SR 167 Master Plan
Planning and Environmental Linkages Study

Attachment B, Appendices A through H

Final Study

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Washington State Department of Transportation

WSDOT

Appendix A. Sources and Additional Resources

Chapter 1 – Introduction

Additional Resources

See the following resources for more information on PEL. studies

- FHWA Planning and Environmental Linkages
- FHWA Questionnaire
- Colorado Department of Transportation Planning and Environmental Linkages Handbook (version 2)
- WSDOT Environmental Manual Chapter 200.04

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Chapter 3 – Community Profile

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Geographic Information Systems Data Sources

Air Quality

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- PM10 (2021 end) - WADOE, Accessed 2021 Published 2017. https://services.arcgis.com/6lCKYNJLvwTXqrmp/arcgis/rest/services/PM10_Maintenance_Areas/FeatureServer/0
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  - Pierce County Parcel and Assessor data. Downloaded December 2021. https://gisdata-piercecowa.opendata.arcgis.com/datasets/piercecowa::tax-parcels/about
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- Historic Districts - WADAHP - 2021. https://services6.arcgis.com/yIPFYZqx6a8IC4Hk/ArcGIS/rest/services/DAHP_%e2%80%93_Register_Districts/FeatureServer

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  - DAHP Historic Property - WADAHP - 2021. https://dahp.wa.gov/about-us/geographic-information-system-information-technology-program
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Climate Vulnerability

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Environmental Justice

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Fish Passage

- WDFW Barriers - Environmental - WDFW - Fish Passage Sites 2021. https://geodataservices.wdfw.wa.gov/arcgis/rest/services/ApplicationServices/FP_Sites/MapServer
- WSDOT - Fish Passage Inventory Barrier Status 2021. https://data.wsdot.wa.gov/arcgis/rest/services/Shared/FishPassageData/MapServer/4
- WSDOT - Fish Passage Uncorrected Injunction Barriers 2021. https://data.wsdot.wa.gov/arcgis/rest/services/Shared/FishPassageData/MapServer/2

Flood Hazards

- FEMA Flood Zones and SFHAs 2021. https://www.arcgis.com/home/item.html?id=2b245b7f816044d7a779a61a5844be23

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  - Pierce County - Deep and/or Fast Flowing Floodway 2021. https://services2.arcgis.com/1UvBaQ5y1ubjUPmd/arcgis/rest/services/Deep_and_or_Fast_Flowing_Floodway/FeatureServer/0

Geologic Hazards

- **Erosion Hazards –**
  - King County, Erosion Hazard Layer. Accessed 2021. Publication data 1997. https://gisdata.kingcounty.gov/arcgis/rest/services/OpenDataPortal/enviro___base/MapServer/295
  - Pierce County Erosion Hazard Areas for unincorporated Pierce County. 2021. https://services2.arcgis.com/1UvBaQ5y1ubjUPmd/arcgis/rest/services/Erosion_Hazard_Areas/FeatureServer
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- **Landslide Hazard Buffer -**
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  - King County Seismic Area. Accessed 2021. Publication date 1997. https://gisdata.kingcounty.gov/arcgis/rest/services/OpenDataPortal/enviro___base/MapServer
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- **Liquefaction -**
  - King County Moderate to High Susceptibility Liquefaction. Department of Homeland Security (DHS) Accessed 2021. Publication data 2018. https://services.arcgis.com/XG15cJAlne2vxtgt/ArcGIS/rest/services/WA_King_Risk_Report_Web_8LiquefactionHazardLoss_201802/FeatureServer/0

  - DNR Accessed 2021, Publication date 2020. https://services6.arcgis.com/GWxg6t7KXELn1thE/arcgis/rest/services/Liquefaction_susceptibility_shapefile/FeatureServer
- **Volcanic Hazards** - Pierce County Volcanic Hazards Mt. Rainier. Accessed 2021, Publication data 2013. https://services2.arcgis.com/1UvBaQ5y1ubjUPmd/arcgis/rest/services/Volcanic_Hazards/FeatureServer
- **NRCS Terrain Slope** - USDA - NRCS, USGS 2021 (compiled merged data served by Esri). https://www.arcgis.com/home/item.html?id=a1ba14d09df14f42ad6ca3c4bcebf3b4

Hazmat -

- **ECY Facilities Sites Interactions** - Washington State Department of Ecology Facility/Site Identification System. 2021. https://www.arcgis.com/home/item.html?id=e4905453d2a8426a934c8f56fea6fd35.
- **Superfund sites and Landfills** - US Environmental Protection Agency Superfund Enterprise Management System (SEMS). 2021. https://www.arcgis.com/home/item.html?id=7dd2b44b4cfc4f75b034a7bbe86c0a60
- **Toxic Release Inventory** - US Environmental Protection Agency Toxic Release Inventory (TRI) System. 2021. https://www.arcgis.com/home/item.html?id=29c2d40eda9c4734bafa450d4d596c2f
- **RCRA** - US Environmental Protection Agency RCRA Inventory, 2021. https://services.arcgis.com/cJ9YHowT8TU7DUyn/arcgis/rest/services/FRS_INTERESTS_RCRA/FeatureServer

Noise

- Existing WSDOT Noise Walls - WSDOT created 2017, last updated 2020. https://www.arcgis.com/home/item.html?id=54fbf833d5f845699c6b04a9128d69d6
- Sensitive Land Uses - King County Assessor Parcels. 2021. Pierce County Assessor Parcels. 2021. https://gisdata.kingcounty.gov/arcgis/rest/services/OpenDataPortal/property__parcel_address_area/MapServer; https://services2.arcgis.com/1UvBaQ5y1ubjUPmd/arcgis/rest/services/Tax_Parcels/FeatureServer

Parks, Trails, 4(f) Resources

- **6(f)** - Washington Recreation and Conservation Office database for LWCF, 2021. https://geo.wa.gov/datasets/wa-rco::wa-rco-funded-projects/explore?location=47.700156%2C-121.915689%2C10.04
- **Trails** - NPS trails data, data updated 2022. https://services2.arcgis.com/FiaPA4ga0iQKduv3/arcgis/rest/services/National_Park_Service_Trails/FeatureServer
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  - Pierce County Parks, Accessed 2021. Publication date 2021. https://services2.arcgis.com/1UvBaQ5y1ubjUPmd/arcgis/rest/services/Parks_polygons/FeatureServer
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  - City parks and recreation databases/websites
    - City of Algona, 2021 - https://www.algonawa.gov/sites/default/files/fileattachments/general/page/2161/algona_zoning_map_-_2015.pdf
    - City of Auburn, 2021 - https://www.auburnwa.gov/city_hall/parks_arts_recreation/parks_trails
    - City of Edgewood, 2021 - https://www.cityofedgewood.org/189/Edgewood-Parks
    - City of Fife, 2021 - https://www.cityoffife.org/239/Parks
    - City of Kent, 2021 - https://www.kentwa.gov/departments/kent-parks/parks-places/parks-and-recreation-facilities
    - City of Milton, 2021 - https://www.cityofmilton.net/182/Parks-Division
    - City of Puyallup, 2021 - https://www.cityofpuyallup.org/248/Parks-Recreation
    - City of Renton, 2021 - https://rentonwa.gov/city_hall/parks_and_recreation
    - City of Sumner, 2021 - https://sumnerwa.gov/parks/
    - City of Tukwila, 2021 - https://www.tukwilawa.gov/departments/parks-and-recreation/parks-and-trails/
  - WA State Parks and Recreation Commission State Parks, 2021. https://parks.state.wa.us/845/Seattle-Tacoma-Region

Social Resources

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- King County Common Points of Interest, Accessed 2021. Publication date 2017, data updated by KC 2018. https://gisdata.kingcounty.gov/arcgis/rest/services/OpenDataPortal/admin__common_interest_point/MapServer/731
- Pierce County Points of Interest
  - Police Stations, Accessed 2021. Publication date 2017, data updated by PC 2020. https://services2.arcgis.com/1UvBaQ5y1ubjUPmd/arcgis/rest/services/Police_Stations/FeatureServer
  - Fire Stations, Accessed 2021. Publication date 2020, data updated by PC 2021. https://services2.arcgis.com/1UvBaQ5y1ubjUPmd/arcgis/rest/services/Fire_Stations_in_Pierce_County/FeatureServer
  - Libraries, Accessed 2021. Publication date 2017, data updated by PC 2019. https://services2.arcgis.com/1UvBaQ5y1ubjUPmd/arcgis/rest/services/Libraries/FeatureServer
  - Schools, Accessed 2021. Publication date 2019, data updated by PC 2021. https://services2.arcgis.com/1UvBaQ5y1ubjUPmd/arcgis/rest/services/Schools/FeatureServer
  - Public Health Care Facilities, Accessed 2021. Publication date 2019. https://services2.arcgis.com/1UvBaQ5y1ubjUPmd/arcgis/rest/services/Public_Health_Care_Facilities/FeatureServer

Stormwater Retrofit and Water Quality

- NPDES EPA - National Pollutant Discharge Elimination System (NPDES) discharge locations 2021. https://services.arcgis.com/cJ9YHowT8TU7DUyn/arcgis/rest/services/FRS_INTERESTS_NPDES_MAJOR/FeatureServer
- Drainageways - WSDOT - Drainage CAD, 405 Program Team
- 303(d) list of impaired waters (clean water act) Ecology GIS Data
- WA ECY - Water Quality 303(d) Assessment. Accessed 2021. Publication date 2016. https://waecy.maps.arcgis.com/home/item.html?id=b2fdb9e45dcb448caeab079b5636816d Wellhead Protection Area - King County - Accessed 2021, Publication date 2005. https://gisdata.kingcounty.gov/arcgis/rest/services/OpenDataPortal/utility___base/MapServer/261
- Aquifer Recharge Area
  - King County - Accessed 2021, Publication date 2005.
  - https://gisdata.kingcounty.gov/arcgis/rest/services/OpenDataPortal/enviro___base/MapServer/256
  - Pierce County - Accessed 2021, Publication date 2015.
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Visual

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Appendix B. Flooding Areas on SR 167

TO: Diana Giraldo

FROM: Mike Golden

DATE: 1-26-22

SUBJECT: Flooding areas on SR 167

Diana

Here is a list of the areas we talked about yesterday.

1) NB Sr 167 Exit to EB SR 18. The ramp at the gore floods into the lane in high rain events.
2) WB SR 18 At SR 167 floods into the second lane. This is being caused by the same event as above Too much water in Mill Creek and no maintenance.
3) NB SR 167 at 15th ST SW, in the median. Water comes out to the line SB SR 167 during high water events. The NB 167 project is getting ready to install a pond that hooks up to this. I think this is going to make the problem worse going forward.
4) SB SR167 just north of Main Street overpass, the water comes out to the road shoulder in high rain events and uses the shoulder of the road for about 1000 feet before getting back into the channel. Result of no maintenance by the city of Auburn.
5) NB SR 167 just south of Central there is a large pipe that goes under the fill section South to north. As we discussed yesterday, this pipe might be a risk if you have to upgrade the offramp NB and Onramp SB.
6) NB SR 167 exit to 212th, there are two pipes that cross the ramp. These drain Garrison Creek on the east side to the King County ditch on the west side. The ramp will flood in times of high water and force the closure of the ramp.
7) SB SR167 at 212th. The King County creek at this location is getting silted up pretty bad as Gary described it. We have not had flooding on the west side yet, but it is contributing to the flooding on the above ramp.
8) SR 167 from 208 to 43rd Ave has problems in the median. This median was originally open ditch with vegetation in it. When they added the HOV lanes, they enclosed the ditch but did not put in adequate drainage. We had a talk with the team yesterday that is looking at that issue (Aleah Olsen). They are looking at a plan now.
9) NB SR 167 just south of 43rd. There is an artesian well in lane one that is starting to leak again. Aleah's group is looking at that also.
10) SR 167 from 43rd to the flyover ramp that connects to I-405 median, there are additional spots where the runoff struggles to get to the drainage. Some of it is out to the fog line during rain events.
11) SR 167 NB onramp from 43rd. Sometimes the creek to the east floods out onto the ramp necessitating a one lane closure. This is a dip in the ramp area that floods.

Micheal Golden
Maint Supt Area 4
253 372-3900

Appendix C. Environmental Methods and Applicable Regulations

This appendix discusses the methodology used for the environmental baseline scan and includes the applicable regulations and guidance for the environmental resources discussed.

Air Quality

Air quality is a result of factors such as climate, airborne pollutants, and topography. The federal Clean Air Act requires the U.S. Environmental Protection Agency (US EPA) to set National Ambient Air Quality Standards (NAAQS) for six common air pollutants. Transportation sources contribute to carbon monoxide, ground level ozone, nitrogen dioxide, and particulate matter (PM_{10} and $PM_{2.5}$). Mobile Source Air Toxics also concern transportation projects. Greenhouse gases are regulated by the permitting requirements of the federal Clean Air Act.

A desktop analysis was performed using Ecology data for maintenance and nonattainment areas. Air quality was qualitatively reviewed using Ecology and US EPA information about the historical air quality issues in the Puget Sound region, criteria pollutants, and maintenance or nonattainment areas within the SR 167 Master Plan analysis area. The analysis did not include carbon monoxide or other air modeling.

The federal Clean Air Act identifies air quality classifications. Areas in **nonattainment** do not meet the NAAQS. When an area meets the NAAQS, US EPA re-classifies the area as in **attainment** or **maintenance status**.

Once an area is in maintenance status, the state is required to implement a **Maintenance State Implementation Plan (SIP)**. The SIP is the plan to meet maintenance compliance with the NAAQS over the next 20 years. Conformity with the SIP shows transportation projects will not produce new air quality violations, worsen existing violations, or delay timely attainment of the NAAQS.

A **hot spot analysis** is required by transportation conformity regulations for nonexempt projects within carbon monoxide or particulate matter nonattainment or maintenance areas.

The following statutes, regulations, and guidance are applicable to air quality. See WSDOT *Environmental Manual* Chapter 425 for more information on statutes and regulations. Chapter 425.02 of that manual provides information on local regulations, including fugitive dust memoranda and guides.

Federal

- CFR Title 23 Part 771 - Environmental Impact and Related Procedures
- CFR Title 40 Part 93 - Federal Conformity Regulations
- USC Title 40 Part 1500-1518
- USC Title 42 Parts 4321–4370 – National Environmental Policy Act of 1969 (NEPA)
- USC Title 42 Part 7401-7431 - Clean Air Act
- USDOT Order 5610.1C - Energy Requirements for Transportation Systems, and Procedure for Estimating Highway User Costs, Fuel Consumption, and Air Pollution

State

- Chapter 70A.15 - Washington Clean Air Act
- Chapter 173-400 WAC Part-040(9) - State Fugitive Dust Regulations
- Chapter 173-420 WAC - State Conformity Regulations
- Chapter 197-11 WAC - State Environmental Policy Act (SEPA) Rules
- WSDOT Guidance - Project Level Greenhouse Gas Evaluations under NEPA and SEPA

Climate Vulnerability

WSDOT assessed the impacts of extreme weather events and the projected climate impacts on its system (climate vulnerability) utilizing Federal Highway Administration's (FHWA) conceptual climate risk assessment model developed for transportation infrastructure (WSDOT 2011). Data from the following datasets were overlaid with the analysis area to determine the areas most vulnerable to climate change.

> Climate change is likely to damage transportation infrastructure through higher temperatures, more severe storms and flooding, and higher storm surges, affecting the reliability and capacity of transportation systems. Coastal roads, railways, ports, tunnels, and airports are vulnerable to sea level rise, which could lead to delays as well as temporary and permanent closures.
>
> -U.S. EPA

- **Climate Vulnerability**: WSDOT's climate vulnerability assessment GIS layer was reviewed to summarize the vulnerability (ranked from low to high) to climate change impacts for state highway systems.
- **Sea Level Rise:** National Oceanic and Atmospheric Administration data were reviewed to identify areas that could potentially be affected by sea level rise and coastal flooding. Sea level rise data were reviewed for inundation of 1 foot to 6 feet above mean higher high water as well as anticipated rise by 2100.

The following statutes, regulations, and guidance are applicable to climate vulnerability. See WSDOT *Environmental Manual* Chapter 425 for more information on statutes and regulations regarding climate vulnerability.

Federal

- CFR Title 23 Part 771 - Environmental Impact and Related Procedures
- CFR Title 40 Part 93 - Federal Conformity Regulations
- FHWA Order 5520 - Transportation System Preparedness and Resilience to Climate Change and Extreme Weather Events
- USC Title 40 Part 1500-1518
- USC Title 42 Parts 4321–4370 - NEPA
- USC Title 42 Part 7401-7431 - Clean Air Act
- USDOT Climate Adaption Plan - Ensuring Transportation Infrastructure and System Resilience
- USDOT Order 5610.1C - Energy Requirements for Transportation Systems, and
- Procedure for Estimating Highway User Costs, Fuel Consumption, and Air Pollution

State

- Chapter 70A.15 RCW - Washington Clean Air Act
- Chapter 86.26 RCW - State Participation in Flood Control Maintenance
- Chapter 173-420 WAC - State Conformity Regulations
- Chapter 197-11 WAC – SEPA Rules
- Chapter 468-12 WAC - Transportation Commission and WSDOT SEPA Rules
- WSDOT Guidance - Project Level Greenhouse Gas Evaluations under NEPA and SEPA

WSDOT's **climate impact vulnerability** layer was developed in local workshops around the state and assumes the best available climate change impact information. The layer provides scores of low, medium, and high which represent the criticality to the overall transportation operations and public safety, and how potential climate changes impact operations.

Low (score 1-3): Corridors with low daily traffic, available alternate routes, not part of the National Highway System. Reduced capacity because the corridor would be partially open to use and full operations could be restored within 10 days.

Medium (score 4 to 6): Corridor with low to medium daily traffic, serves as an alternate route of other state corridors. Temporary operational failure, the corridor would be closed for hours or days. Reopening or repair could be completed within 60 days.

High (score 7 to 10): Corridor is an Interstate or other major highway, is considered a lifeline route or is the sole access to a population center or critical facility. Complete failure, the corridor would likely require major repairs or rebuilds with closures lasting more than 60 days.

Cultural Resources and Historic Bridges

Transportation projects sponsored or performed by WSDOT have the potential to affect cultural resources and are, therefore, required to comply with state and federal regulations that govern how such impacts on archaeological, historic, and cultural resources are taken into consideration.

A desktop analysis was performed, using the DAHP datasets, to identify baseline existing cultural resources within the analysis area. Historic bridges were identified using the web maps available through https://historicbridges.org/. King County and Pierce County assessors' data were reviewed for potentially

historic, un-surveyed resources of at least 45 years of age, to allow for resources that will meet the 50-year age threshold over the next 5 years. No field surveys were completed. WSDOT did not start the process for compliance with Section 106 of the National Historic Preservation Act (NHPA). Review of the analysis area excluded privileged and confidential archaeological data. As such, a search of confidential site-files using DAHP's WISAARD system was not performed.

The following statutes and regulations are applicable to cultural resources. See WSDOT *Environmental Manual* Chapter456 for more information on statutes and regulations, and Chapter 456.02(3) for information on local regulations, including landmark or cultural resources ordinances.

Federal

- CFR Title 36 Part 800 - Section 106 of the NHPA, as amended, and its implementing regulations, and Part 79 - Curation of Federally Owned and Administered Archaeological Collections
- USC Title 49 Part 303 - Section 4(f) of the U.S. Department of Transportation (USDOT) Act of 1966
- USC Title 12 Part 144 (g) - Historic Bridge Program
- USC Title 42 Parts 4321–4370 - NEPA
- CFR Title 43 Part 7.6-7.11 - Archaeological Resources Protection Act

> The WSDOT *Environmental Manual* describes **cultural resources** as sites, buildings, structures, districts, and objects 50 years of age or older. **Archaeological sites** include precontact and historic-era surfaces, buried or underwater features, and artifacts. **Historic properties** consist of buildings and structures such as buildings, roads, bridges, railways, vessels, canals, ditches, geological features, and other features of the landscape.
>
> (WSDOT Environmental Manual Chapter 56)

State

- Centennial Accord
- Governor's Executive Order (EO) 21-02 – Archeological and Cultural Resources
- Chapter 197-11 WAC – SEPA Rules
- Chapter 468-12 WAC – Transportation Commission and WSDOT SEPA Rules
- Chapter 68.60 RCW - Abandoned and Historic Cemeteries Act
- Chapter 27.44 RCW - Indian Graves and Records Act
- Chapter 27.53 RCW - Archaeological Sites and Resources Protection Act
- Chapter 27.34 RCW Part 200 - Archaeology and Historic Preservation

Environmental Justice

See Chapter 3 – Community Profile and Appendix F, Preliminary Equity Focus Area Analysis Methodology.

Fish Passage Barriers

A desktop analysis and qualitative review of fish passage barriers was performed using the datasets and sources listed below. The data were overlaid with the analysis area to identify known fish passage barriers and correction status. Although no field work was conducted for this study, information from field work within WSDOT right-of-way for previous projects was reviewed.

- WSDOT culvert data

- WSDOT 2021 Fish Passage Performance Report (WSDOT 2021b)
- WDFW fish passage data
- U.S. Geological Survey (USGS) National Hydrography Data

The following statutes, requirements, and regulations are applicable to fish passage barriers. See WSDOT *Environmental Manual* Chapter 436 and Chapter 300.03 for more information on statutes and regulations.

Federal

- Endangered Species Act of 1973 (ESA)
- Magnuson-Stevens Fishery Conservation and Management Act (Magnuson-Stevens Act)
- Title 44 CFR, Part 60A – Emergency Management and Assistance, Chapter I – Federal Emergency Management Agency - Bridges, Structures, and Hydraulics

State

- Chapter 70.12 RCW Part 240 - Authority to take wildlife - Disposition
- Chapter 77.57 RCW - Fishways, Flow, and Screening
- Chapter 90.58 RCW - Shoreline Management Act
- Chapter 220 WAC – Hydraulic Project Approvals

WSDOT Executive Orders

- E 1031.02 - Protections and Connections for High Quality Natural Habitats

Fish and Wildlife Habitat and Chronic Environmental Deficiencies

Qualitative research and a desktop analysis were performed to identify fish and wildlife habitat in the analysis area by using the datasets and sources listed below. The desktop analysis focused on wildlife, habitat connectivity and network, CEDs, and federal and state sensitive species. No field visits were conducted. For information on wetlands and fish barriers in the analysis area, see the *Wetlands* and *Fish Passage Barriers* sections.

- USFWS Information for Planning and Consultation
- USFWS and NMFS Threatened or Endangered Species Critical Habitat GIS layers
- WSDOT habitat connectivity support structure and habitat connectivity investment GIS layers
- WSDOT CED dataset
- WDFW PHS dataset (2021)
- King County wildlife network GIS layer
- Pierce County biodiversity network GIS layer
- Multi-Resolution Land Characteristics Consortium, National Land Cover Database (2019)

The following statutes, requirements, and regulations are applicable to wildlife, vegetation, and CED. See WSDOT *Environmental Manual* Chapter 436 for more information on statutes and regulations. See Chapter 436.02(3) of the manual for more information on local comprehensive plans and critical areas ordinances.

Habitat connectivity support structures include structures that support the safe passage of wildlife across state highways and priority areas for wildlife passage solutions to be considered in future scenarios. Types of habitat connectivity structures are bridges, culverts, wildlife barrier fencing, jumpouts, ramps, and wildlife guards that provide safe passage for wildlife.

Habitat connectivity investment priorities include state highway segments with the best opportunities for habitat connectivity and wildlife safety improvement potential. The habitat investment priorities are ranked as High, Medium, and Low for Ecological Stewardship and Wildlife-related Safety and for consideration in Corridor Planning, Environmental Retrofit project identification, and Safety and Mobility projects.

Critical habitat under the federal Endangered Species Act of 1973 (ESA) includes specific geographic areas that contain features essential to the conservation of an endangered or threatened species and that may require special management and protection. Critical habitat may also include areas that are not currently occupied by the species but will be needed for its recovery (USFWS 2021b).

Priority habitats have unique or significant value to a diverse grouping of species and may consist of a unique vegetation type or dominant plant species, successional stage such as old growth forest, or a specific habitat feature (WDFW 2021).

Federal

- USC Title 42 Parts 4321–4370 - NEPA
- ESA
- Magnuson-Stevens Act
- Migratory Bird Treaty Act of 1918
- Bald and Golden Eagle Protection Act of 1940
- Marine Mammal Protection Act of 1978
- National Forest Management Act of 1976
- Northwest Forest Plan (1994)

State

- Chapter 77.12 RCW – WDFW Powers and Duties
- Chapter 90.58 RCW – Shoreline Management Act
- WSDOT State Habitat Connectivity Policy – EO for Protections and Connections for High Quality Natural Habitats

Flood Hazards

Floodplains temporarily store excess water when waterbodies periodically overflow their banks and inundate land. When floodplains are developed or natural flooding processes are altered, flood damage can occur.

A desktop analysis and qualitative research was performed using FEMA's digital National Flood Hazard Layer and Flood Insurance Rate Maps to identify 100-year floodplains (i.e., special flood hazard areas), 500-year floodplains, and floodways within the analysis area.

Floodplains and floodways are regulated by Federal Emergency Management Agency (FEMA) through the National Flood Insurance Program.

FEMA defines **floodplains** as "any land area susceptible to being inundated by floodwaters from any source" (FEMA 2022a).

Special flood hazard areas include areas subject to inundation by the 100-year flood.

100-year floodplains, or base flood, are areas with a 1 percent chance of flooding in any given year. These are considered high-risk areas.

500-year floodplains are areas between the limits of the base flood and the 0.2 percent chance of flooding in any given year. These are considered moderate-risk areas.

Regulatory floodways are channels of a river or tributary and the adjacent land areas that must be reserved in order to discharge the base flood without cumulatively increasing the water surface elevation more than a designated height.

Areas with reduced risk due to levee are areas where the risk of flooding is reduced, but not completely removed. These areas are considered as moderate-risk.

(FEMA 2020a, 2020b, 2022b)

The following statutes, requirements, and regulations are applicable to floodplains. See WSDOT *Environmental Manual* Chapter 432 for more information on statutes and regulations related to floodplains. Chapter 432.02(3) of that manual provides information on local floodplain regulations and floodplain development permits.

Federal

- USC Title 42 – Public Health and Welfare (Chapters 50 and 55)
- USC Title 16 – Conservation (Chapter 35)
- CFR Title 23 - Highways (Parts 650 and 771)
- CFR Title 40 – Protection of the Environment (Parts 1500-1508)
- CFR Title 44 - Emergency Management and Assistance (Part 60.3)
- Public Law 92 234, 87 Statute 975 – Flood Disaster Protection Act of 1973
- Presidential EO 11988 – Floodplain Management (1977)

- FHWA Technical Advisory T 6640.8A (October 1987)
- USDOT Policy statement on climate change adaption (2011)
- USDOT Climate Adaption Plan - Ensuring Transportation Infrastructure and System Resilience (2014)
- FHWA Order 5520 – Transportation System Preparedness and Resilience to Climate Change and Extreme Weather Events (2014)

State

- Chapter 4701 RCW Part 260 - Authority of WSDOT
- Chapters 77.55 – Construction Projects in State Waters
- Chapter 77.57 RCW – Fishways, Flow and Screening
- Chapter 86.16 RCW – Floodplain Management
- Chapter 86.26 RCW – State Participation in Flood Control Maintenance
- Chapter 173-145 and 173-158 WAC – Shoreline Management
- Chapter 197-11 WAC – SEPA Rules
- Chapter 220–660 WAC - Hydraulic Code Rules
- Chapter 468-12 WAC - Transportation Commission and WSDOT SEPA Rules
- Governor's Directive on Acquisitions of Agricultural Resource Land
- WDFW Memorandum of Agreement for Transportation Activities

Geologic Hazards

Geologic hazards analysis helps identify potentially hazardous areas and methods to avoid and mitigate hazards. It also helps to determine work required for construction activities (e.g., cuts and fills), and needs for bridge foundations or retaining walls.

A desktop analysis was performed to locate known geologic hazard areas in the analysis area. Such areas may warrant special design considerations and geotechnical studies in future project phases. The following datasets and sources were reviewed.

- **Seismic hazard areas:**
  - King County Sensitive Areas Ordinance (SAO) seismic hazard areas layer subject to severe risk of earthquake damage as a result of seismically induced settlement or soil liquefaction
  - WSDOT Infrastructure Seismic Resiliency Assessment GIS layer showing potential impacts of a CSZ earthquake on state transportation systems and the ability of emergency response efforts to move supplies into the region
  - WDNR data were used to assess seismic faults.
  - Pierce County data for seismic hazards were not available.
- **Liquefaction-prone areas:**
  - King County GIS layer for moderate to high susceptibility to liquefaction
  - WDNR GIS layer for liquefaction susceptibility
- **Soils:**
  - USGS Natural Resources Conservation Service online Web Soil Survey data

- **Erosion hazard areas**:
  - King County SAO erosion data
  - Pierce County erosion hazard areas (unincorporated Pierce County)
- **Steep slopes/Landslide-prone areas:**
  - King County landslide and steep slope hazards as well as landslide and steep slope hazard 50-foot buffer layers
  - Pierce County landslide hazards (unincorporated Pierce County)
- **Volcanic Hazards:**
  - Pierce County volcanic hazards data for Case I, II, and III lahars from Mount Rainier

The following requirements, policies, and regulations are applicable to geology and soils. See WSDOT *Environmental Manual* Chapter 420 for more information on statutes and regulations. Chapter 420.02(2) provides information on local regulations.

Seismic hazard areas are prone to severe risk of structural damage from earthquakes.

Liquefaction happens when soils adopt characteristics of a liquid, which can cause landslides and severe structural damage.

Steep slopes are those steeper than 40 percent grade and, therefore, at high risk for landslides.

Erosion hazard areas are soils that may experience severe to very severe erosion hazard.

Volcanic hazard areas are areas that, in the recent geologic past, have been inundated by a Case I, Case II, or Case III lahars or other types of debris flow, or have been affected by pyroclastic flows, pyroclastic surges, lava flows, or ballistic projectiles.

(USGS 2022)

Federal

- USC Title 42 Parts 4321–4370 - NEPA
- CFR Title 23 Part 771 - Environmental Impact and Related Procedures
- CFR Title 40 Parts 1500-1508 – NEPA implementing regulations
- CFR Title 7 Part 658 - Farmland Protection Act
- CFR Title 30 Part 700 - Surface Mining Reclamation and Enforcement
- USDOT policy statement on climate change adaption (2011)
- USDOT Climate Adaption Plan - Ensuring Transportation Infrastructure and System Resilience (2014)
- FHWA Order 5520 - Transportation System Preparedness and Resilience to Climate Change and Extreme Weather Events (2014)

State

- Chapter 47.01 Part 260 - Authority of WSDOT
- Chapter 197-11 WAC - SEPA Rules
- Chapter 468-12 WAC - Transportation Commission and WSDOT SEPA Rules

Hazardous Materials

Consistent with WSDOT's guidance for preparing a hazardous materials analysis report (WSDOT 2022), a desktop analysis was conducted to identify hazardous materials sites within the analysis area, where the release or threat of release during or after project construction could harm the environment or human health. Data from the Washington State Department of Ecology (Ecology) were overlaid on the analysis area to identify sites within the analysis area or located on a King or Pierce County parcel within the analysis area. Consistent with the *SR 167 Corridor Plan* (WSDOT 2008b), sites were identified as the following:

- **Federal Cleanup Sites:** Superfund sites, sites listed on the National Priority List (NPL), and sites regulated by the Resource Conservation and Recovery Act (RCRA) corrective action program.
- **State Cleanup Sites:** State cleanup sites.
- **Storage Tanks:** Underground storage tanks (USTs), above ground storage tanks (ASTs) and leaking underground storage tanks (LUSTs).

Hazardous materials transport routes were also reviewed using information from the Federal Motor Carrier Safety Administration.

Hazardous materials are regulated by various state and federal regulations, including those listed below. See WSDOT *Environmental Manual* Chapter 447 (WSDOT 2021c) for more information on statutes and regulations relating to hazardous materials. Information on local clean air agency regulations is available in WSDOT *Environmental Manual* Chapter 447.02(4).

Federal

- USC Title 15 Code 2601 – Toxic Substances Control Act
- USC Title 42 – Public Health and Welfare (Codes 7401 et seq., 300f et seq., 4321 et seq., 6901 et seq., 9601 et seq.)
- USC Title 29 – Labor (Occupational Safety Codes 1926.1101 and 651 et seq.)
- USC Title 33 Code 1251 et seq.– Clean Water Act
- CFR Title 40 – Protection of the Environment (Parts 61 to 71, 763, 112, 312)
- CFR Title 29 – Labor (Occupational Safety Parts 1926.1101, 651 et seq.)

An **underground storage tank system (UST)** is a tank and any underground piping connected to the tank that has at least 10 percent of its combined volume underground. A leaking underground storage tank (LUST) involves the release of a product from a UST that can contaminate surrounding soils, groundwater, or surface waters.

(U.S. EPA: https://www.epa.gov/ust/leaking-underground-storage-tanks-corrective-action-resources#:~:text=Immediate%20response%20actions-,Introduction,or%20affect%20indoor%20air%20spaces.)

State

- Title 173 WAC – Department of Ecology (Chapters 173-160, 173-200, 173-201A, 173-204, 173-303, 173-340, 173-350, 173-360)
- Chapter 197-11 WAC – SEPA Rules
- Title 296 WAC – Department of Labor and Industries (Chapters 296-62, 296-155, 296-843, 296-62-077
- Washington State Model Toxics Control Act

WSDOT Executive Orders

- WSDOT Environmental Policy Statement E 1018.03
- Secretary's EO E 1033.03 – Employee Safety

Noise

Existing WSDOT noise wall locations were identified in the analysis area by overlaying the WSDOT existing noise wall GIS layer with the analysis area. Potentially sensitive receivers were identified by reviewing existing land uses using King County and Pierce County parcel assessor data.

WSDOT considers a predicted sound level of 1 A-weighted decibel (dBA) below the Noise Abatement Criteria as "approaching" those criteria and, therefore, an impact for outdoor uses. Receivers are also affected if the worst hourly traffic noise is predicted to increase by at least 10 dBA over existing conditions. Table 1 summarizes weighted noise levels and human responses. Noise was not modeled as part of this analysis. Table 2 shows land uses by activity category.

The following statutes and regulations are applicable to noise impact assessment. WSDOT *Environmental Manual* Chapter 446.02 offers more information on statutes and regulations. Chapter 446.02(3) of the manual provides information on local regulations, including local noise ordinances related to nighttime construction. Chapter 446.03(1) offers more guidance, including design-related guidance, from FHWA and WSDOT.

Per the WSDOT *Environmental Manual* Chapter 446.01:

Noise is defined as unwanted sound. FHWA developed noise regulations to investigate traffic noise impacts in areas where humans live, work, or play adjacent to highways and to effectively control the undesirable effects of traffic noise.

Noise levels near roadways depend on traffic volume, traffic speed, percent of heavy trucks, distance from roadway, intervening topography, and atmospheric conditions.

Noise sensitive receptors include land uses that are considered sensitive to noise impacts.

Federal

- USC Title 42 Parts 4321–4370 - NEPA
- USC Title 42Part 4901 – Noise Control Act of 1972 (also USC Title 23 Code 109(i))
- CFR Title 23 Code 772 – FHWA Procedures for Abatement of Highway Traffic Noise and Construction Noise

State

- Chapter 70.107 RCW – State Noise Legislation and Implementing Regulations
- Chapters 173-58, 173-60, and 173-62 WAC - Ecology is responsible for these regulations, which address measuring sound levels, establishing maximum noise levels, Environmental Designations for Noise Abatement (EDNA), and noise emission standards for vehicles on public highways.

Table 1. Common Noise Levels and Human Responses

Sound Source	dBA [a]	Response Descriptor
Carrier deck jet operation	130	Painfully loud
Auto horn (3 feet)	120	Threshold of feeling pain
Shout (0.5 feet)	100	Very annoying
Passenger train (100 feet)	80	Annoying
Freeway traffic (50 feet)	70	Intrusive
Normal speech (15 feet)	50	Quiet

Source: CEQ 1970
Note:
[a] Typical A-weighted noise levels taken with a sound-level meter and expressed as decibels on the "A" scale. The "A" scale approximates the frequency response of the human ear.

Table 2. Table 2. Noise Abatement Criteria by Land Use Category

Activity Category	Leq(h) at Evaluation Location	Description of Activity Category
A	57 (exterior)	Lands on which serenity and quiet are of extraordinary significance and serve an important public need and where the preservation of those qualities is essential if the area is to continue to serve its intended purpose
B	67 (exterior)	Residential (single and multi-family units)
C	67 (exterior)	Active sport areas, amphitheaters, auditoriums, campgrounds, cemeteries, day care centers, hospitals, libraries, medical facilities, parks, picnic areas, places of worship, playgrounds, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, recreation areas, Section 4(f) sites, schools, television studios, trails, and trail crossings
D	52 (interior)	Auditoriums, day care centers, hospitals, libraries, medical facilities, places of worship, public meeting rooms, public or nonprofit institutional structures, radio studios, recording studios, schools, and television studios
E	72 (exterior)	Hotels, motels, offices, restaurants/bars, and other developed lands, properties or activities not included in A, B, C, D, or F. Includes undeveloped land permitted for these activities.
F	–	Agriculture, airports, bus yards, emergency services, industrial, logging, maintenance facilities, manufacturing, mining, rail yards, retail facilities, shipyards, utilities (water resources, water treatment, electrical), and warehousing
G	–	Undeveloped lands that are not permitted

Note:
$L_{eq}(h)$ = hourly equivalent sound level which is a noise measurement descriptor for various and typical noise levels at a given location.

Recreational, Section 4(f), and Section 6(f) Resources

Transportation projects sponsored or performed by WSDOT could affect public parks and recreation areas, public wildlife and waterfowl refuges, and historic sites. For projects involving FHWA (or other United States Department of Transportation [USDOT] agencies), WSDOT must consider effects on recreational resources,

including those protected under Section 4(f) of the USDOT Act or Section 6(f) of the Land and Water Conservation Fund (LWCF) Act. WSDOT must also consider impacts on other resources protected under Section 4(f), including wildlife refuges and historic and cultural resources listed on or eligible for listing on the NRHP.

Section 4(f) declares a national policy to "preserve the natural beauty of the countryside, public park and recreation land, wildlife and waterfowl refuges, and historic sites."

Section 6(f) resources are protected under LWCF Act, which established a federal funding program to assist states in developing outdoor recreation sites.

(WSDOT Environmental Manual)

A desktop analysis was performed to identify existing recreational resources in the analysis area. The analysis area was overlaid with GIS data to identify parks, trails, open space areas, wildlife or waterfowl refuges, and historic sites. Potential Section 4(f) and Section 6(f) resources were also identified within the analysis area. Data were collected, and qualitative research was performed to review information from the National Park Service, Washington State Parks and Recreation Commission, King and Pierce Counties, city datasets, NRHP, and DAHP.

Potential Section 4(f) resources were identified using the following criteria. Publicly owned parks, recreation areas and wildlife and waterfowl refuges are assumed to be significant unless the public Official with Jurisdiction concludes that the entire site is not significant.

