Nevada Air Quality Trend Report 2000-2010

Nevada Division of Environmental Protection

NDEP
NEVADA DIVISION OF ENVIRONMENTAL PROTECTION
protecting the future for generations

Contents

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Acronyms and Abbreviations

b Ŝ Ø ŀ Ř ŀ Ω ă м р w dzNJ ŀ f	Carson City, Churchill, Douglas, Elko, Esmeralda, Eureka, Humboldt, Lander, Linc Lyon, Mineral, Nye, Pershing, Storey, and White Pine
AMSL	Above Mean Sea Level
BAQP	Bureau of Air Quality Planning
BAM	Beta Attenuation Monitor
BTU	British Thermal Unit
CAA	Clean Air Act
CFR	Code of Federal Regulations
CO	Carbon Monoxide
DCNR	Department of Conservation and Natural Resources
GDP/GSP	Gross Domestic Product/Gross State Product
H_2S	Hydrogen Sulfide
IMPROVE	Interagency Monitoring of Protected Visual Environments
NAAQS	National Ambient Air Quality Standard
NAC	Nevada Administrative Code
NDEP	Nevada Division of Environmental Protection
NAPCP	Nevada Air Pollution Control Program
O_3	Ozone
Pb	Lead
$PM_{2.5}$	Particulate Matter less than 2.5 microns in diameter
PM_{10}	Particulate Matter less than 10 microns in diameter
SLAMS	State and Local Air Monitoring Station
SO_2	Sulfur Dioxide
SPMS	Special Purpose Monitoring Station
SSMS	Special Study Monitoring Station
USEPA	United States Environmental Protection Agency

Acknowledgements

This Trend Report presents ambient air quality data collected by the State of Nevada and the California Air Resources Board. The Nevada Department of Conservation and Natural Resources (DCNR) Division of Environmental Protection (NDEP), Nevada Air Pollution Control Program (NAPCP) gratefully acknowledges the ambient monitoring data contributions of the California Air Resources Board, Monitoring and Laboratory Division. The cover photo is of the Big Smoky Valley in central Nevada; provided courtesy of Michelle Stamates of NDEP.

Executive Summary

The primary purpose of NAPCP Ώ ă ŀ Ʋ ō ƛ Ŝ ƴ ű Ʋ ƻ ƨ ƛ ű ƻ determine current and projected ƛ concentrations of ambient air pollutants within the state, ensure current resource management strategies are working properly, and to develop new measures by which the ambient air quality standards will continue to be attained.

NAPCP Ώ ă Ŏ dz ǋ ǋ Ŝ ƴ ű ŀ Ŏ ű ƛ Ǿ Ŝ Ʋ ƻ ƴ ƛ ű ƻ ǋ ƛ ƴ ∃ ƴ Ŝ ű ǿ ƻ ǋ ỉ Ŏ ƻ ƴ ă ƛ ă ű ă

- Carson City ς PM$_{10}$, PM$_{2.5}$, CO, and O$_3$
- Gardnerville ς PM$_{10}$, PM$_{2.5}$, and O$_3$
- Stateline ς CO
- Fernley ς PM$_{10}$, PM$_{2.5}$, and O$_3$
- Fallon ς PM$_{10}$, and O$_3$
- Elko ς PM$_{10}$
- Pahrump ς multiple sites with PM$_{10}$

This report spans the monitoring period from 2000 to 2010. During this period, NAPCP monitored the following criteria pollutants and observed the following trends:

- Carbon Monoxide (CO): Ambient concentrations of CO have decreased and remained well below the current National Ambient Air Quality Standards (NAAQS);

- Ground-Level Ozone (O$_3$): Ambient concentrations of O$_3$ have remained steady and below the current 2008 NAAQS;

- t ŀ ǋ ű ƛ Ŏ dz ƒ ŀ ű Ŝ a ŀ ű ű Ŝ ǋ Ж н Ф р (PM$_{2.5}$): Ambient concentrations of PM$_{2.5}$ Ř ƛ ŀ Ʋ Ŝ have trended upward in Gardnerville and are close to the NAAQS in Carson City and Gardnerville. NAPCP is in the process of analyzing samples to determine the cause(s) of the elevated levels. Ambient concentrations of PM$_{2.5}$ have decreased in Fernley.

- t ŀ ǋ ű ƛ Ŏ dz ƒ ŀ ű Ŝ a ŀ ű ű Ŝ ǋ Ж м л (PM$_{10}$): PM$_{10}$ monitoring conducted in Elko Ř ƛ ŀ Ʋ Ŝ ű has shown no significant change in ambient concentrations. Monitoring conducted in Pahrump shows that annual concentrations of PM$_{10}$ have decreased in most of the monitored locations and remain well below the annual standard. The 24-hour PM$_{10}$ concentrations in Pahrump remain steady at or near the standard. However, the number of actual exceedances of the 24-hour standard have been reduced, most of which occurred during uncontrollable high wind events. As a result, the design values for PM$_{10}$ show no exceedances of the NAAQS in the past 5 years.

It should be noted that USEPA is actively reviewing and revising several of the NAAQS. Generally, these reviews are resulting in revised standards that are more stringent. More stringent standards may affect ű Ќ Ŝ Ŧ dz ű dz ǋ Ŝ ŀ ű ű ŀ ƛ ƴ Ʋ Ŝ ƴ ű ă ű ŀ ű dz ă ǿ ƛ ű NAPCP will be required to Ώ ă м р Ŝ ѐ Ǉ ŀ ƴ Ř ű Ќ Ŝ { ű ŀ ű Ŝ Ώ ă Ʋ ƻ ƴ ƛ ű ƻ ǋ ƛ ƴ ∃ ƴ Ŝ ű ǿ ƻ ǋ ỉ Ф

1 Introduction

1.1 Background

Clean air is a managed natural resource. [Nevada Revised Statutes (NRS) 445B.100](#) establishes public policy regarding air quality in Nevada. This statute states:

“It is the public policy of the State of Nevada . . . to achieve and maintain levels of air quality which will protect human health and safety, prevent injury to plant and animal life, prevent damage to property, and preserve visibility and scenic, esthetic and historic values of the state.”

The mission of the [Nevada Division of Environmental Protection](#) (NDEP), and the Nevada Air Pollution Control Program (NAPCP, which comprises the Bureau of Air Quality Planning, BAQP, and Bureau of Air Pollution Control, BAPC) is to protect and enhance the environment in order to sustain healthy ecosystems and contribute to a vibrant economy. Our mission is accomplished through reasonable, fair, and consistent implementation of State and Federal air quality rules and regulations, with emphasis on objective and impartial responsiveness to the needs of a growing population and industrial base.

Air pollution comes from a variety of sources. These include "stationary sources," such as factories, power plants, and smelters; smaller sources, such as dry cleaners and degreasing operations; "mobile sources," such as cars, trucks, buses, trains, and planes; and "natural sources," such as wildfires and windblown dust.

The USEPA has set NAAQS for six principal pollutants, which are called "criteria" pollutants: carbon monoxide (CO), ground-level ozone (O_3), particulate matter ($PM_{2.5}$, with an aerodynamic size less than or equal to 2.5 microns, and PM_{10}, with an aerodynamic size less than or equal to 10 microns), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), and lead (Pb). There are two forms of the NAAQS: Primary and Secondary, and they are summarized in Table 2.1. Primary standards are designed to protect human health, including sensitive populations such as children and the elderly. Secondary standards provide public welfare protection and are designed to protect against decreased visibility, damage to animals, crops, vegetation, and buildings.

The primary purpose of NAPCP Ωă ŀ Ⴤ ō ƛ Ŝ ʏ ű Ⴤ ƨ ʆ to determine current and projected ƛ concentrations of ambient air pollutants within the state, ensure current resource management strategies are working properly, and to develop new measures by which the ambient air quality standards will continue to be attained.

This document summarizes the ambient air data collected for the **1**-year period between 2000 and 2010 from the NAPCP monitoring network in NŜ Ǿ ŀ Ř ŀ Ωă мр[1] wdzNJ ŀ ƒ / ƨdz ʏ ű ƛ Ŝ ă Φ

[1] b Ŝ Ǿ ŀ Ř ŀ Ω ă м р wdzNJ ŀ ƒ / ƨ dz ʏ ű ƛ Ŝ ă ŀ NJ Ŝ / ŀ NJ ă ƨ ʏ / ƛ ű ѐ Σ / Ʀ dzNJ Ŏ Ʀ ƛ ƒ ƒ Σ Lincoln, Lyon, Mineral, Nye, Pershing, Storey, and White Pine. Clark and Washoe counties operate and maintain monitoring networks separate from NAPCP and publish their findings independently.

Review of long-term monitoring data reveals trends in the ambient air quality and provides feedback on the effectiveness of measures utilized for managing the air resource.

NAPCP performs air monitoring throughout the state. The current active monitoring network consists of monitors located in the following towns:

- Carson City ς PM_{10}, $PM_{2.5}$, CO, and O_3
- Gardnerville ς PM_{10}, $PM_{2.5}$, and O_3
- Stateline ς CO
- Fernley ς PM_{10}, $PM_{2.5}$, and O_3
- Fallon ς PM_{10}, and O_3
- Elko ς PM_{10}
- Pahrump ς multiple sites with PM_{10}, and one site with $PM_{2.5}$

It should be noted that USEPA is actively reviewing and revising several of the NAAQS. Generally, these reviews are resulting in revised standards that are more stringent. More stringent standards may affect a ű Ķ Ŝ Ŧ dz ű dz NJ Ŝ ŀ ű ű ŀ ƛ ƴ Ƴ Ŝ ƴ ű ă ű ŀ ű dz ă ǿ ƛ NAPCP may be required to ... ŜÈLJ ŀ ƴ Ř ű Ķ Ŝ { ű ŀ ű Ŝ Ω ă Ƴ ² ƴ ƛ ű ² NJ ƛ ƴ Ǝ ƴ Ŝ ű ǿ ² NJ ƪ Φ ! ō NJ ƛ Ŝ Ŧ Ř ƛ provided in Section 2.

1.2 NÅÖÁ Ä Air Monitoring Network

NAPCP ² LJ Ŝ NJ ŀ ű Ŝ ă ŀ ƴ Ŝ ű ǿ ² NJ ƪ ² Ŧ Ƴ ² ƴ ƛ ű ² NJ ƛ ƴ Ǝ ă ű ŀ ű ƛ ² ƴ ă ŀ Ŏ NJ ² 1.1. The monitors conform to all USEPA siting criteria and are situated to measure air quality in both rural and the urbanized portions of Ŝ Ǿ ŀ Ř ŀ Ω ă м p In addition, NAPCP maintains two meteorological stations, one in Carson City and one in Pahrump, to provide meteorological information for the monitoring conducted in these areas and to support stationary source permitting needs. Detailed descriptions of both active and discontinued air quality monitoring stations are provided in Appendix A. A comprehensive list of monitoring data availability at NAPCP-maintained monitoring stations is provided in Appendix B and monitoring data used in report preparation is in Appendix C.

The monitoring conducted by NAPCP is established for the purposes of meeting federal monitoring requirements and for state informational and planning purposes. These two are categorized as: 1) State and Local Air Monitoring Stations (SLAMS); 2) Special Purpose Monitoring Stations (SPMS); and 3) Special Study Monitoring Stations (SSMS). SLAMS sites are federally required, long-term air quality monitoring stations. SPMS sites are typically established to determine the air quality in a smaller, localized area or to monitor on a temporary basis. These sites typically operate for six to 24 months, and are generally used to measure air quality in areas not previously monitored. They may also be established to monitor the effects of a specific air pollution source or group of sources on the surrounding air quality. Some sites within the network contain monitors to address both SLAMS and SPMS.

SLAMS monitoring is required once an area exceeds established county population thresholds. Monitoring for Pb, SO_2 and NO_2, was not conducted during this reporting period as the population based ű ĶNJ Ŝ ă Ķ ² f Ř ă ǿ Ŝ NJ Ŝ ƴ ² ű NJ Ŝ ŀ Ŏ Ķ Ŝ Ř ƛ ƴ ŀ ƴ è ² Ŧ b Ŝ Ǿ ŀ Ř ŀ Ω ă м p conducted for these three pollutants.

This report presents the results of air quality monitoring conducted by NAPCP from 2000 to 2010. Provided below is a summary of the pollutants monitored, their general trends, and a description of the conditions under which the pollutants are typically found at their highest concentration.

