APPENDIX A

COMPREHENSIVE SO_2 EMISSIONS INVENTORY – 2014, 2020 & 2030 FOR JEFFERSON COUNTY

The department's Air Pollution Control Program creates air emission inventories for criteria pollutants and hazardous air pollutants to meet federal reporting requirements under EPA's Air Emissions Reporting Rule (AERR), and to provide data that supports the functions of the Air Program, including SIP inventory needs. The SO_2 emissions inventory includes anthropogenic emissions from point source facilities like industrial plants, mobile source emissions from diesel powered vehicles, and nonpoint sources of emissions where many small sources are estimated at the county level (household fuel combustion emissions are combined). Point source facility emissions are reported directly by permitted sources in Missouri, while nonpoint and mobile source emissions are estimated using EPA guidelines and state-specific data.

Nonpoint sources of SO_2 include the small emitting sources that are not inventoried by collecting site specific data; their emissions are estimated based on activity surrogates at the county level. For Jefferson county, including portions outside the nonattainment area, the most recently available nonpoint inventory in 2014 shows that residential fuel combustion, diesel fuel distribution, open burning, wildfires, and all other emissions of SO_2 total to 32.94 tons. Mobile sources of SO_2 emissions are piston-driven engines using sulfur-containing fuel, and the county total, including areas outside the nonattainment area, is 27.36 tpy of SO_2. The nonpoint and mobile emissions combined are around 0.2% of the point source emissions.

Table 1 - Jefferson County (entire county) 2014, 2020, & 2030 SO_2 Emissions Summary

Emission Category	2014 SO_2 Emissions (tpy)	2020 SO_2 Emissions (tpy)	2030 SO_2 Emissions (tpy)	Percent of 2014 Total Point Source Emissions
Point Source Total	18,019.91	18,023.72	18,023.80	100.02%
Nonpoint Total	32.94	32.84	33.02	0.18%
Onroad Mobile Total	23.63	6.91	6.33	0.04%
Nonroad Mobile Total	3.73	3.06	3.14	0.02%

SO_2 emissions in the Jefferson County SO_2 nonattainment area are driven by point sources, the large stationary industrial sources related to electric generation and other industrial sources using coal and other sulfur-containing fuels. These sources are required to obtain construction and/or

operating permits from the Air Pollution Control Program and are subject to the Missouri Emission Inventory Reporting Rule, 10 CSR 10-6.110. The rule requires that sources characterize their total annual actual facility emissions by describing the equipment generating the emissions, emission estimation methods, emission control devices, and release parameters. At a point source facility, emissions are generated by many types of equipment and processes, including but not limited to electric generating units, boilers, and other fossil fuel combustion equipment; emissions are characterized for modeling using their release parameters as stack, vent, or fugitive emissions.

Point source emission data is collected via online submission or paper forms depending on facility choice. Over 90% of facilities choose the online submission of data, though all data, whether received electronically or hard copy, is entered to our emissions database called the Missouri Emissions Inventory System (MoEIS). MoEIS performs the initial quality assurance steps by ensuring minimum data fields are included and data is within acceptable ranges. Additional quality assurance is performed including, but not limited to the following: year-to-year variance, industry-type comparisons, and external data source verification. Corrections are made to emissions data with the acknowledgement of the facility representative.

The emission inventory for SO_2 in the Jefferson County SO_2 nonattainment area includes a 2014 attainment year inventory and growth to future years 2020 and 2030, representing projected maintenance year inventories. The inventory includes 16 point source facilities that reported over 0.01 tons of SO_2 in the 2014 emission year.

2014

- Point

The Missouri Department of Natural Resources' Air Pollution Control Program developed a comprehensive statewide emissions inventory for 2014, as required by EPA's AERR rule as revised in 2014 (80 FR 8787). Point source emissions are prepared at the facility level with a geographic coordinate. The emissions cover a continuous 12 month period from January 1 to December 31 of the year.

