



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
RESEARCH TRIANGLE PARK, NC 27711

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OFFICE OF  
AIR QUALITY PLANNING  
AND STANDARDS

MEMORANDUM

**SUBJECT:** Air Quality Statistics for Cities Referenced in Key U.S. Nitrogen Dioxide Epidemiology Papers

**FROM:** Rhonda Thompson, Air Quality Analysis Group  
Scott Jenkins, Ambient Standards Group

**TO:** NO<sub>2</sub> NAAQS Review Docket

To inform the review of the primary NO<sub>2</sub> National Ambient Air Quality Standard (NAAQS), we have calculated 98<sup>th</sup> and 99<sup>th</sup> percentile 1-hour daily maximum NO<sub>2</sub> concentrations associated with key U.S. NO<sub>2</sub> epidemiologic studies (see figures 5-1 and 5-2 of NO<sub>2</sub> Risk and Exposure Assessment at [http://www.epa.gov/ttn/naaqs/standards/nox/s\\_nox\\_cr\\_rea.html](http://www.epa.gov/ttn/naaqs/standards/nox/s_nox_cr_rea.html)). To accomplish this, we have used a combination of AQS data and data submitted by study authors. This information can help to inform decisions regarding potential alternative NO<sub>2</sub> standard levels.

For the paper titled "Association of asthma symptoms with peak particulate air pollution and effect modification by anti-inflammatory medication use" (2002) by Delfino, a SAS dataset was supplied by the author. The data had a row for every day from 3/1/1996 – 4/30/1996 and a column for a 1 hour max, and 8 hour max and the same stats for the previous day. We calculated the mean, 99<sup>th</sup>, and 98<sup>th</sup> percentiles for the 61 observations for both the 1 and 8 hour max values. Both data and calculations are in Attachment 1.

The papers authored by Peel and Tolbert used the same monitor (id - 131210048). The Peel paper "Ambient air pollution and respiratory emergency department visits" covered the period 1/1/93-8/31/2000, which is a subset of the Tolbert paper "Multipollutant modeling issues in a study of ambient air quality and emergency department visits in Atlanta" time period of 1/1/93-12/31/2004. Consequently, the only differences were the year 2000, as the first paper did not include the whole year in 2000, and the additional years for the second paper. For both of these studies, the authors submitted mean, 98<sup>th</sup> percentile, and 99<sup>th</sup> percentile 1-h daily maximum NO<sub>2</sub> concentrations. For comparison, we pulled NO<sub>2</sub> data for the entire Atlanta Metropolitan Statistical Area (MSA) for the time periods of interest from the Air Quality Subsystem (AQS). For each site, we calculated the annual mean and 99<sup>th</sup> and 98<sup>th</sup> percentiles of the 1-hour value, the daily average of the 1-hour values, and the daily maximum of the 1-hour values, for the entire period and by year. No data was excluded because of

completeness requirements; all data for each site was used. The information provided by the authors and the information that we calculated are provided in attachment 2.

The paper titled "Air pollution and emergency department visits for asthma among Ohio Medicaid recipients, 1991-1996" was authored by Jaffee et al, and said that they pulled data from AIRS (the predecessor to AQS) for all active monitoring sites within a 10 mile radius of each of the city's center from June to August from 1991-1996 in Cleveland and Cincinnati (Columbus had no NO<sub>2</sub> data). From AQS We pulled NO<sub>2</sub> data from all monitors in both the Cleveland and Cincinnati MSA's (because specific sites utilized in their analysis were not listed in the paper) from June to August from 1991-1996. We computed for each site, the annual mean and 99<sup>th</sup> and 98<sup>th</sup> percentiles of the 1-hour value, the daily average of the 1-hour values, and the daily maximum of the 1-hour values, for the entire period and by year. No data was excluded because of completeness requirements; all data for each site was used. Using EPA's AirExplorer ([http://www.epa.gov/airexplorer/monitor\\_kml.htm](http://www.epa.gov/airexplorer/monitor_kml.htm)), we determined that the monitor that recorded the highest NO<sub>2</sub> concentrations was actually located in Kentucky. Because the authors indicated in the study that they used monitors within the city limits of Cleveland or Cincinnati, we do not report NO<sub>2</sub> concentrations from this monitor. Rather, in attachment 3 we report the mean, 98<sup>th</sup>, and 99<sup>th</sup> percentile NO<sub>2</sub> concentrations from the monitor reporting the 2<sup>nd</sup> highest NO<sub>2</sub> concentrations, which is located in Cincinnati.