- Parks and recreational areas of national, state, or local significance that are both publicly owned and open to the public
- Historic sites eligible for inclusion on the NRHP in public or private ownership, regardless of public access
- Publicly owned wildlife and waterfowl refuges of national, state, or local significance that are open to the public to the extent that public access does not interfere with the primary purpose of the refuge
- School playgrounds that are open to the general public during non-school hours for organized recreational purposes such as ballgames and other sporting events may serve significant public recreational purposes and, therefore, are subject to Section 4(f) requirements (FHWA 2022b).

Potential Section 6(f) resources were identified using the Recreation and Conservation Office online database for recreation projects or lands acquired or improved with LWCF grants.

Section 4(f) prohibits the incorporation of land from a Section 4(f) resource into a transportation facility unless there is no feasible and prudent alternative to the use of the land, and the action includes all possible planning to minimize harm to the property resulting from the use. It also protects Section 4(f) properties from proximity impacts.

Section 6(f) prohibits the conversion of property acquired or developed with these LWCF Act funds to a non-recreational purpose without the approval of the National Park Service.

(WSDOT Environmental Manual)

The following statutes and regulations are applicable to recreational resources. See WSDOT *Environmental Manual* Chapter 457 for more information on statutes and regulations.

Federal

- CFR Title 23 Part 774 - Parks, Recreation Areas, Wildlife and Waterfowl Refuges, and Historic Sites (Section 4(f) of the USDOT Act)
- Section 106 of the NHPA
- Section 4(f) of the Department of Transportation Act 1966Section 6(f) of the LWCF Act
- USC Title 42 Parts 4321–4370 – NEPA

State/Local

- Not applicable

Social Resources and Public Services

The purpose of the social resources and public services analysis is to identify existing social resources and potential negative and positive effects. These effects may include disrupting or enhancing a community's access to essential services or displacing these resources altogether.

A qualitative review and GIS search was performed to identify social resources within the analysis area. GIS data, including those hosted by local jurisdictions, and city comprehensive plans were reviewed to identify potential social resources.

Social resources and public services can include emergency and health services including police, fire and emergency services, hospitals, and medic units and clinics, social services including affordable housing properties, emergency housing (shelters), food banks, youth and elderly centers, government offices and facilities, and community facilities including recreation facilities, theaters, libraries, major grocery stores, shopping centers.

The DOH Environmental Health Disparities Map (DOH 2022) was reviewed for the overall environmental health disparities of communities within the analysis area. See the Chapter 5, *Community Profile*, for more information.

An analysis of displaced resources was not performed for this PEL study because project footprints have not yet been defined. The following statutes, plans, and regulations are applicable to social resources. See WSDOT *Environmental Manual* Chapter 458 for more information on statutes and regulations, and Chapter 458(04) for information on analysis and documentation requirements, including relocation processes.

Federal

- CFR Title 23 Part 771 – Environmental Impact and Related Procedures
- CFR Title 40 Parts 1500–1508 - National Environmental Policy Act Implementing Regulations
- CFR Title 49 Part 24 - USDOT Implementing Regulations for Uniform Relocation Assistance and Real Property Acquisition Policy Act
- Uniform Relocation Assistance and Real Property Acquisition Policies Act of 1970
- USC Title 42 Parts 4321–4370 – NEPA
- Section 109(h) of the Federal-Aid Highway Act of 1956

State

- Chapter 8.26 RCW and Chapter 468-100 WAC - Relocation assistance and real property acquisition policy
- Chapter 47.04 RCW Part 280 - Transportation System Policy Goals
- Chapter 197-11 WAC - SEPA Rules
- WSDOT Community Engagement Plan

Visual Resources

Visual resources form the overall visual character and perception of an area and can be natural or human-made features. Visual impacts from transportation projects depend on the visual character and quality of an area, the project characteristics, and the presence of people (viewers).

Transportation projects and, in particular, highway projects can affect **visual quality** through changes in the relationship between people and their surrounding environments.

Available information was reviewed to identify potentially sensitive visual resources within the analysis area. Local planning documents, including zoning maps, were reviewed to identify potential valued visual resources. King County data, Pierce County data, NRHP information, aerial imagery, and existing WSDOT preliminary engineering documents were used to identify additional potentially sensitive visual resources, including viewer groups, landmarks, natural features, historic districts, views of unique landforms such as mountains, and potential Section 4(f) and Section 6(f) properties. PSRC data and aerial imagery were used to identify agricultural lands. Visual impact assessments (VIAs) and viewshed analyses were not performed for this PEL study, and areas of visual effects were not defined. Additionally, landscape units were not created because field work has not yet been done.

The following statutes and regulations are applicable to visual resources. See WSDOT *Environmental Manual* Chapter 459 for more information on statutes and regulations. Chapters 459(07) and 459(08) of that manual provide information on analysis and documentation requirements, including the visual impact assessment.

Federal

- CFR Title 23 Parts 750-752 - Highway Beautification Act of 1965
- CFR Title 36 Part 800 - Section 106 of the NHPA, as amended, and its implementing regulations
- Section 4(f) of the USDOT Act
- Section 6(f) of the LWCF Act
- USC Title 42 Parts 4321–4370 – NEPA
- Federal-Aid Highway Act of 1970
- Wild and Scenic Rivers Act

State

- Chapter 47.40 RCW - Roadside Improvement and Beautification
- Chapter 84.34 RCW - Open Space Land Conservation
- Chapter 197-11 SEPA Rules
- Chapter 468-12 WAC – Transportation Commission and WSDOT SEPA Rules

Water Quality and Stormwater

A desktop GIS analysis was performed along with qualitative research for water quality and stormwater as described below. No field visits were conducted as part of this analysis.

- USGS National Hydrography Data
- USGS watershed hydraulic unit code 12 data
- Ecology 303(d) list of impaired water bodies
- King County wellhead protection areas data (no such data were available for Pierce County)
- King County and Pierce County aquifer recharge areas data
- WSDOT stormwater and drainage data from the I-405/SR 167 program design files
- Watershed basin reports

Rivers, streams, and lakes provide habitat for fish and aquatic species as well as recreational activities for people. Changes to chemical, physical, and biological characteristics of surface waters affect water quality and quantity as well as fish and wildlife habitat.

The following statutes, requirements, and regulations are applicable to water quality and stormwater. See WSDOT *Environmental Manual* Chapters 430 and 433 for more information on statutes and regulations. See Chapter 430.07(3) for information on local regulations. In addition, the WSDOT *Highway Runoff Manual* (WSDOT 2019) includes specific minimum requirements for stormwater runoff treatment triggered by new pollutant generating impervious surfaces (PGIS) and additional requirements for retrofit water quality treatment of existing untreated PGIS. The WSDOT *Maintenance Manual* (WSDOT 2021a) addresses maintenance and operations standards to address water quality issues associated with operating highway facilities throughout the analysis area.

Federal

- ESA
- Section 404 and Section 401 - Clean Water Act
- USC Title 42 Parts 4321–4370 - NEPA

State

- Coastal Zone Management Act Certification
- Chapter 90.48 RCW – Water Pollution Control
- Chapter 36.70A RCW – Growth Management Planning
- Chapter 173-201A WAC - Water Quality Standards for Surface Waters of the State of Washington
- Chapter 197-11 WAC – SEPA Rules
- WSDOT National Pollutant Discharge Elimination System Permit
- Washington State Hydraulic Code
- Aquatic Lands Use Authorization

WSDOT Executive Orders

- E 1103 - Accommodation of Stormwater Runoff onto Right of Way

Wetlands

Qualitative research and a desktop analysis were performed to identify wetlands in the analysis area using the datasets and sources listed below. No field visits have been conducted.

- The National Wetlands Inventory produced by USFWS
- WSDOT sensitive aquatic GIS layer
- King County GIS sensitive areas ordinance wetland layer
- Pierce County GIS wetland layer
- Wetland delineation data from the SR 167 Completion Project and previous projects along SR 167

The following requirements and regulations are applicable to wetlands. See WSDOT *Environmental Manual* Chapter 431 for more information on statutes and regulations.

Wetlands are areas that are inundated or saturated by surface water or groundwater at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs, and similar areas (Environmental Laboratory 1987).

Rivers, streams, and lakes provide habitat for fish and aquatic species as well as recreational activities for people. Changes to chemical, physical, and biological characteristics of surface waters affect water quality and quantity as well as fish and wildlife habitat.

Federal

- USC Title 42 Parts 4321–4370 – NEPA
- Section 404 – Clean Water Act
- Final Rule on Compensatory Mitigation for Losses of Aquatic Resources (2008)
- CFR Title 33 part 403 – Section 10 of the Rivers and Harbors Act of 1899
- CFR 23 Title 771 – Highways, Environmental Impact Related Procedures
- CFR 33 Title 332.2 – Navigation and Navigable Waters, Compensatory Mitigation for Losses of Aquatic Resources
- CFR 40 Titles 1500 and 1508 – Protection of Environment, Purpose and Policy, Definitions

State

- Title 47 RCW Parts 47.01.305 and 47.12.370 – Environmental mitigation in highway construction projects – Public lands first or other sites that avoid loss of long-term, commercially significant agricultural lands and Environmental mitigation – Exchange agreements
- Governor's EO 89-10 – Protection of Wetlands
- Chapter 39.26 RCW v Procurement of Goods and Services
- Chapter 197-11 WAC – SEPA Rules
- WSDOT Secretary's EO E 1102.00 – Wetlands Protection and Preservation

Federal and State

- Interagency wetland mitigation guidance: Wetland Mitigation in Washington State Part 1 – Agency Policies and Guidance and Part 2 – Developing Mitigation Plans

Appendix D. Environmental Considerations for Future Phases

This appendix summarizes the considerations for future environmental phases.

Air Quality

Air quality will need to be documented along with the energy effects of the project. As summarized in WSDOT *Environmental Manual* Chapter 425, the US EPA, Ecology, and regional clean air agencies regulate ambient air quality in Washington. Permits may be needed for land-clearing burns, demolition of structures containing asbestos, and new construction that creates temporary sources of emissions.

Transportation projects in maintenance or nonattainment areas must meet conformity requirements set in the federal Clean Air Act and the Washington Clean Air Act State Implementation Plan (SIP). If a project includes intersections where traffic delays may result in increased carbon monoxide concentrations, an air quality and dispersion analysis will be required. Projects or scenarios may be exempt from transportation conformity if the actions are listed under 40 CFR 93.126 or WAC 173-420-110—for example, a scenario that would improve mass transit or be considered to have a neutral impact on air quality. A hot spot analysis (required by transportation conformity regulations for nonexempt projects within carbon monoxide or particulate matter nonattainment or maintenance areas) may be required, depending on transportation conformity.

The WSDOT Air Quality, Greenhouse Gas, and Energy Guidance and Decision Tree should be used to help determine which analyses are required for a specific project.

Decision tree (WSDOT 2021) available at (https://wsdot.wa.gov/sites/default/files/2021-10/ENV-ANE-AQdecisiontree.pdf)

Guidance (WSDOT 2020b) available at https://wsdot.wa.gov/sites/default/files/2021-10/ENV-ANE-AQGuidance.pdf

The White House Council on Environmental Quality (CEQ) rescinded the 2019 draft NEPA guidance for greenhouse gases and is updating the federal guidance. Once new guidance is published, WSDOT's evaluation will need to reflect any changes made to the federal guidance.

Air quality will need to be documented along with the energy effects of the project. Temporary construction emissions should be evaluated qualitatively. If a project requires a quantitative analysis (for a NEPA environmental assessment [EA] or environmental impact statement [EIS]) requiring EPA's Motor Vehicle Emissions Simulator (MOVES), a technical report may be required. Energy analysis is typically not required for documents other than EISs. Temporary construction effects must be addressed in EAs and EISs. Starting in January 2023, US EPA's MOVES3 model will be required for both regional and hot spot analyses.

Climate Vulnerability

Climate vulnerability and climate change impacts should be assessed. Projects should reference WSDOT's *Guidance for Considering Impacts of Climate Change* (WSDOT 2021d). The guidance lists projected climate changes such as increases in winter precipitation, sea level rise, and increase in extreme heat events. Potential impacts on WSDOT highways include increased mudslides, flooding, damage to stormwater drainage, and loss of roadside vegetation. Local planning partners should be engaged during this assessment. FHWA's resilience and sustainability guidance should also be used as a resource (FHWA 2022c).

Cultural Resources

Identifying cultural resources early in planning processes helps to identify potential scope and scheduling impacts. Most WSDOT projects follow the alternative compliance process, which includes defining an Area of Potential Effects (APE); initiating consultation with the State Historic Preservation Officer, Tribal Historic Preservation Officer, tribes, and other interested or affected parties; identifying historic properties within the APE; determining project impacts and NRHP eligibility of resources; and working with the WSDOT Regions and consulting parties to avoid, minimize, or mitigate impacts (WSDOT *Environmental Manual* Chapter 456).

The desktop analysis performed to determine the baseline conditions does not include archaeological or ethnographic information. A key future step will be to conduct a comprehensive DAHP WISAARD search and compilation (into a secure digital vault) of all known and recorded cultural resources sites in the analysis area. This search would compile archaeological site record forms; previous survey, testing, and data-recovery reports; and on-file records of Traditional Cultural Properties/Landscapes (TCP/Ls). TCP data will not be publicly disclosed. Review of previous cultural resources surveys, historical maps, and ethnographic reports or other sources will provide the more detailed information needed to assess low and high probability of archaeological resources and potential impacts for future projects.

Projects should consider potential impacts on historic properties listed on or eligible for the NRHP. An impact analysis will be completed, and mitigation measures will be developed through Section 106 consultation with Indian tribes and agencies. The Section 106 process should be started during NEPA planning phases and continue until all mitigation measures are agreed upon and documented in a Memorandum of Agreement or a Programmatic Agreement. The Section 106 process must be completed prior to the final NEPA decision. The NEPA analysis for historic and archeological resources will include summary information from the Section 106 process and historic built environment and archaeological technical reports. Section 106 requires input from the public and other interested and affected parties.

An **APE** should be developed for the Section 106 process. The lead federal agency (in this case, WSDOT on behalf of FHWA) is responsible for establishing the APE based on the project undertaking. All project areas, including construction and operational impact areas, easements, and staging and laydown areas, should be included in the APE.

Environmental Justice

Environmental justice impacts should be analyzed for all future projects. More detailed environmental justice analysis is required for projects that require an EA or EIS. Exempt projects must meet the documentation requirements listed in WSDOT *Environmental Manual* Chapter 460.04.

Updated state requirements relating to environmental justice will take effect starting in July 2023 for transportation projects over $15 million. WSDOT is developing procedures for complying with the HEAL Act. These requirements will need to be part of any future project documentation.

> For some projects that are categorically excluded from the NEPA process, impacts on environmental justice populations will need to be reviewed, but detailed study will not be required because the projects would not have significant environmental impacts, would not change access or traffic patterns, would not acquire more than a minor amount of right-of-way, would not displace residents or businesses, and would not require temporary road closures and detours during construction.
>
> (WSDOT Environmental Manual Chapter 460)

SEPA does not contain specific requirements for conducting environmental justice analysis. Project mitigation should follow the steps laid out in WSDOT *Environmental Manual* Section 460.08.

Fish Passage Barriers

Fish passage barriers will need to be identified for future projects. WSDOT's Environmental Services Office Stream Restoration Program and WDFW resurvey roadways for large transportation projects to identify or verify all fish-bearing road crossings and barrier status. Coordination with the WSDOT Environmental Services Office, WDFW, and the local tribes will be needed to confirm WSDOT-owned fish barriers that would require correction during future project review. See the *Fish, Wildlife Habitat, and Chronic Environmental Deficiencies* section for additional information for recommended next steps.

Fish and Wildlife Habitat and Chronic Environmental Deficiencies

Fish and wildlife habitat and chronic environmental deficiencies will need to be identified for future projects. Field surveys for the occurrence of the federal- and state-listed species were not conducted for this analysis but may be required for future project environmental review. All potential projects must further evaluate the occurrence of these species and consult with regulatory agencies as the projects are subject to federal, state, and local regulations. If any listed species are present in the potential area of work, projects will need to consider avoidance and minimization measures during the processes of project design and environmental review. Examples of such measures include altering the design, changing construction methods, incorporating construction timing restrictions, providing more water quality treatment for fish species, and protecting and enhancing existing habitat. The Riparian Restoration Program established by the SR 167 Completion Project is one of the examples where a project will improve existing fish and wildlife habitat through restoration.

Flood Hazards

Flood hazards will be identified during NEPA and projects must evaluate impacts on floodways and floodplains to ensure compliance with local, state, and federal floodplain regulations. Scour and climate change analyses may also be necessary to ensure that a project will be resilient to changes that may occur over the design life of

the project. If development within a floodplain area is unavoidable, the project must be evaluated for its regulatory compliance and severity of impact on the surrounding floodway and floodplain.

During future project phases, flood levels should be carefully considered, and information from prior WSDOT studies, FEMA, and local jurisdictions should be reviewed to confirm the latest models are used. Surveys will likely be needed to assure that potentially affected areas are accurately quantified.

Geologic Hazards

Geologic hazards including liquefaction susceptibility will be evaluated during NEPA. Existing structures may require significant retrofitting or replacement to meet current seismic standards. Some bridges within the analysis area that do not meet current design standards for earthquakes and liquefaction, so design of future projects would need to take this into consideration. Soils with moderate or high susceptibility to liquefaction may require ground stabilization, deep foundations, or other appropriate structural modifications.

Hazardous Materials

A Hazardous Materials EDR records search and risk analysis will be needed for each project to assign a low, medium, or high risk for impact for each Non-NPL site within 1/2 mile and NPL sites within 1 mile of the project footprint. Sites that are considered minimal risk would not be reviewed—including sites that had regulatory interactions not related to the potential release of hazardous materials to soil or groundwater, and sites with a small, one-time spill that was reported as cleaned up. Closed sites with on-site contamination that is monitored long term and contained with institutional controls will also be identified. The risk analysis may be done to inform the NEPA process.

- **Low Risk:** Sites where the nature of potential contamination is known based on existing data, and there is low likelihood or no evidence suggesting that groundwater from the site is affected or the contamination from off-site migration is not expected to affect the project during construction.
- **Moderate Risk:** Sites where the nature of potential contamination is known based on existing data and there is moderate likelihood to affect the project from off-site migration of groundwater. The potential contaminants are not extremely toxic or hard to treat, and likely remediation methods are straightforward.
- **High Risk:** Sites where there is substantial contamination and that pose a potentially considerable impact on the project. High-risk sites may have large volumes of contaminated soil, groundwater, or sediment or may have properties that have multiple complex types of contaminants that require special handling and disposal that

A "**risk analysis**" helps prioritize sites and determine the need for avoidance, remediation, and mitigation options.

The risk analysis assesses the risk level and the level of complexity (straightforward or complicated) for future mitigation measures.

Straightforward: Sites determined to be straightforward are typically small to medium in size, and the potential contaminants are not extremely toxic or difficult to treat. Examples of straightforward sites are gas stations, auto repair shops, most USTs, ASTs, and buildings with asbestos or materials that contain lead-based paint.

Complicated: Sites determined to be complicated have widespread contamination or potential contaminants that are difficult to treat. Complicated sites will typically involve additional research, investigation, and possibly regulatory involvement. Examples of complicated sites are dry cleaners, wood treating operations, metal plating facilities, and other operations that use or used large amounts of hazardous materials.

(WSDOT 2021e)

may be expensive to manage. These sites represent a higher risk of additional releases of hazardous materials, and/or they would be likely to involve high levels of regulatory approvals and/or extensive remediation activities that may create other impacts on the environment. They would likely create a major liability for WSDOT either in construction liability or by virtue of acquiring part or all of the site. The information necessary to predict remedial costs may be lacking, and/or the contaminants are persistent or expensive to manage.

Noise

Noise analyses for future projects will need to consider undeveloped lands and land use changes to determine current locations of sensitive receptors at the time of the project.

A project that involves transit, passenger rail, or park and ride facilities will need to apply Federal Transit Administration criteria for noise and vibration impact assessments. This applies to both NEPA and SEPA documentation, although SEPA reporting may be in a simpler memorandum format.

Type 1 projects include activities that could potentially increase traffic noise levels and/or create traffic noise impacts for noise sensitive receivers. Type 1 Projects include roadway projects that incorporate:

- Construction of a highway in a new location
- Physical changes to the horizontal or vertical alignment of an existing highway
- Increase in the number of through traffic lanes
- Addition of a new or substantial alterative of an existing weigh station, rest stop or ride share lot

Type 2 projects include retrofit projects that provide noise abatement for neighborhoods established before highways were built or expanded.

Type 1, Type 2, and Type 3 projects are defined in 23 CFR 772.5.

(WSDOT 2020a)

If a future project is a WSDOT Type 1 or Type 2 project, a traffic noise analysis will be required. A full noise analysis report is required for any project with noise impacts. If no noise impacts are anticipated, then a noise screening analysis can be performed, as outlined in *2020 Traffic Noise Policy and Procedures* (WSDOT 2020a). If nighttime work is needed during future project phases, the proposed project will be subject to local noise ordinances and may require a noise variance or exemption.

Public outreach should be conducted in future project phases. The project team will likely meet with local government staff and officials, and other stakeholders to address issues and concerns identified during the design process. If during public outreach potentially affected receptors behind proposed noise walls indicate that they do not want the wall or the wall may block territorial views for residents then ballots would be prepared for distribution.

Noise walls or other mitigation measures will be required if a project is determined to have noise impacts. Noise walls would need to meet WSDOT cost and effectiveness criteria relating to feasibility and reasonableness.

WSDOT's strategies for controlling traffic noise at nearby sensitive receivers include constructing noise barriers, reducing traffic speeds, coordinating with agencies to prevent noise sensitive development near highways, preserving existing buffer zones, and helping to support local jurisdictions in establishing routes for buses and trucks (WSDOT *Environmental Manual* Chapter 446).

> Noise abatement measures are analyzed for their feasibility and reasonableness.
>
> **Feasibility** is a combination of acoustic and engineering considerations that determine whether the abatement will achieve a meaningful reduction in sound levels.
>
> **Reasonableness** is evaluated after feasibility of abatement and assesses the practicality of the abatement measures based on factors such as cost effectiveness, consideration of viewpoints of property owners, and the overall noise reduction design goal.
>
> (WSDOT 2020a)

If NEPA documentation has been prepared for a project, it can be used for SEPA documentation. SEPA requires identifying the type of noises existing in the project area, short- and long-term types and levels of noise created by or associated with the project, and mitigation measures. Project mitigation should follow the steps identified in WSDOT *Environmental Manual* Section 446.08.

Recreational, Section 4(f) and Section 6(f) Resources

Recreational, Section 4(f) and Section 6(f) resources will need to be analyzed in future phases. Additional project-level analysis will be needed to evaluate potential project-specific impacts on Section 4(f) resources and an impact determination will need to be made in order to receive federal approval and funding when projects are selected. Project-level design and analysis will need to demonstrate avoidance of use of Section 4(f) properties or no more than a *de minimus* impact. If use of a potential Section 4(f) resource is unavoidable, the project must be assessed within an individual Section 4(f) evaluation to indicate that there is no feasible and prudent alternative to the proposed design and all possible planning has been done to minimize harm.

> After taking measures to minimize, avoid or mitigate impacts, a **De Minimis Impact** results in either a Section 106 finding of no adverse effect, or a determination that the project would not adversely affect the affect the activities or attributes that qualify a resource under Section 4(f).
>
> **Use** of a Section 4(f) property occurs either when land is permanently incorporated into a transportation facility, a temporary occupancy of land has an adverse impact on the resource that the resource was created to protect, or when there is a constructive use of the property (including proximity use).
>
> (WSDOT Environmental Manual)

Public engagement must occur if a *de minimus* impact is proposed for a potential Section 4(f) resource. Depending on the level of analysis required, public notice may be accomplished via the NEPA public notice process, city council meetings, a project open house, or a publication in local newsletters. The public must be provided with an opportunity to comment on the decision.

FHWA's programmatic, nationwide Section 4(f) evaluations can help to streamline the evaluation if the project action falls within the description and criteria of one or more of FHWA's five nationwide Section 4(f) evaluations for:

- Independent Walkways and Bikeways Construction Projects
- Historic Bridges
- Minor Involvement with Historic Sites
- Minor Involvement with Parks, Recreation Areas, and Waterfowl and Wildlife Refuges
- Transportation Projects that have a Net Benefit to a Section 4(f) Property

See the FHWA's nationwide Section 4(f) evaluations (FHWA 2022a) and WSDOT *Environmental Manual* Chapter 457 for more detail.

Social Resources and Public Services

Social resources and public services will be identified for future projects. If a project triggers a NEPA EA or EIS, a social and community effects analysis will be required, as described in Section 109(h) of the Federal-Aid Highway Act. NEPA categorical exclusions do not require a community effects analysis.

Although some of the social resources analysis elements are measurable and can be drawn directly from analysis of other disciplines (such as Air, Noise, and Transportation), the analysis requires consideration of the affected community's perception of the impacts' severity and proposed mitigation measures. Therefore, the analysis will be qualitative and will require early, continuous, and meaningful engagement with the community. The impact analysis may be performed and documented either within an environmental justice report or in a standalone discipline report.

Visual Resources

Visual resources will be identified using WSDOT's approach outlined by FHWA's *Guidelines for the Visual Impact Assessment of Highway Projects* (FHWA 2015) for VIA methodology. The amount of detail and analysis required for a future project will depend on the project classification and results from the VIA scoping questionnaire or comparative matrix method.

Potential visual impacts can be a major source of public opposition to projects, so public communication and engagement will be important for project success. The public should help to inform the visual quality and important visual resources as well as the area of visual effect.

A VIA should be prepared for projects, once they are developed, along with a viewshed analysis and on-site photography for consideration of views from the roadway and toward the roadway. Proposed projects must be sufficiently developed before the VIA can be completed. As part of the VIA, landscape units, landscape character, sensitive viewer groups, key viewpoints, and impacts on scenic resources will be identified. Future site visits and coordination with local planners will be needed once a future project is identified, and landscape units will need to be created. Visual simulations are quite helpful for assessing and communicating both existing conditions and potential changes to the visual environment. Because their reservations are near the analysis area, the Muckleshoot and Puyallup Tribes should be engaged to identify visual resources that are sensitive to the Tribes.

Cultural and historic resources and potential Section 4(f) and Section 6(f) properties will be identified using the steps outlined in the *Cultural Resources and Historic Bridges* and *Recreational, Section 4(f), and Section 6(f) Resources* sections. If a future project is near a public park, recreation area, or wildlife refuge or any historic site, the visual impact assessment should be coordinated with the Section 4(f), Section 6(f), and/or cultural resource assessments.

Water Quality and Stormwater

Water quality and stormwater will be identified for all future projects and projects will assess surface waters in the field. As projects are developed, impacts on surface water flows and water quality will need to be evaluated if projects are near surface water or cross surface water. All future projects will also need to avoid and mitigate impacts on surface waters and to identify retrofitting opportunities by using the WSDOT *Highway Runoff Manual* (WSDOT 2019). New and existing impervious surfaces will need to be calculated as project design progresses, to identify whether a project would require runoff treatment or flow control facilities. Modeling from WSDOT's Western Washington Highway Runoff Dilution and Loading Stormwater Model will need to be used to review changes in the dissolved copper and dissolved zinc directed to receiving waters. The model is a substitute for other contaminants such as 6PPD-quinone, which is a chemical in tires that can cause urban runoff mortality syndrome in salmonids. A different approach may be identified between FHWA, WSDOT, and NMFS in the future.

During future project development, stormwater best management practices (BMP) facilities impacted by minor grading changes would be graded to maintain existing function. If stormwater BMPs are fully impacted by the project, the project would construct a new BMP for an area equivalent to the area being treated according to the current Highway Runoff Model (HRM) standards. Any widening projects would need to comply with the HRM stormwater retrofit requirements by implementing retrofit within the project limits as part of the scope of work.

For future projects within aquifer recharge areas, sole source aquifers, or wellhead protection areas, specific measures will be implemented to prevent groundwater contamination. Additional rules and exemptions will apply where the project passes through wetlands and floodplains according to the WSDOT *Highway Runoff Manual*.

Wetlands

Wetlands will be formally delineated in the field to identify the wetland locations and boundaries for future projects. A functional assessment on each wetland will also be required. Expanding the roadway and/or right-of-way will potentially impact wetlands, and future projects will need to evaluate potential impacts on wetlands. To help avoid and minimize potential wetland impacts, design techniques such as selective widening, widening to the median, and incorporating steeper slopes and retaining walls may be used. If total avoidance is not possible, compensatory mitigation will be required for any unavoidable impacts on wetlands. Wetlands are subject to federal, state, and local regulations, and all projects will be required to comply with applicable regulations.

Appendix E. Mobility Barrier Definitions

Mobility Barrier Definitions

Table 1 summarizes and defines the mobility barriers studied. Some mobility barriers and needs are common to different groups of vulnerable populations.

Table 1. Mobility Barrier Definitions

Mobility Barrier	Definition
Long Commute Time	Vulnerable populations may have longer commute times in order to find affordable housing or if they are dependent on alternative modes that are less competitive to travel times in a car (i.e., they do not own a vehicle).
Lack of Vehicle Ownership	Vulnerable populations are less likely to own a vehicle due to financial burden, physical limitation, or age, among other factors.
High Travel Costs	Lower-income households generally pay a larger portion of their expenditure on transportation, particularly for those living in areas without alternative transportation options and lack of public transit.
Technology Adaption for New Mobility	Lack of smartphone and technology education and trainings prevents vulnerable populations from participating in new mobility services and maximizing the value of new mobility options and services.
Transportation Information Unavailability	Vulnerable populations tend to have difficulties locating and receiving transportation information (e.g., bus route and schedule, service availability) due to the lack of information sources (e.g., smartphone) or uneven information distribution.
No Bank Account	Some vulnerable populations, such as low-income and youth groups, tend to be unbanked, and paying for electronic payments for tolling or transit fares is a burden.
Uneven Distribution of Transportation Services	Unequal access to transportation facilities and services (including public transit, bike-share, sidewalks) and lack of even transportation service distribution in vulnerable communities leads to disproportionate barriers to access opportunities.
Time Constraints	The limitation of time (or time poverty) among vulnerable populations can result from factors such as longer time spent on travel, household responsibilities, or need for multiple jobs.
Safety Concerns	The safety concerns for using transportation among vulnerable populations include the physical factors (e.g., unpaved sidewalk, traffic, crashes) and social factors (e.g., crime, lack of lighting on the streets or transit stations).
Unreliable Transit Service	Long or inconsistent waiting time is a prominent challenge for vulnerable populations to use public transit even if some vulnerable communities have relatively high access to transit.
Transportation Facility Design	Poor transportation facility design prevents vulnerable populations from using non-automobile modes, such as lack of curb ramps, bus stations without seats/roof protection, etc.

Appendix F. Preliminary Equity Focus Area and Refined Equity Priority Area Analysis Methodology

The following discussion summarizes the methods used for identifying the preliminary equity focus areas. Methods were refined after consultation with WSDOT, the Equity Advisory Committee, and other community members. The analysis methodology and selected indicators were developed considering the following resources:

- NEPA, Environmental Justice guidance, and Title VI
- Justice40 and HEAL Act (Chapter 70A.02 RCW - Environmental Justice)
- Washington's Environmental Justice Task Force
- Washington Department of Health Environmental Health Disparities Index
- PSRC reports including Regional Transportation Plan 2018 Appendix for Equity Analysis, Regional Transportation Improvement Program Appendix for EJ and Social Equity Analysis
- County guidance including King County Metro Mobility Framework
- Other government plans including Oregon Metro Regional Transportation Plan, Equity Priority Communities Framework Plan Bay Area 2050, San Diego Association of Governments 2050 Regional Transportation Plan, and Colorado Department of Transportation 2045 Statewide Transportation Plan

Key demographic indicators were selected from U.S. Census Bureau data. Block group geography was used for all indicators, except populations with a disability and foreign born populations where tract geography was used. The indicators and the reason for consideration are summarized in Table 1.

The preliminary equity focus areas were identified using an iterative analysis. First, a "medium concentration" threshold, defined as one standard deviation[1] above the mean of all block groups in the Puget Sound Region (King, Pierce, Snohomish, and Kitsap counties) was calculated for each indicator. Medium thresholds are shown in Table 2.

The standard deviation is the variance or spread from the mean for a given dataset. Assuming a normal distribution, 68 percent of a dataset will fall within one standard deviation of the mean. Therefore, anything above (or below) one standard deviation represents the top 16 percent of data results (or bottom 16 percent). The standard deviation will be closer to the mean when the data doesn't have much variation and it further away if there is more variation.

Next, all U.S Census block groups above the medium threshold for low-income populations, minority populations, or limited English proficiency populations indicators were included as a preliminary equity focus area (Figure 1 through Figure 3).

All block groups intersecting tribal reservation lands were included as a preliminary equity focus area, regardless of whether they met the threshold analysis.

[1] The standard deviation method provides an approach that can be consistently applied with different data sets.

The same threshold analysis was performed for each of the remaining indicators (youth/senior populations, single-parent families, populations with a disability, cost-burdened households, households without a vehicle, and foreign born populations). Areas that met the threshold for one of these indicators, but not the threshold for minority populations, low-income populations, or LEP populations are identified as areas to further explore through the engagement process. Figure 4 through Figure 9 show the outcome of this analysis.

There tend to be spatial concentrations of more than one vulnerable population because of cultural and socio-economic backgrounds historically inequitable urban development policies have resulted in economic and racial segregation (Lipsitz, 2007).

Communities with a ranking of 9 or 10 on the Washington Department of Environmental Health Disparities data that had not yet been included as an equity priority area were also identified for further exploration with stakeholders (Figure 10 through Figure 12).

About half of the communities in the study area have an overall risk rank of at least 8, representing communities with the most impact from environmental health disparities. Most of these communities are located north of or surrounding SR 18 and near the Port of Tacoma and Puyallup Tribe Reservation. Most scores of at least 8 for unaffordable housing are found in communities near SR 167, and generally surrounding or north of SR 18. There are no rankings of 8 or higher in the study area for transportation expenses. Scores of 6 to 7 are found in the southeastern portion of the study area, where a person's commute is likely longer to work than in more urban areas.

The thresholds and methods were reviewed by WSDOT, the Equity Advisory Committee and community groups and the additional thresholds were identified for study, as summarized in Table 3. Block groups or tracts meeting the "high threshold" for any of the indicators listed under Table 1, and block groups intersecting tribal lands were included in the refined equity priority areas, as shown on Figure 13. The equity focus areas are used to identify transportation solutions that will maximize benefits and minimize impacts to people within these communities.

Table 1. Equity Priority Area Threshold Options

Demographic Indicator	Low Threshold [a]	Medium Threshold [b]	High Threshold [c]
Low-Income Population (200% federal poverty)	20%	35%	43%
Minority Population	34%	54%	64%
Limited English Proficiency Populations (Speaking English less than 'very well')	8%	17%	21%
Youth and Seniors (under 18 or over 64)	35%	44%	49%
Single-Parent Families (with children under 18)	22%	38%	45%
Populations with a Disability	11%	16%	18%
Cost-Burdened Households (more than 30% income spent on housing)	32%	45%	51%
Households without a Vehicle (rented and owned)	7%	16%	21%
Foreign Born Populations	17%	29%	35%
Block Groups within Tribal Reservation boundaries			

Notes
Low threshold = PSRC average
Medium threshold = 1 standard deviation above PSRC average
High threshold = 1.5 standard deviations above PSRC average

Table 2. Preliminary Demographic Indicators and Reasoning for Selection

Indicator [a]	Reasoning for Selection
Low-Income Population (200% federal poverty)	Environmental Justice Population, included in Executive Order 12898 and PSRC threshold for low-income in Puget Sound Region
Minority Population	Environmental Justice Population, included in Executive Order 12898:and covered under Title VI
Limited English Proficiency (speaking English less than 'very well')	Included in Title VI, Executive Order 13166, includes many foreign-born populations
Youth or Seniors (under 18 or over 64)	Identified by PSRC as special needs populations
Single-Parent Families (with children under 18)	Identified in the literature (Wang et al., 2020) as facing unique transportation challenges. Bay Area Plan 2050 notes they are more likely to have lower incomes
Population with a Disability	Americans with Disabilities Act (ADA), identified by WSDOT Highway System Plan as populations of focus
Cost-Burdened Households (more than 30% income on housing)	Identified as disadvantaged population in the Interim Implementation Guidance for the Justice40 Initiative (2021).
Households without a Vehicle (rented and owned)	Special transportation needs, and transit-dependent populations.
Foreign Born Populations	Identified in King County Metro's Mobility Framework

Notes:
[a] Employment trends have drastically changed during the COVID-19 pandemic, therefore unemployment data from 2019 (most recent U.S. Census Data source) is not being considered in this analysis.

