2 SEATTLE'S FREIGHT ENVIRONMENT AND THE MANUFACTURING & INDUSTRIAL CENTERS

The City of Seattle, enhanced by the natural, protected, deep water port of Elliott Bay and Lake Washington Ship Canal, has prospered and grown due to thriving seaport and maritime commerce. For over a century, the Port of Seattle has been an industrial port with commerce flowing through it from global and domestic destinations. As the Port has grown to be the 5th largest in the United States, the region and City of Seattle have also prospered with strong manufacturing, maritime, industrial, technology, and life-science employment sectors. The region's success depends on these sectors that provide family-wage jobs and support an enviable quality of life.

To protect this quality of life and meet the requirements of Washington's Growth Management Act, the regional metropolitan planning organization, Puget Sound Regional Council, has designated Manufacturing/Industrial Centers (MICs), where manufacturing and industrial uses could be clustered away from residential and other commercial land uses. These designated MICs are also supported by a well-developed intermodal transport system to accommodate marine, truck, and rail freight critical to the success of manufacturing and industrial uses. Within the City of Seattle, there are two designated Manufacturing and Industrial Centers: the Greater Duwamish and Ballard/ Interbay Northend Manufacturing/Industrial Centers. Because these MICs are important to the regional economy, the transport system supporting these areas needs to work efficiently for industry and commerce. The value of the MICs to the global, regional and local economy is summarized on the following page.

Since Seattle's founding, public and private entities have invested heavily in the multimodal transportation infrastructure necessary to support continued economic and job growth in these MICS. Jointly and independently, they have built waterways, locks, port and rail facilities, bridges and roadways. Recognizing the importance of the MICs and the need within them for infrastructure to serve freight, this project aims to maintain and improve truck freight access, mobility, and circulation within and between the Greater Duwamish and Ballard/Interbay Northend Manufacturing/Industrial Centers and from these MICs to the regional highway network.

This chapter provides an overview of the study area and the operations of the freight system it supports. These components include the infrastructure assets that freight uses for operation, and the characteristics of truck and rail freight supporting the two MICs in the City of Seattle. The following chapter (Chapter 3 – Existing Conditions) describes the impact of truck and rail activity on these major facilities and the influence of land use on these travel modes.

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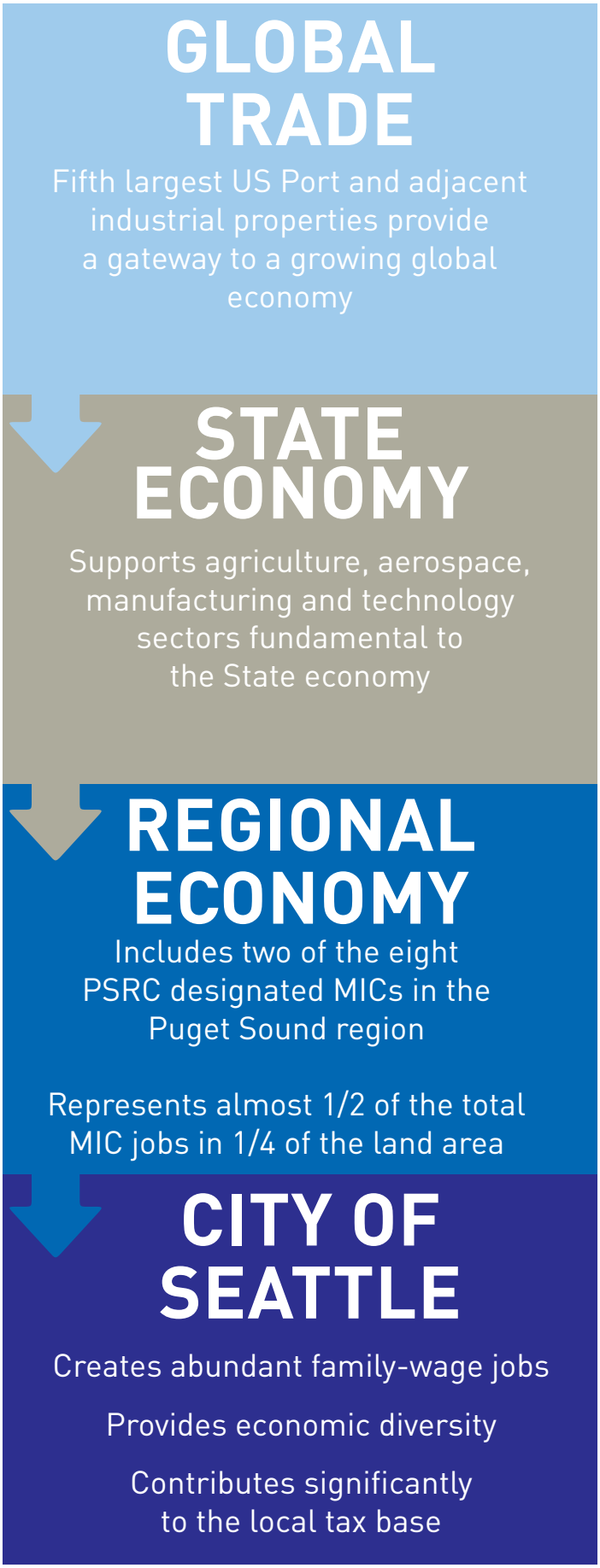

2.1 Study Area Description

The study area for the FAP is Seattle's industrial land, clustered in two distinct locations: the Greater Duwamish Manufacturing/Industrial Center and the Ballard/Interbay Northend Manufacturing and Industrial Centers. A recent study by Seattle's Department of Planning and Development (DPD) concluded that Seattle's industrial land is a regional economic asset at the center of a vibrant industrial eco-system, explaining that the City's land uses work together as a system; industrial land is a critical component of this system and an important source of jobs, income and services.[1] The same study also notes that, while the two MICs comprise 12% of the land in the City of Seattle, they account for 24% ($ 37 million) of the City's Business & Occupation tax, and 32% of the City's annual sales, tax collection (from $ 6 billion in taxable retail sales). Together, they also account for 16%—almost 73,000—of all jobs in Seattle. As DPD's study further explains, industrial jobs are important to the City, because they are a significant source of employment with higher pay and greater benefits for people without a college education.

Another new study succinctly describes the transportation assets that enable the two MICs to function as economic engines for the City and the region. The PSRC's forthcoming Industrial Lands Analysis[2] describes their transportation assets and related economic activity as follows:

As described in the Washington State Freight Mobility Plan (2014), the Greater Duwamish MIC

1 Greater Duwamish M/IC Policy and Land Use Study, draft recommendations, City of Seattle, November 2013.
2 An Industrial Lands Analysis for the Central Puget Sound Region, Puget Sound Regional Council, (forthcoming).

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"is anchored by two of the region's most important industrial assets: the Port of Seattle and King County International Airport. The Port of Seattle operates in one of the region's primary marine shipping areas. A substantial amount of land throughout the Greater Duwamish MIC is used for import/export (international and Alaskan or other domestic) or port-related support services and major railyards. The Port and its related operations account for a great deal of industrial activity present in this area, and King County Airport is a logistical hub for Boeing Commercial Airplanes. In addition, immediate access to I-5 the length of the subarea, access to the national rail system, and buffering from residential zones represent important benefits to industrial firms in this location."

With regard to Ballard/Interbay Northend, the study concludes: "Prominent infrastructure, assets and anchors include the Lake Washington Ship Canal; Fishermen's terminal - anchorage for the over 600 commercial fishing vessels in the North Pacific small fishing fleet; a major freight rail yard (Balmer Yard) and spurs; and truck access to Highway 99 on the eastern edge. Salmon Bay Gravel is a major ballast provider for domestic marine freighters. Many import/export operations are also located along the Lake Washington Ship Canal.

Two waterways provide ship access to the industrial lands: the Greater Duwamish Waterway and the Lake Washington Ship Canal. Bridges over navigable waterways like the Greater Duwamish Waterway and Lake Washington Ship Canal must provide height clearances over the channels or be movable to accommodate vessels. Navigable waterways are under the jurisdiction of the US Coast Guard. Because of the long duration for opening and closing bridges, movable bridges in the MICs can be a significant constraint for truck and other traffic. Movable bridges affecting trucks in the MICs include the SR 99 First Avenue South, Lower Spokane Street, Ballard, Fremont, and South Park bridges. Two rail bridges cross the West Duwamish Waterway near Spokane Street and the two cross Lake Washington Ship Canal west of the Government Locks.

Similarly, King County International Airport/Boeing Field is within the City and carries freight, but is not subject to city jurisdiction.

The fuel yards and BP pipeline are also an important part of the industrial lands and freight assets. The MICs are shown in Figure 2.1 in relation to the City's designated major truck streets. The privately owned and operated BP Olympic Pipeline distributes 300,000 barrels per day of product along a 299-mile corridor that runs roughly parallel to I-5 with a spur running into the Greater Duwamish MIC."[3]

Of particular interest for this project are the roadways and rail systems connecting between the two MICs, specifically those that also cross through downtown Seattle. There are several roadway and rail connections internal to the Greater Duwamish MIC and Ballard/Interbay Northend MIC (BINMIC), between the two MICs, and to the regional transportation system that impact other industries and livelihoods within the City. For this project to provide meaningful recommendations for the role of the transportation

3 Washington State Freight Mobility Plan. WSDOT 2014.

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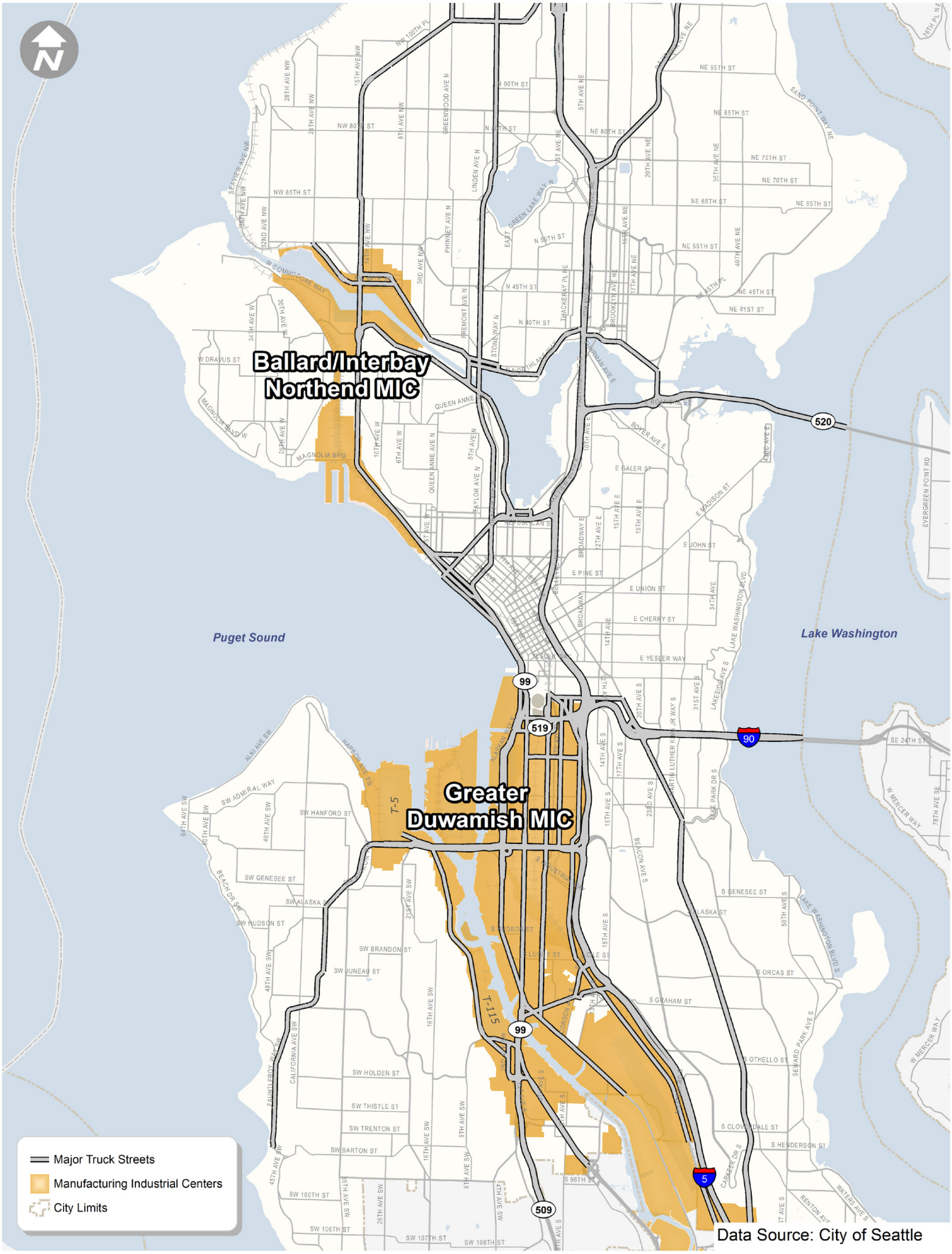

Figure 2.1 Seattle's Manufacturing/Industrial Centers (MICs)

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network in freight accessibility and mobility, the study area focuses on streets that have been previously identified for freight movements in other planning efforts. These connections are classified based on their role in the freight network as described in the following sections.

2.1.1 MIC Areas, Connecting Corridors, and Regional Connectors

There are eight designated MICs in the Puget Sound Region, and two are located in the City of Seattle.

The BINMIC area is partially located in the lowland Interbay area between Seattle's Magnolia and Queen Anne Hill neighborhoods and covers 866 acres. The northern section includes the Ballard 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 Burlington Northern Santa Fe Railway (BNSF) operates its Seattle Interbay rail yard (Balmer Yard) in the BINMIC area. The Port of Seattle operates the Fishermen's Terminal along the Ship Canal, which is the home base to the North Pacific fishing fleet of approximately 700 ships. Terminal 91 is also located in the BINMIC. It provides short-term and long-term moorage for commercial workboats and one of the nation's largest factory trawler fishing fleets, and it supports related cold storage and fish processing facilities. Terminal 91 also accommodates cruise ships during cruise season.

