The Seattle Department of Transportation and Port of Seattle

SEATTLE INDUSTRIAL AREAS FREIGHT ACCESS PROJECT





SDOT
Seattle Department of Transportation

Port of Seattle

May 2015

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Seattle Mayor
Edward B. Murray

Seattle City Council
Tim Burgess, Council President
Sally Bagshaw
Sally J. Clark
Jean Godden
Bruce A. Harrell
Nick Licata
Mike O'Brien
Tom Rasmussen
Kshama Sawant

Port of Seattle Commission
Stephanie Bowman, Co-President
Courtney Gregoire, Co-President
Tom Albro
Bill Bryant
John Creighton

Seattle Department of Transportation
Scott Kubly, Director
Tracy Krawczyk, Policy and Planning Division Director
Cristina VanValkenburgh, Mobility Programs Manager
Tony Mazzella, Project Manager
Ron Borowski, Sr Transportation Manager, Deputy Project Manager
Christopher Eaves, Senior Civil Engineering Specialist
Ian Macek, Associate Transportation Planner

Port of Seattle
Ted Fick, Chief Executive Officer
Linda Styrk, Managing Director Seaport Division
Dan Burke, Regional Transportation Program Planner, Project Lead (Retired)
Christine Wolf, Transportation Program Planner, Seaport, Project Lead
Geri Poor, Regional Transportation Manager

Interagency Management Committee
Bari Bookout, Port of Seattle
Michael Burke, Port of Seattle
Barbara Gray, SDOT
John Layzer, SDOT
Mike Merritt, Port of Seattle
Mary Rutherford, SDOT
Tracy Krawczyk, SDOT

Seattle Freight Advisory Board
Warren Aakervik, Chair, Ballard Oil (Ret.)
Linda Anderson, former member, King County Metro
Bari Bookout, Port of Seattle
Katherine Casseday, Casseday Consulting
Pat Cohn. Pacific Terminals
Hal Cooper Jr., Cooper Consulting Company
Terry Finn, BNSF Railway
Tim Hillis, Charlie's Produce
Dan McKisson, ILWU Puget Sound Regional Council
Frank Rose, Peterbuilt
Michael Sheehan, former member, Seattle Times

Consultants
Jon Pascal, Transpo Group, Consultant Project Manager
Michael Houston, Transpo Group
Jeanne Acutanza, Transpo Group
Dan Smith, The Tioga Group
Michael Fischer, Cambridge Systematics
Chiranjivi Bhamidipati, Cambridge Systematics
Kate Elliott, PRR

Other Contributors
Ed Shilley, Nucor Steel
John Odland, MacMillan Piper
Robert Graham, Graham Trucking
Kaaren Jones, Pacific Freight Express, Inc.
Mike Jones, United Parcel Service, Inc.
Phil Bye, Food Services of America

GLOSSARY OF ACRONYMS

AASHTO.................................American Association of State Highway Transportation Officials
ADT.....................................Average Daily Traffic
ATA ....American Trucking Association
BINMIC.................................Ballard/Interbay Northend Manufacturing and Industrial Center
BNSF...................................Burlington Northern and Santa Fe Railway
BPR.....................................Bureau of Public Records
CBD.....................................Central Business District
CIP.......................................Capital Improvement Plan/Program
CTAS...................................Container Terminal Access Study
CVEO ....Commercial Vehicle Enforcement Officer
CVSA...................................Commercial Vehicle Safety Alliance
DC..Distribution Center
DPD.....................................Department of Planning and Development
FAF3....................................Freight Analysis Framework
FAP......................................Freight Access Project
FAST....................................Freight Action Strategy
FHWA ....Federal Highway Administration
FMP.....................................Freight Master Plan
GIS.......................................Graphical Information System
GVW....................................Gross Vehicle Weight
HOV ....High Occupancy Vehicle
IMC......................................Intermodal Marketing Companies
ITS ....Intelligent Transportation System
LEP......................................Limited English Proficient
LOS......................................Level of Service
LTL ....Less than Truck Load
MAP-21 ....Moving Ahead for Progress in the 21st Century
MIC......................................Manufacturing/Industrial Center
MPO.....................................Metropolitan Planning Organization
MSW....................................Municipal Solid Waste
NHS.....................................National Highway System
PSRC ....Puget Sound Regional Council
RFID ....Radio Frequency Identification

SDOT ....Seattle Department of Transportation
SIG..Seattle International Gateway
SoDo.....................................South of Downtown
SPU ....Seattle Public Utilities
TAZ ....Transportation Analysis Zone
TEU.......................................Twenty-foot Equivalent Units
TMA......................................Transportation Management Association
TWIC.....................................Transportation Worker Identification Credential
UP...Union Pacific Railroad
UPS ....United Parcel Service
USPS....................................United States Postal Service
VMT ....Vehicle-Miles Travelled
WSDOT.................................Washington State Department of Transportation
WTU......................................Warehousing, Trucking, and Utilities

EXECUTIVE SUMMARY

Seattle is home to one of the most unique business environments in the country. We have a diverse economy that is creating jobs and keeping unemployment low.

We held an industrial and maritime summit to explore ways to build upon Seattle's strengths as a manufacturing center, and as a trading hub. As a result, my budget invested in a Heavy Haul Corridor in SoDo, an essential step to help boost the competitiveness of our industrial freight sector.

And we will continue this engagement to create a longer-term vision for the role of manufacturing, maritime, and trade in Seattle's economy.

We are building our strategy to attract foreign direct investment.

—2015 State of the City, Mayor Edward Murray

Seattle is a vital gateway to one of the most trade dependent states in the nation. Through a century of partnership with the Port of Seattle and others, the City supports global trade by protecting, preserving, and enhancing infrastructure and manufacturing/industrial lands. As competition for trade grows, these resources become even more critical to the health of our local, regional, and state economies.

The Seattle Industrial Areas Freight Access Project (FAP) identifies truck -freight transportation infrastructure investments needed over the next 20 years to keep Seattle's industrial lands—the Manufacturing/Industrial Centers (MICs) of the Greater Duwamish and the Ballard/Interbay Northend—vibrant and productive to meet the challenges of the future and to keep Seattle moving.

This Freight Access Project serves as a building block for the key policy, programmatic, and

GLOBAL TRADE
Fifth largest container US port and adjacent industrial properties provide a gateway to a growing global economy

STATE ECONOMY
Supports agriculture, aerospace, manufacturing and technology
Sectors fundamental to the State economy

REGIONAL ECONOMY
Includes two of the eight MICs in the Puget Sound region

Represents almost 1/2 of the total MIC jobs in 1/4 of the land area

CITY OF SEATTLE
Creates abundant family-wage jobs

Provides economic diversity

Contributes significantly to the local tax base

technical issues to be fully examined in the Seattle Freight Master Plan (FMP). The FMP provides a city-wide, comprehensive vision for truck freight transportation and a strategy for implementing policies with a prioritized package of project and program improvements. Together with the other modal plans (Bicycle, Pedestrian and Transit), the FMP serves as a basis for the City's Transportation Strategic Plan, known as "Move Seattle," which addresses the next decade of major SDOT investments.

Importance of Freight and Manufacturing Centers in the City of Seattle

Moving freight by truck is critical to our state, regional, and local economies and is a priority for the City of Seattle and the Port.

- Washington is one of the most trade dependent states in the nation. Freight dependent industries support 1.46 million jobs and $128.8 billion in regional domestic products statewide. Roughly 40% of all jobs in the state can be tied to trade-related activity.
- In Puget Sound, freight dependent industries support almost 900,000 jobs and $91.9 billion in regional domestic product.
- The two Manufacturing/Industrial Centers (MICs) in Seattle employ nearly 75,000 people in mostly family-wage jobs.
- The Port of Seattle, which is the 5th largest port in the US , and associated industries concentrated within the MICs, help make greater Seattle the most active trade region in the nation.
- Recent economic analysis indicates that 79% of global economic growth will occur outside the United States. The Puget Sound has close proximity to global these markets, well-developed Ports (with Tacoma, it is the 3rd largest container cargo complex in the US) and efficient rail systems (freight rail connections to over a dozen states and Canadian provinces). With these attributes, the region is poised to strengthen its role as a global player in foreign direct investment.
- Global investment is projected to drive economic growth, making these port connections and the resources that support them even more important to our regional economy.
- Moving freight safely, efficiently, and effectively within and between the Manufacturing/Industrial Centers in the City of Seattle is critical to the local, regional, and statewide economies.

Assessing Current and Future Needs

The Freight Access Project identifies current and future freight bottlenecks and problem locations, leading to a set of cost-effective operational, capital, and programmatic improvements. These improvements aim to maintain and improve truck-borne freight access, mobility, safety, and circulation within and between the Greater Duwamish MIC and the Ballard/Interbay Northend MIC (BINMIC), including the key connections from the MICs to the region's freeway transportation system. The project also identifies improvements from the Port of Seattle's facilities to local intermodal rail yards.

GOALS/ OBJECTIVES

Safety

Address safety for all travel modes

Mobility

- Maintain and improve truck -freight mobility and access to accommodate expected general traffic, freight and cargo growth.

Connectivity

- Ensure connectivity for major freight intermodal and trans-load facilities

Environment

- Reduce environmental impacts, including greenhouse gas emissions

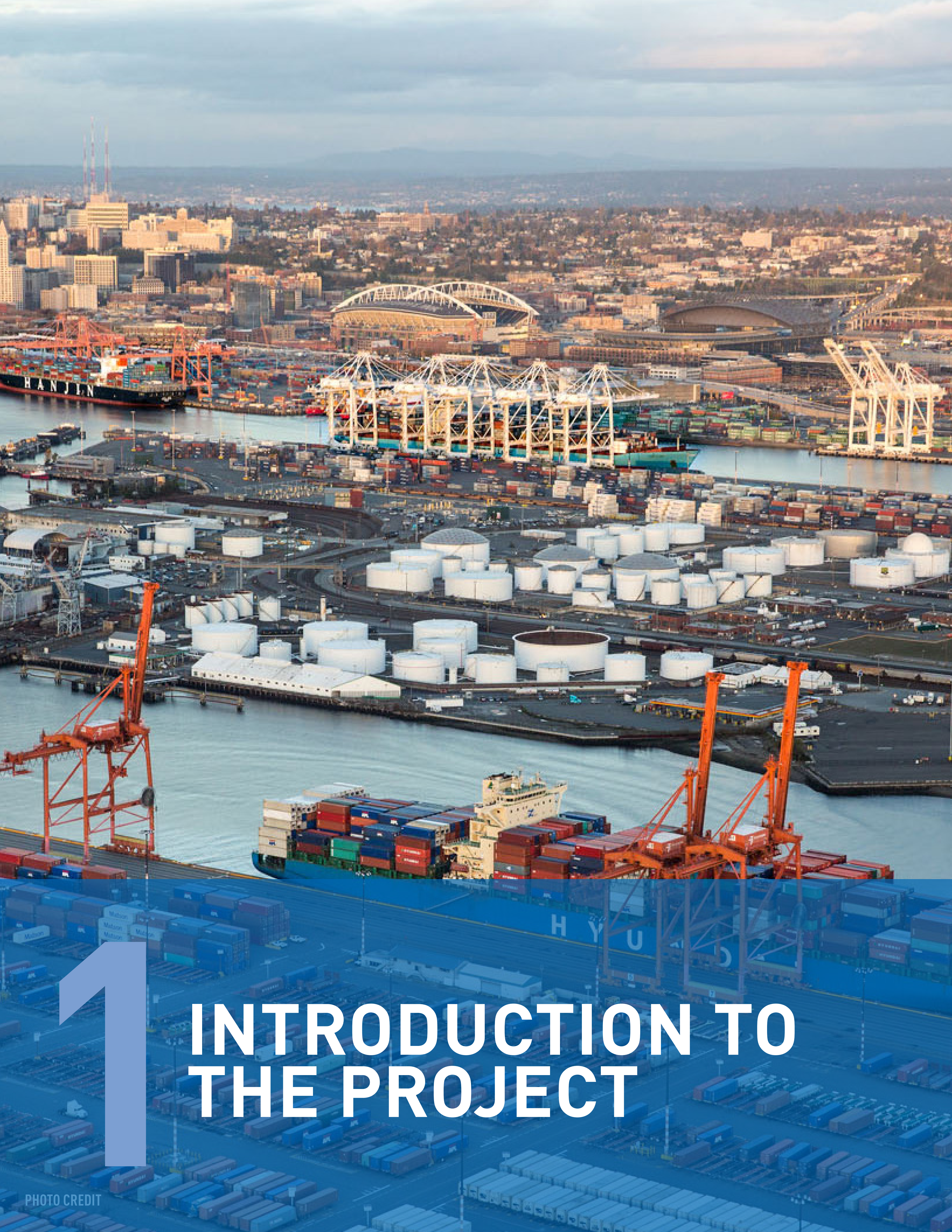
The development of transportation improvement projects contained in this document was guided by the goals and objectives developed through input from the Seattle Freight Advisory Board (FAB) and outreach to key stakeholders. These members of the freight community helped identify needs, define the goals of this project, and establish performance measures. Goals and objectives are noted above.

The needs, goals, performance measures, and objectives guided project development and prioritized a set of improvements that address safety, connectivity, and mobility challenges. The top tier of these projects and programs for initial inclusion in the Freight Master Plan are shown in the table on the following page.

Table E-1 Recommended Priority Project List

No.	Project Name	Project Need (SAFETY / MOBILITY / CONNECTIVITY)	Project Type: Maintenance & Preservation	Capital Investment	ITS* Application	Intersection Operations	Wayfinding for Trucks	Geometric	Ongoing Programs
Ballard/Interbay Northend MIC									
22	15th Avenue W Spot Improvements at W Dravus Street and W Emerson Street	Mobility, Connectivity						✓	
52	BINMIC Truck Route Improvements	Safety, Connectivity				✓	✓	✓	
Greater Duwamish MIC									
5A	East Marginal Way Roadway Rehabilitation	Safety, Mobility	✓	✓	✓				
5B	E Marginal Way S / S Hanford Street Intersection Improvements	Safety, Mobility	✓	✓		✓			
15	Hanford & Main Seattle International Gateway (SIG) Access Improvements	Safety, Mobility		✓		✓			
16	South Lander Street Grade Separation	Safety, Mobility, Connectivity		✓					
17	Study and Implementation of Mainline Grade Separations in Mid-SoDo area	Mobility, Connectivity		✓	✓				
20	4th Avenue S Viaduct Replacement	Safety, Connectivity	✓	✓					
23	South Holgate Street Rail Crossing Improvements	Safety, Connectivity		✓					
24	Lower Spokane Street Freight-Only Lanes Pilot Project	Mobility, Connectivity			✓	✓			
25	South Spokane Street ITS Upgrades	Mobility			✓				
28	Railroad Crossing Delay Warning System	Connectivity			✓				
37A	1st Avenue S / Atlantic Street Intersection Improvements	Mobility, Connectivity	✓			✓		✓	
37B	S Atlantic Street Corridor Improvements	Mobility, Connectivity			✓	✓			
Citywide									
-	Citywide Freight Spot Improvement Program Expansion	Safety, Connectivity	✓			✓	✓	✓	✓
-	Freight Data Collection/Analysis Program	Mobility			✓	✓			✓

*Intelligent Transportation System



1 INTRODUCTION TO THE PROJECT

PHOTO CREDIT

The Seattle Industrial Areas Freight Access Project (FAP) identifies a set of cost-effective operational, capital, and programmatic improvements to maintain and improve freight access and mobility within and between the Greater Duwamish and Ballard/Interbay Northend Manufacturing and Industrial Centers (MICs).

This Freight Access Project report, developed in concert with the Freight Master Plan and other modal plans, will lay the ground work for establishing a prioritized list of investments to keep Seattle moving goods for decades to come.

1.1 Purpose of the Project

The purpose of this project is to develop and carry out a focused and pragmatic technical approach to identifying and evaluating current and future freight bottlenecks and problem locations. The result is a set of cost-effective operational, capital and programmatic improvements. These improvements are aimed at maintaining and improving truck-borne freight access, mobility, and circulation within and between the Greater Duwamish MIC and the Ballard/Interbay Northend MIC (BINMIC), including the key connections from the MICs to the regional transportation system. The project will also identify improvements from the Port of Seattle's facilities to privately-owned rail yards.

This project serves as a building block for the key policy, programmatic, and technical issues to be fully examined in the Seattle Freight Master Plan (FMP). The FMP will provide a city-wide comprehensive vision for freight transportation as well as a strategy for implementing policies and a prioritized package of project and program improvements.

NEEDS

- Growing, urban-area congestion delays freight
- Unreliable access and travel time to and between freight destinations impacts productivity and the cost of goods.
- Multiple modal demands create potential safety challenges
- Increasing congestion, especially for trucks, increases air pollution
- Improvements to support freight need to be coordinated and funded with other City investments

The Freight Access Project has identified the following topics that should be further evaluated within the context of the citywide FMP:

- overall economic importance of freight in the City of Seattle
- examine freight linkages throughout the City
- Update Major Truck Street network
- citywide policies and design standards

A memorandum outlining a strategic framework for recommendations to be considered by the Freight Master Plan is included as Appendix A.

PHOTO CREDIT: WSDOT

In 2015, the Seattle City Council Transportation Committee is expected to consider legislation to establish a Heavy Haul Network of streets between the Port terminals and nearby intermodal facilities on which the City will permit heavy drayage vehicles up to 98,000 pounds to travel without dividing their loads. Doing so will bring the Port of Seattle on par with other competitor ports along the West Coast. It facilitates more efficient operations in transporting goods to and from terminals and rail yards and intermodal facilities. There would be a low-cost annual permit to incentivize use and limit any potential financial burden on drayage drivers. Permit requirements would include twice-yearly Commercial Vehicle Safety Alliance (CVSA) inspections to ensure those vehicles transporting these loads meet basic safety and operations requirements.

The legislation would, if adopted, establish an additional Commercial Vehicle Enforcement Officer (CVEO) position to enforce truck rules and regulations in the vicinity of the heavy haul network and ensure vehicles aren't transporting heavy loads outside those identified streets.

The Port of Seattle has agreed to contribute up to $250,000 through 2016 to help get the program up and running and fund operations, recognizing the low-cost permit revenues may not fully recover program startup and ongoing costs. The Port has also agreed to work with the City to identify infrastructure needs and funding opportunities associated with the heavy haul network.

1.2 Goals and Workplan

The transportation improvement projects identified within the study area were driven by project goals and objectives, which were partially developed through input from the Seattle Freight Advisory Board (FAB) and targeted stakeholder interviews. Stakeholder interviews gathered input from freight businesses and organizations operating within the Greater Duwamish MIC and BINMIC in order to identify potential solutions and options to improve truck travel. FAB input and the interviews helped identify freight needs, define goals, and establish performance measures as shown in the image on this page.

The FAB also helped define the workplan strategies of the project which include:

- Assess existing conditions, data needs, trends, and future conditions for long-haul, regional, drayage and local pick-up/delivery truck freight movement needs.
- Identify, evaluate, and recommend a prioritized list of capital and operational improvements, including options for freight truck priority on Major Truck Streets and Port terminal connector routes.
- Develop and categorize implementing actions in near-term, mid-term and long-term timeframes.
- Report on joint Seattle Department of Transportation / Port of Seattle efforts to assess a potential heavy haul truck network between key terminal locations and rail yards.
- Identify potential policy, programmatic, and design issues for further evaluation within the Seattle Freight Master Plan.
- Engage key stakeholders throughout the study process.

GOALS/ OBJECTIVES

Safety

- Address safety for all travel modes

Mobility

- Maintain and improve truck -freight mobility and access to accommodate expected general traffic, freight and cargo growth.

Connectivity

- Ensure connectivity for major freight intermodal and trans-load facilities

Environment

- Reduce environmental impacts, including greenhouse gas emissions

PERFORMANCE MEASURES

Safety

- Truck collision history

Mobility

- General traffic volumes
- Truck volumes
- Speeds & congestion
- Reliability

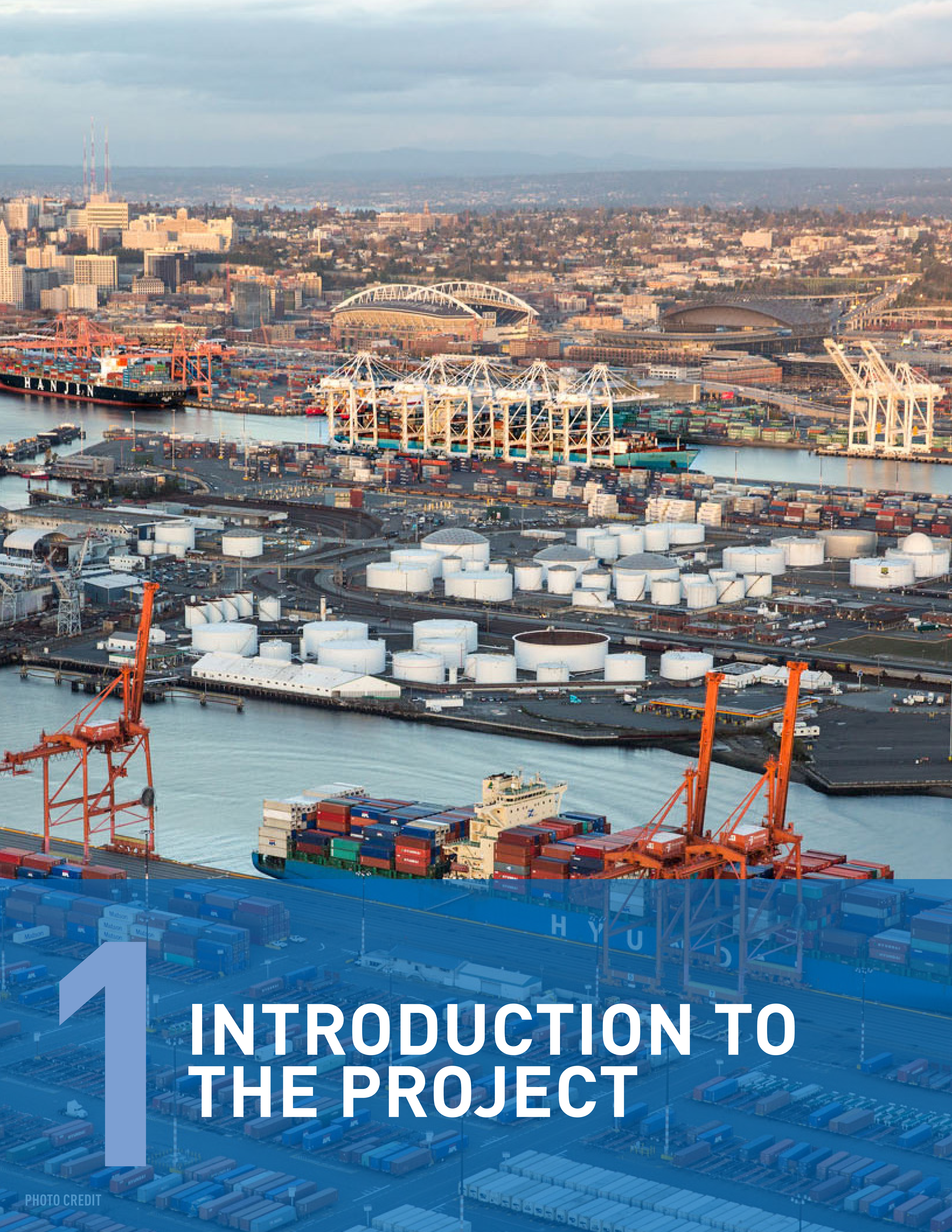
Connectivity

- Access constraints (including over-legal limitations)
- Railroad crossings and bridge openings that cause delays
- Ease of movement (roadway geometric design to support trucks)

1.3 Report Organization

The Seattle Industrial Areas Freight Access Project Report is organized to follow the progress of the analysis and evaluation.

1	**Introduction to the Project**	• Establishes the report framework, aligns the needs, goals and performance measures • Confirms the goals
2	**Seattle's Freight Environment and the Manufacturing & Industrial Centers**	• Overview of freight systems and assets and current freight truck and rail operations in the MICs • Value of the MICs to the State, region, and local economy
3	**Existing Conditions**	• Area description, freight destinations and existing land use • Summary of collisions, network volumes, speeds and geometric constraints
4	**Future Conditions**	• Future land use and anticipated improvements to roadways • Summary of forecast volumes and speeds
5	**Freight Needs**	• System constraints, and defined needs based on performance measures (Mobility, Safety, Connectivity)
6	**System Improvements**	• Application of a set of freight improvement strategies and tools. • Prioritized improvements



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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.

GLOBAL TRADE

Fifth largest US Port and adjacent industrial properties provide a gateway to a growing global economy

STATE ECONOMY

Supports agriculture, aerospace, manufacturing and technology sectors fundamental to the State economy

REGIONAL ECONOMY

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Represents almost 1/2 of the total MIC jobs in 1/4 of the land area

CITY OF SEATTLE

Creates abundant family-wage jobs

Provides economic diversity

Contributes significantly to the local tax base

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).

"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.

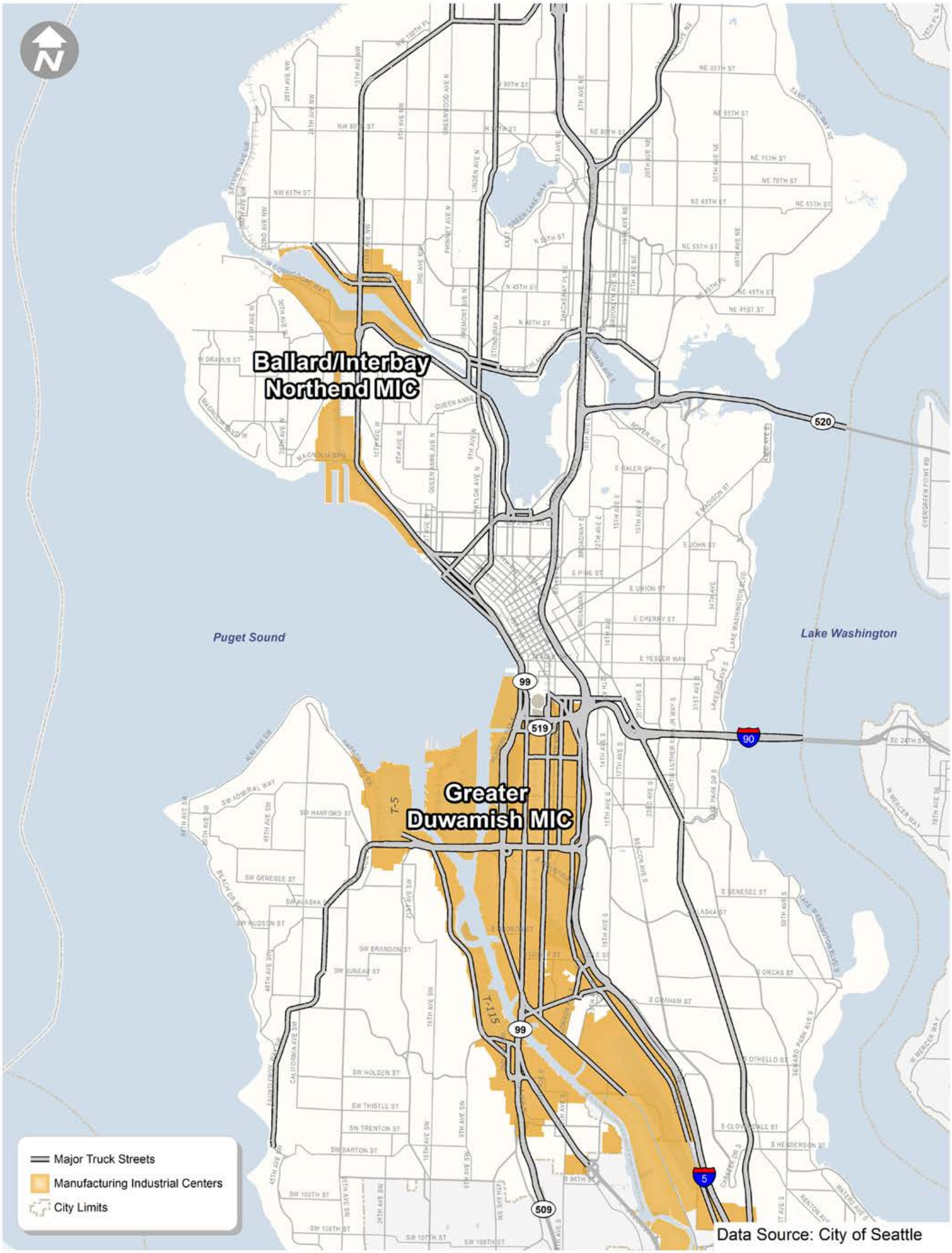


Figure 2.1 Seattle's Manufacturing/Industrial Centers (MICs)

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.

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.

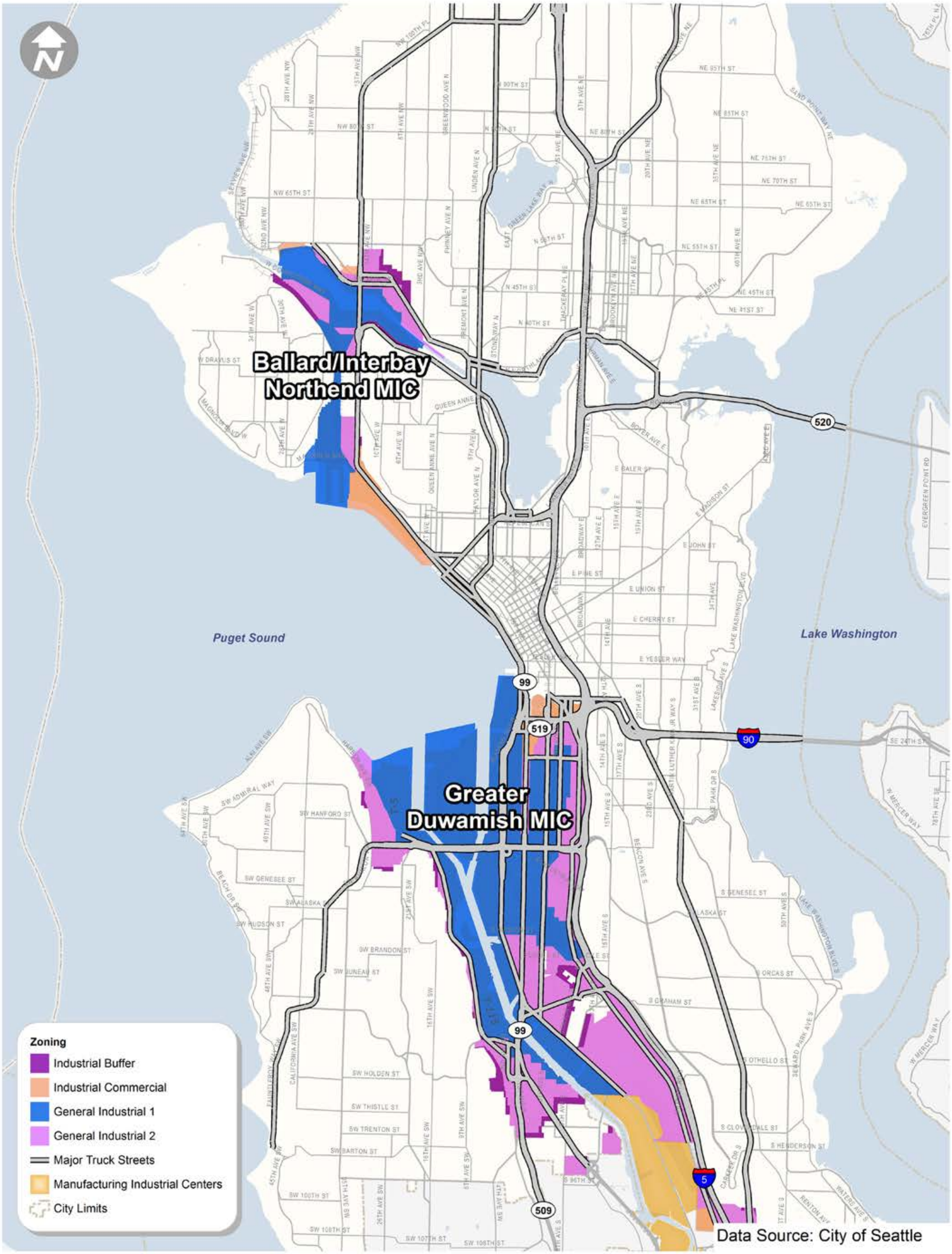


Figure 2.2 Map of Industrial Land Uses in the MICs

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)

	Travel Model Sector	ACTUAL 2010	% OF SUBAREA 2010	SHARE OF SEATTLE
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

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.

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.

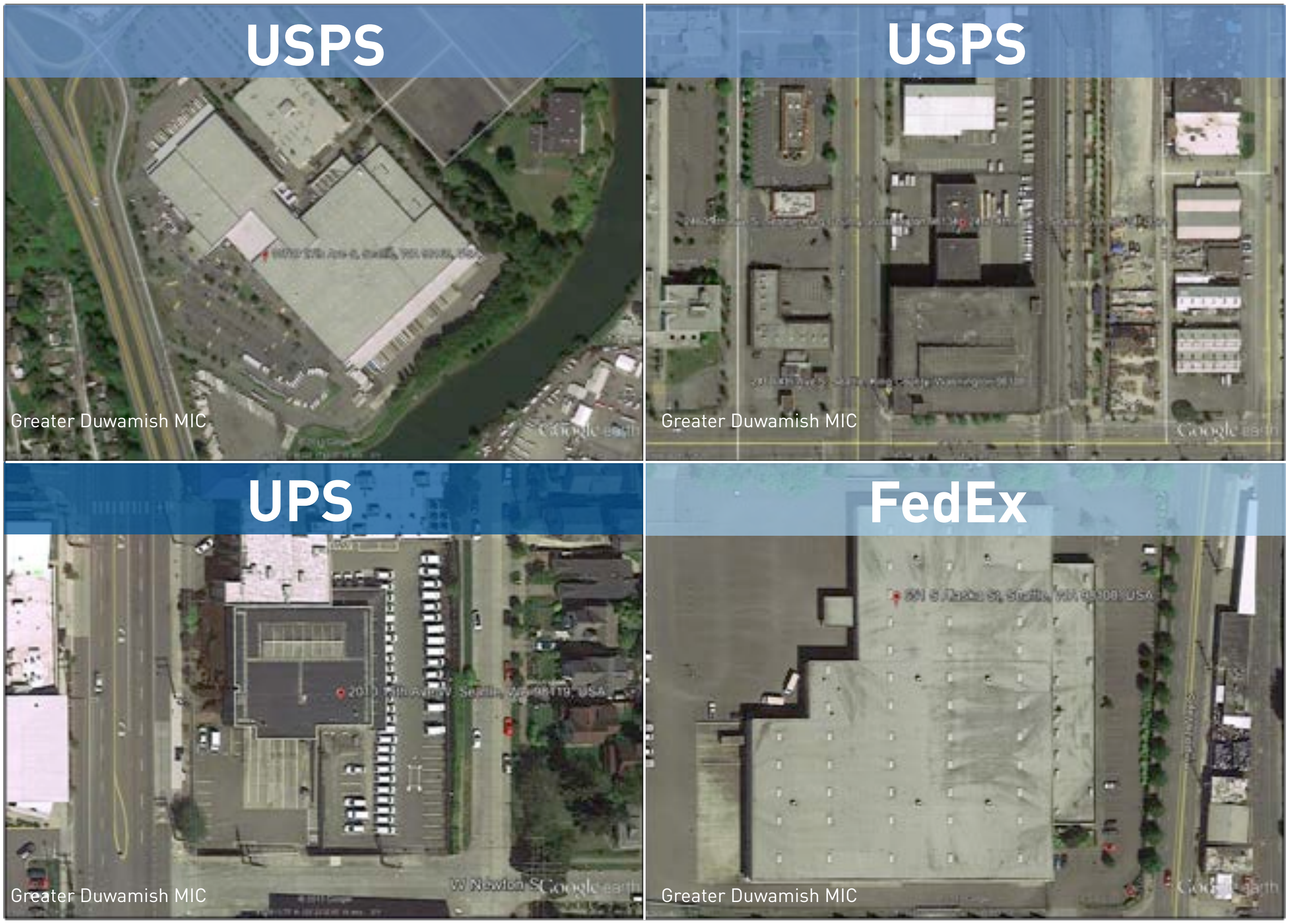


Figure 2.5 United States Postal Service, United Parcel Service, and FedEx Facilities within the Study Area

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.

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)

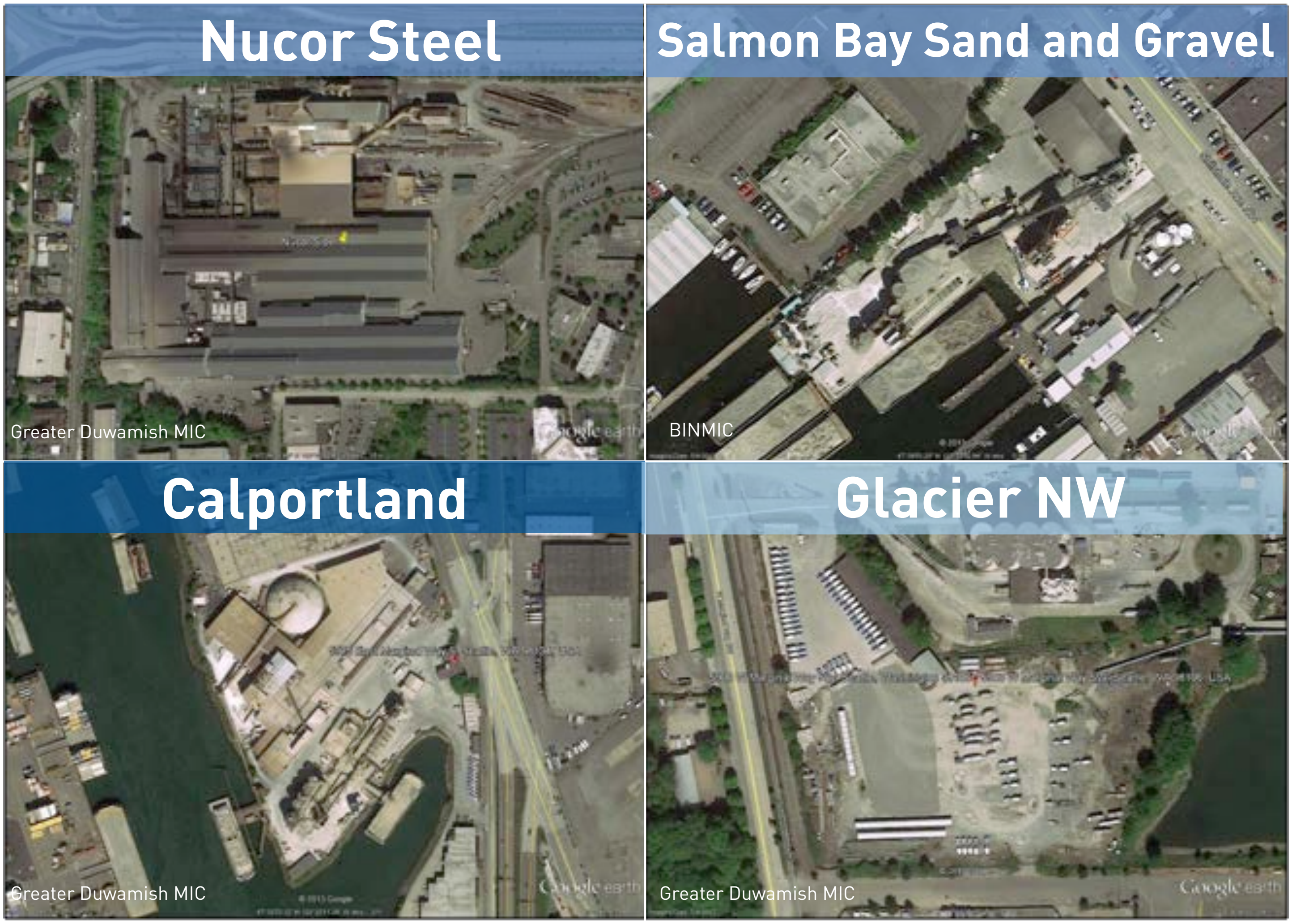


Figure 2.7 Manufacturing and Processing Facilities in the Study Area

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 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


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.

- 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

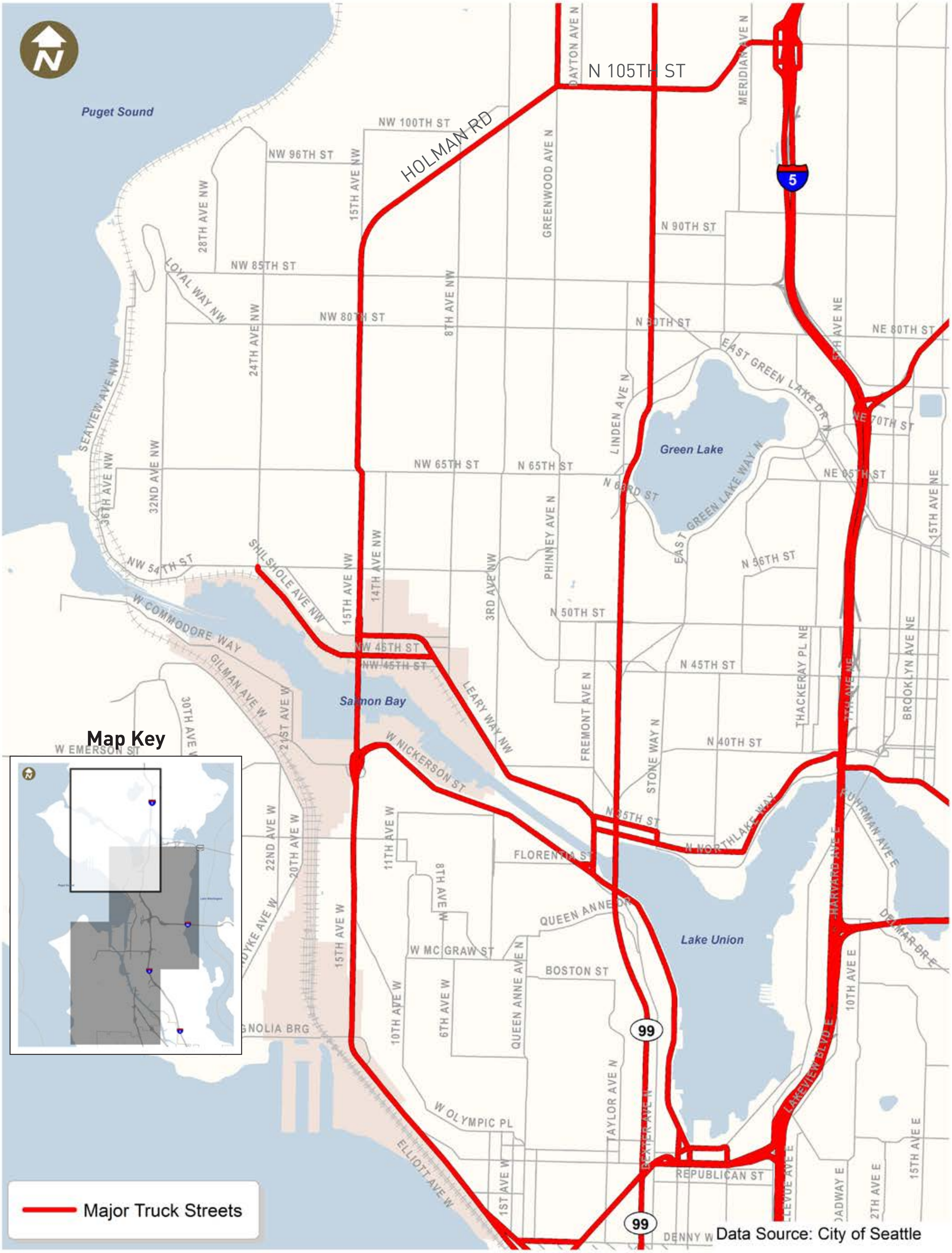


Figure 2.8 SDOT Major Truck Streets – North Section

Figure 2.9 SDOT Major Truck Streets – Central Section

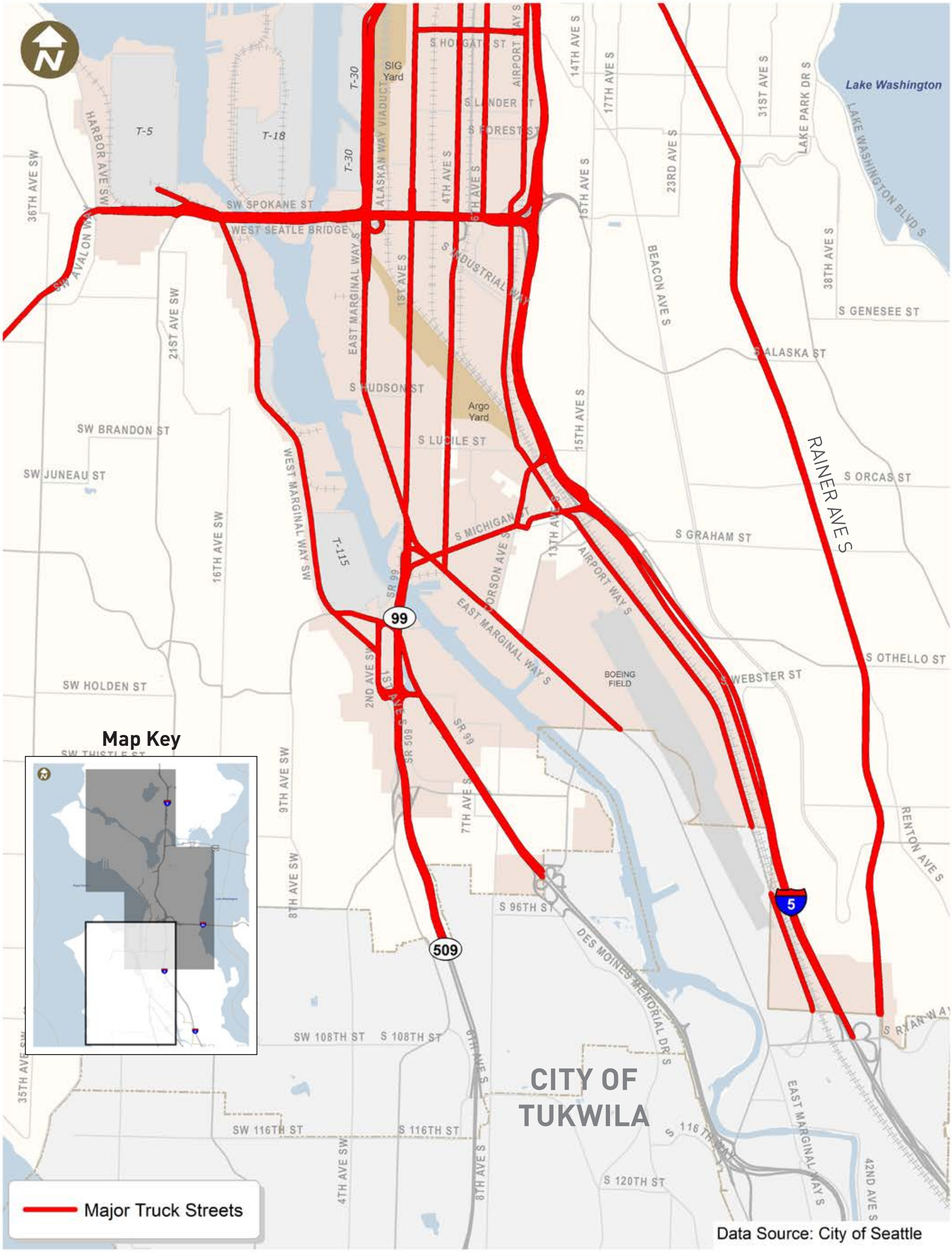


Figure 2.10 SDOT Major Truck Streets – South Section

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.

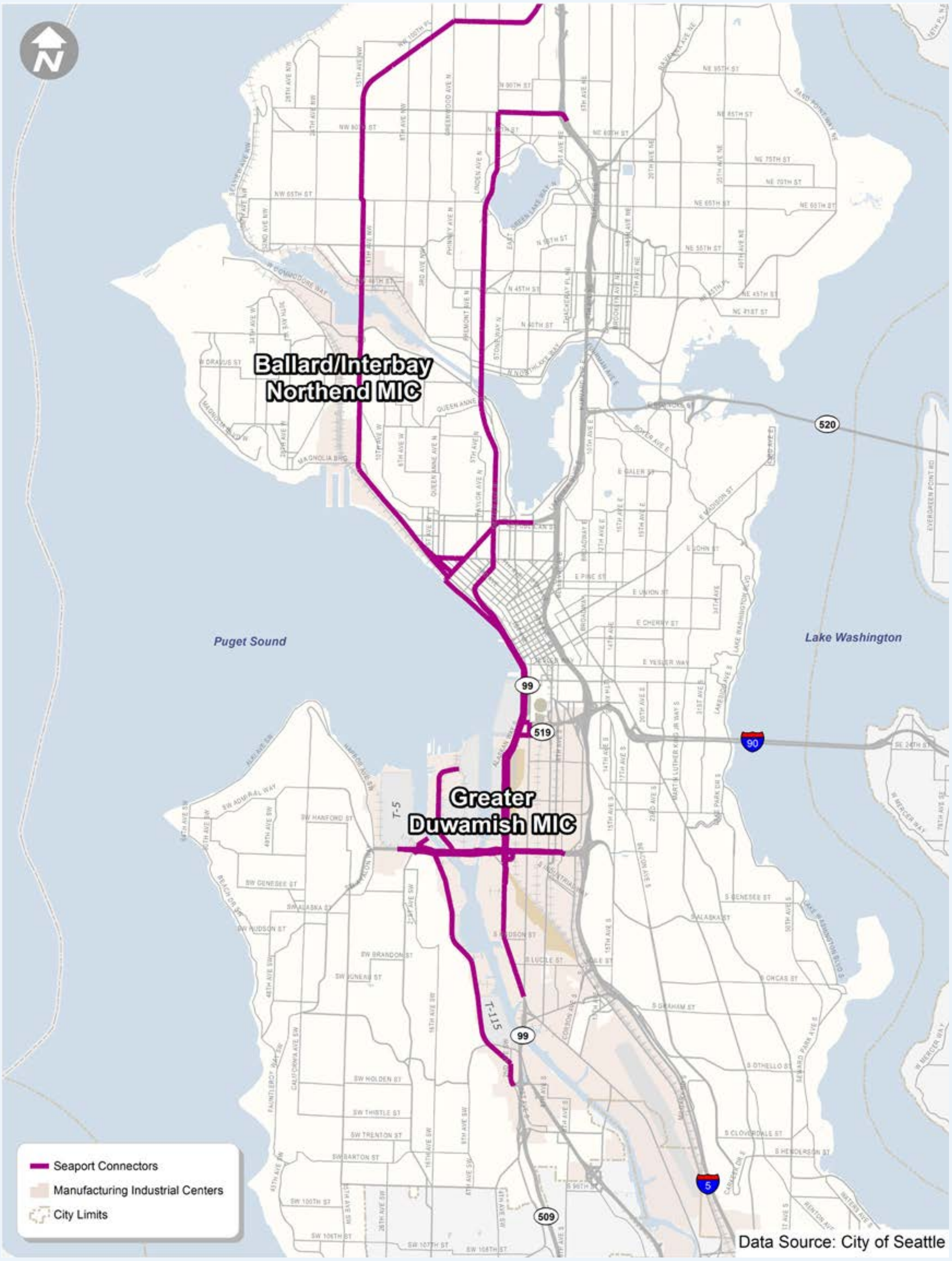


Figure 2.11 Existing Seaport Connectors

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

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

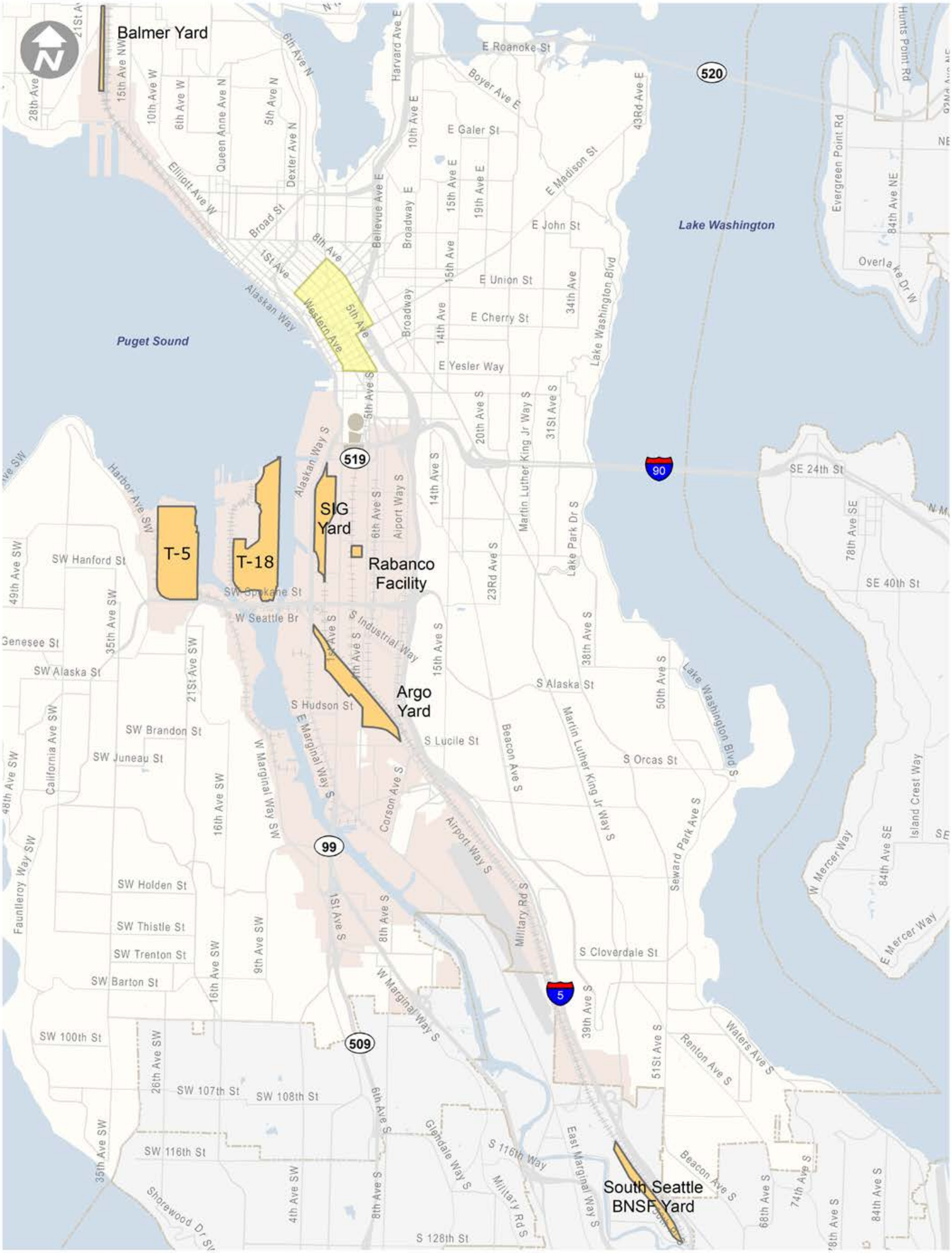


Figure 2.12 Existing Rail Intermodal Facilities

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.

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.

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.

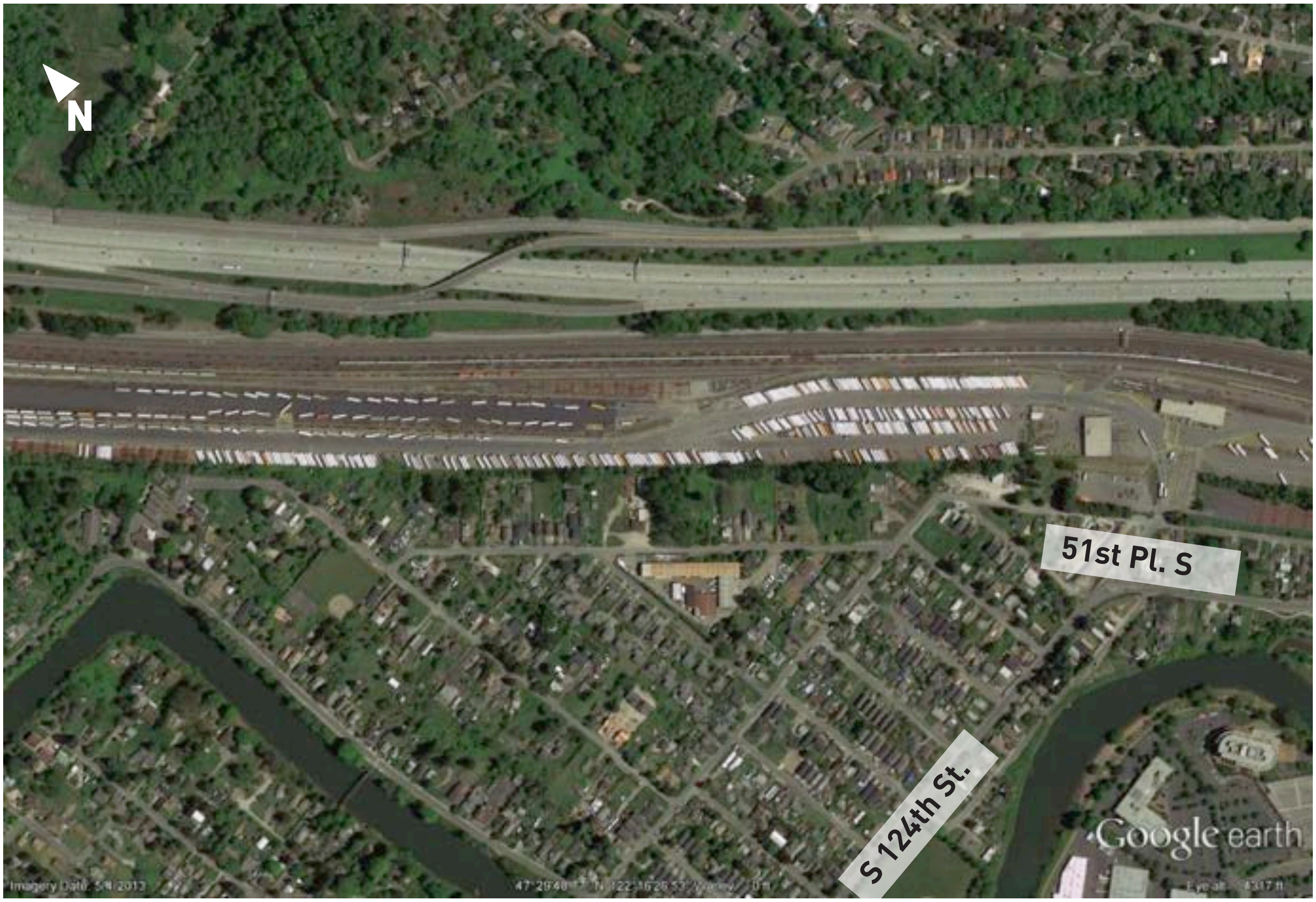


Figure 2.16 BNSF Tukwila

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.

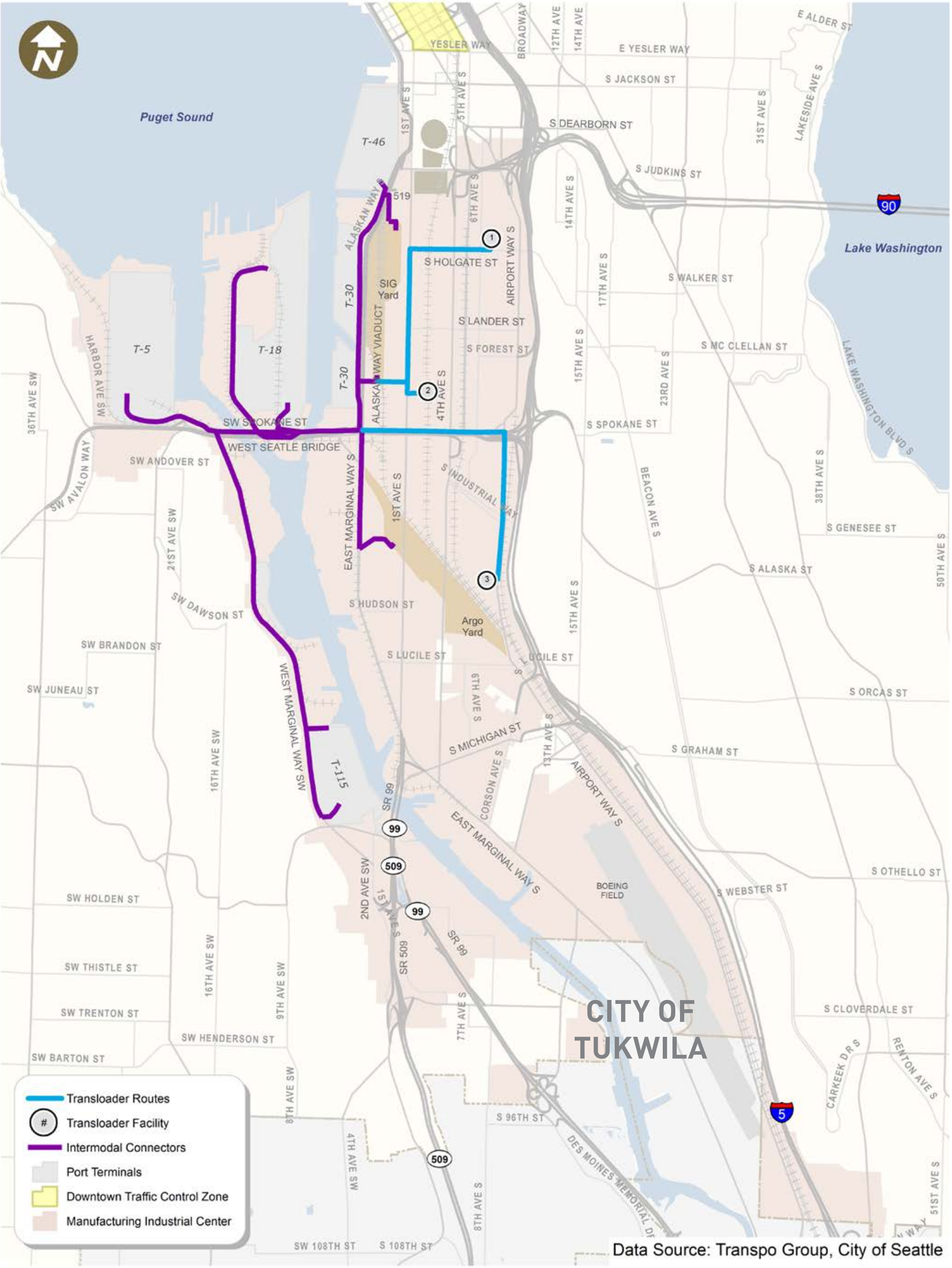


Figure 2.17 Intermodal Connectors

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.

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.

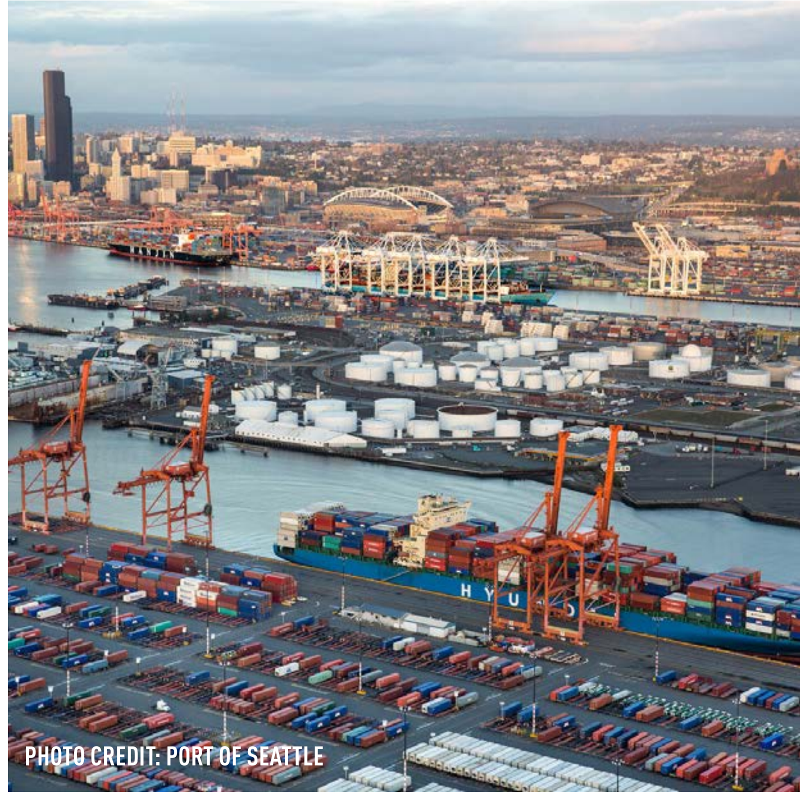


PHOTO CREDIT: PORT OF SEATTLE

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.

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.

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.

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.

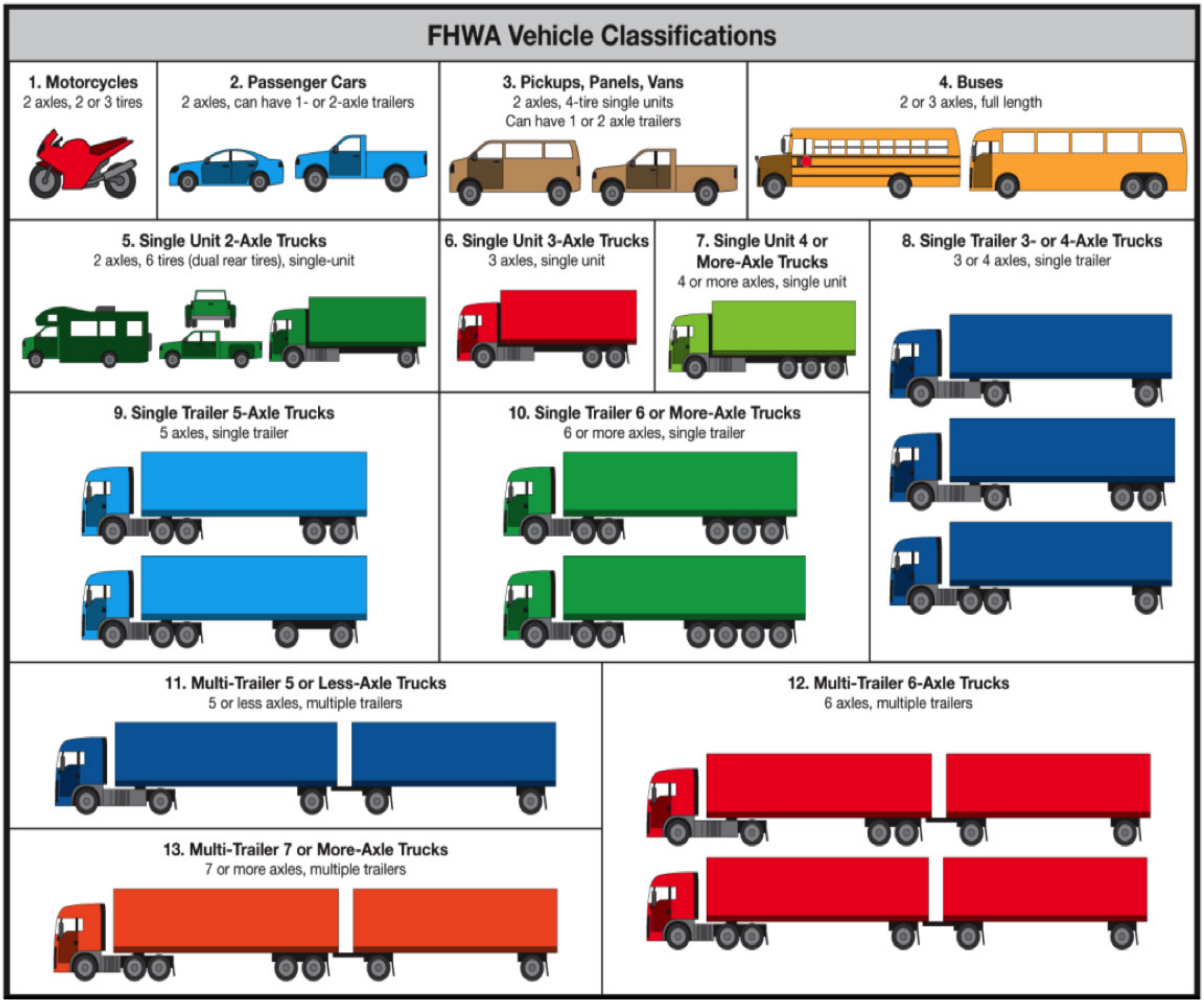


Figure 2.18 FHWA Truck Classifications Based on Axles and Vehicles [11]

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

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.

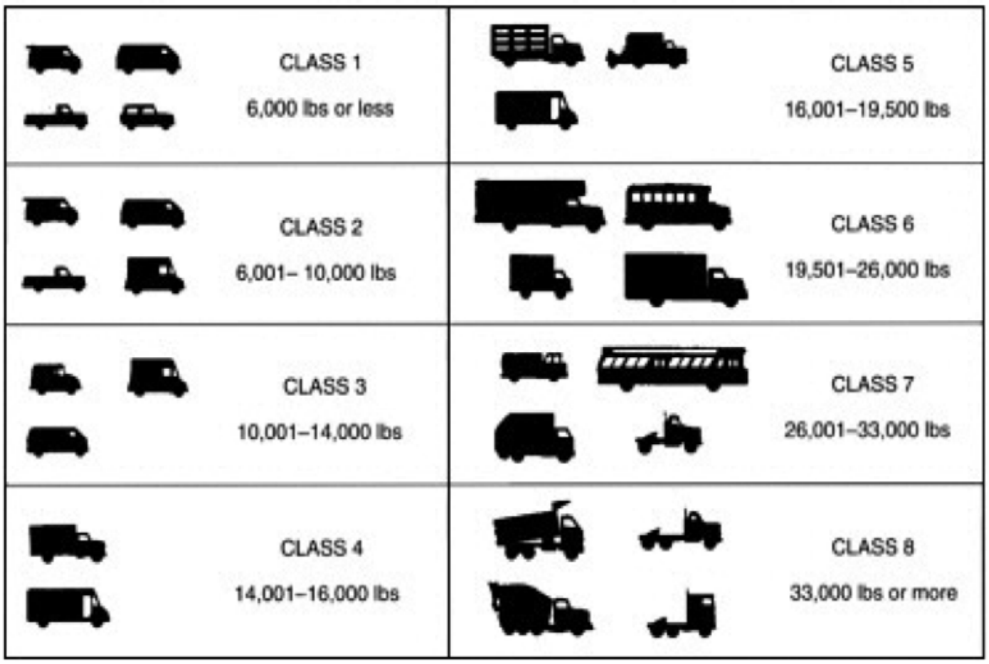


Figure 2.19 Classification Based on Gross Vehicle Weight (GVW) [12]

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

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

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.

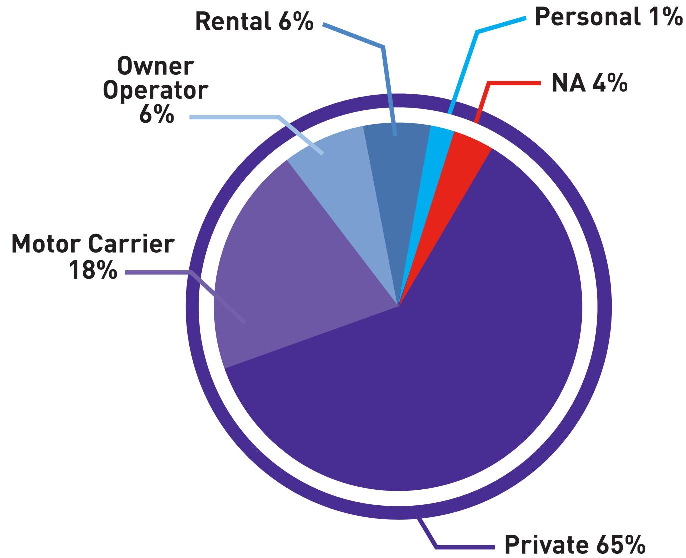
Longer-haul movements beyond the Seattle region are, for this study, basically indistinguishable from regional movements. Longer-haul movements will be channeled onto the same freeways as movements between Seattle and adjacent areas, and will use the same arterials and surface streets to connect final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

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

Figure 2.21 WSDOT Freight Economic Corridors – North Seattle Section

Figure 2.22 WSDOT Freight Economic Corridors – Central Seattle Section

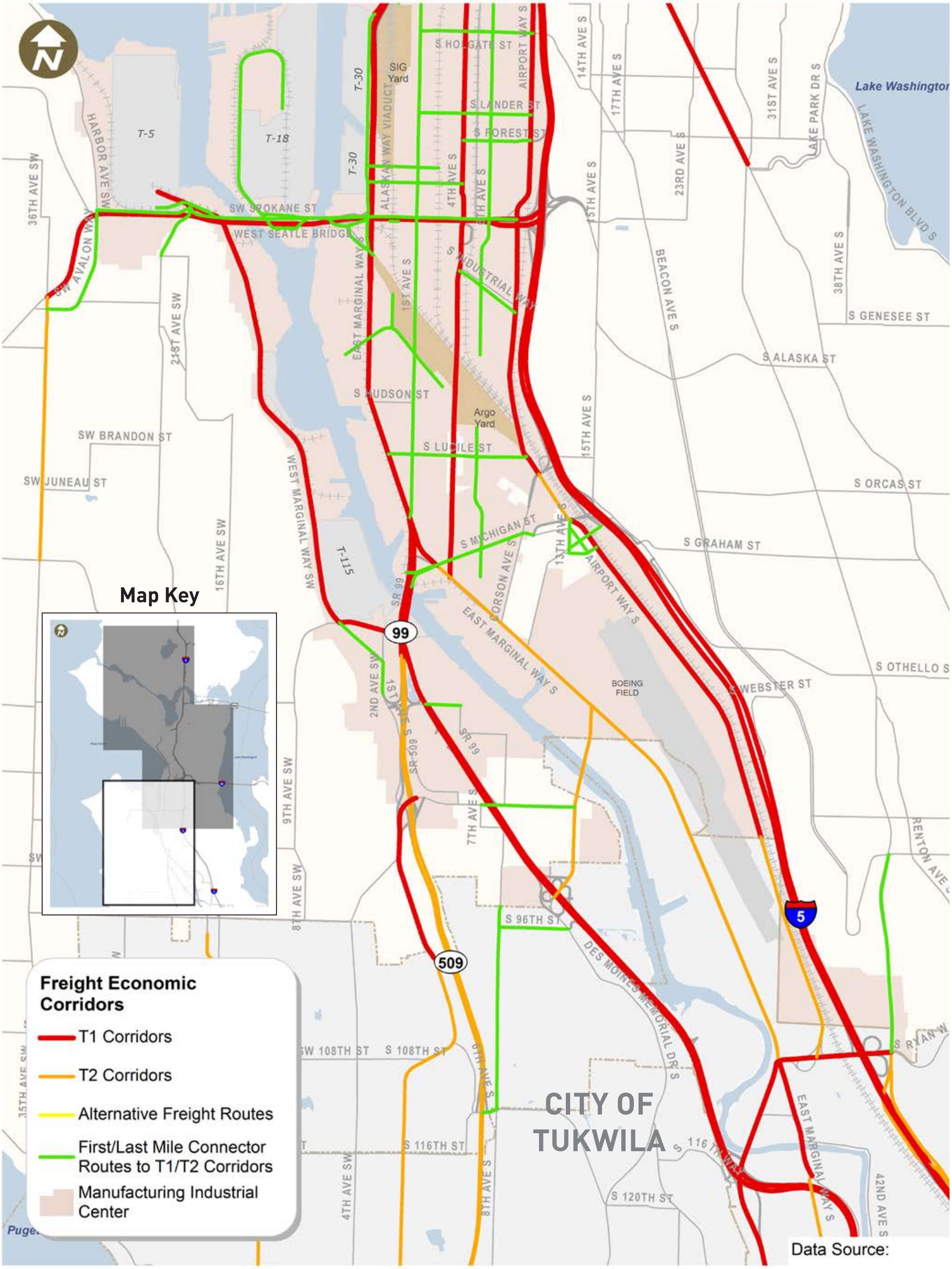


Figure 2.23 WSDOT Freight Economic Corridors – South Seattle Section

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.

Figure 2.24 Examples of Trucking Origins and Destinations

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.

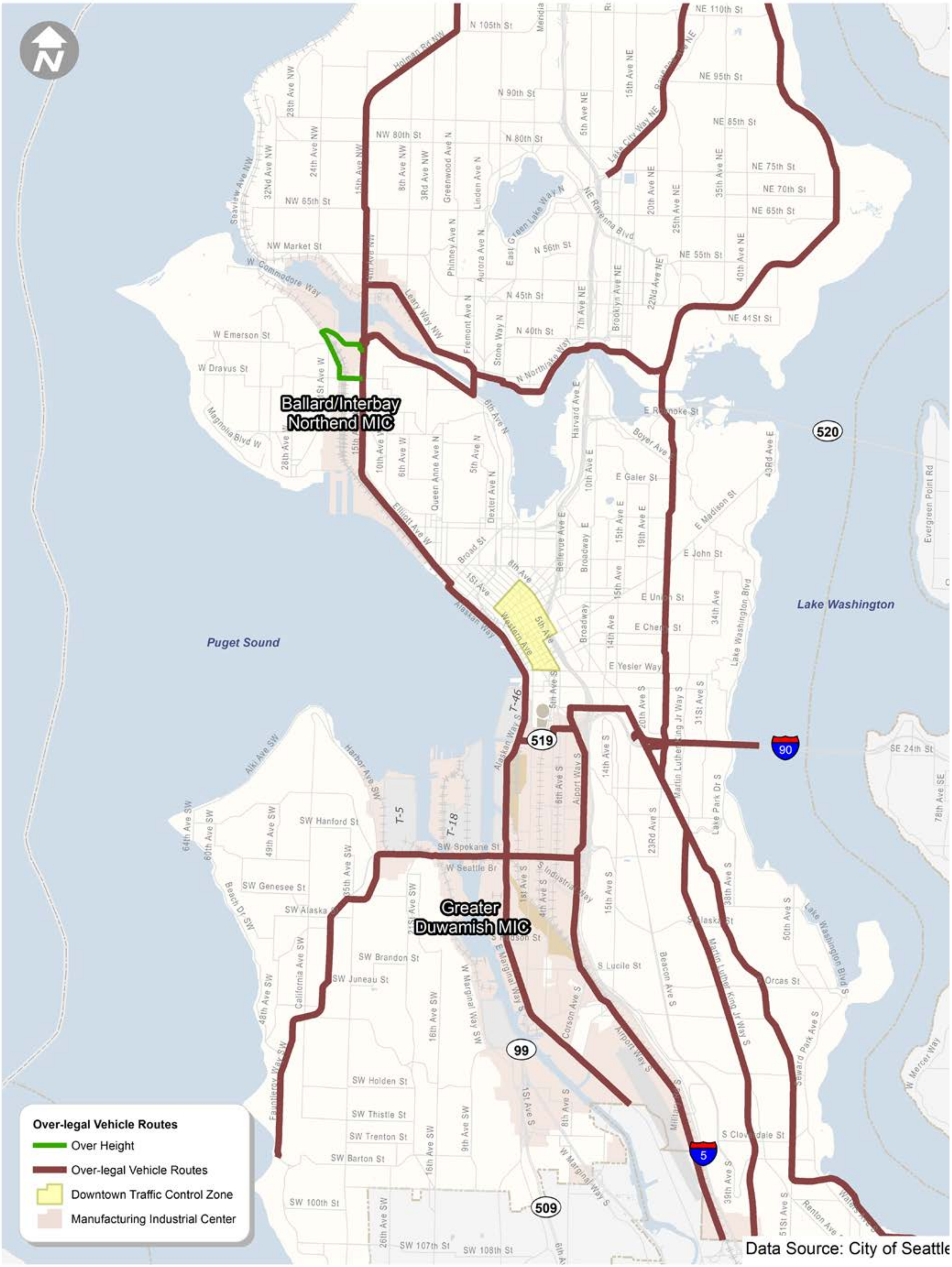
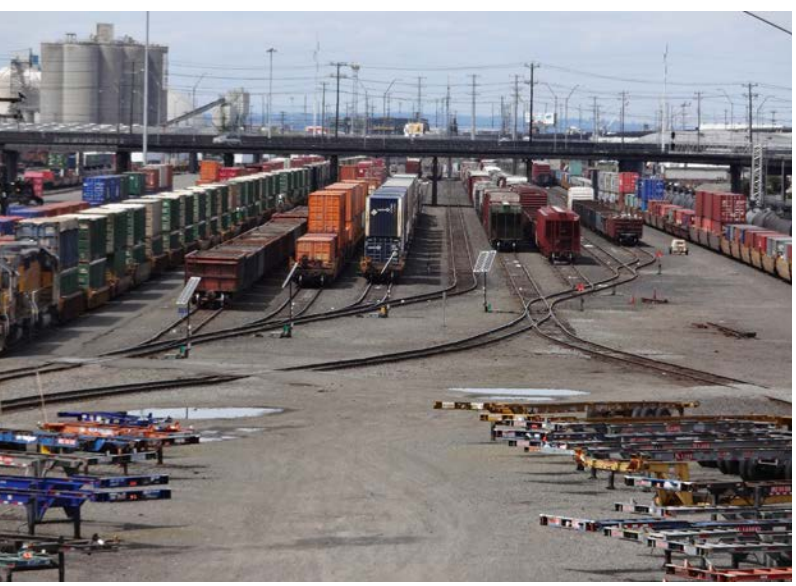


Figure 2.26 Over-legal Load Routes

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.

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

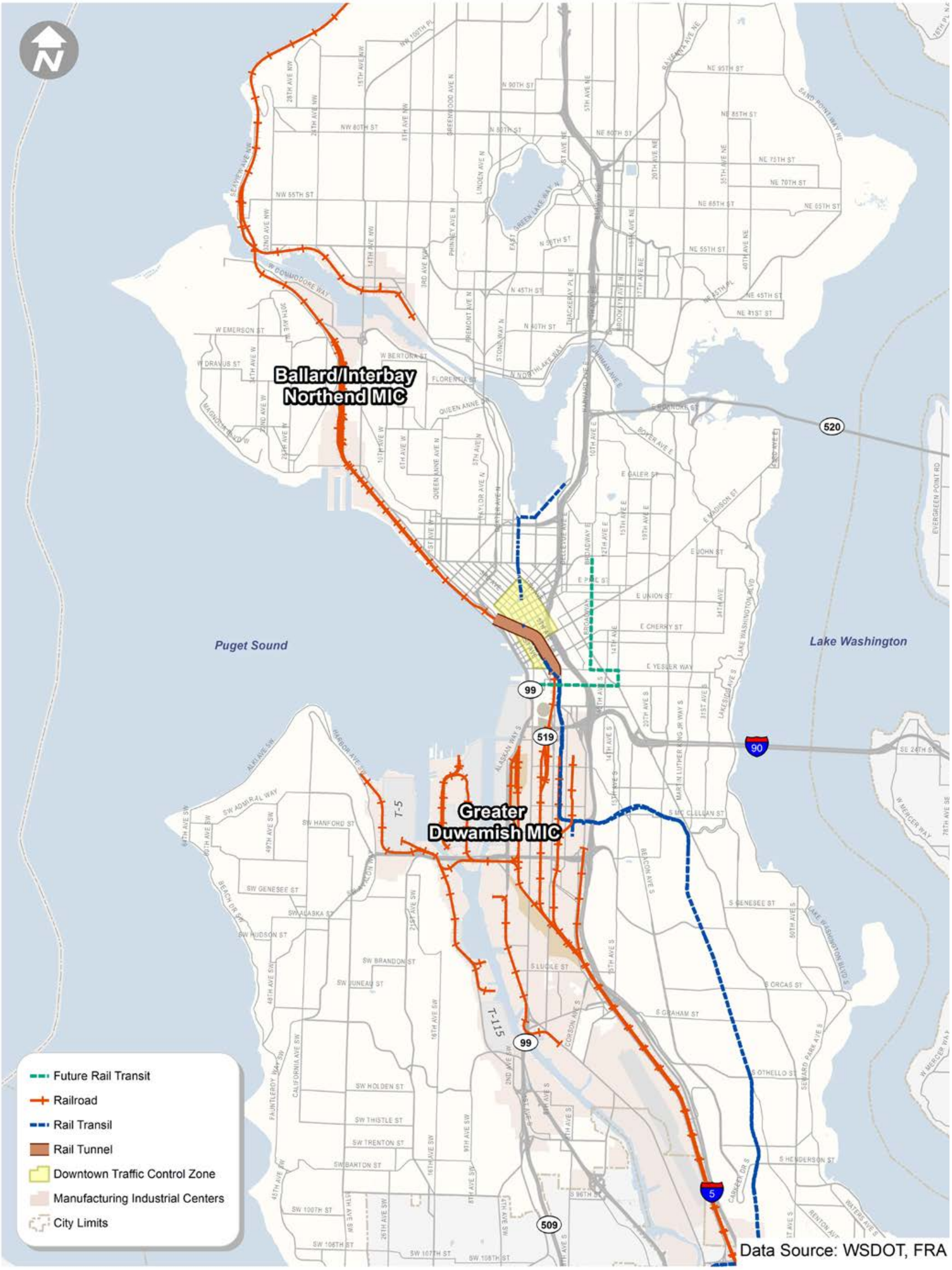


Figure 2.27 Puget Sound Rail Lines*

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

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)

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.

3 EXISTING CONDITIONS

The existing transportation system was inventoried to identify its performance with a specific focus on measures important to freight movement using existing data from City of Seattle sources augmented with new data collected as part of this project. The measures for evaluating the freight network are tied to the project goals described in Chapter 1 and include:

- safety challenges;
- existing vehicle, truck, and rail volumes on select corridors;
- travel speeds for general traffic trucks;
- operational issues that are specific to truck travel;
- pavement and bridge conditions; and
- planning for modal overlap on shared streets.

Additionally, the FAP looked at the connectivity of the overall network serving truck-borne freight, including constraints of rail crossings that cause delay, and other limitations of the systems such as weight restrictions or height limits.

PERFORMANCE MEASURES

Mobility

- General traffic
- Truck volumes
- Speeds & congestion
- Reliability

Safety

- Truck collision history

Connectivity

- Access constraints (including over-legal limitations)
- Railroad crossings and bridge openings that cause delays
- Ease of movement (roadway geometric design to support trucks)

The following sections describe how previous planning efforts have influenced the current situation of freight and goods movement in the MICs. This chapter of the report documents the performance in key areas that align with the overall goals of the project noted in Chapter 1. These performance measures are summarized below and will be estimated for current (existing) conditions in this chapter. The same performance measures will be evaluated for future conditions in Chapter 4. Chapters 5 and 6 are devoted to establishing a priority of needs based on these conditions (Chapter 5) and defining a set of improvement solutions (Chapter 6).

While this project describes the policies and standards that shape freight needs, and solutions, it does not define changes or suggest recommendations to policy, programmatic, and technical issues which will be fully examined in the Seattle Freight Master Plan (FMP). The FMP will provide a city-wide comprehensive vision for freight transportation, as well as a strategy for implementing policies, and a prioritized package of project and program improvements.

3.1 Past Studies and Plans

There have been a number of significant planning efforts undertaken to study existing freight operations and mobility constraints, and gain an understanding and identification of project needs. The organization of this summary begins with plans for the City of Seattle and works outward to address the regional and statewide planning context.

3.1.1 City of Seattle

The City of Seattle has conducted a number of studies on freight mobility and industrial land uses to support truck and rail operations within the City limits. The third and most recent edition of the City's *Freight Mobility Strategic Action Plan*[1] identifies long-term goals and immediate action items to support industrial and maritime sector growth. In addition, the Seattle Department of Transportation developed the *Freight Segmentation Study*[2] in 2008 to provide strategies to improve truck mobility throughout the City.

The Department of Planning and Development's (DPD) *Future of Seattle's Industrial Lands*[3] provides recommendations to the land use code to support industrial uses in the Greater Duwamish MIC. The Seattle Comprehensive Plan includes a chapter specific to Port of Seattle activities titled the Container Port Element. Other relevant freight plans include the *Greater Duwamish Manufacturing and Industrial Center Plan*[4] , the *SoDo Action Agenda*[5], and *Access Duwamish: A Freight Mobility and Economic Strategy*[6].

Findings and Conclusions from the Governors Container Ports Initiative in 2009

The State's two major container ports operate within a complex system of marine terminal operations, truck and train transportation corridors, and industrial/warehousing support services. The operations of these facilities are increasingly affected by the conversion of traditionally-industrial properties into non-industrial commercial or even residential uses, driven by population growth, the economic pressures of the real estate market and trends in urban redevelopment, resulting in conditions that can:

- hinder the operations of existing marine terminal operations.
- limit key truck and train transportation corridors that move freight and cargo.
- convert nearby industrial support services (such as warehousing and cargo-logistics centers) on privately owned land into uses that are incompatible with industrial operations.

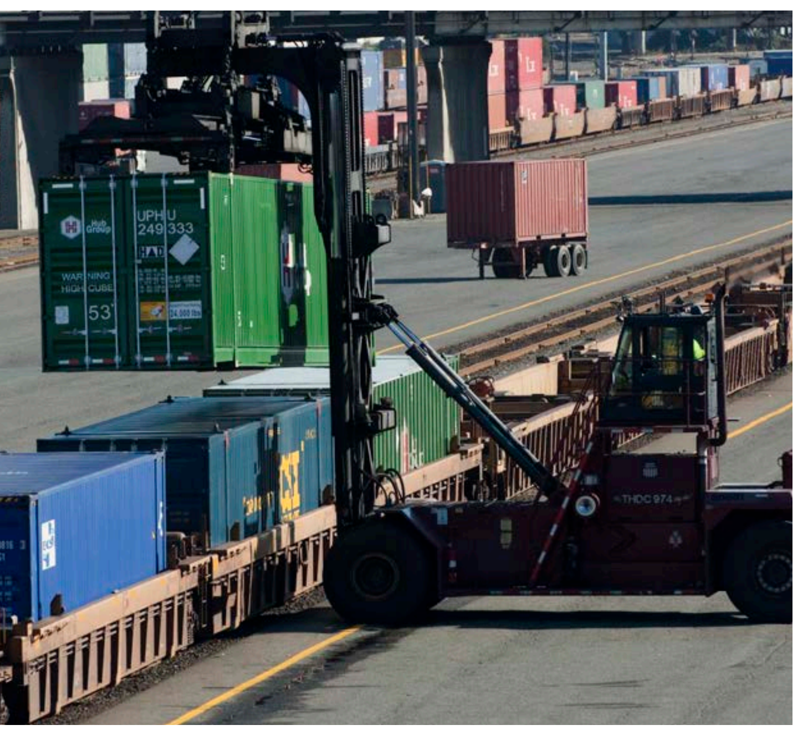
1 Freight Mobility Strategic Action Plan, Seattle, 2005
2 Freight Segmentation Study, Nelson/Nygaard, 2008
3 Future of Seattle's Industrial Lands, Seattle, 2003

4 Greater Duwamish Manufacturing and Industrial Center Plan, Greater Duwamish Committee, 1999
5 SoDo Action Agenda, City of Seattle, Manufacturing/Industrial Council, SoDo Business Association, AHBL, 2009
6 Access Duwamish: A Freight Mobility and Economic Strategy, SDOT, 2001

3.1.2 Port of Seattle

The Port of Seattle periodically conducts planning studies related to port operations and assesses local, regional, state, and national planning, programming and project development efforts as well as trends that impact the container terminals generating truck trips. The *Container Terminal Access Study* is currently undergoing an update expected to be issued in early 2015. The current plan (completed in 2003) includes container forecasts and truck volumes as related to Port activities.

In addition to carrying out its own analysis, the Port regularly reviews the efforts of partner agencies and private developers. In response to the proposal to construct a third arena, the port funded a report called *The Impact of SoDo Arena on Port of Seattle Operations.* This report documents the growth in export and import container volumes to the Port of Seattle and number of truck trips associated with that economic impact. The Governor's Container Ports Initiative also includes recommendations on the role of container shipments in the economic, land use, and transportation elements in the Greater Duwamish MIC.



3.1.3 Puget Sound Regional Council

As the Metropolitan Planning Organization (MPO) for the region, the Puget Sound Regional Council (PSRC) is responsible for land use and transportation planning in the four Puget Sound counties (King, Snohomish, Pierce, and Kitsap). The region-wide policy documents, including *Transportation 2040: Regional Freight Strategy*[7] and the *Urban Centers Report* shape policies related to freight movement for the area. PSRC evaluates and monitors the designated Manufacturing/ Industrial Centers and Regional Centers, and also reports on Industrial Lands. The latest evaluation of industrial lands is included in a draft dated December 2014[8]. PSRC staffs a regional partnership, Freight Action Strategy for Seattle/Tacoma (FAST)[9], which has planned and implemented several grade separations in the Greater Duwamish MIC. PSRC has also conducted an evaluation of the impacts of the Proposed Gateway Pacific Terminal[10].

3.1.4 Washington State Freight Mobility Plan

The Washington State Department of Transportation (WSDOT) recently (October 2014) published a Freight Mobility Plan that meets state law RCW 47.06.045 requires that

7 Transportation 2040 update, Appendix J Regional Freight Strategy, 2014
8 Industrial Lands Analysis for the Central Puget Sound Region, Discussion Draft for the Growth Management Policy Board, Community Attributes, 2014.
9 www.psrc.org/transportation/freight/fast
10 Economic Evaluation of Regional Impacts for the Proposed Gateway Pacific Terminal at Cherry Point, PSRC 2014

the Statewide Multimodal Transportation Plan include the State's interest in freight which assesses the transportation needs to ensure the safe, reliable, and efficient movement of goods within and through the state to ensure the state's economic vitality. *Moving Ahead for Progress in the 21st Century* (MAP - 21) also directs the United States Department of Transportation (US DOT) to encourage states to develop Freight Mobility Plans.

The Washington Freight Mobility Plan seeks to meet state and federal requirements for freight planning, and the national freight goals. Informed by research, data, analysis, and stakeholder input, this plan will improve Washington's ability to achieve these national freight goals:

- Improve the contribution of the freight transportation system to economic efficiency, productivity, and competitiveness.
- Reduce congestion on the freight transportation system.
- Improve the 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.
- Reduce adverse environmental and community impacts of the freight transportation system.

The plan was guided by these three objectives:

1. Develop an urban goods movement system that supports jobs, the economy, and clean air for all; and provides goods delivery to residents and businesses.
2. Maintain Washington's competitive position as a global gateway to the nation with intermodal freight corridors serving trade and international and interstate commerce, and the state and national Export Initiatives.
3. Support rural economies' farm-to-market, manufacturing, and resource industry sectors.

3.1.5 Other Organizations

The Greater Duwamish Transportation Management Association (TMA) has been actively studying transportation facilities in the vicinity of the Greater Duwamish MIC and has identified what it considers existing deficiencies and suggested recommendations for improvements. The *Workable SoDo Report (2013)* includes strategies and recommendations for freight safety, including multimodal improvements in the neighborhood. The Greater Duwamish TMA also developed a *Smart Street Study* identifying travel options for employees working in the Greater Duwamish MIC.

3.1.6 Construction Projects

The Alaskan Way Viaduct Replacement/Tunnel project is a major WSDOT project that consists of replacing the existing SR 99 viaduct with a 2-mile long bored tunnel beneath the downtown city-center. This project began construction in 2008 and is expected to continue through the end of 2017 when the new tunnel will be open to the public. Although the AWV replacement will be complete in 2017, there will be subsequent work that will take place as part of the other major projects to remove the viaduct and restore the Seattle waterfront as a result of the viaduct removal. This includes restoration of a surface

Alaskan Way roadway which will be completed by SDOT after the Viaduct is removed in 2018. When the new tunnel opens as SR 99, tolls will be implemented to offset the cost of construction and help maintain the facility. A separate but related project to reconstruct the central section of the Elliott Bay Seawall is also currently under construction by SDOT and should be complete by 2016.

3.2 Relevant City Policies and Guidelines

The City of Seattle evaluates transportation projects based on principles to improve the safety and mobility for all roadway users. Complete Street principles that encourage and enhance multimodal travel experiences are central to the current project development and evaluation process; while the *Right of Way Improvements Manual* (discussed below) provides engineers and designers with the design tools necessary to help implement these projects. This section of the report describes the current processes and policies supporting the City's evaluation of transportation projects.

3.2.1 Design Guidelines/Standards

The *Right-of-Way Improvements Manual*[11] (ROWIM) includes roadway designations, street types, and street standards for Seattle roadways. The cross-sections referenced in the manual specify the minimum and preferred requirements for typical street sections based on the functional street classifications designated in the *Transportation Strategic Plan* and adjacent land uses.

Design Guidelines are part of the City of Seattle's Design Review Program[12] and apply to all areas in the City except downtown. These guidelines provide a means for private development to achieve design excellence and open discussions with the public during the design review process.

The current design guidelines and standards provide context for development patterns and roadways. As related to transportation and street-

11 Seattle Right-of-Way Improvements Manual SDOT – Available at: www.seattle.gov/transportation/rowmanual/
12 Seattle Design Guidelines. City of Seattle – Department of Planning and Development. December 2013. Available at: www.seattle.gov/dpd/cs/groups/pan/@pan/documents/web_informational/p2083771.pdf

frontages, both the Seattle Design Guidelines and Right-of-Way Improvements Manual emphasize serving all modes of travel and planning ahead for freight, bicycle, pedestrian, and transit connections.

