Technical Assistance Document for the Reporting of Daily Air Quality – the Air Quality Index (AQI)

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This guidance is designed to aid local agencies in reporting air quality using the U.S. Air Quality Index as required in 40 CFR Part 58.50 and according to 40 CFR Appendix G to Part 58.

I. INTRODUCTION TO THE AQI

The AQI is EPA's tool for communicating air quality. The AQI is divided into six categories that correspond to different levels of health concern. For ease of use, the categories are color-coded and provide statements about local air quality, which groups of people may be affected, and steps people can take to reduce their exposure to air pollution. The AQI is also used as the basis for air quality forecasts and current air quality reporting.

EPA establishes an AQI for five major air pollutants regulated by the Clean Air Act. Each of these pollutants has a national ambient air quality standard (NAAQS) set by EPA to protect public health:

- ozone
- particle pollution (also called particulate matter)
- carbon monoxide
- nitrogen dioxide
- sulfur dioxide

The AQI for each pollutant draws on the scientific information that supports the health-based NAAQS for that pollutant. The AQI value of 100 generally corresponds to an ambient air concentration that equals the level of the short-term NAAQS for protection of public health. AQI values at or below 100 are generally thought of as satisfactory. When AQI values are above 100, air quality is unhealthy: at first for certain sensitive groups of people, then for everyone as AQI values get higher. The AQI does not apply to hazardous air pollutants, extreme heat, and other aspects of outdoor air.

II. REPORTING THE AQI

Who has to Report

Metropolitan Statistical Areas (MSAs) with a population of more than 350,000 are required to report the AQI daily to the public. The population of an MSA for purposes of index reporting is based on the latest available U.S. census population.

When to Report

MSAs must report the AQI daily, which is defined as seven days each week on days for which you have measured air quality data (e.g., from continuous $PM_{2.5}$ monitors). This definition allows for equipment failures and accommodates agencies using manual monitoring methods on a 1-in-6-day schedule.

Low AQI values

If the AQI values for all of the pollutants remain below 50 for a year, then you may report the AQI at your discretion. In subsequent years, if any pollutant level rises to where the AQI would be above 50, then you must report the AQI.

If a specific pollutant remains below 50 for an extended period of time (a season or a year), you may exclude that pollutant from your AQI calculation.

What to Report

Required Reporting

It takes a full 24 hours to obtain an AQI value (that's 24 hourly values for PM or the max 1-hour or 8-hour value in a 24-hour period for other pollutants), so you are in effect required to report yesterday's AQI, including the:

- reporting area
- reporting period
- main pollutant (the pollutant with the highest AQI value)
- AQI value
- category descriptor and color (if your report uses color) shown in Table 2
- sensitive groups for all pollutants with an AQI over 100, as shown in Table 4

Voluntary Reporting

To make AQI reporting more useful to the public, most agencies also choose to report some or all of the following:

- Forecasts of the daily and/or sub-daily AQI values
- Hourly concentrations used to compute the current AQI values based on the NowCast
- Health effects and cautionary statements
- Causes for unusual AQI values
- The AQI for sub-areas of the reporting area
- Pollutant concentrations
- The name and AQI for other pollutants, particularly those with an AQI greater than 100
- Statements that "blend" health effects and cautionary information for more than one pollutant, if there is more than one pollutant with an AQI greater than 100

Forecasting the AQI

AQI Forecasts are a prediction of the day's air quality using AQI colors and scale. Forecasts usually are issued by state, Tribal, and local air quality forecasters in the afternoon for the next day. An AQI forecast can help plan outdoor activities for the day. Much like a weather forecast lets people know whether to pack an umbrella, an air quality forecast lets people know when they may want to change their outdoor activities to reduce the amount of air pollution they breathe in. Many forecasters also provide a "forecast discussion," which lets people know when pollution is expected to be highest during the day – and if there are times when air quality is expected to be better.

Air quality action days program

The use of air quality action days or community action programs, which are usually based on AQI forecasts, is voluntary. However, action days and similar programs can help alert the public and encourage them to take protective actions to reduce their exposure. Air quality action days may be called by state or local air agencies when the AQI is expected to get into unhealthy ranges. Different

agencies call them at different levels, such as Orange or Red or sometimes Yellow. To learn more about air quality action days, go to https://www.airnow.gov/aqi/action-days/.

Real-time AQI reporting: the NowCast

Submitting hourly data in real-time to the EPA's AirNow (or future analogous) system is recommended, but not required, and assists the EPA in providing timely air quality information to the public for making health-protective decisions. Submitting hourly data for appropriate monitors (referenced in section 3.2 of 40 CFR Part 58 Appendix G) satisfies the daily AQI reporting requirement because the AirNow system makes daily and sub-daily AQI reports widely available through its website and other communication tools. AirNow uses the hourly concentrations to report current air quality based on the NowCast AQI. The NowCast uses an algorithm that relates hourly readings from air quality monitors to the AQI for ozone and particle pollution. The NowCast gives you the latest information on air quality where you are. Because air quality can change during the day, you can expect to see the NowCast AQI change. Even on days when the daily AQI forecast isn't good, there may be times during the day when air quality is OK for outdoor activity. Providing current conditions gives people the power to take action when necessary to reduce outdoor activities and exposure and protect their health. The NowCast methods for ozone and PM ($PM_{2.5}$ and PM_{10} use the same method) are described in section IV Calculating the AQI. Because the sub-indices for SO_2 and NO_2 are based on 1-hour averages, a NowCast is not needed for these pollutants.

Format for Reporting

AQI reports can take many forms – from television and radio news to apps, web pages, and social media. The purpose of the AQI is to inform people about their air quality so they can take steps to protect their health. This is especially important whenever the AQI exceeds 100. To reach the most people, try to deliver the AQI in as many ways as possible.

Definition of the AQI Colors

Table 1. Names and colors for the six AQI categories

For this AQI…	use this descriptor…	and this color
0 to 50	Good	Green
51 to 100	Moderate	Yellow
101 to 150	Unhealthy for Sensitive Groups	Orange
151 to 200	Unhealthy	Red
201 to 300	Very Unhealthy	Purple
301+	Hazardous	Maroon

The standard AQI colors are defined by the formulas RGB (red, green, blue) and CMYK (cyan, magenta, yellow, black) as shown in Table 2. RGB is traditionally used for screen colors, while CMYK is traditionally used for printing. The color models are based on a 0 - 255 scale (e.g., 50% is 126).