Point source data is collected from permitted facilities in the form of a report called the Emissions Inventory Questionnaire (EIQ). The EIQ is a report detailing facility operational data and estimating the amount of air pollution emitted, and its collection is governed by Missouri State Rule 10 CSR 10-6.110. The facility will either submit a detailed annual "full" report, with updated calendar year operations and emissions, or a "reduced" report, which represents that their last full report emissions are a reasonable estimate for the current year, within emission change and permit tolerances. These reports are certified by the facility, but are subject to review and revision based on quality assurance performed by the state, or notification by the facility of errors in the original submission. The point data presented in this report reflects all updates made to emission reports through March 24, 2016.

The AERR requires submission of Type A and B point source facilities actual emissions for the 2014 reporting year. The AERR definition of Type A and B point source facilities depends on the pollutant-specific potential to emit (PTE) and location within a designated nonattainment

area. Since the air program does not maintain records of facility total PTE, the permit type is used to determine Type A and B status. Missouri has one area designated as a marginal ozone nonattainment area, therefore Type B thresholds for SO_x, VOC, NO_x, CO, Pb, PM_{10} and NH_3 are compared to permit thresholds. Per Missouri operating permit rule 10 CSR 10-6.065, Part 70 sources and Intermediate sources have uncontrolled PTE of at least one pollutant in excess of the AERR Type B thresholds. All Missouri sources with Part 70 operating permits are submitted as Type A sources. All Missouri sources with Intermediate operating permits are submitted as Type B sources. Sources with either permit type are required to complete the "full" emissions report, detailing their actual operations and emissions during the 2014 year. Two sources that had neither a Part 70 operating permit nor an Intermediate operating permit were included in the Point Sources submission as they had annual lead emissions above 0.5 Tons. These two sources were also required to complete a "full" emissions report for 2014. For all facilities submitted as Point Sources, emission units permitted at the facility via their construction or operating permit are included in the report, including both stack and fugitive emission releases.

Though paper forms were the origination of emission reporting, the air program's MoEIS accepts online emission reporting. The data elements on the hardcopy forms have an electronic counterpart in MoEIS, though several data elements which were calculated by the user and written on the form are now automatically populated by MoEIS. For the full emission reports submitted by an AERR Type A or B facility, the report can be submitted either on paper forms or via MoEIS. Both submittals require a signature page to certify that representative emissions have been reported, to the best knowledge of the facility representative.

All data elements for full emission reports are stored in the underlying MoEIS database. For reports that are submitted on paper forms, the data is entered to the MoEIS database by the APCP staff members within a few weeks of receipt. Both the number and type of reports submitted annually are monitored to ensure proper coverage of AERR-reportable point source facilities. Paper forms were due by April 1, 2015, and MoEIS submissions were due by May 1, 2015. Late reports from AERR point source facilities were collected through reminders, compliance assistance (including site visits), or enforcement actions.

EIQ solicitations for calendar year 2014 were mailed to facilities the last week of December 2014. A total of 2,233 EIQs were mailed statewide, of which 227 were submitted as "no production," 778 were full EIQs, and 1,228 were submitted as reduced reporting forms. Of those full reports, 492 facility reports are for AERR Type A or B facilities included as point sources in Missouri's submittal to the NEI.

In the Jefferson County SO_2 nonattainment area, there are nine point source facilities, one of which is an electric generating facility, among other industries. All nine of these facilities reported a fully detailed EIQ for 2014, and all continue in operation as of 2017. The 2014 inventory for these point sources totals 18,020 tons of SO_2, and 97% of that is from the single electric generating facility. The next largest sources are a cement kiln and a glass manufacturer.

- Nonpoint

EPA developed nonpoint emissions estimates for several categories for the 2014 inventory. Where appropriate, the air program accepted these estimates with no modifications. When it was

determined that emissions from the air program may be substantially different than EPA estimates, state specific information was used to produce more accurate data. For some source categories, this was done by modifying the numbers produced by EPA. In other instances, estimates were developed by air program staff. This 2014 inventory does not include biogenic or geogenic emissions

- Mobile
    - Onroad

Emission estimates are required for all onroad vehicles on a three-year cycle based on requirements in the EPA's AERR. EPA requires the use of an approved mobile source emissions model, and the version used for this inventory is MOVES2014.