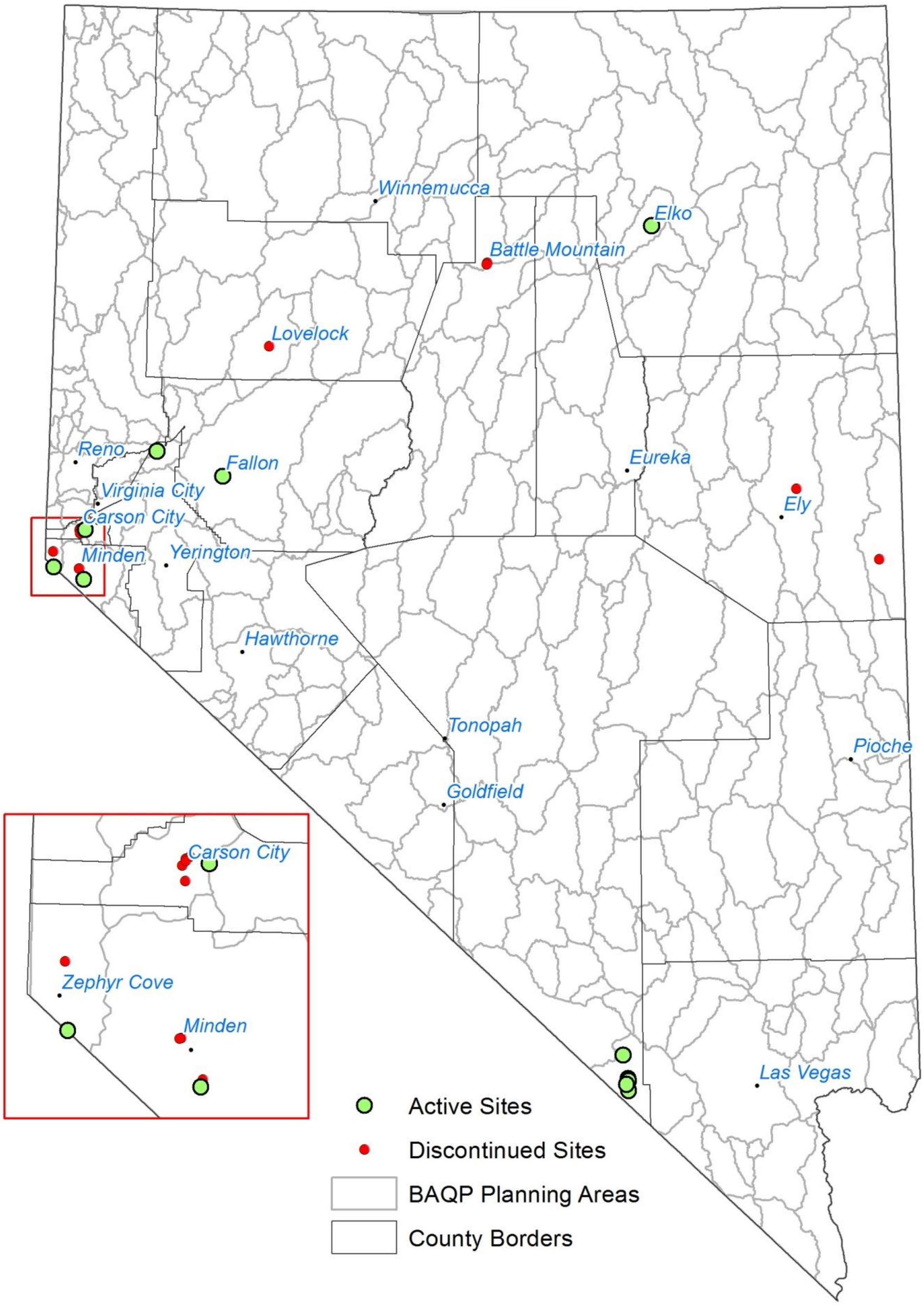
Carbon Monoxide (CO): NAPCP [illegible] the highest concentrations of CO [illegible] occur in the winter during strong temperature inversions in basins surrounded by mountains. When temperature inversions occur, CO is trapped near ground level, causing elevated concentrations. Ambient concentrations of CO have decreased and remained well below the current NAAQS.

Ground-Level Ozone (O_3): NAPCP [illegible] ambient concentrations of O_3 have [illegible] remained steady and below the current 2008 NAAQS. O_3 concentrations are typically affected by the quantity of precursor gases (NO_x [illegible]), temperature, and amount of sunlight available during the summer.

Particulate Matter [illegible] ($PM_{2.5}$): NAPCP [illegible] concentrations of $PM_{2.5}$ have trended upward in Gardnerville. No significant upward/downward linear trends were observed in the other monitored locations, and NAAQS were met all the years analyzed. However, both Carson City and Gardnerville were characterized by large fluctuations in $PM_{2.5}$ concentrations, which occasionally resulted in the daily maximum observations to be above the 1997 NAAQS and potentially could result in concentrations above the tighter 2006 NAAQS. NAPCP is in the process of analyzing samples to determine the cause(s) of the elevated levels. The highest concentrations of $PM_{2.5}$ often occur in the winter during strong temperature inversions in basins surrounded by mountains. When temperature inversions occur, residential wood combustion is often at its peak and $PM_{2.5}$ is trapped near ground level, causing increases in ambient concentrations. Thus $PM_{2.5}$ trends may reflect the occurrence or absence of strong inversions during winter. However, these exceedance events in the daily maximum concentrations did not result in non-attainment conditions, as both 1997 and 2006 standard are defined as the average of 3 consecutive years.

Particulate Matter [illegible] in diameter (PM_{10}): During this reporting period, many of the PM_{10} monitors in the NAPCP [illegible] were taken offline because measurements remained well below the PM_{10} NAAQS. PM_{10} monitoring conducted in Elko has shown no substantial change in ambient concentrations. Monitoring conducted in Pahrump shows that annual concentrations of PM_{10} have decreased in most of the monitored locations and remain well below the annual standard. The 24-hour PM_{10} concentrations in Pahrump remain steady at or near the standard. However, the number of actual exceedances of the 24-hour standard have been reduced, most of which occurred during uncontrollable high wind events.

Figure 1: Location of NAPCP Monitoring Sites, 2000-2010, and NAPCP planning areas.



1.3 Attainment Status of Areas

NAPCP Ø ă ! Ƴ ō ƛ Ŝ ƴ ű ! ƛ NJ is responsible for air quality surveillance in ... Ŝ Ø ŀ Ř ŀ Ω ă м p wdzNJ Counties. In addition to NAPCP's monitoring network, air quality monitoring is being conducted through the Interagency Monitoring of Protected Visual Environments (IMPROVE) network by federal land management agencies. At present, there are two active IMPROVE monitoring sites in Nevada; one located in the Jarbidge Wilderness Area in northeastern corner of the state and the other near the Lehman Caves Visitor Center in Great Basin National Park, along the eastern border of the state near Baker.

The NAAQS published by USEPA in 40 CFR Part 50 define the levels of air quality that USEPA has determined protect human health and welfare. An area is considered to be in nonattainment for a pollutant if it has violations for a particular NAAQS. Conversely, attainment areas are those where monitoring shows that no violation of the NAAQS have occurred. An area is considered unclassifiable if no monitoring has been conducted to determine its classification and NAAQS violations would not ƨ ű K Ŝ NJ ø ƛ ă Ŝ ō Ŝ Ŝ È LJ Ŝ Ŏ ű Ŝ Ř Φ ¢ K Ŝ Ŝ È ű Ŝ ƴ ű ƨ Ŧ ŀ ƴ ŀ NJ Ŝ ŀ Ω ă Ŏ boundaries as established in 1979 for the State of Nevada. The planning area boundaries are shown in Figure 1.1.

From 2000-2010, areas under the jurisdiction of NAPCP were classified as attainment or unclassifiable for all criteria pollutants, with one exception. The Nevada side of the Lake Tahoe Basin was designated nonattainment for CO in 1978, while the rest of Tahoe Basin within NAPCP Ø ă Ƨ dzNJ ƛ ă Ř ƛ Ŏ ű ƛ ƨ ƴ ø ŀ ă attainment/unclassifiable.[2] On October 27, 2003, NAPCP requested redesignation and USEPA approved the request on December 15, 2003.

Clark and Washoe counties have their own independent ambient monitoring networks. Please check each county's web site for additional information.

1.4 Methodology for statistics analysis

Time-series of pollutant concentration from each monitor station were tested for the presence of linear trend using non-parametric algorithms. In particular, the Mann-Kendall method was used to determine ű K Ŝ ă ƛ ∃ ƴ ƛ Ŧ ƛ Ŏ ŀ ƴ Ŏ Ŝ ƨ Ŧ ű K Ŝ ű NJ Ŝ ƴ Ř ŀ ƴ Sen method (Sen's slope) was used to obtain the magnitude (i.e., the slope) of the linear trend. These methods provide a much more robust analysis than the traditional parametric approaches and are less sensitive to outlier values. In general, a time-series was considered having a significant trend if the significance value was equal or less than 5% (i.e., the probability of erroneously assuming a significant trend under actual no-trend conditions is equal or less than 5%). However, as the 5% threshold is commonly used but somewhat arbitrary (as any other potential threshold), specific cases were discussed by reporting different significance levels as well. It is important to recognize that results from statistical analyses were largely limited by the number of data points available, and, still, by outliers. In this respect, results from these analyses should not be considered as absolute proof (or disproof) for the presence (or absence) of significance trends in the concentration datasets.

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[2] The Nevada side of the Lake Tahoe Basin is formally known as Hydrographic Area 90 which includes portions of Carson City County, Douglas County, and Washoe County.

2 Criteria Pollutants

2.1 National Ambient Air Quality Standards

The federal Clean Air Act (CAA), which was last amended in 1990, requires USEPA to set NAAQS for pollutants considered a danger to public health and welfare. The CAA established two types of NAAQS:

Primary standards set limits to protect public health, including the health of sensitive populations such as children, the elderly, and asthmatics.
Secondary standards set limits to protect public welfare, including protection against decreased visibility, damage to animals, crops, vegetation, and buildings.

Criteria pollutants are monitored with federal reference (FRM) or equivalent (FEM) methods that USEPA has approved. For each criteria pollutant, USEPA specifies the monitoring objectives that define the parameters by which health exposure and public welfare are assessed, and the measurement scale classifications that describe the influence of atmospheric movement at a given location.

Table 1: Current National Ambient Air Quality Standards (http://www.epa.gov/air/criteria.html).

Pollutant	Averaging time	Form	NAAQS-Primary	NAAQS-Secondary
Carbon Monoxide (CO)	8-hour	Not to exceed more than once per year	9ppm	N/A
	1-hour	Not to exceed more than once per year	35 ppm	
Lead (Pb)	Rolling 3-month	Not to exceed, over a period of 3 years,	0.15 µg m^3	Same as primary
Nitrogen Dioxide (NO_2)	1-hour	98th percentile of daily maximum distribution, averaged over 3 years, not to exceed	100 ppb	N/A
	Annual Mean	Not to exceed	53 ppb	Same as primary
Ozone (O_3)	8-hour	Annual fourth-highest daily maximum, averaged over 3 years, not to exceed	0.075ppm	Same as primary
Particle Pollution ≤2.5 µm ($PM_{2.5}$)	Annual*	Averaged over 3 year not to exceed	15 µg/m^3	Same as Primary
	24-hour	98th percentile, averaged over 3 year, not to exceed	35 µg/m^3	Same as Primary
Particle pollution ≤10 µm (PM_{10})	24-hour	Not to exceed more than once per year, on average over 3 year	150 µg/m^3	Same as Primary
Sulfur Dioxide (SO_2)	1-hour	99th percentile of daily maximum, averaged over 3 years, not to exceed	75 ppb	
	3-hour	Not to exceed more than once per year		0.5 ppm

*The annual NAAQS for $PM_{2.5}$ was revised from 15 µg/m^3 to 12 µg/m^3 in December 2012

2.2 Carbon Monoxide

Carbon monoxide (CO) is a colorless, odorless, gas that is typically produced by the incomplete combustion of fuels. Compliance with the CO NAAQS is met when the 8-hour and the 1-hour average [illegible] year. The CO NAAQS have not [illegible] changed since they were originally promulgated in 1971; however, they are currently under USEPA review.

NAPCP MONITORING NETWORK:
Between 2000 and 2010, NAPCP measured ambient concentrations of CO at 2 monitors:

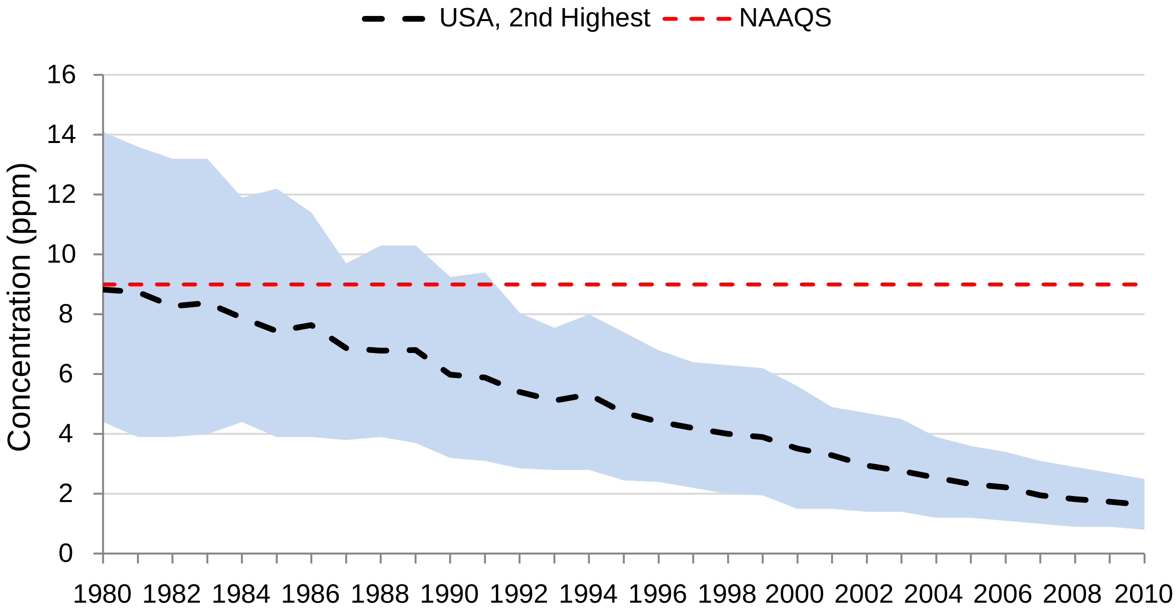
- Long Street in Carson City: 2000-2009 (discontinued site)
- [illegible] 2010 [illegible]

ATTAINMENT STATUS:
From 2000-2010, areas under the jurisdiction of NAPCP were classified as attainment or unclassifiable for CO except for the Nevada side of the Lake Tahoe Basin. This portion of the Basin was designated nonattainment for CO in 1978, while the rest of Tahoe Basin within NAPCP [illegible] attainment/unclassifiable. The nonattainment designation was based on monitoring conducted in Stateline during the 1970s. On October 27, 2003, NAPCP requested redesignation of the Nevada side of the Basin to attainment of the CO standards. NAPCP [illegible] Lake Tahoe Basin was based on ambient air quality monitoring data that showed no violations for calendar years 2001 through 2002. On December 15, 2003, USEPA published a final rule (http://www.federalregister.gov/articles/2003/12/15/03-30369/approval-and-promulgation-of-implementation-plans-state-of-nevada-designation-of-areas-for-air#p-48) effective February 13, 2004 redesignating the Nevada side of the Lake Tahoe Basin attainment for CO.

