

3.4 Emissions Inventory Overview

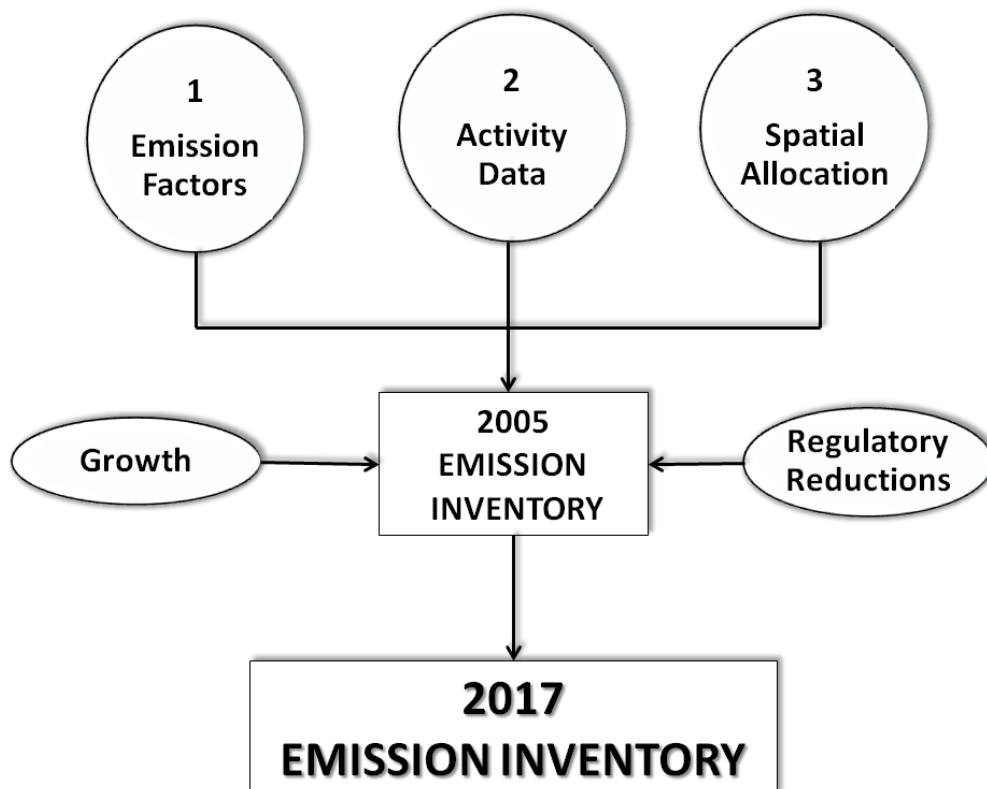
An emissions inventory is a comprehensive estimation of air pollutant emissions by source in a geographic area during a specific time period. DEQ has selected the 2005 inventory year as the base year for this project because that is the year for which DEQ has the most toxics monitoring data and a good emissions inventory data set. To create the projected 2017 emissions inventory, DEQ began with the 2005 emissions inventory, and updated it using:

- Population and employment growth factors obtained from Portland’s Metropolitan Regional Government Organization (Metro) and from federal government agencies;
- Refinements from analytical improvements and more in-depth research; and
- Projected regulatory reductions associated with new regulations that have or will be enacted by 2017, such as National Emission Standards for Hazardous Air Pollutants (NESHAPs) and local programs.

The 2005 emissions inventory estimates emissions based on the amount of a specific air toxic generating activity occurring in the PATS area and the air toxics emission rate for that activity. The emissions are then spatially allocated within the PATS region for input into the CALPUFF model. Figure 5 illustrates the main emissions inventory elements of the 2005 base year inventory:

- Emission factor. An emission factor is an emissions rate per activity. An example would be the amount of benzene emitted per ton of wood fuel burned in a certified woodstove.
- Activity data. Activity data for woodstoves also comes from census and other survey data. In the case of residential wood combustion, it would be how much wood is burned and how many days of the year.
- Spatial allocation. The spatial allocation of woodstoves would be where DEQ places the emissions according to residential zones and the heating characteristics of census block groups as surveyed by the United States Census Bureau.

Figure 5: Emissions Inventory Elements



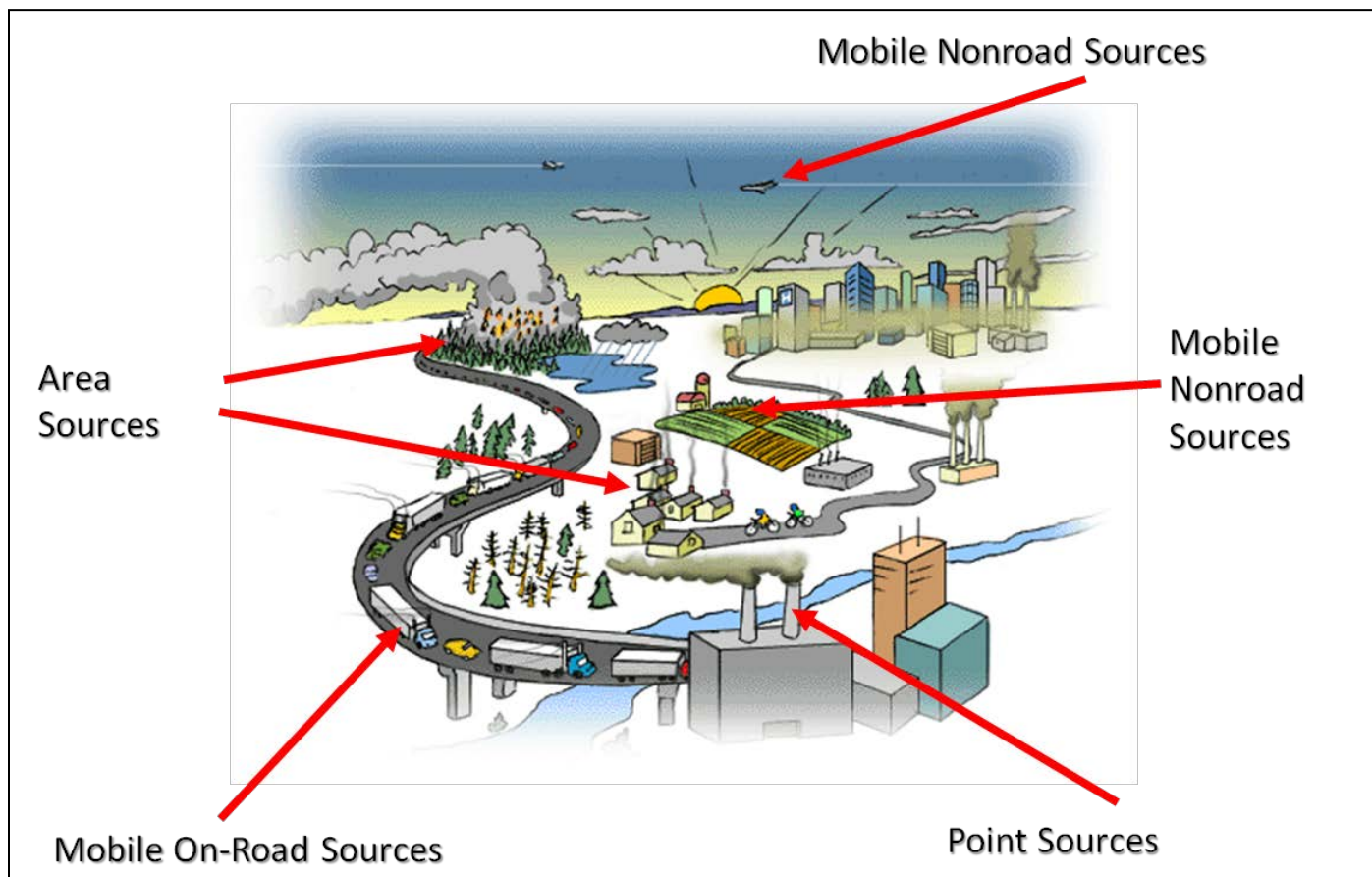
As illustrated in Figure 5, the 2017 forecast is produced by applying growth factors to 2005 emissions, and then subtracting any emissions controlled by federal and state air toxics regulations¹. Examples of these regulatory controls include new National Emission Standards for Hazardous Air Pollutants (NESHAPs), Oregon's Heat Smart rules, new requirements for canisters in car fuel systems that capture benzene and other vapors, and new mobile source air toxics regulations reducing benzene in gasoline.

The following sections describe the emission source categories inventoried, the origin of data for the analysis, how DEQ allocated emissions spatially and temporally, how DEQ accounted for growth and regulatory controls, an evaluation of data quality, and improvements that were made to the emissions inventory prior to modeling the projected 2017 emissions. DEQ made many refinements and improvements in emissions data between the 2005 and 2017 estimates, including information from PATSAC. Refinements and improvements of emissions inventory data are described in section 3.4.5.

3.4.1 Emission Source Categories

Emissions in the PATS area originate from a variety of sources. These include pollutant emissions from area, on-road mobile, nonroad mobile, and point sources. Figure 6 illustrates examples of each type of emission source.

Figure 6: Types of Emission Sources Included in Emissions Inventory



¹ See [section 3.2](#) for information on growth factors and regulatory controls.

The emission sources are further broken down into emission source categories for modeling. Modeled area emission source categories include:

- Residential wood combustion
- Residential open burning
- Residential/commercial/industrial non-permitted fuel use (heating, boilers, etc)
- Surface coating (painting, traffic markings)
- Household solvent use (spray paints, cleaners, auto aftermarket, etc)
- Consumer products
- Asphalt paving and use

Modeled on-road mobile emission source categories include:

- Gasoline and diesel cars
- Trucks
- Buses
- Motorcycles

Modeled non-road mobile emission source categories include:

- Diesel construction equipment
- Lawn and garden equipment
- Aircraft
- Recreational and Commercial Marine
- Rail

Modeled point sources include permitted industrial sources such as:

- Stationary Source Fuel Combustion (Natural Gas, Waste Oil, Liquid Petroleum Gas, etc.)
- Metals Facilities (Steel Foundries, Metal Fabrication, etc.)
- Wood Products (Pulp & Paper, Newsprint, etc.)
- Glass Manufacturing
- Petroleum and Gas Distribution and Storage
- Gas Stations
- Asphalt Manufacturing

3.4.2 Source of Data and Methods

Data for the emissions inventory was generated by Metro, DEQ, Southwest Clean Air Agency (SWCAA), EPA and the Washington Department of Ecology. The sources of the inventory data are shown in Table 2.