Table 2. Standard AQI color formulas

Standard AQI Color	R	G	B	C	M	Y	K
Green	0	228	0	40	0	100	0
Yellow	255	255	0	0	0	100	0
Orange	255	126	0	0	52	100	0
Red	255	0	0	0	100	100	0
Purple	143	63	151	5	58	0	41
Maroon	126	0	35	30	100	100	30

While the standard AQI colors listed in Table 2 are required, reporting entities may also use ColorVision Assist colors that enhance contrast to assist individuals with color vision deficiencies. South Coast Air Quality Management District's Air Quality Sensor Performance Evaluation Center and Air Quality Assessment Group led the development of these modified colors to provide better accessibility for those with color vision deficiencies. The changes were primarily made to the hues, keeping the essential colors associated with each AQI category and health impacts (green, yellow, orange, red, purple, maroon). The standard AQI color scale can be difficult to discern for those individuals who have challenges distinguishing certain colors, especially red and green colors.

Table 3. ColorVision Assist AQI color formulas

ColorVision Assist Color	R	G	B	C	M	Y	K
Green	158	255	145	38	0	43	0
Yellow	255	201	5	0	21	98	0
Orange	255	130	5	0	49	98	0
Red	240	34	0	0	86	100	6
Purple	137	9	151	9	94	0	41
Maroon	100	0	21	0	100	79	61

III. Health Information for AQI Pollutants

Health Effects

The information below describes the health effects that may be associated with each of the AQI pollutants. In general, the proportion of people affected and the likelihood of more severe effects increase as pollutant concentrations increase. More information can be found at https://www.epa.gov/criteria-air-pollutants.

Ozone

Depending on the level of exposure, ozone can:

- Cause coughing and sore or scratchy throat
- Make it more difficult to breathe deeply and vigorously and cause pain when taking a deep breath
- Inflame and damage the airways
- Make the lungs more susceptible to infection
- Aggravate lung diseases such as asthma, emphysema, and chronic bronchitis
- Increase the frequency of asthma attacks

Some of these effects have been found even in healthy people, but effects can be more serious in people with lung diseases such as asthma. They may lead to increased school absences, medication use, visits to doctors and emergency rooms, and hospital admissions. Some studies in locations with elevated concentrations also report associations of ozone with deaths from respiratory causes.

In addition to the health effects that can be experienced in response to short-term (i.e., 1-8 hours) ozone exposure (which is the focus of the AQI), long-term exposure to ozone is linked to aggravation of asthma and is likely to be one of many causes of asthma development.

Particle Pollution

The size of particles is directly linked to their potential for causing health problems. Particles less than 10 micrometers can be inhaled into the body, with smaller particles less than 2.5 micrometers posing the greatest problems because they can get deep into the lungs, and some may even get into the bloodstream.

Exposure to such particles can affect both lungs and heart. Numerous scientific studies have linked particle pollution exposure to a variety of health problems, such as:

- premature death in people with heart or lung disease
- heart attacks
- irregular heartbeat
- aggravated asthma
- decreased lung function
- increased respiratory symptoms, such as irritation of the airways, coughing or difficulty breathing.

In addition to the health effects that can be experienced in response to short-term (or daily) particle pollution exposure (which is the focus of the AQI), long-term exposure (exposures experienced over months and years) can lead to the development of cardiovascular and respiratory diseases, such as atherosclerosis and asthma, nervous system effects (e.g., cognitive effects), lung cancer, and premature death.

Carbon Monoxide (CO)

Breathing air with a high concentration of CO reduces the amount of oxygen that can be transported in the blood stream to critical organs like the heart and brain. At very high levels, which are possible indoors or in other enclosed environments, CO can cause dizziness, confusion, unconsciousness and death.

Very high levels of CO are not likely to occur outdoors. However, when CO levels are elevated outdoors, they can be of particular concern for people with some types of heart disease. These people already have a reduced ability for getting oxygenated blood to their hearts in situations where the heart needs more oxygen than usual. They are especially vulnerable to the effects of CO when exercising or under increased stress. In these situations, short-term exposure to elevated CO may result in reduced oxygen to the heart accompanied by chest pain also known as angina.

Nitrogen Dioxide (NO_2)

Breathing air with a high concentration of NO_2 can irritate airways in the human respiratory system. Such exposures over short periods (i.e., 1-5 hours) can aggravate respiratory diseases, particularly asthma, leading to respiratory symptoms (such as coughing, wheezing or difficulty breathing), hospital admissions and visits to emergency rooms.

In addition to the health effects that can be experienced in response to short-term NO_2 exposures (which is the focus of the AQI), long-term (exposures experienced over months and years) exposure to elevated concentrations of NO_2 may contribute to the development of asthma and potentially increase susceptibility to respiratory infections.

Sulfur Dioxide (SO_2)

Short-term exposures (i.e., 1-6 hours) to SO_2 are linked with respiratory effects including difficulty breathing and increased asthma symptoms. These effects are particularly problematic for people with asthma while breathing deeply such as when exercising or playing. Short-term exposures to SO_2 have also been connected to increased emergency department visits and hospital admissions for respiratory illnesses, particularly for at-risk populations including children, older adults, and those with asthma.

Sensitive Groups

The sensitive groups for each pollutant are listed in Table 4.

Table 4. Pollutant-specific Sensitive Groups

When this pollutant has an AQI above 100…[1]	Report these Sensitive Groups
Ozone	People with lung disease, such as asthma; children, including teenagers; people who are active outdoors; and older adults.
Fine particle pollution[2] ($PM_{2.5}$) and particle pollution (PM_{10})	People with heart or lung disease; older adults; and children, including teenagers. In addition, some minority groups, people with lower incomes, and outdoor workers may experience higher exposure that can worsen underlying health conditions.
Carbon monoxide (CO)	People with heart disease.
Nitrogen dioxide (NO_2)	People with lung disease, such as asthma; children, including teenagers; and older adults.
Sulfur dioxide (SO_2)	People with asthma; children, including teenagers; and older adults.

[1] Cautionary statements may be combined, for all AQI pollutants above 100, so that each sensitive group is mentioned only once.

[2] During a smoke event, EPA recommends including pregnant people as an at-risk group as noted in the At-Risk Groups of People Wildfire Smoke Factsheet found here https://www.airnow.gov/publications/wildfire-guide-factsheets/at-risk-groups-of-people-fact-sheet/.

Cautionary Statements

Table 5 (see next page) lists cautionary statements for each pollutant by AQI category. Use these statements when showing current air quality or for the AQI forecast. Please note Table 5 spans several pages.

