STATE OF ARKANSAS
MIKE BEEBE
GOVERNOR

February 23, 2012

Dr. Al Armendariz, Regional Administrator
United States EPA Region VI
1445 Ross Avenue, Suite 1200
Dallas, TX 75202-2733

Dear Dr. Armanderiz:

I write in response to your letter dated December 9, 2011. I respectfully disagree with your preliminary designation of Crittenden County as nonattainment for the revised National Ambient Air Quality Standard (NAAQS) for eight-hour ozone. This seems to be contraindicated, based on the described criteria that EPA utilized in making the preliminary determination throughout the country. EPA stated that certified air quality monitoring data from 2008-2010, compared against the 2008 Ozone NAAQS of 0.075 ppm, would serve as the basis for the determinations. The design value for Crittenden County, based on the certified monitoring data from 2008 -2010, is in compliance with the 2008 Ozone NAAQS, with a value of 0.074 ppm. Additionally, Crittenden County does not significantly contribute to violations at the Shelby County, Tennessee, Frayser Monitor, as detailed in the attached technical support document. Therefore I submit for consideration an amended recommendation that Crittenden County, as well as Pulaski County, be designated as in attainment with the 2008 Ozone NAAQS with all other Arkansas counties being classified as "Unclassifiable/Attainment".

The EPA justified the designation of five of the eight counties in the Memphis area as in attainment, because they "...all have relatively low population and urbanization, and precursor emission contribution and transport suggesting negligible contribution to the violating county." This same rationale is true of Crittenden County, based on the Arkansas Department of Environmental Quality's (ADEQ) review of the data and the five-factor analysis used in EPA's technical document. The EPA has not provided a scientifically defensible basis for any other determination. Therefore, Crittenden County should be designated in attainment and not part of the nonattainment area for the same reasoning.

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Of further note, meteorological conditions on episode days for the 2008-2010 certified air data for the violating Frayser monitor show that Crittenden County emissions are unlikely to significantly influence ozone concentrations at the Frayser site. The current analysis performed by ICF International for the period 2001-2010 (see appendix to attached technical support document) quantifies the potential for contribution based on both wind direction and emissions. The results indicate that the "potential for contribution is very small (with a frequency equivalent to much less than one exceedance day per year)."

ADEQ's analysis suggests that Crittenden County is not likely contributing to the violation in Shelby County, but instead is in attainment with the 2008 Ozone NAAQS and "…is relatively low population and urbanization, and precursor emission contribution and transport suggesting negligible contribution to the violating county." Therefore, Crittenden County should be classified as in attainment and definitely should not be included as part of the nonattainment area.

If you have questions regarding this submittal, please contact Mike Bates, Air Division Chief, Arkansas Department of Environmental Quality, 5301 Northshore Drive, North Little Rock, AR 72218-5317, (501) 682-0750. We look forward to your prompt reversal of this preliminary designation recommendation.

Sincerely,

Mike Beebe

cc: Teresa Marks, Director - ADEQ
Mike Bates, Air Division Chief - ADEQ
Guy Donaldson, Air Planning Section Chief - EPA - Region 6

Enclosures

Analysis of Environmental Protection Agency Technical Support Document

Arkansas Area Designations for the 2008 Ozone National Ambient Air Quality Standards

Arkansas Department of Environmental Quality

Air Division – Planning Branch

February 2012

Analysis of Environmental Protection Agency Technical Support Document

Arkansas Area Designations for the 2008 Ozone National Ambient Air Quality Standards

On December 9, 2011, the federal Environmental Protection Agency (EPA) sent a letter to the Honorable Mike Beebe, Governor of the State of Arkansas, describing a proposal to designate the attainment status of Arkansas counties with regard to the National Ambient Air Quality Standards (NAAQS) for ozone. Included with the letter as an enclosure, the EPA provided a Technical Support Document (TSD)[1] that describes the reasoning it used to arrive at preliminary designations. In that letter, the EPA stated its intent to designate Crittenden County, AR as being in nonattainment of the 2008 ozone NAAQS and all other counties in the State as unclassifiable/attainment. This document is prepared in response to the EPA TSD. It contains information intended to rebut the EPA proposal to designate Crittenden County, AR as nonattainment for the 2008 ozone NAAQS.

According to an EPA guidance memorandum (Area Designations for the 2008 Revised Ozone National Ambient Air Quality Standards – R. J. Meyers, Principal Assistant Administrator – 12/04/08), during its review of the State's recommended nonattainment designations, EPA is to consider / evaluate 9 factors when determining nonattainment area boundaries. The designation process for the 2008 ozone NAAQS has, by necessity, been altered somewhat from the traditionally followed process due to the reconsideration announced by EPA Administrator Lisa P. Jackson on 9/16/09, the proposal for an alternate "2008" standard and the ultimate decision on 09/22/11 to withdraw the proposed alternate standard and implement the original 2008 Standard.

In the above-referenced letter to Governor Mike Beebe, EPA stated that it would make its preliminary designations decisions based on previously submitted State recommendations, modified as necessary, by the use of the most current certified quality assured/quality controlled data for the 2008 – 2010 time frame (unless the State "early certified" monitor data for 2011 and request the use of 2009 – 2011 data). Arkansas has not yet certified the 2011 ozone monitor data; therefore the monitor data for the years 2008-2010 must be utilized for attainment designation purposes.

Crittenden County, Arkansas is currently designated as a maintenance area for the 1997 ozone NAAQS. In 2009, Arkansas Governor Mike Beebe submitted a letter to EPA that included a designation recommendation of nonattainment for the 2008 ozone NAAQS for Crittenden County, AR. This recommendation was based on monitoring data that was recorded at the ozone monitoring station that is located in Marion, Arkansas for the years 2006 - 2008. Due to delays in implementation of the 2008 ozone NAAQS, as referenced above, this recommendation has become outdated. Based on ozone monitoring data collected at the Marion monitor site through 2010 (the last year for which quality-assured data has been provided to the EPA), Arkansas is now recommending that Crittenden County, Arkansas be designated as attainment for the 2008 ozone NAAQS. The 2010 Design Value (DV) for the Marion monitor is 74 ppb.

EPA states on page 11 of the TSD that it "… is proposing to include all of Crittenden County in the 2008 ozone Memphis, TN-MS-AR nonattainment area because the county was included in its

[1] ARKANSAS – Area Designations for the 2008 Ozone National Ambient Air Quality Standards (Dec. 2011)

entirety in the 1997 ozone Memphis, TN-MS-AR nonattainment area and because Arkansas recommended inclusion of the county in its entirety."

It should be noted that there is no regulatory justification for recommending the inclusion of a county in a nonattainment area based on its classification under a previous NAAQS.

Additionally, the rationale for inclusion of Crittenden County based on the previously submitted (2009) State recommendations significantly departs from EPA's publically announced procedure for making preliminary designation determinations. The 2009 State recommendation should be considered only to the extent that the use of the 2008-2010 monitor data still indicates that a monitor show levels above the 2008 NAAQS.

As noted above, Arkansas is revising its recommendation based on the 2010 DV and is not recommending that Crittenden County, AR be designated as nonattainment.

Based on 2010 DVs for all ozone monitors located in the Memphis, TN-MS-AR CBSA, the only monitoring station that had a DV higher than the NAAQS was the Frayser monitor site in Memphis, Tennessee. ADEQ agrees that the EPA's stated intent to use 2010 DVs as the basis for designations is appropriate, especially since the 2010 DV would best represent the ozone concentrations experienced by the majority of the population in the densely urbanized portion of the Memphis area. Using 2010 DVs would also best represent monitoring in the vicinity of most of the major industrial and mobile sources of ozone precursor emissions in the Memphis area.

Promulgated and proposed federal rules have projected near–future attainment in the Memphis area. Delays in implementation of the 2008 ozone NAAQS and other federally mandated programs have significantly impacted the ability of States to make progress in demonstrating regional attainment. Designating the area nonattainment for the 2008 standard would serve no useful purpose since it is likely, based on current trends further discussed herein, that the entire area will be attaining the standard in the near future.

In the TSD, EPA states that preliminary designations are based on:

> Whether and which monitors are violating the 2008 ozone NAAQS with 2010 DVs.
>
> and
>
> Evaluation of whether nearby areas are contributing to violations.

Based on the above, Crittenden County, AR should not be designated nonattainment for the 2008 Ozone NAAQS nor included in the nonattainment designation due to contribution to NAAQS violation. The 2010 DV for the ozone monitor located in Marion, AR did not violate the 2008 ozone NAAQS. Of the four ozone monitors located in the Memphis, TN-MS-AR Core Based Statistical Area (CBSA), only the Frayser monitor site, located in Memphis, TN, had a DV that exceeded the 2008 NAAQS.

The EPA TSD does not provide a scientifically defensible basis for its presumption that Crittenden County, AR contributes significantly to violations at the Frayser monitor site. While

the TSD attempts to assert that emissions, population and traffic patterns in Crittenden County, AR contribute to the DV of the Frayser monitor, the only indication of potential contributions that the EPA has asserted with any meaningful documentation is that prevailing winds occasionally pass through Crittenden County, AR. The TSD failed to document or elaborate in any way to show a correlation between winds patterns from Crittenden County, AR toward the violating monitor (Frayser) that establishes significant pollutant distribution that could be viewed as contributing to the exceedance of the NAAQS.

