ENVIRON ALPINE GEOPHYSICS UNC INSTITUTE FOR THE ENVIRONMENT

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TECHNICAL MEMORANDUM No. 13: EMISSIONS MODELING PARAMETERS

To: Tom Moore, Western Governors' Association (WGA) (WRAP)

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Subject: Emissions Modeling Parameters, Ancillary Data and Summary Results for the WestJumpAQMS 2008 Photochemical Modeling

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INTRODUCTION

ENVIRON International Corporation (ENVIRON), Alpine Geophysics, LLC (Alpine) and the University of North Carolina (UNC) at Chapel Hill Institute for Environment are performing the West-wide Jump Start Air Quality Modeling Study (WestJumpAQMS) managed by the Western Governors' Association (WGA) Air Quality Program. WestJumpAQMS is setting up the CAMx photochemical grid model for the 2008 calendar year (plus spin up days for the end of December 2007) on a 36 km CONUS, 12 km WESTUS and several 4 km Inter-Mountain West domains. The WestJumpAQMS Team are currently compiling emissions to be used for the 2008 base case modeling, with the 2008 National Emissions Inventory (NEI) being a major data source, and are preparing 13 Technical Memorandums discussing the sources of the 2008 emissions by major source sector:

1. Point Sources including Electrical Generating Units (EGUs) and Non-EGUs;
2. Area plus Non-Road Mobile Sources;
3. On-Road Mobile Sources that will be based on MOVES;
4. Oil and Gas Sources (5 installments);
5. Fires Emissions including wildfire, prescribed burns and agricultural burning;
6. Fugitive Dust Sources;
7. Off-Shore Shipping Sources;
8. Ammonia Emissions;
9. Biogenic Emissions;
10. Eastern USA Emissions;
11. Mexico/Canada;

12. Sea Salt and Lightning Emissions; and

13. Emissions Modeling Parameters including spatial surrogates, temporal adjustment parameters and chemical (VOC and PM) speciation profiles.

This is Technical Memorandum #13. We discuss the approach to be used for developing the emissions modeling parameters that will be used to simulate air pollutant emissions for the WestJumpAQMS project. After a brief description of the different types of emissions modeling parameters, this memo includes detailed descriptions of the sources of the data that will be used for the WestJumpAQMS project.

We will summarize WestJumpAQMS 2008 emissions data after the emissions modeling is complete so that it is comparable on a source category and state/county basis to the WRAP Regional Modeling Center's "Base02b" 2002 emissions modeling results displayed on the WRAP Technical Support System's "Emissions Review Tool", found under "Emissions & Source Apportionment" at: http://vista.cira.colostate.edu/tss/Results/HazePlanning.aspx. These 2008 emissions modeling data will be uploaded to the Emissions Review Tool, and used in the WRAP Regional Haze Reasonable Progress Report (RHRPR) project currently underway for the WRAP region states to use in their 5-year progress reports on the Baseline Regional Haze Plans.

Emissions modeling parameters refer to the non-inventory data used to prepare emissions for input to an air quality model (AQM), including:

- ***Spatial data***. All anthropogenic non-point inventory data, including on-road and non-road mobile sources, are estimated at the county level. Data files called spatial surrogates are used to map the county-level emission inventories to the model grid cells. Spatial surrogates are generated from Geographic Information System (GIS) Shapefiles using software that calculates the fractions of county-level different geospatial attributes in a model grid cell. For example, a Shapefile of the housing distribution in Los Angeles County is combined with a description of a modeling grid to calculate the percentage of L.A. County housing assigned to each grid cell. This information is then used to allocate county-level emission inventory sources that are associated with housing (e.g. residential wood combustion) to the modeling grids.

  Spatial surrogates require cross-referencing data that assign a spatial surrogate to specific categories of inventory sources. Spatial cross-reference files assign surrogates to inventory sources using country/state/county codes (FIPS) and source classification codes (SCCs).

- ***Temporal data***. Air quality modeling systems, such as CMAQ and CAMx, require hourly emissions input data. With the exception of a few source types (e.g. Continuous Emissions Monitoring data, biogenic emissions and some fire inventories), most inventory data include annual or daily emission estimates. Temporal profiles are used to compute hourly emissions from the annual or daily inventory estimates. The SMOKE model, which is being used to process emissions for the WestJumpAQMS study, uses three types of temporal profiles:

  1. Monthly profiles: Convert annual inventory to monthly emissions accounting for seasonal and other effects.

2. Daily profiles: Convert monthly emissions to daily emissions accounting for day-of-week and other effects.

3. Hourly profiles: Convert daily emissions to hourly emissions accounting for the diurnal variation in emissions (e.g., work schedules and commute times).

Temporal profiles are assigned to inventory sources using cross-referencing data that match the profiles and inventory sources using country/state/county (FIPS) and source classification codes (SCCs).

- ***Chemical speciation data.*** Emissions inventories have limited chemical composition information. The emissions inventories for WestJumpAQMS include 6 criteria pollutants: carbon monoxide (CO), nitrogen oxides (NO_X), volatile organic compounds (VOC), ammonia (NH_3), sulfur dioxide (SO_2), particulate matter with a mean diameter < 10 µg/m^3 (PM_{10}), and particulate matter with a mean diameter < 2.5 µg/m^3 ($PM_{2.5}$). Chemical speciation profiles are used to describe the chemical compositions of the effluent from particular emissions sources. The exact specification of the source-specific emissions species is determined by the chemistry mechanism selected for the AQM simulation. Speciation profiles convert the inventory pollutants to more detailed source-specific species in terms required by the AQM chemistry mechanism. For example, there is a speciation profile that converts the inventory pollutant NO_X to the AQM input species NO, NO_2, and HONO. Speciation profiles are required to convert inventory NO_X, VOC, SO_2, and $PM_{2.5}$ into AQM species. For the WestJumpAQMS SMOKE emissions modeling the CB6 chemical mechanism will be utilized and VOC will be speciated using source specific speciation profiles developed using the SPECIATE 4.3 database[1]. Note that because the CB6 has more explicit VOC species than CB05 it can be easily converted to CB05, however not vice versa.

  Chemical speciation profiles are assigned to inventory sources using cross-referencing data that match the profiles and inventory sources using country/state/county (FIPS) and source classification codes (SCCs).

EMISSIONS MODELING PARAMETERS AND QUALITY ASSURANCE

There are three types of emissions modeling parameters required for converting emissions inventories into AQM inputs. Details of the sources of these parameters used for WestJumpAQMS are provided below.

Spatial Surrogates and Cross-Reference Data

Spatial Surrogate Data

Team member UNC has recently developed new spatial surrogates for the U.S. EPA Office of Air Quality Planning and Standards (OAQPS). These new surrogates are replacing the spatial data used by OAQPS for modeling studies completed over the past 10 years. As they represented the best available geospatial information for the U.S., the OAQPS data were also used to support regulatory and research air quality modeling studies conducted by other modeling groups during the same period,

1 http://www.epa.gov/ttnchie1/software/speciate/

including all modeling conducted by the WRAP RMC. The data collected and processed by UNC for OAQPS will be used to create spatial surrogates for WestJumpAQMS.

This section describes the processing, collection, and development of geospatial data for calculating spatial surrogates. All of the surrogates described here were generated with the Surrogate Tool of the Spatial Allocator (SA)[2]. The SA is open-source Java software that manipulates and generates data files related to emissions, air quality, and meteorology modeling. The tools perform functions similar to a GIS and are targeted specifically toward processing data for atmospheric modeling. The Surrogate Tool is a component of the SA that uses the PROJ.4 library[3] to compute spatial surrogates on different map projections for use in emissions processing.

The Spatial Allocator was used for the WestJumpAQMS project to compute spatial surrogates for the U.S., Canada, and Mexico on a North American modeling domain at three grid resolutions: 36, 12, and 4 km. The grid definitions of the Lambert Conformal Conic modeling domains covered by the spatial surrogates are shown in Table 1. Spatial surrogates for the 12 km and 4 km grids will be generated on the continental U.S. (CONUS) domain to support flexibility in the placement of nested modeling domains for the WestJumpAQMS project. Figure 1 is a graphic of the candidate modeling domains for the WestJumpAQMS project.

Table 1. WestJumpAQMS study spatial surrogate and modeling grid definitions

Projection	Lat Centroid	Lon Centroid	Std. Parallel 1	Std. Parallel 2	Central Meridian
Lambert Conformal Conic	40N	97W	33N	45N	97W
Grid	**dx x dy (km)**	**Columns**	**Rows**	**Lat Origin Offset (km)**	**Lon Origin Offset (km)**
CONUS36	36x36	148	112	-2,736	-2,088
CONUS12	12x12	444	336	-2,736	-2,088
CONUS4	4x4	1332	1008	-2,736	-2,088
WestJump36	36x36	148	112	-2,736	-2,088
WestJump12	12x12	227	230	-2,388	-1,236
WestJump4	4x4	317	515	-1,480	-904

[2] Available from http://www.cmascenter.org
[3] http://trac.osgeo.org/proj/

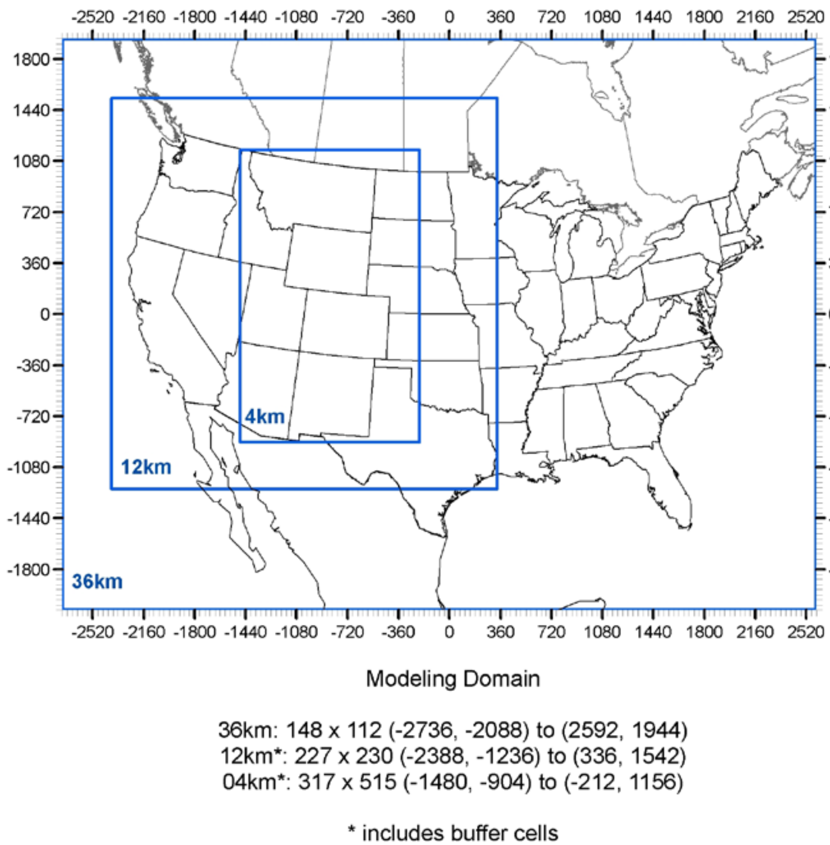

Figure 1. 36 km CONUS, 12 km WESTUS and 4 km Inter-Mountain West processing modeling domains for the WestJumpAQMS project.

UNC updated most of the OAQPS U.S. Shapefile database with the latest available geospatial datasets. The timing of the Shapefile database update was due in part to the recent release of a few key datasets. The 2010 U.S. Census population and housing data, American Community Survey home heating data, year 2010 roadway data from TIGER, rail/port data from the National Transportation Atlas, and Federal Emergency Management Agency (FEMA) HAZUS-MH v2 building square footage data all became available in 2011 and 2012. Analysis of the 2005 U.S. National Emission Inventory showed that the spatial surrogates derived from these datasets were used to allocate the following proportion of the nonpoint inventory to modeling grids[4]:

- CO: 61%
- NO_X: 94%
- VOC: 88%
- NH_3: 69%
- SO_2: 98%
- $PM_{2.5}$: 61%

The roadway surrogates derived from the TIGER data are used to allocate 100% of the on-road mobile emissions to the modeling grid.

4 Adelman, Z. and L. Ran, 2010: Proposal: Updating U.S. Non-mobile Spatial Surrogates, prepared for M. Houyoux, U.S. EPA OAQPS under contract No. EP-D-07-102, Assignment 3-07, September 2010.

In addition to using the new Shapefiles to update existing spatial surrogates, three entirely new surrogates were created to support the processing of new off-network mobile source emissions generated by EPA's MOtor Vehicle Emissions Simulator (MOVES) on-road mobile source emissions model. Of the 77 U.S. spatial surrogates developed from the OAQPS Shapefile database, 66 of them were updated with data that became available in 2011 and 2012. The remaining 11 surrogates were generated using Shapefiles in the existing OAQPS database. Details of the Shapefiles used to create the surrogates, including the sources of the data, are included in at the end of this memo in Table 3. Descriptions of the Shapefiles are included below. Table 4, also at the end of this memo, includes the specifications for all spatial surrogates used for WestJumpAQMS.

Population and Housing: The 2010 TIGER/Line database contains U.S. Census population and housing unit counts at the Census block level for each state. UNC downloaded the entire database, merged the state-level data into a national Shapefile, and projected the data to a U.S. national Lambert Conformal Conic projection. Urban and rural areas were calculated using Census block groups. Urban was defined as Census block groups that have a population density of at least 1,000 people per square mile and everything else was defined as rural.

Roadways: State-level 2010 TIGER/Line Shapefile data were merged to create a national file with urban and rural roadways. The TIGER/Line MTFCC codes S1100 and S1200 were used to define primary and secondary roads, respectively. Urban and rural roadway classifications were calculated using Census block group population densities (see Section 2.1) overlaid onto TIGER roads.

Rail and Waterways: State-level 2010 TIGER/Line Shapefile data were merged to create a national railway network file. The TIGER/Line MTFCC codes R1052, R1051, and R1011 were used to define the different classes of rail lines. The National Transportation Atlas Database (NTAD) 2011 was used to get waterway length information.

Highway Exits, Major Roads, and Transportation Terminals: Data from the ESRI Data and Maps 2010 database were used to create surrogates for the MOVES off-network (rate-per-profile and rate-per-vehicle) emissions sectors. The Off-Network HD/MD surrogate was designed for MOVES rate per profile (RPP) and rate per vehicle (RPV) medium and heavy-duty vehicle sources. It is computed from a combination of industrial building square footage data and highway exit ramps. The rationale behind this surrogate is that idling and starting/stopping medium and heavy-duty vehicles occur mainly while loading freight in industrial areas and at rest areas and along highway exits ramps. As a national Shapefile of highway rest areas is not available, highway exit ramps were used to represent the locations of idling tractor-trailers. The Off-Network LD surrogate is designed for MOVES RPP and RPV light-duty vehicles, including motorcycles. It is computed from a combination of commercial building square footage data, residential building square footage data, and local roads. The rationale behind this surrogate is that idling and starting/stopping light duty vehicles and motorcycles occur mostly in driveways/residential parking areas, parking lots of shopping centers, and along non-residential roadways with street parking. The Off-Network Buses surrogate is designed for MOVES RPP and RPV buses. It is computed from a combination of bus terminal locations and local roads, with the concept behind this surrogate being that bus terminals and local roads represent the majority of locations that buses are loading/unloading passengers.

FEMA Building Footprints: The Federal Emergency Management Agency HAZUS-MH version 2 was released in September 2011 and contains square footage data for different types of buildings throughout the U.S. The building square footage data are used to identify building classifications (i.e. commercial, residential, industrial, and institutional) for allocating non-point inventory sources to modeling grids. Census-block level data by state were merged into a national Shapefile for the database attributes required for generated spatial surrogates.

Home Heating: The American Community Survey (ACS) is U.S. Census project that collects yearly demographic and housing information from randomly selected households throughout the U.S. The data are aggregated in 5 and 10-year increments to provide Census tract estimates for the statistics collected during the survey. Home heating fuel type is used to develop spatial surrogates for home heating sources (i.e. residential wood combustion) in the nonpoint inventory. The ACS 5-year 2010 survey results that were released in 2011 represent data collected from 2006-2010. These data were used to create home heating surrogates.

