



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY  
RESEARCH TRIANGLE PARK, NC 27711

OFFICE OF  
AIR QUALITY PLANNING  
AND STANDARDS

October 30, 1996

MEMORANDUM

SUBJECT: Ambient Air Quality Relationships Among Alternative Ozone  
Air Quality Standards

FROM: Warren P. Freas /signed/  
Air Quality Trends Analysis Group (MD-14)

TO: Files

The purpose of this memorandum is to document the results of analyses of ambient ozone air quality data that examined air quality relationships among alternative ambient standard formulations.

Data Base

The air quality data base used in these analyses was derived from the hourly ozone data available from EPA's Aerometric Information Retrieval System (AIRS) data base. Hourly data were retrieved from each site reporting ambient ozone data to AIRS for the years 1993 through 1995. Eight-hour daily maximum ozone concentrations were obtained by first computing running eight-hour averages. If only 6 or 7 hourly values were available for a given 8-hour period, then the sum was divided by only 6 or 7, respectively. The computed 8-hour average was stored in the first, or start, hour of the 8-hour period. For each day of the ozone season, the 8-hour daily maximum concentration is simply the highest 8-hour average concentration starting within the day. For the three year period, 1993-95, ambient data were available for a total of 958 ozone monitoring sites, while 778 sites reported data for all three years. These 958 sites are located in 561 counties.

Summary Statistics

The following air quality summary statistics were computed from the basic air quality data: the annual 1st through 5th highest daily maximum 1-hour and 8-hour concentrations; the number of 8-hour daily maximum exceedances of 0.08 ppm; the number of 1-hour daily maximum exceedances of 0.12 ppm; and air quality design values for 8-hour standards based on 1, 3, and 5 exceedances per year.

#### Alternative NAAQS Forms

Three different forms of alternative ozone ambient air quality standards were examined: the current 0.12 ppm, 1-hour daily maximum, 1 exceedance per year NAAQS; concentration-based standards which use the average annual nth largest daily maximum 8-hour average concentration at the 0.08 ppm level, where n is the average annual 2nd through 5th largest concentration; and 1, 3 and 5 exceedance per year forms at the 0.08 ppm level.

#### Results

Table 1 provides a summary of the results of the comparisons among the three alternative forms of the NAAQS. The first two columns present the number of counties not meeting the respective ozone standard, and the corresponding population total. All sites reporting data for the years 1993-95 were used in these comparisons, irrespective of data completeness.

In contrast, the remaining columns in Table 1 present air quality relationships among alternative forms for sites just attaining the respective standard. In these comparisons, only sites with three complete years of data were used because three years of data are required to demonstrate attainment of standards. For the concentration-based forms, a site was judged to have met the standard if the average annual nth largest concentration was equal to 0.08 ppm. Based on the standard rounding convention, this means that values could fall between 0.075 ppm and 0.084 ppm and still attain the standard. A similar approach was used for the exceedance-based forms as the design value was rounded to two decimal places prior to comparison with the level of the standard. For the one exceedance per year forms the design value is the 4th largest daily maximum concentration in 3-years, the 10th largest for 3 exceedances per year and the 16th largest for the 5 exceedances per year standard.

The first major grouping of five columns displays the distribution of sites with fourth highest 8-hour daily maximum

concentrations, i.e., the design value for a one exceedance standard, in concentration intervals of 0.08, 0.09, 0.10, 0.11, and 0.12 ppm. To illustrate, the table indicates that 99% of sites attaining either an average annual 2nd or average annual 3rd highest 8-hour daily maximum concentration-based standard of 0.08 ppm have fourth-highest 8-hour daily maximum concentrations less than or equal to 0.09 ppm.

The next column shows the peak 8-hour daily maximum concentrations at the worst site in the worst year of the 3-year period, 1993-95. The worst site recorded a peak 8-hour concentration of 0.13 ppm for all the concentration-based forms, while the worst site for the 5 exceedance standard recorded a peak 8-hour concentration of 0.16 ppm.

The last two columns present the number of daily maximum exceedances of 0.08 ppm in the worst year of the three year period. For example, the worst site in the worst year during 1993-95 just attaining an average 2nd maximum 0.08 ppm standard recorded 12 daily maximum 8-hour exceedances of the 0.08 ppm level. While this is the extreme scenario, 95 percent of the sites meeting the average 2nd maximum .08 ppm standard had 6 or fewer exceedances in the worst year of three.

#### Summary

It is not surprising that these results indicate that the concentration-based forms are better at limiting peak concentrations while the exceedance-based forms are better at limiting the number of exceedances of the standard level.

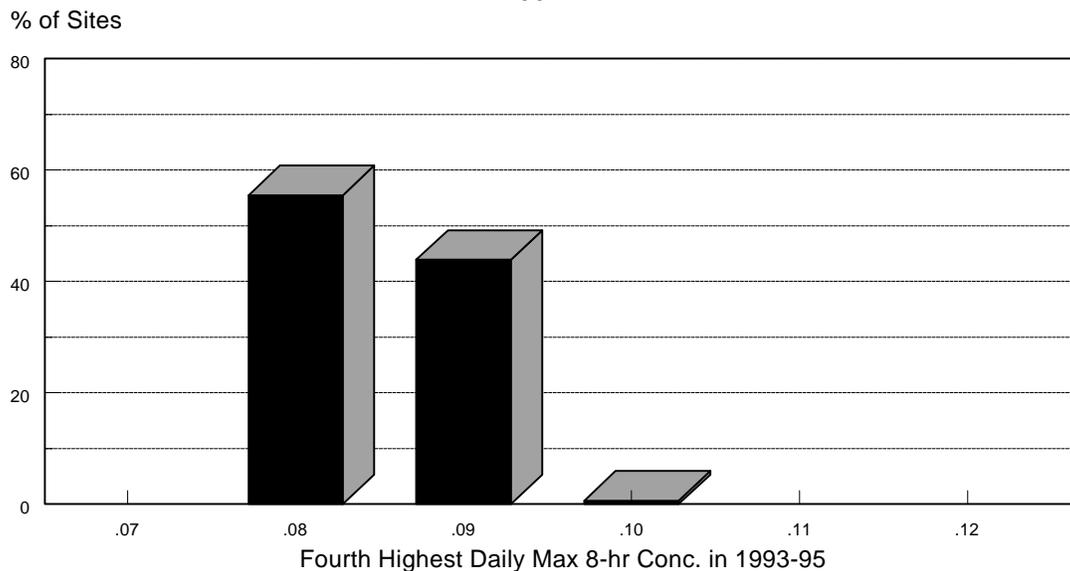
**Table 1 -- Comparisons of Alternative Ozone Ambient Air Quality Standards**

(Based on 1993-95 Data)

