J5.5 ANALYSIS OF AMBIENT OZONE AND PRECURSOR MONITORING DATA IN NEW ORLEANS AND BATON ROUGE, LOUISIANA BEFORE AND AFTER HURRICANE KATRINA

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ABSTRACT

Hurricane Katrina came ashore at Louisiana on August 29, 2005, causing destruction, challenges to industrial operations, and significant population changes in the State's two largest cities of New Orleans and Baton Rouge. This paper will provide detailed analyses of the ambient ozone and precursor (i.e. nitrogen oxides and volatile organic compounds) monitoring data collected by the Louisiana Department of Environmental Quality (LDEQ) in both New Orleans and Baton Rouge before and after Hurricane Katrina. The analyses will cover: (1) a comparison of the last two years (2006 and 2007) of the photochemical monitoring data with long-term trends data, including discussion of any significant changes in ambient ozone and precursor concentrations in New Orleans and Baton Rouge after the landfall of Hurricane Katrina; (2) how Louisiana's two largest cities currently compare to the U.S. 8-hour ozone National Ambient Air Quality Standard (NAAQS); and (3) a preview of how the two cities might fare if the U.S. 8-hour ozone NAAQS is lowered in the future per the July 11, 2007, proposed rule in the Federal Register.

1. INTRODUCTION

One of the many effects of Hurricane Katrina was the dramatic reduction of population in New Orleans and parallel increase in population elsewhere such as in Baton Rouge, Louisiana, about 80 miles to the northwest of New Orleans. According to annual population estimates from the U.S. Census Bureau, Orleans, St. Bernard and Jefferson Parishes in the New Orleans Metropolitan Statistical Area (MSA) lost 228,782, 49,633 and 19,688 people, respectively, between July 1, 2005 and July 1, 2006 (1), representing a 31% decrease. Conversely, in the Baton Rouge MSA, East Baton Rouge, Ascension and Livingston Parishes added 19,264, 6,888 and 5,847 people, respectively, between July 1, 2005 and July 1, 2006 (1), contributing to an overall 5% increase in population in the 5-parish Baton Rouge ozone nonattainment area. Adding to these population changes were rebuilding challenges for industrial operations and the housing sector. This paper will provide detailed analyses of the ambient ozone and precursor monitoring data in both New Orleans and Baton Rouge before and after Hurricane Katrina and will discuss any significant changes in ambient concentrations. Ambient ozone concentrations will be reviewed for both cities in comparison to the existing 8-hour ozone National Ambient Air Quality Standard (NAAQS) and the recently proposed alternate 8-hour ozone standards.

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2. ANALYTICAL METHODS

All data analyzed for this paper were extracted from the U.S. Environmental Protection Agency (EPA) Air Quality System (AQS) database after data collection, validation, and upload by the Louisiana Department of Environmental Quality (LDEQ). The data consisted of all hourly ambient ozone, ozone precursor (i.e. nitrogen oxides (NO_x) and volatile organic compound (VOC)), and meteorological data from all currently operating LDEQ air monitoring sites in the Baton Rouge and New Orleans areas. This included data from 10 air monitoring sites in the current Baton Rouge 8-hour ozone nonattainment area and 3 air monitoring sites in the New Orleans MSA (western portion). Two air monitoring shelters in the eastern portion of the New Orleans MSA, one in Orleans Parish and one in St. Bernard Parish, were adversely affected by Hurricane Katrina, and did not operate past August, 2005. After extraction from AQS the data were analyzed for long-term trends and for comparisons of the last two years of data post-Hurricane Katrina (i.e. 2006 and 2007) with the two years of data pre-Hurricane Katrina (i.e. 2004 and 2005).

3. RESULTS AND DISCUSSION

3.1 Ambient Ozone Concentrations Pre- and Post-Hurricane Katrina

The 8-hour ozone NAAQS is based on a three year running average of the annual 4th highest 8-hour ozone daily maxima (2). Therefore, annual 4th highest 8-hour ozone daily maxima were analyzed for each fully operating monitoring site in the Baton Rouge and New Orleans areas from 2004-2007. For New Orleans, despite the large population loss after 2005, 8-hour ozone concentrations rose at all three sites in 2006-2007 compared to 2004-2005 (reference Figure 1). In Baton Rouge, 8-hour ozone concentrations also increased in 2006-2007 compared to 2004-2005, but this increase was limited to the southern sites in the Baton Rouge 8-hour ozone nonattainment area (reference Figures 2 and 3), and did not include the centrally located LSU site which is currently the highest 8-hour ozone concentration site in the Baton Rouge area. Figures 4 and 5 display the long-term 8-hour ozone concentration trends for the highest 8-hour ozone concentration sites in the Baton Rouge (LSU

