Appendix A
Ambient Air Quality Data

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Appendix A: Ambient Air Quality Data

The concentration of ambient ozone at any given location in the San Joaquin Valley air basin (Valley) is a function of meteorology, the natural environment, atmospheric chemistry, and ozone precursor emissions from both biogenic (natural) and anthropogenic (human caused) sources. The San Joaquin Valley Air Pollution Control District (District), the California Air Resources Board (CARB), and other agencies monitor ozone concentrations throughout the Valley. The U.S. Environmental Protection Agency (EPA) serves as the official repository of ambient ozone data.[1]

The District uses the collected data to show air quality improvement throughout the standardized design value and attainment test calculations, using EPA protocols to document basin-wide improvement and attainment of the National Ambient Air Quality Standards (NAAQS). As shown in this appendix, the design value data show steady, long-term air quality improvement.

The District also uses the data to evaluate the impact that changing daily, monthly, and annual ozone concentrations have on public health. These trend analyses provide the District with critical information about how to develop control measures and incentive programs that contribute to the greatest public health improvements and greatest progress toward EPA air quality standards.

A.1 AMBIENT AIR QUALITY DATA

Chapter 2 describes the calculation methodology for "design values," which are used to determine whether a region attains the NAAQS. For 8-hour ozone, the design value is the 3-year average of the annual fourth-highest daily maximum 8-hour average ozone concentration in order to determine design values. Table A-1 summarizes the first step in calculating design values: includes determining the fourth-highest daily maximum 8-hour average ozone concentrations for currently operating monitoring sites in the San Joaquin Valley (Valley) for each year. Table A-2 shows the final step in determining each site's design value, which is calculating the 3-year average of the annual fourth-highest daily maximum 8-hour average ozone concentration for each site within the Valley. For example, the 2021 design value is the three-year average based on 2019-2021 data. A dash (-) indicates that there is insufficient data available to determine the value.

Attainment status is determined for each site by analyzing 2019 through 2021 ozone measurements[2]. If any monitoring site within the Valley has a design value that is greater than 0.070 ppm, then, by rules established by EPA, the entire air basin is

[1] U.S. Environmental Protection Agency; Technology Transfer Network (TTN), Air Quality System (AQS): AQS Web Application (2010). Available at https://www.epa.gov/aqs

[2] 40 CFR (Code of Federal Regulations) Part 50, Appendix I, Sections 2.2 and 2.3, require that attainment calculations be based on at least the most recent three complete years of quality reviewed data.

nonattainment. Table A-3 summarizes the current attainment status on a site-by-site basis. Green shaded lines in the table indicate that this site is meeting the attainment test for the year 2021. Figure A-1 illustrates the San Joaquin Valley air basin map with 8-hour ozone design values on a site-by-site basis.

Table A-3 shows that three of the 25 air monitoring sites in the Valley (Stockton, Tracy-Airport, and Tranquillity) currently meet the attainment test for 2015 8-hour ozone standard of 70 ppb. Twenty-two out of 25 sites are nonattainment for the 2015 8-hour ozone standard for the 2019-2021 time period. This is an improvement from 2013 to 2015 period where 24 sites were nonattainment. Ongoing emissions reductions and improvements to ozone concentrations across the Valley have continued to bring areas of the region into attainment of the 2015 8-hour ozone standard already, and this progress is expected to continue into future years.

In the data and trends below, the ozone concentrations in the Valley and much of California in the years 2020 and 2021 were heavily influenced by emissions from wildfires, which include precursor emissions (NOx and VOC) that lead to the formation of ozone. Due to this, the Valley's ozone concentrations, design values, and number of days exceeding the ozone standards all increased significantly in 2020 and 2021. Figure A-1 shows the Valley peak design values for 1990-2021, along with an estimate of what the ozone design value would have been in the Valley for 2020 and 2021 without the influence from wildfires. This trend shows the significant progress that has been made in reducing peak levels of ozone across in the region, and how close the Valley is to attaining the initial federal 8-hour ozone standard of 84 ppb. Figure A-2 shows 2020 design values plotted on a map. More air quality trend data can be found on CARB[3] and EPA[4] websites.

[3] https://ww2.arb.ca.gov/our-work/programs/state-and-federal-area-designations/federal-area-designations/ozone
[4] https://www.epa.gov/air-trends/air-quality-design-values

Table A-1 Fourth Highest 8-hr Average Ozone (ppm)

Name	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Stockton-Hazelton	0.076	0.073	0.070	0.066	0.072	0.064	0.071	0.069	0.066	0.065	0.068	0.065	0.067	0.061
Tracy-Airport	-	-	0.075	0.080	0.085	0.073	0.080	0.077	0.080	0.075	0.075	0.069	0.068	0.069
Modesto-14th St	0.086	0.089	0.073	0.074	0.078	0.075	0.081	0.083	0.080	0.084	0.078	0.079	0.080	0.076
Turlock	0.091	0.079	0.087	0.088	0.091	0.080	0.081	0.085	0.085	0.083	0.084	0.079	0.078	0.083
Merced-Coffee	0.103	0.087	0.090	0.082	0.079	0.083	0.082	0.083	0.082	0.078	0.079	0.072	0.079	0.079
Madera-City	-	-	0.090	0.081	0.087	0.085	0.082	0.083	0.084	0.085	0.076	0.073	0.085	0.085
Madera-Pump Yard	0.088	0.076	0.078	0.080	0.078	0.079	0.088	0.080	0.081	0.081	0.072	0.075	0.081	0.083
Tranquillity	-	-	0.077	0.079	0.077	0.075	0.075	0.077	0.077	0.074	0.075	0.067	0.070	0.072
Fresno-Sky Park	0.114	0.101	0.097	0.095	0.085	0.085	0.091	0.084	0.084	0.086	0.079	0.075	0.083	0.084
Clovis	0.104	0.093	0.103	0.096	0.097	0.091	0.097	0.093	0.092	0.087	0.088	0.078	0.088	0.085
Fresno-1st/Garland	0.104	0.101	0.098	0.090	0.095	0.084	0.090	0.087	0.091	0.095	0.086	0.077	0.090	0.086
Fresno-Drummond	0.099	0.086	0.087	0.102	0.096	0.086	0.084	0.088	0.088	0.091	0.081	0.075	0.085	0.088
Parlier	0.108	0.091	0.094	0.089	0.094	0.095	0.087	0.093	0.093	0.090	0.083	0.080	0.082	0.090
Hanford	0.105	0.085	0.103	0.086	0.082	0.085	0.086	0.085	0.083	0.085	0.080	0.076	0.084	0.076
Visalia-Church	0.099	0.095	0.096	0.079	0.088	0.074	0.078	0.087	0.077	0.087	0.091	0.076	0.084	0.094
Porterville	-	-	0.091	0.092	0.088	0.084	0.073	0.086	0.090	0.083	0.078	0.071	0.092	0.092
Lower Kaweah	0.090	0.097	0.077	0.081	0.087	0.087	0.084	0.083	0.087	0.084	0.089	0.075	0.086	0.086
Ash Mountain	0.105	0.107	0.094	0.096	0.095	0.090	0.089	0.088	0.092	0.089	0.088	0.083	0.095	0.093
Shafter	0.092	0.090	0.091	0.084	0.085	0.079	0.081	0.082	0.082	0.078	0.084	0.075	0.087	0.076
Oildale	0.103	0.096	0.093	0.087	0.088	0.078	0.078	0.082	0.072	0.085	0.091	0.076	0.083	0.086
Bakersfield-California	0.102	0.099	0.093	0.087	0.087	0.084	0.084	0.088	0.082	0.089	0.093	0.081	0.083	0.077
Bakersfield-Muni	-	-	-	-	0.099	0.087	0.087	0.097	0.088	0.086	0.090	0.078	0.088	0.085
Edison	0.105	0.097	0.099	0.092	0.088	0.079	0.085	0.090	0.086	0.085	0.096	0.084	0.101	0.094
Arvin-Bear Mtn.	0.111	0.108	0.100	-	-	-	-	-	-	-	-	-	-	-
Arvin-Di Giorgio	-	-	0.092	0.091	0.091	0.087	0.088	0.087	0.087	0.086	0.095	0.082	0.092	0.084
Maricopa	0.095	0.090	0.085	0.094	0.082	0.078	0.078	0.083	0.083	0.083	0.089	0.077	0.091	0.073