The paper titled "Characterization of PM<sub>2.5</sub>, gaseous pollutants, and meteorological interactions in the context of time-series health effects models" was authored by Ito et al, and said they pulled data from all monitors within 20 miles of the city limits of New York from 1999-2002. From AQS We pulled NO<sub>2</sub> data from all sites in the entire state using state fips 36 from 1999-2002 (because specific sites utilized in their analysis were not listed in the paper). We computed for each site, the annual mean and 99<sup>th</sup> and 98<sup>th</sup> percentiles of the 1-hour value, the daily average of the 1-hour values, and the daily maximum of the 1-hour values, for the entire period and by year. No data was excluded because of completeness requirements; all data for each site was used. Data from the site recording the highest 1-hour daily maximum NO<sub>2</sub> concentrations, which is located in New York City, are presented in attachment 4.

The paper titled "Air Pollution and Exacerbation of Asthma in African-American Children in Los Angeles" was authored by Ostro et al, and said they pulled data from two sites in downtown Los Angeles and Pasadena from Aug-Oct in 1993. From AQS We pulled NO<sub>2</sub> data from all sites in the county of Los Angeles (037) (because specific sites utilized in their analysis were not listed in the paper) for time period Aug-Oct 1993. We computed for each site, the annual mean and 99<sup>th</sup> and 98<sup>th</sup> percentiles of the 1-hour value, the daily average of the 1-hour values, and the daily maximum of the 1-hour values, for the entire period and by year. No data was excluded because of completeness requirements; all data for each site was used. Using EPA's AirExplorer, we determined that the monitor that recorded the highest NO<sub>2</sub> concentrations (6371601) was not in either downtown Los Angeles or Pasadena (city was listed as Pico Rivera). Therefore, for purposes of our analysis, we used the monitor reporting the 2<sup>nd</sup> highest NO<sub>2</sub> concentrations (060371103), which is located in Los Angeles. We then provided the

table in attachment 5 which lists the 98<sup>th</sup> and 99<sup>th</sup> percentile NO<sub>2</sub> concentrations recorded by that monitor during the study period.

The paper titled "Air Pollution and Daily hospital Admissions in Metropolitan Los Angeles" was authored by Linn et al, and said they pulled data from 1992-1995 for selected sites in Los Angeles (037), San Bernardino (071), Orange (059), and Riverside (065) counties. The authors did provide NO<sub>2</sub> concentration information; however, it was aggregated across multiple monitors. Therefore, from AQS we pulled NO<sub>2</sub> data from all sites in the above mentioned counties (because specific sites utilized in their analysis were not listed in the paper) and years. We computed for each site, the annual mean and 99<sup>th</sup> and 98<sup>th</sup> percentiles of the 1-hour value, the daily average of the 1-hour values, and the daily maximum of the 1-hour values, for the entire period and by year. No data was excluded because of completeness requirements; all data for each site was used. We then provided the tables in attachment 6 which lists the site with the highest 98<sup>th</sup> percentile for each of the metrics for the entire period.

With regard to the study by the New York Department of Health (A study of ambient air contaminants and asthma in New York City. ATSDR Final Report. PB2006-113523, 2006), we received attachment 7 from the authors.

After completing the above analyses, we went back and calculated, for the current complete year of 2007, the daily maximum annual mean, and 99<sup>th</sup> and 98<sup>th</sup> percentiles for the monitor with the highest concentration values in each of the study areas and provided that table in attachment 8.

## References

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Department of Health and Human Services, Agency for Toxic Substance and Disease Registry.

Ostro, B, Lipsett M, Mann J, Braxton-Owens H, White M. (2001). Air pollution and exacerbation of asthma in African-American children in Los Angeles. *Epidemiology* 12:200-208.

