

Data Analysis for Regulatory Purposes

CARB PQAO Training Module II

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EPA, Region 9

OVERVIEW

- National Ambient Air Quality Standards (NAAQS)
 - Federal
 - State
- Types of Analysis
 - Focus on EPA regulatory actions
- In-Depth Look at PM_{2.5} and Ozone Design Values
- Design Value Calculation Exercise
- Some EPA Regulatory Actions
- **Data Provide the Foundation for Improving Public Health**

NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS)

- EPA sets a NAAQS for each of the criteria pollutants that has both a level (ambient concentration/averaging time), and form (statistical metric)

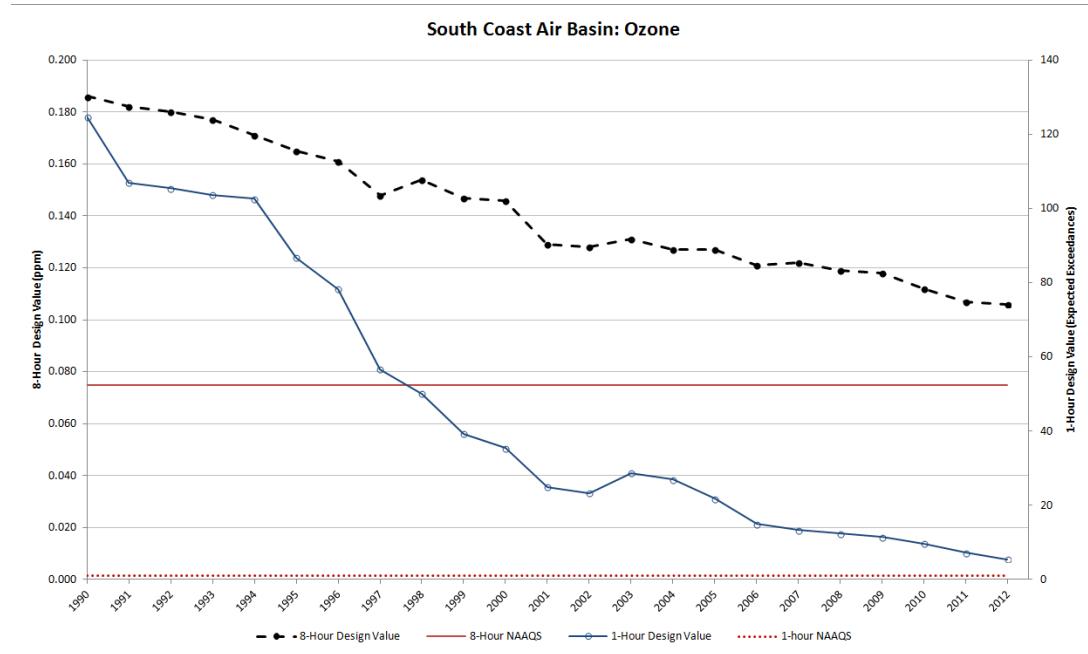
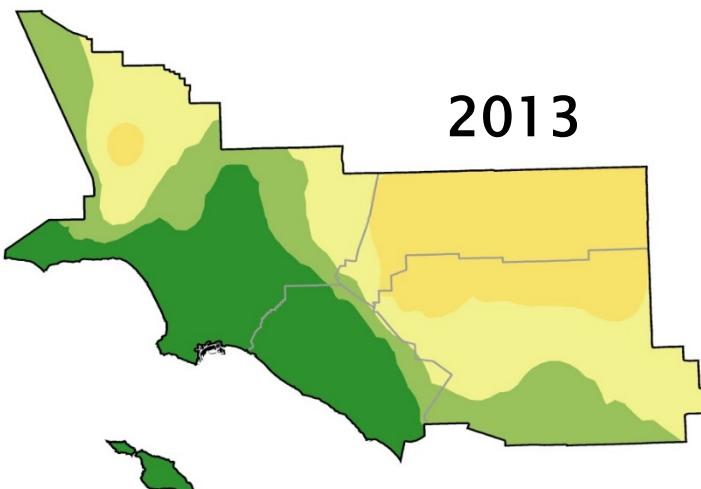
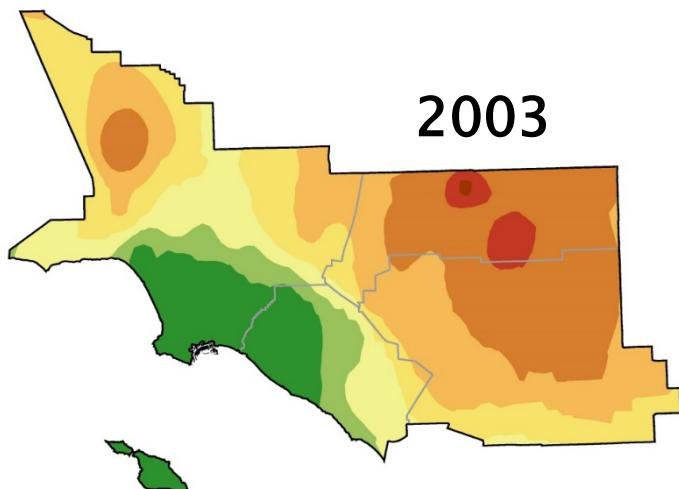
Pollutant [final rule cite]	Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide [76 FR 54294, Aug 31, 2011]	primary	8-hour	9 ppm	Not to be exceeded more than once per year
		1-hour	35 ppm	
Lead [73 FR 66964, Nov 12, 2008]	primary and secondary	Rolling 3 month average	0.15 µg/m ³ (1)	Not to be exceeded
Nitrogen Dioxide [75 FR 6474, Feb 9, 2010] [61 FR 52852, Oct 8, 1996]	primary	1-hour	100 ppb	98th percentile, averaged over 3 years
	primary and secondary	Annual	53 ppb (2)	Annual Mean
Ozone [73 FR 16436, Mar 27, 2008]	primary and secondary	8-hour	0.075 ppm (3)	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
Particle Pollution Dec 14, 2012	PM _{2.5}	primary	Annual	12 µg/m ³ annual mean, averaged over 3 years
		secondary	Annual	15 µg/m ³ annual mean, averaged over 3 years
		primary and secondary	24-hour	35 µg/m ³ 98th percentile, averaged over 3 years
	PM ₁₀	primary and secondary	24-hour	150 µg/m ³ Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide [75 FR 35520, Jun 22, 2010] [38 FR 25678, Sept 14, 1973]	primary	1-hour	75 ppb (4)	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
	secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year

NATIONAL AMBIENT AIR QUALITY STANDARDS (NAAQS)