Table 2: Emissions Inventory Data Sources: 2017 Emissions Inventory

Emissions Inventory Category	----- Data Sources -----	
	Oregon Counties	Clark County, Washington
Residential Wood Combustion	DEQ	DEQ
All other area sources	DEQ, EPA	Washington Department of Ecology
Permitted Point	DEQ	SWCAA
Nonroad, including air, rail, marine	DEQ, Port of Portland	DEQ, Washington Department of Ecology
On-Road	Metro, DEQ	Metro

Emissions for all inventory source types were classified by EPA source classification code (SCC). A wide variety of methodologies were used to generate the inventory. The following gives a brief description of sources and methods; however for details please refer to the emissions inventory [Appendix 12.3](#).

3.4.2.1 Nonpoint (Area) Sources

Area source emissions were estimated on a countywide level. A small amount of Oregon area source inventory data was generated by EPA for Oregon in the 2005 National Emissions Inventory. This EPA data was included in order to generate as complete an area source inventory as possible.

DEQ follows guidance from the US EPA to estimate emissions using a variety of methodologies:

- State Implementation Plan² (SIP) Development Guidelines (ex. EPA450/2-86-001)
- Survey (for example, residential wood combustion survey)
- Emissions Inventory Preparation (ex. EPA450/4-91-016)
- Emissions Inventory Improvement Project from STAPPA/ALAPCO (now National Association of Clean Air Agencies)
- EPA National Emissions Inventory documentation and references

Emissions estimates for nonpoint sources in Clark County in Clark County were developed by the Washington Department of Ecology and DEQ.

3.4.2.2 On-Road Mobile Sources

Portland's Metro provided on-road emission estimates for Multnomah, Washington, and Clackamas counties, as well as Clark County, Washington. Metro's estimates were generated using the EMME/2 travel demand model and US EPA's MOBILE6.2 emission factor model. The travel demand model models activity in the form of vehicle miles travelled, and then MOBILE6.2 generates emission factors. These included annual emission rates by roadway link for freeway and primary arterials, and by transportation analysis zone for secondary and local roadways. A link is a series of roads or streets that a vehicle takes to get from one location to another. A transportation analysis zone is a geographic unit used in travel demand models where trips begin or end. The model or study area is broken into sections. Each of these sections is called an analysis zone. Data on existing population, employment and trip-making patterns, and forecast population and employment is collected and used to determine the number of existing and future trips traveling to and from each transportation analysis zone. Startup and cool down emissions are assigned to these zones. Small portions of Columbia, Marion, and Yamhill counties falling within the modeling domain were not included in Metro's estimates and DEQ developed emission estimates for these areas. On-road emissions were estimated by DEQ using countywide vehicle miles traveled and EPA MOBILE6.2 for these areas.

3.4.2.3 Non road Mobile Sources

Aircraft, locomotive, and commercial marine emissions were estimated using local activity data specific to airport, marine terminal, and locomotive fuel consumption (by rail company and rail line). All other non road sources were modeled using the EPA emissions model NONROAD2008a. Non road sources were developed in the following categories:

- EPA Non road Model
- Non road, equipment & vehicles, recreational marine
- Airport/Aircraft: Port of Portland, Federal Aviation Administration, AirNAV, US Dept. of Transportation
- Locomotive: Class 1 fuel use, Class 2 & 3 survey
- Commercial Marine: Port of Portland, Lloyd's Register, US Army Corps of Engineers

² State Implementation Plans (SIPs) are a collection of regulations that explain how a State will clean up polluted areas under the Clean Air Act.

Emissions estimates for non road mobile sources in Clark County were developed by the Washington Department of Ecology and DEQ.

3.4.2.4 Permitted Point Sources

Major stationary point source data was estimated from activity and emission factors specific to each source. Emissions data included actual or estimated stack parameters (i.e., release height, release velocity, release temperature). Smaller point sources inventoried included permitted gasoline stations and registered perchlorethylene dry cleaners.

Emissions are estimated at the process level for each source. At each facility, there could be multiple emissions from different parts of the process. For example, at one facility the inventory could include air toxics estimated from energy sources such as boilers, product processing such as metal casting, surface coating lines and emissions that escape generally at ground level, or “fugitives”. The point source sector has the least amount of uncertainty of the emissions inventory sectors because data on emissions are obtained from:

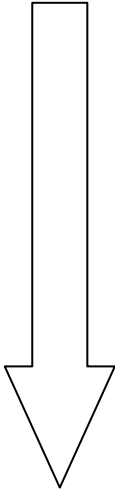
- Title V Permitted Sources (Federal operating permit)
- Smaller, state permitted sources (Air Contaminant Discharge Permit)
- Emission calculations for each process at the source
- Source annual activity reports
- Rule limits, permit conditions, pollution control equipment are documented in facility permits

Emission factors are from EPA data and source testing. Emissions estimates in Clark County were developed by the Southwest Clean Air Agency and DEQ.

3.4.3 Spatial Allocation of Emissions

Spatial allocation prepares the emissions inventory data for input into the model. The model needs the location of emissions within the PATS area. In addition, chemical simulations in most atmospheric models require surface emissions in a specific form. Emissions from the inventory are spatially allocated to points, linear sources, and areas (polygons and grid cells) to prepare for input into the CALPUFF model. Linear sources include high capacity on-road vehicles and rail emissions. Polygons characterize emissions from sources where no single emissions point, such as a stack, exists, but where the emissions are located in a specific area, such as an airport or rail yard. Area sources include emission source categories where emissions are estimated for a county-wide area. Point sources include those sources for which the geographic location of the emissions are known, for example, for permitted industrial sources. For other source categories such as, residential wood combustion, the emissions are estimated countywide, and need to be allocated geographically within the PATS area. Table 3 lists the emissions inventory categories in order of location certainty.

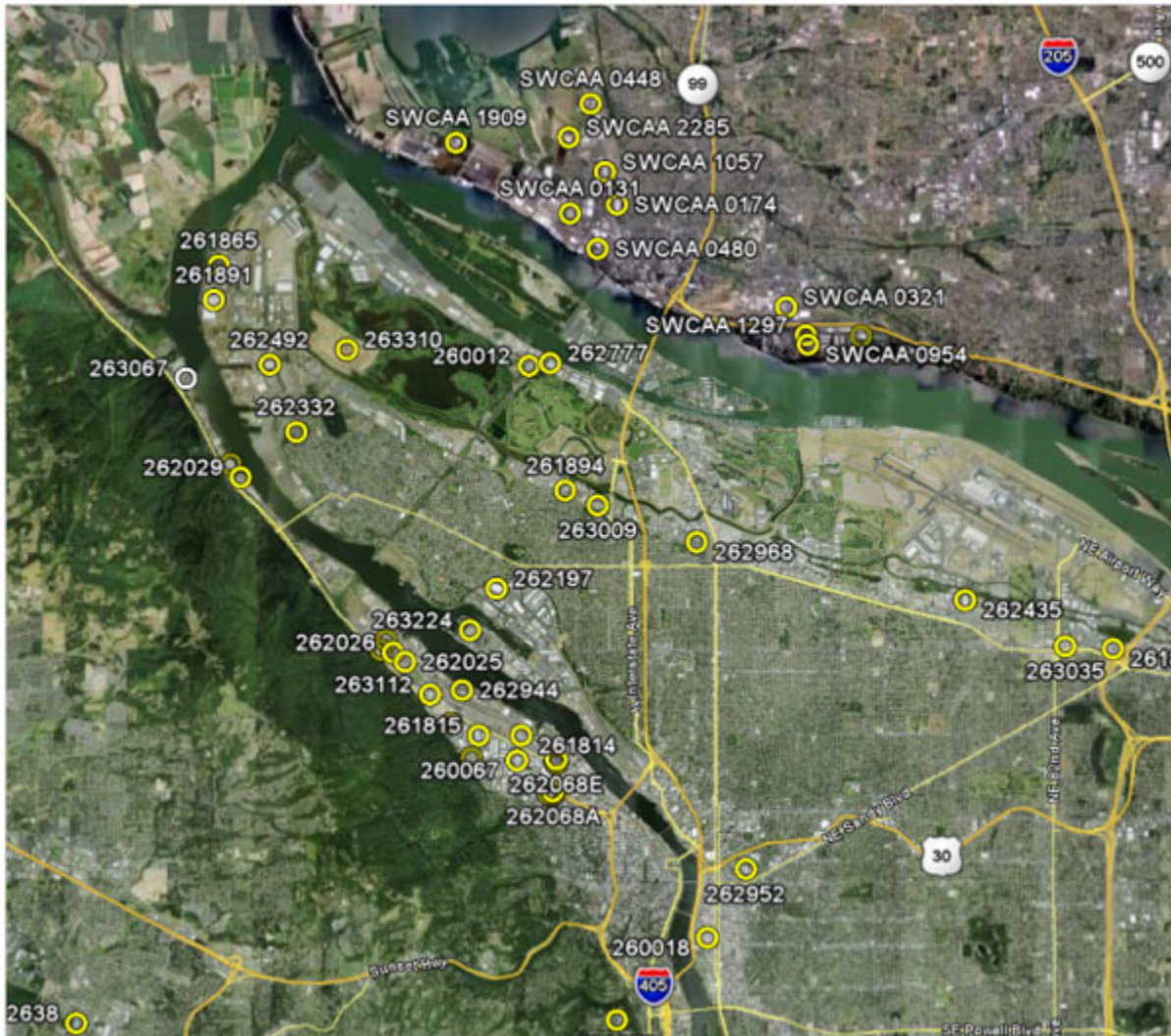
Table 3: Emissions Inventory Categories in Order of Location Certainty

Emissions Inventory Category	Certainty of Emission Location
Point	Location of emissions most certain  Exact location of emissions least certain
Permitted industrial sources	
Perchloroethylene drycleaners	
Gas stations	
Linear	
High emission on-road roadway segment “links”	
High capacity rail lines	
Polygon	
Airports	
Marine	
Rail yards	
POTWs & landfills	
Area	
Nonpoint	
Nonroad vehicles & equipment	
Transportation analysis zones	
• Low emission on-road links • Low emission rail lines	
Recreational marine	

3.4.3.1 Point emission sources

For all permitted point sources, DEQ has spatial coordinates in latitude and longitude. Because of this, there are no intermediate steps between the emissions inventory and modeling. Some larger point sources have emissions located by stack, where each stack has its own set of coordinates. These include facilities with Oregon Title V permits and Oregon air contaminant discharge permits. DEQ also has the latitude and longitude of perchloroethylene dry cleaners, which are currently registered but not permitted in Oregon. Point sources were input at their location. Figure 7 illustrates the location of some of the point sources in the PATS area as verified using Google Earth. Southwest Clean Air Agency (SWCCA) provided the point source locations in Washington.