Section 3.3.4 of the ROWIM discusses over-legal constraints (those locations that are constrained for truck freight due to height, width, length or weight restrictions).

3.2.2 Complete Streets

"Complete Street" principles are applied to the entire street network to help ensure streets serve all roadway users. The focus of Complete Streets goes beyond the modal plans for transit, bicycles, and pedestrians to leverage multiple project elements and funding sources to plan and design streets that support and balance the needs of multiple users.

Seattle's Complete Streets policy, Ordinance # 122386[13], was adopted by the City Council in 2007. It was an important policy document because it was one of the first Complete Street ordinances in the country that clearly incorporated the goal to ensure freight mobility in applying complete street treatments on major truck freight facilities. Section 3 of the ordinance reads:

"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 the major priority on streets classified as Major Truck Streets. Complete Street improvements that are consistent with freight mobility but also support other modes may be considered on these streets."

The Complete Streets Checklist[14] has been used to evaluate construction and maintenance projects within the City. The Complete Streets Checklist requires information on the roadway classifications for individual modes, adjacent land uses and zones, traffic volumes, and the existing and planned design elements for the roadway. The outcomes of this process include a prioritization of project elements that are preferred or should be considered.

13 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

14 Complete Streets Checklist. City of Seattle. April 2011. Available at: www.seattle.gov/transportation/docs/ctac/2011_04_19Final%20Draft%20Checklist.pdf

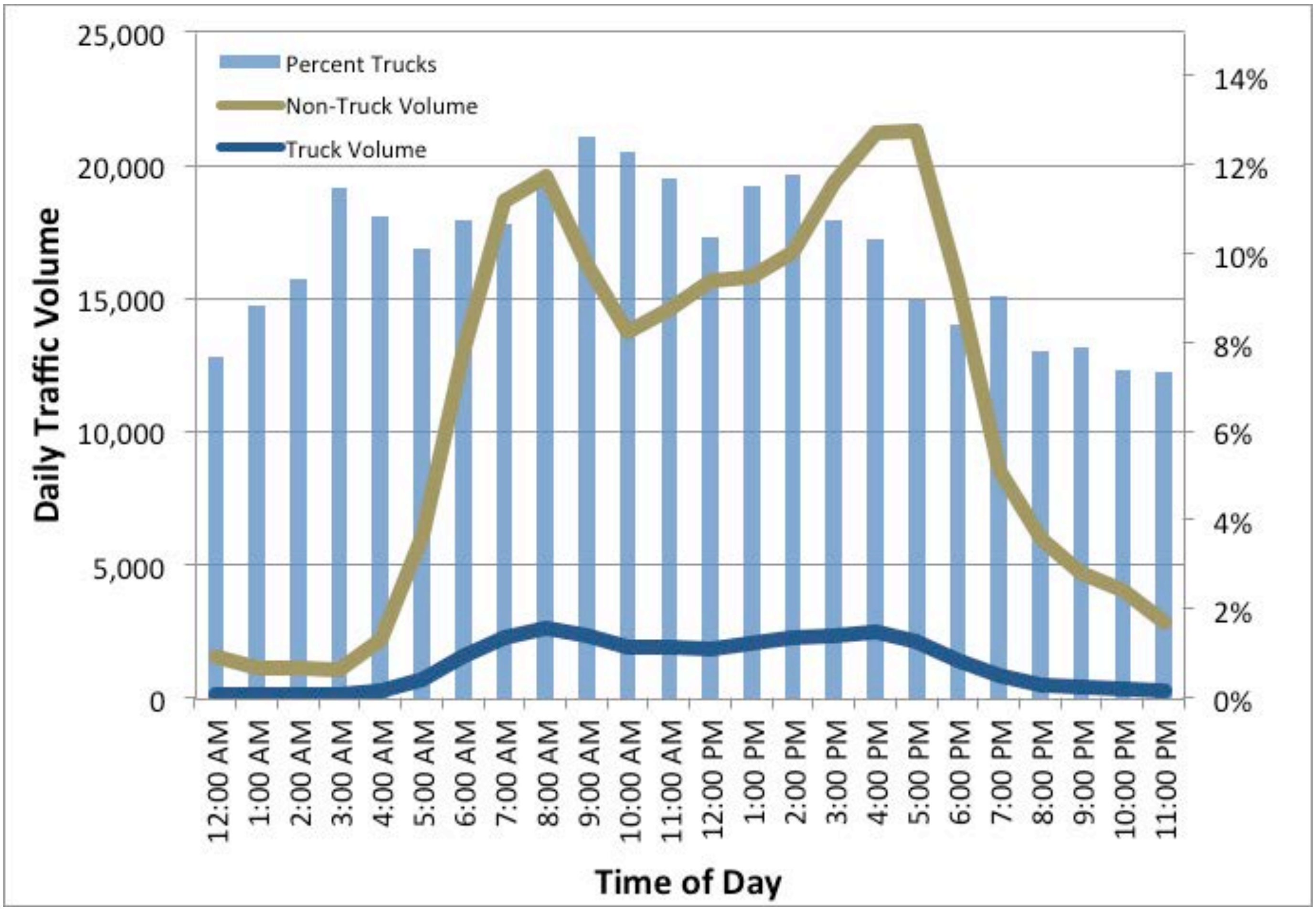


Figure 3.1 Daily Traffic Patterns (Source Transpo, IDAX)

3.3 Trucks

Trucks support local and regional markets by transporting freight on the roadway network. To understand the extent of truck travel on the roadways and within the City, this section covers the corridor truck volumes, roadway travel speeds, truck mobility issues, pavement and bridge conditions, and modal overlap. The Major Truck Streets are shown in Figure 3.2.

3.3.1 Corridor Volumes

Corridor volumes measure the amount of freight activity in the study area and are summarized by the existing truck volumes on the roadway network. Roadway volumes were inventoried based on a number of count sources, including 24-hour tube counts, intersection turning movement volumes, and volume summaries from other reports. Figure 3.1 illustrates truck, non-truck volumes and truck percentage on average for a weekday 24 hour period. This measure of system demand serves as a basis for establishing performance metrics, in addition to providing information on freight travel patterns.

Daily Truck Volumes

Daily traffic volumes show the magnitude of overall traffic activity on the freight network. Daily traffic volumes were drawn from recently conducted counts (January 2014) or from historical counts from SDOT and WSDOT. Figure 3.3 to Figure 3.5 show the average weekday daily and truck volumes on study roadways.

Daily truck volumes show the magnitude of

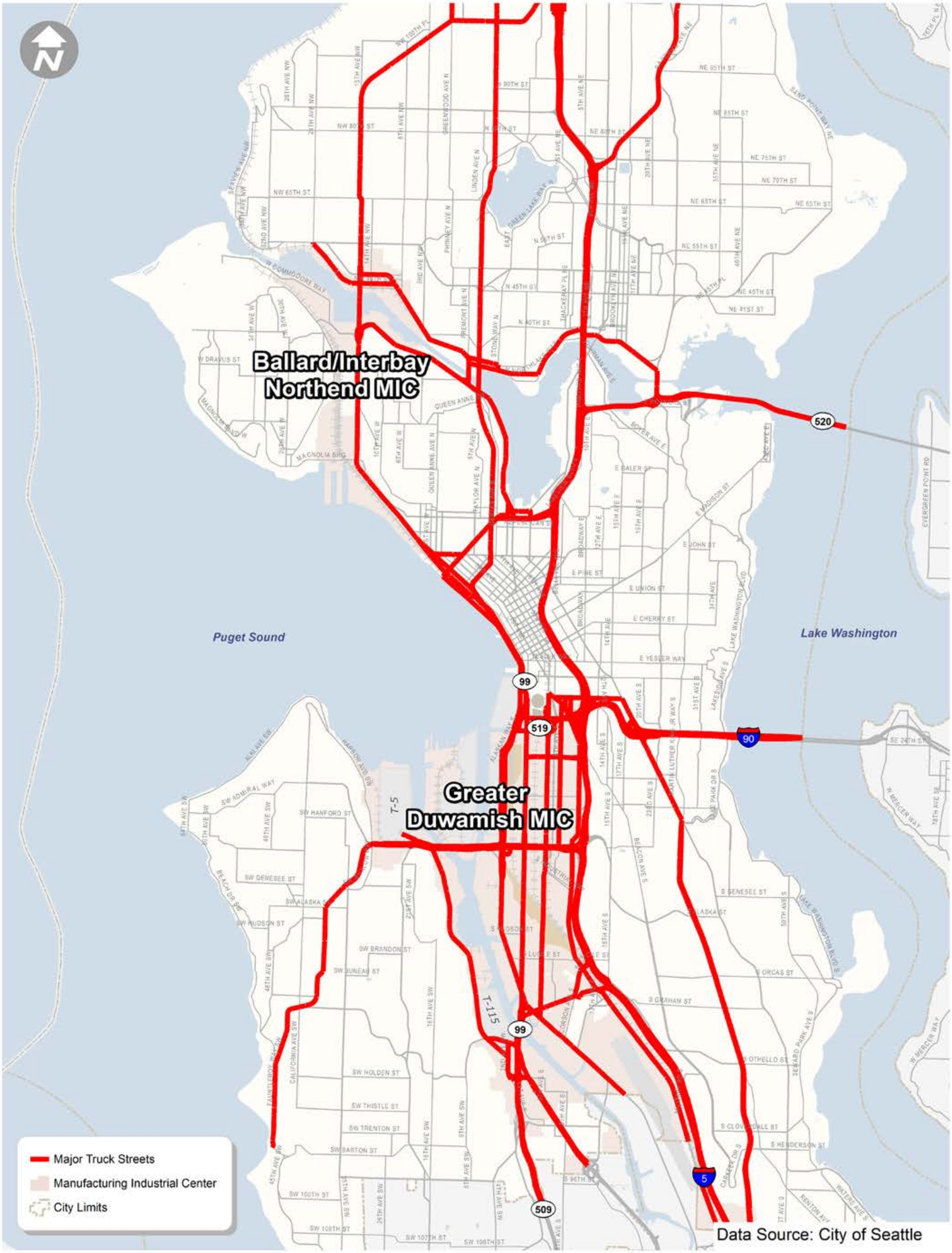


Figure 3.2 Major Truck Streets (Source Transpo, IDAX)

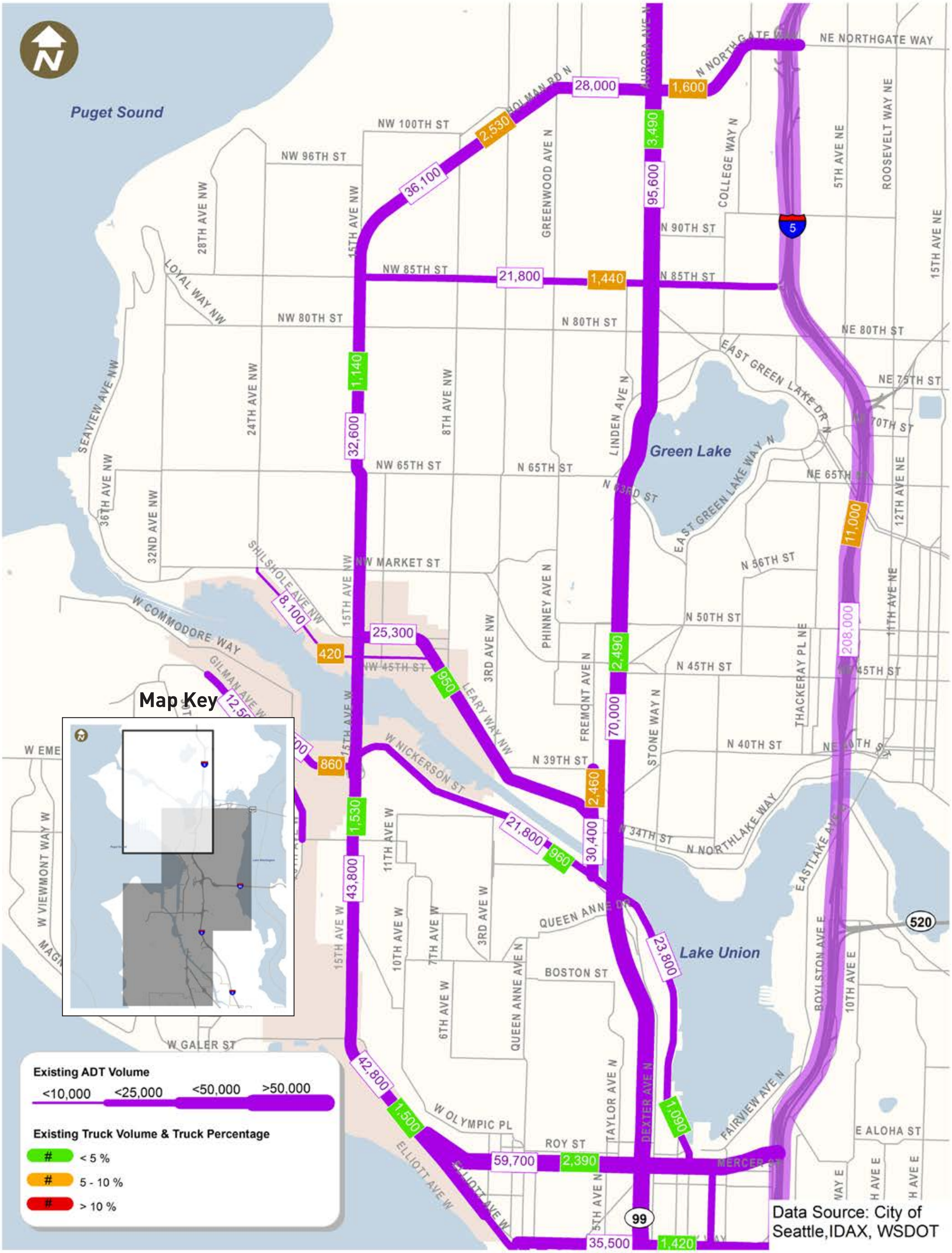


Figure 3.3 Daily Traffic Volumes – North Section (2014)

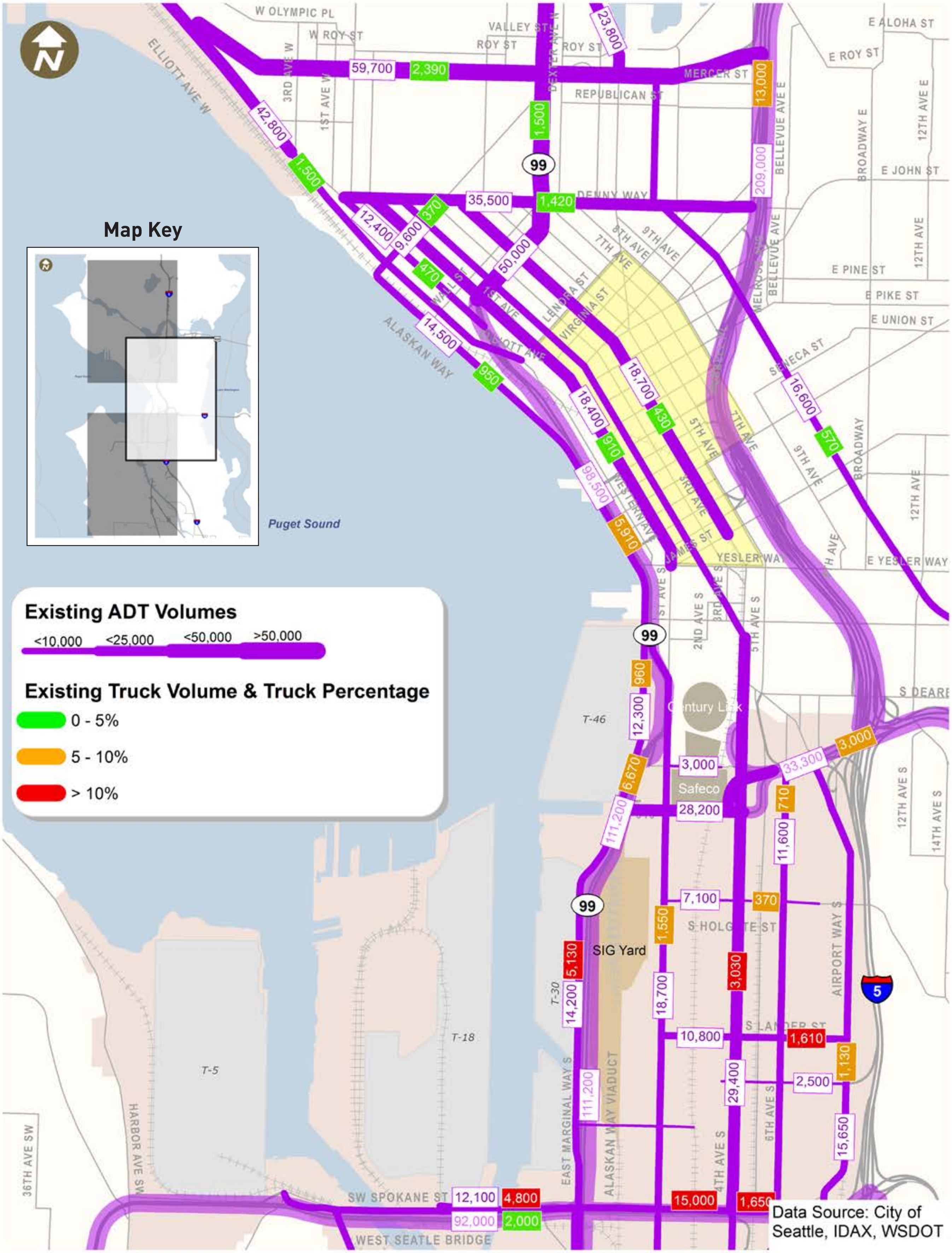


Figure 3.4 Daily Traffic Volumes – Central Section (2014)

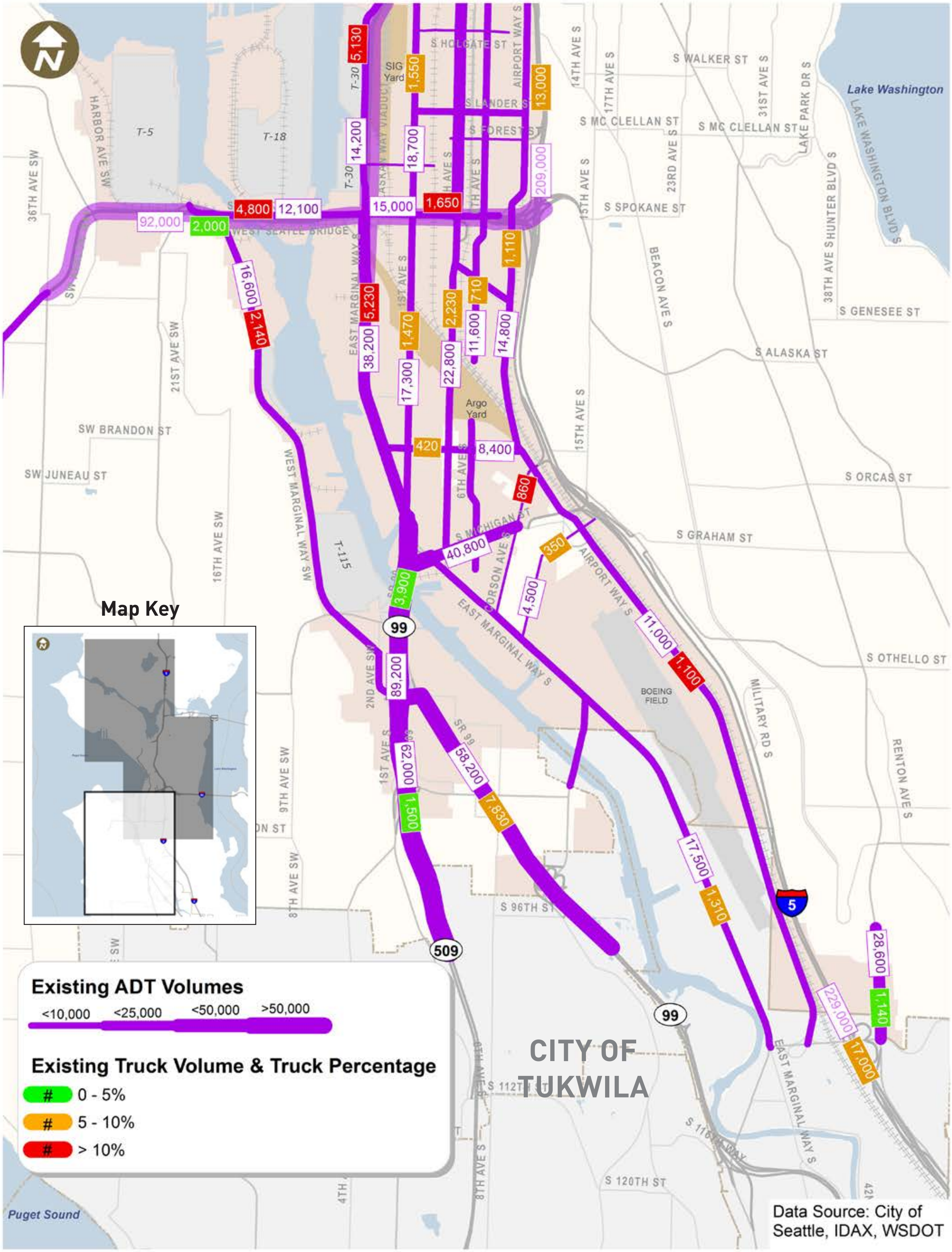


Figure 3.5 Daily Traffic Volumes – South Section (2014)

freight activity within the context of overall traffic demands. As part of the daily vehicle counts, vehicle classification counts were also conducted to determine the amount and size of trucks traveling on study roadways. Figure 3.3 to 3.5 also show the average weekday truck traffic volume as a percentage of total traffic volumes on the study roadways. In general, the highest daily volumes are along state routes, principal arterials, and intermodal yard connectors that are currently designated as local streets. In most cases, trucks represented between 8 to 12 percent of the total daily volumes on the corridors.

Truck Classifications

Truck corridor volumes were broken down to include light, medium, and heavy-duty trucks as defined in Chapter 2 of this report. These groups are related to the FHWA and gross vehicle weight (GVW) classification systems used for freight planning purposes. Figure 3.6 shows the light, medium, and heavy-duty truck classifications for the Greater Duwamish MIC and Ballard/Interbay Northend MIC (BINMIC).

As shown in the figure, both areas show similar ratios of light, medium, and heavy trucks, where light trucks comprise the largest portion of counts and heavy the smallest. The Greater Duwamish MIC has a higher overall percentage of trucks in the Average Daily Traffic (ADT) volumes. As a result, all classifications of trucks (light, medium,

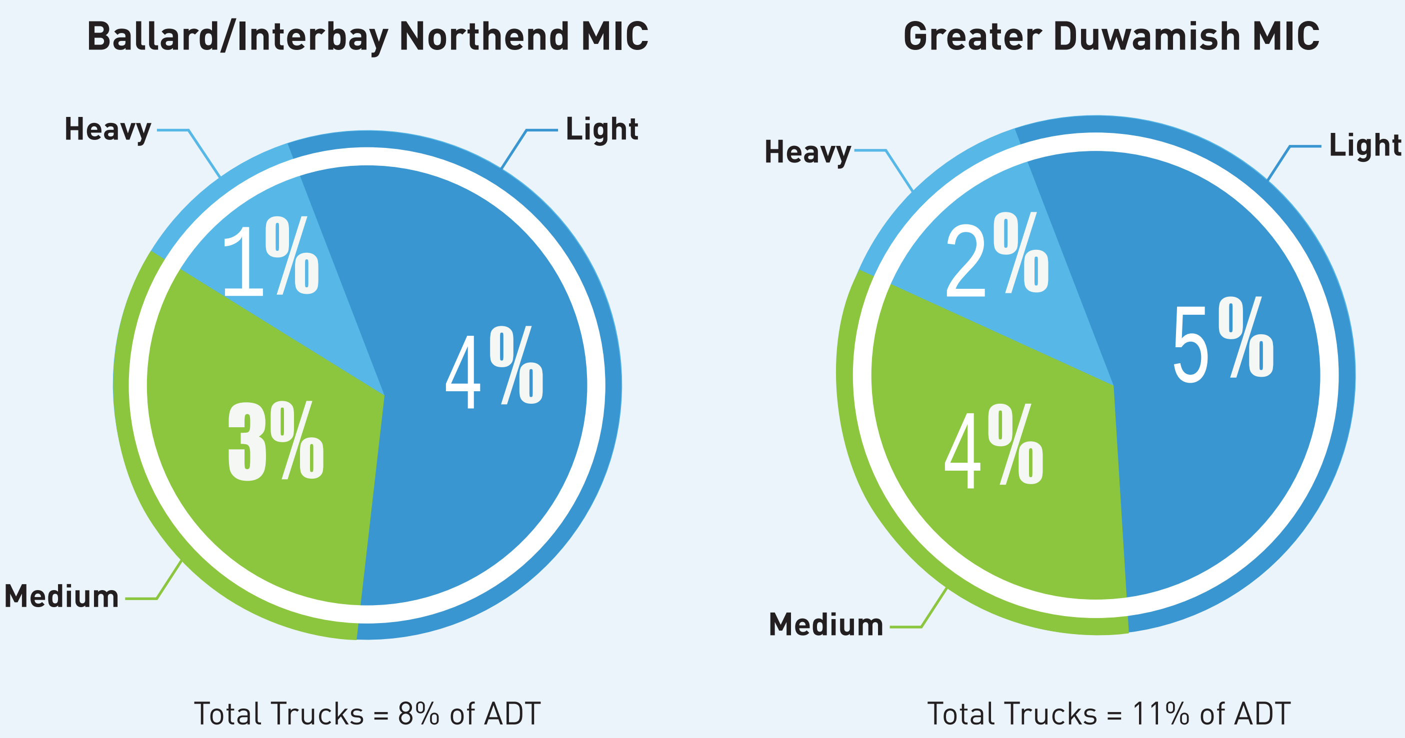


Figure 3.6 Light, Medium, and Heavy-Duty Trucks as Percentage of Total Traffic (source Transpo Group)

and heavy) comprise a slightly higher percentage of total traffic.

3.3.2 Corridor Travel Speeds

Speed, as a surrogate for travel time, provides an important performance measure for trucks as it influences reliability. Travel time for trucks is directly linked to the cost of providing goods and services. As travel time increases costs of goods can potentially increase for consumers. Existing general purpose travel speeds along study corridors were analyzed to understand the overall efficiency of freight corridors. System efficiency evaluates the prevailing speeds on corridors during peak traffic demands to measure the impact of roadway congestion on travel speeds for all vehicles on the roadway. The general purpose traffic data was used due to the more complete dataset that was available. Analysis of speeds in select locations found similar changes in general traffic efficiency and reliability as truck efficiency and reliability.

INRIX[15] speed data was collected for the major study roadways, though data was not available for all corridors. Information from the *WSDOT Mobility Report*[16] was included for regional highway locations that did not have available INRIX data. Morning and evening travel speeds were summarized in 2-hour windows to maintain consistency with previous FHWA studies and capture peak traffic periods for both passenger vehicles and trucks. Roadway congestion was defined based on the average speed of corridors as a percent of the posted speed for that roadway.

15 INRIX collects and disseminates traffic data to travelers and transportation professionals. Through a partnership with Transpo Group, one year of travel speed data was collected for this project
16 WSDOT Mobility Report. WSDOT. 2012

This approach uses thresholds consistent with the congestion levels defined in the WSDOT Handbook for Corridor Capacity Evaluation[17]:

- **Uncongested Flow -** Greater than 85 percent of posted speed.
- **Delayed Flow -** 70 to 85 percent of posted speed.
- **Congested Flow -** 60 to 70 percent of posted speed.
- **Severely Congested Flow -** Less than 60 percent of posted speed.

The historical speed data spans 12 months during 2013 and is summarized in 15-minute increments. Speed data from approximately 75 locations was filtered to remove weekend and holiday travel time periods. Corridor congestion experienced during the morning peak (7-9am) are shown in Figure 3.7 to 3.9.

As shown in the morning peak period average travel speeds, several roadways have travel speeds between 60 and 70 percent of the posted speed limit, and many others average speeds less than 60 percent of the posted speed limit. Congested roadways operating at speeds much lower than posted speeds are generally inbound (toward the Seattle Central Business District) in the peak commute direction. North of the downtown east-west arterials like Mercer Street and Denny Way are congested. In the Greater Duwamish MIC, both north-south and east-west arterials showed heavy congestion. WSDOT's *Corridor Capacity Report (2013)* documents congestion for freeways throughout the region. As noted in the report, during the morning commute

17 Handbook for Corridor Capacity Evaluation. WSDOT 2014

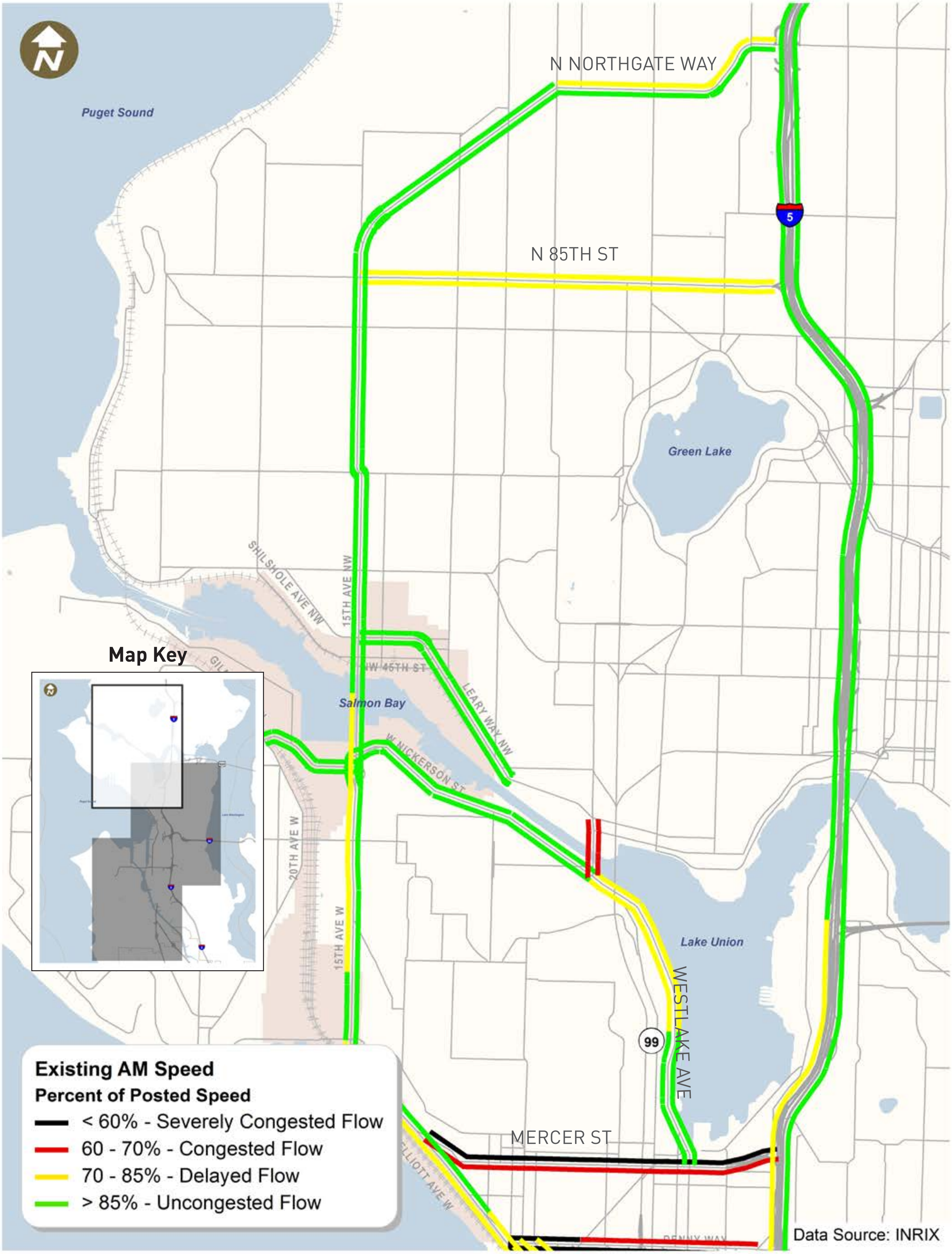


Figure 3.7 Existing (2013) AM Congestion Levels – North

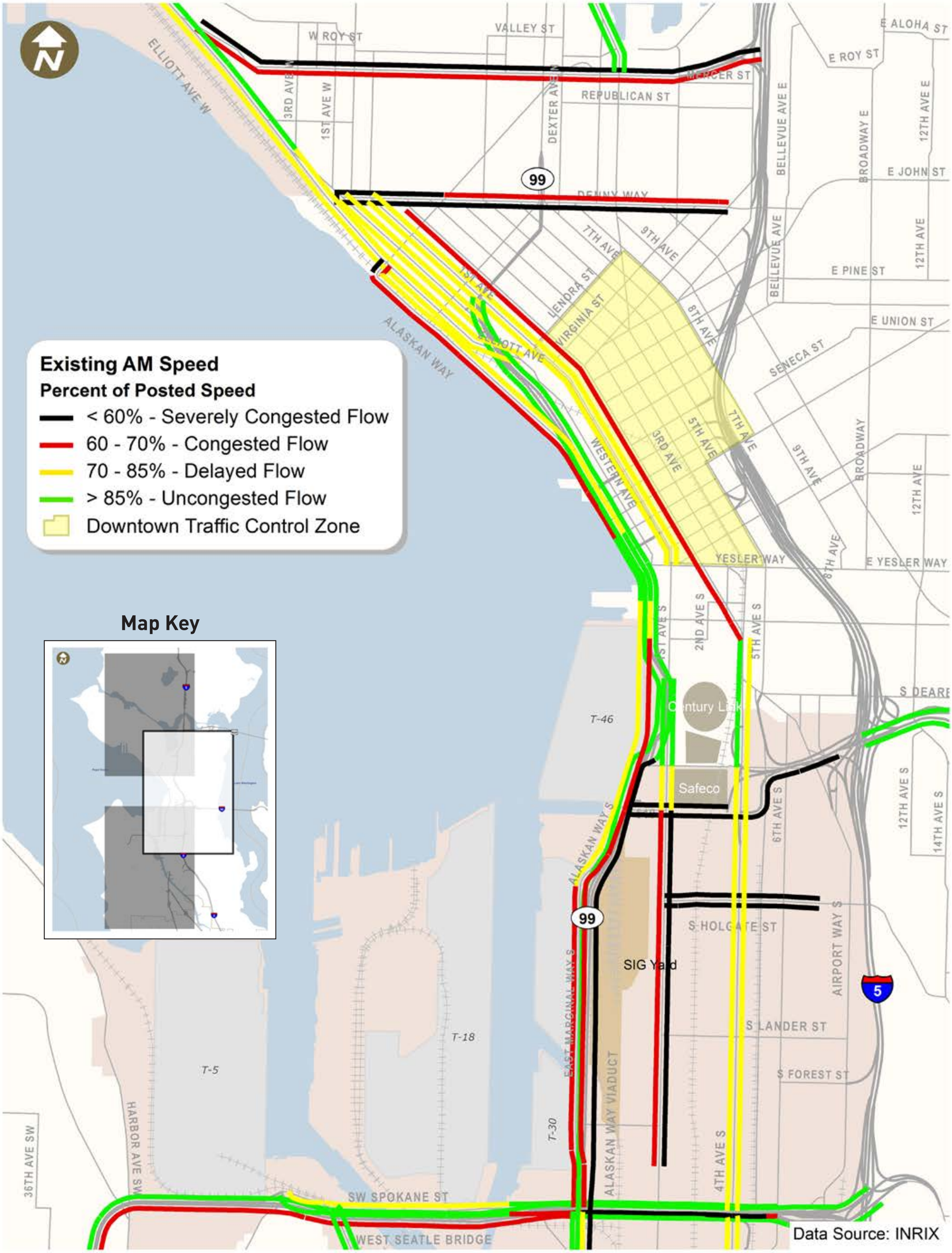


Figure 3.8 Existing (2013) AM Congestion Levels – Central

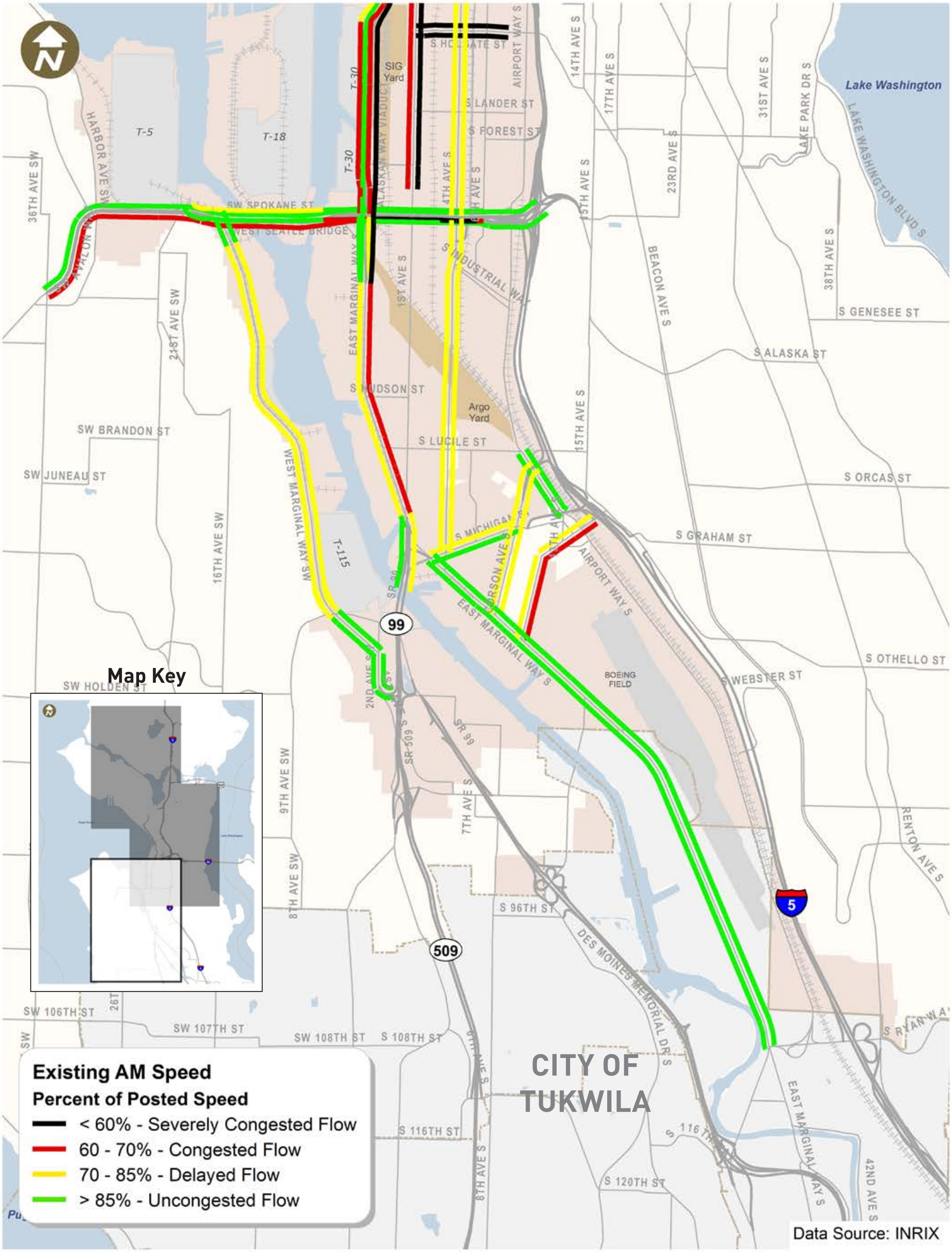


Figure 3.9 Existing (2013) AM Congestion Levels – South

period, travel times from Federal Way to Seattle via I-5 typically take twice as long as other times of the day (45 minutes versus 22 minutes). Similarly, travel times from Everett to Seattle take nearly twice as long via I-5 (44 minutes versus 24 minutes). The evening percent of posted travel speeds for the two-hour period from 3 to 5pm are shown in Figures 3.10 to 3.12.

As shown in the evening peak period average travel speeds, several roadways have average travel speeds less than 60 percent of the posted speed limit (very congested). Roadways with lower travel speeds are typically outbound in the peak commute direction (away from the Seattle Central Business District), but are generally more balanced than during the morning peak period. WSDOT's Corridor Capacity Report (2013) notes during the evening commute period, travel times from Seattle to Federal Way via I-5 typically take 10 minutes longer as during other times of the day (32 minutes versus 22 minutes), while travel times from Seattle to Everett take about 12 minutes longer via I-5 (38 minutes versus 24 minutes). In addition to using the Interstates, freight relies on several corridors with recurring congestion including SR 99, Spokane Street, Atlantic Street, Holgate Street and First and Fourth Avenues in the Greater Duwamish MIC. Freight also relies on the congested Mercer Street corridor north of downtown.

For both morning and evening peak periods, severely congested flow segments are those where traffic is traveling very slowly and travel times can easily double as compared to mid-day, non-peak times. These congested roadways are prone to higher collisions that can compound congestion.

Morning peak periods are slightly less congested and trucks often choose this time to make deliveries. Afternoon peak is generally worse than morning peak. Truck-borne freight operates in both peaks.

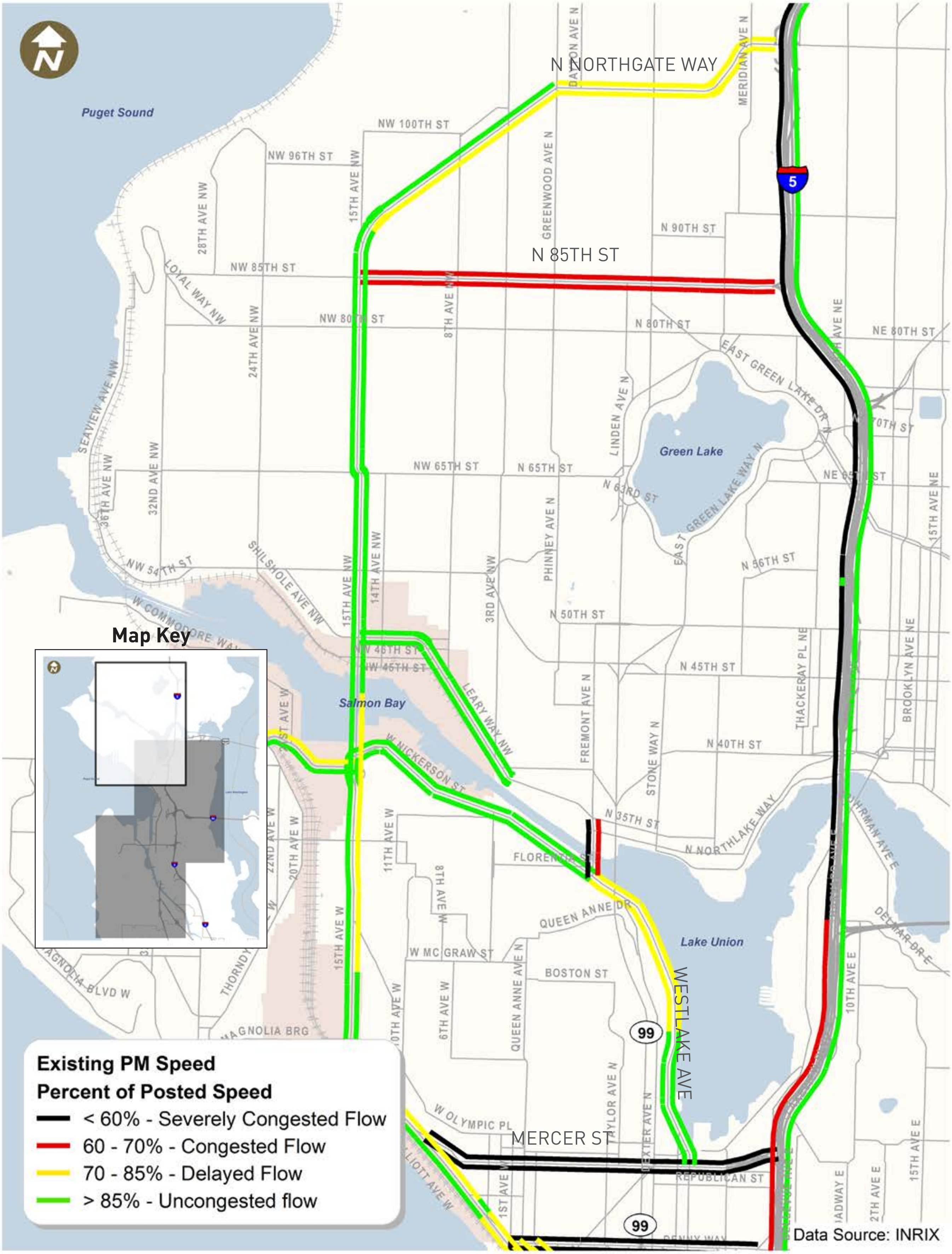


Figure 3.10 Existing (2013) PM Congestion Levels – North

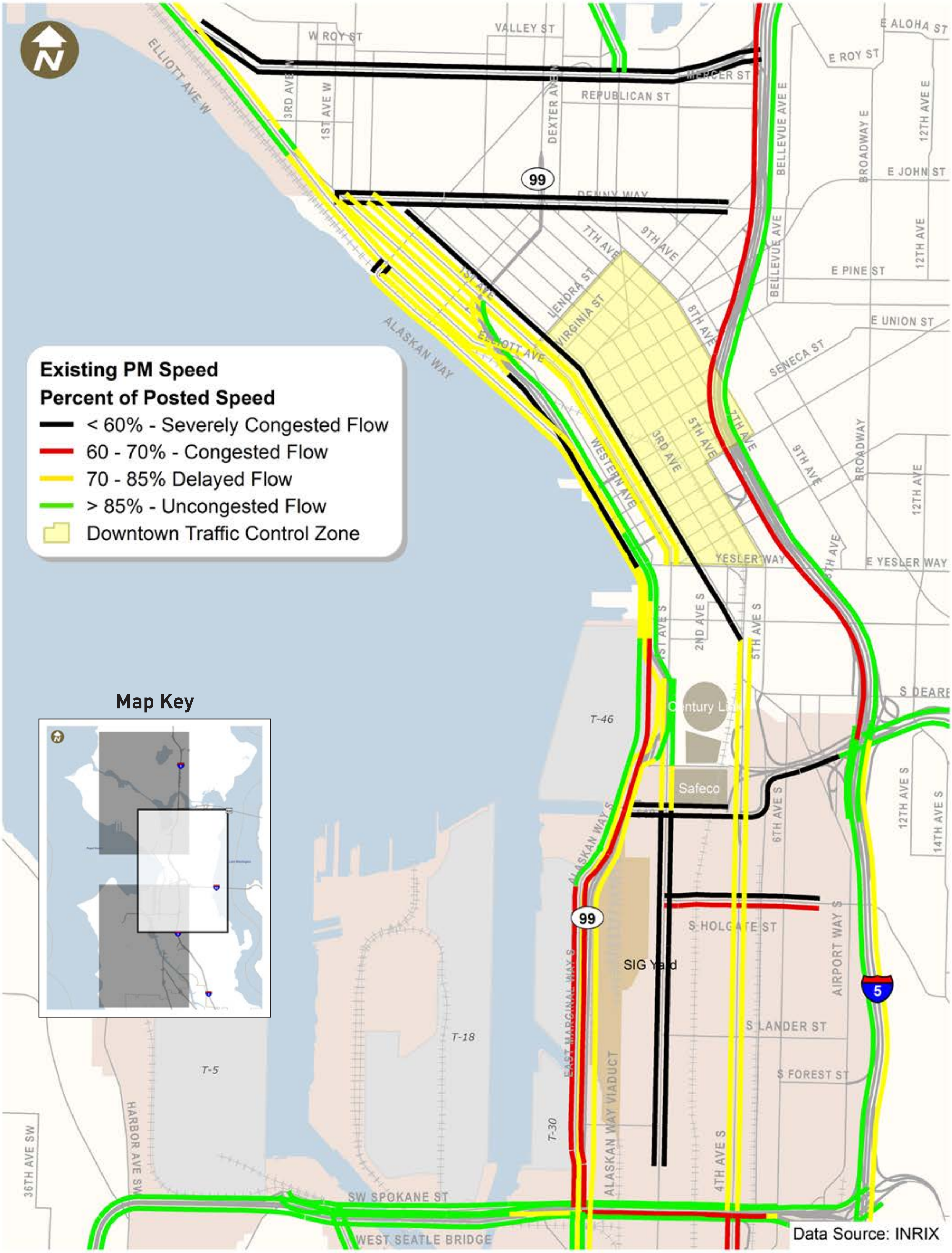


Figure 3.11 Existing (2013) PM Congestion Levels – Central

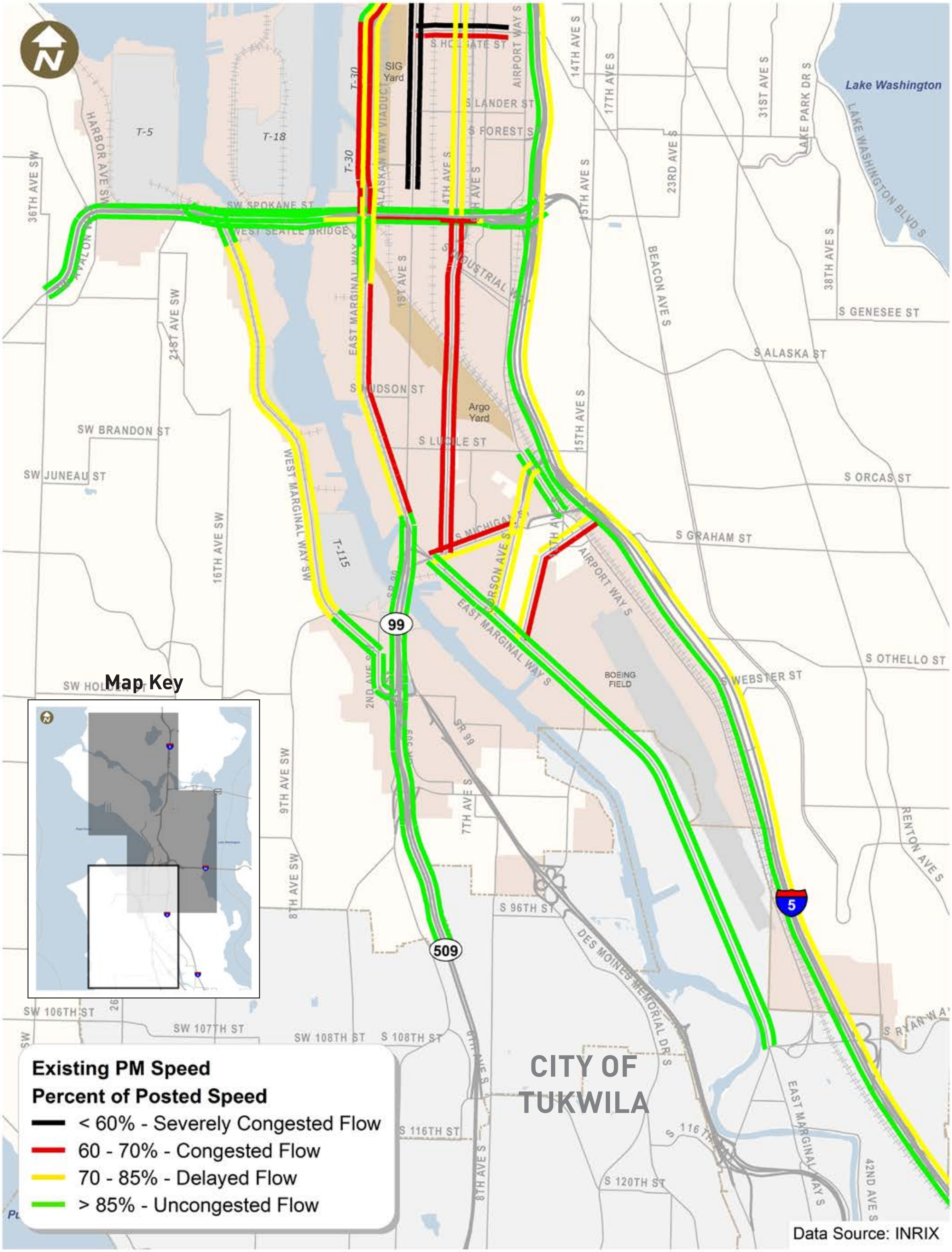


Figure 3.12 Existing (2013) PM Congestion Levels – South

3.3.3 Truck Safety

Truck and vehicle safety is included in the performance measures to evaluate the impact of truck-related collisions on City roadways. The metrics for this evaluation include the number and severity of freight collisions, and their impacts on people and cargo. Collision data was collected for all truck-involved incidents over the most recent available 5-year period for the areas within the MICs and connecting corridors. The number of truck collisions, including those where a pedestrian, cyclist, or passenger vehicle was involved, was used to assess the safety of roadways in the study area.

Truck Collisions

Five year collision data (January 1, 2009 through December 31, 2013) provided by SDOT was used to highlight truck collision history in the Ballard/Interbay Northend and Greater Duwamish MICs. In the BINMIC, there were 14 truck-involved collisions reported in the five years of available data. The majority of the collisions were collisions of trucks with other vehicles, and one was between a truck and a bicycle (truck/bike). None of the collisions resulted in fatalities, but there were 5 injury or serious injury collisions. No pedestrian collisions with trucks were reported within the BINMIC during the 5 years of data reviewed. Figure 3.13 illustrates locations of the collisions within the BINMIC.

In the Greater Duwamish MIC, there were 339 truck-involved recorded collisions over the five years of available collision reports. The majority of these truck/other collisions occurred along heavily used truck routes, such as S Spokane St, E Marginal Way S, and near the SIG Yard and Union Pacific Argo Yard entry points. There were 13 bike / truck collisions were recorded in the Greater Duwamish MIC, where one resulted in a fatality (at the E Marginal Way and Hanford Street intersection). No truck collisions with pedestrians were reported within the Greater Duwamish MIC. A map summarizing the locations of the truck collisions within the Greater Duwamish MIC is provided in Figure 3.14.

Figure 3.13 Truck Collisions in Ballard/Interbay Northend MIC

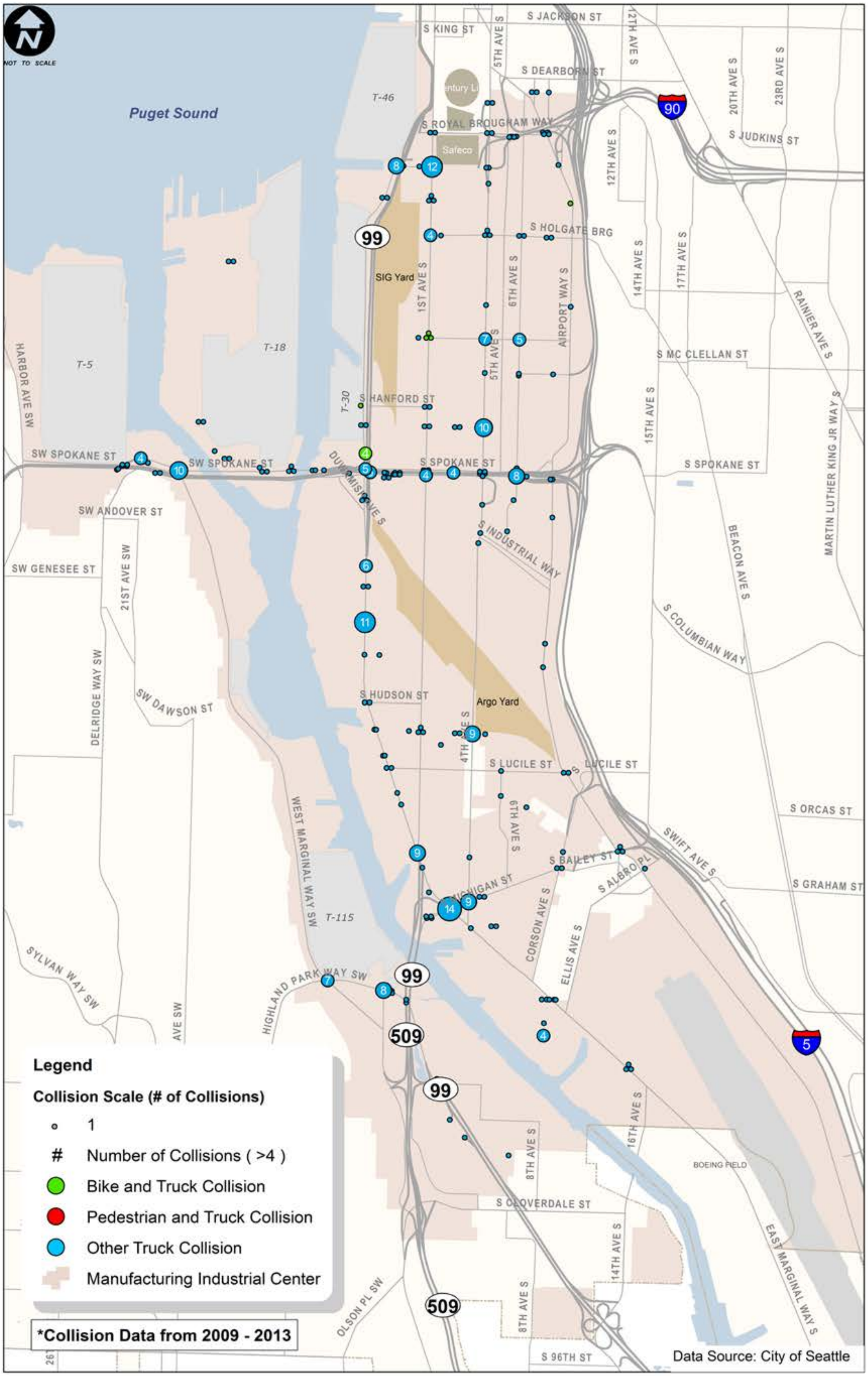


Figure 3.14 Truck Collisions in Greater Duwamish MIC

3.3.4 Truck Mobility Constraints

In order to address overall travel needs for trucks, it is important to inventory constraints on the roadway system that create bottlenecks or barriers for freight traffic. Mobility constraints include bottlenecks or barriers on the transportation network that impact freight access. Some of these constraints are locations that may delay the general traffic stream and therefore impact freight, while others are specific challenges for large trucks. Information on each mobility constraint was collected through SDOT GIS databases, a draft list of Truck Operational Problems in Response to Freight Community,[18] stakeholder comments, and site visits for field confirmation. The advantage of this approach is it can take into account a range of input from existing data sources and stakeholder comments.

One constraint that impacts overall mobility is the limited number of north-south arterials connecting the MICs. Specifically, the Downtown Traffic Control Zone, which is shown on the speed and volume maps, restricts truck access to outside of the downtown and further limits arterial connections that trucks can use between the MICs.

According to Seattle Municipal Code Ordinance 108200 Section 11.14.165, the "Downtown Traffic Control Zone" refers to the area within the downtown district where legal vehicles 30' long and longer may move with a permit from 9am - 3pm, and from 7pm - 6am without a permit. Curfews are in effect 6 - 9am and 3 - 7pm except Saturdays and Sundays.

Permits are required for legal vehicles 30' long and longer on Saturdays but curfews are not in effect.

These restrictions are not in effect on Sundays.

Another general mobility constraint was identified for east-west traffic crossing the railroad tracks in the Greater Duwamish MIC. The following mobility constraints were identified as potential causes of bottlenecks on the freight network:

- intersection and lane geometric constraints
- intersection operations
- at-grade railroad crossings
- over-height restrictions
- weight restrictions
- width restrictions
- roadway grades
- moveable bridges
- port/rail yard operations and security requirements

Improvements to address the mobility constraints are discussed in Chapter 6 – Freight System Improvements.

18 Truck Operational Problems in Response to Freight Community, Work in Progress. 2008-2009. SDOT.

CURB RADII AND LARGE OBJECTS, SUCH AS UTILITY POLES, OUTSIDE THE TRAVEL LANES ARE EXAMPLES OF INTERSECTION AND LANE GEOMETRY CONSTRAINTS.

SIGNAL OPERATIONS FOR FREIGHT INCLUDE COORDINATED SIGNALS AND LEFT-TURN PHASING TO INCLUDE PROTECTED-PERMITTED OPERATION.

Intersection and Lane Geometric Constraints

Due to their large size, trucks have unique needs at intersections and along roadways. The geometry of intersections, which includes the location of curbs, position of lanes, and proximity of objects outside the travel lanes such as poles and street trees, can be challenging for trucks executing turning movements. Wide turns through geometrically constrained intersections may include trucks crossing over road centerlines or mounting adjacent sidewalks or planting strips. Geometric constraints are a safety issue for all roadway users, and result in damage to sidewalks, planting strips, and signage.

Roadway lanes present a similar, but separate types of challenges for trucks. Narrow lanes (less than 12 feet in width) are challenging for trucks to navigate and result in slower speeds and encroachment into adjacent lanes. On-street parking along roadways with narrow lanes constrains available roadway width available for trucks. Signs and trees close to curbs may obstruct truck mirrors or vision for truck drivers. Regular maintenance can alleviate many of these issues, such as trimming and regularly pruning trees close to intersections at heights adequate for truck drivers.

Intersection Operations

The operations of an intersection are influenced by vehicle volumes, the peaking characteristics of traffic flows, and the number of heavy vehicles that travel through an intersection. Trucks have slower acceleration rates than smaller vehicles and require additional time to start from a red light or to traverse an intersection. As a result, signal timing plans that don't account for trucks can create bottlenecks or safety issues at intersections and along corridors with multiple signals.

Intersection operations are typically studied for an expected change in traffic conditions and in advance of any proposed changes to the lane configurations. Potential measures to better support freight mobility include:

- Adding yellow time at signals for trucks braking in advance of intersection.

AT-GRADE RAILROAD CROSSINGS CAN CREATE BLOCKAGES FOR STREETS CARRYING TRUCK TRAFFIC.

- Increasing left turn green times for trucks to complete the turn or add a protected-permitted phase
- Providing signal-interconnect and coordination set at a travel speed appropriate for truck traffic.

At-grade Railroad Crossings

At-grade railroad crossings pose safety issues and create delays for truck freight. Intersections with railroads may include several types of warning signs, gates or whistles, depending on the frequency of trains, amount of vehicle traffic, and location of the crossing. Truck delays are also influenced by the type and use of the rail lines, which determines the duration and frequency of crossing delays.

An inventory of at-grade railroad crossings was completed through comparison of Seattle GIS street and railroad shape files, review of aerial maps, and field verification. At-grade railroad crossings were primarily located on east-west streets in the Greater Duwamish MIC between SR 99 and I-5 and a concentration of crossings in close proximity to the interchange of SR 99 and Spokane Street Viaduct.

The impact on vehicular traffic of these at-grade railroad crossings depends on both the duration and frequency of train crossings as documented in the *Coal Train Traffic Impact Study*[19] for crossings in the Greater Duwamish MIC. Crossing times from this report are shown in table 3.1. Additionally, the type of crossing (mainline, tail or spur track) also affects the safety and delay of each crossing. Mainline crossings may close frequently throughout the day, while tail tracks could be occupied for long durations as longer

Table 3.1 At-Grade Rail Crossing Summary

Average Daily Totals (2012 weekday)	Greater Duwamish MIC		MIC connection
	Holgate Street	Lander Street	Broad Street
Train Crossings	107	87	52
Total Gate Down Time (hours)	3.6	3.7	2.8
Average Gate Down Time (min.)	2.0	2.5	3.3
Minimum/ Maximum Gate Down Time (min.)	0.3 – 8.2	0.5 – 8.1	1.1 – 11.6
Average Train Speed (mph)	7.4	8.1	6.7
Minimum/Maximum Train Speed (mph)	0.4 – 24.6	0.5 – 22.9	0.3 – 22.7
Observed gate closures AM Peak Period (6 – 9AM)	15	15	13
Observed gate closures PM Peak Period (3:30-6:30PM)	18	15	10

19 Coal Traffic Impact Study. Parametrix. 2012.

trains are being built. The introduction of LINK light rail on the SoDo Busway (5th Avenue South) also regularly blocks east-west traffic in the area. These delays are more frequent but have shorter duration due to the short length of LINK light rail vehicles.

The rail activity at the BNSF mainline rail crossings at S Holgate Street, S Lander Street, and S Broad Street blocked each roadway an average of 2.0 to 3.3 minutes per train. This equates to a total daily closure of 2.8 to 3.7 hours over a 24-hour period, and about 8.5 minutes during the PM peak hour.

Over-Height Restrictions

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. Major truck routes with over-height clearance of less than 14'0" were inventoried using Google Streetview, field verification and City data. Within the MICs there is only one height restriction located on Western Avenue at Bell Street.

Weight Restrictions

Bridge weight restrictions, like over-height restrictions, can decrease system efficiency by requiring trucks to take a circuitous route. A list of weight limited bridges on major trucks streets was developed based on a City-maintained list of bridges with posted vehicle weight restrictions and verified using Google Streetview. (Restrictions

OVER-HEIGHT NEEDS FOR TRUCKS MAY EXCEED RESTRICTIONS FOR OTHER ROADWAY USERS.

on non-legal loads were not captured in this review.) The structural condition of these bridges is discussed in a later section.

Hazardous Materials

The City of Seattle restricts the transport of hazardous materials on some routes to ensure public safety. Specifically, traffic code prohibits transport of hazardous materials through the SR 99 tunnel at all times. SDOT has posted signs to remind drivers that hazardous materials are restricted at all times in the SR 99 Battery Street Tunnel and on the Alaskan Way Viaduct during weekday peak travel periods. Weekday restrictions will continue on the Alaskan Way Viaduct between 7:00 and 9:00am and 4:00 to 6:00pm

Roadway Grades

Road segments with steep grades pose a challenge to heavy vehicles if they are required to stop and start on a steep grade or in traffic. Road segments with steep grades were identified using

WEIGHT RESTRICTIONS MAY REQUIRE OUT OF DIRECTION TRAVEL FOR OVER-LEGAL TRUCKS.

Seattle street centerline data. Within the project study area few road segments have steep grades although some routes to and from the project study area do have segments with steep grades. Table 3.2 identifies the ranges of street grades on Seattle streets and the uphill and downhill difficulties encountered for trucks.

Moveable Bridges

Moveable bridges open for waterway traffic, including waterborne freight, and are located on several of the major study roadways. Bridge lifts, when the roadway must close to open the bridge for boats to pass, may delay traffic for several minutes, potentially creating a bottleneck in the freight system.

Grade Percent (%)	Truck Uphill Grade Difficulty	Truck Downhill Grade Difficulty
3% - 5%	None to manageable	None to manageable
5% - 8%	Manageable to moderately difficult	Manageable to moderately difficult
8% - 12%	Difficult and not advised	Difficult and not advised
greater than 12%	Not advised; undesirable route	Not advised; undesirable route

Table 3.2 Roadway Grade Truck Difficulty Levels

Source: Freight Network: Seattle Arterials Street Grades. Seattle Department of Transportation. 2011.

The US Coast Guard controls the navigable waterways of the US, including those in the MIC. The movable bridges in the project are the Ballard Bridge and Fremont Bridge in the vicinity of the BINMIC, and the South Park Bridge, 1st Avenue S Bridge, and the Lower Spokane St. Swing Bridge in the Greater Duwamish MIC. Bridge openings along the Duwamish River are frequently needed by waterborne freight and other commercial traffic. Tidal influences make it difficult to adjust bridge openings to address roadway conditions without major impacts on waterborne freight. The opening of these bridges creates a mobility barrier for both truck freight and general vehicle traffic. Some of these bridges may open between

Moveable Bridges

Seattle operates three movable bridges over the Lake Washington Ship Canal: Ballard, Fremont and University Bridges. WSDOT operates the Montlake Bridge. Each of these bridges takes 3-4 minutes to open and close for boat traffic.

There are three movable bridges over the Duwamish River that are regulated by the US Coast Guard – Seattle's southwest Spokane Street Swing Bridge, WSDOT's First Avenue South (SR 99) Bridge and King County's South Park Bridge (operated by SDOT). These bridges can take up to 11 minutes to open and close.

PHOTO CREDIT: SDOT

10 and 20 times each day[20], and while peak hour restrictions may apply not all openings can be predicted.

In 2012, the Fremont Bridge had an average of 16.6 vessels per day and an average of 14.8 bridge openings. The Ballard Bridge had an average of 14.6 vessels per day and an average of 11.6 bridge openings. From September 2008 to September 2009, the 1st Avenue S Bridge opened an average of 105 times per month. The South Park Bridge reopened in the summer of 2014. Prior to completion of the new bridge, the bridge had between 26 and 95 openings per month for marine vessels. The Lower Spokane Street swing bridge averages 150-200 openings per month.

Port/Rail Yard Operations and Security Requirements

Port and rail yard operations and security requirements determine the times during the day and the rate at which trucks enter terminals and yards. Table 3.3 provides access locations for the four major container terminals at the Port of Seattle. Currently, the railyards are open 24 hours a day, 7 days a week.

Table 3.3 Summary of Major Container Terminals at the Port of Seattle

Terminal	Access Point
T-5	W Marginal Way SW
T-18	SW Spokane St
T-25/30	E Marginal Way
T-46	Alaskan Way

Container terminal hours of operation vary to meet needs. Terminals add hoot-shifts (3-7am) on busy days or work on weekends to manage volume fluctuations. The typical pattern is for trucks to arrive before the gates open in the morning to get the earliest possible start. The busiest days are usually around large vessel arrivals as trucks are bringing goods to load and trucks discharge the imported containers. On occasions when terminal issues have slowed truck processing, it is possible for truck queues to overflow the holding area and extend onto access streets. The terminals all have substantial holding areas for trucks waiting for gate clearance and terminal operators will balance labor resources in the yard to enable it to function efficiently, and that also balances truck trips.

Figure 3.15 to Figure 3.17 show the mobility constraints that are currently identified in the study area. A list describing all of these mobility locations is provided in Table 3.4.

20 Ballard and Fremont Bridge Opening Analysis. SDOT 2012.

Table 3.4 Current Mobility Constraints

Mobility Constraint	Location
Geometric Constraints G	W Dravus Street / 15th Avenue Intersection
	15th Avenue NW / NW Market Street Intersection
	15th Avenue W / Emerson Street Intersection Improvement
	16th Avenue S / E Marginal Way S Intersection
	Airport Way S / Edmunds Street Intersection
	E Marginal Way S / Corson Street Intersection
	I-5 Ramps at S Corson Avenue / S Michigan Street
	I-5 Ramps at S Corson Avenue / S Michigan Street
	S Cloverdale on-ramp to SR 99
	S Dallas Street / 14th Avenue S Intersection
	S Michigan Street / S Bailey Street Intersection
Intersection Operations S	Airport Way S / Edmunds Street Intersection
	NW Leary Way Signal
	Terminal 46 New Signal & Intersection Improvements
	intersection at West Marginal Way / Chelan Street
	14th Avenue S
	E Marginal, Way, 8th Avenue / Myrtle Street
	Harrison Street between Queen Ann / 1st.
	1st Avenue S / Atlantic Street
	5th Avenue NE Signal
	Aurora Avenue N / 95th Street Signal
	NE Northgate Way Signal Optimization
	3rd Avenue NE Signalization
	8th Avenue NE Signal
	Airport Way S / Edmunds Street Intersection
	Meridian Avenue N Signal
	NW Leary Way Signal
	Terminal 46 New Signal & Intersection Improvements
Height Restriction	Western Avenue / Bell Street
T **Weight Restriction**	Airport Way overpass over Argo Yard
Moveable Bridges	15th Avenue Bridge (near Ballard)
	16th Avenue S Bridge (across Greater Duwamish)
	1st Avenue S Bridge (across Greater Duwamish)
	S Spokane Street (across Greater Duwamish)
	Fremont Avenue Bridge (across Lake Union)
At-Grade Rail Crossings (Mainline)	S Lander Street. (between 1st Avenue and 4th Avenue)
	S Holgate Street (between 1st Avenue and 4th Avenue)
	S Horton Street (between 1st Avenue and 4th Avenue)
	Lower Spokane (between 1st Avenue and 4th Avenue)
	Broad Street / Alaskan Way

Spur crossings and steep slopes are shown on the following maps.

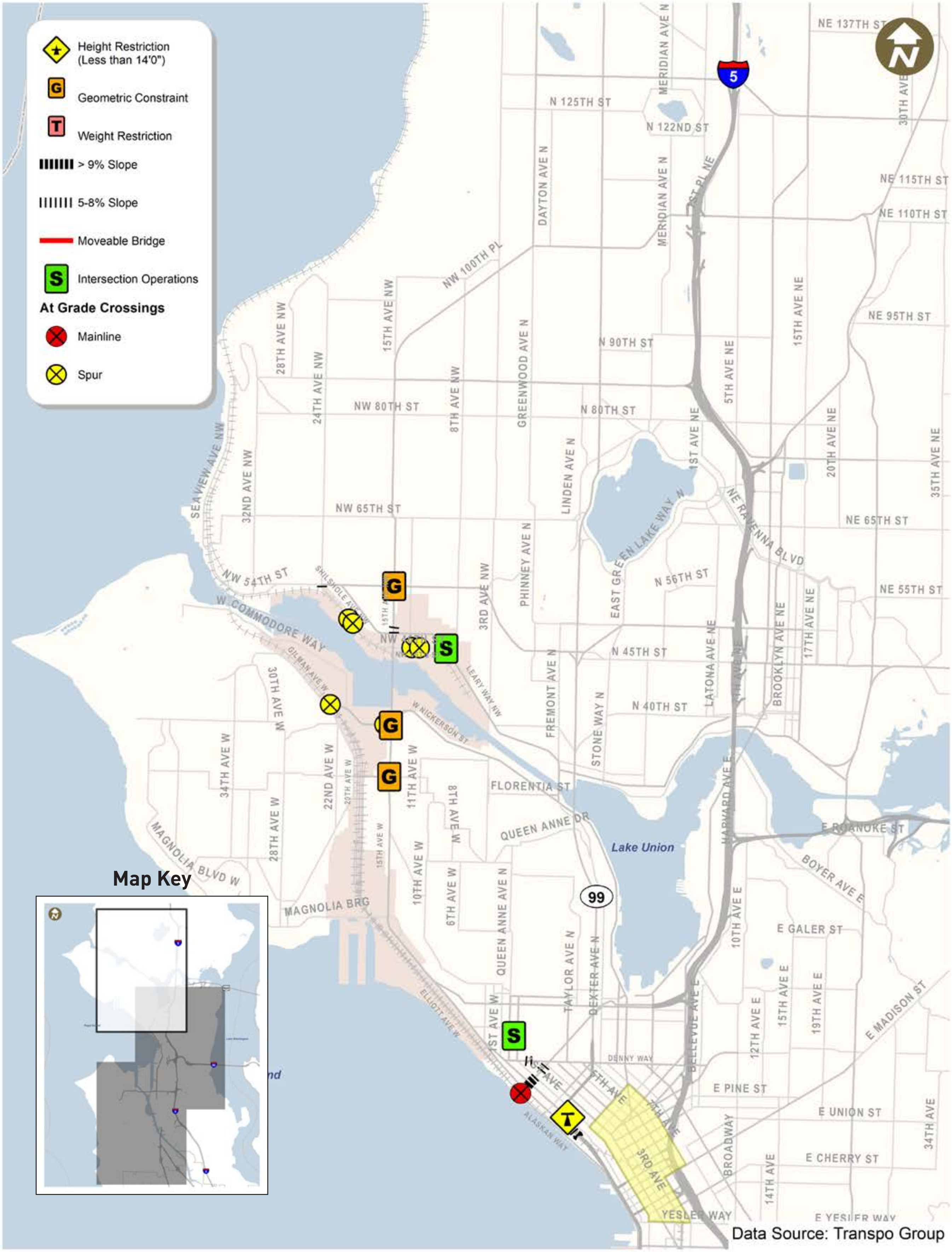


Figure 3.15 Existing Mobility Constraints – North Section

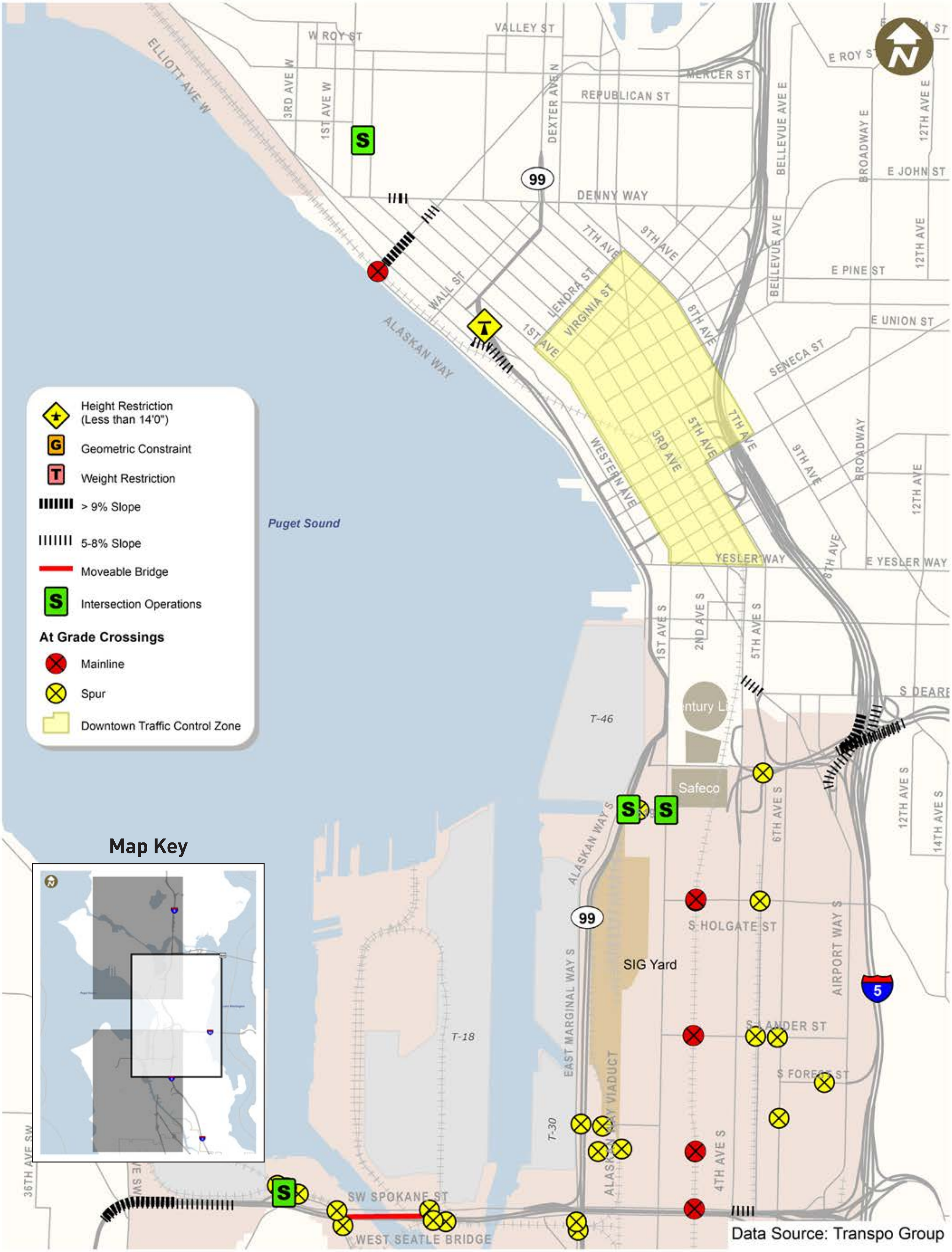


Figure 3.16 Existing Mobility Constraints – Central Section

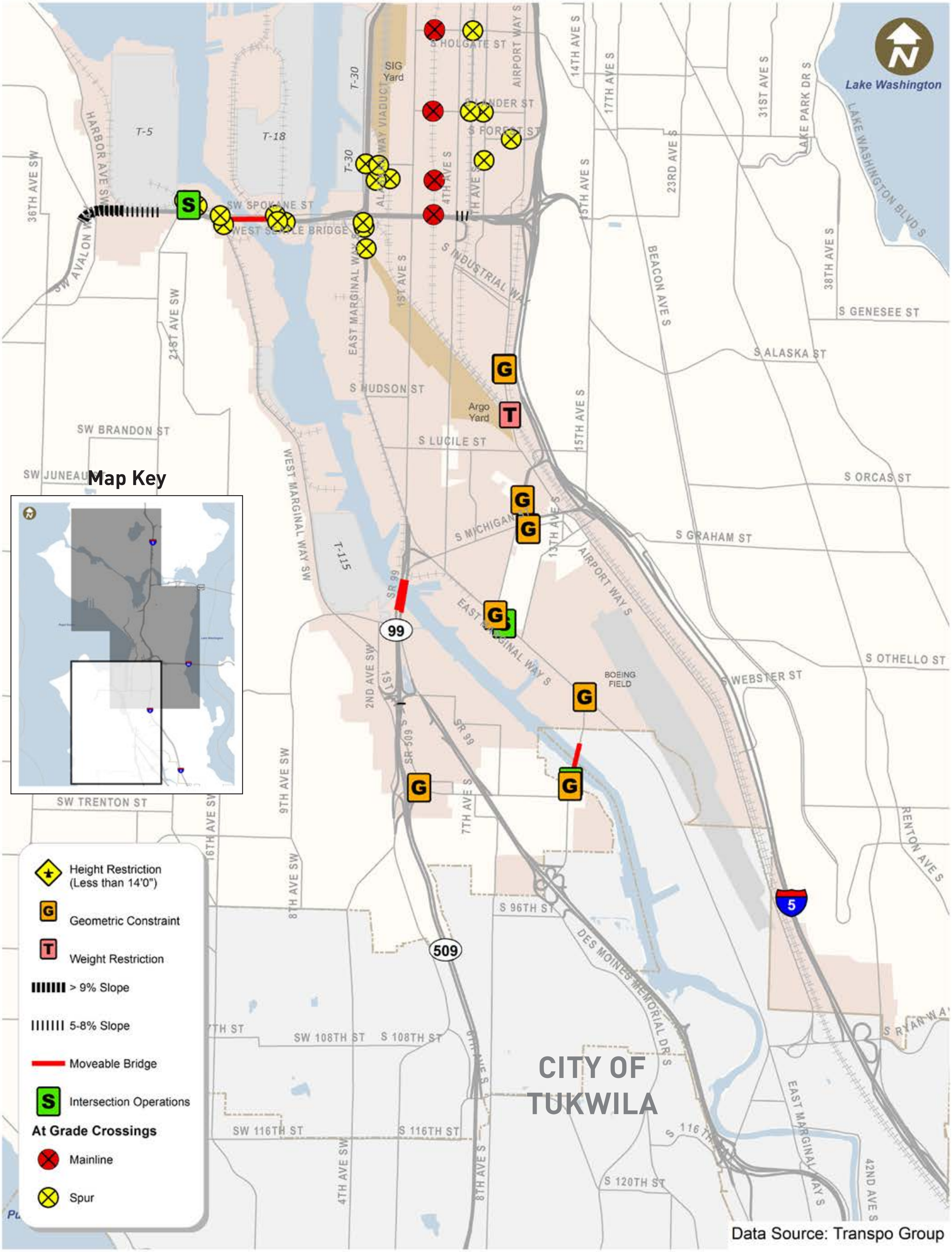


Figure 3.17 Existing Mobility Constraints – South Section

3.3.5 Pavement and Bridge Conditions

Freight system condition measures provide information about the physical condition of freight transportation infrastructure, and can help inform system maintenance and preservation programs. Additionally, accounting for both pavement and bridge condition is a reporting requirement of *Moving Ahead for Progress in the 21st Century* (MAP-21). Most of the recommended freight condition performance measures for the highway system use data from well-established sources. NCFRP Report 10 *Performance Measures for Freight Transportation*[21] proposes several freight system condition measures, including monitoring National Highway System (NHS) pavement condition and NHS bridge conditions.

Pavement Condition Assessment

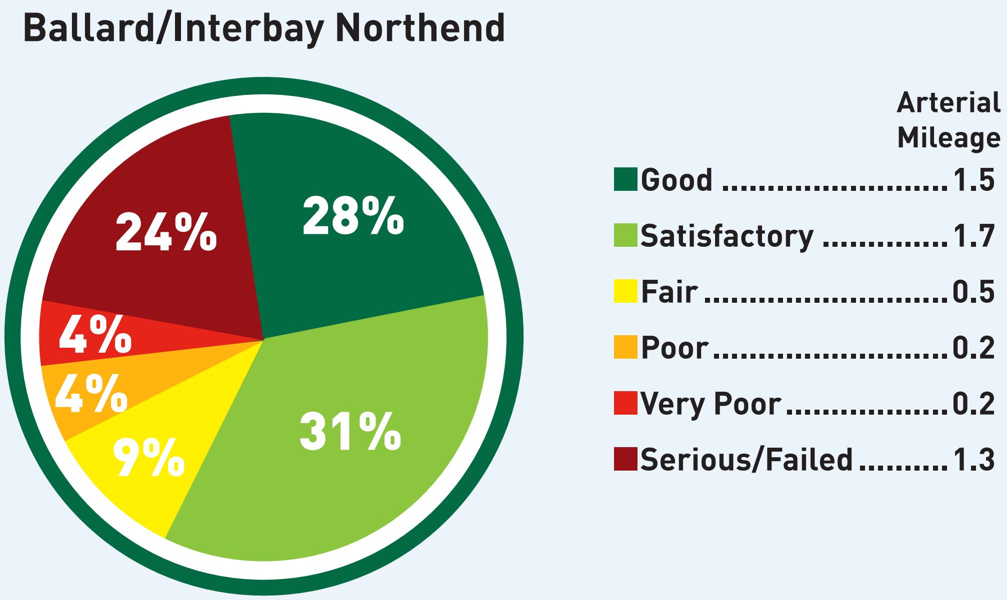
Keeping roadway pavement in a state of good repair decreases the risk of damage to trucks and cargo, and helps ensure a high level of service for freight. It is important to track this measure on critical freight routes including truck routes, intermodal connectors, and other "last mile" road segments.

The number of arterial roadway miles in good repair is maintained in the City Graphical Information System (GIS) database. The pavement condition rating for roadways is based on a 100-point scale, with excellent streets rated at 100 and failed streets rated at 0. This allows for better identification and tracking of the number of streets that only need minor repairs to maintain their high rating, the number of streets that are approaching their life expectancy and are in need of some type of resurfacing, and those streets that are past their life expectancy and are in need of substantial repair prior to resurfacing.

PAVEMENT RUTTING AND CRACKING ON A STUDY ROADWAY IN THE GREATER DUWAMISH MIC

This Freight Access Project largely addresses arterial roadways; however some local streets with high truck volumes may also have very poor pavement conditions, though these streets are not currently being rated and mapped. As shown in Figure 3.18, there is a similar distribution of pavement index ratings for both MICs. The Greater Duwamish MIC has a higher number of roadway miles than BINMIC also highlighted in Figure 3.18. The breakdown of pavement conditions for the study area arterial streets are shown in Figures 3.19 to 3.21.

21 NCFRP Report 10 Performance Measures for Freight Transportation, Research Board, 2011



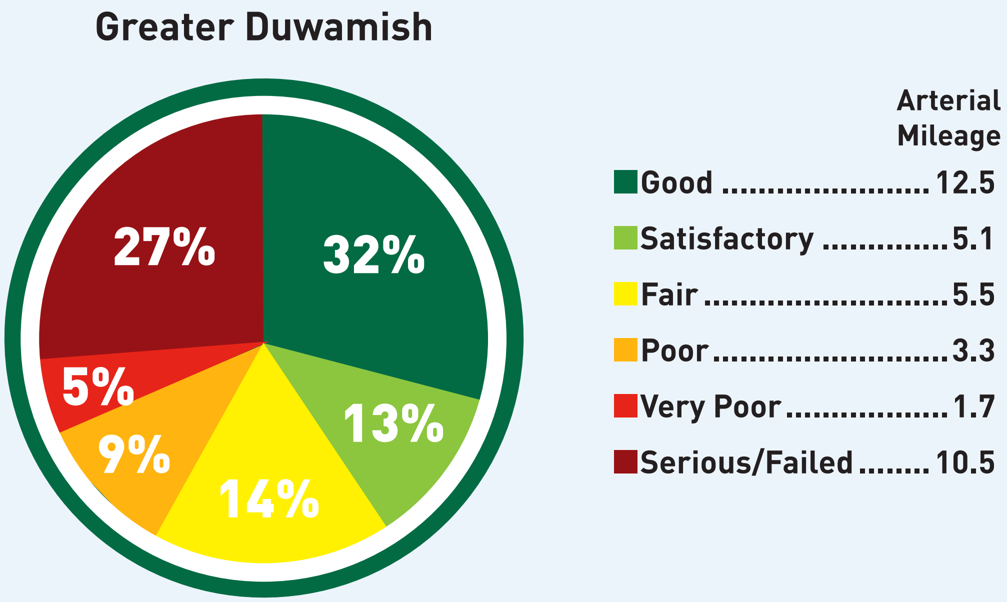


Figure 3.18 Breakdown of Arterial Pavement Conditions – Study Area Roadways (Source City of Seattle)

The best rated pavement categories (good and satisfactory) account for 59 percent of all pavement within the BINMIC while these categories account for only 45 percent of pavement in the Greater Duwamish MIC. Similarly, the worst rated categories (very poor and serious/failed) account for 28 percent of pavement in the BINMIC, while making up 31 percent in the Greater Duwamish MIC. This demonstrates that, generally speaking, the pavement is in better condition in the BINMIC than the Greater Duwamish MIC.

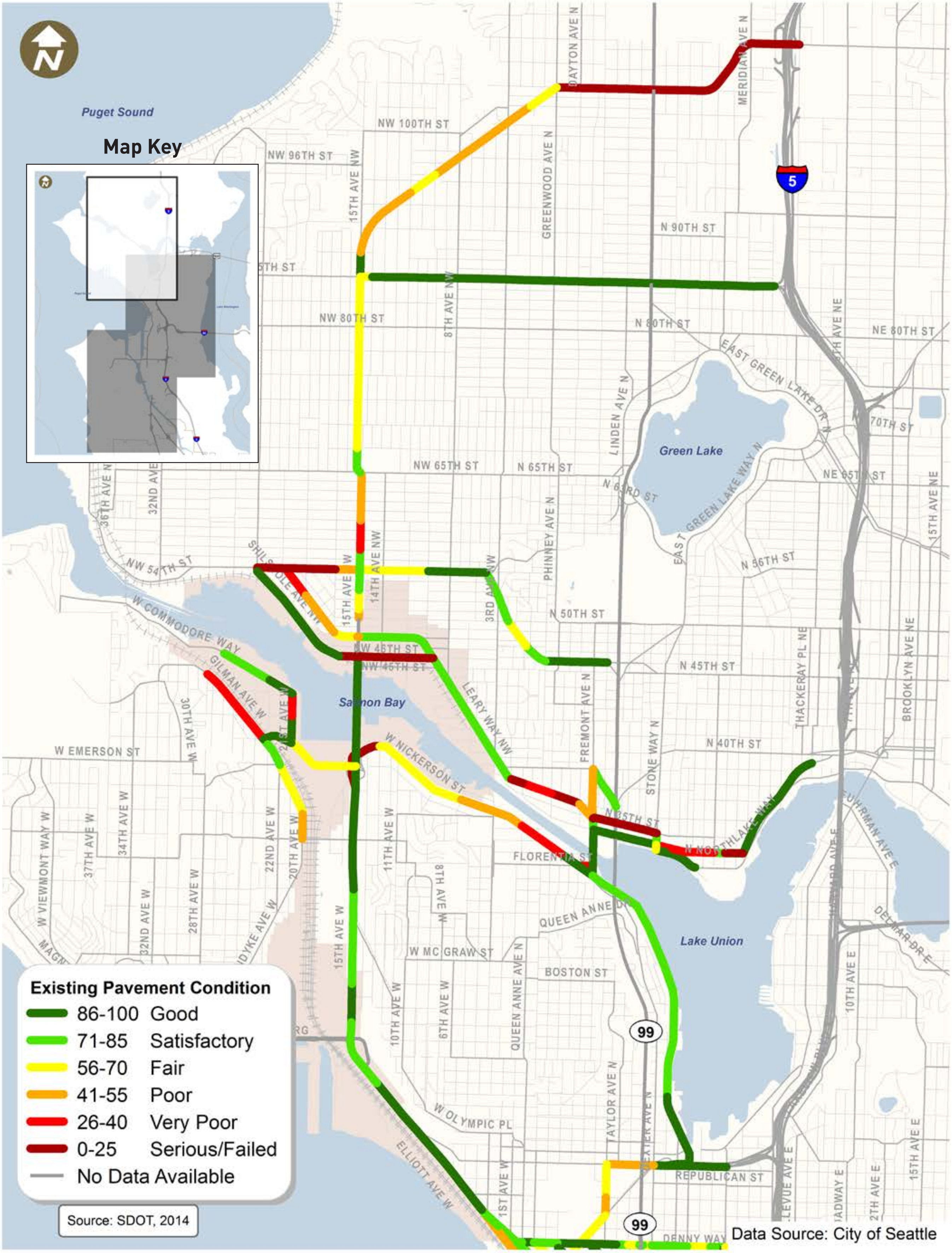


Figure 3.19 Pavement Conditions – North Section

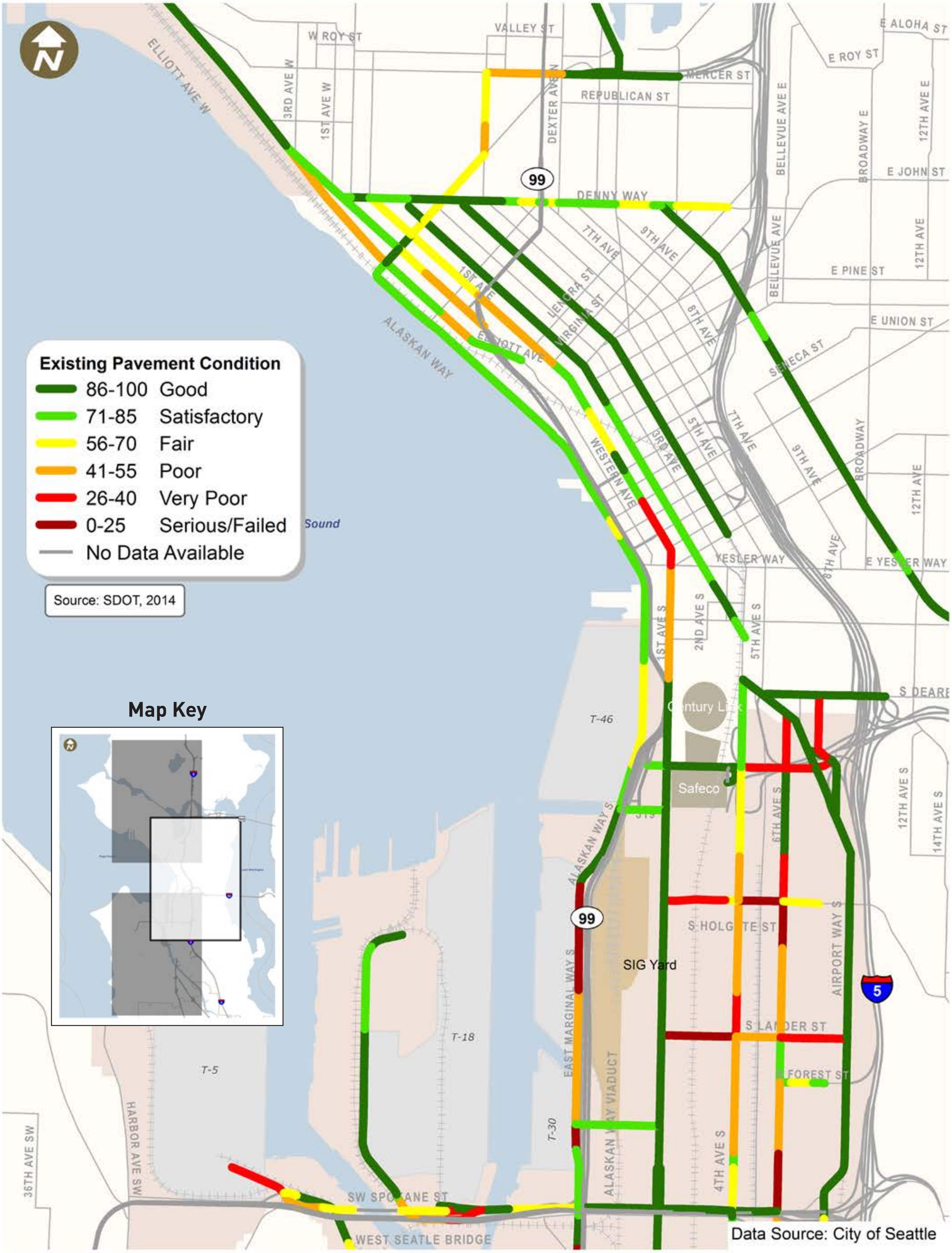


Figure 3.20 Pavement Conditions – Central Section

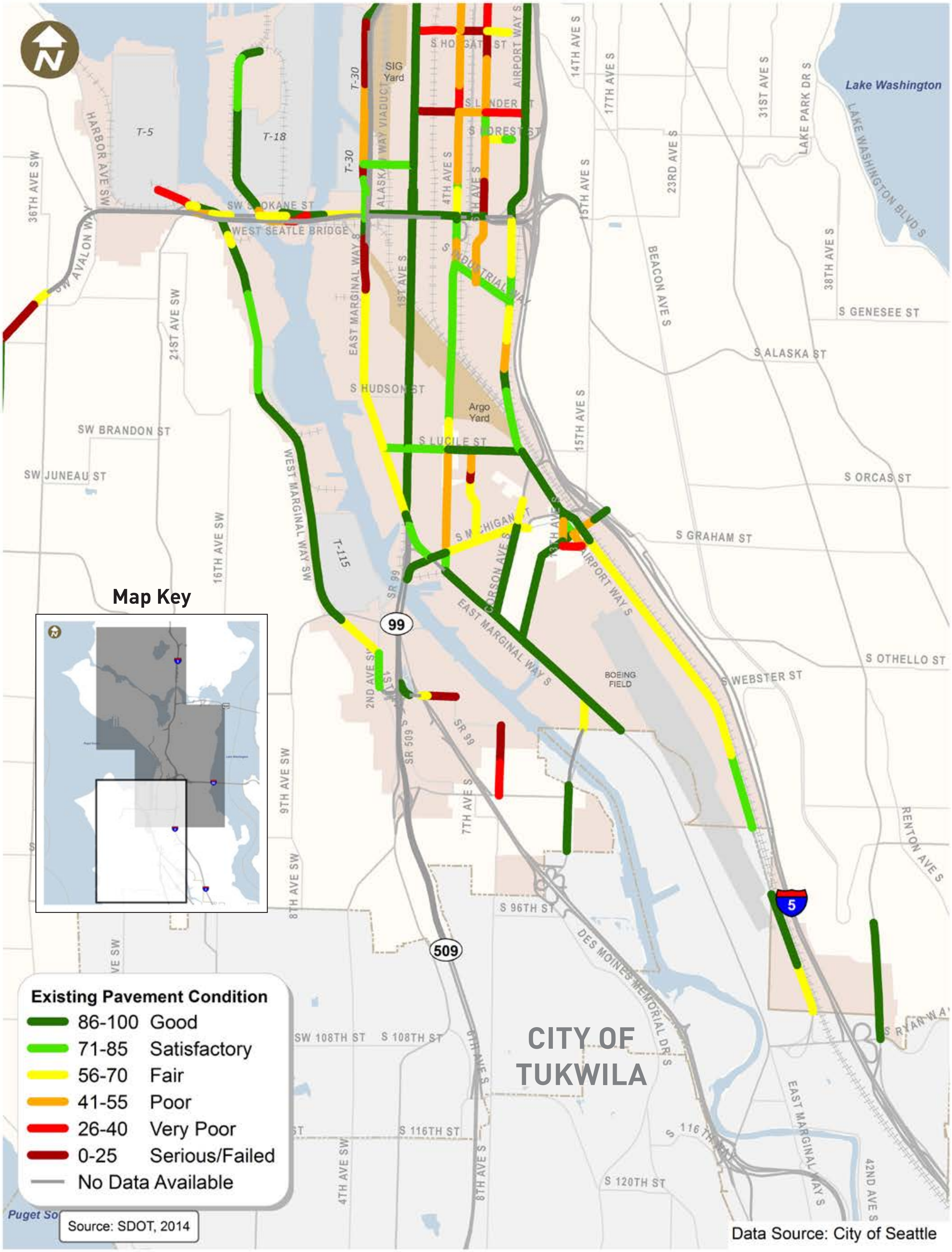


Figure 3.21 Pavement Conditions – South Section

Bridge Conditions

Bridges provide key connections for freight movements in the City of Seattle, allowing for trucks and other modes to cross the railroad tracks and waterways that exist within and connecting to the MICs. Bridges that open are called "moveable bridges" and create a unique set of challenges for freight reliability and movement. Moveable bridges may open at various times during the day to allow commercial boats to pass, creating a conflict between two different freight modes. Bridges in the project area include the Ballard and Fremont Bridges in the vicinity of the BINMIC, and the South Park Bridge, SR 99/1st Avenue South Bridge, and Spokane Street Swing Bridge in the Greater Duwamish MIC.

