# Emission Inventory

This section presents the emissions inventory for this second 10-year maintenance plan and briefly describes its development. The LMP Guidance requires the maintenance plan include an attainment inventory—that is, an inventory with emission levels consistent with attainment of the PM10 standard.

EPA develops a triennial national emission inventory based on EPA and state inputs. EPA issued the Air Emissions Reporting Rule (AERR) to clarify state reporting requirements. EPA and Ecology agreed on developing the attainment inventory from available triennial inventory information and annual reported industrial emissions. Appendix X provides details.

***Emission years and categories -*** EPA approved the Inventory Preparation Plan (IPP) prepared by Ecology that proposed use of readily available information. This plan is provided as Appendix Y. Emission estimates in this maintenance plan inventory are from Ecology’s draft 2011 triennial emissions inventory[[1]](#footnote-1) (2011 EI) and the annual 2011 industrial emissions reported to PSCAA and Ecology.

The original seven significant emission categories are reorganized in seven new categories in this attainment inventory as listed in Table X. County values from the seven most significant categories have been temporally and spatially allocated to their respective maintenance areas. These seven emissions categories were chosen based on a review of the emission sources in the original maintenance plan.

Table X. Emission Categories used in this LMP

|  |  |
| --- | --- |
| **1994 Emissions Categories** | **2011 Emission Categories** |
| Gasoline Exhaust | Onroad Mobile |
| Diesel Exhaust | Port and Marine, Onroad Mobile |
| Ships | Port and Marine |
| Locomotives | Locomotives |
| Wood Burning | Residential Wood Combustion |
| Road Dust | Paved Road Dust, Unpaved Road Dust |
| Allowable Industrial | Industrial |

***Emission inventory geography******-*** Although PM10 emissions from outside the maintenance area can spread into the maintenance area, the emission inventory only captures what is emitted within the maintenance area. The emission inventory is not a spatial model of emissions in the area, but simply an estimate of total tons emitted within the boundary. For example, although residential wood smoke from neighboring homes may disperse into the maintenance area and impact PM10 levels, only residential wood smoke come from within the maintenance area boundary was estimated.

***Significant source categories -*** The most significant sources of PM10 listed in the original maintenance plan for the Seattle and Tacoma Maintenance Areas was industrial emissions. For the Kent Maintenance Area, the major source of emission was from Residential Wood Combustion, and to a lesser extent diesel and gas vehicle exhaust.

Fugitive dust emissions from coal trains were estimated and are included in the total locomotive emissions.

Other sources are deemed insignificant, including outdoor burning, construction dust, aircraft emissions, wildfires, cigarette smoke, and commercial charbroiling. Outdoor burning is prohibited in the three maintenance areas, so emissions would be minimal. Neither Ecology nor PSCAA have local information on emissions for construction dust, cigarette smoke, or commercial charbroiling, but is assumed to be minimal in these areas. Smoke from wildfires in Puget Sound is rare and was considered negligible. Some of these values are included in the 2011 NEI, however the emission estimates have large uncertainties because the data was collected nationally and was not developed specifically for local areas, or for sub-county regions like the Seattle, Tacoma, and Kent Maintenance Areas.

***Maintenance Plan Inventory -*** Emissions for these seven emission categories are shown in Table X below. Washington State’s 2011 EI is the most recent, complete, readily available emission inventory for King and Pierce County.

Table X. Seattle, Tacoma, and Kent Maintenance Area Annual and Winter Day PM10 Emissions