Ambient Air Quality Standards						
Pollutant	Averaging Time	California Standards ¹		National Standards ²		
		Concentration ³	Method ⁴	Primary ^{3,5}	Secondary ^{3,6}	Method ⁷
Ozone (O ₃)	1 Hour	0.09 ppm (180 µg/m ³)	Ultraviolet Photometry	—	Same as Primary Standard	Ultraviolet Photometry
	8 Hour	0.070 ppm (137 µg/m ³)		0.075 ppm (147 µg/m ³)		
Respirable Particulate Matter (PM10) ⁸	24 Hour	50 µg/m ³	Gravimetric or Beta Attenuation	150 µg/m ³	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	20 µg/m ³		—		
Fine Particulate Matter (PM2.5) ⁸	24 Hour	—	—	35 µg/m ³	Same as Primary Standard	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	12 µg/m ³	Gravimetric or Beta Attenuation	12.0 µg/m ³	15 µg/m ³	

TYPES of DATA ANALYSIS

- Design Value (DV) Calculations
 - Clean Data Determinations
 - Finding of Attainment
 - Designations
 - Finding of Failure to Attain
 - State Implementation Plans (SIP)
- Trends Analysis
- Spatial Analysis



Federal Design Value Calculations: 2008 8-hour O₃

Level: ≤0.075 ppm

Form: 3-year average of the annual 4th highest daily max 8-hour concentration

Completeness Criteria:

- 3-year: 90% (*986 of 1095: 109 days*)
- Single year: 75% (*274 of 365: 91 days*)
- 8-hour average: 75% of hourly concentrations (*6 of 8: 2 hours*)

Rounding Convention:

- Hourly Concentrations: 3rd decimal place, truncated
- Running 8-hour average: 3rd decimal place, truncated
- 3-year average (DV): 3rd decimal place, truncated (e.g. 0.0797 = 0.079 ppm)

Attaining Design Value: 0.075 (0.0759) ppm

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
QUICK LOOK REPORT (AMP450)

Sep. 23, 2014

Ozone (44201)

California

Parts per million (007)

8-HOUR

SITE ID	P O C	PQAO	CITY	COUNTY	ADDRESS	YEAR	METH	%OBS	MEAS	REQ	VALID	NUM	1ST	2ND	3RD	4TH	DAY	CERT
											DAYS	DAYS	MAX	MAX	MAX	MAX	MAX >	STD
06-067-0012	1	0145	Folsom	Sacramento	50 NATOMA STREET, FOLSOM	2011	087	92	336	365	.098	.097	.096	.094	.094	33	Y	0
06-067-0012	1	0145	Folsom	Sacramento	50 NATOMA STREET, FOLSOM	2012	087	97	355	366	.105	.103	.099	.097	.097	31	0	
06-067-0012	1	0145	Folsom	Sacramento	50 NATOMA STREET, FOLSOM	2013	087	94	342	365	.087	.084	.083	.079	.079	6	0	

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
AIR QUALITY SYSTEM
PRELIMINARY DESIGN VALUE REPORT

Report Date: Sep. 23, 2014

Pollutant: Ozone(44201)
Standard Units: Parts per million(007)
NAAQS Standard: Ozone 8-Hour 2008

Statistic: Annual 4th Maximum Level: .075

Design Value Year: 2013

REPORT EXCLUDES MEASUREMENTS WITH REGIONALLY CONCURRED EVENT FLAGS.

Site ID	Poc	LOCAL SITE NAME	2013				2012				2011				State:	California
			Valid Days	Percent Complete	4th Max	Cert& Eval	Valid Days	Percent Complete	4th Max	Cert& Eval	Valid Days	Percent Complete	4th Max	Cert& Eval		
06-067-0012	1	Folsom-Natoma	342	94	.079		355	97	.097		336	92	.094	Y	94	.090

Note: The * indicates the site did not satisfy the completeness criteria.

- Notes:**
1. Computed design values are a snapshot of the data at the time the report was run (may not be all data for year).
 2. Some PM2.5 24-hour DVs for incomplete data that are marked invalid here may be marked valid in the Official report due to additional analysis.
 3. Annual Values not meeting completeness criteria are marked with an asterisk ('*').

Federal Design Value Calculations: 2006 24-hour PM_{2.5}

Level: ≤ 35 µg/m³

Form: 3-year average of the annual 24-hour 98th percentile

Completeness Criteria:

- 3-year: 75% every quarter
 - 1 in 1 (Q1: 68 of 90: *22 days*, Q2: 68 of 91, *23 days*, Q3 & Q4: 69 of 92, *23 days*)
 - 1 in 3 (Q1 & Q3: 23 of 30: *7 days*, Q2 & Q4: 24 of 31: *7 days*)
 - 1 in 6 (Q1, Q2, & Q3: 12 of 15: *3 days*, Q4: 12 of 16: *4 days*)
- 24-hour average: 75% of hourly concentrations (*18 of 24: 4 hours*)

Rounding Convention:

- Hourly concentrations: one decimal place, truncated
- 24-hour average: one decimal place, truncated (e.g. 45.87 = 45.8 µg/m³)
- 3-year average (DV): rounded to the nearest 1 µg/m³ (e.g. 35.7 = 36 µg/m³)

Attaining Design Value: 35 (35.4) µg/m³

Federal Design Value Calculations: 2012 Annual PM_{2.5}

Level: $\leq 12 \text{ } \mu\text{g}/\text{m}^3$

Form: 3-year average of the annual mean

Completeness Criteria:

- 3-year: 75% every quarter
 - 1 in 1 (Q1: 68 of 90: *22 days*, Q2: 68 of 91, *23 days*, Q3 & Q4: 69 of 92, *23 days*)
 - 1 in 3 (Q1 & Q3: 23 of 30: *7 days*, Q2 & Q4: 24 of 31: *7 days*)
 - 1 in 6 (Q1, Q2, & Q3: 12 of 15: *3 days*, Q4: 12 of 16: *4 days*)
- 24-hour average: 75% of hourly concentrations (*18 of 24: 4 hours*)

Rounding Convention:

- Hourly concentrations: one decimal place, truncated
- 24-hour average: one decimal place, truncated (e.g. $45.87 = 45.8 \text{ } \mu\text{g}/\text{m}^3$)
- Quarterly mean: do not round or truncate
- Annual mean: do not round or truncate
- 3-year average (DV): rounded to the nearest tenth of a $\mu\text{g}/\text{m}^3$ (e.g. $11.07 = 11.1 \text{ } \mu\text{g}/\text{m}^3$)