A dash (-) indicates that there is insufficient data available to determine the value.

Table A-2 3-yr Average of the Annual Fourth-Highest Daily Maximum 8-hr Average Ozone Concentrations (ppm)

Name	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Stockton-Hazelton	0.082	0.073	0.072	0.068	0.069	0.067	0.069	0.068	0.068	0.066	0.066	0.066	0.066	0.064
Tracy-Airport	-	-	0.081	0.078	0.080	0.079	0.079	0.076	0.079	0.077	0.076	0.073	0.070	0.068
Modesto-14th St	0.090	0.083	0.080	0.075	0.075	0.075	0.078	0.079	0.081	0.082	0.080	0.080	0.079	0.078
Turlock	0.096	0.086	0.093	0.087	0.088	0.086	0.084	0.082	0.083	0.084	0.084	0.082	0.080	0.080
Merced-Coffee	0.083	0.095	0.091	0.084	0.083	0.081	0.081	0.082	0.082	0.081	0.079	0.076	0.076	0.076
Madera-City	-	-	-	-	0.086	0.084	0.084	0.083	0.083	0.084	0.081	0.078	0.078	0.081
Madera-Pump Yard	0.089	0.082	0.084	0.081	0.078	0.079	0.081	0.082	0.083	0.080	0.078	0.076	0.076	0.079
Tranquillity	-	-	-	-	0.077	0.077	0.075	0.075	0.076	0.076	0.075	0.072	0.070	0.069
Fresno-Sky Park	0.111	0.098	0.097	0.095	0.092	0.088	0.087	0.086	0.086	0.084	0.083	0.080	0.079	0.080
Clovis	0.109	0.091	0.103	0.099	0.098	0.094	0.095	0.093	0.094	0.090	0.089	0.084	0.084	0.083
Fresno-1st/Garland	0.108	0.099	0.102	0.096	0.094	0.089	0.089	0.087	0.089	0.091	0.090	0.086	0.084	0.084
Fresno-Drummond	0.104	0.093	0.092	0.095	0.095	0.094	0.088	0.086	0.086	0.089	0.086	0.082	0.080	0.082
Parlier	0.107	0.096	0.092	0.088	0.092	0.092	0.092	0.091	0.091	0.092	0.088	0.084	0.081	0.084
Hanford	0.102	0.088	-	-	0.090	0.084	0.084	0.085	0.084	0.084	0.082	0.080	0.080	0.078
Visalia-Church	0.102	0.093	0.097	0.088	0.087	0.080	0.080	0.079	0.080	0.083	0.085	0.084	0.083	0.084
Porterville	-	-	-	-	0.090	0.088	0.081	0.081	0.083	0.086	0.083	0.077	0.080	0.085
Lower Kaweah	0.093	0.097	0.086	0.079	0.081	0.085	0.086	0.084	0.084	0.084	0.086	0.082	0.083	0.082
Ash Mountain	-	0.105	0.101	0.096	0.095	0.093	0.091	0.089	0.089	0.089	0.089	0.086	0.088	0.090
Shafter	0.095	0.090	0.088	0.085	0.086	0.082	0.081	0.080	0.081	0.080	0.081	0.079	0.082	0.079
Oildale	0.101	0.096	0.094	0.089	0.089	0.084	0.081	0.079	0.077	0.079	0.082	0.084	0.083	0.081
Bakersfield-California	0.101	0.097	0.093	0.088	0.089	0.086	0.085	0.085	0.084	0.086	0.088	0.087	0.085	0.080
Bakersfield-Muni	-	-	-	-	-	-	0.091	0.090	0.090	0.090	0.088	0.084	0.085	0.083
Edison	0.111	0.097	0.101	0.096	0.093	0.086	0.084	0.084	0.087	0.087	0.089	0.088	0.093	0.093
Arvin-Bear Mtn.	0.111	0.113	0.104	-	-	-	-	-	-	-	-	-	-	-
Arvin-Di Giorgio	-	-	-	-	0.091	0.089	0.088	0.087	0.087	0.086	0.089	0.087	0.089	0.086
Maricopa	0.102	0.091	0.085	0.088	0.087	0.084	0.079	0.079	0.081	0.083	0.085	0.083	0.085	0.080
Yearly Max	0.111	0.113	0.104	0.099	0.098	0.094	0.095	0.093	0.094	0.092	0.090	0.088	0.093	0.093

A dash (-) indicates that there is insufficient data available to determine the value.

Table A-3 Current[5] 8-hour Ozone Design Values and Attainment Status for the San Joaquin Valley Air Basin

County	Site	2021 8-hour Ozone Design Values (ppm)	Meets Attainment Test
San Joaquin	Stockton-Hazelton	0.064	Yes
San Joaquin	Tracy-Airport	0.068	Yes
Stanislaus	Modesto-14th St	0.078	No
Stanislaus	Turlock	0.080	No
Merced	Merced-Coffee	0.076	No
Madera	Madera-City	0.081	No
Madera	Madera-Pump Yard	0.079	No
Fresno	Tranquillity	0.069	Yes
Fresno	Fresno-Sky Park	0.080	No
Fresno	Clovis	0.083	No
Fresno	Fresno-1st/Garland	0.084	No
Fresno	Fresno-Drummond	0.082	No
Fresno	Parlier	0.084	No
Kings	Hanford	0.078	No
Tulare	Visalia-Church	0.084	No
Tulare	Porterville	0.085	No
Tulare	Lower Kaweah	0.082	No
Tulare	Ash Mountain	0.090	No
Kern	Shafter	0.079	No
Kern	Oildale	0.081	No
Kern	Bakersfield-California	0.080	No
Kern	Bakersfield-Muni	0.083	No
Kern	Edison	0.093	No
Kern	Arvin-Di Giorgio	0.085	No
Kern	Maricopa	0.080	No
Valley	**All Sites**	**0.093***	**No**

*Max 8-hour Ozone Design Value of all sites

[5] 2019-2021 are the design value years.