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Seattle Duwamish** | **Tacoma Tideflats** | **Kent** |
| **Emission Categories** | **Emission Inventory Source** | **Emission Report Year** | **Annual, tons/yr** | **Tons/winter day** | **% of total tons/winter day** | **Annual, tons/yr** | **Tons/winter day** | **% of total tons/winter day** | **Annual, tons/yr** | **Tons/winter day** | **% of total tons/winter day** |
| Onroad Mobile | 2011 EI | 2011 | 100.8 | 0.29 | 12% | 59.9 | 0.17 | 11% | 21.7 | 0.06 | 10% |
| Port and Marine | 2011 EI | 2011 | 122.2 | 0.33 | 14% | 77.0 | 0.21 | 14% | 0.0 | 0.00 | 0% |
| Locomotives | 2011 EI | 2011 | 43.5 | 0.12 | 5% | 13.4 | 0.04 | 2% | 13.8 | 0.04 | 6% |
| Residential Wood Combustion | 2011 EI | 2011 | 17.0 | 0.13 | 5% | 6.6 | 0.05 | 3% | 34.8 | 0.26 | 42% |
| Paved Road Dust | 2011 EI | 2011 | 190.1 | 0.53 | 22% | 104.6 | 0.29 | 19% | 40.9 | 0.11 | 18% |
| Unpaved Road Dust | 2011 EI | 2011 | 133.6 | 0.65 | 27% | 23.3 | 0.11 | 7% | 28.7 | 0.14 | 23% |
| Industrial | PSCAA, Ecology | 2011 | 127.3 | 0.35 | 15% | 243.4 | 0.67 | 43% | 0.5 | 0.00 | 0% |
| **Total** | -- | 2011 | 734.5 | 2.40 | -- | 528.2 | 1.53 | -- | 140.4 | 0.61 | -- |

**Appendix X**

Ecology developed an inventory of annual and winter weekday PM10 emissions estimates for the LMP. For this LMP, the seven sources in the original 1994 plan were inventoried, but were reorganized as described in Tables Y and X. The seven sources are: Residential Wood Combustion, Paved Road Dust, Unpaved Road Dust, Onroad Mobile, Port and Marine, Locomotives, and Industrial. Other categories inventoried in the original maintenance plan were deemed insignificant, and were not inventoried.

Table Y. List of 2011 Emission Categories

|  |
| --- |
| **2011 Emission Categories** |
| Onroad Mobile |
| Residential Wood Combustion |
| Port and Marine |
| Locomotives |
| Paved Road Dust |
| Unpaved Road Dust |
| Industrial |

Table X. 1994 emission categories with their respective 2011 representative emission category

|  |  |
| --- | --- |
| **1994 Emissions Categories** | **2011 Representative Emission Categories** |
| Gasoline Exhaust | Onroad Mobile |
| Diesel Exhaust | Port and Marine, Onroad Mobile |
| Ships | Port and Marine |
| Locomotives | Locomotives |
| Wood Burning | Residential Wood Combustion |
| Road Dust | Paved Road Dust, Unpaved Road Dust |
| Allowable Industrial | Industrial |

Ecology’s draft 2011 triennial emissions inventory (2011 EI) was used for all categories except industrial emissions, where actual emissions to PSCAA and Ecology were used. Excerpts of Ecology’s draft county resolved emission inventory are found in Appendix Z.

Fugitive dust emissions from coal trains were estimated and is included in the total locomotive emissions category.

Other sources are deemed insignificant, including outdoor burning, construction dust, aircraft emissions, wildfires, cigarette smoke, and commercial charbroiling. Outdoor burning is prohibited in the three maintenance areas, so emissions would be minimal. Neither Ecology nor PSCAA have local information on emissions for construction dust, cigarette smoke, or commercial charbroiling, but is assumed to be minimal in these areas. Smoke from wildfires in Puget Sound is rare and was considered negligible. Some of these values are included in the 2011 NEI, however the emission estimates have large uncertainties because the data was collected nationally and was not developed specifically for local areas, or for sub-county regions like the Seattle, Tacoma, and Kent Maintenance Areas.

Method for Emission Estimates

All the non-industrial source emissions were estimated by multiplying an activity level, such as wood combusted or Vehicle Miles Traveled (VMT), by an emission factor in mass per activity.

 ***Emissions = Activity level x Emission Factor***

***Spatial Allocation Methods***

Spatial surrogates were used to approximate emissions inside the maintenance areas from county data. For sources without specific coordinates, spatial surrogates were used to approximate both the location and magnitude of the emissions. Maintenance areas (MA) emissions are estimated as:

***EMA = ECounty \* SurrogateMA / SurrogateCounty***

Where EMA = emissions in the maintenance area, ECounty = emissions in county,

SurrogateMA = surrogate activity in the maintenance area, and SurrogateCounty = surrogate activity in county.

The spatial surrogates and data sources used are shown in Table XX below.

