

Emission and Air Quality Trends Review

North Dakota

May 2013

Project Objective

- ❑ To develop and present publicly available information on trends in emissions and ambient air quality in the U.S. since 1999 in easy to understand visual and tabular formats

Emission Trends

- Study Team collected and processed U.S. EPA emission inventories for years within the study period of interest (1999-2011)

- By pollutant and source category
 - electric generation fuel combustion
 - mobile sources
 - industrial fuel combustion & industrial processes
 - all other

Emissions Data Summary

- Data Obtained from EPA National Emission Inventory (NEI) and Trends Websites
 - EPA's Trends reports and emission comparisons include interpolations of all categories between key years (1999, 2002, 2005, 2008, 2011) at county-pollutant level
 - Represented Pollutants: VOC, NO_x, SO₂, and PM_{2.5}
- Project Improvement
 - The Study Team augmented above data with year specific CEM emissions (2002 through 2011)

Emission Changes

- ❑ The following slides also include the tonnage-based emissions change from 1999 to 2011 for each pollutant
- ❑ Negative values indicate decrease in emissions, positive values indicate an increase

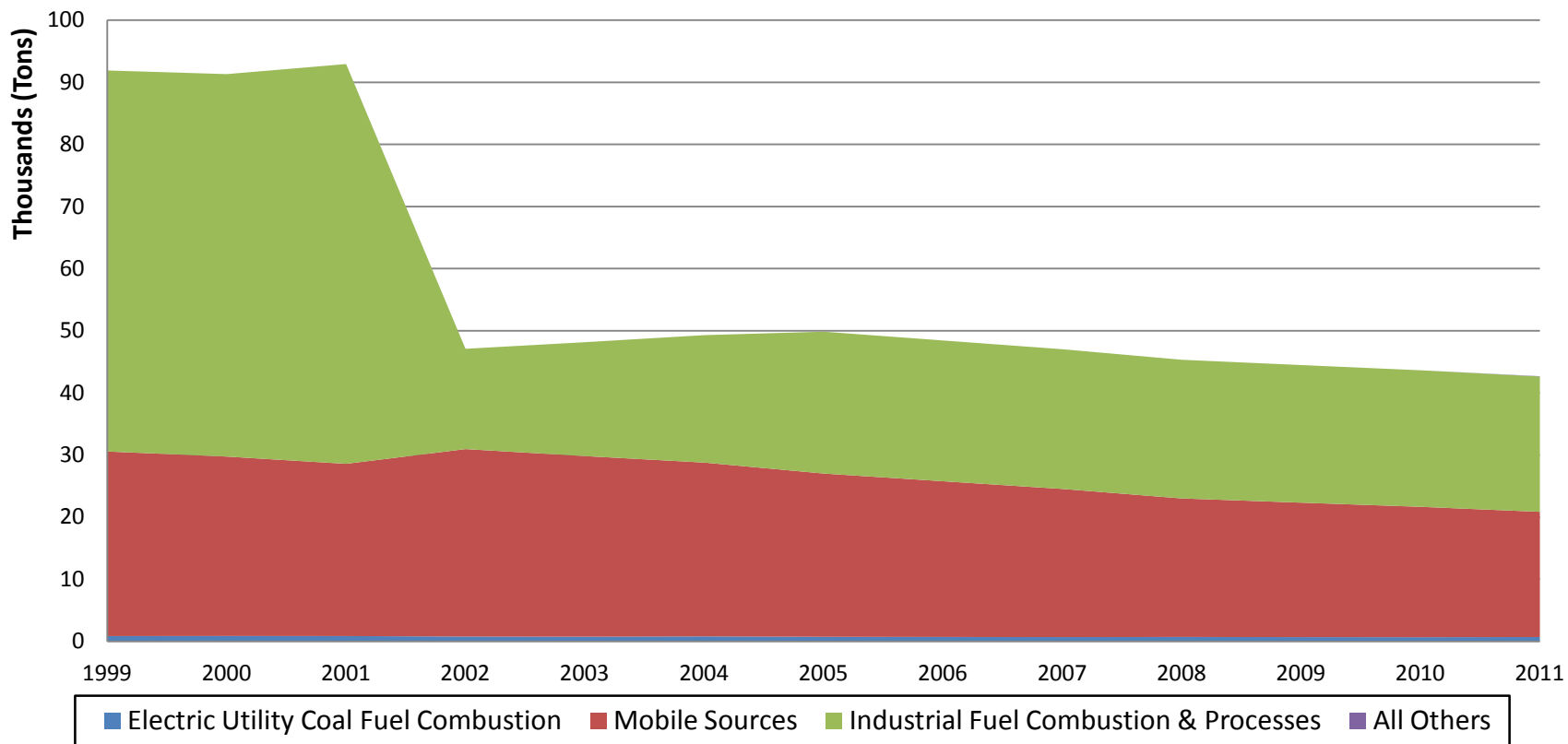
North Dakota Emission Trends (VOC)