Figure A-1 Valley Maximum 8-hour Ozone Design Value Trend

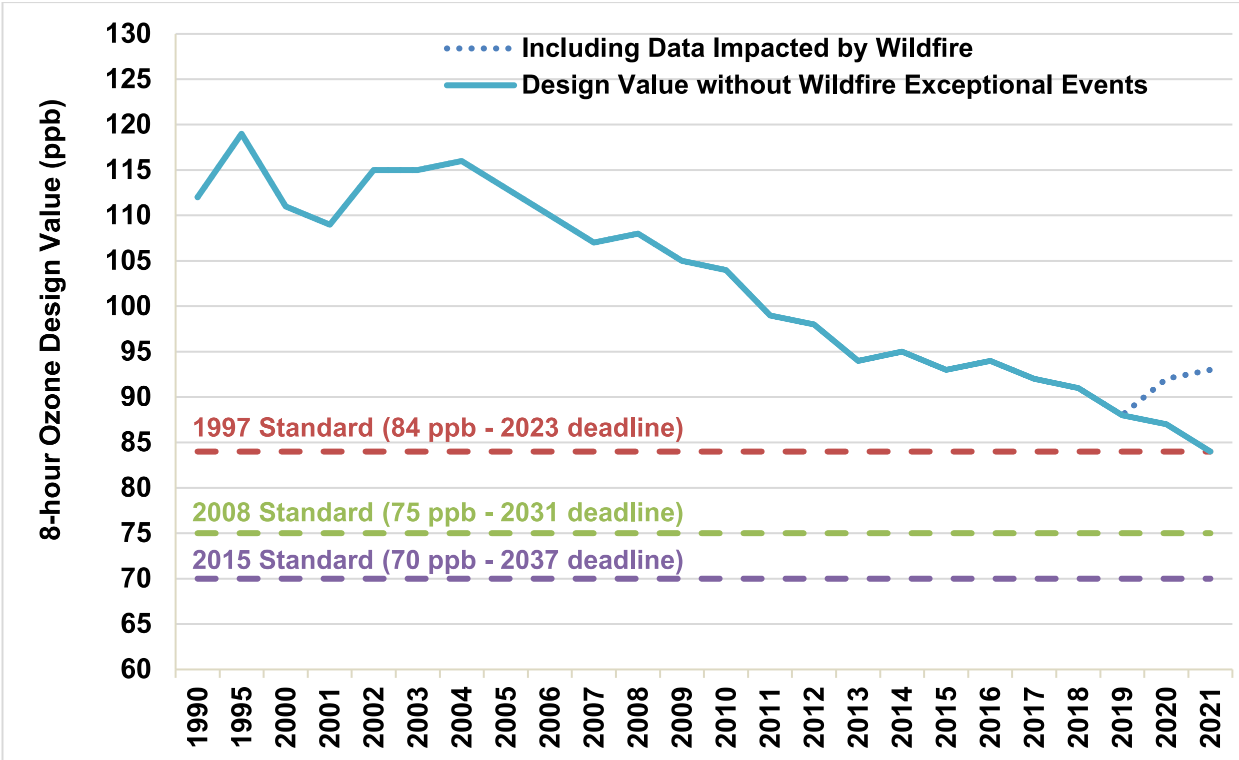
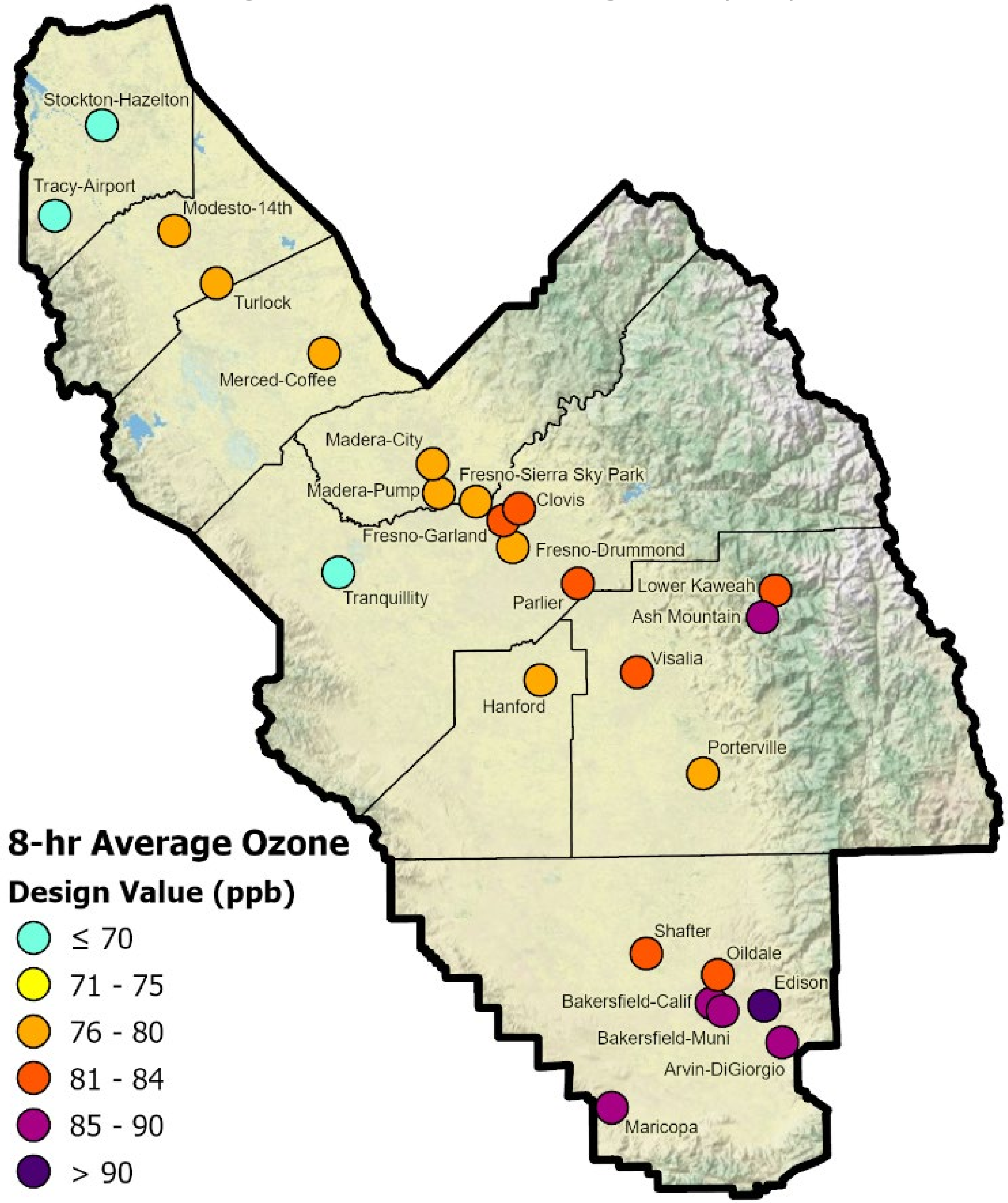


