail and Express Traffic	$0.1	0.3%
Misc. Waste or Scrap	$0.1	0.2%
Shipping Containers	$0.1	0.1%
Misc. Freight Shipments	$0.0	0.0%
All Other Commodities	$0.0	0.1%
Total	$40.2	100%

Source: prepared by CDM Smith, based on Transearch data for 2011.

3.3. Future Freight Flows

Since truck travel dominates in terms of both tonnage and value, it is critical to understand truck movements for the future in the District. **Table 11** shows truck movements by direction in the District. According to these forecasts, inbound truck shipments will grow by 70 percent, while outbound shipments will grow by 137 percent (by tonnage). As expected, by weight and value more freight continues to come into the District than leaves the District in 2040. However, in terms of the average value per ton, freight leaving the District has a higher value per ton ($2,506/ton) on average compared to freight coming into the District ($2,142/ton). However, compared to 2011, the average value per ton of freight coming into the District is forecast to decrease in 2040 from 2011.

Table 11: Washington, DC Truck Freight Traffic (2040)

Direction	Tons		Value (Millions)		Average Value/Ton
	Amount	Percent	Amount	Percent	
Inbound	26,776,501	56.5%	$57,356	63.2%	$2,142
Within	502,136	1.1%	$79	0.1%	$158
Outbound	1,436,489	3.0%	$3,600	4.0%	$2,506
Through	18,697,371	39.4%	$29,785	32.8%	$1,593
Total	47,412,496	100.0%	$90,821	100.0%	$1,916

Source: prepared by CDM Smith, based on Transearch data for 2040.

3.3.1. Inbound Truck Freight

The commodity mix in 2040 is similar to 2011 with construction and retail dominating freight into the District. **Table 12** and **Table 13** show the top commodities coming into the District by weight and value respectively. While Broken Stone and Riprap coming into the District decreases from 33 percent to 25 percent, and gravel decreases from six to five percent, the amount of concrete coming into the District increases from three to four percent, showing a potential decrease in construction related truck traffic by 2040. In terms of weight, warehouse & distribution center (retail goods) share increases from 25 to 28 percent but for the same commodity the value of goods shipped decreases from 22 to 15 percent. While the value of pharmaceuticals coming into the District is forecast to increase from $311M to $1.24B, pharmaceuticals' overall share of the total value of goods will remain at two percent.

Table 12: Top Commodities by Weight Coming Into Washington, DC (2040)

Commodity	Tons	
	Amount	Percent
Warehouse & Distribution Center	7,456,950	28%
Broken Stone or Riprap	6,662,127	25%
Gravel or Sand	1,357,664	5%
Concrete Products	1,100,868	4%
Petroleum Refining Products	1,013,936	4%
Misc. Electrical Industrial Equipment	815,184	3%
Asphalt Paving Blocks or Mix	457,947	2%
Misc. Waste or Scrap	331,247	1%
Cut Stone or Stone Products	306,373	1%
Portland Cement	294,922	1%
All Other Commodities	6,979,285	26%
Total	26,776,501	100%

Source: prepared by CDM Smith, based on TRANSEARCH data for 2040.

Table 13: Top Commodities by Value Coming Into Washington, DC (2040)

Commodity	Value (Millions)	
	Amount	Percent
Warehouse & Distribution Center	$8,348	15%
Missile or Space Vehicle Parts	$8,305	14%
Misc. Electrical Industrial Equipment	$6,014	10%
Solid State Semiconductors	$4,526	8%
Radio or TV Transmitting Equipment	$1,836	3%
Misc. Aircraft Parts	$1,366	2%
Electric Measuring Instruments	$1,317	2%
Pharmaceuticals	$1,241	2%
Aircraft Propellers or Parts	$1,235	2%
Ships or Boats	$1,097	2%
All Other Commodities	$22,072	38%
Total	$57,356	100%

Source: prepared by CDM Smith, based on TRANSEARCH data for 2040.

3.3.2. Outbound Truck Freight

Table 14 and **Table 15** show the top commodities leaving the District by weight and value respectively for 2040. Outbound truck shipments are forecast to grow 137 percent by weight and 129 percent by value. Retail-generated (warehouse and distribution center) freight shows the largest growth from 2011 to 2040 in terms of growth by tonnage. Similarly, bakery products share of total freight tonnage is expected to grow from nine to 15 percent. With respect to value, warehouse and distribution centers experienced a growth of six percent (similar to pharmaceuticals).

Table 14: Top Commodities by Weight Leaving Washington, DC (2040)

Commodity	Tons	
	Amount	Percent
Warehouse & Distribution Center	732,593	51%
Bread or Other Bakery Products	217,974	15%
Paper Waste or Scrap	81,472	6%
Nonmetal Minerals, Processed	75,266	5%
Textile Scrap or Sweepings	74,674	5%
Pharmaceuticals	39,075	3%
Misc. Printed Matter	32,229	2%
Misc. Waste or Scrap	31,486	2%
Periodicals	26,134	2%
Motor Vehicle Parts or Accessories	20,686	1%
All Other Commodities	104,900	7%
Total	1,436,489	100%

Source: prepared by CDM Smith, based on TRANSEARCH data for 2040.

Table 15: Top Commodities by Value Leaving Washington, DC (2040)

Commodity	Value (Millions)	
	Amount	Percent
Warehouse & Distribution Center	$820	23%
Pharmaceuticals	$713	20%
Bread or Other Bakery Prod	$531	15%
Radio or TV Transmitting Equipment	$314	9%
Motor Vehicle Parts or Accessories	$179	5%
Misc. Printed Matter	$165	5%
Optical Instruments or Lenses	$94	3%
Periodicals	$75	2%
Industrial Pumps	$65	2%
Misc. Internal Combustion Engines	$50	1%
All Other Commodities	$596	17%
Total	$3,600	100%

Source: prepared by CDM Smith, based on TRANSEARCH data for 2040.

3.3.3. Internal Truck Freight

The commodity mix in 2040 is projected to be a mix of construction and retail related freight traffic. Truck shipments of goods that originate and end in the District are forecast to grow by 57 percent (by weight) and 98 percent (by value) between 2011 and 2040. **Table 16** and **Table 17** show the top commodities moving internally by weight and value respectively for 2040. Most of the freight movement within DC is wet concrete and while the decrease in its growth by weight is small (two percent,) in terms of value it will fall by 12 percent. On the other hand, the value of warehouse and distribution center-related freight is projected to increase from 27 to 40 percent, while by value, shipments are forecast to increase from 3.0 percent to 5.7 percent.

Table 16: Top Commodities by Weight within Washington, DC (2040)

Commodity	Tons	
	Amount	Percent
Ready-mix Concrete, Wet	462,050	92.0%
Warehouse & Distribution Center	28,820	5.7%
Newspapers	4,685	0.9%
Paper Waste or Scrap	3,776	0.8%
Misc. Waste or Scrap	1,158	0.2%
Shipping Containers	911	0.2%
Misc. Freight Shipments	422	0.1%
Kitchen Cabinets, Wood	145	0.0%
Textile Scrap or Sweepings	107	0.0%
All Other Commodities	38	0.0%
Total	502,111	100.0%

Source: prepared by CDM Smith, based on TRANSEARCH data for 2040.

Table 17: Top Commodities by Value within Washington, DC (2040)

Commodity	Value (Millions)	
	Amount	Percent
Warehouse & Distribution Center	$32.27	40.7%
Ready-mix Concrete, Wet	$31.86	40.2%
Newspapers	$8.21	10.4%
Shipping Containers	$3.73	4.7%
Misc. Freight Shipments	$1.33	1.7%
Paper Waste or Scrap	$0.79	1.0%
Kitchen Cabinets, Wood	$0.64	0.8%
Misc. Waste or Scrap	$0.27	0.3%
Misc. Glassware, Blown or Pressed	$0.08	0.1%
All Other Commodities	$0.04	0.0%
Total	$79.22	100.0%

Source: prepared by CDM Smith, based on TRANSEARCH data for 2040.

3.3.4. Notes on Data

The plan team found anomalies in the data and worked with the data providers, IHS Global Insight, to summarize these:

- **Rail Freight**: The IHS dataset provides general estimates on commodity flow data via rail. In order to gain a better estimation of the total rail freight volume travelling in the city, data from the Railroad Fact Book was considered. According to the 2013 Railroad Fact Book, the average loaded car was 62.9 tons for 2011, which would estimate 43,647,756 tons travelling through the District by rail (62.9 tons x 693,923 loaded cars). The amount of loaded and empty rail cars that travelled through the city is listed in the chart below.

Table 18: Number of Rail Cars Travelling throughout the District

	Loaded			Empty		
Rail Line (CSX)	**Forward**	**Reverse**	**Total**	**Forward**	**Reverse**	**Total**
North-South Line (Virginia Ave Tunnel)	111,079	115,701	226,780	104,290	92,656	196,946
East-West Line (Metropolitan sub)	276,747	190,396	467,143	171,216	285,305	456,521
Total Cars	**387,826**	**306,097**	**693,923**	**275,506**	**377,961**	**653,467**

The Rail Fact Book data does not indicate whether the cars were travelling though, destined for originating from the District. However, the overall rail freight volume by tonnage of approximately 44 million tons would be considered a more accurate depiction of the total rail freight volume for the District.

- **Newsprint**: IHS dramatically dropped the amount of outbound newsprint between the 'full county' and TAZ level database for DC. They calculated the amount of tonnage that we could attribute to the Washington Post, Washington Times, USA Today and other newspapers with known printing operations outside of DC and shifted that amount from having a DC origination. The leftovers were either small media outfits where we did not have information about printing or attributable to the Government Printing Office (GPO). IHS did some research into GPO printing, but do not claim to have the full amount of inbound paper/newsprint and most of that IHS assume's to be output that is delivered within the Federal Government. The forecast for newspapers is driven by IHS's national and regional economic groups outlook for that North American Industry Classification System (NAICS) category.

- **Pharmaceuticals**: There appears to be a headquarters problem that IHS may not have taken into account. IHS tried to systematically eliminate tonnage from the DC TAZ level database where they could not find appropriate sources in the site-level data. When IHS was unsure of whether there was production or not at a facility, they assumed that their original number was as accurate as they could get.

- **Auto Parts**: The demand for auto parts is driven by service stations and retailers (in the absence of manufacturing plants). Typically, these shipments go through a distribution center but where IHS could identify businesses that demand specific commodities their model assigns an industry-specfic code. There are some manufacturers with a presence in the District which lead County Business Patterns to assign them to the auto manufacturing category. IHS captured that data and it flowed through the internal data products that TRANSEARCH is partially built from. The tonnage was low, but the value for auto parts is high.

3.4. Freight Districts

The TRANSEARCH database is an important but highly aggregate source of information about regional flows of commodities by mode, value, and weight. To understand how freight movements work within the geography and the economy of the District, the project team devised a method to estimate the freight movements that impact the District at the city and sub-city level. The project team, including DDOT staff, created 17 sub-districts which are based on traffic analysis zones used by the Metropolitan Washington Council of Governments (MWCOG) in its traffic and travel demand forecasting. Once the 17 freight (sub-) districts were determined, IHS Global Insight created a special dataset to capture movements to and between the districts. This database is currently the most detailed and accurate source of information about freight movements by location, mode, weight, and value. **Figure 7** presents the analysis districts and **Table 19** shows the neighborhood name assigned to each.

Figure 7: Freight Districts

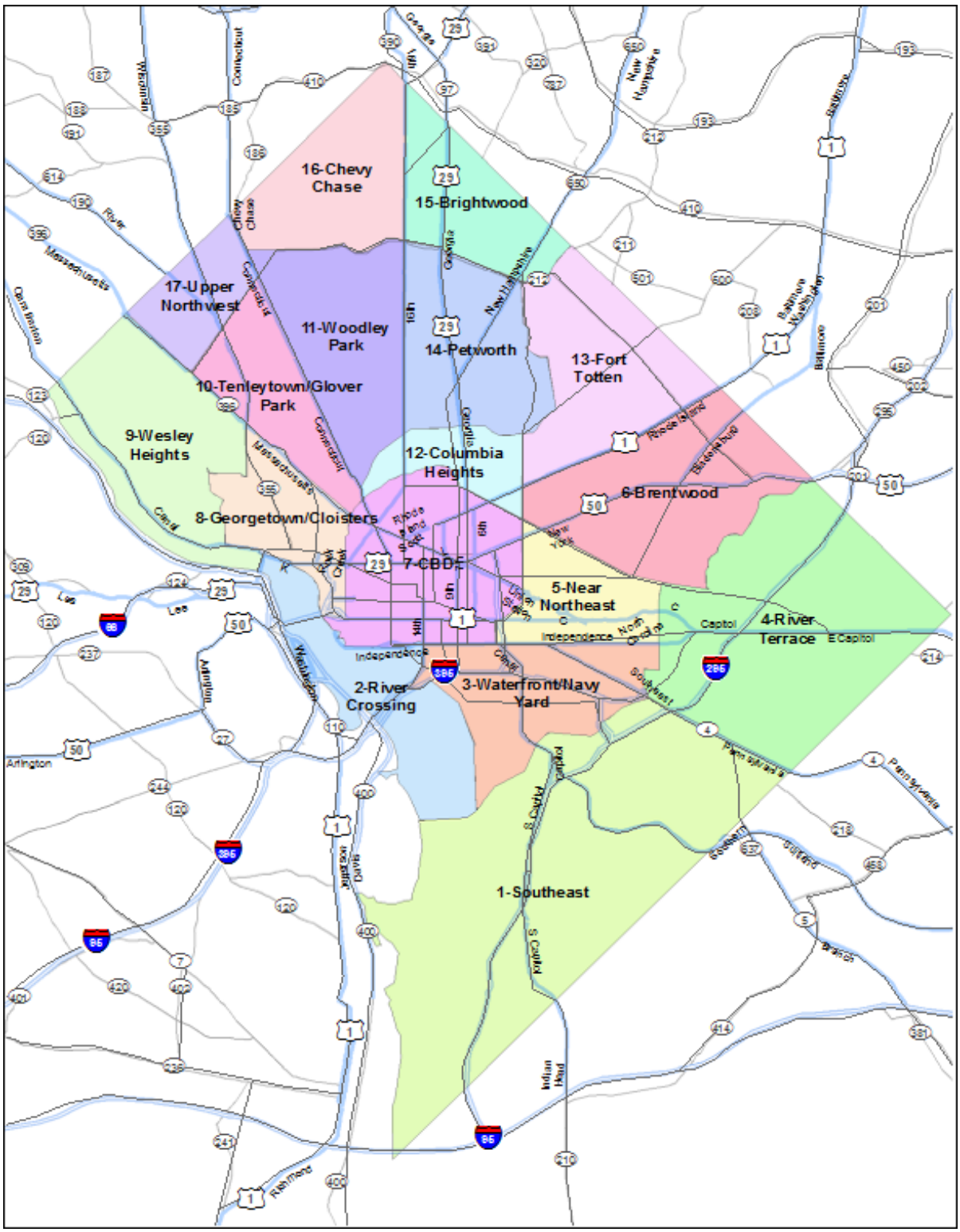


Table 19: Freight Districts for Plan Analysis

District	Name
1	Southeast
2	River Crossing
3	Waterfront/Navy Yard
4	River Terrace
5	Near Northeast
6	Brentwood
7	CBD
8	Georgetown/Cloisters
9	Wesley Heights
10	Tenleytown/Glover Park
11	Woodley Park
12	Columbia Heights
13	Fort Totten
14	Petworth
15	Brightwood
16	Chevy Chase
17	Upper Northwest

3.4.1. Inbound Freight Distribution

Shipments of inbound freight are depicted in **Figure 8** through **Figure 10**. This section presents a summary of the major patterns seen in the District's inbound freight shipments.

- **Inbound Shipments by Weight:** The five districts that import the greatest share of freight are: 1) CBD (47.4 percent); 2) Brentwood (postal facility location, 16.4 percent); 3) Waterfront/Navy Yard (11.1 percent); 4) Near Northeast (6.9 percent); and 5) Georgetown (5.5 percent). By 2040, inbound freight shipments are expected to exceed five percent as a share of all inbound shipments in Tenleytown, and to decrease as a share of the total in the Waterfront/Navy Yard district. Otherwise the relative shares and locations are the same as shown for 2011 (**Figure 8**).

- **Inbound Shipments by Value:** By value, the leading freight destinations are 1) CBD (38.8 percent); 2) Brentwood (36.9 percent); 3) Waterfront/Navy Yard (7.90 percent), and 4) Georgetown (7.5 percent). Over time, the District will import higher value goods. As shown in Figure 8, the growth by weight is not as significant as the growth by value. In terms of value, the CBD and Brentwood districts will grow in significance as their share of the total value of inbound shipments increases (**Figure 9**).

- **Future Growth**: In absolute terms, districts extending in a clockwise arc from Georgetown to Fort Totten are forecast to double their inbounds shipments. In terms of value, districts from the CBD northward around the 16th Street Corridor will experience the highest levels of growth in inbound freight (**Figure 10**).

Figure 8: Freight Distribution by Weight Coming Into Washington, DC (2011 and 2040)

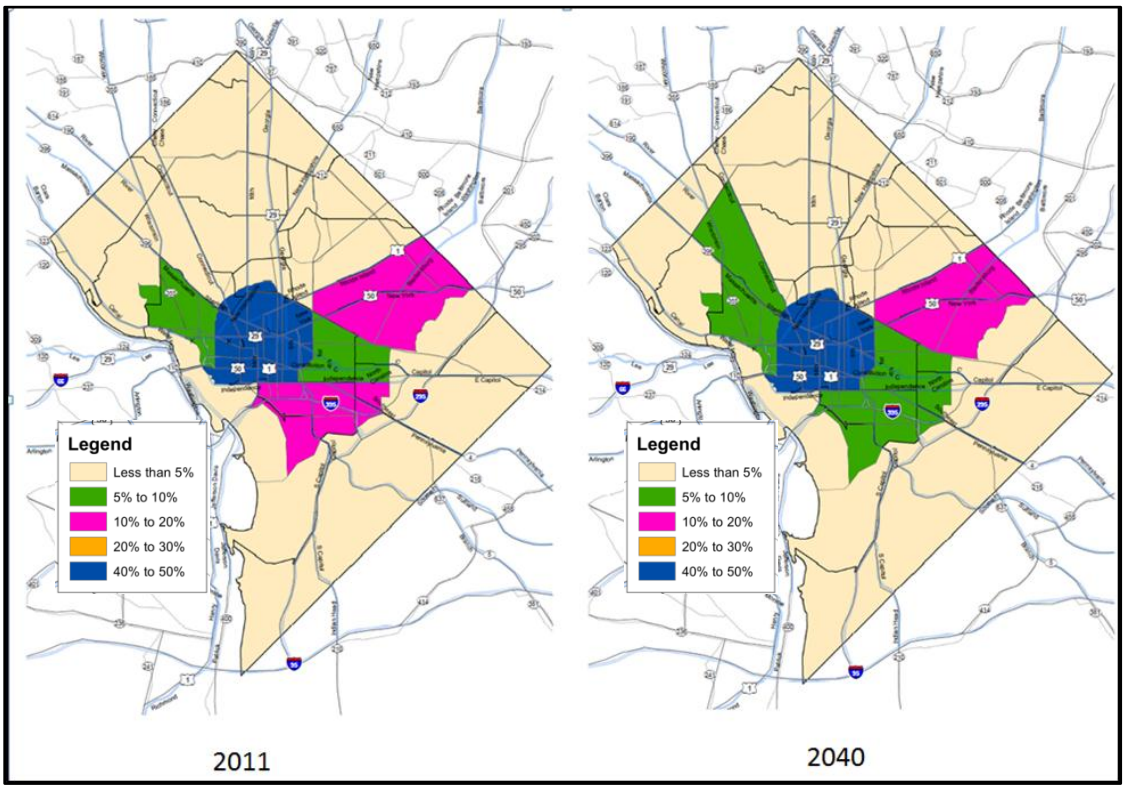


Figure 9: Freight Distribution by Value Coming Into Washington, DC (2011 and 2040)