Source Category	Annual Emissions (Tons)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	858	861	756	743	714	693	715	688	674	703
Mobile Sources	29,707	27,723	29,076	26,282	25,065	23,849	22,300	21,644	20,989	20,155
Industrial Fuel Combustion & Processes	61,329	64,341	18,327	22,828	22,658	22,487	22,317	22,146	21,976	21,775
All Others	1	1	0	0	0	0	0	0	0	50
Total	91,895	92,926	48,159	49,852	48,437	47,029	45,332	44,479	43,639	42,683

Source Category	Annual Emissions Change (Percent since 1999)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	0%	0%	-12%	-13%	-17%	-19%	-17%	-20%	-21%	-18%
Mobile Sources	0%	-7%	-2%	-12%	-16%	-20%	-25%	-27%	-29%	-32%
Industrial Fuel Combustion & Processes	0%	5%	-70%	-63%	-63%	-63%	-64%	-64%	-64%	-64%
All Others	0%	0%	-89%	-89%	-89%	-89%	-89%	-89%	-89%	5630%
Total	0%	1%	-48%	-46%	-47%	-49%	-51%	-52%	-53%	-54%

North Dakota Emission Trends (VOC)

**Major Source Category Summary
Annual VOC Emissions**



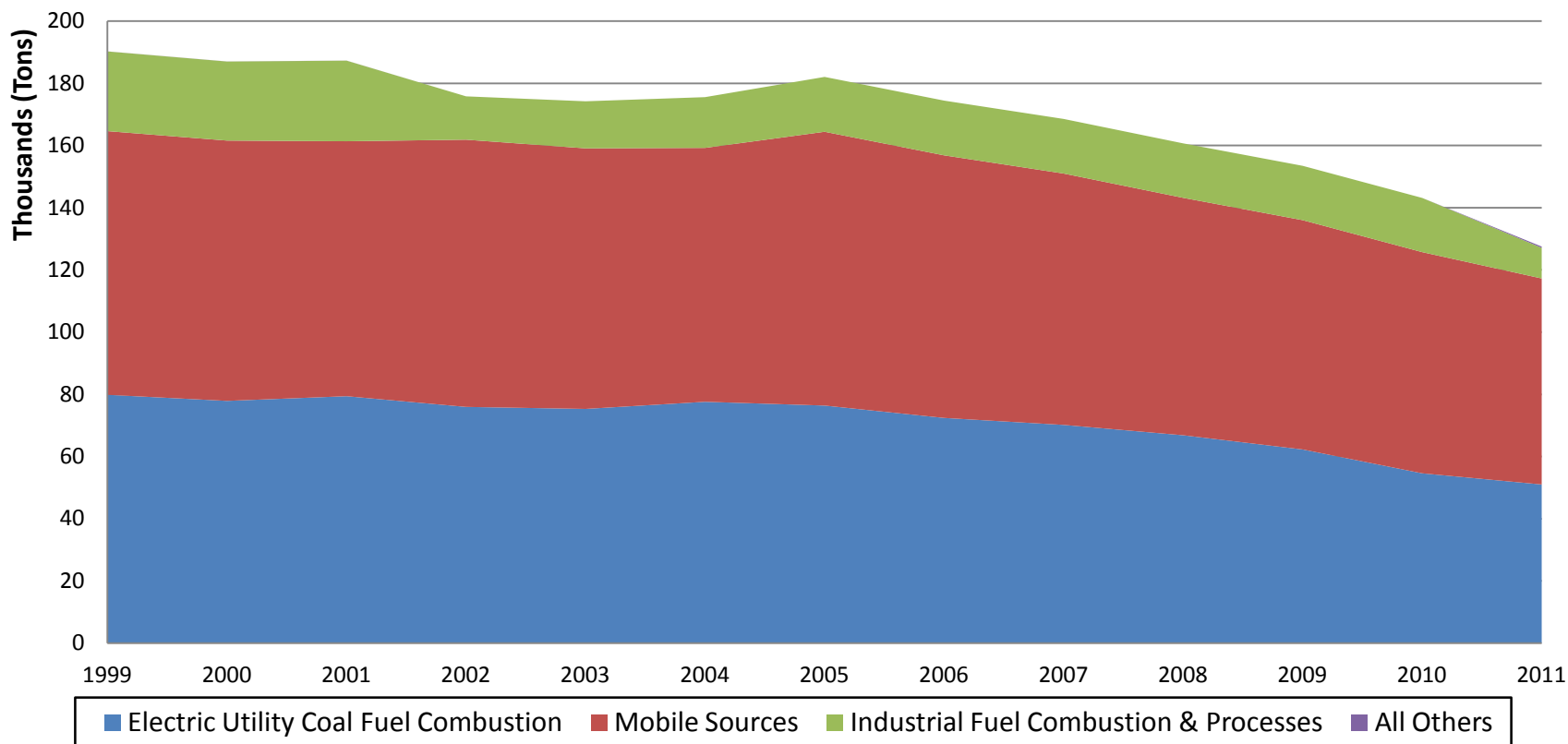
North Dakota Emission Trends (NO_x)