Form of the O <sub>3</sub> NAAQS (at the 0.08 ppm Level)	Counties Failing to Meet an O <sub>3</sub> NAAQS of 0.08 ppm (1 to 3 yrs of data)		Sites Just Attaining an O <sub>3</sub> NAAQS of 0.08 ppm (based on 3 Years of Data)							
			Percent of Sites with the Fourth Highest Daily Maximum 8-hr Concentration Equal to:					Highest 8-hr Daily Max Conc.	Number of Exceedances of 0.08 ppm in worst yr of three	
	Number of Counties	Population (millions)	0.08 ppm	0.09 ppm	0.10 ppm	0.11 ppm	0.12 ppm	Worst site in worst year of three	Worst site in worst year of three	95% of sites are less than or =
<b>Current 1-hr, 1 exc 0.12 ppm NAAQS</b>	106	74	1%	22%	63%	14%		0.14 ppm	67	21
<b>Concentration-based NAAQS</b>										
Avg. 2nd Highest Daily Max 8-hr Conc.	375	132	55%	44%	1%			0.13 ppm	12	6
Avg. 3rd Highest Daily Max 8-hr Conc.	335	122	32%	67%	1%			0.13 ppm	12	7
Avg. 4th Highest Daily Max 8-hr Conc.	280	113	15%	77%	8%			0.13 ppm	19	9
Avg. 5th Highest Daily Max 8-hr Conc.	250	106	10%	73%	15%	2%		0.13 ppm	20	11
<b>Exceedance-based NAAQS*</b>										
Avg. of 1 exceedance per year	416	139	100%					0.12 ppm	3	2
Avg. of 3 exceedances per year	301	117	26%	70%	4%			0.13 ppm	8	6
Avg. of 5 exceedances per year	231	100	8%	70%	20%	2%		0.16 ppm	12	10

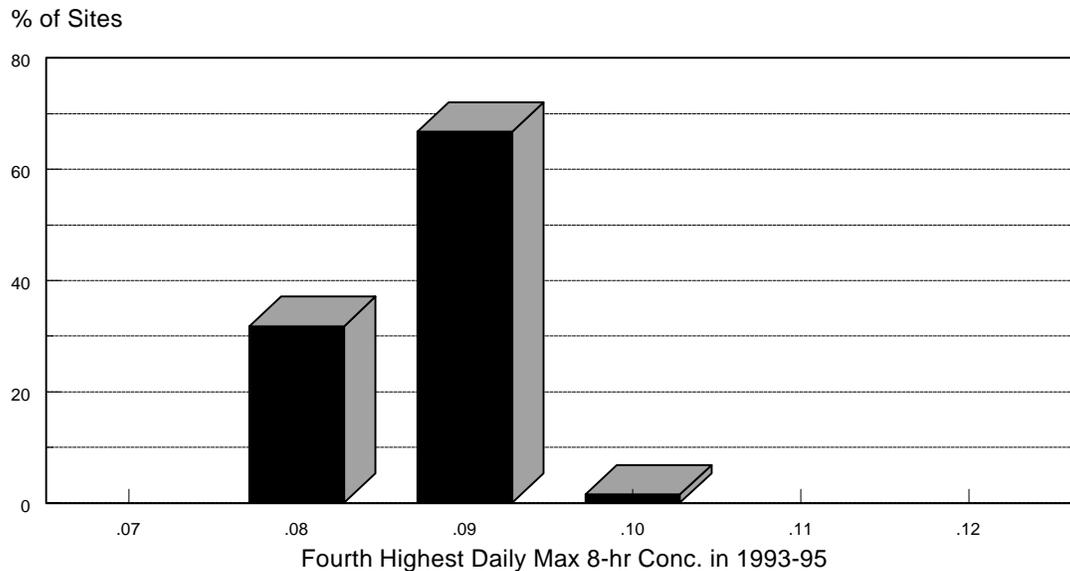
\* Based only on observed exceedances. No adjustment has been made for missing data.

**Fourth Highest Daily Maximum 8-hr Concentrations  
for Sites Just Attaining an Avg 2nd Daily Max  
0.08 ppm NAAQS**



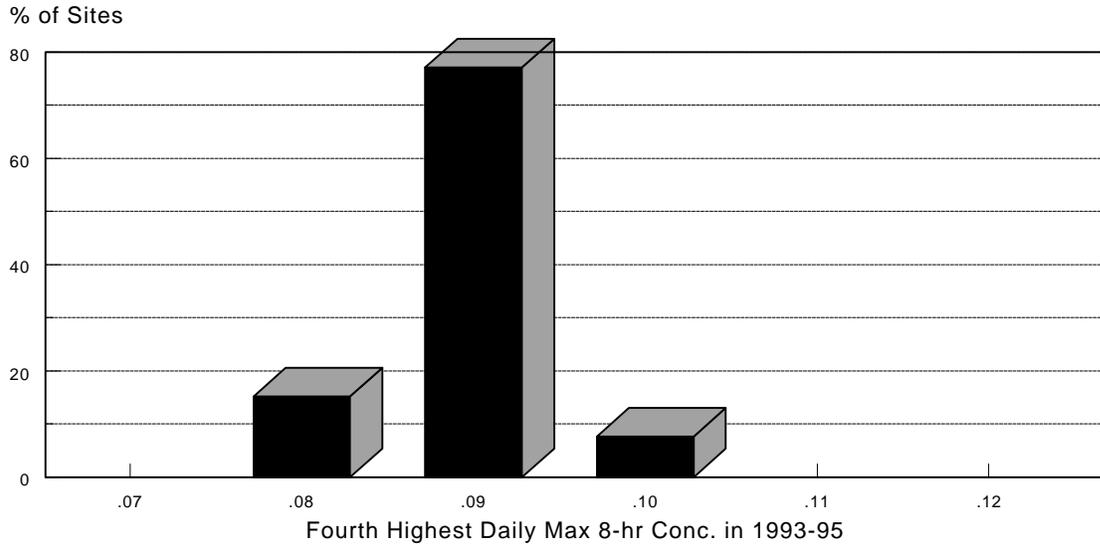
Note: Based on 1993-95 AIRS data.

**Fourth Highest Daily Maximum 8-hr Concentrations  
for Sites Just Attaining an Avg 3rd Daily Max  
0.08 ppm NAAQS**



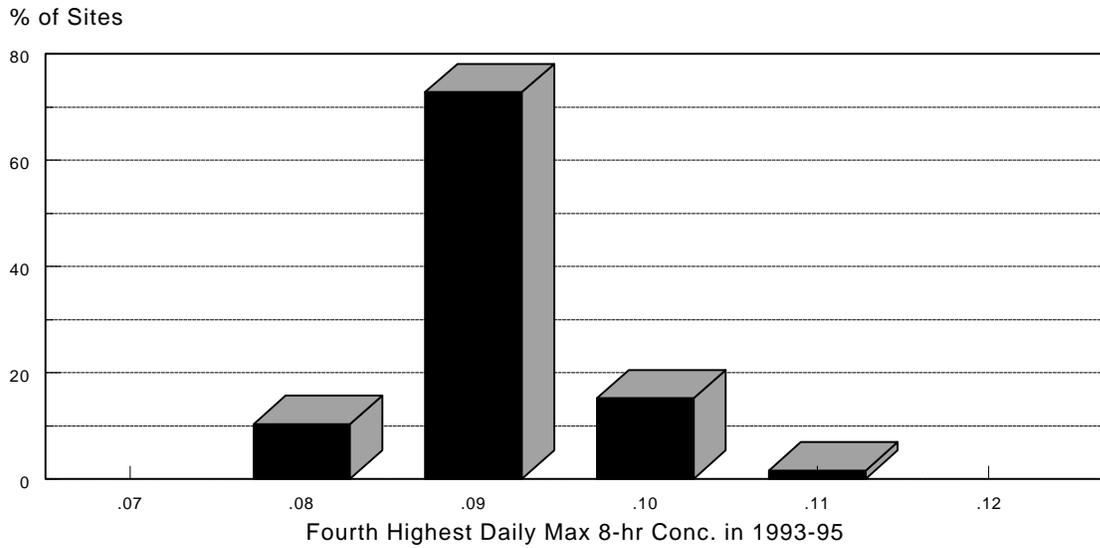
Note: Based on 1993-95 AIRS data.