The City of Seattle's Roadway Structures Division has developed infrastructure standards related to structural condition of bridges within and connecting the MICs. Two categories were developed for the purposes of evaluating the existing condition of bridges[22]:

22 More information can be found at the SDOT freight mobility web page at: www.seattle.gov/transportation/freight.htm.

Bridges with Weight Restrictions

The legal maximum gross vehicle weight for truck and cargo in City of Seattle is 80,000 pounds, which applies to both trucks and their cargo. This information is posted on-line for trip planning purposes, as well as signs posted on the approaches to the structures to warn truck drivers. The existing bridges with weight restrictions in the City of Seattle within the MICs are listed below.

- Magnolia Bridge, Pier 91 Ramps
    - Center ramps to Port of Seattle on Magnolia Bridge
    - No trucks allowed
- Airport Way South Bridge over the Union Pacific Railroad (UP) Argo Yard
    - Airport Way South over the UP Argo Yard
    - Legal truck loads only, no overloads

Other bridges not in the MICs with weight restrictions are noted below:

- Southbound Fairview Avenue North Bridge
    - Fairview Avenue North between East Galer Street and East Prospect Street
    - Weight limit is 40 tons
- Post Alley
    - Post Alley between Columbia Street and Marion Street
    - Weight limit is limited to a two axle single unit truck, not to exceed 19 tons

Bridges Identified for Rehabilitation

The City also maintains a list of structures that have been identified as being desirable candidates for rehabilitation or other major improvements. These structures were built in the last century, and will eventually reach their useful service life. If future funds are not available for bridge replacement or rebuilding, truck weight and size restrictions may have to be posted in the future. Other bridges identified for rehabilitation include structures that are currently under construction, like the SR 99 structure over Mercer Street or will be rebuilt as part of the Alaskan Way Viaduct Project.

3.3.6 Modal Integration

Movement of both people and goods on the transportation system results in competing needs for a range of modes. The increasing urbanization of the City has resulted in reallocating space for transit, bicycles, and pedestrians within constrained right-of-ways with finite infrastructure. The City of Seattle has already implemented projects to reconfigure roadways on Nickerson Street (a Major Truck Street) and Stone Way to improve pedestrian safety and provide dedicated bicycle facilities[23] following guidance in the City's Complete Streets Ordinance (#122386).

The Seattle Department of Transportation (SDOT) will implement Complete Streets policy by designing, operating and maintaining the transportation network to improve travel conditions for bicyclists, pedestrians, transit and freight in a manner consistent with, and supportive of, the surrounding community.

23 As documented in the Nickerson Street Rechannelization Before and After Report and Stone Way N Rechannelization: Before and After Study (May 2010) by the City of Seattle.


PHOTO CREDIT: SDOT

"Freight will be the major priority on streets classified as Major Truck Streets. Complete Street improvements that are consistent with freight mobility but also support other modes may be considered on these streets."

The City is monitoring the performance of Complete Streets. The City is currently developing a multimodal corridors program as the next generation of complete streets. The Multimodal Corridor Program will focus on transforming a street or combination of streets into safer and healthier public spaces with predictable movement of people and goods with safety being the highest priority.

The available national guidance for providing safe, efficient infrastructure for freight vehicles sharing the transportation network with transit and non-motorized users generally promotes separation. However, as freight patterns change to accommodate future trends there will be an increasing need for delivery vehicles and other trucks to share roadways with other modes.

Locally, the Greater Duwamish Transportation Management Association (TMA) has attempted to developed recommendations for infrastructure and programmatic improvements[24]. In addition, the Freight Master Plan is addressing policies and programs related to design standards and roadway hierarchy as related to freight.

A multimodal system can include complementary benefits for competing modes in many situations, but this is not always the case. Individual modal plans[25] consider the needs and priorities of that particular mode, and therefore particular attention should be paid where multiple modes have been prioritized on the same street. Figures 3.22 to 3.24 show the locations of overlapping modal priorities contained in these modal plans to identify where transit, pedestrians, or cycling facilities are already present or have been prioritized by other planning work. The following sections discuss each of these modal overlaps in greater detail.

Transit

Transit streets identified in the Transit Master Plan as Transit Priority Corridors were used to compare locations that overlapped with Major Truck Streets. Transit service improvements may impact freight movements by dedicating a travel lane for bus or rail transit. Siting of stops and stations in locations where pedestrians and bicycles share the right-of-way with trucks may create bottlenecks for trucks when transit vehicles are stopped in the travel lane to pick up or discharge passengers. On the other hand better transit service may reduce auto demand and vehicle congestion thereby improving travel conditions for trucks.

Additionally, streets with existing and proposed Link Light Rail and Seattle Streetcar service were identified. Streetcars often share similar operating characteristics with buses. As compared to other modes included in this analysis across the City, the potential overlap with transit represented the highest proportion of the overall overlap.

Bicycle

The Bicycle Master Plan's guiding principle is to develop a bicycle network that facilitates travel to key destinations and provides substantial biking opportunities for all ages and abilities.

Streets with existing or proposed bicycle facilities, along with planned facilities in the Bicycle Master Plan were used to compare overlaps with Major Truck Streets. Bicycle facilities may

24 The Greater Duwamish TMA has provided recommendations in the Workable SoDo (November 2013) and Street Smart Study available at: www.Greater Duwamishtma.org/street-smart-study/

25 Including the Seattle Pedestrian Master Plan (September 2009), Transit Master Plan (April 2012), and Bicycle Master Plan (April 2014).

reduce available roadway space for other modes or include shared-lane markings that promote bicycle use in the same lane as freight and other vehicles. Cyclists generally travel at slower speeds than other vehicles outside of the CBD and therefore impact the average speed and operations of vehicles on those roadways.

Streets with parallel or crossing bicycle paths should be a consideration if that path crosses access points or intersections frequently used by freight traffic. Stakeholders noted that corridors with overlapping priorities for freight and bikes were the most challenging, especially where modes operated in the same space without separation. Corridors identified as having both freight and pedestrian priorities include East Marginal Way, Lower Spokane Street, Airport Way, and 6th Avenue in the Greater Duwamish MIC, the Nickerson/Westlake Avenue corridor, Dearborn Way, Elliott Avenue, and Alaskan Way.

Pedestrian

City of Seattle policy as articulated in the Pedestrian Master Plan calls for ensuring safe pedestrian travel on all city streets.

Pedestrian overlay zones, including Urban Centers, Hub Urban Villages, and Residential Urban Villages, as identified in the Seattle's Comprehensive Plan were used to compare overlaps with Major Truck Streets. High pedestrian demand is generally localized near the CBD, the Stadium District, and higher-density neighborhoods adjacent to the BINMIC.

As compared to bicycle and transit modes, pedestrian demand had fewer modal overlaps. However, as pedestrian activity increases in certain areas of the city, this modal overlap could become a larger issue. In particular, Alaskan Way serves as a connector between the two MICs, and that role is more important with the bored tunnel configuration replacing the Viaduct. Thus, the development of the Central Waterfront could create a higher potential for conflicts between truck traffic and pedestrians crossing Alaskan Way.

Events at the stadiums with high pedestrian volumes result in closures of major truck corridors including Royal Brougham Way and Atlantic Street/Edgar Martinez Drive.

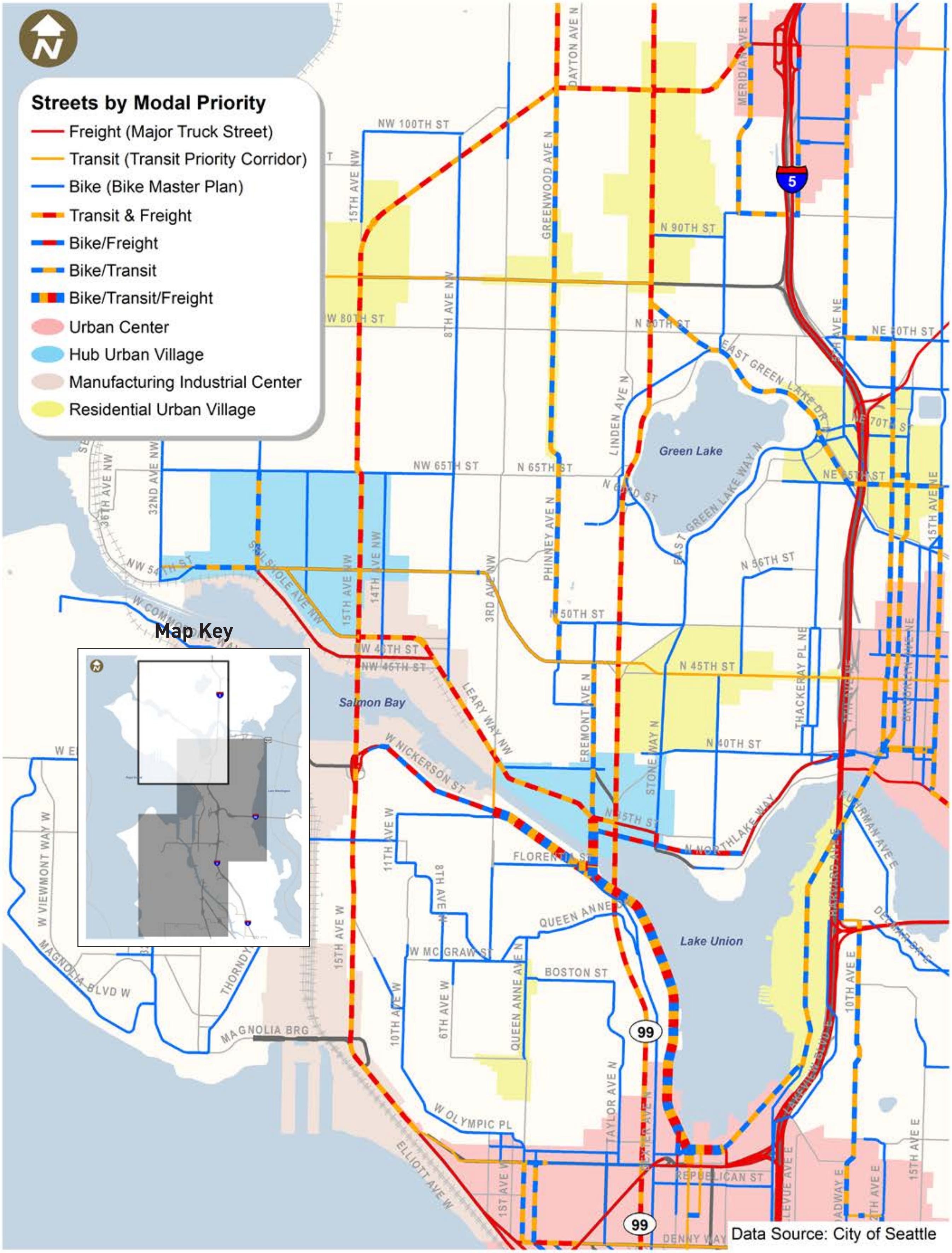


Figure 3.22 Modal Overlap – North Section

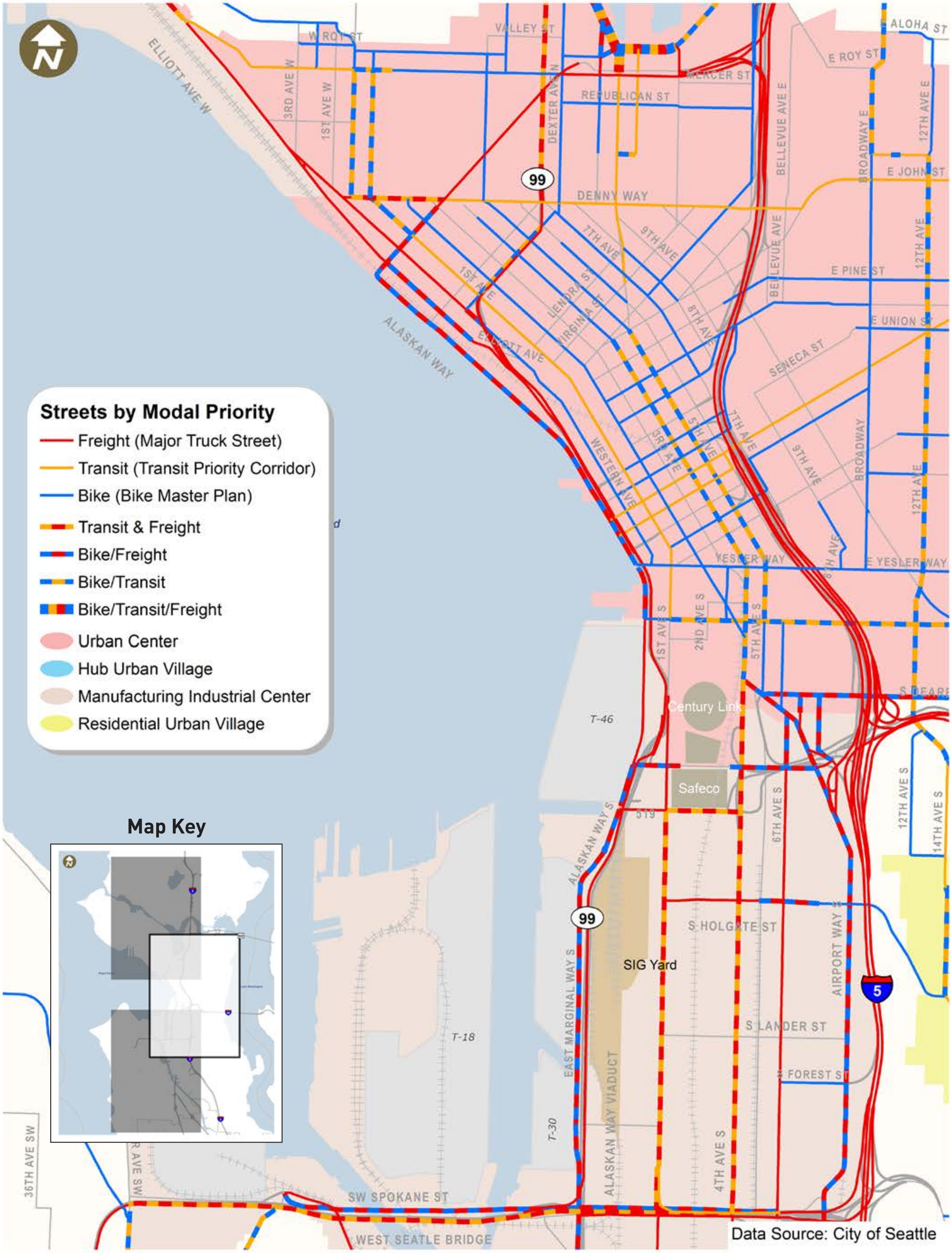


Figure 3.23 Modal Overlap – Central Section

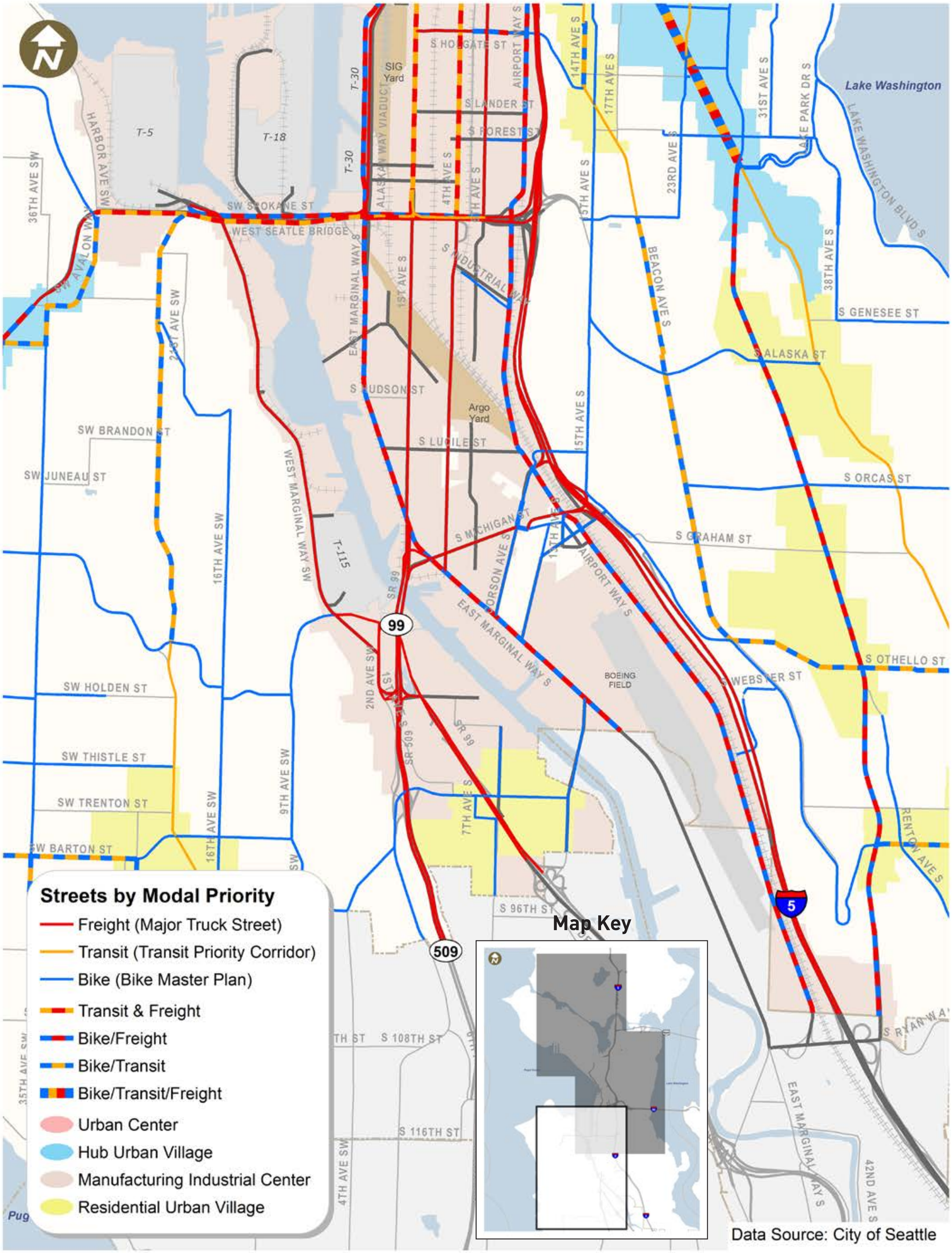


Figure 3.24 Modal Overlap – South Section

3.4 Rail Operations

For truck-borne freight, growth in rail traffic means that constraints at rail crossings will increase. This section describes the current rail operations affecting the MICs.

On a tonnage basis, half of all rail traffic with a Washington destination in 2010 came from out of state.

Commodity flows in the central Puget Sound move primarily through the ports of Seattle, Tacoma and Everett. Together, the ports of Seattle and Tacoma constitute the third largest container hub in North America with an estimated 60-70% moved by rail[26]. Rail freight volume has grown dramatically (81% growth in volume between 1991 and 2010) and is expected to continue to grow. A detailed summary of BNSF mainline rail traffic, including existing rail traffic observations, within the SoDo neighborhood is presented within the *Coal Traffic Impact Study*[27]. Within SoDo, between 65 and 85 rail movements occur each weekday at the BNSF mainline at-grade rail crossings with trains traveling at average speeds of approximately six to eight mph. Table 3.1 summarizes the average number and duration of train crossings at three of the at-grade mainline crossings in the Greater Duwamish MIC and connecting corridors.

Main line passenger rail service in the Puget Sound region is provided by Amtrak and Sound Transit. Amtrak is a federally chartered corporation that operates all intercity train services in the United States. In Seattle, Amtrak's service consists of Amtrak Cascades, and two long distance trains, the Empire Builder and Coast Starlight:

- Amtrak Cascades is a multiple frequency corridor service between Vancouver BC, Seattle, Portland, and Eugene, Oregon, that is administered and financially supported by Washington State DOT and Oregon DOT, in partnership with Amtrak.
- The Empire Builder operates daily along a northern route between Seattle, Spokane, Fargo ND, Minneapolis-St. Paul, and Chicago.

26 Economic Evaluation of Regional Impacts for the Proposed Gateway Pacific Terminal at Cherry Point, PSRC, 2014
27 Coal Traffic Impact Study. Parametrix. 2012.

- The Coast Starlight travels a route along the I-5 corridor between Seattle, Portland OR, Oakland CA, and Los Angeles, also on a daily basis.

The Empire Builder and Coast Starlight are national system trains, and thus are wholly managed and funded by Amtrak and the Federal Government.

Commuter rail service in the Seattle region is provided by Sound Transit and operated through a contract with BNSF and Amtrak, with the former providing operating personnel and the latter maintaining the equipment. Ten round trips are currently being provided on weekdays between Lakewood and Seattle, while four round trips are offered between Seattle and Everett.

4 FORECAST CONDITIONS

Chapter 4 builds on the analysis of existing conditions presented in Chapter 3. It provides forecasts of traffic volumes and speeds on the same network of City streets. The analysis of future traffic conditions uses 2035 conditions as the forecast horizon, making it compatible with existing national, state and regional planning and forecasting efforts. Future public investment decisions will be made by participating agencies during the 20-year time horizon.

Future conditions are reported to address the same performance measures as existing conditions, including an evaluation of Mobility, Safety, and Connectivity.

The forecast conditions, presented below, are based on assumptions of future employment, population, economic growth, and future demand for the movement of freight generated by growth that are consistent with those of related planning efforts. In addition, the analysis also accounts for projected changes in transportation infrastructure and the way that infrastructure will be operated.

The forecasting process followed these general steps:

Review population, employment & economic growth
- Population
- Freight related employment
- Regional economic productivity

Review freight related trends
- Federal Freight Forecasts

Review future regional infrastructure improvements
- Within the MICs
- Regional connections between MICs

Apply Models
- Regional PSRC Model
- Refined Port Movement Model (CTAS)
- Review at Screenlines

Results
- Volumes
- Speed

PERFORMANCE MEASURES

Mobility
- General traffic
- Truck volumes
- Speeds & congestion
- Reliability

Safety
- Truck collision history

Connectivity
- Access constraints (including over-legal limitations)
- Railroad crossings and bridge openings that cause delays
- Ease of movement (roadway geometric design to support trucks)

4.1 Population, Employment and Economic Growth

To develop traffic forecasts for this project, our team reviewed the available data from the regional Metropolitan Planning Organization (MPO), Puget Sound Regional Council (PSRC) including:

1. Overall growth including estimates of population and employment data;
2. Estimates of employment growth specifically in the goods movement (freight related) sectors; and
3. Overall economic trends.

To further refine and ground-truth estimates of growth, the analysis also looked at national trends in freight movement (Section 4.2).

4.1.1 Population Growth

PSRC estimates 5 million people will live in the region by 2040. The strategy for accommodating the nearly 1.5 million new residents is contained in PSRC's VISION 2040, a long-range plan for maintaining a healthy region and promoting the well-being of people and communities. The population forecasts projected by PSRC are a key input for the PSRC Travel Demand Forecast Model[1] that estimates travel patterns throughout the region. Outputs from that model were used to estimate the number of passenger vehicles on roadways introduced in Chapter 3 (described in section 4.4.1). Truck travel patterns contained in the model were also used to distribute non-port and port truck trips onto the roadway system (described in sections 4.4.2 and 4.4.3).

1 www.psrc.org/data/forecasts/travel-demand-forecast/


PHOTO CREDIT: WSDOT

Consistent with regional planning goals and geographical designations such as the MICs, jobs in the goods movement (freight related) sectors in Seattle's MICs are anticipated to grow by 70%, compared to 57% for other jobs. Jobs in goods movement in the MICs are also projected to grow at a greater rate than those same sectors in non-MIC areas of the City and the region. Figure 4.1 shows the growth anticipated for the City's MICs as compared to the City of Seattle and PSRC region.

4.1.2 Employment

As shown in Figure 4.1, the share of total employment of goods movement dependent industries in the BINMIC and Greater Duwamish MIC is larger than that in the City and the PSRC region. Further, employment in these industries is expected to grow in the MICs as well as the City and the PSRC region, but the share of total employment of goods movement dependent industries is increasing in the MICs where as it is decreasing in the region.

2 Transportation 2040; Toward a Sustainable Transportation System. Appendix J Regional Freight Strategy, PSRC, Updated 2014

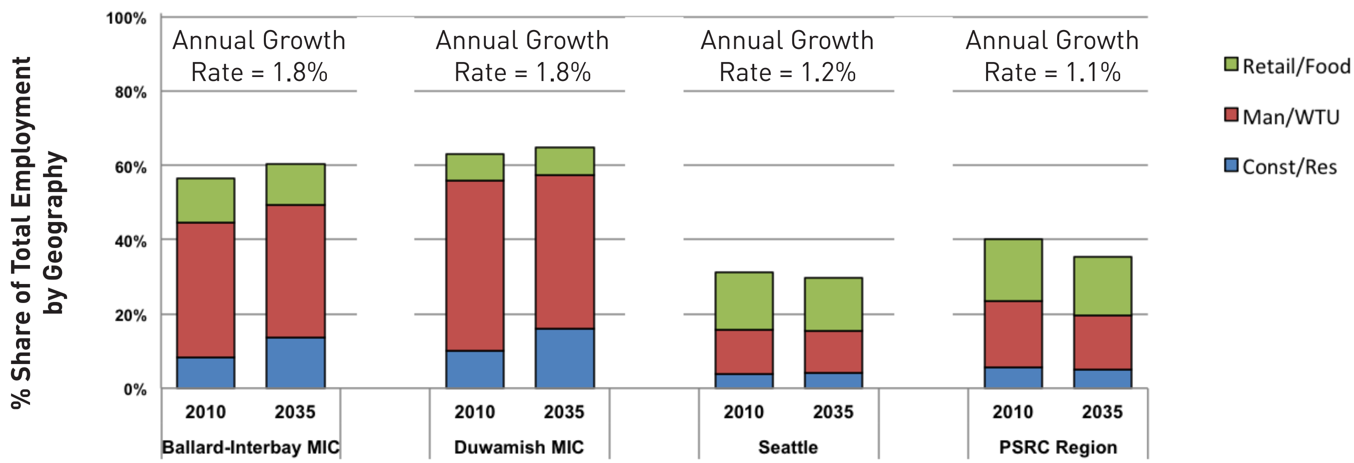


Figure 4.1 Goods movement dependent industry growth[3]

Goods movement industry jobs are expected to grow at a rate of 1.8% per year in each of the MICs as compared to 1.2% in the remainder of Seattle and 1.1% per year in the remainder of the Puget Sound region. As a result, of all growth in goods movement related jobs in the City, almost half (44%) is expected to be located in the MICs.

4.1.3 Regional Productivity

Productivity, or economic output of the region, is anticipated to increase along with forecast growth in population and employment. Population and employment will continue to grow at a steady pace, or about 25% by 2035, which is the study's horizon year. By 2040, the region will grow to 5 million in population and 3.1 million jobs. More manufacturing of goods will require transport to get these goods to market and employees to jobs to support new industries, offer opportunities, and attract new workers. To support domestic and international growth, regional (four county) truck tonnage is expected to increase from 213 million tons to 366 million tons, representing a 72% growth, between 2010 and 2035[4]. This rate of growth far exceeds both population and employment growth for the region but supports aggressive estimates of freight activity. This is consistent with national forecasts, which project a 27% increase in tons for every resident of the U.S., from 55 tons per capita in 2005 to 70 tons in 2040[5].

3 Employment Forecasts, PSRC 2010.

4 Transportation 2040; Toward a Sustainable Transportation System. Appendix J Regional Freight Strategy, PSRC, Updated 2014
5 Freight Analysis Framework, FHWA 2010.

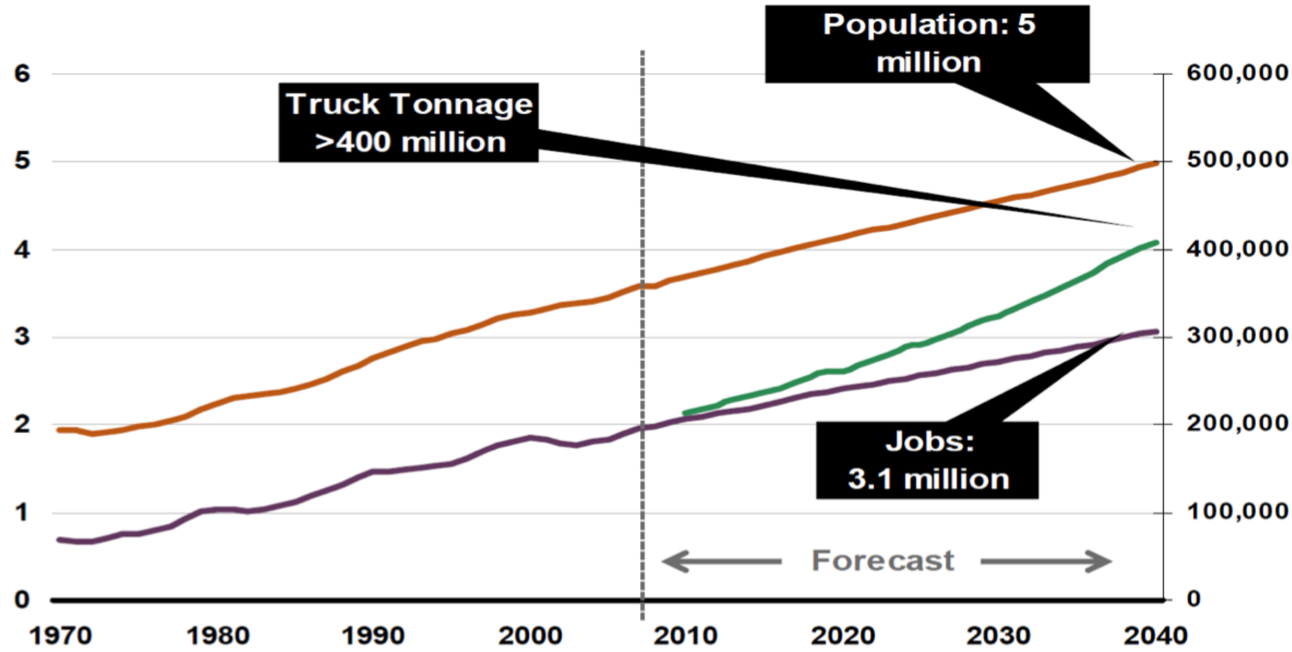


Figure 4.2 Regional Growth Estimates[6]

4.2 Freight Trends

In addition to changes in the region's population, employment, and economy, freight trends are influenced by changes to the national economy, changes to manufacturing and industrial activities within the MICs, Port activity, and related rail activity. This section describes the importance of each of these components and the impact they will have on corridor forecasts for the roadways within and connecting Seattle's MICs.

4.2.1 National Trends in Regional Trucking

General freight trucking (e.g. merchandise, foods, parcels, industrial goods) is expected to grow significantly faster than bulk trucking (e.g. aggregates, cement, fuels) across the nation. This difference is due (in part) to faster growth in the consumer sector and to the increase in on-line shopping (which replaces traditional customer pickup at stores with parcel delivery to homes and offices).

The American Trucking Association (ATA) trucking volume forecasts (2013-2024) are the most recent national data source for tracking national trends in regional trucking available for the US. The key feature of this forecast is the more robust near-term growth (averaging 3.0% per year in 2013-2018) followed by slower mid-term growth (averaging 1.0% in 2019-2024)[7].

This shows that the nationwide estimates of growth between 1.5% and 2% per year are consistent with PSRC forecasts of regional economic growth; however, the nationwide trends might indicate greater growth in the near-term.

4.2.2 Activity in the MICs

The Greater Duwamish and Ballard/Interbay Northend MICs are hubs of industrial activity, generating substantial tax and export revenues[8]. The Greater Duwamish MIC also provides the largest concentration of family-wage and diverse

6 PSRC, Washington State Department of Employment Security.

7 U.S. Freight Transportation Forecast to 2024, ATA 2014.
8 Seattle Industrial Lands Study. City of Seattle. 2012.

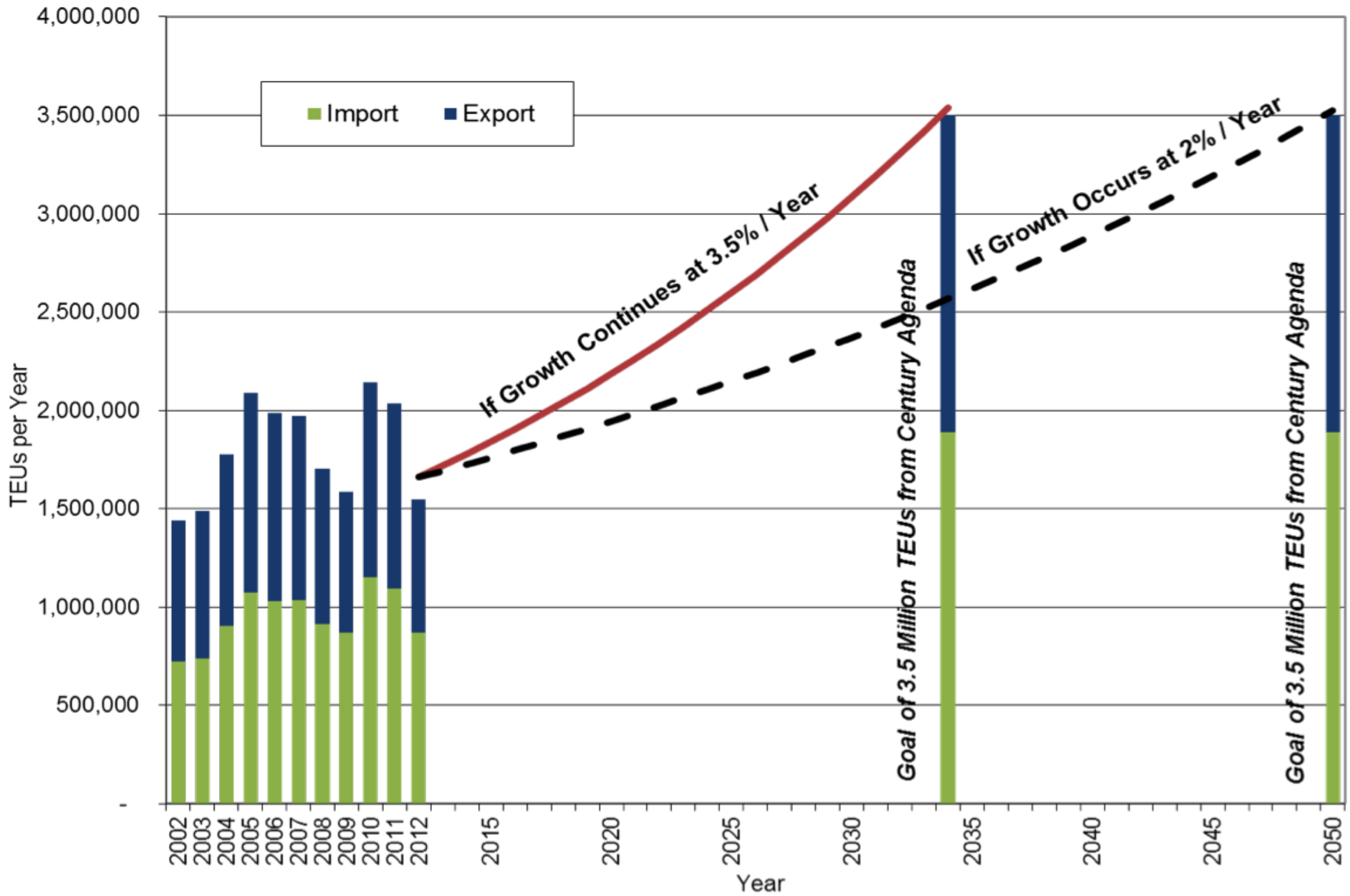


Figure 4.3 Port of Seattle Container Growth (TEU - Twenty-foot Equivalent Unit)

jobs in the Puget Sound region[7]. The region needs to support freight, while the industry also works towards lessening freight's impact on communities adjacent to the MICs including the Georgetown, South Park, and Ballard residential neighborhoods. The designation of MIC seeks to maximize appropriate land uses and complementary infrastructure that support goods-movement industries.

4.2.3 Activity at the Port of Seattle

Port of Seattle sea cargo operations are based around four major international container terminals located within the Greater Duwamish MIC. Future truck forecasts of Port activity are based on a projected growth in cargo throughput to a maximum of 3.5 million twenty-foot equivalent units (TEUs) between 2035 and 2050 as shown in Figure 4.3[9].

In the future, trucks related to Port activities are expected to operate similar to the way they operate today, including operations on 306 days per year and each container generating an average of 1.77 truck trips. Future port activity may be influenced by larger factors that are external to the Port, such as container ships with potentially more intense truck activity per vessel and the expansion of the Panama Canal. Port truck volumes included in the corridor forecasts are consistent with estimates to be included in the update to the Container Terminal Access Study (CTAS) anticipated to be completed in 2015.

9 Century Agenda. Port of Seattle 2012.

4.3 Roadway Freight Infrastructure System and Operations

The Puget Sound's regional roadway network operates at or near capacity for much of the peak morning and evening commuter periods. With limited roadway expansion, future travel demand is anticipated to extend congestion to more hours of the day, infringing on the typical time periods for truck travel. In anticipation of future traffic congestion, a number of infrastructure investments and operational policies have been identified and are in various stages of development.

A review of local and regional capital improvement programs and long-range transportation plans was conducted to determine planned funded and unfunded transportation projects that would impact truck and general traffic within and between the MICs. The review included, but was not limited to, transportation plans from the Washington State Department of Transportation (WSDOT), City of Seattle, King County, Sound Transit, and the Port of Seattle. Table 4.1 provides a summary of key future transportation projects in the study area. Major capital projects, such as the SR 99 tunnel and the rebuilt surface Alaskan Way, will change how vehicles from the north and the south access and travel through downtown. These projects will have significant influence on the travel patterns for trucks and general traffic between the two MICs.

The Center City Streetcar Connector – a streetcar that would utilize an existing lane in each direction on First Avenue exclusively for transit – is not assumed in this analysis and is located largely within the downtown core where trucks do not travel. However, implementation of the streetcar could further reduce lanes available for trips diverting from the SR 99 tunnel due to tolling, increasing pressure on parallel freight corridors and facilities connecting the MICs. This project is funded through final design which is expected to be completed in early 2016. Construction is largely dependent upon the City securing federal and local funds.

Additionally, changes in the way the transportation system is operated may influence travel in the future. These changes include implementation of tolls on SR 99 upon completion of the SR 99 tunnel, other tolling, including express toll lanes on regional freeways, and changing HOV occupancy designation from 2+ to 3+. Current tolling policy excludes use of express toll lanes by large trucks. These operational changes attempt to make better use of the existing transportation system by encouraging use of transit and HOVs, while raising revenue for investments in those corridors.

A regional tolling approach focused on the freeway system is likely to increase general trips on the City's street system, including on corridors analyzed as part of this project. Recommendations by WSDOT for setting toll rates for trucks are based on a per-axle toll consistent with the state's current approach for tolled facilities[10]. Diversion onto parallel routes may increase congestion due to limited alternative freight routes through downtown and on I-5 during the day, thus reducing the speed and reliability of truck movement between the two MICs.

10 Advisory recommendations for tolling the SR 99 tunnel. WSDOT. March 2014.

Table 4.1 Key Study Area Planned Transportation Projects Assumed in the Analysis*

Project Description	Responsible Agency	Expected Completion	Funded?**
Alaskan Way Viaduct Replacement: SR 99 viaduct replaced with a tunnel between S Royal Brougham Way and Mercer Street.	WSDOT	2017	Yes
SR 520 Bridge Replacement: Construction of a new SR 520 floating bridge with two general purpose lanes and one HOV / transit lane per direction. The eastside, floating bridge and west approach bridge north segments are funded and all are currently under construction. The westside connection to I-5 is not funded.	WSDOT	2017	Partial
Mercer Corridor: Convert Mercer Street, Roy Street, and Valley Street to two-way operations and improve non-motorized access	SDOT	2015	Yes
First Hill Streetcar: Two-mile streetcar line serving Capitol Hill, First Hill and International District with connections to Link Light Rail, Sounder commuter rail and bus service.	SDOT	2015	Yes
Link Light Rail: Extension of the regional light rail system. All segments are funded in ST2, but the year of completion may vary depending on revenue available to fund construction. The segments include:	Sound Transit		
North—University District and Capitol Hill (U Link)		2016	Yes
North—Northgate (North Link)		2021	Yes
North—Lynnwood (Lynnwood Link)		2023	Yes
East—Bellevue and Redmond (East Link)		2023	Yes
South—Extension to S 200th Street		2016	Yes
South—Extension to Kent-Des Moines Road (South Link)		2023	Yes
Elliott Bay Seawall Replacement: Replacement of the existing seawall along the Seattle central waterfront from S Washington Street to Broad Street. (Phase 1)	SDOT	2016 (Phase 1)	Yes
Waterfront Seattle: This project creates a continuous public waterfront between S King Street and Bell Street and includes the design and construction of the new surface Alaskan Way and Elliott Way arterial streets.	SDOT	2014 and beyond	Partial
Southwest Transit Pathway: This project creates a new transit corridor on Alaskan Way and Columbia Street with a pair of bus stops near the Stadium District to replace service currently on the Alaskan Way Viaduct	SDOT/ King County Metro Transit	2017	Yes
S Lander Street Grade Separation: This project grade separates S Lander St. roadway and the BNSF mainline railroad tracks between 1st Avenue S and 4th Avenue S	SDOT	Unknown	No

* Please note that transit improvements, combined with regional tolls, are expected to reduce personal vehicle trips on roadways.

** "Yes" means the project is fully funded for construction, "partial" means the project has some, but not complete funding for construction, and "no" means the project does not have any construction funding.

4.4 Methodology for Forecasting Corridor Volumes and Speeds

This section describes the process for applying growth rates and developing non-port and port-related truck forecasts on individual roadways within the MICs. The corridors selected for forecasting are based on important freight roadways defined in Chapter 3, Existing Conditions. Forecast traffic volumes were assigned to roadways within and between the MICs and based on the Major Truck Streets, First/ Last Mile Connections, and the Arterial roadway network.

The corridor forecast methodology begins by dividing vehicle traffic on city roadways into three categories based on the individual operating characteristics and reliable data sources available for forecasting travel demand:

- passenger vehicles
- non-port trucks
- port related trucks

4.4.1 Passenger Vehicles

Travel forecasts from the PSRC's Transportation 2040 model were used to develop corridor growth rates of the amount of passenger vehicle traffic anticipated on roadways within and between the MICs. The data from the PSRC model indicates that regional tolling could have a significant impact on passenger vehicle travel patterns. This change to the regional freeway system is anticipated to result in travelers choosing other modes, such as transit, carpools, or cycling—or driving on City streets instead of freeways. The PSRC Travel Demand Model considers many of these changes to future passenger travel. Even though a significant proportion of the growth in passenger trips in our region is estimated to occur on transit and alternative modes, growth in passenger vehicle travel is still anticipated due to population and employment growth. Passenger vehicle forecasts from the PSRC model were also compared to other available planning sources, including the Alaskan Way Viaduct Replacement Study for regional travel routes.

4.4.2 Non-Port Trucks

Truck trip generation forecast for non-port truck trips was mainly based on FHWA Freight Analysis Framework version 3 (FAF3)[11]. FAF3 is a database of origin-to-destination commodity flows in tonnages and dollars, which provides data for 2007, 2011 and projections at five-year intervals up to 2040. While the PSRC model is a good source of information for use in accounting for different rates of growth on specific roadways

11 FAF3 Network Database and Flow Assignment: 2007 and 2040. Federal Highway Administration. Available at: www.ops.fhwa.dot.gov/Freight/freight_analysis/faf/faf3/netwkdbflow/index.htm

(and the forecast methodology for non-port trucks was developed taking this into account), the PSRC model may not adequately account for constraints to truck movements on specific streets. It should be noted that the FAF3 forecasts have been used by WSDOT for statewide forecasts and forecasts of tonnage on freight routes on state highways during the update of the *State Freight Mobility Plan*. The detailed methodology for forecasts is included in Appendix B.

4.4.3 Port Trucks

Port truck forecast volumes were developed based on information contained in the update to the Container Terminal Access Study (CTAS) anticipated to be completed in 2015. Truck trips for that study are based on a number of data sources (including Port RFID readers, Bluetooth origin-destination studies, and existing traffic counts) that estimate the amount of Port specific truck activity on the local arterial system and determine typical daily port truck volumes and travel patterns to and from Port container terminals. Port truck trips were assigned to roadways within the Greater Duwamish MIC from individual terminals.

The total daily future traffic volumes including vehicles, non-port trucks, and port trucks are shown in Figures 4.4 to 4.6. These figures also note links where daily trucks account for a large portion of traffic (over 10%). These figures add to the constraints shown in Figures 3.15 to 3.17 in Chapter 3.

4.5 Forecast Results

Truck activity is anticipated to grow faster than regional traffic, which is not anticipated to grow as significantly due to transit expansion and tolling. The corridors evaluated in this section include the same roadways evaluated under existing conditions in Chapter 3.

Several sources were used to supplement and verify the results of the forecasts described in this section. Forecasts for port trucks were compared to the 2015 *Container Terminal Access Study* (CTAS)[12], while traffic volumes for highways such as I-5, I-90, SR-99, SR-509, SR-519 and SR-518, were estimated to be consistent with the *Alaskan Way Viaduct Replacement Study*[13], the are also consistent with results from the PSRC regional model.

4.5.1 Corridor Travel Speeds

For trucks, travel time and speed are important measures of effectiveness. Delays for freight have not only an impact on drivers' time but add cost because they delay the goods. This section describes the methodology and results for estimating corridor travel speeds based on the forecast total traffic volumes.

Future speeds were calculated by using current travel speeds (existing speed data from one year of INRIX records as noted in Chapter 3) factored by a ratio of future volumes to current volumes. A "profile curve" based on national data from the Bureau of Public Roads (BPR) estimates change in roadway speeds based on a function of traffic volumes and roadway design speed.

12 Container Terminal Access Study, Transpo Group, Est. 2015.
13 Washington State Department of Transportation, January 2010.

The BPR function was applied to existing speeds based on the change in forecast traffic volumes. This analysis assumes that roadway capacity will remain the same in the future except where there are planned projects to increase capacity. As a result, the FAP has not adjusted for capacity changes that may occur with city transit, bike, and pedestrian plan implementation.

The forecast corridor travel speeds generally resulted in lower traffic speeds and increased congestion due to the increase in traffic volumes within and between the MICs. Forecast AM congestion levels are presented in Figure 4.7 to Figure 4.9, and forecast PM congestion levels are shown in Figures 4.10 to 4.12.

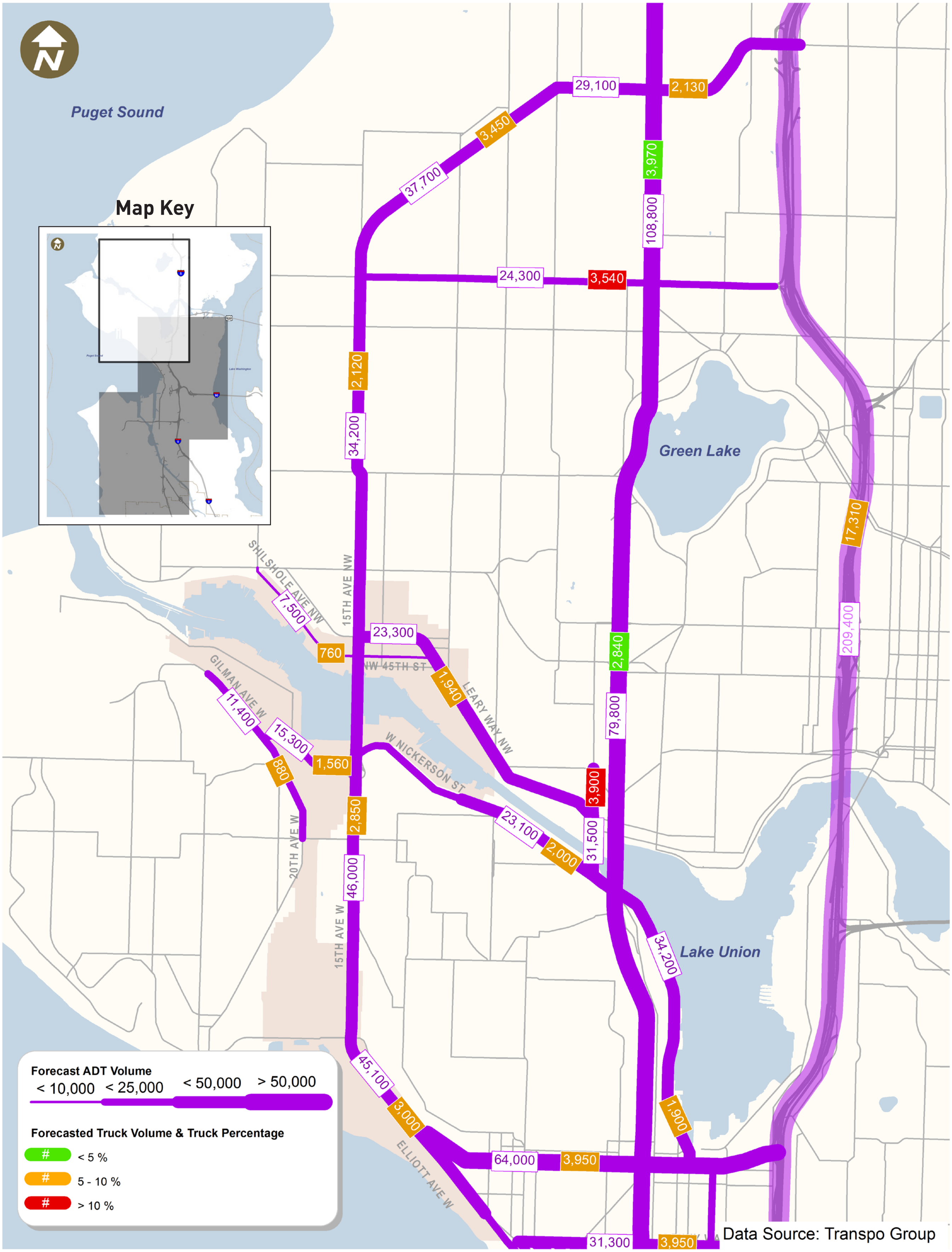


Figure 4.4 2035 Forecast Daily Volumes – North

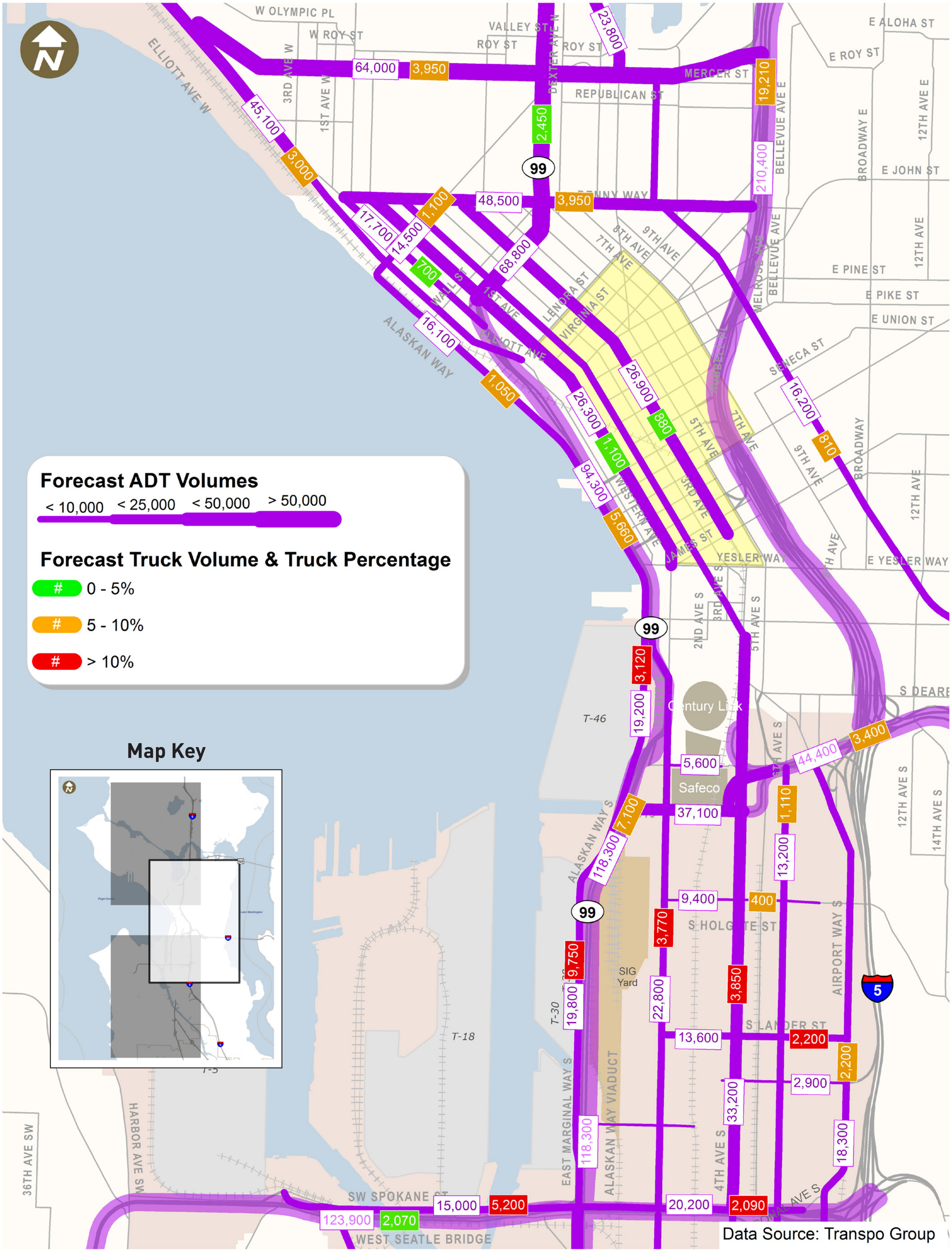


Figure 4.5 2035 Forecast Daily Volumes – Central

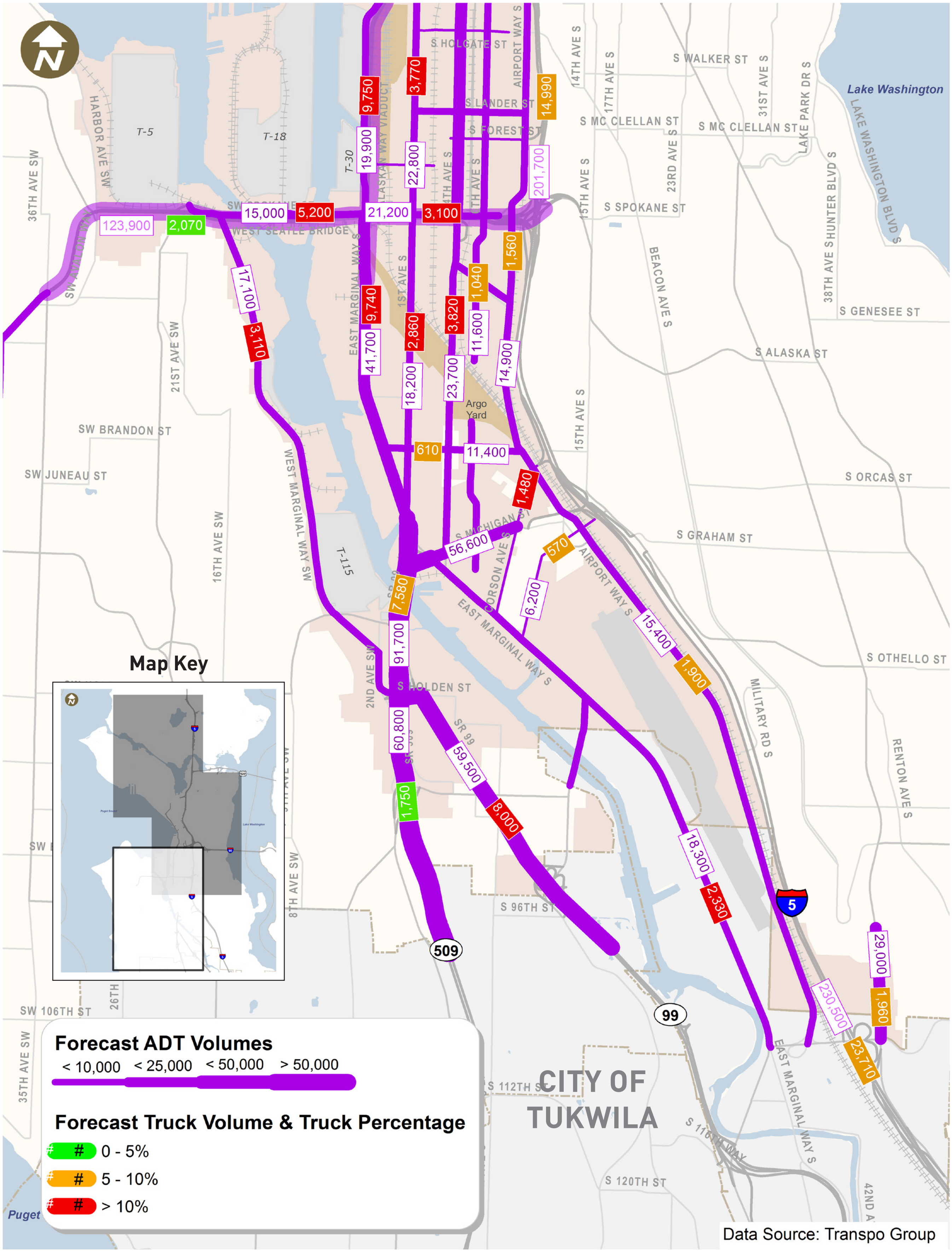


Figure 4.6 2035 Forecast Daily Volumes – South

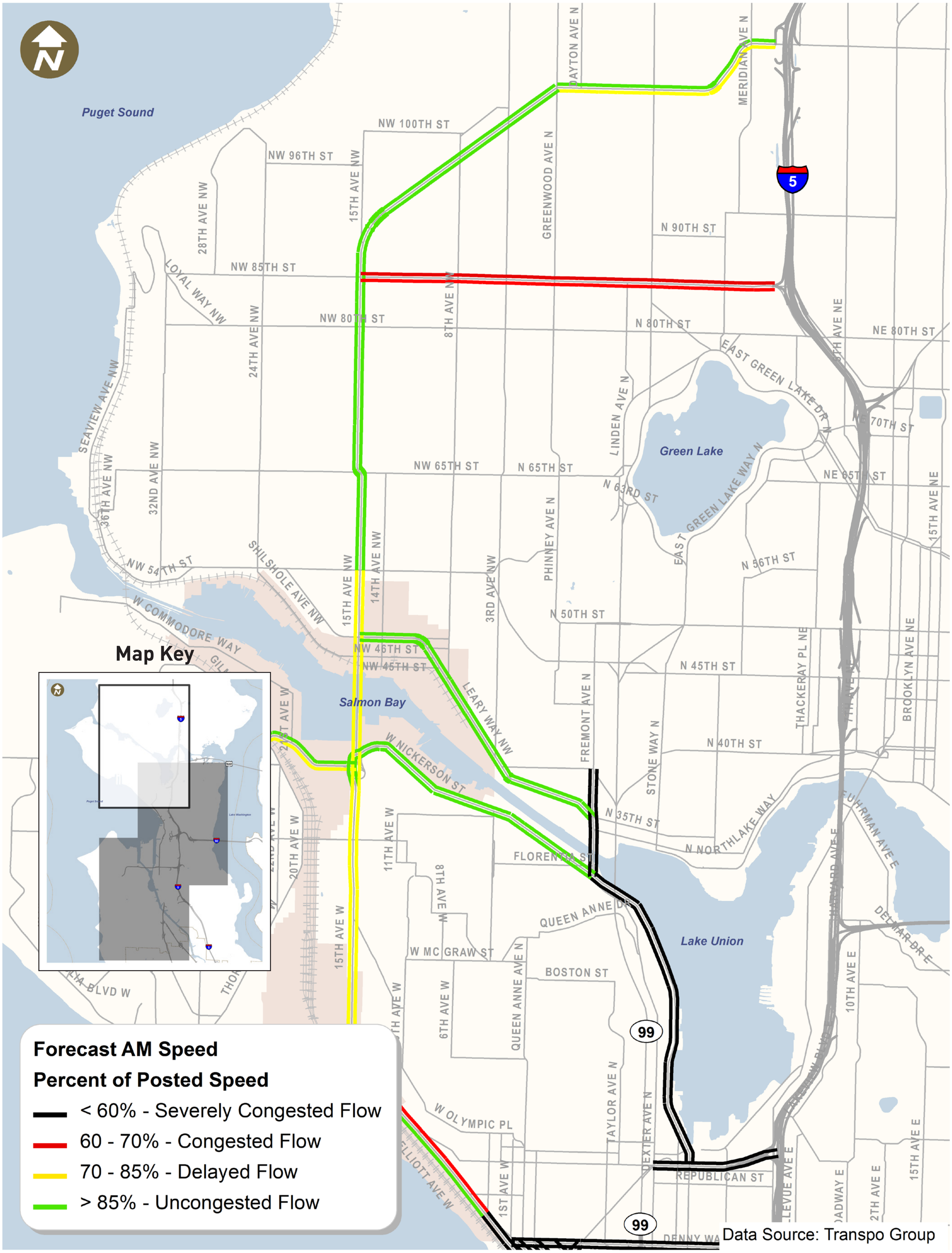


Figure 4.7 2035 Forecast AM Congestion Levels – North

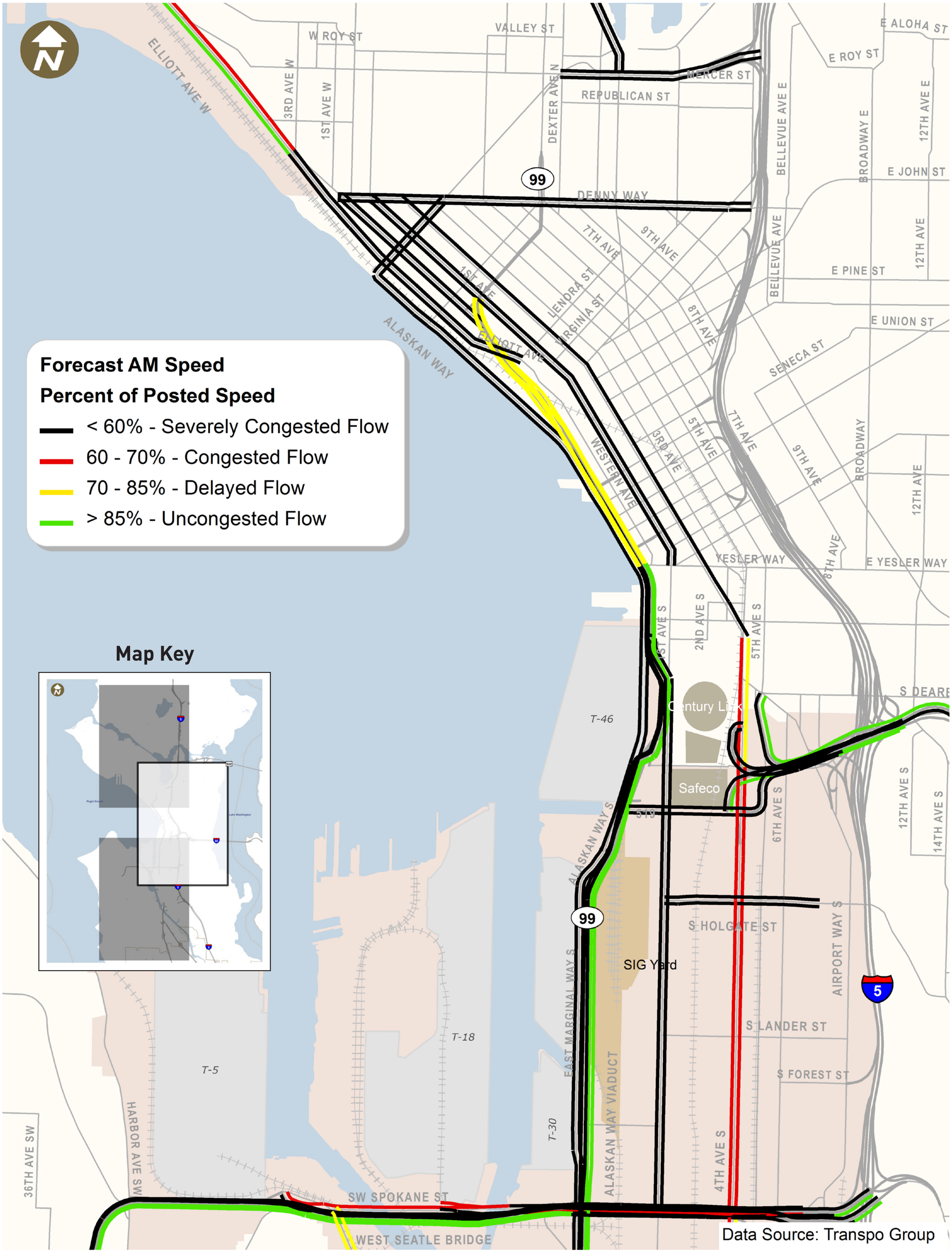


Figure 4.8 2035 Forecast AM Congestion Levels – Central

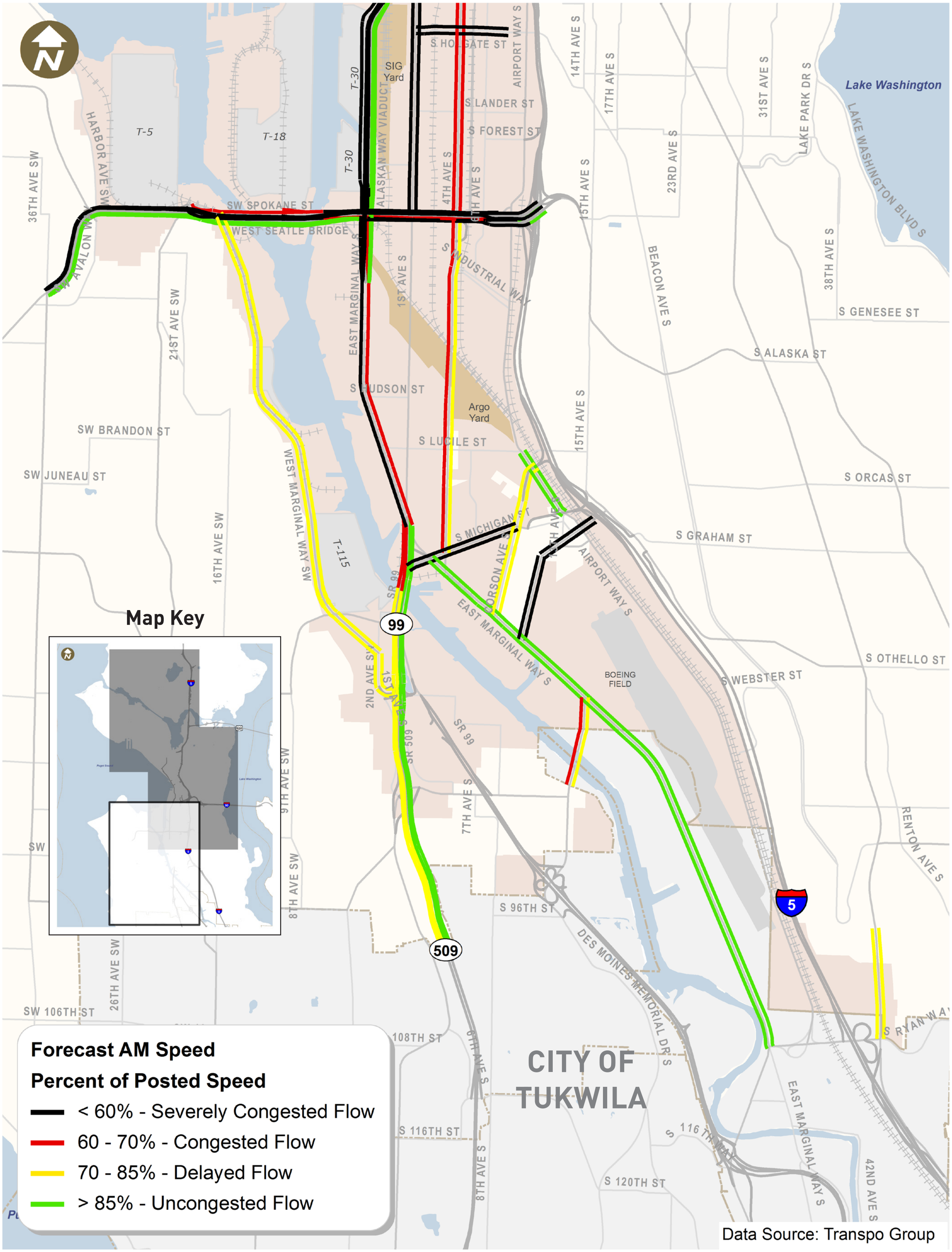


Figure 4.9 2035 Forecast AM Congestion Levels – South

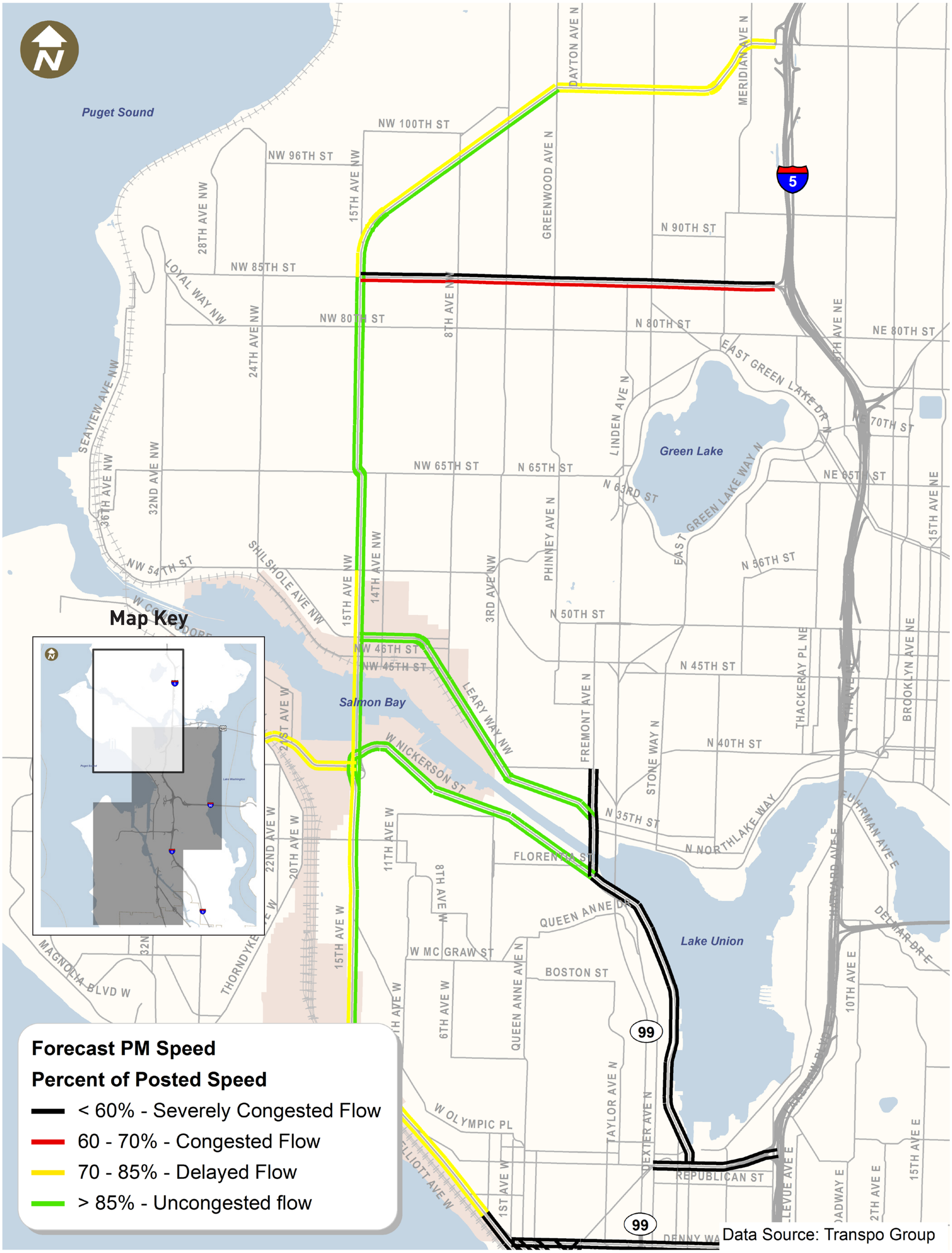


Figure 4.10 PM 2035 Forecast Congestion Levels – North

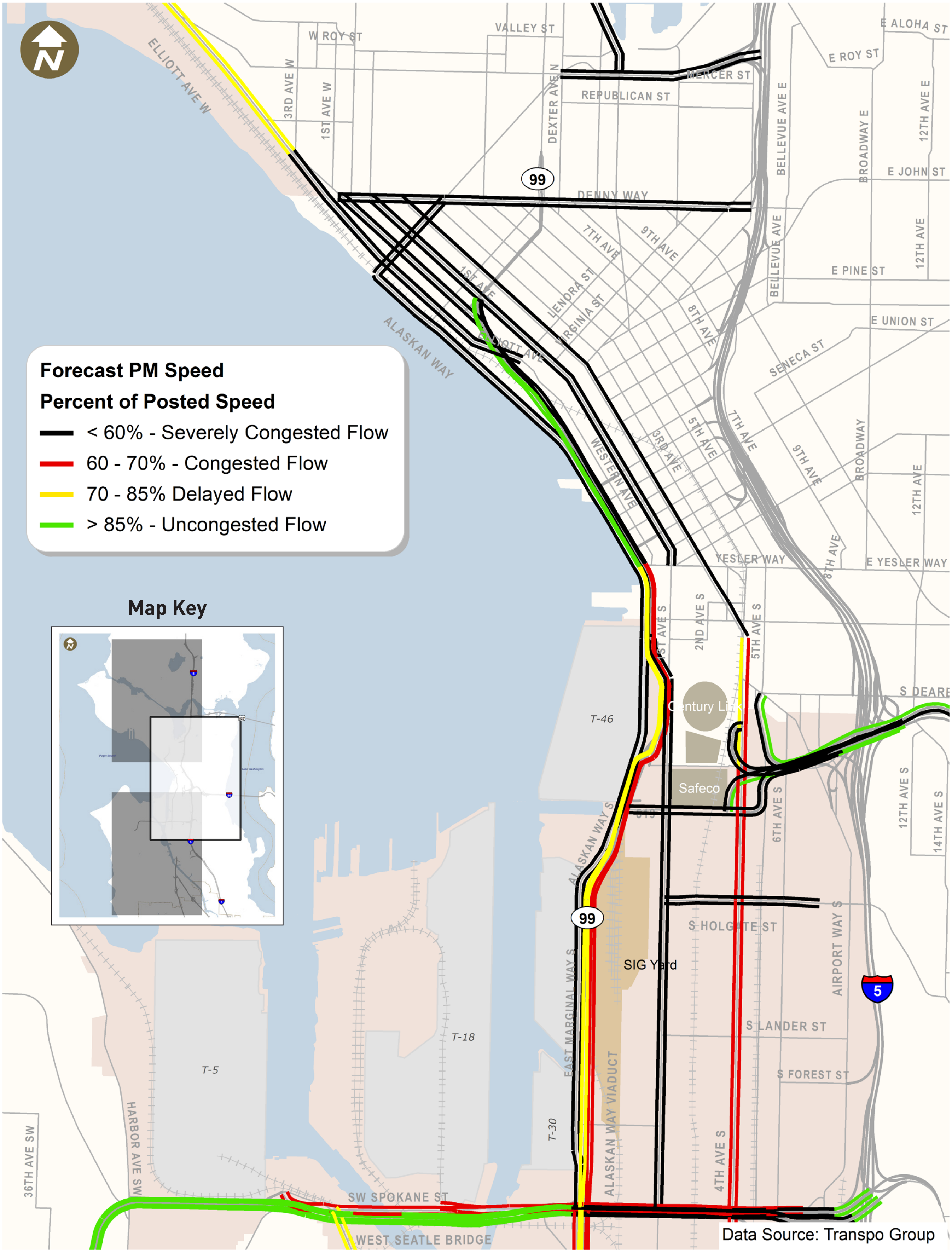


Figure 4.11 2035 Forecast PM Congestion Levels – Central

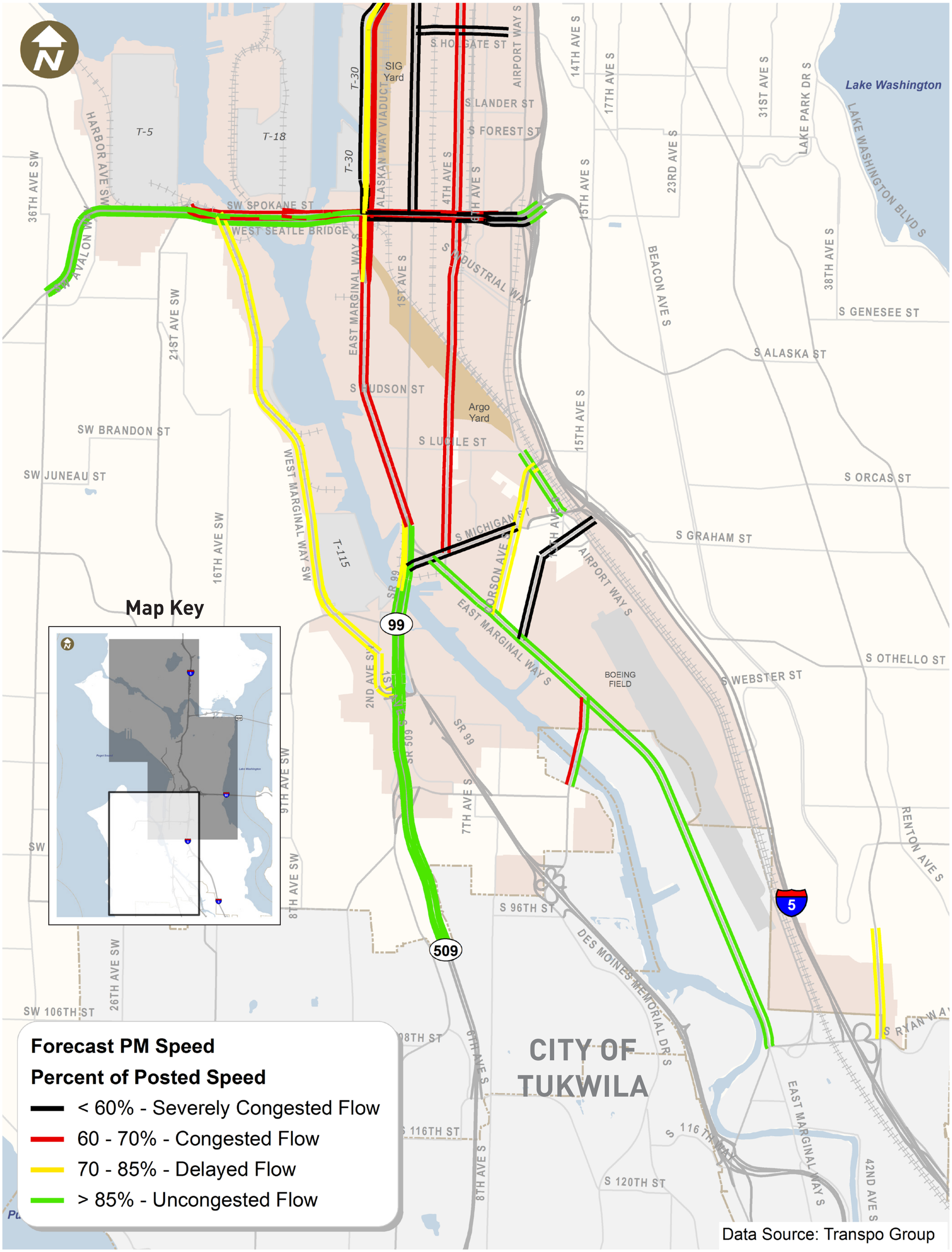


Figure 4.12 2035 Forecast PM Congestion Levels – South

As noted in the previous figures, within the Greater Duwamish MIC, many of the arterial corridors have truck volumes that are expected to grow at faster rates than passenger vehicles, particularly on north-south corridors including E Marginal Way S, 1st Avenue S, and 4th Avenue S.

Westlake Avenue is expected to experience heavy congestion in both directions as shown in Figure 4.7. Mercer Street in the immediate vicinity of the ramps to I-5 is also expected to see higher congestion levels under forecast conditions.

As compared to the existing AM congestion levels, there are locations with reduced travel speeds on several central roadways connecting the two MICs in downtown, as shown in Figure 4.8.

There are also significant increases to forecast AM congestion levels on E Marginal Way and S Michigan Street as shown in Figure 4.9.

Forecast PM congestion levels are high in some of the same locations as shown in the previous maps depicting forecast AM congestion levels. Westlake Avenue and Mercer Street are examples of where drivers will experience heavy congestion in both directions in the future, as shown in Figure 4.10. PM congestion levels are also expected to be higher on 85th Street in the future as also shown in the figure.

As compared to existing PM congestion levels, there are locations with reduced travel speeds on several central roadways connecting the two MICs in downtown as shown in Figure 4.11.

East-west corridors in the Greater Duwamish MIC are expected to experience higher congestion levels as traffic on these corridors increases. S Holgate, S Spokane, and S Michigan Streets are anticipated to have severely congested flow as shown in Figure 4.12.

4.5.2 Other Impacts to Future Truck Mobility

In addition to general trends in congestion, future constraints for trucks including future "bottlenecks" or hot-spots for freight traffic were identified based on current bottlenecks and future intersection operations. Future mobility constraints were identified using data from the Seattle Arena EIS, which studied future intersection LOS in the vicinity of the Greater Duwamish MIC. (Detailed intersection LOS for the BINMIC was not available.) Intersection operations that are anticipated to degrade to LOS E or LOS F are considered a freight mobility constraint because that impacts the number of heavy vehicles that are able to travel through an intersection. Congested signals can create bottlenecks or safety at intersections and along corridors for all roadway users, including freight.

The mobility constraints identified were added to the existing mobility constraint maps presented in Chapter 3 (figures 3.14 to 3.16 and Table 3.4). The central section was the only map with future changes and is shown in Figure 4.13. It shows increased congestion at intersections that provide access to the freeway system and local warehousing and distribution facilities in the Greater Duwamish MIC on or north of S Spokane St.—system components critical to the movement of Port cargo.

The locations with mobility constraints in the future are added to existing mobility constraints listed in Table 3.4. In the future the added mobility constraints were due to worsening intersection operations and were confined to the central section of the study area. The intersections with additional mobility constraint are shown in Table 4.2.

Table 4.2 Future Mobility Constraints

Mobility Constraint	Location
Intersection Operations (S)	4th Avenue / Madison Street
	1st Avenue S / Yesler Way
	1st Avenue S / S Main Street
	1st Avenue S / S Jackson Street
	2nd Avenue S / S Jackson Street
	2nd Avenue S Ext / S Jackson Street
	4th Avenue S / Airport Way S
	5th Avenue S / Airport Way / S Dearborn Street
	Royal Brougham Way / Occidental Avenue S
	4th Avenue S / S Royal Brougham Way
	1st Avenue S / S Atlantic Street
	Holgate Street / Occidental Avenue S
	Lander Street / Occidental Avenue S
	Hanford Street / E Marginal Way

4.5.3 Modal Overlays

In response to population and employment growth, Seattle has in recent years begun to reallocate limited space within existing rights-of-way, allocating more space to transit and non-motorized modes in a number of corridors important to the movement of freight. Competition for scarce transportation resources for all modes, including freight, transit, bicycles, and pedestrians has been and will continue to grow. Major expansion, specifically arterial roadway widening, is not planned and unlikely due other modal needs and overall City policy which limits purely vehicle capacity improvements.

The traffic modeling forecasts above show that congestion is likely to increase for all travelers—including freight—throughout the transportation system, and in particular on major truck streets and arterials critical to the movement of freight in Seattle. The results of this project highlight

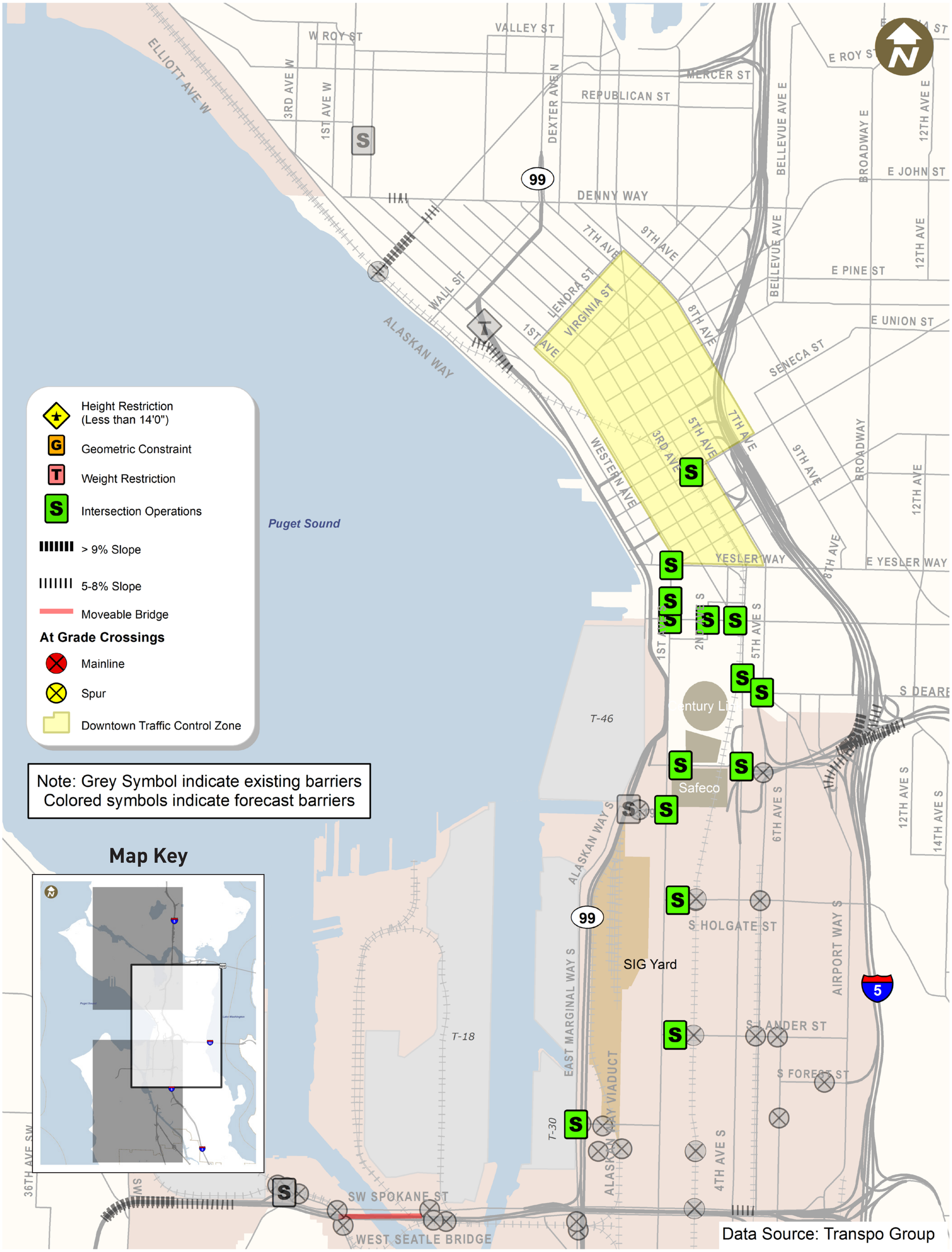
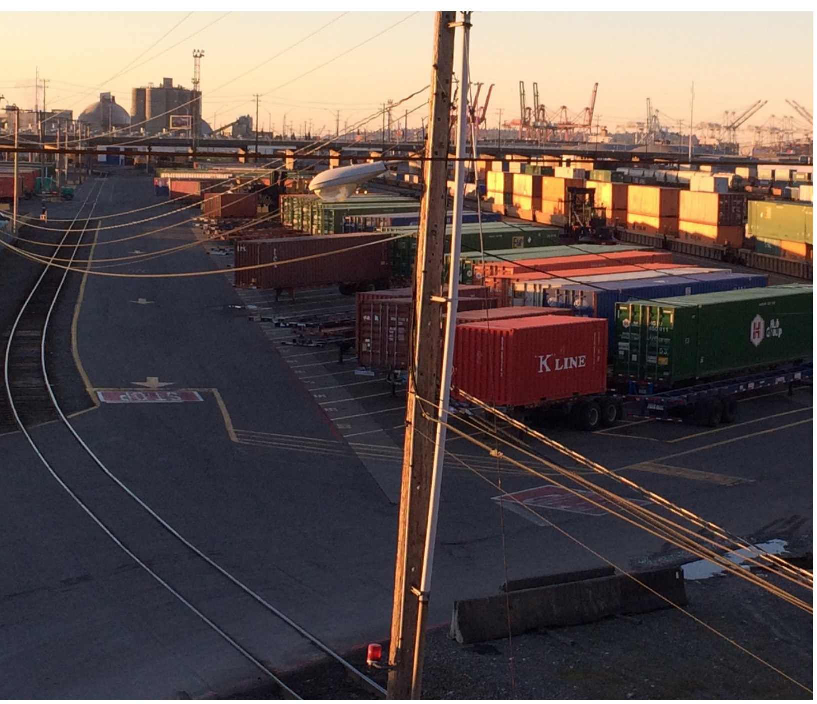


Figure 4.13 Forecast Mobility Constraints

the need for the City to develop an approach that leads to a multi-modal transportation system that balances the needs of all modes, people, and businesses including freight.

This project highlights both existing and future challenges on routes connecting to, between and within the MICs, and shows that there is a need to balance competing demands. The City's Freight Master Plan will take up evaluation of the overlay between modes and continue work towards an approach for developing a multimodal transportation system that addresses freight mobility needs throughout the City of Seattle, especially on Major Truck Streets.



4.6 Rail

National trends indicate growth in both freight and passenger service in the study area. While the north-south BNSF Mainline currently operates below capacity, there are congested areas and choke points that will worsen in the future as passenger and freight rail demands increase. Freight trains are also periodically held up by scheduling conflicts with passenger service, such as the Amtrak Cascades and Sounder commuter service that share railways. Forecast rail volumes and operations will be influenced by the following factors:

- Continued growth in freight intensive industries
- Continued growth in export/import trade
- Shifts in fuel prices and oil trade
- Continued growth in regional consumption

By 2035 freight trains are expected to increase to 104 trains daily along the I-5 corridor, a 94% increase over 2010 volumes[14]. This includes volumes for BNSF trains on the mainline that are expected to grow to 77 trains daily, and volumes for UP trains that are expected to grow to 27 trains daily. Despite these increases in freight train volumes, capacity is expected to stay the same.

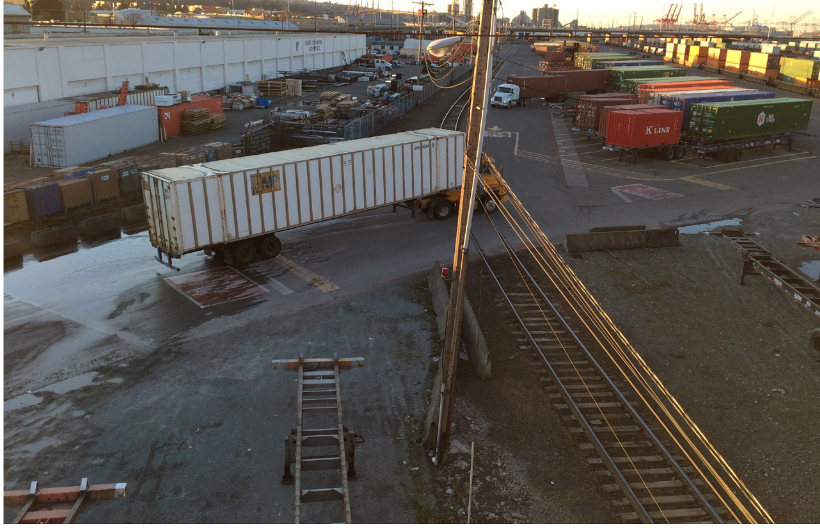
In addition to freight, these rail lines also carry substantial passenger volumes. Passenger Rail for Amtrak Cascades, Coast Starlight, and Empire Builder all serve Seattle's King Street station and use the BNSF tracks, as does the Sounder Commuter Rail, operated by Sound

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

Transit. Ridership on the Amtrak Cascades with passenger rail service between Vancouver, CN and Eugene, Oregon is expected to increase from 836,000 passengers currently to over 1.2 million in the year 2035. The Coast Starlight with service from Seattle to Los Angeles currently has an annual ridership over 400,000 and is projected to increase to 1.2 million by 2035. The Empire Builder connecting Seattle to Chicago has a current ridership just under 500,000 and is projected to increase to 2.3 million by the year 2035. The Sounder commuter rail, operated by Sound Transit currently carries a combined 2.8 million passengers on both the north and south routes (between Everett and Tacoma). By 2035 the combined ridership is anticipated to be 5.8 million.

Given these projections, BNSF's I-5 corridor route through Seattle (including the RH Thompson tunnel) can be expected to have sufficient capacity to handle traffic for some time, though other locations along the Seattle-Portland route are projected to be near 100 percent utilization by 2035. WSDOT and Sound Transit have undertaken a variety of capacity and other improvements along the route to better accommodate passenger service, which is often also beneficial for freight capacity as well.