ICF International, a meteorological consulting firm, has provided ADEQ with an analysis that refutes the contention presented in the TSD by showing that Crittenden County, AR has only a marginal and infrequent influence on ozone concentrations recorded at the Frayser monitor site. The ICF memorandum is included as an Appendix herein.

The following discussion of the EPA TSD follows the structure of that document. Headings in bold type highlight the elements of the "5 factor analysis" that the EPA used to make preliminary determinations.

Weight of Evidence (WOE) analysis

Factor 1: Air Quality Data

EPA's Table 2 shows that Arkansas has recommended nonattainment for Crittenden County. While Arkansas originally recommended nonattainment when recommendations were first required, Arkansas is revising its recommendation to attainment/unclassifiable based on the 2010 DV of 74 ppb for the Marion monitor.

Tennessee has requested that EPA use its 2011 DVs (74 ppb) for designation purposes. The 2011 monitoring data for Arkansas monitors has yet to be certified as meeting quality assurance and control protocols and therefore, cannot be used for attainment designation purposes within Arkansas. Using 2011 DVs would cause the Marion monitor in Crittenden County, AR to have the highest estimated DV (77 ppb) in the CBSA. This would still result in nonattainment but would result in a higher DV being used for classification purposes. Basing a nonattainment designation on the DV of a primarily "downwind" monitor in an adjacent State in a CBSA where all other monitors are showing attainment would not be representative of the regional ozone formation and concentration dynamics.

Factor 2: Emissions and Emissions-Related Data:

location of sources

Memphis/Shelby County Tennessee emission sources dominate the area-wide emissions inventory. Arkansas has no control over the numerous emission sources in the Tennessee inventory. Sources in Tennessee account for 74 percent of the NO_x emissions and 71 percent of the VOC emissions in the CBSA.

A significant portion of the emissions inventory for Crittenden County, AR consists of emissions from agricultural activities. Many of these emissions sources are operated intermittently and should not be considered as contributing to typical ozone season daily emissions. Emissions from agricultural equipment are being reduced through federal programs requiring cleaner fuels and more efficient engines. Emissions from agricultural equipment in Crittenden County, Arkansas should continue to decline as new federal standards regulating non-road engines and fuels are implemented.

As evidenced by the information provided on Pgs. 5 – 8 and in Fig. 2 of the EPA TSD, Memphis/Shelby County, TN has the most potential for effective emission reductions.

location of population

Based on EPA analysis, 70 percent of the CBSA population resides in Shelby County, TN. The population of Crittenden County represents only 4 percent of the CBSA population. Crittenden County, Arkansas is primarily rural croplands and wetlands. As shown in Table 4 of the EPA TSD, the population of Crittenden County, Arkansas has actually decreased between 2000 and 2010. With the exception of West Memphis and Marion, the population density of Crittenden County is extremely low.

amount of emissions

On P. 5, EPA's TSD states that "Crittenden County contributes less than 10 percent of the precursor CBSA emissions." The actual contribution, based on the values in EPA's Table 3 is 7.5 percent. By generalizing, EPA's analysis overstates Crittenden County emissions by 2.5 percent.

P. 6 of EPA's TSD states that "Both Crittenden County and DeSoto Counties have less than 1 percent of the entire area's NOx and VOC emissions." Crittenden County, Arkansas continues to be subject to federal requirements for Prevention of Significant Deterioration (PSD). It is apparent that any Crittenden County point source emission reductions that would be mandated under a new nonattainment designation would have limited effectiveness.

Crittenden County NOx and VOC emissions from all anthropogenic source categories (point, area, mobile and non-road) for 2008 have decreased from 2005 levels. This may well be a factor in the downward trend in ozone DVs that is described in Appendix A herein.

The statement on P. 6 that "The emissions from Fayette and Tipton Counties in Tennessee and Marshall, Tate and Tunica Counties in Mississippi are not thought to contribute significantly to the violations of the 2008 ozone NAAQs that have been observed by monitors in Shelby County, Tennessee and Crittenden County Arkansas." is unsupported by analysis and misrepresents area-wide contributions.

While county-by-county emission totals and percentages show emissions in a relative sense, they do not, of themselves, indicate a significant contribution to nonattainment in an adjacent or nearby county.

emissions controls

Due to its previous nonattainment designation, most practically available emission controls are already in place in Crittenden County. Examples of programs already in place include:

Prevention of Significant Deterioration (PSD) New Source Review

Stage I Vapor Recovery

municipal fleet diesel retrofits

private-sector Truck Stop Electrification

Intelligent Transportation Systems

federal fuel and engine standards have reduced Crittenden County mobile emissions

federal fuel and engine standards have reduced Crittenden County non-road emissions

Transportation Conformity in the West Memphis Area Transportation Study area.

urban growth patterns

Column 6 of EPA's Table 4 represents the population change in Crittenden County as 0 percent. On P. 7 EPA states that Crittenden County "… had less than 1 percent population growth from 2000 – 2010 and contains only 4 percent of the CBSA population." Using the numbers in Table 4, the population of Crittenden County has actually declined by 1 percent.

Table 4 also indicates that there has been population growth in all other counties in the CBSA. DeSoto County, Mississippi has the highest actual population growth in the CBSA.

Ozone DVs in the CBSA have shown a downward trend, despite an overall increase in population of 107,854 in the period from 2000 – 2010.

On P. 7, EPA states that it has evaluated "… the commuting patterns of residents in the area…" but the TSD provides no documentation of any analysis of commuting activity that would support this statement. The title of EPA's Table 5 is labeled "Traffic and Commuting Patterns"

but is mislabeled since it contains no information regarding commuting patterns. The latest available data from the U.S. Census Bureau (1980) shows that only about 10 percent of the population of Crittenden County, AR (~5000 - 6000 people) commutes to work in Shelby County, TN.

EPA states on P. 7 that "Crittenden County accounts for less than 10 percent of the CBSA VMT. The values in Table 5 show that Crittenden County accounts for less than 7 percent of the CBSA VMT. As can be visualized from the data contained in Figure 1, Mobile source NO_x emissions in Crittenden County, Arkansas are dominated by commercial vehicles and passenger vehicles that are passing through the county on the two interstate roadways that traverse it.

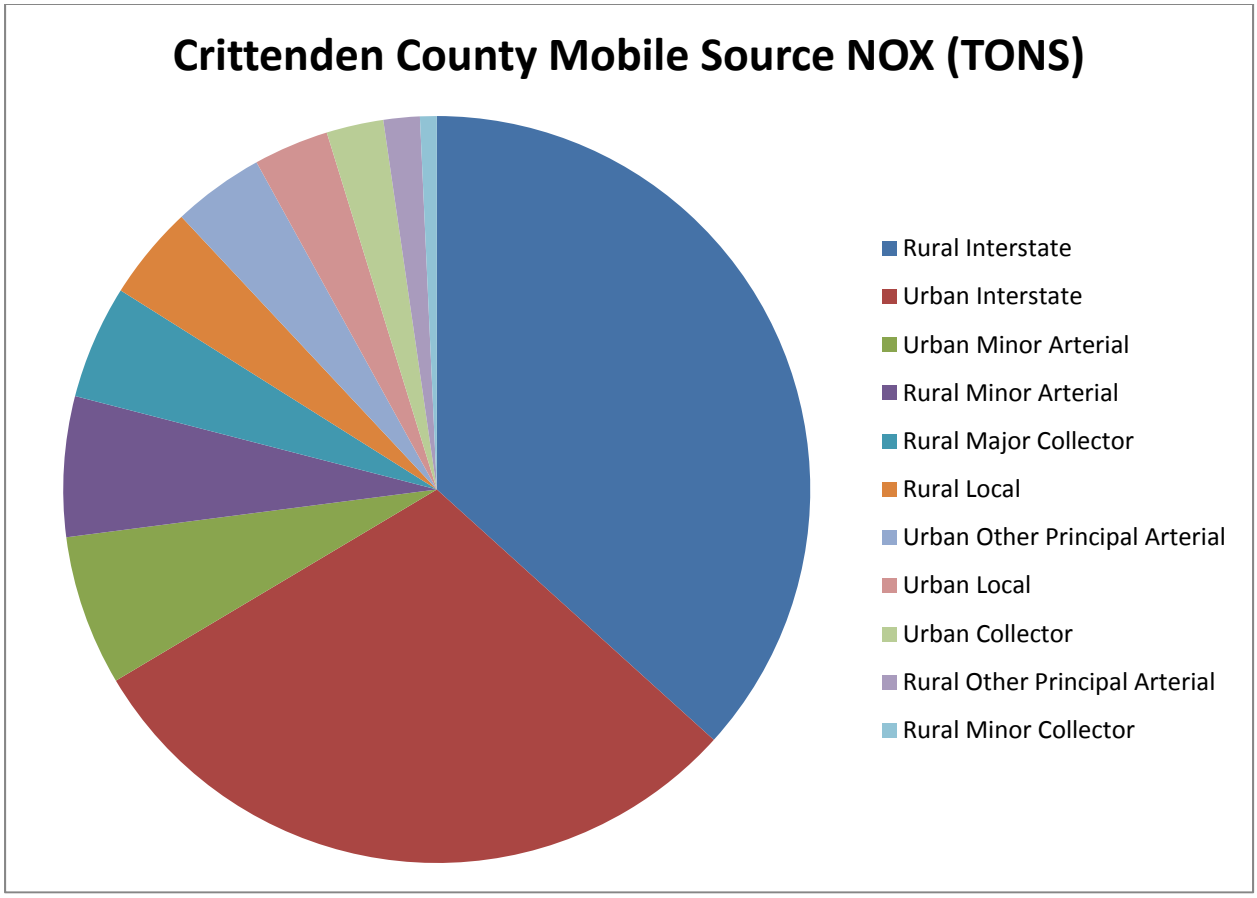
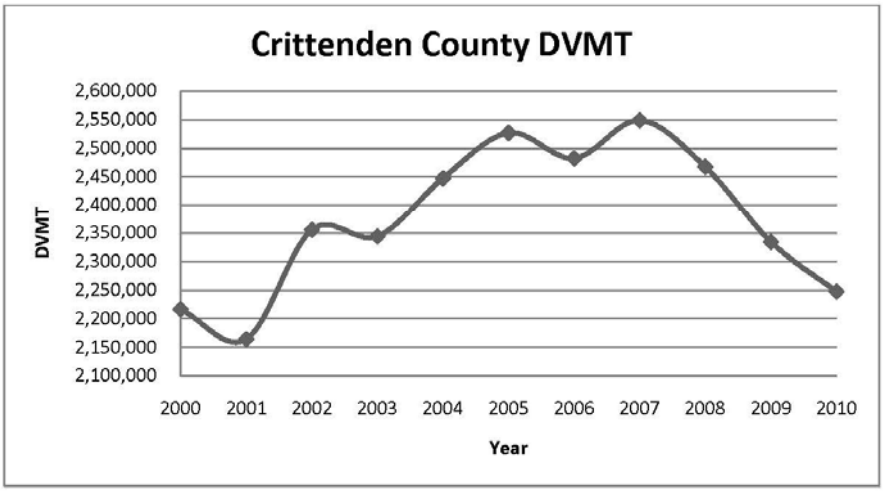