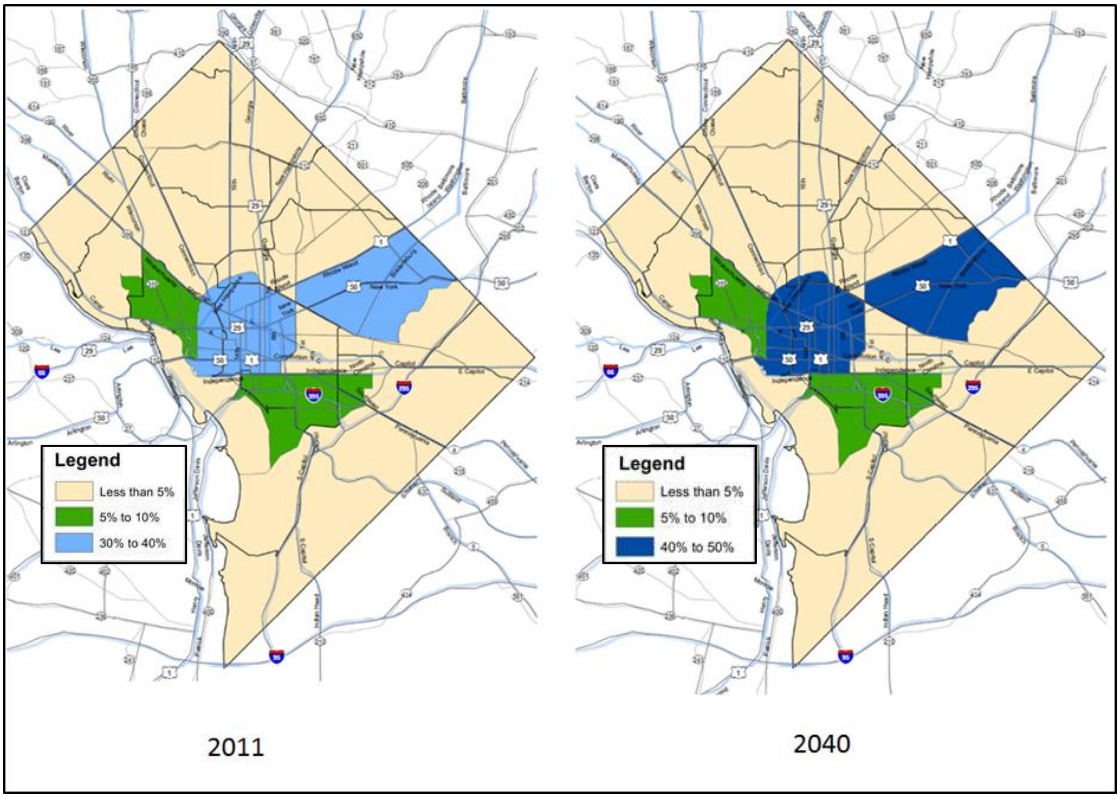
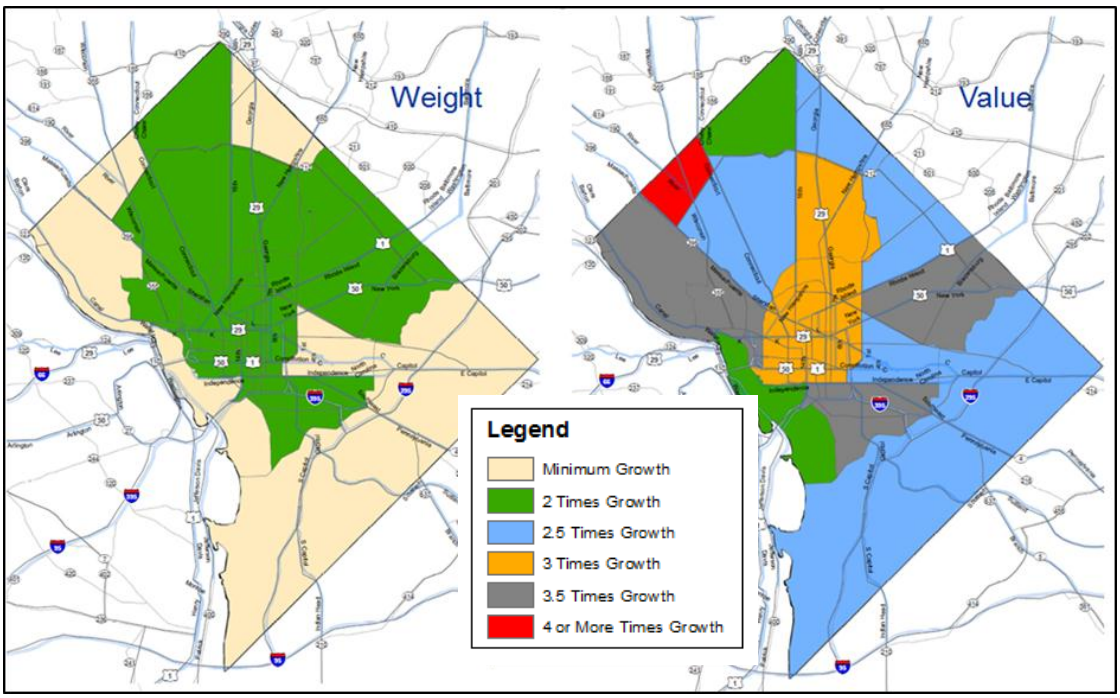


Figure 10: Growth from 2011 to 2040 by Freight District (Inbound Washington, DC)



3.4.2. Outbound Freight Distribution

Shipments of outbound freight are depicted in **Figures 12** through **14**. This section presents a summary of the major patterns seen in the District's inbound freight shipments.

- **Outbound Tonnage**: The CBD (33.4 percent), Brentwood district 6 (29.0 percent), Georgetown district 10 (4.3 percent), and the Waterfront district (9.0 percent) export the greatest volume of freight, in terms of weight. By 2040, the Georgetown district will be a fourth significant exporter of goods (**Figure 11**).

- **Outbound Value**: The CBD (39.3 percent), Brentwood (15.8 percent), Georgetown (14.8 percent), and Tenleytown (6.1 percent) export the greatest volume of freight, in terms of value. By 2040, the River Terrace district is also expected to be a significant source of outbound freight shipments (**Figure 12)**.

- **Future Growth**: In absolute terms, outbound shipments are expected to grow most significantly in the Northwest (Wesley), east and southeast districts (Southeast and River Terrace), as well as Brightwood to the north (**Figure 13).**

Figure 11: Freight Distribution by Weight Leaving Washington, DC (2011 and 2040)

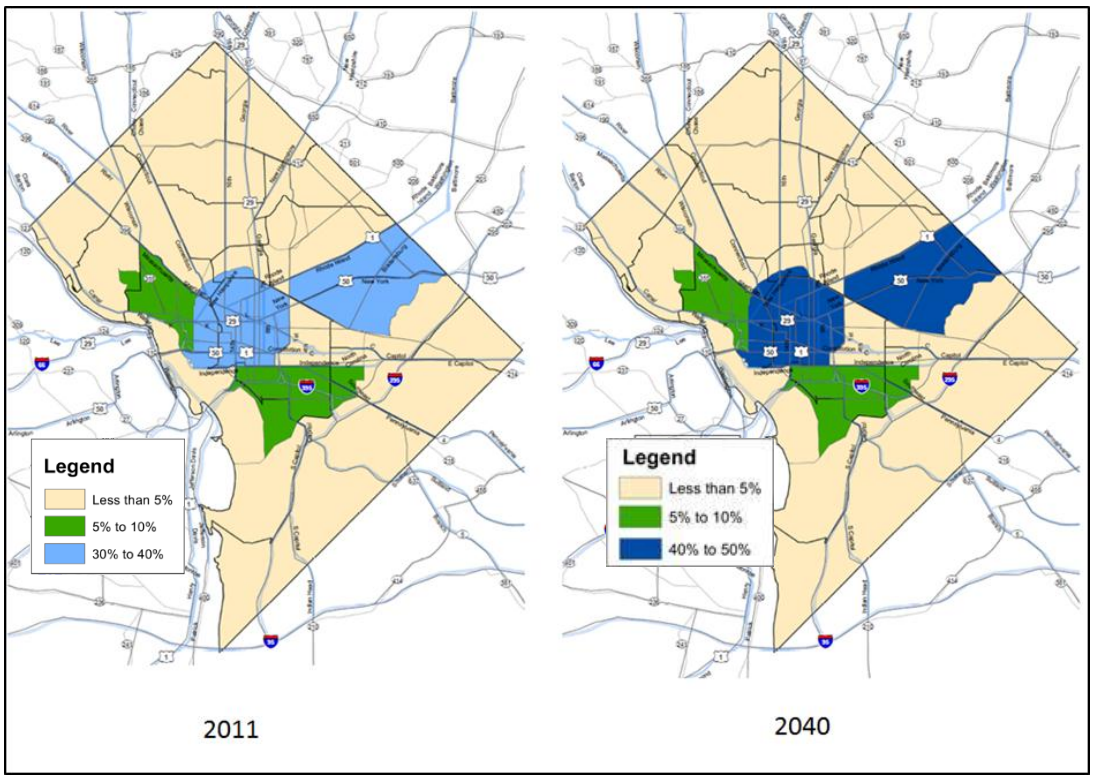


Figure 12: Freight Distribution by Value Leaving Washington, DC (2011 and 2040)

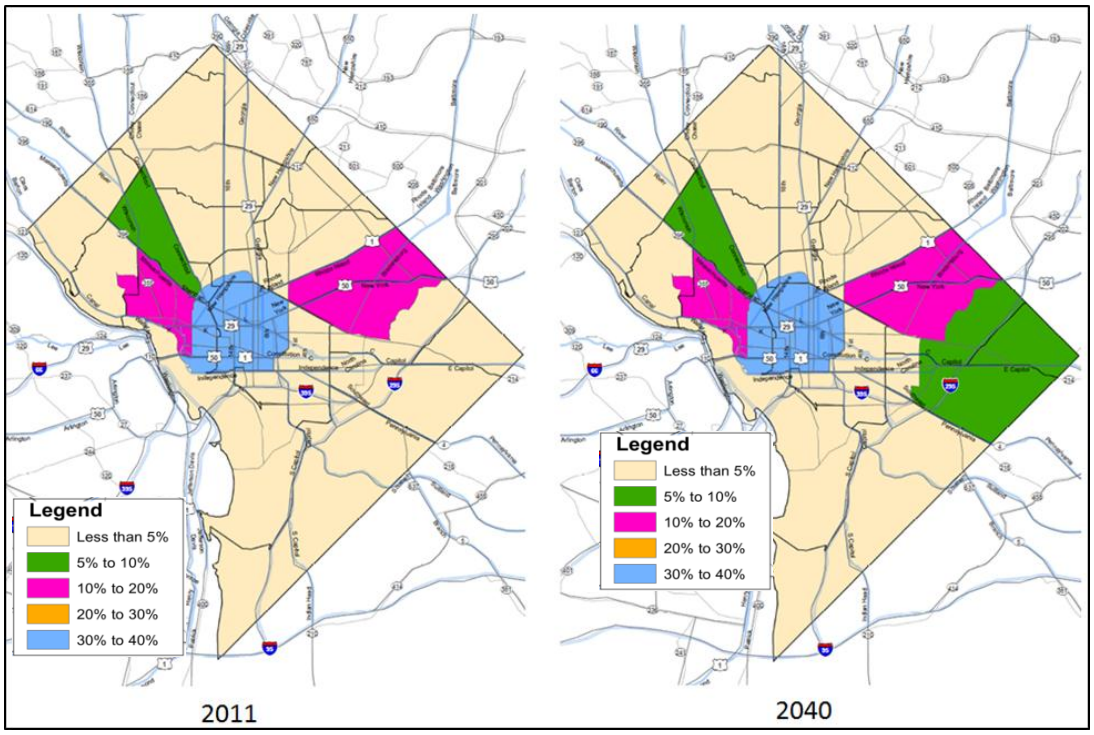
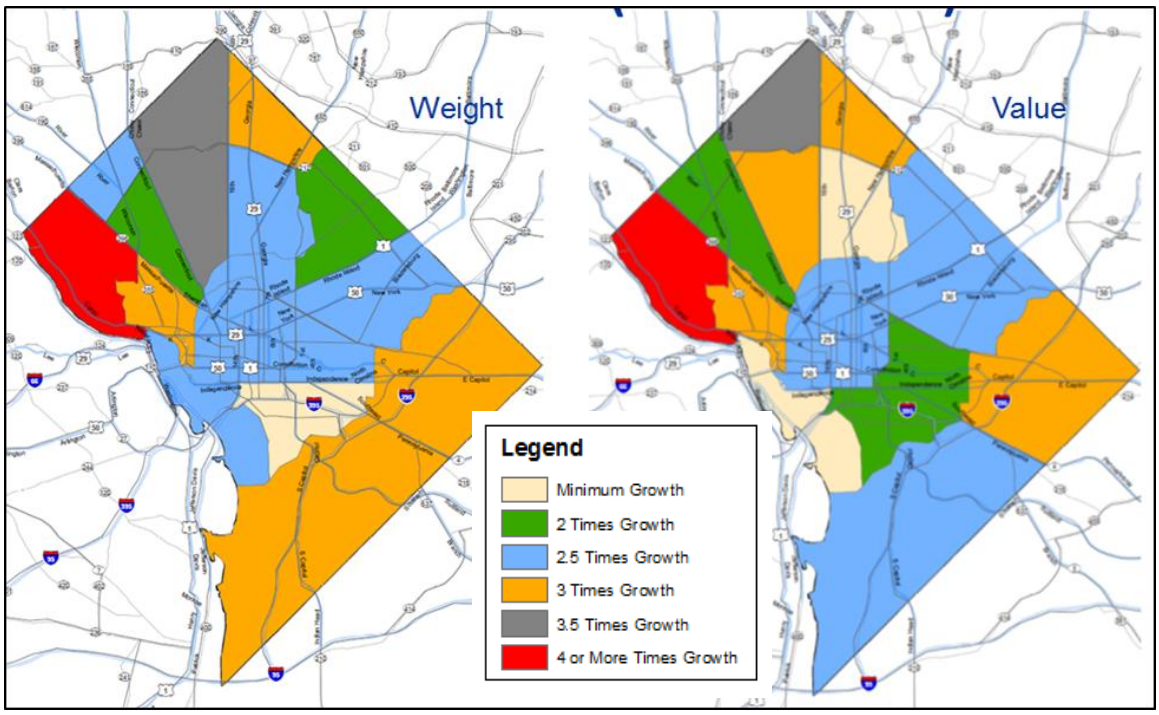


Figure 13: Growth from 2011 to 2040 by Freight District (Outbound Washington, DC)



3.4.3. Internal Freight Distribution

Figure 14 and **Figure 15** show the freight distribution by weight and value respectively for freight traffic by freight district. For the total tonnage and value in 2011 and 2040 that moves within DC, Figure 14 and Figure 15 show what percentage of that commodity movement is shipped for internal consumption by each freight district. As shown in the figures, most of the freight traffic is concentrated in the CBD, with some growth in value from 2011 to 2040 in the Waterfront. However, when considering the growth of freight by weight or value from 2011 to 2040 within each freight district (**Figure 16**), there is not much growth in terms of weight, but in terms of value, growth is expected to increase by 2.5 to 3 times in value for certain freight districts: Upper Northwest, Petworth, and Columbia Heights.

Figure 14: Freight Distribution by Weight within Washington, DC (2011 and 2040)

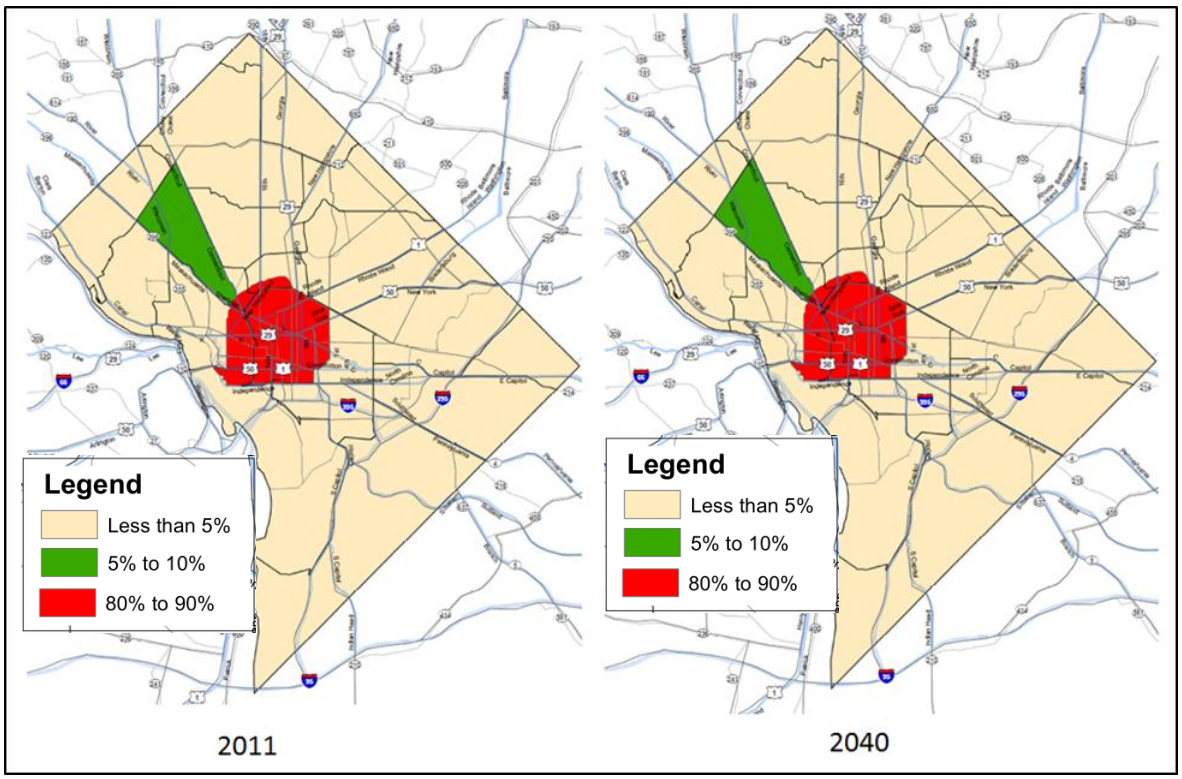


Figure 15: Freight Distribution by Value within Washington, DC (2011 and 2040)

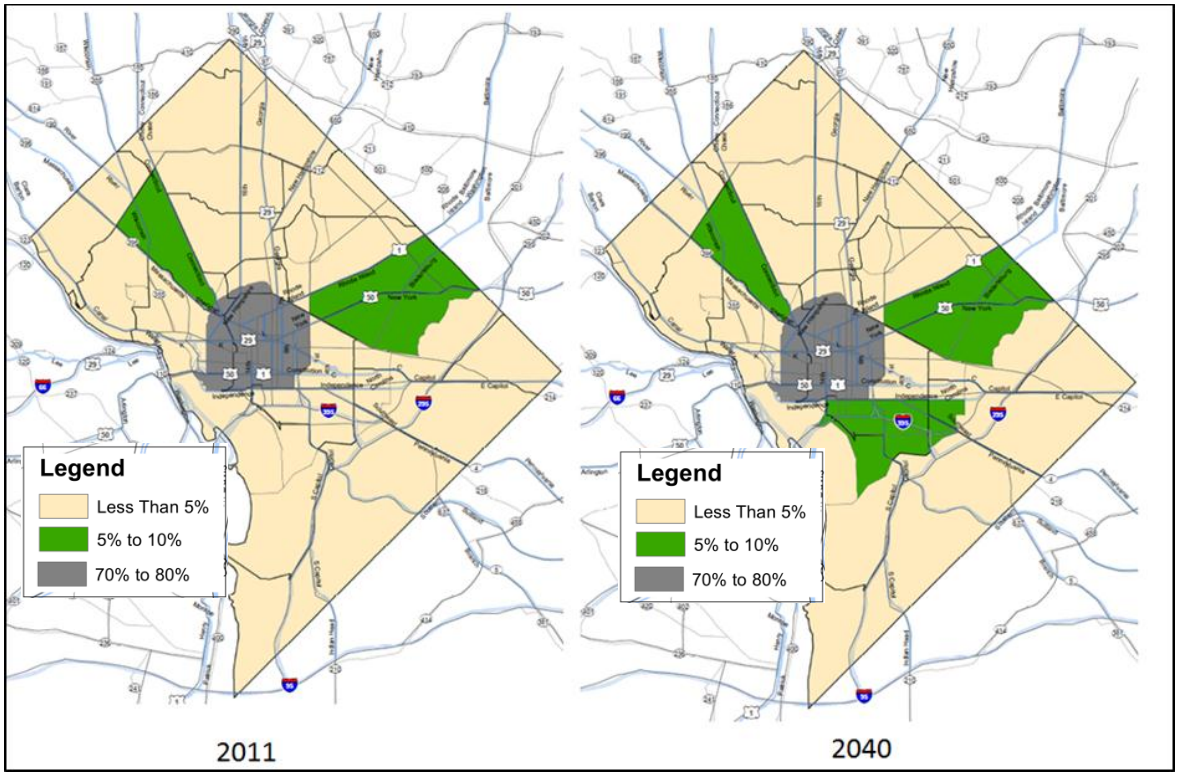
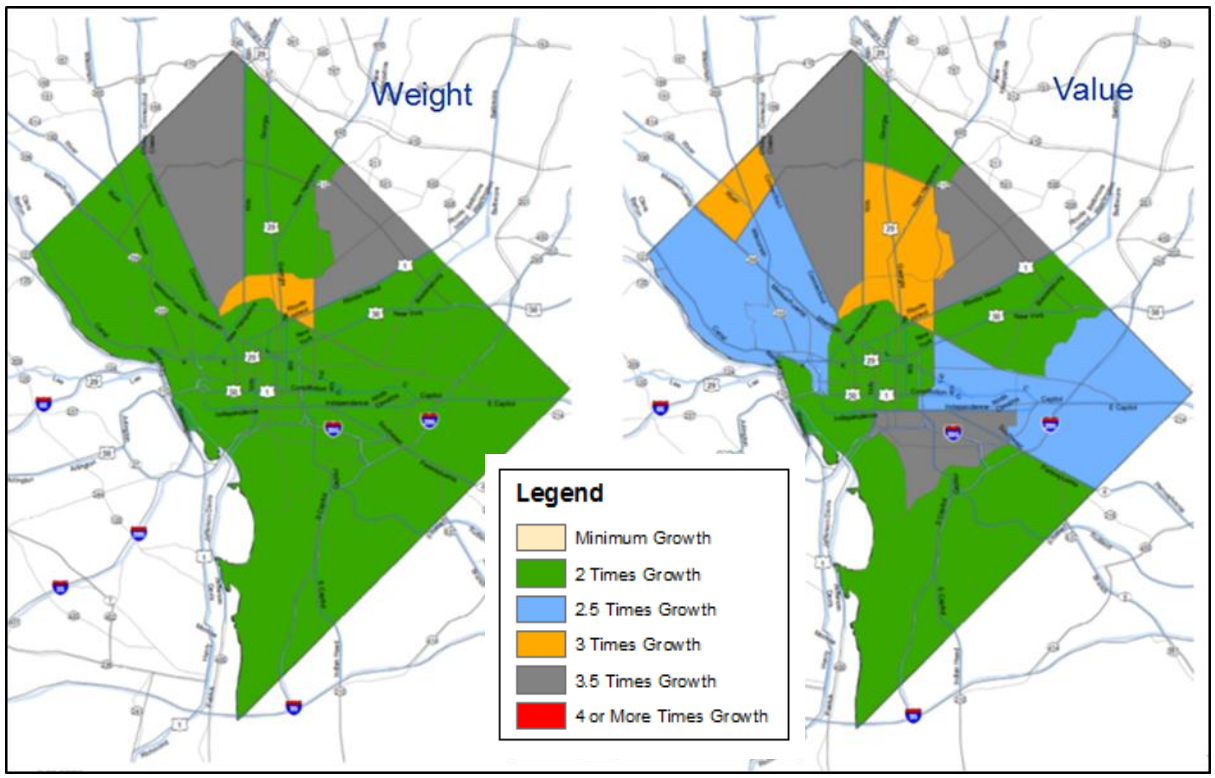