Source Category	Annual Emissions (Tons)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	79,837	79,387	75,303	76,380	72,406	70,164	66,837	62,267	54,600	51,014
Mobile Sources	84,774	81,970	83,775	88,028	84,422	80,816	76,333	73,725	71,116	66,232
Industrial Fuel Combustion & Processes	25,623	25,923	15,122	17,636	17,592	17,549	17,506	17,462	17,419	9,844
All Others	23	23	3	3	3	3	3	3	3	412
Total	190,257	187,304	174,203	182,046	174,423	168,532	160,678	153,457	143,138	127,501

Source Category	Annual Emissions Change (Percent since 1999)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	0%	-1%	-6%	-4%	-9%	-12%	-16%	-22%	-32%	-36%
Mobile Sources	0%	-3%	-1%	4%	0%	-5%	-10%	-13%	-16%	-22%
Industrial Fuel Combustion & Processes	0%	1%	-41%	-31%	-31%	-32%	-32%	-32%	-32%	-62%
All Others	0%	4%	-88%	-88%	-88%	-88%	-88%	-88%	-88%	1725%
Total	0%	-2%	-8%	-4%	-8%	-11%	-16%	-19%	-25%	-33%

North Dakota Emission Trends (NO_x)

**Major Source Category Summary
Annual NO_x Emissions**



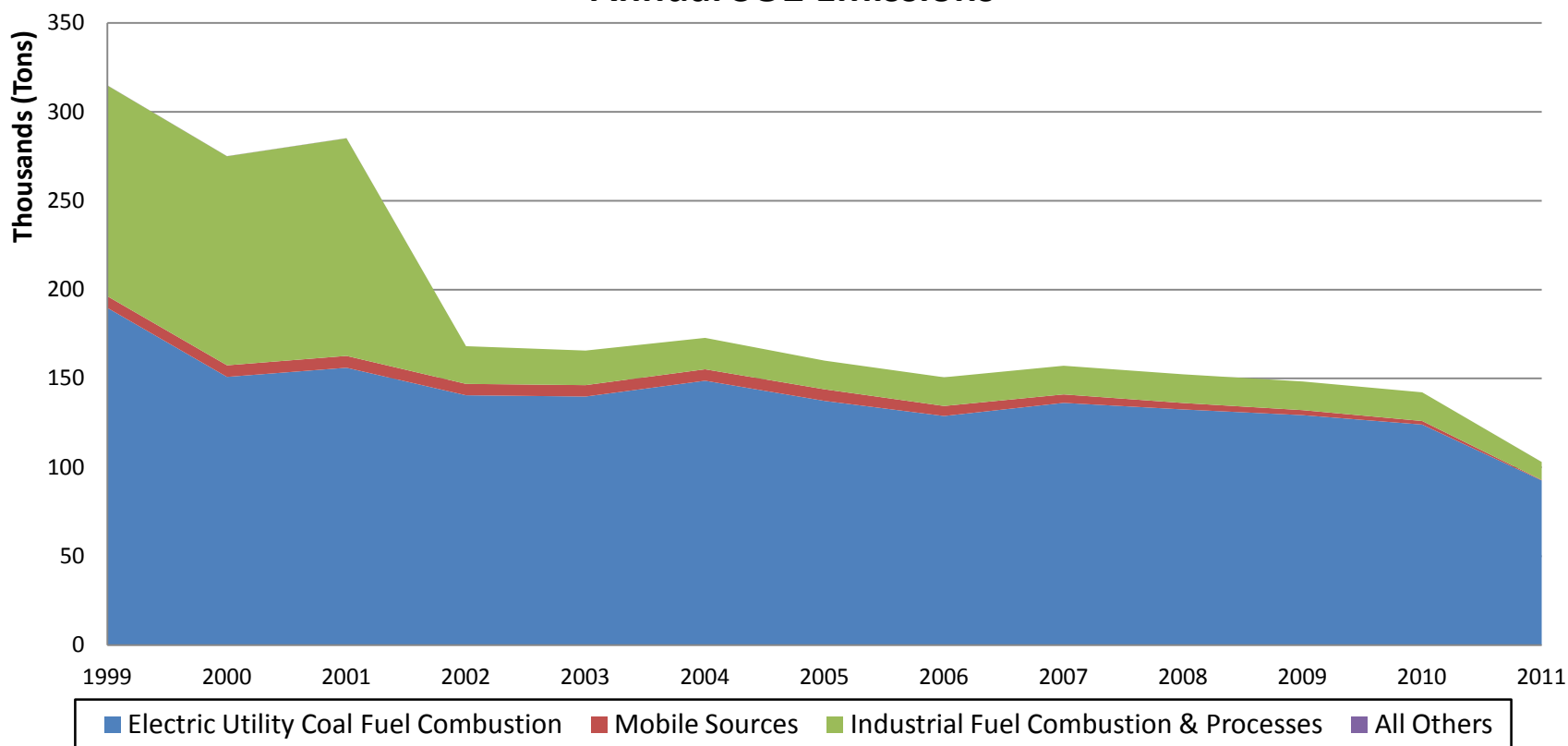
North Dakota Emission Trends (SO₂)