Table 5. Pollutant-Specific Sub-indices and Cautionary Statements

AQI Categories (Index Values)	Ozone		Particulate Matter		Carbon Monoxide (8-hr)	Nitrogen Dioxide (1-hr)	Sulfur Dioxide (1-hr)
	(8-hr)	(1-hr)	$PM_{2.5}$ (24-hr)	PM_{10} (24-hr)			
Good (0-50)	It's a great day to be active outside.		It's a great day to be active outside.		It's a great day to be active outside.	It's a great day to be active outside.	It's a great day to be active outside.
Moderate (51-100)	**Unusually sensitive people:** Consider making outdoor activities shorter and less intense. Watch for symptoms such as coughing or shortness of breath. These are signs to take it easier.		**Unusually sensitive people:** Consider making outdoor activities shorter and less intense. Go inside if you have symptoms such as coughing or shortness of breath.		It's a great day to be active outside.	**Unusually sensitive people:** Consider limiting prolonged exertion especially near busy roads.	It's a great day to be active outside.

AQI Categories (Index Values)	Ozone		Particulate Matter		Carbon Monoxide (8-hr)	Nitrogen Dioxide (1-hr)	Sulfur Dioxide (1-hr)
	(8-hr)	(1-hr)	$PM_{2.5}$ (24-hr)	PM_{10} (24-hr)			
Unhealthy for Sensitive Groups (101-150)	**Sensitive groups:** Make outdoor activities shorter and less intense. Take more breaks. Watch for symptoms such as coughing or shortness of breath. Plan outdoor activities in the morning when ozone is lower. **People with asthma:** Follow your asthma action plan and keep quick-relief medicine handy.		**Sensitive groups:** Make outdoor activities shorter and less intense. It's OK to be active outdoors but take more breaks. Watch for symptoms such as coughing or shortness of breath. **People with asthma:** Follow your asthma action plan and keep quick relief medicine handy. **People with heart disease:** Symptoms such as palpitations, shortness of breath, or unusual fatigue may indicate a serious problem. If you have any of these, contact your health care provider.		**Sensitive group:** Limit heavy exertion outdoors and avoid sources of CO, such as heavy traffic.	**Sensitive groups:** Limit prolonged exertion outdoors, especially near busy roads. **People with asthma:** Follow your asthma action plan and keep quick relief medicine handy.	**Sensitive groups:** Consider limiting outdoor exertion. **People with asthma:** Follow your asthma action plan and keep quick relief medicine handy.

AQI Categories (Index Values)	Ozone		Particulate Matter		Carbon Monoxide (8-hr)	Nitrogen Dioxide (1-hr)	Sulfur Dioxide (1-hr)
	(8-hr)	(1-hr)	$PM_{2.5}$ (24-hr)	PM_{10} (24-hr)			
Unhealthy (151-200)	**Sensitive groups:** Do not do long or intense outdoor activities. Schedule outdoor activities in the morning when ozone is lower. Consider moving activities indoors. **People with asthma:** Follow your asthma action plan and keep quick-relief medicine handy. **Everyone else:** Reduce long or intense outdoor activity. Take more breaks, do less intense activities. Schedule outdoor activities in the morning when ozone is lower.		**Sensitive groups:** Consider rescheduling or moving all activities inside. Go inside if you have symptoms. **People with asthma:** Follow your asthma action plan and keep quick-relief medicine handy. **People with heart disease:** Symptoms such as palpitations, shortness of breath, or unusual fatigue may indicate a serious problem. If you have any of these, contact your health care provider. **Everyone else:** Keep outdoor activities shorter and less intense. Go inside if you have symptoms.		**Sensitive group:** Limit moderate outdoor exertion and avoid sources of CO, such as heavy traffic.	**Sensitive groups:** Avoid prolonged outdoor exertion near roadways. **People with asthma:** Follow your asthma action plan and keep quick relief medicine handy. **Everyone else:** Limit prolonged outdoor exertion especially near busy roads.	**Sensitive groups:** Limit outdoor exertion. **People with asthma:** Follow your asthma action plan and keep quick relief medicine handy.

AQI Categories (Index Values)	Ozone		Particulate Matter		Carbon Monoxide (8-hr)	Nitrogen Dioxide (1-hr)	Sulfur Dioxide (1-hr)
	(8-hr)	(1-hr)	$PM_{2.5}$ (24-hr)	PM_{10} (24-hr)			
Very Unhealthy (201-300)	**Sensitive groups:** Avoid all physical activity outdoors. Move activities indoors* or reschedule to when air quality will be better. **People with asthma:** Follow your asthma action plan and keep quick-relief medicine handy. **Everyone else:** Avoid long or intense outdoor exertion. Schedule outdoor activities in the morning when ozone is lower. Consider moving activities indoors.*		**Sensitive groups:** Avoid all physical activity outdoors. Reschedule to a time when air quality is better or move activities indoors.* **People with asthma:** Follow your asthma action plan and keep quick-relief medicine handy. **People with heart disease:** Symptoms such as palpitations, shortness of breath, or unusual fatigue may indicate a serious problem. If you have any of these, contact your health care provider. **Everyone else:** Limit outdoor physical activity. Go indoors* if you have symptoms.		**Sensitive group:** Avoid outdoor exertion and sources of CO, such as heavy traffic.	**Sensitive groups:** Avoid all outdoor exertion. **Everyone else:** Avoid prolonged outdoor exertion especially near busy roads. **People with asthma:** Follow your asthma action plan and keep quick relief medicine handy.	**Sensitive groups:** Avoid outdoor exertion. **Everyone else:** Reduce outdoor exertion. **People with asthma:** Follow your asthma action plan and keep quick relief medicine handy.

AQI Categories (Index Values)	Ozone		Particulate Matter		Carbon Monoxide (8-hr)	Nitrogen Dioxide (1-hr)	Sulfur Dioxide (1-hr)
	(8-hr)	(1-hr)	$PM_{2.5}$ (24-hr)	PM_{10} (24-hr)			
Hazardous (≥ 301)	**Everyone:** Avoid all physical activity outdoors.* **People with asthma:** Follow your asthma action plan and keep quick-relief medicine handy.		**Sensitive groups:** Stay indoors and keep activity levels light. Follow tips for keeping particle levels low indoors.* **People with asthma:** Follow your asthma action plan and keep quick-relief medicine handy. **People with heart disease:** Symptoms such as palpitations, shortness of breath, or unusual fatigue may indicate a serious problem. If you have any of these, contact your health care provider. **Everyone:** Avoid all physical activity outdoors.*		**Sensitive group:** Avoid outdoor exertion and sources of CO, such as heavy traffic. **Everyone else:** Limit heavy outdoor exertion.	**Sensitive groups:** Remain indoors.* **Everyone else:** Avoid all outdoor exertion. **People with asthma:** Follow your asthma action plan and keep quick relief medicine handy.	**Sensitive groups:** Remain indoors.* **Everyone else:** Avoid outdoor exertion. **People with asthma:** Follow your asthma action plan and keep quick relief medicine handy.