The Greater Duwamish MIC is located south of downtown, west of the I-5 corridor, north of the City of Tukwila, along the Duwamish waterway covering 4,928 gross acres. The Greater Duwamish MIC contains 84 percent of the total industrial-zoned land in the City of Seattle[4]. Land uses within the Greater Duwamish MIC include transportation, utilities, and community facilities, which comprise 39 percent of the available land in this area. Industrial and warehousing land uses comprise another 21 percent and 18 percent, respectively, of the total available land in the Greater Duwamish MIC.

Unique to the Greater Duwamish MIC are the substantial intermodal container facilities where freight containers are transported from the Ports container terminals and loaded onto rail either on-dock or at intermodal facilities. Transferring cargo to rail requires large rail yards. These intermodal facilities are described in detail in section 2.2.5.

The Greater Duwamish MIC is also home to Boeing Field owned and operated by King County; King County Metro facilities, including Metro bus bases (Central, Atlantic, and Ryerson) for operations; Amtrak heavy rail maintenance bases straddling Holgate Street; and the Sound Transit Link light rail operations and maintenance base. Both the Burlington Northern Santa Fe Railway (BNSF) and Union Pacific (UP) Railroads also operate rail yards in the Greater Duwamish MIC. The Port of Seattle leases terminals T-46, T-25/30, T-18, T-5, and T-115 to terminal operators.

4 Duwamish MIC Policy and Land Use Study, City of Seattle, 2013.

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2.1.2 Land Uses & Freight Generators

Because they are located largely within the City of Seattle, the Greater Duwamish and Ballard/Interbay Northend MICs have dense land uses, compared to other MICs. This density results in competition for transportation facilities and land use. Land use drives freight trips in the Greater Duwamish and Ballard/Interbay Northend MICs. There are many types of freight generators throughout these areas that need raw materials that must arrive by truck or rail, and they produce goods that must be delivered by truck or rail. Businesses include concrete plants, steel manufacturing, and garbage/recycling, to name a few. Land use in the BINMIC is dominated by transportation and marine uses. Many of the transportation-use parcels include the sites of seafood processing plants adjacent to the BNSF rail facilities at Interbay. While the rail facilities do not generate significant truck traffic, the seafood processors do. The marine facilities include both industrial functions, such as boatyards, and the Fishermen's Terminal and recreational facilities, such as marinas.

The Greater Duwamish MIC has the most significant truck and freight travel due to transportation-related land uses, including the large intermodal rail terminals that accommodate substantial truck volumes moving containers between the port and rail, the multiple marine terminals, and Boeing Field. The King County International Airport or Boeing Field has 17 acres devoted to air cargo and warehousing. Beyond transportation land uses, the key truck-trip generating land uses in the Greater Duwamish MIC are warehousing, manufacturing/processing, construction materials, and heavy sales/service. Additionally, land uses at the north end of the Greater Duwamish MIC are dominated by the sports stadiums, which have unique freight needs, and also attract crowds of people to events. Non-industrial uses exist, such as a pocket of commercial land uses and housing in Georgetown. In recent years, non-industrial or mixed uses added to the Greater Duwamish MIC include Seattle School District and the Starbucks headquarters buildings. Figure 2.2 shows the different land uses within each MIC.

Warehousing, distribution, transloading, and other logistics functions are split between the two Seattle MICs and areas outside Seattle, such as Kent Valley, Fife, Sumner, and SeaTac. A listing of such operations compiled by the Port of Seattle suggests that the largest such facilities with the most total space are located outside Seattle. The listings show a total of 11.1 million square feet of warehousing and distribution space, of which 24 percent is in Seattle.

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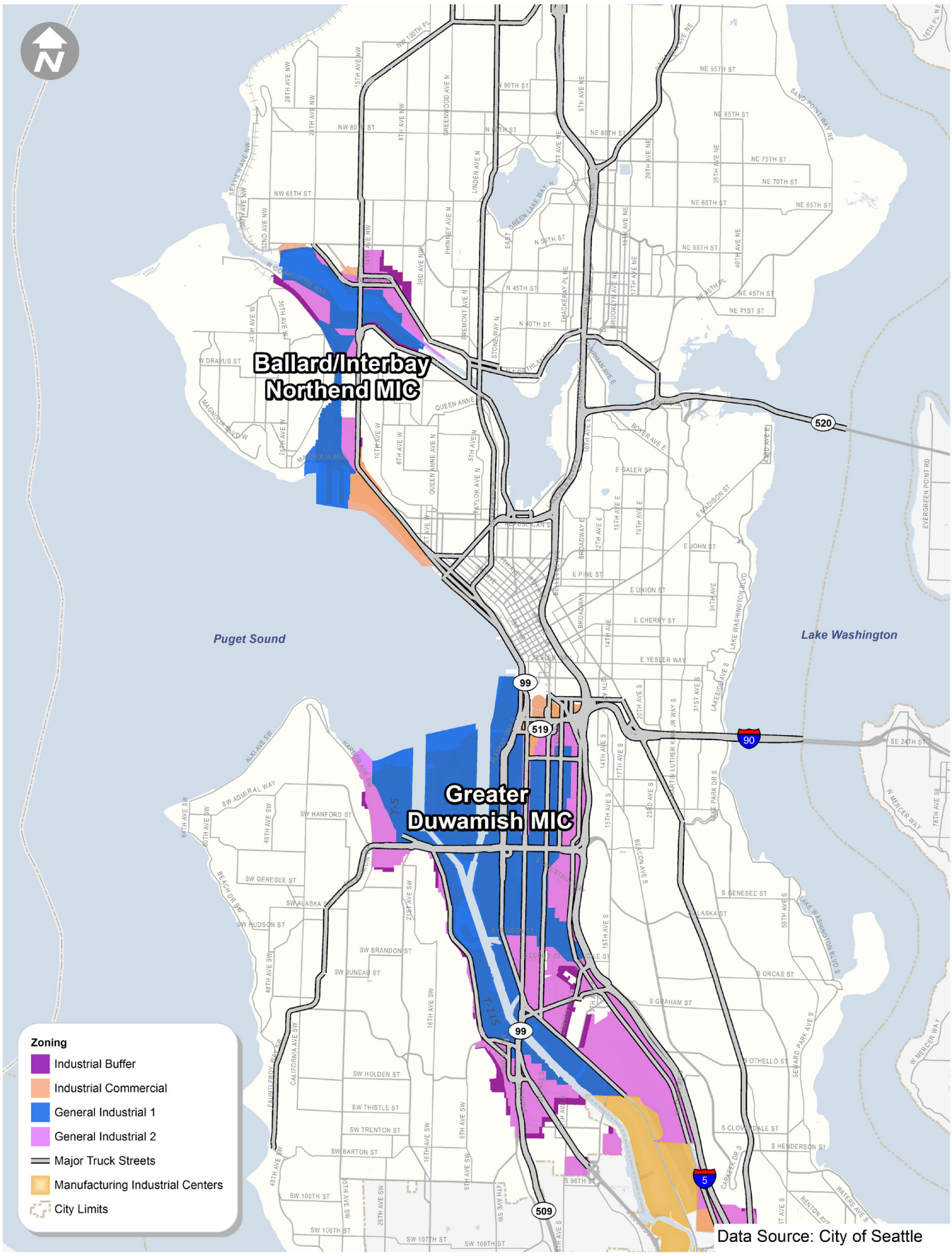

Figure 2.2 Map of Industrial Land Uses in the MICs

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Employment

Employment in the MICs accounts for more than half of the Construction / Resources, Manufacturing / Warehouse, Transportation, and Utilities, and Retail/Food jobs in the City. Table 2.1 provides 2010 employment estimates (latest available) for the two MICs and compares them with Seattle as a whole. Not surprisingly, both MICs have a high combined share of jobs in the two most truck-dependent sectors: Construction/Resources; Manufacturing/ Warehousing; Transportation, and Utilities (WTU); which also comprise more than half of total MIC employment. The concentration is particularly strong in the Greater Duwamish MIC, accounting for 31% of the City's construction/resources jobs and 47% of the Manufacturing/WTU jobs. These jobs are most closely related to truck-dependent job sectors.

Table 2.1 Employment Estimates (representing all jobs)

		ACTUAL	% OF SUBAREA	SHARE OF SEATTLE
	Travel Model Sector	2010	2010	
BINMIC	Const/Res[1]	1,207	8.3%	6%
	Man/WTU[2]	5,323	36.4%	9%
	Retail/Food	1,741	11.9%	2%
	Other	6,337	43.4%	2%
	Total	**14,608**	**100%**	**3%**
Greater Duwamish	Const/Res[1]	6,029	10.0%	31%
	Man/WTU[2]	27,589	46.8%	47%
	Retail/Food	4,424	7.4%	6%
	Other	22,162	36.8%	7%
	Total	**60,204**	**100%**	**12%**
Seattle	Const/Res[1]	19,190	3.9%	
	Man/WTU[2]	58,146	11.8%	
	Retail/Food	75,530	15.4%	
	Other	339,100	68.9%	
	Total	**491,966**	**100%**	

Source: Puget Sound Regional Council (PSRC) Travel Demand Forecast Model. 2010 Employment Estimates

1 Construction/Resources

2 Manufacturing/Warehousing, Transportation and Utilities

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Truck Trip Generators

Characteristics of freight movements can be generalized by the different types of truck trip generators in the study area. Distribution and logistics facilities typically generate high volumes of truck and/or rail shipments, both inbound and outbound. Manufacturing and processing facilities in the MICs receive raw materials by rail and water, as well as by truck, and usually ship finished goods by truck or rail. Commercial and retail establishments can generate numerous smaller shipments in light- and medium-duty trucks, and fewer shipments in heavy-duty trucks. The MICs also include a significant number of other facilities generating truck, rail or barge trips, such as scrap yards and recyclers that do not fit neatly into conventional industry categories.

Distribution and Logistics

Warehousing, distribution, and other logistics operations are a separate land use category because of the high volume of medium- and heavy-duty truck trips they generate. Warehouses and distribution centers are intermediate handling facilities whose basic functions include holding inventory, re-configuring shipments (transloading), and transferring freight between vehicles and modes. The distinguishing feature of intermediate handling facilities is that they generate truck trips and jobs, but they do not generate new freight; everything that arrives at the site eventually departs.

As intermediate handling facilities, warehouses, distribution centers, transloads and other establishments occupy places in the supply chain between production and eventual consumption, as shown in Figure 2.3. In a customer supply chain, an intermediate handling facility exists to modify, sort, or store goods on the customer's behalf. For example, warehouses store goods until needed and distribution centers may break down large shipments into smaller lots for customer delivery.

The economy of Washington State supports several important supply chains as documented in the Washington State Freight Mobility Plan including aerospace manufacturing, and agricultural products (apples, milk, wheat and potatoes)[5]. Aerospace production facilities are located in the Greater Duwamish MIC, and the Port of Seattle serves as an important export gateway for many of Washington's agricultural products. All of which depend on the freight infrastructure supporting that MIC.

Many traditional warehouses are older buildings in older industrial areas. Commercial real estate listings for warehouse space in Seattle suggest that locations in the Ballard/Interbay Northend MIC and the northern part of the Greater Duwamish MIC (SoDo) tend to be smaller buildings, or larger buildings subdivided into smaller spaces.

The inbound movement of goods from manufacturing to an intermediate handling facility

Figure 2.3 Simple Supply Chain

5 Washington State Freight Mobility Plan, WSDOT 2014.

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Figure 2.4 Aerial view of the MacMillan Piper Transloading Facility in the Greater Duwamish MIC

is dominated by rail carload and truckload motor carriers, but also includes intermodal rail, less-than-truckload (LTL), parcel, and air cargo flows (delivered by truck). The outbound distribution trip from an intermediate handling facility to other intermediate facilities, to retail stores, or to the ultimate customer is almost exclusively by truck regardless of shipment size. A summary of unique manufacturing and industrial businesses are further described in the sections that follow.

Transloading Facilities

Transloading facilities, such as MacMillan Piper Transloading Facility (shown in Figure 2.4) in the Greater Duwamish MIC, transfer freight between modes. Transloading facilities also include mail sorting centers and other types of warehouses. They can be managed by almost any party in the freight supply chain but are most often managed by carriers or contractors that may also be truckers. Export transloaders accept truckloads or rail carloads of goods from the actual exporters and reload them into international containers which are drayed to port terminals. For this

DESCRIPTIONS of Technical Terms

LTL, or less than truckload, refers to transport of relatively small loads and are in contrast to full truckload carriers. An example of less than truckload carriers include parcel carriers like UPS where freight can be broken into smaller units. LTL carriers typically operate in a "hub and spoke" manner distributing smaller loads out from a central distributing location, where loads can be broken into smaller loads from full truck load carriers.

Air cargo refers to property such as freight, or packages and mail that is carried in an aircraft. Typically air cargo is time sensitive, either mail or perishable goods, and is carried on passenger planes or aircraft specifically used for cargo such as Fed Ex.

Transload refers to the process of transferring a shipment of freight from one mode to another and is most commonly used when one mode cannot be used for the entire trip including when freight travels internationally, and must be transferred from a vessel such as a ship to a surface mode like rail or truck.

Intermodal refers specifically to freight transported in containers making it easier to move between modes. Intermodal containers have been developed to specific standard sizes such as a TEUs or twenty-foot equivalent units, to make them easier to move from ships to trains or trucks. In addition to easy transfer between modes, intermodal shipping provides other benefits including reduced handling of cargo resulting in less damage and improved security reducing loss since the containers are secured.

Dray refers to a unique type of truck designed for quickly moving freight over a short distance such as from a port terminal to an intermodal yard.