Table 3. Preliminary Equity Focus Area Thresholds

Indicator	PSRC Mean	Standard Deviation	Threshold
Low-Income Population (200% federal poverty)	20.2%	±14.9%	**35%**
Minority Population	34.1%	±19.7%	**54%**
Limited English Proficiency (5 or older speaking English less than 'very well')	8.0%	±8.8%	**17%**
Youth or Seniors (under 18 or over 64)	35.0%	±9.4%	**44%**
Single-Parent Families (with children under 18)	22.3%	±15.2%	**38%**
Population with a Disability	11.2%	±4.6%	**16%**
Cost-Burdened Households (more than 30% income spent on housing)	32.1%	±12.8%	**45%**
Households without a Vehicle (rented and owned)	6.6%	±9.9%	**17%**
Foreign Born Populations	17.2%	±11.6%	**29%**

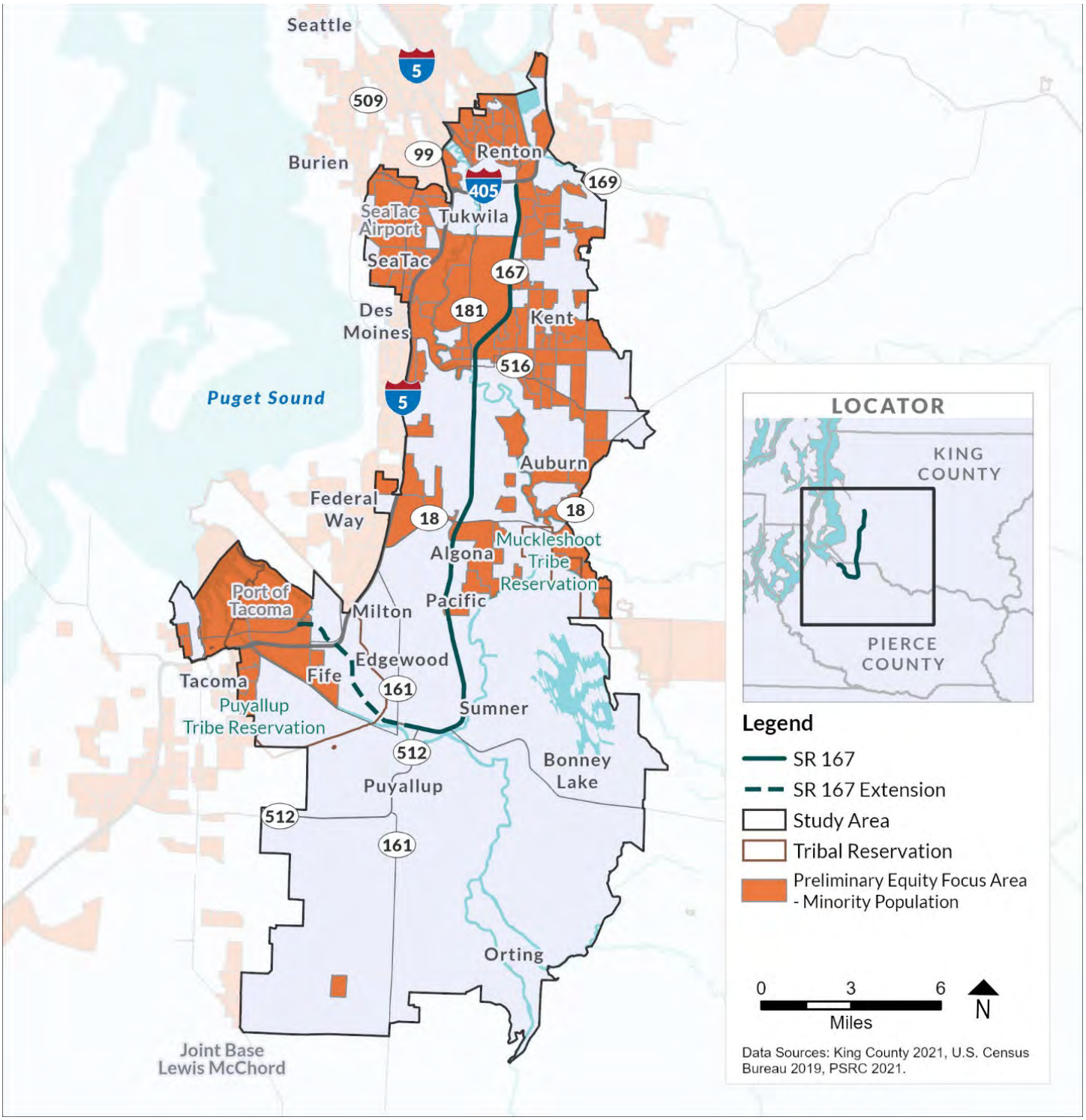


Figure 1. Preliminary Equity Focus Areas – Minority Populations

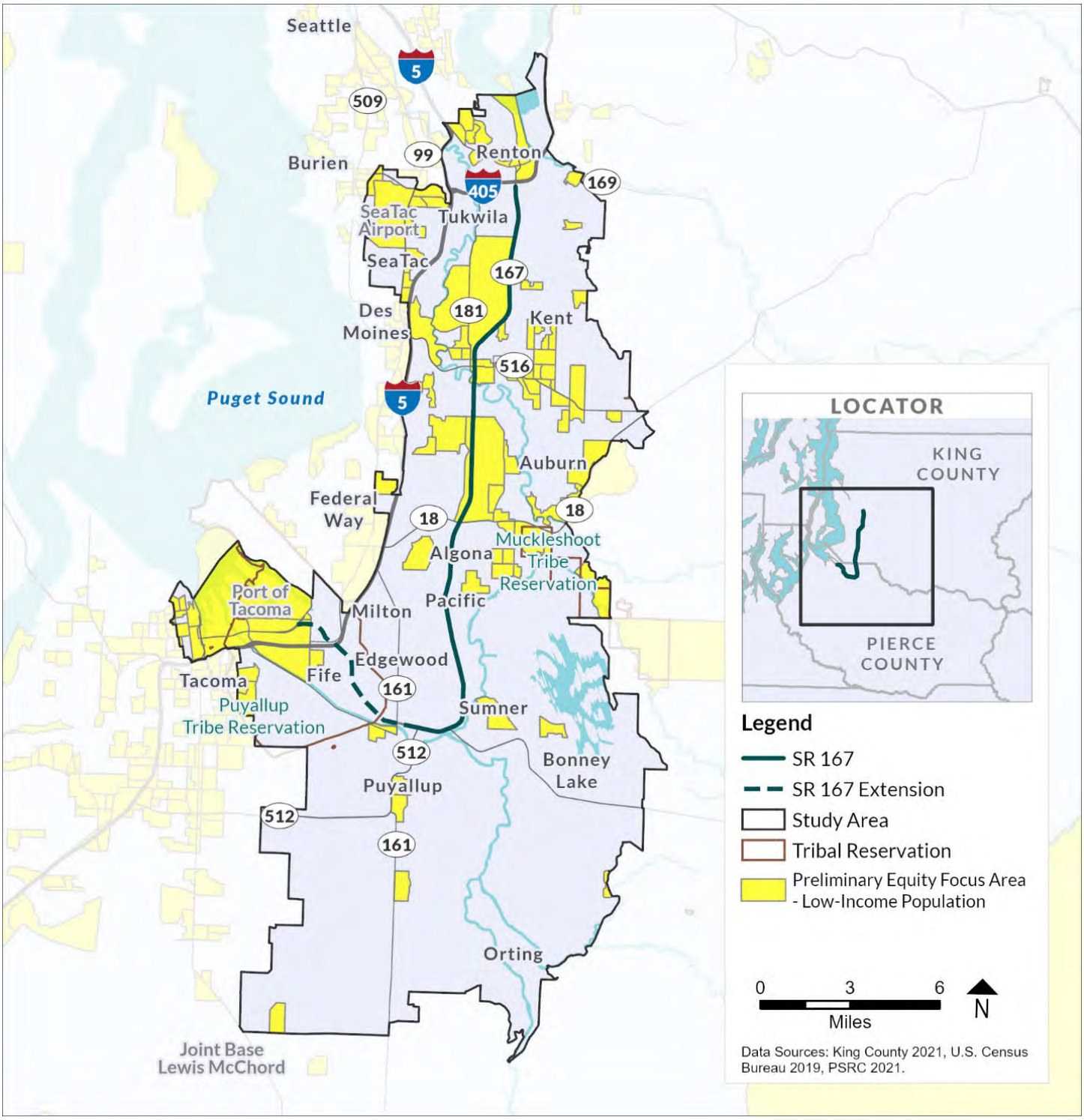


Figure 2. Preliminary Equity Focus Areas – Low-Income Populations

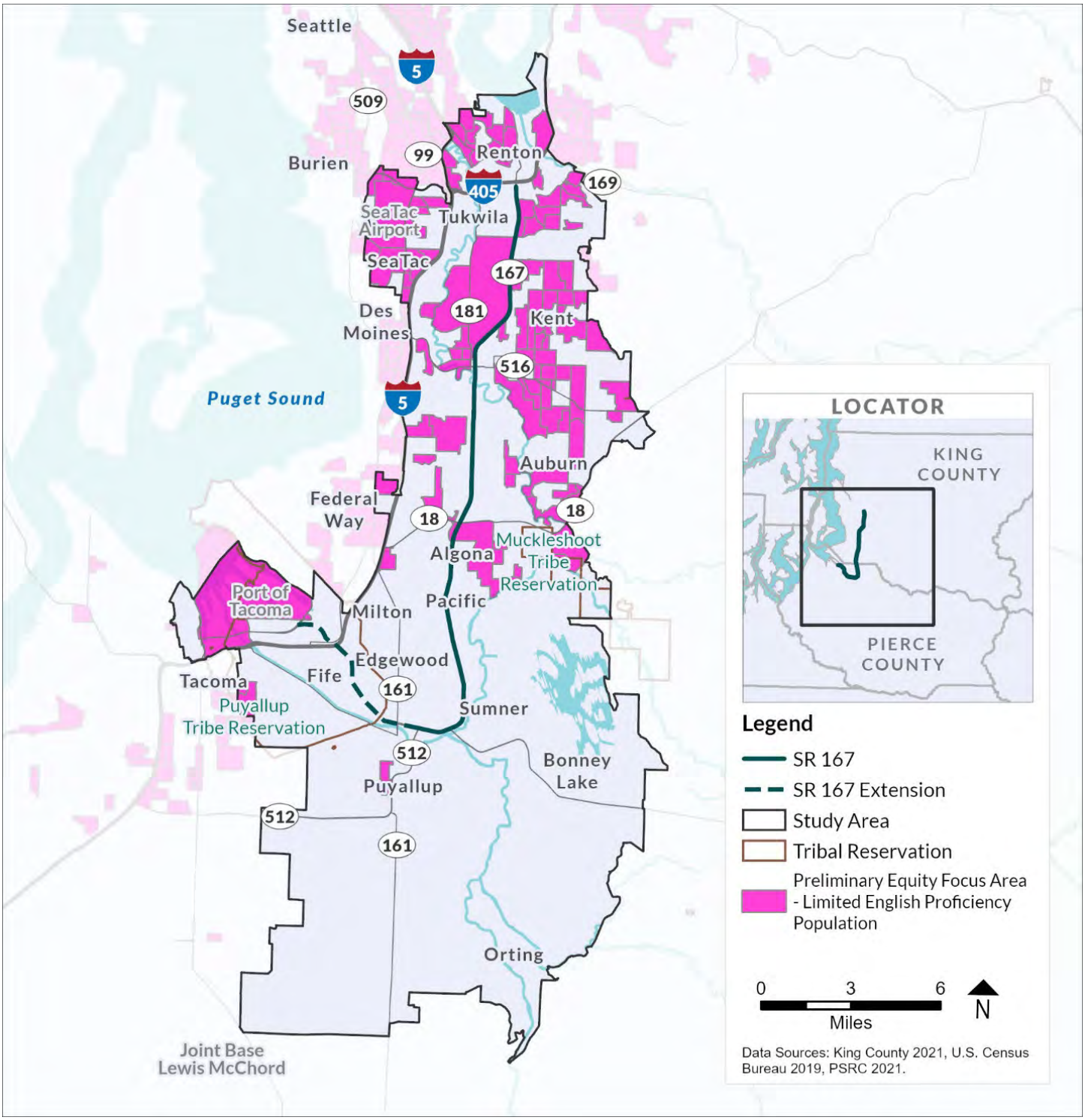


Figure 3. Preliminary Equity Focus Areas – Limited English Proficiency Populations

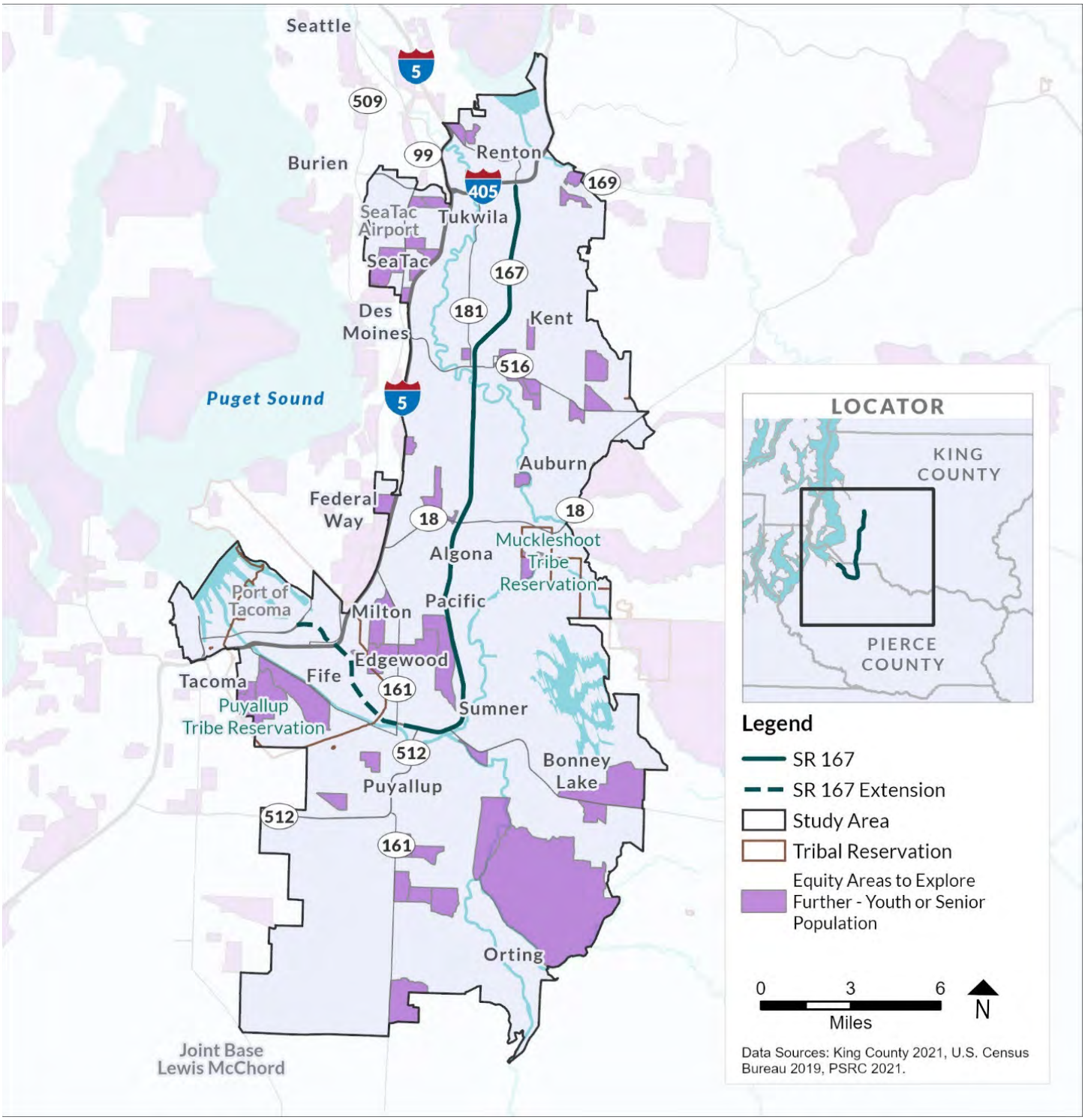


Figure 4. Equity Areas to Explore Further – Youth or Senior Populations above threshold

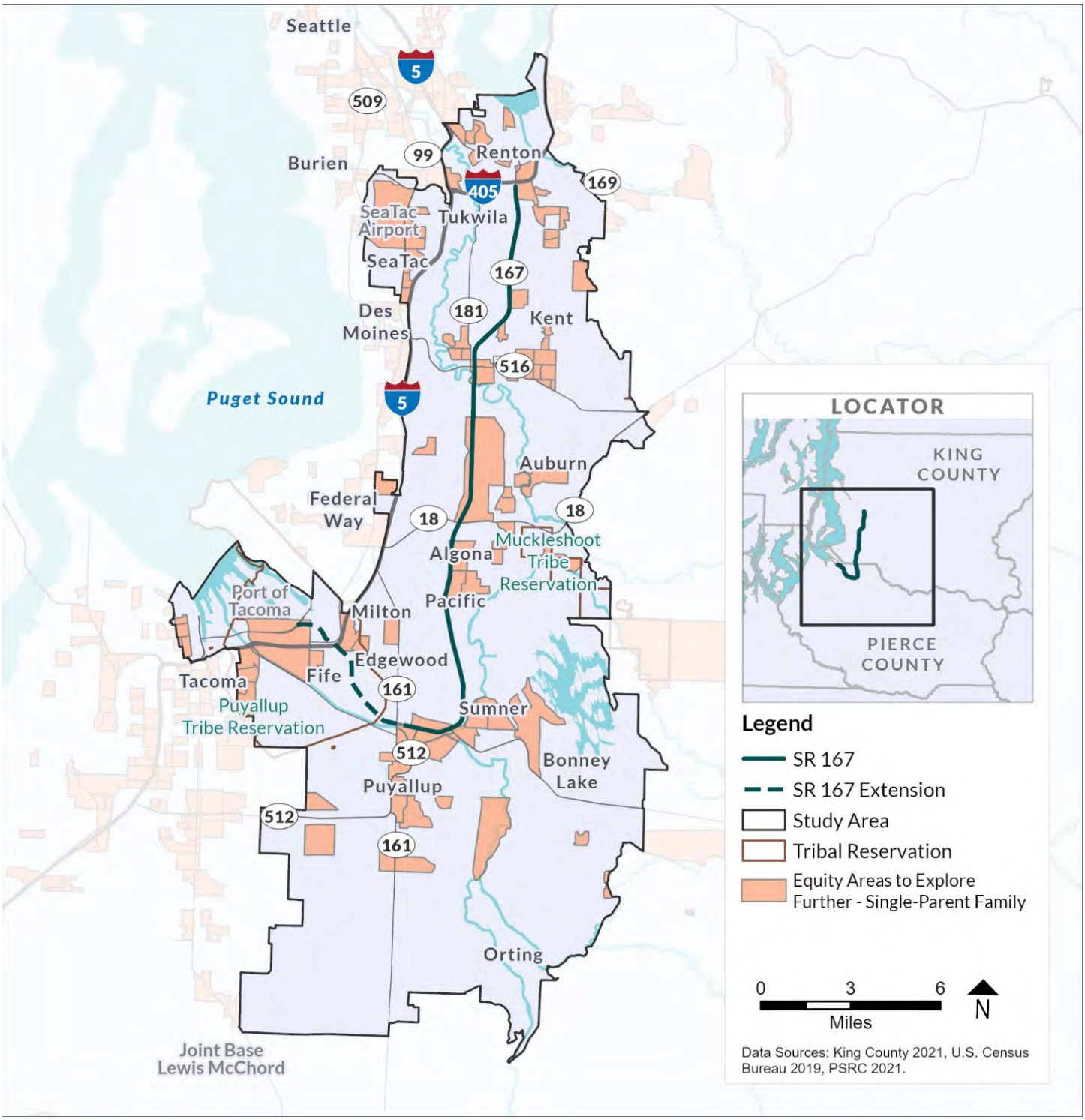


Figure 5. Equity Areas to Explore Further – Single-Parent Families above threshold

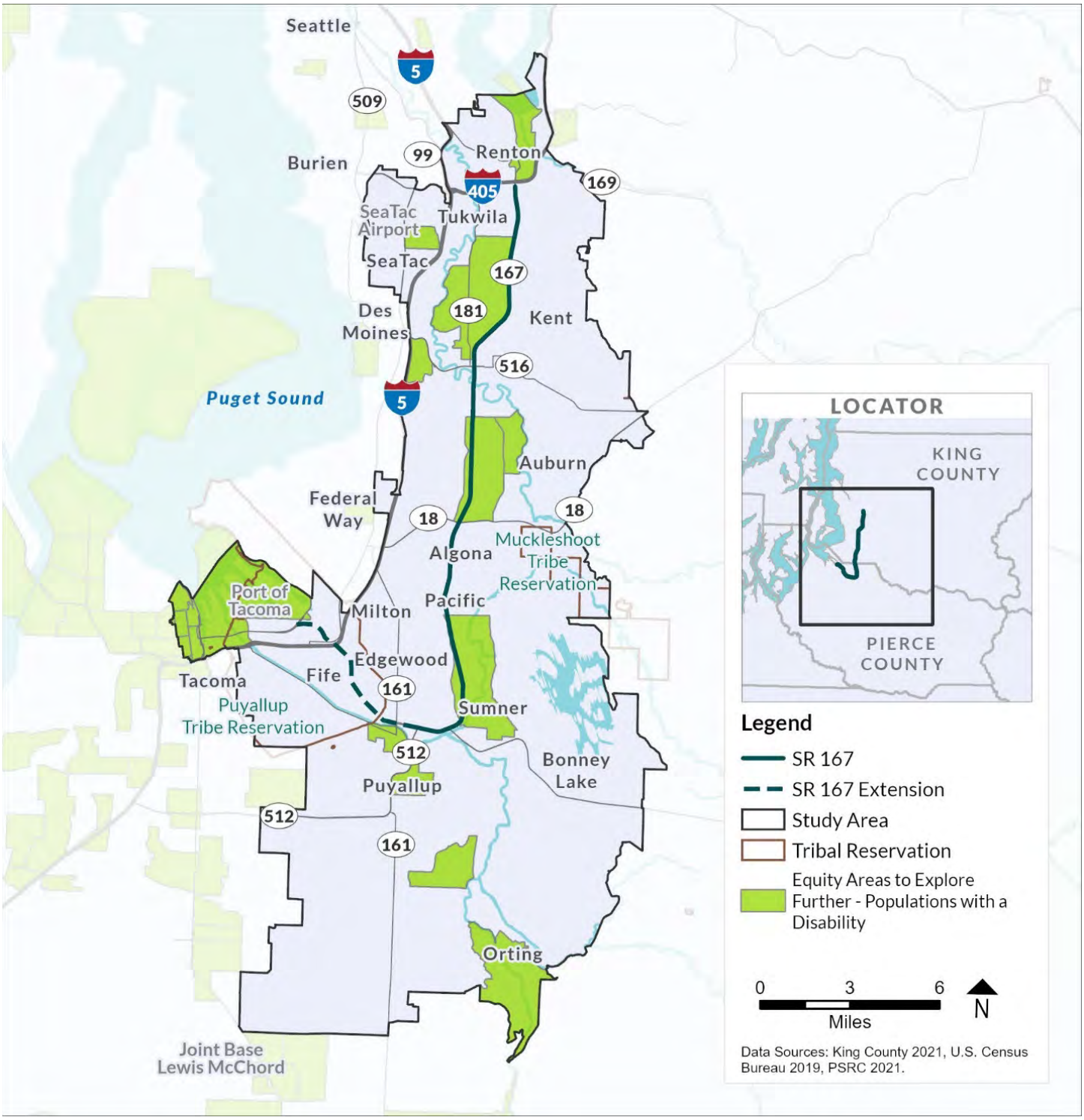


Figure 6. Equity Areas to Explore Further – Populations with a Disability above threshold

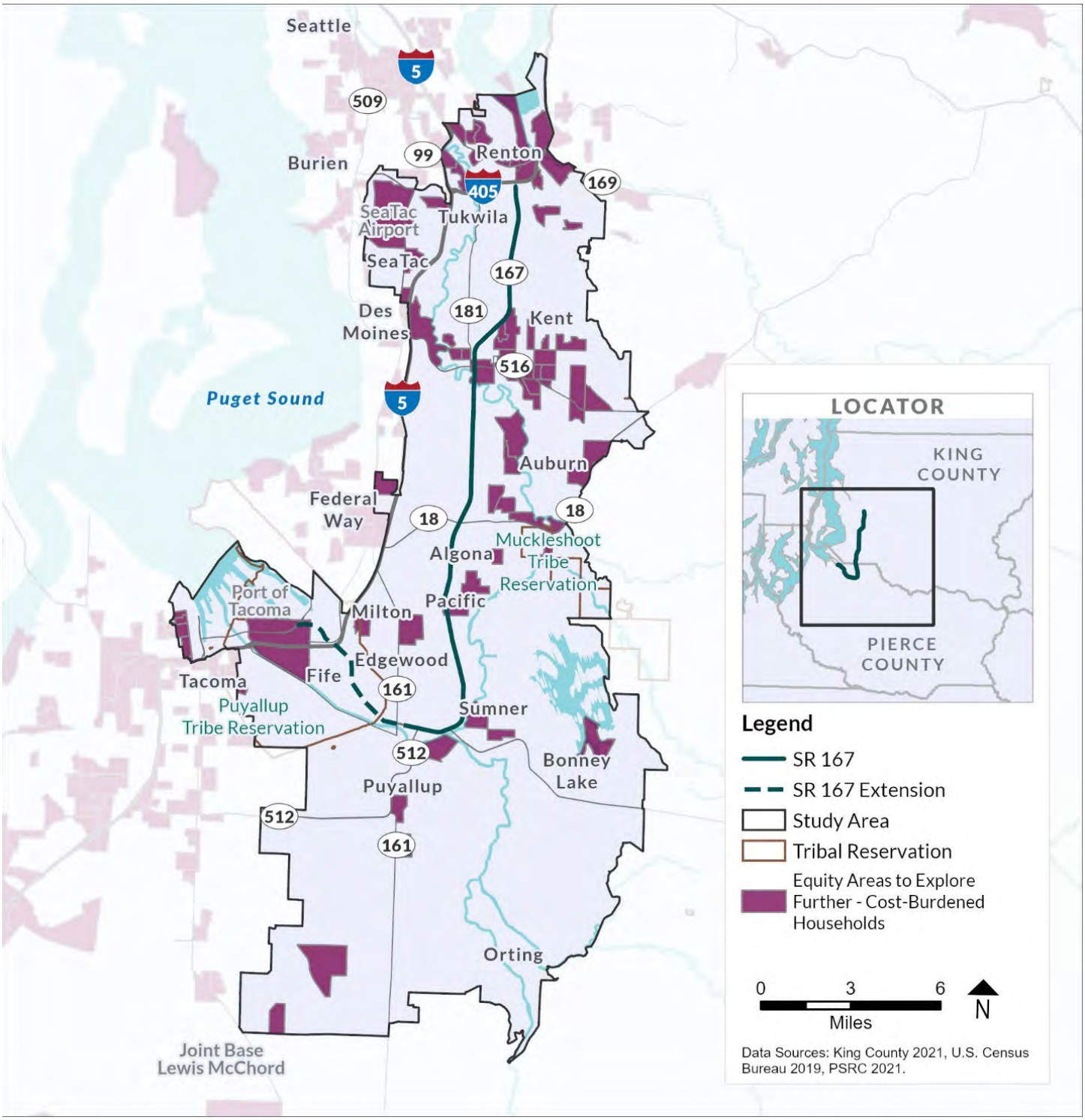


Figure 7. Equity Areas to Explore Further – Cost-Burdened Households above threshold

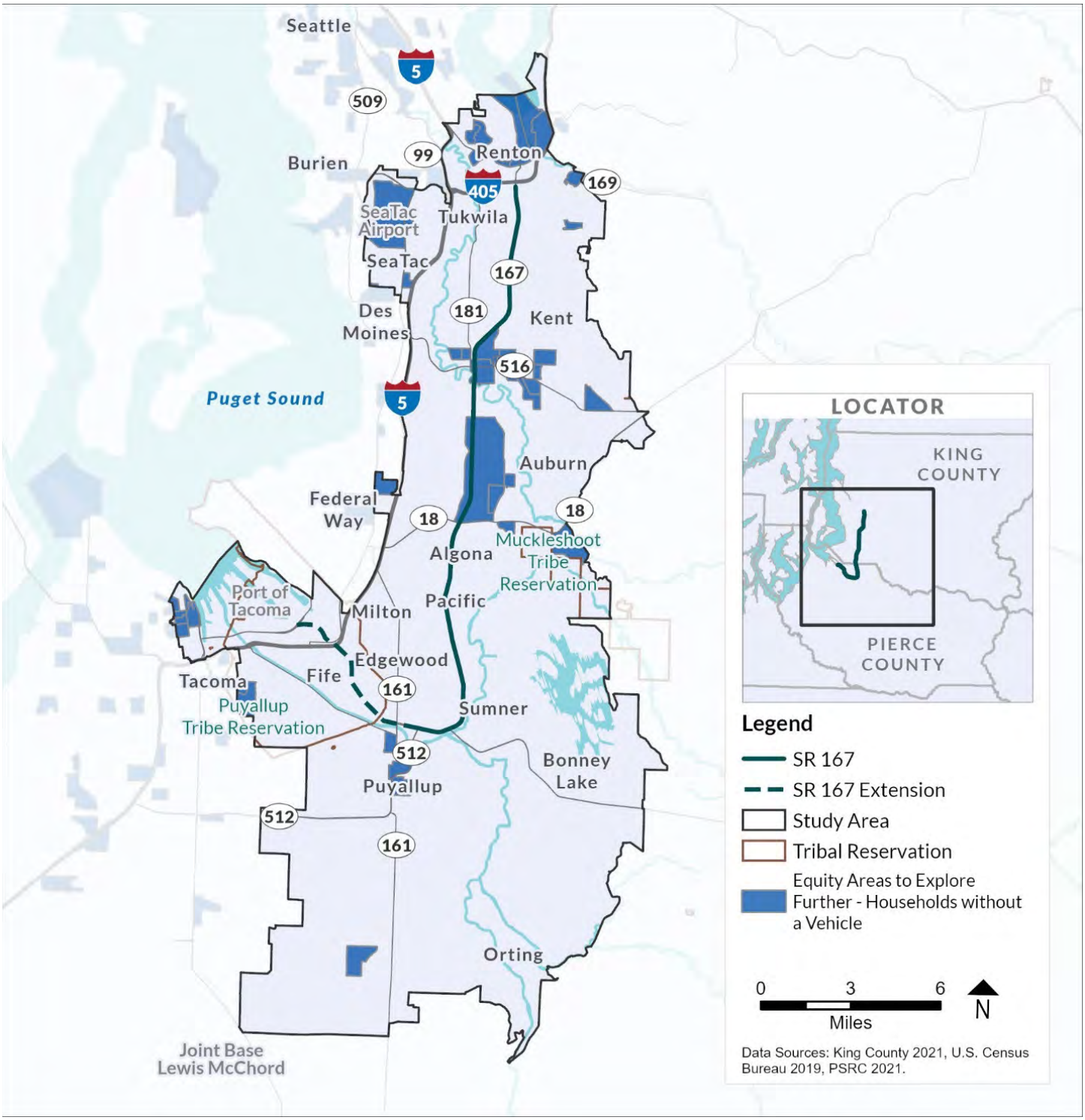


Figure 8. Equity Areas to Explore Further – Households without a Vehicle above threshold

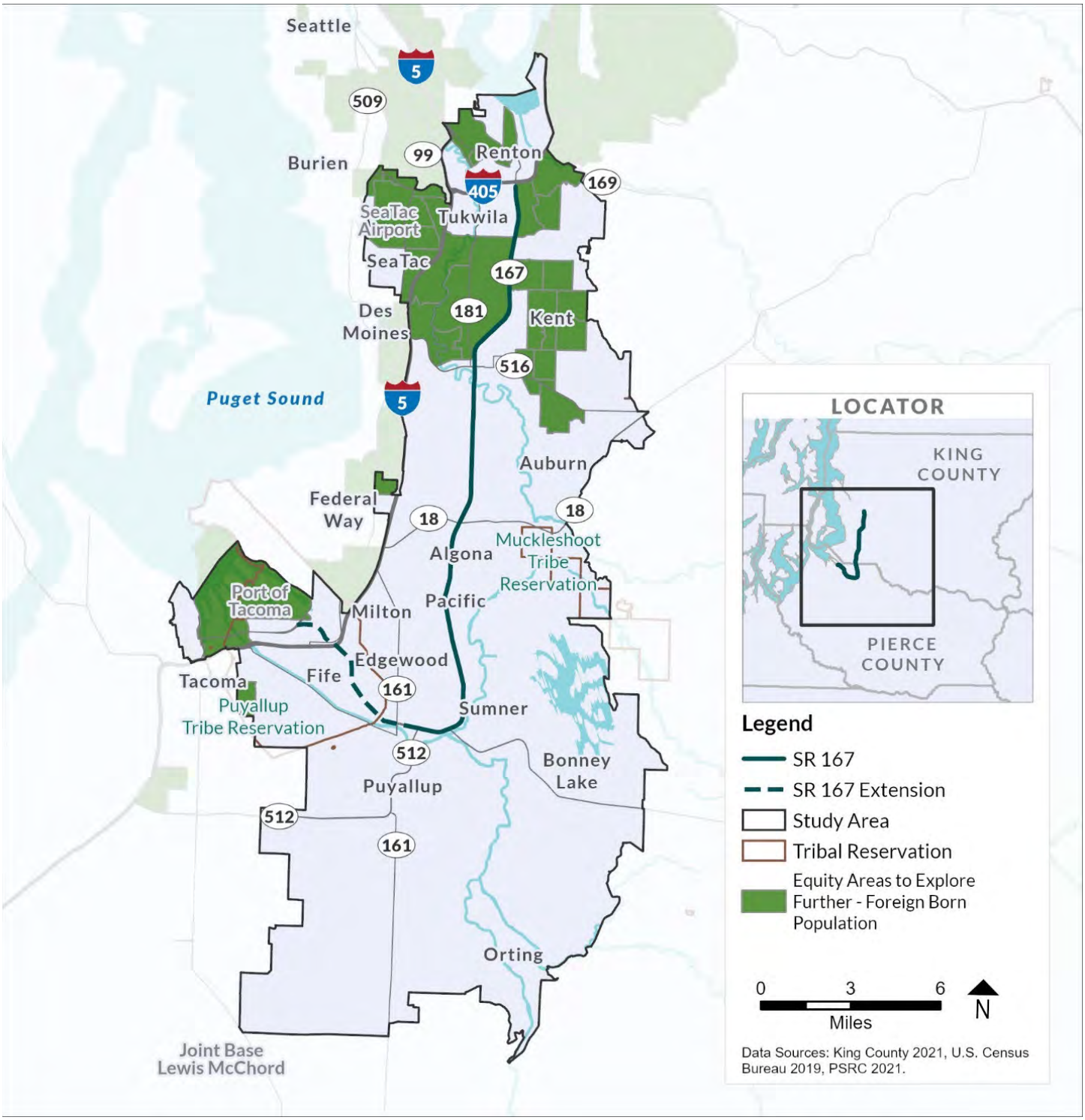


Figure 9. Equity Areas to Explore Further – Foreign Born Populations above threshold