Figure 16: Growth from 2011 to 2040 by Freight District (Within Washington, DC)

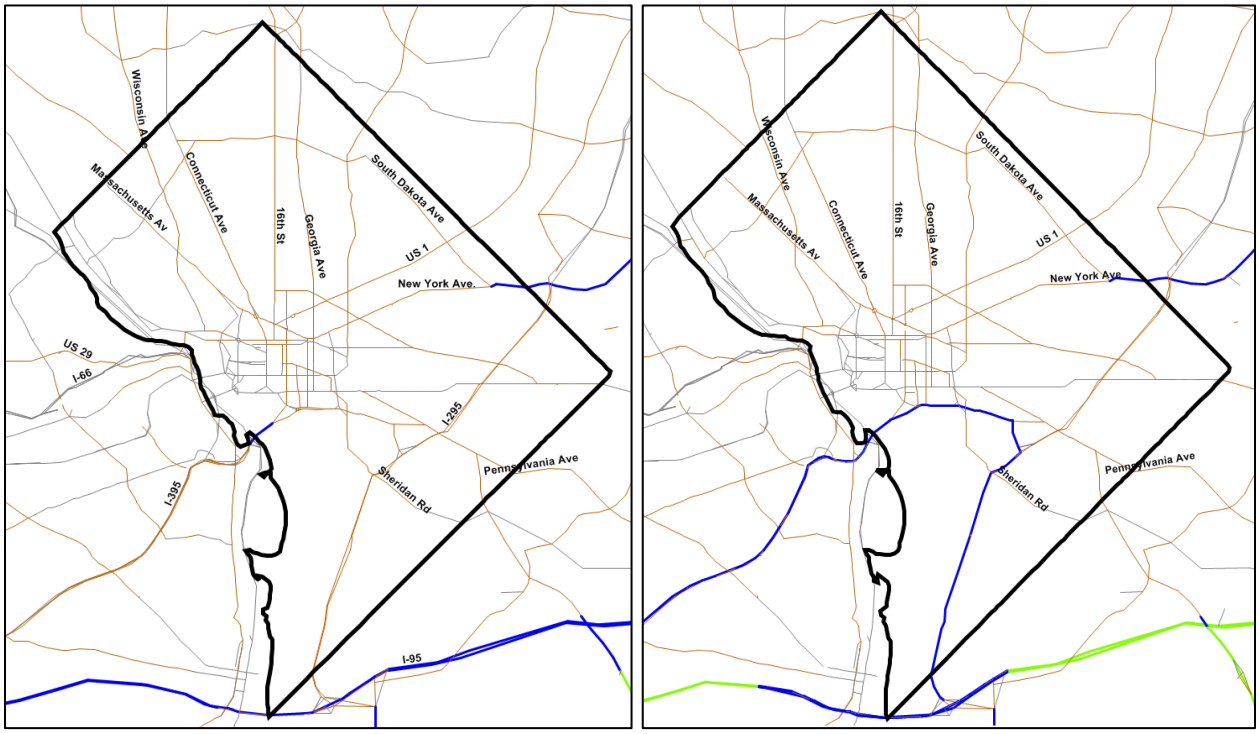


3.5. Truck Freight Flows

To complement the analysis of freight shipments by district, the plan team analyzed the likely truck flows on the District's roadway system. The purpose of the network analysis was to identify the routes that are likely to attract the highest truck volumes and to determine the significance of those volumes.

The commodities shown in Section 3.4 were distributed onto the network using TRANSEARCH data and existing regional truck flow forecasts. **Figure 17** shows the distribution of daily truck traffic in the District. Overall, the growth in daily truck traffic is projected to be 49 percent from 2011 to 2040. The increased truck traffic is projected to be greatest along I-395 and I-295. Truck traffic on other primary routes such as Georgia Avenue, 14th and 16th Streets, and South Dakota Avenue will continue to increase, but at relatively low rates of growth compared to the likely volumes of passenger vehicles. Some routes may experience an increase in the amount of trucks by 2040, from zero to 1000 trucks twice a day to 1000 to 5000 trucks twice a day. However, even at low volumes trucks can have a significant impact on traffic flow due to their size, slower rates of acceleration and deceleration, and difficulty negotiating tight corners in urban areas. These operational factors are beyond the capability of regional traffic models to capture and understand, but they are important factors in planning, design, and operations.

Figure 17: Truck Flow Estimates, 2011 and 2040



4.0 Impact of Freight Movements on the District Economy

4.1. Introduction

Economic impacts of freight activity in the District of Columbia come from transportation services and from industries that use such freight transportation services to trade goods. Of these two activities, freight-users generate the most significant impacts.

Data used to analyze goods movement for the District are from the TRANSEARCH freight flow database product. TRANSEARCH-derived, inbound, outbound, and intra-District commodity flow volumes and values are applied together with the IMPLAN economic model to determine how such commodity movements generate direct economic impacts in the District of Columbia. Further, the indirect impacts associated with suppliers, and the induced impacts associated with the re-spending of income, are also quantified. Combined, the direct, indirect, and induced types comprise the total economic impacts, with each measured in terms of employment, income, value-added (i.e., Gross State Product), output, and taxes. The following sections outline the methodology employed, relevant commodity flow data, and modeling results.

The only economically-significant commodity movements identified within the available TRANSEARCH commodity flow database within the District pertain to truck movements (i.e., inbound, outbound, and intra-district truck tonnage). In addition to the truck movements, some inbound and outbound rail and water movements are identified, but the magnitude is dwarfed by trucking and constitutes such a small fractional component within the region that the related estimates are within margin of errors and are thus deemed inconsequential for the economy. A qualitative description of the non-truck related movements and their economic implications are provided in conjunction with the truck-related quantified impacts.

4.2. Approach, Data Sources, and Movements

The analysis approach follows generally-accepted industry standards by identifying and categorizing the range of economic impacts directly and tangentially related to freight transportation. The following subsection outlines this methodology, the data sources, and the economic model used, as well as the applied tonnage and value movements that drive the freight-related economic results estimates.

4.2.1. Impact Approach and Terminology

Economic impacts of freight are categorized into two broad activities: transport-service and transport users'. For each activity, three types are quantified: direct, indirect, and induced. And for each type, five measures are derived: jobs (employment), income, value-added, output, and taxes. Activities, types, and measures are defined below.

- **Activities**: The District of Columbia freight-related economic impacts are categorized into service and user impacts. Freight transport-services would most-assuredly be lost in the absence of freight activity (elimination of goods movements). And transport user impacts pertain to industries using freight modes to transport goods.

- **Transport-Services**: Impacts associated with the provision of freight operations (i.e., the trucking industry) include a wide range of primarily truck transport activity, but also may include other support administrative operations.

- **Transport/Freight Users**: Impacts associated with shippers/receivers using truck for goods movements (e.g., intermediate and final goods, etc.), excepting the trucking industry itself. Most truck users in the District have limited options available to transport freight. A few could possibly substitute rail and/or water transport if truck services became unavailable.[7] However, even for those few with the option, the choice to use truck to ship/receive freight by those with alternatives indicates cost and/or logistical advantages, and removal of such advantages would negatively affect truck users.

Types – Transport-services and users each consist of three types (and a combined total):

- **Direct**: Impacts from the provision of truck transport (i.e., "transport-services"), as well from the firms/industries that use trucks to ship and receive goods (i.e., "freight users"). Transportation investments that reduce cost and increase productivity have a direct benefit to the profits and business sales of transport service firms and freight users.

- **Indirect**: Impacts associated with the suppliers that provide intermediate goods and services to the directly impacted industries. For example, a trucking firm that sees opportunities for growth because of a transportation investment purchases additional trucks; the manufacturer's windfall is an indirect benefit[8].

- **Induced**: Impacts associated with the re-spending of earned income from both the direct and indirect industries in the study area.[9] For example, a transportation invesment that increases the demand for trucks may also produce a need for additional workers. These workers will use their wages for goods and services, which will also benefit the economy.

- **Total**: Aggregated direct, indirect, and induced types.

Measures – Each type is measured in terms of five economic metrics:[10]

- **Jobs/Employment**: Employment measured in terms of full-time-equivalent (FTE) job-years.

- **Income**: The wage/salary earnings paid to the associated jobs.

[7] Further, the substitutability factor if truck became unavailable also affects the import of goods and material, which might result in changes in geographical sourcing of inbound goods.
[8] As a general rule, benefits to businesses located within the study area only are counted.
[9] Note that the *indirect* and *induced* types are often referred to jointly as the *multiplier* impacts.
[10] Note that all monetary measures are presented in constant 2011 dollars terms (i.e., income, value-added, output, and taxes).

- **Value-Added**: The net additional economic activity (i.e., total output less gross intermediate inputs), synonymous with GRP (gross regional product). Includes employee and proprietor income, other income types, taxes, etc., required in the production of final goods and services.
- **Output**: The total sales value associated with all levels of economic activity (comprised of gross intermediate inputs and value added, combined).
- **Taxes**: Includes various taxes (sales, property, excise, etc.), fines, fees, licenses, permits, etc. resulting from business economic activity.

4.2.2. Data Sources and Models

Reflective of manufacturing and other production sectors, transport user impacts are typically much greater than those related to transport-service. Generating comprehensive freight user-related estimates requires converting commodity movement data into direct industry output estimates. To do so, TRANSEARCH commodity movement data and the IMPLAN model are used.

TRANSEARCH – Developed by IHS Global Insight, TRANSEARCH® is a comprehensive database of North American freight flows, built from more than a hundred industry, commodity, and proprietary data exchange sources. This data set has been produced annually for over 20 years for use in public sector and private sector transportation planning nationwide. TRANSEARCH® combines primary shipment data obtained from some of the nation's largest rail and truck freight carriers with information from public, commercial, and proprietary sources to generate a base year estimate of freight flows at the county level (including the District of Columbia). Further, TRANSEARCH® establishes market-specific production volumes by industry or commodity, which is mostly drawn from their IHS Global Insight's Business Markets Insights (BMI) database, and supplemented by trade association and industry reports, and US government-collected data – especially from the Input/Output (I/O) tables produced by the Bureau of Economic Analysis.[11]

Data applied in the economic analysis include 2011 tons and value, by commodity type and directional movement (inbound, outbound, and intra-district), categorized by Standard Transportation Commodity Classification (STCC) code level. In effect, TRANSEARCH® provides a comprehensive snapshot of goods movements associated with a defined geography in sufficient detail (e.g., data dimensions: transportation mode, origins and destinations (and, thus, direction), year, value, and volume by specific commodity) necessary to incorporate within an economic framework for such geography and determine the economic ramifications of such goods movements.

IMPLAN – The IMPLAN® v3 model, produced by the Minnesota IMPLAN Group, Inc., is an economic modeling, input-output based, social account matrix software used to estimate the economic impacts to a defined geography (i.e., the District of Columbia) ensuing from expenditures in an industry or group of industries (or, commodity, or group of commodities).[12] A social account matrix reflects the economic interrelationships between the various industries (and commodities), households, and governments in

[11] These are the same I/O tables that underlie the IMPLAN model, as subsequently discussed.

[12] Note that all results presented pertain only to one-year static impacts for year 2011 flows (in year 2011 values), and does not provide any dynamic or feedback changes.

an economy and measures the economic interdependency of each industry on others through impact multipliers. Multipliers are developed within IMPLAN from regional purchase coefficients, production functions, and socioeconomic data for each of the economic impact variables and are geographically-specific. IMPLAN data and industry-accounts closely follow the conventions used in the "Input-Output Study of the US Economy" by the US Bureau of Economic Analysis. IMPLAN is one of the most commonly accepted models used for economic impact analysis and estimation throughout the country.

Additionally, IMPLAN provides commodity-to-industry production and absorption matrices that enable the quantification, for example, of how inbound commodities are used (absorbed) across the District of Columbia industries in the respective production processes to create consumable final goods and services, or by institutions for final consumption, thus enabling results estimates. Further, algorithms were developed for this analysis to translate TRANSEARCH commodity (Standard Transportation Commodity Classification, or STCC) data into IMPLAN industry categories. Such data and translation processes are used to estimate the impacts associated with directional commodity movements.

In combination, the TRANSEARCH® model data, providing necessarily nuanced commodity detail, is bridged with the IMPLAN economic model, which provides the economic interrelationships underpinning the District economy, to derive the economic impacts of freight in the region. TRANSEARCH® data is utilized because of the requisite commodity detail for translation into detailed economic interrelationships between commodities, industries, and institutions in the economy, made transparently available via the IMPLAN model. IMPLAN does not identify commodity movements (only the underlying commodity to industry structure) and TRANSEARCH® does not provide the economic interrelationships necessary to determine how the identified detailed commodity movements interact within the economy. As such, the two models and data sources are combined to derive the freight-related economic impacts to the District of Columbia.

4.2.2.1. Economic Impact Findings

Freight truck activity in the District of Columbia impacts an estimated 129,950 *total* jobs across the District. A vast majority of these *total* employment impacts arise from truck users who import goods via the freight system (receivers), with the balance attributable to shippers and transport services. In terms of jobs, *transport user* related employment totals 129,500 jobs (99.7 percent of *total* jobs), versus 450 (0.3 percent) truck transport-service related jobs. These summary truck-service and truck-user results include the *direct* impact of goods and services provided, the *indirect* impact associated with suppliers, and the *induced* impacts associated with income re-spending.

The ensuing discussion details the composition of the employment estimates, as well as the other *measures* (e.g., output, value-added, income, and taxes). The impact *types* (e.g., direct, indirect, and induced) and *measures* are first presented for *transport-services*, and then for *transport users*. The total are then summarized for both truck *activities*, by *measure* and *type*.

4.2.3. Truck Transport-Service Impacts

The *direct* impact of the District of Columbia-based truck operations totals 350 jobs.[13] Total *indirect* and *induced* (i.e., multiplier) effect associated with truck operations yield an additional 110 jobs (80 and 30, respectively) throughout the District. Combined, an estimated 450 people owe their jobs, directly or tangentially to the physical movement of freight by truck. This excludes transport users associated with the shippers/consignees that ship/receive goods.

Direct Truck Transport-Services: The *direct* output related to truck services total $44.8 million, of which $15.9 million is paid in income to the 350 people *directly* employed in the truck industry, as shown in **Table 20.**

Table 20: Truck Transport-Service Impacts

Impact Type/ Measure	Output[1]	Labor Income[1]	Total Value Added[1]	Taxes[1]	Employment[2]
Direct	$44,800	$15,900	$19,300	$500	350
Indirect	$11,900	$5,900	$8,100	$400	80
Induced	$4,400	$1,700	$3,000	$300	30
Total*	$61,100	$23,400	$30,300	$1,100	450

Source: CDM Smith based on Transearch data for 2011 and Implan
[1]: in thousands of 2011 dollars rounded to the nearest hundred thousand
[2]: employment rounded to the nearest ten job-years
**totals may not sum due to rounding*

Multiplier Truck Transport-Services: The *indirect* output associated with the supply of products and services to truck transport providers total $11.9 million, of which $5.9 million is paid in income to 80 *indirect* jobs. The re-spending of *direct* income ($15.9 million) and *indirect* income ($5.9 million) generates an additional $4.4 million in *induced* output, of which $1.7 million is paid to an additional 30 jobs.

Total Truck Transport-Services: Combined, a *total* of 450 jobs are related directly or tangentially (indirect and induced) to the provision of truck transport in the District of Columbia. These employees earn a total of $23.4 million. Total output related to such truck transport services totals $61.1 million.

4.2.4. Truck Transport User Impacts

In addition to the truck-operations (transport-services) impacts detailed above, many consignees and shippers in the District heavily or solely rely on truck service to receive and/or ship freight. In doing so, they generate freight-related economic activity as well. While few of these entities /industries are not entirely dependent on the truck mode for shipping freight (as alternative modes are available), it is hard to envision their continued operation levels without such access. In fact, as mentioned earlier, truck access is often instrumental in major business location decisions.

[13] There are many more truck drivers employed who are working within the District regularly but they are mostly working for companies based elsewhere such as in Maryland or Virginia and thus not counted as District truck transport service workers.

If trucks did not accommodate demand, some consignees and shippers could use other modes (i.e., rail, water, air, etc.) to transport freight; although, this option within the District is extremely limited. However, the use of other modes would likely entail higher transport costs (due to longer transport distances, price, logistics, difficult accessibility, etc.), and could increase overall demand (and resulting handling costs) for all users of other modes. The long-term result could be a migration of businesses that can move away from the District of Columbia to other locations with relatively better truck accessibility, and better modal options/mix.

The following analysis identifies the economic impacts associated the District of Columbia users of truck transport.; This estimation requires an understanding of how the various inbound and outbound commodities are used or produced by various industries to generate output, income, and employment. To do so, the IMPLAN commodity-to-industry matrices and other algorithms were applied to estimate *direct* measures. *Indirect* and *induced* multipliers were then applied to the *direct* estimates to derive *total* economic impacts.

Total Transport-Users: The *direct* output of freight-related truck users in the District of Columbia totals $14.2 billion, of which $7.3 billion is paid in the form of income to 103,670 *direct* jobs. Indirect impacts associated with suppliers account for another $3.1 billion in annual output, of which $1.3 billion is paid in income to 16,140 jobs. The re-spending of direct and indirect income ($8.6 billion) generates additional *induced* impacts of $1.5 billion in output, of which $576 million is paid in income to 9,690 jobs.

As shown in **Table 21,** a *total* of 129,500 jobs in the District of Columbia can be traced back to the organizations that ship and/or receive freight via truck in the District of Columbia. Of these *total transport user* jobs, a significant majority (97 percent, 125,590 jobs) are attributable to freight terminating in the District of Columbia (inbound movements), and only a small fraction (3 percent, 3,910 jobs) are attributable to outbound or intra-district freight originating in the District of Columbia. These impact estimates are based on the freight volumes and values originally presented, as discussed below.

Outbound/Intra-District Freight Users: Nearly 763,000 tons of freight originating in the District of Columbia is either shipped via truck out of the District (503,000 tons) or internally (260,000 tons). Combined, truck freight originating in the District of Columbia is valued at $841 million, and generates an estimated $742 million (see **Table 21**) in *direct* output in the District of Columbia. This *direct* output, tabulated by industry, was applied to IMPLAN multipliers to estimate the associated *indirect* and *induced* impacts associated with the District of Columbia goods and materials transported by truck. As also shown in **Table 21**, the *total* impact associated with such movements totals $966 million in output, of which $384 million is paid in income to 3,910 jobs District-wide.

Table 21: Truck Transport User Impacts

Measure and Type	Trade Related		
	Outbound/Intra	Inbound	Subtotal
Output[1]			
Direct	$742	$13,505	$14,246
Indirect	$163	$2,902	$3,065
Induced	$62	$1,425	$1,486
Total*	$966	$17,831	$18,797
Employment[2]			
Direct	2,710	100,960	103,670
Indirect	790	15,350	16,140
Induced	400	9,290	9,690
Total*	3,910	125,590	129,500
Labor Income[1]			
Direct	$286	$6,990	$7,275
Indirect	$75	$1,274	$1,349
Induced	$24	$552	$576
Total*	$384	$8,816	$9,200
Total Value Added[1]			
Direct	$391	$9,117	$9,508
Indirect	$116	$2,081	$2,197
Induced	$42	$968	$1,010
Total*	$550	$12,166	$12,716
Taxes[1]			
Direct	$6	$655	$661
Indirect	$6	$128	$134
Induced	$4	$83	$86
Total*	$16	$865	$881

Source: CDM Smith based on Transearch data for 2011 and Implan
[1]: in millions of 2011 dollars
[2]: employment rounded to the nearest ten job-years
**totals may not sum due to rounding*

Inbound Freight Users: Of the 15.8 million tons of inbound freight, a small amount (139,000 tons) comprises waste, scrap, or other materials that have minimal value, and thus generate no discernible economic impacts in the District of Columbia. Conversely, the remaining gross majority of inbound truck freight tonnage (15.6 million tons), valued at $20.0 billion is used by the District of Columbia industries and institutions to generate $13.5 billion in *direct* output (see **Table 22**). This output is comprised of *final demand* and *intermediate demand*, where:

Table 22: Inbound Truck Freight User Tonnage, Value, and Direct Output

Demand Type	Tonnage	Freight Value[1]	Direct Output[1]
Final	6,057,844	$15,752	$1,440
Intermediate	9,557,061	$4,251	$12,065
Total	15,614,905	$20,002	$13,505

Source: CDM Smith based on TRANSEARCH data for 2011 and IMPLAN
[1]: in millions of 2011 dollars

- *Final Demand*: Approximately 39 percent (6.1 million tons) of the 15.6 million inbound tons that generate economic activity in the District of Columbia comprise finished goods bound for final demand markets (e.g., households, governments, etc.). Such final demand goods are distributed via wholesale or retail outlets or through direct sales. Wholesale or retail trade entails some economic impacts stemming from the trade margins associated with the transfer of goods from suppliers to end-users; that is, the personnel and resources to sell or resell such goods. Whereas direct sales to end-users have no associated impacts. The value of such final demand movements totals $15.8 billion (79 percent of inbound total value), and the resultant direct output associated from wholesale and/or retail markup totals $1.4 billion (11 percent direct output).

- *Intermediate Demand*: The other 61 percent of inbound tonnage (9.6 million tons) comprises intermediate demand used/absorbed by the District of Columbia industries in their production processes. These commodities, valued at $4.3 billion, are allocated to the major industry and institutional users based on relative commodity absorption patterns. Direct output impacts are then estimated based on each industry's average value-added contribution to intermediate inputs to produce final goods and services.[14] The exercise generates a direct industry output estimate of $12.1 billion.

