Seattle Department of Transportation

EXISTING CONDITIONS REPORT APPENDIX D

SDOT

Seattle Department of Transportation

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FREIGHT MASTER PLAN - EXISTING CONDITIONS REPORT

1.0 PURPOSE

Daily life is affected by the movement of goods. People, businesses, schools, manufacturing, and many others rely on goods, products, and services throughout their day. Virtually all products purchased by someone got to their final destination by some combination of truck, plane, train, and ship. The result is a massive network of freight infrastructure, including airports, ports, rail yards, and distribution centers connected by a large system of truck routes and rail lines.[1]

Washington is the most trade dependent state in the nation and Seattle sits at the center of this economy.[2] Seattle's economy is also an important driver of freight transportation, from stocking retail stores to meet consumer needs, to supplying local manufacturing and service industries with the goods they need. Goods and services are necessary for a thriving and livable urban environment, therefore opportunities and challenges related to goods movement and delivery needs to be better understood to create functional improvements to the system while ensuring efficient freight mobility.

A reliable transportation network is crucial to ensure the efficient movement of both goods and people. This includes focusing on safety for all roadway users, maintaining and investing in assets (streets, bridges, sidewalks, ports, railroad lines, etc.), aligning policies at all government levels, and innovating to reduce environmental and public health impacts.

As important as it is to provide people with transportation choices to get around the city, it is also vital to have a variety of modes available to move goods sustainably, to enhance Seattle's competitiveness and economic vibrancy. Sustainability means more than just focusing on environmental impacts, but also the creation and maintenance of economic vitality and the generation, consumption, and transportation of energy sources that fuel the movement of goods and people. The need to understand how to best accommodate goods movement in Seattle while providing safe and attractive transportation choices for goods and people is of particular importance for the success of the Freight Master Plan.

The Seattle Freight Master Plan will aim to answer two key questions:

- How can we help build a strong and diverse economy in Seattle by improving our position as a gateway for global trade and increasing family wage jobs in the maritime and manufacturing industries?
- How can we efficiently accommodate the need to move goods and people in a sustainable manner in a fast-growing, densely populated, compact environment?

This report presents freight mobility information and data from Seattle, the region, and state. This report was developed using information from numerous sources to provide a snapshot of Seattle's existing goods movement environment.

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[1]California State Department of Transportation, Healthy Communities and Healthy Economies a Toolkit for Goods Movement, March 2009, http://www.rctc.org/uploads/media_items/healthy-communities-and-healthy-economies-a-toolkit-for-goods-movement.original.pdf

[2]*Washington State Department of Commerce, http://www.commerce.wa.gov/Economic-Development/Exports/Pages/default.aspx*

It describes the freight infrastructure, policies, and direct correlation to the type and level of economic activity and the diversity of industries in the region. The Seattle Freight Master Plan will:

- Create freight mobility policies
- Update the freight network map
- Develop truck street design guidelines
- Identify safety, maintenance, enforcement, and education needs to support investments in infrastructure and network improvements
- Develop a prioritization framework to guide implementation of high-priority projects

The baseline information in this report provides context in developing new opportunities to improve goods movement.

2.0 WHAT IS FREIGHT MOBILITY?

In the most general sense, freight mobility is the term applied to moving goods from one place to another by any mode – vehicle (mainly truck), plane, train, pipeline, and boat, often with complex moving parts and logistics. We use the terms goods movement and freight mobility interchangeably. Freight transportation is a mix of publicly and privately-managed systems. Infrastructure constrains the modes in different ways, but each mode requires resilient infrastructure to support economic development and growth and to ensure safe and sustainable delivery of goods.[3] Cities should recognize that streets within their jurisdiction form an essential part of the broader regional freight network.[4]

The State of Washington relies on an efficient freight transportation network as it is one of the most trade dependent states in the nation per capita. In 2013, Washington exported merchandise worth $82 billion and it is estimated that $37 million of goods move on Washington roadways every hour, of every single day.[5] [6]

2.1 DEFINITION AND ROLES OF FREIGHT MOBILITY MODES AND ASSETS

The waterways, rail, airport, and highway and street infrastructure are critical assets that support logistics and shipping within the Seattle area. They are key inputs to Seattle's locational competitive advantage. Keeping freight moving efficiently in Seattle is not just vital for Seattle's economy, but also for the region, Washington State, and other parts of the country, specifically, Alaska. To compete in the global marketplace and to enhance the quality of effective investments in transportation, infrastructure must be safe and resilient, and innovative transportation solutions must be sought. Generally, exports are time-sensitive and imports are high-value, fast-moving goods.[7]

Goods movement within urban areas is characterized by relatively short trips, typically by truck. Goods delivery in urban areas is highly competitive, time sensitive and essential for sectors ranging from professional services in high rise office buildings to mom and pop corner markets to residences. The trip type of first/last

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[3]National Cooperative Freight Research Program, Report 14, Understanding Urban Goods Movement, January 2012, http://onlinepubs.trb.org/onlinepubs/ncfrp/ncfrp_rpt_014.pdf

[4]Laetitia Dablanc, Genevieve Giuliano, Kevin Holliday, and Thomas O'Brien, Best Practices in Urban Freight Management: Lessons from an International Survey, Transportation Research Board, August 2013, https://hal.archives-ouvertes.fr/hal-00854997/document

[5]Washington State Freight Advisory Committee, Washington State Freight Trends & Policy Recommendations for Air Cargo, Freight Rail, Ports & Inland Waterways, & Trucking, May 2014 http://www.fmsib.wa.gov/fac/20140602-FINALComplete%20Folio_for%20printer5-7-14.pdf

[6]Barbara Ivanov, Washington State Department of Transportation, Washington State Freight Mobility Plan: State Truck Freight Economic Corridors, January, 2014 http://www.wsdot.wa.gov/NR/rdonlyres/2C300370-AC1B-41FF-83A3-ECACF47E8842/0/WAStFtPlanbriefingtoTIB114.pdf

[7]National Cooperative Freight Research Program, Report 14, Understanding Urban Goods Movement, January 2012, http://onlinepubs.trb.org/onlinepubs/ncfrp/ncfrp_rpt_014.pdf

mile is important for local deliveries and pick-ups from urban businesses or residences (home deliveries). Last mile represents the final haul of a shipment to its end receiver (a shop, business, facility, home, etc.) while first mile represents goods pick up. Together they represent a third of urban truck trips.[8]

While Seattle's Freight Master Plan will focus on streets and truck movements, since the City of Seattle has the most direct jurisdiction of these issues, it is important to understand the various ways that freight is transported throughout the city and region. This is the focus of the next several sections of the report.

2.1.1 MARITIME SHIPPING

Water transport has been the largest carrier of freight throughout history. Ship transport can be over any distance by sailboat, boat, ship, barge, over oceans, lakes and through canals. Virtually any material can be moved by water, but water transport becomes impractical when materials need to be delivered quickly. Seattle's deep water port provides an international gateway for imports, as well as exports from the state's agricultural and manufacturing businesses. Seattle region ports accounted for between 8 and 9% of total container volumes in the US in 2012.[9]

US waterborne exports through Seattle region ports are dominated by three major commodity groups that represent 84% of its total export tons:

- Agricultural products including cereal grains, animal feed and other agricultural products (64% of total tonnage)
- Forest products including wood, newsprint and paper, and wood products (12% of total)
- Waste and scrap (8% of total)

Most of the import volume, 7.8 million tons out of 9 million tons, moves through Seattle. Washington's maritime industry is rooted in rich history of timber production, shipbuilding, and its proximity to some of the world's most productive fisheries. These early industries helped establish Seattle as a trade hub. The oldest and most established maritime sectors, also known as Maritime Clusters, in the state are Ship and Boat Building, Maintenance and Repair, Fishing and Seafood Processing, and Maritime Logistics and Shipping. A recent report estimated that the state had 57,700 maritime industry jobs with gross business sales of $15.2 billion in 2012. It also calculates a combined impact of 148,000 jobs and $30 billion sales from the maritime industry. As a trading hub to Alaska, Canada, Asia and the rest of the U.S., the Maritime Logistics and Shipping sector moves goods across the globe efficiently. The Maritime Clusters relies on a robust and concentrated support system to fuel its growth.[10]

Waterways and Infrastructure

Seattle has several attributes that have helped the maritime industry thrive (Figure 1). Elliott Bay is a natural deep water port that has helped facilitate maritime activities. The Duwamish Waterway empties into the south end of Elliott Bay. The waterway is a hub of activity that has included cargo handling and storage, marine construction, ship and boat manufacturing, concrete manufacturing, paper and metals fabrication, food processing, and other industrial uses over the years. It is divided at the mouth of the river by the manmade Harbor Island.[11] In 2001, the five-mile stretch of the Lower Duwamish Waterway was listed as a Superfund site by the US Environmental Protection Agency

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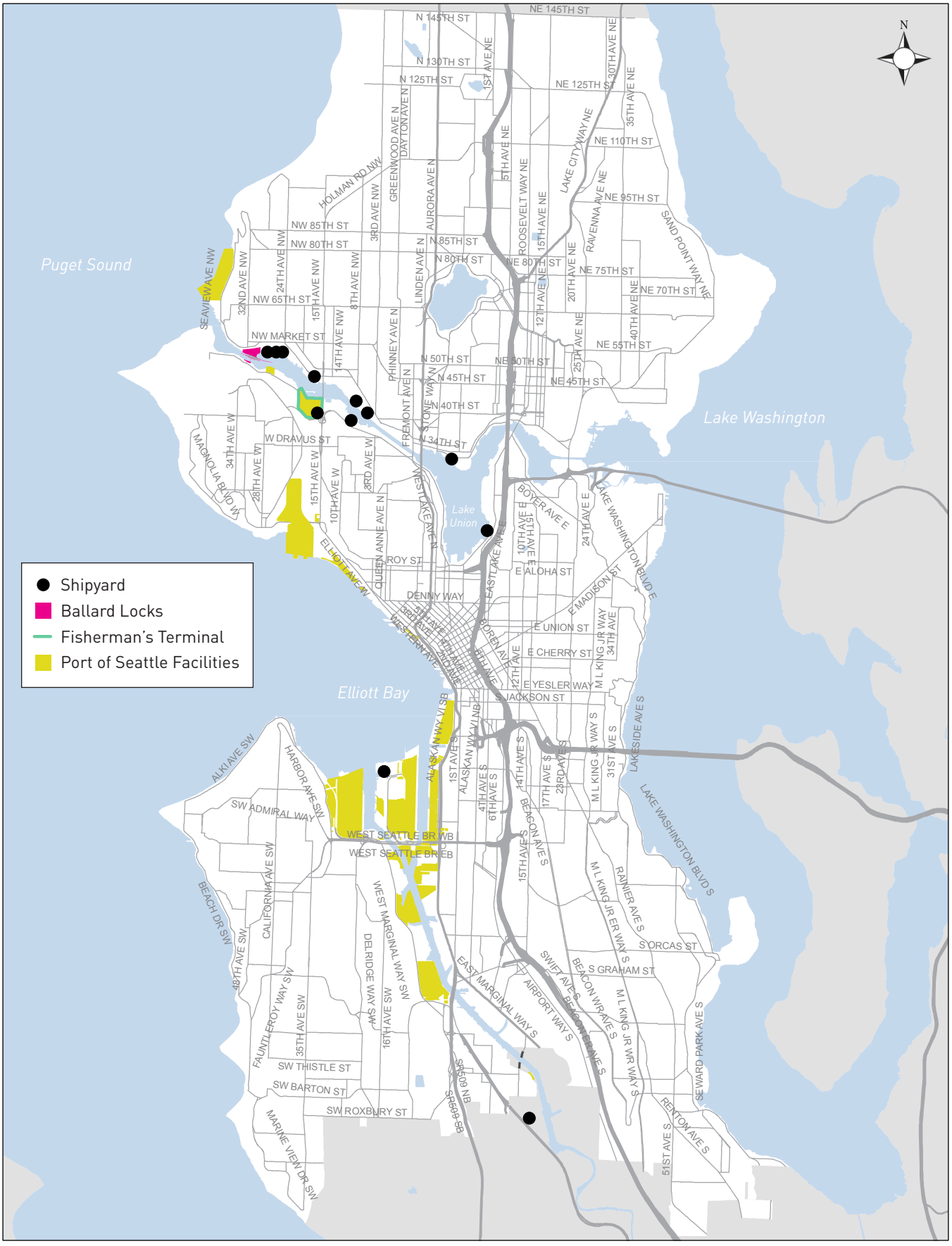
[8]Laetitia Dablanc, Genevieve Giuliano, Kevin Holliday, and Thomas O'Brien, Best Practices in Urban Freight Management: Lessons from an International Survey, Transportation Research Board, August 2013, https://hal.archives-ouvertes.fr/hal-00854997/document

[9]Parsons Brinkerhoff, The Role of Freight in Seattle's Economy, December 2014

[10]Economic Development Council of Seattle and King County, Washington State Maritime Cluster: Economic Impact Study, November 2013, http://edc-seaking.org/wp-content/uploads/2013/11/CAI.WA-Maritime-Cluster-Study.2013-1120.pdf

[11]Lower Duwamish Waterway Group, Discover the Duwamish, http://www.ldwg.org/discover.html

Figure 1: Maritime Assets



(EPA[12]), and work is being done to clean up contaminated sediment and control sources.

The eight-mile Lake Washington Ship Canal connects the freshwaters of Lake Union and Lake Washington with the salt water inland sea of Puget Sound (Figure 1) through the Hiram Chittenden Locks. The locks accommodate a 20 feet water difference between the two bodies of water, and are the largest and most heavily used on the West Coast. Their design incorporated unique, parallel dual-sized lock chambers for water conservation and preventative measures to reduce salt intrusion into Lake Union and Lake Washington. There are many maritime-related industries located along the Ship Canal including services to build, repair, and supply the North Pacific Fishing Fleet, many vessels from which will harbor along the Ship Canal during the off season.

The Port of Seattle an independent economic development jurisdiction has multiple assets in the Duwamish Waterway and Elliott Bay. These include container terminals, general purpose marine/cargo terminals, commercial and recreational moorage, industrial and commercial properties, grain terminal, and two cruise ship terminals. The cruise facilities located at Bell Street Pier and Smith Cove serve nearly one million passengers each year for cruises to Alaska.[13] The Port also operates Fishermen's Terminal and the Maritime Industrial Center along the Lake Washington Ship Canal. Fishermen's Terminal provides freshwater moorage to the Northwest commercial fishing fleet.[14]

Recently, the Port of Seattle and the Port of Tacoma announced a "Seaport Alliance" for unified management of the ports' integrated marine cargo terminal operations. The Seaport Alliance will promote economic development of marine cargo terminal operations with unified business retention and recruitment, coordinated marine terminal planning and operations, and the ability for coordinated capital investments which will help to improve utilization of terminal capabilities and the opportunity to reduce operating costs. Much of the containerized cargo imported through these ports is transferred to and from rail at or near the port terminals for transport to the US interior. This import system provides for infrastructure and lowers the cost of Washington state exports to the world. Cargo destined to or originating in the Pacific Northwest, including agricultural products and supplies or products from manufacturing businesses, is mostly transported to the Port by truck.[15] The Ports of Seattle and Tacoma represent a large gateway for international waterborne trade.

Seattle is home to eleven shipbuilding operations. The majority are located along the Lake Washington Ship Canal, with one operation located on Harbor Island, and another just south of the city limits along the Duwamish Waterway.

Maritime Economy

The maritime sector has and will remain an enormous part of our local, regional, and statewide livelihood and economic competitiveness. Below are several facts outlining the importance of the maritime cluster:[16]

- Between 2009-2011, Maritime business revenues (adjusted for inflation) have grown on average 6.4% per year
- In 2012, the Maritime Cluster employed more than 57,700 people directly in the state
- The average annual salary before benefits among Maritime workers was $70,800 in 2012, though this varied by activity area within the cluster

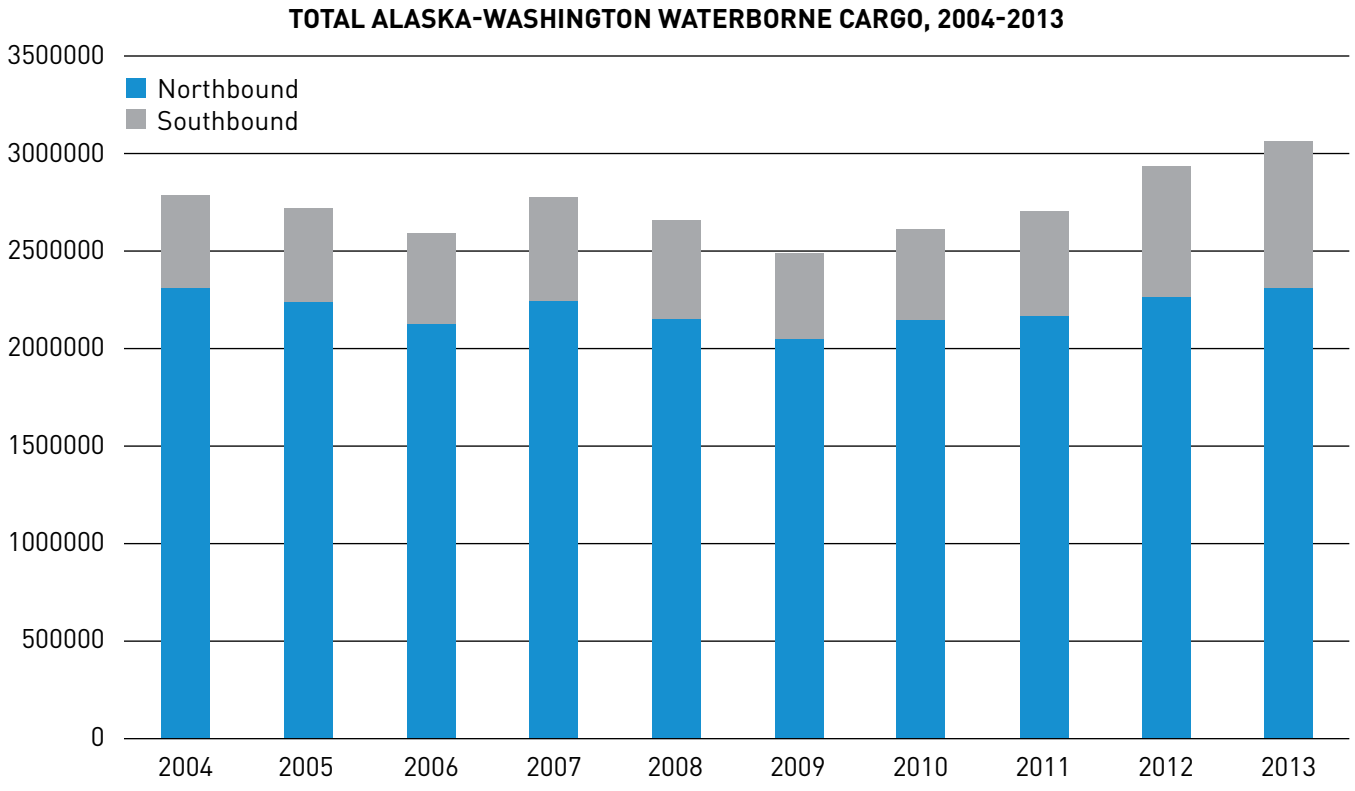
[12]Boeing, History of the Duwamish Waterway, http://www.boeing.com/boeing/aboutus/environment/duwamish/history.page
[13]Port of Seattle website http://www.portseattle.org/Cargo/SeaCargo/Pages/default.aspx
[14]Port of Seattle website http://www.portseattle.org/Commercial-Marine/Pages/default.aspx
[15]The Role of Freight in Seattle's Economy, Parsons Brinkerhoff, September 2014.
[16]Economic and Development Council of Seattle and King County, Washington State Maritime Cluster Economic Impact Study, November 2013, http://edc-seaking.org/wp-content/uploads/2013/11/CAI.WA-Maritime-Cluster-Study.2013-1120.pdf

- Fishing and seafood processing accounted for nearly 60% of total revenues or nearly $8.6 billion in sales and supported nearly 33,500 jobs across the state
- The maritime cluster businesses generated directly more than $15.2 billion in gross business income in 2012
- Indirect and induced maritime jobs account for another 90,000 jobs, for a total impact of 148,000 Washington jobs, with a total contribution effect of $30 billion to Washington's economy
- Economy-wide, Maritime activities supported, via direct, indirect, and induced impacts – an estimated $351.5 million in state tax revenues in 2012
- Fish and Seafood Processing alone contributed, directly and via indirect and induced effects, an estimated $135.7 million in tax revenues to the state
- The largest concentration of Maritime activities is within the Central Puget Sound region; approximately 41% of all direct maritime employment is located in King County

Other important maritime economic impacts:

- Alaska's distant-water commercial fishing fleet is home ported in Puget Sound, and the economic impact of this is large. Many ships are serviced and provisioned along the Lake Washington Ship Canal and at the Port of Seattle's Terminal 91. In addition, Alaska relies on Seattle-area barges to bring products and necessities to allow for Alaskan west coast livelihood. Many of the barge operations that service Alaska are located along the Duwamish River.
- Shipments northbound from Puget Sound to Alaska include household and other consumer goods, construction materials, and a broad range of supplies and materials to support business and industry in Alaska (Figure 2). Seafood

Figure 2: Alaska-Puget Sound Waterborne Cargo (Tonnage)



accounts for the bulk of southbound shipments destined for Puget Sound from Alaska, with lesser amounts of household goods, recyclables, and scrap materials comprising the remainder.