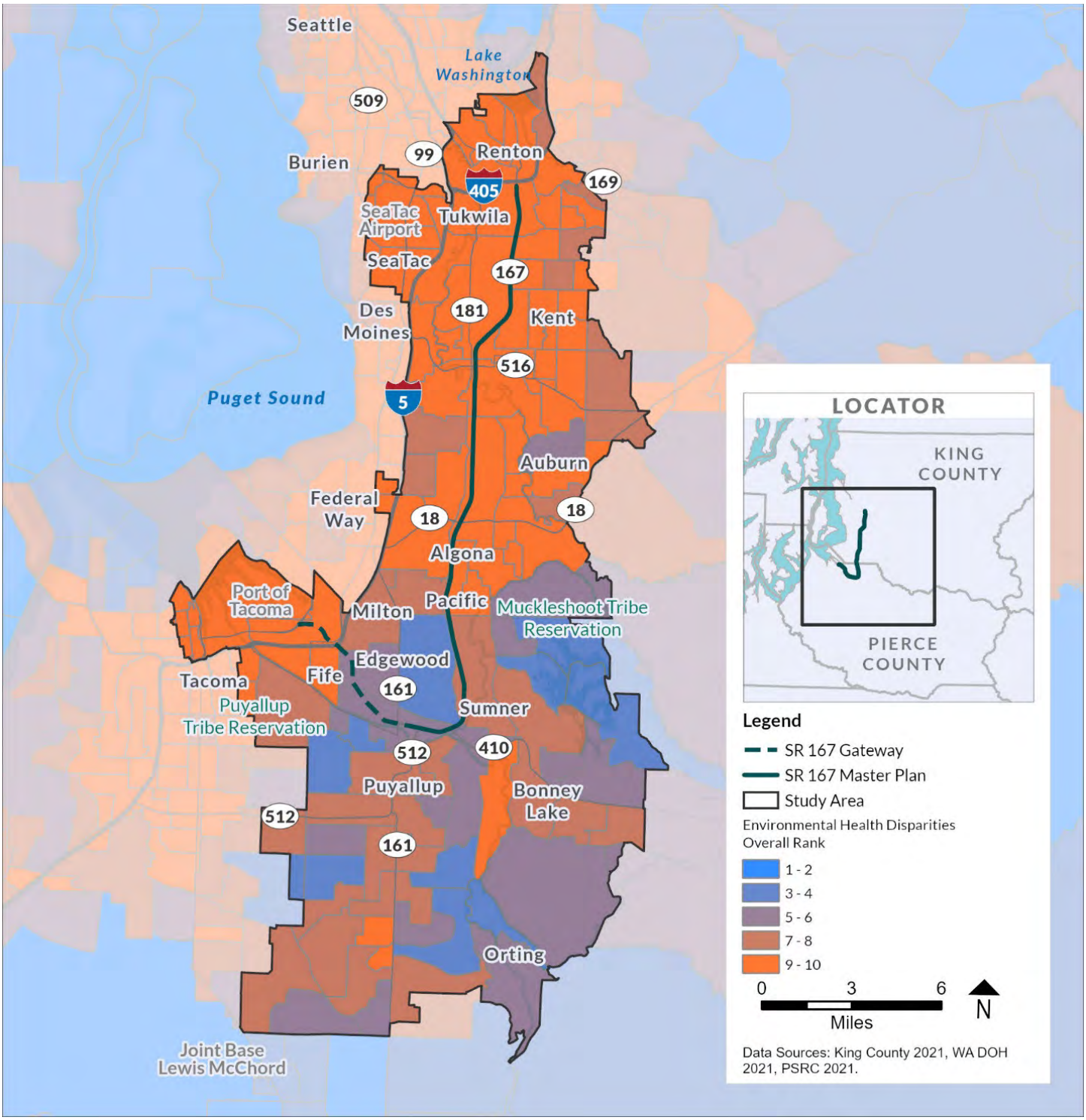


Figure 10. Environmental Health Disparities

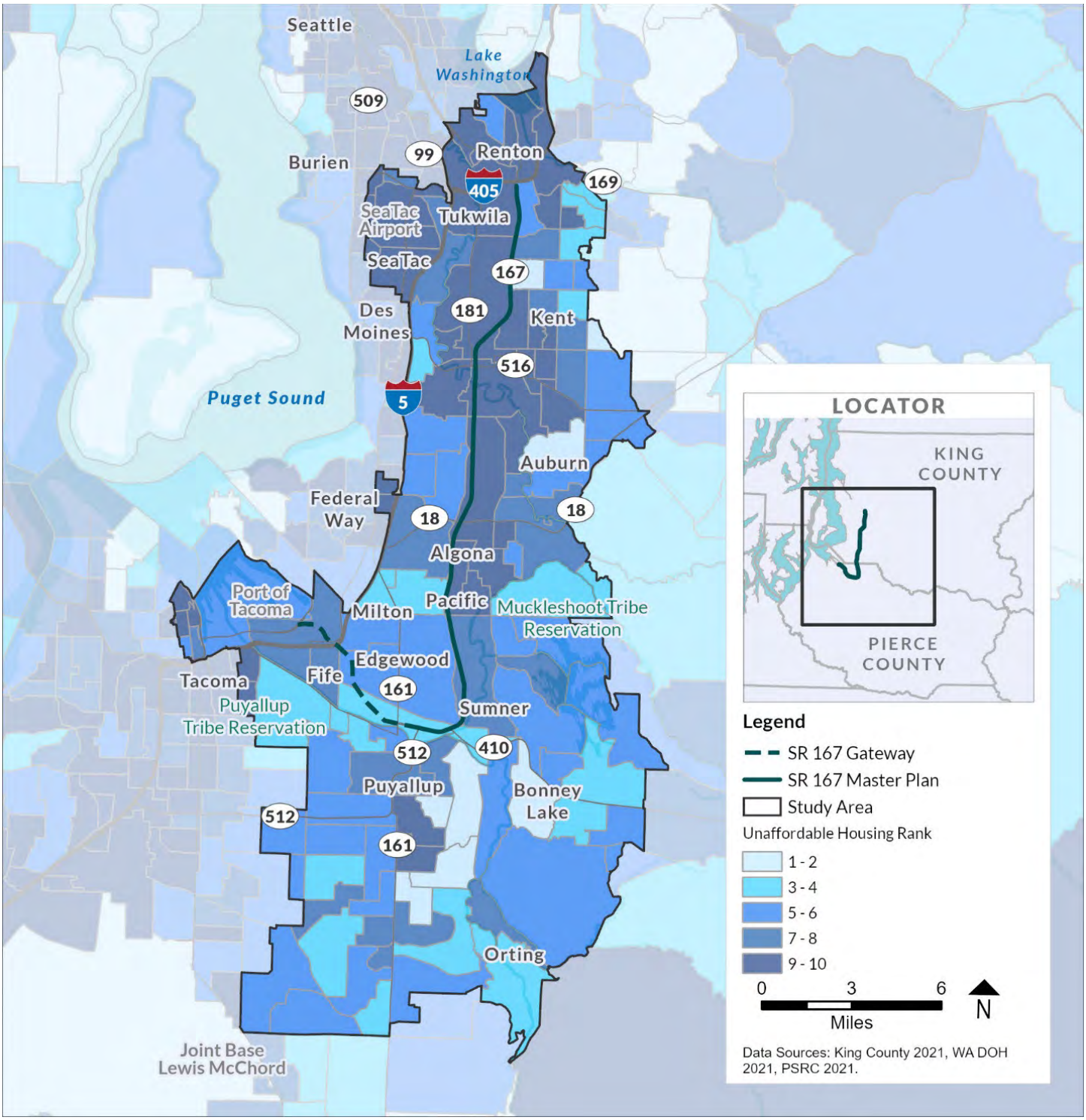


Figure 11. Unaffordable Housing

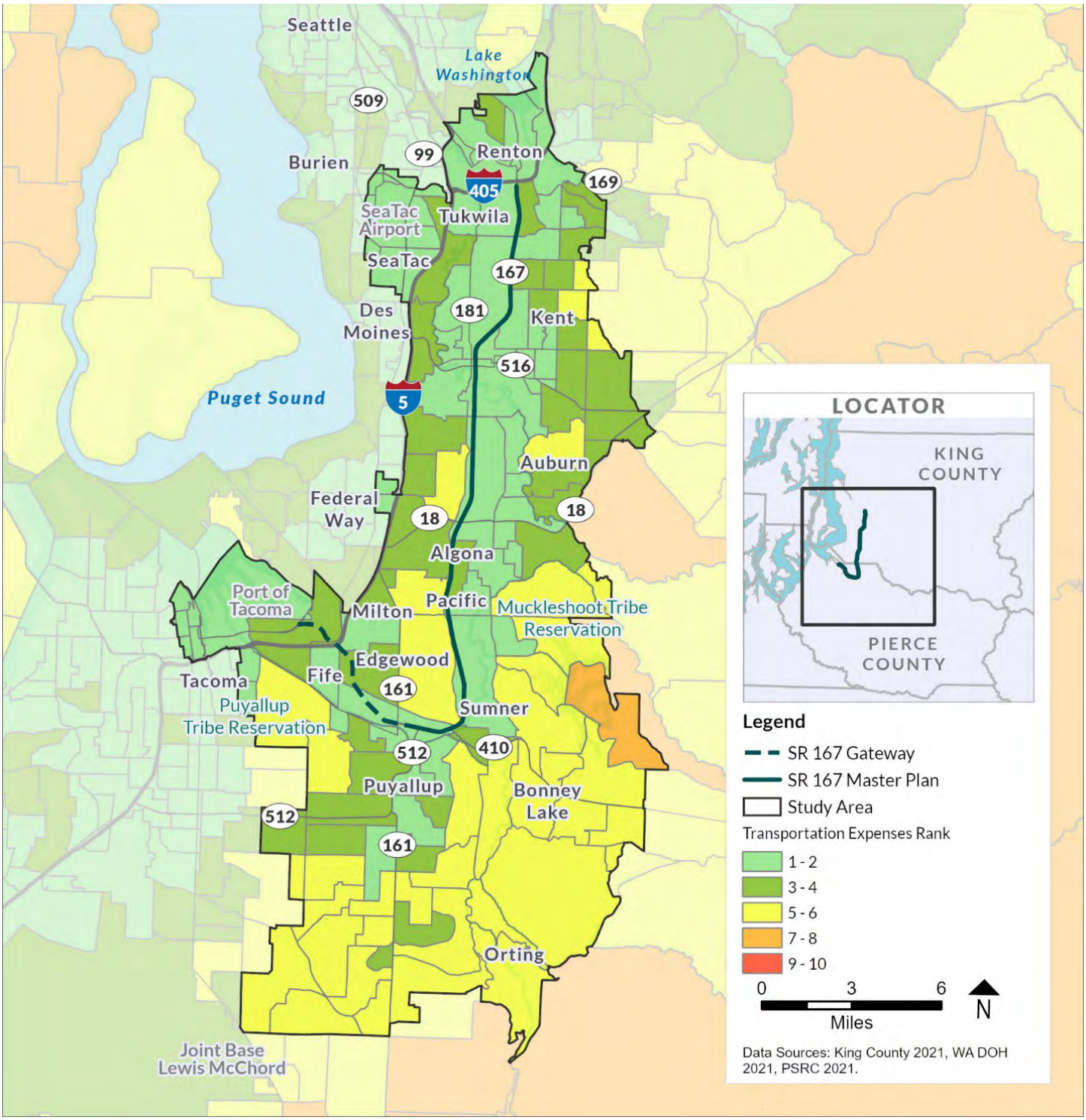


Figure 12. Transportation Expenses

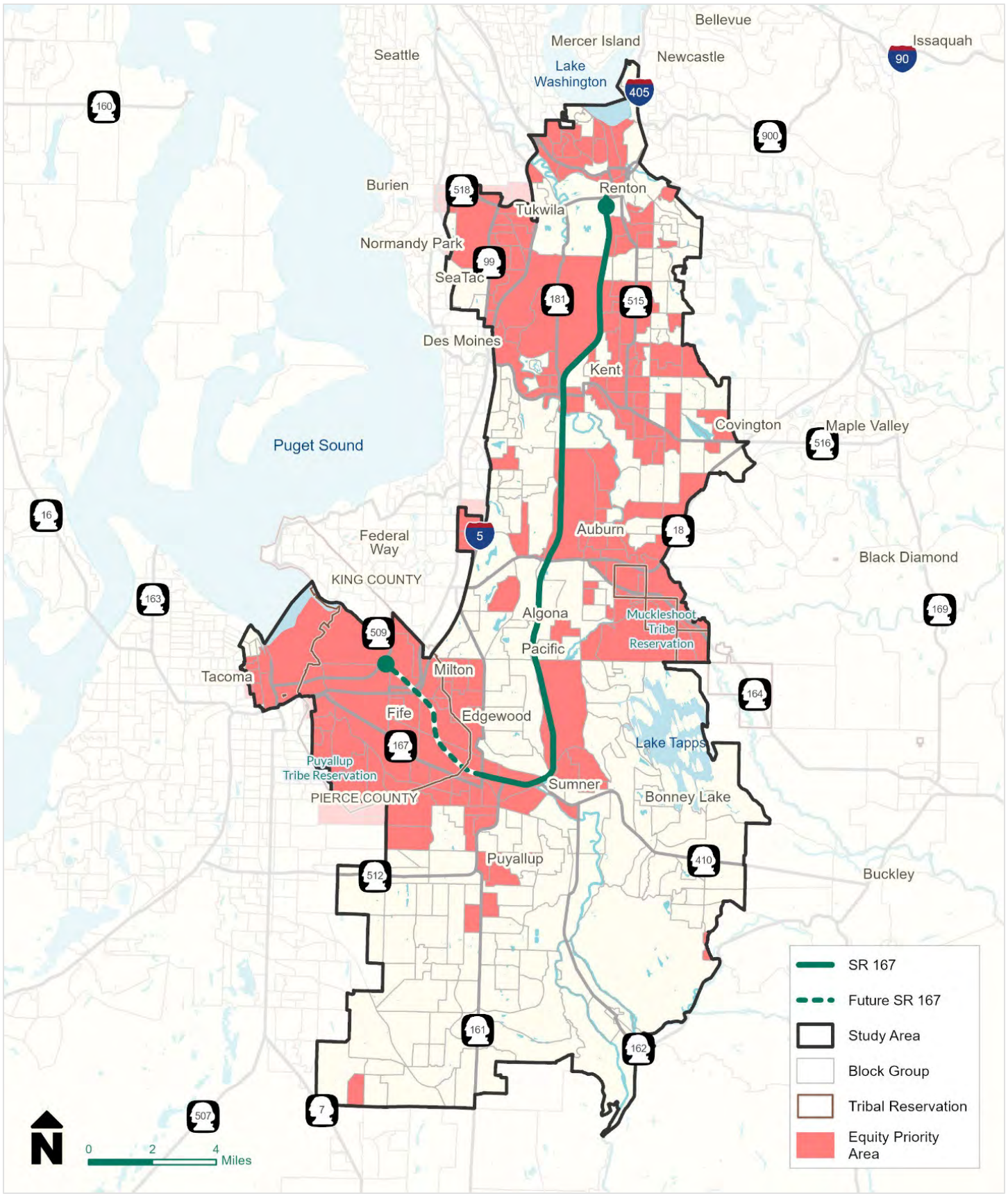


Figure 13. Equity Priority Areas

Appendix G. Streetlight Data Methodology

TECHNICAL MEMORANDUM

Date January 28, 2022

To: [File]

From: I-405/SR 167 Megaprogram Traffic Analysis Team

Subject: SR 167 Master Plan – Streetlight Data Analysis

- ***Introduction***

WSDOT utilized a service called Streetlight Data (Streetlight) for use on the SR 167 Master Plan to inform planners and engineers of the SR 167 users travel patterns, home and work locations, and multimodal activity in the Project Area. This data is amassed from "Big Data" for a very large collection of anonymized location records from smart phones, connected vehicles, wearable technology, and commercial fleet management systems. Streetlight transforms the data into contextualized, quantifiable transportation information for many modes of transportation.

- ***Goal and Objectives***

Streetlight was used to supplement traditional tools and technologies, including in-road data collection, short term traffic counts, tolling data, and demographics information for the SR 167 Master Plan analysis. While traditional data tools are extremely useful (for example, in-road loop detectors are the most accurate method volume counts), they have shortcomings. One of the most significant shortcomings is that they collect data at a finite location. Streetlight was used to overcome these limitations:

- Streetlight provides transportation data from 2019 to November 2021 for all modes analyzed, allowing for seasonal, annual, and Pre-COVID vs current conditions and even specific day analyses
- Data can be collected for any road segment or geographical area within the SR 167 study area and compared with other regional facilities or areas, such as I-5 or nearby regional growth centers. Traditional means to collect this information are both time and cost prohibitive.
- Streetlight can track and see how vehicles and persons move through the entire transportation network.
- Several metrics included in the service, including origin-destination data and multimodal zonal activity, are costly to collect in the field.

To support addressing the purpose and need of the project, Streetlight was applied to address several key questions about users and travel patterns in the study area:

1. Where are SR 167 users traveling to and from and what roads do they utilize? What are the key origin and destinations within the study area?
2. Where do SR 167 users live and work?
3. How long are SR 167 users' trip and what time of day do they travel?
4. Where is active transportation (pedestrian and bicycle) and bus modes most prevalent and deficient in the study area?
5. What are equity issues in travel in the study area?

- ***Methods and Assumptions***

This section describes how the Streetlight service was utilized to conduct analysis for the existing conditions assessment. It provides a brief description of the study area, how the analyses were conducted, what analyses were completed and how the results are summarized.

o Study Area

The Streetlight analysis study area consists of the SR 167 freeway and adjacent communities as shown in **Exhibit 1**. WSDOT developed the study area for the Streetlight analysis based on choosing geographic boundaries or census tracts that were within and adjacent to the SR 167 corridor and connecting regional roadways. The study area includes approximately 80 percent of all daily users that begin and end their trip on SR 167. Freeways include all of SR 167 and portions of I-5, SR 512, SR 410, SR 18, and I-405. Several regional arterials, such as Meridian Ave, SR 162, E Valley Highway, W Valley Highway, Military Road, SR 181, and Auburn Way were also included. Smaller divisions of the study area were also analyzed in detail to understand relative travel activity for those trips that start or end in those smaller areas.

The SR 167 study area and the Streetlight analysis area are different. The SR 167 study area has been refined since the majority of the streetlight analysis was completed. The SR 167 study area was expanded to include along the future SR 167 extension and out to the Port of Tacoma and further to the north and west, including SeaTac Airport. Furthermore, the WSDOT streetlight subscription area limits are a little smaller than the SR 167 study area, especially to the south and east of the corridor.

However, even though the streetlight analysis area is smaller than the SR 167 study area, streetlight has built in tools to understand how regional traffic and mobility patterns influence SR 167 users. Inside the subscription area an extensive level of detail can be acquired, while outside less resolution is available. However, the lower resolution analysis did not impact any findings in this document.

o Modes of Travel

The project team analyzed various modes of travel. The project team used five pre-defined modes of travel for use in the transportation analysis, including:

1. All vehicles (which includes cars, trucks, and buses, and may also include peds and bicycles if their travel behavior is like a motorized vehicle)
2. Heavy trucks (defined as having GVW over 26,000 lbs)
3. Buses
4. Pedestrians
5. Bicycles

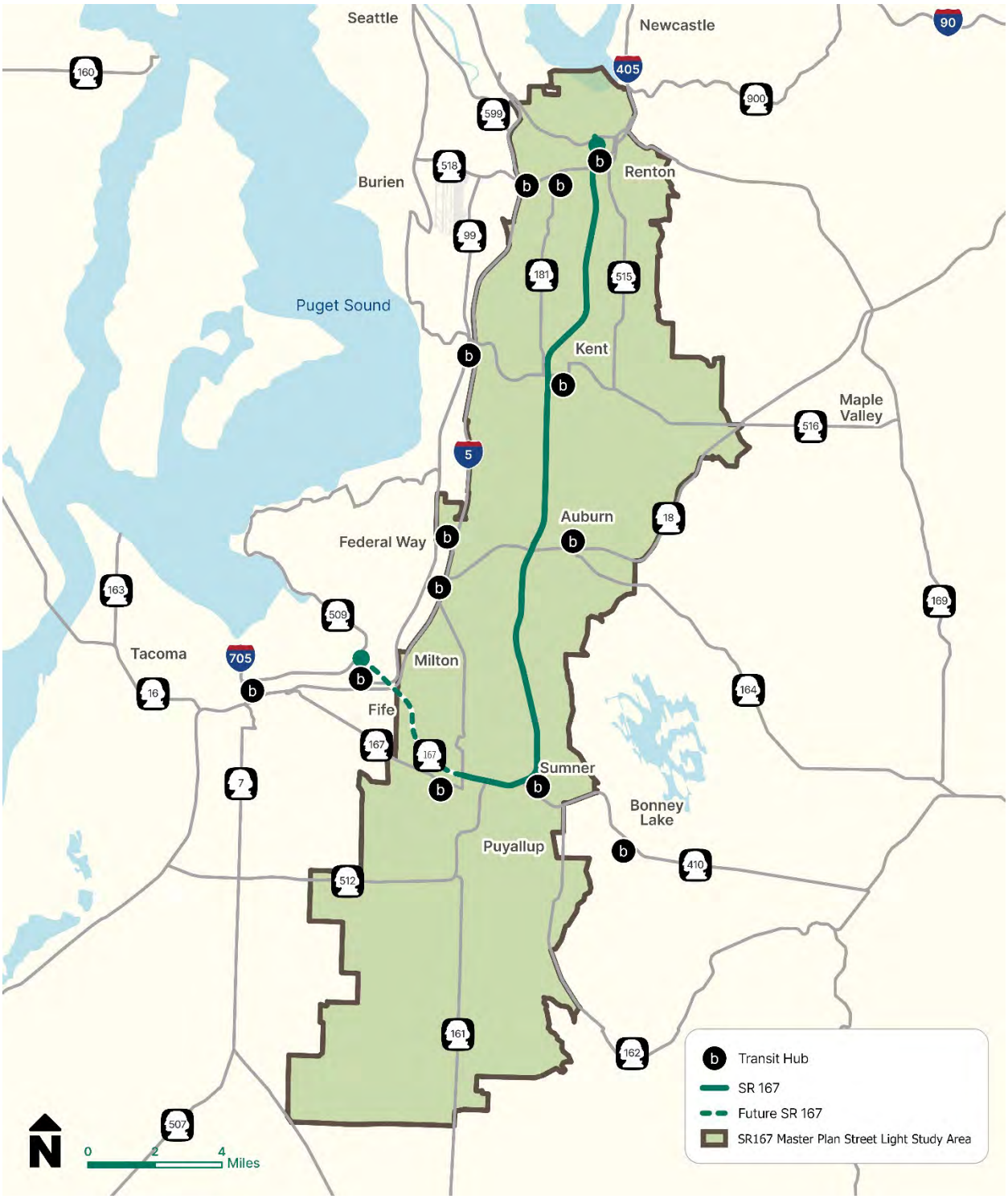


Exhibit 1. Study Area

Two other modes were initially investigated but were not used in this analysis: medium trucks because their characteristics were like the all vehicles mode and rail because of the limited information that could be acquired from the analysis.

o Spatial Analysis

The streetlight analysis was conducted using a combination of roadway segments and area geographies depending on the analysis type. Roadway segments were used to determine several trip characteristics, such as calculating overall average trip lengths or to identify on what roadways vehicles travel to and from a particular segment. In other cases, geographies we used to understand where trips may begin or end their journey or to compare multimodal activity between many areas.

▪ SR 167 Users

To understand the travel behavior of SR 167 users, the analysis focused on travel characteristics of users at various locations on the SR 167 corridor. The analyses looked at travel behavior between each interchange on both directions of SR 167, for a total of 26 (13 northbound, 13 southbound) locations. As needed, the results were further aggregated into areas where there were similar travel patterns. The patterns indicated that the corridor can be generalized by three distinct roadway segments:

1. SR 161 (Meridian Avenue) to SR 410 – This segment is a transition zone that facilitates a mix of shorter, locally based east-west travel between Meridian, SR 512, and SR 410. It also facilitates regional travel between the study area and the South Puget Sound (Tacoma) and southern Washington. Many trips are only on SR 167 for one or two interchanges in this segment. It is often congested during the peak periods.
2. SR 410 to SR 18 – This segment has the highest percentage of trucks and has longer trip lengths compared with other corridor segments. This section also facilitates regional travel between southern Washington and to Eastern Washington via SR 18 and I-90. Managed lanes are intermittent, and travel is congested during much of the peak periods in the general-purpose lanes.
3. SR 18 to I-405 – This segment has a diverse mix of users, including commuters, other home based and non-home-based trips, trucks, and bus users. Segment 3 connects the study area to the central Puget Sound Region, including Seattle and Bellevue, and to SeaTac Airport. High Occupancy Toll lanes are present in both directions of travel and attract users from other parallel facilities willing to pay a toll for a more reliable and faster trip compared with other parallel congested facilities.

HOT lanes were grouped together with the general-purpose (GP) lanes on SR 167 because streetlight cannot provide lane-by-lane travel pattern resolution.

▪ Travel Indirectly Influenced by SR 167

Nearby freeways and parallel arterials to SR 167 were analyzed using the same methods as SR 167 users. Transportation data was collected for these facilities to understand if these roadways have similar travel characteristics to SR 167 and if they are being used as an alternative to SR 167.

▪ Vehicle Travel to and from Areas

Census block groups were used as zones to analyze origin-destination patterns and the relative amount of activity for one zone compared with a group of other zones, otherwise known as zonal activity. This type of aggregation was selected to be consistent with the equity and demographic profile analysis geographies. Census block groups were used for All Vehicle and Heavy Truck modes of travel and identified those trips either starting or ending within this geography. Within the study area, there are 284 internal census block groups included in the analysis. Incomplete census block geographies that were bisected by the streetlight subscription area were not included in the analysis.

- **Buses and Active Transportation Travel**

A smaller area geography was used to analyses bus and active transportation based on feedback from Streetlight staff. A 1 square-kilometer hexagon-shaped area was used to subdivide the study area, resulting in 1,171 unique analysis areas. This area was selected to ensure an appropriate sample size was obtained for each area while having a small enough area to understand mobility trends.

o Temporal Analysis

- **Analysis Years and Period**

The streetlight analysis used October 2019, weekday, daily travel conditions for all analyses unless noted. October data was used as historic data because it best represents an average day during the year. However, some modes of travel, such as buses, pedestrians and bicycles required additional months of data to have an adequate sample size.

The analysis started with a finer temporal resolution (i.e., analyzed specific hours of the day, different months, and weekends). Analysis of this determined the selected weekday daily travel patterns are comparable to other seasonal and time of day trends. It should be noted that some analyses used different analysis years and time periods due to limitations in the dataset and/or desirable information to help address the project's purpose and need.

- **Pre-COVID vs Current Conditions**

The SR 167 project team also assessed Pre-COVID (2019) and Current (2021) conditions to identify any changes in travel patterns. The Pre-COVID period was selected as the default period for a few reasons:

- Other transportation data being used in the SR 167 Master Plan including safety, operations, and demographics used Pre-COVID data.
- A review of the streetlight transportation data indicated travel characteristics such as origin-destination, relative trip activity, and trip lengths have remained relatively consistent for all vehicles between Pre-COVID and current conditions.
- Transit agencies have temporarily reduced bus routes, frequency, and service areas due to COVID. Bus activity is generally expected to return to pre-pandemic levels, but a timeline is currently unknown.

o Analyses

The streetlight analysis focused on identifying the travel characteristics of SR 167 users and of those users indirectly influenced by SR 167. **Exhibit 2** provides a list of the analyses, date and day types, day parts, the modes analyzed, the assumed device penetration rate (an estimate of the number of devices sampled out of the total assumed trips) and spatial aggregation used. Detailed descriptions of each analysis and key findings are presented in **Section 4**.

o Performance Criteria and Evaluation

- **Performance Criteria**

Streetlight uses a trip index for assessing transportation analyses. It represents a relative volume of trip activity but is not an estimated count of actual trips or vehicles. The normalization process differs slightly across different data sources and modes, so a comparison of one mode of activity cannot be directly compared with another mode. However, relative comparisons can be made for the same mode across both space and time. For example, a comparison of pedestrian activity between weekday and weekends or between spring and fall months can be determined. Because an index is used, the data is reported using relative comparisons to express trip flows and activity as percentages.

As an exception, trip attributes are reported using absolute values. Trip attributes give more detailed information on the kind of trips that are being analyzed, including trip travel times, trip length, and speeds. These are presented as both an average value and in distributions.

Unless noted, data is reported for activity specific to the streetlight study area. This is important to state for zonal activity analyses. As an example, an area with a relatively high percentage of pedestrian activity in the SR 167 study area would not necessarily relate to an area with high percentage of pedestrian activity in other areas of the Seattle Metro Area, such as downtown Seattle.

Exhibit 2. Streetlight Analyses used in SR 167 Master Plan

Analysis Name	Date Range	Day Types	Day Parts	Modes	Penetration Rate[1]	Spatial Aggregation
Top Routes	Oct 2019	All Days Weekdays	All Day	All Vehicles, Heavy Trucks	17%	Segments
Study Area Origin-Destination	Oct 2019	All Days Weekdays	All Day	All Vehicles, Heavy Trucks	18%	Segments, Census Block Groups
Regional Origin-Destination	Oct 2019	All Days Weekdays Weekends	All Day, Hourly	All Vehicles, Heavy Trucks	17%	Segments, Census Block Groups
Average Trip Length and Trip Length Distribution	Oct 2019	All Days Weekdays	All Day Hourly	All Vehicles, Heavy Trucks	17%	Segments
Home and Work Locations	Oct 2019	All Days Weekdays	All Day Hourly	All vehicles	17%	Census Block Groups, 1 sq-km grids
Zonal Activity- All Vehicles	Oct 2019	All Days Weekdays Weekends	All Day	All Vehicles, Heavy Trucks	17%	Census Block Groups
Zonal Activity - Peds	May-Oct 2019	All Days Weekdays	All Day Hourly	Pedestrians	18%	1 sq-km zones
Zonal Activity - Bicycles	May-Oct 2019	All Days Weekdays	All Day Hourly	Bicycles	41%	1 sq-km zones
Zonal Activity - Bus	Apr-May 2019 Sep-Oct 2019	All Days Weekdays	All Day Hourly	Buses	25%	1 sq-km zones

Source: Streetlight Data
[1]Streetlight does not provide a penetration rate for heavy vehicles.

- **Evaluation Limitations**

Streetlight aggregates all data and sometimes unexpected trip patterns are present in the data. In some limited cases, these trips may be associated with delivery vehicles or TNCs (like Uber and Lyft). The analysis can also occasionally pick up trips that may briefly divert off of a given route and return shortly after if delays are minimal, such as dropping a child off at daycare.

The analysis team also reviewed the data sample size to ensure illogical trips were minimized. With smaller sample sizes, the results can be biased towards illogical or incorrect travel patterns. In instances where data may be needed during times with low sample sizes (e.g. on weekends during the middle of the night), a larger sample set with more months of data was used.

• *Streetlight Analyses Data and Analysis*

The following section provides a detailed description of the analysis conducted and key findings. For many analyses, supplemental information will be provided in **Attachment A**.

- **Top Routes**

Top routes provides a quantitative visual tool to understand the road segments with the most traffic to or from a selected location.

Top routes is used to assess the top vehicular routes vehicles use to or from a selected zone or roadway segment.

- **Description of Analysis**

The top routes for zones analysis were conducted for the SR 167 corridor between each interchange for both the northbound and southbound direction of travel. Two modes were analyzed: all vehicles and heavy trucks. The analysis investigated the top routes from an upstream origin roadway to the destination segment on SR 167, and conversely, from an origin location on SR 167 to various downstream destination roadway. The top routes analysis is intended to show the most popular origin/destination roads for a given road location rather than a complete inventory down to the single trip on a local road, therefore, a minimum threshold of 5 percent was used to screen the top routes.

After analyzing the individual top routes between all SR 167 interchanges, it was observed the top vehicle routes were very similar for each SR 167 location and were aggregated into the three focus areas discussed in Section 3.3.1. Furthermore, northbound and southbound travel patterns were found to be similar on a daily basis, so only northbound results are reported. Travel patterns were similar between weekday and all days.

- **Key Findings**

The top routes are shown for origins in **Exhibit 3** and for destinations in **Exhibit 4** for the northbound SR 167 segment between SR 410 and SR 18. Additional summaries for the other two focus areas are provided in **Attachment A**. The line weights shown on the graphic indicate the amount of traffic on a given roadway proportional to the total traffic on SR 167 between SR 410 and SR 18.

- **All Vehicles**

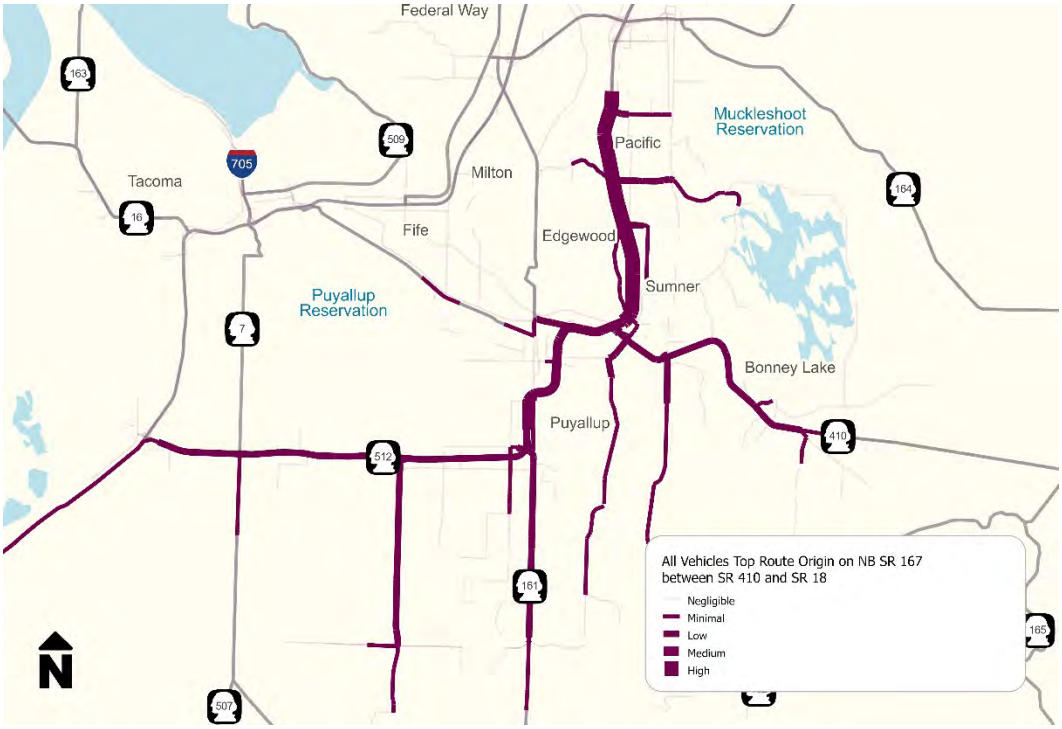
For this segment, most trips for the all-vehicle class enter the corridor from three major origin locations including SR 512 (49 percent), SR 410 (29 percent) and SR 161/N Meridian (7 percent). Breaking down SR 512 further, Canyon Road (11 percent), 31st Ave SW (17 percent), and S Meridian (6 percent) are the largest contributors.

Destinations have key destinations that include SR 18 (17 percent), northbound I-405 (11 percent), and southbound I-405 (10 percent) accounting for approximately 39 percent of all destination traffic while the seven service interchanges between SR 18 and I-405 account for approximately 61 percent of all destinations.

- **Trucks**

Trucks entering the corridor are predominately from I-5 via SR 512 (34 percent), with a smaller proportion from SR 161/Meridian (22 percent) and SR 410 (6 percent). A relatively low percentage of trucks use service interchanges except for 8th Street E/Stewart Road, where trucks are coming from the manufacturing and industrial center east of SR 167 between SR 410 and 8th Street E/Stewart Road. Truck destinations travel patterns are similar to all vehicles but with a higher percentage to SR 18 (21 percent).

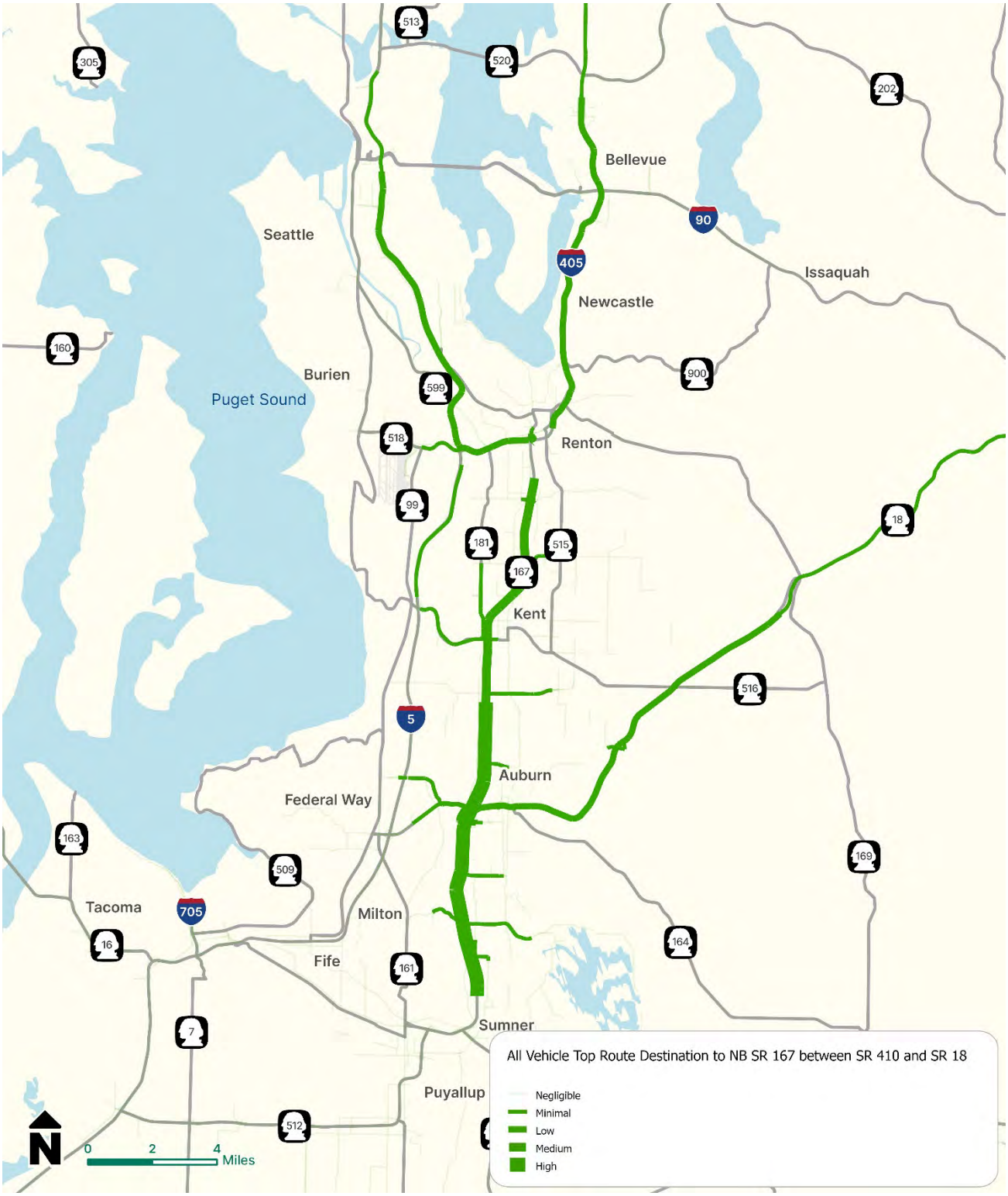
All Vehicles



Trucks

Exhibit 3. Top Routes on Northbound SR 167 between SR 410 and SR 18 – Origins

All Vehicles



Trucks

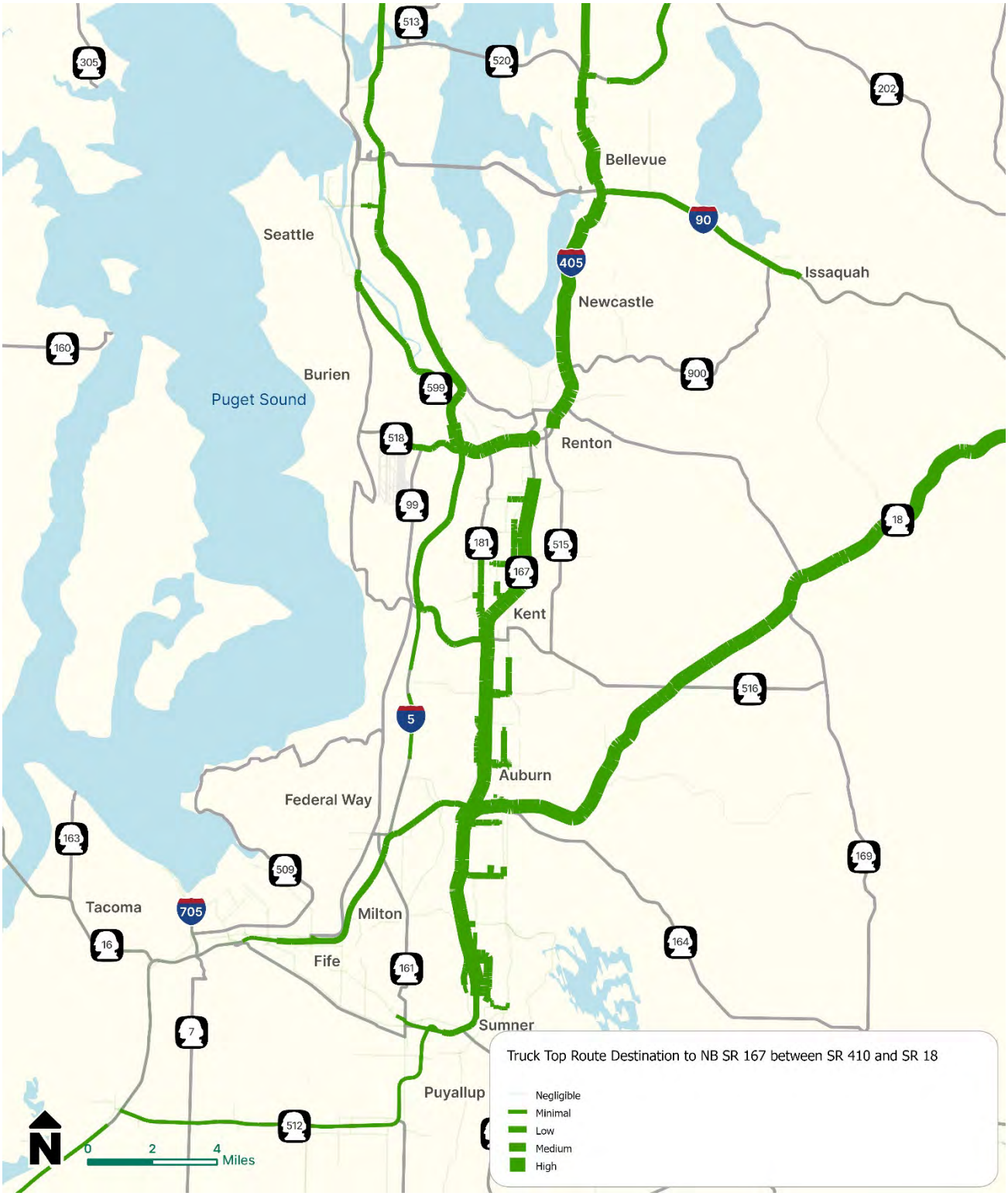


Exhibit 4. Top Routes on Northbound SR 167 between SR 410 and SR 18 – Destinations

o Trip Lengths

Trip lengths is the average trip length (in miles) for trips starting in, passing through, or ending on the roadway link.

The trip lengths analysis calculates the average trip length (in miles) for vehicles passing through a location on SR 167 or other facilities. This type of analysis can be used to assess if a roadway is characterized by longer trips, such as long-haul freight or regional commuters, or is driven by shorter, locally driven activity. Trip lengths are defined as the distance from the beginning of a trip to the end of a trip and does not require one or both trip ends to be within the study area.

▪ Description of Analysis

The trip lengths analysis was conducted on the SR 167 corridor between each interchange for both the northbound and southbound direction of travel. Trip lengths were also assessed on nearby freeways including multiple locations on I-5 and I-405 and on SR 512, I-90, and SR 520. These freeways were assessed to provide a relative comparison with SR 167 and to identify if SR 167 has a greater proportion of long-distance travelers. Several parallel arterials were also included in the analysis: W Valley Highway, E Valley Highway, Military Road, Auburn Way, and SR 181. These parallel arterials were included for two reasons: 1) understand their respective average trip lengths, 2) see if they have a disproportionate number of long-distance travelers that could potentially use freeways. Trip lengths were analyzed using several methods.

- Daily and peak period average trip lengths were analyzed to see if trip lengths varied significantly by location, time of day, and by vehicle class (all vehicles and heavy trucks).
- Trip length distribution was assessed for a daily weekday period to capture the percentage of short (0-20 mi), medium (20-40 mi), long (40-60 mi), and very long (60+ mi) trips. This analysis was completed for both all vehicles and heavy trucks.