In sum, 15.6 million tons of inbound truck freight, valued at $20.0 billion is used by the District of Columbia industries (as intermediate inputs into the production process) and institutions (as final demand via wholesale, retail, or direct sales) to generate $13.5 billion in direct output. As seen **in Table 21,** these direct inbound trade-related impacts result in an estimated 100,960 jobs. The multiplier impacts associated with suppliers (15,350 indirect jobs) and income re-spending (9,290 jobs) accounts for an additional 24,640 jobs. Combined, the economic impact associated with truck-user impacts arising from inbound tonnage totals $17.8 billion in output, of which $8.8 billion is paid in income to 125,590 total jobs.

[14] The value-added contribution is derived using algorithms based on commodity-to-industry coefficients from the IMPLAN model.

Freight User Impact Overlap: Some minor impact *overlap* issues arose in the commodity conversion to economic impact estimation process between inbound and outbound/intra movements. For example, when inbound commodity supplies, such as paper, are imported by a publisher (including the Federal Government), a share of the inbound paper commodities is allocated to the printed materials industry (including newspapers, periodicals, books, etc.), which is then used to estimate the industry-associated output. Potential overlap arises when the printed materials are subsequently transported by truck out of the District, since impacts are also estimated for outbound truck movements. So in effect, the output associated with the printed materials industry would be counted twice: once associated with the inbound movement of paper, and second with the outbound movement of printed materials. To avoid double-counting impacts, such potential overlaps were identified at an aggregate level and subtracted-out of the analysis to ensure conservative estimates.[15] For the District of Columbia, the *potential overlap* subtracted from the impact findings comprise between 0.6 percent and 4.5 percent of the total unadjusted *transport user* impacts, depending on the *impact measure* and *type*. For the purposes of this chapter, the *intra-modal* potential overlaps are proportioned-out of the presented results.

4.2.5. Total Truck Activity Impacts

Truck service is essential to the District of Columbia's economy. While the basic provision of truck service generates a modest 350 direct jobs (450 total jobs including multiplier effects), truck transport users in the District generate a much greater 103,670 direct jobs. Combining the total truck transport users job impacts of 129,500 (inclusive of the 25,830 multiplier job impacts) with truck transport-services jobs yields a total truck-related employment impact of 129,950 jobs, with $9.2 billion paid in income and output of $18.9 billion. The summaries by activity, measure, and type are presented in **Table 23**.

Understanding the relative magnitude of such estimates to District-wide economic indicators further bolsters confidence in the estimates. Specifically, these truck-related impacts are compared with District-wide total employment, income, and gross state product (GSP) in **Table 24**. In summary:

- 129,950 jobs directly or tangentially affected by truck represent 15.8 percent of the 823,000 jobs in the District (in 2011).
- $9.2 billion earned by these employees represents 8.3 percent of the District of Columbia's total wage and salary income ($110.1 billion in 2011).

[15] While the TRANSEARCH data and IMPLAN model provide comprehensive analysis potential, they cannot be used to specifically track how inbound truck commodities result in corresponding outbound truck commodities. Therefore, to avoid double-counting, an estimate is made of the *potential overlap* by identifying the minimum output between the modal directions. For example, if printed material industry output associated with inbound paper totals $100 million, and the printed material industry output associated with outbound truck shipments total $60 million, the maximum potential overlap would be the minimum between the two movements (e.g., $60 million). This is because all of the outbound printed material-related impacts *could* have been produced with the truck inbound paper commodity inputs.
So, instead of estimating a total direct impact of $160 million (aggregating the separately-calculated inbound- and outbound-related impacts), the $60 million in potential overlap is subtracted-out of the analysis, resulting in a conservative trade-user impact estimate of $100 million between the two directional movements.
However, it is doubtful that the overlap would be 100 percent, exactly. Per the example, it is doubtful that the $60 million in truck printed material output could be entirely traced to the same $100 million of inbound truck paper.

Table 23: Total Truck Activity Impacts

Measure and Type	Service Provision	Trade Related Users			Total Service and Trade
		OB/Intra	Inbound	Subtotal	
Output[1]					
Direct	$45	$742	$13,505	$14,246	$14,291
Indirect	$12	$163	$2,902	$3,065	$3,076
Induced	$4	$62	$1,425	$1,486	$1,491
Total*	$61	$966	$17,831	$18,797	$18,858
Employment[2]					
Direct	350	2,710	100,960	103,670	104,020
Indirect	80	790	15,350	16,140	16,220
Induced	30	400	9,290	9,690	9,720
Total*	450	3,910	125,590	129,500	129,950
Labor Income[1]					
Direct	$16	$286	$6,990	$7,275	$7,291
Indirect	$6	$75	$1,274	$1,349	$1,355
Induced	$2	$24	$552	$576	$577
Total*	$23	$384	$8,816	$9,200	$9,224
Total Value Added[1]					
Direct	$19	$391	$9,117	$9,508	$9,528
Indirect	$8	$116	$2,081	$2,197	$2,205
Induced	$3	$42	$968	$1,010	$1,013
Total	$30	$550	$12,166	$12,716	$12,746
Taxes[1]					
Direct	$0	$6	$655	$661	$661
Indirect	$0	$6	$128	$134	$134
Induced	$0	$4	$83	$86	$87
Total*	$1	$16	$865	$881	$882

Source: CDM Smith based on TRANSEARCH data for 2011 and IMPLAN
[1]: in millions of 2011 dollars
[2]: employment rounded to the nearest ten job-years
**totals may not sum due to rounding*

Table 24: Total Truck Activity Impact Comparisons

Measure and Type	Service Provision	Trade Related Users			Total Service and Trade
		OB/Intra	Inbound	Subtotal	
Output					
Direct	0.0%	0.4%	8.1%	8.5%	8.5%
Indirect	0.0%	0.1%	1.7%	1.8%	1.8%
Induced	0.0%	0.0%	0.8%	0.9%	0.9%
Total*	0.0%	0.6%	10.6%	11.2%	11.2%
Employment					
Direct	0.0%	0.3%	12.3%	12.6%	12.6%
Indirect	0.0%	0.1%	1.9%	2.0%	2.0%
Induced	0.0%	0.0%	1.1%	1.2%	1.2%
Total*	0.1%	0.5%	15.3%	15.7%	15.8%
Labor Income					
Direct	0.0%	0.3%	6.3%	6.6%	6.6%
Indirect	0.0%	0.1%	1.1%	1.2%	1.2%
Induced	0.0%	0.0%	0.5%	0.5%	0.5%
Total*	0.0%	0.3%	7.9%	8.3%	8.3%
Total Value Added					
Direct	0.0%	0.3%	6.5%	6.8%	6.8%
Indirect	0.0%	0.1%	1.5%	1.6%	1.6%
Induced	0.0%	0.0%	0.7%	0.7%	0.7%
Total	0.0%	0.4%	8.7%	9.1%	9.1%
Taxes					
Direct	0.0%	0.1%	15.6%	15.8%	15.8%
Indirect	0.0%	0.1%	3.1%	3.2%	3.2%
Induced	0.0%	0.1%	2.0%	2.1%	2.1%
Total*	0.0%	0.4%	20.7%	21.0%	21.1%

Source: CDM Smith based on Transearch data for 2011 and Implan
As percent of District totals, as reported by Implan based on US Bureau of Economic Analysis data

- The combined value-added impact, $12.7 billion, associated with the truck operations and truck users represents 9.1 percent of Gross State Product-equivalent ($139.5 billion in 2011).
- Total output measures $18.9 billion for both transport service and trade users', amounting to 11.2 percent of District-wide output ($167.6 billion in 2011).
- And, the $882 million in taxes associated with truck transport account for about 21.1 percent of total tax collections in the District ($4.2 billion).

The analysis demonstrates the effect of truck transport on the District's economy, and that a vast majority of the impacts pertains to those firms that use freight truck to deliver goods and/or materials they have purchased from businesses outside the District. In turn, the resultant multiplier impacts associated with the indirect supplier impacts and the re-spending of income (both direct and indirect) is

significant. However, such impacts are disbursed differently through the various industries depending on their direct versus supportive role within the District of Columbia's economy, as summarized in the following subsection.

Total Job Impacts by Industry: Review of the total job impacts by industry indicate the greatest number of associated jobs arise in *Accommodation and Food Services,* followed by *Professional, Scientific, and Technical Services*, and *Retail trade*. These industry job impacts are summarized by impact type in **Table 25** and discussed below.

Table 25: Total Truck Activity Job Impacts by Industry

DESCRIPTION	DIRECT	INDIRECT	INDUCED	TOTAL
72 Accommodation and Food Services	16,456	1,170	1,204	18,830
54 Professional- Scientific and Tech Svcs	12,526	3,227	298	16,051
44-45 Retail Trade	13,609	407	1,355	15,371
62 Health and Social Services	12,357	148	2,799	15,303
56 Administrative and Waste Services	5,897	3,971	448	10,316
61 Educational Svcs	8,470	159	721	9,349
23 Construction	8,622	605	53	9,280
81 Other Services	7,582	422	751	8,754
92 Government and Non NAICS	3,950	750	260	4,959
51 Information	3,384	908	151	4,442
42 Wholesale Trade	3,716	179	116	4,010
48-49 Transportation and Warehousing	3,143	656	92	3,891
52 Finance and Insurance	394	1,234	662	2,290
53 Real Estate and Rental	597	1,308	301	2,206
71 Arts- Entertainment and Recreation	1,257	464	427	2,147
31-33 Manufacturing	1,548	39	5	1,592
55 Management Of Companies	116	385	26	526
22 Utilities	118	146	46	310
21 Mining	247	35	2	284
11 Ag, Forestry, Fish and Hunting	31	6	1	38
Total	104,018	16,217	9,715	129,950

Source: CDM Smith based on TRANSEARCH data for 2011 and IMPLAN employment in FTE job-years

- *Accommodation and Food Services*: The 18,830 total accommodation and food services related jobs associated with truck transport account for 14.5 percent of the total 129,950 related job impacts. Of these 18,830 jobs, the vast majority (87 percent, 16,456) are directly related to truck transport.

- *Professional, Scientific, and Technical Services*: As the second largest industry impacted by truck transportation, *PS&TS* accounts for 12,526 direct jobs and 16,051 total jobs. Although this is the second largest impacted industry in the District, the impact constitutes a relatively small portion

of the total *PS&TS* District employment (direct impacts account for 9.7 percent and total impacts account for 12.4 percent of the District-wide total).

- *Retail Trade*: The 15,371 *Retail Trade* related employment impacts account for 11.8 percent of total truck related employment. Direct retail-trade employment (13,609) comprises 88.5 percent of total retail trade employment related to District truck activity (15,371). The other 1,762 jobs reflect indirect (i.e. supplier-related) and induced (income re-spending related) employment impacts.

- *Manufacturing*: Although *Manufacturing*-related employment impacts are relatively small in comparison with other aggregate industry categories, the total employment (1,592) represents 95.8 percent of all manufacturing jobs within the District. As such, the small manufacturing base within the District is almost entirely dependent on trucking movements.

- *Wholesale Trade*: Likewise, the *Wholesale Trade* aggregate industry sector exhibits a relatively modest total employment impact (4,010) compared to other industries. But, as a percentage of total *Wholesale* employment in the District, the truck activity comprises 81.6 percent of total industry employment. As such, *Wholesale Trade* within the District is also heavily dependent on the trucking industry for the importation of goods for further distribution.

Conclusion: The economic analysis demonstrates that freight transportation as provided by truck activities and services plays a vital role in the District of Columbia's economy. The associated employment, income, value added, output, and tax impacts span all industries. Key findings include:

- *Impact Extent*: The impact of freight transport goes far beyond the 350 directly employed in the provision of District-based truck transport. When the transport user impact activities and the indirect/induced effects are included, truck-related employment in the District of Columbia totals 129,950 jobs. These total jobs represent 15.8 percent of the 823,000 jobs statewide.

- *Sector Dependence*: Wholesale Trade and Manufacturing are perhaps the most truck-integrated industry, as measured by the truck-related industry impacts in comparison with the total industry sector economic measures (output, employment, etc.). In addition, the Retail Trade and Construction sectors are also highly dependent on truck transportation, as per the similar composition of impacts in comparison with total economic activity in the District for each industry sector.

- *Modal Alternatives and Substitutability*: If trucks did not accommodate demand, consignees and shippers could try to use other modes (i.e., rail, water, air, etc.) to transport freight. However, accessibility to alternative modes within the District is extremely limited. As such, the use of other modes would likely entail higher transport costs (due to long transport distances, price, logistics, etc.), and could increase overall demand (and resulting handling costs) for all users of other modes (both the diverted truck users as well as current users). The long-term result would be a migration of industry away from the District to other locations with relatively better truck accessibility, and better modal options/mix.

While it would be erroneous to conclude that all of these impacts are entirely and solely dependent on trucks, and would disappear if trucks completely disappeared, the findings do show that that truck service facilitates business throughout the District. Specifically, these impacts highlight the magnitude of truck use by manufacturers across the District, as well as wholesalers, retailers, and others who transport materials, component parts, and products.

4.3. Other Modal Impacts

Other modal shipments totaled 113,132 tons (predominantly water-based refined petroleum imports going into tank storage via pipe), comprise less than one half of one percent of truck tonnage shipments. Further, except for the barged refined petroleum, most all of these movements would be trucked from/to a rail yard (or other intermodal facility) to/from the receiver/shipper. These facilities today are located outside the District, with the connectivity to them provided by truck. Hence, virtually any District impact associated with other modal freight movements is already included in the truck-related impact estimates presented. In summary, other modal impacts are not estimated given the relatively miniscule volume of other modal movements and the fact that virtually any such other modal impacts are already quantified under truck movements.

5.0 Stakeholder Involvement

5.1. Stakeholder Input

The DDOT freight plan sought the insights and opinions of stakeholders with an interest in improving the safety and efficiency of the District's freight system and the cost-effectiveness of future investments and policies. During the plan's development, the team reached out to public agencies, affected businesses, and the movers of the freight. The project team, including DDOT, developed a feasible stakeholder outreach and data acquisition plan. After identifying a representative cross section of stakeholders, the team developed and distributed a survey, then conducted outreach sessions.

5.2. Stakeholder Selection

The stakeholder selection process consisted of working with DDOT staff to determine the appropriate criteria for identifying the freight stakeholders with business interests in the District. The following criteria were selected:

- Businesses representing a range of products and services, including retail, construction, parcel delivery, grocery, restaurant/bar, niche markets),
- Motor carriers that make frequent trips within the District,
- Motor carriers that are active in the public input process (i.e., they attend freight related meetings conducted by the District freight office),
- Developers that are known to be concerned and actively participating in District freight dialogs, and
- Business owners and organizations that will be (or can be) impacted by the results of a district freight plan.

The list of stakeholders is shown in **Table 26**.

5.3. Stakeholder Inputs

A Technical Advisory Group consisting of key freight stakeholder and government agencies was established to help shape the direction of the freight plan. The group convened twice during the preparation of the plan and provided vital input into the development of the study recommendations. Members of the TAC included:

- Adams Morgan Business Improvement District
- Downtown Business Improvement District
- DC Office of Planning
- COG (Council of Governments)

Table 26: List of Stakeholders

1. A & A Transfer Inc. 2. Giant 3. Robinson Terminal Warehouse Corp 4. Acme Paper 5. Green Hat Distillery 6. Rodgers Brothers Service, Inc. 7. Akridge 8. Guernsey Office Products, Inc. 9. Safeway 10. Bacchus Importers Limited 11. Harris Teeter 12. Sodexo 13. Belair Produce Inc. 14. Hotel Association of Washington, DC 15. Sysco	16. Broadview Waste Services 17. J.B. Hunt Transport Inc. 18. The Kane Company 19. Budweiser/Capital Eagle 20. John W. Ritter Trucking/Semi Express 21. Truck Renting and Leasing Association 22. CBRE 23. Maryland Motor Truck Association, Inc. 24. UPS 25. CVS 26. OceanPro Industries, LTD 27. US Food Service 28. DC Truckers Association 29. Owner-operator Independent Driver Association	30. Virginia Trucking Association 31. Douglas Development 32. Pepsi Bottling Group 33. Wal-Mart 34. DOPS Inc. 35. Reliable Churchill/The Charmer Sunbelt Group/Washington Wholesale* 36. Whole Foods/Ruan 37. FedEx 38. Restaurant Association of Metropolitan Washington 39. Yes! Organic Market 40. Fort Myer Construction Corp. 41. Roadway Express/YRC Trucking

- DC Association of Beverage and Alcohol Wholesalers
- CSX
- US Capitol Police
- Deputy Mayor for Planning and Economic Development
- District of Columbia Trucking Association

To solicit further the stakeholders' participation, the team developed and sent out an invitation and information packet to each prospective member. The invitation included a description of the purpose and objectives of the plan, the expected outcomes, the team's assessment of the stakeholder's unique knowledge or perspective, and a copy of representative questions that were to be included in a stakeholder survey.

5.4. Public Outreach

The freight plan project team worked in parallel with the multimodal long-range plan update, MoveDC, to provide information about the freight plan during the multimodal plan's outreach efforts. The project team created story boards describing District freight movements and economic impacts. These storyboards were set up at two MoveDC meetings and the public was invited to view the boards, ask questions, and/or make comments. The first meeting was at Dorothy I. Height/Benning Neighborhood Library, 3935 Benning Road NE, Washington, DC 20019. This MoveDC event was held on October 22nd from 6:30 to 8:30 PM. Approximately 20 District residents (including two commissioners) were in attendance. The second public outreach meeting was also in conjunction with a MoveDC public forum and was held at Petworth Neighborhood Library, 4200 Kansas Ave NW, Washington, DC 20011. This

meeting was held on October 30th from 6:30 to 8:30 PM. The attendance at this meeting was larger than the first with approximately 40 District residents.

The freight team was also present at a DDOT Streetcar Business Impact meeting held at the H Street Country Club on October 30th from noon to 2:00 PM. One (of three) of the freight storyboards was exhibited at the event and several key findings from the study were presented in PowerPoint fashion to the business owners in attendance along with other freight related information provided by District personnel.

5.5. Interim Summary Findings

The summary findings taken from the completed surveys include several corridor trouble spots, as well as the following overall themes:

- There are conflicts with loading areas and bike lanes,
- There is an increase in traffic near restaurant/bar locations business and new establishments,
- Loading zones designed for older smaller vehicles are no longer adequate for today's larger vehicles,
- The increased sizing of bus loading zones has encroached on already inadequate loading zones resulting in more citations),
- The District needs better signage for routing,
- The land uses and transportation system are changing faster than the supporting freight realm (routing, parking, loading, signage, regulations, etc.),
- There should be improved signal timing to account for heavy trucks on specific routes/locations,
- Parking citations are a high cost of doing business in the District,
- Shipping companies welcome the opportunity to bring DDOT officials on 'ride-alongs' with the drivers to get a better understanding of their issues, and
- There should be opportunities to engage the freight industry in District transportation and land use decisions involving freight. Potentially, a standing freight advisory group.

6.0 Infrastructure Obstacles and Impediments

6.1. Existing Conditions

Freight in the District is transported via three major modes: highway, rail, and air. Of these modes, highways (and trucks) play an especially important role as both the dominant mode for moving freight into, out of, and through the region, and by providing door-to-door service for the District's businesses and consumers. Businesses and customers depend on trucks and highways for pick-up and delivery operations and trucks and highways provide connections to and among every other mode of transport, along with warehouses, distribution centers, manufacturing plants, and other freight hubs. They act as a critical link in the supply chain and are an economic lifeline, yet they are vulnerable to interruptions and breakdowns and service failures due to the growing and competing demands of other daily users that must share the same highway system. As a result, it is critical that the highway infrastructure is maintained in a state of good repair so as to be highly conducive to the movement of freight by truck and to maximize the freight's contribution to the District's economy.

The District's highway system faces numerous challenges in meeting the ever growing demand of both passenger and freight highway users. Meeting these demands and managing the shared use of the system is critical to the future economic competitiveness and quality of life in the District. While the existing highway network is generally satisfactory, several challenges to truck freight operations were noted. A summary of challenges is presented below.

6.1.1. Competition for Space

Increasingly, freight-carrying commercial vehicles compete for limited roadway space with passenger vehicles, buses, bicycles and pedestrians. This increased competition raises both short- and long-term concerns over transportation safety and efficiency. The District is investing heavily in expanding passenger transportation choices and establishing supporting policies, in order to grow its economy. With careful planning, engineering, and coordination with the freight community, the potential negative consequences of a passenger transportation-focused policy can be avoided. Understanding the way shippers use the transportation system and its corridors at the level of individual deliveries is an important first step towards creating a shared system that can accommodate the many freight transactions that must be completed, and that are necessary for the District's economy to function.

6.1.2. Truck Routes

- While DDOT has developed a truck route map, truck-related problems will decrease only if truck operators obey the routes and restrictions. The truck-related problems in the District are generally a function of truck movement: where trucks travel and where they stop for loading and/or unloading.

6.1.3. Congestion and Parking Constraints

The Washington, DC region perennially ranks as experiencing one of the highest levels of traffic congestion in the nation. While trucks are not the main cause of congestion, they are a contributor. Their operating characteristics (slower to accelerate and to stop) make them less nimble in traffic. When truck operators park illegally, circulate excessively in search of parking, cause an incident or accident, or circulate on streets where they are not permitted, they add inefficiencies (and danger) to an already-overwhelmed system.

The INRIX Traffic Scorecard[16] ranked the Washington, DC Region as the 10th worst in congestion among major metropolitan areas – behind Los Angeles, San Francisco, New York and Boston. As in other regions, Washington's traffic congestion has been worsening. According to current estimates, the average traveler in the region spent 40.5 hours in congestion in the 12 months between April 2013 and March 2014, as compared to 64.3 hours (Los Angeles), 56.5 hours (San Francisco), 38.8 hours (Boston), and 54.2 hours (New York).

