Seattle Department of Transportation

STAKEHOLDER OUTREACH APPENDIX A

WSP | PARSONS BRINCKERHOFF

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INTRODUCTION AND BACKGROUND

The Freight Master Plan (FMP) will address the unique characteristics, needs, and impacts of goods movement in the City of Seattle. The FMP will primarily focus on urban truck freight and will outline the critical role that freight movement has on meeting the plan's goals.

Understanding the key issues, needs and concerns of the freight community and residents is critical to creating a successful plan. This includes the creation of a project advisory committee and three phases of public outreach and engagement. The first phase engaged freight stakeholders and the second two phases focused on both the residents and freight stakeholders. This summary focuses on the first phase of outreach.

Our engagement efforts began by engaging stakeholders to learn more about their freight needs and issues throughout the city. In addition, we met with representatives from the Duwamish Manufacturing/Industrial Center (MIC), the Ballard-Interbay-Northend Manufacturing/Industrial Center (BINMIC), and a third group focused on Downtown delivery needs. The interviews were used to collect feedback on the needs and concerns of freight-dependent businesses and solicit ideas on how freight mobility might be improved in Seattle.

To collect additional feedback, SDOT developed an online survey. The survey was distributed to those who participated in the initial stakeholder meetings, as well as several groups and organizations listed later in the Appendix. The target audience for the survey was primarily businesses that rely on urban good movement to deliver products and services in Seattle.

HOW STAKEHOLDER OUTREACH INFORMED THE FMP

Feedback received through the stakeholder interviews and online survey was incorporated into the development of the Freight Master Plan. It helped inform the existing conditions report, particularly the gaps and needs, as well as the identification of projects, strategies, and actions. Suggestions we received from stakeholders, like topics for the FMP infographic, were used for outreach and engagement efforts.

STAKEHOLDER INTERVIEW SUMMARY

Stakeholder interview participants were identified by SDOT staff and were intended to be representative of a variety of industries and freight uses. Stakeholders include business owners, truck drivers, and operations managers of businesses that depend on efficient goods movement within and throughout Seattle. Individual interviews were conducted with the organizations/businesses shown in Table 1.

In addition to individual stakeholder interviews, SDOT met with representatives from the Duwamish MIC (Group 1), the BINMIC (Group 2), and Downtown (Group 3). The groups were asked many of the same questions as those asked during the individual stakeholder interviews. The organizations and businesses that participated in the group interviews are included in Tables 2, 3, and 4. The Manufacturing Industrial Council hosted the Group 1 interview on July 28, 2014, the North Seattle Industrial Association hosted the Group 2 interview on July 29, 2014, and the SDOT hosted the Group 3 interview on September 25, 2014.

TABLE 1: INDIVIDUAL INTERVIEW STAKEHOLDERS

Organization/Business	
Amtrak	Pacific Fishermen Shipyard
Boyer Towing	Pacific Merchant Shipping Association
CSR Marine	Peddler Brewing
Darigold	Salish Sea Trading Cooperative
Dunn Lumber	Seattle Public Schools
Franz Bakery	Skagit Transportation
Fremont Brewing	King County Wastewater Treatment Division
Georgetown Brewing Company	Marel
King County International Airport	Total Terminals
MacMillan Piper	Trident Seafood
Martin Family Orchards	Turner Construction
Merlino Foods	UW Consolidated Laundry
Nelson Trucking	VanDyke
Ocean Beauty	Vigor Shipyards

TABLE 2: GROUP 1 INTERVIEW: DUWAMISH MIC STAKEHOLDERS

Organization/Business	
Amtrak	Manufacturing Industrial Council
Ballard Oil	Nucor Steel
BNSF consultant	Port of Seattle
Boyer Towing	Seattle Mariners
Charlie's Produce	Seattle Public Schools
City of Tukwila	WSDOT

TABLE 3: GROUP 2 INTERVIEW: BINMIC STAKEHOLDERS

Organization/Business	
Ballard Oil	Consultant to Block Builders
Ballard Partnership Urban Design Transportation Team	North Seattle Industrial Association
Coastal Transportation	Port of Seattle

TABLE 4: GROUP 3 INTERVIEW: DOWNTOWN STAKEHOLDERS

Organization/Business	
Charlie's Produce	Quality Custom Distribution
Larson Automotive Group	Seattle Caviar
Macrina Bakery	Western Peterbilt
Pagliacci Pizza	

The feedback we received was recorded and summarized by the project team and key discussion themes are captured below.

INTERVIEW METHODOLOGY

Interviews were conducted by SDOT and consultant staff. Following a brief overview of the purpose and goals of the FMP process, interviewers asked participants for their feedback on a variety of topics and questions, ranging from how businesses cope with traffic congestion to what larger-scale economic trends are affecting goods movement in Seattle. All formal interviews were completed between July and October 2014. Additional informal interviews were conducted throughout the FMP development as opportunities arose.

INTERVIEW QUESTIONS

A standard set of interview questions were developed based on identified key issues and project information needs. Each interview started out by gathering information about the organization. We then asked questions grouped into the following 7 topics:

- Safety
- Reliability
- Efficiency
- Resiliency
- Economic vibrancy
- Environment
- How to tell the goods movement story, and how to share information

General themes for the questions included:

- Key issues that should be addressed by the FMP
- Future vision of freight transport in Seattle
- Ideas for informing and engaging the public in conversation

A full list of stakeholder interview questions can be found at the end of the Appendix.

MAJOR THEMES

Over 50 different organizations were interviewed. Major themes that emerged through the stakeholder interviews included:

- Traffic congestion is consistently cited as the number one challenge affecting interviewees' businesses.
- Freight businesses would move deliveries to off-peak hours if they could, but there are a variety of reasons that prevent them from doing so, including: maintaining staff who will work graveyard shifts, customer needs, customer facilities are not open off-hours, increased costs, and night time noise ordinances.

- There is a general desire among interviewees for dedicated freight corridors.
- Conflicts with other modes of traffic (especially bicyclists and pedestrians) are generally cited as the top safety concern relating to freight mobility.
- Interviewees largely feel that the importance of their respective industries to the local economy is too often overlooked by the City.
- The lack of parking and loading zones for deliveries, especially in the downtown area, is consistently cited as a major concern for safety, reliability, and efficiency of goods movement.
- Finding and maintaining well qualified employees is cited often as one of the major challenges affecting freight dependent industries in the city, especially for industries where an aging workforce is a concern.
- Many interviewees thought that how to get the city and its people to understand the importance of goods movement was a key question and important aspect to think about, but not everyone could answer the question. Marketing or public education about role that freight mobility contributions to the economy was generally some of the ideas.

RESPONSES TO KEY QUESTIONS

The stakeholder interviews provided insight into key concerns stakeholders have about urban freight mobility and how they envision freight transport in the future. Key themes of feedback received by topic area are listed below.

Safety

- Participants routinely cited conflicts with other modes of traffic, particularly other motorists, pedestrians and bicyclists, as the biggest safety concern affecting their industry. Interviewees would prefer separation of modes, especially regarding bicyclists, which does not prohibit roadway capacity and controlled pedestrian crossings.
- Many participants cite the need for better wayfinding signage for getting to and from the interstate system.
- Line of sight is an issue for larger trucks and could be alleviated in part by better trimming of overhead vegetation.
- Breweries are especially concerned with the quality of pavement on major arterials (shakes up their beer).
- Vehicles parking too close to driveways or intersections are a concern for neighborhood deliveries or secondary routes that smaller trucks use.
- Route-finding difficulties, especially during peak congestion hours, are compounded by construction related closures and unreliable sources of information about their impacts.
- Many participants suggested more education of general purpose drivers, pedestrians and bicyclists regarding the rules of the road and interaction with other modes of traffic, particularly trucks.

Reliability

- Participants generally stated that all truck operations are heavily influenced by traffic congestion and the lack of alternative truck routes.
- Drivers do their best to avoid morning (7am-9am) and afternoon peak hours (3pm-6pm). Larger and noisier trucks are prevented from making deliveries in off hours due to the night time noise ordinance.
- Businesses, especially near SODO and the Port, are particularly sensitive to sporting events at the stadiums. Incoming and outgoing deliveries all revolve around game times on those days.
- Drivers largely rely on their own knowledge for route finding, however GPS, Google Maps, and traffic cameras are routinely cited as useful tools.

- A few participants suggested creating one website that consolidates all traffic conditions and impacts. Real time traffic analytics was suggested as an idea for improving congestion and reliability issues for freight mobility.
- Bascule bridge openings and railroad crossing closures impact schedules and just-in-time delivery.

Efficiency

- Similar to other categories, congestion is cited as the biggest factor affecting the efficiency of freight mobility.
- Many participants cite the lack of loading zones and other curbside spaces as a major challenge for urban goods delivery. Drivers often circle the block looking for spaces to unload.
- Participants routinely cited that vehicle lanes are being taken away for bike lanes, which to them indicates that the City doesn't prioritize freight in urban planning.
- Unreliable information about construction impacts makes way finding and route planning difficult, especially for out-of-town drivers.
- Day games in the SODO neighborhood are a challenge for efficient freight mobility.
- Smaller trucks are being used for deliveries to neighborhood commercial land uses as well as residential delivery for greater maneuverability and tighter turning radii.
- Changing delivery logistics by using distributors for full truck loads rather than individual businesses delivering less than truckloads.

Resiliency

- Most participants stressed the need for more designated freight routes, especially north-south routes, and preservation of existing routes.
- Some participants expressed a desire for state and local authorities to have on-site response teams citing the excessive length of time it takes to clear or investigate an accident, especially on the highway system.
- When primary routes are congested in urban areas and the driver is able to detour to alternate routes, traffic circles and illegal parking (parking too close to an intersection) are often cited as a concern.
- A few businesses have had success in using smaller, more efficient, and more agile trucks to make urban deliveries. It was suggested to remove large trucks from the city altogether by having them deliver to node points outside the city then have smaller trucks make the urban deliveries.
- It is becoming increasingly hard to find young drivers as the older generation retires.
- As businesses try to shift delivery times to off-peak hours due to traffic congestion, it becomes harder to find good drivers to work those off hours as well as receiving businesses to have staff to intake the delivery.

Economic Vibrancy

- An aging workforce was cited as one of the major concerns for the future economic vibrancy of the industry.
- Many participants cited concerns about the $15 minimum wage affecting their retention of staff. Many others stated that all of their employees are paid better than $15/hour, so that would not affect their business.
- Some concern about the City's sick leave and having the correct number of employees present each day to conduct business.
- Participants that represented smaller businesses generally stated that they felt Seattle was not small business friendly given the tax structure and are concerned about their future in the City.
- Most cited the strong economy and demand for goods and services as the major driver of their industry. As long as Seattle is attracting more people, there will be a demand for goods, and deliveries will be made regardless of congestion.

- Land use changes are a concern for freight industries, especially those that take away industrial zoned parcels.
- Some participants cited concern about noise complaints from housing adjacent to industrial areas or that may prohibit overnight deliveries, thus operations have to occur during the day.

Environment

- Idling, primarily due to congestion, was cited by participants as the area that could be most improved upon.
- Participants suggested that anything that can be done to reduce idling would reduce emissions (roundabouts instead of stop signs/lights, higher clearances in key nodes for more direct routes, better signal timing, signage, real time traffic signs,etc.)
- Many businesses have instituted their own policies to reduce their environmental footprint due to customer demand.
- Switching to smaller or more efficient vehicles/fuel is a common practice taken by businesses. Cost is a driver that has prevented some conversion or purchase of newer, more efficient vehicles.
- Product stewardship, buying locally, and recycling waste products are large components of many businesses sustainable goals.
- Some businesses have upgraded either their building functions to promote better environmentalism or increased efficiencies by use of equipment technological advances.

Telling the story/Public participation process

- Some interviewees had similar suggestions about keeping the message simple and make it personal by focusing on the consumer and the everyday daily needs people that rely on goods and products. Education is an important aspect of the messaging and could use short multi-media video clips to help the public understand why the movement of goods impacts their life.
- "If you bought it, diesel brought it." Trucking is the backbone of America.
- "If you don't like trucks, don't buy shit"
- Although only three interviews asked participants about how best to communicate with businesses and the public, all stated that they would like to stay involved in the FMP process in some capacity. Those same three participants all identified email as the best way to keep them and the public informed. Other suggestions to keep the public informed included informational YouTube videos, billboards, postcards, and social media.

SURVEY SUMMARY

The survey asked a mix of multiple choice and narrative response questions ranging from how businesses cope with traffic congestion to what larger scale economic trends are affecting freight mobility in Seattle. The survey was live on the web between August 1, 2014, and September 21, 2014.

The survey was distributed to the constituents listed in Table 5 by email and in person at the stakeholder meetings, the survey was also posted to SDOT's website, and stakeholders were invited to share the survey with their contact lists as well. The survey received 60 total responses.

TABLE 5: SURVEY DISTRIBUTION

Organization	
Participants in SDOT's Commercial Vehicle Load Zone process	Port of Seattle truckers listserv Washington Trucking Association
Seattle Freight Advisory Board (FAB) listserv	Seattle Office of Economic Development (OED) and OED commissions
Major truck street listserv	Greater Seattle Chamber of Commerce's
Port of Seattle	Puget Sound Regional Council (PSRC) Freight Mobility Roundtable

MAJOR THEMES

Key overall themes that emerged included:

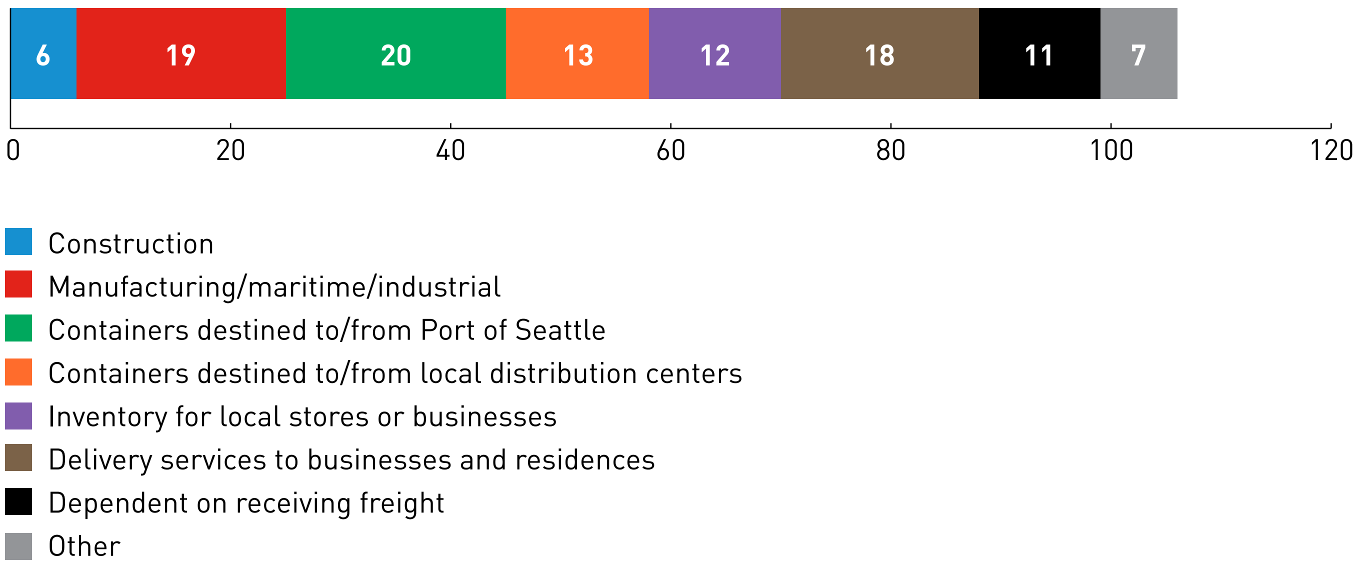
- Congestion is cited as the number one challenge affecting urban goods delivery in the city.
- Business operations schedule are bound to customers' needs and there is often not flexibility to adjust deliveries to off-peak hours.
- Conflicts with other modes of traffic (predominantly bicycle traffic) and turning movements/curb radius are cited by over 50% of respondents as being the top safety concerns relating to freight mobility.
- Although the City's Major Truck Street Network is sometimes used by two thirds of respondents, almost 40% did not know the designations existed.
- Google maps is the most used resource for determining alternate routes, but City and state traffic cams are also valuable.

There is an underlying feeling among some that the City is not giving freight traffic priority and that conditions are getting worse. However, others believe that the challenges facing urban freight movements are simply products of a strong economy and good business.

SURVEY RESPONSES

Q1: What type of freight does your business handle?

The top three types of freight handled by survey respondents included containers destined to or from the Port of Seattle; freight related to the manufacturing/maritime sector, and containers destined to or from local distribution centers. It is important to note that respondents were free to select multiple types of freight.



Q2: Have your business operations changed based on congestion at certain times of day? How? Would it be possible to promote delivery to occur during off-peak hours?

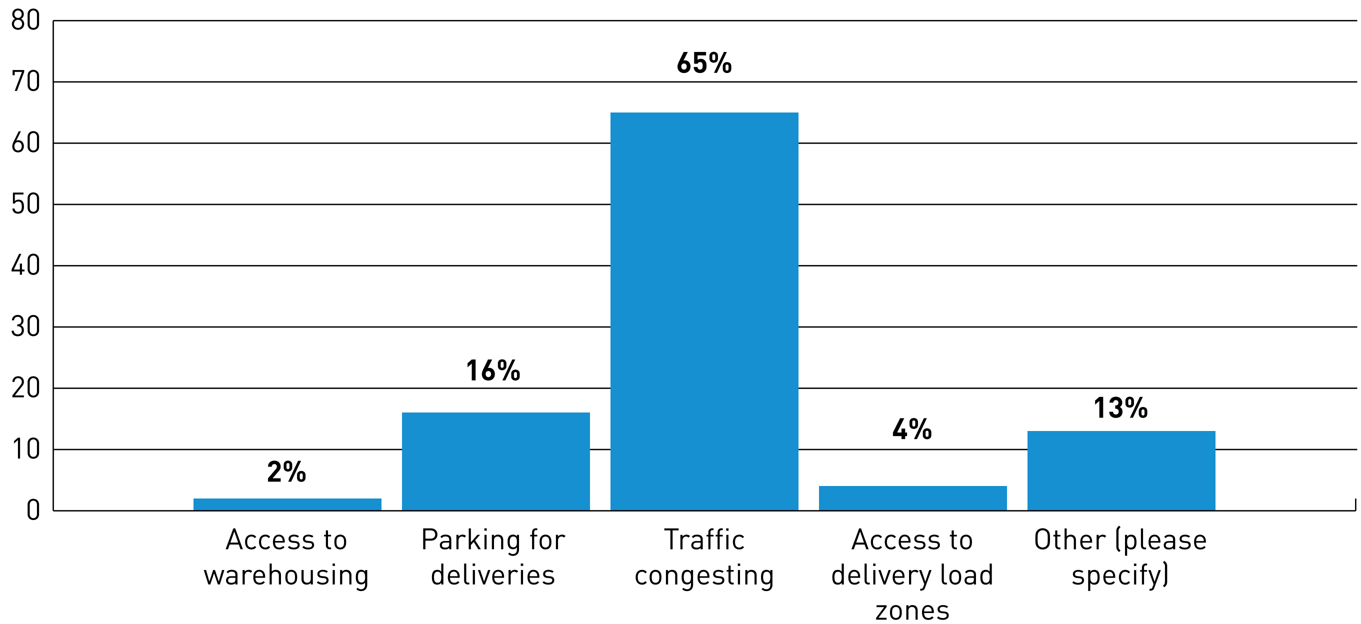
Overall: Businesses try to adjust their operations based on congestion, but options are limited. Schedules revolve around client needs for outgoing deliveries or shipping times for incoming deliveries and cannot always be adjusted.

Sample responses

- "Moved to night shift for maintenance crews, increased carpool slots, instituted compressed work week, reduced number of meetings at John Stanford Center for Educational Excellence (JSCEE)
- "Yes, particularly with freeway closures/ bridge closures close to aircraft departure times like the recent presidential and vice-presidential visits. Delivery at off-peak hours is not likely due to huge additional cost of labor work force needed to implement."
- "Yes, delivery times can take twice as long. It is not possible to perform deliveries in off-peak hours due to the requirements of the Union and legal amount of hours a driver is allowed."
- "The adjustment of freight delivery times to businesses should be considered. Also, tax and other incentives to businesses who utilize off-peak hours for receiving deliveries is one idea for relieving congestion."

Q3: What is the biggest challenge for urban goods delivery in the city?

Responses indicated that traffic congestion is seen as the biggest challenge for urban goods delivery in the city with nearly 2/3 of respondents citing this issue. The second most cited challenge was parking for deliveries; cited by 16% of respondents. Of the 13% (seven respondents) who responded with "other", three cited conflicts with bicyclists as the biggest challenge.



Q4: What is one thing the City can do to help your business move goods more efficiently and reliably?

Overall: Respondents gave a mix of answers, mostly relevant to their respective location. Bike lanes and conflicts with other modes of traffic, prioritizing ingress/egress from the Port of Seattle, and load zone issues such as adding new load zones and maintaining access to current ones were all mentioned. Other secondary responses included: improving signalization, petitioning congress/USCG to change their rules for Ballard bridge openings, and reducing congestion overall

Sample responses

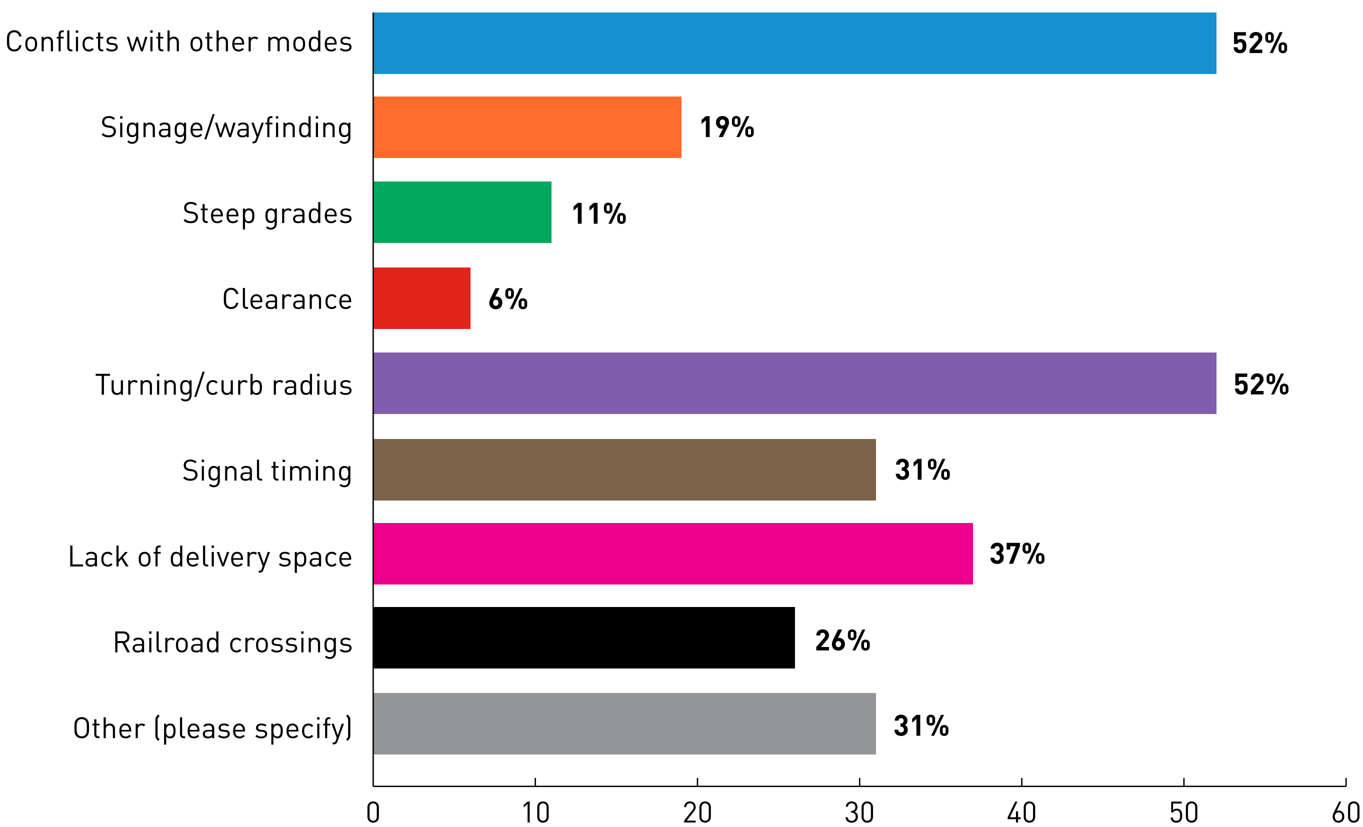
- "If the city simply petitioned Congress/U.S. Coast Guard to rewrite the Ballard Bridge rules to limit openings to certain times of the day for non-commercial water traffic the traffic in North Seattle would be much better."
- "Move other small movement vehicles to parallel streets when possible - presume all arterials are needed to move trucks."
- "Get Unions of longshoremen to not act like organized crime syndicates, truckers are not paid by the hour like them. City can get Port workers and their protective unions [to] work in much more efficient manner so that truckers they work with do not have to suffer and pay with their income. Port

longshoremen and workers are the single most difficult causes of traffic congestion that directly impact truckers."

- "Quit taking lanes away from vehicles on main thorough fares. Bike lanes & bus only lanes have done nothing but make Seattle one of the worst cities in the United States for traffic congestion. By reducing the amount of lanes, SDOT is doubling the amount of emissions (CO) produced by gasoline autos that idle for hours in their daily commute."
- "Bridging additional crossings in SoDo would be a big improvement. The more grade separations between rail and other surface traffic, the better. Also, ingress/ egress to the Port of Seattle is critical. SDOT must continue to work with WSDOT and other stakeholders on improving freight mobility to/from the Port of Seattle."

Q5: What are the top three safety concerns you see relating to freight mobility?

Over 50% of respondents cited turning movements/curb radius and conflicts with other modes as a top safety concern. Although not cited as a major challenge for urban goods delivery, lack of delivery space was cited by almost 40% of respondents as a top safety-related concern. Nearly one third of respondents cited railroad crossings, signal timing, and lack of delivery space as top safety concerns. Of the 31% that cited "other" issues as top safety concerns, conflicts with bicycles/inadequate separation of bicycles and freight traffic and unrestricted openings of the Ballard Bridge were dominant themes.



Q6: What are major choke points (specific locations or neighborhoods) in Seattle, from your perspective?

Overall: Major choke points cited included anywhere where there is narrowing of the road, such as Ballard Bridge/Nickerson Street, Mercer Street, I-5 through downtown, SR99 approaching downtown (either direction). Various corridors where there are multiple modes of traffic such as the Mercer Corridor and 1st-5th Avenues downtown were also cited as choke points.

Sample responses

- Anywhere road narrowing and addition of different modes of transportation are added (i.e. bike lanes, trolley lanes, restricted lanes (especially no flammable materials allowed in the new tunnel); I-5 NB off of 90; sites of perpetual construction such as Mercer, HWY 99; bridges that open, toll bridges, Elliott, Nickerson
- Ballard Bridge (multiple responses)
- Ingress/Egress points to freeways
- Mercer corridor, particularly eastbound since the change to two-way; Denny and Dexter, Stewart, and Fairview.
- SR 99 (multiple responses)

Q7: How do the choke points affect your route planning?

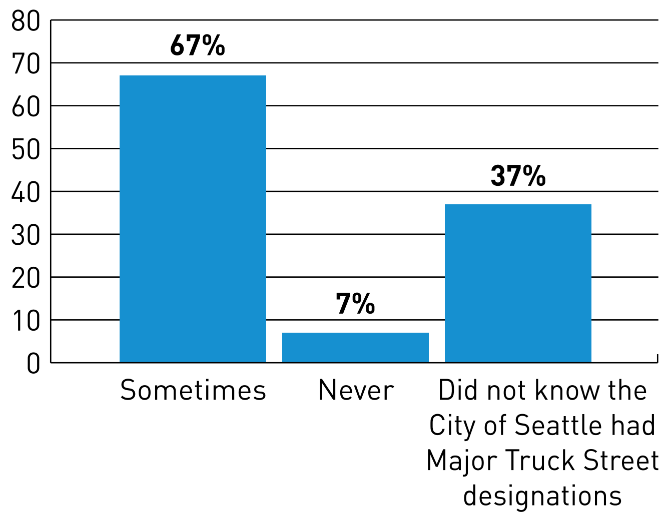
Overall: Since the choke points are known to most businesses, drivers indicated that they either allow more time to make deliveries or to try and take alternate routes. If possible, businesses will plan to operate in off-peak times.

Sample responses

- "We mostly just allow more time and try to avoid rush hour."
- "Can have a major impact with regards to making deadlines and cutoffs for marine terminals and steamship lines. Many drivers will avoid these areas especially at the end of the day where they could get stuck in traffic."
- Alternate routes (multiple responses)

Q8: Do you move goods via the City's Major Truck Street designated streets?

Two-thirds of respondents indicated that they sometimes use the City's Major Truck Streets. However, as 37% were not aware that designated Major Truck Streets existed, some respondents only discovered through taking the survey that they were already using them.



Q9: If you answered "sometimes" or "never" in response to Question 8, what are the primary routes / streets you use to move freight?

Overall: Respondents cited streets that are already designated as Major Truck Streets.

Sample responses

- Mercer, Elliott, Nickerson, Alaskan Way, Westlake, Marginal Way, SR 99, I-5
- "Every day going south I use 15th Ave to Elliot Ave to Viaduct to Harbor Island. Coming back northbound I go 99 to the western off ramp up Western to Elliot back to 15th and Leary back to the yard."

Q10: If the primary route is unavailable, how do you determine which secondary routes to take to deliver goods?

Overall: Most respondents indicated that they use Google maps or left it up to the driver to determine which secondary route to take. Three respondents stated that for certain routes, there are no secondary routes available.

Sample responses

- Google
- Trial and error
- Driver knowledge
- "We don't have the luxury of 'secondary routes'."
- "Secondary routes are not a viable option on the 15th Ave W corridor."
- Talk radio traffic reports

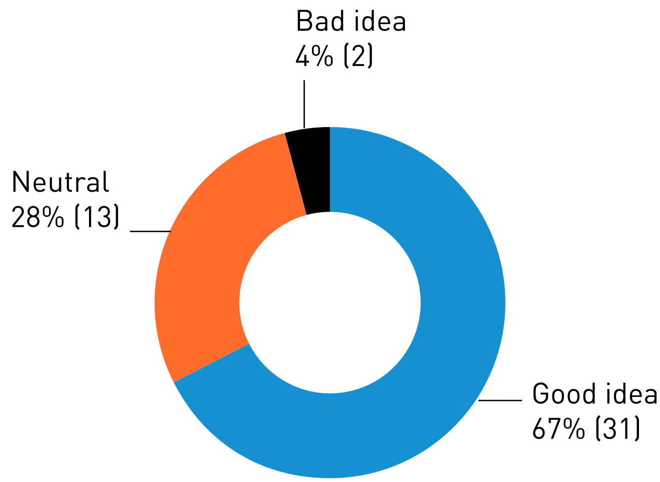
Q11: What tools do your dispatchers and drivers use to predict travel times, find alternate routes, and get directions?

Overall: Drivers and dispatchers use a mix of tools for getting directions and predicting travel times including: Google Maps, city and state DOT traffic cameras, and GPS. Often it is left up to the driver and their knowledge of streets to find alternate routes.

Sample responses

- Google Maps/Mobile apps
- "WSDOT traffic website, SDOT traffic website, and telephone calls to colleagues in tall buildings with views out their windows."
- "Have access to terminal websites and can gauge what types of backups and congestion for each. Use SDOT's website as well."
- "Railroad calls trucking companies and coordinates times for delivering containers from Waterfront to rail yards. Intelligent Traffic Signs helpful."
- Anecdotal/local knowledge

Q12: What do you think about truck drivers using Business Access and Transit (BAT) lanes during the time that buses use them with the acknowledgement that buses have priority?



Q13: What economic trends do you see affecting your industry / business?

Overall: Although there was no single definite trend, there seems to be an underlying feeling of resentment due to a perception that the City is not giving freight traffic priority and that congestion is becoming worse. However, other respondents commented that the larger economic trends that are affecting urban freight movement, both positive and negative, are simply the product of a strong economy which in turn means increased demand for deliveries of goods and services.

Sample responses

- "Seattle is not business friendly. Our trucks and customers can't move without delays, parking is slowly becoming extinct and what there is of it is costly, there are taxes on everything that add up to gutting small business' bottom line, and now the City wants to tell us how much to pay our employees, how much benefits are required to be provided, etc. We want to do business, we want to pay our employees, but the City is skimming all the cream and half the milk from our operations."

- More traffic congestion (multiple responses)
- "Difficult to say but I know that access to the ports and rails are greatly affected by the stadium traffic. Also the city's push of moving more retail and non-industrial uses of SODO area is a big problem for freight mobility. Many warehouses and business complain of illegally parked cars, and inability to have truck access to their buildings because of this crush of retail and office density."
- "Without a strong, trade supportive commitment by SDOT to improve upon freight mobility in and around the Port of Seattle, the economy of Seattle, Washington State, and the Pacific Northwest stands to suffer. Canada continues to make strides in trade infrastructure and freight mobility, the Panama Canal widening project is progressing as well as other important trade infrastructure projects in other parts of the USA. Seattle SDOT must think and act as progressively on freight as they do on social issues. Hopefully, Mayor Murray realizes the importance of trade, trade infrastructure, and being able to obtain permitting for improvement projects in a timely fashion. If he doesn't, Seattle and the region fall further behind our trade competitors."
- "Because transportation is so bad in Seattle, prices of all our goods have been increased to reflect our increased costs."
- "The more time I have to sit in traffic the more fuel I burn. The more times I get stopped at every single light down one street is more wear and tear on the truck trying to get it back up to speed. All these repairs cost money that we should be able to save to customers."

Q14: Other comments?

Overall: Only 18 of 60 respondents answered this question. There again seems to be a feeling that the city does not prioritize freight. Although not a consensus, the most commented upon subject was the safety of having multiple modes of traffic (especially bikes) sharing the road.

Sample responses

- "Our government has decided that cars and therefore roads are evil so I expect matters to get a lot worse."
- "I think that the BAT lanes on Aurora are a very selfish use of transportation capacity and should be modified to allow and encourage additional uses. The toll on the 520 bridge is excessive and should be reduced significantly to encourage greater use."
- "Need streets that support heavy truck traffic to be designed for heavy truck traffic. Many of them are not, particularly in SODO area. Need to get ahead of "Drone Paranoia" early in the game and get business friendly but effective rules of the road in place. We will use drones, but they do need to be flown safely and they need good, sensible rules for usage."
- "The city of Seattle simply has not made freight and goods movement a priority and does not understand its importance within our economy. Not enough concentration on business and industry that produce large revenue and good jobs for the region. This leads to loss of middle class and a 2-class system with great income disparity."
- "Companies that buy load zone permits should be able to also purchase "temporary" load zone permits for drivers of theirs who rent vehicles for delivery. Large rental vehicles have limited options for load/unload parking and I feel there should be a way to support the load zone system and extend the ability to use the system to drivers in rentals. There should be no requirement of a "minimum" number of drivers to get this temporary tag. If your business supports the system by buying the permit, your co-deliverers should be able to also use the system via temporary/one-off permits."
- "The City of Seattle should value small business in the city and reward those businesses which pay a higher price for continuing to stay here."
- "Seattle is the ONLY west coast port city without an overweight corridor! So stupid."

STAKEHOLDER INTERVIEW QUESTIONS

PURPOSE OF THE STAKEHOLDER GROUP INTERVIEWS

- Build relationships between key stakeholders and the project team.
- Obtain input from key freight stakeholders about citywide freight (urban goods movement) issues and concerns.
- Identify issues and challenges for freight mobility.
- Obtain input on how best to include stakeholders.

DRAFT INTERVIEW SCRIPT

Background and purpose of this group interview

- SDOT is developing the Freight Master Plan to address the unique characteristics, needs, and impacts of freight mobility throughout Seattle. The Plan will examine the challenges of moving freight, identify problem areas, and develop solutions to address these challenges, and will ultimately be adopted by City Council. These group interviews, online survey, and individual interviews will help inform the existing conditions report for the FMP.
- The goals of this group discussion are to:
  - Identify issues and challenges for freight, especially trucks, operating citywide.
  - Identify key industry trends affecting delivery of freight
- We are reaching out to businesses that depend on trucks for goods movement.
- We also want your insight on the most effective way to reach out to other businesses throughout the city.
- SDOT staff will be returning later in the planning process (likely in the fall) to conduct a route mapping exercise to assist in reviewing the Major Truck Streets and potentially developing a truck street hierarchy.
- Format:
  - Questions and discussion to help determine baseline conditions via topic areas:
    - Safety
    - Reliability (dependability, consistency)
    - Efficiency (effectiveness, productivity)
    - Resiliency
    - Economic vibrancy (vitality, jobs, economy, competitiveness, necessities for life)
    - Environment (clean air and water)
  - I will ask the questions and Charla will facilitate the discussion

Sign-in sheet survey

- What is your name, email address, phone number, and the business you represent?
- What is your role in your organization/ business? What is your business address?
- Would you be interested in being involved further in the Freight Master Plan? Yes/No
- What is the best way to communicate with you and continue to involve your business in the planning process?
- Do you have any suggestions for other businesses, delivery companies, or other organizations we should contact?

MAIN INTERVIEW QUESTIONS

Safety – 15 min

1. What are the biggest types of safety concerns you have relating to freight mobility?
2. Are there specific locations or neighborhoods that are of particular concern? (list of intersections/chokepoints)
3. What are key things the city can do to improve safety?

Reliability – 15 min

1. Have your business operations changed based on congestion at certain times of day? How? Do you anticipate further changes? Would it be possible to promote delivery to occur during off-peak hours?
2. If you could change one thing to allow freight to move more reliably through Seattle, what would it be?

Efficiency – 15 min

1. What is the biggest challenge for urban good delivery in the city?
2. Has your business been affected by larger changes in industry logistics?

Resiliency – 10 min

1. When your primary preferred route is unavailable, how do you decide which secondary route to take to deliver goods? What is important to consider in providing a resilient freight system?
2. What are the biggest challenges affecting the future of your industry in terms of climate change/adaptation, aging workforce, fuel costs, etc.? And do you have thoughts on solutions to these challenges?

Economic vibrancy – 15 min

1. What economic trends do you see affecting your industry/business? What type of increase in goods movement does your business anticipate for the future?
2. Does anything make your uncertain about continuing to operate a freight dependent business in Seattle? If yes, what can the city do about it, if anything?
3. What would you suggest the city do to make residents understand the importance of freight mobility during the development of the Freight Master Plan?

Environment – 10 min

1. What are examples of innovative measures that either your business or business sector has done to improve the environment?
2. 40% of greenhouse gas emissions in Seattle are from transportation, how can the city and industries work together to reduce GHG emissions (VMT)?

How to Share Information

- In your experience, what is the best way to communicate with delivery companies and businesses?
- Would you be interested in being involved further in the Freight Master Plan?
- What is the best way to involve and inform your organization as this planning process moves forward? (suggest a few prompts – business chamber, one on ones, web)
- Do you have any suggestions for other businesses, delivery companies, or other organizations we should contact?

QUESTIONS FOR SPECIFIC STAKEHOLDERS

Commercial and Residential Deliveries

- How do you decide what route to take? Are your routes stable each day, or do they vary? Which routes do you avoid?
- Do you have seasonal peaks? If yes, can you share when they occur and describe the situation? How do you handle spikes in deliveries?
- How has your business been affected by the increase of at-home delivery from online shopping?
- What technology/vehicle changes may be appropriate in the future? Would an urban consolidation center, potentially using electric vehicles or cargo bike delivery change your business model?

- Where do you typically park when you make deliveries? In a commercial vehicle load zone or a loading dock? Which is your preference? How do you know if buildings have loading berths? What are your thoughts on two-way left turn lane (center lane) loading/unloading? Are alleys used to park vehicles if available?
- Where do you think Seattle needs more commercial vehicle load zones?
- How necessary is truck signage (clearances and restrictions signs) and wayfinding (truck route signs) throughout Seattle?
- What is the steepest grade roadway you will use to park and delivery goods from? Would information about grades of streets be helpful when planning your routes/areas to park and deliver products?
- Do you typically carry a truckload, less than a truckload, or a combination?
- Do you use any idle reduction equipment or methods? What is your main reason for reducing idling?

Truck Drivers (larger trucks)

- Are you familiar with the city's Major Truck Streets Map? If so, how do you use it?
- Do you have out-of-town truck drivers? How necessary is truck signage (clearances/restrictions) and wayfinding throughout Seattle and directing drivers to the interstate system? What types of signs are most useful for driving a truck?
- Currently, where do truck cabs park overnight? Where do you think they should park? How important is it to have overnight truck parking in Seattle? What size, width, and height clearance parking space do you typically need? Are there any safety concerns with leaving trucks overnight?
- What is the steepest grade roadway you will use? Would information about grades of streets be helpful when planning your routes?
- How important is it to have a secondary freight route? Do you typically carry a truckload, less than a truckload, or a combination?
- Do you drive an oversize rig?
- Do you typically carry a truckload, less than a truckload, or a combination?
- Do you use any idle reduction equipment or methods? What is your main reason for reducing idling?

Dispatchers

- How does your dispatch work? What type of technology do you use to make your business more efficient? How do you communicate with your drivers? What kind of information is important to provide to them at the beginning of a shift or throughout a shift?
- Are you familiar with the city's Major Truck Streets Map? If so, how do you use it?
- What tools do dispatchers and drivers use to predict travel times, find alternate routes, get directions? (Google maps, GPS, local/state travel cameras, INRIX app, etc.)
- When your driver's primary preferred route is unavailable, how do you decide which secondary route to take to deliver goods, do you assist your driver or do they decide in real-time which other route to take?
- How do you measure reliability?

Regional Farmers

- How do you get your produce/product to neighborhood farmer's markets? Why do you participate in farmer's markets? How many events do you participate in each week?
- Where do you park your vehicle while working at an event?
- How do you choose your routes to various neighborhood farmer's markets?
- What could the city do to help make your farm to farmer's market business be more successful, if anything?

Business Owners

- How do you advertise to your customers? When giving directions to your business, which modes of travel do you include? What type if information is on your website? (car parking locations, bus routes, bicycle parking, ADA accessibility, etc.)
- Do you prefer business hour or off-hour delivery? Why? If not, what may incentivize you to consider off-peak delivery?
- How important are commercial vehicle load zones/loading docks for your businesses?

STAKEHOLDER SURVEY QUESTIONS

The Seattle Department of Transportation (SDOT) is developing a Freight Master Plan (FMP) to address the characteristics, needs, and impacts of freight mobility. To help ensure the FMP represents the needs and priorities of freight stakeholders, we need your input!

- Where are the major chokepoints in the freight network?
- What is one thing the City could do to help you move goods more efficiently?
- What is the biggest challenge you face when moving freight?

Take the survey and let SDOT know! The responses we receive will help shape the policies and projects that will make freight movement in Seattle more reliable, efficient, and resilient.

All of the questions included in this survey are optional, and the survey is anonymous. Results will be tabulated and presented to the SDOT project team as feedback during policy deliberations. **Surveys should be completed by Friday, September 19, 2014**.

Please return surveys by fax (206-684-3238, c/o Ian Macek) or mail:

Seattle Department of Transportation
Freight Master Plan Survey
c/o Ian Macek
PO Box 34996
Seattle, WA 98124-4996

1. What type of freight does your business handle?

- ☐ Construction
- ☐ Manufacturing / maritime / industrial
- ☐ Containers destined to/from Port of Seattle
- ☐ Containers destined to/from local distribution centers
- ☐ Inventory for local stores or businesses
- ☐ Delivery services to businesses and residences
- ☐ Dependent on receiving freight
- ☐ Other
- ☐ Other (please specify) ______

2. Have your business operations changed based on congestion at certain times of day? How? Would it be possible to promote delivery to occur during off-peak hours?

3. What is the biggest challenge for urban goods delivery in the city?

- ☐ Access to warehousing
- ☐ Parking for deliveries
- ☐ Traffic congestion
- ☐ Access to delivery load zones
- ☐ Other (please specify) ______

4. What is one thing the City can do to help your business move goods more efficiently and reliably?

5. What are your top three safety concerns related to freight mobility?

- ☐ Conflicts with other modes
- ☐ Inadequate signage and wayfinding
- ☐ Steep grades of streets
- ☐ Clearance
- ☐ Turning movements / curb radius
- ☐ Signal timing
- ☐ Lack of delivery space (loading and unloading)
- ☐ Railroad crossings
- ☐ Other (please specify) ________

6. What are major choke points (specific locations or neighborhoods) in Seattle, from your perspective?

7. How do the choke points affect your route planning?

8. Do you move goods via the City's Major Truck Street designated streets? (See map)

- ☐ Sometimes
- ☐ Never
- ☐ Did not know the City of Seattle had Major Truck Street designations

9. If you answered "sometimes" or "never" in response to Question 8, what are the primary routes / streets you use to move freight?

10. If your primary route is unavailable, how do you determine which secondary routes to take to deliver goods?

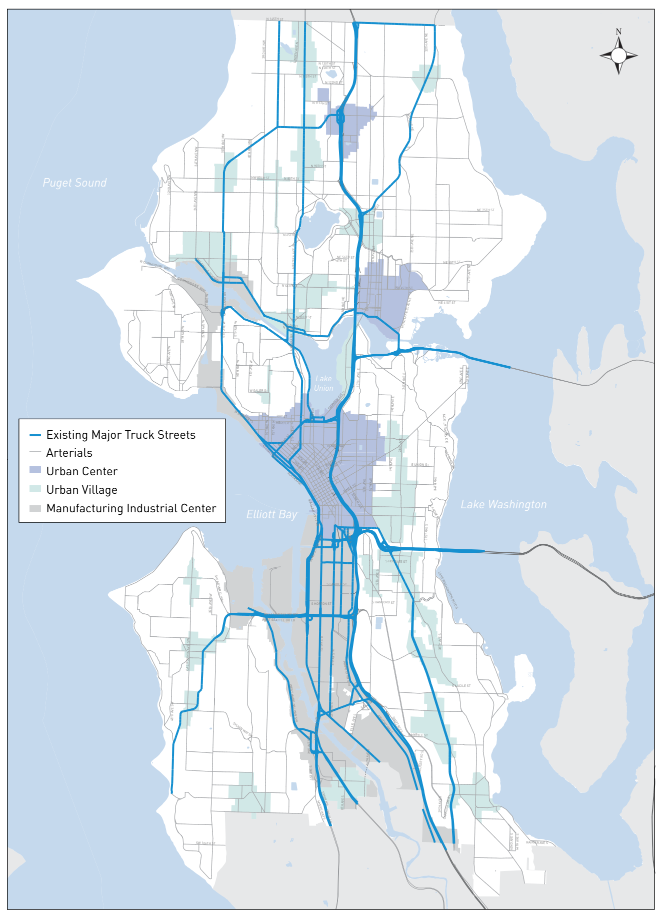
11. What tools do your dispatchers and drivers use to predict travel times, find alternate routes, and get directions?

12. What do you think about truck drivers using Business Access and Transit (BAT) lanes during the time that buses use them with the acknowledgement that buses have priority?

- ☐ Good idea
- ☐ Neutral
- ☐ Bad idea

13. What economic trends do you see affecting your industry/business?

14. Other comments?



Seattle Department of Transportation

EXISTING AND FUTURE TRUCK MOBILITY AND ACCESS APPENDIX B

WSP | PARSONS BRINCKERHOFF

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BACKGROUND

This document summarizes existing and future conditions related to truck movement in and through the City of Seattle. It builds on broader economic trends affecting all modes of freight that were addressed in the Economy and Freight Technical memo[1]. This memo identifies current issues affecting truck mobility, including access to industrial lands, truck flows, gaps in the truck system, potential improvement needs and recent city actions that affect freight on city streets, particularly Major Truck Streets. It also projects future truck flows and resultant conditions and needs.

In order to augment the data collected and freight analysis conducted, and to better understand the key issues, needs and concerns of the freight community, SDOT conducted outreach efforts with representatives from the Duwamish Manufacturing & Industrial Center (MIC) and the Ballard-Interbay Northend Manufacturing & Industrial Center (BINMIC). These meetings, along with additional individual interviews and an online survey, were used to collect feedback on business concerns and solicit ideas on how freight mobility might be improved in Seattle. Results are documented in the "Online Survey - Summary of Feedback Received" and the "Stakeholder Interview Summary" documents, which are attached as Appendices A and B. Feedback related to existing conditions is included as appropriate throughout this technical memorandum.

MAJOR THEMES FROM STAKEHOLDERS

The online survey received 60 total responses. Key overall themes that emerged included:

- Congestion is cited as the number one challenge affecting urban goods delivery in the city.
- Business operations schedule are bound to customers' needs and there is often not flexibility to adjust deliveries to off-peak hours.
- Conflicts with other modes of traffic (predominantly bike traffic) and turning movements/curb radius are cited by over 50% of respondents as being the top safety concerns relating to freight mobility.
- Although the City's Major Truck Streets are sometimes used by two thirds of respondents, almost 40% didn't know the designations existed.
- Google maps is the most used resource for determining alternate routes, but City and state traffic cameras are also valuable.
- There is an underlying feeling of resentment among some towards the perception that the City is not giving freight traffic priority and that conditions are getting worse.

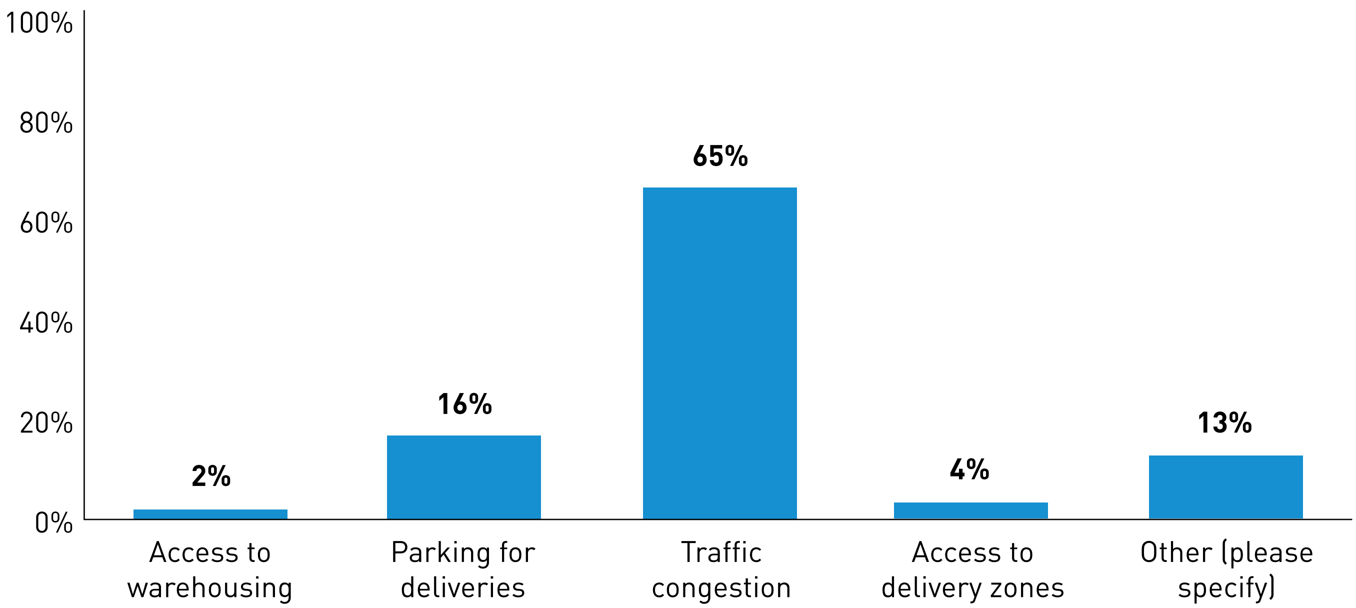
However, others believe that the challenges facing urban freight movements are simply products of a strong economy and good business.

[1]WSP | Parsons Brinckerhoff, December 12, 2014.The Role of Freight in Seattle's Economy.

Stakeholder Overview of Challenges

Figure 1 outlines the largest perceived challenges that freight stakeholders identified through the Online Survey. The largest concern for stakeholders by a wide margin is traffic congestion. Parking for deliveries was also a concern, particularly in the Center City area. In the "other" category, truck-bicycle conflicts were identified several times.

FIGURE 1: ONLINE STAKEHOLDER SURVEY - BIGGEST CHALLENGE FOR URBAN GOODS DELIVERY



The in-person stakeholder interviews mirrored the on-line survey results and identified the following major themes:

- Traffic congestion is the number one challenge affecting interviewees' businesses.
- Freight businesses would move deliveries to off-peak hours if they could, but there are a variety of reasons that prevent them from doing so, including: difficulty of maintaining staff who will work graveyard shifts, customer needs, customer facilities are not open off-hours, increased costs, and night-time noise ordinances.
- There is a general desire among interviewees for designation, and protection of, freight streets.
- Conflicts with other modes of traffic (especially bicyclists and pedestrians) are generally cited as the top safety concern relating to freight mobility.
- The lack of parking and loading zones for deliveries, especially in the downtown area, is consistently cited as a major concern for safety, reliability, and efficiency of freight mobility.
- Finding and maintaining well qualified employees is cited often as one of the major challenges affecting freight dependent industries in the city.

SEATTLE'S TRUCK FREIGHT SYSTEM AND PATTERNS OF MOVEMENTS

The freight system in Seattle is a complex network of supply chain logistics, intermodal connectivity, and linkages to the regional transportation network. This infrastructure and its operations benefits both residents of Seattle and its businesses by providing jobs, delivery of products, and multi-modal shipping options.

HIGHWAY AND ROAD SYSTEM

Figure 2 shows the average daily traffic volumes (year 2014) on Seattle's major roadways. Seattle has an 1100+ mile system of roadways, including Interstate highways, state highways, and arterial and non-arterial roadways that connect the ports, intermodal facilities, residences and businesses to the region. Of those roads, 142 miles are designated as Major Truck Streets by the city (See Figure 3). I-5 and SR-99 (Aurora Avenue) are the major north-south highway connections for the region. I-90 and SR-520 are the major east-west highway connections. Together, these facilities comprise the major roadway connections between Seattle and the rest of the region and country.

Because of severe geographic and topological constraints, including multiple bodies of water and steep terrain, Seattle's roadway network is generally funneled through several major routes that connect areas and neighborhoods to the rest of the metro area.

I-5 is the key north-south interstate facility, which carries over 230,000 total vehicles and 13,000 trucks per day in some segments.

- I-90 is the major east-west interstate facility carrying around 133,000 total vehicles and 10,000 trucks per day.
- SR-520 is a parallel east-west bridge across Lake Washington which serves about 62,000 total vehicles and 4,000 trucks per day.
- SR-99 provides an important north-south connection between key locations within the city, including access between the Duwamish MIC, Seattle CBD, and Ballard/ Interbay/Northend MIC.
- Spokane Street and the Spokane Street Viaduct/West Seattle Bridge are major facilities that connect I-5 to Harbor Island and West Seattle.
- SR-519 connects I-5 and I-90 with the SoDo neighborhood at the north end of the Duwamish MIC as well as to the Washington State Ferry terminal at Colman Dock.
- SR-509 is an important connection between the Duwamish MIC and the SeaTac International Airport. 15th Ave W/Elliott Avenue/Alaskan Way/East Marginal Way S is also a major freight facility that connects the Duwamish MIC to the Ballard/Interbay industrial areas. E Marginal Way S also provides access to Boeing Field. It is also the "over-legal" vehicle route through downtown Seattle (see Figure 4).

FIGURE 2: YEAR 2014 DAILY TRAFFIC VOLUMES

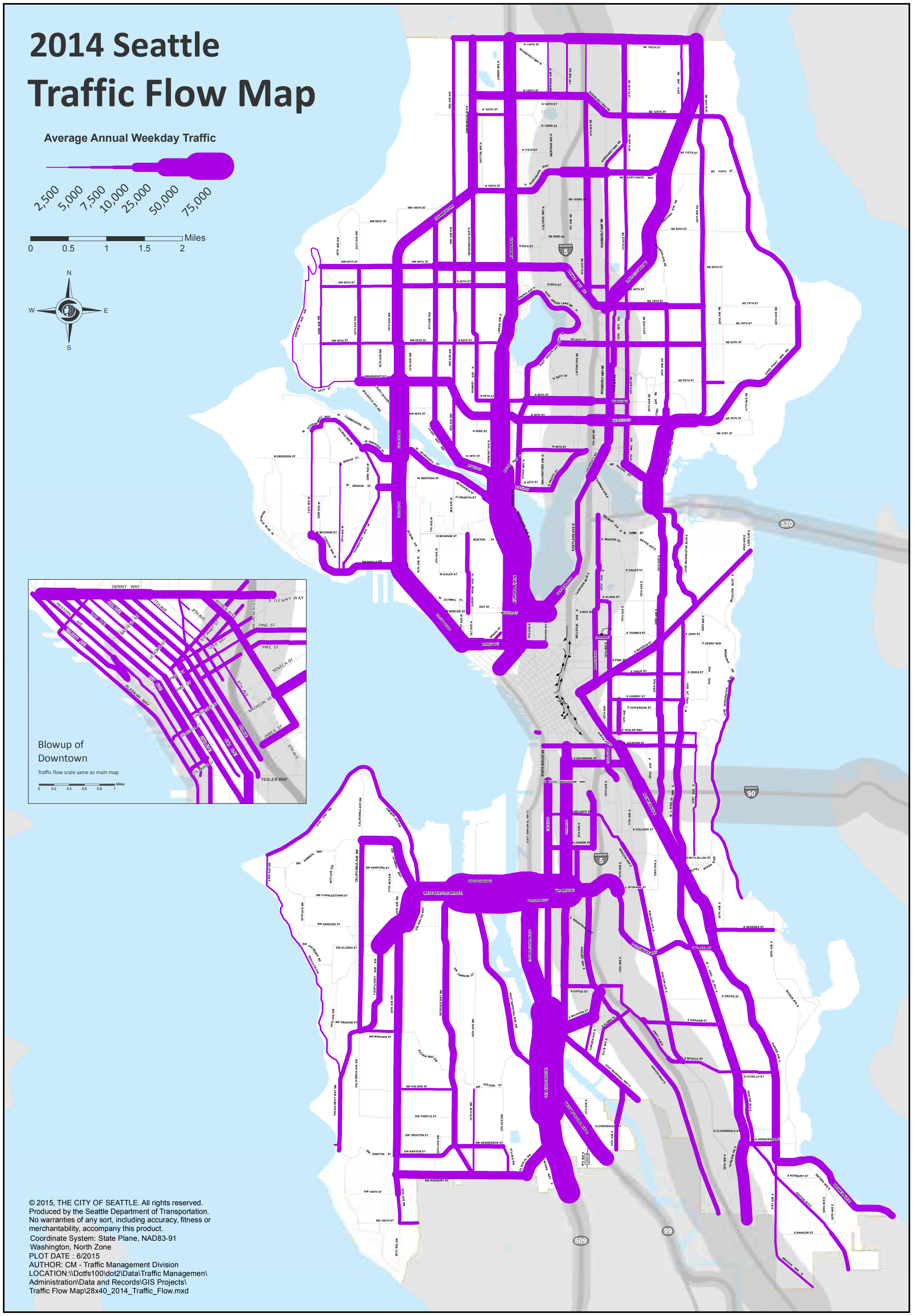


FIGURE 3: 2005 MAJOR TRUCK STREETS

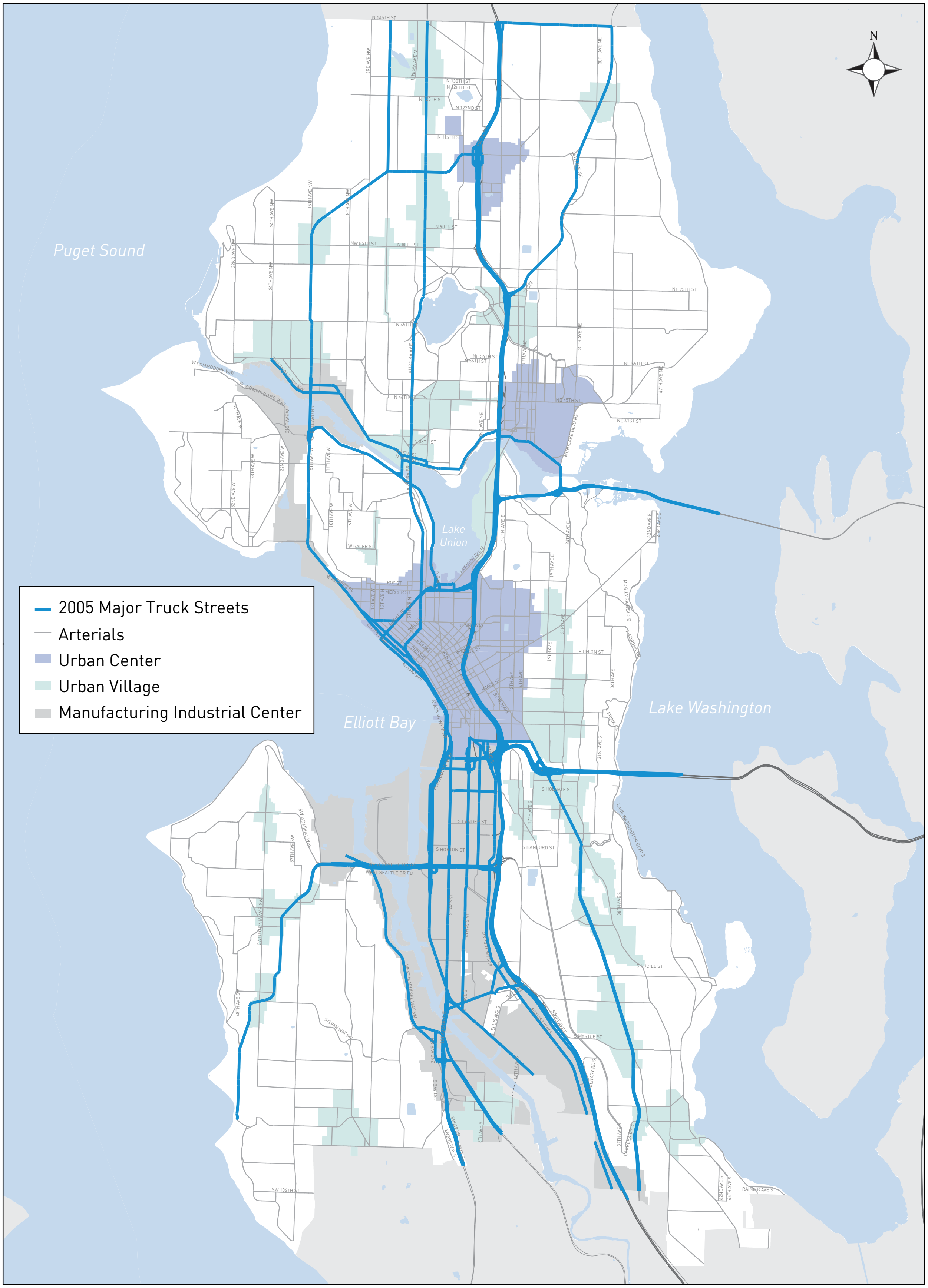


Figure 3 shows the City of Seattle's Major Truck Street (MTS) Network that was adopted as part of the City's 2005 Transportation Strategic Plan (TSP). Also shown in Figure 3 are activity centers within the city that typically generate freight trips—Manufacturing Industrial Centers (MICs), Urban Centers, and Urban Villages. The Major Truck Streets designation is defined by the City as follows:

> *"The Seattle Comprehensive Plan calls for the designation of a network of Major Truck Streets to serve as primary routes for the movement of goods and services. The specific network of Major Truck Streets is defined in Seattle's Transportation Strategic Plan (TSP) and is illustrated on the Major Truck Streets network map. A Major Truck Street is a street classification for an arterial street that accommodates significant freight movement through the City, and to and from major freight traffic generators. Some state routes and highways are also designated as Major Truck Streets on the network map. SDOT uses the designation as an important criterion for street design, traffic management decisions, and pavement design and repair."*[2]

Supplementing the MTS, and distributed throughout the city, are specific routes that we provide for oversized and overweight trucks, referred to as "over-legal." The over-legal network is shown on Figure 4. These routes can accommodate trucks with larger loads that require a 20-foot-wide by 20-foot-high envelope.

Until recently, every vehicle that met the over-legal specifications, which included an exceedance of the maximum height, width, and/or length as specified by state and city laws, was required to obtain a permit to transport goods using the City's street network.

The Washington State Freight and Goods Transportation System (FGTS) is used to classify roadways, freight railroads and waterways according to the annual freight tonnage they carry. Truck tonnage values are derived from actual or estimated truck traffic count data that is converted into average weights by truck type. The FGTS classifies roadways using five truck gross tonnage classifications, T-1 through T-5, as follows:

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

The FGTS, shown in Figure 5 for the Seattle street network, is primarily used to establish funding eligibility for Freight Mobility Strategic Investment Board (FMSIB) grants, fulfill federal reporting requirements, support transportation planning processes, and plan for pavement needs and upgrades. At a minimum, WSDOT updates the list of T-1 and T-2 roadways every two years to assist in maintaining FMSIB strategic freight corridor designations.

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[2]www.seattle.gov/transportation/freight.htm#majorTrucks

FIGURE 4: SEATTLE'S OVER-LEGAL NETWORK

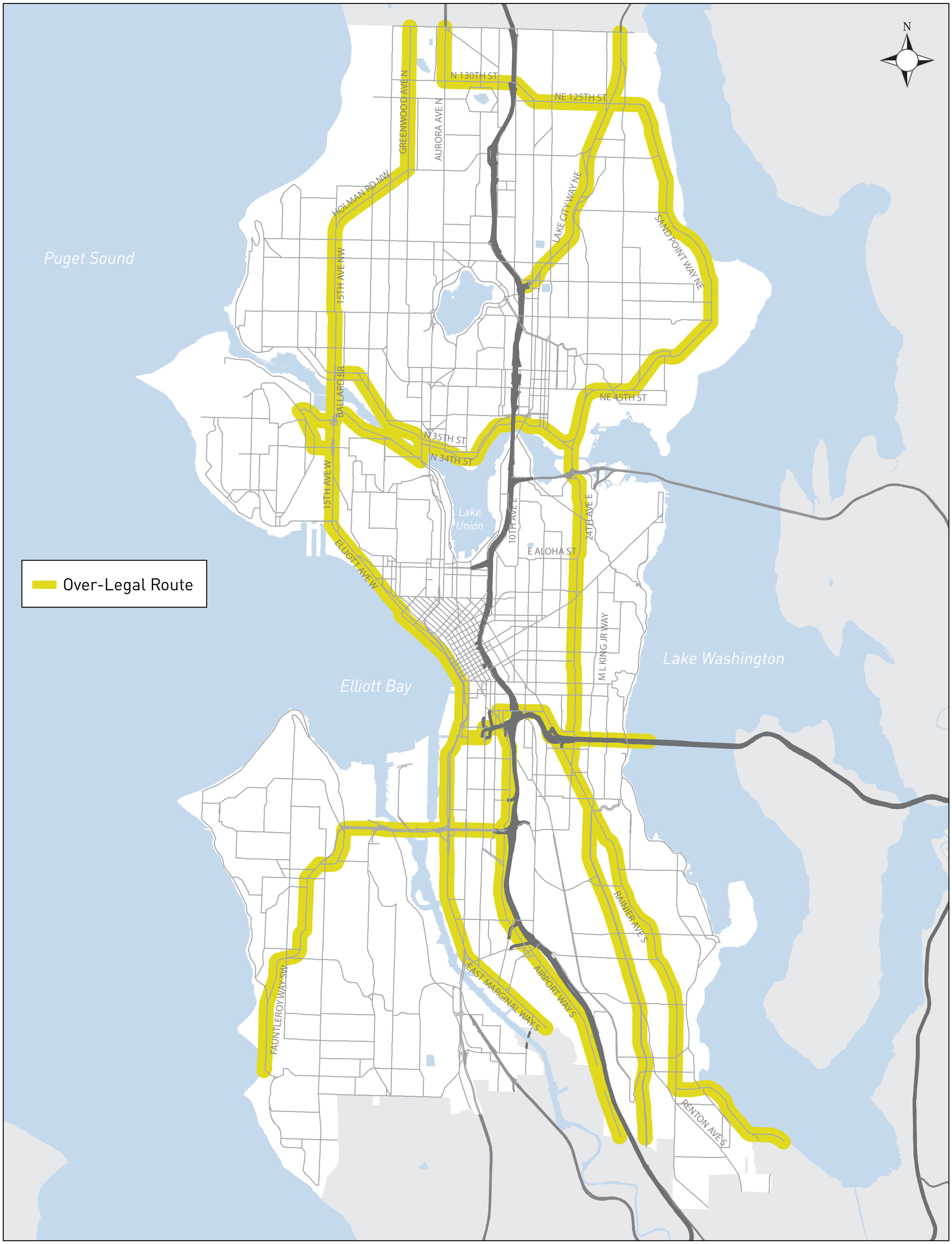
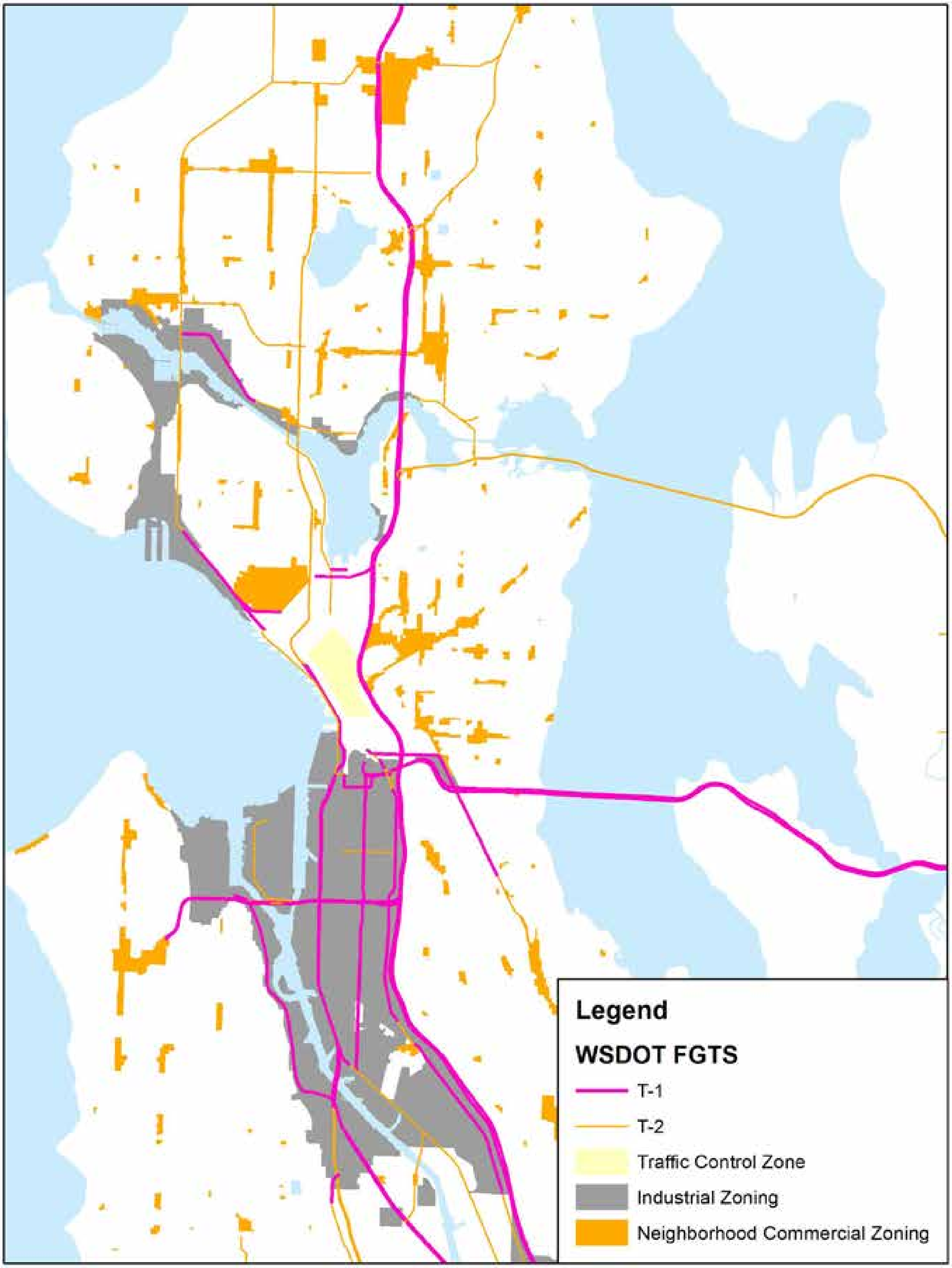


FIGURE 5: WSDOT FREIGHT AND GOODS TRANSPORTATION SYSTEM



Stakeholder Input

The current Major Truck Street system covers many of the main arterials that can be used to access key freight origins and destinations. However, stakeholders also identified streets commonly used by trucks that are not a part of the current Major Truck Street designation, including the following:

- Denny Way (Partially in the current system, certain length trucks are prohibited)
- Dexter Avenue N
- Stewart Street
- Fairview Avenue N
- Stone Way N
- 23rd Avenue E
- Northlake Way N
- N/NE 45th Street
- N 50th Street
- 3rd Avenue NW

Observations about these streets include the following:

- Many of these streets are in areas with no nearby designated Major Truck Streets. These include Stewart Street, Fairview Avenue N, 23rd Avenue E, N/NE 45th Street, and N 50th Street. Many of these streets provide a shortcut compared to using the Major Truck Street system to key facilities or destinations such as I-5 or downtown Seattle.
- Some of these streets are also included in other city modal plans. They will be discussed later on in this memo.
- A few of these streets are parallel to Major Truck Streets including Dexter Avenue N., Stone Way N, N Northlake Way, and 3rd Avenue NW. These roadways are local connections serving businesses and other localized truck destinations.

TRUCK TRAFFIC VOLUMES

The City of Seattle has an ongoing traffic count program to collect counts on city streets via tube count devices and pucks. The City has also made limited use of video counts in selected locations. These counts are used to monitor traffic patterns throughout the city by hour of day and day of week. The count devices record traffic at each location for approximately one week at a time. The City is able to perform truck volume counts at 780 locations over a four year period as a part of the programmed citywide traffic counting effort.

Truck traffic on Seattle streets fluctuates throughout the year based on street location, street type, and truck type as the data has shown. It also varies by day of the week and time of day. Because of this variability, it is important to adjust traffic count data if it is going to be reported as average weekday traffic (AWDT). This adjustment normalizes the count to a “typical weekday” so that the reported counts are not over- or under-stating the traffic based on a count that captured traffic conditions for only a limited time. Ideally, to develop adjustment factors, traffic counts would be taken continuously throughout the city, so that these variations can be measured and accounted for. Unfortunately, this is not realistic given the limited traffic counting devices available, and the cost associated with installing permanent counters city-wide.

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

Other published truck-specific seasonal factors were used to account for the difference between highways and arterials. Ohio State DOT provided adjustment factors for interstates, expressways, arterials, and local roads. Because the state also has a number of Ports along Lake Erie and is heavily freight dependent, it was assumed that the WSDOT interstate adjustment factors would relate to arterial and local road factors in a manner similar to the Ohio data.

The resulting adjustment factors, shown in Appendix C, were used to develop year 2014 average weekday truck volumes shown in Figure 6. These are generalized typical conditions for an average weekday, but may not reflect conditions on any single day. Only roadways with truck volume counts are shown on the map. Additional data from recent and ongoing studies was also added to the dataset. These studies include the City of Seattle's Freight Access Project and the Port of Seattle's Container Terminal Access Study. As can be seen, the highest daily truck volumes in the city are experienced on E Marginal Way and Aurora Avenue N. First Avenue S and 4th Avenue S also carry a high volume of trucks to and from the Duwamish MIC to surrounding industrial areas and highways.

City arterials that carry over 1500 trucks day are all part of the Major Truck Street network and include:

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

Other city arterials that are not a part of the currently designated Major Truck Street network, but still carry 1000+ trucks per day include:

- NE 65th Street east of I-5.
- 85th Street between SR-99 and 15th Avenue NW.
- SW Roxbury Street west of Delridge Way SW.
- Fremont Avenue N north of the Fremont Bridge.
- E Olive Way east of I-5.
- SW Admiral Way west of the West Seattle Bridge.
- N 46th Street west of SR-99.
- N 50th Street west of I-5.
- NE 125th Street east of I-5.
- NW Leary Way west of 15th Avenue NW.

While not on the 2005 Major Truck Street network, these streets provide logical connections between major facilities. These streets should be considered for addition to the freight network, at some level, when the truck street classification system is revised as part of this plan.

Finally, there are some Major Truck Streets that have less than 1000 trucks per day, including:

- Rainier Avenue S south of I-90
- N Northlake Way west of I-5

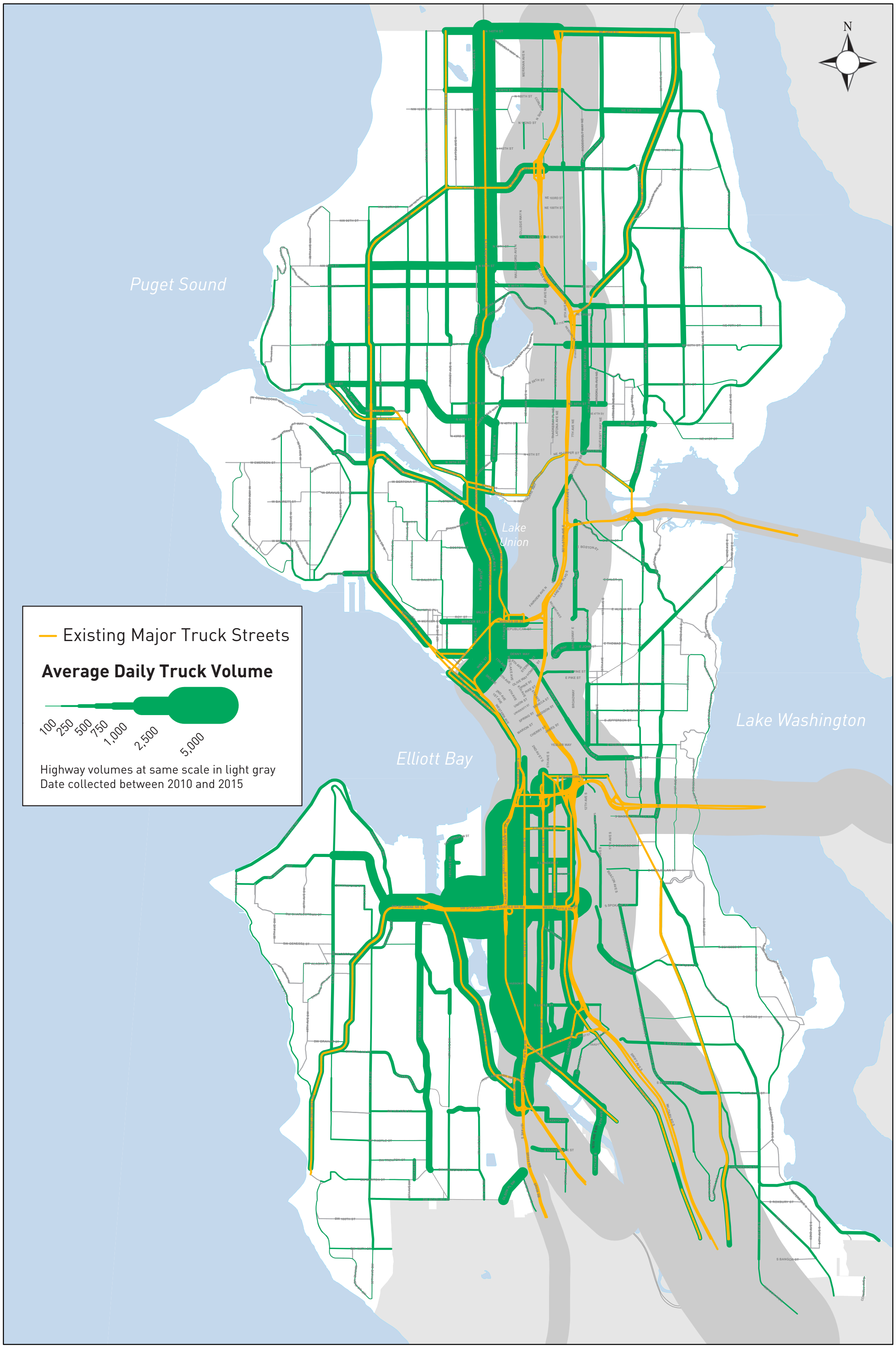
Peak Travel Times for Trucks

On weekdays, there are typically two peak travel periods for all vehicles. This is primarily based on trip patterns of autos, and in particular the AM and PM peak commute periods. For truck trips however, travel patterns can vary, as exhibited in Figure 7 that shows truck flow characteristics on ten city streets[3] with high truck volumes. For example, truck trips on freight access facilities serving the Port of Seattle, such as the Spokane Street Viaduct, typically peak in the morning, but then stay at a relatively high level until tapering off prior to or during the PM peak period. However, other city arterials, such as Aurora Avenue N, serve a more diverse freight market reflecting more retail use and deliveries and experience peak truck flows during the afternoon peak period. When combining the hourly traffic volumes from these ten high truck volume arterials (Figure 8), we see generally high overall truck traffic throughout the day.

---

[3]This is combined typical weekday traffic on 15th Ave NW, 4th Ave S, Aurora Ave N, Boren Ave, Delridge Way SW, N 85th St, NE 125th St, NW Market St, SW Spokane St, and W Marginal Way SW. They were selected based on being the highest truck counts in the SDOT database for single, double and triple unit truck counts.

FIGURE 6: 2014 AVERAGE TRUCK VOLUMES



FUTURE TRAFFIC

Future freight volumes are largely determined by employment growth in the city. As further detailed in The Role of Freight in Seattle's Economy[4], freight generating industries drive freight growth. Based on that analysis, freight is expected to growth between 1.6 and 2.5% a year for the next 20 years.

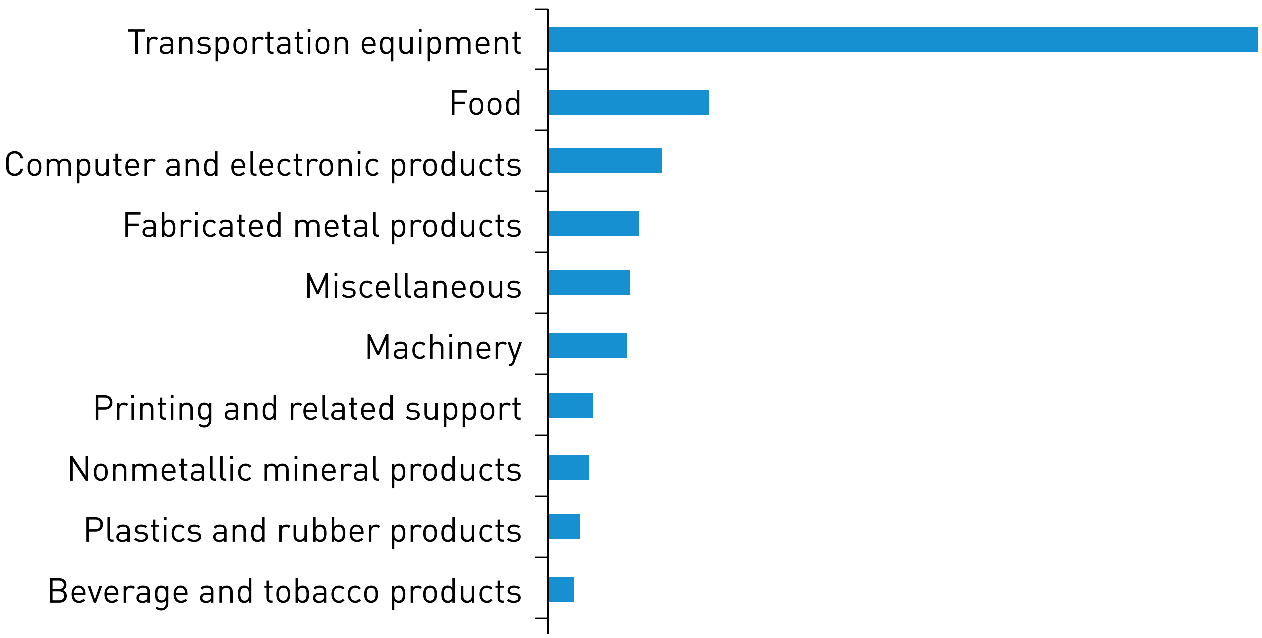
To assign where truck growth will go, we evaluated where key sectors of employment are growing. This provided insight to regions where truck volumes will increase above or below the expected average growth. While the full description of the future truck volumes projection process is described in *Appendix D: Future Conditions Analysis Methodology*, the following four steps in the approach are briefly summarized below:

1. Start with the existing truck volume flow map based on current truck counts.
2. Create distinct geographic districts within the city based on land use and natural travel barriers.
3. Generate district level annual growth factors based on employment and population forecasts.
4. Calibrate specific locations based on more detailed studies.

1. Existing Truck Volumes

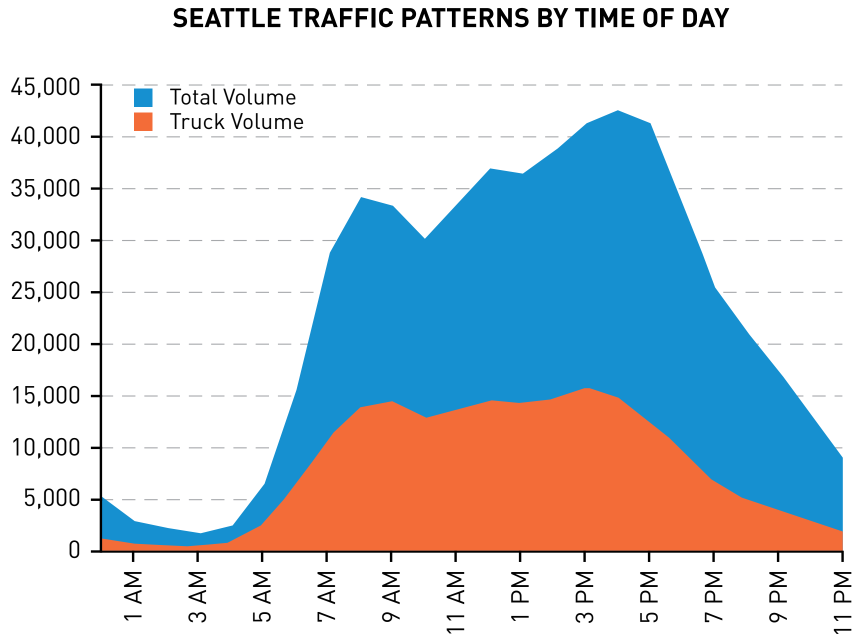
As discussed previously, city wide truck volumes have been measured primarily using tube counters, but also video and other methods. The truck forecasting process starts with these existing counts and then an annual growth factor is developed to project them to year 2040 estimates.

FIGURE 7: TRUCK TRAFFIC BY HOUR ON SELECTED STREETS



[4]WSP | Parsons Brinckerhoff. December 2014.

FIGURE 8: COMBINED TIME OF DAY TRAFFIC AND TRUCK FLOW PATTERNS FOR SELECTED CITY ARTERIALS[5]



2. Growth Districts

Thirteen geographic districts were created based on areas that have consistent land uses and by identifying travel barriers like waterways, freeways, and other natural breakpoints. Figure 9 shows the districts. The purpose of districts is to aggregate the city into reasonable regions that can each have a single growth factor to represent truck growth traveling through the area. The districts were also defined so that they are comprised of Forecast Analysis Zones (FAZs) used by PSRC in development of their population and employment forecasts. The population and employment forecasts for each of the FAZs within a single district were reviewed to ensure that they are expected to grow at similar rates in future.

3. Growth Factors

Truck activity growth factors for each district were based on PSRC Population and Employment forecasts. The PSRC data is based on the "2013 Land Use Baseline, Central Puget Sound Region - Maintenance Release 1 (MR1) Update" which was first released in July 2013 and revised in April 2014.

As described in detail in *The Role of Freight in Seattle's Economy*[6], retail trade, wholesale trade and manufacturing are the primary freight generating employment sectors. The employment forecasts for these three employment sectors were aggregated into the 13 forecast districts to reflect the level of growth in truck activity each district is expected to experience.

Based on these results, each district was then assigned one of four representative annual levels of growth - 1.0%, 1.6%, 2.0%, or 2.5%, which represent very low, low, med, or high growth, respectively. Figure 10 shows the employment growth by district.

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[5]These volumes represent a summation of traffic counts across ten city arterials experiencing high truck volumes. These include the following: 15th Ave NW, 4th Ave S, Aurora Ave N, Boren Ave, Delridge Way SW, N 85th St, NE 125th St, NW Market St, SW Spokane St, and W Marginal Way SW.
[6]WSP | Parsons Brinckerhoff, December 12, 2014.