As a review of the 5-year ACS data for 2010 showed that the number of housing units per Census tract in the ACS are always lower than the number of housing units reported in the 2010 Census. This trend indicates that the ACS only estimates demographic and housing statistics for a random sampling of households in each Census tract and does not represent the entire distribution of households. In order to represent the spatial distribution of home heating sources accurately, the ACS was used to calculate a distribution of heating sources for each Census tract and then these distributions where applied to the 2010 Census Housing Unit Shapefile to construct a home heating Shapefile that is consistent with the number of census tract housing units in the 2010 Census database. For example, if the ACS reports that in Census tract X 75% of the households use coal for heating and 25% of the households use heating fuel, the 2010 U.S. Census estimate of the total number of households in tract X were multiplied by 0.75 and 0.25 to estimate the distribution of coal and heating fuel use, respectively, for tract X.

Oil and Gas Development: EPA's new spatial surrogates for oil and gas development project inventories in the states of Colorado, Wyoming, and Utah include accompanying GIS Shapefiles with the locations of well pads and drill rigs by project, BLM field office, or development basin. These Shapefiles would typically be used to create spatial surrogates to allocate the non-point inventories for the associated development project to the modeling grids. However, for these four states we are using 2008 oil and gas emissions projected from the WRAP Phase III oil and gas emissions development study that have their own spatial surrogates that will be used in the SMOKE emissions modeling.

Spatial Cross-Referencing Data

Spatial cross-reference tables relate inventory sources to spatial surrogates. Each surrogate has a numeric code that can be associated to inventory sources using location and source identifiers in the inventory. Country/state/county (FIPS) and source classification codes (SCC) are used to identify locations and source types, respectively in the non-point and mobile inventories. SMOKE support hierarchical cross-referencing of the spatial surrogates to inventory sources. The most specific cross-referencing takes precedence over less-specific matches. The example spatial cross-reference table below shows a case where two surrogates are assigned to FIPS 01005:

Surrogate ID	SCC	FIPS
1	2210010000	01005
2	-	01005

In this example, sources with SCC 2210010000 in FIPS 01005 would be allocated to the modeling grid with surrogate 1 and all other sources in FIPS 01005 would be allocated using surrogate 2 (because the SCC field is blank).

The spatial cross-referencing table used for WestJumpAQMS will originate from the data distributed with the U.S. EPA NEI2008v2 (filename: amgref_us_can_mex_revised_28nov2011_v17.txt). A key assumption in using the EPA data is that there will be consistency in the encoding of inventory sources with SCCs between WestJumpAQMS and NEI 2008. This is a good assumption because (1) many of the inventory components for WestJumpAQMS are being taken directly from the NEI and (2) the SCC coding convention is standardized in the U.S. The spatial cross-referencing files used by the EPA have been in use for over a decade and through this period have undergone many rounds of quality control.

One task of the WestJumpAQMS will be to verify the spatial surrogate assignments for the largest sources in each inventory category. We will generate reports by state, SCC, and surrogate code and use these reports to verify the surrogate assignments for the top 95% of the sources in each state by inventory pollutant mass. The surrogate code and the SCC descriptions will be used to determine the validity of the surrogate assignments to inventory sources. Discrepancies in these assignments will be corrected by changing the spatial cross-reference entry for the state and SCC in question.

Temporal Profiles and Cross-Reference Data

Temporal Profiles

Temporal profiles are available from the U.S. EPA for a wide range of emissions sources. While the majority of the temporal profiles available from the EPA represent nationally averaged emissions sources, state-specific monthly profiles exist for prescribed fires, wildfires, livestock, and some mobile sources. For most sources we will base the WestJumpAQMS emissions modeling on the U.S. EPA temporal profiles distributed with the NEI2008v2 (filename: amptpro_2008aa_us_can_revised_06oct2011_v0.txt). The WestJumpAQMS modeling process we will evaluate the quality and appropriateness of the EPA temporal profiles. While it is unlikely that new profiles will be added, there is a possibility of changing the assignments of existing profiles to inventory sources through updates to the temporal cross-reference file. For episodic emissions, such as biogenics, prescribed burns and wildfires, we will use day-specific emissions.

Temporal Cross-referencing Data

Temporal cross-reference tables relate inventory sources to temporal profiles. A temporal cross-reference entry includes six elements:

- 10-digit or 7-digit SCC
- Monthly temporal profile code
- Weekly temporal profile code
- Daily temporal profile code
- Pollutant name
- FIPS (country/state/county) code

At a minimum, entries in the temporal cross-reference files must include an SCC and three profile codes that exist in the temporal profile file. Including a pollutant and/or FIPS code in the cross-reference file entries supports more specific assignments of temporal profiles to inventory sources.

The temporal cross-reference table used for the WestJumpAQMS will originate from the data distributed with the U.S. EPA NEI2008v2 (filename: amptref_v3_3_revised_03nov2011_v14.txt). The same assumption about consistency noted for the spatial cross-referencing table also applies to the temporal cross-reference file. One task of the WestJumpAQMS will be to verify the temporal profiles assignments for the largest sources in each inventory category. We will generate reports by state, SCC, and temporal profile code and use these reports to verify the temporal profile assignments for the top 95% of the sources in each state by inventory pollutant mass. As metadata describing the source of the temporal profiles in the EPA database are limited, assessing the validity of the temporal profile assignments will require review of the assignments by WestJumpAQMS participants and stakeholders. If requested, we will produce a spreadsheet of the temporal profile assignments for the top emissions sources that includes graphical representations of the temporal profiles assigned to these sources. Comparisons of the SCC descriptions to the qualitative graphics of the temporal profiles may be used to determine the validity of the profile assignments and inform corrections to these assignments as needed.

Chemical Speciation Profiles and Cross-Reference Data

Speciation Profiles

The U.S. EPA develops speciation profiles from information stored in the SPECIATE database (http://www.epa.gov/ttnchie1/software/speciate/). The current SPECIATE database (version 4.3) is the official repository of volatile organic compound (VOC) and particulate matter (PM) emissions source profiles for different categories of emissions sources. SPECIATE contains 5,592 profiles of chemical mass fractions from source testing conducted by EPA, state agencies, or published in the literature since the 1970’s. Of the current profiles in SPECIATE, 3,570 are for PM sources, 1,775 are for VOC sources, and 247 are for other gases, such as mercury. The most recent update to the SPECIATE database occurred with the release of version 4.3 in September 2011. SPECIATE 4.3 include 405 new profiles obtained from a combination of recommendations for EPA Office of Transportation and Air Quality, EPA and state-sponsored studies of various industrial processes, and literature reviews conducted by the SPECIATE workgroup.

Part of the speciation process for VOCs includes converting inventory reactive organic gases (ROG) to total organic gases (TOG). This step is required because inventoried VOC excludes methane in the mass of total VOC while the speciation profiles include methane. Before the speciation profiles can be applied to the inventory, the inventory VOC must be scaled up to account for the missing methane mass. SCC-specific ROG-to-TOG conversion factors are included with the speciation profiles to prepare the inventories for speciation.

We will base the WestJumpAQMS emissions modeling on Carbon Bond version 6 (CB6) speciation profiles and ROG-to-TOG conversion factors recently developed by ENVIRON. Note that CB6 has several explicit VOC species not included in CB05 so that it is easy to convert CB6 emissions to CB05 if needed, however the reverse is not true. ENVIRON developed an interface to the SPECIATE database called the Speciation Tool. If new speciation information for sources in the WestJumpAQMS modeling domain become available during the project we will use the Speciation Tool to generate SMOKE-ready speciation profiles. For example, we may receive VOC speciation data for oil and gas wells in a specific development basin in the WestJumpAQMS 4-km modeling domain. We could use the Speciation Tool to convert the mass fractions for these wells to a speciation profile for use in simulating VOC emissions from these sources. The latest version of the Speciation Tool developed by ENVIRON creates both ROG-to-TOG conversion factors and SMOKE-ready speciation profiles for multiple photochemical mechanisms, including Carbon Bond 05 and SAPRC07. Note that for the WRAP Phase III Basins we have Basin-specific VOC speciation profiles for the O&G emissions that will be used in the SMOKE emissions modeling.

The latest EPA profiles contain a single profile for inventory NO_X. Inventory NO_X is converted to 9.2% NO_2, 90% NO, and 0.8% HONO using the profile "HONO". There are several profiles for inventory SO_2, which differ in the amount of gas-phase sulfuric acid produced from the profile. All of the SO_2 profiles directly pass through the SO_2 mass from the inventory on a 1:1 basis.

Speciation Cross-referencing Data
Speciation cross-reference tables relate inventory sources to speciation profiles. A speciation cross-reference entry includes four elements:

- 10-digit or 7-digit SCC
- Speciation profile code
- Pollutant name
- FIPS (country/state/county) code

At a minimum, entries in the speciation cross-reference files must include an SCC, pollutant name, and a profile code that exists in the speciation profiles file. Including a FIPS code in the cross-reference file entries supports location-specific assignments of speciation profiles inventory sources.

The speciation cross-reference table used for the WestJumpAQMS will originate from the data distributed with the U.S. EPA NEI2008v2 (source specific profiles tagged as version cmaq_cb05_soa_2007ea_v5_07c_12nov2009). The same assumption about consistency noted for the spatial cross-referencing table also applies to the speciation cross-reference file. One task of the WestJumpAQMS will be to verify the chemical profiles assignments for the largest sources in each inventory category. We will generate reports by state, SCC, VOC speciation profile code, and PM speciation profile code and use these reports to verify the speciation profile assignments for the top 95% of the sources in each state by inventory pollutant mass. We will qualitatively compare descriptions of the profile codes in the SPECIATE database to the descriptions of the SCCs to which they are assigned in order to evaluate the validity of the cross-reference entries. In particular we will look for sources that are assigned the default VOC and PM profiles, which are based on a vast mixture of combustion sources, and update these assignments with profiles that more closely match the emission process described by the SCC.

Emissions Processing

The majority of the emissions processing for WestJumpAQMS will be conducted with the Sparse Matrix Operator Kernel Emissions (SMOKE) model version 3.1 beta (http://www.smoke-model.org). SMOKE is an open-source software for converting emissions inventories into the formats required for regional-scale chemistry and transport modeling. We will base the WestJumpAQMS SMOKE configuration settings on recent simulations using the NEI08v2, including the EPA OAQPS 2008 modeling platform and the SESARM Southeast Modeling, Analysis, and Planning (SEMAP) project (modeling protocol available at http://www.airqualitymodeling.org/semapwiki). Specifics about the SMOKE settings or configurations used for each WestJumpAQMS inventory category are available in the sector-specific memoranda referenced in the introduction of this memo.

We will define a series of emissions processing categories for the WestJumpAQMS project to facilitate the modeling and quality assurance of the inventory data. While there are four main types of inventory data (point, nonpoint, mobile, and biogenic), it is necessary to refine these categories to support special emissions modeling approaches or to provide flexibility for tagging emissions categories in source apportionment air quality modeling.

Efficiencies in the emissions modeling process are gained through consideration of the temporal variability in the emissions sources. If a processing category includes only sources that use a flat temporal profile throughout the year, meaning that the emissions are the same on every hour of every day of the year, it is possible to process a single day for that category and recycle the emissions on each day of the air quality modeling simulation. Both processing time and disk space are conserved by not producing 365 files that all contain the exact same information. Other types of temporal processing configurations that may be used for the WestJumpAQMS project include:

- Single day per year (aveday_yr)
- Single day per month (aveday_mon)
- Typical Monday, Weekday, Saturday, Sunday per year (mwdss_yr)
- Typical Monday, Weekday, Saturday, Sunday per month (mwdss_mon)
- Emissions estimated for each model simulation day (daily)
- Emissions estimated for each model simulation day with temporal profiles generated with average daily meteorology (daily met)
- Emissions estimated for each model simulation day with temporal profiles generated with hourly meteorology (hourly met)

Table 2 defines the emissions categories that we will define for the WestJumpAQMS project. The “Temporal” column in Table 2 refers to the temporal configuration that will be used for each category.

Table 2. WestJumpAQMS Emissions Processing Categories

No.	Emissions Processing Category (Abbr)	Inventory Year	Inventory Source	Temporal	Processing Comments
1	Nonpoint/Area (nonpt)	2008	NEI08v2	mwdss_mon	Remove oil & gas, agricultural NH3, and dust,; includes commercial marine and rail
2	Livestock NH3 (lv)	2008	NEI08v2	mwdss_mon	Do not apply met-based temporal profiles; separate out for possible sensitivity later
	Fertilizer NH3 (ft)	2008	NEI08v2	mwdss_mon	Group with lv as a full agricultural NH3 sector (ag)
3	Fugitive and Road Dust (fd)	2008	NEI08v2	mwdss_mon	Includes paved and unpaved road dust; apply transport factors but not met factors
4	Residential Wood Combustion (rwc)	2008	NEI08v2	mwdss_mon	Do not apply met-based temporal profiles; separate out for possible sensitivity later
5	Area Oil & Gas (og)		IPAMS	mwdss_mon	Basin specific speciation profiles and spatial surrogates
6	Nonroad mobile (nr)	2008	NEI08v2	mwdss_mon	Includes NMIM commercial marine and rail
7	MOVES RPD (rpd)	2008	MOVES2010a	hourly met	Representative weekday and weekends for each year; process as hourly area sources
8	MOVES RPP (rpp)	2008	MOVES2010a	hourly met	Representative weekday and weekends

					for each year; process as hourly area sources
9	MOVES RPV (rpv)	2008	MOVES2010a	hourly met	Representative weekday and weekends for each year; process as hourly area sources
10	CEM Point (ptcem)	2008	NEI08v2/CAMD	daily	Anomalies removed from 2008 CAMD data
11	Non-CEM Point (ptncem)	2008	NEI08v2	mwdss_mon	Removed oil & gas sources and transferred to ptog sector; includes point aircraft and ports
12	Point Oil & Gas (ptog)		IPAMS	mwdss_mon	Combination of WRAP Phase III inventory and NEI08v2 for areas not covered by WRAP EI
13	Point Fires (ptfire)	2008		daily	
14	Commercial Marine (ptseca)	2008	NEI08v2	aveday_mon	
15	Canada/Mexico Area (nusar)	Can2006/Mex2008	Canada NPRI Mexico NEI	mwdss_mon	Mexico inventory projected from 1999 to 2008
16	Canada/Mexico Point (nuspt)	Can2006/Mex2008	Canada NPRI Mexico NEI	mwdss_mon	Mexico inventory projected from 1999 to 2008
17	Canada/Mexico Mobile (nusmb)	Can006/Mex2008	Canada NPRI Mexico NEI	mwdss_mon	Mexico inventory projected from 1999 to 2008
18	Lightning NOx (lnox)	N/A		hourly met	Gridded monthly NLCD lightning flash counts converted to hourly, gridded NO emissions with WRF convective rainfall
19	Sea salt (ss)	N/A		hourly met	Surfzone and open ocean PM emissions
20	Windblown Dust (wbd)	N/A	WRAP WBD Model	hourly met	
21	MEGAN Biogenic (bg)	N/A	MEGAN2.1	hourly met	Use new versions of MEGAN V2.10 updated by WRAP for the western U.S.

Quality Assurance

Quality assurance (QA) of the emissions modeling parameters used for the WestJumpAQMS project will be accomplished through scrutiny of the profile assignments made to specific inventory sources and analysis of the profiles applied to the largest inventory sources. Descriptions of how we will tabulate and analyze the profiles and assignments are provided in each subsection on the different types of profiles used for emissions processing. The general approach to QA of the parameters for WestJumpAQMS includes:

1. Focus on the profiles assigned to the top 95% of the emissions sources by mass. A large amount of emissions are typically associated with a relatively small number of SCCs.
2. Where possible, minimize the application of default temporal, speciation, and spatial profiles
3. Replace default profile applications with profiles that are more appropriate for the source in question. What is considered appropriate for a profile application may be somewhat subjective and will require review by WestJumpAQMS participants and stakeholders
4. Use the best available inventories and ancillary data, including information that may not be packaged with the EPA NEI2008v2. A good example here is spatial surrogates for oil and gas sources in Colorado, Utah, and Wyoming. Basin-specific Shapefiles should be used to generate the spatial surrogates for the WRAP Phase III oil and gas inventories used for WestJumpAQMS.
5. Document all changes made to the WestJumpAQMS modeling parameters in a central location to facilitate compiling these changes into a final report on the modeling conducted for this project.