Figure A-2 8-Hour Ozone Design Value (2021)



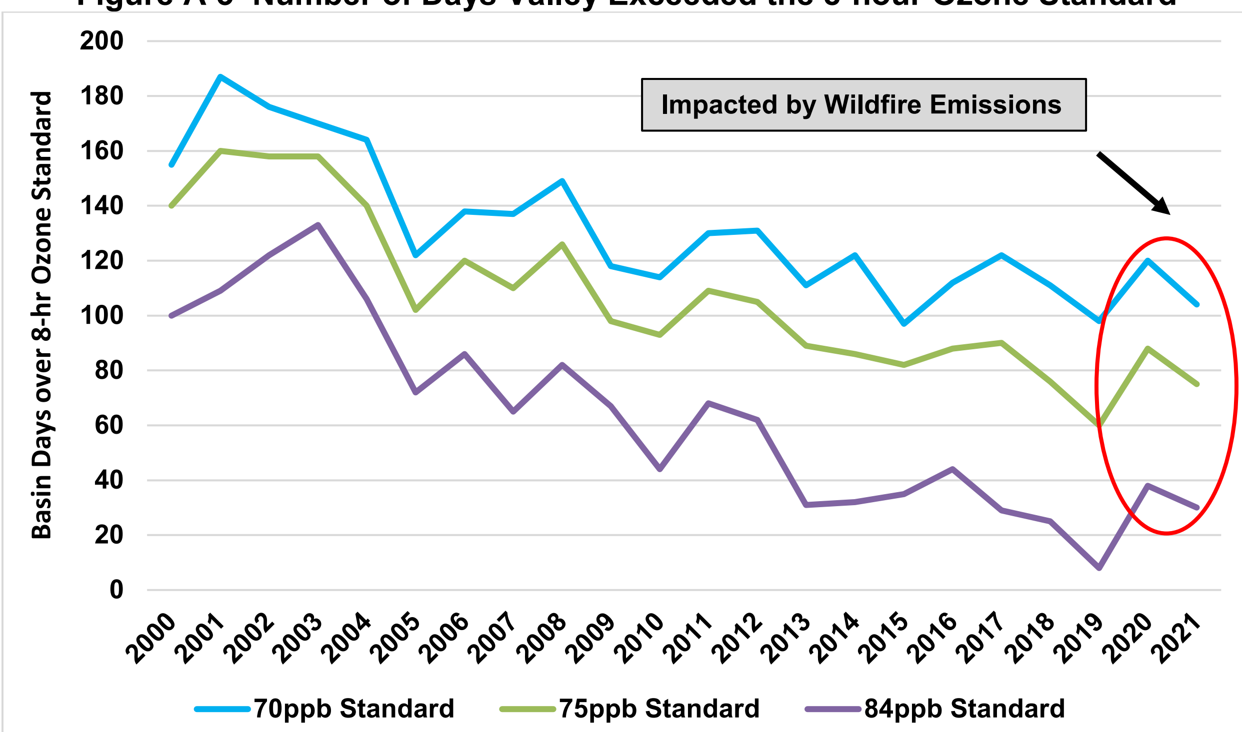
A.2 TREND AND SPATIAL VARIATIONS

A.2.1 Number of Days Above the 8-hour Ozone NAAQS

As detailed earlier, the regulatory 8-hour ozone attainment test for the Valley is based upon the design value being less than or equal to 0.070 ppm. Another way to examine the ozone air quality data is to determine the number of days where the maximum 8-hour average ozone concentration is greater than 0.070 ppm, providing as assessment of the number of days during the year that ozone concentrations rise above this level.

Figure A-3 shows the number of days at least one air-monitoring site exceeded the 2015, 2008, and 1997 8-hour ozone standards of 70, 75, and 84 ppb. Table A-4 summarizes the number of days above the 2015 8-hour ozone standard for each regulatory air monitoring site in the Valley from 2000-2021. The basin-wide count in Table A-4 represents the number of days that at least one air monitoring site had an 8-hour average above the ozone NAAQS of 70 ppb. The majority of Valley residents experienced 8-hour ozone concentrations over the standard far fewer days per year than the basin-wide total on a site-by-site basis. These improving trends were also noted in a recent study[6], observing the decrease in days that the Valley exceeds the federal ozone standards, and the "*marked change in the photochemical regime operating in Fresno over the last 25 years.*"

Figure A-3 Number of Days Valley Exceeded the 8-hour Ozone Standard



[6] De Foy, Benjamin, et al. "Changes in Ozone Photochemical Regime in Fresno, California from 1994 to 2018 Deduced from Changes in the Weekend Effect." Environmental Pollution, vol. 263, 20 Mar. 2020, p. 114380., https://doi.org/10.1016/j.envpol.2020.114380.

Table A-4 Number of Days Above the 2015 8-Hour Ozone Standard

Name	2000	2005	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Stockton-Hazelton	7	10	3	0	5	0	4	2	2	2	1	2	2	1
Tracy-Airport	-	-	8	21	35	5	16	19	19	5	8	3	3	3
Modesto-14th St	26	30	9	7	12	13	24	23	21	21	13	9	13	11
Turlock	41	13	18	33	55	22	27	28	27	31	26	13	13	33
Merced-Coffee	95	34	28	38	24	29	40	29	28	16	21	6	19	22
Madera-City	-	-	18	28	46	43	33	28	40	27	14	10	33	22
Madera-Pump Yard	47	18	12	19	19	23	45	29	25	26	6	6	13	12
Tranquillity	-	-	17	22	24	18	10	10	19	10	7	3	3	6
Fresno-Sky Park	127	55	53	67	33	47	54	37	43	44	27	9	17	16
Clovis	82	53	57	69	87	64	82	50	62	47	43	30	50	37
Fresno-1st/Garland	-	-	-	-	70	29	56	38	55	64	36	18	24	21
Fresno-Drummond	69	27	24	69	72	45	43	39	57	29	32	15	28	40
Parlier	118	66	43	63	86	81	56	73	75	72	49	46	45	29
Hanford	109	37	53	46	27	47	39	42	49	38	29	13	27	19
Visalia-Church	86	62	51	30	57	9	25	49	18	61	53	25	37	51
Porterville	-	-	74	80	77	48	4	41	80	34	36	7	63	64
Lower Kaweah	58	71	30	56	71	62	61	43	64	51	63	28	45	58
Ash Mountain	68	104	90	101	110	79	81	67	87	80	68	61	85	78
Shafter	76	61	39	40	62	17	24	34	49	27	33	14	33	16
Oildale	90	89	47	53	77	13	24	33	7	65	54	20	21	45
Bakersfield-California	102	92	43	48	81	43	36	52	60	85	60	25	25	11
Bakersfield-Muni	-	-	-	-	75	55	58	69	63	55	54	22	45	30
Edison	113	75	71	69	74	19	52	42	64	74	82	54	76	68
Arvin-Bear Mtn.	127	111	88	-	-	-	-	-	-	-	-	-	-	-
Arvin-Di Giorgio	-	-	55	49	83	64	65	53	78	73	65	34	72	46
Maricopa	52	71	31	80	58	23	24	32	50	38	42	44	38	11
Basin-wide Days Over	**155**	**122**	**114**	**130**	**131**	**111**	**122**	**97**	**112**	**122**	**111**	**98**	**120**	**104**

A dash (-) indicates that there is insufficient data available to determine the value.