site) and New Orleans (Kenner site) areas. In Figure 4 note that the LSU site recorded lower 8-hour ozone concentrations in the two years after Hurricane Katrina but the Kenner site recorded higher 8-hour ozone concentrations in 2007 compared to the previous three years 2004-2006. Figure 5 underscores the different behavior of the top 8-hour ozone concentration sites in Baton Rouge and New Orleans over the past two years by showing the increase at the New Orleans Kenner site of the percentage of summer afternoon 8-hour periods recording 8-hour ozone concentrations greater than the standard (i.e. greater than 84 ppb). In contrast for 2006-2007 compared to 2004-2005, the Baton Rouge LSU site shows a decline in the amount of summer afternoon 8-hour periods recording 8-hour ozone concentrations greater than 84 ppb. To place the 8-hour ozone concentrations in proper context, long-term meteorological data from the Baton Rouge Capitol site were downloaded from AQS and analyzed. Long-term data from 1993-2007 is presented in Figure 6 for ambient temperature (both summer daytime means and temperatures equal to and greater than 90 degrees F), resultant wind speed, resultant wind direction, and precipitation. Note that 2006 was a hot year, followed by a below average high-temperature year in 2007.

3.2 Ambient Ozone Precursor (NO_x and VOC) Concentrations Pre- and Post-Hurricane Katrina

3.2.1 NO_x Concentration Trends

The Baton Rouge area, being a long-standing ozone nonattainment area, has an extensive ozone precursor network (10 NO_x sites and 3 VOC sites). The New Orleans area is currently attainment for the 8-hour ozone standard and only has one NO_x monitor operating at the Kenner site. The second NO_x monitor at the Orleans Parish site was adversely affected by Hurricane Katrina and that site is not scheduled for resumption until 2008. Interestingly at the New Orleans Kenner site, despite the large population loss in the New Orleans area after 2005, summer weekday morning NO_x concentrations increased in 2006 compared to 2005 (statistically significant at the 90% confidence interval) and remained at a similar concentration in 2007 (reference Figure 7). Also interesting was that no statistically significant gains in summer weekday morning NO_x concentrations were recorded at any of the Baton Rouge NO_x monitors (reference Figure 8). Indeed, the only statistically significant NO_x concentration change (at the 95% confidence interval) occurred at the Capitol site (the highest NO_x concentration site in the Baton Rouge 8-hour ozone nonattainment area), and consisted of a sharp decrease in concentration from 2006 to 2007. After further analysis, this sharp decrease in NO_x concentration was clearly seen in the stationary source dominated NW sector, coming immediately after a statistically significant NO_x concentration spike in 2006 (reference Figure 9).

3.2.2 VOC Concentration Trends

As mentioned above in Section 3.2.1, only the Baton Rouge area contains sampling sites with VOC monitors. The long-term trend for total VOC (i.e. total non-methane organic compounds, TNMOC) is down at all three Baton Rouge VOC sites from 1996-2007 (reference Figure 10). However, when comparing the two post-Hurricane Katrina years (2006 and 2007) to the two pre-Hurricane Katrina years (2004 and 2005), statistically significant increases in summer weekday morning TNMOC concentrations have occurred at the more rural Plaquemine and Pride sites in 2006 and 2007 compared to 2005. Fortunately, the increases in total VOC concentrations have not involved two important highly reactive VOC, ethylene and propylene. Figure 11 shows that summer weekday morning ethylene and propylene concentrations have not increased at the Plaquemine and Pride sites in 2006-2007 compared to 2004-2005. Ethylene and propylene concentrations were also lower at the Capitol site in 2007 after a 2006 concentration spike.

3.3 Comparison of 8-hour Ozone Air Quality in New Orleans and Baton Rouge to the Current and Potential Alternate 8-hour Ozone NAAQS.

The current 8-hour ozone NAAQS is set at 0.08 ppm (allowed to round up to 0.084 ppb or 84 ppb), according to 40 CFR Part 50 (2). Each ambient ozone monitoring site is required to compare three year design values with the 8-hour ozone NAAQS. The design value is defined as the running three year average of the annual 4th highest 8-hour ozone daily maxima (2). Figure 12 displays the running 8-hour ozone design values for Baton Rouge and New Orleans from the 1986-1988 three year period to the latest 2005-2007 three year period. The Baton Rouge 8-hour ozone design values have always been above the standard and currently stand at 89 ppb. The current New Orleans area 8-hour ozone design value is just one ppb below the standard at 83 ppb. On July 11, 2007, the U.S. EPA proposed alternate lower 8-hour ozone standards for public review and comment, and the U.S. EPA plans to finalize a decision regarding the alternate standards by March 12, 2008 (3). Table 1 compares each ozone monitoring site in the Baton Rouge and New Orleans areas with the existing 8-hour ozone NAAQS (84 ppb), with an alternate 8-hour ozone NAAQS without the current rounding convention (80 ppb), and with alternate lower threshold levels of 75 ppb and 70 ppb. As seen in Table 1, all three New Orleans sites meet the current 8-hour ozone NAAQS, but the Kenner site would not meet an 80 ppb NAAQS, and all three sites would not meet alternate 75 ppb and 70 ppb threshold levels. For Baton Rouge, three out of 10 sites do not meet the current 8-hour ozone NAAQS and eight out of 10 sites would not meet an 80 ppb NAAQS. Like New Orleans, all 10 Baton Rouge sites would not meet lower threshold 8-hour ozone levels of 75 ppb and 70 ppb.