- Tourism
  - Cruise business is responsible for more than 4,000 jobs, $381 million in annual business revenue, and nearly $16.8 million annually in state and local tax revenues.
  - Each vessel call generates almost $2.2 million for the local economy.
  - In 2014, there were a total of 179 vessels docking in Seattle with 823,000 passengers.[17]

The maritime sector continues to evolve and innovate to become more environmentally sustainable. Examples of innovation in the Maritime Cluster are the transformation of Washington and Alaskan fisheries from endangered to some of the best managed in the world. This will help to ensure longevity of fisheries and way of life for many populations that rely on fishing.

Other examples include:

- Ocean carriers are reducing emissions through slow steaming which burns 40% less fuel, use of higher capacity vessels, better hull coatings which improve movement through the water, and by phasing in cleaner engines and order of magnitude cleaner fuels.
- Seattle-area sailboat co-op, Salish Sea Trading Cooperative, founded in 2010 to revitalize sail transport as a response to climate change and peak oil to be a carbon-neutral transportation for local goods and community.

2.1.2 RAILROADS

Rail freight transport is the use of railroads to move cargo and goods. A freight train is a group of train cars hauled by one or more locomotives on a railway, transporting cargo all or some of the way between a shipper and the destination as part of a logistics supply chain. Freight lines in Seattle have different classifications depending on track classification.

Class 1: 10 mph for freight, 15 mph for passenger. Branch line, short line, and industrial spur trackage falls into category.

Class 2: 25 mph for freight, 30 mph for passenger. Branch lines, secondary main lines, many regional railroads, and some tourist operations frequently fall into this class. Examples are Burlington Northern Santa Fe's (BNSF) branch from Sioux Falls to Madison, South Dakota.

Class 3: 40 mph for freight, 60 mph for passenger. This commonly includes regional railroads and Class 1 secondary main lines. Examples are BNSF between Spokane and Kettle Falls, Washington.

The BNSF mainline extends north-south through Seattle. North of downtown, it primarily follows the shoreline of Puget Sound, diverting inland to connect from Elliott Bay to Ballard through the Interbay neighborhood. South of downtown, the mainline parallels the Duwamish River. Through downtown Seattle, the BNSF mainline is in a doubled-tracked tunnel that was built in 1905. The UP mainline only operates south of downtown, with a mainline that parallels the BNSF's.

In addition to intermodal rail associated with the region's container ports, many local rail movements are also associated with grain shipments through the Port of Seattle's Grain Terminal at Pier 86, along with general cargo that is loaded through rail hubs at BNSF's Seattle

[17]Cruise Seattle 2015 Fact Sheet, http://www.portseattle.org/Cruise/Documents/2015_cruise_factsheet.pdf

International Gateway (SIG) Yard and the UP's Argo Yard, both in Seattle's SODO neighborhood located within the Greater Duwamish Manufacturing and Industrial Center. The BNSF also has a rail yard in Interbay, called the Balmer Yard, which is primarily used for railcar storage and sorting. No transfers to other modes occur at this yard. Garbage is also loaded to rail at several facilities including the Rabanco Yard in SODO and UP Argo Yard. There are still many local rail spurs throughout Seattle's manufacturing and industrial area that provide direct rail service for businesses. Some of the larger customers include Nucor Steel in West Seattle, Ash Grove Concrete in SODO, and Coastal Transportation in Interbay.[18]

Railroads' relationship with other modes of freight transportation varies widely – they have almost no interaction with air, close cooperation with marine/maritime-going freight, and a mostly competitive relationship with long-distance trucking and barge transport. Barge shipping remains a viable competitor for rail where water transport is available. Rail transport is expected to grow as the price of fuel decreases and engine efficiency increases.

Railroad Innovation and Environment

BNSF

Clean-diesel locomotives purchased by Class I railroads are 15 percent more efficient than the previous generation. Since 2004, BNSF has acquired approximately 2,900 new locomotives and is removing 3,000 old locomotives, making the fleet one of the newest and most fuel efficient in the industry. Approximately 90 percent of BNSF's fleet uses idle-control technology to automatically shut down locomotives not in use. BNSF has 90 ultra-low-emission locomotives used in switching operations that reduce nitrogen oxide and particulate matter emissions by 80 to 90 percent and improve fuel efficiency by 25 percent compared with standard switch engines. BNSF is also aggressively investing in fuel-efficiency technology, including driver-assist systems, rail lubrication and proper horsepower distribution. BNSF is using electric wide-span cranes and is the first carrier in the US to do so. These cranes produce zero emissions on site while generating power each time they lower a load. The wide stance design of these new cranes eliminates as many as six diesel trucks (hostlers) for shuttling containers within the intermodal facility, reducing emissions and improving fuel efficiency. This technology is currently being used at Seattle International Gateway and in Memphis.[19]

Union Pacific

Since 2000, Union Pacific has spent approximately $6.75 billion to purchase new, more fuel-efficient locomotives. Since that time, more than 3,800 of these locomotives have been added to Union Pacific's fleet, more than 2,900 older locomotives were retired and nearly 5,200 locomotive diesel engines were overhauled or rebuilt with emissions control upgrades. Union Pacific has a comprehensive plan to reduce the amount of time locomotive engines idle. Part of the plan involves using automatic stop-start equipment on newer locomotives to eliminate unnecessary idling. Older locomotives are being retrofitted with similar technology. More than 70 percent of Union Pacific's locomotive fleet is equipped with this technology. Locomotive shutdowns can save 15-24 gallons of fuel per locomotive, per day. Union Pacific continues to look for innovative ways to reduce fuel consumption by constantly searching for more efficient routes to move goods, increasing carrying capacity on trains, and reducing wind resistance and other programs providing additional savings in fuel consumption and reducing greenhouse gas emissions.[20]

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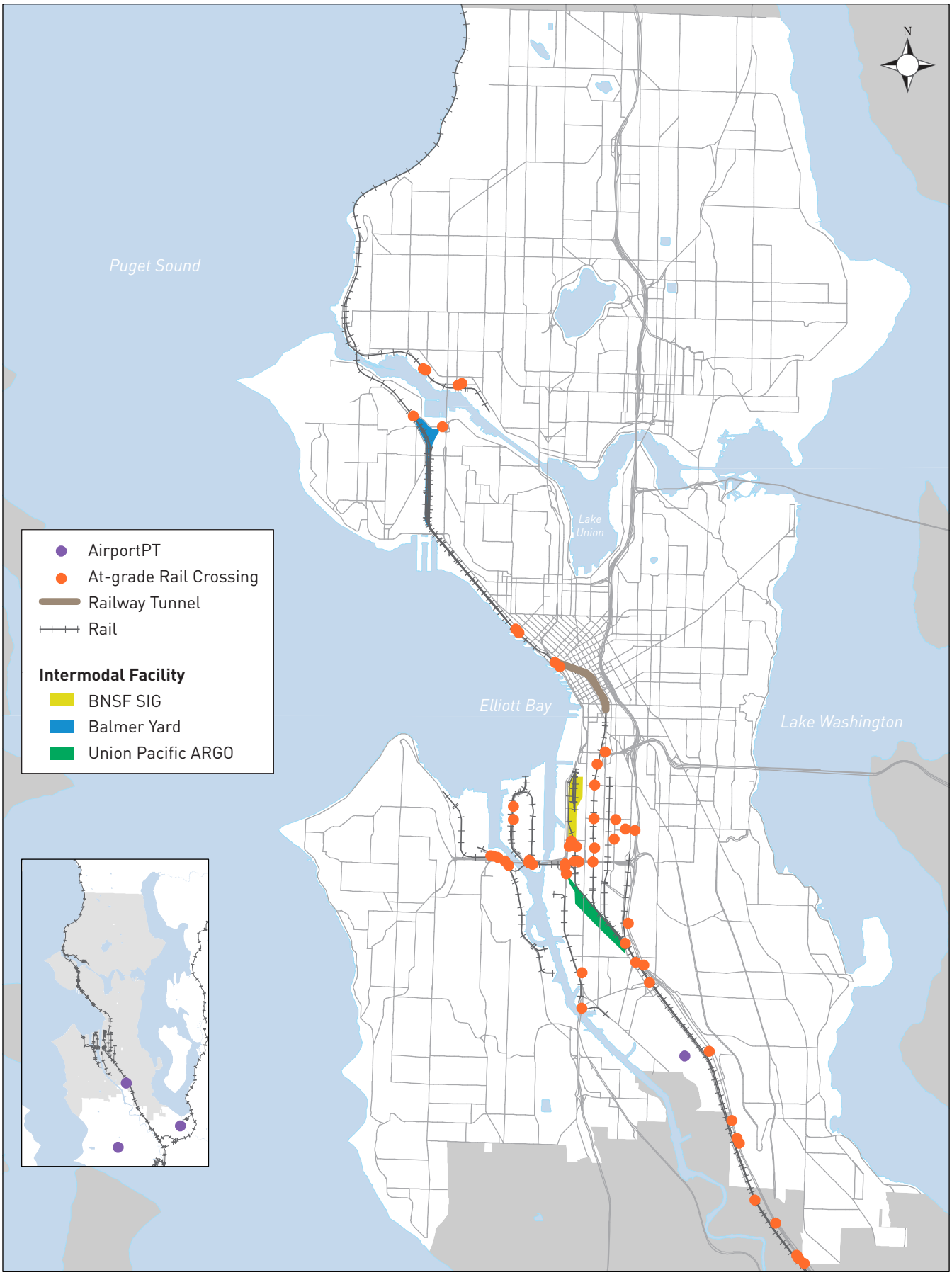
[18]The role of Freight in Seattle's Economy, Parsons Brinkerhoff, September 2014
[19]BNSF, BNSF and the Environment, http://www.bnsf.com/communities/bnsf-and-the-environment/
[20]Sustainability and Citizen Report, Union Pacific, http://www.up.com/aboutup/corporate_info/sustainability/preserve_environment/index.htm

Figure 3: Rail and Intermodal Assets



2.1.3 AIR

Air transport is a vital component of many international logistics networks. Commodities shipped by air have high values per unit or are very time-sensitive. The demand for air freight is limited by costs, typically priced 4-5 times that of road transport and 12-16 times that of sea transport. Some examples are clothes, perishable agriculture and seafood products, pharmaceuticals, and documents or inputs to meet just-in-time production and emergency shipment of spare parts.[21]

The use of air freight can create competitive advantages, such as much shorter transit times. As oil prices increase there could be slower growth in air cargo freight as fuel accounts for about half the annual cost of operating an aircraft. In the long-term, air traffic should continue to grow, but air freight will be increasingly incorporated into multimodal supply chains that offer a better balance between cost and time. In the Seattle area, growth in air freight is expected to triple over the next few decades due to Boeing's forecast of air cargo freight.[22]

King County International Airport/Boeing Field (KCIA)

The King County International Airport manages leasing and project development over its total land area of 597 acres and is the third largest airport in the Pacific Northwest and the 29th ranking national airport for cargo. The location is desirable due to proximity to Seattle's Central Business District, SR-99, I-5, railroads and the Port of Seattle (Figure 3) However, the airport also has tight physical constraints with its neighbors, including many residential areas (Beacon Hill, Georgetown, South Park neighborhoods in Seattle and the City of Tukwila to the south). The airport is bordered by Ellis Ave S to the north, Airport Way S to the east, Norfolk Way to the south, and E Marginal Way to the west. KCIA is a crucial public asset and its quality and capacity of basic infrastructure contribute to the success in attracting and retaining customers.

In recent years, KCIA has seen a dramatic shift in its business opportunities due to the value of its airfield capacity and strategic proximity to downtown Seattle. The airport's upcoming master plan process will explore strategic investment decisions to set the course for the future of the airport and assess the possibility of expanding the runway protection zone.

KCIA is a major economic center and supports significant economy activity in terms of direct (5,100) and indirect (16,000) jobs with 150 companies located at the airport (Boeing being the largest corporation), labor income, overall economic impacts and local and state taxes. The Boeing Company has been a central part of both KCIA's operations and the regional economy, and their presence attracts a significant number of auxiliary manufacturing businesses.[23] Several large air cargo companies, including UPS and FedEx, have facilities at or near the KCIA.

In terms of innovation and environmental impacts, KCIA created a noise program due to its proximity to neighboring residential communities and, through the investment of $68 million dollars on home insulation, noise complaints have decreased from 11,000 in 2000 to 57 as of August 2014. Aircrafts have also become 50% quieter with engine and technology advancements.

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[21]Dr. Charles E. Schlumberger, Cargo Flights: Ready for take-off, the World Bank, Spring 2012, http://siteresources.worldbank.org/INTAIRTRANSPORT/Resources/Air-Cargo-Focus-Spring-2012-pages-10-11.pdf

[22]Washington State Freight Advisory Committee, Washington State Freight Trends & Policy Recommendations or Air Cargo, Freight Rail, Ports & Inland Waterways, & Trucking, May 2014, http://www.fmsib.wa.gov/fac/20140602-FINALComplete%20Folio_for%20printer5-7-14.pdf

[23]King County Department of Transportation and King County International Airport - Boeing Field, King County International Airport Strategic Plan 2014-2020, August 2014.

Seattle-Tacoma International Airport (Sea-Tac)
The Seattle-Tacoma international airport, also known as Sea-Tac airport, serves the cities of Seattle and Tacoma as well as the rest of western Washington State. It is owned and operated by the Port of Seattle. The airport has service to destinations throughout North America, Europe, the Middle East, and East Asia. It is the primary hub for Alaska Airlines, whose headquarters is located near the airport, as well as its regional subsidiary Horizon Air. It is also a Pacific Northwest hub and international gateway to Asia and Europe for Delta Air Lines, which has significantly enlarged its presence at Sea-Tac since 2011.

In 2013, the airport served over 34.7 million passengers, making it the 15th-busiest airport in the United States. It ranks 23rd in total aircraft operations and 21st in total cargo volume with 293,000 metric tons of cargo shipped from the airport. High value exports include commercial aerospace, hi-tech manufacturing, fresh seafood products and high value agriculture (cherries and red raspberries to Asia).

2.1.4 ROADWAY

Trucks and other vehicles deliver almost every material item people buy. Trucks use the urban street network to move goods and products to grocery stores, restaurants, manufacturing facilities, office buildings, and residences. Trucking is a diverse industry with a variety of truck-types, ownership, and services. Movement of goods relies on highways and local roads for regional and long-distance transport, urban goods delivery, and "first/last mile" (i.e. transport from warehouses or intermodal freight terminals to final destinations). First and last mile connections are a vital goods movement supply chain link within the city.

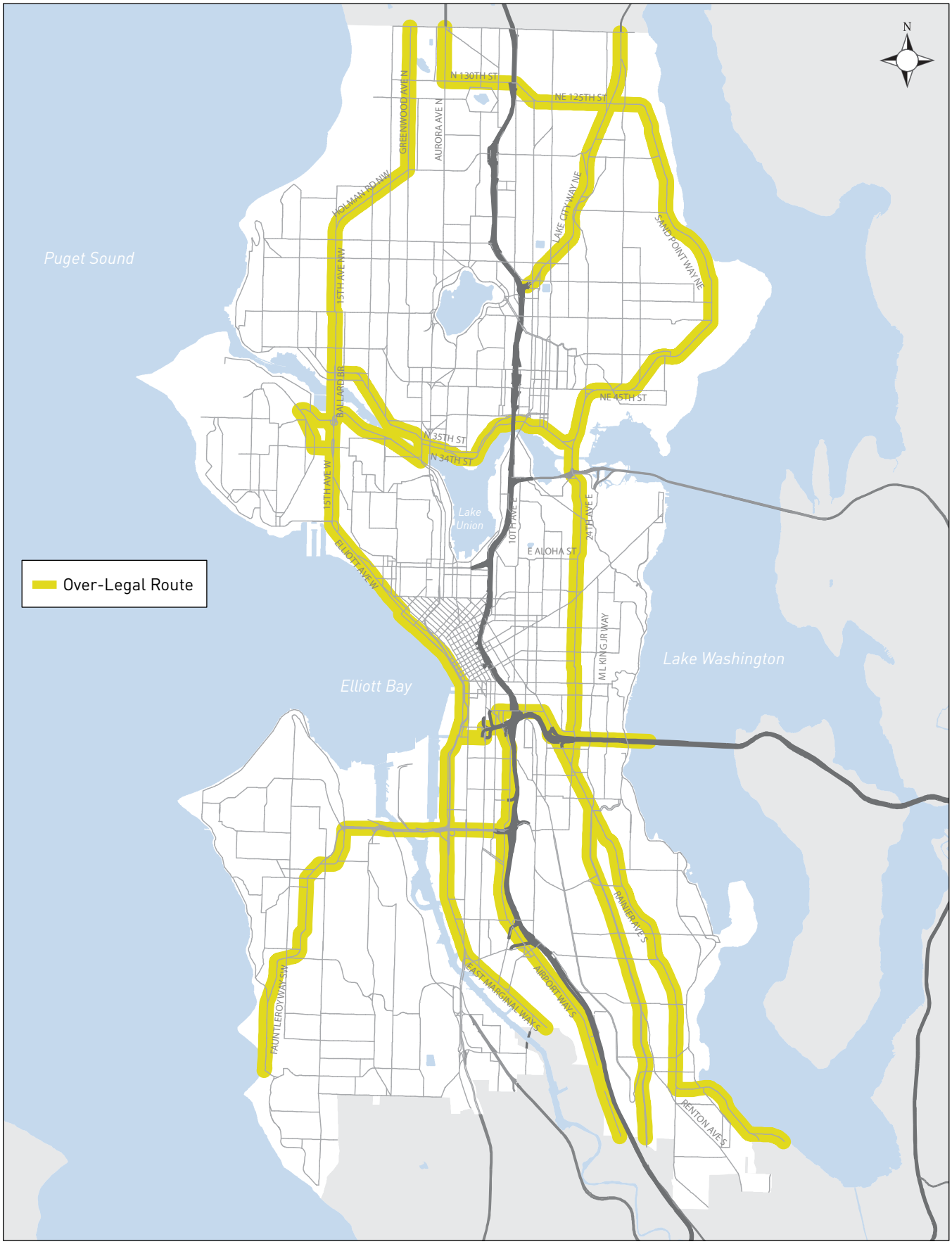
Truck freight at a national level is expected to grow about 2% annually between 2010 and 2040.[24] Trucking dominates the freight transportation industry in terms of both tonnage and revenue, comprising 68.5% of tonnage and 80.7% of revenue in 2011.[25] [26]Trucks carried $334 billion of Washington State's total freight volumes, according to data released by the Federal Highway Administration.[27] Goods moved by truck include:

1) Urban deliveries directly to businesses and residences
2) Urban warehouses or distributors serving Seattle or broader Pacific Northwest regions
3) Shipping to "transload" centers where international containerized goods are unpacked and resorted into larger domestic containers and then moved either by rail or truck to US inland locations

As Seattle continues to grow and densify, urban deliveries will be increasingly important and continually challenged due to growing demand, and competition for space with other roadway users. Figure 5 outlines the oversize load routes in the city. In Seattle, all arterial streets allow trucks, and the city has designated 142 miles of these as Major Truck Streets (MTS). MTS are arterial streets that accommodate significant freight movements through the city and connect major freight generators. These roadways tend to have geometric designs that safely allow the movement of large trucks. In addition, the city has oversize load routes distributed throughout the city. These routes provide east-west and north-south connectivity for

[24]Parson's Brinkerhoff, The Role of Freight in Seattle's Economy, December 2014
[25]Washington State Freight Advisory Committee, Washington State Freight Trends & Policy Recommendations or Air Cargo, Freight Rail, Ports & Inland Waterways, & Trucking, May 2014, http://www.fmsib.wa.gov/fac/20140602-FINALComplete%20Folio_for%20printer5-7-14.pdf
[26]Bob Costello, American Trucking Association, http://www.trucking.org/article.aspx?uid=651bb96d-e134-42b1-81be-d8c6d147f0f6
[27]Washington State Freight Advisory Committee, Washington State Freight Trends & Policy Recommendations or Air Cargo, Freight Rail, Ports & Inland Waterways, & Trucking, May 2014, http://www.fmsib.wa.gov/fac/20140602-FINALComplete%20Folio_for%20printer5-7-14.pdf

Figure 5: Roadway Freight System



trucks with larger loads that require a 20' wide by 20' high envelope for traveling safely.