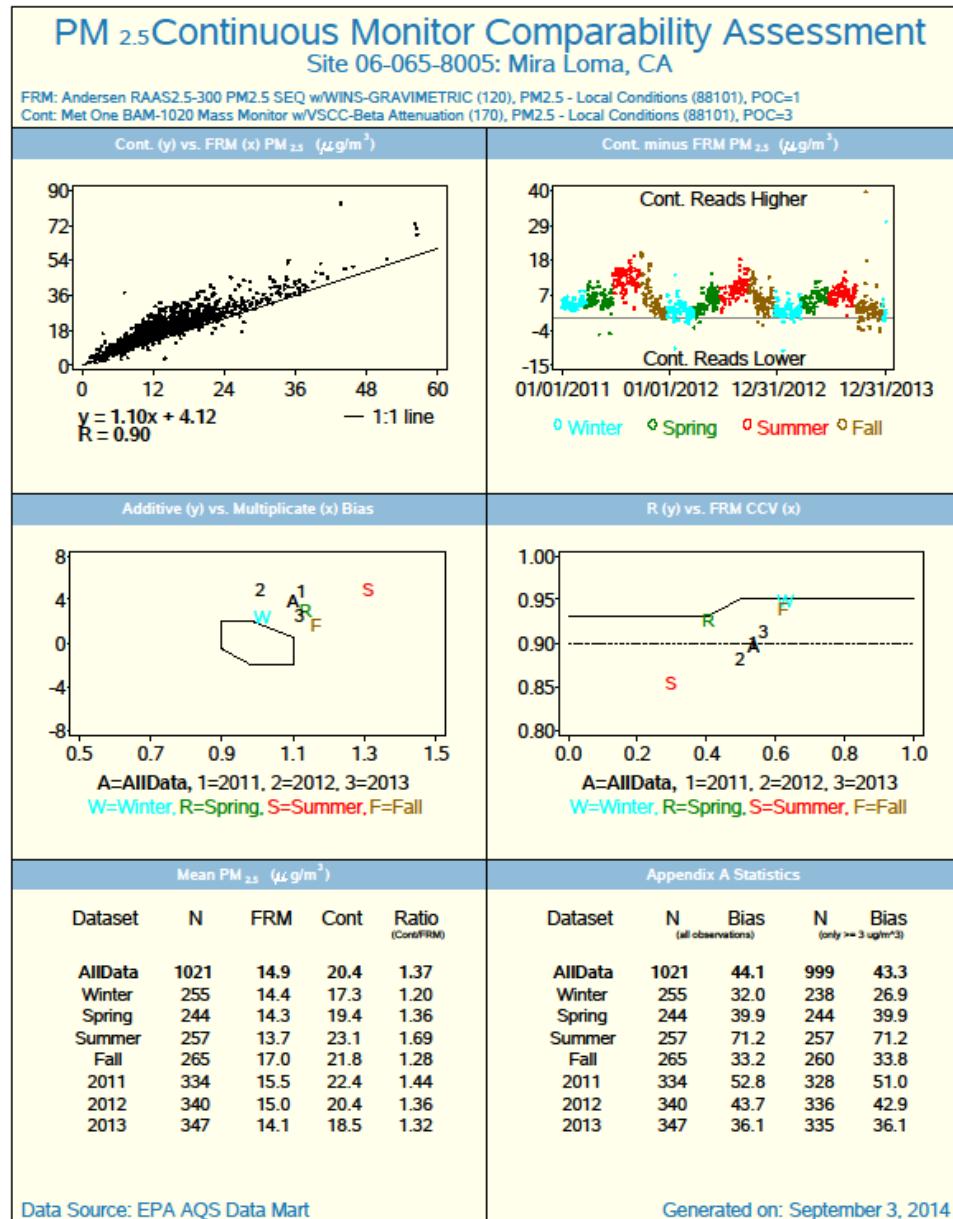
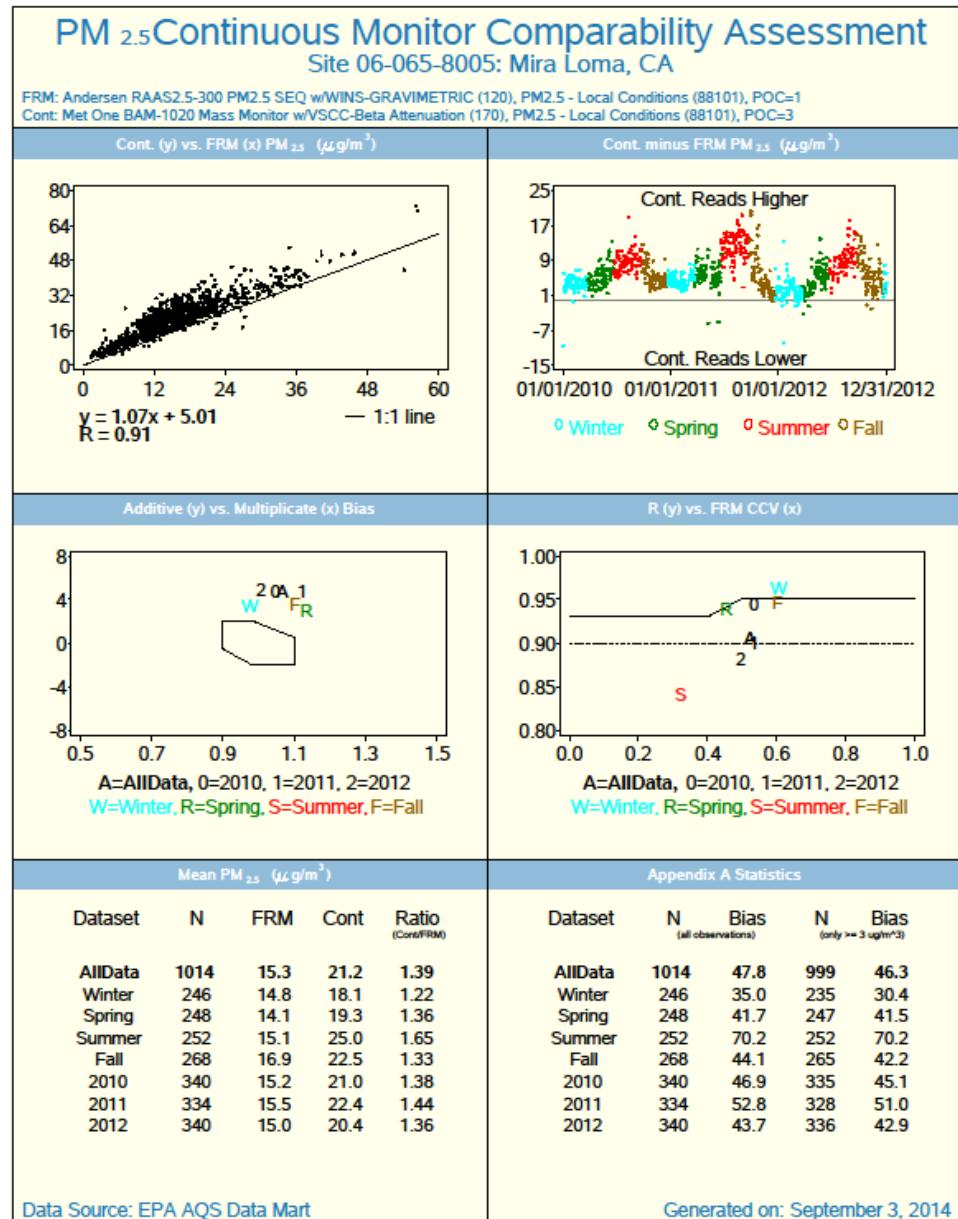
Attaining Design Value: 12.0 (12.04) $\mu\text{g}/\text{m}^3$

PM_{2.5} DESIGN VALUES: ADDITIONAL CONSIDERATIONS

- Calculating the 24-hour 98th percentile
 - Use Table 1 in 40 CFR 50 App. N – “look-up method”
 - **NOT** always the same as traditional calculation on 98th percentile!