FIGURE 9: CITY OF SEATTLE FORECAST DISTRICTS

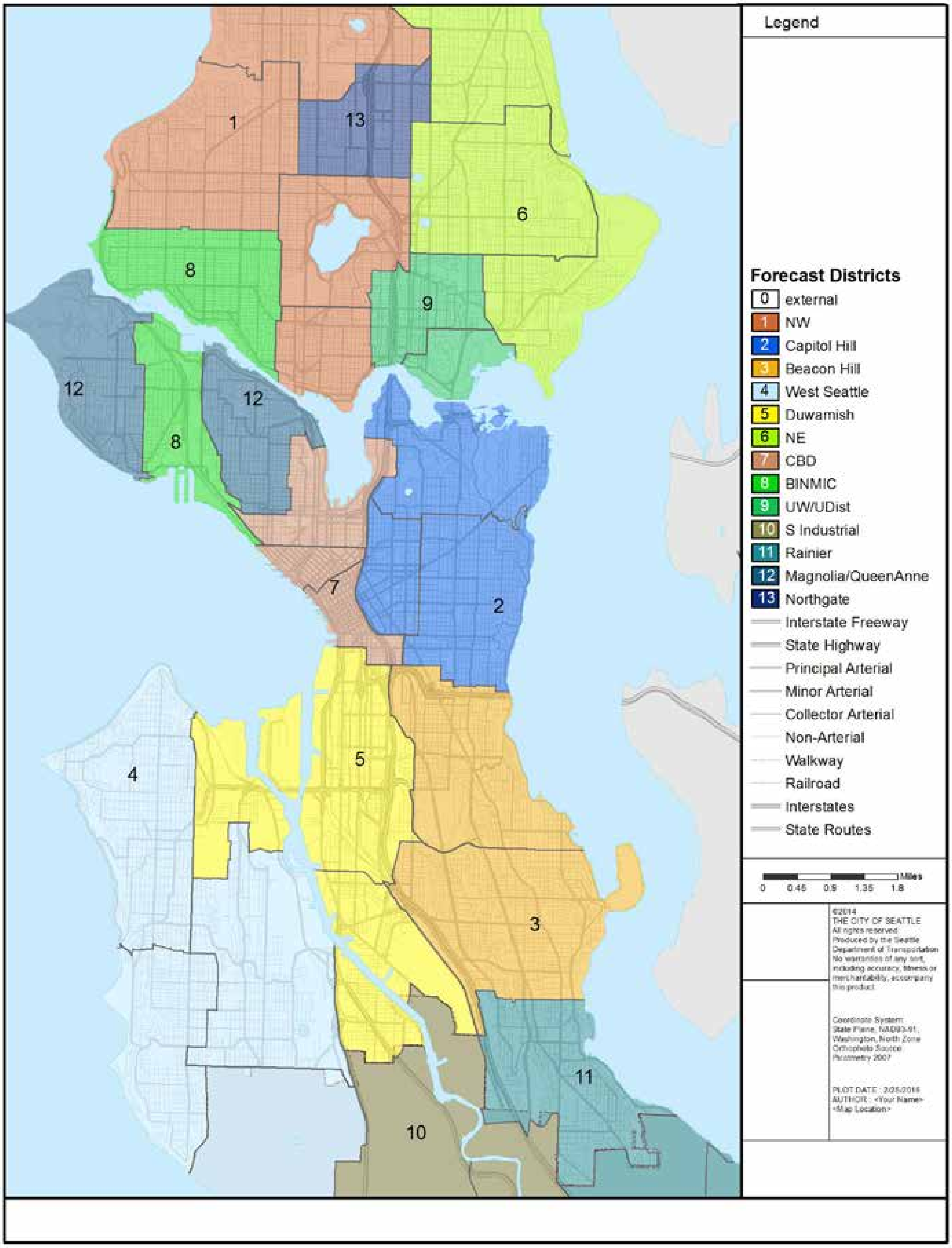


FIGURE 10: PROJECTED ANNUAL EMPLOYMENT GROWTH BY DISTRICT

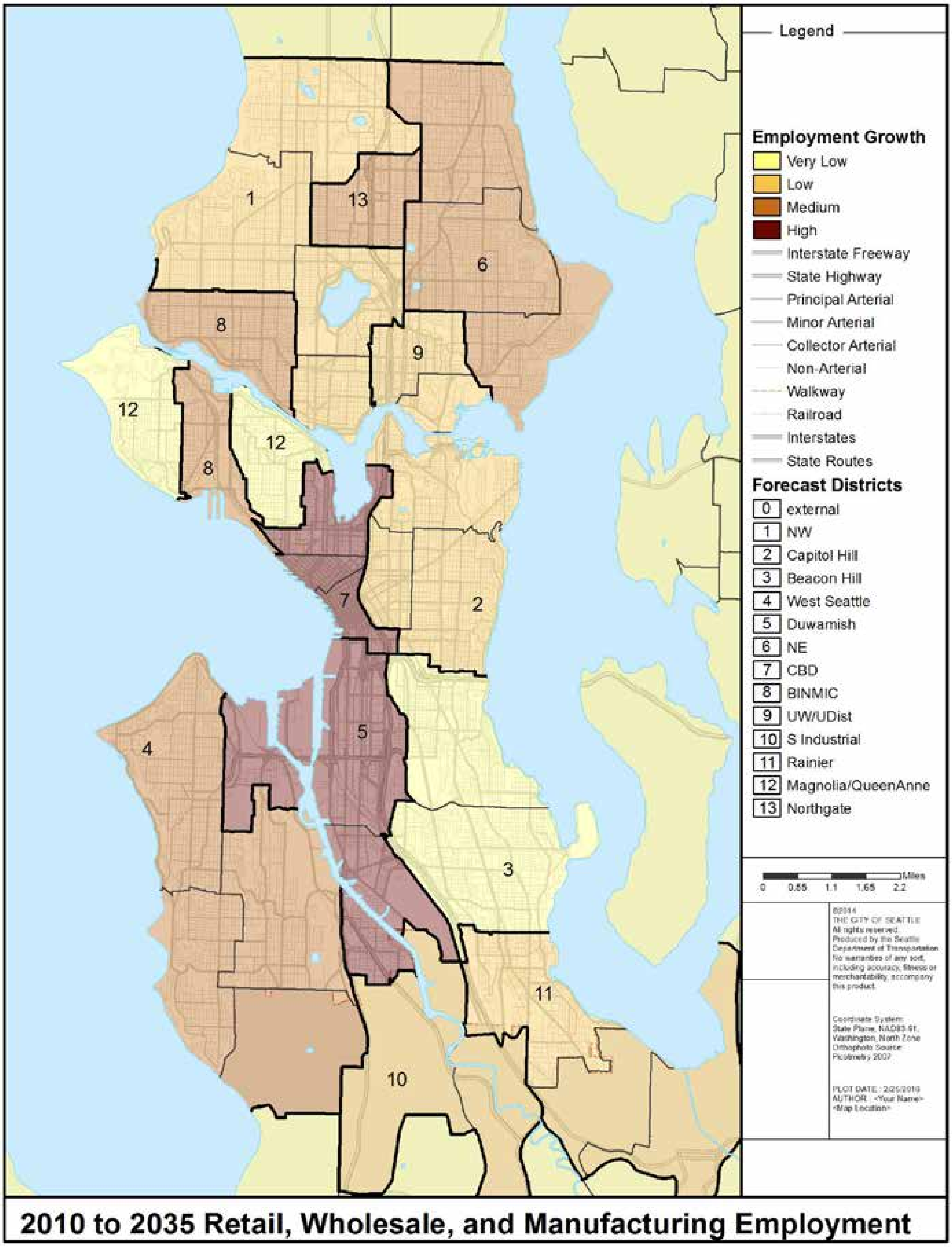


FIGURE 11: PROJECTED ANNUAL POPULATION GROWTH BY DISTRICT

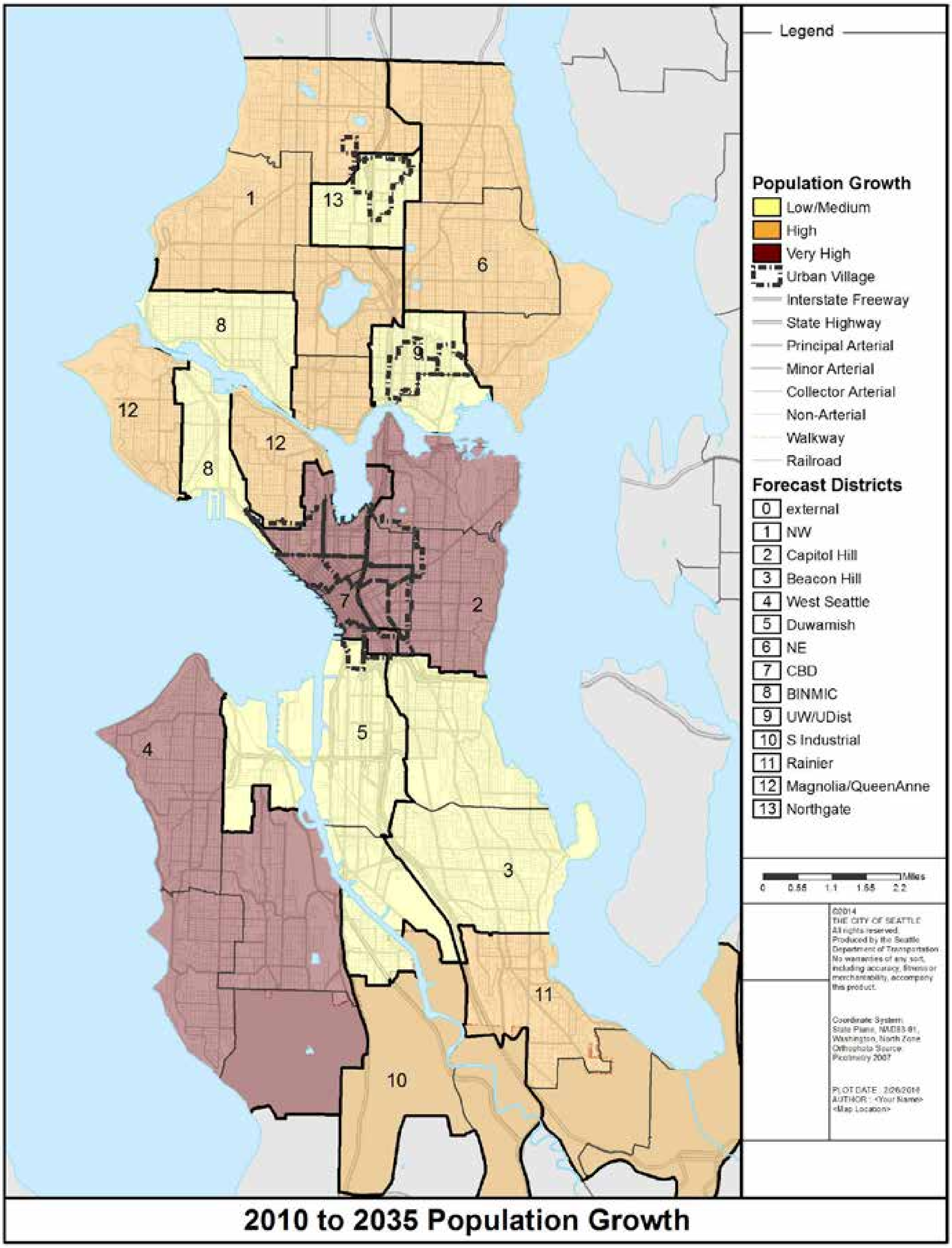
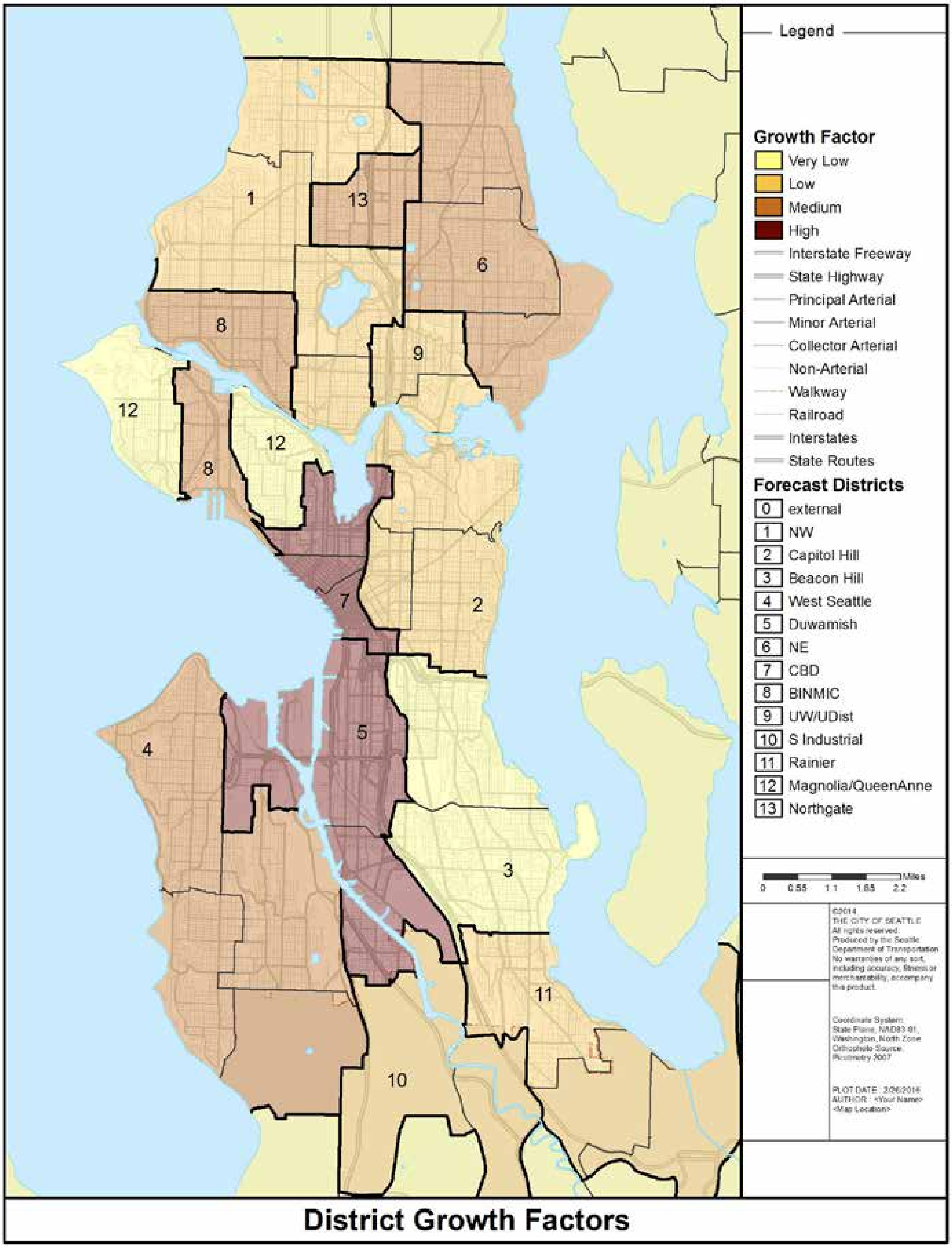


FIGURE 12: FREIGHT GROWTH FACTORS BY DISTRICT



The population growth projections were then reviewed for each district (Figure 11). Because very high population growth could result in substantially more trucks in a district, to make deliveries to homes and local commercial/retail districts, it was determined that districts with population growth of more than 15,000 and/or the presence of urban centers or urban center villages would be moved up into the next highest growth category.

- Districts with urban center / urban center village developments: 2, 7, 9, and 13.
- Districts with growth of more than 15,000 people: 2, 4, and 7.

Figure 12 shows the resulting proposed annual freight growth factors for each district. As a result of the analysis of high growth population areas, districts 2 (Capitol Hill) and 9 (University District) moved from a designation of very low to a designation of low growth. Districts 4 (West Seattle) and 13 (Northgate) moved from low growth to medium growth designations. District 7 (CBD) already had high employment growth and thus remained in the high category.

4. Calibration

The PSRC regional model does a reasonable job quantifying truck volumes on major roadways as they move to major destinations in and outside the region. The regional model's existing and future projected truck volumes were reviewed and used to estimate expected truck growth on highways and principle arterials. State routes and highways are represented on Figure 13 for simplicity, however, the model also contains all principal arterials as well. These volumes and growth rates give regional context to the projections developed from the land use growth since they reflect the larger freight movements within, and through, the City. Annual growth factors were determined by using the growth in volumes between the base year and future year models. This growth was then applied to the regional facilities within the city's transportation network.

Finally, other freight studies with targeted analysis of future truck flows, including the Port of Seattle Container Terminal Access Study and the City's Freight Access Project, were reviewed and the results integrated into the future truck volume analysis. With more refined focus areas and different timelines, these studies have differing base year data and future projections. These studies also provide additional traffic counts that were incorporated into the City of Seattle truck count database. Roads that provide direct connection between the Port of Seattle and the Interstate facilities are projected to experience higher growth in truck volume than other facilities in the city. Incorporating this growth resulted in a growth factor of 3.5% per year, or Very High Growth.

The projected daily truck volumes for year 2035 are shown in Figure 14. Overall, the map indicates a significant growth in truck traffic on many facilities within the City, corresponding with the overall average of 2% per year projected growth in freight volumes outlined in the *Role of Freight in Seattle's Economy* memo. Some of the highest areas for truck growth also correspond to streets that have the highest current truck volumes. The Duwamish MIC is anticipated to have significantly more growth than the rest of the region. Aurora Avenue N is also expected to have large increases in truck traffic in the future.

FIGURE 13: ANNUAL TRUCK VOLUME GROWTH FACTORS FOR PSRC REGIONAL ROADWAYS

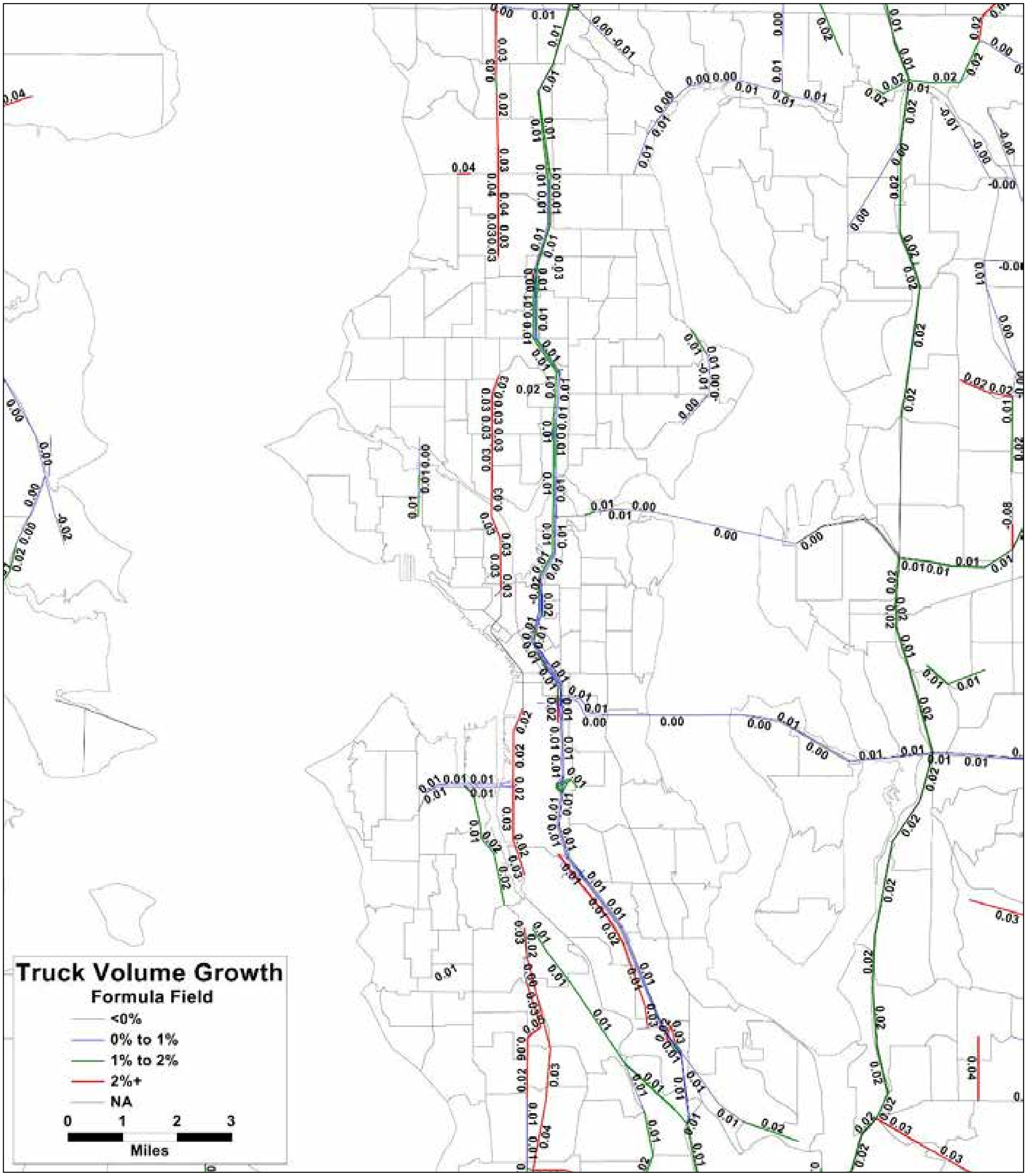


FIGURE 14: 2035 AVERAGE DAILY TRUCK VOLUME

TRUCK MOBILITY AND ACCESSIBILITY

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

ROADWAY CONGESTION

Traffic conditions, including all vehicles, are often shown as Level of Service (LOS) or Volume to Capacity (V/C) ratios. V/C ratios will be used here to evaluate traffic congestion on arterials and highways. They were calculated using the 2010 Puget Sound Regional Council (PSRC) travel demand model calibrated for the SR-99 Phase 1 Investment Grade Tolling Traffic and Revenue Project. This includes a more refined zone system and a more detailed street network within the City of Seattle. It also includes additional features to more accurately reflect conditions in downtown Seattle. The model reflects typical weekday travel patterns and does not account for special events.

Roadway capacities are defined by a combination of the facility type, speed limit, lane width, intersection spacing, as well as other factors. It should be noted that congestion worsens significantly as volumes increase towards capacity. For example, a street with V/C = 0.80 may experience some slowdown below speed limits, but the same street at V/C = 0.90 will likely have breakdown in traffic flow, with highly variable speeds including stop and go conditions. The model is calibrated and validated to ensure that it produces traffic volumes that are representative of observed traffic.

Figure 15 and Figure 16 show city roadways currently experiencing congestion in the AM (7-8) and PM (5-6) peak hours, respectively. Facilities shown in orange are estimated to have V/C ratios of between 0.80 and 0.89 and those in red have V/C ratios of 0.90 or greater. Facilities with V/C rations of less than .80 have been faded out for readability.

The volumes from the model represent all vehicle types, including trucks. The model was used to understand how the overall system is performing currently and where demand is exceeding capacity. It also was used to identify current bottlenecks in the system. The bottlenecks, particularly those located on streets with heavy truck use, will be used to inform planners and engineers where to look for possible solutions during later tasks in the planning process.

Stakeholder input was also used to identify or confirm bottleneck locations. Many trucking and shipping businesses are aware of daily bottlenecks, roads with demand higher than capacity and no reasonable alternative routes, and allow extra time for deliveries or take alternate routes. Some plan operations so that trucks can be on the roads during off peak times. They will often rely on driver knowledge or on-line real-time electronic maps to provide traffic conditions and decide on optimal routing.

Comparing the AM and PM congestion patterns shows that many facilities experience excess demand in both the AM and PM peak periods, including most bridges because they typically funnel traffic from multiple roadways into one crossing.

FIGURE 15: EXISTING AM PEAK HOUR ROADWAY CONGESTION

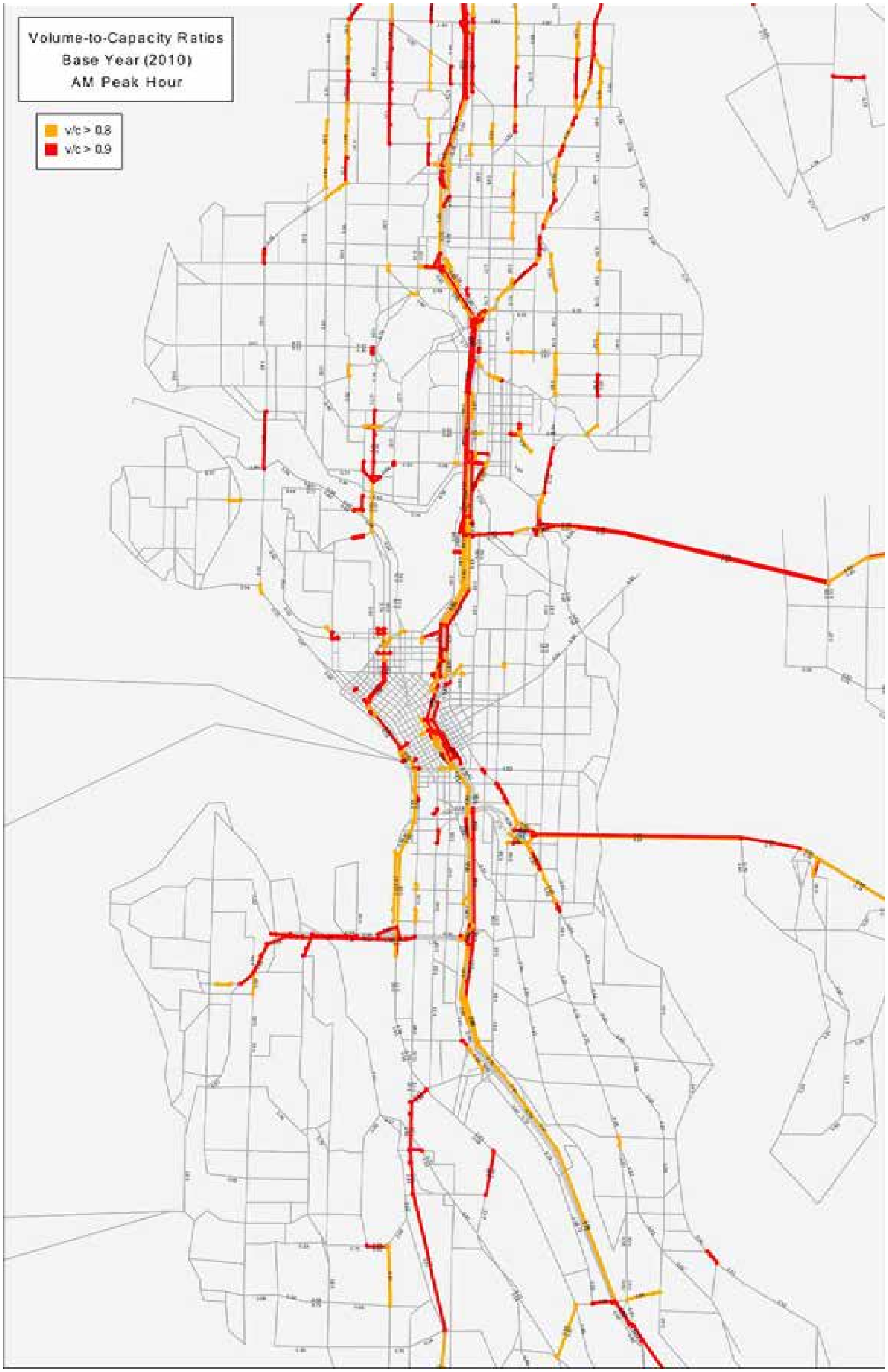
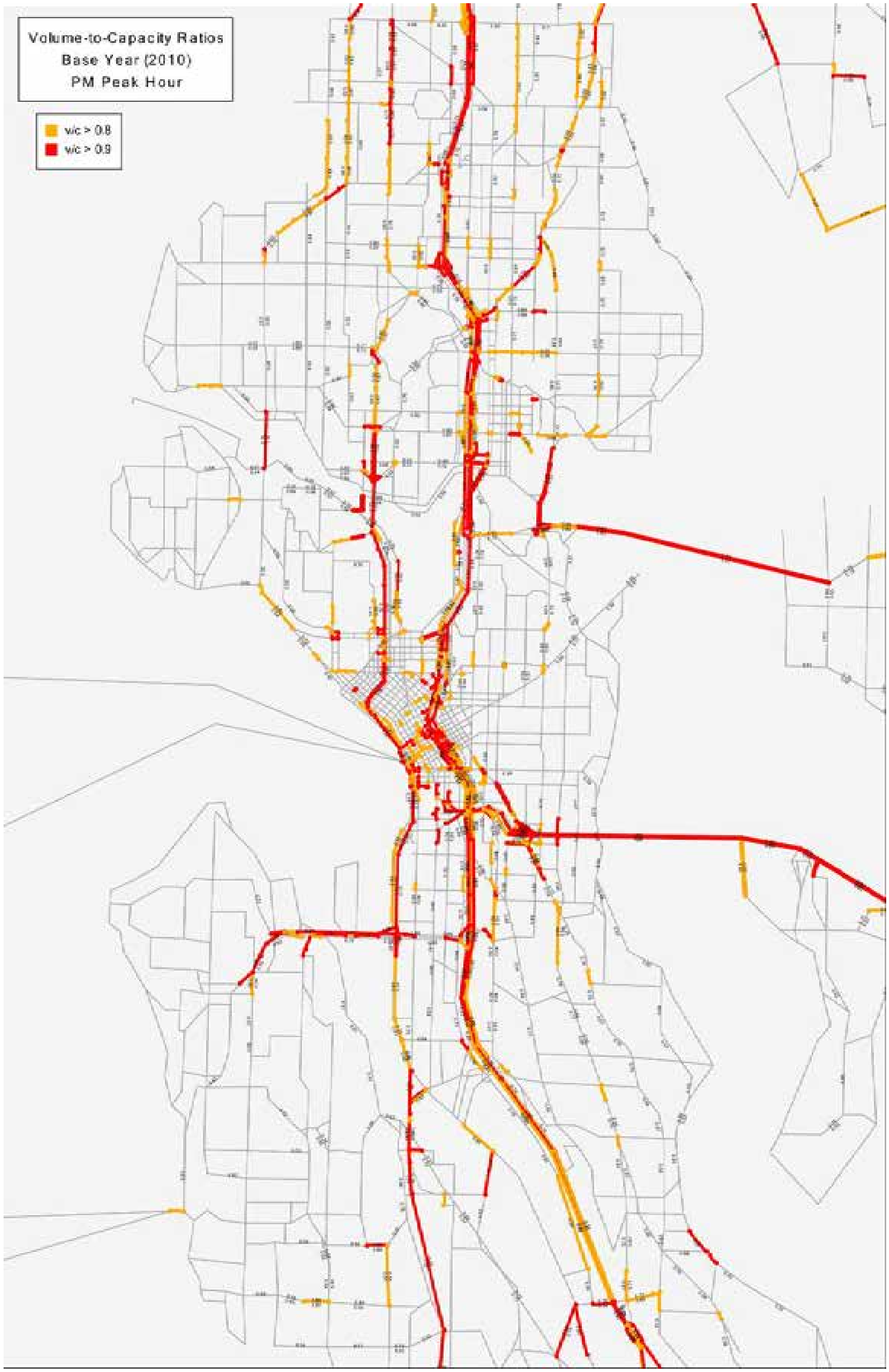


FIGURE 16: EXISTING PM PEAK HOUR ROADWAY CONGESTION



Notable bottleneck points include the following bridge crossings:

- Ballard Bridge
- Fremont Bridge
- University Bridge
- Montlake Bridge
- West Seattle Bridge (
- First Avenue S Bridge
- I-90 Bridge
- SR-520 Floating Bridge

Because the bridges serve as a singular crossing point for a number of arterial streets, congestion at these locations has major downstream effects that impact not only the primary roadway served by the bridge but also many additional side roads and interchanges. For example, congestion on the Ballard Bridge can cause backups on Nickerson Street, Market Street, and other nearby arterials. This situation is exacerbated by bridge openings. Although openings are restricted during peak periods on most bridges (with a few exceptions including the Spokane Street Swing Bridge), the openings in off-peak periods hinder freight movements which occur throughout the day. See Table 9 for details on opening restrictions for moveable bridges and related discussion in the Truck Mobility Constraints section.

All major Interstate and State highways are at or near capacity for the peak periods. This means that not only is local traffic and truck mobility impacted, but longer-distance through-trips are delayed as well. I-5 and to a lesser degree SR-99, are congested throughout the city. Other facilities commonly used by trucks that currently operate with high levels of peak hour congestion include:

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

As indicated in the preceding section, these facilities all carry truck volumes in excess of 500 trucks per day.

The majority of bottleneck locations citywide are on roads that are a part of the Major Truck Street network. Congestion on these key freight corridors of the city negatively impacts reliability of service for trucks. As mentioned above, many of these locations have physical barriers, such as lakes, which make adding additional capacity very costly or infeasible altogether. In most cases, improving mobility will need to be done not by widening or building new roads, but rather by improving operations using other strategies that optimize traffic operations such as ITS, signal coordination, ramp metering, congestion pricing, and transit improvements.

Stakeholder Input

Impaired mobility overall is also reflected in responses from freight stakeholders who indicated that traffic congestion was by far the number one challenge for urban goods movement and delivery in the city. Reliability, being able to accurately predict travel times, is a related concern to freight stakeholders as well. The following themes related to mobility and accessibility were identified during freight stakeholder interviews.

- All truck operations are heavily influenced by traffic congestion and the lack of alternative truck routes.
- Drivers do their best to avoid morning (7am-9am) and afternoon peak hours (3pm-6pm); however, larger and noisier trucks are often prevented from making deliveries in off hours due to the night time noise ordinance.
- Businesses, especially near SoDo and the Port, are particularly impacted by special events at the stadiums such as sports events and concerts. Incoming and outgoing deliveries all revolve around event start and finish times on event days.

- Drivers largely rely on their own knowledge for route finding; however GPS, Google Maps, and traffic cameras are routinely cited as useful tools, even though their use is marginalized because drivers are typically not allowed to look at GPS or cell phones while driving.
- A few participants suggested creating one website that consolidates all traffic conditions on city roadways. Driver access to real time traffic analytics was suggested as an idea for improving congestion and reliability issues for freight mobility.

In addition to general concerns about congestion, stakeholder interviews identified additional bottleneck facilities affecting freight which were not necessarily obvious by looking at peak hour volume to capacity ratios from the travel demand model. This could be due to a variety of reasons, including because the congestion is episodic and not tied to daily peaks, the model may have under-assigned volumes to these roadways, or there are bottleneck constraints that are not adequately recognized by the model. For example, some of the facilities have restrictions regarding trucks during certain hours. Stakeholders identified the following additional streets as being bottlenecks for freight:

- W Nickerson Street
- Mercer Street
- Elliott Avenue
- Denny Way
- Dexter Avenue N
- Stewart Street
- Fairview Avenue N

All of these streets, except Elliott Avenue south of Denny Way, are either transit or bike corridors, or both. Elliott Avenue is a truck facility, but it is in a very urban setting with many signalized intersections, and the access connection to the Alaskan Way Viaduct is a very short ramp which is often backed up from congestion on the viaduct. All of these factors make Elliott Avenue difficult to navigate for larger trucks.

Stakeholders also identified "Problem Areas" that are not necessarily traffic bottlenecks, but present a challenge for freight movement regardless. While these facilities may not experience major congestion, they are still considered by stakeholders to be difficult for truck drivers to use. These problem area locations have a range of unique attributes that affect trucks. These include geometric issues such as turning radii, grade, acceleration/deceleration lane lengths, location of access points, sightlines, mode conflicts, and others. Many of these bottleneck and problem area locations are created by the geography and topography of the City, such as across waterways, which constrain flow for all traffic. The additional problem areas identified by stakeholders include the following:

- SW Spokane Street between West Seattle and Harbor Island
- Spokane Street Viaduct
- Pier 91
- S Alaska Street light rail crossing at Rainier Avenue S
- S Holgate Street
- Lack of northbound access to I-5 from 85th Avenue NW

ACCESS TO INDUSTRIAL LANDS

A separate study, the Seattle Industrial Areas Freight Access Project (FAP), focused specifically on maintaining and improving access to the City's industrial lands. It 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. The Freight Access 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).

FUTURE MOBILITY AND ACCESSIBILITY

There are several considerations for truck movements throughout the city in the future. Key truck facilities, traffic congestion, bottlenecks, and safety issues were identified in order to prioritize which routes are performing adequately, and which need improvements. This analysis is presented below.

Truck street designations

While trucks are allowed on all streets within the City of Seattle (with a few exceptions), there are certain streets that are particularly critical to the freight and goods movements system, some of which are not currently designated as a Major Truck Street (MTS). Additionally, the current MTS designation does not recognize local freight movements to and from commercial centers, or provide alternate routes in some cases. Also, with logistics trends moving to smaller and more disbursed warehouse and distribution centers, and in keeping with Seattle's Urban Village Strategy, a multifaceted freight network with multiple designations was determined to better meet the city's freight mobility needs.

Based on freight planning best practices, and input from stakeholders and regional and national experts, the following four designations for Seattle's freight network were developed:

- **Limited Access Facility** – Limited access facilities support through movements and/or long-distance trips. These facilities include interstate and state highways, such as Interstate 5 (I-5) and Highway 99.
- **First/Last Mile Connector** – These are defined as locations where short truck movements are required for access to and from key freight activity centers, such as Port facilities, and intermodal terminals. These connections are all within the Manufacturing and Industrial Centers (MICs).
- **Major Truck Street** – This is now a subset in the overall freight network. As defined previously, a major truck street is an arterial street serving connections between and through industrial land use (MICs and intermodal terminals), commercial districts and urban centers.
- **Minor Truck Street** – A minor truck street provides connections to and from urban villages and commercial districts, and secondary connections to major truck streets.

The criteria used to determine whether a street should be part of the freight network, and what is appropriate level should be include the following: primary freight purpose of the facility, supported land use, street functional classification, and daily truck volumes. Figure 17 summarizes these criteria for each of the four freight network designations. The freight network is shown in Figure 18 . More details on the methodology of this classification was outlined in the July 2015 CAC meeting and is fully documented in the *Truck Street Designation Memo*.

FUTURE TRAVEL FORECAST

Future traffic conditions were analyzed by using predictive travel demand models. The Puget Sound Regional Council (PSRC) travel demand model calibrated for the WSDOT SR-99 Phase 1 Investment Grade Traffic and Revenue Project. This model utilizes the PSRC population and employment forecast to model future traffic. This future model includes all funded future road and transit projects, as well as future toll and managed lanes projects.

Projected levels of congestion on city streets were estimated based on calculated volume to capacity (v/c) ratios. Figure 19 and Figure 20 show projected v/c ratios for the AM and PM peak periods respectively. Congestion typically occurs when the v/c ratio is 0.8 or higher, meaning that 80 percent or more of the roadway's capacity is being used. Moderate congestion, shown with an orange highlight on the map, reflects v/c ratios

FIGURE 17: TRUCK STREET CRITERIA BY DESIGNATION

LIMITED ACCESS	MAJOR TRUCK STREET
Purpose: Long distance trips **Land use:** Connections between the city and the rest of the region **Roadway classification:** Highway **Truck volumes:** All	**Purpose:** Through trips **Land use:** Connections to MICs, intermodal facilities, Urban Centers, and the regional system **Roadway classification:** Minor arterial or higher **Truck volumes:** 500+ trucks per day

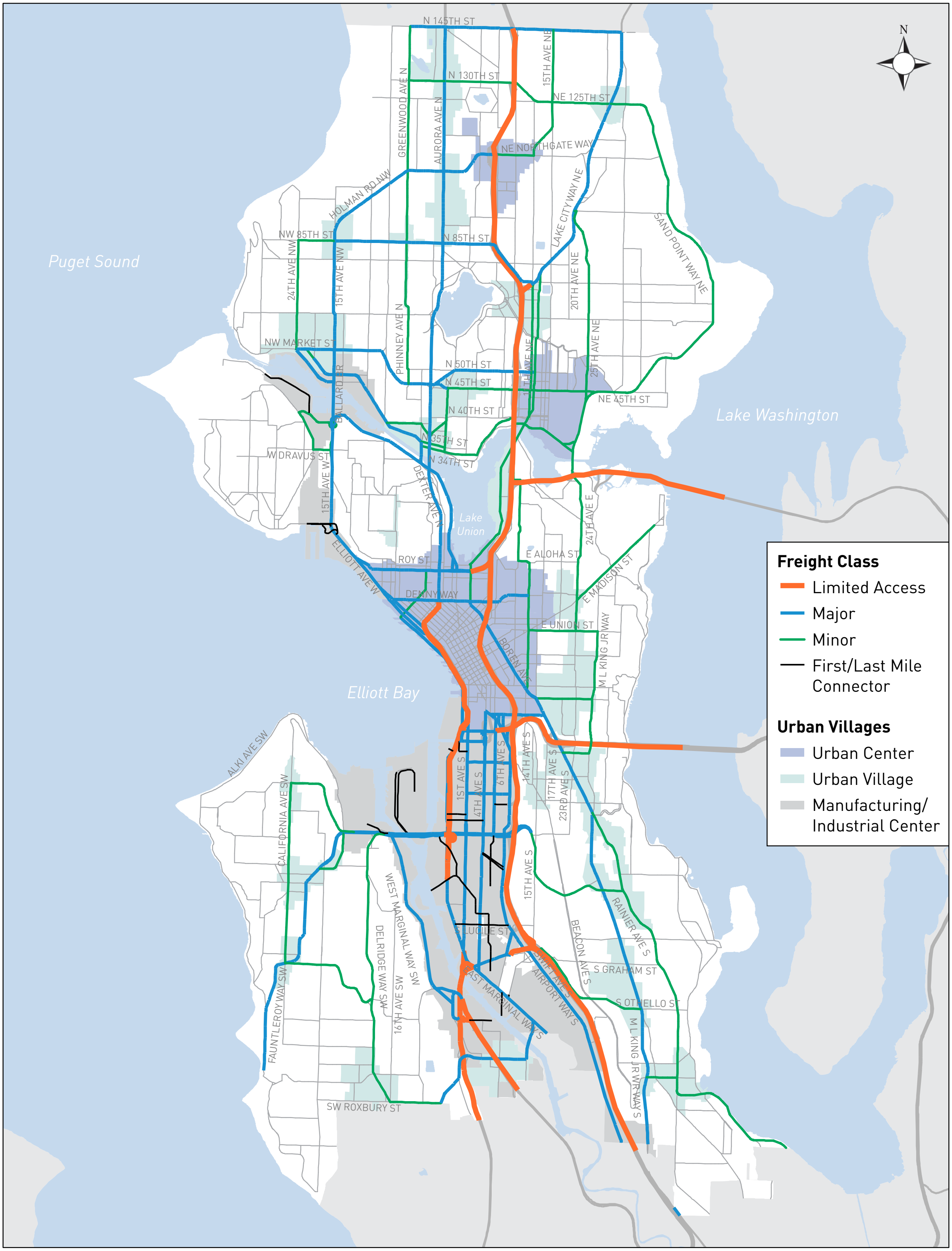
MINOR TRUCK STREET	FIRST/LAST MILE CONNECTORS
Purpose: To/From trips **Land use:** Connections to and from urban villages and commercial districts, provides secondary through routes and network resiliency **Roadway classification:** Collector arterial or higher **Truck volumes:** 500+ trucks per day	**Purpose:** Industrial trips **Land use:** Connections within the Manufacturing and Industrial Centers (MICs) **Roadway classification:** Minor arterial or lower, including non-arterial streets **Truck volumes:** 250+ trucks per day

from 0.8 to 0.9, while more severe congestion is where v/c ratios are 0.9 or higher, and are shown with a red highlight. The current forecasts show traffic congestion worsening throughout the city, particularly true in the AM and PM peak hours, where the majority of highways and major arterials in the city are expected to experience congestion. In these very congested conditions, the model will often show streets that have volumes that exceed capacity. Trips on these streets would either not be able to use the facility within the one hour time period estimated by the model and would spread into the next hour, or they would simply find an alternative route to take.

AM Peak hour congestion is expected to worsen city-wide in 2030 when compared to 2010. All areas that were congested in 2010 remain congested, but additionally, many north-south arterials entering the city from the north are also expected to experience moderate to heavy levels of congestion. These roads include:

- 3rd Avenue NW between NE 145th Street and Holman Road
- Greenwood Avenue N from north of the city limits to Holman Road
- Meridian Avenue N from north of the city limits to Northgate Way
- 1st Avenue NE between NE 145th Street and NE 92nd Street
- 5th Avenue NE from north of the city limits to Northgate Way
- Roosevelt Way NE between NE 130th Street and NE 75th Street
- Eastlake Avenue E across the Ship Canal
- 15th Avenue NE from north of the city limits to NE Ravenna Blvd
- Lake City Way NE from north of the city limits to I-5

FIGURE 18: FREIGHT NETWORK



Also, several main roads that come into the city from the southeast are projected to experience moderate to heavy congestion, including:

- Rainier Avenue S between S Graham Street and Downtown Seattle
- Martin Luther King Jr Way S between S Othello Street and Rainier Avenue S
- Beacon Avenue S between S Orcas Street and S Columbian Way
- Roads in the Queen Anne area, Ballard area, and UW district are also showing additional congestion, including the following:
- Gilman Dr W between 15th Ave W and 11 Ave W
- W Dravus St east of 15th Ave W
- W Nickerson St between 15th Ave W and the Fremont Bridge
- Elliott Ave W between Denny Way and the Magnolia Bridge
- N 36th St between Fremont Ave and Leary Way
- N 45th/46th St between Fremont Ave and Stone Way
- N 50th St between Phinney Ave and Stone Way
- NE 45th St between I-5 and Sand Point Way
- 11th Ave NE between Eastlake Ave and NE 45th St

The PM Peak hour is still projected to be the most congested hour in 2030. Notable new areas of congestion beyond what were noted for AM peak conditions include:

- Westlake Ave N between the Fremont Bridge and Mercer St
- Dexter Ave N between the Fremont Bridge and Mercer St
- E Greenlake Dr N between NE Ravenna Blvd and Winona Ave N

Bottlenecks and Issues

As congestion worsens citywide, freight movement will become more challenging both in terms of mobility and travel time reliability. Since congestion worsens at an exponential rate, in a congested network relatively small day to day variations in traffic flows can cause a disproportionately large increase in travel time delays. Because congestion is widespread during peak periods and will continue to get worse in the future, it was important to identify the congestion areas that have the most impact on truck travel. To do this, locations of projected future traffic congestion were identified and overlaid on a map of projected 2035 truck volumes. Bottlenecks were classified from low to severe as shown in Figure 21. Locations that had both high levels of congestion and high truck volumes were considered to be *severe freight bottlenecks* (see Figure 22). Conversely, locations with low traffic congestion and low truck volumes were considered to be *low freight bottlenecks*. The information on bottlenecks will be used to help identify areas that need improvements in the future to improve traffic flow.

The threshold ranges used to determine the levels of congestion and truck activity are as follows:
Truck volumes:

- High – 2000 or more trucks per day.
- Medium – 1000 to 1999 trucks per day
- Low – Less than 1000 trucks per day.

Congestion:

- High – Modeled volume to capacity ratio (V/C) of 1.2 or greater
- Medium – V/C ratio between 1.05 and 1.2
- Low – V/C ratio between 0.9 and 1.05

FIGURE 19: 2030 AM PEAK HOUR CONGESTION

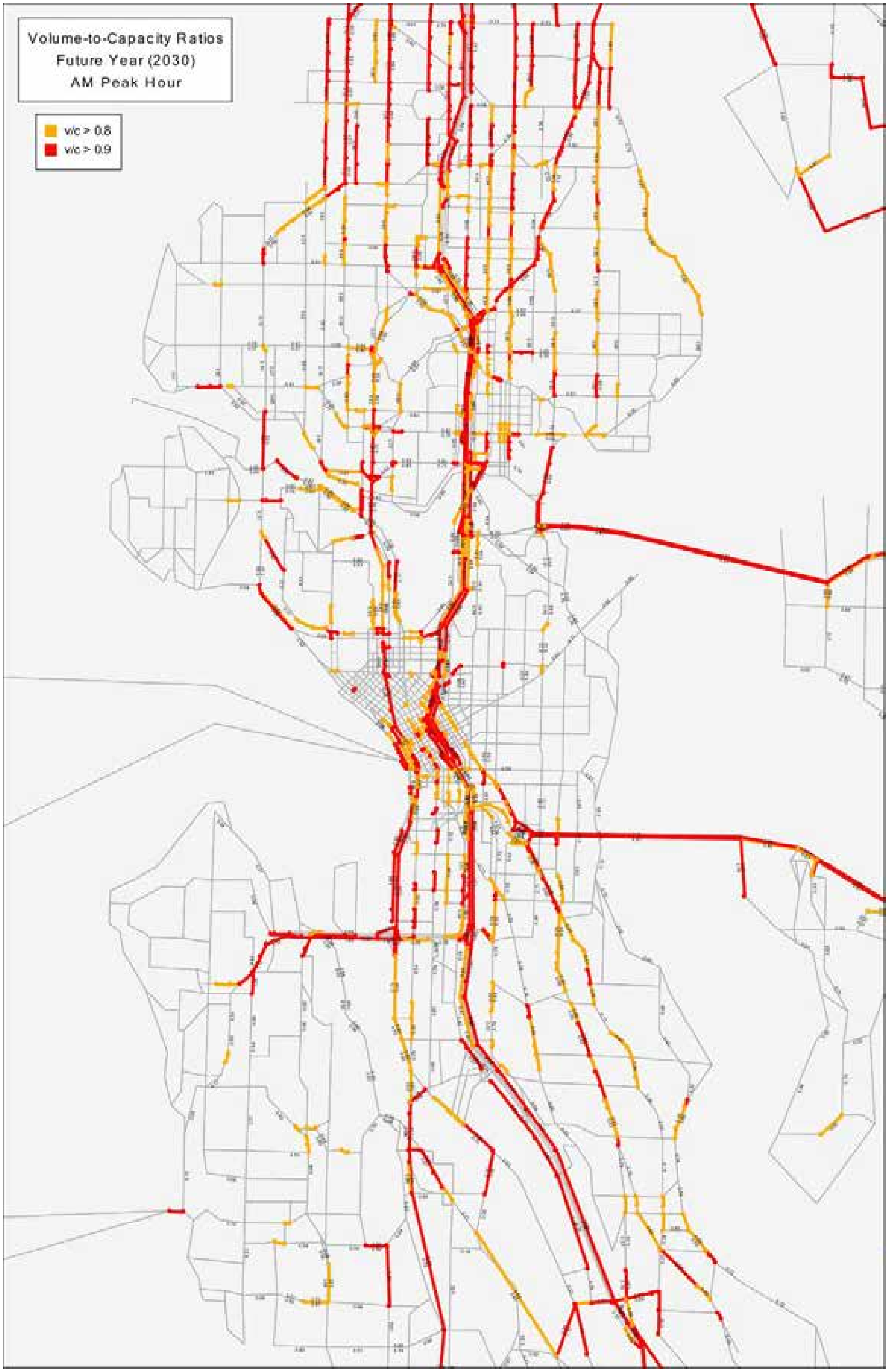


FIGURE 20: 2030 PM PEAK HOUR CONGESTION

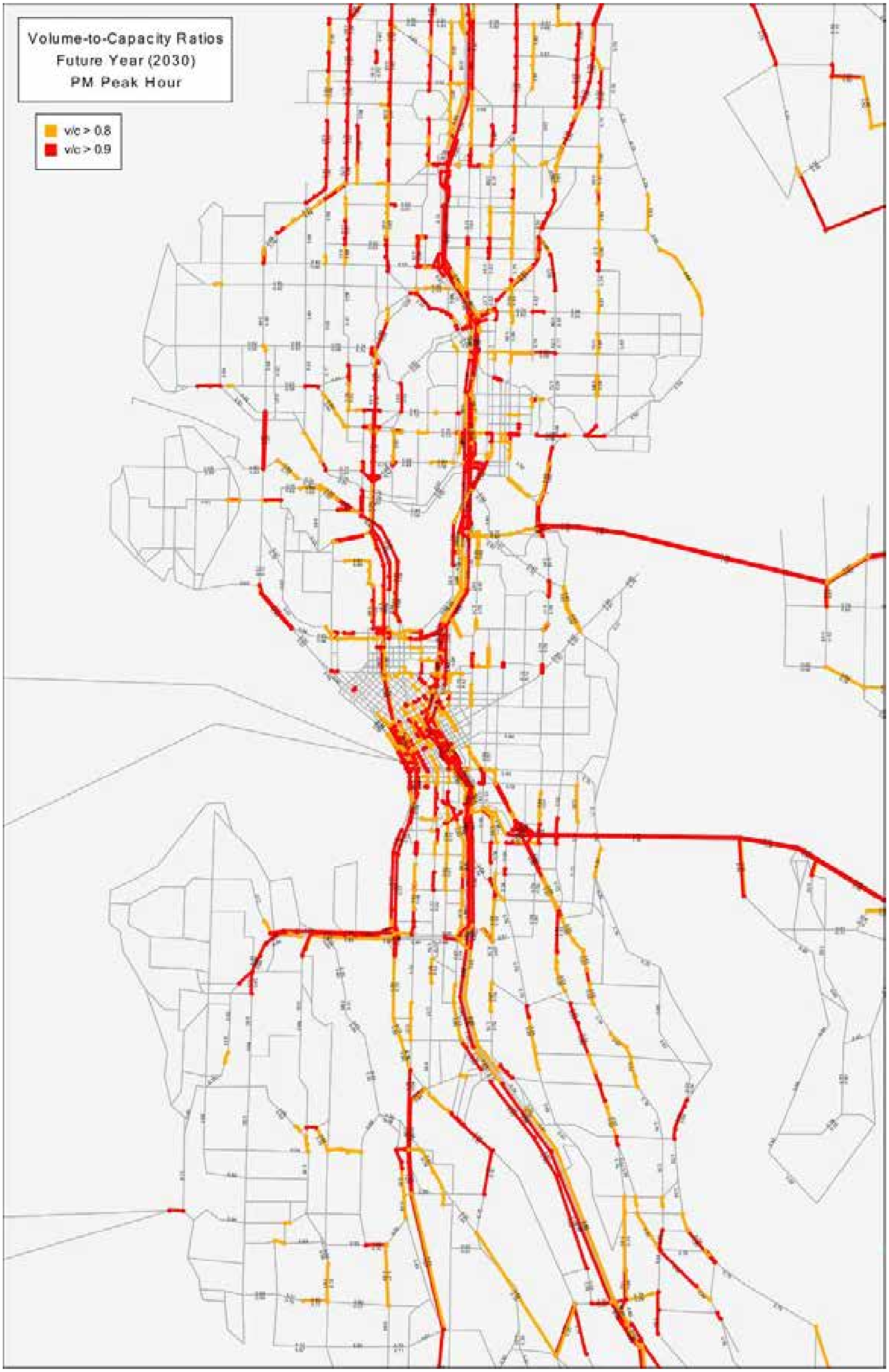
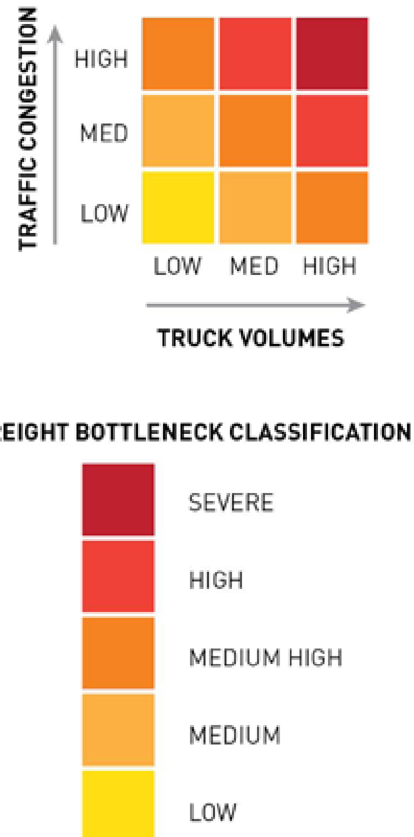


FIGURE 21: FREIGHT BOTTLENECK CLASSIFICATIONS



Congestion used for this evaluation is from the AM Peak hour because the AM period is typically more critical for freight movement. The congestion measure includes volume to capacity ratios that are greater than 1 which means there is more demand for these facilities than is currently able to be served by the existing roadway for the time period in question and, as noted in the previous section, this means in reality these vehicles would likely use an alternate route or wait until traffic is moving again before using the road. In congested areas, it is common that there is more demand than capacity for some roads.

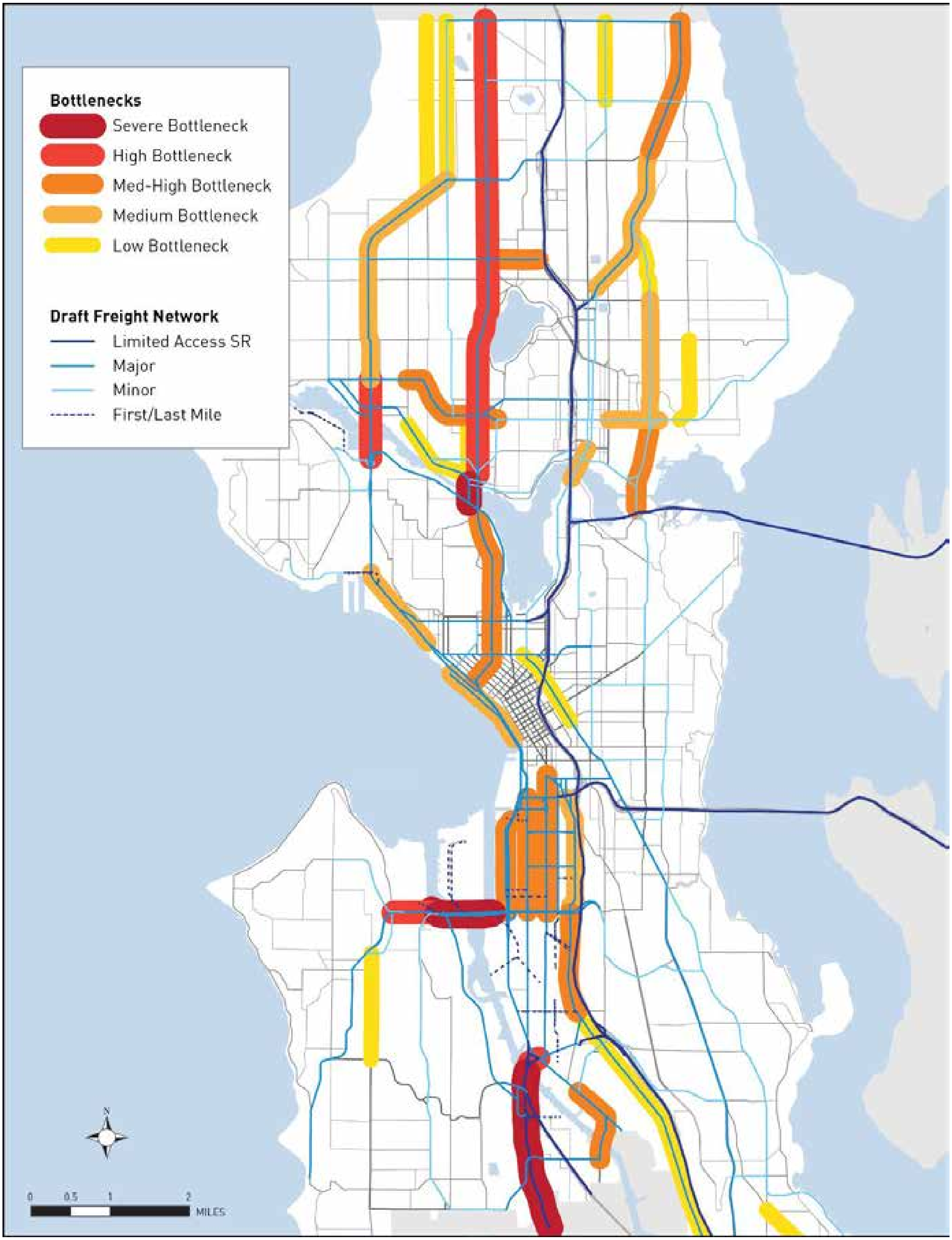
This analysis helped identify and rank severity of the traffic bottlenecks as it pertains to freight movement throughout the city. Results are shown in Table 1 and mapped in Figure 22: Truck Bottlenecks & Issues.

These bottlenecks show areas with high need of freight improvements. These were then combined with locations that experience safety issues related to truck travel to identify other sites that may need improvements to facilitate truck movements. Safety is discussed in detail in the next section; however, it is notable that many of the highest truck related crash locations also correspond with the most congested corridors.

TABLE 1: BOTTLENECKS ON SEATTLE'S TRANSPORTATION NETWORK

Severity and Location	
Severe	
Fremont Bridge	1st Ave S Bridge
West Seattle Bridge	S Spokane St
High	
15th Ave/Ballard Bridge (Nickerson St to Market St)	Aurora Ave N (north City limits to Ship Canal)
Medium-High	
E Marginal Way	N 85th St
Airport Way S	N 46th St
Montlake Blvd NE	16th Ave S
Lake City Way NE	1st Ave S
4th Ave S	15th Ave W
Montlake Bridge	Aurora Avenue N (south of Ship Canal)

FIGURE 22: TRUCK BOTTLENECKS & ISSUES



SAFETY

Vehicle collisions occur throughout the city and they have a high cost for all roadway users. The State of Washington has a Target Zero plan in place for highways with the goal of zero traffic fatalities and zero serious injuries by the year 2030. SDOT is implementing a similar plan called Vision Zero. Collisions involving trucks are perhaps even more of a concern, in that due to the relative size of vehicles, collisions can be disproportionately damaging.

A recent study conducted by SDOT, "Seattle Industrial Areas Freight Access Project", indicates that in the city's industrial areas, truck collision rates (measured in number of collisions per million vehicle miles travelled (MVMT)) are slightly lower than all vehicle collision rates. Though analysis performed for the Freight Master Plan indicates that on a city wide level, truck collision rates are relatively similar to all vehicle collision rates.

CITY WIDE COLLISION STATISTICS

Table 2 summarizes collisions in the city for all vehicle types by severity category over the past five and one-half years. Over this period, while the number of collisions by individual category per year fluctuates, the overall number of collisions has remained relatively constant. This is likely due to a number of reasons, but the fact that total vehicle miles of travel (VMT) has also not increased significantly over this timeframe is probably the most substantial reason.

Over the past five and one-half years, over 60% of total collisions in the city resulted in vehicle damage only, meaning there were no reported injuries as a result of the crash. Roughly a quarter of the collisions resulted in an injury, though less than 0.2% of total collisions involved a fatality.

TABLE 2: ALL MOTOR VEHICLE COLLISIONS BY YEAR AND SEVERITY

Year	Fatality	Serious injury	Injury	Property Damage Only Collision	Unknown	Grand Total
2009	24	200	3377	8354	1317	13272
2010	18	177	3228	7523	1151	12097
2011	10	140	3096	7810	1364	12420
2012	19	177	3464	7446	1861	12967
2013	22	156	3320	7582	1754	12834
2014*	6	59	1394	3373	169	5001
Grand Total	**99**	**909**	**17879**	**42088**	**7616**	**68591**
% of Total	**0.14%**	**1.3%**	**26.1%**	**61.4%**	**11.1%**	

*Through June 7, 2014

Table 3 summarizes truck collisions in the City. It shows that truck collisions have actually increased very slightly in 2013 compared to the previous years, which may correspond to increased goods movement as a result of the economic recovery. Over 78% of truck collisions resulted in property damage only (compared to 60% for all vehicles) and just less than 20% resulted in injuries (compared to 25% for all vehicles). However, while those numbers compare favorably to all vehicle collisions there were proportionately more fatalities as a result of truck collisions (about 0.3% of total truck collisions). The slightly greater propensity for fatalities in collisions involving trucks may be due to the sometimes significant differences in sizes of vehicles involved in truck collisions, particularly truck collisions with other modes (i.e., passenger cars, bicycles or pedestrians).

TABLE 3: TRUCK COLLISIONS BY YEAR AND SEVERITY

Year	Fatality	Serious injury	Injury	Property Damage Only Collision	Unknown	Grand Total
2009	1	4	99	502		606
2010	1	8	87	448	1	545
2011		5	85	391		481
2012	4	8	92	449	2	555
2013	2	6	124	311	38	481
2014*		1	44	101	8	154
Grand Total	**8**	**32**	**531**	**2202**	**49**	**2822**
% of Total	**0.3%**	**1.1%**	**18.8%**	**78.0%**	**1.7%**	

*Through June 7, 2014

Table 4 shows truck collisions by type of truck. Collisions involve all types of trucks, but over 60% of incidents are smaller trucks. This corresponds to data from the regional Travel Demand Forecasting model that indicates that single unit trucks account for approximately two-thirds of the truck vehicle miles traveled (VMT) within the City of Seattle.

TABLE 4: TRUCK COLLISIONS BY TRUCK TYPE AND SEVERITY

Collision Severity	Truck (Flatbed, Van, etc)	Truck and Trailer	Truck Tractor	Truck Tractor and Semi-Trailer	Double Trailer Combinations	Grand Total
Fatality	4	1		2	1	8
Serious Injury	24	3		5		32
Possible or Evident Injury	360	35	13	119	4	531
Property Damage Only	1330	186	66	601	19	2202
Unknown	28	8	1	11	1	49
Grand Total	**1746**	**233**	**80**	**738**	**25**	**2822**
% of Total	**62%**	**8%**	**3%**	**26%**	**1%**	

Table 5 shows the percentage of total collisions (all vehicles) that involved trucks by severity type. Overall, collisions involving trucks range from 4 to 5 percent of all collisions in the city. This is also generally consistent with results from the regional Travel Demand Forecasting model which indicates that trucks account for just over 4 percent of the VMT traveled in the city.

There was a relatively high share of truck collisions that resulted in fatalities in 2012 and 2013. While these stick out as outliers that warrant further investigation, there does not seem to be a pattern or vicinity more prone to these fatal collisions. The total 5 ½ year period results indicate that on average trucks represent a higher proportion of fatal collisions (8.1 percent) as compared to overall traffic than any other type of collision. As discussed earlier, this may be due to the sometimes significant differences in sizes of vehicles involved in truck collisions. Freight stakeholders noted the challenges of interacting with other modes, particularly in terms of predictability in terms of their movements.

TABLE 5: PERCENTAGE SHARE OF TRUCK COLLISIONS WITH RESPECT TO OVERALL COLLISIONS

	Fatality	Serious Injury	Injury	Property Damage Only Collision	Unknown	Grand Total
2009	4.2%	2.0%	2.9%	6.0%	0.0%	4.5%
2010	5.6%	4.5%	2.7%	6.0%	0.1%	3.9%
2011	0.0%	3.6%	2.7%	5.0%	0.0%	4.3%
2012	21.1%	4.5%	2.7%	6.0%	0.1%	3.7%
2013	9.1%	3.8%	3.7%	4.1%	2.2%	3.1%
2014*	0.0%	1.7%	3.2%	3.0%	4.7%	4.1%
Grand Total	**8.1%**	**3.5%**	**3.0%**	**5.2%**	**0.6%**	**4.5%**

*Through June 7, 2014

Location Specific Collisions

Figure 23 shows locations of truck collisions in the city that occurred from 2009 through mid-2014, and specifically identifies those that occurred between trucks and non-motorized modes—bicycles and pedestrians. Each dot in the figure represents one collision. As shown in the figure, while truck collisions occur throughout the city, incidents that involve trucks and either bicycles or pedestrians are particularly concentrated in the CBD and University District, as well as other neighborhood centers such as Fremont, Belltown, SoDo, Capitol Hill (along Broadway) First Hill (along 12th Avenue), and Columbia City (along MLK Jr. Way S and Rainier Avenue S). These and other urban village areas are where there are generally high numbers of walkers and bicyclists in combination with high truck traffic volumes.

Figure 24 identifies truck collisions city wide by intersection or other conflict point for 2009 through mid-2014. As represented by the two largest circles in the figure, high truck collision locations (with greater than 1 collision per year average across the 6 year period) include the following:

- Holman Road NW/Greenwood Avenue N
- Valley Street/Fairview Avenue N
- SR 99 and the Western/Battery Street ramps
- SR 99 north of the WOSCA detour (near Main Street)
- SR 99 south of the WOSCA detour (near Edgar Martinez Drive S)
- S Horton Street/4th Avenue S
- SW Spokane Street/West Marginal Way SW
- S Spokane Street/East Marginal Way S/SR 99
- S Spokane Street/1st Avenue S
- S Spokane Street/4th Avenue S
- Diagonal Avenue S/SR 99
- S Dawson Street/4th Avenue S
- East Marginal Way S/SR 99/1st Avenue S
- S Michigan Street/East Marginal Way S

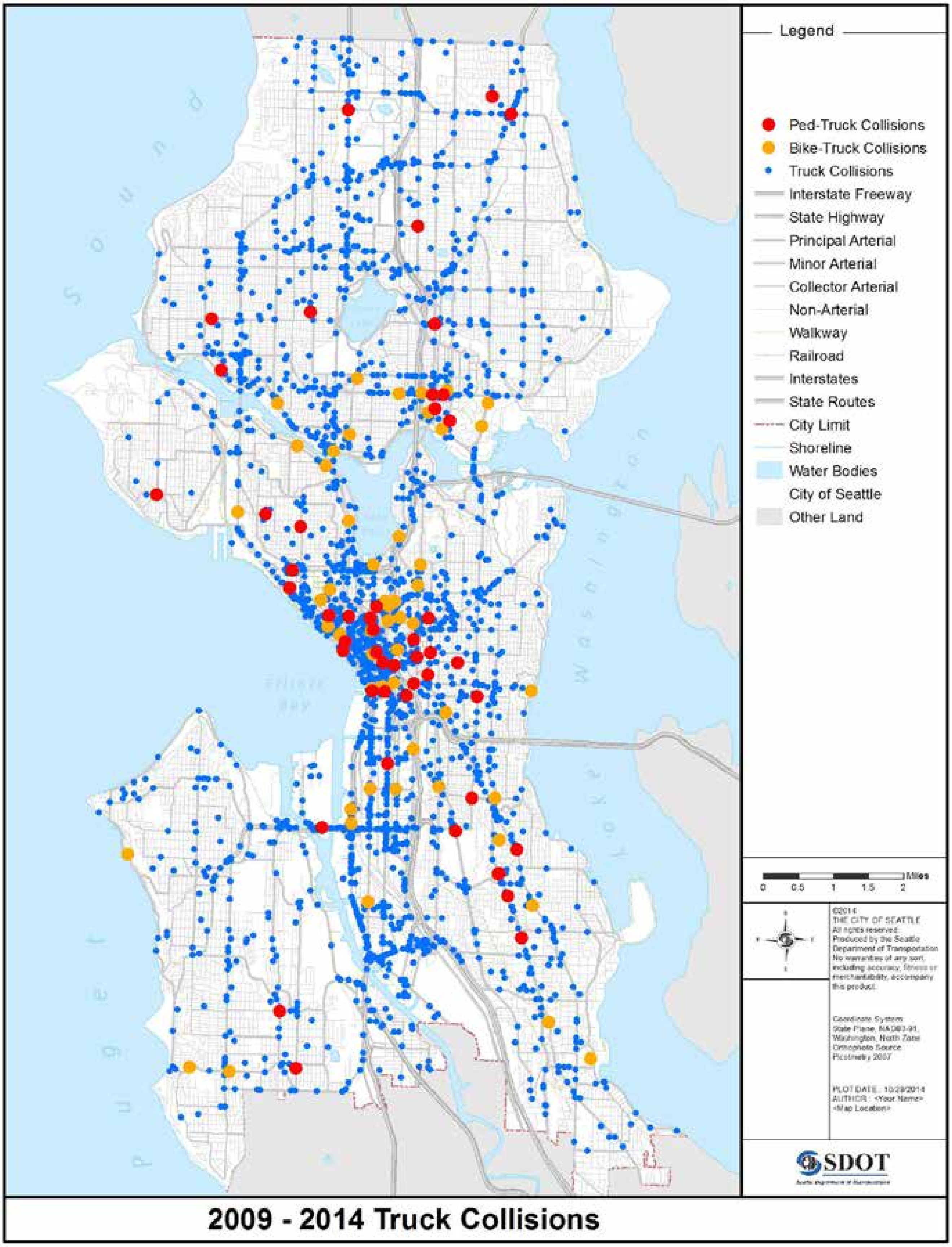
Corridors or sub-areas experiencing a relatively high concentration of truck collisions (with 10 or more collisions within a half block) are shown in Table 6.

TABLE 6: TRUCK COLLISION – HIGH CONCENTRATION SEGMENTS

Segment
North
15th Avenue NW*
NW Market Street* and NW Leary Way northwest of Ballard Bridge
NE 50th and NE 45th Streets near I-5
Aurora Ave north of Greenlake
Downtown Area
Mercer*/Roy/Broad/Valley Streets between 5th Avenue N and Fairview Avenue N
Boren Avenue between Denny Way and Pike Street
1st Ave S / Yesler Way
I-5 ramps/James Street
South
S/SW Spokane Street between Delridge Way SW and I-5
1st Ave S / South Holgate St
SR 99 between S Dawson Street and First Avenue S Bridge*
S Michigan Street between SR 99 and I-5

*Segment includes a top ten crash location listed in Figure 24.

FIGURE 23: TRUCK COLLISIONS BY MODAL TYPE BY LOCATION – 2009 THROUGH MID-2014



Many of these corridors correspond to areas with high truck activity as shown on the daily truck flow map (Figure 6), such as the Duwamish and Ballard/Interbay MICs. These high collision segments are also shown graphically in Figure 24.

Areas with high concentrations of truck collisions without high truck activity (less than 1000 trucks per day) include:

- NE 45th Street near I-5
- Broad Street between Denny Way and Alaskan Way
- Wall St between 4th and Alaskan Way

These locations merit further investigation as to the cause of the higher concentration of truck collisions.

In order to further understand the potential causes of truck collisions, the truck crash locations were overlaid on collisions involving all vehicles. Collisions by intersection over the same time period for all vehicles in comparison to those involving trucks are shown in Figure 25 and Figure 27 for north Seattle plus the CBD, and for south of the CBD, respectively.

Aggregating crash incidents at intersections and conflict points highlights some areas and corridors that have relatively high truck crash incidents. In general, high truck crash locations correspond with high vehicle crash locations except in industrial areas such as Duwamish where high truck volumes exist.

Overall, locations with high truck collisions correspond to facilities that also have a high volume of trucks. To identify more specifically high truck collision locations relative to the amount of truck activity at that particular location, a truck collision index was calculated. The index is a function of the number of collisions at a given intersection or conflict point divided by daily truck volumes through that location. Table 7 lists high crash locations and their corresponding collision index. Figure 28 shows these locations on a map, in combination with the high collision segments discussed previously.

TABLE 7: HIGH TRUCK COLLISION INDEX LOCATIONS

Rank	Annual Trucks	Truck Collisions Per Year	Collisions Per Million Trucks	Site Description
1	146,000	1.66	11.4	Fairview Ave N & Valley St
2	365,000	2.03	5.4	SR-99 & Diagonal Ave S
3	255,500	1.29	4.9	15th Ave W & NW Market St
4	292,000	1.47	4.8	Yesler Way & James St
5	365,000	1.66	4.7	S Jackson St & Alaskan Way S
6	182,500	0.74	4.0	University St & 6th Ave
7	547,500	1.66	3.1	SR-99 & SR-509 Junction
8	255,500	0.74	3.0	S Dearborn St & Rainier Ave S
9	365,000	1.10	3.0	SR-99 & S Idaho St
10	511,000	1.47	2.9	Highland Park Way & 2nd Ave SW

FIGURE 24: TRUCK COLLISIONS BY INTERSECTION – ENTIRE CITY – 2009 THROUGH MID-2014

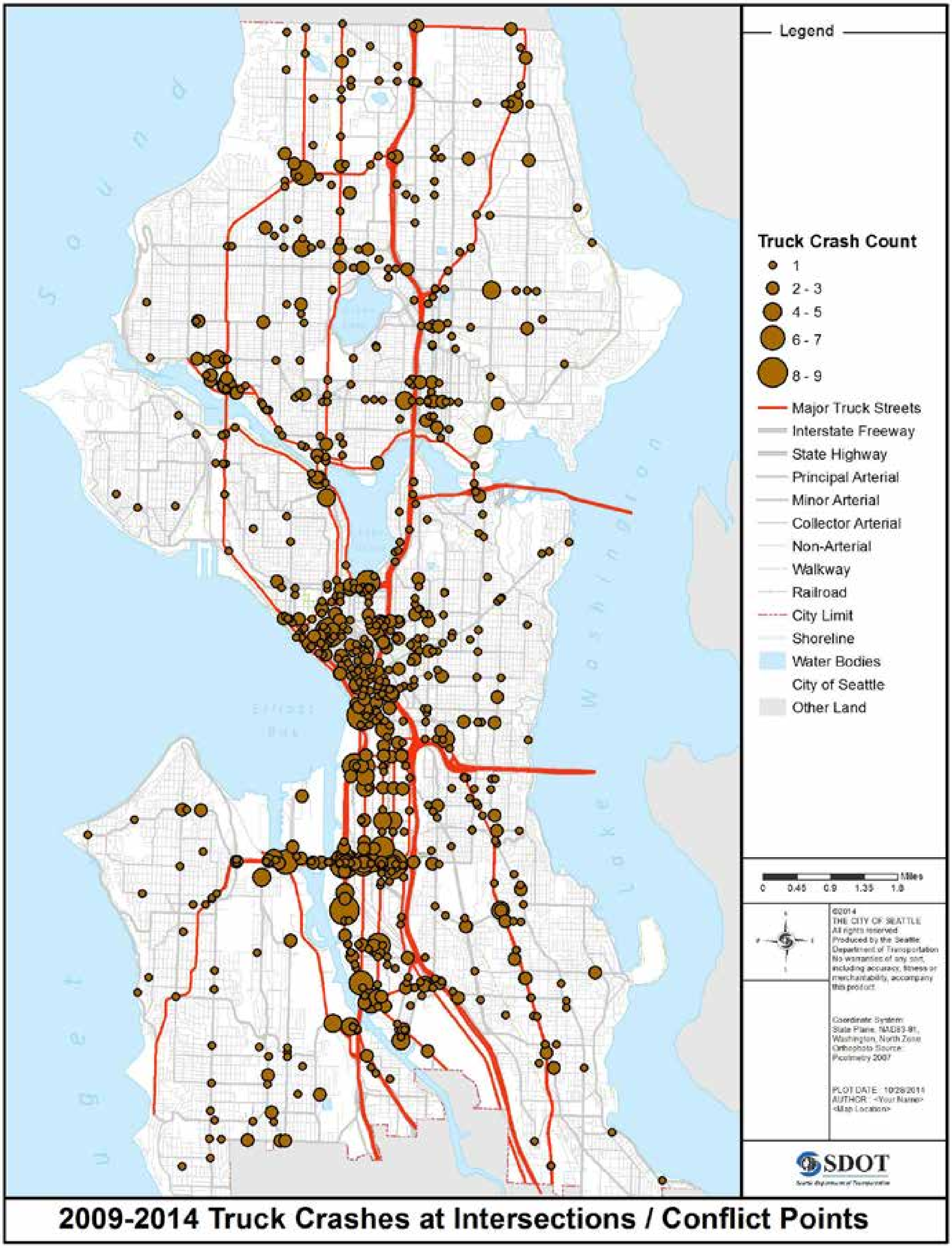


FIGURE 25: TRUCK AND ALL VEHICLE COLLISIONS BY INTERSECTION – CBD AND NORTH – 2009 THROUGH MID-2014

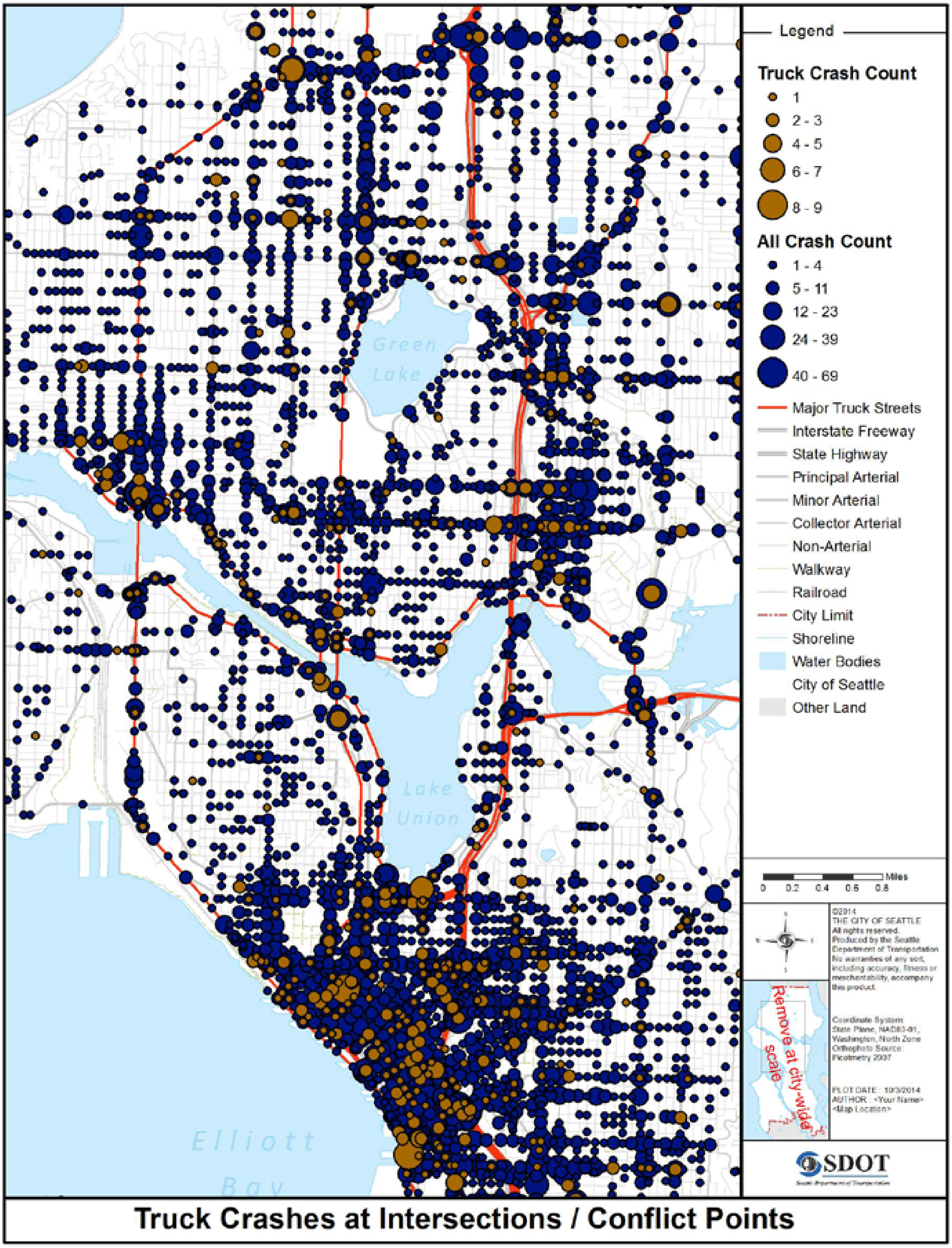


FIGURE 26: TRUCK AND ALL VEHICLE COLLISIONS BY INTERSECTION – CBD – 2009 THROUGH MID-2014

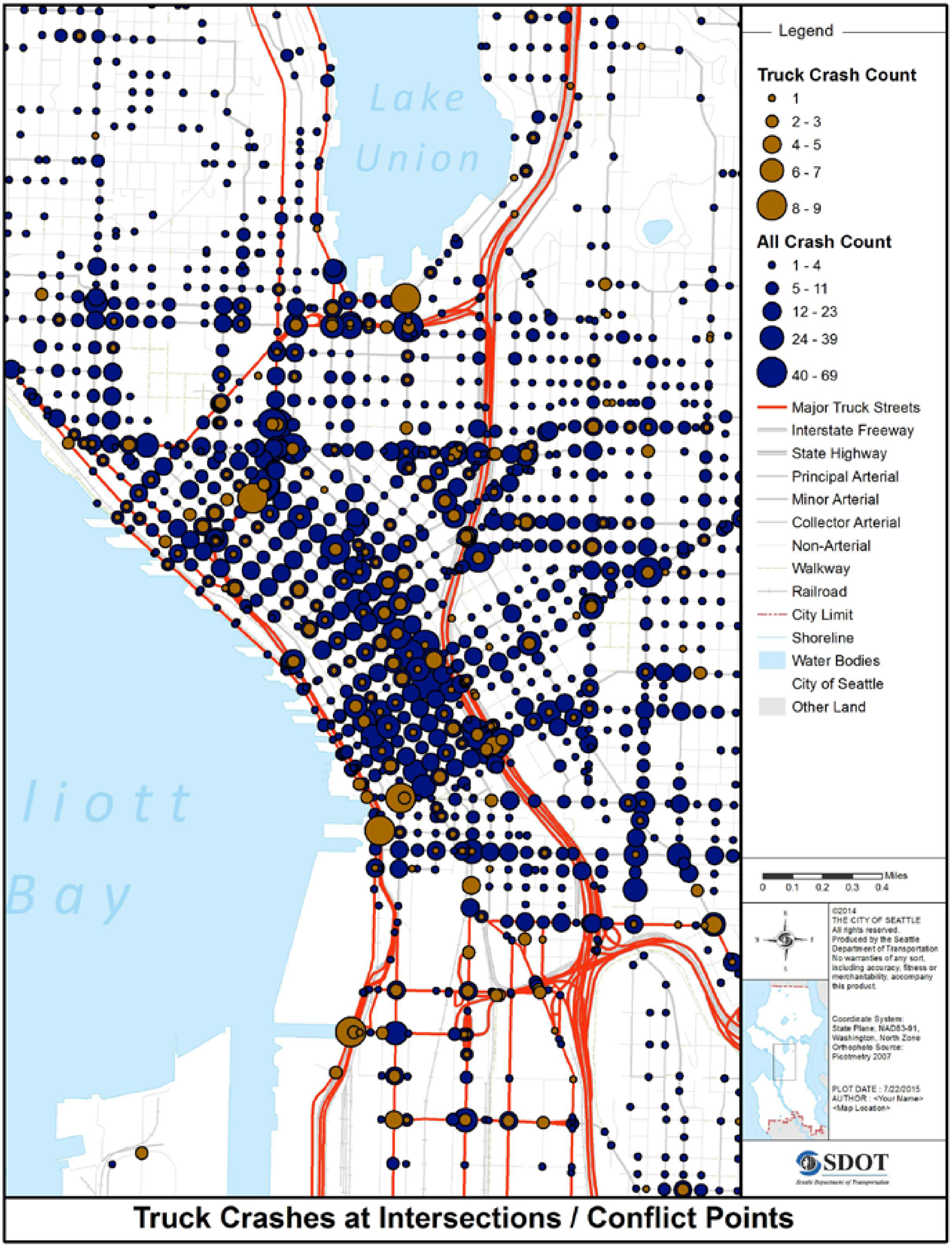


FIGURE 27: TRUCK COLLISIONS BY INTERSECTION – SOUTH OF CBD – 2009 THROUGH MID-2014

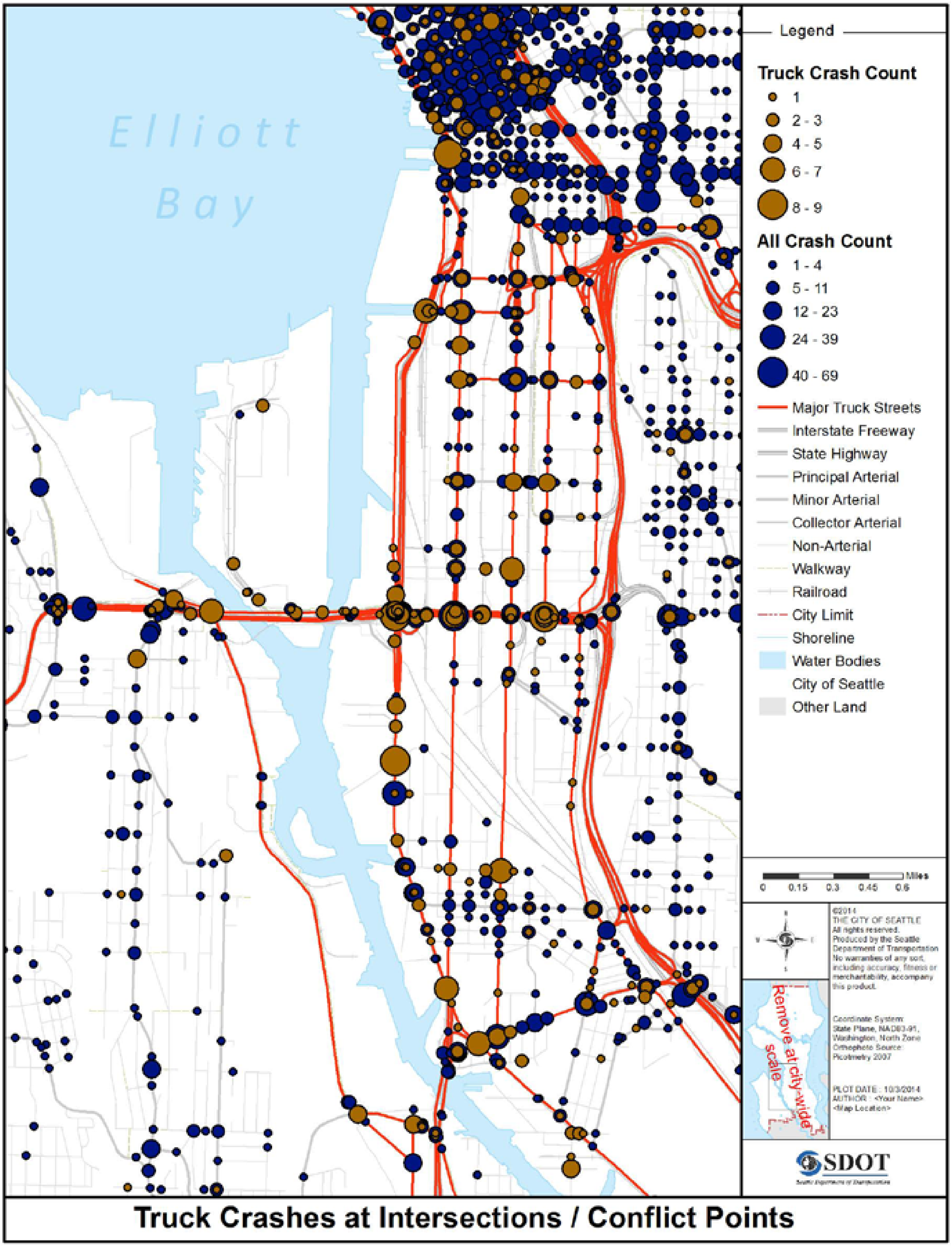
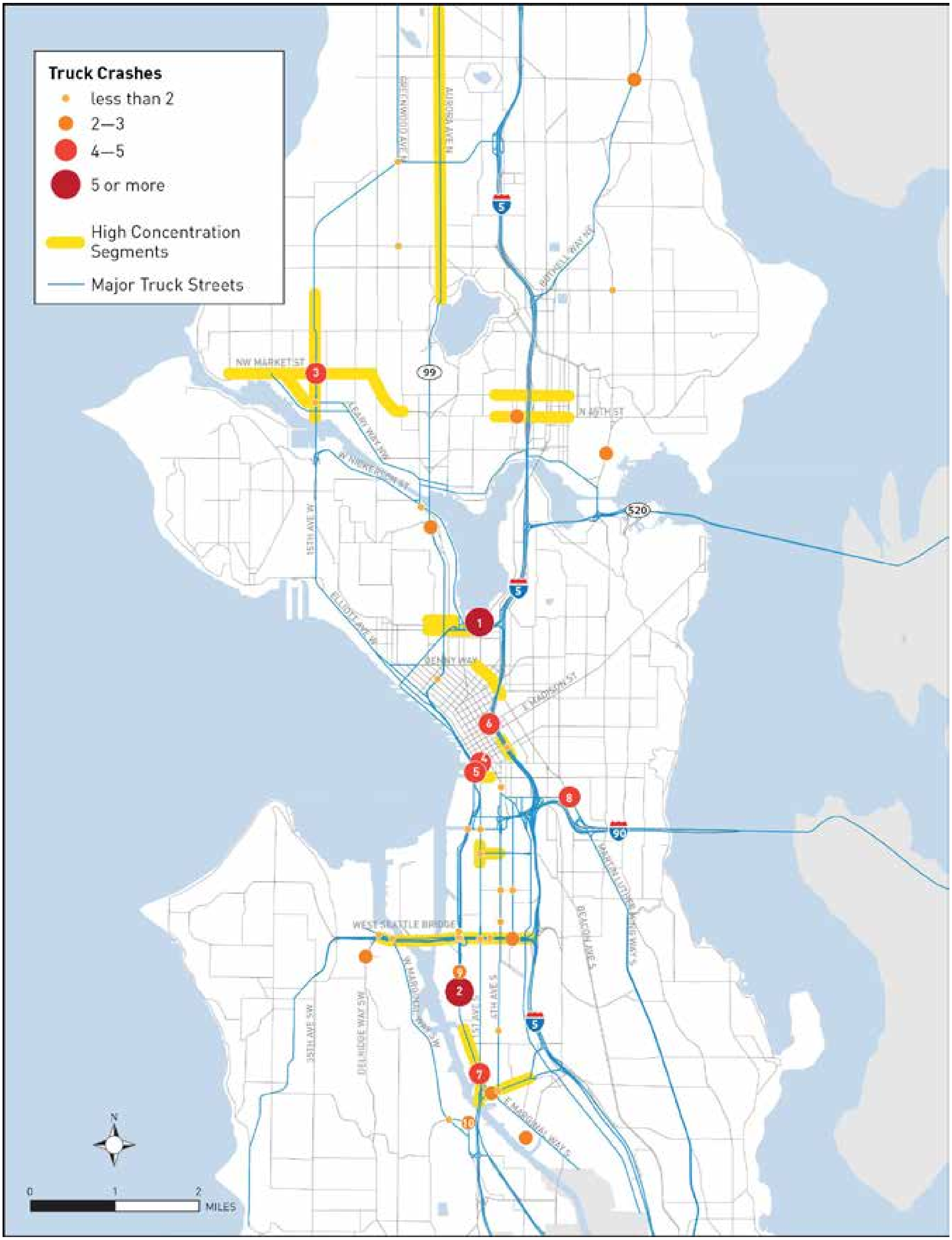


FIGURE 28: HIGH TRUCK COLLISION SEGMENTS AND TRUCK COLLISIONS PER MILLION TRUCKS



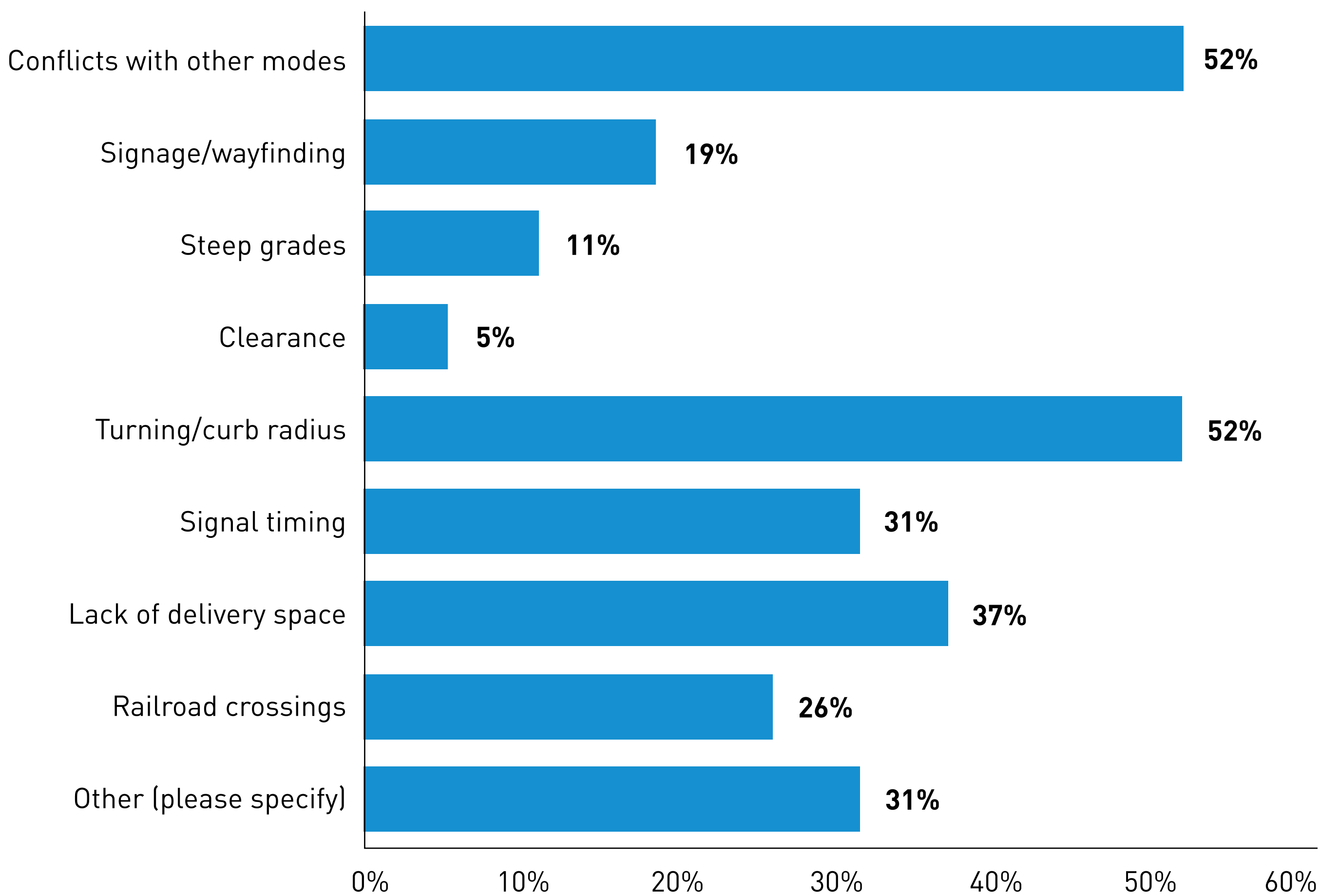
Location numbers reflect rankings as shown in Table 7

As can be seen, the site with the highest index, based on collisions per million trucks, is Fairview Avenue N at Valley Street. This intersection was formerly part of the westbound couplet to eastbound Mercer Street, and vehicles were required to make a succession of turns from I-5 to Valley Street, which may have contributed to additional sideswipe collisions involving trucks. The Mercer East project completed this past year has converted Mercer Street to two-way operation and reconfigured the Fairview Avenue N/Valley Street intersection. Therefore, it is likely that truck-related collisions at this location will decline due to these changes. Additionally, several locations on SR-99 are among the highest crash locations in the city. These include intersection with Diagonal Avenue S, SR-509 and S Idaho Street. These locations are located in a 1.5 mile long section south of the West Seattle Bridge. All have over 3000 trucks per day at the intersections.