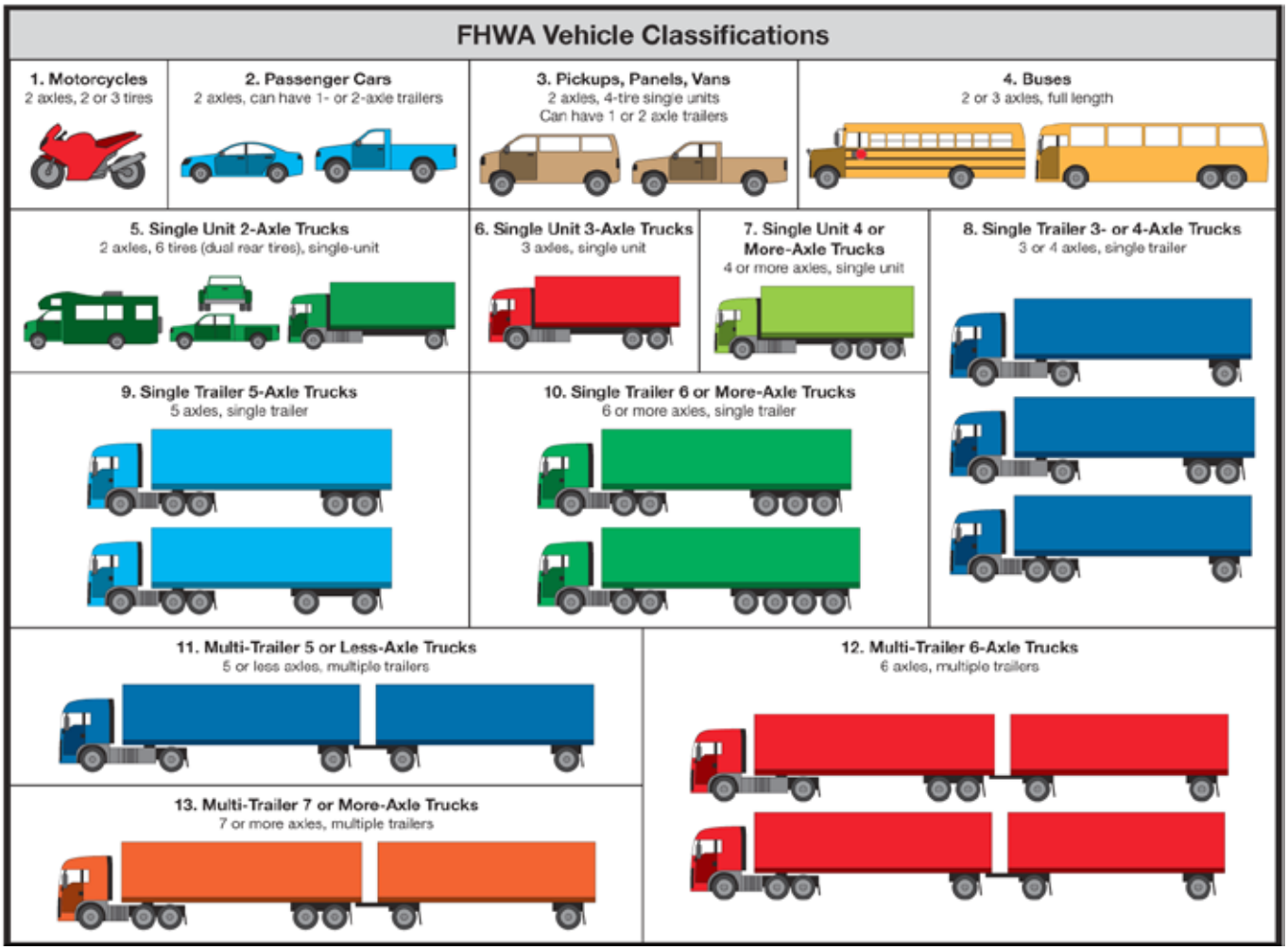
Truck classifications

Different types of trucks are classified in different ways. Truck characteristics that most influence transportation facility design (e.g., roads) are weight and distribution over axles, dimensions (width and height) and turning radius.

The Federal Highway Administration (FHWA) has established a vehicle classification system that groups vehicles based on the vehicle type, number of axles, and number of wheels (Figure 6). This system is used when vehicle classification counts are collected to determine the number and type of vehicles using a specific roadway and is used for truck classification traffic studies. This classification system uses 13 categories as shown below.[28]

The trucking industry usually defines roadway freight in terms of Gross Vehicle Weight (GVW) classifications, which are maximum total weights assigned by the manufacturer. FHWA, the U.S. Environmental Protection Agency, and U.S. Census Bureau also use the gross vehicle weight classifications to serve the needs of many

Figure 6: FHWA Vehicle Classification



[28]U.S. Department of Transportation Federal Highway Administration, FHWA Vehicle Types, April, 2011, http://www.fhwa.dot.gov/policy/ohpi/vehclass.htm

regulations and standards. Figure 7 shows GVW classes 1 through 8.

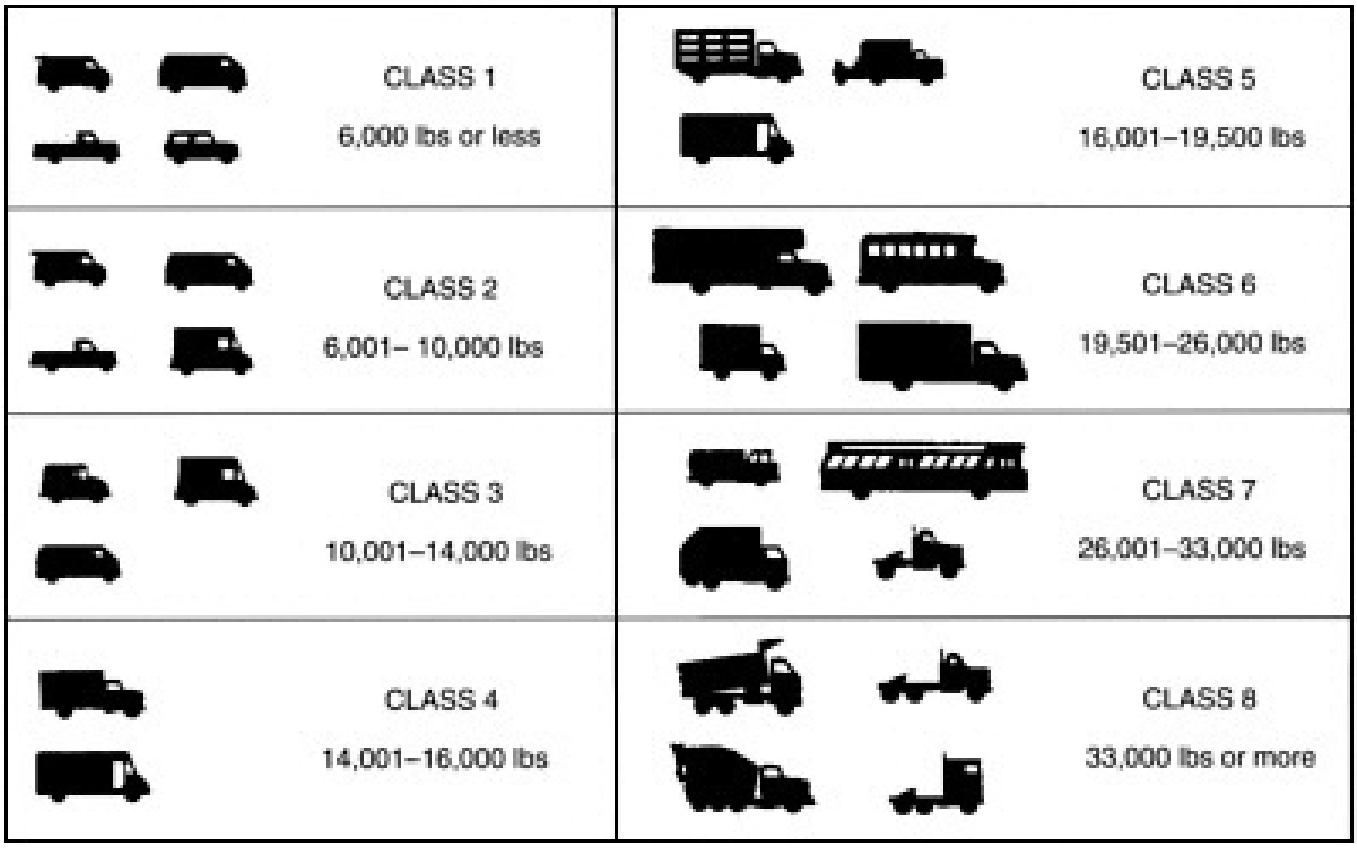
The Washington State Freight and Goods Transportation System (FGTS) is a classification system managed by the Washington State Department of Transportation (WSDOT) and used to classify state highways, county road and city streets according to the average annual gross truck tonnage they carry. The FGTS classified roadways using five freight tonnage classifications, T1 through T5, as follows:

- T-1 more than 10 million tons per year
- T-2 4 million to 10 million tons per year
- T-3 300,000 to 4 million tons per year
- T-4 100,000 to 300,000 tons per year
- T-5 at least 20,000 tons in 60 days

2.1.5 PIPELINE

The Olympic Pipe Line carries 50-60% of the output of the five crude oil refineries in Washington to distribution centers in western Washington. The pipeline is the sole source of jet fuel for Sea-Tac airport.[29] [30] This significant pipeline is the Seattle lateral of the British Petroleum (BP) line running from Ferndale to Portland. The Seattle lateral runs from Renton north to Harbor Island along the Seattle City Light right of way. The pipeline transports gasoline and diesel fuel to a regional distribution center on Harbor Island. About 13.6 million gallons of fuel are transported daily through the pipeline. The pipeline was operated by Olympic Pipeline Company, though today, BP, owns the asset.

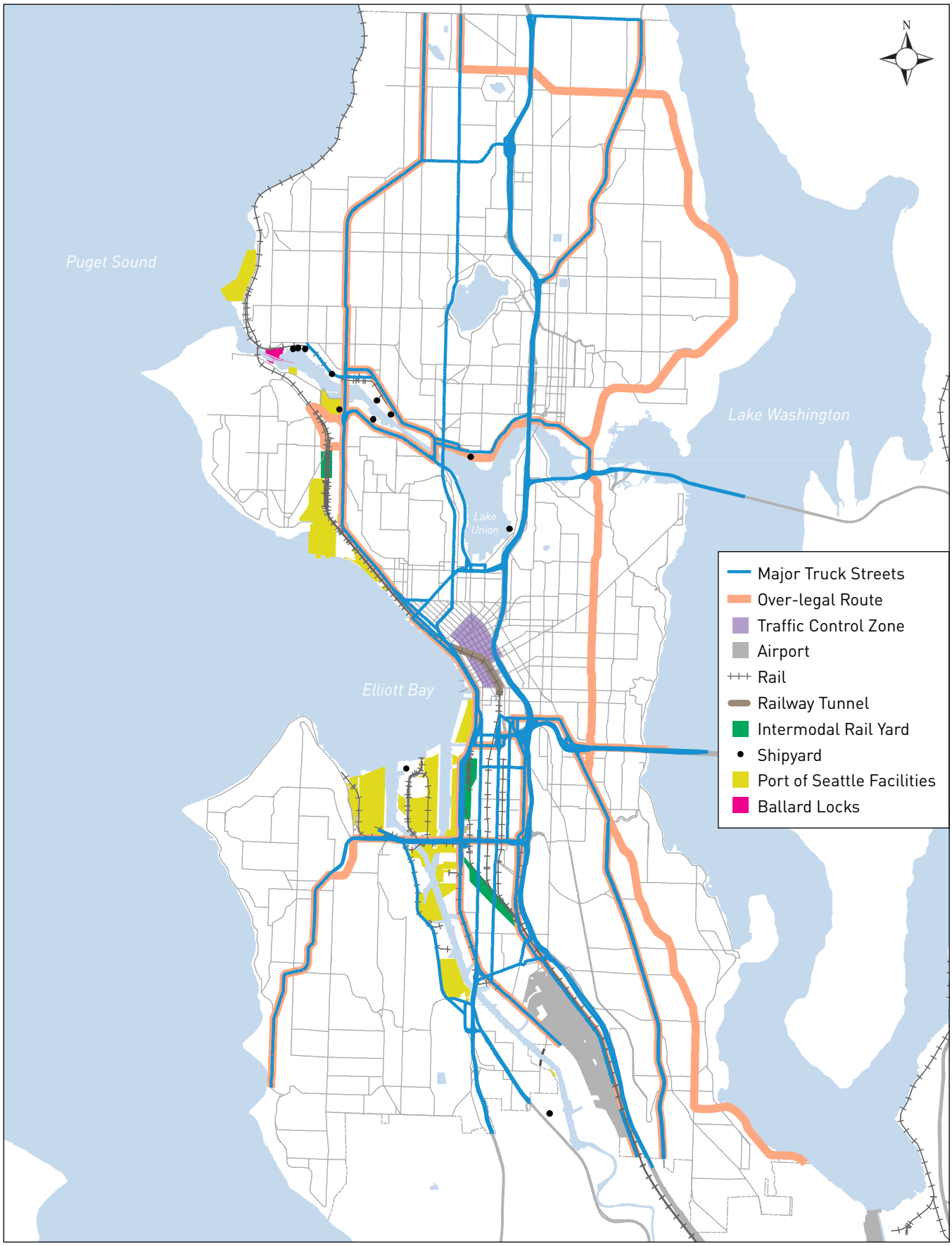
Figure 7: Classification based on Gross Vehicle Weight (GVW)



[29]Washington State Freight Advisory Committee, Washington State Freight Trends & Policy Recommendations or Air Cargo, Freight Rail, Ports & Inland Waterways, & Trucking, May 2014, http://www.fmsib.wa.gov/fac/20140602-FINALComplete%20Folio_for%20printer5-7-14.pdf

[30]Washington State Department of Transportation, http://www.wsdot.wa.gov/planning/wtp/documents/freight.htm

Figure 8: Combined Freight Assets



2.2 LAND USE

Seattle is the region's largest and most diverse city in terms of population, economic activity, and transportation options. The city has a long history of being a maritime, manufacturing, and freight distribution center for the region, and has a number of diverse and unique neighborhoods. By 2035 Seattle expects to see an increase of 70,000 additional housing units, and 115,000 additional jobs. Through the Comprehensive Plan, the city manages and promotes growth in specific areas following the Urban Village Strategy. The strategy puts into practice the regional growth center concept called for in regional plans, which designates urban centers and manufacturing/industrial centers, at a more local scale by also including hub urban villages and residential urban villages. The strategy encourages most future jobs and housing growth to specific areas, and serves several purposes:[31]

- Accommodate Seattle's expected growth in an orderly and predictable way
- Strengthen existing business districts and MICs
- Promote the best and most efficient use of public investments, now and in the future
- Encourage more walking and transit use in the city
- Retain the feel and character of less dense single-family neighborhoods

The Urban Village Strategy strongly influences our transportation system, as well as freight distribution patterns and goods movement throughout the city. Seattle's growth strategy requires a multimodal transportation system that provides travel options for all trips throughout the day, including evening and weekends. This includes Seattle's businesses, industries, and residents that rely on freight for safe, efficient, and timely transportation of goods. Therefore, facilities that help freight move throughout the city, between the Manufacturing and Industrial Centers (MICs), and connect to the regional, national, and international networks are essential. This includes a well-functioning transportation network that consists of rail, water, air, and truck transportation.

The Urban Village Strategy highlights four designations: manufacturing/industrial centers, urban centers, hub urban villages, and residential urban villages. Since these areas are slated for the most growth, they also have accompanying land use zoning to help reach the growth targets. Figure 9 shows the distribution of these designations throughout the city, and each one is described further below.