Table XX. Spatial surrogate and sources of data for subcounty region (maintenance area) estimates

|  |  |  |
| --- | --- | --- |
| **Emission Category** | **Spatial Surrogate** | **Source** |
| Onroad Mobile | Percent of VMT within the maintenance area vs. the county | Puget Sound Regional Council Estimates |
| Residential Wood Combustion | Percent of households within the maintenance area vs. the county | Puget Sound Regional Council Estimates |
| Port and Marine | Percent of Port of Seattle and Tacoma area within the maintenance area  | 2011 Draft Ecology EI (from 2011 Puget Sound Marine Emission Inventory) |
| Locomotives | Percent of the county rail activity or length of rail within the maintenance area | 2011 Draft Ecology EI |
| Paved Road Dust | Percent of VMT within the maintenance area vs. the county | Puget Sound Regional Council Estimates |
| Unpaved Road Dust | Percent of VMT within the maintenance area vs. the county | Puget Sound Regional Council Estimates |
| Industrial | N/A --- actual reported values were used | Source Emission Data Reported to PSCAA and Ecology |

***Temporal Allocation Methods***

The 2011 EI estimates were available as annual and winter season emissions for King and Pierce County. These estimates were temporally allocated to a winter weekday, and spatially allocated to the maintenance areas as described below.

Annual emissions data were adjusted to tons per average winter day for the maintenance area for each source category. Methods for each category are described below.

Residential Wood Combustion

Residential wood combustion (RWC) emissions are based on Ecology’s draft 2011 Emission Inventory. RWC consists of home heating and recreational use of woodstoves, fireplaces, fireplace inserts and central furnaces. Activity parameters for the 2011 EI include the type of wood burning devices [certified (catalytic and noncatalytic) woodstoves, uncertified woodstoves and fireplaces], the amount and species of wood burned from each device and seasonal, daily and hourly usage rates. Most of this information was obtained through the 2007 National Research Center Survey.[[2]](#footnote-2) Emission factors were taken from AP 42, the 2002 NEI, and the particulate matter size distribution from the California Air Resources Board (CARB).

Wood burning devices include central furnaces, fireplaces, pellet stoves, and certified and uncertified woodstoves and inserts. Close to three quarters of all wood burning devices in the state are fireplaces or uncertified woodstoves and inserts.

For residential wood combustion, seasonal activity fractions from the NRC survey were used to calculate emissions for a winter day.2 Table X shows county annual and winter emissions by device type and by county. Table Y shows the population data used for as the surrogate to estimate emissions for the maintenance area. Table Z shows the final results.

Table X. Tons of PM10 by wood burning device, King and Pierce County

|  |  |  |
| --- | --- | --- |
| **Device** | **King County** | **Pierce County** |
|  | Annual tons | Winter tons | Annual tons | Winter tons |
| Fireplace: general | 2,176 | 1,480 | 358 | 244 |
| Woodstove: fireplace inserts; non-EPA certified | 596 | 405 | 250 | 170 |
| Woodstove: fireplace inserts; EPA certified; non-catalytic | 205 | 139 | 155 | 105 |
| Woodstove: fireplace inserts; EPA certified; catalytic | 71 | 48 | 54 | 36 |
| Woodstove: freestanding, non-EPA certified | 601 | 409 | 341 | 232 |
| Woodstove: freestanding, EPA certified, non-catalytic | 206 | 140 | 211 | 144 |
| Woodstove: freestanding, EPA certified, catalytic | 72 | 49 | 73 | 50 |
| Woodstove: pellet-fired, general | 15 | 10 | 6 | 4 |
| Other: All Combustor Types | 51 | 35 | 23 | 15 |
| **Total** | ***3,993*** | ***2,715*** | ***1,470*** | ***1,000*** |

Source: 2011 Draft Ecology EI

Table Y. PM10 Maintenance Area Population Data

|  |  |  |  |
| --- | --- | --- | --- |
| **Area Name** | **Area Population** | **County Population** | **Fraction of County** |
| Kent | 16,841 | 1,931,249 | 0.00872 |
| Seattle | 8,216 | 1,931,249 | 0.00425 |
| Tacoma | 3,594 | 795,225 | 0.00452 |