Stakeholder Input

Stakeholder concerns about safety, summarized in Figure 29, primarily relate to conflicts with other modes and the adequacy of turning/curb radii. Curbs and turning radii are often cited as an issue in congested areas like the CBD, as trucks have limited space to make turns into lanes that are narrow. This can be a safety concern if drivers have to use the entire street to make a turn. It also can be concern if traffic has to come to a stop in an unexpected place while a truck negotiates into loading/unloading position.

FIGURE 29: STAKEHOLDER ONLINE SURVEY: TOP SAFETY CONCERNS



BICYCLE AND PEDESTRIAN CONFLICTS WITH TRUCKS

Regarding other modes, truck conflicts with bicycles and pedestrians are a primary safety concern. A review of crash data reveals that there were 2822 total truck collisions within the city of Seattle between 2009 and 2014, and of these 8 resulted in a fatality. Of these, 55 were truck-bicycle collisions, and one of those involved a fatality (see Table 8); while there were 51 truck-pedestrian collisions, with four of those resulting in a fatality (see Table 9).

TABLE 8: TRUCK & BIKE COLLISIONS

Truck-Bike Collisions	Fatality collision	Serious injury collision	Possible or evident injury collision	Property Damage Only Collision	Unknown	Grand Total
2009			4	1		5
2010		1	5			6
2011		1	3	3		7
2012		1	10	1		12
2013	1	2	15	1		19
2014			4	1	1	6
Grand Total	**1**	**5**	**41**	**7**	**1**	**55**
All Truck Collisions	**8**	**32**	**531**	**2202**	**49**	**2822**
Share	**13%**	**16%**	**8%**	**0%**	**2%**	**2%**

TABLE 9: TRUCK & PEDESTRIAN COLLISIONS

Truck-Ped Collisions	Fatality collision	Serious injury collision	Possible or evident injury collision	Property Damage Only Collision	Grand Total
2009	1		4	1	6
2010	1	2	8		11
2011		2	5		7
2012	1	1	4		6
2013	1	1	13		15
2014			6		6
Grand Total	4	6	40	1	51
All Truck Collisions	**8**	**32**	**531**	**2202**	**2822**
Share	**50%**	**19%**	**8%**	**0%**	**2%**

TABLE 10: BIKE AND PEDESTRIAN COLLISIONS BY INJURY TYPE

2009-2014	Fatality collision	Serious injury collision	Possible or evident injury collision	Property Damage Only Collision	Grand Total
Bike/Ped-Truck Collisions	**5**	**11**	**81**	**8**	**106**
All Truck Collisions	8	32	531	2202	2822
Share	63%	34%	15%	0%	4%

There were about 4000 bike and pedestrian collisions in Seattle in the 5 ½ years of data. 6% of collisions of all vehicle types involve bikes or pedestrians. As seen in Table 10, bikes and pedestrian collisions with trucks make up 4% of the total number of truck collisions.

These incidents resulted in 63% of the fatal truck collisions and 34% of the serious injury collisions, which is real cause for concern. It is not surprising to see when there are collisions between trucks and non-motorized road users, there are often injuries or even fatalities.

Regardless of fault, if any, the laws of physics mean that most if not all of these injuries or deaths are incurred by the walker or biker, rather than the truck driver.

To address these serious concerns, the plan should include recommendations to improve multi-modal safety. In addition to recommendations regarding physical modifications, driver/rider/walker education awareness and education programs should be considered. These programs can provide big benefits throughout the City at a relatively low cost.

OTHER CHALLENGES TO FREIGHT MOBILITY

SIGNAGE

Three types of truck-specific signage are used within the city: regulatory, guide, and warning signs. Guide signs are mostly focused on the Major Truck street system as shown in Figure 30. Regulatory signs include loading zone designations, parking restrictions, and weight restrictions. Examples of warning signs include bridges with height restrictions, tight turns, and steep grades. Some stakeholders mentioned signing as a safety issue in different ways: 1) if wayfinding signs are not adequate, truckers unfamiliar with the area can get lost and wind up on streets not fit for trucks, potentially creating safety issues; 2) parked cars along freight routes can impede truck travel and present safety issues. Placing and enforcing 'no parking' signage would help; and 3), one stakeholder stated that pedestrians and cyclists not paying attention while traveling are most at risk, e.g., when they have headphones on, etc. Placing signs to warn pedestrians and cyclists of heavy truck activity in the area, and encouraging them to remove their earbuds and pay attention may improve safety.

Over one third (37%) of respondents to the freight stakeholder survey were not aware of the Major Truck Street system (Figure 31) This suggests that more information for truck drivers and more on-street signage could make the Major Truck Streets more easily utilized and navigated.

Both the online and in-person stakeholder interviews indicated that signage and way-finding complications were a safely concern, particularly for drivers unfamiliar with Seattle that may find themselves in areas not suited for trucks if way-finding is lacking. Finally, stakeholders were also concerned about detour routes for construction and how easily navigable they are for truck drivers.

The Major Truck Street System should be well known to the truck drivers. Improved or additional signage that is consistent throughout the city may assist way finding for the drivers. Major truck industries should also be informed of the system and its purpose.

TRUCK MOBILITY CONSTRAINTS

Moveable Bridges

There are six bascule (draw) bridges and one swing bridge that can disrupt vehicular traffic on major arterials in Seattle. Four of these bridges—Montlake (WSDOT Owned/operated), University, Fremont and Ballard—cross the Lake Washington Ship Canal, and are a bottleneck to all north-south traffic between downtown and north Seattle. Three of the bridges—Spokane Street, First Avenue S and South Park—cross the Duwamish River. The South Park Bridge is owned by King County, but is operated by SDOT.

When bridges are open to allow a vessel to pass through, they can cause very long vehicle queues and lingering congestion. This is most prevalent during the "boating season" (late spring, summer, and early fall) when a larger number of recreational private sailboats require bridge openings. Those that cross the Ship Canal will not open for vessels under a certain size during the weekday peak commute hours. Table 11 summarizes the restrictions on each bridge. Since trucks travel throughout the day (to meet delivery times or avoid peak period congestion, when possibly), they are affected by off-peak bridge opening delays.

FIGURE 30: TRUCK SIGNAGE

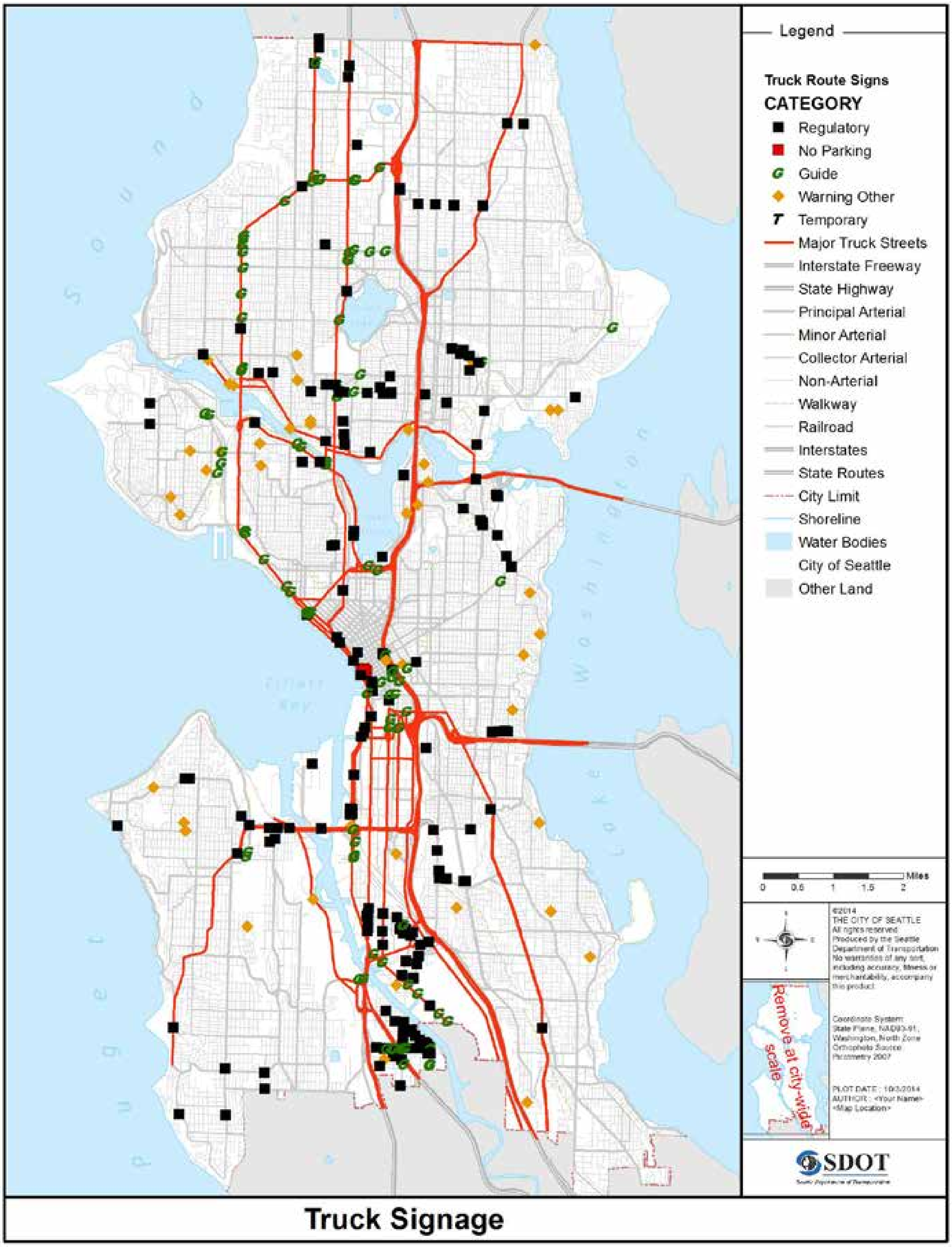


FIGURE 31: ONLINE STAKEHOLDER SURVEY - USAGE OF MAJOR TRUCK STREETS

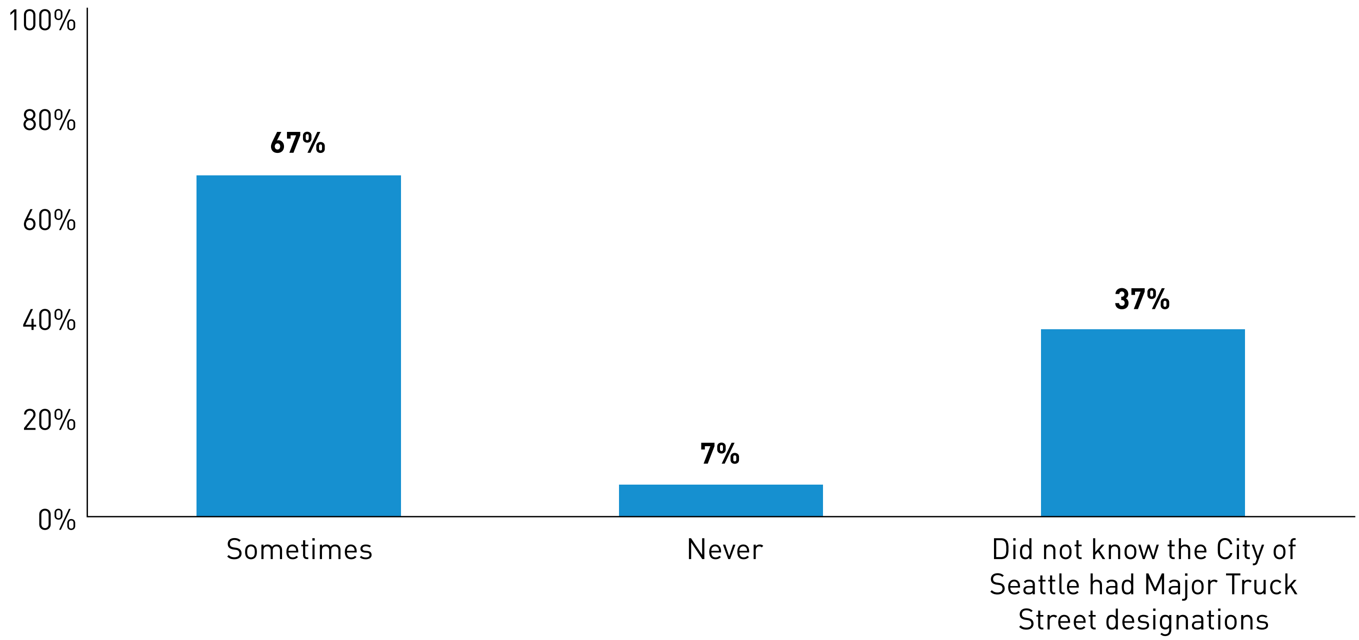


TABLE 11: SEATTLE'S MOVEABLE BRIDGES

Bridge	Owner	Weekday Restricted Period[a]	Summer Restricted Period	Exceptions for Vessels[b]
Montlake Bridge	WSDOT	7:00 -9:00 AM 3:30 – 6:30 PM	7:00 -10:00 AM 3:30 – 7:00 PM	>1,000 tons
University Bridge	City	7:00 -9:00 AM 4:00 – 6:00 PM	Same	>1,000 tons
Fremont Bridge	City	7:00 -9:00 AM 4:00 – 6:00 PM	Same	>1,000 tons
Ballard Bridge	City	7:00 -9:00 AM 4:00 – 6:00 PM	Same	>1,000 tons
Spokane Street Swing Bridge	City	No Restrictions	No Restrictions	
First Avenue S Bridge	WSDOT	6:00-9:00 AM		
3:00-6:00 PM	No Restrictions	>5,000 tons		
South Park Bridge	King County (Operated by SDOT)	6:30-8:00 AM		
3:30-5:00 PM	No Restrictions			

a. Bridge will not open for vessels during restricted period unless they exceed the exception vessel size.
b. Bridges will open, even during restricted periods, for vessels that exceed this size.[7]

[7]CFR 33 Chap. I, sub chap J, 117.1041 and 117.1051

Downtown Traffic Control Zone and Denny Way Restrictions

Trucks longer than 30 feet are prohibited from entering the Downtown Traffic Control Zone between 7:00 AM and 7:00 PM except with a permit (Seattle Municipal Code (SMC) Ordinance 108200 Section 11.14.165). The Downtown Traffic Control Zone extends from Yesler Way on the south to Lenora Street on the north and from 8th Avenue on the east to 1st Avenue on the west. The SMC also prohibits large trucks (over 30-feet long, 8 feet wide, or 32,000 pounds gross weight) from using the following three streets during the commuter peak periods (7:00 to 9:00 AM and 4:00 to 6:00 PM) (SMC 11.62.120):

- Aurora Avenue North. From the north City limits to Denny Way.
- Boren Avenue and Boren Avenue South. From Virginia Street to South Jackson Street; and
- Denny Way between Western Avenue and Olive Way;

Over-legal permit and/or validation number is required for movement within the Downtown Traffic Control Zone between the hours of 7 PM and 6 AM.

Height/Weight Restrictions

Bridge and traffic control zone travel restrictions for trucks as well as dynamic message signs are shown in Figure 32, including several bridge weight restrictions for trucks throughout the city. Most are not on Major Truck Streets, but still need to be considered for trucks making deliveries to local businesses and residences. Additionally, there will be restrictions on trucks hauling hazardous or flammable materials in the new Alaskan Way Viaduct tunnel, similar to restrictions in the current Battery St tunnel.

Rail Crossings

There are many at-grade rail crossings throughout the city, which are also shown in Figure 32. A more detailed look at the crossings, as well as the rail lines through the city, is shown in Figure 33. At-grade rail crossings can be a barrier to truck movements, with particularly large impacts in high truck activity areas such as the Duwamish MIC and Broad St crossing. For example, studies of the South Holgate Street railroad crossing have documented that the average amount of time the train gates are closed is between 11 and 13 minutes per hour throughout the day[8]. However rail movements are also vital for freight movement to/from the Port; hence prioritizing one over the other creates difficult trade-off decisions. One example of conflicts between rail and truck freight activities relates to the drayage of containers from Terminal 46 to the Seattle International Gateway (SIG) yard to load them on trains. The most direct route between Terminal 46 and the SIG is via South Atlantic Street. However, loading the trains at SIG requires the use of a tail track that crosses Atlantic Street. This blockage has lasted for up to 30 minutes in the past and has significantly impeded the drayage movements. As part of the Alaskan Way Viaduct Program however, a grade separated bypass over the tail track was built which is now used by trucks whenever the tail track is occupied by trains, greatly reducing delay to trucks.

While this one issue has been resolved, other conflicts remain. Stakeholders are particularly concerned with the number of at-grade rail crossings in the SoDo and Port areas—such as the rail crossing of South Holgate Street. They would like to see select crossings grade separated to make travel times more reliable for freight trucks.

[8]South Holgate Street Railroad Crossing Study – Phase II Final Report, SDOT, January 2010.

Geometric Constraints

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

This concern would need to be addressed carefully and balance the needs of freight against residential livability. While all streets need to allow local deliveries, many local arterial streets are not appropriate for very large trucks. It would be appropriate to prioritize improvements to arterials that are on the truck network in order to encourage large trucks to stay on those facilities. Detours during construction or due to collisions should consider truck mobility of all sizes, especially if the detour is off of a Major Truck Street.

Curbspace (Delivery)

Stakeholders noted the lack of loading zones and other curbside spaces as a major challenge for goods delivery in some areas. Drivers often circle the block looking for spaces to unload. This seems to primarily be an issue in downtown Seattle, the University District, and Capitol Hill. Figure 34 shows the loading zones in Downtown Seattle. Note that alleyways are also usable for deliveries in some cases but are most critical for waste management trucks.

As can be seen, there is fairly limited space in downtown for any type of parking. Office towers usually have their own loading space underneath the building, but that is not always the case. Often, loading zones are limited to the on-street designated 30-minute load spaces. Typically there are at least 1 or 2 and sometimes up to 6 designated loading areas around a city block. But there are some cases where there are not any on-street designated loading zones. An example would be at Westlake Center between 4th and 5th Avenues, Pine Street, and Olive Way.

Due to the serious stakeholder concerns and the severe limits on curbspace loading zones, this issue merits further exploration. Specific locations of high concern should be identified as part of this plan. Additionally, SDOT should consider further work regarding the restrictions and locations throughout the city, perhaps as part of other on-going studies.

INTERFACE/CONFLICTS WITH OTHER MODAL PLANS

City streets designated as Major Truck Streets often have been recommended as priority streets for other modes as well. Generally, freight corridors are major arterials that are also ideal routes for transit because they provide fast, direct access between key activity centers. Conflict points between buses and trucks could potentially occur at bus stops where there may be inadequate room for buses to stop and trucks to pass. Additionally, pedestrians walking to and from the bus stop may need to cross the street which could result in modal conflicts as well.

Figure 35 shows modal recommendations of city streets and where truck street designations overlap with other modes. Streets designated as both freight and transit corridors include:

- 1st Avenue S
- 4th Avenue S
- 15th Avenue W
- N 105th Street
- Aurora Avenue N
- Fauntleroy Way SW
- Greenwood Avenue N
- Leary Way NW
- Westlake Avenue N

FIGURE 32: FREIGHT MOBILITY CONSTRAINTS

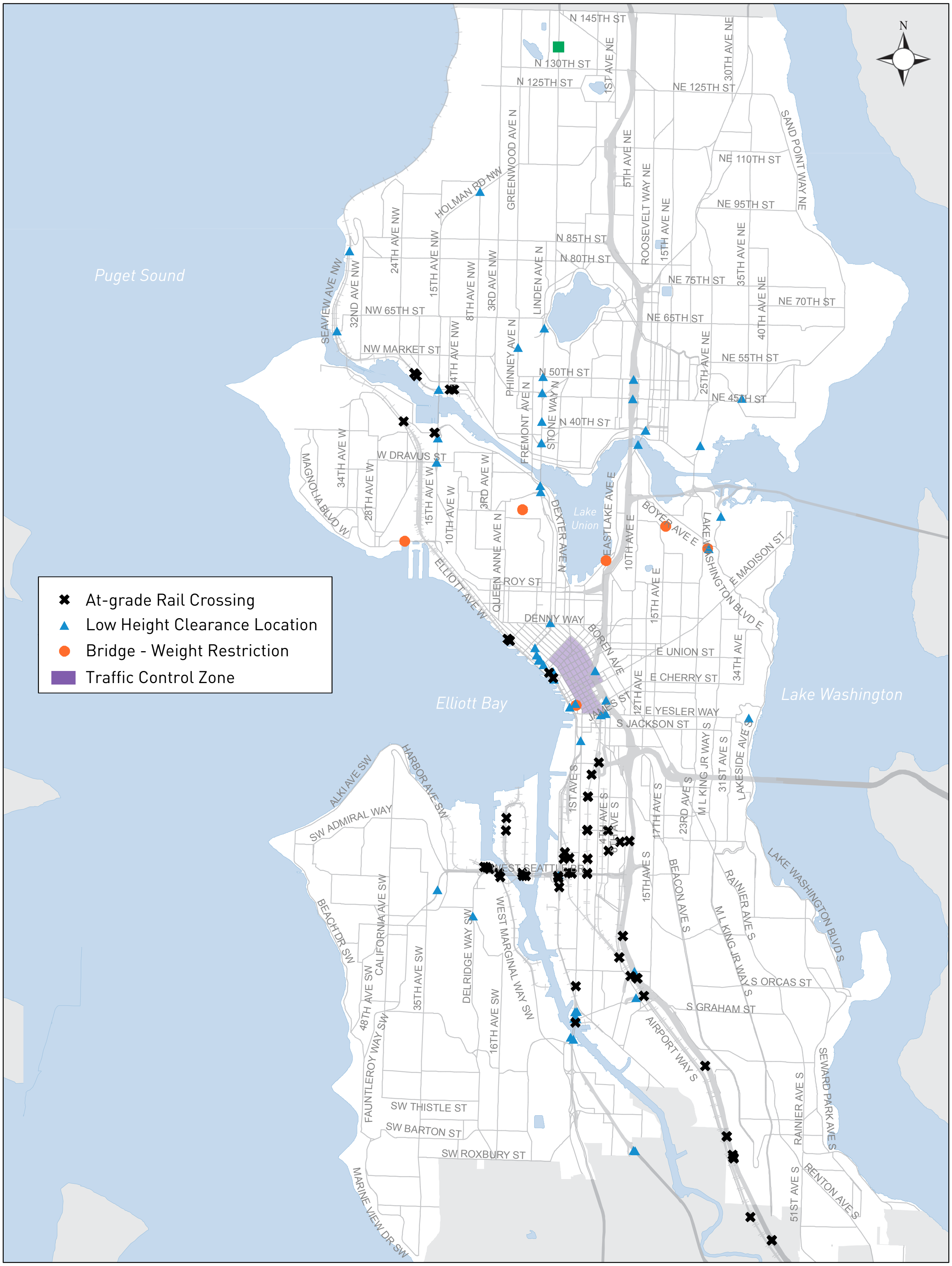


FIGURE 33: RAIL CROSSINGS AND FACILITIES

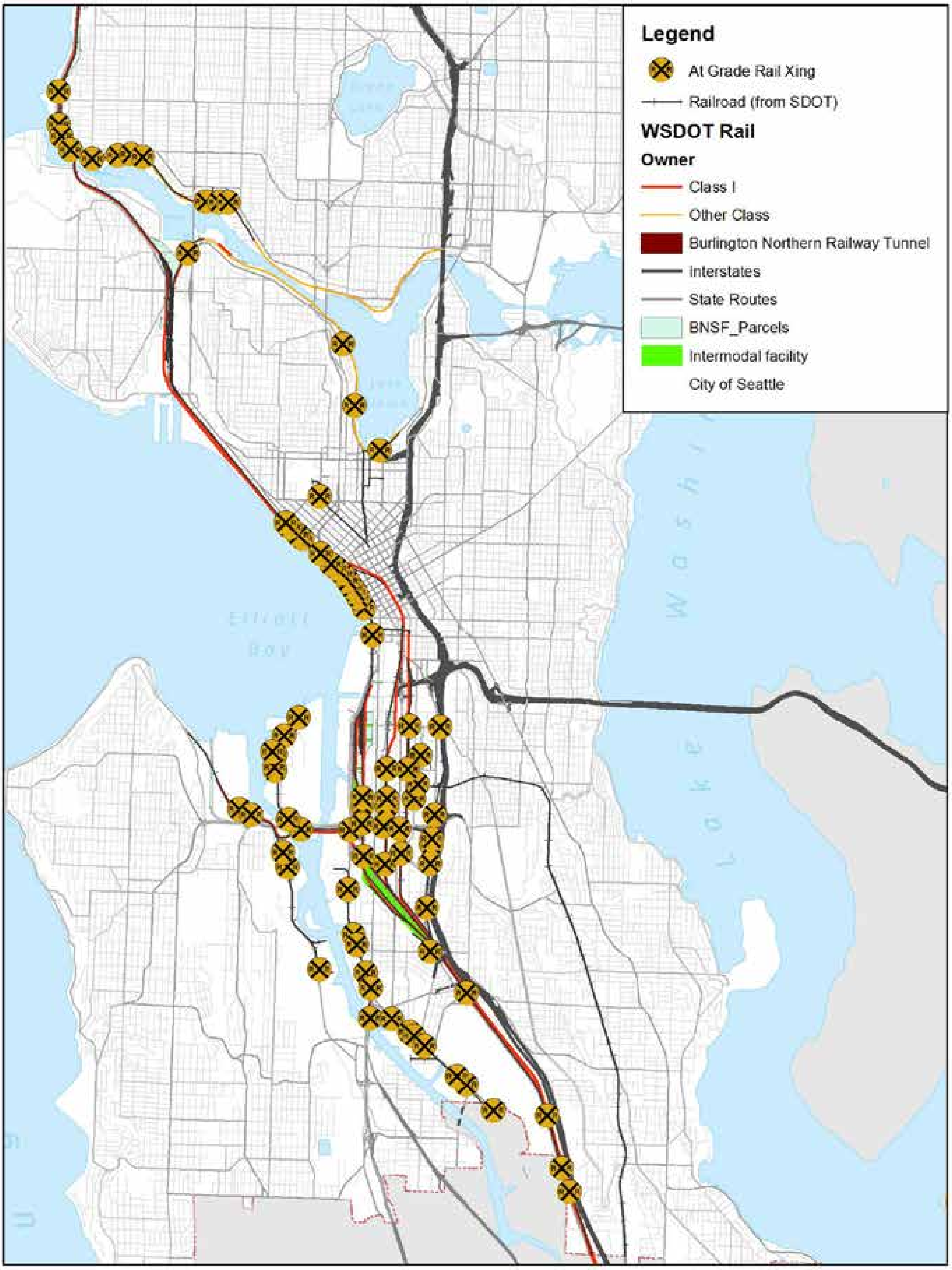
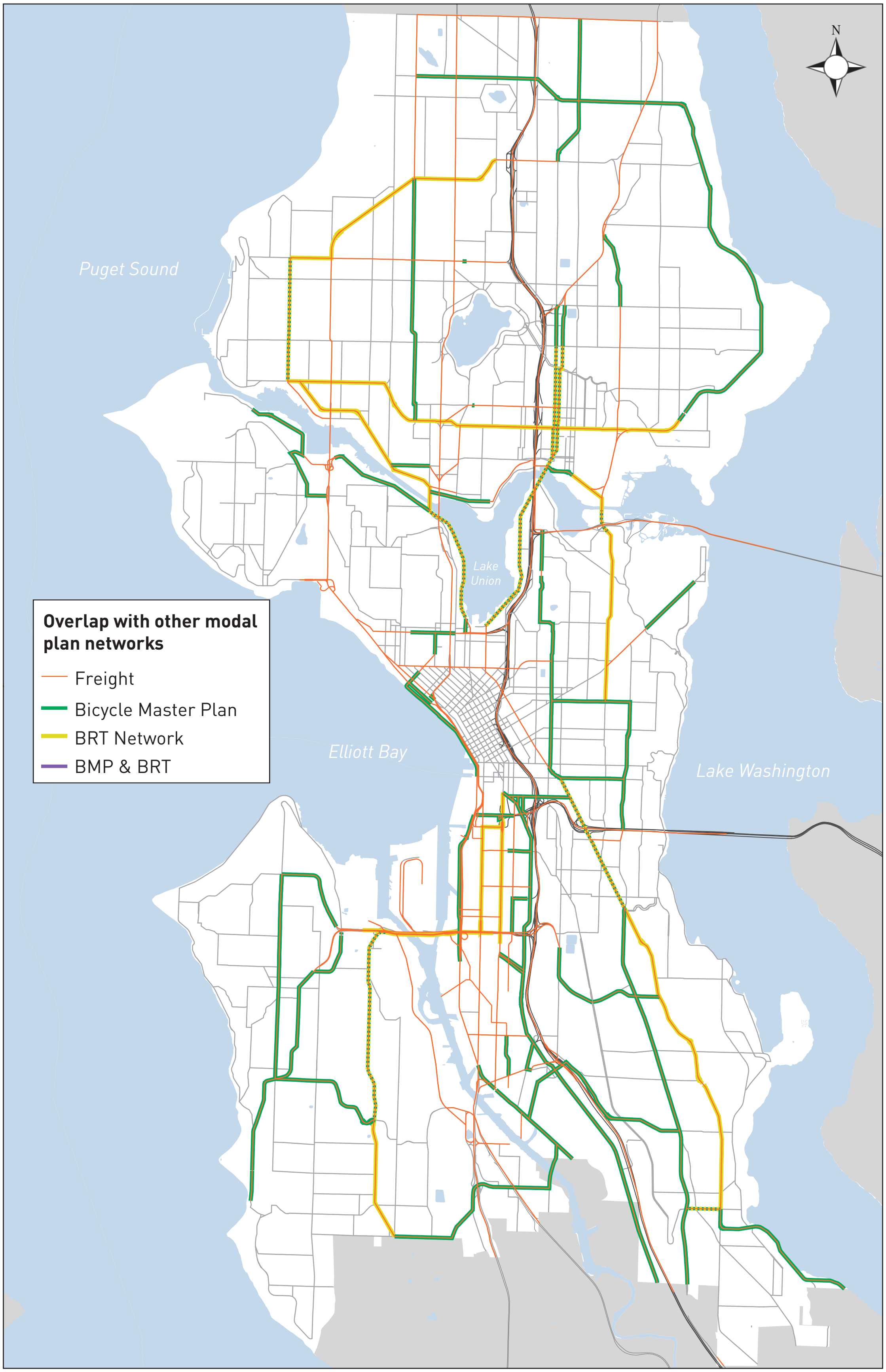


FIGURE 34: DOWNTOWN SEATTLE LOADING ZONES

FIGURE 35: STREETS BY MODAL DESIGNATION



Occasionally, bike facilities are on the same street as truck routes. This may not always be optimal for bicyclists as trucks require more space on the road and have numerous blind spots. Safety concerns, whether real or even imagined, will prevent some bicyclists from using these facilities. Protected bicycle lanes on a street that is also a designated Major Truck Street would provide the most predictability of movement of both modes. This could be accomplished by providing adequate buffers, or curb-separated bicycle lanes, between the travel lane and the bicycle facility.

Streets recommended as both freight and bicycle routes include:

- Alaskan Way
- Airport Way S
- Fauntleroy Way SW
- Rainier Avenue S
- Westlake Avenue N (parking lot areas for bicyclist and not the travel lanes)

Streets recommended as corridors for all three modes (freight, bicycle and transit) can present even further challenges. These facilities include:

- M L King Jr Way S
- W Nickerson Street

These facilities should be considered further in this plan. Where serious concerns have been identified, it would be appropriate to consider resolution of conflicts through establishing modal priorities or proposing projects to resolve conflicts.

Stakeholders also commented about several streets that are both major truck streets and designated in other modal plans. Transit corridors cited included Denny Way, 1st Avenue S, 4th Avenue S, 23rd Avenue E, and N/NE 45th Street. Bicycle Facilities mentioned included Dexter Avenue N, Stewart Street, 4th Avenue S, Stone Way N, and 3rd Avenue NW. Because these streets are identified in multiple modal plans, and hence encouraged for primary use by multiple modes, particular care needs to be given to their design and operation so as to facilitate safe and efficient operations for each of the prioritized modes.

ROADWAY RECHANNELIZATION (NICKERSON CASE STUDY)

The City recently performed a safety corridor improvement project on W Nickerson Street on the north side of Queen Anne Hill. Prior to Rechannelization there were two travel lanes in each direction, and crosswalks had been taken out as they were no longer meeting safety requirements for a four-lane cross section and contributed to potential multiple threats for pedestrians. The street was reconfigured to one lane in each direction and a two-way left turn lane in the center with bike lanes added with the leftover space. The purpose of the project was to reduce speeding incidents and improve safety. Lane width was increased as part of the project, and two new marked crosswalks were installed in order to meet safety standards.[9] This project was completed in August 2010.

A concern about the road diet was that it would limit throughput and therefore limit truck flows as well. As discussed, stakeholders have voiced their concern over reducing travel lanes and giving them to other modes. This type of project is appropriate when certain criteria are met, including daily traffic volumes below 20,000 vehicles per day and left turn movements occurring throughout the corridor. It has been demonstrated that under these conditions, road capacity is not reduced, and safety is increased for all roadway users. Assessment of the traffic counts taken before and after the project, shown in Table 12, suggest that while overall traffic decreased by over 10 percent, the daily truck total actually increased slightly on Nickerson after the road was restriped.It is not surprising that trucks

[9] www.seattle.gov/transportation/docs/Nickerson%20before%20and%20after%20study_FINAL.pdf

would stay on the facility as they may not have other choices. It may also be that there has been an increase in overall demand for freight in this area or that truckers find the new configuration easier to navigate, or it could be a result of economic improvement along the corridor and destinations served by the corridor (e.g., Ballard, north end of Interbay).

Stakeholders interviewed recently indicated the changes were not as bad as they anticipated after the project was completed. This response and the data support the possibility that, in this particular instance, restriping did not worsen truck flow, while walkers received a safer, more visible space. Review of more extensive counts and stakeholder interviews would be needed to confirm this potential finding.

TABLE 12: NICKERSON STREET ROAD DIET - BEFORE AND AFTER DAILY VOLUMES BY VEHICLE CLASS

	Cars and Trailers	Trucks	Buses	Motor Bike
Aug 2010 BEFORE	**13,563**	**2,993**	**211**	**62**
	80.59%	17.79%	1.25%	0.37%

	Cars and Trailers	Trucks	Buses	Motor Bike
Dec 2010 AFTER	**11,790**	**3,141**	**311**	**45**
	77.13%	20.55%	2.03%	0.29%

	Cars and Trailers	Trucks	Buses	Motor Bike
Feb 2011 AFTER	**11,694**	**3,004**	**261**	**55**
	77.89%	20.01%	1.74%	0.36%

SUMMARY CONCLUSIONS

MAJOR ISSUES AFFECTING FREIGHT MOBILITY

Based on the existing and future conditions data and stakeholder input, the key major issues facing freight operations in the City of Seattle include the following:

- Citywide traffic congestion, particularly on key freight routes during peak periods, and the fact that this congestion is growing.
- Truck volumes throughout the city and region are growing as well, which will place additional demands on already constrained roadways.
- Bottlenecks, particularly at bridge locations.
- Conflicts between trucks and non-motorized roadway users.
- Wayfinding via Major Truck Streets to key destinations.
- Truck restrictions on some facilities.

Traffic congestion, which affects all roadway users, is the top concern of many freight stakeholders.

FREIGHT FACILITY GAPS

Issues or elements of the system that represent or create gaps in the freight network include the following:

- Limited capacity on Major Truck Streets
- Grade separations with rail, particularly in the Greater Duwamish MIC/SoDo area.
- Improve wayfinding signage for Major Truck Streets.
- Safety improvements especially in conflict areas with other modes of travel.

Many roads experience congestion under peak conditions. As areas become denser, in both population and employment, some key freight corridors will need improvements to optimize flow for freight vehicles. Some key areas that are already at or over capacity, as discussed in the Roadway Congestion chapter, include the Ballard Bridge, SR-99 through downtown, the West Seattle Bridge, and SR-509 south of the Duwamish area.

As noted in the Rail Crossings section, some additional grade separation in the Duwamish MIC area between highly used truck facilities and rail crossings would minimize mode conflicts and travel delays.

37 percent of freight stakeholders that participated in the online survey were not aware of the Major Truck Street system. There are also several east-west routes that have a high level of truck traffic that are not included in the Major Truck Streets system. Other gaps include the University of Washington area and Capitol Hill, where there are not any designated truck routes.

Some corridors are designated freight routes but are also key or recommended routes for transit, bikes, and pedestrians. These facilities may need additional safety elements so all road users can use the roadway with minimal conflicts and greater predictability of all modes.

FREIGHT NEEDS AND PRIORITIES

Based on the findings of this document, the following needs and priorities are identified:

- Maintain or enhance freight capacity along designated truck streets.
- Thoughtful design that provides predictability of all modes when modal recommendations overlap.
- Inform and educate freight drivers about freight street designations.

- Develop materials to educate other modes about safe interaction with trucks.
- Develop and prioritize projects to address bottlenecks and safety issues.
- Keep existing freight priority in Greater Duwamish MIC area, including through SoDo region, and provide additional priority where possible.
- Maintain or improve/add to commercial vehicle load zones and truck load zones throughout the city.

The effect that increased traffic congestion has on freight mobility has been the number one issue raised by freight stakeholders. Major Truck Streets have been compromised in many places due to increased congestion and/or redesigns that remove truck capacity in favor of providing for other modes. Policies should be established that give priority to truck mobility on major freight corridors and maintain or improve capacity for trucks on these streets. Since many trucks travel during midday hours, having coordinated signal timings during off-peak hour periods would improve conditions for trucks.

Additional safety elements may be necessary on roads that are key connections for multiple modes of transportation. Some examples might include: bus and rail stops that have well-lit pedestrian crossings or separated/protected bike lanes. Further, designing intersections on truck routes that provide good sight lines so truck drivers can better see pedestrians or bikes that might be nearby. Only allow controlled pedestrian crossings on Major Truck Streets. Finally, awareness and education programs that promote safe multi-modal interactions should be further explored and implemented.

Major Truck Streets may need some additional signage in some areas, including routing to key destinations like major highways and MICs. Stakeholder communication with maps of the system might also encourage drivers to use the system. Some east-west roads that already serve high volumes of trucks between I-5 and key origins/destinations could be added to the Major Truck Street network.

Finally, keeping freight a priority in MIC areas is important. This may include adding grade separations for some rail crossings, redesigning existing roads with freight as the primary consideration and with large trucks in mind, and building facilities that minimize conflicts with pedestrians going to and from the stadiums.

APPENDIX A - ONLINE SURVEY - SUMMARY OF FEEDBACK RECEIVED

SDOT Freight Master Plan
Online Survey - Draft Summary of Feedback Received
September 2014

INTRODUCTION AND BACKGROUND

The Seattle Department of Transportation (SDOT) maintains a freight program to improve freight mobility and safety in Seattle, in conjunction with other department efforts to make it easier to move people and goods, across a range of transportation modal opportunities.

Currently, the City of Seattle is developing a Freight Master Plan (FMP) to address the unique characteristics, needs, and impacts of freight mobility, within the broader context of how freight movement and industrial lands contribute to the city's, and the region's, overall economy. The Freight Master Plan will primarily focus on urban truck freight movement to support Seattle's increasing demand for goods and services in a safe and resilient manner. The plan will outline the critical role that freight movement has on meeting the City's goals for social equity, economic productivity, sustainability, and livable neighborhoods.

To develop a Freight Master Plan that represents the needs and priorities of freight stakeholders requires meaningful and substantive input from those stakeholders. To better understand the key issues, needs and concerns of the freight community, SDOT began outreach efforts by meeting with representatives from the Manufacturing & Industrial Center (MIC) and the Ballard-Interbay Manufacturing & Industrial Center (BINMIC). These meetings, along with additional individual interviews, were used to collect feedback on the concerns of businesses and solicit ideas on how freight mobility might be improved in Seattle.

To collect additional feedback, SDOT developed an online survey. The survey was distributed to those who participated in the initial stakeholder meetings, as well as the groups and organizations listed below. The target audience for the survey was primarily businesses that rely on urban truck movement to deliver goods and services in Seattle. In addition to distribution by email and in person at the stakeholder meetings, the survey was also posted to SDOT's website, and stakeholders were invited to share the survey with their contact lists as well.

The survey was distributed to the following constituents:

- Participants in SDOT's Commercial Vehicle Load Zone process
- Seattle Freight Advisory Board (FAB) listserv
- Major truck street listserv
- Port of Seattle
- Port of Seattle truckers listserv Washington Trucking Association
- Seattle Office of Economic Development (OED), OED commissions and Maritime and Manufacturing Summit participants
- Greater Seattle Chamber of Commerce
- Puget Sound Regional Council (PSRC) Freight Mobility Roundtable

SURVEY METHODOLOGY

The survey asked a mix of multiple choice and narrative response questions ranging from how businesses cope with traffic congestion to what larger scale economic trends are affecting freight mobility in Seattle. The survey was live on the web between August 1, 2014, and September 21, 2014.

MAJOR THEMES

The survey received 60 total responses. Key overall themes that emerged included:

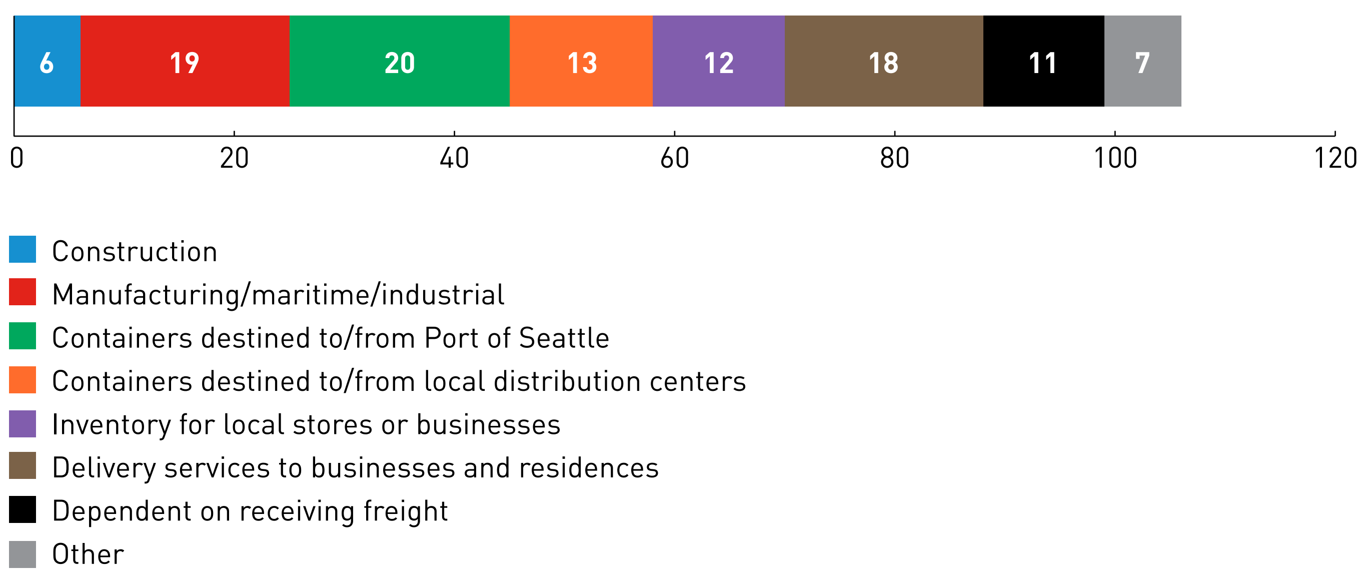
- Congestion is cited as the number one challenge affecting urban goods delivery in the city.
- Business operations schedule are bound to customers' needs and there is often not flexibility to adjust deliveries to off-peak hours.
- Conflicts with other modes of traffic (predominantly bike traffic) and turning movements/curb radius are cited by over 50% of respondents as being the top safety concerns relating to freight mobility.
- Although the City's Major Truck Streets are sometimes used by two thirds of respondents, almost 40% didn't know the designations existed.
- Google maps is the most used resource for determining alternate routes, but City and state traffic cams are also valuable.

There is an underlying feeling of resentment among some towards the perception that the City is not giving freight traffic priority and that conditions are getting worse. However, others believe that the challenges facing urban freight movements are simply products of a strong economy and good business.

SURVEY RESPONSES

Q1: What type of freight does your business handle?

The top three types of freight handled by survey respondents included containers destined to or from the Port of Seattle; freight related to the manufacturing/maritime sector, and containers destined to or from local distribution centers. It is important to note that respondents were free to select multiple types of freight.



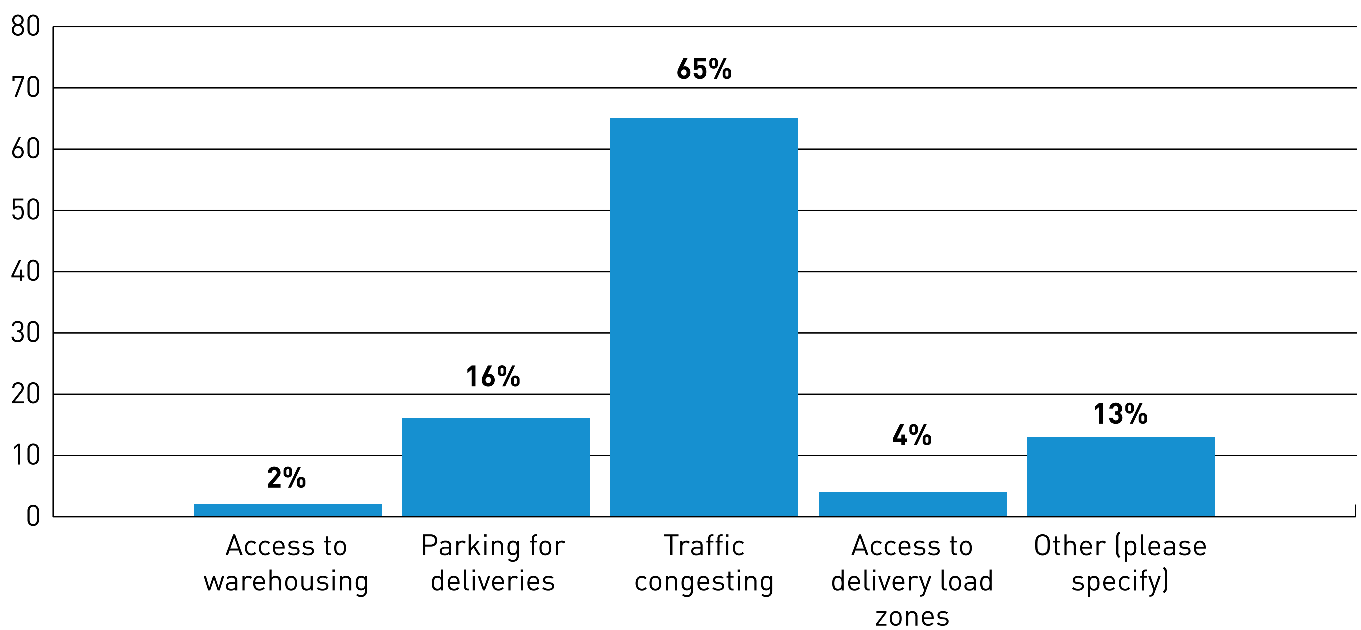
Q2: Have your business operations changed based on congestion at certain times of day? How? Would it be possible to promote delivery to occur during off-peak hours?

Overall: Businesses try to adjust their operations based on congestion, but options are limited. Schedules revolve around client needs for outgoing deliveries or shipping times for incoming deliveries and cannot always be adjusted.

Sample responses

- "Moved to night shift for maintenance crews, increased carpool slots, instituted compressed work week, reduced number of meetings at John Stanford Center for Educational Excellence (JSCEE)
- "Yes, particularly with freeway closures/ bridge closures close to aircraft departure times like the recent presidential and vice-presidential visits. Delivery at off-peak hours is not likely due to huge additional cost of labor work force needed to implement."
- "Yes, delivery times can take twice as long. It is not possible to perform deliveries in off-peak hours due to the requirements of the Union and legal amount of hours a driver is allowed."
- "The adjustment of freight delivery times to businesses should be considered. Also, tax and other incentives to businesses who utilize off-peak hours for receiving deliveries is one idea for relieving congestion."

Q3: What is the biggest challenge for urban goods delivery in the city?
Responses indicated that traffic congestion is seen as the biggest challenge for urban goods delivery in the city with nearly 2/3 of respondents citing this issue. The second most cited challenge was parking for deliveries; cited by 16% of respondents. Of the 13% (seven respondents) who responded with "other", three cited conflicts with bicyclists as the biggest challenge.



Q4: What is one thing the City can do to help your business move goods more efficiently and reliably?

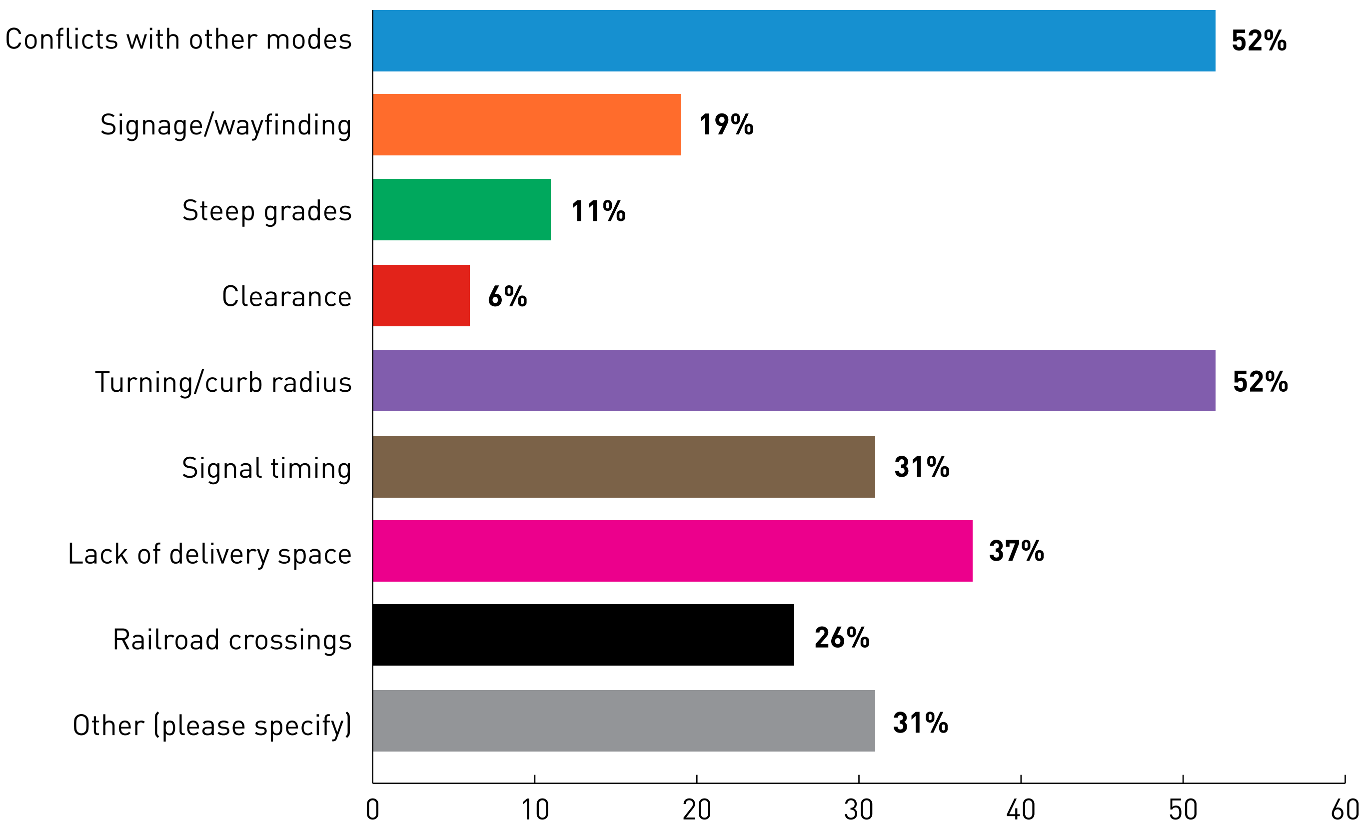
Overall: Respondents gave a mix of answers, mostly relevant to their respective location. Bike lanes and conflicts with other modes of traffic, prioritizing ingress/egress from the Port of Seattle, and load zone issues such as adding new load zones and maintaining access to current ones were all mentioned. Other secondary responses included: improving signalization, petitioning congress/USCG to change their rules for Ballard bridge openings, and reducing congestion overall

Sample responses

- "If the city simply petitioned Congress/U.S. Coast Guard to rewrite the Ballard Bridge rules to limit openings to certain times of the day for non-commercial water traffic the traffic in North Seattle would be much better."
- "Move other small movement vehicles to parallel streets when possible - presume all arterials are needed to move trucks."
- "Get Unions of longshoremen to not act like organized crime syndicates, truckers are not paid by the hour like them. City can get Port workers and their protective unions [to] work in much more efficient manner so that truckers they work with do not have to suffer and pay with their income. Port longshoremen and workers are the single most difficult causes of traffic congestion that directly impact truckers."
- "Quit taking lanes away from vehicles on main thorough fares. Bike lanes & bus only lanes have done nothing but make Seattle one of the worst cities in the United States for traffic congestion. By reducing the amount of lanes, SDOT is doubling the amount of emissions (CO) produced by gasoline autos that idle for hours in their daily commute."
- "Bridging additional crossings in SoDo would be a big improvement. The more grade separations between rail and other surface traffic, the better. Also, ingress/egress to the Port of Seattle is critical. SDOT must continue to work with WSDOT and other stakeholders on improving freight mobility to/from the Port of Seattle."

Q5: What are the top three safety concerns you see relating to freight mobility?

Over 50% of respondents cited turning movements/curb radius and conflicts with other modes as a top safety concern. Although not cited as a major challenge for urban goods delivery, lack of delivery space was cited by almost 40% of respondents as a top safety-related concern. Nearly one third of respondents cited railroad crossings, signal timing, and lack of delivery space as top safety concerns. Of the 31% that cited "other" issues as top safety concerns, conflicts with bicycles/inadequate separation of bicycles and freight traffic and unrestricted openings of the Ballard Bridge were dominant themes.



Q6: What are major choke points (specific locations or neighborhoods) in Seattle, from your perspective?

Overall: Major choke points cited included anywhere where there is narrowing of the road, such as Ballard Bridge/Nickerson Street, Mercer Street, I-5 through downtown, SR99 approaching downtown (either direction). Various corridors where there are multiple modes of traffic such as the Mercer Corridor and 1st-5th Avenues downtown were also cited as choke points.

Sample responses

- Anywhere road narrowing and addition of different modes of transportation are added (i.e. bike lanes, trolley lanes, restricted lanes (especially no flammable materials allowed in the new tunnel); I-5 NB off of 90; sites of perpetual construction such as Mercer, HWY 99; bridges that open, toll bridges, Elliott, Nickerson
- Ballard Bridge (multiple responses)
- Ingress/Egress points to freeways
- Mercer corridor, particularly eastbound since the change to two-way; Denny and Dexter, Stewart, and Fairview.
- SR 99 (multiple responses)

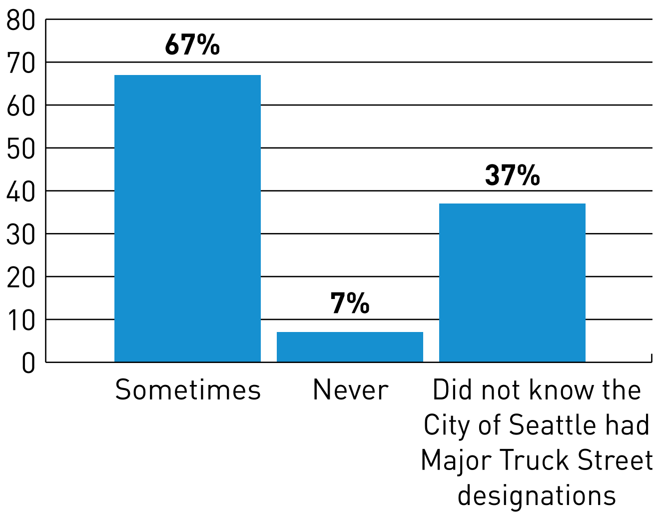
Q7: How do the choke points affect your route planning?

Overall: Since the choke points are known to most businesses, drivers indicated that they either allow more time to make deliveries or to try and take alternate routes. If possible, businesses will plan to operate in off-peak times.

Sample responses

- "We mostly just allow more time and try to avoid rush hour."
- "Can have a major impact with regards to making deadlines and cutoffs for marine terminals and steamship lines. Many drivers will avoid these areas especially at the end of the day where they could get stuck in traffic."
- Alternate routes (multiple responses)

Q8: Do you move goods via the City's Major Truck Street designated streets?
Two-thirds of respondents indicated that they sometimes use the City's Major Truck Streets. However, as 37% were not aware that designated Major Truck Streets existed, some respondents only discovered through taking the survey that they were already using them.



Q9: If you answered "sometimes" or "never" in response to Question 8, what are the primary routes / streets you use to move freight?

Overall: Respondents cited streets that are already designated as Major Truck Streets.

Sample responses
- Mercer, Elliott, Nickerson, Alaskan Way, Westlake, Marginal Way, SR 99, I-5
- "Everyday going south I use 15th Ave to Elliot Ave to Viaduct to Harbor Island. Coming back northbound I go 99 to the western off ramp up Western to Elliot back to 15th and Leary back to the yard."

Q10: If the primary route is unavailable, how do you determine which secondary routes to take to deliver goods?

Overall: Most respondents indicated that they use Google maps or left it up to the driver to determine which secondary route to take. Three respondents stated that for certain routes, there are no secondary routes available.

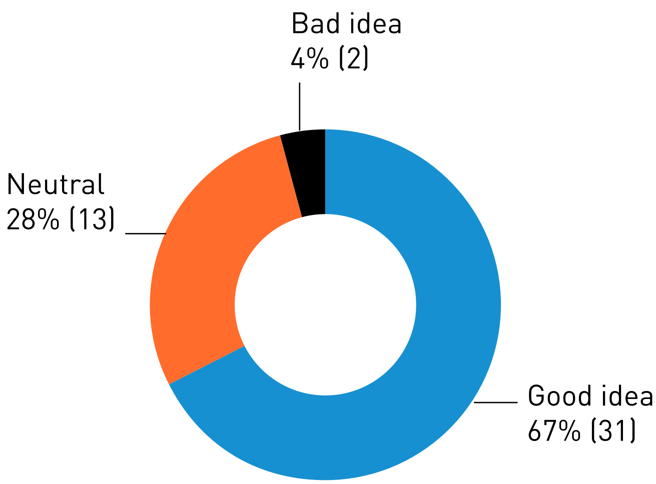
Sample responses
- Google
- Trial and error
- Driver knowledge
- "We don't have the luxury of 'secondary routes'."
- "Secondary routes are not a viable option on the 15th Ave W corridor."
- Talk radio traffic reports

Q11: What tools do your dispatchers and drivers use to predict travel times, find alternate routes, and get directions?

Overall: Drivers and dispatchers use a mix of tools for getting directions and predicting travel times including: Google Maps, city and state DOT traffic cameras, and GPS. Often it is left up to the driver and their knowledge of streets to find alternate routes.

Sample responses
- Google Maps/Mobile apps
- "WSDOT traffic website, SDOT traffic website, and telephone calls to colleagues in tall buildings with views out their windows."
- "Have access to terminal websites and can gauge what types of backups and congestion for each. Use SDOT's website as well."
- "Railroad calls trucking companies and coordinates times for delivering containers from Waterfront to rail yards. Intelligent Traffic Signs helpful."
- Anecdotal/local knowledge

Q12: What do you think about truck drivers using Business Access and Transit (BAT) lanes during the time that buses use them with the acknowledgement that buses have priority?



Q13: What economic trends do you see affecting your industry / business?

Overall: Although there was no single definite trend, there seems to be an underlying feeling of resentment due to a perception that the City is not giving freight traffic priority and that congestion is becoming worse. However, other respondents commented that the larger economic trends that are affecting urban freight movement, both positive and negative, are simply the product of a strong economy which in turn means increased demand for deliveries of goods and services.

Sample responses

- "Seattle is not business friendly. Our trucks and customers can't move without delays, parking is slowly becoming extinct and what there is of it is costly, there are taxes on everything that add up to gutting small business' bottom line, and now the City wants to tell us how much to pay our employees, how much benefits are required to be provided, etc. We want to do business, we want to pay our employees, but the City is skimming all the cream and half the milk from our operations."
- More traffic congestion (multiple responses)
- "Difficult to say but I know that access to the ports and rails are greatly affected by the stadium traffic. Also the city's push of moving more retail and non-industrial uses of SODO area is a big problem for freight mobility. Many warehouses and business complain of illegally parked cars, and inability to have truck access to their buildings because of this crush of retail and office density."
- "Without a strong, trade supportive commitment by SDOT to improve upon freight mobility in and around the Port of Seattle, the economy of Seattle, Washington State, and the Pacific Northwest stands to suffer. Canada continues to make strides in trade infrastructure and freight mobility, the Panama Canal widening project is progressing as well as other important trade infrastructure projects in other parts of the USA. Seattle SDOT must think and act as progressively on freight as they do on social issues. Hopefully, Mayor Murray realizes the importance of trade, trade infrastructure, and being able to obtain permitting for improvement projects in a timely fashion. If he doesn't, Seattle and the region fall further behind our trade competitors."
- "Because transportation is so bad in Seattle, prices of all our goods have been increased to reflect our increased costs."
- "The more time I have to sit in traffic the more fuel I burn. The more times I get stopped at every single light down one street is more wear and tear on the truck trying to get it back up to speed. All these repairs cost money that we should be able to save to customers."

Q14: Other comments?

Overall: Only 18 of 60 respondents answered this question. There again seems to be a feeling that the city does not prioritize freight. Although not a consensus, the most commented upon subject was the safety of having multiple modes of traffic (especially bikes) sharing the road.

Sample responses

- "Our government has decided that cars and therefore roads are evil so I expect matters to get a lot worse."
- "I think that the BAT lanes on Aurora are a very selfish use of transportation capacity and should be modified to allow and encourage additional uses. The toll on the 520 bridge is excessive and should be reduced significantly to encourage greater use."
- "Need streets that support heavy truck traffic to be designed for heavy truck traffic. Many of them are not, particularly in SODO area. Need to get ahead of "Drone Paranoia" early in the game and get business friendly but effective rules of the road in place. We will use drones, but they do need to be flown safely and they need good, sensible rules for usage."
- "The city of Seattle simply has not made freight and goods movement a priority and does not understand its importance within our economy. Not enough concentration on business and industry that produce large revenue and good jobs for the region. This leads to loss of middle class and a 2-class system with great income disparity."
- "Companies that buy load zone permits should be able to also purchase "temporary" load zone permits for drivers of theirs who rent vehicles for delivery. Large rental vehicles have limited options for load/unload parking and I feel there should be a way to support the load zone system and extend the ability to use the system to drivers in rentals. There should be no requirement of a "minimum" number of drivers to get this temporary tag. If your business supports the system by buying the permit, your co-deliverers should be able to also use the system via temporary/one-off permits."
- "The City of Seattle should value small business in the city and reward those businesses which pay a higher price for continuing to stay here."
- "Seattle is the ONLY west coast port city without an overweight corridor! So stupid."

APPENDIX B - STAKEHOLDER INTERVIEW SUMMARY

SDOT Freight Master Plan
Stakeholder Interview Summary (DRAFT)
October 2014

INTRODUCTION AND BACKGROUND

The City of Seattle is developing a Freight Master Plan (FMP) to address the unique characteristics, needs, and impacts of freight mobility. The FMP will primarily focus on urban truck freight and will outline the critical role that freight movement has on meeting the City's goals for social equity, economic productivity, sustainability, and livable neighborhoods.

To better understand the key issues, needs and concerns of the freight community, SDOT outreach efforts began by meeting with representatives from the Duwamish Manufacturing & Industrial Center (MIC) and the Ballard-Interbay Manufacturing & Industrial Center (BINMIC). These meetings were followed by individual stakeholder interviews that were used to collect feedback on the needs and concerns of freight-dependent businesses and solicit ideas on how freight mobility might be improved in Seattle.

STAKEHOLDER INFORMATION

Stakeholder interview participants were identified by SDOT staff and were intended to be representative of a variety of industries and freight uses. Stakeholders include business owners, truck drivers, and operations managers of businesses that depend on efficient goods movement within and throughout Seattle. Volunteers represented a number of organizations, including:

Organization/Entity
Amtrak
CSR Marine
Darigold
Dunn Lumber
Franz Bakery
Fremont Brewing
Georgetown Brewing Company
King County International Airport
MacMillan Piper
Martin Family Orchards
Nelson Trucking
Ocean Beauty
Pacific Fishermen Shipyard
Peddler Brewing
Salish Sea Trading Cooperative
Seattle Public Schools
Skagit Transportation
Terminal 91 tenant
Total Terminals
Trident Seafood
Turner Construction
UW Consolidated Laundry
VanDyke
Vigor Shipyards

GROUP INTERVIEWS

Before individual stakeholder interviews were conducted, SDOT met with representatives from the MIC (Group One) and the BINMIC (Group Two). The groups were asked many of the same questions as those asked during the individual stakeholder interviews. Feedback received was recorded and summarized by the project team and key discussion themes are captured below.

Group One Interview

July 28, 2014
Manufacturing Industrial Council

Organization/Entity
Amtrak
Ballard Oil
Boyer Towing
Charlie's Produce
City of Tukwila
Manufacturing Industrial Council
Manufacturing Industrial Council Board, Freight Advisory Board, BNSF
Nucor Steel
Port of Seattle
Seattle Mariners
Seattle Public Schools
WSDOT

Group Two Interview

July 29, 2014
Ballard-Interbay-Northend Manufacturing & Industrial Center

Organization/Entity
Ballard Oil
Ballard Partnership Urban Design Transportation Team
BINMIC
Coastal Transportation
Consultant to Block Builders
Port of Seattle

INTERVIEW METHODOLOGY

Interviews were conducted by SDOT and consultant staff. Following a brief overview of the purpose and goals of the FMP process, interviewers asked participants for their feedback on a variety of topics and questions, ranging from how businesses cope with traffic congestion to what larger-scale economic trends are affecting freight mobility in Seattle. The interviews were completed between July 29, 2014, and September 19, 2014.

INTERVIEW QUESTIONS

A standard set of interview questions were developed by the project team based on identified key issues and project information needs. These questions were divided into eight categories: Information about the organization, safety, reliability, efficiency, resiliency, economic vibrancy, environment, and how to share information.

General themes for the questions included:

- Key issues that should be addressed by the FMP
- Future vision of freight transport in Seattle
- Ideas for informing and engaging the public in conversation

[See Appendix XX for full list of stakeholder interview questions]

MAJOR THEMES

Thirty-two representatives from twenty-three different organizations were interviewed. Major themes that emerged through the stakeholder interviews included:

- Traffic congestion is consistently cited as the number one challenge affecting interviewees' businesses.
- Freight businesses would move deliveries to off-peak hours if they could, but there are a variety of reasons that prevent them from doing so, including: maintaining staff who will work graveyard shifts, customer needs, customer facilities are not open off-hours, increased costs, and night time noise ordinances.
- There is a general desire among interviewees for a dedicated freight corridor.
- Conflicts with other modes of traffic (especially bicyclists and pedestrians) are generally cited as the top safety concern relating to freight mobility.
- Interviewees largely feel that the importance of their respective industries to the local economy is too often overlooked by the City.
- The lack of parking and loading zones for deliveries, especially in the downtown area, is consistently cited as a major concern for safety, reliability, and efficiency of freight mobility.
- Finding and maintaining well qualified employees is cited often as one of the major challenges affecting freight dependent industries in the city.

RESPONSES TO KEY QUESTIONS

The stakeholder interviews provided insight into key concerns stakeholders have about urban freight mobility and how they envision freight transport in the future. Key themes of feedback received by topic area are listed below.

Safety

Participants routinely cited conflicts with other modes of traffic, particularly pedestrians and bicycles, as the biggest safety concern affecting their industry.

- Many participants cite the need for better signage for getting to and from designated truck routes.
- Line of sight is an issue for larger trucks and could be alleviated in part by better trimming of overhead vegetation.
- Breweries are especially concerned with the quality of pavement on major arterials (shakes up their kegs).
- Route-finding difficulties, especially during peak congestion hours, are compounded by construction related closures and unreliable sources of information about their impacts.
- Many participants suggested more education of general purpose drivers, pedestrians and bicyclists regarding the rules of the road and interaction with other modes of traffic, particularly freight trucks.

Reliability

- Participants generally stated that all truck operations are heavily influenced by traffic congestion and the lack of alternative truck routes.
- Drivers do their best to avoid morning (7am-9am) and afternoon peak hours (3pm-6pm). Larger and noisier trucks are prevented from making deliveries in off hours due to the night time noise ordinance.
- Businesses, especially near SODO and the Port, are particularly sensitive to sporting events at the stadiums. Incoming and outgoing deliveries all revolve around game times on those days.

- Drivers largely rely on their own knowledge for route finding, however GPS, Google Maps, and traffic cameras are routinely cited as useful tools.
- A few participants suggested creating one website that consolidates all traffic conditions and impacts. Real time traffic analytics was suggested as an idea for improving congestion and reliability issues for freight mobility.

Efficiency

- Similar to other categories, congestion is cited as the biggest factor affecting the efficiency of freight mobility.
- Many participants cite the lack of loading zones and other curbside spaces as a major challenge for freight delivery. Drivers often circle the block looking for spaces to unload.
- Participants routinely cited that vehicle lanes are being taken away for bike lanes, which to them indicates that the City doesn't prioritize freight in urban planning.
- Unreliable information about construction impacts makes way finding and route planning difficult, especially for out of town drivers.

Resiliency

- Most participants stressed the need for more designated freight routes, especially north-south routes, and preservation of existing routes.
- Some participants expressed a desire for state and local transit authorities to have on-site response teams citing the excessive length of time it takes to clear an accident.
- When primary routes are congested in urban areas and the driver is able to detour to alternate routes, traffic circles are often cited as a concern.
- A few businesses have had success in using smaller, more efficient, and more agile trucks to make urban deliveries. It was suggested to remove large trucks from the city altogether by having them deliver to node points outside the city then have smaller trucks make the urban deliveries.
- It is becoming increasingly hard to find young drivers as the older generation retires. As traffic congestion has gotten worse and businesses try to shift delivery times to off-peak hours, it becomes harder to find good drivers to work those off hours.

Economic Vibrancy

- An aging workforce was cited as one of the major concerns for the future economic vibrancy of the industry. As the cost of housing rises, freight industry workers are pushed farther to the periphery, and it becomes harder to find qualified workers near Seattle based businesses.
- Many participants cited concerns about the $15 minimum wage affecting their retention of staff.
- Participants that represented smaller businesses generally stated that they felt Seattle was not small business friendly given the tax structure and are concerned about their future in the City.
- Most cited the strong economy and demand for goods and services as the major driver of their industry. As long as Seattle is attracting more people, there will be a demand for goods, and deliveries will be made regardless of congestion.

Environment

- Idling, primarily due to congestion, was cited by participants as the area that could be most improved upon.
- Participants suggested that anything that can be done to reduce idling would reduce emissions (more roundabouts instead of stop signs/lights, higher clearances in key nodes for more direct routes, better signal timing, signage, real time traffic signs.etc.)

- Many businesses have instituted their own policies to reduce their environmental footprint due to customer demand.
- Switching to smaller or more efficient vehicles/fuel is a common practice taken by businesses. Cost is also a driver.

Public participation process

- Although only the final three interviews asked participants about how best to communicate with businesses and the public, all stated that they would like to stay involved in the FMP process in some capacity. Those same three participants all identified email as the best way to keep them and the public informed. Other suggestions to keep the public informed included informational YouTube videos, billboards, postcards, and social media.

NEXT STEPS

Feedback received through the stakeholder interviews will be shared with the project team, SDOT leadership and policy staff. Input will be incorporated into the development of the Freight Master Plan existing conditions report, particularly the gaps and needs. It will also help inform identification of solutions. Finally, suggestions will be utilized for future outreach and engagement efforts.

APPENDIX C - TRUCK SEASONAL FACTORS

Single Unit Truck Seasonal Factors												
	JAN	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
Interstate	1.26	1.24	1.21	1.21	1.22	1.15	1.16	1.14	1.13	1.18	1.22	1.25
Freeway/ Expressway	1.37	1.30	1.27	1.26	1.25	1.20	1.23	1.17	1.21	1.24	1.33	1.34
Major Arterials*	1.52	1.42	1.32	1.22	1.15	1.14	1.18	1.37	1.28	1.07	1.15	1.26
Minor Arterials/ Collectors/Local*	1.16	1.16	1.02	1.07	1.08	1.19	1.13	1.13	0.97	1.00	1.12	1.17

Double Unit Truck Seasonal Factors												
	JAN	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
Interstate	2.22	1.44	1.15	1.20	1.17	1.01	1.24	1.61	1.97	1.43	1.57	1.66
Freeway/ Expressway	1.56	1.42	1.38	1.36	1.33	1.28	1.25	1.20	1.23	1.27	1.44	1.50
Major Arterials*	2.67	1.64	1.25	1.21	1.11	1.01	1.26	1.94	2.24	1.31	1.49	1.67
Minor Arterials/ Collectors/Local*	2.05	1.34	0.96	1.06	1.04	1.05	1.21	1.59	1.69	1.21	1.44	1.56

Triple Unit Truck Seasonal Factors												
	JAN	**FEB**	**MAR**	**APR**	**MAY**	**JUN**	**JUL**	**AUG**	**SEP**	**OCT**	**NOV**	**DEC**
Interstate	2.19	1.36	1.16	1.23	1.31	1.16	1.37	1.85	1.87	1.39	1.60	1.70
Freeway/ Expressway	1.68	1.47	1.40	1.35	1.38	1.32	1.37	1.16	1.23	1.35	1.62	1.70
Major Arterials*	2.64	1.55	1.26	1.24	1.24	1.16	1.40	2.24	2.13	1.27	1.52	1.71
Minor Arterials/ Collectors/Local*	2.02	1.27	0.97	1.08	1.16	1.20	1.34	1.84	1.61	1.18	1.47	1.59

*calculated factors by comparison Ohio DOT factors for interstates to arterials, other local roads.

TRUCK ANNUAL ADJUSTMENT FACTORS

Single Unit Truck Annual Adjustment Factors	
Year	**Factor****
2010	1.00
2011	1.01
2012	1.00
2013	1.00

Double Unit Truck Annual Adjustment Factors	
Year	**Factor****
2010	1.07
2011	1.04
2012	1.00
2013	1.00

Triple Unit Truck Annual Adjustment Factors	
Year	**Factor****
2010	1.07
2011	1.05
2012	1.00
2013	1.00

**Annual Adjustment to 2013

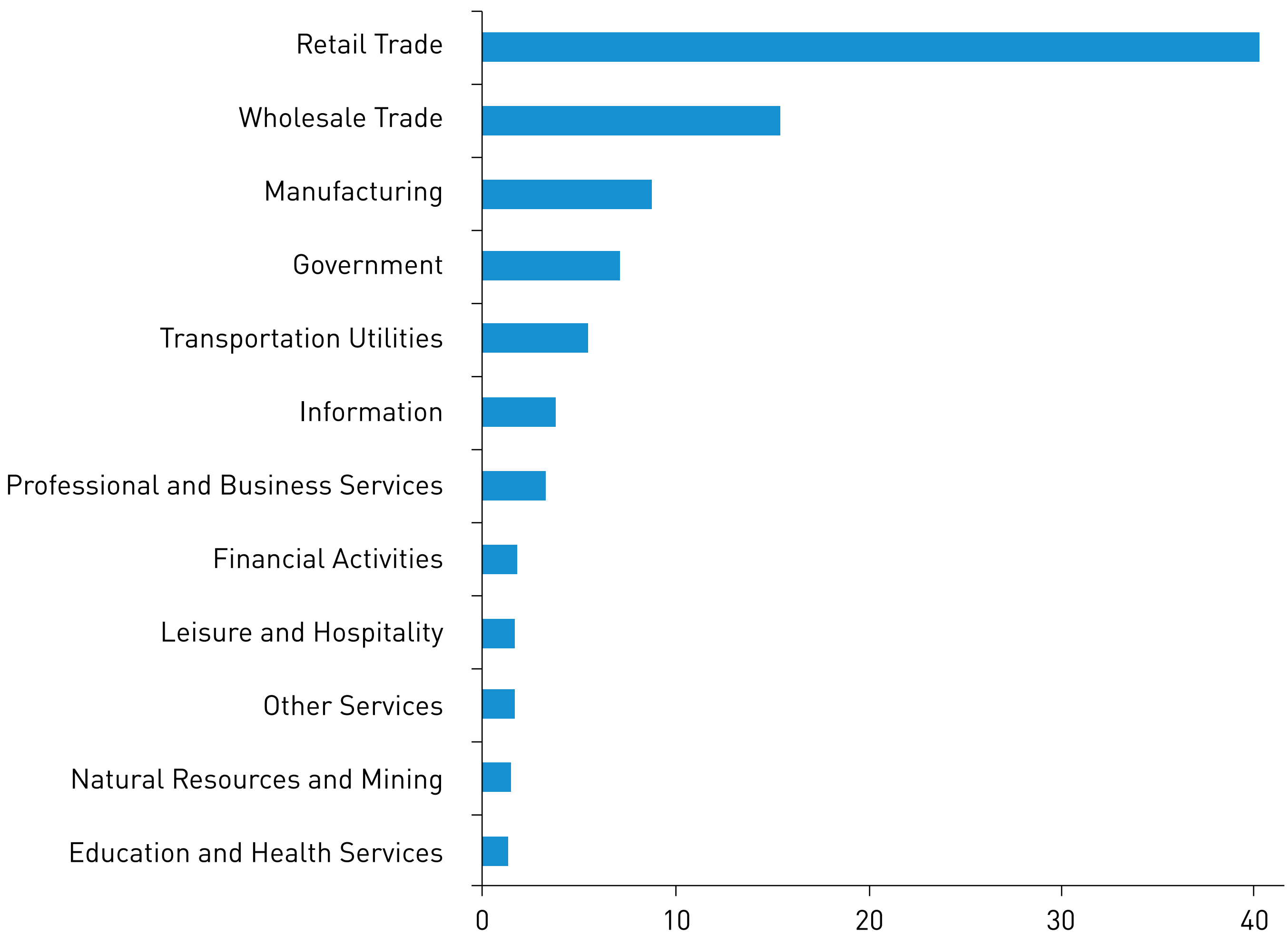
APPENDIX D - FUTURE CONDITIONS ANALYSIS METHODOLOGY

INTRODUCTION

The freight trends were analyzed in detail in the WSP | Parsons Brinckerhoff, The Role of Freight in Seattle's Economy technical memorandum (December 12, 2014). The document focused on global economic indicators as well as local employment growth and trade in Seattle in order to develop a future truck forecast for the City. This document concluded that the expected truck growth in the Seattle area will be between 1.6% and 2.5% compound annually with the likely growth to be about 2% per year, or about 55% overall by 2035.

The technical memorandum identified the top three freight generating employment sectors, wholesale and retail trade and manufacturing. As shown in Figure 1, these three industries account for the vast bulk of trucking and warehousing service demand.

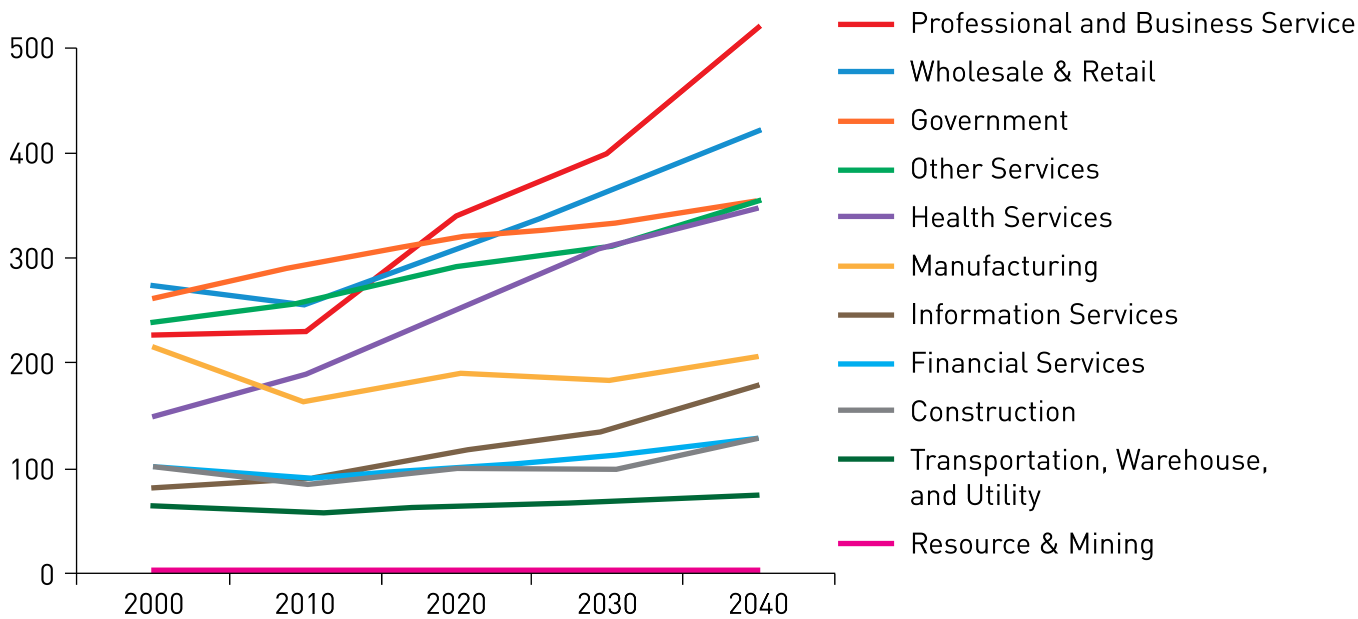
FIGURE 1: UNITED STATES INDUSTRY USE OF TRUCKING AND WAREHOUSING SERVICES ($BILLIONS)



Source: US Bureau of Economic Analysis and WSP | Parsons Brinckerhoff Analysis

Figure 2 shows the expected growth for all employment sectors between 2010 and 2040 based on PSRC projections. The biggest freight generating industries, wholesale and retail trade, are expected to grow at a slightly faster rate than total employment in the region. Between 2010 and 2040, wholesale and retail trade are expected to grow 64% while total employment is expected to grow 58%. This implies freight may grow somewhat faster than the overall employment growth which is equivalent to 1.6% annually during this period.

FIGURE 2: PUGET SOUND 2012 ECONOMIC FORECAST - EMPLOYMENT BY MAJOR SECTOR (THOUSANDS)



Source: Puget Sound Regional Council

Based on the greater than average growth in major freight generating industries, and the expectation that productivity increases will continue in manufacturing, it may be expected that increases in freight volume related to local regional economic growth will be a minimum of 1.6% annually between 2010 and 2040. Actual growth is likely to be higher, especially in the short term.

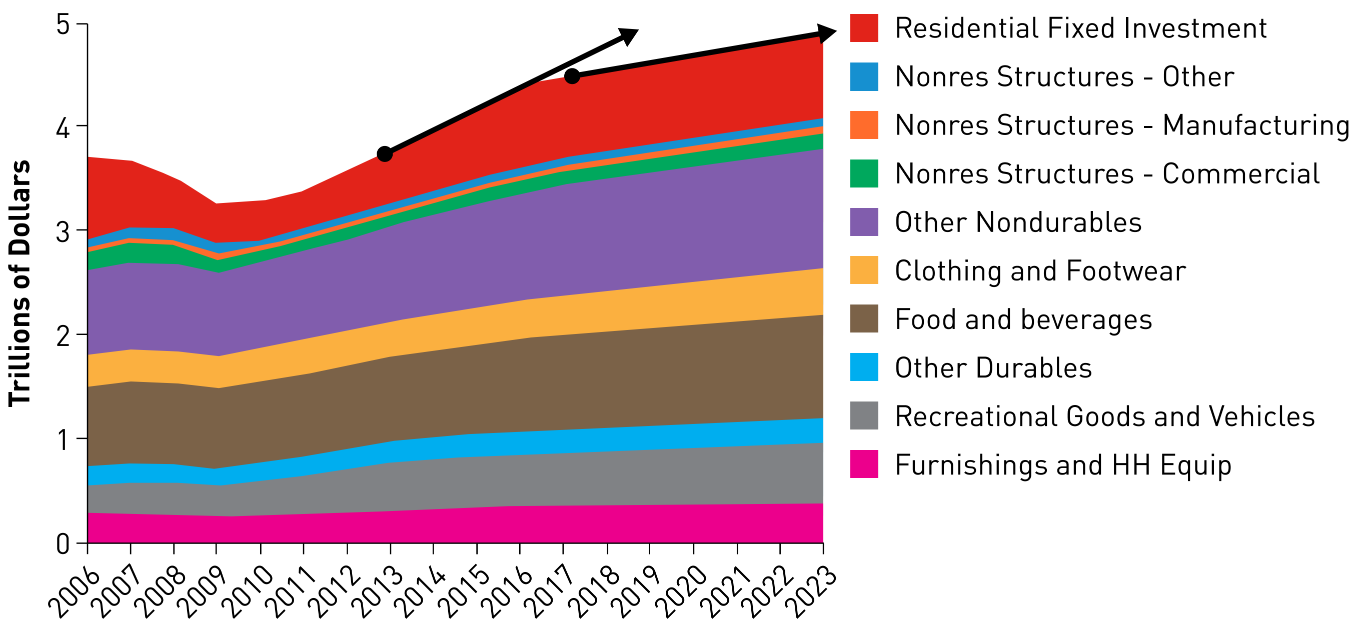
The Role of Freight in Seattle's Economy memorandum also considers the impact of trade growth on freight in Seattle. Due to the importance of the Ports of Seattle and Tacoma to the economy, international trade plays a significant role on the local freight forecast. The technical memorandum discusses the greater impact on the economy and freight of transportation services sectors in Seattle as compared to most cities in the US. As such, US imports, as represented by GDP components, can be expected to drive freight in Seattle. There is a short term spike in imports related to pent up residential demand coming out of the recession. These trends are expected to level off and imports are expected to grow at about 1.6% in the long term as shown in Figure 3. Those trends ands and relationships are discussed in more detail in the technical memo.

Citywide growth in both population and employment will are linked to future truck trips. However, employment in freight generating industries is a much better indicator of truck trips, when compared to population. And, when considering truck movements, overall population growth will be correlated with retail employment growth. While there is a growing movement toward online shopping and direct home delivery, the emergence of omni-channel retail where retail stores serve as mini-distribution centers is reinforcing the linkage between freight and retail employment. These trends are discussed in more detail in *The Role of Freight in Seattle's Economy* technical memorandum, but are likely to result in increases in shorter truck trips in both retail and residential areas.

Other Freight Studies with Forecasts

Other recent projections of freight for the Seattle region and Washington State were reviewed as shown in Table 1. Although they encompass different time periods, geographic boundaries and methodologies, they generally support the 2% growth over the 2014-2035 timeframe. Forecasts with an earlier start or end point than the one developed for this study tend to be higher as they are more affected by the current post recession surge in imports.

FIGURE 3: TOTAL OF REAL GDP COMPONENTS



Source: WSP | Parsons Brinckerhoff

TABLE 1: RECENT REGIONAL AND STATE FREIGHT FORECASTS

Source	Time Period	Estimate and Assumptions
WSDOT Freight Mobility Plan	2011-2030	Statewide truck annual growth = 3.1%
FHWA Freight Analysis Framework (FAF3)	2012-2035	Annual domestic freight for City of Seattle = 2.4%
FHWA Freight Analysis Framework (FAF3)	2012-2040	Annual domestic freight for City of Seattle = 2.16%
Cambridge Systematics for Freight Access Project based on FAF3	2011-2035	Annual domestic freight for City of Seattle = 2.7%
American Trucking Association	2013-2024	Annual national total general and bulk TL, LTL and private carrier = 2.0%

TRUCK GROWTH ALLOCATION METHODOLOGY

To allocate projected truck growth throughout the city, it is necessary to evaluate geographically where employment, and in particular, key sectors, are growing. This provides insight to regions where truck volumes will increase above or below the expected average growth.

Overview of projection approach:

1. Update the 2014 Average Daily Truck Volumes map using current truck counts. This provides the basis for future projections.
2. Create geographic districts based on land use.
3. Generate district level growth factors based on employment and residential forecasts.
4. Calibrate specific locations based on more detailed studies.

1. Truck Volumes

Truck volumes have been measured throughout the city using primarily tube counters, but also video and other counting methods.[10] These counts are the starting point of the analysis. Figure 4 is the 2014 Average Daily Truck Volumes map developed by the City of Seattle to daily truck volumes on city streets.[11] All counts will subsequently be projected to 2035 estimates as part of the future freight forecast.

2. Districts

Thirteen geographic districts were created based on areas that have relatively consistent land uses as shown in Figure 5. The purpose of districts is to aggregate the city into reasonable regions that can each have a single growth factor to represent truck growth for that area. The districts were also defined so that they are comprised of Forecast Analysis Zones (FAZs) used by PSRC in development of their population and employment forecasts. The population and employment forecasts for each of the FAZs within the 13 districts were reviewed to ensure that each of the FAZs within a defined district are expected to grow at a similar rate in future.

3. Growth Factors

Growth were determined by using the current PSRC Population and Employment forecasts. This data is a product of the "2013 Land Use Baseline, Central Puget Sound Region - Maintenance Release 1 (MR1) Update" This data was first released in July 2013 and revised in April 2014.

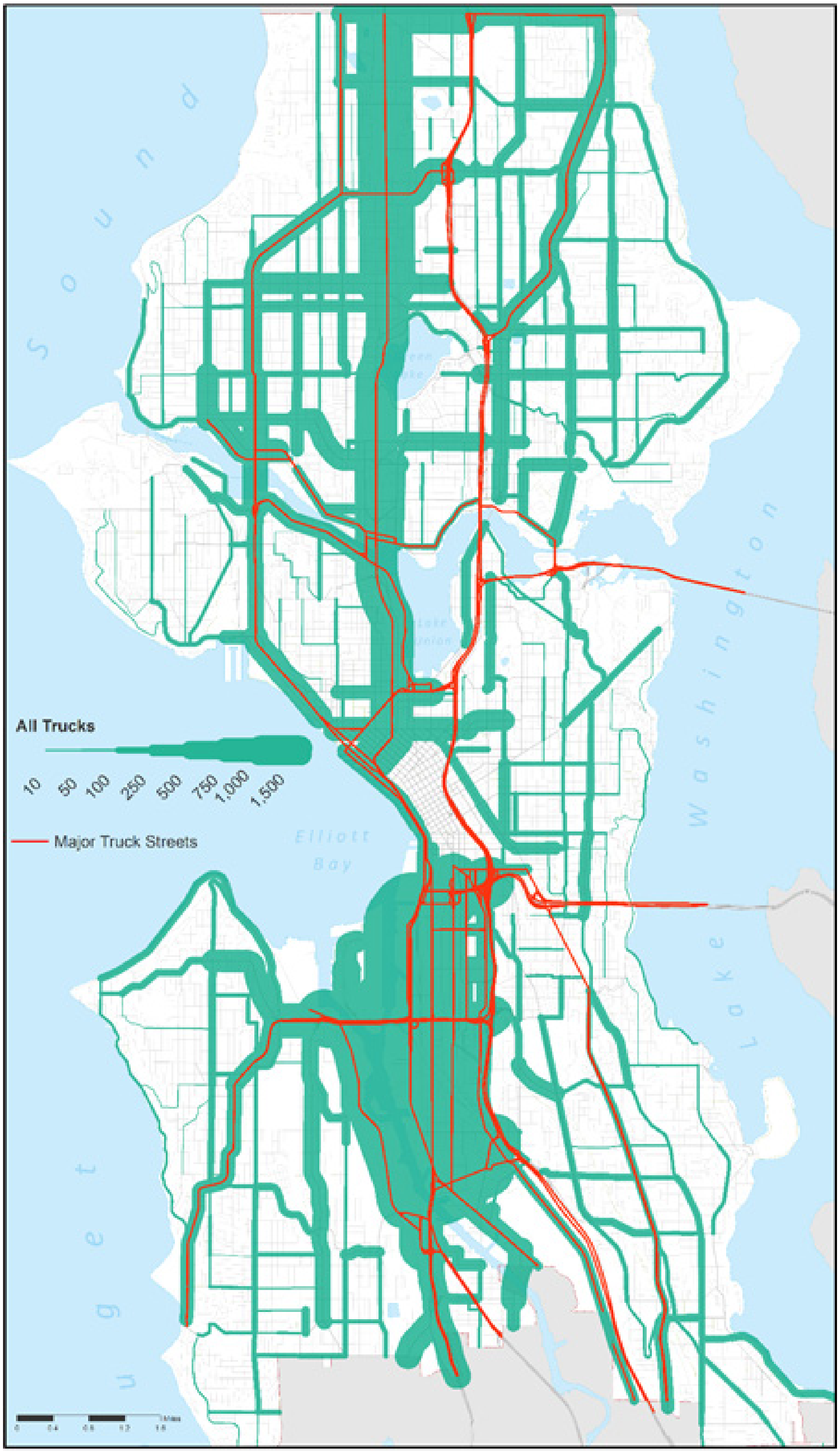
The employment forecasts for the three major freight generating employment sectors—retail trade, wholesale trade and manufacturing—were aggregated to the 13 districts shown in Figure 6. Aggregating these employment categories by district provides a means of identifying where to expect truck trips to be concentrated.