2.2.1 URBAN CENTERS

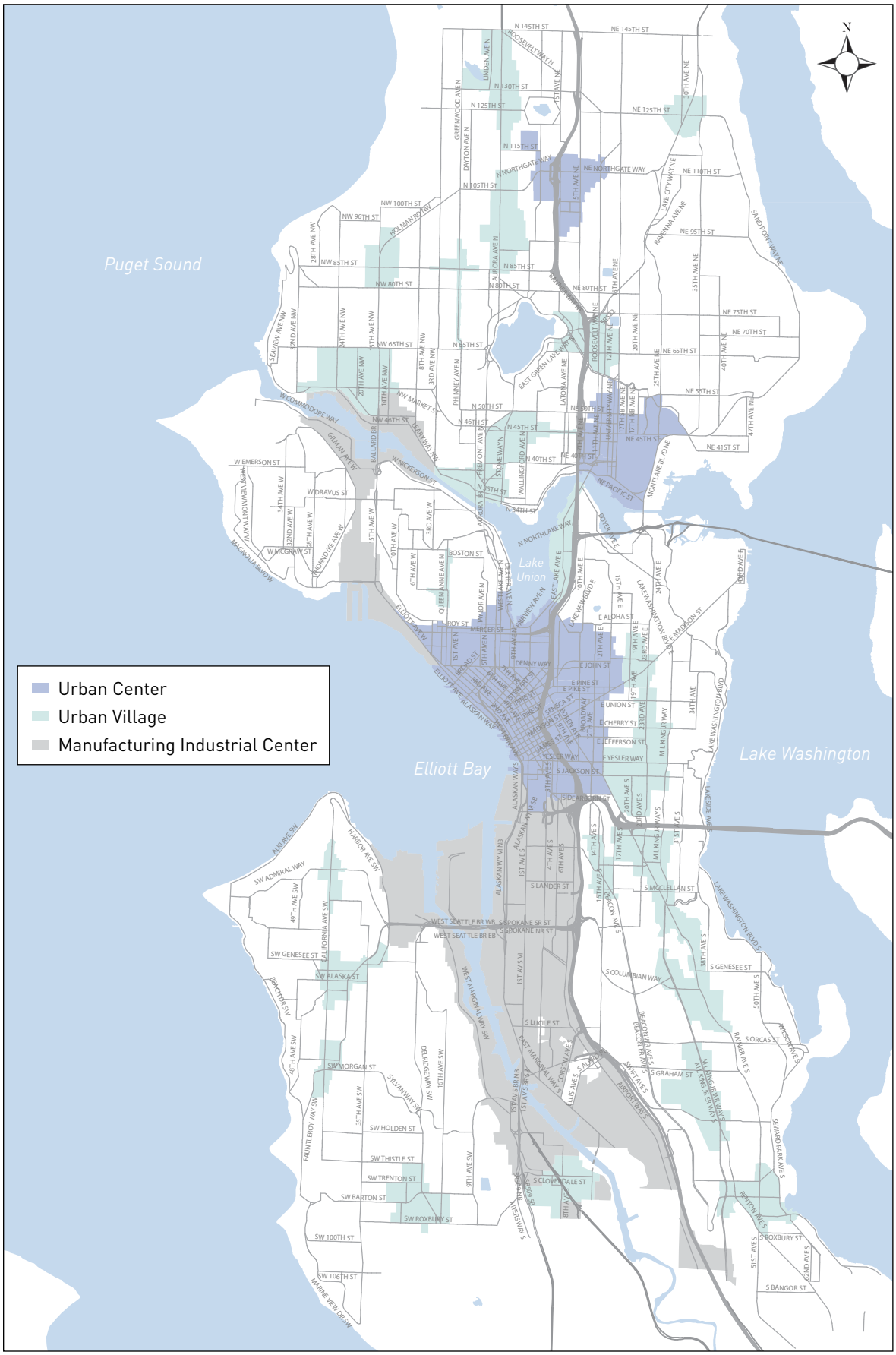
The Puget Sound Regional Council (PSRC) designated regional growth areas that are identified to receive future housing and employment growth. Seattle calls these six designated regional growth areas Urban Centers. They include: Downtown, Uptown, South Lake Union, First Hill/Capitol Hill, University District, and Northgate. These areas comprise much of where housing (22%) and employment (57%) exists in the city, and encompass seven percent of the city's total land area. Between 1995 and 2012, 40% of all new housing units in the city were built in these six urban centers.

2.2.2 HUB URBAN VILLAGES

The city has six designated hub urban villages. These are locally designated growth areas with planning estimates for housing and jobs. In 2012, hub urban villages encompassed three percent of the land area, seven percent of housing units, and five percent of jobs. Between 1995 and 2012, 13% of new housing units were built in these areas.

[31]City of Seattle Department of Planning and Development, Existing Comprehensive Plan and Duwamish M/IC Policy and Land Use Study, 11/2013, http://www.seattle.gov/dpd/cs/groups/pan/@pan/documents/web_informational/p1903847.pdf

Figure 9: Seattle's Urban Village Strategy



2.2.3 RESIDENTIAL URBAN VILLAGES

The city has locally designated 18 residential urban villages, which encompass seven percent of the city's land area. The residential urban villages have 13% of the housing units and 7% of jobs. From 1995-2012, 19% of new housing units were built in these areas. The residential urban villages are scattered throughout the city. Retail and services located here mainly serve the nearby population.

2.2.4 REMAINDER OF THE CITY OF SEATTLE

The remainder of the city has 58% of housing units, 16% of the jobs, and 71% of the city's land area. This area is mostly single family residential and sees daily delivery trucks, and waste pick-up.

2.2.5 MANUFACTURING AND INDUSTRIAL CENTERS (MICS)

Seattle has two of the Puget Sound Regional Council's (PSRC) eight regionally designated MICs: Ballard-Interbay-Northend (BINMIC) and Duwamish MIC. The MICs were established to ensure that adequate accessible industrial land is available to promote a diversified employment base and sustain Seattle's contribution to regional high-wage job growth. Industry has concentrated in the MICs due to the relatively large, flat sites, access to highways, rail, and port facilities, and proximity to similar uses, customers, and labor force. Though the two MICs share many characteristics, there are also many differences in scale, character, development, and surrounding uses. While the majority of 6,000 acres of industrially zoned land is concentrated in these areas, some manufacturing and industrial activity also occurs around the shores of Lake Union and along Rainier Ave S, near Interstate 90 (see Figure 10).

Industrial General 1 (IG1) comprises most of the zoned land in the MICs (Figure 11), followed by Industrial General 2, Industrial Commercial, and then Industrial Buffer. The MICS encompass less than one percent of the city's housing units, 11% of land area, and 15% of jobs. Less than one percent of the new housing units built between 1995 and 2012 were in the MICs.

Seattle's wholesale, manufacturing and trade sectors are concentrated in the MIC areas. Truck trips associated with wholesale, manufacturing and trade sectors are most likely to be made in larger trucks that move longer-distances using the regional interstate or highway network. These trips then use major Truck Streets, city arterials and local streets for the first or last leg of the trip. Businesses located in the BINMIC are farther away from Interstate 5 (I-5) and SR 99, so a higher proportion of travel time can be affected by local congestion or physical constraints to these larger vehicles. In the Duwamish MIC, some of the area's major access points to I-5, I-90 and SR 99 also serve downtown commuters, as well as event traffic destined to the area's two major league sports stadia. This leads to frequent conflicts with general traffic congestion during rush hour peaks and around daytime sporting events.[32]

Duwamish MIC

The Duwamish MIC is the oldest and largest of the eight designated MICs spread across the Puget Sound Region (almost five times larger than the BINMIC), and functions as a focal point for international industrial activity. It is the center of the Port of Seattle's primary marine shipping area, with deep water berths, piers, shipyards, drydocks, container terminal cranes, on-dock rail, container support yards, cargo distribution and warehousing, oil and petroleum storage facilities, and major railroad yards. The Duwamish is also the location of several large public uses. Close to 42% of the property is publicly owned and includes facilities for the City's public utilities, police, and transit (bus and light rail) maintenance, school district headquarters, post office facilities, Port operations, and King County International Airport.

[32]Parsons Brinkerhoff, The Role of Freight in Seattle's Economy, December 2014.

Figure 10: Industrial Zoning in Seattle and the MICs

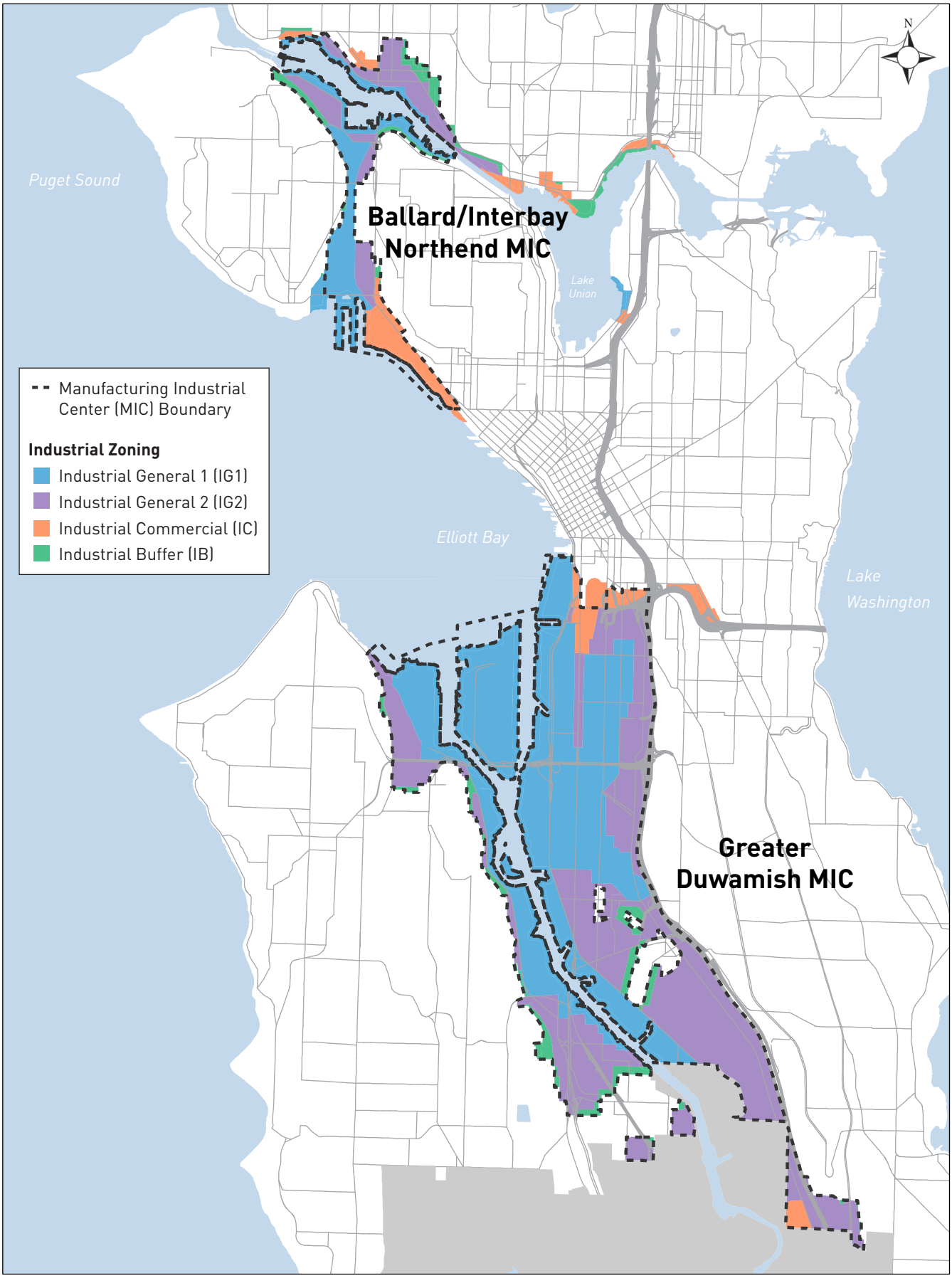
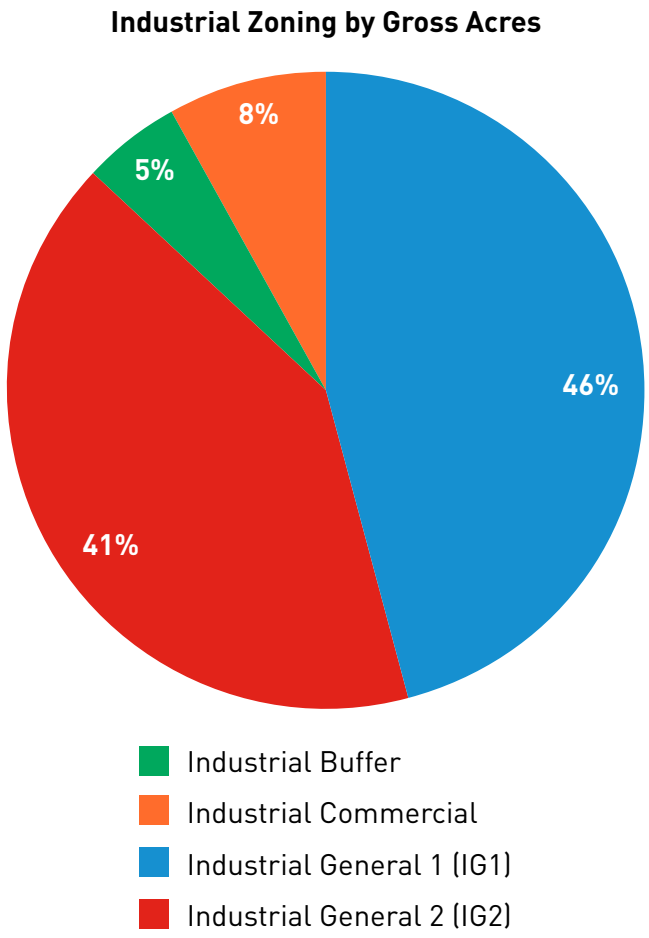


Figure 11: Industrial Zoning Breakdown



The Duwamish MIC is located south of downtown, west of the I-5 corridor, north of the City of Tukwila, along the Duwamish waterway. It covers 4,928 acres of marine and industrial lands. Major land uses in the Duwamish MIC are transportation, utilities or community facilities (39 percent), industrial (21 percent), and warehouses (18 percent), comprising nearly 84 percent of total industrial-zoned land in the City of Seattle.[33]

The Port of Seattle major cargo facilities include Terminals 5, 18, 28, 46 and 115. In 2010, this area included over 50,000 jobs.[34]

Ballard-Interbay-Northend MIC

The Ballard-Interbay-Northend MIC (or BINMIC) is the region's smallest MIC at 932 acres.[35] The BINMIC area is located in the lowland Interbay area between Seattle's Magnolia and Queen Anne Hill neighborhoods, and the northern section includes the industrial areas on either side of the Lake Washington Ship Canal. The central and south sections of this MIC are generally west of 15th Avenue W and Elliot Avenue W northwest of downtown Seattle.

The BINMIC has a generally smaller parcel size with a finer mix of diverse uses than other MICs. These span light manufacturing, maritime, food processing, and warehouse uses, and the BNSF operates its Seattle Interbay rail yard here. The Port of Seattle operates the Fisherman's Terminal along the Ship Canal; T-91, which accommodates a variety of mostly marine-related businesses and the Port's largest cruise terminal; and T-86, the Port's grain elevator. The BINMIC area is a source of high-wage jobs in the Seattle area and contains 14,200 jobs from a diverse group of businesses.[36]

3.0 THE ECONOMIC RELATIONSHIP BETWEEN SEATTLE AND THE FREIGHT INDUSTRY

The two major components of economic activity that generate freight movement in Seattle are 1) the broader Seattle economy , and 2) economic sectors outside Seattle that generate international trade volumes handled through Seattle-region ports.[37]

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[33]City of Seattle Department of Planning and Development, Existing Comprehensive Plan and Duwamish M/IC Policy and Land Use Study, 11/2013, pg 9-15, http://www.seattle.gov/dpd/cs/groups/pan/@pan/documents/web_informational/p1903847.pdf
[34]City of Seattle Department of Planning and Development, Existing Comprehensive Plan and Duwamish M/IC Policy and Land Use Study, 11/2013, pg 7, http://www.seattle.gov/dpd/cs/groups/pan/@pan/documents/web_informational/p1903847.pdf
[35]City of Seattle Department of Planning and Development, Existing Comprehensive Plan and Duwamish M/IC Policy and Land Use Study, 11/2013, pg 9, http://www.seattle.gov/dpd/cs/groups/pan/@pan/documents/web_informational/p1903847.pdf
[36]PSRC, 2013 Regional Centers Monitoring Report, http://www.psrc.org/assets/265/mic-profile-Seattle-Ballard-Interbay.pdf
[37]Parsons Brinkerhoff, The Role of Freight in Seattle's Economy, September 2014.

Seattle's strategic location allows local businesses, especially those that own property, the benefit of being located close to clients and transportation infrastructure and feel that those benefits outweigh the cost savings associated with being located in suburban locations.[38] Continuous investment in infrastructure and the transportation system is critical for retaining and attracting businesses in Seattle.

3.1 ECONOMIC DEVELOPMENT AND COMPETITIVENESS

The freight industry is an economic driver for Seattle, creating jobs and revenue, via state and local taxes, for the local and regional economy. Washington's transportation industry supports over 1 million jobs in the Puget Sound economic area through freight dependent sectors such as agriculture, forestry, construction, and manufacturing – producing nearly $434 billion in gross business income.[39] [40]A reliable transportation network for the movement of goods is vital to:

- Ensure fast and dependable deliveries
- Ensure confidence in existing business and industry sectors
- Encourage additional and diverse businesses to locate in Seattle
- Generate additional jobs, businesses and tax revenue

Trucks and commercial vehicles are critical to the economic vitality of the city, as they account for a vast majority of goods movement into, and within, the city. Due to congestion on city streets and the highway system, combined with the volume of goods movement, trucks and commercial vehicles both contribute to traffic congestion and experience higher costs as a result of wasted time, missed deliveries, and parking tickets. Costs are passed to receivers, raising the cost of doing business, and the cost of living in the city. Well thought-out multimodal corridors can have significant benefits, reducing costs and enhancing the competitiveness of our communities, city, and region.[41]

Seattle region ports and airports represent one of the major US gateways for international trade—especially with Asian countries. Imports flow into the region and feed both local wholesale and retail trade portions of the supply chain, helping meet consumer and business demand. A significant share of waterborne imports is destined to US inland regions. Whether to local regions or more distant locations, the cargo is moved by the local transportation service industry with employment and incomes contributing to the local economy.[42]

According to Port of Seattle statistics, the Port handled a total of 1.6 million twenty-foot equivalent units (TEUs) of containers in 2013, down from a peak of 2.2 million in 2010. Container shipping is different from conventional shipping because it uses 'containers' of various standard sizes - 20 foot (6.09 m), 40 foot (12.18 m) , 45 foot (13.7 m), 48 foot (14.6 m), and 53 foot (16.15 m) - to load, transport, and unload goods. As a result, containers can be moved seamlessly between ships, trucks and trains. The two most important, and most commonly used sizes today, are the 20-foot and 40-foot lengths. The 20-foot container, referred to as a Twenty-foot Equivalent Unit (TEU)

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[38]City Of Seattle Office of Economic Development, Basic Industries Economic Impact Analysis, July 2009
[39]Washington State Freight Advisory Committee, Washington State Freight Trends & Policy Recommendations for Air Cargo, Freight Rail, Ports & Inland Waterways, & Trucking, May 2014, http://www.fmsib.wa.gov/fac/20140602-FINALComplete%20Folio_for%20printer5-7-14.pdf
[40]Association of Washington Business, Association of Washington Cities, and Washington State Association of Counties, Treatment Technology Review and Assessment, December 2013, http://www.awb.org/hdrtechreport/
[41]New York City Department of Transportation, 2010 Sustainable Street Index, Off-Hour Deliveries, http://www.nyc.gov/html/dot/downloads/pdf/ssi10-offhour.pdf
[42]Parsons Brinkerhoff, The Role of Freight in Seattle's Economy, September 2014.

became the industry standard reference so now cargo volume and vessel capacity are commonly measured in TEU.[43] The 2013 volume translates to roughly 900,000 full and empty containers.