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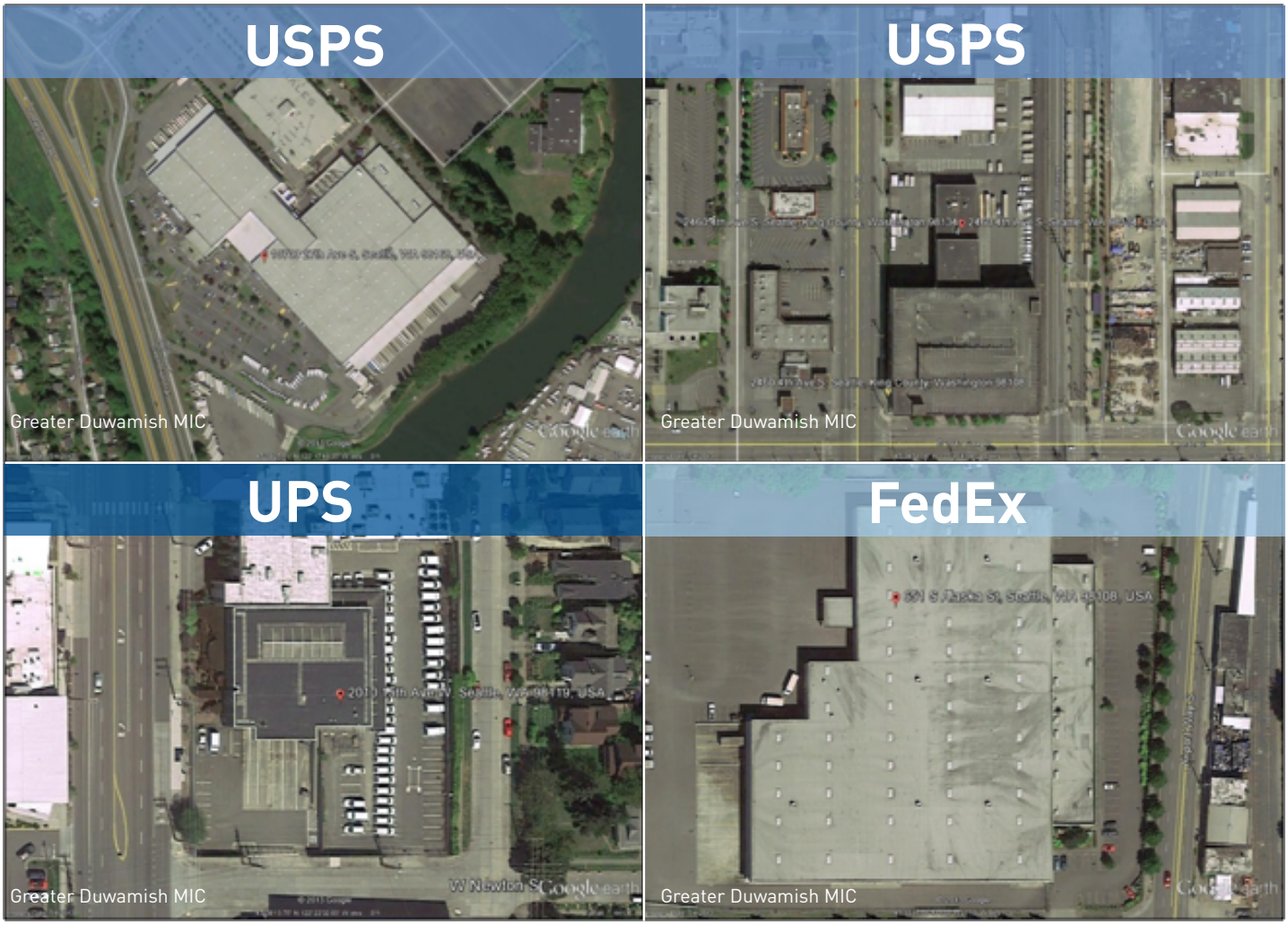

Figure 2.5 United States Postal Service, United Parcel Service, and FedEx Facilities within the Study Area

reason, it is critical for transload facilities to be adjacent to rail spurs. Import transloaders typically accept full container loads of imported goods and reload them into domestic highway or intermodal equipment for inland "domestic" movement. Typically, this involves consolidating from 40' containers to larger 53' containers to reduce the number of truck or rail trips required. As noted, rail spurs throughout the Greater Duwamish are critical for transload activity.

A different type of Transloading Facility include mail and parcel sorting and distribution centers, shown in Figure 2.5. These generate large numbers of truck movements. The United States Postal Service (USPS) has multiple facilities in or near the study area. UPS and FedEx are located in the Greater Duwamish MIC and have similar facilities. Heavy-duty trucks move to and from these points with consolidated loads, while fleets of light- and medium-duty trucks handle urban delivery and pick-up. USPS, UPS, and FedEx Ground are major users of rail intermodal service, so these facilities may also generate trips to and from BNSF and UP intermodal terminals. These businesses rely on timely roadway connections to the airports connecting them to their national networks.

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Distribution Centers

Newer warehouses and distribution centers (DCs) are typically larger buildings in suburban or rural areas and can be up to 2 million square feet, although most are in the 100,000 to 500,000 square foot range. The trend to fewer, more regional, warehouses is being driven by trucking and land cost considerations. Truck operators can now consistently cover a 400 to 600-mile radius, and with overnight service a 500 to 1,000-mile radius. Parcel services are able to cover a 1,000 to 3,000-mile radius with overnight or second morning service. As a consequence, customers have reduced the number of warehouses in their network and increased the size to cover larger territories. The Sears facility shown in Figure 2.6 in Kent is a good example of a modern DC. It covers about 250,000 square feet on a 14-acre site. As the aerial photo shows, it has truck loading doors on three sides. It would usually receive inbound merchandise from venders or larger DCs in truckload lots via for-hire carriers, and deliver mixed lots to stores in its own private (or contract) fleet. Suburban or rural locations are preferred for DCs of this type due to the large amount of land required, less congested freeway access, and the need to serve multiple metropolitan areas.

Figure 2.6 Sears Distribution Center (Kent, Washington)

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Figure 2.7 Manufacturing and Processing Facilities in the Study Area

Manufacturing and Processing

Manufacturing facilities, such as Nucor Steel in the Greater Duwamish MIC, generate manufactured goods from raw materials both requiring truck trips. In some cases, in processing facilities such as dairies and beverage bottling plants, production is combined with distribution. Inbound trucks typically carry raw materials, while outbound trucks may carry by-products and waste, as well as finished goods.

Facilities delivering or receiving large shipments of bulk goods, such as ready-mix concrete plants and aggregate dealers, depend on access for heavy-duty trucks. These businesses typically receive cement, aggregates, and other materials by rail or water, while delivering shipments by truck. The examples shown in Figure 2.7 are located in the study area.

Commercial Fishing

The commercial fishing industry is a special case, as it combines both processing and storage within the MICs. Commercial fishing is seasonal and regulated by the Department of Fish and Wildlife. Fishing results in perishable goods that need to be refrigerated or shipped quickly. The fishing fleet is based in Ballard, Fishermen's Terminal and Terminal 91. The associated processing plants are in the southern BINMIC

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and the southern Duwamish MIC. These plants take the catch from the fleets and process the fish, including making various seafood products as well as cuts of fish. Most products require cold storage or freezing, and are moved to cold storage plants in both MICs. While fresh fish can be sold from the processing plants, frozen fish and fish products are sold wholesale from the cold storage facilities. Most exported seafood is shipped frozen from the cold storage facilities rather than from the processing plants. Fish products exported out of the Seattle Customs District in 2012 were worth $1.6 billion[6].

Retail Commercial

Commercial and retail businesses can generate a wide variety of freight truck trips. These businesses generate large numbers of light-duty truck trips by the United States Postal Service (USPS), FedEx, United Parcel Service (UPS), and a host of other services both picking up and delivering small shipments. Commercial and retail businesses also generate large numbers of medium-duty truck trips delivering food service supplies, office supplies, equipment, industrial goods, finished products, and consumer goods. These businesses also generate significant numbers of heavy-duty truck trips ranging from regular supermarket and gasoline station deliveries to occasional deliveries of office furniture. The MICs include several produce and food service suppliers. Many of these suppliers start business very early in the morning, dispatching delivery trucks to markets and restaurants.

Other Businesses

There are other types of businesses operating in the two Seattle MICs that may not fall under the categories described in the previous sections. These businesses also impact the freight network through the transportation of goods.

Municipal solid waste (MSW) facilities and recyclers receive materials in a wide variety of trucks, ranging from pickups to heavy-duty vehicles. They may ship outbound via truck, rail, or water. Seattle Public Utilities (SPU) operates the South Transfer Station in the Greater Duwamish MIC and is rebuilding the North Transfer Station near the BINMIC. These sites are the operating bases for garbage and recycling trucks that take garbage to disposal sites or intermodal rail transfers. The two transfer sites also receive a large number of inbound trips from trucks of all sizes, ranging from pickups to heavy-duty trucks hauling construction debris.

Recology CleanScapes also has a fleet base and transfer facility in the Greater Duwamish MIC. The Rabanco recycling facility is unusual in having on-site capability to load outbound intermodal containers on rail cars. The Seattle School district offices are centrally located in the Greater Duwmish MIC. Three King County Metro bus maintenance bases (Central, Atlantic, Ryerson) and the Sound Transit Link light rail maintenance facility are also located in the Greater Duwamish.

The Greater Duwamish MIC is also home to Safeco Field, where the Mariners, a Major League Baseball team, plays, and Century Link Field,

6 Washington State Freight Mobility Plan, 2014

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PHOTO CREDIT: SDOT

where the Seahawks National Football League and Sounders Major League Soccer teams play. The events center at Century Link Field includes concerts and trade shows requiring truck access and occasional oversize deliveries.

2.2 Freight Assets

Freight assets are comprised of the roadway and rail infrastructure within the City of Seattle and include several types of facilities that serve freight needs. This section describes the regionally important roadways and railways that are part of and access to the Greater Duwamish MIC and BINMIC. The network of public roadways that serve not only freight but other modes are described hierarchically in various classifications including State Facilities, Arterial Street Network, Major Truck Streets, and Seaport Connectors. The facilities for truck freight interface with rail lines at intermodal terminals and are described later in this section. Waterways and Port facilities that serve as economic drivers of truck freight are described in detail at the end of this section. Finally, facilities carrying air cargo are described for King County International Airport/Boeing Field and Sea-Tac International Airport.

2.2.1 State Facilities

Washington State Department of Transportation (WSDOT) acts as a steward for the Federal Highway Administration and maintains and manages interstate highways that are the backbone of freight travel across the United States. Two interstate highways, I-5 and I-90, have access points within the Greater Duwamish MIC and are accessible from the BINMIC via major arterial roadways. These interstate highways serve as major regional routes throughout Western Washington and connect Seattle to California, Canada, Mexico, and points east. Other state routes, under the stewardship of WSDOT include:

- SR 99, which cuts through the middle of the study area, and serves as a major parallel north-south facility to I-5 through the City.

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- SR 509, which branches from SR 99 to serve as a major link to the Sea-Tac Airport industrial area and points south.
- SR 519, which provides direct access to SoDo, the waterfront, Washington State Ferries main terminal, and the Port terminals from both I-5 and I-90.
- SR 599, which provides access to the south on the west side of the Duwamish waterway.

2.2.2 Arterial Street Network

Seattle's Comprehensive Plan contains a street classification map designating arterial and local streets. All arterial streets are considered truck routes, which are streets where trucks are allowed to travel. Trucks in excess of 10,000 lbs. gross vehicle weight are discouraged from using non-arterial (local) streets unless they have a justifiable reason for traveling there. However, there are some non-arterial streets that are important truck streets and serve freight needs for access and mobility. For example, the gate to the BNSF's SIG yard, a major truck trip generator in the Greater Duwamish, is located Hanford Street between East Marginal Way South and First Avenue South. The City uses street designations as an important criterion for street design, traffic management decisions, and pavement design and repair.

2.2.3 Major Truck Streets

Major Truck Streets are arterial streets that accommodate significant freight movements through the City and connect to major freight generators. These roadways are primary routes for the movement of goods and services and serve both local and non-local truck traffic as defined in the *Transportation Strategic Plan*[7]. In the Greater Duwamish MIC, almost all major north-south arterial streets are major truck streets. Major east-west streets that are considered major truck streets typically provide access to I-5 and other regional roadways. The Major Truck Streets within and between the MICs are shown in Figures 2.8 to 2.10.