Annual Number of Creditable Samples for Year y (cn_y)	The 98 th Percentile for the Year y ($P_{0.98, y}$), is the n^{th} Maximum 24-hour Average Value for the Year Where n is the Listed Number
1 - 50	1
51 - 100	2
101 - 150	3
151 - 200	4
201 - 250	5
251 - 300	6
301 - 350	7
351 - 366	8

PM_{2.5} DESIGN VALUES: FEM WAIVERS



DESIGN VALUE CALCULATION EXERCISE

Description:

Each table will receive either an **Ozone** or a **PM_{2.5}** data package w/ instructions on how to perform the required design value and completeness calculations.

The data package will include:

1. Calculation Instructions
2. Exercise A Dataset
3. Exercise B Dataset

Each exercise has a slightly different data set.

PM2.5 DESIGN VALUE EXERCISE - A												
QUESTIONS: What is the federal 24-hour PM2.5 design value and designation status, based on the dataset provided? Note that the area is currently nonattainment for the federal 24-hour PM2.5 standard.												
Steps for Completing Federal 24-Hour PM2.5 Design Value: 1. Check to see if data are at least 75 percent complete for each quarter of the year. 2. Determine how many creditable samples are available for the year. 3. Use the "Top-10" Table to determine the number of the 5th percentile concentration. 4. Calculate the federal 24-hour design value (the average of the 5th percentile concentrations for each of 3 years). 5. Round the 24-hour design value to the nearest integer (one microgram per cubic meter, µg/m ³). For example, 24.5 µg/m ³ rounds to 25 µg/m ³ . 6. Compare the 24-hour PM2.5 Standard (35 µg/m ³) not to be exceeded. The area is attainment for the federal PM2.5 standard if the design value is less than or equal to 35 µg/m ³ . The area is nonattainment for the federal 24-hour ozone standard if the design value is greater than 35 µg/m ³ .												
RELEVANT INFORMATION												
Top 10 2011 PM2.5 Concentrations												
Rank	Concentration (µg/m ³)	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Quarter 1	Quarter 2	
1	54.3	30 creditable samples	29 creditable samples	29 creditable samples	29 creditable samples	35.3	35.1	35.1	35.1	35.3	35.1	
2	41.8	29 creditable samples	29 creditable samples	29 creditable samples	29 creditable samples	27.1	27.1	27.1	27.1	27.1	27.1	
3	45.9	30 creditable samples	30 creditable samples	30 creditable samples	30 creditable samples	26.5	26.5	26.5	26.5	26.5	26.5	
4	35.2	29 creditable samples	29 creditable samples	29 creditable samples	29 creditable samples	23.1	23.1	23.1	23.1	23.1	23.1	
5	35.1	29 creditable samples	29 creditable samples	29 creditable samples	29 creditable samples	23.1	23.1	23.1	23.1	23.1	23.1	
6	31.4	29 creditable samples	29 creditable samples	29 creditable samples	29 creditable samples	23.1	23.1	23.1	23.1	23.1	23.1	
7	31.8	29 creditable samples	29 creditable samples	29 creditable samples	29 creditable samples	23.1	23.1	23.1	23.1	23.1	23.1	
8	27.5	29 creditable samples	29 creditable samples	29 creditable samples	29 creditable samples	22.2	22.2	22.2	22.2	22.2	22.2	
9	27.0	29 creditable samples	29 creditable samples	29 creditable samples	29 creditable samples	22.2	22.2	22.2	22.2	22.2	22.2	
10	24.7	29 creditable samples	29 creditable samples	29 creditable samples	29 creditable samples	20.4	20.4	20.4	20.4	20.4	20.4	
117 Creditable Samples 82 Non-Creditable Samples												
Top 10 2012 PM2.5 Concentrations												
Rank	Concentration (µg/m ³)	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Quarter 1	Quarter 2	Quarter 3	Quarter 4	Quarter 1	Quarter 2	
1	35.3	30 creditable samples	29 creditable samples	29 creditable samples	29 creditable samples	35.1	35.1	35.1	35.1	35.3	35.1	
2	35.1	29 creditable samples	29 creditable samples	29 creditable samples	29 creditable samples	27.1	27.1	27.1	27.1	27.1	27.1	
3	27.1	29 creditable samples	29 creditable samples	29 creditable samples	29 creditable samples	26.5	26.5	26.5	26.5	26.5	26.5	
4	26.5	30 creditable samples	30 creditable samples	30 creditable samples	30 creditable samples	23.1	23.1	23.1	23.1	23.1	23.1	
5	26.5	30 creditable samples	30 creditable samples	30 creditable samples	30 creditable samples	23.1	23.1	23.1	23.1	23.1	23.1	
6	23.1	30 creditable samples	30 creditable samples	30 creditable samples	30 creditable samples	23.1	23.1	23.1	23.1	23.1	23.1	
7	23.1	30 creditable samples	30 creditable samples	30 creditable samples	30 creditable samples	23.1	23.1	23.1	23.1	23.1	23.1	
8	22.2	30 creditable samples	30 creditable samples	30 creditable samples	30 creditable samples	22.2	22.2	22.2	22.2	22.2	22.2	
9	22.2	30 creditable samples	30 creditable samples	30 creditable samples	30 creditable samples	22.2	22.2	22.2	22.2	22.2	22.2	
10	20.4	30 creditable samples	30 creditable samples	30 creditable samples	30 creditable samples	20.4	20.4	20.4	20.4	20.4	20.4	
170 Creditable Samples 82 Non-Creditable Samples												
2011 - PM2.5 24 Hour Averages												
DAY	January	February	March	April	May	June	July	August	September	October	November	December
1	1.0	1.0	1.7	2.2	3.2	9.5	7.4	9.8	9.8	4.8		
2	1.0	1.0	1.0	2.8	5.9							
3	1.0	1.0	1.0	1.0	4.1	16.8	4.0					
4	1.0	1.0	1.0	1.0	5.0	0.4						
5	1.0	1.0	1.0	1.0	1.0							
6	1.0	1.0	1.0	1.0	1.0							
7	1.0	1.0	1.0	1.0	1.0							
8	1.0	1.0	1.0	1.0	1.0							
9	1.0	1.0	1.0	1.0	1.0							
10	1.0	1.0	1.0	1.0	1.0							
11	22.5	4.2				6.6	5.3	10.7		21.1	34.1	
12	5.4					6.0	6.0	9.2		8.5	7.1	
13	4.5					6.0	6.0	9.2		8.5	7.1	
14	6.2					6.0	6.0	6.0		8.5	11.6	19.9
15	27.5	5.3				8.8	3.3	6.9		23.9		
16	9.3	1.0				2.7	2.4	11.2	2.3	9.6	10.0	9.4
17	9.3	1.0				2.7	2.4	11.2	2.3	9.6	10.0	9.4
18	9.3	1.0				2.7	2.4	11.2	2.3	9.6	10.0	9.4
19	9.3	1.0				2.7	2.4	11.2	2.3	9.6	10.0	9.4
20	31.8	5.5	9.3	4.8	5.9					3.3		
21	31.8	5.5	9.3	4.8	5.9					3.3		
22	31.8	5.5	9.3	4.8	5.9					3.3		
23	6.6	3.6				9.4	7.2					
24	25.0	2.0	7.0	4.0	4.5							
25	5.6	6.3	4.8	11.2	6.9							
26	20.4	6.0	3.4	7.3	6.2							
27	11.4	2.0	5.5	10.3	5.9							
28	11.4	2.0	5.5	10.3	5.9							
29	11.4	2.0	5.5	10.3	5.9							
30	11.4	2.0	5.5	10.3	5.9							
31	11.4	2.0	5.5	10.3	5.9							

DESIGN VALUE CALCULATION EXERCISE

PM2.5 DESIGN VALUE EXERCISE - A

QUESTION: What is the federal 24-hour PM2.5 design value and designation status, based on the dataset provided?

