ADEQ 2020 5-Year Network Assessment

June 2020

Includes an executive summary of findings, a Ranking Analysis of current ADEQ monitors, a Spatial Raster Analysis that shows areas of Arizona for potential monitoring, and conclusions and recommendations.

ARIZONA DEPARTMENT OF ENVIRONMENTAL QUALITY

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Purpose and Objective

This assessment is to determine if the Arizona Department of Environmental Quality's (ADEQ's) ambient air monitoring network meets monitoring goals and objectives set forth by ADEQ to protect and enhance public health and the environment in Arizona. In supporting these goals, an analysis of ADEQ's air monitoring network is provided for ADEQ's air quality professionals for the purpose of determining the adequacy of the network. 40 CFR Part 58.10(d) states the specific requirements for this assessment:

> The state, or where applicable local, agency shall perform and submit to the EPA Regional Administrator an assessment of the air quality surveillance system every 5 years to determine, at a minimum, if the network meets the monitoring objectives defined in appendix D to this part, whether new sites are needed, whether existing sites are no longer needed and can be terminated, and whether new technologies are appropriate for incorporation into the ambient air monitoring network. The network assessment must consider the ability of existing and proposed sites to support air quality characterization for areas with relatively high populations of susceptible individuals (e.g., children with asthma), and, for any sites that are being proposed for discontinuance, the effect on data users other than the agency itself, such as nearby states and tribes or health effects studies. The state, or where applicable local, agency must submit a copy of this 5-year assessment, along with a revised annual network plan, to the Regional Administrator.

To achieve this, the analysis consists of the following:

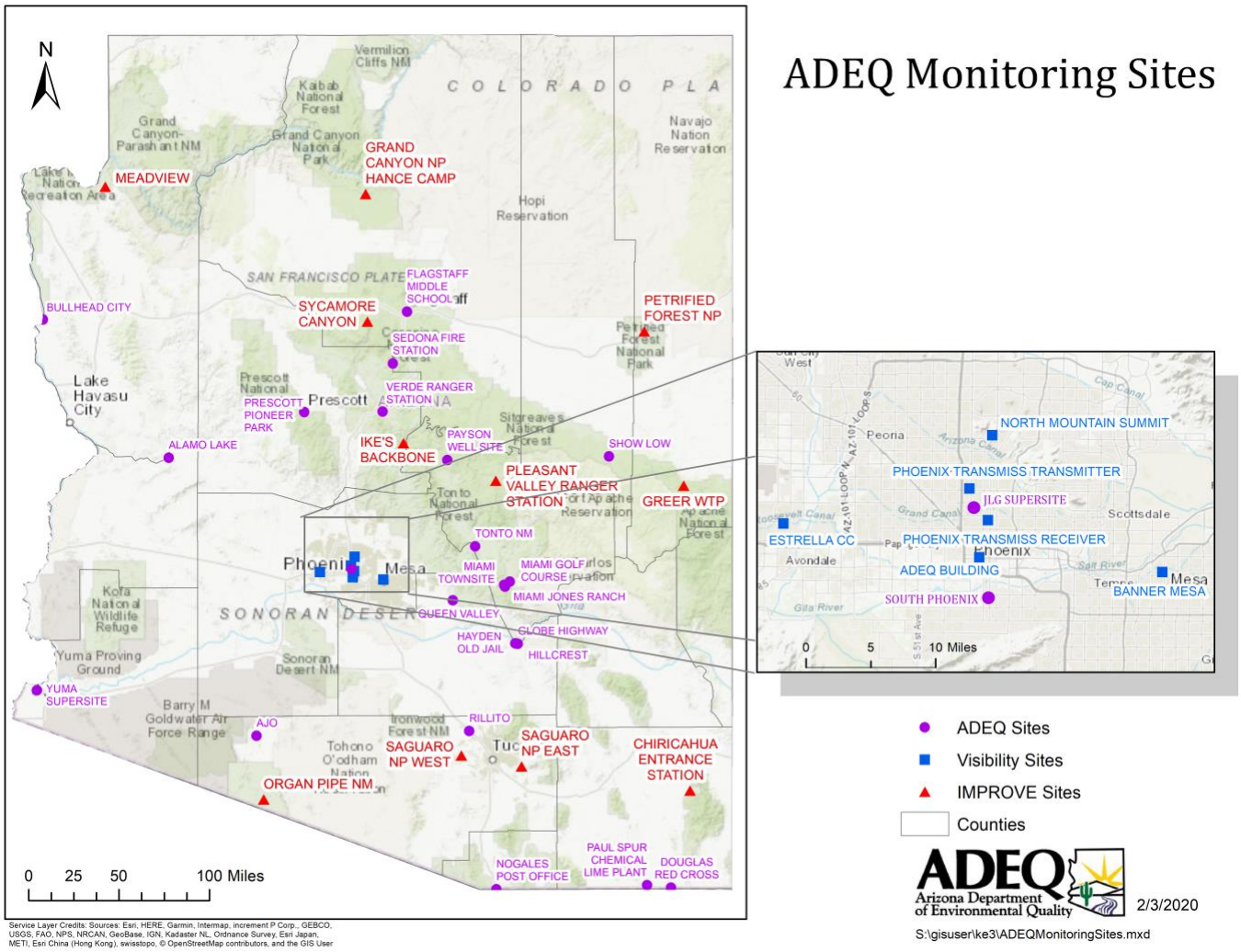
- Executive Summary — A summary of the recommendations and conclusions made by ADEQ's Air Quality Division.
- Section I — An instrument-to-instrument Ranking Analysis that determines the comparative importance of each instrument using a variety of indicators. These indictors cover demographic, geographic, economic, and regulatory perspectives that are important to air monitoring. The individual instruments in the monitoring network are separated by pollutant and ranked. The ranking is then used for the determination of final recommendations. The purpose of the Ranking Analysis is to determine the adequacy of ADEQ's current monitoring network and any recommended network modifications.
- Section II — A Spatial Analysis using a series of raster-based maps representing a variety of indicators. These indicators cover demographic, geographic, and source pollution perspectives that are important to air monitoring. Raster maps are a GIS tool that quantifies areas in Arizona for their importance to air monitoring. The spatial analysis is separated by pollutant and then used for the determination of final recommendations. The purpose of the Spatial Analysis is to visually evaluate areas of interest where sensitive populations are located and assess how well areas across Arizona are covered by the ADEQ monitoring network.
- Section III — Recommendations and final conclusions using both the Ranking and Spatial analyses to determine: if the current network meets monitoring objectives, whether adjustment to the monitoring network are needed, where areas with relatively high populations of sensitive individuals are located, and whether new technologies are appropriate for incorporating into the existing network.

The assessment addresses the criteria pollutants sulfur dioxide (SO_2), ozone (O_3), and particulate matter (both PM_{10} and $PM_{2.5}$) monitored by ADEQ. The assessment uses instrument and site data from 2014 to 2018, as these data are the most current certified five years of data at the time of creation of this assessment. All data used are publicly available and were taken from the Environmental Protection Agency's (EPA's) Air Quality System (AQS), the United States Census Bureau, and the Arizona Department of Health Services.

The recommendations stated in this assessment are used to plan for changes in the air monitoring network for the subsequent five years and to be included in the 2021 Annual Network Plan. The recommendations, conclusions, and rankings in this assessment include only sites and areas operated by ADEQ. The final conclusions and recommendations were determined by ADEQ's Air Quality management.

Figure 1: ADEQ's 2020 Monitoring Sites

This map shows all ADEQ's monitoring sites in Arizona. This can be used for reference when referring to sites in subsequent sections.



Sites Used in This Network Assessment

The following seven tables list all of the sites used in this assessment, organized by their operating agencies. The location and information about each one of these sites comes from the AQS database.

Monitoring Sites Operated by ADEQ

AQS Site Number	Site Name	Address	County	Pollutants Monitored			
				O_3	SO_2	PM_{10}	$PM_{2.5}$
04-019-0001	Ajo	1211 Well Rd.	Pima			X	
04-012-8000	Alamo Lake	Alamo Lake State Park	La Paz	X		X	X
04-015-1003	Bullhead City	990 Highway 95	Mohave			X	
04-003-1005	Douglas Red Cross	1445 E. 15th St.	Cochise			X	X
04-005-1008	Flagstaff Middle School	755 N. Bonito St.	Coconino	X			
04-007-1001	Hayden Old Jail	Canyon Dr. & Kennecott Ave.	Gila		X	X	
04-013-9997	JLG Supersite	4530 N. 17th Ave	Maricopa	X	X	X	X
04-007-8000	Miami Golf Course	SR 188 and US 60	Gila			X	
04-007-0011	Miami Jones Ranch	Cherry Flats Rd.	Gila		X		
04-007-0012	Miami Townsite	Sullivan ST & Davis Canyon	Gila		X		
04-023-0004	Nogales Post Office	300 N. Morley Ave	Santa Cruz			X	X
04-003-0011	Paul Spur Chemical Lime Plant	SR 80 & Paul Spur Rd.	Cochise			X	
04-007-0008	Payson Well Site	204 W. Aero Dr.	Gila			X	
04-025-8034	Prescott Pioneer Park	1200 Commerce Dr.	Yavapai	X			
04-021-8001	Queen Valley	10 S. Queen Anne Dr.	Pinal	X			
04-019-0020	Rillito	8840 W. Robinson St.	Pima			X	
80-026-8012	San Luis Rio Colorado Well 10	Avenida Carranza and Calle 15		X			
04-007-0010	Tonto NM	South of SR 188	Gila	X			
04-027-8011	Yuma Supersite	2029 S. Arizona Ave	Yuma	X		X	X

Monitoring Sites Operated by the Maricopa County Air Quality Department

AQS Site Number	Site Name	Address	Pollutants Monitored			
			O_3	SO_2	PM_{10}	$PM_{2.5}$
04-013-9702	Blue Point	Usery Pass Rd. & Bush Highway	X			
04-013-4011	Buckeye	26453 W. MC85	X		X	
04-013-4008	Cave Creek	37019 N. Lava Lane	X			
04-013-3002	Central Phoenix	1645 E. Roosevelt St.	X	X	X	
04-013-4019	Diablo	1919 W. Fairmont Dr.				X
04-013-9812	Durango Complex	2702 RC Esterbrooks Blvd.		X	X	X
04-013-4010	Dysart	16825 N. Dysart Rd.	X		X	
04-013-1010	Falcon Field	4530 E. McKellips Rd.	X			
04-013-9704	Fountain Hills	16426 E. Palisades Blvd.	X			
04-013-2001	Glendale	6000 W. Olive Ave	X		X	X
04-013-4006	Higley	2207 S. Higley Rd.			X	
04-013-9508	Humboldt Mountain	Seven Springs Rd.	X			
04-013-1003	Mesa	310 S. Brooks	X		X	X
04-013-1004	North Phoenix	601 E. Butler Dr. and N. 6TH St.	X		X	X
04-013-2005	Pinnacle Peak	24301 N. Alma School Rd.	X			
04-013-4003	South Phoenix	33 W. Tamarisk St.	X		X	X
04-013-3003	South Scottsdale	2857 N Miller Rd.	X		X	
04-013-4005	Tempe	1525 S. College Ave.	X		X	X
04-013-4009	West 43rd Ave	3940 W. Broadway Rd.			X	
04-013-4004	West Chandler	275 S. Ellis St.	X		X	
04-013-0019	West Phoenix	3847 W. Earll Dr.	X		X	X
04-013-4016	Zuni Hills	10851 W. Williams Rd.			X	

Monitoring Sites Operated by the Gila River Indian Community

AQS Site Number	Site Name	Address	County	Pollutants Monitored			
				O_3	SO_2	PM_{10}	$PM_{2.5}$
04-021-7004	Casa Blanca	Casa Blanca/Preschool Rd.	Pinal			X	
04-021-7001	Sacaton	35 Pima St.	Pinal	X		X	
04-013-7003	St. Johns	4208 W. Pecos Rd.	Maricopa	X		X	

Monitoring Sites Operated by the National Park Service

AQS Site Number	Site Name	Address	County	Pollutants Monitored			
				O_3	SO_2	PM_{10}	$PM_{2.5}$
04-003-8001	Chiricahua NM-Entrance Station	Chiricahua National Monument	Cochise	X			
04-005-8001	Grand Canyon NP - The Abyss	Grand Canyon National Park , W Rim Dr.	Coconino	X			
04-017-0119	Petrified Forest NP- South Entrance	Pet For Nat Park, Near Old SW Entrance on Old Route 180	Navajo	X			

Monitoring Sites Operated by the Pima County Department of Environmental Quality

AQS Site Number	Site Name	Address	County	Pollutants Monitored			
				O_3	SO_2	PM_{10}	$PM_{2.5}$
04-019-1011	Craycroft & 22nd	1237 S. Beverly Ave	Pima	X			
04-019-1028	Children's Park	400 W. River Rd.	Pima	X	X		X
04-019-1034	Coachline	9597 N. Coachline Blvd.	Pima	X			
04-019-0008	Corona De Tucson	22000 S. Houghton Rd.	Pima			X	
04-019-1020	Fairgrounds	11330 S. Houghton Rd.	Pima	X			
04-019-1113	Geronimo	2498 N. Geronimo Rd.	Pima			X	
04-019-1030	Green Valley	601 N. La Canada Dr.	Pima	X		X	
04-019-0011	Orange Grove	3401 W. Orange Grove Rd.	Pima			X	X
04-019-1032	Rose Elementary	710 W. Michigan St.	Pima	X			
04-019-0021	Saguaro National Park, East	3905 S. Old Spanish Trail	Pima	X			
04-019-1026	Santa Clara School	6910 S. Santa Clara Ave	Pima			X	
04-019-1001	South Tucson	1601 S. 6th Ave	Pima			X	
04-019-1018	Tangerine	12101 N. Camino De Oeste	Pima	X		X	

Monitoring Sites Operated by the Pinal County Air Quality Control District

AQS Site Number	Site Name	Address	County	Pollutants Monitored			
				O_3	SO_2	PM_{10}	$PM_{2.5}$
04-021-3002	AJ Fire Station	3955 E. Superstition Blvd.	Pinal			X	X
04-021-3001	AJ Maintenance Yard	305 E. Superstition Blvd.	Pinal	X			
04-021-0001	Casa Grande Downtown	401 N. Marshall St.	Pinal			X	X
04-021-3003	Casa Grande Airport	660 W. Aero Dr.	Pinal	X			
04-021-3009	Combs School	301 E. Combs Rd.	Pinal			X	
04-021-3004	Coolidge Maintenance Yard	212 E. Broadway Ave	Pinal			X	
04-021-3014	Eloy County Complex	801 N. Main St.	Pinal			X	
04-021-3015	Hidden Valley	43750 W. Carefree Place	Pinal			X	X
04-021-3016	City of Maricopa County Complex	19955 N. Wilson Ave	Pinal			X	
04-021-3007	Pinal Air Park	Water Well #2 Pinal Air Park Rd.	Pinal	X		X	
04-021-3011	Pinal County Housing Complex	970 N. Eleven Mile Corner Rd.	Pinal			X	
04-021-3008	Stanfield County Complex	36697 W. Papago Dr.	Pinal			X	

Monitoring Sites Operated by the Salt River-Pima Maricopa Indian Community

AQS Site Number	Site Name	Address	County	Pollutants Monitored			
				O_3	SO_2	PM_{10}	$PM_{2.5}$
04-013-7024	High School	4827 N. Country Club Dr.	Maricopa	X		X	
04-013-7022	Lehi	3250 N. Stapley Dr.	Maricopa	X		X	
04-013-7021	Red Mountain	15115 Beeline Highway	Maricopa	X			
04-013-7020	Senior Center	10844 E. Osborn Rd.	Maricopa	X		X	X

Executive Summary

This executive summary provides a summary of the analysis and the final recommendations and conclusions. The purpose of the analysis is to determine the adequacy of ADEQ's air monitoring network. This is done using two types of analyses:

1. A Ranking Analysis determines which instruments are of greatest and least impact to protecting and enhancing public health and the environment in Arizona.
2. A Spatial Analysis determines which areas of Arizona are being underrepresented or overrepresented by air monitoring.

Recommendations for the removal/addition of instruments are determined using both analyses and the full recommendations and conclusions are found in Section III: Final Conclusions and Recommendations on Page 51 of this document. The recommendations and conclusions were made by ADEQ's Air Quality management. All results, findings, recommendations, and conclusions are listed below.

1. Ranking Analysis

Results

The ranking scale starts at 1, being the highest ranking instrument and therefore the most important to monitoring.

SO_2 Network Results

Site Name	Ranking
Miami Jones Ranch	3
Miami Townsite	2
Hayden Old Jail	1
JLG Supersite	4

O_3 Network Results

Site Name	Ranking
Flagstaff Middle School	6
Tonto National Mon.	5
Alamo Lake	2
JLG Supersite	4
Queen Valley	3
Prescott Pioneer Park	7
Yuma Supersite	1

PM_{10} Network Results

Site Name	Ranking
Paul Spur Chemical Lime Plant	12
Douglas	4
Payson	5
Hayden Old Jail	8
Miami Golf Course	10
Alamo Lake	7
JLG Supersite	6
Bullhead City	11
Ajo	9
Rillito	3
Nogales Post Office	2
Yuma Supersite	1

$PM_{2.5}$ Network Results

Site Name	Ranking
Douglas	4
Alamo Lake	2
JLG Supersite (Continuous)	6
JLG Supersite (Filter)	7
Nogales Post Office (Continuous)	3
Nogales Post Office (Filter)	5
Yuma Supersite	1

Recommendations

- Removal of the $PM_{2.5}$ (POC 1 Filter) instrument at Nogales Post Office.
    - Investigate if this instrument is still required for collocation requirements, as it is low ranked in this analysis. Determine if Nogales or JLG Supersite has the highest $PM_{2.5}$ concentrations. Currently JLG Supersite and Nogales Post Office have both continuous and filter based instruments. However, to fulfill collocation requirements ADEQ only needs one collocated pair. Furthermore, discontinuance of this monitor will not prevent ADEQ from meeting minimum requirements in 40 CFR Part 58, Appendix D. ADEQ will conduct a cost-benefit analysis to see if the benefit of removal outweighs the cost. If so, a request for removal will be made in the 2021 Annual Network Plan.
- Investigate where Flagstaff Middle School O_3 and Prescott Pioneer Park O_3 stand in terms of meeting 85 percent of the O_3 National Ambient Air Quality Standards (NAAQS).
    - Statistical analysis will determine if these monitors are in attainment of the O_3 NAAQS for the last five years. Additionally, the analysis will see if there is a less than 10 percent probability of exceeding 80 percent of the NAAQS during the next three years at these sites.