Inputs for the model should reflect state-specific data where possible, especially vehicle population, age, and travel information. The recommended source of data for passenger vehicle population and age is registration or inspection information at the state or county level.

The Missouri Department of Revenue (MoDOR) collects vehicle registration information. In late 2014, the air program requested data for registered vehicles as of September 1, 2014. Registered vehicle information includes the VIN, county of registration, and model year. The request specifically asked that all-terrain vehicles (those not approved for on-road use) not be included in the registration list. The list includes both passenger vehicles (cars, trucks, SUVs, motorcycles) and other commercial and recreational vehicles (heavy trucks, buses, motorhomes). A total of 5,227,713 statewide registered vehicles were included in the list from the MoDOR. To create a population of passenger vehicles, the MoDOR VINs were decoded with enough information to place them into MOVES vehicle types. After decoding the VINs, MOVES input tables were created with this state-specific information, including vehicle population by county, age distribution of vehicles, and alternative vehicle fuel type table. Additionally, annual vehicle miles traveled (VMT) from the Missouri Department of Transportation, by county, was used to create mileage traveled information for all counties. Data from the St. Louis Gateway Vehicle Inspection Program (the inspection/maintenance program) for 2014 was used in the calculation of the compliance factor for light duty cars and trucks subject to the vehicle inspection and maintenance program, another MOVES input table.

    - Nonroad

Missouri ran the Nonroad model within MOVES on Jan 13, 2016, using all default information from EPA, for the 2014 emission year. There are no Missouri-specific input tables to replace the defaults.

Growth to 2020 and 2030

To estimate emissions for future years in the maintenance plan, the program used EPA's Modeling Platform to generate growth curves for point and nonpoint sources. EPA develops the Modeling Platform for specific base and ending years and covers all emission sectors. In the case of platform version 2011v6.3, the base year is 2011 emissions from the National Emissions Inventory version 2 dataset. The future years are 2017 and 2023, and the platform develops

future year inventories for criteria pollutants, including SO_2, and several hazardous air pollutants (HAPs). Future year emissions come from model output or adjustments to the base year emissions according to the best estimate of changes expected to occur in the intervening years. For some sectors, the base year emissions remain unchanged in the future years. For other sectors, rules and specific legal obligations that go into effect in the intervening years, along with changes in activity in the sector, are included in the estimates.

- Point

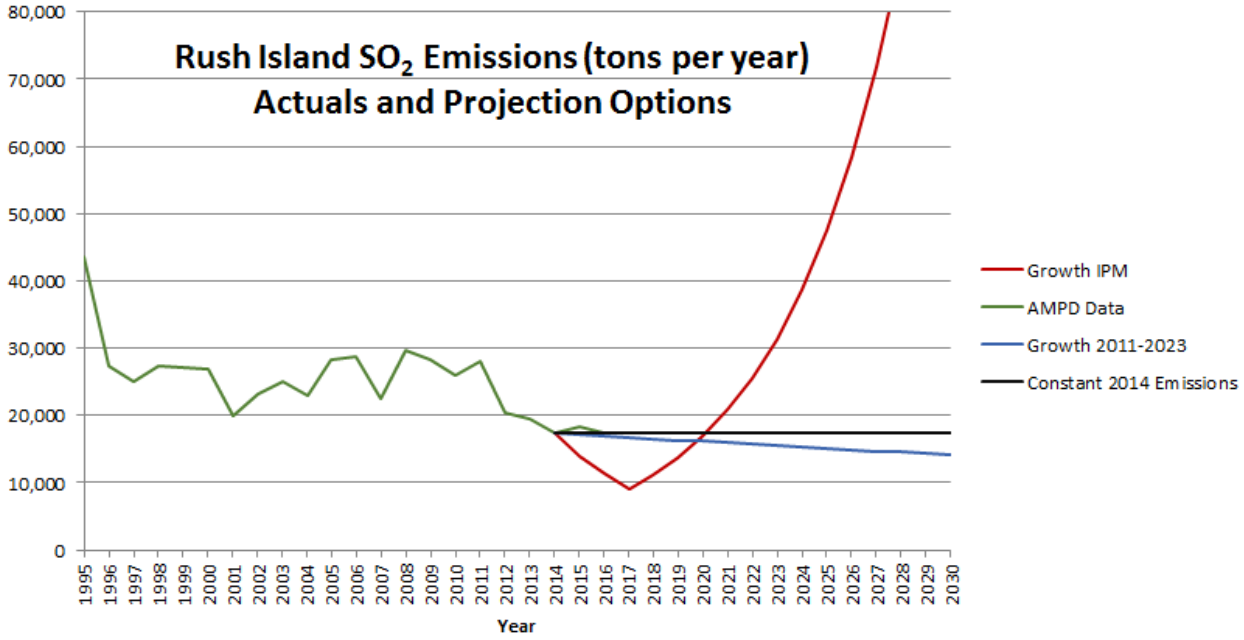
EPA's Modeling Platform divides point sources into two groups: electric generating units (EGU) and non-EGU. The Integrated Planning Model (IPM) estimates emissions for future years based on characteristics of the electricity market such as fuel types, economic incentives, and regulations.