A 2012 Texas Transportation Institute study[17] estimated that truck congestion in the Washington, DC Region costs $730 million annually, based on a commodity value of $86.9 billion or about 8.4 percent of total value. This degree of congestion causes many truckers who can avoid peak hour traffic in the region to do so, while those who cannot incur increased costs of operation and increased delivery delays. These costs are passed on to the District business community (and ultimately the District residents) through increased freight charges and increased stock requirements as a buffer against delivery failures.

Among the tri-states, the District has the highest congestion during the peak hour followed by Virginia and Maryland[18] according to a recent study conducted by the Metropolitan Washington Council of Governments. The overall picture during the morning peak hour shows that the District experiences the highest percentage of level-of-service[19] (LOS) "E-F" during the peak hour. The District of Columbia also experienced the highest percentage of LOS "E-F" during the afternoon peak period and off-peak period, in the tri-state area. As shown in the following sections, congestion in the District is concentrated in the busiest commercial areas.

- Congestion and Parking Constraints
  - **Ward 1**: Ward 1 experiences some of the heaviest truck traffic within the commercial/retail corridor of U Street NW, 14th Street NW, Columbia Road, and 18th Street NW.
  - **Ward 2**: Heavy traffic congestion on I, K, L, and M Streets, as well as Connecticut Avenue, is the prominent concern for commuters and business people alike. While the congestion is not exclusively due to trucks, the double-parking and loading/unloading of truck deliveries along those corridors exacerbate already congested traffic conditions.

[16] http://scorecard.inrix.com/scorecard/

[17] 2012 Transportation Urban Mobility Report, Texas Transportation Institute, Texas A&M Transportation Institute, Shrank, Lomax and Eisele, December, 2012

[18] *MWCOG 2010 Congestion Monitoring & Analysis Results*

[19] *LOS is a qualitative measure that characterizes operational conditions within a traffic stream. LOS are given letter designations A through F, with LOS A representing the best range of operating conditions and LOS F the worst*

- **Ward 3**: Wisconsin Avenue, Connecticut Avenue and Massachusetts Avenue are the major corridors carrying the bulk of truck traffic within the ward. Inadequate loading zone space and management along the arterials exacerbates severe traffic congestion, which induces trucks to spill over onto neighboring streets.
- **Ward 4**: 16th Street NW, Georgia Avenue, and Military Road/Missouri Avenue experience some of the highest truck volumes.
- **Ward 5**: More than 40 percent of trucks entering the District do so via its northeastern border with Maryland. This is expected as the Maryland suburbs east of the District and the eastern part of the District are home to many warehouses and transfer points, particularly along New York Avenue and in the Landover and Lanham, Maryland areas. The industrial facilities range from major food and beer distributors to garbage transfer stations to a major parcel delivery distribution center. Many of the area's roadways (New York Avenue, Rhode Island Avenue, Bladensburg Road, South Dakota Avenue, Florida Avenue) are major delivery routes that experience heavy truck traffic. The Florida Avenue Wholesale Market at 4th Street NE is a major hub of truck traffic.
- **Ward 6**: Buffering the industrial activities of Ward 5 and the corporate activities of Ward 2, Ward 6 consists of both residential and commercial uses, in addition to housing Union Station and part of the US Capitol complex. Within the ward, many of the retail and restaurant destinations for truck deliveries are located along H Street NE and 8th Street NE.
- **Ward 7**: Ward 7 is situated in the eastern-most section of the District, and is primarily a residential area with industrial and commercial activity restricted to streets such as Pennsylvania Avenue, Branch Avenue, Benning Road, Minnesota Avenue and East Capitol Street.
- **Ward 8**: Covering the southernmost end of the District, Ward 8 consists primarily of residences with a few institutional and commercial areas. Due to its location near the Maryland line and I-295, and due to the relative lack of commercial activity within the ward itself, most of the truck traffic in Ward 8 is through-traffic. Major roadways with truck traffic are South Capitol Street, Martin Luther King Jr. Avenue, and Alabama Avenue.

The most recent results show that the District of Columbia routes experienced the worst congestion in the region: about 27.3 percent during the morning peak hour and 14.8 percent during the evening peak period. This is not surprising given that the District of Columbia has few lane miles and highly dense areas. The corridors studied as part of the MWCOG's Congestion Management Process (CMP), for the years 2009 thru 2011, are listed below:

1. M Street/Canal Road, NW: 30th Street NW to Chain Bridge Road
2. Georgia Avenue/7th Street, NW: Independence Avenue to New Hampshire Avenue
3. Georgia Avenue, NW: New Hampshire NW to Eastern Avenue
4. Constitution Avenue, NW: Pennsylvania Avenue to 21st Street NE
5. Wisconsin Avenue, NW: M Street NW to Western Avenue
6. Pennsylvania Avenue, NW: 17th Street to M Street
7. Pennsylvania Avenue: 15th Street NW to Constitution Avenue
8. Pennsylvania Avenue/Branch Avenue, SE: Independence Avenue to Southern Avenue
9. Independence Avenue: 17th Street NW to 2nd Street SE

10. H Street NW: Pennsylvania Avenue to 14th Street NE
11. I Street NW: 14th Street to Pennsylvania Avenue NW
12. Rhode Island Avenue (US-1): Florida Avenue to Eastern Avenue
13. Connecticut Avenue: K Street to Nebraska Avenue
14. K Street/New York Avenue: 21st Street to Bladensburg Road
15. L Street NW: Pennsylvania Avenue to 14th Street NW
16. Military Road: Connecticut Avenue to Georgia Avenue
17. South Dakota Avenue: Bladensburg Road to Hamilton Street NW
18. 15th Street NW: Independence Avenue to E Street NW
19. 17th Street NW: Independence Avenue to Pennsylvania Avenue
20. 14th Street NW: Independence Avenue to K Street NW
21. 16th Street NW: K Street NW to Eastern Avenue

6.1.4. Bridge Network on Truck Routes

Trucks weighing over the allowable legal limit (80,000 lbs.) affect bridges in several ways. Concrete decks and other bridge elements wear out with repetitive loadings by heavy vehicles. The number, spacing, and weight of individual axles, as well as the Gross Vehicle Weight (GVW) carried on a truck are important considerations for bridges. To protect bridges from over-stress, the District law includes a table of maximum weights for truck axle groups. Overweight trucks increase costs for inspecting and rating bridges and for posting signs (the bridge must be signed for restricted use when the design criteria for a bridge is exceeded).

The District has 315 bridges, of which DDOT owns 239 (205 Highway bridges, 16 tunnels, 18 pedestrian bridges), National Park Service owns 39 bridges, and private railways own the remaining 37. Currently, there are 11 structurally deficient (SD) bridges, 101 bridges that are functionally obsolete (FO), and 23 fracture critical (FC) bridges.

A previous 2011 DDOT Truck Safety Enforcement Study analyzed the cost impacts resulting from commercial vehicle traffic on bridges along the truck routes and found that the total bridge impacts (costs) associated with overweight trucks on the truck routes in the District is estimated to be $7 million per year.

Existing Challenges:

- Deficient bridges conditions have a major impact on the routing and movement of over dimensional and over-weight loads. Currently, there is not enough weight information available on trucks traveling within the District to make informed choices about how to restrict truck traffic based on vehicle weight. It should be noted that the District currently does not have a facility for a truck to off-load items, even if is overweight. Weight restrictions on bridges along truck routes are not immediately available to the freight industry.

- Weight restrictions signs are not posted for majority of bridges, especially those that are classified as functionally obsolete or fracture critical.

- Weight restrictions on bridges are not enforced.

- Weight enforcements are conducted through a single weight bridge on southbound I-295 near Blue Plains.

6.1.5. Vertical Clearance Restrictions

Low clearance structures create problems for truckers making access difficult and forcing trucks to use circuitous routings to get around the barrier. And for unfamiliar drivers, these structures are a hazard; hitting them can severely damage a load, and in some cases weaken the structure itself.

There are several vertical clearance structures in the District, including elevated rail lines, tunnels, bridges, highway ramps, and other obstructions. Varying height restrictions along high volume routes can potentially create a hazardous conditions and it is important that the same height restriction is maintained along a truck route.

Existing Challenges:

- Tunnels, bridges, and other infrastructure provide mobility constraints for larger vehicles along the primary routes. While the District provides standardized signage on the approaches to an overhead structure, vehicles frequently strike these structures.
- Differing height restrictions along the same routes (for instance, the height restriction on I-395 varies between 13’ to 15’).
- Inadequate advance signage for restrictions less than 14’.
- Vertical clearance information is not available for all overhead structures.

6.1.6. Pavement Condition

Engineers design roads to accommodate projected vehicle loads but, in particular, they design for vehicle axle loads. The life of a pavement is related to the magnitude and frequency of these heavy axle loads. Pavement engineers use the concept of an equivalent single-axle load (ESAL) to measure the effects of heavy vehicles on pavements. Any truck axle configuration and weight can be converted to this common unit of measure. Adding axles to a truck can greatly reduce the impact on pavement. A conventional five-axle tractor-semitrailer operating at 80,000 pounds gross vehicle weight (GVW) is equivalent to about 2.4 ESALs. If the weight of this vehicle were increased to 90,000 pounds (a 12.5 percent increase), its ESAL value goes up to 4.1 (a 70.8 percent increase), because pavement damage increases at a geometric rate with weight increases. However, a six-axle tractor-semitrailer at 90,000 pounds has an ESAL value of only 2.0, because its weight is distributed over six axles instead of five. An added pavement benefit of the 90,000-pound six-axle truck is that fewer trips are required to carry the same amount of payload, resulting in almost 30 percent fewer ESAL miles per payload ton-mile.

The effect of ESALs on pavements is not constant throughout the year. During the winter, when the ground is frozen, a truck carrying a given load causes much less damage to pavements than at other times of the year. During the spring, the inverse is true: pavement layers are generally in a saturated, weakened state due to partial thaw conditions and trapped water, causing greater pavement damage by the same truck.

Even though overweight vehicles only make up six percent of the total vehicles in the District, they account for more than 40 percent of the pavement damage on District roads. Similar to the bridge analysis, the 2011 DDOT Truck Safety Enforcement Plan calculated the damage on the District's highways due to overweight trucks. Based on the distribution of pavement types in the District, the analysis computed an aggregate per-mile cost of truck impacts for District highways of $0.68 per mile on Interstates, $0.60 per mile on other arterials, and $1.16 for collector/local routes. The ESAL analysis identifies two-axle single-unit trucks (Class SU2) as the greatest contributor to overweight damage. Excluding buses, overweight commercial vehicles traveling in the District of Columbia are estimated to contribute approximately $10 million to pavement wear on the proposed truck route network.

Excluding bridge and pavement costs associated with buses, overweight commercial vehicles are estimated to cost the District more than $16 million per year in premature infrastructure damage (pavement and bridge).

Existing Challenges:

- Limited and sporadic enforcement of overweight commercial motor vehicles (using portable scales).

6.1.7. Geometric Design

Design deficiencies can have significant cost implications for operators. Tight maneuvering can lead to increased travel times, increased safety hazards, and property damage. In some instances, where design deficiencies prohibit the use of the operators' traditional fleet, investment in new equipment is required. These costs directly affect the price of transporting freight, thereby impacting regional economic competitiveness.

While street segments may be rebuilt adjacent to the construction of redevelopment projects to meet today's design standards for large trucks, similar improvements cannot be made to all of the streets comprising the designated Truck Route Network. Some of the most difficult intersections for trucks to maneuver are listed below. It should be noted that these locations were identified based on stakeholder interviews and previous studies. Therefore, the list is not complete and there might be others which are not included here.

Existing Challenges:

- New York Avenue and Florida Avenue NE
- Georgia Avenue and Missouri Avenue NW
- Edwin Street and Montana Avenue NE
- Mid town area, K St, NW, L St, NW, I St, NW, Wisconsin Avenue, and Connecticut Avenue
- Most intersections in Georgetown and Adams Morgan
- Insufficient lane widths on traffic circles (Dupont Cir, Thomas Cir, Washington Cir, etc)

7.0 Strategic Vision and Tactical Plan

The strategic vision for the District of Columbia Freight Plan is intended to inform long-term planning and transportation decision-making for the District and the region. The strategic vision includes high level goals for freight planning within the District as well as specific elements of what will comprise the future system to best serve the District. The vision is consistent with the current Federal transportation legislation MAP-21, which places new emphasis on metropolitan area freight transportation planning. The vision also builds on the National Capital Region Freight Plan 2010 of the Transportation Planning Board of the Metropolitan Washington Council of Governments. Elements of the strategic vision include the economy, the environment, operations, safety, security, and technology.

7.1. Vision

The strategic vision is an efficient goods movement system that has an improved environmental footprint, is safe, secure, and technologically advanced. Additionally, the vision is reliable freight operations to carry the goods that will enable the District economy to continue to grow and the residents and public and private sector establishments to thrive. The following subsections outline the details of the six elements of this strategic vision.

7.2. Strategic Vision Element 1 – The Economy

Providing support for the District economy is an important part of the strategic vision. This element of the strategic vision is for a freight transportation system that can efficiently provide residents, businesses, and public sector organizations in District with the goods they require. Continued growth in employment and business activity in the District will be enabled by a freight transportation system that is able to handle increased goods volume, with a plan that is ever mindful of freight carrier operating costs as those are ultimately paid by consumers. The freight system should support the tax-paying business community and tax-paying residents so that public revenues (sales taxes, property taxes, excise taxes, fines, fees, licenses, permits, etc.) continue and are not lost to neighboring jurisdictions.

7.3. Strategic Vision Element 2 – The Environment

Improvement in the environmental performance of the freight sector is a key element of the strategic vision. As freight transportation equipment is a significant source of criteria pollutants and greenhouse gas (GHG) emissions, the plan envisions the District will benefit from deployment of technology and operational improvements to reduce emissions while freight volumes increase. The District also will benefit from increased use of cleaner later-generation diesel engines, increased use of auxiliary power units to reduce truck and rail locomotive idling, and greater use of advanced routing and traffic information by truckers to reduce congestion which contributes to pollution.

7.4. Strategic Vision Element 3 - Operations

Improved operations for freight allows for increased goods movement volumes with minimal traffic impact. Improved operations will be one of the mechanisms used to support the other elements of the freight plan strategic vision. The vision incorporates truck service operating needs into transportation planning and land-use planning. Truck corridor preservation, truck turning radii considerations, loading dock access provision, assuring truck parking availability, and efficient truck permitting are all to be incorporated into comprehensive planning in the District. Support for continued maritime and rail freight operations will also be incorporated into the plan to preserve access to non-truck modes of transport. Rail freight operations through the District are important to the region and will be taken into consideration in rail planning. The vision is for all planning in the District to have freight operations incorporated due to the shared use of the transportation system by freight, transit, personal vehicles, bicyclists, and pedestrians.

7.5. Strategic Vision Element 4 - Safety

Safety improvements and considerations in planning will result in fewer crashes, property damage, injuries, and loss of life related to goods movement. Improved operations and reductions in congestion will reduce conflicts between trucks and other transportation system users. Wider deployment of technology will help minimize exposure of other traffic to freight and permit faster response to incidents when they occur. Consideration of freight operations will provide for increased goods movement volumes while minimizing additional truck traffic.

7.6. Strategic Vision Element 5 - Security

The transportation system will provide for the secure movement of goods. Public agencies responsible for security of the transportation system will have access to information and an educated, active freight system workforce as partners in assuring security for freight. Freight plans will be developed with considerations for the special security requirements of the District, including cooperation with the agencies responsible for security.

7.7. Strategic Vision Element 6 - Technology

Technology deployment and integration will improve all other aspects of this vision. Technology will enable the productivity gains for freight that will permit a larger volume of goods to be moved safely and securely with fewer emissions and reduced fuel use. Technology will be used by the District to help better monitor and operate the highway network while in-vehicle technology will assist operators to minimize delay and reduce congestion. Roadway engineering and design technologies will permit efficient improvements to the network that accommodate the operational characteristics of freight equipment, minimize pavement wear, and extend bridge and tunnel life.

8.0 Recommendations

As discussed in a previous section, freight movements in the District of Columbia are likely to double by 2040. To maintain an adequate level of mobility and accommodate such levels of growth, it is critical that the District seek ways to increase the efficiency, safety, and overall condition and performance of its freight network. Freight movement in the District is multi-modal in nature, meaning goods frequently travel via the mode that provides the best service at the lowest cost at any particular time and place.

The study team has examined the system as a whole and as a result, the recommendations developed are multifaceted and encompass traffic operations, infrastructure investments, data analytical tools, and stakeholder outreach.

The strategies are not exclusive and one is not more important than any other. Instead, they are mutually supportive – the success of one will amplify the beneficial impact of the others. This leads to the need for coordinated and simultaneous implementation.

At the same time, the plan recognizes the limitations of financial constraints and the reality of multiple decision-making processes. This translates into the development of a coordinated plan that selects and prioritizes strategies in a manner that allows the District to capitalize on short-term, relatively easy to implement solutions while organizing and planning for the longer term investments.

Recommendations are classified according to phasing (short-, mid-, or long-term). Several of these recommendations are conceptual in nature and additional analysis and engineering are required to determine feasibility and ultimate design.

The study team researched best practices and state-of-the-art research concepts from similar urban regions within the United States and Europe and drew upon many of those examples in developing the recommendations presented below.

8.1. Short-Term Recommendations (Five Years and Under)

8.1.1. Conduct a Pilot Off-Peak Delivery Program

Recommendation: The District should undertake a pilot off-peak (7:00 PM to 6:00 AM) delivery program to reduce overall traffic congestion and delays, ease parking for commercial motor vehicles, and improve delivery travel times (Note: Federal Highway Administration (FHWA) has awarded DDOT a grant to conduct a pilot program).

Success of this program hinges on identifying a set of industrial partners (business and delivery companies) and providing them with monetary incentives. The cooperation of Advisory Neighborhood Councils (ANCs) is also vital for a successful implementation.

Discussion and Examples:

In 2010, New York City conducted a pilot program to measure the benefits of off-hour deliveries between 7:00 PM and 6:00 AM instead of at peak hours (**Figure 18**). Through financial assistance, over 30 delivery companies and businesses participated in this pilot program. In addition to overall reduced congestion, the pilot found that delivery travel speeds improved by up to 75 percent compared to travel speeds during the evening rush hours. Further, trucks spent only 30 minutes stopped at the curbside making deliveries, instead of 100 minutes before the pilot. From beginning to end, delivery routes averaged 48 minutes faster during the pilot[20].

Figure 18: Regular vs. Off-Hour Deliveries in New York City

Source: The Off-Hour Deliveries NYC Project, José Holguín-Veras, Rensselaer Polytechnic Institute

The practice of shifting freight deliveries to nighttime or off-peak hours is implemented more in other countries. Overnight freight delivery concept has been pioneered by the PIEK scheme in the Netherlands, but similar schemes, usually based on the PIEK standards, have been implemented by retail chains in London (Sainsburys), in Belgium (Colruyt Group) and in Barcelona (Mercadona, Condis and Lidl) and in a number of French and Dutch cities[21].

[20] NYCDOT, Press Release # 10-028, July, 2010 (http://www.nyc.gov/html/dot/html/pr2010/pr10_028.shtml**).**

[21] DG MOVE, European Commission: Study on Urban Freight Transport, April 2012.

8.1.2. Establish a Freight Corridor Traffic Signalization Program

Recommendation: Optimize signal timing along the following high priority freight corridors:

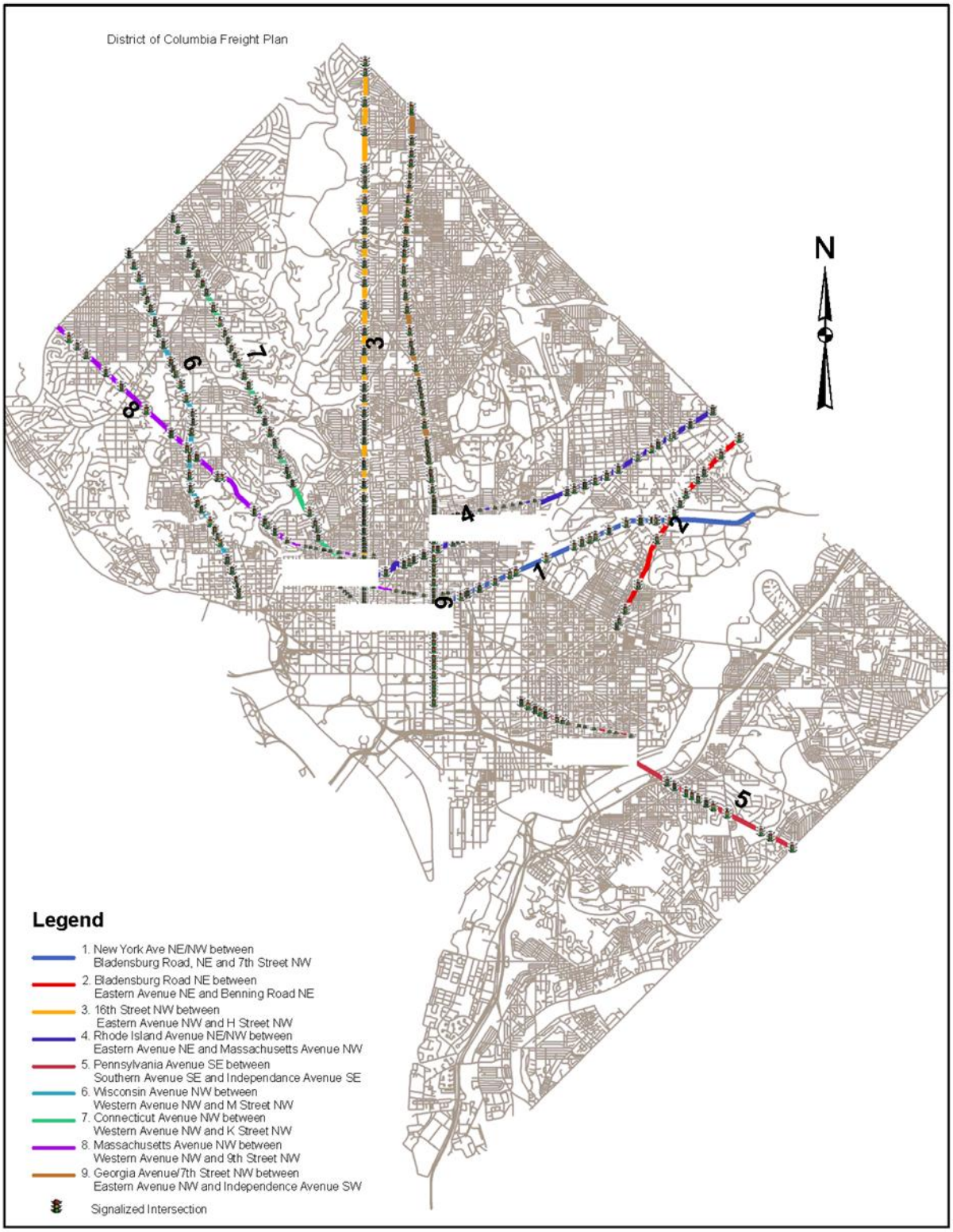
- ***New York Avenue NE/NW between Bladensburg Road NE and 7th Street NW***
- ***Bladensburg Road NE between Eastern Avenue NE and Benning Road NE***
- ***16th Street NW between Eastern Avenue NW and H Street NW***
- ***Rhode Island Avenue NE/NW between Eastern Avenue NE and Massachusetts Avenue NW***
- ***Pennsylvania Avenue SE between Southern Avenue SE and Independence Avenue SE***
- ***Wisconsin Avenue NW between Western Avenue NW and M Street NW***
- ***Connecticut Avenue NW between Western Avenue NW and K Street NW***
- ***Massachusetts Avenue NW between Western Avenue NW and 9th Street NW***
- ***Georgia Avenue/7th Street NW between Eastern Avenue NW and Independence Avenue SW***

Discussion:

Problems with signal timing along truck routes are a common operational issue. These traffic flow problems arise from inadequate timing on signal cycles and lack of synchronization of signals along corridors (**Figure 19**). Because trucks have longer acceleration and deceleration times, many corridors experience increased travel times, idling, and blocked intersections. These travel conditions create inefficiencies not only to trucks but also passenger vehicles as well.