Table 3. Descriptions of the Shapefiles used to generate spatial surrogates for WestJumpAQMS*

Shapefile	Description	Type	Year	Source	URL
cty_pophu2k_revised	U.S. County Boundaries	Polygon	2005	U.S. Census Bureau	ftp://ftp.epa.gov/EmisInventory/emiss_shp2006/us/
pophu_bg2010	Population/ Housing	Polygon	2010	U.S. Census Bureau	http://www.census.gov/geo/www/tiger/tgrshp2010/tgrshp2010.html
rd_ps_tiger2010	Roadways	Line	2010	U.S. Census Bureau	http://www.census.gov/geo/www/tiger/tgrshp2010/tgrshp2010.html
waterway_ntad2011	Waterways	Line	2010	U.S. Bureau of Transport Statistics	http://www.bts.gov/publications/national_transportation_atlas_database/2011/
rail_tiger2010	Railways	Line	2010	U.S. Census Bureau	http://www.census.gov/geo/www/tiger/tgrshp2010/tgrshp2010.html
exits**	Highway Exits	Point	2010	ESRI	Only available through ESRI Data and Maps
mjrrds**	Major Roads	Line	2010	ESRI	Only available through ESRI Data and Maps
transterm**	Transportation Terminals	Point	2010	ESRI	Only available through ESRI Data and Maps
fema_bsf_2002bnd	Building footprints	Polygon	2010	FEMA	http://www.fema.gov/plan/prevent/hazus/
heating_fuels_acs0510_c2010	Home heating fuels	Polygon	2010	U.S. Census Bureau	http://www.census.gov/acs/www/

*All projections = Lambert Conformal Conic (X0=-97,Y1=33,Y2=45,Y0=40), Datum: NAD83, unless otherwise specified

**Projection = Geographic, Datum: WGS84

Table 4. Spatial surrogate specifications

Surrogate	Code	Weight Shapefile, Attribute	Data Shapefile, Attribute	Filter or Merge Function	Updated or New?	2ry, 3ry, 4ry Surrogate	Description
Population	100	pophu_bg2010, POP2010	cty_pophu2k_revised, FIPSSTCO	N/A	Y	Land Area, None, None	Total population from 2010 Census blocks
Population by State	105	pophu_bg2010, POP2010	state_pophu2010, FIRST_STAT		Y	Land Area, None, None	
Housing	110	pophu_bg2010, HU2010	cty_pophu2k_revised, FIPSSTCO	N/A	Y	Population, Land Area None	Total housing units from 2010 Census blocks
Urban Population	120	pophu_bg2010, URBAN	cty_pophu2k_revised, FIPSSTCO	N/A	Y	Population, Land Area None	Total urban population from 2010 Census blocks
Rural Population	130	pophu_bg2010, RURAL	cty_pophu2k_revised, FIPSSTCO	N/A	Y	Population, Land Area None	Total rural population from 2010 Census blocks
Housing Change	137	pophu_bg2010, HUCH1000	cty_pophu2k_revised, FIPSSTCO	N/A	Y	Population, Land Area, None	Total housing change from 2000 to 2010 Census blocks
Housing Change and Population	140	N/A	cty_pophu2k_revised, FIPSSTCO	0.5*Housing Change+ 0.5*Population	Y	Population, Land Area, None	Weighted combination of 2000-to-2010 housing unit change and 2010 population from 2010 Census
Residential Heating – Natural Gas	150	heating_fuels_acs0510_c2010, UTIL_GAS	cty_pophu2k_revised, FIPSSTCO		Y	Housing, Population, Land Area,	Number of Housing Units using Utility Gas for primary heating: ACS 5-year 2010 survey data
Residential Heating - Wood	160	heating_fuels_acs0510_c2010, WOOD	cty_pophu2k_revised, FIPSSTCO		Y	Housing, Population, Land Area,	Number of Housing Units using Wood for primary heating: ACS 5-year 2010 survey data
0.5 Residential Heating – Wood plus 0.5 Low Intensity Residential	165	N/A	cty_pophu2k_revised, FIPSSTCO	0.5*Residential Heating - Wood+0.5*Low Intensity Residential	Y	Housing, Population, Land Area,	
Residential	170	heating_fuels_acs	cty_pophu2k_revise		Y	Housing,	Number of Housing Units using Fuel

Surrogate	Code	Weight Shapefile, Attribute	Data Shapefile, Attribute	Filter or Merge Function	Updated or New?	2ry, 3ry, 4ry Surrogate	Description
Heating – Distillate Oil		0510_c2010, FUEL_OIL	d, FIPSSTCO			Population, Land Area,	Oil for primary heating: ACS 5-year 2010 survey data
Residential Heating – Coal	180	heating_fuels_acs 0510_c2010, COAL	cty_pophu2k_revised, FIPSSTCO		Y	Housing, Population, Land Area,	Number of Housing Units using Coal for primary heating: ACS 5-year 2010 survey data
Residential Heating – LP Gas	190	heating_fuels_acs 0510_c2010, LP_GAS	cty_pophu2k_revised, FIPSSTCO		Y	Housing, Population, Land Area,	Number of Housing Units using LP Gas for primary heating: ACS 5-year 2010 survey data
Urban Primary Road Miles	200	rd_ps_tiger2010	cty_pophu2k_revised, FIPSSTCO	RDTYPE=1	Y	Total Road Miles, Population, Land Area	Primary road miles from TIGER 2010 overlaid with Census block-level urban population
Highway Exit Ramps	201	exits	cty_pophu2k_revised, FIPSSTCO	N/A	NEW	Total Road Miles, Population, Land Area	Exit ramps on U.S. highways from ESRI DM2010; proxy to rest stops for tractor trailers
Local Roads	202	mjrrds	cty_pophu2k_revised, FIPSSTCO	FRC=4,5	NEW	Housing, Population, Land Area	Major local roads and feeders (does not include surface streets) from ESRI DM2010
Bus Stops	203	transterm	cty_pophu2k_revised, FIPSSTCO	FCC=D53	NEW	Local Roads, Total Road Miles, Land Area	Bus terminals from ESRI DM2010
Rural Primary Road Miles	210	rd_ps_tiger2010	cty_pophu2k_revised, FIPSSTCO	RDTYPE=2	Y	Total Road Miles, Population, Land Area	Primary road miles from TIGER 2010 overlaid with Census block-level rural population
Urban Secondary Road Miles	220	rd_ps_tiger2010	cty_pophu2k_revised, FIPSSTCO	RDTYPE=3	Y	Total Road Miles, Population, Land Area	Secondary road miles from TIGER 2010 overlaid with Census block-level urban population
Rural Secondary Road Miles	230	rd_ps_tiger2010	cty_pophu2k_revised, FIPSSTCO	RDTYPE=4	Y	Total Road Miles, Population,	Secondary road miles from TIGER 2010 overlaid with Census block-level rural population

Surrogate	Code	Weight Shapefile, Attribute	Data Shapefile, Attribute	Filter or Merge Function	Updated or New?	2ry, 3ry, 4ry Surrogate	Description
						Land Area	
Total Road Miles	240	rd_ps_tiger2010	cty_pophu2k_revised, FIPSSTCO	RDTYPE=1,2,3,4	Y	Population, Land Area, None	Total road miles from TIGER 2010
Urban Primary plus Rural Primary	250	rd_ps_tiger2010	cty_pophu2k_revised, FIPSSTCO	RDTYPE=1,2	Y	Total Road Miles, Population, Land Area	Total primary road miles from TIGER 2010
Off-Network MD/HD	251	N/A	cty_pophu2k_revised, FIPSSTCO	0.5*Industrial Land+ 0.5*Highway Exit Ramps	NEW	Total Road Miles, Population, Land Area	Off-network MOVES medium and heavy-duty vehicles; freight loading at industrial facilities and rest areas/highway exits
Off-Network LD	252	N/A	cty_pophu2k_revised, FIPSSTCO	0.75*Commercial plus Residential+ 0.25*Local Roads	NEW	Population, Housing, Land Area	Off-network MOVES light-duty vehicles; shopping centers, residential areas, and street parking
Off-Network Buses	253	N/A	cty_pophu2k_revised, FIPSSTCO	0.5*Bus Stops+ 0.5*Local Roads	NEW	Housing, Urban Secondary Road Miles, Land Area	Off-network MOVES buses; bus stations and local streets
0.75*Total Roadway Miles plus 0.25*Population	255	N/A	cty_pophu2k_revised, FIPSSTCO	0.75*Total Road Miles+ 0.25*Population	Y	Population, Land Area, None	Combination of ¾ total road miles and ¼ population
Total Railroad Miles	260	rail_tiger2010	cty_pophu2k_revised, FIPSSTCO	RRTYPE=1,2	Y	Total Road Miles, Population, Land Area	MTFCC codes from TIGER2010 data used to identify rail lines

Surrogate	Code	Weight Shapefile, Attribute	Data Shapefile, Attribute	Filter or Merge Function	Updated or New?	2ry, 3ry, 4ry Surrogate	Description
Class 1 Railroad Miles	270	rail_tiger2010	cty_pophu2k_revised, FIPSSTCO	RRTYPE=1	Y	Total Railroad Miles, Total Road Miles, Population	Railroad miles of class 1 railroads
Class 2 and 3 Railroad Miles	280	rail_tiger2010	cty_pophu2k_revised, FIPSSTCO	RRTYPE=2,3	Y	Total Railroad Miles, Total Road Miles, Population	Railroad miles of class 2 and 3 railroads
Low Intensity Residential	300	us_lowres	cty_pophu2k_revised, FIPSSTCO	GRID_CODE=21	N	Single Family Residential, Population, Land Area	Includes areas with a mixture of constructed materials and vegetation. Constructed materials account for 30-80 percent of the cover. Vegetation may account for 20 to 70 percent of the cover. These areas most commonly include single-family housing units.
Total Agriculture	310	us_ag2k	cty_pophu2k_revised, FIPSSTCO	GRID_CODE=61,81,82,83,84	N	Rural Land Area, Land Area, None	Sum of the following NLCD areas: Pasture/Hay, Grains, Row Crops, Fallow Land and Orchards/Vineyards
Total Agriculture without Orchards/Vineyards	311	us_ag2k	cty_pophu2k_revised, FIPSSTCO	GRID_CODE=81,82,83,84	N	Rural Land Area, Land ARea, None	Sum of the following NLCD areas: Pasture/Hay, Grains, Row Crops and Fallow

Surrogate	Code	Weight Shapefile, Attribute	Data Shapefile, Attribute	Filter or Merge Function	Updated or New?	2ry, 3ry, 4ry Surrogate	Description
							Land
Orchards/Vineyards	312	us_ag2k	cty_pophu2k_revised, FIPSSTCO	GRID_CODE=61	N	Total Agriculture, Rural Land Area, Land Area	Orchards, vineyards, and other areas planted or maintained for the production of fruits, nuts, berries, or ornamentals.
Forest Land	320	us_for2k	cty_pophu2k_revised, FIPSSTCO	GRID_CODE=41,42,43,91	N	Rural Land Area, Land Area, None	Sum of the following NLCD areas: Evergreen Forest, Mixed Forest, Woody Wetland, Deciduous Forest
Strip Mines/Quarries	330	mines_nlcd, AREA	cty_pophu2k_revised, FIPSSTCO		N	Mines, Rural Land Area, Land Area	Area of Mines
Land	340	us_lw2k, AREA	cty_pophu2k_revised, FIPSSTCO	H2O_CODE=2	N	None, None, None	
State Land	345	us_lw2k, AREA	state_pophu02, STATE	H2O_CODE=2	N	None, None, None	
Water	350	us_lw2k, AREA	cty_pophu2k_revised, FIPSSTCO	H2O_CODE!=2	N	Navigable Waterway Miles, Land Area, None	Water Area
Rural Land Area	400	rural_land, AREA	cty_pophu2k_revised, FIPSSTCO	RL_FLAG=Rural Land	N	Land Area, None, None	Land Area that is not within an area designated as an Urbanized Area or an Urban Cluster. Determined by intersecting NLCD land area with US Census spatial information representing areas not classified as Urbanized Area or as Urban Clusters
Commercial Land	500	fema_bsf_2002bnd	cty_pophu2k_revised, FIPSSTCO	COM1+COM2+COM3+COM4+COM5+COM6+COM7+COM8+COM9	Y	Population, Land Area, None	Sum of building square footage from the following FEMA categories: COM1 + COM2 + COM3 + COM4 + COM5 + COM6 + COM7 + COM8 + COM9

Surrogate	Code	Weight Shapefile, Attribute	Data Shapefile, Attribute	Filter or Merge Function	Updated or New?	2ry, 3ry, 4ry Surrogate	Description
Industrial Land	505	fema_bsf_2002bnd	cty_pophu2k_revised, FIPSSTCO	IND1+IND2+IND3+IND4+IND5+IND6	Y	Population, Land Area, None	Sum of building square footage from the following FEMA categories: IND1 + IND2 + IND3 + IND4 + IND5 + IND6
Commercial plus Industrial	510	fema_bsf_2002bnd	cty_pophu2k_revised, FIPSSTCO	COM1+COM2+COM3+COM4+COM5+COM6+COM7+COM8+COM9+IND1+IND2+IND3+IND4+IND5+IND6	Y	Population, Land Area, None	Sum of building square footage from the following FEMA categories: COM1 + COM2 + COM3 + COM4 + COM5 + COM6 + COM7 + COM8 + COM9 + IND1 + IND2 + IND3 + IND4 + IND5 + IND6
Commercial plus Residential	512	fema_bsf_2002bnd	cty_pophu2k_revised, FIPSSTCO	COM1+COM2+COM3+COM4+COM5+COM6+COM7+COM8+COM9+RES1+RES2+RES3+RES4	Y	Population, Land Area, None	
Commercial plus Institutional Land	515	fema_bsf_2002bnd	cty_pophu2k_revised, FIPSSTCO	COM1+COM2+COM3+COM4+COM5+COM6+COM7+COM8+COM9+RES5+RES6+EDU1+EDU2+REL1	Y	Population, Land Area, None	Sum of building square footage from the following FEMA categories: COM1 + COM2 + COM3 + COM4 + COM5 + COM6 + COM7 + COM8 + COM9 + RES5 + RES6 + EDU1 + EDU2 + REL1
Commercial plus Industrial plus Institutional	520	fema_bsf_2002bnd	cty_pophu2k_revised, FIPSSTCO	COM1 + COM2 + COM3 + COM4 + COM5 + COM6 + COM7 + COM8 + COM9 + IND1 + IND2 + IND3 + IND4 + IND5 + IND6 + RES5 + RES6 + EDU1 +	Y	Population, Land Area, None	

Surrogate	Code	Weight Shapefile, Attribute	Data Shapefile, Attribute	Filter or Merge Function	Updated or New?	2ry, 3ry, 4ry Surrogate	Description
				EDU2 + REL1			
Golf Courses plus Institutional plus Industrial plus Commercial	525	N/A	cty_pophu2k_revised, FIPSSTCO	0.5*Commercial plus Industrial plus Institutional+0.5*Golf Courses	Y	Golf Courses, Commercial plus Industrial plus Institutional, Land Area	Combination of the golf courses ratio with the following FEMA categories: COM1 + COM2 + COM3 + COM4 + COM5 + COM6 + COM7 + COM8 + COM9 + IND1 + IND2 + IND3 + IND4 + IND5 + IND6 + RES5 + RES6 + EDU1 + EDU2 + REL1
Single Family Residential	527	fema_bsf_2002bnd	cty_pophu2k_revised, FIPSSTCO	RES1	Y	Housing, Population, Land Area	building square footage from single family dwellings (RES1)
Residential - High Density	530	fema_bsf_2002bnd	cty_pophu2k_revised, FIPSSTCO	RES3+RES4+RES5+RES6	Y	Housing, Population, Land Area	sum of building square footage from the following FEMA residential categories: RES3 + RES4 + RES5 + RES6
Residential + Commercial + Industrial + Institutional + Government	535	fema_bsf_2002bnd	cty_pophu2k_revised, FIPSSTCO	COM1 + COM2 + COM3 + COM4 + COM5 + COM6 + COM7 + COM8 + COM9 + IND1 +IND2 + IND3 + IND4 + IND5 + IND6 + EDU1 + EDU2 + REL1 + GOV1 + GOV2 + RES1 + RES2 + RES3 + RES4	Y	Population, Land Area, None	sum of building square footage from the following FEMA categories: COM1 + COM2 + COM3 + COM4 + COM5 + COM6 + COM7 + COM8 + COM9 + IND1 +I ND2 + IND3 + IND4 + IND5 + IND6 + EDU1 + EDU2 + REL1 + GOV1 + GOV2 + RES1 + RES2 + RES3 + RES4
Retail Trade (COM1)	540	fema_bsf_2002bnd	cty_pophu2k_revised, FIPSSTCO	COM1	Y	Commercial Land, Population, Land Area	building square footage from Retail Trade: SIC Codes: 52,53,54,55,56,57,59
Personal	545	fema_bsf_2002bn	cty_pophu2k_revise	COM3	Y	Commercial	building square footage from