2.2.1 National Carbon Monoxide Trend

Nationally, average CO concentrations have decreased substantially over the years. Based on the annual 2nd highest value of the 8-hour average, national CO average concentration decreased 82% from 1980 to 2010 (Figure 2 and http://www.epa.gov/airtrends/carbon.html). From 2000 to 2010, national CO average concentration decreased 54%, with a significant trend (based on the Mann-[illegible] slope statistics) of -0.2 ppm per year. The decrease in average CO concentrations is largely the result of improved pollution control technology in on-road vehicles that has significantly reduced CO emissions. Since 1970, CO emissions from on-road vehicles have been cut by more than 40 percent nationwide.

Figure 2: National average carbon monoxide trend from 1980 to 2010. The black dashed line is the average 2nd highest value (based on the 8-hour averages) from 104 (1980-1989), 170 (1990-1999), and 265 (2000-2010) monitoring sites (http://www.epa.gov/airtrends/carbon.html). The blue area delimits the 10th and 90th percentile of the annual observation distributions. Red dotted line is the national standard (9 ppm).



2.2.2 Carbon Monoxide Trends in NAPCPõ Ónitoring Network

For the entire 2000-2010 period, ambient concentrations of CO (8-hour and 1-hour average) have trended downward and remained, in most cases, well below the NAAQS (see Figure 3 Figure 4). The Long Street monitor site in Carson City showed a significant downward trend in the 1st highest value of both the 8-hour and 1-hour average (-0.2 ppm per year and -0.6 ppm per year, respectively). In particular, the trend in the 1st highest value of the 8-hour average mirrored the 2nd highest value of 8-hour average national trend (Figure 2). w Ŝ ă dz ƚ ů ă Ŧ NJ ƶ Ỵ ů K Ŝ ł ŀ NJ Ǿ Ŝ è Ω ă w Ŝ ă ƶ NJ ů show a downward trend in the 1st highest values of the 8-hour and 1-hour average, although less consistent trend. The peak in 2002 was observed during the July 2002 Gondola Fire; a timber wildfire that burned 673 acres at the Heavenly Ski Resort a short distance from the monitor. Trends at the ł ŀ NJ Ǿ Ŝ è Ω ă w Ŝ ă ƶ NJ ů ł ƶ ů Ŝ ƚ Ỵ ƶ ý ʎ ů ƶ NJ ă ʎ ů Ŝ . However, they ƶ ů ă ʎ ∃ ý ʎ were significant at the 10% confidence interval, suggesting that a downward, though not very strong, trend existed. The 2nd-highest values of the 8-hour average are shown in Figure 4 as well. This is to confirm that while the highest 8-hour average CO concentration (8.8 ppm) went close to the NAAQS in 2002 (9 ppm), the 2nd-highest value recorded in the same time series was well below the threshold (6.1 ppm).

Figure 3: Carbon Monoxide (1-K 2 dzNJ ! Ø Ŝ NJ l· ∃ Ŝ ú Ŧ 2 NJ ű K Ŝ ole 2 (HRH) { ű Φ monitoring stations. The 1st highest values, are shown for both monitor sites. NAAQS (35 ppm) is shown with a red d line.

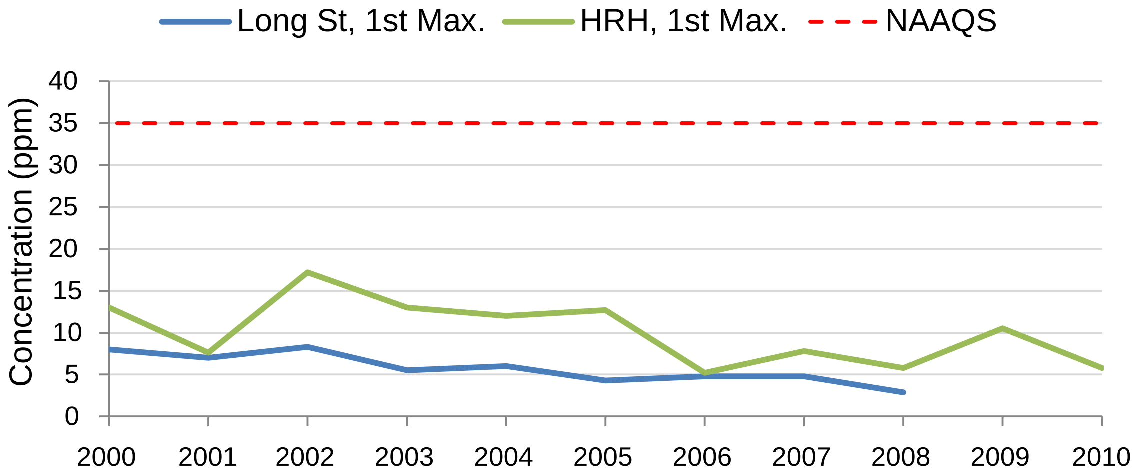
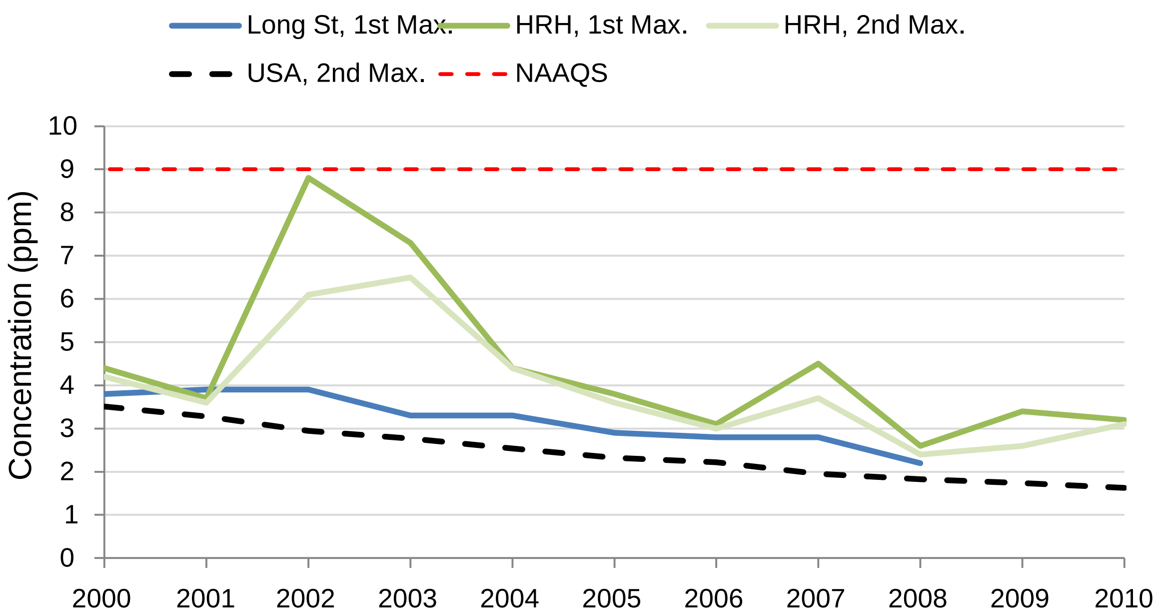


Figure 4: Carbon Monoxide (8-K 2 dzNJ ! Ø Ŝ NJ l· ∃ Ŝ ú Ŧ 2 NJ ű K Ŝ [2 ƴ ∃ { ű monitoring stations. Annual 1st highest values are shown for both stations, while annual 2nd highest concentrations are shown for HRH only. The national average for annual 2nd highest concentration (as in Figure 2) is shown with a dashed black line. NAAQS (9 ppm) is shown with a red dashed line.



2.3 Lead

Lead (Pb) is a metal found naturally in the environment. It is also mined and processed for use in manufactured products such as lead-acid batteries, old lead-based paint, ammunition, and gasoline. From 1978 through 2008, the design value for Pb had been the calendar quarterly average, with a NAAQS established at 1.5 Ǝ ŵ ³ Ϋ Effective January 12, 2009, USEPA changed the design value to a 3-month rolling average, evaluated over a 3 year period, and tightened both the primary and secondary NAAQS to 0.15 Ǝ ŵ ³ Ϋ Therefore, compliance with the Pb NAAQS is met when daily concentrations averaged for 3 adjacent Ϋ ƶ ƴ ǖ Ʀ ă Ř ƶ ƴ ƶ ǖ ³ over a period of 3 years ≤ Ǝ ĸ Ϋ

NAPCP MONITORING NETWORK:
During the reporting period, NAPCP did not conduct ambient monitoring for Pb because monitoring thresholds established by USEPA have not been met in any of Ŝ Ǿ ŀ Ř ŀ Ω ă м р In addition, / ƶ dz ƴ ǖ λ the revised NAAQS now require Pb monitoring near sources such as industrial facilities that emit one-half ton or more of Pb per year and in Core Based Statistical Areas (CBSA) with populations greater than 500,000.[3] L ƴ b Ŝ Ǿ ŀ Ř ŀ Ω ă м р w dz ǋ ŀ ƒ / ƶ dz ƴ ǖ one-half ton or more of Pb per year and no / . { with populations greater than 500,000.

ATTAINMENT STATUS:
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2.3.1 National Lead Trend

Nationally, average Pb concentrations have decreased substantially over the years. From 1980 to 2010 there was an 89% decrease in the national Pb average, based on the same 31 monitor sites measured during the 1980-1989 period. From 2000 to 2010, there was a 61% reduction in the national Pb average, based on 92 monitor sites. The reduction in average Pb concentrations is mainly the result of removing Pb from gasoline used in on-road vehicles, and additional source control programs for stationary sources in those areas that did not meet the national standards (http://www.epa.gov/airtrends/lead.html).

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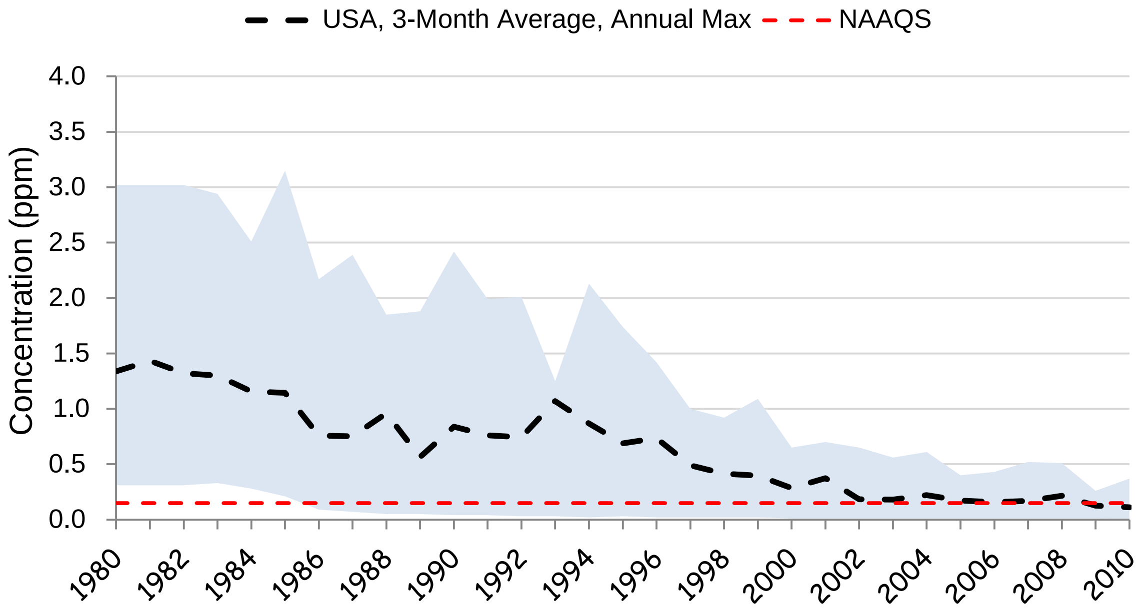
[3] Core Based Statistical Area (CBSA) is a United States Census Bureau term that became effective in 2000 and refers collectively to metropolitan and micropolitan statistical areas. The 2000 census criteria provide that each CBSA must contain at least one urban area of 10,000 or more people. Each metropolitan statistical area must have at least one urbanized area of 50,000 or more inhabitants. Each micropolitan statistical area must have at least one urban cluster of at least 10,000 but less than 50,000 people.

Figure 5: National lead trend, 1980-2010. The black dashed line is the annual 1st highest value (i.e., the annual maximum) based on 3-month average from 31 (1980-1989), 62 (1990-1999), and 92 (2000-2010) monitoring sites (http://www.epa.gov/airtrends/lead.html). The blue area delimits the 10th and 90th percentile of the annual observation distributions. Red dotted line is the 2008 national standard (0.15 ppm).



2.4 Nitrogen Dioxide

Nitrogen dioxide (NO_2) belongs to a group of reactive gases known as nitrogen oxides.[4] Other nitrogen oxides include nitric oxide (NO) and nitrous oxide (N_2O). In the environment, NO_2 is the predominant form.[5] NO_2 forms rapidly, primarily resulting from fuel combustion sources.