***Note:** If you don't have an air conditioner, staying indoors with the windows closed may be dangerous in extremely hot weather. If you are hot, go someplace with air conditioning or check with your local government to find out if cooling centers are available in your community.

IV. CALCULATING THE AQI

Calculating the AQI from pollutant concentration data

The AQI is the highest value calculated for each pollutant as follows:

1. Identify the highest concentration among all of the monitors within each reporting area and truncate as follows:

    Ozone (ppm) – truncate to 3 decimal places

    $PM_{2.5}$ ($\mu g/m^3$) – truncate to 1 decimal place

    PM_{10} ($\mu g/m^3$) – truncate to integer

    CO (ppm) – truncate to 1 decimal place

    SO_2 (ppb) – truncate to integer

    NO_2 (ppb) – truncate to integer

2. Using Table 6 (next page), find the two breakpoints that contain the concentration.

3. Using Equation 1, calculate the index.

4. Round the index to the nearest integer.

Equation 1:

$$I_p = \frac{I_{Hi} - I_{Lo}}{BP_{HI} - BP_{Lo}}(C_p - BP_{Lo}) + I_{Lo}.$$

Where I_p = the index for pollutant p

C_p = the truncated concentration of pollutant p

BP_{Hi} = the concentration breakpoint that is greater than or equal to C_p

BP_{Lo} = the concentration breakpoint that is less than or equal to C_p

I_{Hi} = the AQI value corresponding to BP_{Hi}

I_{Lo} = the AQI value corresponding to BP_{Lo}

Table 6. Breakpoints for the AQI

These Breakpoints...							**...equal this AQI**	**…and this category**
O_3 (ppm) 8-hour	O_3 (ppm) 1-hour[1]	$PM_{2.5}$ (µg/m^3) 24-hour	PM_{10} (µg/m^3) 24-hour	CO (ppm) 8-hour	SO_2 (ppb) 1-hour	NO_2 (ppb) 1-hour	AQI	
0.000 - 0.054	-	0.0 – 9.0	0 - 54	0.0 - 4.4	0 - 35	0 - 53	0 - 50	Good
0.055 - 0.070	-	9.1 – 35.4	55 - 154	4.5 - 9.4	36 - 75	54 - 100	51 - 100	Moderate
0.071 - 0.085	0.125 - 0.164	35.5 – 55.4	155 - 254	9.5 - 12.4	76 - 185	101 - 360	101 - 150	Unhealthy for Sensitive Groups
0.086 - 0.105	0.165 - 0.204	(55.5 - 125.4)[3]	255 - 354	12.5 - 15.4	[3] 186 - 304	361 - 649	151 - 200	Unhealthy
0.106 - 0.200	0.205 - 0.404	(125.5 - (225.4)[3]	355 - 424	15.5 - 30.4	[3] 305 - 604)	650 - 1249	201 - 300	Very unhealthy
0.201-([2])	0.405+	225.5+	425+	30.5+	[3] 605+	1250+	301+	Hazardous [4]

[1] Areas are generally required to report the AQI based on 8-hour O_3 values. However, there are a small number of areas where an AQI based on 1-hour O_3 values would be more precautionary. In these cases, in addition to calculating the 8-hour O_3 index value, the 1-hour O_3 value may be calculated, and the maximum of the two values reported.

[2] 8-hour O_3 values do not define higher AQI values (≥ 301). AQI values of 301 or higher are calculated with 1-hour O_3 concentrations.

[3] 1-hr SO_2 concentrations do not define higher AQI values (≥200). AQI values of 200 or greater are calculated with 24-hour SO_2 concentration.

[4] AQI values between breakpoints are calculated using equation 1 to this appendix. For AQI values in the hazardous category, AQI values greater than 500 should be calculated using equation 1 and the concentration specified for the AQI value of 500. The AQI value of 500 are as follows: O_3 1-hour—0.604 ppm; $PM_{2.5}$ 24-hour—325.4 µg/m^3; PM10 24-hour—604 µg/m^3; CO ppm—50.4 ppm; SO_2 1-hour—1004 ppb; and NO_2 1-hour—2049 ppb.

Using the table and the equation and concentration data to calculate the AQI

Suppose you have an 8-hour O_3 value of 0.07853333. First, truncate the value to 0.078. Then refer to the 8-hour O_3 in table 5 for the values that fall above and below your value (0.071-0.085). In this case, the 0.078 value falls within the index values of 101 to 150. Now you have all the numbers needed to use equation 1.

$$\frac{150-101}{0.085-0.071}(0.78-0.071)+101=\frac{49}{0.14}(0.007)+101=125.5=126$$

An 8-hour O_3 value of 0.07853333 corresponds to an index value of 126.

How to handle values from multiple pollutants

Suppose you have an 8-hour O_3 value of 0.078 ppm, a $PM_{2.5}$ value of 35.9 µg/m^3, and a CO value of 8.4 ppm. You apply the equation 3-times:

$$O_3: \frac{150-101}{0.085-0.071}(0.78-0.071)+101=126$$

$$PM_{2.5}: \frac{150-101}{55.4-35.5}(35.9-35.5)+101=102$$

$$CO: \frac{100-51}{9.4-4.5}(8.4-4.5)+51=90$$

The AQI is 126, with O_3 as the main pollutant.

Using both O_3 1-hour and 8-hour values

You must calculate the 8-hour values, and you may also calculate the 1-hour values. If you calculate both, you must report the higher AQI value.

Suppose you had a 1-hour value of 0.162 ppm and an 8-hour value of 0.078 ppm. Then you apply the equation twice:

$$1-hour: \frac{150-101}{0.164-0.125}(0.162-0.125)+101=148$$

$$8-hour: \frac{150-101}{0.085-0.071}(0.078-0.071)+101=126$$

In this case, the index is 148 (the maximum of 148 and 126) and the main pollutant is O_3.

Calculating AQI values for SO_2

EPA strengthened the primary standard for SO_2 in 2010. Because there was not enough health information to inform changing the upper end of the AQI for SO_2, the upper end continues to use the 24-hour average SO_2 concentration. The lower end of the AQI uses the daily max 1-hour SO_2 concentration.