**Fourth Highest Daily Maximum 8-hr Concentrations  
for Sites Just Attaining an Avg 4th Daily Max  
0.08 ppm NAAQS**



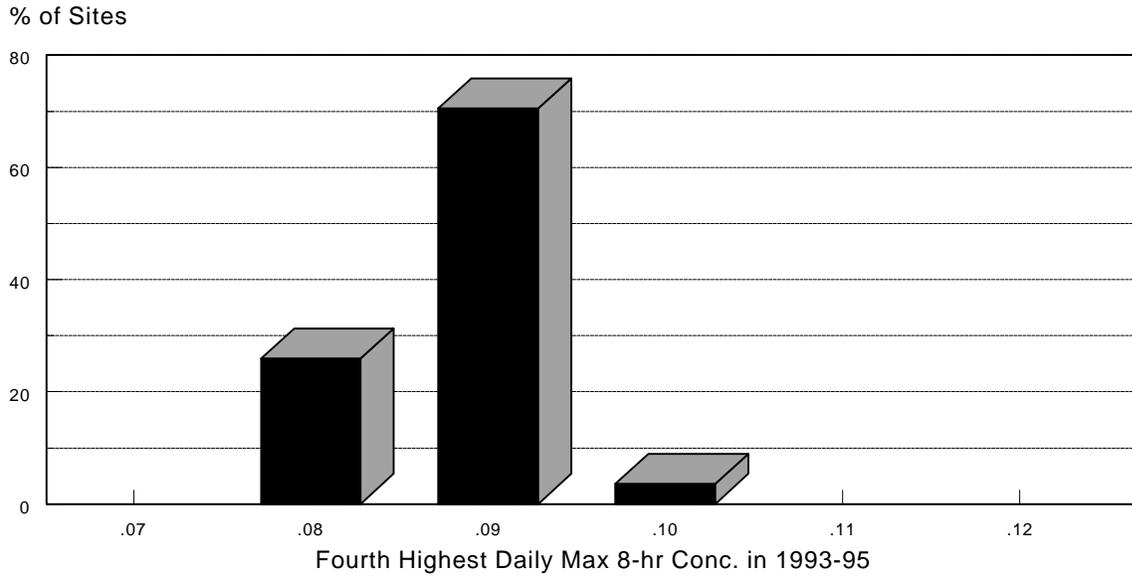
Note: Based on 1993-95 data.

**Fourth Highest Daily Maximum 8-hr Concentrations  
for Sites Just Attaining an Avg 5th Daily Max  
0.08 ppm NAAQS**



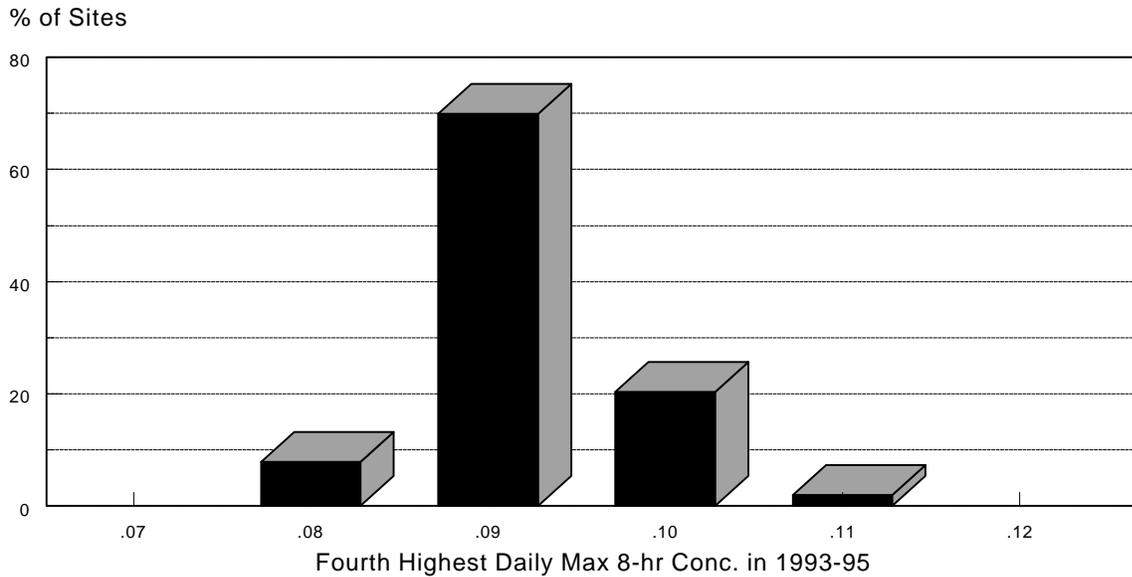
Note: Based on 1993-95 data.

**Fourth Highest Daily Maximum 8-hr Concentrations  
for Sites Just Attaining a 3 Exceedance Per Year  
0.08 ppm NAAQS**



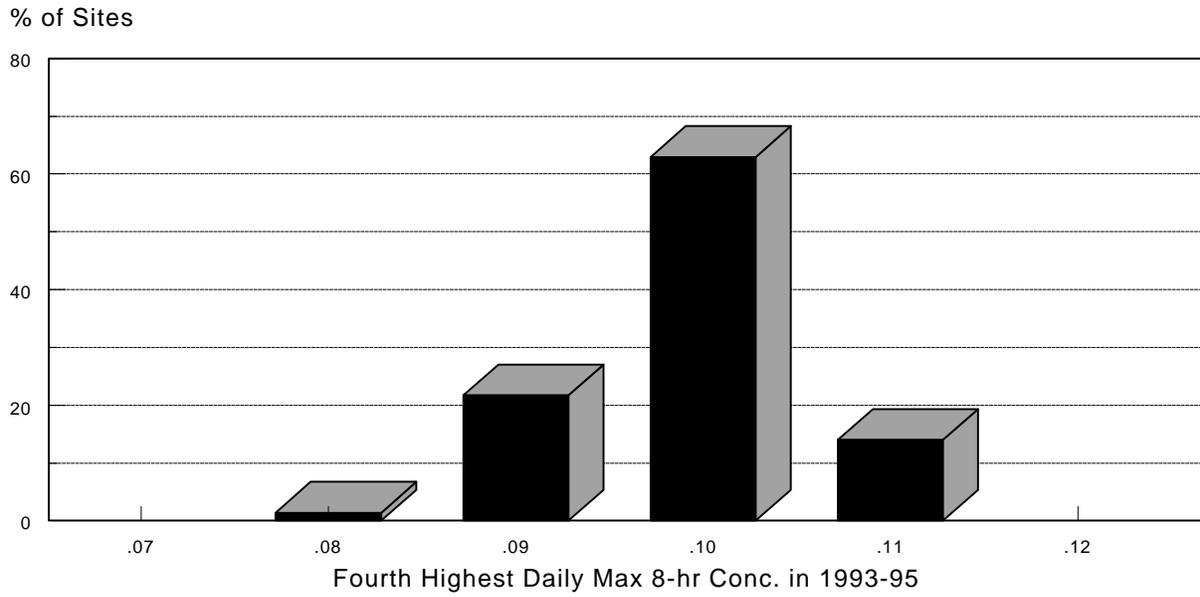
Note: Based on 1993-95 data.