Each district was then assigned one of four levels of growth - 1.0%, 1.6%, 2.0%, or 2.5%, which represent very low, low, med, or high growth, respectively. The population growth projections were then reviewed for each district (Figure 7). Because very high population growth could result in substantially more trucks in a district, to make deliveries to homes and local commercial/retail districts, it was determined that districts with population growth of more than 15,000 and/or the presence of urban centers or urban center villages would be moved up into the next highest growth category.

- Districts with urban center / urban center village developments: 2, 7, 9, and 13.
- Districts with growth of more than 15,000 people: 2, 4, and 7.

[10]This process if further described in SDOT's Existing Freight Conditions Report.
[11]The truck flow map includes only regular count locations where counts will be repeated.

FIGURE 4: 2014 AVERAGE DAILY TRUCK VOLUMES



Source: City of Seattle

FIGURE 5: CITY OF SEATTLE FORECAST DISTRICTS

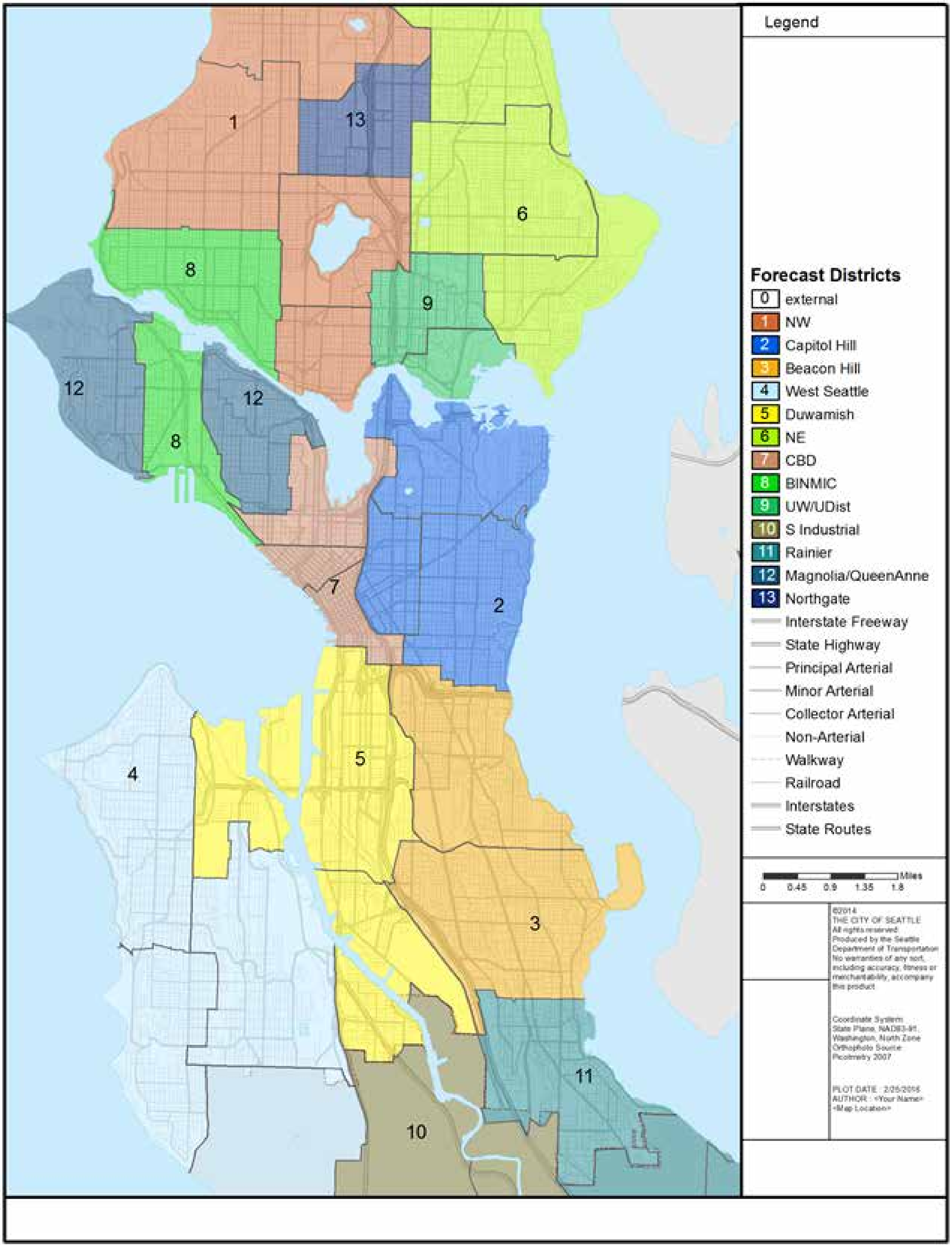


FIGURE 6: EMPLOYMENT GROWTH BY DISTRICT

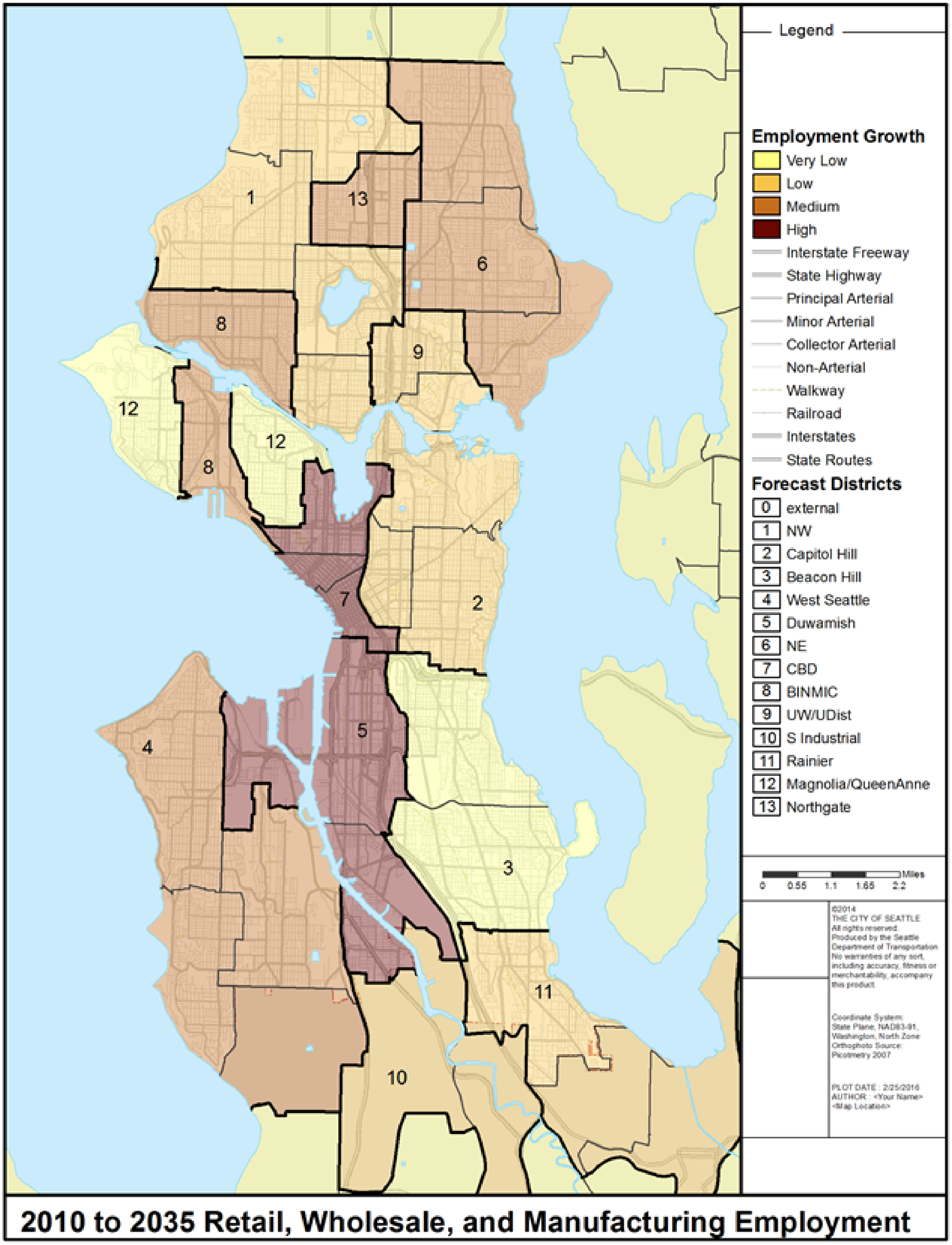


FIGURE 7: CITY OF SEATTLE POPULATION GROWTH 2010-2035

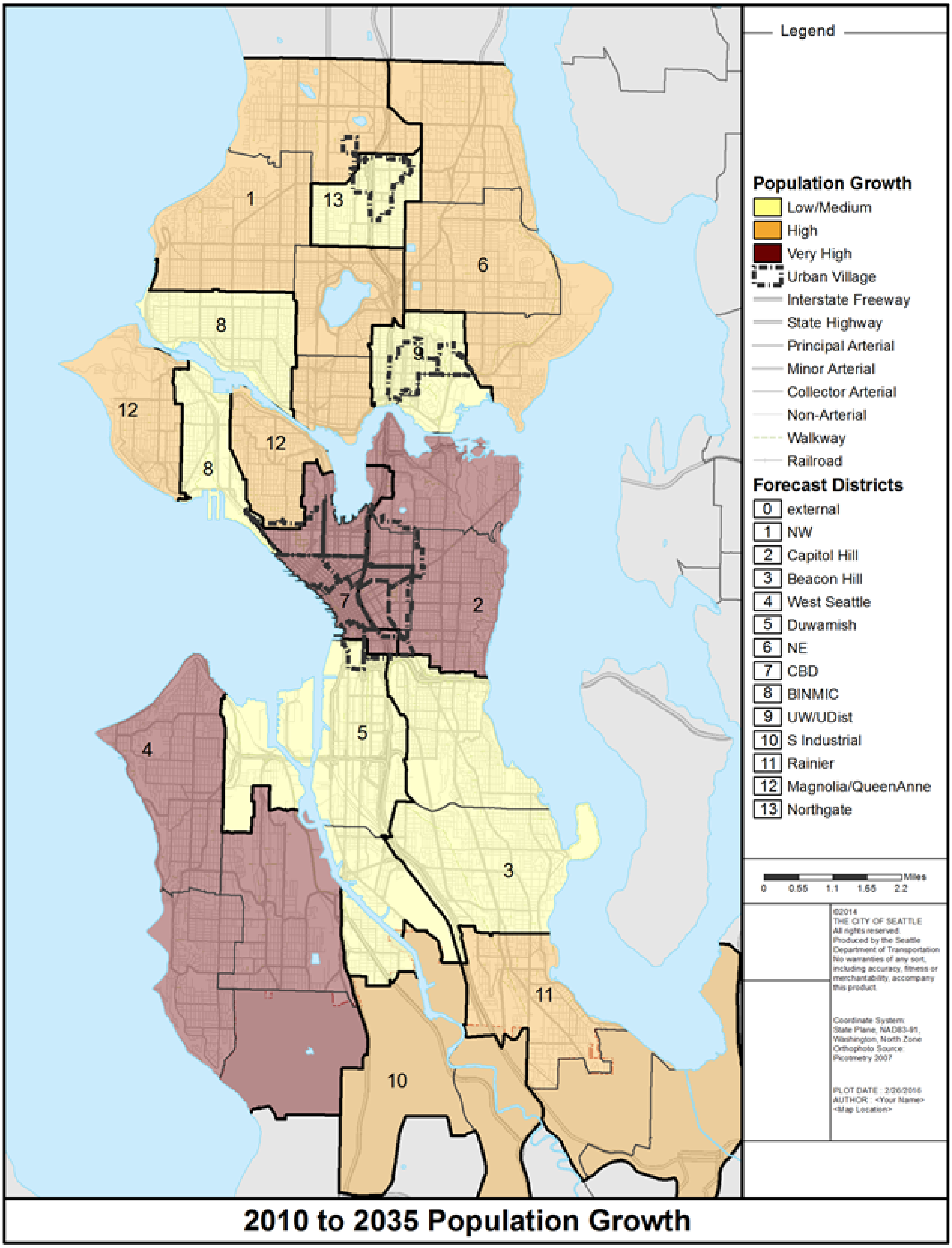


Figure 8 shows the resulting proposed freight growth factors for each district. As a result of the analysis of high growth population areas, districts 2 (Capitol Hill) and 9 (University District) moved from a designation of very low to a designation of low growth. Districts 4 (West Seattle) and 13 (Northgate) moved from low growth to medium growth designations. District 7 (CBD) already had high employment growth and thus remained in the high category. Forecasted population and employment growth by individual FAZ as well as by district is listed in Table 2.

4. Calibration

The PSRC regional model is relatively accurate in representing truck volumes on major roadways as they move to major destinations in and outside the region. The model's truck volumes were reviewed for truck growth on highways and principle arterials. State routes and highways are represented on the model output map in Figure 9. Incorporating these growth rates for regional facilities provides regional context to the truck forecast projections.

These facilities reflect the larger freight movements within the City. Annual growth factors were determined by using the growth between the base year and future year models. This growth was then applied to the regional facilities throughout the transportation network.

Finally, other freight studies with targeted analysis of future truck flows were reviewed and the results integrated. These included the Port of Seattle Container Terminal Access Study and the City of Seattle's Freight Access Project. With more refined focus areas, they will likely have differing base year data and future projections. These studies also provided additional traffic counts that can be incorporated into the City of Seattle truck count database. Roads that provide direct connection to and from the Port of Seattle to Interstate facilities will be allowed to grow at the "very high" growth rate of 3.5% per year.

FIGURE 8: FREIGHT GROWTH FACTORS BY DISTRICT

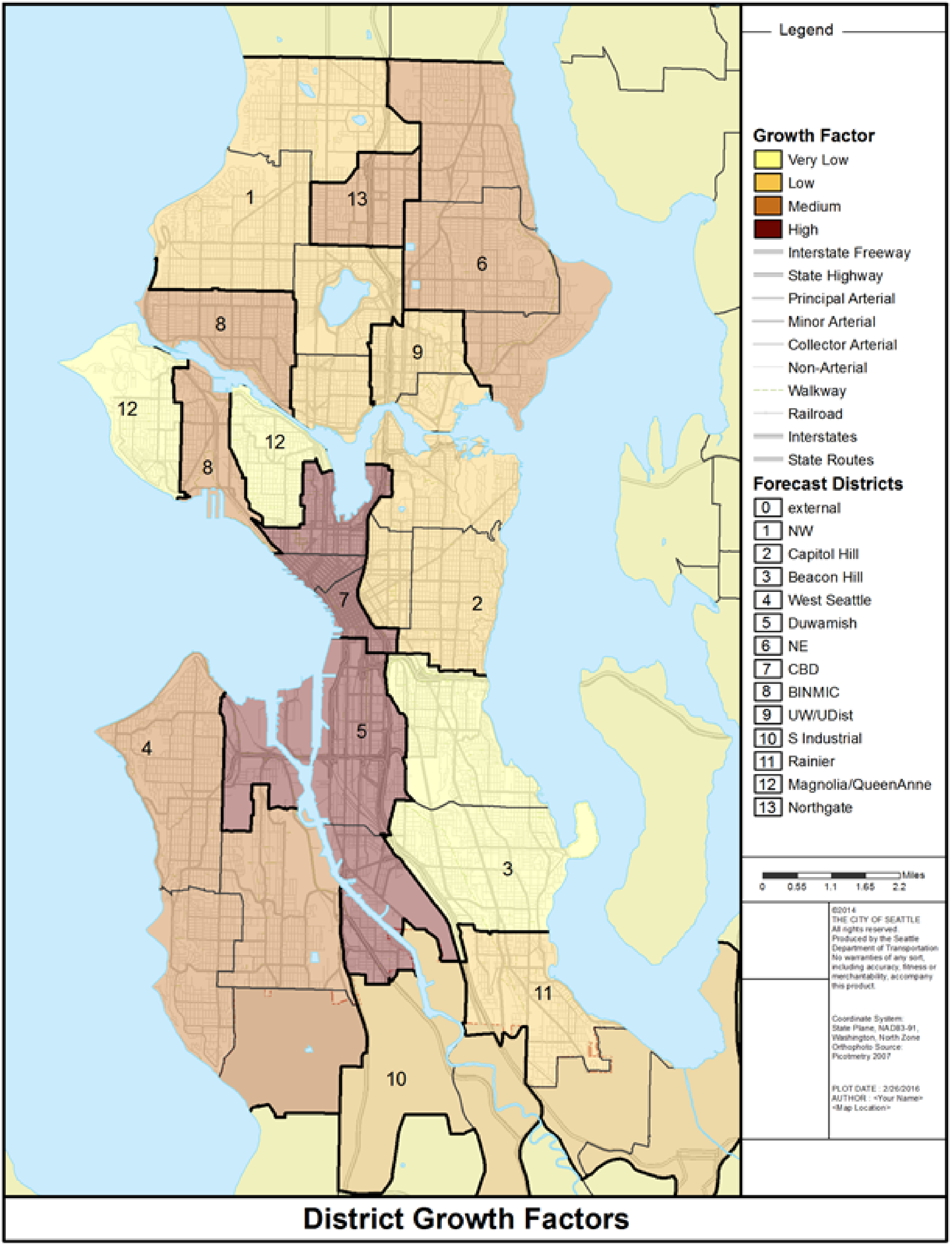


FIGURE 9: FREIGHT GROWTH FACTORS BY DISTRICT

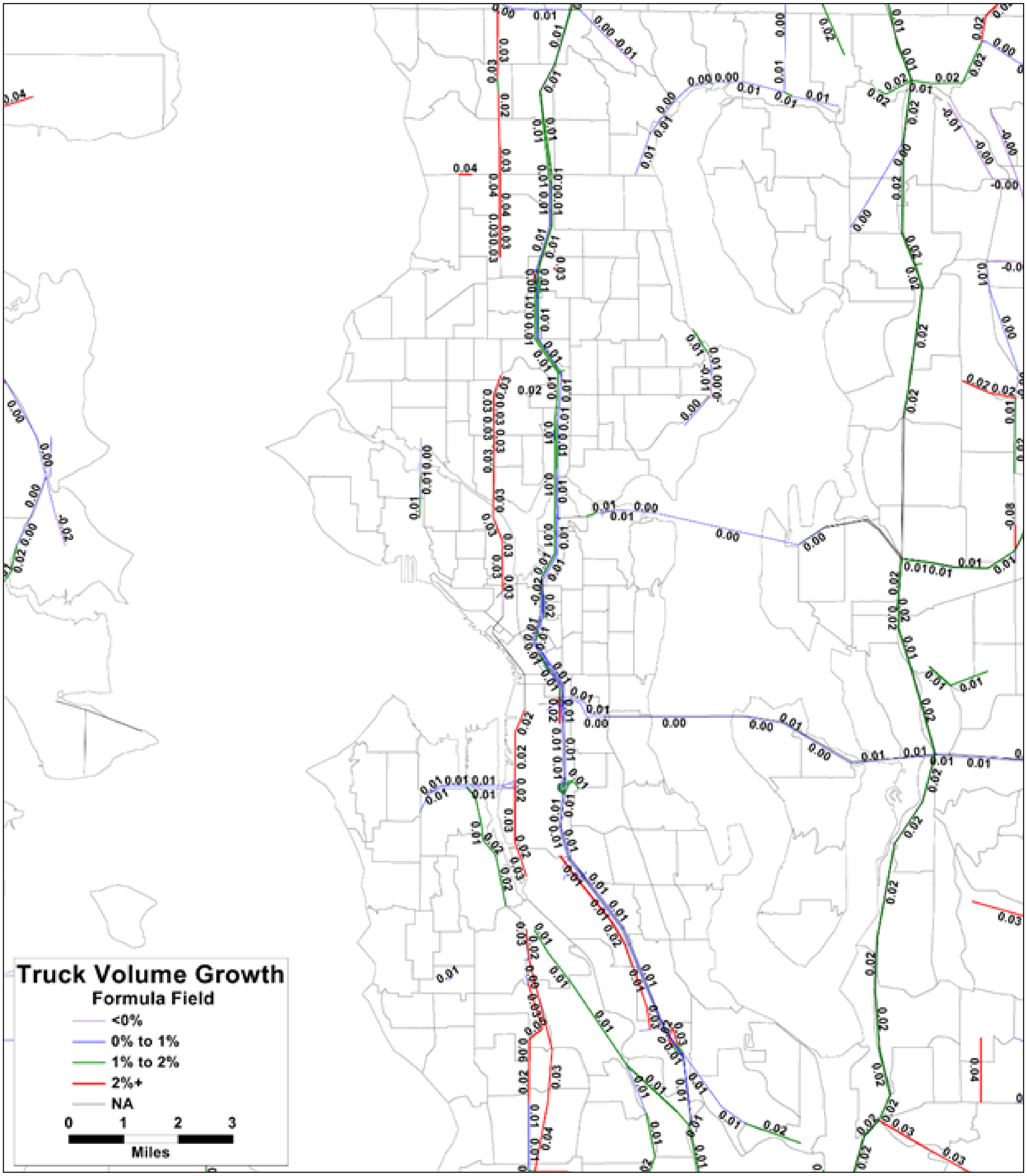


TABLE 2: POPULATION AND EMPLOYMENT FORECASTS BY FAZ AND CORRESPONDING FMP DISTRICTS

PSRC FAZ Forecast			Population		INDIV FAZ	DIST TOTAL	INDIV FAZ	DIST TOTAL	Big 3 Employment		INDIV FAZ	DIST TOTAL	INDIV FAZ	DIST TOTAL	
District	FAZ10	Location	POP2010	POP2040	chg	distChg	POP40gr	POP40gr	RWM2010	RWM2040	chg	distChg	RWM40gr	RWM40gr	GrFact
1	6213	Wallingford - Fremont	18,077	20,431	2,354	11,982	0.4%	0.4%	4,890	4,505	(385)	1,462	-0.3%	0.4%	2.0%
1	6224	Green Lake	20,551	24,018	3,467	11,982	0.5%	0.4%	1,972	2,178	206	1,462	0.3%	0.4%	2.0%
1	6325	Greenwood - Crown Hill	35,518	38,570	3,052	11,982	0.3%	0.4%	2,375	2,535	160	1,462	0.2%	0.4%	2.0%
1	6326	Broadview - Haller Lake	24,441	27,550	3,109	11,982	0.4%	0.4%	2,216	3,697	1,481	1,462	1.7%	0.4%	2.0%
2	6113	First Hill - Broadway	32,399	49,961	17,562	27,090	1.5%	0.9%	na*	na*	na*	680	na*	0.5%	1.6%
2	6114	East Capitol Hill - Central Area	33,366	38,394	5,028	27,090	0.5%	0.9%	2,988	3,295	307	680	0.3%	0.5%	1.6%
2	6115	North Capitol Hill - Madison Park	20,812	25,312	4,500	27,090	0.7%	0.9%	1,427	1,800	373	680	0.8%	0.5%	1.6%
3	5916	South Beacon Hill – Columbia	37,738	39,179	1,441	3,190	0.1%	0.2%	1,527	2,245	718	485	1.3%	0.2%	0.5%
3	5925	North Beacon Hill - Mount Baker	24,712	26,461	1,749	3,190	0.2%	0.2%	7,649	7,416	(233)	485	-0.1%	0.2%	0.5%
4	3816	White Center - Shorewood	22,261	28,353	6,092	15,745	0.8%	0.5%	959	1,770	811	2,942	2.1%	1.1%	2.0%
4	5715	Fauntleroy - Arbor Heights	16,950	19,232	2,282	15,745	0.4%	0.5%	423	631	208	2,942	1.3%	1.1%	2.0%
4	5716	Delridge - Highland Park	26,048	27,645	1,597	15,745	0.2%	0.5%	2,742	4,223	1,481	2,942	1.4%	1.1%	2.0%
4	5720	Alki - Admiral	35,743	41,517	5,774	15,745	0.5%	0.5%	3,341	3,783	442	2,942	0.4%	1.1%	2.0%
5	5815	Lower Duwamish - Boeing Field	5,278	5,623	345	4,338	0.2%	0.9%	14,171	19,684	5,513	15,399	1.1%	1.4%	3.5%
5	5825	Industrial District	3,843	5,597	1,754	4,338	1.3%	0.9%	13,515	22,343	8,828	15,399	1.7%	1.4%	3.5%
5	5826	Upper Duwamish - Harbor Island	4,161	6,400	2,239	4,338	1.4%	0.9%	3,357	4,415	1,058	15,399	0.9%	1.4%	3.5%
6	6216	Windermere - Laurelhurst	15,766	16,565	799	8,610	0.2%	0.4%	864	1,423	559	4,321	1.7%	2.5%	2.0%
6	6223	Lake City	26,953	30,619	3,666	8,610	0.4%	0.4%	1,695	4,545	2,850	4,321	3.3%	2.5%	2.0%

TABLE 2: POPULATION AND EMPLOYMENT FORECASTS BY FAZ AND CORRESPONDING FMP DISTRICTS (CONTINUED)

PSRC FAZ Forecast			Population		INDIV FAZ	DIST TOTAL	INDIV FAZ	DIST TOTAL	Big 3 Employment		INDIV FAZ	DIST TOTAL	INDIV FAZ	DIST TOTAL	
District	FAZ10	Location	POP2010	POP2040	chg	distChg	POP40gr	POP40gr	RWM2010	RWM2040	chg	distChg	RWM40gr	RWM40gr	GrFact
6	6226	Wedgwood - View Ridge	30,144	34,289	4,145	8,610	0.4%	0.4%	1,437	2,349	912	4,321	1.7%	2.5%	2.0%
7	6010	Seattle CBD	12,027	22,213	10,186	37,229	2.1%	2.1%	16,275	21,784	5,509	18,287	1.0%	1.5%	2.5%
7	6020	Denny Regrade	14,993	28,135	13,142	37,229	2.1%	2.1%	7,788	15,142	7,354	18,287	2.2%	1.5%	2.5%
7	6123	Lake Union - Seattle Center	16,192	30,093	13,901	37,229	2.1%	2.1%	8,760	14,184	5,424	18,287	1.6%	1.5%	2.5%
8	6125	Interbay	9,918	11,718	1,800	5,676	0.6%	0.4%	3,478	5,950	2,472	5,664	1.8%	1.4%	2.5%
8	6316	Ballard	30,806	34,682	3,876	5,676	0.4%	0.4%	7,358	10,550	3,192	5,664	1.2%	1.4%	2.5%
9	6214	University Of Washington	5,706	7,907	2,201	5,278	1.1%	0.5%	na*	na*	na*	879	na*	0.5%	1.6%
9	6215	Ravenna - University District	29,177	32,254	3,077	5,278	0.3%	0.5%	5,728	6,607	879	879	0.5%	0.5%	1.6%
10	3825	Boulevard Park	17,773	23,515	5,742	9,301	0.9%	1.0%	2,429	4,192	1,763	1,763	1.8%	2.0%	1.6%
10	3905	North Tukwila - Riverton	8,910	12,469	3,559	9,301	1.1%	1.0%	na*	na*	na*	1,763	na*	2.0%	1.6%
11	4005	Skyway - Bryn Mawr	12,118	19,266	7,148	10,481	1.6%	0.6%	327	753	426	2,823	2.8%	2.7%	2.0%
11	4130	Renton Airport - CBD	17,061	19,219	2,158	10,481	0.4%	0.6%	na*	na*	na*	2,823	na*	2.7%	2.0%
11	5915	Rainier Beach	20,230	21,405	1,175	10,481	0.2%	0.6%	1,486	3,883	2,397	2,823	3.3%	2.7%	2.0%
12	6124	Queen Anne	26,499	31,499	5,000	7,193	0.6%	0.6%	4,218	4,138	(80)	173	-0.1%	0.1%	0.5%
12	6126	Magnolia	11,562	13,755	2,193	7,193	0.6%	0.6%	912	1,165	253	173	0.8%	0.1%	0.5%
13	6225	Northgate	19,253	24,758	5,505	5,505	0.8%	0.8%	4,095	6,106	2,011	2,011	1.3%	1.3%	2.0%

na* = PSRC develops employment forecasts based on Forecast Analysis Zones (FAZs). Some FAZs do not have employment values for the base year due to confidentiality issues, and also do not have projections.

Seattle Department of Transportation

DESIGN GUIDELINES APPENDIX C

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I. INTRODUCTION

The City of Seattle Freight Master Plan (FMP) will contain an updated city freight network in order to improve freight mobility and to direct future investments. To complement the network, the FMP scope of work includes a task to develop design guidelines for how to best accommodate trucks at the various freight street classification levels.

The guidelines are intended to assist in educating transportation professionals about mode-specific needs in the right-of-way for trucks. They include discussion of the planning context for truck mobility, truck design considerations, elements to consider during project development, and best practices for providing safe and efficient truck mobility.

PURPOSE OF THE DESIGN GUIDELINES

The guidelines are primarily intended to be used in the development of roadway improvement projects to better understand how truck movements can affect street design and streetscape features. This document provides guidance on the planning and design of roadway projects that are on or intersect with the updated freight network.

Purposely, the document does not reference nor propose any design "standards." Rather, it provides design "guidelines" and/or design "guidance" for consideration by roadway engineers and planners who work to accommodate all users of Seattle's streets, whether they travel by truck, auto, foot, bicycle, or transit. Detailed design criteria for streets included in the freight network are specified in the Seattle Department of Transportation (SDOT) *Right-of-Way Improvements Manual*. Using guidelines in place of standards recognizes that we need to examine every roadway section within its own unique context and environment.

II. PLANNING AND DESIGN CONTEXT

The truck design guidelines focus on the conceptual level of analysis conducted during the planning of a project to aid in project definition. While this document is primarily focused on Seattle's defined truck network, the information contained herein is also useful for the planning and design of any street improvement where freight mobility is an important consideration. This includes streets with transit, which have similar design characteristics to trucks.

UPDATED FREIGHT NETWORK

While trucks are allowed on all arterials in the city, they are encouraged to use certain streets because of their designation in the freight network and the land uses they serve. The FMP has identified a network of roadways that especially serve truck mobility and connectivity and use the following freight street classifications:

- Limited Access Facility
- Major Truck Street
- Minor Truck Street
- First/Last Mile Connector

A description of the function and design objective for the four freight street classifications is shown in Table 1.

Table 1: Freight Network Classifications

Classification	Function	Roadway type	Truck volumes	Design objective
Limited Access Facility	Serves long-distance through trips between the city and the rest of the region	Highway	All	Design to be limited access facilities and to standards that design for all types of trucks*
Major Truck Street	Serves through trips between Manufacturing and Industrial Centers, intermodal facilities, urban centers/villages, and the regional system	Minor arterial or higher	500+ trucks per day	Design to accommodate all truck types, as practicable
Minor Truck Street	Serves both through and to/from trips connecting urban centers/villages and commercial districts; provides secondary connections to major truck streets	Collector arterial or higher	500+ trucks per day	Design to accommodate truck needs in balance with other modal needs of the street
First/Last Mile Connector	Serves trips to/from industrial facilities, within the Manufacturing and Industrial Centers	Minor arterial or lower, including non-arterial streets	250+ trucks per day	Design to accommodate the movement of all truck types and over-dimensional loads, as practicable

*Design typically determined by the Washington State Department of Transportation (WSDOT)

BALANCING TRANSPORTATION MODES

Like most street design efforts, designing for truck movements will typically require balancing the needs of other, and sometimes competing, transportation modes. When focusing on particular locations and corridors, designers need to take a broad view of how trucks, cars, bicycles, pedestrians and transit travel to and from the site along the corridor being designed. Without taking a larger view of a location(s), the designer runs the risk of addressing only one of several issues in a corridor (e.g., providing an 11.0-foot lane width for one block face, while the block faces before and after have 12.0-foot to 10.0-foot lanes). In addition, a broader system view may result in solutions that rely more on system management, signage, and intelligent transportation system (ITS) improvements, etc. rather than construction solutions.

RELATIONSHIP WITH FEDERAL AND STATE POLICY

The guidelines and design considerations described in this document are for the purposes of designing streets owned and maintained by the City of Seattle. However, some of the streets traversing the City are owned and operated by the Washington State Department of Transportation (WSDOT), and must be designed to meet criteria and guidelines established by WSDOT. Many City streets and State Highways are designated by the federal government as National Highway System (NHS) routes and intermodal connectors, and segments of the National Freight Network and National Network systems. Where streets or highways have these federal designations, the federal design guidelines (administered by WSDOT) may apply.

III. PLANNING FOR TRUCKS

Planning for trucks in an urban environment requires an understanding of the attributes of trucks, the physical impediments in the environment, and where and when we can or cannot address all of these factors. The analysis should apply all available information including traffic and truck counts; truck classifications; identification of significant freight origins and destinations; current and future land uses; and, other roadway users, etc. Questions to consider prior to any modifications of the right of way should include:

- Is the roadway included in the freight network?
- What other plans/projects identify modal improvements (pedestrian/bicycle/transit/auto) for the same roadway?
- What are the truck volumes? What are the truck types?
- Where are the trucks going? Are they passing through or are they turning off?
- What are the truck trip generators in the project area, and how are they using the street network?
- Are there intersecting freight or transit corridors where turns should be closely evaluated?
- Is the street a designated over-legal route, or on the designated Heavy Haul Network?
- Is the project area on or passing through priority areas or corridors designated in the Pedestrian Master Plan, Bicycle Master Plan, or Transit Master Plan?
- Does the project area contain any identified high crash locations?
- Are there curb side roadway elements impeding freight movement?

TYPES OF TRUCKS (DESIGN VEHICLES)

Trucks come in a variety of sizes. These sizes and overall dimensions are dictated by the goods or materials being transported. Trucks typically range from 8.5- to 10.0-feet wide, and with permits can be even wider. Mirrors extend beyond this envelope, typically adding another 12 inches to either side of the vehicle.

The American Association of State Highway and Transportation Officials (AASHTO) has classified the most common sized trucks on United States roadways based either on the overall length of the vehicle (buses and single unit trucks) or vehicle wheel base (tractor-trailers). The classifications include:

- SU-30: 30.0-foot, single unit vehicles typical of most local delivery vehicles
- WB-40 and WB-50: small tractor trailers with wheelbases in the 40.0-foot and 50.0-foot range
- WB-67: 67-foot wheelbase long haul trucks, sometimes called the interstate design vehicle that has an overall length on the order of 74.0-feet.

Figure 1 shows the typical dimensions of the most commonly used AASHTO design vehicles. Additional information on these and other design vehicles can be found in the AASHTO *Policy on Geometric Design of Highways and Streets*.

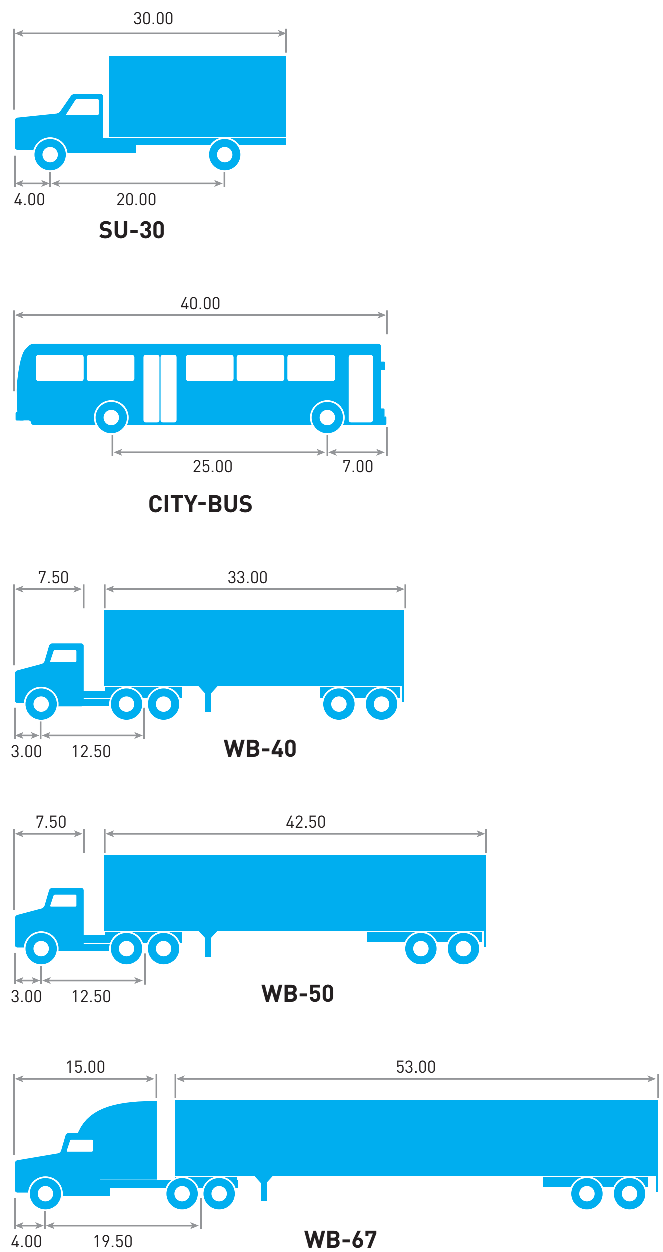
The Seattle *Right-of-Way Improvements Manual* provides design standards and general guidance for all streets and alleys within the City to accommodate fire department vehicles and refuse and recycling trucks. The Manual specifies the standard design vehicle as a single unit (SU-30) truck. However, the manual recognizes the need to accommodate larger vehicles on streets within the truck street network.

Over-legal Trucks (Weight and Size)

These vehicles and loads exceed the maximum height, weight, width, and/or length, specified by state law. All oversized vehicles and loads traveling within Seattle must obtain a permit to operate. City law allows SDOT to issue these permits. Over-legal loads are an important form of freight movement in Seattle. These movements include frequent loads like construction cranes, to less frequent movements like public art pieces. The over-legal routes in the city provide basic north-south or east-west mobility for trucks that are over-height, over-width, over-length, or over-weight. Trucks falling into this special category are larger than 8.5-feet wide, 14.0-feet high, and/or are carrying loads exceeding 105,500 pounds and meet all State requirements. They require a special permit to travel throughout the city, and typically require an escort. Seattle has an established network of over-legal streets predating the establishment of the interstate system that is used to facilitate the movement of goods in and out of Seattle.

To meet the needs for over-legal vehicles, the City has typically required a 20.0-foot wide by 20.0-foot tall clearance envelope for streets on the over-legal network. During project development SDOT staff coordinates with other divisions to preserve the over-legal dimension envelope needed to transport loads that over dimension and weight through various city streets. Intersections where such trucks are expected to turn should also be examined to accommodate the turning of these vehicles, particularly at junctions with state highways and interstates.

Figure 1: Typical Design Vehicles



“Design for” versus “Accommodate”

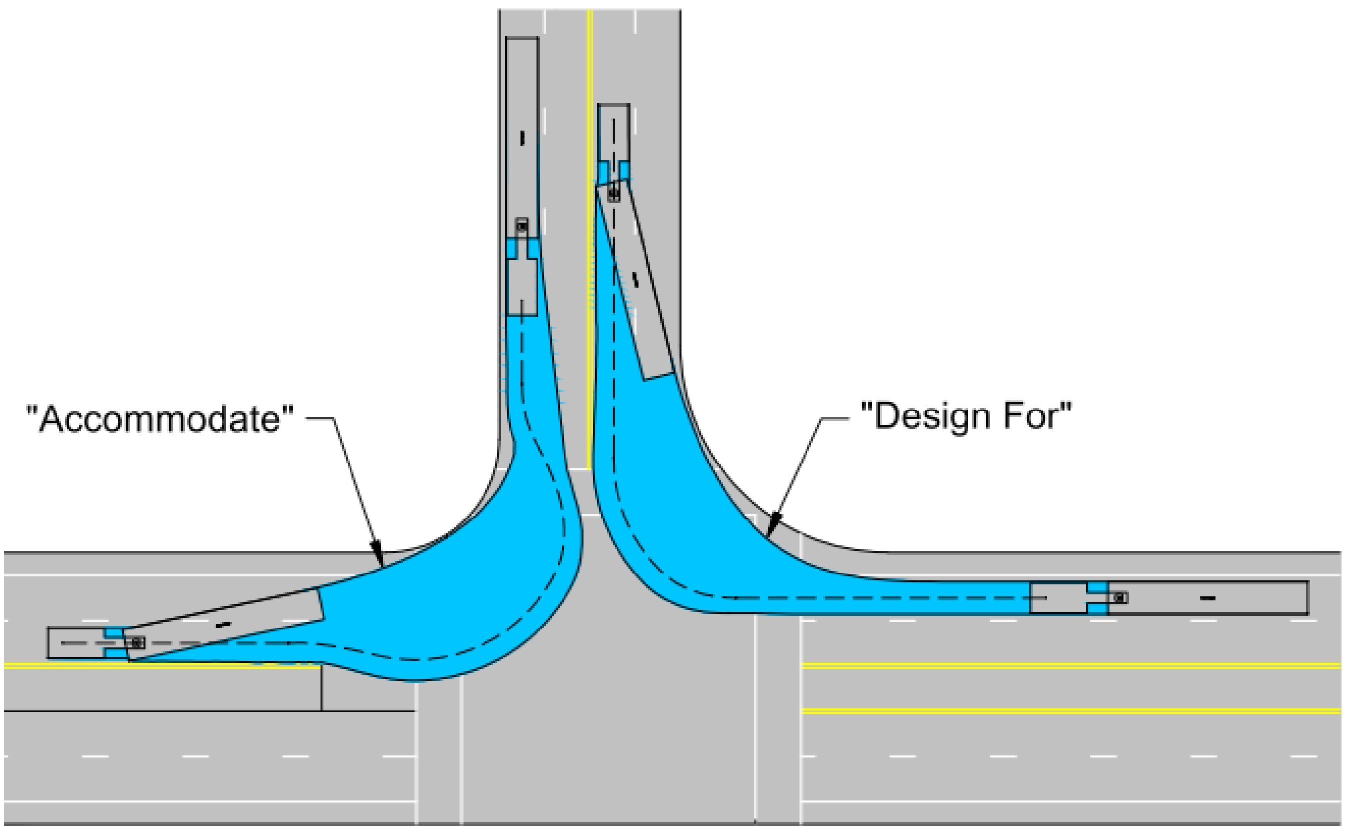
Truck size and type are important factors when planning and designing a project, especially at intersections. By answering the questions listed above, a designer will have an understanding of the expected truck type, and can evaluate the turning track maneuvers of a vehicle; thus making a more informed decision to address truck access and mobility. For a typical passenger vehicle, the path followed by the rear wheels is almost the same as that of the front wheels. With larger vehicles, the swept area becomes much larger as the inside rear wheels track substantially inside of the path of the front wheels. This becomes the most critical factor in sizing the intersection.

A key concept in the design of a project is the "design for" versus "accommodation" of trucks. In WSDOT's *Design Manual* "accommodating for a vehicle allows encroachment of other lanes, shoulders, or other elements to complete the required maneuver. Designing *for* a vehicle does not require encroachment onto those elements." For Seattle freight routes, a slight modification can be made to this definition.

An intersection turn movement is considered "designed for" if the design vehicle is allowed to encroach on the lane adjacent to the typical receiving lane for the turn movement (right lane for right turns), provided that encroachment is not into opposing traffic. When accommodating truck turning movements, over-steering of the truck into adjacent lanes is generally assumed to occur as seen in Figure 2.

Trucks should not cross the centerline of the roadway into opposing traffic with few exceptions, for example turning onto a minor street with stop sign controls with limited expected traffic. At signalized intersections, no encroachment into opposing traffic should occur past the stop bar for the opposing traffic (i.e., a recessed stop bar may be used to allow for this movement without presenting a conflict with queuing vehicles).

Figure 2: Designing For vs. Accommodating



IV. DESIGN GUIDELINES FOR TRUCKS

This section identifies design guidelines that can be used to design for and accommodate trucks on Seattle's freight network. Some of the practices herein may also have applicability to any street in Seattle where large truck movements need to be accommodated.

DESIGN FOR DIFFERENT URBAN ENVIRONMENTS

Like all roadway design, designing for freight truck needs should be evaluated on a case-by-case basis. In general, providing for truck movements through the City's various industrial, commercial, and residential areas follows certain principles for different urban environments. For example, because industrial areas (such as the Duwamish Manufacturing and Industrial Center (MIC) and the Ballard-Interbay-Northend MIC (BINMIC)) accommodate a high volume of trucks, it is important that designers provide lane widths, turning radii, and other street features that can accommodate trucks without impeding their access and ability to maneuver. In contrast, in mixed-use urban areas roadway design must accommodate all modes, which may result in slower and more challenging maneuvers for trucks.

Further, there is variation between areas that even have the same land use designation (e.g., the BINMIC has relatively narrow intersections compared with the Duwamish MIC). The designers cannot simply rely on a list of "design standards;" rather, they must provide a safer and more accessible roadway that accounts for all of the specific physical, environmental, and usage characteristics of the area they are working in, as well as integrate the needs and objectives of its neighbors.

COORDINATION WITH FREIGHT NETWORK

Seattle's Freight Master Plan has classified a number of streets as part of the freight network with a level of classification based on the characteristics of the specified truck traffic including volume, land use, origin/destination, connectivity, etc. The most common needs for truck mobility include:

- Vertical clearance: Freeways and state highways generally require 16.5-feet minimum of vertical clearance to provide for the widest range of freight, including oversized loads as well as national defense. Seattle's Major Truck Streets and First/Last Mile Connectors provide a similar function. Lesser heights can be allowed on Minor Truck Streets, but adjusted as necessary if a street is identified for over-legal vehicles.
- Weight allowance: Limited Access Facilities, Major Truck Streets, and First/Last Mile Connectors will routinely carry high volumes of fully loaded trucks, and may allow over-weight trucks by permit. Truck streets classified at as Minor Truck Streets will typically not have the consistent combination of these elements. Bridge and pavement design should follow AASHTO or other applicable guidance and be based on anticipated truck traffic. SDOT typically identifies routes which currently can or should accommodate over-weight vehicles (including on the newly-designated Heavy Haul Network).
- Turn radii: Provide for turning of the design vehicle determined appropriate through preliminary project development and design. Special attention should be paid where streets on the freight network intersect, and businesses along a corridor have access needs where frequent turning movements are made.

- Lane width: A variety of factors are considered when designing lane widths, including existing constraints within the right of way (such as building orientation, curb and sidewalk location, and on-street parking), right-of-way acquisition needs, current and projected truck traffic volumes, bicycle and pedestrian use, vehicular capacity needs, and the number of travel lanes. Truck type and dimensions are also a factor that should be considered when determining lane width.

FREIGHT NETWORK INTERSECTION CONCEPTS

The design of intersections in dense urban areas that can accommodate freight and other modes can be very challenging. Trucks can require large radius turns, resulting in significant right-of-way needs and longer pedestrian crossings. Considerations for type of vehicle need to be made when addressing turning movements to keep an intersection accessible to trucks while not overdesigning in a way that creates negative impacts on people walking or riding bicycles.

Vehicle off-tracking

Most corner designs for trucks will need to be analyzed for vehicle swept path, also known as off-tracking. Off-tracking is the path a truck makes during left or right turns at intersections, and it does not follow the same path made by a regular size vehicle. AASHTO turning templates may be used for simple designs but provide limited flexibility for complex design scenarios. Another approach is to use specialized software, such as Autoturn, to complete the off-tracking analysis.

Intersection Concepts and Other Modes

While truck mobility is a primary concern along designated freight routes, it must be balanced with the needs of other roadway users traveling by other modes including in cars, by bicycle on foot, and on transit.

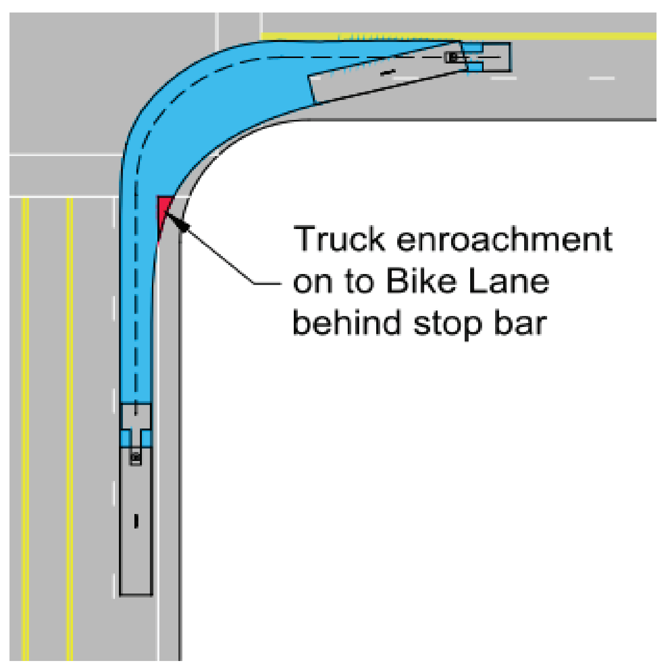
Cars

While automobiles are generally compatible with a corridor and intersections designed for truck traffic, wide intersections can be challenging to traverse due to lack of lane lines for extended distances. Supplemental pavement markings at intersections may be necessary to help vehicle drivers navigate the gap. In addition, large radius corners can encourage speeds higher than desirable. Consideration should be made for traffic calming features and whether it may be appropriate to provide for some of the extra room a truck needs to make a turn through use of truck aprons instead of traditional pavement.

Bicycles

Bicycle use is on the rise in Seattle and truck-bicycle collisions present a significant safety concern as such collisions can cause severe injury to the cyclists and are often fatal. A common conflict point between a person on a bicycle and a person driving a truck occurs at right turn movements. Trucks sweep a large area when making such a turn and people on bicycles can find themselves in a truck blind-spot and trapped within the swept zone, as seen in Figure 3.

Figure 3: Bicycle-Truck Conflict at Right Turn



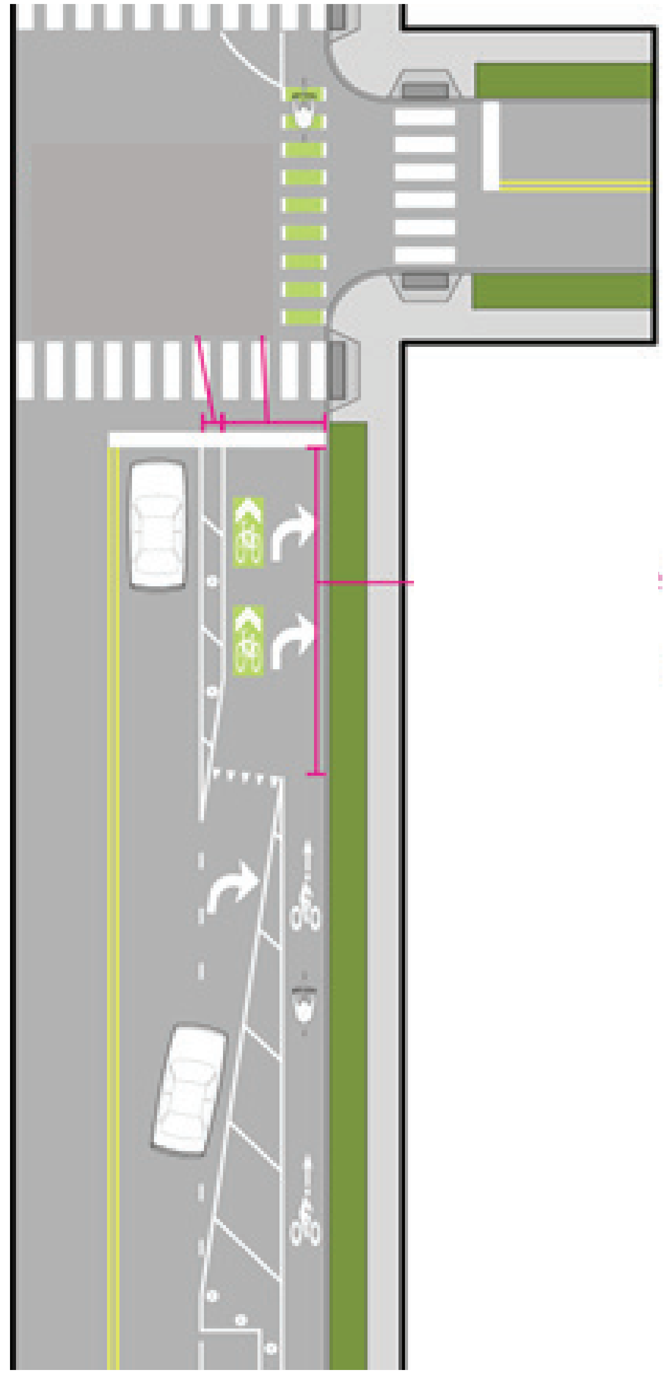
Mitigation measures should be considered at locations where large volumes of right-turning trucks occur including use of bicycle boxes to allow bicycles to queue in front of the right-turning vehicle, and adoption of right-turn lanes that allow for a bicycle lane to be positioned left of the turning vehicle. Routing people on bicycles off the roadway onto multi-use pathways (much like is done at roundabouts or by developing a short length of protected bicycle lane near the intersection, coupled with cross bicycle markings) may also be considered (see the Seattle *Right-of-Way Improvements Manual* for more on these treatments). Exclusive phase bicycle signals where bicycle volumes are expected to be high, used independent of or in conjunction with these treatments can further control the conflict point between people turning trucks and people on bicycles at intersections.

The Seattle *Right-of-Way Improvements Manual* will provide the dimensions for design elements (travel lanes, sidewalks, planters, etc.) depending on street typology. The size of the truck can help determine some of the design dimensions. For example, the "One Way Protected Bicycle Lane Mixing Zone" treatment shown in Figure 4 provides a transition to a shared right turn/bicycle lane when a buffered or protected bicycle lane is used on the street. On truck streets, the design vehicle can help inform the project by creating a mixing zone that is, at a minimum, the length of the design vehicle plus 10.0-feet.

Pedestrians

Intersections designed for trucks can require large radii at corners leading to very long crosswalks, increased crossing times, and pedestrians exposed to traffic. To mitigate these conditions the crosswalks can be setback from the intersection to minimize crossing length and provide better accessibility. However, that design makes a pedestrian in the crosswalk less visible. The design should consider examining intersection signal cycle lengths, turn volumes, and other available data to assess the needs for various additional treatments, such as extra signage or flashing beacons.

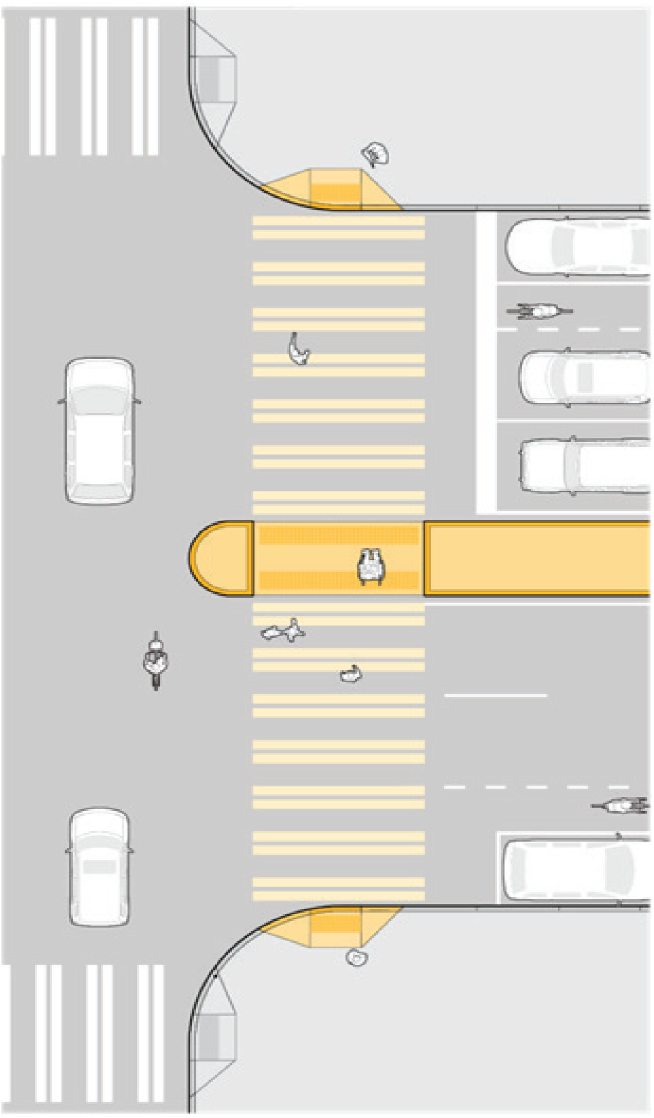
Figure 4: One-way Protected Bicycle Lane Mixing Zone



Careful corner design can reduce crossing distances at the crosswalk. WSDOT uses a tapered corner design, but also considers two- or three-centered (compound curves) included in the AASHTO *Policy on Geometric Design of Highways and Streets*. The compound curve design matches the true turning path of a truck, minimizing unused pavement. Additional design information will be included in the Seattle *Right-of-Way Improvements Manual*.

Corners designed for the largest trucks create long crossing distances for pedestrians, increased when there are more than two lanes in each direction. One approach to managing long crossing distance is by using a median refuge island like the one shown in Figure 5. This allows pedestrians to cross the street in two stages and may be a solution where space is available.

Figure 5: Median Crossing Island



Similarly, an option to shorten crossing distances is a corner island (also known as a "pork chop" island), which can act as a refuge between a right-turn-only lane and through traffic. Such islands do expose the pedestrian to the right-turn stream of traffic, and the safety of that crossing should be considered including incorporation of traffic calming techniques, signage, and flashing beacons as ways to control and/or warn people driving about the crosswalk and requirement to stop. Such islands can also restrict trucks larger than the design vehicle from making the turn, so careful design is required, even going as far as using a larger design vehicle. Due to these caveats, this treatment is typically implemented only when other approaches have been exhausted.

Crosswalks should be checked to make sure minimum illumination levels are achieved, particularly at very large intersections. Additionally sight lines to the crosswalk for turning vehicles need to be kept clear from vegetation, parked cars, signs, and other obstructions. See the Seattle *Right-of-Way Improvements Manual* for detailed information.

Transit

Usually a street designed for transit is well suited for large trucks. Buses used for transit have similar design characteristics as truck traffic, and the modes often prefer the same relatively flat corridors. Roads with articulated buses typically have intersection designs that accommodate turning movements for the AASHTO articulated bus (A-BUS) design vehicle. When planning a project on these routes, review the design to ensure the truck design vehicle is accommodated, if applicable.

CURB SIDE CLEARANCES

Obstructions, such as signs, utility poles, and landscaping, can impede curb side clearances along a freight corridor. Therefore, it is important to consider the dimensions of the truck design vehicle when developing plans for the street side. The Seattle *Right-of-Way Improvements Manual* gives the vertical clearance distance from the face of the curb clear to the edge of any obstruction that could be impacted by the mirror of a truck.

Landscaping

Landscaping can impede sightlines for people who drive trucks, especially the placement and maintenance of street trees. The SDOT *Street Tree Manual*[1] provides information about tree planting, maintenance of trees and other vegetation, and tree protection and preservation that is both required and recommended. The proper care of existing trees enhances public safety, supports citywide canopy goals, improves habitat, protects water quality in our streams, lakes and Sound, and improves the aesthetic qualities of our neighborhoods.

When selecting and designing the placement of trees, consider the anticipated trunk diameter at maturity and set the tree back from the curb accordingly so that, long term, the desirable clearance from face of curb to trunk is preserved.

Consider low vegetation at intersections, curb cuts and mid-block pedestrian crossings. Trees can be an obstruction at the corner radius (radii) of an intersection or a mid-block curb bulb by blocking people waiting to cross. They also may not provide clearance for a truck turning movement that encroaches on the curb or sidewalk, either by accident or because the truck is an uncommon size for the street.

Select tree species compatible with the planned lane configuration so the tree will require minimal trimming to accommodate truck vertical clearances (with trimming typically provided to match the desirable vertical clearance for the design vehicle). The use of tree types that require extensive trimming can lead to unaesthetic shapes to the tree canopy or, if foregone, damage to the tree itself. This may limit the use of large canopy trees in locations where the outside lanes are not buffered from the curb by a planter strip, bicycle lane, or parking, suggesting the use of columnar or vase shaped trees.

ROUTE INFORMATION

Online Information

The City maintains online information for freight mobility which includes:

- Permitting requirements for over-legal loads
- Map of the City's freight network
- Weight restrictions on City-owned bridges
- E-mail service alerting subscribers to real-time impacts to the truck street network
- Traveler information website with real-time traffic impact maps
- City and state traffic cameras

The City also maintains a network of dynamic message signs to provide information to people driving on the road. Additional policies and programs will be added to the Freight Master Plan that promote the development of technologies to benefit freight movement through mapping, dynamic message signs, and mobile applications, and compiling these resources into a central location.

Truck Street Signage

Wayfinding is an important consideration for the design of truck streets. While the Seattle area may be familiar to many drivers, some are making their first time or infrequent trip to Seattle. Aiding these drivers with clear truck route signage is important. While the highway-to-destination is relatively straight forward where truck streets intersect, particularly if a turn is required to stay on the truck street network, the inclusion of "Truck Route" signage at the intersection is appropriate. Signage can also be useful in providing direction to the primary freight route to major freight destinations.

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[1]Seattle Department of Transportation, Street Tree Manual, http://www.seattle.gov/transportation/docs/Street%20Tree%20Manual%20WEB.pdf

V. BEST PRACTICES

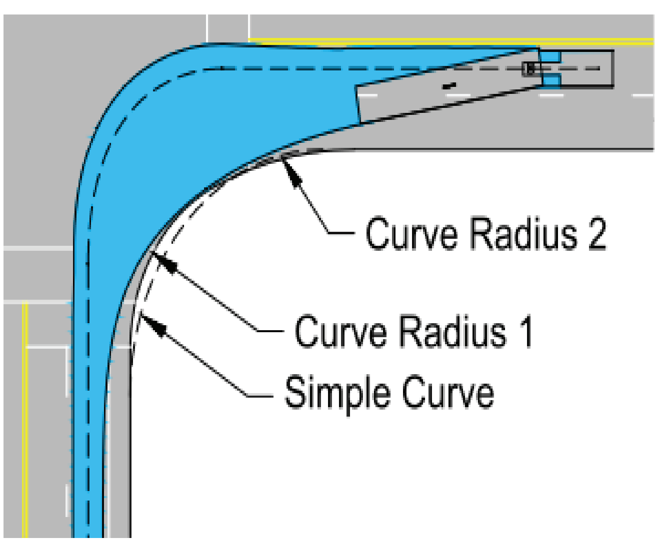
The following best practices have been referred to herein and are illustrative in nature. They are not intended to be comprehensive. Detailed information for design should be informed by the Seattle *Right-of-Way Improvements Manual*, WSDOT *Design Manual*, AASHTO *Policy on Geometric Design of Highways and Streets* and the National Association of City Transportation Officials (NACTO) *Urban Street Design Guide*, as well as other reference materials to aid in developing project specific solutions.

MULTI-CENTERED CORNERS (COMPOUND CURVES)

Design Considerations

When trucks turn, particularly tractor-trailers, they sweep a path that can best be simulated by a series of curves. A simplified approach as seen in would use two or three compound curves to best match the pathway of the truck. By using this approach, the full swept path of the design vehicle can be designed for and larger vehicles checked for accommodation, if appropriate, while still minimizing the amount of roadway surface.

Figure 6: Two-Centered Curve Example



Minimizing roadway surface also manages crossing distances, signal pole arm lengths, etc., and provides both safety and cost benefits to the project. These designs also allow for a tighter radius corner, which will help promote speed reduction for smaller vehicles making the turn. Figure 6 illustrates the efficiencies gained with this design approach, and it should generally be implemented whenever possible.

Design Application

- AASHTO *Policy on Geometric Design of Highways and Streets* Chapter 9 contains more information regarding compound curve design, including tables and exhibits. Note, the recommendations presented in Chapter 9 assume an outside lane to outside lane corner design and could be conservative on multi-lane roads given the definition for "design for" noted earlier in this document.
- Typically, designers will complete an analysis using a two- or three-centered curve design with a vehicle swept path software package (i.e., Autoturn) or turning templates. When using such software, the following guidance is recommended:
    - Start and end the vehicle in the center of the exiting and receiving lanes
    - Set the vehicle speed as follows:
        - 10 miles per hour (mph) or greater for signalized intersections
        - 5 mph for stop sign controlled or uncontrolled intersections
    - In these analyses, designers seek to provide at least 1-foot (2-feet preferred) of clearance from vehicle body to the curb face at any portion of the corner

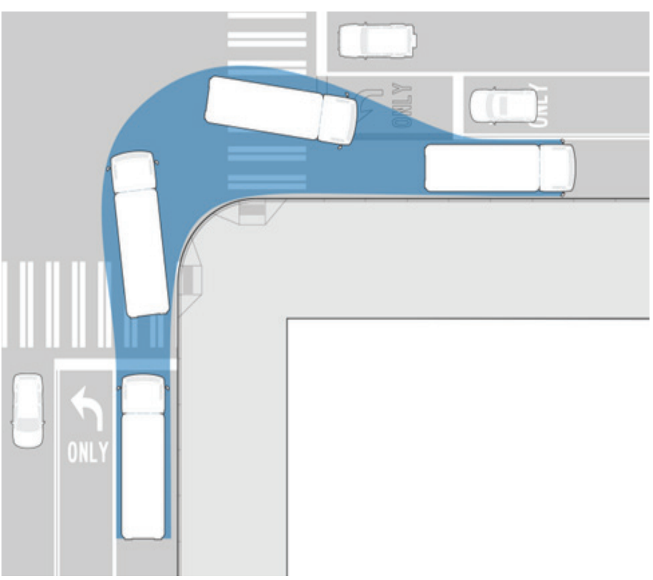
- Use 2-feet of vehicle clearance envelope in most situations so that vehicle path is unlikely to run onto the gutter pans at the curb and gutter, as well as provide a buffer for path variability to the curb face. Over shorter distances, 1-foot of clearance may be acceptable. A strengthening of the gutter may be required in these situations.
- Limit the use of multiple node points within the turn that change the turning radius, a single point-to-point corner path is preferred.

SETBACK STOP BAR PLACEMENT

Design Considerations

Stop bar location on both the street a truck is turning from, as well as the cross street approach the truck is turning into, can have a dramatic effect on the accommodation of truck turning movements. Stop bars can be set back from the intersection and crosswalk to provide room for the swept path of the turning vehicles. Additionally, not all lanes need to have the stop bar setback. On cross street approaches, this treatment is typically limited to the left-turn lane when such a lane is present as seen Figure 7. For cross street approaches without a left-turn lane, the stop bar for the inside through lane can be set back.

Figure 7: Recessed Stop Line



Design Application

- Check stop bar placement for both left- and right-turning movements on both the street a truck is turning from as well as the cross street approaches (if accommodating and not designing for) for the specified design vehicle.
- Verify that the stop bar location does not exceed the maximum stop bar to street light distance as allowed by the *Manual on Uniform Traffic Control Devices*.
- Include supplemental lane markings so that cars have clear indication of the lane locations through the intersection.
- Take into consideration existing signal detection equipment and make adjustments as needed.

CROSSING ISLANDS

Design Considerations

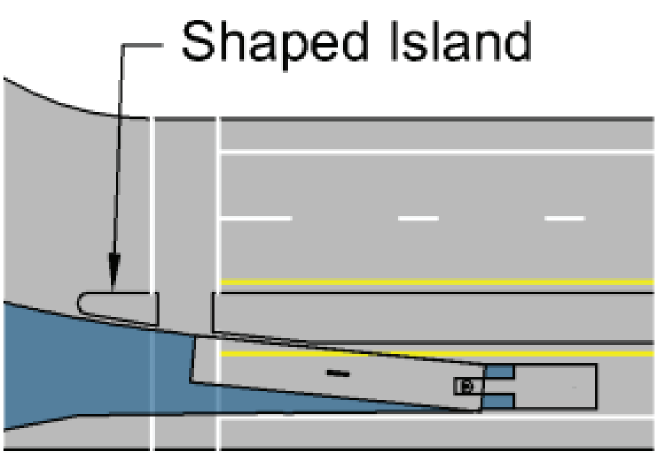
Crossing islands, sometimes called median refuge islands, provide a location in the median of the street for pedestrian refuge on wide roadways. They shorten the effective crossing distance at the expense of creating a two-stage crossing and additional delay for the person crossing the street. The advantages of reducing crossing distances are twofold. First it limits the amount of time a pedestrian is in a crosswalk and exposed to the traffic flow. Second, because signal designs can plan for a two-stage crossing, signal timing can be better optimized for traffic, including trucks, since pedestrian crossing times often dictate the minimum amount of time a signal must remain green.

The islands also provide an opportunity to visually enhance a street with landscaping or textured hardscape within the raised median island, taking care not to obstruct sightlines.

Design Application

- The Seattle *Right-of-Way Improvements Manual* includes details for the design of crossing islands.
- Check for clearance using turning templates or software that simulates the turning movement of the design vehicle to accommodate trucks.
- The island end can be shaped to better match the turning path of the truck as shown in Figure 8.
- Reflectorized markers mounted to the top of the island curb can help visibility at night.

Figure 8: Median Island with Shaped End



CORNER ISLANDS

Design Considerations

Corner islands are typically used on roadways with dedicated right-turn only lanes. The configuration typically allows vehicles a free right-turn and can provide a refuge for people at intersections with long crossing distances. However, they are generally discouraged unless other options have been exhausted.

Like crossing islands, corner islands reduce the amount of time in a signal cycle that is given to people crossing the street, allowing the signal to be optimized for traffic conditions. The pedestrian would cross from the street side sidewalk across the right-turn lane traffic flow to a refuge island containing the pedestrian crossing signals, shown in Figure 9. The corner island effectively squares up the crosswalks and shortens crossing distances.

Figure 9: Truck Apron

These treatments are discouraged because pedestrians crossing the right-turn stream of traffic are exposed with a largely uncontrolled crossing. Further, if not designed properly, the geometry of the traffic island can promote faster automobile turning speeds and present a barrier to large trucks.

Corner islands are not appropriate where large numbers of pedestrians will have to cross the uncontrolled stream of traffic. This situation puts the pedestrian at increased risk for drivers failing to stop, and can lead to inefficient traffic flow if the crosswalk is regularly occupied.

Design Application

- Review pedestrian crossing volumes to verify whether this treatment is appropriate.
- Consider use of a raised crosswalk or truck apron to help control vehicle speeds through the crosswalk area.
- See the Seattle *Right-of-Way Improvements Manual* for pedestrian cut-through design.
- Use this treatment in combination with multi-centered (compound) curve design to limit the crossing distance from the sidewalk to the island.

- Consider the largest potential vehicle size for design, including transit and oversize trucks if appropriate, and not just the standard design vehicle. The larger vehicle design accommodates the turning vehicles without encroachment on either the island or the sidewalk.

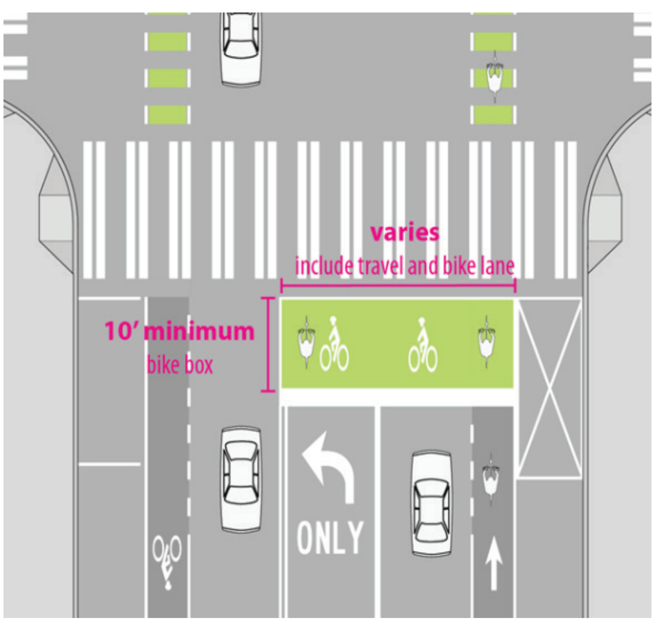
GREEN BICYCLE BOXES

Design Considerations

A green bicycle box is a designated area at the head of a traffic lane at a signalized intersection that allows people on bicycles to queue in front of waiting vehicles rather than in a line within the bicycle lane, as seen in Figure 10. By allowing the person on a bicycle to queue in front of traffic, the time it takes for the bicycle lane to clear for right-turning vehicles is greatly reduced, and people on bicycles are removed from the hazard zone between the curb and a turning vehicle.

Bicycle boxes work best when several bicycles are anticipated to arrive at a signal and where visibility and conflict reduction with right-turning vehicles is important. On routes with a significant number of people on bicycles, the operational impact of preventing right turns on red for the waiting vehicles is offset by improved safety.

Figure 10: Bicycle Box



Design Application

- The Seattle *Right-of-Way Improvements Manual* includes detailed criteria for green bicycle boxes.

BICYCLE SIGNALS

Design Considerations

Bicycle signals provide another means of controlling the movement of people on bicycles at an intersection, an example is shown in Figure 11. Bicycle signals can be used to improve truck and bicycle safety at intersections by separating the turning and through movements of people on bikes and general traffic, and better managing that conflict point. The signals can be set to work in a number ways:

- Provide an exclusive phase for people on bicycles, allowing them to move through the intersection unaffected by other traffic.

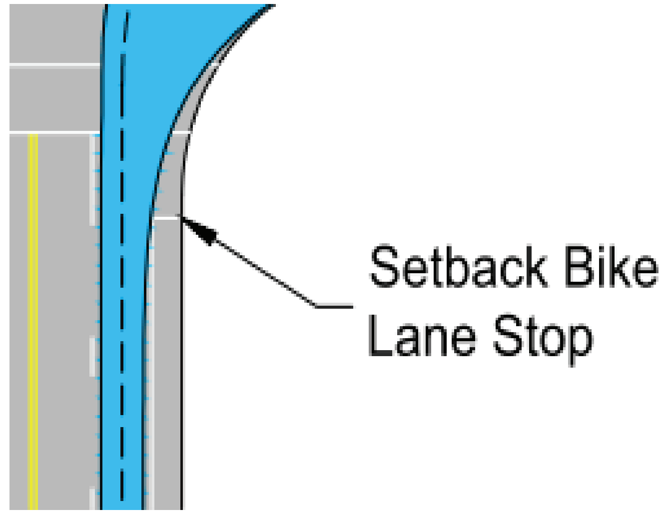
Figure 11: Bicycle Signal

- As a leading bicycle interval (an early green), allowing the bicycles to "queue jump" through the intersection. This helps clear the bicycle lane before the green phase for vehicles starts.
- To separate bicycle movements from conflicting automobile turn movements.

Design Application

- Make sure bicycle signal loop detection is provided and clearly marked.
- Can be used in conjunction with setback bicycle lane stop bar to protect the person in a bicycle lane from encroachment by the path of large turning trucks, shown in Figure 12. Make sure to align the bicycle signal loop detection with the setback stop bar.

Figure 12: Setback Bicycle Lane Stop Bar



Seattle Department of Transportation

EXISTING CONDITIONS REPORT APPENDIX D

SDOT

Seattle Department of Transportation

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FREIGHT MASTER PLAN - EXISTING CONDITIONS REPORT

1.0 PURPOSE

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

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

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

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

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

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

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

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

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

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

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

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

2.0 WHAT IS FREIGHT MOBILITY?

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

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

2.1 DEFINITION AND ROLES OF FREIGHT MOBILITY MODES AND ASSETS

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

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

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

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

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

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

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

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

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

2.1.1 MARITIME SHIPPING

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

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

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

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

Waterways and Infrastructure

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

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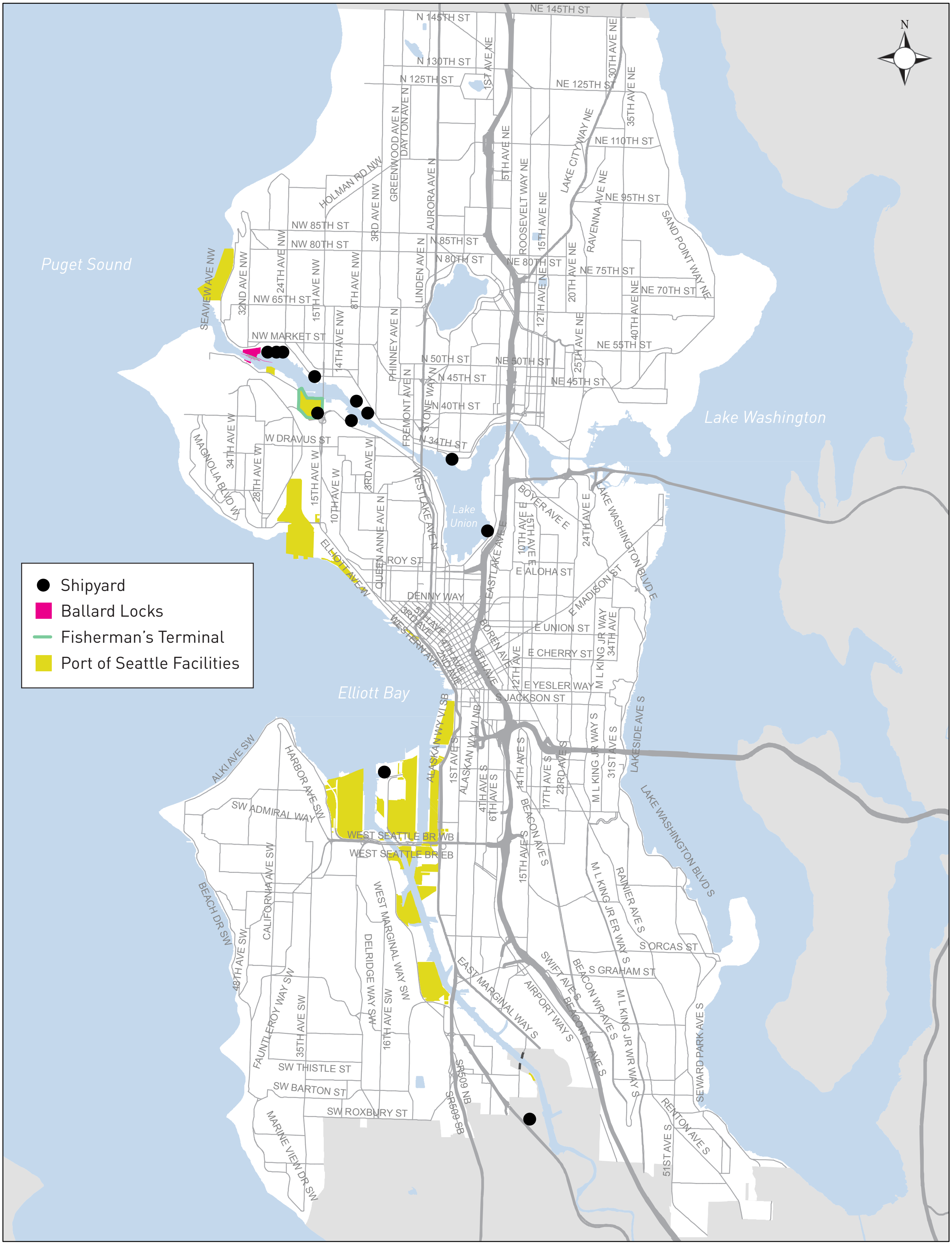
[8]Laetitia Dablanc, Genevieve Giuliano, Kevin Holliday, and Thomas O'Brien, Best Practices in Urban Freight Management: Lessons from an International Survey, Transportation Research Board, August 2013, https://hal.archives-ouvertes.fr/hal-00854997/document
[9]Parsons Brinkerhoff, The Role of Freight in Seattle's Economy, December 2014
[10]Economic Development Council of Seattle and King County, Washington State Maritime Cluster: Economic Impact Study, November 2013, http://edc-seaking.org/wp-content/uploads/2013/11/CAI.WA-Maritime-Cluster-Study.2013-1120.pdf
[11]Lower Duwamish Waterway Group, Discover the Duwamish, http://www.ldwg.org/discover.html

Figure 1: Maritime Assets



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

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

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

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

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

Maritime Economy

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

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

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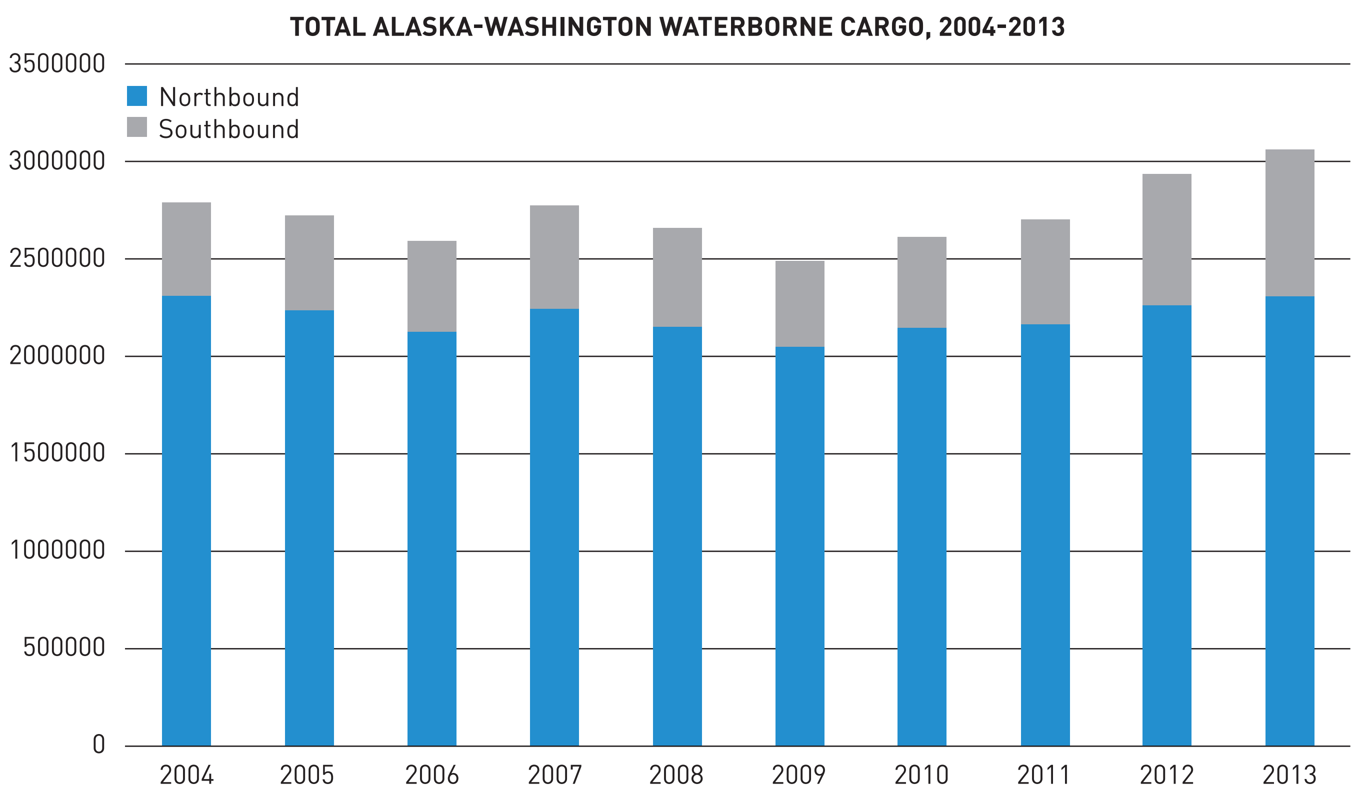
[12]Boeing, History of the Duwamish Waterway, http://www.boeing.com/boeing/aboutus/environment/duwamish/history.page
[13]Port of Seattle website http://www.portseattle.org/Cargo/SeaCargo/Pages/default.aspx
[14]Port of Seattle website http://www.portseattle.org/Commercial-Marine/Pages/default.aspx
[15]The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

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

Other important maritime economic impacts:

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

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



accounts for the bulk of southbound shipments destined for Puget Sound from Alaska, with lesser amounts of household goods, recyclables, and scrap materials comprising the remainder.
- Tourism
    - Cruise business is responsible for more than 4,000 jobs, $381 million in annual business revenue, and nearly $16.8 million annually in state and local tax revenues.
    - Each vessel call generates almost $2.2 million for the local economy.
    - In 2014, there were a total of 179 vessels docking in Seattle with 823,000 passengers.[17]

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

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

2.1.2 RAILROADS

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

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

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

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

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

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

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

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

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

Railroad Innovation and Environment

BNSF

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

Union Pacific

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

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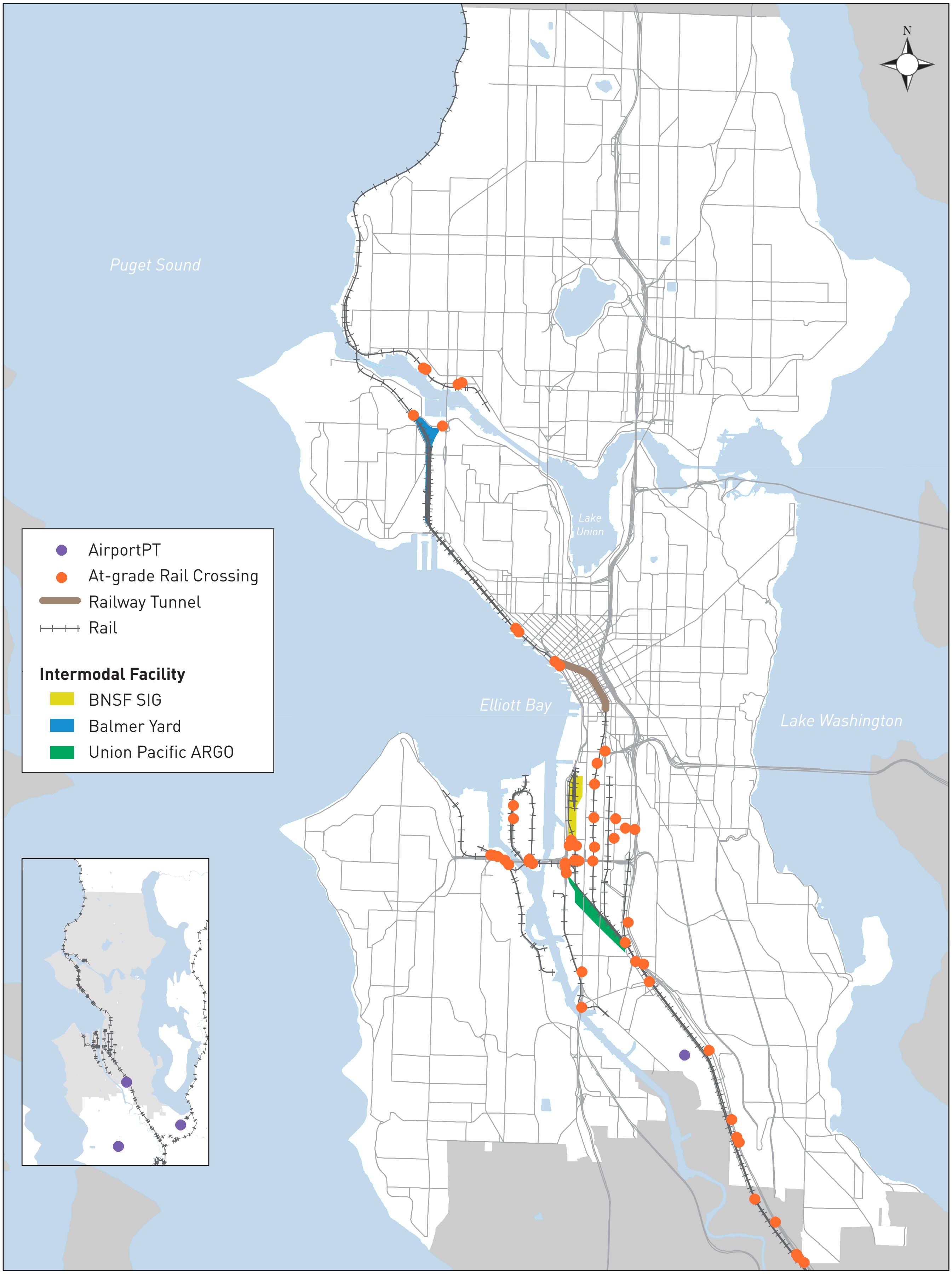
[18] The role of Freight in Seattle's Economy, Parsons Brinkerhoff, September 2014
[19] BNSF, BNSF and the Environment, http://www.bnsf.com/communities/bnsf-and-the-environment/
[20] Sustainability and Citizen Report, Union Pacific, http://www.up.com/aboutup/corporate_info/sustainability/preserve_environment/index.htm

Figure 3: Rail and Intermodal Assets



2.1.3 AIR

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

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

King County International Airport/Boeing Field (KCIA)

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

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

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

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

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

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

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

Seattle-Tacoma International Airport (Sea-Tac)

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

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

2.1.4 ROADWAY

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

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

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

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

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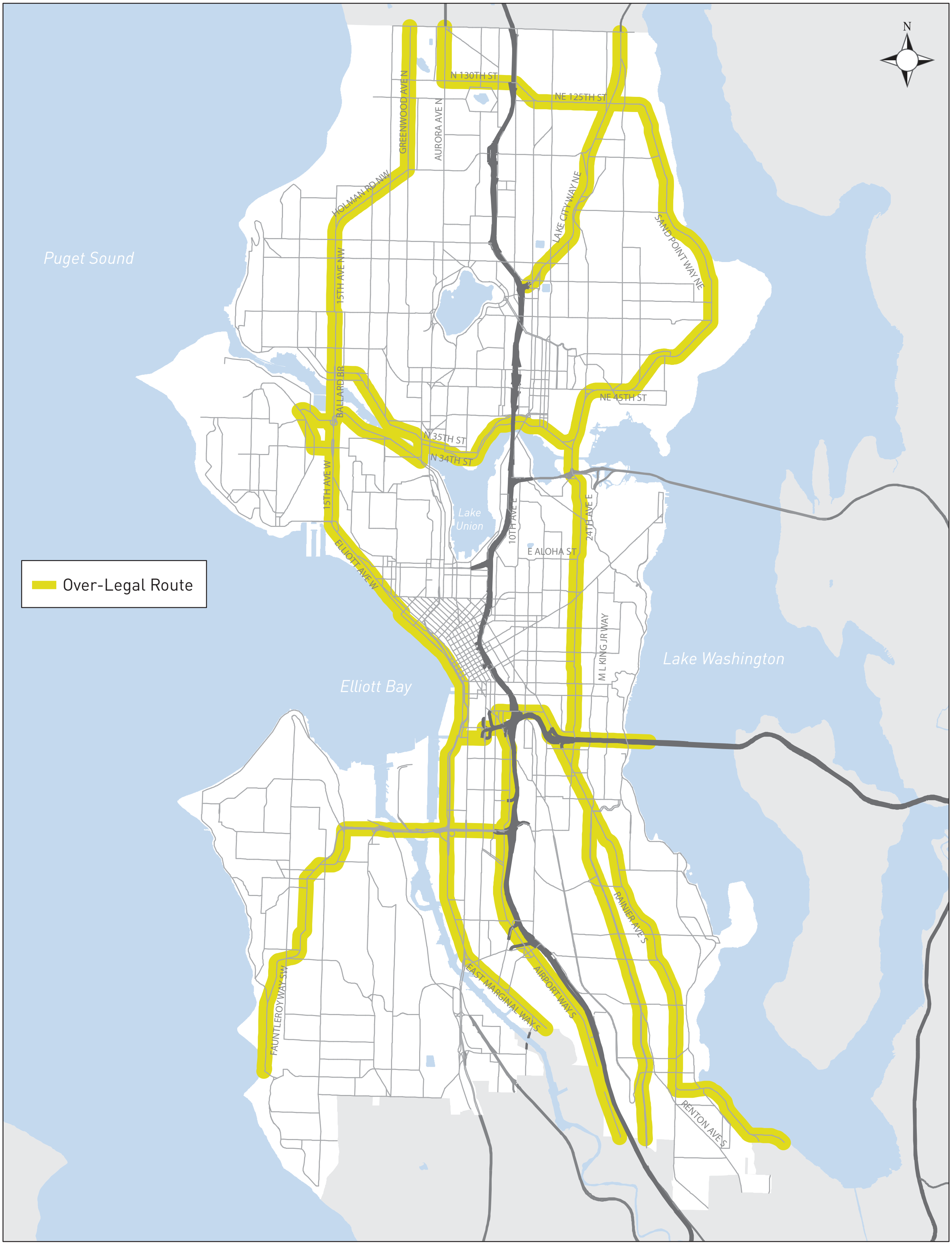
[24]Parson's Brinkerhoff, The Role of Freight in Seattle's Economy, December 2014
[25]Washington State Freight Advisory Committee, Washington State Freight Trends & Policy Recommendations or Air Cargo, Freight Rail, Ports & Inland Waterways, & Trucking, May 2014, http://www.fmsib.wa.gov/fac/20140602-FINALComplete%20Folio_for%20printer5-7-14.pdf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