If you have a daily max 1-hour SO_2 concentration below 305 ppb, then use the breakpoints in Table 6 to calculate the AQI value.

If you have a 24-hour average SO_2 concentration greater than or equal to 305 ppb, then use the breakpoints in Table 6 to calculate the AQI value. If you have a 24-hour value in this range, it will always result in a higher AQI value than a 1-hour value would.

On rare occasions, you could have a day where the daily max 1-hour concentration is at or above 305 ppb but when you try to use the 24-hour average to calculate the AQI value, you find that the 24-hour concentration is not above 305 ppb. If this happens, use 200 for the lower and upper AQI breakpoints (I_{Lo} and I_{Hi}) in Equation 1 to calculate the AQI value based on the daily max 1-hour value. This effectively fixes the AQI value at 200 exactly, which ensures that you get the highest possible AQI value associated with your 1-hour concentration on such days.

How to handle concentrations for pollutants that have blank places in the table for Breakpoints for the AQI

Disregard numbers that have blank places in the table 6: Breakpoints for the AQI. Suppose you had a 1-hour O_3 value of 0.104 ppm and an 8-hour O_3 value of 0.078 ppm. First you disregard the 1-hour O_3 value because it is less than 0.125ppm. Then you calculate the index for the 8-hour O_3 value as before:

$$\frac{150 - 101}{0.085 - 0.071}(0.078 - 0.071) + 101 = 126$$

How the NowCast is calculated

EPA updated the NowCast method for $PM_{2.5}$ on August 1, 2013, and for PM_{10} on December 9, 2014. The same method is used for both $PM_{2.5}$ and PM_{10}. It was designed to be more responsive than the previous method in rapidly changing air quality conditions, such as those we see during fire events. The PM NowCast is an average of the previous 12 hours. When air quality is stable, the hours are weighted more evenly (approaching a 12-hour average). When air quality is variable, the most recent hours are weighted more (approaching a 3-hour average). To calculate the PM NowCast, use the past 12 hours of PM measurements in micrograms per cubic meter (µg/m³):

1. Select the minimum and maximum PM measurements.
2. Subtract the minimum measurement from the maximum measurement to get the range.
3. Divide the range by the maximum measurement in the 12-hour period to get the scaled rate of change.
4. Subtract the scaled rate of change from 1 to get the weight factor. The weight factor must be between 0.5 and 1. The minimum limit approximates a 3-hour average.
5. If the weight factor is less than 0.5, then set it equal to 0.5.
6. Multiply each hourly measurement by the weight factor raised to the power of the number of hours ago the value was measured (for the current hour, the factor is raised to the zero power).
7. Compute the NowCast by summing the products from Step 6 and dividing by the sum of the weight factor raised to the power of the number of hours ago each value was measured.

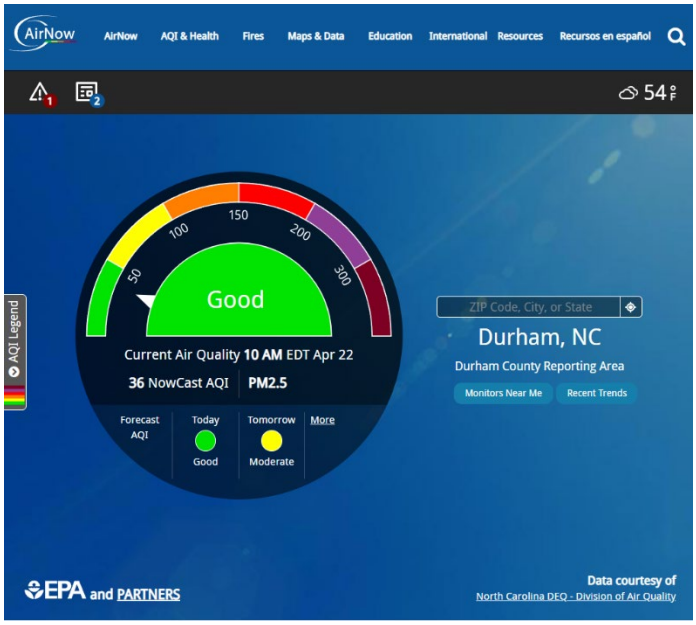
8. Convert this value to an AQI. A “concentration to AQI” converter is available at https://airnow.gov/aqi/aqi-calculator-concentration.

Missing data: 2 of the last 3 hours of data must be valid for a NowCast calculation.

EPA implemented the latest NowCast method for ozone on August 1, 2019. The ozone NowCast method is based on the relationship of 1-hour and 8-hour data over the most recent two-week rolling window. It is designed to rise and fall with the 1-hour concentration and still be representative of an 8-hour average. A paper describing the method and accompanying R code is available at https://github.com/USEPA/O3-NowCast/tree/master.

V. Accessing AQI Data

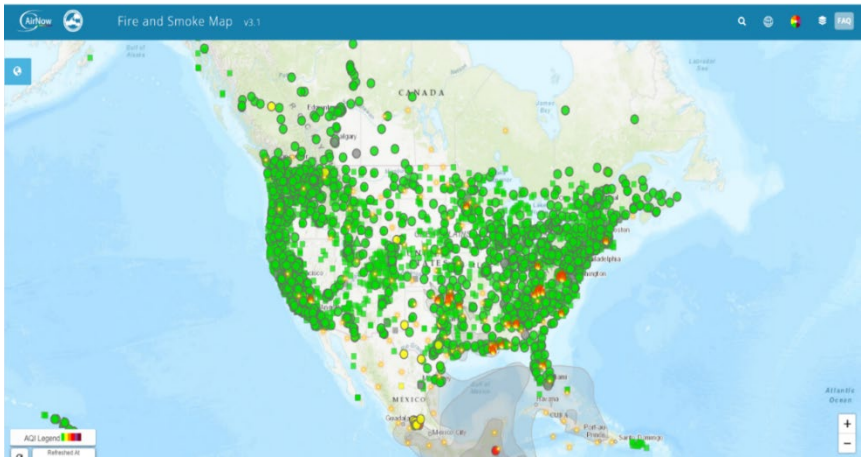
AirNow Website



AirNow.gov is the one-stop source for air quality data. The website highlights air quality at the local level first, while also providing air quality information at the state, national, and world level. The AirNow Dial allows users to quickly see what their current air quality profile is where they live—or anywhere they want to check. It is available immediately on the AirNow home page. There are also menu items to help find more information and resources about air quality, health, and much more.