The NO_2 standard was first established in 1971 and defined attainment conditions when the average annual concentration does not exceed 53 ppb (or 0.053 ppm).[6] Effective April 12, 2010, USEPA established a new 1-hour based primary NAAQS. Compliance with the 1-hour standard is achieved when 3-year average of the 98th percentile of the daily maximum distribution (1-hour average) does not exceed 100 ppb (or 0.1 ppm).

NAPCP MONITORING NETWORK
NAPCP does not currently monitor for NO_2. Historical NO_2 monitoring at Stateline and Carson City was terminated in 1997 due to very low monitored concentrations. During the reporting period, NAPCP did not conduct ambient monitoring for NO_2 because monitoring thresholds established by USEPA have not been met in any of Nevad ŀ Ω ă w dzNJ ŀ ƒ / 2 dz ƴ ű ƛ Ŝ ă Φ

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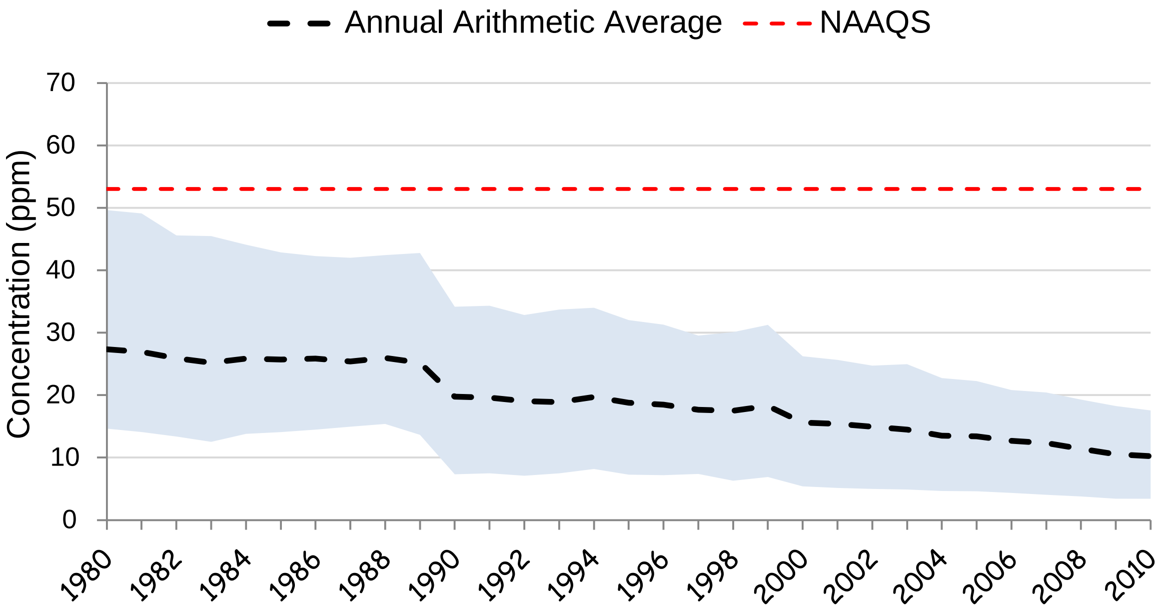
USEt ! Ķ ŀ ă Ř Ŝ ă ƛ ∃ ƴ ŀ ű Ŝ Ř ŀ ƒ Counties as unclassifiable based on the 2010 м р w dzNJ ŀ standards (http://www.epa.gov/no2designations/region/region9.html).

2.4.1 National Nitrogen Dioxide Trend

Nationally, average NO_2 concentrations have decreased substantially over the years. From 1980 to 2010 there was a 52% decrease in the national NO_2 average (based on the annual arithmetic average and on the 81 monitoring sites initially established in the 1980-1999 period). From 2000 to 2010, there was a 38% reduction in the national NO_2 average (based on 283 monitoring sites). The decrease in average NO_2 concentrations is largely the result of improved pollution control technology in on-road vehicles that has significantly reduced NO_2 emissions. Moreover, NO_2 concentrations are expected to continue to decrease as a result of a number of new mobile source regulations (http://www.epa.gov/airtrends/nitrogen.html).

[4] Nitrogen oxides are also referred to as oxides of nitrogen.
[5] NO_2 is the monitored indicator for the larger group of nitrogen oxides.
[6] The official level of the annual NO_2 standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard.

Figure 6: National nitrogen dioxide trend, 1980-2010. The black dashed line is the annual arithmetic average based on 81 (1980-1989), 150 (1990-1999), and 283 (2000-2010) monitoring sites (http://www.epa.gov/airtrends/nitrogen.html). The blue area delimits the 10th and 90th percentile of the annual observation distributions. Red dotted line is the national standard (53 ppm).



2.5 Ground -Level Ozone

Ozone (O_3) in different layers of the atmosphere (i.e., ground-level O_3 versus stratospheric O_3) exhibits different effects. While the physical substance remains the same, ground-level O_3 affects humans adversely and therefore is considered a harmful pollutant. On the other hand, stratospheric O_3 is essential to human survival and prevents harmful ultraviolet solar radiation from reaching the earth's surface. Ground-level ozone is a reactive, oxidant gas and is the primary constituent of photochemical smog. O_3 is formed by reactions between nitrogen oxides and volatile organic compounds (VOCs) in the presence of sunlight. The actual photochemical reaction that produces O_3 can take place far away from where the precursor gases are emitted. In addition, natural sources such as vegetation, soil, wildfires, and lightning emit nitrogen oxides and VOCs that lead to the formation of O_3. Another source of localized O_3 is downward mixing of O_3 from the stratosphere, known as stratospheric O_3 intrusion (especially at high mountain locations).

The O_3 NAAQS was first established in 1979 and based on hourly average concentrations. Primary and secondary standards were met when the number of days per calendar year with maximum hourly average concentrations above 0.12 ppm was less than or equal to 1. In 1997 USEPA created new primary and secondary O_3 standards, based on the 8-hour average and set at 0.08 ppm. These standards are met when the 3-year average of the annual 4th-highest value of daily maximum distribution is less than or equal to 0.08 ppm. On June 15, 2005, USEPA revoked the 1-hour O_3 standard established in 1979. Effective May 27, 2008, USEPA tightened the primary and secondary 8-hour O_3 NAAQS from 0.08 ppm to 0.075 ppm.[7]
USEPA is pursuing a review of the O_3 NAAQS on its normal 5 year review cycle. A proposed rule is expected to be released by the end of 2013 (http://www.epa.gov/glo/actions.html).

NAPCP MONITORING NETWORK:
Between 2000 and 2010, NAPCP measured ambient concentrations of O_3 at 7 monitors:

- Fifth Street in Carson City: from 2008
- Long Street in Carson City: 1998-2007 (discontinued site)
- West End Elementary School in Fallon: from 2005
- Fire Station in Fernley: 1998-2003 (discontinued site)
- Intermediate School in Fernley: from 2007
- Cave Rock State Park in Zephyr Cove: 1999-2004 (discontinued site)
- IMPROVE Site in Great Basin National Park: from 1998[8]

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19971-hour O_3 NAAQS and the 2008 8-hour O_3 NAAQS
(http://www.epa.gov/ozonedesignations/2008standards/final/region9f.htm).

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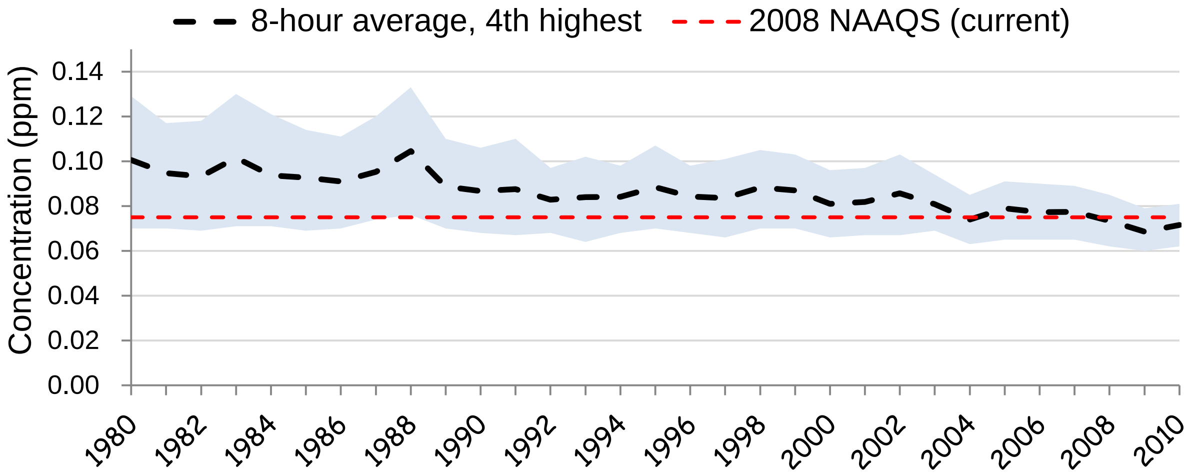
[7] For more information on the history of O_3 regulation, visit USEPA's webpage: Ozone & Health, A Timeline.
[8] Great Basin National Park IMPROVE monitoring site is maintained by the National Park Service.

2.5.1 National Ground-Level Ozone Trend

Nationally, average ground-level O_3 showed a decline of 29% from 1980 to 2010 (based on the annual 4th-highest value of the 8-hour average, Figure 7 and http://www.epa.gov/airtrends/ozone.html), with a significant trend of -0.817 ppb/year. The 2000-2010 period showed the largest rate in concentration decline, 60% larger than the one observed in the 1980-1999 period (-1.21 ppb/year and -0.75 ppb/year for 2000-2010 and 1980-1999, respectively). I ≥ ǿ Ŝ Ǿ Ŝ ŊJ Σ ƛ ű Ω ă ≥ ỳ of the O_3 average н л л п ű K ŀ ű concentration fell below the 2008 NAAQS (0.075 ppm) for the first time. Across the United States, programs have been and are being implemented to reduce NOx and VOCs emissions from motor vehicles, industrial facilities, and power plants. VOCs emissions are used as a surrogate for O_3 since O_3 is not directly emitted by sources. Mitigation strategies also include reducing the emission of O_3 precursor gases by reformulating fuels as well as consumer/commercial products such as paints and chemical solvents that contain VOCs.

Figure 7: National ozone trend, 1980-2010. The black dashed line is the annual 4th highest value of the 8-hour average concentration based on 247 (1980-1989), 507 (1990-1999), and 946 (2000-2010) monitoring sites (http://www.epa.gov/airtrends/ozone.html). The blue area delimits the 10th and 90th percentile of the annual observation distributions. Red dashed line is the current 8-hour national standard (0.075 ppm, accordingly to the 2008 NAAQS). From 1 to 2008, the 8-hour NAAQS was 0.080 ppm. From 1979 to 1997, only the 1-hour NAAQS was used.

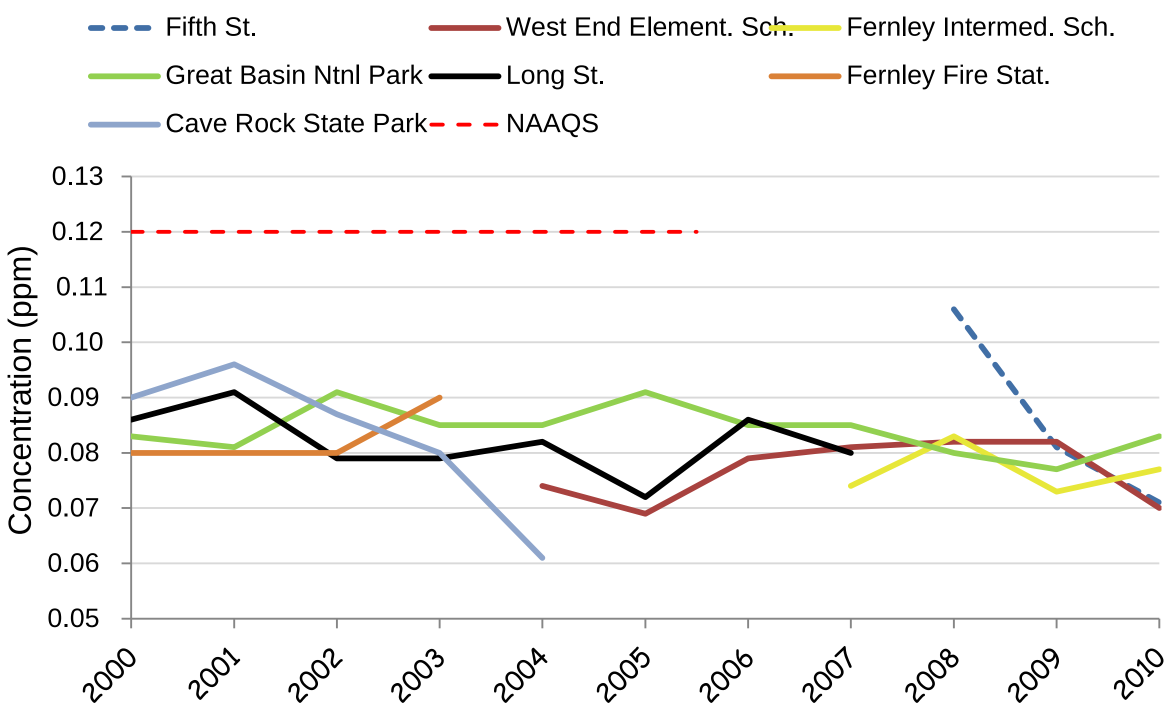


2.5.2 Ozone Trends in NAPCPõ Ómonitoring Network

Because of the multiple historical changes in O_3 NAAQS, trends based on both the 1-hour and 8-hour standards are presented in this report for all the monitor stations. For the 2000-2010 period ambient concentrations of ground-level O_3 have remained relatively constant and below the revoked 1-hour based NAAQS in all active and discontinued stations (Figure 8). The only exceptions are the sites located at the Cave Rock State Park (discontinued in 2005) and Fifth St in Carson City (active from 2008), which both showed noticeable concentration reductions during the monitored periods
The timeseries of the annual 4th highest daily maximum (based on the 8-hour average) and its 3-year average (the design value) fell below the NAAQS (pre- and after-2008 threshold) in all monitor sites (Figure 9 and Figure 10). In 2010, the highest concentrations were observed at the Great Basin National

Park. A study is currently being conducted by NDEP-BAPC and University of Nevada in Reno to investigate the causes for such high O_3 concentrations in the area[9].
USEPA is pursuing a review of the O_3 NAAQS on its normal 5 year review cycle. A proposed rule is expected to be released by the end of 2013 (http://www.epa.gov/glo/actions.html) and it may result in lower O_3 NAAQS.