Conclusions

- Yuma Supersite and JLG Supersite special consideration:
    - These monitoring sites are identified as of particular importance to the ADEQ's air monitoring network. Yuma Supersite is consistently ranked the highest and JLG Supersite is ranked above most other sites. Yuma Supersite is important as a border transport site and representative of a large Metropolitan Statistical Area (MSA). JLG supersite is important due to it long trend and research objectives for the Phoenix area. Any modernization of instrumentation or techniques should be made at these sites first.

2. Spatial Analysis

Results

See Section II (F): Final Weighted Overlay on Page 47 for the final map results.

Recommendations

- This analysis will help ADEQ identify areas of interest (orange and red areas on the maps) for event-based monitoring related to potential episodic and weather-driven air pollution events, and to help focus ADEQ public outreach and education resources.

Conclusions

- It was determined that ADEQ's monitoring network is generally satisfactory for Arizona. The minimum monitoring requirements set forth in 40 CFR Part 58, Appendix D are being met by ADEQ and monitoring represents all major pollutant and population centers.
- It was determined that no areas in Arizona were being overrepresented by ADEQ's monitoring networks. No removals or relocations of instrument are recommended based on this analysis.

Section I: Ranking Analysis

A Ranking Analysis provides an instrument-to-instrument comparison for ADEQ's criteria networks. The purpose of the Ranking Analysis is to determine which instruments are most crucial to air monitoring and which have the potential to be removed or relocated. The analysis uses indicators to rank instruments for their importance to air monitoring. The indicators serve as a way to quantify different aspects important to air quality monitoring and public health. This is done by assigning a value, known as the Indicator Value, to the individual instruments. The Indicator Values are on a scale from 0 to 10, with 0 being lowest value and 10 the highest. The indicators cover regulatory, demographic, and geographic topics. Focusing on one indicator does not give the full picture or status of ADEQ's monitoring network. Therefore, the Ranking Analysis combines all of the indicators in Section I (G): Final Rankings on Page 29 to give a comprehensive and robust ranking of ADEQ's monitoring network.

Chosen indicators represent a variety of pertinent considerations to examine the value of each instrument. Six indicators are used in the Ranking Analysis:

Table 1: Ranking Analysis Indicators

Indicator	Description	Indicator Type
Measured Concentration	Assigns an indicator value to instruments based on their measured concentrations, with the highest concentrations having the highest rankings. This indicator uses average design values from the years 2014 – 2018. It is considered more important to have instruments that measure the highest concentrations. A high concentration results in a high indicator value.	Measured Value
Area Served	Assigns an indicator value based on an instrument's area of influence. The area of influence is calculated using Thiessen polygons in ESRI's ArcGIS. Thiessen polygons are polygons surrounding instruments that show the relative area of representation based on the straight line distance to other instruments. It is considered more important to have instruments that represent large areas. A large area of influence results in a high indicator value.	Spatial
Population Served	Assigns an indicator valued based on the number of people that an instrument serves. Using the stated spatial scale of each monitor to determine each monitor's area of representation, population data are laid over the area to determine the represented population. It is considered more important to have instruments that serve higher populations. Having a high population served results in a high indicator value.	Population
Monitor to Monitor Correlation	Using the daily maximum values from 2018, each instrument is correlated using Pearson's R_2 correlation coefficient. The maximum correlation to another instrument is used to assign an indicator value. It is considered more important to have instruments that are not closely correlated with other instruments. Low correlation with another instrument results in a high indicator value.	Measured Value
Removal Bias	Finds the nearest neighbors to each selected site using the EPA NetAssess2020 tool to estimate concentrations at the site and then compares the estimates to the actual concentrations measured at the selected site. It is considered more important to have instruments with a high removal bias. An instrument with low removal bias may indicate that the monitor is redundant and could be removed. High removal bias results in a high indicator value.	Modeled Value
Source Orientation	This is a simple yes or no indicator. If an instrument's purpose is to monitor for point or area source emissions, it receives the highest indicator value. If the instrument's purpose is not source oriented, it receives the lowest indicator value.	Regulatory

Each indicator uses publicly available data and produces an indicator value that is unique to the different instruments. As shown, the indicators represent a wide range of air monitoring considerations, but it is not assumed that each indicator has equal importance. For this reason, the indicators' values are weighted according to their importance. In order to establish weights for the indicators, ADEQ Air Quality Division staff held two consensus meetings and distributed a survey to external air quality professionals in Arizona. The meetings and survey asked the participants to place a weight on each indicator. As a result, some indicators are more heavily weighed than others. The resulting weights were placed on the Indicator Values and a new Weighted Indicator Value was produced. Using the Weighted Indicator Values, The importance of each monitor to the monitoring network is ranked by averaging the weighted indicator values of each instrument. The instrument with the highest average value being the most important instrument in the network. The results for the Ranking Analysis are found in Section I (G): Final Rankings on Page 29. These rankings were used to determine the adequacy of ADEQ's current monitoring network in Arizona, as described in Section III: Final Conclusions and Recommendations on Page 51.

NOTE: Due to the small number of monitors and sites in ADEQ's Pb, CO, and NO_2 networks, they are not analyzed in the Ranking Analysis. ADEQ only operates three Pb sites, one CO site, and one NO_2 site. The remaining pollutant networks (SO_2, O_3, PM_{10}, and $PM_{2.5}$) are included in the Ranking Analysis. The San Luis Rio Colorado (SLRC) Well #10 O_3 monitor was not included in this analysis due to it being located in San Luis, Mexico.

A. Measured Concentrations

This indicator assesses monitors based on the pollutant concentrations that are measured. The highest valued instrument has the highest average design value over the past five years. Instruments are given an indicator value on a 0 to 10 scale, with the monitor that has the lowest average design value receiving a value of 0, and the highest receiving a value of 10. Design values were taken from EPA's AQS database for the years 2014 – 2018 and were averaged.

It is assumed that instruments that measure higher concentrations are more important for the NAAQS, permitted sources, and regulatory compliance because these instruments already have exceeded or have the potential to exceed the standard. This indicator does not take into account monitors being used for reasons other than NAAQS compliance. Background, informational, and research-oriented monitors provide valuable data to be used for trends and new source permit analysis and may not have high design values.

NOTE: PM_{10} values used in this indicator are not the design values. The design value for PM_{10} is the number of exceedances over a three-year period. This results in a design value that does not represent actual ambient concentrations. Therefore, the highest annual PM_{10} average for each year is used in place of the design value for this and subsequent indicators.

Results

Results for the Measured Concentrations indicator are given by pollutant. The highest 2014 – 2018 average is assigned an indicator value of 10 and the lowest a 0. All instruments are assigned a value relative to these highest and lowest values.

Table 2: SO_2 Instruments by Highest Design Value

AQS ID	Site Name	Design Value (99th Percentile of 1-hour Maximum Concentration, Averaged over 3 years in ppb)						Indicator Value
		2014	2015	2016	2017	2018	Average 2014-2018	
04-007-0011	Miami Jones Ranch	207	242	150.1	269.9	104.9	191.73	**6.95**
04-007-0012	Miami Townsite	240	231	110.2	134.5	134.9	152.65	**5.49**
04-007-1001	Hayden Old Jail	236	246	359	279.9	208.4	273.33	**10.00**
04-013-9997	JLG Supersite	4.9	5.4	5.1	6.4	6.1	5.75	**0.00**

Table 3: O_3 Instruments by Highest Design Value

AQS ID Site Name		Design Value (Annual 4th-highest daily Maximum 8-hour Concentration, Averaged over 3 years in ppb)						Indicator Value
		2014	2015	2016	2017	2018	Average 2014 – 2018	
04-005-1008	Flagstaff Middle School	71	70	69	66	65	68.2	**0.00**
04-007-0010	Tonto National Monument	74	72	71	73	74	72.8	**5.90**
04-012-8000	Alamo Lake	72	70	69	68	68	69	**1.54**
04-013-9997	JLG Supersite	77	77	75	76	75	76	**10.00**
04-021-8001	Queen Valley	73	71	71	73	74	72	**5.48**
04-025-8034	Prescott Pioneer Park	71	69	69	67	67	69	**0.51**
04-027-8011	Yuma Supersite	77	76	74	72	71	74	**7.44**

Table 4: PM_{10} Instruments by Highest Annual Average

AQS ID Site Name		Highest Annual Average in µg/m3						Indicator Value
		2014	2015	2016	2017	2018	Average 2014 – 2018	
04-003-0011	Paul Spur Chemical Lime Plant	21.8	14.8	14.5	16.3	13.8	16.24	**1.07**
04-003-1005	Douglas Red Cross	37.5	26.8	28.7	30.2	25.8	29.80	**5.59**
04-007-0008	Payson	15.2	15.7	17.4	18.8	18.7	17.16	**1.37**
04-007-1001	Hayden Old Jail	37.4	26.3	33.6	30.9	31.2	31.88	**6.28**
04-007-8000	Miami Golf Course	22.5	17.7	19.1	23.5	23.5	21.26	**2.74**
04-012-8000	Alamo Lake	11.7	12.0	13.4	13.7	14.4	13.04	**0.00**
04-013-9997	JLG Supersite	30.3	25.2	30.0	32.5	32.5	30.10	**5.69**
04-015-1003	Bullhead City	20.6	18.9	22.4	19.2	19.9	20.20	**2.39**
04-019-0001	Ajo	27.1	17.6	16.2	17.5	16.0	18.88	**1.95**
04-019-0020	Rillito	39.0	36.4	45.3	49.2	43.3	42.64	**9.87**
04-023-0004	Nogales Post Office	39.9	31.2	38.0	36.4	34.0	35.90	**7.62**
04-027-8011	Yuma Supersite	44.7	38.5	47.7	41.8	42.5	43.04	**10.00**

Table 5: $PM_{2.5}$ Instruments by Highest Design Value

AQS ID Site Name		Design Value (98th Percentile of Annual Values, Averaged over 3 years in µg/m3)						Indicator Value
		2014	2015	2016	2017	2018	Average 2014 – 2018	
04-003-1005	Douglas Red Cross	15.9	10.5	9.1	14	12	12.30	**1.66**
04-012-8000	Alamo Lake	8.2	6.8	10.2	10.5	11.3	9.40	**0.00**
04-013-9997	JLG Supersite (Continuous)	22.5	23.2	19.4	20.7	23.7	21.90	**7.16**
04-013-9997	JLG Supersite (Filter)	23.9	20.9	16.4	21.5	20.9	20.72	**6.48**
04-023-0004	Nogales Post Office (Continuous)	29	27.2	26	30.3	21.8	26.86	**10.00**
04-023-0004	Nogales Post Office (Filter)	19.5	22.1	22.6	23.2	22.6	22.00	**7.22**
04-027-8011	Yuma Supersite	22.9	14.7	23	19.6	25.7	21.18	**6.75**

B. Area Served

This indicator assesses monitors based on the area of influence. All instruments in Arizona, including all state, local, and tribal monitors, are used to show the instrument's area of representation. Thiessen polygons are polygons that surround an instrument, used to show its area of representation. These are drawn by locating the midway point between monitors and creating multisided polygons surrounding each monitor. The area in square-miles of each polygon is used to assess instruments on a 0 to 10 scale, with the monitor that has the largest area receiving a value of 10 and the smallest receiving a value of 0. Monitor location data were taken from EPA's AQS database.

It is assumed that monitors that cover the largest areas are of higher significance to air monitoring in Arizona because it represents the largest unique geographic area and are sampling a unique parcel of air. Instruments that are close together generally measure the same concentration; therefore, it would be advantageous to operate an instrument that covers the largest area. Instruments on the edge of urban areas or background type monitors typically have a larger area of influence.

This indicator has disadvantages because pollutant concentrations at a monitoring site may not be representative of a very large area due to meteorological or topographic changes. Some polygons are so large that it shows a monitor having a representation of half the state. The monitors in these very large areas would not actually be representative of ambient concentrations in the entire area; therefore, this indicator is purely spatial in nature.

Results

Results for the Area Served indicator are given by pollutant. The maximum area served is assigned an indicator value of 10 and the minimum a 0. All instruments are assigned a value relative to these highest and lowest values.

Table 6: SO_2 Instruments by Area Served

AQS ID Site Name		Area Served (sq.-mi)	Indicator Value
04-007-0011	Miami Jones Ranch	4,261	**0.00**
04-007-0012	Miami Townsite	28,600	**7.14**
04-007-1001	Hayden Old Jail	8,190	**1.15**
04-013-9997	JLG Supersite	38,327	**10.00**

Figure 2: SO_2 Thiessen Polygons

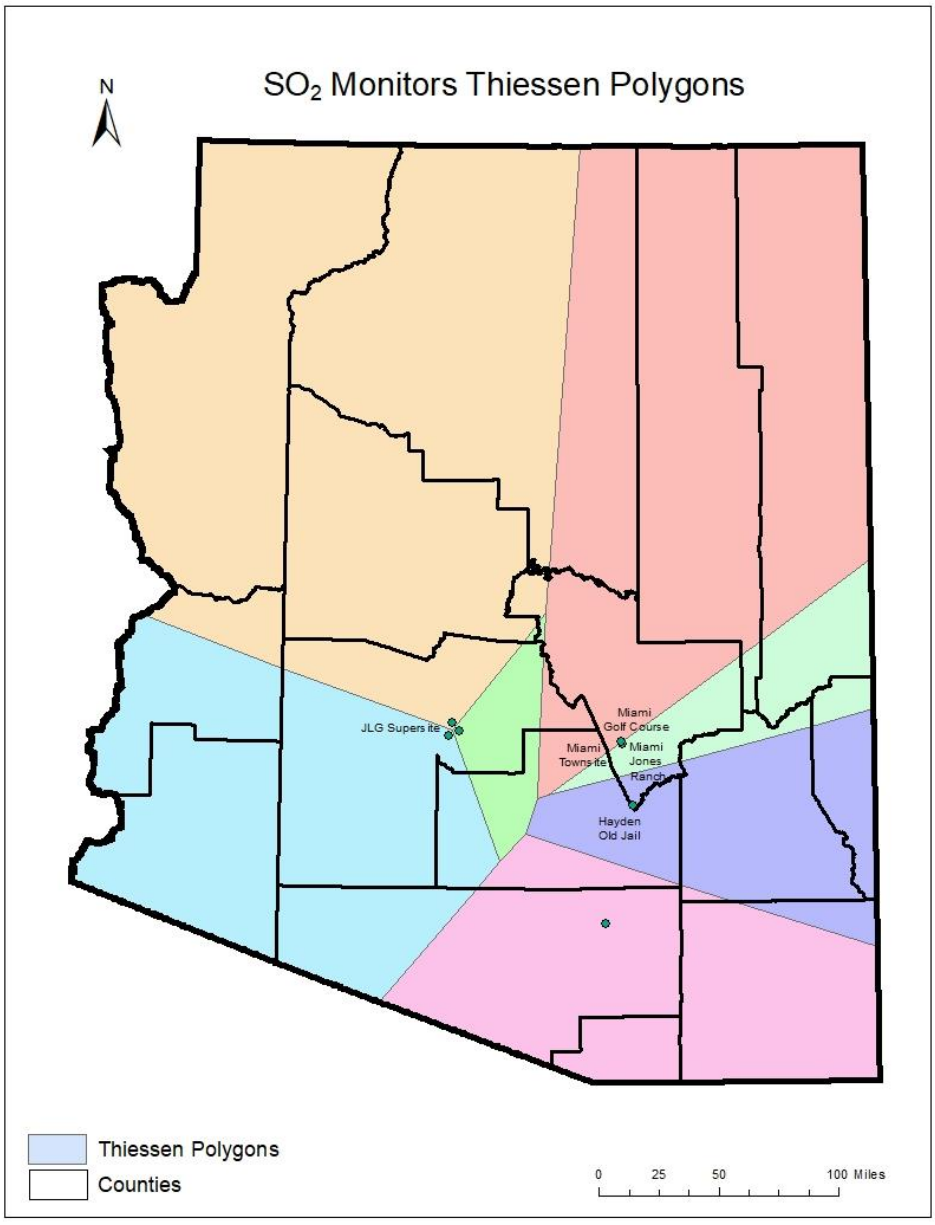


Table 7: O_3 Instruments by Area Served

AQS ID	Site Name	Area Served (sq.-mi)	Indicator Value
04-005-1008	Flagstaff Middle School	7,933	**5.98**
04-007-0010	Tonto National Monument	5,845	**4.40**
04-012-8000	Alamo Lake	13,256	**10.00**
04-013-9997	JLG Supersite	19	**0.00**
04-021-8001	Queen Valley	1,586	**1.18**
04-025-8034	Prescott Pioneer Park	5,281	**3.98**
04-027-8011	Yuma Supersite	5,356	**4.03**