https://www.airnow.gov/

AirNow Fire and Smoke Map

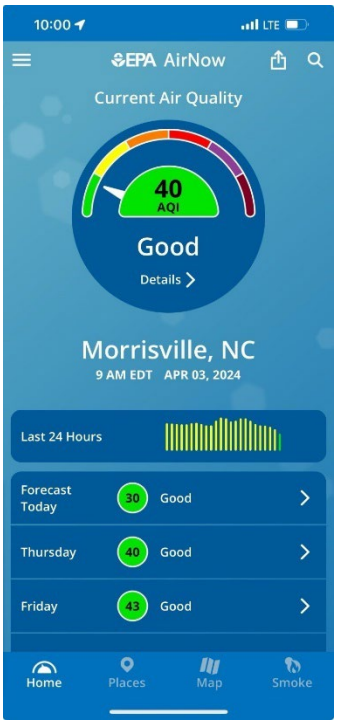


The Fire and Smoke Map, a joint project between the U.S. Forest Service and the EPA, is AirNow's mapping tool specifically for fires and the smoke they bring. The Fire and Smoke Map displays information on ground level air quality monitors recording fine particulates ($PM_{2.5}$) from smoke and other sources using both federal monitors and thousands of sensors, giving most users the nearest readings possible and recommendations on how to protect their health. It also includes information on fire locations, smoke plumes, and special announcements related to fires from the USFS.

https://fire.airnow.gov/

AirNow Mobile App (Android and iOS)

EPA's AirNow mobile app provides a simple interface for quickly checking current and forecast air quality information for planning daily activities and learning how to protect health. The app automatically displays the current AQI for the local area and allows the ability to store multiple areas for quick reference. The app also includes the AirNow interactive map and the AirNow Fire and Smoke map.



iOS

https://apps.apple.com/us/app/epa-airnow/id467653238

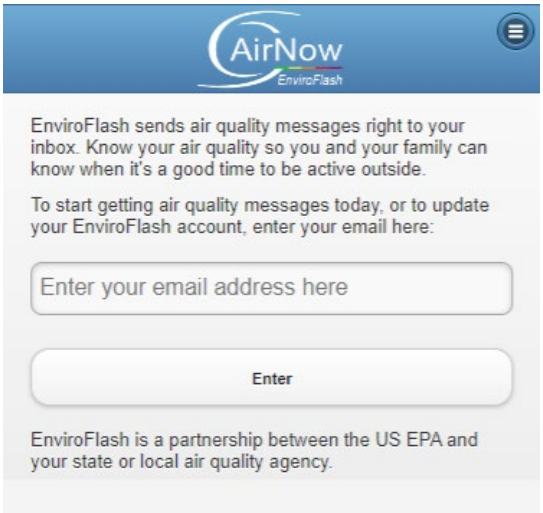
Android

https://play.google.com/store/apps/details?id=com.saic.airnow&hl=en_US&gl=US

AirNow EnviroFlash

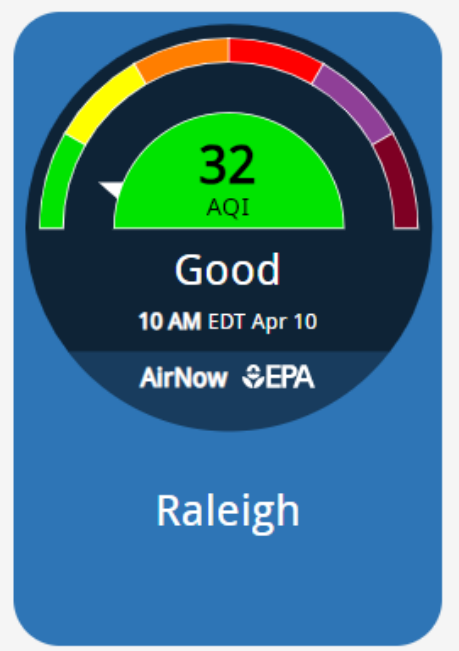
AirNow's EnviroFlash sends air quality information for the selected location to any email or mobile phone. These forecasts and alerts allow people to take air quality into consideration when making outdoor plans.

https://m.enviroflash.info/



AirNow Widget Website

AirNow widgets allow organizations to show air quality information to the people they want to reach on their own website in various formats.



https://www.airnow.gov/aqi-widgets/

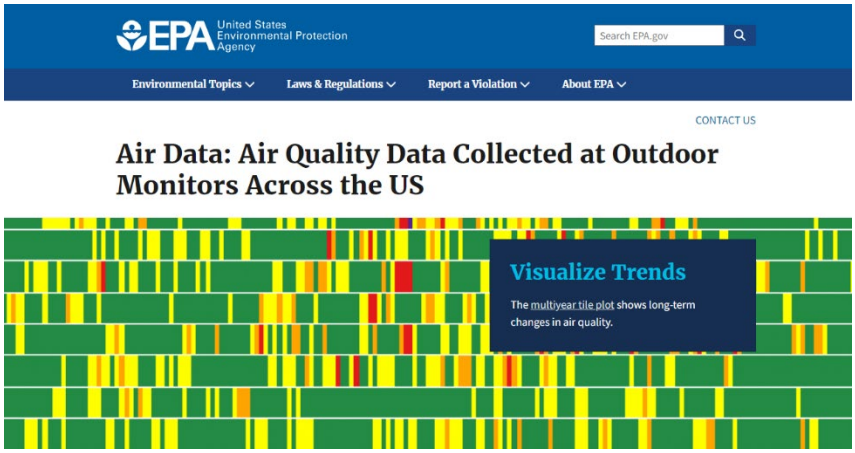
AirNow Department of State

AirNow Department of State collects air quality monitoring data from U.S. embassies and consulates around the world to inform U.S. personnel and citizens overseas.