The forecasts utilized in this analysis are based on general macroeconomic trends in the region, and thus does not take specific potential developments into account. Trends that will affect future freight volumes in the region include potential new bulk exports – including potential coal and crude oil traffic that was anticipated by the forecasters, volatility in global sourcing, competition with other North American ports,



adoption of larger container ships and expanded capacity of the Panama Canal, and shifting modal economics between rail and truck. All of these factors can impact rail volumes in unexpected ways.

Increased rail traffic will also increase closures of arterial streets at-grade rail crossings. Within the Greater Duwamish MIC, there are many at-grade rail crossings that are heavily used by trucks. Increased rail traffic at BNSF mainline crossings (at S Holgate Street, S Lander Street, S Horton Street, and S Spokane Street) will directly impact trucks that use east-west arterials.

5 FREIGHT NEEDS

The Freight Access Project (FAP) is tasked with identifying locations that hamper freight mobility. It determines infrastructure and operational issues and develops solutions that address these needs.

Based on the conditions assessment presented in Chapters 3 and 4, this chapter evaluates truck freight needs. It introduces and applies a 'toolbox' of strategies designed to address these needs, setting the stage for the development of a prioritized list of potential investments to maintain and improve freight mobility between today and the planning horizon year of 2035.

In addition to the analytical process outlined below, the Freight Access Project considered:

- National, state and regional policies related to freight to ensure that its needs assessment and project list are consistent with criteria and goals that are used to make funding decisions at the regional, state, and federal level
- Input from local freight stakeholders and the Seattle Freight Advisory Board

Chapter 5: Freight Needs

EVALUATE freight needs
- Define performance measures
- Score and Index Needs

APPLY toolbox treatments
- Identify gaps
- Consider possible solutions

Chapter 6: System Improvements

DEVELOP project list
- Refine descriptions
- Develop cost estimates and timeframes

PRIORITIZE projects
- Consider implementation issues
- Prioritize

5.1 Policy Context

To ensure that Seattle's freight mobility projects can compete effectively for regional, state, and federal funding, it is important to understand and address the goals and related performance criteria related to programs that provide funding for freight projects. Generally, these policies establish a hierarchy of facilities important for freight to use, define criteria for evaluating freight routes such as safety and preservation, define management oversight and operations of freight routes and identify needed investments to move freight. Aligning with national, state and regional policies regarding freight not only promotes improved coordination between agencies but also supports coordinated investments in shared priorities. A summary of national, state, regional, and local freight policies follows.

5.1.1 National Policy Guiding Investments in Freight Infrastructure

Review of national policies ensures that the FAP provides the information necessary to help the City and the Port align with regional, state and national interests and identify potential opportunities for partnering.

National Freight Strategic Plan (MAP-21) [1]

Moving Ahead for Progress in the 21st Century (MAP-21), signed in July 2012 and effective for fiscal years 2013 and 2014, includes numerous provisions intended to improve the condition and performance of the national freight network and support investment in freight-related surface transportation projects. As a natural deep water port that, together with the Port of Tacoma, comprises the 3rd largest container port complex in North America, which in turn supports the fourth largest warehousing and distribution center in the U.S., the City of Seattle has a critical role in the national freight network. It is therefore important to ensure that the projects identified through the Freight Access Project support MAP-21 goals and meet its funding criteria.

MAP-21 directed USDOT to designate a national freight network to assist the state DOT in strategically directing freight related resources. MAP-21 directed USDOT to develop or improve data and tools to support an outcome-oriented, performance-based approach to evaluating proposed transportation projects. The legislation also changed funding eligibility and prioritization for freight-related projects.

MAP-21 directed that a national freight strategic plan be developed and updated every five years. Among other things, the plan would:

- assess the condition and performance of the national freight network,
- identify highway bottlenecks,
- forecast freight volumes,
- identify major trade gateways and national freight corridors,
- identify best practices for improving the performance of the national freight network and mitigating the impacts of freight movement on communities, and
- provide a process for addressing multistate projects and strategies to improve freight intermodal connectivity.

The analytical and project development approach outlined in this report addresses the goals and criteria for MAP-21's strategic plan at the local level.

1 U.S. Department of Transportation. www.fhwa.dot.gov/map21/fact-sheets/freight.cfm

National Freight Network[2]

MAP 21 also called for establishing a two-part National Freight Network – one network being "primary," the other "rural." The Primary Freight Network would feature the 27,000 centerline miles of existing roadways that are most essential to freight movement. It is within USDOT's discretion to designate a further 3,000 miles of existing and future un-built roadways under the Primary Freight Network. The National Freight Network would serve as a target for state investment. However, the Network did not include freight rail, which carries about 42 percent of the nation's ton-miles (a unit that measures a ton of freight moving one mile). Within the City of Seattle I-90, SR 519, and I-5 are designated as part of the National Freight network.

National Highway System

The National Highways System (NHS)[3] is an interconnected network of strategic highways within the United States, including the Interstate Highway System and other roads serving major airports, ports, rail or truck terminals, railway stations, pipeline terminals and other strategic transport facilities. The NHS was developed by USDOT in 1995 in cooperation with the states, local officials, and metropolitan planning organizations (MPOs). MAP-21 resulted in the addition of 1,200 miles of Washington roads to the NHS.

The NHS also includes Intermodal Facilities and intermodal connector routes, where required for travel from the NHS routes to the Intermodal Facilities. Routes designated as Strategic Highway Network (STRAHNET) by the Department of Defense also form part of the NHS. In Washington, NHS routes are maintained in Washington's Highway Performance Monitoring System (HPMS) and represented in Washington's HPMS spatial network (GIS).

Within the FAP study area, I-5, I-90, SR 519, SR 99, Fourth Avenue S, 1st Avenue and Leary Way are designated on the National Highway System as strategic connections, with the last three as Principal Arterials in MAP 21. A full current (as of 2014) listing of NHS roadways in the City of Seattle is provided in Appendix C.

5.1.2 State and Region

State Freight Mobility Plan[4]

At the state level, the most recent and major undertaking to define freight needs was development of the Washington Statewide Freight Mobility Plan by the Washington State Department of Transportation (WSDOT). It was tasked with

2 Federal Highway Administration. ops.fhwa.dot.gov/freight/infrastructure/nfn/index.htm
3 www.fhwa.dot.gov/planning/national_highway_system/

4 Washington State Freight Mobility Plan, WSDOT 2014.

developing and prioritizing freight transportation system improvement strategies that support and enhance trade, sustainable economic growth, safety, the environment, and goods delivery needs in the state. Development of a State Freight Plan was encouraged by MAP-21, and is required by Washington according to Revised Code of Washington (RCW) 47.06.045.

The Statewide Freight Mobility Plan contains several key new deliverables, including the identification of Washington State Freight Economic Corridors, first- and last-mile truck connector routes, and the identification and prioritization of truck freight highway bottlenecks, as guided by MAP-21. The Freight Access Project (and Freight Master Plan) will assess last mile connectors that are included into the state network.

WSDOT also analyzed nine categories of truck bottlenecks on highways, including safety, pavement and bridge conditions, load restrictions, clearance restrictions, resiliency bottlenecks, truck slow-speed locations in urban areas and on signalized highways, and capacity needs. The Seattle region is a significant area for truck bottlenecks. Preliminary data show poor pavement and bridge conditions along several highways in Seattle, including several height and weight restriction issues. Finally, the portion of I-5 going through Seattle is a truck slow speed location. The Freight Access Project's criteria for scoring of prospective projects are compatible with the state's criteria. The modeling analysis also accounts for the impacts of congestion on the state highway network.

Washington State Rail Plan [5]
This state rail plan identifies policy changes and provides a list of proposed improvements for a 20-year design horizon. The projects listed in the plan cover the entire State. Within the MICs, the plan lists the need for a new-east west grade separation over the BNSF mainline between Spokane and Dearborn Streets as well as the need for the Lander Street grade separation. Both of these are in the later part of the plan horizon due to funding uncertainty.

FMSIB Strategic Freight Corridors [6]
Freight Economic Corridors were identified using volume, resiliency and first-/last-mile connectivity factors. Routes with the highest annual gross tonnage, T-1 and T-2 routes are identified as Strategic Freight Corridors. In the Seattle region, state highways, 15th Avenue in the BINMIC, 4th Avenue S and E Marginal Way S in the Greater Duwamish MIC, and several other arterials are designated as T-1 truck economic corridors (i.e. routes carrying more than 10 million tons of freight per year). Maps of the strategic freight

5 Washington State Rail Plan Integrated Freight and Passenger Rail Plan: 2013-2035, WSDOT March 2014.
6 StatewideMapofFMSIBStrategicFreightCorridors, WSDOT 2013.

corridors are included in Chapter 2 – Freight Context and the MICs.

FAST Program [7]

The Freight Action Strategy for the Everett-Seattle-Tacoma Corridor (FAST Corridor) is a partnership of 26 local cities, counties, ports, federal, state and regional transportation agencies, railroads and trucking interests, intent on solving freight mobility problems with coordinated solutions.

These partners have shared information and funding resources—sometimes shifting funds from projects that were delayed to those that were ready to begin—to benefit the program as a whole. Because of this team approach, projects were built which otherwise might never have been completed in the recommended timeframe. This partnership has identified 25 projects. Since 1998, the partners have identified and assembled $568 million of public and private funding and completed 19 of these priority projects.

In Seattle, the partnership has funded major improvements in the Greater Duwamish MIC, improving freight mobility and reducing the impact of freight traffic on the traveling public. Completed projects include WSDOT's SR-519 project, the City's Spokane Street Viaduct Widening and Duwamish ITS projects, and the Port of Seattle's East Marginal Way Grade Separation. The remaining project is a grade separation of the mainline rail corridor at Lander (which is included in the recommended projects listed below.)

7 FAST Corridors, PSRC.

PSRC 2040

As the local Metropolitan Planning Organization, Puget Sound Regional Council provides coordination of land use and other planning functions and prepares regional long range land use and transportation plans. PSRC's long range transportation plan, Transportation 2040, includes Appendix J the Regional Freight Strategy[8]. This strategy addresses Last Mile needs and recommends system preservation within the MICs.

5.1.3 City of Seattle

City planning includes an overall long range Comprehensive Plan, a Transportation Strategic Plan, and modal plans for pedestrians, bikes and transit, The City also has adopted a Complete Streets ordinance and annually updates its Capital Improvement Program. The influence of these plans on freight needs is described below for each plan.

Comprehensive Plan Building Connections 2035

The City Comprehensive Plan update, Building Connections 2035, will be completed in 2016 to meet the requirements of the Growth Management Act. The plan addresses land use and anticipated population and employment expected by the year 2035. The plan will address land use in the MICs which is expected to continue to grow and in-fill with manufacturing and industrial uses.

When complete, this plan will include goals and policies of a multi-modal transportation element. The plan will be informed by *Move Seattle*, a major strategic initiative bringing together the

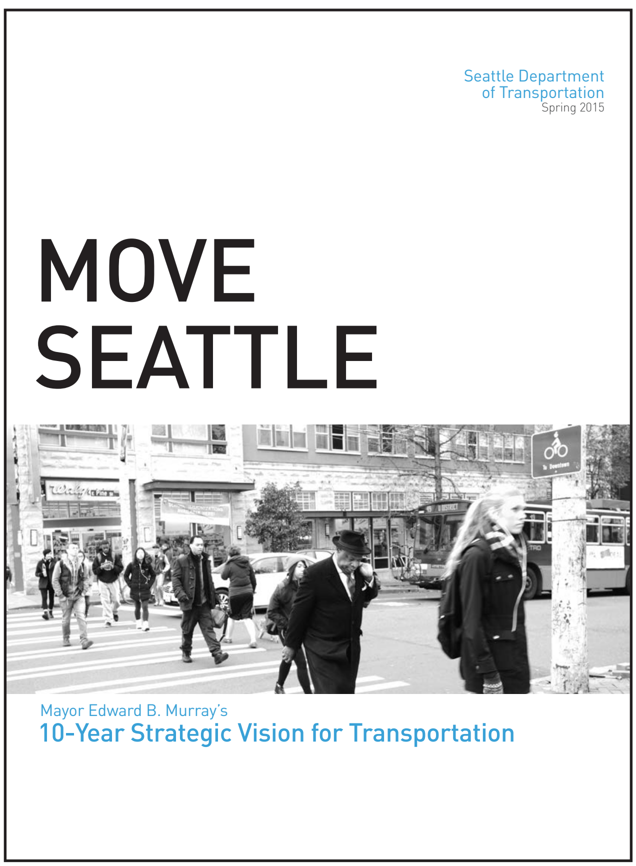
8 Transportation 2040 UPDATE: Appendix J Regional Freight Strategy, PSRC May 2014.

modal plans to develop a 10 year investment commitment.

Container Port Element

The Comprehensive Plan also contains a Container Port Element. The element is based on RCW 36.70A.085, which is a component of the Growth Management Act, The law required the Port and the City to work together to develop a Container Port Element that:

- establishes policies and programs to define and protect core areas for Port uses,
- provides efficient access to core areas through freight corridors,
- resolves key land use conflicts and mitigates incompatible uses,
- ensures consistency with Comp Plan (economic, land use, transportation elements) and the Port's Comprehensive Scheme.



Transportation Strategic Plan[9]—Move Seattle[10]

The 2005 Transportation Strategic Plan (TSP) outlines specific strategies, projects and programs that implement broader citywide goals and policies for Seattle and guide decision making. The TSP was updated with the 2012 Action Agenda. The next Transportation Strategic Plan, known as *Move Seattle,* was released in March 2015 and identified major SDOT investments to be implemented over the next decade. *Move Seattle* lists the development of the Freight Master Plan as a priority and identifies several projects and programs that also appear in FAP.

Complete Streets [11]

The City adopted a Complete Streets ordinance, along with a checklist, in 2007 requiring SDOT wherever possible to design streets to accommodate pedestrians, bicyclists, transit riders, prioritize freight on Major Truck Streets; and accommodate persons of all abilities while promoting safe operations for all modes.

Modal Plans

The City has adopted a Bicycle Master Plan[12] , Transit Master Plan[13] and Pedestrian Master Plan[14]. The Transit Master Plan and Bicycle Master Plan include lists of prioritized projects, while the Pedestrian Master Plan identified priority areas. Some streets within the City may have overlapping projects from more than one modal plan. The Complete Streets ordinance indicates that these investments should, wherever

9 www.seattle.gov/transportation/tsp_2005.htm
10 Move Seattle: Mayor Edward B Murray's 10 Year Strategic Vision for Transportation, SDOT, 2015.
11 www.seattle.gov/transportation/completestreets.htm
12 www.seattle.gov/transportation/bikemaster.htm
13 www.seattle.gov/transportation/transitmasterplan.htm
14 www.seattle.gov/transportation/completestreets.htm

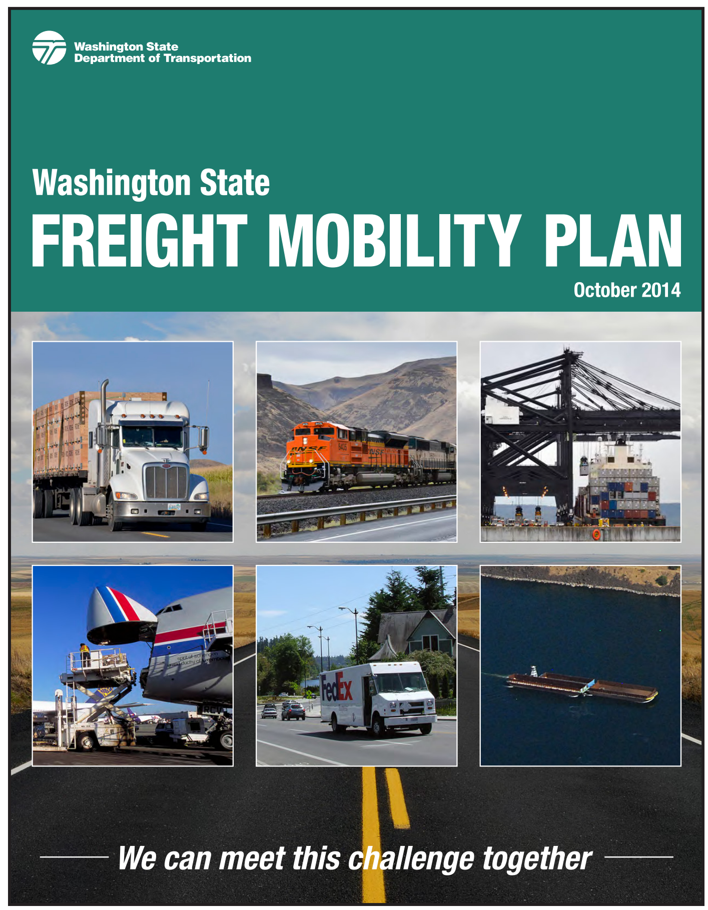
feasible, include accommodations for all modes (with freight as the priority mode on Major Truck Streets). The list of FAP projects may occur on streets where other modal investments are being considered. Where this occurs, safety must be a first priority. As noted above these "modal" plans, including the FAP and Freight Master Plan will be included in a cohesive plan, *Move Seattle*, which identifies a prioritized list of investments.

Capital Improvement Program[15]

The latest Capital Improvement Plan (CIP, 2014-2019) provides a list of budgeted investments programmed for a six-year period. In relation to freight, the CIP includes large and smaller spot investments and improvements along multi modal corridors as well as preservation and maintenance of arterial streets heavily used by trucks.

Other Plans

As described in the previous section, the FAP included a review of past neighborhood plans and related studies prepared for the two MICs. The project team reviewed past input from the North Seattle Industrial Association, the Seattle Manufacturing/Industrial Council, and many other stakeholders throughout the project. The project team also reviewed technical report prepared for the SoDo, Greater Duwamish and BINMIC areas by stakeholder groups and Seattle Office of Economic Development. The team also reviewed the project lists for the SDOT Truck Spot Improvement Program.



15 www.seattle.gov/financedepartment/1419proposedcip/documents/Transportation.pdf

5.2 Stakeholder Input

The FAP conducted stakeholder interviews[16] with representative members from the manufacturing and trucking industry operating in the Greater Duwamish MIC and BINMIC to identify specific issues, needs, and ideas regarding improving freight mobility in the study area. The six stakeholder interviews were conducted between January 13 and 22, 2014. The stakeholder interviews had the following objectives:

- Identify problem locations and challenges for trucks operating:
    - within the Greater Duwamish MIC and BINMIC,
    - on freeway connections to Greater Duwamish MIC and BINMIC,
    - between Greater Duwamish MIC and BINMIC,
    - throughout the regional transportation system.
- Identify potential solutions and options to improve freight operations.

5.2.1 Freight Advisory Board

The Seattle Freight Advisory Board[17] served as the primary sounding board throughout the project. The Freight Advisory Board suggested stakeholders to interview, and reviewed stakeholder interview results. The board also provided additional observations and suggestions on:

- freight related mobility and access problems.
- possible solutions within the Freight Access Project study area.

16 Interviews conducted by PRR
17 www.seattle.gov/sfab

During two FAB workshops, one on freight mobility problems, and the second on solutions, the project team gained feedback on current and future freight needs.

5.2.2 Stakeholder Interviews

Several key themes emerged during stakeholder interviews, including specific periods of the day with unexpected travel times and locations that pose challenges for freight movements. The following is a summary of stakeholder suggestions for freight mobility improvements:

- longer signal green times on established trucking routes and important truck streets
- minimize daytime construction impacts
- complete SR 99 project
- physically separate major bicycle and truck facilities and corridors
- enforce loading zone restrictions
- extend port terminal hours (recognizing this has policy and other implications)

Signal timing. Many freight operators complained about short signal timing that only allows one or two trucks to get through a signal. This was most notable for east-west routes in the SoDo.

Construction and design vehicles. Access along the waterfront along Alaskan Way is a growing challenge due to construction. The design of roadways, especially during construction is governed by several criteria – one being size of the vehicles. When it is assumed the facility will be used by larger vehicles, the radius for turning and the widths of lanes are more generous. Construction traffic control appears to be using a WB 62[18] design vehicle but should consider a larger WB 67 design vehicle. Design vehicles are described in the latest edition of AASHTO's Policy on Geometric Design of Highways and Streets[19].

Modal competition. Many expressed concern about the loss of space or lane miles for freight, specifically lanes assigned to other uses including parking, transit, bike lanes and roadway narrowing. Truck drivers would prefer that bikes and trucks operated in separate right of ways.

Port of Seattle terminal congestion. Port of Seattle terminals are limited by daytime operating hours. Trucks sometimes queue at terminal access points. Stakeholders expressed frustration about congestion on the Spokane Street Bridge (West Seattle Freeway) and related openings of the Lower Swing Bridge.

Loading zone inaccessibility. One challenge identified as a rising and worsening issue is loading zone availability throughout downtown

Seattle and its neighborhood business areas. Interviewees expressed a desire for more or better managed commercial parking procedures.

Location and time of day challenges. Most interviewees expressed frustration regarding truck operations and delay to reach the Port's terminals. Peak travel times, particularly during morning commute hours, were the most challenging times for freight movement through these already congested areas.

5.2.3 Project Team

The joint SDOT/Port project team itself was a collaborative team that guided the development of the FAP. The project team shared findings with SDOT technical experts and City departments, the Port of Seattle, and an Interagency Management Team throughout the FAP work program to obtain input. SDOT staff and consultant team members also undertook field observations of the three project subareas and documented observations from those field reviews.

5.3 Performance Measures and Criteria

In recent years, the use of performance measures in the public sector has matured and expanded significantly, yet nationally the use of freight-specific performance measures remains limited and the performance measures used vary significantly between states and regions. This is due in part to the shared public - and private-sector roles in the freight system and the data available to develop measures. A principle for development of freight system performance

18 Wheelbase, the distance from the front axle under the cab to the last rear axle.
19 AASHTO, 2011.

measures is to not just "implement measures," but to implement measures that are accurate, consistent, and meaningful, and can lead to improved decision making.

For the FAP, the team used historical information from past plans and input from stakeholders on what project needs exist for freight. From this the project team developed quantifiable performance measures based on analysis conducted in Chapters 3 and 4. The performance measures were specifically designed to be compatible with existing performance criteria used (or expected to be used) by the City, PSRC, the state, and the federal government.

The performance measures that were applied to the transportation network in the MICs for the FAP are linked to the overall project goals and objectives. A summary of the performance measures is shown in Table 5.1.

Table 5.1 Project goals and link to performance measures

Goal	Objective	Performance Measures and Data
Safety	Increase safety for all modes	• Truck collision history
Truck Mobility, Reliability, & Throughput	Maintain and improve freight-truck mobility and access	• Volumes & vehicle classifications • Speed (from Chapter 3 & 4) • Buffer index*
Connectivity	Ensure network connectivity, especially for major freight inter-modal facilities	• Mobility constraints (e.g. railroad crossings, geometric constraints, intersection operations, over-legal limitations)
Environment*	Reduce environmental impacts	• Congestion/delay- from speed & travel time • Stormwater management

* Buffer Index and Environment performance measures used for prioritizing projects as described in Chapter 6.

The development and application of performance measures enables the FAP to gauge system condition and use, evaluate transportation programs and projects, and help decision makers allocate limited resources more effectively than would otherwise be possible. There are also several additional reasons to apply performance measures, including:

- **Linking Actions to Goals.** Performance measures can be developed and applied to help link plans and actions to goals and objectives.
- **Prioritizing Projects.** Performance measures can provide information needed to invest in projects and programs that provide the greatest benefits.
- **Managing Performance.** Applying performance measures can improve the management and delivery of programs, projects, and services. The right performance measures can highlight the technical, administrative, and financial issues critical to governing the fundamentals of any program or project.
- **Communicating Results.** Performance measures can help communicate the value of public investments in transportation. They can provide a concrete way for stakeholders to see SDOT and the Port's commitments to improving the transportation system and help build support for transportation investments.
- **Strengthening Accountability.** Performance measures can promote accountability with respect to the use of taxpayer resources. They reveal whether transportation investments are providing the expected performance or demonstrated need for the improvement.

The performance measures are evaluated through a number of components that are individually scored as described in the next section.

5.4 Scoring Methodology for Needs

The evaluation methodology included an assessment of a series of performance data sets that were assigned a maximum point value so that the most points a roadway segment could achieve was 100 points. The scoring components of safety, mobility, and connectivity were selected because they are linked to overall FAP goals. Each component was based on measurable data or analysis conducted during the project process. Table 5.2 shows the breakdown point values assigned for each category.

Table 5.2 Performance measure scoring[20]

	Component	Points	Max Points
Safety	**Truck-Bike Collision**	15	40
	Truck-Pedestrian Collision	15	
	Other truck-involved collisions Fatality Injury Only PDO Only	15 10 5	
Mobility	**Travel Speed**	1 to 25	35
	Daily Truck Volumes	1 to 5	
	Truck Percentage	1 to 5	
Connectivity	**Railroad Crossings** Mainline Tail Track Spur	15 10 5	25
	Geometric Constraints	10	
	Intersection Operations	10	
	Infrastructure Limitations *(weight & height rest.)*	5	
	Total Possible Points		**100**

Because these performance measures align with National, State, and regional objectives for freight, these criteria also align with criteria from transportation grant funding programs. The following sections describe the components of the evaluation methodology in more detail.

5.4.1 Safety (40 points)

The safety score is based on collision records from the five most recent years of complete data. The collisions involving trucks with other vehicles, pedestrians, and bicyclists were the focus for the safety evaluation. Collisions were organized based on collision severity (fatality, injury, or property damage only).

Any roadway segment where a truck collision resulted in a fatality was assigned 15 points. Roadway segments that had truck collisions resulting in injury were assigned 10 points per injury collision. Property damage only (PDO) truck related collisions were assigned 5 points per PDO collision. Thus a roadway segment with a fatality, two injuries, and a PDO collision recorded in the last five years would be assigned 40 points. Appendix D shows the results of the safety evaluation.

Segments with the highest safety score include locations with the most severe collisions. A roadway segment on Fourth Avenue just south of the bridge over the Argo Intermodal Yard received the maximum safety score of 15 points. Other locations in the Greater Duwamish MIC that received high safety scores include E Marginal Way S, 1st Avenue S, Spokane Street, and Diagonal Avenue S. Short segments in the BINMIC on Leary Way and 15th Avenue also received high safety point totals.

20 A segment could score higher than the max, but only receive max points.

5.4.2 Mobility (35 points)

The mobility score was based on three elements:

- Morning and evening congestion levels,
- Percentage of trucks in the daily traffic stream, and
- Total truck volumes on the roadways.

Mobility data was not available for all roadway segments, including some of the last mile connectors that access the intermodal yards in the Greater Duwamish MIC. The average travel speed as a percentage of posted speed represents the congestion level for a roadway. Congestion levels for the weekday AM peak (7–9am) and the PM peak (4–6pm) were used in the mobility score. Congestion levels for existing and forecast conditions were presented in Chapters 3 and 4, respectively. Congestion levels were used to assign a value of 2 to 25 points based on the criteria shown in Table 5.3.

Table 5.3 Congestion level scoring breakdown

Description	Points
Severely Congested Flow (less than 60% of posted speed) during AM and PM in both directions.	25
Severely Congested Flow (less than 60% of posted speed) during AM and PM in one direction.	20
Congested Flow (60 – 70% of posted speed) during AM and PM in both directions.	15
Congested Flow (60 – 70% of posted speed) during AM and PM in one direction.	10
Congested Flow (60 – 70% of posted speed) during AM or PM in both directions.	5
Delayed Flow (70 – 85% of posted speed) during AM or PM in one direction.	2

The second mobility scoring metric is daily truck volume. A score from 1 to 5 points was assigned based on the criteria shown in Table 5.4.

Table 5.4 Daily truck volume scoring breakdown

Description	Points
More than 2,000 daily trucks	5
1,000 to 2,000 daily trucks	3
Less than 1,000 daily trucks	1

The last mobility scoring metric was daily truck percentage. This was calculated by dividing the average daily truck volume by the average daily total volume. Based on the daily truck percentage the following scores were assigned (with a maximum of 5 points) as shown in Table 5.5.

Table 5.5 Daily truck percentage scoring breakdown

Description	Points
More than 8% of trucks in the daily traffic stream	5
4 to 8% of trucks in the daily traffic stream	3
Less than 4% of trucks in the daily traffic stream	1

The total mobility score is based on a maximum of 35 points. The roadway segment with the highest mobility point total is the Atlantic Street/ Edgar Martinez Drive (SR 519) due to peak period congestion and high truck volumes accessing regional routes. Other east-west corridors with high mobility scores include S Holgate Street and roadways accessing state highways (SR 99 and I-5) such as Mercer Street, Denny Way, and S Spokane Street. North-south roadways that experience recurring congestion and thus high mobility scores include Fremont Avenue N, E Marginal Way S, and 1st Avenue S. Appendix D shows maps depicting the results of the mobility evaluation.

5.4.3 Connectivity (25 points)

Connectivity is based on four categories of physical constraints: railroad crossings, geometric constraints, poor intersection operations, and other infrastructure limitations, such as size and weight restrictions.

- Railroad crossings were divided into three categories with point values for each category. Roadways with mainline at-grade crossings were assigned 15 points, while roadways with tail-track crossings were assigned 10 points. Roadways crossing spur lines were assigned 2 points.
- Geometric constraints were taken from an inventory of intersections on freight routes that have known geometric constraints for truck access (such as turning radii issues). All roadway segments approaching an intersection with a geometric constraint were assigned 10 points.
- Intersection operational issues were based on findings from the Seattle Arena EIS where intersections with poor levels of service, under both existing and future conditions, were documented. All roadway segments approaching the intersection with poor signal operations were assigned 10 points.
- Other infrastructure limitations consist of locations with weight or height restrictions and limitations. Bridge openings were also included in the scoring here. All roadways with other infrastructure limitations were assigned 5 points.

Most locations include one or two of the physical constraints for the connectivity evaluation have little overlap with multiple constraints. The maximum connectivity score assigned was 25 points. Mainline rail crossings were some of the highest scoring locations in the Greater Duwamish MIC. In the BINMIC the over-legal limitations on 15th Avenue W are some of the highest scoring locations, including bridges at W Emerson Street and W Dravus Street. Appendix D shows the results of the connectivity evaluation.

5.4.4 Composite Score (Maximum 100 points)

Each category was assigned a maximum point value combining each of the criteria above (safety, mobility and connectivity) which could amount to a total of 100 possible points for each roadway segment. Combining the Safety, Mobility and Connectivity scores reveals locations with high need scores for locations in the MICs. Figures 5.1 to 5.3 show the existing conditions composite score results, and Figures 5.4 to 5.6 show the forecast conditions. Table 5.6 summarizes the high scoring locations (shown in red on the maps) for both existing and future conditions.

Table 5.6 Existing and Future Freight Needs and Deficiencies

Corridor Segment or Intersection Location	Existing Need	Future Need
15th Avenue / Emerson Street	✓	✓
Westlake Avenue *Mercer Street to Fremont Bridge*		✓
Mercer Street *SR 99 to I-5*		✓
Denny Way *Western Avenue to I-5*		✓
Alaskan Way / Broad Street	✓	✓
Alaskan Way *Yesler Way to Atlantic Street (SR 519)*		✓
E Marginal Way S		
Atlantic Street (SR 519) to S Spokane Street	✓	✓
S Spokane Street to 1st Avenue Bridge	✓	✓
1st Avenue S		
Yesler Way to Atlantic Street (SR 519)		✓
Atlantic Street (SR 519) to S Spokane Street	✓	✓
4th Avenue S		
Yesler Way to Atlantic Street (SR 519)		✓
Atlantic Street (SR 519) to S Spokane Street		✓
S Spokane Street to S Michigan Street		✓
Atlantic Street (SR 519) *Alaskan Way to I-90*	✓	✓
Holgate Street		
1st Avenue S to 4th Avenue S	✓	✓
4th Avenue S to Airport Way S		✓
S Lander Street *1st Avenue to 4th Avenue S*	✓	✓
S Spokane Street		
Chelan Street to E Marginal Way	✓	✓
E Marginal Way to Airport Way S	✓	✓
S Spokane Street Viaduct		
Chelan Street to E Marginal Way		✓
E Marginal Way to Airport Way S	✓	✓
S Michigan Street *1st Avenue S to Corson Avenue*		✓
16th Avenue S *E Marginal Way to S Park Bridge*		✓

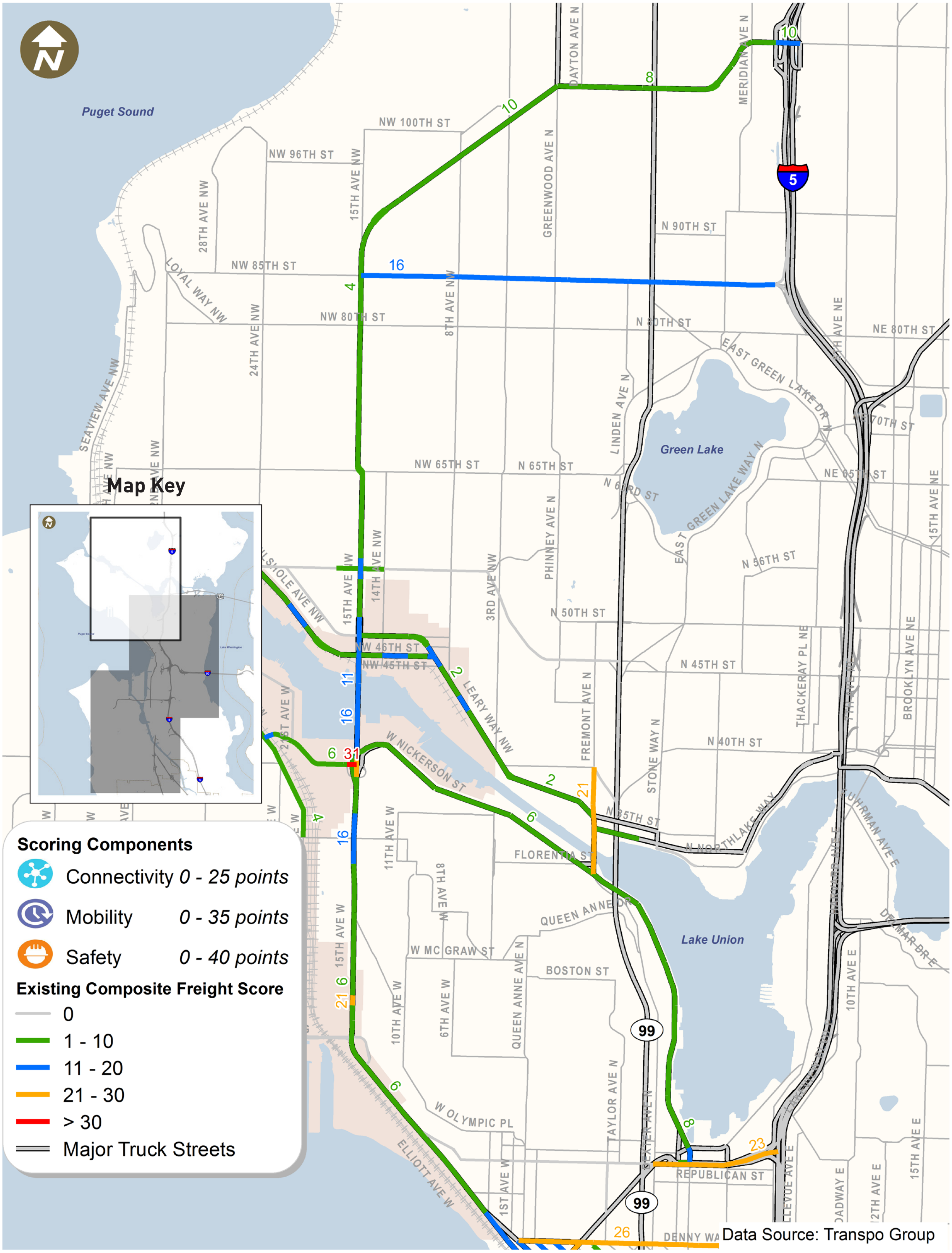


Figure 5.1 Existing Freight Needs and Deficiencies – North

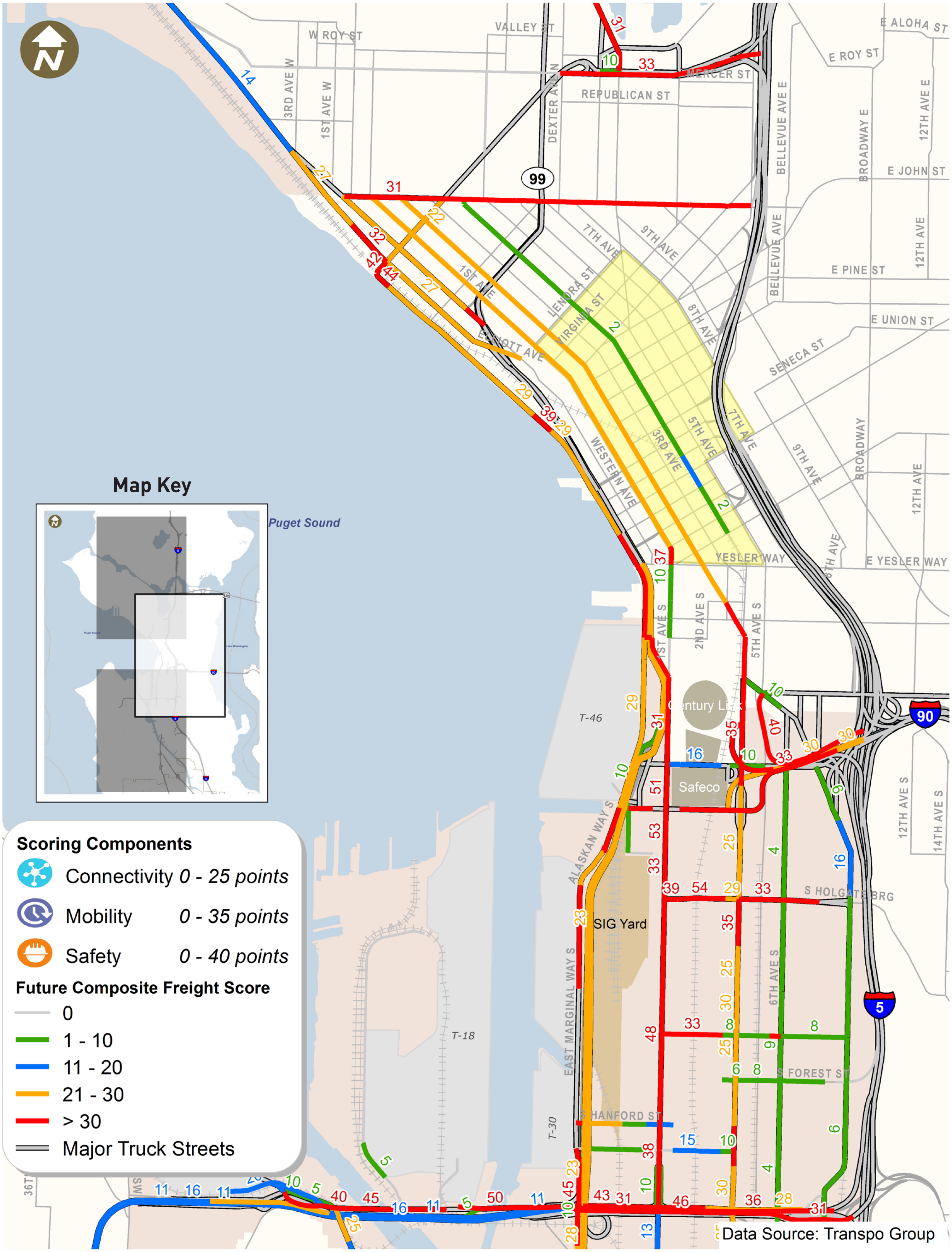


Figure 5.2 Existing Freight Needs and Deficiencies – Central

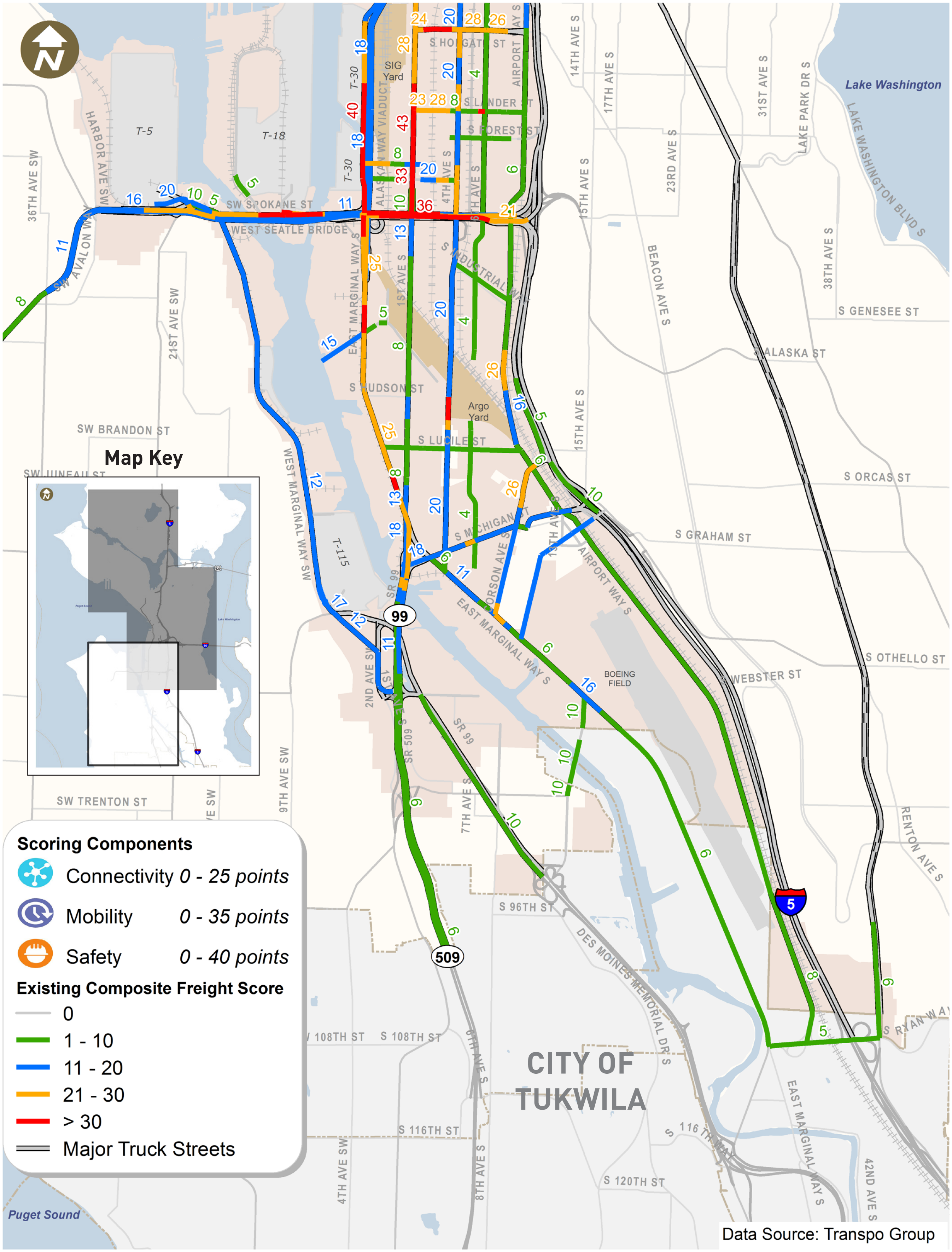


Figure 5.3 Existing Freight Needs and Deficiencies – South

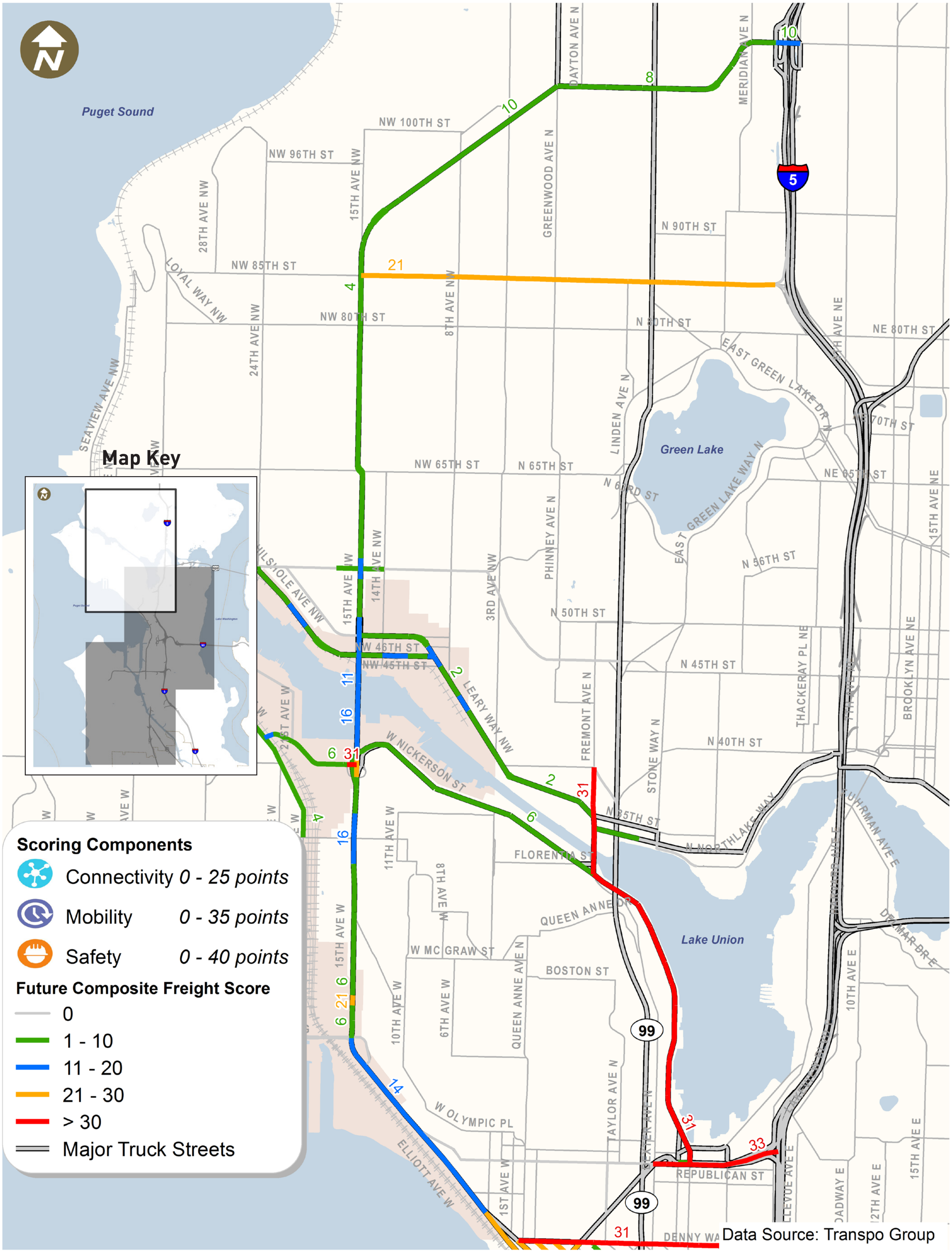


Figure 5.4 Forecast Freight Needs and Deficiencies – North

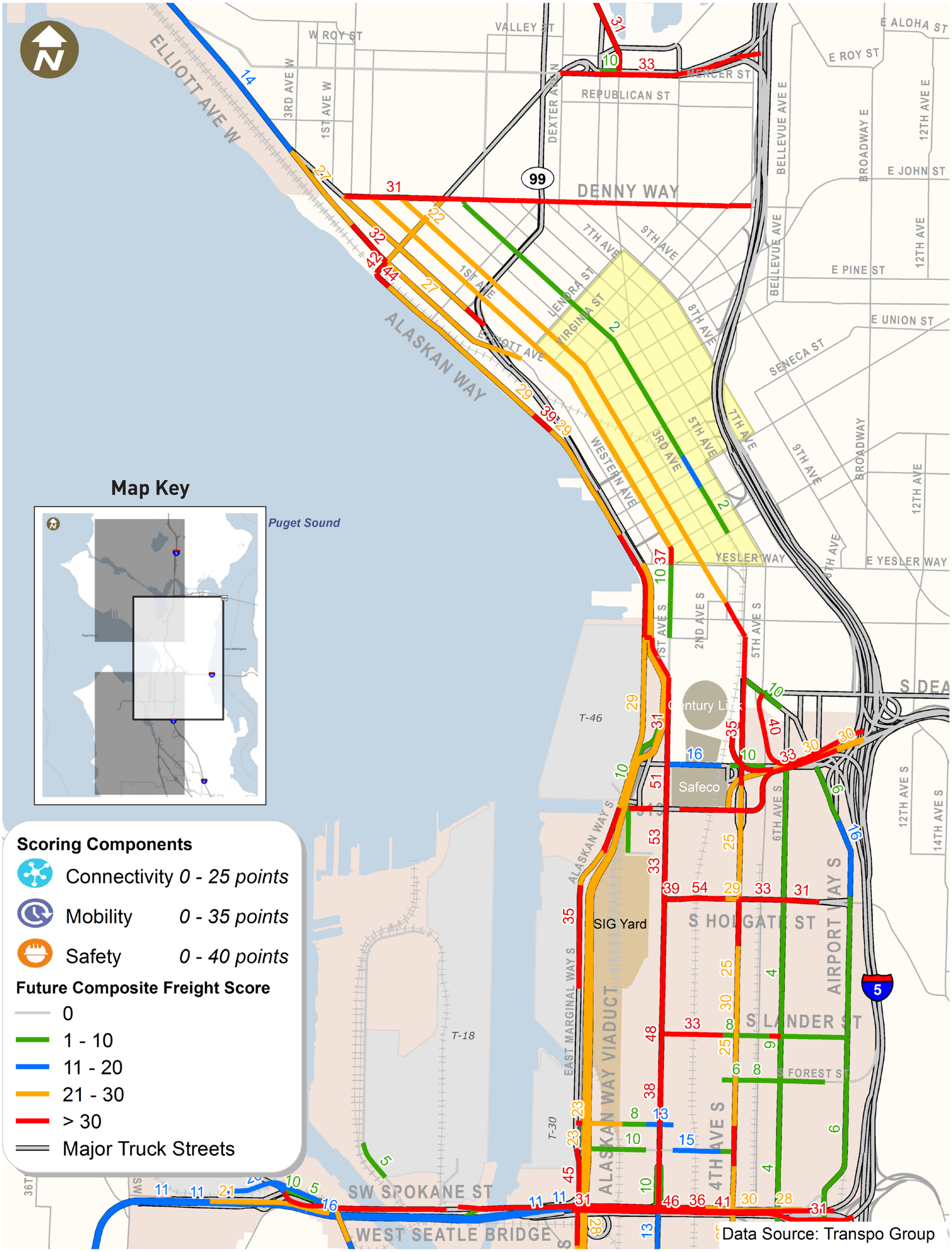


Figure 5.5 Forecast Freight Needs and Deficiencies – Central

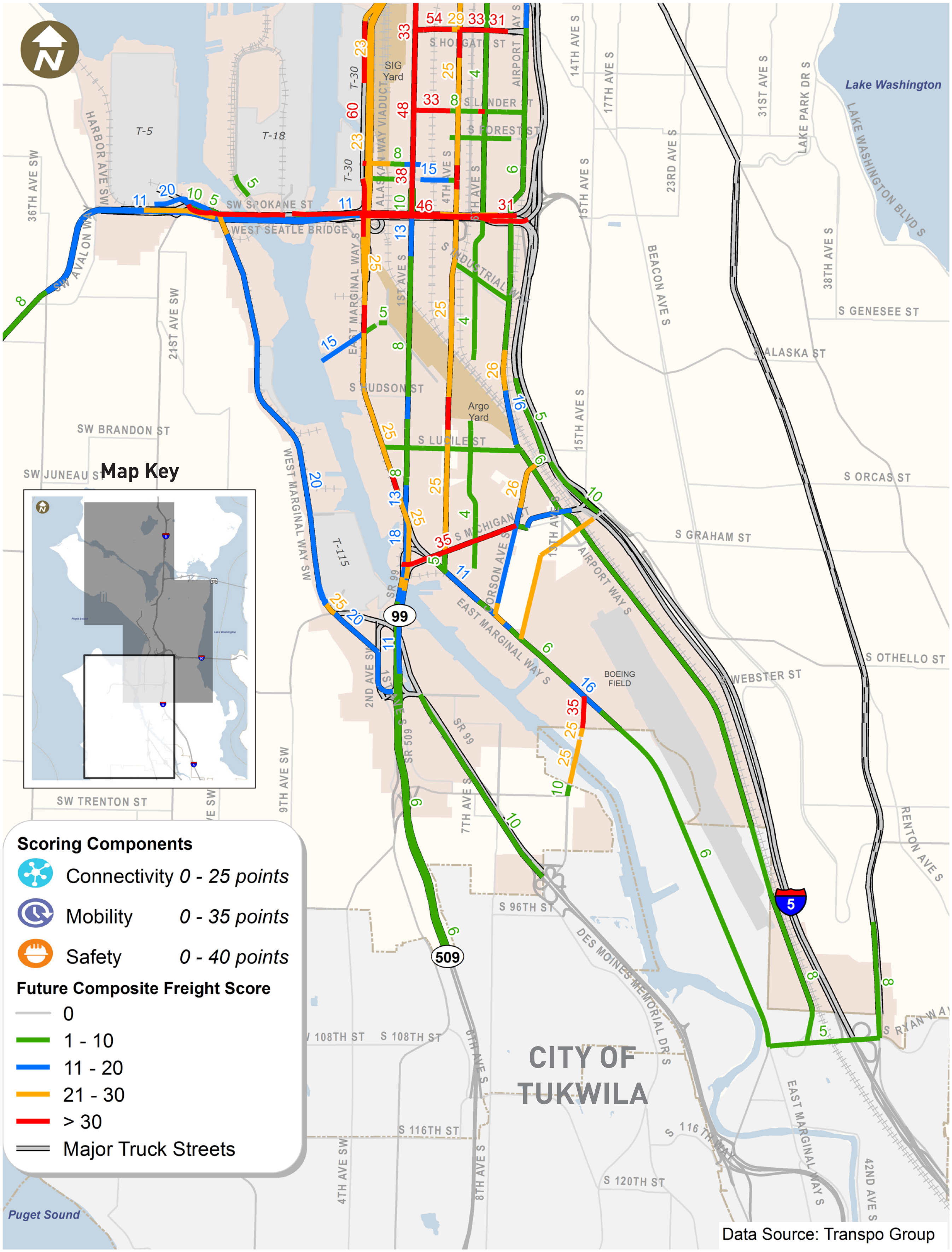


Figure 5.6 Forecast Freight Needs and Deficiencies – South

5.5 Freight Toolbox

With a list and maps of deficient locations, the project team developed a set of solutions to address these needs. This freight toolbox consists of a "menu" of improvement options that represent the types of projects that could enhance freight safety, mobility and connectivity. The toolbox includes various improvement strategies from wayfinding, operations, and technology solutions to geometric improvements and everything in between. The toolbox treatments are listed in Table 5.7 and address specific freight needs identified in the evaluation. For some problem locations, application of a single tool may be sufficient to solve the issues at hand, at other locations a combination of different tools may be needed to improve freight mobility.

Table 5.7 Freight toolbox overview

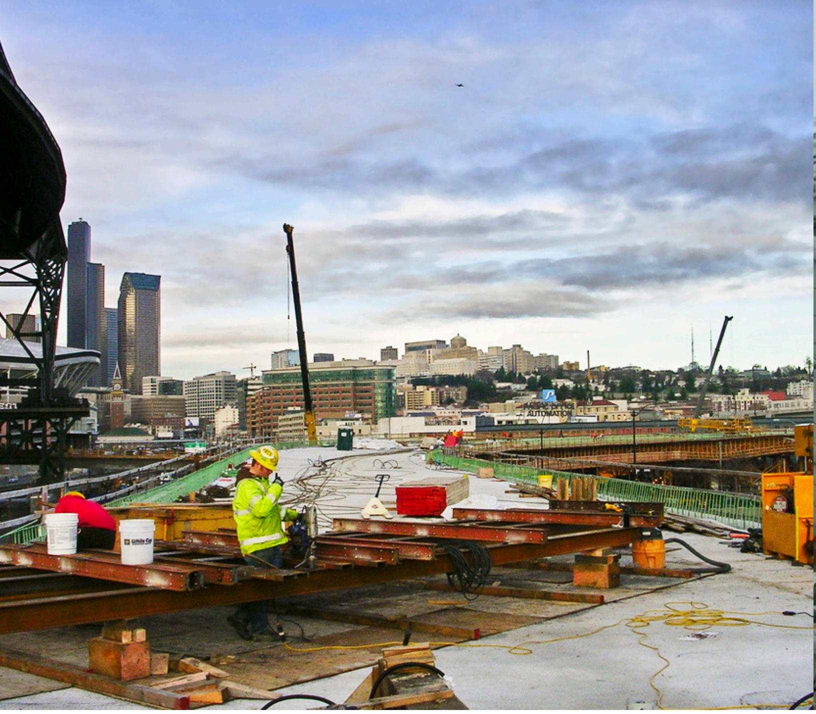
List of Tools	Deficiencies/Needs Addressed		
	Safety	Mobility	Connectivity
Maintenance and Preservation	✓	✓	
Capital Investments	✓	✓	✓
ITS	✓	✓	✓
Intersection Operations	✓	✓	✓
Wayfinding		✓	✓
Geometric Improvements	✓	✓	✓
Freight Operations Management	✓	✓	

The following sections provide examples and describe each of the toolbox items in detail.

CRACKED PAVEMENT WITHIN THE GREATER DUWAMISH MIC

5.5.1 Maintenance and Preservation

Maintenance and preservation projects include pavement and bridge investments. Routine maintenance and preservation can improve safety and mobility for freight routes. This report focuses maintenance and preservation recommendations on routes with heaviest truck traffic, using information from the City's pavement management database, which currently only includes arterial roadways. The projects recommended in Chapter 6 were selected through a systematic approach to prioritize projects based on objective analysis and long-term need. These projects help preserve infrastructure investments and improve conditions for all roadways users.



CONSTRUCTION WORKERS ON THE SR 519 PROJECT

DYNAMIC MESSAGE SIGN

5.5.2 Capital investments

Capital investments can address a range of mobility and connectivity needs and typically have a cost of $500,000 or more:

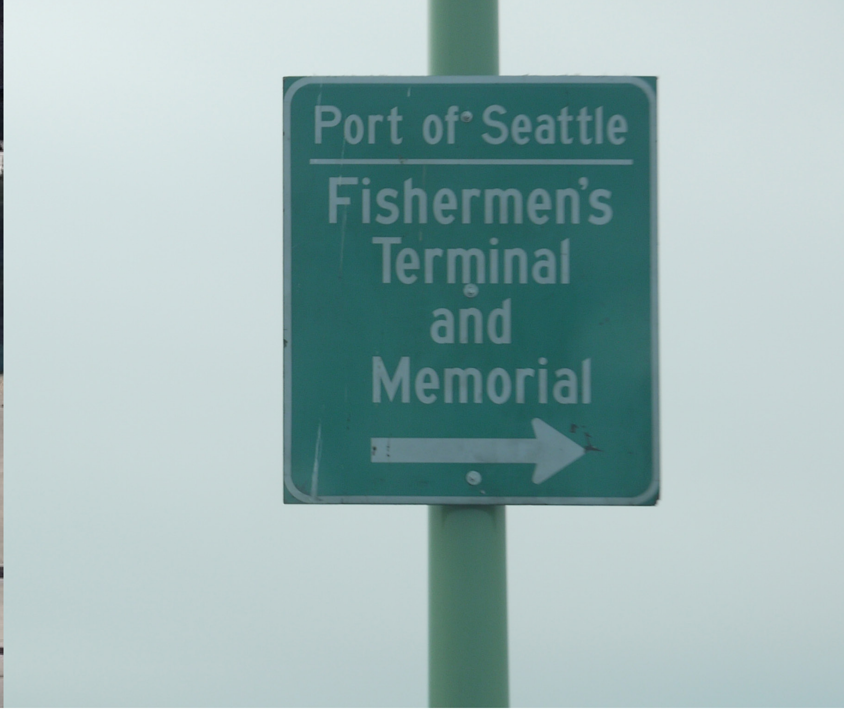
- new roadway connections
- direct freeway access ramps
- truck-only lanes
- grade-separation
- bridge replacement and renovation

The projects recommended in Chapter 6 are aimed at implementing large-scale truck mobility and access improvements that support investments in major truck and over-dimensional routes. Capital projects have significant costs, but can also consist of a package of smaller-scale projects which could be implemented in phases.

5.5.3 ITS Applications

ITS applications can address mobility needs by advising drivers of alternative routes during congested travel times. ITS improvements include traffic information systems, smartphone apps, dynamic message signs, port terminal advisories, and navigational applications. ITS also provides for communications with a central Traffic Management Center (TMC) and allows for that TMC to provide real time intervention to adapt to traffic conditions. This will provide improved traveler information on bottlenecks and current travel time to truck drivers and dispatchers. These are improvements to mobility and operations that can be used as decision making tools for both system users and managers. Implementation of ITS applications may require private and public collaboration to ensure tools are fully realized.

TRUCKS QUEUED ON S ATLANTIC STREET (SR 519)



EXAMPLES OF WAYFINDING SIGN IN BINMIC

5.5.4 Intersection Operations

Intersection operations include a range of signal timing improvements on truck corridors that include signal priority or adjusting signal timing to facilitate heavy truck movements. These signal improvement strategies can significantly improve truck mobility and access.

5.5.5 Wayfinding for Trucks

Wayfinding improves safety for all modes by indicating which streets are best for trucks. Wayfinding for trucks may include signs, striping, and roadway markings on city streets, Port gates, and state highways to:

- improve route decisions,
- reduce illegal movements, and
- alert truck drivers when there are disruptions.

These are quick, low cost strategies to help truck drivers identify truck routes, and avoid routes with height and weight restrictions. Signs and maps, such as the South Seattle Truck Routes[21] map, must be clear, intuitive, and standardized.

21 www.seattle.gov/transportation/docs/SpokaneCorridorTruckRoute-Map050707.pdf

TRUCK NEGOTIATING A TURN IN THE BINMIC

CURBSIDE DELIVERY IN THE CBD

5.5.6 Geometric Improvements

Geometric improvements should support goods movement and allow for harmonization with other modes. Geometric improvements include lane widening, adding left turn pockets, truck only lanes, repositioning utility poles, and turning radius corrections. These projects include small-scale spot improvements for better truck mobility and access.

5.5.7 Freight Management

Freight management includes a range of treatments such as changeable lanes, truck restrictions, time-of-day variations, idling control, and loading zone control. Options could include management of traffic to prioritize freight movements during certain times of the day or in certain areas or street segments (e.g. delivery windows, off-peak delivery). These projects can reduce traffic congestion and improve parking conditions on congested urban streets with limited additional physical capacity or infrastructure.

5.6 System Considerations

Implementation of any new investments to support freight mobility and meet identified needs must also be evaluated related to potential negative impacts or trade-offs on other modes, business, the community and the environment. These trade-offs include but are not limited to:

- Environmental impacts including increases in noise or worsening of air quality. In particular the City is committed to reducing Green House Gas (GHG) emissions. Some investments may reduce GHG by improving traffic flow and reducing idling.
- Impacts to low income, and limited English proficient (LEP) communities. Similar to the environmental justice provisions under the Environmental Protection Act[22] the City has adopted a Race and Social Justice Initiative to end institutionalized racism and race based in-equalities in Seattle. Improving the performance of the truck network supports the industrial sector and its provision of family-wage jobs. This outcome helps achieve wage equity and income equality.
- Modal integration and system resiliency investments in transportation infrastructure provides system-wide safety and mobility improvements for all modes and helps ensure overall system resiliency especially in response to catastrophic events.

All of the performance measures and other factors described throughout this chapter will be applied to establish a prioritized list of infrastructure and programmatic freight investments.

22 www.epa.gov/environmentaljustice/

Construction Impact Mitigation Report

NEXT GENERATION ITS

Prepared for:

SDOT

Seattle Department of Transportation

Presented by **Transpo Group**
11730 118th Avenue NE, Suite 600
Kirkland, WA 98034-7120
Phone: 425-821-3665 Fax: 425-825-8434
www.transpogroup.com

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Executive Summary

Executive Summary

The City of Seattle recognizes the need to employ strategies to minimize the impacts of construction on the travelling public by establishing the Access Seattle initiative, which focuses on a multi-modal approach for maintaining and improving accessibility into the downtown core. The plan focuses on the use of Intelligent Transportation Systems (ITS) strategies, based on studies showing that ITS tools are a cost-effective way to optimize roadway capacity without investing in major civil improvements. The scope of this construction mitigation plan addresses the anticipated transportation system impacts from the following five major construction projects:

- Alaskan Way Viaduct Replacement / Tunnel
- Elliott Bay Seawall Project
- Waterfront Seattle
- Proposed SODO arena
- Mercer West

While SDOT prepares larger ITS design and procurement packages, quick wins have been recommended as immediate implementation strategies that are anticipated to result in significant benefit. The quick win strategies recommended include, but are not limited to:

- Citywide Bluetooth reader deployment
- Traveler Information Map (TIM) enhancements
- "Access Seattle" mobile application

The larger ITS design and procurement packages require a larger capital investment as well as longer implementation timescales. These projects are assigned chronologically after the quick wins and are divided into separate corridors and geographic areas. Projects are separated into corridors and areas so that implementation would generally be completed prior to the anticipated construction impact. Understanding that SDOT is late in implementing ITS mitigation strategies with many major construction projects already significantly underway, several early projects were slightly delayed to reflect an implementation schedule that is both practical and feasible for SDOT to accomplish. Included in the recommended ITS mitigation projects are the following components and their primary benefits:

- CCTV Cameras: Provides operators with visual access for active management
- Dynamic Message Signs: Provides travelling public with on-route information regarding roadway conditions
- Origin-Destination Trackers: Provides data to provide travel time information for the travelling public.
- Blank-out Signs: Dynamically changes roadway restrictions to facilitate certain modes.
- Signal Re-timing: Adjusts signal timing parameters to adapt to changes in vehicle, pedestrian, and bicycle demands.
- Traffic Detection Systems: Improves operational efficiencies at intersections for vehicles, pedestrians, and bicyclists.

Construction projects typically results in added road closures, traffic detours, and restricted access. In addition to mobility impacts, the actual and perceived impediments to accessing downtown can have a negative economic impact on businesses, tourism, and freight movement, affecting the economic vitality and growth of the city. Without implementing the recommended mitigation strategies, SDOT's transportation system will be unable to keep up with the evolving construction environment, resulting in increased congestion, poor traveler awareness, citizen frustration, and reduced operational efficiencies. The strategies outlined in this report are purposed to alleviate these concerns and provide SDOT with a robust ITS system that will dynamically meet the upcoming needs of all modes during the next 8 years of construction and beyond as well as provide City staff with the necessary tools to proactively manage a complex transportation system.

Section 1:
Major Projects Overview

1. Major Projects Overview

Within the scope of this construction impact mitigation plan, the five major projects considered are:

- Alaskan Way Viaduct Replacement / Tunnel
- Elliott Bay Seawall Project
- Waterfront Seattle
- Proposed SODO Arena
- Mercer West

These projects were selected because they are expected to have the most significant impacts to the transportation system in Seattle's downtown core. Current project schedules indicate that the five identified projects will coincide at varying levels of completion, compounding the impact to the transportation system. There are other, smaller construction projects that will also contribute to the stress on the transportation network: Seattle City Light will replace street lighting along certain corridors and Puget Sound Energy will replace a major gas line during the construction of the tunnel. The impacts of these smaller projects were not included in the impact assessment of this report.

Alaskan Way Viaduct Replacement/Tunnel

The Alaskan Way Viaduct Replacement/Tunnel is a Washington State Department of Transportation (WSDOT) project that will replace the existing SR 99 Alaska Way Viaduct with a 2-mile long bored tunnel beneath the downtown city center. The south portal to the tunnel will be located adjacent to the existing stadiums: Safeco Field and Century Link Field. The north portal of the tunnel will be located near Seattle Center within the vicinity of the existing entrance to the Battery Street Tunnel between South Lake Union and Seattle Center. This project began in 2010 and is expected to continue through to the end of 2013 when the new tunnel will be open to the public. Although the AWV replacement tunnel will be complete in 2015, there will be subsequent work that will take place as part of other major projects to restore the Seattle Waterfront as a result of the viaduct removal.

Elliott Bay Seawall Project

The Elliott Bay Seawall Project is a City project that replaces the existing seawall from S. Washington St to Broad St. The seawall replacement will improve public safety by protecting Seattle's waterfront developments and infrastructure from seismic failure and tidal erosion. The existing wall is over 100 years old and has suffered from corrosion which could lead to a potential disaster should it fail. The Seattle waterfront is a major piece of the city's industrial and cultural history. The vibrant waterfront community includes businesses, residences, and multi-modal transportation facilities, all of which support recreation, tourism, and commerce. As a prerequisite in the redevelopment of Seattle's Waterfront, the Elliott Bay Seawall project will begin in late 2013 and continue through 2015.

Waterfront Seattle

The Waterfront Seattle project is an effort led jointly by the SDOT, the Department of Planning and Development, and the Central Waterfront Committee to revitalize the Seattle Waterfront. The Seawall Replacement and the Alaskan Way Viaduct projects will create new public space along the waterfront for 26 blocks from the Olympic Sculpture Park to Pioneer Square. This new space will be used for parks and paths as well as a new street designed to accommodate multiple modes of travel. The project is currently undergoing environmental review and is estimated to begin construction in early 2016 and be completed in 2019.

Proposed SODO Arena

The proposed SODO Arena project consists of a new sports arena on 1st Ave South between Edgar Martinez Drive and South Holgate Street, south of Safeco Field. The construction of the new arena will have an impact on congestion in the surrounding area. The presence of a new arena may also have an impact on the area's existing industrial land uses as well as the current traffic demand during events. Construction of the arena is contingent upon the City's acquisition of a professional basketball team. However, if constructed, the project is expected to begin mid-year 2014 and be completed by late 2015.

Mercer West

The Mercer West Project consists of the final phase of the City of Seattle's Mercer Corridor project. Mercer West changes the roadway alignment on Mercer Street from Dexter to 5th Ave West to a two way street that will provide east-west connections between I-5 and Elliot Avenue West. This project will provide a crossing across Aurora Avenue and enhance the connection between South Lake Union and Lower Queen Anne , including the Seattle Center. Construction began in April of 2013 and is expected to be completed in the summer of 2015.

Figure 1. Major Construction Projects

Section 2:

Mitigating Construction Effects

2. Mitigating Construction Effects

The primary objective of this task is to develop a strategic mitigation plan that utilizes ITS technologies to offset the cumulative major construction impacts, in accordance to the Access Seattle initiative. The following elements were completed to provide the City with a roadmap to the recommended mitigation strategies:

- Identify construction project schedules and impacts
- Identify impacted corridors
- Identify construction mitigation strategy
- Inventory existing ITS equipment
- Recommend ITS technology and improvements
- Identify implementation projects
- Prioritize projects and provide cost estimates

Construction Project Schedules and Construction Impacts

The first step to identify the impacts of the construction was to evaluate the phasing and schedule of each project to determine anticipated closures and detours.

Project phasing plans and schedules were obtained from the project websites and charted to gain an understanding of the overlaps, parallel, and sequential activities. The identified closures and phasing plans were entered into a GIS map to illustrate the progressions for each project in quarterly time periods (see Appendix A for more details). The GIS maps were reviewed with representatives from the projects to confirm planned closures and predicted impacts to traffic. During this process, impacted roadway segments were defined based on the planned phasing and anticipated diversion routes. One conclusion drawn from these discussions was that the impact area of the construction should not be contained only to the immediate vicinity, and should encompass the arterial streets and corridors affected by traffic diversion. Furthermore, the impact of multiple projects occurring simultaneously would have a compounding effect.

Using the GIS map along with a quarterly snapshot provided an opportunity to cycle through the predicted cumulative impact of multiple construction projects. These were grouped into a series of representative quarters based on when projects, or a major phase, would have significant traffic impacts. This resulted in six impact-based project groupings as shown in Table 1.

Table 1. Impact-Based Projects Groupings

Timescale	Projects Under Construction
Q3 2013	Alaska Way Viaduct, Mercer West
Q4 2013 – Q2 2014	Alaska Way Viaduct, Mercer West, Seawall
Q3 2014	Alaska Way Viaduct, Mercer West, Seawall, SODO Arena
Q4 2014 – Q3 2015	Opening of Tunnel, Mercer West, Seawall, SODO Arena
Q1 2016	Viaduct Demolition, Seawall, SODO Arena, Waterfront Seattle
Q2 2016 – Q4 2016	Waterfront Seattle, Tunnel Surface Street

For each timeframe, the anticipated routes impacted were identified by the cumulative effect. One important finding to note is that the culmination of project impact would reach its peak during 2015 Q4. The GIS maps associated with each timescale are presented in Appendix A.

Another predicted impediment to downtown Seattle access caused by construction is parking capacity. The reduction of available on-street parking may result in a reduction of overall downtown activity. A component of the Seattle Next Generation ITS project addresses parking needs and is further discussed in Task 4.

Impacted Corridors

Table 2 provides a summary of all of the corridors affected by identified construction projects. These have been determined using the criteria mentioned previously. The corridors are separated into three primary geographic areas:

- North: Corridors north of Denny Way
- Central: Corridors between Yesler Way and Denny Way
- South: Corridors south of Yesler Way

Table 2. Affected Corridors

North	Central	South
1st Ave North/ Queen Anne Ave North	1st Ave	1st Ave South
5th Ave North / Valley St	2nd Ave / 4th Ave	4th Ave South
6th Ave North	5th Ave	6th Ave South
Elliot Ave / Western Ave (North of Denny)	Elliot Ave / Western Ave	Yesler Way
Dexter Ave	Stewart St / Howell St / Olive Way	Airport Way South
Denny Way	Marion St / Madison St	
Westlake Ave North		South Spokane St.
Nickerson St.		

The approach to selecting projects was based on the following criteria in order of importance:

1. Proximity of the corridor to one (or more) of the major construction projects
2. Quantity/impact of construction projects affecting the corridor
3. Broadest impact to user types including transit, freight, pedestrians and cyclists
4. Project packaging and scheduling

It was established that focusing on key decision-making points would be considered highest priority, followed by operational necessity. This held true even when an entire corridor may have been impacted by a specific project. Through this strategy and the approach for ITS device placement mentioned previously, cameras, DMS, and LPRs were proposed according to the device maps presented in Appendix B.

Stakeholder Outreach

Several functional stakeholders were identified and contacted to create a better picture of Seattle's transportation infrastructure, system status, and perceived impact of upcoming construction projects. These stakeholders included emergency services, freight mobility, IT, major projects, parking, signal maintenance, signal ops, TMC, tolling, traffic management, and transit. Different departments within the City of Seattle were contacted to give their input and a series of meetings were held to better understand the role each stakeholder would play in the operation of a network. Below is a sample of the department specific questions asked:

- **Freight** - What are the major existing bottlenecks for freight mobility and port traffic within the city?
- **Emergency** - How does your group currently interact with the SDOT TMC and describe the effectiveness of emergency response coordination efforts?
- **Major Projects** - What are you project's known impacts to the surrounding transportation system?
- **Signal Maintenance** – How is the signal maintenance group involved with deploying temporary ITS systems to support the upcoming major construction projects?
- **Parking** - How do you foresee the major construction projects impacting the existing parking facilities within the city?
- **TMC** - Which areas in the transportation network are most impacted by the current construction activities in the City? With the additional major projects that will take place, which areas do you foresee as being impacted the most?
- **Transit** – With the major construction projects that will take place in the City, what type of coordination has taken place between the City and the various transit agencies (KC Metro, Sound Transit, and Community Transit) to maintain or improve transit service?

Construction Impact Mitigation Strategy

Construction Impact mitigation in the next 8 years will be accomplished by providing the traveling public with the information to make the best decisions on travel mode and travel route. The best information will be a combination of advanced notice of potential impacts and real-time traffic conditions. This will be accomplished by deploying adequate ITS field devices within and approaching the impacted areas to collect real-time data and implementing the adequate technologies to communicate information to travelers. Information should reach the traveling public in real-time, on the road, and at the home and office before trips begin. This information should benefit all downtown users and multiple modes of travel (commuters, commercial vehicles, leisure visitors, ferry riders, etc.).

Existing ITS Equipment Inventory

In order to develop a strategic ITS implementation plan, an understanding of the existing ITS system is required. Existing infrastructure and ITS field equipment were inventoried and stored on the GIS tool which was developed as part of this task using data acquired from SDOT's GIS database and city records. The data includes locations of traffic signals, communication systems, CCTV cameras, Dynamic Message Signs (DMS), and License Plate Readers (LPR). Once an understanding of the existing signal and ITS system was achieved, a gap analysis was performed to identify system deficiencies on the impacted corridors.

Recommended ITS Technologies and Improvements

After assessing the traffic impacts of the major construction projects and identifying the construction mitigation strategy, the appropriate ITS technologies and improvements were recommended. The combined use of the following technologies and improvements will allow the successful roll out of the identified strategy in a reasonable time frame and cost:

- **CCTV Cameras**: Provides traffic management operators the ability to monitor incidents and traffic conditions in real-time.

- **Dynamic Message Signs**: Provides the ability to communicate information to travelers (drivers, bicyclists, pedestrians) in real-time.
- **Vehicle ID Technology**: Provides the ability to identify unique vehicles to calculate travel times.
- **Blank-out Signs**: Dynamically prohibits specific movements during a specific conditions
- **Traffic Signal Retiming**: Updates signal timing plans to accommodate current traffic demand (vehicles, bicycles, and pedestrians)
- **Traffic Signal Detection**: Improves a signal system's ability to detect vehicles and bicycles for better operational capability and future upgrade potential.

In addition to what is listed above, adaptive signal control (ASC) was also considered as a mitigation strategy. It is our recommendation that ASC not be deployed for construction mtitgation and that further analysis and modeling should take place to analyze the true benefits from ASC. Task 3 discusses the potential of ASC in detail.

1. CCTV Cameras

Pan-Tilt-Zoom (PTZ) CCTV cameras allow for the active monitoring of traffic conditions and incidents from the Traffic Management Center (TMC). Real-time streaming video of the traffic system is the most useful tool for assessing current traffic conditions and incidents. CCTV video provides the most interpretable and digestible format of information to the public. As part of SDOT's procedures, operators are required to verify incidents through CCTV camera prior to public dissemination. With anticipated increase in traffic as well as continual shifts in construction impacts, additional CCTV coverage is necessary for TMC operators to proactively detect incidents and system irregularities. A more complete and comprehensive CCTV network enhances overall traffic management capability and response.

Typical SDOT PTZ Camera

Deployment Strategy

Given the terrain of downtown Seattle and the number of high-rise buildings, providing full coverage and eliminating all blind spots is not economically feasible in the context of construction impact mitigation; therefore, strategic placement of cameras is essential. The following criteria were used to select locations for camera placement:

- Intersections of identified impacted routes
- Key access/decision points
- Vicinity of at-grade railroad crossings
- High accident locations
- Additional strategic locations

The general strategic pattern for camera placement is a grid array throughout the downtown core at approximately every other intersection.

Benefits

CCTV cameras are SDOT's primary tool used by TMC operators to confirm incidents. More coverage in the existing camera network will be necessary to deploy the defined mitigation strategy. CCTV coverage allows for the quick dissemination of traffic incidents and conditions to the public.

2. Dynamic Message Signs

Dynamic Message Signs (DMS) are effective for providing information to the travelling public "on the streets." DMS are effective because they capture a wide audience including drivers, bicyclists, and pedestrians. Information typically conveyed on a DMS includes delay times, suggested alternate routes, as well as information on closures and incidents. The two main types of DMS are portable and permanent fixtures. Portable signs are typically installed on mobile trailers and are commonly used during construction or event management. Permanent DMS are installed at strategic locations where there is as identified need for specific information. Determining the placement of DMS signs requires a tactical system approach to identify decision points where the displayed information has value to influence a user's route or mode choice.

Deployment Strategy

Several DMS at strategic locations have already been installed in anticipation of the Alaskan Way Viaduct project. Additional DMS locations are recommended to provide users with information at key decision points. These DMS deployments are designed to target travelers approaching the central business district with a few within downtown targeting ferry traffic.

Typical SDOT Dynamic Message Sign

Benefits

Dynamic message signs benefit the travelling public by keeping them informed about major incidents, route-specific information, and advisories. The benefit of DMS is that is can be observed by all roadway users including vehicles, pedestrians and cyclists. During the next 8 years of major construction, DMS will provide the City with the flexibility to post a wide array of messages and proactively communicate to roadway users in the transportation system. One of the largest benefits of DMS in a construction setting is the ability to suggest alternative routes and modes to distribute the roadway volumes to relieve congestion. As such, deployment at key decision points is vital. Where a DMS is strategically located is just as important as the information they convey.

3. Vehicle ID Technologies

There are different vehicle ID technologies available for roadside application. Two popular choices are License Plate Readers (LPR) and Bluetooth sensors. Vehicle identification technologies allow for the match of unique identifiers from two locations to calculate travel times. This information can be shared with the public through DMS, local media, and traveler information sites on the web. A thoroughly deployed vehicle identification network can also provide operators and engineers with valuable origin-destination data for transportation planning and performance measurement.

With a large selection of different roadside device options, SDOT will need to consider deployment cost, ease of installation, and ability to interface with other ITS systems including the SDOT TMC system. Past deployment within the City has predominantly been LPR as they have exhibited a high level of accuracy.

Deployment Strategy

Regardless of the vehicle identification technology selected, we generally recommend that each new DMS include a corresponding set of vehicle identification devices to provide travel time data. Many existing LPR placements are located at corridor limits to capture traffic as it passes into key areas. Gaps in the existing system were considered in the proposed locations of DMS placements and additional locations were considered to provide times at key decision points. As a strategy for quick procurement and deployment, Bluetooth readers have been recommended as they require minimal infrastructure and communication upgrades.

Benefits

Travel time information is valuable to both traffic operators and the traveling public (including Freight and Public Transport). Corridor performance can be measured in real-time using travel time information, and on the operations side, certain protocols can be triggered when travel times reach a determined threshold. Operators will be able to utilize their given tools to quickly respond to traffic events and conditions (signal timing, emergency response, DMS, etc.). Additionally, publishing travel times in real-time allows the public to make the best route and mode choices based on the most up to date information available.

4. Blank Out Signs

Electronic blank-out signs are dynamic signs with one dedicated message and can be controlled through various methods such as signal controller actuation or contact closures. These signs are commonly used in locations where there is a specific message that needs to be conveyed during a specific condition or time of day, rather than at all times.

Deployment Strategy

One of the other challenges identified through the SODO area is the delay caused by the various modes of transportation coming together in the same area. At-grade crossings of trains with other vehicles are a major concern for traffic operations. Advanced notice blank-out signs integrated with the rail crossing systems are an effective means of prohibiting movements onto blocked roadways. This could help mitigate the queuing that can occur at a railroad crossing. This will provide advanced warning to travelers when a rail crossing is closed and encourage users to take alternate routes. Placements of these signs will primarily

Typical Blank Out Sign

be for turning movements where the rail crossing may not be visible. Blank out signs will also be used to restrict turning movements at intersections with high pedestrian movements. This strategy will improve pedestrian safety at high pedestrian volume intersections and minimize congestion created by vehicles waiting to turn. In addition to rail crossings, we recommend blank out signals to re-enforce a "NO RIGHT ON RED" restriction where heavy pedestrian activity is experienced. Blank-out signs are a relatively low cost option for a location that requires one active dedicated message. DMS may be considered at locations where there would be a benefit to multiple dynamic messaging.

Benefits

Blank-out signs can significantly enhance message importance (such as NO RIGHT ON RED) when compared to traditional static signs. The dynamic sign uses a more active approach to tell the motorist if the governing condition exists rather than what to do when the condition might exist. The Blank-out sign uses the active approach to tell the motorist if the governing condition currently exists, rather than what to do when a condition might exists. Blank-out signs are a relatively low cost option for a location that requires one active dedicated message. DMS may be considered at locations where there would be a benefit to multiple dynamic messaging.

5. Traffic Signal Retiming

The traffic signals within the study area are predominately operated in fixed time (time-of-day) plans (see Task 3). The signals were last re-timed in 2008/2009 and do not account for the change in demand since nor the impacts caused by construction already underway. Fixed plans do not cope well with changing traffic patterns and many locations already do not handle existing traffic efficiently. Changing traffic signals to a more responsive solution such as Adaptive Signal Control is very capital-intensive and is not recommended as a construction mitigation strategy. Retiming existing plans to accommodate predicted demand changes is a more cost effective option to make existing traffic signals operate more efficiently.

Deployment Strategy

Three different timing options have been considered for deployment at almost 400 signals in the central business district:

1. Retime large areas with closely-linked signals
2. Retime signal corridors to "meter" traffic approaching the CBD by increasing the wait times at key intersections in order to minimize the effect on the core intersections
3. Introduce a Leading Pedestrian Interval (LPI), which delays a right or left turn for 3-5 seconds while crossing pedestrians have an opportunity to enter the crosswalk and increase their visibility to turning traffic

Options 1 and 2 both require substantial effort for data collection and modeling but yield more widespread results. Option 1 requires a large number of linked intersections so it will be deployed in the CBD core, where efficiencies in data collection and the close inter-relationship of all major corridors make it the most viable option. Option 2 will be deployed in three areas on major corridors entering the CBD. Option 3 will be deployed at selected locations in the CBD where high pedestrian and turning vehicle volumes create conflict points that require mitigation.

Benefit

Options 1 and 2, while being resource-intensive, allow for substantial gains in efficiency without impacts to traffic (i.e., from construction). Their primary drawback is that this efficiency fades over time as traffic flows shift, in particular with shifting construction impact areas, and may require constant revision. Option 3 allows for increased pedestrian safety at crossing points, with only nominal impacts to vehicle efficiency.

6. Traffic Signal Detection

Historically, there has been limited vehicle detection deployed at intersections in downtown Seattle because they operate on fixed timing. There are several opportunities to supplement this limited detection for specific target groups (i.e., cyclists, pedestrians, high left turning volumes). Detection can be installed on a temporary basis and shifted as needs change due to construction. These supplemental detection options include quadrupole loops for bicycle detection, passive pedestrian detection, and temporary video detection.

Deployment Strategy

Temporary video detection will be deployed where volumes are expected to shift or additional detection would allow for a signal to operate more efficiently. The temporary nature of the recommended video detection system allows it to be relocated to new intersections as volumes due to construction activity shift. Pedestrian detection systems will be deployed where moderately high pedestrian volumes exist, particularly in locations where there is potential for slow-moving or distracted pedestrians (such as tourists on the waterfront). The pedestrian detection can be configured to influence signal phasing/timing. Bicycle traffic will be better detected with the use of quadrupole loops on identified bicycle routes.

Benefit

Supplemental detection options provide a number of benefits to their targeted groups and overall mobility. Temporary video detection can increase the ability of an intersection to react to changing flows, and to make phasing more efficient. Pedestrian detection has benefits to safety and efficiency by extending walk phases for slow pedestrians, calling a walk phase for pedestrians who have not pressed the push-button, and canceling a call for pedestrians who leave the crossing. Likewise, quadrupole loops have benefits to safety and efficiency for cyclists by providing more reliable detection on bike facilities.

Section 3:

Projects

3. Projects

Project Descriptions

1. Bluetooth Reader Pilot Project (2013 Q3)

The Bluetooth reader pilot project will test the accuracy and reliability of Bluetooth readers to produce travel times. The project results will determine whether or not Bluetooth readers are a viable alternative to LPRs. Compared to LPRs, the Bluetooth readers will be assessed for cost, ease of operation, and ease of installation.

Project Components:

Bluetooth Readers: 10

Project Cost:............. $70,000

2. Access Seattle Mobile Application (2013 Q3)

The project will create a mobile phone application called "Access Seattle" that pulls construction-staging data, TIM, project staging and construction timetables, as well as real time transit information. This application would allow users to access information about what to expect in terms of current and future detours and road closures. The application will provide users with routes to navigate through Seattle while avoiding congestion. Additionally, the application could automatically push information to users about certain routes they personally "subscribe" to.

Project Cost:............. $350,000

3. Center City Active Traffic Management (2014 Q1)

The project will install 75 Bluetooth readers and 8 DMS on selected corridors allowing the City to obtain time stamped vehicle location data such that travel times can be calculated and disseminated. This travel time information can provide both passenger travelers and freight/commercial vehicles with travel information to be used at key decision making points for selecting alternate routes, enticing modal change and influencing traffic demand. Travel time information can be displayed on DMS, TIM, and the "Access Seattle" Mobile Application. This information allows roadway users to make better decisions resulting in a reduction of congestion on major corridors as well as enhanced pedestrian and bicycle safety. The travel time data is also a valuable insight into network performance for the Traffic Management Center and can be used to increase speed of incident response, assist in signal timing efforts, corridor optimization and transit reliability. High priority candidates for Bluetooth reader installation are: 1st Ave S, 1St Ave, 4th Ave, 2nd Ave, Broad Street, Mercer Street, E Marginal Way, Spokane, Denny Way and Alaskan Way.

Project Components:

Bluetooth Readers: ... 75

DMS: 8

Project Cost: $3,800,000

4. Center City Dynamic Signal Timing (2014 Q1)

Travel demand through the Center City is expected to fluctuate during construction of major projects. Dynamic signal timing patterns can be implemented to respond in real-time to accommodate the changing demand. Expected improvements include reduced travel times on primary corridors through the Center City, quicker access to freeways, and increased transit service reliability. Corridor and locations considered for signal timing upgrades include Denny Way, SODO, Capitol Hill, South Lake Union, Queen Anne, and Central CBD.

Project Components

Signal Retiming: 300

Signal Equipment Upgrades: 20

Project Cost: $1,350,000

5. Center City Traffic Camera Deployment (2014 Q1)

This project will install CCTV cameras on major routes into the Center City; specifically on Alaskan Way, 1st, 2nd, 4th, and 5th Avenues. This project will increase the coverage within the Center City to monitor traffic and assess traffic management strategies. Emergency responders will be allowed access to the camera images.

Project Components

CCTV Cameras.......... 64

Project Cost:.............. $1,900,000

6. Railroad Crossing Information Signs (2014 Q1)

This project will install blank-out signs at signalized intersections adjacent to major east-west railroad crossings at Broad St, S Atlantic St, S Spokane St, Lander St, and S Holgate St. These signs will lessen queues at the crossing gates and provide advanced warning of the temporary closure to approaching traffic including emergency responders.

Project Components

LED Blank-out Signs.. 20

Project Cost:.............. $435,000

7. Ferry Arrival Signal Preemption (2014 Q1)

This project will provide SDOT with the capability to obtain and use real-time vehicle capacity data from Washington State Ferries to efficiently clear ferry traffic. This data will be used to automatically select and implement the appropriate signal timing plan for Marion Street upon ferry disembarkation. Blank-out signs will inform drivers on Alaskan Way, Western Ave, 1st Ave, and 2nd Ave of ferry arrival and the estimated duration of the delay. Turn restrictions may also be triggered along the Marion Street corridor.

Project Cost:.............. $80,000

8. Spot ITS Improvements (2014 Q1)

This project will install DMS, Bluetooth (or LPR readers), and CCTV cameras on major routes into the Center City; specifically at Elliott Ave W/W Mercer Pl in Interbay, Delridge Way SW in West Seattle, W Marginal Way S in South Park, and Airport Way S/S Lander St in South Seattle. These devices will allow SDOT to provide travel time and incident information to travelers of these major routes.

Project Components

CCTV Cameras: 25

Bluetooth/ LPR Readers: 12

DMS: 5

Project Cost:.............. $2,800,000

9. Denny Way ITS (2014 Q3)

The Denny Way corridor between I-5 and Western Avenue carries a large percentage of general purpose traffic and freight and distributes it onto major north-south corridors including I-5 and 1st, 2nd, and 5th Avenues. Upgraded signals, vehicle detection, traffic cameras, dynamic message signs, and fiber communication will be installed on Denny Way to improve traffic flow and provide enhanced traveler information. A system engineering evaluation will be completed to determine if adaptive signal control should be included as part of the project.

Project Components

CCTV Cameras: 6

DMS: 1

Signal Upgrades: 14

Project Cost:.............. $4,315,000

10. South Spokane Street ITS (2015 Q1)

Bluetooth readers and dynamic message signs will be installed on South Spokane Street from Airport Way to Terminals 5 and 18 (Port of Seattle) to provide travel times. This is an important corridor for freight traffic. The project will provide travel information for trucks with destinations north of Seattle.

Project Components

Bluetooth Readers: 20

DMS 1

Project Cost:.............. $665,000

11. 1st Avenue South ITS (2015 Q1)

1st Ave S between S Spokane St and East Marginal Way is important for movement of freight and access to the stadium area. Traffic responsive signal operation will be extended on this segment of 1st Ave. This will involve upgrading signals and installing vehicle detection, fiber communication, and traffic cameras.

Project Components

CCTV Cameras:......... 3

Signal Upgrades: 5

Project Cost:.............. $1,590,000

12. South Michigan Street ITS (2015 Q2)

Bluetooth readers and traffic cameras will be installed along S Michigan Street between East Marginal Way S and Carleton Avenue S to provide general purpose traffic and freight information for travel through Georgetown, I-5, SR 509, and SR 99. Signals will be upgraded and vehicle detection and fiber communication will be installed.

Project Components

CCTV Cameras:......... 6

Bluetooth Readers: 8

Signal Upgrades: 5

Project Cost:.............. $1,600,500

13. Nickerson/Westlake ITS (2015 Q1)

This project will install Bluetooth readers on the W Nickerson St/Westlake Ave N corridor that links Ballard's industrial area to South Lake Union and I-5. Ten Bluetooth readers will be installed on portions of 15th Ave W, W Nickerson St, Westlake Ave N, Mercer Street, and Fremont Avenue North to provide travel time information on the corridor.

Project Components

Bluetooth Readers: 10

Project Cost:.............. $50,000

Supplemental Project Descriptions

14. 1st Avenue CBD ITS (2013 Q4)

It is anticipated that 1st Avenue will be most severely impacted from major construction consistently throughout the next 8 years. This corridor has close proximity to SR 99 and the Seattle waterfront, so it is one of the first corridors that many roadway users consider as an alternative for north-south connectivity. It is highly congested at present time and will require investment just to maintain existing performance. This project will install CCTV cameras to help City staff monitor congestion and detect incidents along 1st Avenue. Due to this corridor's proximity to the Colman Dock, it will also include DMS installations SB at Spring St and Marion St to inform the public on queuing conditions at the ferry terminal. Finally, blank-out lane control signs to ban right turns during heavy pedestrian flows will be installed at 3 locations along the corridor – tentatively placed at Yesler, University, and Pike Streets pending further evaluation. By banning right turns, crossing pedestrians face fewer conflicts while through vehicle traffic on 1st Avenue has less friction.

Project Components

CCTV Cameras:......... 10

DMS:......................... 2

LED Blank-out Signs: . 3

Project Cost:............. $551,000

15. Alaskan Way ITS (2013 Q4)

Alaskan Way and the Elliott Bay Trail along the waterfront will have frequent demand changes impacting motorists, freight, pedestrians, and bicyclists from the waterfront and SR 99 projects. Four CCTV cameras will be installed along Alaskan Way to monitor these frequently changing conditions. This area is also isolated from other City surveillance by the viaduct so the new cameras are required for the City to monitor traffic along the waterfront. An additional camera will be installed on Columbia St to aid transit exiting SR 99 to access 3rd Ave. Temporary passive pedestrian detection will be installed at two locations along the waterfront to make pedestrian crossings safer and more efficient. These installations are envisioned for University St and Pike St but will require further evaluation to finalize.

Adaptive signal control is not recommended for Alaskan Way; see the Task 3 report for more details.

Project Components

CCTV Cameras:......... 5

DMS .... -

Passive Pedestrian Detection: 2

Project Cost:............. $72,500

16. Citywide LPR Deployment (2013 Q4)

The City's existing LPR network will be bolstered with the deployment of 21 additional readers in one rollout. These additional readers will add some missing coverage on southern approaches to the CBD. They will further set up cordons along Denny Way at the north edge of the CBD and between University and Seneca Streets in the middle of the CBD. This expanded coverage will provide better data on travel habits through the CBD and as well as travel times on most major north-south arterials. Deployment of the LPRs is necessary before substantial rollout of DMSs in other projects in order to produce travel times. It has also been placed early in the overall program schedule because data from the LPRs will be beneficial for the traffic signal retiming scheduled for 2014 Q1.

Project Components

CCTV Cameras:......... 0

DMS:......................... 0

LPR: 21

Project Cost:............. $1,827,000

17. SODO Phase 1 ITS (2014 Q1)

The SODO Phase 1 ITS will include an area-wide deployment of CCTV cameras and DMS in the area bounded by Yesler Way, 1st Avenue S, 4th Avenue S, and Spokane St. It will also install blank-out signs at signalized intersections adjacent to major east-west railroad crossings at S Atlantic St, S Spokane St, Lander St, and S Holgate St; these signs will reduce queuing at the crossing gates and provide advanced warning to oncoming traffic of the temporary closure. Temporary solar-powered flashing warning signs for pedestrians and cyclists will be installed on E Marginal Way S adjacent to construction haul routes and mobilization yards for SODO projects. This project will also include S. Dearborn St as it provides connections to I-5 from the SODO area. Providing arterial connections into Seattle from the south, 1st Ave S and 4th Ave S are important corridors to improve traffic monitoring capabilities through the use of CCTV cameras as well as inform roadway users of construction impacts in the CBD. Additionally, ITS upgrades in the SODO area will also help to improve efficiencies for freight movement.