Figure 3: O_3 Thiessen Polygons

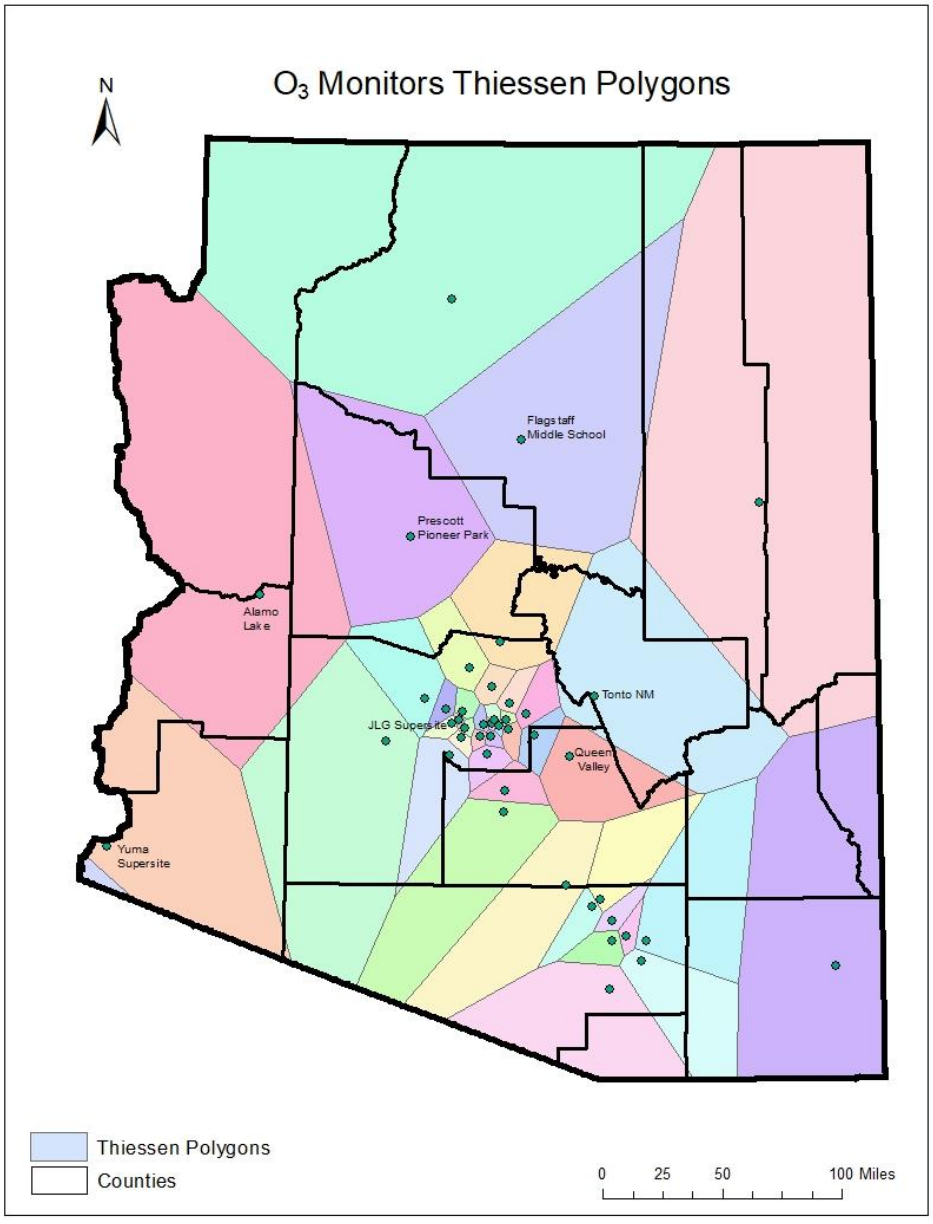


Table 8: PM_{10} Instruments by Area Served

AQS ID Site Name		Area Served (sq.-mi)	Indicator Value
04-003-0011	Paul Spur Chemical Lime Plant	2,544	**0.72**
04-003-1005	Douglas Red Cross	3,189	**0.91**
04-007-0008	Payson	34,868	**10.00**
04-007-1001	Hayden Old Jail	5,448	**1.56**
04-007-8000	Miami Golf Course	9,546	**2.73**
04-012-8000	Alamo Lake	12,700	**3.64**
04-013-9997	JLG Supersite	19	**0.00**
04-015-1003	Bullhead City	12,293	**3.52**
04-019-0001	Ajo	6,048	**1.73**
04-019-0020	Rillito	289	**0.08**
04-023-0004	Nogales Post Office	1,151	**0.33**
04-027-8011	Yuma Supersite	4,480	**1.28**

Figure 4: PM_{10} Thiessen Polygons

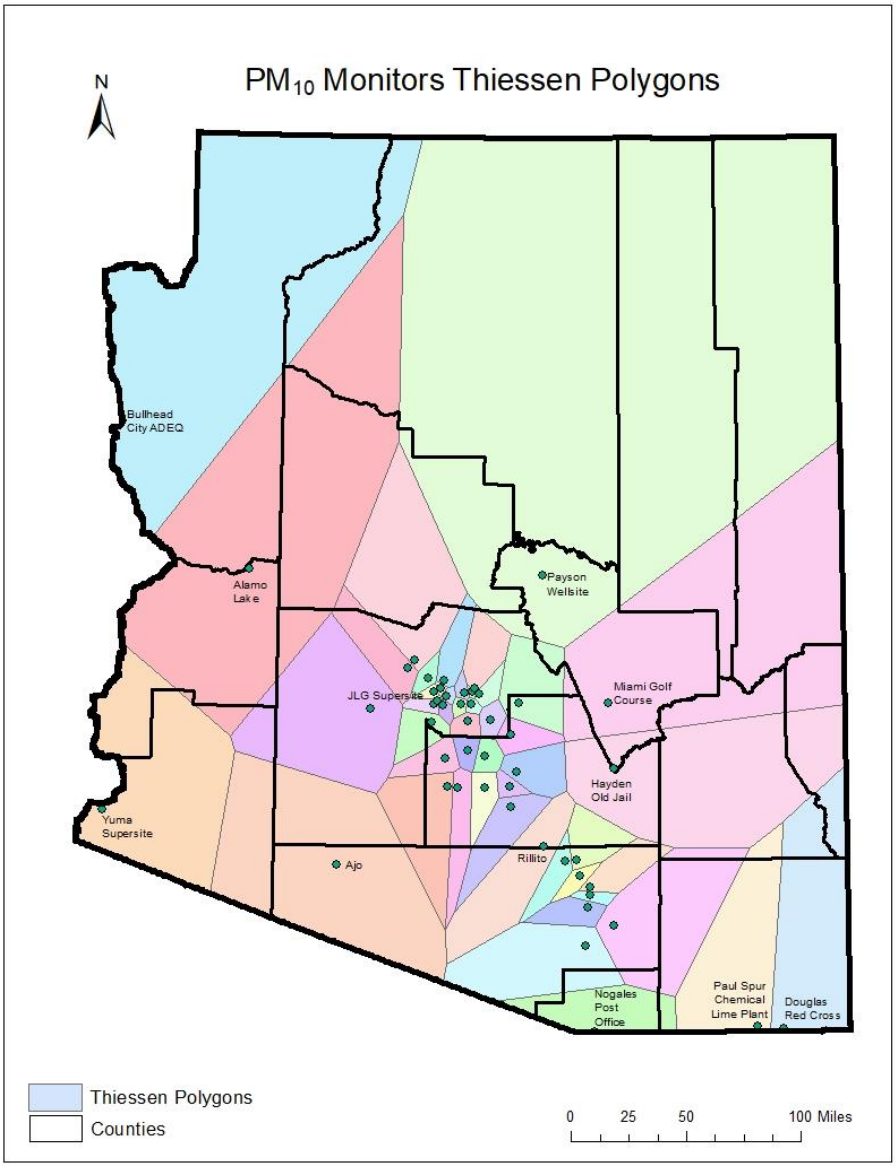
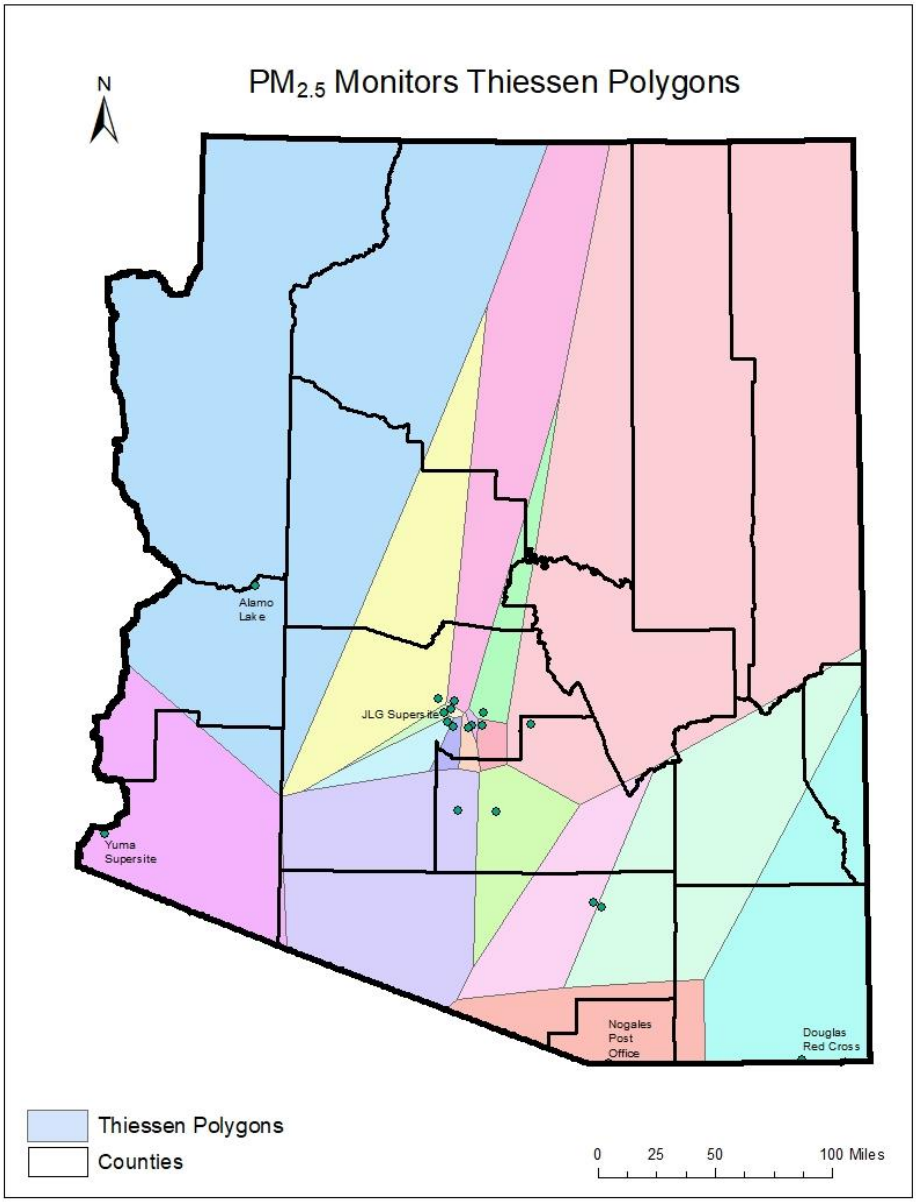


Table 9: $PM_{2.5}$ Instruments by Area Served

AQS ID Site Name		Area Served (sq.-mi)	Indicator Value
04-003-1005	Douglas Red Cross	6,882	**2.23**
04-012-8000	Alamo Lake	30,728	**10.00**
04-013-9997	JLG Supersite (Continuous)	29	**0.00**
04-013-9997	JLG Supersite (Filter)	29	**0.00**
04-023-0004	Nogales Post Office (Continuous)	2,811	**0.91**
04-023-0004	Nogales Post Office (Filter)	2,811	**0.91**
04-027-8011	Yuma Supersite	6,099	**1.98**

Figure 5: $PM_{2.5}$ Thiessen Polygons



C. Population Served

This indicator assesses instruments by the number of people that it represents. Instruments have a stated spatial scale related to their monitoring objectives and purposes, ranging from a few meters to global. EPA's spatial scales and distances are found in Table 10. The spatial scales of monitors are determined by ADEQ before installation and recorded in AQS and in the Network Plan. The EPA confirms the spatial scale. Spatial scale distances are a radius in which concentration readings are relatively uniform.

Using the spatial scale of each monitor, population data are laid over the spatial scale areas and the number of individuals in that area are counted to determine the population served. Population data are broken up into census blocks, which are statistical areas bounded by visible features. To calculate the population in the spatial scale area, total population data were superimposed with the spatial scale circle and then calculated in ArcGIS.

The population in each spatial scale circle is used to assess monitors on a 0 to 10 scale, with the monitor that serves the greatest population receiving a value of 10 and the smallest receiving a value of 0. Population data are taken from the ESRI 2019 population estimates based on 2010 US Census data.

It is assumed that a monitor that represents the largest population is of greatest significance. There are many advantages of using the spatial scale of each monitor to calculate the population served. Monitors are specifically sited to represent the area and population directly surrounding the site. The siting takes into account pollutant sources, roadways, topography, and meteorological considerations to represent the stated spatial scale. This indicator has disadvantages in that it does not take into account the specific purpose of each monitor (background, regional, source specific). Some instruments are not population-oriented thus may not represent a large number of people. This is addressed by only ranking the neighborhood scale type of monitors in each pollutant network as the neighborhood scale is population-oriented.

NOTE: Since this indicator is population-oriented, instruments whose purposes are not for population exposure bias the population results. ADEQ mainly monitors for population exposure using the neighborhood spatial scale. Since this scale is the predominate type for pollutant networks, the ranking values are based on these monitors. Regional scale monitors receive a ranking value of 10. Micro scale and middle scale monitors receive a ranking value of 0. Also, since JLG Supersite is located in a geographic, demographic, and urban anomaly compared to the rest of ADEQ's monitors, it also receives a ranking value of 10. All other monitors are ranked on a 0-10 scale.

Table 10: EPA Monitoring Spatial Scales

Type	Distance	Description
Micro	<100 meters	Defines the concentrations in air volumes associated with area dimensions ranging from several meters up to about 100 meters.
Middle	0.1-0.5 kilometers	Defines the concentration typical of areas up to several city blocks in size with dimensions ranging from about 100 meters to 0.5 kilometer.
Neighborhood	0.5-4.0 kilometers	Defines concentrations within some extended area of the city that has relatively uniform land use with dimensions in the 0.5 to 4.0 kilometers range. The neighborhood and urban scales listed below have the potential to overlap in applications that concern secondarily formed or homogeneously distributed air pollutants.
Urban	4.0-50.0 kilometers	Defines concentrations within an area of city-like dimensions, on the order of 4 to 50 kilometers. Within a city, the geographic placement of sources may result in there being no single site that can be said to represent air quality on an urban scale.
Regional	Tens to hundreds of kilometers *	Defines usually a rural area of reasonably homogeneous geography without large sources, and extends from tens to hundreds of kilometers.
National and Global	A whole nation or the entire globe	These measurement scales represent concentrations characterizing the nation and the globe as a whole.

* For purposes of this report, regional scale monitors use a radius of 100km

Results

Results for the Population Served indicator are given by pollutant. The maximum population served is assigned an indicator value of 10 and the minimum a 0. All instruments are assigned a value relative to these highest and lowest values. Removing the regional scale, middle scale, and JLG Supersite from the Indicator Value scale results in Yuma Supersite having the largest population served of 54,932 individuals.

Table 11: SO_2 Instruments by Population Served

AQS ID	Site Name	Spatial Scale	Population Served	Indicator Value
04-007-0011	Miami Jones Ranch	Neighborhood	3,508	**0.17**
04-007-0012	Miami Townsite	Neighborhood	3,528	**0.17**
04-007-1001	Hayden Old Jail	Neighborhood	1,089	**0.00**
04-013-9997	JLG Supersite	Neighborhood	141,884	**10.00**

Table 12: O_3 Instruments by Population Served

AQS ID	Site Name	Spatial Scale	Population Served	Indicator Value
04-005-1008	Flagstaff Middle School	Neighborhood	47,678	**8.12**
04-007-0010	Tonto National Monument	Regional	3,508,894	**10.00**
04-012-8000	Alamo Lake	Regional	104,988	**10.00**
04-013-9997	JLG Supersite	Neighborhood	141,884	**10.00**
04-021-8001	Queen Valley	Regional	4,441,688	**10.00**
04-025-8034	Prescott Pioneer Park	Neighborhood	16,371	**0.00**
04-027-8011	Yuma Supersite	Neighborhood	54,932	**10.00**