Surrogate	Code	Weight Shapefile, Attribute	Data Shapefile, Attribute	Filter or Merge Function	Updated or New?	2ry, 3ry, 4ry Surrogate	Description
Repair (COM3)		d	d, FIPSSTCO			Land, Population, Land Area	Personal/Repair Services: SIC Codes: 72,75,76,83,88
Retail Trade (COM1) plus Personal Repair (COM3)	550	fema_bsf_2002bnd	cty_pophu2k_revised, FIPSSTCO	COM1+COM3	Y	Commercial Land, Population, Land Area	sum of building square footage from the following FEMA categories: COM1 + COM3
Professional/Technical (COM4) plus General Government (GOV1)	555	fema_bsf_2002bnd	cty_pophu2k_revised, FIPSSTCO	COMV4+GOV1	Y	Commercial Land, Population, Land Area	sum of building square footage from the following FEMA categories: COM4 + GOV1
Hospital (COM6)	560	fema_bsf_2002bnd	cty_pophu2k_revised, FIPSSTCO	COM6	Y	Commercial Land, Population, Land Area	building square footage from Hospitals: SIC Codes: 8062,8063,8069
Medical Office/Clinic (COM7)	565	fema_bsf_2002bnd	cty_pophu2k_revised, FIPSSTCO	COM7	Y	Commercial Land, Population, Land Area	building square footage from Medical Office/Clinics: SIC Codes: 80 (except 8051,8052,8059,8062,8063,8069)
Heavy and High Tech Industrial (IND1 + IND5)	570	fema_bsf_2002bnd	cty_pophu2k_revised, FIPSSTCO	IND1+IND5	Y	Industrial Land, Population, Land Area	sum of building square footage from the following FEMA categories: IND1 + IND5
Light and High Tech Industrial (IND2 + IND5)	575	fema_bsf_2002bnd	cty_pophu2k_revised, FIPSSTCO	IND2+IND5	Y	Industrial Land, Population, Land Area	sum of building square footage from the following FEMA categories: IND2 + IND5
"Food, Drug, Chemical Industrial (IND3)"	580	fema_bsf_2002bnd	cty_pophu2k_revised, FIPSSTCO	IND3	Y	Industrial Land, Population, Land Area	building square footage from Food/Drugs/Chemical Factories: SIC Codes: 20,21,28,29

Surrogate	Code	Weight Shapefile, Attribute	Data Shapefile, Attribute	Filter or Merge Function	Updated or New?	2ry, 3ry, 4ry Surrogate	Description
Metals and Minerals Industrial (IND4)	585	fema_bsf_2002bnd	cty_pophu2k_revised, FIPSSTCO	IND4	Y	Industrial Land, Population, Land Area	building square footage from Metals/Minerals Processing Factories: SIC Codes: 10,12,13,14,33
Heavy Industrial (IND1)	590	fema_bsf_2002bnd	cty_pophu2k_revised, FIPSSTCO	IND1	Y	Industrial Land, Population, Land Area	building square footage from Heavy Industrial Factories - SIC Codes: 22,24,26,32,34,35 (except 3571,3572), 37
Light Industrial (IND2)	595	fema_bsf_2002bnd	cty_pophu2k_revised, FIPSSTCO	IND2	Y	Industrial Land, Population, Land Area	building square footage from Light Industrial Factories: SIC Codes: 23,25,27,30,31,36 (except 3671,3672,3674), 38,39
Industrial plus Institutional plus Hospitals	596	fema_bsf_2002bnd	cty_pophu2k_revised, FIPSSTCO	IND1+IND2+IND3+IND4+IND5+IND6+COM6+EDU1+EDU2+REL1+RES5+RES6	Y	Population, Land Area, None	sum of building square footage from IND1, IND2, IND3, IND4, IND5, IND6, COM6, EDU1, EDU2, REL1, RES5, RES6
Gas Stations	600	us_gas_sta, NUM_OF_GAS	cty_pophu2k_revised, FIPSSTCO		N	Commercial Land, Population, Land Area	Number of Gas Stations
Refineries and Tank Farms	650	us_oil	cty_pophu2k_revised, FIPSSTCO	TANKFARM,REFINERY	N	Industrial Land, Population, Land Area	Number of Oil Refineries and Tank Farms
Refineries and Tank Farms and Gas Stations	675	us_oilgas, NUM_OILGAS	cty_pophu2k_revised, FIPSSTCO		N	Commercial plus Industrial, Population, Land Area	Number of Oil Refineries, Tank Farms and Gas Stations
Airport Points	710	airport_point,	cty_pophu2k_revised, FIPSSTCO		N	Population, Land Area, None	Number of Airports
Airport Areas	700	airport-area,	cty_pophu2k_revise		N	Airport	Area of Commercial Airports

Surrogate	Code	Weight Shapefile, Attribute	Data Shapefile, Attribute	Filter or Merge Function	Updated or New?	2ry, 3ry, 4ry Surrogate	Description
		AREA	d, FIPSSTCO			Points, Population, Land Area	
Military Airports	720	military_air	cty_pophu2k_revised, FIPSSTCO		N	Airport Points, Population, Land Area	Number of Military Airports
Marine Ports	800	ports_ntad2010	cty_pophu2k_revised, FIPSSTCO e	N/A	Y	Navigable Waterway Miles, Water, Land Area	NTAD 2010 dataset of number of ports, not just marine, but also inland lakes and rivers
Navigable Waterway Miles	807	waterway_ntad2010, LENGTH	cty_pophu2k_revised, FIPSSTCO		Y	Marine Ports, Water, Land Area	NTAD 2010 dataset of navigable inland and intracoastal waterways, used for gapfilling
Navigable Waterway Activity	810	nav_water_activity, CTY_ACTIV	cty_pophu2k_revised, FIPSSTCO		N	Navigable Waterway Miles, Marine Ports, Water	Miles of waterways - navigable inland and intracoastal waterways
Golf Courses	850	us_golf	cty_pophu2k_revised, FIPSSTCO		N	Housing, Population, Land Area	Number of Golf Courses
Mines	860	mines_usgs	cty_pophu2k_revised, FIPSSTCO		N	Strip Mines/Quarries, Rural Land Area, Land Area	Number of mines
Construction and Mining	861		cty_pophu2k_revised, FIPSSTCO	0.5*Housing Change and Population+0.5*Mines	NEW	Population, Land Area, None	

Surrogate	Code	Weight Shapefile, Attribute	Data Shapefile, Attribute	Filter or Merge Function	Updated or New?	2ry, 3ry, 4ry Surrogate	Description
Wastewater Treatment Facilities	870	us_wwtp	cty_pophu2k_revised, FIPSSTCO		N	Commercial Plus Industrial, Population, Land Area	Number of Wastewater Treatment Plants (WWTP)
Drycleaners	880	us_dryclean, NO_EST	cty_pophu2k_revised, FIPSSTCO		N	Commercial Land, Population, Land Area	Number of Dry Cleaners
Commercial Timber	890		cty_pophu2k_revised, FIPSSTCO		N	Forest Land, Rural Land Area, Population	Number of Possible Timber Removal Locations

Summary of Results

Tables 4 through 8 summarize the WestJumpAQMS 2008 emissions for NO_X, VOC, NH_3, SO_2 and $PM_{2.5}$, respectively. The emissions are presented by state and then the total across all states in the contiguous U.S. The emission summaries are broken down by the following major source categories:

- Area: Represents Area Sources that are called Non-Point Sources in the 2008 NEI inventory (Discussed in Technical Memorandums #2 and #4e).
- Area-O&G: Area source oil and gas that is just from the WRAP Phase III Basins. Oil and gas area source emissions outside of the WRAP Phase III Basins are under the Area category (Discussed in Technical Memorandums #4a-4d).
- Dust: Fugitive dust emissions from the 2008 NEI (e.g., road dust and mechanically generated dust; Discussed in Technical Memorandum #6).
- Biogenic: Annual biogenic emissions from MEGAN using grid cell definitions of states (Discussed in Technical Memorandum #9).
- Off-Road: Off-road mobile source emissions from 2008 NEI (EPA NONROAD; Discussed in Technical Memorandum #2).
- On-Road: On-road mobile sources emissions using MOVES and EMFAC2011 (California) (Discussed in Technical Memorandum #3).
- Fires: Fire emissions from the Fire INventory from NCAR (FINN) (Discussed in Technical Memorandum #5).
- WBD: Wind Blown Dust (WBD) emissions from the WRAP WBD model (Discussed in Technical Memorandum #6).
- PT-O&G: Point source oil and gas that is just from the WRAP Phase III Basins. Oil and gas point source emissions outside of the WRAP Phase III Basins (from NEI) are under the PTNCEM category (Discussed in Technical Memorandums #4a-4d).
- PTCEM: Point sources with Continuous Emissions Monitoring (CEM) devices whose hourly emissions are from the EPA CAMD website (Discussed in Technical Memorandum #1).
- PTNCEM: Non-CEM point sources from the 2008 NEI (Discussed in Technical Memorandum #1 and #4e).

Across the contiguous U.S. in 2008 there was 18.12 million (18.12M) tons per year NO_X emissions (Table 4a). The five largest emitting states were Texas (1.57M), California (1.13M), Florida (1.57M), Ohio (0.76M) and Georgia (0.72M) whose emissions represent 29% of the total U.S. NO_X emissions in 2008. Table 4b displays the percent contribution of each major source category to the total NO_X emissions by state and then for all states combined. Across the U.S., on-road mobile (42%) is the largest contributor to total NO_X emissions followed by PTCEM

(17%), area (12%), off-road (11%) and PTNCEM (11%). The dominant source category contribution by state depends on the population and amount of coal-fired electrical generation. For most states, on-road mobile is the largest contributor, although West Virginia has more PTCEM (43%) than on-road mobile NO_X (25%). California, on the other hand, has essentially no PTCEM NO_X (0.3%) with almost half the NO_X being from on-road mobile (46%). At the other extreme are Tribal lands whose NO_X is dominated by PTCEM (90%), presumably due to the inclusion of the Navajo power plant and the exclusion of on-road and non-road mobile and WRAP Phase III O&G that are assigned to the states where they reside.

There is 44.43M tons per year of VOC emissions in the contiguous U.S. of which two thirds (29.54M) is from biogenic sources (Table 5). Texas has the highest total VOC emissions (6.34M) that is nearly three times higher than the next highest state (Georgia with 2.23M). This is due in part to Texas having high biogenic VOC emissions (4.09M) that is over double what the next highest state has (again Georgia with 1.81M). When just looking at anthropogenic VOC emissions, the five highest VOC emitting states in 2008 were Texas (2.25M), California (1.05M), Florida (0.83M), New York (0.58M) and Georgia (0.51M). These five states emit 35% of the total U.S. anthropogenic VOC emissions. As noted previously, across the U.S. biogenic VOC contribute 67% of the total VOCs. Biogenic emissions are a larger percentage of a state's total VOC emissions for sparsely populated states and states in the south and lowest relative contribution for more populated states in the northeast. Biogenic emissions of VOC also have a strong seasonal signal with most of the emissions occurring in the late spring through early fall and peaking in the summer. Just looking at anthropogenic VOC emissions across the contiguous U.S., area sources are the largest contributor (34%), followed by on-road (23%), off-road (17%), and area source O&G (13%). Note that for states with the WRAP Phase III O&G emission updates, the O&G VOC is a significant contributor to the state-wide anthropogenic VOC emissions: Colorado (44%), New Mexico (69%), Utah (43%), and Wyoming (66%). Texas and Oklahoma, which had O&G area and point source updates in the NEI, also have significant O&G VOC contributions (58% and 50%, respectively). Note that some other states with large O&G emissions may also have significant O&G VOC emissions, but since the emissions are below the reporting threshold their emissions are not included in the 2008 NEI (see Technical Memorandum#4e).

There is 4.00M tons per year of ammonia (NH_3) emissions across the contiguous U.S. (Table 6) with a vast majority (3.77M or 94%) coming from the Area Source sector that includes the agricultural livestock and fertilizer categories (see Technical Memorandum#8). Across the U.S. there are small amounts of ammonia emissions from on-road mobile (3.5%) and point sources (1.3% for PTCEM and PTNCEM). For states in the Northeast Corridor that have large amounts of mobile sources and not as much livestock and fertilizer application, on-road mobile tends to be the largest contributor. However, these Northeast States tend to have the lowest amounts of ammonia emissions. The five states with the highest amounts of ammonia emissions are California (9.34M), Texas (0.31M), Iowa (0.30M), Minnesota (0.19M) and Nebraska (0.18M), which are all states known for having large amounts of livestock and agriculture.

There is approximately 10M tons per year of SO_2 emissions across the contiguous U.S. of which 7.7M (77%) is due to the PTCEM electrical generation sector. The ten highest emitting SO_2 states are known for having the highest number of coal-fire electricity generating units and contribute 58% of the U.S. SO_2 emissions with each state have total SO_2 emissions ranging from

0.98M to 0.38M tons per year (from highest to lowest the top ten SO_2 emission states are: PA, OH, IN, TX, GA, AL, MO, MI, IL and KY).

Table 8 summarizes the primary $PM_{2.5}$ emissions by state. Total contiguous U.S. $PM_{2.5}$ emissions are 4.62M tons per year that are spread out across several source categories: Fugitive Dust (26%), Fires (18%), Area (16%), Windblown Dust (11%), PTNCEM (9%) and PTCEM (7%). The five highest emitting primary $PM_{2.5}$ states are California (0.45M), Texas (0.42M), Florida (0.18M), Kansas (0.18M) and Ohio (0.16M) who together emit 30% of the U.S. $PM_{2.5}$ emissions. However, the source category with the highest $PM_{2.5}$ contribution varies by state. For example, for California it is Fires (58%), for Texas it is Fugitive Dust (41%), for Florida it is Fires (39%), for Kansas it is Fugitive Dust (44%) and for Ohio it is PTCEM (27%).

Table 4a. Summary of 2008 NO_X emissions (tons per year) by state and major source category (not shown are 678,716 TPY near-shore and 475,000 TPY off-shore commercial marine vessel and Mexico/Canada emissions).