Optimizing signal timing is a common strategy used by many jurisdictions throughout the country. However, the needs of pedestrians and commuter traffic must be balanced as well.

Figure 19: High Priority Corridors for Signal Optimization



8.1.3. 'Last Mile' Delivery/Pick-Up using Bikes

Recommendation: Consider supporting the use of human-powered vehicles (often with electric assistance modes) for delivery and pick-up from businesses that send/receive small shipments.

Discussion:

Many small retail businesses, offices, and cafés regularly receive small shipments which can be carried without the use of gas or electricity. Therefore, human-powered vehicles (often with electric assistance modes) can do a hefty share of last-mile carrying, replacing diesel trucks and making the Central Business District cleaner and more livable.

Several cities in the United States which implemented this strategy have met with success. For example, Metro Pedal Power, a Boston-area company uses pedal-trucks (bicycles with trailers attached) to haul up to 500 pounds of localized freight. Similarly, B-Line, a Portland company, specializes in delivering to businesses large and small in downtown Portland. Since its foundation in February 2009, B-Line transported over 10,000 deliveries (over 12,000 miles), delivered approximately 400,000 pounds of organic produce, and reduced CO2 emissions by an estimated 54,000 pounds. Revolution Rickshaws is another organization which provides comprehensive mini-freight delivery and logistics using 'trikes' in New York City (**Figure 20**).

Figure 20: Deliveries using Bikes in Boston (left) and New York (right)

Source: Left (www.metropedalpower.com), Right (www.revolutionrickshaws.com)

8.1.4. Improve Existing Loading Zone Program

Recommendations:

- ***Expand morning parking restrictions to 10:00 AM to accommodate couriers and deliveries of perishable goods.***
- ***Create Eco-Loading Zones for low emission delivery vehicles.***

- ***Modify curbside signs so that loading zones are reserved for vehicles that are actively loading or unloading goods.***
- ***Step up enforcement of parking regulations, especially those that apply to vehicles that are blocking a traffic lane or that are illegally parked in a commercial vehicle zone.***
- ***Install parking meters for commercial vehicles to encourage turnover.***

8.1.5. Conduct Periodic Truck Freight Stakeholder Surveys

Recommendation: Gather input from truck freight stakeholders through comprehensive periodic surveys (every two to three years) to identify bottleneck locations, parking concerns and physical factors and conditions that may constrain the safe operation of commercial vehicles.

Discussion:
The survey process should be reviewed and enhanced as appropriate and used periodically to identify and prioritize freight transportation system improvements. Of particular concern are lane widths, turning radii, pavement and bridge load restrictions, vertical clearance constraints, and shoulder availability and width. This will require coordination across various DDOT departments, as well as with other stakeholders including MWCOG, MD, VA, and freight system operators.

DDOT should also ensure that factors influencing bottlenecks including physical and operational attributes, economic growth, and industrial location patterns are updated annually where possible to accurately reflect freight congestion levels.

8.1.6. Implement a Freight-User Communication Program

Recommendation: Provide real time information to major freight carriers and shippers on traffic conditions via the DDOT traffic management center (TMC).

Discussion:
Increasing the use of the highway system information outputs from traffic management centers (TMCs) has wide appeal among public and private sector stakeholders. Better utilization of real-time traffic incident and delay-related information by the private sector is a tremendous opportunity. DDOT's TMC includes the operation of numerous closed-circuit television cameras, dynamic message signs on I-395, I-295, and other arterial state roads via the extensive fiber optic network.

A program that encourages directly sharing information between TMC staff and dispatchers for major freight carriers and shippers is recommended. Information on crashes, construction, and general congestion can be passed to truck drivers. The same information should also be made available on DDOT's freight webpage. Centralizing communication increases system efficiency and effectiveness.

8.1.7. Establish a formal Freight Advisory Committee

Recommendation: Establish a freight advisory committee to serve as a forum for the discussion of freight-related topics and to advise on freight-related priorities, issues, projects, and funding needs.

Discussion:

A formal freight advisory committee (either standing or ad hoc) would benefit both the freight industry and the District by providing a structured method for information exchange. A formal committee, made up of a diverse group of freight stakeholders, with specific membership duties, could provide regular feedback to DDOT and also serve as a pool to provide data to the District for future studies mentioned in this document. Membership in the committee would require a commitment to the tenets of the group (to be developed). Requirements could include providing stakeholder representation at all committee meetings and commitment to providing stakeholder feedback for DDOT studies conducted while serving as a committee member. Feedback from committee members would not preclude participation from other stakeholders but would provide a "guaranteed" minimum level of stakeholder feedback for future studies, policy considerations, etc.

8.1.8. Install Weigh-in-Motion (WIM) Sensors at Key Locations

Recommendation: Install WIM stations at key entry points in the District. Suggested locations include:

- ***Southbound Anacostia Freeway near Eastern Avenue, NE,***
- ***Francis Case Memorial Bridge (I-395), inbound and outbound directions,***
- ***14th Street Bridges, inbound and outbound directions,***
- ***Connecticut Avenue, NW near Nebraska Avenue, NW, inbound direction,***
- ***Benning Road, NE near 42nd Street, NE, inbound direction,***
- ***Pennsylvania Avenue, SE near Alabama Avenue, SE, inbound direction, and***
- ***Georgia Avenue, NW near Hemlock Street, NW, inbound direction.***

Discussion:

Currently, the District operates two WIM stations, located in both directions, on I-295 near Blue Plains Drive SE exit (see **Figure 21**) and on New York Avenue near Prince George's County line. While the two existing WIM stations provide commercial motor vehicle volume and weight data, they are inadequate in establishing the volume and weight data on several of the high volume commercial vehicle corridors. To overcome this drawback, it is recommended that DDOT plan to install additional WIM scales in the future at key entry locations on high commercial vehicle corridors.

Figure 21: Existing WIM scale on NB I-295

Source: KLS Engineering, LLC

The preliminary step in installing WIM stations is to identify the sites which warrant a WIM station. The 2040 forecasted volumes modeled as part of this study should act as a starting point for further engineering analysis. If budget constraints prohibit WIM scales to be installed across all lanes, it is recommended that DDOT install WIM scales in a single "truck only" travel lane. This would require that the District appropriately sign and enforce the "truck only" lane. Cooperation with Maryland will be necessary to install the necessary signs on the Maryland State Highway Administration (MDSHA) maintained roads for effective operation of the WIM scales.

8.1.9. Identify Potential Truck Conflict Locations with Bike Lanes, Transit Stops, and Streetcars

Recommendation: Identify potential truck conflict locations with bike lanes and streetcars and utilize engineering, enforcement, and education strategies to minimize these conflicts.

Discussion:

While loading zones typically allow deliveries to be made safely without having to block the travel lane, there are some inherent competing uses of curb side space which make it a challenge. For instance, there are 48 loading zones that are directly joined to a Metro bus stop. Similarly, the District has 56 miles of bicycle lanes and three miles of cycle tracks. Navigating in and out of a loading zone directly into a bicycle lane presents an inherent safety hazard to both the delivery person and the bicyclist (**Figure** 22).

Other carrier safety concerns include inaccessible point-of-delivery, inadequate sight lines, conflicts with driveways, fire hydrants, use of loading zones for pick-up/drop-off by taxis, valets, etc.

Further, the District has plans to install almost 37 miles of streetcar system over the next 30 years. To identify any streetcar/truck route interference, the truck routes in the District need to be reviewed, including restrictions on turns, roadway geometrics, loading zones and driveway access.

Figure 22: Bike Lane Conflict on L Street NW

Source: www.whosblockinglsttoday.tumblr.com

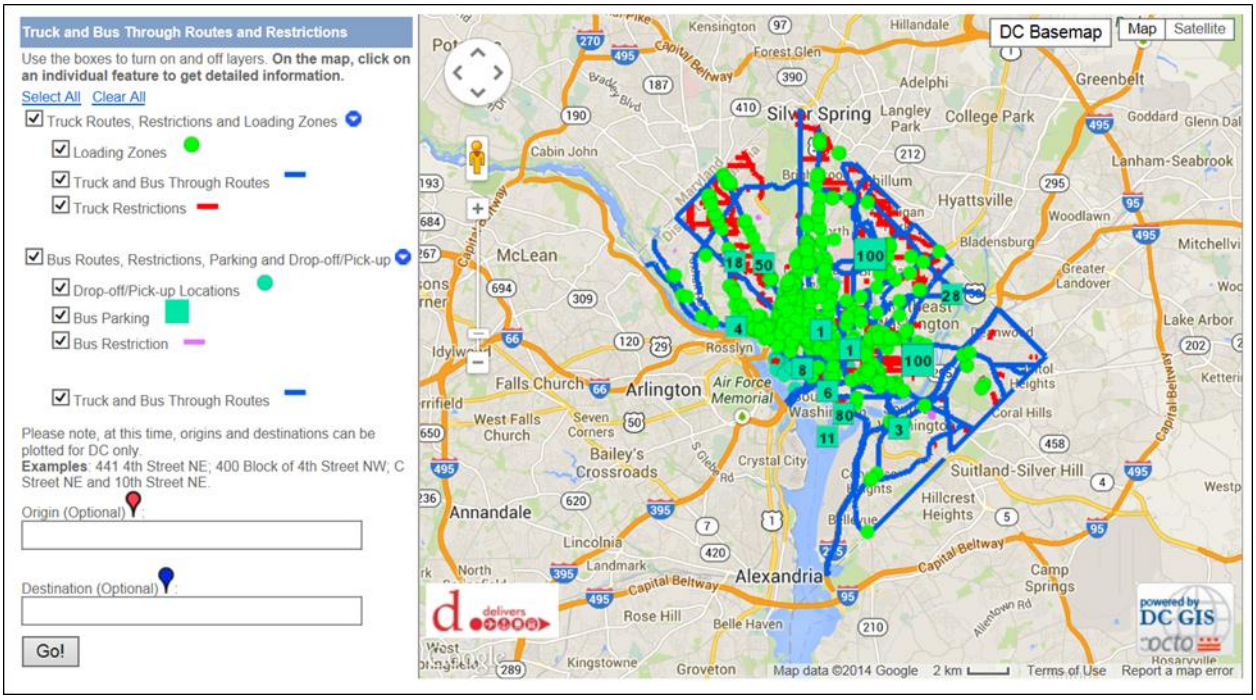
8.1.10. Dynamic Truck Routing

Recommendation: Dynamically route truck traffic based on real-time traffic conditions.

Discussion:

Currently, DDOT hosts a web-based mapping site which provides information on truck and bus through routes and restrictions, loading zones, drop-off/pick-up locations, and bus parking. A snapshot of the site is shown **Figure 23** and the site can be accessed at **http://www.godcgo.com/home/group-travel/truck-and-bus-map.aspx.**

Figure 23: Snapshot of Existing Truck Route Mapping Site



DDOT has made some critical truck route information available to the public. An important next step should be to dynamically route truck traffic based on real-time traffic conditions. Dynamic Routing systems route vehicles to their shortest-path destination, based on current speed and delay conditions. They are designed to update the routing in real time and in response to changing traffic conditions.

There are now companies like ALK Technologies, Inc. (ALK) with their Co-Pilot product, working in cooperation with Qualcomm, that have developed truck specific navigation applications that provide reliable routing on truck-legal roads and also includes bridge heights and other truck-specific information that truckers can rely upon. The District can now work with companies like ALK and others that are trying to be more truck conscious with their products.

8.1.11. Maritime Improvements

Recommendation: Develop options for preserving existing Anacostia River and associated Potomac River navigation channel and dock access for the current petroleum product and stone/sand/gravel delivery by tug/barge from outside the metro area.

Discussion:
This means waterfront land use planning and highway bridge design traversing the waterways must take into account existing maritime freight traffic. This recommendation is to assure that the District continues to benefit from the existing system capacity provided via maritime transportation. The consequences of not following this recommendation could be diversion of these heavy bulk waterborne materials to truck. There would be negative environmental, safety, and cost implications of a mode shift to trucking from maritime if this system element of the existing District maritime transportation system is not preserved.

Recommendation: Explore the potential for additional maritime shipments of commodities to substitute for truck or barge should be included in planning.

Discussion:
Diversion of truck freight to 'marine highways' may be possible for other bulk commodity movements, if potential access through waterfront commercial and government property for freight loading and discharge are included in planning. An example could be the development of a trash/recycling barge facility on the riverfront, which could reduce trash truck VMT inside the District itself. Barges could also be used for hauling away dirt from job sites when excavation is substantial, or construction debris.

Recommendation: Consider and avoid the impacts of encroachment by waterfront development into berthing locations or navigation channels in the rivers.

Discussion:
Marine shipping offers clear benefits in terms of air quality and other environmental impacts as well as road-congestion reduction benefits. The District should strive to maintain, and where feasible, increase opportunities to divert land surface mode transportation to maritime vessels.

8.1.12. Truck Route Signage

Recommendation: Implement a comprehensive truck route signage program.

Discussion:
DDOT should consider implementing a comprehensive signage program that easily identifies designated truck routes, facilitates the safe and efficient movement of trucks, and minimizes illegal truck traffic. The recommended truck signage program for the District consists of two primary sign types: guide or regulatory signs for route identification and prohibitive regulatory signs. Regulatory or guide signs direct drivers to and through the truck route network. Prohibitive signage consists of regulatory signs intended to discourage truck drivers from using roads that are not preferred truck routes (**Figure 24**).

Central to the program is a sign that is designed for easy recognition and consistency with a single standardized design, size, shape, color, and content. Any new signs should be clear in their meaning and intention and be consistent with Manuel on Uniform Traffic Control Devices (MUTCD) standards.

Thoughtful placement of signs is also essential so that truckers know where to look for the information at decision points in the Truck Route Network. Designating a typical placement for the truck signs at intersections and setting a typical spacing between signs along a corridor will cultivate driver awareness and help serve as a self-enforcing mechanism to regulate truck movements.

Figure 24: Existing Guide Sign on Georgia Avenue and Missouri Avenue

8.1.13. Aviation Improvements

Recommendation: Prioritize investments that improve the performance of the integrated express service. Specific examples include:

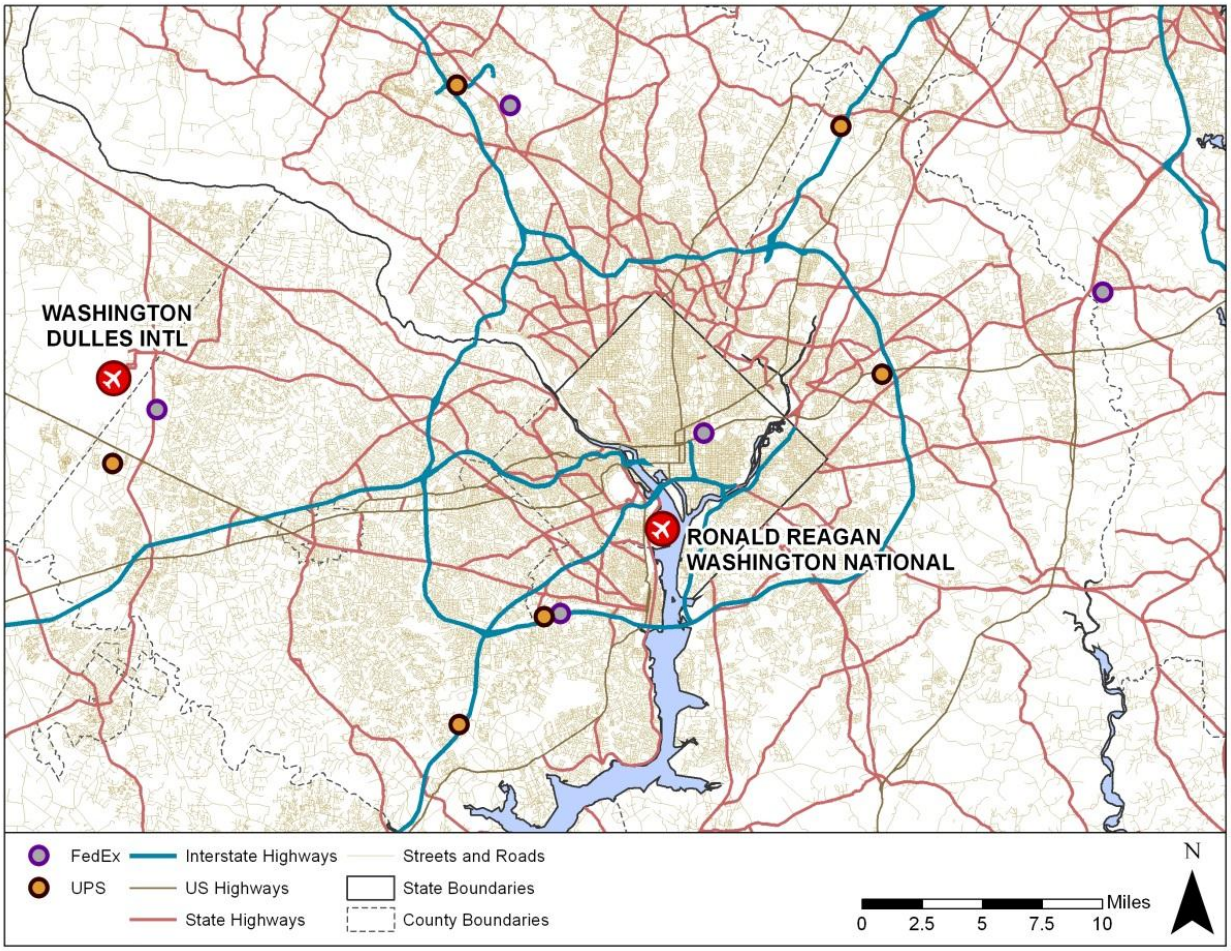
- ***Providing defined "freight zones" on streets in office districts and retail centers within the city to allow for ample box truck and van parking. Planning should also include ample space for truck docks when designing buildings.***
- ***Improve truck mobility on arterial roadways and expressways frequented by integrated express carriers.***
- ***Advocate for the development of cargo areas on Reagan National and Dulles International Airports that have efficient roadways designed to separate passenger traffic from cargo traffic.***

Discussion:

Integrated express operators (also known as couriers) move the customer's goods door-to-door, providing shipment collection, and transport via truck and then by aircraft. Integrated express operators include FedEx, UPS, and to a certain extent DHL. Integrated express carriers commonly operate vans and trucks in urban areas, mainly on arterial roadways, providing pick-up and delivery of high value, light weight, and time-sensitive commodities. Commodities carried by these operators include documents,

pharmaceuticals, electronics, computers, perishables, automotive and aerospace parts, and medical devices. Packages are collected directly from drop boxes, businesses, and retail centers, from which they are driven to service centers to be consolidated. FedEx and UPS service centers serving the DC area are presented in **Figure 25**. FedEx has one service center within DC while UPS has two on the periphery. After consolidation packages and parcels are trucked over major expressways in the metro area, to Dulles International Airport primarily, where packages are loaded onto aircraft destined for their air cargo hub. Some air cargo is transported to Reagan National Airport and BWI. Integrators measure performance down to the minute and an efficient roadway network is absolutely critical in keeping the commitments these companies make to their customers.

Figure 25: Freight Integrators in Washington, DC Region



8.1.14. Rail Improvements

Recommendation: Preserve and enhance rail throughput in the District of Columbia by preventing encroachment and coordinating expansion and preservation activities.

Discussion:

The District of Columbia is a major gateway for rail freight moving through the mid-Atlantic region but it is not a major generator of rail freight. The District should be a good steward of the portion of the

regional freight rail network that is within its borders, so the District doesn't become a choke affecting many states' rail market shares. The District should also support freight and commuter rail system capacity expansion efforts, while minimizing disruptions to city streets and utilities during construction.