Note that the area is currently nonattainment for the federal 24-hour PM2.5 standard

Steps for Developing Federal 24-Hour PM2.5 Design Value

- 1 Check to see if data are at least 75 percent complete for each quarter of the year
(in other words, 75% of the possible sampling days during each quarter must have creditable samples)
- 2 Determine how many creditable samples are available for the year
- 3 Use the Look-Up Table to determine the number of the 98th percentile concentration
(for example, if there are 237 samples for the year, the 98th percentile concentration is the 6th highest value)
- 4 Calculate the federal 24-hour design value (the average of the 98th percentile concentrations for each of 3 years)
- 5 Round the 3-year average design value to the nearest 1 microgram per cubic meter ($\mu\text{g}/\text{m}^3$; for example, $24.5 \mu\text{g}/\text{m}^3$ rounds to $25 \mu\text{g}/\text{m}^3$)
- 6 Compare the federal design value to the federal standard:

Federal 24-hour PM2.5 Standard = $35 \mu\text{g}/\text{m}^3$, not to be exceeded

The area is attainment for the federal PM2.5 standard if the design value is less than or equal to $35 \mu\text{g}/\text{m}^3$

The area is nonattainment for the federal 8-hour ozone standard if the design value is greater than $35 \mu\text{g}/\text{m}^3$

DESIGN VALUE INSTRUCTIONS

DESIGN VALUE CALCULATION EXERCISE

RELEVANT INFORMATION

Top 10 2011 PM 2.5 Concentrations	
Rank	Concentration ($\mu\text{g}/\text{m}^3$)
1	54.3
2	41.8
3	39.8
4	35.2
5	35.1
6	34.1
7	31.8
8	27.5
9	25.0
10	24.7

Quarter 1:
30 possible samples
29 creditable samples
Quarter 2:
30 possible samples
Quarter 3:
31 possible samples
31 creditable samples
Quarter 4:
30 possible samples
28 creditable samples

117 Creditable Samples
2 Non-Creditable Samples

Top 10 2012 PM 2.5 Concentrations	
Rank	Concentration ($\mu\text{g}/\text{m}^3$)
1	35.3
2	35.1
3	27.1
4	26.5
5	26.5
6	23.5
7	23.1
8	22.2
9	21.1
10	20.4

Quarter 1:
29 possible samples
29 creditable samples
Quarter 2:
30 possible samples
Quarter 3:
31 possible samples
30 creditable samples
Quarter 4:
30 possible samples
30 creditable samples

120 Creditable Samples
0 Non-Creditable Samples

Top 10 2013 PM 2.5 Concentrations	
Rank	Concentration ($\mu\text{g}/\text{m}^3$)
1	53.8
2	47.9
3	45.3
4	42.5
5	41.7
6	41.3
7	39.7
8	39.3
9	36.9
10	36.5

Quarter 1:
90 possible samples
87 creditable samples
Quarter 2:
91 possible samples
88 creditable samples
Quarter 3:
92 possible samples
91 creditable samples
Quarter 4:
92 possible samples
85 creditable samples

351 Creditable Samples
0 Non-Creditable Samples

Look-up Table for Determining 98th Percentile PM2.5 Value	
Number of Creditable Samples for Year	Rank Value of 98th Percentile Concentration
1 to 50	1
51 to 100	2
101 to 150	3
151 to 200	4
201 to 250	5
251 to 300	6
301 to 350	7
351 to 366	8

YEARLY DATA SUMMARY

DESIGN VALUE CALCULATION EXERCISE

2011 - PM2.5 24-Hour Averages

DAY	MONTH											
	January	February	March	April	May	June	July	August	September	October	November	December
1			17.2					7.4				
2		10.8				3.2	9.5				9.8	4.8
3	13.0			2.8	5.9				8.7	4.9		
4			7.8					4.0				
5		11.5				4.1	16.8				9.8	24.7
6	13.3			5.8	8.4				7.0	3.6		
7			1.0					5.7				
8		1.0				9.5	9.2				20.3	41.8
9	15.8			6.9	2.4				9.7	7.7		
10			4.2					10.7				
11		22.5				6.6	5.3				21.1	34.1
12			5.4						8.5	7.1		
13			4.5					9.2				
14		6.2				6.8	6.0				18.9	23.9
15	27.5			8.8	3.3				8.5	11.6		
16			5.3					6.9				
17		1.0				11.2	2.3				8.4	
18	9.3			2.7	2.4				9.0	10.0		
19			1.0					8.4				
20		9.3				4.8	5.9				3.3	
21	31.8			3.5	9.3				7.9	10.6		35.2
22			3.6					5.8				
23		6.6				9.4	7.2				19.8	
24	25.0			2.0	7.0				6.6	11.9		
25			4.0					4.5				
26		5.6				11.2	6.9				11.3	
27	20.4			6.3	4.8				6.2	16.0		35.1
28			6.0					6.3				39.8
29						3.4	7.3				16.8	54.3
30	11.4		3.0	2.3	5.5				5.9	19.3		
31			7.8					10.3				

RAW DATA

DESIGN VALUE CALCULATION EXERCISE

Goal:

Calculate the appropriate **Design Value** and **Completeness** for each exercise.

