

Appendix 7.3

Emissions Inventory Technical Documentation

Appendix 7.3 2002 Emissions Inventory Technical Documentation

This appendix contains a summary of the 2002 emissions inventory improvements developed by CENRAP and its contractors as part of the development of a baseline inventory for the 2002 modeling inventory. This document refers back to three reports prepared by Sonoma Technology, Inc. (STI), a contractor retained to develop and improve various inventory categories, which dealt with:

- Planned burning emissions inventory
- Ammonia inventory
- Mobile source and fugitive dust emissions inventory

Planned Burning Emissions Inventory

Agricultural and prescribed burning activities, referred to as planned burning, likely contribute to episodes of impaired visibility in the CENRAP region. STI developed planned burning emissions inventories for the CENRAP region, including Kansas. In Kansas, planned burning is an important component of the nonpoint source category, with a significant amount of emissions.

STI used a “bottom-up” approach in preparing these emissions estimates. This preparation included using the First Order Fire Effects Model (FOFEM), incorporating emission factors and fuel loadings gathered from published literature, geographic information systems (GIS) databases of land cover and vegetation, and activity data gathered through telephone surveys.

In Kansas, a significant amount of the burning occurs on rangeland and cropland. To best characterize the amounts burned, STI performed an agricultural burning survey of the county agricultural extension service offices within the state. This survey included rangeland burning questions designed to determine the fraction of rangeland acreage typically burned each year and the timing of such burn events. Of the 105 total counties surveyed, 59 responded, which represents a 56% response rate. The results of these surveys for wheat stubble and rangeland burning are represented in Figures A7.3.1 and A7.3.2.

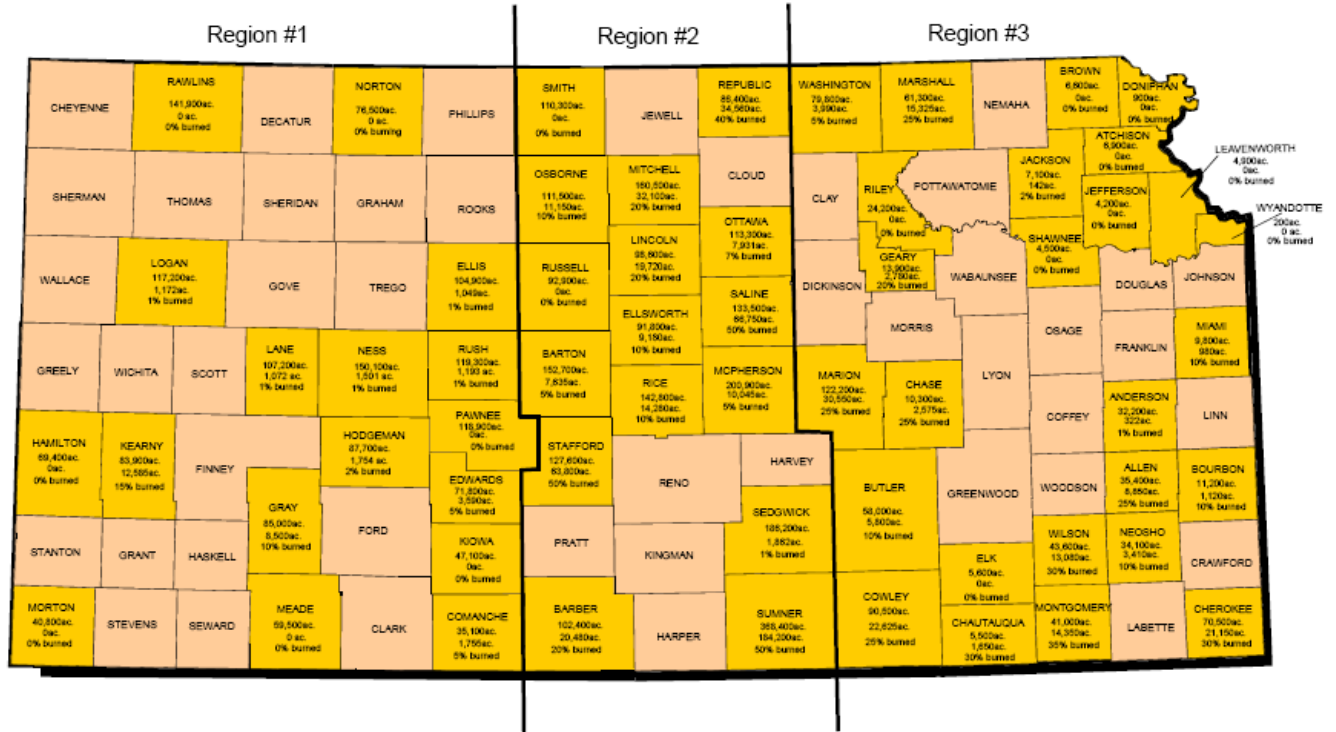
Assuming the responding counties comprise a representative sample, these two categories, wheat stubble burning and rangeland burning, together represent approximately 93% of the acres burned in Kansas. As can be seen in Table A7.3.1, these two categories also represent the majority of the burning inventory emissions.