**Fourth Highest Daily Maximum 8-hr Concentrations  
for Sites Just Attaining a 5 Exceedance Per Year  
0.08 ppm NAAQS**



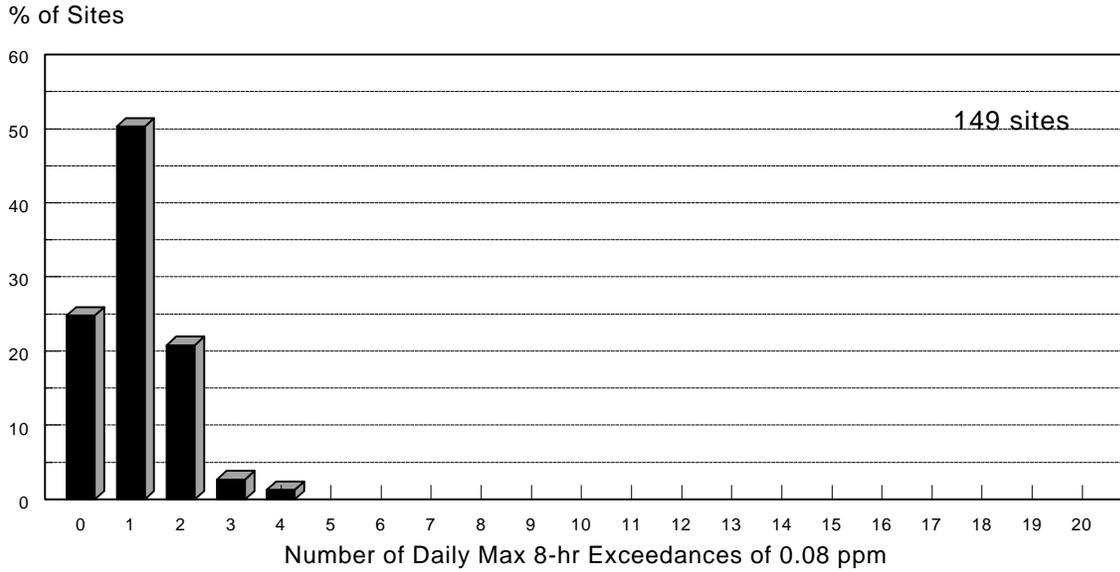
Note: Based on 1993-95 data.

**Fourth Highest Daily Maximum 8-hr Concentrations  
for Sites Just Attaining the Current 1-hr  
0.12 ppm NAAQS**



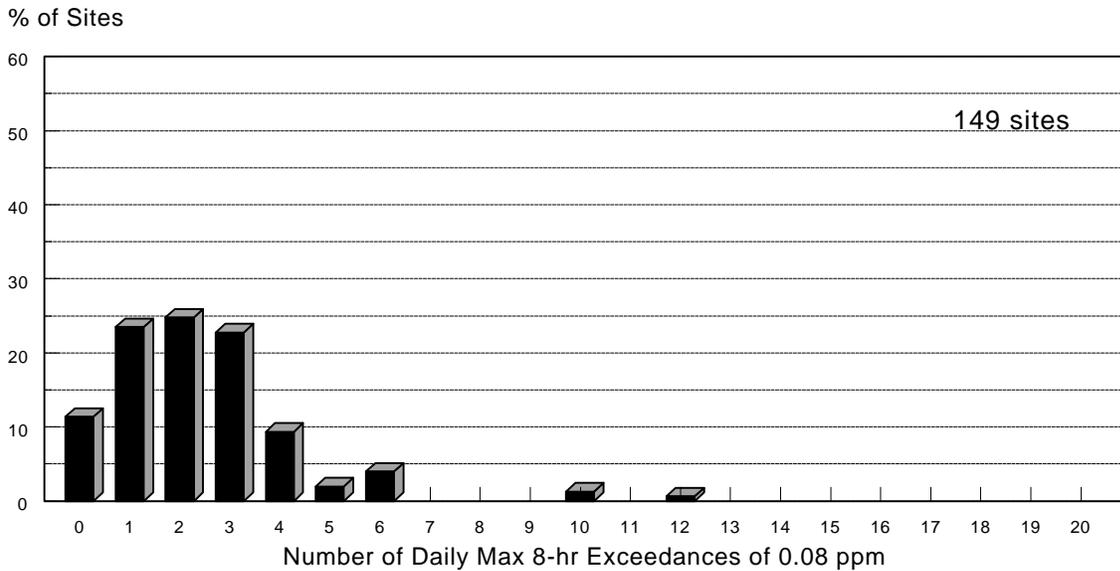
Note: Based on 1993-95 data.

**Average Number of Exceedances of 0.08 ppm for Sites Just Attaining an Average 2nd Daily Max 0.08 ppm NAAQS**



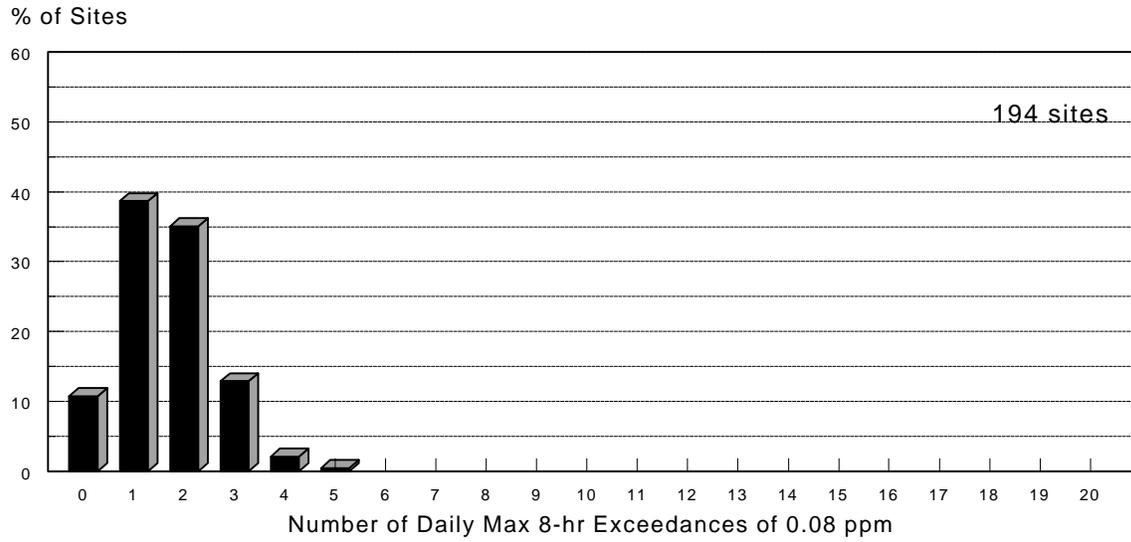
Note: Based on 1993-95 AIRS data.