Ozone:

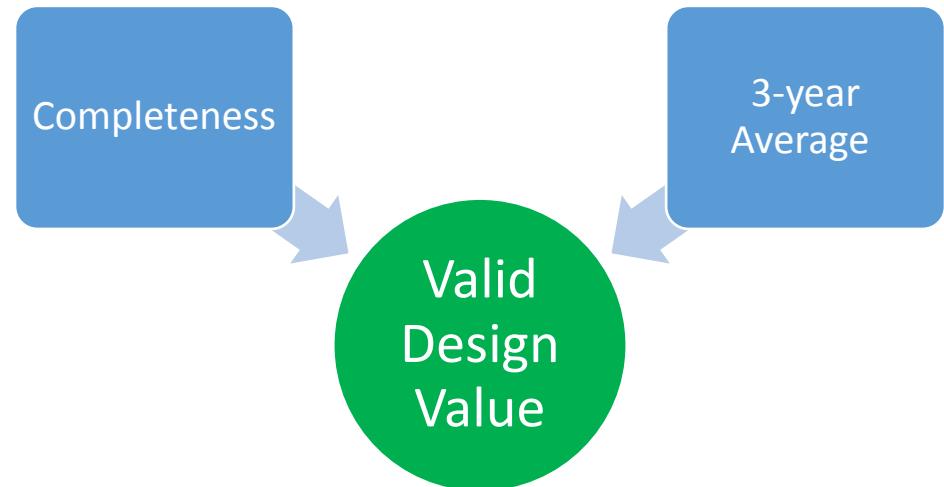
Calculate the completeness and design values for

- (1) 8-hour Federal NAAQS *and*
- (2) 8-hour State Standard

PM_{2.5}:

Calculate the completeness and design values for

- (1) 24-hour Federal NAAQS



EXERCISE ANSWERS: IMPLICATIONS OF MISSING DATA

PM_{2.5}

Ozone
(Federal)

Ozone
(State)

DESIGNATIONS

- 5-Factor Analysis

1. Air Quality Data

- Design Values
- Trends
- Speciation Data

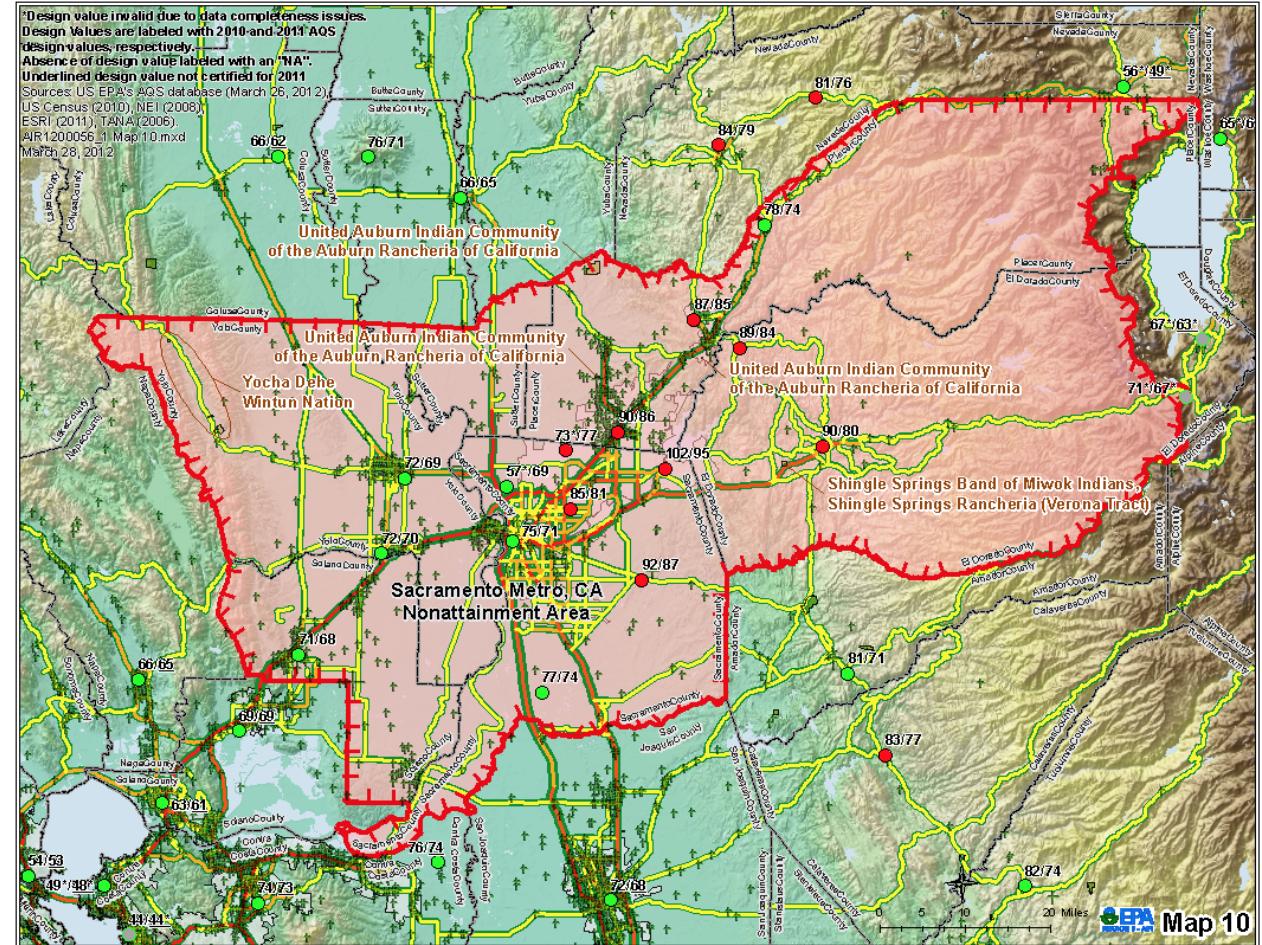
2. Emissions

- Point Sources
- Area Sources
- Population Density
- Degree of Urbanization
- Traffic & VMT