A.2.2 Monthly Assessment of Days Above the 8-hour Ozone NAAQS

Not only are 8-hour ozone exceedance days becoming fewer at all monitoring sites (as shown above in Table A-4), but 8-hour ozone exceedances are now limited to a smaller window of time than they once were.

Figures A-4 through A-6 show the valley-wide exceedance days for the 1997, 2008, and 2015 8-hour ozone standards. The District has included data from years 2002, 2010, and 2019 to represent data from 20 years ago, a median year, and the most recent year without severe wildfire smoke impacts, respectively. In past years, 8-hour ozone exceedances occurred as early as March, with maximum frequency occurring through the summer, and extending into the fall. In recent years, days over the 2015 8-hour ozone standard no longer occur in March, and days over the 1997 standard no longer occur in March or April. Overall, the District has recorded less frequent exceedances during the summer and fall months for the 1997, 2008, and 2015 standards.

Figure A-4 Frequency of Days Valley Exceeded the 2015 8-hour Ozone Standard

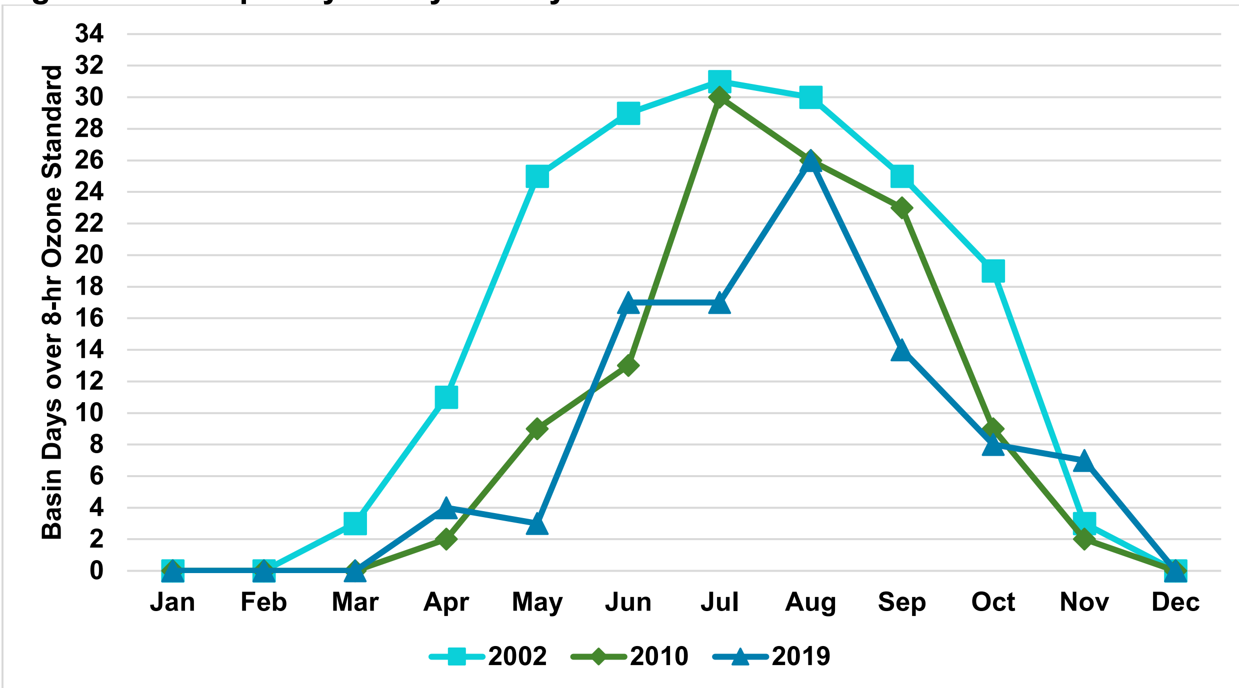


Figure A-5 Frequency of Days Valley Exceeded the 2008 8-hour Ozone Standard

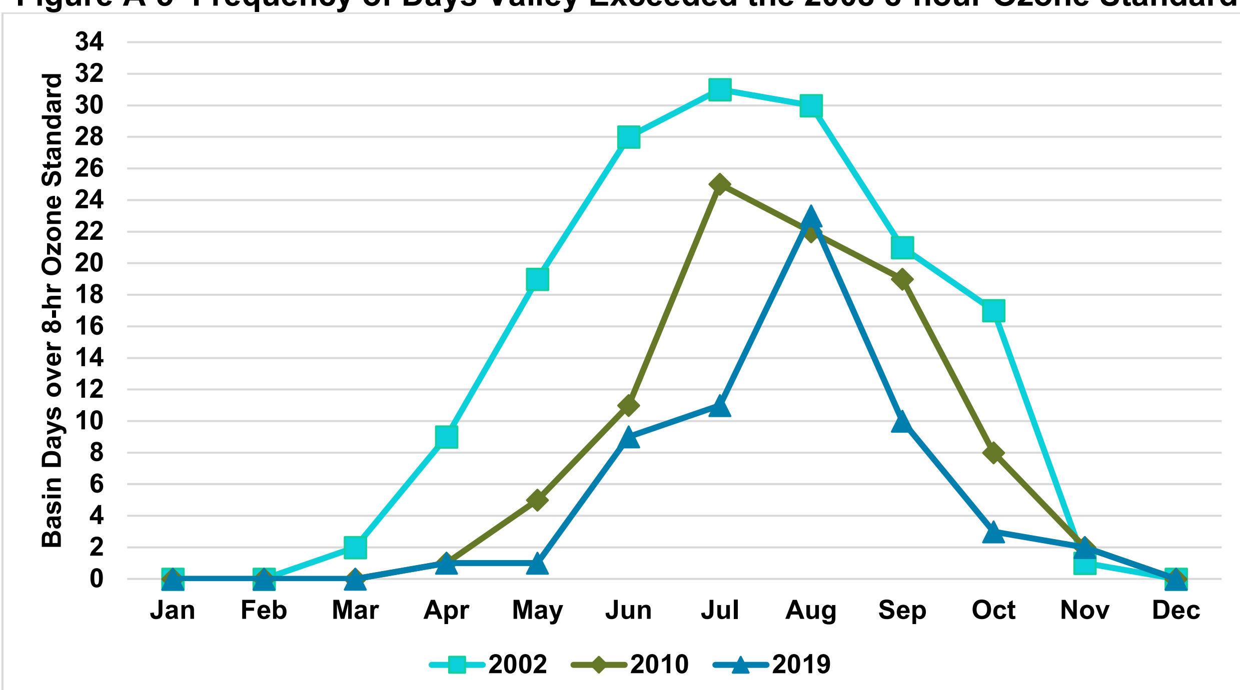
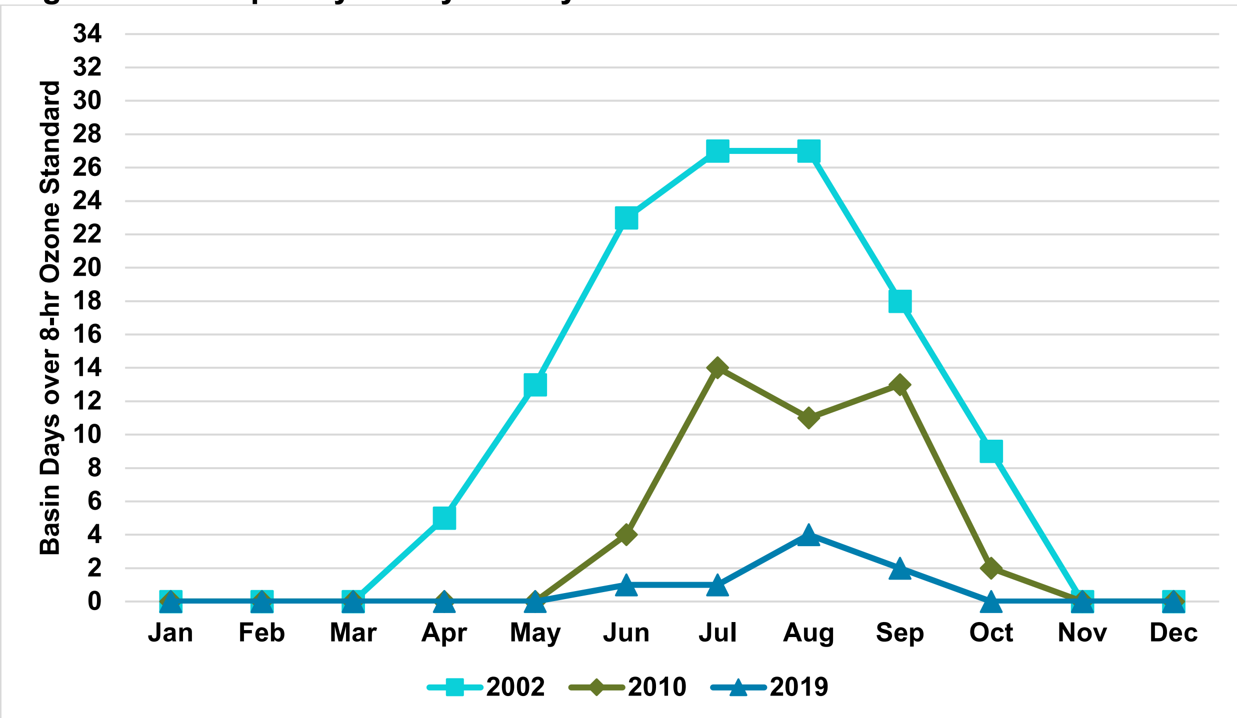


Figure A-6 Frequency of Days Valley Exceeded the 1997 8-hour Ozone Standard



Tables A-5 through A-7 show the number of basin-days over the 1997, 2008, and 2015 8-hour ozone standards for each year and for each month from 2000 through 2021. The cells in these tables are shaded according to the magnitude of the value, where the highest numbers are shaded a darker color of red and progressing toward values of zero with no shading. There is an overall reduction in the number of exceedance days over this period and fewer months per year where exceedances are common, with March-May specifically showing greater reduction in the occurrence of exceedances of the 8-hour ozone standards. From 2000-2004, Basin exceedances of the 2015 8-hour ozone standard occurred between 150-190 times per year. Within the last 5 years, the frequency of days over the 2015 8-hour ozone standard has reduced significantly, with only about 100 exceedances each year with far less occurrence of exceedances in March-May.