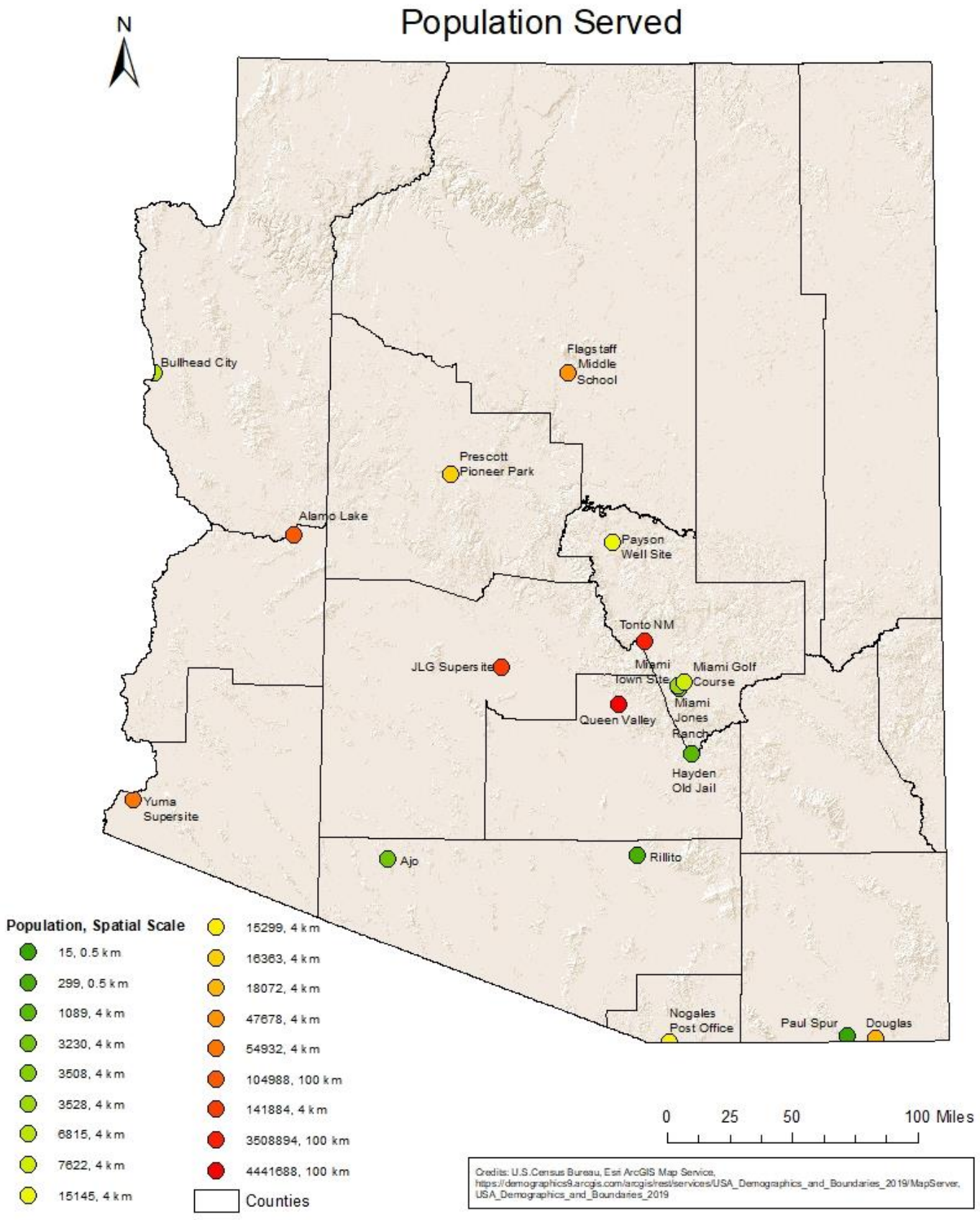
Table 13: PM_{10} Instruments by Population Served

AQS ID	Site Name	Spatial Scale	Population Served	Indicator Value
04-003-0011	Paul Spur Chemical Lime Plant	Middle	15	**0.00**
04-003-1005	Douglas Red Cross	Neighborhood	18,072	**3.15**
04-007-0008	Payson	Neighborhood	15,154	**2.61**
04-007-1001	Hayden Old Jail	Neighborhood	1,089	**0.00**
04-007-8000	Miami Golf Course	Neighborhood	7,622	**1.21**
04-012-8000	Alamo Lake	Regional	104,988	**10.00**
04-013-9997	JLG Supersite	Neighborhood	141,884	**10.00**
04-015-1003	Bullhead City	Neighborhood	6,815	**1.06**
04-019-0001	Ajo	Neighborhood	3,230	**0.40**
04-019-0020	Rillito	Middle	299	**0.00**
04-023-0004	Nogales Post Office	Neighborhood	15,299	**2.64**
04-027-8011	Yuma Supersite	Neighborhood	54,932	**10.00**

Table 14: $PM_{2.5}$ Instruments by Population Served

AQS ID	Site Name	Spatial Scale	Population Served	Indicator Value
04-003-1005	Douglas Red Cross	Neighborhood	18,072	**0.70**
04-012-8000	Alamo Lake	Regional	104,988	**10.00**
04-013-9997	JLG Supersite (Continuous)	Neighborhood	141,884	**10.00**
04-013-9997	JLG Supersite (Filter)	Neighborhood	141,884	**10.00**
04-023-0004	Nogales Post Office (Continuous)	Neighborhood	15,299	**0.00**
04-023-0004	Nogales Post Office (Filter)	Neighborhood	15,299	**0.00**
04-027-8011	Yuma Supersite	Neighborhood	54,932	**10.00**

Figure 6: Population Served by Site



D. Correlation Between Monitors

This indicator assesses instruments based on how well each monitor correlates with other monitors. The correlation used is Pearson's R_2 or coefficient of determination and is a measure of linear correlation between two data sets, giving a value between 0.0 and 1.0. For this indicator, the highest monitor to monitor Pearson's correlation for each monitor was used to assess an instrument's statistical uniqueness. The highest assessed instrument in each network has the lowest correlation from other instruments over the past five years (2014 – 2018). Each pollutant network is assessed on a 0 to 10 scale, with the monitor that correlates best receiving a value of 0, and the most unique instrument receiving a value of 10.

Daily Maximum data were taken from EPA's AQS database for the year 2018 and were chosen to determine if sites on a large scale are similar to one another. All monitors in the pollutant networks in Arizona were used to determine correlation for each of ADEQ's monitors. Data were used from Maricopa County Air Quality Department, Pinal County Air Quality Control District, Pima County Department of Environmental Quality, tribal monitors, and the National Park Service and taken from EPA's AQS database.

It is assumed that monitors that have the lowest correlation to other monitors are most important because they may have a unique data set that is not represented elsewhere. If monitors correlate well with each other, then they may be monitoring the same pollutant sources and in the same area. This would be beneficial to determine which monitors are suitable for removal/relocation.

This indicator has disadvantages in that it does not take into account the requirements for collocation of monitors. The purpose of a collocated monitor is to ensure that there is good correlation; therefore, in these circumstances it would be advantageous to have monitors that correlate well.

Results

Results for the Correlation Between Monitors indicator are given by pollutant. The instrument with lowest correlations is assigned an indicator value of 10 and the highest correlation a 0. All instruments are assigned a value relative to these highest and lowest values.

Table 15: SO_2 Instruments by Correlation Between Monitors

AQS ID	Site Name	Maximum Correlation	Highest Correlated Instrument	Indicator Value
04-007-0011	Miami Jones Ranch	0.4117	Miami Townsite	**0.72**
04-007-0012	Miami Townsite	0.4117	Miami Jones Ranch	**0.72**
04-007-1001	Hayden Old Jail	0.0926	JLG	**10.00**
04-013-9997	JLG Supersite	0.4366	Durango Complex	**0.00**

Table 16: O_3 Instruments by Correlation Between Monitors

AQS ID	Site Name	Maximum Correlation	Highest Correlated Instrument	Indicator Value
04-005-1008	Flagstaff Middle School	0.8388	Prescott Pioneer Park	**3.72**
04-007-0010	Tonto National Monument	0.9224	Blue Point	**1.35**
04-012-8000	Alamo Lake	0.7556	Buckeye	**6.07**
04-013-9997	JLG Supersite	0.9702	North Phoenix	**0.00**
04-021-8001	Queen Valley	0.9250	AJ Maintenance Yard	**1.28**
04-025-8034	Prescott Pioneer Park	0.8388	Flagstaff Middle School	**3.72**
04-027-8011	Yuma Supersite	0.6166	Alamo Lake	**10.00**

NOTE: All of the O_3 monitors correlate very well with each other, all having a minimum correlation coefficient of 0.617. This indicates that O_3 is a regional issue and not a microscale problem.

Table 17: PM_{10} Instruments by Correlation Between Monitors

AQS ID Site Name		Maximum Correlation	Highest Correlated Instrument	Indicator Value
04-003-0011	Paul Spur Chemical Lime Plant	0.2017	South Tucson	9.13
04-003-1005	Douglas Red Cross	0.2485	Geronimo	8.50
04-007-0008	Payson	0.2081	City of Maricopa County Complex	9.04
04-007-1001	Hayden Old Jail	0.2503	Rillito	8.48
04-007-8000	Miami Golf Course	0.2981	Tangerine	7.84
04-012-8000	Alamo Lake	0.2969	Coolidge Maintenance Yard	7.85
04-013-9997	JLG Supersite	0.8832	North Phoenix	0.00
04-015-1003	Bullhead City	0.1837	Zuni Hills	9.37
04-019-0001	Ajo	0.3850	Coolidge Maintenance Yard	6.67
04-019-0020	Rillito	0.2766	Pinal Air Park	8.13
04-023-0004	Nogales Post Office	0.1367	Douglas	10.00
04-027-8011	Yuma Supersite	0.2504	Coolidge Maintenance Yard	8.48

Table 18: $PM_{2.5}$ Instruments by Correlation Between Monitors

AQS ID Site Name		Maximum Correlation	Highest Correlated Instrument	Indicator Value
04-003-1005	Douglas Red Cross	0.1221	Children's Park	**10.00**
04-012-8000	Alamo Lake	0.2904	AJ Fire Station	**7.98**
04-013-9997	JLG Supersite (Continuous)	0.9399	JLG Supersite (Filter)	**0.17**
04-013-9997	JLG Supersite (Filter)	0.9399	JLG Supersite (Continuous)	**0.17**
04-023-0004	Nogales Post Office (Continuous)	0.9541	Nogales Post Office (Filter)	**0.00**
04-023-0004	Nogales Post Office (Filter)	0.9541	Nogales Post Office (Continuous)	**0.00**
04-027-8011	Yuma Supersite	0.1813	AJ Fire Station	**9.29**

E. Removal Bias

Removal bias is a modeled value based indictor. Using the EPA NetAssess2020 tool, it finds the nearest neighbors to each selected site and then uses the data from the neighboring sites to estimate concentrations at the site. It then compares the estimates to the actual concentrations measured at the selected site to determine the Removal Bias. Sites with a greater bias are more important for interpolation because they add a unique value while sites with low bias can be redundant. The site having the greatest absolute bias receives a value of 10, and the least a value of 0.

It is assumed that monitors with a low bias can be removed due to redundancy. It determines redundancies in monitoring networks. This indicator has disadvantages in that it does not take into account geographic features, meteorology or local sources. Additionally, this method is most useful for pollutants with large networks.

Results

Results for the Removal Bias indicator are given by pollutant.

Table 19: SO_2 Instruments by Removal Bias

AQS ID	Site Name	Absolute Mean Removal Bias	Indicator Value
04-007-0011	Miami Jones Ranch	0.90	**0.12**
04-007-0012	Miami Townsite	4.90	**1.10**
04-007-1001	Hayden Old Jail	41.20	**10.00**
04-013-9997	JLG Supersite	0.40	**0.00**

Table 20: O_3 Instruments by Removal Bias

AQS ID	Site Name	Absolute Mean Removal Bias	Indicator Value
04-005-1008	Flagstaff Middle School	0.0022	**5.53**
04-007-0010	Tonto National Monument	0.0007	**1.58**
04-012-8000	Alamo Lake	0.0023	**5.79**
04-013-9997	JLG Supersite	0.0001	**0.00**
04-021-8001	Queen Valley	0.0035	**8.95**
04-025-8034	Prescott Pioneer Park	0.0011	**2.63**
04-027-8011	Yuma Supersite	0.0039	**10.00**

Table 21: PM_{10} Instruments by Removal Bias

AQS ID	Site Name	Absolute Mean Removal Bias	Indicator Value
04-003-0011	Paul Spur Chemical Lime Plant	13.30	**3.60**
04-003-1005	Douglas Red Cross	12.60	**3.40**
04-007-0008	Payson	4.20	**0.98**
04-007-1001	Hayden Old Jail	4.40	**1.04**
04-007-8000	Miami Golf Course	7.30	**1.87**
04-012-8000	Alamo Lake	17.00	**4.67**
04-013-9997	JLG Supersite	0.80	**0.00**
04-015-1003	Bullhead City	1.60	**0.23**
04-019-0001	Ajo	35.50	**10.00**
04-019-0020	Rillito	19.30	**5.33**
04-023-0004	Nogales Post Office	18.40	**5.07**
04-027-8011	Yuma Supersite	1.60	**0.23**

Table 22: $PM_{2.5}$ Instruments by Removal Bias

AQS ID	Site Name	Absolute Mean Removal Bias	Indicator Value
04-003-1005	Douglas Red Cross	2.34	**9.40**
04-012-8000	Alamo Lake	2.32	**9.28**
04-013-9997	JLG Supersite (Continuous)	0.77	**0.00**
04-013-9997	JLG Supersite (Filter)	0.77	**0.00**
04-023-0004	Nogales Post Office (Continuous)	2.44	**10.00**
04-023-0004	Nogales Post Office (Filter)	2.44	**10.00**
04-027-8011	Yuma Supersite	2.10	**7.96**

F. Source Oriented

A source oriented monitor is a regulatory category. The source oriented indicator is a simple yes or no. Monitors in either a nonattainment or a maintenance area are source oriented. If an instrument's purpose is to monitor for point or area source emissions, it is source oriented and receives the highest value of 10. If it is not source oriented, it receives a value of 0.

It is assumed that it is more important to have a monitor that is source oriented. This indicator has disadvantages in that it does not take into account the full breadth of monitoring needed to fully characterize a unique area's ambient air quality.

Results

Results for the Source Oriented Monitor indicator are given by pollutant. The source oriented monitors are assigned an indicator value of 10 and the non-source oriented a 0.

Table 23: SO_2 Instruments by Source Oriented Monitor

AQS ID	Site Name	Source Oriented Monitor?	Indicator Value
04-007-0011	Miami Jones Ranch	Yes	**10.00**
04-007-0012	Miami Townsite	Yes	**10.00**
04-007-1001	Hayden Old Jail	Yes	**10.00**
04-013-9997	JLG Supersite	No	**0.00**

Table 24: O_3 Instruments by Source Oriented Monitor

AQS ID	Site Name	Source Oriented Monitor?	Indicator Value
04-005-1008	Flagstaff Middle School	No	**0.00**
04-007-0010	Tonto National Monument	No	**0.00**
04-012-8000	Alamo Lake	No	**0.00**
04-013-9997	JLG Supersite	No	**0.00**
04-021-8001	Queen Valley	No	**0.00**
04-025-8034	Prescott Pioneer Park	No	**0.00**
04-027-8011	Yuma Supersite	No	**0.00**

Table 25: PM_{10} Instruments by Source Oriented Monitor

AQS ID	Site Name	Source Oriented Monitor?	Indicator Value
04-003-0011	Paul Spur Chemical Lime Plant	Yes	**10.00**
04-003-1005	Douglas Red Cross	Yes	**10.00**
04-007-0008	Payson	Yes	**10.00**
04-007-1001	Hayden Old Jail	Yes	**10.00**
04-007-8000	Miami Golf Course	Yes	**10.00**
04-012-8000	Alamo Lake	No	**0.00**
04-013-9997	JLG Supersite	Yes	**10.00**
04-015-1003	Bullhead City	Yes	**10.00**
04-019-0001	Ajo	Yes	**10.00**
04-019-0020	Rillito	Yes	**10.00**
04-023-0004	Nogales Post Office	Yes	**10.00**
04-027-8011	Yuma Supersite	Yes	**10.00**

Table 26: $PM_{2.5}$ Instruments by Source Oriented Monitor

AQS ID	Site Name	Source Oriented Monitor?	Indicator Value
04-003-1005	Douglas Red Cross	No	**0.00**
04-012-8000	Alamo Lake	No	**0.00**
04-013-9997	JLG Supersite (Continuous)	No	**0.00**
04-013-9997	JLG Supersite (Filter)	No	**0.00**
04-023-0004	Nogales Post Office (Continuous)	Yes	**10.00**
04-023-0004	Nogales Post Office (Filter)	Yes	**10.00**
04-027-8011	Yuma Supersite	No	**0.00**

G. Final Rankings

The final rankings combine all the indicators in the Ranking Analysis and ranks the instruments by averaging the indicator values. The highest indicator value average is the highest ranked instrument in the network and is therefore the most meaningful and important. The lowest ranked instrument could be considered for relocation or removal if possible. Recommendations for possible relocation, removal, or addition of monitors are in Section III: Final Conclusions and Recommendations on Page 51 of this assessment.

Indicator values from each of the previous indicator sections are then individually weighted and averaged to get a final ranking. Results are shown both weighted and un-weighted. Weighing the indicators is necessary because it is not assumed that all the indicators have the same importance to the public welfare, regulatory actions, and to ambient air monitoring in Arizona. For example, the measured concentration indicator is considered to be of higher importance and has more meaning than the Source Oriented indicator. Both indicators are considerations when running an air monitoring network, but operating an instrument that has higher concentrations is of higher significance than if the instrument is source oriented or not.

Weights were derived from two consensus meetings with ADEQ's Air Quality Division staff and a survey given to others in Arizona's air monitoring community. The consensus meetings and survey were conducted by asking participants to rate the importance of each indicator listed in Section I: Ranking Analysis on Page 11 on a scale from 1 to 5 (1=0.10, 2=0.25, 3=0.50, 4=0.75 and 5=1.00). In total, 30 members of ADEQ's Air Quality Division staff attended the meetings and one survey response was collected from Arizona's air monitoring community. Indicators with lower importance were rated 1 and higher importance were rated 5. The results are found in Table 27 and were multiplied to the indicator values. The weighted indicator values were then averaged by instrument for the Final Rankings.