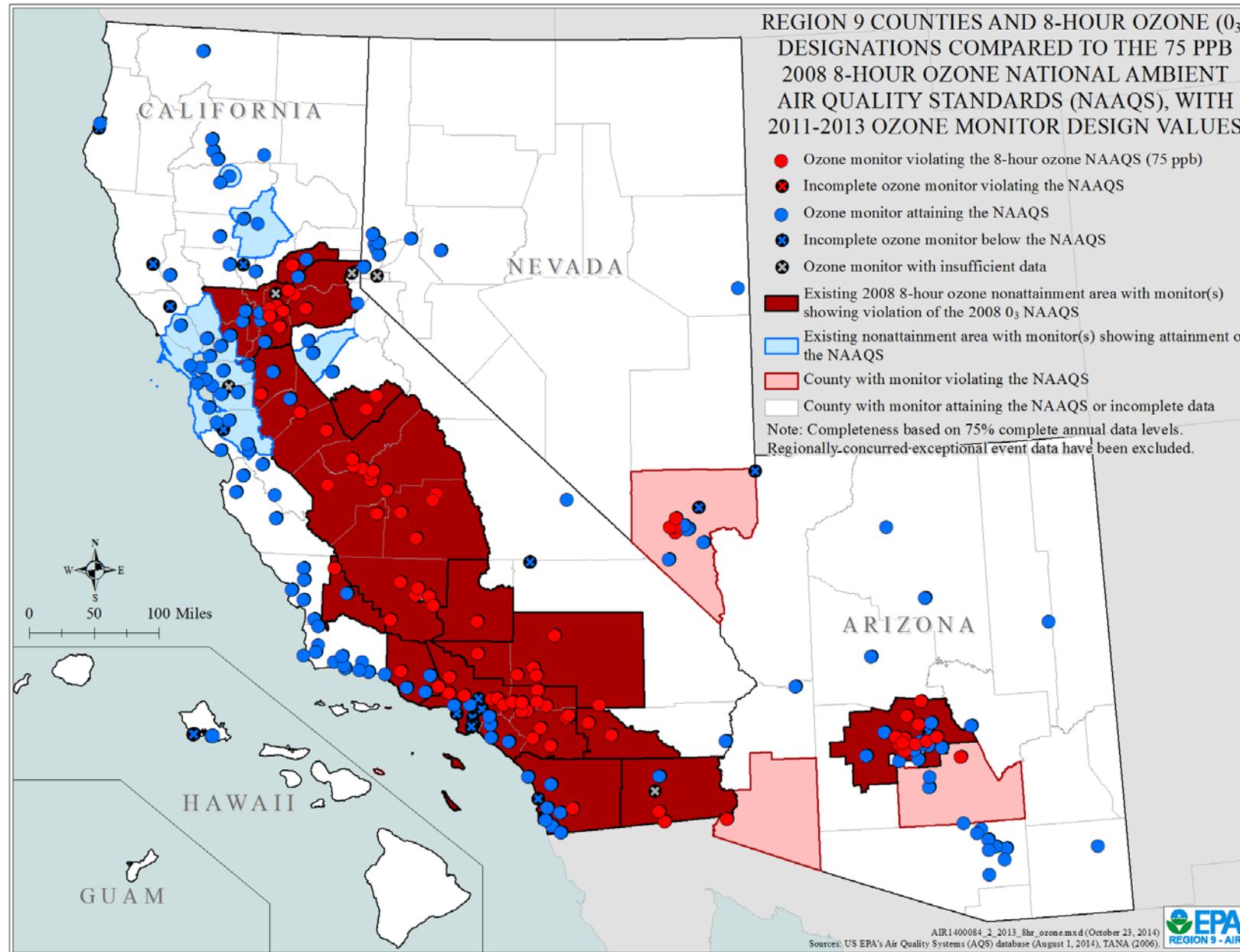
3. Meteorology

4. Geography & Topography

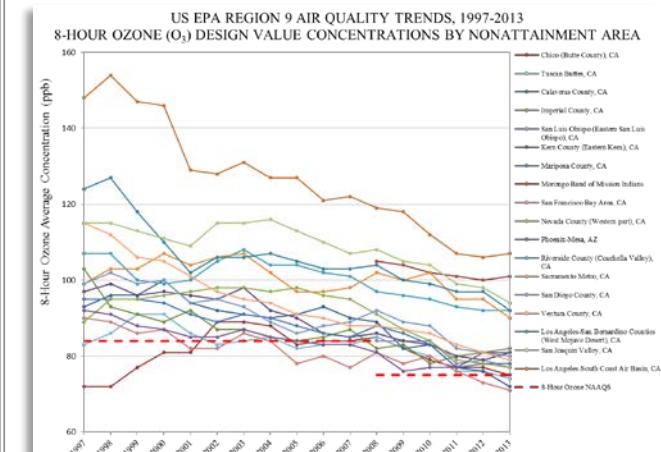
5. Jurisdiction



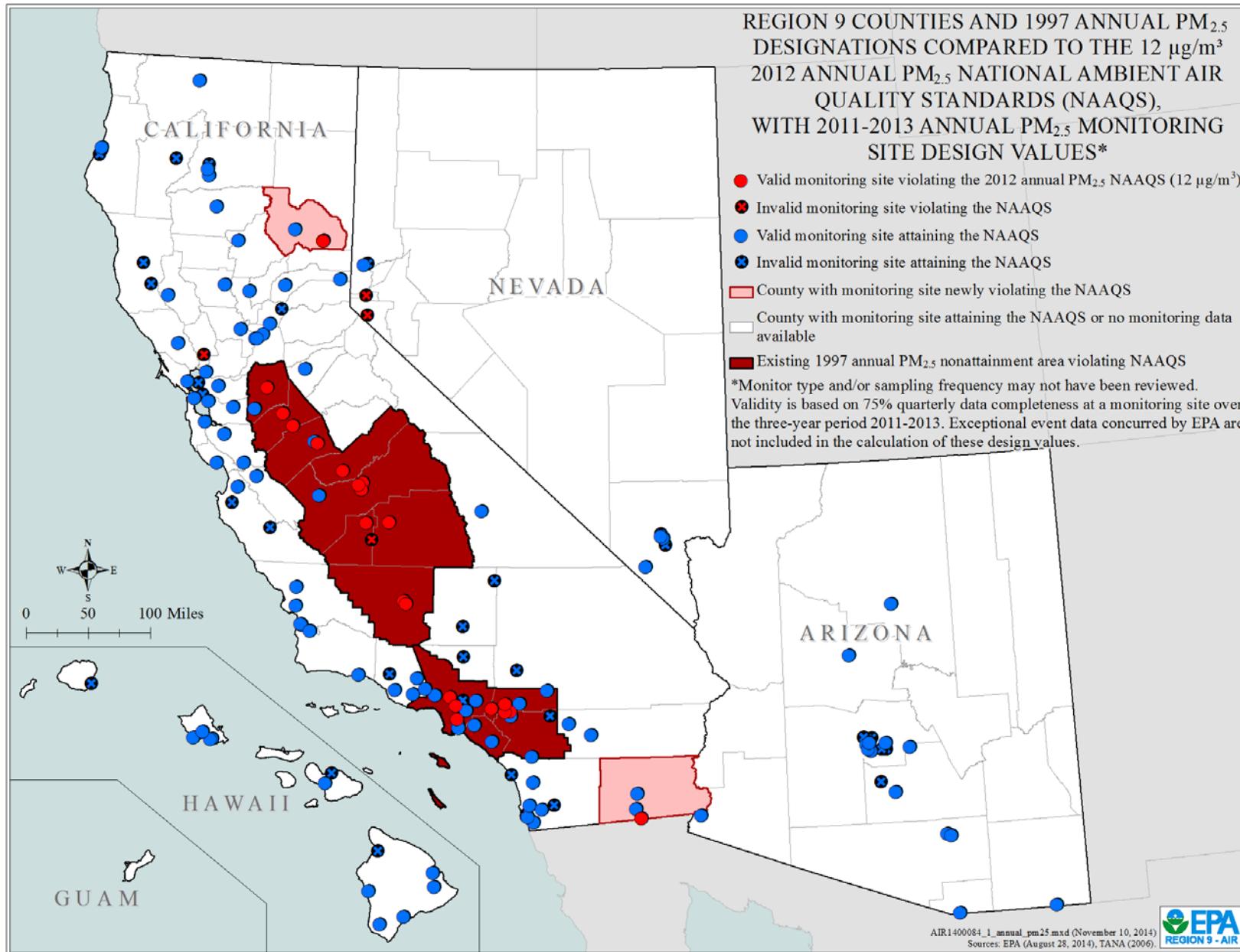
8-hour OZONE NONATTAINMENT AREAS



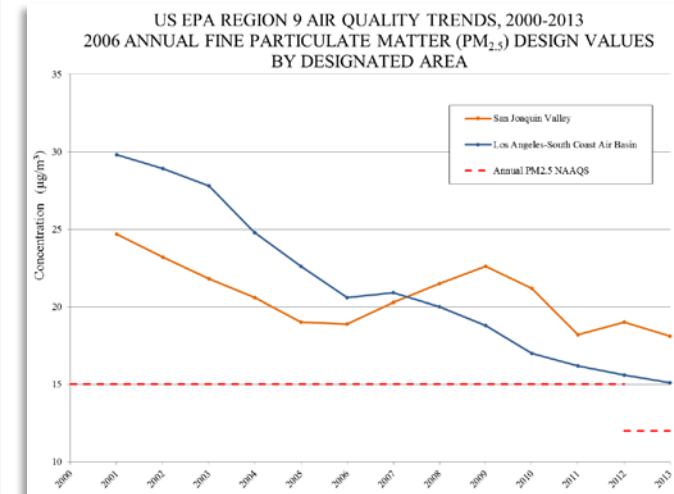
- 13 NAAs violating the NAAQS
- 3 counties violating the NAAQS
- 3 NAAs currently attaining the NAAQS



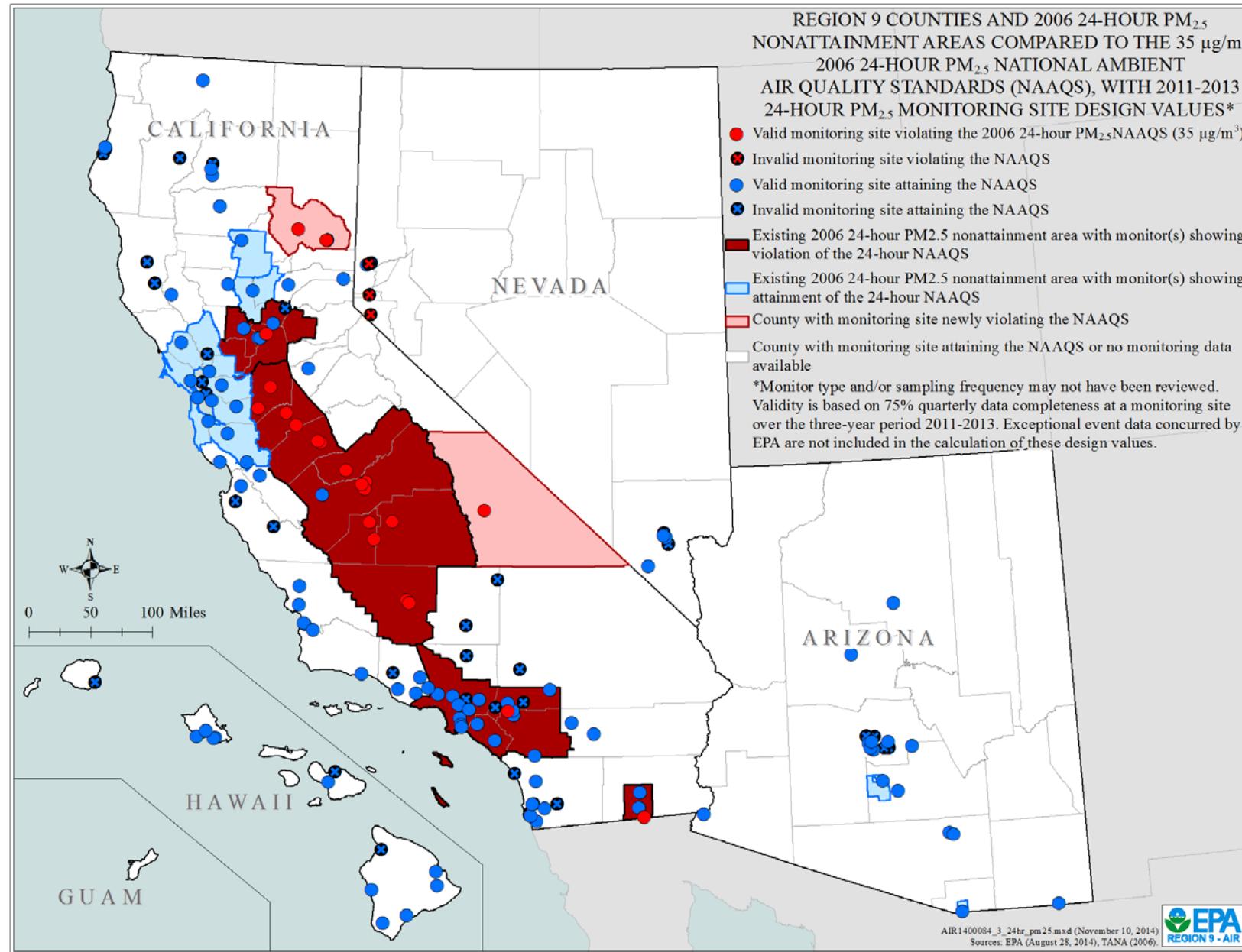
ANNUAL PM_{2.5} NONATTAINMENT AREAS



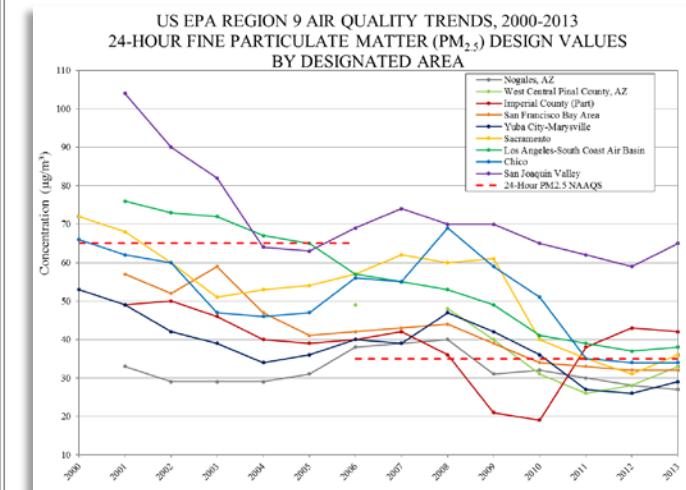
- 2 NAAs violating the NAAQS
- 2 counties violating the NAAQS



24-hour PM_{2.5} NONATTAINMENT AREAS



- 4 NAAs violating the NAAQS
- 2 counties violating the NAAQS
- 3 NAAs currently attaining the NAAQS



EPA REGULATORY ACTIONS

- EPA regulatory actions that require complete valid design values:
 - Clean Data Determination (CDD)
 - Finding of Attainment
 - Redesignation
 - State Implementation Plan (SIP) approval
- There are consequences if monitoring data is insufficient to determine whether an area is violating or attaining the NAAQS
 - Delay in implementation of emissions controls = delay in improvement in public health
 - Bump-up to higher classification (i.e. moderate to serious)
 - Federal highway sanctions

CLEAN AIR!!!

I ❤️
Clean Air