Source Category	Annual Emissions (Tons)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	189,675	156,026	139,823	137,373	128,879	136,263	132,564	129,353	124,059	92,613
Mobile Sources	6,548	6,666	6,417	6,521	5,640	4,760	3,640	2,829	2,017	306
Industrial Fuel Combustion & Processes	118,566	122,413	19,444	16,123	16,122	16,122	16,121	16,121	16,120	10,090
All Others	80	71	1	1	1	1	1	1	1	22
Total	314,869	285,176	165,684	160,017	150,643	157,146	152,327	148,303	142,196	103,031

Source Category	Annual Emissions Change (Percent since 1999)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	0%	-18%	-26%	-28%	-32%	-28%	-30%	-32%	-35%	-51%
Mobile Sources	0%	2%	-2%	0%	-14%	-27%	-44%	-57%	-69%	-95%
Industrial Fuel Combustion & Processes	0%	3%	-84%	-86%	-86%	-86%	-86%	-86%	-86%	-91%
All Others	0%	-11%	-99%	-99%	-99%	-99%	-99%	-99%	-99%	-72%
Total	0%	-9%	-47%	-49%	-52%	-50%	-52%	-53%	-55%	-67%

North Dakota Emission Trends (SO₂)

**Major Source Category Summary
Annual SO₂ Emissions**



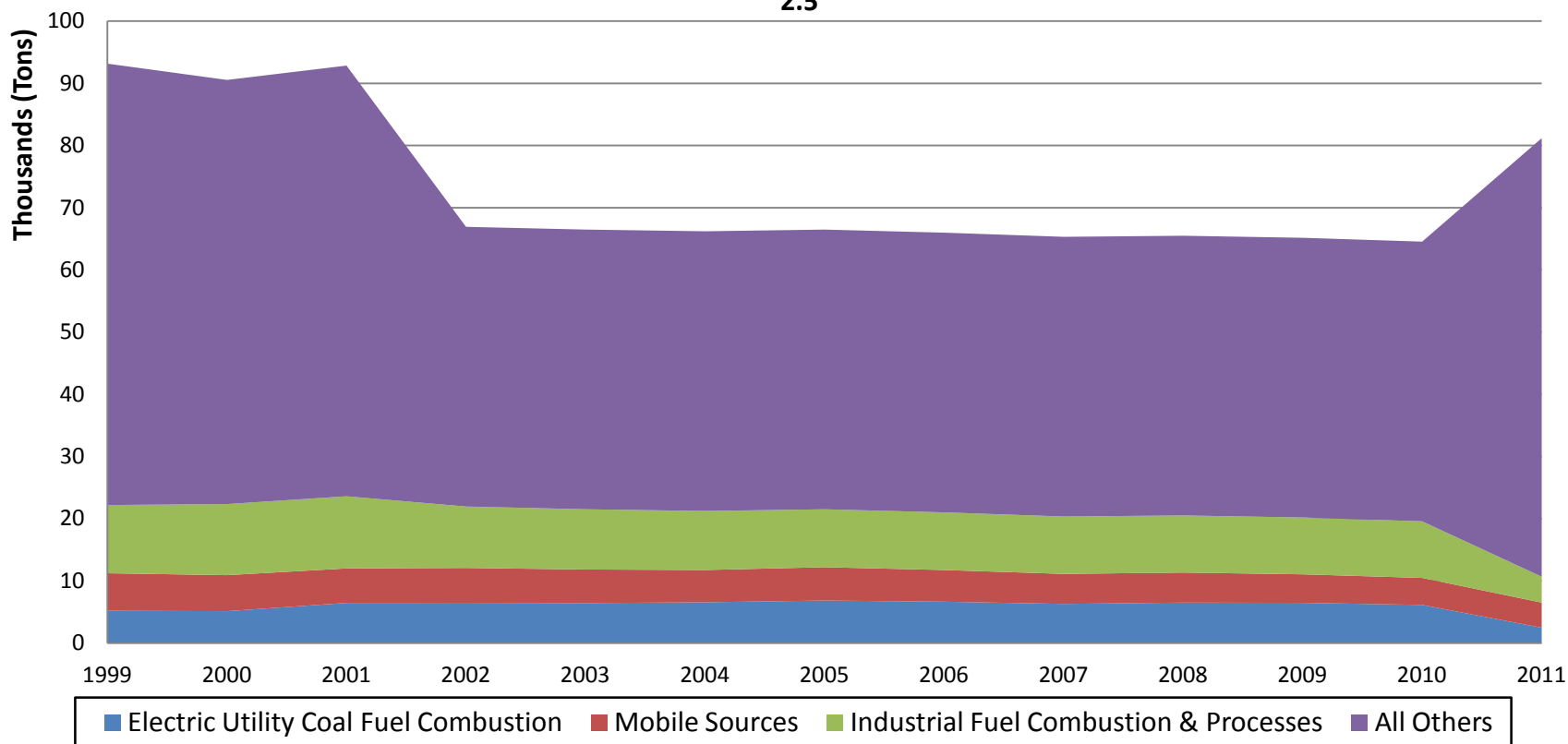
North Dakota Emission Trends (PM_{2.5})