Table 27: Ranking Analysis Pollutant Results

Indicator	SO_2	O_3	PM_{10}	$PM_{2.5}$
Measured Concentration	1.00	1.00	1.00	1.00
Area Served	0.25	0.50	0.50	0.50
Population Served	0.25	0.75	0.75	0.50
Monitor to Monitor Correlation	0.25	0.50	0.50	0.50
Removal Bias	0.25	0.50	0.50	0.50
Source Oriented	0.75	0.10	0.25	0.25

Results

The ranking results for the four pollutant networks are shown hereafter. The unweighted and weighted ranking results are shown to compare the difference before the weighting and after the weighting. The highest indicator average is the highest ranked monitor and is the most important and meaningful to air monitoring.

a. SO_2 Results

Table 28: Weighted SO_2 Instrument Results. Unweighted Results in Parentheses

AQS ID	Site Name	County	Measured Concentration	Area Served	Population Served	Correlation Between Monitors	Removal Bias	Source Oriented	Average	Rank
04-007-0011	Miami Jones Ranch	Gila	6.95 (6.95)	0 (0)	0.04 (0.17)	0.18 (0.72)	0.03 (0.12)	7.5 (10)	2.45	**3**
04-007-0012	Miami Townsite	Gila	5.49 (5.49)	1.79 (7.14)	0.04 (0.17)	0.18 (0.72)	0.28 (1.1)	7.5 (10)	2.55	**2**
04-007-1001	Hayden Old Jail *	Gila	10 (10)	0.29 (1.15)	0 (0)	2.5 (10)	2.5 (10)	7.5 (10)	3.80	**1**
04-013-9997	JLG Supersite	Maricopa	0 (0)	2.5 (10)	2.5 (10)	0 (0)	0 (0)	0 (0)	0.83	**4**

*** Nonattainment Area**

b. O_3 Results

Table 29: Weighted O_3 Instrument Results. Unweighted Results in Parentheses

AQS ID	Site Name	County	Measured Concentration	Area Served	Population Served	Correlation Between Monitors	Removal Bias	Source Oriented	Average	Rank
04-005-1008	Flagstaff Middle School	Coconino	0 (0)	2.99 (5.98)	6.09 (8.12)	1.86 (3.72)	2.77 (5.53)	0 (0)	2.74	**6**
04-007-0010	Tonto National Mon. *	Gila	5.9 (5.9)	2.2 (4.4)	7.5 (10)	0.68 (1.35)	0.79 (1.58)	0 (0)	2.84	**5**
04-012-8000	Alamo Lake	La Paz	1.54 (1.54)	5 (10)	7.5 (10)	3.04 (6.07)	2.9 (5.79)	0 (0)	3.33	**2**
04-013-9997	JLG Supersite *	Maricopa	10 (10)	0 (0)	7.5 (10)	0 (0)	0 (0)	0 (0)	2.92	**4**
04-021-8001	Queen Valley *	Pinal	5.48 (5.48)	0.59 (1.18)	7.5 (10)	0.64 (1.28)	4.48 (8.95)	0 (0)	3.11	**3**
04-025-8034	Prescott Pioneer Park	Yavapai	0.51 (0.51)	1.99 (3.98)	0 (0)	1.86 (3.72)	1.32 (2.63)	0 (0)	0.95	**7**
04-027-8011	Yuma Supersite *	Yuma	7.44 (7.44)	2.02 (4.03)	7.5 (10)	5 (10)	5 (10)	0 (0)	4.49	**1**

*** Nonattainment Area**

c. PM_{10} Results

Table 30: Weighted PM_{10} Instrument Results. Unweighted Results in Parentheses

AQS ID	Site Name	County	Measured Concentration	Area Served	Population Served	Correlation Between Monitors	Removal Bias	Source Oriented	Average	Rank
04-003-0011	Paul Spur Chemical Lime Plant *	Cochise	1.07 (1.07)	0.36 (0.72)	0 (0)	4.56 (9.13)	1.8 (3.6)	2.5 (10)	1.56	**12**
04-003-1005	Douglas *	Cochise	5.59 (5.59)	0.46 (0.91)	2.37 (3.15)	4.25 (8.5)	1.7 (3.4)	2.5 (10)	2.87	**4**
04-007-0008	Payson ***	Gila	1.37 (1.37)	5 (10)	1.96 (2.61)	4.52 (9.04)	0.49 (0.98)	2.5 (10)	2.67	**5**
04-007-1001	Hayden Old Jail *	Gila	6.28 (6.28)	0.78 (1.56)	0 (0)	4.24 (8.48)	0.52 (1.04)	2.5 (10)	2.36	**8**
04-007-8000	Miami Golf Course *	Gila	2.74 (2.74)	1.37 (2.73)	0.91 (1.21)	3.92 (7.84)	0.94 (1.87)	2.5 (10)	2.06	**10**
04-012-8000	Alamo Lake	La Paz	0 (0)	1.82 (3.64)	7.5 (10)	3.93 (7.85)	2.34 (4.67)	0 (0)	2.60	**7**
04-013-9997	JLG Supersite **	Maricopa	5.69 (5.69)	0 (0)	7.5 (10)	0 (0)	0 (0)	2.5 (10)	2.61	**6**
04-015-100	Bullhead City	Mohave	2.39 (2.39)	1.76 (3.52)	0.8 (1.06)	4.69 (9.37)	0.12 (0.23)	2.5 (10)	2.04	**11**
04-019-0001	Ajo *	Pima	1.95 (1.95)	0.87 (1.73)	0.3 (0.4)	3.34 (6.67)	5 (10)	2.5 (10)	2.32	**9**
04-019-0020	Rillito *	Pima	9.87 (9.87)	0.04 (0.08)	0 (0)	4.06 (8.13)	2.67 (5.33)	2.5(10)	3.19	**3**
04-023-0004	Nogales Post Office *	Santa Cruz	7.62 (7.62)	0.17 (0.33)	1.98 (2.64)	5 (10)	2.54 (5.07)	2.5 (10)	3.30	**2**
04-027-8011	Yuma Supersite *	Yuma	10 (10)	0.64 (1.28)	7.5 (10)	4.24 (8.48)	0.12 (0.23)	2.5 (10)	4.17	**1**

*** Moderate Nonattainment Area; ** Serious Nonattainment Area; *** Maintenance Area**

d. $PM_{2.5}$ Results

Table 31: Weighted $PM_{2.5}$ Instrument Results. Unweighted Results in Parentheses

AQS ID	Site Name	County	Measured Concentration	Area Served	Population Served	Correlation Between Monitors	Removal Bias	Source Oriented	Average	Rank
04-003-1005	Douglas **	Cochise	1.66 (1.66)	1.12 (2.23)	0.35 (0.7)	5 (10)	4.7 (9.4)	0 (0)	2.57	**4**
04-012-8000	Alamo Lake	La Paz	0 (0)	5 (10)	5 (10)	3.99 (7.98)	4.64 (9.28)	0 (0)	3.73	**2**
04-013-9997	JLG Supersite (Continuous)	Maricopa	7.16 (7.16)	0 (0)	5 (10)	0.09 (0.17)	0 (0)	0 (0)	2.45	**6**
04-013-9997	JLG Supersite (Filter)	Maricopa	6.48 (6.48)	0 (0)	5 (10)	0.09 (0.17)	0 (0)	0 (0)	2.31	**7**
04-023-0004	Nogales Post Office (Continuous) *	Santa Cruz	10 (10)	0.46 (0.91)	0 (0)	0 (0)	5 (10)	2.5 (10)	3.09	**3**
04-023-0004	Nogales Post Office (Filter) *	Santa Cruz	7.22 (7.22)	0.46 (0.91)	0 (0)	0 (0)	5 (10)	2.5 (10)	2.54	**5**
04-027-8011	Yuma Supersite	Yuma	6.75 (6.75)	0.99 (1.98)	5 (10)	4.65 (9.29)	3.98 (7.96)	0 (0)	4.27	**1**

*** Nonattainment Area; ** Removed Jan. 1, 2020**

Section II: Spatial Raster Analysis

In order to determine if ADEQ's existing ambient monitoring network adequately represents Arizona's unique air quality, a spatial analysis is conducted using a variety of indicators shown in Table 32. The indicators are mapped to visually show places in Arizona where monitoring could be beneficial for Arizona's population and to show the adequacy of ADEQ's ambient monitoring network.

The five indicators used in this analysis have two general classifications: demographic and spatial. For each indicator, a map is produced showing areas of higher interest based on the indicator's data. The results are then converted to a 0 to 10 scale using Natural Breaks, which enable the indicator maps to be eventually combined into one map.

To accomplish this, each indicator map is converted into a GIS raster image. A raster image is a type of spatial data set that assigns numerical values to every part of Arizona, represented by grid cells. By placing numerical values around Arizona, each indicator can be quantified in every area of the state. The five raster images are then weighed because indicators vary in importance to ambient air monitoring. Lastly, the weighted raster images for each indicator are combined to show the final weighted spatial overlay map for all of Arizona. Weighted spatial overlay maps were created for O_3, PM_{10}, and $PM_{2.5}$.

Chosen indicators represent a variety of aspects that are important to developing a robust air monitoring network. The following five indicators are used in the raster analysis:

Table 32: Raster Analysis Indicators

Indicator	Description	Indicator Type
Mortality & Morbidity Rate	Using the primary care areas in Arizona, this indicator ranks the areas based on mortality and morbidity rate of air pollution related health effects per area population. The highest valued areas have the highest rate of both.	Demographic
Sensitive Age Distribution	Using the ESRI 2019 population estimates Census blocks, this indicator ranks the areas based on the total number of sensitive individuals per 10,000 people. Age sensitive individuals are children and the elderly, therefore the highest valued areas have the highest total number of children 0-14 and the elderly >65.	Demographic
Total Population	Using the ESRI 2019 population estimates Census blocks, this indicator ranks the areas based on the total population. The highest valued areas have the highest number of individuals.	Demographic
Distance between Monitors	This indicator ranks the straight line distance between monitors. The areas that have the greatest distances between monitors are valued highest.	Spatial
Predicted Values	Applying Kriging interpolation to 2014-2018 average design values, this indicator ranks areas that are based on the predicted values. A Kriging interpolation map is a prediction model that projects air concentrations in unmonitored areas, based on actual measurements. The areas that have the highest predicted values are valued highest.	Spatial

A. Mortality and Morbidity Rate

This indicator values areas based on mortality counts for deaths from heart disease and chronic lower respiratory disease and morbidity (chronic or acute poor health) hospitalization records for adult asthma, chronic obstructive pulmonary disease (COPD), and congestive heart failure. The rate of mortality and morbidity is per 10,000 people per primary care area and is used to show areas that have a greater number of individuals potentially affected by air pollution (see Figure 7). This indicator provides a method of accounting for sensitive individuals by identifying people that are particularly sensitive to air quality issues.

It is assumed that areas with more deaths and higher hospitalizations are of greater importance, therefore, such areas are assigned higher scores. This indicator does not assume that the deaths and hospitalizations are a direct result of poor air quality in the area, only that individuals with the previously mentioned conditions can be sensitive to poor air quality. This indicator has disadvantages in that hospitalization records do not show where the individuals work or live, only where they went to the hospital.

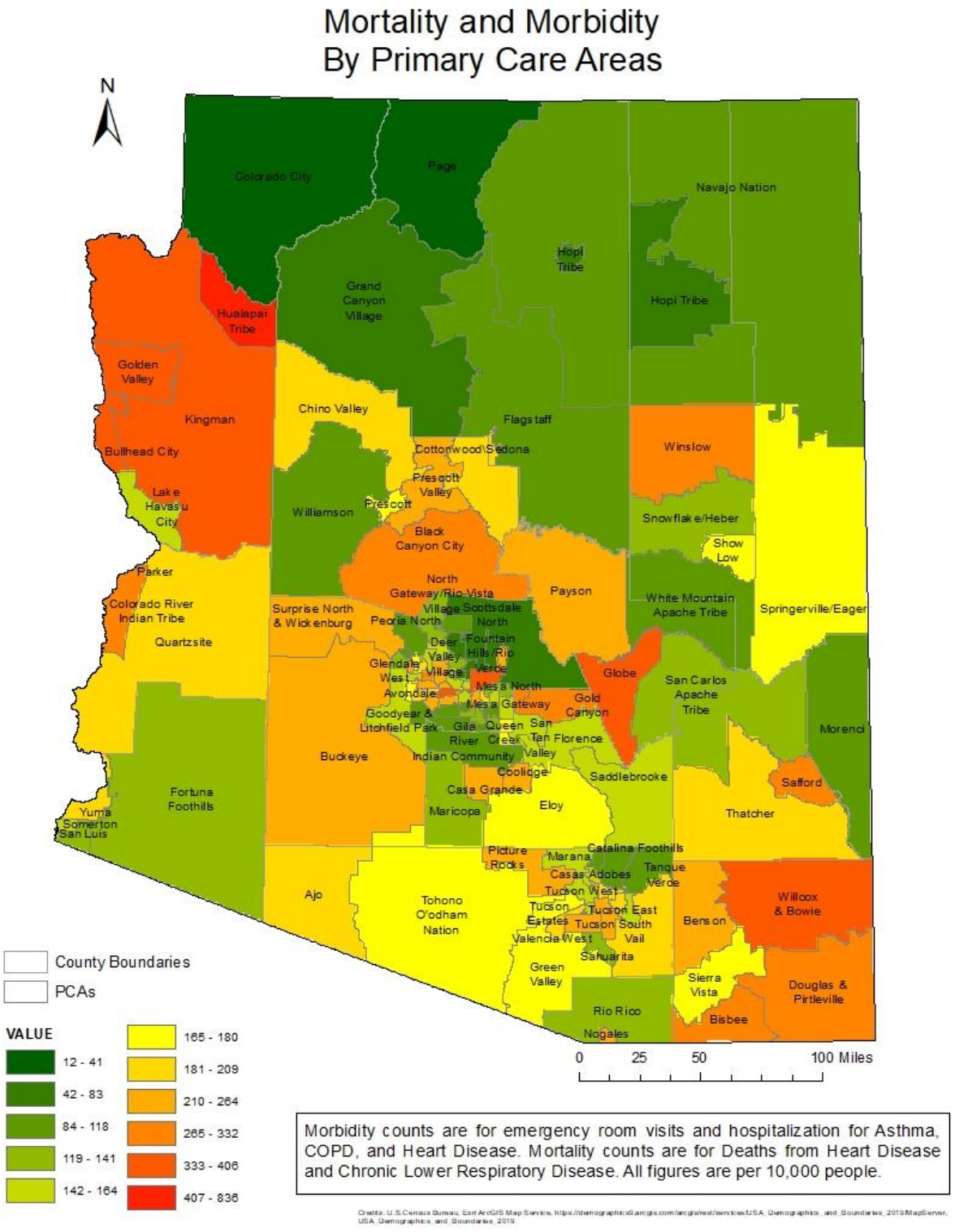
The entire distribution of deaths and hospitalizations is divided into 11 parts and assigned a score of 0 to 10, with 10 being the highest partition.

Deaths and hospitalization data is from the Arizona Department of Health Services (AZDHS), where it is listed by primary care area, and is publicly available on the AZDHS website at azdhs.gov/phs/phstats/profiles.

Results

The highest rate of deaths and hospitalizations per 10,000 people is shown in red.

Figure 7: Mortality and Morbidity Rate Map



B. Sensitive Age Distribution

This indicator uses the ESRI 2019 population estimates based off the 2010 US Census data to account for another population of sensitive individuals. This indicator values areas based on the total number of individuals in the age categories of 0 to 17 and older than 65. The total number of sensitive age individuals of each census block group (sensitive individuals per area) is calculated. Census block groups are geographical areas that have between 600 and 3,000 individuals. Areas with a higher distribution of sensitive ages receive higher scores. This indicator provides another method of accounting for sensitive individuals.

It is assumed that areas with the highest number of children and the elderly are most affected by air quality issues. This indicator does not assume that all individuals in the 0 to 17 and older than 65 age groups are sensitive to poor air quality, only that these age groups are considered to be sensitive for the assessment. This indicator has disadvantages in that it does not take into account where people go to school or work, only where they live.

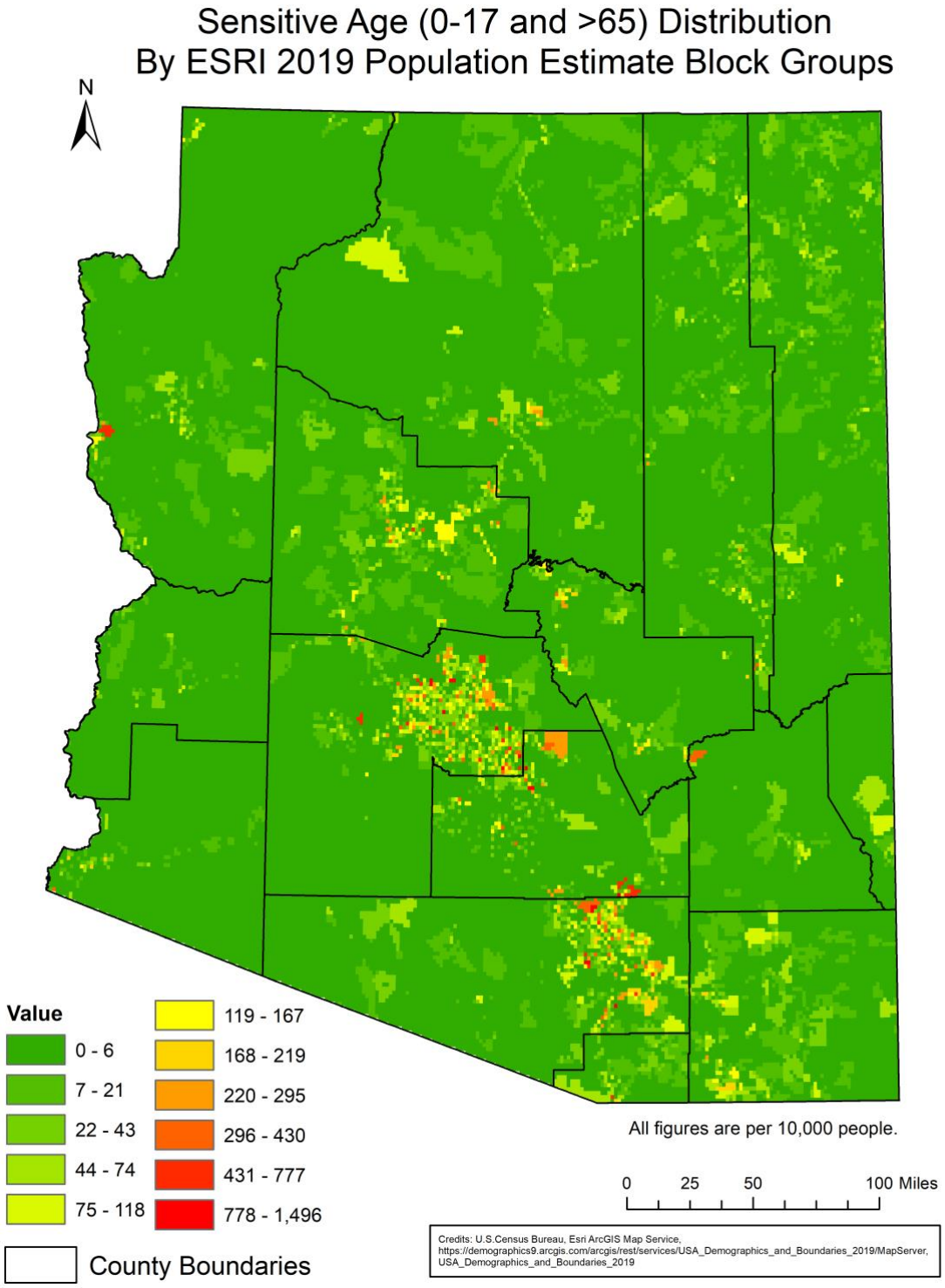
The entire distribution of sensitive individuals is divided into 11 parts and assigned a score of 0 to 10, with 10 being the highest partition.