**Maximum Number of Exceedances of 0.08 ppm for Sites Just Attaining an Average 2nd Daily Max 0.08 ppm NAAQS in the Worst Year of Three**



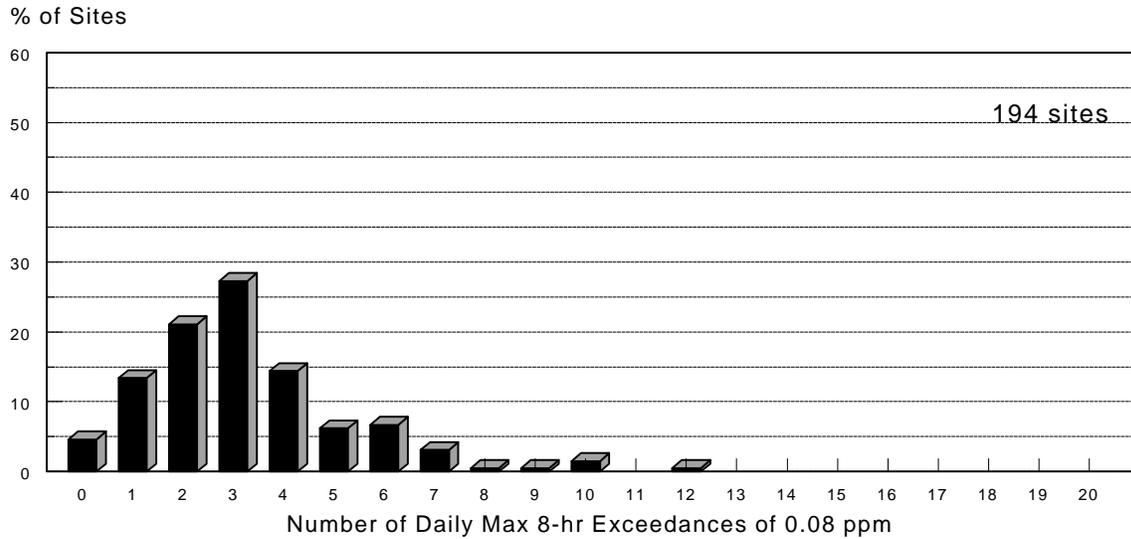
Note: Based on 1993-95 AIRS data.

**Average Number of Exceedances of 0.08 ppm for Sites Just Attaining an Average 3rd Daily Max 0.08 ppm NAAQS**



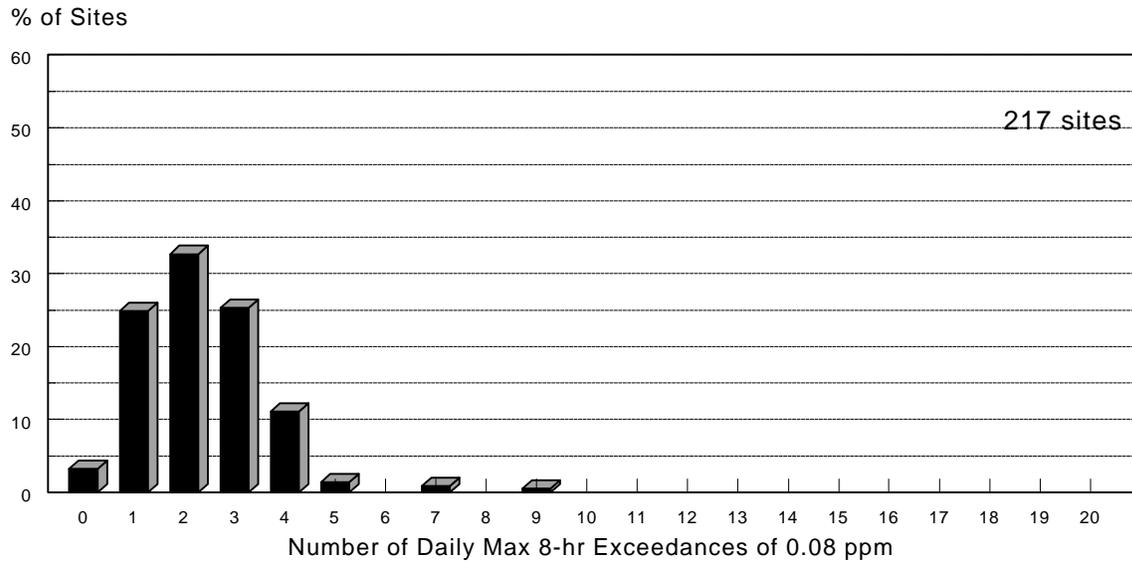
Note: Based on 1993-95 AIRS data.

**Maximum Number of Exceedances of 0.08 ppm for Sites Just Attaining an Average 3rd Daily Max 0.08 ppm NAAQS in the Worst Year of Three**



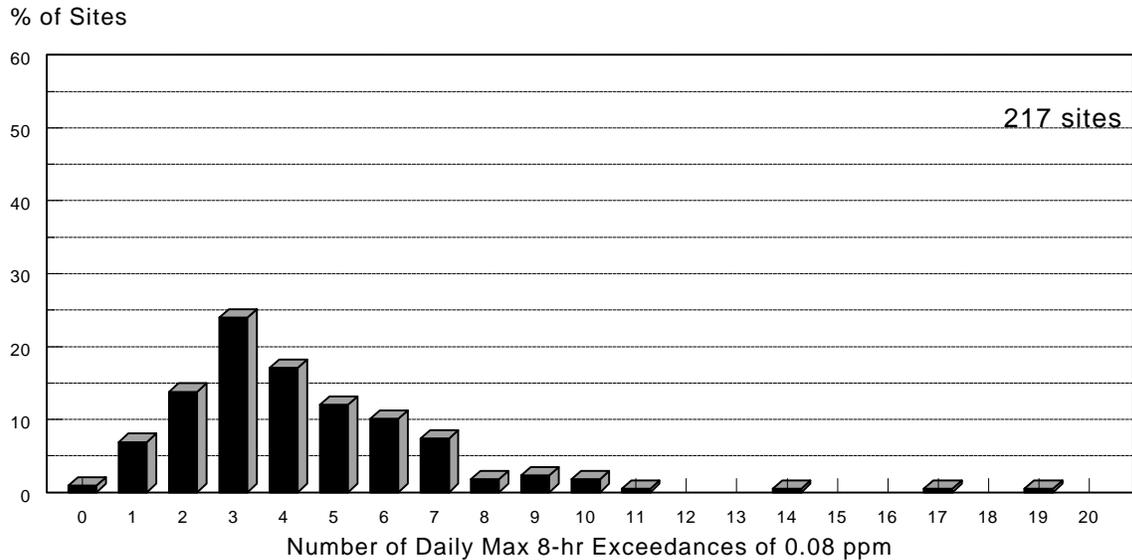
Note: Based on 1993-95 AIRS data.