Source: PSRC 2011

Table Z. Tons of PM10 by wood burning device in each maintenance area:

|  |  |  |  |
| --- | --- | --- | --- |
| **Device** | **Kent** | **Seattle** | **Tacoma** |
|   | Annual tons | Winter tons | Tons/winter day | Annual tons | Winter tons | Tons/winter day | Annual tons | Winter tons | Tons/winter day |
| Fireplace: general | 19.0 | 12.9 | 0.14 | 9.2 | 6.3 | 0.07 | 1.6 | 1.1 | 0.01 |
| Woodstove: fireplace inserts; non-EPA certified | 5.2 | 3.5 | 0.04 | 2.5 | 1.7 | 0.02 | 1.1 | 0.8 | 0.01 |
| Woodstove: fireplace inserts; EPA certified; non-catalytic | 1.8 | 1.2 | 0.01 | 0.9 | 0.6 | 0.01 | 0.7 | 0.5 | 0.01 |
| Woodstove: fireplace inserts; EPA certified; catalytic | 0.6 | 0.4 | 0.00 | 0.3 | 0.2 | 0.00 | 0.2 | 0.2 | 0.00 |
| Woodstove: freestanding, non-EPA certified | 5.2 | 3.6 | 0.04 | 2.6 | 1.7 | 0.02 | 1.5 | 1.0 | 0.01 |
| Woodstove: freestanding, EPA certified, non-catalytic | 1.8 | 1.2 | 0.01 | 0.9 | 0.6 | 0.01 | 1.0 | 0.7 | 0.01 |
| Woodstove: freestanding, EPA certified, catalytic | 0.6 | 0.4 | 0.00 | 0.3 | 0.2 | 0.00 | 0.3 | 0.2 | 0.00 |
| Woodstove: pellet-fired, general | 0.1 | 0.1 | 0.00 | 0.1 | 0.0 | 0.00 | 0.0 | 0.0 | 0.00 |
| Other: All Combustor Types | 0.4 | 0.3 | 0.00 | 0.2 | 0.1 | 0.00 | 0.1 | 0.1 | 0.00 |
| **Total** | ***34.8*** | ***23.7*** | ***0.26*** | ***17.0*** | ***11.5*** | ***0.13*** | ***6.6*** | ***4.5*** | ***0.05*** |

Paved Road Dust

Fill with Rebecca’s

Onroad Mobile Sources

Fill with Rebecca’s

***Unpaved Road Dust***

Fill with Rebecca’s

***Port and Marine***

To estimate port and marine activity, the 2011 Ecology Emission Inventory used the 2011 inventory prepared for the Puget Sound Maritime Air Forum by Starcrest Consulting Group, LLC.[[3]](#footnote-3) The inventory is a bottom-up, activity-based emissions inventory which provides detailed information on the five major source categories associated with the marine activities: ocean-going vessels, harbor vessels, cargo handling equipment, on-road heavy-duty vehicles, and rail operations. It was an update to a similar inventory prepared by Starcrest for the 2005 inventory. Activity level and emission rates are described in the source inventory documentation.

Port and marine emissions were multiplied by the fraction within the maintenance area. Table X shows the fractions of the port areas within the maintenance areas. For winter day estimates, the emissions were assumed to be uniform throughout the year. Table Y shows the annual emissions. The Kent maintenance area has no port or marine activities to estimate.

Table X. Fraction of Port Areas in Maintenance Areas

|  |  |  |
| --- | --- | --- |
| **Maintenance Area** | **Fraction of Port Area** | **Name of Port** |
| Seattle | 65% | Port of Seattle |
| Tacoma | 100% | Port of Tacoma |
| Kent | NA | NA |