Project Components

CCTV Cameras:......... 19

DMS:......................... 2

LED Blank-out Signs:. 8

Temporary
Warning Signs:........... 4

Project Cost:.............. $870,000

18. Mercer ITS (2014 Q2)

The Mercer ITS project will include CCTV cameras and DMS upgrades in the area bounded by 5th Avenue N, Roy St, Westlake Ave N, and Denny Way. This project will provide ITS upgrades primarily on 5th Ave N, Dexter Ave N, and Westlake Ave N, which are the major corridors impacted by the Mercer West and SR 99 projects. The additional CCTV cameras provide monitoring of north-south arterials that do not currently exist. The arterial DMS will provide travel time and incident information to motorists before they reach decision points at Denny Way. It is most important that this project be implemented prior to the Broad St closure of the SR 99 North Portal construction in Q3 of 2014 as this closure will have major impacts.

Project Components

CCTV Cameras:......... 5

DMS:......................... 3

Project Cost:.............. $493,000

19. I-5 Connector ITS (2014 Q2)

The I-5 Connector ITS project covers the streets that provide CBD access to/from I-5/90: Union, University, Seneca, Spring and James Streets. It will install CCTV cameras along these streets to provide congestion monitoring of traffic interchanging with the freeways. The cameras will be installed primarily at existing signalized intersections and provide fuller coverage of the steep grades along these streets. These freeway accesses relieve longer-distance freight and motorist traffic that might otherwise use SR 99 to northern and southern destinations.

Project Components

CCTV Cameras:......... 6

Project Cost:.............. $188,500

20. 2nd Avenue CBD ITS (2014 Q3)

It is anticipated that 2nd Ave, similar to 1st Ave, will be highly utilized as a southbound corridor through the CBD. This corridor will serve as an alternative southbound connector for SR 99 and 1st Avenue. This project will install CCTV cameras to help City staff monitor congestion and detect incidents along 2ndAvenue. DMS will also be installed along this corridor to inform travelers of ferry terminal conditions. Finally, three blank-out lane control signs to ban turns during heavy pedestrian flows will be installed at University, Pike, and Pine Streets pending further evaluation. By banning turns, crossing pedestrians face fewer conflicts while through vehicle traffic on 2nd Avenue has less friction from stopped turning traffic.

Project Components

CCTV Cameras: 9

DMS:......................... 1

LED Blank-out Signs:. 3

Project Cost:.............. $290,000

21. 4th Avenue CBD ITS (2014 Q3)

4th Avenue is expected to operate with similar characteristic as 2nd Avenue, providing northbound connections through the CBD. This corridor will serve as an alternative northbound connector for SR 99 and 1st Avenue. This project will install CCTV cameras to help City staff monitor congestion and detect for incidents along 4th Avenue as well as DMS to inform travelers of ferry terminal conditions. Two blank-out lane control signs to ban turns during heavy pedestrian flows will be installed at Pike and Pine Streets pending further evaluation. By banning turns, crossing pedestrians face fewer conflicts while through traffic on 4th Avenue has less friction from stopped turning traffic.

Project Components

CCTV Cameras:......... 10

DMS:......................... 2

LED Blank-out Signs:. 2

Project Cost:............. $493,000

22. Belltown ITS (2014 Q4)

The Belltown ITS grouping primarily covers Western Avenue and Elliott Avenue. As a major north-south corridor that serves as a convenient alternative to Alaskan Way traffic, Western and Elliott will experience higher demands. The implementation of CCTV cameras will be the primary ITS strategy to monitor traffic in this corridor. A DMS will be installed on Elliott Avenue W at approximately W. Harrison St. Although just outside of the Belltown neighborhood, this DMS is placed strategically to provide information before the key decision point at Denny Way and Western Avenue. By displaying travel times, incidents, and event notifications, the DMS can help travelers make more informed choices. Solar-powered flashing warning signs for pedestrians and cyclists will be installed adjacent to construction haul routes and mobilization yards. Finally, a blank-out sign will be installed at Broad St and Elliott Ave; this sign will reduce queues at the crossing gates and provide advanced warning to approaching traffic when a train is crossing.

Project Components

CCTV Cameras:......... 8

DMS:......................... 1

LED Blank-out Sign:... 1

Temporary
Warning Signs:........... 4

Project Cost: $377,000

23. Denny Triangle ITS (2015 Q1)

CCTV cameras will be installed along Westlake, Stewart, Olive, and Howell corridors. Implementation of this grouping will allow for improved video monitoring and traffic management capabilities. This will help improve flow for traffic entering the CBD on Stewart St and exiting the CBD via Olive Way to the east and Howell St to I-5. It also improves monitoring of vehicle and streetcar traffic along Westlake Ave. CCTVs will be installed at existing signalized intersections. Additional fiber optics may be required along Olive Way. A blank-out lane control sign to prohibit left turns (except transit) during heavy pedestrian flows will be installed on Stewart St at 5th Ave pending further evaluation. By prohibiting turns, pedestrians crossing around McGraw Square face fewer conflicts while through traffic on Stewart St have less friction. These corridors provide the primary access to the CBD, north I-5 and South Lake Union, as well as a detour route for Mercer St traffic during Mercer West construction closures.

Project Components

CCTV Cameras:......... 7

DMS:......................... 0

LED Blank-out Sign:... 1

Project Cost:............. $464,000

24. 5th Avenue ITS (2015 Q2)

The 5th Avenue corridor through the CBD from S. Dearborn St to Olive Way will have CCTV cameras installed. This provides congestion monitoring of southbound traffic traversing the CBD as well as a high volume of southbound suburban and regional buses. Two blank-out lane control signs to prohibit turns during heavy pedestrian flows will be installed at Pike and Pine Streets pending further evaluation. By prohibiting turns, crossing pedestrians face fewer conflicts while through traffic on 5th Avenue has less friction. 5th Ave provides an alternative southbound route when construction impacts SR 99, 1st Ave, and 4th Ave.

Project Components

CCTV Cameras:......... 9

DMS:......................... 0

LED Blank-out Signs:. 2

Project Cost:............. $174,000

25. SODO Phase 2 ITS (2015 Q3)

The SODO Phase 2 ITS will include ITS upgrades along 6th Ave S and Airport Way S. Due to impacts from the Arena project, traffic is expected to divert to these two north-south corridors. In addition to providing north-south connectivity, Airport Way also serves as one of the major alternate routes to I-5. With the cumulative impacts of projects anticipated in Quarter 4 of 2015, Airport Way S will attract many more users. Airport Way S is also identified as a future bicycle route into the CBD so bicycle detection will be installed as necessary for bicycle detection at major intersections along Airport Way S – S Lander St, S Holgate St, Maynard Ave S, 6th Ave S.

Project Components

CCTV Cameras:......... 8

DMS:......................... 2

Quadrupole
Loop Installation:........ 8+/-

Project Cost:.............. $681,500

Project Prioritization and Cost Estimates

The projects implementing the recommended ITS technologies need to be prioritized considering operational and logistical criteria. The approach to prioritizing the ITS deployments was based on the composite construction impact maps presented in Appendix A. Ideally, all planned elements along a corridor would be implemented in advance of the anticipated impact. Based on the significant impacts anticipated in the short term, other factors had to be considered for prioritization to account for lost time. It is important to note that many of the major construction projects underway have already introduced impacts- this includes The Alaska Way Viaduct project, Mercer West project, and preparations for the seawall replacement. Because this is not an ideal situation, an aggressive deployment schedule has been proposed to first catch up and get ahead of the existing construction.

By reviewing the construction scheduling and using the GIS tool, it was apparent that all improvements should be implemented prior to Q4 of 2015 as all major projects have construction occurring at that time.

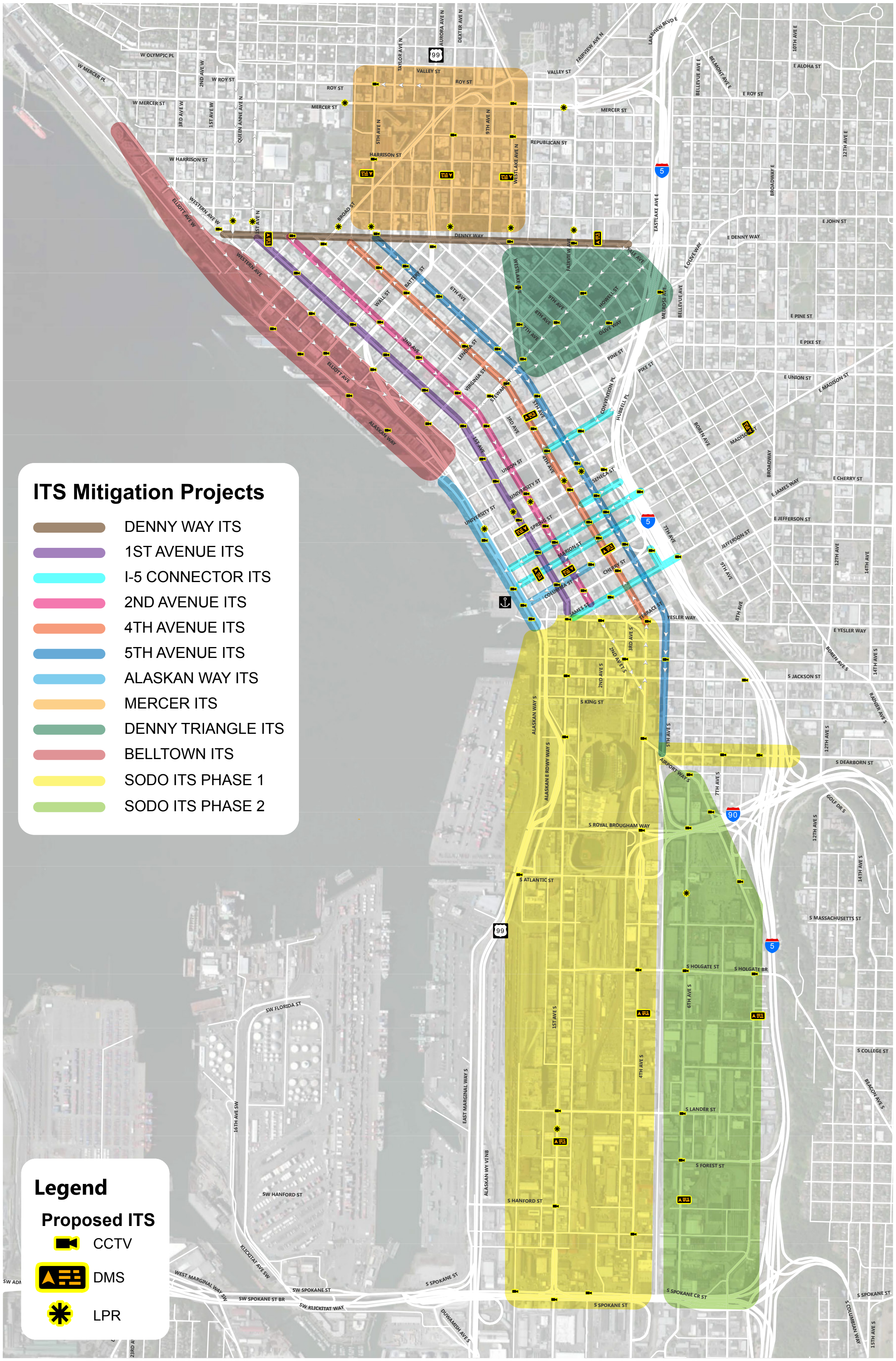
Table 3. ITS Projects Implementation Schedule Summary

Project Name	2013		2014				2015		
	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3
1. Bluetooth Reader Pilot Project	X								
2. Access Seattle Mobile App	X								
3. CBD Active Traffic Management			X						
4. CBD Dynamic Signal Timing			X						
5. CBD Traffic Camera Deployment			X						
6. Railroad Crossing Information Signs			X						
7. Colman Dock Ferry Arrival Information			X						
8. Spot ITS Improvements			X						
9. Denny Way ITS					X				
10. South Spokane Street ITS							X		
11. 1st Avenue South ITS							X		
12. South Michigan Street ITS								X	
13. Nickerson/Westlake ITS							X		
Supplemental Project Name									
14. 1st Avenue CBD ITS		X							
15. Alaskan Way ITS		X							
16. Citywide LPR Deployment		X							
17. SODO Phase 1 ITS			X						
18. Mercer ITS				X					
19. I-5 Connector ITS				X					
20. 2nd Avenue CBD ITS					X				
21. 4th Avenue CBD ITS					X				
22. Belltown ITS						X			
23. Denny Triangle ITS							X		
24. 5th Avenue ITS								X	
25. SODO Phase 2 ITS									X

Table 4. ITS Projects Cost Summary

Project Name	Project Cost
1. Bluetooth Reader Pilot Project	$70,000
2. Access Seattle Mobile App	$350,000
3. CBD Active Traffic Management	$3,800,000
4. CBD Dynamic Signal Timing	$1,350,000
5. CBD Traffic Camera Deployment	$1,900,000
6. Railroad Crossing Information Signs	$435,000
7. Colman Dock Ferry Arrival Information	$80,000
8. Spot ITS Improvements	$2,800,000
9. Denny Way ITS	$4,315,000
10. South Spokane Street ITS	$665,000
11. 1st Avenue South ITS	$1,590,000
12. South Michigan Street ITS	$1,600,500
13. Nickerson/Westlake ITS	$50,000
Supplemental Project Name	
14. 1st Avenue CBD ITS	$551,000
15. Alaskan Way ITS	$72,500
16. Citywide LPR Deployment	$1,827,000
17. SODO Phase 1 ITS	$870,000
18. Mercer ITS	$493,000
19. I-5 Connector ITS	$188,500
20. 2nd Avenue CBD ITS	$290,000
21. 4th Avenue CBD ITS	$493,000
22. Belltown ITS	$377,000
23. Denny Triangle ITS	$464,000
24. 5th Avenue ITS	$174,000
25. SODO Phase 2 ITS	$681,500

Figure 2. ITS Mitigation Projects




Legend
Impacted Corridor
Construction Activity
Full Closure
Construction Impact
Construction
Temporary Roadway
Temporary Parking
Ferry Queuing
Other
Colman Ferry Dock
Major Closure
W OLYMPIC PL
W ROY ST
W MERCER ST
W HARRISON ST
ROY ST
MERCER ST
VALLEY ST
HARRISON ST
REPUBLICAN ST
DENNY WAY
E DENNY WAY
ELLIOTT AVE W
WESTERN AVE W
WESTERN AVE
ELLIOTT AVE
ALASKAN WAY
BROAD ST
WESTLAKE AVE N
WESTLAKE AVE
DEXTER AVE N
AURORA AVE N
TAYLOR AVE N
5TH AVE N
9TH AVE N
QUEEN ANNE AVE N
1ST AVE N
FAIRVIEW AVE N
EASTLAKE AVE E
LAKEVIEW BLVD E
BELLEVUE AVE E
10TH AVE E
E ROY ST
BROADWAY E
YALE AVE
E OLIVE WAY
E PINE ST
E PIKE ST
E UNION ST
E MADISON ST
MADISON ST
JEFFERSON ST
BROADWAY
BOREN AVE
UNIVERSITY ST
UNION ST
SPRING ST
MARION ST
CHERRY ST
COLUMBIA ST
JAMES ST
TERRACE ST
YESLER WAY
S JACKSON ST
S KING ST
S DEARBORN ST
S ROYAL BROUGHAM WAY
S HOLGATE ST
S HOLGATE BR
SW FLORIDA ST
ALASKAN WAY S
ALASKAN WY VI NB
EAST MARGINAL WAY S
1ST AVE S
2ND AVE S
4TH AVE S
5TH AVE S
6TH AVE S
7TH AVE S
MAYNARD AVE S
AIRPORT WAY S
99
5
90

Figure 4. Construction Impacts (Q4 2013 - Q2 2014)

Figure 5. Construction Impacts (Q3 – 2014)

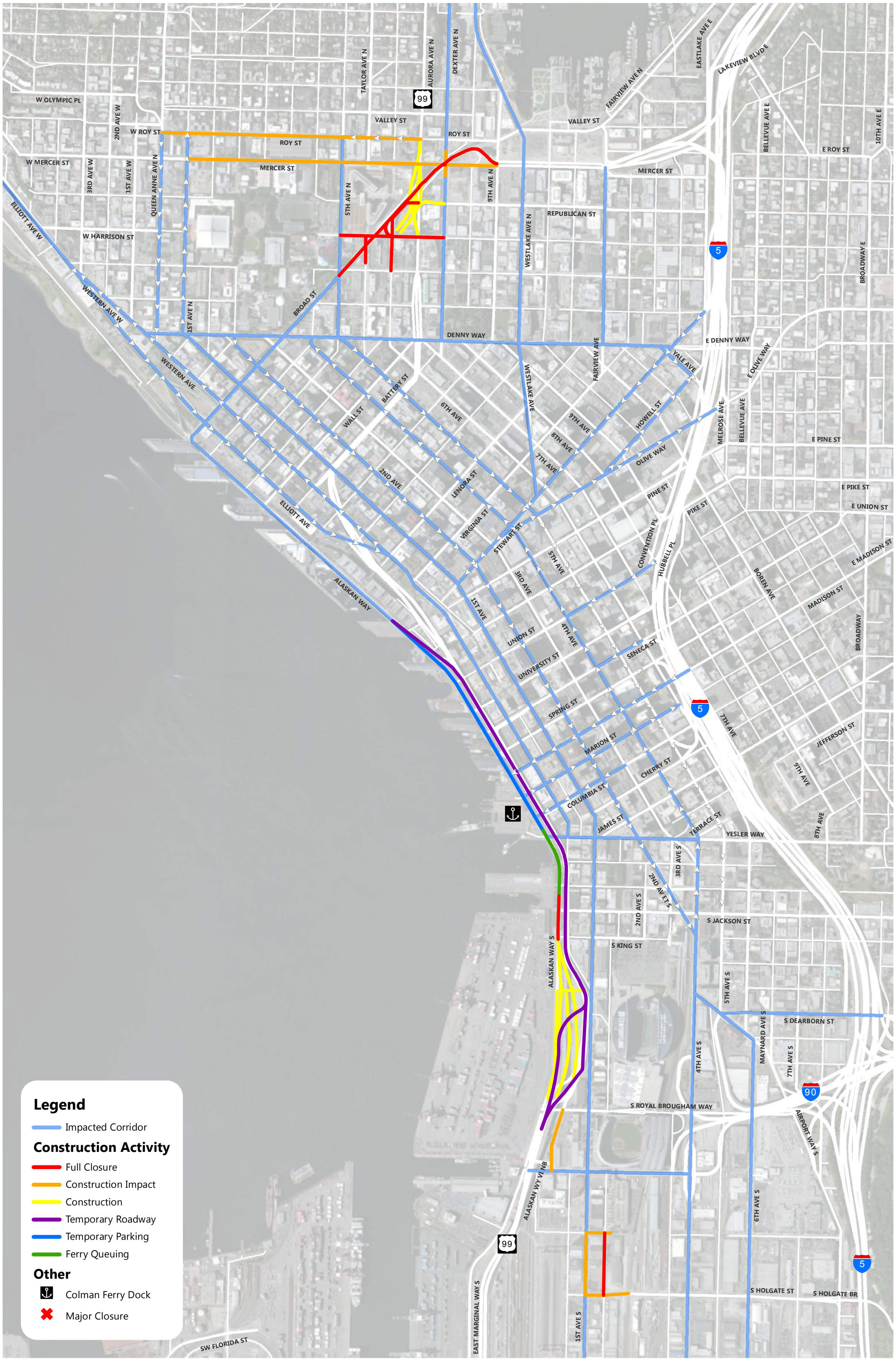


Figure 6. Construction Impacts (Q4 2014 - Q3 2015)

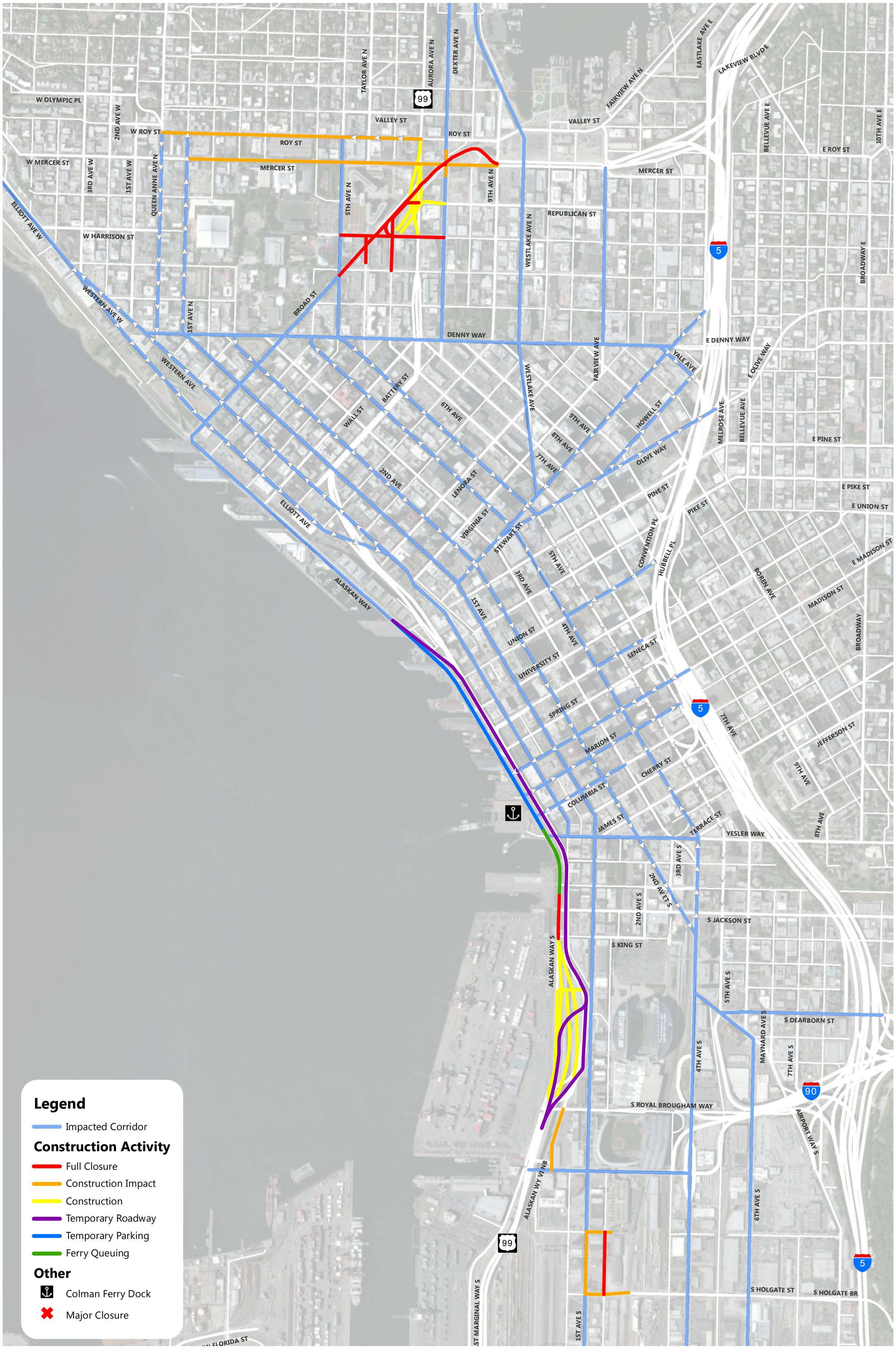


Figure 7. Construction Impacts (Q4 – 2015)

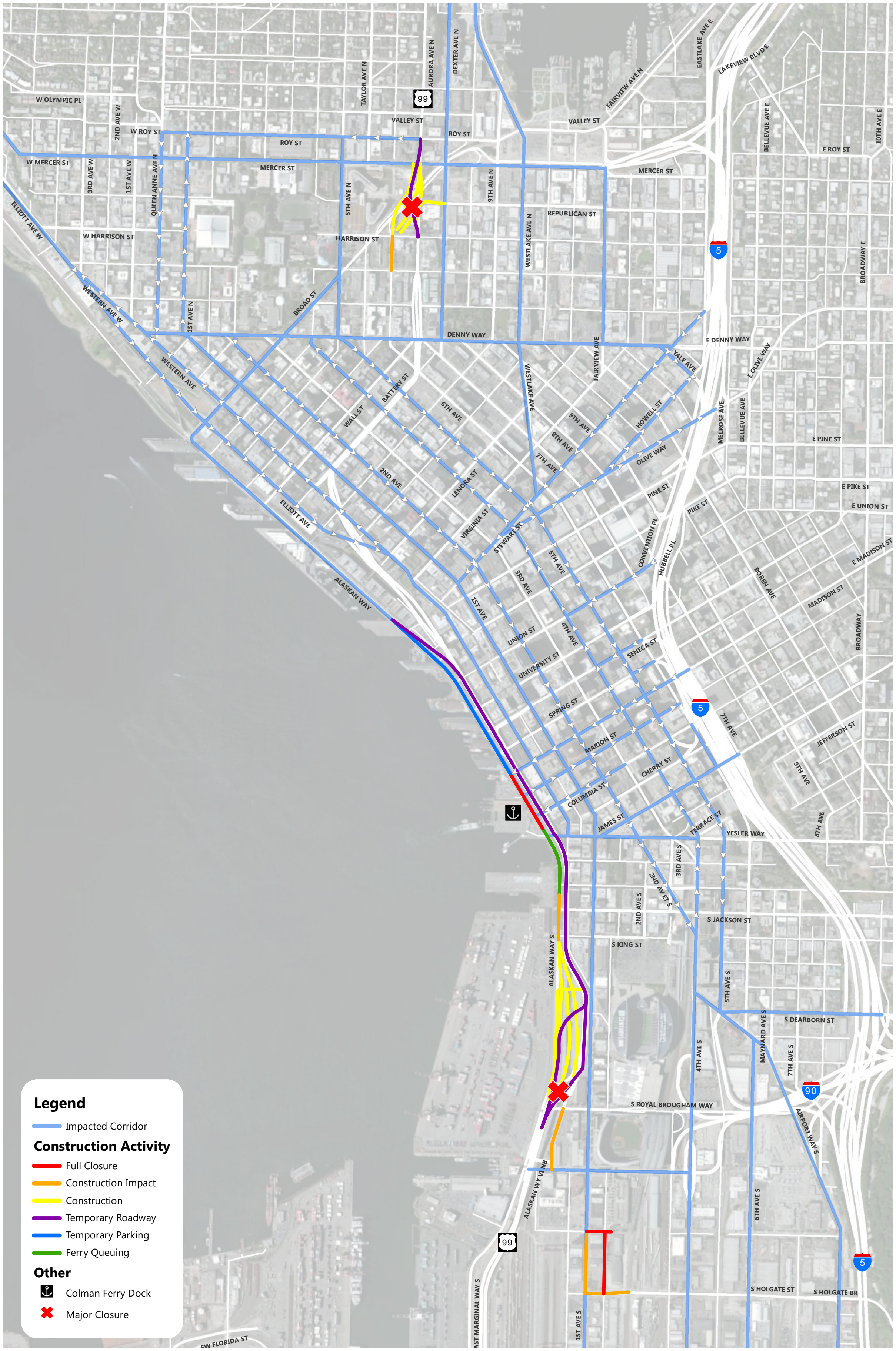


Figure 8. Construction Impacts (Q1 2016)

Figure 9. Construction Impacts (Q2 2016 - Q4 2016)

Figure 10. Construction Impacts (Q1 2017 - Q2 2018)

Section 4:
Recommendations

4. Recommendations

Following the above discussion, project identification and prioritization, the following high level recommendations are being made as part of the delivery of this Task:

ITS Projects

The Project Implementation Schedule (Table 3) does not completely align with when the corridors are impacted; however, this takes into account the City's best efforts in obtaining necessary budget, establishing RFP's, awarding contracts, and carrying out work. It is our recommendation that this schedule be followed as closely as possible in order to minimize the effects of construction.

Signal Timing

In conjunction with the implementation of ITS technology, a series of signal retiming efforts should be considered in the CBD at locations where the network has reached saturation. These timing efforts should be carried out in-house utilizing existing resources, using current and forecasted traffic data.

Back Office Requirements

The necessary improvements to the existing TMC / Back Office should be in place to support the ITS deployments immediately as they come on line. This includes additional staffing and the upgrade of the existing video wall. Implemented ITS will not be used to its full potential without these improvements. These requirements are discussed further in Task 2 and also recommended here to highlight its importance.

Geographical Information System

The GIS system should be improved and maintained. This can occur by integrating the system with current SDOT GIS systems or by introducing additional construction projects and impacted corridors. This effort will provide a tool for the City to gauge whether current and future deployed ITS strategies are adequate for construction mitigation and possibly identify any gaps in the system.

Appendix A:
GIS Tool Description

Appendix A: GIS Tool Description

Geographical Information System (GIS) Tool Description

To assist in the complex task of identifying impacted corridors, the timeframe in which those impacts occur, and development of the ITS mitigation strategies, an interactive Geographic Information System (GIS) map was created to display all construction projects through their different phasing on one platform noting overlaps, and highlighting major closures.

GIS is a digital mapping system that allows for relation of physical points, lines or polygons with metadata, in this case construction activities and time. The interactive layered nature of a GIS platform allows for construction phasing data to be entered and the impacts measured in an interactive manner without the need to resort to lengthy documentation and large static maps.

GIS Tool Purpose

The large number of major projects, unprecedented project overlap, and long timelines of these projects made the GIS tool critical to the project approach. Major construction projects, impacted corridors and the proposed ITS mitigation projects were mapped with time metadata. This allows for the use of a time slider in to advance or reverse through time while viewing all data sources.

The inventory taken for all ITS field devices and systems (such as existing CCTV cameras, existing DMS, existing LPR, existing Fiber and existing copper) was stored within this tool to provide SDOT with a single point of reference. Once ITS projects were identified, future ITS field devices and systems were also stored within this tool.

Using this GIS tool, a user can advance through time using the time slider. The different projects phasing's are displayed and the impacted routes highlighted. Along with the highlighted routes, ITS field devices are displayed in the priority and time frame they should be in place.

Tool Development

The GIS tool was developed using construction phasing documentation and stakeholder interviews. First, construction activities and closure dates were coded into the GIS tool for each project Construction activities from full roadway closures to temporary parking were coded and given a start and end date by quarter and year. This was done for all five major projects.

The interactive GIS tool was then used to identify major changes in construction activities and which downtown corridors would be most impacted. As the number of projects and their impacts increase from 2013 up till 2016 additional corridors are impacted. Identification of the impacted corridors and the time in which they are impacted was then used to identify, prioritize and create a phased ITS implementation plan.

Future Possible Uses

This tool will give SDOT staff an “easy to use” platform to understand and plan into the future. Where this tool contains the 5 major projects currently ongoing and planned, SDOT can continue to develop the construction, impacted corridors and ITS plan as new projects such as utility work or lighting are planned. This tool could also be used to quickly communicate construction phasing and ITS mitigation strategies to policy makers or the public.

Another use would be with 3rd party data integration. As identified within this report, one of our quick win recommendations was to integrate 3rd party data such as that from INRIX with current SDOT systems. This data, if fed directly into the GIS map, can highlight Network Performance. Using the same time slider can provide a means to measure how successful the ITS deployment strategies have been in relation to the current network performance.

Appendix B:
Proposed ITS Devices

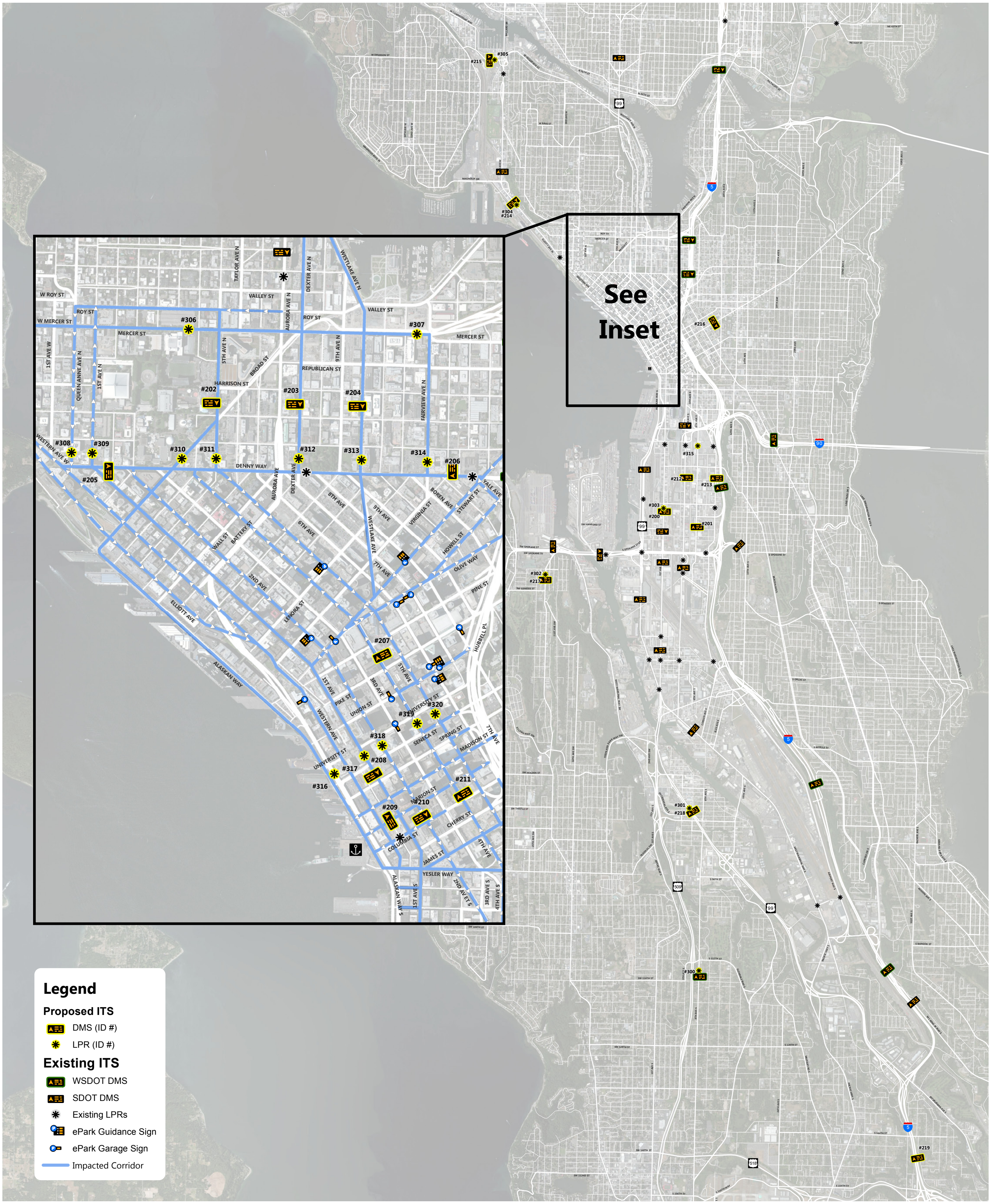

See Inset
Legend
Proposed ITS
DMS (ID #)
LPR (ID #)
Existing ITS
WSDOT DMS
SDOT DMS
Existing LPRs
ePark Guidance Sign
ePark Garage Sign
Impacted Corridor

Figure 12. Proposed CCTVs

APPENDIX A

FREIGHT MASTER PLAN STRATEGIC FRAMEWORK MEMORANDUM

DRAFT

MEMORANDUM

Date:	January 31, 2014 updated March 9, 2015	**TG:**	13152.00
To:	Tony Mazzella, SDOT		
From:	Project Team – Freight Access Project		
cc:	Ian Macek and Ron Borowski, SDOT		
Subject:	Freight Master Plan Strategic Framework		

This memorandum explores several issues and opportunities that have been raised as part of the Freight Access Project, but should be further evaluated within the context of the citywide Freight Master Plan (FMP). The specific topics that have been identified by the project team include:

1. Developing approaches to evaluate and communicate the economic significance of freight and our investments in freight infrastructure, and how freight relates to the regional economy, jobs, and ultimately consumers
2. Evaluating the freight transportation linkages between the Greater Duwamish and Ballard-Interbay Northend Manufacturing and Industrial Centers (MICs) and other major freight generators outside of the City
3. The need to re-evaluate the local street system in the context of freight to identify the criteria and methodology by which to determine a hierarchy of truck streets and associated design guidelines
4. Other policies, guidelines, processes, or standards that should be further evaluated or updated to address potential inconsistencies

Our review of each topic includes a discussion about the issue, and then presents an approach the City could consider to address the issue as part of the FMP.

Background Discussion about the Importance of a Freight Master Plan

Seattle's industrial and commercial areas are in transition, with heavy industry and distribution functions moving to outlying locations and being replaced by smaller businesses and service providers. The freight transportation needs are changing in parallel, and the system that served an earlier era, needs to adapt as well.

While the Freight Access Project is analyzing access to the MICs and planning for a local truck street system in those areas, it should ultimately be conducted within the context of an FMP. The FMP would help focus and prioritize efforts, and provide solid policy basis for specific projects or programs that might be identified as part of the Freight Access Project effort.

An FMP would typically address the following areas:

- Explain the role that freight movement now plays, and will play, in Seattle's economic growth and quality of life
- Identify the assets and systems that together make up Seattle's freight movement network, and plan for their development and maintenance
- Link freight transportation needs and plans to Seattle's land use planning
- Address the critical need for co-existence of freight with other transportation modes
- Identify and prioritize projects, initiatives, and other actions to provide the goods movement capability Seattle needs, while mitigating adverse impacts on the environment and the community.

The essential nature of freight transportation guarantees that the goods Seattle needs will be shipped and delivered. Freight carriers and customers will adapt to changing circumstances, but without a coherent plan, that adaptation will become increasingly difficult for participants and increasingly disruptive to the community.

Regional and municipal freight and goods movement plans have been completed by many planning agencies around the nation, and Seattle can draw on those efforts to facilitate development and implementation of the FMP. The discussion below has focused on several key topics that would be better explored as part of the FMP. The potential approaches that are summarized are based upon elements of FMPs, or equivalent plans, from Portland, Sacramento, San Francisco, Chicago, and other jurisdictions.

Topic 1: The Economic Significance of Freight

Definition of the Issue

The Freight Access Project will begin to investigate the potential economic significance of freight by better quantifying the impacts of delay on the street network and the costs of infrastructure improvements to maintain good access into and out of, and between, the Greater Duwamish and Ballard-Interbay Northend MICs. However, the broader question should explore the economic significance of freight and our investments in freight infrastructure in the City, and how those investments relate to the regional economy, jobs, and ultimately consumers.

Possible Approach to the FMP

Many cities, regions, and states around the country have begun to develop a process of understanding and communicating the significance of freight in the regional economy that starts with the identification of "goods movement-dependent industries." These industries are defined as those that generate the largest share of demand for freight transportation services and that spend the most on these services. Typically, industries such as manufacturing, construction, warehousing and distribution, and retail and wholesale trade are identified as the goods movement-dependent industries. These industries can then be analyzed to determine the share of Gross Domestic Product (GDP) and employment they contribute to the economy. By analyzing the economic data further, it is possible to get a better understanding of the type of manufacturing and trade-oriented businesses that comprise this portion of the regional economy and to help elected officials and the general public better understand the range of business activities that drive goods movement demand.

Understanding the types of economic activities that drive goods movement demand in the city also allows for determination of the logistics and supply chain patterns that support the industries and determine freight transportation system performance requirements. By examining how the economy is likely to evolve and understanding critical trends in logistics and supply chains for the goods movement-dependent industries, the City will be better able to plan for a goods movement system that meets the needs of users and will be able to communicate to the general public what the economic value of the goods movement system is in real dollars.

Another aspect of examining the economic significance of the freight system is to understand the types of jobs that are provided in the goods movement sector. A number of cities and regions have looked beyond the aggregate employment numbers for goods movement service providers (motor carriers, logistics service providers, warehouse operators, rail carriers, marine terminal operators, etc.) to better understand the types of jobs they provide, the educational requirements for these jobs, and the pay scales. The Metropolitan Transportation Commission (MTC) of the San Francisco Bay Area was one of the first regional agencies to do this type of analysis and similar

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analyses have been conducted by the Southern California Association of Governments (SCAG). What these agencies were able to determine was that goods movement service providers are a source of job diversity in an urban economy, providing jobs that require relatively high pay for relatively low levels of education as compared to other jobs in the service sectors. Conducting this type of analysis as part of the FMP can help support investment in freight system improvements by demonstrating economic value.

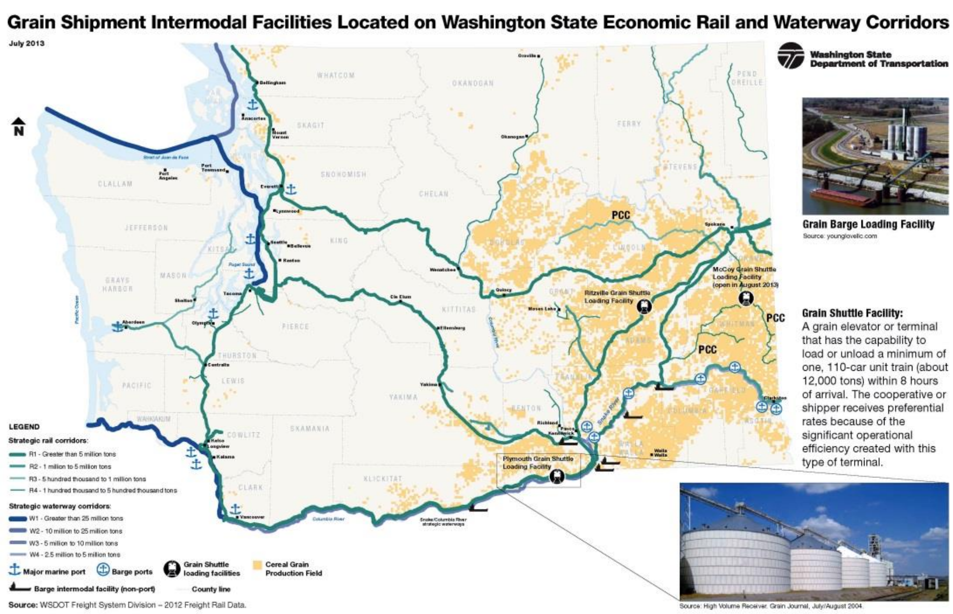
Topic 2: Evaluating City Freight Linkages to Regional Demand

Definition of the Issue

The City of Seattle, like many cities around the country, is experiencing continued development pressure around industrial areas. While efforts will continue to be made to ensure the long-term health and viability of Seattle's MICs, the ability to expand industrial activity within the City is limited. This means that growth in manufacturing and especially in distribution centers and warehousing, is likely to occur outside of the city. A prime example is the continuing growth of the Kent Valley MIC, where much of the distribution to Seattle residents and businesses is centered.

While the Freight Access Project will examine current origin-destination patterns, changes in the intensity and type of freight uses could impact future linkages that are needed between the study area and other industrial areas within the region and state. The FMP can provide an opportunity to examine those regional linkages to promote the efficient delivery of goods to other areas outside of the City, that impact the industrial and manufacturing areas, and other economic centers within the City.

The 2014 Washington State Freight Mobility Plan illustrates the supply chain with relevant commodities including aerospace, milk, potatoes and wheat, as shown below:



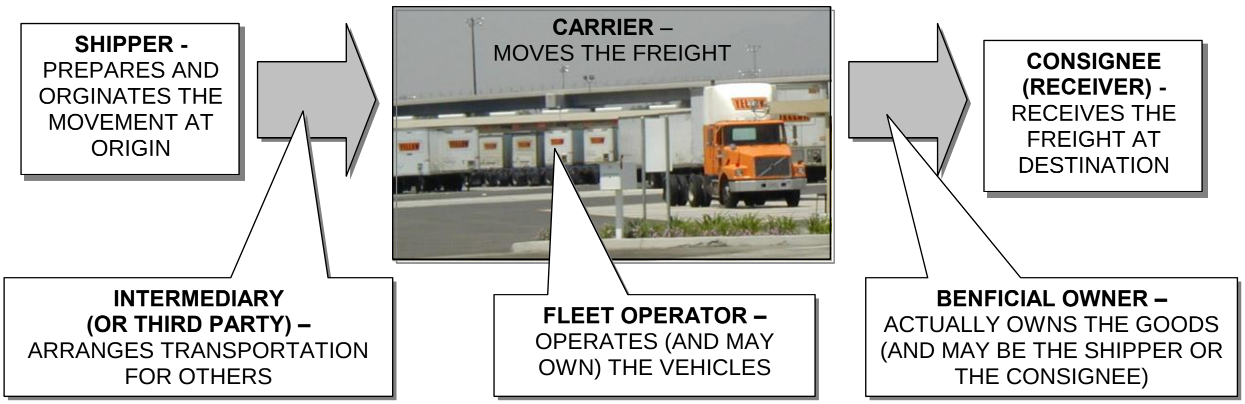
As noted in the image above, the wheat industry in Washington State relies on highway, port and rail facilities. Congestion and inefficiency in these facilities impacts the productivity and profitability of this industry. The FAP will identify facilities within the MICs and between the MICs but as noted in most of the key supply chains in the WSDOT Freight Mobility Plan, many facilities important to the supply chain extend beyond the MICs.

Possible Approach to the FMP

In order to address this issue, the FMP could examine the major intercity origin-destination (O-D) patterns that need to be supported to connect with the Greater Duwamish and Ballard-Interbay Northend MICs. This could be based on some analysis of supply chains for major industries likely to grow in the area taking into consideration major O-D trends.

Exhibit 1 provides an illustration of the major participants in the supply chain of freight transportation that should be considered and explored on a citywide and regional level.

Exhibit 1: Freight Transportation Participants



- **Shippers** (typically manufacturers or other producers and distributors) prepare freight for transport and originate the movement.
- **Consignees** or **receivers** (typically customers of the shippers) receive the freight at the destination.
- The shipper or receiver may or may not actually own the goods. The party who owns the goods being shipped is the **beneficial owner**.
- **Carriers** (transportation service providers) are firms that move freight by one or more mode. The direct customer of a freight carrier may be a shipper, a consignee, a beneficial owner, an intermediary, or even another carrier.
- **Fleet operators** operate (and may also own and maintain) the vehicles used to move freight. Fleet operators include both **for-hire carriers** (that transport freight for customers as the primary business) and **private operators** (that transport their own freight, usually for final delivery to customers).
- **Intermediaries** or **third parties** (including freight forwarders, shipper's agents, third party logistics managers, and brokers) arrange transportation on behalf of shippers or receivers.

While the most obvious examples of freight transportation are the large trucks, trains, airplanes, and ships that move to, from, and through the region, the freight transportation supply chain is actually far more complex, an integral part of almost everything Seattle residents and businesses do on a daily basis.

Some of the supply chain information including intermodal connectors will be developed in the Freight Access Project and can feed directly into planning at a system level during the FMP. The FMP should address major inter-city corridors of movement linking the MICs in Seattle with those areas with a large concentration of freight providers outside of the City. The corridors should include connectivity between the Greater Duwamish and Ballard-Interbay Northend MICs, regional highway systems to facilitate the movement of freight to regional and far-away destinations,. key freeway links and links that provide connectivity to external distribution centers via major arterial corridors.

Topic 3: Better Defining a Local Truck Street System

Definition of the Issue

While all arterial streets in the City are considered truck routes, the 2005 Transportation Strategic Plan designated a network of Major Truck Streets to serve as primary truck routes. The Major Truck Street designation implies the roadway is an arterial street that accommodates significant freight movement through the City and to and from major freight generators. The designation is important in helping guide decision making regarding street design, traffic management, and maintenance activities to accommodate freight transportation needs.

The current designation needs to be revisited to also include local streets that serve as important freight connections, such as those streets that connect directly to inter-modal facilities or serve as alternative routes to heavily congested parallel facilities. In addition, a hierarchy of truck streets should be explored recognizing that different streets and corridors serve various freight purposes and different levels of freight demand. In other words, not all truck streets should be treated equal, especially due to the increase in model conflicts as users compete for the limited amount of public right-of-way that is available. For example, the City of Portland Freight Master Plan describes how a hierarchy of truck streets helps in distinguishing where trucks need to be “designed for,” rather than just be “accommodated.”

The Freight Access Project is exploring improvements to the local street system within and between the MICs, and those corridors connecting to the regional highway system. Working from a more defined truck street system, that includes all classes of roadways, categorizes various freight functions and demands, and provides for improved design guidance, will assist in identifying and prioritizing projects and balancing the demand of various modes. However, a revised truck street system is a significant policy decision and needs to consider the entire city, which would be more appropriate as part of the FMP.

Possible Approach to the FMP

One approach to better define the truck street system would be to determine a truck street hierarchy. Such a concept should not be limited by just those roadways designated as Major Truck Streets today, but start by re-evaluating the entire local street system within the City. The basic idea would be to develop different levels of truck street designations with higher levels giving greater priority to truck uses (and in some cases, may involve significant restrictions on non-truck uses) and lower levels providing greater restrictions to truck operations in order to allow for greater levels of use by autos, transit, bicycles, and pedestrians. The types of considerations that would be built into the truck street hierarchy would include:

- Access management and geometrics
- Weight and height restrictions
- Signalization
- Time of day operating restrictions
- On and off-street loading management
- Local and through operations
- Connectivity to freight activity centers, intermodal hubs and terminals, and freeways
- Existing or planned modal facilities (bike lanes, transit only-lanes, etc.)

The designation of a truck street hierarchy would also help guide investments in the goods movement system to the areas of greatest need and greatest payoff. This approach would be more consistent with the idea of road typologies that jurisdictions have been developing as part of their approach to implementing Complete Streets policies.

In order to develop a truck street hierarchy, a set of criteria should be established to define different levels of operating restrictions. Some of these criteria could be quantitative while most would be qualitative. Criteria can be grouped into three broad categories:

- **Function** - These criteria would consider the various functions that truck streets need to play in a comprehensive goods movement system and ensure that the hierarchy adequately addresses all functional needs.
- **Form** – These criteria would consider the street characteristics to ensure that truck streets have necessary physical characteristics to accommodate truck operations.
- **Conflict Management** – These criteria would examine the degree to which other users may need access to truck streets and to ensure that conflicts are effectively managed in the designation of truck streets.

It is assumed that many of these criteria are already incorporated into the existing truck street designations. However, by examining these criteria more explicitly, a hierarchy could be created for better allocation of scarce street right-of-way while still meeting freight user needs.

Examples of each of the categories of criteria are described below. Quantitative and qualitative criteria can be developed for each criterion.

Function Criteria

- **Primary System**: Major corridors in the MICs that provide access to freight centers that are lined by industrial users or corridors that provide connectivity to the interstate and state highway system, between MICs, or to other freight hubs and intermodal terminals
- **Secondary System**: Corridors that provide access to industrial areas, but where other non-industrial uses are present
- **Delivery Network**: Corridors providing access to local retail and commercial centers
- **Specialized Uses**: Streets for over-dimensional, heavy-haul, and hazardous materials

Form Criteria

- Does the roadway have horizontal and vertical clearance constraints that limit certain types of truck access?
- Are there bridge weight restrictions?
- Are lane widths sufficient to accommodate heaviest trucks?
- Turning radii or other geometric constraints to access the street or access destinations along the street.
- Signal spacing and potential impacts on truck operations.
- Availability of both on and off-street loading areas.
- Sensitive receptors for hazardous materials exposure (for haz mat route designation)

Conflict Management Criteria

- Potential points of conflict at modal access locations – e.g., is there sufficient space to separate users during turning movements
- Can conflicts in use be managed through time-of-use restrictions – e.g., do users have different time-of-use patterns
- Are there alternative routing options for users that still provide connectivity to an overall network

As part of the development of the FMP, the City can establish a refined set of criteria and conduct a detailed review of the local street system using the criteria to determine if there are multiple levels of truck streets that could be designated in a connected network. Potentially two or more levels of truck street designations could be incorporated in a re-designed truck street system.

Topic 4: Other Policies and Standards

There are a range of other policies, standards, and processes that may need to be evaluated and addressed as part of the FMP to identify and correct inconsistencies. Below are a few specific items raised by the project team members during the course of the project to date.

Right-of-Way Improvements Manual

Streets in the Greater Duwamish and Ballard-Interbay Northend MICs, as well as the corridors connecting to the regional highway system, need to fully accommodate truck movements without impeding their mobility or compromising safety of other users. The City's Right-of-Way (ROW) Improvements Manual is a resource to guide the design of improvements within the public street right-of-way while considering the access and mobility needs of all users, including freight. While it does acknowledge Major Truck Streets and the need to accommodate the movement of trucks along those corridors, it often presents conflicting guidelines and does not provide for a clear way for officials to make decisions regarding the amenities provided with the ROW. The manual will need to be evaluated and updated to identify and correct any inconsistencies.

Consistency with Other Model Plans / Complete Streets Process

The City has undertaken and completed a number of model plans over the past several years, such as the Pedestrian Master Plan, Bicycle Master Plan, and Transit Master Plan. Each plan has identified important corridors for each respective mode. While the Freight Access Project will identify needed investments in freight infrastructure within and between the Greater Duwamish and Ballard-Interbay Northend MICs, and the potential conflicts with other modal plans or projects, it will not be able to fully resolve the conflict without a more complete policy basis for Seattle's freight strategy, which the FMP will help develop. This will help inform and update the City's existing Complete Streets Review Process and framework for making decisions regarding the design of facilities within the public right-of-way.

APPENDIX B

NATIONAL HIGHWAY SYSTEM (NHS) ROUTES IN SEATTLE

NHS Routes in the City of Seattle

County	City	NHS Route Description	From	To
King	Seattle	Olson Pl SW	SW Roxbury St	Olson/Myers Park-N-Ride
King	Seattle	Olson Pl SW	Olson/Myers Park-N-Ride	1st Ave S / Myers Way S
King	Seattle	Myers Way S	Seattle CL (0.17mi N Of S 101st St)	Olson Myers P&R
King	Seattle	1st Ave S / Myers Way S	Olson Myers Park-N-Ride Entrance/Exit	Olson Pl SW
King	Seattle	1st Ave S	Olson Pl SW	S Cloverdale St
King	Seattle	S Cloverdale St	SR 509 (North Bound Off Ramp)	SR 509 (South Bound Lanes)
King	Seattle	S Albro Pl	Corgiat Dr S	Stanley Ave S
King	Seattle	S Albro Pl	Stanley Ave S	Hardy St
King	Seattle	S Albro Pl	Hardy St	Ellis Ave S
King	Seattle	Ellis Ave S	S Albro Pl	E Marginal Way
King	Seattle	Corson Ave S	S Michigan St	Airport Way S
King	Seattle	East Marginal Way S	Seattle South C/L (0.26mi S/O 16th Ave S)	16th Ave S
King	Seattle	East Marginal Way S	16th Ave S	14thAve S
King	Seattle	East Marginal Way S	14th Ave S	Carleton Ave S
King	Seattle	East Marginal Way S	Carleton Ave	S Michigan Ave
King	Seattle	East Marginal Way S	S Michigan Ave	1st Ave S (Bridge)
King	Seattle	Seattle Blvd S	4th Ave S	S Dearborn St
King	Seattle	Airport Way S	S Dearborn St	S Royal Brougham Way
King	Seattle	Airport Way S (SB)	S Royal Broughham Way	I-5 (Airport South bound Off Ramp)
King	Seattle	Airport Way S	I-5 (Airport SB Off Ramp)	S Holgate S St
King	Seattle	Airport Way S	S Holgate S St	S Lander N St
King	Seattle	Airport Way S	S Lander N St	S Spokane St
King	Seattle	Airport Way S	S Spokane St	S Alaska St
King	Seattle	Airport Way S	S Alaska St	S Lucile St
King	Seattle	Airport Way S	S Lucile St	13th Ave S
King	Seattle	Airport Way S	13th Ave S	S Hardy St
King	Seattle	Airport Way S	S Hardy St	Military Rd S Connection / S Rose St
King	Seattle	Airport Way S	Military Rd S Connection / S Rose St	Seattle South C/L (0.4mi S Of S Norfolk St)
King	Seattle	Airport Way S	Tukwila E C/L (2.13mi S Of S Hardy St)	Seattle South C/L (0.26mi S Of S Norfolk St)
King	Seattle	Airport Way S (NB)	I5 Airport Nb Off	Airport Way S
King	Seattle	11th Ave SW	16th Ave SW	SW Spokane St
King	Seattle	SW Roxbury St	Olson Pl SW	14th Ave SW
King	Seattle	SW Roxbury St	14th Ave SW	35th Ave SW
King	Seattle	Duwamish Ave S	S Spokane SR St	E Marginal Way S
King	Seattle	S Dawson St	4th Ave S	Truck/Rail Facility Entrance
King	Seattle	S Alaska St	M L King Jr Way S	S Columbian Way
King	Seattle	S Columbian Way (South Leg)	S Alaska St	15th Ave S
King	Seattle	15th Ave S	S Columbian Way (South Leg)	S Nevada St
King	Seattle	15th Ave S	S Nevada St	S Columbian Way (North Leg)
King	Seattle	S Columbian Way (North Leg)	15th Ave S	14th Ave
King	Seattle	West Seattle Freeway	14th Ave	I-5 NB Ramp(Center of Overpass)
King	Seattle	West Seattle Freeway	I-5 NB Ramp(Center of Overpass)	Alaskan Way / East Marginal Way S Xings
King	Seattle	West Seattle Freeway (Bridge)	Alaskan Way / East Marginal Way S Xings	Delridge Rmps
King	Seattle	West Seattle Freeway (Bridge)	Delridge Ramps	35th Ave SW
King	Seattle	Fauntleroy Way SW	35th Ave SW	SW Avalon Way
King	Seattle	Fauntleroy Way SW	SW Avalon Way	SW Alaska St
King	Seattle	Fauntleroy Way SW	SW Alaska St	SW Edmunds St
King	Seattle	Fauntleroy Way SW	SW Edmunds St	SW Findlay St
King	Seattle	Fauntleroy Way SW	SW Findlay St	SW Graham St
King	Seattle	Fauntleroy Way SW	SW Graham St	California Ave SW
King	Seattle	Seattle Fwy E (East Bound)	Diverge W Seattle Fwy East Bnd Ex S Columbian Way	S Columbian Way at 14th Ave
King	Seattle	SW Morgan St	Fauntleroy Way SW	35th Ave SW
King	Seattle	Highland Park Way SW	West Marginal Way SW	SR 99 / W Marginal Way S
King	Seattle	S Michigan St	E Marginal Way	Corson Ave S
King	Seattle	Stanley Ave S	S Hardy St	S Albro Pl
King	Seattle	S Hardy St	Stanley Ave S	Airport Way S
King	Seattle	35th Ave SW	Fauntleroy Way SW	Avalon Way SW
King	Seattle	35th Ave SW	Avalon Way SW	SW Alaska St
King	Seattle	35th Ave SW	SW Alaska St	SW Brandon St
King	Seattle	35th Ave SW	SW Brandon St	SW Morgan St
King	Seattle	35th Ave SW	SW Morgan St	SW Myrtle St
King	Seattle	35th Ave SW	SW Myrtle St	SW Holden S St
King	Seattle	35th Ave SW	SW Holden St	SW Thistle St

Source: National Highway System Routes (NHS) - Washington State. WSDOT. 2015.

NHS Routes in the City of Seattle

County	City	NHS Route Description	From	To
King	Seattle	35th Ave SW	SW Thistle St	SW Roxbury St
King	Seattle	S Hanford St	E Marginal Way S	1st Ave S
King	Seattle	Royal Brougham Way S	4th Ave S	Airport Way S
King	Seattle	Delridge Way SW	W Marginal Way SW	SW Andover St
King	Seattle	Delridge Way SW	SW Andover St	SW Dakota St
King	Seattle	Delridge Way SW	SW Dakota St	SW Juneau St
King	Seattle	Delridge Way SW	SW Juneau St	Sylvan Way SW
King	Seattle	Delridge Way SW	Sylvan Way SW	SW Thistle St
King	Seattle	Delridge Way SW	SW Thistle St	SW Barton St
King	Seattle	Delridge Way SW	SW Barton St	17th Ave SW
King	Seattle	17th Ave SW	Delridge Way SW	SW Roxbury St
King	Seattle	SW Admiral Way	Calif Ave SW	SW Avalon Way / SW Spokane Wb
King	Seattle	West Marginal Way SW	Marginal Pl W	SW Edmunds St
King	Seattle	West Marginal Way SW	SW Edmunds St	Highland Park Way SW
King	Seattle	SW Spokane St	W Marginal Way SW	11th Ave SW
King	Seattle	SW Spokane St	11th Ave SW	S Spokane St
King	Seattle	S Spokane (N Route & S Route) St	SW Spokane St	E Marginal Way S
King	Seattle	SW Florida St	13th Ave SW	16th Ave SW
King	Seattle	16th Ave SW / Klickitat Ave SW	SW Florida St	SW Spokane St
King	Seattle	16th Ave SW / Klickitat Ave SW	11th Ave SW	13th Ave SW
King	Seattle	11th Ave SW	SW Spokane St	Kilckitat Ave SW
King	Seattle	14th Ave S	C/L Seattle/S Director St	Dallas Ave S / 16th Ave S
King	Seattle	16TH Ave S (Temporarily Closed)	Tukwila-Seattle C/L	E Marginal Way
King	Seattle	4th Ave S	S Royal Brougham Way	Airport Way S
King	Seattle	4th Ave S	Airport Way S	Yesler Way
King	Seattle	4th Ave / 4th Ave S	Yesler Way	Madison St
King	Seattle	4th Ave	Madison St	Seneca St
King	Seattle	4th Ave	Seneca St	Union St
King	Seattle	4th Ave	Union St	Battery St
King	Seattle	Duwamish Ave S	Alaskan Way NB Ramp	E Marginal Way S
King	Seattle	East Marginal Way S	Duwamish Ave S	S Spokane St (East Bound)
King	Seattle	East Marginal Way S	S Spokane St (East Bound)	S Hinds St
King	Seattle	S Henderson St	Martin Luther King Jr Way S	Renton Ave S
King	Seattle	S Henderson St	Renton Ave S	Rainier Ave S
King	Seattle	S Plum St	Rainier Ave S	23rd Ave S
King	Seattle	Swift Ave S	S Albro Pl	S Eddy St
King	Seattle	S Myrtle St / Swift Ave S	S Eddy St	32nd Ave S
King	Seattle	S Othello St / S Myrtle Pl	32nd Ave S	Martin Luther King Jr Way
King	Seattle	8th Ave	Facility	Stewart St
King	Seattle	9th Ave N	Westlake Ave N	Mercer St
King	Seattle	9th Ave N / 9th Ave	Mercer St	Westlake Ave
King	Seattle	9th Ave	Stewart St	Facility
King	Seattle	W Nickerson St	15th Ave W	13th Ave W
King	Seattle	W Nickerson St	13th Ave W	12th Ave W
King	Seattle	W Nickerson St	12th Ave W	3rd Ave W
King	Seattle	W Nickerson St	3rd Ave W	Queen Anne Ave N
King	Seattle	Nickerson St	Queen Anne Ave N	Westlake Ave N / SR 99
King	Seattle	Westlake Ave N	SR 99	Newton St
King	Seattle	Westlake Ave N	Newton St	9th Ave N
King	Seattle	Westlake Ave N	9th Ave N	Harrison St
King	Seattle	Westlake Ave N	Harrison St	Denny Way
King	Seattle	Westlake Ave	Denny Way	Stewart St
King	Seattle	Westlake Ave	Stewart St	Olive Way
King	Seattle	S Walker St	23rd Ave S	Rainier Ave S
King	Seattle	S Dearborn St	Seattle Blvd S	7th Ave S
King	Seattle	S Dearborn St	7th Ave S	Rainier Ave S
King	Seattle	2nd Ave	Wall St	Stewart St
King	Seattle	2nd Ave	Stewart St	Pine St
King	Seattle	2nd Ave	Pine St	Pike St
King	Seattle	2nd Ave	Pike St	Marion St
King	Seattle	2nd Ave	Marion St	Yesler Way
King	Seattle	2nd Ave Ext S	Yesler Way	S Jackson St
King	Seattle	2nd Ave Extension S	S Jackson St	4th Ave S

Source: National Highway System Routes (NHS) - Washington State. WSDOT. 2015.

NHS Routes in the City of Seattle

County	City	NHS Route Description	From	To
King	Seattle	S Jackson St	Alaskan Way S	1st Ave S
King	Seattle	S Jackson St	1st Ave S	2nd Ave S
King	Seattle	S Jackson St	2nd Ave S	2nd Avenue Extended S
King	Seattle	S Jackson St	2nd Avenue Extended S	5th Ave S
King	Seattle	S Jackson St	5th Ave S	14th Ave S
King	Seattle	Harrison St	5th Ave N	Broad St
King	Seattle	W Galer Flyover	16th Ave W / BN-Interbay Yard	Elliott Ave W
King	Seattle	Queen Anne Ave N	W Roy St	Mercer St
King	Seattle	James St	2nd Ave	4th Ave
King	Seattle	James St	4th Ave	7th Ave
King	Seattle	James St	7th Ave	Boren Ave
King	Seattle	Martin Luther King Way S	Rainier Ave S	S Alaska St
King	Seattle	Martin Luther King Way S	S Alaska St	S Othello St
King	Seattle	Martin Luther King Way S	S Othello St	Seattle South C/L (0.13mi N Of Boeing Access Rd)
King	Seattle	23rd Ave S	Rainer Ave S	S Jackson St
King	Seattle	23rd Ave S	S Jackson St	S Yesler Way
King	Seattle	24th Ave E / 23rd Ave E / 23rd Ave	E Yesler Way	Boyer Ave E
King	Seattle	East Montlake Pl E / 24 Ave E	Boyer Ave E	E Lake Washington Blvd
King	Seattle	Columbia St	2nd Ave	1st Ave
King	Seattle	Leary Ave NW	NW Market St	17th Ave NW
King	Seattle	NW Leary Way	17th Ave NW	Leary Way NW
King	Seattle	Leary Way NW	NW Leary Way	8th Ave NW
King	Seattle	Leary Way NW	8th Ave NW	NW 36th St
King	Seattle	N 36th St	Leary Way NW	Fremont Ave N
King	Seattle	Fremont Ave N	N 35th St	N 34th St
King	Seattle	Fremont Ave N	N 34th St	Nickerson St
King	Seattle	Marion St	2nd Ave	6th Ave
King	Seattle	Madison St	2nd Ave	4th Ave
King	Seattle	Madison St	4th Ave	6th Ave
King	Seattle	Madison St	6th Ave	7th Ave
King	Seattle	Madison St	7th Ave	9th Ave
King	Seattle	Madison St	9th Ave	Broadway
King	Seattle	E Madison St	Broadway	20th Ave
King	Seattle	E Madison St	20th Ave	23rdAve
King	Seattle	Alaskan Way	Yesler Way	Madison Way
King	Seattle	Alaskan Way	Madison St	Broad St
King	Seattle	Broad St	Alaskan Way	Elliott Ave
King	Seattle	Elliott Ave	Broad St	Denny Way
King	Seattle	Elliott Ave W	Denny Way	Western Ave W
King	Seattle	Elliott Ave W	Western Ave W	W Mercer Pl
King	Seattle	Elliott Ave W	W Mercer Pl	W Galer St
King	Seattle	15th Ave W	W Galer St	W Dravus St
King	Seattle	15th Ave W	W Armour St	W Bertona St
King	Seattle	15th Ave W	W Dravus St	W Emerson St
King	Seattle	15th Ave NW (Ballard Br)	W Emerson St	NW 50 St
King	Seattle	15th Ave NW	NW 50th St	NW Market St
King	Seattle	15th Ave NW	NW Market St	NW 85th St
King	Seattle	15th Ave NW	NW 85th St	NW 87th St
King	Seattle	Holman Rd NW	NW 87th St	Greenwood Ave N / N 105th St
King	Seattle	N Northgate Way / N 105th St	Greenwood Ave N	Meridian Ave N
King	Seattle	N Northgate Way	Meridian Ave N	Corliss Ave N
King	Seattle	N Northgate Way	Corliss Ave N	1st Ave NE
King	Seattle	NE Northgate Way	1st Ave NE	3rd Ave NE
King	Seattle	NE Northgate Way	3rd Ave NE	Roosevelt Way NE
King	Seattle	NE Northgate Way	Roosevelt Way NE	15th Ave NE
King	Seattle	NE Northgate Way	15th Ave NE	Lake City Way N
King	Seattle	Seneca St	1st Ave	2nd Ave
King	Seattle	Seneca St	2nd Ave	4th Ave
King	Seattle	Elliott Ave	Broad St	Elliot Ramp To SR 99
King	Seattle	Western Ave	Bell St / SR-99 Off Ramp	Broad St
King	Seattle	Western Ave	Broad St	W Denny Way
King	Seattle	W Western Ave	W Denny Way	Elliott Ave W
King	Seattle	Union St	5th Ave	4th Ave

Source: National Highway System Routes (NHS) - Washington State. WSDOT. 2015.

NHS Routes in the City of Seattle

County	City	NHS Route Description	From	To
King	Seattle	1st Ave S	1 Ave (South Ramps)	S Royal Brougham Way
King	Seattle	1st Ave S	Edgar Martinez Dr S	S Spokane St
King	Seattle	1st Ave S	S Spokane St	E Marginal Way S
King	Seattle	Pike St	2nd Av	4th Ave
King	Seattle	Pike St	4th Ave	9th Ave
King	Seattle	Pike St	9th Ave	Boren Ave
King	Seattle	Battery St	4th Ave	6th Ave
King	Seattle	Aurora Ave	6th Ave	Denny Way
King	Seattle	Pine St	Boren Ave	9th Av
King	Seattle	Pine St	9th Ave	5th Ave
King	Seattle	Pine St	5th Ave	2nd Ave
King	Seattle	4th Ave S	E Marginal Way	S Dawson St
King	Seattle	4th Ave S	S Dawson St	Costco Ent
King	Seattle	4th Ave S	Costco Ent	S Spokane St
King	Seattle	4th Ave S	S Spokane St	S Horton St
King	Seattle	4th Ave S	S Horton St	S Lander St
King	Seattle	4th Ave S	S Lander St	S Royal Brougham Way
King	Seattle	Olive Way	Stewart ST	Westlake Ave / 5th Ave
King	Seattle	Olive Way	5th Ave	7th Ave
King	Seattle	Olive Way	7th Ave	Terry Ave
King	Seattle	Olive Way	Terry Ave	Minor Ave
King	Seattle	Olive Way	Minor Ave	I-5 / Olive (North Bound On Ramp)
King	Seattle	E Olive Way	I-5 Olive NB On	Bellevue Ave
King	Seattle	E Olive Way	Bellevue Ave	E Denny Way
King	Seattle	E Olive Way	E Denny Way	Belmont Ave E
King	Seattle	E Olive Way	Belmont Ave E	Broadway E
King	Seattle	5th Ave N	Roy St	Harrison St
King	Seattle	5th Ave N	Harrison St	Broad St
King	Seattle	5th Ave N	Broad St	Denny Way
King	Seattle	5th Ave	Pine St	Union St
King	Seattle	Eastlake Ave E	Fairview Ave N	E Aloha St
King	Seattle	Eastlake Ave E	Aloha St	Roy St
King	Seattle	Eastlake Ave E	Roy St	Mercer St
King	Seattle	Eastlake Ave E	Mercer St	Stewart St
King	Seattle	Stewart St	Eastlake Ave E	Boren Ave
King	Seattle	Stewart St	Boren Ave	9th Ave
King	Seattle	Stewart St	9th Ave	8th Ave
King	Seattle	Stewart St	8th Ave	7th Ave
King	Seattle	Stewart St	7th Ave	Westlake Ave
King	Seattle	Stewart St	Westlake Ave	5th Ave
King	Seattle	Stewart St	5th Ave	2nd Ave
King	Seattle	6th Ave	Madison St	Marion St
King	Seattle	Fairview Ave N	Denny Way	Mercer St
King	Seattle	Fairview Ave N	Mercer St	Valley St
King	Seattle	7th Ave	Stewart St	Olive Way
King	Seattle	Wall St	Denny Way	5th Ave
King	Seattle	Wall St	5th Ave	2nd Ave
King	Seattle	Broad St	Elliott Ave	Western Ave
King	Seattle	Broad St	Western Ave	1st Ave
King	Seattle	Broad St	1 Ave	Denny Way
King	Seattle	Broad St	Denny Way	Harrison St
King	Seattle	Broad St	Harrison St	Westlake Ave N
King	Seattle	Denny Way	Western Ave W	2nd Ave
King	Seattle	Denny Way	2nd Ave	4th Ave
King	Seattle	Denny Way	4th Ave	Westlake Ave
King	Seattle	Denny Way	Westlake Ave	Terry Ave
King	Seattle	Denny Way	Terry Ave	Fairview Ave
King	Seattle	Denny Way	Fairview Ave	Stewart St
King	Seattle	Denny Way	Stewart St	Melrose Ave
King	Seattle	E Denny Way	Melrose Ave	Bellevue Ave
King	Seattle	E Denny Way	Bellevue Ave	E Olive Way
King	Seattle	2nd Ave S	S King St	S Jackson St
King	Seattle	Bellevue Ave E	E Denny Way	Olive Way

Source: National Highway System Routes (NHS) - Washington State. WSDOT. 2015.

NHS Routes in the City of Seattle

County	City	NHS Route Description	From	To
King	Seattle	15th Ave NE	NE 145th St	NE 140th St
King	Seattle	15th Ave NE	NE 140th St	Pinehurst Way N
King	Seattle	Pinehurst Way NE / Roosevelt Way NE	15th Ave NE	NE Northgate Way
King	Seattle	Roosevelt Way NE	NE Northgate W	NE 92nd St
King	Seattle	Roosevelt Way NE	NE 92nd St	NE 85th St
King	Seattle	Roosevelt Way NE	NE 85th St	NE 75th St
King	Seattle	Roosevelt Way NE	NE 75th St	NE 73rd St
King	Seattle	Roosevelt Way NE	NE 73th St	NE 65th St
King	Seattle	Roosevelt Way NE	NE 65th St	NE 45th St
King	Seattle	Roosevelt Way NE	NE 45th St	Eastlake Ave NE (NE 41st St)
King	Seattle	Valley St	Westlake Ave N	Fairview Ave N
King	Seattle	Fairview Ave N	Valley St St	East Lake Ave E
King	Seattle	Eastlake Ave E	Fairview Ave N	E Boston St
King	Seattle	Eastlake Ave E	E Boston St	E Hamlin St
King	Seattle	Eastlake Ave E	E Hamlin St	Fuhrman Ave E
King	Seattle	Eastlake Ave E (University Br)	Fuhrman Ave E	NE 40th St
King	Seattle	Eastlake Ave NE	NE 40th St	NE 41st St
King	Seattle	11th Ave NE	Eastlake Ave NE	NE 45th St
King	Seattle	11th Ave NE	NE 45th St	NE 50th St
King	Seattle	11th Ave NE / 12th Ave NE	NE 50th St	NE 75th St
King	Seattle	12th Ave NE	NE 75th St	SR 522 / Lake City Way N
King	Seattle	W Mercer St / W Mercer Pl	Elliott Ave W	1st Ave N
King	Seattle	Mercer St / W Mercer St	1st Ave N	Dexter Ave N
King	Seattle	Mercer St	Dexter Ave N	9 Ave N
King	Seattle	Mercer St	9th Ave N	Westlake Ave N
King	Seattle	Mercer St	Westlake Ave N	Fairview Ave N
King	Seattle	Rainier Ave S	Seattle C/L (0.50mi N Of S Lakeridge Dr)	S Henderson St
King	Seattle	Rainier Ave S	S Henderson St	Martin Luther King Way S
King	Seattle	Rainier Ave S	Martin Luther King Way	I-90 (East Bound Lanes)
King	Seattle	Rainier Ave S	I-90 (East Bound Lanes)	S Jackson St
King	Seattle	Boren Ave S	S Jackson St	E Yesler Way
King	Seattle	Boren Ave	E Yesler Way	Olive Way
King	Seattle	Boren Ave	Olive Way	Howell St
King	Seattle	Boren Ave	Howell St	Stewart St
King	Seattle	Boren Ave	Stewart St	Virginia St
King	Seattle	Boren Ave	Virginia St	Denny Way
King	Seattle	Roy St	5th Ave N	2nd Ave N
King	Seattle	Roy St	2nd Ave N	Queen Anne Ave
King	Seattle	Howell St	8th Ave / Olive Way	Terry Ave
King	Seattle	Howell St	Terry Ave	Yale Ave
King	Seattle	Eastlake Ave	Yale Ave	Denny Way
King	Seattle	Eastlake Ave	Denny Way	Stewart St
King	Seattle	NW Market St	15th Ave NW	9th Ave NW
King	Seattle	NW Market St	9th Ave NW	Greenwood Ave N
King	Seattle	N 46th St	Greenwood Ave N	Green Lake Way N
King	Seattle	N 34th St	Fremont Ave N	N Pacific St / Meridian Ave N
King	Seattle	N Pacific St	Meridian Ave N	NE 40th St
King	Seattle	NE Pacific Pl	NE Pacific St	Montlake Blvd NE
King	Seattle	NE 80th St	Corliss Way N	Banner Way NE
King	Seattle	Greenwood Ave N	N 145th St	N 130th St
King	Seattle	Greenwood Ave N	N 130th St	N 105th St / Holman Rd NW
King	Seattle	Green Lake Way N	N 50th St	Aurora Ave N
King	Seattle	NE Pacific St	15th Ave NE	NE Pacific Pl
King	Seattle	NE Pacific St	NE Pacific Pl	Montlake Blvd NE
King	Seattle	NE 41st St	Roosevelt Way N	Eastlake Ave NE
King	Seattle	NE 42nd St	7th Ave NE	Roosevelt Way N
King	Seattle	N 50th St	Green Lake Way N	Meridian Ave N
King	Seattle	NE 50th St / N 50th St	Meridian Ave N	Latona E Ave NE
King	Seattle	NE 50th St	Latona E Ave NE	5th Ave NE
King	Seattle	NE 50th St	5th Ave NE	7th Ave NE
King	Seattle	NE 50th St	7th Ave NE	Roosevelt Av
King	Seattle	NE 50th St	Roosevelt Ave	Brooklyn Ave
King	Seattle	NE 50th St	Brooklyn Ave NE	15th Ave NE

Source: National Highway System Routes (NHS) - Washington State. WSDOT. 2015.

NHS Routes in the City of Seattle

County	City	NHS Route Description	From	To
King	Seattle	NE 103rd St	1st Ave NE	0.05 Mi E Of 1st Ave (Facility Ent)
King	Seattle	NE 103rd St	0.05 Mi E Of 1st Ave (Facility Ent)	5th Ave NE
King	Seattle	N 45th St	5th Ave NE	Roosevelt Way N
King	Seattle	NE 45th St	Roosevelt Way N	11th Ave
King	Seattle	NE 45th St	11th Ave	Brooklyn Ave
King	Seattle	NE 45th St	Brooklyn Ave NE	Montlake Blvd
King	Seattle	NE Ravenna Blvd	NE 65th St	8th Ave NE
King	Seattle	1st Ave NE	NE 103rd St	NE Northgate Way
King	Seattle	5th Ave NE	Northgate Park-N-Ride (0.12mi N Of Northgate)	NE 103rd St
King	Seattle	Roosevelt Way NE	NE 130 N St	NE 125th St
King	Seattle	Lake City Way NE	12th Ave NE	Roosevelt Way N
King	Seattle	Corliss Way N	N 85th St	2nd Ave NE
King	Seattle	N 85th St / NW 85th St	15th Ave NW	Fremont Ave N
King	Seattle	N 85th St	Fremont Ave N	Wallingford Ave N
King	Seattle	N 85th St	Wallingford Ave N	I-5 On Ramp
King	Seattle	Banner Way NE	I-5 (North Bound On-Ramp)	NE 80th St
King	Seattle	Banner Way NE	NE 80th St	5th Ave NE
King	Seattle	Banner Way NE	5th Ave NE	NE 75th St
King	Seattle	NE 75th St	Banner Way NE	Roosevelt Way N
King	Seattle	NE 75th St	Roosevelt Way N	20th Ave NE
King	Seattle	NE 75th St	20th Ave NE	25th Ave NE
King	Seattle	8th Ave NE	NE 65th St	NE Ravenna Blvd
King	Seattle	15th Ave NE	NE 50th St	NE 41st St
King	Seattle	15th Ave NE	NE 41st St	NE Campus Wb P
King	Seattle	15th Ave NE	NE Campus Eb P	NE Pacific St
King	Seattle	N 145th St	Greenwood Ave N	Aurora Ave N
King	Seattle	N 130th St	Greenwood Ave N	Aurora Ave N
King	Seattle	NE 130th St	Aurora Ave N	5th Ave NE
King	Seattle	44th St NE / Pend Oreille Rd	25th Ave NE	Montlake Blvd NE
King	Seattle	NE 125th St	Roosevelt Way NE	28th Ave NE
King	Seattle	NE 125th St	28th Ave NE	33rdAve NE
King	Seattle	NE 125th St	33rd Ave NE	35th Ave NE
King	Seattle	Ravenna Ave NE	SR 522 / NE 92nd St	NE 85th St
King	Seattle	Ravenna Ave NE	NE 85th St	25th Ave NE
King	Seattle	25th Ave NE	Ravenna S Ave N	NE 70th St
King	Seattle	25th Ave NE	NE 70th St	Montlake Blvd NE
King	Seattle	24th Ave NE	NE Northgate Way	Lake City Way
King	Seattle	13th Ave SW	SW Florida St	Port Facilities (SW Massachusetts St)
King	Seattle	Corgiat Dr S	S Albro Pl	18th Ave S
King	Seattle	S Hardy St	Stanley Ave S	S Albro Pl
King	Seattle	S King St	2nd Ave S	Amtrack Station
King	Seattle	SR 519	Yesler Way	4th Avenue S
King	Seattle	Interstate 90	6th Ave On Ramp	City Limits
King	Seattle	Interstate 5	South City Limits	Northern City Limits
King	Seattle	SR 520	Interstate 5	Eastern City Limits
King	Seattle	SR 99	South City Limits	Northern City Limits
King	Seattle	SR 513	SR 520	Magnuson Park
King	Seattle	SR 509	South City Limits	SR 99
King	Seattle	SR 522	Interstate 5	Northern City Limits

Source: National Highway System Routes (NHS) - Washington State. WSDOT. 2015.

APPENDIX C

PROJECT PRIORITIZATION METHODOLOGY FRAMEWORK

Project Prioritization Framework

The project list developed as part of the Freight Access Project (FAP) includes a prioritization process that will rank projects into a priority tier system.

Prioritization Criteria and Weighting

The following table highlights the possible list of prioritization criteria and the relative weighting on a scale of 0 to 100 points.

Criteria	Description	Maximum Points
Freight Conditions Score	Existing and future conditions composite score of Safety, Mobility, and Connectivity	50
Roadway Designation	Location on Major Truck Street, Heavy Haul Route, or First/Last Mile Connection	15
Pavement Conditions	Pavement condition index	15
Environmental	Qualitative assessment of congestion relief and drainage improvements	10
Reliability	Existing conditions buffer index based on travel times	10
Total		**100**

Planning-level project cost estimates, funding opportunities, and the approximate timing of the project need will be considered in the overall context of the priorities and factored into the prioritization process after the quantitative scoring has been completed.

Priority Tier Scale

Each criterion would be evaluated on a project-by-project basis to determine the overall project priority on a tiered scale. Projects in the Tier I category would be summarized in a more detailed project cut-sheet to assist with grant funding proposals and/or CIP planning.

Tier	Approximate Point Range
I	Top quartile
II	2nd and 3rd quartile
III	Bottom quartile

Details of the scoring process are summarized on the following page.

Scoring Methodology

Freight Conditions Score (50 points)

This criterion is a normalization of the average existing and future conditions composite score of Safety, Mobility, and Connectivity. The project with the highest freight conditions score would receive the maximum 50 points, and the remaining scores would receive fewer points based on a normalized scale from 0 to 50.

Roadway Designation (15 points)

This criterion benefits projects on Major Truck Streets, Heavy Haul Routes, or First/Last Mile Connections. Projects that are on one of these routes would receive 10 points. Projects on roadways with two or more of these roadway designations would receive the full 15 points.

Pavement Conditions (15 points)

This criterion is based on an average evaluation of pavement conditions over length of the project. The average is based on the six categories of pavement condition multiplied by the number of lane miles for each category. The best rated pavement categories (Good and Satisfactory) would receive 0 points, while the worst rated categories (Very Poor and Serious/Failed) would receive a full 15 points. Roadways falling into the middle categories would receive 5 (Fair) and 10 (Poor) points.

Environmental (10 points)

This criterion is a qualitative assessment of congestion relief and drainage improvements that would have some environmental benefit. The maximum number of points a project could receive is 10.

Reliability (10 points)

This criterion evaluates the reliability of the average travel time under existing conditions. Where available, the buffer index would be normalized on a 0 to 10 point scale for roadways with proposed projects. For projects without an existing conditions buffer index, these points would be omitted from the final score.

Other Factors

Financial Feasibility

This criterion would consider the planning-level cost estimates (where available), funding opportunities, or general cost ranges to help determine priority.

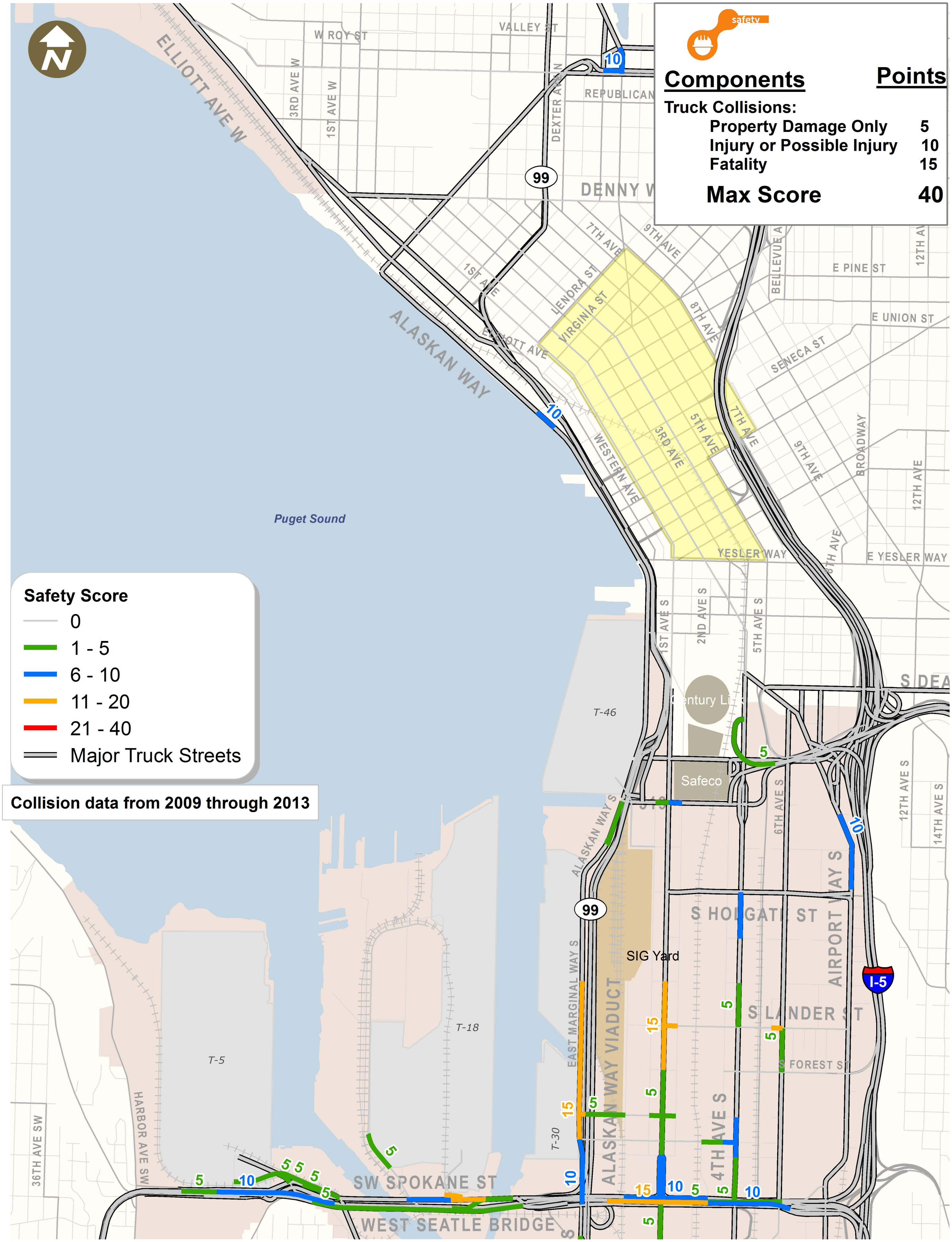
Timing

This criterion considers the timing of the need for the project improvement based on future travel demand and infrastructure investments.