Figure 5: Roadway Freight System



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

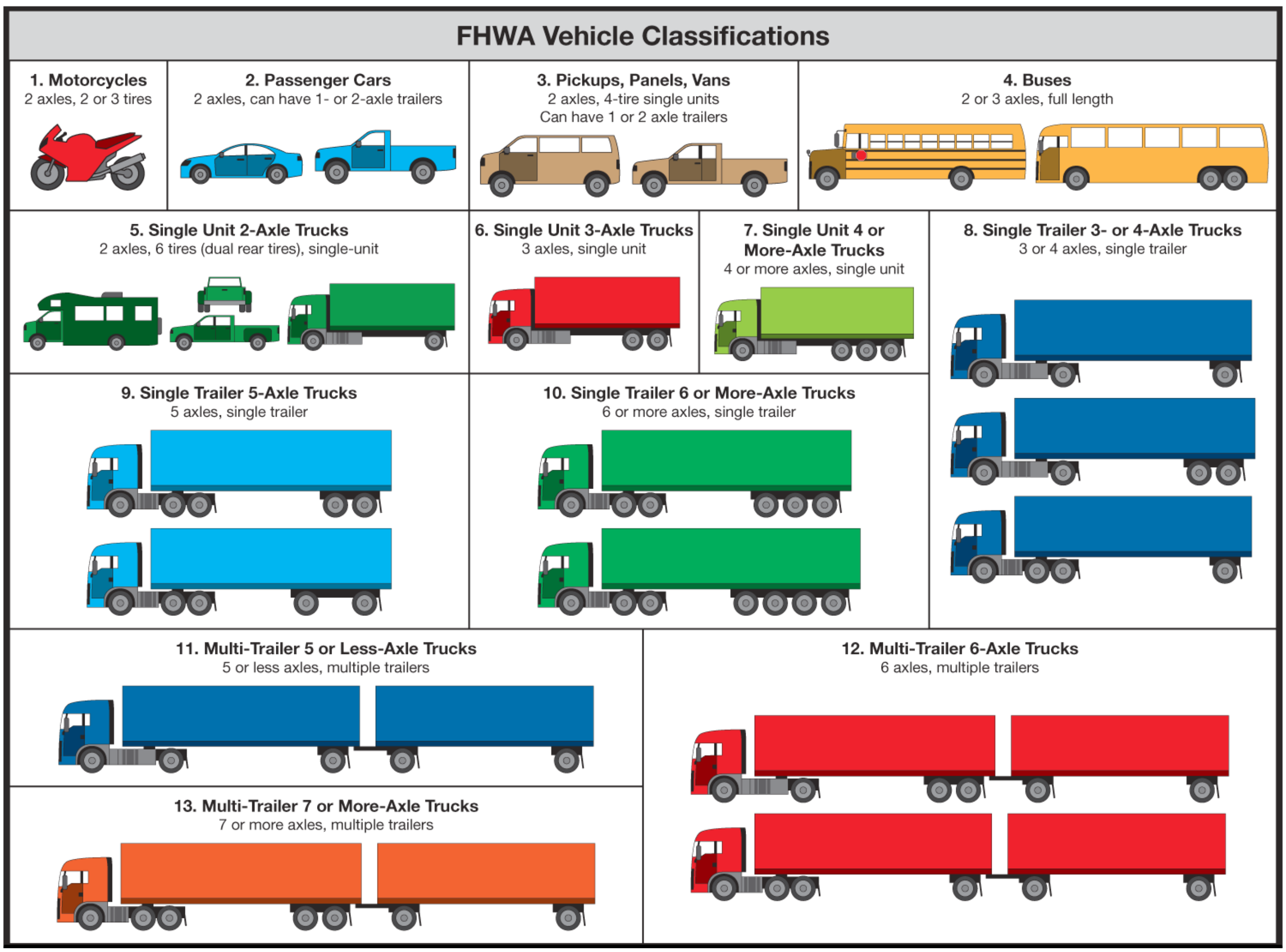
Truck classifications

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

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

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

Figure 6: FHWA Vehicle Classification



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

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

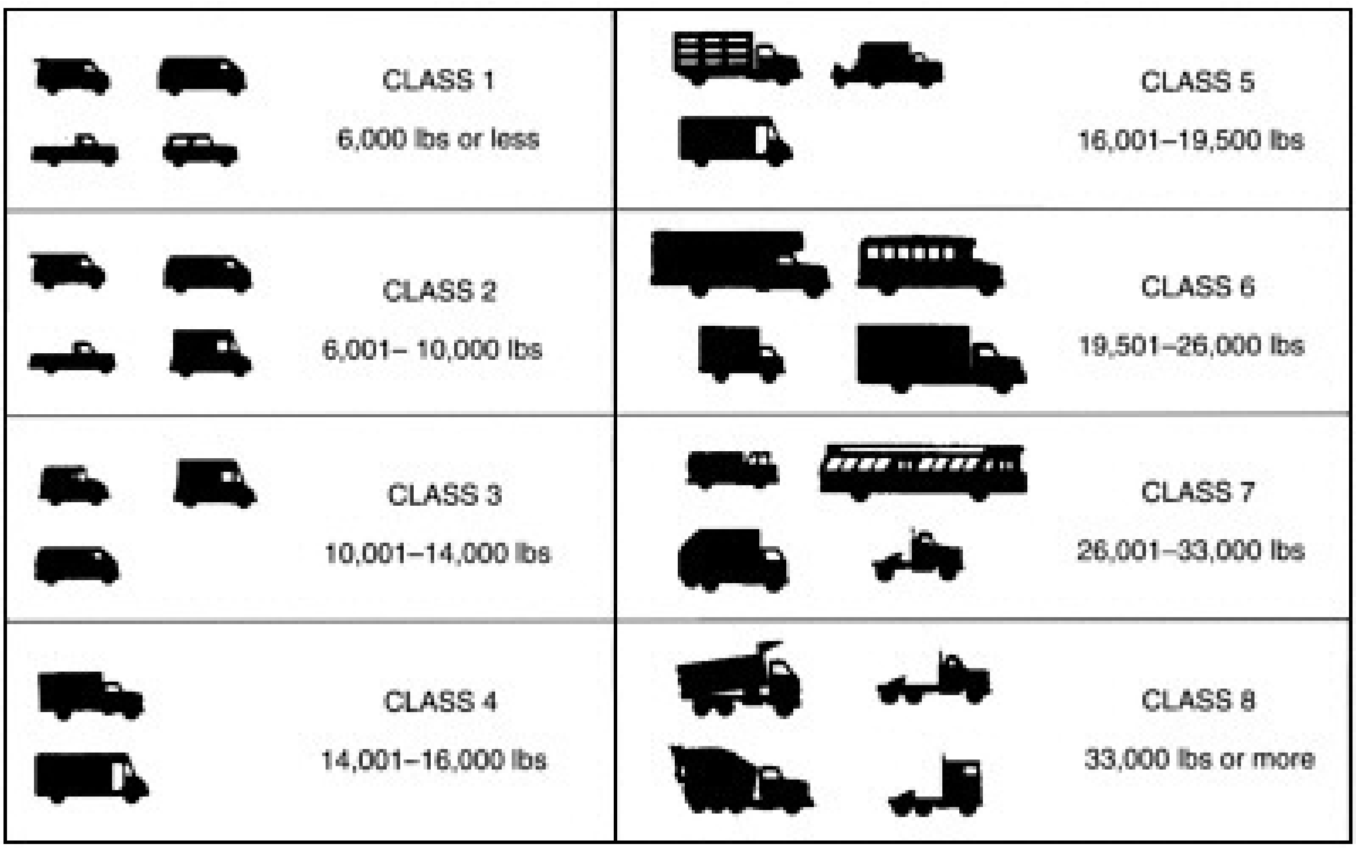
The Washington State Freight and Goods Transportation System (FGTS) is a classification system managed by the Washington State Department of Transportation (WSDOT) and used to classify state highways, county road and city streets according to the average annual gross truck tonnage they carry. The FGTS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

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

2.1.5 PIPELINE

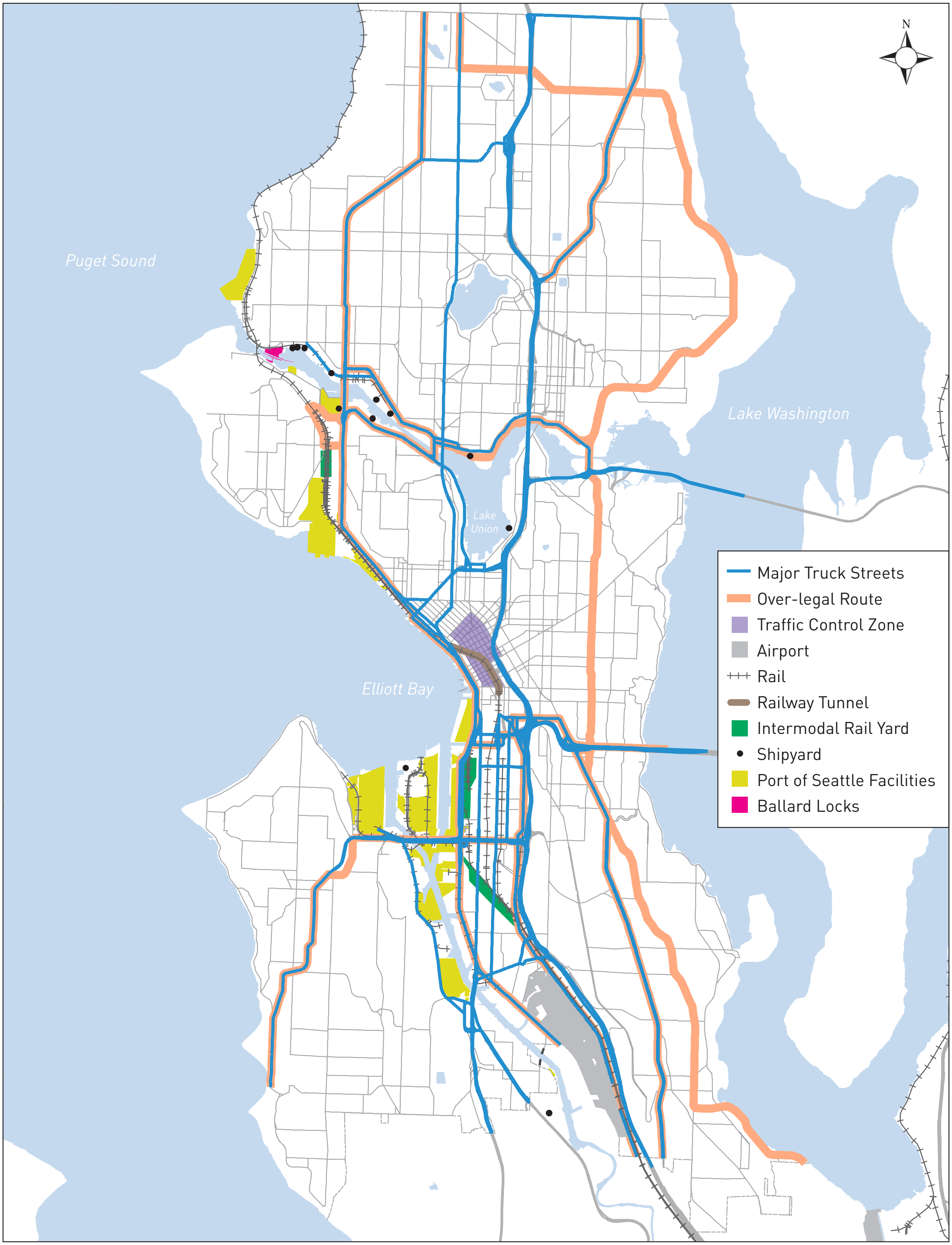
The Olympic Pipe Line carries 50-60% of the output of the five crude oil refineries in Washington to distribution centers in western Washington. The pipeline is the sole source of jet fuel for Sea-Tac airport.[29] [30] This significant pipeline is the Seattle lateral of the British Petroleum (BP) line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

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



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

Figure 8: Combined Freight Assets



2.2 LAND USE

Seattle is the region's largest and most diverse city in terms of population, economic activity, and transportation options. The city has a long history of being a maritime, manufacturing, and freight distribution center for the region, and has a number of diverse and unique neighborhoods. By 2035 Seattle expects to see an increase of 70,000 additional housing units, and 115,000 additional jobs. City's Comprehensive Plan establishes the city's vision for land use, transportation, and growth management policy issues. 6 Through the Comprehensive Plan, the City manages and promotes growth in specific areas: regionally-significant urban centers and MICs and, at a more local scale, urban villages, where existing neighborhood business districts are located. The growth strategy to focus most future jobs and housing growth in specific areas serves several purposes:

- Accommodate Seattle's expected growth in an orderly and predictable way
- Strengthen business districts, including MICs
- Promote the best and most efficient use of public investments, including transportation infrastructure
- Preserve Seattle's distinctive natural features
- Contribute to the vibrancy of our neighborhoods

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

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

2.2.1 URBAN CENTERS

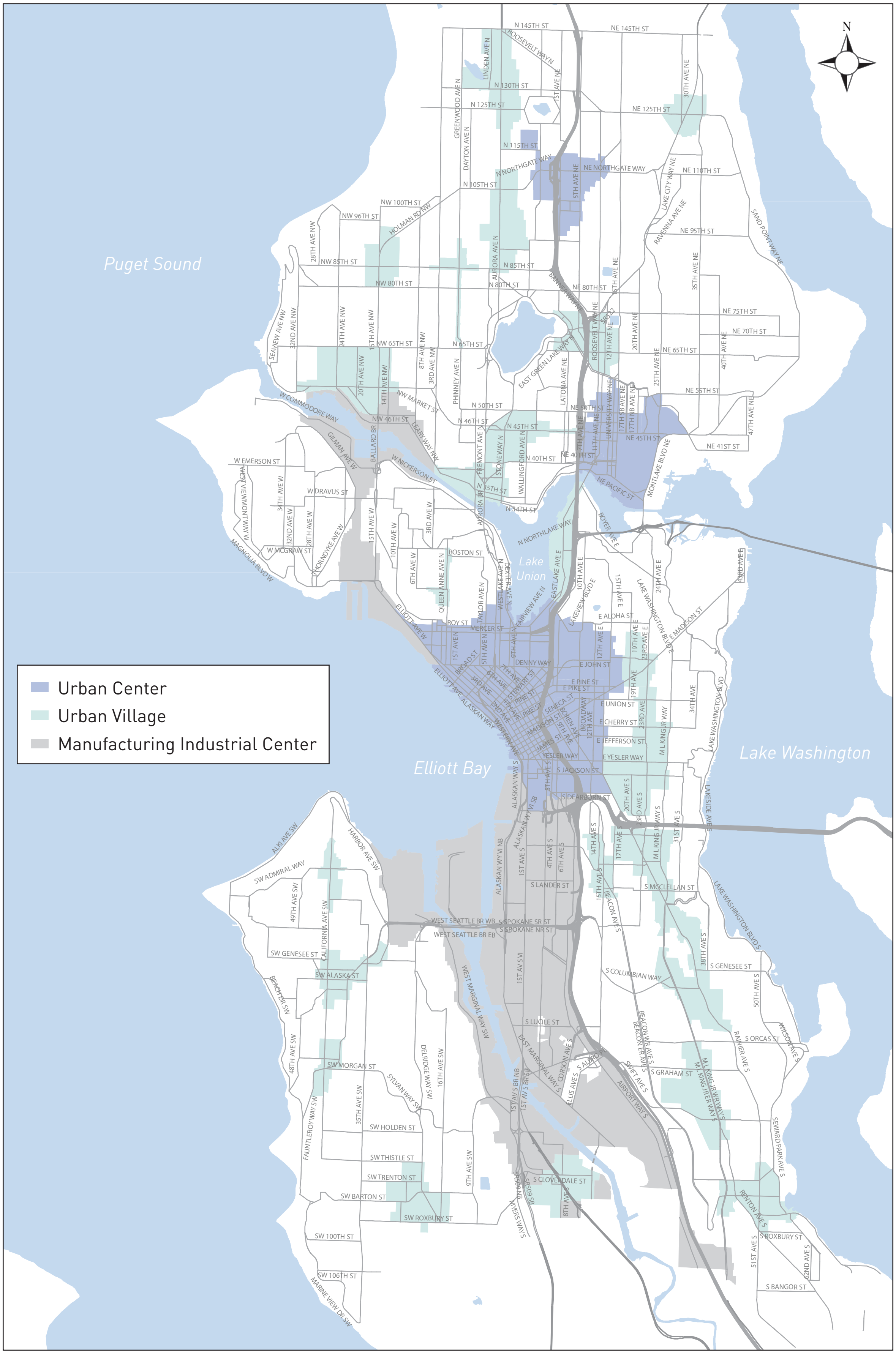
The Puget Sound Regional Council (PSRC) designated regional growth areas that are identified to receive future housing and employment growth. Seattle calls these six designated regional growth areas Urban Centers. They include: Downtown, Uptown, South Lake Union, First Hill/Capitol Hill, University District,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

2.2.2 HUB URBAN VILLAGES

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

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

Figure 9: Seattle's Urban Village Strategy



2.2.3 RESIDENTIAL URBAN VILLAGES

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

2.2.4 REMAINDER OF THE CITY OF SEATTLE

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

2.2.5 MANUFACTURING AND INDUSTRIAL CENTERS (MICS)

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

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

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

Duwamish MIC

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

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

Figure 10: Industrial Zoning in Seattle and the MICs

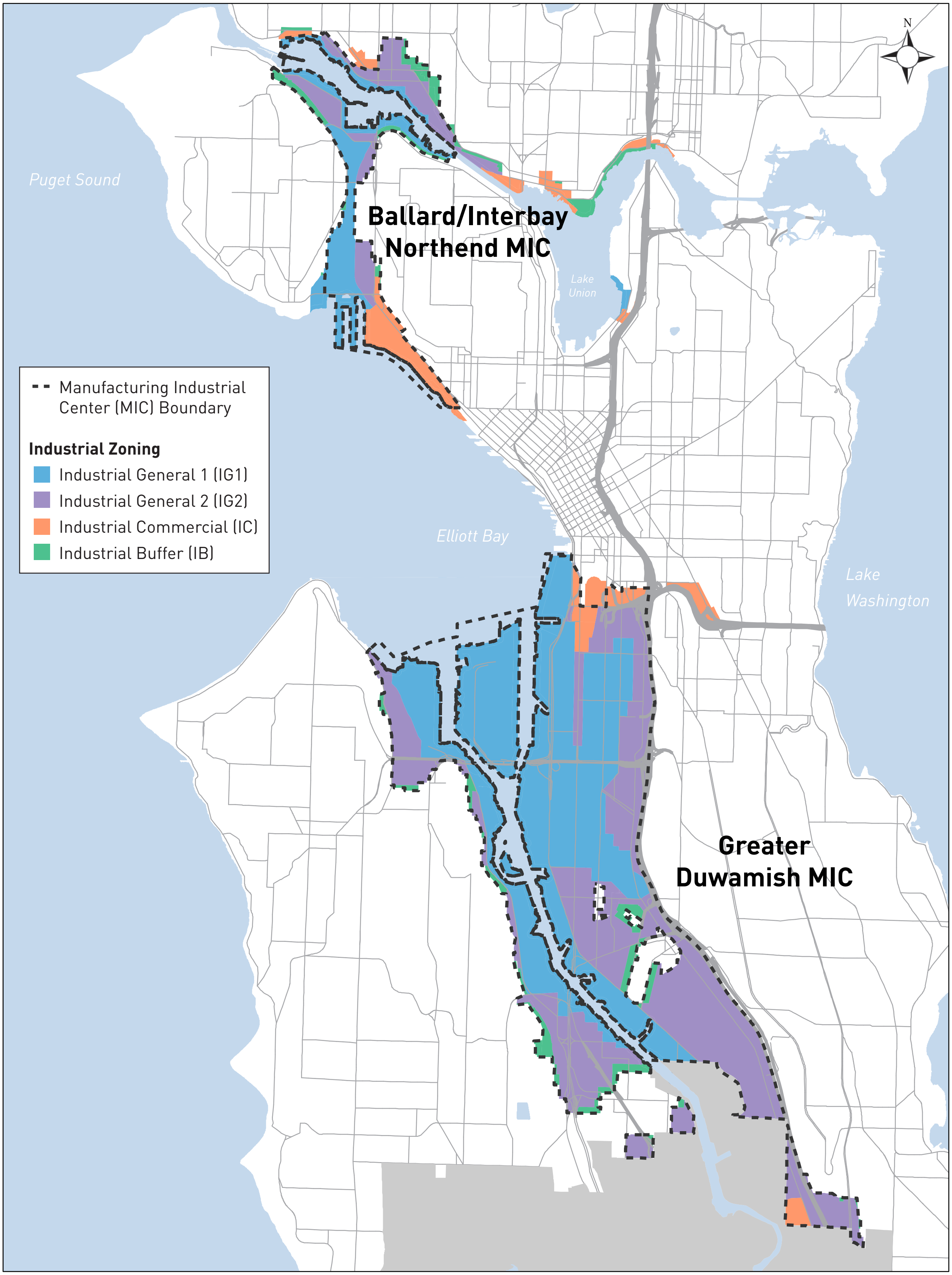
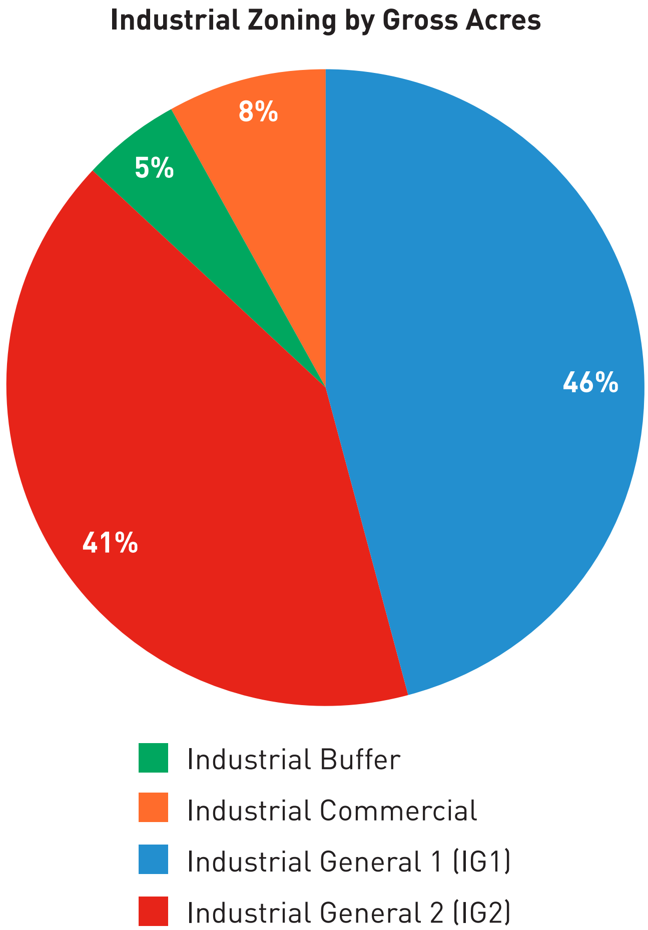


Figure 11: Industrial Zoning Breakdown



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

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

Ballard-Interbay-Northend MIC

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

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

3.0 THE ECONOMIC RELATIONSHIP BETWEEN SEATTLE AND THE FREIGHT INDUSTRY

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

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

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

3.1 ECONOMIC DEVELOPMENT AND COMPETITIVENESS

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

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

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

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

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

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[38]City Of Seattle Office of Economic Development, Basic Industries Economic Impact Analysis, July 2009

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

[40]Association of Washington Business, Association of Washington Cities, and Washington State Association of Counties, Treatment Technology Review and Assessment, December 2013, http://www.awb.org/hdrtechreport/

[41]New York City Department of Transportation, 2010 Sustainable Street Index, Off-Hour Deliveries, http://www.nyc.gov/html/dot/downloads/pdf/ssi10-offhour.pdf

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

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

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

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

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

3.1.1 EMPLOYMENT

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

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

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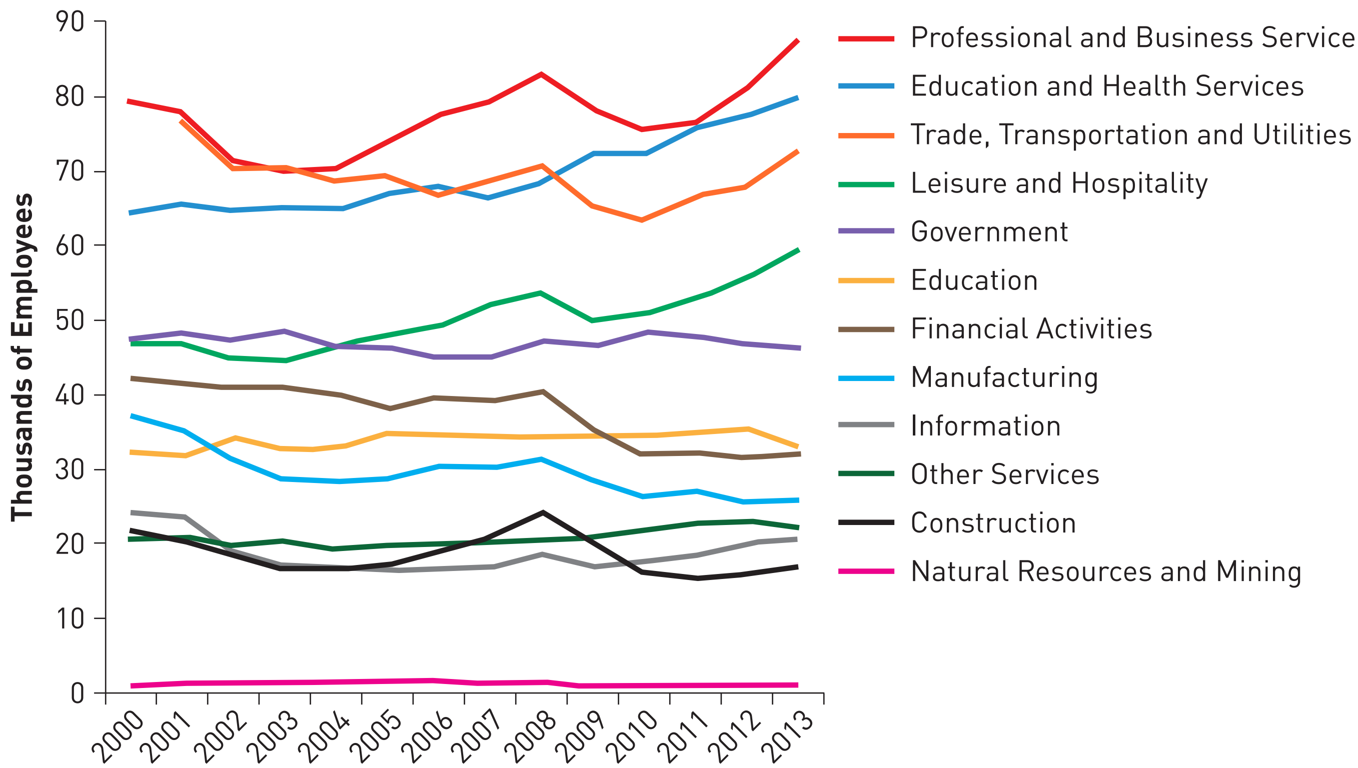
[43]World Shipping Council, Containers, 2014, http://www.worldshipping.org/about-the-industry/containers
[44]Industrial Areas Freight Access Project, Transpo Group
[2]Heffron Transportation, May 2014.
[3]Parsons Brinkerhoff, The Role of Freight in Seattle's Economy, December 2014.
[45]Parsons Brinkerhoff,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

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



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

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

3.1.2 TOP FREIGHT-GENERATING INDUSTRIES

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

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

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

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

Retail trends

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

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

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

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

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

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

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

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

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

Wholesale trends

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

Manufacturing trends

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

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

3.1.3 SUPPLY CHAIN

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

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

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

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

3.2 LIVABILITY

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

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

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

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

3.3 FREIGHT IMPACTS

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

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

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

Environmental impacts

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

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

Social impacts

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

Health Impacts

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

3.4 SUSTAINABLE FREIGHT PRACTICES

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

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

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

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

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

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

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

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

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

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

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

4.0 FREIGHT ROADWAY SYSTEM

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

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

Seattle has over 1,100 miles of roadways, including interstate highways, state highways, and arterial roadways that connect the Port, intermodal facilities, residences and businesses to the region. Of those roads, 142 miles are designated as Major Truck Streets by the city (Figure 4). Because of severe geographic and topological constraints, including multiple bodies of water and steep terrain, Seattle's roadway network is generally funneled through several major routes that connect areas and neighborhoods to the rest of the metro area. The major connections between Seattle and the rest of the region and country are I-5 and SR-99 for north/south connections; and I-90 and SR-520 for east/west connections.

4.1 TRUCK TRAFFIC VOLUMES

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

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

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

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

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

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

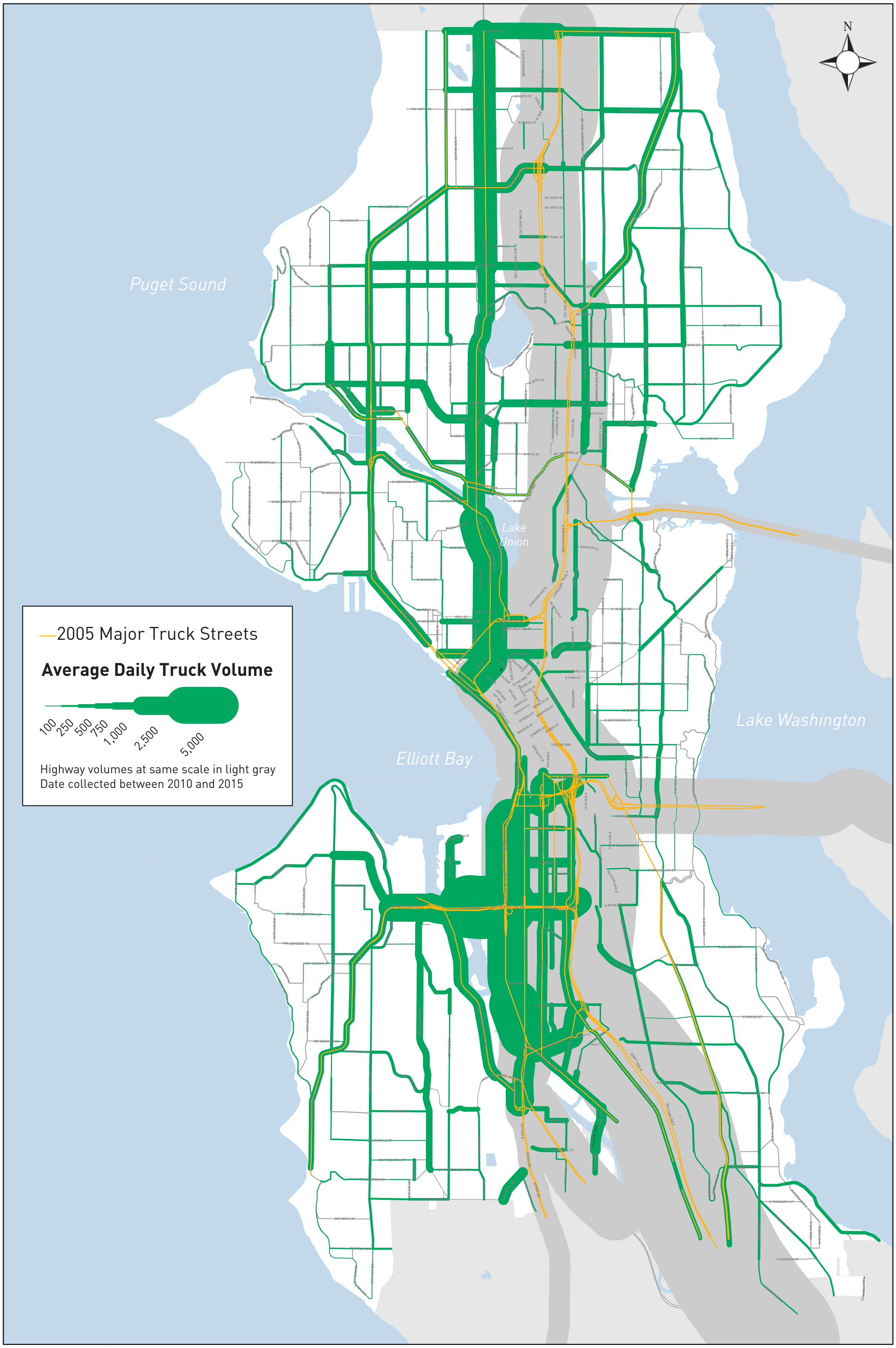
Major Truck Streets that carry significant daily truck volumes (over 1500 per day), include:

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

While not on the 2005 MajorTruck Street network, several other streets provide logical connections between major facilities and carry 1000+ trucks per day, these include:

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

Figure 13: 2014 Average Daily Truck Volumes



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

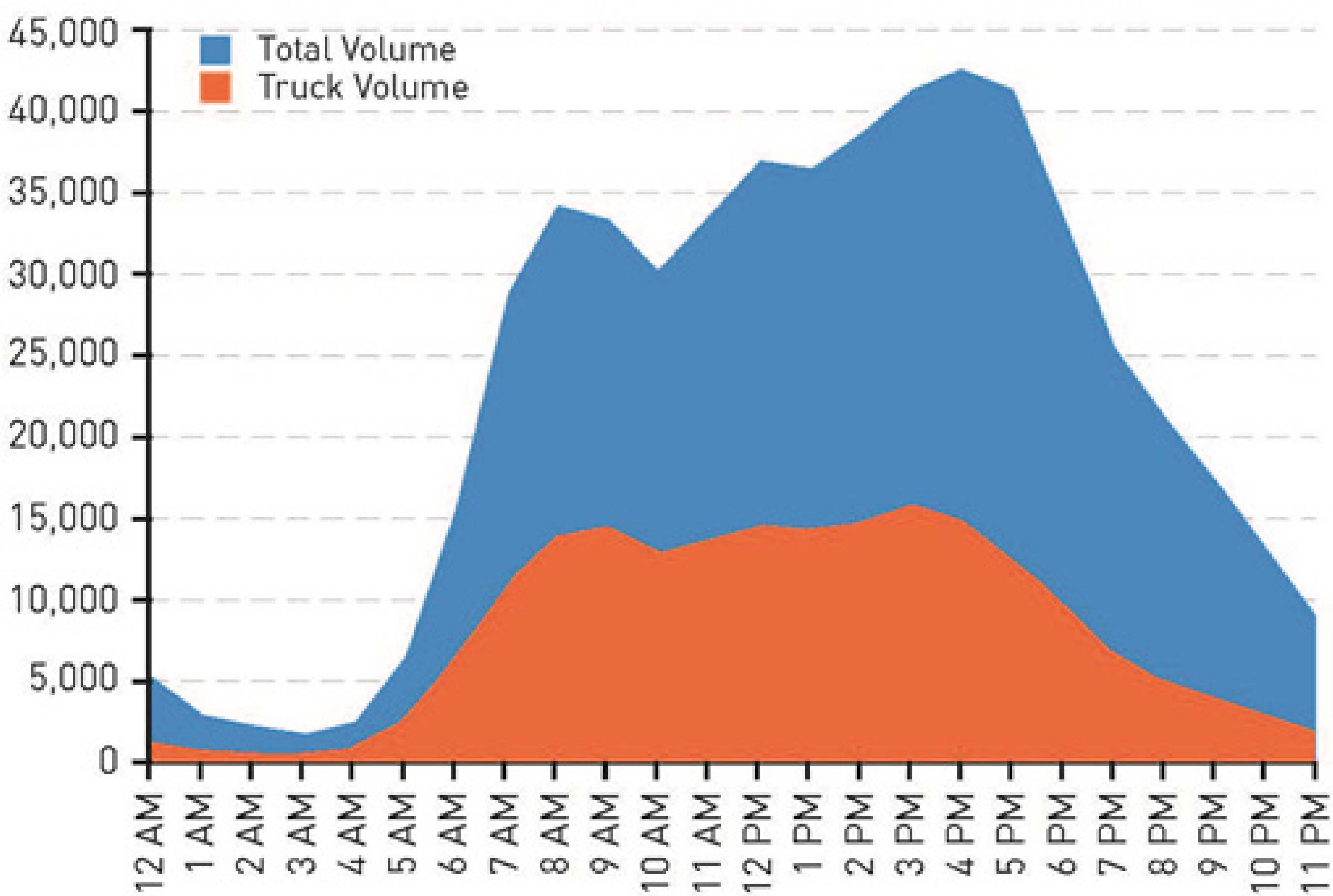
Analysis on 12 corridors with the highest truck volumes show that truck trips typically peak in the morning between 8:00 AM and 9:00 AM and stay relatively constant until the end of the evening rush hour period around 7:00 PM. This truck travel pattern is shown on Figure 14 and follows approximately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

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

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

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

Figure 14: Time of Day Patterns



4.2 COLLISIONS

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

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

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

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

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

4.3 MOBILITY CONSTRAINTS

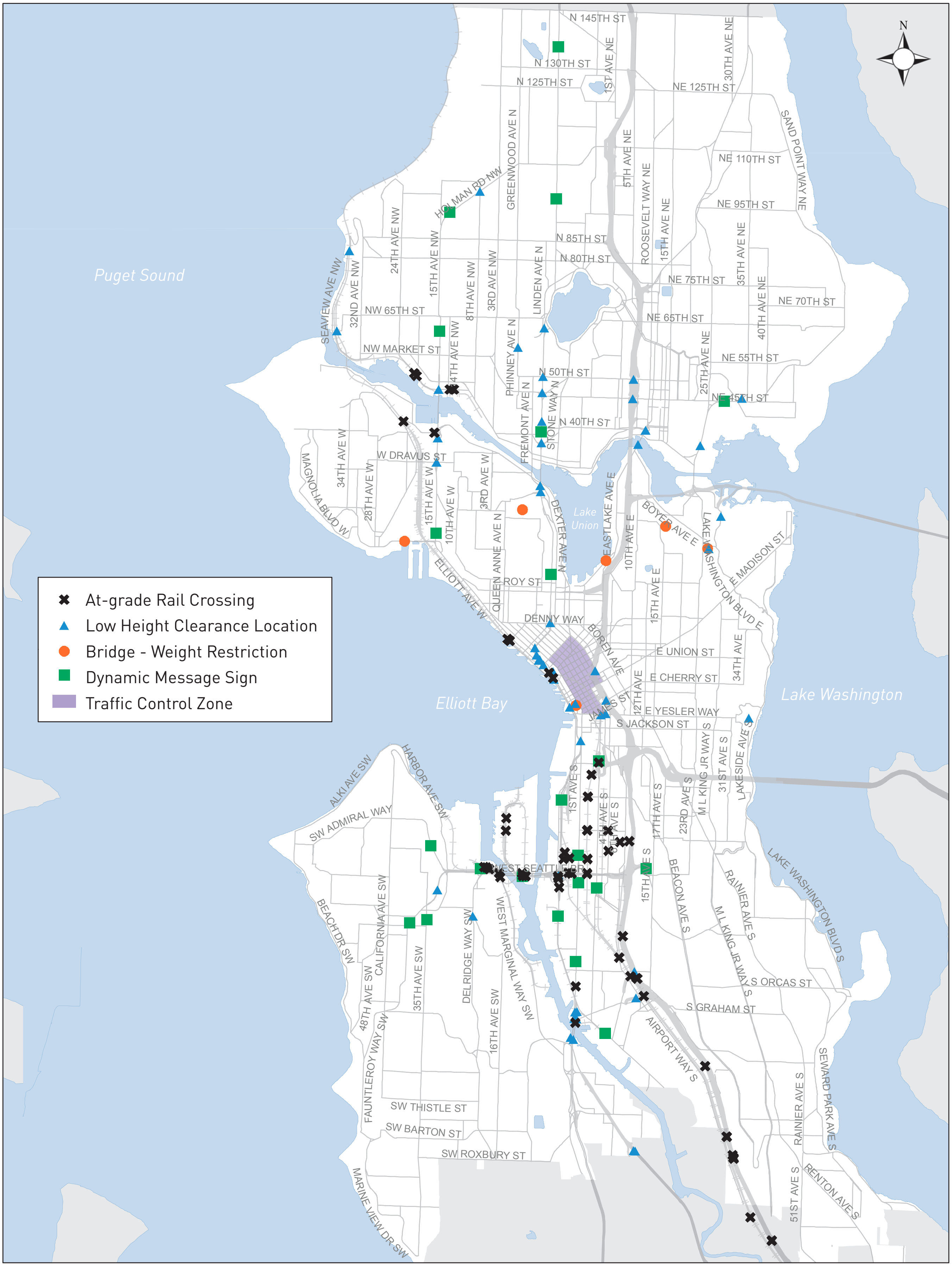
Mobility constraints include bottlenecks or barriers on the transportation network that impact freight access. Some of these constraints are in locations that may delay the general traffic stream and therefore impact freight, while others are specific challenges for large trucks such as insufficient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

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

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

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

Figure 15: Freight Mobility Constraints



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

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

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

Signage

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

Moveable bridges

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

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

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

Downtown traffic control zone and Denny Way restrictions

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

Truck restrictions

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

[62]Industrial Areas Freight Access Project, Transpo Group

At-grade rail crossings

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

Geometric constraints

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

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

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

4.4 CURB SPACE ACCESS

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

In residential areas the priorities for curb space use are:

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

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

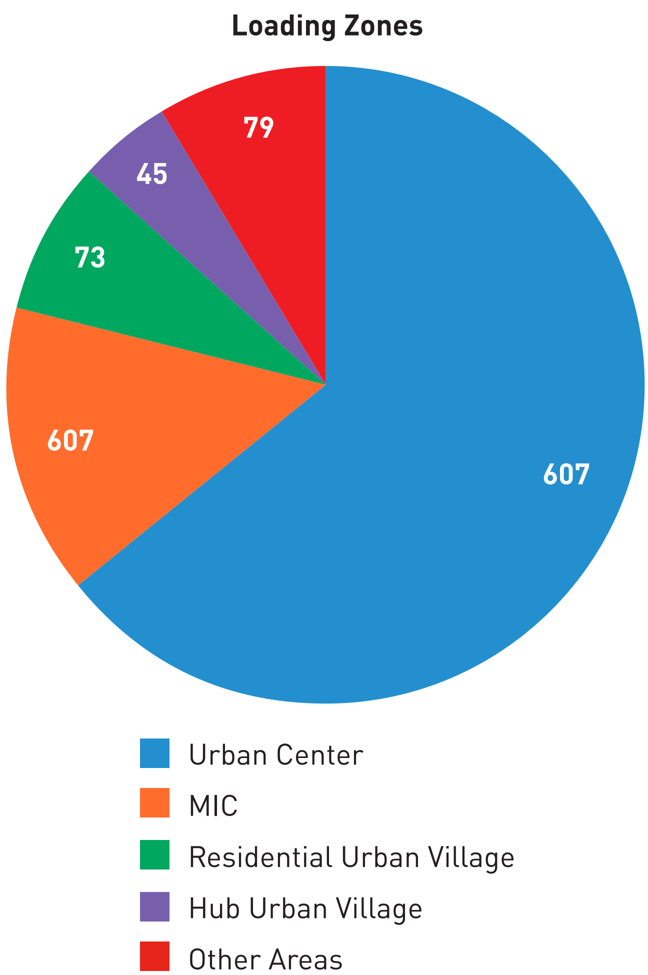
- transit use (bus stops and spaces for bus layover),
- passenger and commercial vehicle loading zones,
- short-term customer parking (time limit signs and paid parking typically for 1- or 2-hours);
- parking for shared vehicles,
- bicycle lanes, and
- vehicular capacity.

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

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

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

Figure 16: Loading Zone Locations in Seattle



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

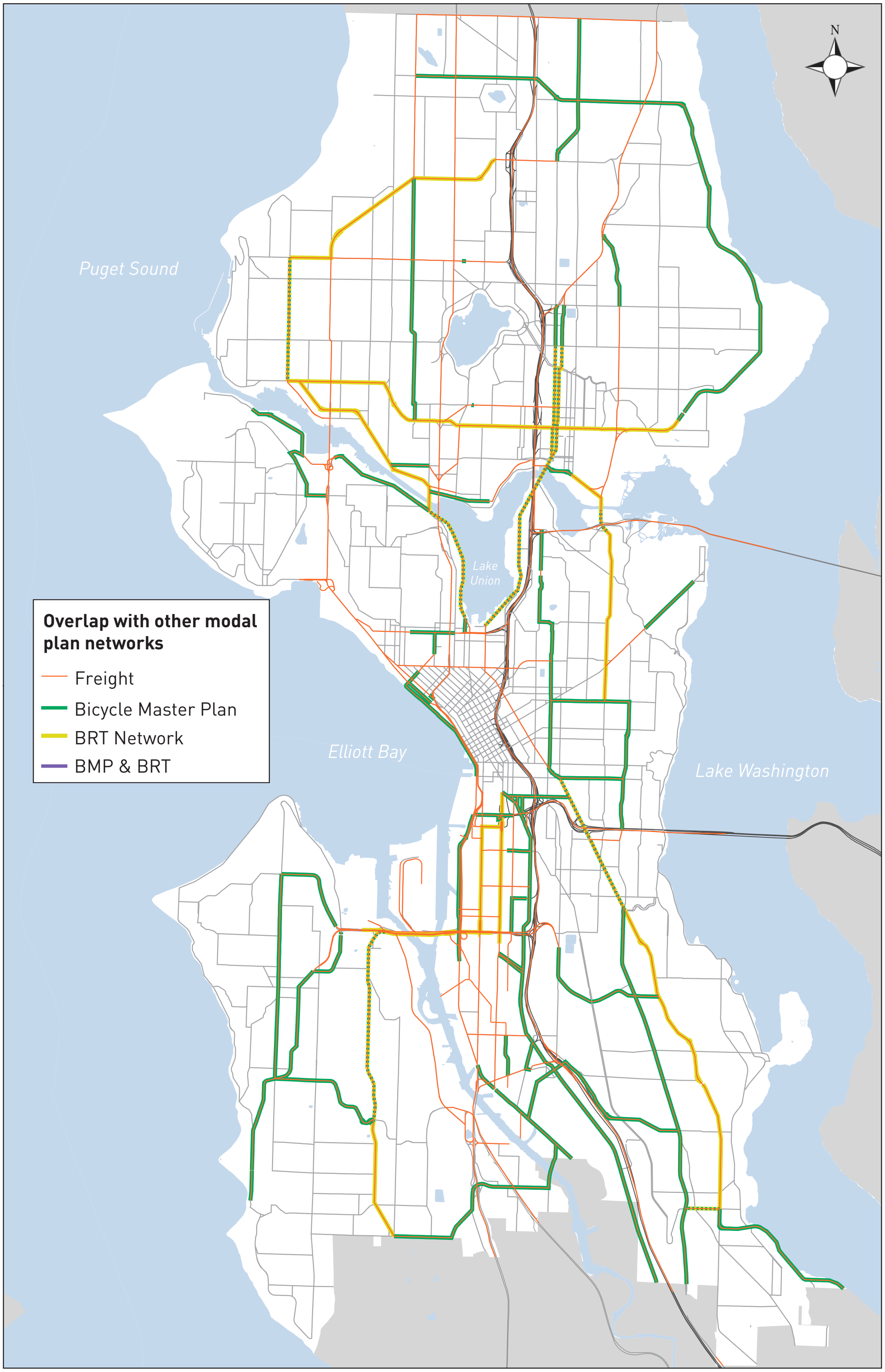
4.8 MULTIMODAL CORRIDORS

Streets in Seattle that carry freight also support a variety of other uses: transit, general purpose traffic, bicycles, pedestrians, on-street parking, etc. The City of Seattle has identified needs and priorities for some of these other modes through the Transit Master Plan, Bicycle Master Plan, and Pedestrian Master Plan. Figure 17 displays the corridors in the city where the 2005 Major Truck Streets designations overlap with other modal priorities.

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

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

Figure 17: Modal overlap corridors



5.0 ROLE OF PUBLIC SECTOR

5.1 INFRASTRUCTURE MANAGEMENT

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

5.2 POLICY FRAMEWORK

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

Comprehensive Plan

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

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

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

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

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

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

UV20 Designate the following locations as manufacturing/industrial centers:

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

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

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

LUG22 Provide opportunities for industrial activity to thrive in Seattle.

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

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

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

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

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

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

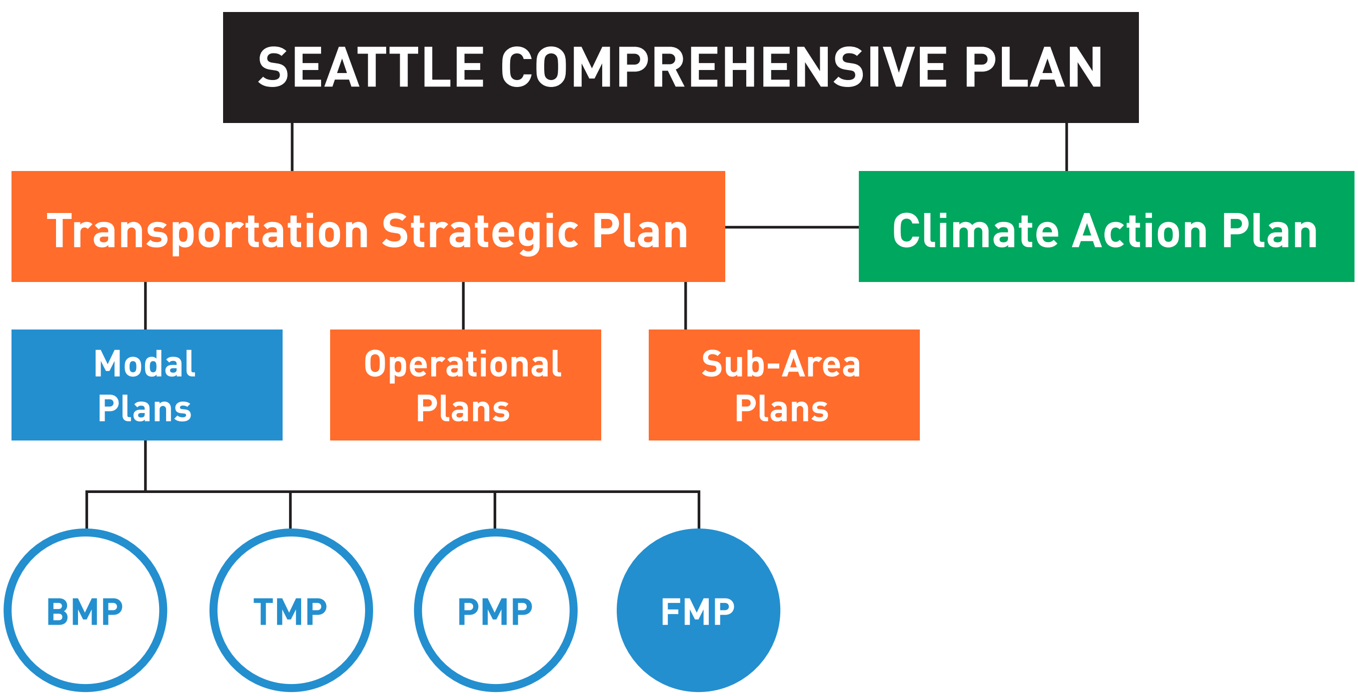
The two latter policies in the Container Port element deal with freight mobility. As required by the Growth Management Act, Seattle's Comprehensive Plan also contains a Transportation Element. The Transportation Element is intended to be consistent with, and help implement, the land use vision for the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

With regard to transportation, within the Seattle Department of Transportation (SDOT), the overall policy direction in the Transportation Element of the Comprehensive Plan helps frame the more specific goals, policies, and strategies in other documents, including the Transportation Strategic Plan and modal plans such as the Bicycle Master Plan, Pedestrian Master Plan, the Transit Master Plan, and now the Freight Master Plan [see figure below]. These plans, once adopted, are ultimately implemented by the project and program teams within SDOT.

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

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

Figure 18: Policy Framework



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

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

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

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

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

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

The April 2014 greenhouse gas emission inventory states that in 2012, road transportation (especially passenger travel) comprises the largest share of Seattle's core emissions at 64%. Of that percentage, freight contributes 19% and passengers contribute 45%. The interesting trend is that while Seattle's population has grown 23% from 1990 to 2012 and jobs have increased 14% over that same time period, core greenhouse gas emissions have actually declined by 4%. The emissions have also decreased on a per person basis.[65]

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

Washington State Freight Mobility Plan

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

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

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

SDOT Freight Mobility Strategic Plan

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

5.3 ACCOMPLISHMENTS

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

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

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

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

5.4 FUNDING HISTORY

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

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

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

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

State and federal funds

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

5.7 CLIMATE ADAPTATION AND EMERGENCY PREPAREDNESS

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

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

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

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

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

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

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

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

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

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

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

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

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

Seattle Department of Transportation

NEIGHBORHOOD CASE STUDIES APPENDIX E

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BACKGROUND

This document summarizes research related to truck movement in and through two case study neighborhoods in the City of Seattle. The Freight Industrial Access Project and other research efforts of the Seattle Freight Master Plan have focused significant attention on truck access to industrial areas in the City. In order to better understand the key issues, needs and concerns associated with trucks in residential neighborhoods and neighborhood commercial districts city-wide, SDOT conducted interviews with commercial and residential representatives in two Seattle neighborhoods, Ballard and South Lake Union. These neighborhoods were selected because SDOT had extensive existing data on population and employment as well as freight movement characteristics. These two neighborhoods, while each is unique, can produce lessons learned for application across the city. The case study interviews were used to collect feedback on business and residential concerns and solicit ideas on how freight mobility might be improved in Seattle.

Interviews were conducted by SDOT and/or City consultant staff. The following were the individuals and groups interviewed for this technical memorandum:

- Mars Maynard, General Manager, Hi-Life Restaurant, Ballard
- Mike Pedersen, General Manager, Ballard Market, Ballard
- East Ballard Community Council
- Central Ballard Residents Association
- Brent Murray, General Manager, Brave Horse Tavern (Tom Douglas Company), South Lake Union
- Sean Hartley, Operations Manager, Tom Douglas Company, Locations in South Lake Union and Belltown
- Chad O'Bara and Ben Roeder, Shipping and Receiving, Glazer's Camera Store, South Lake Union
- South Lake Union Community Council

KEY FINDINGS

The following are the key findings of this research:

- The two case study neighborhoods, Ballard and South Lake Union, have been experiencing rapid growth and development
- Available on-street parking is limited and spaces near popular destinations may be filled during some times of day
- Designation of additional loading zones could help medium and large trucks that need extra space to maneuver and unload goods.
- Congestion has affected business practices, but it is considered a fact of life for both those making and receiving deliveries.
- Evening noise ordinances that limit nighttime deliveries were a concern both for Ballard businesses and residents in South Lake Union who would like to see more deliveries shift to off peak hours.
- Neighborhood residents are concerned about truck safety, including volumes, speeds and noise. The high volume of pedestrian and truck activity in South Lake Union increases the potential for collisions and might require additional education and changes to traffic control.

CASE STUDY NEIGHBORHOODS

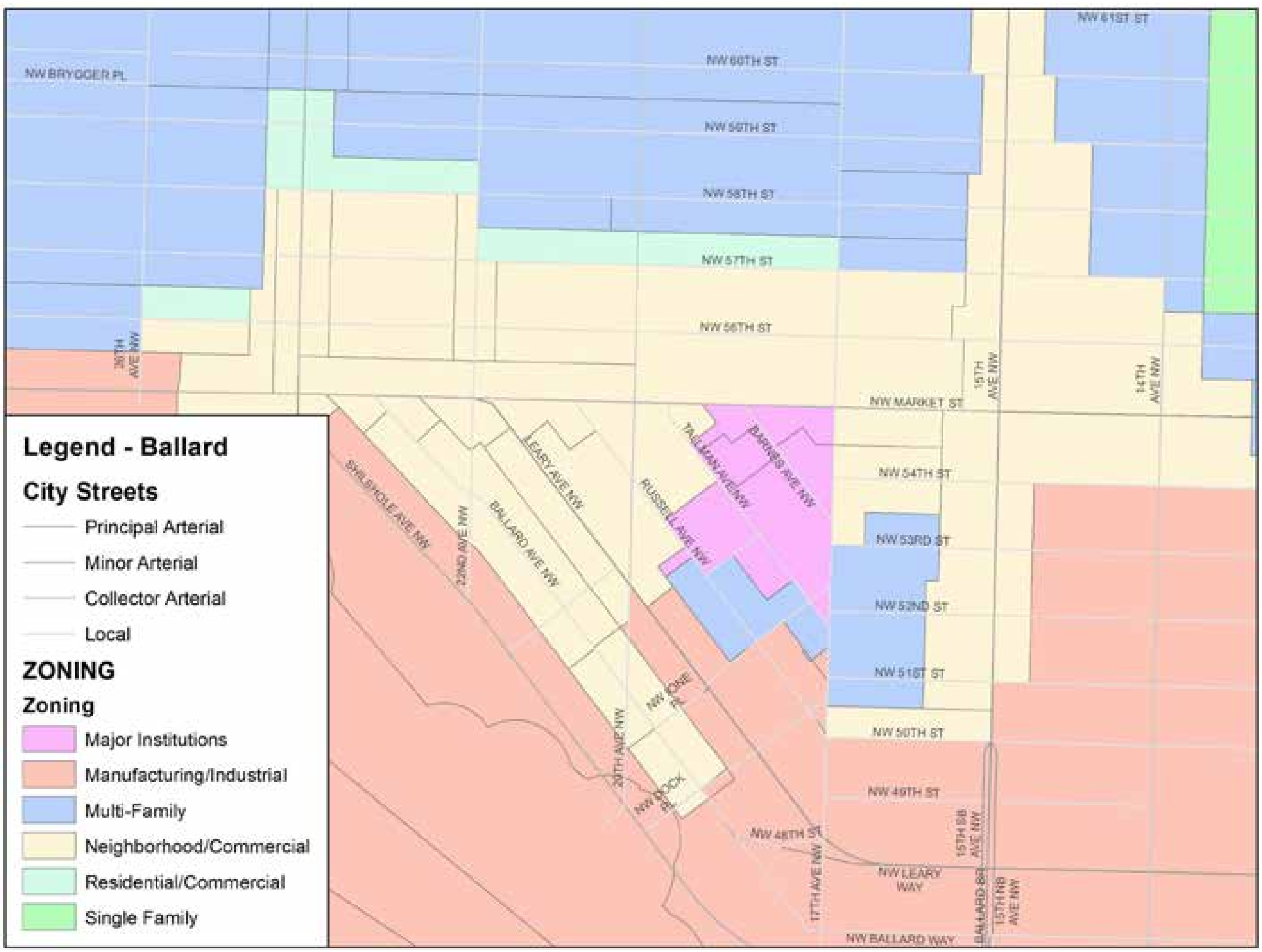
This section includes a brief description of each of the case study neighborhoods, Ballard and South Lake Union, which were selected for this study.

BALLARD

Zoning

The vibrant neighborhood of Ballard enjoys a robust manufacturing and industrial area adjacent to the well-established neighborhood commercial district of old Ballard. The Ballard Interbay Northend Manufacturing Industrial Center (BINMIC) zone located adjacent to Salmon Bay and the Lake Washington ship canal has deep roots in the maritime fishing industry. As shown in Figure 1, low-rise multifamily and single family residential zones of Ballard are located immediately north of the neighborhood commercial/commercial zone. Ballard is designated in the Seattle Comprehensive Plan as a Hub Urban Village. Hub Urban Villages are

Figure 1: Ballard Zoning. Source: SDOT GIS ZONING layer, 2014



"communities that provide a balance of housing and employment." Because the topic of the case studies is the residential neighborhood and associated commercial uses, the geographic focus of this technical memorandum is on the neighborhood commercial/commercial zone within the larger Ballard neighborhood.

Existing Land Uses

Existing land uses in Ballard have been a mix of low-scale industry along with commercial and residential uses, but the area has been transitioning over time to higher intensity and mixed use. As shown on Figure 2, manufacturing, industrial and marine terminal activities continue to dominate land use in the southern and eastern parts of the neighborhood. Shopping and retail uses, traditionally focused along 15th Avenue NW, NW Market Street and Ballard Avenue NW, have been increasing in other parts of the neighborhood. The Ballard Blocks is an example of a large office and retail building now located on what was formerly industrial land. Ballard has seen particularly rapid growth in multifamily residential construction over the past several years with projects often encompassing an entire block. Office uses are primarily clustered along arterials, such as 15th Avenue NW and NW Market Street, mostly in older one or two-story buildings. Hospital and associated medical uses are found south of NW Market Street and west of 17th Avenue NW.

Figure 2: Ballard Existing Land Uses. Source: SDOT GIS CGDB_PARCEL_SV layer, 2014

The close proximity of the active manufacturing and industrial area to residential uses is relatively unique to Ballard and other neighborhoods bordering the Lake Washington ship canal. In other parts of Seattle, steep topography more distinctly separates low-lying industrial areas (e.g., Interbay) from adjacent residential uses (e.g., Magnolia).

Access to the Regional Highway System and Major Truck Streets

Access to Ballard from the regional highway system is via principal arterials including 15th Avenue NW (c rossing the Ballard Bridge to the south), NW Market Street, and Leary Avenue NW/NW Leary Way. Major trucks streets serving Ballard are Shilshole Avenue NW, 15th Avenue NW, and NW Leary Way. These routes are shown in Figure 3.

Traffic Congestion

Traffic congestion in Ballard is heaviest along principal arterials and is particularly noticeable at choke points leading to the Ballard Bridge (southbound). Figure 4 shows travel speeds for streets in Ballard during a typical mid-week morning peak period.

Figure 3: Ballard Arterials and Major Truck Streets. Source: SDOT GIS MajTrkStrts & urban_villages layer, 2014

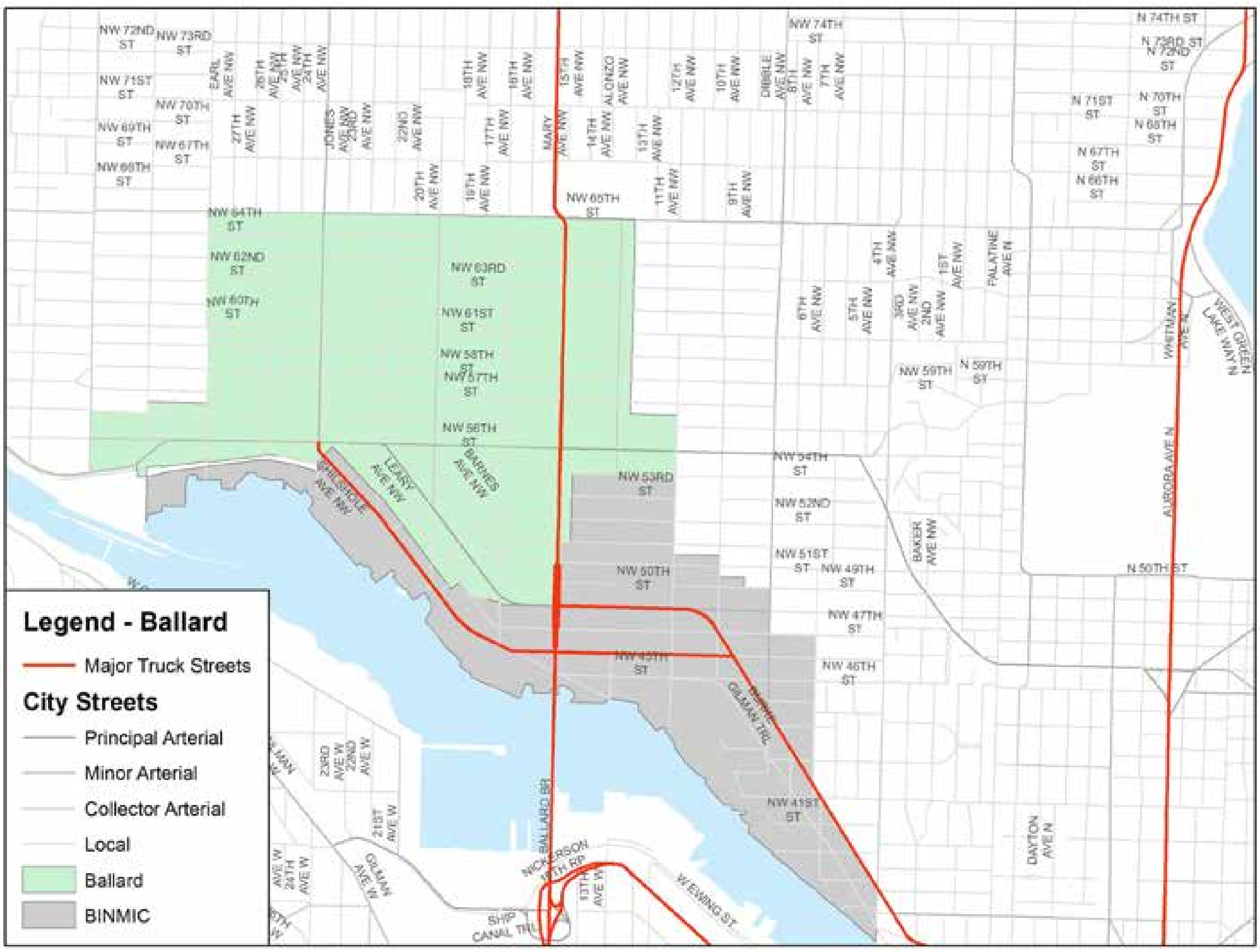
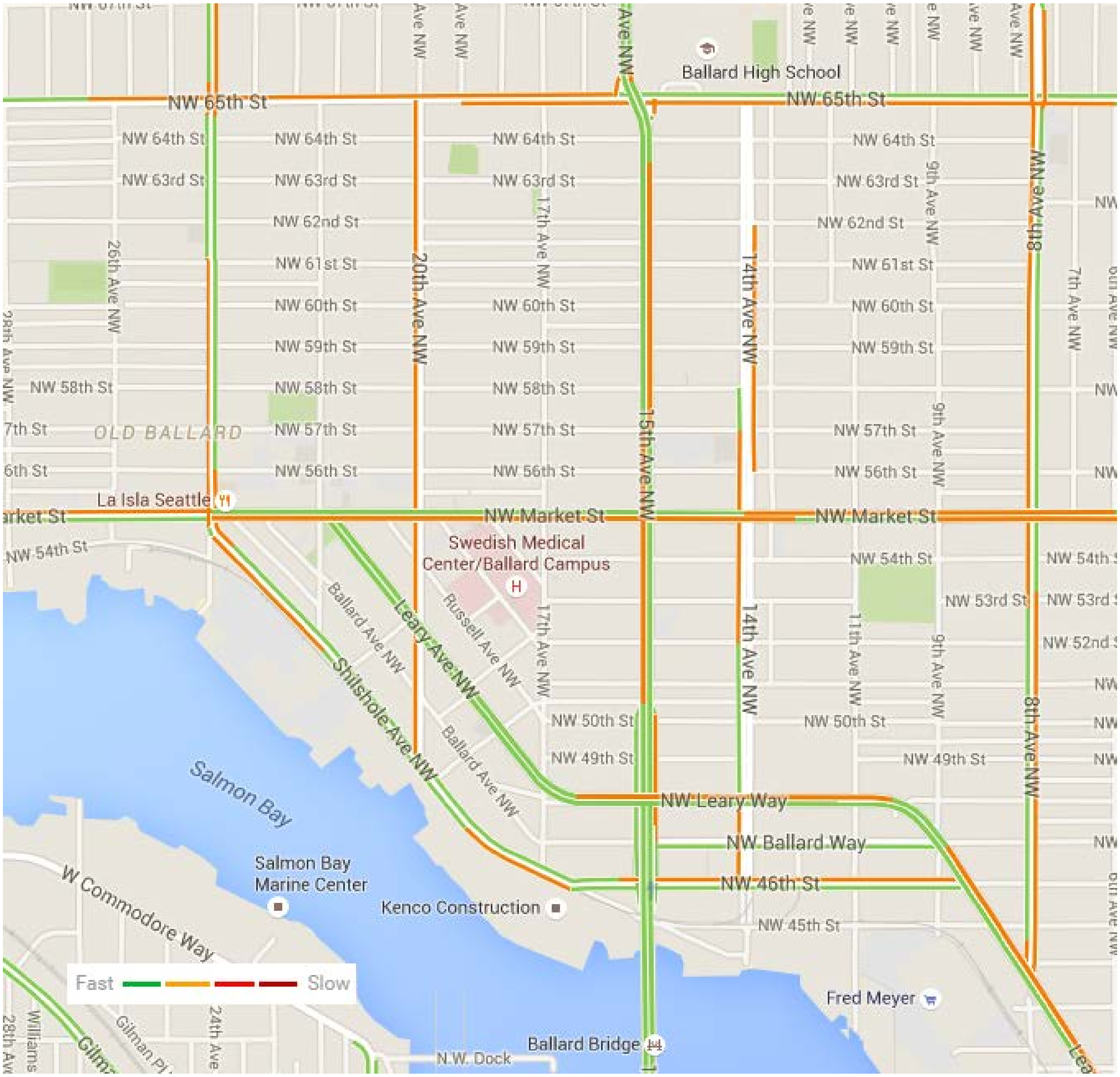


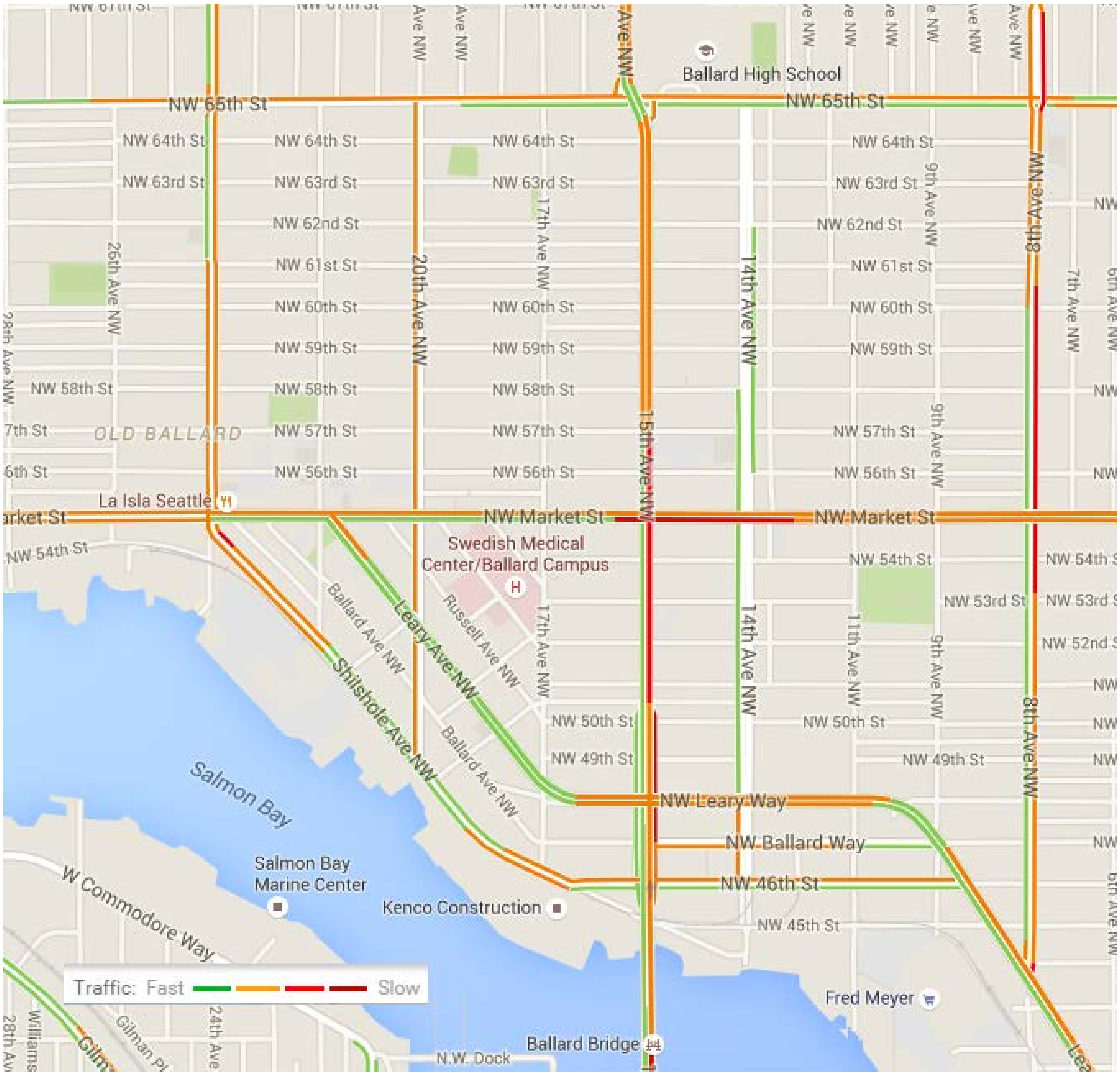
Figure 4: Ballard Traffic Congestion during Morning Peak Period (Typical). Source: maps.google.com



Source: Google Maps

Figure 5 shows travel speeds for streets during a typical mid-week evening peak period. In addition to the northbound Ballard Bridge/15th Avenue NW corridor, northbound 8th Avenue NW experiences traffic congestion in the evening peak period. Arterial streets throughout Ballard are congested in the evening peak period.

Figure 5: Ballard Traffic Congestion during Evening Peak Period (Typical). Source: maps.google.com

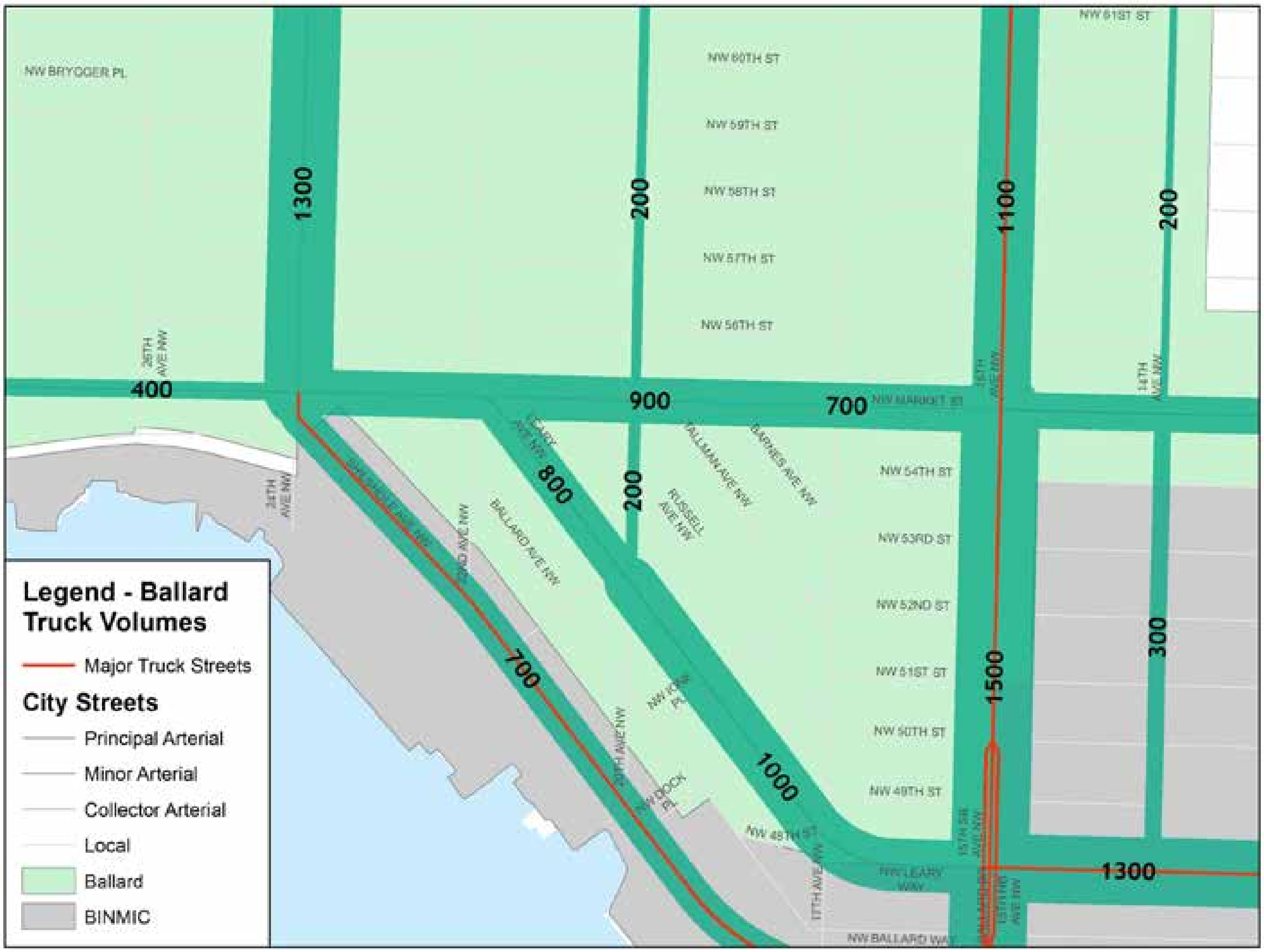


Source: Google Maps

Daily Truck Volumes

Figure 6 shows the daily truck volumes using streets in Ballard. As indicated, the majority of high truck volumes are occurring on principal arterials and/or Major Truck Streets. The exception is 24th Avenue NW north of NW Market Street, which experiences high truck volumes but is classified as a minor arterial and is not a Major Truck Street. High truck volume routes generally experience congestion in both morning and evening peak periods.

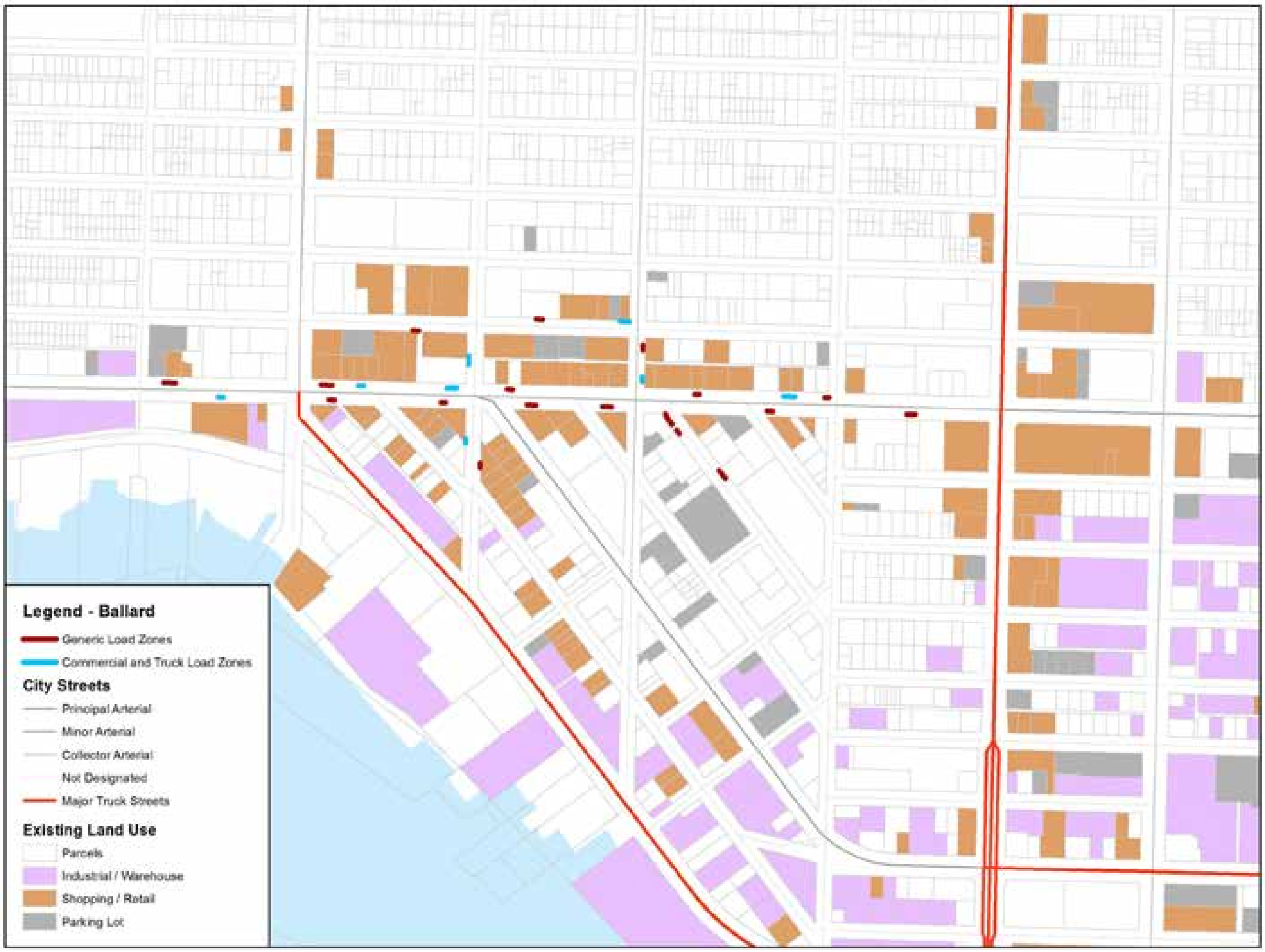
Figure 6: Ballard Daily Truck Volumes. Source: SDOT GIS FreightFlow_segments_final layer, 2015



Loading Zones

Once truck drivers arrive in the neighborhood to make their deliveries, they need a place to park to unload goods. Figure 7 shows loading zones in Ballard. Loading zones are generally concentrated near NW Market Street. Because parking meters become operational at 8AM, on-street metered parking (see next section) is generally not available for use by trucks during the day.

Figure 7: Ballard Loading Zone Designations. Source: SDOT GIS CURB_SPACES layer, 2014



On-street parking in Ballard is extremely well used during peak periods. As shown in Figure 8, most on-street parking stalls are used in excess of 70% of the time, with over 85% being common.

The high occupancy levels make it challenging for trucks to find places to park while making deliveries during peak periods in the event that alleys and building loading zones are unavailable.

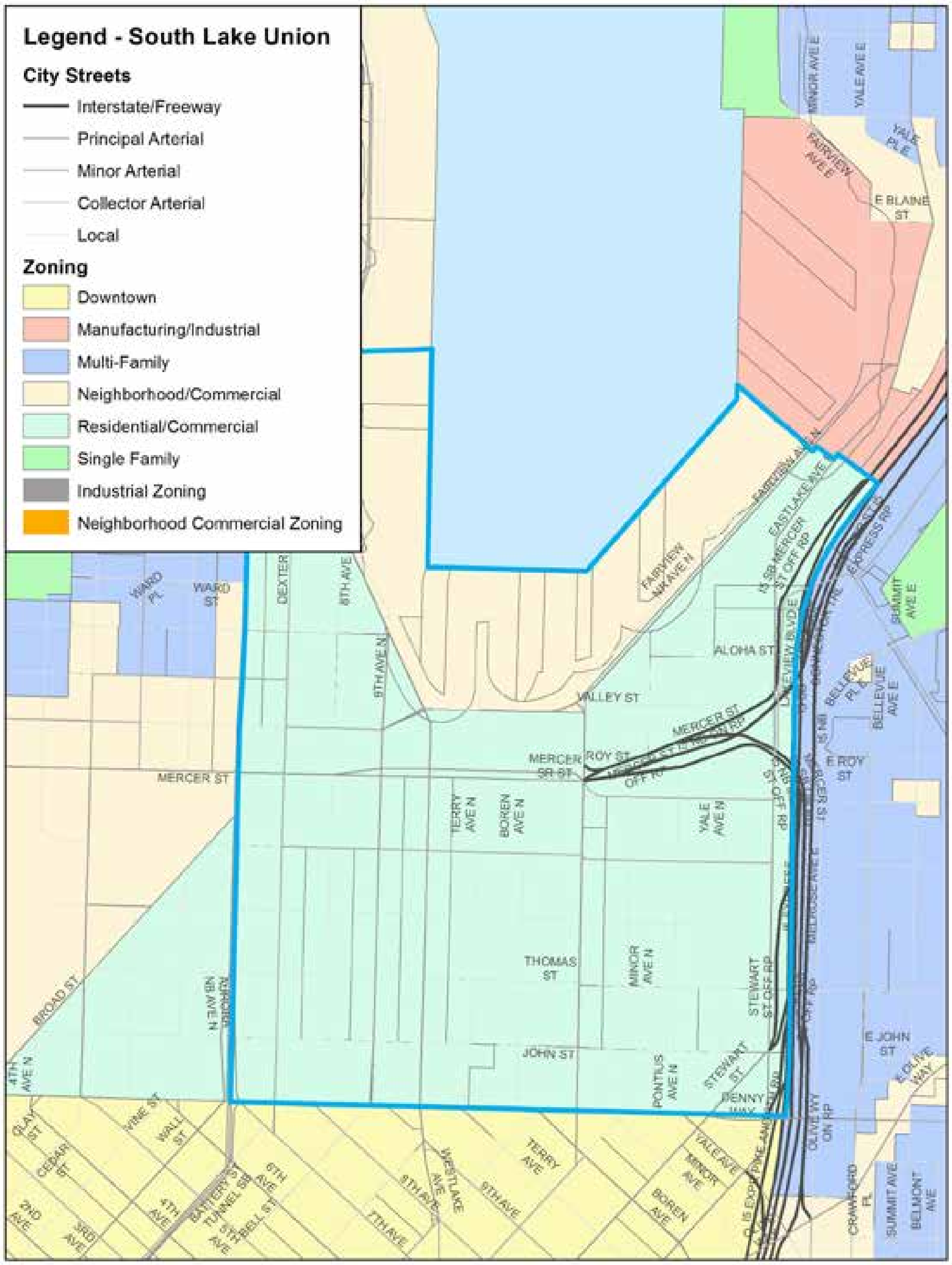
Figure 8: Ballard On-Street Parking Occupancy, Average Peak 3 Hours of each blockface during 8AM-5PM, Source: http://www.seattle.gov/transportation/parking/docs/SDOT2014ParkingMaps.pdf, 2014

SOUTH LAKE UNION

Zoning

Since undergoing a substantial rezoning several years ago, the South Lake Union neighborhood has been rapidly transforming from a modest, primarily manufacturing and industrial area into a thriving office, retail and residential district. As shown in Figure 9, the district is mostly zoned Residential/Commercial. Along the shoreline of Lake Union, zoning is Neighborhood/Commercial. The City of Seattle has designated South Lake Union as an Urban Center. It is designated as a Regional Growth Center by the Puget Sound Regional Council.

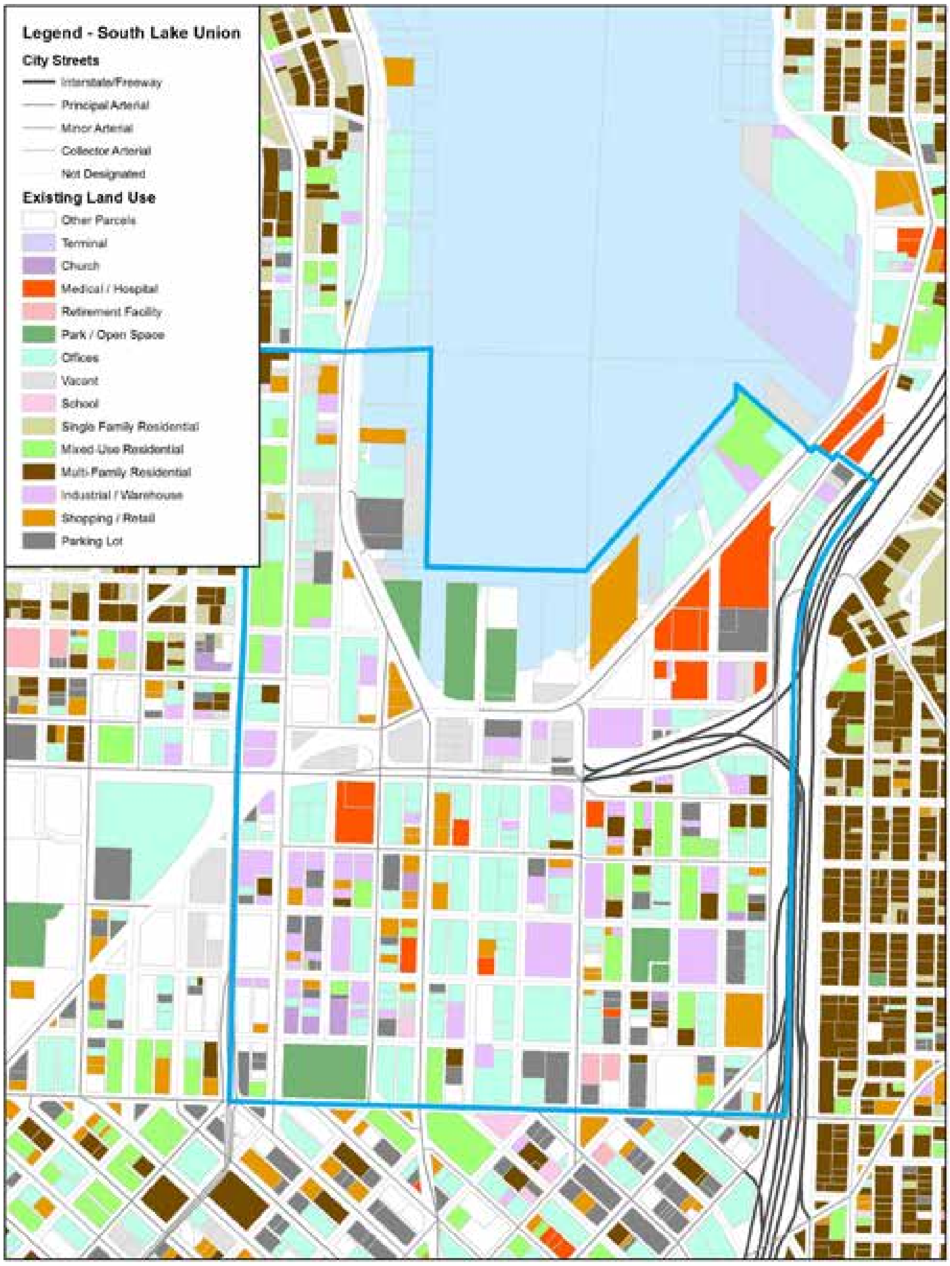
Figure 9: South Lake Union Zoning. Source: SDOT GIS ZONING layer, 2014



Existing Land Uses

As South Lake Union continues to grow under its new zoning, industrial and warehouse land is being converted to office and mixed use development. As shown in Figure 10, there are few remaining blocks that are entirely occupied by industrial and warehouse uses. The relocation of the Amazon.com headquarters and the growth of many other technology and biotechnology organizations have brought thousands of white-collar employees to the district; current district employment now exceeds 35,000[1]. Population grew by 25 percent over the past 5 years[2], and retail uses have also grown.

Figure 10: South Lake Union Existing Land Uses. Source: SDOT GIS CGDB_PARCEL_SV layer, 2014



[1]Downtown Seattle Association, 2014
[2]Ibid.

Access to the Regional Highway System and Major Truck Streets

Located between Interstate 5 and State Route 99 (Aurora Avenue N), South Lake Union enjoys excellent access to the regional highway system. As shown on Figure 11, principal arterials serving the neighborhood include Mercer Street/Valley Street, Denny Way, Westlake Avenue North/Ninth Avenue North, and Fairview Avenue North. Other than the highways, Major Trucks Streets serving South Lake Union include Broad Street, Mercer Street/Valley Street, and Westlake Avenue North/Ninth Avenue North.

Figure 11: South Lake Union Arterials and Major Truck Streets. Source: SDOT GIS MajTrkStrts & urban_villages layer, 2014

Traffic Congestion

Traffic congestion in the South Lake Union neighborhood is particularly concentrated on Interstate 5 and its approaches. Figure 12 shows travel speeds for streets in South Lake Union during a typical mid-week morning peak period.