State	Area	Area-O&G	Dust	Biogenic	Off-Road	On-Road	Fires	WBD	PT-O&G	PTCEM	PTNCEM	Total
Alabama	38,509	-	-	11,746	25,981	251,996	16,561	-	-	112,812	67,489	525,093
Arizona	39,403	-	-	15,256	33,857	137,555	3,513	-	-	42,769	18,157	290,511
Arkansas	27,030	6,183	-	12,677	24,867	81,057	13,367	-	-	37,269	37,680	240,130
California	153,233	2,221	-	18,218	233,142	513,028	113,934	-	-	3,725	91,265	1,128,764
Colorado	22,852	27,048	-	9,542	31,360	129,591	1,674	-	21,205	61,560	25,392	330,224
Connecticut	14,884	-	-	347	15,921	134,539	8	-	-	3,789	4,709	174,197
Delaware	4,709	-	-	523	4,980	35,937	46	-	-	9,197	4,714	60,108
District of Columbia	1,730	-	-	10	2,693	12,649	0	-	-	-	598	17,681
Florida	40,057	-	-	41,393	108,275	561,917	34,422	-	-	160,297	56,579	1,002,940
Georgia	40,657	-	-	16,095	50,662	444,346	19,042	-	-	105,556	45,512	721,870
Idaho	19,869	-	-	4,806	14,129	44,554	11,952	-	-	-	12,706	108,016
Illionis	101,752	-	-	15,864	90,120	268,604	1,721	-	-	123,594	82,042	683,697
Indiana	53,493	-	-	8,991	56,127	207,414	1,039	-	-	196,119	69,568	592,751
Iowa	31,431	-	-	13,704	57,103	83,250	1,072	-	-	48,886	40,947	276,393
Kansas	53,041	-	-	28,199	42,020	77,939	13,325	-	-	52,716	53,373	320,613
Kentucky	39,461	-	-	8,918	27,971	239,040	1,683	-	-	157,246	40,490	514,810
Louisiana	175,628	-	-	12,782	25,880	97,757	18,727	-	-	49,270	144,065	524,109
Maine	14,395	-	-	1,430	7,356	40,206	30	-	-	585	16,212	80,215
Maryland	28,439	-	-	1,928	25,261	114,574	228	-	-	36,608	21,841	228,879
Massachusetts	30,409	-	-	407	26,309	121,138	132	-	-	9,489	13,823	201,707
Michigan	68,061	-	-	5,715	65,730	264,786	480	-	-	103,217	78,779	586,768
Minnesota	53,516	-	-	8,957	60,928	144,617	1,824	-	-	59,774	59,208	388,823
Mississippi	29,130	-	-	12,969	19,489	99,171	10,974	-	-	40,993	53,501	266,226
Missouri	64,829	-	-	18,535	47,642	182,342	3,769	-	-	88,246	45,497	450,859
Montana	25,777	332	-	12,953	16,910	29,931	4,627	-	379	28,354	14,249	133,512
Nebraska	74,124	-	-	17,994	36,062	52,451	1,365	-	-	43,052	14,214	239,261
Nevada	11,321	-	-	7,364	17,081	50,068	702	-	-	16,002	14,127	116,665
New Hampshire	6,426	-	-	411	7,156	26,275	15	-	-	4,635	2,334	47,252
New Jersey	84,584	-	-	852	36,687	155,562	405	-	-	11,890	16,970	306,951
New Mexico	27,754	35,838	-	15,983	8,566	72,074	1,654	-	31,129	26,930	4,456	224,383
New York	100,561	-	-	3,546	71,841	307,553	258	-	-	31,595	47,562	562,916
North Carolina	30,033	-	-	10,803	52,900	235,470	10,658	-	-	55,878	40,872	436,614
North Dakota	16,719	-	-	9,133	34,572	22,879	2,884	-	-	66,849	11,434	164,469
Ohio	91,078	-	-	6,646	74,636	288,475	1,076	-	-	235,229	66,386	763,525
Oklahoma	34,757	68,744	-	26,325	27,736	117,681	8,449	-	-	79,716	65,476	428,885
Oregon	24,121	-	-	5,560	23,463	98,399	13,968	-	-	9,463	14,124	189,098
Pennsylvania	80,021	-	-	5,149	53,635	244,630	1,283	-	-	185,496	70,686	640,900
Rhode Island	4,931	-	-	38	4,086	18,869	30	-	-	199	1,323	29,475
South Carolina	19,225	-	-	8,580	25,776	124,855	6,448	-	-	43,929	29,119	257,931
South Dakota	5,904	-	-	14,758	24,699	26,865	765	-	-	13,852	2,539	89,382
Tennessee	53,817	-	-	9,299	35,879	182,233	2,938	-	-	84,204	47,817	416,185
Texas	135,207	248,359	-	86,105	163,763	519,964	23,056	-	38,934	157,388	198,111	1,570,886
Utah	17,269	12,521	-	6,144	13,249	64,186	996	-	3,023	61,308	23,356	202,053
Vermont	4,539	-	-	524	3,656	20,658	20	-	-	296	206	29,899
Virginia	51,231	-	-	6,465	39,017	181,383	4,499	-	-	42,655	53,160	378,411
Washington	50,287	-	-	3,845	38,096	139,989	5,288	-	-	10,804	27,689	275,999
West Virginia	31,383	-	-	2,091	7,339	57,757	1,147	-	-	99,344	34,725	233,787
Wisconsin	43,994	-	-	6,500	47,302	160,748	707	-	-	48,261	40,926	348,439
Wyoming	37,685	22,526	-	6,928	4,848	27,211	5,370	-	23,456	74,762	24,016	226,802
Tribal Data	251	-	-	-	-	-	-	-	-	82,241	8,870	91,362
Grand Total	2,209,516	423,772	-	543,008	1,966,761	7,514,176	368,132	-	118,126	3,018,047	1,958,894	18,120,431

Table 4b. Percent contribution of source categories to NO_X emissions by state.

State	Area	Area-O&G	Dust	Biogenic	Off-Road	On-Road	Fires	WBD	PT-O&G	PTCEM	PTNCEM
Alabama	7.3%	0.0%	0.0%	2.2%	4.9%	48.0%	3.2%	0.0%	0.0%	21.5%	12.9%
Arizona	13.6%	0.0%	0.0%	5.3%	11.7%	47.3%	1.2%	0.0%	0.0%	14.7%	6.2%
Arkansas	11.3%	2.6%	0.0%	5.3%	10.4%	33.8%	5.6%	0.0%	0.0%	15.5%	15.7%
California	13.6%	0.2%	0.0%	1.6%	20.7%	45.5%	10.1%	0.0%	0.0%	0.3%	8.1%
Colorado	6.9%	8.2%	0.0%	2.9%	9.5%	39.2%	0.5%	0.0%	6.4%	18.6%	7.7%
Connecticut	8.5%	0.0%	0.0%	0.2%	9.1%	77.2%	0.0%	0.0%	0.0%	2.2%	2.7%
Delaware	7.8%	0.0%	0.0%	0.9%	8.3%	59.8%	0.1%	0.0%	0.0%	15.3%	7.8%
District of Columbia	9.8%	0.0%	0.0%	0.1%	15.2%	71.5%	0.0%	0.0%	0.0%	0.0%	3.4%
Florida	4.0%	0.0%	0.0%	4.1%	10.8%	56.0%	3.4%	0.0%	0.0%	16.0%	5.6%
Georgia	5.6%	0.0%	0.0%	2.2%	7.0%	61.6%	2.6%	0.0%	0.0%	14.6%	6.3%
Idaho	18.4%	0.0%	0.0%	4.4%	13.1%	41.2%	11.1%	0.0%	0.0%	0.0%	11.8%
Illinois	14.9%	0.0%	0.0%	2.3%	13.2%	39.3%	0.3%	0.0%	0.0%	18.1%	12.0%
Indiana	9.0%	0.0%	0.0%	1.5%	9.5%	35.0%	0.2%	0.0%	0.0%	33.1%	11.7%
Iowa	11.4%	0.0%	0.0%	5.0%	20.7%	30.1%	0.4%	0.0%	0.0%	17.7%	14.8%
Kansas	16.5%	0.0%	0.0%	8.8%	13.1%	24.3%	4.2%	0.0%	0.0%	16.4%	16.6%
Kentucky	7.7%	0.0%	0.0%	1.7%	5.4%	46.4%	0.3%	0.0%	0.0%	30.5%	7.9%
Louisiana	33.5%	0.0%	0.0%	2.4%	4.9%	18.7%	3.6%	0.0%	0.0%	9.4%	27.5%
Maine	17.9%	0.0%	0.0%	1.8%	9.2%	50.1%	0.0%	0.0%	0.0%	0.7%	20.2%
Maryland	12.4%	0.0%	0.0%	0.8%	11.0%	50.1%	0.1%	0.0%	0.0%	16.0%	9.5%
Massachusetts	15.1%	0.0%	0.0%	0.2%	13.0%	60.1%	0.1%	0.0%	0.0%	4.7%	6.9%
Michigan	11.6%	0.0%	0.0%	1.0%	11.2%	45.1%	0.1%	0.0%	0.0%	17.6%	13.4%
Minnesota	13.8%	0.0%	0.0%	2.3%	15.7%	37.2%	0.5%	0.0%	0.0%	15.4%	15.2%
Mississippi	10.9%	0.0%	0.0%	4.9%	7.3%	37.3%	4.1%	0.0%	0.0%	15.4%	20.1%
Missouri	14.4%	0.0%	0.0%	4.1%	10.6%	40.4%	0.8%	0.0%	0.0%	19.6%	10.1%
Montana	19.3%	0.2%	0.0%	9.7%	12.7%	22.4%	3.5%	0.0%	0.3%	21.2%	10.7%
Nebraska	31.0%	0.0%	0.0%	7.5%	15.1%	21.9%	0.6%	0.0%	0.0%	18.0%	5.9%
Nevada	9.7%	0.0%	0.0%	6.3%	14.6%	42.9%	0.6%	0.0%	0.0%	13.7%	12.1%
New Hampshire	13.6%	0.0%	0.0%	0.9%	15.1%	55.6%	0.0%	0.0%	0.0%	9.8%	4.9%
New Jersey	27.6%	0.0%	0.0%	0.3%	12.0%	50.7%	0.1%	0.0%	0.0%	3.9%	5.5%
New Mexico	12.4%	16.0%	0.0%	7.1%	3.8%	32.1%	0.7%	0.0%	13.9%	12.0%	2.0%
New York	17.9%	0.0%	0.0%	0.6%	12.8%	54.6%	0.0%	0.0%	0.0%	5.6%	8.4%
North Carolina	6.9%	0.0%	0.0%	2.5%	12.1%	53.9%	2.4%	0.0%	0.0%	12.8%	9.4%
North Dakota	10.2%	0.0%	0.0%	5.6%	21.0%	13.9%	1.8%	0.0%	0.0%	40.6%	7.0%
Ohio	11.9%	0.0%	0.0%	0.9%	9.8%	37.8%	0.1%	0.0%	0.0%	30.8%	8.7%
Oklahoma	8.1%	16.0%	0.0%	6.1%	6.5%	27.4%	2.0%	0.0%	0.0%	18.6%	15.3%
Oregon	12.8%	0.0%	0.0%	2.9%	12.4%	52.0%	7.4%	0.0%	0.0%	5.0%	7.5%
Pennsylvania	12.5%	0.0%	0.0%	0.8%	8.4%	38.2%	0.2%	0.0%	0.0%	28.9%	11.0%
Rhode Island	16.7%	0.0%	0.0%	0.1%	13.9%	64.0%	0.1%	0.0%	0.0%	0.7%	4.5%
South Carolina	7.5%	0.0%	0.0%	3.3%	10.0%	48.4%	2.5%	0.0%	0.0%	17.0%	11.3%
South Dakota	6.6%	0.0%	0.0%	16.5%	27.6%	30.1%	0.9%	0.0%	0.0%	15.5%	2.8%
Tennessee	12.9%	0.0%	0.0%	2.2%	8.6%	43.8%	0.7%	0.0%	0.0%	20.2%	11.5%
Texas	8.6%	15.8%	0.0%	5.5%	10.4%	33.1%	1.5%	0.0%	2.5%	10.0%	12.6%
Utah	8.5%	6.2%	0.0%	3.0%	6.6%	31.8%	0.5%	0.0%	1.5%	30.3%	11.6%
Vermont	15.2%	0.0%	0.0%	1.8%	12.2%	69.1%	0.1%	0.0%	0.0%	1.0%	0.7%
Virginia	13.5%	0.0%	0.0%	1.7%	10.3%	47.9%	1.2%	0.0%	0.0%	11.3%	14.0%
Washington	18.2%	0.0%	0.0%	1.4%	13.8%	50.7%	1.9%	0.0%	0.0%	3.9%	10.0%
West Virginia	13.4%	0.0%	0.0%	0.9%	3.1%	24.7%	0.5%	0.0%	0.0%	42.5%	14.9%
Wisconsin	12.6%	0.0%	0.0%	1.9%	13.6%	46.1%	0.2%	0.0%	0.0%	13.9%	11.7%
Wyoming	16.6%	9.9%	0.0%	3.1%	2.1%	12.0%	2.4%	0.0%	10.3%	33.0%	10.6%
Tribal Data	0.3%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	90.0%	9.7%
Grand Total	12.2%	2.3%	0.0%	3.0%	10.9%	41.5%	2.0%	0.0%	0.7%	16.7%	10.8%

Table 5a. Summary of 2008 VOC emissions (tons per year) by state and major source category (not shown are 25,259 TPY near-shore and 17,165 TPY off-shore commercial marine vessel and Mexico/Canada emissions).

State	Area	Area-O&G	Dust	Biogenic	Off-Road	On-Road	Fires	WBD	PT-O&G	PTCEM	PTNCEM	Total
Alabama	76,980	-	-	1,762,020	47,313	115,402	30,208	-	-	1,037	31,249	2,064,208
Arizona	100,256	12	-	686,255	42,297	54,589	4,989	-	-	492	3,006	891,897
Arkansas	78,116	1,250	-	1,527,879	32,580	35,817	46,272	-	-	488	27,552	1,749,953
California	297,201	15,149	-	1,230,279	164,441	198,383	331,443	-	-	428	41,989	2,279,313
Colorado	67,133	68,895	-	275,328	34,301	55,953	3,732	-	79,847	508	29,160	614,856
Connecticut	34,918	-	-	80,798	24,291	57,602	13	-	-	151	1,099	198,871
Delaware	10,126	-	-	23,155	8,343	15,416	139	-	-	80	3,060	60,318
District of Columbia	5,926	-	-	1,277	1,461	5,748	0	-	-	-	70	14,482
Florida	271,935	-	-	1,300,657	184,173	271,441	71,868	-	-	1,909	31,442	2,133,426
Georgia	193,060	2	-	1,812,923	65,986	191,315	37,034	-	-	1,563	24,257	2,326,140
Idaho	89,706	-	-	240,280	21,971	18,852	35,143	-	-	-	1,168	407,120
Illinois	220,505	-	-	340,743	86,268	121,532	6,502	-	-	1,611	49,787	826,948
Indiana	157,552	-	-	246,726	47,016	94,503	4,003	-	-	1,954	37,688	589,442
Iowa	72,253	-	-	205,546	37,382	40,382	4,948	-	-	642	21,854	383,007
Kansas	74,796	-	-	303,333	19,675	35,329	35,743	-	-	743	18,017	487,636
Kentucky	65,753	-	-	607,945	34,537	102,156	4,506	-	-	1,598	44,025	860,519
Louisiana	142,759	1,627	-	1,366,208	52,974	49,730	45,123	-	-	1,089	67,684	1,727,193
Maine	27,547	-	-	235,236	29,353	17,703	65	-	-	34	4,150	314,086
Maryland	69,461	-	-	185,604	38,551	51,039	484	-	-	330	2,873	348,343
Massachusetts	86,801	-	-	95,444	41,113	52,645	235	-	-	331	4,012	280,582
Michigan	191,730	10,505	-	373,995	138,301	132,274	934	-	-	1,127	28,008	876,873
Minnesota	117,043	-	-	449,437	86,508	72,627	7,962	-	-	637	22,448	756,663
Mississippi	62,248	-	-	1,611,910	32,271	44,474	29,856	-	-	551	32,378	1,813,687
Missouri	124,875	-	-	1,262,144	51,348	81,169	13,759	-	-	1,571	16,512	1,551,376
Montana	18,512	204	-	305,432	12,449	13,231	13,434	-	136	395	4,150	367,944
Nebraska	45,187	-	-	167,093	15,104	24,272	6,281	-	-	436	3,563	261,936
Nevada	40,973	-	-	262,912	18,783	21,302	1,127	-	-	159	2,801	348,056
New Hampshire	22,282	-	-	91,432	19,528	13,952	15	-	-	93	692	147,993
New Jersey	104,950	-	-	104,571	60,061	68,286	761	-	-	135	9,642	348,407
New Mexico	37,395	174,990	-	468,258	11,383	29,629	2,677	-	7,573	281	2,006	734,193
New York	276,502	-	-	341,530	159,616	134,192	487	-	-	747	6,996	920,069
North Carolina	179,251	-	-	1,118,947	72,837	103,811	22,312	-	-	969	38,171	1,536,298
North Dakota	21,194	-	-	118,195	11,892	10,928	13,873	-	-	744	3,142	179,968
Ohio	179,500	-	-	322,698	80,466	129,332	2,443	-	-	1,305	31,308	747,052
Oklahoma	60,527	190,550	-	949,937	30,881	54,459	15,942	-	-	1,044	24,655	1,327,994
Oregon	63,741	-	-	339,630	33,308	39,649	41,271	-	-	226	8,351	526,176
Pennsylvania	200,885	-	-	428,612	94,997	116,818	2,487	-	-	724	28,592	873,115
Rhode Island	10,258	-	-	8,317	6,332	8,163	68	-	-	8	1,191	34,337
South Carolina	97,066	-	-	910,898	39,523	52,834	11,748	-	-	546	24,539	1,137,153
South Dakota	27,164	-	-	151,342	10,827	11,521	2,833	-	-	126	2,430	206,244
Tennessee	110,817	-	-	852,463	50,671	79,157	7,754	-	-	886	37,110	1,138,859
Texas	409,731	1,299,083	-	4,094,242	152,377	229,629	39,683	-	4,118	3,601	108,514	6,340,979
Utah	72,811	96,412	-	237,799	23,213	27,138	1,977	-	2,619	275	6,409	468,653
Vermont	11,303	-	-	66,394	10,152	8,469	37	-	-	33	458	96,845
Virginia	140,761	-	-	823,308	52,186	83,170	9,501	-	-	548	27,386	1,136,860
Washington	102,173	-	-	224,471	52,264	59,343	16,533	-	-	15	12,726	467,525
West Virginia	27,945	-	-	411,187	16,711	23,538	2,455	-	-	1,191	10,926	493,951
Wisconsin	135,333	-	-	338,335	97,471	75,111	1,828	-	-	1,032	30,522	679,632
Wyoming	11,719	103,208	-	177,044	9,081	10,760	14,792	-	9,441	827	10,526	347,397
Tribal Data	1,448	-	-	-	-	-	-	-	-	572	880	2,900
Grand Total	5,048,106	1,961,886	-	29,540,164	2,464,564	3,344,778	947,278	-	103,734	35,791	981,174	44,427,474

Table 5b. Percent contribution of source categories to VOC emissions by state.