7 Transportation Strategic Plan. City of Seattle. 2005

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Figure 2.8 SDOT Major Truck Streets – North Section

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Figure 2.9 SDOT Major Truck Streets – Central Section

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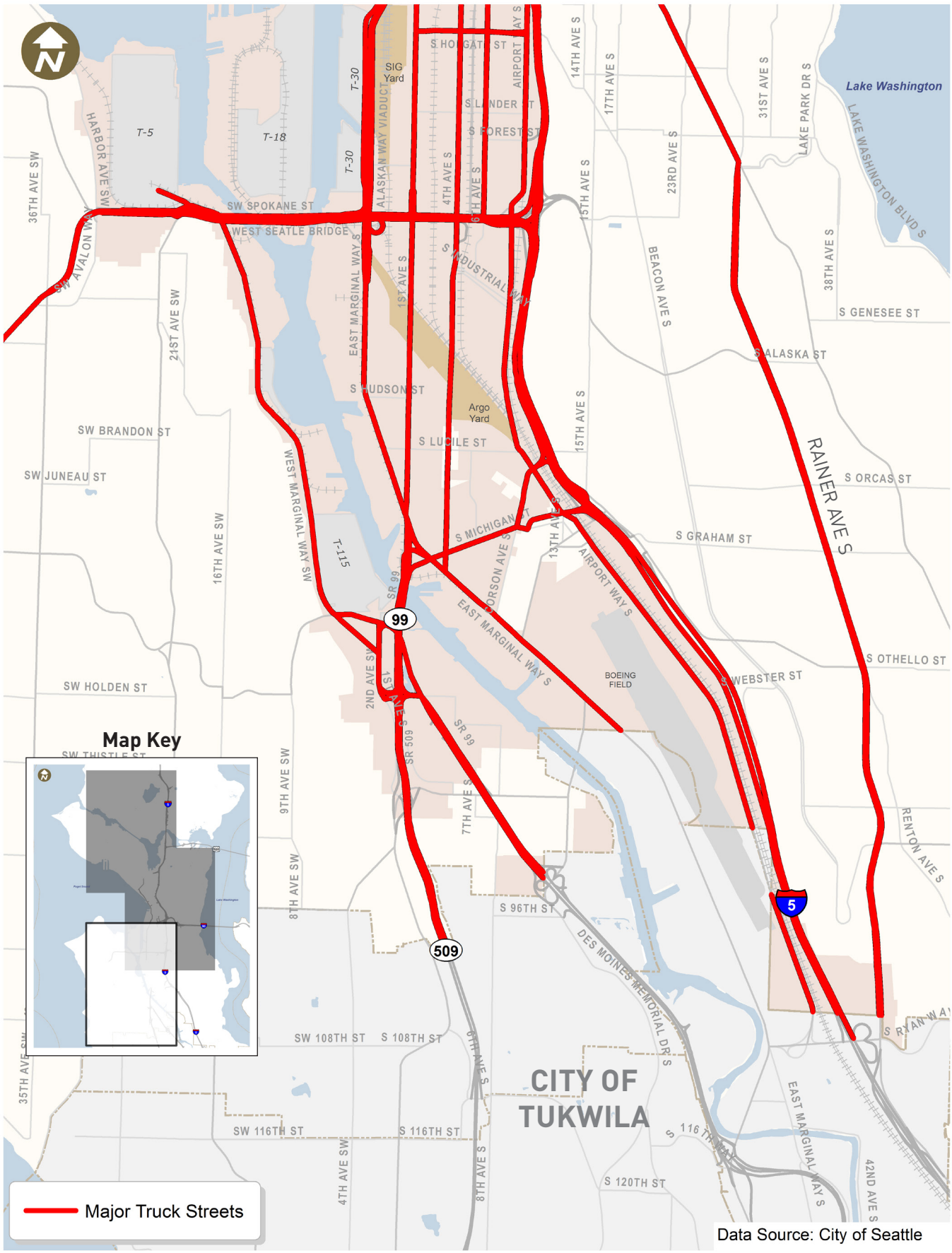

Figure 2.10 SDOT Major Truck Streets – South Section

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2.2.4 Seaport Connectors

Seaport Connectors[8] directly link Port of Seattle terminals and facilities to rail intermodal facilities and the regional highway system. These connections are important to maintain the economic activity related to the Port and are shown in Figure 2.11.

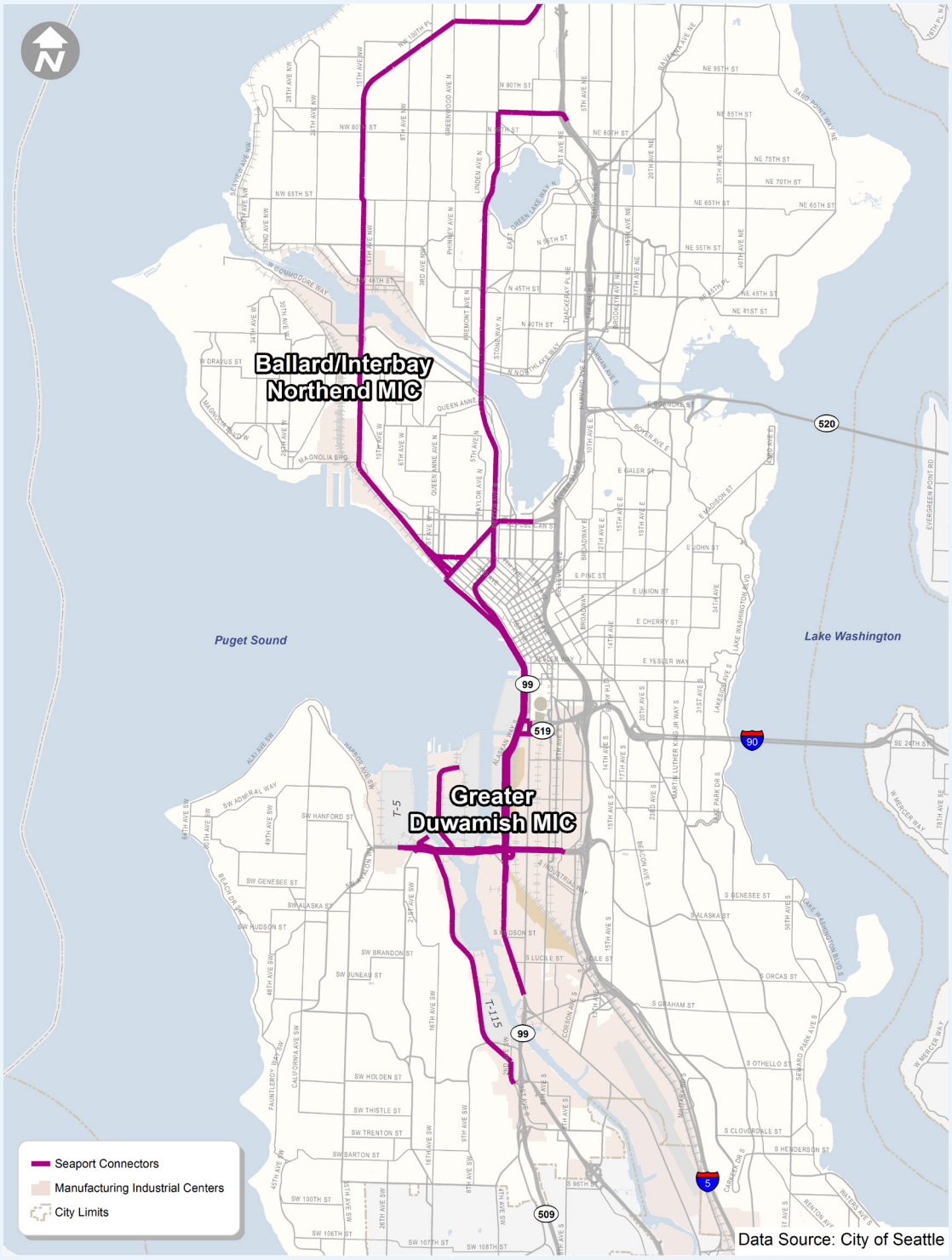

Figure 2.11 Existing Seaport Connectors

8 www.seattle.gov/transportation/freight.htm#seaports

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Intermodal Freight Transport

Intermodal freight transport involves the transport of freight in an intermodal container using multiple modes of transportation (rail, ship, and truck), without any handling of the freight itself when changing modes. The method allows for freight to be moved and stacked efficiently by reducing handling. This method of moving goods in containers of standard size improves security and reduces damage and loss.

International containers are measured in TEUs (twenty foot equivalent units.) In international shipping, the most common container is a cube that is 40 feet long by 8 feet wide by 9 ½ feet tall.

2.2.5 Intermodal Terminals

In the Ballard/Interbay Northend MIC, there is one intermodal yard, Balmer Yard, which has very little truck activity.

Within the Greater Duwamish MIC, there are on-dock intermodal facilities on Port terminals as well as five facilities involved in rail intermodal shipments including three within the BNSF's Seattle International Gateway (SIG), one at Union Pacific's Seattle (Argo) Terminal, and one at Rabanco's small transfer facility for the company's own use (Figure 2.12). A fourth facility, BNSF's South Seattle (Tukwila) terminal, is just south of the Greater Duwamish MIC in the City of Tukwila. Two Port terminals have on-dock rail access, Terminal 5 in West Seattle and Terminal 18 on Harbor Island. In addition, Terminal 86, the Port's grain export terminal, receives its cargo exclusively by rail.

Domestic intermodal trailers or containers are typically 53' or 28', versus 40' or 20' for international containers. Major customers for domestic intermodal service include UPS, USPS, FedEx Ground, and other less-than-truckload (LTL) carriers. These customers move large volumes of trailers and containers between UP's Argo or BNSF's South Seattle yard and their sorting centers. A second major customer group is the truckload carriers, such as J.B. Hunt, Schneider National, and Swift that typically move domestic trailers or containers directly between intermodal terminals and rail customers, but also may hold units in local staging facilities. The third major customer group for domestic intermodal movement is the intermodal marketing companies (IMCs) such as Hub City, Alliance Shippers, and C.H. Robinson. IMCs act as agents and brokers, arranging intermodal moves on behalf of a wide range of shippers.

Balmer Yard

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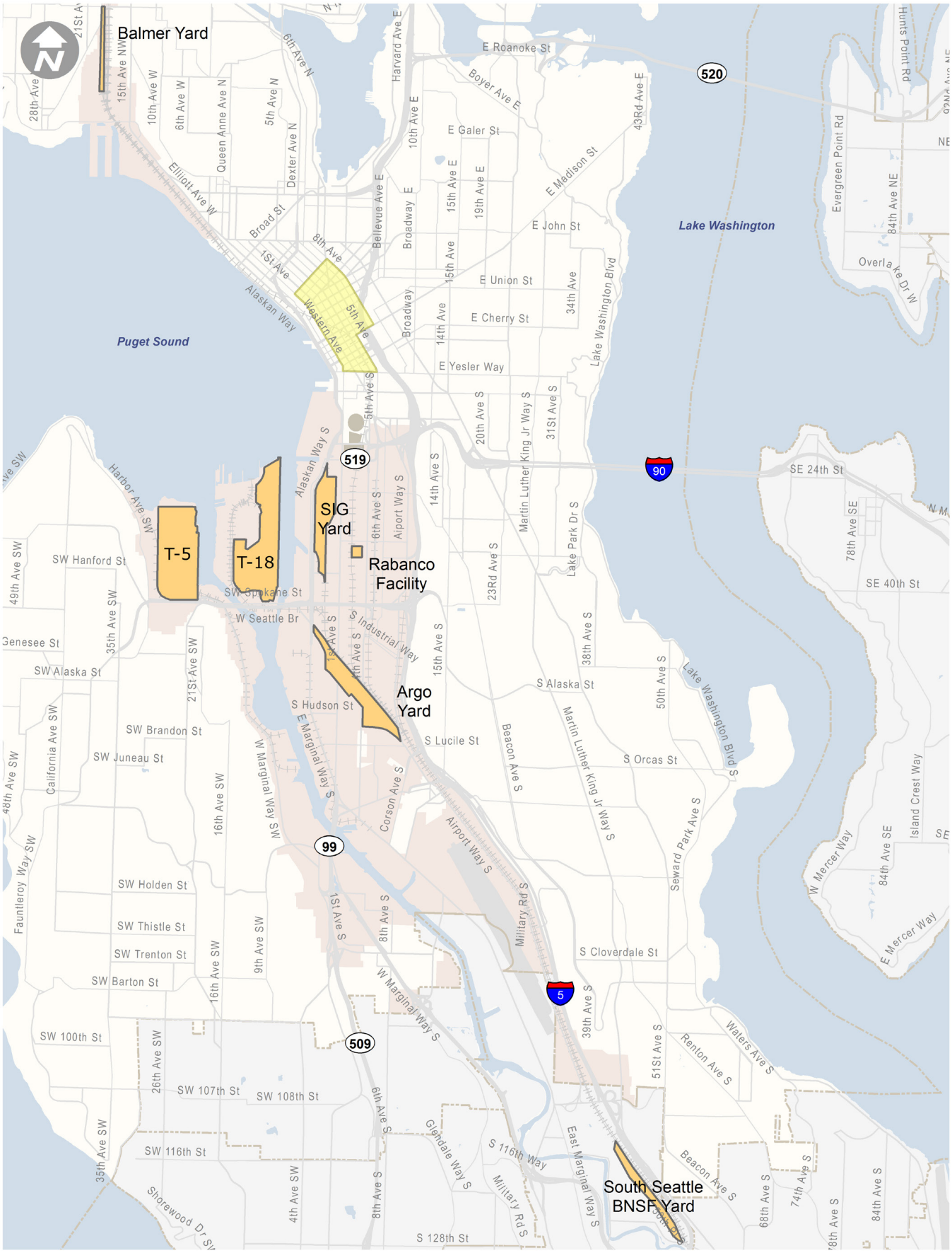

Figure 2.12 Existing Rail Intermodal Facilities

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Figure 2.13 Balmer Yard

BNSF Balmer Yard, shown in Figure 2.13, is a roughly 80-acre intermodal yard with 41 parallel tracks located in the BINMIC. The yard is owned by BNSF Railway, and was built by predecessor Great Northern Railway as Interbay Yard. It is primarily used for railroad maintenance with very little truck activity. It is strategically located between Terminal 91 and Fisherman's Terminal.

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Figure 2.14 BNSF SIG Yard

BNSF SIG Yard

BNSF's Seattle International Gateway (SIG) Yard is a dedicated facility for international containers. Traffic to and from SIG and North SIG is primarily focused on the Port marine terminals.

The BNSF SIG Yard shown in Figure 2.14 is comprised of three facilities: Main SIG (intermodal) and Stacy (mixed cargo) are accessed via the original south entrance from Hanford Street. North SIG with the wide-span electric gantry cranes is accessed from Massachusetts Street. There are no internal truck connections. SIG operates 24 hours a day, 7 days a week, although truck movements mostly occur from 8am-5pm.