4. CONCLUSION

This paper analyzed ambient ozone and ozone precursor concentrations both pre- and post-Hurricane Katrina. Interestingly in the New Orleans area, despite a large population drop (-31% in 3 parishes), ozone and NO_x concentrations have increased in the two years after Hurricane Katrina, putting the New Orleans area just one ppb under the current 8-hour ozone NAAQS, and above all alternate proposed 8-hour ozone standards. In Baton Rouge, which experienced a 5% increase in population in 2006 after Hurricane Katrina, rural total VOC concentrations and ozone concentrations at the southern Baton Rouge air monitoring sites have increased in 2006-2007. Even a small tightening of the 8-hour ozone standard to 80 ppb has a large effect on the Baton Rouge area, where 80% of the monitoring network would be over the standard. Like the New Orleans sites, all Baton Rouge sites would not meet lower threshold 8-hour ozone levels of 75 ppb and 70 ppb.

REFERENCES

1. U.S. Census Bureau, Population Division, Table 1: Annual Estimates of the Population for Counties of Louisiana: April 1, 2000 to July 1, 2006 (CO-EST2006-01-22), Release Date: March 22, 2007.

2. Code of Federal Regulations (CFR) Forty (40), Part 50 – National Primary and Secondary Ambient Air Quality Standards, Appendix I – Interpretation of the 8-Hour Primary and Secondary National Ambient Air Quality Standards for Ozone, U.S. Government Printing Office, Washington, DC, 1st July 2005.

3. Federal Register, Volume 72, Number 132, National Ambient Air Quality Standards for Ozone: Proposed Rule, pages 37818-37919, Washington, DC, July 11, 2007.

5. ILLUSTRATIONS AND TABLES

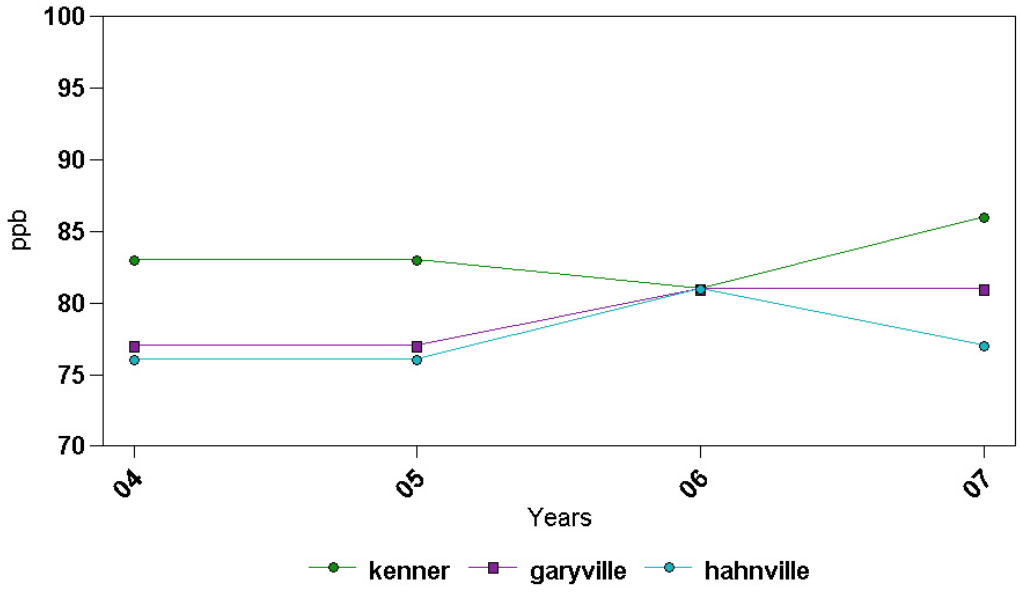

Figure 1. New Orleans area monitoring sites annual 4th highest 8-hour ozone daily maxima; 2004-2007; kenner site in Jefferson Parish, hahnville site in St. Charles Parish, and garyville site in St. John the Baptist Parish.