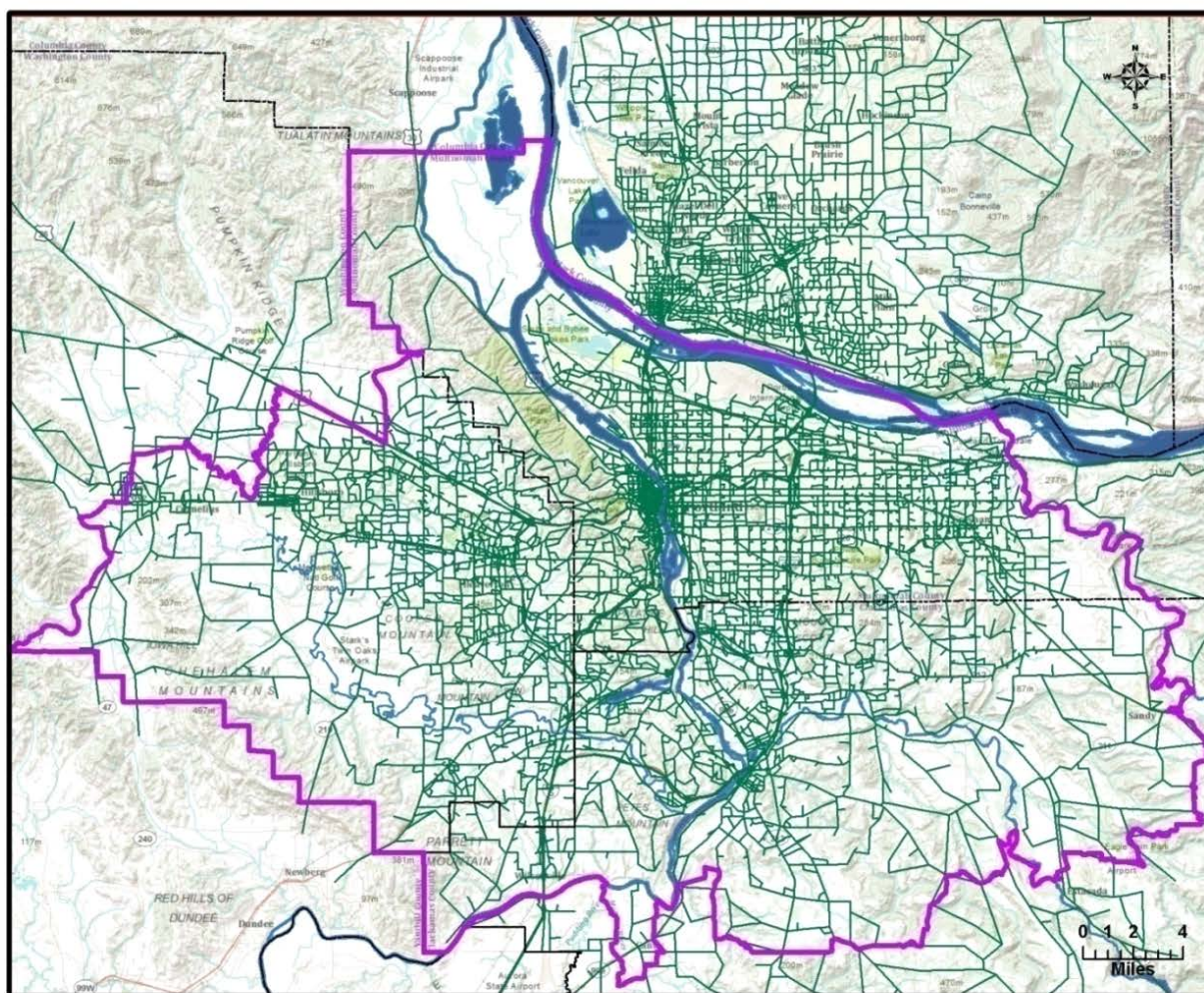
Figure 7: Point Source Coordinates Quality Checked via Google Earth



3.4.3.2 Linear Emission Sources

Linear emission sources include high capacity on-road and rail emissions. The following methodology is specific to on-road emissions data, however high capacity linear rail emissions were treated in a similar fashion. Traffic related emissions are one of the largest contributors to air toxics pollution in the PATS study area. Therefore, it is desirable to model these emissions with the highest accuracy possible. Metro spatially allocated on-road emissions data to approximately 29,000 roadway links. Figure 8 illustrates on-road links within the PATS modeling domain.

Figure 8: On-Road Emission Links from Metro



To reduce the amount of data for dispersion modeling input without losing the integrity of the emissions location, emissions by link were grouped and summed in the following fashion. Links were characterized as “hot”, “warm”, and “cold” by mapping the distribution of benzene emissions using ArcGIS. Emissions by link were then grouped into segments, and summed along each segment. As expected, higher emissions links resulting in hot and warm segments correlated to more heavily traveled highways and arterials. Figure 9 shows the hot and warm segments as determined through GIS mapping and link combination.

Figure 10 shows similar results for rail lines. For line-haul (road) locomotive emissions, emissions by rail company were assigned to track by track ownership. High volume track was grouped into segments in a similar fashion to on-road mobile. Low volume (“cold”) links, Transportation Analysis Zones, and rail lines were spatially allocated to the emissions inventory grid. The development of the emissions inventory grid is detailed in section 3.4.3.4.

Figure 9: Hot (red) and Warm (orange) Traffic Links

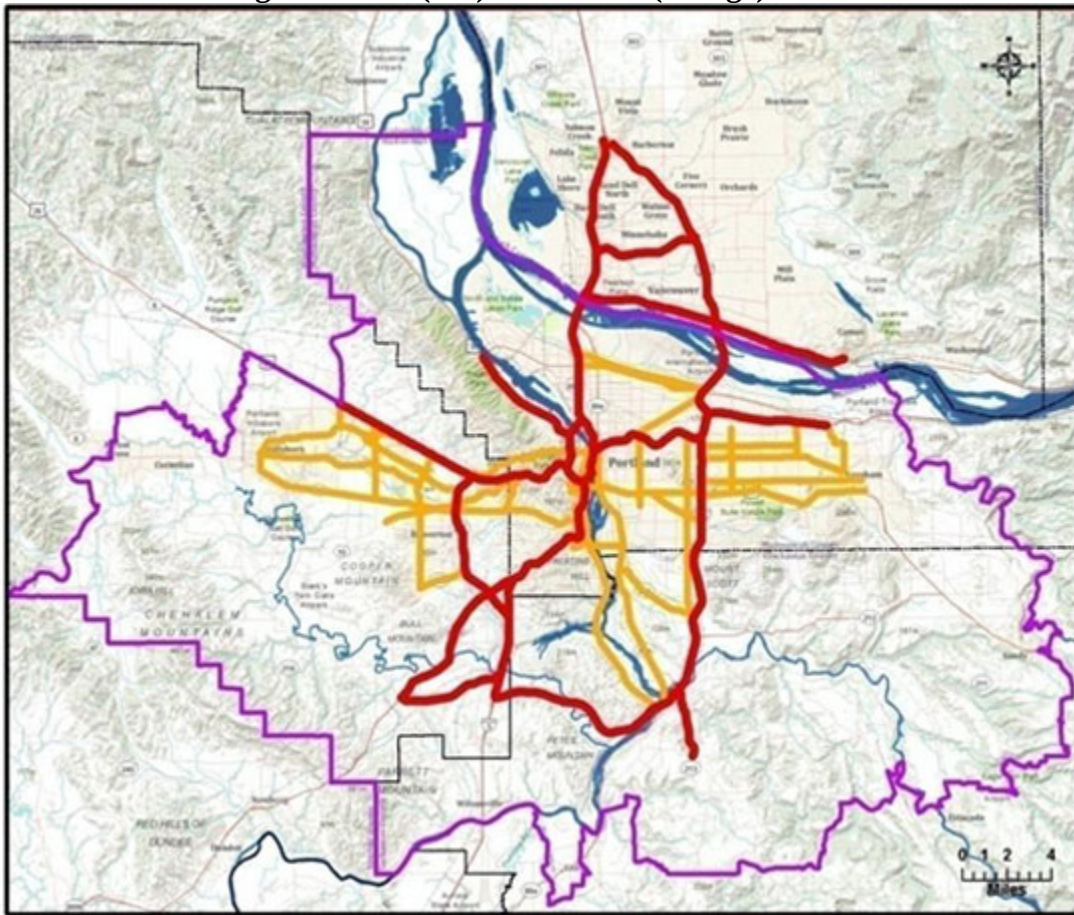
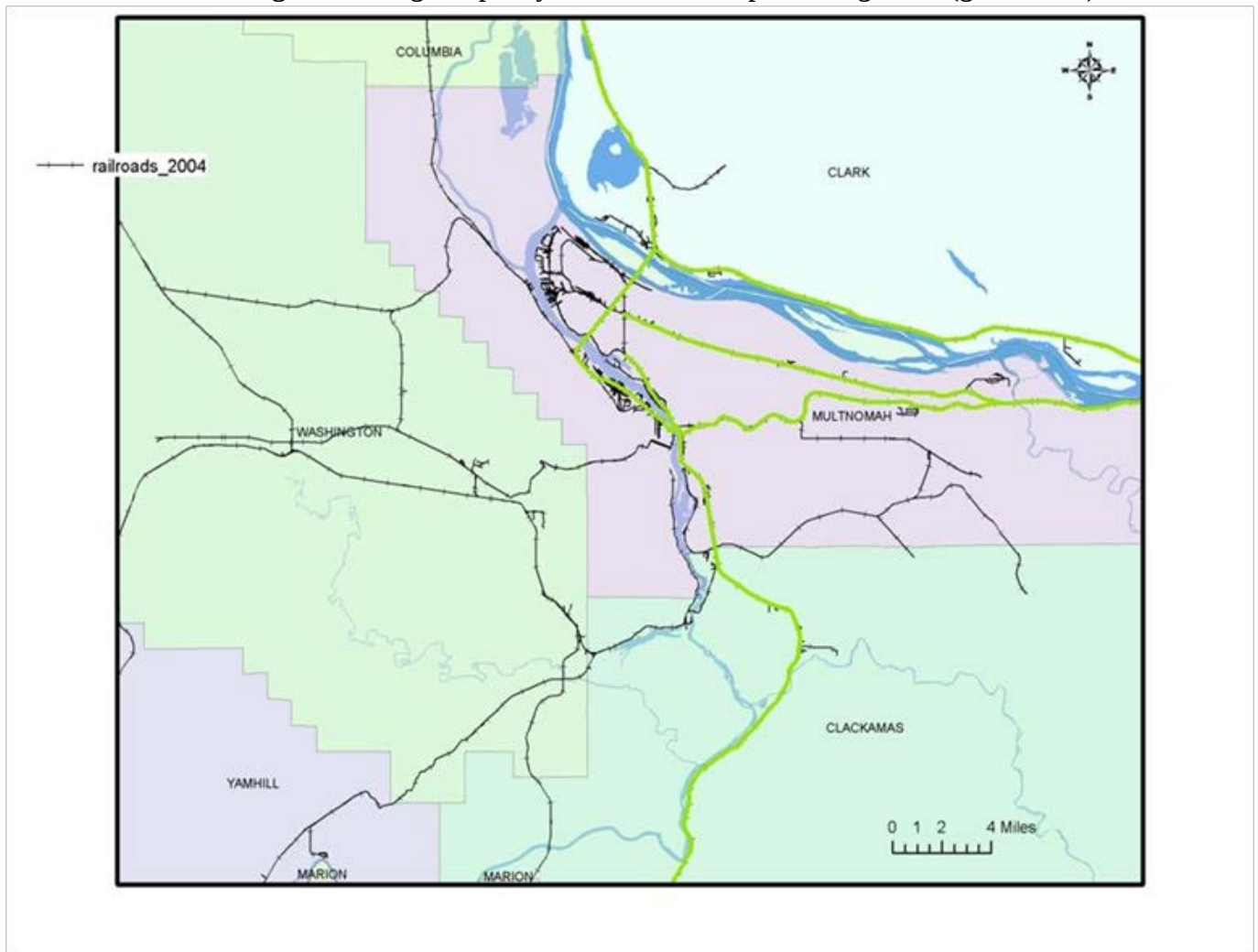