State	Area	Area-O&G	Dust	Biogenic	Off-Road	On-Road	Fires	WBD	PT-O&G	PTCEM	PTNCEM
Alabama	3.7%	0.0%	0.0%	85.4%	2.3%	5.6%	1.5%	0.0%	0.0%	0.1%	1.5%
Arizona	11.2%	0.0%	0.0%	76.9%	4.7%	6.1%	0.6%	0.0%	0.0%	0.1%	0.3%
Arkansas	4.5%	0.1%	0.0%	87.3%	1.9%	2.0%	2.6%	0.0%	0.0%	0.0%	1.6%
California	13.0%	0.7%	0.0%	54.0%	7.2%	8.7%	14.5%	0.0%	0.0%	0.0%	1.8%
Colorado	10.9%	11.2%	0.0%	44.8%	5.6%	9.1%	0.6%	0.0%	13.0%	0.1%	4.7%
Connecticut	17.6%	0.0%	0.0%	40.6%	12.2%	29.0%	0.0%	0.0%	0.0%	0.1%	0.6%
Delaware	16.8%	0.0%	0.0%	38.4%	13.8%	25.6%	0.2%	0.0%	0.0%	0.1%	5.1%
District of Columbia	40.9%	0.0%	0.0%	8.8%	10.1%	39.7%	0.0%	0.0%	0.0%	0.0%	0.5%
Florida	12.7%	0.0%	0.0%	61.0%	8.6%	12.7%	3.4%	0.0%	0.0%	0.1%	1.5%
Georgia	8.3%	0.0%	0.0%	77.9%	2.8%	8.2%	1.6%	0.0%	0.0%	0.1%	1.0%
Idaho	22.0%	0.0%	0.0%	59.0%	5.4%	4.6%	8.6%	0.0%	0.0%	0.0%	0.3%
Illinois	26.7%	0.0%	0.0%	41.2%	10.4%	14.7%	0.8%	0.0%	0.0%	0.2%	6.0%
Indiana	26.7%	0.0%	0.0%	41.9%	8.0%	16.0%	0.7%	0.0%	0.0%	0.3%	6.4%
Iowa	18.9%	0.0%	0.0%	53.7%	9.8%	10.5%	1.3%	0.0%	0.0%	0.2%	5.7%
Kansas	15.3%	0.0%	0.0%	62.2%	4.0%	7.2%	7.3%	0.0%	0.0%	0.2%	3.7%
Kentucky	7.6%	0.0%	0.0%	70.6%	4.0%	11.9%	0.5%	0.0%	0.0%	0.2%	5.1%
Louisiana	8.3%	0.1%	0.0%	79.1%	3.1%	2.9%	2.6%	0.0%	0.0%	0.1%	3.9%
Maine	8.8%	0.0%	0.0%	74.9%	9.3%	5.6%	0.0%	0.0%	0.0%	0.0%	1.3%
Maryland	19.9%	0.0%	0.0%	53.3%	11.1%	14.7%	0.1%	0.0%	0.0%	0.1%	0.8%
Massachusetts	30.9%	0.0%	0.0%	34.0%	14.7%	18.8%	0.1%	0.0%	0.0%	0.1%	1.4%
Michigan	21.9%	1.2%	0.0%	42.7%	15.8%	15.1%	0.1%	0.0%	0.0%	0.1%	3.2%
Minnesota	15.5%	0.0%	0.0%	59.4%	11.4%	9.6%	1.1%	0.0%	0.0%	0.1%	3.0%
Mississippi	3.4%	0.0%	0.0%	88.9%	1.8%	2.5%	1.6%	0.0%	0.0%	0.0%	1.8%
Missouri	8.0%	0.0%	0.0%	81.4%	3.3%	5.2%	0.9%	0.0%	0.0%	0.1%	1.1%
Montana	5.0%	0.1%	0.0%	83.0%	3.4%	3.6%	3.7%	0.0%	0.0%	0.1%	1.1%
Nebraska	17.3%	0.0%	0.0%	63.8%	5.8%	9.3%	2.4%	0.0%	0.0%	0.2%	1.4%
Nevada	11.8%	0.0%	0.0%	75.5%	5.4%	6.1%	0.3%	0.0%	0.0%	0.0%	0.8%
New Hampshire	15.1%	0.0%	0.0%	61.8%	13.2%	9.4%	0.0%	0.0%	0.0%	0.1%	0.5%
New Jersey	30.1%	0.0%	0.0%	30.0%	17.2%	19.6%	0.2%	0.0%	0.0%	0.0%	2.8%
New Mexico	5.1%	23.8%	0.0%	63.8%	1.6%	4.0%	0.4%	0.0%	1.0%	0.0%	0.3%
New York	30.1%	0.0%	0.0%	37.1%	17.3%	14.6%	0.1%	0.0%	0.0%	0.1%	0.8%
North Carolina	11.7%	0.0%	0.0%	72.8%	4.7%	6.8%	1.5%	0.0%	0.0%	0.1%	2.5%
North Dakota	11.8%	0.0%	0.0%	65.7%	6.6%	6.1%	7.7%	0.0%	0.0%	0.4%	1.7%
Ohio	24.0%	0.0%	0.0%	43.2%	10.8%	17.3%	0.3%	0.0%	0.0%	0.2%	4.2%
Oklahoma	4.6%	14.3%	0.0%	71.5%	2.3%	4.1%	1.2%	0.0%	0.0%	0.1%	1.9%
Oregon	12.1%	0.0%	0.0%	64.5%	6.3%	7.5%	7.8%	0.0%	0.0%	0.0%	1.6%
Pennsylvania	23.0%	0.0%	0.0%	49.1%	10.9%	13.4%	0.3%	0.0%	0.0%	0.1%	3.3%
Rhode Island	29.9%	0.0%	0.0%	24.2%	18.4%	23.8%	0.2%	0.0%	0.0%	0.0%	3.5%
South Carolina	8.5%	0.0%	0.0%	80.1%	3.5%	4.6%	1.0%	0.0%	0.0%	0.0%	2.2%
South Dakota	13.2%	0.0%	0.0%	73.4%	5.2%	5.6%	1.4%	0.0%	0.0%	0.1%	1.2%
Tennessee	9.7%	0.0%	0.0%	74.9%	4.4%	7.0%	0.7%	0.0%	0.0%	0.1%	3.3%
Texas	6.5%	20.5%	0.0%	64.6%	2.4%	3.6%	0.6%	0.0%	0.1%	0.1%	1.7%
Utah	15.5%	20.6%	0.0%	50.7%	5.0%	5.8%	0.4%	0.0%	0.6%	0.1%	1.4%
Vermont	11.7%	0.0%	0.0%	68.6%	10.5%	8.7%	0.0%	0.0%	0.0%	0.0%	0.5%
Virginia	12.4%	0.0%	0.0%	72.4%	4.6%	7.3%	0.8%	0.0%	0.0%	0.0%	2.4%
Washington	21.9%	0.0%	0.0%	48.0%	11.2%	12.7%	3.5%	0.0%	0.0%	0.0%	2.7%
West Virginia	5.7%	0.0%	0.0%	83.2%	3.4%	4.8%	0.5%	0.0%	0.0%	0.2%	2.2%
Wisconsin	19.9%	0.0%	0.0%	49.8%	14.3%	11.1%	0.3%	0.0%	0.0%	0.2%	4.5%
Wyoming	3.4%	29.7%	0.0%	51.0%	2.6%	3.1%	4.3%	0.0%	2.7%	0.2%	3.0%
Tribal Data	49.9%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	19.7%	30.3%
Grand Total	11.4%	4.4%	0.0%	66.5%	5.5%	7.5%	2.1%	0.0%	0.2%	0.1%	2.2%

Table 6a. Summary of 2008 NH_3 emissions (tons per year) by state and major source category (not shown are Mexico and Canada emissions).

State	Area	Area-O&G	Dust	Biogenic	Off-Road	On-Road	Fires	WBD	PT-O&G	PTCEM	PTNCEM	Total
Alabama	62,464	-	-	-	30	4,514	-	-	-	551	1,599	69,159
Arizona	34,878	-	-	-	40	2,377	-	-	-	923	51	38,267
Arkansas	120,628	-	-	-	26	1,388	-	-	-	256	935	123,233
California	322,270	-	-	-	192	8,729	-	-	-	745	10,874	342,810
Colorado	70,451	-	-	-	35	2,201	-	-	-	468	1	73,156
Connecticut	3,471	-	-	-	18	2,572	-	-	-	283	-	6,344
Delaware	13,294	-	-	-	6	729	-	-	-	142	128	14,299
District of Columbia	180	-	-	-	3	299	-	-	-	-	0	482
Florida	33,829	-	-	-	137	12,069	-	-	-	3,618	1,761	51,414
Georgia	85,923	-	-	-	58	8,506	-	-	-	1,058	4,911	100,455
Idaho	104,060	-	-	-	16	689	-	-	-	-	1,045	105,810
Illinois	122,497	-	-	-	100	5,089	-	-	-	193	1,297	129,176
Indiana	103,870	-	-	-	54	3,533	-	-	-	346	843	108,647
Iowa	296,453	-	-	-	52	1,416	-	-	-	22	3,406	301,350
Kansas	152,679	-	-	-	37	1,317	-	-	-	358	1,581	155,972
Kentucky	52,417	-	-	-	29	4,125	-	-	-	795	177	57,543
Louisiana	61,866	-	-	-	32	2,006	-	-	-	1,477	6,250	71,630
Maine	5,888	-	-	-	13	672	-	-	-	29	584	7,186
Maryland	28,295	-	-	-	31	2,416	-	-	-	202	0	30,944
Massachusetts	4,238	-	-	-	31	2,570	-	-	-	196	327	7,361
Michigan	66,125	-	-	-	85	4,745	-	-	-	141	768	71,864
Minnesota	186,073	-	-	-	65	2,466	-	-	-	200	1,809	190,613
Mississippi	59,473	-	-	-	21	1,723	-	-	-	481	1,486	63,184
Missouri	126,012	-	-	-	48	3,228	-	-	-	143	1,518	130,948
Montana	55,254	-	-	-	16	458	-	-	-	6	48	55,782
Nebraska	176,682	-	-	-	31	852	-	-	-	192	1,023	178,780
Nevada	5,717	-	-	-	20	849	-	-	-	225	77	6,887
New Hampshire	1,530	-	-	-	10	580	-	-	-	153	47	2,321
New Jersey	6,406	-	-	-	45	3,328	-	-	-	118	1,005	10,902
New Mexico	39,399	-	-	-	10	1,090	-	-	-	274	0	40,773
New York	42,019	-	-	-	88	6,262	-	-	-	1,596	1,441	51,406
North Carolina	169,574	-	-	-	59	4,366	-	-	-	149	1,376	175,525
North Dakota	78,857	-	-	-	29	345	-	-	-	369	6,019	85,618
Ohio	88,035	-	-	-	79	5,177	-	-	-	66	3,019	96,376
Oklahoma	98,039	-	-	-	29	2,063	-	-	-	718	2,347	103,196
Oregon	43,814	-	-	-	27	1,668	-	-	-	252	3	45,764
Pennsylvania	72,491	-	-	-	61	4,976	-	-	-	413	1,632	79,573
Rhode Island	589	-	-	-	5	404	-	-	-	4	115	1,118
South Carolina	30,367	-	-	-	30	2,121	-	-	-	283	1,845	34,645
South Dakota	131,616	-	-	-	21	386	-	-	-	34	229	132,286
Tennessee	34,903	-	-	-	39	3,197	-	-	-	207	988	39,334
Texas	290,794	-	-	-	1,125	10,151	-	-	35	4,404	2,207	308,716
Utah	37,639	-	-	-	16	1,048	-	-	-	23	534	39,260
Vermont	8,019	-	-	-	5	341	-	-	-	15	-	8,380
Virginia	43,188	-	-	-	46	3,619	-	-	-	269	1,289	48,410
Washington	44,368	-	-	-	43	2,543	-	-	-	92	350	47,397
West Virginia	12,857	-	-	-	9	904	-	-	-	33	274	14,077
Wisconsin	118,588	-	-	-	57	2,796	-	-	-	426	498	122,366
Wyoming	19,446	-	-	-	6	374	-	-	-	440	278	20,543
Tribal Data	1,452	-	-	-	-	-	-	-	-	286	30	1,768
Grand Total	3,768,976	-	-	-	3,060	139,275	-	-	35	23,674	68,025	4,003,044

Table 6b. Percent contribution of source categories to NH_3 emissions by state.