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Figure 2.15 UP ARGO

UP Argo Yard

Union Pacific's South Seattle (Argo) terminal is a dual-purpose facility, handling domestic containers and trailers, as well as international containers. This yard handles outbound solid waste. Shown in Figure 2.15, the domestic containers and trailers move between Argo and customers in the two MICs: industrial, agricultural, and logistics clusters outside Seattle; and other local and regional points. Access to Argo is on Diagonal Avenue S, just east of East Marginal Way S. The Argo Yard Truck Roadway project, currently underway, will provide southbound access to the Argo Yard under the new SR99 Spokane Street Trestle, allowing trucks coming from the Port's T-18 and T-5 to avoid the East Marginal Way southbound crossover. Argo gates typically operate Monday - Friday, 5 am - midnight; Saturday and Sunday 7am - 5pm, but operations and train movements may occur around the clock.

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Figure 2.16 BNSF Tukwila

BNSF Tukwila

BNSF's South Seattle yard (Tukwila) yard is primarily a domestic intermodal facility. It is accessed from 51st Place South. Although just outside the Greater Duwamish MIC, this facility, shown in Figure 2.16, generates numerous trips to and from the MIC and shares truck routes to points south. Tukwila's gates are open 24 hours a day, 7 days a week.

Rabanco

The Rabanco facility at 2733 3rd Avenue S handles the company's recycled materials in specialized containers.

Intermodal Connectors

Intermodal Connections are shown in Figure 2.17. Jointly defined by the Port of Seattle and SDOT, they comprise the heavily used routes that connect the Port of Seattle terminals to the intermodal facilities at SIG and Argo yards.

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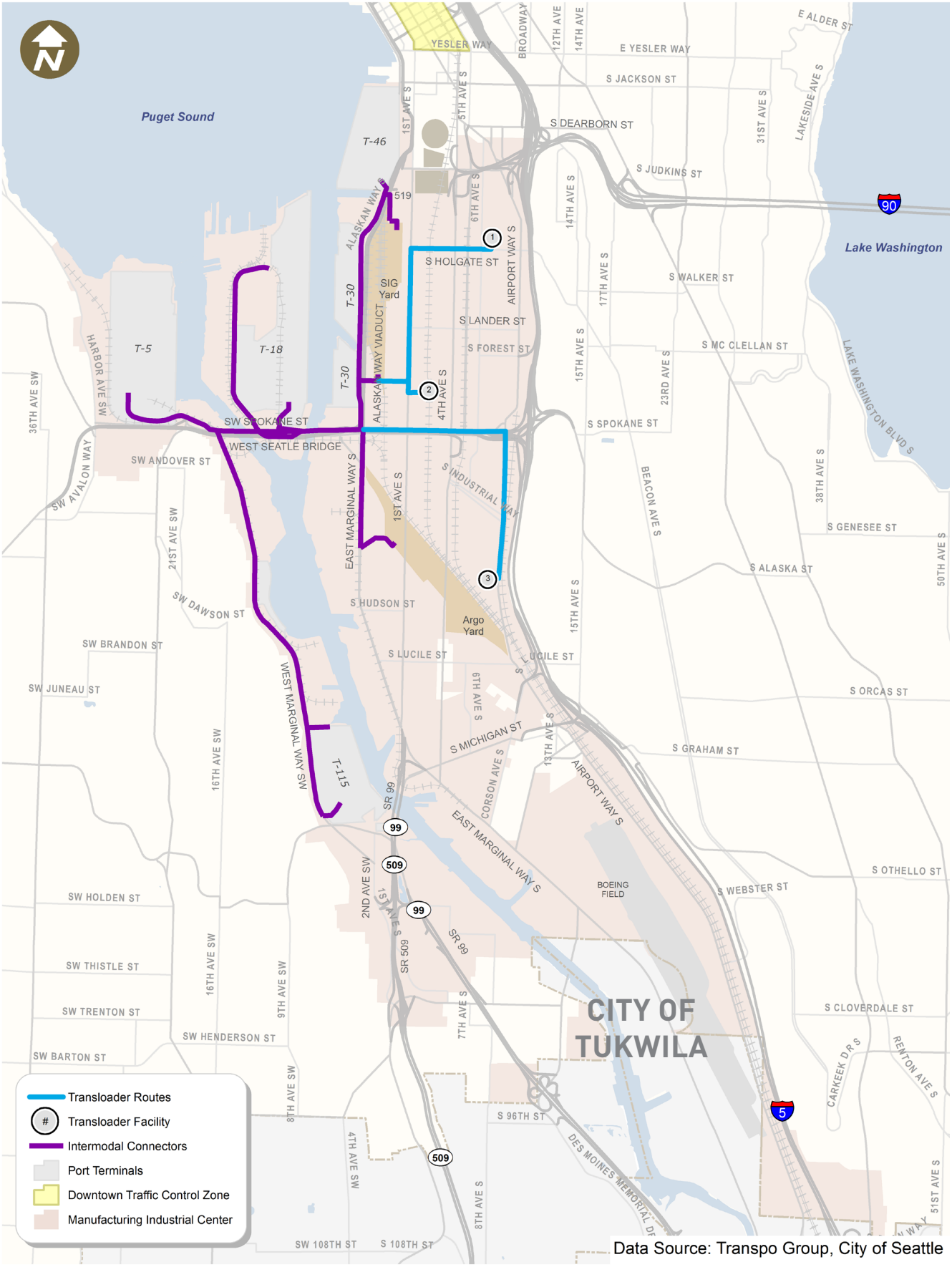

Figure 2.17 Intermodal Connectors

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2.2.6 Waterways and Port Operations

Waterways

The Lake Washington Ship Canal and the Duwamish Waterway are navigable channels that provide another choice for moving goods within the City of Seattle. The Lake Washington Ship Canal serves the Ballard/Interbay Northend MIC specifically by providing access for the large seasonal commercial fishing fleet. The Lake Washington Ship Canal also serves vessels moving construction materials. The Duwamish Waterway provides access to all of the Port of Seattle Container Terminals served by cargo ships and other industrial businesses including construction materials on barges.

Elliott Bay is a large natural deep water port on the West Coast of the United States and provides the primary shipping route to the Port of Seattle. The Puget Sound waterway system, including Elliott Bay, moved over 51.7 million tons of freight in 2011[9].

Port Operations

The Port of Seattle has multiple terminals in or adjacent to the study area MICs. Four major container terminals located within the Greater Duwamish MIC generate the most truck trips: Terminal 5 in West Seattle, Terminal 18 on Harbor Island, and Terminals 25/30 and 46 along East Marginal Way S. Terminal 115 in the south end of the Greater Duwamish MIC along W Marginal Way and Terminal 86 at the south end of the BINMIC are other Port terminals.

These terminals facilitate the transfer of import and export cargo containers between ships and land transportation modes such as railcars or trucks. Terminals 5 and 18 support drayage and intermodal transfers and have on-dock rail capability, where containers to a common destination can be loaded directly onto a train at the terminal. International container movements to and from the terminals are handled by specialized drayage firms using either owner-operators under contract, or employee drivers.

Waterborne Traffic

The Duwamish Waterway began construction in the 1911 as a waterway for vessel traffic. In 1963, ownership of the roughly 5-mile-long and 500-foot wide waterway was transferred from the Commercial Waterway District #1 of King County to the Port of Seattle. In the 1980s the Spokane Street Bridge was constructed with sufficient vertical and horizontal clearance to maintain marine traffic. In the 1990s the Spokane Street Swing Bridge (a moveable bridge) was constructed. Vessels using the Duwamish include treaty fishing, tugs, ships and barges carrying bulk, and containers, pleasure craft and commercial vehicles, and other cargo vessels. All are dependent on unimpeded marine traffic to and from the Duwamish waterway. The drawspan openings range from 10-17 minutes delaying waterborne vessels. These delays can be exacerbated when tides restrict vessel movements. While surface traffic over the Spokane Street Swing Bridge may have alternate routings, vessel traffic is limited to the waterway.

9 Washington State Freight Master Plan, WSDOT 2014.

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The volume of truck trips generated by container movements at these port terminals is determined by:

- Frequency of vessel calls.
- Size of vessel.
- Number of containers unloaded and loaded.
- Share of containers transferred to/from rail at on-dock facilities (T-5 and T-18.)

Other things being equal, the arrival of a large vessel will create more demand for short-term truck trips, and therefore greater potential for terminal congestion and impacts on adjacent streets, than the same number of containers spread out over more calls by smaller vessels.

PHOTO CREDIT: PORT OF SEATTLE

The Port also has other terminals that generate truck trips. In BINMIC, Terminal 91 is an operating base for commercial fishing vessels and also handles non-containerized cargo in refrigerated break-bulk ships or on roll-on/roll-off (ro-ro) vessels. Terminal 91 generates truck trips associated with processed seafood and with other cargo types. In addition to fishing vessels, Terminal 91 includes Smith Cove Cruise Terminal. In Seattle's summer cruise season, it operates as a two berth cruise terminal with primarily weekend homeports which require additional provisioning for 7-day cruise. T-91 is accessed via 16th Avenue W. Terminal 115 (T-115) is a marine break-bulk and container barge terminal operated by Northland Services. Alaska Marine Lines provides service to Alaska and Aloha Marine Lines provides service to Hawaii. Charter services are also offered. T-115 is accessed via W Marginal Way SW. Finally, Terminal 86 (T-86) grain facility is operated by Louis Dreyfus Commodities. T-86 primarily transfers grain from rail cars to the storage elevator and from the elevator to ships. Truck trips are not a major factor for this facility.

Terminal Operations

The four major Port container terminals are currently served by eight vessel services[10]. As of mid-April 2014, these services employed vessels of various sizes. Container vessel sizes are given in twenty-foot equivalent units (TEU). The trade through Seattle is predominantly in 40' containers, so on average, at Seattle there are 1.76 TEU per container.

Vessel size is only part of the story since the percentage of cargo that is actually loaded and unloaded at a given port varies widely. As of 2010, the average vessel arriving in Seattle had a capacity of 5,055 TEU and discharged and loaded an average of 2,451 TEU, or 48% of the vessel capacity.

10 Washington State Rail Plan. Washington State Department of Transportation. March 2014.

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In April 2014, the smallest vessels were used in the Westwood and Matson services.

- Westwood (T-5) is a specialized PNW-Asia carrier operating combination ("Conbulk") ships for forest products, containers, and oversized cargo. Eastbound vessels from Asia first called at Everett, then at Seattle and Vancouver. The vessels that called at Seattle are 2,048-2,061 TEU.
- Matson (T-18) operated services between Seattle and Hawaii and Guam, with two weekly arrivals in Seattle. These vessels range from 1,600-2,500 TEU.

As of April 2014, these two niche carriers were unlikely to shift to significantly larger vessels within the time horizon for this study.

Terminal 5 had two larger vessel services:

- PSX – Pacific Southwest Express, operated by APL/Hyundai/MOL, using MOL vessels, typically of about 6,700 TEU.
- PNX – Pacific Northwest Express, operated by APL/Hyundai/MOL, using Hyundai vessels of about 8,500-8,700 TEU.

Terminal 18 also had two major services:

- Cosco – Pacific Norwest Express Serve, operated by Cosco/"K"-Line/Yang Ming/Hanjin, using vessels of about 8,400 TEU.
- TP9/Columbus Coop – operated by Maersk/CMA-CGM/ANL/Safmarine, with vessels of about 9,300 TEU.

Terminal 30 had one regular service: ANWI – West American Line IV, operated by China Shipping and UASC, with 4,300 TEU vessels.

Terminal 46 had vessel calls from three services:

- CAX – California Express, operated by MSC, using 5,048 TEU vessels.
- PNH – Pacific Northwest Hanjin Express, using 5,068 TEU vessels.
- PSX – Pacific Southwest Hanjin Express, operated by Hanjin, using 9,954 TEU vessels.

These vessel calls can change on short notice, especially with changes in consortia and vessel-sharing agreements (VSAs), so the current mix of vessel sizes can be regarded as typical rather than definitive.

The 2014 mix of vessels for major Asian services ranged from roughly 5,000-10,000 TEU. There has been a trend to larger vessel sizes throughout the history of containerization and that trend is continuing. There are two generic options for ocean carriers to employ as trade grows:

- Increasing vessel size while maintaining voyage frequency (typically weekly).
- Adding new services with overlapping port calls, effectively increasing service frequency.

Carriers often employ a mix of strategies, introducing both newer, larger vessels and adding services. Ocean carriers also attempt to capture the scale economies of larger vessels by forming consortia or vessel sharing agreements. Most of the services calling Seattle are actually operated on behalf of multiple carriers. By combining cargo volumes, carriers can use larger vessels on the same schedules. Consolidation of this kind is the likeliest driver of potential vessel size increase in Seattle in the near-term.

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PHOTO CREDIT: CITY OF SEATTLE

Long-term regional planning should anticipate more frequent calls by larger vessels. In April 2014, there were no concurrent calls by large vessels at a single terminal. This is expected to change with a continuing trend towards fewer strings with larger vessels. In addition, schedule reliability can be impacted by weather and other delays, creating unexpected overlap and peak container handling requirements.

If container volumes become more concentrated, impacts could include more truck congestion and queues. These can be mitigated by more use of on-dock rail, adjustments to terminal operations, enhanced truck processing at gates, and extended terminal gate hours.

2.3 Truck Freight and Operations

From the uses described above including warehousing, transload, distribution, port and terminal, different truck types are employed to meet these specific needs. Different types of trucks are classified in different ways. Truck characteristics that most influence design are weight and distribution over axles, dimensions (width and height) and turning radius. Vehicle speeds are also a factor in operational analysis. These factors influence the types of truck trips, the business operations of the industry, and the trip generators.

2.3.1 Relevant Truck Classifications

Trucks and truck operators are grouped in different classification systems based on the number of axles and gross vehicle weight. Truck classification systems have been established by the Federal Highway Administration (FHWA) and the trucking industry to discuss the broad range of truck types in simpler terms. These classification systems are typically broken down to include light, medium, and heavy-duty trucks. A comparison of classifications is provided in Table 2-2.