Figure 1

The Arkansas Highway and Transportation Department has provided an analysis comparing Daily Vehicle Miles Traveled (DMVT) in Crittenden County, AR to statewide totals for the years 2000 – 2010. Crittenden County DMVT peaked in 2007 at 2,500,000 and dropped to 2,250,000 in 2010. The 2010 DVMT for Crittenden County, AR is at the lowest level since 2001. Over the same period, the statewide DVMT trend has continued to rise. When compared to statewide trends, this regional decline in traffic may be indicative of factors that are influencing

driving behavior in Crittenden County. Factors contributing to the decline in Crittenden County DVMT might include reduced commercial activity caused by a sluggish economy and a reduction in driving influenced by rising fuel prices. Charts 1 and 2 depict Crittenden County, Arkansas and state-wide VMT trends for the years 2000 – 2010.

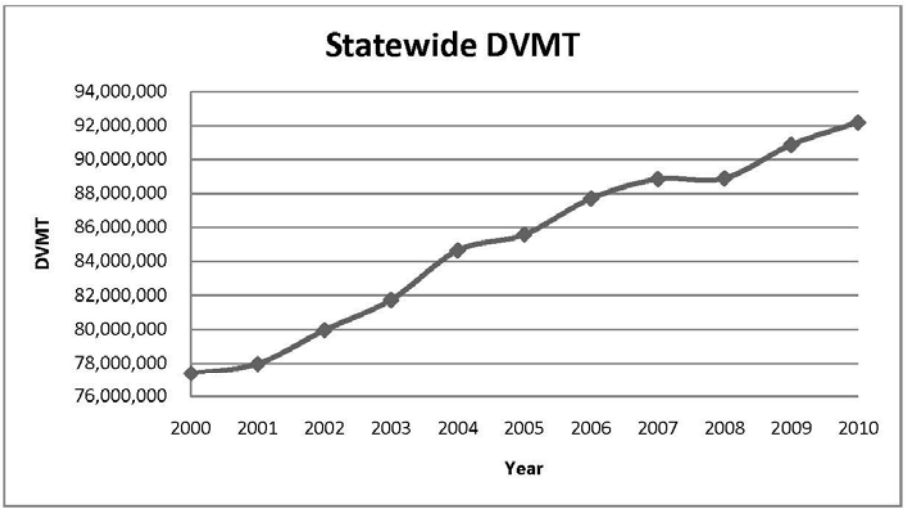
Chart 1



2000-2010 AAGF=0.14% increase in VMT

2006-2010 9.5% decrease in VMT

Chart 2



2000-2010 AAGF=1.91% increase in VMT

2006-2010 5.1% increase in VMT

AHTD: P&R: PAS: MCH *1/25/2012*

Factor 3: Meteorology (weather/transport patterns)

With respect to monitored concentrations at the Frayser site, EPA has provided insufficient evidence of a significant contribution from Crittenden County. The analysis provided herein as an Appendix (Analysis of 8-Hour Ozone Design Value Trends – ICF International – Jan, 2011) describes how emissions from Crittenden County are unlikely to have a significant impact on the DV for the Frayser monitor. Note that Crittenden County lies to the west of the rest of the CBSA. As stated in the ICF memorandum:

> For both periods considered, there is no apparently causal relationship between winds from the SW to the W and high ozone at the Frayser monitor. In fact, low wind speeds, easterly wind components (E to SSE winds), and/or northerly winds are more likely on ozone exceedance days compared to all days and appear to be a determining factor for ozone exceedances at this site.

The EPA TSD describes the use of historic meteorological data, primarily wind patterns, as a means of representing current contributions to nonattainment at the Frasier monitor. It does not consider the air quality of the air mass that might influence ozone concentrations at a particular monitoring site and does not account for emission reductions realized in the latest years analyzed.

The fact that an air mass passed through a portion of Crittenden County, AR prior to it arriving in the vicinity of the Frayser monitor site does not constitute a demonstration of significant contribution to a monitored exceedance. HYSPLIT modeling alone is insufficient evidence of a significant contribution. The EPA TSD acknowledges “back trajectories going back through Crittenden County, AR on only one out of 10 days” for the years 2008 – 2010. The ICF analysis provides additional analysis indicating that Crittenden County would influence Frayser monitor site ozone concentrations only infrequently and marginally.

Factor 4: Geography and topography (mountain ranges or other basin boundaries)

EPA asserts that this factor "did not play a significant role in this evaluation." ADEQ has identified no relevant issues with respect to this factor.

Factor 5: Jurisdictional boundaries

Crittenden County, Arkansas was previously designated as a Targeted Economic Development Zone (TEDZ). At that time, ADEQ was required to demonstrate through photochemical modeling that the emissions from any new major facilities would not cause or contribute to either reattainment or maintenance of the 1997 ozone standard. Since then, no new major sources have been sited in Crittenden County, AR.

Also since that time, total annual emissions of ozone precursor pollutants have decreased and ozone concentrations at the Marion monitor site, and all other sites in the CBSA, have been trending downward (see Fig. 2). It is apparent that emission reductions already being realized in Crittenden County, AR are resulting in improved air quality in the region.

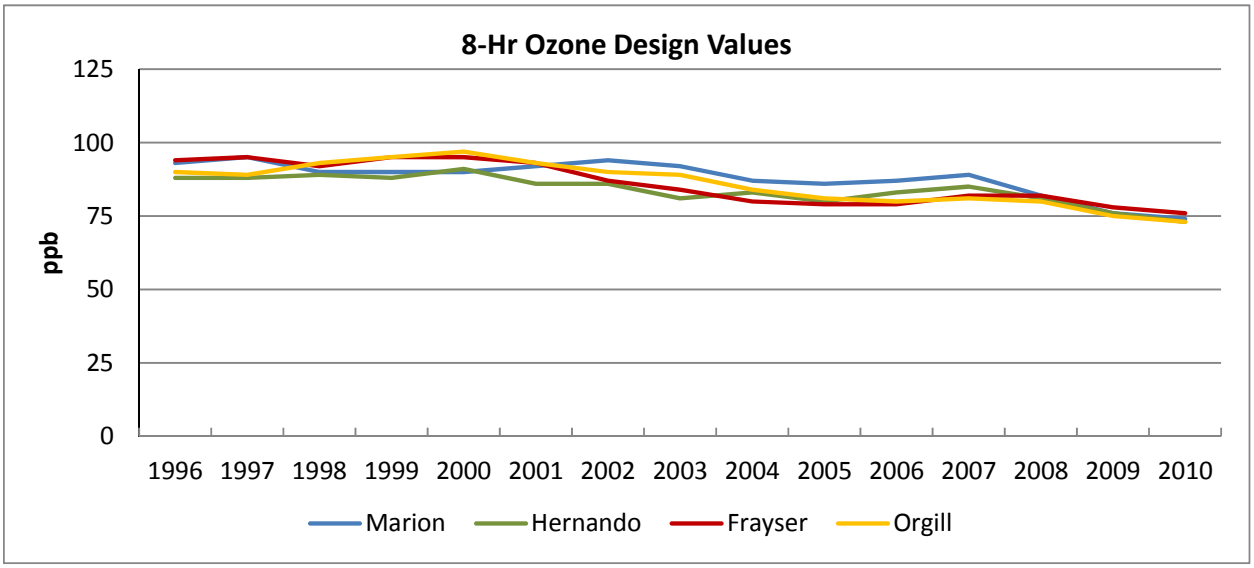


Figure 2

The major sources of ozone precursor emissions within the CBSA are located in the State of Tennessee. Table 3 in the EPA TSD clearly demonstrates this. The State of Arkansas has no authority to require either the State of Tennessee or Memphis/Shelby County, Tennessee, a jurisdiction with a local air quality control program, to implement any control measures that might be required to assure attainment and maintenance of the ozone NAAQS.