Population details by census block group are publicly available data from the US Census.

Results

The highest Sensitive Age Distribution is shown in red.

Figure 8: Sensitive Age Distribution Map



C. Total Population

This indicator values areas by the number of people per census block groups. A spatial output map is created showing the total populations in Arizona. The entire distribution is divided into 11 parts and assigned a score of 0 to 10, with 10 being the highest partition.

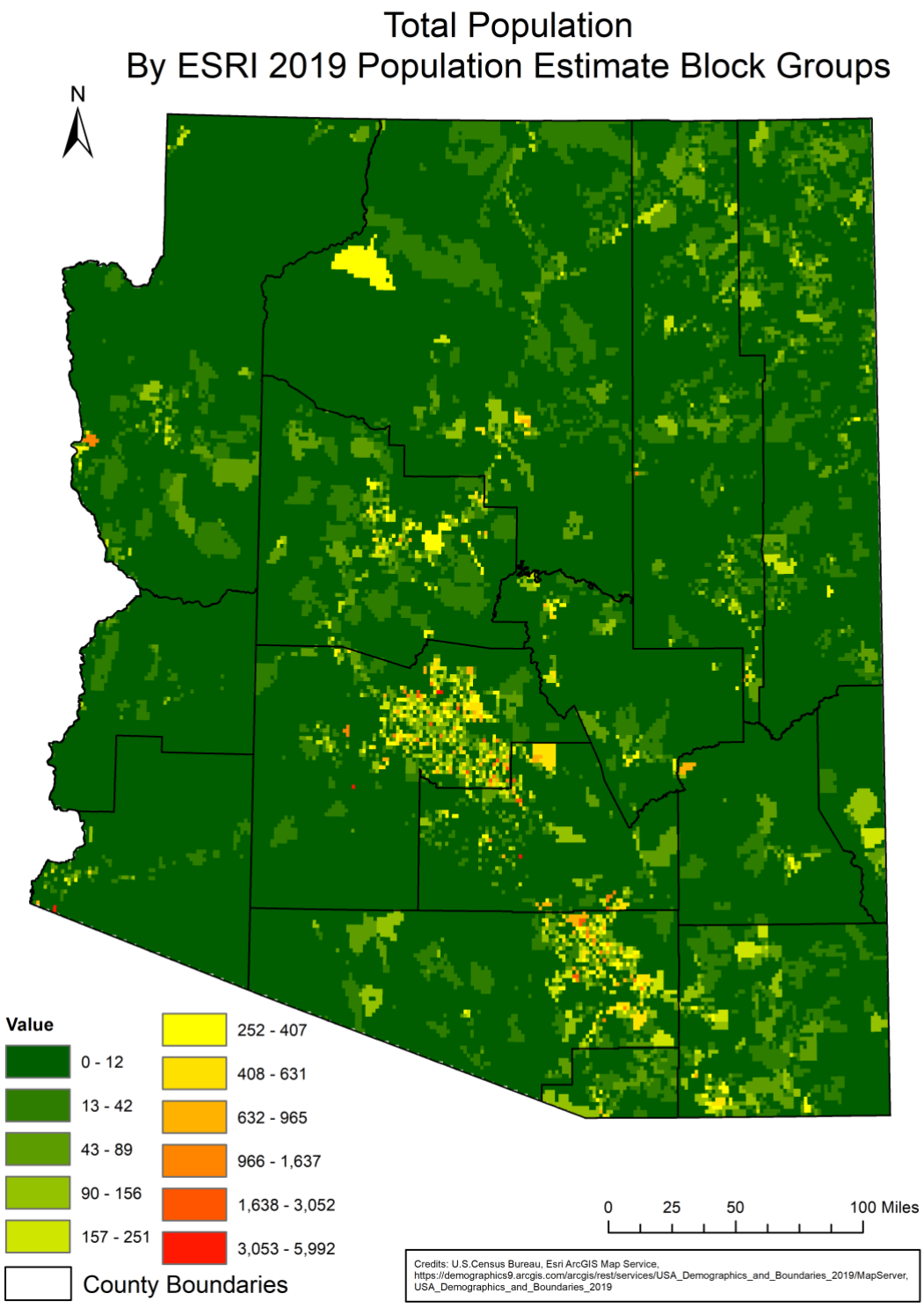
Higher populations per block group are assigned higher scores since it is assumed that it is more desirable to have a monitor representing the greatest number of people. This indicator has disadvantages in that census blocks generally have the same number of individuals, therefore each one may not differ drastically from another. This would then not correctly show areas of high concentrations of individuals. Population density (population divided by area) was also considered to be used for this indicator, as it gives a better representation of the urban areas but produces inaccuracies and over represented densities in the rural areas. Total population was chosen over population density because it gives a better representation of the rural areas and an acceptable representation of the urban areas of Arizona. Another disadvantage is that census block groups can include both an urban population and surrounding non-populated areas. This results in a block that seems to show a large number of people over a big area, where the actual population is concentrated in one spot. The resultant total population map (Figure 9) shows an accurate representation of populations in all of Arizona.

Population details by census block are publicly available data from the US Census.

Results

The highest total population is shown in red.

Figure 9: Total Population Map



D. Distance Between Monitors

This indicator values areas based on the how far existing monitoring sites are from other existing monitoring sites. This is achieved by calculating the straight-line distance from an existing monitoring site. In application, this indicator creates concentric rings around each monitoring site at pre-defined distances. The scored value increases the farther away from existing monitoring sites to show that it is more desirable to place a monitor farther from another monitor. Overlapping concentric rings use the shortest distance value to adjust for nearby sites. The locations of all state, local, and tribal monitors in Arizona are used.

The assumption is that it is more desirable to have a new monitoring site farther away from an existing site to represent a different population, cover an underrepresented area, and/or measure a unique air parcel. Concentric ring sizes are defined by pollutant in Table 33 and are taken from the Section I (D): Correlation Between Monitors (Page 23) data set. By using the correlation values, the maximum distance of correlation was determined. Monitors that do not correlate with each other are farther in distance. This distance of correlation (influence) is the maximum distance set between monitors, with 10 concentric rings leading up to that maximum. Each pollutant's distance of influence is dependent on its reactivity and longevity in the atmosphere.

This indicator has disadvantages in that it does not take into account pollutant sources, meteorological factors, or topography in Arizona.

The entire distribution of distances is divided into 11 parts and assigned a score of 0 to 10, with 10 being the highest partition. This highest partition includes any area beyond the maximum concentric ring to extend the coverage to all of Arizona.

Monitor locations were taken from EPA's AQS web application database. The AMP500 Extract Site/Monitor Data report was run for all monitors in Arizona, including state, local, and tribal monitors. Only monitors that were in operation during the 2014 to 2018 time period were used.

Table 33: Distance Between Monitors Concentric Ring Sizes

Pollutant	Concentric Ring Size
O_3	6 mile rings up to 60 miles
PM_{10}	3 mile rings up to 30 miles
$PM_{2.5}$	3 mile rings up to 30 miles

Results

The areas farthest away from monitors are shown in red.

Figure 10: O_3 Distance Between Monitors Map

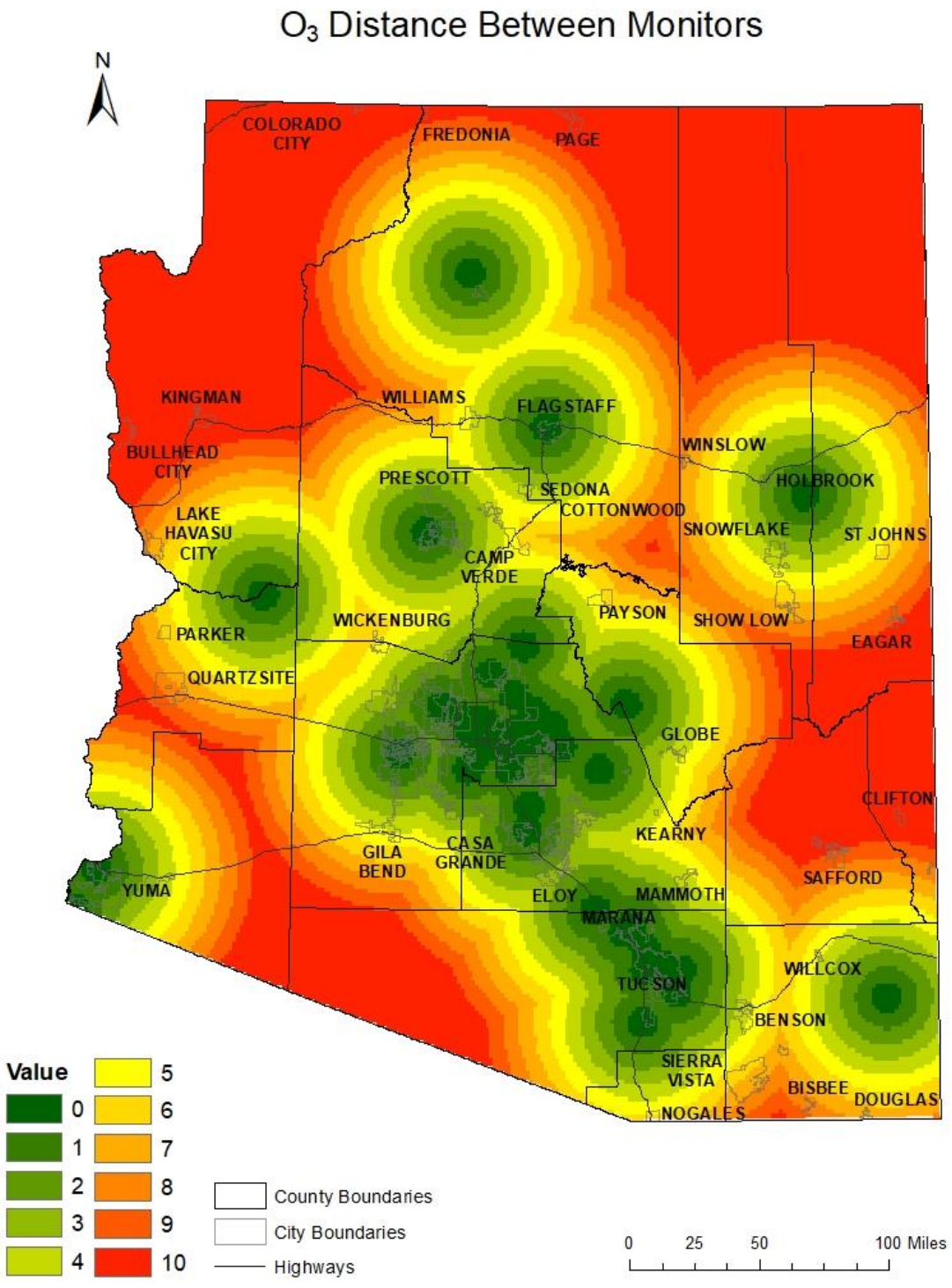


Figure 11: PM_{10} Distance Between Monitors Map

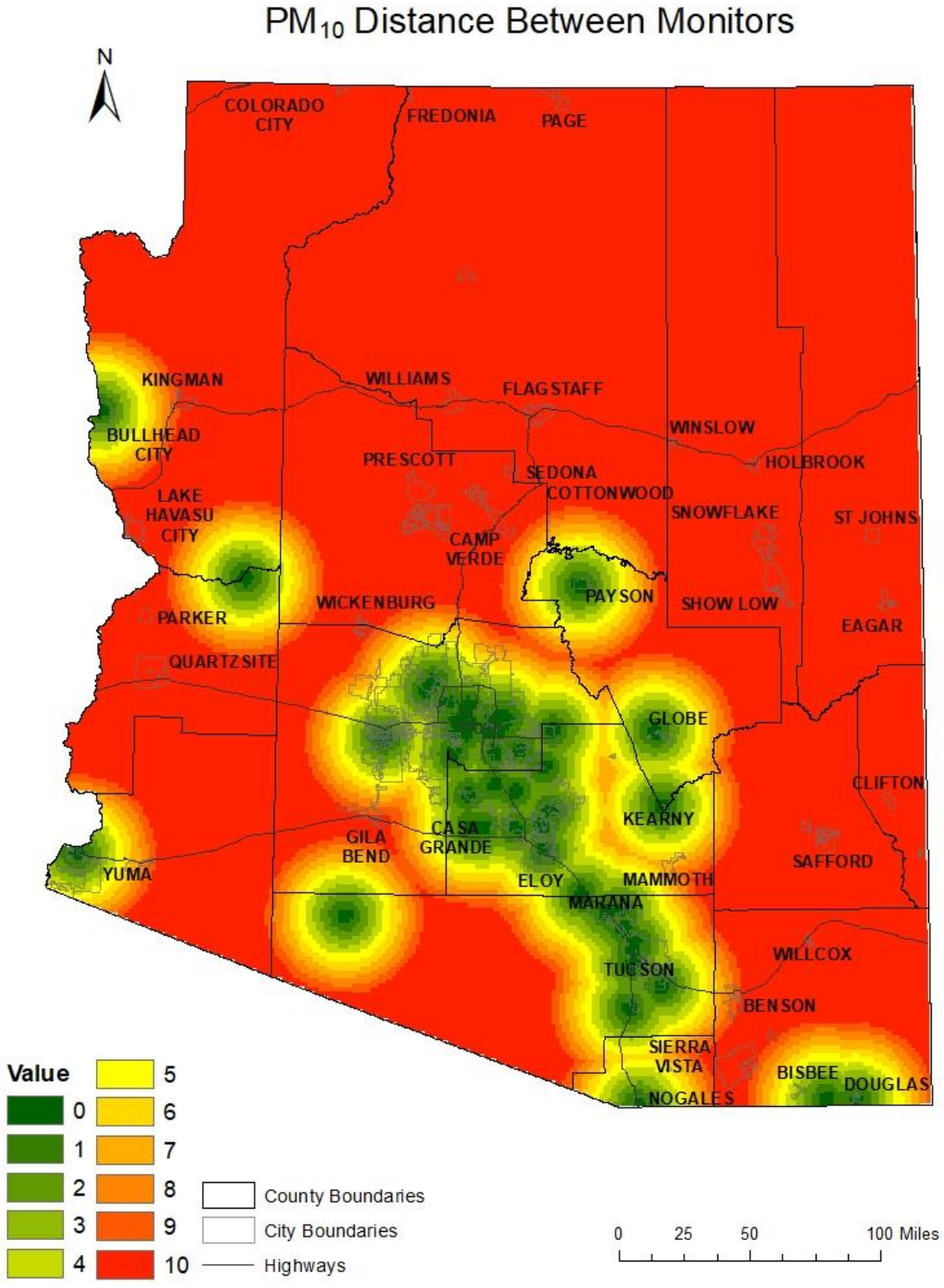
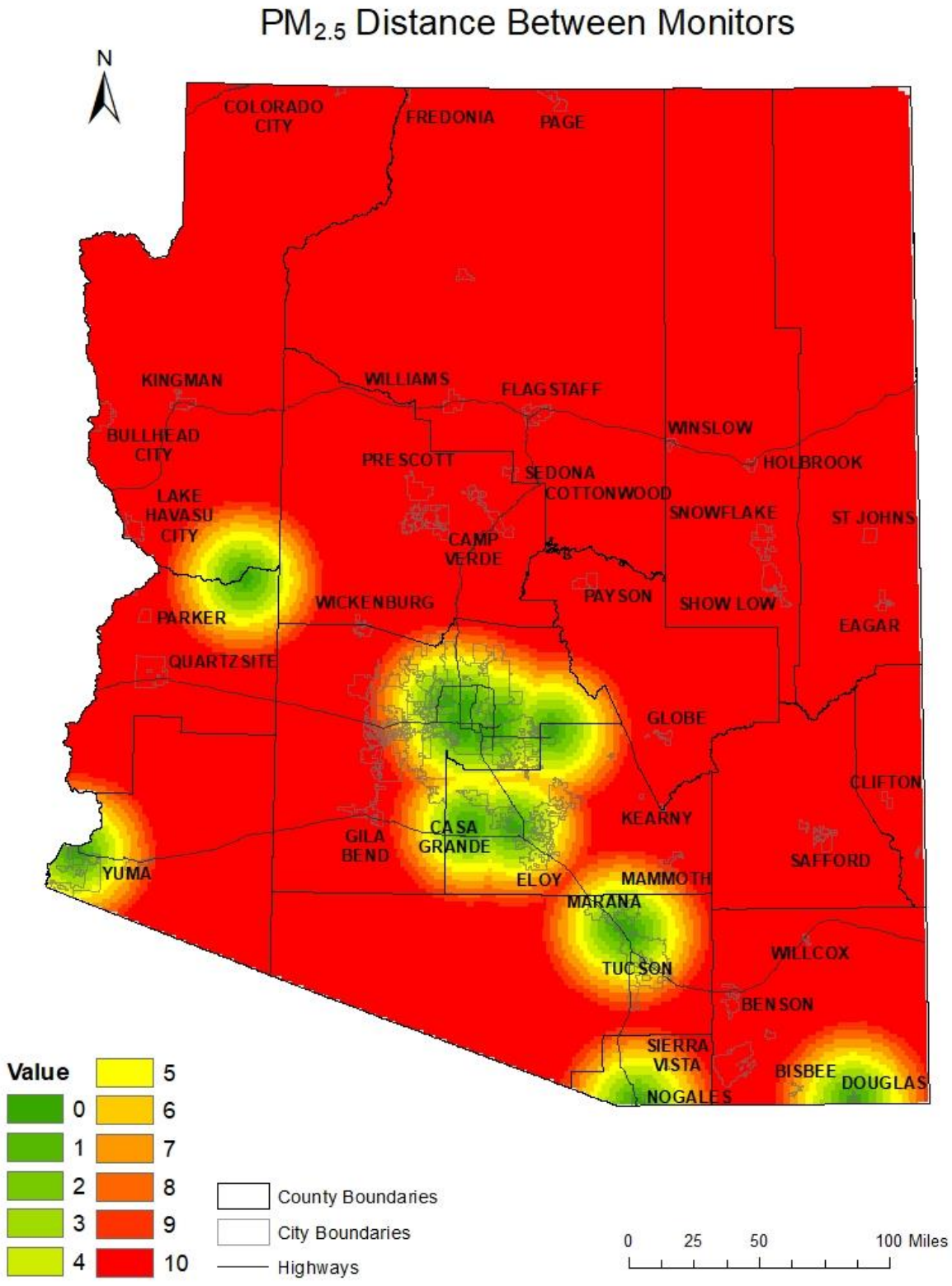


Figure 12: $PM_{2.5}$ Distance Between Monitors Map



E. Predicted Values

This indicator is a prediction model that uses a Kriging interpolation tool in ArcGIS to show predicted pollutant values. To make its prediction, the Kriging interpolation is applied to 2014 – 2018 average design values for O_3, PM_{10}, and $PM_{2.5}$. However, it does not take into account topographic, demographic, or meteorological factors in its prediction. In general, this indicator shows areas of higher and lower predicted average design values (concentrations) on a gradient similar to a topographic map. The indicator scores areas higher that have greater predicted concentrations.