Source Category	Annual Emissions (Tons)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	5,203	6,467	6,440	6,848	6,662	6,306	6,518	6,477	6,147	2,484
Mobile Sources	6,029	5,542	5,400	5,360	5,093	4,825	4,827	4,585	4,342	4,031
Industrial Fuel Combustion & Processes	10,971	11,596	9,680	9,309	9,266	9,222	9,179	9,135	9,092	4,163
All Others	70,948	69,235	44,962	44,963	44,963	44,963	44,963	44,963	44,963	70,497
Total	93,151	92,841	66,481	66,480	65,983	65,317	65,488	65,161	64,544	81,175

Source Category	Annual Emissions Change (Percent since 1999)									
	1999	2001	2003	2005	2006	2007	2008	2009	2010	2011
Electric Utility Coal Fuel Combustion	0%	24%	24%	32%	28%	21%	25%	24%	18%	-52%
Mobile Sources	0%	-8%	-10%	-11%	-16%	-20%	-20%	-24%	-28%	-33%
Industrial Fuel Combustion & Processes	0%	6%	-12%	-15%	-16%	-16%	-16%	-17%	-17%	-62%
All Others	0%	-2%	-37%	-37%	-37%	-37%	-37%	-37%	-37%	-1%
Total	0%	0%	-29%	-29%	-29%	-30%	-30%	-30%	-31%	-13%

North Dakota Emission Trends (PM_{2.5})

**Major Source Category Summary
Annual PM_{2.5} Emissions**



Emission Trends Summary

- ❑ All pollutants have decreased since 1999 in aggregate across North Dakota
- ❑ NO_x and SO₂ from Electric Utility Fuel Combustion sources show decrease over time as a result of participation in the Acid Rain Program
- ❑ Onroad emission step increase seen between 2004 and 2005 is the result of EPA's method change and MOVES model integration for estimating onroad mobile source emissions

Air Quality Design Values

- Ozone
 - Annual 4th highest daily maximum 8-hour average averaged over three consecutive years
 - Current standard = 0.075 ppm
- PM_{2.5} Annual
 - Annual arithmetic mean of quarterly means averaged over three consecutive years
 - Current standard = 12 ug/m³
- PM_{2.5} 24-Hour
 - Annual 98th percentile of daily averages averaged over three consecutive years
 - Current standard = 35 ug/m³

State-Wide Design Value (DV) Trends

- Trends in state-wide maximum DV and average DV
 - Max DV: Maximum DVs over all valid trend monitoring sites in the state in each overlapping three year period
 - Average DV: Average of DVs over all valid trend monitoring sites in the state in each overlapping three year period
- Compute linear trend via least-squares regression