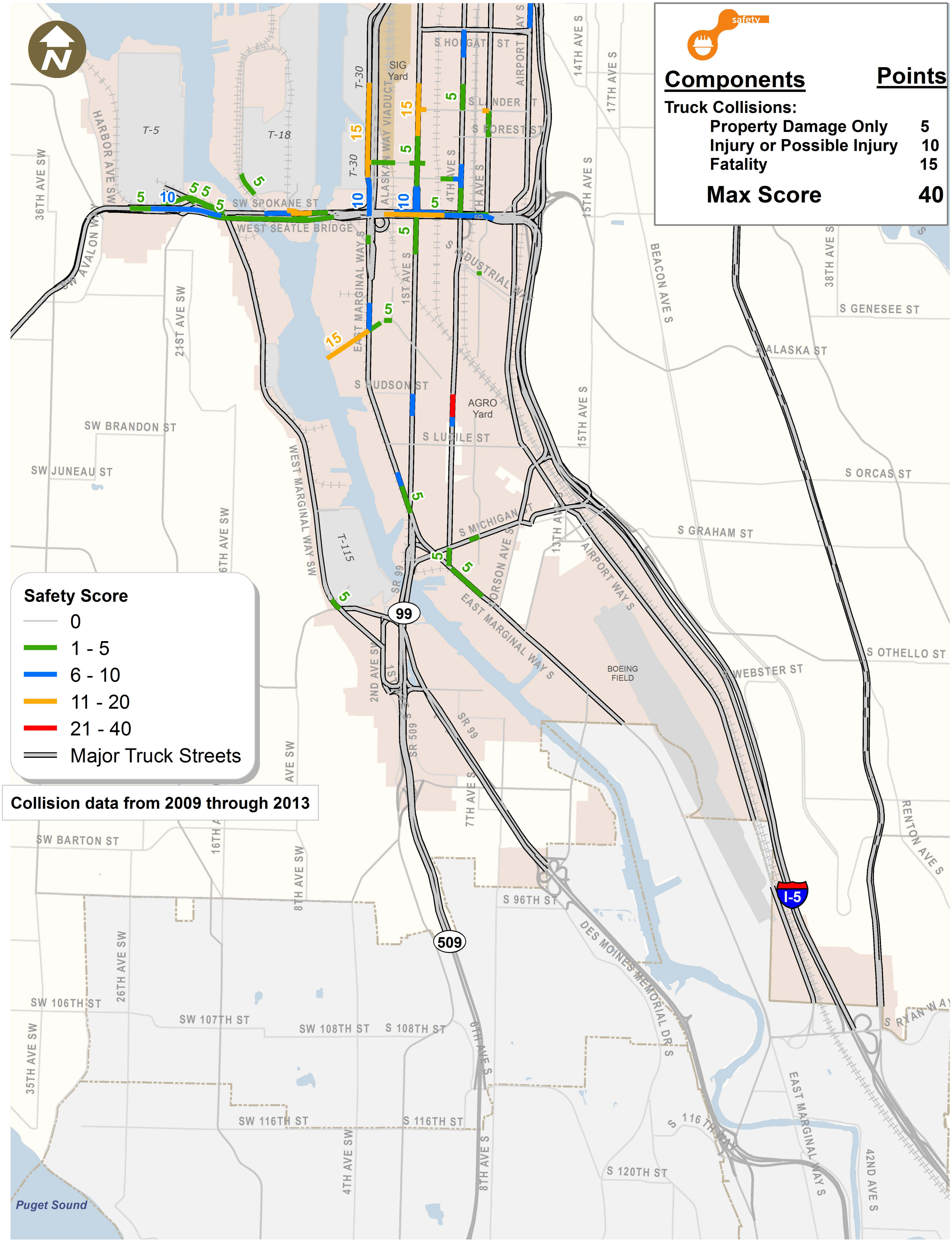
APPENDIX D

SAFETY, MOBILITY AND CONNECTIVITY SCORING MAPS

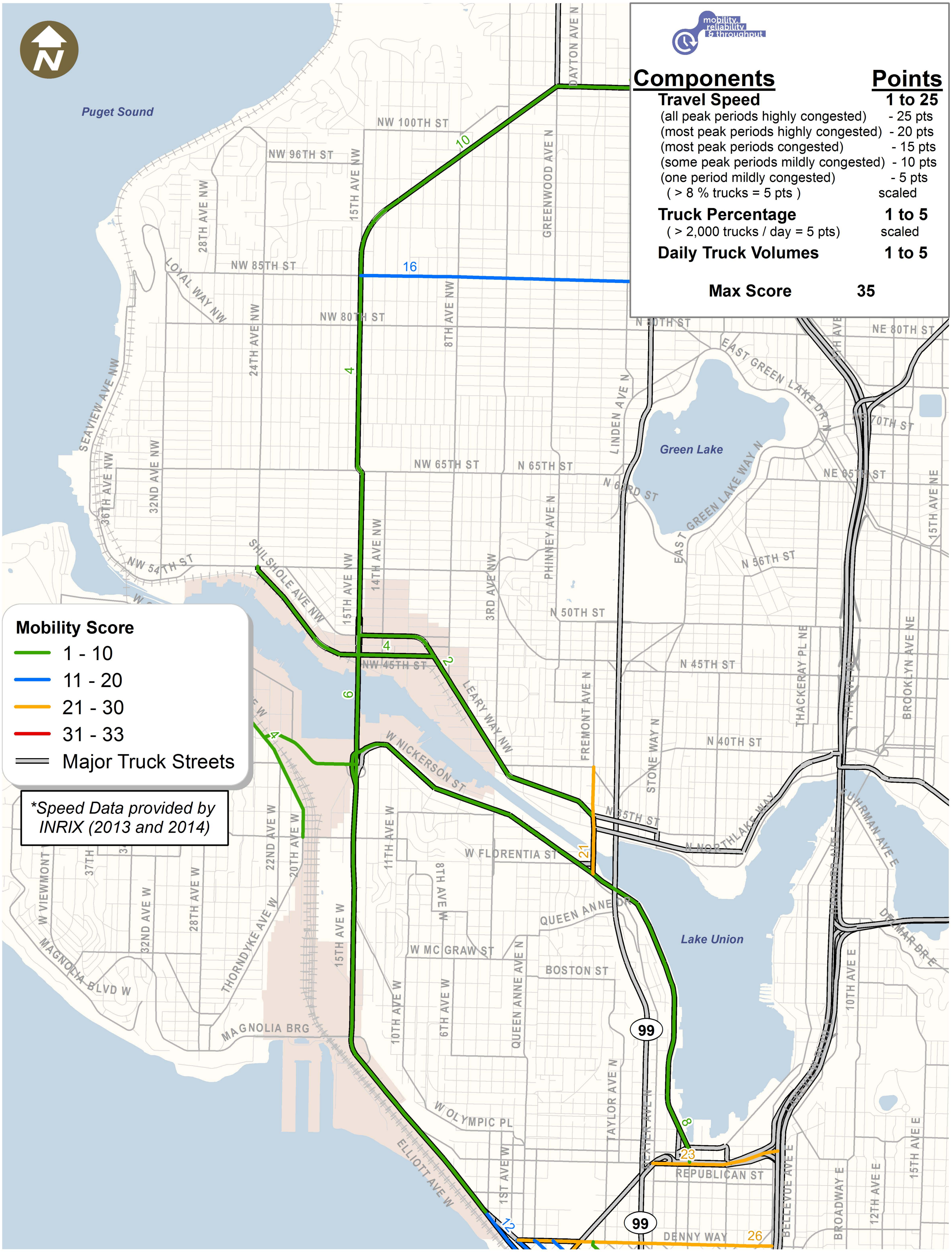

safety
Components
Points
Truck Collisions:
Property Damage Only 5
Injury or Possible Injury 10
Fatality 15
Max Score 40
Safety Score
0
1 - 5
6 - 10
11 - 20
21 - 40
Major Truck Streets
Collision data from 2009 through 2013
Puget Sound
Green Lake
Salmon Bay
Lake Union
NW 100TH ST
NW 96TH ST
NW 85TH ST
NW 80TH ST
N 80TH ST
NE 80TH ST
NW 65TH ST
N 65TH ST
NE 65TH ST
NW 54TH ST
N 50TH ST
NW 46TH ST
NW 45TH ST
N 45TH ST
N 40TH ST
N 35TH ST
N 56TH ST
N NORTHLAKE WAY
15TH AVE NW
14TH AVE NW
8TH AVE NW
3RD AVE NW
24TH AVE NW
28TH AVE NW
32ND AVE NW
36TH AVE NW
SEAVIEW AVE NW
LOYAL WAY NW
SHILSHOLE AVE NW
LEARY WAY NW
W NICKERSON ST
GREENWOOD AVE N
DAYTON AVE N
PHINNEY AVE N
LINDEN AVE N
FREMONT AVE N
STONE WAY N
THACKERAY PL NE
BROOKLYN AVE NE
15TH AVE NE
EAST GREEN LAKE DR N
EAST GREEN LAKE WAY N
FLORENTIA ST
QUEEN ANNE DR
W MC GRAW ST
BOSTON ST
15TH AVE W
11TH AVE W
10TH AVE W
8TH AVE W
6TH AVE W
1ST AVE W
QUEEN ANNE AVE N
TAYLOR AVE N
W VIEWMONT WAY
MAGNOLIA BLVD W
MAGNOLIA BRG
THORNDYKE AVE W
21ST AVE W
20TH AVE W
22ND AVE W
28TH AVE W
32ND AVE W
W OLYMPIC PL
ELLIOTT AVE W
REPUBLICAN ST
DENNY WAY
FUHRMAN AVE E
DELMAR DR E
10TH AVE E
BELLEVUE AVE E
BROADWAY E
12TH AVE E
15TH AVE E
99
5
10
15

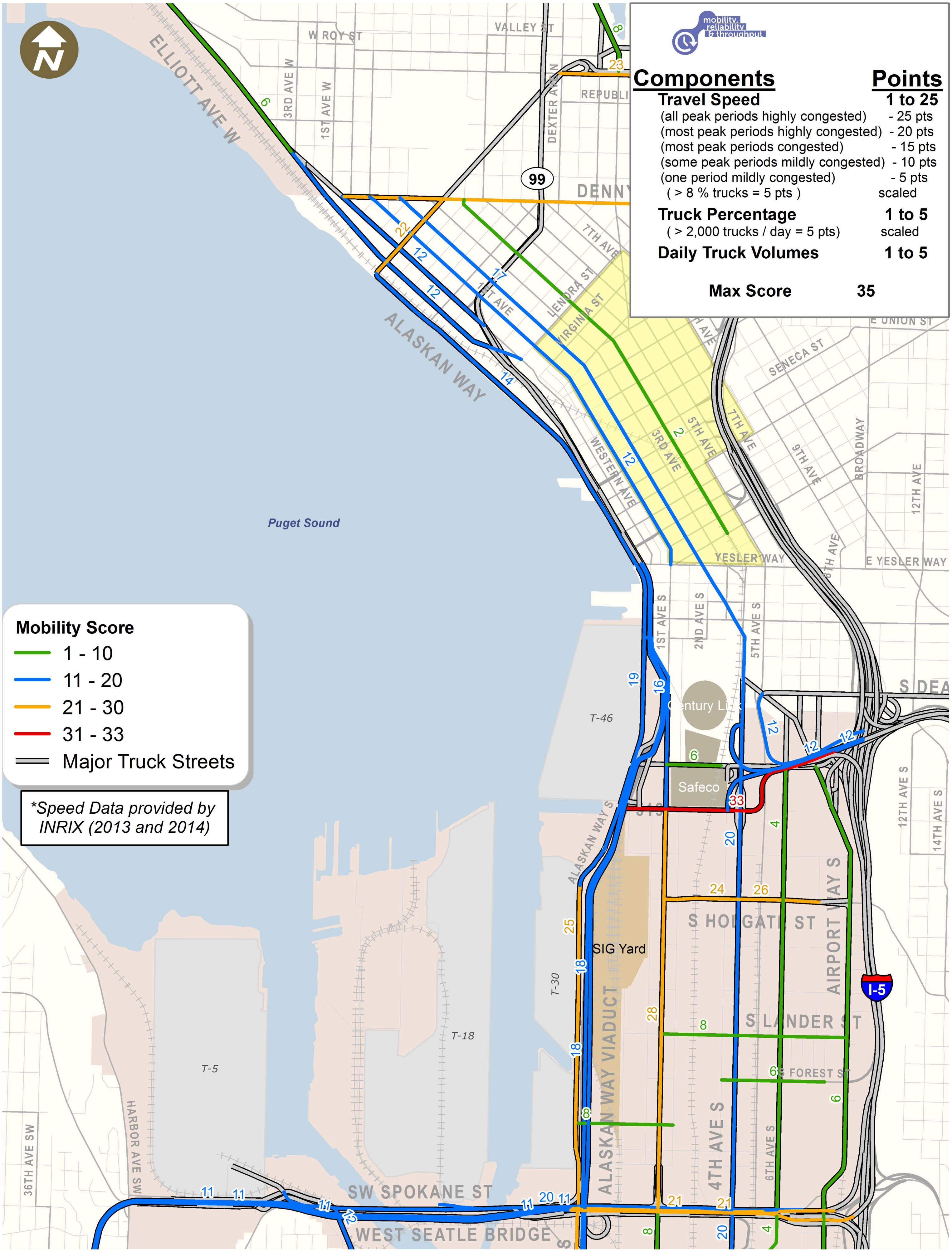


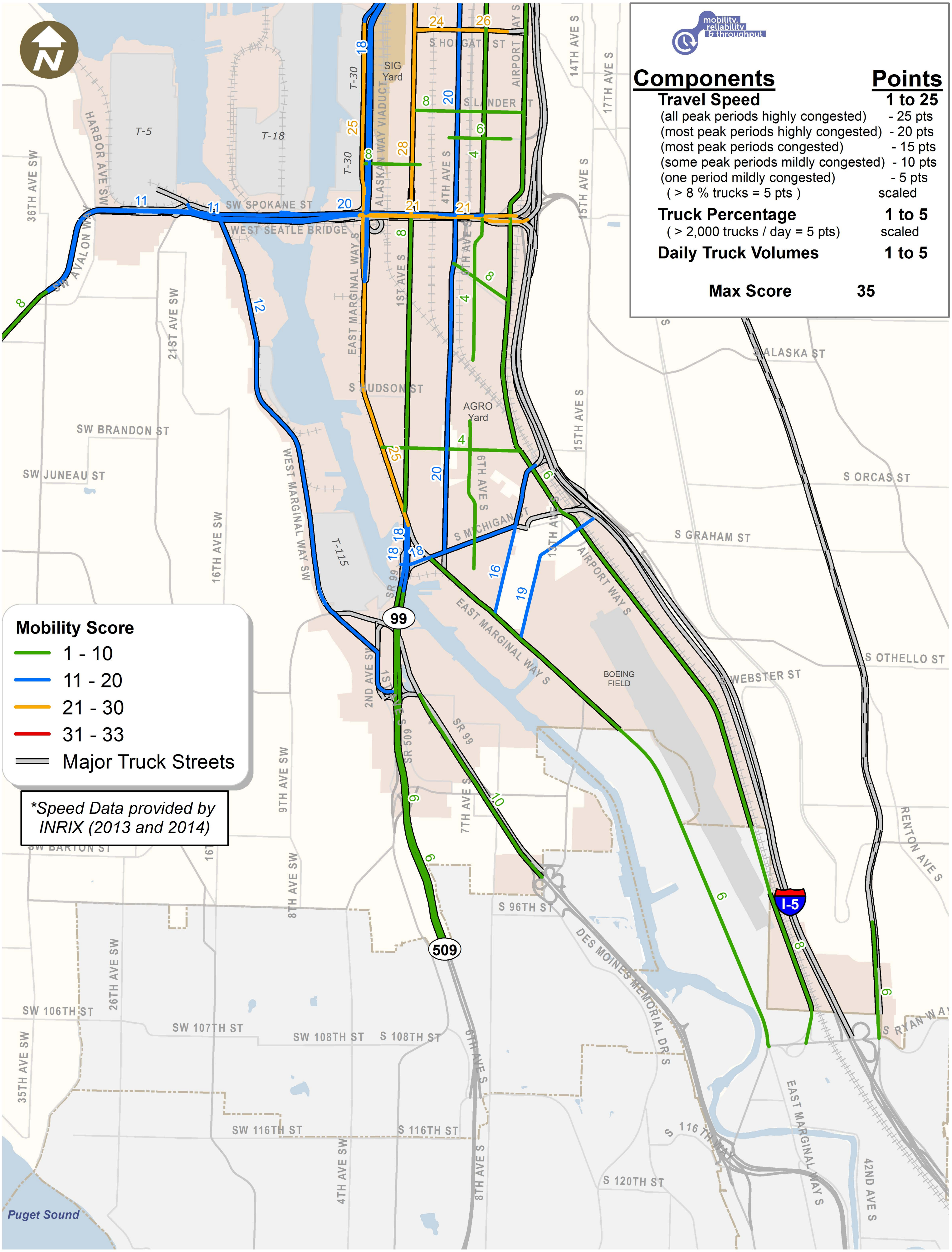
Components
Points
Truck Collisions:
Property Damage Only 5
Injury or Possible Injury 10
Fatality 15
Max Score 40
Safety Score
0
1 - 5
6 - 10
11 - 20
21 - 40
Major Truck Streets
Collision data from 2009 through 2013
Puget Sound
ELLIOTT AVE W
ALASKAN WAY
SW SPOKANE ST
WEST SEATTLE BRIDGE
ALASKAN WAY VIADUCT
EAST MARGINAL WAY S
AIRPORT WAY S
S HOLGATE ST
S LANDER ST
YESLER WAY
DENNY WAY
SIG Yard
Safeco
T-46
T-18
T-5
T-30



safety
Components
Points
Truck Collisions:
Property Damage Only 5
Injury or Possible Injury 10
Fatality 15
Max Score 40
Safety Score
0
1 - 5
6 - 10
11 - 20
21 - 40
Major Truck Streets
Collision data from 2009 through 2013
T-5
T-18
T-30
T-115
SIG Yard
AGRO Yard
BOEING FIELD
ALASKAN WAY VIADUCT
WEST SEATLE BRIDGE
SW SPOKANE ST
S HOLGATE ST
S LANDER ST
S FOREST ST
S INDUSTRIAL WAY
EAST MARGINAL WAY S
WEST MARGINAL WAY SW
S HUDSON ST
S LUCILE ST
S MICHIGAN ST
CORSON AVE S
AIRPORT WAY S
1ST AVE S
4TH AVE S
14TH AVE S
17TH AVE S
15TH AVE S
13TH AVE S
BEACON AVE S
38TH AVE S
S GENESEE ST
S ALASKA ST
S ORCAS ST
S GRAHAM ST
S OTHELLO ST
S WEBSTER ST
RENTON AVE S
S RYAN WAY
36TH AVE SW
HARBOR AVE SW
SW AVALON WAY
21ST AVE SW
SW BRANDON ST
SW JUNEAU ST
16TH AVE SW
2ND AVE SW
SR 99
SR 509
99
509
I-5
SW BARTON ST
S 96TH ST
DES MOINES MEMORIAL DR S
7TH AVE S
8TH AVE SW
26TH AVE SW
SW 106TH ST
SW 107TH ST
SW 108TH ST
S 108TH ST
35TH AVE SW
SW 116TH ST
S 116TH ST
S 116TH WAY
S 120TH ST
4TH AVE SW
8TH AVE S
EAST MARGINAL WAY S
42ND AVE S
Puget Sound

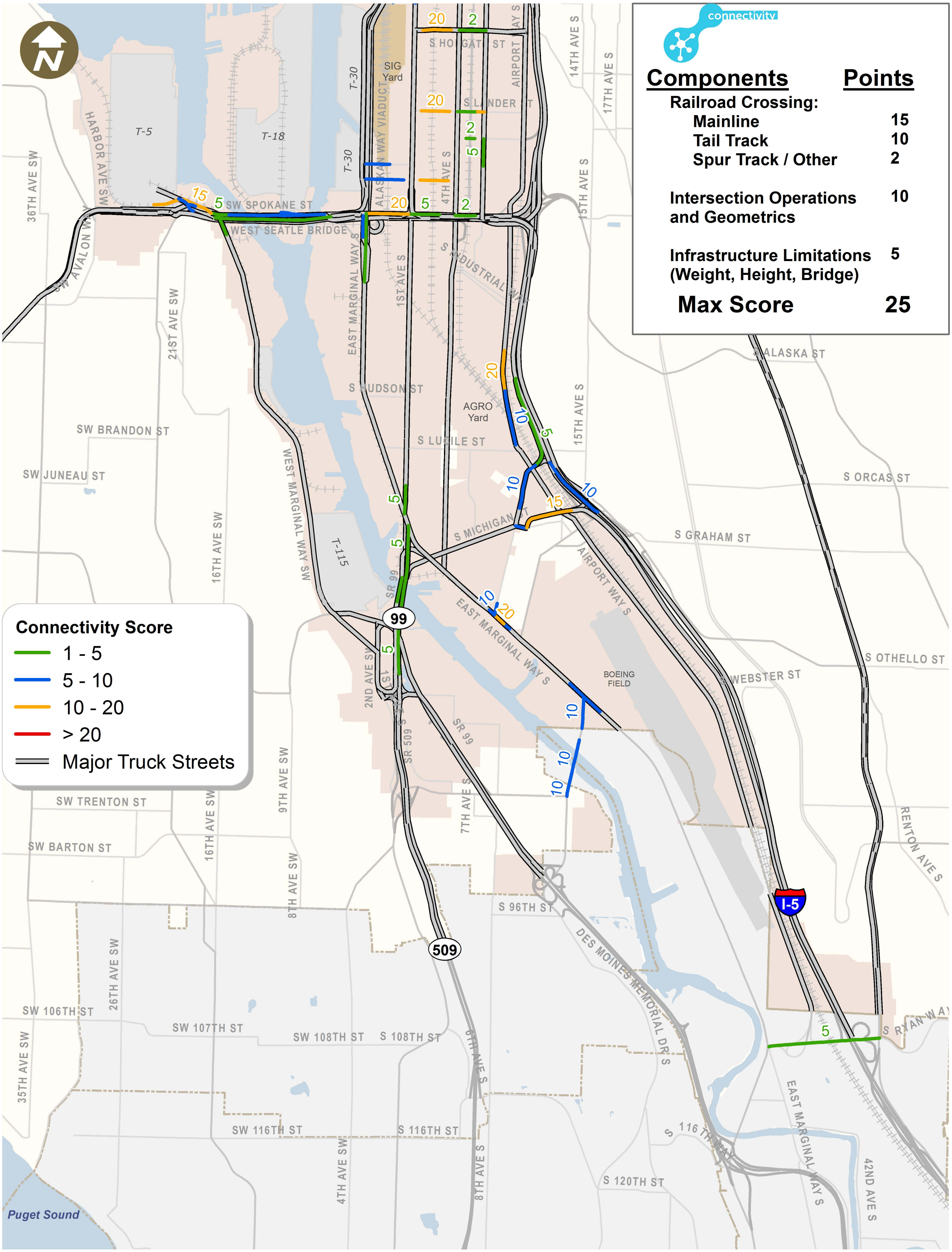

mobility, reliability & throughput
Components
Points
Travel Speed
1 to 25
(all peak periods highly congested) - 25 pts
(most peak periods highly congested) - 20 pts
(most peak periods congested) - 15 pts
(some peak periods mildly congested) - 10 pts
(one period mildly congested) - 5 pts
(> 8 % trucks = 5 pts) scaled
Truck Percentage
1 to 5
(> 2,000 trucks / day = 5 pts) scaled
Daily Truck Volumes
1 to 5
Max Score 35
Mobility Score
1 - 10
11 - 20
21 - 30
31 - 33
Major Truck Streets
*Speed Data provided by INRIX (2013 and 2014)
Puget Sound
Green Lake
Lake Union
NW 100TH ST
NW 96TH ST
NW 85TH ST
NW 80TH ST
NW 65TH ST
N 65TH ST
NW 54TH ST
NW 45TH ST
N 50TH ST
N 45TH ST
N 40TH ST
N 35TH ST
N 80TH ST
NE 80TH ST
NE 70TH ST
NE 65TH ST
N 63RD ST
N 56TH ST
15TH AVE NW
14TH AVE NW
8TH AVE NW
3RD AVE NW
24TH AVE NW
28TH AVE NW
32ND AVE NW
36TH AVE NW
SEAVIEW AVE NW
LOYAL WAY NW
SHILSHOLE AVE NW
LEARY WAY NW
W NICKERSON ST
GREENWOOD AVE N
PHINNEY AVE N
DAYTON AVE N
LINDEN AVE N
FREMONT AVE N
STONE WAY N
EAST GREEN LAKE DR N
EAST GREEN LAKE WAY N
N NORTHLAKE WAY
THACKERAY PL NE
BROOKLYN AVE NE
15TH AVE NE
FUHRMAN AVE E
DELMAR DR E
W FLORENTIA ST
QUEEN ANNE DR
W MC GRAW ST
BOSTON ST
QUEEN ANNE AVE N
TAYLOR AVE N
W OLYMPIC PL
ELLIOTT AVE W
1ST AVE W
6TH AVE W
8TH AVE W
10TH AVE W
11TH AVE W
15TH AVE W
20TH AVE W
22ND AVE W
28TH AVE W
32ND AVE W
37TH
W VIEWMONT
MAGNOLIA BLVD W
MAGNOLIA BRG
THORNDYKE AVE W
REPUBLICAN ST
DENNY WAY
BELLEVUE AVE E
BROADWAY E
10TH AVE E
12TH AVE E
15TH AVE E
99
10
16
4
2
6
21
8
23
12
26


N
mobility, reliability & throughput
Components
Points
Travel Speed
1 to 25
(all peak periods highly congested) - 25 pts
(most peak periods highly congested) - 20 pts
(most peak periods congested) - 15 pts
(some peak periods mildly congested) - 10 pts
(one period mildly congested) - 5 pts
(> 8 % trucks = 5 pts) scaled
Truck Percentage
1 to 5
(> 2,000 trucks / day = 5 pts) scaled
Daily Truck Volumes
1 to 5
Max Score
35
Mobility Score
1 - 10
11 - 20
21 - 30
31 - 33
Major Truck Streets
*Speed Data provided by INRIX (2013 and 2014)
ELLIOTT AVE W
W ROY ST
VALLEY ST
3RD AVE W
1ST AVE W
DEXTER AVE N
REPUBLI
DENNY
99
7TH AVE
LENORA ST
VIRGINIA ST
1ST AVE
ALASKAN WAY
WESTERN AVE
3RD AVE
5TH AVE
7TH AVE
9TH AVE
BROADWAY
12TH AVE
SENECA ST
E UNION ST
YESLER WAY
E YESLER WAY
Puget Sound
1ST AVE S
2ND AVE S
5TH AVE S
S DEA
Century Link
Safeco
T-46
ALASKAN WAY S
SIG Yard
T-30
T-18
T-5
S HOLGATE ST
AIRPORT WAY S
S LANDER ST
S FOREST ST
12TH AVE S
14TH AVE S
I-5
ALASKAN WAY VIADUCT
4TH AVE S
6TH AVE S
36TH AVE SW
HARBOR AVE SW
SW SPOKANE ST
WEST SEATLE BRIDGE


mobility, reliability & throughput
Components
Points
Travel Speed
1 to 25
(all peak periods highly congested) - 25 pts
(most peak periods highly congested) - 20 pts
(most peak periods congested) - 15 pts
(some peak periods mildly congested) - 10 pts
(one period mildly congested) - 5 pts
(> 8 % trucks = 5 pts) scaled
Truck Percentage
1 to 5
(> 2,000 trucks / day = 5 pts) scaled
Daily Truck Volumes
1 to 5
Max Score 35
Mobility Score
1 - 10
11 - 20
21 - 30
31 - 33
Major Truck Streets
*Speed Data provided by INRIX (2013 and 2014)
S HOLGATE ST
S LANDER ST
SW SPOKANE ST
WEST SEATTLE BRIDGE
SIG Yard
T-5
T-18
T-30
T-115
HARBOR AVE SW
36TH AVE SW
SW AVALON WAY
21ST AVE SW
SW BRANDON ST
SW JUNEAU ST
16TH AVE SW
WEST MARGINAL WAY SW
EAST MARGINAL WAY S
ALASKAN WAY VIADUCT
1ST AVE S
4TH AVE S
6TH AVE S
AIRPORT WAY S
14TH AVE S
17TH AVE S
15TH AVE S
S ALASKA ST
S HUDSON ST
AGRO Yard
S ORCAS ST
S GRAHAM ST
S MICHIGAN ST
S OTHELLO ST
S WEBSTER ST
BOEING FIELD
2ND AVE SW
SR 99
SR 509
99
509
I-5
9TH AVE SW
8TH AVE SW
7TH AVE S
26TH AVE SW
35TH AVE SW
4TH AVE SW
8TH AVE S
SW BARTON ST
S 96TH ST
DES MOINES MEMORIAL DR S
SW 106TH ST
SW 107TH ST
SW 108TH ST
S 108TH ST
SW 116TH ST
S 116TH ST
S 116 TH WAY
S 120TH ST
EAST MARGINAL WAY S
42ND AVE S
RENTON AVE S
S RYAN WAY
Puget Sound

connectivity
Components
Points
Railroad Crossing:
Mainline 15
Tail Track 10
Spur Track / Other 2
Intersection Operations and Geometrics 10
Infrastructure Limitations (Weight, Height, Bridge) 5
Max Score 25
Connectivity Score
1 - 5
5 - 10
10 - 20
> 20
Major Truck Streets
Puget Sound
Green Lake
Lake Union
NW 100TH ST
NW 96TH ST
NW 85TH ST
NW 80TH ST
NW 65TH ST
N 65TH ST
NE 65TH ST
NE 70TH ST
N 63RD ST
NW 54TH ST
N 56TH ST
N 50TH ST
NW 45TH ST
N 45TH ST
N 40TH ST
N 35TH ST
N NORTHLAKE WAY
W NICKERSON ST
W FLORENTIA ST
QUEEN ANNE DR
W MC GRAW ST
BOSTON ST
MAGNOLIA BRG
MAGNOLIA BLVD W
W OLYMPIC PL
ELLIOTT AVE W
REPUBLICAN ST
DENNY WAY
DAYTON AVE N
GREENWOOD AVE N
15TH AVE NW
8TH AVE NW
28TH AVE NW
24TH AVE NW
LOYAL WAY NW
SEAVIEW AVE NW
36TH AVE NW
32ND AVE NW
SHILSHOLE AVE NW
14TH AVE NW
3RD AVE NW
PHINNEY AVE N
LINDEN AVE N
EAST GREEN LAKE DR N
EAST GREEN LAKE WAY N
LEARY WAY NW
FREMONT AVE N
STONE WAY N
THACKERAY PL NE
BROOKLYN AVE NE
15TH AVE NE
FUHRMAN AVE E
DELMAR DR E
21ST AVE W
22ND AVE W
20TH AVE W
W VIEWMONT WAY W
37TH AVE W
34TH AVE W
32ND AVE W
28TH AVE W
THORNDYKE AVE W
15TH AVE W
11TH AVE W
8TH AVE W
10TH AVE W
6TH AVE W
QUEEN ANNE AVE N
TAYLOR AVE N
1ST AVE W
10TH AVE E
BELLEVUE AVE E
BROADWAY E
12TH AVE E
15TH AVE E
99
5
10
15

connectivity
Components Points
Railroad Crossing:
Mainline 15
Tail Track 10
Spur Track / Other 2
Intersection Operations and Geometrics 10
Infrastructure Limitations (Weight, Height, Bridge) 5
Max Score 25
Connectivity Score
1 - 5
5 - 10
10 - 20
> 20
Major Truck Streets
Puget Sound
ELLIOTT AVE W
ALASKAN WAY
W ROY ST
VALLEY ST
3RD AVE W
1ST AVE W
DEXTER AVE N
REPUBLICAN
DENNY
99
7TH AVE
LENORA ST
VIRGINIA ST
1ST AVE
WALL ST
WESTERN AVE
3RD AVE
5TH AVE
7TH AVE
MADISON ST
SENECA ST
9TH AVE
BROADWAY
12TH AVE
YESLER WAY
E YESLER WAY
1ST AVE S
2ND AVE S
5TH AVE S
CenturyLink
Safeco
T-46
S DEA
6TH AVE S
12TH AVE S
14TH AVE S
S HOLGATE ST
AIRPORT WAY S
SIG Yard
ALASKAN WAY VIADUCT
EAST MARGINAL WAY S
T-18
T-5
T-30
S LANDER ST
FOREST ST
4TH AVE S
I-5
HARBOR AVE SW
36TH AVE SW
SW SPOKANE ST
WEST SEATLE BRIDGE


connectivity
Components
Points
Railroad Crossing:
Mainline 15
Tail Track 10
Spur Track / Other 2
Intersection Operations and Geometrics 10
Infrastructure Limitations (Weight, Height, Bridge) 5
Max Score 25
Connectivity Score
1 - 5
5 - 10
10 - 20
> 20
Major Truck Streets
S HOLGATE ST
S LANDER ST
SIG Yard
T-30
T-5
T-18
SW SPOKANE ST
WEST SEATLE BRIDGE
ALASKAN WAY VIADUCT
EAST MARGINAL WAY S
1ST AVE S
4TH AVE S
S INDUSTRIAL WAY
AIRPORT WAY S
14TH AVE S
17TH AVE S
15TH AVE S
S ALASKA ST
S HUDSON ST
AGRO Yard
S LUCILE ST
S ORCAS ST
S GRAHAM ST
S MICHIGAN ST
T-115
SR 99
99
EAST MARGINAL WAY S
BOEING FIELD
S OTHELLO ST
S WEBSTER ST
SW BRANDON ST
SW JUNEAU ST
16TH AVE SW
21ST AVE SW
36TH AVE SW
HARBOR AVE SW
SW AVALON WAY
WEST MARGINAL WAY SW
2ND AVE SW
SR 509
SW TRENTON ST
SW BARTON ST
9TH AVE SW
8TH AVE SW
7TH AVE S
S 96TH ST
I-5
509
RENTON AVE S
DES MOINES MEMORIAL DR S
S RYAN WAY
SW 106TH ST
26TH AVE SW
SW 107TH ST
SW 108TH ST
S 108TH ST
35TH AVE SW
SW 116TH ST
S 116TH ST
S 116TH WAY
S 120TH ST
4TH AVE SW
8TH AVE S
EAST MARGINAL WAY S
42ND AVE S
Puget Sound

APPENDIX E

COMPLETE FREIGHT PROJECT LIST AND SCORING

Seattle Industrial Areas Freight Access Project

Project List and Priority Scoring

Tier	Project No.	Project Name	Project Extents	Project Description	Project Type	Area	Priority Score Components: Freight Conditions Score	Roadway Designation	Pavement Conditions	Environmental	Reliability	Priority Score
Tier I	24	Lower Spokane Street Freight Only Lanes Pilot	Harbor Island to Airport Way South	Pilot project to design, implement, and evaluate freight-only lanes on the corridor. The first phase of the project would determine project limits; identify design options and new infrastructure needed to implement the pilot. The second phase would implement the modifications to roadway channelization for truck-only lanes, install signal and signage upgrades, and provide ITS equipment such as variable message signs and detection equipment. The project would evaluate time-of-day operations, while providing a contingency for allowing all traffic to use the lanes in the event of an incident on the upper bridge.	Intersection Operations; ITS Application	N of Spokane	50	15	6	10	6	87
Tier I	23	South Holgate Street Rail Crossing Improvements	Occidental Avenue to 4th Avenue South	Rebuild the pavement to Heavy Haul route requirements, improve channelization and signage, add new curb/gutter, and provide sidewalks along the south side outside the immediate crossing areas.	Capital Investment	N of Spokane	47	15	11	10	2	85
Tier I	37B	South Atlantic Street Corridor Improvements	Alaskan Way to 4th Avenue South	As the SR 99 bored tunnel is completed, SDOT will regularly monitor travel conditions to evaluate potential changes in corridor operations. This project would implement signal, channelization, and ITS improvements based on the results of the monitoring program.	ITS Application; Intersection Operations	N of Spokane	48	15	10	5	6	84
Tier I	5B	E Marginal Way / S Hanford Street Intersection Improvements	Intersection	Upgrade the signal, lengthen the northbound right-turn lane, improve the railroad crossing pavement, and evaluate the need for railroad crossing gates at the Whatcom track crossings. The project also includes rebuilding the intersection and its approaches to Heavy Haul route requirements. This project will also more clearly delineate parking on the southeast corner of the intersection.	Intersection Operations; Maintenance & Repair; Capital Investment	N of Spokane	48	15	13	5	2	83
Tier I	25	South Spokane Street ITS Upgrades	Chelan Avenue to Airport Way	Install ITS equipment along the corridor to collect and provide real-time travel time information for trucks and the general public. The specific equipment would include Bluetooth readers and dynamic message signs installed along the corridor to collect and disseminate travel time information between Airport Way and Chelan Avenue, including access to Port Terminal 5. An additional project component, which has not yet been evaluated for cost, may be to improve the signal system at the intersection of Chelan Avenue at the western terminus of the corridor.	ITS Application	S of Spokane	48	15	10	5	4	82
Tier I	37A	1st Avenue S / Atlantic Street Intersection Improvements	Intersection	Enhance signal operations and lighting at the intersection by installing new LED street lighting and right-turn overlap signal phases on the east and west approaches. The project would also improve the turn radius for trucks at the southeast corner of the intersection by widening the northbound right-turn lane. Pavement marking improvements are included to enhance the visibility and durability of the lane lines and crosswalks.	Geometric Improvement; Intersection Operations	N of Spokane	48	15	10	0	6	79
Tier I	17	Study and Implementation of Mainline Grade Separations in Mid-SODO Area	Mainline between S Atlantic Street to S Spokane Street	Identify alternatives for an additional (to S Lander Street) grade separated crossing of the BNSF mainline railroad tracks between S Atlantic Street and S Spokane Street, and will include a value engineering evaluation of the South Lander Street Grade Separation (#16) to identify potential cost savings. This project could also identify other technology investments, including adaptive signal timing, to maintain reliable east/west street movement for motor vehicles, including trucks, and non-motorized traffic.	Capital Investment; ITS Application	N of Spokane	47	15	2	10	2	76
Tier I	28	Railroad Crossing Delay Warning System	Crossings at Holgate, Lander, and Horton Streets	Install ITS equipment to monitor and inform the public of road closures due to train activity, and provides alternative routing options via of dynamic message signs that display real-time information to drivers at key locations.	ITS Application	N of Spokane	47	15	4	5	2	73

Seattle Industrial Areas Freight Access Project

Project List and Priority Scoring

Tier	Project No.	Project Name	Project Extents	Project Description	Project Type	Area	Priority Score Components: Freight Conditions Score	Roadway Designation	Pavement Conditions	Environmental	Reliability	Priority Score
Tier I	5A	East Marginal Way South Roadway Rehabilitation	S Dakota Street (SR 99 ramps) to S Massachusetts Street	Rebuild the roadway to Heavy Haul route standards, upgrades signal hardware, and adds CCTV cameras and dynamic message signs to improve truck travel conditions.	Maintenance & Repair; Capital Investment; ITS Application	N of Spokane	48	15	8	0	2	73
Tier I	20	4th Avenue South Viaduct Replacement	Grade crossing over Union Pacific Railroad Argo Yard	Replace the viaduct structure spanning the Union Pacific Railroad (UPRR) yard at the conclusion of its service life, which is expected to occur within the 20-year planning timeframe (by 2035). The new structure will increase vertical clearance above the railroad tracks to improve safety and rail operations. Columns and pier walls will be removed to increase and optimize rail yard functionality and operations.	Capital Investment; Maintenance & Repair	S of Spokane	45	10	4	10	3	72
Tier I	52	BINMIC Truck Route Improvements	Area bounded by Dravus Street, Nickerson Street, Market Street, and Fremont Avenue	The first phase of the project will be to evaluate truck freight movements to identify specific projects to address geometric and operating challenges for trucks. The projects will be focused on readily feasible improvements with primary consideration given to safety and freight connectivity. They may include signal timing adjustments, additional signage or wayfinding, larger intersection turn radii, lane width adjustments, and joint use of bus lanes. • Phase I: Collect data on needs through a detailed assessment of truck volumes, truck sizes, and over-dimensional truck activity. Build from the forecasts developed in the FAP and work with stakeholders to identify and prioritize specific truck route projects. • Phase II: Implement top priority projects given funding availability and opportunities. Develop long term budget and funding strategy to implement remaining projects.	Geometric Improvement; Intersection Operations	BINMIC	34	15	7	10	6	72
Tier I	16	South Lander Street Grade Separation	1st Avenue S to 4th Avenue S	Construct a grade separated bridge over the mainline BNSF railroad tracks between approximately 1st Avenue S and 4th Avenue S.	Capital Investment	N of Spokane	37	10	8	10	2	67
Tier I	22	15th Avenue West Spot Improvements at West Dravus Street and W Wmerson Street	Intersection	This project addresses turn radii issues for trucks through small-scale geometric and intersection operational improvements along 15th Avenue W. Trucks of all sizes experience challenges traveling on the elevated structures at W Emerson Street and W Dravus Street. 15th Avenue W, W Emerson Street, and W Dravus Street are vital connections for freight traveling to and from the Ballard/Interbay Northend Manufacturing and Industrial Center (BINMIC). This project includes two components to implement changes at these locations. • The W Emerson Street ramp over 15th Avenue W serves trucks going to and from W Nickerson Street. This component includes moving the centerline on the ramp to provide a greater turning radius for trucks and making adjustments to the stop bars at the intersection on the west side of the ramp. • W Dravus Street is used by trucks of all sizes, including overlegal vehicles unable to pass underneath the bridge on 15th Avenue W. Northbound trucks have particular difficulty turning left onto W Dravus Street from the off-ramp. This component of the project includes upgrading signal timing and hardware at the ramp terminals to ensure vehicle queues on the bridge clear to allow trucks adequate space to turn at the intersection.	Geometric Improvement; Intersection Operations	BINMIC	30	15	7	10	5	67
Tier I	15	Hanford & Main SIG Access Improvements	Intersection	Improve access to the Main SIG Yard. Initially, it examines the feasibility of installing a traffic signal and other potential changes to facilitate traffic flow in the area. If or when warranted, a traffic signal at the Main SIG entrance could alleviate congestion and allow for improved truck access to the yard. This project also rebuilds the segment of Hanford Street between the E Marginal Way S and 1st Avenue S to Heavy Haul route standards, including new pavement at railroad crossings. It may include rail crossing gates or other devices, if needed.	Capital Investment; Intersection Operations	N of Spokane	27	15	10	10	-	62

Seattle Industrial Areas Freight Access Project

Project List and Priority Scoring

Tier	Project No.	Project Name	Project Extents	Project Description	Project Type	Area	Priority Score Components: Freight Conditions Score	Roadway Designation	Pavement Conditions	Environmental	Reliability	Priority Score
Tier II	35	S Michigan St ITS Improvements	E. Marginal Way S to Corson Ave S	Update signal timing, vehicle detection, CCTV cameras, dynamic message signs and fiber communications to improve traffic flow and provide enhanced traveler information along S Michigan St ITS Improvements.	ITS Application	S of Spokane	31	15	8	5	-	59
Tier II	41	E Marginal Way	1st Avenue S to 4th Avenue S	Study bottlenecks and congestion in the vicinity of the 1st Avenue S Bridge and identify intersection and operational improvements.	Intersection Operations	S of Spokane	24	15	3	5	10	57
Tier II	44	W Marginal Way / Chelan Street Intersection Improvement	Intersection	Intersection signal operational improvements for freight. There is another study underway to improve access for cyclists, but that project is currently unfunded.	Geometric Improvement	S of Spokane	24	15	13	0	2	54
Tier II	34	1st Avenue S Bridge ITS	1st Avenue S Bridge	Provide information and advance warnings about bridge openings during peak travel times for freight based on historical statistics and real-time information	ITS Application	S of Spokane	22	10	15	5	-	52
Tier II	30	Denny Way ITS	I-5 to Western Ave	Update signal timing, vehicle detection, CCTV cameras, dynamic message signs and fiber communications to improve traffic flow and provide enhanced traveler information along Denny Way from I-5 to Western Ave.	ITS Application	Central	27	10	7	5	-	49
Tier II	48	E Marginal Way S railroad track removal	Diagonal Street to 1st Avenue Bridge (or W Marginal Way)	Improve pavement and remove unused rail lines.	Geometric Improvement	S of Spokane	24	15	7	0	3	49
Tier II	9	15th Avenue / Elliott Avenue Rebuild	Mercer Place to Holman Road NW	Rebuild and make operational/ITS improvements to 15th Avenue/Elliott Avenue.	Maintenance & Repair	BINMIC	25	10	7	0	5	47
Tier II	8	S Hanford Street Rebuild	E Marginal Way to Occidental Street	Rebuild and make operational/ITS improvements to S Hanford Street.	Maintenance & Repair	N of Spokane	27	10	8	0	-	45
Tier II	38	Airport Way S / Edmunds Street	Intersection	Monitor and evaluate for future signal warrants and address geometric issues.	Intersection Operations	S of Spokane	25	15	0	5	-	45
Tier II	45	15th Avenue NW / NW Market Street Intersection Improvement	Intersection	Improve southeast corner curb radius, which would impact existing signal equipment.	Geometric Improvement	BINMIC	15	15	7	0	6	43
Tier II	47	E Marginal Way S and Corson Street Intersection Improvement	Intersection	Improve curb radius.	Geometric Improvement	S of Spokane	25	15	0	0	3	43
Tier II	19	1st Avenue South Viaduct over UPRR Yard	Grade crossing over Union Pacific Railroad Argo Yard	Replace the existing viaduct structure spanning the Union Pacific rail yard at the end of its useful life span.	Capital Investment	S of Spokane	17	15	0	10	-	42
Tier II	36	NW Leary Way at 46th Street or 45th Street	Intersection	Intersection operations should be evaluated and treatments considered to improve access to/from 46th Street or 45th Street. Type of improvements to be coordinated with outcomes of the BINMIC Truck Route Improvements (#52).	Intersection Operations	BINMIC	16	10	9	5	2	42
Tier II	51	Elliott Avenue	Broad Street to SR 99 ramps	Study and implement freight only lanes for southbound truck traffic.	Geometric Improvement	Central	19	10	8	0	5	42
Tier II	21	West Emerson Street / 21st Avenue West / West Commodore Way	Intersection and structures	Rebuild the existing structures.	Capital Investment	BINMIC	10	15	5	10	-	40
Tier II	6	NW Market Street / Leary Way / N 36th Street Rebuild	46th Street to Shilshole Avenue	Rebuild and make operational/ITS improvements to Leary Way corridor to facilitate freight movement. This project would coordinate specific truck operational improvements with the BINMIC Truck Route Improvements (#52).	Maintenance & Repair	BINMIC	16	10	11	0	2	39
Tier II	42	S Bailey Street Channelization and Operational Improvements	S Michigan Street to Carleton Avenue S	Improvements for the eastbound left-turn movement to access the I-5 ramps, including a review of signal operations and channelization changes.	Intersection Operations	S of Spokane	10	15	6	5	-	36

Seattle Industrial Areas Freight Access Project

Project List and Priority Scoring

Tier	Project No.	Project Name	Project Extents	Project Description	Project Type	Area	Priority Score Components					Priority Score
							Freight Conditions Score	Roadway Designation	Pavement Conditions	Environmental	Reliability	
Tier III	10	Holman Road NW Rebuild	15th Avenue NW to Greenwood Avenue N	Rebuild and make operational/ITS improvements.	Maintenance & Repair	N Seattle	10	10	9	5	-	34
Tier III	43	16th Avenue S and E Marginal Way S Intersection Improvement	Intersection	Improve northbound right-turn curb radius.	Geometric Improvement	S of Spokane	15	10	5	0	3	33
Tier III	11	N 105th Street / Northgate Way	Greenwood Avenue N to I-5	Rebuild and make operational/ITS improvements.	Maintenance & Repair	N Seattle	8	10	13	0	-	31
Tier III	50	Holman Road / 13th Avenue Intersection Improvement	Intersection	Remove height limitation from existing pedestrian overpass and install half signal.	Geometric Improvement	N Seattle	10	10	9	0	-	29
Tier III	12	S Lucile Street Rebuild	Airport Way to SR 99	Rebuild and make operational/ITS improvements.	Maintenance & Repair	S of Spokane	4	10	4	0	-	18
Tier III	13	Massachusetts Street (access road) Rebuild	Colorado Avenue to 1st Avenue S	Rebuild Massachusetts Street to improve safety and access to North SIG Yard, while maintaining two-way operations. Roadway would be segregated for GP and truck traffic. Provide improved truck access/operations at the 1st Avenue S / S Massachusetts Street intersection.	Maintenance & Repair	N of Spokane	-	15	-	0	-	15
Tier III	14	Diagonal Avenue S / S Oregon Street / Denver Avenue S Rebuild	East Marginal Way (SR 99) to Union Pacific Argo Yard	Rebuild existing drayage route facility.	Maintenance & Repair	S of Spokane	-	15	-	0	-	15
Tier III	49	S Dallas Avenue / 16th Avenue S Intersection Improvement	Intersection	Improve curb radius for northbound and westbound turning movement	Geometric Improvement	S of Spokane	10	0	-	0	-	10
Tier III	26	Next Generation ITS Improvements	Citywide	Project will implement ITS system upgrades to Traffic Management Center.	ITS Application	Citywide	-	0	-	5	-	5
Tier III	27	City Center Dynamic Signal Timing	Downtown Core	Dynamic signal timing installation downtown to help adjust to fluctuating traffic patterns during construction phases.	ITS Application	Central	-	0	-	5	-	5
Tier III	32	SODO Phase 1 ITS	--	This will provide advanced warning for railroad closures to minimize queuing as well as improve traffic monitoring capabilities for major haul routes in the SODO area.	ITS Application	N of Spokane	-	0	-	5	-	5
Tier III	33	I-5 Connector ITS	--	Installation of CCTV cameras along streets that provide CBD access to I-5/I-90 to provide congestion monitoring of traffic interchanging with the freeway.	ITS Application	Citywide	-	0	-	5	-	5

APPENDIX F

FREIGHT PRIORITY PROJECTS COST ESTIMATES

Seattle Industrial Areas Freight Access Project Concept Level Cost Estimates

ID	Name	Contractor Cost (Hard Cost)			Construction Admin. (Soft Cost)		Design (Soft Cost)		Acquisition Cost		Total (rounded)
		Engineer's Estimate[1]	EE Allowance[2]	Contingency[3]	Base[4]	Contingency[3]	Base[5]	Contingency[3]	Estimated Acquisition Cost[6]	Contingency[3]	
22	15th Ave W Spot Improvements at Dravus St and Emerson St	$ 257,000	$ 102,800	$ 53,970	$ 125,930	$ 18,890	$ 79,156	$ 23,747	$ -	$ -	$ 700,000
5	East Marginal Way South Roadway Rehabilitation	$ 19,045,000	$ 7,618,000	$ 3,999,450	$ 9,598,680	$ 1,439,802	$ 4,799,340	$ 1,439,802	$ -	$ -	$ 48,000,000
15	Hanford & Main SIG Access Improvements	$ 2,171,000	$ 868,400	$ 455,910	$ 1,063,790	$ 159,569	$ 668,668	$ 200,600	$ -	$ -	$ 5,600,000
20	4th Avenue S Viaduct Replacement	$ 36,528,000	$ 14,611,200	$ 7,670,880	$ 17,898,720	$ 2,684,808	$ 11,250,624	$ 3,375,187	$ 300,000	$ 90,000	$ 94,500,000
23	South Holgate Street Rail Crossing Improvements	$ 2,156,000	$ 862,400	$ 452,760	$ 1,056,440	$ 158,466	$ 664,048	$ 199,214	$ -	$ -	$ 5,600,000
24	Lower Spokane Street Freight Only Lanes Pilot Project	$ 834,000	$ 333,600	$ 175,140	$ 1,552,908	$ 232,936	$ 758,940	$ 227,682	$ -	$ -	$ 4,200,000
37A	1st Ave S / Atlantic St Intersection Improvements	$ 200,000	$ 80,000	$ 42,000	$ 98,000	$ 14,700	$ 61,600	$ 18,480	$ -	$ -	$ 600,000
40	E Marginal Way / Hanford St Improvements	$ 2,708,000	$ 1,084,000	$ 569,100	$ 1,327,900	$ 199,185	$ 834,680	$ 250,404	$ 17,500	$ 5,250	$ 7,000,000

1. Baseline Engineer's Estimate; developed by Transpo Group
2. Engineer's Estimate Allowance is based on the level of design to account for expected buy unknown costs; developed by SDOT Top-Down Cost Estimating Tool
3. Contingency costs; developed by SDOT Top-Down Cost Estimating Tool
4. Baseline construction administration costs; developed by SDOT Top-Down Cost Estimating Tool
5. Baseline design costs; developed by SDOT Top-Down Cost Estimating Tool
6. Cost for acquisition of real property required for the project; developed by SDOT Top-Down Cost Estimating Tool

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Top-Down Cost Estimating Tool
Tab B. Cost Estimate Summary

Project Name	15th Ave W at Dravus and Emersoı	Project Number	22
Prepared by	Transpo Group	Date	Feb. 2015
		Milestone	10%

BUILD-UP ASSUMPTIONS

Baseline

Engineer's Estimate	$ 257,000
Estimated Acquisition Cost	$ 0

Escalation Schedule	Year	Rate
Current	2015	-
Design Midpoint	2015	0.0%
Acquisition Midpoint	2015	0.0%
Construction Midpoint	2015	0.0%

Build-Up Rates	
Construction Contingency	15%
Engineer's Est. Allowance	40%
Design Contingency	30%
Acquisition Contingency	30%
Construction Soft Cost Ratio	35%
Design Soft Cost Ratio	22%

BUILD-UP SUMMARY

	A	B	C = A + B	D	E = C + D
	Base Estimate	Contingency	Current-Year Cost	Midpoint Escalation	TOTAL
Contractor Cost (Hard Cost)					
Engineer's Estimate (EE)	257,000				
EE Allowance (40%)	102,800				
Estimated Contractor Cost (ECC)	359,800	53,970	413,770	0	413,770
Construction Admin. (Soft Cost)					
35% of $.4M ECC	125,930	18,890	144,820	0	144,820
Design (Soft Cost)					
22% of $.4M ECC	79,156	23,747	102,903	0	102,903
Acquisition Cost					
Estimated Acquisition Cost	0	0	0	0	0
Estimated Total Project Cost	**$ 564,886**	**$ 96,606**	**$ 661,492**	**$ 0**	**$ 661,492**

Build-Up Notes

1. The Engineer's Estimate Allowance, Design Contingency, and Acquisition Contingency are determined by the selected level of design completion (Milestone).
2. Escalation rates are based on IHS Global Insight indices.

Version 21 - Aug 2014

Planning-Level Project Cost Details

15th Avenue W Spot Improvements at W Dravus St and Emerson St

Project ID: 22

Length (ft): 250

Right-of-Way Costs

Administration	$	-	
Structures	$	-	
Land	$	-	
Est. Acq. Cost	$	-	
		Notes:	0

Road Costs

Base roadway	$	188,410	Pavement structural section, utility adjustments, landscaping, striping and signing, clearing & grubbing, etc.
Select roadway	$	8,225	Curbing, gutter, sidewalk, street lighting, and multi-use paths
Subtotal	$	196,635	
		Notes:	Assume 15th Ave northbound to W Nickerson St onramp is widened for 250' by 4' to accommodate off tracking. Assume poor condition of existing lane requires replacement.

Intersection Costs

Widening	$	-	Turn lanes/pockets or other roadway widened sections - pavement structural section, utility adjustments, landscaping, striping and signing, clearing & grubbing, etc.
Other	$	1,704	New/upgrade traffic signals, roundabouts, ADA curb ramps, etc.
Subtotal	$	1,704	
		Notes:	0

Other Costs

Other	$	15,000	Driveways, at-grade railroad crossings, guardrail, pedestrian signals, traffic calming, etc.
Bridge	$	-	
Subtotal	$	15,000	
		Notes:	Assume 1 fire hydrant requires relocation and minor storm drainage modifications

Summary

Construction	$	213,339	Road costs + intersection costs + other costs
Mob. and Demob.	$	19,200.50	9% of Construction Cost
Traffic Control	$	23,467.28	11% of Construction Cost
Eng. Estimate	$	257,000	

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Top-Down Cost Estimating Tool
Tab B. Cost Estimate Summary

Project Name	E Marginal Way S Roadway Rehabi	Project Number	5
Prepared by	Transpo Group	Date	Dec. 2014
		Milestone	10%

BUILD-UP ASSUMPTIONS

Baseline

Engineer's Estimate	$ 19,045,000
Estimated Acquisition Cost	$ 0

Escalation Schedule	Year	Rate
Current	2014	-
Design Midpoint	2014	0.0%
Acquisition Midpoint	2014	0.0%
Construction Midpoint	2014	0.0%

Build-Up Rates	
Construction Contingency	15%
Engineer's Est. Allowance	40%
Design Contingency	30%
Acquisition Contingency	30%
Construction Soft Cost Ratio	36%
Design Soft Cost Ratio	18%

BUILD-UP SUMMARY

	A	B	C = A + B	D	E = C + D
	Base Estimate	Contingency	Current-Year Cost	Midpoint Escalation	TOTAL
Contractor Cost (Hard Cost)					
Engineer's Estimate (EE)	19,045,000				
EE Allowance (40%)	7,618,000				
Estimated Contractor Cost (ECC)	26,663,000	3,999,450	30,662,450	0	30,662,450
Construction Admin. (Soft Cost)					
36% of $26.7M ECC	9,598,680	1,439,802	11,038,482	0	11,038,482
Design (Soft Cost)					
18% of $26.7M ECC	4,799,340	1,439,802	6,239,142	0	6,239,142
Acquisition Cost					
Estimated Acquisition Cost	0	0	0	0	0
Estimated Total Project Cost	**$ 41,061,020**	**$ 6,879,054**	**$ 47,940,074**	**$ 0**	**$ 47,940,074**

Build-Up Notes

1. The Engineer's Estimate Allowance, Design Contingency, and Acquisition Contingency are determined by the selected level of design completion (Milestone).
2. Escalation rates are based on IHS Global Insight indices.

Version 21 - Aug 2014

Planning-Level Project Cost Details

E Marginal Way

Project ID: 5

Length (ft): 8,750

Right-of-Way Costs			
Administration	$	-	
Structures	$	-	
Land	$	-	
Est. Acq. Cost	$	-	
		Notes:	0

Road Costs			
Base roadway	$	15,172,500	Pavement structural section, utility adjustments, landscaping, striping and signing, clearing & grubbing, etc.
Select roadway	$	472,500	Curbing, gutter, sidewalk, street lighting, and multi-use paths
Subtotal	$	15,645,000	
		Notes:	Excludes the ramp from West Seattle Bridge to SW Klickitat Way
Intersection Costs			
Widening	$	-	Turn lanes/pockets or other roadway widened sections - pavement structural section, utility adjustments, landscaping, striping and signing, clearing & grubbing, etc.
Other	$	142,780	New/upgrade traffic signals, roundabouts, ADA curb ramps, etc.
Subtotal	$	142,780	
		Notes:	0
Other Costs			
Other	$	82,575	Driveways, at-grade railroad crossings, guardrail, pedestrian signals, traffic calming, etc.
Bridge	$	-	
Subtotal	$	82,575	
		Notes:	0
Summary			
Construction	$	15,870,355	Road costs + intersection costs + other costs
Mob. and Demob.	$	1,428,331.95	9% of Construction Cost
Traffic Control	$	1,745,739.05	11% of Construction Cost
Eng. Estimate	$	19,045,000	

SDOT
Seattle Department of Transportation

Top-Down Cost Estimating Tool
Tab B. Cost Estimate Summary

Project Name	Hanford & Main SIG Access Improv	Project Number	15
Prepared by	Transpo Group	Date	Dec. 2014
		Milestone	10%

BUILD-UP ASSUMPTIONS

Baseline

Engineer's Estimate	$ 2,171,000
Estimated Acquisition Cost	$ 0

Escalation Schedule	Year	Rate
Current	2014	-
Design Midpoint	2014	0.0%
Acquisition Midpoint	2014	0.0%
Construction Midpoint	2014	0.0%

Build-Up Rates	
Construction Contingency	15%
Engineer's Est. Allowance	40%
Design Contingency	30%
Acquisition Contingency	30%
Construction Soft Cost Ratio	35%
Design Soft Cost Ratio	22%

BUILD-UP SUMMARY

	A	B	C = A + B	D	E = C + D
	Base Estimate	Contingency	Current-Year Cost	Midpoint Escalation	TOTAL
Contractor Cost (Hard Cost)					
Engineer's Estimate (EE)	2,171,000				
EE Allowance (40%)	868,400				
Estimated Contractor Cost (ECC)	3,039,400	455,910	3,495,310	0	3,495,310
Construction Admin. (Soft Cost)					
35% of $3.M ECC	1,063,790	159,569	1,223,359	0	1,223,359
Design (Soft Cost)					
22% of $3.M ECC	668,668	200,600	869,268	0	869,268
Acquisition Cost					
Estimated Acquisition Cost	0	0	0	0	0
Estimated Total Project Cost	**$ 4,771,858**	**$ 816,079**	**$ 5,587,937**	**$ 0**	**$ 5,587,937**

Build-Up Notes

1. The Engineer's Estimate Allowance, Design Contingency, and Acquisition Contingency are determined by the selected level of design completion (Milestone).
2. Escalation rates are based on IHS Global Insight indices.

Version 21 - Aug 2014

Planning-Level Project Cost Details

Hanford & Main SIG Access Improvements

Project ID: 15

Length (ft): 550

Right-of-Way Costs

Administration	$	-	
Structures	$	-	
Land	$	-	
Est. Acq. Cost	$	-	

Notes: 0

Road Costs

Base roadway	$	679,511	Pavement structural section, utility adjustments, landscaping, striping and signing, clearing & grubbing, etc.
Select roadway	$	103,400	Curbing, gutter, sidewalk, street lighting, and multi-use paths
Subtotal	$	782,911	

Notes: 0

Intersection Costs

Widening	$	-	Turn lanes/pockets or other roadway widened sections - pavement structural section, utility adjustments, landscaping, striping and signing, clearing & grubbing, etc.
Other	$	100,566	New/upgrade traffic signals, roundabouts, ADA curb ramps, etc.
Subtotal	$	100,566	

Notes: 0

Other Costs

Other	$	925,000	Driveways, at-grade railroad crossings, guardrail, pedestrian signals, traffic calming, etc.
Bridge	$	-	
Subtotal	$	925,000	

Notes: 0

Summary

Construction	$	1,808,477	Road costs + intersection costs + other costs
Mob. and Demob.	$	162,762.95	9% of Construction Cost
Traffic Control	$	198,932.50	11% of Construction Cost
Eng. Estimate	$	2,171,000	

Top-Down Cost Estimating Tool

Tab B. Cost Estimate Summary

Project Name	4th Ave S Viaduct Replacement	Project Number	20
Prepared by	Transpo Group	Date	Dec. 2014
		Milestone	10%

BUILD-UP ASSUMPTIONS

Baseline

Engineer's Estimate	$ 36,528,000
Estimated Acquisition Cost	$ 300,000

Escalation Schedule	Year	Rate
Current	2014	-
Design Midpoint	2014	0.0%
Acquisition Midpoint	2014	0.0%
Construction Midpoint	2014	0.0%

Build-Up Rates	
Construction Contingency	15%
Engineer's Est. Allowance	40%
Design Contingency	30%
Acquisition Contingency	30%
Construction Soft Cost Ratio	35%
Design Soft Cost Ratio	22%

BUILD-UP SUMMARY

	A	B	C = A + B	D	E = C + D
	Base Estimate	Contingency	Current-Year Cost	Midpoint Escalation	TOTAL
Contractor Cost (Hard Cost)					
Engineer's Estimate (EE)	36,528,000				
EE Allowance (40%)	14,611,200				
Estimated Contractor Cost (ECC)	51,139,200	7,670,880	58,810,080	0	58,810,080
Construction Admin. (Soft Cost)					
35% of $51.1M ECC	17,898,720	2,684,808	20,583,528	0	20,583,528
Design (Soft Cost)					
22% of $51.1M ECC	11,250,624	3,375,187	14,625,811	0	14,625,811
Acquisition Cost					
Estimated Acquisition Cost	300,000	90,000	390,000	0	390,000
Estimated Total Project Cost	**$ 80,588,544**	**$ 13,820,875**	**$ 94,409,419**	**$ 0**	**$ 94,409,419**

Build-Up Notes

1. The Engineer's Estimate Allowance, Design Contingency, and Acquisition Contingency are determined by the selected level of design completion (Milestone).
2. Escalation rates are based on IHS Global Insight indices.

Version 21 - Aug 2014

Planning-Level Project Cost Details

4th Avenue South Viaduct Replacement

Project ID: 20

Length (ft): 2,500

Right-of-Way Costs

Administration	$	7,500	
Structures	$	-	
Land	$	300,000	
Est. Acq. Cost	$	307,500	
		Notes:	0

Road Costs

Base roadway	$	-	Pavement structural section, utility adjustments, landscaping, striping and signing, clearing & grubbing, etc.
Select roadway	$	200,000	Curbing, gutter, sidewalk, street lighting, and multi-use paths
Subtotal	$	200,000	
		Notes:	Assume new bridge cross section is 2' bridge rail, 10' sidewalk, 2' pedestrian rail, four 12' lanes, 2' bridge rail.

Intersection Costs

Widening	$	-	Turn lanes/pockets or other roadway widened sections - pavement structural section, utility adjustments, landscaping, striping and signing, clearing & grubbing, etc.
Other	$	-	New/upgrade traffic signals, roundabouts, ADA curb ramps, etc.
Subtotal	$	-	
		Notes:	0

Other Costs

Other	$	-	Driveways, at-grade railroad crossings, guardrail, pedestrian signals, traffic calming, etc.
Bridge	$	30,240,000	
Subtotal	$	30,240,000	
		Notes:	Assume new bridge cross section is 2' bridge rail, 10' sidewalk, 2' pedestrian rail, four 12' lanes, 2' bridge rail.

Summary

Construction	$	30,440,000	Road costs + intersection costs + other costs
Mob. and Demob.	$	2,739,600.00	9% of Construction Cost
Traffic Control	$	3,348,400.00	11% of Construction Cost
Eng. Estimate	$	36,528,000	

SDOT
Seattle Department of Transportation

Top-Down Cost Estimating Tool
Tab B. Cost Estimate Summary

Project Name	South Holgate Street Improvement	Project Number	23
Prepared by	Transpo Group	Date	Dec. 2014
		Milestone	10%

BUILD-UP ASSUMPTIONS

Baseline

Engineer's Estimate	$ 2,156,000
Estimated Acquisition Cost	$ 0

Escalation Schedule	Year	Rate
Current	2014	-
Design Midpoint	2014	0.0%
Acquisition Midpoint	2014	0.0%
Construction Midpoint	2014	0.0%

Build-Up Rates	
Construction Contingency	15%
Engineer's Est. Allowance	40%
Design Contingency	30%
Acquisition Contingency	30%
Construction Soft Cost Ratio	35%
Design Soft Cost Ratio	22%

BUILD-UP SUMMARY

	A	B	C = A + B	D	E = C + D
	Base Estimate	Contingency	Current-Year Cost	Midpoint Escalation	TOTAL
Contractor Cost (Hard Cost)					
Engineer's Estimate (EE)	2,156,000				
EE Allowance (40%)	862,400				
Estimated Contractor Cost (ECC)	3,018,400	452,760	3,471,160	0	3,471,160
Construction Admin. (Soft Cost)					
35% of $3.M ECC	1,056,440	158,466	1,214,906	0	1,214,906
Design (Soft Cost)					
22% of $3.M ECC	664,048	199,214	863,262	0	863,262
Acquisition Cost					
Estimated Acquisition Cost	0	0	0	0	0
Estimated Total Project Cost	**$ 4,738,888**	**$ 810,440**	**$ 5,549,328**	**$ 0**	**$ 5,549,328**

Build-Up Notes

1. The Engineer's Estimate Allowance, Design Contingency, and Acquisition Contingency are determined by the selected level of design completion (Milestone).
2. Escalation rates are based on IHS Global Insight indices.

Version 21 - Aug 2014

Planning-Level Project Cost Details

South Holgate Street Rail Crossing Improvements

Project ID: 23

Length (ft): 850

Right-of-Way Costs

Administration	$	-	
Structures	$	-	
Land	$	-	
Est. Acq. Cost	$	-	

Notes: 0

Road Costs

Base roadway	$	1,750,256	Pavement structural section, utility adjustments, landscaping, striping and signing, clearing & grubbing, etc.
Select roadway	$	45,900	Curbing, gutter, sidewalk, street lighting, and multi-use paths
Subtotal	$	1,796,156	

Notes: 0

Intersection Costs

Widening	$	-	Turn lanes/pockets or other roadway widened sections - pavement structural section, utility adjustments, landscaping, striping and signing, clearing & grubbing, etc.
Other	$	-	New/upgrade traffic signals, roundabouts, ADA curb ramps, etc.
Subtotal	$	-	

Notes: 0

Other Costs

Other	$	-	Driveways, at-grade railroad crossings, guardrail, pedestrian signals, traffic calming, etc.
Bridge	$	-	
Subtotal	$	-	

Notes: 0

Summary

Construction	$	1,796,156	Road costs + intersection costs + other costs
Mob. and Demob.	$	161,654.06	9% of Construction Cost
Traffic Control	$	197,577.19	11% of Construction Cost
Eng. Estimate	$	2,156,000	

SDOT
Seattle Department of Transportation

Top-Down Cost Estimating Tool
Tab B. Cost Estimate Summary

Project Name	Lower Spokane St Freight Only Lan	Project Number	24
Prepared by	Transpo Group	Date	Dec. 2014
		Milestone	10%

BUILD-UP ASSUMPTIONS

Baseline

Engineer's Estimate	$ 834,000
Estimated Acquisition Cost	$ 0

Escalation Schedule	Year	Rate
Current	2014	-
Design Midpoint	2014	0.0%
Acquisition Midpoint	2014	0.0%
Construction Midpoint	2014	0.0%

Build-Up Rates	
Construction Contingency	15%
Engineer's Est. Allowance	40%
Design Contingency	30%
Acquisition Contingency	30%
Construction Soft Cost Ratio	133%
Design Soft Cost Ratio	65%

BUILD-UP SUMMARY

	A	B	C = A + B	D	E = C + D
	Base Estimate	Contingency	Current-Year Cost	Midpoint Escalation	TOTAL
Contractor Cost (Hard Cost)					
Engineer's Estimate (EE)	834,000				
EE Allowance (40%)	333,600				
Estimated Contractor Cost (ECC)	1,167,600	175,140	1,342,740	0	1,342,740
Construction Admin. (Soft Cost)					
133% of $1.2M ECC	1,552,908	232,936	1,785,844	0	1,785,844
Design (Soft Cost)					
65% of $1.2M ECC	758,940	227,682	986,622	0	986,622
Acquisition Cost					
Estimated Acquisition Cost	0	0	0	0	0
Estimated Total Project Cost	**$ 3,479,448**	**$ 635,758**	**$ 4,115,206**	**$ 0**	**$ 4,115,206**

Build-Up Notes

1. The Engineer's Estimate Allowance, Design Contingency, and Acquisition Contingency are determined by the selected level of design completion (Milestone).
2. Escalation rates are based on IHS Global Insight indices.

Version 21 - Aug 2014

Planning-Level Project Cost Details

Lower Spokane Street Freight Only Lanes Pilot Project

Project ID: 24

Length (ft): 7,500

Right-of-Way Costs

Administration	$	-
Structures	$	-
Land	$	-
Est. Acq. Cost	$	-

Notes: 0

Road Costs

Base roadway	$	-	Pavement structural section, utility adjustments, landscaping, striping and signing, clearing & grubbing, etc.
Select roadway	$	-	Curbing, gutter, sidewalk, street lighting, and multi-use paths
Subtotal	$	-	

Notes: 0

Intersection Costs

Widening	$	-	Turn lanes/pockets or other roadway widened sections - pavement structural section, utility adjustments, landscaping, striping and signing, clearing & grubbing, etc.
Other	$	695,000	New/upgrade traffic signals, roundabouts, ADA curb ramps, etc.
Subtotal	$	695,000	

Notes: 0

Other Costs

Other	$	-	Driveways, at-grade railroad crossings, guardrail, pedestrian signals, traffic calming, etc.
Bridge	$	-	
Subtotal	$	-	

Notes: 0

Summary

Construction	$	695,000	Road costs + intersection costs + other costs
Mob. and Demob.	$	62,550.00	9% of Construction Cost
Traffic Control	$	76,450.00	11% of Construction Cost
Eng. Estimate	$	834,000	

Top-Down Cost Estimating Tool
Tab B. Cost Estimate Summary

Project Name	1st Ave S / Atlantic St Intersection	Project Number	37A
Prepared by	Transpo Group	Date	Dec. 2014
		Milestone	10%

BUILD-UP ASSUMPTIONS

Baseline

Engineer's Estimate	$ 200,000
Estimated Acquisition Cost	$ 0

Escalation Schedule	Year	Rate
Current	2014	-
Design Midpoint	2014	0.0%
Acquisition Midpoint	2014	0.0%
Construction Midpoint	2014	0.0%

Build-Up Rates	
Construction Contingency	15%
Engineer's Est. Allowance	40%
Design Contingency	30%
Acquisition Contingency	30%
Construction Soft Cost Ratio	35%
Design Soft Cost Ratio	22%

BUILD-UP SUMMARY

	A	B	C = A + B	D	E = C + D
	Base Estimate	Contingency	Current-Year Cost	Midpoint Escalation	TOTAL
Contractor Cost (Hard Cost)					
Engineer's Estimate (EE)	200,000				
EE Allowance (40%)	80,000				
Estimated Contractor Cost (ECC)	280,000	42,000	322,000	0	322,000
Construction Admin. (Soft Cost)					
35% of $.3M ECC	98,000	14,700	112,700	0	112,700
Design (Soft Cost)					
22% of $.3M ECC	61,600	18,480	80,080	0	80,080
Acquisition Cost					
Estimated Acquisition Cost	0	0	0	0	0
Estimated Total Project Cost	**$ 439,600**	**$ 75,180**	**$ 514,780**	**$ 0**	**$ 514,780**

Build-Up Notes

1. The Engineer's Estimate Allowance, Design Contingency, and Acquisition Contingency are determined by the selected level of design completion (Milestone).
2. Escalation rates are based on IHS Global Insight indices.

Version 21 - Aug 2014

Planning-Level Project Cost Details

1st Ave S / Atlantic St Intersection Improvements

Project ID: 37A

Length (ft): 300

Right-of-Way Costs

Administration	$	-	
Structures	$	-	
Land	$	-	
Est. Acq. Cost	$	-	
		Notes:	0

Road Costs

Base roadway	$	71,535	Pavement structural section, utility adjustments, landscaping, striping and signing, clearing & grubbing, etc.
Select roadway	$	28,200	Curbing, gutter, sidewalk, street lighting, and multi-use paths
Subtotal	$	99,735	
		Notes:	0

Intersection Costs

Widening	$	-	Turn lanes/pockets or other roadway widened sections - pavement structural section, utility adjustments, landscaping, striping and signing, clearing & grubbing, etc.
Other	$	66,704	New/upgrade traffic signals, roundabouts, ADA curb ramps, etc.
Subtotal	$	66,704	
		Notes:	0

Other Costs

Other	$	-	Driveways, at-grade railroad crossings, guardrail, pedestrian signals, traffic calming, etc.
Bridge	$	-	
Subtotal	$	-	
		Notes:	0

Summary

Construction	$	166,439	Road costs + intersection costs + other costs
Mob. and Demob.	$	14,979.51	9% of Construction Cost
Traffic Control	$	18,308.29	11% of Construction Cost
Eng. Estimate	$	200,000	

SDOT
Seattle Department of Transportation

Top-Down Cost Estimating Tool
Tab B. Cost Estimate Summary

Project Name	E Marginal Way / Hanford St Impro	Project Number	40
Prepared by	Transpo Group	Date	Dec. 2014
		Milestone	10%

BUILD-UP ASSUMPTIONS

Baseline

Engineer's Estimate	$ 2,710,000
Estimated Acquisition Cost	$ 17,500

Escalation Schedule	Year	Rate
Current	2014	-
Design Midpoint	2014	0.0%
Acquisition Midpoint	2014	0.0%
Construction Midpoint	2014	0.0%

Build-Up Rates	
Construction Contingency	15%
Engineer's Est. Allowance	40%
Design Contingency	30%
Acquisition Contingency	30%
Construction Soft Cost Ratio	35%
Design Soft Cost Ratio	22%

BUILD-UP SUMMARY

	A	B	C = A + B	D	E = C + D
	Base Estimate	Contingency	Current-Year Cost	Midpoint Escalation	TOTAL
Contractor Cost (Hard Cost)					
Engineer's Estimate (EE)	2,710,000				
EE Allowance (40%)	1,084,000				
Estimated Contractor Cost (ECC)	3,794,000	569,100	4,363,100	0	4,363,100
Construction Admin. (Soft Cost)					
35% of $3.8M ECC	1,327,900	199,185	1,527,085	0	1,527,085
Design (Soft Cost)					
22% of $3.8M ECC	834,680	250,404	1,085,084	0	1,085,084
Acquisition Cost					
Estimated Acquisition Cost	17,500	5,250	22,750	0	22,750
Estimated Total Project Cost	**$ 5,974,080**	**$ 1,023,939**	**$ 6,998,019**	**$ 0**	**$ 6,998,019**

Build-Up Notes

1. The Engineer's Estimate Allowance, Design Contingency, and Acquisition Contingency are determined by the selected level of design completion (Milestone).
2. Escalation rates are based on IHS Global Insight indices.

Version 21 - Aug 2014

Planning-Level Project Cost Details

E Marginal Way / Hanford Street Intersection Improvements

Project ID: 40

Length (ft): 1,000

Right-of-Way Costs

Administration	$	7,500
Structures	$	-
Land	$	10,000
Est. Acq. Cost	$	17,500

Notes: 0

Road Costs

Base roadway	$	1,647,300	Pavement structural section, utility adjustments, landscaping, striping and signing, clearing & grubbing, etc.
Select roadway	$	114,000	Curbing, gutter, sidewalk, street lighting, and multi-use paths
Subtotal	$	1,761,300	

Notes: 0

Intersection Costs

Widening	$	-	Turn lanes/pockets or other roadway widened sections - pavement structural section, utility adjustments, landscaping, striping and signing, clearing & grubbing, etc.
Other	$	125,000	New/upgrade traffic signals, roundabouts, ADA curb ramps, etc.
Subtotal	$	125,000	

Notes: 0

Other Costs

Other	$	370,000	Driveways, at-grade railroad crossings, guardrail, pedestrian signals, traffic calming, etc.
Bridge	$	-	
Subtotal	$	370,000	

Notes: 0

Summary

Construction	$	2,256,300	Road costs + intersection costs + other costs
Mob. and Demob.	$	203,067.00	9% of Construction Cost
Traffic Control	$	248,193.00	11% of Construction Cost
Eng. Estimate	$	2,708,000	

Seattle Industrial Areas Freight Access Project

Image Credit: Port of Seattle

Freight Advisory Board

March 17, 2015

Port of Seattle

SDOT

Seattle Department of Transportation

Our mission, vision, and core values

Mission: deliver a high-quality transportation system for Seattle

Vision: connected people, places, and products

Committed to **5 core values** to create a city that is:

- Safe
- Interconnected
- Affordable
- Vibrant
- Innovative

Presentation overview

- Highlights of draft report
- FAP/FMP coordination
- Relationship to *Move Seattle*
- Tier I project review
- Next steps

Table of contents

	Freight Access Project (FAP)*	Freight Master Plan (FMP)
Purpose	Address freight mobility needs between and within the MICs and the regional system	Establish citywide vision for freight mobility to guide and prioritize actions and investments
Type of effort	Technical project	Council-adopted plan
Geography	MICs and connections	Citywide
Time horizon	2035	2035
Projects	Yes	Yes
Policies	No, will flag issues for FMP	Yes
Programs	Expand existing	Yes
Prioritization	Yes	Yes, revisit and revise FAP prioritization for citywide needs
Proponents	Port & City	City
Schedule	Winter 2015	Fall 2015

* PB is reviewing and integrating the FAP data and flagging any relevant differences for SDOT resolution

FAP & Move Seattle address the importance of freight

"Goods movement is the lifeblood of our city and must be supported"

Near-term actions	Large Capital Projects
• Complete Freight Master Plan	• East Marginal Way Corridor Improvements, including reconstruction to heavy haul vehicle standards
• Make spot improvements to help truck move more quickly at key bottlenecks	• South Lander Street Grade Separation/Railroad Crossing
• Pilot freight-only lanes in the Greater Duwamish MIC	
• Ramp up the monitoring and collection of truck volume data	

Tier I project review

- Reviewed by SDOT technical staff
- Consensus with Port
- Cost estimates developed using SDOT methodology for "soft costs"
- Coordinated with Move Seattle team


Image Credit: WSDOT

Tier I projects

No.	Project Name	Project Benefit	Project Cost	Timeframe	Move Seattle Overlap
	Ballard-Interbay Northend MIC				
22	West Dravus St / 15th Avenue West and W Emerson Street Rechannelization	Connectivity	$700,000	2015-2020	
52	BINMIC Truck Route Improvements	Safety, Connectivity	$500,000 (Phase I) $1.5M (Phase II)	2015-2018 2019-2021	
	Citywide				
-	Citywide Freight Spot Improvement Program Expansion	Safety, Connectivity	$1.5M / year	Ongoing	✓
-	Freight Data Collection/Analysis Program	Mobility	$150,000 / year	Ongoing	✓

No.	Project Name	Project Benefit	Project Cost	Timeframe	Move Seattle Overlap
	Greater Duwamish MIC				
5A	East Marginal Way South Freight Improvements	Mobility	$48M	2015-2020	✓
5B	E Marginal Way S / S Hanford Street Operational and Paving Improvements	Mobility	$7M	2015-2020	
15	Hanford & Main SIG Access Improvements	Mobility	$5.6M	2021-2026	
16	South Lander Street Grade Separation	Safety, Mobility, Connectivity	$150M*	2015-2020	✓
17	Study and Implementation of Mainline Grade Separation	Mobility, Connectivity	$500,000 (study) TBD (construction)	2015-2020 (study) TBD (construction)	
20	4th Avenue South Viaduct Replacement	Safety, Connectivity	$94.5M	2027-2035	
23	South Holgate Street ITS, Paving Infrastructure Improvements	Safety, Connectivity	$5.6M	2015-2020	
24	Lower Spokane Street Freight Only Lanes Pilot	Mobility, Connectivity	$200,000 (study) TBD (construction)	2015-2017 (study) TBD (construction)	✓
25	South Spokane Street ITS Improvements	Mobility	$1.5M	2015-2020	
28	Railroad Crossing Delay Warning System	Connectivity	$500,000	2015-2020	
37A	1st Avenue S / Atlantic Street Operational Improvements	Mobility, Connectivity	$600,000	2015-2017	
37B	South Atlantic Street Corridor Improvements	Mobility, Connectivity	TBD	2015-2020	

* Cost reduction opportunities to be explored as part of project #17

FAP Tier I project costs

• New large capital	$170M +
• S Lander Street	$150M +
• Special studies	$1.2M
• SDOT Improvement Program and data collection/analysis	$1.6M/annually

Next steps

March 17	FAB briefing
March 24	NSIA briefing
March 30	MIC briefing
April 13	Release draft report for public
May	Release final report

Seattle Industrial Areas Freight Access Project

Image Credit: Port of Seattle

Tony Mazzella, SDOT, Jon Pascal, Transpo

Seattle Freight Advisory Board

January 20, 2015

Port of Seattle

SDOT Seattle Department of Transportation

Presentation overview

- Project list development
- Prioritization framework
- Tier I cut-sheets
- Next steps

Project list development

- Process to evaluate freight needs, and develop and prioritize project list

1. Evaluate freight needs
- Performance measures
- Freight composite score

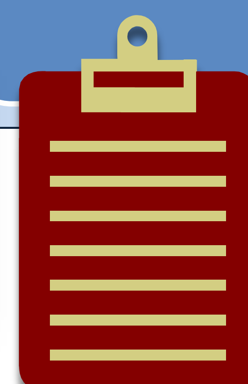
2. Review assumed projects
- Projects identified through other planning efforts

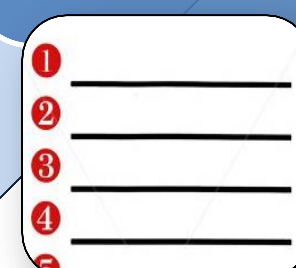
3. Apply toolbox treatments
- Identify gaps
- Consider possible solutions

4. Develop project list
- Cost, schedule, location, etc.

5. Prioritize projects
- Freight composite score, pavement conditions, reliability, environmental, etc.

e.g. ITS applications





Project prioritization framework

Criteria	Description	Maximum Points
Freight Composite Score	Existing and future freight composite score of Safety, Mobility, and Connectivity	50
Roadway Designation	Location on Major Truck Street, Heavy Haul Route, or First/Last Mile Connection	15
Pavement Conditions	Pavement condition index	15
Environmental	Qualitative assessment of congestion relief and drainage improvements	10
Reliability	Existing conditions buffer index based on travel times	10
Highest possible project priority score		100

PRELIMINARY

Tier I cut-sheet overview

- Title
- Project aerial
- Freight need
- Description
- Toolbox treatments
- Project elements
- Project benefits
- Current status
  - Schedule
  - Funding
- Related projects

Next steps

JANUARY	FEBRUARY	MARCH	APRIL/MAY
• FAB briefing • Cut-sheet review	• Preliminary draft report	• Release draft report for public review • FAB briefing • MIC briefings	• Release final report

Seattle Industrial Areas Freight Access Project

Image Credit: Port of Seattle

Tony Mazzella, SDOT, Michael Houston, Transpo

Seattle Freight Advisory Board

November 18, 2014

Port of Seattle

SDOT

Seattle Department of Transportation

Presentation overview

- Project list development
- Prioritization framework
- Next steps

Project list development

- Process to evaluate freight needs, and develop and prioritize project list

1. Evaluate freight needs
- Performance measures
- Freight composite score

2. Review assumed projects
- Projects identified through other planning efforts

3. Apply toolbox treatments
- Identify gaps
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4. Develop project list
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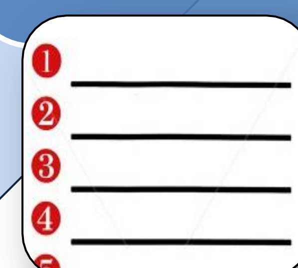

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Highest possible project priority score		100

PRELIMINARY

Next steps

December 16	FAB meeting – review draft project & program improvements
December	Develop draft report & project list, including related program improvements
January	Release final report

Seattle Industrial Areas Freight Access Project

Needs Assessment and Project Evaluation

Image Credit: Port of Seattle

Tony Mazzella and Jon Pascal
Freight Advisory Board
September 16, 2014

SDOT
Seattle Department of Transportation

Outline

1. Where we are
2. Scoring performance
3. Mapping conditions
4. Review of toolbox treatments
5. Moving toward a freight project list
6. Next steps

FAB workshops

Issues, concerns, solutions	✓
Performance Measures	✓
Summary of Existing Conditions	✓
Future Conditions I & II	✓ ✓
Identification of freight needs Preliminary list of projects	We are here
Recommended project list	❑

Methodology

- Process to evaluate freight needs and develop project list

1. Evaluate freight needs
- Performance measures

2. Review assumed projects
- Projects identified through other planning efforts

3. Apply toolbox treatments
- Identify gaps
- Consider possible solutions

e.g. ITS applications

4. Develop project list
- Cost, schedule, location, etc.

Performance measures

Goal	FAP Objective	Performance Measure	Metric or Indicator
Safety	Increase safety for all modes	• Truck safety • Safety for other modes	1. Truck collision rates 2. Collision history
Truck Mobility, Reliability, & Throughput	Maintain and improve freight-truck mobility and access	• Volumes & vehicle classifications • Speed • Travel time • Buffer index	1. Daily total, truck volumes and truck percent 2. Average speed as percent of the posted speed limit 3. Point-to-point travel time (selected corridors) 4. Percent travel time to arrive on time w/ 95% certainty
Connectivity	Ensure network connectivity, especially for major freight inter-modal facilities	• Mobility constraints	1. Operational & geometric constraints 2. Weight and height restrictions 3. Delay from RR and bridge closure (hours per day) 4. Improved lane-miles of Last Mile connections
Environment	Reduce environmental impacts	• Congestion/delay- from speed & travel time • Stormwater management	1. Qualitative assessment of environmental benefits of congestion relief and drainage improvements

Preliminary performance scores

	Component	Points	Maximum
Safety	Truck-Bike Collision	15	40
	Truck-Pedestrian Collision	15	
	Other truck-involved collisions Fatality Injury Only PDO Only	 15 10 5	
Mobility	Travel Speed	1 to 25	35
	Daily Truck Volumes	1 to 5	
	Truck Percentage	1 to 5	
Connectivity	Railroad Crossings Mainline Tail Track Spur	 15 10 5	25
	Geometric Constraints	10	
	Intersection Operations	10	
	Infrastructure Limitations (weight & height rest.)	5	
Total Possible Points			100

Performance: Mapping conditions

Safety

Mobility

Connectivity

Composite Score

- Sum of the safety, mobility, and connectivity scores

Components	Points
Safety Score	0 to 40
Mobility Score	0 to 35
Connectivity Score	0 to 25
Total Possible Points	100

Existing conditions

Composite Score

- Sum of the safety, mobility, and connectivity scores

Components	Points
Safety Score	0 to 40
Mobility Score	0 to 35
Connectivity Score	0 to 25
Total Possible Points	100

Future conditions

Determine project needs

- Review results from condition assessment
- Determine data or analysis gaps due to data or analysis limitations

Assumed improvements

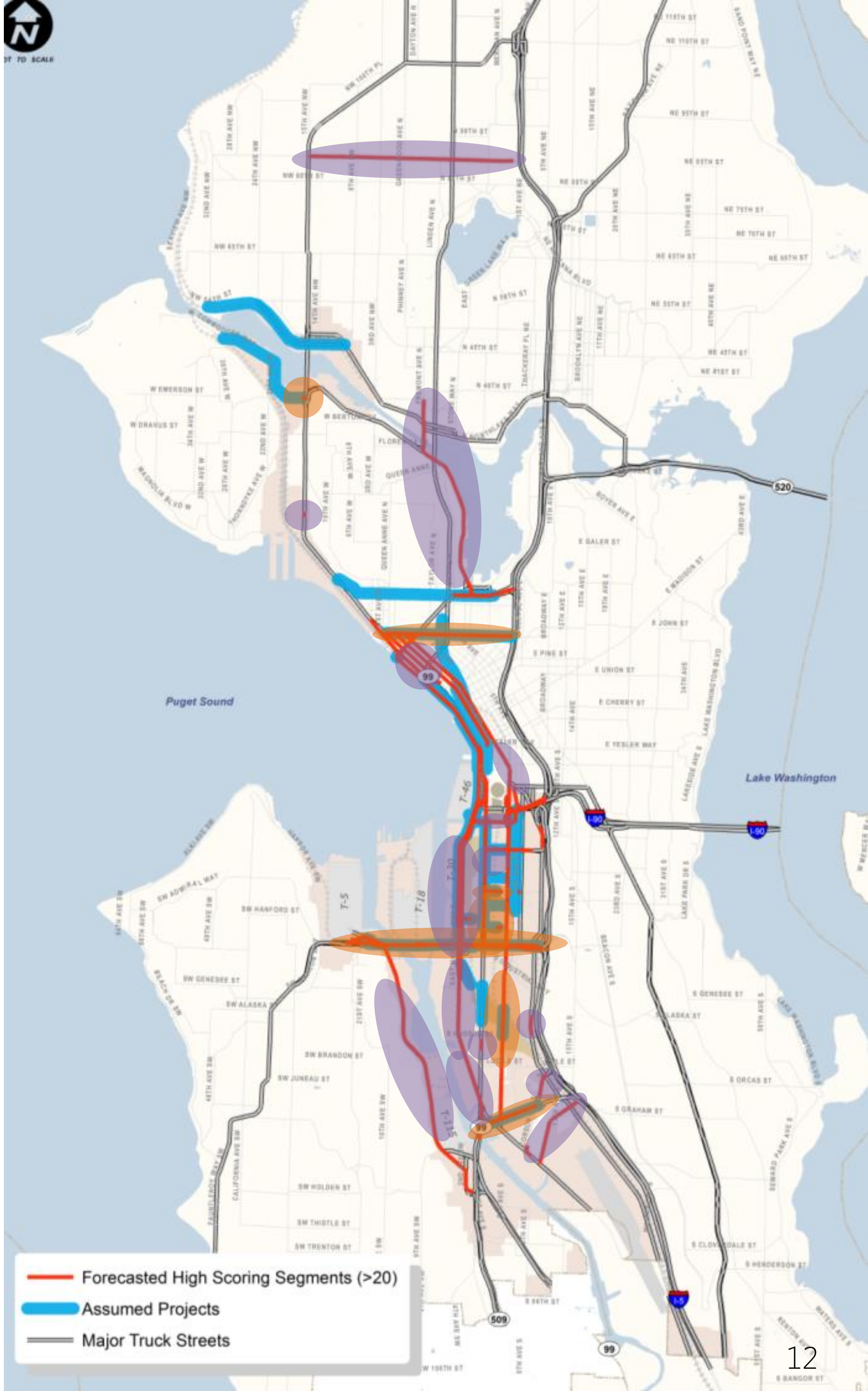
- Transportation projects identified in previous planning efforts
- Major projects include:
  - Alaskan Way Viaduct Replacement
  - Mercer Street Improvements
  - Seattle Waterfront / Alaskan Way
  - Lander Street Grade Separation

Identify needs

- Identify gaps not covered by existing project definitions

<u>Options to address gaps</u>

1. Refine/expand previously identified project
2. Identify new projects and programs



Freight toolbox treatments

- Freight-specific tools for developing the project list

Freight toolbox elements

- Maintenance and repair
- Capital investments
- ITS applications
- Intersection operational changes
- Wayfinding for trucks
- Geometric improvements
- Freight management

Maintenance and repair

Capital investments

Freight toolbox elements

ITS applications


Intersection operational changes

Wayfinding for trucks

Geometric improvements

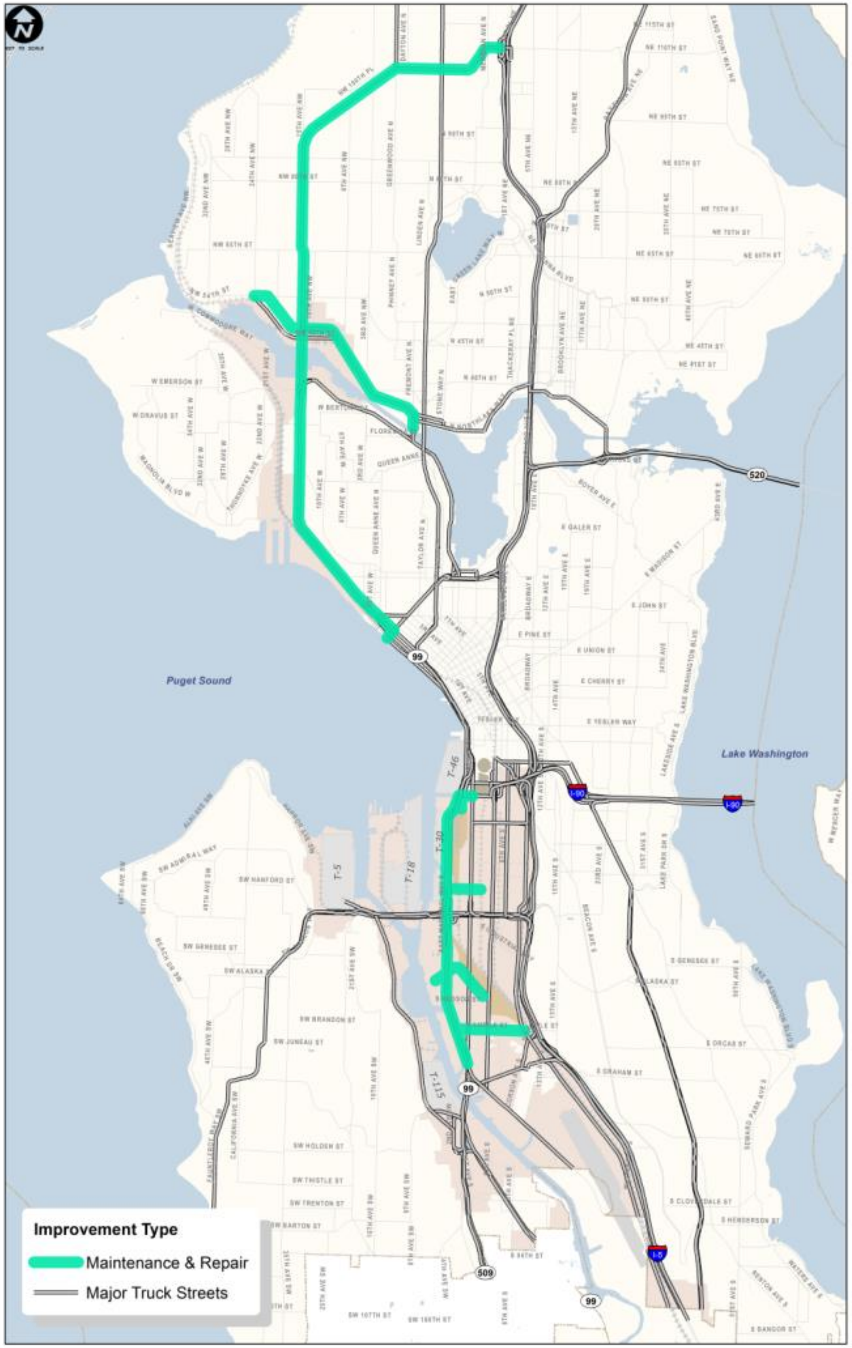
Freight management

Apply toolbox treatments

- Verify condition assessment and determine project need.
- Analysis didn't pick up locations we know need attention.
- Scale or granularity not addressed—yet.
- Technology can only do so much, still need humans.
- Next slides are a smorgasbord of concepts.
- What makes sense, what doesn't, what's missing?

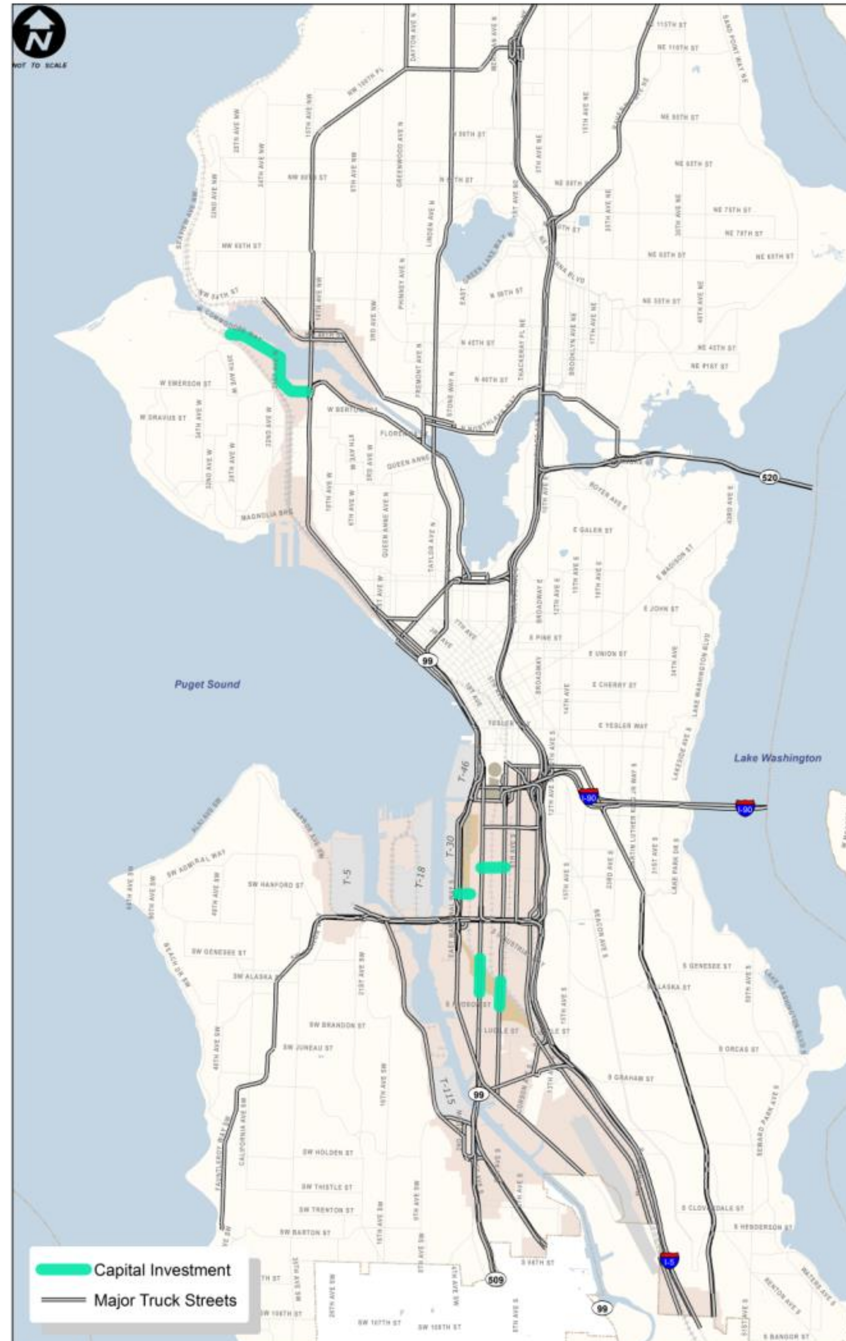
Maintenance and repair

Preliminary Projects
E Marginal Way S Rebuild
NW Market St / Leary Way / N 36th St
S Atlantic Street Rebuild
S Hanford Street Rebuild
Northgate Way / Holman Rd / 15th Ave / Elliott Ave Rebuild
S Lucile Street Rebuild
Colorado Avenue (access road) Rebuild
Diagonal Avenue S / S Oregon St / Denver Avenue S Rebuild



Capital investments

Preliminary Projects
Hanford & Main SIG's Entry Gate Improvements
South Lander Street Grade Separation
1st Avenue South Viaduct over UPRR Yard
4th Avenue South Viaduct over UPRR Yard
West Emerson Street / 21st Avenue West / West Commodore Way

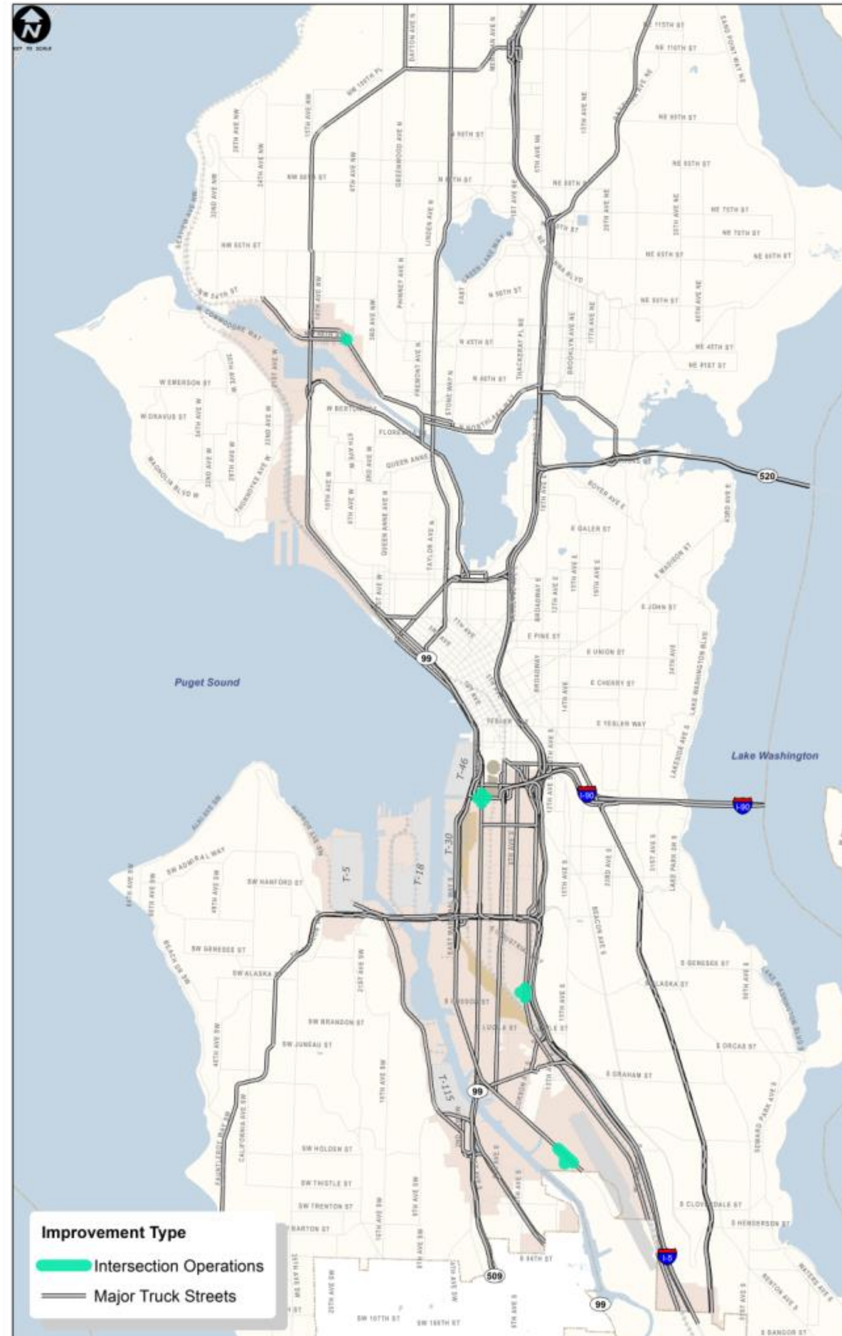


ITS applications

Preliminary Projects
Next Generation ITS Improvements
Railroad Crossing ITS implementation
City Center Dynamic Signal Timing
Railroad Crossing Information Signs
Access Seattle Mobile App
1st Ave S ITS
Denny Way ITS
South Spokane Street ITS
SODO Phase 1 ITS
I-5 Connector ITS
S Michigan Street ITS
1st Ave S Bridge
Freight Position within TMC

Intersection operations

Preliminary Projects
16th Ave S and E Marginal Way S Intersection
NW Leary Way / 46th Street
Airport Way S / Edmunds Street
1st Avenue and Atlantic



Geometric improvements

Preliminary Projects
West Marginal Way / Chelan Street
W Dravus St and 15th Ave Intersection
15th Av NW and NW Market St Intersection
15th Ave W and Emerson St Intersection Improvement
Airport Way S and Edmunds St Intersection
E Marginal Way S and Corson St Intersection
S Cloverdale on-ramp to SR 99
S Dallas St and 14th Av S Intersection

Freight management

- Possible programmatic approaches to address on-going freight needs:
  - Truck operational problems
  - Freight signal priority at intersections
  - Turn-radii and maintenance program
  - Include freight design standards in SDOT ROW Improvements Manual
  - Utilize improved truck data

Develop project list

- Identify relevant projects assumed from other planning efforts which address corridor and intersection problems in the study area
- Identify new projects that address corridor and intersection problems in the study area

Prioritize projects

- Factors for consideration in prioritization process:
  - Freight conditions score
  - Location on Major Truck Street, Heavy Haul Route, or First/Last Mile Connection
  - Environmental concerns
  - Cost estimate
  - Timing of need
  - Others?