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FHWA Classification

The FHWA Vehicle Classification system groups vehicles based on the vehicle type, number of axles, and number of wheels. 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 in Figure 2.18.

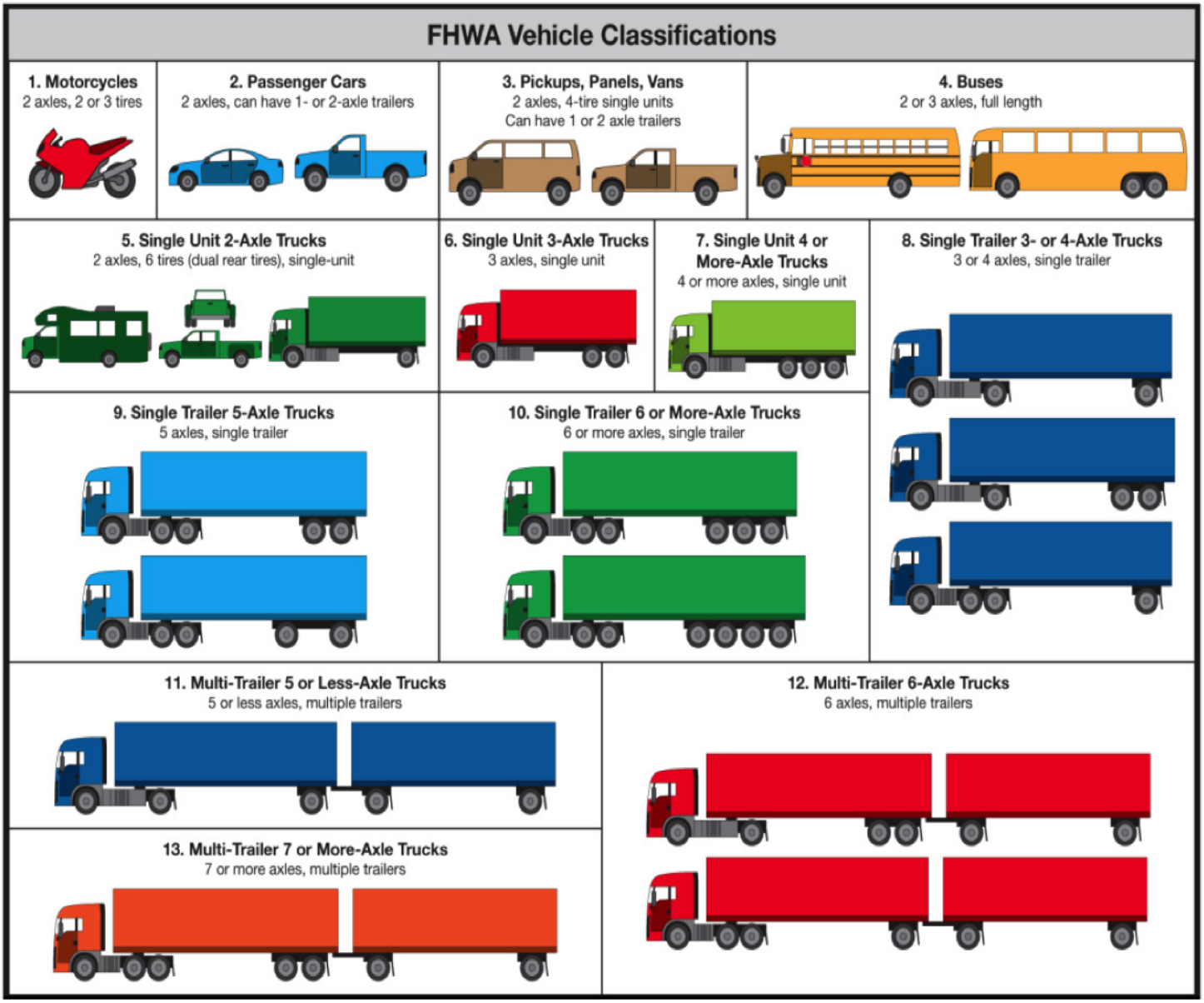

Figure 2.18 FHWA Truck Classifications Based on Axles and Vehicles [11]

11 TxDOT Traffic Recorder Instruction Manual. Texas Department of Transportation. 2012.

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Gross Vehicle Weight

The trucking industry usually defines roadway freight in terms of gross vehicle weight (GVW) classifications, which are maximum total weights assigned by the manufacturer. FWHA, the U.S. Environmental Protection Agency, and U.S. Census Bureau also use the gross vehicle weight classifications to serve the needs of many regulations and standards. Figure 2.19 shows GVW classes 1 through 8.

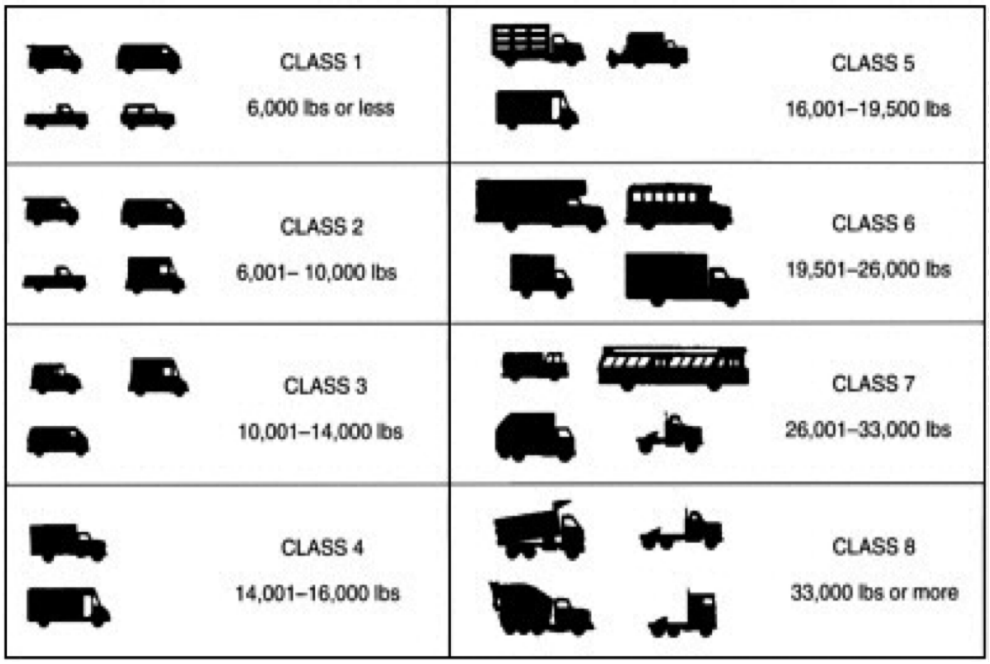

Figure 2.19 Classification Based on Gross Vehicle Weight (GVW) [12]

12 Image available at: www.nap.edu/books/0309072514/xhtml/images/2000316f000701.jpg

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Light, Medium, and Heavy Duty Trucks

The following classifications were used in summarizing the truck counts for this Freight Access Project:

- Light-duty vehicles are used primarily for urban delivery, trades, and services. Commercial vehicles overlap private vehicles (such as large pick-ups trucks used to pull boats) in these classes.
- Medium-duty vehicles are mostly single-unit "straight trucks" with two axles, although there are exceptions.
- Heavy-duty vehicles include both straight trucks (such as dump trucks, garbage trucks, and cement mixers) and tractors pulling semi-trailers ("18-wheelers").

The classifications are consistent with SDOT practices. These groups are compared to the FHWA and GVW classification systems in

Table 2.2 Truck Classifications

Vehicle Type	Light, Medium, or Heavy-Duty Truck	FHWA Classification	Gross Vehicle Weight
Bicycles/Motorcycles	-	1	-
Cars and Trailers	-	2	< 16,000 lb
2-Axle Long	-	3	< 16,000 lb
Buses	-	4	-
2-Axle, 6 Tire	Light	5	< 16,000 lb
3-Axle, Single	Light	6	Single Unit 16 – 52,000 lb
4-Axle, Single	Light	7	Single Unit 16 – 52,000 lb
< 5-Axle, Single	Medium	8	Tractor-Trailer – one trailer > 52,000 lb
5-Axle, Double	Medium	9	Tractor-Trailer – one trailer > 52,000 lb
> 6-Axle, Double	Medium	10	Tractor-Trailer – one trailer > 52,000 lb
< 6-Axle, Multi	Heavy	11	Tractor-Trailer – two trailers > 52,000 lb
6-Axle, Multi	Heavy	12	Tractor-Trailer – two trailers > 52,000 lb
> 6-Axle, Multi	Heavy	13	Tractor-Trailer – two trailers > 52,000 lb

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Table 2.2. Bicycles/motorcycles, passenger cars, pickups, and buses are FHWA classes 1 through 4, and freight trucks are classes 5 through 13. Light-duty trucks comprise classes 5 to 7, medium-duty trucks classes 8 to 10, and heavy-duty trucks classes 11 to 13.

GVW classes 3 to 8 comprise most commercial vehicles involved in freight movements, with the exception of local delivery that includes many Class 2 vans. In general, single-unit trucks are considered light-duty, tractor-trailers with one trailer are considered medium-duty, and trucks with two trailers are heavy-duty trucks. Because gross vehicle weight ranges considerably within each vehicle type, a general GVW is provided in Table 2.2.

Commercial and industrial businesses can generate a wide variety of freight truck trips. These businesses generate large numbers of light-duty truck trips by United States Postal Service (USPS), FedEx, United Parcel Service (UPS), and a host of other services both picking up and delivering small shipments. Commercial and industrial businesses also generate large numbers of medium-duty truck trips delivering food service supplies, office supplies, equipment, industrial goods, finished products, and consumer goods. These businesses also generate significant numbers of heavy-duty truck trips ranging from regular supermarket and gasoline business locations to occasional deliveries of office furniture and routine inbound and outbound factory shipments.

Total traffic volumes and the percentage of freight vehicles on roadways within the City of Seattle, along with the representation of light, medium, and heavy-duty trucks, is included in Chapter 3 – Existing Conditions of this report.

2.3.2 Truck Travel Purposes/Functions

This section outlines the several types of truck trips. These include intermodal drayage, urban/local trips, and regional trips.

Regional and Long Haul

Regional long-haul truckload trips by for-hire carriers typically deliver an inbound load at a local destination, reposition the empty trailer, and pick up an outbound load somewhere else in the region. Regional trips by private carriers are more likely to return empty to the origin. Regional trips rely heavily on state and regional highways to conduct business, and use local streets as first or last mile facilities to access major freight origins and destinations. These movements use larger single-unit straight trucks as well as tractor/semi-trailer combinations.

Longer-haul movements beyond the Seattle region are, for this study, basically indistinguishable from regional movements. Longer-haul movements will be channeled onto the same freeways as movements between Seattle and adjacent areas, and will use the same arterials and surface streets to connect final origins and destinations.

Urban/Local

The majority of commercial truck trips in urban areas are based on local pickup and delivery requirements. The most visible component of urban and local truck activity is the familiar parcel and mail service (e.g., U.S. Postal Service, UPS,

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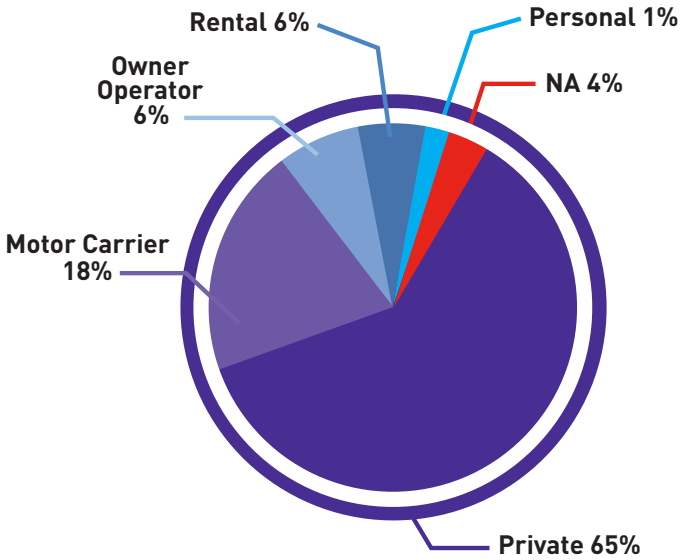
and FedEx). Most local trips begin and end at the same point, the truck's home base. The home base can range from a large-scale fleet operation to a single retail store parking lot or a driver's residence.

Local trips typically use local arterials, or short sections of state highways. Due to the small business or residential destinations of these types of truck trips, many truck services will utilize on-street parking while fulfilling deliveries. The City of Seattle designates truck load zone spaces in high-demand parking areas in the Central Business District (CBD) and commercial districts. The findings from the SDOT Commercial Vehicle Pricing Project are anticipated to provide recommendations on these issues for urban/local truck freight in the City.

Port Trucking and Intermodal Drayage

Intermodal containers that are not loaded on trains in a terminal are drayed to one of the three near-dock intermodal yards: SIG, North SIG, or Argo. Import containers may also be trucked to a local warehouse or distribution center, repackaged from an ocean-going 20 or 40-foot container to a 53-foot domestic container, and then trucked to a nearby rail yard for inland transport. In 2012, 40 percent 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. The remaining 60% of containers were moved by truck to or from local and regional businesses, warehouses, or distribution centers.