Peel, JL, Tolbert PE, Klein M, Metzger KB, Flanders WD, Knox T, Mulholland JA, Ryan PB, Frumkin H. (2005). Ambient air pollution and respiratory emergency department visits. *Epidemiology*. 16:164-174.

Tolbert, PE, Klein M, Peel JL, Sarnat SE, Sarnat JA. (2007). Multipollutant modeling issues in a study of ambient air quality and emergency department visits in Atlanta. *J Expos Sci Environ Epidemiol*. 17S2:S29-35.

Attachments 1-8

cc: Phil Lorang

## Attachment 1

## Delfino Paper Data and Statistics.

date	1-Hour NO2max	Max of 8hr moving average
3/1/1996	36	23.5
3/2/1996	20	16.375
3/3/1996	32	27.125
3/4/1996	22	10.875
3/5/1996	13	8.5
3/6/1996	15	6.625
3/7/1996	26	13.875
3/8/1996	37	24.625
3/9/1996	45	26.375
3/10/1996	18	10
3/11/1996	19	11.375
3/12/1996	8	6
3/13/1996	15	8.75
3/14/1996	16	11
3/15/1996	25	12.25
3/16/1996	31	22.75
3/17/1996	42	29.375
3/18/1996	43	31.125
3/19/1996	42	26.375
3/20/1996	50	34.25
3/21/1996	23	19.375
3/22/1996	14	9.875
3/23/1996	14	8.375
3/24/1996	22	13
3/25/1996	17	10.875
3/26/1996	19	11.625
3/27/1996	36	20.71428571
3/28/1996	11	7.875
3/29/1996	27	18
3/30/1996	31	16.25
3/31/1996	21	14.25
4/1/1996	26	17.375
4/2/1996	16	10.75
4/3/1996	19	15.25
4/4/1996	25	17.25
4/5/1996	16	7.625
4/6/1996	15	7.75
4/7/1996	23	11.875
4/8/1996	29	20.5
4/9/1996	25	17
4/10/1996	12	6.375
4/11/1996	53	18.75
4/12/1996	18	12
4/13/1996	23	15.5
4/14/1996	15	9.25
4/15/1996	20	15.125
4/16/1996	20	12.375

4/17/1996	13	9.75
4/18/1996	8	5.875
4/19/1996	17	12
4/20/1996	16	11.875
4/21/1996	14	8.375
4/22/1996	18	11
4/23/1996	23	16.8
4/24/1996	22	18.625
4/25/1996	34	27.625
4/26/1996	43	30.25
4/27/1996	24	16.375
4/28/1996	18	12.14285714
4/29/1996	16	11.125
4/30/1996	34	20
Mean	23.68852459	15.37552693
Number of Observations	61	61
99th Percentile	53	34.25
98th Percentile	50	31.125

Attachment 2 Peel and Tolbert Tables  
1993-2004

Table 1 all sites - all hourly values - entire period 1/1/93-12/31/2004

State_Code	County_Code	Site_ID	mean	nobs	p99	pp98
13	223	3	0.005	78336	0.028	0.023
13	247	1	0.007	94272	0.027	0.023
13	89	3001	0.016	83496	0.052	0.047
13	89	2	0.016	103776	0.053	0.048
13	121	48	0.022	102432	0.069	0.062

Table 2 all sites - daily average (1 hour) - entire period 1/1/93-12/31/2004

State_Code	County_Code	Site_ID	mean	nobs	p99	pp98
13	223	3	0.005	3264	0.020	0.018
13	247	1	0.007	3928	0.020	0.018
13	89	2	0.016	4324	0.041	0.036
13	89	3001	0.016	3479	0.039	0.037
13	121	48	0.022	4268	0.052	0.048

Table 3 all sites - daily maximum (1 hour) - entire period 1/1/93-12/31/2004

State_Code	County_Code	Site_ID	mean	nobs	p99	pp98
13	247	1	0.014	3928	0.041	0.036
13	223	3	0.011	3264	0.041	0.038
13	89	3001	0.032	3479	0.069	0.063
13	89	2	0.033	4324	0.074	0.066
<b>13</b>	<b>121</b>	<b>48</b>	<b>0.042</b>	<b>4268</b>	<b>0.093</b>	<b>0.086</b>