Figure 10: High Capacity Rail Links Grouped to Segments (green lines)

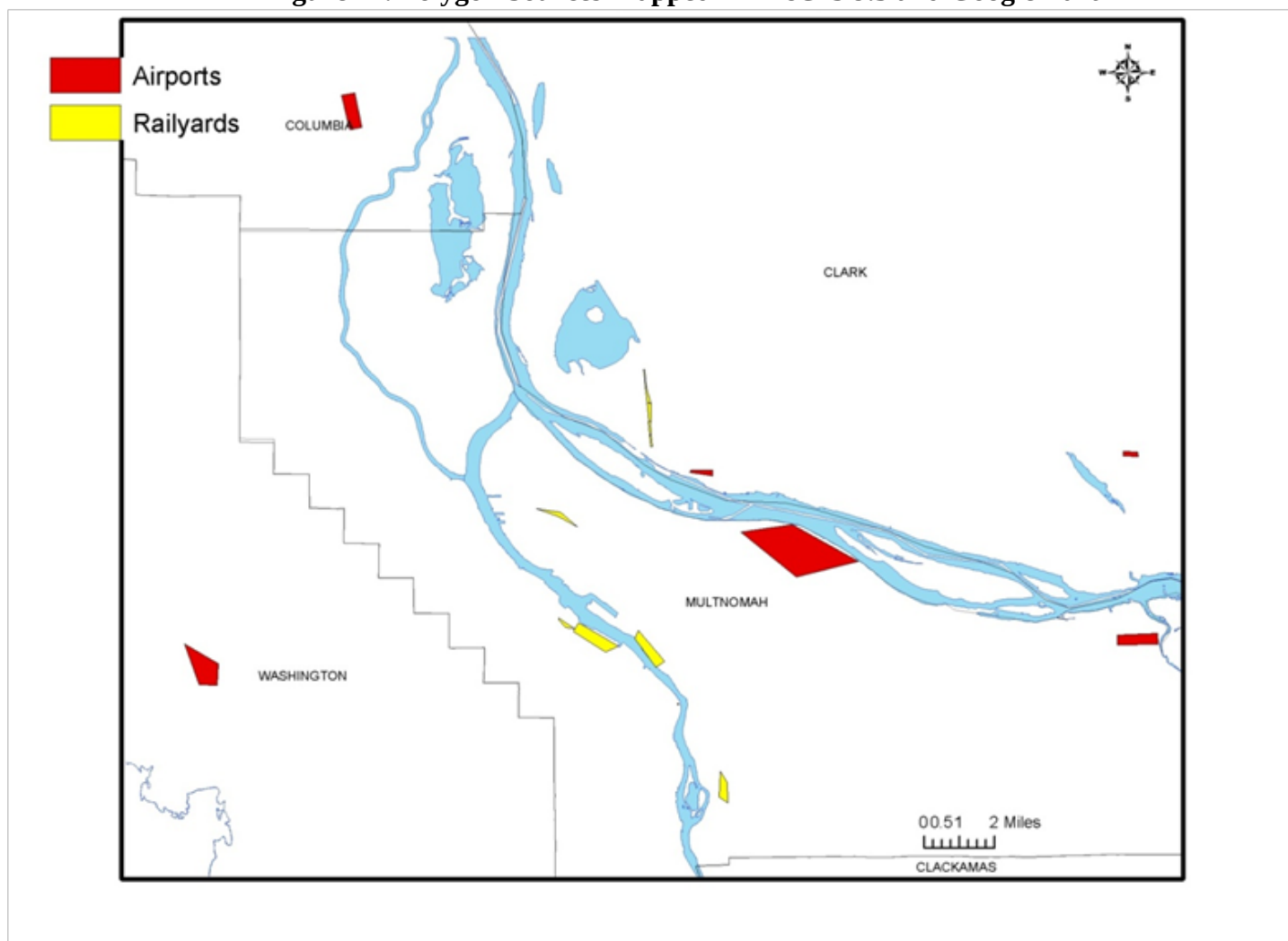


Emissions along high-volume link and rail segments were further refined for dispersion modeling by allocating the emissions data to points on each segment. The details of this refinement may be found in the modeling section of this report.

3.4.3.3 Polygon Emission Sources

Polygons are used to represent sources where there is not a single point source such as a stack, but where the emissions are located in a specific area. For these, latitude and longitude is known, and there are no intermediate steps between the emissions inventory and modeling. Figure 11 illustrates airports and rail yards mapped as polygons. Other emission sources mapped as polygons include commercial marine in-port (hotelling, maneuvering, and harbor craft), commercial marine in-transit, commercial marine barging, POTWs and landfills.

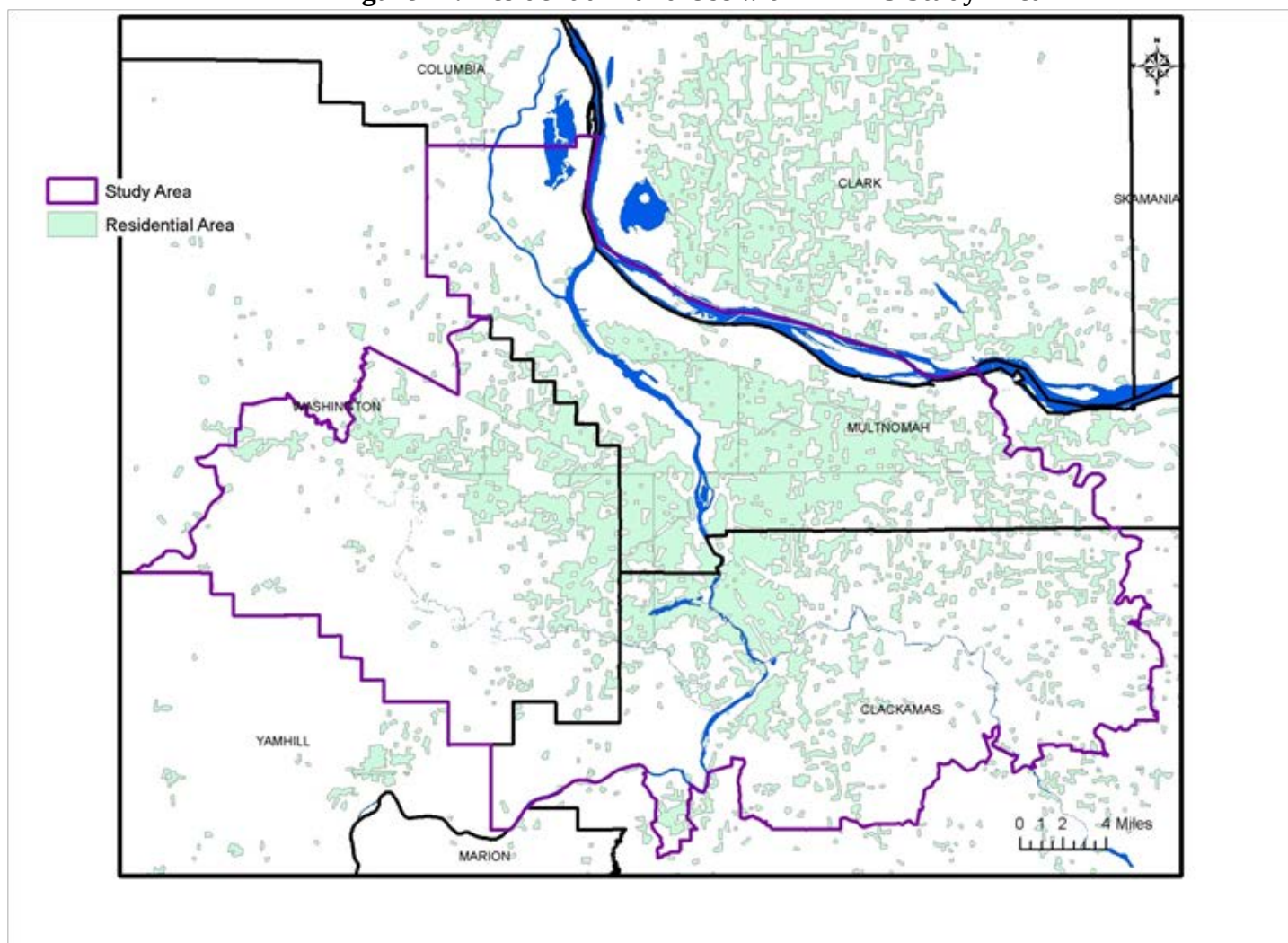
Figure 11: Polygon Sources Mapped in ArcGIS 9.3 and Google Earth



3.4.3.4 Area Emission Sources

Area emission sources are typically estimated on a per county basis in the emissions inventory. For example, residential heating fuel use comes from the Energy Information Administration at the state level and DEQ apportions emissions to each county based on the number of housing units within that county. However, emissions occur only in specific areas. As a result, DEQ needed to spatially allocate the countywide emissions to residentially zoned areas where the pollution most likely originates. Figure 12 illustrates residential areas within the PATS study area. Similar maps can be made for commercial, industrial, agricultural, and mixed land uses.