▪ Key Findings

Exhibit 5 show the average daily and peak period trip lengths for the all-vehicle and heavy truck modes on northbound SR 167 and **Exhibit 6** for southbound SR 167. For all vehicles, average daily trip lengths range from 23 miles to 35 miles and for heavy trucks average daily trip lengths range from 41 miles to 69 miles. Trip lengths are shortest in the southern section of SR 167 between Meridian and SR 410 where a large portion of motorists are shorter distance east-west travelers using SR 167 between SR 512, River Road, and SR 410. The SR 167 sections between SR 410 and SR 18 has the longest trip lengths for both all vehicles and trucks. This section has a large portion of users that commute to Renton, Seattle, and Eastside destination for work and has the highest percentage of heavy vehicles, two trip types that contribute to longer trip lengths. The peak period trip lengths are similar to daily conditions for all vehicles, having slightly longer trip average trips during the morning and midday periods (up to 4 miles longer). Truck trip lengths are shorter during the evening peak period, likely as truck drivers are avoiding congestion.

Exhibit 7 shows how select segments of SR 167 compare with regional freeways and parallel local arterials using trip length distributions for all vehicles. A plurality of trips on SR 167 has trip lengths between 20 miles to 40 miles, like most other regional freeways. However, SR 167, especially north of SR 410, has a smaller portion of short trips and a greater percentage of long and very long trips compared to most other regional freeways. SR 167 travel compared to other parallel regional arterials is serving a greater portion of longer-distance travel, as expected except for E Valley Highway south of SR 18. This facility, often in the weekday morning peak periods, has a higher percentage of long trips (greater than 40 miles). Based on a detailed analysis of the data, E Valley Highway has the following travel patterns that contribute to the longer trip lengths.

- A portion of trips traveling between SR 410 and I-405 and I-5 and are bypassing SR 167 due to congestion. This is most prevalent northbound in the weekday AM and southbound PM peak periods.
- MICs adjacent to the facility attract more truck which inherently have longer trip lengths

- The facility is higher speed with few signalized intersections, making it an attractive bypass to SR 167

Heavy truck trip distributions show a different trend for parallel freeways compared with all vehicles as shown in **Exhibit 8**. On the corridor, SR 167 has the highest percentage of short trip lengths compared with regional freeways, except for SR 520. The shorter truck trip lengths are a good indicator that a portion of trucks have at least one trip end beginning or ending near the SR 167 corridor. For example, approximately 20 percent of all truck trips that originate at the Port of Tacoma, a major freight generator, has a destination in the SR 167 study area. This trip is relatively short. In addition to those shorter truck trips, the corridor also carries a large portion of long-distance freight travel, where approximately 30 percent of all freight trips are longer than 60 miles in length.

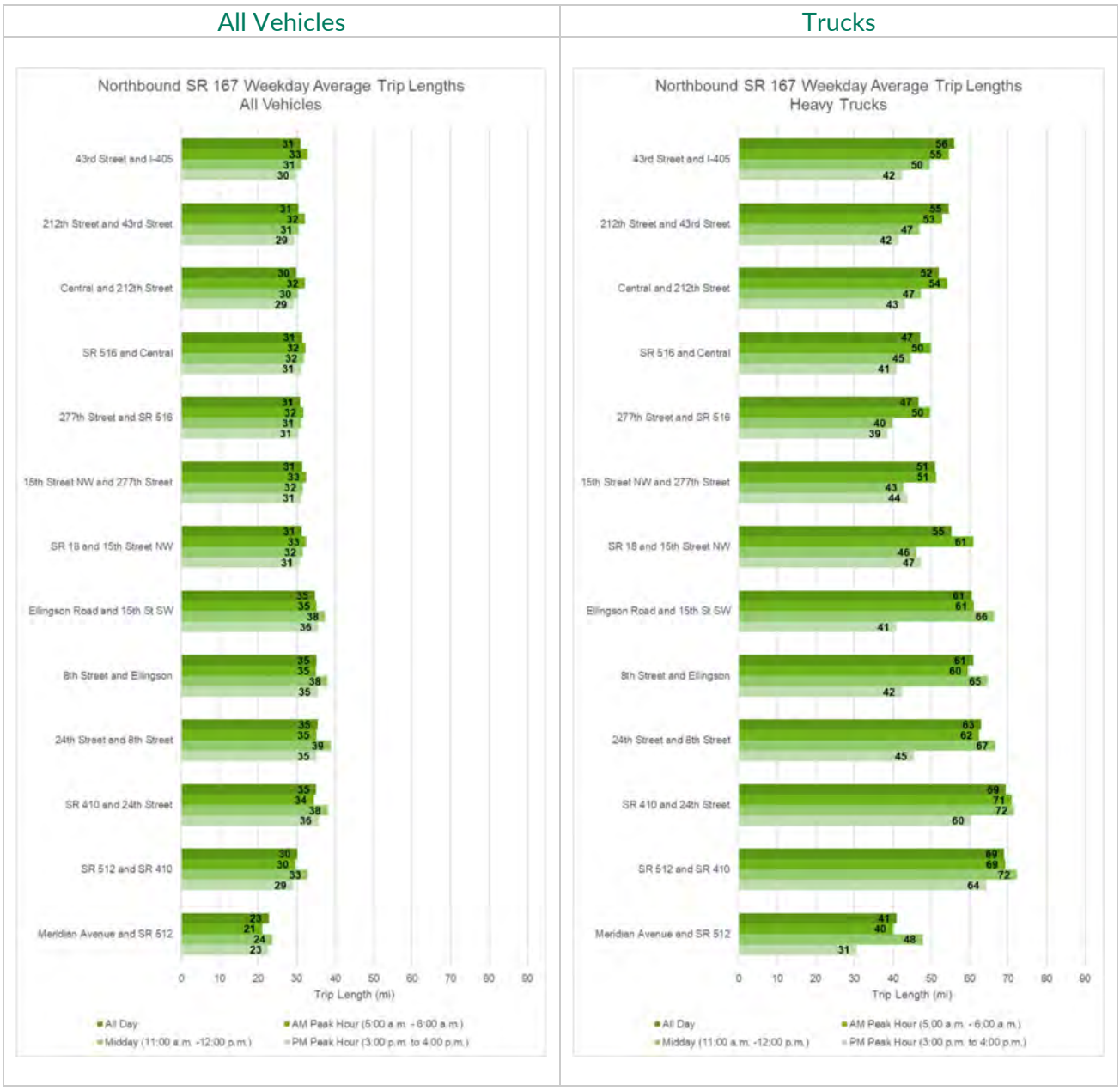
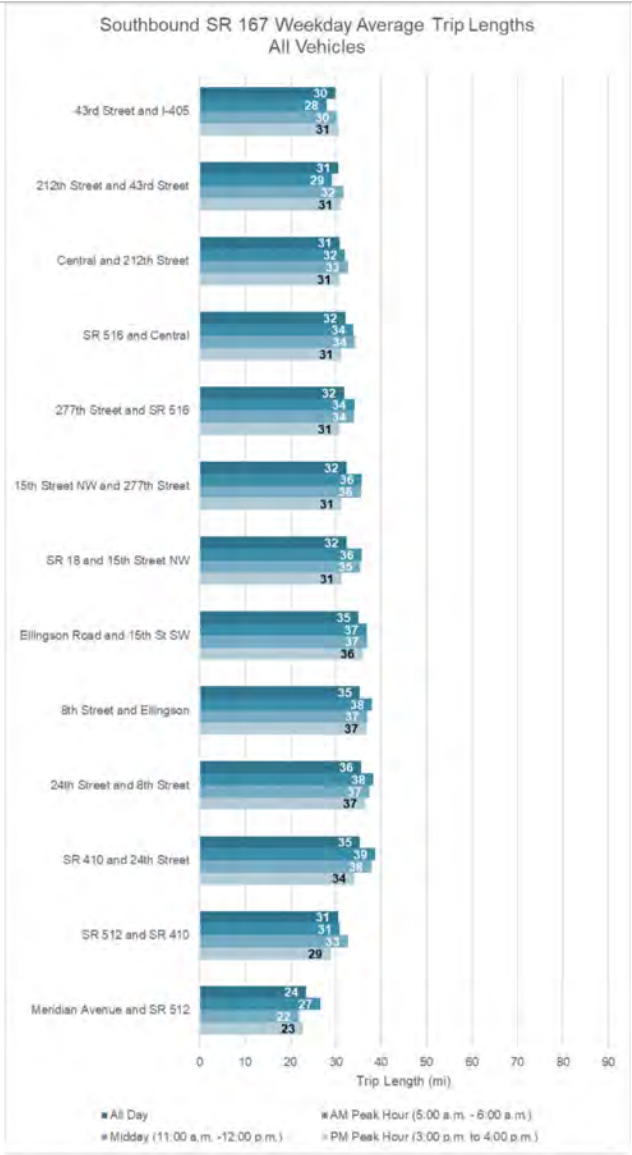


Exhibit 5. Average Weekday Vehicle Trip Lengths for Northbound SR 167, Meridian Ave to I-405

All Vehicles



Trucks

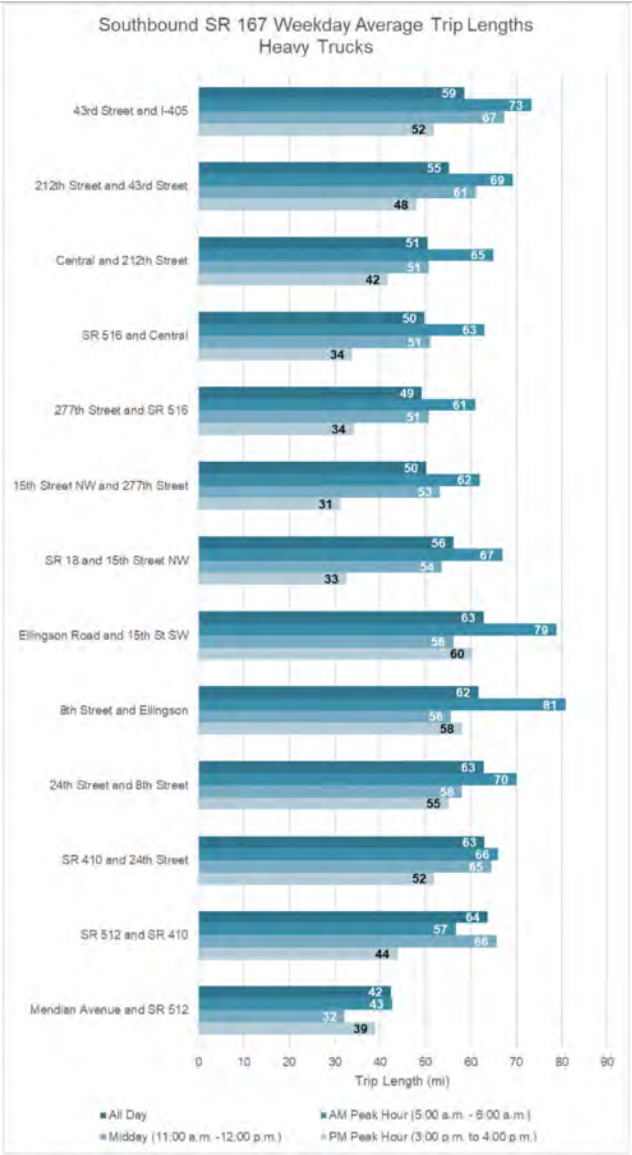


Exhibit 6: Average Weekday Vehicle Trip Lengths for Southbound SR 167, Meridian Ave to I-405

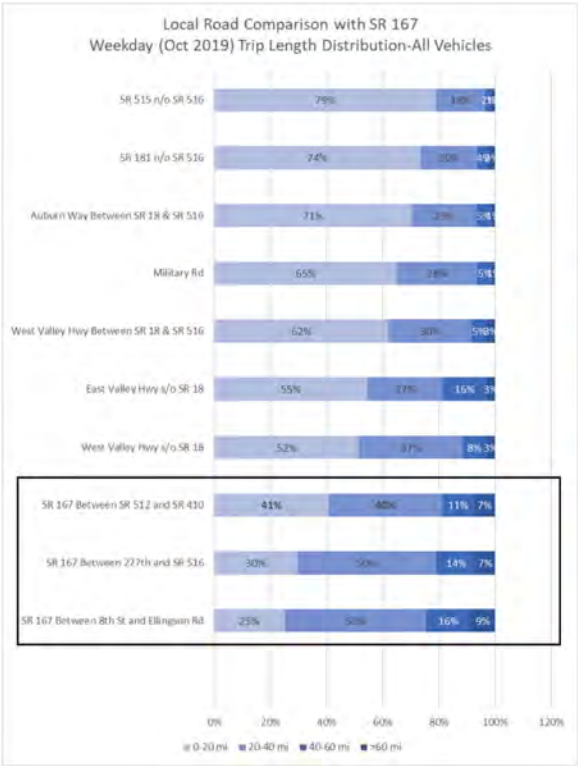
Freeways	Parallel Arterials
	

Exhibit 7. Trip distribution for SR 167, Nearby Freeways, and Parallel Arterials: All Vehicles

Freeways	Parallel Arterials
	

Exhibit 8. Trip distribution for SR 167, Nearby Freeways, and Parallel Arterials: Trucks

- **Study Area Origin and Destination Analysis**

Origin-Destination (OD) is an analysis that shows the trip origins and destinations for SR 167 users within the SR 167 Master Plan study area.

Origin-destination is an analysis that shows true trip origins and destinations for area geographies within the SR 167 study area.

- **Description of Analysis**

OD were identified for census block groups within the SR 167 study area to understand where a relatively high proportion of activity is occurring between one or more zones to other zones. Census block groups were used to aggregate geographic areas for zones located in the study area. To capture trips originating outside of the study area, a small zone was placed on each major roadway at the boundary of the study (otherwise known as a gate). Two vehicle modes were analyzed, all vehicles and heavy trucks. This approach provides information for those trips that are internal (I) to the study (I-I), have one trip end that is internal and another that is external (E) to the study area (E-I or I-E) or have

both trip ends begin or end outside of the study area (E-E). **Exhibit 9** shows the location of internal and external zones in the streetlight study area. They are further group into regions within the study area. The O-D analysis required at least a portion of the trip to use either northbound or southbound SR 167. A review of the data indicated the travel patterns on northbound SR 167 were similar to southbound SR 167, therefore, only northbound results are reported.

- **Key Findings**

- **All Vehicles**

An assessment of internal and external trips that use SR 167 was analyzed and is shown for all vehicles in **Exhibit 10** for northbound SR 167. For these SR 167 corridor users, approximately 60 percent of all trips begin internal to the study area. Most of these trips start in the south and east portions of the study area. The remaining 40 percent of origins start outside of the study area. For trip destinations, approximately 52 percent of all trips have destinations outside the study area while the remaining 48 percent remain within the study area. A deeper dive on specific OD flows was also conducted and are shown in the chord diagram in **Exhibit 11**. It shows the flows of northbound SR 167 trips based on general geographic areas for both internal (as shown in tan) and external zones (as shown in blue). Origins are represented by the outside arc while specific O-D flows are indicated by internal connections (colored by destination) between arcs. The highest traffic flow is between internal zones east of SR 167 to external zones north of the corridor, which represents approximately 12 percent of all activity.

External to external trips vary between 16 to 28 percent of all trips on the corridor. Many of these trips begin or end on SR 512, SR 410, SR 18, I-405, and I-5. The top three E-E trip pairs for each analysis area are shown in **Exhibit 12**. The highest E-E trips pairs in the study area are from SR 410 to those destinations north of the corridor, including I-5 and I-405.

Conversely, trips that are exclusively contained within the study area (I-I) vary between 13 percent to 32 percent of all trips. The most predominant I-I flows of SR 167 users come to or from the south and east sections of the study area. I-I trips that begin and end their trip on either the west or east side of SR 167 represents about 7 percent of all study area activity.

Exhibit 12. Top External to External Trip Pairs

Origin	Destination
Northbound SR 167 between SR 512 and SR 410	
SR 512 at Portland Ave E	SR 410 at 166th Ave E
River Road (SR 167) at 70th Ave E	SR 410 at 166th Ave E
SR 512 at Portland Ave E	SR 18 at SE 272nd St
Northbound SR 167 between Ellingson Rd and 15th Street SW	
SR 512 at Portland Ave E	SR 18 at SE 272nd St
SR 410 at 166th Ave E	I-405 at NE Sunset Blvd
SR 410 at 166th Ave E	I-5 at SR 599
Northbound SR 167 between S 277th Street and SR 516	
SR 410 at 166th Ave E	I-405 at NE Sunset Blvd
SR 410 at 166th Ave E	I-5 at SR 599
SR 512 at Portland Ave E	I-405 at NE Sunset Blvd

- **Trucks**

An assessment of internal and external trips that use northbound SR 167 was analyzed and is shown for trucks in **Exhibit 13**. Approximately 61 percent of all trips begin internal to the study area while the remaining 39 percent originate outside of the study area. Of the trucks that start in the study area, most origins are from the east while most

origins outside of the study area come from the southwest, primarily SR 512. For trip destinations, approximately 47 percent of all trips have destinations outside the study area while the remaining 52 percent remain within the study area, indicating a slightly larger percentage of truck trips have a trip end internally located in the study area as compared with all vehicles. Specific OD flows are also shown in the chord diagram in **Exhibit 10** using the same color scheme and format as all vehicles**.** The highest traffic flow is between internal zones east of SR 167 to external zones north of the corridor, which represents approximately 14 percent of truck activity.

External to external trips truck trips vary between 7 to 13 percent of all trips on the corridor, indicating through truck travel is less than all vehicle through travel. Many of these trips begin or end on SR 512, SR 410, SR 18, I-405, and I-5. The highest E-E trips pairs in the study area are from SR 512 and SR 410 to those destinations north of the corridor, including I-5 and I-405. Conversely, trips that are exclusively contained within the study area (I-I) vary between 10 percent to 35 percent of all trips, similar to all vehicles. The most predominant I-I flows of SR 167 users come to or from the east and west sections of the study area representing about 12 percent of truck study area activity. These truck trips often travel from one MIC to another requiring trucks to travel on SR 167 for a relatively short distance.

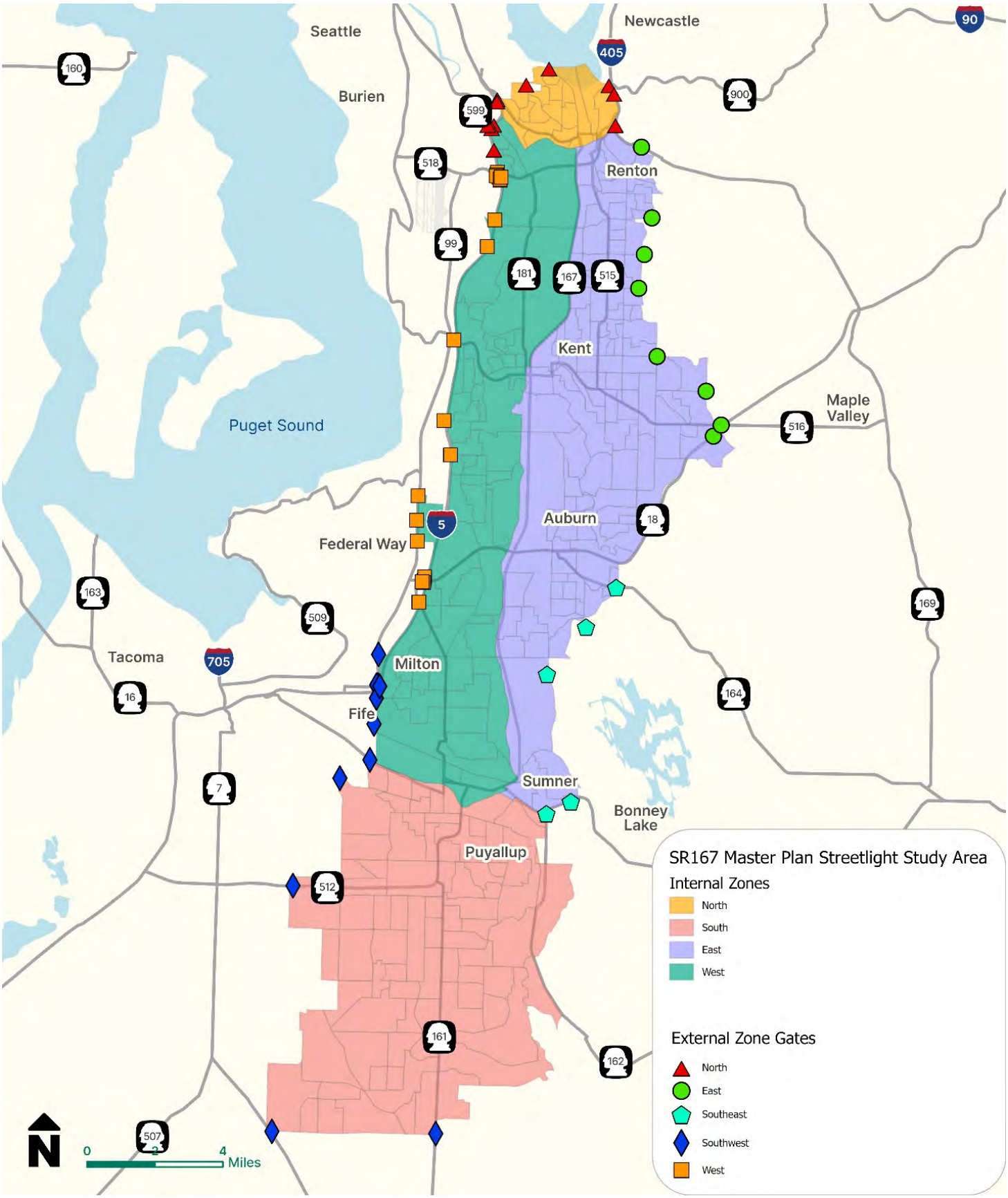


Exhibit 9. Internal and External Zone Locations

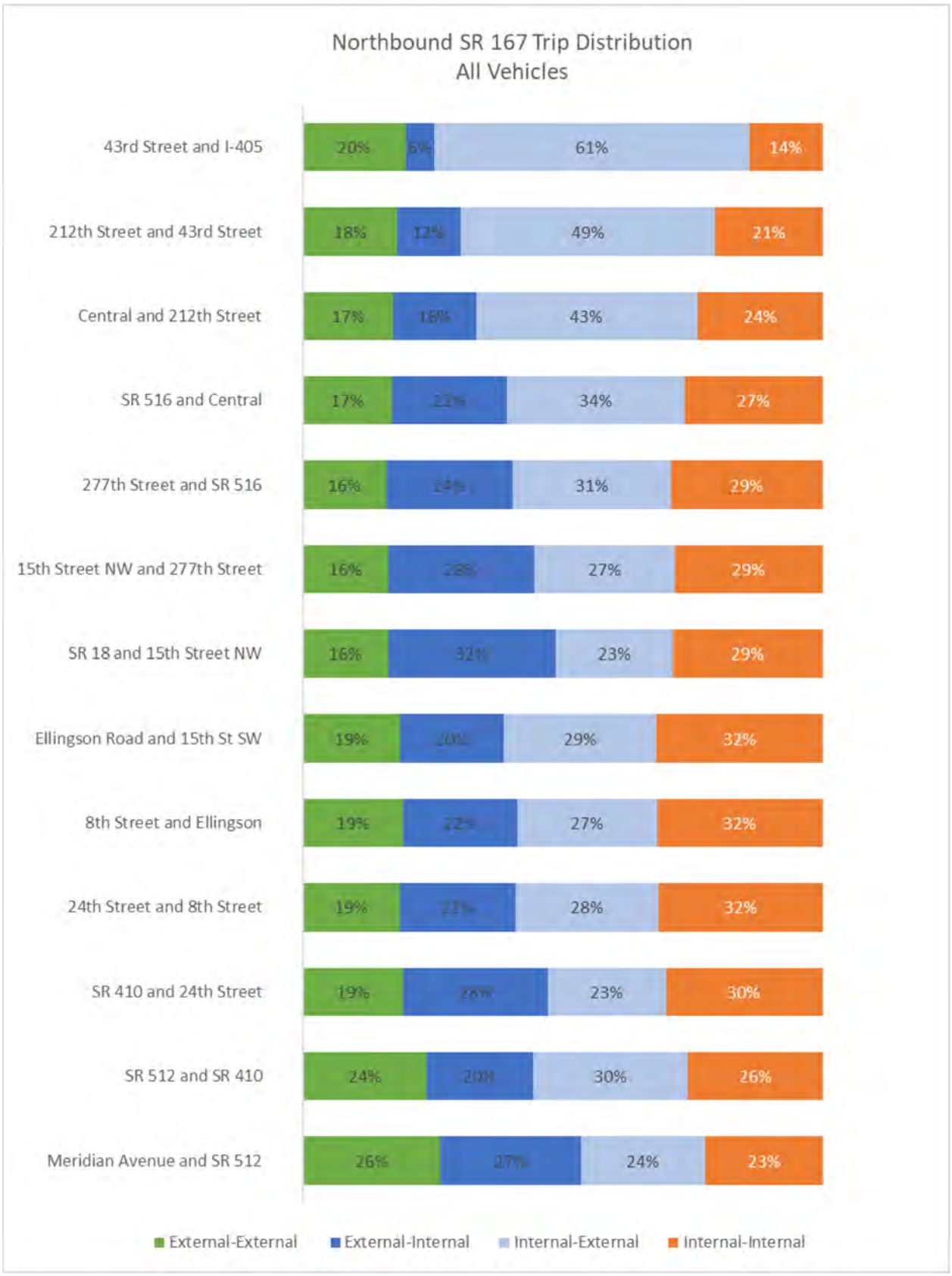


Exhibit 10. All Vehicle Origin-Destination Analysis by Trip Type Distribution

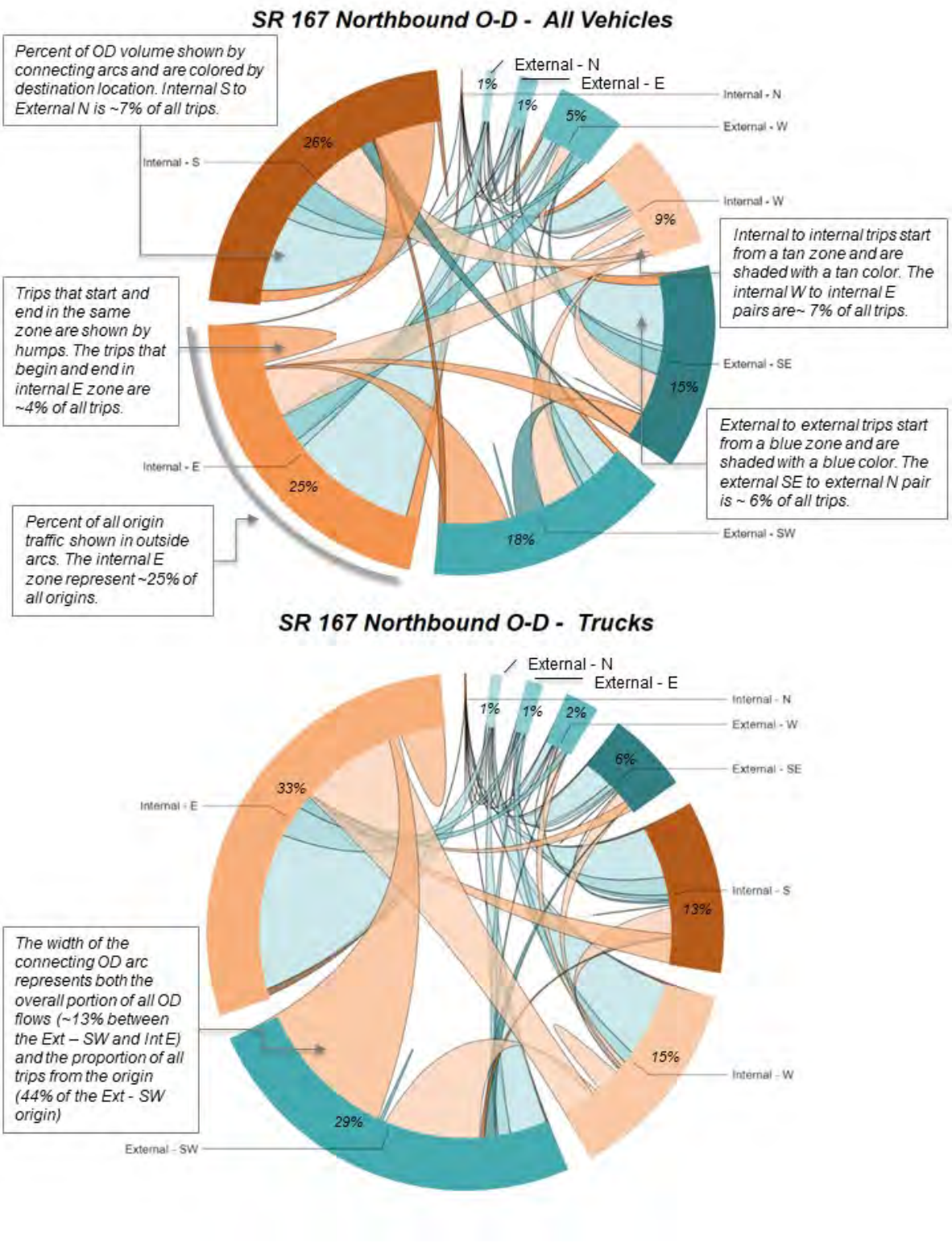


Exhibit 11. All Vehicles and Truck Chord Diagrams

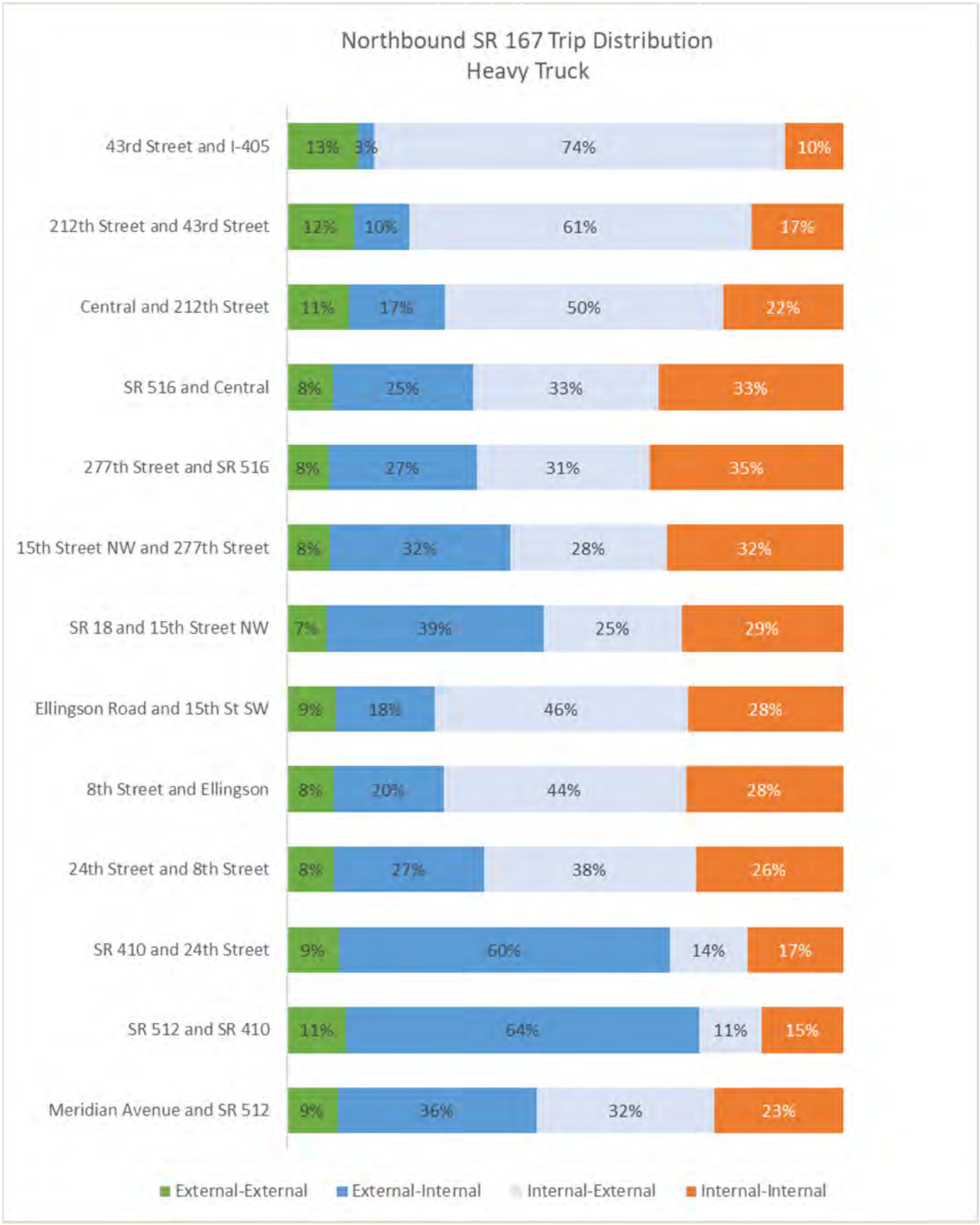


Exhibit 12. Truck Origin-Destination Analysis by Trip Type Distribution -

o Regional Origin/Destination Analysis

Regional OD Analysis, or known as "Origin-Destination (OD) by pre-defined geography" by Streetlight, is a specific analysis type provided by streetlight. This type of OD analysis provides more robust information outside of the SR 167 study area. The analysis can only be conducted using standard geographies such as census block groups or zip codes for the analysis.

Regional OD is an origin-destination analysis that provides information for standard geographies, such as census block groups.

▪ Description of Analysis

Regional OD analyses were used in conjunction with the locations between each interchange for both directions of SR 167. The analysis looked at both where trips were originating to a given destination on the SR 167, and vice versa, where trips starting on the SR 167 were destined to. Census block groups were used for the standard geography and two vehicle modes were analyzed, all vehicles and heavy trucks. This approach to an OD analysis is useful because it provides information outside of the study area and can give a more complete picture of travel patterns.

After analyzing the ODs on each location, it was observed the travel patterns were very similar for each SR 167 locations within the three key focus areas on the corridor, therefore results were aggregated for these areas. Also, northbound and southbound travel patterns are similar so only northbound results are reported.

▪ Key Findings

- **All vehicles**

Exhibit 14 shows the all vehicle average daily origins to northbound SR 167 between SR 410 and SR 18 and **Exhibit 15** shows the average daily destination areas from SR 167 between SR 410 and SR 18. The color gradations, known as a heat map, show areas with low to high activity. Additional heat maps for the other two analysis areas of SR 167 are provided in **Attachment A.** The highest percentage of all trip origins on this segment of SR 167 originate in the manufacturing and industrial center (MIC) between SR 410 and 8th Street E/Stewart Rd, approximately 7 percent of all travelers. Most trips originate south of the SR 167 corridor and originate as far away as Enumclaw and DuPont. Trip destinations for all vehicles are generally concentrated along the SR 167 corridor with the highest percent of trips to commercial and industrial areas in Auburn, Kent, and Renton. Other key destinations include SeaTac Airport (3 percent), Boeing Renton (3 percent), along SR 18 including the Cities of Covington and Maple Valley, and further north into downtown Seattle and the Eastside.

- **Trucks**

Heavy Truck data is provided for origins and destinations in **Exhibit 16** and **Exhibit 17**, respectively. Like all vehicles, the highest percentage of truck trip origins are in the MIC between SR 410 and 8th Street E/Stewart Road (37 percent), with also high concentration of trips originating from land uses adjacent to the SR 167 extension out to and including the Port of Tacoma (19 percent). Other truck origin zones are generally located near I-5 at rest areas and truck stops, and extend as far south as Portland, OR. Trucks also have the highest percentage of destinations in commercial and industrial areas in Auburn, Kent, and Renton. However, a greater percentage of destinations are further from the study area than all vehicles. Many destinations are located east on I-90 between SR 18 and Spokane and along I-5 as far north as Bellingham.