Table Y. PM10 emissions breakdown in tons of port and marine emissions within each maintenance area by subcategory

|  |  |
| --- | --- |
| **Port and Marine Emission Category** | **Annual Emissions in tons** |
|  |  |
| *Seattle Maintenance Area* |  |
|  |  |
| Ocean-going vessels hoteling | 33.3 |
| Harbor craft cruising | 77.1 |
| Off-hwy diesel cargo handling equipment | 10.77 |
| Off-hwy gas cargo handling equipment | 0.001 |
| Off-hwy LPG cargo handling equipment | 0.04 |
| ARGO Railyard: Off-highway Diesel /Construction & Mining Equipt /Rubber Tire Loaders/Terminal Tractors/Indust Equip | 0.5 |
| BNSF SIG Railyard: Off-highway Diesel /Construction & Mining Equipt /Rubber Tire Loaders/Terminal Tractors/Forklifts | 0.5 |
| ***Seattle Total*** | ***122.2*** |
|  |  |
| *Tacoma Maintenance Area* |  |
|  |  |
| Ocean-going vessels hoteling | 36.1 |
| Harbor craft cruising | 30.9 |
| Off-hwy diesel cargo handling equipment | 10.0 |
| Off-hwy gas cargo handling equipment | 0.01 |
| Off-hwy LPG cargo handling equipment | 0.01 |
| ***Tacoma Total*** | ***77.0*** |

***Locomotives***

To estimate locomotive activity, the 2011 Ecology Emission Inventory used the emissions from Class I line haul and switch yard locomotives using EPA guidance and other information.[[4]](#footnote-4) U.S. Class I railroads are line haul freight railroads with operating revenue in excess of $319.3 million (amount changes over time). Two Class I railroads operate in Washington: Burlington Northern Santa Fe Railway (BNSF) and Union Pacific Railroad (UP). Amtrak was also included in this inventory. Class 2 and 3 railroad locomotive emissions were not inventoried. A special AIRQUEST (formerly Northwest Regional Technical Center) project conducted by the Oregon Department of Environmental Quality (ODEQ) found that emissions from Class 2 and 3 railroad locomotives were a small percentage of total locomotive emissions.[[5]](#footnote-5),[[6]](#footnote-6)

BNSF and UP provided activity and emissions information for 2011. Amtrak provided passenger rail activity information for 2011.

Activity level is measured in gallons of diesel consumed by locomotives. All of the railroads provided county fuel use for line haul and switch yard locomotives for 2011.[[7]](#footnote-7)

Most of the activity information is available in the maintenance areas and no spatial surrogate is necessary. Spatial surrogates for passenger rail and coal line were based on the length of rail in each county.

To quantify winter day emissions, locomotives were assumed to operate uniformly year-round per EPA guidance.[[8]](#footnote-8)

*Estimate of fugitive dust from coal trains*

Fugitive coal dust emissions from rail transport was estimated using the suggested approach described by Cope and Bhattacharyya, 2001.[[9]](#footnote-9) The emission factor is described below:

Rail Coal Dust Emission Factor (kg dust/tonne of coal transported) = 0.1\*(0.62\*D)0.6\*((365-P)/365)\*(SD/D)\*((100-CE)/100)\*SF

 Where: D = total rail distance from origin to destination (km)

 P = number of precipitation days

 SD = segment distance through the maintenance area (km)

 CE = coal dust control efficiency (i.e. surfactant efficiency)

 SF = scaling factor from TSP to PM10

The reported tons of coal exported in 2011 that would have travelled through the maintenance areas was 4,854,451.[[10]](#footnote-10) The proportional segment distances through the maintenance areas were calculated through ArcGIS 9.3 and listed in Table W. Table W shows the values for the variables above for each maintenance area.

Table W. Values used in the rail coal dust emission factor equation

|  |  |  |  |
| --- | --- | --- | --- |
| **Variable** | **Value** | **Units** | **Source** |
| D | 2414 | km | 10 |
| P | 177 | days | 2011 EI – KSEA |
| CE | 21.25 (0 for 9 months, and then 85 for last 3 months of 2011 with adopted surfactant requirement) | % | 10 |
| SF | 0.5 | none | 9 |
| SD | 3.80 – Kent10.51 – Seattle3.01 – Tacoma | km | Estimated with GIS |

*Rail Yards*

As rail yards are only reported by county, we can’t adequately separate the emissions from the major railyards in King County and Pierce County, therefore all the county emissions were used without a spatial surrogate for activity within the Seattle and Tacoma maintenance areas.