It is appropriate that Crittenden County, Arkansas be treated as a separate jurisdiction when considering its attainment status and any implications of nonattainment implementation. Its previous designation as a TEDZ and the fact that it was required to conduct its own Transportation Conformity demonstrations are examples of how it has been previously treated as a separate jurisdiction when required to address regional air quality issues.

Since Crittenden County, Arkansas is currently designated as a maintenance area for the 1997 ozone standard and has already been required to implement emission reduction and control

measures, there are no additional benefits to be achieved by a new nonattainment designation. Designating Crittenden County, Arkansas as a nonattainment area for the 2008 NAAQS would serve no useful purpose.

Appendix – Analysis of 8-hour Ozone Design Value Trends

MEMORANDUM

To: Kelly Jobe, Mark McCorkle, and Tony Davis, Arkansas DEQ

From: Sharon Douglas, Jay Haney, and Belle Hudischewskyj, ICF

Date: January 24, 2012

Re: 8-Hour Ozone Related Analyses

Analysis of 8-hour Ozone Design Value Trends

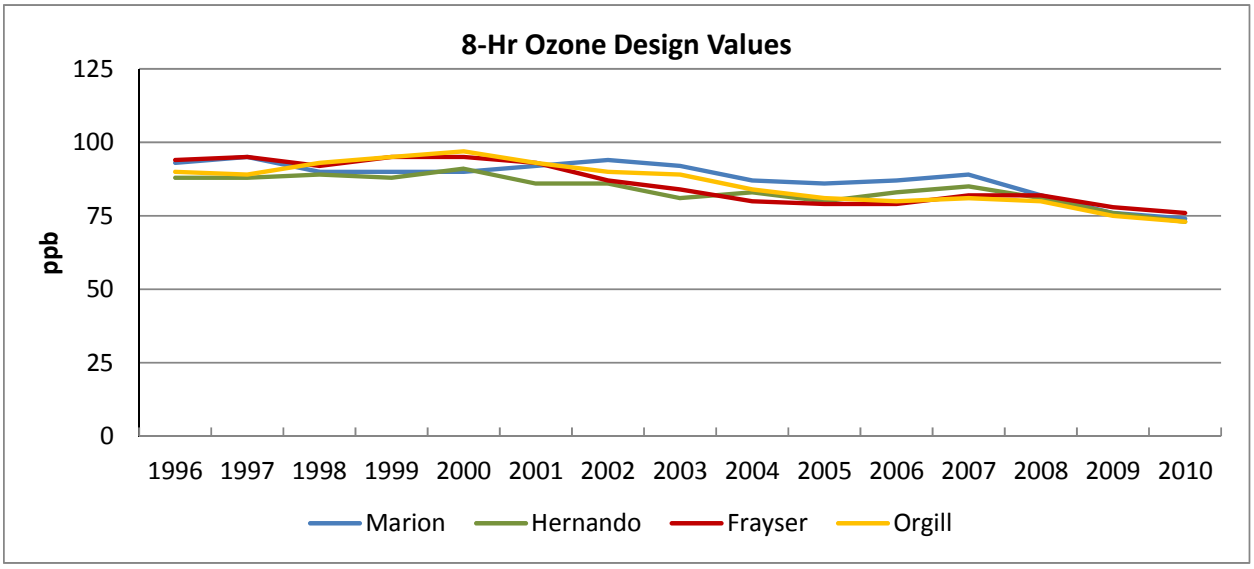
The 2008-2010 8-hour ozone design values for monitoring sites within the greater Memphis area are very close to the current National Ambient Air Quality Standard (NAAQS) of 75 ppb. The design values are 76 ppb for the Frayser monitoring site in Shelby County (TN), 74 ppb for the Marion monitoring site in Crittenden County (AR), and 73 ppb for both the Edmund Orgill Park monitoring site in Shelby County and the Hernando monitoring site in DeSoto County (MS). The design value for a given monitor is the three-year average of the fourth highest daily maximum 8-hour average concentration for each of the three years. This metric was formulated to limit the effects of year-to-year variations in meteorology as well as unusual or infrequent meteorological or emissions conditions on attainment designations and attainment status.

With values so close to the NAAQS, however, year-to-year variations in meteorology can influence the designation of attainment. As an example, preliminary data indicate that the design values for 2009-2011 are 74, 77, 73, and 74 ppb for the Frayser, Marion, Orgill, and Hernando monitors, respectively (with the values for the Frayser and Marion sites giving a different outcome relative to attainment just one year later). In this case, given the potential confounding effects of year-to year-variations in meteorology, it is important to consider both current design values and longer-term trends in the determination of attainment/nonattainment.

The following analysis examines recent trends in design values for each of the monitors in the Memphis area and attempts to reconcile the trends in 8-hour ozone with known changes in emissions, both locally and regionally. This analysis focuses on the 15-year period 1996-2010.

Figure 1 displays the 8-hour ozone design values for each of the four monitoring sites in the Memphis area. The sites and counties are as follows: Marion (Crittenden County, AR), Hernando (DeSoto County, MS), Frayser and Edmond Orgill Park (Shelby County, TN). Note that the design value for the Frayser monitor is the higher of the two values for Shelby County. The year indicated on the plot is the end year of the three-year design-value period.

Figure 1. 8-Hour Ozone Design Values for Sites within the Greater Memphis Area for the Period 1996-2010.



All four sites show a clear downward trend in design value for the period, culminating with values near 75 ppb in 2010.

Previous studies such as the Arkansas-Tennessee-Mississippi Ozone Study (ATMOS) (Douglas et al., 2004) and the Crittenden County Ozone Study (CCOS) (Douglas et al., 2005), have indicated that the site with the maximum design value for the area varies from year to year based on the frequency of occurrence of meteorological conditions (primarily wind directions) that are conducive to high ozone at the specific sites. The CCOS study found that:

- High ozone days at the Frayser site are characterized, on average, by southerly or northwesterly surface winds (depending on the concentration level), and easterly to southwesterly winds aloft.
- High ozone days for Edmund Orgill Park have southerly wind components at all levels, and, on average, southerly to southwesterly winds at the surface and southeasterly to southwesterly winds aloft.
- High ozone days for the Marion site are characterized, on average, by southeasterly winds both near the surface and aloft. Certain of the high ozone days have easterly winds near the surface. Winds aloft also vary from southeasterly (to southwesterly or westerly) on certain of the higher ozone days.
- High ozone days for Hernando are clearly distinguished by northerly and easterly wind components. Surface winds range from northwesterly to northeasterly, while winds aloft are primarily from these same directions, but occasionally (especially on the highest ozone days) from the east or southeast.

Considering two consecutive design-value periods, a large percentage of days with wind from the northwest might result in the regional maximum value at the Frayser site for the first period, while a shift to more southwesterly winds during the next design value period might cause the location of

maximum design value to shift to the Marion site. This finding indicates that it is important to consider the sites as a group (as well as individually) in determining attainment.

Figure 2 shows the average 8-hour ozone design value, where the average is taken over all four sites.

Figure 2. Four-Site Average 8-Hour Ozone Design Values for the Greater Memphis Area for the Period 1996-2010.