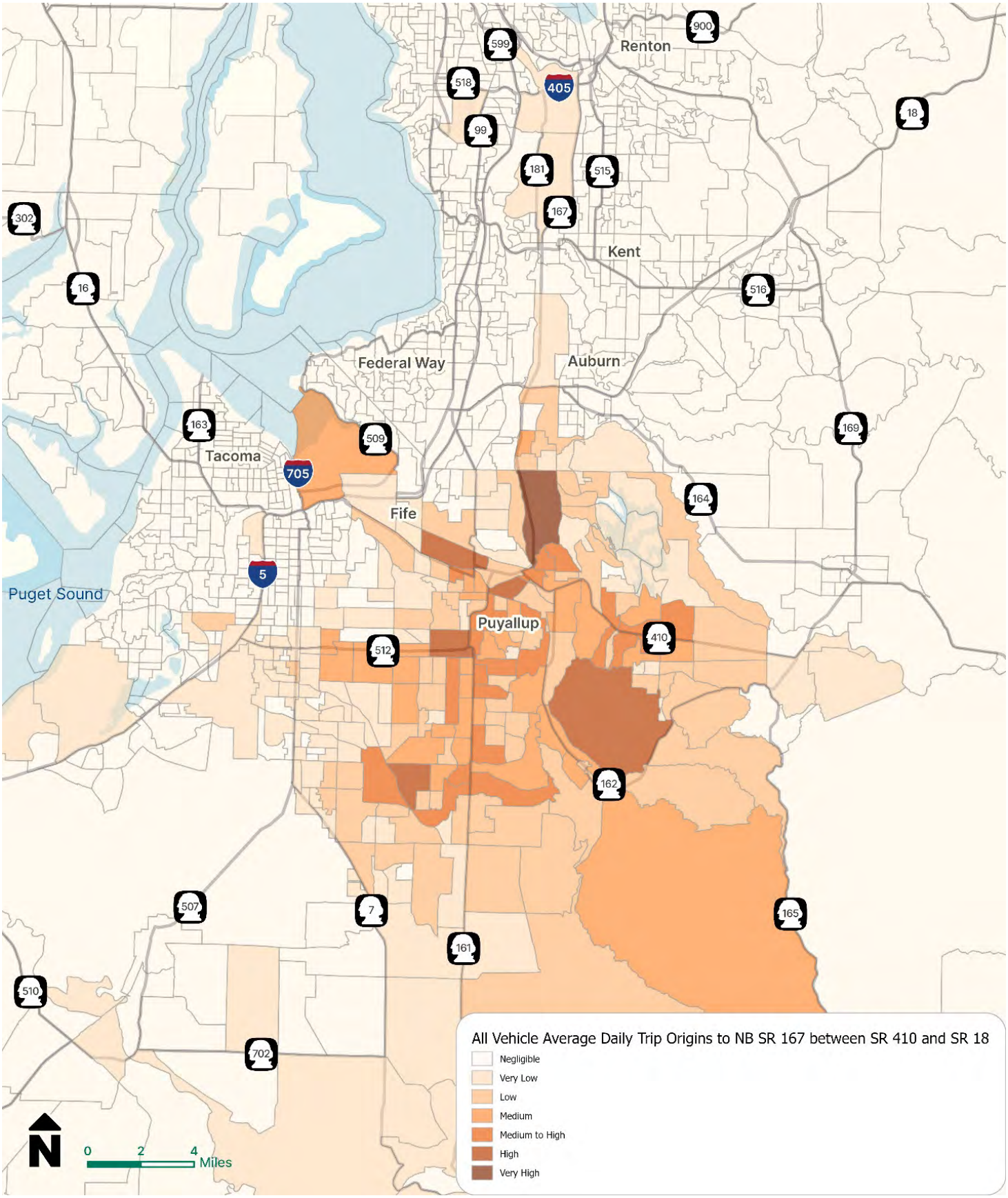


Exhibit 13. Regional OD All Vehicle Trip Origins

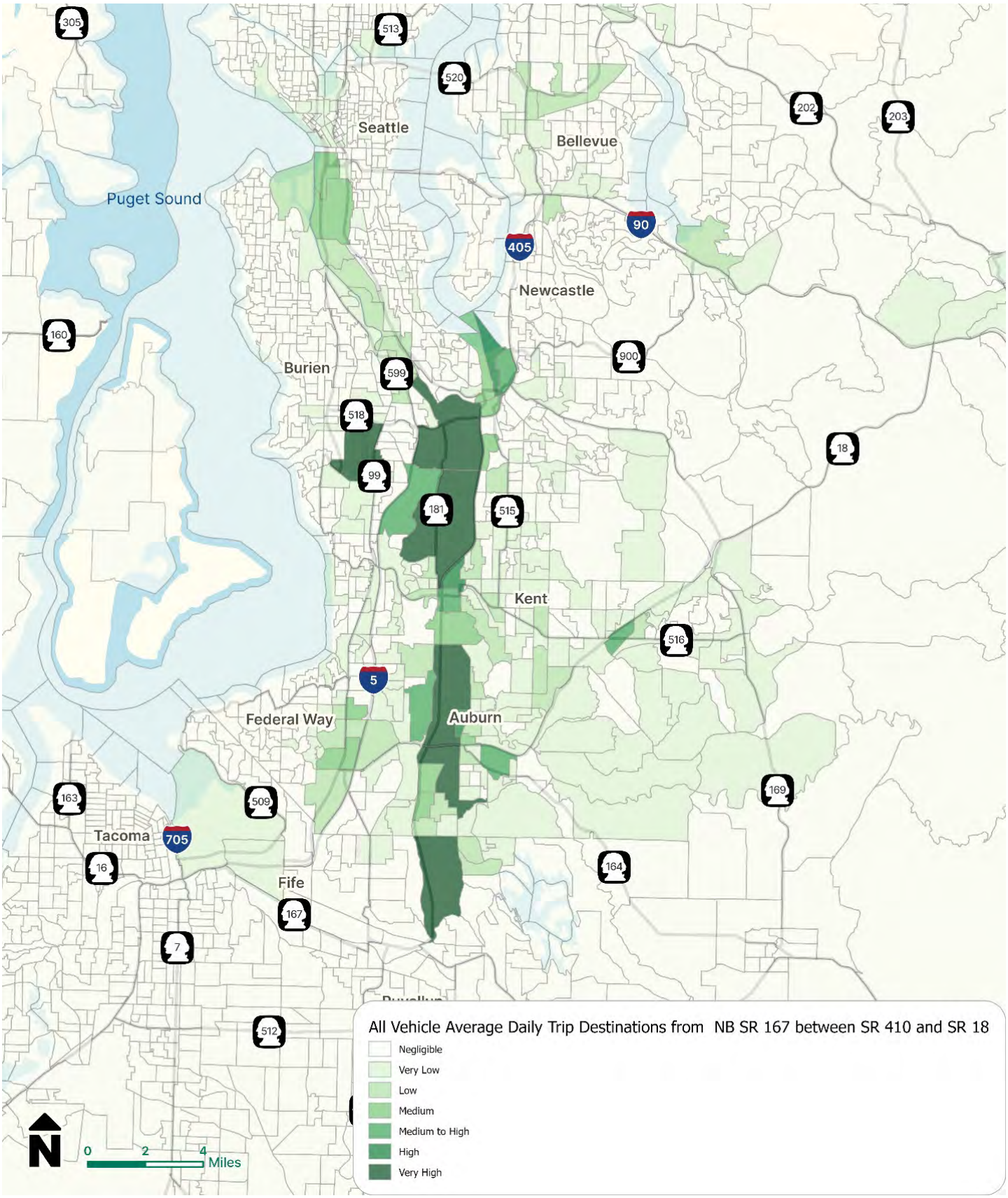


Exhibit 14. Regional OD All Vehicle Trip Destinations

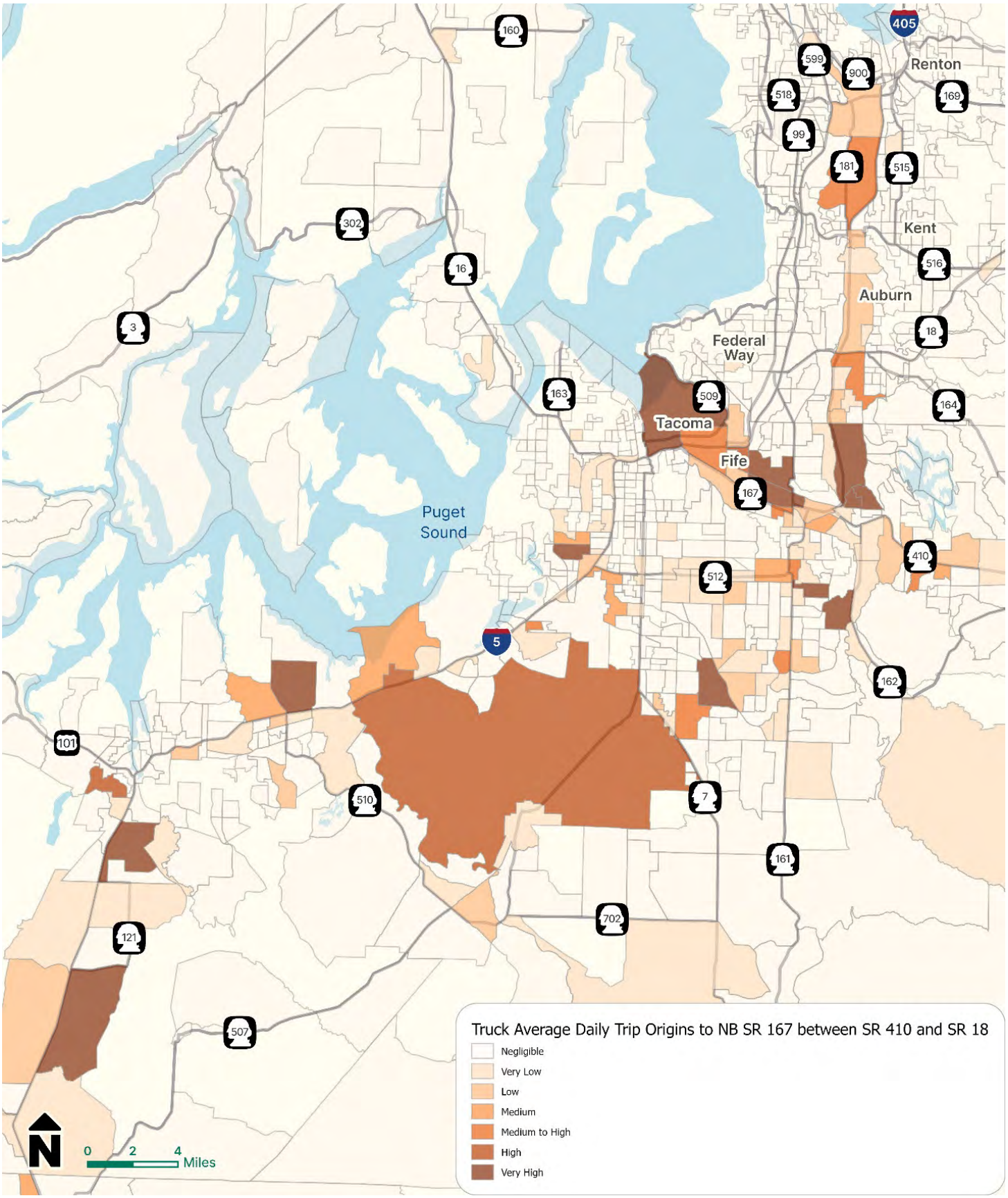


Exhibit 15. Regional OD Truck Trip Origins

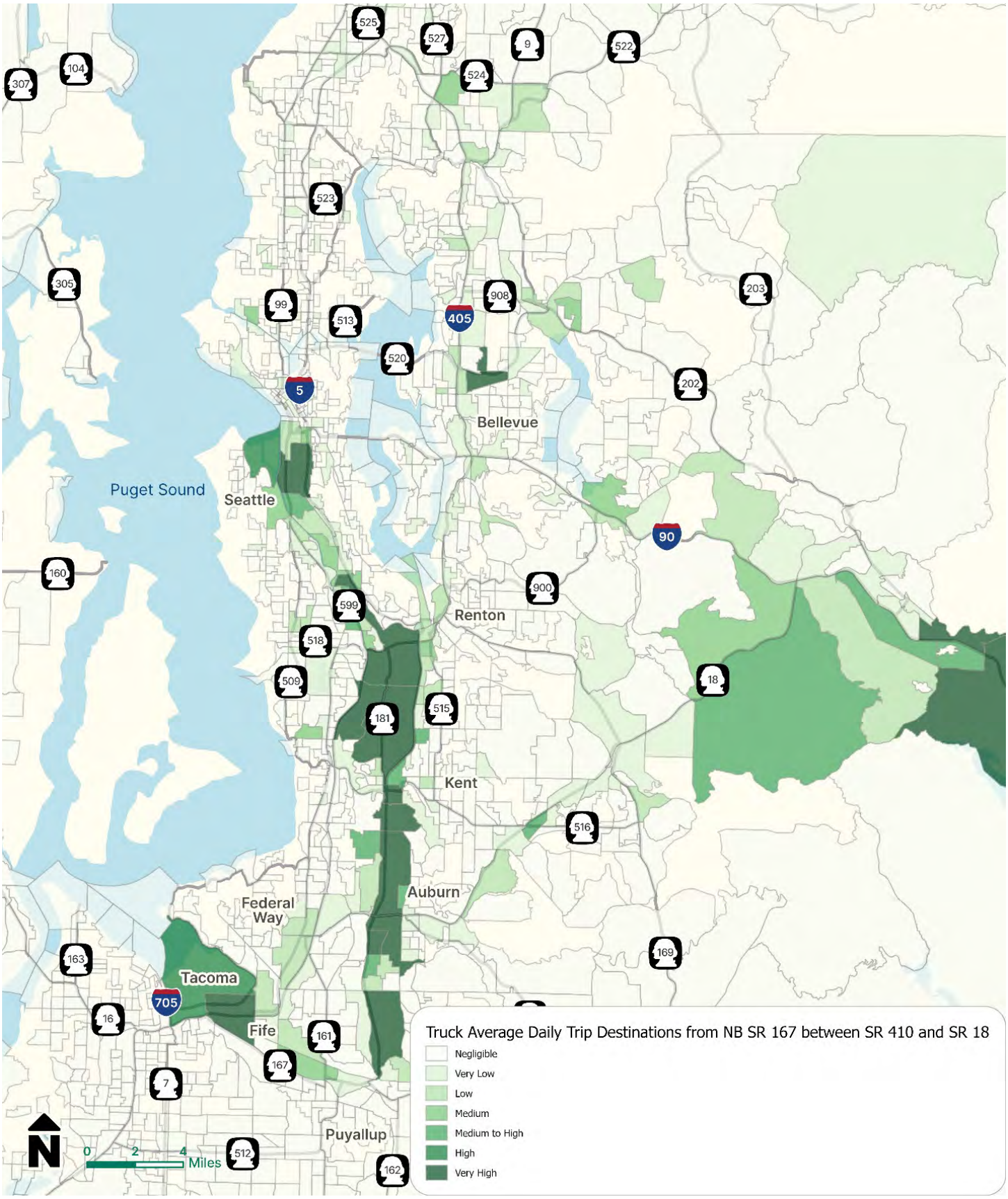


Exhibit 16. Regional OD Truck Trip Destinations

- **Home and Work Locations**

This analysis was used to determine the inferred home and work location based on where a device resides during certain hours of the day. A home location is generally based on where the device resides during nighttime hours (7 p.m. to 8 a.m.) while a work location is based on where the device resides during the middle of the day (11 a.m. to 4 p.m.).

Home and Work Locations is the inferred home or work locations related to an analyzed roadway or zone.

- **Description of Analysis**

A home and work locations analysis of SR 167 users were conducted between each interchange for both the northbound and southbound direction of travel. This analysis looked at the home and work locations for an entire weekday day and individual weekday hours. The hourly analysis was conducted to see if their work or home locations change throughout the day.

Home and work locations were analyzed with two types of geographic aggregation. On a daily level, census block groups were used to understand where SR 167 users live and work. An hourly analysis focused on work locations and used a 1 sq-km aggregation to better identify if certain businesses or types of land uses were disproportionally contributing to the overall work locations of SR 167 users. It should be noted if a person does not work during typical hours (9 a.m. to 5 p.m. weekdays) the analysis may not correctly categorize a home/work location. As an example, second or third shift workers or restaurant workers may be misclassified.

- **Key Findings**

Exhibit 18 shows a heat map of the top 80 percent of all home and work locations for all vehicles for users on SR 167. Home locations are generally near the corridor or to the south and east of the corridor with very few users living north of the corridor. Approximately 49 percent of all home locations are south and east of the corridor in communities such as Puyallup, South Hill, Bonney Lake, Enumclaw, Parkland, and Summit. These users generally use other freeways such as SR 512 and SR 410 to access SR 167.

Work locations are predominately adjacent to the corridor in MICs and other census block groups with high activity. Over 25 percent of work locations are concentrated north and east of the corridor with higher concentrations in Renton, Seattle, and Bellevue. Few users work north of downtown Seattle and Bellevue. Because home locations are predominately concentrated to the south of the corridor and work locations are generally along the corridor and north of the corridor, the heaviest traffic flows correlate with home-based work travel, northbound in the AM peak period and southbound in the PM peak periods.

Work locations by time-of-day are provided in **Attachment A**. Work locations change drastically throughout a typical morning peak period. For example, for users traveling on northbound SR 167 at the beginning of the AM peak period (4 a.m. to 5 a.m.) when congestion is starting on the corridor, work locations are predominately driven by Boeing Renton workers (9 percent) and the MICs in Kent and South Renton. Continuing through the morning (6 a.m. to 7 a.m.), work locations are still prevalent in Kent and Renton industrial areas but also sees medical workers near the Valley Medical Center and Seattle/Eastside commuters. Finally, at the end of the typical morning period (8 a.m. to 9 a.m.), most work locations near the corridor.

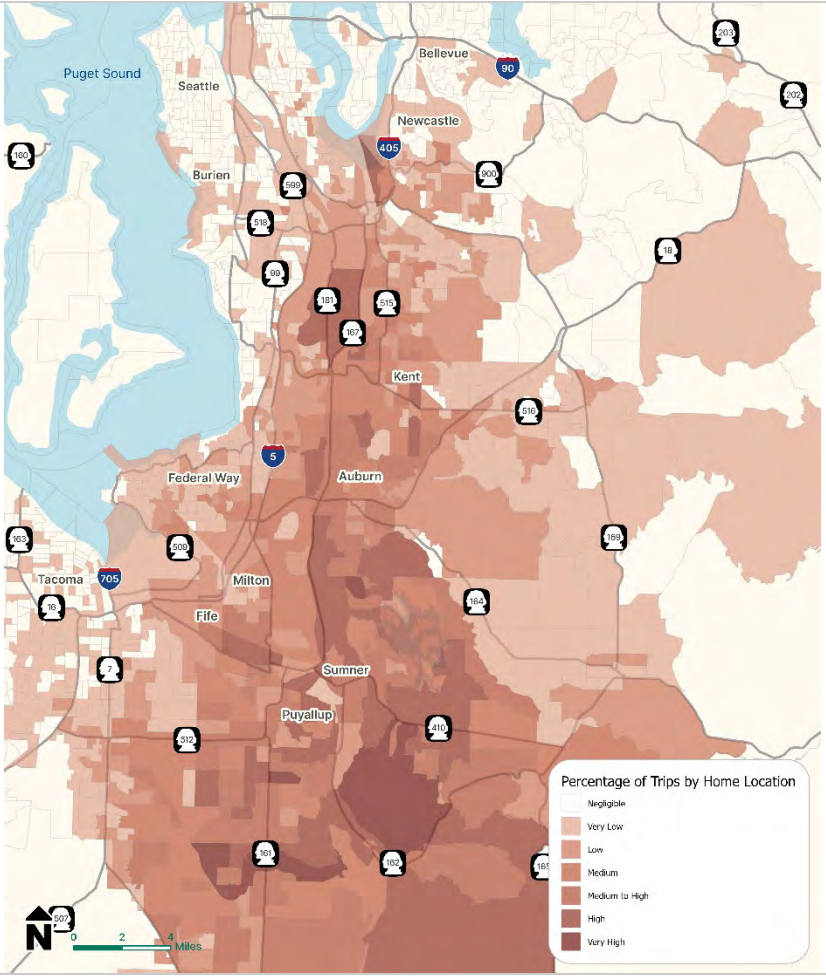
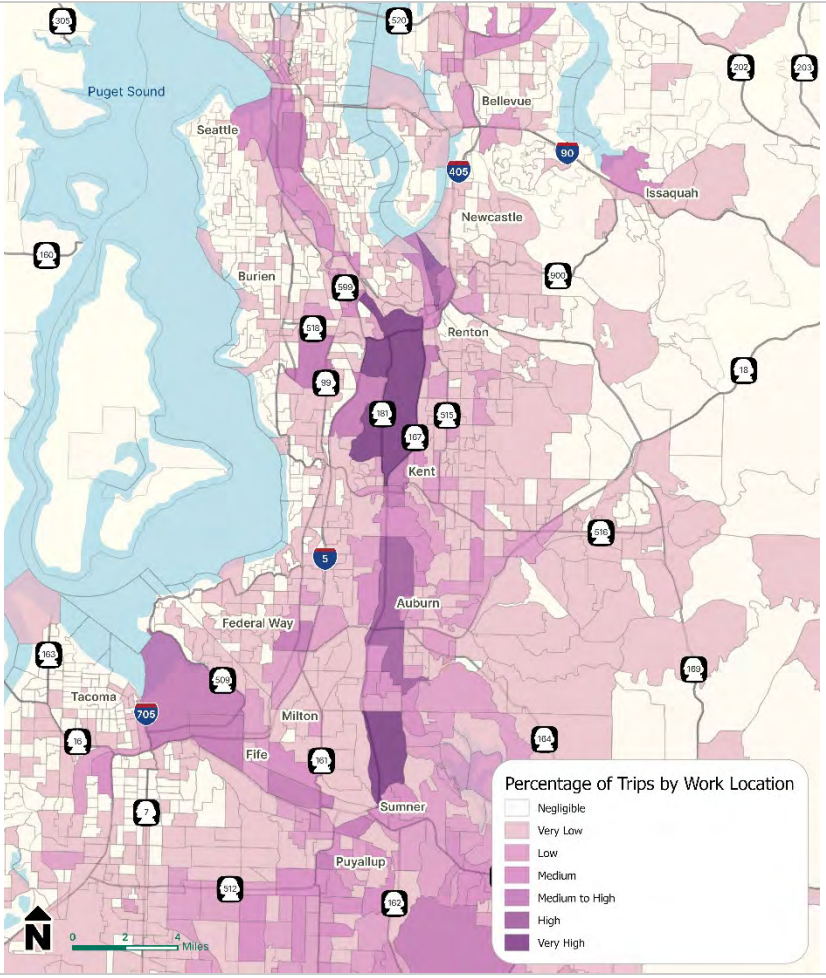
Home	Work
	

Exhibit 17: Home and Work Locations

- **Zonal Activity – All Vehicles and Heavy Trucks**

Zonal activity is used to analyze the activity for various modes in a zone set. It provides a relative comparison of the activity level and can also be used to understand traveler and demographic information within the streetlight analysis area.

Zone activity analyzes all travel patterns in a zone set, regardless of origins and destinations.

- **Description of Analysis – All Vehicles and Heavy Trucks**

Zonal activity for all vehicles was used to identify those areas that have varying levels of vehicular activity. Census block groups were used to understand those trips that are starting or ending within a given zone. It provides a relative comparison of activity across zones, regardless of the size of the zone or the amount of population and employment within each area. This analysis is useful to identify the following characteristics:

- Identification of areas with high and low vehicular activity
- Help quantify those zones with a higher proportion of vehicular and truck activity as compared with other modes of travel (transit and active transportation)
- Assess if high activity areas are adequately served by access across SR 167 and other facilities

- **Key Findings**

- **All vehicles**

Exhibit 19 shows the total zonal activity for all vehicles in the SR 167 study area. The heat map indicates areas with low activity as indicated in green with those areas with the most activity indicated in red. The greatest proportion of all vehicle activity occurs within manufacturing and industrial centers on the west side of SR 167, generally bound by SR 167, 68th Avenue S, SR 516, and SW 7th Street. Two census block group makes up this area and account for approximately 13 percent of the trip ends in the study area, while accounting for 6 percent of the total area. This area predominately has warehousing, retail commercial uses, the Southcenter Mall, and hotels. Other high activity areas are in other MICs adjacent to SR 167 and in retail centers such as near the South Hill Mall in Puyallup and the Outlet Collection Mall in Auburn. Vehicle activity decreases as land uses change from more commercial/industrial based to areas with high concentrations of single family detached housing.

- **Trucks**

Exhibit 20 shows the total zonal activity for heavy trucks in the SR 167 study area. These areas represent approximately 80 percent of the total heavy truck activity. The heat map indicates areas with low activity as indicated in green with those areas with the most bus activity indicated in red. Like all vehicles, the greatest proportion of heavy truck activity occurs within manufacturing and industrial center in the north Kent Valley on the west side of SR 167 generally bound by SR 167, 68th Avenue S, SR 516, and SW 7th Street. Two census block group makes up this area and account for approximately 27 percent of the trip ends in the study area. The two other MICs in the study area in the south Kent Valley contribute an additional 29 percent (Puyallup/Sumner MIC: 17 percent, Auburn MIC 12 percent). Other truck activity is generally located along those census block groups directly adjacent to the SR 167 corridor. As expected, census block groups that predominately have residential land uses have little to no truck activity.

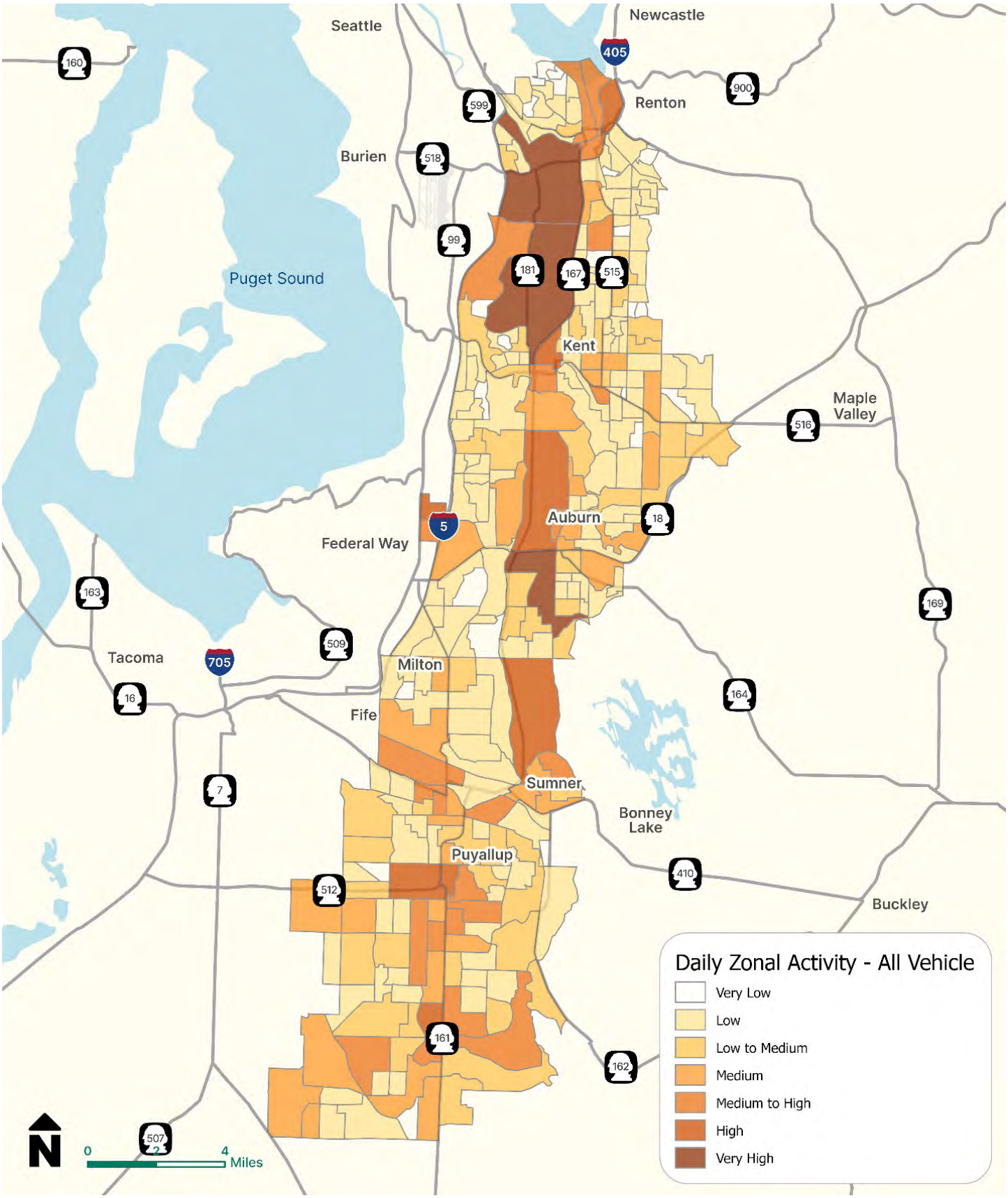


Exhibit 18. All Vehicle Zonal Activity

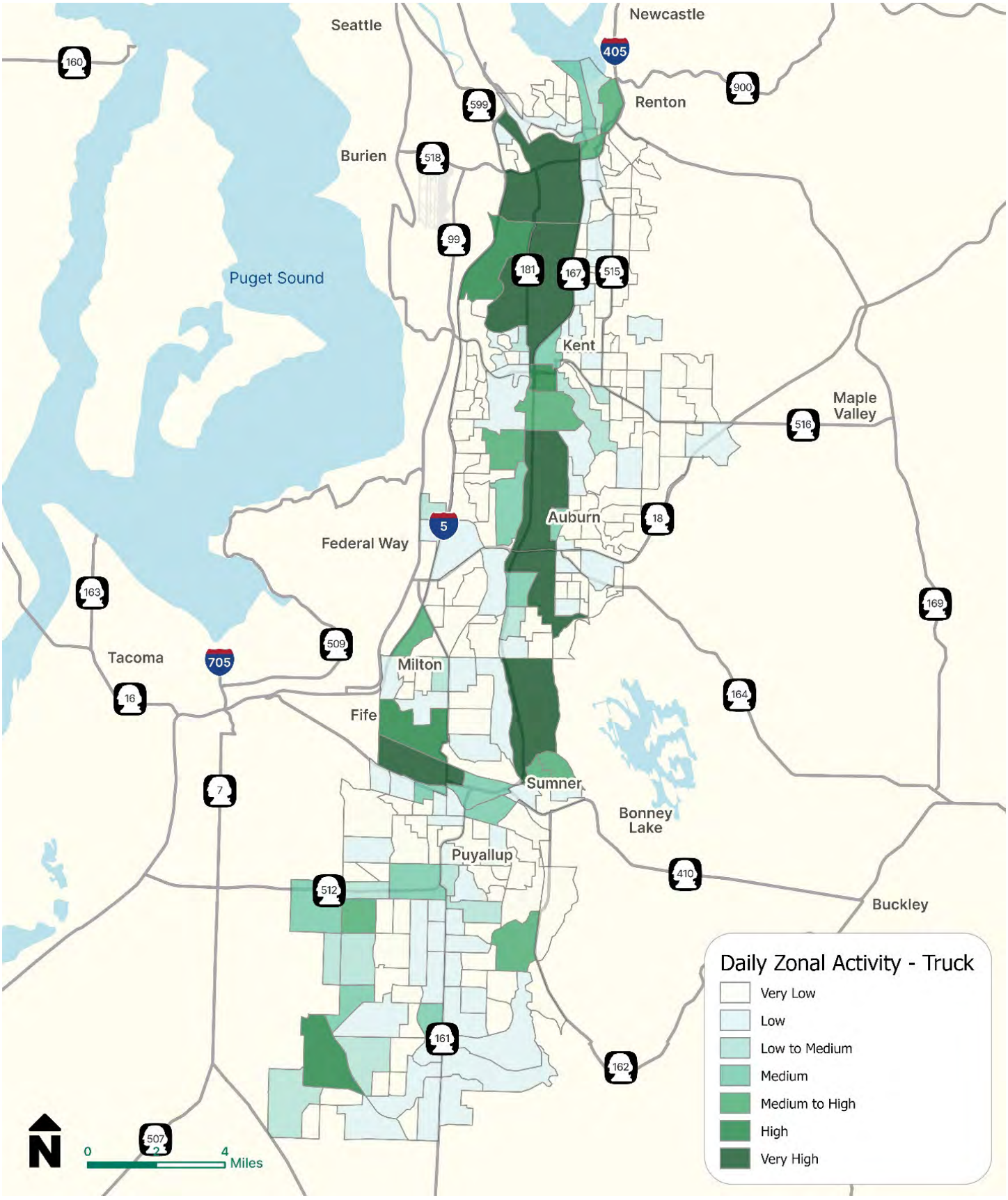


Exhibit 19. Trucks Zonal Activity

- **Zonal Activity – Active Transportation**

  - **Description of Analysis – Active Transportation**

Zonal activity for active transportation was used to identify those corridors and areas that have high levels of activity including walking, running, and bicycling, within the streetlight analysis area. Using the 1 sq-km hexagon geographies, the analysis identifies those areas that have active transportation trips starting, ending, or passing through a given zone. This analysis is useful to identify the following characteristics:

- Identification of roadways that have a high or low percentage of users.
- Identify high activity areas where sidewalks and bicycle lanes are missing or intermittent
- Correlate high activity areas with over-represented areas of pedestrian and bicycle crashes
- Assess areas with bus stops with a high percentage of boardings/alightings and transfers between bus routes as these folks are pedestrian and bicycle trips prior to becoming bus riders.

  - **Key Findings**

Exhibit 21 shows the zonal activity for pedestrians and **Exhibit 22** shows the zonal activity for bicycles in the SR 167 study area. The heat map indicates areas with low activity as indicated in green with those areas with the most activity indicated in red. Areas without any coloration indicate minimal bicycle and pedestrian activity.

- **Pedestrians**

The greatest proportion of pedestrian activity occurs near the Southcenter Mall, at the Boeing Renton Site and adjacent land uses, surrounding Kent Station, downtown Auburn, and the areas surrounding the Washington State Fairgrounds. Other higher activity areas are generally around major retail areas, hospitals, and transit hubs.

Very little pedestrian and bicycle activity is intermittent throughout the study area and is emphasized by those areas without any coloration. For pedestrians, very limited pedestrian activity occurs west of SR 167 between SR 410 and SR 516. Challenging topography, limited sidewalks, few connections across SR 167 and SR 18 and no major destinations likely contribute to less activity.

- **Bicycles**

Areas of high bicycle activity are generally the same as pedestrian activity with a few notable exceptions. The highest uses are still around the Boeing Renton Site, which utilizes bicycles to get around their factory, and has the Lake Washington Loop trail adjacent to the facility. Regional trails, including the Green River Trail and Interurban Trail also show moderate to high levels of bicycle activity.

Lower bicycle activity areas is a bit better compared with pedestrians, with some limited use on major north-south arterials but still have low overall usage south of SR 18. The City of Edgewood stands out as an area with a relatively low level of active transportation.

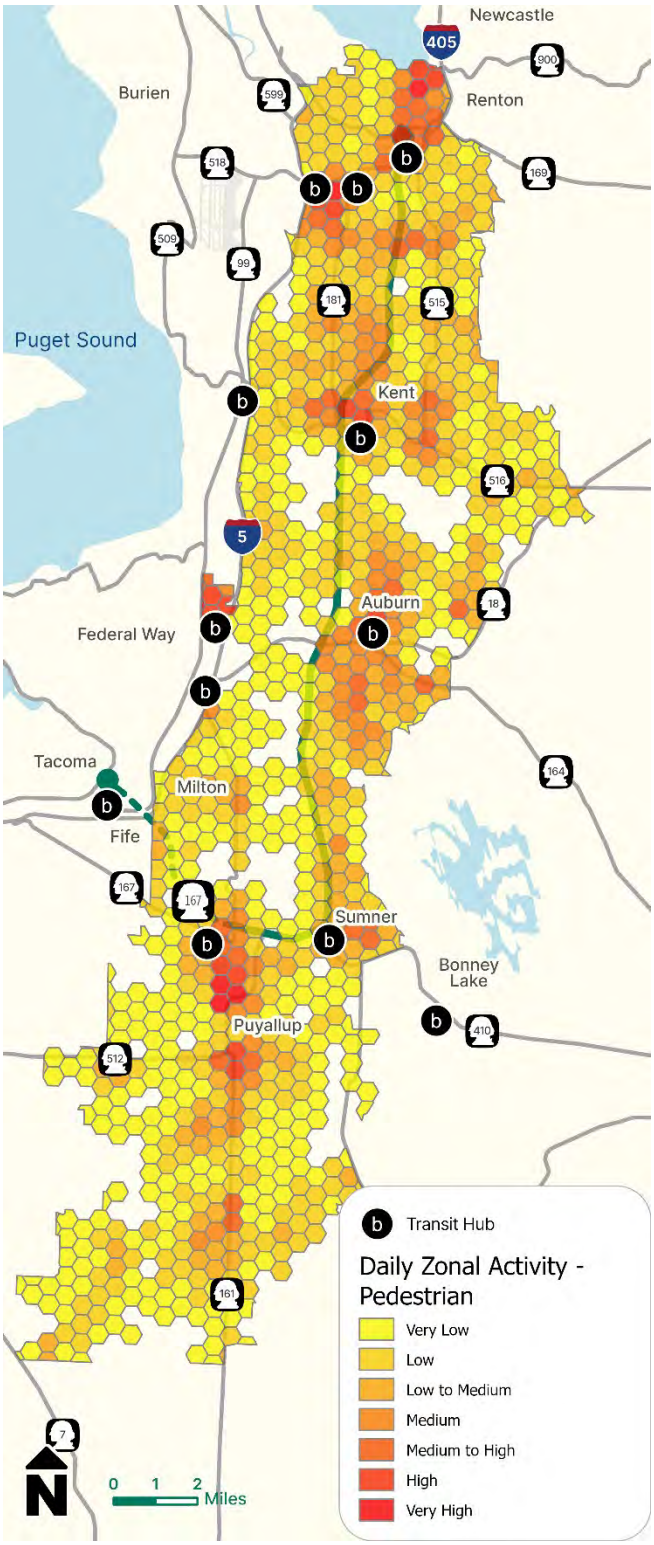


Exhibit 20. Pedestrian Zonal Activity

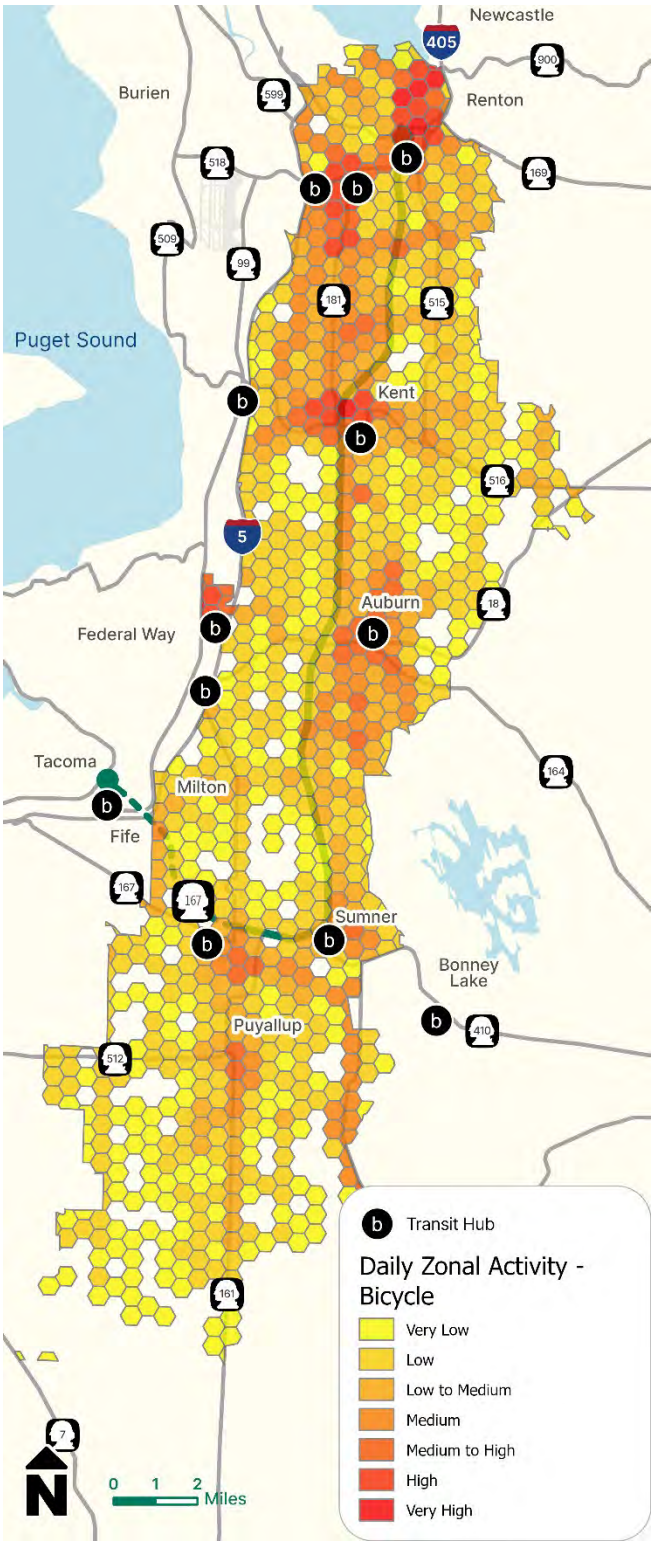


Exhibit 21. Bicycle Zonal Activity

- **Zonal Activity - Buses**

  - **Description of Analysis - Buses**

Zonal activity for buses was used to identify those corridors and areas that have both high levels of bus activity and those that are not being served by buses in the streetlight analysis area. Using the 1 sq-km hexagon geographies, the analysis identifies those areas that have bus trips starting, ending, or passing through a given zone. This analysis is useful to identify the following characteristics:

- Identification of roadways that have a high or low percentage of bus users. In combination with supply data such as where bus route are located, can be used to assess if a roadway is highly utilized.
- Assess areas with bus stops with a high percentage of boardings/alightings and transfers between bus routes.

  - **Key Findings**

Exhibit 23 shows the zonal activity for buses in the SR 167 study area. The heat map indicates areas with low bus activity as indicated in green with those areas with the most bus activity indicated in red. Areas without any coloration indicate no bus service.

The greatest proportion of bus activity occurs within the Kent City Center generally bound by SR 167, SR 516/Canyon Road, 94th Avenue S and South 235th Place. This area has frequent, all day bus service from multiple routes by King County Metro and Sound Transit and connections to commuter rail. The activity in this subarea represents about seven percent of the total bus usage within the study area. Other areas with moderate to high bus activity are located near major transit hubs, including Auburn Station, Tukwila Station, and South Renton. Roadways with high bus activity include 68th Avenue S, SR 516, and Auburn Way; all facilities served by one or more bus routes with all day, frequent service.