https://www.airnow.gov/international/us-embassies-and-consulates/

AirData Website

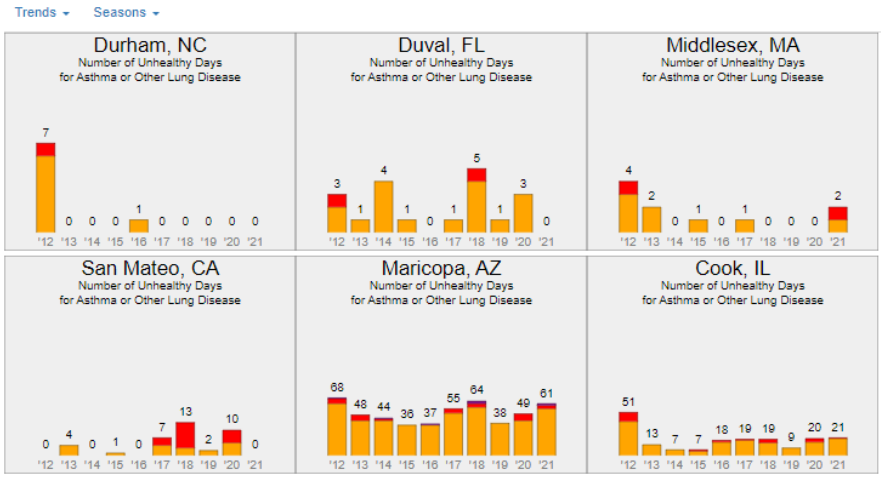
AirData provides air quality data collected at outdoor monitors across the United States, Puerto Rico, and the U.S. Virgin Islands. Users can download, output, view or visualize the data.



https://www.epa.gov/outdoor-air-quality-data

AirCompare Website

AirCompare maps provide information for counties in the United States that monitored outdoor air quality in recent years, and tailor that information for groups more likely to be affected by different levels of pollution.



https://www3.epa.gov/aircompare/

VI. Frequently Asked Questions

Q. Can AirNow help me meet the reporting requirements for the AQI?

A. Yes, AirNow is one way you can submit, store, and display your AQI values. This includes the required elements of AQI reporting and the voluntary elements. The information you submit to airnow.gov is reported in national and state/local pages on the website. It is available to anyone through the AirNow app, AirNow widgets, and Enviroflash emails. It is also available for distribution to media and weather service provider companies.

Q. Why doesn't my area report an Air Quality Index value?

A. Towns and cities with 350,000 or fewer inhabitants are not required to report the AQI. Some may not have monitors. In addition, AirNow is a voluntary program and some state or local air quality monitoring agencies may not submit data to AirNow.

Q. The other day, the air quality in my area was reported as green, or good air quality. However, it was pretty hazy outside. Why didn't the AQI report this accurately?

A. If this was an AQI forecast, there are still a few areas of the United States that only forecast for ozone and not particle pollution. It is possible that the ozone AQI forecast was "GOOD" while the hazy conditions experienced were due to particle pollution. In this instance, the reported AQI forecast may have only represented ozone.

If this was a real-time air quality report, it may be because there are only ozone monitors nearby, which were reading that ozone was in the "GOOD" category while the hazy conditions experienced were due to particle pollution.

There are also occasions where hazy conditions may be due primarily to high humidity and not pollution. On these days, it is still good to check the AQI maps and forecasts to make sure that pollution is not the primary cause of the haze.

Q. It looks smoky outside, but the AirNow dial is reporting green or yellow air quality. How can that be right?

A. During smoky condition, particle pollution levels can vary considerably, even over small distances and short periods of time. This is particularly true when smoke plumes move in and out of an area. As a result, monitors in the same area may show different NowCast AQI categories. The main AirNow website currently does not include sensor information and cannot always account for these rapidly changing conditions. The AirNow Fire and Smoke Map, which EPA operates in partnership with the U.S. Forest Service, does include sensor data, which updates more frequently. The Fire and Smoke Map also shows smoke plumes from National Oceanic and Atmospheric Administration satellites to give the public information on how far smoke has traveled. Note that smoke plume images on the map cannot tell you whether the smoke is high in the atmosphere or at ground level.

If it looks smoky where you are, check your air quality on the AirNow Fire and Smoke Map. You can click on a colored icon to get additional information, including steps you can take to reduce your pollution exposure. The map is available at https://fire.airnow.gov, or by clicking the "Smoke ”icon on the lower right of the free AirNow smartphone app.

Q. What does it mean when the AQI values are above 500?

A. All AQI values above 300 are part of the Hazardous category. This includes values above 500 and the hazardous category information should be used. The 500 breakpoint of the AQI is used to calculate the AQI values in the hazardous category (AQI values above 300), with AQI values above 500 based on the same linear slope as the AQI values between 301 and 500.

Q. What is the U.S. AQI and how is it different than some AQIs I see reported?

A. The U.S. AQI is the official Air Quality Index for the United States. The U.S. AQI was developed to provide a uniform scale for communicating air quality -- so no matter where you are in the country, you know what the AQI categories mean. The U.S. AQI is what you see on AirNow.gov, the AirNow app, and on the AirNow Fire and Smoke Map, on most state and local air quality websites, and in many private applications.

EPA reassesses the U.S. AQI for specific pollutants as new science becomes available, always doing so through a transparent process that gives the public the opportunity to comment. The Agency does not assess private air quality indexes; please contact the provider if you have questions about what those indexes are based on.

Q. If the AQI information reported in the local media is incorrect, what should I do?

A. Common problems with AQI information reporting in the local media include reporting inaccurate cautionary statements and health information, reporting data values that are wrong or reporting pollutant concentrations instead of the AQI. Another frequent mistake is to report inconsistent AQI colors or terminology, as well as incorrect pollutant names. To minimize potential problems establish a good working relationship with your local media and educate them about how using the correct information can be helpful to their audiences, and how misleading or erroneous AQI information can be harmful. If you spot a significant error in a weathercast or news story, don’t wait until the next day to request a correction. Reach out quickly.

Q. Why doesn't the U.S. AQI cover toxic air pollutants or air toxics?

A. While the AQI is an excellent indicator of the air quality resulting from ozone, particulate matter, carbon monoxide, nitrogen dioxide and sulfur dioxide, it does not directly include health implications from all air pollutants such as air toxics. Levels of air toxics that would pose adverse health effects generally do not occur episodically on a regional scale, like ozone and particulate matter; therefore, air toxics are monitored and evaluated differently. For information on air toxics and risk, visit EPA’s Air Toxics Screening Assessment. For information on air toxics monitoring, visit: https://www.epa.gov/amtic/air-toxics-ambient-monitoring