Figure 8: Ground level ozone trend. The annual 1st highest values from hourly average concentrations are shown. Red dashed line is the National Standard (0.12ppm), which was revoked by US EPA in June 2005.



[9] ά b Ŝ Ǿ ŀ Ř ŀ wdzNJ ŀ ƒ ς Principal Investigator: Dr. Mae Gustin, Department of Natural Resources and Environmental Sciences, UNR

Figure 9: Ground-level ozone trend The annual 4th-highest daily maximum from the 8-hour averages are shown. The red dashed line is the National Standard, which was revised from 0.08 ppm to 0.075 ppm in May 2008. Black dashed lir national average (see also Figure 7).

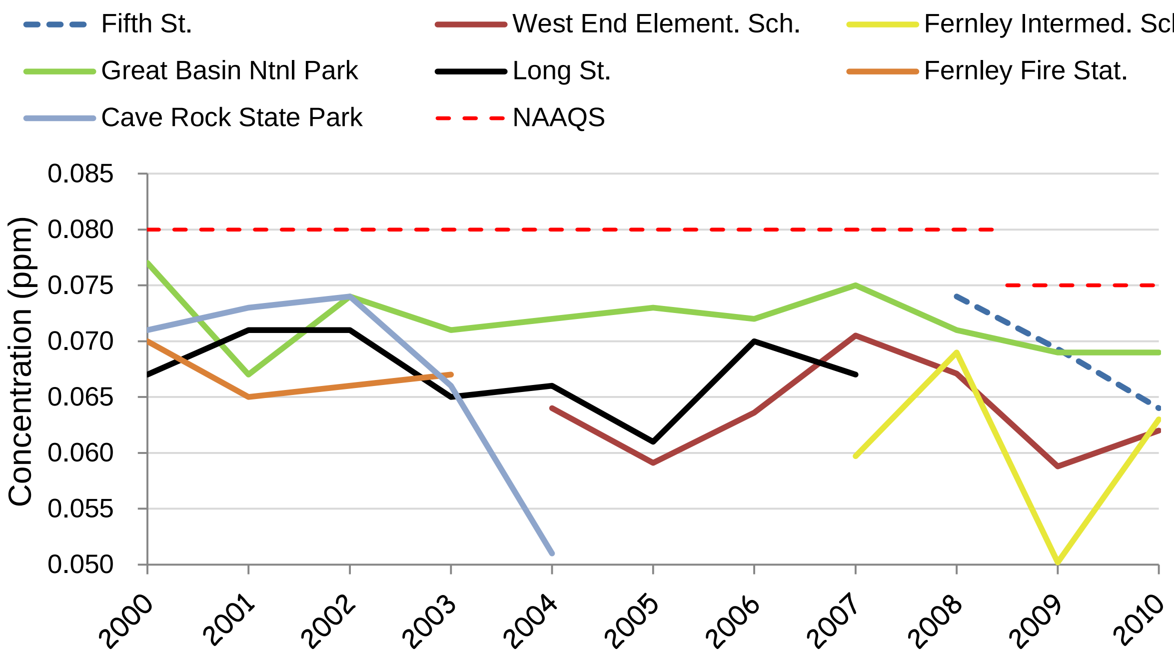
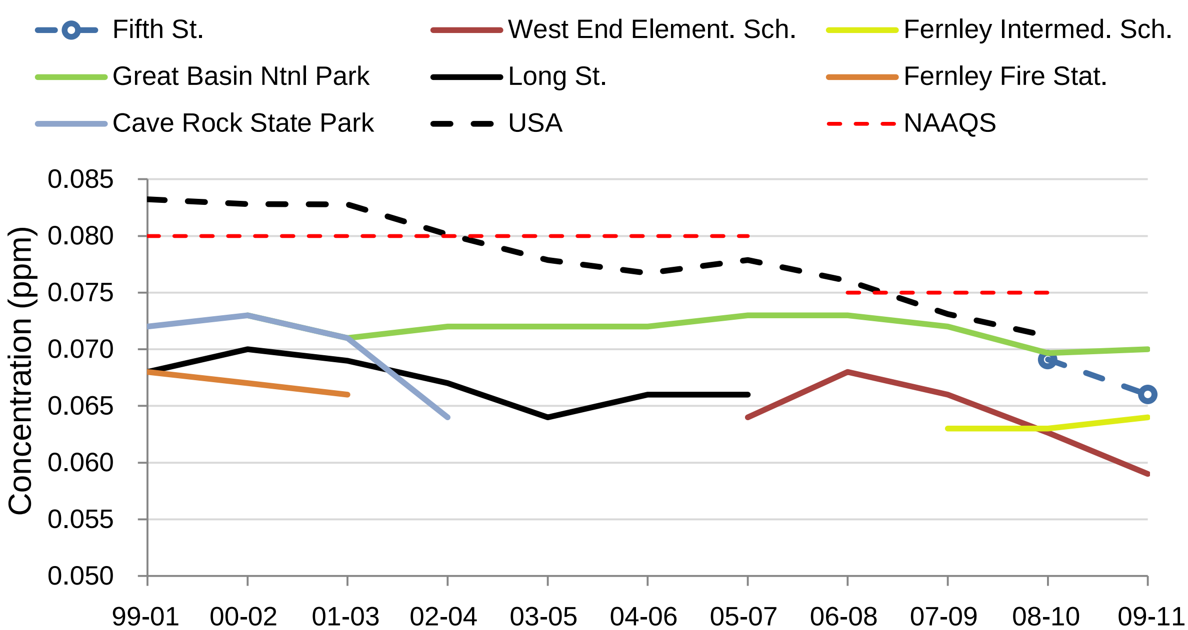


Figure 10: Design values for ground-level ozone (3-year average of the annual 4th-highest daily maximum, based on the 8-hour average, as in Figure 8). Red dotted line is the National Ambient Air Quality Standard, which was revised from 0.08 ppm to 0.075 ppm in May 2008.



2.6 Particulate Matter

Particulate matter (PM) generally consists of a mixture of particles of dust, pollen, ash, soot, metals and other various solid and liquid chemicals found in the atmosphere.[10] There are two categories of particle matter pollutants: $PM_{2.5}$ and PM_{10}. $PM_{2.5}$ ó ǀ ᶠ ă ⱺ ʅ ʃ ⱺ ǿ ʃ ǀ ă particulate matter 2.5 ű ƛ Ŏ dz ᶠ ǀ ű Ŝ microns or smaller in aerodynamic diameter. PM_{10} ó ǀ ᶠ ă ⱺ ʅ ʃ ⱺ ǿ ʃ ǀ ă ά ƛ ʃ K ǀ ᶠ ǀ ō ᶠ Ŝ Ŏ ⱺ particulate matter 10 microns or smaller in aerodynamic diameter. For reference, microns is about one-seventh the diameter of human hair.

$PM_{2.5}$ can be directly emitted from sources such as fires, construction sites, residential wood combustion, or unpaved roads. PM_{10} emissions are from sources such as seas salt, unpaved roads, construction/demolition dust, and rock processing. These particles are referred to as primary particles, as they are directly emitted by the sources. $PM_{2.5}$ and PM_{10} can also form as the result of the interaction of gaseous pollutants (such as SO_2, NOx, and VOCs, emitted, among others, from power plants, industries and automobiles) in the atmosphere. These particles are referred to as secondary particles. Given the small size, $PM_{2.5}$ can remain suspended in the air and be transported extremely long distances. Meteorological conditions (e.g., inversion, rain, wind) can have a significant effect on ambient particulate concentrations.

USEPA first issued standards for total suspended particles in 1971 and revised them in 1987 (for PM_{10} only), 1997 (for PM_{10} and $PM_{2.5}$), 2006 and 2012.

$PM_{2.5}$: In September 1997, new standards were established, based on 24-hour and annual averages. The 24-hour average-based NAAQS is met when the 98th percentile of the annual distribution, averaged over 3 years, does not exceed 65 µg/m³. The annual NAAQS is met when the 3-year average of the annual weighted mean concentration is less or equal to 15 µg/m³. In December 2006, USEPA tightened the 24-hour $PM_{2.5}$ NAAQS from 65 µg/m³ to 35 µg/m³. In December 2012, the annual-average-based primary standard was tightened from 15 µg/m³ to 12 µg/m³.

PM_{10}: new standards were established in 1987, based on 24-hour and annual averages. The annual-based NAAQS is met when the 3-year average of the 98th percentile 24-hour concentration is less than or equal to 50 µg/m³. The annual NAAQS was revoked in 2006. The primary and secondary 24-hour PM_{10} NAAQS are met ǿ K Ŝ ʃ ű K Ŝ Ŝ ȅ LJ Ŝ Ŏ ű Ŝ Ř ʃ dz Ꮍ ō Ŝ NJ ⱺ Ŧ Ř³ is less than or ǀ ă Ŝ NJ Ŏ ǀ ᶠ Ŝ ʃ equal to one, over a 3-year period.

NAPCP MONITORING NETWORK:

Between 2000 and 2010, NAPCP measured ambient concentrations of $PM_{2.5}$ at 5 monitor sites:

- Fifth Street in Carson City: 2009-2010 (special study monitoring station)
- Long Street in Carson City: 2000-2009 (discontinued)
- Intermediate School in Fernley: 2000-2010
- Gardnerville Ranchos in Gardnerville: 2001-2010
- Cave Rock State Park in Zephyr Cove: 2000-2001 (discontinued)

[10] The majority of compounds that form particle pollution can be grouped into five categories: sulfates, nitrates, Ŝ ᶠ Ŝ Ꮍ Ŝ ʃ ű ǀ ᶠ Ŏ ǀ NJ ō ⱺ ʃ Σ ⱺ NJ Ǝ ǀ ʃ ál ƛ Ŏ Ŏ ǀ NJ ō ⱺ ʃ Σ ǀ ʃ Ř ά Ŏ NJ dz ă ű ǀ ᶠ ἐ Ꮍ ǀ ű Ŝ NJ ƛ

The Fifth Street, Gardnerville Ranchos, and Fernley Intermediate School monitors are maintained within NAPCP. ǐ ă ƴ Ŝ ű ǿ ƨ NJ ʅ Ŧ ƨ NJ ă LJ Ŝ Ŏ ʎ ŀ ƒ ă ű dz Ř è LJdzNJLJ ƨ ă Ŝ ă Φ

Between 2000 and 2010, NAPCP measured ambient concentrations of PM_{10} at 10 monitor sites:

- High School in Battle Mountain: 2000-2002 (discontinued)
- State Offices Building in Elko: 2000-2008 (discontinued)
- Grammar School No. 2 in Elko: 2008-2010
- Community Pool in Pahrump: 2001-2004 (discontinued)
- Linda Street in Pahrump: 2002-2010
- Willow Creek in Pahrump: 2002-2009 (discontinued)
- Church in Pahrump: 2004-2010
- Glenoaks Street in Pahrump: 2009-2010
- Manse Elementary School in Pahrump: 2005-2010
- Cave Rock State Park in Zephyr Cove (Lake Tahoe): 2000 (discontinued)

The Community Pool site in Pahrump was relocated to the Manse Elementary School site because the site location did not conform to USEPA siting criteria and for a lack of continued maintenance access.

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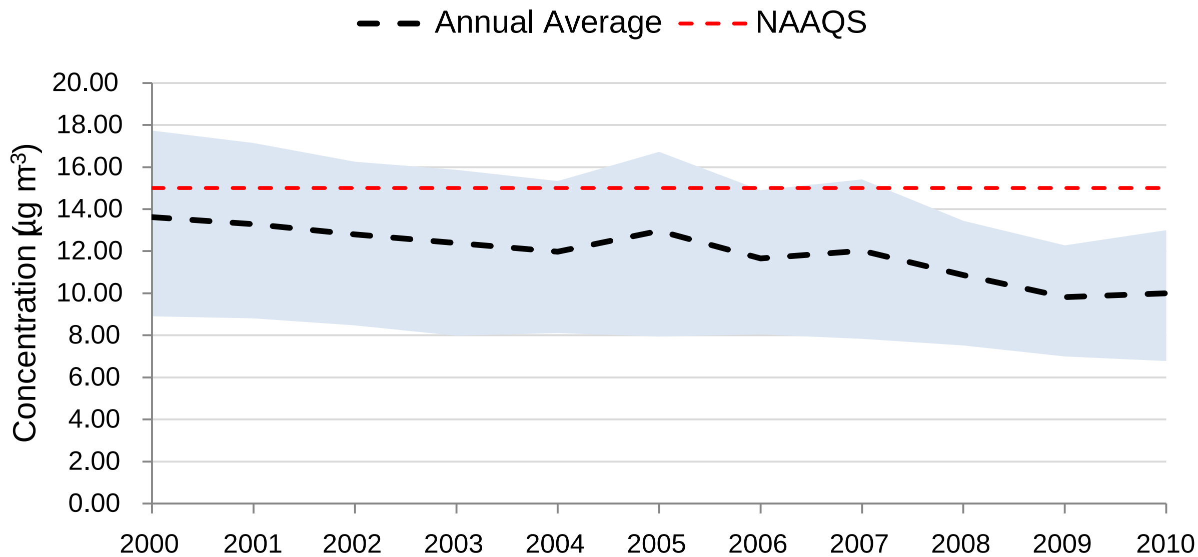
attainment/unclassifiable for the 1997 24-hour and annual $PM_{2.5}$ NAAQS. On December 13, 2009, USEPA
Ř Ŝ ă ʎ ∃ ƴ ŀ ű Ŝ Ř ŀ ƒ ƒ ŀ NJ Ŝ ŀ ă ǿ ʎ ű Ķ ʎ ƴ b Ŝ Ǿ ŀ Ř ŀ Ω ă м р w dzNJ ŀ ƒ / ƨ dz
24-hour $PM_{2.5}$ b ! ! v { Φ h ƴ b ƨ Ǿ Ŝ Ƴ ō Ŝ NJ м р Σ м ф ф л Σ ¦ { 9 t ! Ř Ŝ ă ʎ ∃ ƴ ŀ ű
Counties as unclassifiable for PM_{10}.