Low to no bus activity is present in several areas in the study area, including through most of the City of Edgewood and to the south and east of SR 410 and SR 161 including the communities of Sumner and Bonney Lake.

• *Next Steps*

Streetlight will continue to be used throughout the SR 167 Master Plan Project. The data collected represents a snapshot of existing conditions as of the time of this writing. Changes in travel conditions, such as the end of the pandemic or more current updated data may necessitate additional analyses. The streetlight analysis is expected to be further refined to answer more detailed project questions and to complete an equity analysis assessment of disadvantaged populations.

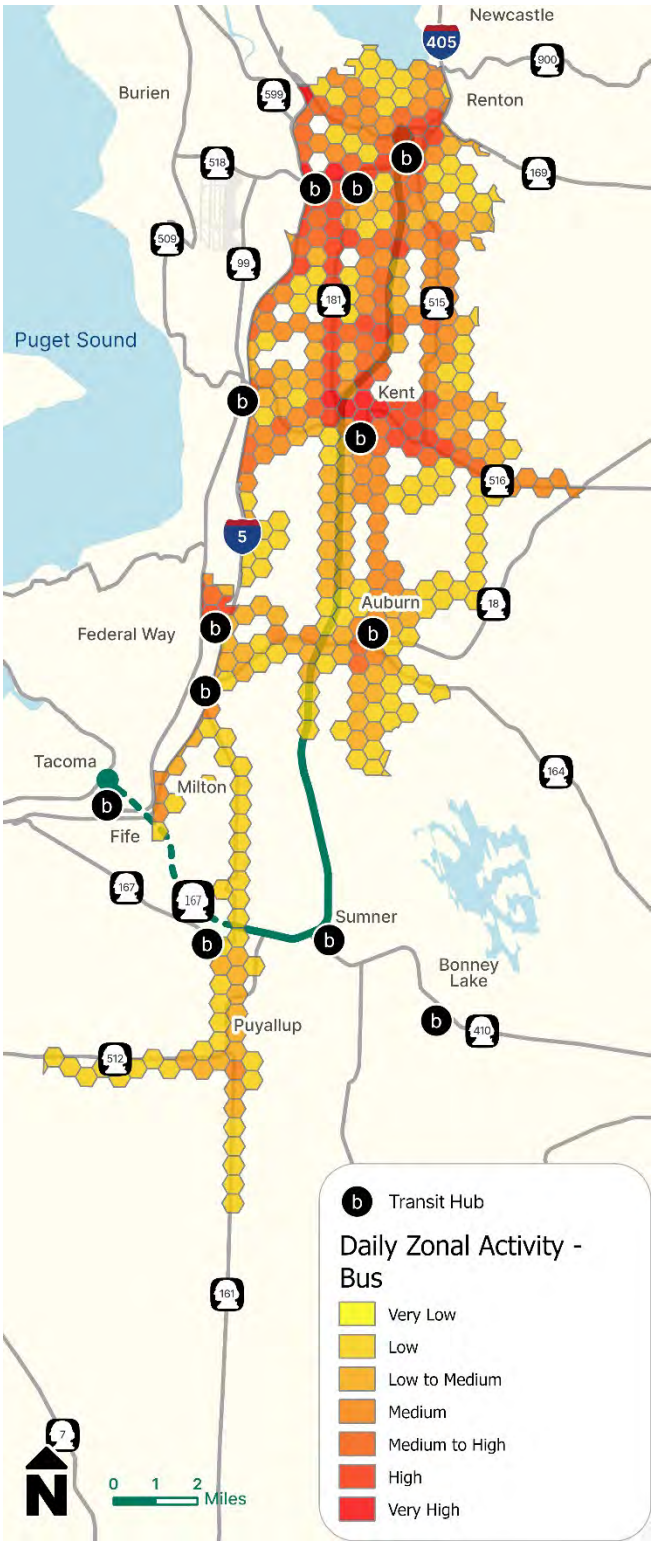
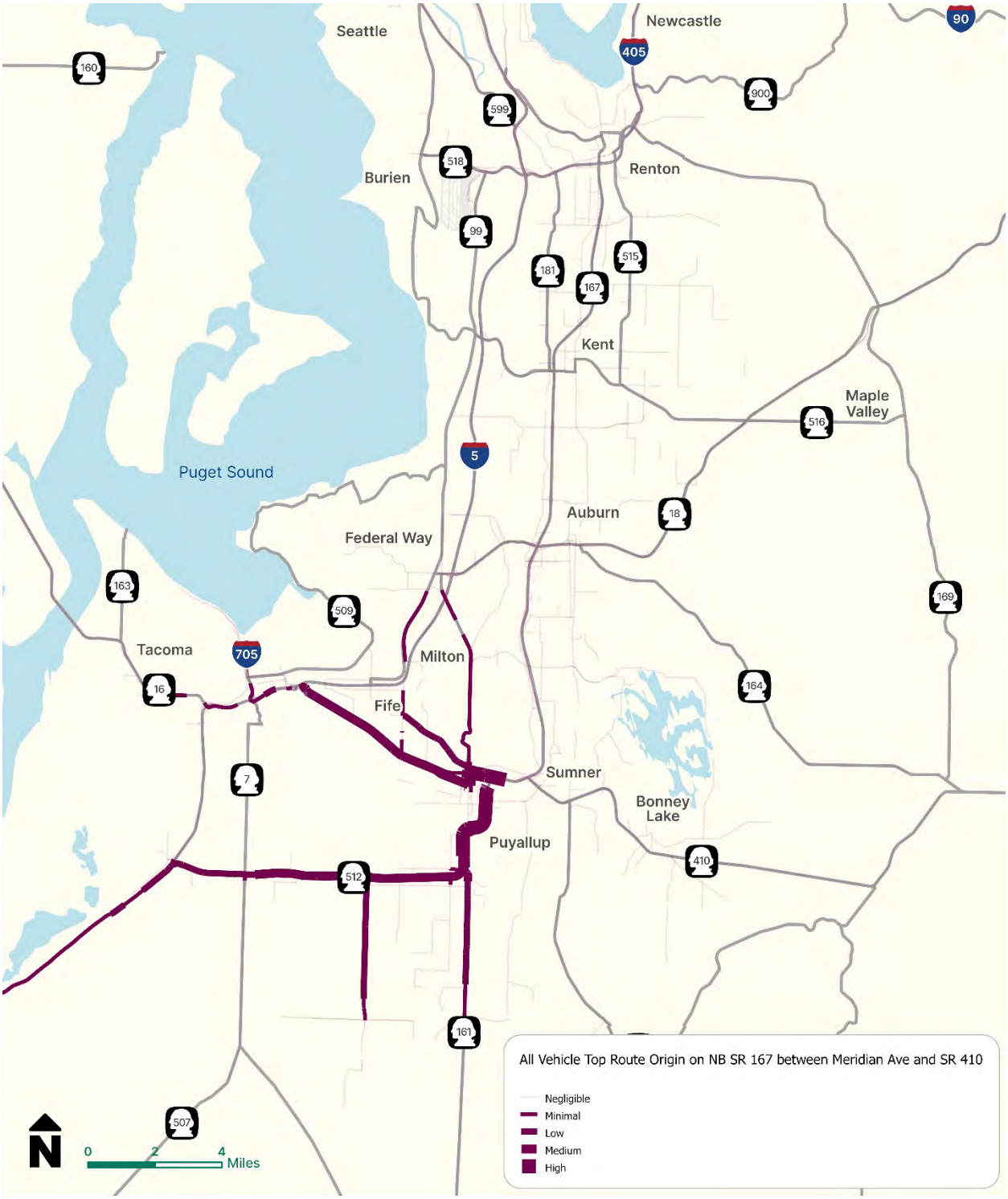
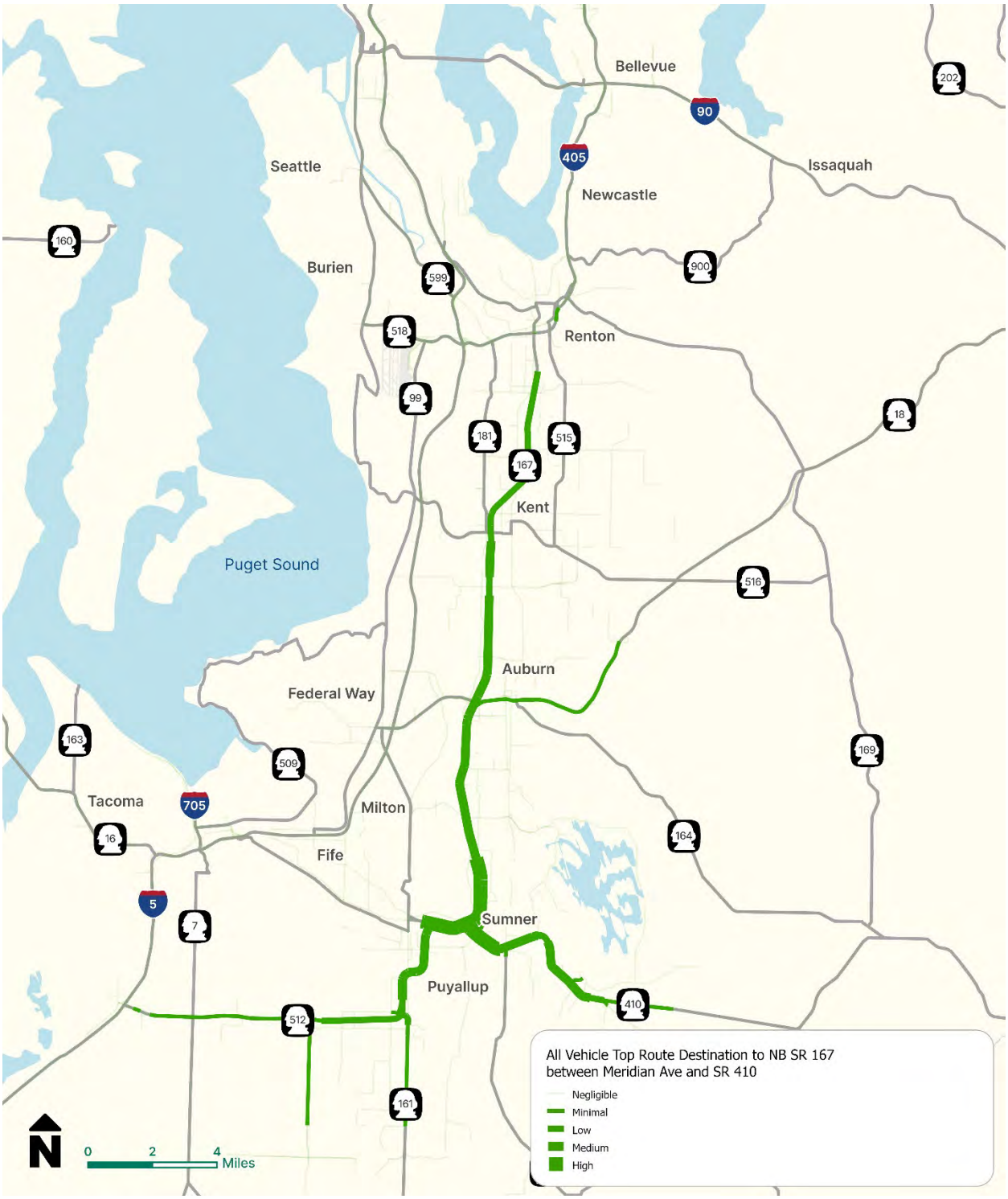


Exhibit 22. Bus Zonal Activity

Attachment A – Additional Streetlight Data Analyses

Top Routes

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All Vehicle Top Route Destination to NB SR 167
between Meridian Ave and SR 410
Negligible
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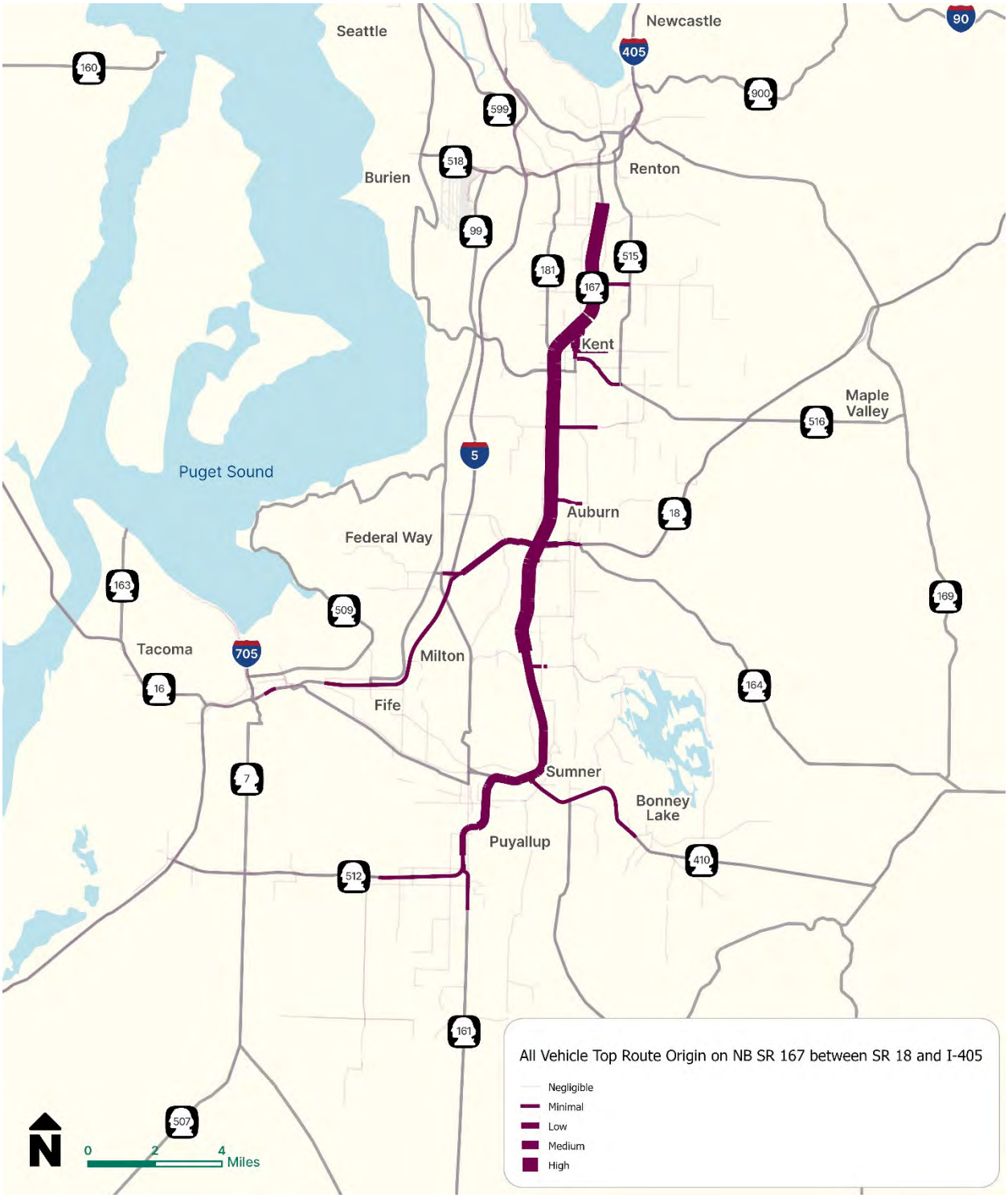
Medium
High
0 2 4 Miles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All Vehicle Top Route Origin on NB SR 167 between SR 18 and I-405
Negligible
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High
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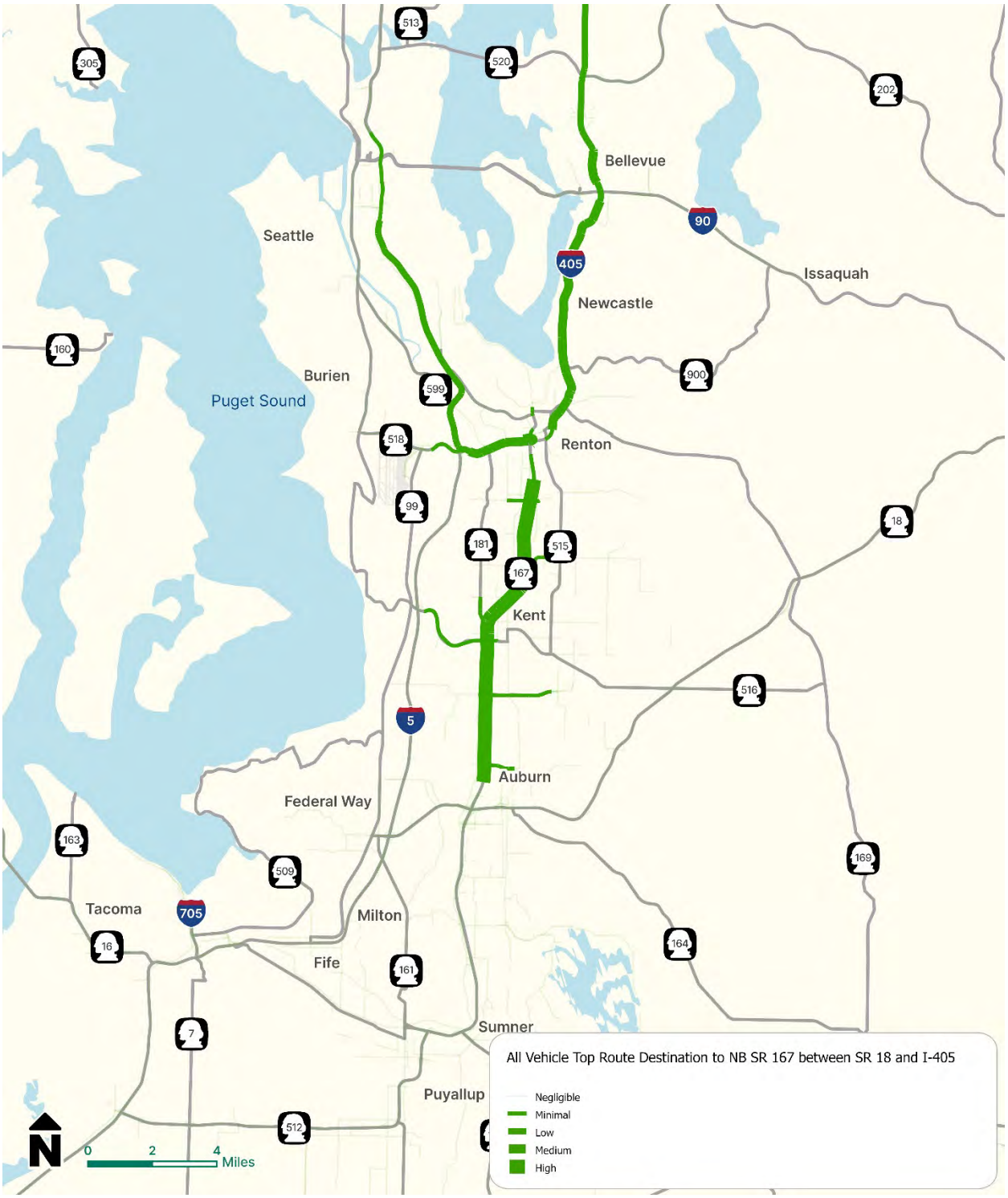
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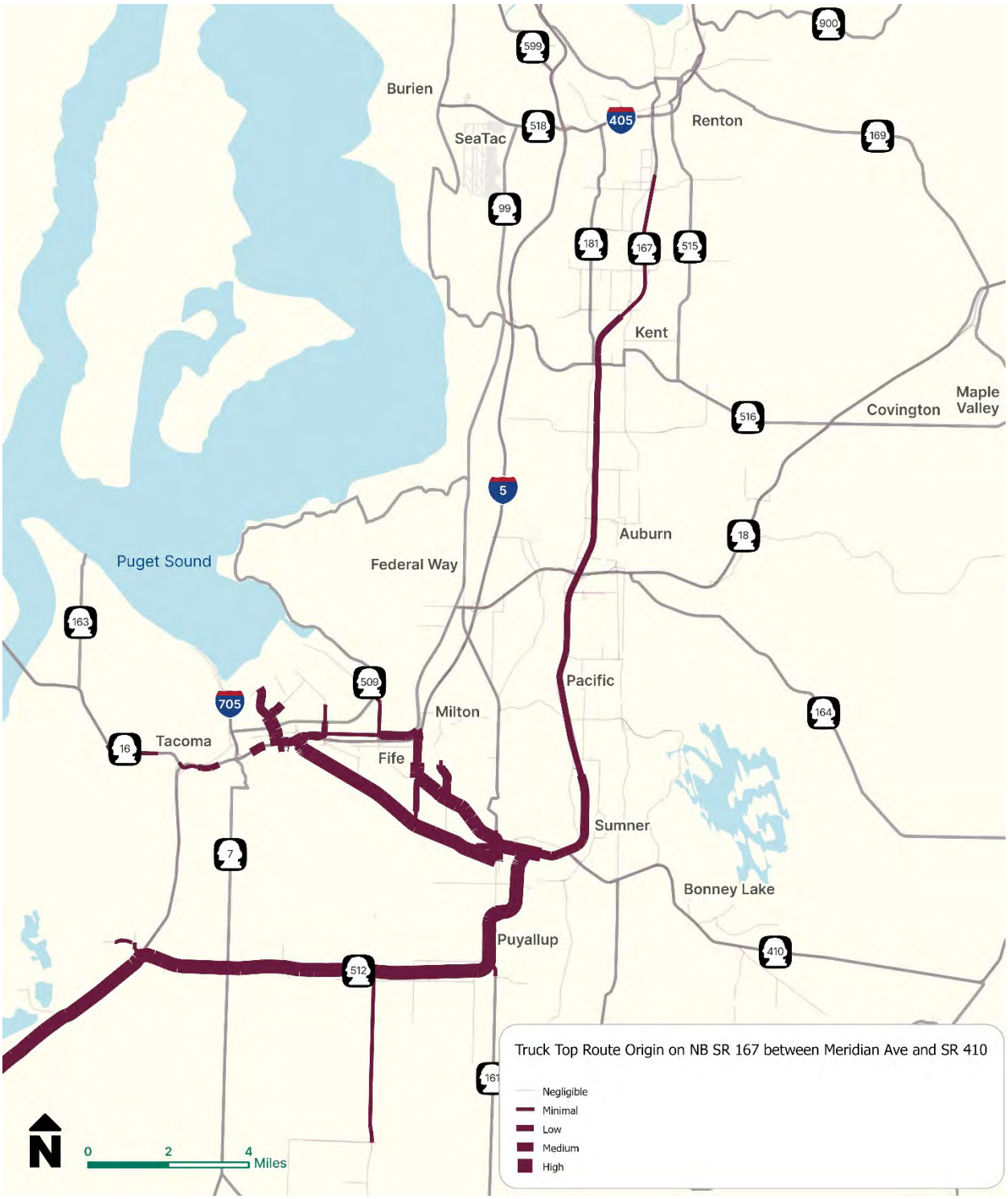
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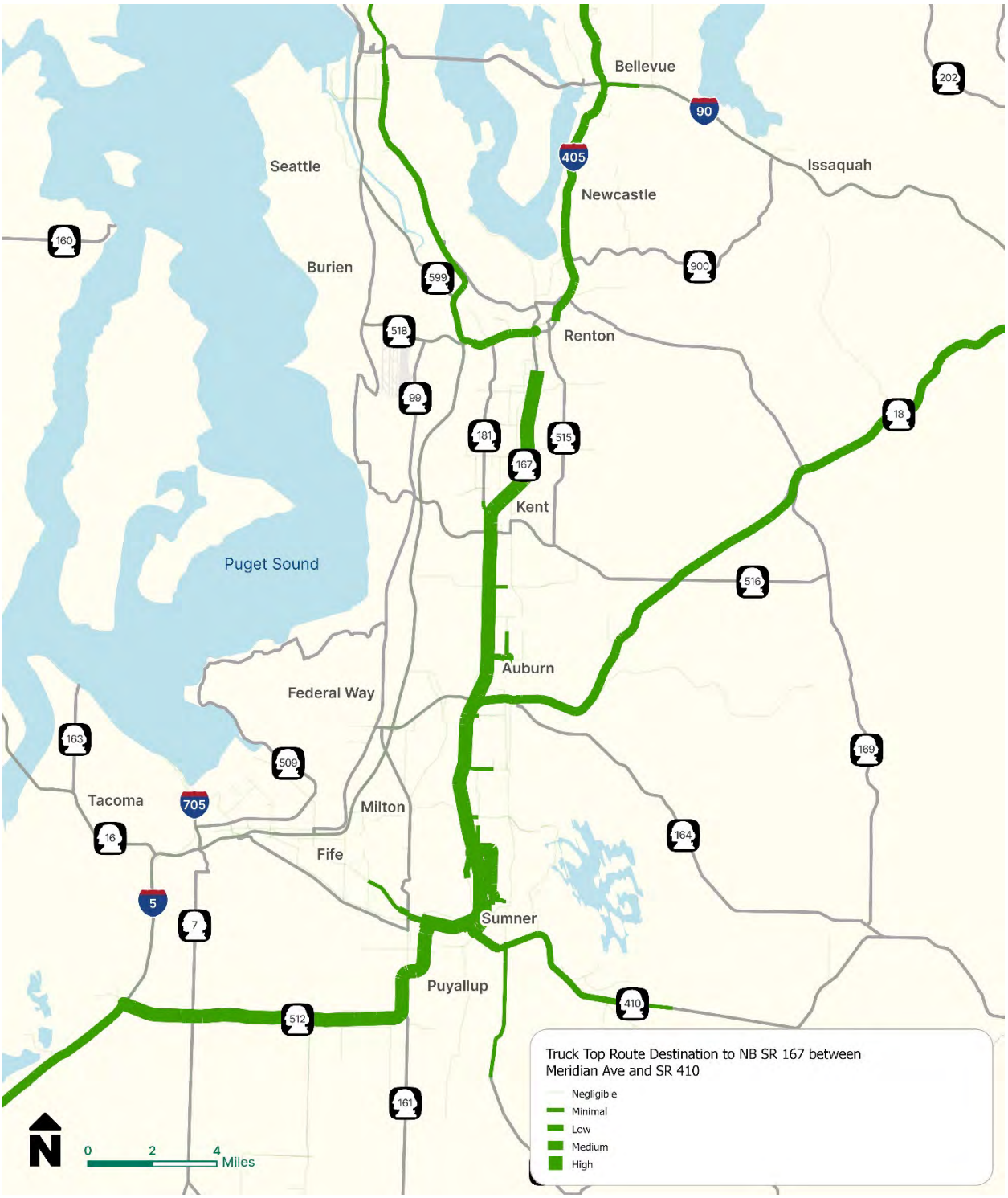
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Truck Top Route Destination to NB SR 167 between Meridian Ave and SR 410
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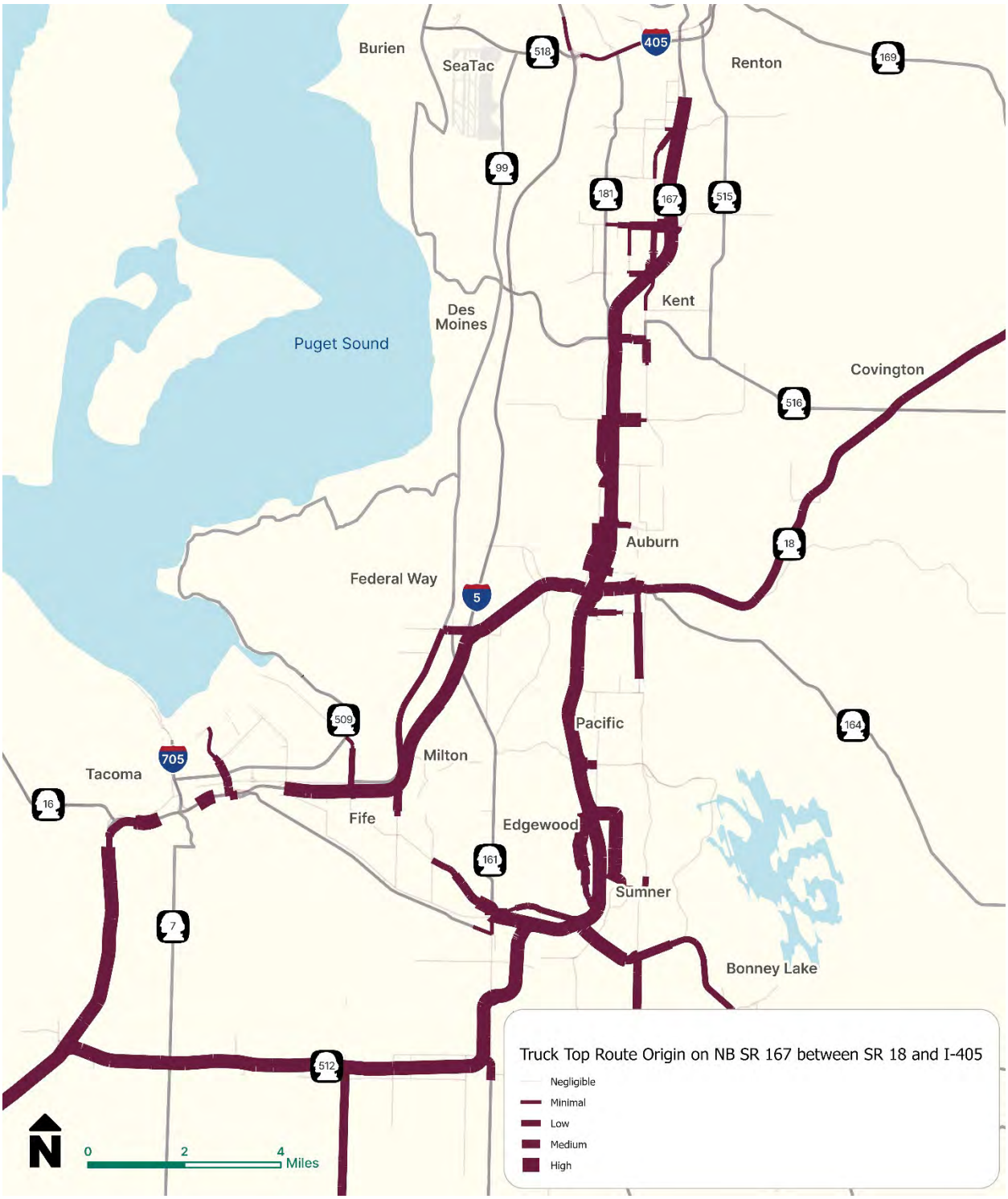
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Truck Top Route Origin on NB SR 167 between SR 18 and I-405
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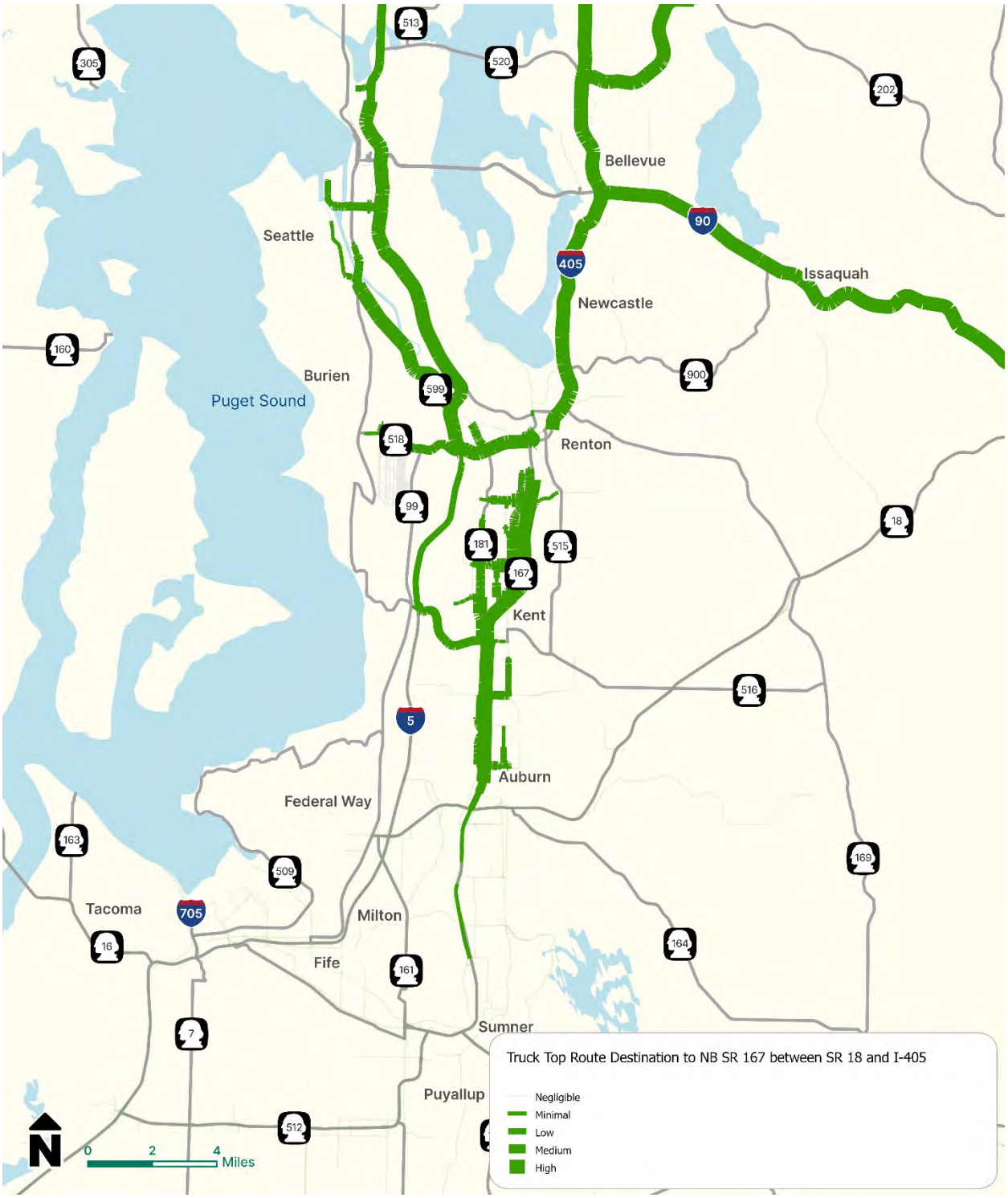
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Truck Top Route Destination to NB SR 167 between SR 18 and I-405
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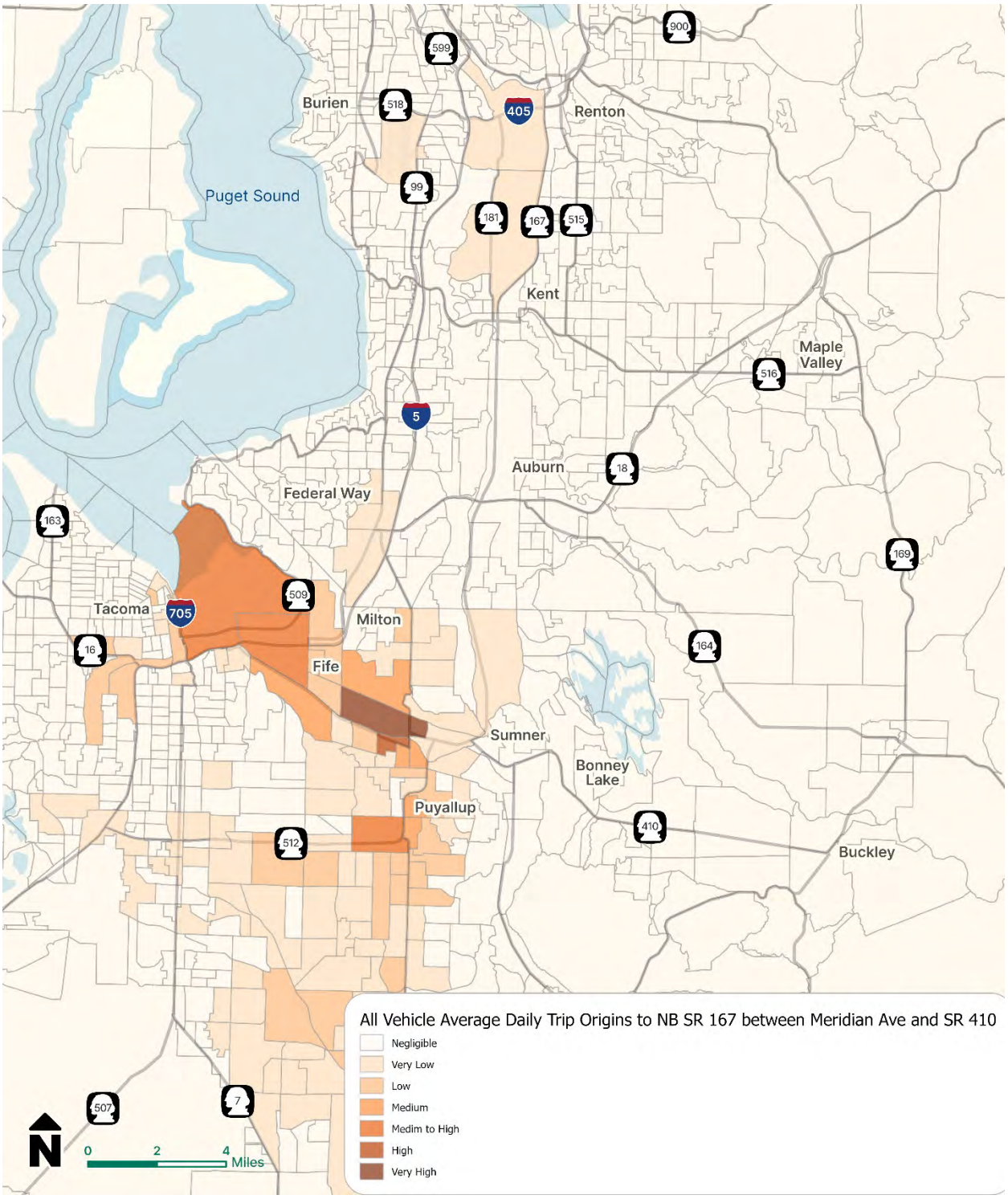
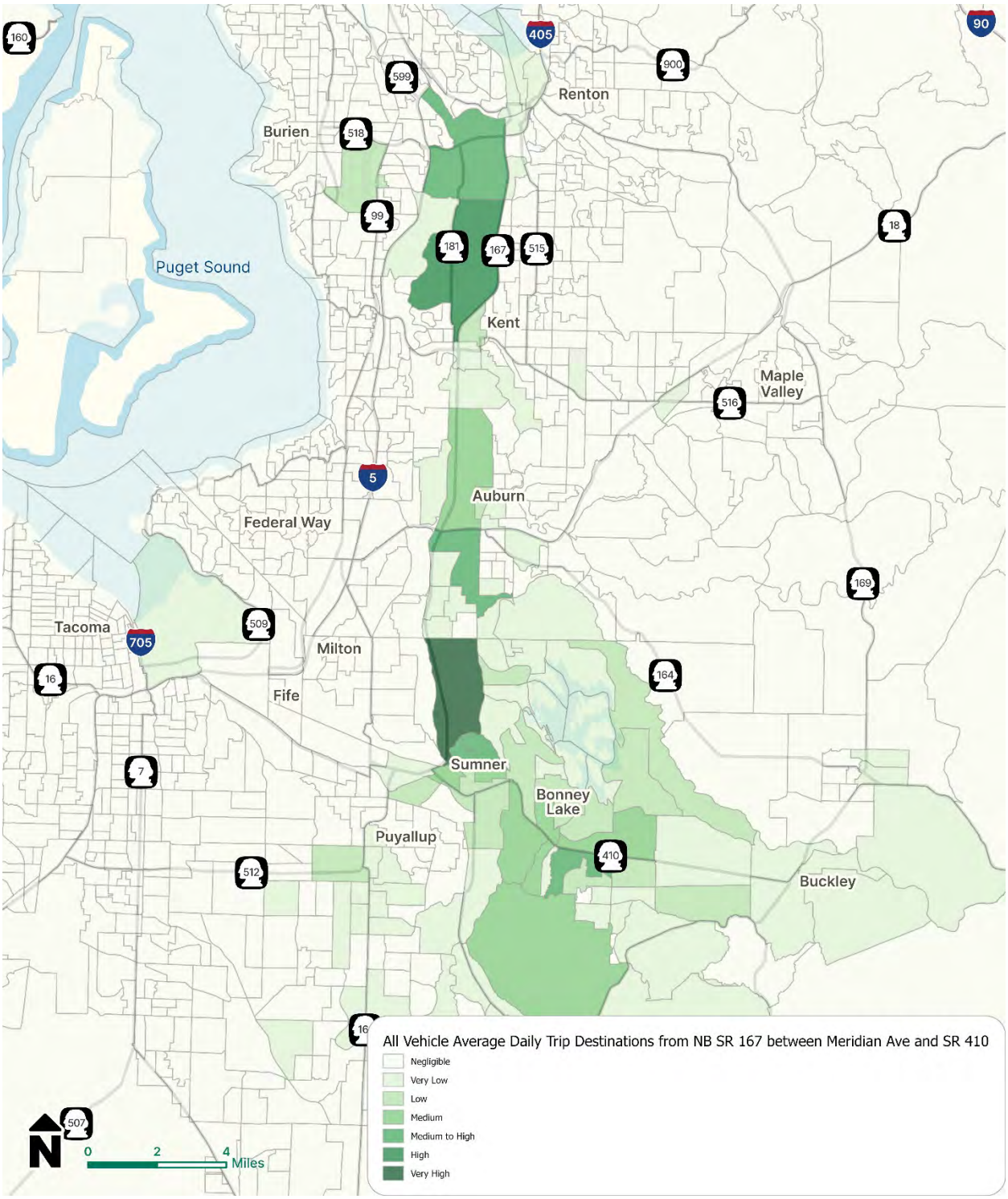
Origin-Destination by Predefined Geography