Table A-5 2015 8-hour Ozone Basin Exceedances by Month from 2000-2021

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Grand Total
2000	0	0	0	15	19	27	28	30	22	14	0	0	155
2001	0	0	5	11	30	28	27	31	30	24	1	0	187
2002	0	0	3	11	25	29	31	30	25	19	3	0	176
2003	0	0	1	3	21	30	31	31	27	26	0	0	170
2004	0	0	13	14	16	28	31	29	22	11	0	0	164
2005	0	0	2	2	11	18	29	31	20	9	0	0	122
2006	0	0	0	4	21	25	30	30	25	3	0	0	138
2007	0	0	7	8	21	25	27	30	15	1	3	0	137
2008	0	0	2	10	16	24	30	27	25	15	0	0	149
2009	0	0	0	6	18	13	30	22	23	4	2	0	118
2010	0	0	0	2	9	13	30	26	23	9	2	0	114
2011	0	0	0	1	9	18	26	31	28	17	0	0	130
2012	0	0	0	6	15	19	27	30	27	7	0	0	131
2013	0	0	1	7	11	19	27	20	15	10	1	0	111
2014	0	0	0	10	15	20	25	19	19	12	2	0	122
2015	0	0	2	7	8	24	11	22	17	6	0	0	97
2016	0	0	0	4	6	22	25	31	19	4	1	0	112
2017	0	0	0	2	11	20	31	24	16	18	0	0	122
2018	0	0	1	3	3	20	28	27	22	7	0	0	111
2019	0	0	0	4	3	18	17	27	13	9	7	0	98
2020	0	0	0	1	8	14	26	28	22	18	3	0	120
2021	0	0	0	2	7	16	29	24	22	4	0	0	104

Table A-6 2008 8-hour Ozone Basin Exceedances by Month from 2000-2021

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Grand Total
2000	0	0	0	11	15	26	25	28	21	14	0	0	140
2001	0	0	4	6	28	24	23	27	30	18	0	0	160
2002	0	0	2	9	19	28	31	30	21	17	1	0	158
2003	0	0	1	2	17	28	31	30	26	23	0	0	158
2004	0	0	9	11	10	26	30	27	18	9	0	0	140
2005	0	0	0	1	8	14	29	31	14	5	0	0	102
2006	0	0	0	2	14	23	30	30	21	0	0	0	120
2007	0	0	5	3	16	22	23	26	14	1	0	0	110
2008	0	0	0	4	15	21	30	23	25	8	0	0	126
2009	0	0	0	5	12	11	27	21	20	2	0	0	98
2010	0	0	0	1	5	11	25	22	19	8	2	0	93
2011	0	0	0	1	5	15	25	29	25	9	0	0	109
2012	0	0	0	2	13	14	23	26	22	5	0	0	105
2013	0	0	0	5	8	15	26	15	13	7	0	0	89
2014	0	0	0	3	8	17	19	13	16	9	1	0	86
2015	0	0	1	5	6	21	10	19	15	5	0	0	82
2016	0	0	0	2	5	19	20	27	11	4	0	0	88
2017	0	0	0	0	8	15	26	19	10	12	0	0	90
2018	0	0	0	2	1	11	23	22	15	2	0	0	76
2019	0	0	0	1	1	9	11	23	10	3	2	0	60
2020	0	0	0	0	5	10	19	22	19	13	0	0	88
2021	0	0	0	1	2	12	24	22	11	3	0	0	75