Sector	Share
Goods Movement	34%
For-hire Transp & Warehousing	18%
Retail Trade	7%
Wholesale Trade	5%
Manufacturing	4%
Mixed Freight/Service	60%
Construction	19%
Agriculture, forestry, etc.	14%
Not Reported/Not Applicable	11%
Vehicle Leasing or Rental	6%
MSW, Landscape, admin/support	5%
Utilities	3%
Mining	2%
Service	6%
Other Services	3%
Accommodation & Food Service	1%
Info Services	1%
Personal Transportation	1%
Arts, Ent, Rec	0%
Total	100%

Source: 2002 VIUS

Figure 2.20 National Data for Types of Truck Fleet Owners and Truck Usage

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Types of Truck Operators

National data provides a comparative breakdown of truck operators as shown in Figure 2.20. This national breakdown of medium and heavy-duty truck fleet operators is from 2002 and may not reflect current local ownership in Seattle. Most of the medium and heavy-duty trucks are in dedicated "private" fleets such as service industries, construction companies, and other operators that haul their own goods or use trucks for other purposes. These private fleets account for about 65% of medium and heavy-duty trucks, whereas about 24% are involved in for-hire trucking (commercial motor carriers or owner operators).

As shown in Figure 2.20, for the nation as a whole, about a third of the medium and heavy-duty trucks are directly involved in moving goods in for-hire trucking or in retail, wholesale, or manufacturing sectors. Another 60% of trucks are in mixed-use sectors, with construction the single most prominent industry.

Private Fleets

Private fleets are used primarily in local and regional businesses. A very large part of the total trucking activity is therefore carried out by local and regional carriers, contractors, and fleet operators.

For-hire Trucking

Commercial motor carriers or owner operators that move freight belonging to customers include:

- Less-than-truckload carriers, such as UPS, which operate long-haul trucks between terminals and perform local pickup and delivery with smaller trucks.
- Truckload carriers, such as J.B. Hunt, Swift, or Schneider National, which moves full truckloads directly from shipper to receiver.
- Contract carriers that provide trucking under long-term agreements for specific customers.
- Drayage firms that move intermodal containers or trailers between marine container terminals, rail intermodal terminals, and local customers.
- Specialized carriers of many types that handle specific commodities (e.g. gasoline delivery to service stations) or provide specific services (e.g. movement of oversized heavy loads).

Mixed-use

Other types of truck operators include service providers (such as tradesmen and utilities) and the construction industry. These trucks may not carry traditional freight, but they have similar infrastructure requirements and similar impacts. The construction industry is a large component of trucking in general, and a significant presence in the study area.

2.3.3 Estimated Tonnage

The freight economic corridors identified in the Washington State Freight Mobility Plan[13] are managed by WSDOT and used to classify state highways, county roads and city streets according to the average annual gross truck tonnage they carry. The Freight Economic Corridors classifies roadways as follows and are mapped in the Seattle MIC areas in Figures 2-21 through 2-23.

- T-1: more than 10 million tons per year
- T-2: 4 million to 10 million tons per year

13 Washington State Freight Mobility Plan, 2014

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Figure 2.21 WSDOT Freight Economic Corridors – North Seattle Section

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Figure 2.22 WSDOT Freight Economic Corridors – Central Seattle Section

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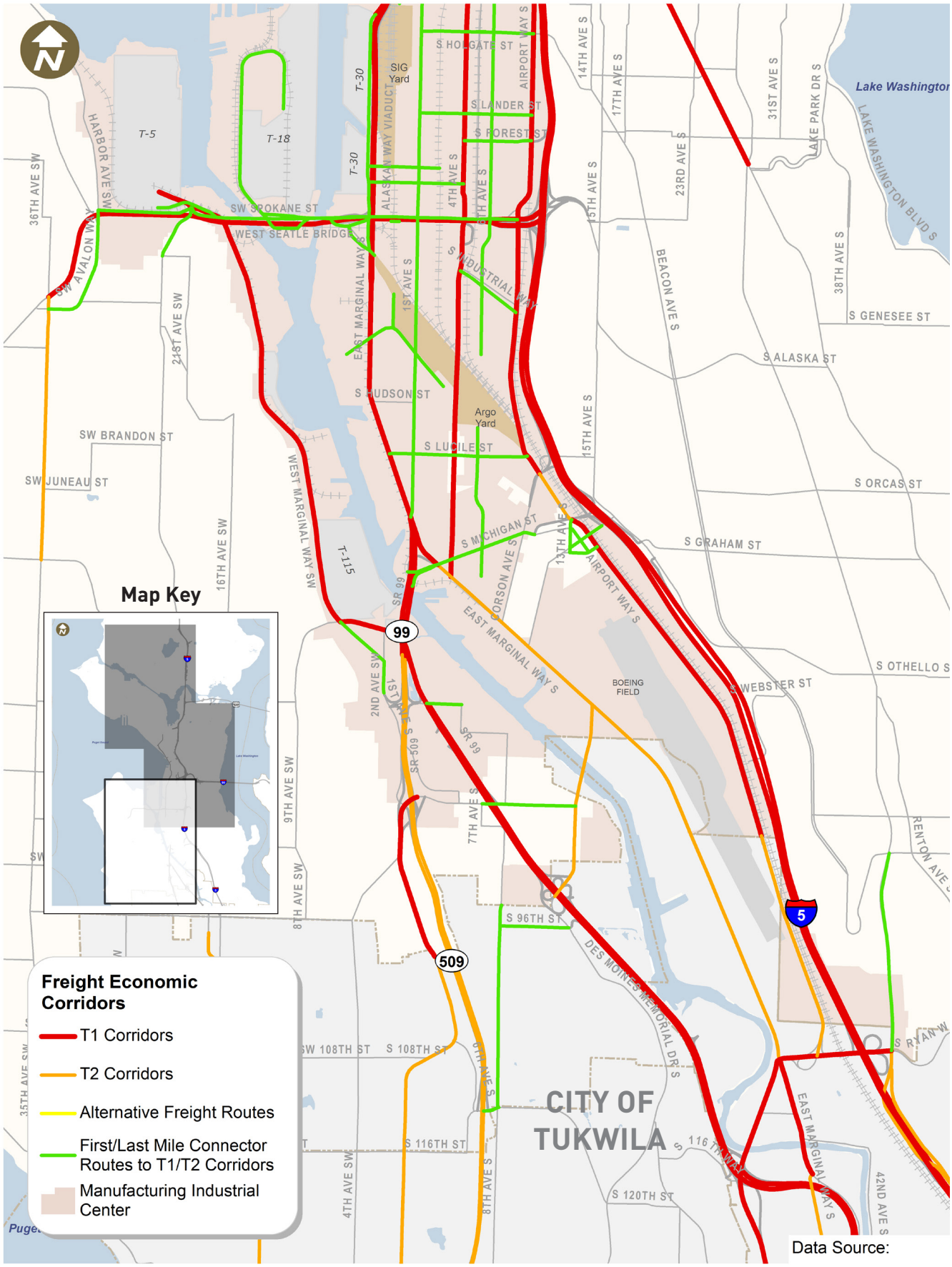

Figure 2.23 WSDOT Freight Economic Corridors – South Seattle Section

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Classification is based on data and information provided by the City of Seattle. Classifications may be revised as new data is collected.

Alternative Freight Economic Corridors are corridors carrying 600,000 to 4 million tons per year and serve as alternatives to T1 freight routes. In addition to the T-1 and T-2 corridors, first- and last-mile truck connector routes are included in the Strategic Economic Corridors identified in the PSRC region [14] These routes provide key connections to the T-1 and T-2 routes and are a supplemental piece to the freight corridors identified by WSDOT.

2.3.4 Truck Origins and Destinations

The freight access needs of each MIC depend on the types of businesses that originate and terminate truck trips there. This section discusses the various truck origin and destinations points within the MICs, including port terminals, intermodal facilities, and supporting land uses. In addition, the major highways and arterials within the MICs are significant origins and destinations at the edge of the MICs for all freight entering or exiting the area. Figure 2.24 highlights representative examples of origins and destinations in the study area.

Port Terminals

Five container terminals at the Port of Seattle currently generate the majority of container traffic. T-30 is along East Marginal Way and T-46 is along Alaskan Way. T-5 and T-18 are accessed via Spokane Street in West Seattle and Harbor Island, respectively. T-115, a smaller terminal serving domestic cargo, is located at the southern end of the study area along West Marginal Way. The most concentrated Port truck trip volumes are between the container terminals and the SIG and Argo intermodal rail terminals.

According to Port data, drayage trips are split between local customers in Seattle (almost exclusively in the two MICs), the two rail intermodal facilities (SIG and Argo), and customers outside the study area.

The Port of Seattle's container terminals are special cases for multiple reasons:

- Port container drayage is conducted exclusively by heavy-duty trucks (although container terminals also generate some trips by other truck types).
- Port container drayage is concentrated on the day shift, with limited movements in the early morning or night hours.
- Port drayage movements tend to be linked to vessel schedules, they peak in the day before vessel arrival (for exports) and the 2 days after vessel arrival (for imports).
- Port drayage may lead to congestion on adjacent streets and on the interstates.

It is rare that the queue on the terminal exceeds the capacity of the truck holding area. Most off-terminal queues are due to Coast Guard security requirements which allow only one truck at a time to enter the on-terminal queuing area after inspection of the Transportation Worker Identification Credential (TWIC) card. Trucks may also queue in the early morning shortly before the security check opens, and the queue typically dissipates quickly after it does.

14 Strategic Economic Corridors Map. WSDOT. 2010.

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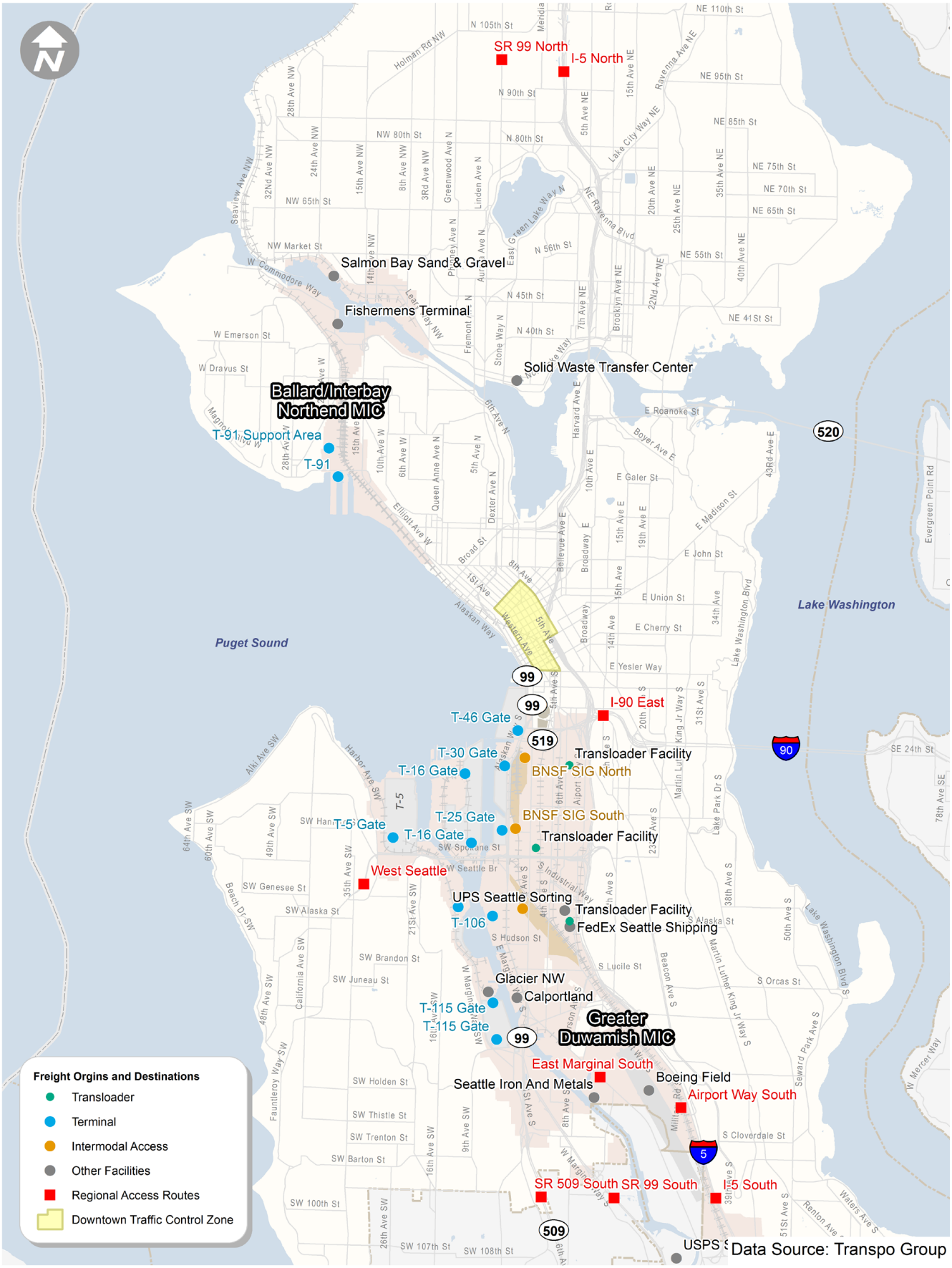

Figure 2.24 Examples of Trucking Origins and Destinations

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2.3.5 Time of Day Characteristics

Truck traffic has different peaking characteristics than the general traffic stream, and the percentage of trucks on the roadway varies by time of day. Hourly traffic volumes are useful for comparing the peaking characteristics of general traffic and freight traffic. These are shown in Figure 3.1 in Chapter 3. Many of the data sources included in the daily traffic volumes and truck percentages included 24-hour classification counts. Hourly traffic volumes for the major study roadways were organized by individual MICs to provide a more detailed picture of hourly traffic patterns in these areas.

Truck volumes peak in the morning at approximately 8am and remain relatively constant for most of the day until peaking again around 4pm and then tapering off. As a percentage of total traffic on the roadways, however, truck traffic rises throughout the day and generally makes up the largest percent during mid-morning at 10% of the total traffic stream. Non-truck volumes follow a typical commuter peaking pattern with highest volumes during the morning and evening peak periods.