Figure 12: South Lake Union Traffic Congestion during Morning Peak Period (Typical). Source: maps.google.com

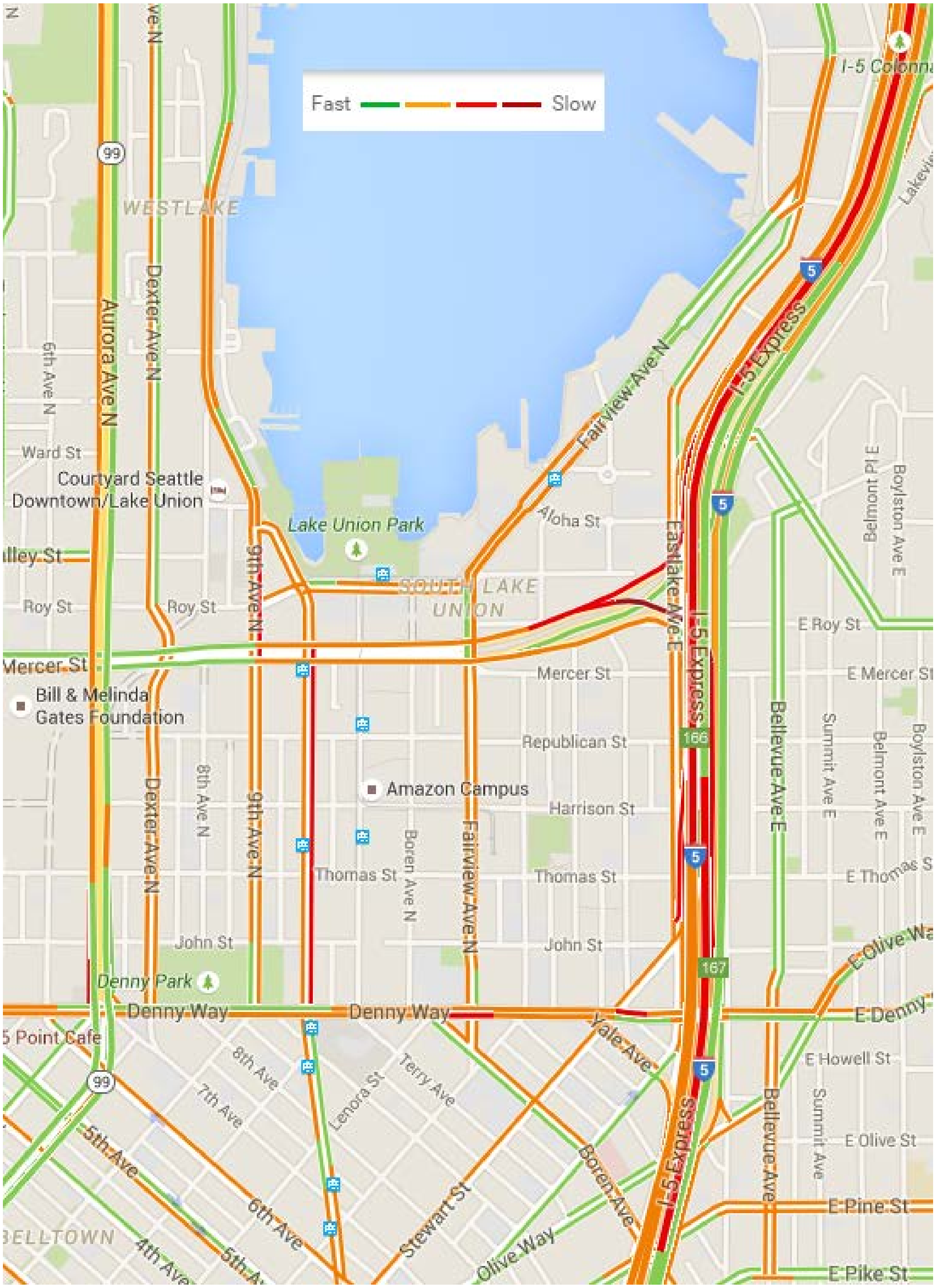
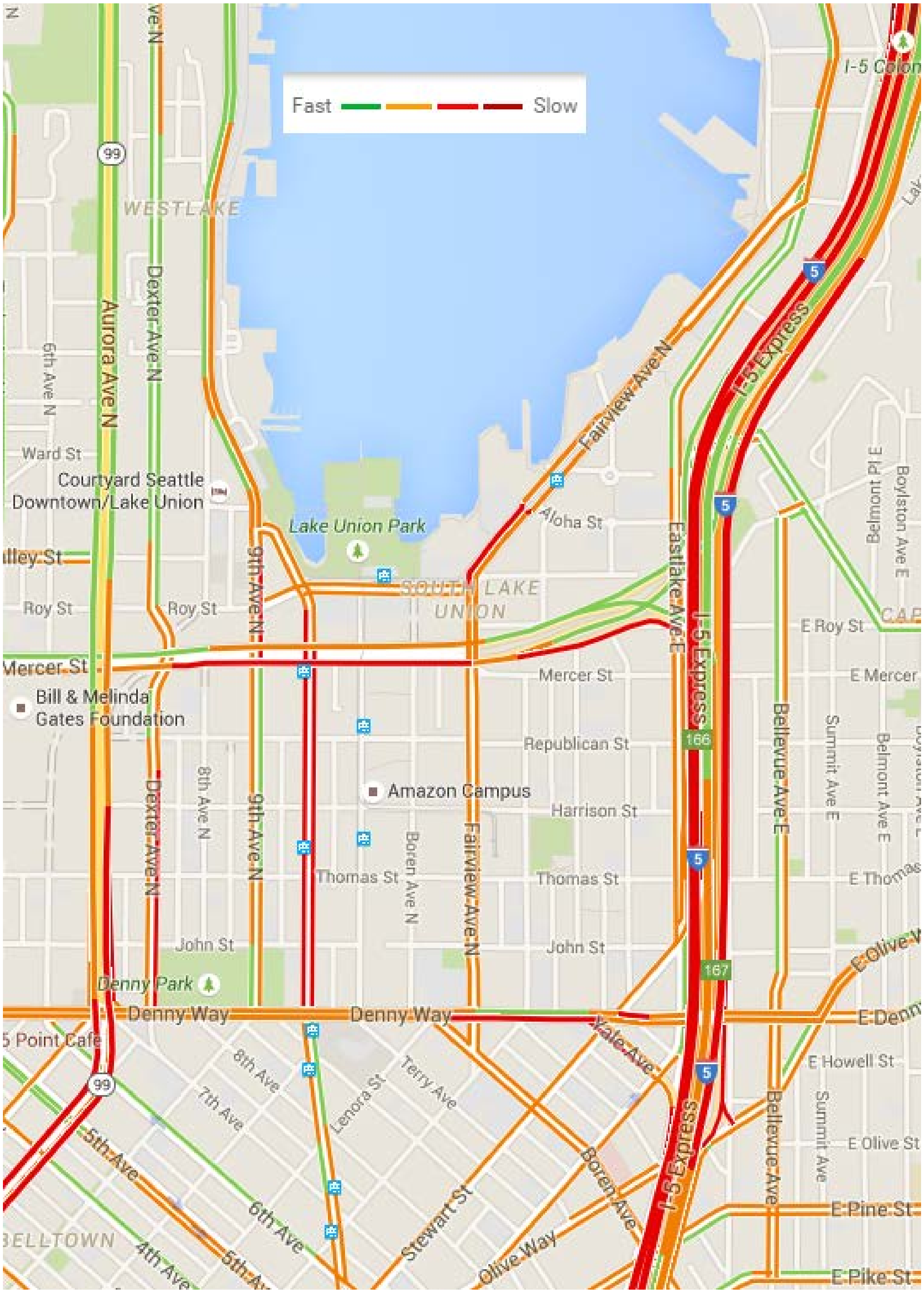


Figure 13 shows travel speeds for streets during a typical mid-week evening peak period. In addition to heavy congestion on State Route 99 and Interstate 5, traffic congestion along Westlake Avenue North is approaching capacity during the evening peak period.

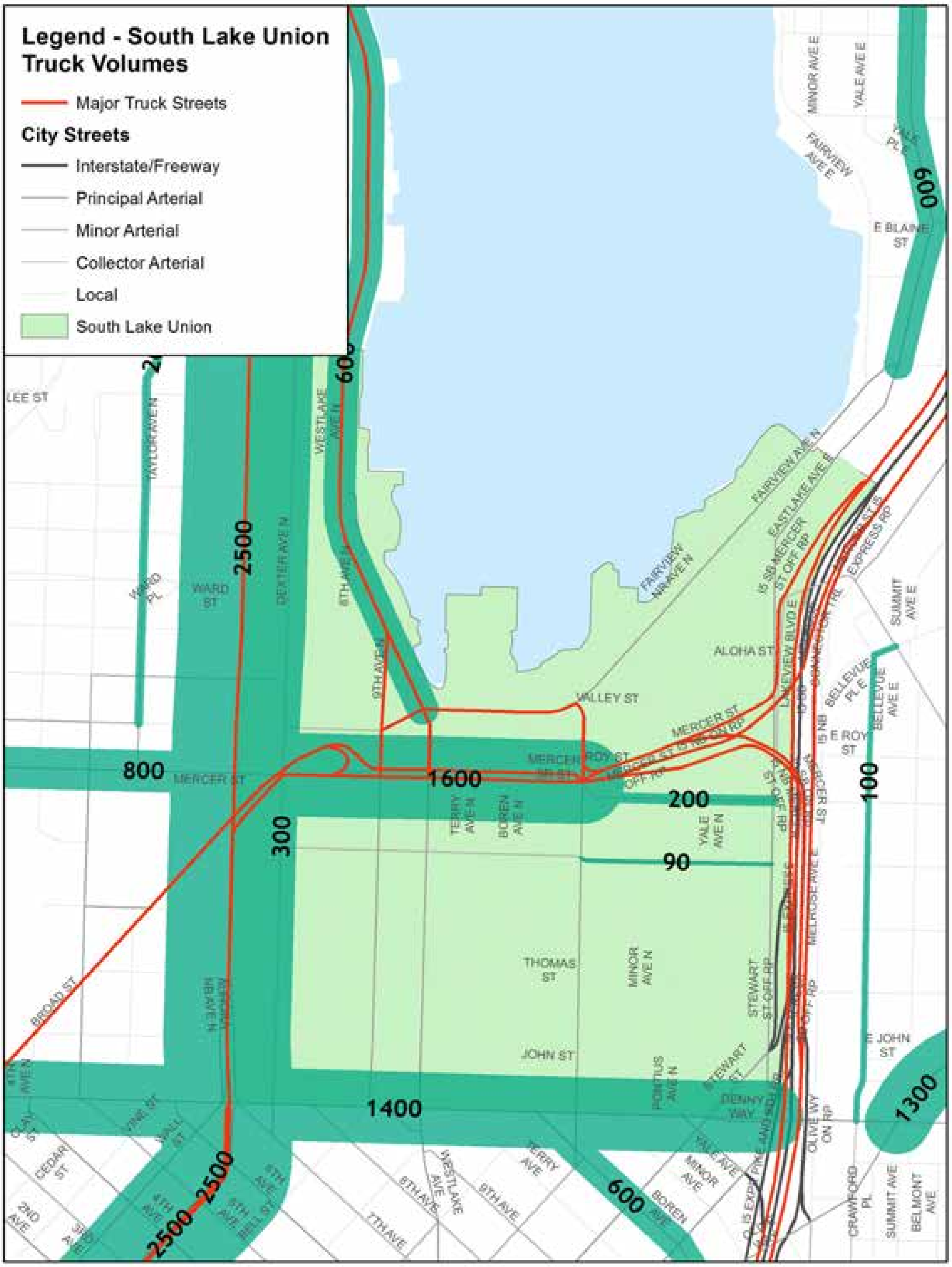
Figure 13: South Lake Union Traffic Congestion during Evening Peak Period (Typical). Source: maps.google.com



Daily Truck Volumes

Figure 14 shows the daily truck volumes using city streets in South Lake Union. As indicated, the majority of high truck volumes are occurring on principal arterials and/or Major Truck Streets. The exception is Dexter Avenue North, which experiences high truck volumes but is classified as a minor arterial and is not a Major Truck Street. High truck volume routes generally experience congestion in both morning and evening peak periods.

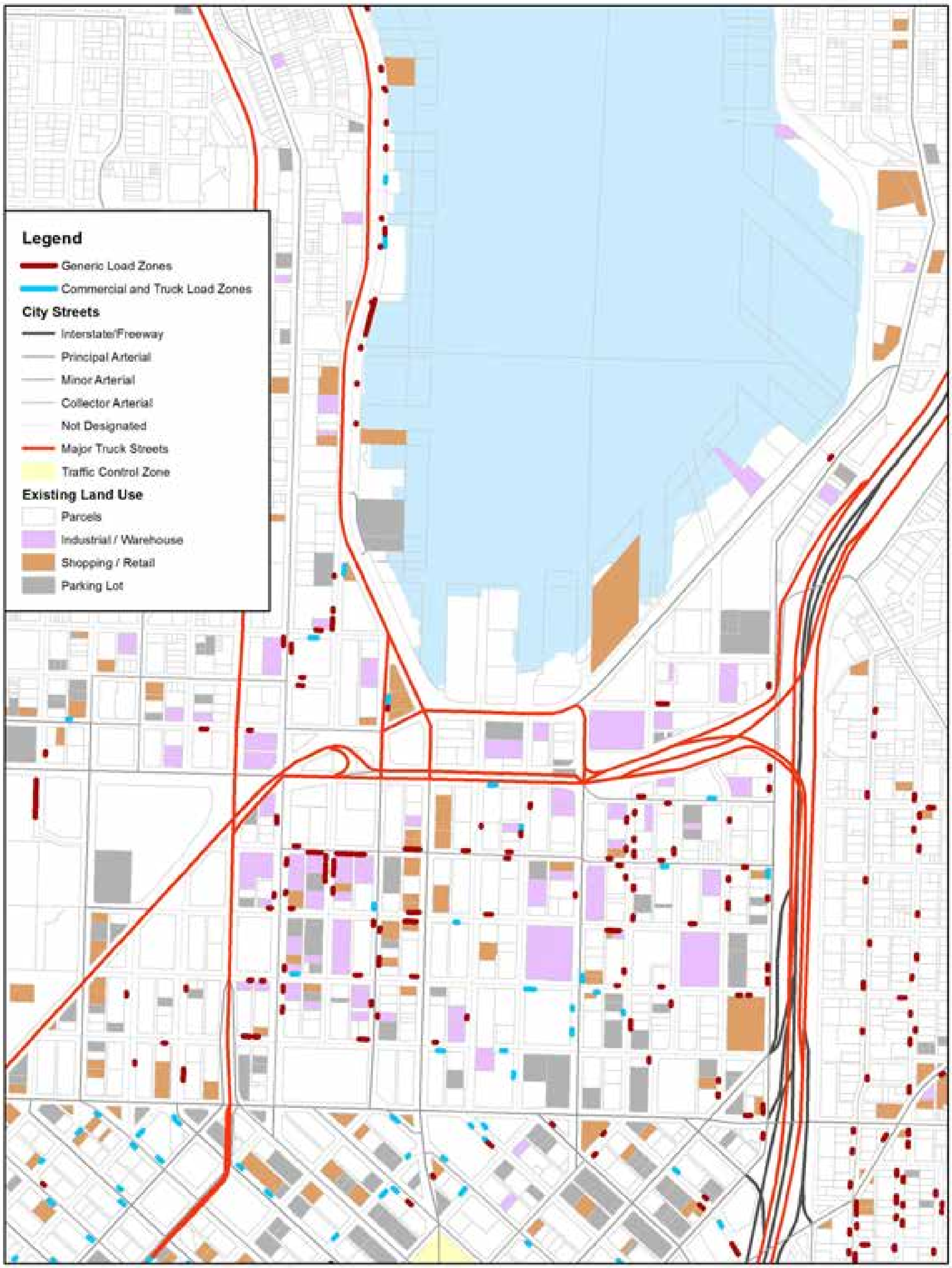
Figure 14: South Lake Union Daily Truck Volumes. Source: SDOT GIS FreightFlow_segments_final layer, 2015



Loading Zones

Once truck drivers arrive in the neighborhood to make their deliveries, they need a place to park to unload goods. Figure 15 shows loading zones in South Lake Union. Loading zones are dispersed throughout the neighborhood. Because parking meters become operational in the morning, on-street metered parking (see next section) is generally not available for use by trucks as an additional resource.

Figure 15: South Lake Union Loading Zone Designations. Source: SDOT GIS CURB_SPACES layer, 2014



On-street parking in South Lake Union is extremely well used during peak periods. As shown in Figure 16, most on-street parking stalls are used in excess of 70% of the time, with over 85% being common. The high occupancy levels make it challenging for trucks to find places to park while making deliveries during peak periods in the event that alleys and building loading zones are unavailable.

Figure 16: South Lake Union On-Street Parking Occupancy, Average Peak 3 Hours of each blockface during 8AM-5PM, Source: http://www.seattle.gov/transportation/parking/docs/SDOT2014ParkingMaps.pdf, 2014

STAKEHOLDER INTERVIEW RESULTS

The following sections provide a summary of the results of the stakeholder interviews for the two case study neighborhoods. The information presented below is based on the comments provided during the interviews and is supplemented with City data. While the information was obtained in two different neighborhoods, the goal of the analysis was to provide information and findings that could be applicable to communities across the City. Therefore, the information is presented in a consolidated manner.

The interview questions asked of case study neighborhood business and residential representatives are included in Appendixes A and B and shown in the boxes on this page and the following page, respectively. Notes taken during each interview are included in Appendix C.

The discussions below include some comments provided by BINMIC stakeholders during an interview held with that group in mid-2014. The comments identified here are those that are most relevant to this paper's topic of freight movement to and within neighborhood commercial areas. A summary from that interview is included in Appendix D.

TRUCK DELIVERIES (FREQUENCY AND VEHICLE TYPE)

Most business interviewees indicated that box trucks (generally 14 to 16-foot long cargo compartment) are the predominant size of truck that delivers goods to their businesses. Most reported having deliveries by box truck at least once per weekday, with occasional deliveries by smaller (vans) or larger (semi-trailer) trucks for larger items or major re-stocking. United

CASE STUDY INTERVIEW QUESTIONS: BUSINESS STAKEHOLDERS

1. Please describe the deliveries to your company (type of delivery, size of trucks, frequency, time of day)? Where do the trucks park and unload?
2. Please describe the pick-ups from your company (type of pick-up, size of trucks, frequency, time of day)?
3. Have your truck pick-ups or deliveries changed based on congestion at certain times of day? If so, how? Would it be possible to promote delivery to your business during off-peak hours? If not, why?
4. Describe any concerns or issues that you have regarding truck pick-ups and deliveries to your business. What have you heard from your customers, businesses located near yours, residents, etc? What have you heard from truck drivers and your suppliers?
5. What are the top safety concerns you see relating to truck activity in this neighborhood?
6. What is one thing the City can do to help truck deliveries to your business be more efficient and reliable?
7. Do you have any other comments related to freight movement?
8. Would you like to receive e-mail updates about the Freight Master Plan? If yes, please provide your email address.

Parcel Service (UPS) and Federal Express (FedEx) deliveries were daily for many businesses, and those deliveries generally occur in the morning hours.

The community residents in both neighborhoods that were interviewed reported the UPS and FedEx trucks as being the types of vehicles most likely to deliver items to their households. Both groups noted a wide range of businesses that do home delivery, and this is becoming a bigger driver of freight delivery, generally.

Most businesses, other than grocery stores, do not take regular deliveries on weekends. Ballard Market reported significantly more daily deliveries (typically 24-34 trucks daily of various sizes, seven days per week) than the other businesses interviewed due to its large and diverse inventory. Interestingly, the SLU community council suggested that, in order to shift trucks off of peak, the City consider relaxing the noise ordinance.

Most of the businesses interviewed are already making the most of evening/nighttime deliveries to the extent possible for their type of business. Some retail businesses, such as the Glazer's Camera company, are not open are staffed during the evening or at night. In particular, the camera store indicated that it cannot accept deliveries of its goods (often fragile and expensive photographic equipment) when no one is on site to receive those deliveries. Restaurants, in general, reported being open longer and later hours, including weekends, and are more likely to be able to accept night time deliveries. The Tom Douglas Company centralized bakery has staff working on site around the clock and is able to accept deliveries at off-peak times.

The General Manager of the Ballard Market indicated that the City noise ordinance limits nighttime deliveries in residential neighborhoods. Truck unloading activities can be noisy even during daytime hours. The Market is installing hydraulic levelers to reduce noise during deliveries (including regular delivery hours).

CASE STUDY INTERVIEW QUESTIONS: RESIDENTIAL STAKEHOLDERS

1. Other than regularly scheduled garbage and recycling pick up, what types of things do you receive and/or send out by truck?
2. Describe the truck activity in the neighborhood to the best of your knowledge (how many trucks a day, size, are they making local stops, etc.). What do you think are the major generators of trucks in your neighborhood?
3. Please describe any concerns or issues that you have regarding truck activity in your neighborhood.
4. Do you have any suggestions for what the City can do to help truck activity in your neighborhood be safer?
5. Do you have any suggestions for what the City can do to help manage the effects of trucking on your neighborhood?
6. Do you have any other comments related to freight movement in your neighborhood?
7. Would you like to receive e-mail updates about the Freight Master Plan? If so, please provide your email address.
8. Is there anyone else we should contact regarding freight in your community or the freight master plan?

TRAFFIC CONGESTION AND ACCESS TO AND FROM THE REGIONAL HIGHWAY SYSTEM

For the most part, the managers reported that "the truck drivers are used to congestion." The managers in the fast-growing South Lake Union area indicated that the on-going construction has caused delays but said that the City requirements for contractors do a "pretty good job" of keeping travel lanes open during construction.

City actions could help improve the efficiency of truck movements. Several respondents suggested that the City should improve wayfinding for truck drivers to get to and from the regional highway system. Better direction to the highway system could help reduce trucks cutting through neighborhoods on residential streets. Truck drivers (and Google maps) may be unaware of the City's major truck street network.

In general, geometric constraints with the arterial street system were not identified as a major concern for truck deliveries. The primary exception to this situation was noted for trucks needing access to shops and restaurants in the old Ballard area. The skewed intersections along Ballard Avenue NW, NW Market Street and Shilshole Avenue NW, for example, create sharp turns which are particularly difficult for larger vehicles to maneuver. In addition, the travel lanes are narrow and constrained by parking on both sides.The General Manager of the Ballard Market expressed concerns with truck maneuverability on streets surrounding the grocery store. In particular, he indicated that turns between 14th Avenue NW and NW 56th Street are problematic for large trucks accessing the grocery store loading dock. Neighborhood residents also expressed concerns with large trucks moving though and temporarily blocking neighborhood streets and intersections.

The BINMIC stakeholder group identified congested conditions along NW Leary Way and 15th Avenue NW as concerns for truck drivers using those routes. In addition, drivers diverting to non-arterial streets to avoid the congested conditions also create conflicts for trucks accessing their businesses on local streets. Traffic congestion caused by shoppers backing into the on-street parking stalls along NW 47th Street near the Trader Joe's grocery store makes it difficult for large trucks to travel down this street.

SAFETY

Safety associated with trucks in neighborhood areas was identified as a concern by residents. The size and travel speed of trucks using (often) narrow city streets was mentioned by both Community Councils. Better visibility for truck drivers, through improved signage and removal of tree branches, were suggestions to improve the situation. One business noted that trucks circling the block or parking in the middle of the street for deliveries was a safety concern.

In the Ballard area along Shilshole Avenue NW and the ship canal, the BINMIC stakeholder group indicated concerns regarding conflicts between trucks serving the businesses and bicyclists and pedestrians. There are a variety of businesses in the area that attract pedestrians and bicyclists, particularly during later afternoon and evening hours.

PARKING AND UNLOADING FOR DELIVERIES

Box trucks (typically between 12 and 24 feet in length) can park in most alleyways in the City of Seattle as long as there is sufficient width (e.g., no parked cars blocking the way), and these alleys often provide the most direct access to the back doors and storage areas for many businesses and restaurants. At the Hi-Life restaurant, the back alley is privately owned by the building (i.e., not a public alley), so the building managers are able to control access and allow for convenient truck deliveries to the restaurant. Where no alleyways exist, trucks making pick-ups or deliveries are required to park on the street, which can be challenging if loading zones are not provided.

Even if a loading zone is present, the space is unusable for delivery trucks if it is occupied by another vehicle. The Hi-Life restaurant in Ballard has a 30-minute loading zone across the street from its front door, but the zone is adjacent to a dry cleaner business. The dry cleaner has customers arriving frequently to drop off and pick up items, so the loading zone is often in use, according to the restaurant manager.

To identify issues and concerns with loading zones, the City embarked on the Commercial Vehicle Loading Zone Pilot Pricing Project. According to this study, "most use of loading zones by commercial vehicles takes place between 11:00 AM and 3:00 PM." The study also found high use of the loading zones by passenger vehicles. Additional details on the study and its findings are available on the project web site[3].

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[3]http://www.seattle.gov/transportation/parking/CVLZpilot.htm, accessed May 12, 2015.

FINDINGS AND RECOMMENDATIONS

The following are the key findings of this research:

- The two case study neighborhoods, Ballard and South Lake Union, have been experiencing rapid growth and development
- Available on-street parking is extremely scarce, so enforcement of parking regulations and additional loading zones or loading docks is needed in both areas.
- Congestion has affected business practices, but it is considered a fact of life for both those making and receiving deliveries.
- Evening noise ordinances that limit nighttime deliveries were a concern both for Ballard businesses and residents in South Lake Union who would like to see more deliveries shift to off peak hours.
- Neighborhood residents are concerned about truck safety, including volumes, speeds and noise. The high volume of pedestrian and truck activity in South Lake Union increases the potential for collisions and might require additional education and changes to traffic control.

The following are recommendations for further study and evaluation:

- Parking and loading zones are significant issues that merit further evaluation and discussion.
    - The City could consider an on-going loading zone monitoring program to periodically review changing business needs – (e.g., times, numbers, locations and enforcement).
    - The City could review commercial load zone parking policies for passenger cars with commercial plates since those vehicles can park elsewhere.
- Truck street designations should be re-evaluated and consider current information. The streets listed below have a high volume of trucks but aren't classified as major truck streets:
    - NW Market Street near 24th Avenue NW and east of 15th Avenue NW
    - Leary Avenue NW south of NW Market Street
    - 24th Avenue NW north of NW Market Street (a minor arterial so it may merit a different designation than principal arterials)
    - Westlake Avenue North near Denny Way
    - Dexter Avenue North (a minor arterial so it may merit a different designation than principal arterials)

APPENDIX A:
CASE STUDY INTERVIEW QUESTIONS: BUSINESS STAKEHOLDERS

1. Please describe the deliveries to your company (type of delivery, size of trucks, frequency, time of day)? Where do the trucks park and unload?
2. Please describe the pick-ups from your company (type of pick-up, size of trucks, frequency, time of day)?
3. Have your truck pick-ups or deliveries changed based on congestion at certain times of day? If so, how? Would it be possible to promote delivery to your business during off-peak hours? If not, why?
4. Describe any concerns or issues that you have regarding truck pick-ups and deliveries to your business. What have you heard from your customers, businesses located near yours, residents, etc? What have you heard from truck drivers and your suppliers?
5. What are the top safety concerns you see relating to truck activity in this neighborhood?
6. What is one thing the City can do to help truck deliveries to your business be more efficient and reliable?
7. Do you have any other comments related to freight movement?
8. Would you like to receive e-mail updates about the Freight Master Plan? If yes, please provide your email address.
9. Is there anyone else we should contact regarding freight in this neighborhood or the freight master plan?

APPENDIX B: CASE STUDY INTERVIEW QUESTIONS: RESIDENTIAL STAKEHOLDERS

1. Other than regularly scheduled garbage and recycling pick up, what types of things do you receive and/or send out by truck?
2. Describe the truck activity in the neighborhood to the best of your knowledge (how many trucks a day, size, are they making local stops, etc.). What do you think are the major generators of trucks in your neighborhood?
3. Please describe any concerns or issues that you have regarding truck activity in your neighborhood.
4. Do you have any suggestions for what the City can do to help truck activity in your neighborhood be safer?
5. Do you have any suggestions for what the City can do to help manage the effects of trucking on your neighborhood?
6. Do you have any other comments related to freight movement in your neighborhood?
7. Would you like to receive e-mail updates about the Freight Master Plan? If so, please provide your email address.
8. Is there anyone else we should contact regarding freight in your community or the freight master plan?

APPENDIX C:
CASE STUDY INTERVIEW NOTES

CASE STUDY INTERVIEW: BALLARD

Ballard Market, Ballard

1. **Please describe the deliveries to your company (type of delivery, size of trucks, frequency, time of day)? Where do the trucks park and unload?**

    - Deliveries take place 7 days a week. Fewer deliveries on Sunday. Ballard Market receives products on vehicles ranging in size from vans to large semi trucks.
    - Ballard Market can receive between 24-34 deliveries per day
    - The almost have no fedex/ups pick up or deliveries
    - Lowest truck delivery number – 12/day
    - Highest truck delivery number - 36/day

2. **Please describe the pick-ups from your company (type of pick-up, size of trucks, frequency, time of day)?**

    - Recycle – 3 times/week
    - Regular trash – 3 times/week
    - Compost – once weekly (Tuesday morning)

3. **Have your truck pick-ups or deliveries changed based on congestion at certain times of day? If so, how? Would it be possible to promote delivery to your business during off-peak hours? If not, why?**

    - Summer is better for deliveries.

4. **Describe any concerns or issues that you have regarding truck pick-ups and deliveries to your business. What have you heard from your customers, businesses located near yours, residents, etc? What have you heard from truck drivers and your suppliers?**

    - Noise ordinance is a concern. Also big concern is the Tunnel project – most of his deliveries are coming from the south – if there are problems with the tunnel project there are concerns about the timing of deliveries.
    - Ballard market is installing hydraulic levelers to keep noise down during deliveries – keep noise down during regular delivery hours.
    - Park on median along 14th Street – not a good idea – parking is very tight in the neighborhood.
    - Trying to navigate 40ft+ trucks on some streets is very challenging – the problem with Ballard Market is that access to the loading dock has to be through 14th Avenue in the southbound direction and go west on 56th Street – this is problematic for turning movements. Depending on where the trucks are coming from, they have to turn from 15th Avenue to 57th Street East, south on 14th Ave, west on 56th Street.

5. **What are the top safety concerns you see relating to truck activity in this neighborhood?**

   - N/A

6. **What is one thing the City can do to help truck deliveries to your business be more efficient and reliable?**

   - Modify the noise ordinance to facilitate deliveries on off-peak periods

7. **Do you have any other comments related to freight movement?**

   - A lot of questions for the Viaduct project that have not been clarified

8. **Would you like to receive e-mail updates about the Freight Master Plan? If yes, please provide your email address.**

   - N/A

9. **Is there anyone else we should contact regarding freight in this neighborhood or the freight master plan?**

   - N/A

CASE STUDY INTERVIEW: BALLARD

Hi-Life Restaurant, Ballard
2/19/2015 11 AM

1. **Please describe the deliveries to your company (type of delivery, size of trucks, frequency, time of day)? Where do the trucks park and unload?**

   Mostly box trucks.

   Typical suppliers include:
   - Merlino (SODO/Georgetown warehouse)
   - SK Produce
   - Beer and wine vendors
   - Meats (Interbay)

   Difference between large delivery sources (multiple trips per week) and occasional sources. Occasionally might be distributor of special wines/spirits (Southern, Klik), which is only one box

   Basic stock items are delivered Mon/Tues (restock from weekend) plus Thurs/Fri (stock up for weekend)

   Each day of week has different number of deliveries

   Rarely: full semitruck (once per year) which is usually a piece of large equipment (e.g. stove)

   Everyday there is at least one delivery. Average is 4 per day and range is 1-7 per day.

   Occasionally a van will deliver items.

   Park/unload in alley space depending on availability. Alley is owned by the building and building tenants share it. In past there have been a few times where a car (owned by upstairs tenant) was hit by a truck.

   The 30 minute load zone across street from front door is also used, but it is often filled. It's next to the dry cleaners. Otherwise, trucks will park in the middle of the street to unload.

   Gabriela provided information about requesting a load zone from the city. Mars will follow up.

2. **Please describe the pick-ups from your company (type of pick-up, size of trucks, frequency, time of day)?**

   Linens are picked up Tuesdays and Fridays at 8 AM. They park in the alley (typically not full at that time).

   Beer distributors pick up empty kegs when delivering new (full) kegs. Others also pick up empties when delivering new supplies.

3. **Have your truck pick-ups or deliveries changed based on congestion at certain times of day? If so, how? Would it be possible to promote delivery to your business during off-peak hours? If not, why?**

   Not really. This has not been identified as a problem by drivers. Restaurant serves breakfast, lunch and dinner, so someone is always on-site. Deliveries can happen any time of day. Example of Boundary Bay brewery delivery (from Bellingham): If there's heavy traffic congestion on I-5, they might be late but it's a time window and someone would be on-site to receive the delivery.

4. Describe any concerns or issues that you have regarding truck pick-ups and deliveries to your business. What have you heard from your customers, businesses located near yours, residents, etc? What have you heard from truck drivers and your suppliers?

From drivers/vendors: we don't hear of any problems. Customers often complain about lack of parking. Especially with nearby construction, any space that isn't metered is taken by 7AM and is full all day (construction workers).

New meter app could help so that drivers can re-up the parking meter without returning to their car.

If restaurant was in the middle of old Ballard (e.g., on Ballard Avenue) they might have more problems with deliveries. No alleyway (or back doors) there and the street width is tight.

5. What are the top safety concerns you see relating to truck activity in this neighborhood?

If trucks can't park in the load zone, they drive around a lot and/or park in the middle of the street.

6. What is one thing the City can do to help truck deliveries to your business be more efficient and reliable?

Zoning in the area has increased activity levels, so on-street parking is usually full. Designated loading zones would be more efficient for deliveries.

7. Do you have any other comments related to freight movement?

Could consider improving way-finding: how to direct freight coming to the neighborhood from the freeways. Shilshole Avenue has awkward (sharp) turn. Old Ballard Avenue is narrow and also has skewed intersections which are a challenge for trucks.

8. Would you like to receive e-mail updates about the Freight Master Plan? If yes, please provide your email address.

Yes. Especially interested in future of industrial land uses.

9. Is there anyone else we should contact regarding freight in this neighborhood or the freight master plan?

Restaurants on old Ballard Avenue could be useful to talk to – they have different conditions. Matador is located at awkward street intersection on corner of NW Market Street and no alley.

CASE STUDY INTERVIEW: BALLARD

East Ballard Community Council

1. **Other than regularly scheduled garbage and recycling pick up, what types of things do you receive and/or send out by truck?**

    - UPS, FedEx, mulch, furniture, appliance, moving trucks, amazon fresh, roofing supplies, safeway, some construction.

2. **Describe the truck activity in the neighborhood to the best of your knowledge (how many trucks a day, size, are they making local stops, etc.). What do you think are the major generators of trucks in your neighborhood?**

    - Ballard Market – highest number of trucks – most of them do not come north of 57th Street (loading dock is on 56th Street). Construction on 14th Street Ave. Goodwill is a generator of truck trips. Fred Myer, Salmon Bay. Cement.

3. **Please describe any concerns or issues that you have regarding truck activity in your neighborhood.**

    - Wear and tear of public infrastructure and also private property

4. **Do you have any suggestions for what the City can do to help truck activity in your neighborhood be safer?**

    - Residential streets – driving too fast

5. **Do you have any suggestions for what the City can do to help manage the effects of trucking on your neighborhood?**

    - Maximize truck activity outside rush hour. Improve visibility for truck drivers (low branches, signs with poor visibility)

6. **Do you have any other comments related to freight movement in your neighborhood?**

    - Area south of Market Street carries a lot of freight. Poor turning radii – maybe not appropriate truck route. Getting across Ballard Bridge needs to improve for all modes (trucks, peds and bikes – very bad transition)

CASE STUDY INTERVIEW: BALLARD

Central Ballard Residents Association
Interview conducted on February 12, 2015

1. **Other than regularly scheduled garbage and recycling pick up, what types of things do you receive and/or send out by truck?**

   - Fuel oil, UPS.

2. **Describe the truck activity in the neighborhood to the best of your knowledge (how many trucks a day, size, are they making local stops, etc.). What do you think are the major generators of trucks in your neighborhood?**

   - Construction project trucks, QFC

3. **Please describe any concerns or issues that you have regarding truck activity in your neighborhood.**

   - Roads, Street conditions, side streets are too narrow.

4. **Do you have any suggestions for what the City can do to help truck activity in your neighborhood be safer?**

   - No trees in front of truck signs, poor visibility, confusing signs on 22nd Street (not clear)

5. **Do you have any suggestions for what the City can do to help manage the effects of trucking on your neighborhood?**

   - Look at possibility to schedule deliveries at different hours – stacked deliveries, traffic circles for larger vehicles not useful – they just destroy them

6. **Do you have any other comments related to freight movement in your neighborhood?**

   - We support thriving businesses but need to accommodate all trucks but not on all streets

CASE STUDY INTERVIEW: SOUTH LAKE UNION

Brave Horse Tavern Restaurant, SLU
2/25/2015 2PM

1. **Please describe the deliveries to your company (type of delivery, size of trucks, frequency, time of day)? Where do the trucks park and unload?**

    - Almost entirely box trucks
    - Some bigger trucks from Columbia Distributors (beverages)
    - Beverages delivered: kegs, bottles (one day/week)
    - Food delivered: meat, produce, specialty (each type one day/week)
    - Typically receive 2-4 deliveries per day.
    - Merlinos (grocery) is 3 times per week (M-W-F). Used to be 5 days/week but is now more consolidated.
    - Loading dock in building - Amazon parking garage with back elevator. Provides plenty of space for trucks to use. No deliveries happen during 11:30 to 1:30 lunch rush (staff availability for receiving).

2. **Please describe the pick-ups from your company (type of pick-up, size of trucks, frequency, time of day)?**

    - 2 Pick-ups daily
    - internal transfers (inter-company) outgoing (using the same vehicles as above)
    - dirty linens picked up 3x per week

3. **Have your truck pick-ups or deliveries changed based on congestion at certain times of day? If so, how? Would it be possible to promote delivery to your business during off-peak hours? If not, why?**

    - Would like to shift more deliveries to off-peak (late) but some trucks can't do that. They have already done as much as they can.

4. **Describe any concerns or issues that you have regarding truck pick-ups and deliveries to your business. What have you heard from your customers, businesses located near yours, residents, etc? What have you heard from truck drivers and your suppliers?**

    - Dock makes it easy. Landlord is responsive. Elevator may break down which causes problems in moving the goods to the restaurant. If they have an occasional large item (e.g., large oven), they work with the building manager to make it happen.
    - Good loading dock design helps. Info for Cantina Building (new building with TD restaurant) has had some issues with its loading dock as-built.

5. **What are the top safety concerns you see relating to truck activity in this neighborhood?**

    - Lots of pedestrians in neighborhood. Traffic control is mostly stop signs. The tech folks "travel in packs" and don't pay attention to the traffic signals or moving traffic. They walk right out in front of cars even if the signal has changed to red.

6. **What is one thing the City can do to help truck deliveries to your business be more efficient and reliable?**

    - Not really anything he can think of.

7. **Do you have any other comments related to freight movement?**

   - Parking garage is very busy. Arrivals in AM and departures in PM create congestion. Amazon not using unlicensed traffic control staff anymore - back to using licenses police officers for traffic control. The building management company (CBRE) works with them on this.

8. **Would you like to receive e-mail updates about the Freight Master Plan? If yes, please provide your email address.**

   - Add Brent to email list for FMP

9. **Is there anyone else we should contact regarding freight in this neighborhood or the freight master plan?**

   - Also should talk with TD company operations manager: Sean Hartley

CASE STUDY INTERVIEW: SOUTH LAKE UNION

Tom Douglas Company, SLU and Belltown
2/25/2015 2PM

1. **Please describe the deliveries to your company (type of delivery, size of trucks, frequency, time of day)? Where do the trucks park and unload?**

   - Each restaurant 6x/week:
     - Company-owned box trucks (14' long)
     - Vendors: all sizes of vehicles. independent suppliers (e.g., mushroom growers, specialty items)
   - Vans (small)
   - Larger 18' are 5-6x/week
   - UPS/FedEx
   - Non-refrigerated TD Company Warehouse in Ballard stores produce, spice rubs, etc. In/Out 5x/week
   - Semi-truck: Jars for spice rubs - 2x/month
   - Freight restrictions in downtown Seattle affect movements of large trucks
   - Occasional large trucks if restaurant is being remodeled.
   - Parking
     - Commercial load zones, alleyway (commercial). "We don't supply load zones to drivers"
   - Internal deliveries: Serious Pie restaurant in SLU is bakery to supply pastries and baked goods company-wide.
   - In/out to Serious Pie shop is internal distribution 4x/day and supplies 5x/day. 2 full-time drivers.
   - We request load zones as we need to.

2. **Please describe the pick-ups from your company (type of pick-up, size of trucks, frequency, time of day)?**

   - Linens 3x/week. Big truck 20'
   - Waste oil pick up 1-2x/month in big trucks

3. **Have your truck pick-ups or deliveries changed based on congestion at certain times of day? If so, how? Would it be possible to promote delivery to your business during off-peak hours? If not, why?**

   - Truck drivers are used to congestion. The construction companies do a pretty good job of keeping lanes open (due to City requirements).
   - We can't change our patterns of delivery frequencies. Yes to night-time deliveries. Staffing is on-duty 24 hours/day at the bakery.

4. **Describe any concerns or issues that you have regarding truck pick-ups and deliveries to your business. What have you heard from your customers, businesses located near yours, residents, etc? What have you heard from truck drivers and your suppliers?**

   - Hard to complain about traffic congestion since we benefit from the growth in population.
   - Drivers are savvy about congestion and know where to go to load/unload. Congestion increases => Fuel/labor time Cost increases.
   - Finding parking (storage) for the 2 company box trucks used to be easy - lots of surface lots around. Now those lots are re-developing so it's difficult to find parking. Temporary parking in Ballard now.

5. **What are the top safety concerns you see relating to truck activity in this neighborhood?**

   Safety is not really an issue. Amazon uses police officers at parking garage exits.

6. **What is one thing the City can do to help truck deliveries to your business be more efficient and reliable?**

    - Would like the City to maintain load zones for vehicles of all sizes. Drivers will figure out how to get products to us: large well-known restaurant company with multiple locations.
    - For new construction: make sure that buildings have appropriate load docks (even if only an alcove off the alley). If the load dock isn't well designed, then the trucks block the whole alley (e.g., trash collection)

7. **Do you have any other comments related to freight movement?**

    - No.

8. **Would you like to receive e-mail updates about the Freight Master Plan? If yes, please provide your email address.**

    - Yes. Sean@tomdouglas.com

9. **Is there anyone else we should contact regarding freight in this neighborhood or the freight master plan?**

    - Our building is well-managed by CBRE

CASE STUDY INTERVIEW: SLU

Receiving
Glazer's Camera Store, SLU
2/26/2015 4:30PM

Note: their new location (under construction across the street) will consolidate all 3 shops into one space.

1. **Please describe the deliveries to your company (type of delivery, size of trucks, frequency, time of day)? Where do the trucks park and unload?**

   Delivery garage doors open from the alley directly into the shipping area of the store

   Most box trucks:
   UPS delivers at 9AM 1 x/weekday plus 2x month directly to the other locations (a few blocks away). Sometimes they will deliver on a weekend (store is open).

   FedEx Ground is 1x/day (noon-1pm)

   FedEx Express is 1x/day (noon-1pm)

   FedEx Freight is approx 4x/month (varies)

   Other:
   ABF pallet delivered 2x/month
   Roadrunner 1x/month
   Semitruck 4x/month

2. **Please describe the pick-ups from your company (type of pick-up, size of trucks, frequency, time of day)?**

   Inter-store transfers 1x/day

   UPS picks up at 5pm 5x/week

   FedEx picks up by request

   Used to have outgoing mail picked up daily by

   Post Office out front

   If alley is blocked (car repair company nearby) then they have to park out front and send thru the store. Some alleys he's seen have "no parking" signs but this one doesn't.

3. **Have your truck pick-ups or deliveries changed based on congestion at certain times of day? If so, how? Would it be possible to promote delivery to your business during off-peak hours? If not, why?**

   UPS is sometimes late from congestion

   FedEx running late quite often lately

   Lots of construction in the neighborhood and the truck drivers face new detours each day.

   Off-peak deliveries wouldn't work. No one is at the store to receive off-peak. Can't leave the high value/fragile product lying around.

4. **Describe any concerns or issues that you have regarding truck pick-ups and deliveries to your business. What have you heard from your customers, businesses located near yours, residents, etc? What have you heard from truck drivers and your suppliers?**

   Glad the city is interested in their opinions.

   New location will have loading zone in the building with garage entrance.

5. **What are the top safety concerns you see relating to truck activity in this neighborhood?**

   Wide 20' alley provides plenty of space to park cars to avoid sideswipes

6. **What is one thing the City can do to help truck deliveries to your business be more efficient and reliable?**

   Post "no parking/do not block alley" signs along the alley

7. **Do you have any other comments related to freight movement?**

   There is a lot of freight moving around.

8. **Would you like to receive e-mail updates about the Freight Master Plan? If yes, please provide your email address.**

   Yes (Ken Roeder provided his email address to Gabriela)

9. **Is there anyone else we should contact regarding freight in this neighborhood or the freight master plan?**

   No

CASE STUDY INTERVIEW: SLU

South Lake Union Community Council

1. **Other than regularly scheduled garbage and recycling pick up, what types of things do you receive and/or send out by truck?**

    - UPS, FedEx, condo construction, amazon fresh, laundry services, moving trucks, pods (moving storage), boats, fuel trucks (for yachts), event trucks, postal service.

2. **Describe the truck activity in the neighborhood to the best of your knowledge (how many trucks a day, size, are they making local stops, etc.). What do you think are the major generators of trucks in your neighborhood?**

    - 76 trucks from AGC (associated general contractors) – very specific about this – they have actually counted. No counts for the other trucks.

3. **Please describe any concerns or issues that you have regarding truck activity in your neighborhood.**

    - Speed, soft stops, blocking residential access, illegal parking, trucks coming off I-5 too fast or getting stuck middle of intersection. Dexter Avenue (not specific but there is a lot of construction)

4. **Do you have any suggestions for what the City can do to help truck activity in your neighborhood be safer?**

    - Look at REI, look at alleys – trucks and vehicle conflicts on alleys, restricting access during rush hours, what is our relationship with commercial drivers (industry)?

5. **Do you have any suggestions for what the City can do to help manage the effects of trucking on your neighborhood?**

    - How does the City communicate to truck drivers what restrictions are in place? Try to work around the noise ordinance in some locations?

6. **Do you have any other comments related to freight movement in your neighborhood?**

    - How is the city going to manage new road facilities? – Dexter? Westlake corridor?
      - there were a couple of questions of overlapping modes (multimodal corridors)

APPENDIX D: GROUP STAKEHOLDER INTERVIEW WITH BALLARD-INTERBAY-NORTHEND MANUFACTURING AND INDUSTRIAL CENTER (BINMIC)

Stakeholder Interviews – Group Two
July 29 2014
7:30 AM – 9:00 AM
Ballard-Interbay-Northend Manufacturing & Industrial Center

Attendance

- Warren Aakervik (Ballard Oil)
- Kevin O'Neil (SDOT)
- Sara Zora (SDOT)
- Ian Macek (SDOT)
- Justin McCaffree
- Charla Skaggs
- Bridget Wieghart (Parsons Brinckerhoff)
- George Colazzo (Coastal Transportation)
- Eugene Wasserman (BINMIC)
- Christine Wolf (Port of Seattle)
- Katherine Brooke (Ballard Partnership Urban Design Transportation Team)
- Nate Dreyon (Consultant to Block Builders)

SUMMARY

Sara Zora introduced the group, presented the meeting agenda, and explained the purposes of the interview to gather insights into problems and find potential solutions.

SAFETY

Bridget Wieghart asked the group to identify the biggest types of safety concerns that they have. George Colazzo stated that he didn't have any major safety issues at his business. George explained that before the ship canal trail was built, safety was an issue, but since its completion, it really hasn't been an issue.

Bridget Wieghart further inquired about safety issues specific to trucks.

George Colazzo responded saying that his business is primarily ocean transport and his customers come to his business for offloading and that trucking out of Tacoma is more of an issue due to general congestion. Warren Aakervik added that transporting items out of George's business can be a challenge (13th and Nickerson). Eugene Wasserman commented that north of the ship canal, a lot of business are on streets in neighborhoods with a mix of bikes, trucks, and pedestrian traffic. Eugene also made special note of the traffic that is growing in the "beer making area" and that it also brings in a lot of pedestrians and bikes.

Kevin O'Neil asked if all this growing traffic is causing more conflicts with pedestrians.

Eugene Wasserman commented again that in general it is bringing more cars, pedestrians, and others who are not used to being around big trucks. Eugene noted that the increase in that type of traffic tends to occur in the evening. He again noted that there are a variety of activities in the area bringing people in citing whiskey makers and Theo's Chocolate. Warren Aakervik added that a lot of loading on the street is being done by double parking. Eugene stated that Ballard Ave. is a "heavy duty" night spot; during the day there is not much traffic, but it can spill over. Eugene said that the most traffic is definitely seen during afternoon peak times.

Bridget Wieghart inquired about specific locations for the heavy traffic.

Eugene Wasserman stated that Leary Way and 15th Ave NW can get really bad and noted that 15th Ave NW is a major bus corridor. Warren Aakervik added that Shilshole Ave. is becoming a major thoroughfare through Ballard which creates conflicts for larger trucks. Kevin asked Eugene if there are any particular streets that are of more concern than others. Eugene responded saying that it was the general area; again stating that there are a lot of streets with mixed uses.

Katherine Brooke asked if it is fair to say that since it's been an industrial area, there's been less of an emphasis on pedestrian amenities.

Eugene Wasserman reiterated that there are more uses now than just industrial. Eugene cited the backup near Trader Joe's where people are trying to avoid the parking garage. Eugene said that people backing into the spots in front of Trader Joe's is a major chokepoint for traffic coming off of the Ballard Bridge. Warren Aakervik added that since he is always seeing vehicles backing in and people pulling out that he finally just decided to take Leary Way instead. Warren continued that if you try and figure out how to go westbound from Market St. and 24th Ave. NW that it is a challenge to get back.

Kevin O'Neil commented that it seemed that a lot of the issues they were discussing were land-use based due to the influx of new uses.

Eugene Wasserman stated that there had been a number of collisions on the Burke Gilman Trail (BGT) where bicyclists were crashing into people pulling out from businesses. Eugene continued that there is no light on the BGT and that sometimes walkers wear dark clothing. He added that we have fixed most of the lighting, but that sometimes people still run into each other (on bikes) on the Ballard Bridge.

Bridget Wieghart asked the group about key things the city can do to help with these issues.

Nate Dreyon responded with "the intentions". Nate stated that the "road diet thing" has made things worse in a lot of conditions—both for safety and congestion. Nate continued that you have a more entitled cyclist group for which there is really not room on places like Nickerson St. Nate added that the main reason that Foss moved their headquarters off of Nickerson St. after 100 years was because of all the congestion. Warren Aakervik added that with Nickerson St. being a major truck street and with the South Lake Union (SLU) trail being completed a week after, the road diet on Nickerson St. made it worse. Nate agrees saying that that was one of the most ridiculous things that he had ever seen. Eugene Wasserman stated that the area around Fred Meyer is a disaster. Eugene said that he had explained this to SDOT, but that they don't seem to care about safety and would rather do what is politically best in the area. Eugene added again that they (SDOT) don't seem to be safety oriented.

Bridget Wieghart asked for recommendations about what to do there (Fred Meyer area)

Eugene Wasserman responded saying that there needs to be traffic engineering. Eugene stated that he had requested that SDOT put signs up on the BGT to alert people in cars that there is a trail there. Eugene explained that SDOT did in fact put up those signs, but that it took them a year to do it. He reiterated that although he does not believe that SDOT is purposely putting people in danger, that they are not prioritizing safety. Christine Wolf added that there have been issues in front of Fisherman's Terminal with bicyclists and pedestrians. Christine stated that because it is a split trail, people are confused about which way to go. Christine added that because the trail goes under the bridge, there are big site distance issues. Warren Aakervik commented that there were not any directions on the trail. Warren continued that the whole west side of Fisherman's Terminal is a bike path and that very few people know that it's there and thus almost no one uses it. Christine replied that she was talking about the south side, under Emerson St. Warren expressed that American Disabilities Act (ADA) compliance was a big issue. He continued that the only reason why SDOT couldn't build a ramp there was because they couldn't accept the grades that you would need to comply with the ADA. Eugene stated that SDOT had a consultant do a study on that area (Ballard Bridge and Emerson St.) over a year ago, but that he hasn't been able to get a copy of it. Eugene reiterated that overall he does not feel that SDOT cares about safety and that it had been an issue for the past several directors. Eugene finished by saying that we gave up one lane under the bridge for a path that no one uses.

RELIABILITY

Bridget Wieghart asked the group if their business operations change depending on congestion and if they anticipate further changes.

George Colazzo said that his business did not. Bridget Wieghart asked that since because people f those who deliver to George's business have requested different times (based on congestion). George responded that they deliver when they want and that the medium haul truckers are the same. Kevin O'Neil asked when George's deliveries come; George responded that peak time is on Wednesdays and Thursdays from about 7am-3pm. Warren Aakervik further explained that people drop of their trucks and leave them at George's business and then George's employees will unload them and then they will come back and pick them up when finished. George added that many of the trucks come from Tacoma and Bellingham. Eugene Wasserman commented that because of the noise ordinance that people don't really operate at night.

Sara Zora asked about the Salmon Bay area and if they work at night.

Warren Aakervik said that they do not.

Bridget Wieghart asked why did Foss switch.

Nate Dreyon explained that it only takes a couple of complainers to make things difficult. Nate added that taking on individual residents is not super fun or productive. Bridget asked why they worked at night to begin with and if was it because of congestion. Nate said that he didn't know, but recalled that people on Nickerson St. and Queen Anne were complaining. Warren Aakervik explained that the city instituted a noise ordinance to protect residential neighborhoods from industrial issues, but didn't do anything to protect the industrial uses. Warren further explained that urbanization has created the problem. Warren added that he thought trucks were exempt from the noise ordinance as long as they were moving. Warren explained that there is a compressed time when you can operate as a shipyard so that all of their operations have to happen during the day. Warren said that we are reducing the amount of shipyards and there's still a lot of work to be done so they do what they can. Eugene added they everyone usually stops work by 3:00pm.

Bridget Wieghart asked what could be done to promote off-peak deliveries.

Warren Aakervik explained that his business can't do off peak deliveries and that you'd have to respect the industrial areas being industrial areas. Warren explained that for example, not having new buildings have balconies in industrial areas. Eugene Wasserman explained that his business is in a very unique area in that they are right up next to residential areas and thus there are land-use issues and they don't have a lot of flexibility. Warren stated that next to Pacific Fisherman they were able to put in a hotel because it's a conditional use and thus they can't complain. Nate Dreyon stated that there is not enough of an industrial buffer and that it needs to be expanded. Nate continued that the buffer serves a great purpose by protecting residences from industrial activities and vice versa. Christine Wolf explained that the approach that the city tried with IC zoning in Interbay is an example of that not working well, because then you get things like Whole Foods which generates a huge amount of traffic, but does not help the industry stay alive.

Christine asked that the IC designations be looked at to allow for more industrial/craft businesses. Warren said that all the traffic tends to just dump onto major truck streets. Warren said that in terms of reliability, the intersection of 24th Ave NW and Market St. has lots of trucks and trailers and traffic in general. Warren continued that that is really not the way to go because you block the street with trucks and trailers. Warren mentioned that at one time he had talked about providing an exit at 54th St. by the railroad tracks, but now we take everything out via 26th Ave. Warren explained that as you are coming out of 26th, you're coming out of a narrow driveway, crossing four lanes of traffic with a 75-foot trailer which is clearly a safety issue as there is no sight distance.

Bridget Wieghart asked if the group would rather have the bikes on a sidewalk or down the hill.

Warren Aakervik responded that he would rather have them where they belong on NW 58th St., which is a greenway and that SDOT needs to design bike facilities that are separate from traffic and are attractive to use.

George Colazzo asked why is it that no one petitions congress to change regulations on the Ballard Bridge so that commercial vessels can go through whenever and non-commercial vessels can't. Sara Zora explained that they can't open the bridge during peak AM/PM hours. Warren suggested maybe having a longer peak time, or allow commercial vessels more flexibility, but restricting recreational vessels more. George stated that if the period when recreational could go through the bridge was restricted that that would be huge. George explained that Seattleites hate the fact that the bridge opens multiple times a day for a single guy with a sailboat. Sara commented that this was very helpful feedback and that as part of the plan we can identify potential policies to push forward and work with elected officials on this. Warren added that we need more VMS signs as by the time you get to Crown Hill and see the sign that the bridge is up, it's too late. Kevin O'Neil commented that when the Fremont Bridge is up that it completely shuts down everything. Warren suggested that SDOT could put a laser beam out there that gives people a better sense of then the bridge actually needs to be opened. Nate commented that we need a traffic cam and to send them a $250 ticket.

Eugene explained that traffic on the south side of the bridge on Nickerson St. has gotten really bad particularly during the afternoon peak hours. Eugene continued that morning rush hour traffic is bad as well as the city created a bus lane that increases congestion which then bicyclists also use which causes the buses to swing out. Sara asked about the idea of allowing trucks to use the BAT lanes and if that would help. Warren responded that that should absolutely happen and that the biggest problem is when you have a bicyclist that wants to use that lane and slows everybody down. Eugene commented that one problem they have is losing truck access to the freeways and that the city is not prioritizing the remaining routes for us. Eugene commented that they are always fighting the city and he feels that they are not listened to and is tired of it. Eugene said that he hopes the freight master plan will make a difference, but thinks that the city would prioritize 10-15 bikes on 15th Ave. NW over us any day of the year.

EFFICIENCY

Bridget Wieghart asked the group what is the biggest challenge for urban goods delivery.

Eugene Wasserman stated that speaking for Salmon Bay (Sand & Gravel) they would say that they're losing their routes around the city and that the road diets don't help. Eugene said that things are taking longer, there is no place to park, and that they can't make deliveries to downtown. Warren Aakervik stated that the consequence of getting everyone into bikes or transit is that everyone still has cars, but now those cards are parked all over the place and you can't park, you can't deliver to homes and park, and that you have to sit out in the middle of the street. Warren suggested that the city could work on unlicensed vehicles that are still parked in the street given that people are reluctant to get rid of their cars even when they don't need them. Sara suggested using the find-it fix-it app where you can take a photo of a car that you think has been parked in one place for too long and send it in. Warren commented that the BINMIC sign off of Emerson St. near the Ballard Bridge is falling down. Eugene stated that the city doesn't do much to help us make deliveries to retail stores; cycle tracks; no place to park.

Charla Skaggs asked Christine Wolf if there were any goods delivery issues at Terminal 91 (T91).

Christine Wolf responded that actually the number of truck trips that's required to provision cruise ships at T91 is actually pretty small—maybe 50 to-60 trucks for two vessels—passenger operations actually generate most of the traffic. Christine added that there are also industrial tenants at T91 such as Trident Seafood and Seafreeze and she gets comments from them every now and then that they have trouble getting fish on and off of 15th Ave. Christine added that the signal timing at Galer St. is an issue there. Warren stated that DPD ought to know where the school district is taking the school buses there as the storage area for buses is moving. Katherine Brooke commented that it's not SPS and that those are contracted out. Christine said that portions of T91 are still industrial such as fish processing or when the fleet is in and they need to rehab or exchange gear. Christine continued that they have a company that makes the production line for trawlers and that those things generate truck trips year round. Warren commented that when the cruise ships are there (T91) that there are no security gates. Sara Zora replied that they have always thought that there needs to be more security there. Christine mentioned that it is almost possible to control without backing things up all the way downtown and across the Ballard Bridge thought industrial areas often have separate facilities.

Bridget Wieghart asked if any of the group's businesses have been affected by larger changes in logistics.

George Colazzo said that they are now hauling more in rail cars which depends on the world fish markets. George explained that if Asia isn't buying the fish, it will get bought by Europe and the way they haul that is by rail to the east coast. Warren stated that he always thought it would be great to haul oil on the Ballard Terminal Railway as the only place that you can load diesel is in Pasco, WA. Warren continued that he thought looking at traffic congestion cameras is important and that they need to make sure that that info is out there. Warren said that he is very limited in where he can go with petroleum products as he can't use the freeway. Bridget asked George if since he is using more rail cars, has that changed his business. George replied that they are lucky in that we're only a quarter mile or less from Seattle's main railroad yard. George explained that there is nothing between them and other in terms of the street and that in a perfect world they have access to those cars at anytime. George added that they have a pretty good industrial setback so there aren't conflicts with neighbors although sometimes people wander off the ship canal trail onto the property.

Kevin O'Neil asked how often the shoreline tracks are used.

Eugene Wasserman replied that it was only a few times a week. George Colazzo explained that he moves his trains on a weekly basis: Monday-Wednesday. Christine Wolf asked George how many cars he has. George replied that he has 13 cars a week at this time of year, but many weeks it's only four per week.

RESILIENCY

Bridget Wieghart asked the group that when their primary preferred route in is unavailable, how do they decide which secondary route to take.

George Colazzo replied that he has only one way in and that's by Nickerson St. George explained that if there is an collision on the Ballard or Fremont Bridge then everything gets blocked up. Christine asked if things are different from when there were two lanes in each direction on Nickerson St. George replied that that did not really make a difference. Warren Aakervik explained that when the 2001 earthquake happened that he sent a driver down to Harbor Island to make a pick up and it took him three hours to get back. Warren commented that now we're going to squeeze things down on the waterfront……Warren continued that he looks at the cameras to get a sense of how different routes are going and stated that info needed to be available online. Eugene Wasserman stated that when there's an incident that shuts the street down, police need to consider the fact that you can't move a big vehicle down side streets and when there's no other possibility they should thing about trying to let those big trucks through somehow.

Eugene commented that they are biggest losers in the tunnel project because they will lose their direct access to SR 99 and will thus have to take the waterfront. Eugene added that they have been very involved in that project and worked to keep two lanes there as there will be a lot of trips along the central waterfront. Warren suggested that trucks with a wheelbase of 67 feet or greater should be able to turn onto all major truck streets. Warren said that a lot times the city could move the center lane over a foot or so and that that would help facilitate truck movement. He reiterated that trucks should be able to make the corners and that while transit might be able to make them with the jointed busses, trucks can't always.

Bridget Wieghart asked the group what are the biggest challenges affecting their industry overall; climate change, aging workforce, etc.

George Calazzo replied that next June they will have a new ship online and that they are talking about the corner of 13th and Nickerson. George explained that historically there wasn't a light there, but now they are installing one and that that stub of 13th and Nickerson is basically the driveway to their property. George continued saying that when the new ship comes online it will carry 25% more cargo than their other ships and that they'll be hauling more cargo once a month for about three days which concerns him because of possible traffic problems on 13th Ave. George explained that coming from I-5 then making the right at 13th Ave to get down to his property will fill up his lot and the stub of 13th and that then they will have no place left to go other than lining up on Nickerson St. Warren Aakervik asked George to clarify if they have the capacity for that. George replied that yes he did. Eugene Wasserman commented that most businesses along the waterfront are doing well. Charla Skaggs commented that bigger ships mean more trucks.

Warren suggested that they need a countdown timer so that you can see when the signal is about to change as stopping on that hill is difficult. George stated that they need lane markings on that section of 13th Ave and for a right hand turn lane on Warren St.

Eugene stated that one problem they have is that they don't know who to call at the city to address these issues. Christine Wolf explained that when the city makes decisions about regionalization, you often see a focus on mainline traffic only which was the case with Nickerson St. Christine continued that the studies said that it wasn't that bad, but there was not analysis of what it did to the industrial side streets and the connections to the businesses that need access to Nickerson St. to do their work. Christine suggested that we need to think about those types of things as part of the analytics process and it needs to be comprehensive. Warren agreed with Christine's comment adding that it was especially important when it's involving a major truck street. Warren continued that with regard to resiliency, SDOT should think about making 85th St. a major trucking street. Warren added that turning radii and where they are on major truck streets needs to be designed correctly rather than allow them to go in wrong.

Warren stated that signage is an issue as well citing his experience on 58th St. yesterday where he saw a sign for bicyclists letting them know the post office was coming up. Warren explained that bicyclists can turn around pretty quickly, but trucks can't and that he doesn't know of a system that allows a truck driver to know where he can go in the city and thus they need better signage for trucks which will reduce congestion. Warren offered exampled of signs that would instruct trucks on how to get to the M&I center and how to get back to the interstate system through the major truck routes. Eugene Wasserman commented that if people feel like they won't be able to get supplies, trucks, and their employees around in a reasonable amount of time that they need a transportation plan where people know what's going to happen. Eugene commented that the Westlake bike thing [cycle track] came out of nowhere.

Warren commented on the BGT saying that if the new section goes in where the bike groups want it to be then it will be the end of the maritime industries in Seattle as we know it. Warren explained that he got a letter in the mail from his insurance company stating that they may cancel his insurance if it goes in due to safety concerns. Warren continued that he wouldn't be able to provide fuel to ships and that that will be the straw that breaks the camel's back. Warren said he believed it was in the EIS process now and that hopefully they're taking a serious route. Christine asked if they are doing an economic impact analysis. Kevin O'Neil said that they were. Warren reiterated that it will determine the future of the maritime industry in Seattle.

Christine commented that people need to understand what freight means to the Seattle economy and how it provides good jobs. George Colazzo commented that he thinks there needs to be a good publicity campaign and that these buildings next to bike trails are filled with good jobs. Katherine Brooke stated that the bike community is big on shopping local and that we need to help people understand how freight supports that. George added that there should be photos of people that work in those buildings along the bike trail. Warren stated that we need to emphasize the uniqueness of Seattle; two bodies of water, seven hills, ports for Asia/Pacific, port for Alaska, and that most people don't get it and don't know what maritime means.

Seattle Department of Transportation

SUSTAINABLE FREIGHT OPPORTUNITIES APPENDIX F

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SUSTAINABLE FREIGHT OPPORTUNITIES

Sustainable freight is about more than just the environmental impacts generated by operations and transport of goods, it's also about the creation and maintenance of economic vitality and the generation, consumption and transportation of energy sources that fuel the movement of goods and people.

Sustainable freight practices consider three main drivers:

- The Environment
- The Community
- The Economy

Freight is a low margin industry and is slow to take on new practices or technologies, unless they are imposed by regulation or are more efficient. Practices must consider the company's financial bottom line before they will be adopted. In this case, the macro and micro economics are inextricably intertwined and a prerequisite to achieving the environmental and community benefits. Addressing sustainable freight practices in these three areas results in a "win" for businesses, consumers, residents, and the environment. This paper overviews trends in the freight industry as they relate to sustainability.

In describing trends, this analysis focuses on three major components of freight activity in Seattle:

- Imports/Exports
- Deliveries to/from/between businesses and industries
- Deliveries to consumers (primarily e-Commerce)

The paper then explores case studies in the areas of fuel, warehousing facilities and delivery that illuminate several sustainable practices in these areas.

The Seattle Climate Action Plan indicates that freight represents a significant share of Seattle's GHG emissions, because freight, regardless of mode, moves almost exclusively by diesel engines. It states that transportation represents the largest source of citywide emissions, 40% of which are from cars and trucks and nearly half of that from heavy- and medium-duty trucks involved in the movement of freight.[1] Due to the impact of diesel emissions, the 2030 vision is that "significant progress has been made in transition of diesel vehicles to next generation alternative fuels."

Using more fuel increases carbon emissions and costs the goods movement industry more money. Conversely, using cleaner fuels, such as natural gas and electricity, reduces both emissions and operating costs.

High-cube warehouse facilities[2] encourage redevelopment and consolidation of existing antiquated warehouse facilities and could reduce the number and length of trips between facilities and to consumers. This is also supported by the Climate Action Plan which has a vision for 2030 to "continue efforts to preserve Seattle's industrial lands which provide local jobs and have efficient access to deep water port, rail lines and highways."

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[1] p. 75-6

[2] High-cube warehouses are multi-storied warehouse facilities where automated stacking technologies allow the same processes to take place with significantly less floor area.

It also proposes by 2015 to improve the permitting processes to promote the most sustainable buildings. Applying sustainable building and operations practices to the freight industry reduces energy and water consumption, as well as emissions, landfill waste, and urban storm water runoff.[3]

Finally, the idling associated with congestion increases fuel usage and emissions. Several programs that seek to spread truck travel to other times of day are discussed.

[3]Green building is the practice of creating structures and using processes that are environmentally responsible and resource-efficient throughout a building's life-cycle from siting to design, construction, operation, maintenance, renovation and deconstruction. This practice expands and complements the classical building design concerns of economy, utility, durability, and comfort. Green building is also known as a sustainable or high performance building.(http://www.epa.gov/greenbuilding/pubs/about.htm)

OVERVIEW

Over the past seven years, dynamic changes in logistics and supply chains have occurred as industries have struggled to survive the most devastating economic downturn since the Great Depression. At the run-up to what has come to be known as the Great Recession, trade throughput was at an all-time high and all cargo forecasts indicated that the growth would continue. Concerned communities near growing ports, industrial uses, and rail yards began demanding more protection from the impacts of congestion, emissions, and noise. Numerous key programs and changes to the industry began taking shape just before the economy fell, including clean truck programs and emissions monitoring at several ports, transloading, e-commerce, and warehouse automation.

At the same time, oil prices were on the rise but new discoveries of natural gas in North America were finding their way into the market, thus providing a significantly cheaper energy source for manufacturing. Since 2011, there has been a steady growth in energy-intensive industries, such as steel manufacturing and chemical production due to the availability and relatively low-cost of natural gas. Before the abundance of natural gas, most steel and many chemicals were being produced overseas and then shipped to the US due to the cost of energy, i.e. petroleum-based fuels and coal. Both the production and the shipment of steel contributed significantly to greenhouse gas emissions. Re-shoring of these two industries has been happening for the past few years because of natural gas availability.

Natural gas is having profound impacts on transportation. Natural gas powered trucks provide significant operating cost reductions, as well as significant air quality benefits. While there are costs to upgrade or purchase natural gas fleet vehicles above traditional diesel, the gap between the cost of purchasing natural gas versus diesel trucks continues to decrease as demand increases. Whereas natural gas trucks in 2007 were approximately $100,000[4] more than diesel trucks, that cost has decreased to as low as $40,000. Retrofitting a diesel truck into a dual-fueled natural gas based system costs approximately $25,000. Both the US Environmental Protection Agency and US Department of Energy have been providing grant funds to off-set the equipment cost. Several larger companies are voluntarily moving in this direction as described later in this report. Smaller companies may face challenges with the upfront capital costs, although these conversions may still occur as fleets are replaced.

These changes are affecting Seattle. Seattle has already converted its refuse fleet and airport taxis to CNG.[5] Southern California's Omnitek Engineering has been selected by the Puget Sound Clean Air Agency to demonstrate its diesel-to-natural gas engine conversion technology for drayage trucks serving the Port of Seattle.[6]

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[4]White Paper on Best Available Control Technology and Liquefied Natural Gas Fueled Trucks, Port of Long Beach, 2007. http://www.polb.com/civica/filebank/blobdload.asp?BlobID=4841
[5]http://www.greenfleetmagazine.com/channel/natural-gas/news/story/2008/09/cng-refuse-trucks-fuel-station-to-come-to-seattle.aspx
[6]http://www.fleetsandfuels.com/fuels/cng/2013/07/omnitek-with-asg-for-seattle-port/

SHIP OPERATIONS

In general, throughput at the Ports of Seattle and Tacoma has not rebounded as quickly as other key west Coast ports, notably, Los Angeles and Long Beach. Three key factors contributing to this phenomenon include fleet conversion to larger vessels, shipping alliances, and the growth in transloading and value-added services. Specifically, the Ports have been losing business to Metro Vancouver and Prince Rupert Ports which have benefitted from major investments in rail and other infrastructure by the Canadian government.[7] In recognition of the challenges confronting them and a bid to remain competitive, the Ports of Seattle and Tacoma recently announced their decision to combine their container terminal operations.[8]

Fleet conversion was anticipated due to significant growth in trade from 2000-2006. Vessel operating companies began ordering larger ships, known as the New Panamax and the Triple E classes, and retiring smaller vessels, and even during the recession, most had few options but to honor their purchases as the ships were already under construction. What is most interesting is the rate of scrapping of relatively young vessels (less than 20 years)[9]. The push for efficiency gains from fuel consumption and the related environmental benefits prompted the industry to convert much more quickly than previously anticipated.

This quick conversion created significant impacts to ports, including surges of goods as a large vessel offloads in one day the same amount that a terminal typically once handled over the course of two to three days. The larger vessels also created winners and losers as marine terminals with berths capable of accommodating the larger ships won more cargo, while those that could not, lost cargo.

West Coast ports also are adjusting to the reality that carriers, through alliances and vessel-sharing arrangements, are concentrating their vessel calls at fewer ports and terminals. Shipping lines seek density. Shipping alliances had a drastic impact on the Port of Seattle two years ago when it lost a bid for the Grand Alliance to the Port of Tacoma. Pushing more freight through fewer ports allows the carriers to use the capacity of their big ships more effectively and achieve the economies of scale inherent in the mega-ships. The cost savings are compelling. Compared to a Panamax vessel with a capacity of 4,800 20-foot equivalent units (TEU), an 8,000-TEU ship offers a 47 percent lower slot cost, and a 14,000-TEU ship has a 60 percent lower slot cost.[10] This new reality creates winners and losers among ports and marine terminals and gateways. This trickles down through the supply chain, resulting in long truck queues at the gates and more deliveries to warehouses in a condensed timeframe.

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[7]http://kuow.org/post/tacoma-seattle-ports-join-forces-take-canada

[8]http://www.bizjournals.com/seattle/news/2014/10/07/in-historic-decision-ports-of-seattle-and-tacoma.html

[9]Danish Ship Finance, http://www.shipfinance.dk/en/SHIPPING-RESEARCH/~/media/Shipping-Market-Review/Shipping-Market-Review---April-2013.ashx

[10]Mongelluzo, Bill, Journal of Commerce, Strong infrastructure draws big ships to Pacific ports, July 7, 2014, http://www.joc.com/port-news/strong-infrastructure-draws-big-ships-pacific-ports_20140707.html

In order to remain competitive, Seattle and the Greater Seattle Region must improve intermodal capabilities, such as creating logistics supportive land uses. The Los Angeles region currently has over 2 billion square feet in warehouse space, which is one reason why it has been ebbing away at the other West Coast ports' shares. The warehouse availability in Southern California is nearing saturation and, with significant pressure from the South Coast Air Quality Management District to curb growth of new high-tech warehouse facilities, another region may soon have an opportunity to accommodate new demand. In addition, the demand for same-day delivery of consumer products driven by "the Amazon effect" also creates opportunities in terms of more high-tech, smaller, strategically placed warehouse facilities within close proximity to major population bases, such as Seattle, rather than large, consolidated high-cube warehouses located in just a few locations throughout the country. The Amazon effect is changing the location, configuration, and operation of retail warehousing and distribution. This is an opportunity for major urban markets near major ports to attract these high-tech facilities.

SUPPLY CHAIN EFFICIENCIES

Aside from the consolidation of vessel operations, the Great Recession prompted several other changes in the supply chain. These changes included more efficient packing, re-packing, and shipping practices. These changes not only helped shippers survive a near economic disaster, but they have resulted in economic efficiency gains through smarter logistics, conversion to more cost-effective warehouse operations, and less fuel consumption.

Within the first year of the drastic economic downturn, companies began investigating every opportunity to reduce the costs of doing business. Beneficial Cargo Owners (BCO), such as Walmart and Target, as well as the world's largest shipping companies, UPS and FedEx, began working with suppliers and shippers to implement packaging methods aimed at fully utilizing as much space as possible in ocean-going and domestic containers, as well as on cargo planes and local delivery trucks. This led to them working with suppliers to maximize shipping space by minimizing and/or reconfiguring packaging. Along those same lines, the BCOs also reduced cargo weight through packaging reductions. Minor per package weight reductions created significant overall shipping cost savings. Additionally, the major BCOs also looked more closely at consolidation, sortation, and dissemination of goods.

The 2002 Pacific Maritime Association (PMA) Lockout of West Coast labor (ILWU) had resulted in what is commonly known in the industry as the "four corners" approach. Whereas major BCOs, such as Walmart, had previously relied on a couple of major distribution centers (DCs) located on the east and west coasts, they altered their practice by creating major DCs in the four corners of the country to better manage future labor disputes. The Ports of Seattle and Tacoma were beneficiaries of this move as shippers diversified their Port portfolios many of which previously might have been exclusively run through the Ports of LA and Long Beach. Just as importantly, the Great Recession prompted more efficient consolidation and distribution of goods via transloading, including value-added servicing of goods prior to final distribution. Regions with significant warehouse space were the winners of this industry shift. As mid-size BCOs began to capitalize on this practice, regions with large amounts of available warehousing space and workers have benefitted. In the Greater Seattle area, most of this growth has occurred in suburban areas, such as Kent.

In addition, warehousing is also becoming more efficient due to new technology and the consolidation of multiple facilities. Technology, such as bar coding and radio-frequency identification (RFID), coupled with automated warehouse inventory and sortation practices, have resulted in significant efficiency gains and cost savings. Not only can these systems better manage inventory, but they can also store more goods under one roof, improve safety, and reduce the number of automobile trips and parking demand. On the downside, these new facilities require fewer unskilled workers to drive forklifts and manage inventory. However, they create some high-tech jobs to operate and maintain the automated systems. Amazon, headquartered in Seattle, The Kroger Company, and Highland Fairview provide excellent examples of this next generation of warehousing technology.

Furthermore, energy consumption has played an equally important role in the economic vitality of the industry. Trucks serving Seattle have access to alternative fueling facilities, including a recent installation of a public liquefied natural gas (LNG) fueling station located 26 miles outside of Seattle, and several public compressed natural gas (CNG) and propane stations that can accommodate all vehicle types, including heavy duty trucks.

For the past 10 years, there has been a steady conversion to the use of alternative fuels for transportation. Initially, the size of engines and tanks, as well as the range and fueling availability prohibited the trucking industry from taking advantage of this low-cost fuel. More recently, technology and fueling availability have begun to dismantle the barriers to purchasing natural gas powered Class 8 trucks. Natural gas is not only cleaner than diesel and gasoline, but it is also substantially less expensive due to recent discoveries and new extraction practices in the United States.

Cleaner fuel trucks provide a variety of public benefits (improved air quality, reduced reliance on imported petroleum, etc.), but cost savings are driving the decision for companies to convert. The cost to purchase natural gas trucks still represents a barrier to entry, however. Natural gas trucks cost between $40,000 and $50,000 more than a diesel truck primarily because of the large carbon-fiber fuel tanks that are required to store compressed or liquefied natural gas.[11] In large fleets, that premium could add millions of dollars to equipment cost. In addition, natural gas requires more space to store the equivalent of petroleum-based fuels adding weight and reducing the amount of space for carrying goods.

There are several programs which that support retrofit of older diesel engines. Three Ports in Washington formed the Northwest Ports Clean Air Strategy with the goal of having all trucks to the Port having emissions equivalent to 2007 or newer engines by 2017. The EPA Smartway Transport Partnership is making upgrade kits available to all truckers on I-5. And the West Coast Collaborative recently installed diesel oxidation catalysts on construction equipment and trucks that significantly reduce emissions.[12]

These benefits and challenges are also being faced by ocean-going vessel and railroad operators who, in addition to looking for cost savings, are also being required to meet new emissions standards. For example, vessels operating in U.S. regulated waters are converting to natural gas or dual-fuel engines to reduce costs while meeting emissions targets. U.S. railroads are also exploring alternative fuel options, for similar reasons. Lower fuel prices make freight movement less expensive, and states that can facilitate clean fuel fleets can gain a competitive advantage. Blu. just constructed a new LNG public truck fueling facility in Sumner, WA near Tacoma and is planning one in Kent WA near Seattle, and a Tacoma-based trucking fleet, Interstate Distributors Co., recently ordered 10 LNG trucks that will be using the new facility.

Policies such as the EPA's SmartWay Transport Partnership are also encouraging shippers to turn to cleaner technologies. Since 2004, SmartWay has been instrumental in saving its partners $16.8 billion in fuel costs. SmartWay incentives, coupled with incentives provided by states and private utility companies, are making it possible for manufacturers to invest in technology development, for trucking companies to purchase natural gas vehicles, and for natural gas fuel providers to construct the fueling infrastructure.

As more and more shippers join SmartWay, the demand for cleaner transport will continue to

[11]Ramsey, Mike, Wall Street Journal, Truckers Tap Into Gas Boom Operators of U.S. Truck Fleets Are Accelerating a Shift to Natural Gas Fueled Vehicles, October 29, 2013, http://online.wsj.com/news/articles/SB10001424052702304200804579165780477330844
[12]Seattle Climate Action Plan, p. 76-9.

grow. Already, major shippers such as Walmart, Home Depot, Krogers, IKEA, Best Buy, Canon, HP, Tyson, and Walgreens (to name a few) are SmartWay members, and many of them are requiring the cleanest transport for both their own fleets and those of their contractors. Many shipping companies, including UPS and FedEx, are leading the charge.

The industry's focus on reducing energy consumption has benefitted not only the bottom line, but more importantly, for the communities most heavily impacted by trade. It has created major environmental benefits from the reduction in emissions. The larger vessels are resulting in fewer emissions, but beyond that, companies are also turning to renewable fuels and natural gas to power facilities and transport goods.

In addition to cleaner fuels for trucks, other alternative delivery vehicles are also being tested by large and small delivery companies. For example, UPS, FedEx, and DHL have been testing small, electric delivery vehicles. Amazon, who is seriously testing drones, has submitted an official request to the FAA to utilize drones. Even bicycle delivery services, like Postmates.com and local restaurants/sandwich shops are emerging, although the market for these types of technologies and services are limited.

These new options provide cleaner, more sustainable delivery options. As mentioned by Amazon in its letter to the FAA, 80 percent of the packages that they ship weigh less than five pounds. While drones and bicycle delivery will continue to develop, the efficiencies gained through new routing technology points to the smaller, electric delivery vehicles appear to have the most utility of these emerging technologies in the short term.

http://www.zerohedge.com/sites/default/files/images/user5/imageroot/2014/11/amazon%20drone.jpg

E-COMMERCE

The advent of e-commerce changed business as usual for the retail industry, prompted most notably by Seattle's own Amazon. Started in 1994, the online business focused mainly on the sale of books, but has since changed the way that the world shops. E-commerce impacts not only typical retail, but it's also beginning to have a real impact on the grocery industry.

The brick-and-mortar establishments, such as Walmart and Macy's, appeared to sit back and warily watch what consumers wanted as Amazon pushed more and more into the forefront. As Amazon began to perfect its return processes and reduce its delivery times, its brick-and-mortar contenders soon realized that they would need to adjust in order to retain their customers. Walmart began shipping online, and also making in-store pick-ups available. Macy's began using its department stores as online fulfillment centers. For instance, the department store chain has converted more than half its 840 physical stores to be able to fulfill online orders. This move has allowed it to keep the majority of its inventory of popular items on store shelves and in front of customers, rather than stocking them in faraway warehouses.

But a significant reduction in impulse shopping created by consumers' ability to find the best deals online, drive to the store selling it for the lowest price, and then leave has resulted in significant losses in foot traffic at brick-and-mortar stores, That trend is likely to continue. This is why retailers, such as Home Depot, have cut back on new store openings in favor of shifting that investment toward online operations. Meanwhile, Sears, The Gap, JC Penney, and others have closed hundreds of stores over the past couple of years. Such closings could accelerate as leases for big retailers, which typically last between 10 and 25 years, are not renewed. Only 44 million square feet of retail space opened in the 54 largest U.S. markets last year, down 87 percent from 325 million in 2006, according to CoStar Group, Inc., a real-estate research firm.[13] There will continue

"In 2013, Macy's expanded its fulfillment network to include 200 more department stores, bringing the total number of stores in its fulfillment network to 500. Each day, employees at these 500 stores receive a list of goods ordered by customers living near that particular store. The associates round up the ordered items and bring them to a specific station in the store to prepare them to be packaged and tagged for delivery. On a typical day, a Macy's store ships 50-60 orders, and on a one-day sale day, 75-100 orders."

Integrated Solutions for Retailers, December 19, 2013

[13]Banjo, Shelly and Drew Fitzgerald, Wall Street Journal, Stores Confront New World of Reduced Shopper Traffic E-Commerce Not Only Siphons Off Sales, but Changes Shopping Habits, January 16, 2014, http://online.wsj.com/news/articles/SB100014240527023044191045793251003724358O2

to be more of this as the growth and demand for easy and convenient shopping and merchandise returns continue.

One of the biggest unknowns for city planners is the true impact of e-commerce on land use and infrastructure. Macy's was never envisioned as an e-commerce distributor that would go out to local neighborhoods. How does this impact traffic patterns? How will the closure of hundreds of thousands of square feet of retail space impact the built environment? Some initial research indicates that e-commerce will actually reduce overall trips.[14] But, clearly, the trip generation rates of years passed will change for these dual-purpose retail store fronts with a likely result being fewer auto trips and more short truck trips, with some of these trips being completed with smaller trucks.

These changing consumer demands and behaviors will require communities to closely re-evaluate land use plans and zoning as retail stores close and the need for e-commerce facilities increases. As a result, there will be less demand for retail/commercial space and more demand for warehousing, albeit, a new type of warehousing. These facilities may include retail space or areas for customer pick-up and returns. An example of this in Seattle, is the Comcast facility on SR-99. Customers can pick up orders at the store but more frequently will have the product shipped to their home. In order to preempt long-term vacancies of large commercial space, planners should recognize the changes, begin talking with real estate developers and commercial realtors, and identify future needs.

[14]Cao, Xinyu (Jason), Frank Douma, Fay Cleveland, and Zhiyi Xu, The Interactions between E-Shopping and Store Shopping: A Case Study of the Twin Cities Final Report, Humphrey Institute of Public Affairs, University of Minnesota, August 2010, The Intelligent Transportation Systems InstituteCenter for Transportation Studies http://conservancy.umn.edu/bitstream/11299/101340/1/CTS%2010-12.pdf

CASE STUDIES

In order to highlight some of the key points raised in the introduction, the following three case studies will focus on the latest trends. The objective of these case studies is to stimulate and inform policy discussions as part of the Freight Master Plan. These cases provide information that could help Seattle achieve freight sustainability goals of increasing environmental protection and economic vitality.

Case Studies:

1. **Natural Gas and Renewables**
   a. Kroger's sustainable waste practices and their link to transportation: donations, anaerobic digester, composting, recycling
   b. Kroger's and UPS' alternative fuel transportation
2. **Warehousing: The Next Generation**
   a. Highland Fairview, SKECHERS Facility, Moreno Valley CA
   b. Kroger's: automation
   c. The Amazon effect on distribution practices, size, location, and automation of warehouses/DCs. Seattle just happens to be the home of Amazon's Corporate Headquarters in the Duwamish area. Amazon currently operates three fulfillment centers in the Greater Seattle region located in the cities of Bellevue, Dupont, and Sumner, with a new sortation facility in Kent.
3. **Off Peak Truck Operations**
   a. PierPass: Ports of Long Beach/Los Angeles
   b. New York City Off-Peak Delivery Demonstration Project
   c. Guidelines for Off-Peak Delivery from London

THE THREE PILLARS OF SUSTAINABILITY: ENERGY + ECONOMICS + COMMUNITY

The City of Seattle's Climate Action Plan (Plan) provides many goals and strategies for reducing greenhouse gas (GHG) emissions. Interestingly, the Plan includes the quote to the right. While the City may have limited regulatory power to address truck technology, there are specific actions that the City could take to encourage faster implementation of cleaner, more efficient technologies.

"Emissions from freight transportation, which make up 18% of road transportation GHG emissions as of 2008, are not a primary focus of the Climate Action Plan because the main strategies for reducing freight emissions are related to vehicle fuel and technology improvements, which the City has limited ability to influence. That said, many of the strategies recommended in this section will have some impact on freight emissions..."

For example, two of the strategies recommended in the Plan are being encouraged through both programs at the federal, state and regional levels:

1. Support programs which help heavy duty truck owners and operators transition to more efficient vehicles and cleaner fuels.
2. Explore ways to use Seattle waste to produce alternative fuels, such as liquid natural gas from anaerobic digesters.

Examples include the Northwest Port's Clean Air Strategy and grant funding through the federal Congestion Mitigation and Air Quality program for assisting the industry in purchasing trucks that met Port requirements for 1994 or newer trucks, as well as the Department of Energy grants for alternative fueled vehicles, such as Kroger's new LNG trucks that will be serving QFC and Fred Meyer stores. Kroger has a long-term vision of generating its own source of natural gas for these trucks, as will be discussed in this report.

CASE STUDY 1: KROGER

The following case study highlights what private companies are doing to be more sustainable, both environmentally and economically. Public agencies can encourage others to follow suit by both educating private companies about new technology, operating procedures, and available financial incentives, as well as implementing policies that support and foster changes. This can come from understanding what works, the benefits, and lessons learned from others. One key example would be the anaerobic digester, a goal directly out of Seattle's Climate Action Plan. Kroger is the first of its kind to have an anaerobic digester constructed at its main distribution and manufacturing facility in Southern California. The digester intakes otherwise unusable perishable foods to create natural gas that powers their facilities, with a future vision of fueling their natural gas trucks.

OVERVIEW

The Kroger Company, founded in 1883 in Cincinnati, Ohio, is the country's largest supermarket chain, and the second-largest general retailer (after Walmart). Kroger employs more than 375,000 workers and operates 2,640 grocery stores in 34 states, including 16 QFC and 3 Fred Meyer stores in the city of Seattle that are served by a distribution center located approximately 30 miles south in Puyallup, WA. Kroger is also a large food manufacturer and owns and operates 37 manufacturing plants, and also owns and operates 1,240 retail fuel centers and 786 convenience stores. Kroger's passion for sustainability makes it a national leader and a positive impact on the communities in which it operates.

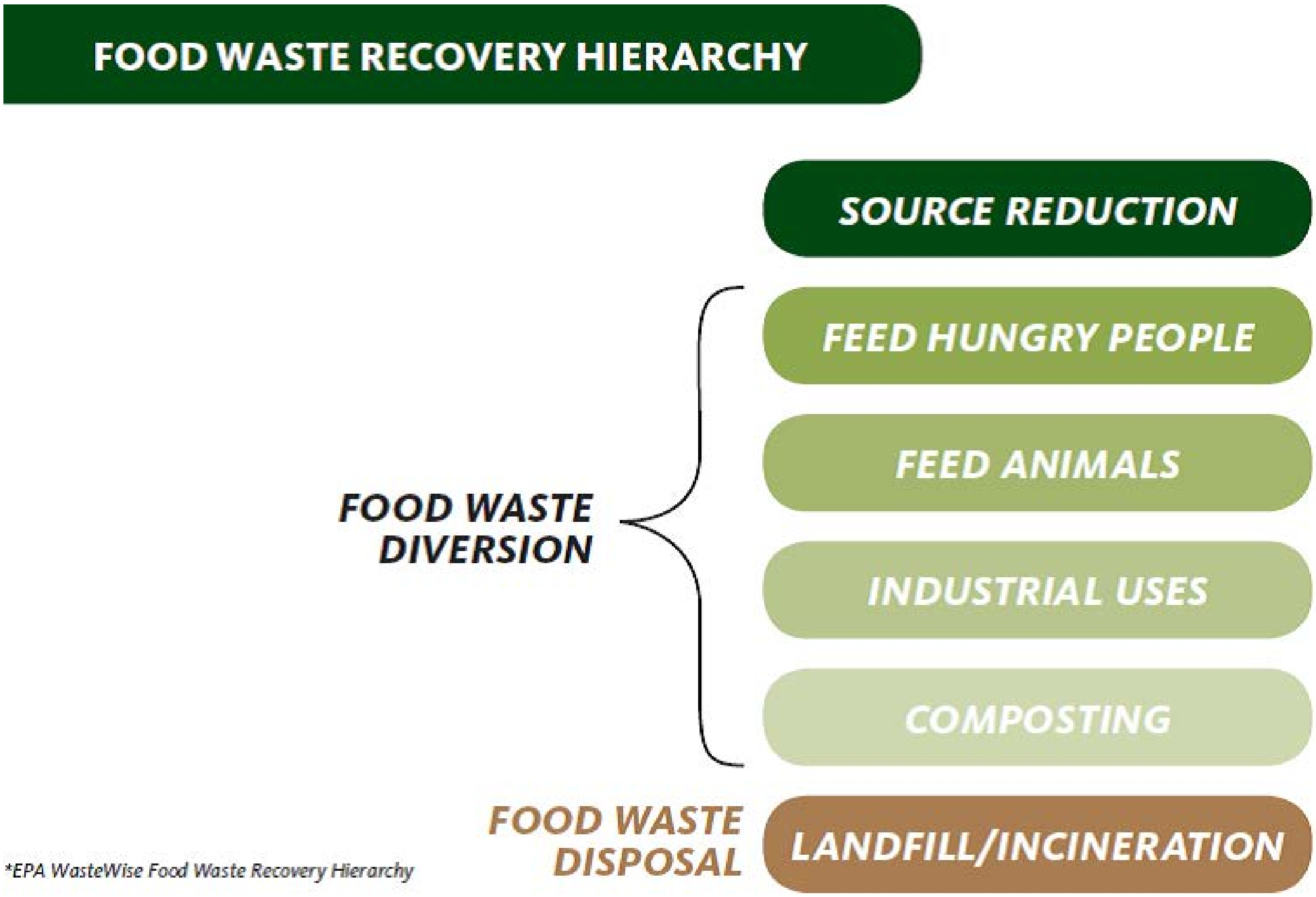
SUSTAINABILITY

Kroger's notable goals for sustainability focus on reducing waste, emissions, water consumption, and inefficiencies through the development and implementation of new processes, technological advances, and operating parameters. Some examples include the installation of an anaerobic digester in Southern California, use of alternative fuels, generation of renewable energy, and its coordination with local food banks and charities to ensure maximum donation of foods before considering alternatives, such as anaerobic digestion, composting or landfill. Kroger is also a founding member of Feeding America, member of the United States Environmental Protection Agency's (EPA's) SmartWay and Waste Wise programs.

ZERO WASTE

Kroger joined the EPA's Waste Wise Program and adopted the EPA's "zero waste" definition as part of its Company-wide sustainability efforts in 2012. The program allows members to benchmark, measure and communicate efforts in a more consistent and cohesive way by tracking individual waste streams and progress over time. This allows members to identify even more opportunities to reduce waste. Kroger has established a goal to meet and exceed the EPA's Zero Waste threshold of 90 percent. To that end, in 2013, Kroger implemented an enterprise-wide waste diversion initiative in all of its grocery stores. This initiative focuses on donations to local food banks, composting and animal feed for food products that cannot be donated, and finally, anaerobic digestion. Kroger is on target to meet its goal of 70 percent of zero waste by 2015. Aside from diverting reusable material from landfills, this program is also reducing overall truck miles traveled.

Figure 2: EPA WasteWise Food Waste Recovery Hierarchy



http://www.epa.gov/waste/conserve/pubs/food-guide.pdf

Donate
Kroger's number one community goal is to "support organizations that bring food and hope to our hungry neighbors".[15] By donating, Kroger eliminates long-haul truck trips to landfills and green recycling facilities. In Seattle, the main landfill operated by WasteManagement, Seattle's provider, is located in East Wenachee – a one-way trip of about 150 miles from Seattle.