To view the entire STI report on planned burning visit
<http://www.kdheks.gov/bar/index.html>.

Figure A7.3.1 Kansas Wheat Stubble Burning Statistics, by Responding County

KANSAS

Acres of Wheat Burned/Year



MORTON — County Name
 40,800ac. — Total Wheat in County (acres)
 0ac. — Total Wheat in County Burned (acres)
 0% burned — % Burned

*Note - Data supplied by Sonoma Technology, Inc. April 2004

*Note - Wheat regions verified by Bill Hargrove at Kansas State University Agriculture Extension Office

Figure A7.3.2 Kansas Rangeland Burning Statistics, by Responding County

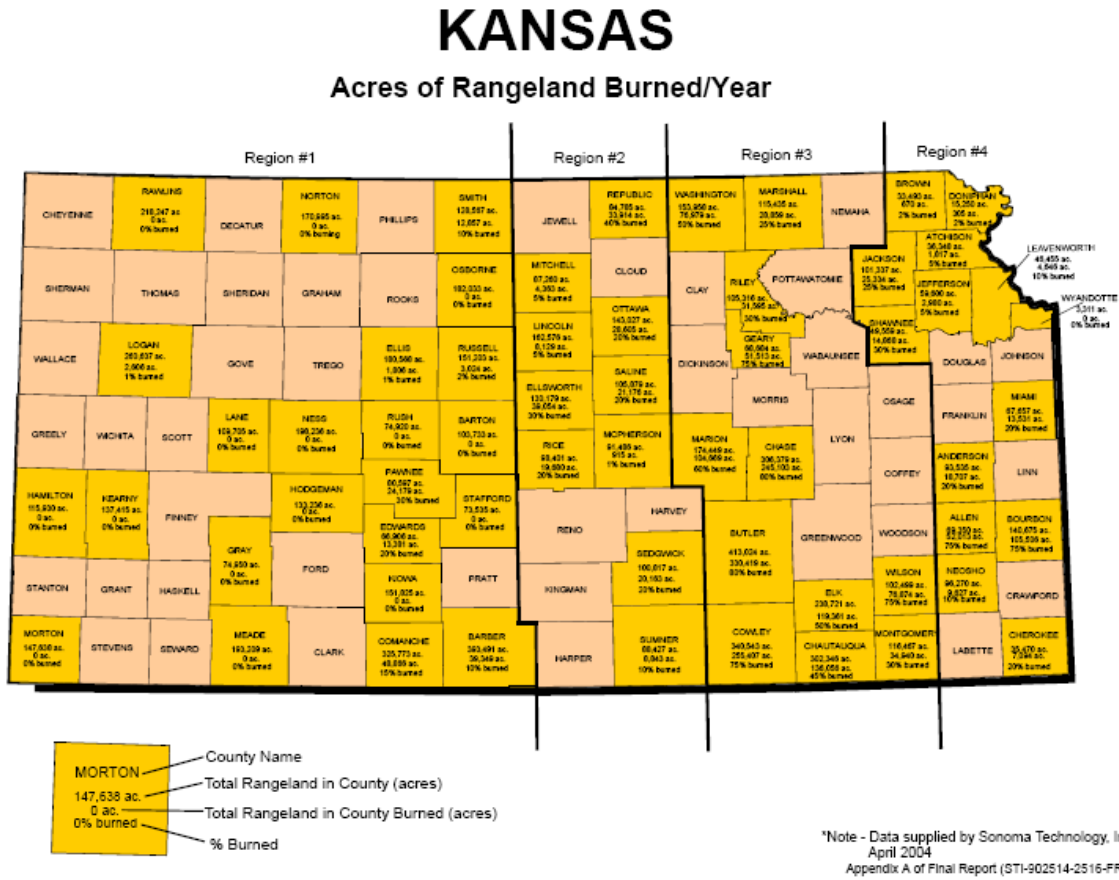


Table A7.3.1 Total Acres Burned in Kansas with Estimated Annual Emissions

State	Burn Type	Acres Burned	Emissions (tons/year)						
			PM ₁₀	PM _{2.5}	CO	NO _x	SO ₂	NH ₃	VOC
Kansas	Prescribed Burning	38,106	1,450	1,226	14,424	228	114	143	881
	Rangeland Burning	3,625,270	75,943	52,901	652,250	23,185	10,160	7,487	43,483
	Cropland Burning	1,390,520	23,227	22,156	153,313	5,909	777	3,950	11,401
	Wheat	1,058,014	17,420	16,610	118,902	4,523	603	3,216	8,194
	Hay/Alfalfa	189,085	2,252	2,148	12,701	408	54	290	1,143
	Sugarcane	0	0	0	0	0	0	0	0
	Corn	126,956	3,039	2,906	18,902	880	107	373	1,760
	Soybeans	9,996	210	200	1,252	34	5	24	154
	Rice	0	0	0	0	0	0	0	0
	Other	6,469	306	292	1,557	65	9	46	150
	Total	5,053,896	100,620	76,283	819,987	29,322	11,052	11,579	55,765

Ammonia Inventory

It is widely recognized that the formation of secondary particulate matter, which is generated from chemical transformations in the atmosphere of gaseous precursor species such as ammonia, nitrogen oxides, sulfur oxides, and volatile organic compounds,

contributes significantly to regional haze issues in the CENRAP region. In Kansas, agriculture-related ammonia emissions, coming from sources such as confined animal feeding operations (CAFOs) and crop fertilization, are significant. Because ammonia can have an impact on the formation of secondary particulate species, CENRAP and Kansas spent considerable resources on developing an accurate ammonia inventory. STI developed a comprehensive inventory for CENRAP. To view the entire STI report on ammonia visit <http://www.kdheks.gov/bar/index.html>.

In Kansas, over 50% of the ammonia emissions come from livestock emissions, including CAFOs and free range grazing. In 2002, it is estimated that 91,000 tons/yr of ammonia came from these two source categories. In addition, it is estimated that 65,000 tons/yr of ammonia emissions came from fertilizer emissions. The remainder of the ammonia emissions in Kansas is from biogenic and point sources categories.