Table A-7 1997 8-hour Ozone Basin Exceedances by Month from 2000-2021

Year	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Grand Total
2000	0	0	0	5	9	20	20	24	15	7	0	0	100
2001	0	0	1	1	19	16	16	23	24	9	0	0	109
2002	0	0	0	5	13	23	27	27	18	9	0	0	122
2003	0	0	0	0	12	20	30	28	25	18	0	0	133
2004	0	0	3	6	8	18	26	23	15	7	0	0	106
2005	0	0	0	0	5	7	24	24	11	1	0	0	72
2006	0	0	0	0	8	17	22	24	15	0	0	0	86
2007	0	0	2	2	4	15	15	17	10	0	0	0	65
2008	0	0	0	0	5	19	22	18	15	3	0	0	82
2009	0	0	0	0	8	7	22	14	16	0	0	0	67
2010	0	0	0	0	0	4	14	11	13	2	0	0	44
2011	0	0	0	0	1	9	16	19	19	4	0	0	68
2012	0	0	0	0	5	9	12	19	14	3	0	0	62
2013	0	0	0	0	2	7	14	3	5	0	0	0	31
2014	0	0	0	0	1	8	7	3	8	5	0	0	32
2015	0	0	0	1	1	9	5	7	8	4	0	0	35
2016	0	0	0	0	0	11	14	14	5	0	0	0	44
2017	0	0	0	0	3	6	6	9	2	3	0	0	29
2018	0	0	0	0	0	1	10	9	5	0	0	0	25
2019	0	0	0	0	0	1	1	4	2	0	0	0	8
2020	0	0	0	0	1	3	3	11	14	6	0	0	38
2021	0	0	0	0	0	6	8	11	5	0	0	0	30

A.3 DIFFERENCE BETWEEN URBAN AND RURAL OZONE RESPONSE

The difference between how ozone levels change in urban areas versus rural areas is most evident during the nighttime hours when ozone formation ceases. At night, fresh NOx emissions in urban areas interact with and remove or scavenge existing ozone. This process causes a rapid change, which results in very low nighttime ozone concentrations. A recent study[7] found that the photochemical regime in the atmosphere of urban areas has evolved such that nightly carryover is increasingly important in determining local ozone concentrations. In the 1990s, the "weekend effect" was assess in the Valley, where decreased NOx levels on the weekends led to increased levels of ozone on Saturdays and Sundays due to decreased levels of ozone scavenging. However, later data from the 2010s shows that even with decreased levels of NOx on the weekends compared to weekdays, there is a lower level of ozone formation on Saturdays, Sundays, and Mondays, due to the Valley now being NOx-limited for ozone, making NOx reductions increasingly effective at reducing ozone. This illustrates that while NOx emissions in urban areas are decreasing, scavenging of ozone is still critical

[7] De Foy, Benjamin, et al. "Changes in Ozone Photochemical Regime in Fresno, California from 1994 to 2018 Deduced from Changes in the Weekend Effect." Environmental Pollution, vol. 263, 20 Mar. 2020, p. 114380., https://doi.org/10.1016/j.envpol.2020.114380.

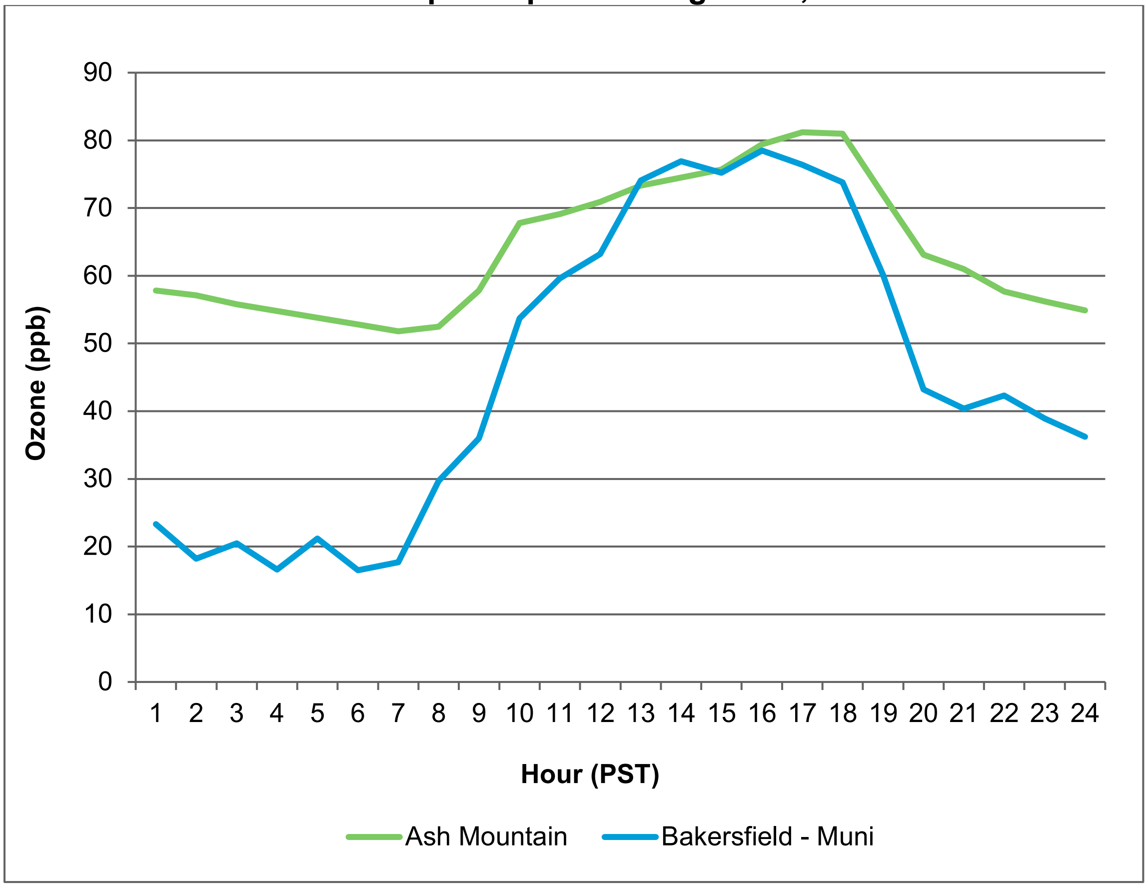
to the nightly decline of ozone concentrations, which influences ozone concentrations on the following day.