**Average Number of Exceedances of 0.08 ppm for  
Sites Just Attaining an Average 4th Daily Max  
0.08 ppm NAAQS**



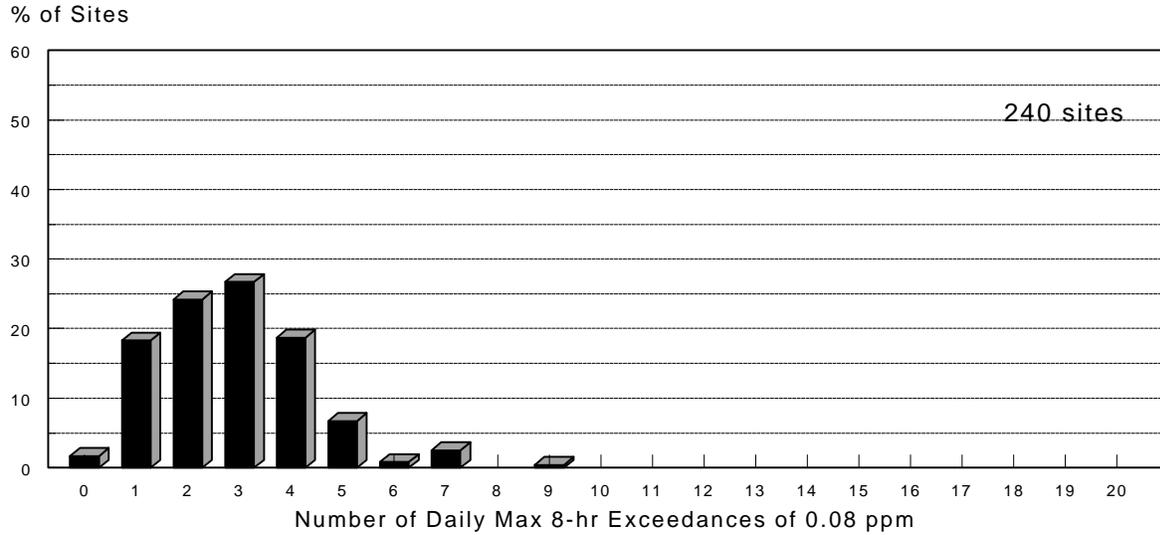
Note: Based on 1993-95 AIRS data.

**Maximum Number of Exceedances of 0.08 ppm for  
Sites Just Attaining an Average 4th Daily Max  
0.08 ppm NAAQS in the Worst Year of Three**



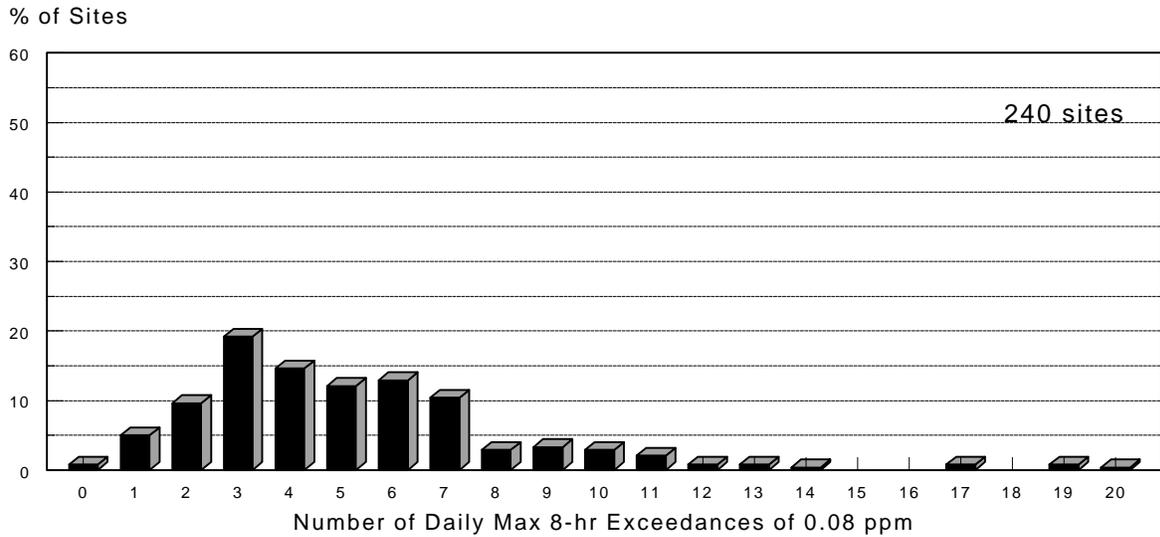
Note: Based on 1993-95 AIRS data.

**Average Number of Exceedances of 0.08 ppm for Sites Just Attaining an Average 5th Daily Max 0.08 ppm NAAQS**



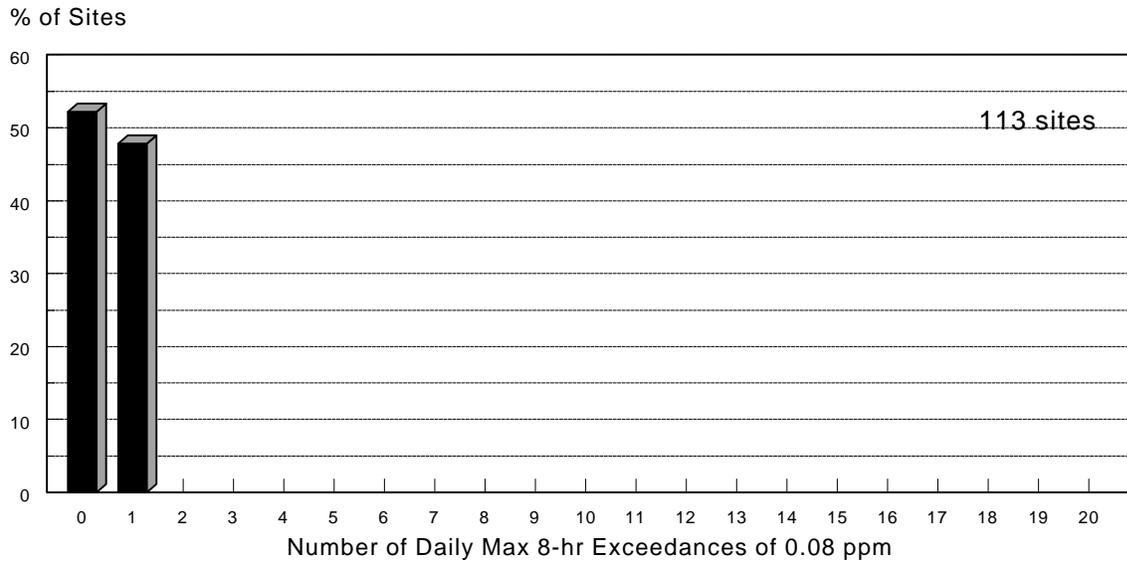
Note: Based on 1993-95 AIRS data.

**Maximum Number of Exceedances of 0.08 ppm for Sites Just Attaining an Average 5th Daily Max 0.08 ppm NAAQS in the Worst Year of Three**



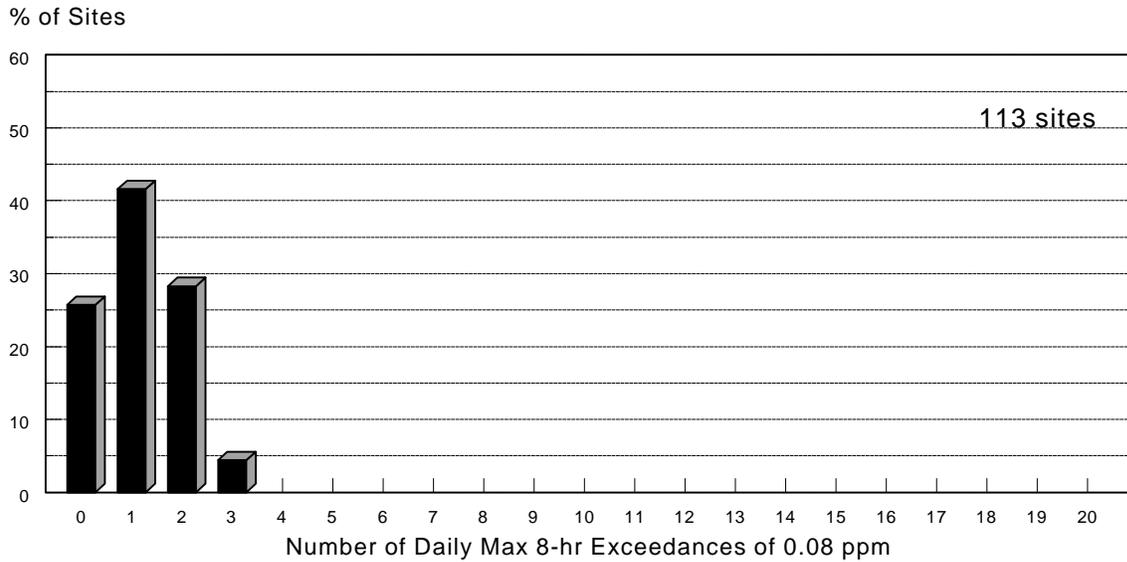
Note: Based on 1993-95 AIRS data.