*Line Haul and Passenger Rail*

Table X shows the emissions from each locomotive category. Table Y shows the maintenance area fraction of the rail line of the total county rail for estimating passenger, line haul, and coal dust emissions. Table Z shows the fraction of county rail activity in the maintenance area for line haul estimates.

Table X. Estimated annual locomotive PM10 emissions by category

|  |  |
| --- | --- |
| **Locomotive Emission Category** | **Annual Emissions in tons** |
|  |  |
| *Kent Maintenance Area* |  |
|  |  |
| Passenger | 0.1 |
| Coal | 12.5 |
| Line Haul | 1.2 |
| ***Kent Total*** | 13.8 |
|  |  |
| *Seattle Maintenance Area* |  |
|  |  |
| Passenger | 0.3 |
| Coal | 34.4 |
| Line Haul | 2.4 |
| Rail Yards | 6.4 |
| ***Seattle Total*** | 43.5 |
|  |  |
| *Tacoma Maintenance Area* |  |
|  |  |
| Passenger | 0.02 |
| Coal | 9.9 |
| Line Haul | 1.6 |
| Rail Yards | 1.9 |
| ***Tacoma Total*** | 13.4 |

Table Y. Maintenance area fraction of the rail line of the total county rail for estimating passenger and coal dust emissions

|  |  |  |  |
| --- | --- | --- | --- |
| **Maintenance Area** | **Length of County Passenger and Coal Train Line in miles** | **Length of Maintenance Area Portion in miles** | **Fraction of County Passenger and Coal Train Lengths in Maintenance Area** |
| Kent | 40.18 | 2.36 | 0.0587 |
| Seattle | 40.18 | 6.53 | 0.163 |
| Tacoma | 71.79 | 1.87 | 0.0260 |

Table Z. Fraction of county rail activity in the maintenance area for line haul estimates.

|  |  |
| --- | --- |
| **Maintenance Area** | **Fraction of County Rail Activity in Maintenance Area** |
| Kent | 0.060 |
| Seattle | 0.118 |
| Tacoma | 0.104 |

***Industrial***

The federal Clean Air Act defines point sources as any stationary source having the potential to emit 100 tons per year of a criteria pollutant. These sources require Air Operating (Title V) Permits.

Sources that emit more than 25 tons, but less than 100 tons per year of PM10, must register with the Puget Sound Clean Air Agency. These registered sources must report their PM10 emissions if over 25 tons per year. Although not required, many other sources report their PM10 emissions. Table X summarizes the all the industrial sources that report PM10 emissions since 1994.

Table X. The number of industrial sources (active or inactive) reporting PM10 emissions between 1994 and 2011.

|  |  |  |  |
| --- | --- | --- | --- |
| **Maintenance Area** | **Air Operating Permit Sources** | **Other reporting sources** | **Total** |
| Seattle  | 8 | 17 | 25 |
| Tacoma  | 5 | 17 | 22 |
| Kent | 1 | 6 | 7 |
| *Grand Total* | *14* | *40* | *54* |

To have a more complete inventory, we used reported emissions from both air operating permit sources and other reporting registered sources. All these sources fall within PSCAA’s jurisdiction, except for Simpson Tacoma Kraft, which Ecology also provided.

In the Inventory Preparation Plan, we originally proposed to create our industrial inventory using the maximum emissions from each emission segment since 1994. However, EPA commented that only a future year inventory would need such a conservative estimate. They also suggested that the best inventory for a limited maintenance plan is a base year planning inventory, which would better represent actual emissions. Therefore, we used actual reported emissions for 2011 from the reporting industrial sources.

Table V below shows the added maximums from each segment since 1994 (including sources that no longer emit or report), as was previously proposed in the Inventory Preparation Plan, along with the actual emissions in 1994 and 2011. Industrial emissions have lowered significantly since 1994 and that 2011 numbers are more representative of actual recent emissions versus the more conservative approaches, such as allowable emissions.

Table V. PM10 Emissions from all industrial sources from 1994 to 2011:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Maintenance Area** | **1994 Allowable Emissions (tons)** | **Max of emissions each emission segment since 1994 (tons)** | **1994 actual emissions (tons)** | **2011 actual emissions (tons)** |
| Seattle | 955 | 866 | 510 | 127 |
| Tacoma  | 1,624 | 1212\* | 544\* | 243 |
| Kent | N/A | 1.0 | 0.1 | 0.5 |

\* Since data for Simpson Tacoma Kraft is missing for 1994 and 1995, 1996 data was used for the 1994 actuals. The Simpson Tacoma Kraft maximum was estimated using 1996-2011 emissions.