Similarly, in rural areas, there are fewer sources of fresh NOx emissions that contribute to ozone scavenging overnight, so rural areas do not experience the same ozone removal process that occurs in urban areas. Since ozone is either transported directly to rural areas, or it is created, in part, by precursors that have been transported to those areas, there are not enough fresh scavenging emissions to remove the ozone quickly. Thus, ozone in rural areas may remain elevated for longer durations during a 24-hour period and the elevated concentrations will carry-over to the following day.

Figure A-7 shows how urban and rural ozone levels vary due to the differences in local emissions during a day. The diurnal increase and decrease in ozone levels at the Bakersfield-Municipal Airport air monitoring station are quite distinct, whereas, the diurnal response of the ozone levels at Ash Mountain is more subtle. The urban mechanism described above is evident when analyzing the ozone data at Bakersfield, where there are higher emissions of NOx and volatile organic compounds (VOC) available. After sunrise, there is a dramatic rise in ozone because sunlight is now available to drive the creation of ozone from the available NOx and VOC. After sunset, the components necessary to create new ozone are limited. The continuous introduction of NOx into the environment allows for high amounts of ozone scavenging. Ozone scavenging results in a drop in ozone concentrations, which typically continues its downward trend from nightfall until dawn.

The Ash Mountain monitoring site, which is located at the entrance of Sequoia National Park at an elevation of 1,500-feet, demonstrates the hourly ozone response in a rural area. Ozone and precursors can transport to Ash Mountain from other locations on summer days. At this location, there are significantly lower hourly emissions of NOx as compared to urban areas such as Bakersfield or Fresno. At Ash Mountain, the amount of NOx available to scavenge the ozone is much lower. Because much less ozone scavenging occurs at Ash Mountain compared to urban areas, Ash Mountain can experience elevated ozone concentrations throughout a 24-hour period. Since the ozone concentration is already fairly high at dawn, only a relatively small amount of additional ozone can cause levels at Ash Mountain to exceed federal standards. All areas with small populations and low NOx emissions that are located in regions subject to ozone transport can experience a similar ozone pattern, though this pattern typically occurs in the foothills and mountainous areas.

Figure A-7 Temporal Changes in Ozone Concentrations at Ash Mountain and Bakersfield-Municipal Airport on August 23, 2019



A.4 WILDFIRE IMPACTS

A.4.1 2020 Wildfire Season

In 2020, over 9,900 wildfires were recorded in California, with nearly 4.3 million acres burned across the state, more than doubling the previous statewide record of approximately 2 million acres burned in 2018. In addition, six of the “Top 20” largest wildfires in California history all occurred during the 2020 season, highlighting the severity of this past season. A new record for the largest wildfire in state history also occurred in 2020, with the August Complex in northern California alone burning over 1 million acres. These points underscore how extreme and extensive the wildfire season has become for California.

Leading to the most severe period of the 2020 wildfire season, dry conditions and hot summer temperatures continued to scorch and desiccate the Californian landscape during July and August 2020. On August 15, 2020 a dry lightning storm, later named the August 2020 Lightning Siege, passed through California, resulting in over 14,000 lightning strikes to the ground level across the region, causing hundreds of new fires to erupt across the state simultaneously. Major fires that adversely affected air quality in the Valley during the August-September 2020 period included the following fires:

- Canyon Fire (Stanislaus County),
- Hills Fire (Fresno County),
- Lake Fire (Los Angeles County),
- SCU Lightning Complex (Stanislaus and San Joaquin Counties),
- CZU August Lightning Complex (San Mateo and Santa Cruz Counties),
- Creek Fire (Fresno/Madera Counties), and
- SQF Complex (Tulare County).

The SQF Complex eventually burned nearly 175,000 acres becoming the 18th largest fire in California history. The SQF Complex was finally fully contained when winter conditions extinguished the fire on January 6, 2021. The Creek Fire (Fresno and Madera Counties) ignited in late summer on September 4, 2020 was active for 165 days, devastating nearly 380,000 acres and becoming the largest single non-complex fire in California history. The Creek Fire was declared 100 percent contained on December 24, 2020.

The enormous amount of wildfire smoke from these fires significantly impacted the Valley's air quality for nearly 3 months, leading to some of the worst air quality in recent history and unhealthy conditions across the entire region for a prolonged period of time, particularly for particulate matter. Wildfires also emission high concentrations of ozone precursors, which can lead to higher than average ozone concentrations on the Valley floor. During the 2020 summer ozone season, the unprecedented wildfire activity across California directly affected the Valley's ozone concentrations. The highest ozone concentrations in the Valley for 2020 were recorded in August 2020 when excessive smoke from wildfires surrounding the Valley were impacting the region's air quality.

A.4.2 2021 Wildfire Season

In 2021, more than 8,800 wildfires were recorded in California, with over 2.5 million acres burned across the state, ending as one of the most severe wildfire seasons in California history, second only to the unprecedented and historic 2020 wildfire season. In addition, four of the "Top 20" largest wildfires in California history all occurred during the 2021 season, highlighting the severity of this past season. A new record for the largest single non-complex wildfire in state history also occurred in 2021, with the Dixie Fire in northern California alone burning over 960,000 acres. These points underscore how extreme and extensive the 2021 wildfire season was for California.

Leading to the most severe period of the 2021 wildfire season, dry conditions and hot summer temperatures continued to scorch and desiccate the Californian landscape during the summer months across the region. Major fires that adversely impacted air quality in the Valley during the August-October 2021 period included the following fires:

- Dixie Fire (northern California counties),

- River Complex (Trinity/Siskiyou counties),
- French Fire (Kern County),
- Walkers Fire (Tulare County),
- KNP Complex (Tulare County),
- Windy Fire (Tulare County),
- River Fire (Mariposa County), and
- Tiltill Fire (Tuolumne County)

Both the KNP Complex and the Windy Fire significantly and directly impacted the Valley's air quality beginning in September, when on September 9, 2021 a lightning storm passed over the Sierra Nevada. Combined, these fires in Tulare County burned over 185,000 acres and heavily impacted air quality throughout the region. These Tulare County fires were declared 100 percent contained by December 16, 2021. The Dixie Fire, and many other significant fires in northern California, severely impacted air quality in the San Joaquin Valley and across the Western U.S. during the 2021 wildfire season.

The enormous amount of wildfire smoke from these fires significant impacted the Valley's air quality over a 2 month period, leading to very poor air quality and unhealthful conditions across the entire region for prolonged periods of time. As in 2020, these wildfires affected particulate matter as well as ozone concentrations.

The District works collaboratively with the public, media, land managers, schools and school districts, county public health officers, and other stakeholders to alert the public of poor air quality and increase the understanding of the devastating public health impacts of wildfires as well as the need for improved management of the public forests. The District continues to pursue enhanced forest management efforts at the state and federal level to address the extraordinary build-up of fuels in our surrounding forests and minimize wildfire impacts in the future. See, also, 2022 Ozone Plan Appendix H (Weight of Evidence).

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