State	Area	Area-O&G	Dust	Biogenic	Off-Road	On-Road	Fires	WBD	PT-O&G	PTCEM	PTNCEM
Alabama	90.3%	0.0%	0.0%	0.0%	0.0%	6.5%	0.0%	0.0%	0.0%	0.8%	2.3%
Arizona	91.1%	0.0%	0.0%	0.0%	0.1%	6.2%	0.0%	0.0%	0.0%	2.4%	0.1%
Arkansas	97.9%	0.0%	0.0%	0.0%	0.0%	1.1%	0.0%	0.0%	0.0%	0.2%	0.8%
California	94.0%	0.0%	0.0%	0.0%	0.1%	2.5%	0.0%	0.0%	0.0%	0.2%	3.2%
Colorado	96.3%	0.0%	0.0%	0.0%	0.0%	3.0%	0.0%	0.0%	0.0%	0.6%	0.0%
Connecticut	54.7%	0.0%	0.0%	0.0%	0.3%	40.5%	0.0%	0.0%	0.0%	4.5%	0.0%
Delaware	93.0%	0.0%	0.0%	0.0%	0.0%	5.1%	0.0%	0.0%	0.0%	1.0%	0.9%
District of Columbia	37.4%	0.0%	0.0%	0.0%	0.6%	62.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Florida	65.8%	0.0%	0.0%	0.0%	0.3%	23.5%	0.0%	0.0%	0.0%	7.0%	3.4%
Georgia	85.5%	0.0%	0.0%	0.0%	0.1%	8.5%	0.0%	0.0%	0.0%	1.1%	4.9%
Idaho	98.3%	0.0%	0.0%	0.0%	0.0%	0.7%	0.0%	0.0%	0.0%	0.0%	1.0%
Illionis	94.8%	0.0%	0.0%	0.0%	0.1%	3.9%	0.0%	0.0%	0.0%	0.1%	1.0%
Indiana	95.6%	0.0%	0.0%	0.0%	0.0%	3.3%	0.0%	0.0%	0.0%	0.3%	0.8%
Iowa	98.4%	0.0%	0.0%	0.0%	0.0%	0.5%	0.0%	0.0%	0.0%	0.0%	1.1%
Kansas	97.9%	0.0%	0.0%	0.0%	0.0%	0.8%	0.0%	0.0%	0.0%	0.2%	1.0%
Kentucky	91.1%	0.0%	0.0%	0.0%	0.0%	7.2%	0.0%	0.0%	0.0%	1.4%	0.3%
Louisiana	86.4%	0.0%	0.0%	0.0%	0.0%	2.8%	0.0%	0.0%	0.0%	2.1%	8.7%
Maine	81.9%	0.0%	0.0%	0.0%	0.2%	9.4%	0.0%	0.0%	0.0%	0.4%	8.1%
Maryland	91.4%	0.0%	0.0%	0.0%	0.1%	7.8%	0.0%	0.0%	0.0%	0.7%	0.0%
Massachusetts	57.6%	0.0%	0.0%	0.0%	0.4%	34.9%	0.0%	0.0%	0.0%	2.7%	4.4%
Michigan	92.0%	0.0%	0.0%	0.0%	0.1%	6.6%	0.0%	0.0%	0.0%	0.2%	1.1%
Minnesota	97.6%	0.0%	0.0%	0.0%	0.0%	1.3%	0.0%	0.0%	0.0%	0.1%	0.9%
Mississippi	94.1%	0.0%	0.0%	0.0%	0.0%	2.7%	0.0%	0.0%	0.0%	0.8%	2.4%
Missouri	96.2%	0.0%	0.0%	0.0%	0.0%	2.5%	0.0%	0.0%	0.0%	0.1%	1.2%
Montana	99.1%	0.0%	0.0%	0.0%	0.0%	0.8%	0.0%	0.0%	0.0%	0.0%	0.1%
Nebraska	98.8%	0.0%	0.0%	0.0%	0.0%	0.5%	0.0%	0.0%	0.0%	0.1%	0.6%
Nevada	83.0%	0.0%	0.0%	0.0%	0.3%	12.3%	0.0%	0.0%	0.0%	3.3%	1.1%
New Hampshire	65.9%	0.0%	0.0%	0.0%	0.4%	25.0%	0.0%	0.0%	0.0%	6.6%	2.0%
New Jersey	58.8%	0.0%	0.0%	0.0%	0.4%	30.5%	0.0%	0.0%	0.0%	1.1%	9.2%
New Mexico	96.6%	0.0%	0.0%	0.0%	0.0%	2.7%	0.0%	0.0%	0.0%	0.7%	0.0%
New York	81.7%	0.0%	0.0%	0.0%	0.2%	12.2%	0.0%	0.0%	0.0%	3.1%	2.8%
North Carolina	96.6%	0.0%	0.0%	0.0%	0.0%	2.5%	0.0%	0.0%	0.0%	0.1%	0.8%
North Dakota	92.1%	0.0%	0.0%	0.0%	0.0%	0.4%	0.0%	0.0%	0.0%	0.4%	7.0%
Ohio	91.3%	0.0%	0.0%	0.0%	0.1%	5.4%	0.0%	0.0%	0.0%	0.1%	3.1%
Oklahoma	95.0%	0.0%	0.0%	0.0%	0.0%	2.0%	0.0%	0.0%	0.0%	0.7%	2.3%
Oregon	95.7%	0.0%	0.0%	0.0%	0.1%	3.6%	0.0%	0.0%	0.0%	0.6%	0.0%
Pennsylvania	91.1%	0.0%	0.0%	0.0%	0.1%	6.3%	0.0%	0.0%	0.0%	0.5%	2.1%
Rhode Island	52.7%	0.0%	0.0%	0.0%	0.4%	36.2%	0.0%	0.0%	0.0%	0.4%	10.3%
South Carolina	87.7%	0.0%	0.0%	0.0%	0.1%	6.1%	0.0%	0.0%	0.0%	0.8%	5.3%
South Dakota	99.5%	0.0%	0.0%	0.0%	0.0%	0.3%	0.0%	0.0%	0.0%	0.0%	0.2%
Tennessee	88.7%	0.0%	0.0%	0.0%	0.1%	8.1%	0.0%	0.0%	0.0%	0.5%	2.5%
Texas	94.2%	0.0%	0.0%	0.0%	0.4%	3.3%	0.0%	0.0%	0.0%	1.4%	0.7%
Utah	95.9%	0.0%	0.0%	0.0%	0.0%	2.7%	0.0%	0.0%	0.0%	0.1%	1.4%
Vermont	95.7%	0.0%	0.0%	0.0%	0.1%	4.1%	0.0%	0.0%	0.0%	0.2%	0.0%
Virginia	89.2%	0.0%	0.0%	0.0%	0.1%	7.5%	0.0%	0.0%	0.0%	0.6%	2.7%
Washington	93.6%	0.0%	0.0%	0.0%	0.1%	5.4%	0.0%	0.0%	0.0%	0.2%	0.7%
West Virginia	91.3%	0.0%	0.0%	0.0%	0.1%	6.4%	0.0%	0.0%	0.0%	0.2%	1.9%
Wisconsin	96.9%	0.0%	0.0%	0.0%	0.0%	2.3%	0.0%	0.0%	0.0%	0.3%	0.4%
Wyoming	94.7%	0.0%	0.0%	0.0%	0.0%	1.8%	0.0%	0.0%	0.0%	2.1%	1.4%
Tribal Data	82.1%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	16.2%	1.7%
Grand Total	94.2%	0.0%	0.0%	0.0%	0.1%	3.5%	0.0%	0.0%	0.0%	0.6%	1.7%

Table 7a. Summary of 2008 SO_2 emissions (tons per year) by state and major source category (not shown are 305,580 TPY near-shore and 300,238 TPY off-shore commercial marine vessel and Mexico/Canada emissions).

State	Area	Area-O&G	Dust	Biogenic	Off-Road	On-Road	Fires	WBD	PT-O&G	PTCEM	PTNCEM	Total
Alabama	1,686	-	-	-	465	1,866	3,831	-	-	365,285	66,061	439,193
Arizona	3,678	-	-	-	673	812	607	-	-	44,226	35,006	85,001
Arkansas	688	380	-	-	464	589	2,103	-	-	73,296	14,074	91,595
California	9,562	0	-	-	428	1,936	20,011	-	-	196	27,204	59,337
Colorado	493	555	-	-	609	959	207	-	110	56,713	7,714	67,360
Connecticut	12,190	-	-	-	247	926	1	-	-	5,000	522	18,887
Delaware	919	-	-	-	267	277	6	-	-	33,669	7,464	42,603
District of Columbia	818	-	-	-	59	107	0	-	-	-	344	1,328
Florida	1,971	-	-	-	2,114	4,975	4,524	-	-	269,734	45,070	328,388
Georgia	1,110	-	-	-	962	2,974	3,557	-	-	514,496	39,300	562,400
Idaho	8,929	-	-	-	276	332	2,019	-	-	-	7,511	19,067
Illinois	7,730	-	-	-	137	2,037	145	-	-	277,649	99,789	387,486
Indiana	16,100	-	-	-	1,031	1,514	108	-	-	598,510	81,755	699,018
Iowa	2,527	-	-	-	1,051	628	70	-	-	109,277	51,777	165,330
Kansas	7,527	-	-	-	816	578	1,181	-	-	95,683	7,334	113,119
Kentucky	2,140	-	-	-	507	1,673	344	-	-	343,756	30,992	379,412
Louisiana	10,223	-	-	-	474	853	3,307	-	-	82,221	138,334	235,412
Maine	8,935	-	-	-	136	298	6	-	-	1,035	12,578	22,987
Maryland	5,646	-	-	-	455	967	43	-	-	228,351	27,327	262,788
Massachusetts	19,259	-	-	-	424	821	25	-	-	46,517	6,432	73,478
Michigan	15,338	-	-	-	1,156	2,236	67	-	-	327,282	59,764	405,842
Minnesota	9,448	-	-	-	1,104	956	145	-	-	74,039	25,261	110,953
Mississippi	1,199	-	-	-	355	729	1,933	-	-	65,082	18,877	88,174
Missouri	45,425	-	-	-	881	1,453	471	-	-	258,118	109,614	415,962
Montana	584	21	-	-	336	229	725	-	2	19,506	7,916	29,319
Nebraska	927	-	-	-	701	378	89	-	-	75,695	2,579	80,367
Nevada	4,863	-	-	-	322	298	100	-	-	9,328	1,832	16,744
New Hampshire	5,996	-	-	-	120	214	2	-	-	36,889	2,049	45,270
New Jersey	10,459	-	-	-	604	1,162	83	-	-	24,685	3,408	40,401
New Mexico	347	1,076	-	-	167	498	282	-	12,801	11,326	556	27,053
New York	71,087	-	-	-	3,404	2,410	53	-	-	65,779	48,257	190,991
North Carolina	12,268	-	-	-	989	1,861	2,406	-	-	227,880	46,503	291,907
North Dakota	729	-	-	-	683	156	182	-	-	132,584	9,563	143,897
Ohio	14,915	-	-	-	1,338	2,324	119	-	-	709,286	134,327	862,309
Oklahoma	4,623	10	-	-	519	904	1,079	-	-	101,316	36,015	144,466
Oregon	1,528	-	-	-	431	654	2,375	-	-	11,344	4,586	20,918
Pennsylvania	72,063	-	-	-	1,285	2,033	232	-	-	859,470	42,763	977,846
Rhode Island	2,801	-	-	-	63	131	5	-	-	5	917	3,920
South Carolina	1,760	-	-	-	483	953	1,452	-	-	160,915	30,622	196,185
South Dakota	339	-	-	-	484	179	87	-	-	13,535	1,196	15,821
Tennessee	65,626	-	-	-	642	1,390	538	-	-	209,981	45,423	323,601
Texas	7,853	4,487	-	-	3,495	3,939	3,223	-	2,327	484,207	112,996	622,526
Utah	1,988	425	-	-	286	497	140	-	7	20,075	8,146	31,564
Vermont	3,738	-	-	-	65	150	5	-	-	2	165	4,125
Virginia	14,509	-	-	-	739	1,477	1,152	-	-	124,100	50,296	192,273
Washington	3,220	-	-	-	703	994	801	-	-	2,015	13,487	21,221
West Virginia	5,716	-	-	-	130	405	302	-	-	312,097	31,787	350,436
Wisconsin	7,164	-	-	-	811	1,147	84	-	-	133,461	59,983	202,650
Wyoming	501	1,822	-	-	95	190	927	-	7,022	81,911	19,850	112,319
Tribal Data	389	-	-	-	-	-	-	-	-	15,139	42	15,570
Grand Total	509,534	8,777	-	-	33,984	55,072	61,155	-	22,268	7,712,661	1,635,370	10,038,821

Table 7b. Percent contribution of source categories to SO_2 emissions by state.

State	Area	Area-O&G	Dust	Biogenic	Off-Road	On-Road	Fires	WBD	PT-O&G	PTCEM	PTNCEM
Alabama	0.4%	0.0%	0.0%	0.0%	0.1%	0.4%	0.9%	0.0%	0.0%	83.2%	15.0%
Arizona	4.3%	0.0%	0.0%	0.0%	0.8%	1.0%	0.7%	0.0%	0.0%	52.0%	41.2%
Arkansas	0.8%	0.4%	0.0%	0.0%	0.5%	0.6%	2.3%	0.0%	0.0%	80.0%	15.4%
California	16.1%	0.0%	0.0%	0.0%	0.7%	3.3%	33.7%	0.0%	0.0%	0.3%	45.8%
Colorado	0.7%	0.8%	0.0%	0.0%	0.9%	1.4%	0.3%	0.0%	0.2%	84.2%	11.5%
Connecticut	64.5%	0.0%	0.0%	0.0%	1.3%	4.9%	0.0%	0.0%	0.0%	26.5%	2.8%
Delaware	2.2%	0.0%	0.0%	0.0%	0.6%	0.7%	0.0%	0.0%	0.0%	79.0%	17.5%
District of Columbia	61.6%	0.0%	0.0%	0.0%	4.4%	8.1%	0.0%	0.0%	0.0%	0.0%	25.9%
Florida	0.6%	0.0%	0.0%	0.0%	0.6%	1.5%	1.4%	0.0%	0.0%	82.1%	13.7%
Georgia	0.2%	0.0%	0.0%	0.0%	0.2%	0.5%	0.6%	0.0%	0.0%	91.5%	7.0%
Idaho	46.8%	0.0%	0.0%	0.0%	1.4%	1.7%	10.6%	0.0%	0.0%	0.0%	39.4%
Illionis	2.0%	0.0%	0.0%	0.0%	0.0%	0.5%	0.0%	0.0%	0.0%	71.7%	25.8%
Indiana	2.3%	0.0%	0.0%	0.0%	0.1%	0.2%	0.0%	0.0%	0.0%	85.6%	11.7%
Iowa	1.5%	0.0%	0.0%	0.0%	0.6%	0.4%	0.0%	0.0%	0.0%	66.1%	31.3%
Kansas	6.7%	0.0%	0.0%	0.0%	0.7%	0.5%	1.0%	0.0%	0.0%	84.6%	6.5%
Kentucky	0.6%	0.0%	0.0%	0.0%	0.1%	0.4%	0.1%	0.0%	0.0%	90.6%	8.2%
Louisiana	4.3%	0.0%	0.0%	0.0%	0.2%	0.4%	1.4%	0.0%	0.0%	34.9%	58.8%
Maine	38.9%	0.0%	0.0%	0.0%	0.6%	1.3%	0.0%	0.0%	0.0%	4.5%	54.7%
Maryland	2.1%	0.0%	0.0%	0.0%	0.2%	0.4%	0.0%	0.0%	0.0%	86.9%	10.4%
Massachusetts	26.2%	0.0%	0.0%	0.0%	0.6%	1.1%	0.0%	0.0%	0.0%	63.3%	8.8%
Michigan	3.8%	0.0%	0.0%	0.0%	0.3%	0.6%	0.0%	0.0%	0.0%	80.6%	14.7%
Minnesota	8.5%	0.0%	0.0%	0.0%	1.0%	0.9%	0.1%	0.0%	0.0%	66.7%	22.8%
Mississippi	1.4%	0.0%	0.0%	0.0%	0.4%	0.8%	2.2%	0.0%	0.0%	73.8%	21.4%
Missouri	10.9%	0.0%	0.0%	0.0%	0.2%	0.3%	0.1%	0.0%	0.0%	62.1%	26.4%
Montana	2.0%	0.1%	0.0%	0.0%	1.1%	0.8%	2.5%	0.0%	0.0%	66.5%	27.0%
Nebraska	1.2%	0.0%	0.0%	0.0%	0.9%	0.5%	0.1%	0.0%	0.0%	94.2%	3.2%
Nevada	29.0%	0.0%	0.0%	0.0%	1.9%	1.8%	0.6%	0.0%	0.0%	55.7%	10.9%
New Hampshire	13.2%	0.0%	0.0%	0.0%	0.3%	0.5%	0.0%	0.0%	0.0%	81.5%	4.5%
New Jersey	25.9%	0.0%	0.0%	0.0%	1.5%	2.9%	0.2%	0.0%	0.0%	61.1%	8.4%
New Mexico	1.3%	4.0%	0.0%	0.0%	0.6%	1.8%	1.0%	0.0%	47.3%	41.9%	2.1%
New York	37.2%	0.0%	0.0%	0.0%	1.8%	1.3%	0.0%	0.0%	0.0%	34.4%	25.3%
North Carolina	4.2%	0.0%	0.0%	0.0%	0.3%	0.6%	0.8%	0.0%	0.0%	78.1%	15.9%
North Dakota	0.5%	0.0%	0.0%	0.0%	0.5%	0.1%	0.1%	0.0%	0.0%	92.1%	6.6%
Ohio	1.7%	0.0%	0.0%	0.0%	0.2%	0.3%	0.0%	0.0%	0.0%	82.3%	15.6%
Oklahoma	3.2%	0.0%	0.0%	0.0%	0.4%	0.6%	0.7%	0.0%	0.0%	70.1%	24.9%
Oregon	7.3%	0.0%	0.0%	0.0%	2.1%	3.1%	11.4%	0.0%	0.0%	54.2%	21.9%
Pennsylvania	7.4%	0.0%	0.0%	0.0%	0.1%	0.2%	0.0%	0.0%	0.0%	87.9%	4.4%
Rhode Island	71.4%	0.0%	0.0%	0.0%	1.6%	3.3%	0.1%	0.0%	0.0%	0.1%	23.4%
South Carolina	0.9%	0.0%	0.0%	0.0%	0.2%	0.5%	0.7%	0.0%	0.0%	82.0%	15.6%
South Dakota	2.1%	0.0%	0.0%	0.0%	3.1%	1.1%	0.6%	0.0%	0.0%	85.6%	7.6%
Tennessee	20.3%	0.0%	0.0%	0.0%	0.2%	0.4%	0.2%	0.0%	0.0%	64.9%	14.0%
Texas	1.3%	0.7%	0.0%	0.0%	0.6%	0.6%	0.5%	0.0%	0.4%	77.8%	18.2%
Utah	6.3%	1.3%	0.0%	0.0%	0.9%	1.6%	0.4%	0.0%	0.0%	63.6%	25.8%
Vermont	90.6%	0.0%	0.0%	0.0%	1.6%	3.6%	0.1%	0.0%	0.0%	0.0%	4.0%
Virginia	7.5%	0.0%	0.0%	0.0%	0.4%	0.8%	0.6%	0.0%	0.0%	64.5%	26.2%
Washington	15.2%	0.0%	0.0%	0.0%	3.3%	4.7%	3.8%	0.0%	0.0%	9.5%	63.6%
West Virginia	1.6%	0.0%	0.0%	0.0%	0.0%	0.1%	0.1%	0.0%	0.0%	89.1%	9.1%
Wisconsin	3.5%	0.0%	0.0%	0.0%	0.4%	0.6%	0.0%	0.0%	0.0%	65.9%	29.6%
Wyoming	0.4%	1.6%	0.0%	0.0%	0.1%	0.2%	0.8%	0.0%	6.3%	72.9%	17.7%
Tribal Data	2.5%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	97.2%	0.3%
Grand Total	5.1%	0.1%	0.0%	0.0%	0.3%	0.5%	0.6%	0.0%	0.2%	76.8%	16.3%