Table X. Estimated annual emissions by reporting industrial source

|  |  |  |
| --- | --- | --- |
| **Maintenance Area** | **Source** | **2011 Emissions (tons)** |
| Seattle | Saint-Gobain Containers, Inc (Verallia) | 64.9 |
| Seattle | CertainTeed Gypsum Manufacturing Inc | 31.4 |
| Seattle | Ash Grove Cement Co, E Marginal | 30.7 |
| Seattle | Puget Sound Coatings Machinists DSR | 0.3 |
| Seattle | Kinder Morgan Liquids Terminal, LLC | 0.1 |
| ***Seattle*** | ***Total*** | ***127.3*** |
|   |   |   |
| Kent | Rexam Beverage Can Co | 0.4 |
| Kent | Hytek Finishes Co | 0.1 |
| ***Kent*** | ***Total*** | ***0.5*** |
|   |   |   |
| Tacoma | Simpson Tacoma Kraft Co | 97.0 |
| Tacoma | Graymont Western US Inc | 85.1 |
| Tacoma | Georgia-Pacific Gypsum LLC | 26.8 |
| Tacoma | Simpson Lumber Company, LLC | 22.2 |
| Tacoma | US Oil & Refining Co | 12.3 |
| ***Tacoma*** | ***Total*** | ***243.4*** |

1. Draft Excerpts of the Washington State Base Year 2011 County Inventories, Washington State Department of Ecology Air Quality Program, Sally Otterson, 2013. Draft Excerpts are found in Appendix Z. [↑](#footnote-ref-1)
2. Puget Sound Clean Air Agency Indoor Wood-burning Emission Inventory Survey of King, Kitsap, Pierce and Snohomish Counties, Report of Results, Prepared by National Research Center, Inc., 3005 30th Street, Boulder, CO 80301, November 2007. [↑](#footnote-ref-2)
3. *2011 Puget Sound Maritime Air Emissions Inventory*. Prepared by: Starcrest Consulting Group, LLC, Starcrest sonsulting Group, LLC, Poulsbo, Washington 98370. September 2012. [↑](#footnote-ref-3)
4. *Procedures for Emission Inventory Preparation, Vol. IV: Mobile Sources*. EPA-450/4-81-026d (Revised), Section 6.0. 1992. [↑](#footnote-ref-4)
5. *Regional Technical Center Demonstration Project: Summary Report*. Idaho Department of Environmental Quality, Oregon Department of Environmental Quality, Washington Department of Ecology, US EPA Region 10, Washington State University, University of Washington. January 11, 2002 (draft). [↑](#footnote-ref-5)
6. *Oregon 1996 Railroad Emissions Inventory Project, Emission Estimate Methodology Documentation*. Oregon Department of Environmental Quality. August 2001. [↑](#footnote-ref-6)
7. *BNSF, UP and Amtrak Railway Company 2011 Estimation of Locomotive Emissions*. Email transmittal of information from Kelly Harvey (BNSF), Michael Germer (UP), and Delia Ann Pfleckl (Amtrak) to Sarah Clouse Washington State Department of Ecology. March 2012. County fuel use and emissions. [↑](#footnote-ref-7)
8. *Procedures for the Preparation of Emission Inventories for Carbon Monoxide and Precursors of Ozone*. Volume II, table 6-11. EPA-454/R-92-026, March 1992. [↑](#footnote-ref-8)
9. Cope, Douglas; Bhattacharyya Kamal. “A Study of Fugitive Coal Dust Emissions in Canada”, prepared for the Canadian Council of Ministers of the Environment, 2001. [↑](#footnote-ref-9)
10. Kotchenruther, Robert. “Fugitive Dust from Coal Trains: Factors Effecting Emissions and Estimating PM2.5”, EPA Region 10, Annual NW-AIRQUEST Meeting, June 2013. [↑](#footnote-ref-10)