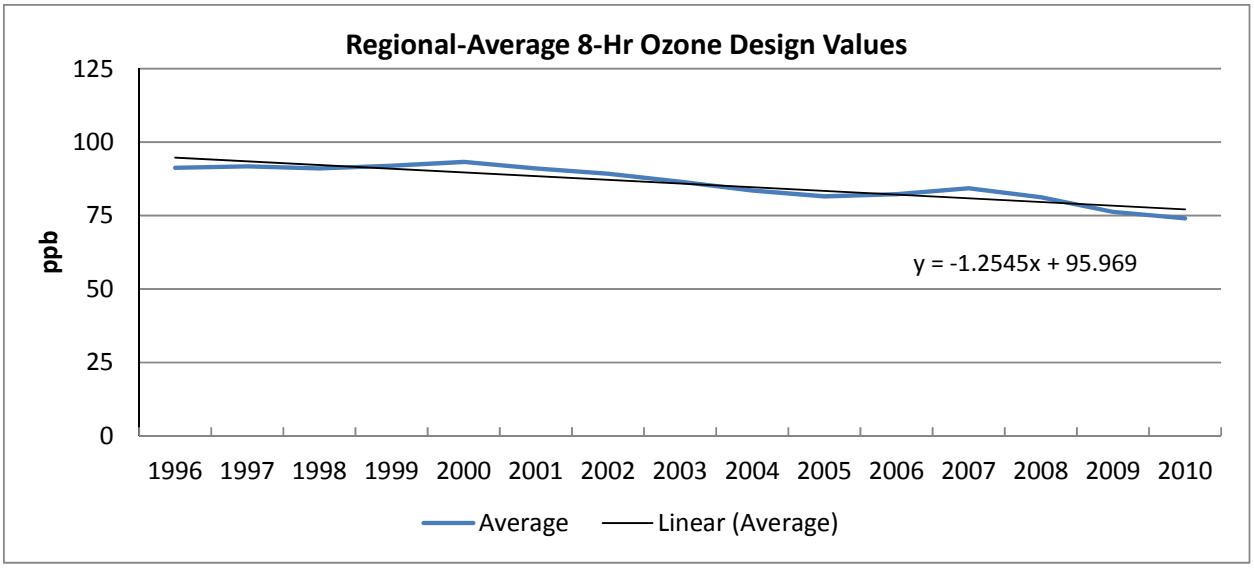
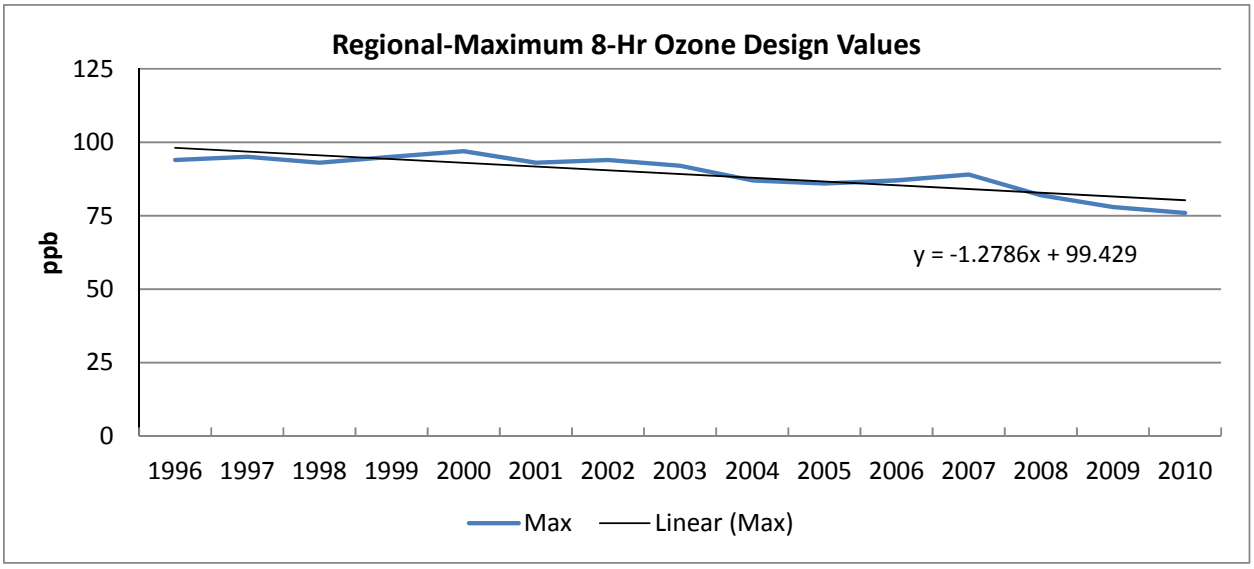


Figure 3 shows the maximum 8-hour ozone design value, where the maximum is taken over all four sites.

Figure 3. Four-Site Maximum 8-Hour Ozone Design Values for the Greater Memphis Area for the Period 1996-2010.



Linear trend lines indicate that, on average, both the regional-average design value (based on all four sites) and the regional-maximum design value (based on all four sites) decrease by approximately 1.25 ppb per year during this period. The confirms the overall downward trend despite that year-to-year differences in meteorology (and specifically prevailing wind directions) cause the location of the regional maximum value to vary from year to year.

It follows that the decrease in ozone design values between 1996 and 2010 is attributable to emissions reductions during that period. Many of these reductions are associated with the Clean Air Act Amendments (CAAA) of 1990, which has led to reductions in emissions of volatile organic compounds (VOCs), oxides of nitrogen (NO_x), and carbon monoxide (CO) from a variety of sources including electric generating units (EGUs), industrial point sources, non-point industrial and area sources, and on-road and non-road motor vehicles and other equipment. National-scale emissions reductions associated with the CAAA during the period 1996-2010 have affected national, regional, and local pollutant concentrations. General emission reduction programs associated with the CAAA include the following:

- Title I VOC and NO_x reasonably available control technology (RACT) requirements in ozone nonattainment areas (NAAs);
- Title II on-road motor vehicle and non-road engine/vehicle provisions (NO_x, VOC, and CO);
- Title III National Emissions Standards for Hazardous Air Pollutants (NESHAPS), and
- Title IV emissions programs for electric generation units (EGUs), primarily for SO_2.

In 1999, EPA promulgated the Regional Haze Rule to help protect visibility in national parks and wilderness areas. The rule mandated that states develop programs to identify short and long-term strategies to reduce precursor emissions (primarily NO_x and SO_2) in an effort to reduce the formation of secondary fine particulates ($PM_{2.5}$). The program included the identification of best available retrofit technology (BART) for older industrial sources and expanded visibility monitoring of Class I areas. Regional haze program plans were to be finalized by the states by 2008 with the initial phase of the program reductions completed by 2018. In addition, specific emission reduction programs targeting interstate transport of ozone and precursor emissions, primarily NO_x, that were expected to affect air quality somewhat in the Greater Memphis area include the NO_x SIP Call and the Clean Air Interstate Rule (CAIR). The NO_x SIP Call (Phase I) was promulgated in September 1998 and mandated that 22 eastern states implement programs to decrease NO_x emissions, primarily from EGUs, to lessen the effects of the regional transport of ground-level ozone. Phase I reductions were to begin in 2003. Phase II of the NO_x SIP call rule was promulgated in April 2004 and required that reductions be in place by 2007. Reductions in emissions from the NO_x SIP call were required in Tennessee and Missouri, but not Arkansas, Mississippi, Texas, or Louisiana, so the effect on Greater Memphis may have been limited.

The Clean Air Interstate Rule (CAIR) was promulgated in March 2005 and mandated significant reductions in SO_2 and NO_x emissions primarily from EGUs in 28 eastern states. Concurrent with this legislation, EPA also issued the Clean Air Mercury Rule (CAMR) targeting mercury emissions from coal-fired EGUs. Together, the CAIR and CAMR programs were intended to reduce regional emissions in the eastern U.S., with Phase I reductions originally slated to start in 2010, and Phase II reductions in 2015. The CAIR and CAMR rules mandated reductions in Tennessee, Mississippi, Arkansas (ozone season only), Texas, and Louisiana, but not Missouri. The effects of emission reductions from CAIR may have only been realized somewhat in 2009 and more fully in 2010 when control equipment was supposed to be in place.

In July 2008, the U.S. Court of Appeals for the D.C. Circuit remanded the CAIR rule back to EPA for review and possible revisions but kept in place the original emission reduction requirements of CAIR. In July 2011, EPA issued the Cross-State Air Pollution Rule (CSAPR), also referred to as the Transport Rule, which was intended to replace CAIR. The CSAPR rule mandated emission reductions in Tennessee, Mississippi, Arkansas, Texas, Louisiana, Missouri, and Nebraska. However, in December 2011, the rule was stayed by the D.C. Circuit court for further review, keeping in place the original provisions of CAIR.

In addition to programs primarily targeting EGUs and other large industrial sources, regional emissions reductions during this period have likely been realized in the on-road mobile source sector due to the fleet turnover of older vehicles, the use of cleaner fuels, and the introduction of cleaner, more efficient engines resulting from compliance with the applicable Corporate Average Fuel Economy Standards (CAFE) for cars and trucks, despite increases in vehicle miles traveled. Other programs promulgated by EPA in this period include new regulations and emission standards resulting from the Clean Air Nonroad Diesel rule of 2004 for diesel fuels, and engines (including locomotives and marine diesel engines), and updated performance standards/rules for spark-ignition engines affecting various off road equipment promulgated in 2008, with emission reductions expected from equipment turnover primarily after 2010.

EPA recently conducted an analysis to assess the effects of the Clean Air Act (CAA) on air quality, the environment, public health, and the economy (EPA, 2011a). This work was performed in accordance with Section 812 of the CAAA of 1990 that requires the EPA to periodically assess the effects of the Clean Air Act (CAA) on air quality, the environment, public health, and the economy. As part of this analysis, EPA prepared emissions estimates for 1990, 2000, 2010, and 2020. Emissions for the historical years (1990 and 2000) were based on the best available emission inventories for these years. Projection to the future years was based on economic growth projections, future-year control requirements (for attainment of NAAQS), and control efficiencies.

Figures 4 and 5 display the emissions data from the Section 812 EPA study (EPA, 2011a) for the years 1996-2010, for two different geographical regions. Figure 4 displays VOC and NO_x emission totals for the three states for which a portion of the state is a part of the greater Memphis area (Arkansas, Tennessee, and Mississippi) as well as ten additional states surrounding the three-state area: Alabama, Georgia, Illinois, Indiana, Kansas, Kentucky, Louisiana, Missouri, Oklahoma, and Texas. Figure 5 displays emission totals for Arkansas, Tennessee, and Mississippi only. Estimates for the interim years are based on interpolation.

Figure 4. Estimated Emissions Totals for the 13-State Region Surrounding Memphis for the Period 1996-2010.