Project summary sheets

Project #34

Advanced Traveler Information and Warning Systems at Railroad Crossings

Freight Need	Description
connectivity 1. Delay at RR crossings	There are five (5) mainline railroad crossings at Broad Street, Lander Street, Spokane Street, Holgate Street, and that block roadways for extended periods of time. Providing advanced traveler information and warning through early train detection will result in less delay at the crossing. As part of this project, verifying warning signage will also improve safety at these locations.

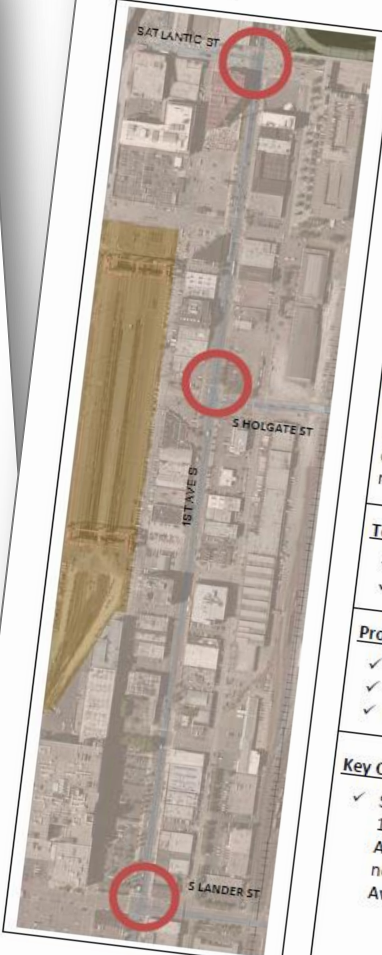
Toolbox Treatment	Project Benefits	Cost Estimate
✓ ITS Improvements	✓ Reduced traveler delay ✓ Improved safety ✓ Fewer idling vehicles	$XXX,000

Location

Key Components

- ✓ Add variable message sign displaying information for when train will arrive, and how long
- ✓ Add signage detailing alternate routes for pedestrians

Project #35



1st Avenue S Signal Timing and ITS Updates

Freight Need

mobility, reliability & throughput

1. Peak Period Congestion
2. Many truck-vehicle collisions since 2011
3. Multiple Signals require retiming

Description

Data collected in 2013 shows that multiple intersections along 1st Avenue South are forecasted to operate at an LOS E or F by 2035. By installing ITS equipment that will enable "Freight Priority" as well as signal re-timing, freight vehicles will have to stop less often providing them with faster travel between local destinations and heavy haul routes on the freight network.

Toolbox Treatments	Cost Estimate
✓ Intersection operations ✓ ITS Improvements	$XXX,000

Project Benefits

- ✓ Improved Freight Mobility
- ✓ Reduced Greenhouse Gases
- ✓ Low Cost Improvement

Key Components

- ✓ Signal retimings at 1st Ave S / S Holgate Street, 1st Ave S / S Lander Street, and 1st Ave S / S Atlantic Street to add heavy vehicle priority for northbound and southbound movements on 1st Avenue S

Next steps

October / November	Prepare Draft Recommendations
December	Final report

Questions?

tony.mazzella@seattle.gov | (206) 684-0811

www.seattle.gov/transportation/freight_industrialareas.htm

http://www.seattle.gov/transportation

Seattle Department of Transportation

Seattle Industrial Areas Freight Access Project

Future Conditions – Part II

Image Credit: Port of Seattle

Tony Mazzella and Jon Pascal
Freight Advisory Board
July 15, 2014

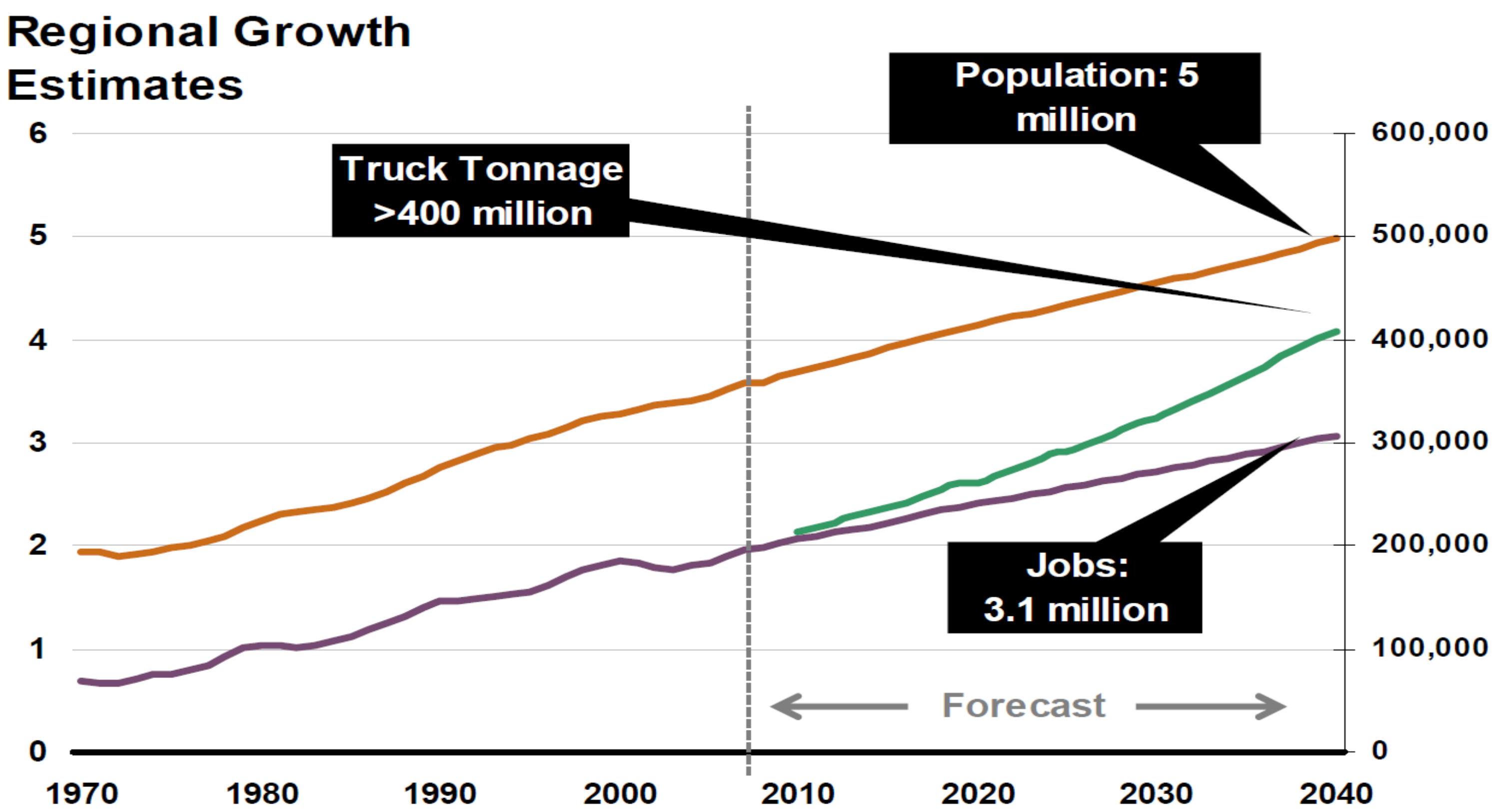
Port of Seattle

SDOT
Seattle Department of Transportation

Presentation overview

- Future freight travel conditions
  - Congestion levels
  - Mobility constraints
  - Rail volumes
- Urban freight focus areas
- Freight toolbox

Regional growth and truck tonnage



[4] PSRC, Washington State Department of Employment Security

Future freight travel conditions

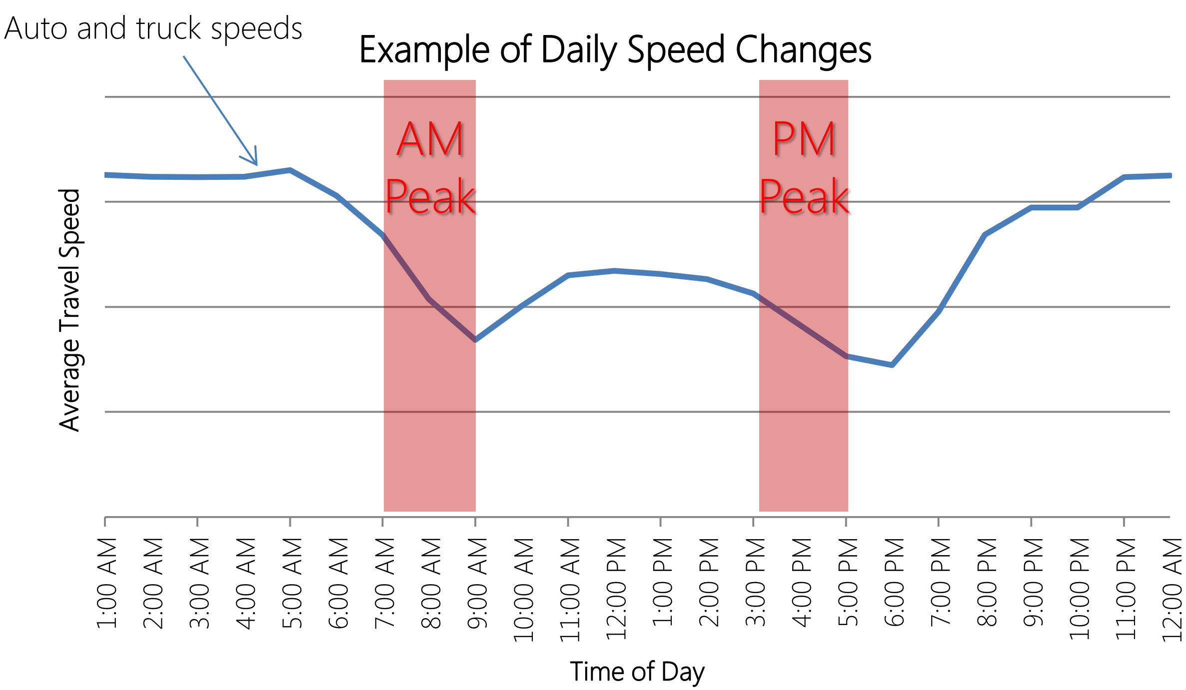
- Population and employment are expected to grow by more than 25% by 2035
- Truck activity will grow faster than regional traffic
- Port activity to significantly expand
- Future street network includes programmed projects to accommodate all modes

Future freight travel conditions

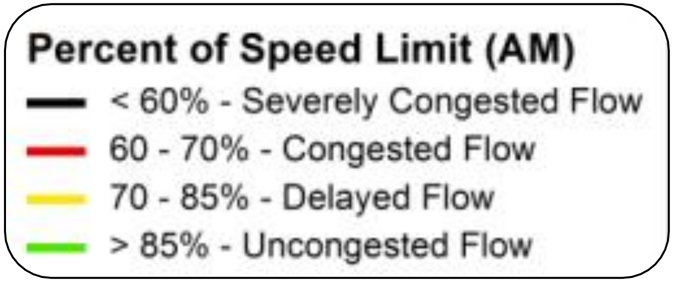
- Rising congestion and mobility constraints have the potential to increase:
  - Congestion for all modes
  - Delays in goods delivery
  - Transportation costs for consumers
  - Emissions of air pollutants
  - Truck and vehicle safety considerations

Travel speed methodology

- Congestion measured as percent of posted speed limit
- Focus on peak periods
  - 7:00 to 9:00 AM
  - 3:00 to 5:00 PM

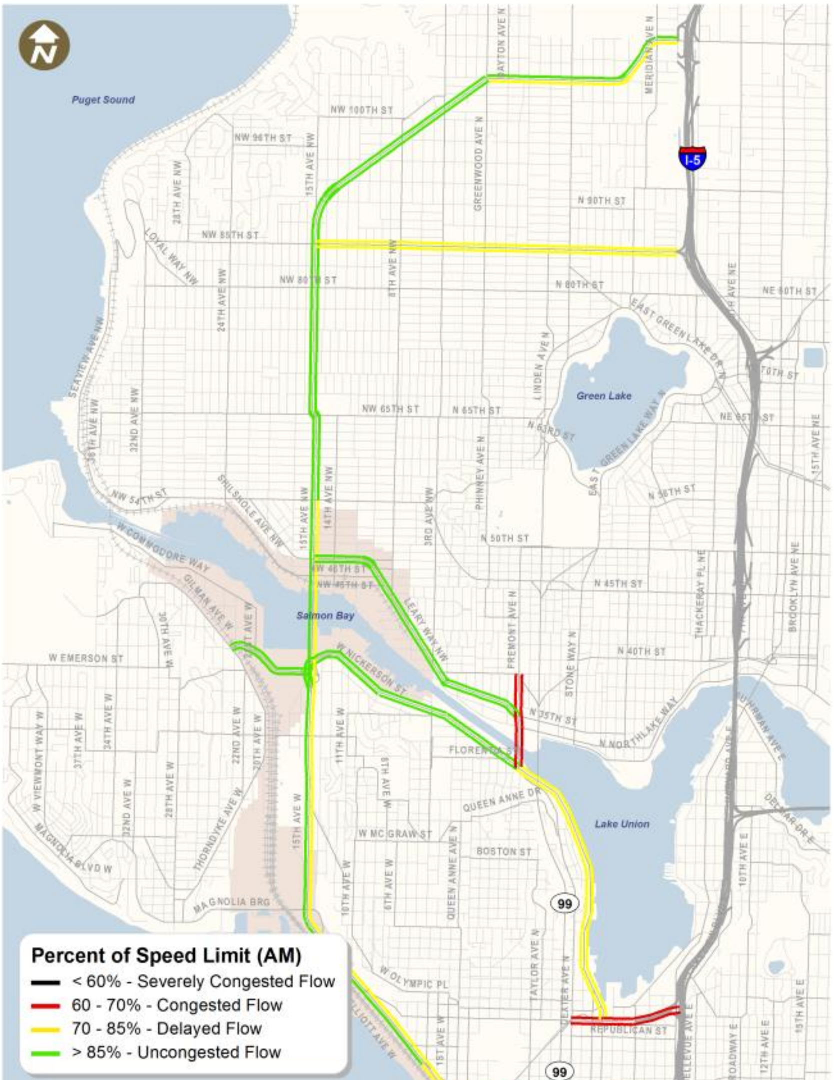


Legend for Congestion Maps

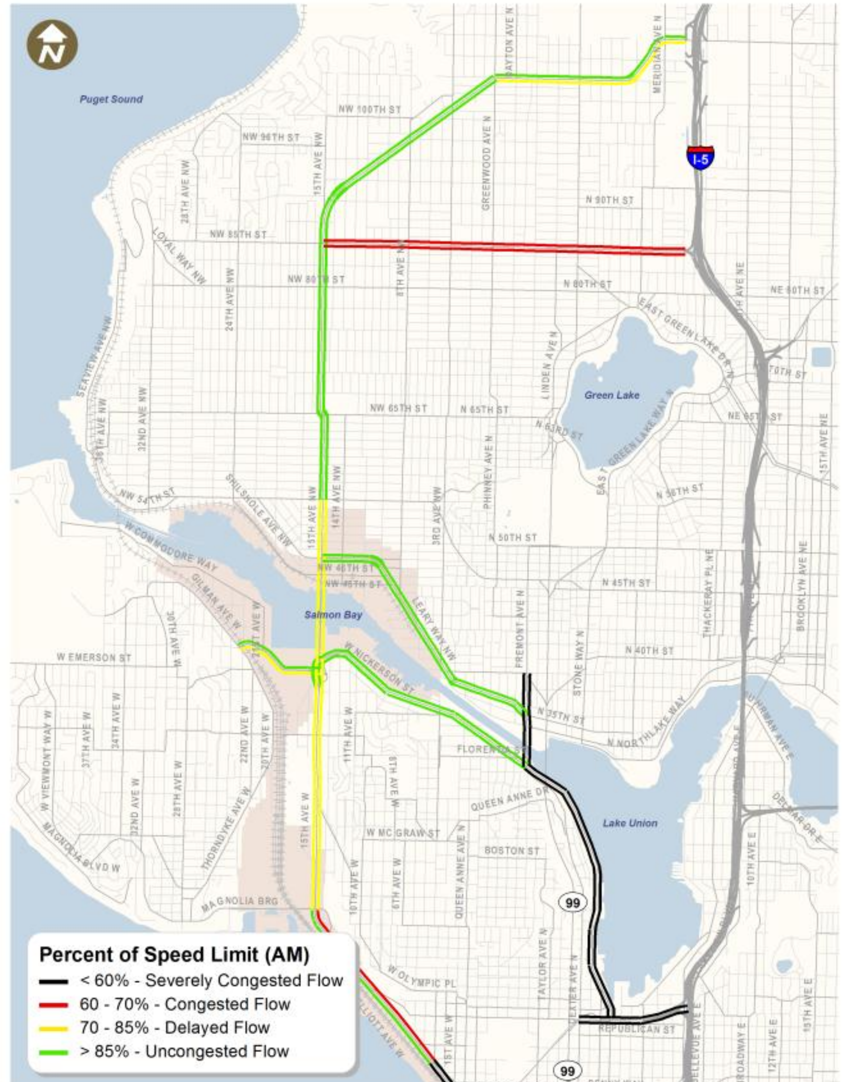


Congestion levels – north

AM Peak
7:00 – 9:00 AM



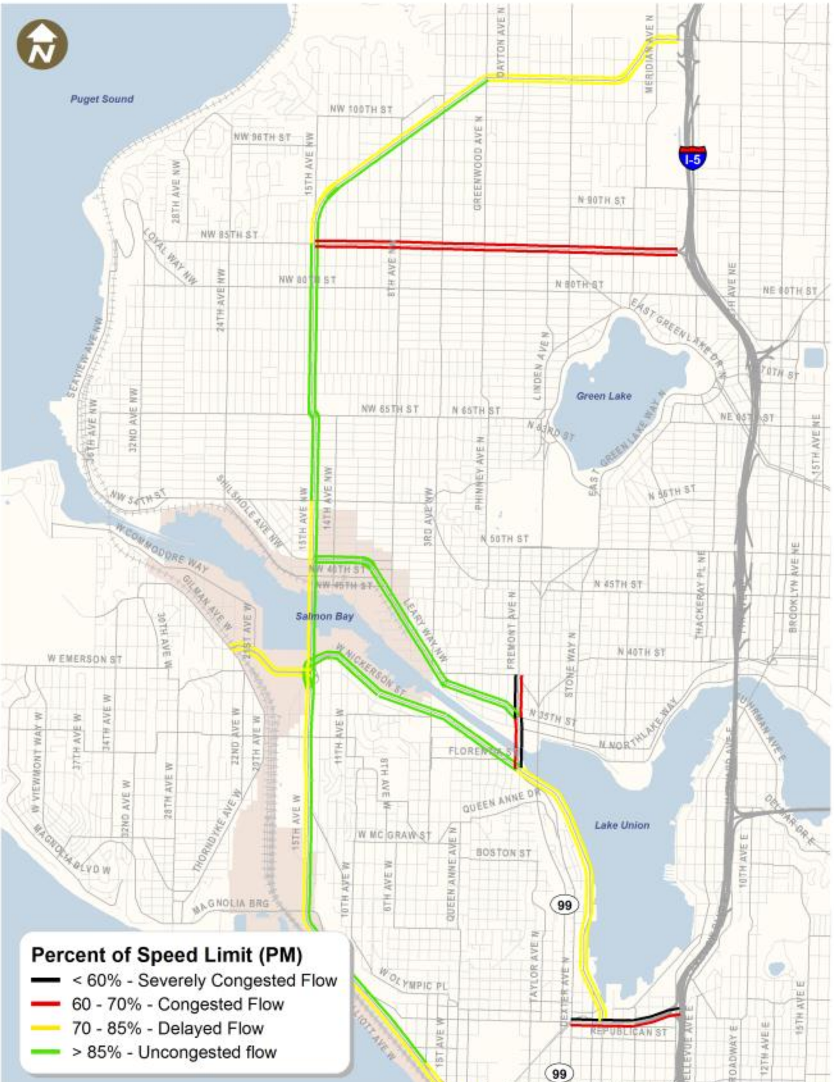
Existing



Future

Congestion levels – north

PM Peak
3:00 – 5:00 PM



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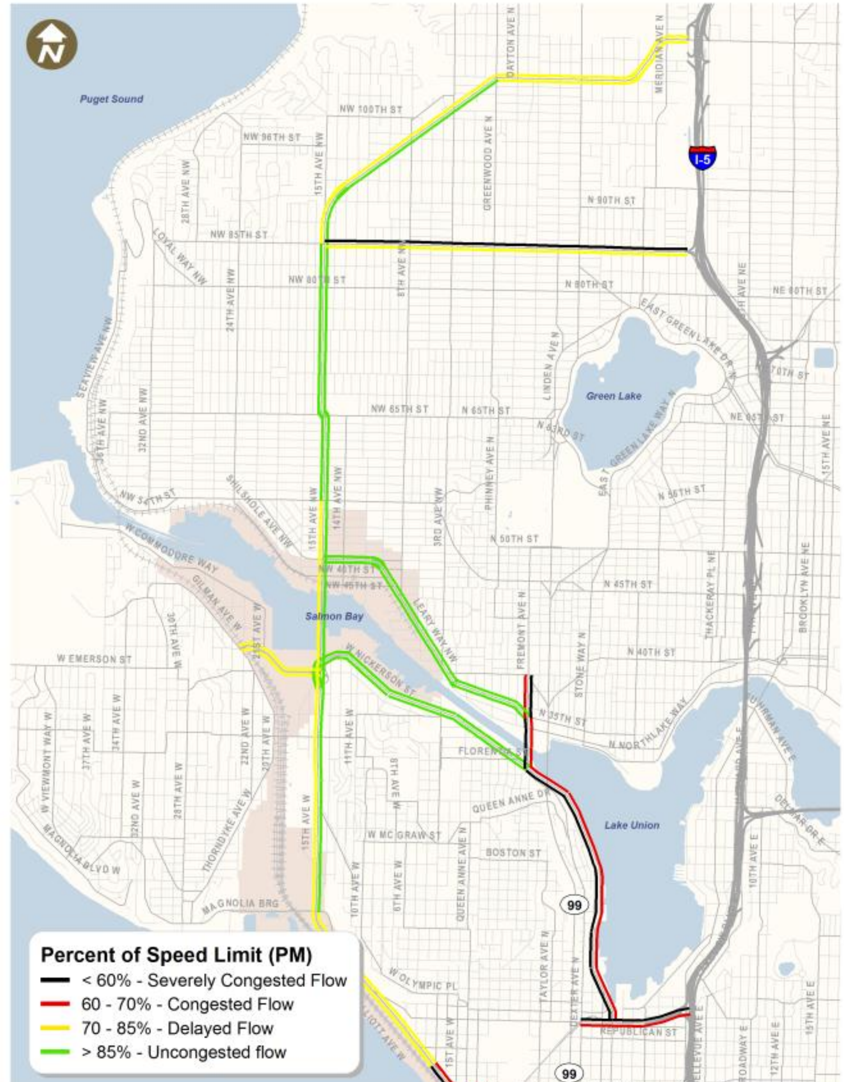
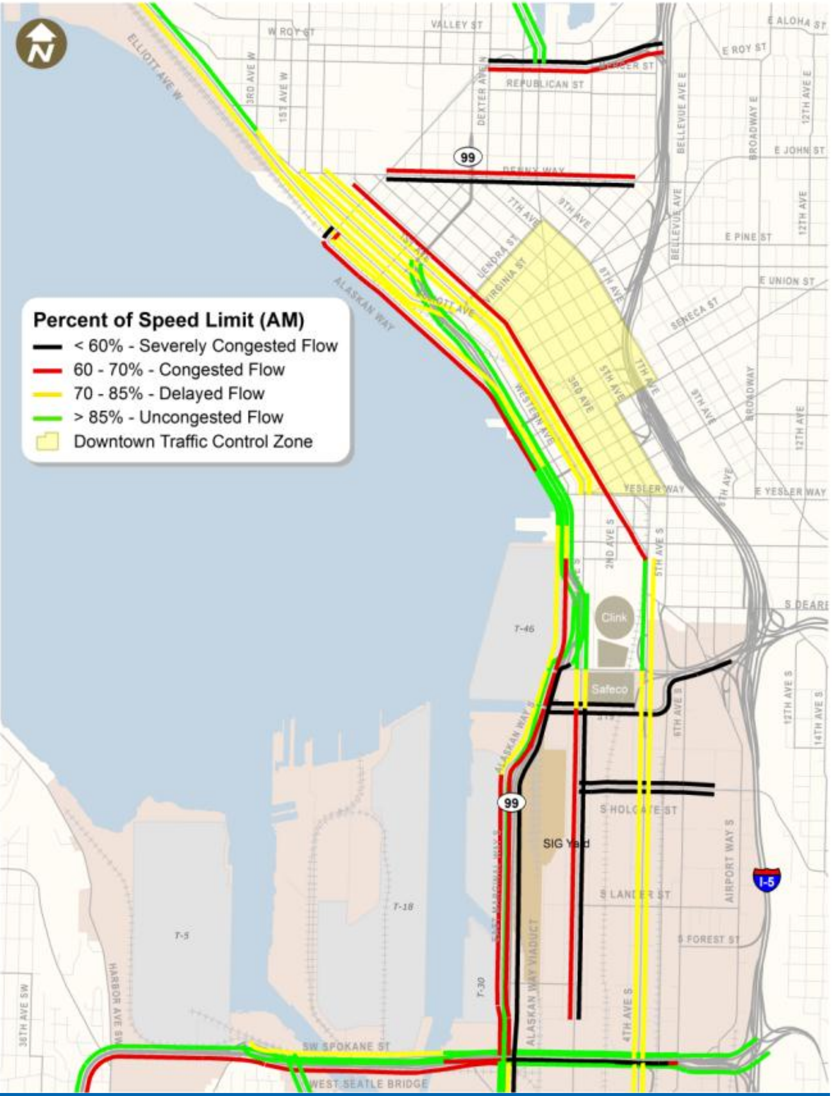


Future

Congestion levels – central

AM Peak
7:00 – 9:00 AM



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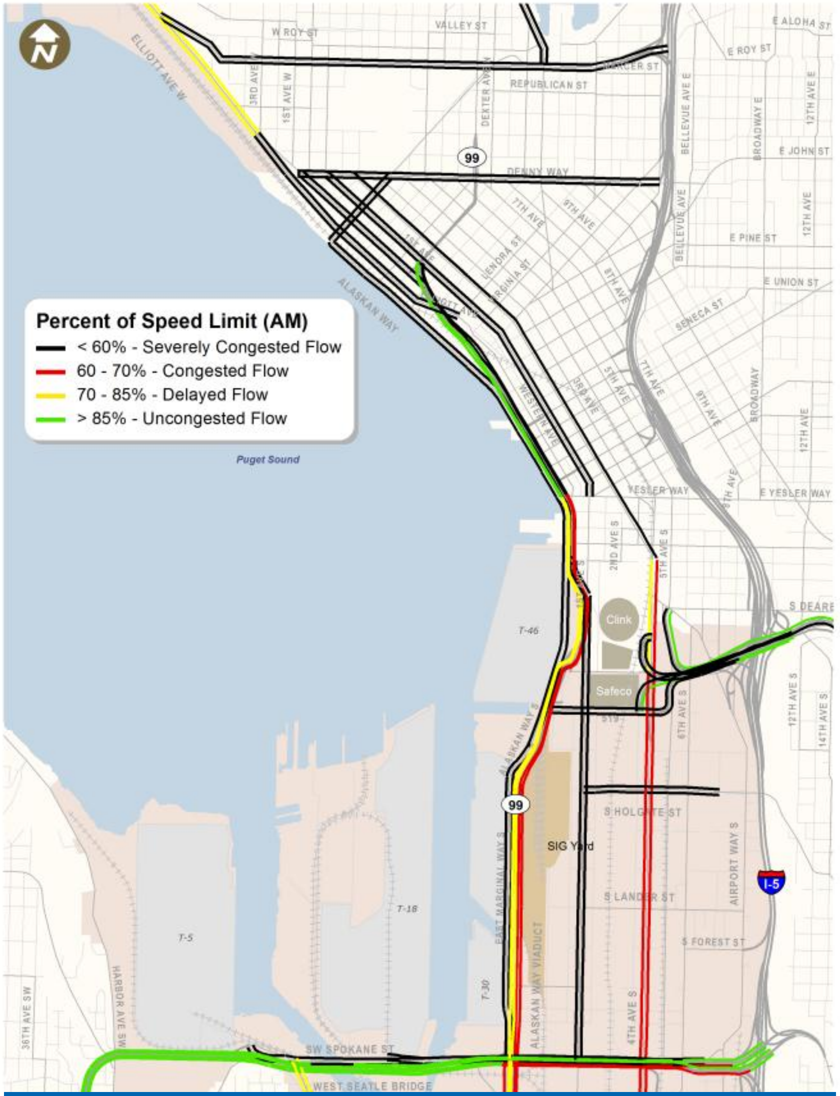

Future

Congestion levels – central

PM Peak
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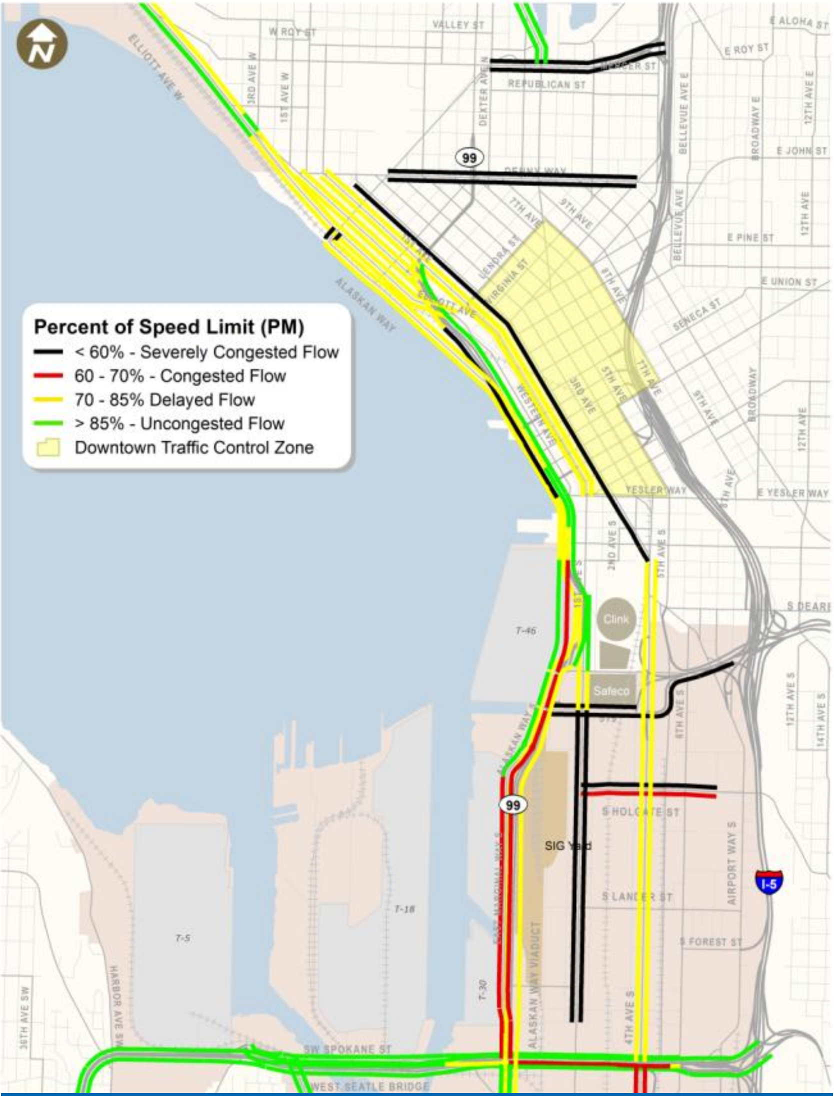

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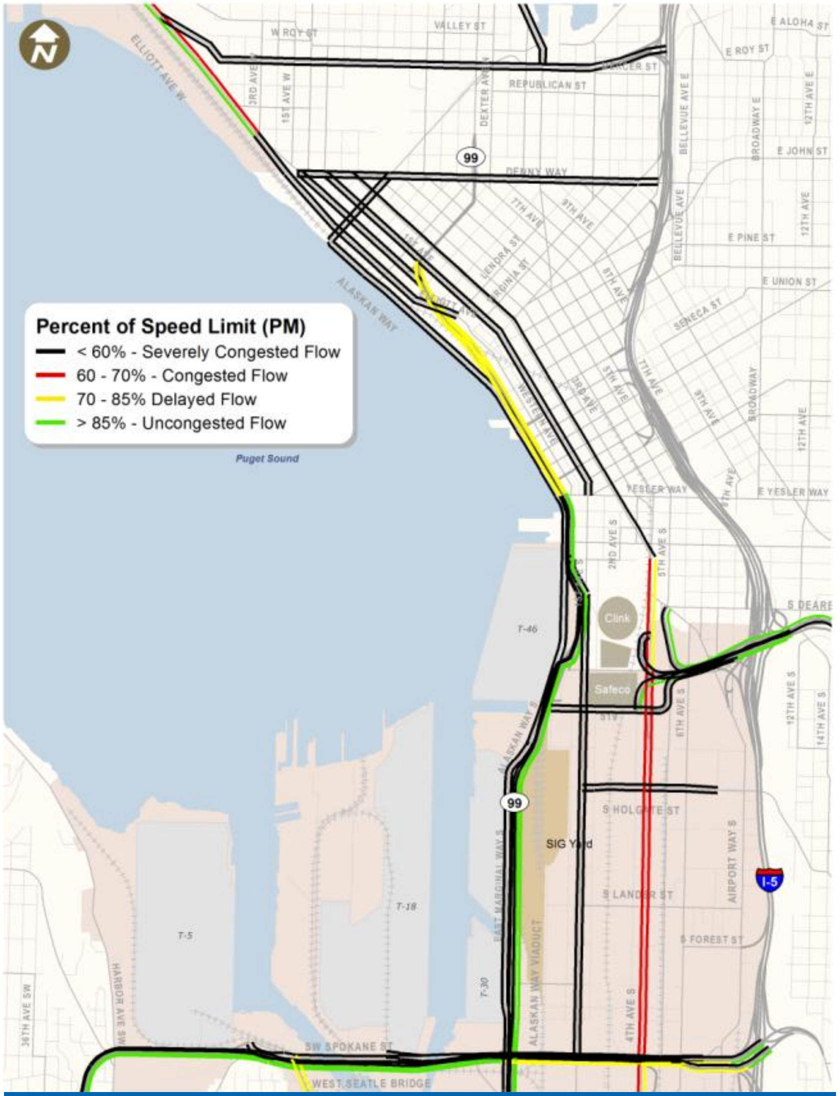
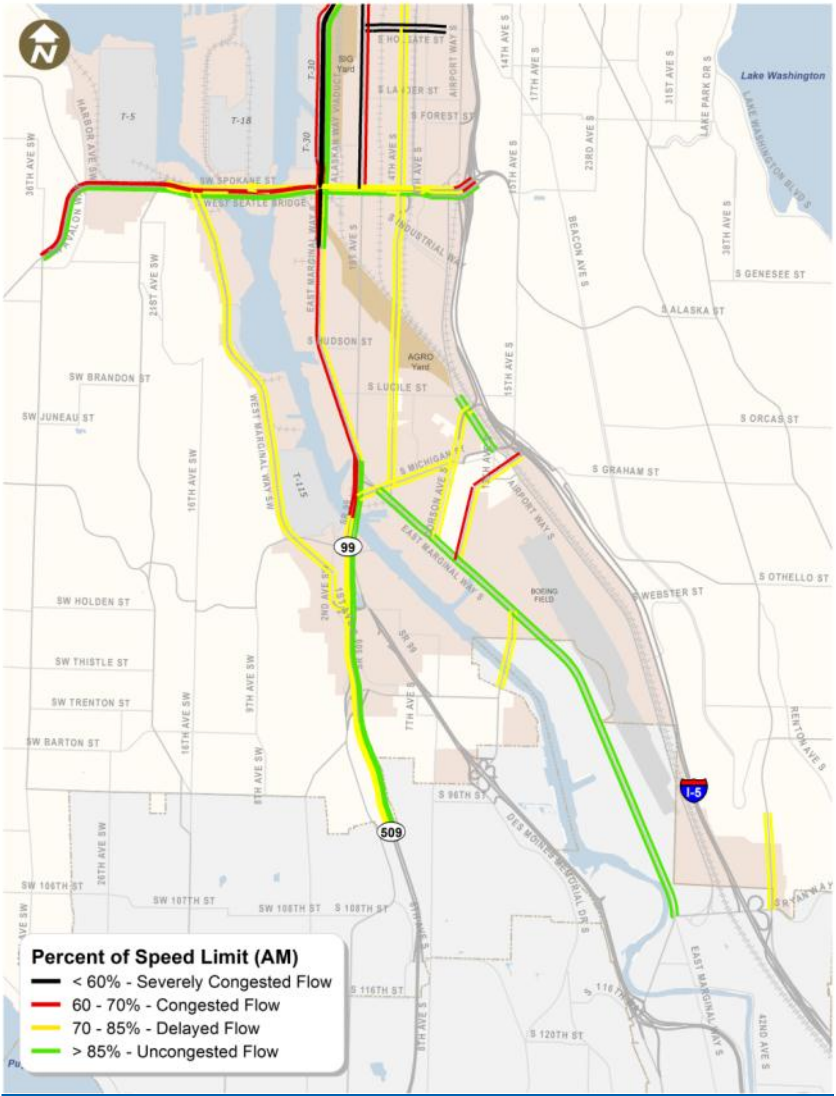


Future

Congestion levels– south

AM Peak
7:00 – 9:00 AM



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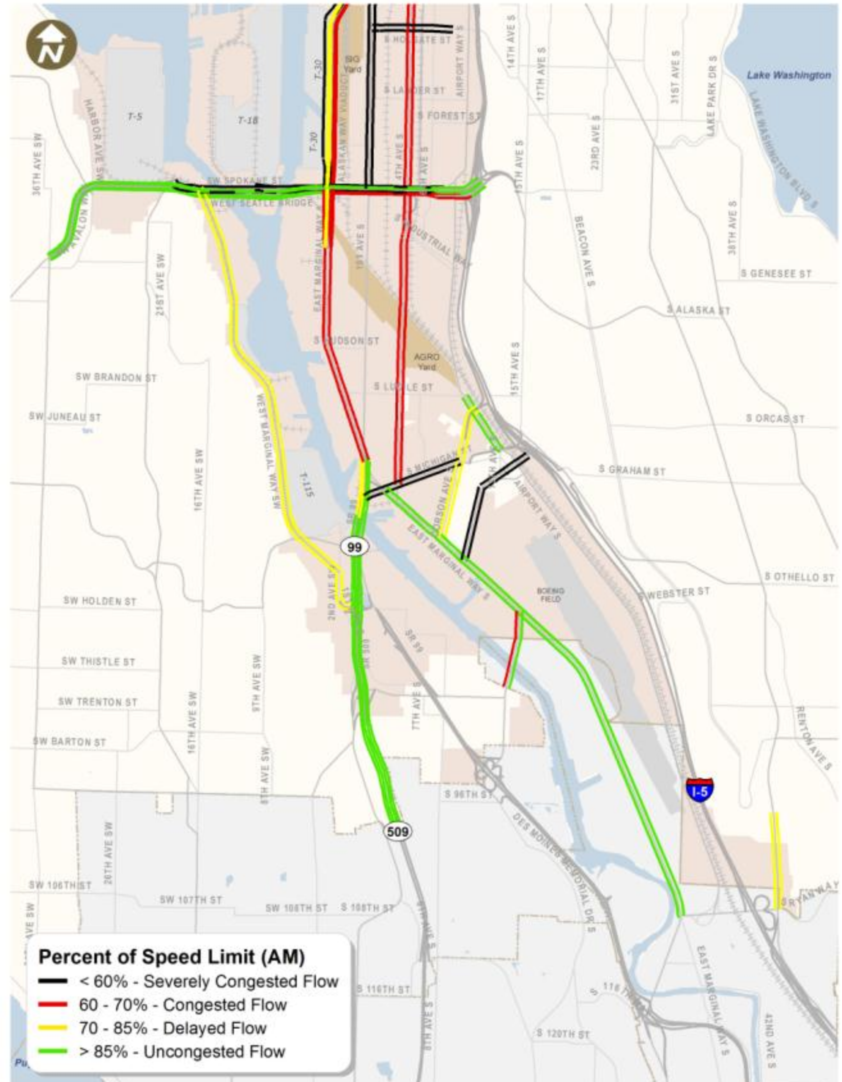
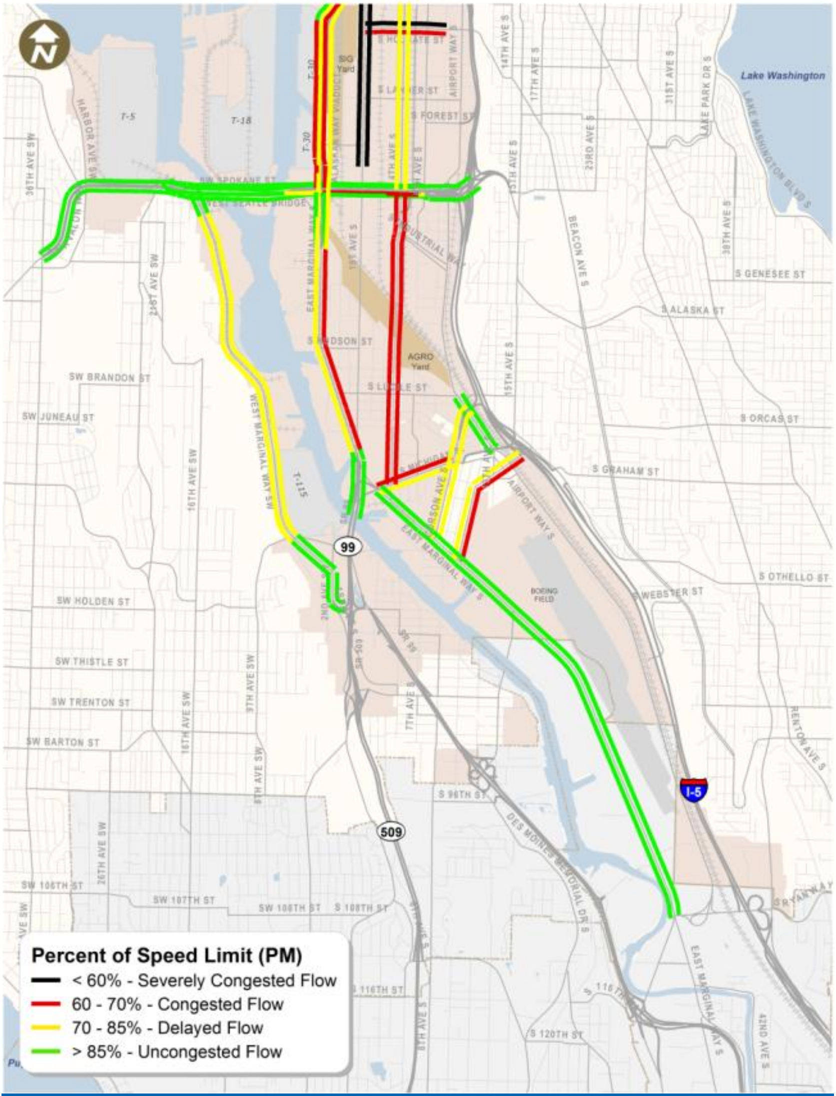


Future

Congestion levels– south

PM Peak
3:00 – 5:00 PM



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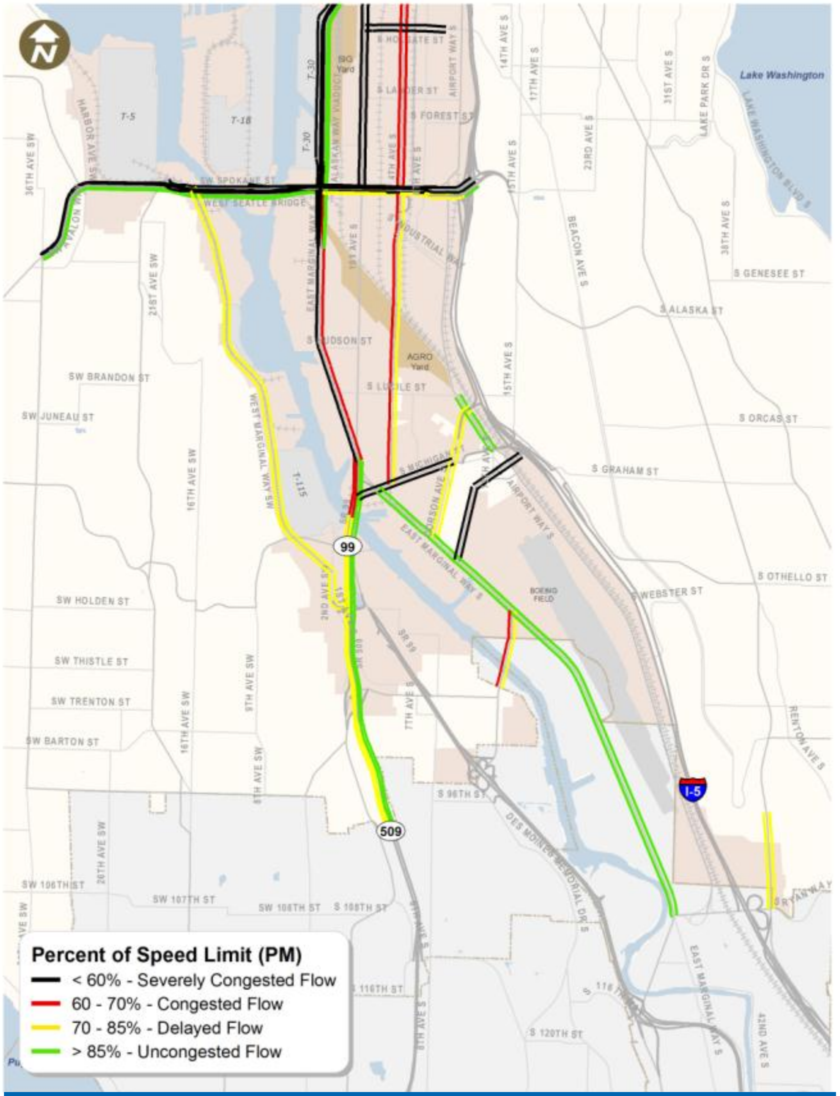
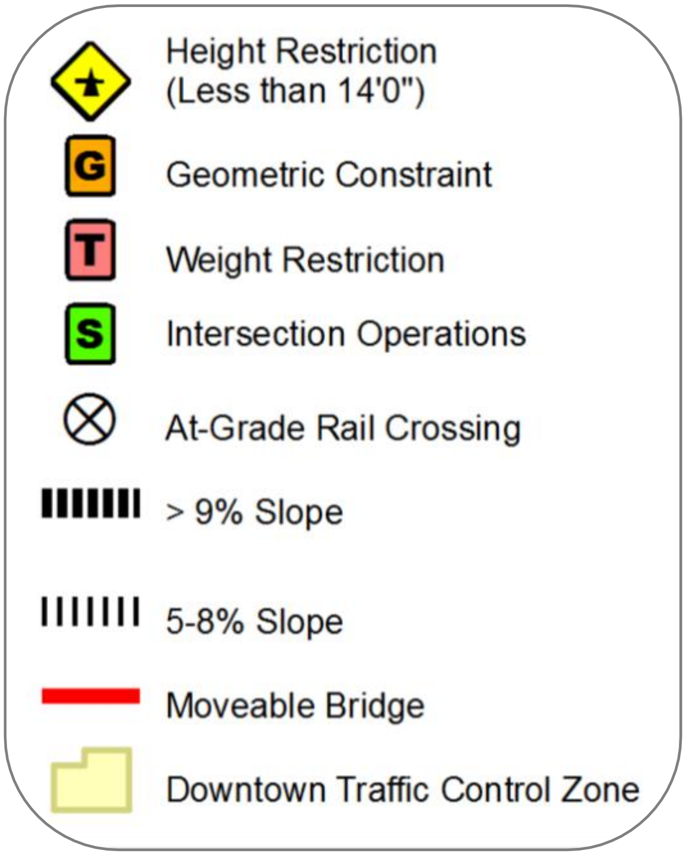
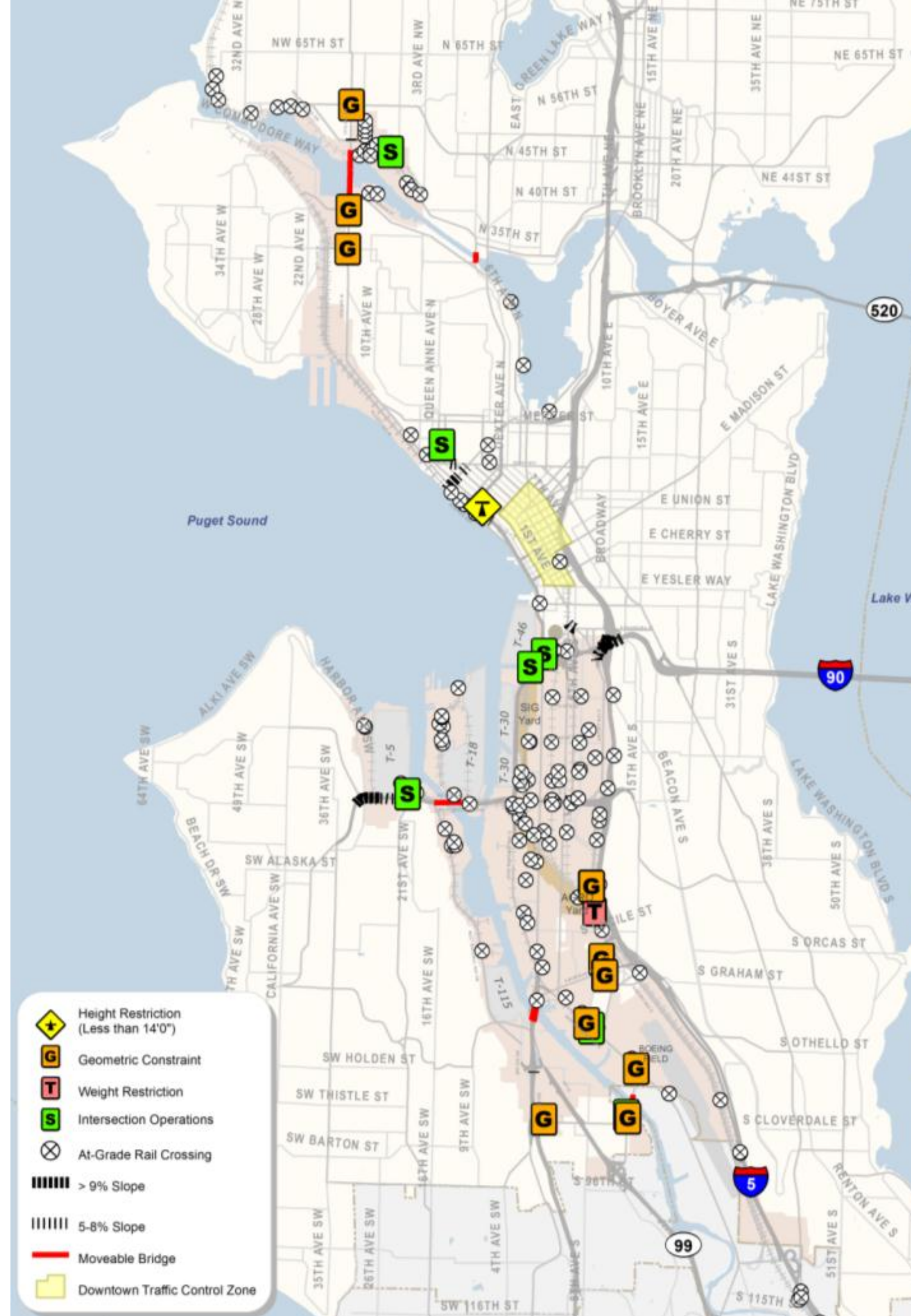


Future

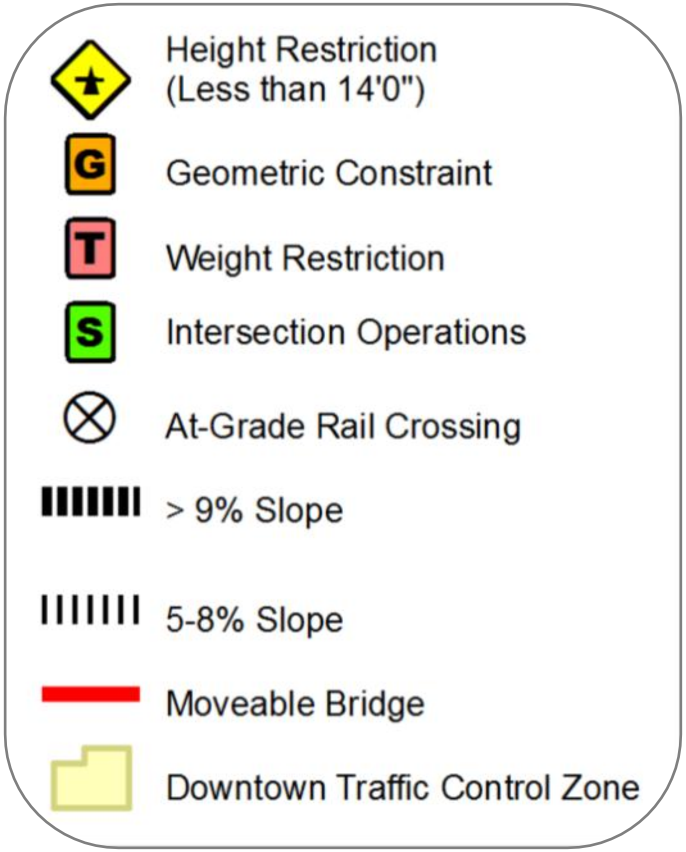
Mobility constraints





Existing mobility constraints

Mobility constraints



Future mobility constraints

Future rail volumes

- By 2035 freight trains are expected to grow to 104 trains daily along the I-5 corridor, a 94% increase over 2010 volumes

Washington State Rail Plan. WSDOT, 2014.

Future rail conditions

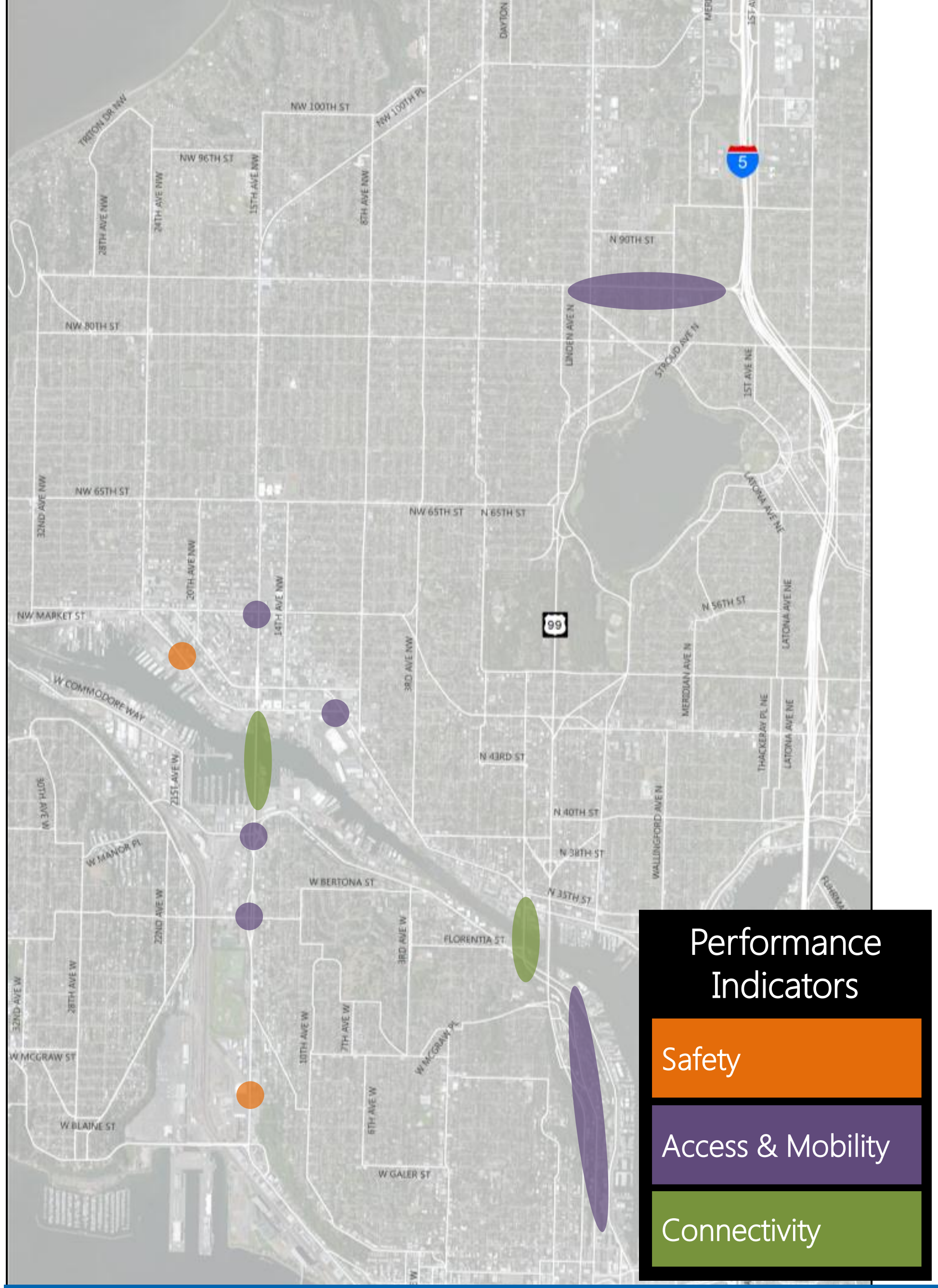
- Key trends affecting future freight rail conditions:
  - Continued growth in freight intensive industries
  - Continued growth in export/import trade
  - Shifts in fuel prices and oil trade
  - Larger container ships and expansion of the Panama Canal
- Passenger/freight rail conflicts along corridors will further limit capacity and access

Urban freight focus areas

- Focus areas are the result of existing and future analysis based on performance indicators consistent with project objectives
- Toolbox solutions applied to targeted areas for developing a freight project list

Ballard/Interbay Northend MIC

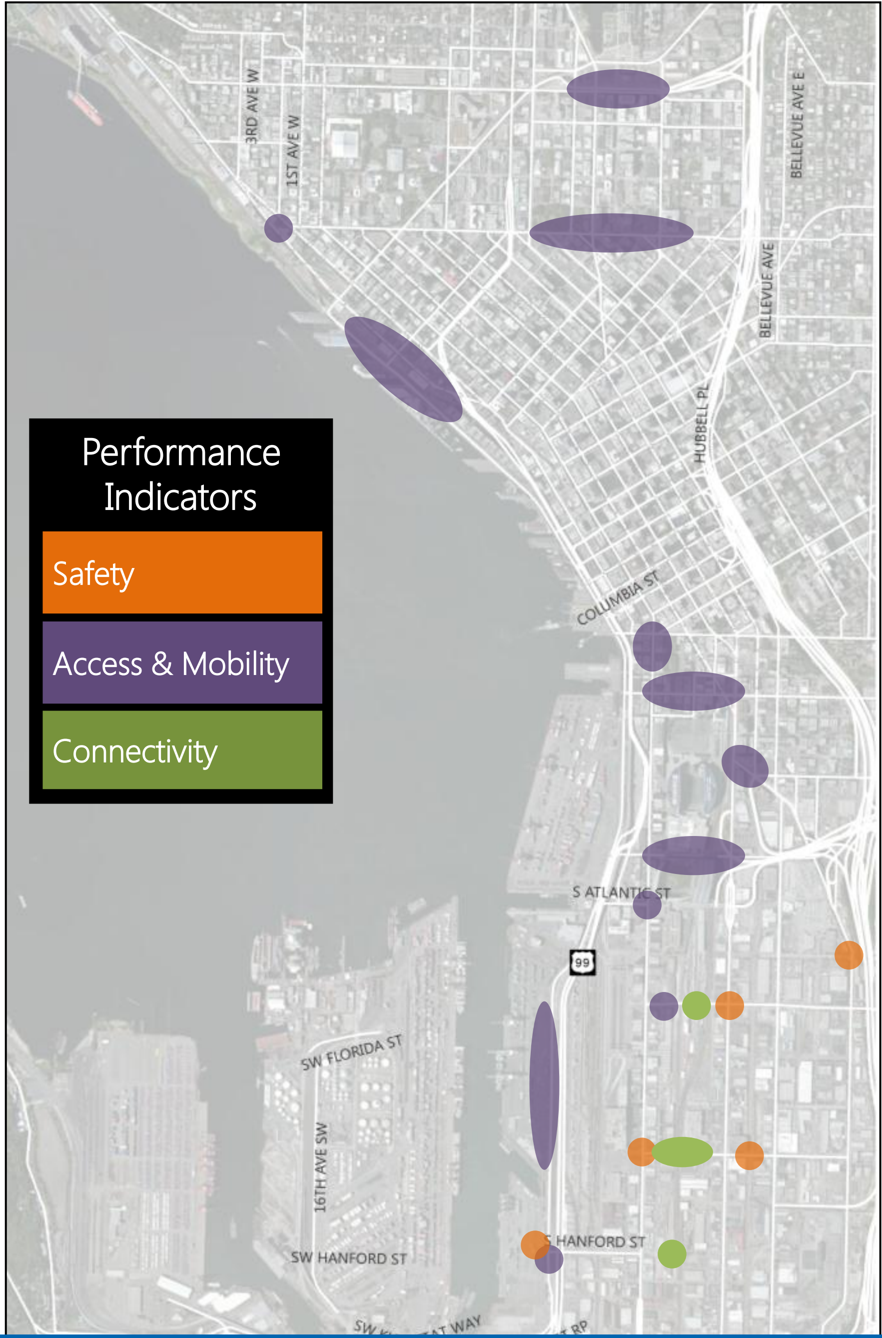
- Bridges are a mobility constraint
- Historical safety incidents with cyclists
- Geometric constraints on 15th Avenue



Focus areas - north

Central connections

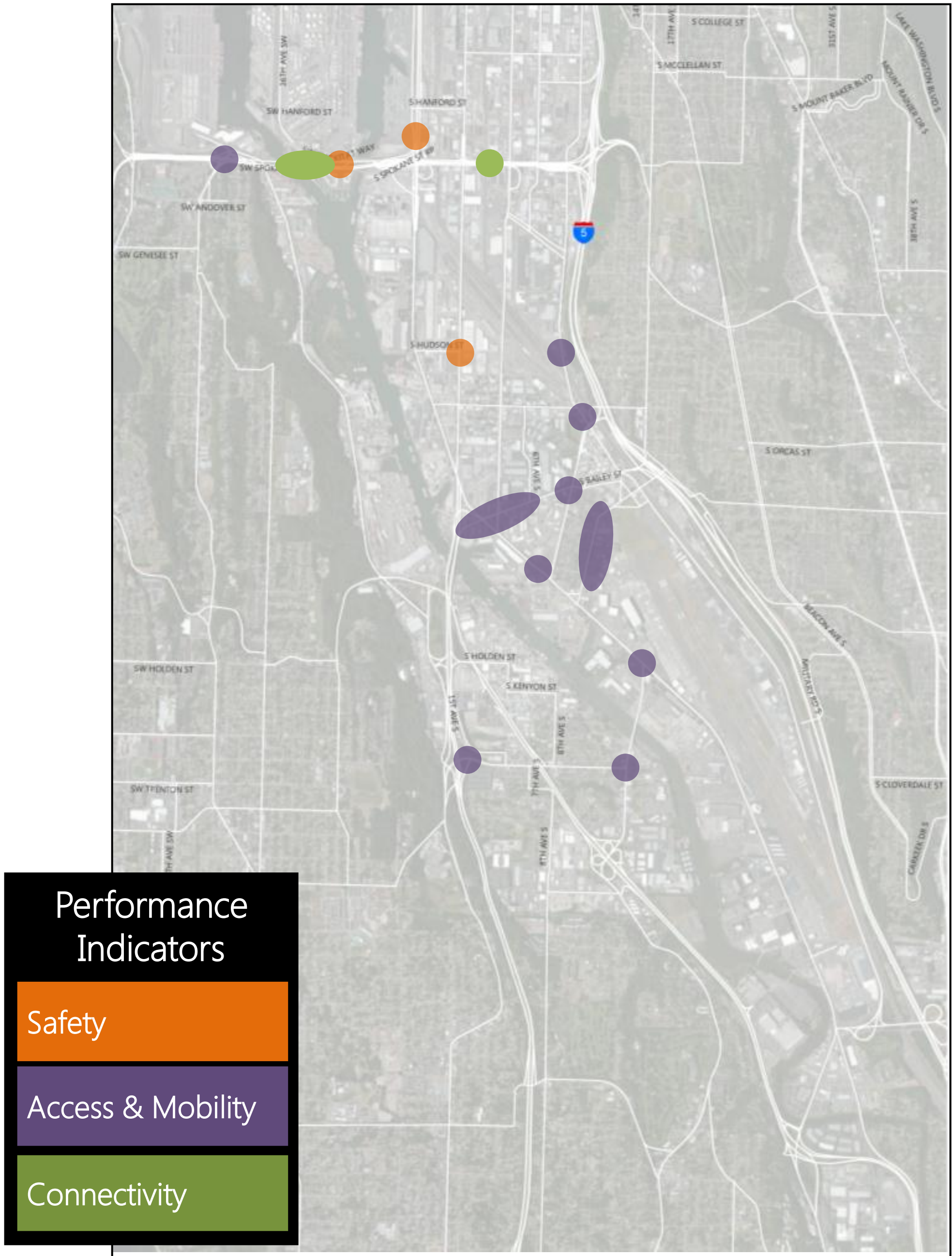
- Increased congestion on regional and arterial roadways
- Rail crossings on east-west connections
- Intersection operational issues



Focus areas - central

Duwamish MIC

- Intersection operational issues
- Historical safety incidents with cyclists and pedestrians



Focus areas - south

Freight toolbox

- Toolbox treatments: range of strategies to address urban freight movement
  - Large scale improvements (game changers)
  - Small scale fast deploying solutions (quick wins)
- A mix of techniques can be used to address unique challenges
- Seek consistency with policy and planning efforts:
  - Complete Streets Checklist
  - Container Terminal Access Study
  - Freight Master Plan

ITS Applications
Toolbox Treatment #1

- Intelligent Transportation System (ITS):
  - Real-time freight traveler information
  - Dynamic route guidance and drayage options

Dynamic message sign. City of Seattle.

- <u>Advantages</u>
  - Improvements to mobility, safety, air quality, and freight operations .
  - Decision making tools for both system users and managers.

- <u>Considerations</u>
  - Implementation requires private and public collaboration and investment.

Freight Delivery Management
Toolbox Treatment #2

- Management of traffic to prioritize freight movements during certain times of the day or to certain areas (e.g. delivery windows, off-peak delivery).

FedEx Deliver in downtown Seattle. City of Seattle.

- <u>Advantages</u>
  - Reduces traffic congestion and improve parking conditions on congested urban streets.
  - Does not require additional physical capacity or infrastructure.

- <u>Considerations</u>
  - Ensure strategies have minimal effect on business operations and traffic safety.

Capital Investments
Toolbox Treatment #3

- Range of projects that could include:
  - new roadway connections
  - direct freeway access ramps
  - truck-only lanes
  - grade-separation

SR 519 under construction. WSDOT.

- **Advantages**
  - Implements large-scale truck mobility and access improvements.
  - Supports investments in major truck and over-dimensional routes.

- **Considerations**
  - Capital projects can include significant costs
  - Project implementation with smaller-scale projects.

Intersection Operational Changes
Toolbox Treatment #4

- Range of signal timing improvements on truck corridors that may include signal priority or adjusting signal timing to facilitate heavy truck movements.

Trucks waiting at an intersection. Transpo Group.

- <u>Advantages</u>
  - Includes small scale signal improvement strategies that can improve truck mobility and access in the short-term.

- <u>Considerations</u>
  - Signal operational improvements should maximize benefit for all roadway users.

Geometric Improvements
Toolbox Treatment #5

- Geometric design strategies:
  - improve turn radii
  - change curb widths
  - remove telephone poles or other obstructions

Utility pole placed close to an intersection. Transpo Group.

- <u>Advantages</u>
  - Includes small-scale spot improvements.
  - Improves truck mobility and access.

- <u>Considerations</u>
  - Geometric improvements should support goods movement and allow for harmonization with other modes.

Wayfinding for Trucks
Toolbox Treatment #6

- Signs, striping, and roadway markings to:
  - improve route decisions
  - reduce illegal movements
  - alert truck drivers when there are disruptions.

Directional and Vertical Clearance Signs. Transpo Group.

- <u>Advantages</u>
  - Quick, low cost strategy to help truck drivers identify truck routes, and avoid routes with height and weight restrictions.

- <u>Considerations</u>
  - Signs must be clear, intuitive, and standardized.
  - Signage should be consistent with of the truck route roadway system.

Maintenance and Repair
Toolbox Treatment #7

- Involves network analysis and design to prioritize pavement and bridge investment on routes with heaviest truck traffic.

Pavement cracking and spalling. Transpo Group.

- Advantages
  - System approach to prioritize maintenance and repair projects based on objective analysis and long-term need.
- Considerations
  - Determine construction activity priority based on freight network.

Next steps

September	Project Identification and Prioritization
October / November	Preparation of Draft Recommendations

Questions?

tony.mazzella@seattle.gov | (206) 684-0811

www.seattle.gov/transportation/freight_industrialareas.htm

http://www.seattle.gov/transportation

SDOT

Seattle Department of Transportation

Seattle Industrial Areas Freight Access Project

Summary of Future Conditions

Image Credit: Port of Seattle

Tony Mazzella and Jon Pascal
Freight Advisory Board
June 17, 2014

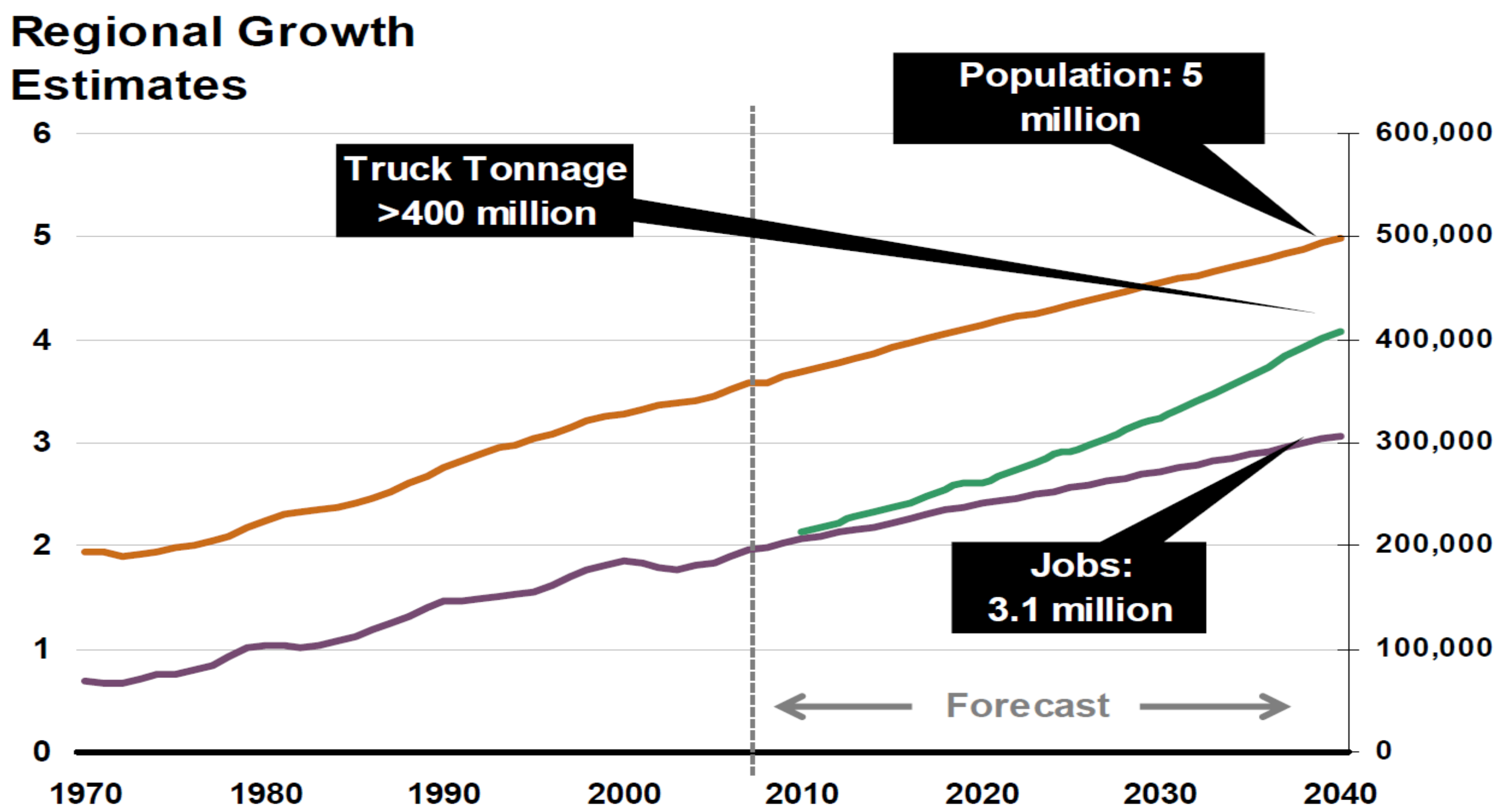
Port of Seattle

SDOT
Seattle Department of Transportation

Presentation overview

- What drives future traffic growth – overview of assumptions
- Changes to the transportation network – assumed improvements
- Forecast traffic volumes along key corridors
- Next steps
- Questions

Regional growth and truck tonnage



[4] PSRC, Washington State Department of Employment Security

Future travel demands

- Population and employment are expected to grow by more than 25% by 2035
- Future travel demand will grow with population and economic activity
- Vehicle trips will not grow as significantly due to transit expansion and tolling
- Truck activity will grow faster than regional traffic
- Street network will remain much the same except for programmed projects and SDOT changes in managing streets for transit, bicycles, and passenger rail

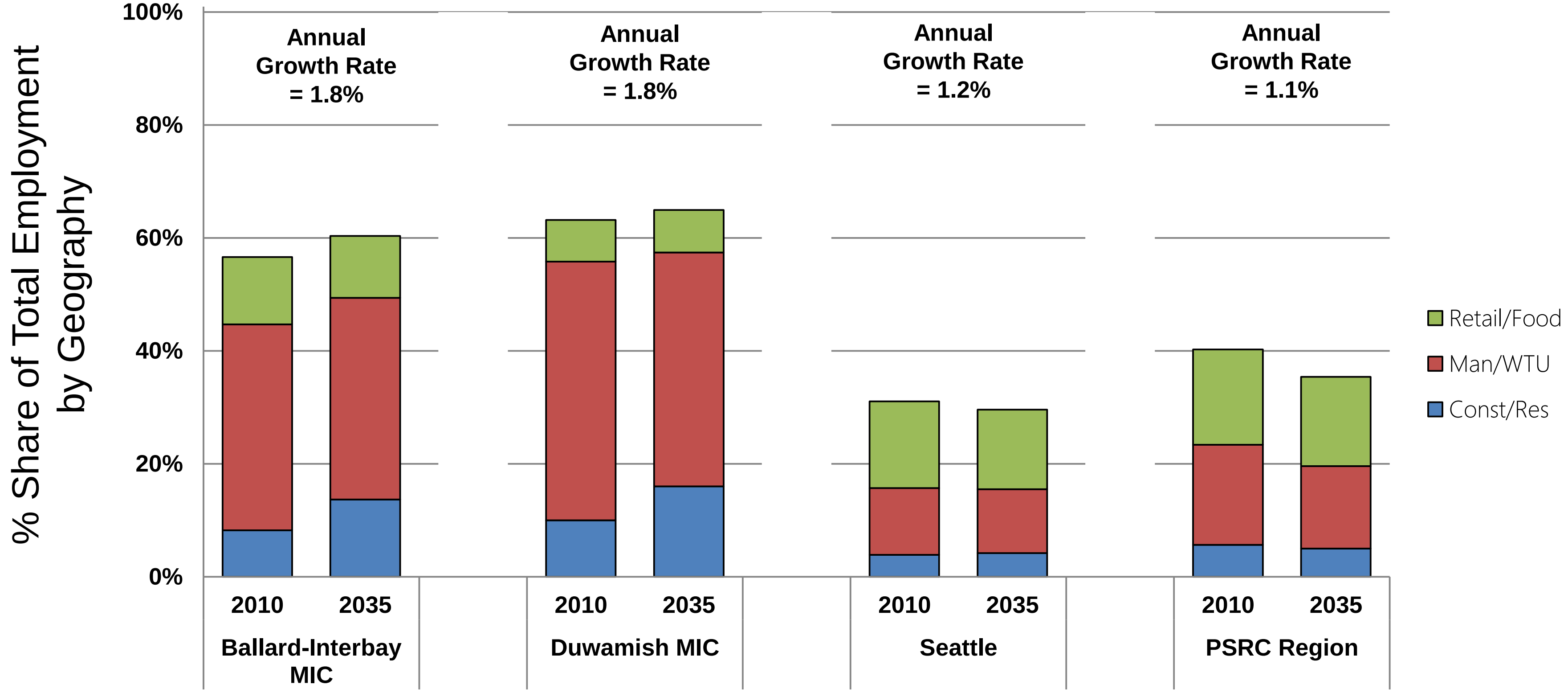
What drives future traffic growth?

Vehicle mode	Reasons change occurs
Passenger Vehicles	• Population and employment growth • Changes in land use and modal options Sources → • Alaskan Way Viaduct Tolling Study • PSRC Travel Demand Model
Non-Port Trucks	• MIC industrial growth • Changing industry composition Source → Commodity Flow Profile from Freight Analysis Framework (FAF3)
Port Trucks	• Trade growth and intermodal shifts Source → Port of Seattle Container Terminal Access Study

Non-port truck trips growth

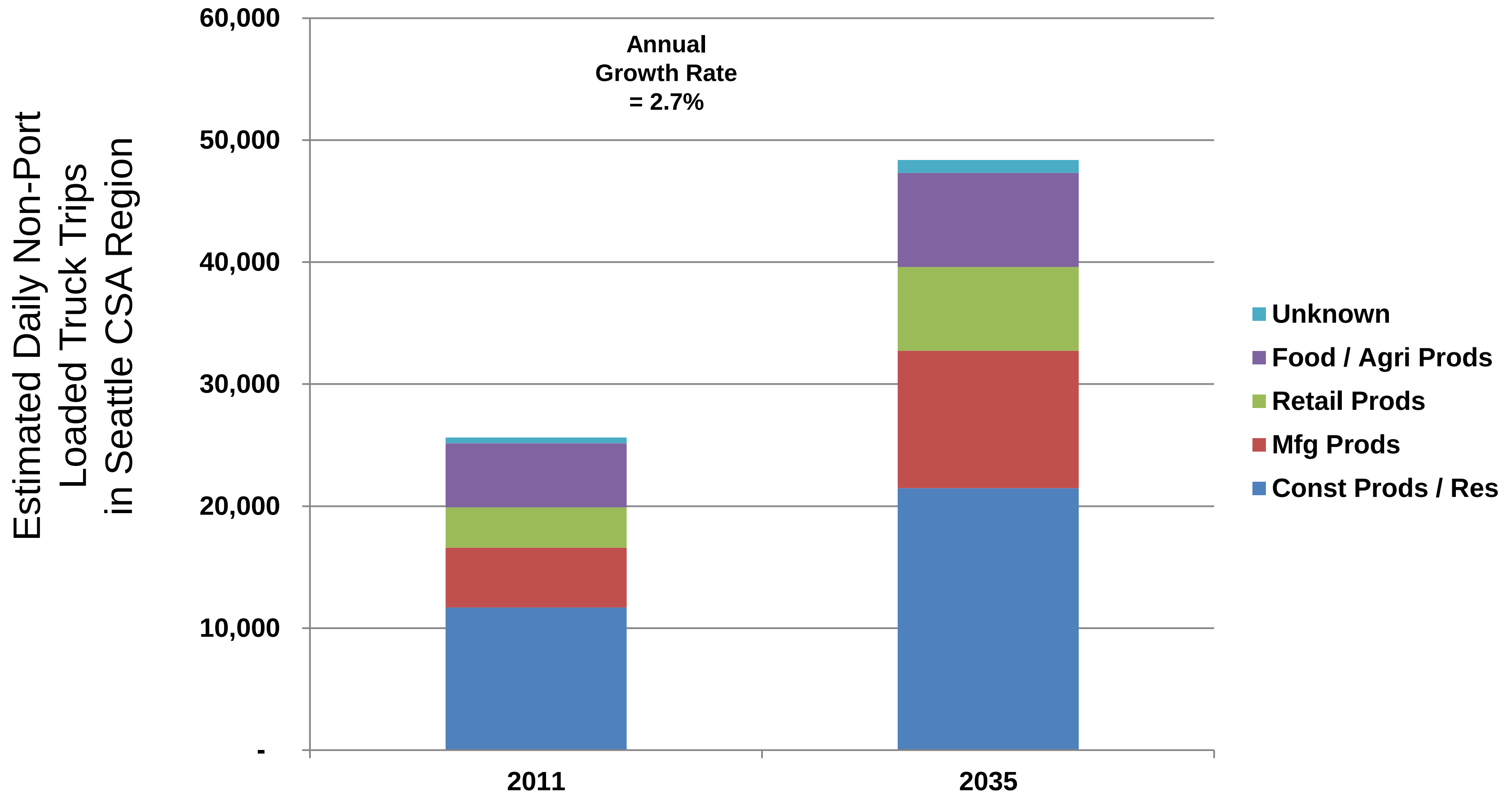
- MICs will comprise an increasing share of regional goods movement dependent industry activity
  - Construction
  - Natural Resources
  - Manufacturing
  - Wholesale
  - Transportation
  - Utilities
  - Retail
  - Food Services
- Output and demand from goods movement dependent industries is growing faster than employment – productivity gains
- As a result, non-port truck trips will grow faster than overall regional traffic

Goods movement dependent industry growth



Source: PSRC Employment Forecasts, 2010.

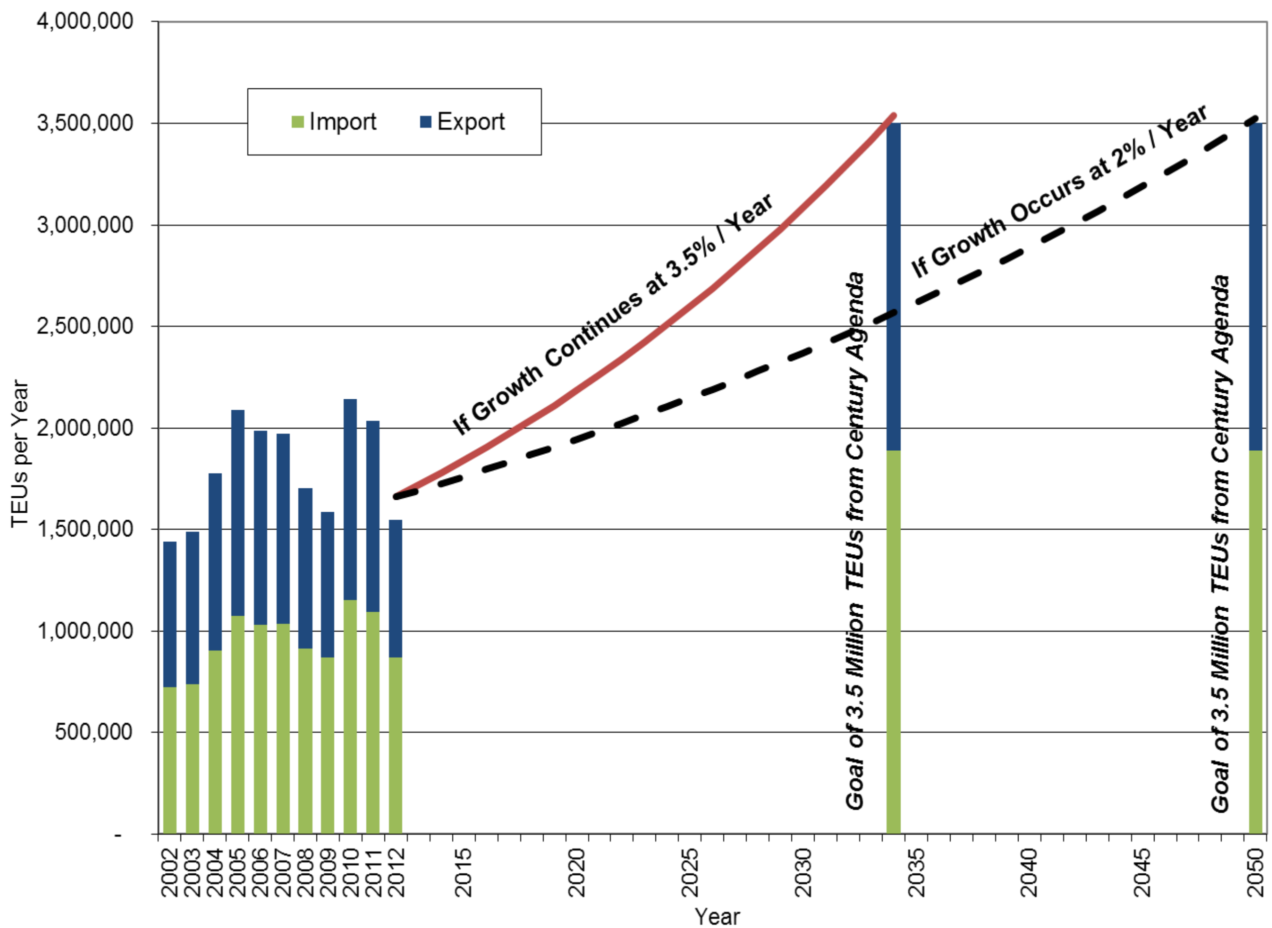
Non-port truck trips growth by commodity type

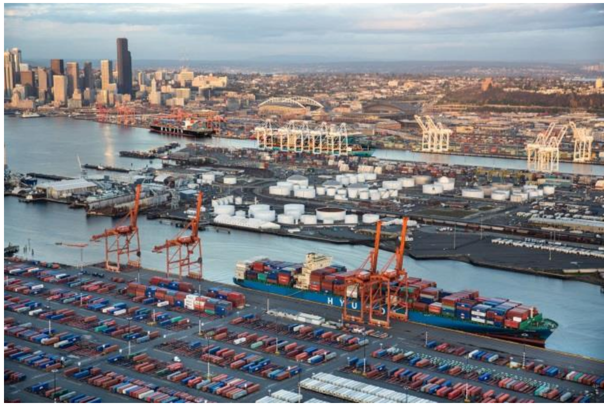


Source: Regional Forecasts from FHWA's FAF3 National Model and Cambridge Systematics Assumptions on Average Truck Payload Factors by Commodity.

Port truck trips growth

- Consistent with the Port of Seattle Growth Goal of 3.5 million TEUs/Year





Source: Port of Seattle Container Terminal Access Study, 2014.