Figure 12: Residential Land Use within PATS Study Area



For area emission sources, DEQ distributed the emissions from a county level inventory to finely gridded emission values. Distributing county level emissions to a finely gridded scale for modeling consists of two steps:

- Grid development

- Emission allocation to the grid cells based on the land use data (activity)

A. Grid development

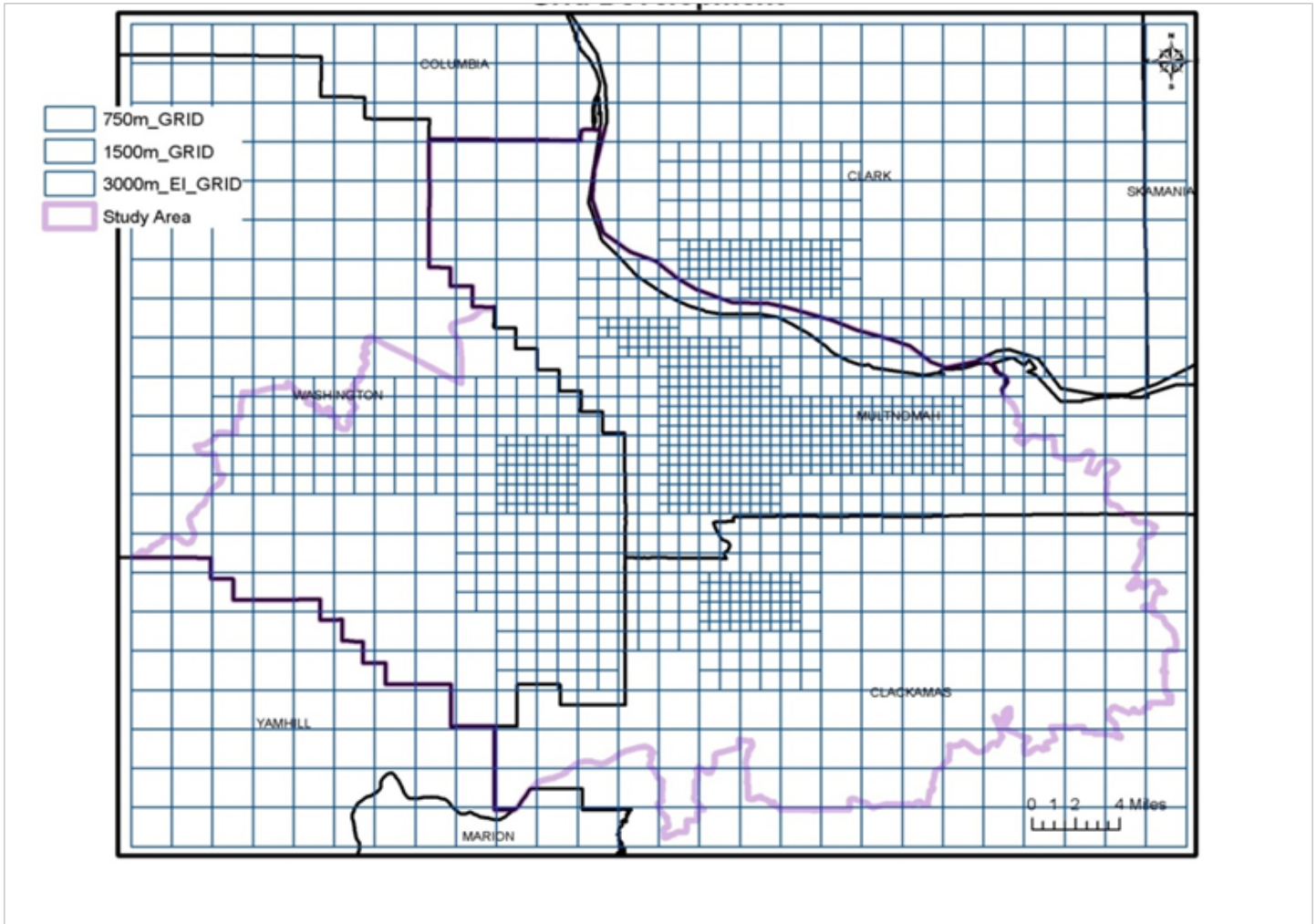
Two important but competing factors must be considered in grid development. Where there is higher population density, it would have been useful to have greater spatial resolution of pollutant concentrations. However, this requires smaller, and therefore more, grid cells. Having more grid cells meant that model run times would increase. That could not be done for the entire project area within the project timelines.

To address these conflicting objectives, DEQ created a fine grid over the densely populated areas and a more coarse grid in the more rural parts of the study area, for a total of 1446 grids. Figure 13 illustrates the three grid sizes developed:

- 750 meter grid cells placed over the highest population density areas;
- 1500 meter grid cells placed over less populated areas; and
- 3000 meter grid cells placed over the least populated areas.

The variable grid cell size offer the highest resolution in the high population density areas while preserving the model run time.

Figure 13: Grid Development



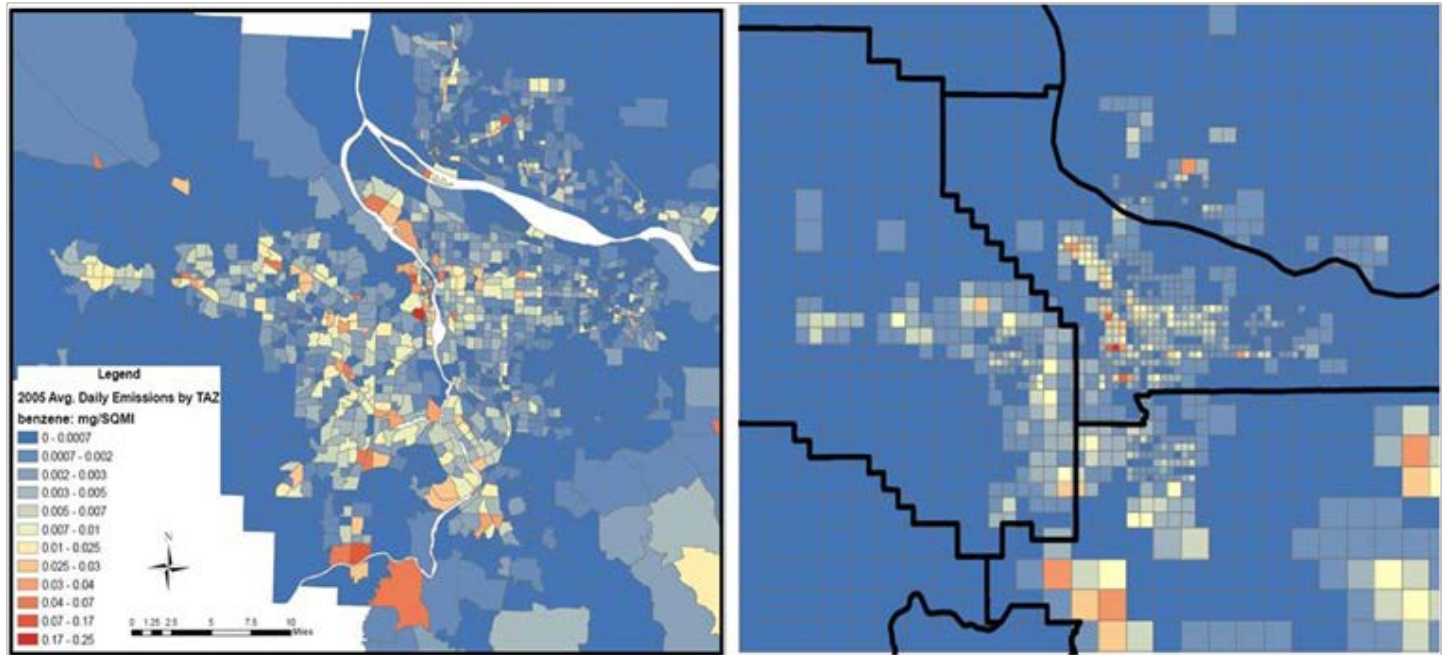
B. Emissions Allocation

County emissions data were allocated to land use, which were then allocated to a grid cell, using equations developed through ArcGIS, for input into the CALPUFF model. To allocate the emissions to grid cells, DEQ first developed an “allocation factor” for each grid cell by taking the area of specific land use (for example residential) within each grid cell and then dividing the grid cell land use area by the total area of that land use within the county. Next, DEQ estimated the emissions from each grid by multiplying the allocation factor by the county emissions. Figure 14 illustrates the residential areas within the modeling domain covered by the grid. Please note that the smallest grid cells are over the most populated areas, and the largest grid cells are over the least populated areas.

The map displays the Willamette Valley region with a grid overlay. The legend identifies three main components: the Study Area (purple outline), Residential Area (light green shading), and the EI GRID (blue grid). The map is labeled with county names: Columbia, Clark, Skamania, Washington, Multnomah, Clackamas, Yamhill, and Marion. A scale bar in the bottom right corner indicates distances from 0 to 4 miles. A north arrow is located in the top right corner.

Page 14 of 25

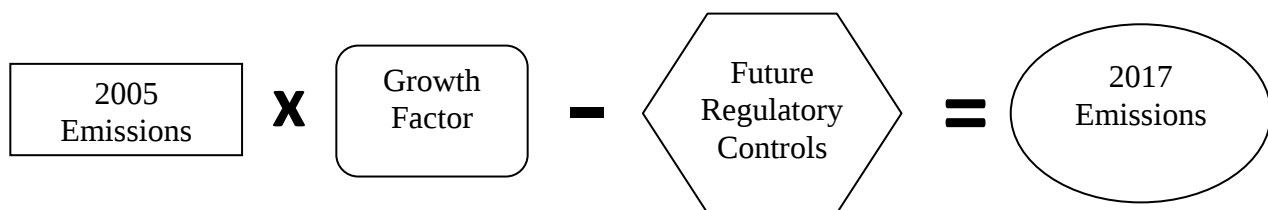
Figure 15: Transportation Analysis Zones Gridded Benzene Emissions Using GIS Analysis: A= Metro Data Normalized by Transportation Analysis Zone Area, B = Gridded Emissions Data Normalized by Grid Cell Area



3.4.4 Emissions Forecasting: Growth Factors and Future Regulatory Controls

In order to predict 2017 emissions, DEQ accounted for growth or decline in all emission source categories. Between the base year in 2005, and 2017, changes in population, jobs, and industry will increase some air toxic emissions and possibly decrease others. In addition, regulations that will be implemented prior to 2017 will reduce toxic emissions. Figure 16 illustrates that both growth and future regulatory controls are taken into account in the PATS process. To predict 2017 emissions, the 2005 emissions from each source category are multiplied by the source categories' growth factor³. Next, emission reductions expected from the implementation of future regulatory controls are subtracted, to give expected 2017 emissions.