**Average Number of Exceedances of 0.08 ppm for  
Sites Just Attaining a 1 Exceedances Per Year  
0.08 ppm NAAQS**



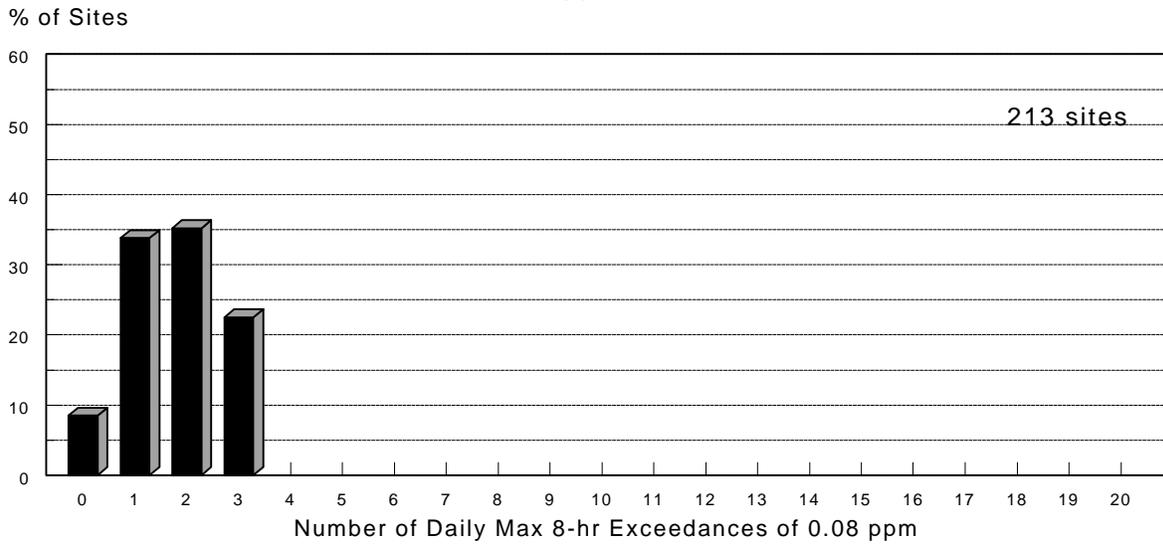
Note: Based on 1993-95 AIRS data.

**Maximum Number of Exceedances of 0.08 ppm for  
Sites Just Attaining a 1 Exceedances Per Year  
0.08 ppm NAAQS in the Worst Year of Three**



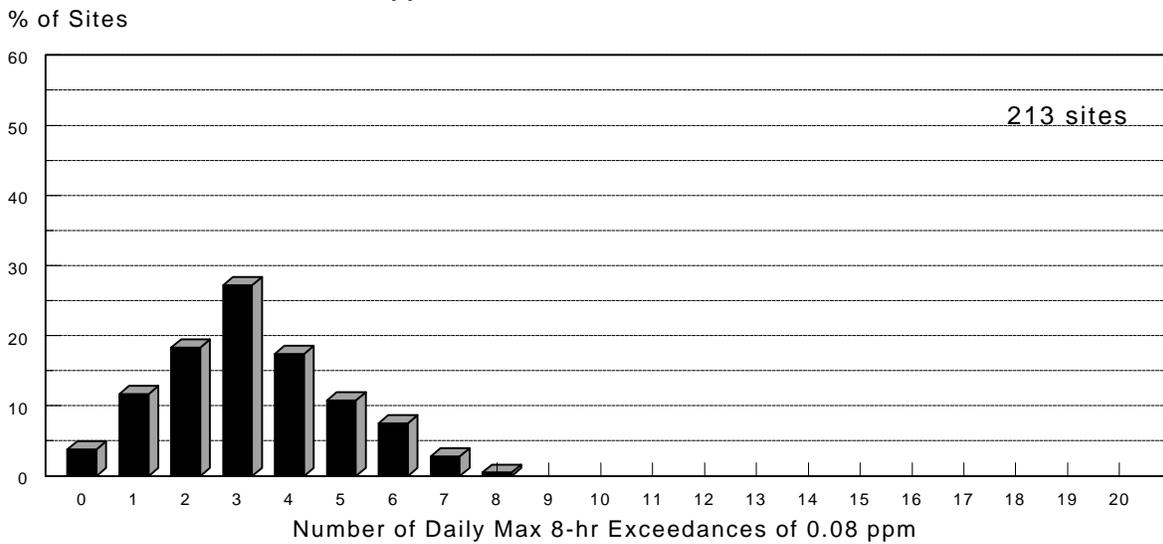
Note: Based on 1993-95 AIRS data.

**Average Number of Exceedances of 0.08 ppm for Sites Just Attaining a 3 Exceedances Per Year 0.08 ppm NAAQS**



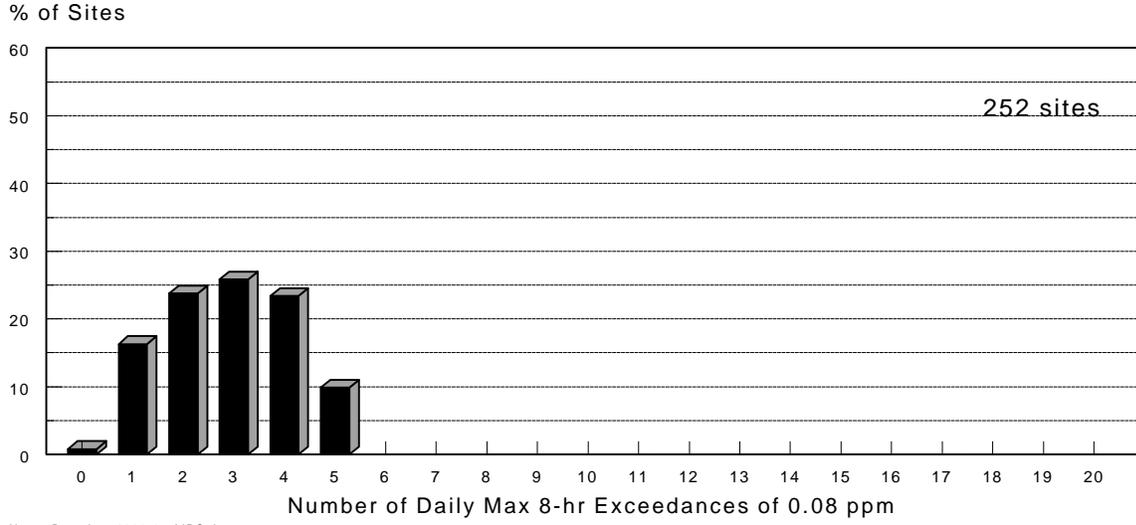
Note: Based on 1993-95 AIRS data.