Recommendation: Focus additional resources on inter-jurisdictional cooperation in freight planning, to help assure that East Coast railroad mainlines can be improved to permit greater use of freight rail.

Discussion:
The District can work with Maryland, Virginia, and the I-95 corridor coalition states, as well as rail operators, to help assure that East Coast railroad mainlines can be improved to permit greater use of freight rail. This can potentially reduce truck and passenger vehicle conflicts and increase safety and mobility in high-capacity corridors. Also, establishing an office of rail within the Statewide and Regional Planning Department in DDOT would strengthen planning and coordination efforts.

8.2. Medium Term Recommendations (6-10 Years)

8.2.1. Incorporating Truck Routes into Commercial GPS Providers

Recommendation: Hold talks with commercial GPS providers/map companies to incorporate District truck route information into GPS devices.

Discussion:
Consumer-grade or car GPS devices may be inappropriate for commercial motor vehicles as they do not have information on road restriction (bridge heights, bridge weights, or hazardous materials prohibition) required for safe navigation by larger vehicles. Without this knowledge, truckers may make poor route decisions that put them and other motorists in danger, or result in tickets from local law enforcement.

In 2010, Illinois General Assembly created a task force to consider advances in and utilization of GPS technology related to routing information for commercial vehicles (Public Act 96-1370). Two key recommendations of the task force were (a) to merge together databases containing key truck routing data such as overpasses and legal restrictions, and (b) educating truck drivers on the differences between GPS devices designed for trucks and those used in cars.

House Bill 1377[22], which went into effect on January 1, 2012, also requires local jurisdictions to provide the most up-to-date truck route information to the Illinois Department of Transportation (IDOT), which in turn will post this information online.

8.2.2. Implement Dynamic Truck Parking

Recommendation: Implement a dynamic pricing and a reservation system for commercial vehicle parking.

[22] *Veh CD-Truck Routes/CDL GPS, Bill Status of HB1377, 97th Illinois General Assembly*

Discussion:
DDOT should consider implementing dynamic pricing and a reservation system for commercial vehicle parking to manage metered curb-side spaces in the congested downtown business district and tourist areas. This will encourage freight travel at off-peak times and enable tour bus operators to find parking, as well as use parking revenues to support transit services. Similar programs have been implemented in San Francisco, Chicago, and Los Angeles.

8.2.3. Review Roadway Design Guidelines

Recommendation: Review and revise DDOT's Design and Engineering Manual to include information on the special logistical needs of commercial motor vehicles (turning radii, loading zone design, etc.).

Discussion:
Review roadway and intersection design criteria and standards to consider modifications to enhance truck operations, especially on major truck corridors. The stakeholder outreach has identified numerous locations throughout the District where trucks have difficulty operating, because of inadequate turning radii, lane widths, ramp configuration, grades, and other factors.

It is proposed that DDOT's design engineers review roadway and bridge design criteria and standards with representatives of the trucking industry to obtain their insights on the issues and problems faced by the industry in using the District's highways. These insights may foster modifications to design criteria and standards, especially for application to projects in major truck corridors.

Traffic forecasts that are prepared to guide the design of roadway improvements often do not reflect or highlight potential heavy truck usage, and thus the designs may not be adequate to withstand the additional stresses and forces exerted by heavy truck traffic. Therefore, it is proposed that any roadway or bridge improvement project on a route that is part of the system of major truck corridors should include a specific estimate of truck traffic and identify truck operational issues for input to project design.

8.2.4. Improve Data Collection on Truck Movements

Recommendation: Improve the understanding of freight demand and movements in the District and improve truck/freight forecasting procedures.

Discussion:
Historically, DDOT's efforts to collect data to understand freight demands and movements have been limited by a lack of resources. Now, however, with increasing competition for limited road space from pedestrians, buses, bicycles, and passenger vehicles, it is in the District's interest to collect more and better information about freight travel patterns, volumes, and other information important to decision-making for reasons of safety, mobility and good asset management. A few examples include:

- DDOT can review its traffic management system and assess whether there are adequate truck traffic count data for planning, design and operations purposes.

- The Federal Highway Administration plans to make cell-phone based travel time and speed data available to transportation agencies, and DDOT can use this information to inform its freight planning efforts.

- The District can partner or take the lead in conducting various types of surveys to complement recent extensive data collection efforts of passenger travel in District and surrounding regions. For example, surveys of shippers, carriers, and receivers can help planners understand freight movement freight decision making with respect to choice of mode, routes, and time of day of goods movements. A business establishment survey can help capture the travel behavior of smaller commercial vehicles. A significant portion of truck activity within the District can be classified as light truck (used to transport commercial goods and services) and this is one of the big data gaps in understanding truck movements.

- DDOT could partner with Metropolitan Washington Council of Governments (MWCOG) and use the newly procured TRANSEARCH data to develop a trip based freight model. The TRANSEARCH data can also be used to understand the relationship between commodity production, consumption and employment. The current freight model uses area type and land activity variable-based trip generation rates to estimate commodity production and attraction.

8.2.5. Conduct a Location-Aware Device-Based Study of Truck Movements in the District

Recommendation: Conduct a pilot study to collect and analyze truck movement data using in-vehicle GPS systems to locate and quantify delay at truck freight bottlenecks.

Discussion:

Data scarcity is one of the most critical challenges for understanding truck freight vehicle activities in urban areas. Recognizing this data gap, several states/agencies are using truck GPS data to gather information and develop performance measures. Typically, this involves installing portable GPS devices in volunteer trucks to collect specific truck movement data. With the collected GPS data, congestion locations can be identified and, by aggregating this information over time, performance measures can be generated (travel time, speed, delay, stop location, etc.).

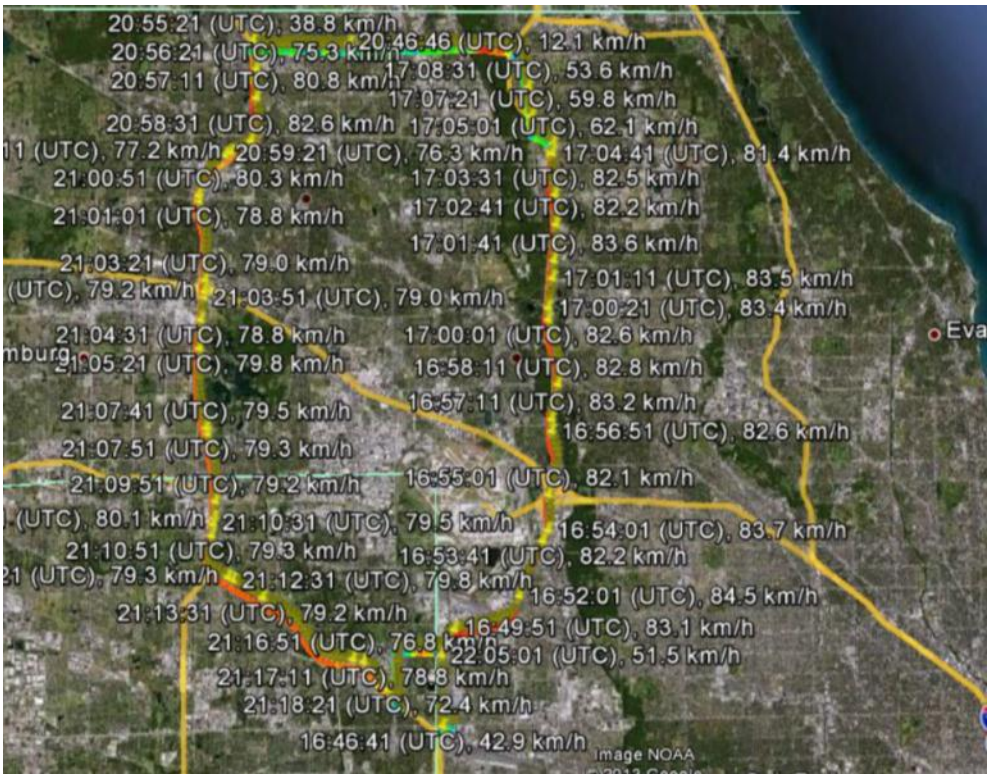
In 2010, New York City completed a study that combined time-of-day pricing, with tax deductions to receivers willing to accept off-peak deliveries and GPS based traffic monitoring, to induce a shift of truck traffic to the off-hours[23]. The GPS devices installed in the participant vehicles indicate that, on average, a truck traveling in the off-hours achieve speeds of about 8 miles per hour, while in the regular hours they typically fall below 3 miles per hour. A truck that travels 10 miles delivering from customer to customer would save 1.25 hours per each tour shifted to the off-hours.

The National Center for Freight & Infrastructure Research & Education at the University of Wisconsin–Madison conducted a GPS study through the cooperation of a major Illinois based grocery chain with their distribution center located in the Chicago region[24]. A descriptive analysis of tours and activities was

[23] Integrative Freight Demand Management for the New York City Metropolitan Area, USDOT #DTOS59-07-H-0002, September, 2010.
[24] GPS Based Pilot Survey of Freight Movements in the Midwest Region, CFIRE 04-13, April 2013.

performed to identify freight vehicle tour patterns and activity characteristics. Analyses highlighted useful characteristics including tour and activity durations, number of activities per tour, tour distance, and traveled distance per activity for the focused industry type (see **Figure 26**).

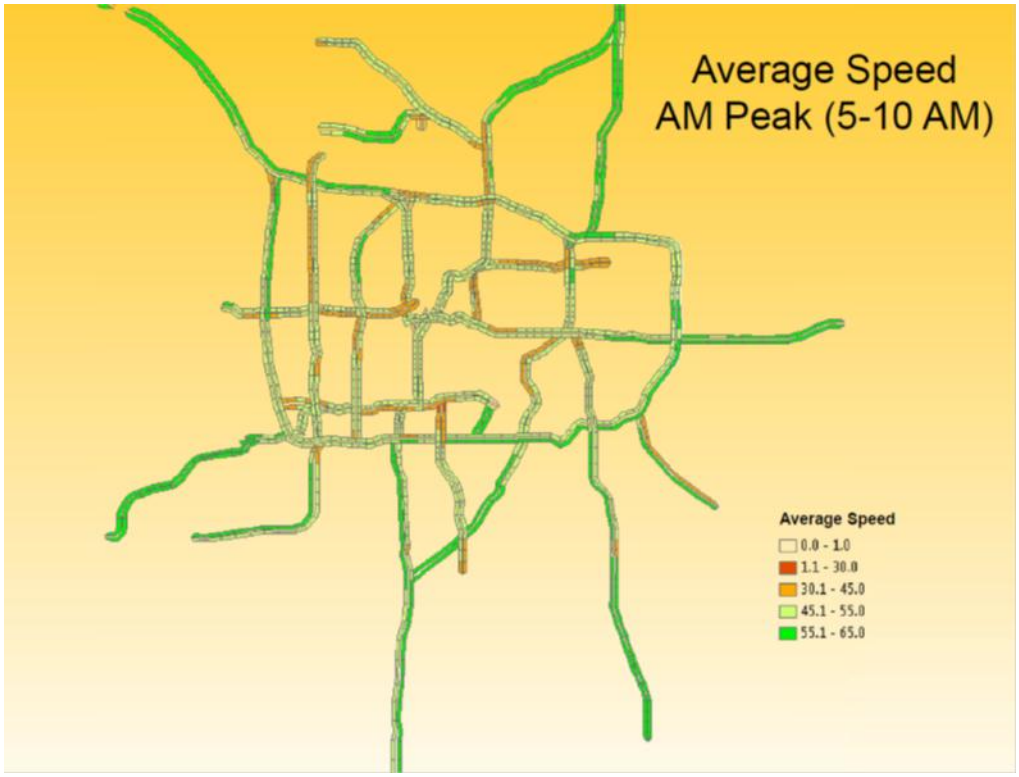
Figure 26: GPS Trace with Labeled Time and Speed Values (Chicago area)



Minnesota Department of Transportation (MnDOT) is conducting a study that integrates private and public freight data sources to generate freight mobility and reliability measures[25]. The study identifies significant data impediments in the Twin Cities Metro and selected rural corridors. It is expected that the results of this study will support improvements in freight traffic management and planning, complement the existing freight/truck models, and guide regional or statewide transportation decision-making of infrastructure development and investment (see **Figure 27**).

[25] Using Truck Global Positioning System (GPS) Data for Freight Performance Analysis, MnDOT Contract No. 99008 Work Order No.47, 2013.

Figure 27: Average Speed AM Peak in Twin Cities (Minnesota)



8.2.6. Promote FMCSA Share the Road Safely Campaign

Recommendation: Expand educational efforts to advise motorists and pedestrians regarding safety issues associated with the operation of trucks on District streets.

Discussion:

There is a need for a broad-based public understanding of the hazards associated with trucks, passenger vehicles, and pedestrians circulating in dense urban areas, and the District should take advantage of all the resources provided by the Federal Motor Carrier Safety Administration (FMCSA) and the National Highway Traffic Safety Administration (NHTSA). Public information and education campaigns are ways of increasing this understanding. Share the Road Safely is the current FMCSA program to improve the knowledge of all highway users to minimize the likelihood of a crash with a large truck and reduce the consequences of those that do occur (**Figure 28**). A District-focused Share the Road campaign will be most relevant and impactful.

Figure 28: Snapshot of FMCSA Share the Road Safely Brochure

Source: www.sharetheroadsafely.gov

8.3. Long Term Recommendations (10+ Years)

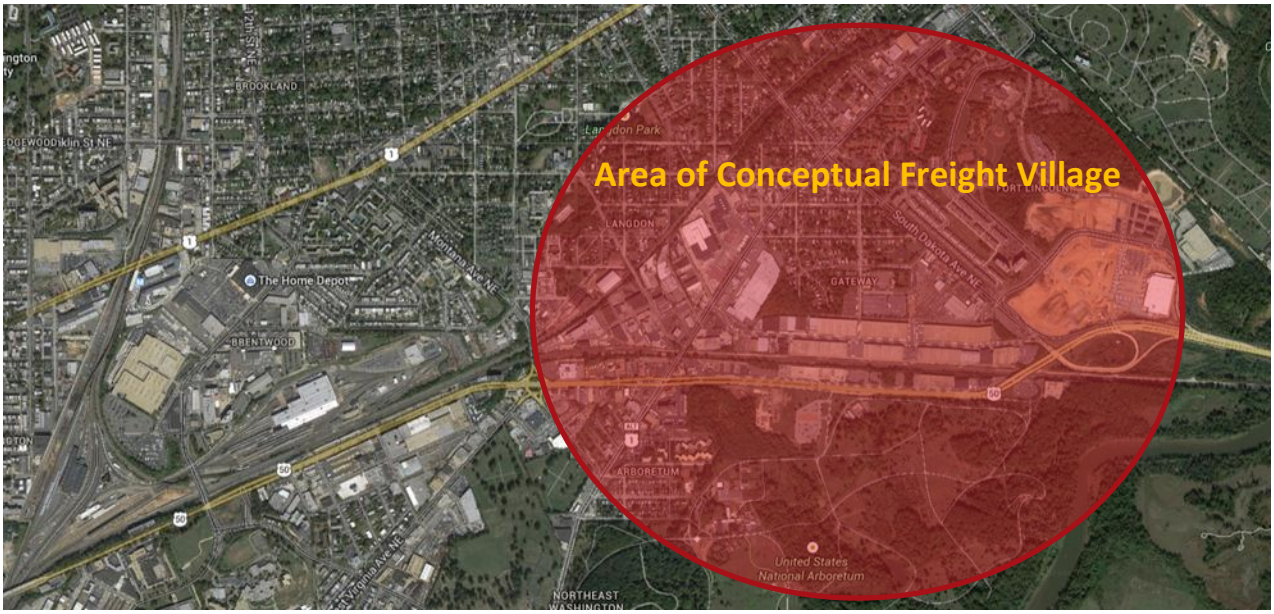
8.3.1. Freight Village/Intermodal Facility

Recommendation: Develop a freight village/intermodal dock facility at the intersection of New York Avenue and Bladensburg Road (see Figure 29).

Discussion:

To consolidate freight destined for the various areas, the District should consider developing a freight village, also known as integrated logistics center or urban consolidation center, near the intersection of New York Avenue and Bladensburg Road. This location is ideal as more than 40 percent of trucks entering the District do so via its northeastern border with Maryland. This is expected as the Maryland suburbs east of the District and the eastern part of the District are home to many warehouses and transfer points, particularly along New York Avenue and in the Landover and Lanham, Maryland areas. The industrial facilities range from major food and beer distributors to garbage transfer stations to a major parcel delivery distribution center.

Figure 29: Proposed Freight Village Location



Moreover, New York Avenue has the greatest absolute volume of truck traffic entering and exiting the District. Light and heavy two-axle single unit trucks form the largest part of the truck traffic, with combination truck-trailer traffic accounting for 10 to 15 percent of inbound and outbound truck traffic.

The benefits for such a concept would include reduced delays for regional carriers that operate in the District, efficient and timely deliveries and increased employment opportunities. The implementation of such a facility would require:

- Coordinating with Office of Deputy Mayor for Planning and Economic Development (DMPED) on identifying available property,
- Coordinating with Department of Employment Services (DOES) to train DC residents,
- Contracting with carriers to provide shuttle delivery service,
- Identifying customer base,
- Identifying pricing options/incentives,
- Consolidation of loads to one peddle trailer,
- Startup funding (ARRA/FHWA), and
- Additional funding for future years (CMAQ).

There are several examples of urban freight villages in the Unites States, most notably the Hillsborough, NJ Compact Freight Village (260 acres) and the Mesquite Intermodal Facility/Skyland Business Park in Texas (400 acres). Currently, New York City also is examining the feasibility of a freight village.

8.3.2. Truck Corridor Improvement Projects

Recommendation: Conduct a demonstration project on high priority corridors by converting the right lane into an exclusive shared truck/bus lane during non-peak hours. Examples of potential corridors for implementation include:

- ***New York Avenue NE between the Prince Georges County and Florida Avenue,***
- ***Pennsylvania Avenue SE between Southern Avenue and Independence Avenue, and***
- ***Florida Avenue NE between H Street NE and New York Avenue.***

Discussion:

As the District grows, its streets will need to support more and different transportation users and an increasingly broad mix of vehicular traffic. To support a mix of uses and vehicular trips, the MoveDC project assigned modal priorities for each major District corridor as shown in **Figure 30**. DDOT should conduct a feasibility study to determine the most suitable transit and freight corridors, as illustrated in **Figure 31**, for purposes of conducting the demonstration project.

Important issues to consider prior to implementing a shared truck lane are discussed below.

- Planning and design considerations:
  - Shared truck/bus lanes should be considered as one component among a much broader group of treatment and policy options that can be used to improve truck travel time, reliability, safety, and to reduce emissions in urban areas.
  - Natural segregation of cars and trucks is possible by protecting and developing land exclusively for industrial purposes and thereby discouraging passenger vehicles from using roads serving these areas.
  - Stakeholder consultation and involvement are essential for helping to decide whether truck/bus lanes are appropriate for a given situation.

- Operational considerations:
  - Weaving interactions between cars, bicycles, buses, and trucks pose an operational and safety concern. Truck lane analyses should be conducted at a detailed level that includes mobility issues at trip endpoints (i.e., origin and destination) not limited to on-road performance. For the time being, some bicycle and freight lanes are shown as overlapping in **Figure 31**. This overlapping operation should be considered temporary and reconciled before the study is concluded, unless a physical separation of the modes can be accommodated.
  - The safety performance of truck lanes may be the deciding factor for implementation; however, the safety performance of truck lanes is currently uncertain.
  - Enforcing truck lane compliance may require legislative changes and some form of automation.