Figure 16: Emissions Forecasting Process



To forecast 2017 emissions, DEQ used a variety of methods, depending on the inventory source category.

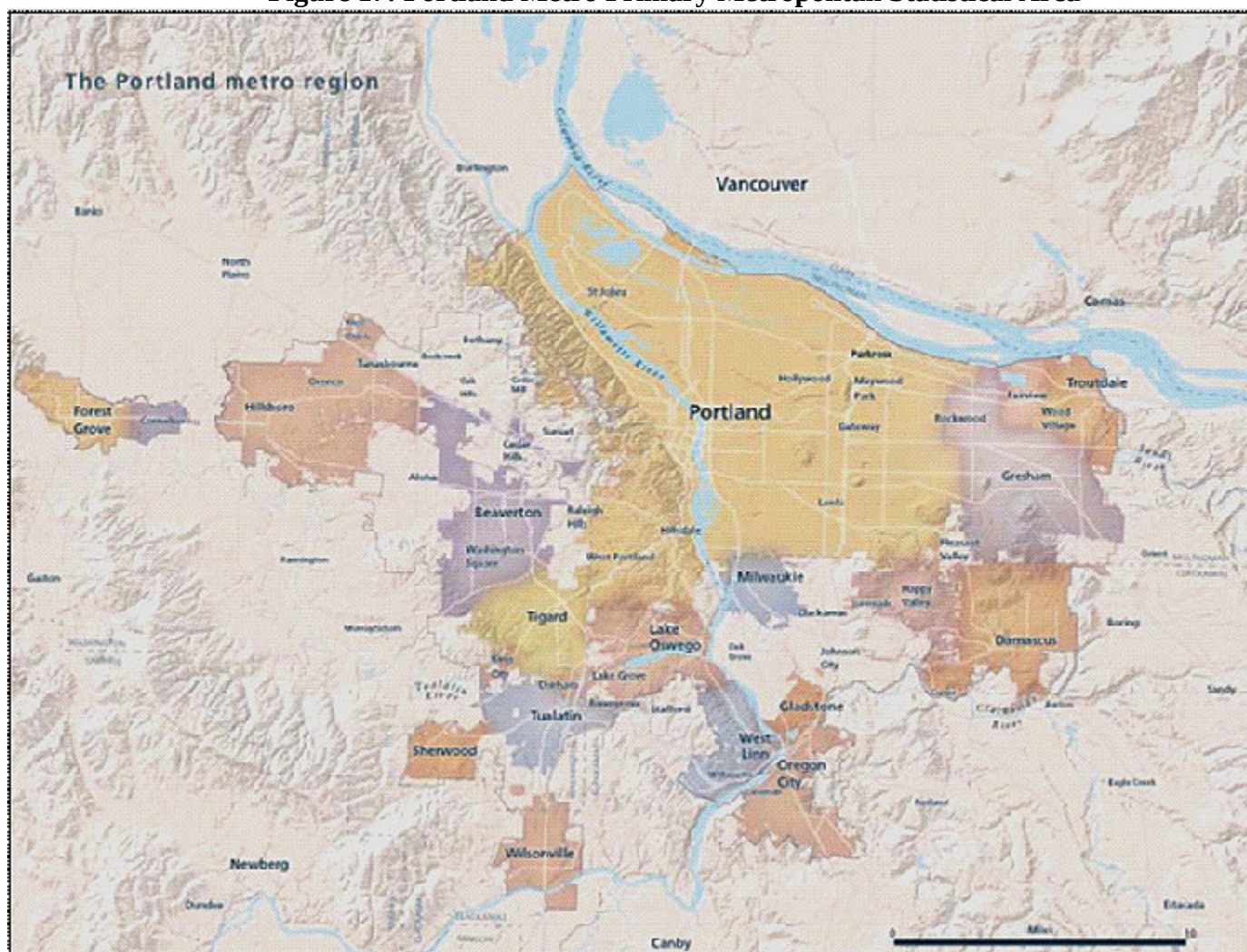
1. Metro forecasting. DEQ used growth factors developed by Metro, and applied the growth forecast to emission generating activities in the PATS area. Using Metro information ensures consistency with regional planning efforts. For PATS, the best information available is the Metro 2017 Regional Primary Metropolitan Statistical Area Forecast (for 7 Counties) - Unpublished - DEC. 2009. This forecast was adjusted for this project to account for the drastic impact the recession has had on the local economy. The Metro forecast covers cities and counties in the Portland-Vancouver metropolitan region (see Figure 17). The Metro forecast estimates the amount of growth that will occur between the base year of 2005 and 2017 within the

³ A growth factor is a measure of how much a source category will grow or decline, based on a forecast.

Portland Metropolitan Statistical Area. Metro’s forecast draws on several models, two that were directly important to forecasting growth from emission source categories in PATS were the Regional Economic Model and the Transportation Forecast.

2. EPA NONROAD2008. DEQ uses the EPA NONROAD2008a emissions model for forecasting emissions from nonroad equipment and vehicles. This model, developed by EPA, is more comprehensive than Metro growth factors for the nonroad source categories, in part because it accounts for engine age distribution and expected changes in fuel parameters. The model includes more than 80 basic and 260 specific types of nonroad equipment and vehicles, and further separates sources by horsepower rating and fuel types including gasoline, diesel, compressed natural gas (CNG), and liquefied petroleum gas (LPG). In estimating future year projections, the model includes growth and scrappage rates for equipment. NONROAD2008a does not include aircraft, marine or locomotives.

Figure 17: Portland Metro Primary Metropolitan Statistical Area



The following sections describe which forecast was used for which PATS emission source categories, as well as how future regulatory controls in those source categories are accounted for.

3.4.4.1 Metro Forecast: Permitted point sources; Area sources such as Residential Heating, Aircraft, Locomotives, Commercial Marine

DEQ used the Metro forecast to account for growth from the following source categories:

- Permitted point sources
- Residential Stationary Source Fuel Combustion
- Residential Wood Combustion
- Architectural Surface Coating
- Paint Stripping
- Non-Industrial Consumer & Commercial
- Portable Gas Can Evaporation, Permeation, Spillage
- Residential Open Burning
- Waste Disposal, Treatment & Recovery (Landfills & POTWs)
- Structure Fires
- Cremation (natural gas use)
- Commercial Cooking
- Industrial Stationary Source Fuel Combustion
- Miscellaneous Industrial Processes
- Surface Coating (excluding Architectural)
- Asphalt Production
- Aircraft
- Airport Ground Support Equipment
- Commercial Marine Vessels
- Locomotives
- Barging
- Truck Transport of Auto Gas

Figure 18 gives an example of the growth factor data for permitted point source growth for the following primary metals industries, as classified by their primary North American Industry Classification System (NAICS) code:

- Blast Furnaces & Steel Mills
- Grey & Ductile Iron Foundries
- Steel & Steel Investment Foundries
- Nonferrous Foundries

In Figure 18, percent change is the vertical axis, and time is along the horizontal axis. The two lines show Year-To-Year vs. compounded growth: For each type of growth, there is negative trend due to the recession followed by a positive change. Since the compounding factor takes into account the previous year's growth, it lags behind the year-to-year. The result is 4% compounded growth overall from 2005 to 2017. Thus, the final growth factor used to project emissions for primary metals industries from 2005 to 2017 is 1.04.

Figure 18: Metro Growth Factor Data: Primary Metals

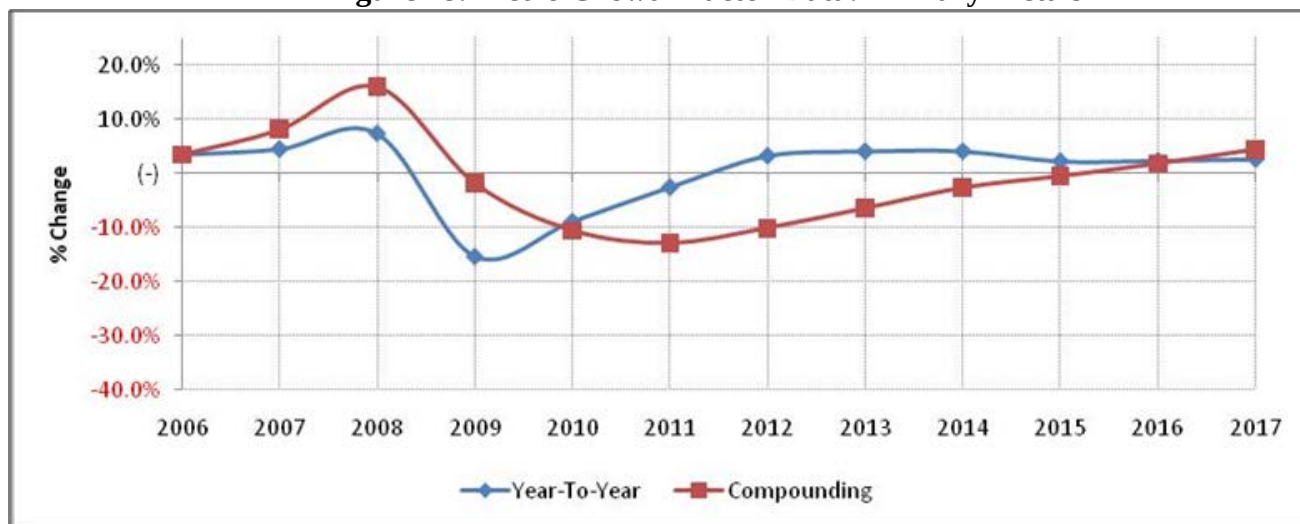
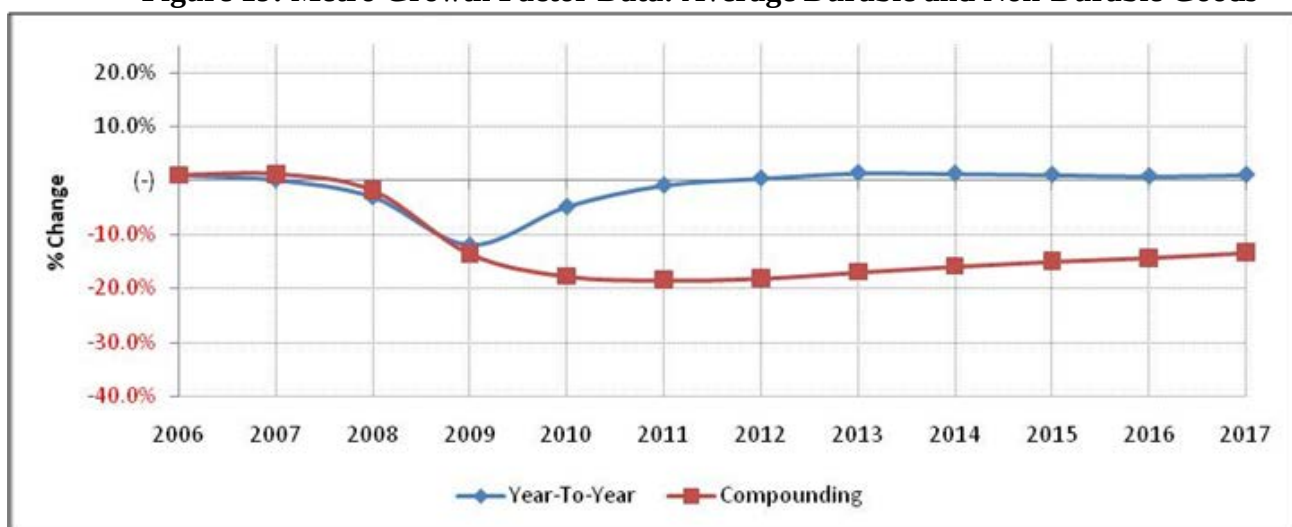