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All Vehicle Average Daily Trip Destinations from NB SR 167 between Meridian Ave and SR 410
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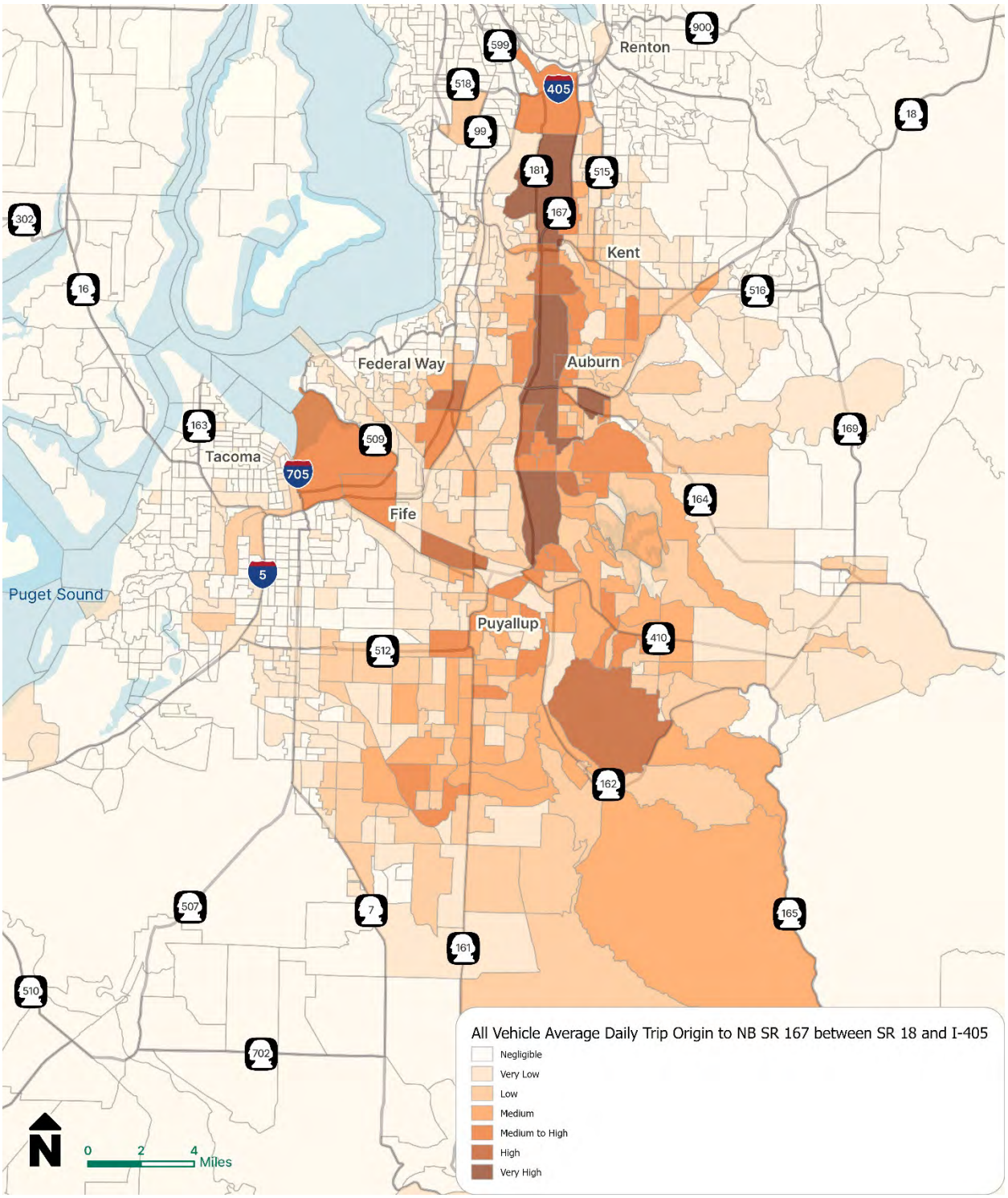
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All Vehicle Average Daily Trip Origin to NB SR 167 between SR 18 and I-405
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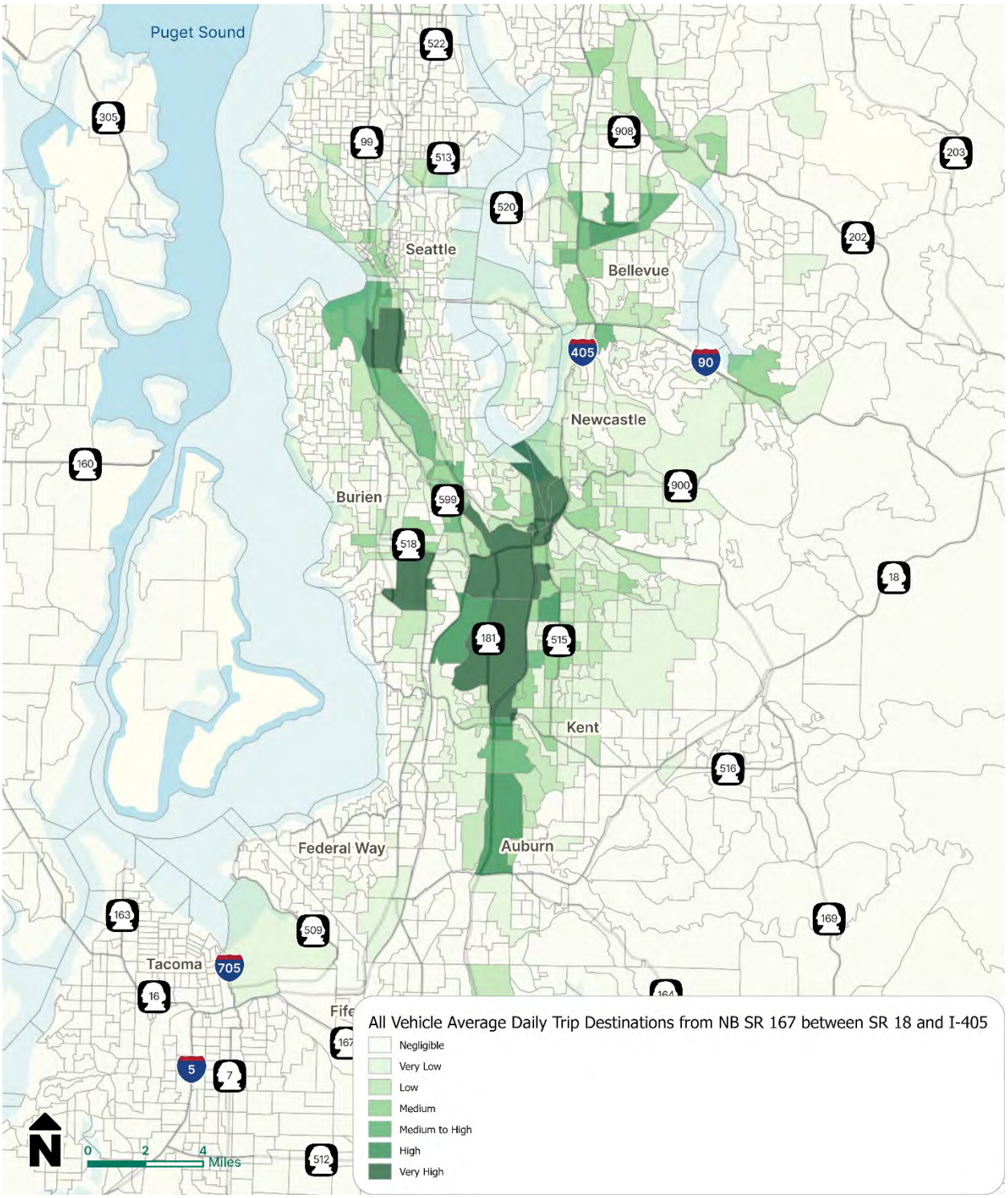
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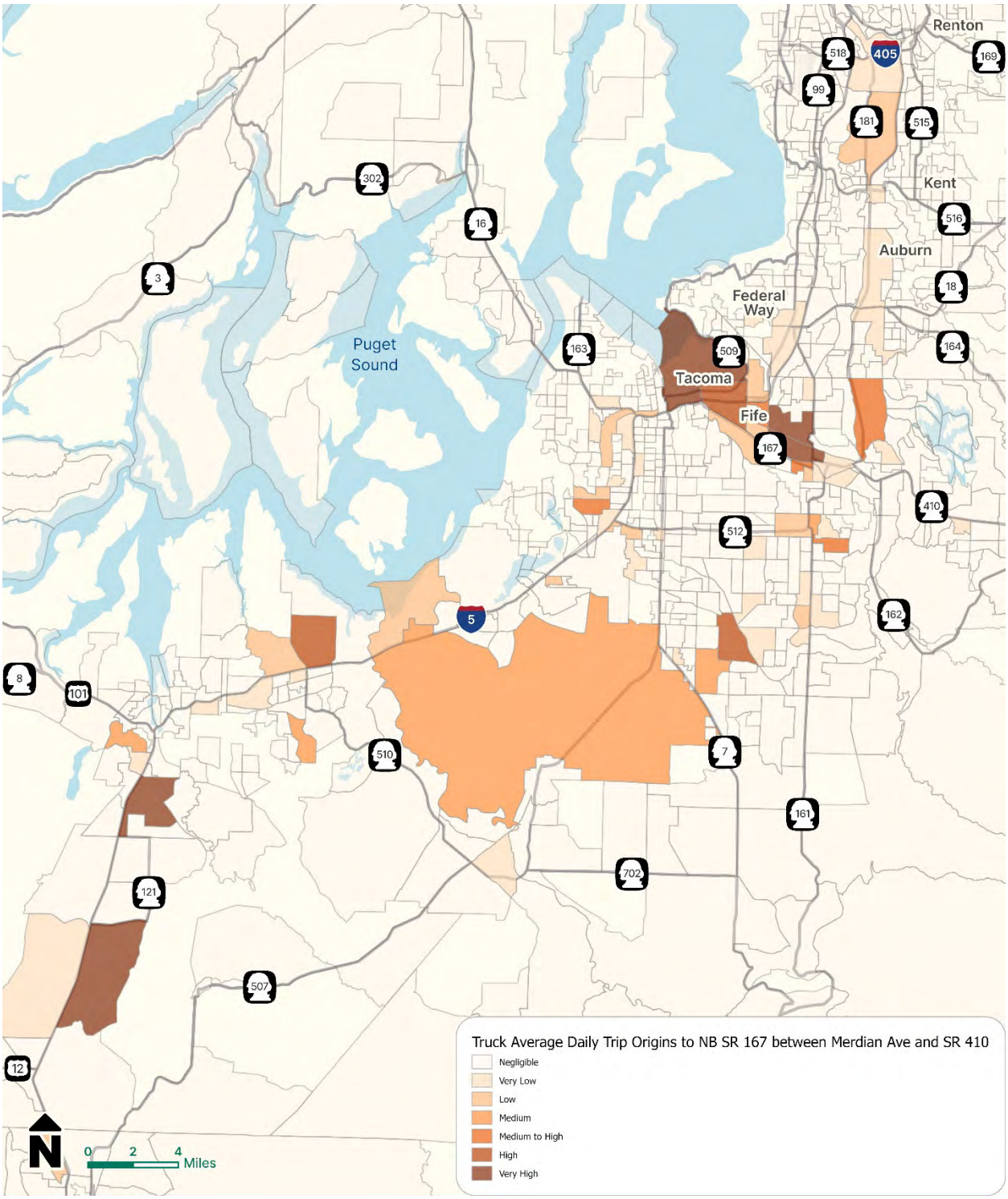
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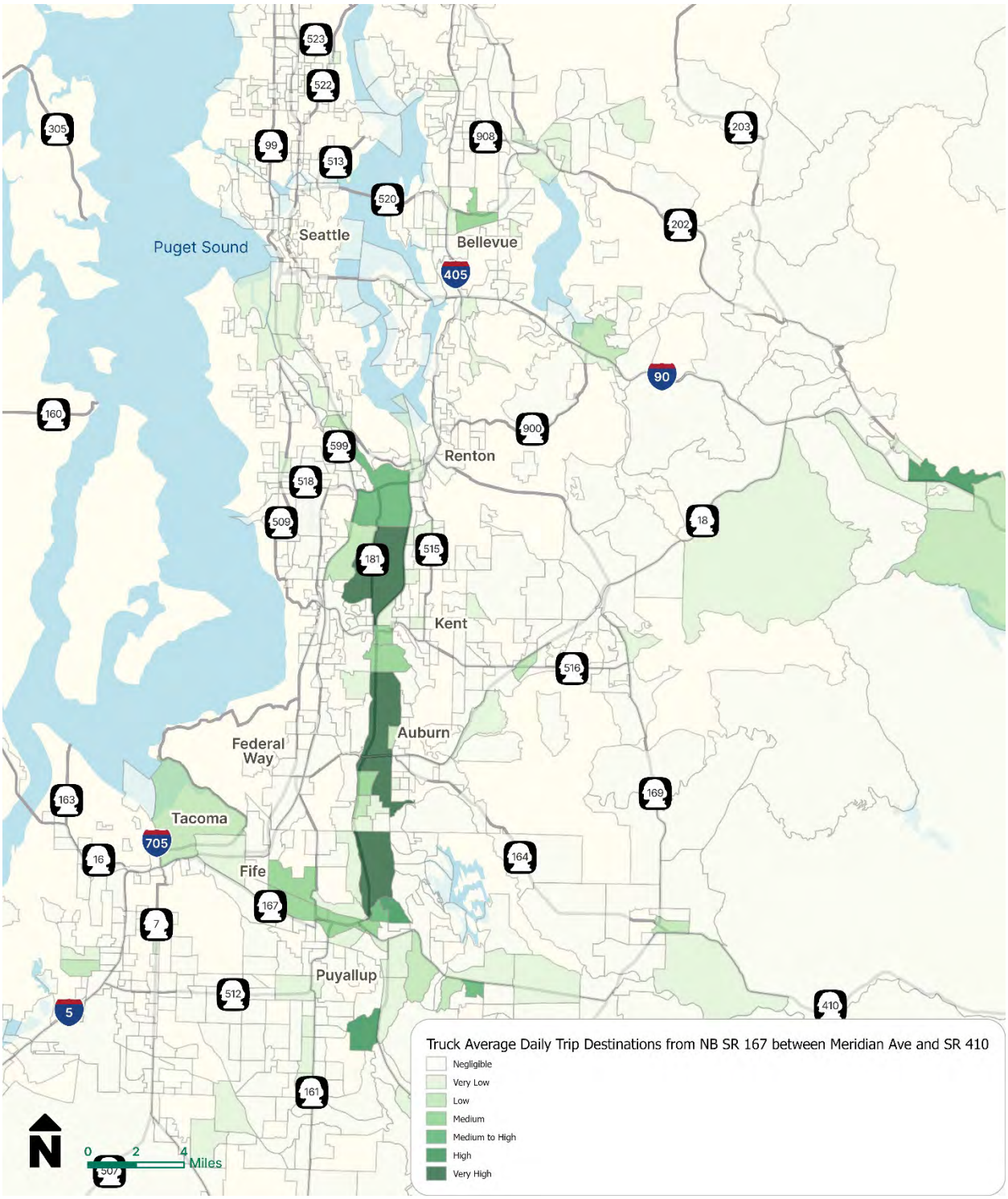
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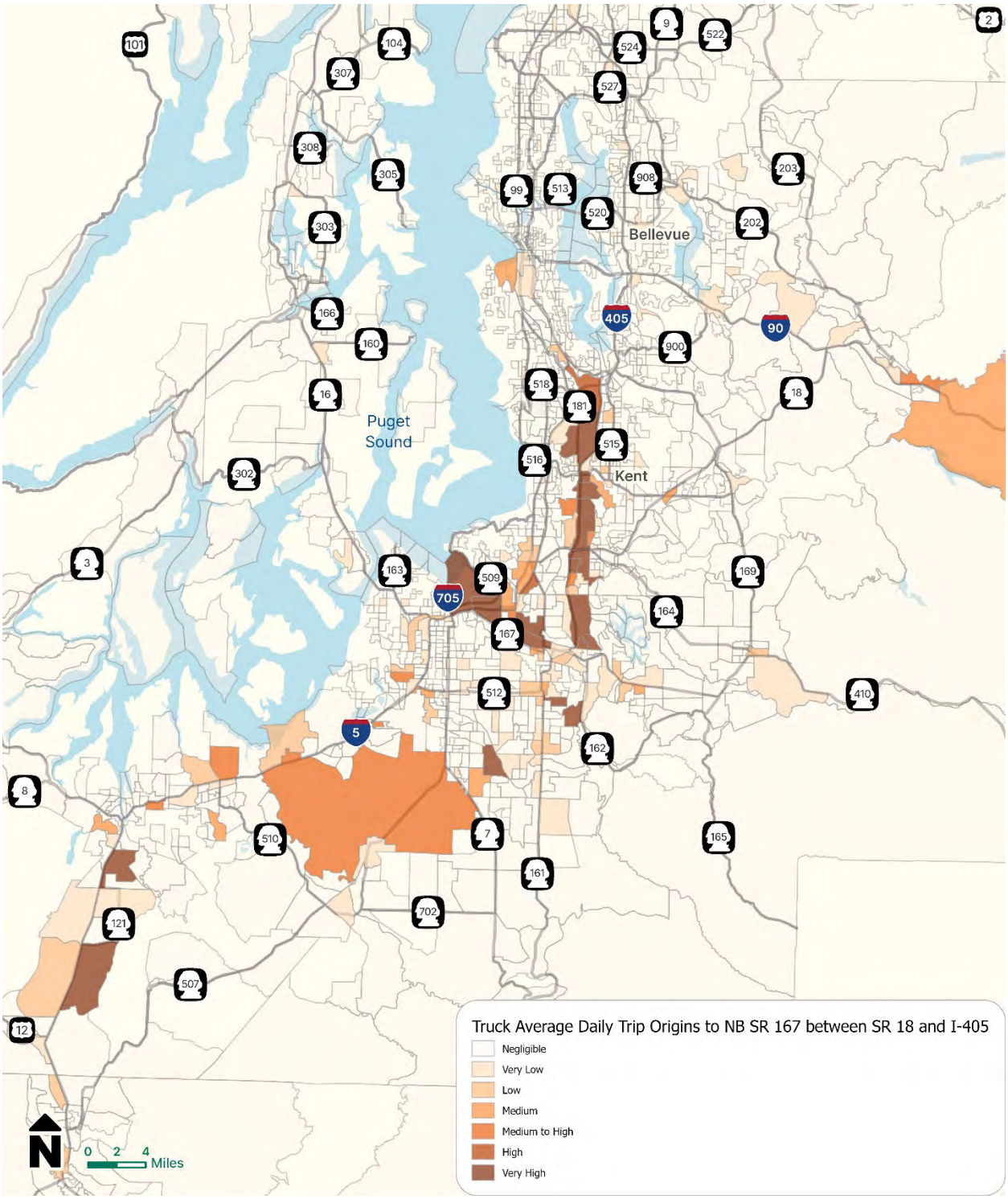
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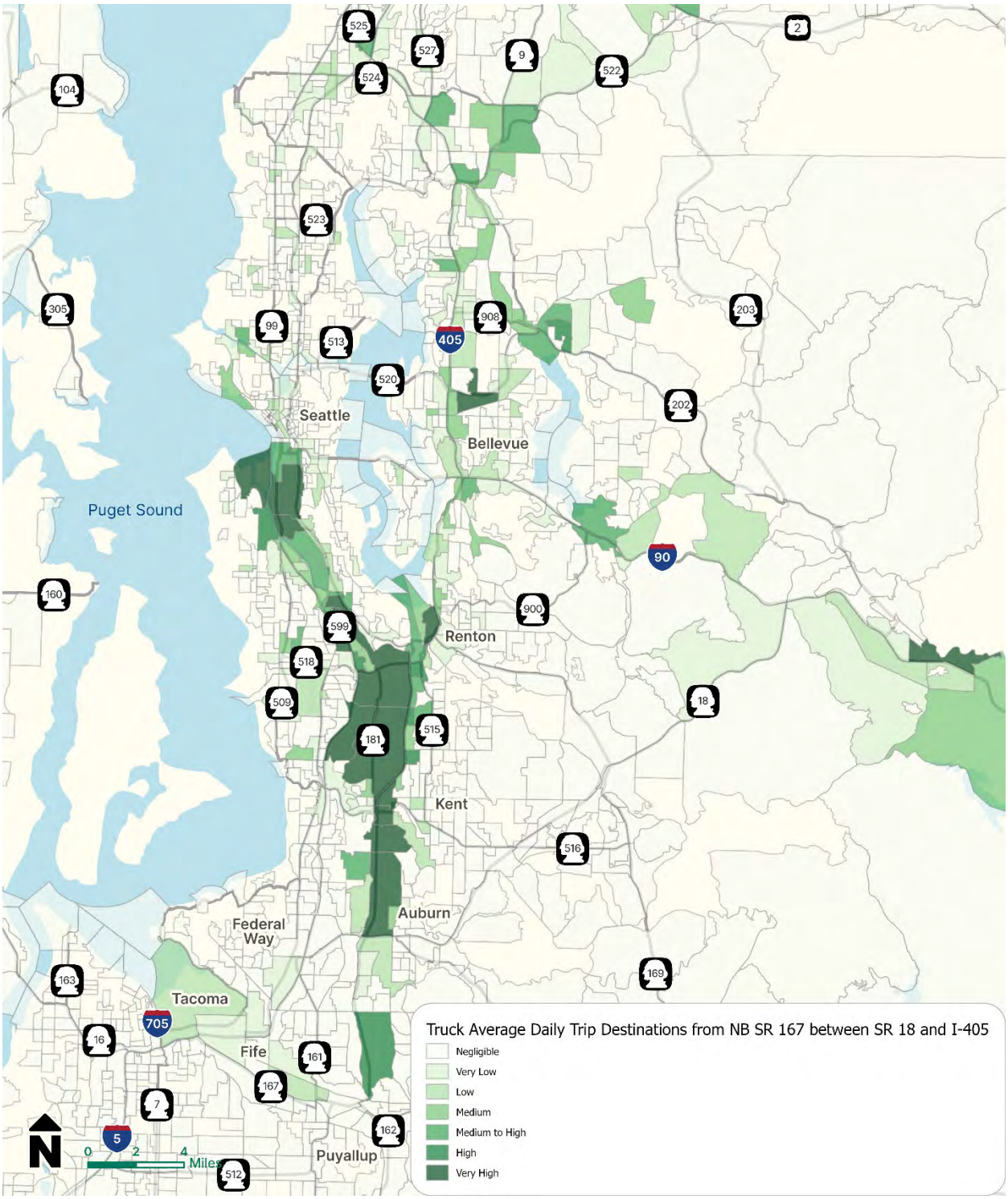
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Truck Average Daily Trip Destinations from NB SR 167 between SR 18 and I-405
Negligible
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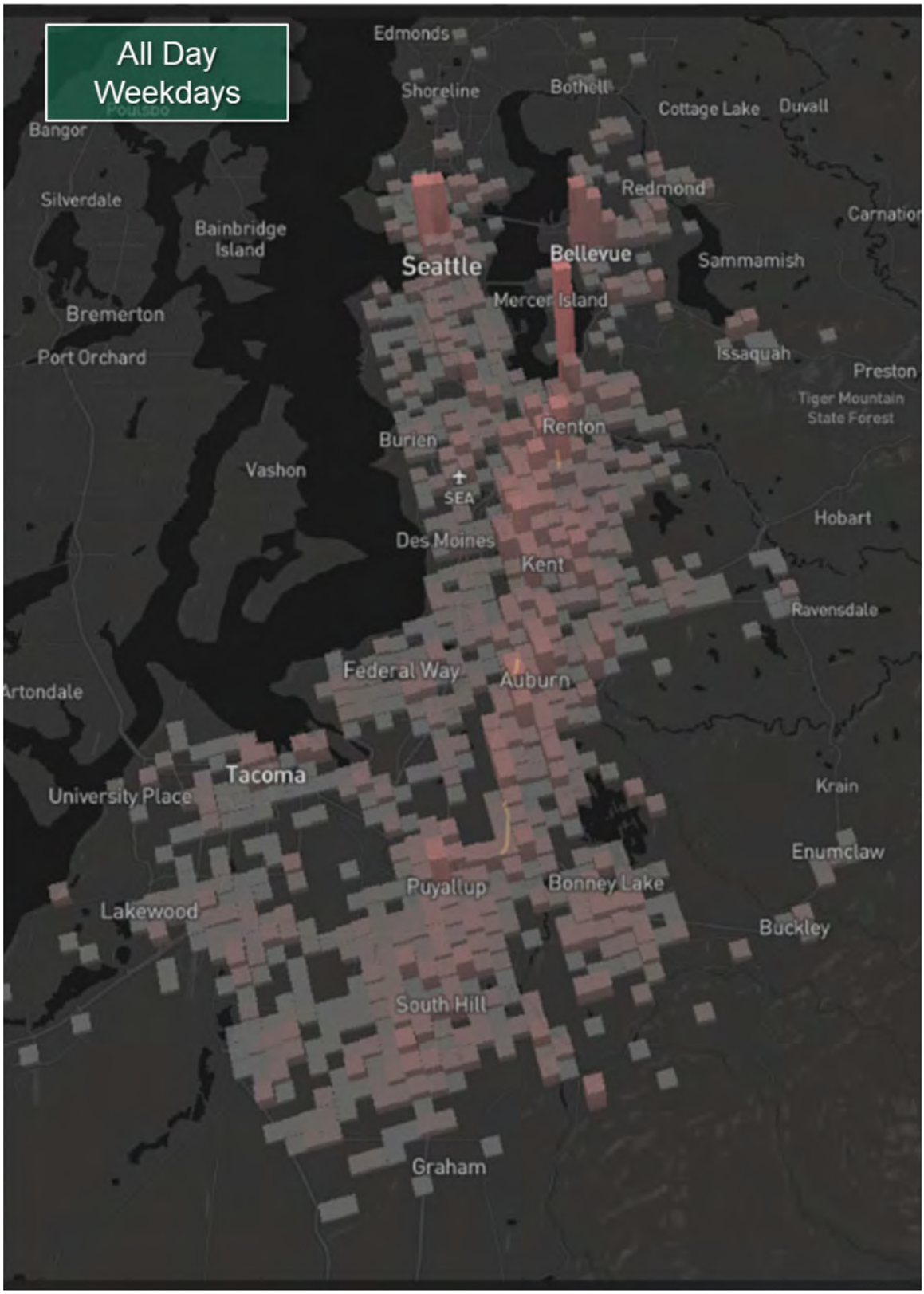
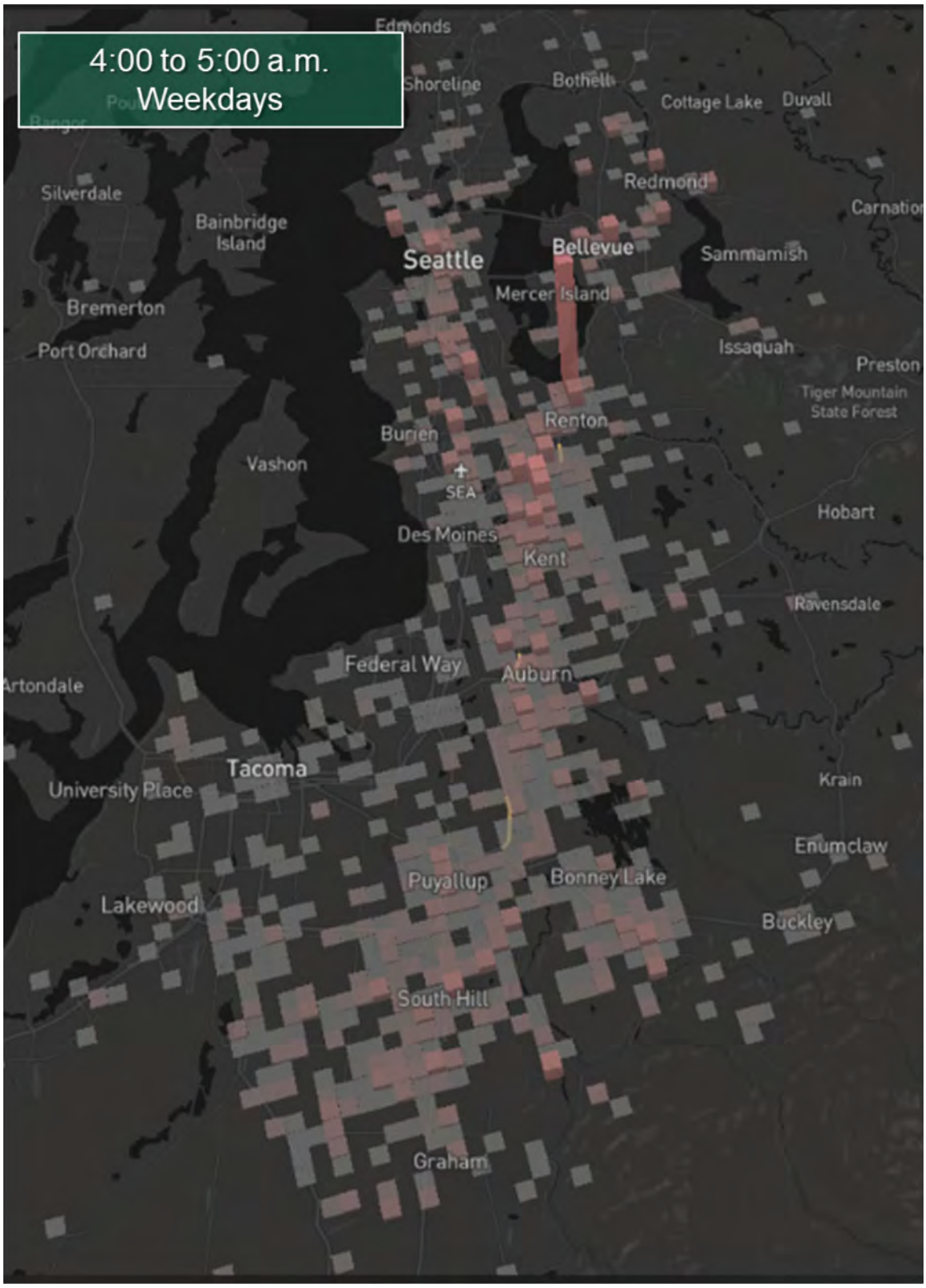
0 2 4 Miles

Work Locations by Time of Day

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Port Orchard
Issaquah
Preston
Tiger Mountain State Forest
Renton
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Vashon
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Hobart
Des Moines
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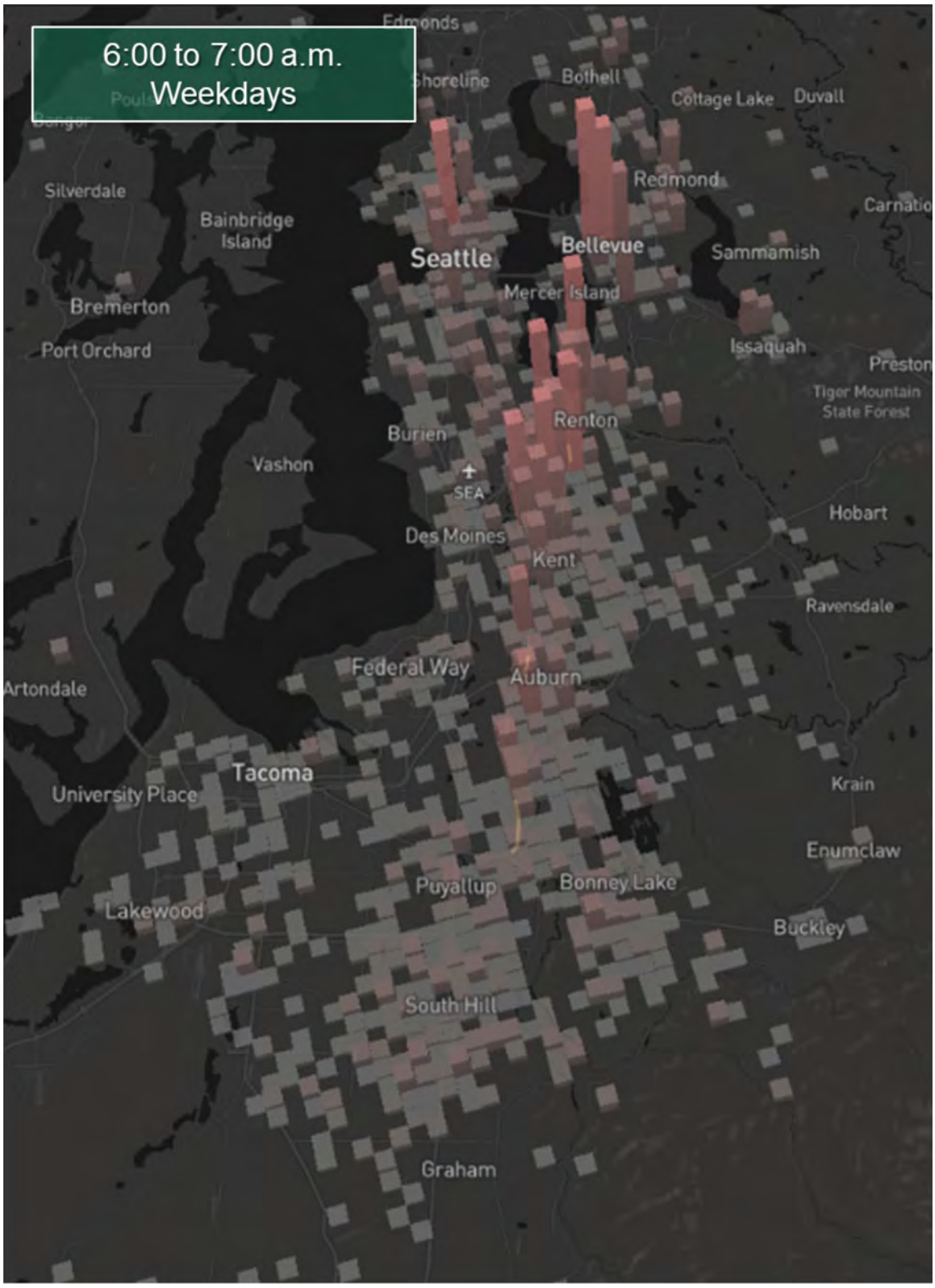
Lakewood
Buckley
South Hill
Graham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Sammamish
Mercer Island
Bremerton
Port Orchard
Issaquah
Preston
Tiger Mountain State Forest
Renton
Burien
Vashon
SEA
Hobart
Des Moines
Kent
Ravensdale
Federal Way
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Artondale
Tacoma
University Place
Krain
Enumclaw
Puyallup
Bonney Lake
Lakewood
Buckley
South Hill
Graham


8:00 to 9:00 a.m.
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Bothell
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Duvall
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Silverdale
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Buckley
South Hill
Graham

Appendix H. Arterial V/C Ratio Methodology

Table 1 presents arterial roadway capacity assumptions for the SR 167 study area developed using the Florida Department of Transportation's (FDOT) Quality/ Level of Service (Q/LOS) Handbook. The Handbook discusses maximum capacity volumes relative to various factors such as area types, speed limit, and number of lanes. The FDOT Q/LOS methodology is based on standard calculations and methods presented in the Highway Capacity Manual (HCM), a publication by the National Academy of Sciences Transportation Research Board, which is the industry-standard approach to evaluating arterial traffic operations. Generally, non-state roadways have lower capacities and service volumes than state facilities because they have shorter green times at signalized intersections.[2] The tabulated capacity assumptions are also based on a calibration of outputs from the SR 167 travel demand model to match existing conditions as reported in various community Comprehensive Plans and Transportation Master Plans.

Table 1. Arterial Roadway Capacity Assumptions

Arterial Description (per direction)	Capacity Assumptions (vehicles per lane per hour)
One-lane, undivided	600
One-lane, divided with a median or two-way left-turn lane	700
One-lane, divided with a median or two-way left-turn lane and characterized as a State Highway	750
One-lane, one-way facility	750
Multi-lane, undivided	650
Multi-lane, divided with a median or a two-way left-turn lane	700
Multi-lane, divided with a median or two-way left-turn lane and characterized as a State Highway	750
Multi-lane, one-way facility	750

Source: FDOT's Quality/Level of Service (Q/LOS) Handbook, 2020, Fehr & Peers, 2022

[2] Quality/ Level of Service Handbook, 2020 https://fdotwww.blob.core.windows.net/sitefinity/docs/default-source/planning/systems/systems-management/document-repository/qlos/fdot_qlos_handbook_june-2020.pdf?sfvrsn=98f689a7_2