Q. Why does AirNow provide AQI forecasts only for ozone and particle pollution?

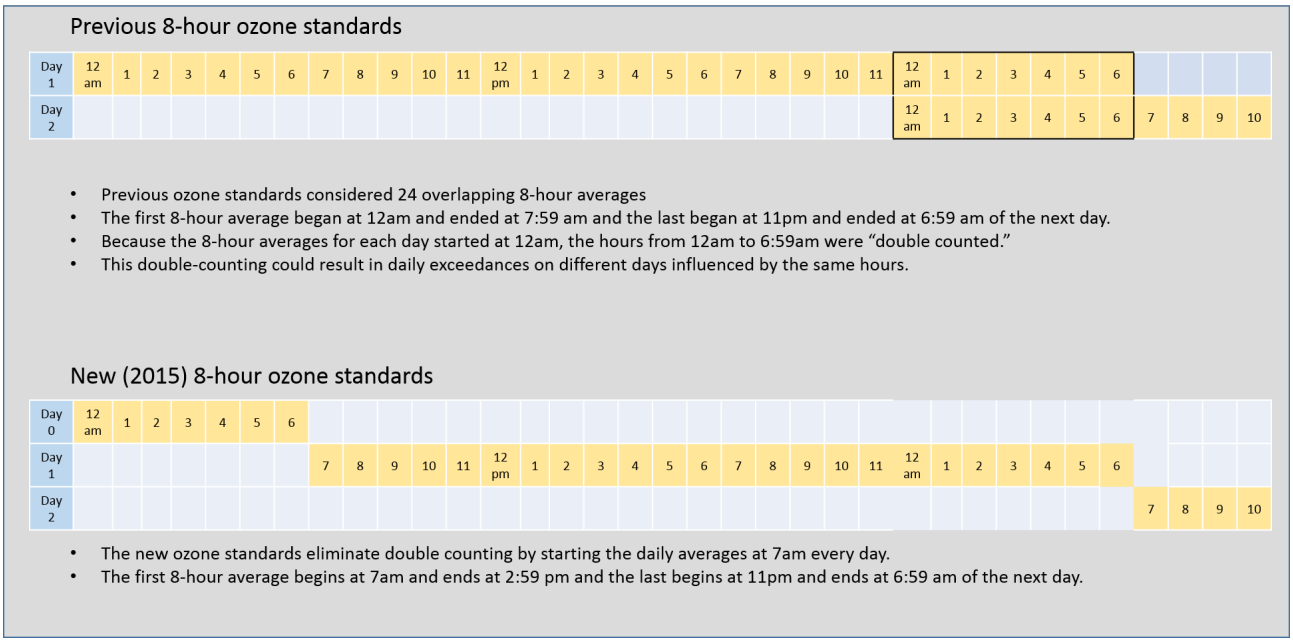
A. AQI reporting is required for all criteria pollutants when they have an index value of 50 or above, but forecasting the AQI is not required. Most cities forecast for ozone and particle pollution as these pollutants are the major sources of unhealthy air quality around 99% of the time. However, several cities forecast for all five pollutants: ground-level ozone, particle pollution, carbon monoxide, sulfur dioxide, and nitrogen dioxide.

Q. What is the NowCast and what does it have to do with the AQI?

A. The NowCast is EPA's method for relating short-term (less than 24-hour) data to the AQI for the purposes of real-time reporting. The AQI is based on *daily* air quality summaries, specifically daily maximums or daily averages. It is not valid to use shorter-term (e.g., hourly) data to calculate an AQI value. However, the real-time reporting of the NowCast requires shorter-term data to caution people in time for them to reduce their 24-hour exposure. Learn more about the NowCast.

Q. When calculating the AQI for ozone, which 8-hour periods should be used?

A. When the ozone standard was revised in 2015, the data handling for the daily max 8-hour average was modified to use only the 8-hour averages starting at 7am. This was done to avoid double counting an exceedance from a single, short-term episode that spans the nighttime hours of the first day into the early hours of the second day. The daily maximum 8-hour average used for computing the AQI value is the same daily maximum 8-hour average described in the data handling for the revised ozone standard (i.e., it is based on the 17 consecutive moving 8-hour periods in each day, beginning with the 8-hour period from 7am to 3pm, and ending with the 8-hour period from 11pm to 7am).



Q. Should I use particulate matter or particle pollution when speaking with the public?

A. Based on focus group testing by EPA, people better understand and prefer the term “particle pollution” than "particulate matter."

Q. Why are some people using low-cost, compact sensors to measure air quality?

A. Many citizens are interested in learning more about local air quality where they live, work, and play. Low-cost, compact, sometimes-portable sensors are becoming more popular for collecting real-time air quality data. EPA scientists created the *Air Sensor Toolbox for Citizen Scientists* to provide information about sensor performance and how to interpret the data from sensors.

Learn more at http://www.epa.gov/air-research/air-sensor-toolbox-citizen-scientists.

In addition, EPA and the U.S. Forest Service use data from sensors on the AirNow Fire and Smoke Map. Before sensor data appears on the map, an EPA scientific correction equation is applied so sensor data can be compared to data from permanent monitors.

Q. Can I apply the AQI colors to realtime data from low-cost air quality sensors?

A. As a general matter, EPA does not advise applying AQI values to realtime sensor data, especially 1-minute readings. Health studies do not tell us what a single minute of exposure to a pollutant may mean. The AQI is based on EPA’s national air quality standards, which come from health studies that show the effects of longer exposures.

Q. What is the ozone monitoring season for each state?

A. EPA requires ozone monitoring during the time of year when weather conditions are most favorable for ozone formation. This season varies by state. In some states with warmer climates, monitoring is required year-round. In states where the climate is colder, ozone monitoring is required for as little as five months during the summertime. You can find a list of ozone monitoring seasons by state in 40 CFR Part 58 Appendix D, Table D-3.

VII. ADDITIONAL RESOURCES

AQI Final Rule 64 FR 42530, August 4 1999**:** https://www.airnow.gov/publications/air-quality-index/air-quality-index-reporting-final-rule/

List of monitoring season by state in 40 CFR Part 58 Appendix D, Table D-3: https://www.ecfr.gov/current/title-40/chapter-I/subchapter-C/part-58/appendix-Appendix%20D%20to%20Part%2058

AirNow's Wildfires Page: https://www.airnow.gov/wildfires/

Air quality outreach materials in Spanish: https://www.airnow.gov/spanish-resources/

Basic information on the AQI in Spanish: https://www.airnow.gov/aqi/aqi-basics-in-spanish/

EPA's Air Quality Flag Program: https://www.airnow.gov/air-quality-flag-program/

Air Sensor Toolbox for Citizen Scientists: http://www.epa.gov/air-research/air-sensor-toolbox-citizen-scientists

EPA's Air Toxics Screening Assessment: https://www.epa.gov/AirToxScreen

United States Environmental Protection Agency	Office of Air Quality Planning and Standards Air Quality Assessment Division Research Triangle Park, NC	EPA-454/B-24-002 May 2024