Table 8a. Summary of 2008 $PM_{2.5}$ emissions (tons per year) by state and major source category (not shown are 38,019 TPY near-shore and 37,227 TPY off-shore commercial marine vessel and Mexico/Canada emissions).

State	Area	Area-O&G	Dust	Biogenic	Off-Road	On-Road	Fires	WBD	PT-O&G	PTCEM	PTNCEM	Total
Alabama	7,761	-	8,953	-	2,544	15,806	50,163	957	-	2,786	22,181	111,151
Arizona	16,114	-	26,124	-	3,311	8,756	8,238	9,307	-	1,904	3,730	77,483
Arkansas	7,214	-	23,607	-	2,474	5,416	27,885	5,397	-	1,236	6,452	79,682
California	83,888	7	39,371	-	14,681	18,437	261,920	12,133	-	965	22,741	454,144
Colorado	14,940	2,106	24,330	-	3,071	9,096	2,625	13,138	436	527	7,498	77,768
Connecticut	8,285	-	913	-	1,355	9,107	18	1	-	121	220	20,021
Delaware	1,143	-	716	-	455	2,265	80	11	-	1,875	1,080	7,626
District of Columbia	814	-	35	-	222	788	0	0	-	-	46	1,904
Florida	15,772	-	16,662	-	10,508	35,438	68,475	768	-	13,160	16,451	177,234
Georgia	22,019	-	17,096	-	4,864	29,351	47,301	562	-	5,999	6,567	133,760
Idaho	7,103	-	13,387	-	1,545	3,106	26,192	5,286	-	-	2,369	58,988
Illinois	27,875	-	64,780	-	8,397	18,873	1,918	8,083	-	5,474	12,037	147,437
Indiana	19,589	-	36,082	-	4,494	13,803	1,421	2,988	-	30,115	27,476	135,968
Iowa	7,787	-	51,972	-	5,025	6,166	979	27,674	-	5,657	5,796	111,055
Kansas	6,400	-	77,675	-	3,792	5,191	14,334	64,378	-	1,747	3,633	177,149
Kentucky	11,745	-	9,442	-	2,612	16,114	4,488	3,742	-	6,459	17,473	72,075
Louisiana	15,194	-	10,039	-	2,572	7,284	44,019	3,557	-	3,506	45,877	132,050
Maine	9,104	-	1,374	-	1,062	3,064	78	55	-	50	2,781	17,568
Maryland	10,694	-	3,773	-	2,447	8,389	550	137	-	5,945	2,674	34,609
Massachusetts	11,736	-	4,269	-	2,286	8,617	313	4	-	600	1,296	29,121
Michigan	36,601	-	21,668	-	6,539	17,931	820	1,628	-	1,602	13,401	100,191
Minnesota	24,606	-	47,934	-	6,025	10,909	1,971	10,661	-	3,470	12,909	118,484
Mississippi	10,035	-	13,082	-	1,917	6,410	25,544	3,597	-	1,007	7,053	68,644
Missouri	13,580	-	40,722	-	4,432	12,319	6,220	15,762	-	5,252	6,240	104,526
Montana	3,593	23	25,220	-	1,692	2,382	9,354	26,475	8	221	1,955	70,922
Nebraska	5,433	-	45,950	-	3,263	3,691	1,241	29,728	-	1,871	2,056	93,232
Nevada	3,760	-	20,186	-	1,700	3,142	1,273	17,051	-	360	3,082	50,555
New Hampshire	6,678	-	442	-	796	2,479	25	6	-	592	3,101	14,121
New Jersey	10,318	-	1,607	-	3,307	11,986	1,078	35	-	4,333	2,766	35,431
New Mexico	5,374	750	59,604	-	835	4,774	3,766	28,151	349	686	543	104,831
New York	35,271	-	10,198	-	7,154	22,203	684	904	-	1,867	4,423	82,706
North Carolina	21,750	-	8,537	-	4,954	15,132	31,244	664	-	16,969	8,712	107,962
North Dakota	1,808	-	44,139	-	3,199	1,777	2,577	15,784	-	306	2,275	71,865
Ohio	37,916	-	28,074	-	6,245	19,732	1,451	2,854	-	43,349	21,670	161,290
Oklahoma	9,666	397	52,850	-	2,596	7,516	13,316	26,462	-	3,328	5,665	121,796
Oregon	17,175	-	10,030	-	2,289	6,767	30,947	8,499	-	706	8,394	84,807
Pennsylvania	30,841	-	8,054	-	5,026	19,078	2,917	319	-	53,923	13,991	134,150
Rhode Island	2,367	-	304	-	331	1,329	59	1	-	5	128	4,524
South Carolina	8,718	-	7,207	-	2,414	8,408	18,740	466	-	14,524	5,619	66,095
South Dakota	1,957	-	26,458	-	2,295	1,987	1,163	34,242	-	229	655	68,985
Tennessee	21,053	-	8,628	-	3,323	11,796	6,951	2,434	-	5,284	9,938	69,408
Texas	26,077	4,842	171,368	-	14,531	32,677	41,533	85,509	872	11,599	29,328	418,337
Utah	5,220	664	15,122	-	1,436	4,435	1,815	10,810	42	883	3,133	43,560
Vermont	8,051	-	616	-	443	1,550	68	12	-	43	95	10,876
Virginia	19,633	-	4,374	-	3,771	12,847	14,930	578	-	1,618	7,250	65,000
Washington	20,579	-	16,042	-	3,638	9,883	10,463	4,520	-	459	3,962	69,545
West Virginia	7,771	-	1,186	-	873	3,958	3,915	66	-	25,969	4,288	48,025
Wisconsin	34,858	-	19,855	-	4,694	11,848	1,046	2,422	-	606	3,037	78,365
Wyoming	2,587	1,105	37,636	-	551	2,032	12,061	5,631	229	7,371	15,897	85,099
Tribal Data	137	-	-	-	-	-	-	-	-	5,659	949	6,744
Grand Total	738,591	9,894	1,177,689	-	177,987	496,045	808,173	493,451	1,935	302,214	410,891	4,616,870

Table 8b. Percent contribution of source categories to $PM_{2.5}$ emissions by state.

State	Area	Area-O&G	Dust	Biogenic	Off-Road	On-Road	Fires	WBD	PT-O&G	PTCEM	PTNCEM
Alabama	7.0%	0.0%	8.1%	0.0%	2.3%	14.2%	45.1%	0.9%	0.0%	2.5%	20.0%
Arizona	20.8%	0.0%	33.7%	0.0%	4.3%	11.3%	10.6%	12.0%	0.0%	2.5%	4.8%
Arkansas	9.1%	0.0%	29.6%	0.0%	3.1%	6.8%	35.0%	6.8%	0.0%	1.6%	8.1%
California	18.5%	0.0%	8.7%	0.0%	3.2%	4.1%	57.7%	2.7%	0.0%	0.2%	5.0%
Colorado	19.2%	2.7%	31.3%	0.0%	3.9%	11.7%	3.4%	16.9%	0.6%	0.7%	9.6%
Connecticut	41.4%	0.0%	4.6%	0.0%	6.8%	45.5%	0.1%	0.0%	0.0%	0.6%	1.1%
Delaware	15.0%	0.0%	9.4%	0.0%	6.0%	29.7%	1.1%	0.1%	0.0%	24.6%	14.2%
District of Columbia	42.7%	0.0%	1.8%	0.0%	11.6%	41.4%	0.0%	0.0%	0.0%	0.0%	2.4%
Florida	8.9%	0.0%	9.4%	0.0%	5.9%	20.0%	38.6%	0.4%	0.0%	7.4%	9.3%
Georgia	16.5%	0.0%	12.8%	0.0%	3.6%	21.9%	35.4%	0.4%	0.0%	4.5%	4.9%
Idaho	12.0%	0.0%	22.7%	0.0%	2.6%	5.3%	44.4%	9.0%	0.0%	0.0%	4.0%
Illinois	18.9%	0.0%	43.9%	0.0%	5.7%	12.8%	1.3%	5.5%	0.0%	3.7%	8.2%
Indiana	14.4%	0.0%	26.5%	0.0%	3.3%	10.2%	1.0%	2.2%	0.0%	22.1%	20.2%
Iowa	7.0%	0.0%	46.8%	0.0%	4.5%	5.6%	0.9%	24.9%	0.0%	5.1%	5.2%
Kansas	3.6%	0.0%	43.8%	0.0%	2.1%	2.9%	8.1%	36.3%	0.0%	1.0%	2.1%
Kentucky	16.3%	0.0%	13.1%	0.0%	3.6%	22.4%	6.2%	5.2%	0.0%	9.0%	24.2%
Louisiana	11.5%	0.0%	7.6%	0.0%	1.9%	5.5%	33.3%	2.7%	0.0%	2.7%	34.7%
Maine	51.8%	0.0%	7.8%	0.0%	6.0%	17.4%	0.4%	0.3%	0.0%	0.3%	15.8%
Maryland	30.9%	0.0%	10.9%	0.0%	7.1%	24.2%	1.6%	0.4%	0.0%	17.2%	7.7%
Massachusetts	40.3%	0.0%	14.7%	0.0%	7.8%	29.6%	1.1%	0.0%	0.0%	2.1%	4.5%
Michigan	36.5%	0.0%	21.6%	0.0%	6.5%	17.9%	0.8%	1.6%	0.0%	1.6%	13.4%
Minnesota	20.8%	0.0%	40.5%	0.0%	5.1%	9.2%	1.7%	9.0%	0.0%	2.9%	10.9%
Mississippi	14.6%	0.0%	19.1%	0.0%	2.8%	9.3%	37.2%	5.2%	0.0%	1.5%	10.3%
Missouri	13.0%	0.0%	39.0%	0.0%	4.2%	11.8%	6.0%	15.1%	0.0%	5.0%	6.0%
Montana	5.1%	0.0%	35.6%	0.0%	2.4%	3.4%	13.2%	37.3%	0.0%	0.3%	2.8%
Nebraska	5.8%	0.0%	49.3%	0.0%	3.5%	4.0%	1.3%	31.9%	0.0%	2.0%	2.2%
Nevada	7.4%	0.0%	39.9%	0.0%	3.4%	6.2%	2.5%	33.7%	0.0%	0.7%	6.1%
New Hampshire	47.3%	0.0%	3.1%	0.0%	5.6%	17.6%	0.2%	0.0%	0.0%	4.2%	22.0%
New Jersey	29.1%	0.0%	4.5%	0.0%	9.3%	33.8%	3.0%	0.1%	0.0%	12.2%	7.8%
New Mexico	5.1%	0.7%	56.9%	0.0%	0.8%	4.6%	3.6%	26.9%	0.3%	0.7%	0.5%
New York	42.6%	0.0%	12.3%	0.0%	8.6%	26.8%	0.8%	1.1%	0.0%	2.3%	5.3%
North Carolina	20.1%	0.0%	7.9%	0.0%	4.6%	14.0%	28.9%	0.6%	0.0%	15.7%	8.1%
North Dakota	2.5%	0.0%	61.4%	0.0%	4.5%	2.5%	3.6%	22.0%	0.0%	0.4%	3.2%
Ohio	23.5%	0.0%	17.4%	0.0%	3.9%	12.2%	0.9%	1.8%	0.0%	26.9%	13.4%
Oklahoma	7.9%	0.3%	43.4%	0.0%	2.1%	6.2%	10.9%	21.7%	0.0%	2.7%	4.7%
Oregon	20.3%	0.0%	11.8%	0.0%	2.7%	8.0%	36.5%	10.0%	0.0%	0.8%	9.9%
Pennsylvania	23.0%	0.0%	6.0%	0.0%	3.7%	14.2%	2.2%	0.2%	0.0%	40.2%	10.4%
Rhode Island	52.3%	0.0%	6.7%	0.0%	7.3%	29.4%	1.3%	0.0%	0.0%	0.1%	2.8%
South Carolina	13.2%	0.0%	10.9%	0.0%	3.7%	12.7%	28.4%	0.7%	0.0%	22.0%	8.5%
South Dakota	2.8%	0.0%	38.4%	0.0%	3.3%	2.9%	1.7%	49.6%	0.0%	0.3%	0.9%
Tennessee	30.3%	0.0%	12.4%	0.0%	4.8%	17.0%	10.0%	3.5%	0.0%	7.6%	14.3%
Texas	6.2%	1.2%	41.0%	0.0%	3.5%	7.8%	9.9%	20.4%	0.2%	2.8%	7.0%
Utah	12.0%	1.5%	34.7%	0.0%	3.3%	10.2%	4.2%	24.8%	0.1%	2.0%	7.2%
Vermont	74.0%	0.0%	5.7%	0.0%	4.1%	14.3%	0.6%	0.1%	0.0%	0.4%	0.9%
Virginia	30.2%	0.0%	6.7%	0.0%	5.8%	19.8%	23.0%	0.9%	0.0%	2.5%	11.2%
Washington	29.6%	0.0%	23.1%	0.0%	5.2%	14.2%	15.0%	6.5%	0.0%	0.7%	5.7%
West Virginia	16.2%	0.0%	2.5%	0.0%	1.8%	8.2%	8.2%	0.1%	0.0%	54.1%	8.9%
Wisconsin	44.5%	0.0%	25.3%	0.0%	6.0%	15.1%	1.3%	3.1%	0.0%	0.8%	3.9%
Wyoming	3.0%	1.3%	44.2%	0.0%	0.6%	2.4%	14.2%	6.6%	0.3%	8.7%	18.7%
Tribal Data	2.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%	83.9%	14.1%
Grand Total	16.0%	0.2%	25.5%	0.0%	3.9%	10.7%	17.5%	10.7%	0.0%	6.5%	8.9%