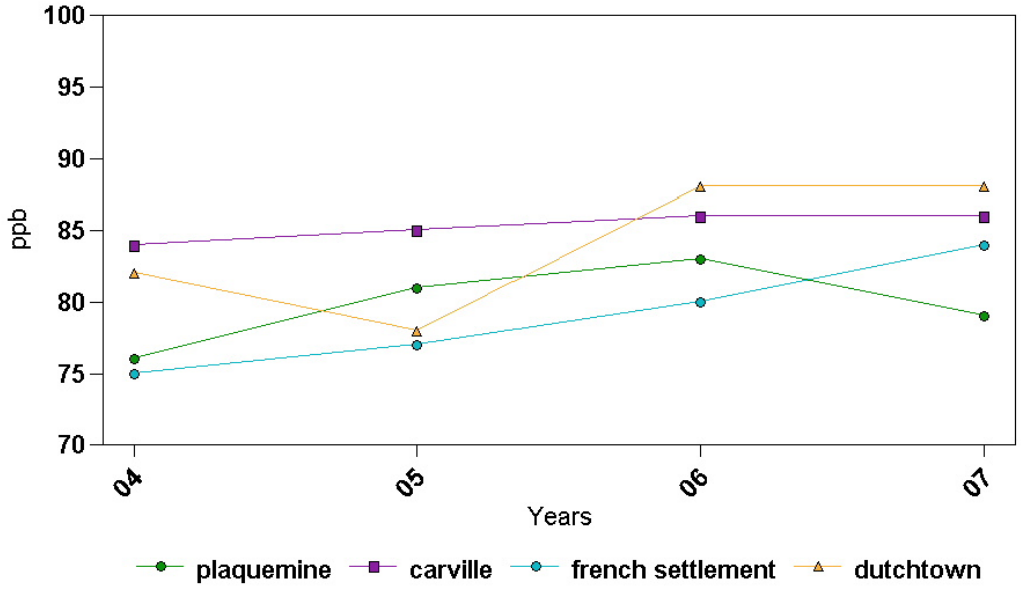

Figure 2. Southern Baton Rouge area monitoring sites annual 4th highest 8-hour ozone daily maxima; 2004-2007.

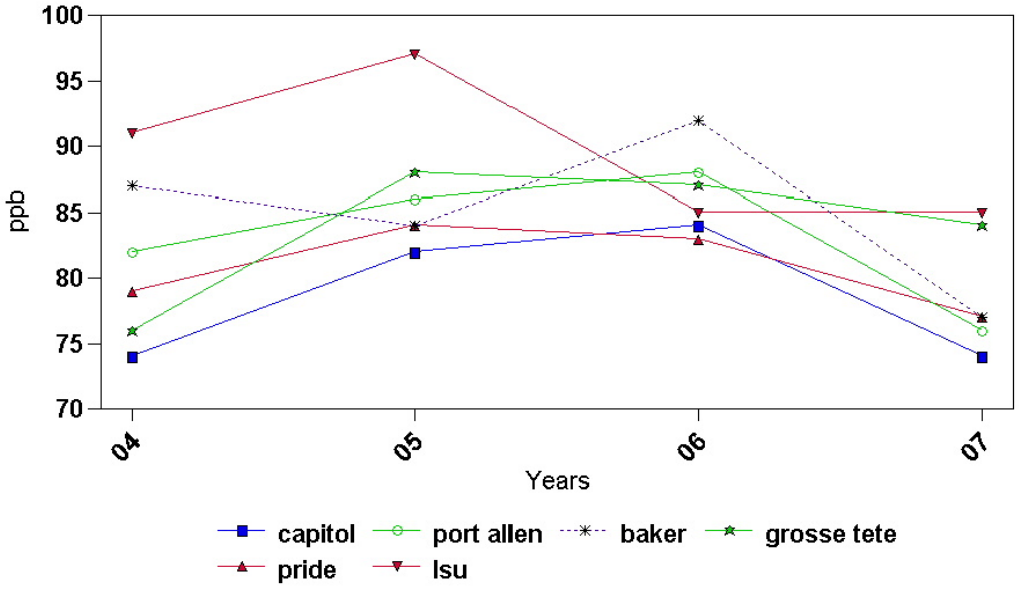

Figure 3. Northern and Central Baton Rouge area monitoring sites annual 4th highest 8-hour ozone daily maxima; 2004-2007.