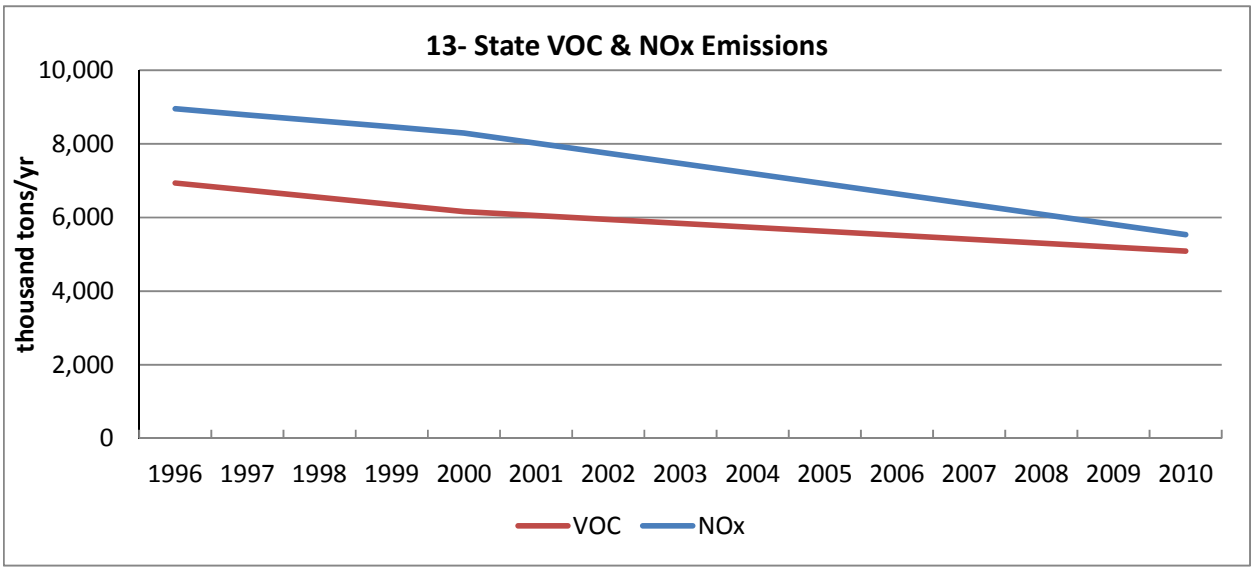
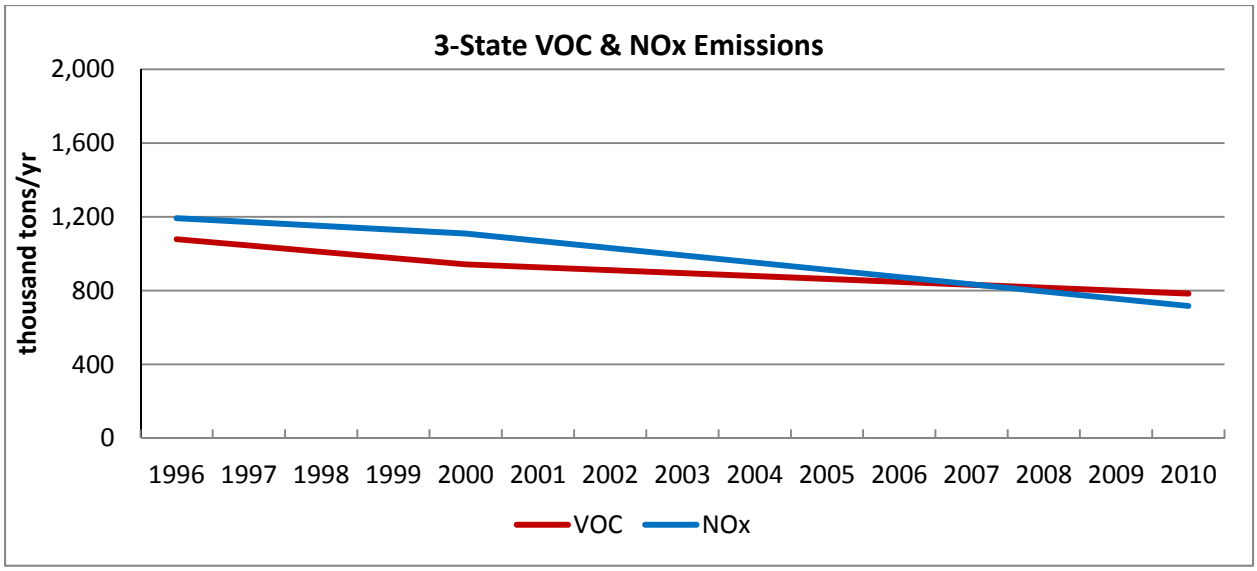
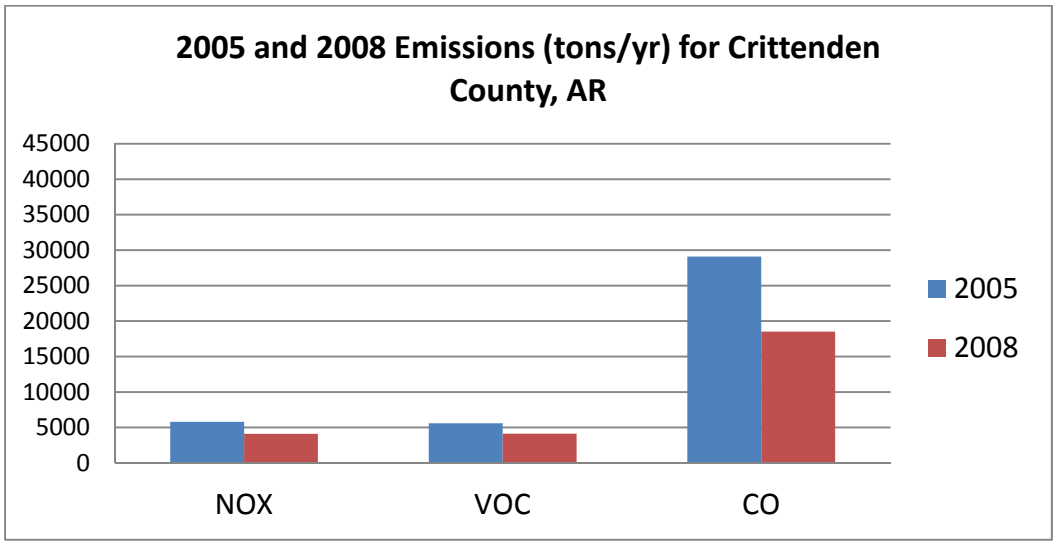


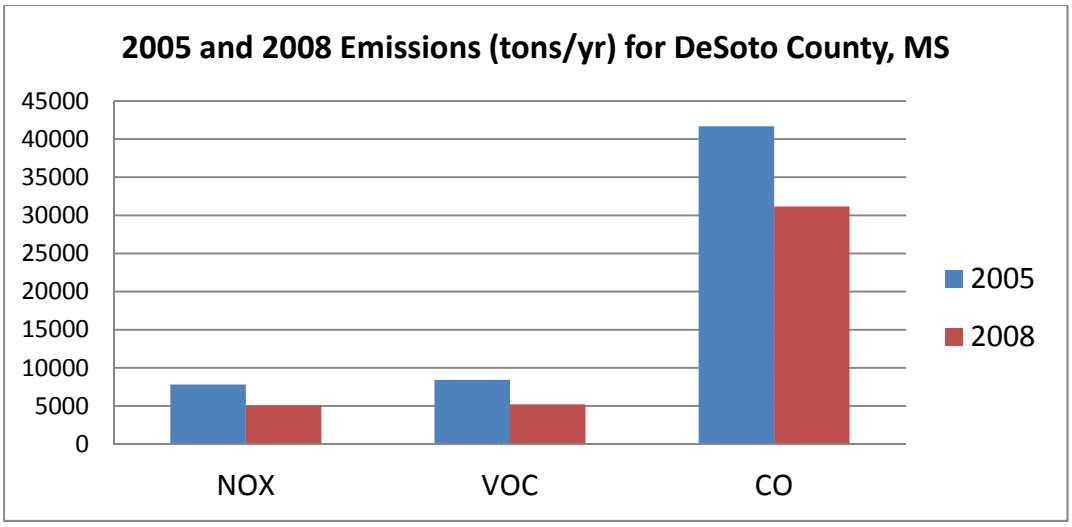
Figure 5. Estimated Emissions Totals for the 3-State Region Surrounding Memphis for the Period 1996-2010.

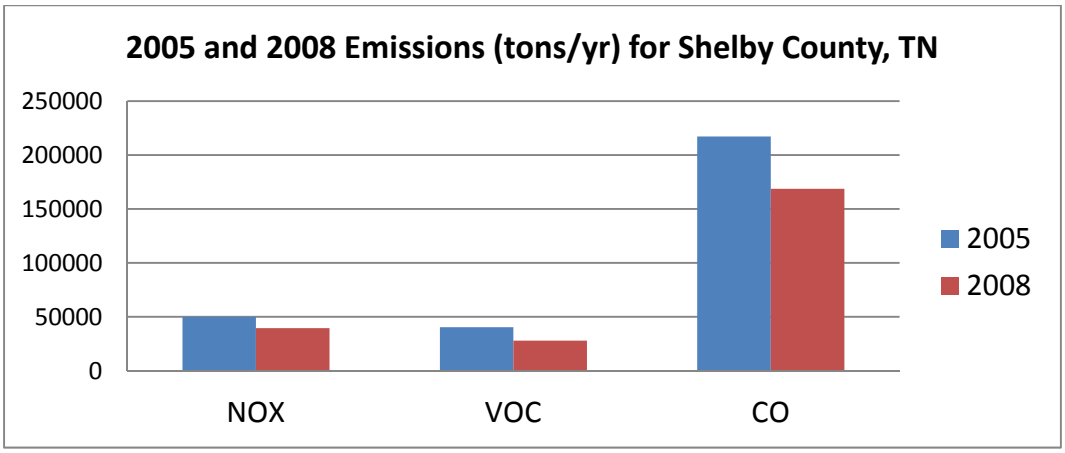


The emissions trends for both the 13-state and 3-state regions indicate a reduction in both VOC and NO_x emissions between 1996 and 2010. NO_x emission decrease at a faster rate than VOC emissions. These reductions are consistent with the expected reductions in EGUs, area sources, and on-road and non-road sources resulting fleet turnover, equipment replacement, and other controls mandated by CAAA programs as well as the special rules targeting ozone transport in the eastern U.S. An examination of the trends in local emissions in recent years also shows a reduction in emissions. Figure 6 provides annual anthropogenic emission totals for Crittenden County, AR; Shelby County, TN; and DeSoto County, MS for 2005 and 2008. This information was extracted from EPA's National Emission Inventory (NEI). (Note the difference in scale for Shelby County). The percent reductions in NOx and VOC are very consistent for each of the counties and, with a few exceptions, emissions for nearly all source categories are less in 2008 compared to 2005.