Beginning in 2001, NAPCP began special purpose monitoring in the Pahrump Valley in Nye County. This monitoring indicated exceedances of the PM_{10} NAAQS (Figure 17 and Table 2). To correct the problem USEPA, NAPCP, the Pahrump Town Board, and Nye County agreed to implement control measures throughout the valley to address the exceedances. The measures generally are targeted at decreasing the sources and causes for PM emissions, such as increasing the fraction of paved roads, land disturbance mitigation, and dust control enforcement. Continued monitoring in the area indicates that the implemented control strategies have resulted in significant reductions in the number of monitored PM_{10} exceedances (Figure 17 and Table 2). Remaining exceedances are attributed to uncontrollable high-wind Ř Ŝ Ǿ Ŝ ƴ ű ă Σ ƨ NJ ά Ŝ Ȅ Ŏ Ŝ LJ ű ʎ ƨ ƴ ŀ ƒ Ŝ Ǿ Ŝ ƴ ű ă exceptional Ķ Ŝ b 5 9 t Ķ
events ű ƨ ű Ķ Ŝ ¦ { 9 t ! ŀ ƴ Ř ʎ ă ŀ ǿ ŀ ʎ ű ʎ ƴ ∃ 9 t ! Ω ă Ŏ ƨ ƴ Ŏ dzNJNJ Ŝ ƴ Ŏ Ŝ

2.6.1 National $PM_{2.5}$ Trend

Nationally, average $PM_{2.5}$ concentrations have significantly decreased since 2000 (Figure 11, and http://www.epa.gov/airtrends/pm.html). From 2000 to 2010 there was a 27% decrease in the national $PM_{2.5}$ average, based on the seasonally-weighted average and 646 sites. The reduction in average $PM_{2.5}$ concentrations is mainly the result of regional and national rules that have been and are being implemented to reduce emissions of pollutants that form $PM_{2.5}$. In addition, a number of voluntary programs also are helping to reduce $PM_{2.5}$ pollution (http://www.epa.gov/air/particlepollution/reducing.html).

Figure 11: National $PM_{2.5}$ Trend, 2000–2010 based on seasonally-weighted average (black dashed line) and 646 sites (http://www.epa.gov/airtrends/pm.html). National monitoring of $PM_{2.5}$ started in 1999. The 2006 NAAQS for annual average is shown as a reference (15 µg/m^3, red dashed line). The blue area delimits the 10th and 90th percentiles of the distribution of annual values reported by the monitor sites nationwide.



2.6.2 $PM_{2.5}$ Trends in NAPCP Monitoring Network

$PM_{2.5}$ trends across the state showed high degree of variability (Figure 12, Figure 13, Figure 14, Figure 15) and likely reflect localized conditions such as wintertime temperature inversions. The timeseries of the 98th percentile of the annual 24-hour average distribution (Figure 12) do not present any significant trend. However, the monitor stations on Long St. (Carson City) and at Gardnerville Ranchos (Gardnerville) showed a substantial peak in 2005. Even though the 2005 values in these locations exceeded the 1997 NAAQS, attainment conditions were met, as the 24-hour based USEPA NAAQS for $PM_{2.5}$ is defined as the average of three consecutive years (Figure 13). Under this definition, none of the stations reported values higher than the implemented NAAQS (Figure 13).

Figure 12: 24-hour 98th percentile trend for $PM_{2.5}$. The NAAQS are shown as a reference as well. However, exceedance events in these time-series do not indicate non-compliant conditions, as both 1997 and 2006 standard are defin as the average of 3 consecutive years (as in Figure 13).

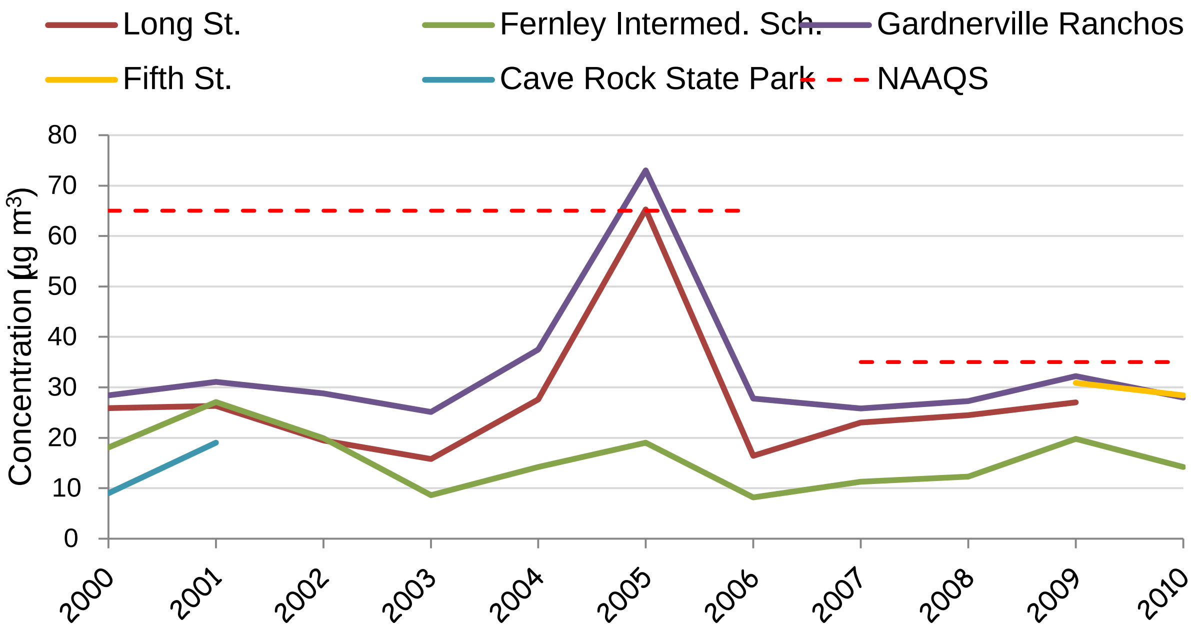
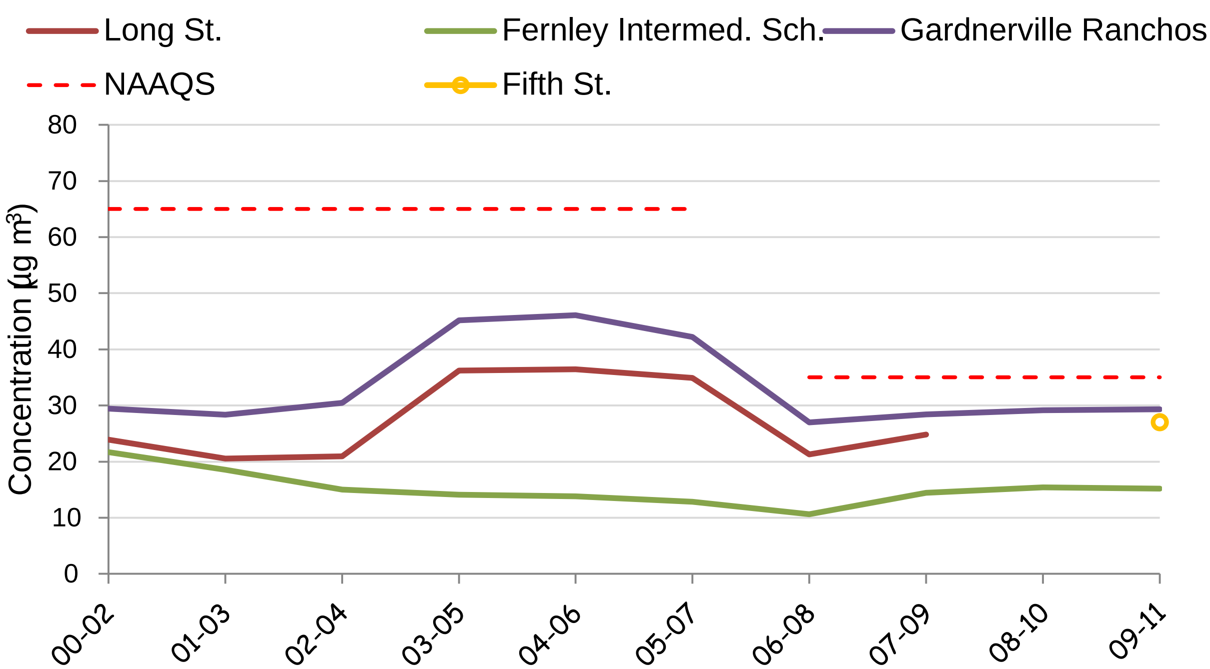


Figure 13: 24-hour 98th percentile trend for $PM_{2.5}$, averaged over 3 consecutive years (i.e. the desig values). The NAAQS are shown as well. Design values for monitors in Cave Rock State Park are not shown, as less than consecutive years of data were available.



The annual average time-series present similar results (Figure 14), with all but one station showing no significant trends. The exception is represented by the Gardnerville Rancho station, where a positive trend of approximately 0.7 μg/m^3 is detected. Annual and 3-year-averaged values are well below the 1997 NAAQS (15 μg/m^3). However, if the 2012 NAAQS are applied (12 μg/m^3), annual values are above the threshold in 2010 (Figure 14), though the 3-year average would maintain attainment (Figure 15).

Figure 14: Annual averages of $PM_{2.5}$ concentrations. The 1997 NAAQS (15 μg/m^3) is shown as well.

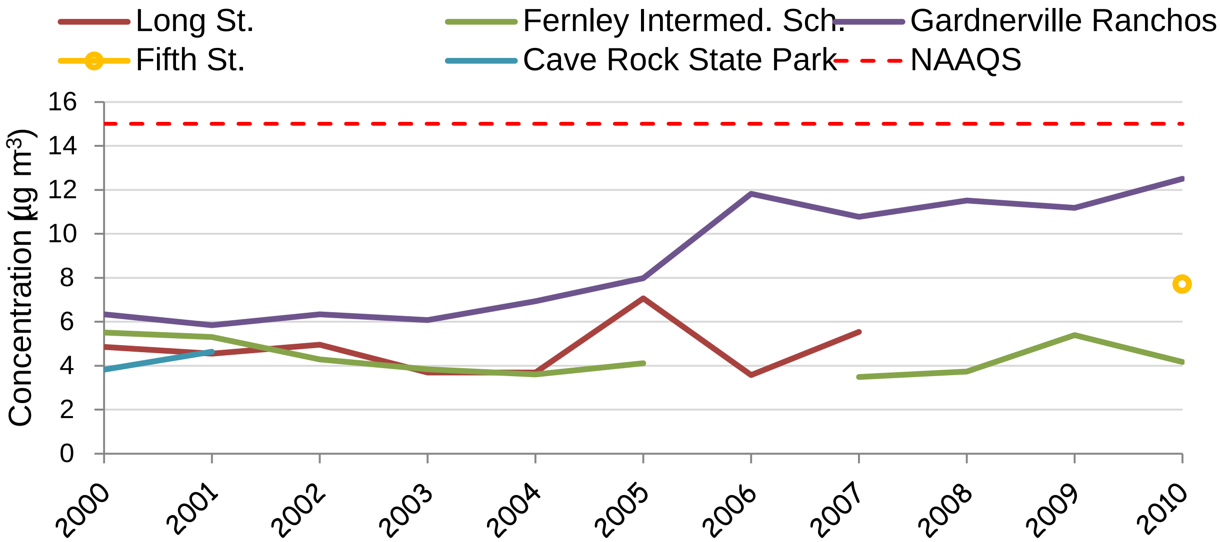
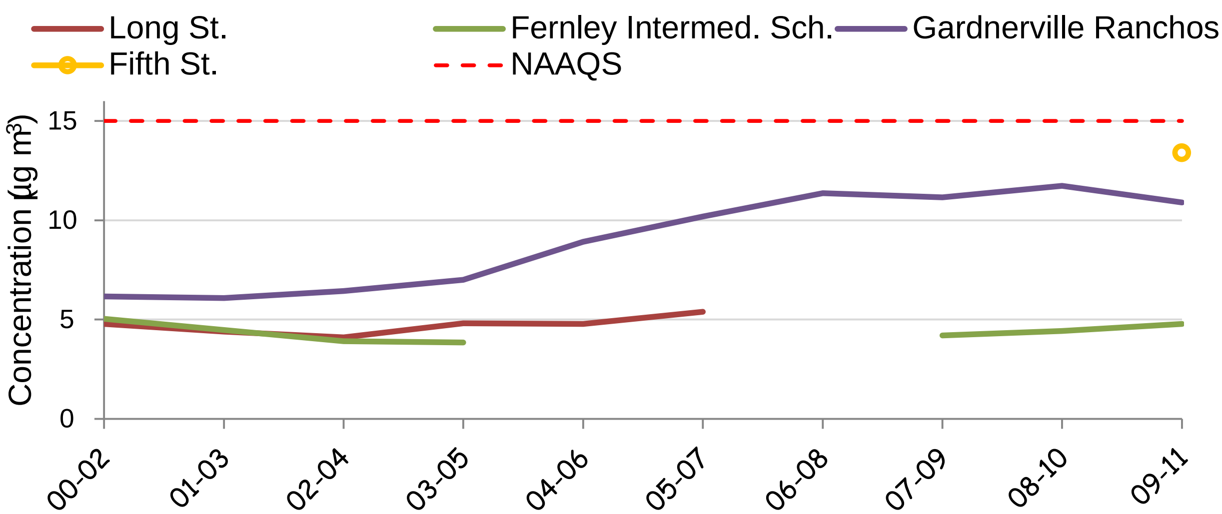