The population and employment of the Pacific Northwest comprises a relatively small percentage of the United States' total population and employment. As a result, there is a limited market for goods that are consumed or produced in the Pacific Northwest. Therefore, the majority of import cargo handled at Port of Seattle terminals is discretionary cargo – cargo destined for inland markets that could enter the country at any seaport. Much of the import cargo that enters port terminals moves via rail (known as intermodal cargo) to markets in the Midwestern and Eastern United States. Direct rail intermodal cargo is drayed to one of the two near-dock intermodal yards—SIG and Argo—or loaded onto trains at one of the two on-dock rail yards located within Terminals 5 and 18. Import containers may also be trucked to a local warehouse or distribution center, repackaged from an ocean-going 20 or 40 foot to a 53 foot domestic container, and then trucked to a nearby rail yard for inland transport.[44]

In 2012, 40% of the total port throughput was moved by direct rail, which included containers that were drayed (trucked) to near-dock intermodal yards at SIG (for the BNSF Railway) and Argo (for the Union Pacific) or loaded onto and from trains directly at T-5 and T-18. This is down from a high of 57% in 2007.

The remaining 60% of the containers were moved by truck to or from local and regional businesses, warehouses or distribution centers. Keeping discretionary cargo moving through the Port of Seattle is important for Washington's agriculture industry because it provides empty containers that can be filled with agricultural products from Eastern Washington. After discharging import containers, ships calling at the Port of Seattle load full export and empty containers for the trip back to Asia. In 2013, an average day at the Port of Seattle in 2013 had about 2,700 trucks entering the four container terminals, which generated a total of 5,400 one-way truck trips per day.[2] Of these, about 30% were local dray trips to the near-dock intermodal terminals, and another 5% were to local businesses located in the Duwamish industrial area.[3] [45]

3.1.1 EMPLOYMENT

The principal measure of regional economic activity by industry is employment. Seattle's top six largest employment sectors are considered service-providing: professional and business services; education and health services; trade transportation and utilities; leisure and hospitality; government; and financial activities (Figure 12). Again, due to the Port and related industries, trade plays a big role in our economy. Seattle had the 15th highest trade value of US metropolitan areas in 2010.[46]

The goods movement sector creates well-paying jobs for both skilled and unskilled workers, which typically include benefits such as health insurance, retirement packages, and others. Many employees live throughout the region, hence the whole region's economy benefits from these jobs and continuing efforts are made to keep these jobs in the area and not lose them due to adverse business conditions.

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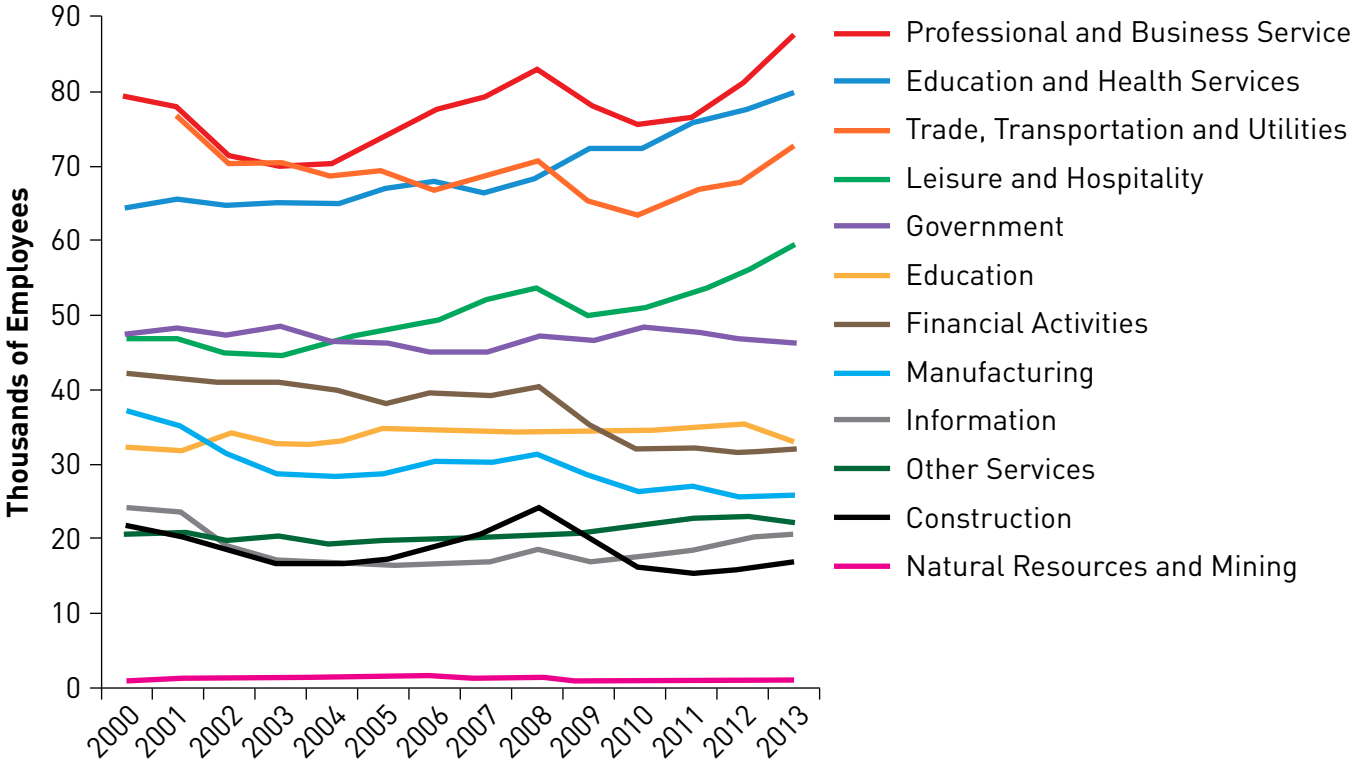
[43]World Shipping Council, Containers, 2014, http://www.worldshipping.org/about-the-industry/containers
[44]Industrial Areas Freight Access Project, Transpo Group
[2]Heffron Transportation, May 2014.
[3]Parsons Brinkerhoff, The Role of Freight in Seattle's Economy, December 2014.
[45]Parsons Brinkerhoff, The Role of Freight in Seattle's Economy, December 2014.
[46]Adie Tomer, Robert Puentes, and Joseph Kane, Metro-to-Metro: Global and Domestic Goods Trade in Metropolitan America, October 2013, http://www.brookings.edu/~/media/research/files/reports/2013/10/21%20metro%20freight/srvymetrotometro.pdf

Figure 12: Seattle's Employment by Major Economic Sector[47]



In 2012, WSDOT determined that a 20 percent increase in congestion would cost the state 29,500 jobs and $4.6 billion in economic output. Overall, this represents about 0.7% loss in employment and output statewide.[48] While increased congestion forces industries to add employees and assets, these are more than off-set as consumers have to pay more for these products and have less to spend in other areas.

In the Puget Sound region, where freight dependent industries are concentrated, these losses are even more staggering. The study estimated that the Puget Sound region would lose an estimated 21,700 jobs and $3.6 billion in output. With a 20 percent increase in congestion, the region is estimated to lose 0.9% of its employment and 0.82 percent of its economic output.[49] [50]

3.1.2 TOP FREIGHT-GENERATING INDUSTRIES

Retail trade, wholesale trade, and manufacturing (the principal goods-producing industry) are high freight-generating industries in Seattle. The next three major industry sectors – government; transportation and utilities; and information– are all relatively low freight generators. The remaining major industry groups of professional and business services; financial activities; leisure and hospitality; other services; natural resources

[47]Puget Sound Regional Council and Parsons Brinkerhoff analysis
[48]Washington State Department of Transportation and Freight Policy Transportation Institute Washington State University, the Economic Impact of Increased Congestion for Freight-Dependent Business in Washington State, January 2012, http://www.wsdot.wa.gov/NR/rdonlyres/0DA2A843-8BC3-41B7-A0F3-C72A610BEA90/0/EconomicImpactCongestion.pdf
[49]The Role of Freight in Seattle's Economy, Parsons Brinkerhoff, September 2014
[50]Washington State Department of Transportation and Freight Policy Transportation Institute, 2010, http://www.wsdot.wa.gov/NR/rdonlyres/0DA2A843-8BC3-41B7-A0F3-C72A610BEA90/0/EconomicImpactCongestion.pdf

and mining; and education and health services are all very low freight generators.

Retail trade is one of Seattle's biggest economic sectors and is the largest freight-generating industry sector. Retail trade's use of trucking and warehousing represents a very high 3.4% share of total industry output according to the US Input-Output data (I-O). The I-O accounts show how industries interact; specifically, they show how industries provide input to, and use output from, each other to produce Gross Domestic Product (GDP). These accounts provide detailed information on the flows of the goods and services that comprise the production process of industries. Within the overall retail trade sector, general merchandise and food and beverage stores have high total outputs, 7.2% and 4.6% respectively. Retail sector freight is generated by goods moving from distribution centers and warehouses to retail stores. This freight is almost universally carried by truck.[51]

Retail trends

The retail sector is witnessing a shift from an old siloed perspective that separated e-commerce from brick-and-mortar store operations to a more comprehensive focus on omni-channel retail.[52] Within this new omni-channel orientation, considerable attention has been paid to the consumer end of things, as companies try to create a customer experience that involves the advantages of both the online and in-store platform. E-commerce providers are offering same-day or next-day deliveries to compete with the immediacy of in-store purchasing. At the same time, traditional retailers are developing a more digital relationship to their in-store customers, through use of cell phone apps and digital tracking.

Perhaps even more importantly, the omni-channel phenomenon is motivating a comparable shift in logistics approaches that combine logistics operations for both direct-to consumer and store needs. For example, Macy's has begun operating 500 of its stores as mini-distribution centers for e-commerce.[53] Home Depot is developing a nationwide network of direct fulfillment centers to process orders for both home delivery and pickup at their stores. Combined distribution approaches and merging of the fulfillment cycle can be used to maximize customer flexibility and offer a competitive advantage. Already customers can order products online and pick them up in stores. Alternatively, a customer might view and purchase a product in store, but then have the product delivered to their home on the same day.

Apart from the omni-channel nature of logistics requirements, there are other trends in retail distribution that are related to the rise of e-commerce. These include:

- Increasing need to process and redirect returned goods;
- Growing capacity requirements for peak demand periods; and
- A shift of distribution center networks to be closer to customer markets.

Beyond the trend towards rapid direct-fulfillment, retail, along with other major industries, is also experiencing an independent, and at times, conflicting trends towards "green logistics." Companies such as Dell and Recreational Equipment Inc. (REI) have implemented comprehensive programs that involve reduced packaging, materials recycling, load optimization, and modal shift strategies to reduce the environmental impacts of the supply chain.

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[51]Parsons Brinkerhoff, The Role of Freight in Seattle's Economy, September 2014.
[52]Omni-channel retail provides the consumer with the ability to shop through many possible methods, including mobile internet devices, computers, brick-and-mortar, television, radio, direct mail, and catalog.
[53]Antonio Regalado, MIT Technology Review, It's all e-commerce now, November 2013, http://www.technologyreview.com/news/520786/its-all-e-commerce-now/

Finally, there are shifts in distribution centers toward increased automation and toward the incorporation of final-stage manufacturing/value-added functions into the fulfillment process.

Various companies in the US (Amazon and UPS) and in some European cities (UPS Germany) have invested in package pick-up and delivery fleets using bicycle models that can accommodate a larger number of packages than the traditional bicycle messenger. They navigate in areas where traditional delivery vehicles don't have access or where parking is expensive and highly restricted. These fleets tend to operate seasonally (Christmas holidays) and where the geography for bicycle operations provides and economic edge based on faster deliveries on busy streets.[54]

Urban delivery services have also been challenged by just-in-time (JIT) deliveries which have led freight business deliveries to make more efficient trips with smaller shipments and vehicles to dense mixed-use areas.[55] The costs of a missed delivery due to congestion, road closures, or other reasons are high given the just-in-time nature of production. Any delay slows the entire assembly process or can leave store shelves without stock.

Wholesale trends

Wholesale trade includes merchant wholesalers that supply products across a broad spectrum of durable and nondurable consumer and industrial products. The industry's use of trucking and warehousing ranks as the number two freight generating industry. In addition, the portion of total industry output represented by trucking and warehousing is a relatively high 1.2%. These products range from consumer durable goods, such as motor vehicles and parts; appliances; and industrial materials, to non-durables, such as food, apparel and gasoline and are delivered to both retail stores and businesses.[56]

Manufacturing trends

Manufacturing is the second largest of the major freight-generating industries in terms of Seattle employment, but the third largest industry in terms trucking and warehousing services' share of total industry output. In aggregate, the sectors' use of these services at the national level actually represents a very small 0.1% of output, an order of magnitude less than the much larger shares in retail trade (3.4%) or wholesale trade (1.2%). Outputs of manufacturing processes include products ranging from industrial materials such as primary metals; intermediate products, e.g. fabricated metals; and final goods including airplanes, food and apparel. Each of these products represents a freight output transported to local markets, US regional markets or are exported. By far the largest category of manufacturing in the Seattle area are transportation equipment (automotive, aerospace, railroad and ships) which includes Boeing and its local suppliers as well as Paccar and local shipyards.

The final goods that are manufactured, from airplanes to seafood, are more likely to be destined to markets in the US or overseas than headed to local consumption. Along with many service industries manufacturing represents the direct "exports" to the US and overseas that help drive Seattle's economy and jobs.

3.1.3 SUPPLY CHAIN

A supply chain consists of a group of human and physical entities including procurement specialists, wholesalers, logistics managers,

[54]Matt Amato, Double take: Did I just see a package-carrying bicycle roll by?, http://compass.ups.com/BlogDetail.aspx?id=4294967333
[55]National Cooperative Freight Research Program, Report 14, Understanding Urban Goods Movement, January 2012, http://onlinepubs.trb.org/onlinepubs/ncfrp/ncfrp_rpt_014.pdf
[56]Parsons Brinkerhoff, The Role of Freight in Seattle's Economy, December 2014

manufacturing plants, distribution centers, and retail outlets, linked by information and transportation in a seamless, integrated network to supply goods or services from the source of production through the point of consumption. Speed to market is one of the most important factors in supply chain design and execution, as it influences mode selection by commodity type.

There are profound changes occurring in the supply chains and logistics systems used to get goods to consumers including electronic markets and direct delivery. As a result, the patterns of truck transportation services, and the size of trucks employed in these services may change but the total volume of goods trucked is likely to rise in proportion to increasing consumer demands for goods.

3.2 LIVABILITY

Goods movement benefits residents and businesses by reducing the cost of shipping goods and contributing to the economic growth of Seattle, resulting in more affordability and a higher quality of life. Goods movement contains unintended consequences in the form of congestion, noise, and pollution. Because of these negative impacts, it is critical that freight be delivered as efficiently and sustainably as possible.

Growth forecasts for the City of Seattle estimate that by 2035 there will be 120,000 new people and 115,000 jobs within city limits. That is more growth than Seattle experienced over the last twenty years. Without intervention, this will increase's freight impact on congestion and climate change.

Residents rely on efficient freight mobility through both the convenience that freight allows for daily life as well as necessity and desire for goods and services. For example, those who live in Seattle depend upon weekly and bi-weekly garbage, recycling and composting services to be picked up from their residence and pay for an external company to dispose of the trash. People who live, work, and spend time in Seattle rely on restaurants, coffee shops, bars, grocery stores, retail shops, etc. to sell them goods that they desire.

Businesses, like residents, rely on the transportation system to move goods within the city, region, state, country, and international on a daily basis. Business expectation is a safe, efficient and resilient freight system ensuring that goods are transported to customers where and when they are needed.

3.3 FREIGHT IMPACTS

While it is important to recognize the economic importance of goods movement, it is also important to address community concerns and quality of life issues associated with goods movement. Freight mobility does generate negative externalities that affect public health and environmental health. Goods movement causes air pollution, noise, is a part of congestion, potential safety issues, and visual blight. These impacts are most directly felt by people who live near ports, rail yards, freeways, railways, warehouses, and distribution centers. Port and intermodal yards are air pollution "hot spots" due to concentration of truck traffic and the prevalence of older and more polluting trucks.[57]

Sustainable freight practices result in a "win" for businesses, consumers, residents, and the environment. Using cleaner fuels, such as natural gas and electricity, reduces both emissions and costs and applying sustainable development and operations practices to the freight industry reduces energy and water consumption, as well as emissions, landfill waste, and urban storm water runoff.

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[57]Laetitia Dablanc, Genevieve Giuliano, Kevin Holliday, and Thomas O'Brien, Best Practices in Urban Freight Management: Lessons from an International Survey, Transportation Research Board, August 2013, https://hal.archives-ouvertes.fr/hal-00854997/document

Environmental impacts

Air emissions from diesel engines have been shown to cause cancer and a variety of respiratory problems. These emissions are widespread since diesel engines power trucks, locomotives, ship and cargo handling equipment – most vehicles involved in the goods movement.[58] Additionally, Seattle's Climate Action Plan has stated that the transportation sector accounts for 40% of Seattle's greenhouse gas (GHG) emissions. Encouraging efforts to buy locally will help reduce vehicle miles traveled (VMT) and thus create fewer greenhouse gas emissions.

Retail, along with other major industries, is experiencing an independent, and at times, conflicting trends towards "green logistics." As mentioned previously, companies such as Dell and Recreational Equipment Inc. (REI) have implemented comprehensive programs that involve reduced packaging, materials recycling, load optimization, and modal shift strategies to reduce the environmental impacts of the supply chain.

Social impacts

Goods movement can be noisy for neighboring communities and negatively impact local residents. Reduction of noise exposure is important to residents that may live near or adjacent to major truck-related businesses or rail lines or airports, like those in the Manufacturing and Industrial Centers or the King County International Airport. Some typical measures to shield residents from truck induces noise include installation of noise barriers, the sound-proofing of structures, and/or routing truck traffic to reduce noise exposure and for airplane noise, a noise abatement program in part of KCIA business model and have $68M on home insulation in Georgetown, Beacon Hill and Tukwila neighborhoods.[59]

Health Impacts

Some goods movement activities can negatively impact air quality and health of residents living near freight routes and facilities. The health risks (potential for disease) of exposure to many pollutants is well understood, and it is well established that low-income and/or minority populations are disproportionately exposed to pollution and increased health risks because of their proximity to pollution sources such as industrial facilities, highways, low income housing (lead), and agricultural areas (pesticide application).[60] The Duwamish Valley Cumulative Health Impacts Analysis (CHIA) supports the identification of Seattle's 98108 ZIP code (Georgetown/Beacon Hill/South Park) as a geographic area with disproportionate health burdens and fewer health benefits as compared to other areas of Seattle. These disproportionate burdens are a result of the cumulative impact of social and environmental vulnerabilities, including socioeconomic factors, sensitive populations, environmental exposures and effects, and public health effects.