Recognizing both the incredible need to feed the hungry and an opportunity to reduce waste and costs, Kroger is eliminating waste and improving the quality of life through the creation of Perishable Donations Partnership (PDP), a company-wide program that donates food to Feeding America food banks with the capacity to safely handle and distribute fresh food. In 2013, the PDP program expanded to 2,300 stores resulting in 50 million pounds of perishable food and 23 million pounds of other items being donated to local food banks instead of processed as waste. This donation is equivalent to 200 million meals which otherwise would have ended up in landfills. Through its relationship with Feeding America, Kroger worked with more than

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[15]Kroger, Improving Today to Protect Tomorrow 2014 Sustainability Report, http://sustainability.kroger.com/1-Kroger_30043_CSR14.pdf

100 local food banks – something it's been doing for more than 30 years. The company continues to be one of the top donors to Feeding America.

Not only does this program reduce truck trips to distant landfills, but it also reduces "returns" to major food manufacturers that are typically located several hundred miles away. Many of the food manufacturers have agreed to provide the same credit for donated food that they would for returned, unusable items. Del Monte, Kellogg's and Bush's Beans are leading examples of those that are willing to increase the amount of donations. This in turn results in fewer truck trips to return items, and fewer trips to deliver the returned food items to a landfill.

Compost/Recycle

In 2008, Kroger became one of the first major grocery chains to implement a food scrap composting program in 24 Ohio stores. In its first four months, more than 650 tons of food waste were diverted from landfills and instead composted.

The Ohio Environmental Protection Agency (Ohio EPA) initiated the conversation with the grocery industry in 2007. The idea was further discussed by the Environmental Task Force created by the Ohio Grocers Foundation (OGF), who received a grant from the Ohio Department of Natural Resources (ODNR) to develop a supermarket manual to help grocers plan and implement food waste composting programs.

Kroger was one of the first companies to conduct a waste audit, which revealed that nearly 60 percent of the waste at its stores consisted of compostable material. Kroger then committed 24 of its Ohio stores to participate in a four-month pilot program designed to determine logistical and economic feasibility. Store managers monitored the efficiency of separating compostable wastes from packaging both in terms of time and contamination. Departments selected to participate in the project used containers with clearly marked signage and lined with compostable bags. In many stores this included produce, floral, deli, bakery and dairy.

The cost of transporting waste was also studied and compared to disposal costs to the local landfill versus shipping organics up to 40 miles west to the nearest permitted compost facility. The study determined that it would be economically feasible to divert food scraps to compost facilities despite the relatively low landfill tipping fees at the time. The demand for composting is increasing throughout the country, and as it continues to grow, Kroger and others are hopeful that new composting facilities will be developed in closer proximity.

The start-up of the pilot project did encounter challenges, similar to any other program that requires behavioral change. Kroger addressed this challenge by designating an employee in every store to champion the program by motivating and assisting coworkers. Once they understood the impacts, employees quickly embraced the program. Kroger educated employees via a training video filmed at one of its participating stores and the composting facility to communicate the purpose of the program. The video is now a training requirement for all employees.

The project, which started with 24 stores, has proven so successful that, as of last year, 97 percent (2,300 stores) of all Kroger-owned stores were participating. Perishable foods and flowers that are not suitable for donation are collected from the deli, meat and flower departments and are picked up by local companies for composting.

Composting may not seem to have much of a "freight" aspect since its demands on the transportation network are similar to traditional landfill. However, these steps tell the story of how Kroger began to think bigger – what if we could locally recycle, compost and generate our own energy source?

Anaerobic Digester

The anaerobic digester took the recycling and composting ideas a huge step forward. It not only significantly reduces fleet vehicle miles of travel (VMT) and costs, but it also produces valuable products: commercial grade compost and natural gas. The Kroger Recovery System, the first of its kind anaerobic digester for grocery uses, converted 46,500 tons of food waste to create 3.5 million kWh of renewable energy at Kroger's Ralphs/Food 4 Less Distribution Center in Compton, CA in 2013.

Prior to the installation of this system, approximately 300 Ralphs and Food 4 Less grocery stores in Southern California each produced 150 tons of food waste, which would be trucked to a distribution center in Compton, CA for consolidation and shipment to a composter 100 miles away. Kroger estimates that the system is helping it to avoid about 500,000 truck VMT a year on congested Southern California freeways. Not only is this resulting in a significant congestion and emissions reduction for the region, but it is also saving Kroger money that it used to pay contractors to move the waste from store, to consolidation center, to composter or landfill.[16]

The system, designed by Feed Resource Recovery, allows Kroger to turn a waste stream into an energy resource for the 49-acre logistics center, which includes a creamery and corporate offices for Ralphs and Food 4 Less, along with a 650,000 square-foot distribution center.

Kroger has plans for installing this technology in the Pacific Northwest in the future. The facility recycles spoiled food via anaerobic digestion, a naturally occurring process, and transforms this otherwise waste into renewable biogas. In 2013, 46,500 tons of food waste was processed. This biogas is then turned into power for onsite operations. The process is carried out in an enclosed, oxygen-free environment, which

Figure 3: Kroger's Anaerobic Digester

[16]Bardelline, Jonathan, How Kroger turned food waste into warehouse-powering energy, GreenBiz.com, August 9, 2013, http://www.greenbiz.com/news/2013/08/09/kroger-fuels-warehouse-food-waste

means the process takes up less space and generates no odors.

In 2013, the system saved Kroger approximately $4.5 million and reduced carbon emissions by 90,000 tons. Thinking bigger than just fueling its distribution center, Kroger has been working with Clean Energy Fuels to investigate future opportunities for fueling its trucks with the natural gas produced from the anaerobic digester. As a first step, Kroger recently purchased LNG trucks.

Kroger and Natural Gas Trucks

"This is the first step in Kroger's effort to transition our fleet to alternative fuels," said Kevin Dougherty, Kroger's group vice president and chief supply chain officer. "Converting to LNG trucks will allow us to reinvest savings into lower prices for our customers while also benefitting the environment."[17] This is a message that makes sense to private companies, and a message that Seattle could echo, particularly as renewable natural gas (through landfill and dairy farm capture systems, as well as anaerobic digestion) becomes more of a reality.

The trucks will make deliveries to about 50 Fred Meyer and QFC stores as far south as Corvallis, OR and as far north as Longview, WA., averaging approximately 175 miles per day, six days a week, 52 weeks a year. They are expected to reduce greenhouse gas emissions by approximately 755 metric tons per year, which equates to removing approximately 159 passenger cars from the road annually. The fleet will be fueled at a new, private LNG fueling station at Kroger's Clackamas Distribution Center, which will be designed and engineered by Clean Energy Fuels Corp.

Figure 4: Heavy-Duty Truck Natural Gas Comparisons

Natural Gas Fuel

CNG

- Gas is Compressed
- Gas from Pipeline
- Compressed On-site, Stored in Tanks
- Shorter Ranges
- Requires More Tanks
- Heavier Weight
- Longer Length Tractor

LNG

- Gas is Cooled to -260° F
- Gas is Trucked in
- Stored in On-Site Cryogenic Tanks
- Longer Ranges Than CNG and Less Than Diesel
- Lighter Weights
- Shorter Length Tractor

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[17]Kroger Company Release, May 6, 2014

"These trucks are nearly identical to our diesel fleet, which allows us to have minimal impact on operations and still achieve the same caliber and standard of performance," said Matt Hoffman, Kroger regional logistics director, based in Portland. "They are truly the prototype truck of the future – the safest, cleanest and quietest way… to deliver product to the stores."

The shift to LNG trucks began as Kroger investigated fleet fueling efficiencies through the development of an Alternative Fuel White Paper. Key questions to answer included: Will alternative fuels work for Kroger's heavy-duty Class 8, on-road trucks? If so, which alternatives will meet all of the operational parameters, including range and truck configuration, as well as economic and environmental goals?

Kroger considered three alternative fueling sources: natural gas, electric, and hybrid electric fuel cells. The technology for electric and hybrid electric fuel cells has not developed enough to provide the necessary range for Kroger's operations. In addition, the cost of these technologies is much more expensive, as are hydrogen fueling facilities. Due to cost and range, natural gas was selected for further consideration.

Kroger compared and contrasted liquefied versus compressed natural gas based on the following parameters:

- 34 Distribution Centers
- 1,200 Owned Tractor Fleet, 1,800 Third Party
- 24/7/363 Operations
- High Miles, Local Delivery, Hub and Spoke
- Tight Behind Store Space for Deliveries
- Heavily Regulated On-Road Applications

Since Kroger serves grocery stores in urban areas that often have constraints, such as turning radius and restricted access to loading docks, the vehicle requirements for CNG and LNG were closely analyzed prior to purchasing the first natural gas trucks.

Figure 5: Ideal Kroger Truck Platform

- ✓ 168" Maximum Wheelbase
- ✓ 15,900 lbs. Maximum Dry Weight
- ✓ 1150 ft./lbs. Minimum Torque
- ✓ 400 HP
- ✓ 350 Mile Range
- ✓ No Reduction in Swing Clearance
- ✓ No Decrease in End User Performance
- ✓ Minimal Impact to Existing Operations
- ✓ MUST BE SAFE

CNG requires more storage space than LNG, thus the fuel tanks are larger and weigh more. Kroger has a limitation of 168 inches of wheelbase, which leaves less than 20 inches behind the cab. As shown in Figure 5: , behind-the-cab mounted CNG tanks are not a viable solution for Kroger.

Side mounted CNG and LNG tanks were investigated as shown in Figure 6, below. One CNG and two LNG configurations met the operating parameters and were further studied for consideration.

Figure 6: Class 8 Truck Length Constraints for Behind the Cab Fuel Tanks

Length Constraints: Behind the Cab

168” Wheelbase = >20” Behind the Cab Clearance

Behind The Cab Systems

System DGE	Qty of Tanks	Fuel Type	Cylinder Size	Cylinder Width w/ Clearance
~~45~~	~~3~~	~~CNG~~	~~16" x 80"~~	~~23.5”~~
~~60~~	~~4~~	~~CNG~~	~~16" x 80"~~	~~23.5”~~
~~75~~	~~5~~	~~CNG~~	~~16" x 80"~~	~~23.5”~~
~~52~~	~~2~~	~~CNG~~	~~21" x 86"~~	~~28.5”~~
~~80~~	~~3~~	~~CNG~~	~~21" x 86"~~	~~28.5”~~
~~105~~	~~4~~	~~CNG~~	~~21" x 86"~~	~~28.5”~~

*Need an Additional 7.5” Clearance for the Tank Housing Unit

Figure 7: Class 8 Truck Length Constraints for Side Mounted Fuel Tanks

Length Constraints: Side Mounted

168" Wheelbase = >86" Frame Rail Clearance

Side Mounted Systems

System DGE	Qty of Tanks	Fuel Type	Cylinder Size	Cylinder Length w/ Clearance*
28	1	CNG	25" x 61"	71"
~~80~~	~~2~~	~~CNG~~	~~25" x 80"~~	~~90"~~
~~88~~	~~2~~	~~CNG~~	~~25" x 90"~~	~~100"~~
~~80~~	~~2~~	~~CNG~~	~~26" x 80"~~	~~90"~~
~~92~~	~~2~~	~~CNG~~	~~26" x 90"~~	~~100"~~
~~63~~	~~1~~	~~CNG~~	~~26" x 120"~~	~~130"~~
70	1	LNG	26" x 76"	86"
140	2	LNG	26" x 76"	86"
~~88~~	~~1~~	~~LNG~~	~~26" x 90"~~	~~100"~~
~~176~~	~~2~~	~~LNG~~	~~26" x 90"~~	~~100"~~

*Need an Additional 10-12" Clearance to Access Tanks for Maintenance

Figure 8: Class 8 Truck Operating Range Comparison

Minimum 350 Mile Range

System DGE	Qty of Tanks	Fuel Type	Type of System	Cylinder Size	Cylinder Length w/ Clearance	System Range
~~28~~	~~1~~	~~CNG~~	~~SM~~	~~25" x 61"~~	~~71"~~	~~140~~
70	1	LNG	SM	26" x 76"	86"	350
140	2	LNG	SM	26" x 76"	86"	700

The last two remaining factors included range and weight. The remaining CNG option could not meet the required 350-mile range necessary for Kroger's operations. With a range of only 140 miles, it fell short, thus making LNG the clear winner.

Natural gas fuel costs up to $1.50 less per gallon than gasoline or diesel, depending on local market conditions, according to Clean Energy Fuel. The use of natural gas fuel not only reduces operating costs for vehicles, but also reduces greenhouse gas emissions up to 30 percent in light-duty vehicles and 23 in medium- to heavy-duty vehicles, the company said, noting that nearly all natural gas consumed in North America is produced domestically.[18]

The cost and availability of natural gas from an extraction standpoint is becoming very attractive to the trucking industry, but even more encouraging is the real capability to fuel their fleets with renewable natural gas generated by recycling their own waste. WasteManagement in California is currently using methane captured from its landfills to fuel its fleet, and one of Kroger's dairy farms is currently capturing methane generated from cow manure to fuel its dairy delivery trucks. The cost savings alone are enough to make the industry take notice, and the GHG and waste reduction benefits create a true opportunity for the City to investigate. Could there be a City-supported organic waste collection program for use in an anaerobic digester? Could such a program generate fuel for city fleets? The lessons being learned from Kroger's California installation are valuable for others considering this technology.

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[18]Green Retail Decisions, Kroger, Cardenas Markets Add Natural Gas Trucks to Fleets, May 8, 2014, http://www.greenretaildecisions.com/news/2014/05/08/kroger-cardenas-markets-add-natural-gas-trucks-to-fleets

CASE STUDY 2: UPS ALTERNATIVE FUEL INITIATIVES

Founded in 1907 in Seattle, UPS has long been a proponent of efficiency, and since about the 1930s, a pioneer in testing different technologies such as electric vehicles. As a SmartWay participant, UPS continues to test a number of alternative local and over-the-road truck technologies in order to reduce its impacts on the environment. The company continues to test electric bike and electric golf cart technologies in Europe; natural gas, electric-hybrid, and hydrogen delivery vans in the US; and LNG for long-haul trucking. Beginning in the 1980s, UPS began testing medium-sized delivery trucks that operated on natural gas. Now, 30 years later, the company has committed to deploying 1,000 natural gas delivery vehicles. Increasing the miles driven with these vehicles provides incremental increases in emissions efficiency. Just as importantly, it increases the amount of information flowing in from their "rolling laboratory" of non-conventional vehicles, including the "cargo cruiser" electric assist bicycle delivery vehicle in use in Dortmund, Germany, and the Ducati "Free Duck" in use in Italy. Both vehicles can access narrow streets that would take a typical delivery truck much too long to pass through. These vehicles have a maximum operating speed of 15 mph and a range of 21 miles. These vehicles are most effective in parts of Europe where the streets are too narrow and the parking too limited for the larger trucks to get through. The vehicles make multiple sprints of deliveries, reloading from a big truck used as a mini hub. UPS is considering them in interested US cities with similar operating restrictions, such as historic sections of Boston, New Orleans, and Key West.

Also being tested in the Netherlands, UPS deployed four Mercedes P80-E fully electric trucks in April 2014. These vehicles, as well as the other aforementioned technologies, joined

Figure 9: UPS "Ducati Free Duck"

UPS' rolling laboratory of vehicles to track vehicle performance, including range, fuel consumption, and emissions. UPS shares this information with manufacturers who use the data to make technological advancements.

To date, natural gas technology has been the most successful in the US, due in part to more than thirty years of testing. This is particularly true for long-haul trucking. LNG-configured heavy-duty tractors combine strong pulling power and long range so they compete operationally with comparable diesel-powered tractors while offering a lower emission profile and cost less to operate.

The challenge with natural gas is fueling infrastructure and equipment cost in comparison to standard diesel trucks. Creating a critical mass of natural gas users, which results in lower equipment and infrastructure prices. It's a fine balance between equipment and infrastructure as operators need available fueling stations, while fueling stations require demand to survive. For these reasons, UPS is making substantial financial and operational investments in LNG vehicles and infrastructure in the United States. Bigger LNG fleets enable manufacturers to achieve economies of scale. They also make it economically viable for companies to build fueling and maintenance stations. As natural gas-fueled commercial transportation becomes more widely affordable, it will help the country lower its greenhouse gas emissions, especially as technology to prevent methane release during fueling improves.

UPS already plays an important role in the nation's longest LNG corridor, known as the Interstate Clean Transportation Corridor (ICTC). This corridor stretches from the West Coast to the Rocky Mountains and into the Southwest. UPS built a station along the ICTC in 2010 and has deployed 114 LNG tractors in the region. In the Southeastern United States, UPS is rapidly building up a substantial presence in LNG-fueled commercial transportation. It employs a hub-and-spoke strategy within the ICTC region, which means that their long-haul tractors return each evening to a base near an LNG fueling station. In 2013, UPS completed two new fueling stations in the state of Tennessee and plans to complete another 11 new stations throughout the United States in 2014. UPS also purchased 156 new LNG vehicles, bringing the total to 249 vehicles at the end of the year as it closes in on its plan to have over 1,000 LNG vehicles in operation by the end of 2014. UPS intends that all new tractors purchased for its Domestic Small Package operations in 2014 will be LNG or CNG.

Figure 10: UPS "Cargo Cruiser" Electric Bicycle Delivery

Just as importantly, it increases the amount of information flowing in from their "rolling laboratory" of non-conventional vehicles, including the "cargo cruiser" electric assist bicycle delivery vehicle. This vehicle has a maximum operating speed of 15 mph and a range of 21 miles. It is being tested for short-hauls in Germany, but due to its limited speed and range, the future use in the US is unknown.

UPS is rapidly expanding its use of liquefied natural gas and propane as vehicle fuels because of the positive results they showed as part of its rolling laboratory. In 2013, UPS was operating 3,142 and logged 55 million miles in those vehicles during the year. Since 2000, UPS alternative fuel and advanced technology fleet logged more than 350 million miles, resulting in the avoidance of 34.5 million gallons of conventional gasoline and diesel (a savings of over 700 million pounds of carbon dioxide), with a goal to reach 1 billion miles in 2017.[19]

The following summarizes UPS' alternative fueled fleet in the US (operates an additional 1,059 outside of the US).[20]

TOTAL Alternative Fuel Vehicles: 2,378

- Compressed Natural Gas (CNG) Vehicles: 1,001
- Liquefied Natural Gas (LNG) Vehicles: 727
- LNG fueling facilities: 13
- Electric Vehicles: 102
- Propane Vehicles: 28
- Hydraulic Hybrid Vehicles: 41
- Composite Body Diesel: 400

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[19]UPS Corporate Sustainability Report, 2013 http://sustainability.ups.com/media/UPS-2013-Corporate-Sustainability-Report.pdf
[20]Testimony of Jim Bruce, Senior Vice President, UPS Corporate Public Affairs to the United States Joint Economic Committee Hearing on "The Economic Impact of Increased Natural Gas Production", 216 Hart Senate Office Building, June 24,2014

The following are criteria UPS has for adopting and deploying alternative fuel technologies:

- Safe
- Reliable fueling infrastructure
- Predictable supply of vehicles and parts
- Results in measurable improvement in emissions, fuel savings and/or environmental benefit
- Economically viable in terms of initial purchase price, maintenance costs and reliability and adapted to UPS fleet use characteristics

The criteria above explain why most of UPS' alternative fueled fleet consists of natural gas technology. Natural gas is more reliable, has a more reliable fueling infrastructure, has more vehicle options, and is more economical than other alternative fuel technologies they studied, including electric and compressed natural gas. However, UPS aims to change this by continuing to create market demand for cleaner technologies through continuing investment in testing options.

UPS continues to test all alternatives as reflected in some highlights, below:

- UPS has a rolling laboratory for alternative fuels development. The rolling laboratory tests prototypes on the road. Because natural gas has been in use in heavy-duty vehicles for the past 30 years, natural gas technology is ahead of electric, fuel cell, and other alternatives. The company works with manufacturers of all types of technologies, the EPA and other government agencies to pilot projects before new vehicles are ready for commercial deployment.
- In 2013, UPS reached a new milestone of logging more than 55 million miles using alternative fuels and advanced technology vehicles.
- Goal for 2017: log 1 billion miles with alternative fuel fleet

CASE STUDY 3: WAREHOUSE AUTOMATION

THE PORT OF SEATTLE AND INDUSTRIAL LAND

Warehousing and industrial uses, including the Port of Seattle, create significant benefits in terms of jobs and economic vitality for Seattle, but these uses also generate significant health and environmental impacts. Through a variety of efforts, including several outlined in the Climate Change Action Plan, Seattle offers the lowest carbon footprint of any other US port. Over the next 25 years, the Port of Seattle intends to:

1) Meet all increased energy needs through conservation and renewable sources.
2) Reduce air pollutants and carbon emissions, specifically:
    a. Reduce air pollutant emissions by 50% from 2005 levels.
    b. Reduce carbon emissions from all port operations by 50% compared to 2005 levels, and
    c. Reduce aircraft-related carbon emissions at Sea-Tac by 25%.
3) Anchor Puget Sound urban-industrial land use to prevent sprawl to less developed areas by protecting existing industrial land clustered in Manufacturing and Industrial Centers.

The last goal above directly relates to the next case study. Due to limited available land near the Port of Seattle, particularly for large warehouse sites, meeting this goal requires an understanding of what the industry needs – allowable building heights, cleared and very level sites, and access. In addition, although not specifically stated in the Plan, it's important to Seattle that these new facilities strive for the highest efficiencies, particularly with energy usage. The following case study will outline not only how new construction can reduce congestion, but also how it can reduce the carbon footprint of freight operations in Seattle.

WAREHOUSE EFFICIENCIES

As part of the trend toward greener warehouses, businesses are seeking not only energy savings, but also more efficient materials handling. Automated storage and retrieval systems (AS/RS, the robotic handling system, and warehouse management systems (WMS), the warehouse handling system, help achieve significant efficiencies by maximizing storage space while reducing operating costs. The WMS has the added benefit of increasing the speed of delivery and deployment of goods, which reduces truck queues and idling, particularly during peak seasons or immediately following a supply chain disruption.

Flexible, hybrid AS/RS designs use one or more cranes in an aisle that only need be as wide as the largest commodities – a significant space savings in comparison with forklift operated facilities. Automated racking systems can store products single deep, double deep, or up to 12 loads deep in the rack structure. AS/RS systems can be customized based on the warehouse's inventory mix of high, intermediate, and slow moving products to minimize the cubic space required for storage and handling. Unmanned rack entry vehicles quickly, smoothly, and accurately transport pallets and containers in and out of the storage rack, resulting in faster throughput. These systems benefit small and large warehouses, alike. Although the following example focuses on a very large scale warehouse, it demonstrates the ability of systems like this to perform a vast amount of work in a very small space – a potential opportunity for Seattle.

Automated systems also deliver the following environmental benefits:

- **Less land usage:** A warehouse with an AS/RS uses up to 40 percent less space than a conventional warehouse to store the same number of products.
- **Less energy consumption:** Automated warehouses require less lighting and cooling; regenerative braking on storage/retrieval machines produce energy for assisting with powering the system; the warehouse maintenance system controls all product flows and optimizes product movements.
- **Less product waste:** Automated warehouses reduce product damage caused by human error; require less shrink wrapping to secure pallets; improve accuracy of fulfillment through technology like RFID
- **Reduced maintenance:** Maintenance costs for AS/RS are lower than for forklift operations; automated facilities require less space resulting in facility leasing savings
- **Safety benefits:** Automated facilities have fewer workers moving goods, thus resulting in fewer injuries that are typically inherent in warehouses, such as back and neck injuries and forklift accidents.

HIGHLAND FAIRVIEW: A VISION FOR SUSTAINABLE GOODS MOVEMENT

On December 28, 2012, SKECHERS received LEED (Leadership in Energy and Environmental Design) Gold certification for its North American distribution center in Rancho Belago, California from the U.S. [21]Green Building Council. SKECHERS and developer Highland Fairview, who designed and constructed the cutting edge warehouse facility, shared a vision of attaining the highest environmental standards for the 1.82 million-square-foot SKECHERS facility. Not only did Highland Fairview and SKECHERS build the largest LEED Gold certified building in the United States to have received this honor, but they pioneered the way forward for the logistics and supply chain industry through a combination of significant energy and water consumption savings, waste reduction, truck trip reductions, and emissions reductions.

The official groundbreaking ceremony for the SKECHERS distribution center took place in March 2010 and the building opened for operation in November 2011. A summary of the facility dimensions and LEED features is included in the following.

BUILDING DIMENSIONS

- **Building Area:** 1,820,000 square feet
- **Building Length:** Approx. 2,850 linear feet
- **Building Width:** Approx. 650 linear feet
- **Building Height:** Varies 45 – 66 feet

BUILDING AND SITE FEATURES

- **Parking and Loading Docks:** The facility provides 715 automobile parking spaces, including two electric vehicle spaces with charging stations, as well as 37 spaces designated for alternative fueled vehicles and carpools. The number of vehicle parking spaces complies with the City's zoning code. The developer requested that fewer spaces be provided due to projected demand. The high-tech automation and the facility's 24/7 operations equate to less demand for parking. Currently, the employee parking lot is under-utilized. Typical parking demand is approximately 450 spaces resulting in unnecessary paving.

[21]LEED certification for commercial buildings involves a scorecard that evaluates several categories: sustainability, water efficiency, energy and atmosphere, materials and resources, indoor environmental quality, and innovation.

The facility offers 254 dock doors with over 200 cross-dock opportunities and 306 truck parking spaces. This facility operates as both a national and regional distribution and warehouse center. This facility receives goods directly from the Ports of Long Beach and Los Angeles in marine containers, cross-docks them into 53' over-the-road containers for shipment via truck or train throughout the country, and also stores some goods and fulfills orders within the greater Southern California region directly.

This represents a significant change from Sketcher's previous operations which consisted of six warehouses of up to 1.5 miles apart where one warehouse would receive, break the goods up and wrap them for movement to another warehouse where they would be handled up to two more times before being shipped. This prior practice cost SKECHERS $1 million annually to shrink wrap inter-warehouse moves and generated 58 percent more truck trips.

- **Power, Lighting, and Cooling:** Highland Fairview developed the facility with enough solar panels on the roof to supply 100 percent of the power necessary to operate SKECHERS' corporate office, which is also part of the facility. The extensive use of parabolic skylights to increase natural lighting greatly reduces the need for facility lighting during the day. The lighting operates as needed, regulated by motion sensors.

  The roof has been designed as a "cool roof" and consists of a single-ply poly membrane to deflect heat absorption, and the ventilation system utilizes outside air drawn through louvers facing the prevailing winds, supplemented by energy efficient heating and cooling systems.

Figure 11: Rendering of SKETCHERS Facility

- **Water Usage:** The facility reuses gray water for irrigation, exclusively utilizes drought tolerant native plant species for landscape, and utilizes the latest technology for drip irrigation.

- **Green building Certification:** Project is in process for certification under the U.S. Green Building Councils LEED's program for "Green Buildings."

- **Visual Screening:** The facility was designed with image in mind. This facility is SKECHERS' corporate office in addition to being a major warehouse and distribution center. This facility is also near a major community-serving retail area. Community concerns about the visual appearance of the facility resulted in solid wall around the employee and truck parking areas ensure full screening from local streets.

- **Security:** Facility is fully secured and certified as a Free Trade Zone

LEED GOLD CERTIFICATION ELEMENTS

- **Water Useage:** The facility's drip irrigation and drought resistant landscape, reclamation efforts (the image above shows a holding pond), as well as installation of low water fixtures within the building were recognized by LEED. The facility recycles water via an on-site system. Furthermore, stormwater runoff is captured in natural infiltration basins and treated.
- **Recycling:** The facility recycled an extensive amount of construction materials used in the construction of the building and site. The facility shreds and compacts all recyclable cardboard and materials on site, and encourages recycling of all recyclable materials on site.
- **Reduced "Heat Island" Effect:** The white "cool roof" and light colored paving reduce heat absorption and global warming effects.

- **Energy Efficiency:** The use of natural light and cooling, coupled with energy efficient mechanical heating and cooling systems greatly reduce energy consumption, and the solar panels generate enough electricity to power the Corporate Office.
- **Environmentally Friendly Materials Use:** Low emitting VOC materials, such as glues, adhesives, paints etc., were incorporated into the building construction

From an operations and cost savings perspective, the new SKECHERS facility consolidated six warehouse facilities consisting of interior ceiling heights of up to 32 feet and totaling approximately 2 million square feet, into one 1.8 million square-foot facility with internal ceiling heights of 45-66 feet. Whereas SKECHERS was incurring significant costs from shipping between its facilities, the new facility reduced those costs by approximately $2 million per year. The consolidation is estimated to have reduced truck and auto trips generated by SKECHERS' operations by 58 percent – a significant improvement in traffic operations and emissions reductions for the community and the region.. This reduction was in part from eliminating inter-warehouse truck trips, and in part from moving the facility closer to where their employees live.

Figure 12: SKETCHERS Automated Warehouse in Moreno Valley, CA

Beyond all of these features, the SKECHERS facility utilizes an automated system from Japan-based Daifuku Co. The $100 million AS/RS, nearly half of the facilities overall $250 million price tag, enables SKECHERS to move as many as 20,000 pairs of shoes in an hour as compared to approximately 7,000 pairs per hour in its previous six locations combined. The speed, efficiency, and accuracy of the AS/RS tripled the previous shipping capacity. In its previous operations of a network of warehouses, SKECHERS' workers handled items three times between arrival and shipment to stores. Workers moved goods by forklift and by truck between warehouses before shipping to the final destination, whereas,today, all of those processes occur under the same roof.

KROGER: WAREHOUSE AUTOMATION

In the early 2000's, Kroger began working with a systems integrator (Witron Integrated Logistics[22]) to create a new automated warehouse design for its grocery distribution centers. Kroger's system can receive, sort and shelve full pallets, break them down, and repackage them into store-ready mixed pallets organized according to their location within the destination with very little human intervention. Goods are only touched by workers when lift truck operators unload pallets at the receiving dock and load them at the shipping dock for store deliveries.

The system uses:

- automatic pallet exchange and depalletizing machines
- a 10-crane unit load automated storage and retrieval system (AS/RS) with approximately 21,000 pallet positions for reserve storage
- a 32-aisle mini-load AS/RS with nearly 400,000 tray positions for temporary storage of cartons prior to order fulfillment
- transfer vehicles that deliver pallets from the system induction area in receiving to a pallet exchange station and from the conveyor system to the AS/RS crane selected for storage
- a unique system that automatically builds mixed pallets in the sequence they will be stocked on shelves in a specific store aisle; the system uses a separate mini-load system for buffer storage, a custom-designed palletizer to place the cartons on the right spot on the pallet, and an automatic stretch wrapper

In 2009, Kroger processed approximately 110,000 cases per day with a peak capacity of 160,000 cases in its newly designed facility in Arizona. Since then, Kroger has built two additional automated distribution centers in Colorado and Southern California.

Kroger set out to re-engineer the way it distributes product to its stores, creating a distribution system for the 21st century. Most in the grocery industry believe that it's important to place distribution and support facilities close to retail outlets. Kroger decided to take a closer look at this assumption. Kroger began to tackle SKU (stock keeping unit) proliferation in order to manage the amount of real estate necessary to handle large numbers of SKUs. Second, Kroger began investigating ways to efficiently build a mixed case pallet for individual stores. The automation played a key role by allowing the AS/RS (automated storage and retrieval system) to automatically build a pallet of mixed SKUs without damaging the products, maximizing the cube of a truck, and delivering an aisle-aligned pallet to the store based on the planogram for that store. The AS/RS system was designed to take into account constraints such as crushability to prevent cans of soup from being placed on top of Japanese noodles on the pallet.

After Kroger identified supply chain goals and priorities, as well as operational challenges that

[22]Trebilcock, Bob, automation in command, MODERN MATERIALS HANDLING, May 2009

it needed to address, it incorporated a number of familiar automated materials handling technologies:

- unit load automated storage and retrieval system (AS/RS) for full pallet storage
- automated depalletizer that removes a layer of cartons and orients them for putaway in a mini-load AS/RS
- automated palletizer and stretch wrapper.

Completed pallets are automatically stretch-wrapped, and uniquely join to build aisle-aligned pallets. The case order machine, for instance, takes cases from the mini-load and places them in a buffer storage system that then delivers them in sequence to the palletizer, which uses a unique series of arms to maneuver a carton into the right position on a pallet before delivering the finished pallet to an automatic stretch wrapper. What's special about this solution is the way the software coordinates pulling the pallets out of the AS/RS, dictates how much product needs to be placed in a mini-load tray, and sequences the delivery of the cartons to the palletizer.

From the supplier to the store, pallets are only touched on the inbound and outbound moves. These systems result in fewer injuries, fewer distribution errors and returns, optimized use of truck space, and increased efficiencies. By optimizing truck space, more goods can be moved per truck resulting in fewer truck trips.

CASE STUDY 4: AMAZON AND ITS IMPACTS ON E-COMMERCE

How Amazon continues to change the game for retailers is still to be seen. From kicking off free shipping during Christmas, regardless of costs, to aiming for same-day shipments, Amazon's impact on e-commerce provides an excellent example of the direction that the industry is headed.

Amazon has tremendous influence on its industry. In recent news, Walmart announced that it plans to offer same-day shipment of online orders in select markets. In the view of Jim Tompkins, president of Tompkins International and one of the sharpest observers of our industry, it's going to have a profound impact on retail distribution and retailers in general. "Retail is at a crossroads," Tompkins says. "The reality is that Amazon is so big that they are now mandating what the customer satisfaction requirements are for everyone, even if you don't think that you compete with Amazon." As examples of how Amazon is redefining the retail game, Tompkins points out that most shoppers expect free shipping, free returns, and delivery in two days or less.

Unlike many other major companies, such as SKECHERS who recently consolidated six regional distribution centers into one major distribution center, Amazon is building more individual warehouses closer to markets in order to deliver goods to consumers more quickly – within a day or two in major markets. These two ways of doing business may seem counter to one another, but in fact, they work well together. Major manufacturers, such as SKECHERS, sell both wholesale and retail. Amazon fills the customer needs of "same day" by purchasing from SKECHERS' wholesale customers, such as Macy's In the Seattle region, Amazon recently added a new sortation facility.

In 2004, 38 percent of Amazon's fulfillment capacity was less than 200 miles from a major metropolitan area, whereas today, 79 percent of its distribution centers are within 200 miles of a major metro area.

System-wide, Amazon is in the process of adding 15 or more "sortation" centers. These facilities are typical located within 30 miles of a major metropolitan center. Sortation centers not only make shipping more efficient, but they facilitate Sunday delivery. Amazon sends prepared customer packages to sortation centers, sorts them and then ships them to individual post offices for faster delivery, including on Sundays, by the US Postal Service. Amazon began rolling out Sunday deliveries in 2013 and, quite recently, upon opening the new 313,000 square-foot sortation facility in Kent, Washington, began Sunday deliveries in the City of Seattle in July 2014.[23]

Sunday deliveries are being made possible by an unprecedented move – postal delivery service on Sundays. Amazon and the USPS have teamed up

[23]Greene, Jay, *Amazon launches Sunday delivery from Kent warehouse*, Seattle Times, July 20, 2014, http://seattletimes.com/html/businesstechnology/2024114127_amazonkentxml.html

to implement the service in major US markets. The rollout offers yet another way to entice consumers to utilize e-commerce. Amazon has also introduced on-line grocery shopping through AmazonFresh, accompanied with a new technology for easy online ordering that involves a wand that allows you to scan, say or type in grocery items and then beam them to your online grocery list. Kroger recently purchased a grocery chain in the south with over 200 stores equipped with a similar e-commerce platform aimed at competing with AmazonFresh.

The retail industry is paying attention. Four key elements that they need to consider according to Jim Tompkins include:

- Price: Can you beat Amazon on price?
- Selection: Can you offer more selection?
- Experience: Can you beat them on experience? (Amazon invented this type of retailing)
- Convenience: How fast and conveniently can you get product to a customer?

But in this ever-changing market, another competitor may yet change the playing field as it has done so many times before: Google. Google's Shopping Express service intends to go head-to-head with Amazon in competition for the "last mile deliveries". While traditional retailers continue to experience flat sales growth, Amazon again experienced outlandish growth in the last quarter as its sales rose 23 percent. Google wants in on the action and, unlike retailers like Walmart and Macy's, they have the technological know-how and financial capability to possibly do it.

AmazonFresh recently began filling same day orders based on inventory stored in its warehouses in limited markets, including Seattle, with grocery chains as its new target. However, AmazonFresh's refill ordering for everyday essentials targets many non-grocery items, such as diapers.

In 2013, Google launched Shopping Express in San Francisco and Silicon Valley and expanded into New York and Los Angeles markets in early 2014. This service competes with Amazon's same day service, Amazon Fresh, in the San Francisco Bay Area and West Los Angeles.[24]

So what makes Shopping Express different than AmazonFresh? First, it relies upon partnerships with traditional retailers. Second, it relies on contracts with courier. And third, Google utilizes a hub-and-spoke type of system where all items from retailers are taken to a warehouse operated by Google and then packed into a vehicle for delivery during a specified time window to the customer.

There is no available data describing how the routing and delivery occurs but, based on Google's technological capabilities, some speculate that warehouses are small and strategically placed throughout a region in a zone system to allow for quick fulfillment of orders. Further speculation indicates that this type of warehouses operation may operate similar to a "cross-dock" facility where inventory is quickly moved from one vehicle to another, overnight storage is minimal, and space requirements are far less than an Amazon distribution facility.

In short, the combination of couriers and low cost order consolidation warehouses would allow Google Shopping Express to not only compete in same day delivery, but operate more cost-effectively. This is something for Seattle to watch. Google could help traditional retailers remain profitable – a key point that cities and regions should continue to monitor in order to anticipate, monitor and prevent long-term vacancies of retail storefronts.

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[24]Banker, Steve, *Amazon Grows Rapidly, Traditional Retailers Struggle, Should Brick and Mortar Retailers Partner with Google?*, Forbes, August 25, 2014, http://www.forbes.com/sites/stevebanker/2014/08/25/amazon-grows-rapidly-traditional-retailers-struggle-should-brick-and-mortar-retailers-partner-with-google/

CASE STUDY 5: OFF-PEAK FREIGHT DELIVERY

Off-hours deliveries seek to shift truck activity out of the peak traffic periods and hence reduce congestion and emissions. Despite obvious advantages in terms of avoiding congestion, few examples of off-hours delivery programs exist. This is due to the supply chain - off-hours deliveries require off-hours truck drivers and receivers. Constraints on the trucking side include federal hours of service requirements, shift premium pay for unionized drivers, and possible efficiency losses associated with spreading shipments out across more hours of the day. Constraints on receivers include having to open receiving facilities early and to operate loading terminals more hours of the day, shift premium pay for terminal workers, and local zoning codes that prohibit after hours truck activities in residential neighborhoods.

There is only one permanent off-hours program in the US, the PierPass program at the Los Angeles/Long Beach ports. It was implemented due to the extreme congestion and very high volume of good flowing through the Port, circumstances that do not exist in other US metropolitan areas. It has resulted in reduced congestion, energy consumption, and emissions and thus demonstrates the potential benefits of such programs. However, these benefits have not been fully utilized due to the receiver constraints. Often times, truck drivers will pick up during peak hours and wait until the PierPass off-peak hours begin to drop the cargo off at the ports. Until receivers have an incentive to incur the additional costs, and local residents can be protected from the noise, off-peak delivery will continue on only a limited basis.

A New York City demonstration was the first and only in-city program. In the New York City test, receiver constraints were found to be the most difficult to overcome. It has resulted in reduced congestion, energy consumption and emissions and thus demonstrates the potential benefits of such programs.

Off-hours delivery may have potential as a voluntary regulation. The public sector could offer incentives such as recognition (green certification for receivers) or tax breaks to promote off-hours deliveries in areas where residents would not be affected (e.g., commercial zones). Shippers might be incentivized to purchase and use quieter trucks and handling equipment in exchange for being able to deliver off-hours, as in the PIEK program in the Netherlands. In that program, Dutch law set down strict limits for nighttime noise rather than banning freight activity altogether. Due to the high demand for Port facilities there, the noise restrictions have led to identification of quieter equipment solutions to most portions of Port activity. In Seattle, additional financial support would likely be needed in order to keep the Port competitive.

PIERPASS: PORTS OF LONG BEACH/LOS ANGELES

PierPASS began at the Ports of Los Angeles and Long Beach in July 2005 in the midst of unprecedented growth in truck traffic resulting from significant trade activity at the Ports of Long Beach/Los Angeles. Due to political pressure caused by community concerns over trucks clogging up the I-710 Freeway, terminal operators at both ports joined forces to develop and implement an off-peak gate incentive program aimed at shifting trucks to off-peak hours.

PierPASS assesses a Traffic Mitigation Fee (TMF) on most containers (exceptions include intermodal containers destined for a rail yard) moved in and out of the San Pedro Bay ports. The current fee of $66.50 per 20-foot container and $133 per 40-foot container is assessed between the hours of 3 AM and 6 PM, Monday through Friday. The TMF helps fund the additional cost of longshore labor necessary to operate the terminals during off-peak periods. To date, the PierPASS program has shifted an estimated 30-40 percent of truck traffic at the marine terminal gates to evenings and weekends.

A few significant barriers that inhibit off-peak gate operations include longshore labor costs (especially for overtime pay), longshore labor minimum hour guarantees, longshore labor minimum size of labor work units, operating hours of warehouses, distribution centers, manufacturers, and other entities which must also be available to process cargo during off-peak hours.

In spite of these challenges, PierPASS has reduced truck congestion in and around the ports by successfully shifting a significant amount of eligible cargo to the evening (approximately 40 percent). However, shifting truck traffic at the ports has generated changes and unintended consequences along the entire supply chain, most notably, the impacts of the program on the trucking community.

One of the most significant unintended consequences has been the measures that truckers have taken to avoid paying the TMF. The trucking industry operates on very thin margins. Truckers that are either picking up an export or dropping off an import from/to a facility that only operates during peak hours must then decide to pay PierPASS or wait for the off-peak gate to open. Particularly for independent truck drivers, finding a place to park and wait is a challenge. The closest truck stop to the ports is located approximately 50 miles east in Ontario, CA. Truckers are driving to Ontario, parking and waiting for either warehouses to open so that they can deliver or for the off-peak gates to open so that they can pick up the container. The true efficacy of PierPASS has been the reduction in congestion in and around the ports. The unintended consequences include time and monetary costs incurred by the trucking industry, as well as a possible increase in vehicle miles traveled and related emissions.

NEW YORK: OFF-PEAK DELIVERIES

In 2003, New York City contracted with Rensselaer Polytechnic Institute to investigate the potential for delivering goods to businesses in Manhattan between the hours of 7 PM and 6 AM. The study was expanded in 2005 to include Brooklyn. Moving goods and passengers is complex in urban areas that experience severe congestion and have significant physical constraints. The costs incurred by carriers due to parking citations and other violations in New York City, as well as the time and idling costs associated with being stuck in traffic, result in costs of as much as 30 percent, according to FedEx. Other New York City area business representatives reported that moving a shipment from the container terminals in New Jersey to Manhattan, a straight line distance of 1.5 miles, costs as much as sending a shipment from Connecticut to Ohio, a difference of 500 miles.[25]

The research for this Off-Hours Delivery project focused on: (a) identifying policies and initiatives that would be effective in inducing a shift to off-peak deliveries; (b) assessing the overall effectiveness of such initiatives; and, (c) fully understanding the implications to shippers, receivers and carriers.

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[25]Holguin-Veras, Jose, POTENTIAL FOR OFF-PEAK FREIGHT DELIVERIES TO CONGESTED URBAN AREAS (TIRC Project C-02-15), Rensselaer Polytechnic Institute, December 21, 2006

The study only considered policies and programs based on voluntary participation of the industry. The study focused on the following key objectives:

- Define the set of policies and programs that would induce a shift in deliveries to off-peak hours (referred to here as off-peak delivery initiatives)
- Quantify the effectiveness of these initiatives
- Quantify extra costs to stakeholders so that compensation schemes could be implemented, should off-peak deliveries be found to be economically beneficial to society at large
- Conduct the analyses using advanced statistical and econometric techniques to minimize the risk of biased results

The Study process involved:

1. Identifying the key stakeholders, including shippers, warehouses, receivers and carriers
2. Documenting geographic patterns of economic activities using economic datasets that contain a breakdown of businesses and employment at the ZIP code level to define the sampling areas for receivers
3. Outreach Activities: in-depth interviews, an on-line survey, and a focus group to gauge stakeholders' willingness and ability to employ off-peak deliveries
4. Stakeholder interviews: 2 trucking companies, 4 trucking/warehouse companies, 3 shippers, 4 shipper/trucking/warehouse companies, 2 receivers, and 2 lobbyists

Based on the outreach, not surprisingly, all respondents that operated trucks preferred off-peak hours, citing less congestion, fewer parking conflicts, and an increase in worker productivity. Conversely, receivers that were closed for business during the off-peak hours cited concerns related to labor costs, security concerns, and unwillingness of employees to work nights.

The study found that the restaurant industry tends to operate during off-peak hours and have staff available to accept deliveries. The study also found that off-peak deliveries offer the most cost saving for longer trips.

New York City Off-Peak Delivery Policies Considered

For Receivers:
(R1) tax deductions
(R2) lower shipping costs

For Carriers:
(C1) a request from receivers
(C2) a request from receivers together with parking availability during the off-peak hours
(C3) a request from receivers and security clearances at bridges and tunnels
(C4) a request from receivers and toll savings to carriers doing OPD
(C5) a request from receivers and financial rewards for each mile the carrier traveled during the off-peak (C6) a request from receivers and an off-peak delivery permit that enables trucks to double park during off-peak hours
(C7) the creation of a (neutral) company to do the last leg of delivery to the congested areas
(C8) the creation of a staging area in Brooklyn to allow trucks to travel to Brooklyn during the off-peak hours, spend the night at the staging area and then deliver to consignees during day hours

The effectiveness of the two scenarios targeting receivers (R1 and R2 above) was based on the likelihood of receivers to: (1) commit to do a given percentage of off-peak deliveries if they receive a tax deduction for one employee assigned to off-peak hours work; and (2) commit to do off-peak deliveries if delivery costs were less during the off-peak hours. These tax incentives are currently provided by the City of New York.

Similarly, the most effective scenarios targeting carriers were C1, C3, C and C6, above. The receiver was key in the success. Convincing the carriers is much easier since off-peak delivery greatly reduces uncertainties, travel time, and parking penalties.

In conclusion, several of these incentives have proven successful, especially the employee tax incentive for receivers and the cost and time savings for carriers. New York and Brooklyn have shifted a meaningful portion *of truck traffic to off-peak hours, particularly led by the restaurant industry where a tax deduction of $10,000 is anticipated to result in 20 percent industry participation in off-peak delivery service.

LONDON: OFF-PEAK DELIVERIES

Seattle, like many cities, has rules in place that prohibit night-time deliveries, particularly near residential areas. In order to pursue a program like the one in New York City, London provides guidance that is useful in considering such a program. The London Quiet Delivery Scheme guidelines are included in their entirety below.

How to introduce a Quiet Deliveries Scheme
Menu of Measures for Retailers and Freight Operators
(based on Transport for London's code of practice for quieter out-of-hours deliveries)

General guidance – activities mainly within your control

Think about the potential noise impact of any out-of-hours activity on local residents, and review the likely sources and consider how to address these by:

- Using newer and quieter delivery vehicles and equipment, where possible.
- Making sure all equipment – both on the vehicle and at the delivery point – is in good working order and maintained or modernized to minimize noise when in operation.
- Ensuring all staff involved in delivery activity are briefed and trained appropriately, in accordance with the code of practice.
- Ensuring all suppliers and carriers receive copies of the code and are aware of its importance.

General guidance – activities that you will need to collaborate on

- Liaising with your local Borough/District Council and contacting the Environmental Health Officer (responsible for noise issues) to explain the plans to manage night-time delivery and servicing activity. This needs to happen in partnership with your key customer/retailer.
- Liaising with your local Borough/District Council and contacting the Planning Department to identify and help address any variations to planning conditions required and the process for carrying this out. This needs to happen in partnership with your key customer/retailer.
- Liaising with clients, colleagues, other local businesses, suppliers and carriers to minimize the likelihood of more than one vehicle arriving at the same time.

Ensure all drivers/deliveries/loading/unloading personnel follow the guidance below:

The Delivery Point

- Ensure delivery bay doors, gates and shutters are well maintained to minimize noise when opening and closing .
- Switch off any external tannoy systems.
- Avoid using external bells at delivery points.
- Switch off the radio when delivery point doors are open.
- Ensure the delivery point and surrounding areas are clear of obstructions so vehicles can maneuver easily.
- Keep doors other than the delivery point closed to ensure noise does not escape.

- Where possible, prepare all empty handling units, salvage and returns behind closed doors. Check they are in the correct condition and position and at the right height before taking them out. This will minimize outdoor activity and unnecessary noise.
- Think about how to minimize contact between hard surfaces, particularly metal on metal, during the unloading/loading processes. For example, use rubber matting and buffering material on doors.
- Service any delivery equipment in advance to minimize noise.
- Make sure the delivery point is ready for the vehicle before it arrives – gates and doors should be open to avoid the vehicle idling.
- Make sure the driver knows the precise location of your delivery point and is aware of any local access issues.
- Ensure staff do not shout or whistle to get the attention of the driver.

The Driver

- Plan ahead to ensure you know the location of the delivery point and the appropriate access route.
- Adjust or restrict routings for evening/night-time deliveries to avoid housing areas.
- If early for your delivery slot, do not wait near residential property and switch off the engine.
- As you approach the site and maneuver your vehicle into position, remain aware of the effect noise levels can have on local residents.
- Do not sound your horn.
- Reversing alarms should be switched off or modified for white noise, if not subject to health and safety requirements or localized risk assessment issues (e.g. proximity to a cycle route). Use a qualified banksman instead, if available.
- Engines should be switched off immediately when not maneuvering, however, try to minimize start-ups and avoid over-revving.
- Refrigeration equipment should be switched off in advance of arrival at premises.
- If the radio is on, ensure the cab windows are closed and switch the radio off before opening the door.
- Minimize the frequency of opening and closing vehicle doors, and do so quietly.
- Allow extra time if needed to unload as quietly as possible. Take particular care to minimize rattle from metal-on-metal contact when moving roll cages.
- Where practical, notify staff at the delivery point in advance of arrival to ensure they are ready for you.
- Be aware of how far your voice can carry when talking outside at night.
- If opening a gate/cellar flap/roller shutter door to gain access, do so gently and as little as possible.
- Lower flaps on tail-lifts carefully and quietly.
- Do not whistle or shout to get the attention of store employees.
- When moving gates, locks and load restraint bars ensure they are placed gently in their resting position/ stowage point – do not drop or drag them on the ground.
- When safe to do so, use sidelights rather than headlights while off-road and maneuvering, to minimize light intrusion.
- Minimize excessive air brake noise.

CONCLUSIONS AND RECOMMENDATIONS

ALTERNATIVE FUELS

The US and the world continue to move towards cleaner transportation technologies. Seattle continues to support these efforts by working with Puget Sound Clean Air Agency to identify opportunities to work together towards new technology. As the region moves towards a low to zero emission goal, good examples from the Ports of Los Angeles and Long Beach can be found for moving the industry. Below are some opportunities for Seattle:

1. A Technology Advancement Program with seed money jointly provided by the air resource district, EPA, and the City to test new technology. Seattle could coordinate with the Port and local stakeholders to explore means to aid the freight industry's use of cleaner technologies.

Fueling station development, which could be hydrogen, liquefied or compressed natural gas would improve the air quality as well as the economic sustainability of freight. The Ports of Los Angeles and Long Beach offer the best example of requiring and supporting the development and testing of alternative-fueled trucks, including battery-electric, hydrogen fuel cell, and both liquefied and compressed natural gas.

Presently, hydrogen fuel technology does not meet the range needs of the freight industry. In as much hydrogen fueling stations almost exclusively support passenger vehicles, but as technology improves, opportunities for hydrogen fuel cell trucks may become feasible. Hydrogen fuel stations typically cost approximately $2 million to develop. California in 2013, approved $200 million to fund the construction of 100 hydrogen fueling stations. In anticipation of future hydrogen truck opportunities, Seattle could coordinate with hydrogen fuel station developers to ensure future access for trucks could be accommodated at the new stations.

Development of one or more public natural gas fueling stations could be a partnership between the City and one of the providers (such as Blu or Clean Energy). The partnership would require the City to potentially off-set the initial lack of demand – if any.

1. Develop guidelines for the development of hydrogen fueling stations, and seek opportunities for the City to encourage or support the inclusion of truck access
2. Study the needs and opportunities for development of alternative fueling stations within the City. Develop station development guidelines that consider both the potential demand and all potential environmental effects
3. Develop an implementation plan that supports increased use of alternative fueled trucks

WAREHOUSING

Seattle has an opportunity to capture warehousing that supports same-day delivery of consumer product. The development of new high-tech, smaller, strategically placed warehouse facilities within close proximity to major population bases, such as Seattle, continues to grow. Capturing a piece of this market could reduce overall vehicle miles traveled in the Seattle area, improve economic efficiency for the industry, and result in reuse of vacant or underutilized industrial land. Recommendations for investigating this opportunity include:

1. Identify vacant industrial land and unoccupied warehouse and industrial buildings in Seattle

2. Investigate the opportunities for redeveloping these sites based on the most current industry warehouse space demands (area, height, loading docks, access, etc) by preparing a study that collects available commercial real estate information, investigates sites, and develops a business development strategy for capturing this opportunity

OFF-PEAK TRUCK OPERATIONS

Off-peak truck operations offer a real solution to discouraging trucks on regional freeways during peak hours, but the ability to implement these operations has been limited to seaports and a few major cities. The success of these programs has been based on significant coordination across the supply chain. Deliveries require off-hours truck drivers and receivers. Constraints on the trucking side include federal hours of service requirements, shift premium pay for unionized drivers, and possible efficiency losses associated with spreading shipments out across more hours of the day. Constraints on receivers include having to open receiving facilities early and to operate loading terminals more hours of the day, shift premium pay for terminal workers, and local zoning codes that prohibit after hours truck activities in residential neighborhoods.
The following recommendations could lead to a successful off-peak freight operations program:

1. Identify all existing City regulations that impact, restrict or prohibit off-peak truck operations
2. Follow up with stakeholders who expressed an interest in off-peak delivery. Identify others.
3. Further investigate their operational needs and work with them to develop potential off-peak solutions
4. Develop off-peak delivery guidelines, if needed, to address potential impacts of an off-peak delivery program (i.e., noise, light, vibration)
5. Explore potential industry incentives to encourage off-peak operations, such as tax incentives to employers who hire a third shift at a warehouse

Seattle Department of Transportation

THE ROLE OF FREIGHT IN SEATTLE'S ECONOMY APPENDIX G

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7.0 Freight's Impact on the Economy 37

1.0 INTRODUCTION

The goals of this document are to connect information about economic sectors in Seattle, and beyond the city, to freight movement in Seattle and to address why freight related industries are important to Seattle. Specific objectives include:

- Show how economic sectors have grown over time
- Provide projections of growth by major sector and how this may impact freight volumes
- Assess why freight-generating industries are worth supporting including jobs and incomes
- Show spatial intensity of economic sectors within Seattle

In examining economic sectors related to freight, it is important to note that some major economic sectors are freight **generators** and a smaller subset of industries are freight transportation **service providers**. For example, freight trucking may be the most visible of freight-related industries but it carries freight generated other sectors and creates no freight volumes on its own.

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

Sections which follow provide:

- An overview of Seattle's economy covering major industry sectors
- Details about freight-generating industries and their growth prospects
- An overview of international freight volumes
- A view of the geographic intensity of Seattle's industries
- A forecast of economic growth by industry sector and how this may affect freight volumes

2.0 SEATTLE'S ECONOMY

Seattle's economy includes sectors largely connected to the United States' and global economies as well as sectors that are more regional in nature. Both broad economic components are significant generators of freight. In the global economy, Seattle's deep water port provides an international gateway for imports as well as exports to and from US inland regions as well as from the state's agricultural and manufacturing businesses. The Port of Seattle which ranked as the 5th largest port in the US in terms of volume in 2012 has a profound effect on freight movement in Seattle and is discussed in Section 4.[1] Due to the Port and associated industries, Seattle's economy is particularly tied to freight and trade.

Seattle's more regional economic sectors are also an important driver of freight transportation, from stocking retail stores to meet consumer needs, to supplying local manufacturing and service industries with the goods they need to produce products and services for their customers. This section briefly summarizes the composition, size and growth of Seattle's major industry groups and also compares Seattle's economic sectors to those of the United States as a whole.

2.1 OVERVIEW OF SEATTLE'S MAJOR INDUSTRIES

The principal measure of regional economic activity by industry used in this report is employment, as measured by data derived from state employment surveys. Industry and employment growth is driven by both overall population growth (which results in increased consumer spending, residential investment, and growth in other economic sectors) as well as industry-specific factors related to the Seattle region's "exports" of goods and services to the US and global economies. Employment data are available for industry groups defined under the North American Industry Classification System (NAICS) and published by state employment agencies including the Washington State Employment Security Department and the US Bureau of Labor Statistics (BLS). More limited data for Gross Domestic Product, measuring output by industry, are available from the US Bureau of Economic Analysis (BEA).

NAICS is a hierarchical system and the top level includes 11 "super sectors" grouped into those that are Service-Providing and Goods-Producing:

Service-Providing

- Trade, Transportation and Utilities
- Information
- Financial Activities
- Professional and Business Services
- Education and Health Services
- Leisure and Hospitality
- Other Services
- Public Administration

Goods-Producing

- Natural Resources and Mining (including agriculture and fishing)
- Construction
- Manufacturing

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[1]www.logisticsmgmt.com/images/site/LM1205_TopPorts.pdf

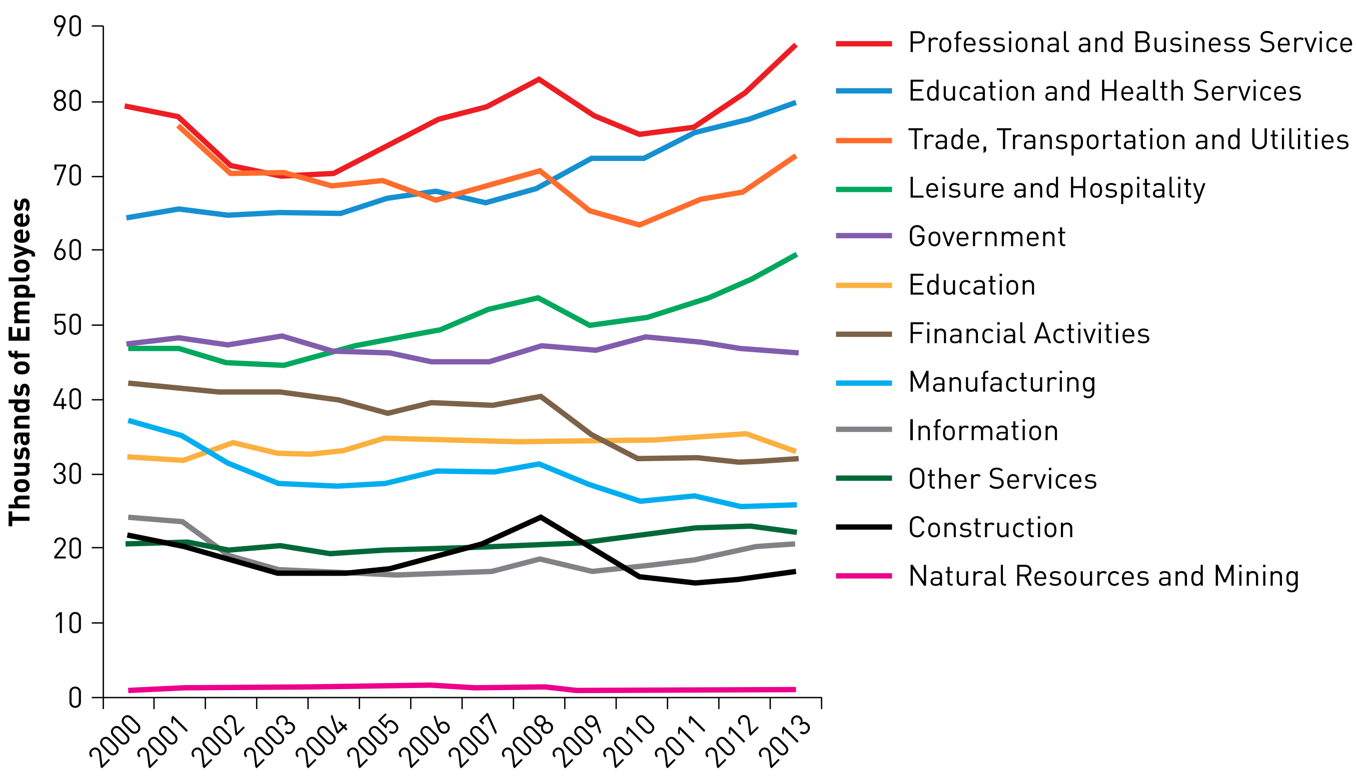
The following sections provide an overview of Seattle's employment for these economic sectors including historic changes in employment levels and the extent to which the sector generates freight. Later sections provide additional details for economic sectors that are high freight generators.

2.2 SEATTLE'S TRENDS IN EMPLOYMENT BY MAJOR SECTOR

Looking at employment over more than a decade, Seattle's top six largest industries are service-providing: professional and business services; education and health services; trade transportation and utilities; leisure and hospitality; government; and financial activities. Again, due to the Port and related industries, trade plays a big role in the economy. Seattle had the 15th highest trade value of US metropolitan areas in 2010.[2]

According to data from the Puget Sound Regional Council, as shown in Figure 1 below, four of the top six sectors experienced downturns during the Great Recession (Dec. 2007 to June 2009): professional and business services; trade, transportation and utilities; leisure and hospitality; and financial activities. While the first three have shown a recovery, employment in financial activities has been flat from 2010 to 2013. Government employment has remained relatively flat over the past decade but has declined slightly in 2011 to 2013.

FIGURE 1. SEATTLE'S EMPLOYMENT BY MAJOR ECONOMIC SECTOR



Source: Puget Sound Regional Council and Parsons Brinckerhoff analysis

[2]Adie Tomer, Robert Puentes, and Joseph Kane, Metro-to-Metro: Global and Domestic Goods Trade in Metropolitan America (Brookings, October 2013)

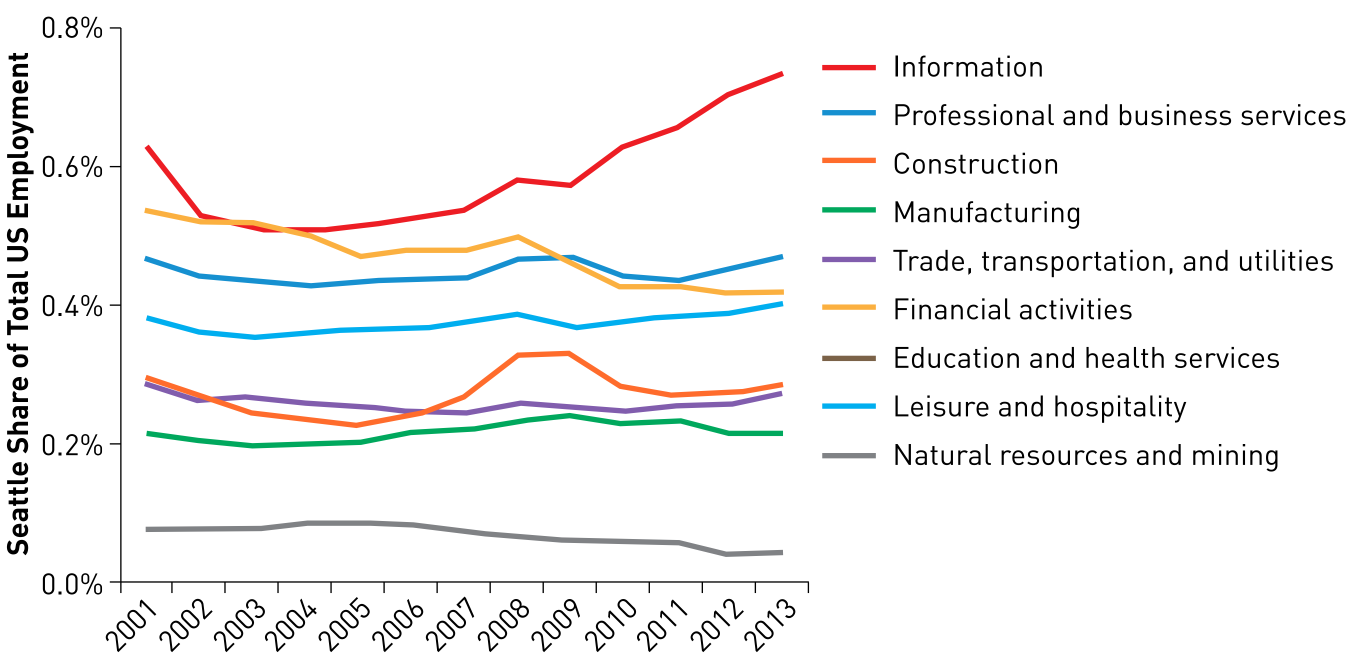
Trends in other industries include:

- Manufacturing employment grew in pre-recession years, but dropped during the recession and has declined slightly since then.
- Employment in other services and information sectors has shown relatively steady growth over the last decade.
- Construction employment is among the most cyclical of industries, peaking in 2008, dropping sharply in 2009-2010 and rebounding slightly in 2012 and 2013.
- In natural resources and mining, which includes agriculture, forestry and fishing, employment is very small and has been declining. Note that fish processing, which has substantial employment in Seattle, is included in manufacturing.

As summarized above, employment dropped sharply during the Great Recession in half of Seattle's top-level industries. Of course this decline is not unique to Seattle, this economic decline occurred throughout the nation.

Another useful view of Seattle's major economic sectors, as shown in Figure 2, is how the City's industries fared relative to the rest of the country. This view also illuminates which industries are especially concentrated in Seattle (and which are not). Specifically, Figure 2 displays Seattle industry shares of US employment and how these shares have changed over time. In this view, it can be seen that the information sector has grown rapidly while the financial activities sector has been in decline relative to the rest of the US. This view also illustrates that Seattle fared better than the rest of the country in construction employment and manufacturing. Slight share growth has occurred in both trade, transportation and utilities and leisure and hospitality. Seattle's economic growth relative to the nation has benefitted primarily in the newer information sector, where both numbers of employees and Seattle's share of the US total have grown while in financial services there have been declines in number of employees and shares of the US total.

FIGURE 2. SEATTLE'S SHARE OF TOTAL US EMPLOYMENT BY MAJOR ECONOMIC SECTOR



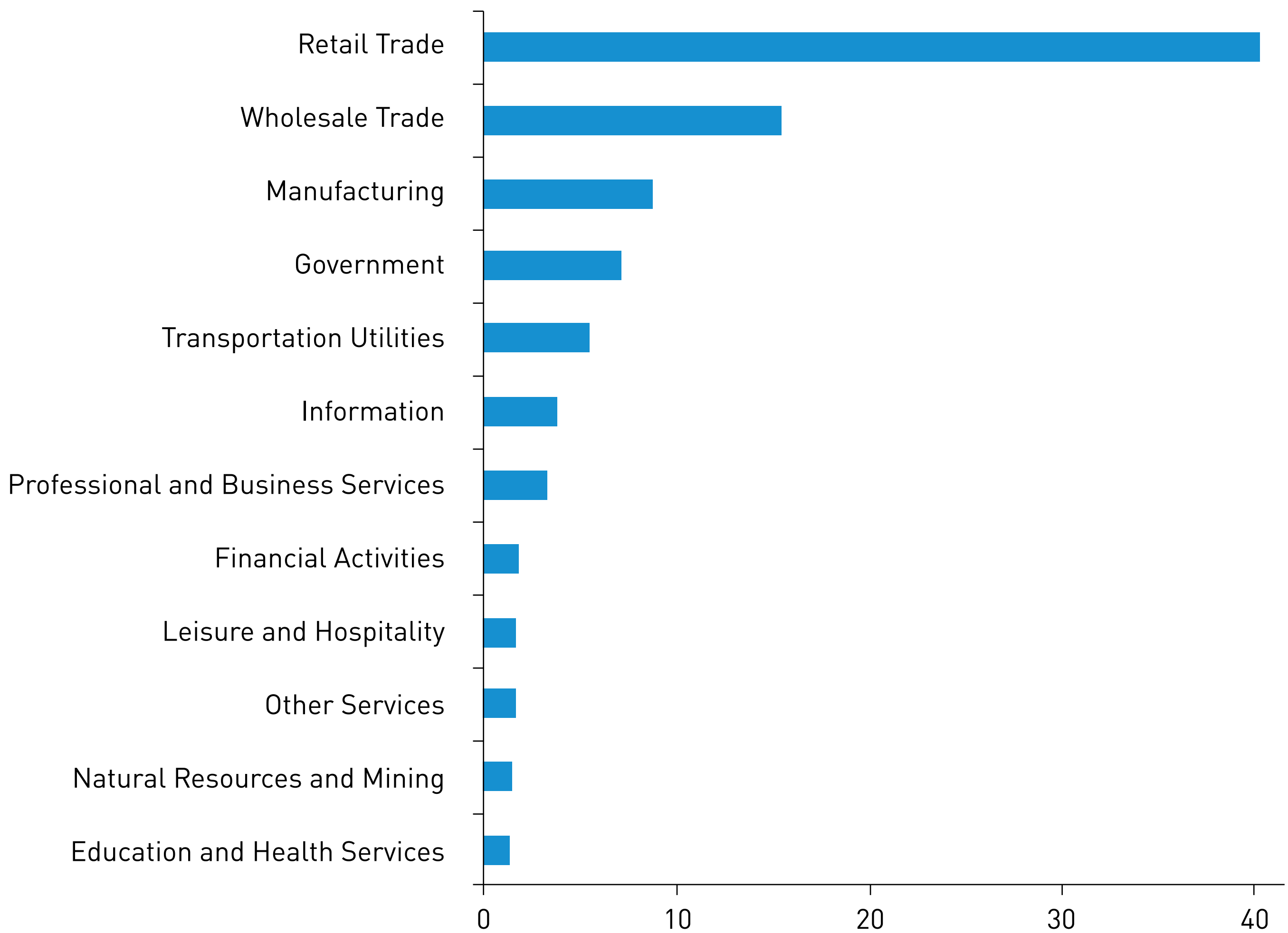
Source: Puget Sound Regional Council and Parsons Brinckerhoff analysis

2.3 FREIGHT GENERATION

One of the primary goals of this document is to connect economic activity to freight. Since different industry sectors vary dramatically in how much freight they generate, the question is how to measure these differences. To address this, information from the United States Input-Output (I-O) Accounts produced by the US Bureau of Economic Analysis (has been used to develop a national freight generation measure. This information is relatively comprehensive and up to date, with 2007 data released in December 2013. The I-O accounts provide total value, for each industry, on how much input from other industries is required to produce the output for the industry in question. This information covers all products and services from raw materials to services and all industries including government services.

The freight generation measure adopted here is the value of trucking plus warehousing and storage services used by each industry. Figure 3 displays this information for the top level industry sectors discussed above. Details for subsectors of Trade, Transportation and Utilities, which is a huge employer in Seattle, are broken out given their large size.

FIGURE 3. UNITED STATES INDUSTRY USE OF TRUCKING AND WAREHOUSING SERVICES ($BILLIONS)



Source: US Bureau of Economic Analysis and Parsons Brinckerhoff Analysis

Top National Freight-Generating Industries

Retail and wholesale trade are high freight-generating industries along with manufacturing, the principal goods-producing industry. These three sectors are the "Big Three" freight-generating industries. They are addressed in more detail in the following section (section 3.0) on freight-generating industries. The next three major industry sectors – government; transportation and utilities; and information–are all relatively low freight generators.

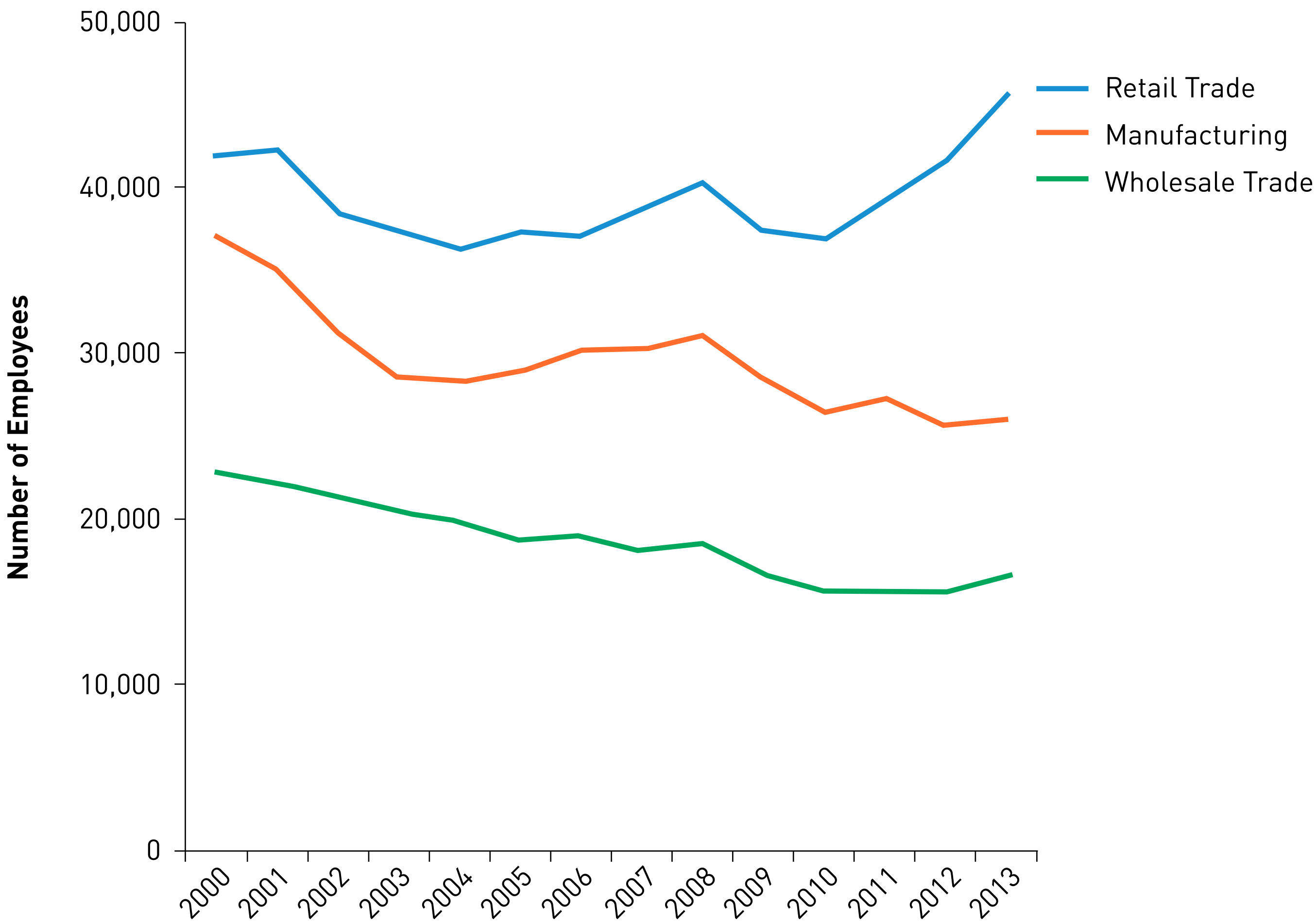
- Nearly half of government use of trucking and warehousing is in defense with most of the rest occurring in state and local general government. Thus the freight generation of government may vary widely by region. The Seattle metropolitan area, with major military facilities based in Pierce, Snohomish and Kitsap Counties, likely generates more government-related freight than most metropolitan areas and Seattle may therefore have more government related freight moving through it due to the proximity of these facilities.
- Transportation and utilities (excluding trucking and warehousing) are low freight generators since the principal industry subsector using trucking and warehousing is scenic and sightseeing transportation (e.g. tour buses or charter boat fishing) and transportation support where trucking and warehouse use may not be freight related.
- The information industry is a relatively low freight generator, generally producing information in various forms rather than volumes of goods. Trucking and warehousing services comprise 0.2% of information industry output according to the BEA I/O table data. Within the information industry, trucking and warehousing services account for a relatively high percentage of total output in the newspapers (0.7%) and periodicals (0.8%) subsectors where publishing does involve manufacturing processes using materials including inputs of paper.

The remaining major industry groups of professional and business services; financial activities; leisure and hospitality (encompassing arts, entertainment and recreation as well as accommodation and food services and drinking places); other services; natural resources and mining; and education and health services are all very low freight generators.

3.0 FREIGHT GENERATING INDUSTRIES

This section provides additional details for the top freight-generating industries—retail trade, manufacturing and wholesale trade —including the importance of freight within each sector and the types of products transported. Due to growth in the retail trade sector, total employment for these three freight generating sectors has grown from 2009 to 2013 by about 10% (from 80 to 88 thousand employees).

FIGURE 4. SEATTLE'S EMPLOYMENT IN FREIGHT GENERATING INDUSTRIES (NUMBER OF EMPLOYEES)



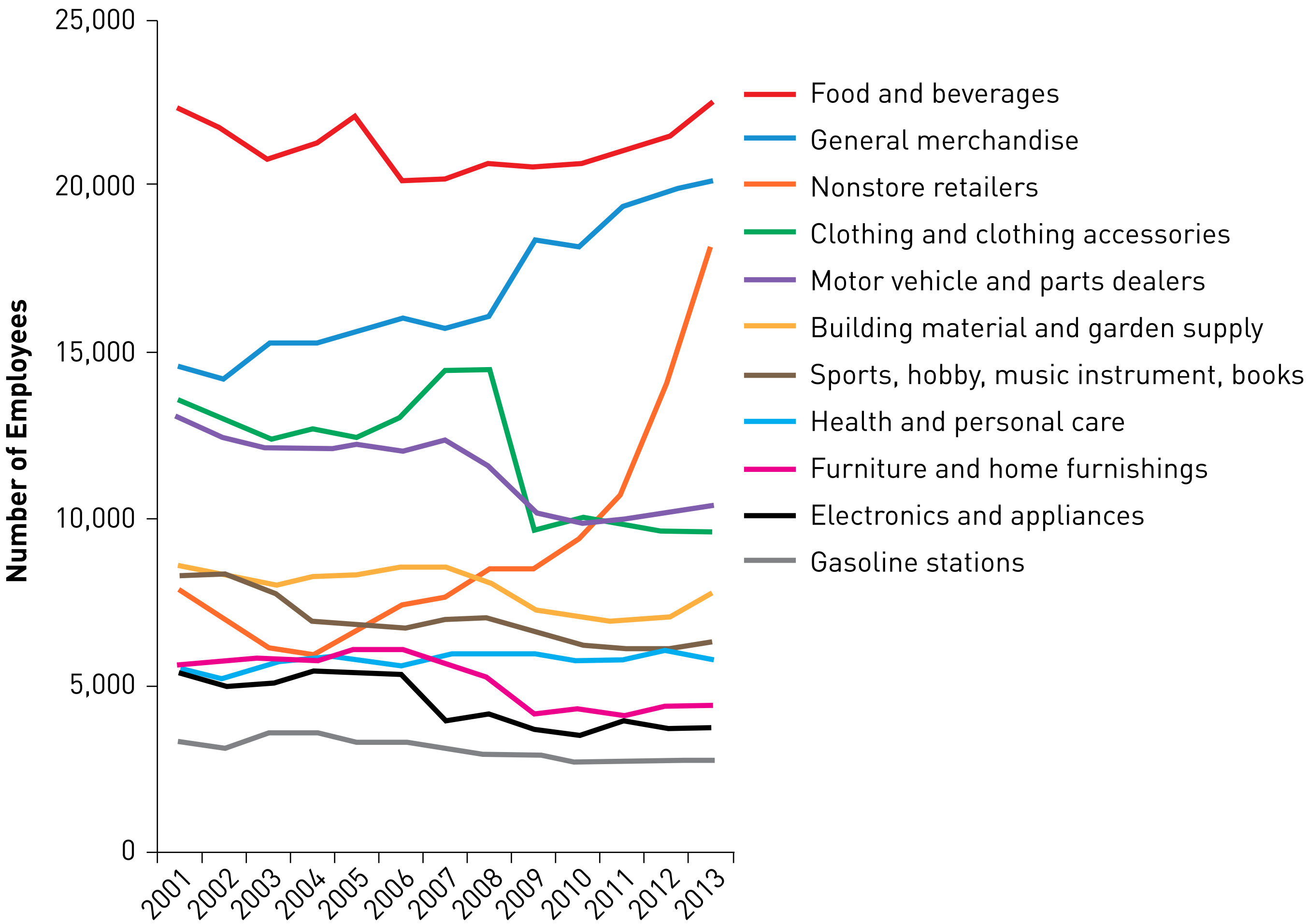
Source: Puget Sound Regional Council and Parsons Brinckerhoff analysis

3.1 RETAIL TRADE

Retail trade is one of Seattle's biggest economic sectors and is also the largest freight-generating industry sector. Retail trade's use of trucking and warehousing represents a very high 3.4% share of total retail trade industry output according to the US Input-Output data described earlier (compared to 0.1% for manufacturing and 1.2% for retail trade). Within the overall retail trade sector, two subsectors' use of trucking and warehousing as a share of total output is especially high. For general merchandise stores, this share is a very high 7.2% and for food and beverage stores it is 4.6%, indicating the importance of freight transportation services and urban goods delivery in these industry subsectors.

Retail sector freight is generated by goods moving from distribution centers and warehouses to retail stores. This freight is almost universally carried to stores by truck. A view of the types of retailers and products transported is shown in Figure 5 that displays retail employment at the 3-digit NAICS code level for King County Washington (to allow a view of more detailed industry data).

FIGURE 5. RETAIL TRADE EMPLOYMENT IN KING COUNTY WASHINGTON



Source: US Bureau of Labor Statistics and Parsons Brinckerhoff analysis

A summary of historic trends and product categories (by category of retail store), as shown on Figure 5, is as follows:

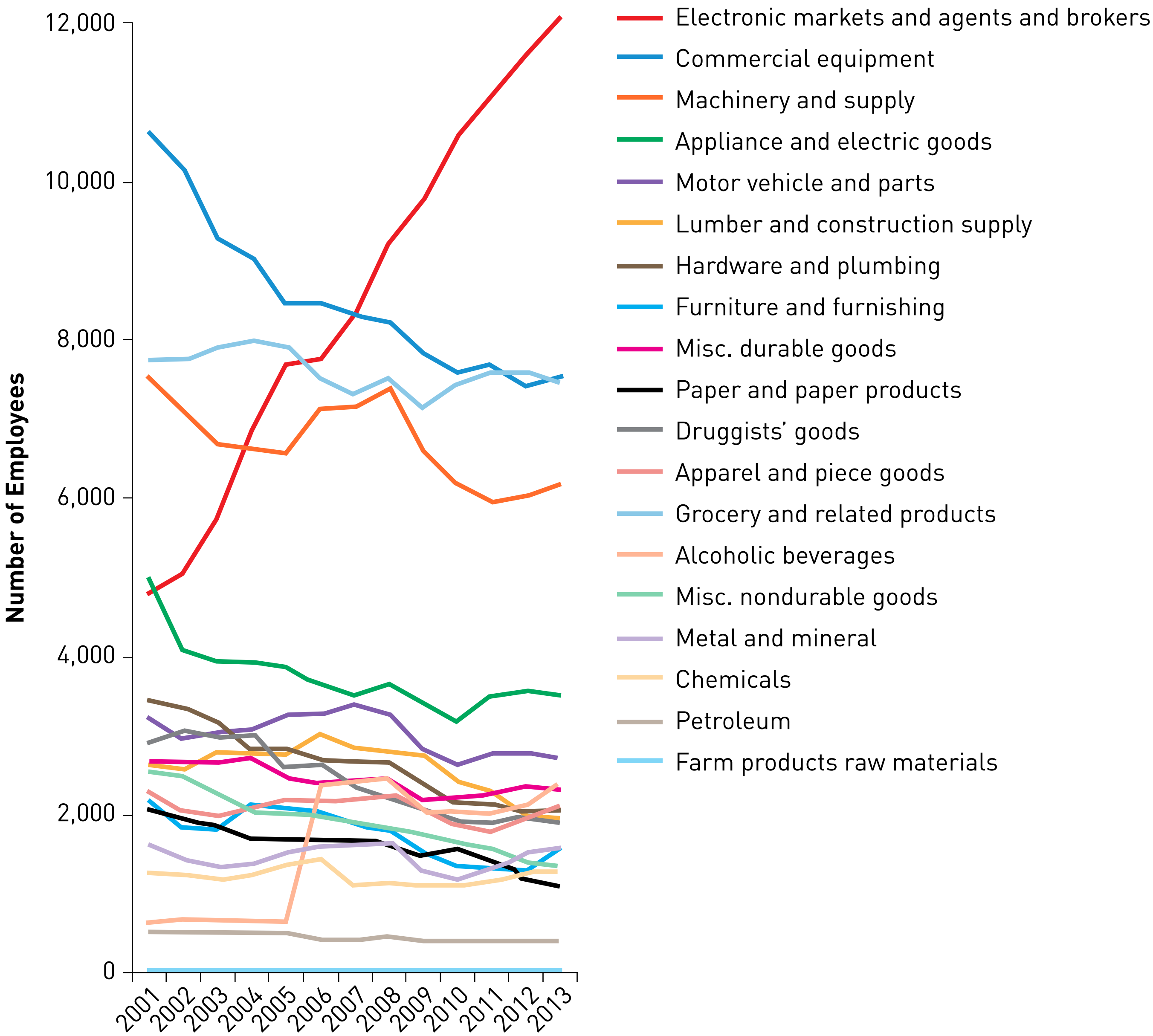
- Food and beverage is the largest of the 3-digit retail trade industries. Most employment is in grocery stores, but the category also includes specialty food stores and beer, wine and liquors.
- General merchandise stores include department stores which account for a majority of employment in the sector and other general merchandise stores.
- The fastest growing retail trade type is non-store retailers where employment has skyrocketed since 2009. This industry category principally includes electronic shopping and mail-order houses, but also vending machine operations and direct selling establishments. Employment at Seattle-based Amazon.com falls into this category.
- Employment in clothing and accessories stores dropped sharply during the Great Recession as personal consumption and inventory levels both declined.
- Employment in building materials and supplies stores and furniture and home furnishings stores both declined during the Great Recession.
- Health and personal care retailing, related to consumer spending on health care products, is one of the few retail sectors in which employment grew steadily during the Great Recession.

3.2 WHOLESALE TRADE

Wholesale trade includes merchant wholesalers that supply products across a broad spectrum of durable and nondurable consumer and industrial products. The industry's use of trucking and warehousing ranks it as the number two industry in terms of freight generation. The portion of total wholesale trade industry output represented by trucking and warehousing is a relatively high 1.2% (compared to manufacturing at 0.1%).

To provide a local view of the mix of products supplied by wholesalers, Figure 6 below displays employment in wholesale industries at the 4-digit NAICS code level. These products are delivered to both retail stores and businesses and the figure shows that products range from consumer durable goods, such as motor vehicles and parts, appliances, and industrial materials; to non-durables, such as food, apparel and gasoline. The rapidly growing employment line rising to the top of the figure is the relatively new wholesale electronic markets and agents and brokers category. This industry includes wholesale trade agents and brokers for all durable and nondurable goods.

FIGURE 6. WHOLESALE TRADE EMPLOYMENT IN KING COUNTY WASHINGTON



Source: US Bureau of Labor Statistics and Parsons Brinckerhoff analysis

Emerging Trends in Retail and Wholesale Supply Chains

Two major shifts in employment patterns in retail and wholesale trade noted in sections above highlighted dramatic shifts that are occurring in supply chains and logistics. The first was the significant increase in non-store retailers seen in Figure 5, above, in section 3.1. The second was the massive rise of electronic markets noted in the section on wholesale trade (see Figure 6). These are both symptomatic of major changes in supply chains.

The retail sector is witnessing a shift from an old siloed perspective that separated e-commerce from brick-and-mortar store operations to a more comprehensive focus on omni-channel retail.[3] Within this new omni-channel orientation, considerable attention has been paid to the consumer end of things, as companies try to create a customer experience that involves the advantages of both the online and in-store platform. E-commerce providers are offering same-day or next-day deliveries to compete with the immediacy of in-store purchasing. At the same time, traditional retailers are developing a more digital relationship to their in-store customers, through used of cell phone apps and digital tracking.

Perhaps even more importantly, the omni-channel phenomenon is motivating a comparable shift in logistics approaches that combine logistics operations for both direct-to consumer and store needs. For example, Macy's has begun operating 500 of its stores as mini-distribution centers for e-commerce.[4] Home Depot is developing a nationwide network of direct fulfillment centers to process orders for both home delivery and pickup at their stores. Combined distribution approaches and merging of the fulfillment cycle can be used to maximize customer flexibility and offer a competitive advantage. Already customers can order projects online and pick them up in stores. Alternately, a customer might view and purchase a product in stores, but then have the product delivered to their home on the same day.

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

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

Beyond the trend towards rapid direct-fulfillment, retail, along with other major industries, is also experiencing an independent, and at times, conflicting trends towards "green logistics." Companies such as Dell and Recreational Equipment Inc. (REI) have implemented comprehensive programs that involve reduced packaging, materials recycling, load optimization, and modal shift strategies to reduce the environmental impacts of the supply chain. Finally, there are shifts in distribution centers toward increased automation and toward the incorporation of final-stage manufacturing/value-added functions into the fulfillment process. See sustainable memo for more information.

A telling analysis by Tompkins International compared the size of Amazon.com to Wal-Mart, usually viewed as the biggest company in retail. Wal-Mart buys goods for its own account and recognizes 100 percent of the revenue at sale, in keeping with normal accounting practice. Amazon

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[3]Omni-channel retail provides the consumer with the ability to shop through many possible methods, including mobile internet devices, computers, brick-and-mortar, television, radio, direct mail, and catalog.
[4]www.technologyreview.com/news/520786/its-all-e-commerce-now/

does the same with the goods it buys and sells, but Amazon also operates a marketplace, where products from vendors are purchased via Amazon and shipped from the vendor. Amazon recognizes fees for the service, but not the full value of the goods, again in keeping with normal accounting practice. However if this difference is corrected for and the companies are compared in terms of the dollars they transact in the marketplace, the firms are about the same size and Amazon is growing faster. This insight helps explain the attention Amazon attracts in the retail sector and why, for example, its push into same day delivery – an attempt to match the convenience of storefront purchases – is a source of competitive concern. Tompkins believes that Amazon's expansion into groceries and newspapers can be best explained by its desire to control the delivery channel to consumer homes and the need for delivery density in same day delivery corresponds to that.[5]

A few further points from Tompkins' Supply Chain Consortium for the retail sector are outlined below. They show the signs of emphasis on time to market, as proximity is valued and more distribution centers deployed, as well as the blurring of lines with e-commerce:

- The trend is toward moderate growth in master distribution centers as opposed to regional distribution centers. The database shows an average of two regional distribution centers two years ago per company and today this average is over three regional distribution centers. By contrast master distribution centers went from an average of seven facilities two years ago to 10 facilities today.
- There is also significant evolution of the regional distribution facilities to operate as fulfillment centers for e-commerce businesses or portions of traditional product retail companies.
- Key criteria for determining different distribution center locations include the following:
    - Conform to quota limitations or minimize import duties
    - Proximity to customers/stores for shorter order fulfillment times
    - Inventory segregated by sales channel
    - Access to foreign trade zones

A further trend affecting large companies, including large retailers and e-commerce entities, is efforts towards "green logistics". Green logistics has three primary dimensions, some of them reflecting a related business interest in energy and fuel economy, and opportunities to reduce transportation costs generally through logistical efficiencies:[6]

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

These factors are affecting how supply chain networks are constructed and managed, and the types of support they require. However, challenges to green logistics include:[7]

- Door-to-door and just-in-time delivery practices tend to require truck transportation as the mode best able to meet their requirements, despite its relatively higher air emissions

[5]"Reshoring, Rightshoring – Where is it Headed?" Tompkins International recorded by Stifel, Nicolaus & Company, Inc., 12/13/14.
[6]http://people.hofstra.edu/geotrans/eng/ch8en/appl8en/logistic_green_dimensions.html
[7]http://people.hofstra.edu/geotrans/eng/ch8en/appl8en/ch8a4en.html

- Reliability issues associated with "greener" modes, such as the "debilitating service issues" suffered by railroads in the past year, exemplified by prolonged delays in the national hub in Chicago[8]
- Inventory reductions mean inventories are now carried by the transportation system
- E-commerce demands for quick turn-around times

Impact of Supply Chain Trends on Freight in Seattle

Retail and wholesale trade together represent the great majority of freight generated in the Seattle economy, outweighing all other sectors combined in terms of their use of trucking and warehousing services relative to total output. Retail trade, and the wholesale trade that supports it, is what allows Seattle consumers to purchase the goods they need, from cars, furniture, and electronics to food, apparel and gasoline. Simply put, if you buy something in a store, it likely got there by one or more trucks.

As described above, there are profound changes occurring in the supply chains and logistics systems used to get goods to consumers including electronic markets and direct delivery. The trends are still emerging and it will take time before the full impacts are clear. However, while the patterns of truck transportation services and the size of trucks employed in these services may change, the total volume of goods trucked is likely to rise in proportion to increasing consumer demands for goods, especially as the population of Seattle continues to grow. Overall, the trends in warehousing and distribution are likely to result in an increase in shorter truck trips, with potential for at least some of these to take place in smaller vehicles.