Figure 19 gives an example of the growth factor data for area sources for the following non-permitted area source emission categories:

- Industrial Stationary Source Fuel Combustion
- Miscellaneous Industrial Processes
- Surface Coating (excluding Architectural)
- Asphalt Production

DEQ has used the average of durable and non-durable goods here to represent specific commercial and industrial activities too small to be on permits. As you can see from the graph, reduction in activity during the 2008 recession is followed by near zero growth, resulting in an overall compounding reduction of 13%, and a final compounding applied growth factor of 0.87.

Figure 19: Metro Growth Factor Data: Average Durable and Non-Durable Goods



For details on all growth factors used to project 2017 emissions, please see [Appendix 12.3.5](#).

DEQ accounted for emission reductions for future regulatory controls such as Oregon's Heat Smart rules and gasoline vapor recovery, and federal rules such as upcoming NESHAPs and Residual Risk and Technology:

- Oregon Heat Smart. As a regulatory change to the emissions inventory, DEQ's new Heat Smart program requires the removal of inefficient, uncertified stoves upon home sale, along with other requirements related to solid fuel burning devices. Heat Smart is expected to reduce emissions of pollutants of concern by between 4% and 12%, depending upon pollutant. (The reductions are based on DEQ staff expertise and knowledge in expected removal and replacement rates for uncertified devices in the region.) For more information, see [Appendix 12.3.7](#).
- National Emission Standards for Hazardous Air Pollutants (NESHAP). A NESHAP is a federally mandated pollution control or standard that applies to certain industries or industrial processes. Several new NESHAP standards have been enacted since 2005 and need to be considered in our new model. Most significantly, EPA has created NESHAPs that apply to area, that is, smaller industrial sources. Several area source NESHAPs (such as ones for gas stations, dry cleaners, and autobody facilities) will reduce emissions for the 2017 emissions inventory, but were not in effect for the 2005 emissions inventory. The 2017 emissions inventory will also be reduced by new NESHAPs that will require emission reductions for industries such as polyurethane foam production (methylene chloride reduction), solvent utilization (nine metal fabrication facilities), and paint stripping and surface coating operations.
 - For solvents in particular, all reductions are the result several measures to reduce both metal and volatile organic compound⁴ (VOC) emissions (metals – chromium VI, hazardous air pollutants, lead). In particular, the reduction of HAP-containing solvents and coatings use, increased use of filtered spray booths, and increased training are all measures that will contribute to these reductions.
 - Another NESHAP regulating halogenated solvent use caused sources to discontinue using trichloroethylene and perchloroethylene. For 2005, the PATS model estimated concentrations of these solvents above benchmarks at several industrial facilities using them for degreasing. In contrast, there were no areas with concentrations above the benchmarks for perchloroethylene and trichloroethylene in 2017 model projections, because facilities discontinued their use.
 - Since many industries in the Portland area have reduced their VOCs to comply with ozone regulations, DEQ found them to already be in compliance with some of the upcoming federal regulations to reduce air toxics.
- Commercial Marine. The International Maritime Organization has amended regulations in the North American Emission Control Area to require the use of cleaner fuels in ocean going vessels and some harbor craft vessels that will achieve reductions in particulate matter beginning in 2015. This reduction in particulate matter will also yield reductions in 15-PAH and metals.
- Rail. EPA has revised its emissions factors to reflect the turnover of older locomotives for newer more efficient ones. The new emission factors account for cleaner locomotive engines as they are phased in over the years. The EPA's Clean Air Nonroad Diesel Rule establishes standards for both hydrocarbons and PM, as well as CO and NOx. Essentially, these engine requirements result in reduced levels of all PATS pollutants attributed to rail.

⁴ "Volatile organic compound (VOC)" means any compound of carbon, excluding carbon monoxide, carbon dioxide, carbonic acid, metallic carbides or carbonates, and ammonium carbonate, which participates in atmospheric photochemical reactions.

3.4.4.2 EPA NONROAD2008a: Nonroad Mobile Sources

As described above, DEQ uses EPA NONROAD2008a to model emissions growth in nonroad vehicles and equipment. This includes the following:

- Lawn and Garden
- Construction Equipment
- Agricultural Equipment
- Industrial Equipment
- Recreational Equipment
- Personal Watercraft

The nonroad model accounts for changes in equipment population over time. Data output is in emissions in tons per year, by source classification code (SCC), and by county. DEQ staff ran NONROAD2008a for all counties falling within the PATS emissions inventory grid. Fuel parameters specific to 2017, such as sulfur content, were accounted for in the model input. Additionally, in estimating future year projections, the model includes a variety of regulatory control options. NONROAD2008a accounts for the emission reductions associated with two rules finalized in 2008:

- Diesel recreational marine standards in the Locomotive/Marine final rule (May 6, 2008); and
- Small spark ignition lawn and garden and Recreational Marine engines (October 8, 2008).

NONROAD2008a also contains the effects for the nonroad diesel engine rule (construction); beginning with new engines in 2008 and fully phased in by 2015.

- Small engine standards. Small engine standards for spark ignition engines have been coming out from EPA. They will impact several area sources and are represented in the 2017 emissions inventory, and vary depending on the kind of engine or vehicle. The rules will create new standards for emissions of hydrocarbons, NO_x, and CO for a variety of nonroad engines, equipment, and vessels that cause or contribute to air pollution.

3.4.4.3 Metro Forecast: On-Road Mobile Sources

Traffic related emissions are one of the largest contributors to the air toxics pollution in the PATS study area. The on-road mobile sources methodology combines the growth forecasts with known controls. Metro's Travel Demand Model provided forecasted vehicle miles traveled which Metro combined with EPA's MOBILE6.2 2017 emission factors to give 2017 air toxics emissions for every road link.

Forecasted growth is based on Portland's increased population, changing transportation modes, and location of jobs relative to housing. Future emission factors in MOBILE 6.2 include exhaust and evaporative emissions that are representative of the Federal Tier II emissions standards on new vehicles, the nationwide phase-in schedule, and Portland's current vehicle registration age. DEQ accounted for EPA's Mobile Source Air Toxics regulation by assuming 0.69 volume percent fuel benzene content. The outputs are pollutant emissions by link and transportation analysis zone.

While it is technically possible to model California's and Oregon's Low Emission Vehicle II standards with MOBILE6.2, this was not done due to the complexity of making such adjustments in comparison to the overall PATS work plan timelines and appropriate blueprint level of analysis. DEQ therefore performed an "off model" adjustment of 3% for VOCs (including PAHs) and 6% for Benzene, 1,3 –Butadiene, Acrolein, Acetaldehyde, and Formaldehyde to account for Low Emission Vehicle II standards in 2017. In addition, MOBILE6 has recently been replaced by EPA's MOVES model; however, Metro modeled the 2017 on-road emissions well before the release of MOVES, so any improvements in the MOVES model are not incorporated in the PATS study.

3.4.5 Data Quality and Emissions Inventory Improvements

In order to assist PATSAC with its work in understanding the science of air toxics and making recommendations, DEQ developed a qualitative approach to describing the data used in the emissions inventory. Through the development of the emissions inventory and collaboration with PATSAC members, DEQ staff made improvements to analytical methods. Section 3.4.5.1 outlines developments in assessing and describing data quality, and section 3.4.5.2 gives an overview of some of the more significant improvements to the emissions inventory. Improvements in modeling based on PATSAC recommendations can be found in the modeling section of this report.

3.4.5.1 Data Quality

DEQ and PATSAC used the best available science on air toxics to identify problems and recommend solutions. In the course of doing any scientific analysis, there are varying degrees of data quality. In response to committee interest, DEQ has developed a qualitative approach to describing PATS data quality. DEQ and PATSAC benefitted from a systematic approach to considering data quality in evaluating air toxics problems and developing emission reduction recommendations.

DEQ developed a comprehensive data quality rating tool to inform emission reduction decisions. In rating the data, DEQ considered published EPA ratings of data quality, past DEQ data quality ratings, and the source of the data. For example, for industrial emissions, DEQ may have actual measurements from facilities in known locations. This is the highest quality of data but only available for limited source categories. For area-source emissions like wood burning, the highest quality data available are estimates based on data from surveys and land use, because it is not possible to monitor the chimneys of homes where people burn wood.

Data quality for a source category is one consideration in the larger picture of emission contributions and solutions. In order to rate the data quality, DEQ rated the quality of the emission factor, the activity data, and the spatial allocation of the emission.