3.4 SUSTAINABLE FREIGHT PRACTICES

A further trend affecting large companies, including large retailers and e-commerce entities, is efforts towards "green logistics". Green logistics has three primary dimensions, some of them reflecting a related business interest in energy and fuel economy:[61] These

[58]California State Department of Transportation, Healthy Communities and Healthy Economies: A Toolkit for Goods Movement, March 2009, http://www.rctc.org/uploads/media_items/healthy-communities-and-healthy-economies-a-toolkit-for-goods-movement.original.pdf

[59]Ontario Trucking Association, Local Truck Routes: A Guide for Municipal Officials, December 2011, http://www.omkn.ca/OMKN-Docs/Best-Practices/Beneficial-Reports/111201OTAGuideFINAL.aspx

[60]Linn Gould and BJ Cummings, Duwamish Valley Cumulative Health Impacts Analysis: Seattle, Washington, Just Health Action and Duwamish River Cleanup, March 2013, http://duwamishcleanup.org/wp-content/uploads/2013/03/CHIA_low_res.pdf

[61]Dr. Jean-Paul Rodrigue, the Geography of Transportation System, Hofstra University, http://people.hofstra.edu/geotrans/eng/ch8en/appl8en/logistic_green_dimensions.html

factors are affecting how supply chain networks are constructed and managed, and the types of support they require.

- Product design and production planning: production process, near sourcing strategies, application of environmental standards
- Physical distribution: better consolidation of loads, modal shift, fuel consumption improvements to vehicle fleets
- Materials management: more efficient packaging, recycling ("reverse logistics"), turning waste into inputs

Truck technology (automatic idling turn-off, for example) and fuel innovation have helped companies who pursue environmental-conscious business practices to become better partners and lead the way to cut emissions. The Port of Seattle has a Clean Truck Program and is systematically replacing older heavy-duty drayage trucks with trucks powered by 2010 or newer certified engines. Trucks are using ultra low sulfur diesel and the latest generation diesel engines are the cleanest burning in trucking history.

Portions of the trucking industry are converting to natural gas either by retrofitting their current engines or by purchasing natural gas engines during normal fleet replacement. LNG configured heavy-duty tractors combine strong pulling power and long range so they compete operationally with comparable diesel-powered tractors while offering a lower emission profile and cost less to operate. The challenge natural gas faces is fueling infrastructure and equipment cost in comparison to standard diesel trucks. The liquid natural gas (LNG)/compressed natural gas (CNG) fueling network is experiencing growth nationwide. Creating a critical mass of natural gas users will result in lower equipment and infrastructure prices. It's a fine balance between equipment and infrastructure as operators need available fueling stations, while fueling stations require demand to survive. Companies with large truck fleets are investing in the retrofit of diesel to LNG engines realizing large savings in fuel consumption.

Natural gas is much cleaner than diesel. There are still concerns about how natural gas is extracted from origin locations. Unless these are resolved or more environmentally friendly sources (such as compost) fully develop, it might remain a transition fuel on the path to something more sustainable in the long term.

Other ways businesses and sectors are contributing to better efficiencies are both private and for hire freight carriers using routing optimization software, cross dock programs, and long combination vehicles (when possible) to maximize truck capacity, and minimize trucks on the road. Though due to vehicle miles traveled and corresponding greenhouse gas emissions is not acceptable and private-public partnerships should determine incentives to upgrade fleets to reduce to move goods via a truck.

4.0 FREIGHT ROADWAY SYSTEM

Freight movement supports the daily functions of every business and household in Seattle through a distribution system. Seattle has built infrastructure in the form of ports, airports, and road network that make it a desirable location for businesses that need access, mobility and efficiency to bring and distribute products to the region and international markets in a timely manner. Efficient movement of freight is critical to Seattle's economy. Establishing a baseline of Seattle's freight network will help residents, business owners and operators understand how freight operates in the city.

Streets are the backbone of Seattle's ground transportation system. The public right of way accounts for over one quarter of Seattle's land area and as Seattle is already a built out city, very little land is available for new roadways. Seattle has been ranked 8th in the nation for traffic congestion, suggesting that Seattle possesses little reserve capacity.

Seattle has over 1,100 miles of roadways, including interstate highways, state highways, and arterial roadways that connect the Port,

intermodal facilities, residences and businesses to the region. Of those roads, 142 miles are designated as Major Truck Streets by the city (Figure 4). Because of severe geographic and topological constraints, including multiple bodies of water and steep terrain, Seattle's roadway network is generally funneled through several major routes that connect areas and neighborhoods to the rest of the metro area. The major connections between Seattle and the rest of the region and country are I-5 and SR-99 for north/south connections; and I-90 and SR-520 for east/west connections.

4.1 TRUCK TRAFFIC VOLUMES

The City of Seattle has an ongoing traffic count program to collect counts on city streets via tube count devices. These counts are used to monitor traffic patterns throughout the city by hour of day and day of week. The count devices record traffic at each location for approximately one week at a time. The City has performed truck counts at 780 locations over a four year period.

Truck traffic on Seattle streets fluctuates throughout the year based on street location, street type, and truck type. It also varies by day of the week and time of day. Because of this variability, it is important to adjust traffic count data if it is going to be reported as average weekday traffic (AWDT). This adjustment normalizes the count to a "typical weekday" so that the reported counts are not over- or under-stating the traffic based on a count that captured traffic conditions for only a limited time.

Ideally, to develop adjustment factors, traffic counts would be taken continuously throughout the city, so that these variations can be measured and accounted for. Unfortunately, this is not realistic given the limited traffic counting devices available, and the cost associated with installing permanent counters city-wide.

WSDOT has permanent traffic counters located on state owned facilities. In the Seattle metro area, this includes 21 Interstate count locations and 13 arterial State-Route count locations. These counts were used to generate representative adjustment factors by truck type, year, and month for city streets.

Other published truck-specific seasonal factors were used to account for the difference between highways and arterials. Ohio State DOT provided adjustment factors for interstates, expressways, arterials, and local roads. Due to commonalities between uses of interstates versus arterial, it was assumed that the WSDOT interstate adjustment factors would relate to arterial and local road factors in a manner similar to the Ohio data.

The resulting adjustment factors were used to develop average weekday truck volumes for 2014 shown in Figure 13. As can be seen, the highest daily truck volumes in the city are experienced on the West Seattle Bridge and Aurora Avenue N. First Avenue S and 4th Avenue S also carry significant traffic to and from the Duwamish MIC to surrounding industrial areas and highways.

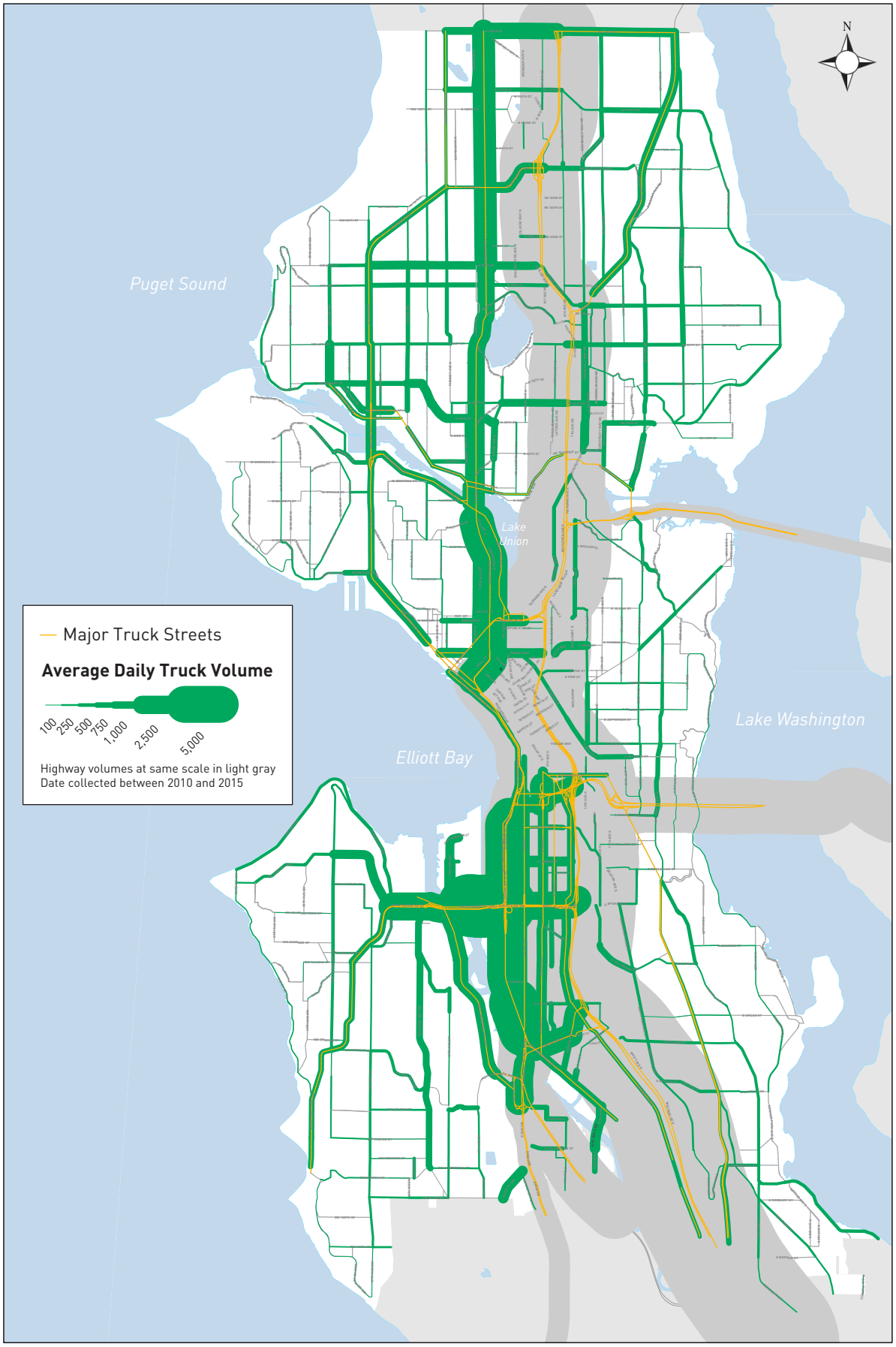
Major Truck Streets that carry significant daily truck volumes (over 1500 per day), include:

- N 145th Street west of I-5
- 4th Avenue S in Duwamish MIC area
- West Marginal Way SW, south of the West Seattle Bridge
- 1st Avenue S in Duwamish MIC area
- 15th Avenue W, south of the Ballard Bridge
- Greenwood Avenue N, north of Holman Road
- Holman Road NW, west of I-5

While not on the existing Major Truck Street network, several other streets provide logical connections between major facilities and carry 1000+ trucks per day, these include:

- NE 65th Street, east of I-5
- 85th Street between SR-99 and 15th Avenue NW
- SW Roxbury Street west of Delridge Way SW
- Fremont Avenue N, north of the Fremont Bridge
- E Olive Way, east of I-5

Figure 13: Average Daily Truck Volumes



- SW Admiral Way, west of the West Seattle Bridge
- N 46th Street, west of SR-99
- N 50th Street, west of I-5
- NE 125th Street, east of I-5
- NW Leary Way, west of 15th Avenue NW

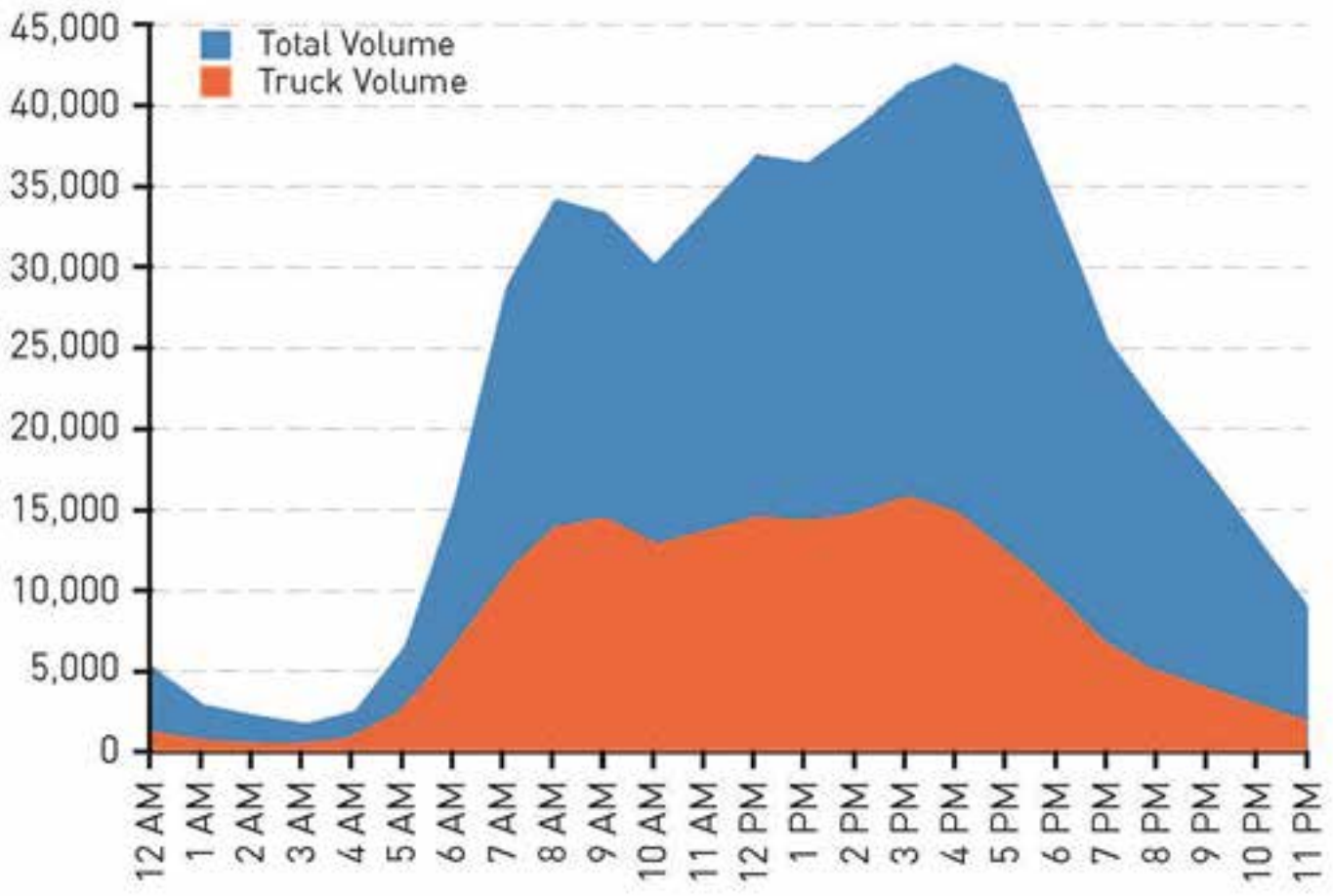
Analysis on 12 corridors with the highest truck volumes show that truck trips typically peak in the morning between 8:00 AM and 9:00 AM and stay relatively constant until the end of the evening rush hour period around 7:00 PM. This truck travel pattern is shown on Figure 14 and follows approximately the same patterns as autos, except that autos have a higher peak in the PM peak period and for trucks the AM and PM peaks are comparable.

Seattle area shippers and receivers depend on trucks to provide timely, reliable service. However, most roadways in the metro area experience some level of congestion, particularly in the AM and PM peak travel periods. This congestion increases cost and decreases reliability of truck freight service.

Many businesses are aware of daily bottlenecks and allow extra time for deliveries or take alternate routes. Some plan operations so that trucks can be on the roads during off peak times. They will often rely on driver knowledge or Google maps to provide traffic conditions and decide on optimal routing.

Current congestion patterns in Seattle follow similar patterns in the AM and PM peak periods.

Figure 14: Time of Day Patterns



4.2 COLLISIONS

Vehicle crashes occur throughout the city and have a high cost for all roadway users. The State of Washington has a Target Zero plan in place for collisions on highways with the goal of zero traffic fatalities and zero serious injuries by the year 2030. Seattle has a shared goal of eliminating traffic deaths and serious injuries by 2030. In 2015, the City will roll out a series of activities to get toward zero. Crashes involving freight vehicles are perhaps even more of a concern, in that due to the relative size of vehicles, crashes can be disproportionately damaging.

A recent study conducted by SDOT, "Seattle Industrial Areas Freight Access Project", indicates that in the city's Manufacturing and Industrial Centers (MICs), truck collision rates (measured in number of collisions per million vehicle miles travelled (MVMT)) are slightly lower than all vehicle collision rates. Analysis for the FMP shows that city-wide however, truck and all vehicle collision rates are relatively similar.

Truck crashes have increased slightly in 2013 compared to previous years, which may correspond to increased goods movement as a result of the economic recovery. Over 77% of truck collisions resulted in property damage only (compared to 60% for all vehicles) and just less than 20% resulted in injuries (compared to 25% for all vehicles). While those numbers compare favorably to all vehicle collisions, there were proportionately more fatalities in truck crashes (less than 0.40%) as compared to all vehicles (0.14%). The slightly greater propensity for fatalities in collisions involving trucks may be due to the sometimes significant differences in sizes of vehicles involved in truck crashes, particularly truck collisions with other modes (i.e., passenger cars, bicycles or pedestrians).

High truck crash locations (with 6 or more crashes) include the following:

- Holman Road NW/Greenwood Avenue N
- Valley Street/Fairview Avenue N
- SR 99 and the Western/Battery Street ramps
- S Horton Street/4th Avenue S
- SW Spokane Street/West Marginal Way SW
- S Spokane Street/East Marginal Way S/ SR 99
- S Spokane Street/1st Avenue S
- S Spokane Street/4th Avenue S
- Diagonal Avenue S/SR 99
- S Dawson Street/4th Avenue S
- East Marginal Way S/SR 99/1st Avenue S
- S Michigan Street/East Marginal Way S

4.3 MOBILITY CONSTRAINTS

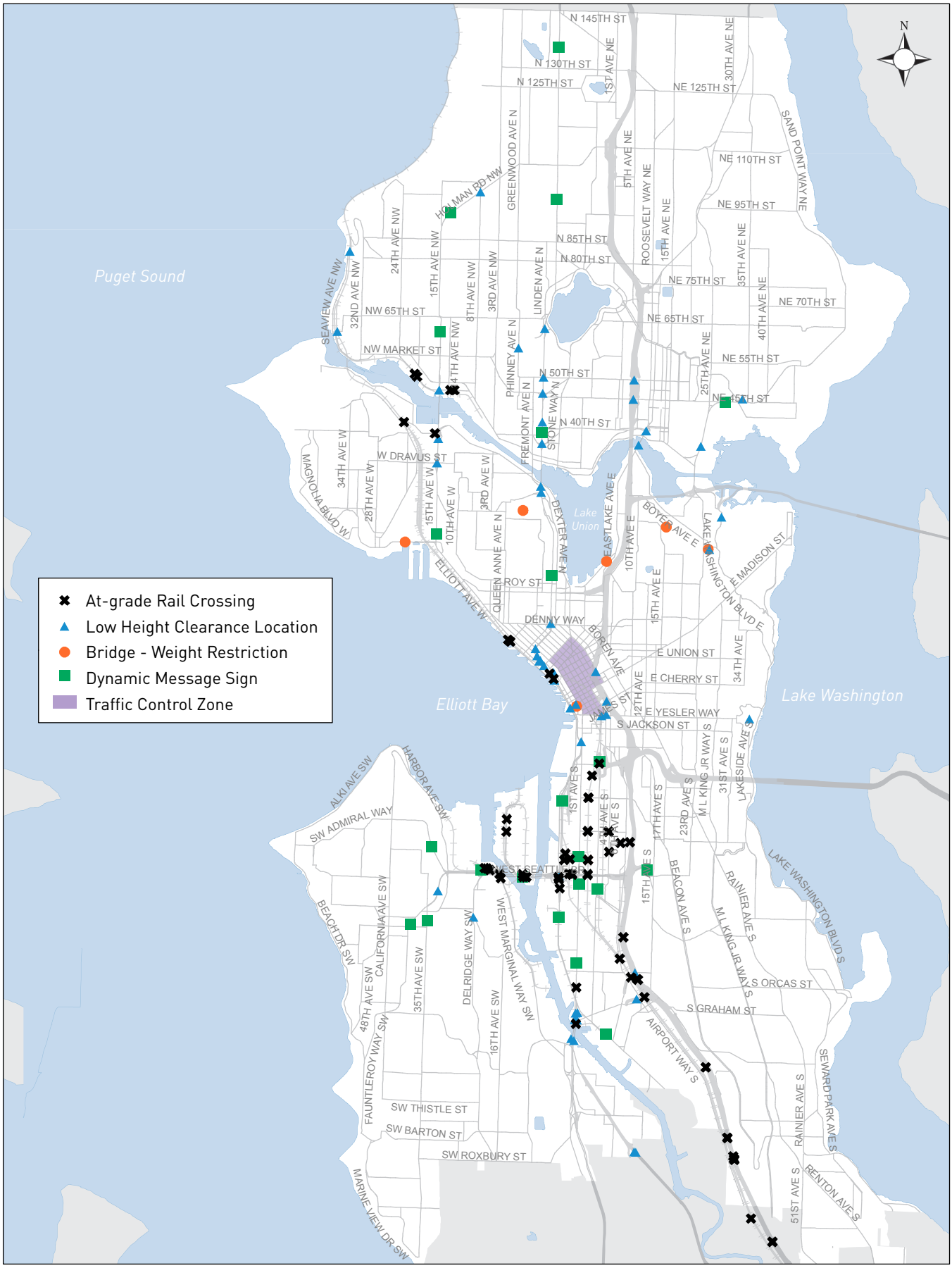
Mobility constraints include bottlenecks or barriers on the transportation network that impact freight access. Some of these constraints are in locations that may delay the general traffic stream and therefore impact freight, while others are specific challenges for large trucks such as insufficient turning radii, or lack of freight load zones. The following constraints, shown in Figure 15, were identified as potential challenges for trucks effectively delivering freight:

- Signage
- Movable Bridges
- Downtown Traffic Control Zone
- Truck Restrictions
- At Grade Rail Crossings
- Geometric Constraint
- Lack or Shortage of Commercial Load Zones

Bottleneck locations include bridge crossings along key freight corridors because the bridges serve as a singular crossing point for a number of local streets. Congestion at these locations has major downstream effects that impact not only the primary roadway served by the bridge but also many additional side roads and interchanges. For example, congestion on the Ballard Bridge can cause backups on Nickerson Street, Market Street, and other local roads.