3.4 MANUFACTURING

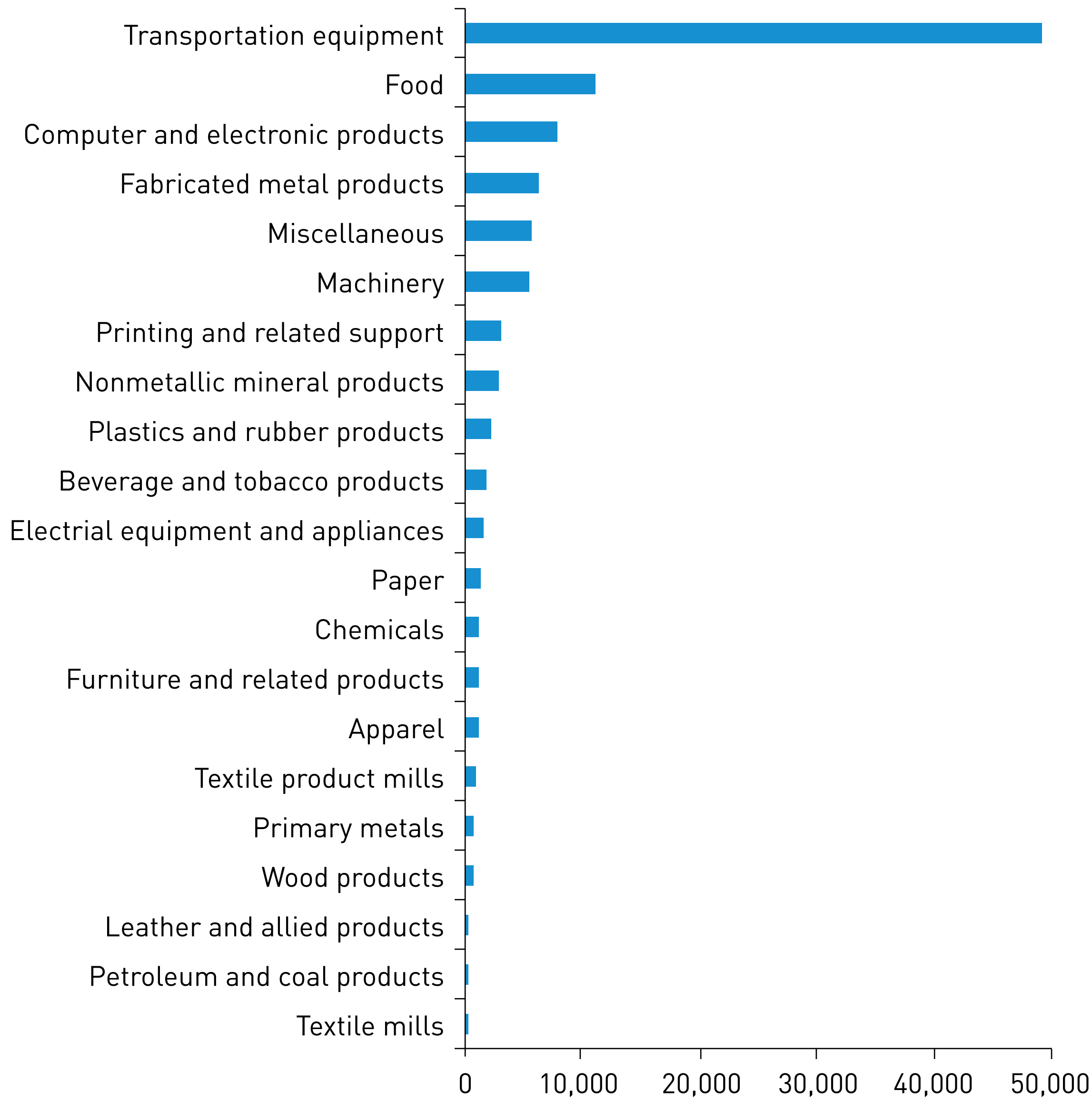
Manufacturing is the second largest of the major freight-generating industries in terms of Seattle employment (see Figure 4), but the third largest industry in terms trucking and warehousing services' share of total industry output (as shown above in Figure 3). In aggregate, the sectors' use of these services at the national level actually represents a very small 0.1% of output, an order of magnitude less than the much larger shares in retail trade (3.4%) or wholesale trade (1.2%).

Outputs of manufacturing processes include products ranging from industrial materials such as primary metals; intermediate products, e.g. fabricated metals; and final goods including airplanes, food and apparel. Each of these products represents a freight output transported to local markets, US regional markets or exported. Figure 7 displays 2013 manufacturing employment in King County by 3-digit NAICS code. By far the largest category, transportation equipment (automotive, aerospace, railroad and ships) includes Boeing and its local suppliers as well as Paccar and local shipyards.

Manufacturing also involves inbound freight including raw materials and intermediate products used as inputs to the manufacturer's products as well as machinery and other goods used in the manufacturing process.

[8] "Key Takeaways from the Rail Trends Annual Conference", Stifel, Nicolaus & Company, Inc, 11/24/14

FIGURE 7: 2013 MANUFACTURING EMPLOYMENT IN KING COUNTY



Source: US Bureau of Labor Statistics and Parsons Brinckerhoff analysis

Conclusion

Manufacturing represents the second largest of Seattle's major freight generating economic sectors. However, the final goods that are manufactured, from airplanes to seafood, are more likely to be destined to markets in the US or overseas than headed to local consumption. Along with many service industries manufacturing represents the direct "exports" to the US and overseas that help drive Seattle's economy and jobs.

3.5 REGIONAL CONCENTRATIONS OF FREIGHT GENERATING INDUSTRIES

Economic Sectors' Geographic Distribution within Seattle

Figure 8, below, shows the total concentration of employment within Seattle by census track.

As described in the previous sections, the top freight generating sectors in Seattle are retail trade, wholesale trade, manufacturing, and trade. The employment concentrations of these Top Three freight generating industries are shown by census tract in figures 9-11, below.

FIGURE 8: TOTAL EMPLOYMENT IN SEATTLE BY CENSUS TRACT

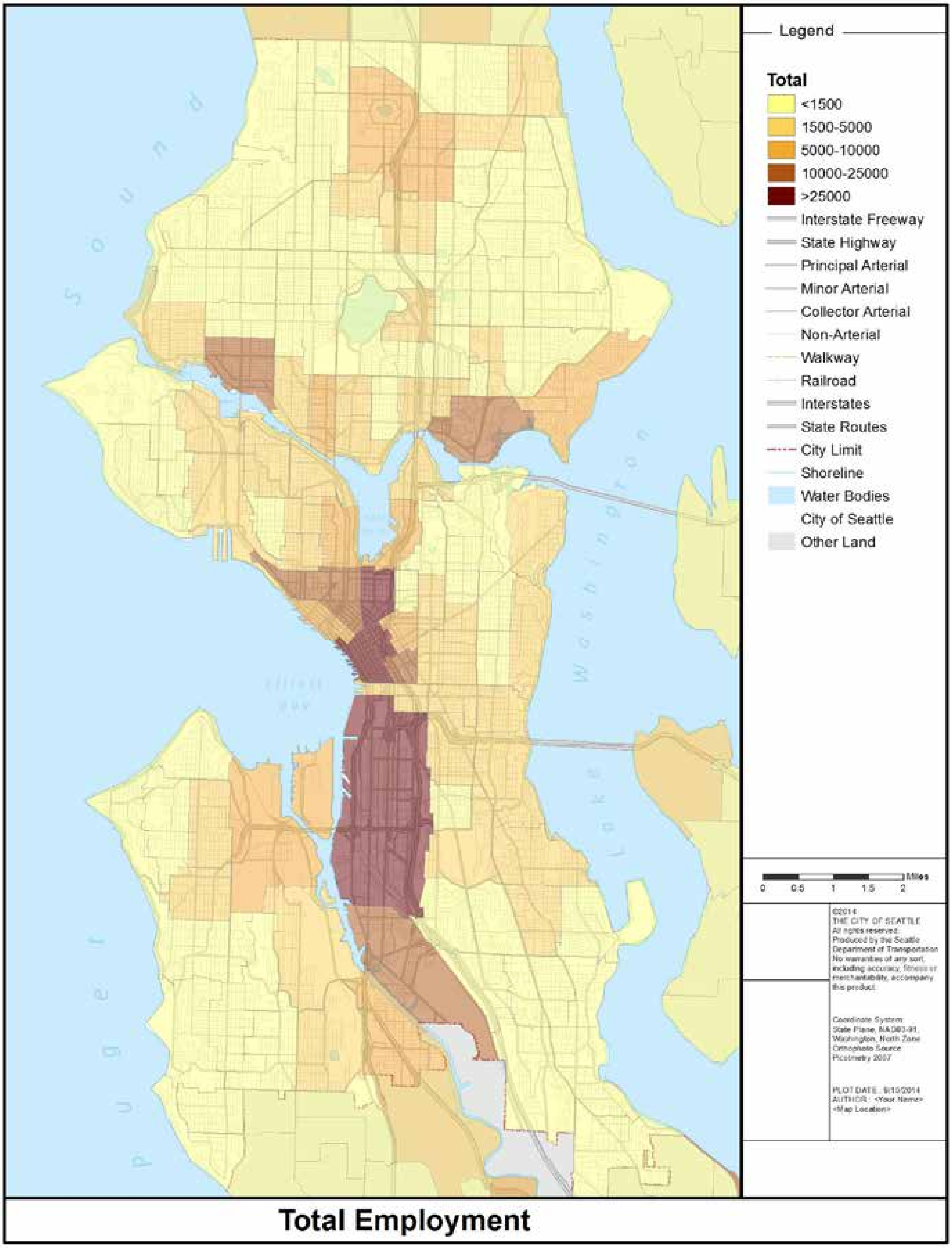


FIGURE 9: RETAIL EMPLOYMENT IN SEATTLE BY CENSUS TRACT

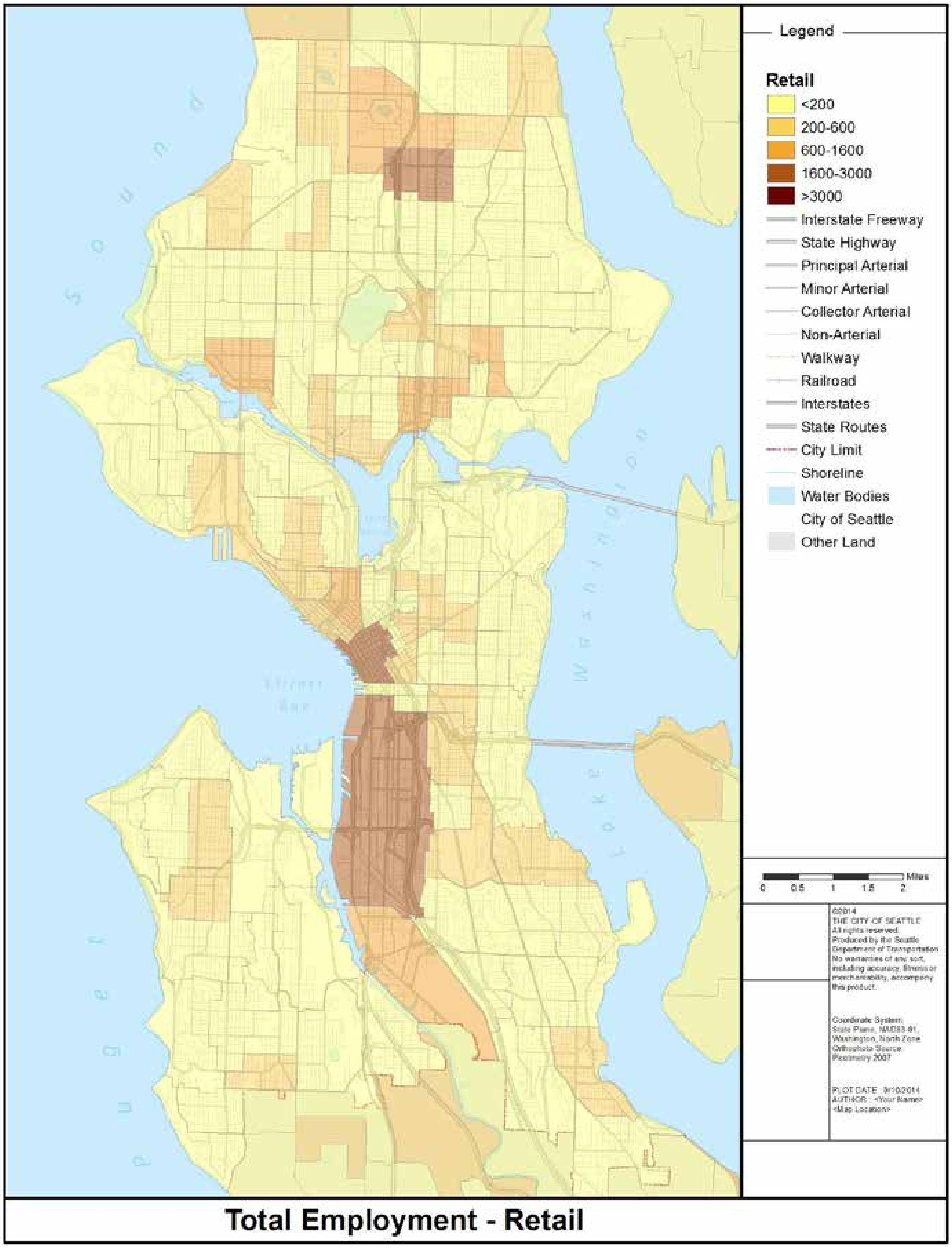
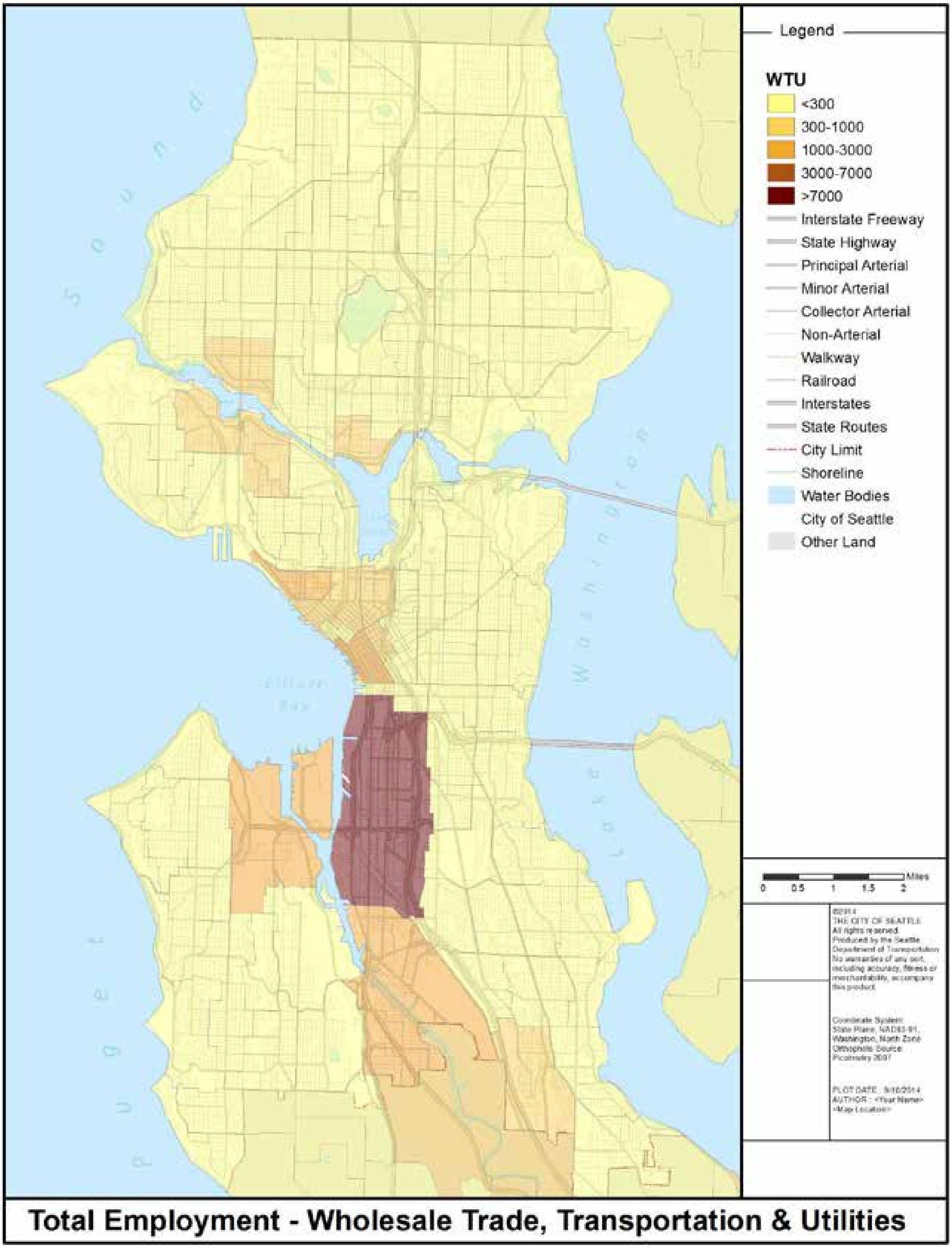
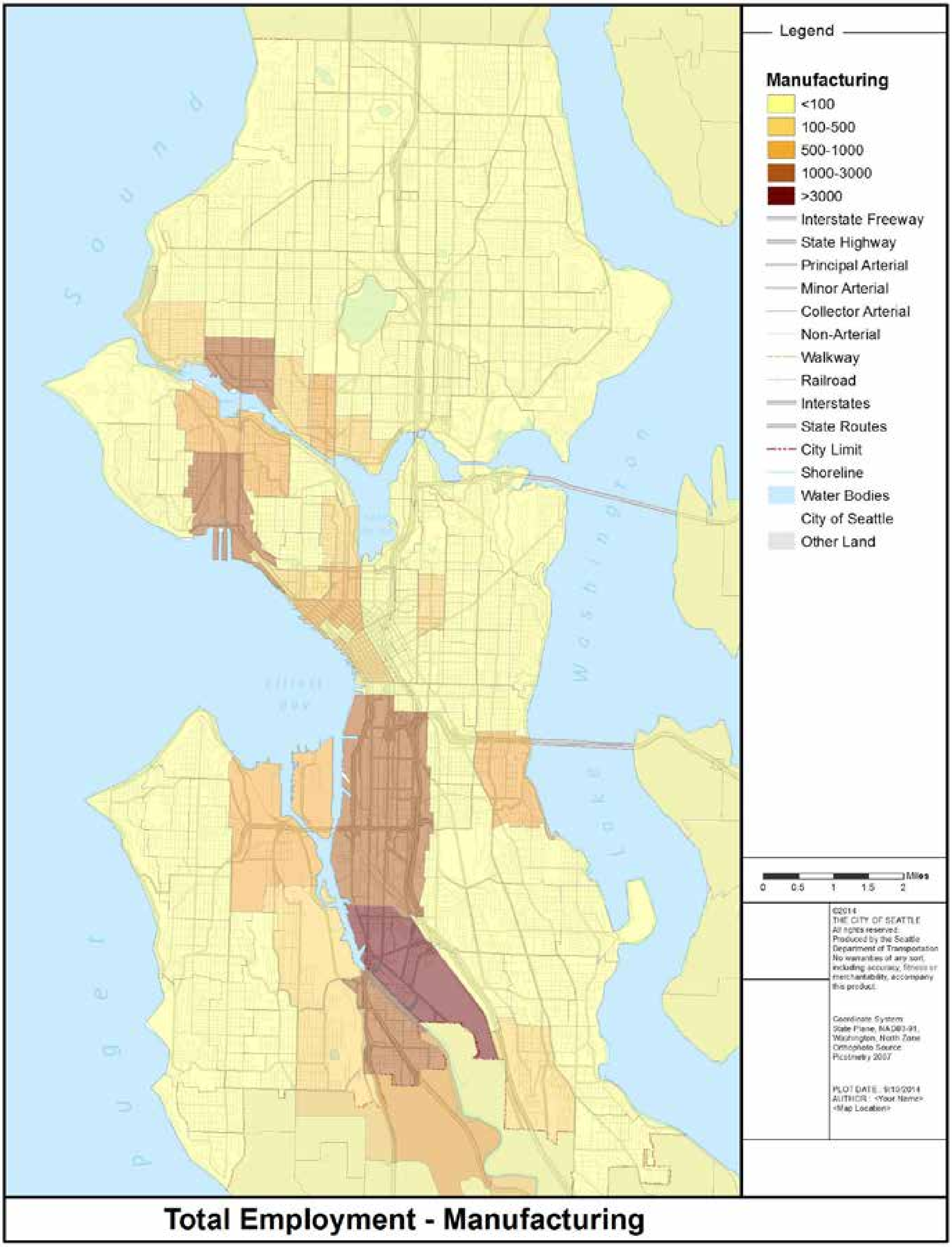


FIGURE 10: WHOLESALE TRADE, TRANSPORTATION AND UTILITIES EMPLOYMENT BY CENSUS TRACT.[9]



[9]Puget Sound Regional Council

FIGURE 11: MANUFACTURING EMPLOYMENT BY CENSUS TRACT.



As shown in figure 9, the retail sector is spread throughout the city with clusters in the urban and neighborhood centers. Retail movements within the city typically occur in small single-unit trucks that make multiple stops along their delivery route. The start and end of the delivery trip are most affected by local and regional congestion, but intermediate stops are often close together and delays due to congestion are limited. The size of delivery trucks are relatively maneuverable in the urban environment. One common challenge is a lack of on-street loading space, particularly in the older retail districts where shops do not have back-of-house loading areas.

As shown in figures 10 and 11, the wholesale, manufacturing and trade sectors are concentrated in the Duwamish and Ballard-Interbay Manufacturing and Industrial Centers (Duwamish MIC and BINMIC, respectively). Truck trips associated with wholesale, manufacturing and trade sectors are more likely to be made in larger trucks that move longer-distance using the regional interstate or highway network. These trips then use city arterials and local streets for the final segment of the trip. Businesses located in the BINMIC are a further distance from Interstate 5 (I-5) and SR 99, so a higher proportion of trip travel time can be affected by local congestion or physical constraints to these larger vehicles. In the Duwamish MIC, some of the area's major access points to I-5, I-90 and SR 99 also serve downtown commuters as well as event traffic destined to the area's two major league sports stadia. This leads to frequent conflicts with general traffic congestion during rush hour peaks and around daytime sporting events.

In sum, freight generating industries are spread throughout the City of Seattle, with particular concentrations in and around the downtown core. This makes for challenges as high volumes of trucks flow to and from the business establishments in these highly developed and congested areas. These issues will be further explored in future memos.

3.6 EMPLOYMENT IN TRANSPORTATION SERVICES

While transportation services are typically a relatively small freight generator, the presence of the Port makes it more significant in Seattle. Transportation services includes industry subsectors that move the freight generated by other industries (and also provide passenger transportation services). As shown in Figure 12, King County transportation services employment accounted for 4.0% of total county employment in 2013, higher than the 3.8% share for the US as a whole.

While the county had a 0.9% share of total US private employment in 2013, the shares of employment directly related to the Port of Seattle were much higher. Reflecting the importance of the Port, the county has a very high relative concentration in water transportation services with 4.9% of total US private employment and a 2.4% share of support activities for water transportation. The 2.2% share of freight transportation arrangement services is also more than double the overall average county employment share of 0.9%.

FIGURE 12: 2013 FREIGHT-RELATED TRANSPORTATION SERVICES EMPLOYMENT IN THE US AND THE SEATTLE REGION (NAICS INDUSTRIES WITHOUT NON-DISCLOSURE LIMITATIONS)

	US Total	King County	County Share of US
Total Private	**112,958,334**	**1,041,080**	**0.9%**
48-49 Transportation and warehousing	4,246,329	41,296	1.0%
481 Air transportation	448,618	9,914	2.2%
483 Water transportation	65,988	3,230	4.9%
4841 General freight trucking	941,184	4,202	0.4%
4883 Support activities for water transportation	92,095	2,196	2.4%
4885 Freight transportation arrangement	187,720	4,063	2.2%
493 Warehousing and storage	708,067	2,905	0.4%

The Port, and its impact on freight movement in and through Seattle, is discussed in the next section.

4.0 THE ECONOMY BEYOND SEATTLE

4.1 SEATTLE REGION PORTS

Economic factors outside the borders of Seattle that affect freight in the City include US demand for goods that drives import volumes and US production that results in exports moving through the region's ports and airport. This section focuses on the freight movement through the Ports. Section 7 of this report discuss the economic implications of these movements.

International Imports Moving through the Ports of Seattle and Tacoma

Freight moving through ports affects the City of Seattle in different ways. Port and airport employment, that supports the movement of international cargos, are included in the transportation and utilities industry sector and is discussed further in Section 5.2.

The Ports of Seattle and Tacoma represent a large gateway for international waterborne trade, especially for imported goods from Asia and the rest of the world. Together the two ports represent the third largest gateway for containerized goods in the US.[10] Much of the containerized cargo imported through these ports is transferred to and from rail at or near the port terminals. The destinations noted in Figure 13 below provide an indication of the direction and route goods take out of Seattle. For example, only 8.5% of total rail traffic originating in Washington is destined south to the States of Oregon and California. In comparison much larger shares of rail traffic are destined to Midwest states including Illinois (27.8%) and Ohio (11.4%). Cargo destined to or originating in the Pacific Northwest, including agricultural products and supplies or products from manufacturing businesses, are mostly transported direct by truck.

The table below displays total estimated imports from all world regions moving through the Seattle metropolitan region (principally through the Ports of Seattle and Tacoma) in 2012 according to data from the Federal Highway Administration Freight Analysis Framework (FAF) database. It is noted that about 44% of the Seattle waterborne freight tonnage is transported by "Other and Unknown ", which corresponds to pipeline or a non-domestic mode and mainly reflects crude petroleum activity.

[10]Northwest Seaport Alliance Corporate brochure, www.nwseaportalliance.com/sites/default/files/NWSA_Overview_2015.pdf

FIGURE 13: TOP 20 STATE DESTINATIONS FOR IMPORTS THROUGH THE SEATTLE REGION BY DOMESTIC MODE (2012 WATERBORNE IMPORTS IN THOUSANDS OF TONS)

	Tons (thousands)				State Shares of Total Tons			
	Total	Truck	Rail	Other	Total	Truck	Rail	Other
Grand Total	**19,915**	**10,245**	**5,864**	**3,806**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
Washington	9,025	4,890	654	3,481	45.3%	47.7%	11.2%	91.5%
Seattle	7,835	3,776	611	3,448	39.3%	36.9%	10.4%	90.6%
Other	1,190	1,113	43	33	6.0%	10.9%	0.7%	0.9%
Illinois	2,736	983	1,685	69	13.7%	9.6%	28.7%	1.8%
California	1,401	1,010	274	117	7.0%	9.9%	4.7%	3.1%
Ohio	1,102	366	668	67	5.5%	3.6%	11.4%	1.8%
Minnesota	726	511	215	0	3.6%	5.0%	3.7%	0.0%
Oregon	554	321	222	11	2.8%	3.1%	3.8%	0.3%
New Jersey	485	130	354	2	2.4%	1.3%	6.0%	0.0%
Michigan	384	221	163	1	1.9%	2.2%	2.8%	0.0%
New York	373	323	46	4	1.9%	3.2%	0.8%	0.1%
Wisconsin	314	210	99	4	1.6%	2.1%	1.7%	0.1%
Indiana	290	158	129	3	1.5%	1.5%	2.2%	0.1%
Tennessee	243	81	162	0	1.2%	0.8%	2.8%	0.0%
Colorado	223	168	54	2	1.1%	1.6%	0.9%	0.1%
Kentucky	218	121	97	0	1.1%	1.2%	1.7%	0.0%
Arkansas	205	69	135	0	1.0%	0.7%	2.3%	0.0%
Pennsylvania	204	93	106	4	1.0%	0.9%	1.8%	0.1%
Missouri	202	31	170	0	1.0%	0.3%	2.9%	0.0%
Georgia	155	56	96	2	0.8%	0.5%	1.6%	0.1%
Texas	153	80	70	3	0.8%	0.8%	1.2%	0.1%
Iowa	132	18	114	0	0.7%	0.2%	2.0%	0.0%
Other	790	405	350	35	4.0%	4.0%	6.0%	0.9%

As shown in the table, Washington is the largest state destination for imported goods that flow through Seattle region Ports, representing 45% of total waterborne import tons. The Seattle metropolitan region accounts for most of this volume (7.8 out of 9.0 million tons). If the cargo moved by "Other" modes is removed from the total, then 86% of the imported cargo is transported by truck and 16% is transported by rail.

Goods moved by truck include those going:

1. Directly to businesses where the products are used or resold to customers
2. To local wholesalers or distributors serving Seattle or broader Pacific Northwest regions
3. To "transload" centers where containerized goods are unpacked and resorted into larger domestic containers and then moved either by rail or truck to US inland locations.

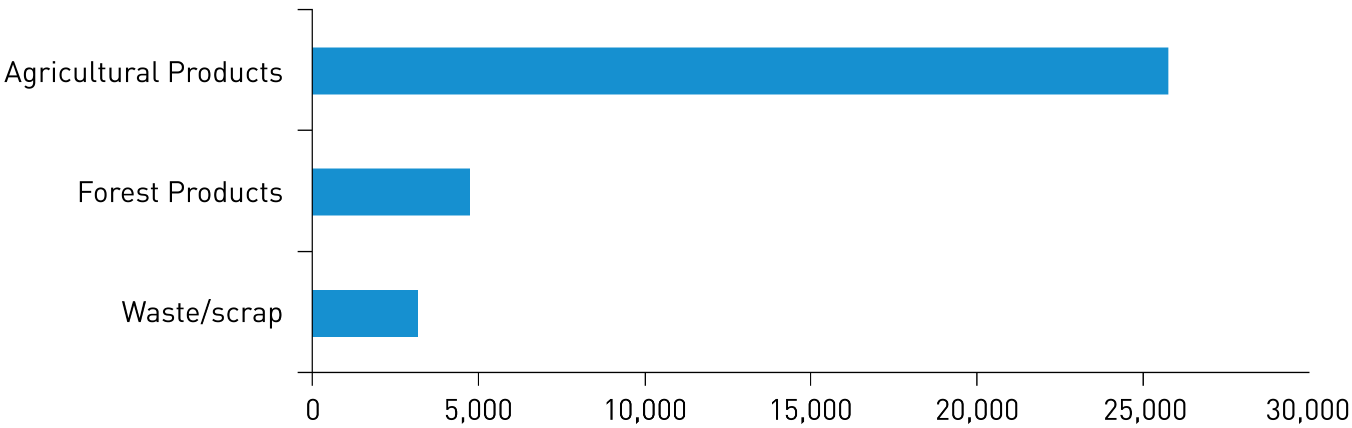
The West Coast states of California and Oregon are also principal destinations of goods imported through the Seattle/Tacoma region and, together, represent 10% of goods imported through the region. Of these goods, the great majority of tonnage is also transported by truck. Midwestern and Northeastern states comprise most of the remaining Top 20 destinations for imported waterborne tons. For the Top 20 states other than Washington, Oregon and California, over half of total tons are transported by rail.

US Exports through Seattle Region Ports

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

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

FIGURE 14: TOP 3 US WATERBORNE EXPORT COMMODITY GROUPS (THOUSANDS OF TONS IN 2012)



Source: FHWA Freight Analysis Framework Database and Parsons Brinckerhoff analysis

Washington is the largest state in terms of waterborne export tons flowing through Seattle region Ports accounting for almost half of total exports in 2012 (48%). Trucking is the primary mode of transportation from Washington to ports at 7.9 million tons out of a total of 19 million tons. Of total export tons transported to Seattle by truck, about half originate in Washington.

The large agricultural exporting states of Minnesota and Illinois are the next largest origins with a total of 27% of export tons between the two. However, in contrast to Washington, given the longer distances involved, rail is the primary mode of transportation (both containerized and bulk) with 68% of total tons originating in these two states transported by rail.

FIGURE 15: TOP 10 STATE ORIGINS OF EXPORTS THROUGH SEATTLE REGION PORTS BY DOMESTIC MODE(2012 WATERBORNE EXPORTS IN THOUSANDS OF TONS)

					State Share of Total Tons			
	Total	Truck	Rail	Other	Total	Truck	Rail	Other
Grand Total	**40,582**	**17,955**	**16,886**	**5,741**	**100.0%**	**100.0%**	**100.0%**	**100.0%**
Washington	19,275	8,854	4,857	5,564	47.5%	49.3%	28.8%	96.9%
Minnesota	6,240	2,246	3,991	3	15.4%	12.5%	23.6%	0.1%
Illinois	4,611	1,184	3,428	0	11.4%	6.6%	20.3%	0.0%
Connecticut	2,589	1,999	590	0	6.4%	11.1%	3.5%	0.0%
Oregon	2,577	1,479	1,023	74	6.3%	8.2%	6.1%	1.3%
California	835	555	277	3	2.1%	3.1%	1.6%	0.1%
Kansas	734	76	658	0	1.8%	0.4%	3.9%	0.0%
Florida	434	419	14	1	1.1%	2.3%	0.1%	0.0%
Ohio	428	155	273	0	1.1%	0.9%	1.6%	0.0%
Nebraska	308	58	250	0	0.8%	0.3%	1.5%	0.0%
Other	2,551	930	1,525	95	6.3%	5.2%	9.0%	1.7%

Source: FHWA Freight Analysis Framework Database and Parsons Brinckerhoff analysis

It should be noted that the exports described here refer to international goods but that domestic goods originating in the Seattle region and the rest of the US represent an important source of goods to the Alaska economy. Similarly, fish and fish products from Alaska that come through Seattle are considered domestic good rather than import. Regardless of its designation, the trade to and from Alaska, which is concentrated in the Ballard/Interbay area, represents an important marine activity in Seattle.

Summary

The State of Washington is the most important market for both imports through the region's ports (the destination for 45% of imported goods) and for exports (48% of originating volume). In both cases trucking is the predominant form of transportation.

Trucking is also the primary mode for moving imports to Oregon and California while rail is used to carry the majority of imports to other states.

Agricultural products are the principal products exported through regional ports, with the Midwestern States of Minnesota and Illinois representing the largest origins and rail is the principal mode of transportation.

Despite the use of rail for import and exports to the Midwest and east, the dominance of the western origins and destinations means that trucking plays an essential role in trade through the region. This means that enormous volumes of trucks move in and through the City in order to support the import/export economy.

4.2 AIR FREIGHT

Air freight is used to transport goods with very high value or that are otherwise time sensitive. In terms of transportation patterns and impacts on regional freight demand, international and domestic air freight are essentially the same. Inbound cargo from international origins, such as Asia, or domestic origins, such as Alaska, arrives at Seattle Tacoma Airport, is processed at airport air freight facilities and is transported by truck to beneficial cargo owners or to local logistics facilities or distribution centers which may serve local, regional or even US markets. The reverse patterns occur for air shipments to Asia or Alaska.

The nature of air freight cargo origins and destinations is much different than waterborne cargo. The shipments are generally much smaller and lighter and aggregate volumes are tiny compared to waterborne cargo. According to FAF data, in 2012 total international air freight cargo through the Seattle region totaled 170 thousand tons compared to 60 million tons of waterborne trade. Domestic air freight cargo added another 100 thousand tons. Air freight cargo mostly moves through SeaTac International Airport and the King County International Airport at Boeing Field.

Conclusion

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

The ports' role in exports supports US production of exports both from more distant US locations as well as from the local region. In addition to the economic benefits derived from exports, handling the export cargo also supports the local economy through jobs related to handling export trade.

5.0 TRANSPORTATION IMPACTS OF FREIGHT RELATED TO INTERNATIONAL TRADE

As noted above, transportation impacts of freight related to international trade are concentrated in goods moving by truck and rail. The impacts of waterborne trade are discussed first followed by impacts from air freight.

WATERBORNE FREIGHT

According to Port of Seattle statistics the port handled a total of 1.6 million twenty-foot equivalent units (TEUs)[11] of containers in 2013, down from a peak of 2.2 million in 2010. In the past 10 years, the ratio of TEUs per container has remained relatively steady at 1.74; therefore, the 2013 volume translates to roughly 900,000 full and empty containers. An estimated 40% of the total port throughput is currently moved by rail, which includes containers that are drayed (trucks) to near-dock intermodal yards at SIG (for the BNSF Railway) and Argo (for the Union Pacific) or are loaded to and from trains directly at Terminal 5 and 18. This is down from a high of 57% in 2007. The majority of containers that are hauled by rail are destined to or originate in the midwest. Some export containers also arrive from closer states, many of which are likely to be empty containers being repositioned to Seattle or Tacoma for export back to Asia.

The remaining 60% of the containers are moved by truck to local and regional businesses. Including the containers that are drayed to the near-dock intermodal yards, an average day at the Port of Seattle in 2013 had about 3,300 trucks entering the five container terminals, which generated a total of 6,600 one-way truck trips per day.[12] Note that this does not include bulk or break-bulk cargos or traffic to and from the Port of Tacoma that may affect Seattle truck traffic. Of these, about 30% are local dray trips to the near-dock intermodal terminals, and another 5% are to local businesses located in the Duwamish industrial area. Of the imports that move by truck beyond the local area, the majority are destined to logistics facilities and distribution center in the Pacific Northwest and California. Export moves usually come from a wider area given the broader reach of agricultural products in the region as well as the economics of having to bring truck equipment back to the Northwest to balance with higher imports. As previously shown on Figure 16, export cargo is trucked to Seattle from as far away at Connecticut. In addition to intermodal rail associated with the region's container ports, local rail movements are also associated with grain shipments through the Port of Seattle's Grain Terminal at Pier 86 along with general cargo that is loaded through rail hubs at the BNSF Stacy Yards (in SODO) and Seattle Yard in Tukwila as well as through the UP's Argo Yard. Garbage is also loaded to rail at several facilities including the Rabanco Yard in Sodo and UP Argo Yard. There are still many local rail spurs throughout Seattle's industrial areas that provide direct rail service for businesses. Some of the larger customers include Nuccor Steel in West Seattle and Ash Grove Concrete in Sodo.

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[11]A forty-foot container is equivalent to 2.0 TEUs.
[12]Source: Heffron Transportation, Inc. and Port of Seattle for 1st Quarter 2013.

AIR FREIGHT

The transportation impacts of air freight are fundamentally different. Individual shipments are much smaller and transported in smaller van or box trucks rather than by large trucks handling containers on chassis (or moved by railcars to and from US inland regions). The transportation impacts are also more local. For example, of the 60 thousand tons of air cargo tons imported through the Seattle region in 2012, 52 thousand tons was destined to Washington according to FAF data. In the Seattle area, most of the air cargo is handled through SeaTac International Airport and the King County International Airport at Boeing Field.

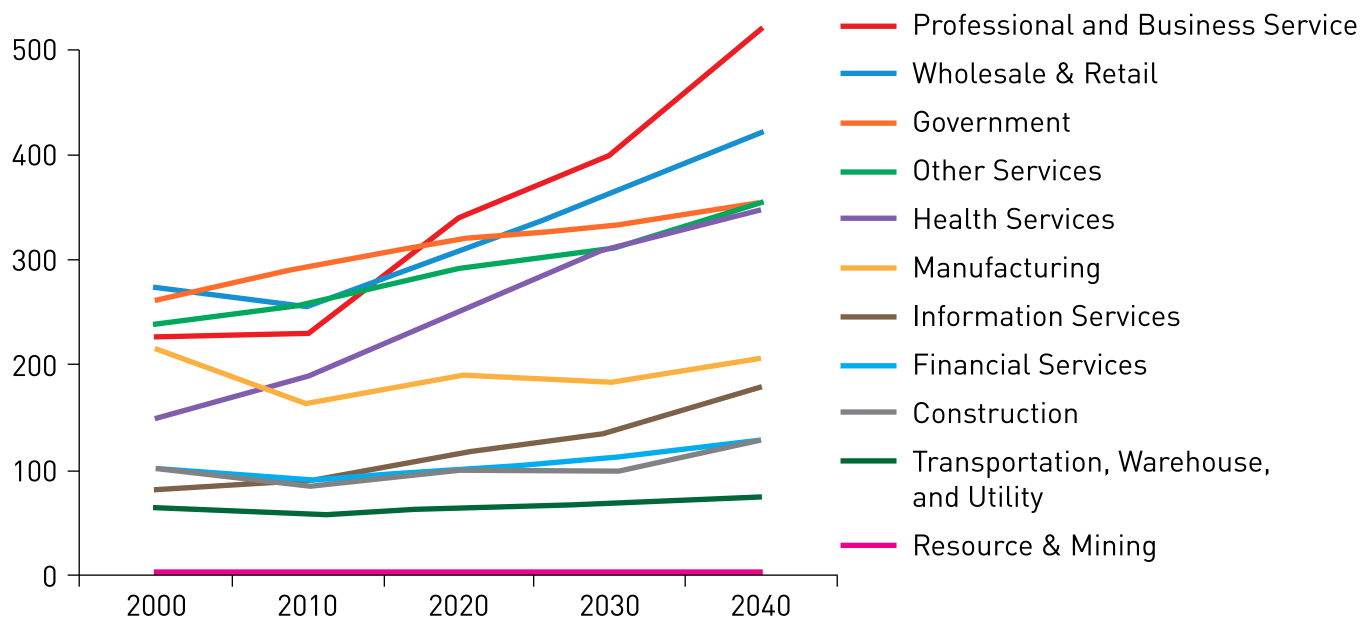
6.0 FUTURE FREIGHT GROWTH IN THE SEATTLE REGION

As discussed in the existing conditions, the future of freight volumes in Seattle depends on two principal factors 1) economic growth in Seattle and the surrounding region and 2) international trade moving through Seattle region ports. These fundamental drivers of freight overlap to the extent that international trade volumes are destined to or originate in the Seattle region. Sections which follow describe regional economic projections that drive local freight volumes and projections of international trade volumes and rail volumes moving through Seattle related to that growth.

6.1 SEATTLE ECONOMIC GROWTH AND ITS IMPACT ON FREIGHT

To help address the question of regional economic growth prospects, a regional economic forecast prepared by the Puget Sound Regional Council is summarized in Figure 16, focusing on PSRC's employment growth projections by major economic sector. It should be noted that this forecast is for the Puget Sound region as a whole but these projected growth rates may be considered indicative of Seattle's growth prospects. The region's total employment is projected to grow from 1.7 million in 2010 to 2.7 million in 2040, an increase of 58% over that period. Specifically, in Seattle total employment in may increase by as many as 115,000 jobs by 2035 (Seattle Comprehensive Plan Update). However, freight volumes are likely to grow at that average rate or higher based on: 1) above-average growth in freight generating sectors, and 2) increases in industry productivity, which leads to growth in industry output (and freight volumes) greater than increases in employment.

FIGURE 16: PUGET SOUND 2012 ECONOMIC FORECAST - EMPLOYMENT BY MAJOR SECTOR



Source: Puget Sound Regional Council and Parsons Brinckerhoff analysis

Employment in the largest freight-generating sectors, wholesale and retail trade, specifically, is projected to grow by 64% from 2010 to 2040 compared to the 58% average for all industries, which would lead to the conclusion that freight could be expected to grow faster than average employment growth. While projected 27% growth in manufacturing employment is lower than the average of all industries manufacturing output has historically increased more than employment due to productivity improvements. Those trends are expected to continue.

Based on the projected aggregate employment increases of 58% from 2010 to 2040, greater than average growth in major freight generating industries, and the expectation that productivity increases will continue in manufacturing, it may be expected that increases in freight volume related to local regional economic growth will be a minimum of 60% from 2010 to 2040. This represents a compounded annual growth rate of 1.6%. Actual growth is likely to be higher. Average annual growth of 2.0% would result in 2010 to 2040 an 80% total increase in freight. Annual average growth of 2.5% would more than double local freight volumes from 2010 to 2040. According to FHWA FAF data total freight tonnage from, to and within the Seattle region is projected to grow 2.2% per year from 2012 through 2040.

In summary, freight is expected to grow between 60% and 100% over the next 25 years.

6.2 GROWTH IN INTERNATIONAL TRADE AND ITS IMPACT ON FREIGHT

International freight volumes moving through Seattle region ports, and the major subset represented by containerized trade, are driven by four fundamental factors:

- US demand for goods including consumer spending and business investment
- The share of demand met by imported goods, i.e. the import propensity
- Sourcing of imported goods, i.e. Northeast Asia vs. Europe vs. Canada or Mexico
- The share of international goods handled by Seattle region ports

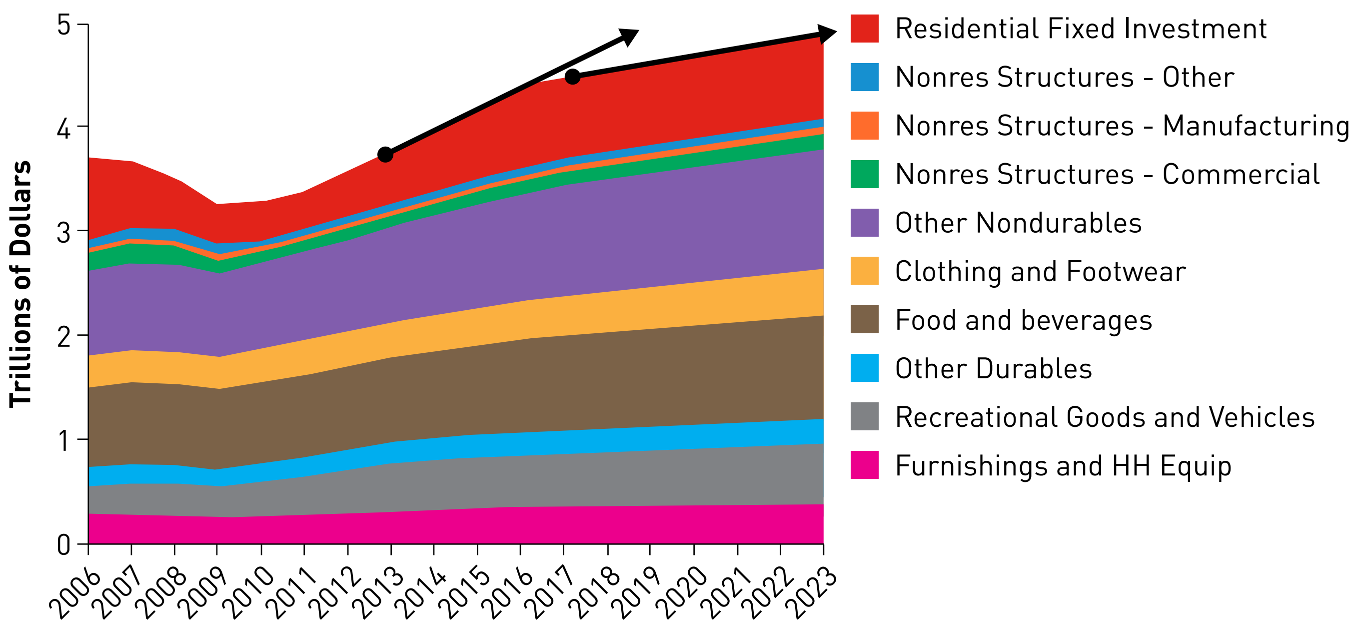
US Demand

US demand for imported goods is the fundamental driver of total container trade volumes. Imports significantly outweigh exports and the difference is comprised of large numbers of empty exported containers.

US demand can be viewed in terms of major components of Gross Domestic Product (GDP) that are related to goods as opposed to services. As displayed in Figure 17, these major components of GDP include consumer spending for durable goods such as furniture and household equipment and recreational goods, and non-durable goods including food and beverages and apparel. Demand also includes residential investment and business investment in structures.

As shown in the figure, projected short term growth in total real GDP for the selected components is higher than longer term growth largely due to projected increases in residential investment. A recovery in the housing sector, which declined sharply during the Great Recession, is expected to spark the short term spike in growth. Average projected growth in 2014 to 2017 is 4.7% while the average for 2018 to 2023 is 1.6%.

FIGURE 17: TOTAL OF REAL GDP COMPONENTS

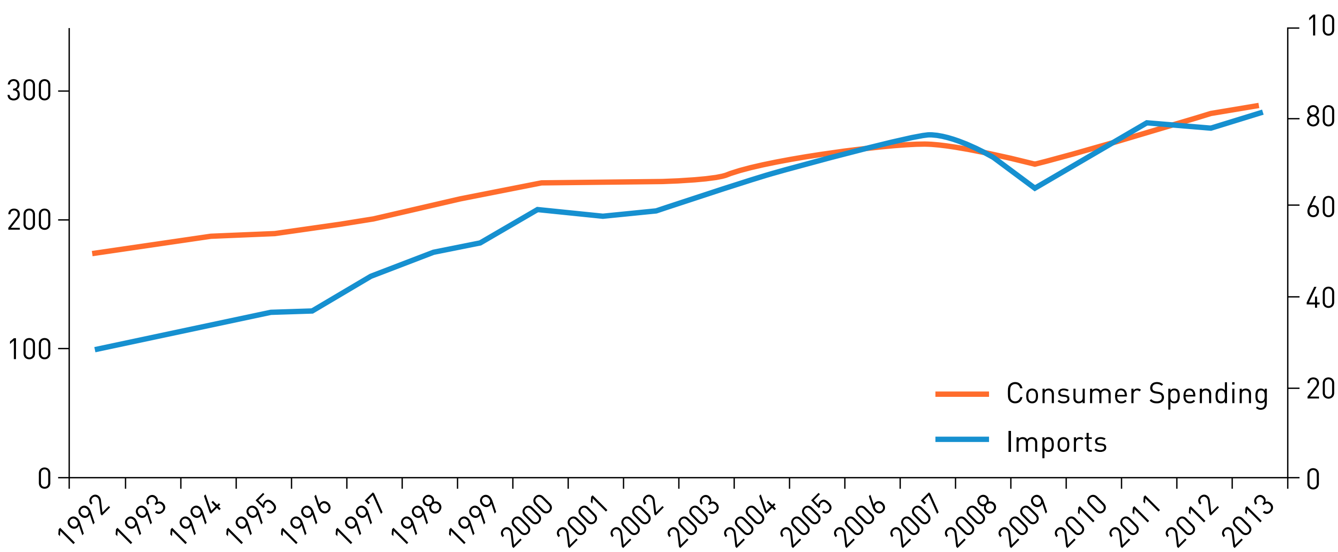


Source: Parsons Brinckerhoff, Los Angeles Economic Development Corporation International Trade Outlook Conference, June 5, 2014

Import Propensity

In past years growth in import volumes was driven in part by an increasing share of total demand being met by imports (i.e. the outsourcing of manufacturing to other countries). For many product categories, this trend has come to an end and is no longer an independent source of container trade growth. For example, in the figure shown below it can be seen that imports of apparel increased faster than consumer spending on apparel though 2005, but has tracked relatively closely from 2006 through 2013.

FIGURE 18: U.S. IMPORT PROPENSITY (OUTSOURCING) – CONSUMER SPENDING ON APPAREL VS. IMPORTS ($BILLIONS)



Sourcing of Imported Goods

Another source of historic US container trade growth has been changes in import sourcing. As shown in the figure 19, below, beginning in 2000 Mexico's position as the principal exporter of apparel began to decline as China's share of imports grew rapidly. Since imports from Mexico were largely transported by rail or truck to US destinations while imports from China are transported primarily by water through US ports, this has resulted in an increase in container trade solely due to sourcing and the related shift in modal transportation rather than fundamental demand as noted above. Most recently sourcing of apparel has shifted from China to other countries such as Vietnam but such shifts still involves ocean transportation, largely through West Coast ports. If there were a shift in sourcing back to Mexico (near-shoring) from overseas locations, this would mean a relative reduction in container trade given any level of demand.

Port Shares of Total US Container Trade

The final major factor affecting Seattle region ports' container volumes is their share of total US container trade. As shown in the figure below, this share declined during the 1990's but has been relatively stable, at about 9%, since 2000. The question of how Seattle's share of US container volumes may change is further discussed below.

FIGURE 19: COUNTRY SHARES OF U.S. IMPORT VALUE FOR APPAREL

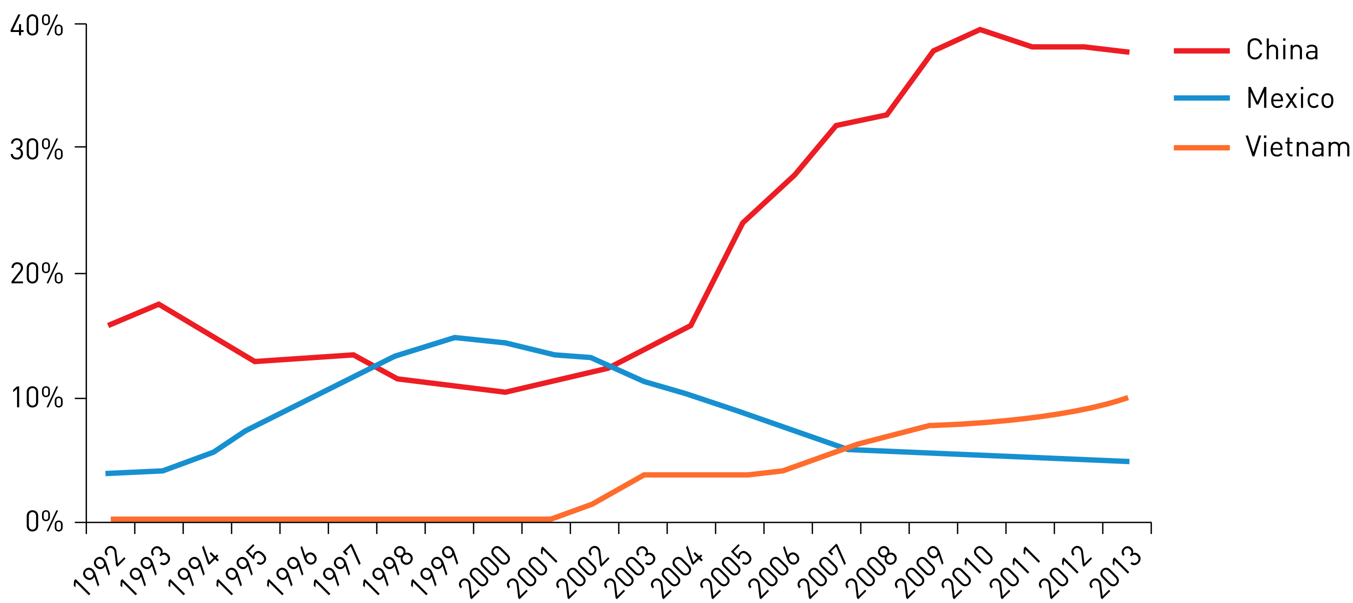
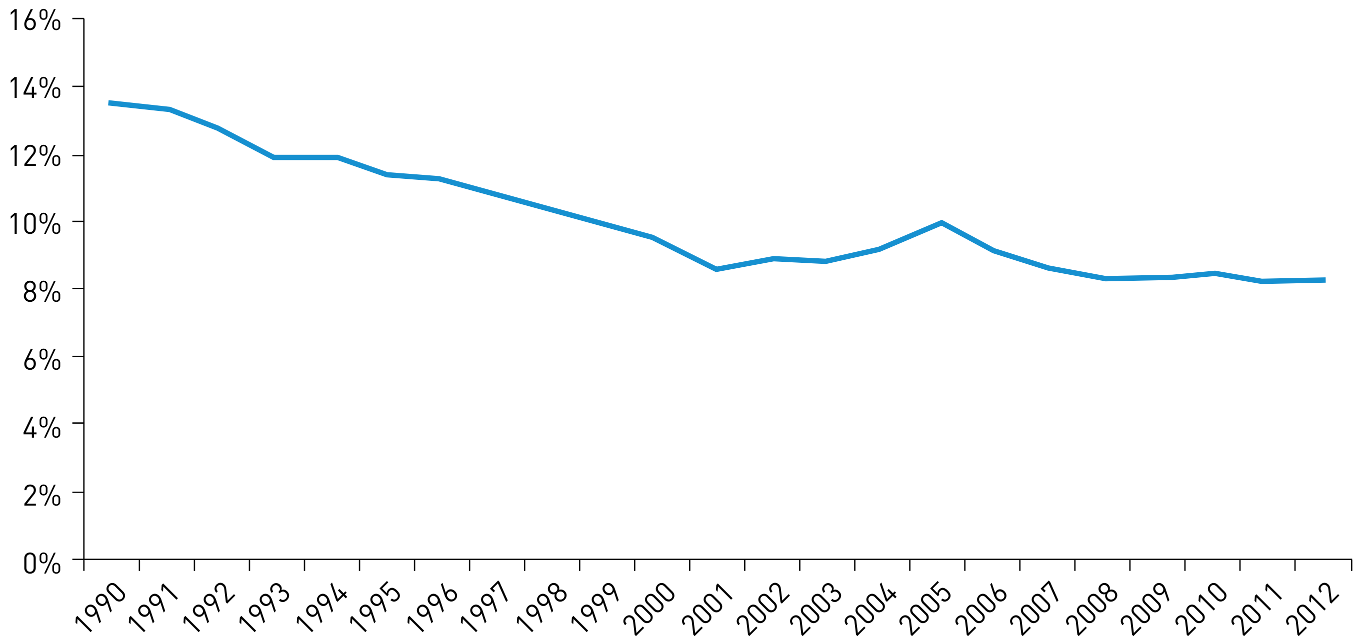


FIGURE 20: SEATTLE REGION PORTS' SHARES OF TOTAL US CONTAINER TRADE



Source: American Association of Port Authorities and Parsons Brinckerhoff analysis

The Port of Seattle's Century Agenda was developed in 2012 and targets long-term growth in its container operations in order to increase local and regional jobs. Its goal is to increase container throughput to 3.5 million TEUs within about 25 years. If growth were to continue at the same rate as the past decade—at 3.5% per year—then the Port could reach its 3.5 million TEU goal in about 22 years. If growth were to slow to a rate of 2% per year, the goal would be reached in about the year 2050. For planning purposes, the Port has assumed that the growth target can be achieved by the year 2035.

Due to competitive pressures which have resulted in erosion of market-share, the Ports of Seattle and Tacoma recently announced a decision to join their container terminal operations.[13] This is an attempt to help them achieve the more aggressive target. However, the alliance is brand new and the competitive pressures from Ports in Southern California and Canada are quite real, so it is too early to predict the effect.

As container volumes through the Port of Seattle increase, more of them (both in terms of volume and as a percentage of the total) would be transported to larger inland markets in other parts of the country via rail. While local consumption will increase, it will continue to comprise a smaller portion of the overall growth compared to growth of inland markets throughout the U.S. As previously described, at its peak in 2006/2007, approximately 646,000 TEUs per year, or 57% of all containers through the Port of Seattle, were transferred to or from rail. For planning purposes, this is expected to increase to 2,100,000 TEUs per year, or 60% of the throughput, with total volumes at 3.5 million TEUs per year. This would reflect an annual growth rate in direct rail volume of between 8.2% and 2.4% per year depending on whether that throughput is achieved by 2035 or 2050.

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[13] www.bizjournals.com/seattle/news/2014/10/07/in-historic-decision-ports-of-seattle-and-tacoma.html?page=all

The Port has available capacity to spread the growth out among several terminals or concentrate it at one or two terminals. If concentrated at Terminal 5 and/or 18, a higher percentage of cargo is likely to be moved direct to rail at those terminal's on-dock rail yards. If concentrated at Terminal 46, then more would be drayed to the near-dock rail yards. Depending on the growth scenario, total trucks trips at the Port of Seattle are forecast to range from 11,000 to 12,600 one-way trips per day. About 5,500 of these would be trips beyond the local industrial area and near-dock rail yards.[14]

6.3 GROWTH IN RAIL AND TRUCK VOLUMES

According to FHWA FAF forecast data US waterborne imports through Seattle region ports will triple from 18 million metric tons in 2012 to 55 million metric tons in 2040 but there will be a slight long-term modal shift from trucking to rail. The rail share of total US import tonnage through Seattle region ports to all US regions is projected to increase from 29% in 2012 to 33% in 2040, and the truck share is projected to decrease from 60% to 58% over that same period.

US exports through Seattle region ports are projected to nearly triple from 2012 to 2040, increasing from 36 million metric tons in 2012 to over 100 million metric tons in 2040. While rail volumes are projected to grow, truck volumes are expected to grow more rapidly, with the rail share of total volumes expected to decrease from 47% in 2012 to 40% in 2040. The truck share is expected to grow from 49% to 57% over this same period.

With any long term freight forecast, there are many variables. Not only is this subject to international economic and logistics factors, but local project relating to movement of oil, grain and coal could also impact the projection. If capacity is constrained by local projects, then modal shifts could occur, unless improvements are developed to meet those demands.

6.4 EFFECTS OF CLIMATE CHANGE ADAPTATION

Adaptation to the effects of climate change has taken two principal forms in the freight industry: improvement in fuel efficiency and management of risk from disruption.

Fuel Efficiency

Supply chain managements in many sectors have taken aggressive action in respect to fuel usage, and their carriers have followed suit, as is extensively documented in the recently released NCFRP Report 28 "Sustainability Strategies Addressing Supply Chain Air Emissions".[15] The primary motivation for improvement has been the rise in fuel prices over the past decade, but reduced fuel use also reduces greenhouse gas emissions, an effect that industry has embraced.

Goals for fuel economy and CO2 reduction are often cited together, and methods of achieving them are diverse. Examples include changed designs in distribution networks, length of haul and empty mile reduction, product densification, routing practices, driver training and tracking, and a variety of equipment improvements in trailers, tires, and motive power. Most notable is the serious if gradual adoption of natural gas powered vehicles, which produce lower GHG emissions than diesel as a transportation fuel, provided methane release in the supply system can be controlled. The surge in availability of low cost natural gas from U.S. domestic sources has been behind this development, and while the recent drop in oil prices to four year lows could slow it, that drop can be interpreted as an attempt by overseas competitors simply to diminish U.S. production.[16] Fuel remains a major component

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[14]Heffron Transportation, Inc., April 2014.
[15]Available at www.trb.org/main/blurbs/170749.aspx
[16]See for example www.nytimes.com/2014/11/29/business/energy-environment/free-fall-in-oil-price-underscores-shift-away-from-opec.html?module=Search&mabReward=relbias%3Ar%2C%7B%221%22%3A%22RI%3A6%22%7D

of transportation and distribution cost, and industry efforts to control it are unlikely to abate. From a GHG perspective, this means that private sector efforts that reduce carbon emissions will continue, quite apart from regulatory efforts that political forces may block.[17]

Management of Risks from Disruption

The consequences of climate change include greater frequency of severe weather events. Costly incidents of recent years including tempests and bitter winter weather have captured the attention of supply chain managements, such that natural disasters loom nearly as large as potential labor stoppages as a risk factor for supply chain disruption.[18] Initiatives to manage such risks begin with resiliency – for example, by utilizing geographically dispersed suppliers or gateways. They ultimately extend to facility location decisions, such that locations at lower risk for disruptive weather could become preferable.

6.5 CONCLUSION

Based on the fundamental drivers of US demand represented by consumer spending and investment, US container trade may be expected to grow in the short term (i.e. through 2017) at a rate of over 4% per year depending in large part on the recovery of the US housing sector. Long term growth in container trade could be expected to grow on the order of 2% per year thereafter based on growth of total real GDP components most closely related to imports of goods.

Increasing imports relative to demand and changes in sourcing are not expected to provide additional boosts to container trade volumes such as those experienced in the past.

Given these relatively stable fundamental drivers of container volumes, Seattle region ports' volumes may be expected to grow on the order of 2% per year with additional volumes in the Port of Seattle dependent on the success of its *Century Agenda* program.

The mid-range growth of 2% for freight volumes related to regional economic growth described earlier is at the same level as the 2% growth rate for international trade just outlined, indicating that the balance between the two principal sources of freight volumes will remain roughly the same. Based on anticipated growth and trends in logistics, section 6.1 concluded that freight would grow between 1.6 and 2.5% annually for the next 30 years. Taking 2% as a conservative baseline, freight volumes can then be expected to increase by approximately 55% between 2013 and 2035.

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[17]Example of a recent regulatory proposal in the general area of greenhouse gas emissions is summarized at www.nytimes.com/2014/06/03/us/politics/key-details-of-epa-carbon-emissions-proposal.html?module=Search&mabReward=relbias%3As%2C%7B%221%22%3A%22RI%3A6%22%7D
[18]Tompkins International Supply Chain Consortium, June 2012

7.0 FREIGHT'S IMPACT ON THE ECONOMY

The sections above demonstrate the important role that freight intensive industries play in the Seattle economy today, describes how these sectors are expected grow and forecasts the effect on freight volumes.

Other recent studies further illuminate the broader effect freight intensive sectors have on the Seattle economy. A National Cooperative Freight Research Program study found that, in 2011, freight dependent industries like manufacturing, retail and wholesale, construction and natural resources were responsible for over 30% of the Seattle/Tacoma region's GDP.[19] Two local studies, one which explores the importance of the maritime industry to Seattle and the other calculates the economic impact of congestion on the region, are discussed below.

THE ECONOMIC IMPACT OF THE MARITIME INDUSTRY

The maritime industry has a long and central role in the Washington State economy. Core maritime industries include maritime logistics and shipping, ship and boat building, maintenance and repair, fishing and seafood processing and passenger water transportation. A recent report estimated that the state had 57,700 maritime industry jobs with gross business sales of $15.2 billion in 2012.[20]

The maritime industry is supported by numerous support industries including technical services, supply and wholesale and professional services. In addition to jobs and spending in supporting industries, there are also benefits from personal spending. The report calculates a combined impact of 148,000 jobs and $30 billion sales, from the maritime industry as shown in Figure 21.

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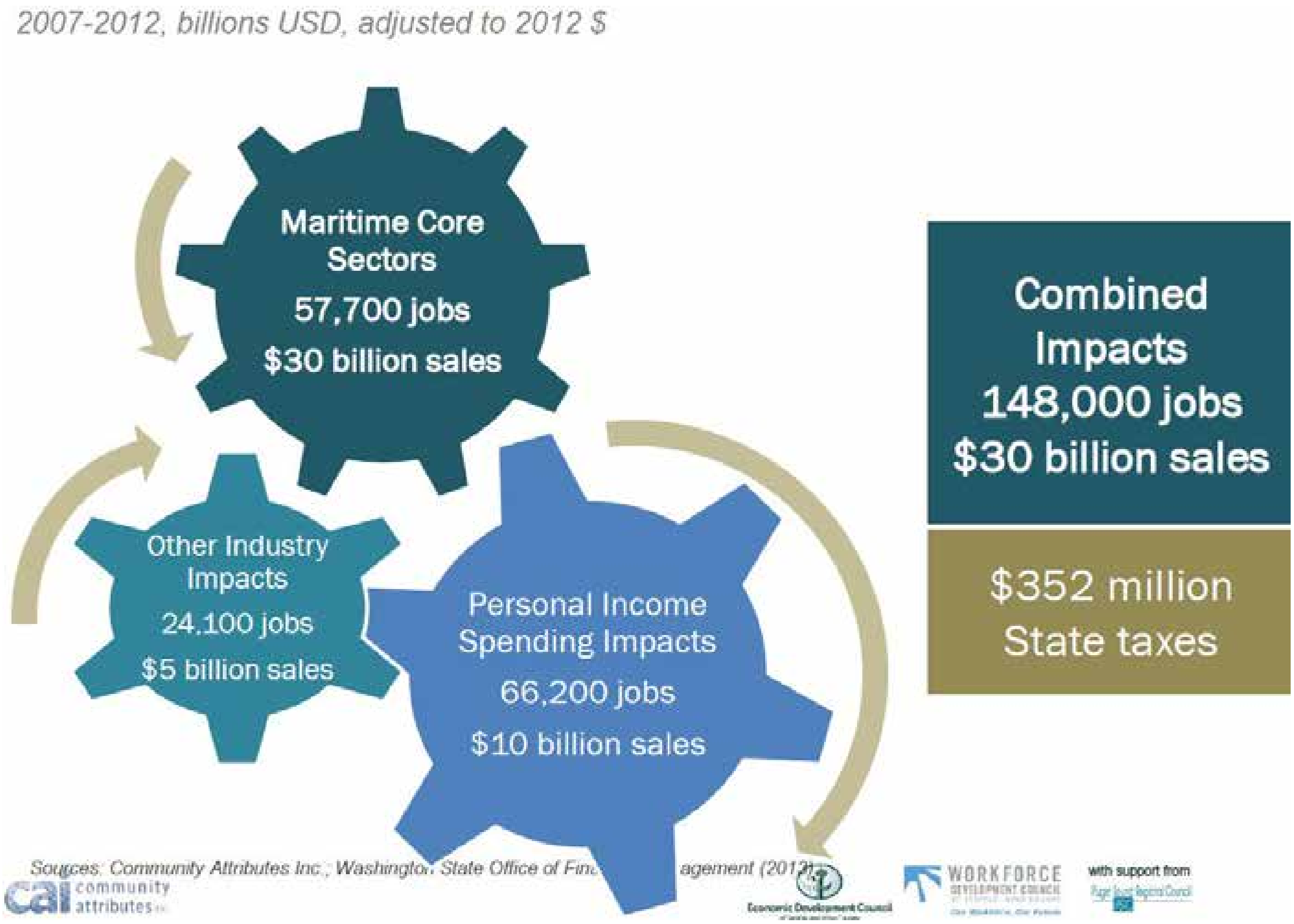
[19]Jose Holquin Vargas, "Freight Action Strategy for the Seattle Tacoma Corridor Case Study" (NCFRP 38, 2014)
[20]Community Attributes Inc., Washington State Maritime Cluster (Economic Development Council of Seattle and King County and Workforce Development Council of Seattle and King County, November 2013)

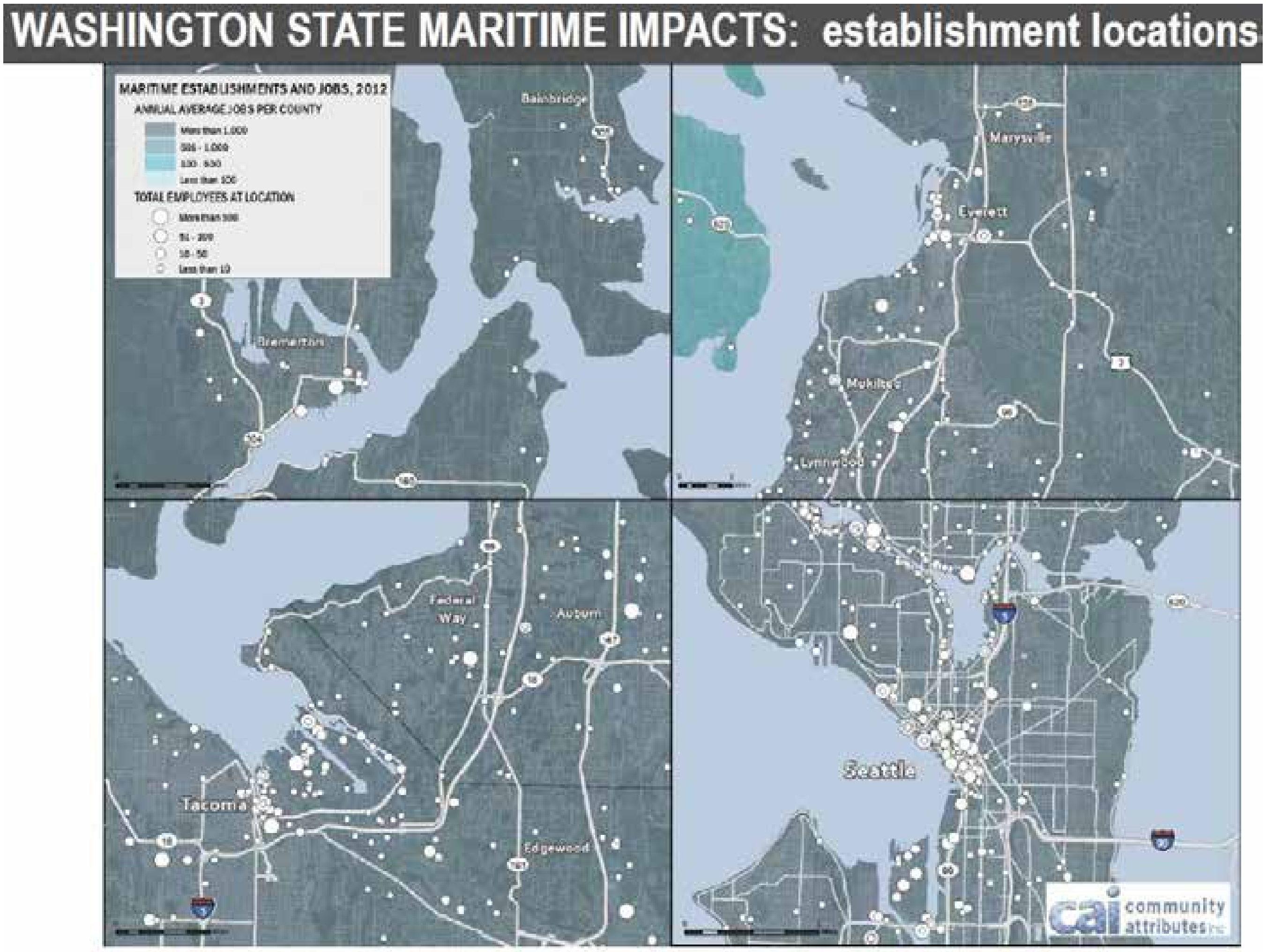
FIGURE 21: WASHINGTON STATE MARITIME IMPACTS[21]



[21]Community Attributes Inc., The Impacts of the Maritime Industry in Washington State, (presentation to the freight Mobility Roundtable, 2014)

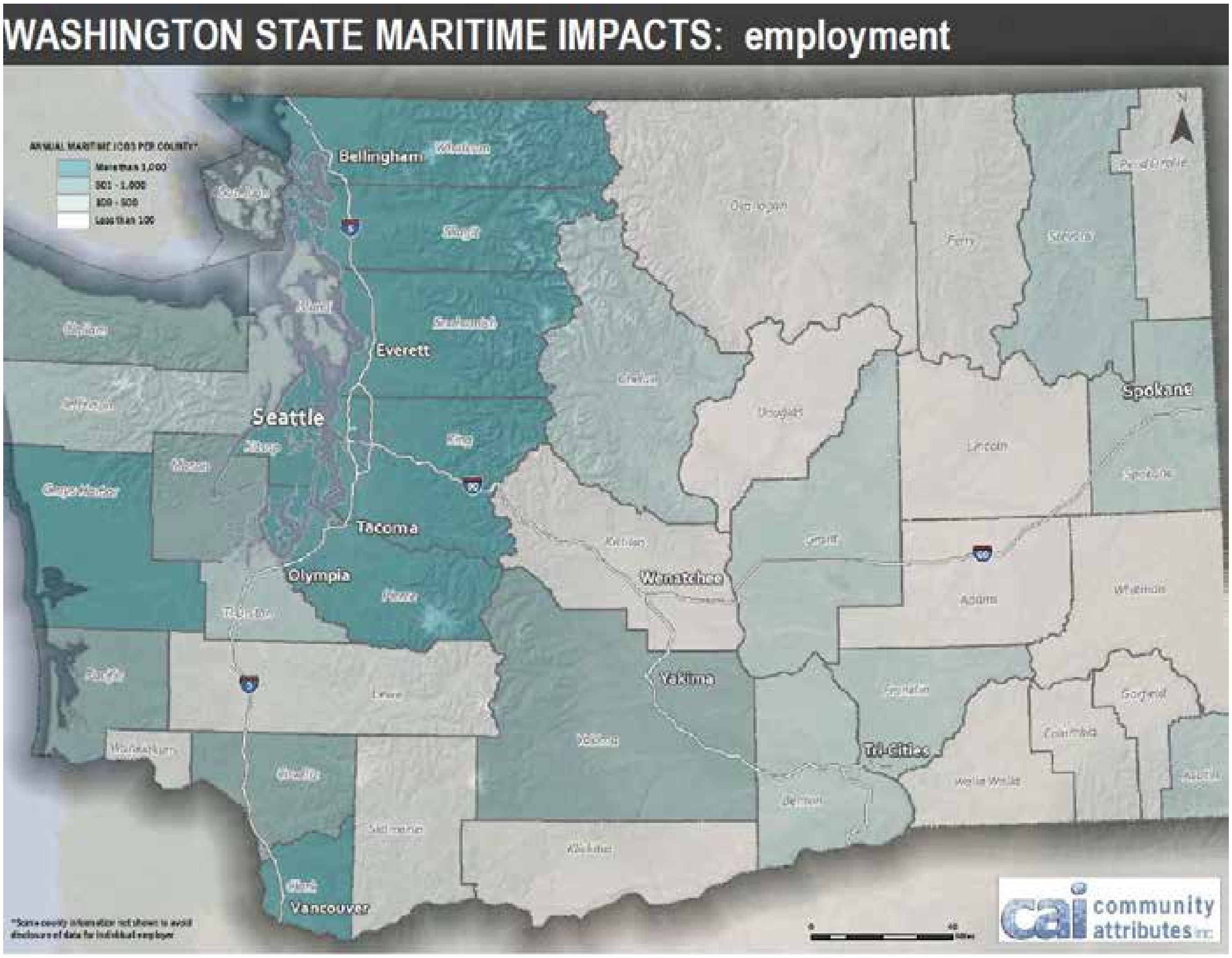
These facilities and jobs are concentrated in the Puget Sound region as shown in Figures 22 and 23.

FIGURE 22: MARITIME ESTABLISHMENT LOCATIONS[22]



22CAI, 2014 p 9-10

FIGURE 23: MARITIME EMPLOYEMENT BY COUNTY



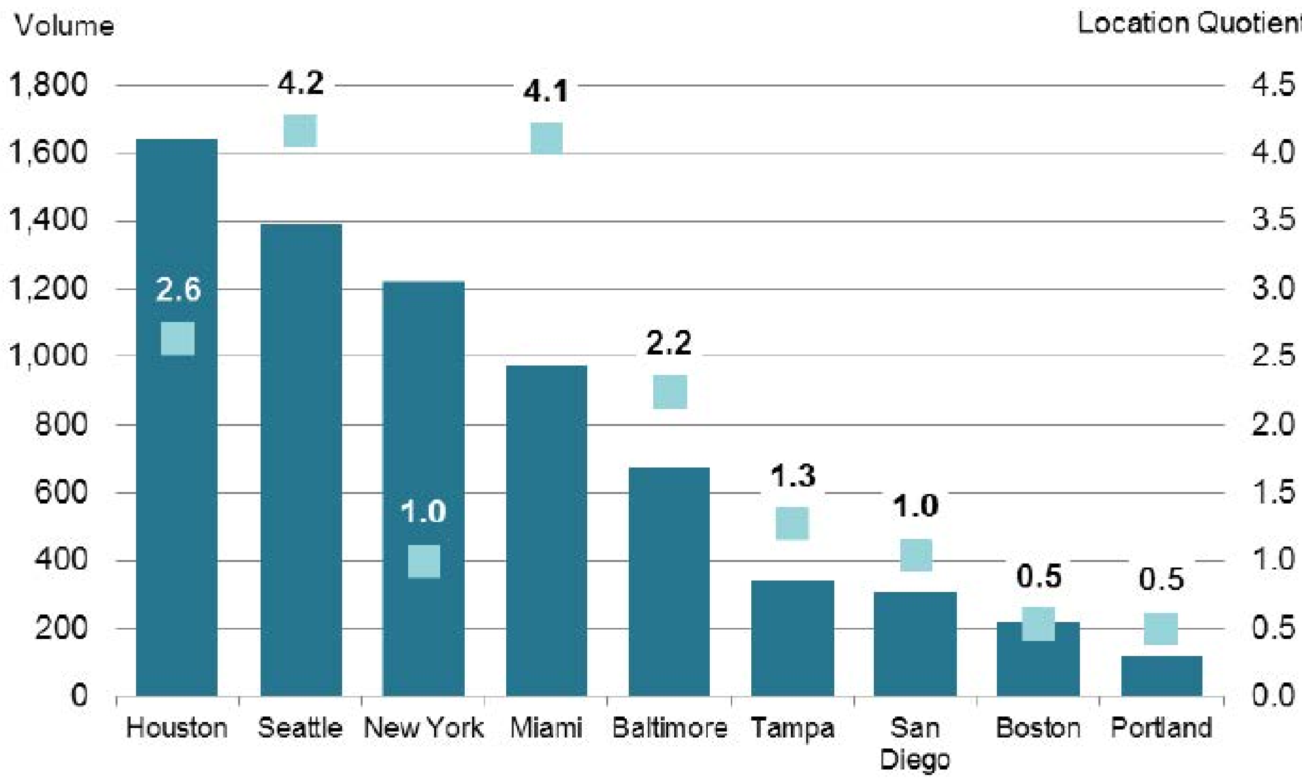
Most of these jobs offer wages higher than the state median wage of $51,000 in 2012. Maritime jobs include marine and related industry engineers, operators of maritime equipment, capitals mates and pilots, fish and game wardens and various kinds of technicians. Lower wages jobs include fish cutters and machine setters or cutting and slicing.[23]

The report points to the high concentration of key occupations as an indicator of the State's prominence in the maritime industry. Seattle has locations quotients between four and seven times the national average for ship engineers, sailors and marine oilers and captains mates and pilots. This places it in the top one or two of major coastal regions in the country.[24]

Figure 24 compares Seattle to selected coastal metropolitan statistical areas in terms of the volume and location quotient of captains, mates and pilots.

[23]Community Attributes Inc, 2013, p 64.
[24]CAI, 2013, p58

FIGURE 24: VOLUME AND RELATIVE CONCENTRATION OF CAPTAINS, MATES AND PILOTS (LOCATION QUOTIENT), SELECT MSAS[25]



Source: U.S. Bureau of Labor Statistics, Occupational Employment Statistics (2012).

THE IMPACT OF CONGESTION ON THE FREIGHT ECONOMY

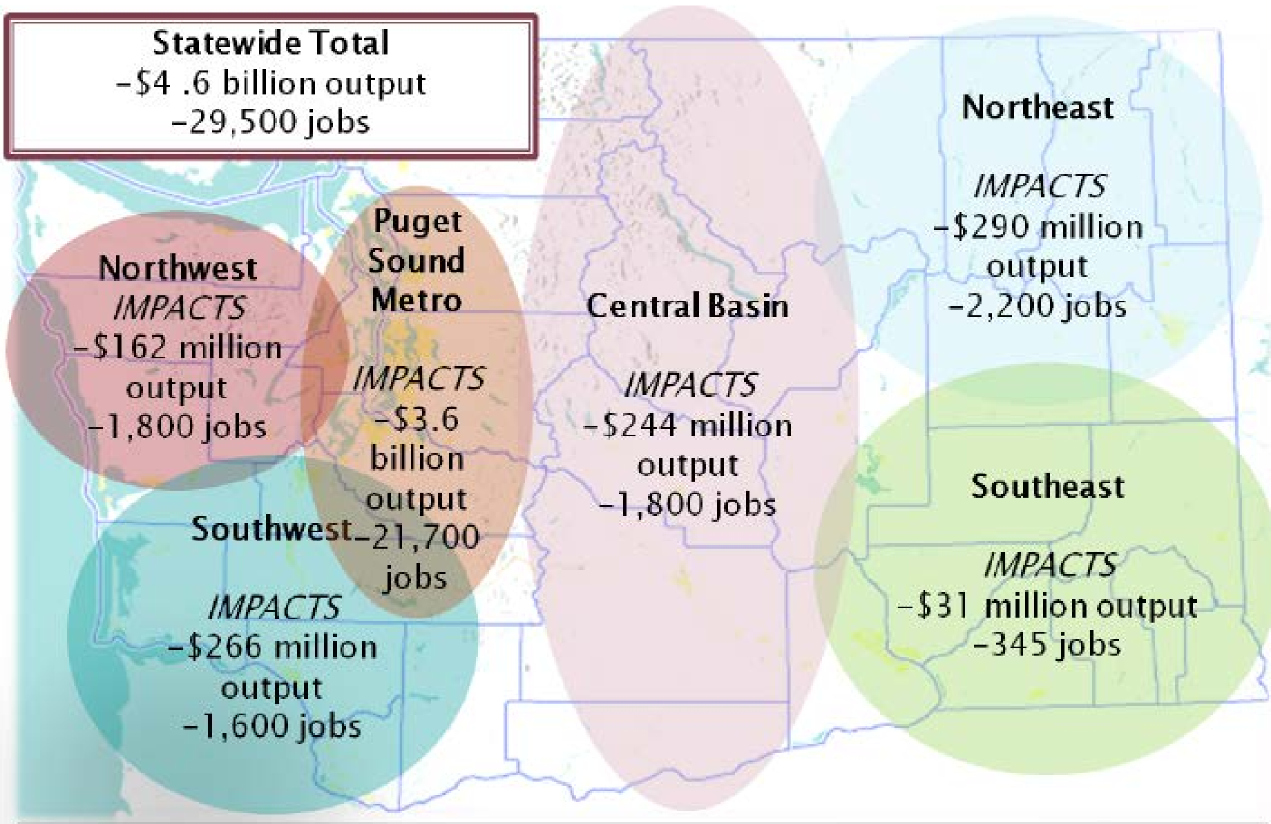
In 2012, WSDOT published *The Economic Impact of Increased Congestion for Freight-Dependent Businesses in Washington State*. The report, prepared by Justin Taylor of 2L Data Solutions with Ken Casavant and Danna Moore of the Freight Policy Transportation Institute at WSU, used IMPLAN to determine the economic output of freight dependent businesses in Washington State. It took into account a survey with over 1,000 businesses regarding the impact of increased congestion.

Using input output analysis, the study found that a 20 percent increase in congestion would cost the state 29,500 jobs and $4.6 billion in economic output. Overall, this represents more than a .7% loss in employment and output statewide. While increased congestion forces industries to add employees and assets, these are more than off-set as consumers have to pay more for these products and have less to spend in other areas.

In the Puget Sound region, where freight dependent industries are concentrated, these losses are even more staggering. The study estimated that the Puget Sound region would lose an estimated 21,700 jobs and $3.6 billion in output. With a 20 percent increase in congestion, the region is estimated to lose .9% of its employment and .82 percent of its economic output. Figure 25 shows the economic impacts of a 20 percent increase in congestion by region.

[25]CAI, 2013, p59

FIGURE 25: STATEWIDE AND REGIONAL EFFECTS OF CONGESTION ON ECONOMIC OUTPUT AND JOBS.[26]



Region	Employment	Output ($millions)	Percentage of Regional Total: Employment	Percentage of Regional Total: Output
Northwest	-1,786	-$162	-0.48%	-0.29%
Southwest	-1,622	-$266	-0.52%	-0.57%
Central Basin	-1,793	-$244	-0.47%	-0.54%
Northeast	-2,213	-$290	-0.77%	-0.80%
Southeast	-345	-$31	-0.31%	-0.21%
Puget Sound	-21,741	-$3,600	-0.90%	-0.82%
Statewide Total	**-29,500**	**-$4,600**	**-0.76%**	**-0.72%**

This paper has described the important role that freight generating industries play in the Seattle economy and developed a forecast of freight volumes moving within the region. It has broadly outlined the potential effects that congestion could have on these industries. A subsequent memo will detail the conditions for truck mobility and accessibility within Seattle today and in the future.

[26] Justin Taylor, Ken Casavant, Danna Moore, Jeremy Sage and Barbara Ivanov, "The Economic Impact of Increased Congestion for Freight Dependent Businesses in Washington State" Transportation Research Board 92nd Annual Meeting, (Washington, D.C.), January 2013.

Seattle Department of Transportation

SEATTLE 2035 COMPREHENSIVE PLAN APPENDIX H

SDOT

Seattle Department of Transportation

Below is a selection of relevant goals and policies found in the Seattle Comprehensive Plan update that relate to freight and industrial lands.

<table>
<tr><th colspan="2">Growth Strategies Element</th></tr>
<tr><td>GS 2.15</td><td>“Designate areas as manufacturing/industrial centers consistent with the following characteristics and with the Countywide Planning Policies:
Existing zoning that promotes manufacturing, warehousing, and distribution uses
Zoning that discourages uses that pose short- or long-term conflicts with industrial uses, or that threaten to convert significant amounts of industrial land to nonindustrial uses
Zoning that strictly limits residential uses and discourages land uses that are not compatible with industrial uses
Buffers that protect neighboring, less intensive land uses from the impacts associated with industrial activity (provided by generally maintaining existing buffers, including existing industrial buffer zones)
Sufficient zoning capacity to accommodate a minimum of ten thousand jobs
Relatively flat terrain allowing for efficient industrial processes
Reasonable access to the regional highway, rail, air, and/or waterway systems for transportation of goods”</td></tr>
<tr><th colspan="2">Transportation Element</th></tr>
<tr><td>T 1.6</td><td>Enhance goods movement to, within, and between Seattle’s manufacturing/ industrial centers and urban villages and business districts.</td></tr>
<tr><td>T G 2</td><td>Allocate space on Seattle’s streets to safely and efficiently connect and move people and goods to their destinations while creating inviting spaces within the rights-of-way.</td></tr>
<tr><td>T 2.1</td><td>Devote space in the street right-of-way to accommodate multiple functions of mobility, access for commerce and people, activation, landscaping, and storage of vehicles</td></tr>
<tr><td>T 2.2</td><td>Ensure that the street network accommodates multiple travel modes, including transit, freight movement, pedestrians, bicycles, general purpose traffic, and shared transportation options.</td></tr>
<tr><td>T 2.3</td><td>Consider safety concerns, modal master plans, and adjacent land uses when prioritizing functions in the pedestrian, travelway, and flex zones of the right-of-way</td></tr>
<tr><td>T 2.5</td><td>Prioritize mobility needs in the street travelway based on safety concerns and on the recommended networks and facilities identified in the respective modal plans.</td></tr>
<tr><td>T 4.6</td><td>Improve mobility and access for freight in order to reduce truck idling, improve air quality, and minimize the impacts of truck parking and movement in residential areas.</td></tr>
<tr><td>TG 5</td><td>Improve mobility and access for the movement of goods and services to enhance and promote economic opportunity throughout the city.</td></tr>
<tr><td>T 5.1</td><td>Enhance Seattle’s role as the hub for regional goods movement and as a gateway to national and international suppliers and markets.</td></tr>
<tr><td>T 5.2</td><td>Develop a truck freight network in the Freight Master Plan that connects the city’s manufacturing/industrial centers, enhances freight mobility and operational efficiencies, and promotes the city’s economic health.</td></tr>
<tr><td>T 5.3</td><td>Ensure that freight corridors are designed, maintained, and operated to provide efficient movement of truck traffic.</td></tr>
</table>

Transportation Element (continued)	
T 5.4	Use intelligent transportation system technology to alert motorists, bicyclists, and pedestrians to the presence and anticipated length of closures due to train crossings and bridge openings for water vessels.
T 5.5	Evaluate the feasibility of grade separation in locations where train-induced street closings result in significant delays and safety issues for other traffic, and improve the safety and operational conditions at rail crossings of city streets.
T 5.6	Work with freight stakeholders and the Port of Seattle to maintain and improve intermodal freight connections involving Port container terminals, rail yards, industrial areas, airports, and regional highways.
T 5.7	Support efficient and safe movement of goods by rail where appropriate, and promote efficient operation of freight rail lines and intermodal yards.
T 5.9	Improve access to urban villages and other neighborhood business districts for customers and delivery of goods.
T 6.5	Improve safety for all modes of transportation on streets heavily used by trucks.
T 6.6	Invest in education measures that increase mutual awareness among motorists, pedestrians, and bicyclists
T 7.5	Plan for the city's truck freight network, developed as part of the Freight Master Plan, to connect to the state and regional freight network, and to continue providing good connections to regional industrial and warehouse uses.
T 8.6	Designate a heavy haul network for truck freight to provide efficient freight operations to key port terminals and intermodal freight facilities.
Container Port Element	
CP 1.8	"Make operational, design, access, and capital investments to accommodate trucks and railroad operations and preserve mobility of goods and services. Improvements may include improvement of pavement conditions, commute trip reduction strategies, roadway rechannelization to minimize modal conflicts, use of intelligent transportation systems, construction of critical facility links, and grade separation of modes, especially at heavily used railroad crossings."
CP 1.10	Identify emerging cargo-container freight transportation issues by working with affected stakeholder groups, including the Seattle Freight Advisory Board. Provide regular opportunities for communication between the City, the freight community, other affected communities, and other agencies and stakeholders.
CP 1.11	Continue joint City and Port efforts to implement relevant Port recommendations, such as recommendations contained in the Container Terminal Access Study.
CP 1.12	Given the importance of cargo container–terminal operations to the state and regional economies, develop partnerships within the City, the Port, the region, and the State to advocate for project prioritization and timely funding to improve and maintain freight infrastructure, and explore funding partnerships.
CP 1.13	Maintain consistency between local, regional, and State freight-related policies.
CP 1.15	Work cooperatively with other agencies to address the effects of major land use and transportation projects to avoid or mitigate construction and operational effects on the cargo container–industry sector.

Land Use Element	
LU G10	Provide sufficient land with the necessary characteristics to allow industrial activity to thrive in Seattle and protect the preferred industrial function of these areas from activities that could disrupt or displace them.
LU 10.2	Preserve industrial land for industrial uses, especially where industrial land is near rail- or water-transportation facilities, in order to allow marine- and rail-related industries that rely on that transportation infrastructure to continue to function in the city.
LU 10.3	Accommodate the expansion of current industrial businesses and promote opportunities for new industrial businesses within Seattle to strengthen the city's existing industrial economy
LU 10.5	"Provide a range of industrial zones that address varying conditions and priorities in different industrial areas. Those priorities include maintaining industrial areas that have critical supporting infrastructure, providing transitions between industrial areas and less intensive areas, and promoting high-quality environments attractive to business expansion or to new industrial activities."
LU 10.7	Use the general industrial zones to promote a full range of industrial activities and related support uses.
LU 10.11	Recognize the unique working character of industrial areas by keeping landscaping and street standards to a minimum to allow flexibility for industrial activities, except along selected arterials where installing street trees and providing screening and landscaping can offset impacts of new industrial development in highly visible locations.
LU 10.12	Set parking and loading requirements in industrial zones to provide adequate parking and loading facilities to support business activity, promote air quality, encourage efficient use of the land in industrial areas, discourage underused parking facilities, and maintain adequate traffic safety and circulation. Allow some on-street loading and occasional spillover parking.