Table 4 summarizes the emissions inventory rating information. It combines DEQ and EPA rating definitions. The first row of information shows the range of quality for emission factors. Many emission factors come directly from EPA, and for those, DEQ has adopted EPA data quality ratings. Where EPA has no ratings or emission factors are not from EPA, DEQ generated its own data quality ratings. The “Lowest” emission factor rating was assigned to data defined by a single source test or possibly a surrogate source test. Emission factor ratings for each pollutant from each subcategory were averaged to get rating by pollutant for each source category.

The second row shows the range of quality for activity data. The “Highest” rating is for permitted point source activity reported to DEQ by sources and checked and verified by DEQ staff. The “Higher” rating is activity based on survey results or similar information. The rating of “Medium” activity data was assigned to data compiled by EPA as part of their models and approved for criteria pollutant work. A rating of “Lower” for activity data was assigned when a survey was not available and DEQ used per capita emission factors from EPA documentation. Consumer and commercial product use is an example.

The third row of information shows the range of quality for spatial allocation of emissions. The highest quality data has exact latitudes and longitudes. Lower quality but still acceptable data would be based on associations with other factors like housing or land use patterns.

Table 4: Guide to Emissions Inventory Rating System

Emissions Inventory Element	A Highest	B Higher	C Medium	D Lower	E Lowest
Emission Factor	Direct source test; primarily permitted point source emissions estimates.	EPA data, but also contractor and survey data.	From EPA documents and/or models.	EPA grades for surrogate data used.	Source tests do not represent a random sample of the industry or source category.
Activity Data	Throughput reported directly to DEQ by permitted facilities or another regulatory authority.	Survey results.	Activity based on models (for example EPA's nonroad model).	Population or number of employees based activity.	Limited information (e.g. National average)
Spatial Allocation	Exact latitude and longitude for a point or line where emissions occur is known (e.g. industrial facilities, highways).	Exact latitude and longitude for a polygon where emissions occur is known (e.g. airports).	Emission location is known and assigned to the area of a grid cell where the emissions occur (e.g. low traffic volume roadways).	Emissions are allocated to a grid cell based on land use qualification (e.g. residential open burning).	Emissions are allocated to a grid cell based on land use qualifications but emission location is variable (e.g. construction).

DEQ created a cumulative 2005 emissions inventory confidence based on the three emissions inventory elements.

Table 5 provides an example of the data quality rating chart for benzene. DEQ has summarized an average confidence for the 2005 emissions inventory. Lower grades are weighted heavier in the cumulative rating to illustrate that if one of the emissions inventory components is more qualitative, then predictive confidence in the emissions is lower. The rating scheme is as follows: **A** = Highest (1), **B** = Higher (2), **C** = Medium (4), **D**=Lower (8), **E**=Lowest (16). It is important to understand that a grade of “**C**” means meeting expectations, not at all unacceptable, and sufficient for emissions inventory purposes. Higher grades of “**B**” and “**A**” show where data quality increases. It is rare to have much “**A**” data in an emissions inventory. Most of the data used in PATS is in the range of “**B**” through “**D**”, which is the best science available. For pollutants included in the PATS study, data quality is not a limiting factor in the PATS study. The exception to this is methylene chloride. A data quality chart for each pollutant can be found in the Emissions Inventory [Appendix 10.3.6](#).

Table 5: Summary Data Quality Chart for Benzene

Benzene Data Quality				
Emission Source Category	Emission Factors (2005)	Activity (2005)	Spatial Allocation (2005)	Cumulative 2005 Emissions Inventory Confidence
Permitted Point sources	A	A	A	A = Highest
Dry Cleaners	-	-	-	-
Gas Stations	C	B	A	B = Higher
Airports	B	B	B	B = Higher
Residential Wood Combustion	C	B	C	C = Medium
Construction	C	C	E	D = Lower
Lawn and Garden	C	C	E	D = Lower
Marine	Recreational	C	C	C = Medium
	Commercial	C	B	B = Higher
Rail	High volume	C	A	B = Higher
	Low volume	C	C	C = Medium
Road	High volume	C	C	B = Higher
	Low volume	C	C	C = Medium
Landfills	C	C	A	B = Higher
Publicly Owned Treatment Works (POTW)	C	C	A	B = Higher
Other Nonroad	C	C	E	D = Lower
Residential Open Burning	C	B	D	C = Medium
Solvents	C	C	D	C = Medium
Area sources (general)	C	C	E	D = Lower

3.4.5.2 Emissions Inventory Improvements

A modeling project such as this is an iterative process. Based on PATSAC input, four main changes were made to the 2005 emissions inventory, described below. Improvements to the model are discussed in [section 3.5](#). Ensuring that our projected 2017 emissions inventory is as complete and as comprehensive as possible is very important since this will be the foundation for all future recommendations with regards to achieving our goals. DEQ has spent considerable energy refining the projected 2017 emissions inventory to create a strong foundation for which to evaluate and recommend additional reduction measures. Updates to the 2005 and projected 2017 emissions inventory are described below. More detail on improvements to the emissions inventory can be found in [Appendix 10.3.7](#).

3.4.6.2.1 2005 Emissions Inventory Updates

- **Residential wood combustion emissions.** In order to calculate 2005 emissions for residential wood combustion, DEQ used survey data collected in 2001. Shortly before the August, 2009 PATSAC meeting, Portland State researchers, under contract with DEQ, completed an updated statewide residential wood combustion survey. The new survey results indicated that the emissions were overestimated for 2005 based on the survey results. More specifically, the new survey incorporated the following improvements over the old survey:

- a. Survey questions were more accurately ordered to separate respondents who owned wood burning devices but did not burn wood in those devices from respondents who burned wood in devices
- b. Emission factors used were those reviewed and updated by the EPA Residential Wood Combustion workgroup in 2008
- c. Emission factors specific to compressed firelogs were used
- d. More detailed descriptions of cord sizes were provided to interviewers to better inform respondents
- e. There were more completed survey interviews in the new survey
- f. Additional survey questions asked in the new survey but not the old survey included
 - i. Wood species and variety burned
 - ii. Amount of pellets burned in inserts
 - iii. Detailed questions to differentiate inserts from fireplaces

As a result, the 2005 residential wood combustion emissions inventory was recalculated based on the new survey results.

- Chrome plating emissions. The old emissions inventory method for emissions of hexavalent chromium - also called chromium VI - from chrome plating operations was based on estimations using emission factors, a process that had been carried forward from earlier inventories (1999). However, since 1999, DEQ evaluated actual source tests for every hard chrome electroplating facility in Oregon for a DEQ rulemaking. DEQ applied this source test data and the actual emissions were recalculated, which resulted in lower and more accurate emissions.
- Plastic parts coating. A review of the plastic parts coating emissions inventory methodology was triggered by the initial PATS modeling work. It was discovered that the risk from ethylbenzene in the PATS study area was being driven by 2005 emissions estimates for plastic parts coating. Emissions inventory methodology and EPA NESHAP documentation were subsequently reviewed, and it was found that emission factor calculations were incorrectly inflated through averaging of the NESHAP data. A change in factor calculation methodology resulted in emissions estimates being reduced by an order of magnitude.
- Additional industrial facilities from EPA's Toxic Release Inventory review. The original industrial facility inventory focused mainly on Title V sources and a handful of smaller sources that were in the original Portland Air Toxics Assessment and emit one of the 19 pollutants in the study. Concerns from PATSAC at the August 2009 PATSAC meeting led to an investigation by DEQ regarding the sources that were reported to the Toxic Release Inventory but were not included in the initial PATS inventory. Through a combination of staff discussions about sources that should be in the inventory and an investigation of which sources reported to the Toxics Release Inventory, DEQ found 25 additional sources that reported at least one of our 19 pollutants as a release to the air and has added them to the inventory. This brings the total number of major facilities to 103.

The improvements to the 2005 emissions inventory and modeling are further described in [Appendix 10.3.7](#).

3.4.6.2.2 2017 Emissions Inventory Updates

- Residential wood combustion emissions. DEQ refined residential wood combustion emissions modeling by using more specific US Census Bureau home heating data information about where the emissions themselves are located.
- On road and non road emissions. The EPA Mobile Sources Air Toxics (MSAT) rule has been incorporated into the projected on-road mobile, non road mobile, and gas station emissions inventories.

- Gasoline station updates

- a. The Federal Mobile Source Air Toxics final rule is a two-step approach to reducing the benzene content of gasoline, ultimately requiring refineries to import and produce gasoline with specific volume percent benzene content. This reduction will be very important to achieving the ambient benchmark concentration for benzene. These new rules were enacted at the federal level, with amendments to assure reductions in Oregon as a result of intense lobbying by Oregon's congressional delegation.
- b. The increased use of electric and hybrid vehicles will impact emissions for gasoline stations by impacting their throughput of gasoline. DEQ used projections from the Energy Information Administration over Metro growth factors for 2017, because their data takes into account the changing composition of cars that will be on the road in the future (for example, gas, hybrid and electric). The Energy Information Administration data is published by a federal agency and is also being used for the low carbon fuel work at DEQ.
- c. Because of incompatibility during fueling, some types of vapor recovery systems actually result in an increase in emissions. For some newer cars the gas tank vacuum vapor capture system interferes with vapor controls at the gas pump, rendering them both ineffective. Eventually, the stations' controls will be phased out as more cars have their own systems, at which point there will be an emissions reduction.
- d. Some 15-PAH emissions were included in the 2005 emissions inventory but are eliminated for the projected 2017 emissions inventory. DEQ discovered an error in the Emissions Inventory Improvement Project emission factor for PAHs at gas stations, which was identified by a SWCAA and confirmed by EPA staff. The reason for the removal of 15-PAH from gas station volatile emissions is because PAH is in effect particulate matter, usually associated with combustion, and not a volatile compound. This error resulted in 9.1 tons per year of 15- PAH removed from the gasoline station inventory.
- e. Metals will increase for the on-road mobile source category. Metal emissions are modeled as a function of vehicle miles travelled (VMT). They are products of engine wear, trace level fuel and engine oil contamination, catalyst attrition, etc. Because EPA uses fixed emission factors, the inventory increases with VMT. Advanced emission controls (e.g. traps) will likely reduce emissions, but that is not accounted for in MOBILE6.2. Although we see an increase in metals for the on-road mobile category, they represent a negligible amount of the total metals for the overall emissions inventory.

- Point Sources. The PATS technical team performed a thorough review of all applicable NESHAPs for point sources. All point sources were already in compliance with NESHAPs in 2005 so no further reductions will occur due to these NESHAPs by 2017. During the review, DEQ identified a few sources with emissions that were not included in the 2005 emissions inventory. Additionally, some sources had discontinued certain emissions as well. These adjustments have been included for the 2017 emissions inventory.