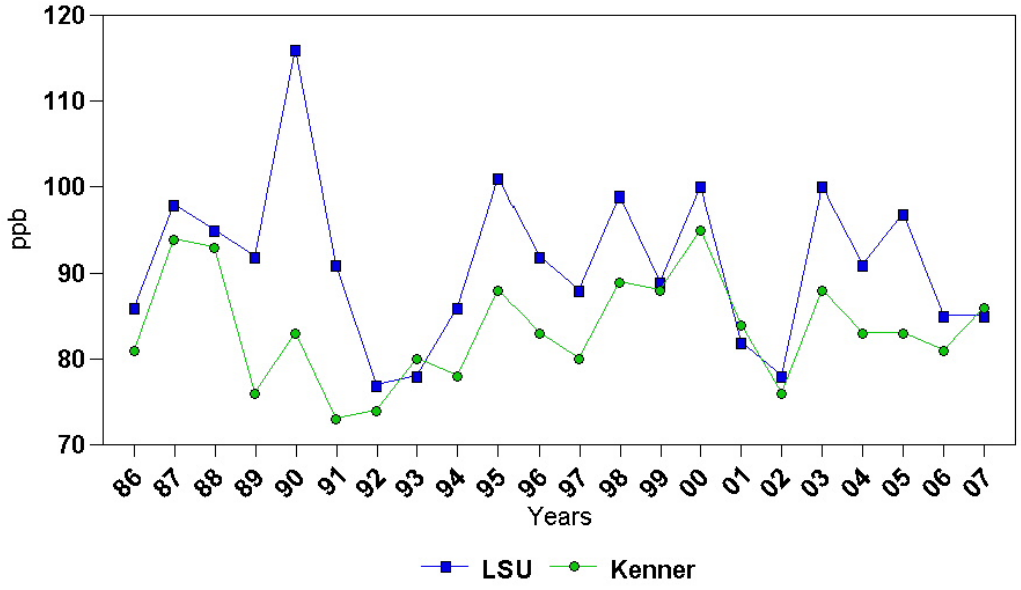

Figure 4. Baton Rouge (LSU site) and New Orleans (Kenner site) annual 4th highest 8-hour ozone daily maxima; 1986-2007.

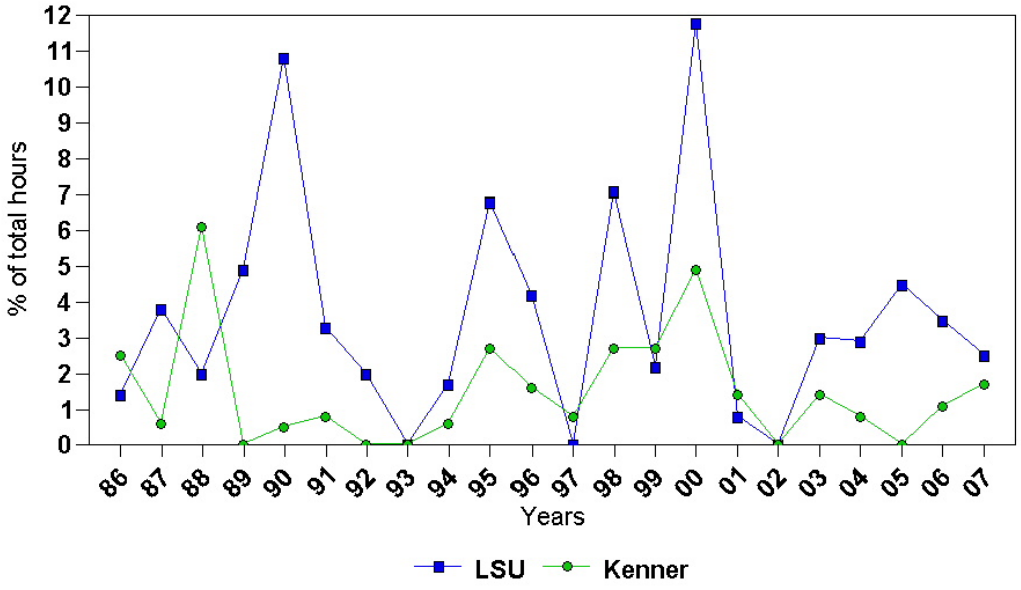

Figure 5. Baton Rouge (LSU site) and New Orleans (Kenner site) percentage of 8-hour time periods from 0800-1900 LST, June-August, in which 8-hour ozone concentrations are greater than 84 ppb; 1986-2007.

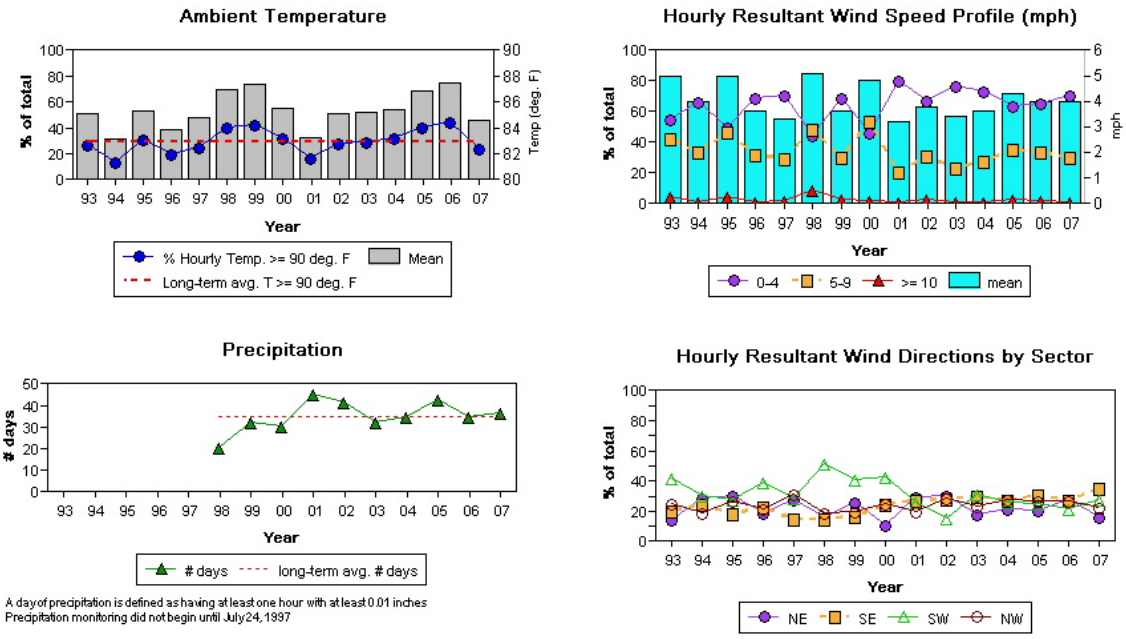

Figure 6. Baton Rouge (Capitol site) meteorological data trends; June-August; 0500-1900 LST.