Table 4 Author supplied Descriptive statistics for 1-hour max NO2 from Georgia Tech monitor  
Study Period 1/1/93-8/31/2000

N	Mean	98 <sup>th</sup> percentile	99 <sup>th</sup> percentile
2775*	45.9 ppb	87.0 ppb	95.0 ppb

\* out of 2800 days in study period

Study Period 1/1/93-12/31/2004

N	Mean	98 <sup>th</sup> percentile	99 <sup>th</sup> percentile
4351*	43.2 ppb	85.0 ppb	93.0 ppb

\* out of 4383 days in study period

Attachment 3 Jaffee Tables  
June to August from 1993-1996

Table 1 highest site - 1 hour average (all hours)

Site	mean	n	99th	98th
390610035	0.029	4416	0.072	0.065

Table 2 highest site - Daily 1 hour average

Site	mean	n	99th	98th
390610035	0.029	184	0.053	0.050

Table 3 highest site - Daily 1 hour maximum

Site	mean	n	99th	98th
211170007	0.047	368	0.09	0.089
<b>390610035</b>	<b>0.051</b>	<b>184</b>	<b>0.098</b>	<b>0.086</b>

\* although monitor 211170007 had the highest 98th percentile for the daily 1-hour maximum, site 390610035 was chosen because it was in the city limits.



Attachment 4 Ito Tables 1999-2002

Table 1 highest site entire period - 1 hour average (all hours)

State_Code	County_Code	Site_ID	mean	nobs	p99	pp98
36	61	56	0.039	35064	0.075	0.070
36	5	73	0.032	3455	0.072	0.066
36	5	110	0.031	29088	0.070	0.064
36	61	10	0.036	21503	0.071	0.064
36	5	80	0.033	11711	0.070	0.062
36	81	98	0.029	34296	0.067	0.062
36	5	83	0.029	35063	0.066	0.060
36	81	97	0.026	26208	0.066	0.060
36	81	124	0.028	12864	0.066	0.060
36	59	5	0.024	35064	0.059	0.053
36	29	5	0.021	35064	0.056	0.051
36	103	9	0.017	26304	0.047	0.043
36	1	12	0.014	4727	0.047	0.042
36	29	2	0.015	35064	0.046	0.041

Table 2 highest site - Daily 1 hour average

State_Code	County_Code	Site_ID	mean	nobs	p99	pp98
36	61	56	0.039	1461	0.066	0.063
36	61	10	0.036	896	0.061	0.058
36	5	110	0.031	1212	0.061	0.056
36	5	73	0.032	144	0.058	0.055
36	81	98	0.029	1429	0.057	0.054
36	5	80	0.033	488	0.058	0.053
36	5	83	0.029	1461	0.056	0.051
36	81	97	0.026	1092	0.053	0.050
36	81	124	0.028	536	0.052	0.049
36	59	5	0.024	1461	0.050	0.045
36	29	5	0.021	1461	0.042	0.039
36	103	9	0.017	1096	0.038	0.035
36	1	12	0.014	197	0.042	0.033
36	29	2	0.015	1461	0.033	0.030

Table 3 highest site - Daily 1 hour maximum

State_Code	County_Code	Site_ID	mean	nobs	p99	pp98
<b>36</b>	<b>5</b>	<b>73</b>	<b>0.052</b>	<b>144</b>	<b>0.112</b>	<b>0.094</b>
36	5	80	0.047	488	0.097	0.088
36	5	110	0.047	1212	0.096	0.088
36	61	10	0.049	896	0.094	0.087
36	61	56	0.052	1461	0.095	0.087
36	81	124	0.045	536	0.088	0.084
36	5	83	0.045	1461	0.089	0.081
36	81	98	0.045	1429	0.089	0.081
36	81	97	0.043	1092	0.083	0.077
36	29	5	0.038	1461	0.077	0.070
36	59	5	0.040	1461	0.079	0.070

36	29	2	0.030	1461	0.063	0.058
36	1	12	0.029	197	0.063	0.056
36	103	9	0.033	1096	0.060	0.056

Attachment 5 Ostro Tables  
 Aug-Oct in 1993

Highest site - 1 hour average (all hours) entire period

	<b>mean</b>	<b>99th</b>	<b>98th</b>	<b>n</b>
060371103	0.033	0.110	0.100	1988
060372005	0.045	0.110	0.100	2038