    - EGU

In Jefferson County, there is one EGU source – Ameren Missouri's Rush Island Plant. Two boilers burn pulverized subbituminous coal at a design rate of 5,922 MMBtu/hour each. Actual emissions from the Air Markets Program Data (AMPD, https://ampd.epa.gov/ampd/), retrieved on June 12, 2017, and covering years 1995 through 2016, are displayed below in green.

One option for growth comes from EPA's modeling platform. The platform takes 2011 facility-total annual SO_2 emissions of 28,036 tons, and the IPM model projects them to 7,488 tons in 2017 and 25,913 tons in 2023. Compound annual average growth factors are around -20% between 2011 and 2017 and 23% from 2017 to 2023. The IPM model does not explain large swings in emissions, like the case of Rush Island, where fuel switching, additions of controls, or unit shutdowns are not predicted. Using the model platform compound annual growth rates for the 2011 to 2017 and 2017 to 2023 periods to extrapolate actual 2014 emissions to 2030 results in unreasonably large emissions in 2030 of 133,665 tons per year as shown by the red line below. Because of this, this option is dismissed from further consideration. Part of the reason for this large growth is the assumption that the IPM growth rate from 2017 to 2023 will continue unchecked from 2023 to 2030.

Another growth option uses the compound annual growth rate from 2011 to 2023, bypassing the IPM projected drop in emissions in 2017. The resulting growth rate is -1.3%, and 2030 emissions are estimated at 14,140 tons per year in the blue line below. The level of emissions from this method is possible, but is not a conservative estimate of future activity. A more conservative estimate of emissions is holding 2014 actual emissions constant to 2030 in the black line below. This is the air program's chosen method of growth and is used in the determination of 2030 emissions estimates.



- Non-EGU

The platform estimates non-EGU emissions using industrial source growth factors from the Control Strategy Tool (CoST). The modeling platform for Jefferson County contains several non-EGU point sources, including a cement plant, glass manufacturer, and primary lead smelter. As of 2014, the primary lead smelter has permanently shut down, and no emissions are included for this source in future years. The modeling platform included their 2011 SO_2 emissions of 15,229 tons, but has zero emissions for future years. The remaining units with SO_2 emissions over 50 tons in 2011 are at River Cement and Ardagh Glass (formerly Saint-Gobain).