Figure 6. Anthropogenic Emissions Totals (tons/year) for the Greater Memphis Area for 2005 and 2008







The regional-scale emissions trends are consistent with the reduction in 8-hour ozone design values during this period. The local-scale emissions in recent years also show a reduction in ozone precursor emissions. This indicates that national/regional air quality improvement programs, including those realized on the local scale, are contributing to the observed ozone reductions in the Memphis area.

Beyond 2010, in addition to the emission reductions expected to be realized by the Regional Haze Rule and the final version and full implementation of the Cross-State rule for EGUs, other new or updated standards and regulations to take full effect include those for recreational equipment, lawn & garden equipment, and gasoline-powered boats and personal watercraft. For the on-road mobile sector, further emission reductions are expected from fleet turnover and the introduction of cleaner and more fuel efficient engines mandated by the applicable CAFE standards that are currently in place for cars and trucks.

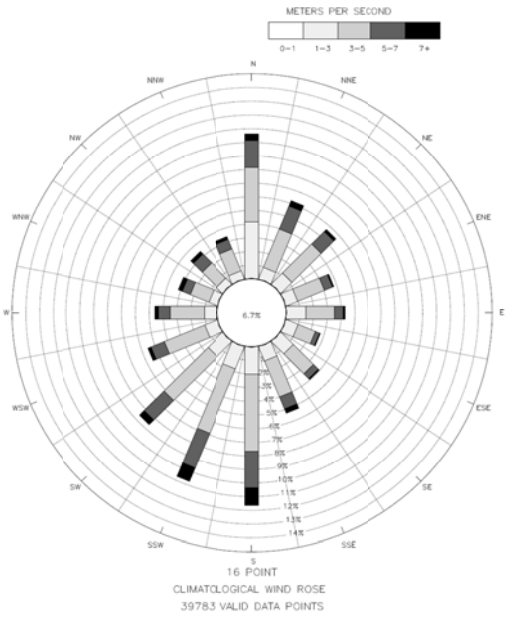
It follows that these anticipated future emissions reductions associated with national, regional, and local air quality improvement programs will lead to further reductions in ozone and design values that are sufficiently below the standard to achieve sustained attainment of the NAAQS in the near future.

Frequency Analysis of Contributions from Crittenden County Emissions to High Ozone at the Fraser Monitor

A key factor in EPA's recommendation (EPA, 2011b) to include Crittenden County in the Memphis nonattainment area is an analysis of meteorological data that "indicates that emissions from Crittenden County do occasionally contribute to violations of the 2008 ozone NAAQS in Shelby County." EPA based its conclusion that emissions from Crittenden County contribute to exceedances at the Frayser monitor in part on backward trajectories derived using the HYSPLIT model. This analysis explores this finding in more detail and examines the frequency of occurrence of wind directions (and wind speeds) that are conducive to transport of precursor emissions from Crittenden County to the Frayser monitor in Shelby County. This analysis focusses on the 15-year period 1996-2010 and uses hourly surface wind data from the National Weather Service (NWS) monitoring site at the Memphis International Airport.

Figure 7 illustrates the frequency of wind directions and speeds for all ozone season days (April through October) for the period 1996-2010. Wind data for the hours prior to and during the normal period of highest ozone concentration 6 am - 6 pm CST are shown. In this diagram, the indicated wind direction is the direction from which the wind is blowing. The length of the bar within that wind-direction sector indicates the frequency of occurrence of a particular wind direction. The shading indicates the distribution of wind speeds.

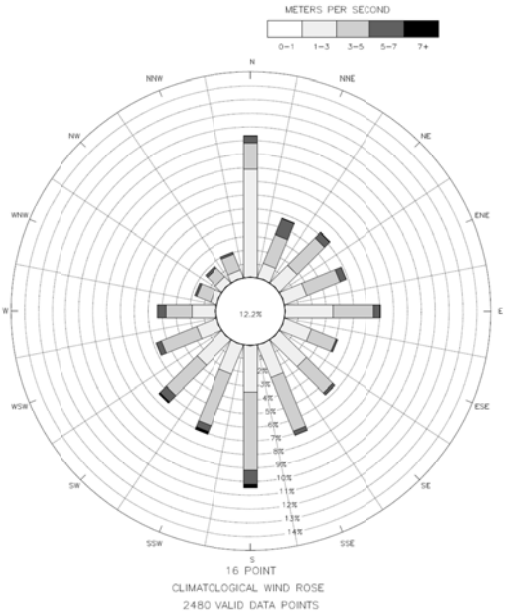
Figure 7. Surface Wind Directions and Wind Speeds at the Memphis NWS Station for the Hours 6 am – 6 pm CST for All Ozone Season Days (April–October 1996–2010).



Winds from the north, south, and southwest are most common during the daytime hours during the ozone season, but all wind directions are represented.

Figure 8 illustrates the frequency of wind directions and speeds for all ozone season days for which the daily maximum 8-hour ozone concentration at the Frayser monitoring site was greater than or equal to 75 ppb. Again the data are for 6 am – 6 pm and represent the period April through October, 1996-2010. Distinguishing features in the wind plots for the ozone exceedance days, when contrasted to those for all ozone-season days, can help to define the wind and/or transport patterns leading to high ozone.

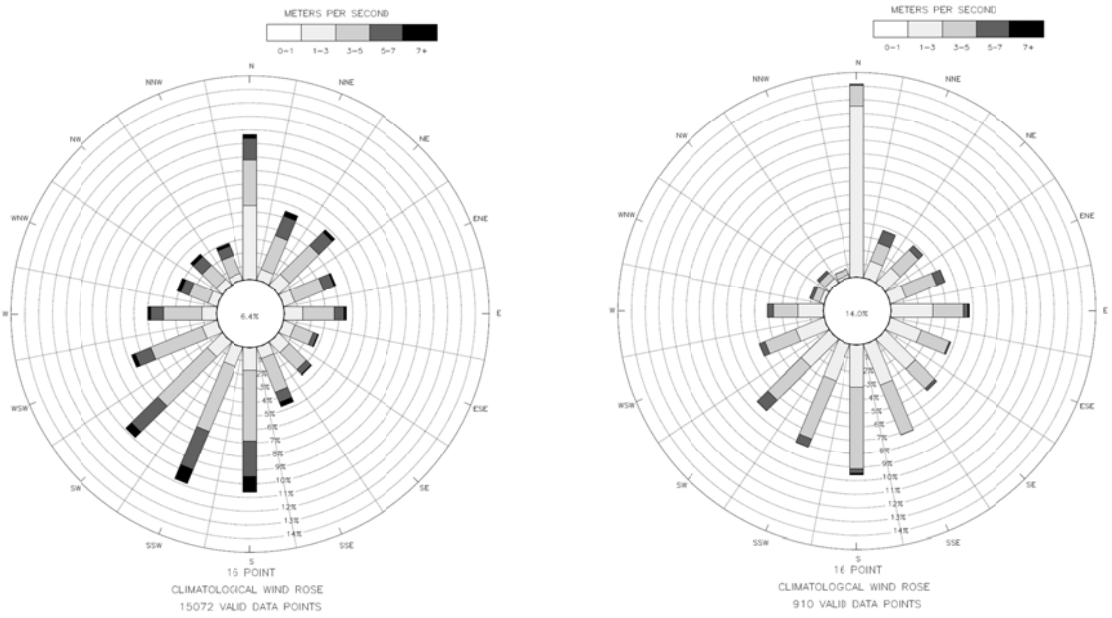
Figure 8. Surface Wind Directions and Wind Speeds at the Memphis NWS Station for the Hours 6 am – 6 pm CST for Ozone Exceedance Days for the Frayser Monitoring Site (April–October 1996–2010).



In this case, wind speeds are lower for the high ozone days. In addition, westerly wind components (winds from SSW to NNW) are less frequent and easterly wind components (from NNE to SSE) are more frequent on high ozone days. These results indicate that the distribution of wind directions and wind speeds is different on high ozone days compared to all ozone season days and that easterly wind components are more likely to occur and are possibly a contributing factor for some high ozone days. Note that winds with a westerly component (specifically SW to NW) are conducive to transport of ozone and precursor emissions from Crittenden County to the Frayser monitor. If the location of emissions sources within the county is considered, the range is SW to W, since most emissions are located in West Memphis, Marion, and along I-70 all of which are within this range of direction.

Most (more than 55 percent) of the daily maximum 8-hour ozone concentrations for the Frayser monitor are based on hourly data for the hours of 10 am to 6 pm. In addition, most (more than 70 percent) of the daily maximum 1-hour ozone concentrations occur between the hours of 11 am and 2 pm. To focus on the hours leading up to the peak ozone concentrations, the distribution of wind directions and wind speeds for the hours 8 am to noon was also examined. The wind directions and wind speeds leading up to the hours of maximum ozone (8 am – noon) are shown in Figure 9 for both all ozone season days and days with maximum ozone concentrations at the Frayser monitoring site.