Highest site - Daily 1 hour average entire period

060371103	0.033	0.068	0.068	87
060372005	0.045	0.075	0.072	90

Highest site - Daily 1 hour maximum entire period

060371103	0.071	0.210	0.180	87
060372005	0.075	0.180	0.170	90

Attachment 6 Linn  
Tables  
1992-1995

Table 1 highest site - 1 hour average (all hours)

Site	mean	99th	98th	n
060370206	0.045	0.130	0.114	13193

Table 2 highest site - Daily 1 hour average

Site	mean	99th	98th	n
060370206	0.045	0.112	0.097	581

Table 3 highest site - Daily 1 hour maximum

Site	mean	99th	98th	n
<b>060371103</b>	<b>0.072</b>	<b>0.197</b>	<b>0.178</b>	<b>1430</b>

Summary statistics for sulfur dioxide and nitrogen dioxide from NYSDOH study of ambient air pollutants and asthma ED visits in Manhattan and Bronx, NYC (NYSDOH 2006. A study of ambient air contaminants and asthma in New York City. ATSDR Final Report. PB2006-113523).

site*	N	Concentration (ppm)		
		mean	98 <sup>th</sup> percentile	99 <sup>th</sup> percentile
<b>NO2 24-hour averages</b>				
<b>Manhattan</b>	625	0.036	0.057	0.060
<b>Bronx (all days)</b>	425	0.031	0.057	0.060
<b>site A</b>	102	0.030	0.054	0.057
<b>site B</b>	323	0.032	0.057	0.062
<b>NO2 1-hour averages</b>				
<b>Manhattan</b>	14980	0.036	0.065	0.070
<b>Bronx (all days)</b>	10073	0.031	0.065	0.071
<b>site A</b>	2422	0.030	0.065	0.072
<b>site B</b>	7651	0.032	0.065	0.070
<b>NO2 maximum daily 1-hour averages</b>				
<b>Manhattan</b>	625	0.050	0.086	0.093
<b>Bronx (all days)</b>	425	0.049	0.088	0.098
<b>site A</b>	102	0.049	0.083	0.094
<b>site B</b>	323	0.049	0.088	0.098
<b>SO2 24-hour averages</b>				
<b>Manhattan</b>	648	0.012	0.033	0.036
<b>Bronx (all days)</b>	608	0.011	0.031	0.036
<b>site A</b>	194	0.010	0.032	0.035
<b>site B</b>	414	0.011	0.031	0.037
<b>SO2 1-hour averages</b>				
<b>Manhattan</b>	15426	0.012	0.039	0.045
<b>Bronx (all days)</b>	14317	0.011	0.039	0.047
<b>site A</b>	4565	0.010	0.037	0.046
<b>site B</b>	9752	0.011	0.040	0.048
<b>SO2 maximum daily 1-hour averages</b>				
<b>Manhattan</b>	648	0.024	0.062	0.080
<b>Bronx (all days)</b>	608	0.023	0.065	0.078
<b>site A</b>	194	0.022	0.060	0.068
<b>site B</b>	414	0.024	0.068	0.086

\*Manhattan = Mabel Dean Bacon HS (site # 7093-05N) operated from January 1, 1999 – November 22, 2000

Bronx site A = IS155 (site # 7094-03) operated from January 1 – July 14, 1999; operation was discontinued due to building construction at the site

Bronx site B = Middle School 52 at 681 Kelly Street Bronx NY, approximately 0.5 miles northeast of site # 7094-03; operated from September 2, 1999 – November 22, 2000; this site was approved by US EPA during the study as an acceptable alternative as an urban regional site to replace the discontinued Bronx monitoring location

Attachment 8 Current Complete Year 2007

State	Paper Main Author	Site	Daily Max			
			mean	nobs	p99	pp98
OH	Jaffee	390610035	not operating			
GA	P&T	131210048	0.034	365	0.078	0.075
CA	Linn	060371103	0.047	360	0.092	0.087
CA	Ostro	060371601	not operating			
		060372005	0.038	365	0.073	0.071
NY	Ito	360050073	not operating			