It is assumed that areas with the highest predicted average design values are most important to monitoring in Arizona. This indicator has a disadvantage in that the predicted values have greater error in areas that are farther away from monitoring sites. This error should thus be taken into account when interpreting this indicator. It is important to include a predicted value model in this analysis to estimate concentration levels around Arizona and therefore the Kriging interpolation ArcGIS tool was used to create this unique data set.

The entire distribution of values is divided in 11 parts and assigned a score of 0 to 10, with 10 being the highest partition and highest predicted value.

Data were taken from the EPA's AQS web application database. The AMP480 Design Value Report was run for all monitors in Arizona, including state, local, and tribal monitors. Only monitors that were in operation during the 2014 to 2018 time period were used. Additional instruments outside of Arizona were used to lower the amount of error in the prediction models. The instruments outside of Arizona that were used in the analysis can be found in Table 34.

Table 34: Sites Outside of Arizona

SITE NAME	Site ID	State	O_3	PM_{10}	$PM_{2.5}$
NA Cedar city	49-021-0005	Utah	X		X
NA St. George	49-053-0007	Utah	X		X
Hawthorne Elementary School	49-035-3006	Utah	X	X	
Escalante National Monument	49-017-0006	Utah	X		
Mesa Verde NP - Resource Management Area	80-083-0101	Colorado	X		
6ZK Chaparral	35-013-0020	New Mexico	X	X	
6ZM Desert View	35-013-0021	New Mexico	X		X
6CM Anthony	35-013-0016	New Mexico			X
6Q Las Cruces in New Mexico	35-013-0025	New Mexico			X
South Valley	35-001-0029	New Mexico	X		
Foothills	35-001-0023	New Mexico	X	X	
Chaco Culture NHP - Radio Repeater	35-045-0020	New Mexico	X		
El Paso Chamizal C41	48-141-0044	Texas	X		X
Ivanhoe	48-141-0029	Texas	X		
Jean	32-003-1019	Nevada	X	X	X
Green Valley	32-003-0298	Nevada	X	X	X
Calexico-Ethel Street	60-025-0005	California	X	X	X
Joshua Tree NP - Cottonwood Visitor Center	60-065-0010	California	X		X
Blythe-445 W Murphy Street	60-065-9003	California	X		
Brawley-220 Main Street	60-025-0007	California		X	X
San Luis Rio Colorado Well 10	80-026-8012	Mexico	X		
Random Mexico Point	N/A	Mexico	X	X	X

Results

The highest predicted values are shown in red.

Figure 13: O_3 Predicted Values Map

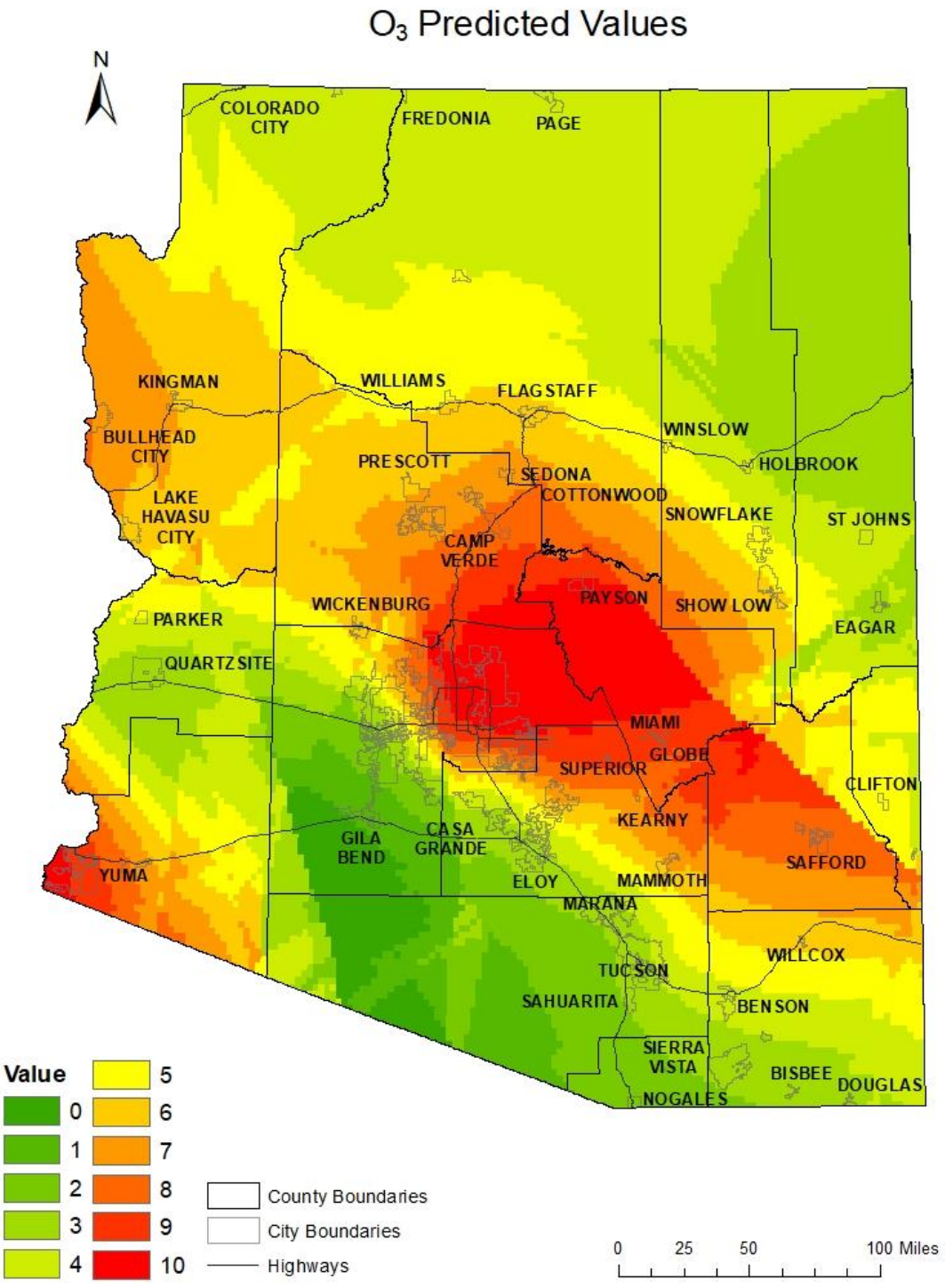


Figure 14: PM_{10} Predicted Values Map

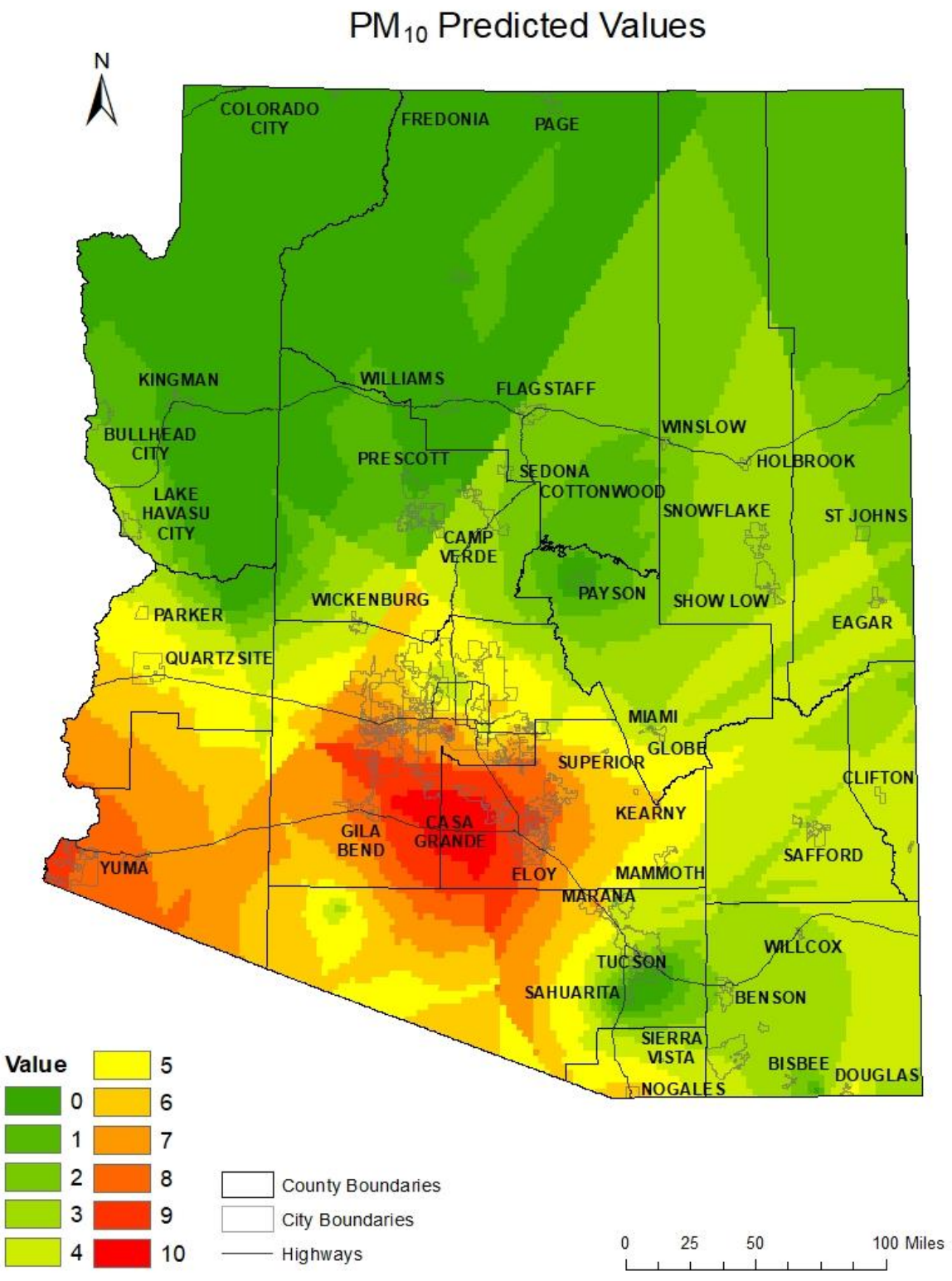
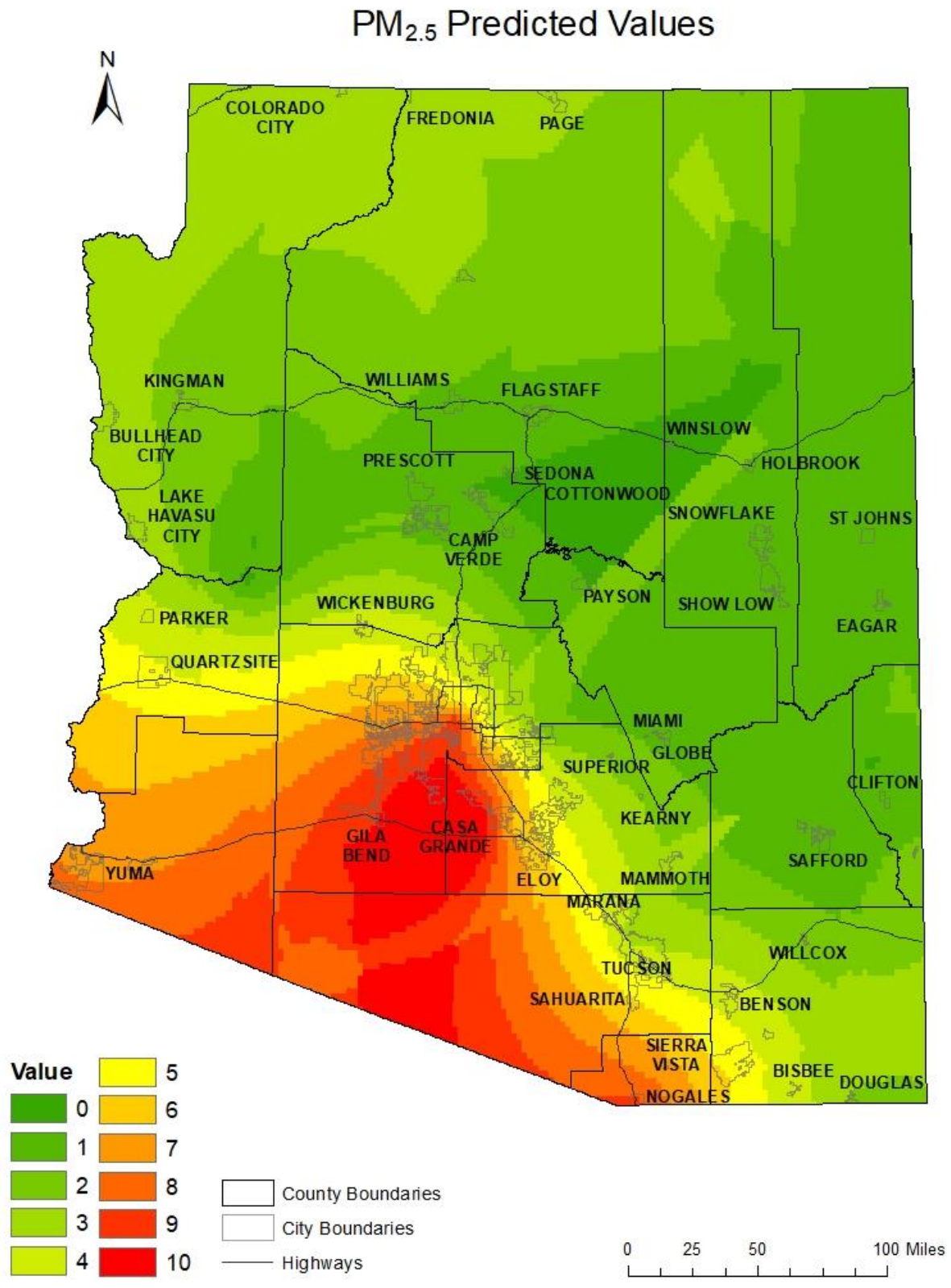


Figure 15: $PM_{2.5}$ Predicted Values Map



F. Final Weighted Overlay

The five indicators in Section II (A – E) are combined together to form a single pollutant map that shows the final results of the Spatial Raster Analysis. The final maps are called weighted overlay maps and are produced to identify areas in Arizona that are of the highest importance to ambient air monitoring. These final maps will be used for suggestions to possible relocations, removals, or additional monitors. See Section III: Final Conclusions and Recommendations on Page 52 for the final conclusions and recommendations of the Spatial Raster Analysis.

Before the creation of the final overlay maps, the indicators were weighted according to their value to air monitoring in Arizona. Weights were derived from two consensus meetings with ADEQ's Air Quality Division staff and a survey given to others in Arizona's air monitoring community. The consensus meetings and survey were conducted by asking each individual to rate the importance of each indicator listed in Section II: Spatial Raster Analysis on Page 32. During the meetings, there was discussion to voice opinions related to assigned values. In total, 30 members of ADEQ's Air Quality Division staff attended the meetings and one survey response was collected from Arizona's air monitoring community. That information was then applied to each ranking value in order to determine the final monitor rankings. It is not assumed that each indicator carries the same significance to the public welfare, regulatory actions, and to ambient air monitoring in Arizona. One indicator might be of greater significance than another, therefore the indicators needed to be ranked. Results from the meetings and survey were weighted to come up with a final value that was then adjusted to a 0 to 1 scale listed in Table 35. They were adjusted to 0 to 1 because the weighted overlay tool in ArcGIS requires the total weight to be 1.0. All of the areas on the indicator maps were multiplied by the survey results to apply the weighting.