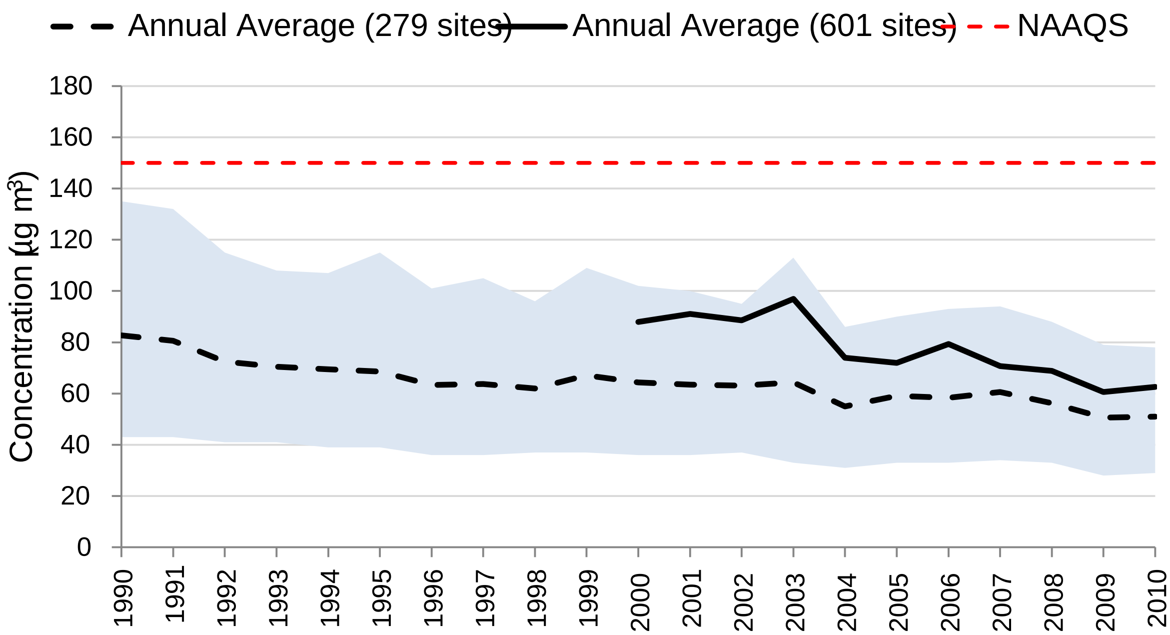
Figure 15: 3-year average of annual mean $PM_{2.5}$ concentrations (i.e., the design values). The 1997 NAAQS (15 μg/m^3) is shown as well. Cave Rock State Park Stations is not shown, as less than 3 consecutive years of data were avail



2.6.3 National PM_{10} Trend

Nationally, average PM_{10} concentration has decreased significantly over the years. From 1990 to 2010 there was a 38% decrease in the national PM_{10} average (based on 279 sites). From 2000 to 2010, the reduction in concentration was 29%, based on 601 sites (Figure 16 and http://www.epa.gov/airtrends/pm.html). The reduction in average PM_{10} concentrations is mainly the result of regional and national rules that have been and are being implemented to reduce emissions of pollutants that form PM_{10}. In addition, a number of voluntary programs also are helping to reduce PM_{10} pollution (http://www.epa.gov/air/particlepollution/reducing.html).

Figure 16: National PM_{10} Trend, 2000-2010 based on the annual 2nd highest value of the 24-hour average and 279 sites (1990-1999) and 601 sites (2000-2010, http://www.epa.gov/airtrends/pm.html). National monitoring of PM_{10} started in 1990. Black dashed line is the average from all the sites nationwide, and blue area delimits the 10th and 90th percentiles of the data distribution. Red dashed line is the National Ambient Air Quality Standard (150 µg m^{-3}). The addition of 322 new sites in 2000 caused an increase in average PM_{10} concentration. This increase is likely due to a better representation of PM_{10} concentration across the Country.



2.6.4 PM_{10} Trends in NAPCP[illegible] Monitoring Network

PM_{10} measurements are typically influenced by local conditions [illegible] -winds. For this reason, annual mean concentrations provide a good indicator of ambient PM_{10} trends and they are here presented together with the 24-hour averages (used with the NAAQS).

In general, 24-hour concentrations of PM_{10} in Elko, Battle Mountain and Lake Tahoe have remained below the standard, with very few exceptions (Figure 17). Based on PM_{10} NAAQS, which require a 3-year average period, all of these sites met the requirements for attainment (Table 2). None of these sites present significant linear trend in the annual averages or were not active long enough to allow statistical analysis (Figure 18). Monitor sites in Pahrump showed 24-hour concentrations above the NAAQS at the

Manse Elementary School, Willow Creek, and Community Pool stations (Figure 17 and Table 2). However, the Community Pool site was relocated to the Manse Elementary School site because the site location did not conform to USEPA siting criteria and for a lack of continued access.

Strong linear trends are detected in the annual average time-series of several of these sites. The Church station showed a trend of about -1.3 μg/m^3 per year. The site at the Manse Elementary School showed a decline of about -4.7 μg/m^3 per year; this trend, while not significant at the 5% confidence interval, is significant at the 10% confidence interval.

The apparent contradiction between the observed strong decline in concentrations and low statistical significance of the trend is likely due to the choice of the statistical approach and overall number of data points, rather than lack of trend in the observations. The Mann-Kendall algorithm is quite robust towards outliers (or spikes) in the dataset. The Manse ES time-series presents a strong decline in concentrations between 2005 (i.e. the first point of the series) and 2006, and a more consistent, but weaker, downwards trend thereafter (Figure 18). It is quite possible that the Mann-Kendall algorithm Ψdz ƴ Ř Ŝ ǋ Ŝ ă ű ƛ Ÿ ŀ ű Ŝ Ř Ω -2006 decline in the time-series, therefore decreasing the confidence level of the overall detected linear trend. An analysis of the time-series using a more standard parametric, but less robust approach, revealed a significant linear trend. The Manse ES station is currently active, and it is likely that the addition of more data points from more recent years may help in determining the actual pattern of the trend. A similar situation was found at the Willlow Creek site; a strong decline in PM_{10} concentration was observed in the last year of monitoring (2009), following a somewhat weaker downwards trend in the previous 4 years (Figure 18). Given the relatively short period the station was active (5 years), the statistical procedure failed in detecting a linear trend, even though it is very likely that an improvement in air quality occurred.

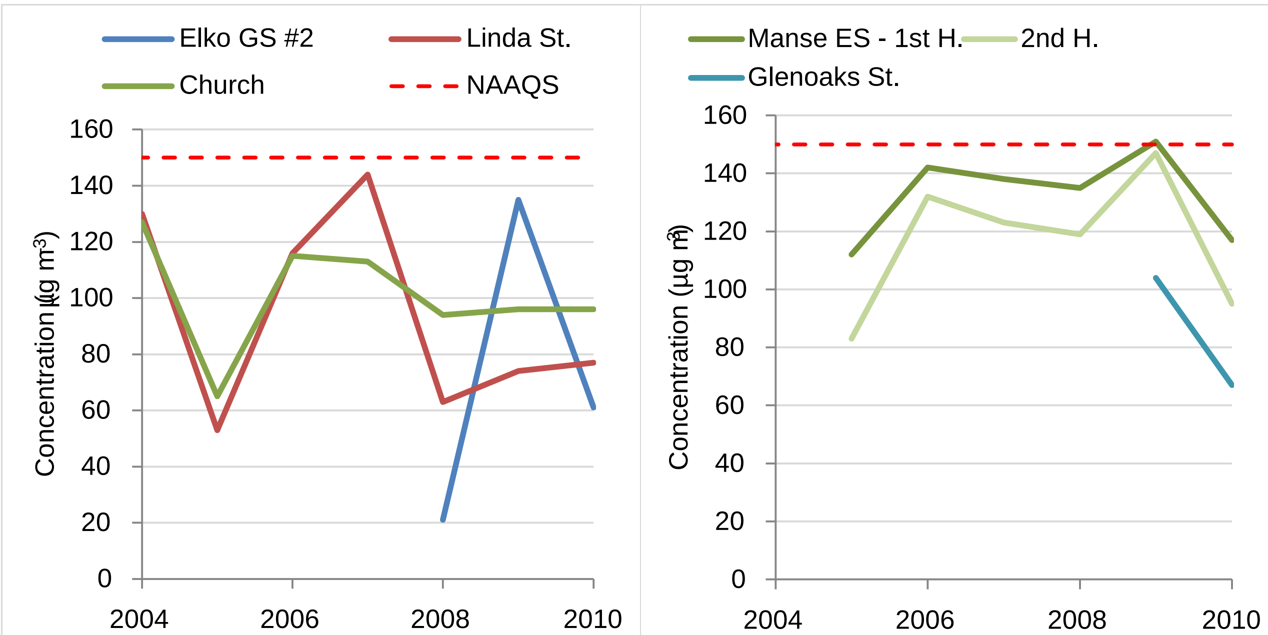
The station on Linda St. is the only station in Pahrump that displayed a significant positive trend of about 2.5 μg/m^3 per year. As explained earlier in this report, USEPA, NRCP, the Pahrump Town Board, and Nye County have been implementing control measures throughout the valley to address the high PM_{10} concentrations measured in this area. Continued monitoring in the area indicates that the implemented control strategies have resulted in significant reductions in the number of monitored PM_{10} exceedances (Figure 17 and Table 2). Remaining exceedances are attributed to uncontrollable high-wind events, or ά Ŝ È Ŏ Ŝ Ǉ ű ƛ ƺ ƴ ŀ ƒ Ŝ Ǿ Ŝ ƴ ű ă έ Φ ¢ Κ Ŝ b 5 9 t Ƙ ŀ ă ădz ō Ÿ ƛ ű ű Ŝ Ř Ŝ Ǿ ƛ Ř are awaiting 9 t ! Ω ă Ŏ ƺ ƴ Ŏ dzǋǋ Ŝ ƴ Ŏ Ŝ Φ

Figure 17: Annual 1st-highest value (1st H) for PM_{10} based on the 24-hour average. The 2nd-highest values (2nd H.) are shown for those stations where the 1st highest is above the NAAQS (red dashed line, 150 µg m^{-3}). The design value is defined as the average number of times that the 24-hour average exceeds the NAAQS over 3 years. To comply with the NAAQS, this number cannot exceed 1.

The following acronyms were used for the stations

Elko Grammar School #2: Elko GS #2 *Battle Mountain High School: BM HS* *Willow Creek: WC*
Manse Elementary School: Manse ES *State Office Buildings: SOB* *Community Pool: CP*
Cave Rock State Park: Cave Rock SP