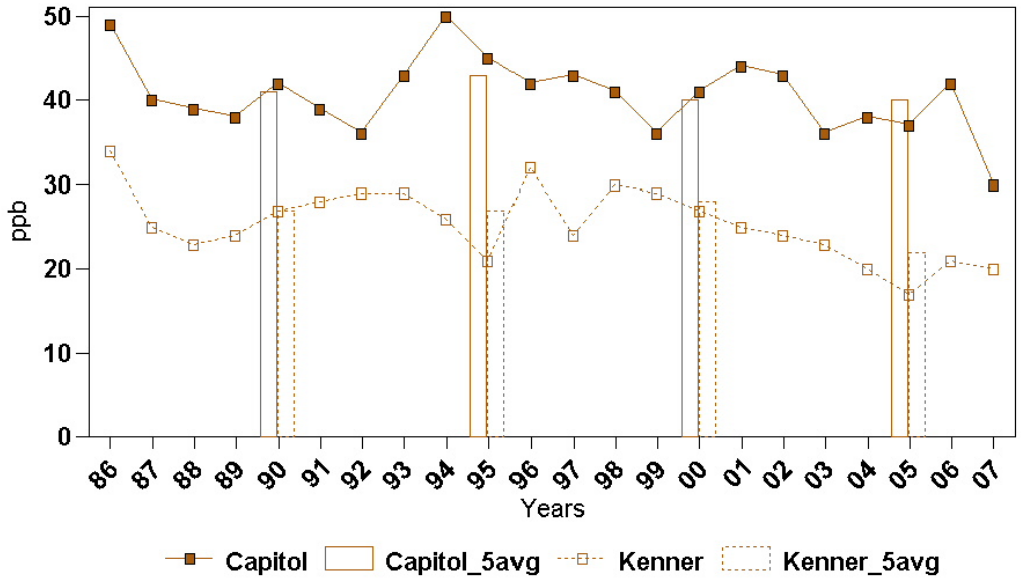

Figure 7. Baton Rouge (Capitol site) and New Orleans (Kenner site) NO_x data trends; June-August weekdays; 0500-0800 LST.

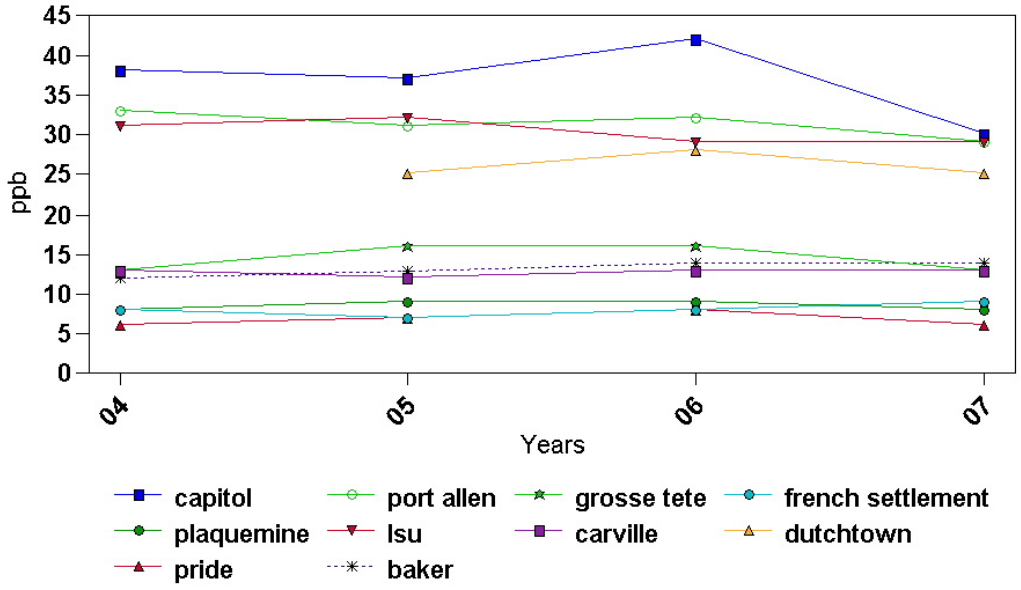

Figure 8. Baton Rouge area NO_x data trends; June-August weekdays; 0500-0800 LST.