The modeling platform contains unit-specific projections for 25 units at 6 facilities in Jefferson County (not including airports). To grow the 2014 reported emissions, the first step was to match up the modeling platform units (base year 2011) to 2014 reported SO_2 emission units. Nineteen units that account for over 575 tons of emissions in 2014 have a unit-specific growth curve. Twenty-one units that account for less than 0.04 tons of emissions in 2014 did not have a unit-specific growth curve in the modeling platform. These units are likely too small, with fractions of a ton of emissions, to be considered in the modeling platform. For this growth estimate, these twenty-one units were given the highest growth curve for Jefferson County SO_2 to be conservative, and their emissions grew to 0.12 tons. For the nineteen units with specific growth curves, emissions of 575 tons are grown from 2014 to 579 tons in 2030. Of that total, River Cement accounts for 562 tons, and Ardagh Glass accounts for 16 tons in 2030. The River Cement growth curve was replaced with their permit limited emissions of 562.5 tons SO_2 per year from their most recent construction permit 012017-009 issued January 18, 2017. It contains a production limit of 2,500,000 tons of clinker per year beginning in 2017, and an emission limit of 0.45 pounds of SO_2 per ton of clinker on a 12-month rolling average as monitored by continuous emissions monitors (CEMS).

Total Point Sources

The sum of EGU and non-EGU point sources in 2014, 2020, and 2030 is shown below.

SO_2 Emissions by year and point source type

	EGU	Non-EGU	Total
2014	17,444	576	18,020
Percent	97%	3%	100%
2020	17,444	579	18,024
Percent	97%	3%	100%
2030	17,444	579	18,024
Percent	97%	3%	100%

- Nonpoint

The program downloaded 2011NEIv2-based Platform (2011v6.3) for 2011, 2017 and 2023 non-EGU and nonpoint sources from the Emissions Modeling Clearinghouse website (https://www.epa.gov/air-emissions-modeling). The program estimated growth factors for years by first calculating the compound annual growth rate between model platform years of 2011 and 2017, then between 2017 and 2023. The annual growth rates are applied to the most recent 2014 inventory data to estimate emissions for 2020 and 2030. Only 2014 nonpoint sources with emissions of SO_2 greater than zero are estimated. A second growth curve going directly between 2011 and 2023, bypassing the 2017 estimate, was dismissed as it missed key interim year emission changes that would affect 2020 estimates.

- Mobile

Onroad – Emissions for the mobile sector were grown using the MOVES2014a model because it accepts state-specific data and reflects changes in vehicle standards that take effect in future years. The growth of onroad mobile source emissions via the MOVES model requires consideration of several future year model input tables. Specifically, Missouri developed age distribution, VMT, and vehicle population tables for 2020 and 2030. Other tables that were not modified, other than changing the analysis year to 2020 or 2030, are the speed, ramp fraction, fuels, I/M, starts, hoteling, and meteorology.

Future year age distribution guidance is given in section 4.4 of the EPA's MOVES2014 guidance document *MOVES2014a Technical Guidance: Using MOVES to Prepare Emission Inventories for State Implementation Plans and Transportation Conformity*, last updated November 2015. While MOVES can produce default age distributions, the guidance states that state-specific data is preferred. Missouri prepared state-specific 2014 age distributions for light duty vehicles from decoded VINs obtained from the Missouri Department of Revenue vehicle registration database. MOVES can also produce future year default age distributions, but in past SIPs, Missouri used

the age distribution from the base year in the future years without modification. Missouri did not use MOVES-produced default future year age distributions because of the possibility of projecting a future fleet that is younger than the base year, against EPA guidance. Missouri will continue to follow past EPA guidance and use the same age distribution for all analysis years, including the state-specific light duty profile. While EPA has provided an Age Distribution Projection Tool for MOVES2014 (found at www.epa.gov/otaq/models/moves/tools.htm), it is not used in the current projections.

VMT for future years was developed with the input of the Missouri Department of Transportation (MoDOT), the Federal Highway Administration (FHWA), and the East West Gateway Council of Governments (EWGW). MoDOT provided historic VMT data from 2007-2015, broken out by road type and urban/rural classification. Urban road types include both the St. Louis counties of interest, but also include Kansas City, Springfield, and Columbia areas. All urban road types were combined, and the trend of VMT change was plotted year by year and over discreet time periods. Both the average and median growth rates were examined over the entire 9 year period, and again over more recent 5 and 3 year periods. Negative urban VMT growth from 2008-2012 occurred during the recession, but VMT from 2013-2015 shows strong growth of up to 9% per year on certain road types, as measured by vehicle counts. With such a large variation in growth over the period, the average growth rate is ruled out because it skews toward outlier values. The median growth rate of 1.7% per year from 2013-2015 is a preferred option as it shows a growth rate that straddles the recession years and post-recession growth years, is a positive growth rate similar to past SIP growth rates of 1.5%, and is similar to the FHWA long term 1990-2014 national average VMT growth rate of 1.74%. The FHWA national average VMT from travel monitoring data was retrieved from https://www.fhwa.dot.gov/policyinformation/travel_monitoring/historicvmt.cfm (last updated April 18, 2016). Because the growth rate is to be applied out to 2030, more than 15 years beyond the base year, the growth rate is chosen to be reasonable over the entire period, recognizing the individual years will show variations from this average. The 1.7% per year growth rate is preferred because it has origins in MoDOT data, is supported by FHWA, and is consistent with previous growth estimates.