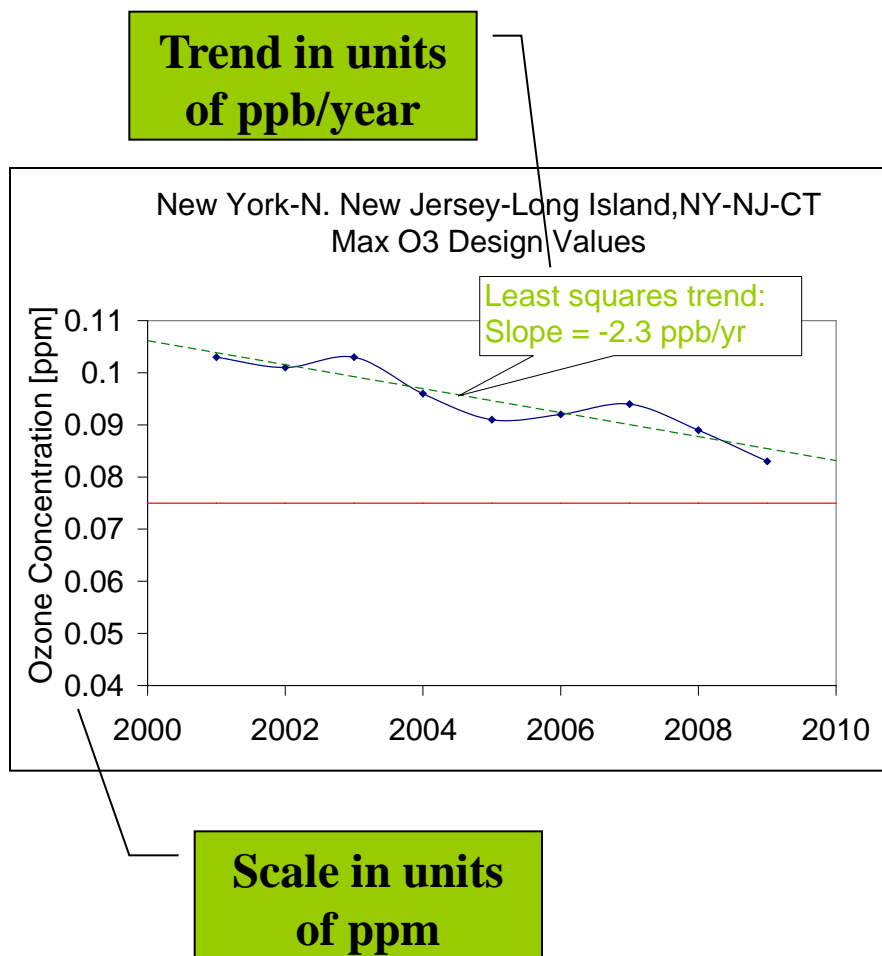
Data Handling Procedures

- O₃ design value (DV) for each overlapping three-year period starting with 1999-2001 and ending with 2009-2011
 - DV calculated using annual 4th highest daily max 8-hr averages and percent of valid observations, based on EPA data handling conventions
 - Data associated with exceptional events that have received EPA concurrence are omitted
 - Selection of trend sites require valid DV in 9 out of 11 three-year periods between 1999 and 2011
 - Identification of nonattainment areas is with respect to the 2008 8-hour standard only

Data Handling Procedures

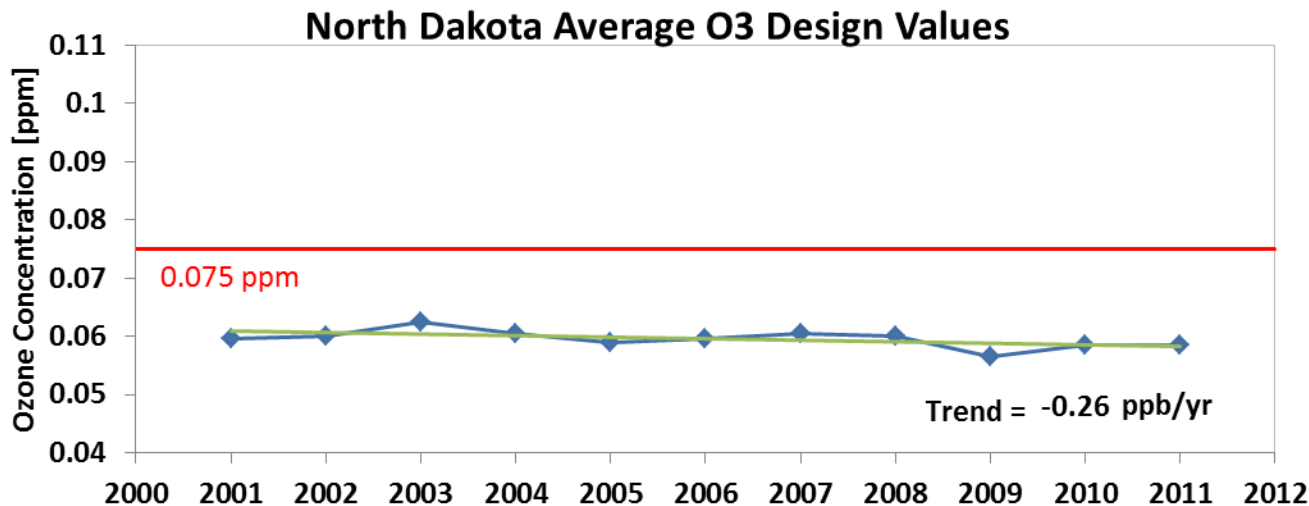
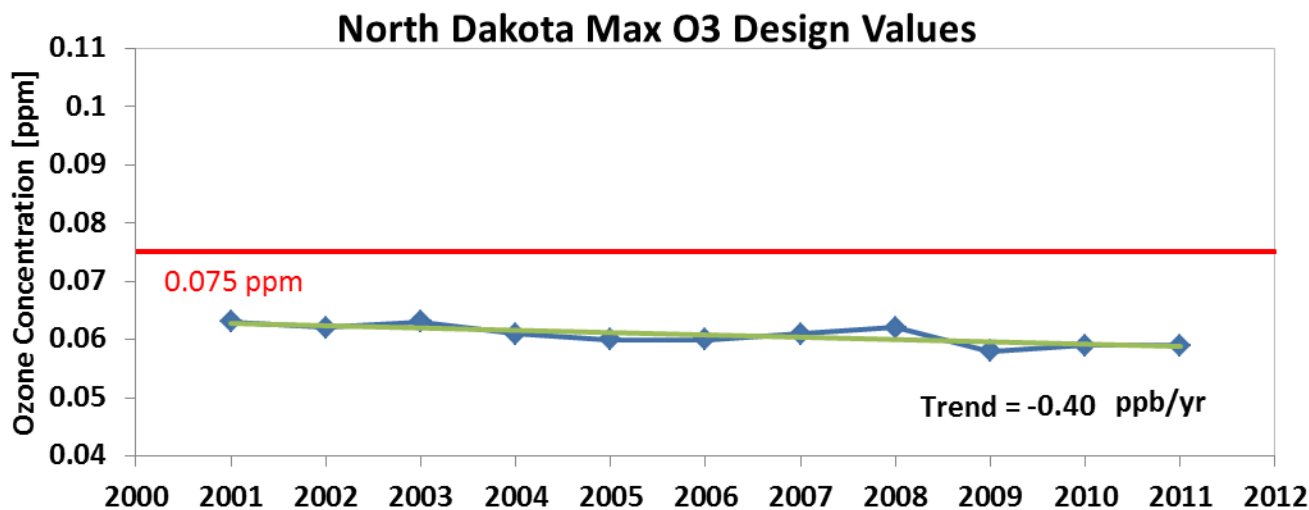
- Annual $PM_{2.5}$ DV and 24-hr $PM_{2.5}$ DV for each overlapping three-year period starting with 1999-2001 and ending with 2009-2011
 - DV calculations based on EPA data handling conventions
 - Data extracted from monitors that have a non-regulatory monitoring type are omitted
 - Selection of trend sites require valid DV in 9 out of 11 three-year periods between 1999 and 2011