**Maximum Number of Exceedances of 0.08 ppm for Sites Just Attaining a 3 Exceedances Per Year 0.08 ppm NAAQS in the Worst Year of Three**

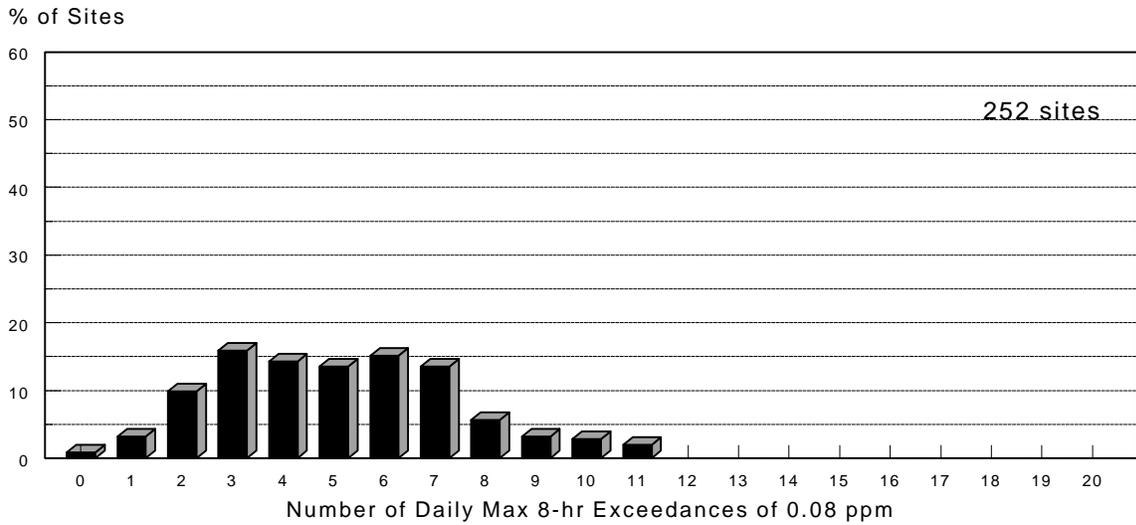


Note: Based on 1993-95 AIRS data.

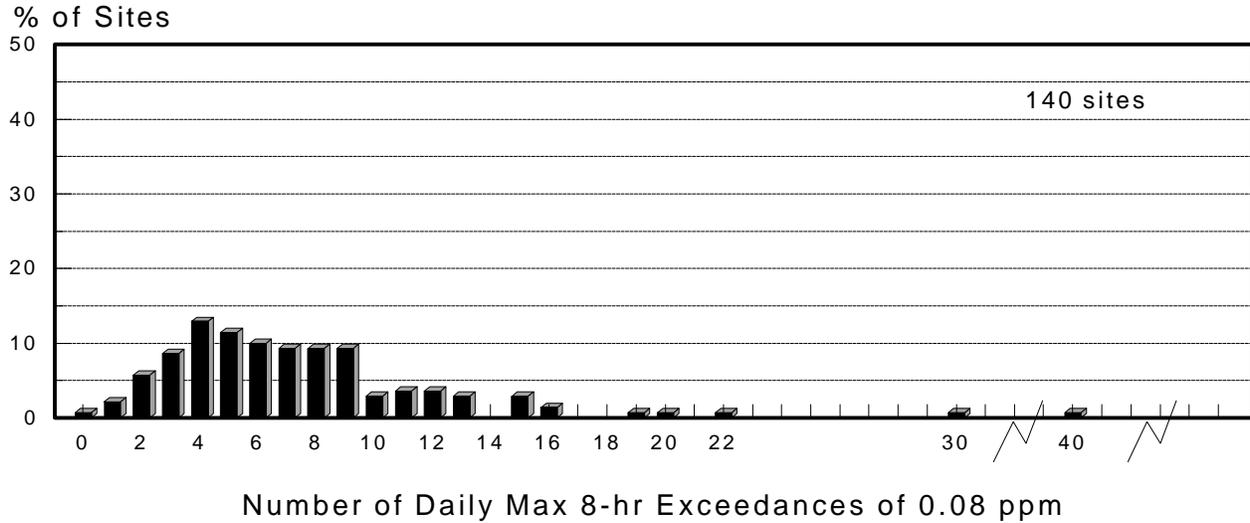
**Average Number of Exceedances of 0.08 ppm for Sites Just Attaining a 5 Exceedances Per Year 0.08 ppm NAAQS**



**Maximum Number of Exceedances of 0.08 ppm for Sites Just Attaining a 5 Exceedances Per Year 0.08 ppm NAAQS in the Worst Year of Three**

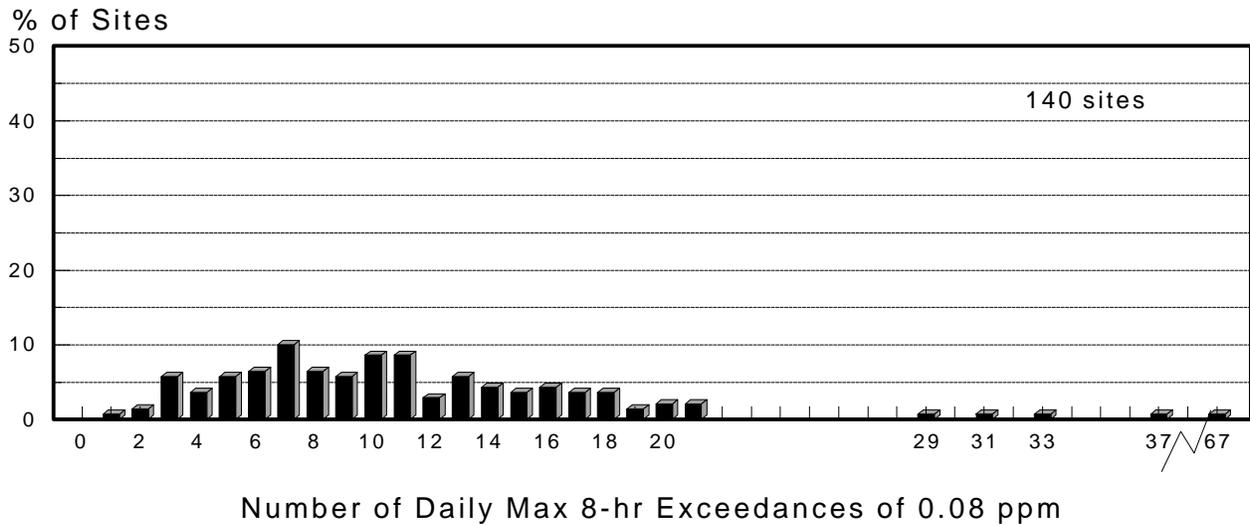


**Average Number of Exceedances of 0.08 ppm for Sites Just Attaining the Current 1-hr 0.12 ppm NAAQS**



Note: Based on 1993-95 AIRS data.

**Maximum Number of Exceedances of 0.08 ppm for Sites Just Attaining the Current 1-hr 0.12 ppm NAAQS in the Worst Year of Three**



Note: Based on 1993-95 AIRS data.