Figure 30: MoveDC Proposed Modal Corridors

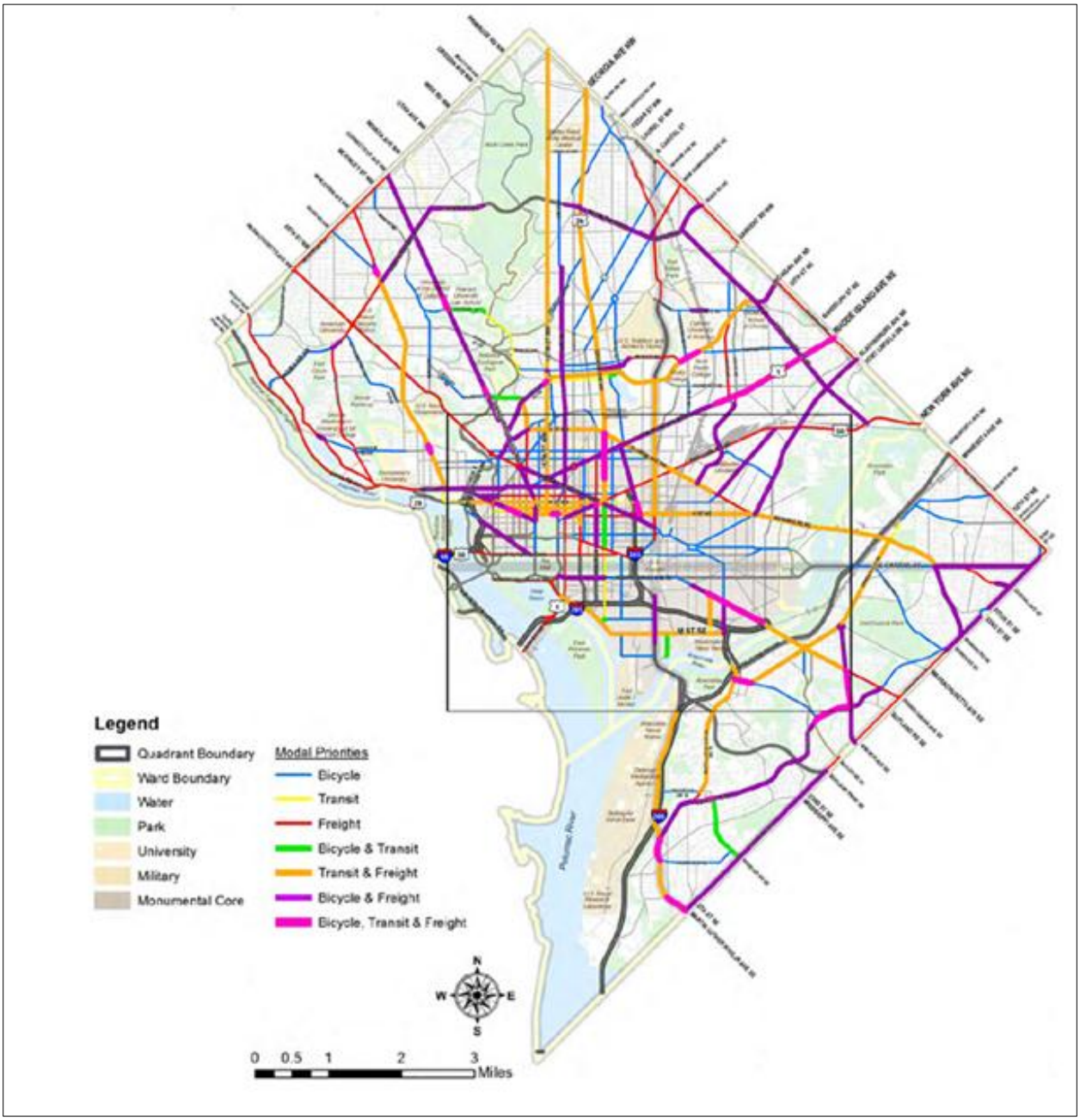
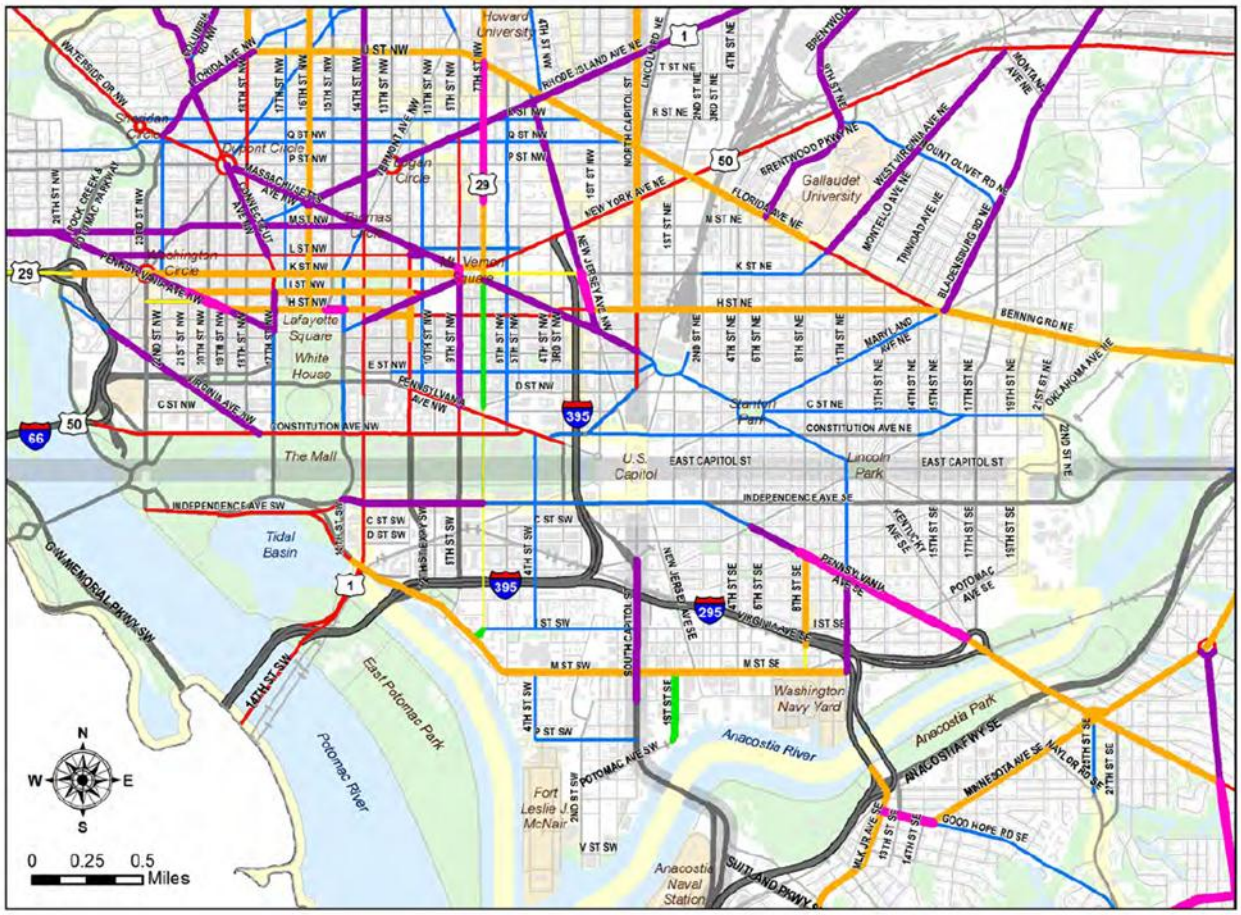


Figure 31: MoveDC Proposed Modal Corridors (Inset)



- Analysis and evaluation considerations:
  - Pilot testing and purposeful monitoring and evaluation of truck lanes are a principal means of developing the empirical knowledge necessary for analysis and evaluation.
  - Uncertainties impeding the calculation of truck lane benefits include truck diversion rates (i.e., the number of trucks that divert from general purpose lanes to truck lanes), the value of truck travel time savings and travel time reliability, truck trip distance along a truck lane, site-related delays, and safety performance.
  - Detailed characterization of traffic and truck traffic volumes (e.g., temporal and directional distributions) is necessary and should be done for any planning, design or traffic impact study, rather than relying on metrics such as truck percentages or passenger car equivalents (PCEs) which may mask the true performance impacts of truck lanes.

8.3.3. Upgrade Existing I-295 SB Static Scale to Automated Enhancement

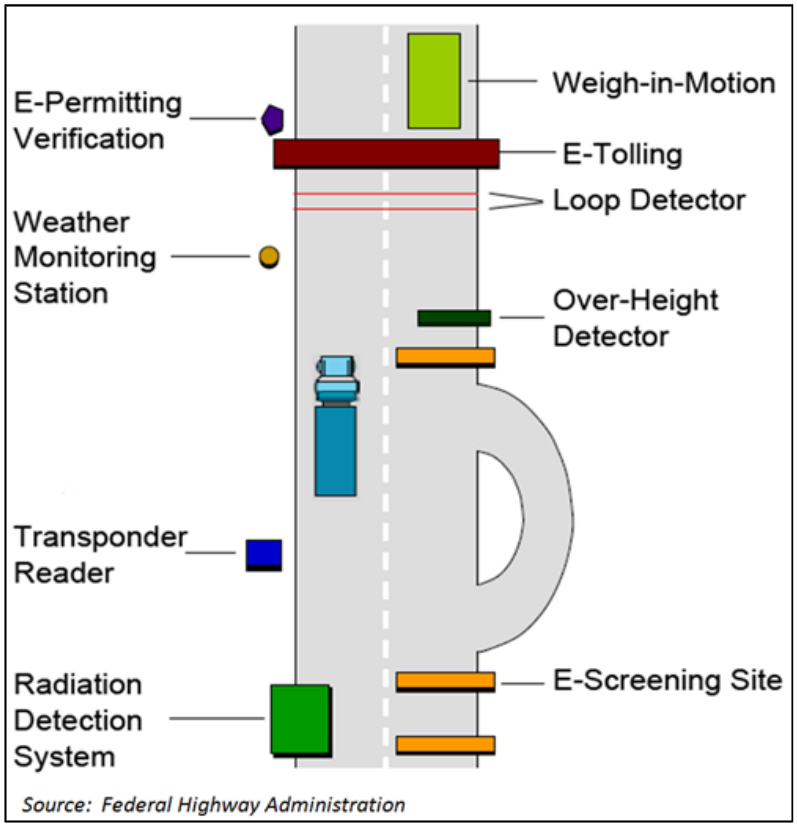
Recommendation: Upgrade existing I-295 SB static scale to automated enforcement.

Discussion:

Currently, the District conducts fixed site weight enforcement only on outbound I-295 SB near Blue Plains, in SE DC. The site is essentially an off-ramp connected to a 70-foot platform scale and then connected back with an on ramp. As commercial vehicles approach the station 'Weigh Station Ahead When Flashing' and 'All Trucks Use Right Lane' signs direct all commercial vehicles to stop at the weigh station. Trucks are weighed on a 70-ft-long weighbridge capable of individually weighing up to three axles. A ticket is issued giving the axle breakdown and the gross vehicle weight. Vehicles in violation are pulled to the shoulder and cited. Safety inspections are not performed at this location as there is no walk-around space.

The recommended future enforcement vision for the District is the FHWA's Smart Roadside Vision concept. The Smart Roadside Vision is an emerging concept linking State's safety, security, and mobility building blocks into coordinated and comprehensive roadside programs. This improved integration and data sharing will increase effectiveness of all contributing programs and reduce implementation costs for all participating stakeholders. **Figure 32** illustrates some of the current roadside systems that are not coordinated but could be part of an integrated approach to future roadside operations.

Figure 32: FHWA Smart Roadside Vision Components



8.3.4. Collection/Delivery Point Network

Recommendation: Identify land use/development barriers for allowing local post offices/attended delivery depots in residential neighborhoods and commercial districts.

Discussion:

The business-to-consumer delivery market is particularly challenging for freight firms as, in addition to the wide dispersion of receivers, carriers also wrestle with the costs resulting from frequent failed deliveries. A collection/delivery point (CDP) network is an attended delivery system that consists of

designated locations where packages can be delivered or picked up by a carrier. Locker banks are unattended delivery points, where carriers leave packages. Customers are responsible for retrieving packages from the CDP or locker bank. These delivery strategies achieve economic benefits for carriers through the consolidation of parcel deliveries and the elimination of failed deliveries. This strategy also promises to improve the environmental sustainability of parcel delivery through reductions in vehicle miles traveled.

While the provision of collection/delivery point networks and locker banks are typically operated by private sector logistic companies (i.e., FedEx and DHL in Germany), the District can help facilitate these types of operations through the city's zoning and development code language[26].

8.3.5. Metro Freight

Recommendation: Consider transportation of freight using Metro and/or DC Streetcar.

Discussion:

Metro freight is an urban rail system plugged into the containerized shipping network. The system runs in rail lines in open cuts parallel to central boulevards. Sophisticated metro-freight trains are loaded with standard shipping containers at loading docks which travel into the heart of the city to make deliveries. These deliveries can go either directly into the basements of adjacent buildings or, when the final destination does not abut the metro-freight line, to distribution centers (or freight depots). From the distribution centers, deliveries are made via small delivery vehicles or other relatively simple means. Though nothing like this has ever been built, extant technology could make such a system possible.

A few cities are thinking of re-activating services that use tramways to distribute goods in city centers. Vienna, for example, has carried out feasibility studies and operational tests. Investigations have included looking at the potential use of tramways to link a detergent manufacturer's production and logistics facilities to provide a link between storage and customers for a beverage producer and a large bakery and to supply inner city supermarkets. In Paris, APUR (the planning agency) and RATP (the mobility agency) are currently investigating the technical and commercial feasibility of a similar freight service.

[26] City of Portland Central City Sustainable Freight Strategy, October 2012.

9.0 Funding Assessment and Financing Strategies

At the Federal level many of the existing Federal funding programs and financing tools could be used to facilitate freight investments in the District. Federal funding programs target specific projects which also can address freight transportation needs. Financing tools include loans, credit enhancement, and tax exempt financing programs. Federal funding is available through traditional transportation agencies (US DOT, FHWA, etc.) but also through non-transportation agencies. Federal funds can be used for a variety of freight related projects and the Federal share of projects is often based on a sliding scale and can cover up to the full cost of a project.

The District can tap Federal highway funding provided through the Federal-Aid Highway System and Federal-Aid Programs. The roadway systems eligible for Federal highway aid are those designated as part of the National Highway System (NHS) and those eligible for Surface Transportation System (STP) funds.

Specific Federal funding programs can be used to fund freight transportation improvements. These are categorized as Special Funding Programs, such as Highway Bridge Program, Railway-Highway Crossings, Truck Parking Facilities, Capital Grants for Rail Line Relocation projects, the Fixed Guideway Modernization Program, and other Federal funding programs, or Discretionary Programs, such as Projects of National and Regional Significance (PNRS), National Corridor Infrastructure Improvement Program, and the Freight Intermodal Distribution Grant Program. For the projects related to air cargo freight, the FAA's Airport Improvement Program (AIP) provides funding for airport planning and development projects.

One special funding program is the Congestion Mitigation and Air Quality Improvement Program (CMAQ) which funds transportation projects and programs that improve air quality. CMAQ funds have been used for freight related projects that improve air quality by reducing truck, locomotive, or other emissions. Examples of CMAQ-funded freight projects include construction of intermodal facilities for moving containers off of highways and onto rail, defraying barge operating costs, rail track rehabilitation, diesel engine retrofits, idle-reduction projects, and new rail sidings. CMAQ is often the only funding source that many freight projects can access.

Although Federal funding programs for freight improvement projects have increased, it should be noted that issues remain which affect the ability to use these programs and funds. For example, many programs are limited to specific modes or specific types of projects. Even though CMAQ has been widely used for several freight projects, CMAQ funds cannot be used for highway improvements that increase capacity for single-occupant vehicles, and are limited to projects that improve air quality in nonattainment or maintenance areas.

Beyond the Federal programs and funds, nontraditional funding methods and financing tools are available to fund freight improvements. These are grouped into three major categories: funding sources, which refers to dedicated revenue sources (user fees/tolls, dedicated taxes, special taxing and assessment districts); financing tools that use debt; and institutional arrangements, which include

public-private partnerships and tax exempt corporations. Currently, DDOT is examining the feasibility of a managed lane strategy on portions of its interstate system.

Finally, the greatest opportunity for freight funding at the present time may be the Federal stimulus package through the American Reinvestment and Recovery Act (ARRA). ARRA provides discretionary funding through FHWA that may be used for highway or other modal projects. The FRA also has ARRA funding for intercity capital rail improvements, which may be mutually beneficial if applied to shared passenger/freight corridors.

Examining the full spectrum of funding sources currently accessible to DDOT and possible funding sources DDOT has not yet tapped into should be among the highest priority. The process of navigating regulations related to different funding pools can sometimes require a lengthy learning curve, and some funding mechanisms could even require legislative or organizational changes.

A summary of all recommendations organized by the plan goal areas appears in **Table 27**.

Table 27: Recommendations Organized by Plan Goal Area

Recommendation	Number	Economy	Safety	Operations	Environment	Security
Short-Term Recommendations (5 Years and Under)						
Conduct a Pilot Off-Peak Delivery Program				X	X	
Establish a Freight Corridor Traffic Signalization Program			X	X		
Consider supporting the use of human-powered vehicles (often with electric assistance modes) for delivery and pick-up			X	X	X	
Improve Existing Loading Zone Program			X	X		
Conduct Periodic Truck Freight Stakeholder Surveys		X	X	X	X	X
Implement a Freight-User Communication Program		X	X	X	X	X
Establish a formal Freight Advisory Committee		X	X	X	X	X
Install Weigh-in-Motion Sensors at Key Locations			X	X		X
Identify Potential Truck Conflict Locations with Bike Lanes, Transit Stops, and Streetcars			X	X		
Implement Dynamic Truck Routing		X	X	X	X	X
Develop options for preserving existing Anacostia River and associated Potomac River navigation channels		X		X	X	
Explore the potential for additional maritime shipments of commodities		X		X	X	
Consider and avoid the impacts of encroachment by waterfront development		X		X	X	
Implement a comprehensive Truck Route Signage program		X	X	X	X	X
Providing defined “freight zones” on streets in office districts and retail centers			X	X	X	
Improve truck mobility on arterial roadways and expressways frequented by integrated express carriers		X		X	X	
Advocate for the development of cargo areas on Reagan National and Dulles International Airports that have efficient roadways designed to separate passenger traffic from cargo traffic		X		X	X	
Preserve and enhance rail throughput in the District of Columbia by preventing encroachment and coordinating expansion and preservation activities		X		X	X	

Table 26: Recommendations Organized by Plan Goal Area (Cont'd)

Recommendation	Number	Economy	Safety	Operations	Environment	Security
Focus additional resources on inter-jurisdictional cooperation in freight planning, to help assure that East Coast railroad mainlines can be improved to permit greater use of freight rail		X	X	X	X	X
Mid-Term Recommendations (5+ Years)						
Hold talks with commercial GPS providers/map companies to incorporate District truck route information into GPS devices		X	X	X	X	X
Implement a dynamic pricing and a reservation system for commercial vehicle parking		X	X	X	X	X
Review and revise DDOT's Design and Engineering Manual to include information on the special logistical needs of commercial motor vehicles			X	X	X	
Improve the understanding of freight demand and movements in the District and improve truck/freight forecasting procedures		X	X	X	X	X
Conduct a pilot study to collect and analyze truck movement data using in-vehicle GPS systems to locate and quantify delay at truck freight bottlenecks			X	X	X	
Expand educational efforts to advise motorists and pedestrians regarding safety issues associated with the operation of trucks on District streets		X	X	X	X	X
Long-Term Recommendations (10+ Years)						
Develop a freight village/intermodal dock facility at the intersection of New York Avenue and Bladensburg Road		X	X	X	X	X
Conduct a demonstration project on high priority corridors by converting the right lane into an exclusive shared truck/bus lane during non-peak hours		X	X	X		
Upgrade the existing I-295 SB static scale to automate enforcement			X	X	X	
Identify land use/development barriers for allowing local post offices/attended delivery depots in residential neighborhoods and commercial districts			X	X		X
Consider transportation of freight using Metro and/or Streetcar			X	X	X	

10.0 Implementation Plan

Many of the recommendations in Section 8 are conceptual in nature and additional analysis and engineering are required to determine feasibility and ultimate design.

The most important recommendations relate to the integration of freight infrastructure projects into DDOT's Transportation Improvement Plan (TIP). Infrastructure improvements, such as expanding roadways, are typically the most complex, take the most time, and are the most costly. Hence, DDOT should prioritize these improvements and develop a strategy to include them in the TIP. The recommended freight infrastructure projects are summarized below:

1. Optimize signal timing on high priority freight corridors — Refer to Section 8.1.2
2. Improve loading zones (e.g. color coded, modify signs, install parking meters, etc.) — Refer to Section 8.1.4
3. Install WIM stations at key entry points in the District— Refer to Section 8.1.8
4. Preserve existing Anacostia River and associated Potomac River navigation channel and dock access for the current petroleum product and stone/sand/gravel delivery by tug/barge from outside the metro area — Refer to Section 8.1.11
5. Implement a comprehensive truck route signage program — Refer to Section 8.1.12
6. Implement a dynamic pricing and a reservation system for commercial vehicle parking — Refer to Section 8.2.3
7. Develop a freight village/intermodal dock facility at the intersection of New York Avenue and Bladensburg Road — Refer to 8.3.1
8. Conduct a demonstration project on high priority truck corridors by converting the right lane into an exclusive shared truck/bus/passenger high occupancy vehicle (+3) lane — Refer to Section 8.3.2
9. Upgrade existing I-295 SB static scale to automated enhancement — Refer to Section 8.3.3

Though priorities may differ, most recommendations can and should be pursued in parallel and as soon as resources allow. Communication is also a vital component for the future of freight transportation in the District; it should be continuous, multi-faceted, and targeted to numerous audiences. Communication helps to present information on projects and policies to stakeholders, obtain feedback for planning, and achieve stakeholder buy-in and support.

Implementation of the project team's recommendations is expected to improve freight efficiency, reduce impacts on the DDOT's infrastructure, and improve overall safety.

10.1. Performance Measures

A comprehensive and consistent set of performance measures of the freight transportation system is essential for ensuring the continued movement of goods through the District's highway, rail, and the air systems. Freight-specific performance measures help to identify needed transportation improvements and monitor their effectiveness. Measuring performance is more critical than ever given the challenging economic climate and budget constraints DDOT is facing. The need to allocate resources wisely is vital if the District is to meet its goals of providing a high standard of service quality, maintaining safe and secure systems, improving the efficiency and performance of the existing network, protecting and preserving District's environment, and pursuing increased system connectivity.

Freight performance measures also are important at the Federal level. Federal Highway Administration (FHWA) has established a Performance Measurement Exchange site with a section specifically on Performance Measurement of Freight and Private Sector. The FHWA website focuses on developing performance measures (and supporting data) to monitor how well transportation systems are meeting the needs of private sector freight users. It also discusses how public agencies can obtain data from the private sector and/or reuse measures that already have been developed by the private sector.

Travel times, travel rates, congestion costs, and delay times at freight bottleneck areas are examples of measures used to monitor freight performance. Some of the specific FHWA freight performance measures include:

- Travel Time in Freight Significant Corridors,
- Expenses per Mile for the Motor Carrier Industry,
- Measuring Improvements in the Movement of Highway and Intermodal Freight, and
- Railroad Performance Measures.

The challenge is developing the key freight-specific performance measures the District can use to assess the condition of the transportation system, identify needed transportation improvements, set priorities on actions to resolve problems, and monitor their effectiveness.

NCFRP Report 10: Performance Measures for Freight Transportation presents a comprehensive, objective, and consistent set of measures to gauge the performance of the freight transportation system. These measures are presented in the form of a Freight System Report Card, which reports information in three formats, each increasingly detailed, to serve the needs of a wide variety of users from decision makers at all levels to anyone interested in assessing the performance of the nation's freight transportation system.