Figure 9. Surface Wind Directions and Wind Speeds at the Memphis NWS Station for the Hours 8 am – Noon CST for All Ozone Season Days and Ozone Exceedance Days for the Frayser Monitoring Site (April–October 1996–2010).



The results for 8 am – noon are similar to those for all daytime hours in that wind speeds are lower and there is a shift from westerly to easterly wind components for high ozone days at the Frayser monitor.

For both periods considered, there is no apparently causal relationship between winds from the SW to the W and high ozone at the Frayser monitor. In fact, low wind speeds, easterly wind components (E to SSE winds), and/or northerly winds are more likely on ozone exceedance days compared to all days and appear to be a determining factor for ozone exceedances at this site.

Further examination of the wind directions on the exceedance days at the Frayser monitoring site reveals that up to 19.2 percent of the exceedance days that occurred between 1996 and 2010 had one or more hours of SW to NW winds and that up to 15.6 percent of the exceedance days had one or more hours of SW to W winds. Considering that there were an average of 14.3 exceedance days per year during this period, it follows that emissions from all of Crittenden County had the potential to contribute to exceedances at the Frayser site on at most 2.8 days per year if the SW to NW wind direction range is considered and at most 2.2 days per year if the SW to W range is considered.

This potential for contribution, however, should also consider the total emissions for Crittenden County relative to other counties. The 2008 emissions for Crittenden, DeSoto, and Shelby Counties (as presented by EPA in the technical support document for the designation (EPA, 2011b)) are summarized in Table 1.

Table 1. 2008 VOC and NO_x Emissions.

	Emissions (tpy)		% of 3-County Emissions Total	
County	VOC	NO_x	VOC	NO_x
Crittenden	3,805	4,047	10.3	8.3
DeSoto	5,222	5,080	14.1	10.4
Shelby	27,929	39,519	75.6	81.2
3-County	36,956	48,646		

VOC emissions from Crittenden County account for about 10 percent of the emissions for the 3-county area. NO_x emissions from Crittenden County account for about 8 percent of the total emissions for the 3-county area.

The simple probability analysis in Table 2, couples the wind direction frequency and emissions data. The analysis estimates the number of exceedance days per year at the Frayser monitoring site with a potential contribution from emissions from Crittenden County based on wind direction alone, as well as an adjusted value that accounts for the emissions relative to the overall emissions totals for the area. The analysis considers two periods: 1996-2010 and 2001-2010 and the wind direction range from SW to NW. The overall percentage of days with SW to NW winds assumes one hour per day with winds from this direction and is thus a high estimate. The larger of the two emissions fractions comparing emissions for Crittenden County to the 3-county area (the VOC fraction) is used.

Table 2. Summary of Number of Exceedance Days at the Frayser Monitoring Site with a Potential for Contribution from Emissions from Crittenden County, Based on Wind Direction Alone and Adjusted for Emissions: Based on SW to NW Winds.

(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)
Period	# Exceedance Days	# Yrs	# Exceedance Days/Yr	% of Exceedance Days with SW to NW Wind Directions (%)	# of Exceedance Days/Yr with a Potential for Contribution	Fraction of Exceedance Days on Which Contribution is Possible	Fraction of Emissions Represented by Crittenden Co	Joint Probability of Contribution Based on Wind Direction & Emissions	Emissions-Adjusted # of Exceedance Days/Yr with a Potential for Contribution
1996-2010	215	15	14.33	19.20	2.75	0.19	0.10	0.02	0.28
2001-2010	89	10	8.90	19.10	1.70	0.19	0.10	0.02	0.18

Calculated values by column are as follows:

D = B/C (Number of exceedance days per year)

F = D • E/100 (Number of exceedance days with SW to NW winds for at least one daytime hour)

I = G • H (Joint probability defined as fraction of days with SW to NW wind directions multiplied by the emissions fraction for Crittenden County)

J = D • I (Adjusted number of exceedance days per year with a potential for contribution that accounts for both SW to NW wind direction frequency and the emission fraction)

Considering only wind directions as an indicator of potential contribution, emissions from Crittenden County may have contributed to exceedances at the Frayser monitor on fewer than three days per year during the period 1996-2010 and on fewer than 2 days per year during the period 2001-2010. As noted above, the calculated values are conservatively high estimates since they are based on the maximum number of exceedance days with transport-conducive winds. In both cases, this contribution is not likely to influence the fourth highest ozone concentration at the Frayser monitor in any given year. Since the emissions for Crittenden County are small compared to the total emissions for Shelby County and the three-county area, an adjusted potential for contribution is also calculated based on the joint probability of 1) wind directions from SW to NW and 2) the likelihood of emissions from Crittenden County being involved in the ozone formation (based on the relative amount of emissions compared to the entire area). The adjusted potential for contribution is very small and is estimated to have occurred on less than one day per year for both periods.

As noted earlier, a majority of the emissions in Crittenden County are located to the west and southwest of the Frayser monitoring site. Table 3 estimates the number of exceedance days per year at the Frayser monitoring site with a potential contribution from emissions from Crittenden County for the wind direction range from SW to W.

Table 3. Summary of Number of Exceedance Days at the Frayser Monitoring Site with a Potential for Contribution from Emissions from Crittenden County, Based on Wind Direction Alone and Adjusted for Emissions: Based on SW to W Winds.

(A)	(B)	(C)	(D)	(E)	(F)	(G)	(H)	(I)	(J)
Period	# Exceedance Days	# Yrs	# Exceedance Days/Yr	% of Exceedance Days with SW to NW Wind Directions (%)	# of Exceedance Days/Yr with a Potential for Contribution	Fraction of Exceedance Days on Which Contribution is Possible	Fraction of Emissions Represented by Crittenden Co	Joint Probability of Contribution Based on Wind Direction & Emissions	Emissions-Adjusted # of Exceedance Days/Yr with a Potential for Contribution
1996-2010	215	15	14.33	15.60	2.24	0.16	0.10	0.02	0.23
2001-2010	89	10	8.90	15.40	1.37	0.15	0.10	0.02	0.14

Calculated values by column are as follows:

D = B/C (Number of exceedance days per year)

F = D • E/100 (Number of exceedance days with SW to NW winds for at least one daytime hour)

I = G • H (Joint probability defined as fraction of days with SW to NW wind directions multiplied by the emissions fraction for Crittenden County)

J = D • I (Adjusted number of exceedance days per year with a potential for contribution that accounts for both SW to NW wind direction frequency and the emission fraction)

Considering only wind directions as an indicator of potential contribution, emissions from Crittenden County may have contributed to exceedances at the Frayser monitor on approximately two days per year during the period 1996-2010 and approximately one day per year during the period 2001-2010. Again, this contribution is not likely to influence the fourth highest ozone concentration at the Frayser monitor in any given year. For this range of wind directions, the adjusted potential for contribution is very small and is estimated to have occurred on less than one day per year for both periods.

These results are generally consistent with EPA findings (EPA, 2011b) which are based on the use of HYSPLIT and 2006-2010 meteorological data. EPA found that most of back trajectories for ozone exceedance days at the Frayser monitor pass "through Shelby County TN, and many of the back trajectory centerlines pass through Desoto County in northern Mississippi with a comparatively smaller percentage passing through Crittenden County, Arkansas." The current analysis considers a longer period and quantifies this potential for contribution based on both wind direction and emissions. The results suggest that the potential for contribution is very small (with a frequency equivalent to much less than one exceedance day per year).

Summary

Meteorological conditions on episode days for the Frayser monitor show that Crittenden County emissions are unlikely to significantly influence ozone concentrations at the Frayser site. Considering only wind directions as an indicator of potential contribution, emissions from Crittenden County may have contributed to exceedances at the Frayser monitor on approximately two days per year during the period 1996-2010 and approximately one day per year during the period 2001-2010. The current analysis considers a longer period and quantifies this potential for contribution based on both wind direction and emissions. The results suggest that the potential for contribution is very small (with a frequency equivalent to much less than one exceedance day per year).

All four monitoring sites in the greater Memphis area sites show a clear downward trend in 8-hour ozone design value for the period 1996-2010, culminating with values near 75 ppb in 2010. Both the regional-average design value (based on all four sites) and the regional-maximum design value (based on all four sites) also indicate a clear downward trend and both values decrease by approximately 1.25 ppb per year during the period. This trend is consistent with a reduction in national, regional, and local ozone precursor emissions during this same time period. This indicates that national/regional air quality improvement programs, including those realized on the local scale, are contributing to the observed ozone reductions in the Memphis area.

Current design values and trends indicate that emission reductions being realized from current and planned federal measures should result in near-term air quality improvements. The resulting emissions reductions will lead to further reductions in ozone and design values that are sufficiently below the standard to achieve sustained attainment of the NAAQS in the near future. The emission reductions include those expected to be realized by the final version and full implementation of the Cross-State rule for EGUs, the Regional Haze Rule, as well as new or updated standards and regulations for recreational equipment, lawn & garden equipment, and gasoline-powered boats and personal watercraft. For the on-road mobile sector, further emission reductions are expected from fleet turnover and the introduction of cleaner and more fuel efficient engines mandated by the applicable CAFE standards that are currently in place for cars and trucks.

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