Trend Calculation



- Trends based on linear least squares fit to rolling three year design values (DVs)
- Negative trend indicates improving air quality
- DVs based on each 3-year period: 1999-2001, 2000-2002, ... 2009-2011
- Notes
 - On plots, DVs are for three year period ending in year shown (i.e., 2009-2011 DV plotted as 2011 value)
 - Ozone trend values expressed as ppb/year (1,000 ppb = 1 ppm); DVs are plotted as ppm

Max/Ave O₃ DVs and Trend



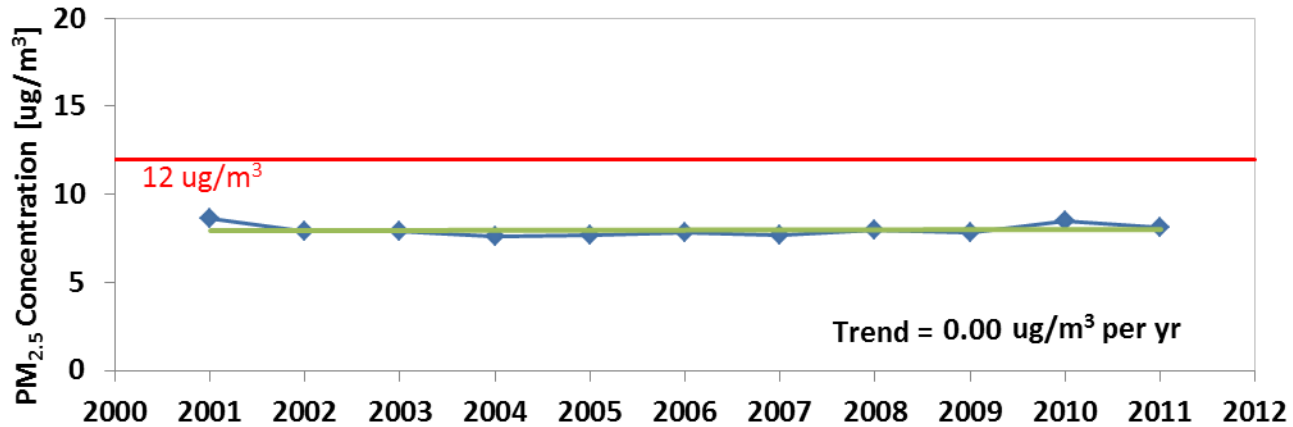
Ozone Trends by Site in North Dakota

Monitoring Sites	County	2009-2011 DV [ppm]	Trend [ppm/yr]
3801710044420101	Cass, ND	0.059	-0.60
3805700044420101	Mercer, ND	0.058	0.08

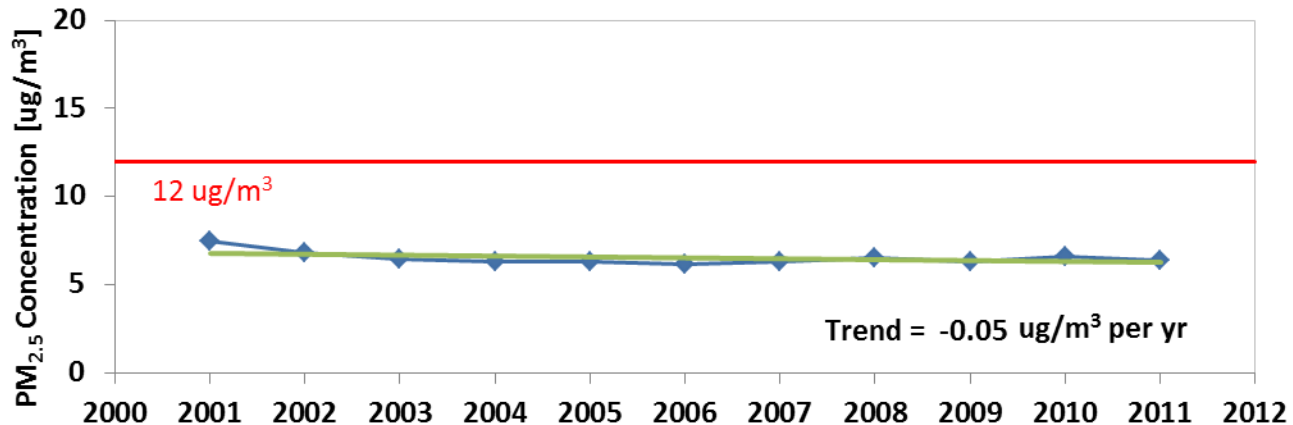
Note: Only monitoring sites meeting data completeness criteria listed