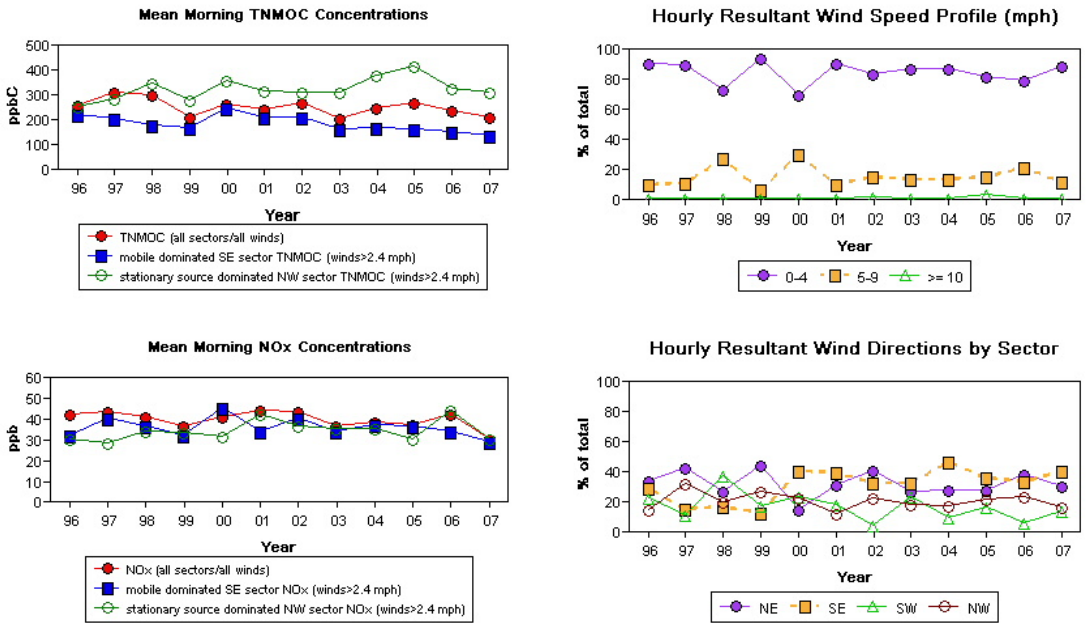

Figure 9. Baton Rouge (Capitol site) meteorological/NO_x/TNMOC data trends; June-August weekday; 0500-0800 LST.

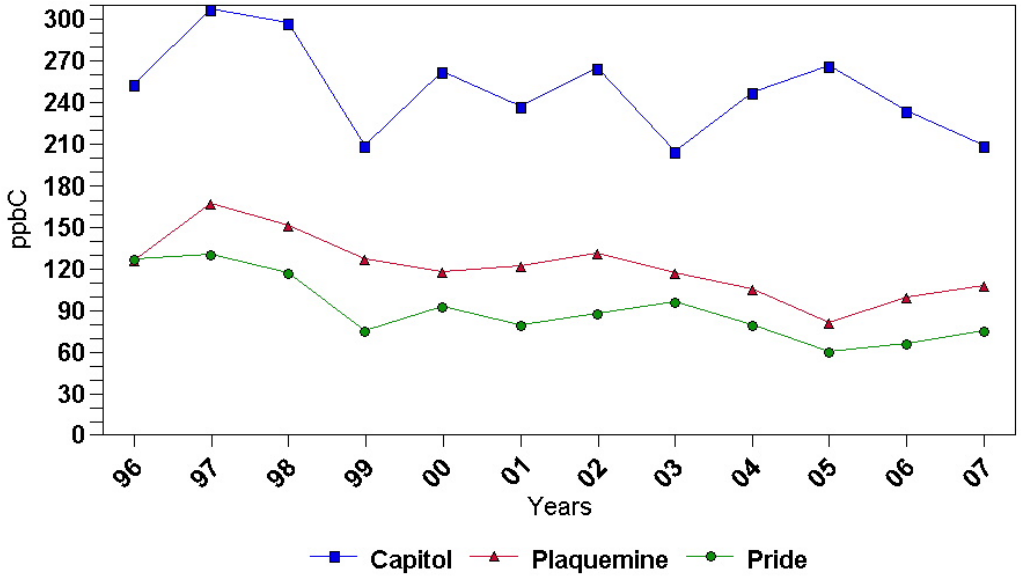

Figure 10. Baton Rouge VOC (TNMOC) concentration data trends; June-August weekday; 0500-0800 LST.