Table 35: Spatial Raster Analysis Results

Indicator	O_3	PM_{10}	$PM_{2.5}$
Mortality and Morbidity Rate	0.22	0.24	0.22
Sensitive Age Distribution	0.22	0.24	0.22
Total Population	0.17	0.11	0.17
Distance Between Monitors	0.17	0.24	0.17
Predicted Values	0.22	0.17	0.22

Results

The areas that are most important to new monitoring are shown in red.

Figure 16: O_3 Weighted Spatial Overlay

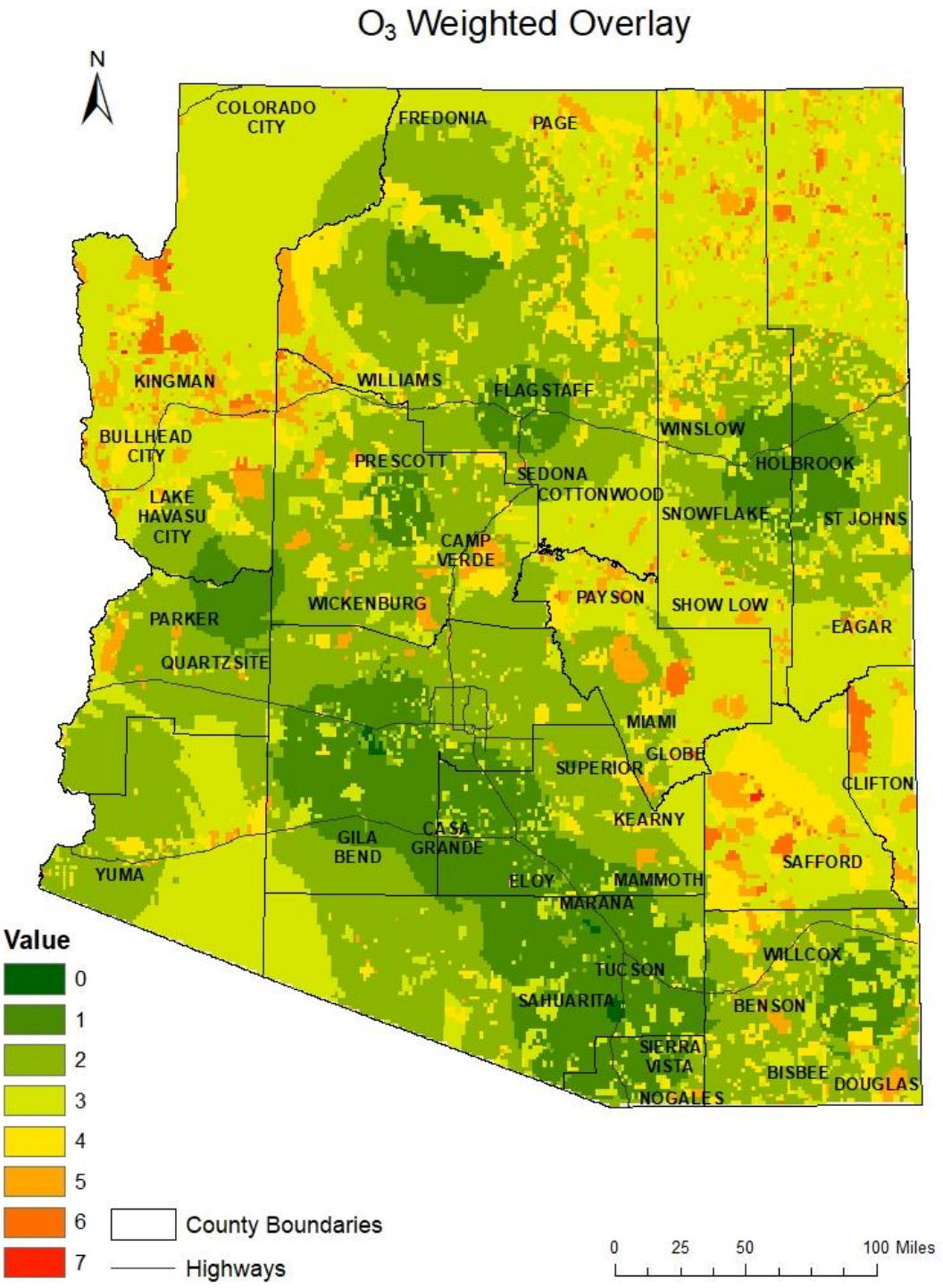


Figure 17: PM_{10} Weighted Spatial Overlay

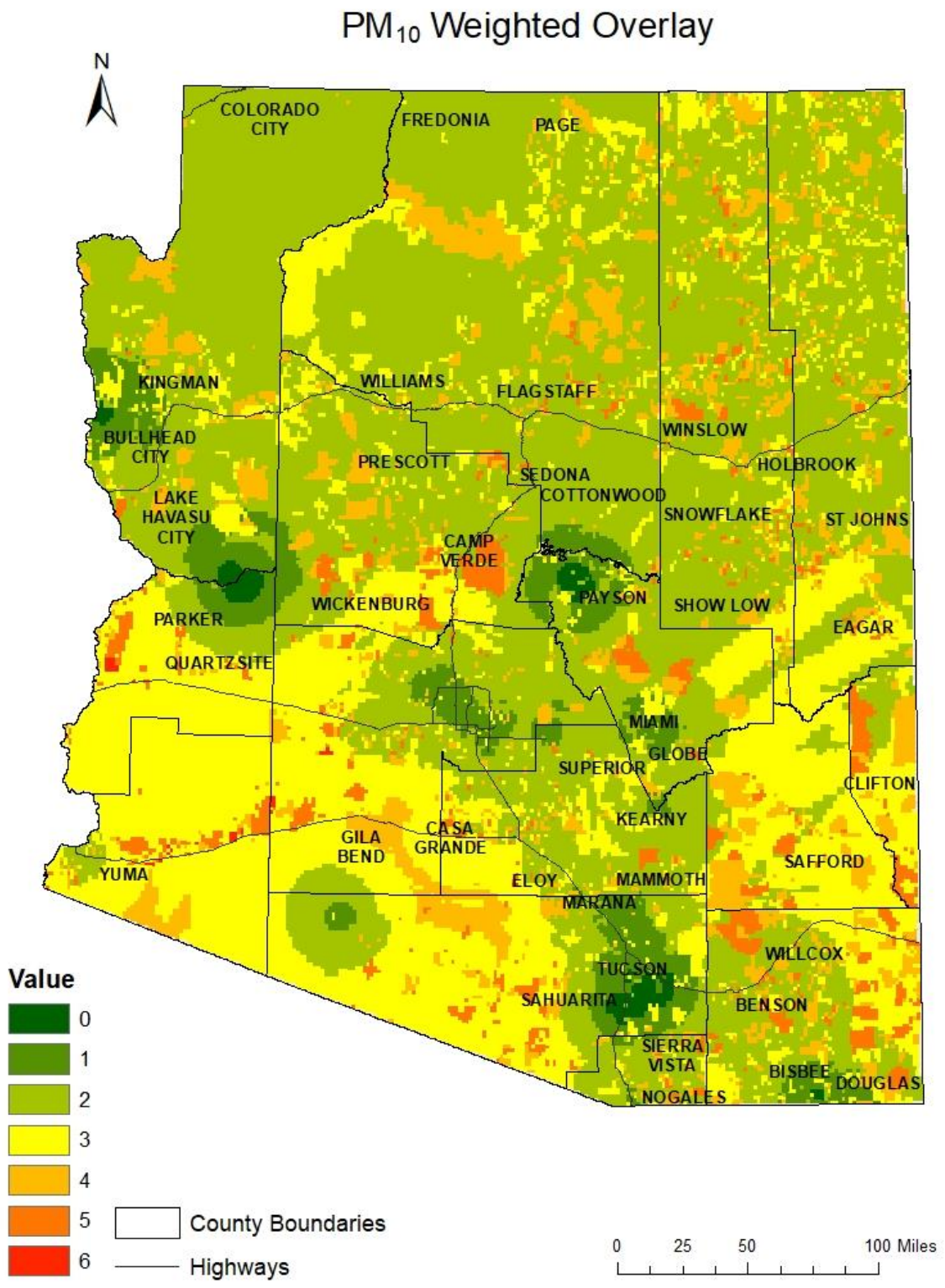
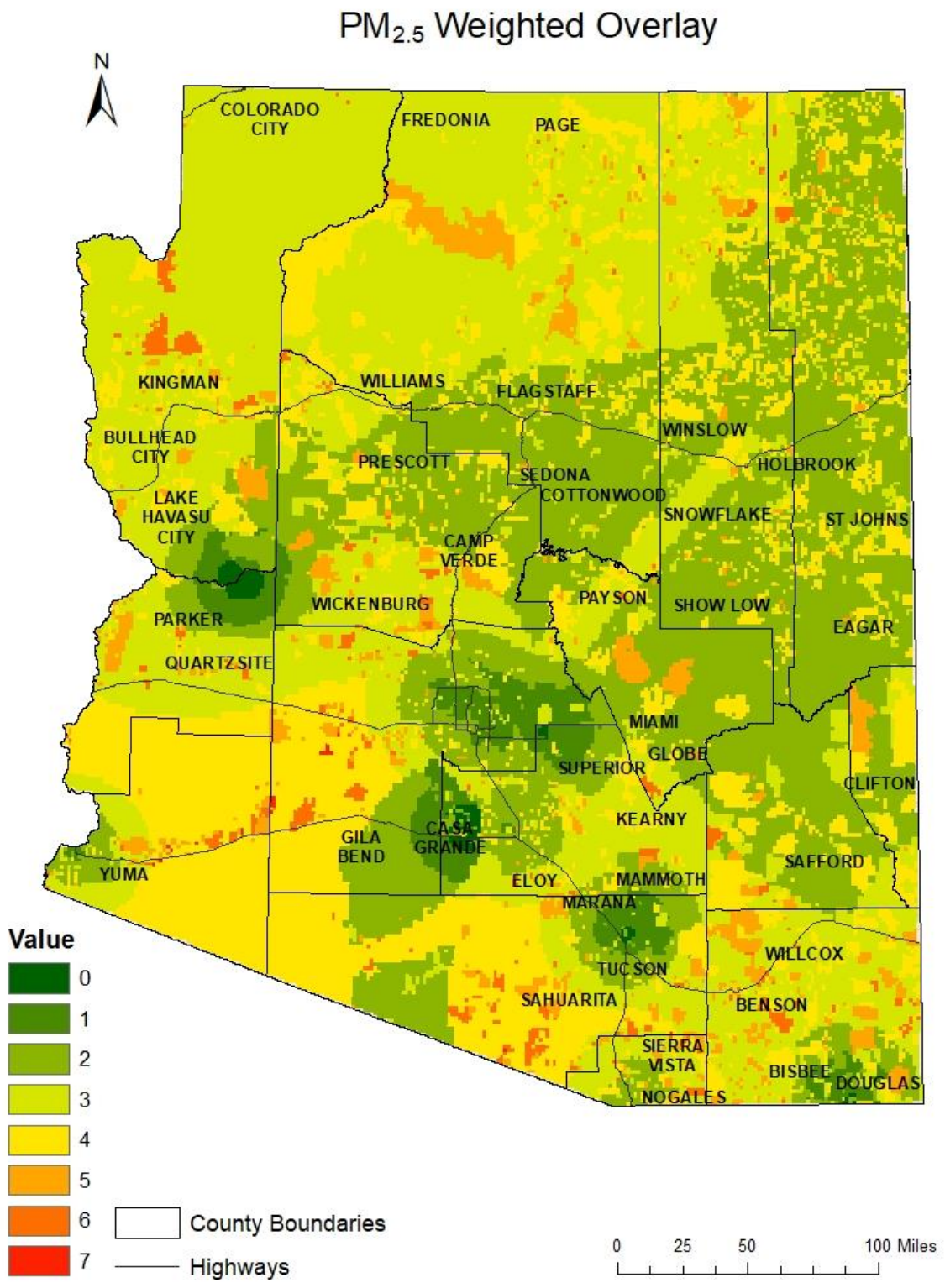


Figure 18: $PM_{2.5}$ Weighted Spatial Overlay



Section III: Final Conclusions and Recommendations

The final conclusion and recommendations were made by ADEQ's Air Quality management from both the Ranking Analysis and the Spatial Raster Analysis. These recommendations are only made from this 5-Year Network Assessment and are intended to improve the quality and adequacy of ADEQ's air monitoring network. These conclusions and recommendations are made for the next five years and plans to modify the air monitoring network will be made in the 2021 Annual Network Plan.

In 2015, the Environmental Protection Agency (EPA) revised the Photochemical Assessment Monitoring Stations (PAMS) requirements in 40 CFR Part 58 Appendix D. It requires state monitoring agencies with moderate and above 8-hour ozone (O_3) nonattainment areas to develop and implement an Enhanced Monitoring Plan (EMP) detailing enhanced O_3 and O_3 precursor monitoring activities. The Phoenix-Mesa 8-hour O_3 Nonattainment Area is classified as moderate for the 2008 O_3 Standard and therefore is required to submit an EMP. At a minimum, the EMP shall be reassessed and approved as part of the 5-year network assessments required under 40 CFR 58.10(d). The EMP includes monitoring activities deemed important to understanding O_3 formation in the Phoenix-Mesa 8-hour O_3 Nonattainment Areas. ADEQ submitted their initial EMP in October 2019 to fulfill this requirement, in which ADEQ committed to form a working group with stakeholders to identify any monitoring gaps and develop a plan for any additional monitoring for the following five years.

The following broad knowledge gap categories were identified by the working group as priorities to better understand behavior in the Phoenix area:

- ground-level O_3 and O_3 precursor measurements
- vertical O_3 and meteorology.

Closing these two knowledge gaps would serve to:

- improve our ability to assess current and future control strategies mitigating O_3 and O_3 precursor emissions,
- aid verification and building of air quality modelling efforts, and
- provide data necessary for increased air quality forecasting accuracy purposes that give the health sensitive community warning of imminent unhealthy air quality episodes and trigger voluntary action by the broader public domain to reduce emissions.

General Conclusions from the Ranking Analysis

Two sites stand out as particularly significant for ADEQ's networks based on the Monitor Ranking Analysis. The Yuma Supersite monitor is consistently ranked the highest across all pollutant networks as important to air monitoring and JLG Supersite is ranked above most other sites. Specific attention to their operation should be in place so important ambient air data at these sites are not lost. Technology and supporting equipment upgrades should be made to these sites first as modernizing and upgrading improved data security, quality, and quantity. Data from Yuma Supersite are particularity important to support regulatory actions for this area and for border air quality research. The JLG Supersite is specifically important to the trends analysis and air quality research for the Phoenix area.

SO_2

a. Ranking analysis

Currently, all monitors are required in the area and, as such, no recommendations are made at this time.

O_3, PM_{10}, and $PM_{2.5}$

a. Ranking Analysis

Currently all O_3 monitors are required and no recommendations are made based on the Ranking Analysis. All of ADEQ's O_3 monitors are considered important to O_3 monitoring. Future statistical analysis will need to be done to investigate where Flagstaff Middle School and Prescott Pioneer Park sites stand in terms of meeting 85 percent of the O_3 National Ambient Air Quality Standards (NAAQS) to determine if these monitors are in attainment of the O_3 NAAQS for the last five years. Additionally, ADEQ will conduct statistical analysis to see if there less than 10 percent probability of exceeding 80 percent of the NAAQS during the next three years.

Currently all PM_{10} and $PM_{2.5}$ monitors are required and there are no recommendations for the twelve PM_{10} and seven $PM_{2.5}$ monitors. However, ADEQ will investigate if the Nogales Post Office $PM_{2.5}$ (POC 1 Filter) is still required to fulfill collocation requirements. The removal of this instrument will not cause data loss since it is a collocated monitor and only runs 1-in-6 days. ADEQ will conduct a cost-benefit analysis to determine if the POC 1 Filter should be removed.

b. Spatial Raster Analysis

It was not determined that any O_3, PM_{10}, or $PM_{2.5}$ monitors should be closed based on this analysis due to being over representative.

ADEQ plans to use this analysis to help identify areas of interest (orange and red areas on the maps) for episodic monitoring. This information will aid in developing special projects to promote voluntary public measures to decrease local O_3 precursors, PM_{10}, and $PM_{2.5}$.

Currently, there is an E-BAM Network of six (Flagstaff Middle School, Payson Well Site, Prescott Pioneer Park, Sedona Fire Station AQD, Show Low, and Verde Ranger Station) semi-permanent monitors that were not included in this analysis. Additionally, a PM_{10} special purpose monitor (SPM) at Quartzsite and a $PM_{2.5}$ SPM at Bullhead City were not included in this analysis. The E-BAM Network is non-regulatory and is used for public health and information purposes. ADEQ has additional E-BAM monitors available to use for placement during wildfire or other weather events.

Appendix A – Definitions and Abbreviations

ADEQ	Arizona Department of Environmental Quality
ArcMap	GIS Analysis Software
AQS	Air Quality System (EPA database)
AZDHS	Arizona Department of Health Services
BAM	Beta Attenuation Monitor
CFR	Code of Federal Regulations
CO	Carbon Monoxide
COPD	Chronic Obstructive Pulmonary Disease
E-BAM	Environment Proof - Beta Attenuation Monitor
EPA	Environmental Protection Agency
GIS	Geographic Information System
MSA	Metropolitan Statistical Area
µg/m3	Micrograms per Cubic Meter
NAAQS	National Ambient Air Quality Standard
NO_2	Nitrogen Dioxide
O_3	Ozone
PAMS	Photochemical Assessment Monitoring Station
Pb	Lead
PM	Particulate Matter
PM_{10}	Particulate Matter ≤ 10 microns
$PM_{2.5}$	Particulate Matter ≤ 2.5 microns
POC	Parameter Occurrence Code
ppb	Parts Per Billion
ppm	Parts Per Million
SO_2	Sulfur Dioxide
SPM	Special Purpose Monitor
SR	State Route

Appendix B – References

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Publication Number: OFR-20-03