Active Monitors



Discontinued Monitors

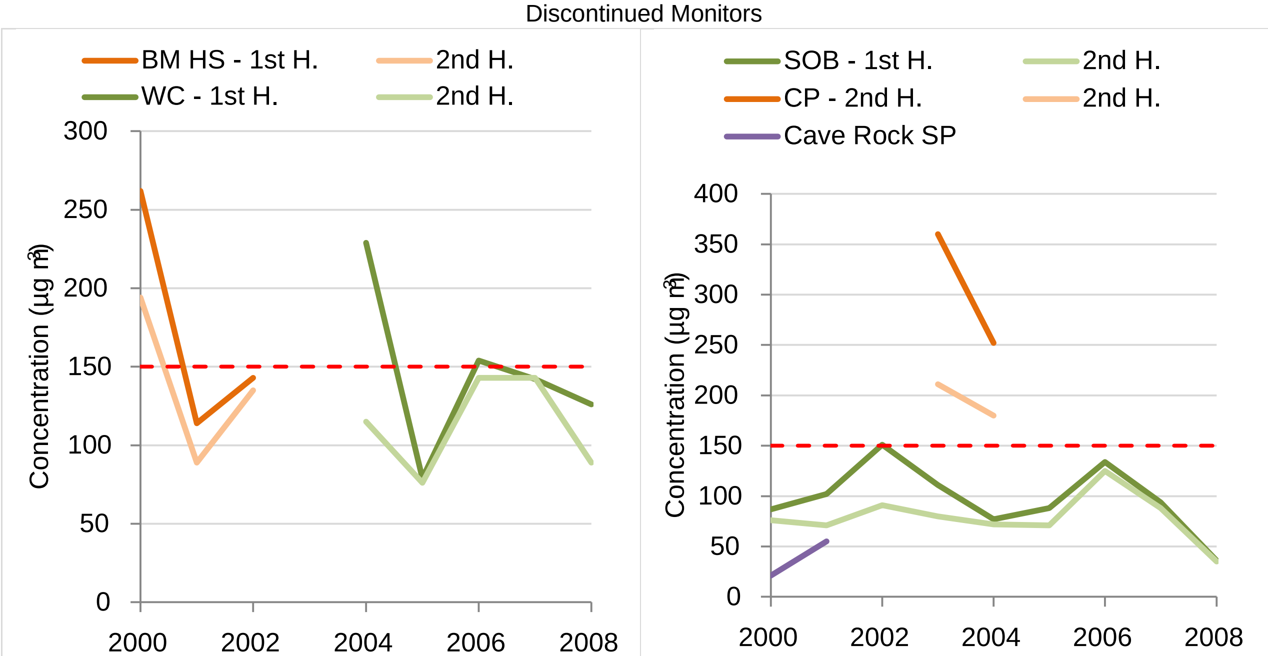
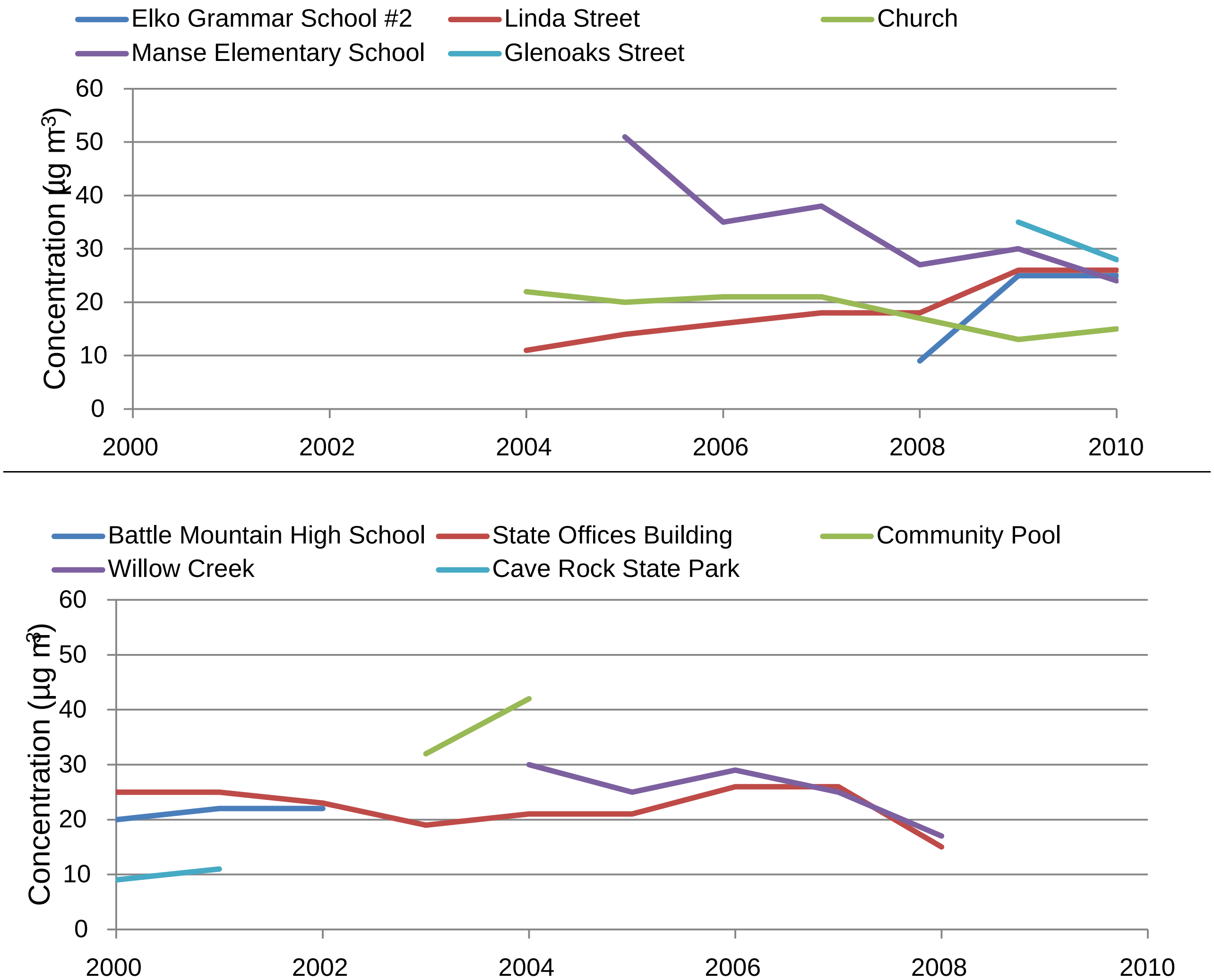


Table2: Total number of exceedances of the PM_{10} 24-Hour Standard, between 2000 and 2010. Reported, are the total exceedances for each station and the average of each 3-year period (i.e., the design value). Compliance with the NAAQ is met when the average number of exceedances in the 3-year period is less or equal to 1. Numbers in red indicate exceedance conditions.

	Elko Grammar School #2	Linda Street	Church	Manse Elementary School	Glenoaks Street
2004-2006	---	0	0	---	---
2005-2007	---	0	0	0	---
2006-2008	---	0	0	0	---
2007-2009	0	0	0	0	---
2008-2010	0	0	0	0	0
	Battle Mountain High School	State Offices Building	Community Pool	Willow Creek	
1998-2000	1 (0.3)	0	---	---	
1999-2001	1 (0.3)	0	4 (1.3)	---	
2000-2002	1 (0.3)	1 (0.3)	18 (6.0)	---	
2001-2003	---	1 (0.3)	21 (7.0)	---	
2002-2004	---	1 (0.3)	14 (4.7)	---	
2003-2005	---	0	19 (6.3)	---	
2004-2006	---	0	2 (0.7)	2 (0.7)	
2005-2007	---	0	---	1 (0.3)	
2006-2008	---	0	---	1 (0.3)	

Figure 18: Annual average for PM_{10} from active (above) and discontinued (below) monitors



2.7 Sulfur Dioxide

Sulfur oxides (SO_2) commonly originate from burning fossil fuels and are also produced from various industrial processes. SO_2 is the measured criteria pollutant of concern. In the air, SO_2 reacts with oxygen, ammonia and other compounds, including water vapor, to form sulfate salts and sulfuric acid mist. Sources of SO_2 include metal smelters, oil refineries, and large oil- or coal-fired power plants. Across the United States, the largest sources of SO_2 emissions are from fossil fuel combustion at power plants (66%) and other industrial facilities (29%). Smaller sources of SO_2 emissions include industrial processes such as extracting metal from ore as well as the burning of high sulfur containing fuels by locomotives, large ships, and nonroad equipment. Since 2010, USEPA recognizes a 1-hour primary standard for SO_2 at a level of 75 ppb, and a 3-hour average secondary standard. To attain the primary standard, the 3-year average of the 99th percentile of daily maximum distribution (based on 1-hour averages) must not exceed 75 ppb. To attain the secondary standard, the 3-hour average concentration cannot exceed 0.5 ppm more than once per year.

NAPCP MONITORING NETWORK:

During the reporting period, NAPCP did not conduct ambient monitoring for SO_2 because monitoring ű ƘNJŜ ă Ƙ 2 f ă Ŝ ă ű ŀ ō f ƛ ă Ƙ Ŝ Ř ō è ¦ { 9 t Ƙ ŀ Ǿ Ŝ ƴ 2 ű ō Ŝ Ŝ ƴ Ƴ Ŝ ű ƛ Forest Service monitors SO_2 at the Jarbidge Wilderness area through the IMPROVE network (http://vista.cira.colostate.edu/improve/Overview/Overview.htm).

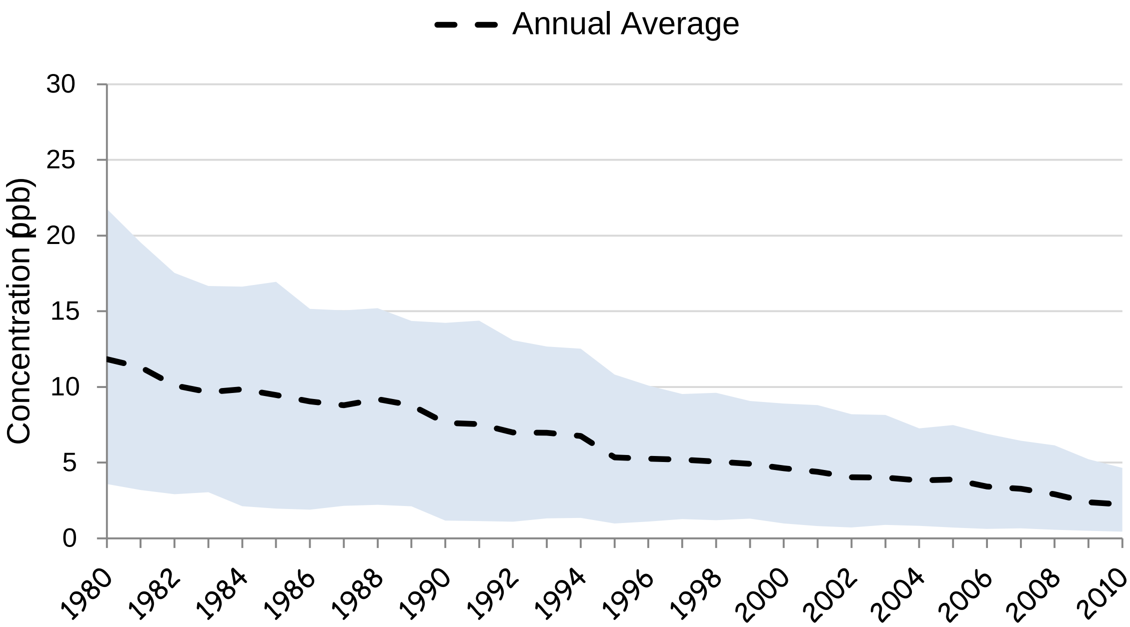
ATTAINMENT STATUS:

With the exception of the central Steptoe Valley (near Ely), USEPA ! Ƙ ŀ ă Ř Ŝ ă ƛ Ǝ ƴ ŀ ű Ŝ Ř ŀ f f ŀ N 15 Rural Counties as unclassifiable. Prior to 2002, the central Steptoe Valley was designated by USEPA as SO_2 non-attainment due to the historic operation of a copper smelter at McGill. The smelter ceased operation in 1983 and NAPCP requested reclassification of the area to attainment. USEPA approved the request on April 12, 2002. USEPA will designate areas for the 2010 standard in 2013 (http://www.epa.gov/so2designations/). NAPCP expects its jurisdiction to remain unclassifiable

2.7.1 National Sulfur Dioxide Trend

Nationally, average SO_2 concentrations have decreased over the years. From 1980 to 2010 there was an 81% decrease in the national SO_2 average. From 2000 to 2010 there was a 52% decrease in the national SO_2 average. The reduction in average SO_2 concentrations is mainly the result of switching to low sulfur fossil fuels especially in on-road and off-road vehicles (http://www.epa.gov/airtrends/sulfur.html).

Figure 19: Annual national average for SO_2 from 1980 to 2010 (black dashed line), based on 121 (1980-1989), 229 (1990-1999), and 341 site (2000-2010). Blue area delimits the 10th and 90th percentile of the annual distribution of concentrations reported by all sites nationwide (http://www.epa.gov/airtrends/sulfur.html).



3 Appendixes

3.1 Monitoring Station Description

Monitoring stations active at any time during the 2000-2010 period are described in this section. A synopsis of all stations and data availability is presented in section 3.2.

High School, Battle Mountain
32-015-0004 (SLAMS)

Pollutant(s) Monitored				
CO	NO_2	O_3	$PM_{2.5}$	PM_{10}
				1998-2002

Project Type = Population Oriented Surveillance

Measurement Scale = Neighborhood

Located at 625 Weaver Avenue in Battle Mountain, this PM_{10} site was on the grounds of Battle Mountain High School. This site was at the edge of a residential neighborhood, near the intersection of Interstate Highway 80 and Nevada Highway 305. The TEOM continuous PM_{10} monitor was sited on the announcer's tower at ű K Ŝ ă Ŏ K ƻ ƻ ƒ Ω ă ŀ ű K ƒ Ŝ ű ƛ Ŏ Ŧ ƛ Ŝ ƒ Ř Φ a ƻ ƴ ƛ ű ƻ NJ ƛ ƴ ∃ discontinued in 2002.

Fifth Street, Carson City
32-510-0002 (SLAMS/SMS)

Pollutant(s) Monitored				
CO	NO_2	O_3	$PM_{2.5}$	PM_{10}
1981-1989		1974-1989, 2008-2010	2009-2010	1991-1997

Project Type = Population Oriented Surveillance (Typical Concentration)

Measurement Scale = Neighborhood

Located at 3300 East Fifth Street in Carson City, this CO, O_3, and $PM_{2.5}$ site is near the Carson City Public Works Department maintenance yard. In addition, meteorological data is collected at the Fifth Street site. This site is situated in a transition area that is adjacent to the maintenance yard, a sewage treatment plant, residential neighborhoods, wetlands, and the new extension of Highway 580. CO and O_3 were monitored from 1974 through 1989. PM_{10} monitoring commenced in March 1991 and was discontinued at the end of February 1997. In 2006, an existing meteorological station was restarted. In 2008, O_3 monitoring commenced at the Fifth Street site. In 2009, $PM_{2.5}$ monitoring commenced at the Fifth Street site[11]. This station was discontinued and relocated in December 2012.

[11] The O_3 and $PM_{2.5}$ monitors were relocated from the Long Street site.