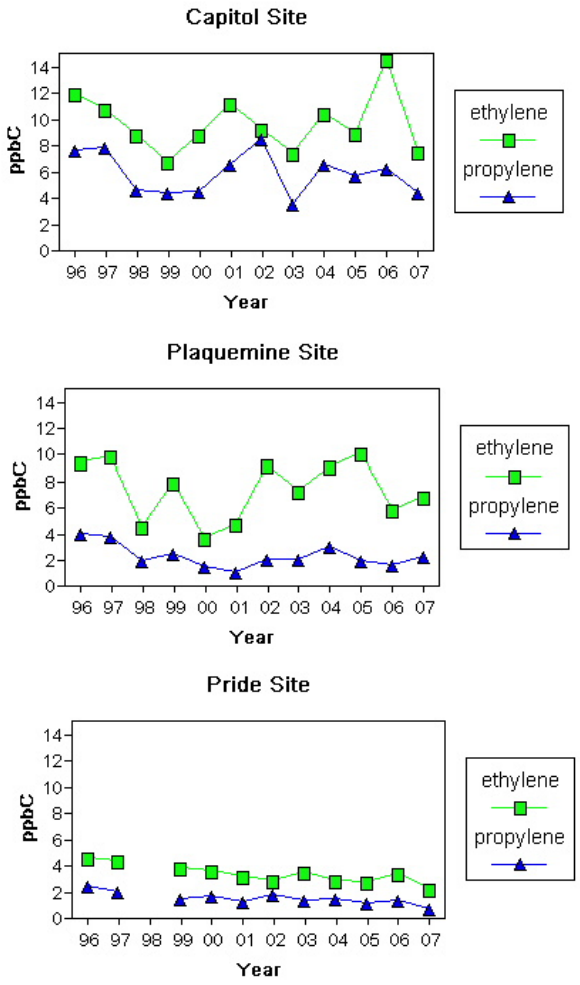

Figure 11. Baton Rouge HRVOC concentration data trends; 3-hour integrated canisters; June-August weekday; 0300-0900 LST.

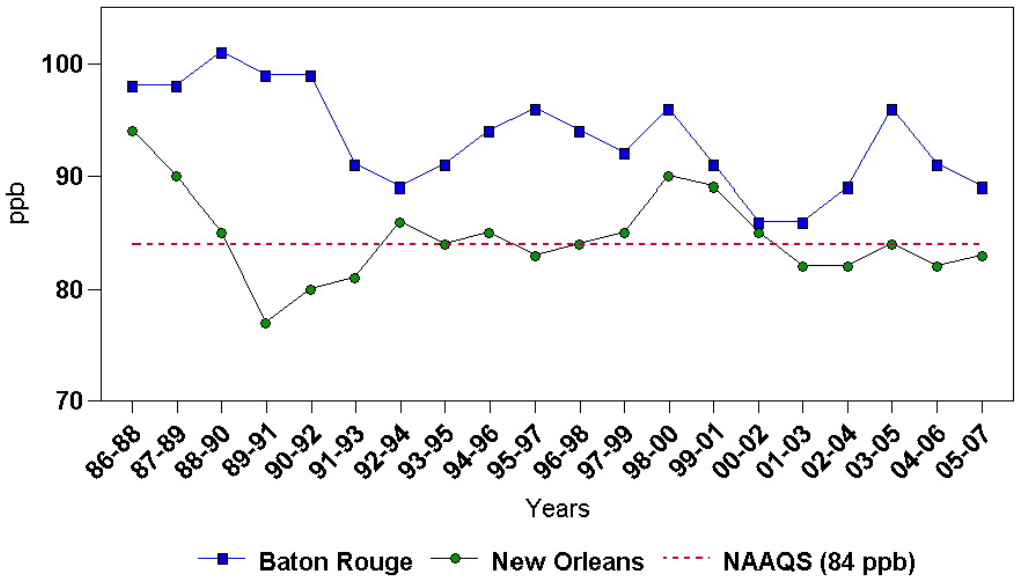

Figure 12. Baton Rouge and New Orleans 8-hour ozone design values.

MSA	Site Name and AQS #	2005-2007 8-hr O3 dv	dv > 84 ppb?	dv > 80 ppb?	dv > 75 ppb?	dv > 70 ppb?
Baton Rouge	LSU (22-033-0003)	89 ppb	yes	yes	yes	yes
	Pride (22-033-0013)	81 ppb	no	yes	yes	yes
	Capitol (22-033-0009)	80 ppb	no	no	yes	yes
	Baker (22-033-1001)	84 ppb	no	yes	yes	yes
	Carville (22-047-0012)	85 ppb	yes	yes	yes	yes
	Grosse Tete (22-047-0007)	86 ppb	yes	yes	yes	yes
	Plaquemine (22-047-0009)	81 ppb	no	yes	yes	yes
	French Settlement (22-063-0002)	80 ppb	no	no	yes	yes
	Dutchtown (22-005-0004)	84 ppb	no	yes	yes	yes
	Port Allen (22-121-0001)	83 ppb	no	yes	yes	yes
	All 10 Baton Rouge sites		3/10	8/10	10/10	10/10
New Orleans	Kenner (22-051-1001)	83 ppb	no	yes	yes	yes
	Garyville (22-095-0002)	79 ppb	no	no	yes	yes
	Hahnville (22-089-0003)	78 ppb	no	no	yes	yes
	All 3 New Orleans sites		0/3	1/3	3/3	3/3

Table 1. Baton Rouge and New Orleans 8-hour ozone design values compared to current 8-hour ozone standard and proposed alternate standards.