All major Interstate and State highways are at or near capacity for the peak periods. This means that not only is local traffic and truck mobility impacted, but longer-distance through-trips are delayed as well. I-5 and to a lesser degree SR-99, are congested throughout the city. Other key

Figure 15: Freight Mobility Constraints



facilities that carry high truck volumes and operate with high levels of peak hour congestion include:

- Lake City Way (SR-522),
- Fauntleroy Avenue SW south of the Alaska Junction,
- Fremont Avenue N north of the Fremont Bridge,
- Portions of Greenwood Avenue N in north Seattle.

The majority of bottleneck locations citywide are on roads that are part of the Major Truck Street network which impacts reliability of service for trucks.

Signage

Three types of truck-specific signage are used within the city: regulatory, guide, and warning signs. Guide signs are mostly focused on the Major Truck Street system as shown in Figure 15. Regulatory signs include loading zone designations, parking restrictions, and weight restrictions. Examples of warning signs include bridges with height restrictions, tight turns, and steep grades.

Moveable bridges

There are six bascule (draw) bridges and one swing bridge that can disrupt vehicular traffic on major arterials in Seattle when opened for marine traffic. Four of these bridges—Montlake, University, Fremont and Ballard—cross the Lake Washington Ship Canal, and can be locations of bottleneck to all north-south traffic between downtown and north Seattle if the bridges are open during the rush hour period or for prolonged times.

Three of the bridges —Spokane Street, First Avenue S and South Park—cross the Duwamish River. The South Park Bridge is owned by King County, but is operated by SDOT. The South Park Bridge does not need to open for the passage of vessels from 6:30–8:30am and 3:30-5:00pm, Monday through Friday, except Federal Holidays.

When bridges open to allow a vessel to pass through during rush hour periods, they can cause very long vehicle queues and lingering congestion. This is most prevalent during the "boating season" (late spring, summer, and early fall) when a larger number of recreational private sailboats require bridge openings. Since many truck drivers avoid traveling in the peak periods to avoid congestion, they can be more impacted by off-peak bridge opening delays.

Downtown traffic control zone and Denny Way restrictions

Trucks longer than 30 feet are prohibited from entering the Downtown Traffic Control Zone between 7:00 A.M. and 7:00 P.M. except with a permit (Seattle Municipal Code (SMC) 11.62.080). The Downtown Traffic Control Zone extends from Yesler Way on the south to Lenora Street on the north and from 8th Avenue on the east to 1st Avenue on the west. The SMC also prohibits large trucks (over 30-feet long) from using Denny Way between Western Avenue and Olive Way during the commuter peak periods (7:00 to 9:00 A.M. and 4:00 to 6:00 P.M.) (SMC 11.62.120).

Truck restrictions

Trucks can be restricted on routes throughout the city due to height, weight, or materials. A number of travel restrictions for trucks are shown on Figure 14. The presence of over-height restrictions on freight routes decreases system efficiency by requiring trucks to take a circuitous route with increased travel time. Clearances less than 14'0" can also result in property damage to both public bridges and freight vehicles.[62] Over-weight restrictions also decrease system efficiency. Most restrictions are not on Major Truck Streets, but still need to be considered for trucks making deliveries to local businesses and possibly to residences. Additionally, there will be materials restrictions in the new Alaskan Way Viaduct tunnel, which will be a barrier for trucks carrying flammable materials.

[62]Industrial Areas Freight Access Project, Transpo Group

At-grade rail crossings

At-grade rail crossings pose safety issues and create delays for truck freight. The impact on vehicular traffic at the at-grade rail crossings depend on both the duration and frequency of trains. There are several at-grade rail crossings throughout the city, as shown in Figure 14. These can be a barrier to truck movements, with particularly large impacts in high truck activity areas such as the Duwamish MIC. However rail movements are also vital for freight movement to/from the Port; hence prioritizing one over the other creates difficult trade-off decisions.

Geometric constraints

Stakeholders have said that geometric constraints are one of the top two safety concerns within the city. Some respondents indicated that many of the conflicts truck drivers face were due to rerouting onto local streets in an attempt to avoid congestion. These roads are often narrow and are not always designed with large trucks in mind. An example common on some local streets would be traffic calming devices like neighborhood traffic circles.

This concern would need to be addressed carefully and balance the needs of freight against residential livability. While all streets need to allow local delivers, many local streets are not appropriate for large trucks. Improving the travel conditions on arterials roads will encourage trucks to use these streets and not look for alternatives routes on smaller residential streets.

Large vehicles make urban neighborhood deliveries increasingly difficult from a physical standpoint. Simultaneously, neighborhood residents want more restrictions on noise and disruption associated with large trucks. In Seattle, truck operations at many grocery stores are restricted during the evening. Businesses recognize that smaller, 24- to 28-foot trucks operate more nimbly thus deliver the same amount of goods during a day with less stress because the driver can get around much more easily.

4.4 CURB SPACE ACCESS

Curb space is part of the public street system, and as such it is a public good that is available for all people to use. The Seattle Department of Transportation regulates the use of curb space to address competing needs, to assist in moving people and goods more efficiently, to support the vitality of business districts, and to create livable neighborhoods. The Department prioritizes the uses for curb space as follows:

In residential areas the priorities for curb space use are:

- transit use (bus stops and spaces for bus layover),
- passenger and commercial vehicle loading zones,
- parking for local residents and for shared vehicles, and
- vehicular capacity.

In business or commercial areas, including blocks with mixed-use buildings containing residential units, the priorities for curb space use are:

- transit use (bus stops and spaces for bus layover),
- passenger and commercial vehicle loading zones,
- short-term customer parking (time limit signs and paid parking typically for 1- or 2-hours);
- parking for shared vehicles,
- bicycle lanes, and
- vehicular capacity.

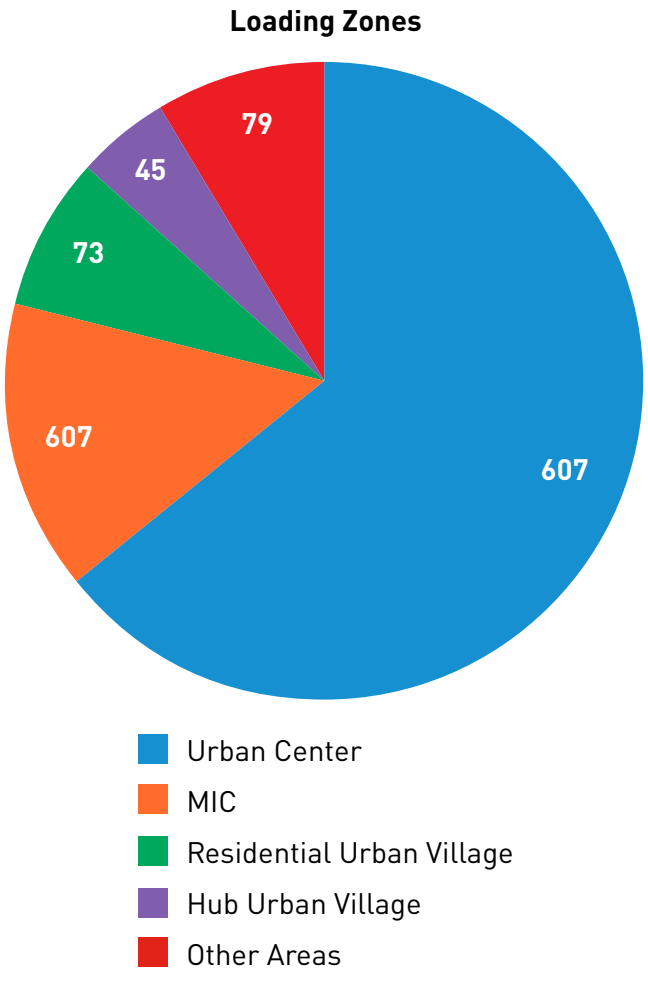
A load zone is a type of curb use that restricts a portion of the curb for loading and unloading activities. It is second in the prioritization of curb use in Seattle. Seattle uses four distinct types of load zones which are described below along with their curb colors. Some load zones are metered and some are not. Some load zones are in effect only for certain hours (such as 7 a.m. - 6 p.m.) while others have no hours posted and are in effect 24 hours a day. The sign for each load zone will have specific information for that load zone posted. Seattle also designates Bus Zones,

which are indicated by an alternating red and yellow curb.

Loading and unloading activities are not the same as parking, and load zones should not be used for parking. Using a load zone for anything other than its intended purpose can result in a fine. Some load zones are also Tow-Away Zones when not being used for loading and unloading activities.

Based on sign records in the city database there are a total of 943 commercial load zones. Other areas and their loading zones numbers are reflected in Figure 16

Figure 16: Loading Zone Locations in Seattle



Freight stakeholders have noted the lack of loading zones and other curbside spaces as a major challenge for freight delivery in some areas. Drivers often circle the block looking for spaces to unload. This is particularly an issue in downtown Seattle, the University District, and Capitol Hill.

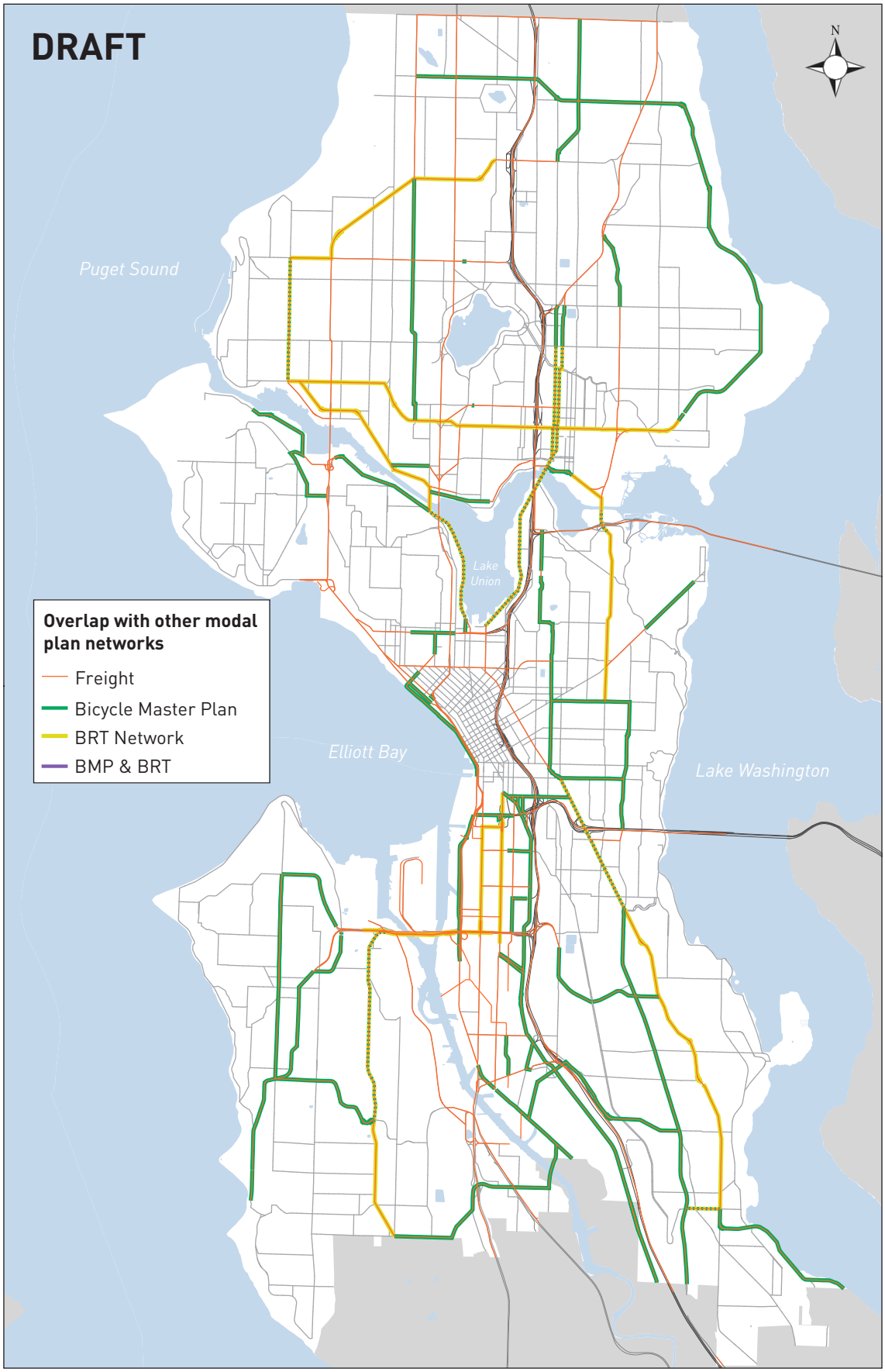
4.8 MULTIMODAL CORRIDORS

Streets in Seattle that carry freight also support a variety of other uses: transit, general purpose traffic, bicycles, pedestrians, on-street parking, etc. The City of Seattle has identified needs and priorities for some of these other modes through the Transit Master Plan, Bicycle Master Plan, and Pedestrian Master Plan. Figure 17 displays the corridors in the city where existing Major Truck Streets designations overlap with other modal priorities.

Major Truck Streets are also ideal routes for other modes because they provide fast, direct access between key activity centers; and they typically have lower grades, which make them attractive particularly for bicycles. Roadway elements in dense urban settings such as medians, in-lane bus stops, sharrows, marked bicycle lanes, midblock crosswalks, or curb bulbs may hinder truck mobility when the geometric changes are not implemented to accommodate truck movements. Planning, design and implementation of complete streets infrastructure need to consider freight and the movement of goods due to the increased need for trucks to share the road with other modes. The city of Seattle has a Complete Streets Ordinance[63] to provide safe, efficient infrastructure for freight vehicles sharing the transportation network with transit and non-motorized users.

[63]City of Seattle Department of Transportation, Complete Streets Ordinance, http://clerk.ci.seattle.wa.us/~scripts/nph-brs.exe?d=CBOR&s1=115861.cbn.&Sect6=HITOFF&l=20&p=1&u=/~public/cbor2.htm&r=1&f=G

Figure 17: Modal overlap corridors



5.0 ROLE OF PUBLIC SECTOR

5.1 INFRASTRUCTURE MANAGEMENT

The national and international movements of freight are beyond the jurisdiction of any one municipality, though local governments have an important opportunity to facilitate safe and efficient freight mobility in their communities. Understanding and reducing goods movement impacts is challenging and there are multiple layers of government involved in regulation. Agencies of the federal government including the Federal Highway Administration (FHWA), Federal Railroad Administration (FRA), Federal Transit Administration (FTA), United States Coast Guard (USCG), and the US Environmental Protection Agency (EPA) set overall regulations and standards that all must adhere to. Only the FRA and EPA have authority over the railroads; locally-developed strategies must be voluntary and/or negotiated.[64] The USCG controls waterway access and thus, the City of Seattle has to adhere to city-operated bascule bridge opening restrictions that have been imposed to allow water vessels priority. The Washington State Department of Transportation (WSDOT) is the owner/operator of the interstate system – they provide statewide transportation planning addressing goods movement, program funding for improvements, and provide guidance on strategies to reduce goods movement impacts. The region also focuses on freight mobility within Transportation 2040 via the Puget Sound Regional Council (PSRC). The city is often the first contact in dealing with goods movement and its impacts. The city manages and maintains local infrastructure for safe, efficient, and resilient movement of people and goods.

5.2 POLICY FRAMEWORK

The City of Seattle is currently guided by a number of goals and policies relating to urban development and mobility. These goals and policies can be found in various documents, and provide the overall policy framework for developing the Freight Master Plan.

Comprehensive Plan

The City of Seattle is generally guided on land use and transportation policy issues by the 2005 Comprehensive Plan, Toward a Sustainable Seattle. The Comprehensive Plan is organized around a set of four core values:

- Community
- Environmental Stewardship
- Economic Opportunity and Security
- Social Equity

The plan is currently undergoing a major update (likely to be adopted in 2016), but the overall growth strategy of the plan will not change. The primary strategy for accommodating future growth in Seattle is around concentrating growth in centers; known as the Urban Village Strategy.

Seattle's Comprehensive Plan contains several goals and policies throughout the document that speak to the importance of industrial lands, and the importance of industrial businesses to the city's overall economy. The plan's Urban Villages Element has several goals and policies that summarize this:

> **UV**G21 Ensure that adequate accessible industrial land remains available to promote a diversified employment base and sustain Seattle's contribution to regional high-wage job growth.
>
> **UV**G23 Encourage economic activity and development in Seattle's industrial areas by supporting the retention and expansion of existing industrial businesses and by providing opportunities for the creation of new businesses consistent with the character of industrial areas.

[64]California State Department of Transportation, Healthy Communities and Healthy Economies - A Toolkit for Goods Movement, March 2009

UV20 Designate the following locations as manufacturing/industrial centers:

1. The Ballard Interbay Northend Manufacturing/Industrial Center; and
2. The Duwamish Manufacturing/ Industrial Center.

UV21 Promote manufacturing and industrial employment growth, including manufacturing uses, advanced technology industries, and a wide range of industrial-related commercial functions, such as warehouse and distribution activities, in manufacturing/industrial centers.