Max/Ave PM_{2.5} Annual DVs and Trend

North Dakota Max PM_{2.5} Annual Design Values

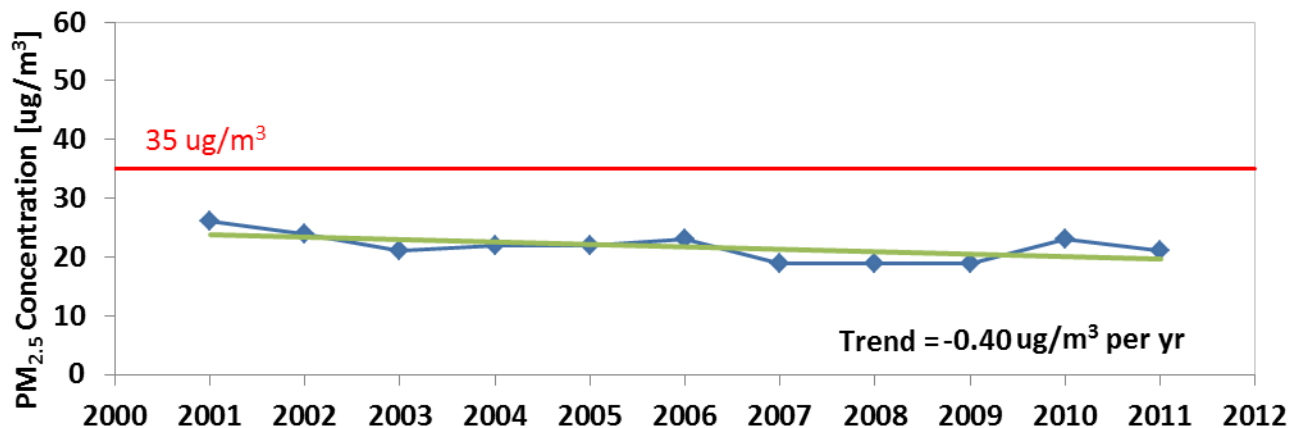


North Dakota Average PM_{2.5} Annual Design Values

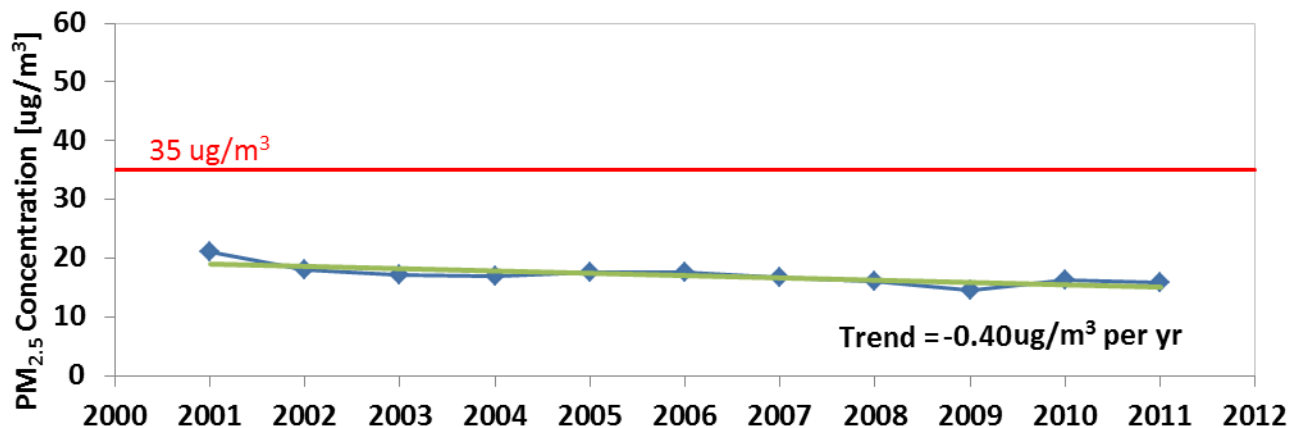


Max/Ave PM_{2.5} 24-Hour DVs and Trend

North Dakota Max PM2.5 24-Hour Design Values



North Dakota Average PM2.5 24-Hour Design Values



PM_{2.5} Trends by Site in North Dakota

Monitoring Site	County	2009-2011 DV [ug/m ³]		Trend [ug/m ³ per year]	
		Annual	24-Hr	Annual DV	24-Hr DV
380070002	Billings	4.3	11	-0.03	-0.27
380150003	Burleigh	6.9	16	0.04	-0.02
380171004	Cass	8.1	21	0.00	-0.40
380570004	Mercer	6.3	15	0.01	-0.25

Note: Only monitoring sites meeting data completeness criteria listed

Air Quality Trends Summary

- ▣ Based on data from two monitor stations, average O_3 design values have remained steady since 1999 in North Dakota; average annual and 24-hour $PM_{2.5}$ design values have also remained steady since 1999 in North Dakota.
- ▣ There are no currently designated O_3 or $PM_{2.5}$ non-attainment areas in North Dakota.