2.3.6 Over-Legal Routes

Over-legal routes provide basic north-south or east-west mobility for trucks that are over-legal or over-weight. These routes mean that a 20' wide by 20' high envelope must be maintained along the extent of the route to accommodate these over-dimensional loads. This designation limits the impacts of these trucks on arterials in the City of Seattle and is important to ensure that designated routes can accommodate large trucks with over-legal loads. SDOT has identified ten "Over-legal Load Routes" as shown in Figure 2.26. The over-legal load routes are distributed throughout the City to provide east-west and north-south connectivity for trucks with larger loads that require the 20' wide by 20' high envelope for traveling safely.

2.3.7 Special Event Impacts

The proximity of major sports Stadiums (Century Link Field and Safeco Field) to freight generators in the Greater Duwamish MIC raises concerns about the impact of special events on goods movement. This issue has been analyzed extensively in the Draft Environmental Impact Statement (DEIS) for the proposed Seattle Arena[15]. This has also been discussed in the Transportation Management Plans for Safeco and Century Link Field events.

The event induced impacts on Port trucks following any future arena development will depend on:

- The number and routing of Port trucks operating in the hours affected by stadium and arena events.
- Delays on normal terminal access routes compared to alternate routes.
- The effectiveness of traffic control measures or other mitigations.

Port trucking cost impacts were estimated from trucking data and projections provided by the Port, and traffic impacts estimated for the Seattle Arena DEIS.

15 Seattle Arena Draft Environmental Impact Statement, Seattle Department of Planning & Development, 2013.

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Figure 2.26 Over-legal Load Routes

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2.4 Rail Freight

North American railroads operate in an integrated manner, with carriers generally owning and maintaining the infrastructure and providing the service. In contrast to other regions of the world, the rail system is primarily focused on the handling of freight, with passenger service generally being a secondary function. The rail network consists of an expansive network of main lines, branch lines, yards and terminals. The passenger rail system consists of long-distance, intercity and commuter rail services operating primarily on rail lines owned by the freight railroads.

Washington's railways are very important in the movement of products and commodities ranging from consumer electronics to heavy bulk goods. Washington's rail system is essential in moving these products to consumer markets in the U.S. and internationally. Washington's rail system moved over 105 million tons, of freight worth $20 billion in 2011[16]. Rail facilities within the State of Washington include Passenger/Commuter Rail Service, Class I Railroads, and Non-Class I Railroads[17]. Within the City of Seattle, railroads include freight lines owned and operated by BNSF, Union Pacific, and Ballard Terminal Railroad Company, national passenger operations by Amtrak, and regional passenger service owned and operated by Sound Transit (Sounder and Link light rail) and the City of Seattle. Figure 2.22 shows the existing rail lines in the City. The BNSF mainline is an important international rail line, connecting Pacific coast Ports including the Port of Seattle, and major cities from Canada to Mexico. The BNSF mainline travels under downtown Seattle using the RH Thompson tunnel to minimize rail/vehicle crossing conflicts and various overpasses have been built over time for rail and road separations; however, numerous at-grade rail crossings remain throughout the City.

16 Washington State Freight Mobility Plan, 2014

17 Washington State Rail Plan. WSDOT, March 2014.

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2.4.1 Rail Purposes/Functions

The Seattle-area rail network, shown in Figure 2.27, consists of a primary north-south line between Tacoma, Seattle, Everett, and points north and south, the western termini of two transcontinental main lines, and a number of branches. Intercity and/or commuter rail service is operated along the north-south line as well as the northern transcontinental route heading east from Everett.

Freight rail operations in Seattle are carried out primarily by BNSF and UP. For the state as a whole, these two Class I railroads in Washington operate nearly 60%[18] of the total rail mileage in the state, and constitute the main arteries for moving freight into, out of and through the state. BNSF is the largest rail operator in Washington in terms of miles operated, tonnage and other factors, operating 1,633 miles of track in the state. BNSF owns 1,444 miles of this track, and operates over the remaining 189 miles through trackage rights (mainly with UP). To manage and maintain this system, BNSF employed over 3,000 workers in Washington in 2011, equating to a payroll of $166 million. In the Seattle region, the BNSF I-5 rail corridor offers a complete route from the Canadian border through Bellingham, Everett, Seattle, and Tacoma to Vancouver and Portland.

UP is the second largest railroad in Washington, operating on 532 miles of track, 260 miles of which are made possible through various trackage rights. UP reaches Puget Sound using trackage rights over BNSF from Vancouver, Washington. UP's operations in Washington created 309 jobs in 2011 and generated a $24 million payroll. Commodities carried on UP's system in Washington include intermodal/ consumer products, chemicals, and coal. UP transports soda ash and grain to Kalama and containerized consumer products on double-stack trains from the ports of Seattle and Tacoma. In addition, UP also moves municipal trash from Seattle to a landfill in eastern Oregon.

Freight rail lines passing through and located in Seattle include two Class I railroads, and two shortline railroads. The freight railroads are categorized in a three-tiered structure established by the federal Surface Transportation Board that is based on annual revenues:

- **Class I:** Annual operating revenue of more than $433.2 million in 2011. BNSF Railway (BNSF) and the Union Pacific Railroad (UP) are the only Class I railroads in Washington. In the Seattle area, the two railroads share track along with passenger rail traffic.
- **Class II:** Annual operating revenue between $34.7 million and $433.2 million. Class II railroads are also commonly referred to as regional railroads by the Association of American Railroads. There are no Class II railroads in the Seattle area.
- **Class III:** Revenues of less than $34.7 million and are engaged in line-haul transportation or switching or terminal operations. While short line operators are usually private, it is not uncommon for the underlying properties to be owned by public entities. The Ballard Terminal Railroad owns a spur that connects to BNSF near the Shilshole Yard.

18 Washington State Freight Mobility Plan, WSDOT 2014

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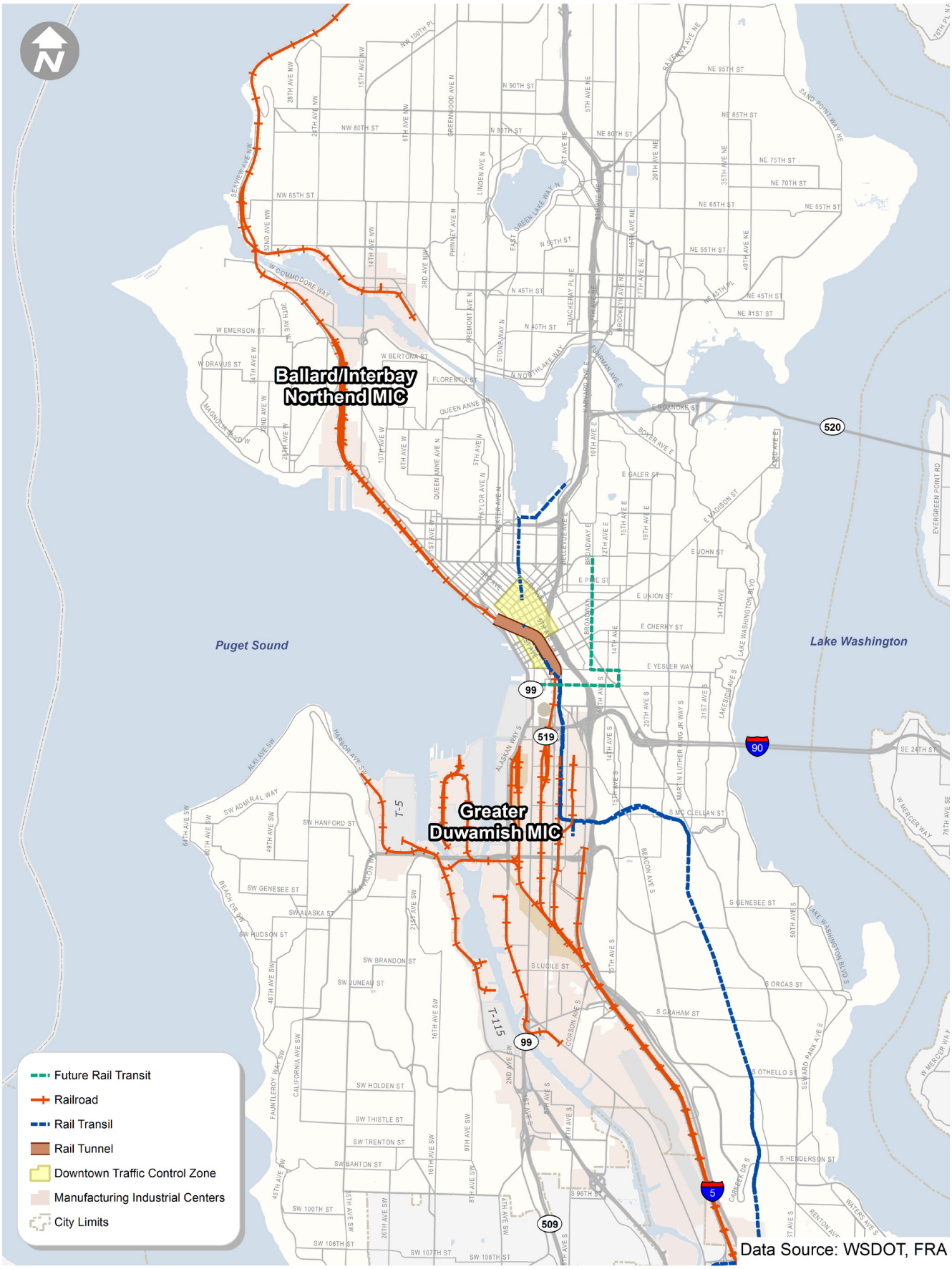

Figure 2.27 Puget Sound Rail Lines*

* WSDOT. Available at: http://www.wsdot.gov/planning/wtp/datalibrary/facilitiessystems/

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The freight rail network in Seattle provides a vital link from Washington to the rest of the country and beyond. For example, freight trains carry Washington grain and agricultural products to the Port of Seattle for export to international markets, and deliver manufactured goods arriving through the Puget Sound ports to markets throughout North America. In addition, the freight rail system helps to deliver goods required by Seattle's industries and growing population, and transports municipal solid waste produced by its citizens to inland landfills.

2.4.2 Rail Lines within the MICs

BINMIC

Within the BINMIC, there are two primary freight facilities:

- The BNSF mainline railroad tracks
- The Ballard Terminal Railroad

These two facilities are described in more detail in the following sections.

BNSF Tracks

In addition to being a major freight route to Canada and Ports in Everett and Whatcom County, the BNSF mainline runs north-south through the Interbay rail terminal and continues north along the eastern edge of the Ballard neighborhood providing passenger rail service between Portland, Seattle, and Vancouver B.C. operated by Amtrak. Within the BINMIC, it runs between Elliott Avenue W and the Elliott Bay Bike Trail before entering Terminal 91 between the Queen Anne and Magnolia neighborhoods. The rail line crosses a movable bridge west of the Ballard Locks and runs north between Seaview Avenue and the Loyal Heights neighborhood.

Ballard Terminal Railroad

The Ballard Terminal Railroad operates on a single-track that is a spur of the BNSF mainline. This rail line serves some of the maritime industry and businesses located along Shilshole Avenue NW.

Greater Duwamish MIC

Within the Greater Duwamish MIC there are four primary freight rail facilities, supplemented by on-dock rail facilities at the Port terminals:

- The BNSF mainline railroad tracks
- The BNSF Seattle International Gateway (SIG Yard)
- The Amtrak Seattle King Street Coach Yard maintenance facility
- The Union Pacific Argo Yard (intermodal)

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BNSF Tracks

The BNSF mainline runs north-south through the Greater Duwamish MIC. The mainline runs between 1st Avenue S and 4th Avenue S from the Great Northern Tunnel near the 4th Avenue S / S Washington Street intersection down south parallel to Airport Way and I-5. Several small spur tracks along the mainline serve adjacent businesses.

UP operates a spur track that runs along the west side of 5th Avenue S / SoDo Busway beginning near S Massachusetts Street and extending south of the West Seattle Bridge. Smaller spur tracks extend further east across 4th Avenue S and north along 5th Avenue S to S Massachusetts Street. These spur lines allow freight train access to the intermodal facilities, industrial uses in the area, and the Port of Seattle facilities.

SIG Yard Tracks

The SIG Yard is divided into two facilities, the North SIG Yard, which is accessed by trucks from S Massachusetts Street at Colorado Avenue, and Main SIG/Stacy, which is accessed by trucks from S Hanford Street east of E Marginal Way. There is no internal truck connection between these two yards. Containers destined to or originating from locations beyond the Pacific Northwest generally make their overland trip by train. This cargo, known as "intermodal," is either loaded on a train on T-5 or T-18 or is trucked between the marine terminal and the near-dock rail yards. All intermodal cargo on the east waterway Terminals 30 and 46, travels by truck to the rail yard.

The lead and tail tracks that connect to the SIG Yard extend along the east side of SR 99 from south of S Spokane Street through the yard and north, crossing over Alaskan Way to the west side of Alaskan Way, adjacent to Terminal 46. These tracks support both arriving and departing trains as well as train building, in which segments of a train are put together (or taken apart). This activity can block street crossings of the lead or tail tracks for long periods of time. The Atlantic Street overcrossing, as part of SR 519, phase II Intermodal access, was completed in 2010, and provides a grade-separated overpass for vehicles to bypass blockages of surface Atlantic Street. Train arrivals, departures, and train building activities will continue to periodically block the at-grade crossings located south of the SIG Yard at S Hanford, Horton, Hinds and Spokane Streets.

Amtrak

Amtrak's King Street Coach Yard extends south from Edgar Martinez Drive S to south of S Walker Street, east to 3rd Avenue S, and across the rail spur line that serves the King Street Coach Yard. The site currently includes as many as 14 sets of active rail lines. The rail yard serves many functions including locomotive and passenger car maintenance, train washing, and staging/parking. Along S Holgate Street a total of 13 rail crossings exist with 9 being active crossings. These tracks create frequent rail gate closures of Holgate Street.

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