One of the important considerations in the development of the ammonia inventory was the temporal allocation of the ammonia emissions, both seasonally and diurnally. STI did considerable work in developing temporal profiles for the ammonia inventory in Kansas. These temporal profiles were then utilized during photochemical modeling.

Mobile source and fugitive dust emissions inventory

In Kansas, the emissions inventory for the on-road mobile and nonroad mobile source categories are fairly significant for certain pollutants. STI prepared detailed inventories for these source categories, including refined spatial and temporal data. Table A7.3.2 has a summary of the locomotive emissions in Kansas, while Table A7.3.3 shows emissions from other nonroad source categories. There are minimal emissions from recreational boating in Kansas, thus it is not summarized here.

Table A7.3.2 2002 Locomotive Emissions in Kansas (tons/yr)

State	Fuel Consumption (1000 gallons)	PM _{2.5}	CO	NO _x	SO ₂	VOC	NH ₃
Kansas							
Class I Line Haul	150,063	1,000	4,397	31,596	2,702	1,659	14
Class II & III Line Haul	6,518	43	191	1,372	117	72	1
Amtrak	1,050	6	31	221	20	11	0
Yard/Switching	12,594	115	529	3,832	318	293	0

Table A7.3.3 2002 Nonroad Mobile Source Emissions in Kansas by Equipment Type (tons/yr)

State	Category	PM _{2.5}	NO _x	VOC	SO ₂	CO	NH ₃
Kansas	Agricultural Equipment	3,337	30,673	4,346	452	36,410	17
	Construction & Mining	785	9,622	1,744	161	14,608	5
	Lawn & Garden	206	909	7,155	35	106,296	2
	Commercial Equipment	124	1,535	2,033	30	52,119	1
	Industrial Equipment	112	4,024	977	26	15,550	1
	Other	101	618	3,125	13	19,689	72
	Total		4,665	47,382	19,381	716	244,673

The final emissions category that STI analyzed dealt with direct PM_{2.5} emissions from agricultural sources. These emissions come from sources such as agricultural fugitive dust from tilling operations. In Kansas, it is estimated that there are over 50,000 tons/yr of direct PM_{2.5} emissions from agricultural tilling operations. As was the case for ammonia emissions, the temporal distribution of these emissions is important as they are seasonal in nature. To view the entire STI report on mobile source and fugitive dust visit <http://www.kdheks.gov/bar/index.html>.