Transportation network changes

- Improvements to the transportation system will change routing patterns
  - New projects
  - Tolling

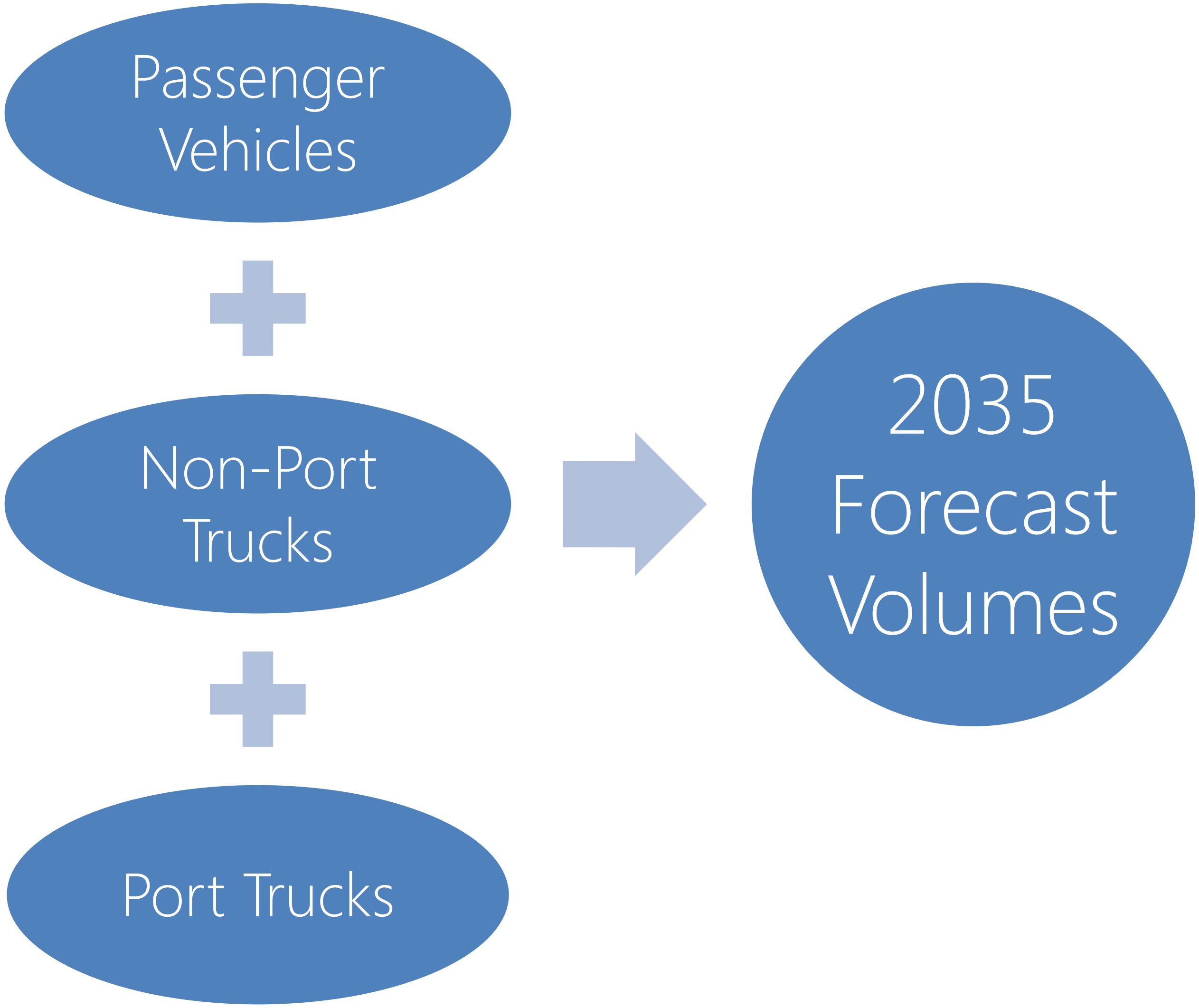
- Shifting routes of auto trips and changes in congestion will impact truck routing
  - Relative pattern of truck route shifts obtained from PSRC model

Assumed improvements

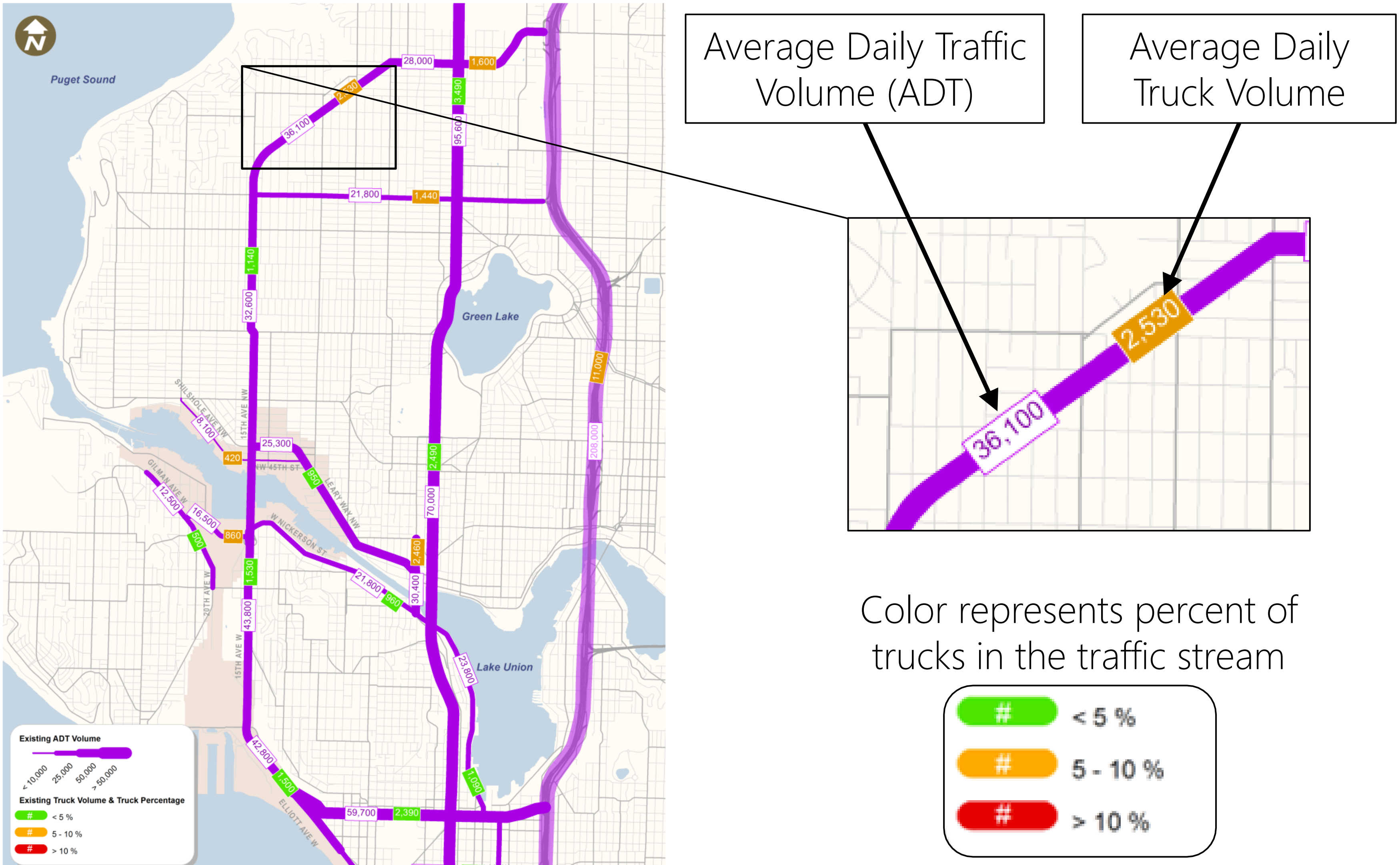
- Transportation projects identified in previous planning studies
- Major projects include:
  - Alaskan Way Viaduct Replacement
  - Mercer Street Improvements
  - Seattle Waterfront / Alaskan Way
  - Lander Street Grade Separation

Major Projects

Forecasting methodology



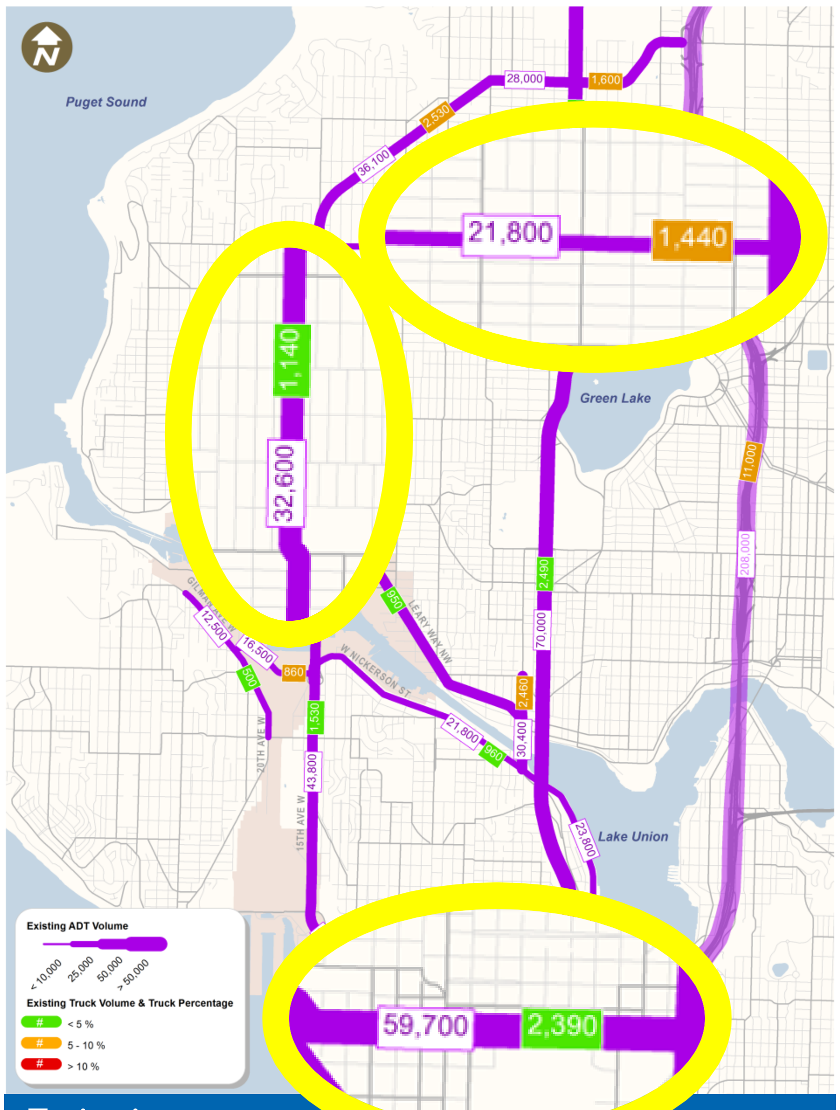
Truck volumes – reading the maps



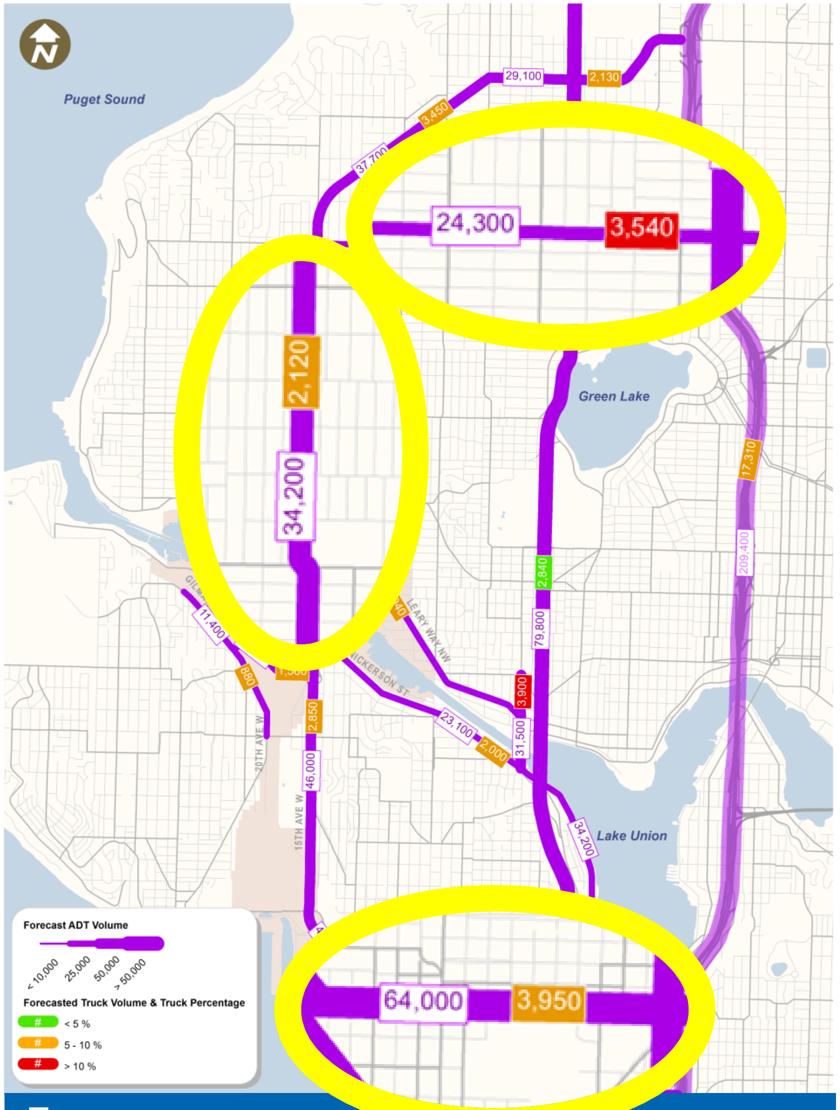
Example Map

Truck volumes – north

PRELIMINARY



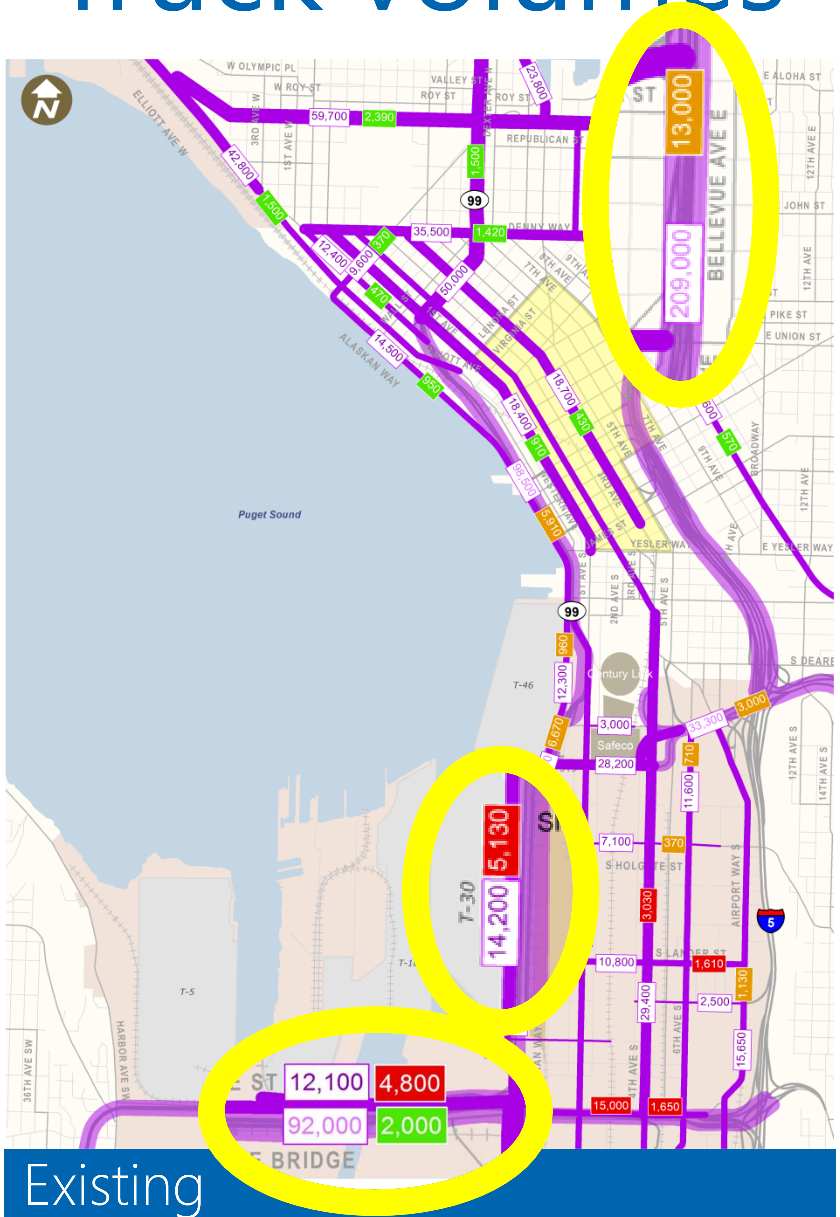
Existing

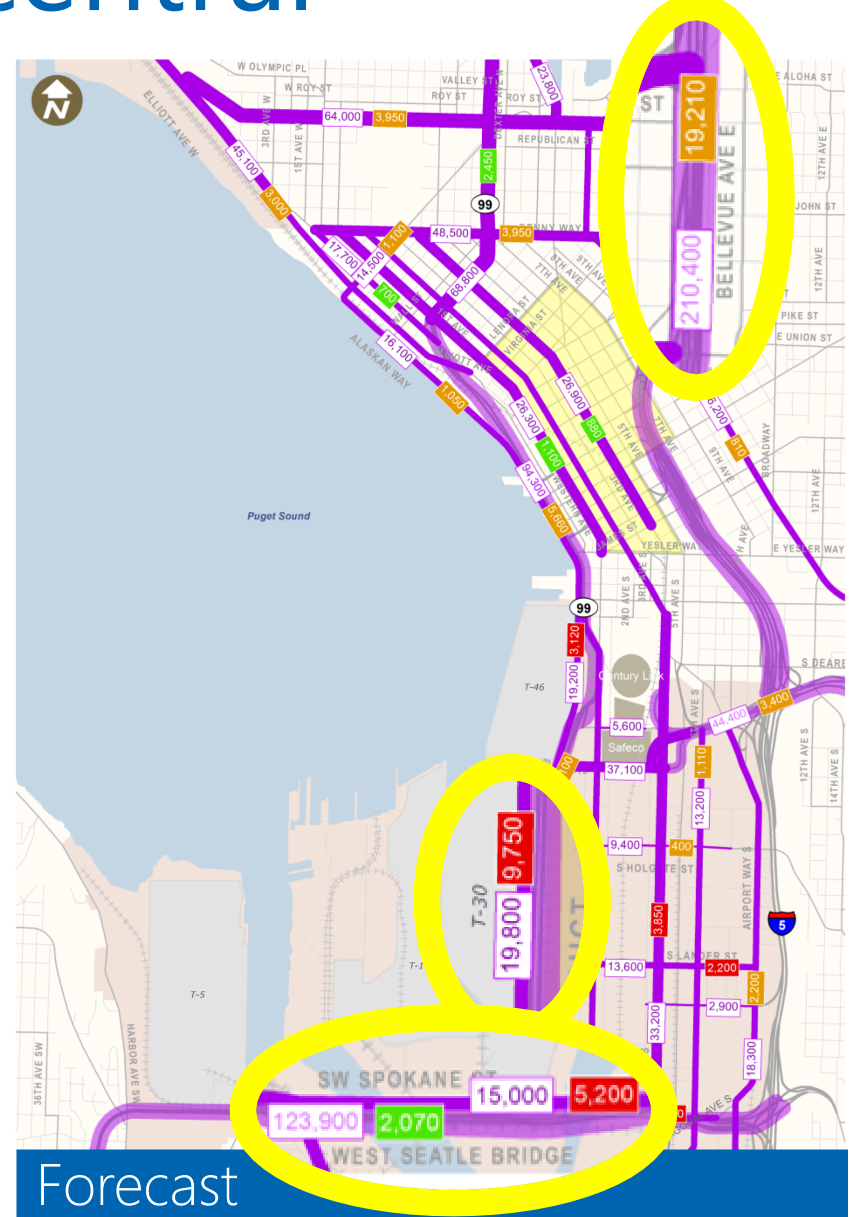


Forecast

Truck volumes – central

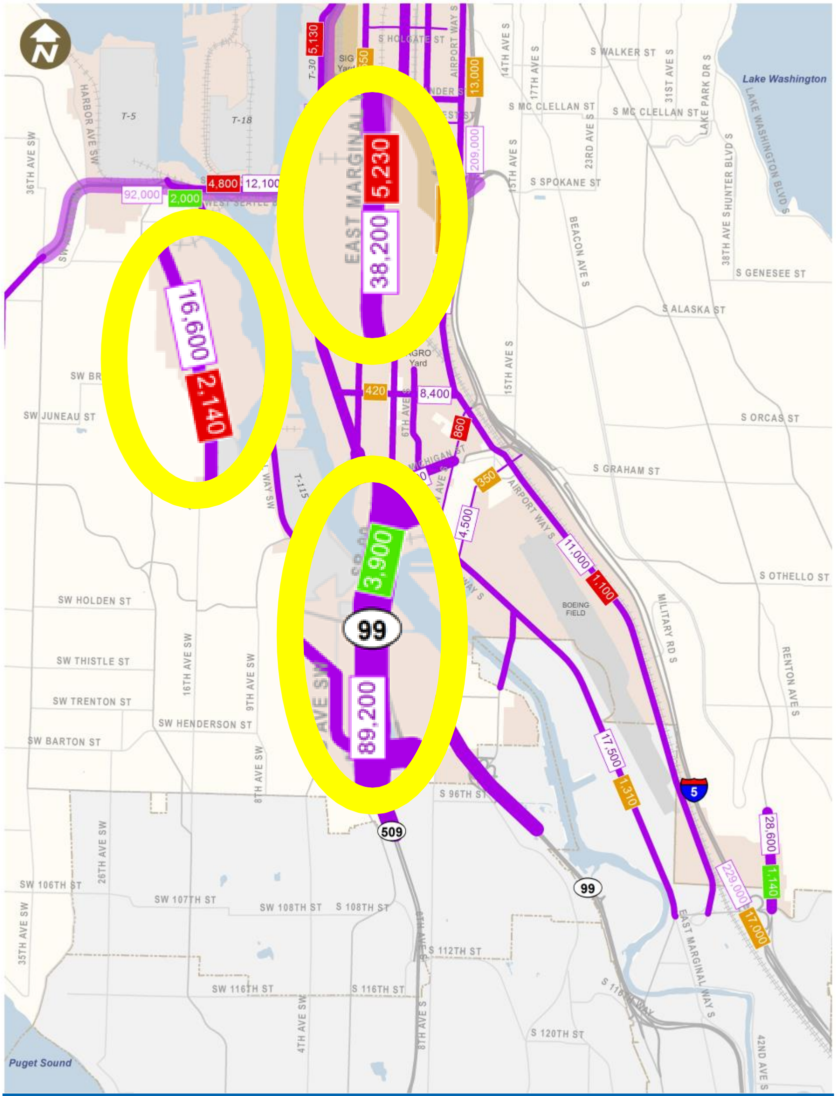
PRELIMINARY



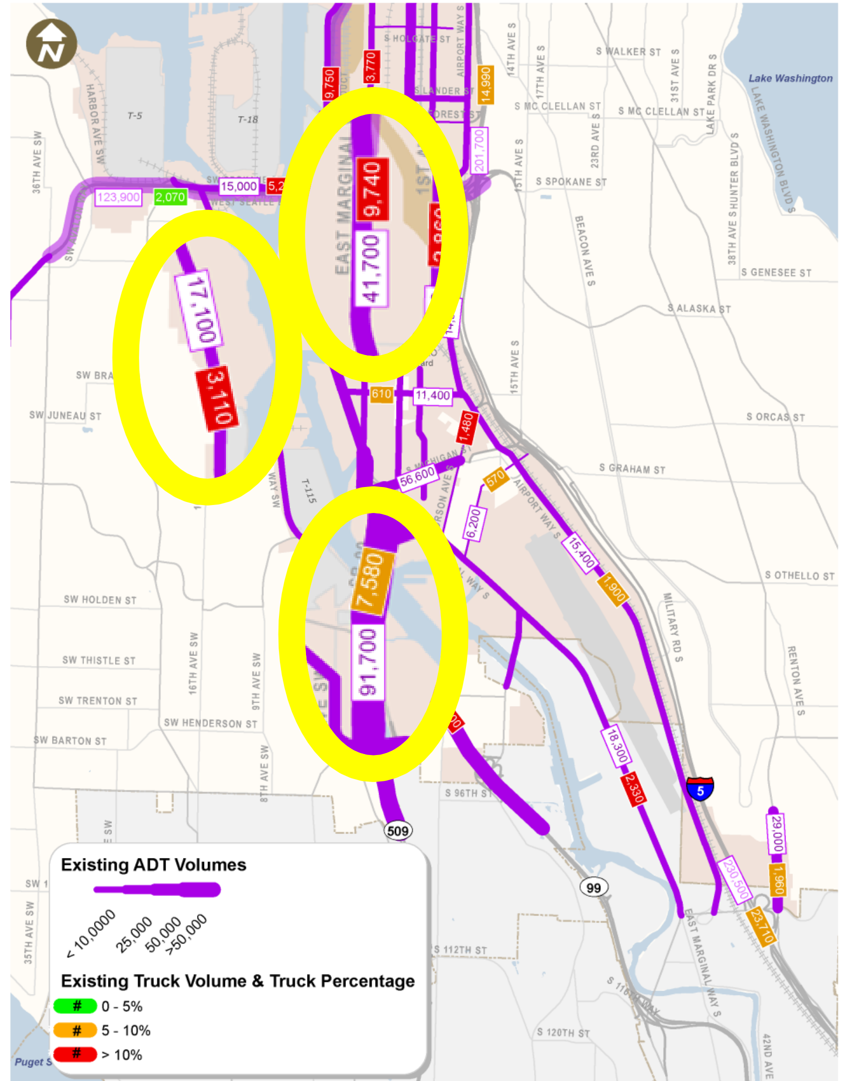


Truck volumes – south

PRELIMINARY



Existing



Forecast

Next steps

July	Future Conditions and Needs Identification
September	Improvement Project Identification and Prioritization
October / November	Preparation of Draft Plan

Questions?

tony.mazzella@seattle.gov | (206) 684-0811

www.seattle.gov/transportation/freight_industrialareas.htm

http://www.seattle.gov/transportation

SDOT

Seattle Department of Transportation

Seattle Industrial Areas Freight Access Project

Summary of Existing Conditions

Image Credit: Port of Seattle

Port of Seattle

SDOT
Seattle Department of Transportation

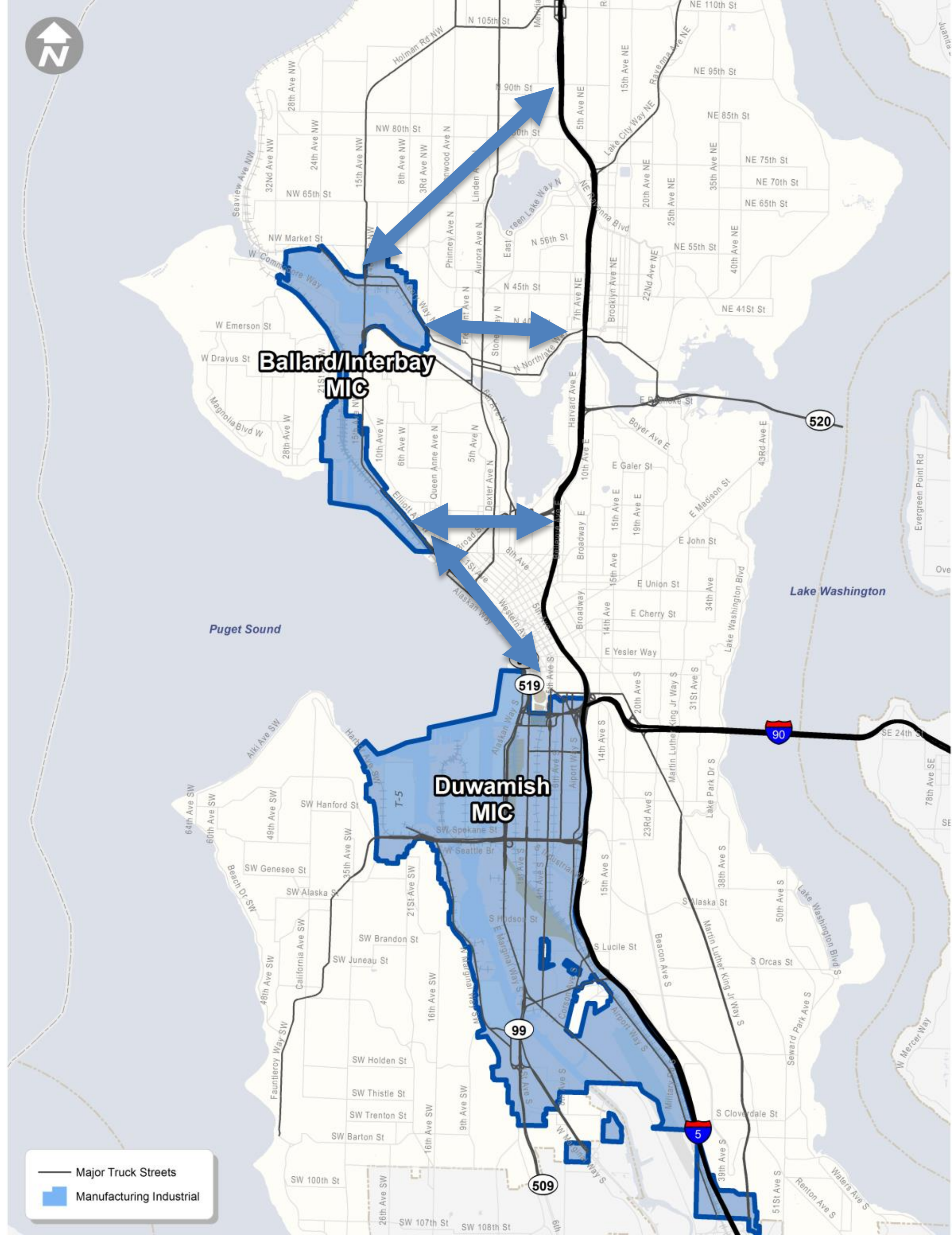
May 2014

Presentation overview

- Project area
- Project objectives
- FAB workshops
- Existing conditions
- Next steps
- Questions

Project area

- MICs
  - Ballard/Interbay
  - Duwamish
- Connecting Corridors between MICs
- Corridors from the MICs to the Regional Highway System



Project objectives

1. Increase safety for all travel modes

2. Maintain and improve truck mobility and access to accommodate expected general traffic, freight, and cargo growth

3. Ensure connectivity for major freight intermodal facilities

4. Reduce environmental impacts, including greenhouse gas emissions

Image Credit: WSDOT

FAB workshops

Issues, concerns, solutions	✓
Performance Measures	✓
Summary of Existing Conditions	May 20
Future Conditions	June 17
Draft improvement concepts	TBD
Final Draft improvement projects	TBD

Existing conditions for trucks

- Street network
- Mobility constraints
- Corridor volumes
- Corridor travel speeds
- Collision history
- Pavement and bridge conditions
- Multi-modal demands

Street network

- Arterial Streets – trucks are allowed
- Major Truck Street:
  - principal arterials
  - Complete Streets ordinance states “freight will be the major priority”
- Last mile connections

Arterial Map

Mobility constraints

Intersection Operations

Geometric Constraints

Height Restrictions

At-grade RR Crossings

Mobility constraints

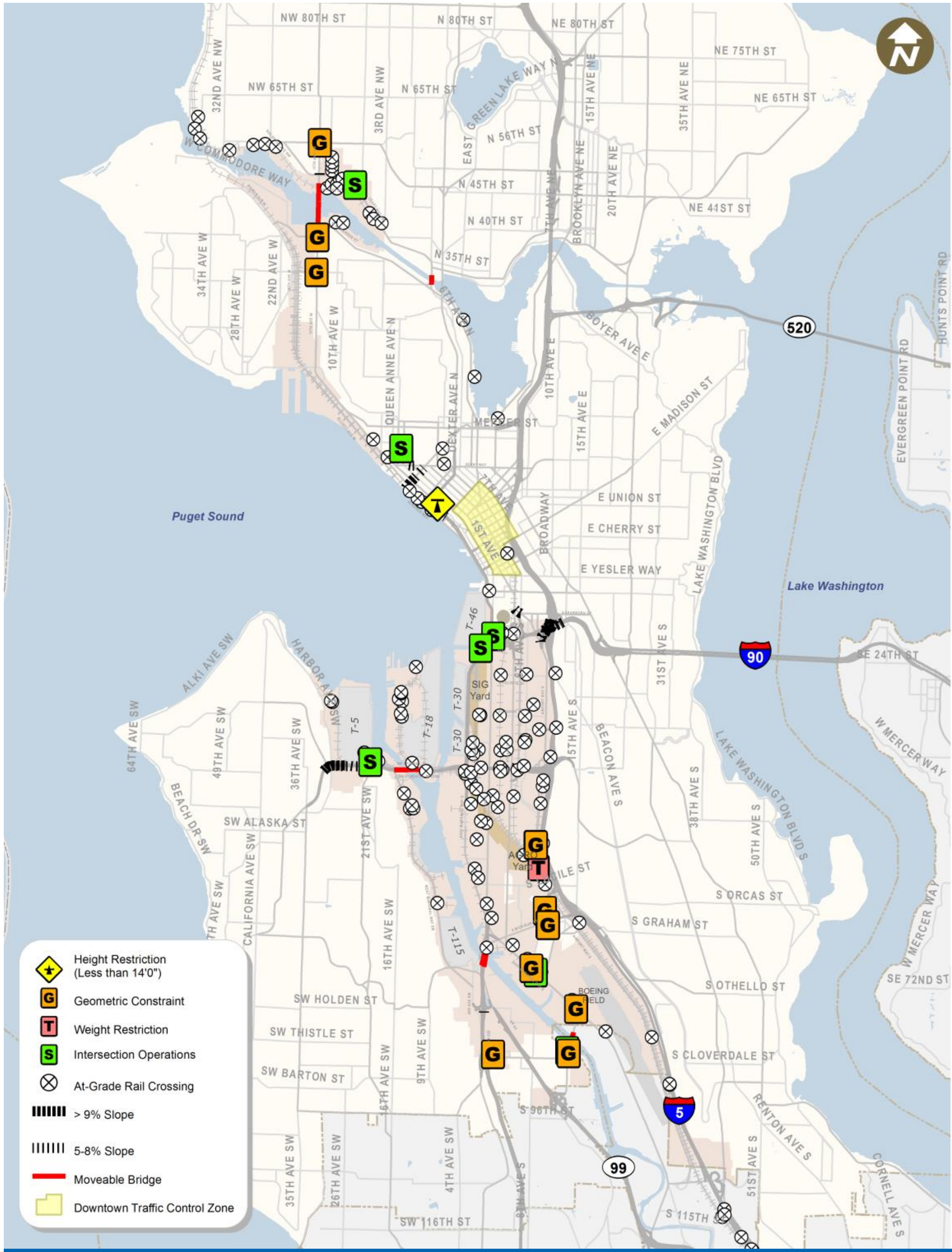
Weight & Width Restrictions

Port/Rail Yard Operations

Moveable Bridges

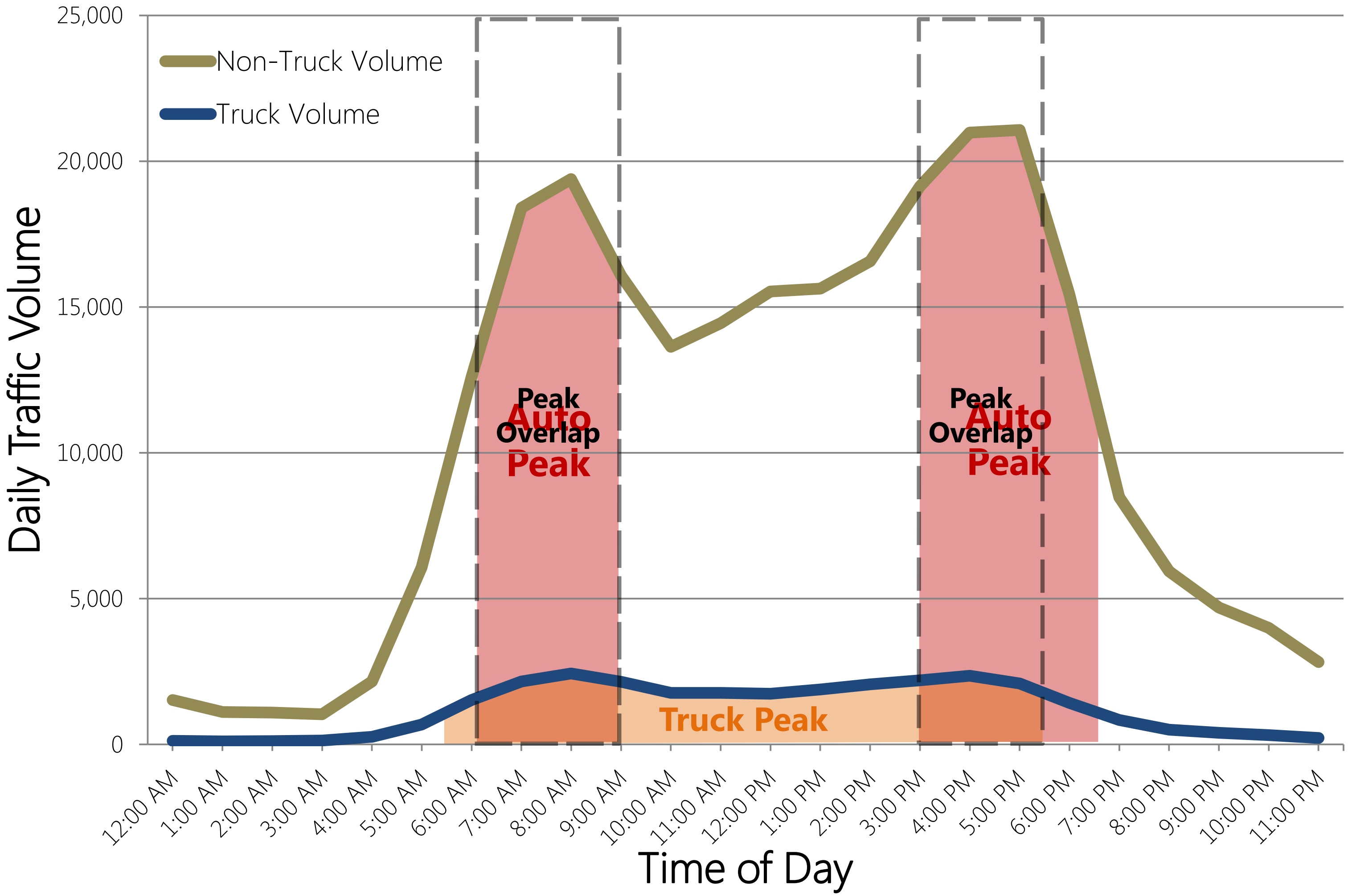
Mobility constraints

- Height Restriction (Less than 14'0")
- Geometric Constraint
- Weight Restriction
- Intersection Operations
- At-Grade Rail Crossing
- > 9% Slope
- 5-8% Slope
- Moveable Bridge
- Downtown Traffic Control Zone



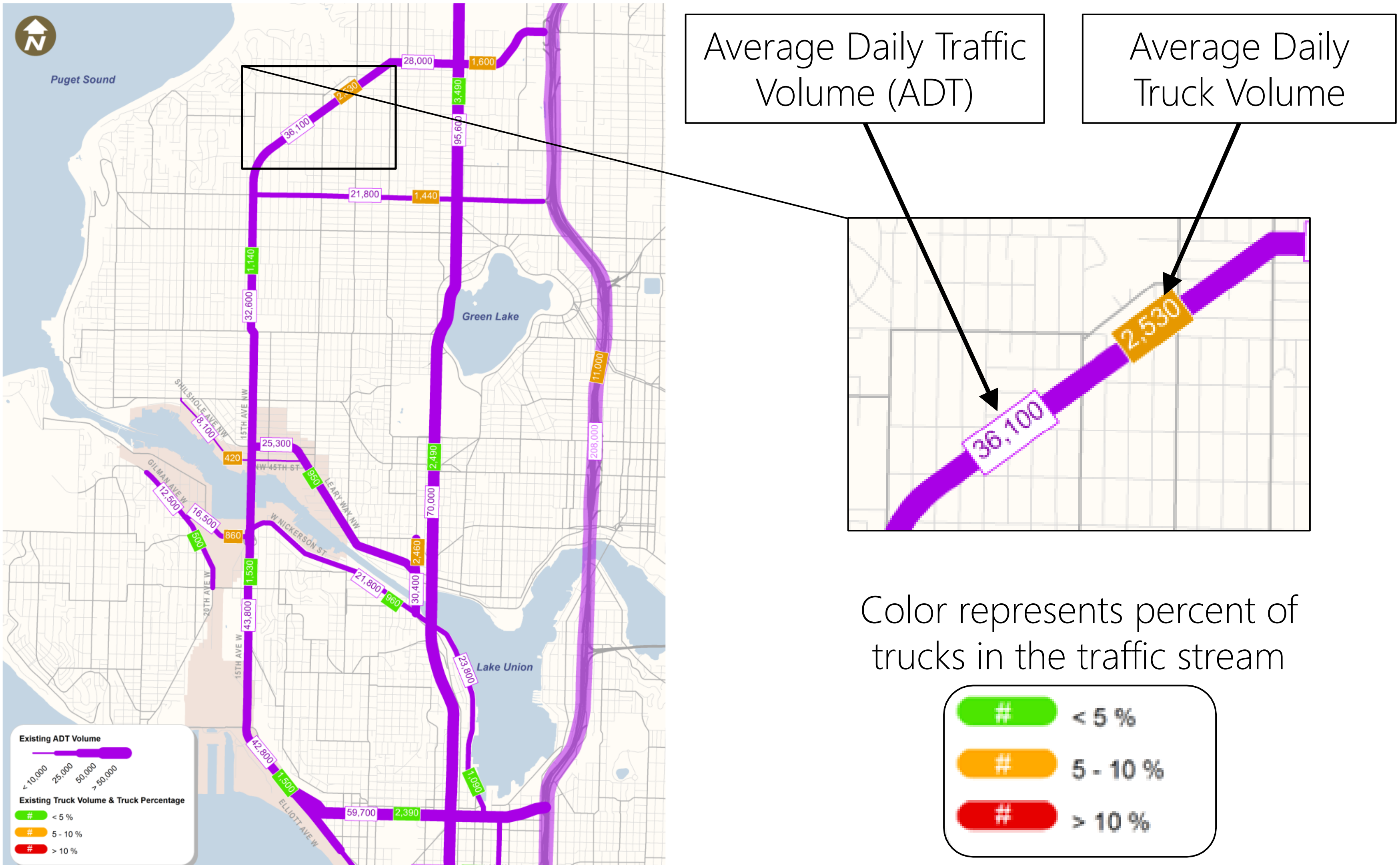
Map of Constraints

Average daily truck & auto volumes



Source: 24-hour tube counts from 14 locations in the Duwamish MIC.

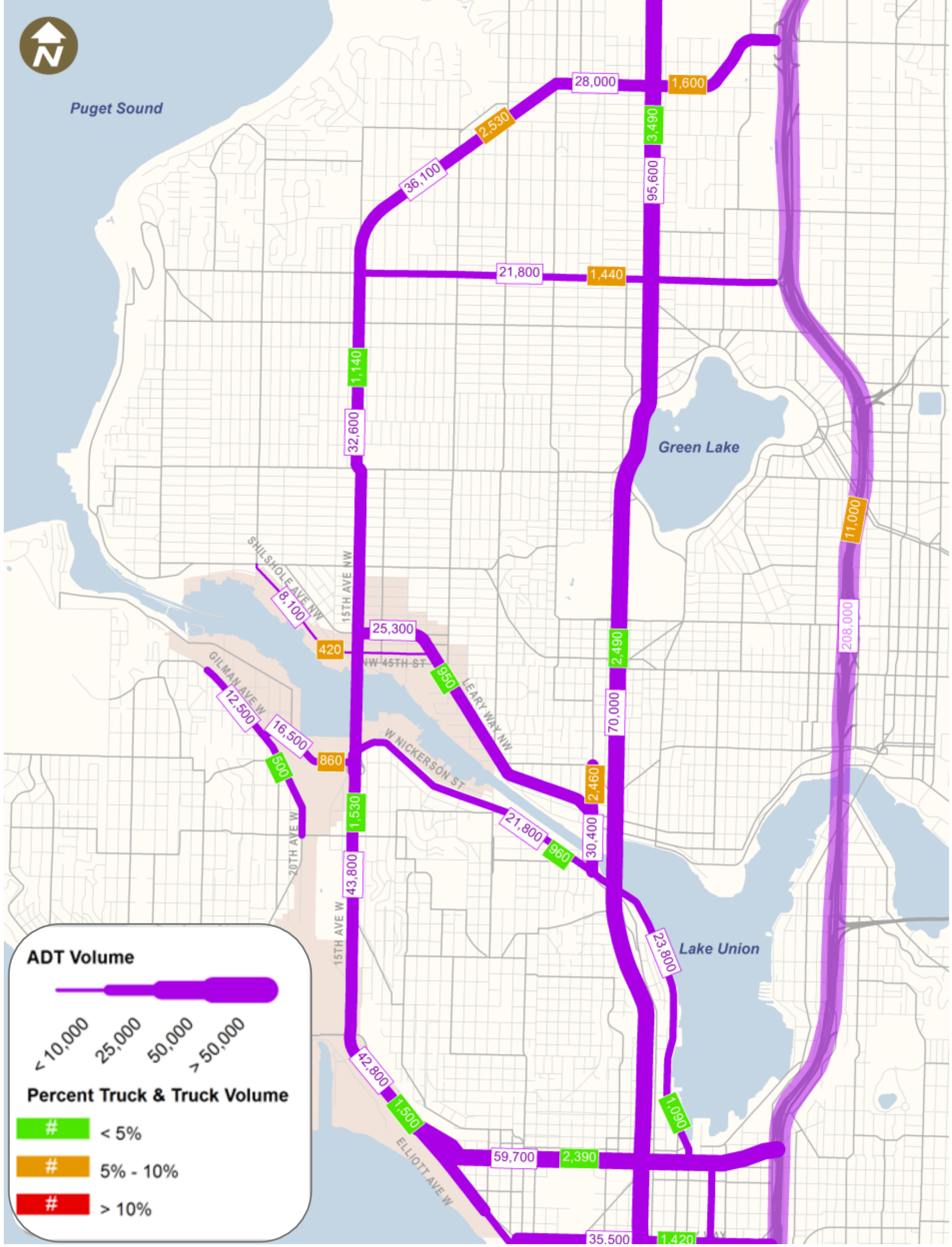
Truck volumes – reading the maps



Example Map

Truck volumes

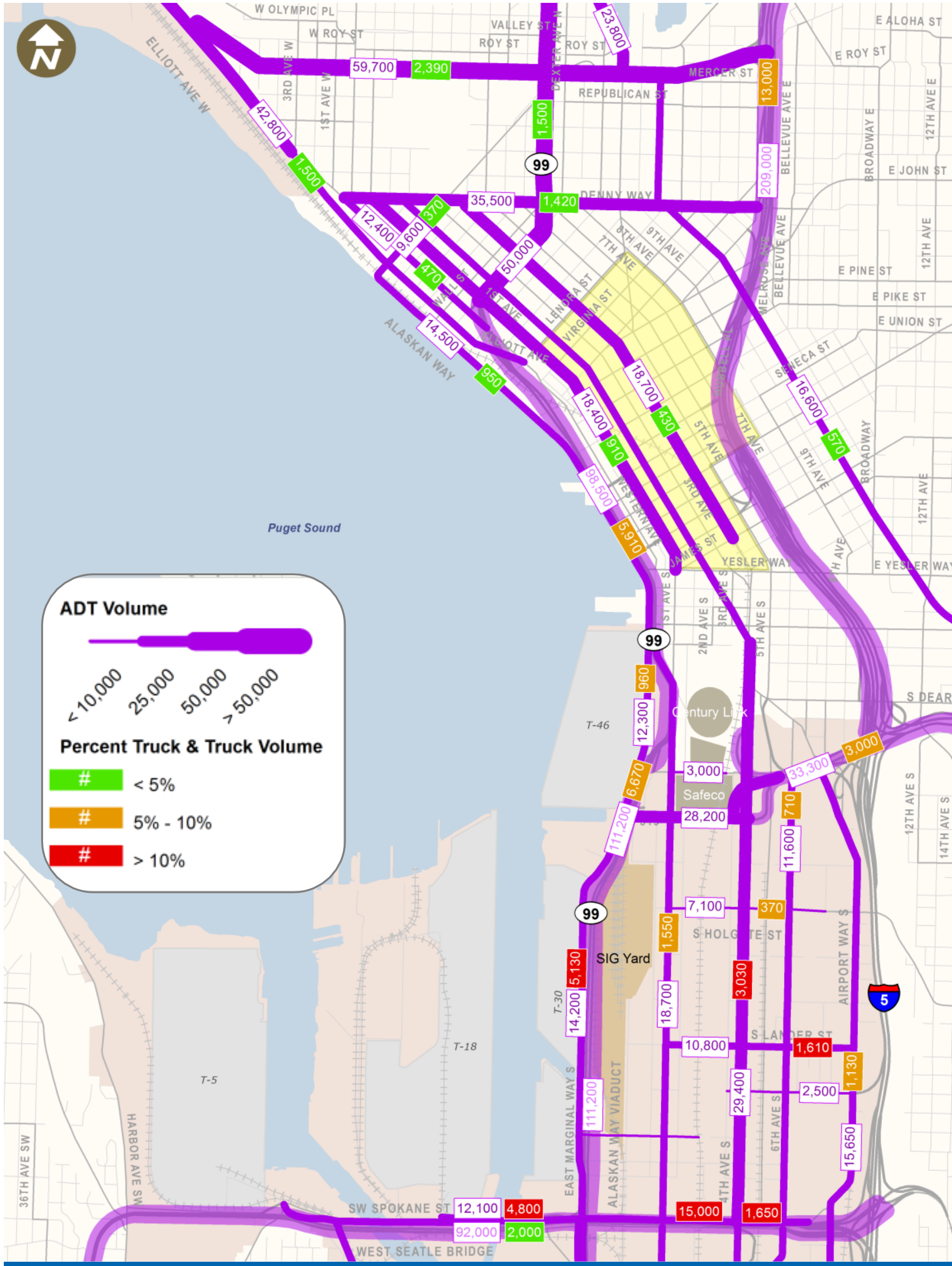
- 15th Avenue NW and Elliott Ave W have the highest daily percentage of trucks
- Limited east-west truck routes
- Data gaps still exist



North

Truck volumes

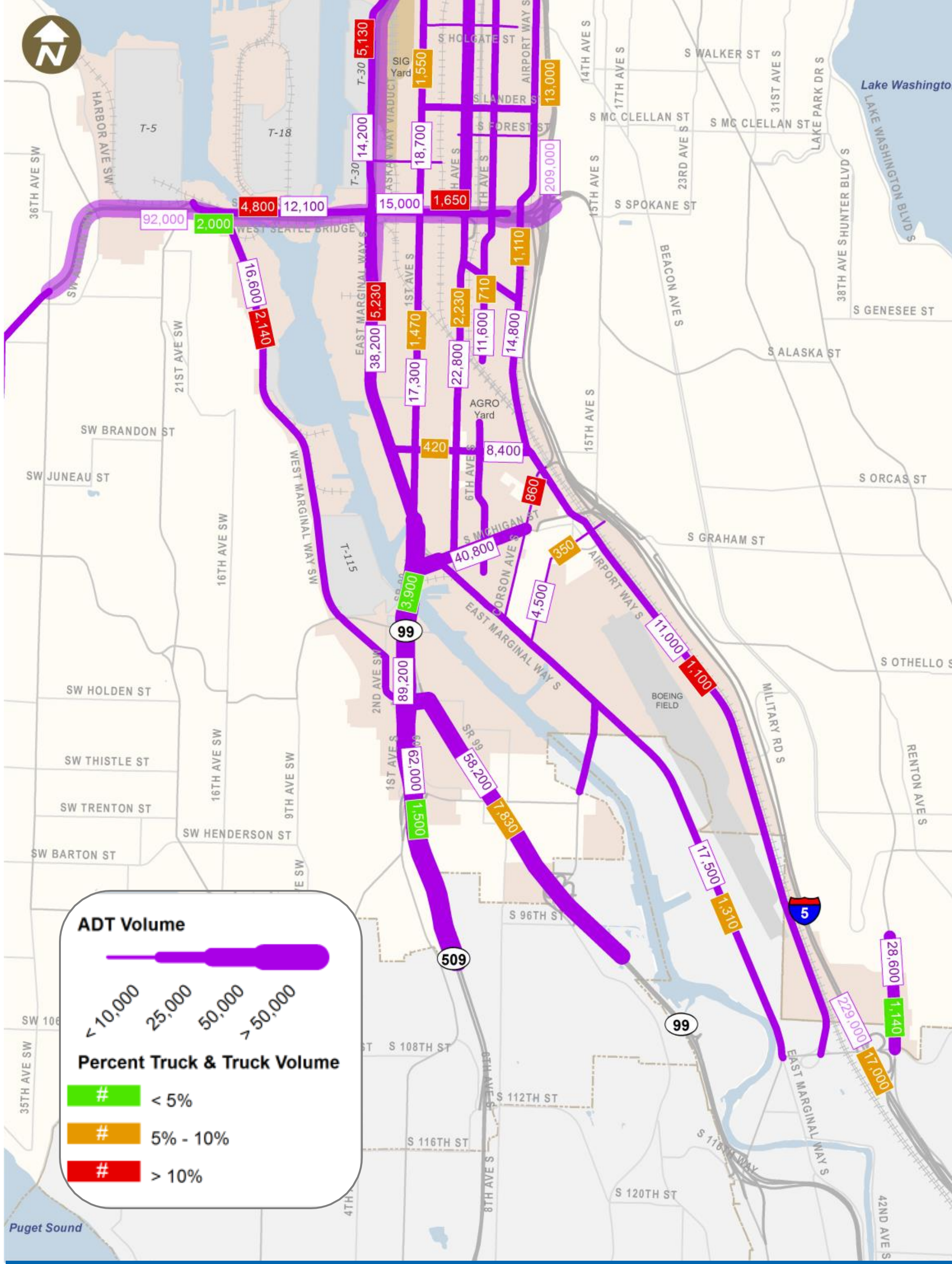
- Few surface street connections through Downtown



Central

Truck volumes

- Trucks account for more than 10 percent of traffic on most roadways
- Port activity contributes to the large number of Duwamish truck movements



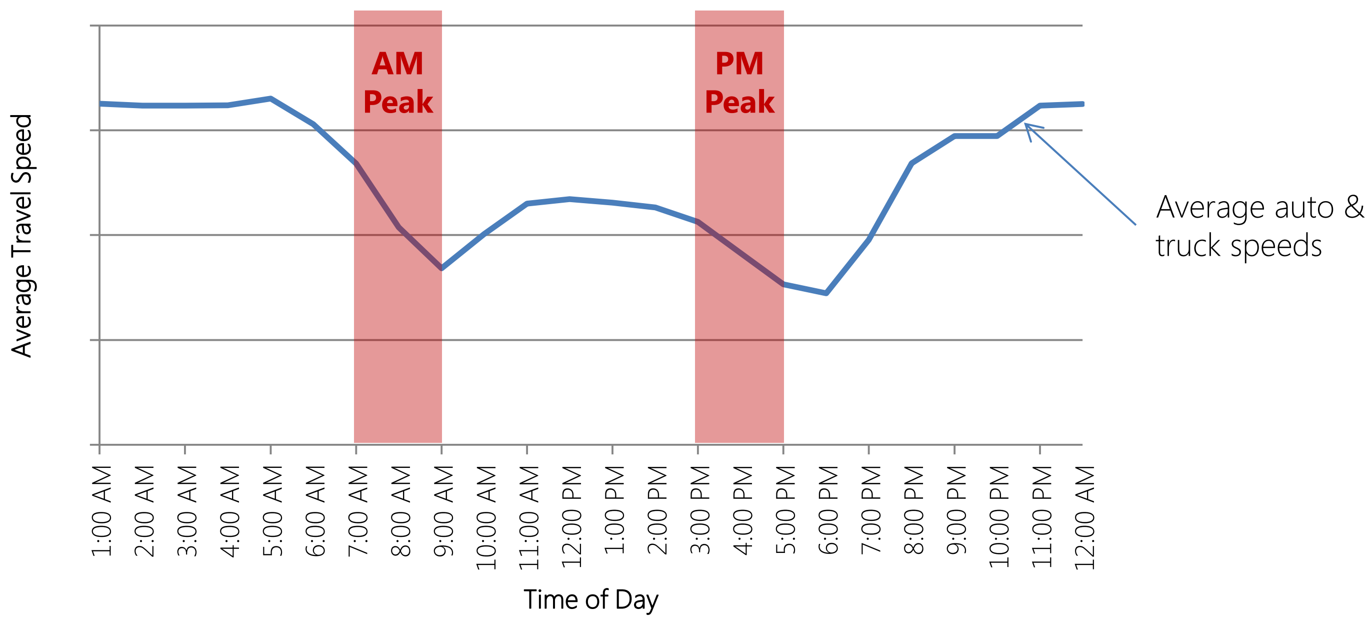
South

New travel speed methodology

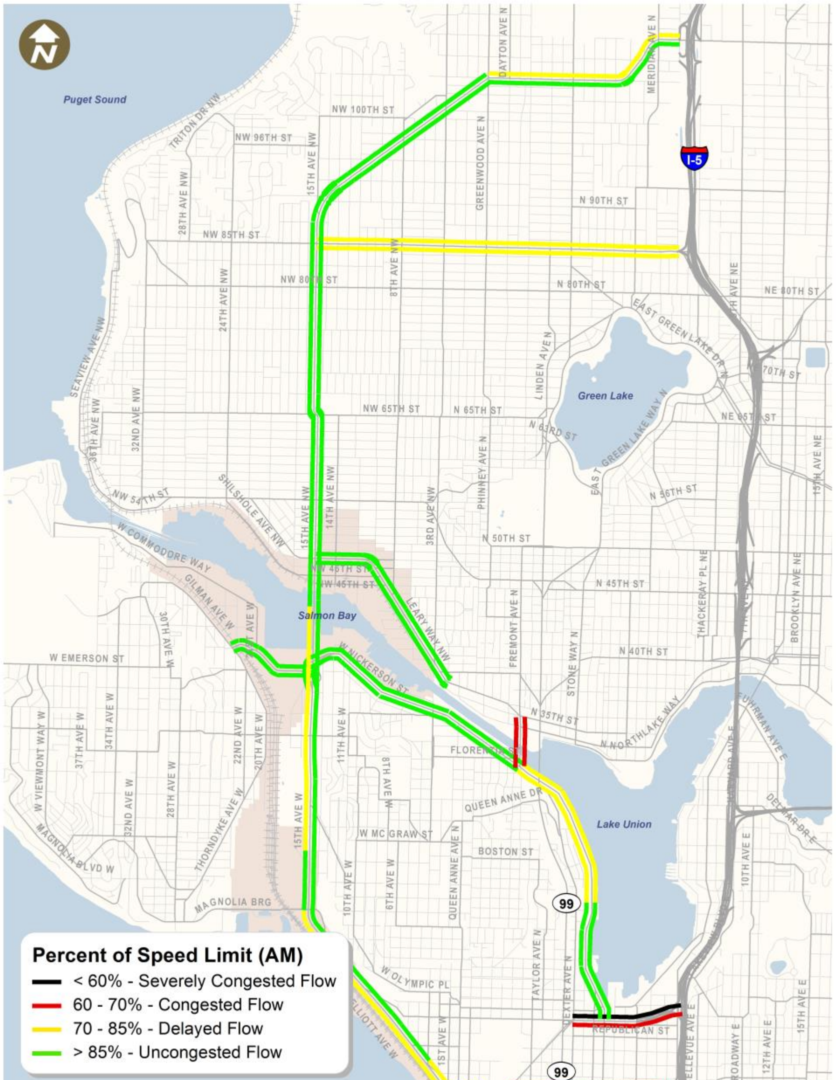
- Congestion measured as percent of posted speed limit
  - i.e. < 60% of speed limit is severely congested flow

- Focus on peak periods
  - 7:00 to 9:00 AM
  - 3:00 to 5:00 PM

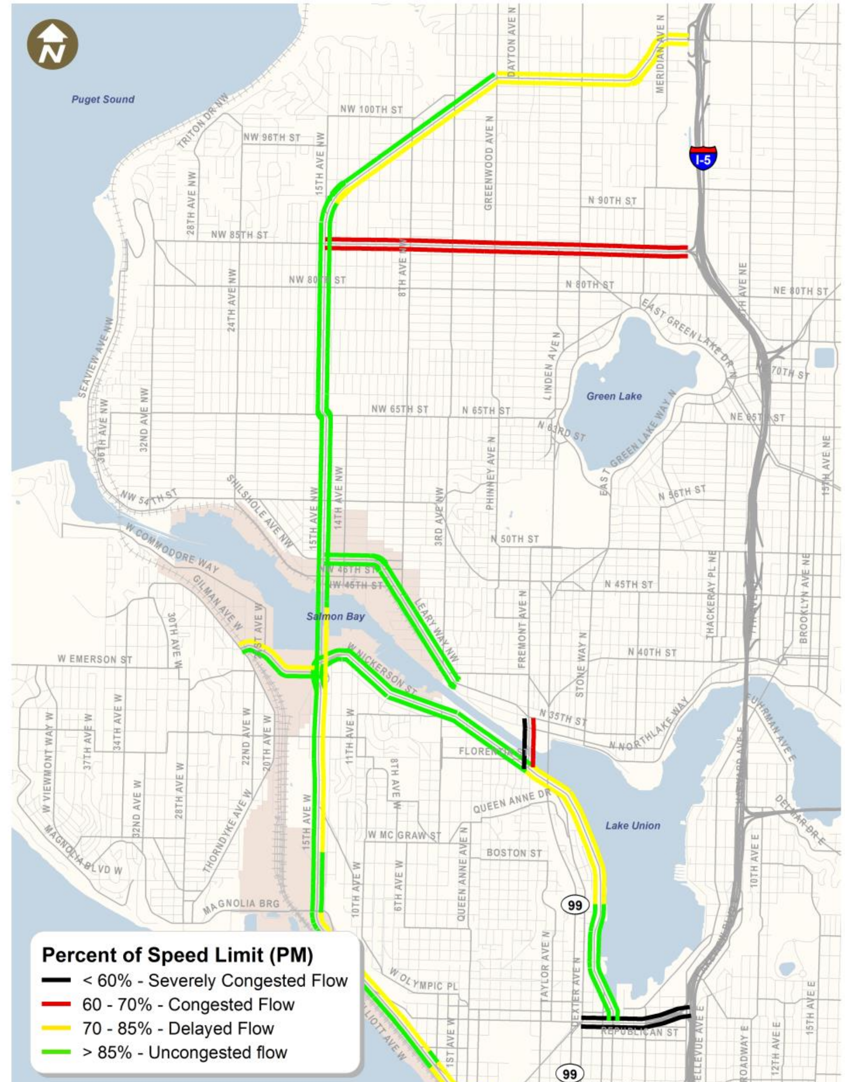
Example



Congestion levels – north

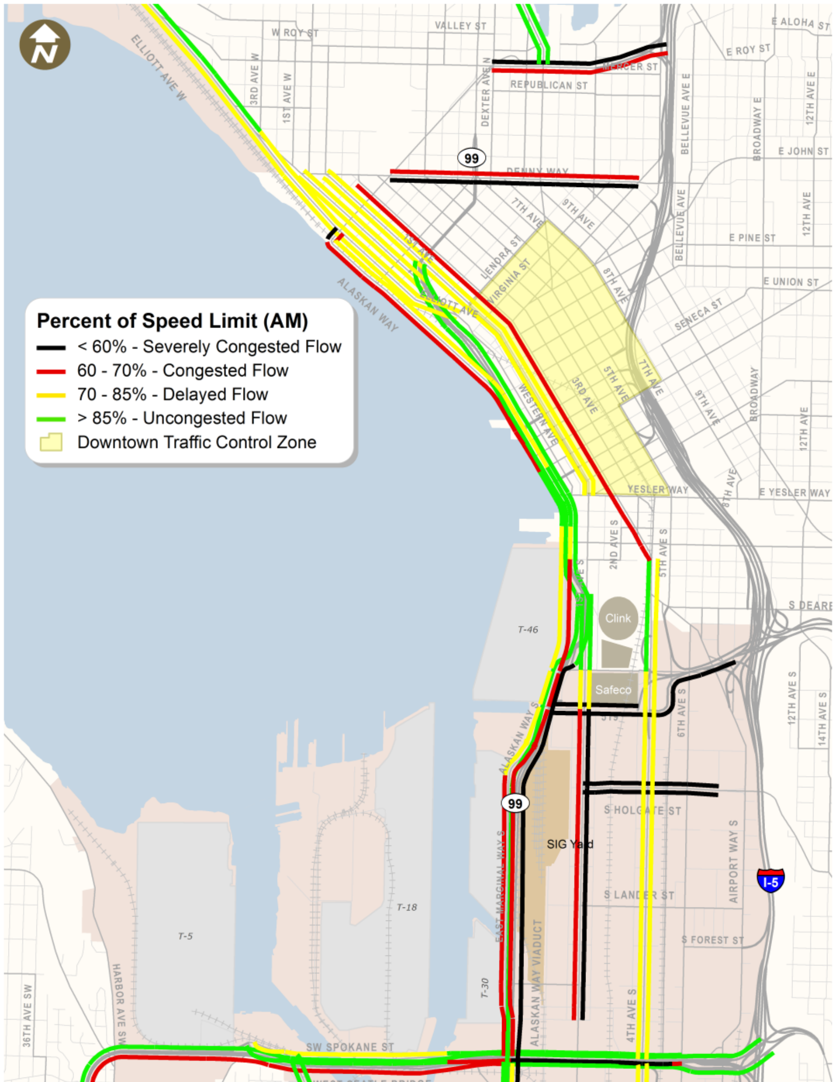


AM Peak: 7:00 – 9:00 AM

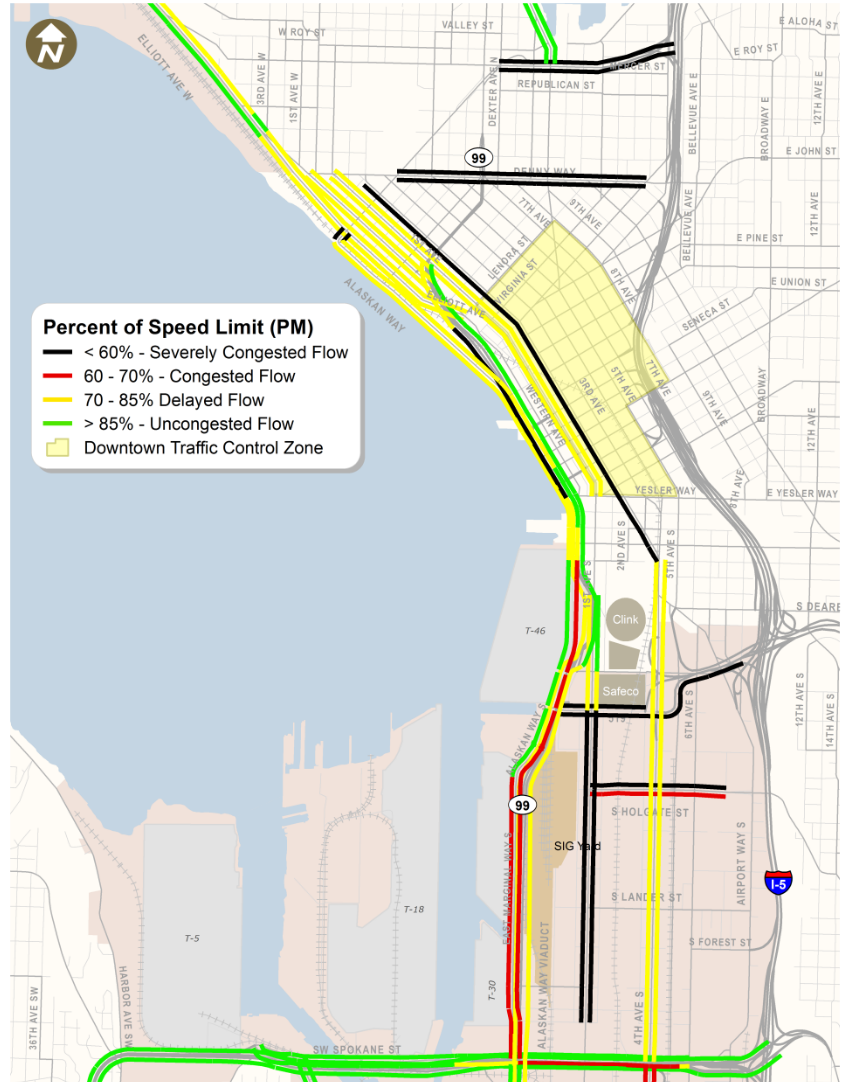


PM Peak: 3:00 – 5:00 PM

Congestion levels – central

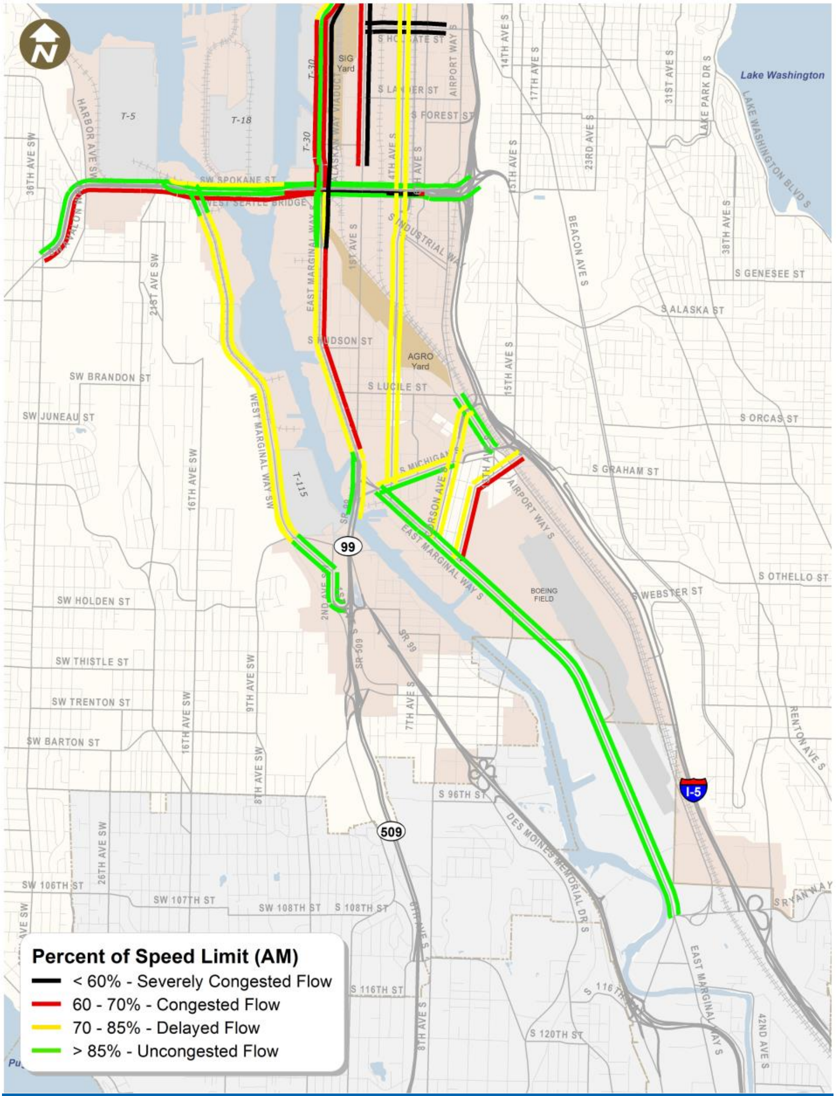


AM Peak: 7:00 – 9:00 AM

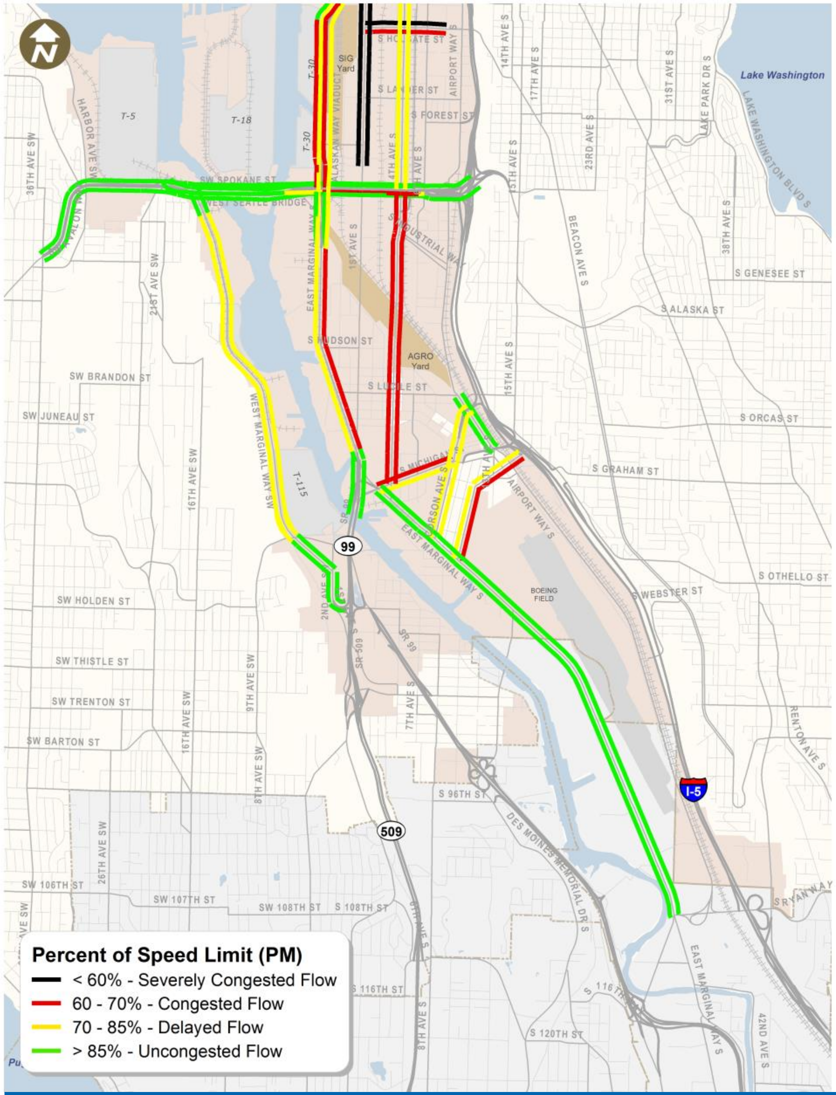


PM Peak: 3:00 – 5:00 PM

Congestion levels– south



AM Peak: 7:00 – 9:00 AM



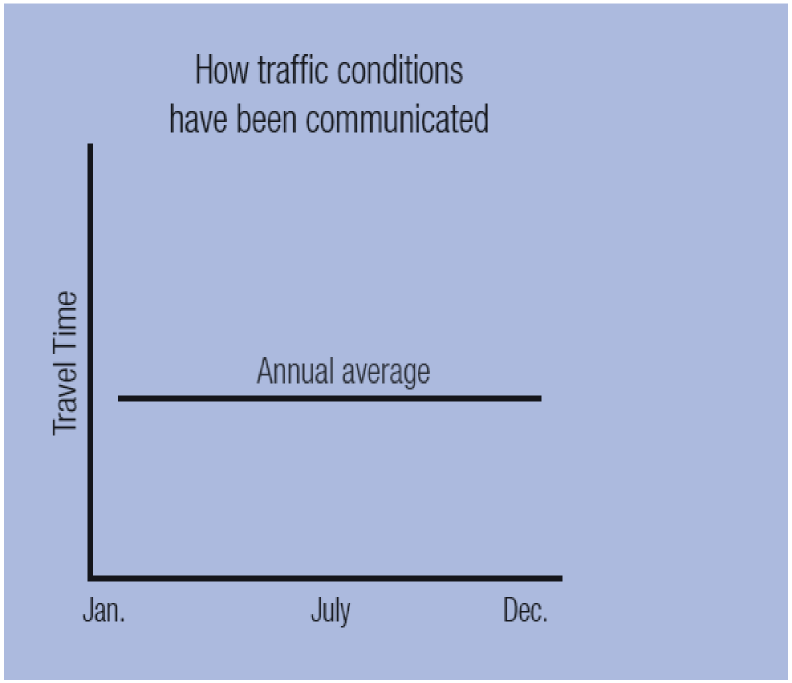
PM Peak: 3:00 – 5:00 PM

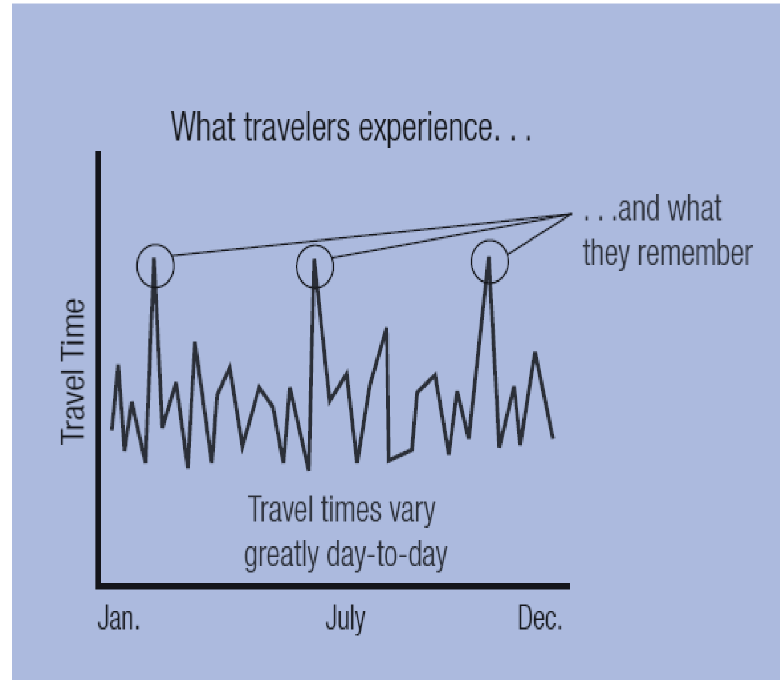
System reliability

What it Measures

- Variability of travel time or delay
- Concept of buffer index

Buffer index





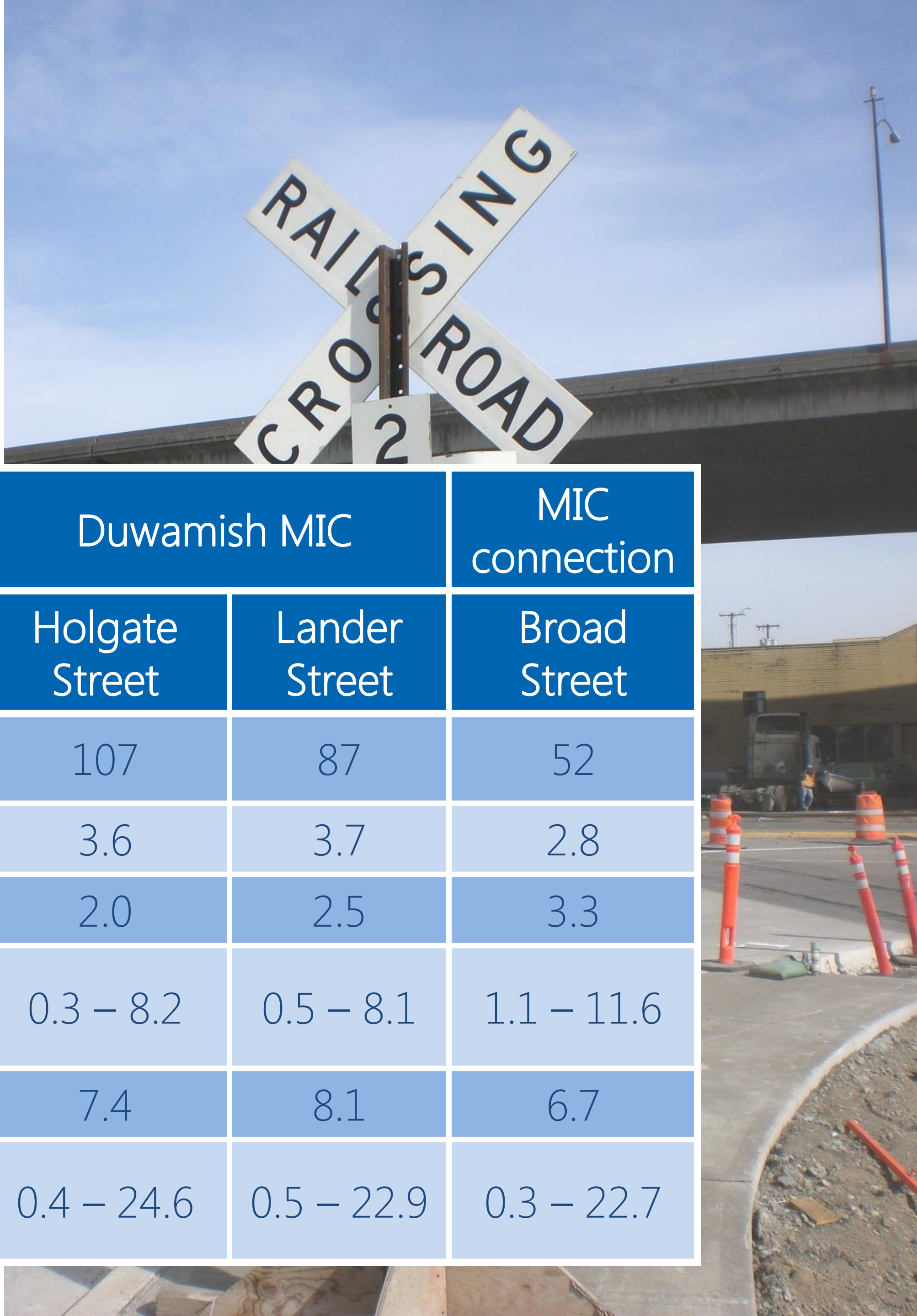
Example

Plan for 40% more travel time ~ or six additional minutes to arrive on-time

$$\text{Buffer Index } (40\%) = \frac{\left(95^{th}\text{-Percentile } (21 \text{ min}) \text{ minus Average } (15 \text{ min})\right)}{\text{Average } (15 \text{ min})}$$

Rail operations

- At-grade rail crossings on mainline in MICs



Average Daily Totals (2012 weekday)	Duwamish MIC		MIC connection
	Holgate Street	Lander Street	Broad Street
Train Crossings	107	87	52
Total Gate Down Time (hours)	3.6	3.7	2.8
Average Gate Down Time (min.)	2.0	2.5	3.3
Minimum/ Maximum Gate Down Time (min.)	0.3 – 8.2	0.5 – 8.1	1.1 – 11.6
Average Train Speed (mph)	7.4	8.1	6.7
Minimum/Maximum Train Speed (mph)	0.4 – 24.6	0.5 – 22.9	0.3 – 22.7

Source: SDOT Coal Train Traffic Impact Study (2012)

Next steps

July	Future Conditions and Needs Identification
September	Improvement Project Identification and Prioritization
October/ November	Preparation of Draft Plan

Questions?

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www.seattle.gov/transportation/freight_industrialareas.htm

http://www.seattle.gov/transportation

SDOT

Seattle Department of Transportation

Industrial Areas Freight Access Project (FAP)

Freight Advisory Board
January 21, 2014

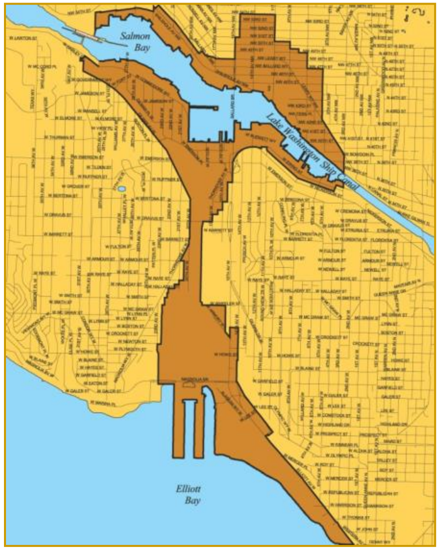
Key Outcomes from Last Meeting

- Identified Challenges/Solutions
  - Street Paving/Construction
  - Traffic Signals
  - Obstructions/Clearances
  - Traffic Operations/Congestion
  - Other Issues
- Stakeholder Outreach
  - Businesses in the MICs
  - Shippers/Carriers
  - Others

PERFORMANCE MEASURES

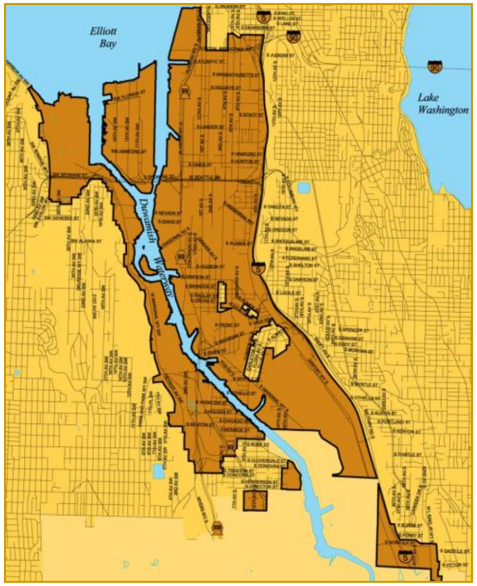
Purpose in Context of the FAP

- Evaluate System Conditions
- Prioritize Projects
- Communicate Results



Items we have Considered

- WSDOT Freight Plan
- MAP-21 Performance Guidance
- Best Practices
- Data Availability / Resources



PERFORMANCE MEASURES

<u>Key Categories</u>

1. System Demand
2. System Efficiency
3. System Reliability
4. Mobility Barriers
5. Safety and Condition

**Performance is based upon a combination of several measures*

1. SYSTEM DEMAND

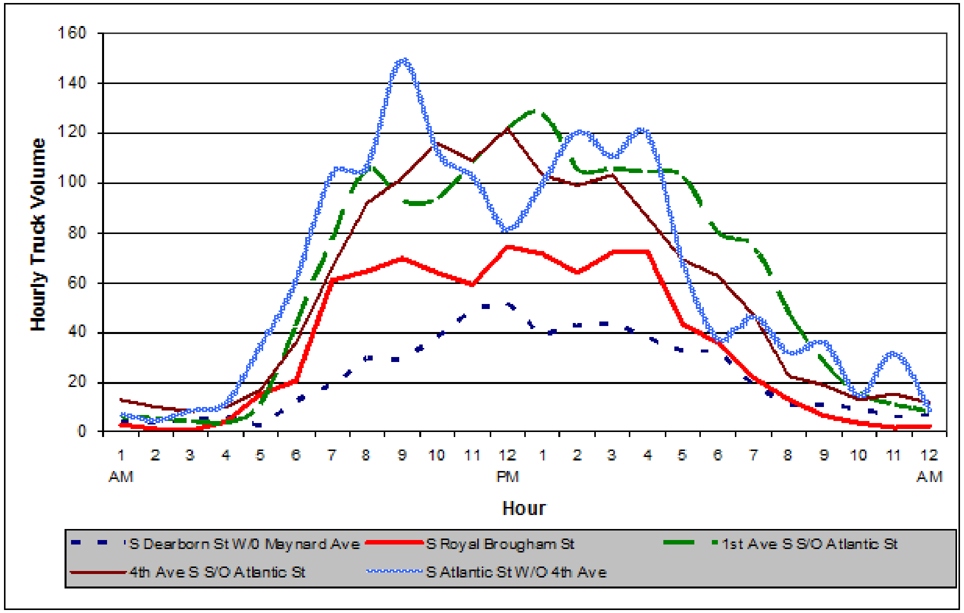
What it Measures

Scale of freight activity along a corridor

Possible Metrics

- Total Traffic Volumes
- Truck Volumes
- Tonnage

  per Corridor



2. SYSTEM EFFICIENCY

What it Measures

Travel times / delays along a network for a defined period

State Route/ Interstate	Route Description	Distance (miles)	Average Travel Time	Current Travel Time	Via HOV (min.)
405	Alderwood to Southcenter	29.40	29	29	N/A
5	Alderwood to Southcenter	27.97	29	28	N/A
5	Arlington to Everett	13.32	13	13	N/A
167	Auburn to Renton	9.76	10	10	10
405	Bellevue to Bothell	9.61	10	10	10
405 5	Bellevue to Everett	26.04	26	26	27

Possible Metrics

- Total Delay by Corridor during Peak Periods*
- Annual Hours of Truck Delay by Corridor

* Prioritized for freight activity

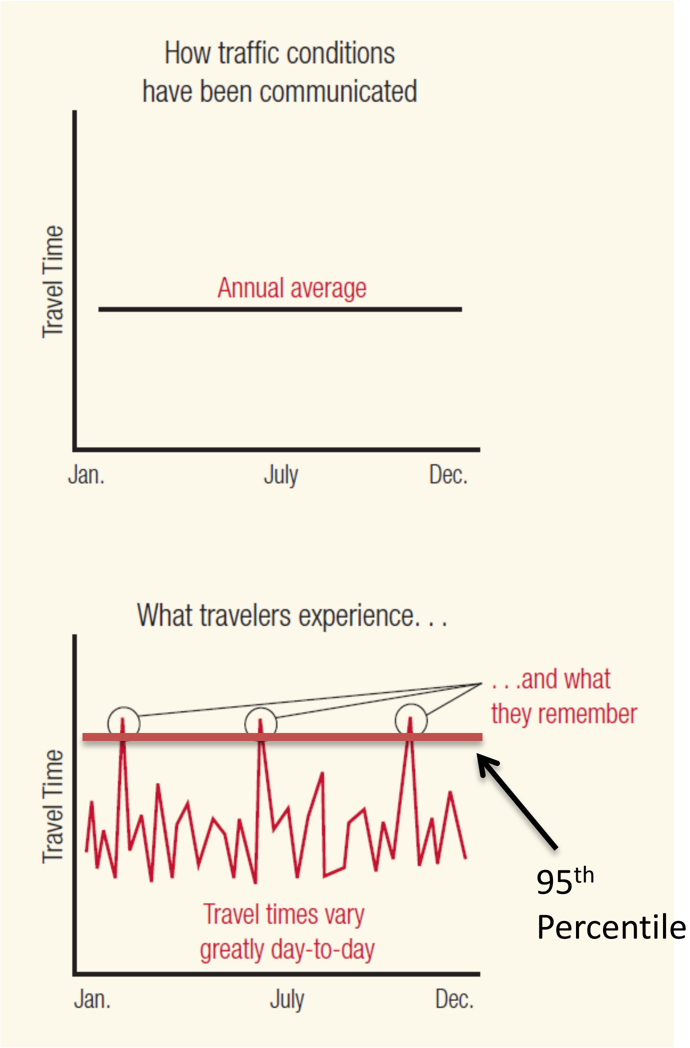
3. SYSTEM RELIABILITY

What it Measures

Variability of travel time or delay

Possible Metrics

- 80th Percentile Travel Time by Corridor
- Buffer Index (95th Percentile) per MIC



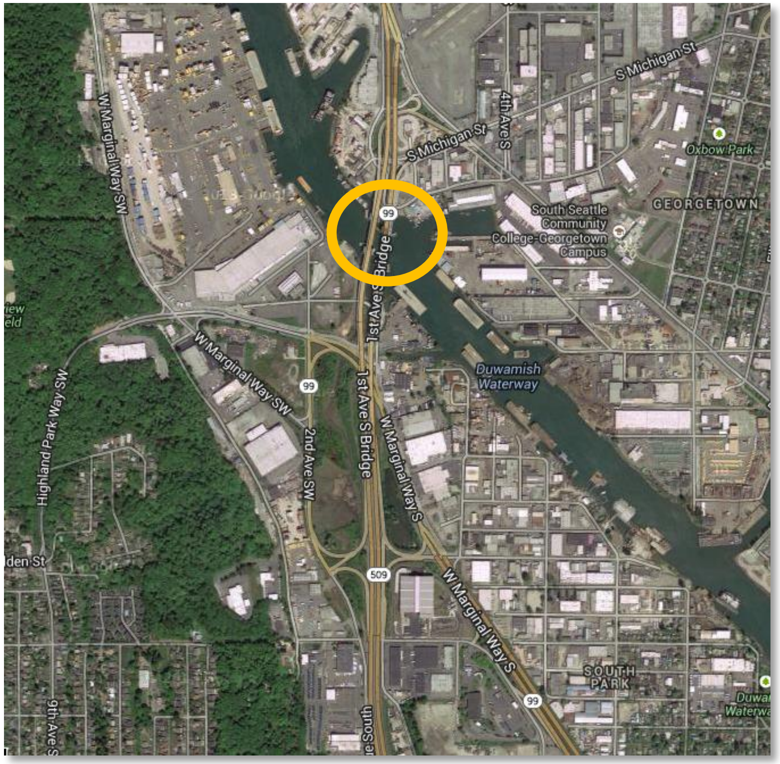
4. MOBILITY BARRIERS

What it Measures

Bottleneck locations or route constraints

Possible Metrics

- Bottlenecks per Corridor
- At-grade Crossings



5. SAFETY AND CONDITION

What it Measures

Collisions and roadway conditions

Possible Metrics

- Freight Collision Rates
- Pavement Conditions
- Potential Modal Conflicts

Questions to Consider

- Do these measures capture how we should be evaluating the health of the transportation system for freight?
- Are these measures relevant to routing decisions?
- What are we missing?

SEATTLE INDUSTRIAL AREAS FREIGHT ACCESS PROJECT

February 2014

SDOT
Seattle Department of Transportation

Credit: Joe Mabel/Wikimedia

What is the Freight Access Project?

The Freight Access Project (FAP) is a partnership between the Seattle Department of Transportation (SDOT) and the Port of Seattle to examine current and future truck freight bottlenecks and problem locations in the Greater Duwamish and Ballard Interbay Northend Manufacturing and Industrial Centers (MICs).

Through the FAP, we will identify a set of cost-effective operational and/or capital improvements to maintain and improve freight access and circulation within and between the MICs. This includes key connections from the MICs to the regional transportation system.

The safe and reliable movement of freight within and through these industrial centers is critical to our local, regional, and state economy. Roughly one-third of regional jobs depend on goods movement. The movement of goods and services is anticipated to grow within the region as the state's population, employment and economic activity grow.

The FAP will result in a set of project and program solutions and an implementation plan to guide future decision making on freight mobility improvements and inform the Seattle Freight Master Plan (currently underway by SDOT in a separate process).

What is the Goal of the Project ?

The goal of the FAP is to identify transportation improvement projects within the project area that will:

- Increase safety for all travel modes
- Maintain and improve freight-truck mobility and access to accommodate expected general traffic, freight, and cargo growth
- Ensure connectivity for major freight intermodal and transload facilities
- Reduce environmental impacts, including greenhouse gas emissions

How will the FAP benefit freight?

SDOT expects to develop a set of prioritized short-, intermediate-, and long-term improvement recommendations to be considered in the Freight Master Plan and the respective agencies' implementation programs.

How are we Coordinating with Stakeholders and the Community?

With members from the manufacturing and trucking industry, the City's Freight Advisory Board (www.seattle.gov/sfab) will serve as the project's sounding board. We will discuss project findings with other boards, commissions, and city departments. We're also interviewing and briefing members of the freight community.

What is the Project Timeline?

The FAP will be completed this fall.

Project Funding

SDOT leads the project, in partnership the Port of Seattle. The FAP is funded by a Federal Highway Administration (FHWA) Surface Transportation Program (STP) grant provided by the Puget Sound Regional Council, and City of Seattle funds .

Want to Learn More?

www.seattle.gov/transportation/freight_industrialareas.htm

To request a project briefing, contact:
Tony Mazzella, Project Manager
206-684-0811
tony.mazzella@seattle.gov

Seattle Freight Advisory Board Meeting Minutes
Date/Time: November 19, 2013 / 9:30 a.m.
Location: Seattle City Hall

Draft

Members Present: Warren Aakervik, Christine Wolf (For Bari Bookout POS), Terry Finn/BNSF, Mike Sheehan, Linda Anderson

Guests Present:

Transpo Consultant team: Bruce Haldors, Jon Pascal, Jeanne Acutanza

City Staff Present:

Tony Mazzella, Ron Borowski, Chris Eaves, Kevin O'Neill, Cristina VanValkenburgh, Sara Zora, Kristen Simpson

1. Welcome and Introductions

Board members, City staff, and other attendees introduced themselves

2. Public Comment - None

3. Approval of minutes

4. Chair's Report and Announcements
There were no announcements.

5. **Industrial Areas Freight Access Project Workshop**

SDOT initiated the Seattle Industrial Areas Freight Access Project this month. SDOT conducted a special interactive workshop for Seattle Freight Advisory Board members to hear their perspectives and recommendations about 1) freight related mobility and access problems and 2) possible solutions within the Freight Access Project study area. There were two sessions, one on freight mobility problems, and the second on solutions. SDOT requested feedback on current and future timeframes. The planning horizon is approximately 20 years.

Staff provided handouts to the audience indicating what feedback staff are looking for from the Board, and guidance on the potential problem categories: traffic operations and congestion, obstruction clearances, signals, paving and other categories.

Data Provided – Maps on Display

- Downtown Seattle Traffic Control Zone – Freight restricted zone where trucks >30' are restricted 6 days a week
- Port Heavy Haul Network map prepared by Port of Seattle

- WSDOT Annual Tonnage map (state ratings by weight) from 2011
- Port Trucks Seaport Map – Intermodal Connectors
- Port Trucks Seaport Map – Highway Connectors
- Major Truck Streets Map
- Industrial Centers: BINMIC and Duwamish MIC Maps
- Greater Downtown Map
- Freight Projects Inventory Map

Highlights of input provided by Freight Advisory Board members:

STREET PAVING

Issues

1. Advance notification prior to paving and construction so trucks are aware of construction
2. Traffic control at construction sites not set for large capacity vehicles, cones through intersections create bottlenecks, especially when left overnight (after 3PM) when the site is closed
3. Provide more concrete, less asphalt needed on arterials
4. Paving projects often become "Lane Reduction" projects. Designers should keep freight in mind when developing complete streets, specifically if street is a major truck street
5. Focus of Principal Arterials should address freight needs especially if they are major truck corridors or provide a last mile (intermodal) access to the Port of Seattle
6. Roadways with rutted/potholed streets in the curb lanes result in trucks straddling the center lanes

Solutions

1. Funding
2. Provide one lane for autos to park and one lane for commercial vehicles
3. Develop flow planning
4. MAP-21 funds for dedicated major truck streets
5. Opening construction sites back up to meet peak demands after 3PM (not so much paving because they do that already)
6. Will last mile numbers be part of the freight study? Find out how much gross domestic product (GDP) is lost to businesses and trucks due to congestion at these points. What is the cost to consumers?
7. Construction traffic control plans to account for large truck movements

TRAFFIC SIGNALS

Issues

1. Optimize traffic signals to flow better for trucks during peak hours, 1st /Atlantic does not have enough clearance for trucks

2. Pedestrians do not obey “Don't Walk” signs creating conflicts for trucks and reducing time for trucks to clear the intersections.
    a. There is a lack of enforcement to jay walkers (mid-block) or walking against “Don’t Walk”
    b. Peds cross rail during events
3. Signals are not responsive to traffic flows (smart signals)
4. Magnolia Bridge Gates flyover signal timing does not fully address demand scenarios

Solutions

1. New funding
2. A truly adaptive signal system in the Elliott/15th Corridor, 1st and Atlantic and other major truck corridors
3. More enforcement of pedestrians and bikes for illegal crossings (jay walking, speeding etc.)
4. More signals for uncontrolled crossings where peds run in front of or impeded trucks
5. Demand responsive signals timed for effective freight traffic flow
6. Truck signal priority and pre-emption in major truck corridors

OBSTRUCTIONS CLEARANCES

Issues

1. Lots of issues with railroad crossing delays at Holgate, Lander, and Broad with no alternatives
2. Buses stopped in lanes (e.g. Ballard) and trucks can't get around. Other obstructions include bulb-outs and other devices that narrow the travel way
3. Consider revising event traffic management plans for before and after events to address freight movements
4. Freeway connections like 1st/Atlantic, north of the ship canal, north of the CBD turns are a challenge
5. Improper lane width for turning trucks slows commercial traffic specifically on East-West arterials leading to I-5 (left-turns are also a problem)
6. When congestion, accidents, or other blockage occurs on I-5 or SR 99, there are no overflow or parallel bypass options for trucks
7. Bridge openings should be managed better. Boats have been observed requesting bridge openings even if they fit under the bridge. Can bridge openings be limited to specific times of the day?
8. There is substantial congestion on I-5 South of the CBD making it hard to get into the SODO
9. Narrow lanes on arterials including left turn lane
10. Difficulty making turns for super chassis at intersections like 6th/Spokane and 1st/Spokane
11. Pedestrians cross the railroad tracks unprotected during sport/other events

Solutions

1. Real time information about obstructions and getting information to operators
2. More grade separations

3. Provide U-turns at railroad crossings including pulling back stop bars to provide clearance and open adjacent driveways (Example school district driveway near Holgate)
4. Update stadium area event TMP to reflect or consider freight and specifically work with (SDOT and SPD) at East-West grade separations in the Duwamish
5. Provide priority for freight at ramp meters
6. Improve boater information like heights that justify bridge openings or use laser height detection to reduce boats opening bridges unnecessarily
7. Improve I-5 ramps on Industrial Way for freight and transit
8. Re-evaluate maintenance at problem spots
9. Design treatment at intersections for turning movements of trucks

TRAFFIC OPERATIONS CONGESTION

Issues

1. Waterfront function including SODO interference, terminal rail junction, etc.,
2. Ferry on-street queue blocking issues at Pier 51 (Colman Dock). Does waterfront design accomplish solution for access, freight and business vitality now, during the interim period while the tunnel is being constructed and after tunnel opens, with tolling
3. Management of loading zones citywide. Are loading zones and parking for non-zoned vehicles working effectively?
4. Bridges take extremely long (12-20 minutes) to open and close (examples Lower West Seattle, Ballard, and 1st Avenue) could the open/closing times be sped up? Are protocols for bridge openings and closures consistent? Must consider maritime rules and Federal Waterways.
5. Major truck streets should not be compromised to other modes (in-line BRT, consider opening BAT lanes to trucks). Truck streets should be a priority for trucks. (e.g. 1st/Elliott)
6. Need alternative routes and bypass for trucks during emergency conditions or congestion on key truck routes (I-5, SR 99)
7. Consider opening lanes for trucks as a bypass when major truck streets congested (e.g. Ballard)
8. Central waterfront number of lanes on Alaskan Way may not be adequate either in number of lanes or overall width
9. Elliott/15th corridor is impacted by BAT lane and potentially will impact future traffic
10. 1st Atlantic's and future congestion will be compounded by potential vacation of "safety valve" Occidental Avenue
11. Game day traffic impacts trucks

Solutions

1. Installation of adaptive traffic signals, for example along Elliott/15th corridor
2. Grade-separations
3. Allow trucks to use transit lanes or create dedicated truck lanes
4. Create a dedicated Truck Way, east-west at Terminal 7
5. Work with SPD on traffic truck flows during (before and after) events so they know not to close off necessary streets
6. More enforcement of load zones and bus zones. Provide more parking load zones

7. Define a complete major truck street. What does a truck street look like?
   Not promised to maximize freight, but rather how not to compromise too badly for economic purposes

OTHER

Issues

1. Transit service reductions may increase total vehicles
2. Bicycles on arterials including truck routes and in turn lanes
3. On -street loading areas are not available.
4. Potentially use in-street lanes like two way left turn lanes
5. Keep off-arterial circulation open for truck loading areas (keep these)
6. Narrow lanes allow trucks to take two lanes
7. On-street parking results in conflicts and reduced capacity for trucks
8. Planning for bus and freight weights on streets from 18,000 to ____ gross vehicle weights (GVW). State guidance increases from over 80K to over 100K as legal. This issue will be discussed in the near future.
9. Federal laws that contribute to congestion or impact freight for example required rests after hours of service
10. Bicycles ignoring traffic laws without consequences
11. Safety
12. Create a circulation and access during next decade of construction including a freight route through CBD
13. Not enough information for truckers on where they can go or how to get to open (and clear terminals using cameras)
14. Wayfinding needed for trucks to state and interstate systems
15. Need on-board cameras and traffic timing systems
16. Need real-time traffic info for trucks that is a voice-based to avoid distraction
17. Confirm that there is a viable waterfront design match solutions
18. During or after I 90 and SR 99 tolling, how to deal with diversions
19. Bridge openings create congestion for trucks.
20. truck parking overnight and early morning

Solutions

1. Freight Advisory Board could write a letter to the legislature regarding the importance of transit funding as a way to reduce congestion and the freight
2. Better enforcement of traffic laws for bikes including possible licensing with revenue going to SDOT and Metro
3. City support to make deliveries with freight
4. Mitigation for tolling I 90 and SR 99
5. Use of Metro layovers (peak period layovers) for trucks instead of allowing on-street car parking
6. Improve reliability
7. Complete major truck streets plan and design standards

8. Optimize freight without compromising other modes