As noted in the goals and policies above, one of the primary purposes of the Manufacturing/ Industrial Center designation (both in Seattle's Comprehensive Plan and the regional Vision 2040 plan) is to promote the retention, and growth, of industrial and warehouse land uses. This is further clarified in the Comprehensive Plan Land Use Element:

LUG22 Provide opportunities for industrial activity to thrive in Seattle.

LUG24 Preserve industrial land for industrial uses and protect viable marine and rail-related industries from competing with non-industrial uses for scarce industrial land. Give special attention to preserving industrial land adjacent to rail and water-dependent transportation facilities.

LUG25 Promote high-value-added economic development by supporting growth in the industrial and manufacturing employment base.

The Comprehensive Plan also has a Container Port Element, which recognizes the importance of the Port of Seattle as an important economic development entity and cargo container. The Port Container Element contains several goals and policies that support retention of this function, including:

CP1 Help preserve cargo container activities by retaining industrial designations on land that supports marine and rail-related industries including industrial land adjacent to rail or water-dependent transportation facilities.

CP6 Monitor, maintain and improve key freight corridors, networks and intermodal connections that provide access to cargo container facilities and the industrial areas around them to address bottlenecks and other access constraints. Provide safe, reliable, efficient and direct access between Port marine facilities and the state highway or interstate system, and between Port terminals and railroad intermodal facilities, recognizing that Port operations must address other transportation needs, such as pedestrian safety.

CP8 Maintain the City's classification of "Major Truck Streets." Because freight is important to the basic economy of the City and has unique right-of-way needs to support that role, freight will be a major priority on streets classified as Major Truck Streets. Street improvements that are consistent with freight mobility but also support other modes may be considered on these streets.

The two latter policies in the Container Port element deal with freight mobility. As required by the Growth Management Act, Seattle's Comprehensive Plan also contains a Transportation Element. The Transportation Element is intended to be consistent with, and help implement, the land use vision for the City (articulated in the plan's Urban Village and Land Use Elements).

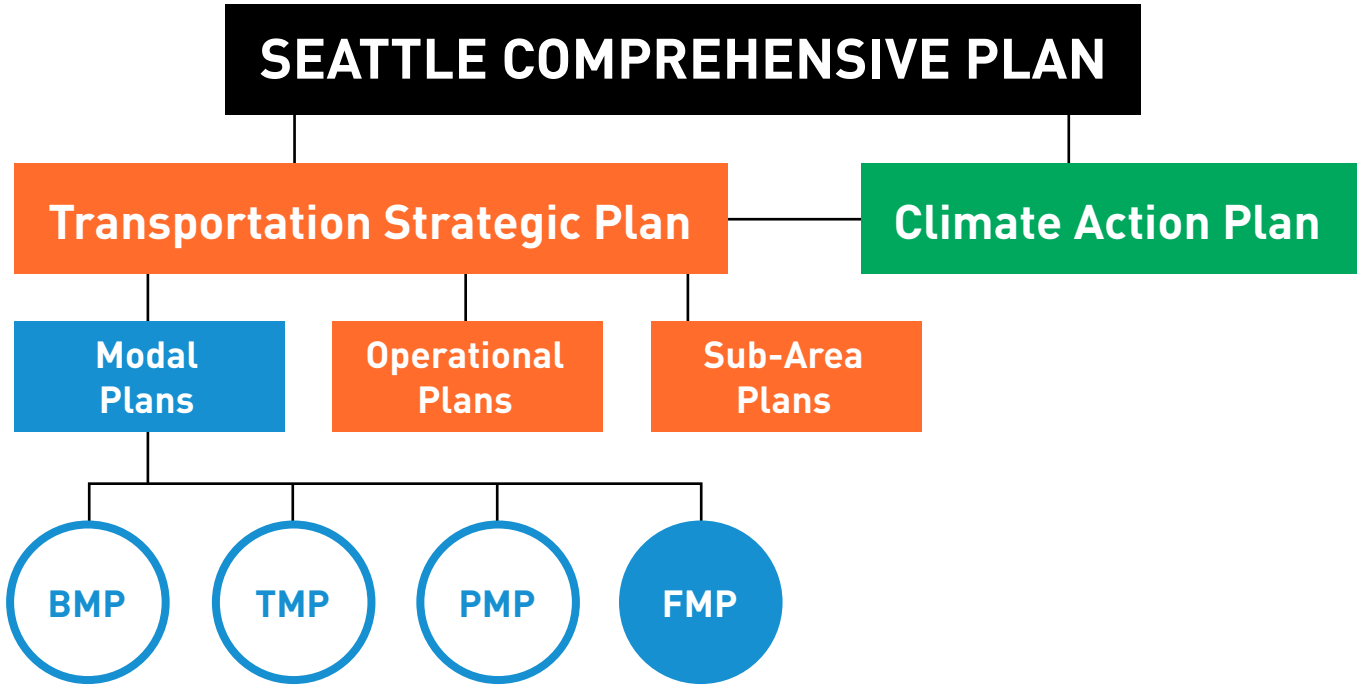
With regard to transportation, within the Seattle Department of Transportation (SDOT), the overall policy direction in the Transportation Element of the Comprehensive Plan helps frame the more specific goals, policies, and strategies in

other documents, including the Transportation Strategic Plan and modal plans such as the Bicycle Master Plan, Pedestrian Master Plan, the Transit Master Plan, and now the Freight Master Plan [see figure below]. These plans, once adopted, are ultimately implemented by the project and program teams within SDOT.

In the Transportation Element of the Comprehensive Plan, there are several goals and policies that relate to freight mobility. These include:

> **T**G19 Preserve and improve mobility and access for the transport of goods and services.
>
> **T**G20 Maintain Seattle as the hub for regional goods movement and as a gateway to national and international suppliers and markets.
>
> **T**48 Recognize the importance of the freight network to the city's economic health when making decisions that affect Major Truck streets as well as other parts of the region's roadway system. Complete Street improvements supporting freight mobility along with other modes of travel may be considered on Major Truck Streets.
>
> **T**51 Consider the needs for local delivery and collection of goods at businesses by truck when making street operational decisions and when developing and implementing projects and programs for highways, streets and bridges.
>
> **T**10 Designate, in the Transportation Strategic Plan, a truck street classification network to accommodate trucks and to preserve and improve commercial transportation mobility and access. Designate as follows:
>
> - Major Truck Streets: an arterial street that accommodates freight movement through the city, and connects to major freight traffic generators

Figure 18: Policy Framework



The goals and policies in the Transportation Element make reference (also noted in the figure above) to the Transportation Strategic Plan (TSP). That document was prepared in 2005 to provide more specificity on issues discussed in the Transportation Element of the Comprehensive Plan. The TSP contains a map showing where Major Truck Streets are currently designated. It is assumed that the Freight Master Plan, which will include an updated freight network map, will supersede the information in the current Transportation Strategic Plan relating to freight mobility. The FMP will also contain goals and objectives that will provide more specificity on freight mobility than the higher level goals and policies in the Comprehensive Plan.

Complete Streets Policy

The City Council adopted a Complete Streets policy in 2007. The Complete Streets policy is broader than just freight mobility issues, but it helps frame the City's overall commitment to a variety of travel modes. The Complete Streets policy states in part that:

- SDOT will plan for, design and construct all new City transportation improvement projects to provide appropriate accommodation for pedestrians, bicyclists, transit riders, and persons of all abilities, while promoting the safe operation for all users; and
- SDOT will incorporate Complete Streets principles into the Department's Transportation Strategic Plan; Seattle Transit Plan; Pedestrian and Bicycle Master Plans; Intelligent Transportation System Strategic Plan; and other SDOT plans, manual, rules, regulation and programs as appropriate.

Because freight is important to the economy of the City and has unique right-of-way needs to support that role, freight will be the major priority on streets classified as Major Truck Streets. Complete Streets improvements that are consistent with freight mobility, but also support other modes may be considered on these streets. While the complete streets ordinance focuses on ensuring that streets are planned, designed, and operated to meet broad needs, the policy does recognize the unique demands of Major Truck Streets in moving freight. As the Freight Master Plan updates the freight network map, the Complete Streets ordinance may need to be update to reflect any changes in how streets planned for freight mobility are referenced in the policy.

Climate Action Plan

In 2013, the City Council adopted a major update to the City's Climate Action Plan (CAP). The updated CAP was developed to help implement the Council's goals (as established in Resolution 31312) of being "climate neutral" (producing zero net greenhouse gas emissions) by 2050. The CAP articulates a comprehensive strategy for reaching this goal over time, and contains a number of actions for both the near term (2015) and longer term (2030). One of the sections of the plan deals with transportation and land use, which recognized that approximately 40% of all greenhouse gas emissions in Seattle are generated by the road transportation sector. The CAP included a near term (2015) action to:

- Develop a Freight Master Plan that includes goals to make freight movement more efficient and reduce its impact on greenhouse gas emissions.

The April 2014 greenhouse gas emission inventory states that in 2012, road transportation (especially passenger travel) comprises the largest share of Seattle's core emissions at 64%. Of that percentage, freight contributes 19% and passengers contribute 45%. The interesting trend is that while Seattle's population has grown 23% from 1990 to 2012 and jobs have increased 14% over that same time period, core greenhouse gas emissions have actually

declined by 4%. The emissions have also decreased on a per person basis.[65]

Based on this direction, the Freight Master Plan update will include analysis of sustainable freight practices, and how this issue should be incorporated into the plan.

Washington State Freight Mobility Plan
The Washington State Department of Transportation (WSDOT) led the development of the 2014 State Freight Mobility Plan to ensure that the transportation system in Washington State support and enhance trade and sustainable economic growth. As one of the most trade-dependent states in the nation, Washington relies on an efficient freight transportation network.

The strategic goals of the Freight Mobility Plan are as follows:

- Improve the contribution of the freight transportation system to economic efficiency, productivity and competitiveness
- Reduce congestion on the freight transportation system
- Improve safety, security, and resilience of the freight transportation system
- Improve the state of good repair of the freight transportation system
- Use advanced technology, performance management, innovation, competition, and accountability in operating and maintaining the freight transportation system

SDOT Freight Mobility Strategic Plan
Finally, while not a City Council-adopted document, SDOT did develop a strategic plan for freight mobility in 2005. The plan identified 22 actions that the department should implement to improve freight mobility. The actions identified in this strategic plan will be analyzed for relevance as the Freight Master Plan is developed and an implementation plan is identified as part of the FMP.

5.3 ACCOMPLISHMENTS

The 2005 Freight Mobility Strategic Action Plan identified 22 actions for improving Truck and Rail Access in Seattle and specific improvements to improve access to the Manufacturing and Industrial Areas. SDOT, WSDOT and the Port of Seattle have been partners in several of these recommendations and projects totaling approximately $ 590 million. The listed projects have resulted in positive impacts for the freight industry by improving infrastructure and reliability not only for freight but for other modes that share the same network.

- Spokane Street Viaduct
  - Improved access to Duwamish industrial businesses on 1st and 4th Avenues
  - Major access improvement to Port of Seattle and Duwamish industrial center
- Holgate to King - South Segment Alaskan Way Viaduct (WSDOT Lead)
  - Improved truck access to industrial area and Port of Seattle
  - Avoid rail blockages at S Atlantic St and Terminal 46 ("Little H" – new WSDOT grade separation)
- SR 519 Phase 2 Overpass (WSDOT Lead)
  - Reduced traffic delays caused by train crossings
  - Improved major access route to Port of Seattle
- E Marginal/Spokane Rail Overpass (Port of Seattle Lead)
  - Reduced traffic delays caused by slow train crossings
- Airport over Argo Bridge Rehabilitation
  - Restored load-bearing capacity/ removed truck weight restrictions

[65]City of Seattle, 2012 Climate Action Control Plan, 2012 Seattle Community Greenhouse Gas Emissions Inventory, 2012, http://www.seattle.gov/Documents/Departments/OSE/2012%20GHG%20inventory%20report_final.pdf

- E Duwamish Waterway Bridge Rehabilitation
  - Maintain availability of bridge for freight movement
- E Marginal Bridge Replacement at S Horton St
  - Maintain availability of E Marginal for freight movement
- Jose Rizal Bridge over Dearborn Rehabilitation
  - Maintain availability of bridge for freight movement
  - In the event of bridge failure, avoid potential disruption to Dearborn truck traffic
- Ballard Bridge Seismic Retrofit
  - Prevent seismic failure – maintain access to BINMIC/Port of Seattle
- Albro Bridge over Airport Way Seismic Retrofit
  - Prevent seismic failure – maintain access to Duwamish
- SR 99 Spokane Overcrossing Trestle Replacement (WSDOT lead)
  - Provides direct connection between E Marginal Way and Argo Yard Truck Roadway under new SR 99 overcrossing
- Mercer Corridor Project
  - Provide a more direct route for freight to Fremont and BINMIC areas
  - Eliminate two sharp turns and improve turning radii at Fairview/ Valley/Westlake for large trucks traveling to Fremont and BINMIC
- Greenwood Ave N Improvements (North of 105th Street)
  - Improve truck circulation with added lane
- 14th Ave S Street Improvements
  - Improve pavement surface for trucks
- 15th and Elliott
  - Improve pavement surface for trucks serving BINMIC
  - Widened north-bound on-ramp from Nickerson to 15th Ave ramp
- 1st Ave S Street Improvements
  - Improve pavement surface for trucks serving Duwamish
- 4th Ave S
  - Improve pavement surface for trucks serving Duwamish
- N/NW 85th St
  - Improve pavement surface for trucks serving BINMIC
- Airport Way S - Spokane St to Dearborn
  - Improve pavement surface for trucks serving Duwamish
- E Marginal Way
  - Improve pavement surface for trucks serving Duwamish and Boeing Field

5.4 FUNDING HISTORY

The Seattle Department of Transportation (SDOT) funds freight-related projects through different capital projects and programs within its budget. Large capital projects such as Mercer Street have elements that enhance freight mobility in the corridor but may not be listed as a specific freight improvement project. Through its Freight Spot Improvement program SDOT works to implement signage improvements, turning radius revisions (small scale), pavement repair and railroad crossing improvements (in partnership with railroads).

In 2006, Seattle voters passed a nine-year, $365 million levy for transportation maintenance and improvements known as Bridging the Gap (BTG). The levy is complemented by a commercial parking tax. The nine-year goals of Bridging the Gap are to:

- Reduce the infrastructure maintenance backlog
- Pave and repair Seattle streets
- Make seismic upgrades to the city's most vulnerable bridges
- Improve pedestrian and bicycle safety and create safer routes to school
- Increase transit speed and reliability

The levy funds many programs and projects to achieve these goals, many of which relate to freight mobility and a resilient transportation system. The BTG levy approved by voters stipulates that certain percentages of the levy revenue be spent on different categories of projects. The levy expires in 2015.

State and federal funds

SDOT has been successful in obtaining grant funding for roadway maintenance and upgrade projects through state and federal programs. SDOT has been more strategic in recent years about ensuring that grants are submitted for the most competitive projects. It is difficult to determine the exact amount of freight-specific grant funding that SDOT has received, as improvements have historically been included as portions of larger Capital Improvement Projects.

5.7 CLIMATE ADAPTATION AND EMERGENCY PREPAREDNESS

Additional considerations for each freight mode now include a safety and climate adaptation element. The safe and reliable movement of goods is crucial to maintaining a high quality of life and thriving economies.

Preparing for climate change impacts include shifting of the frequency, intensity, and timing of extreme events such as flooding, heat waves, and high tides. The City of Seattle has strategies for responding to these events, though it may need to consider an extreme event as the new normal. The most significant changes projected in the Pacific Northwest will be to temperature, precipitation, and sea level:[66]

- Sea level – increase in base sea level and high tides; Seattle may experience 7 inches of sea level rise by 2050 and 24 inches by 2100. Areas in the MICs, Harbor Island, along the Duwamish are especially vulnerable as land was filled in in the last century to create more land mass.
- Temperature – increase in average temperature, minimum temperatures, and the frequency and duration of extreme heat events.
- Mountain snowpack – reductions in snowpack and shifts in the timing of stream flow.
- Precipitation – little change in annual precipitation, but wetter winters, driers summers, and more extreme precipitation events.

The need for a resilient transportation system and infrastructure will be crucial to allow responding for disaster relief and extreme events. Preparing now will help ensure that Seattle will remain a successful city, one that plans pro-actively and invests in energy productivity, clean energy, and green infrastructure and design.

If an extreme event were to occur and damage a major roadway, traffic would shift to already overloaded infrastructure. Seattle also depends on bridges and has over 900 in its inventory. Damage would impair emergency services and the economy. As it is, during high heat times, steel expands which can damage some older structures and SDOT must cool its bascule bridges to ensure that they can be opened and closed.

Safety and climate adaptation improvements should ensure access and detour plans for any extreme event that damages bridges, rail lines that are susceptible to landslides and storms, and rail yards, SODO, the Duwamish area, and KCIA within liquefaction zones, and the shoreline edges that contain marine terminals and transportation infrastructure. Liquefaction zones make up 15% of the zoning area in Seattle with General Industrial (IG 1 and IG2), Industrial Buffer (IB), and Industrial Commercial (IC) encompassing 51% of the zone.[67]

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[66]City of Seattle, Office of Sustainability and the Environment, Adaptation Planning, http://www.seattle.gov/environment/climate-change/adaptation-planning

[67]State of Washington Department of Ecology, Draft 2014 Marine & Rail Oil Transportation Study, December 2014

Other safety concerns involve the transportation of Bakken oil in rail cars moving through Washington State to delivery locations along the coast. Bakken crude oil comes from the Bakken Formation in the Williston Basin, which is one of the largest contiguous deposits of oil and natural gas in the United States.[68]

For Bakken crude, the greatest concerns are the potential volatility or flammability of the oil and the higher potential for groundwater intrusion due to its solubility. These properties create the potential for public safety and health risk. Oil transportation has increased significantly in the last decade as the focus to produce oil and gas in the United States increases and importing these products decreases. Today, Bakken oil transported by rail comes through Spokane to facilities on the Columbia River and Puget Sound. Right now there is a total of 19 Bakken oil loaded trains passing through the state every week and projections for these shipments to grow continue to be made. As of December of 2014 prices for oil have decreased significantly due to increased production in the United States and abroad and there are questions of how and what effects low oil prices will have on US production and the transportation.

Additional concerns of transporting Bakken oil in trains across the state are the potential spills and damage to the environment. Contamination of groundwater and damage to lakes and rivers that are important to spawning and fishing as a tourist industry but also as cultural heritage to native tribes are additional reasons for concern. Derailments in populated areas (Magnolia, July 2014) and spills in environmental sensitive areas have increased awareness of the product among residents of the affected areas and have raised questions about safety and equity of transporting such a flammable product.
Other impacts of additional oil trains making their way through the Seattle region are additional delays to other modes as oil trains cross through intersections with no grade separation. Vehicles and other modal delays will increase with more trains as there are also delays for trains carrying grain or other perishable, as well as passenger that have to share the same tracks.

There is ongoing planning for increases in oil production and potential risks to the environment and populated areas. This planning will continue whether oil prices stay stable or continue to drop. What could potentially change is the number of trains and that number depends on the industry and world economy as it reflects weak or strong demand for oil production and consumption.

[68]State of Washington Department of Ecology, Draft 2014 Marine & Rail Oil Transportation Study, December 2014