Vehicle population for the future year is estimated using FHWA Office of Highway Policy Information Highway Statistics reports found at http://www.fhwa.dot.gov/policyinformation/statistics.cfm. Within the annual report is a table named MV-1 that lists the total reported state motor vehicle registrations. The level of detail provided is state total registrations broken out by vehicle types (automobiles, buses, trucks, and motorcycles). Multiple years of this table are available to construct historical trends. The Missouri total registration information is examined for the years of 2011 and 2014 as these correspond to the most recent triennial emission inventory years. Missouri's average annual compound growth rate is estimated for each vehicle type from the FHWA data as shown below.

	Missouri Vehicle Population				
Year	Automobiles	Buses	Trucks	Motorcycles	All Motor Vehicles
2011	2,440,765	16,087	2,572,195	140,947	5,169,994
2014	2,231,294	5,901	2,941,907	153,799	5,332,901
Compound Annual Average Growth Percentage	-2.9%	-28.4%	4.6%	3.0%	1.0%

The numbers for Missouri align generally with the national trend. Total motor vehicle registrations over the same period grew by 0.93% nationally, close to Missouri's 1.0% growth. National automobile growth is also negative as it is in Missouri, with the strongest positive growth in the truck category. Missouri is using the FHWA compound annual average growth percentages to estimate future vehicle populations with two changes. The negative growth in automobiles and buses seen in the statewide numbers may not be reflective of the St. Louis area. Specifically, the St. Louis transit agency METRO shrunk their bus fleet after the late 2000's recession. The agency plans to hold the bus fleet population steady for the next several years, so the negative trend in Missouri's FHWA bus population will not be used in favor of a flat growth assumption in future years (0% growth). Likewise, the negative growth in automobiles, mainly light duty passenger cars, may not be reflective of the specific St. Louis area. To maintain a conservative and likely higher future year emission estimate, the negative automobile trend will be replaced with a flat growth assumption (0%) in future years.

Two other sources of information were considered for use in creating future year vehicle population estimates. The Missouri Department of Revenue registered vehicle list used to develop the 2014 base year vehicle population was considered for use in constructing a historical trend. The lack of consistent vehicle types in past Missouri DOR data and limited decoding of certain vehicle types (heavy duty, buses) makes the Missouri DOR data less desirable for creating historical vehicle population trends. EPA's method of growing vehicle populations based on the human population growth and heavy duty VMT were also considered but not chosen. Using human population as a surrogate for light duty vehicle growth does not account for the use of transit in densely populated areas. Additionally, the St. Louis area population trend for 2011 to 2014 is positive 3%, but the state and national trend in registered automobiles is negative according to FHWA. Using heavy duty VMT to grow heavy duty populations assumes a constant rate of travel per vehicle in future years and creates a linear relationship between vehicle population and vehicle travel that may not exist. While these other methods may be sufficient for EPA, Missouri believes the registration data reported by FHWA is the dataset most directly related to growth in vehicle population.

Nonroad – Nonroad mobile emissions were also estimated using the MOVES2014a model because it reflects nonroad emission standards taking effect in future years. The air program does not collect state-specific information on nonroad equipment operating characteristics or population, and accepts the default model input tables. Accepting default information for nonroad equipment in 2020 and 2030 is the same methodology used for base year 2014 emission estimates.